SEL-2030

COMMUNICATIONS PROCESSOR

REFERENCE MANUAL

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CAUTION: Frequent archive record clearing may exceed EEPROM capabilities. See the discussion in the Archive Data Region subsection of ***Section 6: Database***. If you completely clear an archive region that contains a large number of records (thousands of records), it may take a few minutes for the clearing to complete. During this time, most SEL-2030 automatic data collection will be suspended.

ATTENTION: De fréquentes suppressions d'archives pourraient dépasser la limite des EEPROM. Se référer à la discussion dans la sous-section Région des Données d'Archives de la ***Section 6: Banque de Données***. Si vous supprimez une zone d'archives qui contient un grand nombre d'enregistrements (par milliers), l'opération pourrait prendre quelques minutes. Pendant ce temps, la collecte automatique de données du SEL-2030 sera suspendue.

CAUTION: Frequent archive record clearing may exceed EEPROM capabilities. Refer to the following paragraphs.

ATTENTION: Des suppressions fréquentes d'enregistrements d'archives peuvent dépasser la limite des EEPROM. Se référer aux paragraphes suivants.

WARNING: This device is shipped with default passwords. Default passwords should be changed to private passwords at installation. Failure to change each default password to a private password may allow unauthorized access. SEL shall not be responsible for any damage resulting from unauthorized access.

AVERTISSEMENT: Cet équipement est expédié avec des mots de passe par défaut. A l'installation, les mots de passe par défaut devront être changés pour des mots de passe confidentiels. Dans le cas contraire, un accès non-autorisé à l'équipement pourrait être possible. SEL décline toute responsabilité pour tout dommage résultant de cet accès non-autorisé.

DANGER: Removal of this front panel exposes circuitry which may cause electrical shock that can result in injury or death.

DANGER: Le retrait du panneau avant expose à la circuiterie qui pourrait être la source de chocs électriques pouvant entraîner des blessures ou la mort.

DANGER: Contact with instrument terminals may cause electrical shock which can result in injury or death.

DANGER: Le contact avec les bornes de l' instrument peut causer un choc électrique pouvant entraîner des blessures ou la mort.

REFERENCE MANUAL CHANGE INFORMATION

The date code at the bottom of each page of this user's guide reflects the creation or revision date. Date codes are changed only on pages that have been revised and any following pages affected by the revisions (i.e., pagination). If significant revisions are made to a section, the date code on all pages of the section will be changed to reflect the revision date.

Each time revisions are made, both the main table of contents and the affected individual section table of contents are regenerated and the date code is changed to reflect the revision date.

Changes in this user's guide to date are summarized below (most recent revisions listed at top).

Revision Date	Summary of Revisions
The ***Reference Manual Change Information*** section has been created to begin a record of revisions to this user's guide. All changes will be recorded in this Summary of Revisions table.	
20010619	Reverse of the title page–added Warranty statement. Section 2–updated drawing format, reissued entire section. Section 3, **Data Parsing Options**–added Flexible Parsing (Parse 6) option, updated drawing format, adjusted formatting of setting sheets, reissued entire section. Section 4–updated drawing format, reissued entire section. Section 6–updated drawing format, reissued entire section. Appendix A, **Firmware Versions**–additions
20010122	Reverse of the title page–added Cautions, Warnings, and Dangers in English and French. Section 1–made typographical changes. Added information about the **CARD** and **SET O** commands to **Table 1.1**. Section 2–added information about the **CARD** and **SET O** commands; added warning about changing default passwords to private passwords at installation; made typographical corrections; changed **ID** command description; added clarifying information about **IRIG** command; added vitual terminal usage and NOCONN information to **PORT** command description; added settings class "O" references to **COPY**, **SET**, **SHOWSET**, **SWAP** command descriptions and **Table 2.2**; changed **STATUS** and **WHO** command descriptions to reflect vitual terminal changes; changed **TARGET** and **TOGGLE** commands due to NOCONN, CCIN, CCOUT additions. Command Summary–added **CARD** command and **SET O** to the list of **SET n** commands. *20010122 entry continued*

Revision Date	Summary of Revisions
20010122	Section 3–added **SET O** command information; added setting NOCONN to **SET A** automatic message settings information, including **Tables 3.7**, **3.8**, **3.10**, and **3.11**; added virtual terminal section; added vitual terminal settings notes to **Table 3.3**; added SENDTIME to **Table 3.4**. Section 4–created **Table 4.2** which shows the order in which the SEL-2030 processes SELOGIC® Control Equations; updated **Figure 4.8**. Section 6—made typographical corrections; added rows 18 and 19 to **Table 6.6**; added CCIN and CCOUT element description and **Table 6.8**. Appendix A–added firmware version R113, which supports the SEL-2701 Ethernet Processor and adds Virtual Terminal settings.
20000508	Appendix E, **Figures E.2, E.4, E.5** – Additions
20000503	Section 3, **SET M – Math/Data Movement Settings** – Correction (pages 3-38 – 3-48 reissued)
20000221	Appendix A, **Firmware Versions** – Additions
20000120	Section 1, **Table 1.1** – Additions Section 3, **SET M Item Labels** – Addition, Settings Sheets – Additions Section 6, **Port Status Register** – Clarifications (all pages reissued) Appendix A, **Firmware Versions** – Additions
991222	Section 3, **SET M Examples** – Additions (all pages reissued) Section 3, **SET G – Global Settings** – Additions Section 3, **Table 3.17** – Additions Section 3, **Table 3.18** – Additions Section 7, **Internal Indication Object** – Additions (all pages reissued) Section 7, **Time Synchronization** – Additions Appendix A, **Firmware Versions** – Additions
991021	Appendix A, **Firmware Versions** – Additions
990805	Initial Issue

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SECTION 1: INTRODUCTION

This section provides a useful introduction to this manual. This section includes two parts: an Overview of the Manual and a List of Acronyms, Abbreviations, and Glossary Terms.

We, the employee-owners of Schweitzer Engineering Laboratories, are dedicated to making electric power safer, more reliable, and more economical. The SEL-2030 Communications Processor is designed to meet that goal.

We appreciate your interest in SEL products and we are dedicated to making sure you are satisfied. If you have any questions about the SEL-2030 or the manual, please contact us at:

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We provide prompt, courteous, and professional service.

We appreciate any comments and suggestions about new products or product improvements that would help us make your job easier.

OVERVIEW OF THE MANUAL

Background Information

This manual is designed to help you make the most effective use of the SEL-2030 Communications Processor, from the most basic to the most advanced applications. Each section begins with a detailed table of contents followed by a short paragraph summarizing the main areas of the section. The manual also includes the following helpful aids:

- Cross-references.
- Sample screens with notations.
- Numbered steps for sequential instructions.
- Many explanatory figures, tables, and illustrations.
- Caution symbols for your safety and the protection of the equipment.
- Pull-out lists on SEL-2030 commands and on special characters and predefined strings.

Other References

In addition to this manual, there are a number of other reference documents that may be useful in applying the SEL-2030 Communications Processor. The ***SEL-2030 User's Guide*** provides introductory information, examples on using these products, and troubleshooting guidelines. If you are using a SEL-2030 with a plug-in protocol card, you will also want to refer to the instruction manual for the protocol card.

Manual Conventions

A number of conventions are used in this manual. Commands you type appear in bold/uppercase: **ACC**. Keys you press appear in bold/uppercase/brackets: **<ENTER>**. Output screen images appear boxed and in the following format:

```
COMMUNICATIONS PROCESSOR - S/N 95012004     Date: 03/02/95    Time: 15:38:33          1
```

1 Explanatory notes: Explanatory notes associated with the SEL-2030 screen images are provided below each screen image.

The SEL-2020 and SEL-2030 Communications Processors share most features. The key differences in the products are shown in the following table:

Table 1.1: Differences Between the SEL-2020 and SEL-2030

SEL-2020	SEL-2030
No plug-in protocol card support.	Support for two plug-in protocol cards. Cards are referenced as Ports 17 and 18. This support includes the **CARD** and **SET O** commands.
Alarm contact pulsed by SALARM only if no I/O board is installed.	Alarm contact under SELOGIC® Control Equation control with default being ALARM=SALARM.
Optional internal modem available on Port 8.	No internal modem option available.
Code stored in ROM. Upgrades provided by swapping ROMs.	Code stored in Flash. Upgrades can be uploaded through front port.
Hardware flow control (RTS/CTS) and DCD flow control with modems are mutually exclusive.	Ports 1 and 9 provide a DCD input separate from CTS, so modems can be used with both hardware handshaking and DCD control on these two ports.
The only IRIG-B input is via the IRIG-B BNC connector.	IRIG-B can come in via the IRIG-B BNC, or the IRIG-B pin in Port 15 can be configured as an IRIG-B input, instead of output.
IRIG-B input modulated versus demodulated selection is done using jumpers.	IRIG-B input modulated versus demodulated selection is done using a setting.
No SET R or Sequential Events Recorder (SER) support.	Accepts binary SER records from SEL relays. Supports SER generation via **SET R** command.

SEL-2020	SEL-2030
No VT and WT timer elements.	VT and WT timer elements.
Allows only a single \W…/ string within a MESGn setting.	Supports multiple \W…/ strings within a single MESGn setting.
Maximum 250 lines of SET M equations.	Maximum 600 lines of SET M equations.
Optional 5 Vdc power to Ports 1–16 (jumper selectable).	Optional 5 Vdc power to Ports 3, 4, 11, 12, 14, 16 (jumper selectable).
No support for SEL-2600 RTD Module.	Supports collection of temperature data from SEL-2600 RTD Module.

Section Highlights

The following list summarizes the main purpose of each section:

- ***Section 2: Commands***, describes the command set that you use to control, monitor, operate, and set the SEL-2030. This section also includes the rules governing the use of these commands. A list summarizing the commands appears at the end of this section and on a blue pull-out card at the back of the book.
- ***Section 3: Settings***, provides detailed information about the commands used to configure and control the SEL-2030 and explains how you should respond to the SEL-2030 settings prompts. The SEL-2030 setting sheets are included at the end of ***Section 3: Settings***.
- ***Section 4: SELOGIC® Control Equations***, covers SELOGIC Control Equation operation, inputs, syntax, and outputs.
- ***Section 5: Message Strings***, provides information about the characters and predefined strings that you can use in a number of SEL-2030 settings. At the end of this section and also on a blue pull-out card at the end of the book is a summary list of special characters and predefined strings.
- ***Section 6: Database***, describes the structure of the SEL-2030 database and the various ways data within the database can be accessed.
- ***Section 7: Protocols***, describes the protocols native to the SEL-2030. These include LMD Distributed Port Switch Protocol, *Fast Operate*, Modbus® RTU Slave, and DNP 3.00 Level 2 Slave protocol.

Appendices

The following appendices provide supplemental reference information:

- ***Appendix A: Firmware Versions***
- ***Appendix B: ASCII Reference Table***
- ***Appendix C: Planning Sheets***
- ***Appendix D: SEL-2020/2030 Compatibility***
- ***Appendix E: SEL-2030 Physical Characteristics***

List of Acronyms, Abbreviations, and Glossary Terms

Term	Definition
ASCII	American National Standard Code for Information Interchange
CPU	Central Processor Unit
CTS	Clear-To-Send
DCD	Data-Carrier-Detect
DNP	Distributed Network Protocol
EEPROM	Electronically Erasable Programmable Read-Only Memory
EIA	Electronic Industries Association
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
FID	Firmware Identification
Flash Memory	Nonvolatile memory (retains data when power is removed)
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
HMI	Human Machine Interface
IED	Intelligent Electronic Device
IRIG-B	Inter-Range Instrumentation Group (U.S. Government)
LMD	SEL Distributed Port Switch Protocol
LPS	Linear Power Supply
LSB	Least Significant Bit
MOV	Metal Oxide Varistor
MSB	Most Significant Bit
Parse	To separate a string into its component parts and decide which parts to keep
PS	Power Supply
RFI	Radio Frequency Interference
RTS	Request-To-Send
RTU	Remote Terminal Unit
RXD	Receive
SCADA	Supervisory Control and Data Acquisition
TTL	Transistor-Transistor Logic (0 Vdc to +5 Vdc)
TXD	Transmit
VT	Virtual Terminal: A method to emulate a direct serial communications link through a network
XON	Transmit ON character
XOFF	Transmit OFF character

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SECTION 2: COMMANDS

INTRODUCTION

You control, monitor, operate, and set the SEL-2030 Communications Processor with the command set described in this section. This section also includes the rules governing the use of these commands. A list summarizing the commands appears at the end of this section and on a blue pullout card at the back of the book.

COMMAND OPERATION

Command/response protocol refers to the command structure and syntax that you must use to communicate with the SEL-2030. Access levels determine the levels at which you can interrogate the SEL-2030. Higher levels of access are required to set and operate the device.

Command/Response Protocol

The built-in SEL-2030 command set operates according to the following command/response protocol:

- All commands accepted by the SEL-2030 must be of the form:

  <command><CR> or <command><CR><LF>

- The SEL-2030 recognizes both full commands or commands abbreviated to the first three characters: **SHOWSET 1** is equivalent to **SHO 1**.
- You may use upper- and lower-case characters without distinction, except in passwords.
- Arguments are separated from commands by spaces, commas, semicolons, colons, or slashes.

Note: The ENTER key on most keyboards is configured to send the ASCII character 13 (^M) for a carriage return. This manual instructs you to press the **<ENTER>** key after commands, which should send the proper ASCII code to the SEL-2030.

- The SEL-2030 transmits all non-interactive messages in the following format:

```
<STX><MESSAGE LINE 1><CR><LF>
     <MESSAGE LINE 2><CR><LF>
       .
       .
       .
<LAST MESSAGE LINE><CR><LF>
<ETX><STX> <PROMPT><ETX>
```

  Each message begins with the start-of-transmission character STX (ASCII character 02) and ends with the end-of-transmission character ETX (ASCII character 03). Each line of the message ends with a carriage return and line feed.

- The CAN character (ASCII character 24) aborts a pending transmission. This capability is useful in terminating an unwanted transmission.
- You can send control characters from most keyboards with the following keystrokes:

XON: <CTRL-Q>	(hold down the Control key and press Q)
XOFF: <CTRL-S>	(hold down the Control key and press S)
CAN: <CTRL-X>	(hold down the Control key and press X)

Command Access Levels

A multilevel password system with three access levels provides security against unauthorized access. This system allows you to give personnel access only to those functions they require. The password system is disabled when the password jumper is inserted on the main board of the SEL-2030. (See ***SEL-2030 User's Guide; Section 3: Installation*** for information on using this jumper.) Passwords can be set or disabled on an access level basis using the **PASSWORD** command, described later in this section.

Each level has an associated screen prompt that indicates the active level. Table 2.1 shows the access levels of the prompts as well as the commands available from each access level.

WARNING

This device is shipped with default passwords. Default passwords should be changed to private passwords at installation. Failure to change each default password to a private password may allow unauthorized access. SEL shall not be responsible for any damage resulting from unauthorized access.

Table 2.1: Access Level Characteristics

Access Level	0	1	2
Prompt	*	*>	*>>
Available Commands	**ACCESS HELP ID QUIT**	**2ACCESS ACCESS AUTO BROADCAST CARD CLEAR DATE DNPMAP HELP ID IRIG MAP MEM PORT QUIT SHOWSET STATUS TARGET TIME VIEW WHO**	**2ACCESS ACCESS AUTO BROADCAST CLEAR CONTROL COPY DATE DEFRAG DNPMAP HELP ID IRIG L_D* MAP MEM PASSWORD PORT QUIT SET SHOWSET STATUS STORE SWAP TARGET TIME TOGGLE VIEW WHO**

* The **L_D** command is only available on Port F of the SEL-2030.

Changing Access Levels

The SEL-2030 always reverts to Access Level 0 at power-up, after time-out, and when you issue the **QUIT** command at the end of a communication session. To access Level 1, you must type **ACCESS<ENTER>** at the “*” prompt and then enter the password. To enter Access Level 2 from Access Level 1, use the **2ACCESS** command and the Access Level 2 password. If the password disable jumper is installed on the main board, a password is not required to change access levels. (See ***SEL-2030 User’s Guide; Section 3: Installation*** for information on installing jumpers.)

To return to Access Level 0, use the **QUIT** command. The port automatically returns to Access Level 0 after no activity has occurred on the port for the specified time-out interval.

See the following paragraphs for the details of using the **ACCESS**, **2ACCESS**, and **QUIT** commands.

SEL-2030 COMMAND SET

This section describes all SEL-2030 commands in alphabetical order. The minimum access level for each command is indicated in parentheses after the command name. See Table 2.1 for a complete summary of command access levels.

2ACCESS (Access Level 1)

Use the **2ACCESS** command to enter Access Level 2. You need a password unless the password disable jumper is installed (J17 B in the SEL-2030). Use the **PASSWORD** command at Level 2 to change passwords.

The following display exemplifies successful access:

```
*>2ACCESS<ENTER>

Password: ? @@@@@@<ENTER>

COMMUNICATIONS PROCESSOR - S/N 95012004     Date: 03/07/95    Time: 08:38:10

Level 2

*>>
```

You may use any command from the "*>>" prompt. The SALARM bit will go to 1 for one second for a successful Level 2 access and for three successive bad passwords. In the SEL-2030, you can use SALARM in the ALARM SELOGIC® Control Equation.

ACCESS (Access Level 0)

Use the **ACCESS** command to enter Access Level 1. You need a password unless the password disable jumper is installed (J17 B in the SEL-2030). From Access Level 2, you can use the **PASSWORD** command to change this password.

The following display exemplifies successful access:

```
*ACCESS<ENTER>

Password: ? @@@@@<ENTER>


COMMUNICATIONS PROCESSOR - S/N 95012004     Date: 03/07/95    Time: 08:45:43

Level 1
*>
```

If you enter wrong passwords for three consecutive attempts, the SEL-2030 pulses the SALARM bit for one second and displays:

```
Access Denied
WARNING: Access by unauthorized persons strictly prohibited.
```

In the SEL-2030, you can use SALARM in the ALARM SELOGIC Control Equation.

AUTO n (Access Level 1)

The **AUTO** command displays the results of auto-configuration on a port. The response message shows the device FID string, the device ID string, the baud rate, the supported operate commands, and a list of supported “20” commands. The operate command support indicates whether ASCII or binary operate messages are supported, the number of breakers and remote bits supported, and the type of remote bit operations supported (set, clear, pulse). Each “20” command is preceded by an A to indicate that data will be collected using an ASCII format or B to indicate binary *Fast Meter* format. The following screen shows an example of a typical **AUTO** command response.

```
*>>AUTO 1 <ENTER>

FID:       FID=SEL-151-R412-V656rp1rqys-D940901-E2
DEVICE ID: Example 21.6 kV Line
BAUD RATE: 9600
OPERATE SUPPORT:ASCII (1 Breakers, 0 Remote Bits)
COMMANDS SUPPORTED:
  B 20METER
  A 20DEMAND
  B 20TARGET
  A 20HISTORY
  A 20STATUS
  A 20BREAKER
  A 20EVENT
  A 20EVENTS

*>>
```

BROADCAST (Access Level 1)

The **BROADCAST** command allows you to communicate from one master port to all IED ports simultaneously. When you issue the **BROADCAST** command, the SEL-2030 will indicate the connected ports. From then on, anything you enter will be sent to all connected ports.

Any messages from any of the connected IED ports will be sent to the single master port, as long as they are framed with the <STX>/<ETX> characters. To transfer binary messages, add an AAh byte after the <STX> character and then a message length as the next byte. The SEL-2030 will use the message length to determine the end of the message, instead of checking for an <ETX> character.

Use the **BROADCAST** command with an R parameter to enter broadcast communications in a receive-only mode. In this mode, master port messages are used for connection termination only.

Exit broadcast mode by entering the transparent termination sequence defined in the SEL-2030 master port settings. (See ***Section 3: Settings*** for additional discussion on termination sequences.) You will need to allow an extra second for TERTIME1 due to some additional **BROADCAST** command delays. Note that the **BROADCAST** command is not supported for virtual terminal master ports.

CARD n (Access Level 1)

Use the **CARD** command to display the value of the Control Input and Control Output elements for the protocol card ports. Parameter n specifies the port (17 or 18).

```
*>CARD 17<ENTER>

Protocol Card Input Logic Elements =
0000 0000 0000 0000

Protocol Card Output Logic Elements =
0000 0000 0000 0000

*>
```

Append the Bit Label flag BL to display the control bit labels.

CLEAR m:n (Access Level 1)

The **CLEAR** command clears data from the unsolicited message queue or from the archive data region of an intelligent electronic device (IED) port. Parameter m specifies which port (1 through 18). Parameter n may be BUF for the unsolicited message queue or A1, A2, or A3 for the appropriate archive. Alternatively, for the archive regions, you may use the data label for the region (see **MAP** command). Clearing the unsolicited message queue clears all received messages from the buffer. Clearing an archive entry removes the oldest item from that archive queue; subsequent entries will remain. To completely clear an archive queue, add the parameter A. For example, use: **CLEAR 4:A2 A** to clear Port 4, Archive 2, all entries.

⚠ CAUTION

Frequent archive record clearing may exceed EEPROM capabilities. See the discussion in the Archive Data Region subsection of ***Section 6: Database***. If you completely clear an archive region that contains a large number of records (thousands of records), it may take a few minutes for the clearing to complete. During this time, most SEL-2030 automatic data collection will be suspended.

CONTROL m (Access Level 2)

Use the **CONTROL** command to set (assert), clear (deassert), and pulse (assert and deassert) global element bits R1 through R8. These bits exist in the Global region of the SEL-2030 database. In the example below, executing the **CONTROL** command controls the global element bit R5. When you enter the **CONTROL** command with parameter m to identify the bit number to control, the SEL-2030 prompts for an operation; enter one of the following operation codes:

- SRB to set the specified bit

- CRB to clear the specified bit
- PRB to pulse the specified bit.

These are the only acceptable operations. You must again specify the bit to control (1 through 8) following the operation. If you intend to pulse the bit, you can supply a time parameter or a one-second time is the default. The example below pulses R5 for 3 seconds.

```
*>>CONTROL 5<ENTER>

Control RB5:  PRB 5 3<ENTER>

*>>
```

COPY m n (Access Level 2)

The **COPY** command copies port-specific settings port (P), automatic message (A), data movement (M), user-defined command (U), protocol card control (O), and logic (L) settings from Port m to Port n (m and n equal any combination of 1 through 16). You can also copy between Ports 17 and 18. Type **COPY 1 ALL<ENTER>** to copy Port 1 settings to all other rear-panel ports.

Use **SET** to modify copied settings. Settings cannot be copied to any port that is actively involved in transparent communications.

The SEL-2030 makes the following confirmations for each port to which settings are copied:

```
*>>COPY 1 5<ENTER>

Copy settings from Port 1 to Port 5 (Y/N) ? Y<ENTER>

Perform auto-configuration on Port 5 (Y/N) ? N<ENTER>
Port 5 Settings Changed

*>>
```

If you copy to multiple ports using the ALL parameter, the confirmation is repeated for each port.

If you copy settings having CONFIG=Y, the SEL-2030 asks if you want to auto-configure the destination port. If you answer N (No), the SEL-2030 assumes the devices connected to the two ports are identical. If you answer Y (Yes), you may lose some auto-message settings on the destination port if the connected device is not the same type as the device connected to the source port.

When you use the **COPY** command, the SEL-2030 will make changes to port numbers used in strings and in SELOGIC Control Equations within the copied settings based on the following rules: for the command format "**COPY n m**", any reference to Port n will change to m, and any reference to a port other than n will remain unchanged. Always use the **SHOWSET** command to verify settings following a copy. Use the **SET** command to make required adjustments to settings.

The SALARM bit asserts for one second after a successful copy to indicate that the settings have changed. In the SEL-2030, SALARM is assigned to ALARM by default, so the alarm contact will close for one second unless this setting has been changed.

If you copy settings to the current port, change your terminal's communication parameters to match once you accept the changes.

DATE (Access Level 1)

The **DATE** command, without parameters, displays the date stored by the internal calendar/clock. Use the **DATE** command with a date parameter to change the date: **DATE mm/dd/yy**. For example, set the date to March 20, 1994, by entering:

```
*>>DATE 03/20/94<ENTER>

03/20/94
*>>
```

If you use IRIG-B, the day of the year determined from IRIG-B overrides the date settings.

DEFRAGMENT (Access Level 2)

The **DEFRAGMENT** command defragments EEPROM. The SEL-2030 settings are stored in EEPROM. After multiple settings changes, the available portion of EEPROM may become fragmented (available bytes exist as several small blocks as opposed to a single larger block). The **DEFRAG** command may be necessary in order to allow further settings changes to be successfully saved.

```
*>>DEFRAG<ENTER>

Performing EEPROM defragmentation will suspend most SEL-2030 activities.

Perform EEPROM defragmentation (Y/N)? Y<ENTER>

Defragmenting ... complete.

*>>
```

Executing the **DEFRAG** command will momentarily suspend many of the SEL-2030 database and communications activities while the SEL-2030 concentrates the available EEPROM into a single block. Use the **MEM** command to check EEPROM fragmentation.

DNPMAP (Access Level 1)

The **DNPMAP** command displays a map of the data available to DNP, including object type, index, and default variation. This map is based on the port and math settings on Port 16. Event objects will not be displayed; event objects will have the same indexes as their corresponding static object. See ***Section 7: Protocols*** for more information.

```
*>>DNPMAP<ENTER>

                                             Date: 03/03/97    Time: 15:06:06

DNP Address:  0000h

Object Type     Index      Default Variation      Label
     01          0-47           02                1:TARGET:TARGET
     20          0-2            06                1:LOCAL:ARCHIVE_CNTRS
     30          0              03                1:METER:IA(A)
     30          1              03                1:METER:IB(A)
     30          2              03                1:METER:IC(A)
     30          3              03                1:METER:VA(V)
     30          4              03                1:METER:VB(V)
     30          5              03                1:METER:VC(V)

*>>
```

HELP (Access Level 0)

The **HELP** command lists all commands available at the current access level with a one-line description of each, as shown in the display below. Use the **HELP** command with another command as its parameter and it will provide the syntax and a brief description of the command. If you use the **HELP** command with an invalid command parameter, the SEL-2030 responds with an error message.

```
*HELP<ENTER>
Commands available at current access level:

- ACCESS - Change access level to Access Level 1
- HELP - Provide information on available commands
- ID - Display SEL-2030 identification information
- QUIT - Change access level to Access Level 0

*
```

ID (Access Level 0)

The SEL-2030 responds to the **ID** command with identification information, including the following:

FID	SEL-2030 firmware identification string
BFID	SELBoot firmware identification string
CID	SEL-2030 firmware checksum
DEVID	ID as set in the global settings
DEVCODE	Device Code
PARTNO	Part Number: Reserved for future use
CONFIG	Configuration: Reserved for future use
SPECIAL	Reserved for future use

An example command response is as follows:

```
*ID<ENTER>
"FID=SEL-2030-X179-V0-Z000000-D20001228","08D6"
"BFID=SLBT-2030-X015-V0-Z000000-D20001226","095C"
"CID=507D","025D"
"DEVID="COMMUNICATIONS PROCESSOR - S/N 97312004","0A70"
"DEVCODE=52","030E"
"PARTNO=","0281"
"CONFIG=000000","0383"
"SPECIAL=","02AE"
*
```

The four digits at the end of each line are the 16-bit checksum in ASCII-hexadecimal for the preceding string. This checksum is calculated by summing the character codes starting with the first quotation mark and going through the comma separating the string and checksum.

You can also use the **WHO** or **STATUS** command to determine **ID** information. The **ID** command provides consistency between the SEL-2030 and the new standard **ID** command format for SEL relays.

Add a port number to the **ID** command (**ID p**, where p is any valid port number 1 to 16) to obtain the FID, BFID, and DEVID of the device connected to that port of the SEL-2030. Use a port number of 17 or 18 to determine the FID and device name of an installed protocol card, as shown below:

```
*ID 17<ENTER>
"SEL-2701-X045-V0-Z000000-D20010102","07BA"
"BFID=SLBT-2701-X019-V0-Z000000-D20001228","0967"
"DEVID=Ethernet","0558""
*
```

IRIG (Access Level 1)

The **IRIG** command directs the SEL-2030 to read the IRIG-B time-code input at the IRIG-B port on the back panel.

If it reads the time code successfully, it updates the internal clock/calendar time and date. The SEL-2030 then sends its ID, date, and time to the terminal.

```
*>IRIG<ENTER>

COMMUNICATIONS PROCESSOR - S/N 95012004     Date: 03/07/95    Time: 09:06:33

*>
```

If the IRIG-B signal is not present or cannot be read, the SEL-2030 sends the error message “IRIG-B DATA ERROR.” If the signal is present but the global TIMESYNC setting is not set to IRIG, the SEL-2030 will display the error message, “IRIG SIGNAL PRESENT BUT NOT PROCESSED DUE TO TIMESYNC SETTING.”

Normally, using this command is unnecessary because the SEL-2030 automatically synchronizes every few minutes; however, you can use the **IRIG** command to avoid waiting for automatic synchronization during testing and installation checkout.

L_D (Access Level 2)

The **L_D** command causes the SEL-2030 to exit normal execution mode and enter SELBoot mode. This command is only available from the front port. This command should only be used when you are going to load new firmware into the SEL-2030 or into a plug-in card using the SEL-2030. All normal operation will cease while in SELBoot mode.

MAP m (Access Level 1)

Use the **MAP** command to see the organization of data stored in a port database. Parameter m specifies the port number. Data are listed by association with each region if only the port number parameter is given. If you add a region parameter, text and numeric references are shown for data stored in the region, e.g., **MAP 2:TARGET**. (See access methods' discussion in ***Section 6: Database*** for a complete description of database access methods.)

To observe the use of the Port 1 database, type **MAP 1<ENTER>**. You will see a screen with the following format:

```
*>>MAP 1<ENTER>

Port 1 Database Assignments

  Region    Data Type   # Records

  GLOBAL    --
  LOCAL     --
  BUF       --
  D1          Unused
  D2        B METER
  D3          Unused
  D4        B TARGET
  D5        A STATUS
  D6          Unused
  D7          Unused
  D8          Unused
  A1          Unused
  A2          Unused
  A3        A EVENT        0
  USER        Unused


*>>
```

In the above example, every region in the database is listed by its label. GLOBAL, LOCAL and BUF contain data pertinent to the SEL-2030, and the other regions contain data collected for Port 1. The type of data stored in each region is listed. The letter just to the left of the data name in the Data Type column indicates the data transfer format: A for ASCII, B for Binary. The # Records column lists records queued in the A1 through A3 archive data regions.

Use the **MAP** command with a region specifier to see the labels, addresses, and types of data stored in that region:

```
>>MAP 1:D2<ENTER>

Port 1,  Data Region METER  Map

Data Item    Starting Address   Type

_YEAR        2800h              int
DAY_OF_YEAR  2801h              int
TIME(ms)     2802h              int[2]
IA(A)        2804h              float[2]
IB(A)        2808h              float[2]
IC(A)        280Ch              float[2]
VA(V)        2810h              float[2]
VB(V)        2814h              float[2]
VC(V)        2818h              float[2]
IAB(A)       281Ch              float[2]
IBC(A)       2820h              float[2]
ICA(A)       2824h              float[2]
VAB(V)       2828h              float[2]
VBC(V)       282Ch              float[2]
VCA(V)       2830h              float[2]
PA(MW)       2834h              float
QA(MVAR)     2836h              float
PB(MW)       2838h              float
QB(MVAR)     283Ah              float
PC(MW)       283Ch              float
QC(MVAR)     283Eh              float
P(MW)        2840h              float
Q(MVAR)      2842h              float
I0(A)        2844h              float[2]
I1(A)        2848h              float[2]
I2(A)        284Ch              float[2]
V0(V)        2850h              float[2]
V1(V)        2854h              float[2]
V2(V)        2858h              float[2]

*>>
```

Each item within a data region has a label, a numeric address (given in hexadecimal), and a type. The types are "char" for character data, "int" for integer data, and "float" for floating point data. If an item consists of an array of these entries, the number of items is indicated in brackets after the type specifier, e.g., int[2] means there are two integers stored. For vector quantities, the first float contains the magnitude and the second float contains the angle. In the example above, IA(A) magnitude is at address 2804h and IA(A) angle is at address 2806h.

Add the BL parameter to the **MAP** command to receive bit label information if it is available. The following example illustrates the BL parameter:

```
*>>MAP 2:TARGET BL<ENTER>

Port 2,  Data Region TARGET  Map

Data Item    Starting Address   Type   Bit Labels

_YEAR        4800h              int
DAY_OF_YEAR  4801h              int
TIME(ms)     4802h              int[2]
TARGET       4804h              char[9]
             4804h              INST  A     B     C     Q     N     RS    LO
             4805h              51P   50L   50H   51QP  50Q   51NP  50NL  50NH
             4806h              51T   50LT  50C   51QT  50QT  51NT  50NLT 27
             4807h              79RS  79CY  79LO  79SH  52AT  52BT  IN6   IN5
             4808h              PDEM  QDEM  NDEM  TF    CF    TCMA  ST    TRIP
             4809h              A     B     C     D     E     F     G     H
             480Ah              J     KT    L     V     W     X     Y     ZT
             480Bh              *     *     IN6   IN5   IN4   IN3   IN2   IN1
             480Ch              *     TRIP  CLOSE A1    A2    A3    A4    ALRM


*>>
```

The bit labels are listed in most-significant to least-significant bit order, the same as in SEL relays. Bit labels are available in the GLOBAL, LOCAL, and TARGET (if not in archive) regions.

MEMORY (Access Level 1)

The **MEMORY** command shows the status of all dynamically allocated memory. This includes RAM, which is used for temporary data storage; EEPROM, where string and SELOGIC Control Equation settings are stored; nonvolatile Flash, where archive data are stored; and Shared RAM, where the database is stored. The report indicates the number of bytes of dynamic memory, the number of free (unused) bytes, the number of free blocks (contiguous segments of unused memory), and the size of the largest free block. The following screen shows a typical **MEM** report.

```
*>>MEM <ENTER>

Memory        Total         Bytes       Blocks    Largest block
type          bytes         free         free       available

RAM          334618        155490           2        151890
EEPROM        18308         14018          20         11516
FLASH       2097152       1081344         584        146176
SRAM        1046524        937228           1        937228

*>>
```

You can use the free bytes and largest available block to determine if you are running out of memory. The number of free blocks indicates how badly the memory is fragmented. The more free blocks there are, the less efficiently the SEL-2030 can use the available free memory.

PASSWORD (Access Level 2)

Use the **PASSWORD** command to inspect or change existing passwords. To inspect passwords, type **PAS<ENTER>**. The passwords for Level 1 and Level 2 are displayed.

```
*>>PASSWORD<ENTER>

1:OTTER
2:TAIL
*>>
```

The command **PAS 1**, followed by a password string, is used to change the Level 1 password. For example, **PAS 1 Ot3579 <ENTER>** sets “Ot3579” as the password for Access Level 1. Similarly, the command **PAS 2**, followed by a password, will set the Level 2 password.

After entering your new passwords, use the **PAS** command to view the new settings. The following example shows how to use the **PAS** command for viewing and setting passwords. When setting your passwords, be sure to choose “strong” passwords that cannot be guessed or broken easily with automated “password cracking” software.

```
*>>PAS 1 Ot3579
Set

*>>PAS 2 Ta2468
Set

*>>PAS

1:Ot3579
2:Ta2468

*>>QUIT

COMMUNICATIONS PROCESSOR - S/N 98205023     Date: 10/06/00    Time: 14:16:54

*
```

If you are certain that your physical control of all access to the SEL-2030 is sufficient to prevent unauthorized access, or if the devices connected between the SEL-2030 and any other access points provide sufficient protection from unauthorized access, then you may disable password protection.

To disable passwords at a specific level, enter the keyword DISABLE instead of a password when setting the password:

```
*>>PAS 1 DISABLE<ENTER>

Disabled

*>>PAS<ENTER>

1:PASSWORD DISABLED
2:TAIL

*>>
```

The SEL-2030 sets the password, asserts the SALARM global element for approximately one second, and transmits the response “Set”. After entering new passwords, type **PAS <ENTER>** to inspect them. Make sure they are what you intended, and record the new passwords.

When you change passwords, the SALARM bit will assert for one second. In the SEL-2030, SALARM is assigned to ALARM by default, so the alarm contact will close for one second unless the ALARM setting has been modified.

If the passwords are lost or you wish to operate the SEL-2030 without password protection, install the Password Jumper (J17 B in the SEL-2030) on the main board (see ***SEL-2030 User’s Guide; Section 3: Installation*** for jumper location). With no password protection, you and others can gain access without knowing the passwords and view or change active passwords and settings.

Using Strong Passwords

It is important that you establish strong password protection to safeguard against unauthorized persons setting or controlling your SEL 2030 and the devices attached to it. Strong passwords consist of six characters, with at least one special character or digit and mixed-case sensitivity, but do not form a name, date, acronym, or word. Passwords formed in this manner are less susceptible to password guessing and automated attacks. Examples of valid, distinct strong passwords include:

Ot3579 A24.68 Ih2dcs 4u-Iwg Ic-4+

Note: Do not use characters that you have selected as LMD prefix characters. See ***Section 7: Protocols***, for a description of LMD prefixes.

Used properly, passwords provide good protection against unauthorized access. Make sure you choose strong passwords and record them in a secure location. If your passwords are forgotten and lost, you will need to install the main board password jumper in order to disable password protection long enough to view them with the **PAS** command.

PORT n (Access Level 1)

The **PORT** command connects the master port issuing the command to the designated port, permitting transparent communication between the two ports. To terminate transparent communications and return to SEL-2030 command operation, use the disconnect sequence set for your port. You cannot connect to a port that is already communicating transparently.

The following example illustrates using the **PORT** command to enter and exit transparent communications:

```
*>>PORT 9<ENTER>

Transparent Communications to Port 9 established

ID<ENTER>
"FID=SEL-2030-X179-V0-Z000000-D20001228","08D6"
"BFID=SLBT-2030-X015-V0-Z000000-D20001226","095C"
"CID=507D","025D"
"DEVID="COMMUNICATIONS PROCESSOR - S/N 97312004","0A70"
"DEVCODE=52","030E"
"PARTNO=","0281"
"CONFIG=000000","0383"
"SPECIAL=","02AE"

<CTRL-D>
Transparent Communications to Port 9 terminated

*>>
```

This example uses the default termination character <CTRL-D> to exit transparent communications. You can set the termination string on the master port using the TERSTRING setting within the **SET P** command.

When connecting to a printer port, you may add an E parameter to enable echoing from the SEL-2030 (e.g., **PORT 5 E**). Using this parameter, you can see what you are sending to the printer, but you will not see any messages sent to you by the printer.

To select the Direct Transparent mode, add the D parameter to the **PORT** command (**PORT n D**, where n selects the port number). The Direct Transparent mode passes characters through rapidly, without significant buffering delays and disables RTS/CTS handshaking regardless of the RTS_CTS setting for the port.

If you have a card that supports virtual terminal features installed in Ports 17 or 18, use the **PORT** command to establish communications with other devices on the network. For example, if you have an SEL-2701 in Port 18, type **PORT 18 XX**, where XX is the IP address of a device on the network. This will establish a transparent, virtual connection with the device with IP address XX. For virtual terminal connections, you may append the optional NOECHO parameter to prevent echoing. The D and E parameters are not supported for Ports 17 and 18.

See ***Section 3: Settings*** for a more complete discussion of transparent communications.

If the NOCONN bit is set, a transparent connection will not be established and an error message will be sent.

QUIT (Access Level 0)

The **QUIT** command causes the SEL-2030 to return control to Access Level 0 from Level 1 or Level 2. The command displays the SEL-2030 ID, date, and time of **QUIT** command execution.

Use this command when you finish communicating with the SEL-2030 to prevent unauthorized access. Control returns to Access Level 0 automatically after a settable interval with no activity (see TIMEOUT setting in the **SET P** subsection of ***Section 3: Settings***). If the port you are communicating with is using LMD Distributed Port Switch Protocol, the connection is dropped when you issue the **QUIT** command. If you are connected to the port through a dial-up modem, the SEL-2030 will hang up the modem when it receives a **QUIT** command.

SET Commands (Access Level 2)

Use the nine **SET** command variations to configure the SEL-2030. These nine **SET** command variations are listed in Table 2.2 with their parameters, formats, and uses. Table 2.3 lists the editing keys used with all **SET** commands. **SET M** has some additional editing features, which are described in ***Section 3: Settings***.

The **SET** command always requires a class parameter (G, C, R, P, A, M, L, 0, or U). If the setting is port specific, the class will be P, A, M, L, O, or U, and you must supply the port (1 through 16 or F). In the SEL-2030, Ports 17 and 18 may also be used with the P, M, L, and O classes. You may also specify the setting to start with. You can give these parameters in any order.

On the SEL-2030, **SET P 17** and **SET P 18** are used to modify the settings of a plug-in card. The settings that are presented in response to these commands are a function of the installed card. See the instruction manual of the plug-in card to learn about its settings.

Table 2.2: Variations on the SET Command

Command	Sets	Format	Application
SET P n	Enter port ID. Set all port configuration and communication parameters.	SET P SET P 1 SET P 2 PARITY	Set current port Set Port 1 Set Port 2 starting at entry PARITY
SET A n	Define automatic message and trigger sequences. Determine response handling for messages.	SET A SET A 4 SET A 3 ISSUE1A	Set current port Set Port 4 Set Port 3 starting with ISSUE1A
SET U n	Create user-defined commands.	SET U SET U 4 SET U 12 READ	Set current port Set Port 4 Set Port 12 starting with READ setting
SET L n	Defines logic equations.	SET L SET L 6 SET L 6 SBR3	Set current port Set Port 6 Set Port 6 starting with the SBR3 setting
SET M n	Define data scaling and movement equations.	SET M SET M 7	Set current port Set Port 7
SET G	Enter SEL-2030 ID. Define intermediate SELOGIC Control Equations. Define contact output functions.	SET G SET G ID	Set global settings Set global settings starting at ID

Command	Sets	Format	Application
SET R	Sequential Events Recorder (SER) elements.	SET R	Set SER elements
SET C	Oscillator frequency.	SET C	Set calibration setting
SET O n	Defines logic equations for CCOUT elements.	SET O 17 SET O 18 CCOUT6	Set Port 17 Set Port 18 starting with the CCOUT6 setting

Note 1: The **SET A**, **SET M**, **SET L**, and **SET U** commands are not available on the front-panel port (Port F).

Note 2: The **SET U** command is not available when the port device type is set to Printer. (You select the port device type using **SET P**.)

Note 3: If you use **SET P** to change settings on a modem port and there is an active connection, the connection will be hung up when you accept the settings.

Note 4: In the SEL-2030, **SET P**, **SET M**, **SET L**, and **SET O** are available for Ports 17 and 18 if there is a plug-in protocol card installed in the appropriate slot.

Table 2.3: Editing Keys for SET Commands

Press Key(s)	Results
∧ <**ENTER**>	Moves to previous entry in a setting category until you get to the first entry in the category and then it moves to previous category.
< <**ENTER**>	Moves to the first entry prompt in the previous settings category.
> <**ENTER**>	Moves to the first entry prompt in the next settings category.
<**ENTER**>	Accepts setting, then moves to next entry prompt.
END<**ENTER**>	Exits editing session and displays all settings. Prompts: "Accept settings (Y/N)?". Type **Y**<**ENTER**> to save changes and exit, **N**<**ENTER**> to exit without saving. Lower-case letters (end, y, n) are also accepted.
<**CTRL-X**>	Aborts editing session without saving changes.
OFF<**ENTER**>	Flags a setting as not applicable. Lower-case letters (off) are also accepted.

Section 3: Settings explains all of the settings, including their applicability to various connected device types. Refer to that section for complete reference information.

The SEL-2030 checks each entry to ensure that it is a valid choice. If it is not, the SEL-2030 generates an "Out of Range" message, and prompts for the setting.

When you finish a setting, it is not necessary to scroll through the remaining settings. Type **END<ENTER>** after your last change to display the new settings and acceptance prompt.

After you enter all data, the SEL-2030 displays the new settings and asks you to confirm that they are correct. Type **Y<ENTER>** to approve the new settings or **N<ENTER>** to abort setting changes. If you type **Y<ENTER>** and have a setting violation, an error message is displayed, and the settings prompt moves to the first setting that affects the failure. If settings are acceptable, the SEL-2030 saves them. While the active settings are updated, the SEL-2030 port being modified is disabled and the SALARM bit asserts for one second. In an SEL-2030, SALARM is assigned to ALARM by default, so the alarm contact will close for one second unless the ALARM setting has been modified.

When the settings change on a port, that port is reset. If you change the settings on the current port, the settings become effective after being accepted. If you change the baud rate, you also must change the baud rate on your terminal to match in order to resume communicating with the SEL-2030. You may not change the settings on a port that is currently communicating transparently with another port.

Use the **COPY** or **SWAP** commands to move settings between ports.

SHOWSET t (Access Level 1)

You use the **SHOWSET** command to display settings. **SHOWSET** works with all settings classes: P, A, M, U, L, O, G, R, and C. The P, A, U, M, and L classes require a port number parameter (1 through 16 or F). In the SEL-2030, classes P, M, L, O, and U are also available for Ports 17 and 18. For example, enter the command **SHOWSET P F** to examine the front-panel port settings or enter the command **SHOWSET G** to examine the global settings. You can display P, A, M, U, L, and O settings for a port by giving the port number as the only parameter to **SHOWSET**. (For example, use **SHOWSET 5** to view all Port 5 settings.) Enter parameters following the **SHOWSET** command in any order.

You cannot enter or modify settings with this command. Change settings with the **SET** command.

STATUS (Access Level 1)

Use the **STATUS** command to inspect self-test status, the configuration of this unit, and the status of each port. The SEL-2030 automatically sends the **STATUS** command response message to Port F whenever the self-test software enters a warning or failure state. Add a repeat count parameter to cause the **STATUS** command to repeat a given number of times. For example, type **STATUS 4** to view the status information four times.

The SEL-2030 **STATUS** report format appears as follows:

```
*>>STATUS<ENTER>

COMMUNICATIONS PROCESSOR - S/N 97300004     Date: 12/05/00    Time: 10:12:06
FID=SEL-2030-R113-V0-Z0-D20001215           FID=SLBT-2030-R103-V0-D20001215

SELF-TESTS

RAM     SRAM      CODE    ARCH    EEPROM   P.S.      SET       BATTERY
512 kb  1024 kb   OK      2048 kb OK       OK        OK        OK

IRIG-B Input: Present
I/O Board: Installed


Port   Status         Success Rate   SET M       Database Delays
1      Active             100%       Running     D2 D4 D5 D6 D7
2      Active              80%       None        D2 D3 D4 D5 D6 D7
3      Trans F            100%       None
4      Active             100%       Disabled    D2 D3 D4 D5
5      Active             100%       None
6      Active              66%       None
7      Active             100%       None        D2 D3 D4 D5
8      Active                        None
9      Active                        None
10     Inactive                      None
11     Active                        None
12     Active                        None
13     Inactive                      None
14     Inactive                      None
15     Inactive                      None
16     Active              66%       None
17     NORMAL(Oh)         NORM       None
18     NORMAL(Oh)         NORM       None
F      Trans 3            100%       None
18     Trans 2 VT1        100%
17     Active VT2         100%


*>>
```

Table 2.4 describes the **STATUS** report self-test and configuration fields.

The configuration information (RAM size, nonvolatile Flash memory size, IRIG-B input, and I/O board presence) reported in the status message is determined at system power-up. A configuration item not reported as expected may indicate a problem in accessing that item. If a failure occurs, the SEL-2030 will attempt to continue operating, but invalid data may be reported.

Table 2.4: Status Report Description

Parameter	Status Displayed	Explanation
RAM	xxxx kb Uxx	Installed RAM size; self-test OK. Self-test failure in specified RAM device.
SRAM	xxxx kb Uxx	Installed Shared-RAM size; self-test OK. Self-test failure in specified RAM device.
CODE	OK Uxx	Code Flash self-test successful. Self-test failure in specific device.

Parameter	Status Displayed	Explanation
ARCH	xxxx kb Absent FAIL	Installed nonvolatile Flash memory size; self-test successful. No nonvolatile Flash memory installed. Self-test failure.
EEPROM	OK FAIL	EEPROM self-test successful. Self-test failure.
P.S.	OK FAIL	Power supply voltages are acceptable. A power supply voltage is out-of-tolerance.
SET	OK FAIL	Settings are OK. Settings are not valid.
BATTERY	OK FAIL	Battery-backed clock battery was OK on last power-up. Bad date or time reported by battery-backed clock on last power-up. This is probably due to a low battery.
IRIG-B Input	Absent Present	No IRIG-B input signal is detected. IRIG-B input signal is present.
I/O Board	Absent Installed	No I/O board is installed. I/O board is installed.

The SEL-2030 settings become invalid when the SEL-2030 copies ROM default settings into EEPROM. This problem occurs when new code is installed in the SEL-2030. You use the **SET C** command to change the settings to VALID. For any unexpected self-test failure, you should contact the factory immediately to get the unit repaired.

Port Status Information

Status. The Port Status Column of the report indicates, for each port, whether the port is Unused, Active (in a normal active state), Inactive (not responding), pInactive (in an inactive state with a power-up auto-configuration pending), ConfigFail (in a power-up auto-configuration failure state), Trans n (communicating transparently with some other port, e.g., Trans 7), Trans C yyyy (communicating transparently with card C to network device yyyy), or Broadcast (communicating to all IED ports simultaneously).

Plug-in card status and status code are reported for Ports 17 and 18. See the plug-in card's instruction manual for information about these indications. For cards that support virtual terminal connections, an additional line is appended for active virtual terminal connections; the status can include Master VTn (virtual terminal master session) or Trans PVtn (virtual terminal transparent connection to Port P).

Success Rate. The Success Rate column indicates the percentage of error-free messages received; errors could be due to checksum failure or unexpected data items. The Success Rate is reset when you issue a **STATUS CLEAR** or **STATUS RESET** command, or you issue a **SET P** command for a port.

In the SEL-2030, additional plug-in card status is provided in this column. The value will be NORM if everything is working as expected. The value will be FAIL if the card quits responding to the SEL-2030.

SET M. The SET M column indicates the state of SET M settings. 'None' indicates that there are not SET M settings on the port or that the SEL-2030 is still doing power-up initialization and the settings have not yet compiled. 'Running' indicates that SET M settings exist and are running on the designated port. 'Disabled' indicates that SET M settings exist but are not running on the designated port; this is typically due to insufficient RAM. See ***Section 3: Settings*** for a complete discussion of SET M settings.

Database Delays. The Database Delays column indicates in which database regions (e.g., D1 A1) data have not been collected at the desired rate since the last **STATUS CLEAR** or **STATUS RESET** command was issued. Any entry in this column indicates a request for data with a previous request pending. These delays will occur: a) in transparent mode because the SEL-2030 cannot perform its data collection operation, b) if the data collection rate is set too high for the IED response time, or c) if the SEL-2030 is so busy that it cannot process data requests at the set rates.

STORE m:n d (Access Level 2)

Use the **STORE** command to store data directly into a database. Parameter m specifies the port number (1 through 18 in the SEL-2030); parameter n specifies the starting database address; and parameter d is a data stream with each item consisting of data as characters, decimal integers, hexadecimal integers, or single-precision floating-point numbers. You identify the data as character data by placing the character(s) in single quotes (i.e., 'F'), null-terminated string data by placing the character(s) in double quotes (i.e., "G"). Decimal integer data are the default. Hexadecimal integer data are indicated when the last character is an "h." Floating-point data are indicated by the presence of a decimal point (.) within the number.

Use the **STORE** command to force data into the database for test purposes. The database address being accessed must be a valid database address for writing. You cannot write to read-only addresses in the Global and Local Data Regions. You can write to any allocated User Data Region. You set up the User Data Region for each port as a portion of the auto-message settings (SET A). Use the **VIEW** command to confirm that data are stored as you expected.

The following example illustrates how you use the **STORE** command to store various types of data and how you use the **VIEW** command to see the stored response:

```
*>>STORE 3:F800h 'F' 123 123h 123.<ENTER>

*>>VIEW 3:F800h NR 5<ENTER>

3:F800h

0046h 007Bh 0123h 42F6h 0000h

*>>
```

SWAP n m (Access Level 2)

The **SWAP** command switches all port-specific settings (P, A, M, U, O, and L settings) between two ports. The SEL-2030 requests confirmation, as for the **COPY** command. This command can only be performed if neither of the two ports is currently communicating transparently. Before performing the **SWAP**, the SEL-2030 requests confirmation. If you answer yes, the alarm contact is pulsed and the involved ports are reset. Neither of the selected ports may be the current port or Port F. In the SEL-2030, Ports 17 and 18 can be used only to swap with each other only if identical cards are installed in both slots.

```
*>>SWAP 4 6<ENTER>

Swap Port 6 settings with Port 4 settings (Y/N) ? Y<ENTER>

Port 6 Settings Changed
Port 4 Settings Changed

*>>
```

When you use the **SWAP** command, the SEL-2030 makes changes to port numbers used in strings and in SELOGIC Control Equations within the settings on all ports, based on the following rules: for the command format "**SWAP n m**", any reference to Port n will change to m, and any reference to Port m will change to n; any reference to a port other than n or m will remain unchanged. You should always use **SHOWSET** after a swap to make sure all settings and port references are as desired.

TARGET n m (Access Level 1)

The **TARGET** command displays global or port-specific element information. You enter G for parameter n to display global elements or 1 through 18 for port-specific elements (Port F has no elements). Port-specific elements include elements from the LOCAL region and from the TARGET region (if it exists as a data region). For parameter m, enter the element row number you want displayed or enter ALL to show all of the elements. You may add a repeat count as a third parameter to repeat the displayed response the specified number of times. You can always abort the display using the <CAN> character (<CTRL-X>).

Because many of the SEL-2030 elements will assert (logical 1) for only a few milliseconds, the SEL-2030 elements displayed by the **TARGET** command are the logical OR of each element's status during the last one-second period. If an element is asserted at any point within the last second, the element status is displayed as asserted. When displaying repeatedly, each update will be one second apart, so each will show the element status since the previous row's display. The **TARGET** display of the SEL IED elements will simply show the result of the most recent sample from the device. See ***Section 4: SELOGIC® Control Equations*** for a description of all local and global elements.

TIME (Access Level 1)

The **TIME** command displays and sets the internal clock. To set the clock, type **TIME** and the desired setting, then press **<ENTER>**. To set the clock to 23:30:00, enter:

```
*>TIME 23:30:00<ENTER>

23:30:00
*>
```

A quartz crystal oscillator provides the time base for the internal clock. You can also set the time clock automatically through the SEL-2030 time-code input using a source of modulated or demodulated IRIG-B time code. The SEL-2030 contains a battery-backed real-time clock, so the time and date will be maintained through a loss of power.

TOGGLE m (Access Level 2)

The **TOGGLE** command toggles the specified element (parameter m) for test purposes. You may specify global elements simply by giving their name. Local elements must have the port number preceding the element label (e.g., 4:D2). Toggle the Control Input and Output bits by specifying the port and element label (e.g., 17:CCIN12). If that element can trigger an operation, then that operation will occur. Use this command to test your data collection and data access functions without having to force some external condition.

When you use the **TOGGLE** command with the CCOUTn bits, internal logic in the SEL-2030 executes normally. However, to reduce the likelihood of misoperation due to testing in a network environment, the CCOUTn toggle changes are not sent to the plug-in cards.

Normally, the toggled element will automatically toggle back as a result of subsequent SELOGIC Control Equation calculations. However, if the specified bit has an unused SELOGIC Control Equation, it will remain in the new state until you use the **TOGGLE** command to return it to the original state. The **TOGGLE** command is intended for test purposes only; you should use the **CONTROL** command for operational control.

VIEW (Access Level 1)

Use the **VIEW** command to look at data stored in a port's database. The data are displayed as formatted data if accessed by data region, as hexadecimal words if accessed by address, or as binary value if accessed by bit. Supply the following parameters after the **VIEW** command in the order listed:

data reference	Use any valid data region (port number, region label, or data type label), register address, or bit access method to specify the data to be viewed. See ***Section 6: Database*** for a description of valid access methods. Examples:

VIEW 1:D1	(port #:region label)
VIEW 1:METER	(port #:data type label)
VIEW 1:0807h	(port #:register address)
VIEW 1:0807h:4	(port #:register address:bit number)

C — Add the clear flag after a BUF or archive region reference to clear that region as you view it.
Example: **VIEW 1:BUF C**

CAUTION — Frequent archive record clearing may exceed EEPROM capabilities. See the discussion in the Archive Data Region subsection of ***Section 6: Database***.

BL — Add the bit label flag after a region reference to see any elements in that region displayed as bits with their labels. Such elements exist in the GLOBAL, LOCAL, and TARGET (if not in archive) regions.
Example: **VIEW 1:GLOBAL BL**

/n — Add a number “n” after an archive region reference to see that record number within the archive record queue. Number 1 is the oldest record, higher numbers reference newer records.
Example: **VIEW 1:A3/4**

Note: You cannot use the clear parameter C with /n, i.e., you can only clear the oldest record.

NR n — Add an NR followed by a count parameter “n” after a register reference to see “n” registers of data.
Example: **VIEW 1:0807h NR 4**

Note that the CCOUT and CCIN elements for Ports 17 and 18 are not in the port database but are in the card interface; use the **CARD** command for these elements.

WHO (Access Level 1)

You can use the **WHO** command to obtain a list of devices connected to the SEL-2030, including installed plug-in protocol cards. The SEL-2030 responds with a table showing device type, protocol, baud rate, data bits, stop bits, parity, and a device identification string for the device on each port. The screen below shows a sample response.

```
*>WHO<ENTER>

                                          Date: 11/29/00    Time: 11:06:56
FID=SEL-2030-R113-V0-Z0-D20001215         FID=SLBT-2030-R103-V0-D20001215

Port#  Device    Protocol   Parameters  Identification
1      SEL-151   SEL        9600,8,2,N  Example 21.6 kV Line
2      SEL-151   SEL        9600,8,2,N  Example 21.6 kV Line
3      SEL-151   SEL        9600,8,2,N  Example 21.6 kV Line
4      SEL-151   SEL        9600,8,2,N  Example 21.6 kV Line
5      SEL-151   SEL        9600,8,2,N  Example 21.6 kV Line
6      SEL-151   SEL        9600,8,2,N  Example 21.6 kV Line
7      SEL-151   SEL        9600,8,2,N  Example 21.6 kV Line
8      Master    SEL        38400,8,2,N MODEM
9      Printer   ASCII      9600,8,2,N  Line Printer

                                      (continued on next page)
```

```
                                   (continued from previous page)

10     SEL IED   SEL        9600,8,2,N
11     Master    SEL        9600,8,2,N  RTU
12     Other IED ASCII      300,8,1,N   DGH1000
13     SEL IED   SEL        9600,8,2,N
14     SEL IED   SEL        9600,8,2,N
15     SEL IED   SEL        9600,8,2,N
16     Master    DNP        9600,8,2,N
17     SEL-2701  Ethernet   VTm:HS,CTl:HS,TIm:S,SBt:S
18     SEL-2701  Ethernet   VTm:HS,CTl:HS,TIm:S,SBt:S
F*     Master    SEL        9600,8,2,N

*>
```

Note the "*" just to the right of the F in the Port # column on the above screen. This "*" indicates the port you are connected to.

When a plug-in protocol card is installed, Port 17 or 18 will identify it. The Parameters column indicates the capabilities of the card. The possible features are:

FTx	File transfer
VTm	Virtual terminal
CTl	Control operations
SBt	SELBoot
TIm	Time synchronization

For each of these, there is an indication if the SEL-2030 can accept these operations (H) and if the plug-in card can accept these operations (S).

SEL-2030 COMMAND SUMMARY

Access Level 0

ACCESS	Use this command to enter Access Level 1. Access Level 1 provides you with interrogate, read-only capability. You will be prompted for the Level 1 Password if the SEL-2030 password disable jumper is removed.
HELP	Lists all commands available at the current access level. Use with a command as its parameter and it will provide the syntax and a brief description of the command.
ID	Displays SEL-2030 current ID, as set in the global settings, and the firmware identification string (FID string). (See also WHO and STATUS commands.)
QUIT	Causes the SEL-2030 to return control to Access Level 0 from Level 1 or 2. The command displays the SEL-2030 ID, date, and time of QUIT command execution.

Access Level 1

2ACCESS	Use to enter Access Level 2. Access Level 2 provides you with the ability to change SEL-2030 settings. You will be prompted for the Level 2 Password if the password disable jumper is removed.
AUTO n	Displays the results of auto-configuration on selected port.
BROADCAST	Establish direct communications with all IED ports simultaneously. To terminate communications and return to command operation, use the termination sequence set for your port. (<CTRL-D> is the default termination sequence.)
CARD	Displays the value of the Control Input and Control Output elements for the protocol card ports (Ports 17 and 18).
CLEAR m:n	Clears data from the unsolicited message queue or from the archive data regions of an intelligent electronic device (IED) port. Parameter m specifies which port (1-16). Parameter n may be BUF for the unsolicited message queue or A1, A2, or A3 for the archive data regions. CLEAR m:BUF clears all messages stored in the Port m buffer. Clearing an archive entry removes the oldest item from that queue; subsequent entries remain. To completely clear an archive queue, add the parameter A (CLEAR 4:A2 A).
DATE	Displays the date stored by the internal calendar/clock. Use a date parameter to change the date: DATE mm/dd/yy.
DNPMAP	Displays map of data available on DNP port.
IRIG	Directs the SEL-2030 to read IRIG-B time-code input at the IRIG-B port. It updates the internal clock/calendar time and date to the time code.
MAP m:n	Displays the data structure and format for data stored in a port database. Parameter m = port number (1-18). Parameter n = data region (GLOBAL, LOCAL, BUF, D1-D8, or A1-A3). Gives port data structure and format if only port number is given. With both parameters, shows data region structure and data address format.
MEMORY	Displays the status of memory usage.
PORT n i	Establishes transparent communication between the master port issuing the command and the designated port n. To terminate communications and return to command operation, use the termination sequence set for your port. (<CTRL-D> is the default termination sequence.) With Ports 17 and 18, use parameter i to specify a network address.
SHOWSET n	Displays settings for the specified class or port number. Settings cannot be entered or modified with this command. Change settings with the SET command in Access Level 2.
STATUS	Shows SEL-2030 self-test status and the configuration, communication, and data performance of each port. Type STATUS 4 to view the status information four times. Type STATUS C or STATUS R to view status information and clear port statistics.

TARGET n m	Displays global element or port-specific element information. Enter G for parameter n to display global elements or enter 1-18 to display port-specific elements (the front-panel port has no elements). For parameter m, enter the element row number you want displayed or enter ALL to show all of the elements. You may add a repeat count as the third parameter.
TIME	Displays and sets time for the internal clock. To set the clock, type TIME and the desired setting, then press <ENTER>. Separate the hours, minutes, and seconds with colons, semicolons, spaces, commas, or slashes.
VIEW m:n	Shows data stored in a port's database. Parameter m specifies which port (1-18). Parameter n specifies what data to view: an address range in decimal or hex; a specific region of the database; GLOBAL for global data region, LOCAL for local data region, BUF for auto-message buffer, D1-D8 for automatic data collection regions, or A1-A3 for archived data regions; or you can specify the data type directly, i.e., METER, TARGET, HISTORY, etc.); or an element. If you are viewing a region, you can add BL to the command strings to request the SEL-2030 to display element bits with their bit labels.
WHO	Shows what is connected to each port. Gives a table showing, for each port, the connected device type (specific relay type if it is an SEL relay port, otherwise simply the port device type), protocol, baud rate, data bits, stop bits, parity, and a device identification.

Access Level 2

CONTROL m	Parameter m specifies the global elements, R1 through R8, you will operate. You are then prompted to enter one of three control operations: SRB sets a specified bit; CRB clears a specified bit; and PRB pulses a specified bit. You specify the bit (1-8) following the operation. To pulse, supply a time as a second parameter or a one-second time is the default.
COPY m n	Copies port-specific settings (classes P, A, M, U, and L) from Port m to Port n (m and n equal any combination of 1-18). Type COPY m ALL<ENTER> if you wish to copy the Port m settings to all other rear-panel port.
DEFRAGMENT	Defragments EEPROM.
L_D	Causes SEL-2030 to enter SELBoot mode. This is used when you want to load new code into the SEL-2030.
PASSWORD	Shows or sets passwords. PASSWORD 1 BIKE<ENTER> changes Level 1 password to BIKE. The ALARM contact closes for approximately one second and transmits the response "Set."
SET n	Parameter n specifies the specific class: SET G enters global settings; SET C enters calibration settings; SET A enters automatic message settings; SET U enters user-defined command settings; SET P enters port settings, SET M enters data movement settings, and SET L enters logic settings. SET A, SET U, SET P, SET M, SET L, and SET O must have an additional parameter to designate the port (1-18, F).
STORE m:n d	Stores data directly into a database. Parameter m specifies the port number (Port F is not a valid option); parameter n specifies the starting database address; and parameter d is a data stream with each item consisting of data as characters, strings, decimal integers, hexadecimal integers, or single-precision floating point numbers.
SWAP n m	Switches all port-specific settings (P, A, M, U, and L settings) between two ports. Confirmation is requested. The involved ports are reset.
TOGGLE m	Toggles a specified element bit, m. You specify global elements by their name. Port-specific elements need the port number preceding the element label (i.e., 4:D2).

Note: All commands accepted by the SEL-2030 are of the form <command><CR> or <command><CR><LF> (<command><ENTER>) where <command> consists of:

- Commands truncated to the first three characters (SHO 1 = SHOWSET 1)
- Upper- and lower-case characters, without distinction, except in passwords
- Arguments separated from commands by spaces, commas, semicolons, colons, or slashes

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SECTION 3: SETTINGS

INTRODUCTION

This section provides detailed information about the commands used to configure and control the SEL-2030 and explains how you should respond to the SEL-2030 settings prompts. The SEL-2030 setting sheets are included at the end of this section.

SET COMMANDS

There are eight **SET** command variations used to configure and control the SEL-2030's operation. These commands correspond to the eight different classes of settings shown in Figure 3.1 and listed in Table 3.1, namely **SET P**, **SET A**, **SET U**, **SET M**, **SET L**, **SET O**, **SET G**, and **SET C**. Figure 3.1 shows how the **SET** commands relate to specific ports. Table 3.1 lists the **SET** commands: their parameters, formats, and uses.

Note 1: The **SET A, SET M, SET L,** and **SET U** commands are not available on the front-panel port (Port F).

Note 2: The **SET U** command is not available when the port device type is set to Printer. (You select the port device type using **SET P.)**

Note 3: If **you use** SET P to change settings on a modem port and there is an active connection, the connection will be hung **up when** you accept the settings.

Note 4: In the SEL-2030, **SET P,** SET M, SET L, and SET O are available for Ports 17 and 18 if there is a plug-in protocol card installed in the appropriate slot.

Table 3.2 lists the user-friendly editing keys used with all **SET** commands.

The **SET** command always requires a class parameter (P, A, U, M, L, O, G, R, or C). If the setting is port specific, the class is P, A, M, L, O, or U and you must supply the port position (1 through 16 or F). Classes P, M, L, or O may also be used with port numbers 17 and 18. You can give these parameters in any order, for example, SET 1 A or SET A 1. The default **SET** command starts with the first setting for the setting class. You may override the default and specify the first setting displayed for editing by entering it as a **SET** parameter. For example, type **SET 1 A ISSUE1** to jump directly to the ISSUE1 setting for Port 1.

Basic, but intelligent, port configurations are established with **SET P** commands. You apply the SEL-2030's advanced communication, control, and database features with the **SET A**, **SET U**, **SET M**, **SET L**, **SET O**, **SET R**, and **SET G** commands. The settings classes used in this section, and how they apply, are outlined in Figure 3.1.

SET Function	Port 1	. . .	Port 16	Port 17	Port 18	Port F
Port Configuration	SET P 1	. . .	SET P 16	SET P 17	SET P 18	SET P F
Automatic Messages	SET A 1	. . .	SET A 16	------	------	------
User-Defined Commands	SET U 1 (not printer ports)	. . .	SET U 16 (not printer ports)	------	------	------
Data Movement Equations	SET M 1	. . .	SET M 16	SET M 17	SET M 18	------
Logic Equations	SET L 1	. . .	SET L 16	SET L 17	SET L 18	------
Output Logic for Protocol Cards	------	. . .	------	SET O 17	SET O 18	------

Global Settings	SET G (not port specific)
SER Settings	SET R (not port specific)
Calibration Settings	SET C (not port specific)

Figure 3.1: SET Commands as They Apply to SEL-2030 Ports

Table 3.1: Variations on the SET Command

Command	Sets	Format	Application
SET P n	- Port ID. - All port communication parameters.	SET P SET P 1 SET P 2 PARITY	Set current port Set Port 1 Set Port 2 starting at entry PARITY
SET A n	- Unsolicited message control. - Automatic messages and trigger conditions. - Data parsing.	SET A SET A 4 SET A 3 ISSUE1A	Set current port Set Port 4 Set Port 3 starting with ISSUE1A
SET U n	- SEL-2030 command set control. - User-defined commands.	SET U SET U 4 SET U 12 READ	Set current port Set Port 4 Set Port 12 starting with READ setting
SET L n	- Logic equations.	SET L SET L 6 SET L 12 CBR2	Set current port Set Port 6 Set Port 12 starting with CBR2 setting
SET M n	- Define data scaling and movement equations.	SET M SET M 7	Set current port Set Port 7
SET G	- SEL-2030 ID. - Intermediate SELOGIC® Control Equation Elements. - Contact output functions.	SET G SET G ID	Set global settings Set global settings starting at ID
SET R	- Sequential Events Recorder (SER) elements.	SET R	Set SER elements
SET C	- Clock oscillator frequency. - Settings valid.	SET C	Clock calibration, validate settings after ROM change
SET O	- Logic equations for protocol card points CCOUT1 through CCOUT64. - Ports 17 and 18 only.	SET O 17 SET O 18 CCOUT6	Set Port 17 Set Port 18, starting with the CCOUT6 setting

Note 1: The **SET A**, **SET M**, **SET L**, and **SET U** commands are not available on the front-panel port (Port F).

Note 2: The **SET U** command is not available when the port device type is set to Printer. (You select the port device type using **SET P**.)

Note 3: If you use **SET P** to change settings on a modem port and there is an active connection, the connection will be hung up when you accept the settings.

Note 4: In the SEL-2030, **SET P**, **SET M**, **SET L**, and **SET O** are available for Ports 17 and 18 if there is a plug-in protocol card installed in the appropriate slot.

Table 3.2: Editing Keys for SET Commands

Press Key(s)	Results
^ <**ENTER**>	Moves to previous entry in a setting category until you get to the first entry in the category and then it moves to previous category.
< <**ENTER**>	Moves to the first entry prompt in the previous settings category.
> <**ENTER**>	Moves to the first entry prompt in the next settings category.
<**ENTER**>	Accepts setting, then moves to next entry prompt.
END<**ENTER**>	Exits editing session and displays all settings. Prompts: "Accept settings (Y/N)?". Type **Y**<**ENTER**> to save changes and exit, **N**<**ENTER**> to exit without saving. Lower-case letters (end, y, n) are also accepted.
<**CTRL-X**>	Aborts editing session without saving changes.
OFF<**ENTER**>	Flags a setting as not applicable. Lower-case letters (off) are also accepted.

The SEL-2030 checks each entry to ensure that it is a valid choice. If it is not, an "Out of Range" message is generated, and the SEL-2030 prompts for the same setting again.

After you enter all data, the SEL-2030 displays the new settings and asks to enable them. Answer **Y<ENTER>** to approve the new settings. If you violate a rule for setting relationships, an error message is displayed, and the settings prompt moves to the first setting that affects the failure. If settings are acceptable, the SEL-2030 saves them. While the active settings are updated, the SEL-2030 port being modified is disabled. On a settings change, the SEL-2030 pulses the SALARM bit to 1 for one second. On the SEL-2030, the default ALARM setting is SALARM so the alarm contact will pulse unless the ALARM setting has been modified.

When the settings change on a port, that port is reset. If you change the settings on the current port, the settings become effective after being accepted. If you change the baud rate, you will have to change the baud rate on your terminal to match in order to resume communicating with the SEL-2030. You may not change the settings on a port that is currently communicating transparently with another port. Also, only one setting session is permitted at one time; you will receive a message that the **SET** command is not available if someone else is using one of the **SET** commands at the time you send a **SET** command.

Use the **COPY** or **SWAP** commands to copy and move settings between ports. Always use the **SHOWSET** command on ports you copied or swapped settings on to verify that all port references and messages are correct.

SET P - Port Configuration and Communication Settings

Use the **SET P** command to:

- Configure each port you connect to a new device.
- Reconfigure a port you connect to a different device.
- Reconfigure a port connected to a device that has upgraded firmware.

SET P Settings

When you issue the **SET P** command, the SEL-2030 will prompt you for configuration and communication parameters according to Table 3.3 for Ports 1 through 16 and for Port F. A description of each prompt and a discussion about the appropriate responses to each prompt follows these tables. When you use the **SET P** command for Port 17 or 18, the settings are provided by the plug-in protocol card. See the instruction manual for the plug-in protocol card to see what settings are available.

Table 3.3: SET P Prompts

“SET P n” Port Communications Setting Prompts for Ports n = 1 through 16								SET P F Prompts
DEVICE (**U**, **S**, **O**, **P**, **M**)								
U(nused)	**S**(EL IED)	**O**(ther IED)	**P**(rinter)	**M**(aster)				
	CONFIG (Y/N)	MODEM (Y/N)		PROTOCOL (**L**, **S**, **M**, **D**)				
		N(O): AUTO_BAUD Y(ES): MSTR, CD_CTS, DCD_FLOW** PROTOCOL (A/B) A(SCII) | B(inary)		**L**(MD) ADDRESS PREFIX SETTLE	**S**(EL) FAST_OP	**M**(odbus) MAP_TYPE START_ID SETTLE1 SETTLE2 ADDRESS 1-16	**D**(NP) ADDRESS CLASS 0 | 1-3 16BIT SO_TIMEOUT DL_CONFIRM 0 | 1-15, DL_TIMEOUT MIN_DELAY MAX_DELAY SETTLE1 SETTLE2 REPORT_ON UNSOL_REP N(O) | Y(ES): UNSOL_POW, REP_ADDR, NUM_EVENT, AGE_TX CONFIRM_TO	
	PORTID	PORTID	PORTID	PORTID				PORTID
					MODEM (Y/N) N(O) | Y(ES): MSTR, CD_CTS, DCD_FLOW**			MODEM (Y/N) N(O) | Y(ES): MSTR, CD_CTS, DCD_FLOW**
	BAUD	BAUD	BAUD	BAUD				BAUD
	DATABIT	DATABIT	DATABIT	DATABIT				
	STOPBIT	STOPBIT	STOPBIT	STOPBIT				
	PARITY	PARITY	PARITY	PARITY				PARITY
	RTS_CTS (Y/N)	RTS_CTS (Y/N)*	RTS_CTS (Y/N)		RTS_CTS (Y/N)*			RTS_CTS (Y/N)*
		XON/XOFF (Y/N)	XON/XOFF (Y/N)	XON/XOFF (Y/N)***				XON/XOFF (Y/N)
	TIMEOUT	TIMEOUT	TIMEOUT	TIMEOUT***				TIMEOUT
				ECHO (Y/N)				
				AUTOHELP (Y/N)				AUTOHELP (Y/N)
				TERTIME1***				TERTIME1
				TERSTRING***				TERSTRING
				TERTIME2***				TERTIME2
Save changes (Y/N)								
Y(ES) Port n Settings Changed				**N**(O) Settings Aborted				

*If CD_CTS=Y, RTS_CTS will not be available

**DCD_FLOW is only available if CD_CTS=N.

***Also on Port 17 or 18 if card supports virtual terminal operation.

Table 3.4 includes detailed information about the SET P settings.

Table 3.4: SET P Port Communications Settings Information

Setting	Comment
DEVICE	**Prompt**. Device Type (Unused, SEL IED, Other IED, Printer, Master). **Description**. You select the device type attached to this port: **U**nused if no device is connected. **S**EL IED if an SEL device is connected. **O**ther IED if another vendor's IED is connected. **P**rinter if a serial printer is connected. **M**aster if an RTU, PC, PLC, NIM or ASCII terminal is connected.
CONFIG	**Prompt**. Auto-configure port (Y/N). **Description**. If you say yes, the SEL-2030 determines relay type, model number, metering capability, port ID, baud rate, passwords, relay elements, and other information necessary for the SEL-2030 to automatically communicate with SEL relays. The SEL-2030 reports the results of the auto-configuration once it successfully completes. This process may take up to two minutes. **Note:** If auto-configuration fails, it may indicate that the connected device is not recognized, that there is a communication problem between the devices, or that the connected device was slow to respond. Check for any obvious problems with the connection, then reattempt auto-configuration. If auto-configuration still fails, attempt to gain transparent communications with the device using PORT n. If this does not succeed, there is a communication problem. If you can connect transparently, but auto-configuration still fails, there probably is an incompatibility between the connected device and the SEL-2030. If this happens, contact the factory for further assistance.
AUTO_BAUD	**Prompt:** Attempt to detect port baud rate (Y/N). **Description:** The SEL-2030 depends on the IED returning a <CR> or <LF> character in response to a <CR><LF> for baud rate determination to work.
PROTOCOL	**Prompt**. Communications Type (SEL/LMD/Modbus/DNP for Master, or ASCII/BINARY for Other IED). **Description**. This setting identifies special port communication parameters. For Other IEDs you may choose between ASCII and BINARY; selecting ASCII allows the normal ASCII and binary communication; selecting BINARY automatically disables XON/XOFF handshaking. If Port 16 DEVICE is set to master, the choices are SEL, LMD, Modbus®, and DNP. If Port 12 or 14 DEVICE is master, then the choices are SEL, LMD, and Modbus. For any other port with DEVICE set to master, the choices are SEL and LMD. Selecting SEL allows the normal ASCII and binary communications, selecting LMD adds the SEL LMD Protocol, selecting Modbus disables normal communications and enables Modbus communications on the selected port, and selecting DNP disables normal communications and enables DNP communications on the selected port. If you choose LMD, you must select an address and prefix character and set the settle time. If you choose Modbus, you must select the address for each port with Modbus data. If you choose DNP, there are a number of additional settings to configure the DNP operation. (See ***Section 7: Protocols*** for reference information on LMD, Modbus, and DNP protocols.)

Setting	Comment
ADDRESS	**Prompt**. First LMD Port Address (1 through 81). **Description**. You supply a port address only if you selected LMD as the PROTOCOL. The LMD address is the first of 17 used by the SEL-2030; the defined address is for SEL-2030 communications and the next 16 are for transparent communications to the respective ports. (See ***Section 7: Protocols*** for an explanation of LMD Distributed Port Switch Protocol.)
PREFIX	**Prompt**. LMD Address Prefix Character (@#$%&). **Description**. You supply LMD prefix character only if LMD was selected as the PROTOCOL. The prefix setting is the character the SEL-2030 watches for when using LMD protocol. (See ***Section 7: Protocols*** for an explanation of LMD Distributed Port Switch Protocol.)
SETTLE	**Prompt**. LMD Port Settle Time (0-30 seconds). **Description**. You supply an LMD port settle time only if LMD was selected as the PROTOCOL. (See ***Section 7: Protocols*** for an explanation of LMD Distributed Port Switch Protocol.)
MAP_TYPE	**Prompt.** Modbus Map Type (F=Float, I=Integer). **Description.** Selection for Modbus map style. See ***Section 7: Protocols*** for an explanation of the two map styles.
START_ID	**Prompt.** Starting Code for ID List (0-255). **Description.** Used to offset Modbus device ID list. (See ***Section 7: Protocols*** for reference information on Modbus.
SETTLE1	**Prompt.** Transmission delay from RTS assertion (0-30,000 ms). **Description.** Delay between RTS assertion and start of transmission for Modbus and DNP protocols. (See ***Section 7: Protocols*** for reference information on Modbus and DNP protocols.)
SETTLE2	**Prompt.** Posttransmit RTS deassertion delay (0-30,000 ms). **Description.** Delay between end of transmission and RTS deassertion for Modbus and DNP protocols. (See ***Section 7: Protocols*** for reference information on Modbus and DNP protocols.)
ADDRESS1	**Prompt.** Address of Port 1 (1-247). **Description**. Modbus device address 1-247, or OFF if no Modbus access desired. Similarly for ADDRESS2-16. (See ***Section 7: Protocols*** for reference information on Modbus.)
ADDRESS	**Prompt**. DNP Address (0-65534 or 0000h-FFFEh). **Description**. Address of the SEL-2030. It must be unique from all other DNP addresses on the connection. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
CLASS	**Prompt**. Class for event data (0 for no event data, 1, 2, 3). **Description**. Enter the DNP class, 1-3, to reference SEL-2030 event data under. Enter 0 if you do not want any event data. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)

Setting	Comment
16BIT	**Prompt**. Use 16 or 32-bit default variations for analog inputs (16/32). **Description**. DNP analog input objects can use default variations 16 or 32-bits in size. Set this to 16 or 32-bit, based on which default you prefer. Generally 32-bit is preferable, because you get a better range, but if your master does not support 32-bit analog inputs, you must use 16-bit. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
SO_TIMEOUT	**Prompt**. Select/Operate time-out interval, seconds (0.0-30). **Description**. Enter the maximum allowable time between DNP function codes for Select and Operate. If an Operate command follows the Select command by more than this time-out, the operation will not occur. Set based on worst-case timing of your master. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
DL_CONFIRM	**Prompt**. Number of data-link retries (0 for no confirmation, 1-15). **Description**. Set to 0 to disable DNP data-link confirmation. Otherwise, set to the number of retries you want the DNP data-link to use. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
DL_TIMEOUT	**Prompt**. Data Link Time-out (0-5,000 milliseconds). **Description**. Set to the worst-case DNP data-link acknowledge time of your master. When using DNP data-link confirmation, this is the time the SEL-2030 will wait before assuming there is no confirmation and resending the message. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
MIN_DELAY	**Prompt**. Minimum Delay from DCD to transmission (0-1,000 msec). **Description**. This is the minimum delay the SEL-2030 will wait from DCD going away or from the last character being received before initiating data transmission. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
MAX_DELAY	**Prompt**. Maximum Delay from DCD to transmission (0-1,000 msec). **Description**. This is the maximum delay the SEL-2030 will wait from DCD going away or from the last character being received before initiating data transmission, if there is a transmission pending. Set this to something bigger than MIN_DELAY to cause some randomness in the time at which it attempts to transmit again. In a system with unsolicited messaging, this will help reduce the likelihood of repeated collisions. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
REPORT_ON	**Prompt**. Percent of Full-Scale Change to Report on (0-100%). **Description**. This setting determines at what point counter and analog input events are declared. Set this to the percent of the full-scale that you want events reported on. With the default size set to 16-bit, full scale is +/- 32,767. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
UNSOL_REP	**Prompt**. Allow Unsolicited Reporting (Y/N). **Description**. Set to Yes to enable unsolicited DNP event reporting or No to disable such reporting. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)

Setting	Comment
UNSOL_POW	**Prompt**. Enable unsolicited messages on power-up (Y/N). **Description**. Set based on whether or not you want DNP unsolicited reporting enabled on power-up. If your master supports the unsolicited message enable function code, set this to No and let your master enable it to reduce bus contention on power-up. Otherwise, set it to Yes. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
REP_ADDR	**Prompt**. Address of master to Report to (0-65534 or 0000h-FFFEh). **Description**. Set this to the address of the master on your DNP network. This is the address the SEL-2030 will send unsolicited responses to. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
NUM_EVENT	**Prompt**. Number of events to transmit on (1-200). **Description**. Set this to the number of events you want to have accumulate before the SEL-2030 sends the data in a DNP unsolicited response. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
AGE_TX	**Prompt**. Age of oldest event to force transmit on (1.0-60.0 sec). **Description**. Set this to the maximum age you want your event data to get to before sending it in a DNP unsolicited response, even if the minimum number of events have not yet accumulated. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
CONFIRM_TO	**Prompt**. Time-out for Acknowledge of Event Data (50-50,000 msec). **Description**. Set this to the maximum time it should take your master to issue a DNP application layer confirm to an unsolicited or event data response. When sending DNP unsolicited responses or event data, this is the delay the SEL-2030 will wait before considering the data transmission unsuccessful. (See ***Section 7: Protocols*** for an explanation of the DNP protocol.)
FAST_OP	**Prompt:** Enable *Fast Operate* commands on this port (Y/N). **Description:** Use this setting to enable (Y) or disable (N) fast operate support on this master port. *Fast Operate* commands can be used to rapidly change the various set and clear logic bits. (See ***Section 7: Protocols*** for more information on *Fast Operate* commands.)
PORTID	**Prompt**. Port Identification String. **Description**. Provides a convenient means to label or identify the connected device. Auto-configuration automatically sets the Port ID to the relay ID on SEL IED ports. Used by the **WHO** command to identify the port. Maximum 40 characters.
MODEM	**Prompt**. Modem Control (Y/N). **Description**. You set to Y (Yes) if using an external dial-up modem. This setting is only available for master and other IED ports.

Setting	Comment
MSTR	**Prompt**. Modem Startup String. **Description**. If you use a modem, you must enter a modem startup string to initialize the modem. The default string sets the modem to answer on four rings. You may set this number to match the needs of your modem and application, but, to match SEL-2030 expectations, there are a few modem settings that should not be modified: • The escape character must be "+" • The modem must be in verbal mode • The echo must be disabled • The X0 code set should be selected • The escape code guard time should be one second (See your modem instruction manual for details on your modem.)
CD_CTS	**Prompt**. Modem Carrier Detect connected to CTS input (Y/N). **Description**. If you are using an external modem which has its Data Carrier Detect (DCD) output connected to the SEL-2030 CTS input (such as with SEL-C222 cable), set this to Y. Otherwise, set it to N.
DCD_FLOW	**Prompt**. Use DCD control line for flow control (Y/N). **Description**. If you are using an external modem on Ports 1 or 9 of the SEL-2030 and connect the Data Carrier Detect (DCD) output of the modem to the DCD input (pin 1) of the SEL-2030, set this to Y. Otherwise, set it to N.
BAUD	**Prompt**. Baud Rate (300; 600; 1,200; 2,400; 4,800; 9,600; 19,200; 38,400). **Description**. You enter the baud rate this port will communicate at. Port F limits are 300 to 9,600 baud. Only ports designated masters may use 38,400 baud. Automatically set if auto-configured.
DATABIT	**Prompt**. Number data bits (7, 8). **Description**. You enter the number of data bits this port requires for communication. Port F is fixed at 8 data bits with no parity or 7 bits with parity. Figure 3.2 illustrates how this setting influences the EIA-232 character format.
STOPBIT	**Prompt**. Stop bits (1, 2). **Description**. You enter the stop bits this port requires for communication. Port F is fixed at 1 stop bit. Figure 3.2 illustrates how this setting influences the EIA-232 character format
PARITY	**Prompt**. Parity (N, O, E, 1, 0). **Description**. You enter the parity this port will use in communicating. Port F limited to parity options N (No), O (Odd), and E (Even). Figure 3.2 illustrates how this setting influences the EIA-232 character format
RTS_CTS	**Prompt**. Enable RTS/CTS handshaking (Y/N). **Description**. You set to Y (Yes) to enable RTS/CTS handshaking. If LMD Protocol, Modbus, or DNP is used, RTS/CTS control is not available. Instead, RTS is driven to control any external transceiver. (For a definition of RTS/CTS, see Data Flow Control subsection following this table.) With Modem set to Y (Yes) and CD_CTS set to Y (Yes), RTS_CTS control is not available.

Setting	Comment
SENDTIME	**Prompt.** Send Date/Time synchronization to Protocol Card (Y/N) SENDTIME = N? **Description**. If the installed protocol card supports host-initiated time synchronization, the Port settings include a SENDTIME setting. This setting allows you to enable/disable host-initiated time synchronization of the connected protocol card. The only values accepted for this setting are "Y" and "N." If the connected protocol card does not support the receipt of time synchronization commands, then the SENDTIME setting is hidden for the port.
XON_XOFF	**Prompt**. Enable XON/XOFF flow control (Y/N). **Description**. You set to Y (Yes) to enable XON/XOFF flow control. If PROTOCOL is set to binary, XON/XOFF flow control is forced to N (No). (For a definition of XON/XOFF, see ***Data Flow Control*** following this table.)
TIMEOUT	**Prompt**. Port Time-out in minutes (0-120). **Description**. The time-out setting is used for two different functions. After a set amount of idle time expires with the port in transparent mode, transparent mode is automatically terminated. On Master ports, if this time expires with the port idling, any in-process command is terminated and the access level is reduced to Level 0. Time-out action will also disconnect LMD communications and hang up the modem if it is connected. A value of 0 disables time-out. **NOTE:** Use a non-zero time-out value for modem ports. If the modem connection is unintentionally interrupted, you can call and successfully reconnect TIMEOUT minutes later.
ECHO	**Prompt**. Echo received characters (Y/N). **Description**. Master Port only **-** The echo option allows you to decide whether or not you wish the SEL-2030 to provide character echo to a master device (only printable characters are echoed). ECHO is always Y (Yes) for Port F.
AUTO_HELP	**Prompt.** Automatic help messages enabled (Y/N). **Description:** Default setting is AUTO_HELP=Y. You can disable Auto-Help on a port by setting AUTO_HELP=N. Auto-Help provides correct commands and command syntax messages when you enter an incorrect command or command syntax. If you disable Auto-Help on a Master port, you can still request help with the **HELP** command.
TERTIME1	**Prompt**. First delay time (0 to 600 seconds). **Description**. You enter a time that a port must be idle before checking for the termination string. For a description of transparent communications, see ***Transparent Communications*** following this table.
TERSTRING	**Prompt**. Termination string. **Description**. You enter a string that will terminate transparent communications. The default is \004, the code for <Ctrl-D>. For a description of transparent communications, see ***Transparent Communications*** following this table.

Setting	Comment
TERTIME2	**Prompt**. Second delay time (0 to 600 seconds). **Description**. You enter a time the port must be idle, after receiving the termination string, before terminating transparent communications. For a description of transparent communications, see the Transparent Communications subsection following this table.

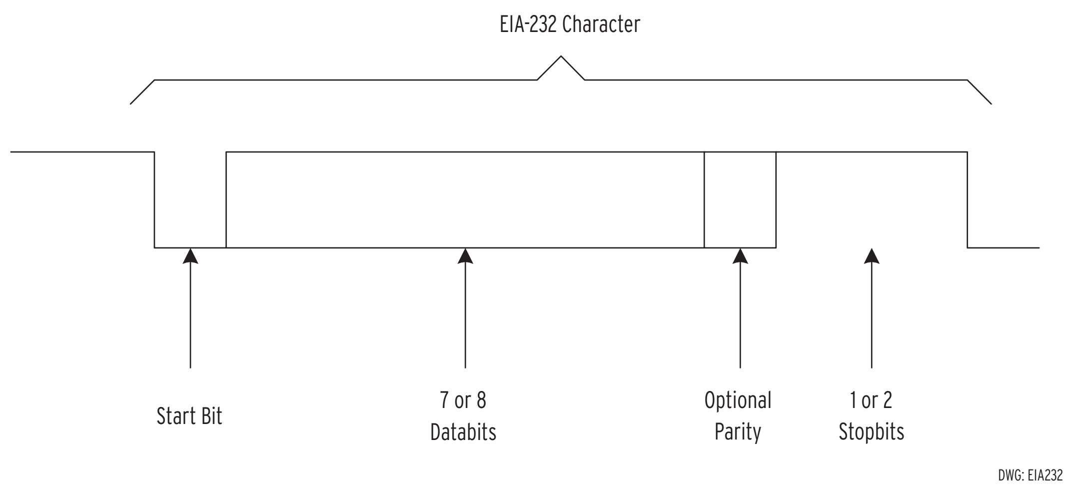

Figure 3.2: EIA-232 Character Format

Transparent Communications

Transparent communications allow a master device to communicate directly with an IED or printer through the SEL-2030. You enter the transparent communications mode using the **PORT** command from the SEL-2030 command set or using a special user-defined command string you set with the TRANS setting (see **SET U** subsection in this section).

Broadcast communications are similar to transparent communications, except that a master port communicates with multiple IEDs simultaneously. Broadcast communications can only be entered using the **BROADCAST** command.

When you connect to an SEL IED, the SEL-2030 automatically issues a **QUIT** command to the SEL IED before completing the connection. This way, initial access to the SEL IED will be at Level 0, requiring the user to know the relay password(s) in order to access it. When the transparent connection is terminated, the SEL-2030 reissues the STARTUP string to restore the SEL IED to the necessary access level for data collection and control.

While you are transparently communicating through the SEL-2030, *Fast Meter* binary data will continue to be collected and *Fast Operate* control operations will continue to be sent. If you attempt a *Fast Meter* or *Fast Operate* request via the transparent connection, your request and the automatic request may collide, leading to neither taking place. If you plan to use *Fast Meter* or *Fast Operate* commands while transparently connected, you should disable any automatic *Fast Meter* collection and *Fast Operate* control to avoid these collisions.

The SEL-2030 requires a three-step procedure to terminate transparent communications. This three-step procedure helps ensure that transparent mode is not accidentally terminated by normal data communications. The three-step process includes an initial channel idle time (set with TERTIME1), a termination character sequence (set with TERSTRING), and a second channel idle time (set with TERTIME2). All of these items are user definable and can be set such that they are not used when less security is required. The SEL-2030 default termination sequence has the first time delay set to one second, the termination character set to <EOT> (end of transmission character, ASCII character 4, <CTRL-D> on most keyboards), and the second time delay set to zero.

Direct Transparent Mode

The SEL-2030 normally uses data buffering when transferring data through transparently connected ports. Some non-SEL IED protocols are intolerant of this data buffering since the buffering introduces random inter-character time delays into the data stream. The SEL-2030 includes a Direct Transparent mode that eliminates these inter-character delays while maintaining the buffering effectiveness. The Direct Transparent mode inter-character delay is typically less than one millisecond and never exceeds two milliseconds. The Direct Transparent mode is available on any rear-panel Master port, however is not available on the front Master port.

To select the Direct Transparent mode, add the D parameter to the **PORT** command (**PORT n D**, where n selects the port number). The SEL-2030 passes characters through rapidly, without significant buffering delays. Therefore, no handshaking is required if the Master and Slave port baud rates match. Hardware handshaking may be required if the Master and Slave port baud rates do not match. Software handshaking (XON/XOFF) is not supported by the SEL-2030 in Direct Transparent mode, regardless of the XON_XOFF port setting. However, XON/XOFF characters pass through the transparent port connection, allowing the connected devices to use software handshaking independent of the SEL-2030.

The Direct Transparent mode (D parameter) typically should not be used when transparently connecting to SEL devices. SEL interleaved binary messages (binary 20METER, 20TARGET, etc.) are not supported during Direct Transparent mode connections.

Virtual Terminal Communications

The SEL-2030 supports virtual terminal (VT) communications when a VT-enabled card is installed in Port 17 or Port 18. VT support allows a user to communicate using ASCII commands through a network, similar to directly communicating via an ASCII terminal.

The SEL-2030 can function as a VT server. For example, with an SEL-2701 Ethernet Processor installed in an SEL-2030, a user located at a PC connected to the Ethernet network can communicate with the SEL-2030. The virtual terminal mechanism for Ethernet is Telnet. At the PC, using Telnet client software, the user specifies the information to establish a connection with the SEL-2030. At this point, the keyboard and Telnet window on the PC emulate a direct ASCII terminal link to the SEL-2030.

The SEL-2030 can also function as a VT client. This is a special case of the transparent communications, initiated by a **PORT** command from a terminal connected to an SEL-2030 master port. The user specifies a network port with VT capability and a network destination address. For example, with a laptop PC connected to the front port of an SEL-2030, a user can establish a Telnet connection through an SEL-2701 and Ethernet to a relay located in another station. For example, use the command **PORT 17 10.200.0.53** to connect to the device with IP address 10.200.0.53.

Data Flow Control

All SEL devices, including the SEL-2030, support XON/XOFF software data flow control. The SEL-2030 also supports RTS/CTS hardware data flow control. If the device connected to an SEL-2030 port has XON/XOFF software data flow control capability, you should enable this flow control method on both the SEL-2030 and the connected device. You should use RTS/CTS hardware data flow control only if the connected device has RTS/CTS capability and does not have XON/XOFF capability. In either case, both the SEL-2030 and the connected device must have the same data flow control method enabled.

You can enable XON/XOFF data flow control on an SEL-2030 port with the **SET P** command by setting XON_XOFF = Y. With XON/XOFF data flow control enabled, the SEL-2030 monitors the volume of data in its received data buffer on that port and transmits an XON (hexadecimal code 11) character when that port's buffer drops below one-quarter (25%) full. The SEL-2030 transmits an XOFF (hexadecimal code 13) character when that port's buffer is over three-fourths (75%) full. A device connected to the SEL-2030 port with XON/XOFF software data flow control enabled should terminate message transmission at the end of the message in progress when an XOFF character is received from the SEL-2030 and should resume transmission when an XON character is received.

Likewise, you can use XON/XOFF to control the SEL-2030 message and data transmission. When the SEL-2030 receives an XOFF character when it is transmitting a message, the SEL-2030 pauses transmission until it receives an XON character. If the SEL-2030 is not sending a message or data when it receives XOFF, the SEL-2030 does not send any new transmission until it receives an XON character from the other device.

Set RTS_CTS = N for any SEL-2030 to SEL relay connection. If RTS_CTS = N, the SEL-2030 RTS output will always be asserted, and the CTS input status will have no effect on communication.

Consult the instruction manual or contact the device vendor to determine the proper flow control technique for each non-SEL device. If you select RTS/CTS hardware data flow control, make sure that the cable you are using to connect the device to the SEL-2030 is wired for RTS/CTS.

When RTS/CTS hardware flow control is required, use **SET P** to set RTS_CTS = Y. Automatic communication sources with RTS/CTS hardware data flow control enabled must stop message transmission immediately when the SEL-2030 deasserts RTS so they do not overwrite the SEL-2030 buffer on that port. Likewise, if RTS_CTS = Y, the SEL-2030 does not send message or data characters until the CTS input is asserted.

Modem Operation

There are a number of issues to consider if you are using a modem. In particular, flow control and disconnect sequences need to be considered.

When a modem connection is made, it is possible for the phone line connection to be at a lower baud rate than the modem-to-SEL-2030 connection. This can lead to a loss of characters during large data transfers, because the SEL-2030 can overrun the modem. This can be prevented by setting the SEL-2030 to the lowest likely connection rate, typically 2,400 baud. Alternatively, you can enable RTS/CTS or XON/XOFF flow control between the SEL-2030 and the modem.

To use hardware flow control, set RTS_CTS = Y on the modem port. Only use this setting if the RTS and CTS control lines are wired between the SEL-2030 and the modem. The modem should default to use hardware flow control.

Alternatively, to use software flow control, set XON_XOFF=Y on the modem port and modify the MSTR setting to enable XON/XOFF handshaking within the modem. You will need to look in your modem data sheet to determine the appropriate code for your modem.

Many external modems do not behave well if they receive non-modem messages while they are not connected. For this reason, you should connect the Data Carrier Detect output of the modem to the SEL-2030 so transmissions to the modem can be prevented. If you have the modem connected to Port 1 or 9 of an SEL-2030, you can connect DCD and RTS/CTS flow control signals to the SEL-2030. If you are connected to any other port of a SEL-2030, connect the modem DCD output to the CTS input of the SEL-2030 and set CD_CTS to Yes. Of course, with this connection you will not be able to use RTS/CTS flow control.

Another thing to consider when using modems is how you will terminate the connection. If you simply hang up, the SEL-2030 will be left in whatever state you were in. This could be a state to which you cannot call back. To avoid this, you should do two things:

- When a modem is on a master port, always exit transparent connections and issue the **QUIT** command to terminate the connection. This way, you will always leave the SEL-2030 in a known state.
- Set the port TIMEOUT setting to something other than 0. If you do leave the SEL-2030 in an undesired state, it will go back to a basic Access Level 0 state after the TIMEOUT time, as if a **QUIT** command had been issued.

SET A - Automatic Message Settings

Use the **SET A** command to set the SEL-2030 to:

- Automatically buffer unsolicited messages the SEL-2030 receives.
- Automatically print those unsolicited messages, and clear the buffer after printing if you desire.
- Automatically issue operate messages based on operating elements.
- Automatically collect Sequential Events Recorder data.
- Define startup strings for connected devices so the SEL-2030 can automatically communicate with those devices.
- Create messages to send to other devices and define conditions that trigger those messages (messages are commands, data, or both).
- Define data parsing methods you want used on responses received.
- Define conditions where data are archived in optional nonvolatile memory.

You can create up to 12 automatic messages per port with the standard SEL-2030 configuration. Eight of these message functions have an associated data area to store responses, and the other four are for messages only. Three additional message functions are available with the nonvolatile Flash memory option, for a total of 15 possible message functions per port.

Automatic Message Operation

The messaging process is diagrammed in Figure 3.3.

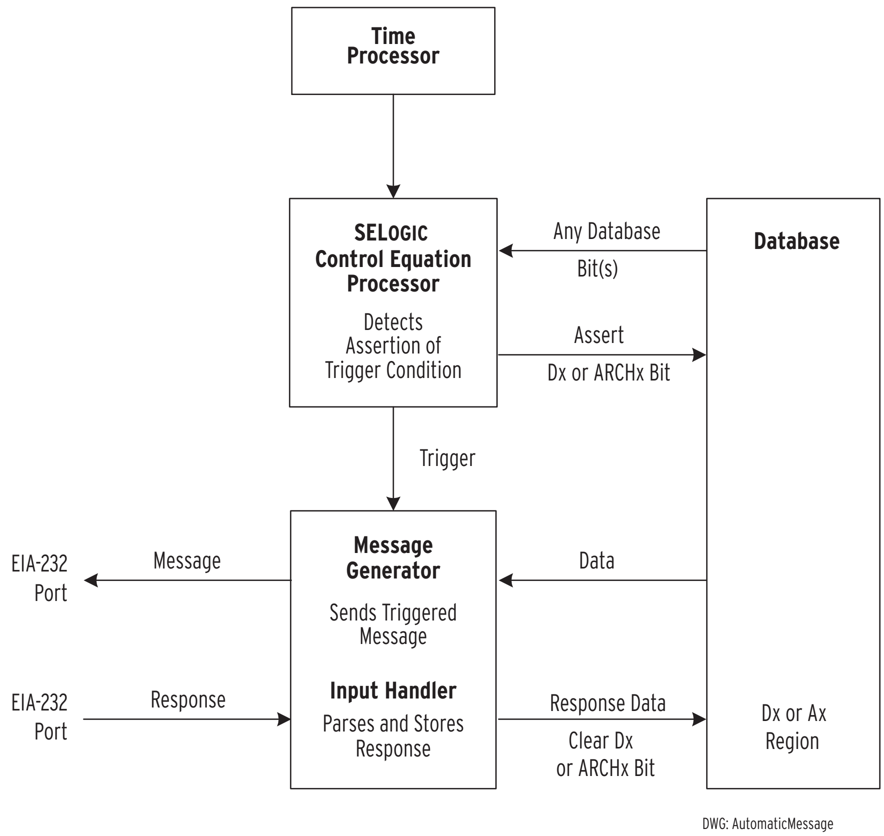

Figure 3.3: Automatic Message Operation Functional Block Diagram

The SELOGIC® Control Equation Processor (Figure 3.3) detects the true or false status of the trigger condition as defined in a SELOGIC Control Equation (using the ISSUEx setting). When the condition becomes true, SELOGIC Control Equation Processor sets the Dx or ARCHx bit (depending on whether it is a data or archive region of the database involved) and causes the Message Generator to issue the message that you have defined with the auto-message setting. (See ***Section 4: SELOGIC® Control Equations*** for more details about triggering.)

The message issued may elicit a response. With the settings, you tell the SEL-2030 what data to expect (including meter, ASCII floating point, and integer) and how to parse, validate, and store the data. The data are then stored in the appropriate region of the database and the Dx or ARCHx bit is cleared. If a response is not expected, the Dx or ARCHx bit is cleared upon issue of the triggered message. See ***Section 5: Message Strings*** for details on strings.

Data Collection Periods

You can set the SEL-2030 Communications Processor to collect data from attached devices on an exception basis, i.e., only when an event occurs, and you can set the SEL-2030 to collect data on a regular, periodic basis. Each SEL-2030 port collects data independently, based on your settings, and you can set each port to collect data in different ways using separate message trigger conditions and data request messages. Likewise, each SEL-2030 port responds to requests for data independently, based on your settings. In either case, the SEL-2030 will not issue or respond to another request for data on the same port until the previous request has been satisfied. If the data response has not been completed before the same message trigger condition occurs again, the second trigger will be missed completely. The SEL-2030 will acknowledge this missed trigger by setting a delay bit in the port register, which is reported in the SEL-2030 status report.

Although both exception and periodic data collection can encounter this type of delay, you can control the periodic collection period, and thereby minimize the possibility of collection delays and missed triggers. First, you should consider if the attached device is capable of transferring data in binary format, or only in ASCII character format, and second, the type of data you plan to request, i.e., meter, target, demand, or another type.

Table 3.5 presents some general guidelines regarding minimum data collection periods you should use to collect various types of data from SEL relays in binary or ASCII format. The guidelines in this table assume the relay is using a baud rate of 2,400 or above and is not busy processing events or communicating on more than one port. As this table shows, there is a dramatic difference between the minimum collection period for a relay that has *Fast Meter* (binary data transfer) capability and one that can transfer data only in ASCII format.

Table 3.5: SEL-2030 Minimum Data Collection Period (in Seconds)

Command	**Binary Data Format (*Fast Meter*)**	**ASCII Data Format (no *Fast Meter*)**
20METER	1	10
20DEMAND	1	10
20TARGET	1	20[1]
20STATUS	N/A	10
20BREAKER	N/A	10
20HISTORY	N/A	20[2]
20EVENT	N/A	120
20EVENTS	N/A	120
20EVENTL[3]	N/A	300

Notes: [1] SEL-321 Relay requires one minute.

[2] SEL-321 Relay requires 30 seconds. The SEL-BFR and SEL-2BFR Relays require 40 seconds.

[3] Only supported on SEL relays that support 16 sample/cycle event reports.

When connecting to SEL 100 and 200 series relays that have *Fast Meter* binary data capability, always connect to Port 2 on the relay. Binary data transfer is not supported on Port 1 of these relays.

Collection periods for non-“20” message-based collections are dependent on the device response speed and the value of the DELAY setting. As a minimum, the collection period will always contain the time required to send a request and receive the response. If DELAY is set ON, there will be an additional delay while the SEL-2030 waits for the port to be idle for 15 seconds on SEL IED ports and 5 seconds on all other ports.

Data Parsing Options

The SEL-2030 database stores data that are parsed, or separated, into the smallest useful element or bit size. Parsing data in the SEL-2030 reduces the communication and processing burden for other devices or systems that use these data by permitting them to request and transfer only the specific data they need.

The SEL-2030 automatically parses data that are recognized from SEL relays. You request these data using the “20” message format. The type of response will depend on the SEL relay’s capability. If the relay has *Fast Meter* capability, the response to the 20METER message is in a binary format. Some relays also respond to 20TARGET and 20DEMAND messages with a binary data format. Binary data are transferred faster than ASCII data and allow simultaneous ASCII dialogue, making *Fast Meter* binary data transfer the preferred choice whenever possible.

The SEL-2030 also automatically calculates additional metering parameters from the binary data. For example, ASCII meter data provide current and voltage magnitude, but the binary meter data results include magnitude and angle. Binary meter data also include calculated voltage and current sequence quantities, calculated per-phase watts and vars, and three-phase watts and vars.

You can parse message responses that are not recognized SEL data in several ways. You can set the SEL-2030 to ignore the data by setting PARSEx = 0. Or you can set the SEL-2030 to accept the data and parse it according to one of the six techniques listed below. If DEVICE is set to SEL and the connected device echoes the request message, parsing begins after the echoed request is received.

ASCII Integer (Parse = 1)

This technique parses numbers only; every number separated by a space, comma, decimal, or any other nonnumeric character is stored as a separate item. For example, if you selected the ASCII Integer option, and set the number of responses (NUMx) to 7, the following message is parsed as shown below:

Message: “This is a 2030 message with numbers 10, -6.2, and 2,459.884”

Parsed result: “2030, 10, -6, 2, 2, 459, 884”

If you set the number of responses less than 7, the parsed result will be truncated; if you set the number of responses greater than 7, the result will include trailing 0s, i.e., “..., 884, 0, 0, 0.”

ASCII Float (Parse = 2)

This technique also parses numbers only, but retains decimals as part of each number. All other nonnumeric characters are parsing characters. For example, if you selected the ASCII Float option and set the number of responses (NUMx) to 5, the following message is parsed as shown below:

Message: “This is a 2030 message with numbers 10, -6.2, and 2,459.884”

Parsed result: “2030, 10, -6.2, 2, 459.884”

If you set the number of responses less than 5, the parsed result set will be truncated; if you set the number of responses greater than 4, the result will include trailing 0s, i.e., “..., 459.884, 0, 0, 0.”

Character String (Parse = 3)

This technique retains all numbers and characters in a character string. For example, if you selected the Character String option and set the number of responses (NUMx) to 60, the example message is parsed as follows:

Message: “This is a 2030 message with numbers 10, -6.2, and 2,459.884”

Parsed response: “This is a 2030 message with numbers 10, -6.2, and 2,459.884”

For this parsing method, the SEL-2030 always appends a NULL character (00h) to the end of the parsed response before storing it to the database. This means that the NUMx setting must be set to a value one greater than the expected number of response items. The above string is actually 59 characters in length, yet the NUMx setting was set to 60.

If you set the number of responses less than 60, the parsed result will be truncated; if you set the number of responses greater than 60, the result will include extra trailing nulls, which are non-printing characters, so you will not see any difference when using default data viewing methods, i.e., “...d 2,459.884.”

Integer String (Parse = 4)

This technique stores each pair of received bytes in a register, most-significant-byte first. The Integer String option is primarily useful for capturing data from devices that send data in binary words. Because this parsing option uses both upper and lower bytes of each register, it stores data in fewer registers (less space) than the Character String option. You can retrieve data from these registers using the special strings designed to work with a data word. See ***Section 5: Message Strings*** for more detailed information.

Integer String with XON/XOFF Encoding (Parse = 5)

This technique works just like Integer String, except each pair of received bytes is compared to a set of special codes that are used to encode the XON (11h) and XOFF (13h) characters. If one of the special codes is encountered, the appropriate 11h or 13h character is stored. The encodings used are as follows: a 99h followed by a 01h represents XON (11h), a 99h followed by a 02h represents a XOFF (13h), a 99h followed by a 03h represents a 99h. Since 99h is always encoded, any 99h that is received and is not followed by 01h, 02h, or 03h is ignored. For example, if you set the parse option to Integer String with XON/XOFF encoding and set the number of items (NUMn) to 4, the following message is parsed as shown below (all data shown as hexadecimal character codes):

Message: 019902109903249915FF9934C80B

Parsed result: 011310992415FF34

Notice that the NUMn setting applies to the number of "parsed" items, not to the number of received items. This parsing method is useful when binary data are being received while XON/XOFF flow control is enabled. When communicating with another SEL-2020/2030, the \Rx.../ and \Ry.../ strings can be used in the downstream SEL-2020/2030 to encode the data before sending it to the upstream SEL-2020/2030. See ***Section 5: Message Strings*** for more detailed information.

Flexible Parsing (Parse = 6)

This technique parses received characters according to a user-defined Decode Equation. The Decode Equation identifies data types and search strings expected in the received characters. Text strings that match the Decode Equation are stored into the data region.

Decode Equations

Decode Equations contain one or more Decode Expressions. Decode Expressions consist of either Decode Elements or Search Strings.

Decode Equation Syntax: A Decode Equation consists of one or more Decode Expressions as shown below.

$$DEq = DExp_1, DExp_{2, \ldots} DExp_n$$

Use braces, { }, to enclose a group of expressions together. This is especially useful when parsing tabular data.

Decode Equation Example: 4{(I, S5, I, F)& '\00D'}

In this example, the SEL-2030 expects four rows of data with each row containing an integer, string of 5 characters, an integer, and a floating-point value. At the end of each row is a carriage return.

Decode Expression Syntax: A Decode Expression consists of one or more Decode Elements or a Search String as shown below.

$$DExp = DElem$$

$$D\ Exp = (DElem_1, DElem_2, \ldots, DElem_n)$$

$$D\ Exp = \text{Search String}$$

Use parentheses, ( ), to enclose a logical group of Decode Elements, and commas to separate the Decode Elements within a logical group.

Decode Expression Example: I, 3F, S20

This example specifies one integer, an array of three floating-point numbers, and a string of 20 characters.

Decode Element Syntax: A Decode Element consists of a Data Type (Type) and optional parameters. These optional parameters are shown below in brackets but the brackets are not actually entered, see the Decode Element Example.

DElem = [r]Type[n][@|;label]

Element Definitions:

r = **Repeat Count.** Optional number of times to repeat the data type in the expanded Decode Equation. Range is 1–2048. Repeat count data items are stored as an array.

Type = **Data Type.** The parser ignores all leading white space (space or tab characters) for all data types except C. See Table 3.6 for specific data types and definitions.

Reset Values. If parsing fails, the SEL-2030 stores the data type reset value into the database. See Table 3.6 for data type reset values. Also see ***User-Defined Reset Values***.

n = **Length.** Optional maximum expected size of the ASCII string for the data type. Range is 1–32767. If *n* is not specified, the value of *n* is based on the data type specified. See Table 3.6 for the default length of *n*.

Once a valid character is found, all valid characters are read and stored until the specified length of characters is read or an invalid character is found.

Table 3.6: Data Type Characteristics

Data Types	Definitions	Reset Values	Default Length (if *n* not specified)
I	Integer (0–9 and leading + or –)	8000h	5 valid characters plus sign
F	Floating Point (0–9, + or –, and scientific notation)	7F800000h	10 valid characters
C	ASCII String (all ASCII characters including leading white space)	‘’ (empty string)	1 character
S	ASCII String (all ASCII characters excluding leading white space)	‘’ (empty string)	1 character
H	ASCII Hexadecimal Number (0–9, A–F, a–f)	8000h	4 valid characters
RI*v*	User-defined reset value for I Data Type, where *v* is the reset value. Format the same as I Data Type.		
RF*v*	User-defined reset value for F Data Type, where *v* is the reset value. Format the same as F Data Type.		
RH*v*	User-defined reset value for H Data Type, where *v* is the reset value. Format the same as H Data Type. *V* is specified in hexadecimal.		

@ = **Non-Storage Element.** The @ sign causes the data item to be parsed according to the data type, but not stored in the database. In the example, I, F@, the @ sign reserves space for an integer, but not for the floating-point. The @ sign cannot be specified with the label option.

Label = **Optional Label.** This optional label is applied to the data type. Only one label is allowed per data type. Data elements with a repeat count share the same label. Labels are limited to ten characters, and characters must be (a–z, A–Z, 0–9 or the underscore character). A label cannot be specified with the @ sign option.

Decode Element Example: 2F5;My_Float

This example shows an array of two floating-point numbers, each with a maximum of 5 ASCII characters. The data are stored in the SEL-2030 database with the My_Float label.

Search String Syntax: Use any keyboard character in a string. A Search String may be specified with either a preceding ampersand (&) or a comma as shown below.

SExp = 'str'

SExp = & 'str'

Sexp = , 'str'

When the Search String is specified in the Decode Expression, the SEL-2030 searches the incoming message for an exact match or until the message acquisition times out.

A preceding ampersand causes the SEL-2030 to search the incoming string for an exact match to the Search String. If the Search String is found, the previous Decode Expression is evaluated. If the Decode Expression is successfully parsed before the Search String is found, the Search String is treated as a Search String with a preceding comma. When using the ampersand, the Search String has precedence over the preceding Decode Expressions.

A preceding comma causes the SEL-2030 to evaluate all expressions in the specified order. If an expression before the search string fails, and then the Search String is found, the parser will continue parsing after finding the Search String.

The Search String allows characters in hexadecimal format using \0xx (where xx = hexadecimal number represented by ASCII characters). Null characters (\000) and single quotes are not allowed within Search Strings.

Search String Example: 'Text', I, F& 'str'

In this example, the parser searches for the string 'Text', then it parses the next integer and floating-point value. While evaluating the floating-point value, the parser is also searching for the Search String 'str'. If 'str' is found before the floating-point, the floating-point value is reset. See Table 3.6 for the data type reset values.

User-Defined Reset Values: It may be desirable to have user-defined reset values for failed parsing conditions. Specify the numerical reset values in the Decode Equation. After defining a reset value, any subsequent data items that fail to parse are reset to the new reset value.

Example: DECODE = “F, H, I, RF3.55, RH3A, RI222, F, H, I”

If the SEL-2030 fails to parse the incoming data, the database will be reset with the following:

F = 78F0 0000h (default reset value defined in table 3.6)

H = 8000h (default reset value defined in table 3.6)

I = 8000h (default reset value defined in table 3.6)

F = 3.55 (reset value defined with RF3.55)

H = 3Ah (reset value defined with RH3A)

I = 222 (reset value defined with RI222)

Database Storage and Parsing Rules

After successful setting creation, the database storage is reserved. After receipt and parsing of the first response, the database region is valid regardless of the success or failure of the data parsing. This allows you to view the database region and aids in troubleshooting the Decode Equation.

An element is parsed successfully if the first character evaluated is within the ranges specified in Table 3.6 for each data type. Once a valid character is found, all valid characters are read and stored until the maximum number of characters is read or an invalid character is found.

If an invalid character is read before any valid characters, then the parse rule fails and the data element is reset.

If an invalid character is found after at least one valid character, the current Decode Element is valid and evaluation of the next element starts.

If all the Decode Elements within a Decode Expression fail, or the message collection times-out, then all the remaining data elements referenced in the Decode Equation are reset to the values listed in Table 3.6.

Parsing Precedence

Parsing is evaluated from left to right according to the Decode Equation. However, special rules apply to Search Strings using a preceding ampersand. This type of Search String is referred to as an ampersand Search String in the text below.

If a Search String is the first expression in the Decode Equation, then the parser searches for the Search String in the message. Once the Search String is found, evaluation of the Decode Equation proceeds.

The ampersand Search String has the highest precedence. If a Decode Equation contains a Search String, and the Search String is found before the completion of the previous Decode Expression, the Decode Expression has failed and all remaining elements in the Decode Expression are reset (see the reset values in Table 3.6).

If the incoming string contains data that is both valid for the specified data type, and matches the ampersand Search String, the Search String has precedence. If the incoming data only contains the Search String, then the previous Decode Expression is reset.

The ampersand Search String is evaluated with the preceding Decode Expression. A Search String with a preceding comma is evaluated in the order it appears in the Decode Expression.

Parsing Precedence Examples:

I, F, H& 'str'. The parser watches for 'str' while evaluating for the H element. If 'str' is found before the H element, then H is reset.

I, (F, H)& 'str'. The parser watches for 'str' while evaluating for both the F and H elements. If 'str' is found while evaluating F, both F and H are reset.

2{I, (F, H)}& 'str'. In this case, because the 'str' is outside the brace, the 'str' is only searched for on the very last element of the array. To evaluate 'str' for each row of the array, move 'str' inside the brace.

I, H, 'str', F. The parser evaluates the incoming data for Integer and Hex and then parses the data until 'str' is found. After 'str' is found, the parser evaluates the next floating point. If H is not found and 'str' is found, processing continues for F.

Flex Parsing Example

Parse the maximum and minimum values from an SEL-351R min/max meter report.

Enter the following SET A settings.

ISSUE1 = T10:00:00
MESG1 = "MET M \n"
PARSE1 = 6
DECODE1 = " 'Min', '\00D', 11{S6, (F, 5I, F, F, 5I, F)& '\00D'}"

These settings cause the SEL-2030 to request a min/max meter report from the SEL-351R at 10:00 am and parse the response according to the decode string, DECODE1. Shown below is an example SEL-351R min/max meter report.

```
==>>met m

RECLOSER R1                     Date: 03/28/01    Time: 10:39:02.389
FEEDER XYZ
           Max    Date      Time             Min    Date      Time
IA(A)      200.0  03/28/01  10:38:56.774     198.0  03/28/01  10:38:57.291
IB(A)      202.1  03/28/01  10:38:56.774     199.0  03/28/01  10:38:58.069
IC(A)      202.2  03/28/01  10:38:57.091     197.0  03/28/01  10:38:56.774
IN(A)    RESET                             RESET
IG(A)    RESET                             RESET
VA(kV)   RESET                             RESET
VB(kV)   RESET                             RESET
VC(kV)   RESET                             RESET
VS(kV)   RESET                             RESET
MW3P     RESET                             RESET
MVAR3P   RESET                             RESET
LAST RESET 03/28/01 10:38:56.773
```

In this example, the parser inspects eleven rows of data after finding the 'Min' string and a carriage return. If a row contains min and max data, the database stores the following data for the Max string and repeats the process for the Min string:

- First label — IA(A)
- Max value as a floating-point value — 200.0
- Date and Time as integers (up to the seconds field) — 03 28 01 10 38
- Seconds as a floating-point value — 56.774

If the row contains the RESET string, the decode elements are not evaluated and are set to the reset value.

Parsing Delays

When you use any of the above "generic" parsing methods, (Parse = 1, 2, 3, 4, 5), the SEL-2030 uses the NUMx setting to determine when to stop collecting data items. For flex parsing (Parse = 6), the SEL-2030 uses DECODEx to determine when to stop collecting data items. If the SEL-2030 has not received the specified number of items, it will continue to wait for them until a predetermined amount of time has passed without receipt of a new item. This time delay is 5 seconds for ports with DEVICE set to Other-IED and 15 seconds for ports with DEVICE set to SEL-IED. Once this amount of time passes, the SEL-2030 takes the data items that it has received and continues to the next step in the parsing process, either performing checksum validation or simply storing the data to the database.

If the SEL-2030 receives the number of items specified by the NUMx or DECODEx setting, the next task is determined by the DELAYx setting. If the DELAYx setting is set to “ON,” then the SEL-2030 will execute the same type of delay as described above, ignoring any received items until no more items are received for a fixed time interval. It then moves on to the next step in the parsing process. If the DELAYx setting is set to “OFF,” then the SEL-2030 will immediately move on to the next step in the parsing process. Any characters received beyond the number of expected data items may end up in the Unsolicited Message Buffer or may even be captured by a subsequent data collection process. Setting the DELAYx setting to “ON” helps to ensure that excess characters in a device response will not be treated as part of a subsequent request-response sequence. This introduces time delays in the parsing process, preventing rapid successive data collections. When it is known that the responding device will send a fixed number of items without any excess trailing characters, setting DELAYx to “OFF” may be preferable because this enables the parsing process to complete quickly, allowing for rapid successive data collections.

Checksum Validation

If you choose a parse type of Character String (PARSEn=3), Integer String (PARSEn=4), or Integer String with XON/XOFF encoding (PARSEn=5), you can set the SEL-2030 to perform checksum validation on the parsed response. The CHECKn setting specifies the type of checksum being used (CRC-16, 8-bit checksum, or 16-bit checksum) and the format of the checksum (ASCII hexadecimal or binary). The ORDERn setting specifies the byte ordering of the checksum for CRC-16 and 16-bit checksums. The STARTn, STOPn, and CHKPOSn settings specify the locations of the data to be validated and the checksum in the received data stream. Three methods are available for specifying these position settings: 1) specify a byte index in the received data stream, where byte index 1 is the first position, 2) specify a character or character code, where a trailing ‘i’ can be appended to indicate that the character itself is included, 3) specify the number of bytes that follow the item being specified. To specify a byte index, you enter a positive integer. To specify a character you can enter the character or, if the character is nonprintable, the ASCII character code. Add the trailing ‘i’ to specify inclusion of the character itself. You must quote any numeric character so that it is not treated as a byte index (e.g., enter ‘9’ or “9” to indicate the character 9 as opposed to byte 9). The examples in Table 3.7 demonstrate the use of each method.

Table 3.7: Example Position Settings

Example Setting	Meaning
START1 = 1	Start calculating checksum at first received byte.
START1 = #	Start calculating checksum at the first byte following the character ‘#’.
START1 = #i	Start calculating checksum at the ‘#’ character (‘#’ is included in checksum).
START1 = E10	Start calculating checksum 10 bytes before the end of the message.
STOP1 = 20	Stop checksum calculation at 20th byte (byte 20 is the last byte of data).

Example Setting	Meaning
STOP1 = \003	Stop checksum calculation at ETX character (03 character code) (ETX character is not included in checksum).
STOP1 = \003i	Stop checksum calculation after ETX (ETX character is included in checksum).
STOP1 = E4	Stop calculating checksum 4 bytes before the end of the message.
CHKPOS1 = 40	The checksum starts at the 40th byte of the received data.
CHKPOS1 = \001	The checksum starts after the SOH character (01 character code).
CHKPOS1 = E2	The checksum is located 2 bytes from the end of the message.

Suppose the string below will be sent to the SEL-2030 and you wish to verify that there are no transmission errors. Assume that the checksum is calculated on the data within the quotes. In this case the checksum is a 16-bit checksum in ASCII hexadecimal format with the high byte first. There are many different ways that you could specify the locations of the data and checksum. Four examples are given.

received data: “This is data”, 044E

settings:

CHECK = 16A,
ORDER = H,

method 1: START = 2, STOP = 13, CHKPOS = 16
method 2: START = E18, STOP = E6, CHKPOS = E4
method 3: START = “, STOP = ”, CHKPOS = ‘,’
method 4: START = 2, STOP = ”, CHKPOS = E4

The method you choose for each of the position settings will depend on the format of the received data. These position settings apply only to the data to be stored. This means that the NUMn setting must be large enough to contain all of the data and the checksum. Otherwise, the checksum verification will consistently fail. The position settings must be sequential in the received data: the STARTn position must be on or before the STOPn position and the STOPn position must precede the CHKPOSn position.

The ACKn and NACKn settings allow you to set strings to be sent following successful or failed checksum validation, respectively. The content of these strings is limited to characters and character codes. None of the special SEL-2030 strings are allowed.

When the SEL-2030 is set to do checksum verification, data are only stored to the database when the checksum verification is successful. If the checksum verification fails, the SEL-2030 will rerequest the data by sending the NACKn string if one is set. If no NACKn string is set, the MESGn string will be sent again. The SEL-2030 will then parse the data and attempt checksum verification again. If this verification fails again, one final attempt (for a total of three) will be made. If the NACKn string was sent previously and resulted in no response at all, the final rerequest will be made using the MESGn string. If the checksum verification is successful, the data are stored to the database (including the checksum) and the ACKn string is sent to the connected device.

SET A Settings

When you send the **SET A** command to a specific port, the SEL-2030 will prompt you for responses based on the type of device connected to that port.

Table 3.8 shows the prompts for an SEL IED device port; Table 3.9 shows prompts for an Other IED device port; Table 3.10 for a Printer device port; and Table 3.11 for a Master device port. Detailed descriptions of these settings are included in Table 3.12.

Table 3.8: SET A Auto-Message Settings Prompts for SEL IED Device

AUTOBUF (Y/N)
STARTUP
NOCONN
SEND_OPER
REC_SER
MSG_CNT (0–12)
0 | **1–8** | **9–12**
ISSUE1–8 | ISSUE9–12
MESG1–8 | MESG9–12
"20" msg. | non "20" msg.
PARSE1–8 (0–6)
0 | **1–5** | **6**
NUM1–8 | DECODE1–8
DELAY1–8 | DELAY9–12
CHECK1–8
N | 8A, 8B | 16A,16B,CA,CB
ORDER 1–8
START1–8
STOP1–8
CHKPOS1–8
ACK1–8
NACK1–8
ARCH_EN (Y/N)
Y(ES) | **N**(O)
ISSUE1A–3A
MESG1A–3A
"20" msg. | non "20" msg.
PARSE1A-3A (0-6)
0 | **1–5** | **6**
NUM1A–3A | DECODE1A–3A
DELAY1A–3A
CHECK1A–3A
N | 8A, 8B | 16A,16B,CA,CB
ORDER1A–3A
START1A–3A
STOP1A–3A
CHKPOS1A–3A
ACK1A–3A
NACK1A–3A
USER | USER | USER
Only available with optional nonvolatile Flash memory
Save changes (Y/N)
Y(ES) Port n Settings Changed | **N**(O) Settings Aborted

Table 3.9: SET A Auto-Message Prompts for OTHER IED Device

AUTOBUF (Y/N)				
STARTUP				
NOCONN				
MSG_CNT (0-12)				
0	**1-8**			**9-12**
	ISSUE1-8			ISSUE9-12
	MESG1-8			MESG9-12
	PARSE1-8 (0-6)			
	0	**1-5**	**6**	
		NUM1-8	DECODE1-8	
	DELAY1-8			DELAY9-12
	CHECK1-8			
	N	8A,8B	16A,16B,CA,CB	
			ORDER1-8	
		START1-8		
		STOP1-8		
		CHKPOS1-8		
		ACK1-8		
		NACK1-8		
ARCH_EN (Y/N)				Only available with optional nonvolatile Flash memory
Y(ES)			**N**(O)	
ISSUE1A-3A				
MESG1A-3A				
PARSE1A-3A (0-6)				
0	**1-5**		**6**	
	NUM1A-3A		DECODE1A–3A	
DELAY1A-3A				
CHECK1A-3A				
N	8A,8B	16A,16B,CA,CB		
		ORDER1A-3A		
	START1A-3A			
	STOP1A-3A			
	CHKPOS1A-3A			
	ACK1A-3A			
	NACK1A-3A			
1-4				
NUM1A-3A				
Y(ES) Port n Settings Changed		**N**(O) Settings Aborted		

Table 3.10: SET A Auto-Message Setting Prompts for PRINTER Device

<table>
<tr><td colspan="4">STARTUP</td></tr>
<tr><td colspan="4">MSG_CNT (0-12)</td></tr>
<tr><td rowspan="5">0</td><td colspan="2">1</td><td rowspan="3">2-12</td></tr>
<tr><td colspan="2">PRINT_ALL (Y/N)</td></tr>
<tr><td>Y(ES)</td><td>N(O)</td></tr>
<tr><td rowspan="2">CLEAR_BUF (Y/N)</td><td>ISSUE1</td><td>ISSUE2-12</td></tr>
<tr><td>MESG1</td><td>MESG2-12</td></tr>
<tr><td colspan="4">USER</td></tr>
<tr><td colspan="4">Save changes (Y/N)</td></tr>
<tr><td colspan="2">Y(ES)
Port n Settings Changed</td><td colspan="2">N(O)
Settings Aborted</td></tr>
</table>

Table 3.11: SET A Auto-Message Settings Prompts for MASTER Device

<table>
<tr><td colspan="2">PROTOCOL = SEL or LMD</td><td colspan="2">PROTOCOL = MODBUS or DNP</td><td></td></tr>
<tr><td colspan="2">NOCONN
MSG_CNT (0-12)</td><td colspan="2">MSG_CNT (1-1)</td><td></td></tr>
<tr><td rowspan="3">0</td><td>1-12</td><td rowspan="3">0</td><td>1</td><td></td></tr>
<tr><td>ISSUE1-12</td><td>ISSUE1</td><td></td></tr>
<tr><td>MESG1-12</td><td>MESG1</td><td></td></tr>
<tr><td colspan="2">ARCH_EN (Y/N)</td><td colspan="2">ARCH_EN(Y/N)</td><td rowspan="4">Only available with optional nonvolatile Flash memory</td></tr>
<tr><td>Y(ES)</td><td rowspan="3">N(O)</td><td>Y(ES)</td><td rowspan="3">N(O)</td></tr>
<tr><td>ISSUE1A</td><td>ISSUE1A</td></tr>
<tr><td>MESG1A</td><td>MESG1A</td></tr>
<tr><td colspan="2">USER</td><td colspan="2">USER</td><td></td></tr>
<tr><td colspan="2">Save changes (Y/N)</td><td colspan="2">Save Changes (Y/N)</td><td></td></tr>
<tr><td>Y(ES)
Port n Settings Changed</td><td>N(O)
Settings Aborted</td><td>Y(ES)
Port n Settings Changed</td><td>N(O)
Settings Aborted</td><td></td></tr>
</table>

Table 3.12: SET A Automatic Message Settings Information

Setting	Comment
AUTOBUF	**Prompt**. Save unsolicited messages (Y/N)**.** **Description**. You enter Y (Yes) to save unsolicited messages received by the SEL-2030. Ports configured for IEDs can buffer unsolicited messages. User-defined commands will work regardless of this setting. Not available for Master or Printer.
STARTUP	**Prompt**. Port startup string. **Description**. You enter a startup string for the device attached to this port. The startup string supports devices that need some initialization on power-up. When the SEL-2030 is powered-up, these startup messages will be transmitted. Typically, this string is used on SEL relays that need to be at Access Level 1 or Access Level 2 for automatic data collection by the SEL-2030. Not available for Master ports. The SEL-2030 will not show this setting to a Level 1 user of the SEL-2030. This is to prevent an unauthorized user from getting access to passwords that may be embedded in the startup string. The startup string is sent: • When you accept setting changes after the **SWAP** or **COPY** commands. • At power-up. • When an inactive port becomes active. • When you accept SET A setting changes. • When leaving transparent communications with a device.
SEND_OPER	**Prompt**. Send operate command on logic bit transition (Y/N/YP). **Description**. Use this setting to enable automated control of the attached SEL device. The YP selection indicates that Remote Bits should always be pulsed. See the following subsection, ***Automated Control***, for more information.
REC_SER	**Prompt**. Enable Automatic Sequential Events Recorder Collection (Y/N). **Description**. Set to Y (Yes) to enable automatic Sequential Events Recorder data collection from an SEL IED. Not all SEL IEDs support this feature.
NOCONN	**Prompt**. Block external connections to this port. **Description**. Set to NA to enable modem, transparent and virtual terminal connections to this port. Set to SELOGIC Control Equation that equals 1 when you want connections to be disabled.
MSG_CNT	**Prompt**. How many auto-message sequences (0-12). **Description**. You enter the number of the auto-message(s) you wish to use. Messages 1 to 8 have an associated data area to store responses, messages 9 to 12 are for messages only.

Setting	Comment
PRINT_ALL	**Prompt**. Print all unsolicited messages (Y/N). **Description**. You set to Y (Yes) to print all unsolicited messages received by the SEL-2030 to a Printer port. Only those messages received on ports that have AUTOBUF=Y will be printed. The PRINT_ALL prompt only appears on ports with a DEVICE = P for printer. This setting occupies the Message 1 position. You can create more selective printing functions using SELOGIC Control Equations and message strings on other message functions.
CLEAR_BUF	**Prompt**. Clear unsolicited message buffer after print (Y/N). **Description**. You set to Y (Yes) to clear the unsolicited message buffer after printing. Only applies to Printer ports.
Note: Up to 12 auto-messages may be defined using the ISSUEx and MESGx settings. The first 8 may have their responses parsed using the PARSEx setting.	
ISSUE1-12	**Prompt**. Item 1-12 trigger. **Description**. You enter the trigger condition as a SELOGIC Control Equation that triggers the associated message. ISSUE1 triggers MESG1, ISSUE2 triggers MESG2, etc. See the ***Section 4: SELOGIC® Control Equations*** for instructions on developing these trigger conditions. There is a 200-character per equation limit for a single equation and a 50-term (element names and time functions) limit per equation.
MESG1-12	**Prompt**. Item 1-12 message. **Description**. You enter the message string to be sent when the associated ISSUE condition is met. Each message is limited to 1,000 characters. Use the \ symbol at the end of a line and press **<ENTER>** to continue on the next line. See ***Section 5: Message Strings*** for information the special strings that can be entered here.
PARSE1-8	**Prompt**. Item 1-8 response parsing method (0=IGNORE, 1=ASCII_INT, 2=ASCII_FLOAT, 3=CHAR_STRING, 4=INT_STRING, 5=INT_STRX, 6=FLEX). **Description**. You select the parsing option to be used for the message response. For Masters and Printers, the parsing option is always forced to IGNORE. Parsing is automatically set for SEL relays if the message string is a recognized "20" command.
DECODE 1-8	**Prompt.** Flexible Parsing Decode Equation. **Description.** Enter a Decode Equation to parse a response. The string is limited to 1000 characters. (See the preceding subsection, ***Flexible Parsing***, for more information on using this setting.)
NUM1-8	**Prompt**. Item 1-8 number of data items. **Description**. You enter the maximum number of items the SEL-2030 may store from the response. The limit is determined by the type of data and the size of the associated region. See ***Section 6: Database*** for more information on region sizes.

Setting	Comment
DELAY1-12	**Prompt**. Item 1-12 time delay to allow response to complete (OFF, ON). **Description**. If you know you are collecting the entire response, use the OFF setting to avoid unnecessary delays. Otherwise, use the ON setting so the response does not confuse subsequent data collections. When on, the SEL-2030 waits for the port to go idle for 15 seconds on an SEL IED port or 5 seconds on an Other IED port before considering the response complete.
CHECK1-8	**Prompt**. Checksum verification (N=NONE, 8A=8BIT ASCII, 8B=8BIT Binary, 16A=16BIT ASCII, 16B=16BIT Binary, CA=CRC16 ASCII, CB=CRC16 Binary). **Description**. You select the verification method you wish to use to confirm that the data was accurately transmitted over the data channel. The data must contain a validation code of this same type and format. Otherwise, select NONE.
ORDER1-8	**Prompt**. Checksum byte order (H=High byte first, L=Low byte first) **Description**. You enter the ordering of the bytes in the received validation code. Does not apply to 8-bit (single-byte) checksums.
START1-8	**Prompt**. Position or character where verification will start. **Description**. You enter the position in the received data where the checksum validation should begin. This position can be an index from the start, an index from the end, or a specific character. (See the preceding subsection, ***Checksum Validation***, for more information on using this setting.)
STOP1-8	**Prompt**. Position or character where verification will stop. **Description**. You enter the position in the received data where the checksum validation should end. This position can be an index from the start, an index from the end, or a specific character. (See the preceding subsection, ***Checksum Validation***, for more information on using this setting.)
CHKPOS1-8	**Prompt.** Position or character where checksum located. **Description.** You enter the position in the received data where the validation code will be located. This position can be an index from the start, an index from the end, or a specific character. (See the preceding subsection, ***Checksum Validation***, for more information on using this setting.)
ACK1-8	**Prompt.** Acknowledge string. **Description.** You define the string to send to the connected device when the data received from it passes the checksum verification. This string is limited to 10 characters. (See the preceding subsection, ***Checksum Validation***, for more information on using this setting.)
NACK1-8	**Prompt.** Negative Acknowledge string. **Description.** You define the string to send to the connected device when the data received from it does not pass the checksum verification. This string is limited to 10 characters. (See the preceding subsection, ***Checksum Validation***, for more information on using this setting.)
ARCH_EN	**Prompt**. Enable use of archive data items (Y/N). **Description**. You enter Y (Yes) to enable use of nonvolatile memory. ARCH_EN is forced to N (No) if nonvolatile Flash memory is not installed. Not available for printer ports.

Setting	Comment
ISSUE1A-3A	**Prompt**. Archive 1 to 3 trigger. **Description**. You define the trigger condition as a SELOGIC Control Equation that initiates a message. This setting available only if ARCH_EN is set to Y (Yes).
MESG1A-3A	**Prompt**. Archive 1 to 3 message. **Description**. You enter the message to send in response to the associated trigger condition. This setting available only if ARCH_EN is set to Y (Yes).
PARSE1A-3A	**Prompt**. Archive 1 to 3 response parsing method (0=IGNORE, 1=ASCII_INT, 2=ASCII_FLOAT, 3=CHAR_STRING, 4=INT_STRING, 5=INT_STRX, 6=FLEX). **Description**. You select the parsing option to be used for the message response. This setting available only if ARCH_EN is set to Y (Yes). Parsing is automatically set for SEL IEDs if string is a recognized "20" command.
DECODE1A-3A	**Prompt.** Flexible Parsing Decode Equation. **Description.** Enter a Decode Equation to parse a response. The string is limited to 1000 characters. (See the preceding subsection, ***Flexible Parsing***, for more information on using this setting.)
NUM1A-3A	**Prompt**. Archive 1 to 3 number of data items. **Description**. You enter the maximum number of data items the SEL-2030 may store from the response.
DELAY1A-3A	**Prompt:** Archive 1 to 3 time delay to allow response to complete (OFF, ON). **Description.** If you know you are collecting the entire response, use the OFF setting to avoid unnecessary delays. Otherwise, use the ON setting so the response does not confuse subsequent data collections.
CHECK1A-3A	**Prompt.** Checksum verification (N=NONE, 8A=8BIT ASCII, 8B=8BIT Binary, 16A=16BIT ASCII, 16B=16BIT Binary, CA=CRC16 ASCII, CB=CRC16 Binary). **Description.** You select the verification method you wish to use to confirm that the data was accurately transmitted over the data channel. The data must contain a validation code of this same type and format. Otherwise, select NONE.
ORDER1A-3A	**Prompt.** Checksum byte order(H=High byte first, L=Low byte first) **Description.** You enter the ordering of the bytes in the received validation code. Does not apply to 8-bit (single-byte) checksums.
START1A-3A	**Prompt.** Position or character where verification will start. **Description.** You enter the position in the received data where the checksum validation should begin. This position can be an index from the start, an index from the end, or a specific character.
STOP1A-3A	**Prompt.** Position or character where verification will stop. **Description.** You enter the position in the received data where the checksum validation should end. This position can be an index from the start, an index from the end, or a specific character.

Setting	Comment
CHKPOS1A-3A	**Prompt.** Position or character where checksum located. **Description.** You enter the position in the received data where the validation code will be located. This position can be an index from the start, an index from the end, or a specific character.
ACK1A-3A	**Prompt.** Acknowledge string. **Description.** You define the string to send to the connected device when the data received from it passes the checksum verification. This string is limited to 10 characters.
NACK1A-3A	**Prompt.** Negative Acknowledge string. **Description.** You define the string to send to the connected device when the data received from it does not pass the checksum verification. This string is limited to 10 characters.
USER	**Prompt**. Size of user-defined data space in registers. **Description**. You enter the number of registers you need to use for data storage in the User region of memory. This may be automatically increased during SET M operations.

Automated Control

You can associate SELOGIC Control Equation elements with specific SEL IED operations by enabling the SEND_OPER setting. Changes in these elements can then cause the SEL-2030 to directly issue operate commands to the attached SEL IED.

To find out what will be associated, use the **AUTO n** command to determine the number of supported breakers and remote bits for operate control. For every breaker supported, one BRn bit will be associated with an SEL IED breaker. For every remote bit supported, one RBn bit will be associated with an SEL IED remote bit. Setting and clearing of BRn bits corresponds to issuing **OPEN** and **CLOSE** commands, respectively. When SEND_OPER=Y, setting and clearing of RBn bits corresponds to issuing remote bit set and clear commands, respectively. When SEND_OPER=YP, setting RBn bits corresponds to issuing remote bit pulse commands and clearing RBn bits has no direct effect.

If the attached SEL IED is an SEL-2020/2030, the 16 breakers correspond to the BR1 bits on each port. Similarly, the 16 remote bits correspond to the RB1 bits on each port. For example, if you set BR5 in the local SEL-2030 on a port auto-configured with an SEL-2020/2030 attached, the command to set Port 5 BR1 will be issued to the attached SEL-2020/2030.

The SEL-2030 can issue these commands in one of two ways: ASCII or binary. The **AUTO** command will tell you which is supported. When ASCII commands are used, the SEL-2030 will have to wait for any ASCII communications in process to complete before issuing the command. If binary commands are used, the SEL-2030 will issue the command to the attached SEL IED within 100 milliseconds.

The operate commands will be issued on the rising edge of the set and clear bits, unless they both rise simultaneously. Consequently, the breaker and remote bits will track the value of the last operation the SEL-2030 performed. The relay may operate breakers or have its remote bits changed independent of the SEL-2030, so you cannot depend on the state of the breaker and remote bits to indicate the state of the relay.

If you wish to block the operation of one of these bits, assign both the set and clear equations to a blocking element. For instance, if you use X to block breaker one operations, you would set the equations to:

SBR1 = X
CBR1 = X

With both the set and clear elements asserted, there can be no rising edges to trigger operate commands.

SET U - USER-DEFINED COMMANDS

Use the **SET U** command to:

- Create user-defined commands that the SEL-2030 will recognize and obey.
- Enable handling of a recognized, but unsolicited, SEL relay auto-message.
- Control the SEL-2030 command set.

User-defined commands allow the SEL-2030 to recognize unsolicited inputs. You can create up to 11 user-defined commands for any Master port, including 8 general-purpose and 3 special-purpose commands. You can create up to 4 general-purpose user-defined commands on SEL IED and other IED ports.

The SEL-2030 has a predefined command set (e.g., **SHOW**, **VIEW**, **SET**) that allows you to control, interrogate, and set the SEL-2030 functions from your computer. If a port is connected to an unattended device (e.g., an RTU or substation computer), the SEL-2030 predefined command set may be supplemented or replaced by user-defined commands that are appropriate for the device and function. They are called user defined because you define the command string and the action performed by the SEL-2030 when the command is received by the SEL-2030. These commands are available at all access levels.

On IED ports, the SEL-2030 recognizes unsolicited messages from the IED based on user-defined message strings you define with the **SET U** command (e.g., a summary event report from an SEL relay).

On a Master port, commands are normally terminated with a carriage return (<CR>). The carriage return is typically sent from a terminal or PC by depressing the Enter key. User-defined commands on a Master port will similarly be recognized upon receipt of a <CR>. If you disable the SEL-2030 command set to use only user-defined commands on that port (using the CMD_EN setting), you may select an alternate command termination character (using the CMD_CH setting).

General-Purpose Commands

You can set the SEL-2030 so that receipt of a command you defined sets an SEL-2030 database bit. You can then use that bit in a SELOGIC Control Equation to trigger a control action or message response.

When the SEL-2030 receives a general-purpose user-defined command, it pulses the associated local element command (CMDx) bit. You may create up to eight general-purpose commands per port to control the local elements CMD1 through CMD8.

For SEL relays, there are predefined auto-messages that you can set the SEL-2030 to recognize, such as status, summary event reports, and group switch reports. For example, if you define the first general-purpose command on an SEL IED port to be **20EVENT**, the SEL-2030 element CMD1 on that port pulses when the SEL-2030 receives a summary event report. You use the CMD1 bit within a SELOGIC Control Equation to trigger a message or a control action in response. See Example 5 in ***SEL-2030 User's Guide; Section 4: Job Done® Examples*** for an application example.

Similarly, on a Master port, you could define "XYZ" to be a user-defined command (CMD1="XYZ"). When the SEL-2030 receives "XYZ" on the Master port, it will pulse the CMD1 bit as shown in Figure 3.4, which you may use to trigger a response. See Examples 4 and 8 in ***SEL-2030 User's Guide; Section 4: Job Done® Examples*** for some application examples. See ***Section 5: Message Strings*** for definitions of valid message strings.

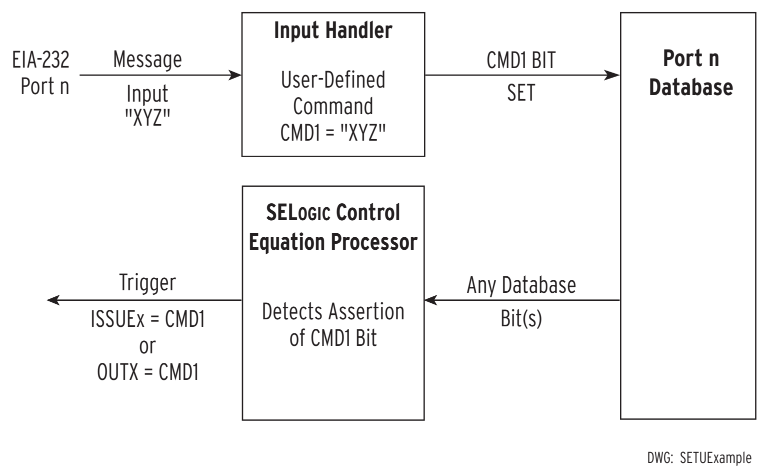

Figure 3.4: SET U Example CMD1 Message Detection

Special-Purpose Commands

There are three commands whose syntax and response messages you may define using the settings READ, WRITE, and TRANS (transparent connect). These commands read data items, write data items, and enter transparent communications. These commands are similar to the **VIEW**, **STORE**, and **PORT** commands available in the SEL-2030 command set. The **READ**, **WRITE** and **TRANS** special purpose commands may be useful with master devices that you can program to automatically communicate with the SEL-2030.

To build these commands, you must specify the position and format of the port number, address, and data, as applicable, within the message. You then specify how the SEL-2030 should respond to each of these commands for both successful and unsuccessful operations.

For example, assume you have made the following settings. (See ***Section 5: Message Strings*** for an explanation of the special characters used in these settings.)

TRANS = "TR\Pa/" TRANSACK = "\006" TRANSNACK = "\015"	To enter transparent mode with another SEL-2030 port, use the message format you defined with the **TRANS** command. For example, to enter transparent mode with Port 5 with these settings, issue the command **TR05<ENTER>**. If the transparent connection is successful, the SEL-2030 will respond with 06h (ASCII ACK) and you will be transparently connected. To terminate the transparent connection, use the transparent disconnect sequence you set using SET P. If the transparent connection could not be established, the SEL-2030 will respond with 15h (ASCII NACK).
READ = "RD\Pa/@\Aa/" READACK = "RP\Dh/" READNACK = ""	To read data from the SEL-2030 database, use the message format you defined with the **READ** command. To read from Port 7's database at address 1001h with these settings, send the command **RD07@1001<ENTER>**. The SEL-2030 will respond with the data if the read is successful (e.g., RP0013). If the read cannot be performed, the SEL-2030 will not respond, because there is no response defined for a failed read (READNACK) in these settings.
WRITE = "WR\Pa/@\Aa/=\Dh/" WRITEACK = "OK" WRITENACK = "FAIL"	To write data to the SEL-2030 database, use the message format you have defined with the **WRITE** command. To write 0036h to Port 11's database at address D007h with these settings, send the message **WR0B@D007=0036<ENTER>** to the SEL-2030. The SEL-2030 will respond “OK” if successful, or “FAIL” if the write could not be performed.

This example uses ASCII commands, but these commands could also have been built as binary commands.

SET U Settings

The **SET U** command will prompt you for user-defined strings and the command you want to use to trigger a response on Master, SEL IED, and other IED ports. **SET U** is not applicable to printer ports. You can also use the **SET U** command to disable the SEL-2030 command set on Master ports. Table 3.13 and Table 3.14 show the prompts you will see with the **SET U** command. Table 3.15 includes detailed information about the **SET U** settings.

Table 3.13: SET U User-Defined Setting Prompts for MASTER Device

<table>
<tr><td colspan="3">CMD_EN (Y/N)</td></tr>
<tr><td rowspan="2">Y(ES)</td><td colspan="2">N(O)</td></tr>
<tr><td colspan="2">CMD_CH</td></tr>
<tr><td colspan="3">CMD_CNT (0-8)</td></tr>
<tr><td rowspan="2">0</td><td colspan="2">1-8</td></tr>
<tr><td colspan="2">CMD1 to CMD8</td></tr>
<tr><td colspan="3">STR_EN (Y/N)</td></tr>
<tr><td rowspan="13">N(O)</td><td colspan="2">Y(ES)</td></tr>
<tr><td colspan="2">TRANS</td></tr>
<tr><td rowspan="3">“”</td><td>“x”</td></tr>
<tr><td>TRANSACK</td></tr>
<tr><td>TRANSNACK</td></tr>
<tr><td colspan="2">READ</td></tr>
<tr><td rowspan="3">“”</td><td>“x”</td></tr>
<tr><td>READACK</td></tr>
<tr><td>READNACK</td></tr>
<tr><td colspan="2">WRITE</td></tr>
<tr><td rowspan="3">“”</td><td>“x”</td></tr>
<tr><td>WRITEACK</td></tr>
<tr><td>WRITENACK</td></tr>
<tr><td colspan="3">Save changes (Y/N)</td></tr>
<tr><td>Y(ES)
Port n Settings
Changed</td><td colspan="2">N(O)
Settings Aborted</td></tr>
</table>

Table 3.14: SET U User-Defined Setting Prompts for SEL IED Device and Other IED Device

<table>
<tr><td colspan="2">CMD_CNT (0-4)</td></tr>
<tr><td rowspan="2">0</td><td>1-4</td></tr>
<tr><td>CMD1 to CMD4</td></tr>
<tr><td colspan="2">Save changes (Y/N)</td></tr>
<tr><td>Y(ES)
Port n Settings Changed</td><td>N(O)
Settings Aborted</td></tr>
</table>

Table 3.15: SET U User-Defined Command Settings

Setting	Comment
CMD_EN	**Prompt**. Enable SEL-2030 Commands (Y/N). **Description**. You enter N (No) to disable the SEL-2030 command set. This setting is only available for Master ports.
CMD_CH	**Prompt**. Command termination character. **Description**. You may define the command termination character with this entry. This setting is only available if CMD_EN is set to N (No); it is forced to <CR> otherwise. Changing this character from <CR> will disable prompting on this port.
CMD_CNT	**Prompt**. Number of general-purpose commands (0-8). **Description**. You enter a number (0-8) to enable command strings (CMD1 through CMD8). (0-4) on SEL IED and other IED ports.
Note: You may define up to eight command strings: CMD1 through CMD8.	
CMD1-8 or CMD1-4	**Prompt**. Command String 1-8 (see Table 3.13) or Command String 1-4 (see Table 3.14). **Description**. You enter the string that the SEL-2030 watches for to control the associated CMD bit. Each string is limited to 40 characters.
STR_EN	**Prompt**. Enable use of special-purpose commands (Y/N). **Description**. You set to Y (Yes) to enable use of the special-purpose user-defined commands. For Master ports only.
TRANS	**Prompt**. Initiate transparent mode sequence. **Description**. You define a character sequence that the SEL-2030 watches for to initiate transparent communications. This setting is only available if STR_EN is set to Y (Yes). Must include \P.../ port number string. This string is limited to 40 characters.
TRANSACK	**Prompt**. Transparent mode acknowledge. **Description**. You define the response string the SEL-2030 uses if an entry into transparent mode is successful. This setting is only available if STR_EN is set to Y (Yes). This response string is limited to 1,000 characters.
TRANSNACK	**Prompt**. Transparent mode denial. **Description**. You define the response string the SEL-2030 uses if an entry into transparent mode is unsuccessful. This setting is only available if STR_EN is set to Y (Yes). This response string is limited to 1,000 characters.
READ	**Prompt**. Read data. **Description**. You define the character sequence the SEL-2030 watches for to perform a data read operation. You must include \P../ and \A../ strings. This setting is only available if STR_EN is set to Y (Yes). This string is limited to 40 characters.
READACK	**Prompt**. Read data normal response. **Description**. You define the response string the SEL-2030 uses if a read operation is successful. Must include \D.../ string. This setting is only available if STR_EN is set to Y (Yes). This response string is limited to 1,000 characters.

Setting	Comment
READNACK	**Prompt**. Read data error response. **Description**. You define the response string the SEL-2030 uses if a read operation is not successful. This setting is only available if STR_EN is set to Y (Yes). This response string is limited to 1,000 characters.
WRITE	**Prompt**. Write data. **Description**. You define the character sequence the SEL-2030 watches for to perform a data write operation. Must include \P.../, \A.../ and \D.../ strings. This setting is only available if STR_EN is set to Y (Yes). This string is limited to 40 characters.
WRITEACK	**Prompt**. Write data success response. **Description**. You define the response the SEL-2030 uses if a write operation is successful. This setting is only available if STR_EN is set to Y (Yes). This response string is limited to 1,000 characters.
WRITENACK	**Prompt**. Write data error response. **Description**. You define the response the SEL-2030 uses if a write operation is unsuccessful. This setting is only available if STR_EN is set to Y (Yes). This response string is limited to 1,000 characters.

Note: If CMD_CH is set to <CR>, the SEL-2030 will ignore nonprinting characters entered on the port. Therefore, you should not use nonprinting characters in user-defined commands unless you change the termination character.

SET L - LOGIC SETTINGS

Use the **SET L** command to establish the SELOGIC Control Equations that control the intermediate breaker and remote bit logic. There are a total of 64 bits that can be directly controlled by these equations. These elements act as inputs to 32 S-R latches, whose outputs are also available for use in SELOGIC Control Equations. On SEL IED ports, these bits can be associated with IED breaker and remote bit operation, as discussed earlier in this section. The operation of these latches is more fully described in ***Section 4: SELOGIC® Control Equations***.

Table 3.16 fully describes these settings.

Table 3.16: SET L Logic Settings and Definitions

Setting	Comment
SBR1-SBR16	**Prompt**. SBR*n*=. **Description**. You enter a SELOGIC Control Equation definition for this set breaker logic element.
CBR1-CBR16	**Prompt**. CBR*n*=. **Description**. You enter a SELOGIC Control Equation definition for this clear breaker logic element.
SRB1-SRB16	**Prompt**. SRB*n*=. **Description**. You enter a SELOGIC Control Equation definition for this set remote bit logic element.
CRB1-CRB16	**Prompt**. CRB*n*=. **Description**. You enter a SELOGIC Control Equation definition for this clear remote bit logic element.

SET M - MATH/DATA MOVEMENT SETTINGS

You use the **SET M n** command to create a macro that automatically copies specific data from any designated SEL-2030 port database to the SEL-2030 port "n" database User region. This permits you to concentrate selected data from one or more port databases into a single port database User region for quick and easy data retrieval. You can also scale each selected data item by multiplying or dividing by a scaling constant. The **SET M n** command permits you to create up to 600 lines of equations and operations for each of the 18 SEL-2030 port databases.

This settings class is unique from all others. There are no settings labels and prompts. Instead, you enter equations and operations as lines within the settings. Because of this, the edit control keys and commands are slightly different. Table 3.17 lists the available editing keys and commands.

Table 3.17: Editing Keys and Commands for SET M and SET R

Command	Function
<**ENTER**>	Go to next line; if on empty line at end of settings, exit settings.
END<**ENTER**>	Exit settings.
<**CTRL-X**>	Abort settings (lose all changes).
^<**ENTER**>	Go back to previous line.
<<**ENTER**>	Go back to first line.
><**ENTER**>	Go to blank line following the last line.
n<**ENTER**>	Go to line *n*.
DELETE [**n**]<**ENTER**>	Delete the current line. If *n* is included, delete *n* lines, starting with the current line.
INSERT<**ENTER**>	Insert a blank line at the current location; current line and all following lines shift down one line.

Each line within the **SET M** entry may contain an equation, operation, or a comment.

Equations define how to move data into the port User region. They have the following syntax, where brackets [ ] indicate optional items, and vertical bar | is used to separate mutually exclusive options:

dest[,*type*][;[*atype*][;*label*]][+|-|*|/]=*source*[,*type*][*scaling*][;*repeat_count*]

or

dest[,*type*] [;[*atype*][;*label*]][+|-|*|/]=*constant*[;*repeat_count*]

or

dest:*bit*[;[*atype*][;*label*]][+|*]=[!]*source_bit*

or

dest:*bit*[;[*atype*][;*label*]][+|*]=*bit_const*

where:

type is the data type for the location: f - float (IEEE single-precision), i - signed integer (16-bit 2’s complement), p-pack character data LSB first (available on left side only), c-pack character data MSB first (available on left-side only), H1L - read low byte as ASCII-hex value (available on right-side only), H1H - read high byte as ASCII-hex value (available on right-side only); *dest* will default to integer; *source* will default to location data type; *constant* will default to float if a decimal point is present, to integer otherwise;

atype is the access type: B to treat as 16 binary items (default if type is P or equation is a bit assignment), I to treat as 16-bit signed integer (default if type is I), L to treat as 32-bit signed integer, F to treat as floating point number (default if type is F), C to treat as 16-bit counter, S to treat as packed ASCII string (default if type is C);

label is an ASCII text label of up to 19 characters; characters must be alphanumeric (a-f, A-F, 0-9) or underscore (_).
[+|-|*|/] specifies (for register operations) mathematical operator, add, subtract, multiply, divide;
source is a source address using any valid register addressing method;
scaling is either */constant* or **constant*; this is simply a mathematical operation;
dest is the destination address as an offset into the user region in decimal or hexadecimal;
repeat_count is how many times to repeat this for subsequent addresses;
constant is a numeric, decimal (integer or floating-point) constant;
bit is a bit number 0-15
+ used (in bit operations) in front of = to form "+=" indicates that the source bit will be ORed into the destination bit.
* used (in bit operations) in front of = to form "*=" indicates that the source bit will be ANDed into the destination bit.
! indicates that the source bit value should be inverted (complemented);
source_bit is a bit from an SEL-2030 database (see ***Section 6: Database*** for more information on bit access methods; and
bit_const is the constant 0 or 1, indicating the state of a bit.

SET M Item Labels

The labels that you enter are limited to alphanumeric characters (a-f, A-F, 0-9) and the underscore character (_). If you enter any other items within a **SET M** label, you will either receive an error message from the SEL-2030 or the equation that you entered will not function as expected. For example, the equation below could be entered with the intention of assigning the label "QA+" to the item in the first User region register.

0;;QA+=2:METER:QA

This equation is actually interpreted as shown below:

0;;QA += 2:METER:IA

(add the value of 2:METER:IA to the first User region register and give this register the label "QA")

Versions R100-R107 of the SEL-2030 allowed the use of several other characters within the item labels. For this reason, it is possible that you may upgrade your SEL-2030 firmware and find that you can no longer enter the types of item labels that you previously used. While your existing SET M settings will not be lost or altered, attempts to read them out of the SEL-2030 and then send them back may fail. In order to correct this problem, the item labels must be changed so that they use only the alphanumeric characters (a-f, A-F, 0-9) and the underscore character (_).

SET M Examples

0 = 1:METER:IA	Store the Port 1 IA value to the first location in the User region; if the value is stored as a floating-point value, it will be converted to integer.
1 = 1:METER:VA/100	Divide the Port 1 VA value by 100 and store it to the second location in the User region; if the value is stored as a floating-

	point value, it will be converted to an integer after the division.
2,f = 2:2800h,f;6	Starting from the Port 2 address 2800h, copy 6 values to the User region, starting at the third register; treat both the source and destination values as floating-point values, so each copy will move two registers.
14 = 123H	Store the value 123h (291) in the 15th register of the User region.
15,C = 1:GLOBAL:0;40	Copy FID string into a packed character format.
55;C;DEAD_COUNTER=5	Store a 5 in the 56th register of the User region and treat it as a counter with the label “DEAD_COUNTER.”
60:0 = X	Store the value of Global Element X to bit 0 of the 61st register in the User region.
60:0;;GLOBALS += Y	Perform a Logical OR of Global bit Y with the current value of bit 0 in the 61st User region register. Store the result to bit 0 in the 61st User region register and give that register the label “GLOBALS.”
122:14 = 1	Set bit 14 of the 123rd register in the User region to 1.
97:4;I;TAR_WRD = !3:52A	Store the inverted value of the Port 3 relay 52A element to bit 4 of the 98th User region register and treat it as a 16-bit signed integer with the label “TAR_WRD”.
1 += 1:METER:VB	Add the Port 1 VB value to the value in the second register of the User region and store the result in the second register of the User region.

ASCII Hexadecimal Data Conversion Example

Assume that region D1 on port 1 contains the string “A5F0” in registers 4 and 5. A **VIEW** command displays the following:

VIEW 1:D1:4 NR 2

4135h   4630h

The objective is to convert to the integer value A5F0 (42,480). Use the SET M functions described above to convert as illustrated below:

```
0 = 1:D1:5,H1L           # convert and store first half of low byte
0 += 1:D1:5,H1H*16   # convert, shift, and add second half of low byte
0 += 1:D1:4,H1L*256  #convert, shift, add low 4 bits of upper byte
0 += 1:D1:4,H1H*4096  #convert, shift, and add upper 4 bits
```

If the data were parsed using Character String parsing (parse type 3), the **VIEW** command display appears as follows:

VIEW 1:D1:4 NR 4

0041h   0035h   0046h   0030h

The objective is to convert to the integer value A5F0 (42,480). Use the SET M functions to convert as illustrated below:

```
0 = 1:D1:7,H1L         # convert and store first half of low byte
0 += 1:D1:6,H1L*16   # convert, shift, and add second half of low byte
0 += 1:D1:5,H1L*256  #convert, shift, add low 4 bits of upper byte
0 += 1:D1:4,H1L*4096  #convert, shift, and add upper 4 bits
```

SET M Data Type Considerations

You may need to give special consideration to data types within your equations. When working with analog quantities, the meaning of integer and floating-point quantities is straightforward. However, when accessing other types of data (e.g., status, strings, targets) you will want to be more careful. These types of items are stored as character or integer data. Generally, you will simply want to copy them using default data types with no scaling. This will result in no change in their representation.

When multiple equations are used to manipulate the same register, the access type and label from the last reference to that register will be used to define its final access type and label.

Another thing to consider is reasonable limits to the repeat count. Generally, you should only copy one type of data with a single equation. This is because the SEL-2030 will do its type determinations based on the first item only. Thus, if your repeat count tries to copy data of multiple types, the data of types that differ from the initial type will be misinterpreted.

Two types of operations are allowed:

FREEZE *n*
RELEASE *n*

where *n* is a region reference (port number:region label) in the SEL-2030. The FREEZE operation prevents the specified database area from changing until the corresponding RELEASE operation has been performed. Use these operations to maintain data coherency while moving multiple data items from a specific port database. If you do not use these, it is possible that data may be updated in the midst of copying a block of data. For every FREEZE operation, a corresponding RELEASE operation is required. Only one port database may be frozen at a time.

You may also add comments. Comments start with a '#' character and continue to the end of the line. Comments may exist as stand-alone lines or following equations or operations.

On any type of entry, comment, equation, or operation you may continue the entry to a second line by placing a backslash (\) as the last character on the line. Whether you make an entry all on one line, or use multiple lines, the total length of the entry may not exceed 80 characters.

When you exit settings, you will be prompted for settings acceptance, just like in all other settings classes. If the User region allocation (USER settings in SET A) is insufficient for the given SET M settings, the SEL-2030 will automatically increase it as necessary. If there is insufficient memory for the increased User region, you will be warned and the **STATUS** command will show the SET M status on the port to be disabled.

Once these settings have been accepted, the SEL-2030 will process them every half second, on the half second.

SET G - GLOBAL SETTINGS

Use the **SET G** command to:

- Create a device identification string.
- Select a time synchronization source.
- Select between modulated and demodulated IRIG-B input.
- Define intermediate logic using SELOGIC Control Equations.
- Define SELOGIC Control Equations that control optional I/O board output contacts.

Table 3.18: SET G Global Setting Prompts

DEVICE ID		
TIME_SRC		
IRIG	**DNP**	
IRIG_SIG		
PCFAIL		
LOG_EN (Y/N)		
N(O)	**Y**(ES)	
	V	
	W	
	X	
	Y	
	Z	
	VPICKUP	
	VDROPOUT	
	WPICKUP	
	WDROPOUT	
	XPICKUP	
	XDROPOOUT	
	YPICKUP	
	YDROPOUT	
	ZPICKUP	
	ZDROPOUT	
ALARM		
OUT1		Only with optional I/O Board
OUT2		
OUT3		
OUT4		
Save changes (Y/N)		
Y(ES)	**N**(O) Settings Aborted	

Global settings include primarily the intermediate logic and optional output contact logic available in the SEL-2030. Table 3.19 lists all Global settings and their description strings. You should use **SET G** to modify and **SHO G** to view these settings.

Each of the five intermediate logic variables (V, W, X, Y, and Z) described in Table 3.19 has corresponding generic pickup/dropout timers. For the output of a timer to be asserted, its input must first be asserted for the pickup time. Once a timer is asserted, for its output to be deasserted, its input must be deasserted for the dropout time. If an I/O board is installed, you may define conditions that assert outputs on the board.

You define the logic elements using SELOGIC Control Equations and set their timers using the **SET G** command. For a complete discussion of these equations, see ***Section 4: SELOGIC® Control Equations.***

Table 3.19 includes a complete description of the **SET G** settings.

Table 3.19: SET G Global Settings and Definitions

Setting	Comment
ID	**Prompt**. Device Identification. **Description**. Any string of up to 40 characters that you wish to use to identify this device.
TIME_SRC	**Prompt**. SEL-2030 Time Synchronization source (IRIG, DNP, OFF). **Description**. Select the source used by the SEL-2030 to time-synchronize itself.
IRIG_SIG	**Prompt.** Type of IRIG Source (Modulated/Demodulated) **Description.** Use this setting to select the type of IRIG-B input you are expecting. If you are using the port 15 IRIG-B input, this setting must be demodulated. If you are not using any IRIG-B input, we recommend that you set it to demodulated.
PCFAIL	**Prompt.** PCFAIL=. **Description.** Enter a SELOGIC Control Equation to control the PCFAIL global status element. The default equation will cause the PCFAIL bit to assert if a card is present, but not alive and initialized.
LOG_EN	**Prompt**. Enable use of intermediate logic (Y/N). **Description**. There are five intermediate logic variables, three of which have associated timers. You set this setting to Y (Yes) to enable their use, or set it to N (No) if you do not plan to use them.
V	**Prompt**. V=. **Description**. You enter a SELOGIC Control Equation definition for the intermediate logic element V.
W	**Prompt**. W=. **Description**. You enter a SELOGIC Control Equation definition for the intermediate logic element W.
X	**Prompt**. X=. **Description**. You enter a SELOGIC Control Equation definition for the intermediate logic element X.
Y	**Prompt**. Y=. **Description**. You enter a SELOGIC Control Equation definition for the intermediate logic element Y.

Setting	Comment
Z	**Prompt**. Z=. **Description**. You enter a SELOGIC Control Equation definition for the intermediate logic element Z.
VPICKUP	**Prompt**. V Timer Pickup time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
VDROPOUT	**Prompt**. V Timer Dropout time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
WPICKUP	**Prompt**. W Timer Pickup time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
WDROPOUT	**Prompt**. W Timer Dropout time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
XPICKUP	**Prompt**. X Timer Pickup time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
XDROPOUT	**Prompt**. X Timer Dropout time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
YPICKUP	**Prompt**. Y Timer Pickup time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
YDROPOUT	**Prompt**. Y Timer Dropout time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
ZPICKUP	**Prompt**. Z Timer Pickup time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
ZDROPOUT	**Prompt**. Z Timer Dropout time (seconds). **Description**. The range is 0.0-86,400.0 seconds in 0.1-second increments.
ALARM	**Prompt.** ALARM=. **Description.** Enter a SELOGIC Control Equation to control the alarm contact. Independent of this equation, the alarm contact will assert (close) for self-test failures. Use this setting to control under what other conditions you want the alarm contact to close. The default setting will cause the alarm contact to pulse and access level change to Level 2, on successive password failures, and on settings changes.
OUT1	**Prompt**. Output contact 1 assignment. **Description**. You enter a SELOGIC Control Equation definition for contact OUT1. This setting is available only if the optional I/O board is installed.
OUT2	**Prompt**. Output contact 2 assignment. **Description**. You enter a SELOGIC Control Equation definition for contact OUT2. This setting is available only if the optional I/O board is installed.
OUT3	**Prompt**. Output contact 3 assignment. **Description**. You enter a SELOGIC Control Equation definition for contact OUT3. This setting is available only if the optional I/O board is installed.

Setting	Comment
OUT4	**Prompt**. Output contact 4 assignment. **Description**. You enter a SELOGIC Control Equation definition for contact OUT4. This setting is available only if the optional I/O board is installed.

SET R - SER SETTINGS

Use the **SET R** command to:

- Define which bits are monitored for Sequential Events Recorder (SER) data.

This settings class has no labels or prompts. You enter the names of those SEL-2030 elements that you wish to monitor for SER tracking. The only elements that are allowed are the Digital Input elements IN1-IN16. You may monitor one or all of these elements. Because the Digital Inputs are available only with the optional IO Board installed, the **SET R** command has no effect when the IO Board is not installed.

The various editing keys and commands are listed in Table 3.17. You may enter only a single element name on each line. To complete the settings process you may either type END followed by <ENTER> or simply hit <ENTER> at a blank line.

In order to use the SER data that is generated as a result of these settings, you must enable the SEL-2030 to transmit the data via a binary protocol. See ***Sequential Events Recorder (SER) Data***.

Sequential Events Recorder (SER) Data

The SEL-2030 is capable of collecting Sequential Events Recorder (SER) data from SEL relays, generating SER data based on its 16 Digital Inputs, and automatically forwarding all SER data to another SEL-2030 or other programmable data gathering device. All SER data is collected and transmitted using the SEL *Fast Message* protocol. This protocol is described in ***Section 7: Protocols***. The SEL-2030 currently does not support any SER commands, so there is no way to "view" any of the SER information without capturing and then translating the *Fast Message* SER data.

If you have a Master device that is capable of capturing and translating the data, you must follow these steps to perform SER data collection:

1) Use **SET P n** to auto-configure all relay ports. Not all SEL relays support the *Fast Message* protocol that is used to collect the SER data. After auto-configuration, use the **AUTO n** command to determine the capability of the connected relay. If the relay supports the *Fast Message* protocol, you should see the line "SER Support: Binary Unsolicited" in the **AUTO** command response. If this line is not present, then the REC_SER setting will have no affect and the SEL-2030 cannot perform automatic SER collection from the relay. You may wish to connect one or more relay Digital Outputs to the Digital Inputs of the SEL-2030 and monitor the SEL-2030 Input elements as SER data.

2) Use **SET A n** to set REC_SER=Y on all ports (n) from which you wish to gather SER data. This setting causes the SEL-2030 to enable automatic SER data transmission within the connected relay. The relay will now send all SER data to the SEL-2030 as the data is generated.

3) Use the **SET R** command to define SEL-2030 SER elements. If all the data of interest is within the relays, you may not wish to define any SEL-2030 SER elements. Alternately, if you have relays that do not support automatic SER collection, you may need to monitor the SEL-2030 Digital Inputs in order to get SER data that represents the data within those relays.

4) Connect your intelligent Master to a rear-panel Master port on the SEL-2030. Your Master must send a binary "Enable SER" message to the SEL-2030 to enable the SEL-2030 port to transmit the SER data. The SEL-2030 will then transmit the SER data in an unsolicited fashion as the data is received and/or generated. Your Master must send an "SER Acknowledge" message to the SEL-2030 to indicate successful receipt of the data. Only then will the SEL-2030 proceed to the next block of data. Until it receives the Acknowledge message, the SEL-2030 will retransmit the same data repeatedly every 500 milliseconds. Your Master may disable the SER data transmission at any time by sending the binary "Disable SER" message.

SET C - Calibration Command

Use the **SET C** command to:

- Recalibrate the SEL-2030 internal clock frequency.
- Change the settings to VALID after replacing ROMs.

The SEL-2030 clock frequency is calibrated at the factory and normally needs no calibration. If you must install new ROMs, check and note the clock frequency before you remove the old ROM chips, and again after you install the new chips using the **SHO C** command. The example following Table 3.20 illustrates how you change the SEL-2030 clock frequency in the unlikely event that it is necessary. This example also illustrates how to change the settings to VALID, which is the common step required after replacing ROMs.

Table 3.20: Calibration Settings

Setting	Comment
OSCFREQ	**Prompt**. Oscillator Frequency (kHz). **Description**. Enter the measured or recorded oscillator frequency. Used to correct the real-time clock for the difference between actual and ideal oscillator frequency. (See the example below.)
CVALID	**Prompt**. Calibration Settings Valid (Y/N). **Description**. Set to Y (Yes) to validate the settings. This will clear a SET failure as reported by the **STATUS** command. You are prompted for this setting only if it is currently set to N (No).

Type **SHO C<ENTER>** and record the OSCFREQ setting so it can be reentered after the ROMs are changed. The OSCFREQ setting used in the following example is used only to show the setting process.

After changing ROMs, use the **SET C** command to enter the recorded frequency and set the settings to VALID as shown in the example below:

```
*>>SET C<ENTER>

Calibration settings

Oscillator Frequency (kHz)                OSCFREQ =16777.217  ?16780.110<ENTER>

Calibration Settings Valid (Y/N)          CVALID  = N     ?Y<ENTER>

OSCFREQ = 16780.110

Save changes (Y/N) ?Y<ENTER>

*>>
```

SET O - LOGIC SETTINGS

Use the **SET O** command to establish the SELOGIC Control Equations that control the CCOUT bits. There are a total of 64 bits for each of Ports 17 and 18 that can be directly controlled by these equations. The card installed in the slot must support the CCOUT bits to access these settings. These elements act as inputs to each card installed in a card slot. The operation of these settings is more fully described in ***Section 4: SELOGIC® Control Equations***.

Table 3.21 fully describes these settings.

Table 3.21: SET O Logic Settings and Definitions

Setting	Comment
CCOUT1-CCOUT64	**Prompt**. CCOUT*n*=. **Description**. You enter a SELOGIC Control Equation definition to control the state of the element bit.

WORKSHEET SET G

Date _____________
Approved by _____________
SEL-2030 S/N _____________

Device Identification = ________________________________

SEL-2030 Time Synchronization Source (IRIG, DNP, OFF) = ____________________

Type of IRIG Source (Modulated/Demodulated) = ____________________

PCFAIL = ________________________________

Enable use of intermediate logic (Y/N) = ____________________

V = ________________________________

W = ________________________________

X = ________________________________

Y = ________________________________

Z = ________________________________

V Timer Pickup time (seconds) = ____________________

V Timer Dropout time (seconds) = ____________________

W Timer Pickup time (seconds) = ____________________

W Timer Dropout time (seconds) = ____________________

X Timer Pickup time (seconds) = ____________________

X Timer Dropout time (seconds) = ____________________

Y Timer Pickup time (seconds) = ____________________

Y Timer Dropout time (seconds) = ____________________

Z Timer Pickup time (seconds) = ____________________

Z Timer Dropout time (seconds) = ____________________

ALARM = ____________________

OUT1 = ____________________

OUT2 = ____________________

OUT3 = ____________________

OUT4 = ____________________

SETTINGS SHEET - SEL IED - SET P and SET A

Date _______________
Approved by _______________
SEL-2030 S/N _______________

Port ( )

SET P

DEVICE	(U=Unused, S=SEL IED, O=Other IED, P=Printer, M=Master)	S
CONFIG	Auto-configure port (Y/N)	________
PORTID*	Port Identification String	________
BAUD*	(300; 600; 1,200; 2,400; 4,800; 9,600; 19,200)	________
DATABIT	Number data bits (7, 8)	________
STOPBIT	Stop bits (1, 2)	________
PARITY	(N, O, E, 1, 0)	________
RTS_CTS	Enable RTS_CTS handshaking (Y/N)	________
TIMEOUT	Port timeout (0.0-30.0 minutes)	________

SET A

AUTOBUF	Save Unsolicited Messages (Y/N)	________
STARTUP*	Port Startup String	________
NOCONN	Block external connections to this port	________
SEND_OPER	Send operate command automatically (Y/N/YP)	________
REC_SER	Enable automatic SER collection when applicable (Y/N)	________
MSG_CNT	How many auto-message sequences (0-12)	________

ISSUE1-12	Items 1-12 triggers D1-D12	See Worksheet SET A
MESG1-12	Items 1-12 messages	See Worksheet SET A
PARSE1-8	Items 1-8 response parsing methods	See Worksheet SET A
NUM1-8	Items 1-8 number of data items	See Worksheet SET A
DELAY1-12	Items 1-12 time delay to allow response to complete (OFF,ON)	See Worksheet SET A
CHECK1-8	Items 1-8 message validation	See Worksheet SET A
ORDER1-8	Items 1-8 validation byte order	See Worksheet SET A
START1-8	Items 1-8 validation start	See Worksheet SET A
STOP1-8	Items 1-8 validation stop	See Worksheet SET A
CHKPOS1-8	Items 1-8 validation position	See Worksheet SET A
ACK1-8	Items 1-8 acknowledge string	See Worksheet SET A
NACK1-8	Items 1-8 negative acknowledge string	See Worksheet SET A

Archive Settings

ARCH_EN	Enable use of archive data items (Y/N)	________
ISSUE1A-3A	Archive 1-3 triggers A1-A3	See Worksheet SET A
MESG1A-3A	Archive 1-3 messages	See Worksheet SET A
PARSE1A-3A	Archive 1-3 response parsing methods	See Worksheet SET A
NUM1A-3A	Archive 1-3 number of data items	See Worksheet SET A
DELAY1A-3A	Archive 1-3 time delay to allow response to complete (OFF,ON)	See Worksheet SET A
CHECK1A-3A	Archive 1-3 message validation	See Worksheet SET A
ORDER1A-3A	Archive 1-3 validation byte order	See Worksheet SET A
START1A-3A	Archive 1-3 validation start	See Worksheet SET A
STOP1A-3A	Archive 1-3 validation stop	See Worksheet SET A
CHKPOS1A-3A	Archive 1-3 validation position	See Worksheet SET A

ACK1A-3A	Archive 1-3 acknowledge string	See Worksheet SET A
NACK1A-3A	Archive 1-3 negative acknowledge string	See Worksheet SET A
USER	Size of user-defined data space in registers	____________________

SET U See Worksheet SET U

* Set automatically if auto-configuration is performed.

SETTINGS SHEET - OTHER IED - SET P and SET A

Date _______________
Approved by _______________
SEL-2030 S/N _______________

Port ( )

SET P

DEVICE	U=Unused, S=SEL IED, O=Other IED, P=Printer, M=Master)	O
MODEM	Modem control (Y/N)	___________
MSTR	Startup string (only if MODEM is Y)	___________
CD_CTS	Modem CD connected to CTS input (Y/N) (only if MODEM is Y)	___________
DCD_FLOW**	Use DCD control line for flow control (Y/N)	___________
AUTO_BAUD	(Y/N)	___________
PROTOCOL	(A=ASCII, B=BINARY)	___________
PORTID	Port Identification String	___________
BAUD*	(300; 600; 1,200; 2,400; 4,800; 9,600; 19,200)	___________
DATABIT	Number data bits (7, 8)	___________
STOPBIT	Stop bits (1, 2)	___________
PARITY	(N, O, E, 1, 0)	___________
RTS_CTS	Enable RTS_CTS handshaking (Y/N)	___________
XON_XOFF	Enable XON_XOFF flow control (Y/N)	___________
TIMEOUT	Port timeout (0.0-30.0 minutes)	___________

SET A

AUTOBUF	Save Unsolicited Messages (Y/N)	___________
STARTUP	Port Startup String	___________
NOCONN	Block external connections to this port	___________
MSG_CNT	How many auto-message sequences (0-12)	___________
ISSUE1-12	Items 1-12 triggers D1-D12	See Worksheet SET A
MESG1-12	Items 1-12 message	See Worksheet SET A
PARSE1-8	Items 1-8 response parsing methods	See Worksheet SET A
NUM1-8	Items 1-8 number of data items	See Worksheet SET A
DELAY1-12	Items 1-12 time delay to allow response to complete (OFF,ON)	See Worksheet SET A
CHECK1-8	Items 1-8 message validation	See Worksheet SET A
ORDER1-8	Items 1-8 validation byte order	See Worksheet SET A
START1-8	Items 1-8 validation start	See Worksheet SET A
STOP1-8	Items 1-8 validation stop	See Worksheet SET A
CHKPOS1-8	Items 1-8 validation position	See Worksheet SET A
ACK1-8	Items 1-8 acknowledge string	See Worksheet SET A
NACK1-8	Items 1-8 negative acknowledge string	See Worksheet SET A
ARCH_EN	Enable use of archive data items (Y/N)	___________
ISSUE1A-3A	Archive 1-3 trigger A1-A3	See Worksheet SET A
MESG1A-3A	Archive 1-3 messages	See Worksheet SET A
PARSE1A-3A	Archive 1-3 response parsing methods	See Worksheet SET A
NUM1A-3A	Archive 1-3 number of data items	See Worksheet SET A
DELAY1A-3A	Archive 1-3 time delay to allow response to complete (OFF,ON)	See Worksheet SET A
CHECK1A-3A	Archive 1-3 message validation	See Worksheet SET A
ORDER1A-3A	Archive 1-3 validation byte order	See Worksheet SET A

START1A-3A	Archive 1-3 validation start	See Worksheet SET A
STOP1A-3A	Archive 1-3 validation stop	See Worksheet SET A
CHKPOS1A-3A	Archive 1-3 validation position	See Worksheet SET A
ACK1A-3A	Archive 1-3 acknowledge string	See Worksheet SET A
NACK1A-3A	Archive 1-3 negative acknowledge string	See Worksheet SET A
USER	Size of user-defined data space in registers	____________________

SET U See Worksheet SET U

* Set automatically if auto-baud is performed.
** Only available if MODEM=Y and CD_CTS=N.

SETTINGS SHEET - MASTER PORT (SEL or LMD protocol) - SET P and SET A

Date ______________
Approved by ______________
SEL-2030 S/N ______________

Port ( )

SET P

DEVICE	(U=Unused, S=SEL IED, O=Other IED, P=Printer, M=Master)	M
PROTOCOL**	(S=SEL, L=LMD, M=Modbus, D=DNP)	______________
ADDRESS*	First LMD port address (1-8)	______________
PREFIX*	LMD address prefix character (@, #, $, %, &)	______________
SETTLE*	LMD port settle time (0-30 seconds)	______________
FAST_OP***	Enable *Fast Operate* commands (Y/N)	______________
PORTID	Port Identification String	______________
MODEM	Modem control (Automatically Y if modem installed, automatically N if LMD protocol is selected) (Y/N)	______________
MSTR	Startup string (only if MODEM is Y)	______________
CD_CTS	Modem CD connected to CTS input (Y/N) (only if MODEM is Y)	______________
DCD_FLOW****	Use DCD control line for flow control (Y/N)	______________
BAUD**	(300; 600; 1,200; 2,400; 4,800; 9,600; 19,200; 38,400)	______________
DATABIT**	Number data bits (7, 8)	______________
STOPBIT**	Stop bits (1, 2)	______________
PARITY**	(N, O, E, 1, 0)	______________
RTS_CTS	Enable RTS_CTS handshaking (Y/N)	______________
XON_XOFF	Enable XON_XOFF flow control (Y/N)	______________
TIMEOUT	Port timeout (0.0-30.0 minutes)	______________
ECHO**	Echo received characters (Y/N)	______________
AUTOHELP	Automatic help messages enabled (Y/N)	______________
TERTIME1	First delay time (0-600 seconds)	______________
TERSTRING1	Termination string	______________
TERTIME2	Second delay time (0-600 seconds)	______________

SET A

NOCONN	Block external connections to this port	______________
MSG_CNT	How many auto-message sequences (0-12)	______________
ISSUE1-12	Items 1-12 triggers D1-D12	See Worksheet SET A
MESG1-12	Items 1-12 messages	See Worksheet SET A
USER	Size of user-defined data space in registers	______________

SET U See Worksheet SET U

* Applies if PROTOCOL set to LMD.
** Port F is limited to baud rates from 300-9,600, 8 data bits (including parity), 1 stop bit, SEL protocol, echo enabled, and parity options N, 0, and E.
*** Applies if Protocol set to SEL.
**** Only available if MODEM=Y and CD_CTS=N.

SETTINGS SHEET - MASTER Modbus® PORT - SET P and SET A

Date ______________
Approved by ______________
SEL-2030 S/N ______________

Port ( )

SET P

DEVICE	(U=Unused, S=SEL IED, O=Other IED, P=Printer, M=Master)	M
PROTOCOL	(S=SEL, L=LMD, M=Modbus, D=DNP)	M
MAP_TYPE	(F=Float, I=Integer)	
START_ID	Starting Code for ID list (0-255)	
SETTLE1	Transmission delay from RTS assertion, ms	
SETTLE2	Post-transmit RTS deassertion delay, ms	
ADDRESS1	Address of Port 1 (1-247)	
ADDRESS2	Address of Port 2 (1-247)	
ADDRESS3	Address of Port 3 (1-247)	
ADDRESS4	Address of Port 4 (1-247)	
ADDRESS5	Address of Port 5 (1-247)	
ADDRESS6	Address of Port 6 (1-247)	
ADDRESS7	Address of Port 7 (1-247)	
ADDRESS8	Address of Port 8 (1-247)	
ADDRESS9	Address of Port 9 (1-247)	
ADDRESS10	Address of Port 10 (1-247)	
ADDRESS11	Address of Port 11 (1-247)	
ADDRESS12	Address of Port 12 (1-247)	
ADDRESS13	Address of Port 13 (1-247)	
ADDRESS14	Address of Port 14 (1-247)	
ADDRESS15	Address of Port 15 (1-247)	
ADDRESS16	Address of Port 16 (1-247)	
PORT ID	Port Identification String	
BAUD	(300; 600; 1,200; 2,400; 4,800; 9,600; 19,200; 38,400)	
PARITY	(N,O,E)	

SET A

MSG_CNT	How many auto-message sequences (0-1)	
ISSUE1	Item 1 trigger D1	
MESG1	Item 1 message	20USER
ARCH_EN	Enable use of archive data items (Y/N)	
ISSUE1A	Item 1A trigger ARCH1	
MESG1A	Item 1A message	20USER
USER	Size of user-defined data space in registers	

SET U

Not available.

SETTINGS SHEET - MASTER DNP PORT - SET P and SET A

Date ______________
Approved by ______________
SEL-2030 S/N ______________

Port ( )

SET P

DEVICE	(U=Unused, S=SEL IED, O=Other IED, P=Printer, M=Master)	M
PROTOCOL	(S=SEL, L=LMD, M=Modbus, D=DNP)	D
ADDRESS	DNP Address (0-65534 or 0000h-FFFEh)	
CLASS	Class for event data (0 for no event, 1-3)	
16BIT	Use 16 or 32-bit default variations for analog inputs	
SO_TIMEOUT	Select/Operate time-out interval, seconds (0.0-30.0)	
DL_CONFIRM	Number of data-link retries (0 for no confirm, 1-15)	
DL_TIMEOUT	Data Link Time-out interval, seconds (0.0-30.0)	
MIN_DELAY	Minimum Delay from DCD to transmission, ms	
MAX_DELAY	Maximum Delay from DCD to transmission, ms	
SETTLE1	Transmission delay from RTS assertion, ms	
SETTLE2	Post-transmit RTS deassertion delay, ms	
REPORT_ON	Percent of Full-Scale Change to Report on (0-100%)	
UNSOL_REP	Allow Unsolicited Reporting (Y/N)	
UNSOL_POW	Enable unsolicited messages on power-up (Y/N)	
REP_ADDR	Address of master to Report to (0-65534 or 0000h-FFFEh)	
NUM_EVENT	Number of events to transmit on (1-200)	
AGE_TX	Age of oldest event to force transmit on, sec (1.0-60.0)	
CONFIRM_TO	Time-out for confirmation of unsolicited message, ms	
PORT ID	Port Identification String	
BAUD	(300; 600; 1,200; 2,400; 4,800; 9,600; 19,200; 38,400)	
PARITY	(N,O,E)	

SET A

MSG_CNT	How many auto-message sequences (0-1)	
ISSUE1	Item 1 trigger, D1	
MESG1	Item 1 message	20USER
ARCH_EN	Enable use of archive data items (Y/N)	
ISSUE1A	Item 1A trigger, ARCH1	
MESG1A	Item 1A message	20USER
USER	Size of user-defined data space	

SET U

Not available.

SETTINGS SHEET - PRINTER - SET P and SET A

Date _______________
Approved by _______________
SEL-2030 S/N _______________

Port ( )

SET P

DEVICE	(U=Unused, S=SEL IED, O=Other IED, P=Printer, M=Master)	P
PORTID	Port Identification String	____________________
BAUD	(300; 600; 1,200; 2,400; 4,800; 9,600; 19,200)	____________________
DATABIT	Number data bits (7, 8)	____________________
STOPBIT	Stop bits (1, 2)	____________________
PARITY	(N, O, E, 1, 0)	____________________
RTS_CTS	Enable RTS_CTS handshaking (Y/N)	____________________
XON_XOFF	Enable XON_XOFF flow control (Y/N)	____________________
TIMEOUT	Port timeout (0.0-30.0 minutes)	____________________

SET A

STARTUP	Port Startup String	____________________
MSG_CNT	How many auto-message sequences (0-12)	____________________
PRINT_ALL	Print all buffered unsolicited messages (Y/N)	____________________
CLEAR_BUF	Clear unsolicited message buffer after print (Y/N)	____________________
ISSUE2-12	Items 2-12 trigger D2-D12	See Worksheet SET A
MESG2-12	Items 2-12 messages	See Worksheet SET A
USER	Size of user-defined data space in registers	____________________

SET U

Not available.

SETTINGS SHEET - SEL-2701- SET P and SET A

Date _______________
Approved by _______________
SEL-2030 S/N _______________

Port (17 / 18)

SET P

SENDTIME	Send Date/Time synchronization to Protocol Card (Y/N)	____________________
XON_XOFF	Enable XON/XOFF flow control (Y/N	____________________
TIMEOUT	Port Timeout in minutes (0.0-120.0)	____________________
TERTIME1	First delay time (0-600 seconds)	____________________
TERSTRING	Termination string	____________________
TERTIME2	Second delay time (0-600 seconds)	____________________
IPADDR	IP address (www[h].xxx[h].yyy[h].zzz[h])	____________________
SUBNETM	Subnet mask (www[h].xxx[h].yyy[h].zzz[h])	____________________
DEFRTR	Default router (www[h].xxx[h].yyy[h].zzz[h])	____________________
NETPORT	Primary network port (A=Port A, B=Port B, D=Disabled)	____________________
FAILOVR	Enable fail over mode (Y/N)	____________________
FTIME	Network port fail over time (0-65535 msec)	____________________
NETASPD	Network speed, Port A (A=Auto, 10=Mbs, 100=100Mbs)	____________________
NETBSPD	Network speed, Port B (A=Auto, 10=Mbs, 100=100Mbs)	____________________
FTPSERV	Enable FTP server (Y/N)	____________________
FTPCBAN	FTP connect banner	____________________
FTPIDLE	FTP idle time-out (5-255 minutes)	____________________
FTPANMS	Enable anonymous FTP login (Y/N)	____________________
FTPAUSR	Associate anonymous user access rights with user	____________________
T1CBAN	Telnet connect banner for host	____________________
T1INIT	Allow Telnet sessions to be initiated by the host (Y/N)	____________________
T1RECV	Allow Telnet sessions to be received by the host (Y/N)	____________________
T1PNUM	Telnet port number for host (port_num = 23 or >= 1024)	____________________
T2CBAN	Telnet connect banner for card	____________________
T2RECV	Allow Telnet sessions to be received by the card (Y/N)	____________________
T2PNUM	Telnet port number for card (port_num >= 1024)	____________________
TIDLE	Telnet idle time-out (0-255 minutes)	____________________
HOST1	Alias for host #1	____________________
IPADR1	IP address for host #1 (www[h].xxx[h].yyy[h].zzz[h])	____________________
HOST2	Alias for host #2	____________________
IPADR2	IP address for host #2 (www[h].xxx[h].yyy[h].zzz[h])	____________________
HOST3	Alias for host #3	____________________
IPADR3	IP address for host #3 (www[h].xxx[h].yyy[h].zzz[h])	____________________
HOST4	Alias for host #4	____________________
IPADR4	IP address for host #4 (www[h].xxx[h].yyy[h].zzz[h])	____________________
HOST5	Alias for host #5	____________________
IPADR5	IP address for host #5 (www[h].xxx[h].yyy[h].zzz[h])	____________________
HOST6	Alias for host #6	____________________
IPADR6	IP address for host #6 (www[h].xxx[h].yyy[h].zzz[h])	____________________
HOST7	Alias for host #7	____________________
IPADR7	IP address for host #7 (www[h].xxx[h].yyy[h].zzz[h])	____________________
HOST8	Alias for host #8	____________________
IPADR8	IP address for host #8 (www[h].xxx[h].yyy[h].zzz[h])	____________________
HOST9	Alias for host #9	____________________

IPADR9	IP address for host #9 (www[h].xxx[h].yyy[h].zzz[h])	
HOST10	Alias for host #10	
IPADR10	IP address for host #10 (www[h].xxx[h].yyy[h].zzz[h])	
HOST11	Alias for host #11	
IPADR11	IP address for host #11 (www[h].xxx[h].yyy[h].zzz[h])	
HOST12	Alias for host #12	
IPADR12	IP address for host #12 (www[h].xxx[h].yyy[h].zzz[h])	
HOST13	Alias for host #13	
IPADR13	IP address for host #13 (www[h].xxx[h].yyy[h].zzz[h])	
HOST14	Alias for host #14	
IPADR14	IP address for host #14 (www[h].xxx[h].yyy[h].zzz[h])	
HOST15	Alias for host #15	
IPADR15	IP address for host #15 (www[h].xxx[h].yyy[h].zzz[h])	
HOST16	Alias for host #16	
IPADR16	IP address for host #16 (www[h].xxx[h].yyy[h].zzz[h])	
HOST17	Alias for host #17	
IPADR17	IP address for host #17 (www[h].xxx[h].yyy[h].zzz[h])	
HOST18	Alias for host #18	
IPADR18	IP address for host #18 (www[h].xxx[h].yyy[h].zzz[h])	
HOST19	Alias for host #19	
IPADR19	IP address for host #19 (www[h].xxx[h].yyy[h].zzz[h])	
HOST20	Alias for host #20	
IPADR20	IP address for host #20 (www[h].xxx[h].yyy[h].zzz[h])	
ENUCA	Enable UCA protocol (Y/N)	
NSAP	Network Service Access Point (xxxx.yyyy.zzzz)	
ENTXGOS	Enable transmission of the GOOSE (Y/N)	
TRMULGR	GOOSE sending multicast group address (uu-vv-ww-xx-yy-zz)	
GOSIED	GOOSE sending IED name	
GOSRPTC	GOOSE sending repeat timing coefficient (1.0<=coeff<2.0)	
GOSIED1	GOOSE sending IED for monitor1	
GOSIED2	GOOSE sending IED for monitor2	
GOSIED3	GOOSE sending IED for monitor3	
GOSIED4	GOOSE sending IED for monitor4	
GOSIED5	GOOSE sending IED for monitor5	
GOSIED6	GOOSE sending IED for monitor6	
GOSIED7	GOOSE sending IED for monitor7	
GOSIED8	GOOSE sending IED for monitor8	
CTRLB1	Control bit 1 assignment (msg=1-8:bit=0-160)	
CTRLB2	Control bit 2 assignment (msg=1-8:bit=0-160)	
CTRLB3	Control bit 3 assignment (msg=1-8:bit=0-160)	
CTRLB4	Control bit 4 assignment (msg=1-8:bit=0-160)	
CTRLB5	Control bit 5 assignment (msg=1-8:bit=0-160)	
CTRLB6	Control bit 6 assignment (msg=1-8:bit=0-160)	
CTRLB7	Control bit 7 assignment (msg=1-8:bit=0-160)	
CTRLB8	Control bit 8 assignment (msg=1-8:bit=0-160)	
CTRLB9	Control bit 9 assignment (msg=1-8:bit=0-160)	
CTRLB10	Control bit 10 assignment (msg=1-8:bit=0-160)	
CTRLB11	Control bit 11 assignment (msg=1-8:bit=0-160)	
CTRLB12	Control bit 12 assignment (msg=1-8:bit=0-160)	
CTRLB13	Control bit 13 assignment (msg=1-8:bit=0-160)	
CTRLB14	Control bit 14 assignment (msg=1-8:bit=0-160)	
CTRLB15	Control bit 15 assignment (msg=1-8:bit=0-160)	
CTRLB16	Control bit 16 assignment (msg=1-8:bit=0-160)	
CTRLB17	Control bit 17 assignment (msg=1-8:bit=0-160)	
CTRLB18	Control bit 18 assignment (msg=1-8:bit=0-160)	

CTRLB19	Control bit 19 assignment (msg=1-8:bit=0-160)	____________________
CTRLB20	Control bit 20 assignment (msg=1-8:bit=0-160)	____________________
CTRLB21	Control bit 21 assignment (msg=1-8:bit=0-160)	____________________
CTRLB22	Control bit 22 assignment (msg=1-8:bit=0-160)	____________________
CTRLB23	Control bit 23 assignment (msg=1-8:bit=0-160)	____________________
CTRLB24	Control bit 24 assignment (msg=1-8:bit=0-160)	____________________
CTRLB25	Control bit 25 assignment (msg=1-8:bit=0-160)	____________________
CTRLB26	Control bit 26 assignment (msg=1-8:bit=0-160)	____________________
CTRLB27	Control bit 27 assignment (msg=1-8:bit=0-160)	____________________
CTRLB28	Control bit 28 assignment (msg=1-8:bit=0-160)	____________________
CTRLB29	Control bit 29 assignment (msg=1-8:bit=0-160)	____________________
CTRLB30	Control bit 30 assignment (msg=1-8:bit=0-160)	____________________
CTRLB31	Control bit 31 assignment (msg=1-8:bit=0-160)	____________________
CTRLB32	Control bit 32 assignment (msg=1-8:bit=0-160)	____________________
CTRLB33	Control bit 33 assignment (msg=1-8:bit=0-160)	____________________
CTRLB34	Control bit 34 assignment (msg=1-8:bit=0-160)	____________________
CTRLB35	Control bit 35 assignment (msg=1-8:bit=0-160)	____________________
CTRLB36	Control bit 36 assignment (msg=1-8:bit=0-160)	____________________
CTRLB37	Control bit 37 assignment (msg=1-8:bit=0-160)	____________________
CTRLB38	Control bit 38 assignment (msg=1-8:bit=0-160)	____________________
CTRLB39	Control bit 39 assignment (msg=1-8:bit=0-160)	____________________
CTRLB40	Control bit 40 assignment (msg=1-8:bit=0-160)	____________________
CTRLB41	Control bit 41 assignment (msg=1-8:bit=0-160)	____________________
CTRLB42	Control bit 42 assignment (msg=1-8:bit=0-160)	____________________
CTRLB43	Control bit 43 assignment (msg=1-8:bit=0-160)	____________________
CTRLB44	Control bit 44 assignment (msg=1-8:bit=0-160)	____________________
CTRLB45	Control bit 45 assignment (msg=1-8:bit=0-160)	____________________
CTRLB46	Control bit 46 assignment (msg=1-8:bit=0-160)	____________________
CTRLB47	Control bit 47 assignment (msg=1-8:bit=0-160)	____________________
CTRLB48	Control bit 48 assignment (msg=1-8:bit=0-160)	____________________
CTRLB49	Control bit 49 assignment (msg=1-8:bit=0-160)	____________________
CTRLB50	Control bit 50 assignment (msg=1-8:bit=0-160)	____________________
CTRLB51	Control bit 51 assignment (msg=1-8:bit=0-160)	____________________
CTRLB52	Control bit 52 assignment (msg=1-8:bit=0-160)	____________________
CTRLB53	Control bit 53 assignment (msg=1-8:bit=0-160)	____________________
CTRLB54	Control bit 54 assignment (msg=1-8:bit=0-160)	____________________
CTRLB55	Control bit 55 assignment (msg=1-8:bit=0-160)	____________________
CTRLB56	Control bit 56 assignment (msg=1-8:bit=0-160)	____________________
CTRLB57	Control bit 57 assignment (msg=1-8:bit=0-160)	____________________
CTRLB58	Control bit 58 assignment (msg=1-8:bit=0-160)	____________________
CTRLB59	Control bit 59 assignment (msg=1-8:bit=0-160)	____________________
CTRLB60	Control bit 60 assignment (msg=1-8:bit=0-160)	____________________
CTRLB61	Control bit 61 assignment (msg=1-8:bit=0-160)	____________________
CTRLB62	Control bit 62 assignment (msg=1-8:bit=0-160)	____________________
CTRLB63	Control bit 63 assignment (msg=1-8:bit=0-160)	____________________
CTRLB64	Control bit 64 assignment (msg=1-8:bit=0-160)	____________________

SET A

NOCONN	Block external connections to this port	____________________
USER	Size of user-defined data space in registers	____________________

SET U

Not available.

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SETTINGS SHEET - SEL-2711- SET P

Date _______________
Approved by _______________
SEL-2030 S/N _______________

Port (17 / 18)

SET P

ADDRESS	Modbus Plus node Address (1-64)	________
MAP_IR	Map Input Registers to Holding Registers (Y/N)	________
PATH_1	Control Point 1 routing path (Address range 1-247, 0=OFF)	________
COIL_1	Control Point 1 Modbus coil number	________
PATH_2	Control Point 2 routing path (Address range 1-247, 0=OFF)	________
COIL_2	Control Point 2 Modbus coil number	________
PATH_3	Control Point 3 routing path (Address range 1-247, 0=OFF)	________
COIL_3	Control Point 3 Modbus coil number	________
PATH_4	Control Point 4 routing path (Address range 1-247, 0=OFF)	________
COIL_4	Control Point 4 Modbus coil number	________
PATH_5	Control Point 5 routing path (Address range 1-247, 0=OFF)	________
COIL_5	Control Point 5 Modbus coil number	________
PATH_6	Control Point 6 routing path (Address range 1-247, 0=OFF)	________
COIL_6	Control Point 6 Modbus coil number	________
PATH_7	Control Point 7 routing path (Address range 1-247, 0=OFF)	________
COIL_7	Control Point 7 Modbus coil number	________
PATH_8	Control Point 8 routing path (Address range 1-247, 0=OFF)	________
COIL_8	Control Point 8 Modbus coil number	________
PATH_9	Control Point 9 routing path (Address range 1-247, 0=OFF)	________
COIL_9	Control Point 9 Modbus coil number	________
PATH_10	Control Point 10 routing path (Address range 1-247, 0=OFF)	________
COIL_10	Control Point 10 Modbus coil number	________
PATH_11	Control Point 11 routing path (Address range 1-247, 0=OFF)	________
COIL_11	Control Point 11 Modbus coil number	________
PATH_12	Control Point 12 routing path (Address range 1-247, 0=OFF)	________
COIL_12	Control Point 12 Modbus coil number	________
PATH_13	Control Point 13 routing path (Address range 1-247, 0=OFF)	________
COIL_13	Control Point 13 Modbus coil number	________
PATH_14	Control Point 14 routing path (Address range 1-247, 0=OFF)	________
COIL_14	Control Point 14 Modbus coil number	________
PATH_15	Control Point 15 routing path (Address range 1-247, 0=OFF)	________
COIL_15	Control Point 15 Modbus coil number	________
PATH_16	Control Point 16 routing path (Address range 1-247, 0=OFF)	________
COIL_16	Control Point 16 Modbus coil number	________

SET A

Not available.

SET U

Not available.

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WORKSHEET SET A

Date _______________
Approved by _______________
SEL-2030 S/N _______________

D1

ISSUE1:				
MESG1:				
PARSE1:		NUM1:		DELAY1:
CHECK1:	ORDER1:	START1:	STOP1:	CHKPOS1:
ACK1:		NACK1:		

D2

ISSUE2:				
MESG2:				
PARSE2:		NUM2:		DELAY2:
CHECK2:	ORDER2:	START2:	STOP2:	CHKPOS2:
ACK2:		NACK2:		

D3

ISSUE3:				
MESG3:				
PARSE3:		NUM3:		DELAY3:
CHECK3:	ORDER3:	START3:	STOP3:	CHKPOS3:
ACK3:		NACK3:		

WORKSHEET SET A (continued)

Date _______________
Approved by _______________
SEL-2030 S/N _______________

D4

ISSUE4:				
MESG4:				
PARSE4:		NUM4:		DELAY4:
CHECK4:	ORDER4:	START4:	STOP4:	CHKPOS4:
ACK4:		NACK4:		

D5

ISSUE5:				
MESG5:				
PARSE5:		NUM5:		DELAY5:
CHECK5:	ORDER5:	START5:	STOP5:	CHKPOS5:
ACK5:		NACK5:		

D6

ISSUE6:				
MESG6:				
PARSE6:		NUM6:		DELAY6:
CHECK6:	ORDER6:	START6:	STOP6:	CHKPOS6:
ACK6:		NACK6:		

WORKSHEET SET A (continued)

Date _______________
Approved by _______________
SEL-2030 S/N _______________

D7

ISSUE7:				
MESG7:				
PARSE7:		NUM7:		DELAY7:
CHECK7:	ORDER7:	START7:	STOP7:	CHKPOS7:
ACK7:		NACK7:		

D8

ISSUE8:				
MESG8:				
PARSE8:		NUM8:		DELAY8:
CHECK8:	ORDER8:	START8:	STOP8:	CHKPOS8:
ACK8:		NACK8:		

WORKSHEET SET A (continued)

Date _______________
Approved by _______________
SEL-2030 S/N _______________

D9	ISSUE9:
	MESG9:
	DELAY9:
D10	ISSUE10:
	MESG10:
	DELAY10:
D11	ISSUE11:
	MESG11:
	DELAY11:
D12	ISSUE12:
	MESG12:
	DELAY12:

WORKSHEET SET A (continued)

Date _______________
Approved by _______________
SEL-2030 S/N _______________

A1

ISSUE1A:				
MESG1A:				
PARSE1A:		NUM1A:		DELAY1A:
CHECK1A:	ORDER1A:	START1A:	STOP1A:	CHKPOS1A:
ACK1A:		NACK1A:		

A2

ISSUE2A:				
MESG2A:				
PARSE2A:		NUM2A:		DELAY2A:
CHECK2A:	ORDER2A:	START2A:	STOP2A:	CHKPOS2A:
ACK2A:		NACK2A:		

A3

ISSUE3A:				
MESG3A:				
PARSE3A:		NUM3A:		DELAY3A:
CHECK3A:	ORDER3A:	START3A:	STOP3A:	CHKPOS3A:
ACK3A:		NACK3A:		

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WORKSHEET SET U

Date _______________
Approved by _______________
SEL-2030 S/N _______________

CMD_EN*	Enable SEL-2030 commands (Y/N) ____________
CMD_CH*	Command termination character ____________
CMD_CNT	Number of general-purpose commands (0-8) ____________
CMD1	Command String 1 = ____________
CMD2	Command String 2 = ____________
CMD3	Command String 3 = ____________
CMD4	Command String 4 = ____________
CMD5*	Command String 5 = ____________
CMD6*	Command String 6 = ____________
CMD7*	Command String 7 = ____________
CMD8*	Command String 8 = ____________
STR_EN*	Enable use of special-purpose commands (Y/N) ____________
TRANS*	Initiate transparent mode sequence ____________
TRANSACK*	Transparent mode acknowledge ____________
TRANSNACK*	Transparent mode denial ____________
READ*	Read data ____________
READACK*	Read data normal response ____________
READNACK*	Read data error response ____________
WRITE*	Write data ____________
WRITEACK*	Write data success response ____________
WRITENACK*	Write data error response ____________

*Only available on Master ports

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WORKSHEET SET L

Date ________________
Approved by ________________
SEL-2030 S/N ________________

Port #____

SBR1 = ____

SBR2 = ____

SBR3 = ____

SBR4 = ____

SBR5 = ____

SBR6 = ____

SBR7 = ____

SBR8 = ____

SBR9 = ____

SBR10 = ____

SBR11 = ____

SBR12 = ____

SBR13 = ____

SBR14 = ____

SBR15 = ____

SBR16 = ____

CBR1 = ____

CBR2 = ____

CBR3 = ____

CBR4 = ____

CBR5 = ____

CBR6 = ____

CBR7 = ____________________

CBR8 = ____________________

CBR9 = ____________________

CBR10 = ____________________

CBR11 = ____________________

CBR12 = ____________________

CBR13 = ____________________

CBR14 = ____________________

CBR15 = ____________________

CBR16 = ____________________

SRB1 = ____________________

SRB2 = ____________________

SRB3 = ____________________

SRB4 = ____________________

SRB5 = ____________________

SRB6 = ____________________

SRB7 = ____________________

SRB8 = ____________________

SRB9 = ____________________

SRB10 = ____________________

SRB11 = ____________________

SRB12 = ____________________

SRB13 = ____________________

SRB14 = ____________________

SRB15 = ____________________

SRB16 = ____________________

CRB1 = ____________________

CRB2 = ____________________

CRB3 = ____________________

CRB4 = ____________________

CRB5 = ____________________

CRB6 = ____________________

CRB7 = ____________________

CRB8 = ____________________

CRB9 = ____________________

CRB10 = ____________________

CRB11 = ____________________

CRB12 = ____________________

CRB13 = ____________________

CRB14 = ____________________

CRB15 = ____________________

CRB16 = ____________________

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WORKSHEET SET M

Date _____________
Approved by _____________
SEL-2030 S/N _____________

Data Source			Data Destination				Equation	Comments
Register or Bit Address, or Constant	Type	Scaling	Register or Bit Reference	Type	Access Type	Label		

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WORKSHEET SET O

Date ________________
Approved by ________________
SEL-2030 S/N ________________

Port #____

CCOUT1 = ______________________________

CCOUT2 = ______________________________

CCOUT3 = ______________________________

CCOUT4 = ______________________________

CCOUT5 = ______________________________

CCOUT6 = ______________________________

CCOUT7 = ______________________________

CCOUT8 = ______________________________

CCOUT9 = ______________________________

CCOUT10 = ______________________________

CCOUT11 = ______________________________

CCOUT12 = ______________________________

CCOUT13 = ______________________________

CCOUT14 = ______________________________

CCOUT15 = ______________________________

CCOUT16 = ______________________________

CCOUT17 = ______________________________

CCOUT18 = ______________________________

CCOUT19 = ______________________________

CCOUT20 = ______________________________

CCOUT21 = ______________________________

CCOUT22 = ______________________________

CCOUT23 = ______________________

CCOUT24 = ______________________

CCOUT25 = ______________________

CCOUT26 = ______________________

CCOUT27 = ______________________

CCOUT28 = ______________________

CCOUT29 = ______________________

CCOUT30 = ______________________

CCOUT31 = ______________________

CCOUT32 = ______________________

CCOUT33 = ______________________

CCOUT34 = ______________________

CCOUT35 = ______________________

CCOUT36 = ______________________

CCOUT37 = ______________________

CCOUT38 = ______________________

CCOUT39 = ______________________

CCOUT40 = ______________________

CCOUT41 = ______________________

CCOUT42 = ______________________

CCOUT43 = ______________________

CCOUT44 = ______________________

CCOUT45 = ______________________

CCOUT46 = ______________________

CCOUT47 = ______________________

CCOUT48 = ______________________

CCOUT49 = ______________________

CCOUT50 = ______________________________

CCOUT51 = ______________________________

CCOUT52 = ______________________________

CCOUT53 = ______________________________

CCOUT54 = ______________________________

CCOUT55 = ______________________________

CCOUT56 = ______________________________

CCOUT57 = ______________________________

CCOUT58 = ______________________________

CCOUT59 = ______________________________

CCOUT60 = ______________________________

CCOUT61 = ______________________________

CCOUT62= ______________________________

CCOUT63 = ______________________________

CCOUT64 = ______________________________

TABLE OF CONTENTS

TABLES

FIGURES

SECTION 4: SELOGIC® CONTROL EQUATIONS

INTRODUCTION

This section covers SELOGIC® Control Equation operation, inputs, syntax, and outputs.

SELOGIC Control Equations are central to many of the functions of the SEL-2030. They are defined within the global (SET G), auto-message (SET A), plug-in card logic (SET O), and logic (SET L) settings described in ***Section 3: Settings***.

OPERATION

SELOGIC Control Equations are at the heart of the more advanced functions of the SEL-2030 because they define when operations are to take place, and they control contact outputs on the optional I/O board. Many conditions detected by the device are represented by Boolean values or bits that are used in these equations. You can assign the value of one bit to an output bit, which has some predefined use. You can also use Boolean equations to combine multiple input bits to drive a specified output. You will find examples of these equations later in this section. Figure 4.1 illustrates the SELOGIC Control Equation data flow.

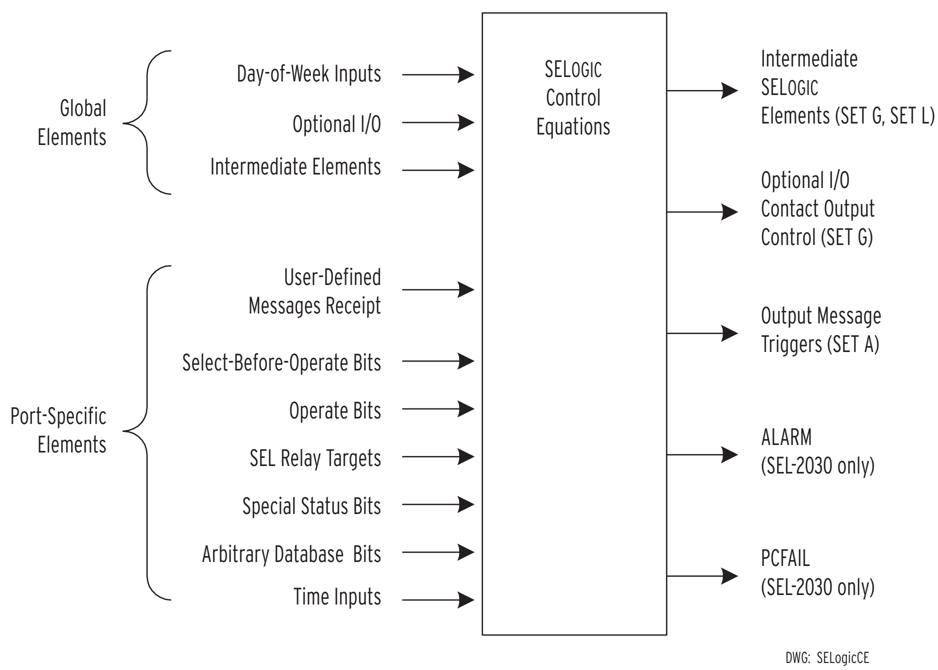


Figure 4.1: SELOGIC Control Equations Inputs and Outputs

SELOGIC Control Equation inputs include the current time, global elements (as seen by executing the **TAR G** command), local elements (as seen by executing the **TAR n** command), and arbitrary database bits.

Messages are triggered by the rising edge (or assertion) of the trigger condition bit. You can use output messages for the following tasks:

- Request data from an IED.
- Send a command to an IED (to change setting groups, for example).
- Send data you want stored to a printer or master device.

In addition to inputs and outputs, there are five global intermediate logic variables and the 96 port-specific logic variables. You can use these variables to write equations, the results of which may be used in output equations. Three intermediate elements have pickup and dropout delay timers associated with them.

INPUTS

As shown in Figure 4.1, there are a number of different types of SELOGIC Control Equation inputs. These include global elements, local elements, relay elements, relay status information, arbitrary database bits, and timed conditions.

Global Elements

Global elements exist within the Global data region that is common to all port databases. Items within this region include the day of the week, remote bits, intermediate SELOGIC Control Equation terms, and I/O board inputs and outputs. These elements are defined in ***Section 6: Database***. Global elements are referenced in SELOGIC Control Equations by their element names. For example, you would enter the Sunday day-of-week element in a SELOGIC Control Equation as SUN.

Local Elements

Local elements exist within the Local data region of each port's database. Some of these elements are asserted by user-defined command receipt, some by select-before-operate registers, some by SELOGIC Control Equations, and others by data collection operation. These elements are defined in ***Section 6: Database***. To use a local element in a logic equation, you must give both its port number and label. For example, to access element D1 on Port 3, the element label to use is 3:D1. If the SELOGIC Control Equation you are writing is port-specific, the port for elements on that port need not be specified.

Relay Elements

SEL relay elements are available on any SEL relay port that is collecting element data (uses 20TARGET data collection). Each element may be specified by its element label, preceded by the port number. For example, to access relay element 51NT on Port 4, you use 4:51NT. If the element name matches a local or global element, you must specify the region to identify the proper element (e.g., 4:TARGET:IN1). If you write a port-specific equation, the port for the desired relay element is in the local port, and the relay element label is unique from any local and global elements, then you do not need to specify the port number. You can view the relay element labels by using the **TAR n ALL**, **MAP n TARGET BL**, or **VIEW n TARGET BL** commands.

Note: Because the SEL-2030 can only sample relay elements, you should only use elements you are confident will be asserted when a sample occurs. Elements that are only asserted momentarily will probably not be seen by the SEL-2030 in their asserted state. To use them, you will need to use the capabilities of the SEL relay to extend the element assertion time so it can be seen by the SEL-2030.

Status Information

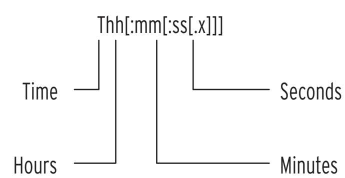
Along with their meter information, some SEL relays provide status information, which includes bits for self-test failures and new events. These bits are stored in the SEL-2030 as part of the relay element data. Use the **TARGET** command once a port is configured to see what SEL relay special elements are available. These items are selected the same way as SEL relay elements.

Database Bits as Elements

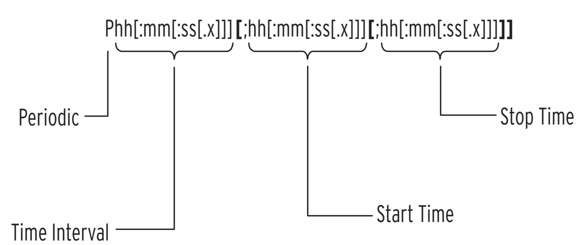
Arbitrary database bit references allow any bit of any register within any database region to be referenced as a SELOGIC Control Equation term. To specify an element of this type, you must select the port number, register number, and bit number. For example, to access bit 11 of register 800Fh on Port 12, use the element label: 12:800Fh:Bh. If the register does not exist when you select it, you will be warned, but the term will be accepted. If it does not exist when SELOGIC Control Equations run, it will be treated as false (logic 0).

Timed Conditions

For controlling operations that must occur at specified times or periodically, you may use time-of-day or periodic items. Time-of-day equation entries have the following syntax:



This portion of an equation is true when the specified time-of-day occurs. The minutes, seconds, and tenths-of-seconds fields are optional, as indicated by the square brackets. To make something occur periodically, use a periodic item:



This item specifies the interval, optional start time, and optional stop time. The minutes, seconds, and tenths-of-seconds fields for all three time fields are optional, as indicated by the square brackets. For all three time fields the interval specifies how often to perform an operation. The start time specifies the time-of-day to start the interval. If the start time is not included, it will default to 00:00:00.0. The stop time specifies the time-of-day to stop the periodic samples. It defaults to 24:00:00.0. Both of these timed conditions will be true for approximately 100 milliseconds. If a start time is specified with a smaller time increment than the periodic time interval, the start time will act as an offset. This may be useful to prevent simultaneous operation of multiple messages that could result in database delays.

EQUATION SYNTAX

You create SELOGIC Control Equations by combining terms (inputs described above) in logical equations. This section describes the syntax of these equations. The simplest equation consists of directly entering a single element. More complex equations require the use of logical operators.

Operators

You can create SELOGIC Control Equations that use multiple SEL-2030 elements with logical AND (*), OR (+), and inversion (!) operators in a single equation. The following list defines the use of these operators.

*	AND	Requires that elements on both sides of the * symbol be asserted before the logic condition is true. For example, in the equation OUT1=IN1*IN2 the terms IN1 and IN2 must both be true for OUT1 to be true.
+	OR	Requires that one element on either side of the + symbol be asserted before the logical condition is true. The equation OUT1=IN1+IN2 requires either IN1 or IN2 to be true for OUT1 to be true.
!	Invert	Inverts the value of the element immediately following the ! symbol. For example, the equation OUT1=IN1*!IN2 requires IN1 to be true and IN2 to be false for OUT1 to be true.

Insert a backslash (\) symbol at the end of the line of a SELOGIC Control Equation (just before pressing <ENTER>) to continue the same equation on a subsequent line. Otherwise, the equation may only be one line. There is a 200-characters-per-equation limit for a single equation and a 50-term (element names and time functions) limit per equation.

Operator Precedence

When the SEL-2030 processes the SELOGIC Control Equations, the ! is applied first, followed by AND (*) functions, and finally by OR (+) functions. The *, +, and ! functions may be used in any combination. For example, consider the equation:

OUT4=X*Y+Z*V

This logic says that the AND function (*) is performed on assigned values for intermediate elements X and Y, Z and V before they are ORed (+) to determine the state of output 4 (OUT4=(X*Y)+(Z*V)). This is typically referred to as a sum-of-products equation.

Limitations

Table 4.1 lists unacceptable combinations of SELOGIC Control Equation operators:

Table 4.1: Unacceptable SELOGIC Control Equation Operator Combinations

*+	**	!*	!+
+*	++	!!	

Equation Disabling

Programming an equation to NA disables that function, i.e., OUT4 = NA.

OUTPUTS

You use SELOGIC Control Equations to control contact outputs, intermediate logic, and auto-message triggers.

Contact Outputs

Four contact outputs on the optional I/O board are controlled by SELOGIC Control Equations. The contact output equations are processed every 3.9 milliseconds. An output contact will be asserted (closed for a type A contact) when its corresponding SELOGIC Control Equation is true; it will be deasserted when its corresponding SELOGIC Control Equation is false. Contact output SELOGIC Control Equations are established in the global settings.

In the SEL-2030, there is an additional contact output equation, ALARM. This equation is for controlling the alarm contact. The alarm contact will close for self-test failures, regardless of this setting. With this setting, you can control what additional conditions the alarm contact is closed for. This equation will be processed every 3.9 milliseconds, like the other outputs.

Global Intermediate Logic

Five intermediate logic elements (V, W, X, Y, Z) may be used to hold intermediate results. These elements also have associated pickup/dropout timers which the SEL-2030 may use for various timing functions. These elements are processed every 15.6 milliseconds.

The timers operate as standard pickup/dropout timers. For a timer output (VT, WT, XT, YT, or ZT) to assert, the corresponding input must be true for the pickup time. Similarly, for a timer output to deassert once it has asserted, the corresponding input must be false for the dropout time. Pickup and dropout times can be set to zero to disable them.

Intermediate logic SELOGIC Control Equations and timer values are established in the global settings.

In the SEL-2030, there is also an equation for PCFAIL. This is an element which appears in the global elements to indicate protocol card failure. You can modify this equation to suit your particular definition of a card failure. You can then use this result to indicate card failure to your system.

Local Intermediate Logic

There are 96 intermediate logic elements associated with each port. These elements operate together to form 32 S-R latches where 32 elements are set elements, 32 are clear elements, and 32 are the latch outputs. The set and clear elements are driven by SELOGIC Control Equations (SET L), by master port *Fast Operate* commands, and by Modbus®, and DNP operations. (See ***Section 7: Protocols*** for information on using *Fast Operate* commands, Modbus control, and DNP control.) Figure 4.2 illustrates the relationship of these control methods.

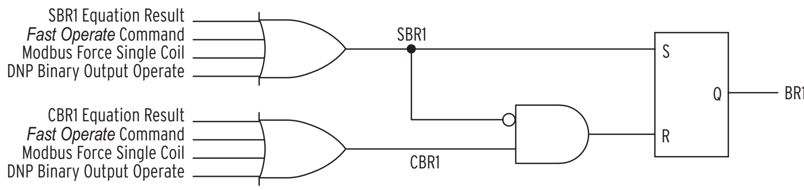


Figure 4.2: Example of Latch Operation

Message Triggers

On all used ports, you can set the port to send a message based on a trigger condition. These trigger conditions, which are defined using SELOGIC Control Equations, are processed every 15.6 milliseconds.

Whenever the SEL-2030 detects a rising edge ( ) of a trigger condition (ISSUEx setting), it sets the corresponding Dx or ARCHx element. Once the message has been issued and any corresponding data collection is completed, the Dx or ARCHx is cleared. If a rising edge of a trigger condition is detected but the corresponding Dx or ARCHx element is already set, then the corresponding DLYx or DLYAx bit will be set to indicate that an auto-message operation has been missed. You can clear DLYx and DLYAx bits by executing a **STATUS C** or **STATUS R** command. Figure 4.3 illustrates this logic.

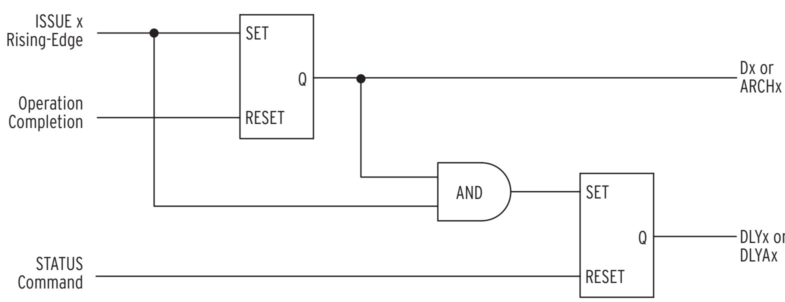


Figure 4.3: Message Triggering Logic

A typical trigger sequence starts with a trigger condition being satisfied. For example, consider the SELOGIC Control Equation ISSUE1 = P00:00:10.0. This trigger condition will have a rising edge every 10 seconds. Figure 4.4 illustrates the relative timing of this issue condition and its corresponding message element (D1).

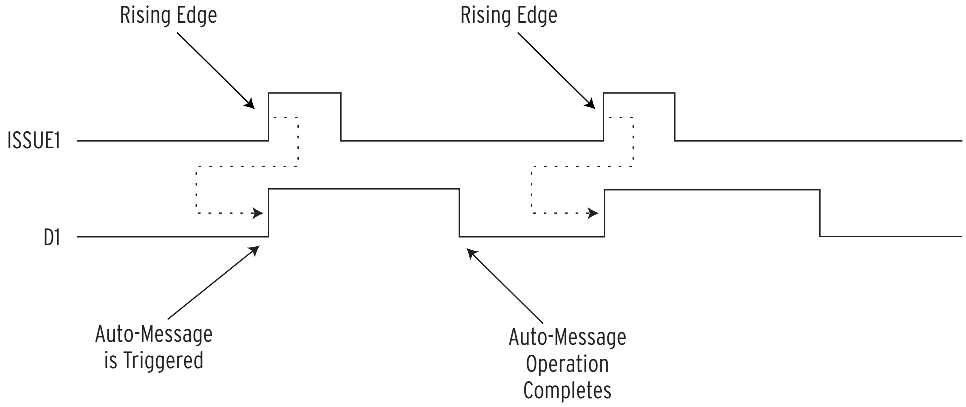


Figure 4.4: Normal Auto-Message Trigger

If the auto-message is not completely processed before the next trigger occurs (for this example, longer than 10 seconds), then the DLYx bit will be set, as shown in Figure 4.5.

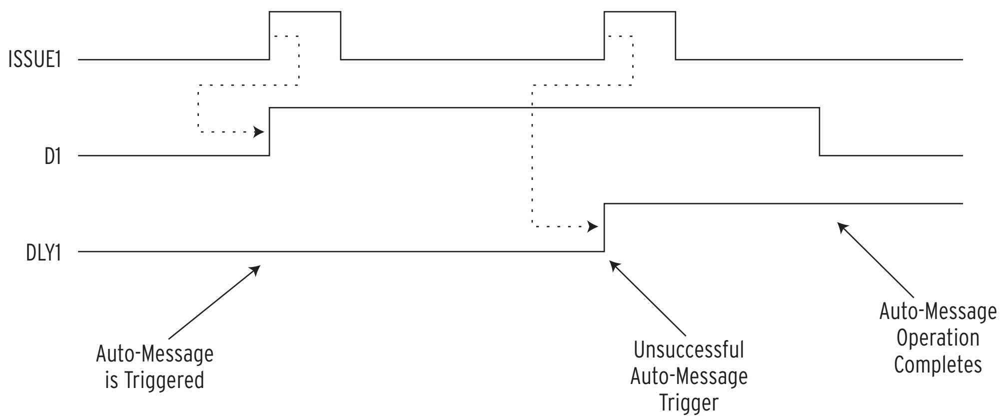


Figure 4.5: Unsuccessful Auto-Message Trigger

The database delay region of the **STATUS** command response indicates which auto-messages are unsuccessful. You may need to increase the ISSUE period to eliminate repeated unsuccessful auto-message triggers.

Another interesting case to consider is when SELOGIC Control Equations contain elements that are cleared by the triggered auto-message. If such an element is set again before the auto-message processing is complete, further triggering may be disabled. For example, consider the following trigger and message settings:

ISSUE2 = 1:UMB+2:UMB
MESG2 = \DAC1/\DAC2/

These settings are meant to output any unsolicited messages received on Ports 1 and 2. However, 1:UMB can become set while \DAC2/ is being processed, leaving the trigger condition in a set state and precluding any further rising edges; the trigger condition has become disabled. Figure 4.6 illustrates this problem.

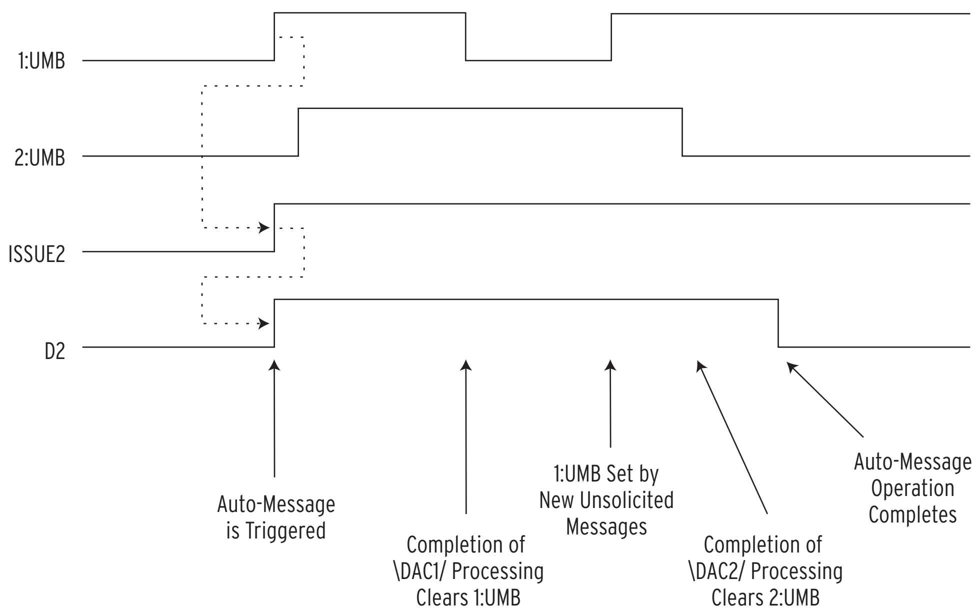


Figure 4.6: Trigger Lock-Out Problem

You can prevent this problem by writing a SELOGIC Control Equation that forces the trigger condition to reset itself immediately.

The following SELOGIC Control Equation adds !D2 to the previous equation:

ISSUE2 = 1:UMB*!D2+2:UMB*!D2

Now, as shown by Figure 4.7, the trigger condition will only be true momentarily; then it will retrigger upon completion of the message processing.

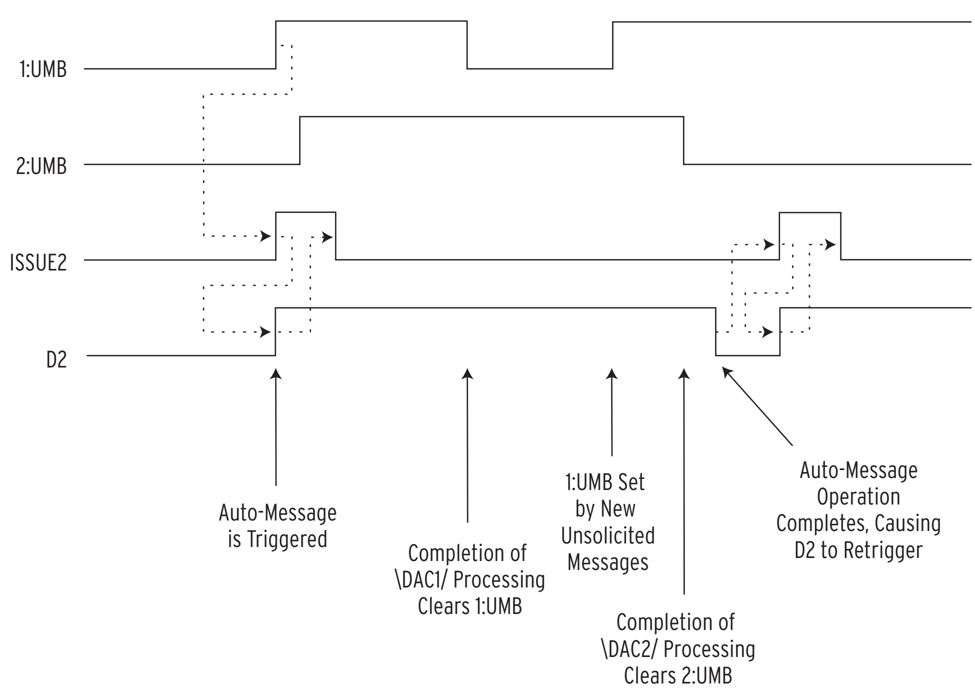


Figure 4.7: Forcing Retriggering Avoids Trigger Lock-Out

Processing Sequence

You may need to consider the order in which SELOGIC Control Equations are processed to fully understand their operation and thereby ensure the desired result. When a SELOGIC Control Equation contains, as one of its terms, the result of another SELOGIC Control Equation, the order in which the equations are processed may affect the result. For example, consider three SELOGIC Control Equations, A, B, and C, that are processed in alphabetic order. It takes 1 µs to process each equation, and the group is processed every 31 ms in the SEL-2030. If SELOGIC Control Equation B contains the results of equation A, the results of B will be current (within 1 µs) because A was processed as part of the current process cycle. However, if equation B contains the results of equation C, the results of B will not be current because the results of C are from the previous process cycle, which is now one processing interval old.

The SEL-2030 processes SELOGIC Control Equations in the order and frequency shown in Table 4.2. Figure 4.8 illustrates this processing sequence.

Table 4.2: SELOGIC Control Equation Execution Order

Symbol	Period	Description	Execution Order
DI, DO	7.8 ms	Output SELOGIC Control Equations	OUT1 to OUT4, ALARM
I	31.2 ms	Intermediate Logic	V,VT,W,WT,X,XT,Y,YT,Z,ZT, PCFAIL
1–18	31.2 ms	Port Logic (e.g., 3 = Port 3 Logic)	SBR1, SBR2, …, SBR16, CBR1, CBR2, …, CBR16 SRB1, SRB2, …, SRB16, CRB1, CRB2, …, CRB16, ISSUE1 to ISSUE12, ISSUE1A to ISSUE3A, BR1, BR2, …, BR16, RB1, RB2, …, RB16
CC	7.8 ms	Card Output Logic	17:CCOUT1,…,17:CCOUT64 18:CCOUT1,…,18:CCOUT64

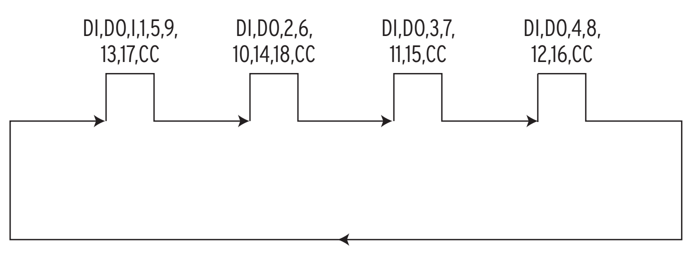


Figure 4.8: Processing Sequence Illustration

To illustrate the effects of the processing sequence, consider the following equations:

W=V	Equation 1
V=W	Equation 2
ISSUE1=1:UMB*!D1	Equation 3

In Equation 1, V is processed before W, so W will always exactly match V in value. However, in Equation 2, V will always lag W by one processing interval because V is processed before W; V is assigned the value W was set to during the last processing interval. In Equation 3, the issue condition will be true for one processing interval, because D1 is found based on the ISSUE1 value; so the D1 used in the equation will be the result of the previous processing interval's computations.

Processing of Local Intermediate Logic

The processing of the Local Intermediate Logic elements (SBR1, CBR1,…, CRB16) has some unique properties that the user should be aware of. These properties have changed, so the discussion below is based on the firmware version of your SEL-2030. This discussion applies only to the Local Intermediate Logic elements. These are the elements whose SELOGIC Control Equation are defined via the **SET L** command.

In the SEL-2020 and Versions R100-R102 of the SEL-2030

The Logic bits function such that a SELOGIC Control Equation cannot be based on any Logic bit on the same port that is later in the SELOGIC Control Equation execution sequence. For example, an equation such as SBR1 = !CBR1 will not work. The SBR1 bit will remain low, regardless of the state of the CBR1 bit. But an equation such as SRB2 = SRB1 will function as expected, with the SRB2 bit following the state of the SRB1 bit.

In SEL-2030 Versions R103 and Later

Any SELOGIC Control Equation can be based on any other Logic bit, regardless of the sequence of execution.

TABLE OF CONTENTS

TABLES

SECTION 5: MESSAGE STRINGS

INTRODUCTION

This section provides information about the characters, special sequences of characters, and predefined strings that you can use in a number of SEL-2030 settings. At the end of this section and also on a blue pull-out card at the end of the book is a summary list of special characters and predefined strings.

OVERVIEW

A string is a sequence of characters that make up part, or all, of a message command or identifier label. Each character may be an ASCII printable character or any 8-bit code that represents a nonprintable character. You use these strings in the following ways:

- Device and Port IDs, termination strings, and modem startup strings in Port configuration using the SET P command.
- Startup sequence for an IED and message strings in auto-messages using the SET A command.
- User-defined commands and responses using the SET U command.

Note: You should avoid using LMD prefix characters in Master port user-defined commands. For an explanation of LMD and a list of LMD prefix characters see ***Section 7: Protocols.***

Message strings consist of literal characters, special sequences, and predefined strings. Literal characters include both ASCII printable and nonprintable characters. Special sequences are strings that are interpreted to have a special meaning when they are used, such as dial a particular phone number, or output a specified set of database data. Predefined strings are used with SEL IEDs to represent certain predefined operations, such as 20METER means collect meter data in best method available for attached device. The following sections further describe these types of message sequences.

LITERAL CHARACTERS

Message strings typically contain some literal characters. These consist of both ASCII printable characters and nonprintable characters. Printable characters (except '\') are entered into a string by directly entering the character (depressing the key for that character on your keyboard). You can also enter any character based on its 8-bit code. To enter a nonprintable character (or special sequence strings) using printable characters, you must use a special sequence to indicate that you are entering something other than a printable character. These sequences always begin with a backslash ('\'). Table 5.1 shows the format of the various special character sequences available.

The following are examples of simple strings:

"Another device"	A literal string for "Another device"
"TRIG\nY\n"	String for TRIG<ENTER>Y<ENTER>
"\002HI\\BOB\003"	String for <STX>HI\BOB<ETX>

You can use the quote character to define the beginning and end of a string. If you don't, the SEL-2030 will put the string in quotes anyway. The only exception is for predefined strings discussed later in this section.

Table 5.1: Special Characters for Use in Strings

Character	Comments
\"	The SEL-2030 interprets this as a quote character in a string, as distinguished from quotes at the beginning and end of a string.
\\	The SEL-2030 interprets this as a backslash character in a string.
\n	ENTER sequence (CR/LF combination, just CR on SEL IED ports).
\0xx	The SEL-2030 interprets this as an 8-bit character, where xx = an ASCII character value in hexadecimal; (e.g., \004 is ASCII End-of-Text, EOT, character). See ***Appendix B: ASCII Reference Table*** for conversion table.
\ <ENTER>	Use to continue a string to the next line.

SPECIAL SEQUENCES

The SEL-2030 is preprogrammed to interpret special sequences of characters for special purposes. You can use these special character sequences in auto-messages or user-defined commands to control the data that are referenced by the message and to control the response initiated by the message. These special sequences are particularly well suited for use with non-SEL IEDs and devices.

Message Sequences

You may use the special character sequences listed in Table 5.2 in automatic messages, configured with SET A, and special-purpose user-defined command responses, configured with SET U.

Table 5.2: Special Message Sequences for Strings

Character	Comments
\CSx/	Begin checksum calculation. x specifies checksum type. c=CRC-16. Based on the polynomial $X^{16} + X^{15} + X^{2} + 1$ b=8-bit checksum. Sum all bytes and take least significant byte. w=16-bit checksum. Sum all bytes and take two-byte result.
\CE/	Stop checksum calculation.
\COyz/	Output checksum. y specifies format. a=ASCII-hexadecimal. b=binary. x=binary with XON/XOFF encoding z specifies byte order. h=high byte first. l=low byte first.
\DA[C][P]n/	Output unsolicited message queue data for Port n. C= if included, clear the queue after the read. P= if included, only read characters that have been added to the unsolicited message queue since the last time the message queue was read. P and C options are mutually exclusive.
\Dt/	Data item output for READACK setting (SET U). t specifies the data format. b=binary word (2 bytes). h=ASCII-hexadecimal word (4 digits). c=binary bytes (1 byte). g=ASCII-hexadecimal byte (2 digits).
\Fp:r[;C[A]]/	Output formatted region data. p=the port number. r=the data region. ;C=clear archive item after it is read. ;CA=read the entire queue of records from an archive region and clear them as they are read. **CAUTION** Frequent archive record clearing may exceed EEPROM capabilities. See the discussion in the Archive Data Region subsection of ***Section 6: Database.*** If you completely clear an archive region that contains a large number of records (thousands of records), it may take a few minutes for the clearing to complete. During this time, most SEL-2030 automatic data collection will be suspended.

Character	Comments
\Idstr[:h]/	Initiate a phone call using the given dial string. Only applies to modem ports. dstr=a dial string of up to 40 characters. Typically consisits of ATDT and phone number. See your modem user's manual for more information on dial strings. h= hang up flag. Set to Y to automatically hang up modem at end of string. Set to N to leave modem connected. You will need to send a separate message later to disconnect the modem (i.e., "\MATH"). (If not included, the default is Y.)
\M	Modem Escape String. Sends modem escape sequence to force a modem into command mode. (The modem escape sequence is a 2-second pause, issuance of the string "+++", and another 2-second pause.) Only available on modem ports. Literal characters in a string after this sequence will be output, even if the carrier detect input is low.
\Rt;saddr[;n]/	Output register contents. t specifies the data format. b=binary word (2 bytes). c=binary byte (1 byte). h=ASCII-hexadecimal word (4 digits). g=ASCII-hexadecimal byte (2 digits). f=float in ASCII. i=integer in ASCII. u=unsigned integer in ASCII. x=binary byte with XON/XOFF encoding. y=binary word with XON/XOFF encoding saddr= register address, using any valid register access method. (See ***Section 6: Database***.) n= specifies how many registers to read. Data items are delimited by spaces for all but b and c formats. One (1) is assumed if you do not specify.
\SP/	Suppress prompt (on Master port). Do not display new prompt after message contents.
\Td/	Time delay; use this code to place a delay within string output. d= time in seconds and may be specified as decimal fraction. (This time delay will be rounded to the nearest 1/32 of a second.) Time must be in the range of 0.03 - 2047.

Character	Comments
\W;saddr;n,daddr/	Unsolicited database write. Applies only to ports where DEVICE= MASTER or SEL, and PROTOCOL=SEL. Unsolicited Write messages are binary format and interleaved within ASCII message exchanges. While you may include several \W…/ sequences within the same Automatic Message Setting (MESGn), no other characters or special message sequences are allowed before, after, or in between the Unsolicited Write strings. saddr= Source register starting address, using any valid register access method. The source address range may be any database region other than the Archive regions (A1-A3). (See ***Section 6: Database.***) n= Specifies how many registers to write. Number of registers must not exceed 115. daddr= Destination SEL-2020/2030 User region address, using any valid User region address (F800h-FFFFh). (See ***Section 6: Database.***) Note: Since the destination starting address refers to allocated memory within a separate SEL-2020/2030, there is no verification that the destination User region memory exists. Use the SET A command to adjust the User region memory size of a destination SEL-2020/2030. (See ***Section 3: Settings.***)

The following are examples of using special message sequences in strings:

MESG1="\F1:METER/"

Output the formatted meter data from Port 1. The screen below shows a sample response to this message.

```
Port 1,  Data Region METER   Data

_YEAR = 1995  DAY_OF_YEAR = 1 (01/01)  TIME = 01:59:37.859
IA(A) =   2374.623,   102.078  IB(A) =   2353.747,   -17.810
IC(A) =   2369.258,  -137.949  VA(V) =  11278.516,   103.606
VB(V) =  11289.020,   -16.545  VC(V) =  11270.235,  -136.424
IAB(A) =   4092.593,   131.987  IBC(A) =   4093.101,    12.229
ICA(A) =   4107.771,  -107.898  VAB(V) =  19558.934,   133.546
VBC(V) =  19524.914,    13.488  VCA(V) =  19524.873,  -106.397
PA(MW) =     26.773  QA(MVAR) =      0.714  PB(MW) =     26.565
QB(MVAR) =      0.587  PC(MW) =     26.693  QC(MVAR) =      0.711
P(MW) =     80.030  Q(MVAR) =      2.012  I0(A) =      7.170,   135.000
  I1(A) =   2365.875,   102.106  I2(A) =      5.750,    40.418
V0(V) =      7.299,   -80.537  V1(V) =  11279.251,   103.546
V2(V) =     13.106,   163.608
```

MESG2="DATE \Ri;1:GLOBAL:MONTH//\ \Ri;1:GLOBAL:DATE//\Ri;1:GLOBAL:_YEAR/\n"

Output SEL IED date command, with date being read from global region of Port 1's database. Example output from this:
DATE 5/2/1995<CR><LF>.

MESG3="\IATDT15093321890/\T5/\DAC7/"	Initiate a phone call by issuing embedded dial string and waiting for connect indication from modem, wait 5 seconds after connection, output unsolicited message data from Port 7, and clear Port 7's unsolicited message buffer. The phone call will be placed, even if there is no data to send (the unsolicited message buffer is empty). The connection will be dropped once the transfer is complete.
MESG4="\CSC/\002\RH;12:USER:0;100/\003\CE/,\COah/\n"	Output <STX> followed by Port 12 User Region data and <ETX>, followed by comma and CRC-16 checksum displayed in ASCII hexadecimal format and then <CR><LF>. The \CSc/ and \CE/ strings indicate that the CRC-16 checksum is calculated on all of the data output from the <STX> through the <ETX>.

Parsing Sequences

You use the SET U command to create basic and complex user-defined message strings that the SEL-2030 will recognize. Basic user-defined commands have a fixed character sequence. The SEL-2030 will recognize a basic message from an attached device only if that message matches the user-defined message character sequence exactly, in both form and content.

For more advanced applications, you can use parsing sequence characters to develop a user-defined message that permits the message sent from the attached device to vary in content, provided it matches the message format exactly. You can also use parsing sequences to construct a single user-defined message string. This string format can recognize messages having a partially fixed character sequence with a “wildcard” format. Refer to Table 5.3 for parsing sequence characters you can use with the SEL-2030.

Table 5.3: Special Parsing Sequences for Strings

Character	Comments
\At/	Register address. For READ and WRITE settings only. t specifies the address format. b=binary (2 bytes). a=ASCII-hexadecimal (4 digits).
\Dt/	Data item. For WRITE setting only. t specifies the data format. b=binary word (2 bytes). h=ASCII-hexadecimal word (4 digits). c=binary bytes (1 byte). g=ASCII-hexadecimal byte (2 digits).
\Pt/	Port number. For TRANS, READ, and WRITE settings only. t specifies the Port number format. b=binary (1 byte). a=ASCII-hexadecimal (2 digits).
\X[X]/	Ignore character. \X/ indicates ignore one character. \XX/ indicates ignore all characters following until the next defined character is encountered.

The following are examples of using special parsing sequences in strings:

CMD1="In the\XX/"	The CMD1 bit will assert whenever a string that begins with "In the" is received at the SEL-2030 Port set with this user-defined message.
WRITE="W\Pa/@\Aa/=\Dh/"	Creates a write command that the SEL-2030 uses to recognize data in a special format. In this example, the string containing the data must begin with a W, followed by a Port number, an @ symbol, a database address, an = character, and finally the data. For instance, to write 0 (zero) to Port 8, address F800h, you would have to send the string "W08@F800=0000" to the SEL-2030.

PREDEFINED STRINGS

When working with SEL relays, the SEL-2030 includes some predefined strings you can use in SET A auto-messages to collect data. The SEL-2030 also includes four predefined strings you can enter as SET U user-defined commands to recognize automatic messages sent from an SEL relay. Table 5.4 lists the predefined strings you can use on auto-configured SEL IED ports for data collection (SET A MESGx settings). Table 5.5 lists other predefined strings that are available regardless of the port type.

Table 5.6 lists predefined strings you can use on SEL IED ports to watch for unsolicited messages (relay auto-messages).

Table 5.4: Predefined Strings for Auto-Messages with Auto-Configured SEL IEDs

String	Comment
20METER	Send ASCII meter or *Fast Meter* command, as appropriate.
20DEMAND	Send ASCII demand meter or fast demand meter command, as appropriate.
20TARGET	Send ASCII target command sequence or *Fast Meter*, as appropriate. **Note**: When the SEL-2030 collects target data from relays that do not have *Fast Meter* capability, the TARGET commands sent by the SEL-2030 may momentarily modify the front-panel targets on the relays—just as if you were sending the target command to the relay without the SEL-2030.
20HISTORY	Send ASCII history command.
20STATUS	Send ASCII status command.
20BREAKER	Send ASCII breaker command.
20EVENT	Send ASCII request for standard (4 sample/cycle) event report. Stored in a parsed format. (Refer to the following subsection for some additional features.)
20EVENTS	Send ASCII request for standard (4 sample/cycle) event report. Stored in a literal format. (Refer to the following subsection for some additional features.)
20EVENTL	Send ASCII request for long (16 sample/cycle) event report. Stored in a literal format. (Refer to the following subsection for some additional features.)

Table 5.5: Other Predefined Strings for Auto-Messages

String	Comment
20USER	No message is sent, but data from User Region is copied to this region.

Table 5.6: Predefined Strings for General-Purpose User-Defined Commands with SEL IEDs

String	Comment
20EVENT	Recognize summary event reports received from SEL relays and trigger with delay. Will continue to retrigger until all reports are collected.
20EVENTQ	Recognize summary event reports received from SEL relays and trigger immediately.
20STATUS	Recognize status messages received from SEL relays.
20GROUP	Recognize group switch messages from SEL relays.

20EVENT Features

Because SEL relays may trigger multiple event reports in rapid succession, the SEL-2030 has special features based on these triggers to facilitate collecting event reports. To take advantage of these special features, you must set 20EVENT as a user-defined command with SET U. The SEL-2030 then keeps track of the number of summary event reports received from the SEL relay on that port. You must then set MESG3 or MESG3A to 20EVENT, 20EVENTS, or 20EVENTL. The SEL-2030 will then collect the oldest unread event report from the SEL relay. The CMDx bit corresponding to the 20EVENT command will continue to retrigger every 5 minutes as long as there are uncollected event reports. (To have the CMDx bit trigger immediately on each unsolicited summary event report, use the user-defined command 20EVENTQ.) The number of reports left to read is visible in the Local region of the port database.

These features can be used to collect and process event reports in a number of ways. Examples 4, 5, and 6 in ***SEL-2030 User's Guide; Section 4: Job Done Examples*** illustrate using these features to collect event reports into archive memory, to print them, and, once a day, to call out to a remote computer to upload the event reports. The following example illustrates collecting event reports and calling them out when you do not have archive memory installed. Consider a relay on Port 1 and modem on Port 8 with the following settings:

```
SET U 1

    CMD1=20EVENT

SET A 1

    ISSUE3=CMD1*!8:D1
    MESG3=20EVENT

SET A 8

    ISSUE1=!1:D3
    MESG1="\IATDT15093321890/\F1:D3/"
```

Consider what happens when the relay triggers three event reports in rapid succession. The 1:CMD1 bit triggers collection of an event report. Because the SEL-2030 received three summary event reports, the SEL-2030 collects the third event report. After the SEL-2030 finishes collecting this event report, the modem initiates a phone call and uploads the event report. Every 5 minutes, the SEL-2030 retriggers the 1:CMD1 causing the next event report to be collected and transferred via modem, until all three event reports have been collected and transferred.

If the modem port is unsuccessful at initiating a phone call when the next 1:CMD1 trigger occurs, the !8:D1 term in the event report collection trigger equation prevents a new event report from being read until the event report has been successfully transferred. The 1:CMD1 bit will continue to retrigger every 5 minutes until all unread event reports are collected.

MODEM DIAL-OUT PROCESS

The SEL-2030 can dial out to a remote PC, terminal, or IED through an attached or internal modem. This feature is useful to automatically transfer data from the SEL-2030 database to a remote location or to acquire data from a remote device. With the SET A command, set an ISSUEn message trigger to define the condition that initiates the dial-out process, and set a MESGn to define the message content and data.

The ISSUEn trigger condition can be based on time and/or day-of-week, or any logic condition using global and local elements in the SEL-2030 database collected from attached devices. The MESGn message string must begin with a \I.../ special string sequence, followed by the data (or data request) and/or data output strings, \R.../ or \F.../, that define the message to be sent.

The \I special string sequence initiates the dial-out process through the modem using the provided dial string. For example \IATDT15093321890/ would dial the SEL factory. The SEL-2030 will wait up to 60 seconds for a carrier signal from the remote modem, which indicates the call has been completed. If a carrier signal is not detected in 60 seconds, the SEL-2030 will hang-up and wait 2 minutes before initiating a subsequent dial-out attempt. (Only two attempts are made before the SEL-2030 gives up on the message.) You must, therefore, set the remote modem to answer a call in less than 60 seconds. The SEL-2030 data are transferred when a successful connection is made.

SEL-2030 STRINGS

Special Characters for Use in Strings

Character	Use	Comment
\"	A	Quote character. Use to insert a quote character in a string.
\\	A	Backslash character. Insert a backslash character in a string.
\n	A	New line character (CR/LF combination, just CR on SEL IED ports).
\0xx	A	Insert any 8-bit character.
		xx = A character value in hex; (e.g., \004 is ASCII EOT character. See ***Appendix B: ASCII Reference Table*** for ASCII conversion table.)
\<ENTER>	A	Use this sequence to continue a string to the next line.
\At/	I*	Register address.
		t= specifies the address format:
		b=binary (2 bytes) a=ASCII-hex (4 digits)
\Csx/	O	Begin checksum calculation
		x specifies checksum type
		c=CRC-16
		b=8-bit checksum
		w=16-bit checksum
\CE/	O	Stop checksum calculation
\COyz/	O	Output checksum
		y specifies format
		a=ASCII-hexadecimal
		b=binary
		x=binary with XON/XOFF encoding
		z specifies byte order
		h=high byte first
		l=low byte first
\DA[C][P]n/	O	DA=output unsolicited message queue data for Port n;
		C= if included, clear the queue after the read; the data are handled as set of characters.
		P= only output characters not previously output; mutually exclusive with C parameter.
\Dt/	I* or READACK	D=data item
		t=specifies the data format:
		b=binary word (2 bytes), c=binary bytes (1 byte),
		h=ASCII-hex word (4 digits), g=ASCII-hex byte (2 digits).
\Fp:r[;C[A]]/	O	F=Output formatted region data.
		p= the port number.
		r= the data region.
		;C= clear archive item after it is read; CA=read the entire queue of records from an archive region and clear them as they are read.
\Idstr[:h]/	O	Initiate a phone call using the given dial string. Only applies to modem ports.
		dstr= a dial string of up to 40 characters. Typically consists of ATDT and phone number.
		h= hang up flag. Y to hang up at end of message, N to stay on-line.
\M	O	Issue modem escape sequence. Only applies to modem ports.
\Pt/	I*	P=Port number
		t=specifies the port number format:
		b=binary (1 byte), a=ASCII-hex (2 digits)

Character	Use	Comment
\Rt;saddr[;n]/	O	R=Output register contents t=specifies the data format: b=binary word (2 bytes), c=binary byte (1 byte) g=ASCII-hex byte (2 digits), h=ASCII-hex word (4 digits) f=float in ASCII i=integer in ASCII u=unsigned integer in ASCII x=binary byte with XON/XOFF encoding y=binary word with XON/XOFF encoding saddr=register address, using any valid register access method. n= specifies how many items to read. Data items are delimited by spaces for all except b and c formats. One is assumed if you do not specify.
\SP/	O	Suppress prompt (on Master port). Do not display new prompt after message contents.
\Td/	O	Time delay; use this code to place a delay within string output; d=time in seconds and may be specified as decimal fraction. Time must be in the range of 0.03 to 2047.
\W;saddr;n,daddr/	O	Unsolicited database write. Applies only to ports where DEVICE=MASTER or SEL, and PROTOCOL=SEL. saddr= Source register starting address, using any valid register access method. The source address range may be any database region other than the Archive regions (A1-A3). n= Specifies how many registers to write. Number of registers must not exceed 115. daddr= Destination SEL-2020/2030 User region address, using any valid User region address (F800h-FFFFh).
\X[X]/	I	X= Ignore character. \X/ indicates ignore one character. \XX/ indicates ignore all characters following until the next defined character is encountered.

Use code:
A=All messages I=Input messages O=Output messages
*Only usable in special-purpose user-defined commands.

Pre-Defined Strings for Auto-Messages With Auto-Configured SEL Relays

String	Comment
20METER	Send ASCII meter or *Fast Meter* command, as appropriate.
20DEMAND	Send ASCII demand meter or fast demand meter command, as appropriate.
20TARGET	Send ASCII target command sequence or *Fast Meter*, as appropriate.

Note: When the SEL-2020/2030 collects target data from relays that do not have *Fast Meter* capability, the TARGET commands sent by the SEL-2020/2030 may modify the front-panel targets on the relays--just as if you were sending the target command to the relay without the SEL-2020/2030.

String	Comment
20HISTORY	Send ASCII history command.
20STATUS	Send ASCII status command.
20BREAKER	Send ASCII breaker command.
20EVENT	Send ASCII event command. Store in parsed format.
20EVENTS	Send ASCII event command. Store in literal format.
20EVENTL	Send ASCII long event command. Store in literal format.

Pre-Defined Strings for Auto-Messages

String	Comment
20USER	Copy user region data to this region.

Pre-Defined Strings for General-Purpose User-Defined Commands With SEL IEDs

String	Comment
20EVENT	Recognize summary event reports received from SEL IEDs (delay between triggers).
20EVENTQ	Recognize summary event reports received from SEL IEDs (trigger immediately).
20STATUS	Recognize status messages received from SEL IEDs.
20GROUP	Recognize group switch commands from SEL IEDs.

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SECTION 6: DATABASE

INTRODUCTION

The SEL-2030 database contains status information and data collected from devices attached to the 16 rear communication ports. There is also information associated with the plug-in protocol card(s). This section describes the structure of the database and the various ways data within the database can be accessed.

DATABASE STRUCTURE

The SEL-2030 data area includes a database for each of the 16 rear communication ports and a database for each of the two plug-in protocol cards. Each port database consists of up to 15 regions, including Global (GLOBAL), Local (LOCAL), Unsolicited Message Buffer (BUF), eight Data regions (D1 to D8), three Archive regions (A1 to A3), and a User data region (USER). Global, Local, and User regions are available on all used ports. The unsolicited message buffer (BUF) and Data regions are available on ports with SEL IED and other IED device types. The Archive data regions are available on IED ports if the SEL-2030 is equipped with optional nonvolatile Flash memory. The first data region (D1) and Archive data region (A1) are available on Master ports for use with the 20USER setting (see ***Section 5: Message Strings*** for more information). Figure 6.1 illustrates the overall database structure.

Table 6.1 provides detailed information about each port's database. More detailed information about each region is located in this section under ***Region Descriptions***.

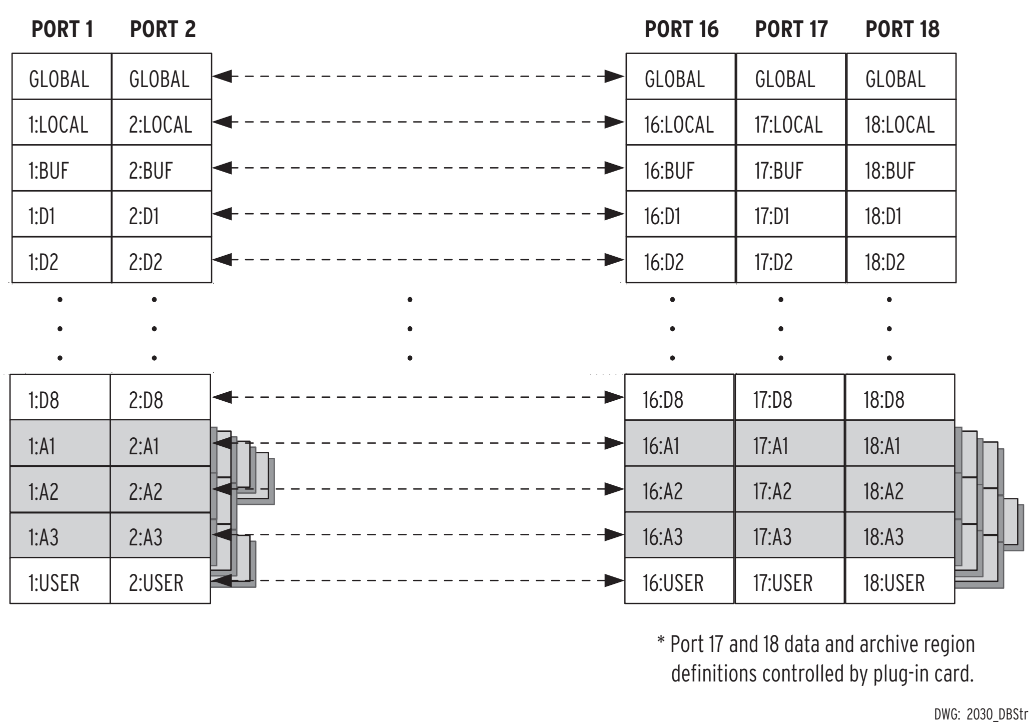


Figure 6.1: Overall Database Structure

The region sizes shown in Table 6.1 indicate the maximum amount of data that can be stored in each region. The actual data stored in each region of each port depends on the settings you apply using the **SET A** command.

If you set AUTOBUF=Y on a port, unsolicited messages are stored in the BUF region until the region is cleared or until the region is completely filled. When the BUF region is filled, the newest data will overwrite the oldest data as they are received.

The data regions D1 to D8 store data solicited by messages you create with the ISSUEx and MESGx settings. The data you solicit using “20” messages are parsed automatically in the associated data region. All of the “20” message responses will fit in any of the data regions, except the response to the 20EVENT, 20EVENTS, and 20EVENTL messages. These messages elicit an event report from an SEL relay. Only the D3 and A3 data regions are large enough to hold an entire 20EVENT or 20EVENTS event report response and only the A3 region is large enough to hold a 20EVENTL event report response. Check the event size of newer relays to determine if they will fit in the available regions.

You control the size of the data solicited with non-“20” messages based on the parsing method you choose and the size of the message response you define with the NUMx setting. If you specify a size larger than the region size, the SEL-2030 will respond immediately with an “Out of Range” message.

The data and archive regions of Ports 17 and 18 are controlled by the plug-in protocol card. Refer to the instruction manual of your protocol card to determine if, and how, these regions are used by the protocol card.

You can only reference those portions of regions that have data assigned. If you reference an address that is not assigned, the SEL-2030 will respond with a message that the data address does not exist.

You allocate all, or a portion, of the User data region with the **SET A** command, or the **SET M** command automatically allocates the User data region. You must use the **STORE** command, user-defined write command, or Modbus® write function code to put the data into this area. You may also use **SET M** to establish automatic storage of data into the User region.

Archive regions are structured differently from other regions. Where all other regions contain only a single record, the archive regions contain a queue of records. From a data access point of view, the archive regions appear to only contain the oldest record. However, as soon as it is cleared, the next oldest record will appear. The number of archive records that can be stored is only limited by the amount of nonvolatile Flash memory.

Table 6.1: Database Regions for a Single Port

Region	Address		Size
	From	To	(Registers)
Global Data	0000h	07FFh	2 k
Local Data	0800h	0FFFh	2 k
BUF (Unsolicited Message Queue)	1000h	1FFFh	4 k
Data Region 1	2000h	27FFh	2 k
Data Region 2	2800h	2FFFh	2 k
Data Region 3	3000h	47FFh	6 k
Data Region 4	4800h	4FFFh	2 k
Data Region 5	5000h	57FFh	2 k
Data Region 6	5800h	5FFFh	2 k
Data Region 7	6000h	67FFh	2 k
Data Region 8	6800h	6FFFh	2 k
Archive Data Region 1	7000h	77FFh	2 k
Archive Data Region 2	7800h	7FFFh	2 k
Archive Data Region 3	8000h	F7FFh	30 k
User-Defined Data Region	F800h	FFFFh	2 k

Archive regions are only available if the SEL-2030 is equipped with optional nonvolatile Flash memory. The nonvolatile nature of these data regions, combined with the unique capability to contain multiple records, make them ideally suited to long-term data collection and storage. You can use the **VIEW** command to view the data associated with any record in the Archive region queue; all other commands read only the oldest record. See the memory calculation procedure in ***Appendix C: Planning Sheets*** for more information.

The SEL-2030 assigns Data and Archive regions alternate labels or names based on the data stored in them. For instance, if you use the 20METER message to collect and store SEL relay meter data in Data region D1, that region is assigned the alternate label “METER.” Use the **MAP** command to view a list of regions on a port and any alternate labels associated with some of the regions.

You can also use the **MAP** command to show the detailed structure of any region.

DATA STORAGE FORMATS

Data are contained within the SEL-2030 database in various formats. Character items and strings are stored with each character requiring one register but only using the lower byte of the register; the high byte is always zero. Any unused characters in a string are set to a value of zero. Integer items require a complete register. Real numbers are stored in IEEE single-precision floating-point format in two registers with the most-significant word stored in the lower-addressed register of the two. (See Figure 6.2 for an illustration of how these data types map into the registers.) You can use the **VIEW** and **MAP** commands to identify the data storage format and see the stored data. You can use message strings in an auto-message to transfer the data from the SEL-2030 to another device in virtually any format. See ***Section 5: Message Strings*** for more detailed information.

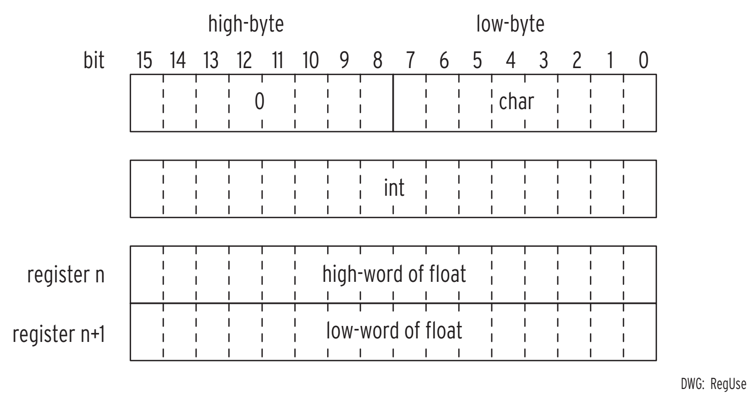


Figure 6.2: Register Usage for Different Data Types

REGION DESCRIPTIONS

Global Data Region (GLOBAL)

The Global data region includes the following data that are common to all ports: SEL-2030 FID string, status and configuration information, date and time, global element bits, plug-in card status within an SEL-2030, and Port F status (see Table 6.2, Table 6.3, and Table 6.4). Each port database contains the same information in this region (e.g., 1:GLOBAL is the same as 2:GLOBAL).

Table 6.2: Global Data Region

Starting Address	Data Item Label	Data Type	Notes
0000h	FID	char[40]	Read-only.
0028h	STATUS	int	Bit for each type of failure; read-only. See ***Global Status Register*** following this table.
0029h	CONFIG	int	Indicates SEL-2030 hardware configuration; read-only. See ***Configuration Register*** following this table.
002Ah	_YEAR	int	i.e., 1994.
002Bh	DAY_OF_YEAR	int	1 through 365.
002Ch	MONTH	int	1 through 12.
002Dh	DATE	int	1 through 31.
002Eh	TIME(ms)	int[2]	Append two registers to get 32-bit time; register 2Eh has high-word, 2Fh has low-word; 0-86,399,999.
0030h	ELEMENTS	char[7]	8-bit character for each row. See Global Elements in Table 6.3.
0037h	REMOTE_BIT_REG	int	See ***Remote Bit Control Register*** following this table.
0038h	REMOTE_BITS	int	Directly operate all 8 remote bits. Lower byte corresponds to bits: bit 0 is R8, bit 1 is R7, … bit 7 is R1. The upper byte must be the complement of the lower byte for command to be accepted.
0039h	_YEARS	int	Years in the century. 0 through 99.
003Ah	_HOURS	int	Hours in the day. 0 through 23.
003Bh	_MINS	int	Minutes in the hour. 0 through 59.
003Ch	_SECS	int	Seconds in the minute. 0 through 59.
0100h	PC1_FID	char[40]	Firmware identification string of the plug-in protocol card in Port 17.

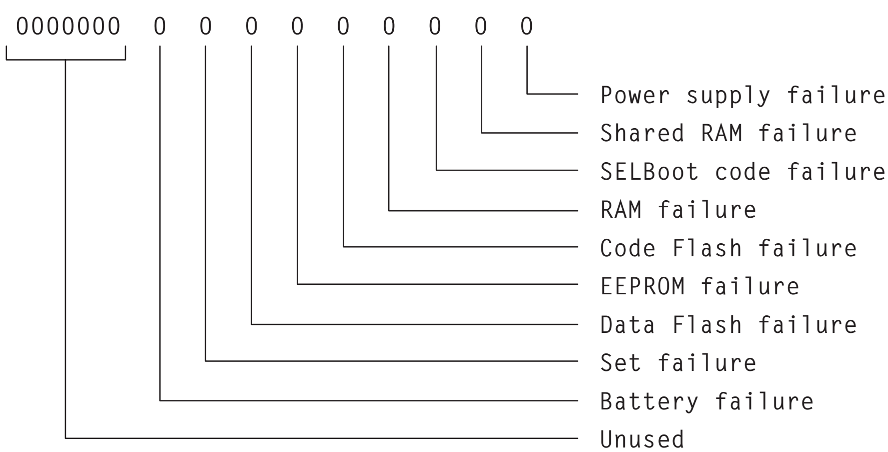
Starting Address	Data Item Label	Data Type	Notes
0128h	PC1_SERVICES	int[2]	Indicates what services are supported by both the SEL-2030 and the plug-in protocol card in Port 17. The first register is always 0. The second register uses the following bits: Bit 0: Card-initiated Virtual Terminal Bit 1: SEL-2030-initiated Virtual Terminal Bit 2: Card-initiated File Transfers Bit 3: SEL-2030-initiated File Transfers Bit 4: Card-initiated Control Operations Bit 5: SEL-2030-initiated Control Operations Bit 6: SEL-2030 can force card into SELBoot mode Bit 7: Card-initiated Time Sync. Bit 8: SEL-2030-initiated Time Sync. Bit 9: Card can force SEL-2030 into SELBoot mode
012Ah	PC1_STATUS	int	Bit-mapped integer that indicates card status: Bit 0: Card alive and initialized Bit 1: Card self-test failure Bit 2: Card network port failure Bit 3: Settings error Bit 4: Card running in SELBoot mode Bit 15: Card is no longer accessing shared-memory; card has probably failed
012Bh	PC1_CONFIG	int	Set to 0 if no card is recognized in Port 17; set to 1 if card is recognized
012Ch	PC1_STEST_ERR	int	Contains self-test error code from card. See the instruction manual for the card for interpretation.

Starting Address	Data Item Label	Data Type	Notes
0200h	PC2_FID	char[40]	Firmware identification string of the plug-in protocol card in Port 18
0228h	PC2_SERVICES	int[2]	Indicates what services are supported by both the SEL-2030 and the plug-in protocol card in Port 18. The first register is always 0. The second register uses the following bits: Bit 0: Card-initiated Virtual Terminal Bit 1: SEL-2030-initiated Virtual Terminal Bit 2: Card-initiated File Transfers Bit 3: SEL-2030-initiated File Transfers Bit 4: Card-initiated Control Operations Bit 5: SEL-2030-initiated Control Operations Bit 6: SEL-2030 can force card into SELBoot mode Bit 7: Card-initiated Time Sync. Bit 8: SEL-2030-initiated Time Sync. Bit 9: Card can force SEL-2030 into SELBoot mode
022Ah	PC2_STATUS	int	Bit-mapped integer that indicates card status: Bit 0: Card alive and initialized Bit 1: Card self-test failure Bit 2: Card network port failure Bit 3: Settings error Bit 4: Card running in SELBoot mode Bit 15: Card is no longer accessing shared-memory; card has probably failed
022Bh	PC2_CONFIG	int	Set to 0 if no card is recognized in Port 18; set to 1 if card is recognized

Starting Address	Data Item Label	Data Type	Notes
022Ch	PC2_STEST_ERR	int	Contains self-test error code from card. See the instruction manual for the card for interpretation.
0400h	PORT_STATUS	int	Read-only. See Port F Status Register subsection following this table.
0401h	ALT_PORT	int	Port number Port F is in transparent communications with; 255 if not transparently connected; read-only.
0402h	NUM_MESGS	Int	PORT F #Messages Received. Reset when port reset, or count exceeds 32767; read-only.
0403h	BAD_MESGS	Int	PORT F #Bad Messages Received. Reset when previous field reset; read-only.
0404h	Unused		

Global Status Register

SEL-2030 Global Status Register:



See **STATUS** command for complete discussion of failure types.

Configuration Register

SEL-2030 Configuration Register:

```
0  0  00  0  000  10  10  000  0

0 = No Modem
100 = I/O Board
000 = No I/O Board
10 = 512 kb RAM
11 = 64 kb EEPROM
000 = 0 kb Flash
100 = 2 Mb Flash
1 = 20 MHz CPU
00 = 256 kb Shared Memory
10 = 1 Mb Shared Memory
0 = 1 Mb Code Flash
1 = 2 Mb Code Flash
Not Used
```

Global Elements

Table 6.3 shows global elements. Table 6.4 lists definitions for global elements.

Table 6.3: Global Elements

Row	Global Elements							
0	SUN	MON	TUE	WED	THU	FRI	SAT	IRIG
1	V	W	X	XT	Y	YT	Z	ZT
2	R1	R2	R3	R4	R5	R6	R7	R8
3	PINAC	PCF	INAC	SDLY	*	PCFAIL	ALARM	SALARM
4	IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1
5	IN16	IN15	IN14	IN13	IN12	IN11	IN10	IN9
6	OUT1	OUT2	OUT3	OUT4	*	*	VT	WT

Row 0: Day-of-Week elements, SUN through SAT; one is asserted each day of the week; and the external IRIG-B status element (IRIG) is asserted when the SEL-2030 detects the external IRIG-B signal.

Row 1: Intermediate Variable elements, V, W, X, Y, and Z, are asserted when the corresponding intermediate logic equation is true; and associated timer bits, XT, YT, and ZT, are asserted when the pickup timer times out until the dropout timer times out.

Row 2: Remote elements, R1 to R8, are set, cleared, or pulsed by the **CONTROL** command.

Row 3: SEL-2030 Status elements indicate a port is inactive pending auto-configuration (PINAC); a port has failed power-up auto-configuration (PCF); at least one port is inactive because it is not responding or not responding correctly (INAC); and there has been at least one data collection missed since the last **STATUS** command (SDLY). The PCFAIL bit indicates if a plug-in protocol card has failed and is based on a SET G setting. The ALARM bit indicates if an alarm condition has occurred, based on a SET G setting. (If a self-test failure caused the alarm contact to close, this will not be indicated by this bit; only user-configured alarms will be indicated.) The SALARM bit asserts for one second whenever there is a settings change, Access Level 2 is gained, a password is entered incorrectly on three successive attempts, or a password is changed.

Row 4: External Input elements, IN1 to IN8, are asserted when the associated external input is asserted (only available with optional I/O board).

Row 5: External Input elements, IN9 to IN16, are asserted when the associated external input is asserted (only available with optional I/O board).

Row 6: External Output elements, OUT1 to OUT4, are asserted when the associated external output contact operates (only available with optional I/O board). Timer bits, VT and WT, assert when the pickup timer times out until the dropout timer times out.

All bit positions with an * are reserved for future use.

Table 6.4: Global Element Definitions

Element	Definition
SUN	Sunday Flag
MON	Monday Flag
TUE	Tuesday Flag
WED	Wednesday Flag
THU	Thursday Flag
FRI	Friday Flag
SAT	Saturday Flag
IRIG	IRIG-B Input Present Flag is set when IRIG-B input is sensed.
V	Intermediate Element V
W	Intermediate Element W
X	Intermediate Element Y
XT	X Element Timer Output
Y	Intermediate Element Y
YT	Y Element Timer Output
Z	Intermediate Element Z
ZT	Z Element Timer Output
R1	Remote Bit 1
R2	Remote Bit 2

Element	Definition	
.	.	
.	.	
.	.	
R8	Remote Bit 8	
PINAC	A port is in a Power-Up Inactive State	
PCF	A port is in a Power-Up Configuration Failure State	
INAC	A port is in an Inactive State	
SDLY	A SELOGIC® Control Equation automatic message operation has been missed on a port.	
*	Unused	
PCFAIL	A protocol card has failed; result of PCFAIL SELOGIC Control Equation setting	
ALARM	An alarm condition has occurred; result of ALARM SELOGIC Control Equation setting	
SALARM	Settings Change Alarm	
IN8	Input Eight Element	
IN7	Input Seven Element	
.	.	
.	.	
.	.	
IN1	Input One Element	
IN16	Input Sixteen Element	
IN15	Input Fifteen Element	Available with Optional I/O Board
.	.	
.	.	
.	.	
IN9	Input Nine Element	
OUT1	Output One Element	
OUT2	Output Two Element	
OUT3	Output Three Element	
OUT4	Output Four Element	
*	Unused	
*	Unused	
VT	V Element Timer Output	
WT	W Element Timer Output	

Remote Bit Control Register

```
00000000000  00  000

                           Bit Number
                           000 = R8
                           001 = R1
                           010 = R2
                           011 = R3
                           100 = R4
                           101 = R5
                           110 = R6
                           111 = R7

                           Operation
                           01 = set
                           10 = clear
                           11 = pulse

                                      Time
                           00000000001 = 1 sec
                           00000000011 = 3 sec
                                 .
                                 .
                                 .
Example:

writing 0000000001111011 or 007Bh to register 0037h
pulses remote bit R3 for 3 seconds.
```

Port F Status Register

```
00000000  0  000  0  100

                           Device Type
                           100 = Master Port

                           1 = Transparent Mode
                           0 = Not Transparent Mode

                           Unused

                           1 = Modem Connected Remotely
                           0 = No Modem or Modem Disconnected

                           Unused
```

Local Data Region (LOCAL)

The Local Data Region contains information specific to the local port. This information includes port status, local elements (intermediate logic, general command receipt, select-before-operate flags), database status, select-before-operate registers, archive queue counters, device FID (for auto-configured SEL IED ports), and port ID setting. (See Table 6.5, Table 6.6, and Table 6.7 for detailed information).

The Local Data Region also contains the most recent fault location and type. These registers are only used if 20EVENT or 20EVENTQ is set as a user-defined command so that the SEL-2030 is watching for unsolicited summary event reports. Once the fault location and type are updated, the SEL-2030 will not update them again until 30 seconds elapse during which no unsolicited event reports are received. This allows the database to maintain the type and location of the initial fault.

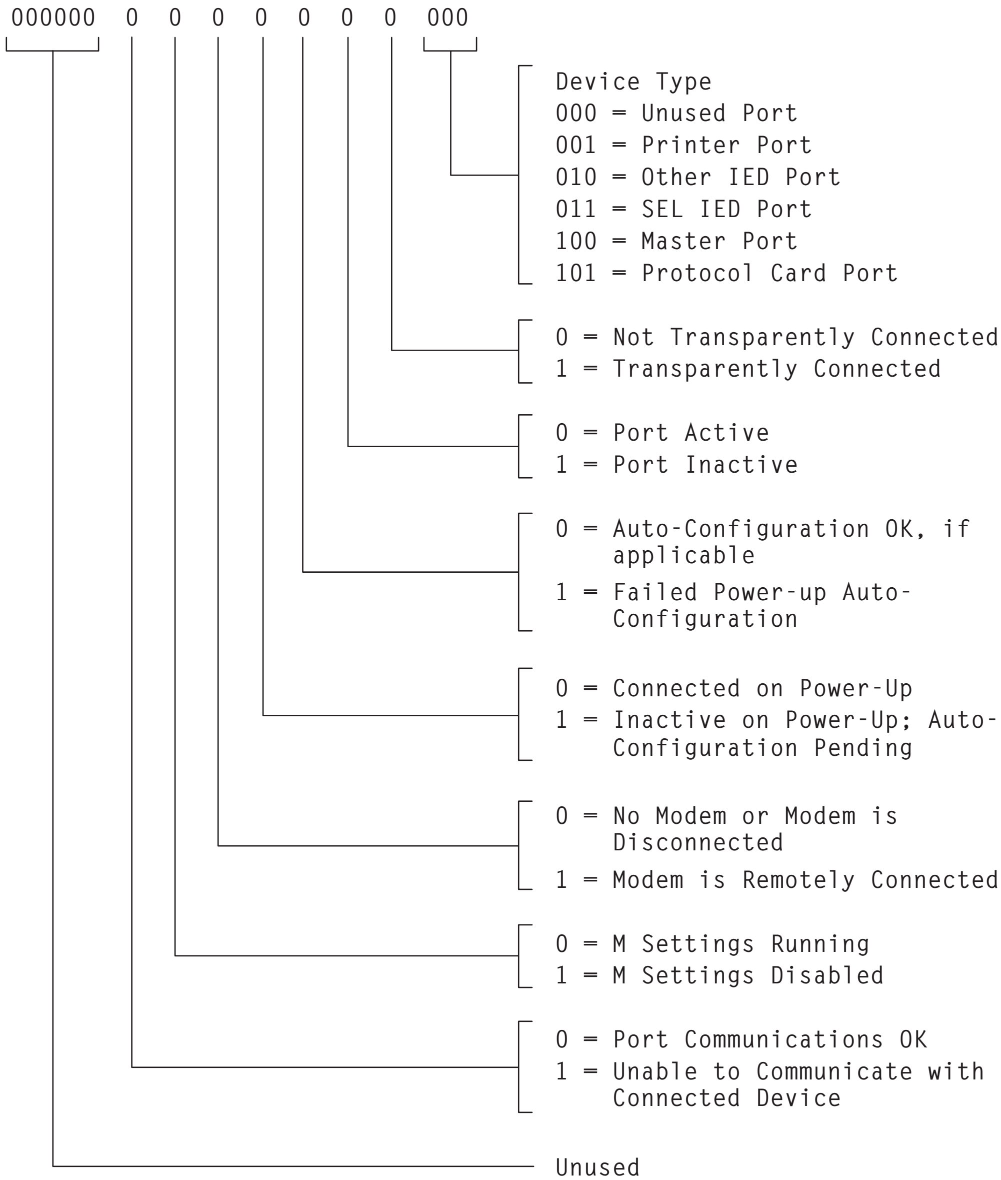
Table 6.5: Local Data Region

Starting Address	Data Item Label	Data Type	Notes
0800h	PORT_STATUS	int	Read-only. See ***Port Status Register*** following this table.
0801h	ALT_PORT	int	Port number this port is in transparent communications with; 255 if not transparently connected; read-only.
0802h	NUM_MESGS	int	#Messages Received. Reset when port reset, port inactive, or count exceeds 32,767; read-only.
0803h	BAD_MESGS	int	#Bad Messages Received. Reset when previous item reset; read-only.
0804h	ARCHIVE_CNTRS	int[3]	Number of records in each archive region; read-only.
0807h	ELEMENTS	char[18]	Read-only. See ***Local Elements*** following this table.
0819h	SBO_REGS	char[4]	Must write AAh then 55h to this register within 1 second to pulse SELOGIC Control Equations bit (SB01 through SB04 Table 6.7).
081Dh	COMMAND_REG	char	Number (1 through 8) of command bit (CMDx) to set; write-only.
081Eh	CLR_ARCH_REG	int	Write FE01h, FD02h, or FC03h to clear record in archive regions 1-3, respectively.
	⚠ CAUTION	Frequent archive record clearing may exceed EEPROM capabilities. See the discussion in the Archive Data Region subsection of ***Section 6: Database***.	
081Fh	FID	char[80]	FID string of attached SEL IED.
086Fh	PORTID	char[41]	Port ID setting.

Starting Address	Data Item Label	Data Type	Notes
0898h	EVENT_COUNT	char	Number of unread event reports. See ***20EVENT Features*** subsection in ***Section 5: Message Strings*** for more information.
0899h	FAULT_LOC	float	Most recent fault location.
089Bh	FAULT_TYPE	char[10]	ASCII string describing most recent fault type.
08A5h	UNSOL_WRT	int	Number of Unsolicited Write messages received since last reset. Resets when count exceeds 65,535, port reset, **STATUS C** or **STATUS R** command execution or UW_TIME reset; read only.
08A6h	UW_FAIL	int	Number of failed Unsolicited Write messages received since last reset. Resets when UNSOL_WRT or UW_TIME resets; read only. Note: The UW_FAIL register represents the total number of message failures. Additional detail is reported when the UW_FAIL register is read using the default SEL-2030 **VIEW** command (**VIEW n LOCAL**, where n represents port number). Failure counts are itemized and reported based on the following categories: CRC Fail Address Fail Insufficient Memory Busy General Data Error
08A7h	UW_TIME(ms)	int[2]	Time period since last Unsolicited Write statistics reset. Use this value to calculate message success/failure rates. Append two registers to get 32-bit time; register 08A7h is high-word, 08A8h is low-word. Resets when count exceeds 4,294,967,296 (about 50 days) or UNSOL_WRT reset; read only.

Starting Address	Data Item Label	Data Type	Notes
08A9h	UW_MAXTIME(ms)	int[2]	Maximum time between received Unsolicited Write messages. Append two registers to get 32-bit time; register 08A9h is high-word, 08AAh is low-word. Resets when UNSOL_WRT or UW_TIME resets
08Abh	BIN_STATUS	int	Binary Communications Status. Bit 0 = SER receipt enabled Bit 1 = SER transmit enabled Bit 2 = Unread SER data available Bit 3 = SER Data lost (from this port point of view) Bit 4-8 = Unused Bit 3 cleared by **STATUS C** or **STATUS R** command.
08Ach	BIN_MSG_LOST	int	Number of Binary Messages Dropped due to buffer overflow or invalid header. Cleared by **STATUS C** or **STATUS R** command
08ADh	UNSOL_SER_RX	int	Number of Unsolicited Binary SER Messages Received. Cleared by **STATUS C** or **STATUS R** command
08AEh	SER_RX_NOACK	int	Number of Unsolicited Binary SER Messages Received but not Acknowledged. Cleared by **STATUS C** or **STATUS R** command
08AFh	UNSOL_SER_TX	int	Binary SER Messages Transmitted. Cleared by **STATUS C** or **STATUS R** command
08B0h	SER_TX_NOACK	int	Binary SER Messages Transmitted but not Acknowledged. Cleared by **STATUS C** or **STATUS R** command

Port Status Register



The “Port Inactive” bit indicates a communications problem. Once the SEL-2030 has completed its power-up initialization, this bit sets whenever the connected device fails to respond correctly to an automatic message (SET A). The bit is cleared as soon as the SEL-2030 communicates successfully again with the device. The “Port Inactive” bit may be set and cleared regularly if the communications link is noisy. The “Port Inactive” bit does not apply to ports with Device Type set to Master. This bit will always be cleared (Port Active) for Master ports (including DNP and Modbus ports).

The “Unable to Communicate with Connected Device” bit is set only when the SEL-2030 fails on 10 consecutive attempts to communicate with the connected device. The bit is cleared as soon as the SEL-2030 communicates successfully with the device. This bit generally indicates a major communications problem, as opposed to an intermittent problem. This bit does not apply to ports with Device Type set to Master. The bit will always be cleared (Port Communications OK) for Master ports.

See the **STATUS** command description for a more complete discussion of the various port status possibilities.

Local Elements

Table 6.6 shows local elements. Table 6.7 lists the definitions for all port-specific elements.

Table 6.6: Local Elements

Row	Local Elements							
0	CMD1	CMD2	CMD3	CMD4	CMD5	CMD6	CMD7	CMD8
1	SBO1	SBO2	SBO3	SBO4	CTS	XOFF	INAC	UMB
2	D1	D2	D3	D4	D5	D6	D7	D8
3	D9	D10	D11	D12	ARCH1	ARCH2	ARCH3	MSET
4	DLY1	DLY2	DLY3	DLY4	DLY5	DLY6	DLY7	DLY8
5	DLY9	DLY10	DLY11	DLY12	DLYA1	DLYA2	DLYA3	DLY
6	BR1	BR2	BR3	BR4	BR5	BR6	BR7	BR8
7	BR9	BR10	BR11	BR12	BR13	BR14	BR15	BR16
8	RB1	RB2	RB3	RB4	RB5	RB6	RB7	RB8
9	RB9	RB10	RB11	RB12	RB13	RB14	RB15	RB16
10	SBR1	SBR2	SBR3	SBR4	SBR5	SBR6	SBR7	SBR8
11	SBR9	SBR10	SBR11	SBR12	SBR13	SBR14	SBR15	SBR16
12	SRB1	SRB2	SRB3	SRB4	SRB5	SRB6	SRB7	SRB8
13	SRB9	SRB10	SRB11	SRB12	SRB13	SRB14	SRB15	SRB16
14	CBR1	CBR2	CBR3	CBR4	CBR5	CBR6	CBR7	CBR8
15	CBR9	CBR10	CBR11	CBR12	CBR13	CBR14	CBR15	CBR16
16	CRB1	CRB2	CRB3	CRB4	CRB5	CRB6	CRB7	CRB8
17	CRB9	CRB10	CRB11	CRB12	CRB13	CRB14	CRB15	CRB16
18	*	*	*	*	*	*	*	NOCONN
19	*	*	*	*	*	*	*	*

Row 0: Command elements, CMD1 to CMD8, are each associated with one of the eight user-defined commands. The associated CMD bit is asserted when the SEL-2030 receives the user-defined command.

Row 1: Select-Before-Operate elements, SBO1 to SBO4, assert when two specific messages are sent in proper time sequence. Clear-To-Send element, CTS, is asserted when the CTS line is "up"; Transmit-OFF element, XOFF, is asserted when the SEL-2030 receives an XOFF signal from the attached device; the inactive element, INAC, is set when the port is inactive; and the Unsolicited-Message-Buffer element, UMB, asserts when a message is stored in the port BUF region.

Row 2: Message trigger elements, D1 to D8, set when the associated trigger operation is pending or in progress.

Row 3: Message trigger elements, D9 to D12, and Archive region trigger elements, ARCH1 to ARCH3, set when the associated trigger operation is pending or in progress. M settings element, MSET, is asserted while the Math/Move equations for the port are executing.

Row 4: Message trigger delay elements, DLY1 to DLY8, assert when the associated message trigger element, D1 to D8, does not reset before the next trigger condition occurs, indicating a possible data collection delay or message error.

Row 5: Message trigger delay elements, DLY9 to DLY12 and DLYA1 to DLYA3, assert when the associated message trigger element, D9 to D12 or ARCH1 to ARCH3, does not reset before the next trigger condition occurs, indicating a possible data collection delay or message error.

Rows 6–7: Breaker bits (BR1 - BR16) may be associated with issuing breaker operate commands (**OPEN**/**CLOSE**) or may be used as latches for intermediate SELOGIC Control Equations. These bits are set by the SBR1 - SBR16 elements and cleared by the CBR1 - CBR16 elements.

Rows 8–9: Remote bits (RB1 - RB16) may be associated with issuing remote bit commands (**CONTROL**) or may be used as latches for intermediate SELOGIC Control Equations. These bits are set by the SRB1 - SRB16 elements and cleared by the CRB1 - CRB16 elements.

Rows 10–13: Set breaker (SBR1 - SBR16) and set remote bit (SRB1 - SRB16) set the corresponding breaker and remote bit elements, but may also be used as intermediate terms for SELOGIC Control Equations. These bits are controlled by logic equations (SET L) and by receipt of master port *Fast Operate* commands.

Rows 14–17: Clear breaker (CBR1 - CBR16) and clear remote bit (CRB1 - CRB16) clear the corresponding breaker and remote bit elements, but may also be used as intermediate terms for SELOGIC Control Equations. These bits are controlled by SELOGIC Control Equations (SET L) and by receipt of master port *Fast Operate* commands.

Row 18–19: Asterisks indicate elements for future use. When NOCONN is set, no transparent communications are allowed to or through the port. Row 19 does not show in the **VIEW** command.

You can use the **VIEW** or **TARGET** command to show local element status. The SEL-2030 **TARGET** command response will also display the status of relay elements received from an attached SEL relay in rows 20 and up, as if they were appended to the local elements.

The **TARGET** command for Ports 17 and 18 will display the status of the CCIN and CCOUT bits in rows 20 and up, as if they were appended to the local elements.

Table 6.7: Local Element Definitions

Element	Description
CMD1	User-defined command number one received flag.
CMD2	User-defined command number two received flag.
.	.
.	.
.	.
CMD8	User-defined command number eight received flag.
SBO1	Select-before-operate register one flag. Pulsed by writing AAh then 55h to register 0819h within 1.0 second of each other.
SBO2	Select-before-operate register two flag. Controlled by register 081Ah.
SBO3	Select-before-operate register three flag. Controlled by register 081Bh.
SBO4	Select-before-operate register four flag. Controlled by register 081Ch.
CTS	Follows the state of CTS input.
XOFF	Set when port has been disabled by remote device using XOFF character.
INAC	Set when port is inactive.
UMB	Data present in unsolicited message buffer flag.
D1	Auto-message one trigger.
D2	Auto-message two trigger.
.	.
.	.
.	.
D12	Auto-message twelve trigger.
ARCH1	Archive one auto-message trigger.
ARCH2	Archive two auto-message trigger.
ARCH3	Archive three auto-message trigger.
MSET	Set while Math/Move equations executing.
DLY1	Auto-message one trigger overrun flag.
DLY2	Auto-message two trigger overrun flag.
.	.
.	.
.	.
DLY12	Auto-message twelve trigger overrun flag.
DLYA1	Archive one auto-message trigger overrun flag.
DLYA2	Archive two auto-message trigger overrun flag.
DLYA3	Archive three trigger overrun flag.
DLY	Logical OR of DLY1-12 and DLYA1-3.

Element	Description
BR1 BR2 . . . BR16	Local latch result which may be associated with Breaker 1. Local latch result which may be associated with Breaker 2. . . . Local latch result which may be associated with Breaker 16.
RB1 RB2 . . . RB16	Local latch result which may be associated with Remote Bit 1. Local latch result which may be associated with Remote Bit 2. . . . Local latch result which may be associated with Remote Bit 16.
SBR1 SBR2 . . . SBR16	Intermediate result which sets element BR1. Intermediate result which sets element BR2. . . . Intermediate result which sets element BR16.
SRB1 SRB2 . . . SRB16	Intermediate result which sets element RB1. Intermediate result which sets element RB2. . . . Intermediate result which sets element RB16.
CBR1 CBR2 . . . CBR16	Intermediate result which clears element BR1. Intermediate result which clears element BR2. . . . Intermediate result which clears element BR16.
CRB1 CRB2 . . . CRB16	Intermediate result which clears element RB1. Intermediate result which clears element RB2. . . . Intermediate result which clears element RB16.

Table 6.8 lists additional elements that are appended to the local elements for Ports 17 and 18, as viewed by the **TARGET** command and accessed by SELOGIC Control Equations. They are in the interface memory for the card slots rather than in the local database so are not included in the **VIEW** command.

Table 6.8: Ports 17 and 18 Control Input and Output Elements

Row	Control Elements							
20	CCIN1	CCIN2	CCIN3	CCIN4	CCIN5	CCIN6	CCIN7	CCIN8
21	CCIN9	CCIN10	CCIN11	CCIN12	CCIN13	CCIN14	CCIN15	CCIN16
22	CCIN17	CCIN18	CCIN19	CCIN20	CCIN21	CCIN22	CCIN23	CCIN24
23	CCIN25	CCIN26	CCIN27	CCIN28	CCIN29	CCIN30	CCIN31	CCIN32
24	CCIN33	CCIN34	CCIN35	CCIN36	CCIN37	CCIN38	CCIN39	CCIN40
25	CCIN41	CCIN42	CCIN43	CCIN44	CCIN45	CCIN46	CCIN47	CCIN48
26	CCIN49	CCIN50	CCIN51	CCIN52	CCIN53	CCIN54	CCIN55	CCIN56
27	CCIN57	CCIN58	CCIN59	CCIN60	CCIN61	CCIN62	CCIN63	CCIN64
28	CCOUT1	CCOUT2	CCOUT3	CCOUT4	CCOUT5	CCOUT6	CCOUT7	CCOUT8
29	CCOUT9	CCOUT10	CCOUT11	CCOUT12	CCOUT13	CCOUT14	CCOUT15	CCOUT16
30	CCOUT17	CCOUT18	CCOUT19	CCOUT20	CCOUT21	CCOUT22	CCOUT23	CCOUT24
31	CCOUT25	CCOUT26	CCOUT27	CCOUT28	CCOUT29	CCOUT30	CCOUT31	CCOUT32
32	CCOUT33	CCOUT34	CCOUT35	CCOUT36	CCOUT37	CCOUT38	CCOUT39	CCOUT40
33	CCOUT41	CCOUT42	CCOUT43	CCOUT44	CCOUT45	CCOUT46	CCOUT47	CCOUT48
34	CCOUT49	CCOUT50	CCOUT51	CCOUT52	CCOUT53	CCOUT54	CCOUT55	CCOUT56
35	CCOUT57	CCOUT58	CCOUT59	CCOUT60	CCOUT61	CCOUT62	CCOUT63	CCOUT64

Rows 20 - 27: CCIN1 **-** CCIN64 are input bits, set by the card installed in the slot.

Rows 28 - 35: CCOUT1 **-** CCOUT64 are output bits, set by the SEL-2030 using SELOGIC Control Equations specified with the **SET O** command.

You can use the **CARD** or **TARGET** command to view the status of the CCIN and CCOUT bits.

Unsolicited Message Queue (BUF)

The unsolicited message queue contains all unsolicited messages received from an IED. You must set AUTOBUF=Y with the **SET A** command for unsolicited messages to be stored here. Use the **CLEAR m:BUF** or **VIEW m:BUF C** commands periodically to clear the message queue so data are not overwritten. Alternatively, a \DACn/ string can clear these buffers.

At the top of the BUF region are two registers, Start Index and End Index (see Table 6.9), that contain register offsets. The Start and End Indices reference the beginning address of the circular buffer (1002h) to determine the address of the start and end of data. The first offset points to the address of the beginning of unread data. The second offset points to the address just beyond the last unread data. The SEL-2030 maintains the second offset. If you reference these data by region with VIEW, CLEAR, or \DAC string, the SEL-2030 maintains the first index for you. If you are directly reading the data (using VIEW by address, or user-defined **READ** command) you must maintain the first offset as data are read.

The remainder of the region acts as a circular character buffer beginning at address 1002h. Each register in the circular buffer contains one character. When the end of the buffer is reached, it wraps around to the beginning of the circular buffer (address 1002h) and continues. If the buffer gets full (end index catches up to start index), the oldest data will be overwritten.

When the SEL-2030 is connected to an SEL IED, the SEL-2030 removes all passwords that are echoed from the SEL IED that would otherwise go into the unsolicited message buffer. This typically occurs in response to issuing the STARTUP string to the SEL IED. This is to prevent unauthorized users from gaining access to the SEL IED passwords by examining the unsolicited message buffer.

Table 6.9: BUF (Unsolicited Message Queue) Organization

Starting Address	Data Item Label	Data Type	Notes
1000h	START_OFFSET	int	Offset from 1002h to first active character in buffer (0-4093).
,h	END_OFFSET	int	Offset from 1002h to next available character location in buffer (0-4093); read-only.
1002h	BUFFER	char[4094]	Circular buffer of characters; Start and End indices indicate where nonerased information exists; read-only.

Data Regions (D1-D8)

The Data regions hold data collected by the SEL-2030. The first four registers of each Data region hold the date and time the data were collected. The remainder of the Data region is for the collected data. Using the **SET A** command, you specify a parsing method for data. There are parsing methods defined specific to SEL relays for the following types of data:

- Demand meter
- Meter
- History
- Status
- Elements
- Breaker
- Event

The following parsing options are valid for any IED data:

- Extract and store integers.
- Extract and store floating points.
- Store response as character string.
- Store response as integer string.
- Store response as integer string while decoding XON/XOFF encodings.
- Ignore response.

The format of the data stored in a Data region depends on the parsing method and the type of device connected. Once you have set a Data region to collect a specific type of data, use the **MAP** command to determine how the data are organized and formatted. Refer to ***Section 3: Settings***, under **SET A**, for more detailed information about parsing options.

Archive Data Regions (A1 - A3)

These regions are very similar to the data regions. However, in these regions, the data are stored in nonvolatile Flash memory. Each region acts as a queue, buffering multiple responses. Each record can be as large as the region. The only limit on the number of records you can store in an archive region is the amount of available nonvolatile Flash memory. These data regions are only usable if optional nonvolatile Flash memory is installed in the SEL-2030. (Confirm the presence of nonvolatile Flash memory using the **STATUS** command.)

In the LOCAL Data Region of the database, counters are maintained for each Archive data region indicating the number of records currently queued up. You can view the archived data records with the **VIEW** command, or you can read the archived data records with an auto-message using the \F.../ formatted read message string. You can remove archived data records using the **CLEAR** or **VIEW C** commands, you can include the ;C or ;CA modifiers in a \F.../ string, or you can use the Clear Archive Register in the Local Data region.

⚠ CAUTION	Frequent archive record clearing may exceed EEPROM capabilities. Refer to the following paragraphs.

Carefully consider the method used for archive record clearing to ensure the SEL-2030 EEPROM does not experience premature failure. Every time an archive record(s) is cleared, a register corresponding to that port and region is updated. The EEPROM is guaranteed to support 100,000 writes; therefore, select a clearing method that will not clear any specific region more than 100,000 times.

The best way to minimize clearing operations is to use the **CLEAR A** command or the \F...; CA/ string to clear archive records on a periodic basis. These methods only cause one EEPROM update, while clearing a potentially large number of records. Use ***Appendix C: Planning Sheets*** to determine memory usage and necessary clearing frequency.

If the archive memory becomes full, the SEL-2030 will not store any new records until enough archive memory is freed up. Use the **MEMORY** command to check how full the memory is. You can use the planning guides in ***Appendix C: Planning Sheets*** to determine how much data will fit in the archive and plan your clearing method accordingly.

User-Defined Data (USER)

You can use this data region for whatever purpose you desire. When you are using DNP communications this is where the data is read from (see ***Section 7: Protocols*** for more information). Data can be put in this data region by writing from a master device using either the **STORE** command or the user-defined data **WRITE** command. Data can also be stored in this data region automatically using the **SET M** command. Any port may then use this data in constructing messages. Use SET A to enable this region. SET M will also enable this region if it was not previously set using SET A.

ACCESS METHODS

You can access data contained within the database by function, region, register, or bit.

Access by Function

You can access much of the data within the database based on its function; you do not need to know where it is in the database to reference it. The following commands access database information by function:

CONTROL	Affects Global elements in Global region.
DATE	Accesses date information in Global region.
ID	Reads FID string from Global or Local regions.
STATUS	Reads various Global and Local region items.
TARGET	Reads Global, Local, and Relay elements contained in Global, Local, and Dx regions.
TIME	Accesses time within Global region.

Access by Region

Access data by region when working with groups of associated data. To access by region, specify a port number and a region label. The region label may be the generic label or the data type, as given by the **MAP** command.

Table 6.10: Data Access by Region Labels

Generic Labels	Example Data Type Labels
GLOBAL	METER
LOCAL	DEMAND
BUF	TARGET
D1 through D8	STATUS
A1 through A3	FLOAT
USER	CHAR

The following commands use region access methods:

CLEAR
MAP
VIEW

The special message string \F.../ also uses region access.

Some examples of accessing data by region are:

VIEW 2:METER	Displays meter data from the Port 2 database.
MESG1="\F8:DEMAND/"	Defines the contents of MESG1 as formatted demand data from the Port 8 database.
CLEAR 7:A1	Clear the oldest record from region A1 of Port 7's database.

Access by Register

When you view a port database by register you are viewing a contiguous space of 64k registers. You reference a register in one of three ways:

Port Number:Address

Port Number:Region Label:Address Offset

Port Number:Region Label:Data Item Label

The **STORE** and **VIEW** commands support address accesses, as does the \R.../ special message string.

Consider accessing the year within the Global region. It can be referenced any of the following ways (the port number is arbitrary when you are accessing the Global region):

1:002Ah

1:GLOBAL:2Ah

1:GLOBAL:_YEAR

Some other examples are:

VIEW 5:1234h	An SEL-2030 command typed from the command line that displays the contents of Port 5, hexadecimal address 1234.
MESG1="\Rb;5:1234h/"	The same register and port number as above in a message string that defines the contents of Message 1 as register data found in that address in binary format.
MESG1="\Rf;5:METER:IA/"	Defines the contents of Message 1 as the IA data item of the meter data found in the Port 5 database in floating-point format.
STORE 8:USER:0 "Data"	Stores the string "Data" starting at first address of User data region on Port 8.

Often, you will wish to access multiple adjacent registers at once. The **STORE** command allows this by letting you store a set of data, starting at the specified address. Add the parameters NR and a count after the address in a **VIEW** command to display multiple registers. Add a semicolon and a count after the address within a \R.../ special message string to read multiple registers. The following examples illustrate multiple register access:

STORE 8:USER:0 5,7,9,11	Store integers 5,7,9, and 11 in first four registers of User region.
VIEW 5:LOCAL:ELEMENTS NR 6	View 6 registers, starting with first element register in Port 5's Local region.
MESG2= "\Rf;5:METER:IA;6/"	Read 6 registers (3 floats), starting with the IA register in the meter region of Port 5.

Access by Bit

Individual bits within the database can also be accessed. Five bit access methods are available:

Bit Label

Port Number:Bit Label

Port Number:Region Label:Bit Label

Port Number:Address:Bit Number

Port Number:Region Label:Address Offset:Bit Number

The first two access methods are shorthand notations for the third method. When only a bit label is specified, the SEL-2030 searches the Global, then Local, and then TARGET regions for the bit. When only a port number and bit label are specified, the SEL-2030 searches the Local, then TARGET regions on the specified port for the bit.

The last two access methods use bit numbers. Bit numbers must be in the range 0 to 15 where 0 is the least-significant bit and 15 is the most-significant bit.

Bit access is primarily used within SELOGIC Control Equations but can also be used within SET M equations and by the **VIEW** and **TOGGLE** commands. Bits within archive regions may not be used in SELOGIC Control Equations nor by the **TOGGLE** command. They can still be examined using the **VIEW** command. You can view the bit labels using the **TAR**, **MAP region BL**, and **VIEW region BL** commands.

Consider accessing the local element CMD4 on Port 5 from the Port 5 settings. This bit can be referenced the following ways:

CMD4	Bit Label
5:CMD4	Port Number : Bit Label
5:LOCAL:CMD4	Port Number : Region Label : Bit Label
5:0807h:4	Port Number : Address : Bit Number
5:LOCAL:7:4	Port Number : Region Label : Address Offset : Bit Number

Some other examples are:

	ISSUE1=IN1	References Global IN1 element if the I/O board is installed; otherwise references IN1 bit in TARGET region, if it exists.
or	VIEW 1:27L VIEW 1:TARGET:27L	View status of 27L bit on Port 1 within the TARGET region (27L does not exist in Local region).
	OUT2=5:TARGET:LOP	Causes OUT2 to follow the state of the LOP element in Port 5's TARGET region.
	OUT3=7:1234h:7	Causes OUT3 to follow the state of bit 7 (high bit of low byte) of register 1234h within the Port 7 database.
	X=9:D2:13h:Ah	Causes X to follow the state of bit 10 within the 19th register of Port 9's D2 region.

Within a SELOGIC Control Equation setting, if you reference a bit by address that does not exist, the SEL-2030 will respond with a warning message, but it will accept the setting.

TABLE OF CONTENTS

TABLES

SECTION 7: PROTOCOLS

INTRODUCTION

This section provides a detailed description of the protocols supported by the SEL-2030. The native command/response handling is described in ***Section 2: Commands***. This section describes the LMD Distributed Port Switch Protocol, *Fast Operate* Configuration and Commands, Modbus RTU Protocol, and DNP 3.0 Protocol. All of these protocols apply to master ports only; the SEL-2030 acts as a slave to these protocols.

LMD DISTRIBUTED PORT SWITCH PROTOCOL

This protocol permits multiple SEL devices to share a common communications channel. It is appropriate for low-cost, low-speed port switching applications where updating a real-time database is not a requirement.

Settings

Use the SET P command to activate the multidrop protocol. Change the PROTOCOL port setting from the default SEL to LMD to reveal the following settings:

ADDRESS:	Two character ASCII address. The range is "01" to "81". The default is "01". This address represents the first of 17 addresses that the SEL-2030 will use. The first address will connect you to the SEL-2030 in command/response mode. The subsequent 16 addresses will connect you directly to the respective port.
PREFIX:	One character to precede the address. This should be a character which does not occur in the course of other communications with the relay. Valid choices are one of the following: "@" "#" "$" "%" "&". The default is "@".
SETTLE TIME:	Time in seconds that transmission is delayed after the request to send (RTS line) asserts. This delay accommodates transmitters with a slow rise time.

Operation

1. The device ignores all input from this port until it detects the prefix character and the two-byte address.
2. The device then asserts the RTS line, which you can use to key a serial data transmitter. The port enables echo and message transmission. If the port has received an XOFF character, the device performs as if it received an XON.
3. Wait until you receive a prompt before entering commands to avoid losing echoed characters while the external transmitter is warming up.

4. Until the device connection terminates, you can use the standard commands that are available when PROTOCOL is set to SEL.
5. The QUIT command terminates the connection. If no data are sent to the device before the port time-out period, it automatically terminates the connection.
6. Enter the sequence CTRL-X QUIT <CR> before entering the prefix character if all devices in the multidrop network do not have the same prefix setting.

Note: You can use the SET P command to change the port settings to return to SEL protocol.

CONFIGURATION AND *FAST OPERATE* COMMANDS

Overview

This subsection describes the binary commands supported on SEL-2030 master ports using SEL protocol with FAST_OP=Y. There are three types of commands supported: device definition, *Fast Operate* configuration, and *Fast Operate* commands. See ***Application Guide AG95-10: Configuration and Fast Meter Messages*** to see how these commands relate to the general SEL binary command definitions.

Device Definition

The device definition can be found in response to the A5C0h command. It will have the following format:

A5C0	Command
10	Message length (16 bytes)
03	Support three protocols
00	Does not support *Fast Meter* messages
00	Does not support status flag commands
0100	Supports SEL protocol with *Fast Operate* commands
0001	Supports LMD protocol without *Fast Operate* commands
0002	Supports Modbus protocol
0005	Supports DNP protocol
00	Pad byte
xx	Checksum

Fast Operate Configuration

The *Fast Operate* Configuration information is returned in response to the A5CFh command. It has the following format:

A5CF	Command
0C	Message length (12 bytes)
12	18 ports
10	16 breakers per port supported
10	16 remote bits per port supported
A5E5	*Fast Operate* command to open a breaker

A5E6	*Fast Operate* command to close a breaker
A5E8	*Fast Operate* command to clear a remote bit
A5E7	*Fast Operate* command to set a remote bit
00	Pad byte
xx	Checksum

***Fast Operate* Commands**

Using the SEL-20202030 *Fast Operate* commands, you can set or clear any of the 256 breaker and 256 remote bits within the SEL-2020 or any of the 288 breaker and 288 remote bits in the SEL-2030. The impact of these bits depends on whether or not they are used in SELOGIC® Control Equations and whether or not they are used to trigger issuing of operate commands. See ***Section 3: Settings*** for more information.

Upon receipt of a *Fast Operate* message, the SEL-2020/2030 will set the appropriate bit within 100 milliseconds.

All SEL-2020/2030 *Fast Operate* commands have the following format:

Bytes	Usage
2	Command (one of A5E5, A5E6, A5E7, A5E8)
1	Message length - always 8
2	Operate Code - upper byte is port number (1-16 for SEL-2020, 1-18 for SEL-2030); lower byte is bit number (1-16)
2	Operation Validation Code: (4 * Operate Code) + 1
1	Checksum

FAST MESSAGE PROTOCOL

All values are displayed in hexadecimal format.

General message format:

Value	**Bytes**	**Description**
A546	2	Special binary header code to flag beginning of message
xx	1	Message length in bytes
xxxxxxxxxx	5	Routing value - will be 0 for point-to-point messages
xx	1	Status Byte
xx	1	Function Code - type of data transfer
xx	1	Sequence byte - always C0 for single frame message
xx	1	Response Number - sequential value 0-3
xxxx	??	First word of data
.	.	.
.	.	.
.	.	.
xxxx	??	Last word of data
yyyy	2	CRC-16 checksum for message

Routing

Routing value is currently always 0.

Status Byte

Bit 0 of the status byte is an acknowledge request bit. If this bit is set, the receiving device must acknowledge the message, as long as it has a valid CRC-16. (Messages with an invalid CRC-16 are ignored.)

Bit 1 indicates “configuration changed”. This implies settings or configuration changes that may affect the end receiving device. This bit is cleared when the message that contained this status information is acknowledged.

Function Code

Supported Function Codes:
0x01 - Enable unsolicited data transfers
0x02 - Disable unsolicited data transfers
0x18 - Unsolicited SER
0x20 - Unsolicited Data Write

Sequence Byte

Always 0xC0.

Response Number

Has one of the four values 00, 01, 02, 03. Should change from message to message. Used to associate an Acknowledge message with the appropriate Request message.

CRC

The CRC-16 code used by this protocol is the same as that used by the Modbus protocol, except for the byte ordering. This protocol shall send the CRC Most Significant Byte first. This CRC is based on the polynomial ($x^{16} + x^{15} + x^2 + 1$).

Acknowledge Message format:

Value	**Bytes**	**Description**
A546	2	Special binary header start code
0E	1	Message length in bytes - always 14 (0E)
xxxxxxxxxx	5	Routing value - will be 0 for point-to-point messages
xx	1	Status Byte - bit 0 must be 0
xx	1	Function Code - echo of acknowledged function code with high-bit set
xx	1	Response Code
xx	1	Response Number - numeric message identifier 0-3
yyyy	2	CRC-16 checksum

Response Codes are as follows:

0 success
1 unrecognized function code
2 function disabled (function code supported but turned "OFF")
3 invalid data address
4 invalid data
5 insufficient memory
6 busy (system resource unavailable)

The Response Number in the Acknowledge message is determined by the Response Number in the request. It the request has Response Number 02, then the Acknowledge should have Response Number 02.

Data Format for Supported Function Codes

0x01 - Enable unsolicited data transfers

This will allow the attached device to begin sending unsolicited data, if it has such data to transfer. All devices will start-up with their unsolicited data disabled. The data area includes four bytes per enabled Function Code with the first byte specifying the Function Code and the three subsequent bytes used for configuration parameters. Only the following Function Codes are applicable: 0x18. For function code 0x18, the low byte of the three configuration bytes is used to set the maximum number of SER records within the message. For example, to enable Unsolicited SER messages with a maximum of 20 records per SER message, the data area contents in hexadecimal could be as follows: 18 00 00 14 (enabled Function Code = 0x18, maximum records for Function Code 0x18 is 20 decimal).

0x02 - Disable unsolicited transfers

This will cause the attached device to discontinue transferring unsolicited data. The data area includes a list of disabled Function Codes, with two data bytes per function code (not currently used). The same list of Function Codes applies here as with Function Code 0x01. For example, to disable Function Code 0x18, the data area should be as follows (hexadecimal): 18 00.

0x18 - Unsolicited Sequential Events Recorder Response

Used to transmit Sequential Events Recorder (SER) data. The data format is shown below:

4-byte origination path (d1.d2.d3.d4)
2-byte day-of-year (1-366),
2-byte 4-digit year,
4-byte time of day in milliseconds,
1st record 1-byte element index,
1st record 3-byte microseconds,
2nd record 1-byte element index,
2nd record 3-byte microseconds,
.
.
.

nth record 1-byte element index,
nth record 3-byte microseconds,
4-byte End-Of-Records indicator - FF FF FF FE (not included when MAX=1)
4-byte element status (packed bits)

A single SER message can have a maximum number MAX of 32 records and the data may span a time period t of no more than 16 seconds. The device that enables the Unsolicited SER message determines the value of MAX. This value is transmitted within the "Enable" message (function code 0x01). When the maximum number of records is set to 1, the End-Of-Records indicator (FFFFFFFE) should not be included.

The origination path (d1.d2.d3.d4) identifies the route that a message took from the sender (originator) to the ultimate receiver (Master). This uniquely identifies each potential SER message originator. Each of the four bytes within the origination path identifies a port number or device address, where the highest byte (d1) is the first device identifier and (d4) is the last. The value zero (0) is not allowed as a port number or address and, if used, indicates the end of the origination path (e.g. 2.45.0.0)

The element status is a sequence of packed bits, with bit 0 (Least Significant Bit) corresponding to record 1 (first SER element) and bit 31 corresponding to record 32 if applicable.

0x20 - Unsolicited Write

This function code is used to write data to a device via the \W…/ message string. The data format consists of a 4-byte destination User Region address (F800-FFFE), a 2-byte register count (1-115), and the register data to write.

MODBUS RTU PROTOCOL

Overview

The SEL-2030 Communications Processor supports the Modbus RTU protocol on ports 12, 14, and 16 for data access from any SEL-2030 port. The SEL-2030 is always a Modbus slave. All data within the SEL-2030 database can be read using Modbus. Basic control functions can be performed using Modbus.

You can set the SEL-2030 for up to 18 Modbus slave addresses; set a unique slave address for each port that has data you want to collect through a Modbus port. The Modbus master views the SEL-2030 as a group of individual devices, each with a unique Modbus slave address.

Modbus protocol compatibility facilitates connection to many Remote Terminal Units (RTU), and to most Programmable Logic Controllers (PLC) and PLC Networks.

Settings

From Port F or another master port, use the SET P 12, SET P 14, or SET P 16 command to set the device type to "MASTER" and the protocol to "MODBUS". The SEL-2030 will prompt for the map style, device ID offset, and Modbus slave address for each of 18 ports. With the map type setting, you select between the default map which contains floating-point data and the integer-only map. With the device ID offset setting, you can select an offset for the device ID table, which is discussed later in this appendix. You must also provide the slave device address(es) for Modbus access to data from the desired port(s).

For each SEL-2030 port connected to an IED with data you want to access by Modbus, you must use the following SET commands (refer to ***Section 3: Settings***):

- Use the SET P command to set and auto-configure the SEL IED Port.
- For function code 04 access, use the SET A command to specify 20METER, 20DEMAND, 20HISTORY, 20TARGET, and 20BREAKER data retrieval as desired. The region selected for the data collection does not matter; Modbus will access the first data region of that type on the port. You can also access user region data using this function code.
- For function code 03 access, set the collections as desired and use the MAP command to determine the data addresses.
- For custom data access, use SET M to organize and scale data as desired. This is generally the most efficient method.

Hardware Connections and RTS Line Usage

An EIA-232 Connection is the most common connection between an SEL-2030 Communications Processor and a Remote Terminal Unit. When Modbus is used in a dedicated link, the RTU should ignore the RTS output from the SEL-2030. To accomplish this, you may need to connect the Clear-To-Send (CTS) pin to +12 Vdc in the cable connector at the RTU.

If you use the SEL-2030 as a slave in a multidrop Modbus configuration, use the Request-To-Send (RTS) output as your “push-to-talk” signal to “key on” the slave transmitter. Devices that typically utilize RTS keying include EIA-232 to 4-wire EIA-485 converters and modems bridged to a shared audio line. The SEL-2030 asserts the RTS line prior to transmitting, executes the delay established by the SETTLE1 setting, transmits a message, executes the delay established by the SETTLE2 setting, and deasserts the RTS line. While the SETTLE2 (posttransmit) delay is executing, the RTS line remains asserted. So, a transmission that occurs during the SETTLE2 delay will be sent without executing the SETTLE1 (pretransmit) delay.

Data Access Considerations

When you program the Modbus master device to read data, you may access all data in one read message, or you may access selected data with separate read messages. If you read all data, the data you read will all correspond to a single data sample from the attached relay. However, if you read the data in pieces, subsequent reads will not necessarily be from the same data sample. You can avoid this by using the 05 function code to freeze a copy of the data for reading. This is discussed in detail later in this subsection.

Data can be stored in either an archive region or a normal database region. If the data are stored in a normal database region, the data retrieved through Modbus protocol are the newest collected data from the relays. If the data are stored in an archive region, the data retrieved through Modbus protocol are the oldest collected data from the relays.

To clear the oldest collected data in an archive region, send the “clear” message (using function code 05h). After the oldest record is cleared, the next record can be read. The “clear” only works for data in an archive region. If the data are not stored in an archive region, the SEL-2030 will respond to the “clear” with an exception message containing error code “Illegal Data Address (02h).”

Timing

The SEL-2030 will respond to all Modbus requests, if it is going to respond at all, within 0.5 seconds of receiving the request (1.0 seconds if reading from an archive region). To determine the minimum sampling interval, you must add the maximum time for request and response messages and for master processing to this response time. If the SEL-2030 receives a Modbus request before it has finished processing the previous request, it will ignore the new request and respond to the original one.

The SEL-2030 monitors the elapsed time between receipt of characters. If 3-½ character times elapse without a new character, then the SEL-2030 ends the message and starts listening for a new transmission. All messages received by the SEL-2030 must be separated by at least 3-½ character times plus 2.0 ms to ensure there is no confusion between messages. (3-½ character times is 4.0 ms at 9600 baud.)

Function Codes

Message Framing

All Modbus data requests consist of an address, a function code, some data, and a checksum. For the SEL-2030 to respond, the address must match one of those established in the settings and the checksum must be valid. This frame format can be viewed as:

1 byte	Slave Address (must match an ADDRESSn setting)
1 byte	Function Code (see below for supported function codes)
n bytes	Information specific to function code
2 bytes	CRC-16 code for message

For successful operations, the response message will have the same format as the request message. For error responses, the message format will be as follows:

1 byte	Slave Address (echo of received)
1 byte	Exception Function Code (function code with high-bit set)
1 byte	Exception Code (see below)
2 bytes	CRC-16 code for message

Whenever multiple-byte values are sent over Modbus, they are sent most significant byte first.

The function codes supported by the SEL-2030 are:

01h	Read Coil Status
02h	Read Input Status
03h	Read Holding Register
04h	Read Input Register
05h	Force Single Coil
06h	Preset Single Register
10h	Preset Multiple Registers
11h	Report Slave ID

Read Coil Status (Function Code 01h)

The SEL-2030 uses function code 01h to read the status of various bits. You may read up to 1000 bits at once.

The master request must have the following format:

1 byte	Slave Address
1 byte	Function Code (01h)
2 bytes	Starting Bit Address
2 bytes	Number of Bits to Read
2 bytes	CRC-16 for Message

A successful SEL-2030 response will have the following format:

1 byte	Slave Address
1 byte	Function Code (01h)
1 byte	Byte Count
n bytes	Data
2 bytes	CRC-16 for Message

The data response contains 8 bits per data byte, with the LSB of the first byte corresponding to the addressed bit.

The following table lists the supported bit addresses:

Bit Addresses	Corresponding Database Register
1000h - 100Fh	Global Status Register
1010h - 101Fh	Global Configuration Register
1020h - 1057h	7 Global Element Registers (low-byte only)
1058h - 105Fh	Reserved - Always 0
1060h - 106Fh	Local Status Register
1070h - 10FFh	18 Local Element Registers (low-byte only)
1100h - 15FFh	Target Region Targets (low-bytes only)
1600h -	User Region Registers

In all cases, bit numbering starts with the LSB of each register. See ***Section 6: Database*** for a description of these registers. To access relay target data, you must set a region to collect the target data. Then, using the command MAP n TARGET BL, you can determine how many bytes of target data exist and what each bit is. The first target element is accessible at 1100h.

When referencing the data from most masters, you will need to set the coil number one greater than the listed bit address (0X references).

Read Input Status (Function Code 02h)

Function code 02h is used in a manner identical to function code 01h, as discussed above. Most masters use 1X references with this function code. To find the 1X reference with 5-digit addressing, add 10001 to the bit address specified above.

Read Holding Register (Function Code 03h)

The SEL-2030 uses function code 03h for reading from the database directly. ***Section 6: Database*** discusses the database. Use the MAP command to determine the details of the register maps based on your settings. You may read a maximum of 125 registers at once with this function code. Most masters use 4X references with this function code. To find the 4X reference with 5-digit addressing, add 40001 to the database addresses.

From a Modbus Master, reading registers in the database with addresses above 9999 (270Fh), requires 6-digit addressing to avoid corrupting the type identifier digit 4. For example, the first register in the user region is at address F800h which translates to 463489 in 6-digit addressing.

To read the user region with 5-digit addressing, access registers as 3X using function code 04.

The master request must have the following format:

1 byte	Slave Address
1 byte	Function code (03h)
2 bytes	Starting database address
2 bytes	Number of registers to read
2 bytes	CRC-16 for message

A successful SEL-2030 response will have the format:

1 byte	Slave Address
1 byte	Function code (03h)
1 byte	Byte count (should be twice number of registers read)
n bytes	Byte Count Bytes of Data
2 bytes	CRC-16 for Message

Read Input Register (Function Code 04h)

The SEL-2030 uses function code 04h for reading from a Modbus specific map. This map has various kinds of data at specific addresses, independent of user settings. You must merely collect the data in some region, and it will be visible in this register map. In this map, you can also select whether to use the standard-style, which includes floating-point data, or an integer-only map, based on a setting. You may read a maximum of 125 registers at once with this function code.

The master request must have the following format:

1 byte	Slave Address
1 byte	Function Code (04h)
2 bytes	Starting database address
2 bytes	Number of registers to read
2 bytes	CRC-16 for message

A successful SEL-2030 response will have the format:

1 byte	Slave Address
1 byte	Function Code (04h)
1 byte	Byte Count (should be twice number of registers read)
n bytes	Byte count bytes of data
2 bytes	CRC-16 for message

Table 7.1 through Table 7.10 contain register maps for meter data, demand meter data, history data, target data, and breaker data from various SEL relays for 04h accesses. You can use these maps to identify the registers that contain the data you want to collect through the Modbus port. These maps contain the same data available in database regions, but it is arranged differently. Most masters use 3x references when accessing input registers. To use this reference method with 5-digit addressing, simply add 30001 to the address in the tables. Floating-point items are transferred most-significant word first. Make sure your master can accept floating-point data in this format before using it.

User region registers can be accessed using 5-digit addressing starting at 32401 and following.

Force Single Coil (Function Code 05h)

The SEL-2030 uses this function code for a variety of data control purposes. Specifically, you can use it to clear archive records, hold copies of data records, release copies of data records, and operate breaker and remote bit elements.

The master request must have the following format:

1 byte	Slave Address
1 byte	Function Code (05h)
2 bytes	Coil Reference
2 bytes	Operation Code
2 bytes	CRC-16 for Message

A successful SEL-2030 response will be an echo of the request message.

There are six special purpose coil references:

0000h	Clear archive record using function code 04h addressing
0003h	Copy a region using function code 04h addressing
0004h	Release a region copy using function code 04h addressing
0010h	Clear archive record using function code 03h addressing
0013h	Copy a region using function code 03h addressing
0014h	Release a region copy using function code 03h addressing

Coil references 0000h and 0010h are for clearing archive records. The operation code must be the starting address of the record to clear. Once you clear an archive record, subsequent reads from that region will return data from the next record stored in that region.

CAUTION Frequent archive record clearing may exceed EEPROM capabilities. See the discussion in the Archive Data Region subsection of ***Section 6: Database***.

Coil references 0003h and 0013h cause a copy of the specified region to be made. Subsequent reads from this region will read from your copy. This allows you to read data regions that are larger than 125 registers without the data changing between accesses. Specify the region to copy by giving its starting address as the operation address. Use coil references 0004h and 0014h to release the region copy once you are done with it. If there is insufficient memory to make the requested copy, the SEL-2030 will respond with a BUSY exception code.

For coil references 0000h, 0003h, and 0004h, the operation code must correspond to a modified map address (map function code 04h uses). For operation code 0010h, 0013h, and 0014h, this starting address must correspond to a true database address.

Coil references 10AOh through 10BFh correspond to the port breaker and remote bit elements:

10A0h - 10A7h	correspond to BR8-BR1
10A8h - 10Afh	correspond to BR16-BR9
10B0h - 10B7h	correspond to RB8 - RB1
10B8h - 10BFh	correspond to RB16 - RB9

Send a coil ON (operation code FF00h) to set the bit and OFF (operation code 0000h) to clear the bit.

When referencing coils from most masters, you will need to set the coil number one greater than the specified coil reference.

Preset Single Register (Function Code 06h)

The SEL-2030 uses this function to allow a Modbus master to write directly to a database register. ***Section 6: Database*** shows which registers are writeable and defines their operation. If you are accustomed to 4X references with this function code, for 6-digit addressing simply add 400001 to the standard database addresses.

The master request must have the following format:

1 byte	Slave Address
1 byte	Function Code (06h)
2 bytes	Register Address
2 bytes	Data
2 bytes	CRC-16 for message

A successful SEL-2030 response will be an echo of the request message.

Preset Multiple Registers (Function Code 10h)

This function code works much like code 06h, except that it allows you to write multiple registers at once, up to 120 per operation. Normally, this function code will only be used in the User region. If you are accustomed to 4X references with the function code, for 6-digit addressing simply add 400001 to the standard database addresses.The master request must have the following format:

1 byte	Slave Address
1 byte	Function Code (10h)
2 bytes	Starting Address
2 bytes	Number of registers to write
1 byte	Byte count (should be twice number of registers)
n bytes	Byte count bytes of data
2 bytes	CRC-16 for Message

A successful response will have the format:

1 byte	Slave Address
1 byte	Function Code (10h)
2 bytes	Starting Address
2 bytes	Number of Registers
2 bytes	CRC-16 for Message

Report Slave ID (Function Code 11h)

The SEL-2030 identifies the port device type when it receives this request. It also provides information on how data is being collected from an SEL relay so the specific map to use can be determined.

The master request must have the following format:

1 byte	Slave Address
1 byte	Function Code (11h)
2 bytes	CRC-16 for Message

A successful SEL-2030 response will have the following format:

1 byte	Slave Address
1 byte	Function Code (11h)
1 byte	Byte Count (7)
1 byte	Slave ID (see following table)
1 byte	Run Status
1 byte	*Fast Meter* status
4 bytes	Reserved (always 0)
2 bytes	CRC-16 for Message

The reported slave ID is simply the sum (modulo-256) of the START_ID setting and the device ID from the following table:

Slave ID		
	00	Unused
	01	Printer
	02	Other IED
	03	Unknown SEL IED
	04	Master Port
	05	SEL-49
	06	SEL-121
	07	SEL-121-10
	08	SEL-121B/221B
	09	SEL-121C/221C
	10	SEL-121D/221D
	11	SEL-121F/221F
	12	SEL-121G/221G
	13	SEL-121H/221H
	14	SEL-121S/221S
	15	SEL-151/251
	16	SEL-151C/251C
	17	SEL-151CD/251CD
	18	SEL-151D/251D
	19	SEL-167/267
	20	SEL-167D/267D
	21	SEL-187V/287V
	22	SEL-279
	23	SEL-279H
	24	SEL-321
	25	SEL-501
	26	SEL-BFR/2BFR
	27	SEL-PG10/2PG10
	28	SEL-587
	29	SEL-551
	30	SEL-351
	31	SEL-352
	32	SEL-387
	33	SEL-300G
	34	SEL-351R
	35	SEL-701

You would normally only offset this table, using START_ID, if you need the values to be unique from the IDs of other devices on your Modbus network. The reported run status will be FFh if the port is Active, 00h otherwise. The *Fast Meter* status indicates what data is being collected using binary data collection. Possible values are:

0 No *Fast Meter*
1 Meter data only
3 Meter and Target data
7 Meter, Target, and Demand data

Error Handling

There are a number of errors that an SEL-2030 Modbus port can detect and handle. Framing errors (message did not have a correct slave address or length) and CRC mismatches will prevent an SEL-2030 response to the message. If a legitimate message is received, but cannot be processed, the SEL-2030 will respond with an error response, as indicated in the Message Framing subsection above. The following is a list of possible exception codes:

01 - ILLEGAL FUNCTION	The received function code is not supported.
02 - ILLEGAL DATA ADDRESS	Some portion of requested registers is undefined or invalid. For data writes, this may mean that the address is read-only. For force single coil operations, the address is not the beginning of a valid region.
03 - ILLEGAL DATA VALUE	The referenced data value in a force single coil operation is not valid for the given coil.
04 - FAILURE IN ASSOCIATED DEVICE	The port accessed is not currently collecting the desired data because of improper settings or because the port is inactive or read from an empty region.
06 - BUSY, REJECTED MESSAGE	The SEL-2030 is unable to respond in a timely fashion due to internal data access conflicts. Also, used to indicate insufficient memory for requested operation.

Master Device Configuration Considerations

Modbus masters are capable of block requesting registers. Block requests of data can be a problem, as described in the following example. You want 5 registers starting at address 105, and another 5 registers starting at address 205, and your Modbus master can request up to 125 registers. It will request 105 registers starting at address 105. The SEL-2030 may not have data defined for all addresses between 100 and 200, and will declare the request invalid. To get these 10 registers, you must alter the maximum registers that your Modbus master can request, or move the registers to a contiguous area of a user region (using the SET M procedure) and request them at this new address.

“Job Done” Examples For Modbus

Example #1: Simple Meter Data Access

This example demonstrates the ability of the SEL-2030 to provide data to a Modbus master device. This example uses the SEL-2030, an SEL-321-1 Relay, and a Modbus Master set-up as follows:

1. Connect the SEL-321-1 Relay to an SEL-2030 port (this example uses Port 2). Use the SEL-C239 (Y type) cable because it handles both communication and IRIG-B. Connect the communication terminal at the Y end of the cable to a port on the SEL-321-1 Relay. Connect the IRIG-B terminal at the Y end to the relay's AUX input port. Connect the single connector end of the cable to Port 2 on the SEL-2030.
2. Connect a Modbus master device to an SEL-2030 Modbus port; this example uses Port 16.
3. Change the SEL-2030 access level to Access Level 2 on the SEL-2030 and issue the command SET P 16 to configure Port 16. The SEL-2030 will prompt for the type of device connected to the port. Enter **M** for Master, enter **M** a second time for Modbus protocol. Select the default floating-point map and set the start ID to 0. Assign an address to Port 2 and enter OFF for other port addresses. See the following example:

```
*>>SET P 16<ENTER>

Port communications settings for Port 16

Device Type (U=Unused, S=SEL IED, O=Other IED,
             P=Printer, M=Master)            DEVICE  = S     ? M<ENTER>

Communications Type (S=SEL, L=LMD, M=MODBUS)  PROTOCOL= S     ? M<ENTER>

Modbus Map Type (F=Float, I=Integer)          MAP_TYPE= F     ? <ENTER>

Starting Code for ID List (0-255)            START_ID= 0     ? <ENTER>

Transmission delay from RTS assertion (0-30000 milliseconds) SETTLE1=0 ? <ENTER>

Post-transmit RTS deassertion delay (0-30000 milliseconds) SETTLE2=0 ? <ENTER>

Address of Port 1 (1-247)                    ADDRESS1= OFF   ? <ENTER>

Address of Port 2 (1-247)                    ADDRESS2= OFF   ? 6<ENTER>

Address of Port 3 (1-247)                    ADDRESS3= OFF   ? END<ENTER>

PORT:16
DEVICE  = M
PROTOCOL= M
MAP_TYPE= F
START_ID= 0
SETTLE1 = 0
SETTLE2 = 0
ADDRESS1= OFF  ADDRESS2= 6    ADDRESS3= OFF  ADDRESS4= OFF
ADDRESS5= OFF  ADDRESS6= OFF  ADDRESS7= OFF  ADDRESS8= OFF
ADDRESS9= OFF  ADDRESS10= OFF  ADDRESS11= OFF  ADDRESS12= OFF
ADDRESS13= OFF  ADDRESS14= OFF  ADDRESS15= OFF  ADDRESS16= OFF
ADDRESS17= OFF  ADDRESS18= OFF
PORTID  =""
BAUD    = 9600
PARITY  = N

Save changes (Y/N) ? Y<ENTER>

Port 16 Settings Changed

*>>
```

4. Issue the command SET P 2 to configure Port 2. The SEL-2030 will prompt for the type of device connected to the port. Enter **S** for SEL IED, enter **Y** to auto-configure the port, and press **<ENTER>** to confirm the configuration prompts. The SEL-2030 will establish communication with the relay, relay ID, and communication baud rate and determine if the relay is capable of *Fast Meter*. Enter **Y** to save port configuration changes at the final prompt.

5. Next, issue the command SET A 2 to set an auto-message to collect relay meter data. Respond to prompts about saving unsolicited messages (AUTOBUF) and the STARTUP string. Press **<ENTER>** to confirm the defaults for both prompts. Enter 1 when prompted for the message count. At the ISSUE1 prompt, enter **P00:00:01** to set the message to trigger once every second. At the MESG1 prompt, enter **20METER** to send the request for meter data to the SEL relay. Press **<ENTER>** to accept the default for remaining settings and enter Y to save changes. As soon as the SEL-2030 accepts the setting change, the TXD and RXD Port 2 LEDs on the SEL-2030 will begin to flash as the SEL-2030 requests and receives meter data every second.

6. Confirm that the meter data are collected in binary format by issuing a MAP 2 command. The D1 region should show a "B" preceding the METER data type, indicating binary collection.

7. View the data stored in the Port 2 METER data region by issuing the command VIEW 2:METER or VIEW 2:D1. The SEL-2030 responds with a data "dump" showing the data stored in the region at the time of the request with the respective data item labels. In this example, the data are updated once each second.

8. Cause the Modbus master to send a "read PORT 2 METER region" message. In the message, the slave address field is the Port 2 address set in Step 3. The Register Address field is METER (100). The Register Count is the meter data length for SEL-321-1. (See Table 7.1 for the register map.) The returned METER data are the same as the data displayed by the VIEW command if the data have not been updated since issuing the VIEW command. The following shows a typical exchange:

   Received message:

06	to address 6
04	function code 4
00 64	starting register address 100
00 60	read 96 registers
xx xx	CRC-16 code

Response message:

06 — from address 6

04 — successful function code 4 response

C0 — 192 bytes of data following

00
05 — first register

00
02 — second register

...

yy
yy
yy
yy — last two registers (IEEE float)

xx
xx — CRC-16 code

Example #2: Accessing Centralized Data

This example demonstrates the ability of the SEL-2030 to centralize data to reduce the number of Modbus accesses necessary to collect data. This example uses an SEL-121F and an SEL-501 on Ports 3 and 4 of an SEL-2030, respectively. The objective is to read the current and voltage magnitudes from the relays with a single Modbus access. The following procedure explains how to set the SEL-2030 and collect the data.

1. Connect the two relays to Ports 3 and 4 of the SEL-2030. Establish basic communications settings to the first relay by auto-configuring using SET P 3. Use SET A 3 to set meter data collection. Copy these settings to Port 4 using COPY 3 4. Auto-configure Port 4 while copying.

2. Set Port 16 to be a Modbus port, as shown below:

```
*>>SET P 16<ENTER>

Port communications settings for Port 16

Device Type (U=Unused, S=SEL IED, O=Other IED,
             P=Printer, M=Master)           DEVICE  = U     ? M<ENTER>

Communications Type (S=SEL, L=LMD, M=MODBUS) PROTOCOL= S     ? M<ENTER>

Modbus Map Type (F=Float, I=Integer)         MAP_TYPE= F     ? <ENTER>

Starting Code for ID List (0-255)            START_ID= 0     ? <ENTER>

Transmission delay from RTS assertion (0-30000 milliseconds) SETTLE1=0 ? <ENTER>

Post-transmit RTS deassertion delay (0-30000 milliseconds) SETTLE2=0 ? <ENTER>

                                    (continued on next page)
```

(continued from previous page)

```
Address of Port 1 (1-247)                   ADDRESS1= OFF   ? <ENTER>

Address of Port 2 (1-247)                   ADDRESS2= OFF   ? <ENTER>

Address of Port 3 (1-247)                   ADDRESS3= OFF   ? 15<ENTER>

Address of Port 4 (1-247)                   ADDRESS4= OFF   ? 16<ENTER>

Address of Port 5 (1-247)                   ADDRESS5= OFF   ? <ENTER>

Address of Port 6 (1-247)                   ADDRESS6= OFF   ? <ENTER>

Address of Port 7 (1-247)                   ADDRESS7= OFF   ? <ENTER>

Address of Port 8 (1-247)                   ADDRESS8= OFF   ? <ENTER>

Address of Port 9 (1-247)                   ADDRESS9= OFF   ? <ENTER>

Address of Port 10 (1-247)                  ADDRESS10= OFF   ? <ENTER>

Address of Port 11 (1-247)                  ADDRESS11= OFF   ? <ENTER>

Address of Port 12 (1-247)                  ADDRESS12= OFF   ? <ENTER>

Address of Port 13 (1-247)                  ADDRESS13= OFF   ? <ENTER>

Address of Port 14 (1-247)                  ADDRESS14= OFF   ? <ENTER>

Address of Port 15 (1-247)                  ADDRESS15= OFF   ? <ENTER>

Address of Port 16 (1-247)                  ADDRESS16= OFF   ? 17<ENTER>

Address of Port 17 (1-247)                  ADDRESS17= OFF   ? <ENTER>

Address of Port 18 (1-247)                  ADDRESS18= OFF   ? <ENTER>

Port Identification String
PORTID  =""
 ? Modbus Port<ENTER>

Communications Settings

Baud Rate (300, 600, 1200, 2400, 4800, 9600,
           19200, 38400)                    BAUD    = 9600  ? <ENTER>

Parity (N,O,E)                              PARITY  = N     ? <ENTER>


PORT:16
DEVICE  = M
PROTOCOL= M
MAP_TYPE= F
START_ID= 0
SETTLE1 = 0
SETTLE2 = 0
ADDRESS1= OFF  ADDRESS2= OFF  ADDRESS3= 15   ADDRESS4= 16
ADDRESS5= OFF  ADDRESS6= OFF  ADDRESS7= OFF  ADDRESS8= OFF
ADDRESS9= OFF  ADDRESS10= OFF  ADDRESS11= OFF  ADDRESS12= OFF
ADDRESS13= OFF  ADDRESS14= OFF  ADDRESS15= OFF  ADDRESS16= 17
ADDRESS17= OFF  ADDRESS18= OFF
PORTID  ="Modbus Port"
BAUD    = 9600
PARITY  = N

Save changes (Y/N) ? Y<ENTER>

Port 16 Settings Changed

*>>
```

3. Determine where the data of interest is located using the commands MAP 3:METER and MAP 4:METER:

```
*>>MAP 3:METER<ENTER>

Port 3,  Data Region METER  Map

Data Item    Starting Address   Type

_YEAR        2000h              int
DAY_OF_YEAR  2001h              int
TIME(ms)     2002h              int[2]
IA(A)        2004h              float[2]
IB(A)        2008h              float[2]
IC(A)        200Ch              float[2]
VA(V)        2010h              float[2]
VB(V)        2014h              float[2]
VC(V)        2018h              float[2]
VS(V)        201Ch              float[2]
IAB(A)       2020h              float[2]
IBC(A)       2024h              float[2]
ICA(A)       2028h              float[2]
VAB(V)       202Ch              float[2]
VBC(V)       2030h              float[2]
VCA(V)       2034h              float[2]
PA(MW)       2038h              float
QA(MVAR)     203Ah              float
PB(MW)       203Ch              float
QB(MVAR)     203Eh              float
PC(MW)       2040h              float
QC(MVAR)     2042h              float
P(MW)        2044h              float
Q(MVAR)      2046h              float
I0(A)        2048h              float[2]
I1(A)        204Ch              float[2]
I2(A)        2050h              float[2]
V0(V)        2054h              float[2]
V1(V)        2058h              float[2]
V2(V)        205Ch              float[2]

*>>
```

```
*>>MAP 4:METER<ENTER>

Port 4,  Data Region METER  Map

Data Item    Starting Address   Type

_YEAR        2000h              int
DAY_OF_YEAR  2001h              int
TIME(ms)     2002h              int[2]
IAX(A)       2004h              int
IBX(A)       2005h              int
ICX(A)       2006h              int
IAY(A)       2007h              int
IBY(A)       2008h              int
ICY(A)       2009h              int
3I2X(A)      200Ah              int
IRX(A)       200Bh              int
3I2Y(A)      200Ch              int
IRY(A)       200Dh              int

*>>
```

4. Set-up the Port 16 user region to hold the currents and voltages of interest using the command SET M 16:

```
*>>SET M 16<ENTER>

Mathematical/move equation settings for Port 16

  1
 ? 0=3:METER:IA<ENTER>
  2
 ? 1=3:METER:IB<ENTER>
  3
 ? 2=3:METER:IC<ENTER>
  4
 ? 3=3:METER:VA<ENTER>
  5
 ? 4=3:METER:VB<ENTER>
  6
 ? 5=3:METER:VC<ENTER>
  7
 ? 6=4:METER:IAX<ENTER>
  8
 ? 7=4:METER:IBX<ENTER>
9
 ? 8=4:METER:ICX<ENTER>
 10
 ? 9=4:METER:IAY<ENTER>
11
 ? 10=4:METER:IBY<ENTER>
 12
 ? 11=4:METER:ICY<ENTER>
 13
 ? <ENTER>

  1 000h = 3:METER:IA(A)
  2 001h = 3:METER:IB(A)
  3 002h = 3:METER:IC(A)
  4 003h = 3:METER:VA(V)
  5 004h = 3:METER:VB(V)
  6 005h = 3:METER:VC(V)
  7 006h = 4:METER:IAX(A)
  8 007h = 4:METER:IBX(A)
  9 008h = 4:METER:ICX(A)
 10 009h = 4:METER:IAY(A)
 11 00Ah = 4:METER:IBY(A)
 12 00Bh = 4:METER:ICY(A)

Save changes (Y/N) ? Y<ENTER>

USER database region too small: Current size = 0  Size needed = 12
Attempting to allocate larger USER region... Done.

Port 16 Settings Changed

*>>
```

5. The SEL-2030 is now collecting meter data from the two relays. The items of interest are being copied to the Port 16 user region every half second. You can now access this data via Modbus. For this example, we will read the data using function code 03 from address F800h. (***Section 6: Database*** shows that the User region starts at address F800h.) The data could also be read using function code 04 from address 2400 (0960h). To read the data, send the following message:

   Received message:

11	address 17
03	function code 3
F8 00	starting register address F800h
00 0C	read 12 registers
xx xx	CRC-16 code

Response message:

11	from address 17
03	successful function code 3 response
18	24 bytes of data following
00 14	SEL-121F IA data
00 15	SEL-121F IB data
...	
xx xx	SEL-501 ICY data
xx xx	CRC-16 code

Table 7.1: Register Maps for Meter Data, Floating-Point Type

The METER command provides up-to-date meter information. However, for different SEL relays, the meter data have different formats. Therefore, the register map will depend on the type of relay. The meter data will always start at register address 100.

The first eight registers of Modbus meter data are the date and time stamp. This is the closest time known to the SEL-2030; for all SEL-300 and SEL-500 series relays that use *Fast Meter*, it is the time to the nearest millisecond that the data were sampled. For other relays, it is the time the SEL-2030 received the meter data. The data types of currents, voltages, and power are IEEE single-precision floating-point numbers; all other data are integers. All of these registers are read-only, as indicated by the (R) following the register addresses. The following are meter maps for all current SEL relays: Group I for ASCII meter data format and Group II for binary meter data format.

The meter data the SEL-2030 retrieves may be in ASCII or binary format. Use the MAP n command to determine the data types on a port. It will show an A for ASCII or a B for binary data preceding the meter data type. The meter data retrieved with ASCII message format are shown in the "ASCII Meter" MAP; the meter data retrieved with the binary meter format are shown as "Binary Fast Meter" in this table.

Reg.#	Description	Units	Range

I. Data from Relays with ASCII Meter Format.

SEL-49; SEL-121/221,-1,-2,-2A,-3,-4,-5,-6,-8; SEL-121/221,-10,-16,-17; SEL-121B/221B,-1; SEL-121C/ 221C,-1; SEL-121G/221G,-3,-4,-5,-6,-7,-8,-9; SEL-121H/221H; SEL-121S/221S; SEL-BFR/2BFR,-1, SEL-PG10/ 2PG10,-7,-8; SEL-321:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current IA	A, primary	IEEE float
110-111(R)	Phase Current IB	A, primary	IEEE float
112-113(R)	Phase Current IC	A, primary	IEEE float
114-115(R)	Difference Current IAB	A, primary	IEEE float
116-117(R)	Difference Current IBC	A, primary	IEEE float
118-119(R)	Difference Current ICA	A, primary	IEEE float
120-121(R)	Phase Voltage VA	kV, primary	IEEE float
122-123(R)	Phase Voltage VB	kV, primary	IEEE float
124-125(R)	Phase Voltage VC	kV, primary	IEEE float
126-127(R)	Difference Voltage VAB	kV, primary	IEEE float
128-129(R)	Difference Voltage VBC	kV, primary	IEEE float
130-131(R)	Difference Voltage VCA	kV, primary	IEEE float
132-133(R)	Real Power P	MW, primary	IEEE float
134-135(R)	Reactive Power Q	MVAR, primary	IEEE float

SEL-121D/221D:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current IA	A, primary	IEEE float
110-111(R)	Phase Current IB	A, primary	IEEE float
112-113(R)	Phase Current IC	A, primary	IEEE float
114-115(R)	Difference Voltage VAB	kV, primary	IEEE float
116-117(R)	Difference Voltage VBC	kV, primary	IEEE float
118-119(R)	Difference Voltage VCA	kV, primary	IEEE float
120-121(R)	Real Power P	MW, primary	IEEE float
122-123(R)	Reactive Power Q	MVAR, primary	IEEE float

SEL-121F/221F,-1,-2,-3,-8:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23

104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current IA	A, primary	IEEE float
110-111(R)	Phase Current IB	A, primary	IEEE float
112-113(R)	Phase Current IC	A, primary	IEEE float
114-115(R)	Difference Current IAB	A, primary	IEEE float
116-117(R)	Difference Current IBC	A, primary	IEEE float
118-119(R)	Difference Current ICA	A, primary	IEEE float
120-121(R)	Residual Current IR	A, primary	IEEE float
122-123(R)	Phase Voltage VA	kV, primary	IEEE float
124-125(R)	Phase Voltage VB	kV, primary	IEEE float
126-127(R)	Phase Voltage VC	kV, primary	IEEE float
128-129(R)	Difference VAB	kV, primary	IEEE float
130-131(R)	Difference VBC	kV, primary	IEEE float
132-133(R)	Difference VCA	kV, primary	IEEE float
134-135(R)	Synchronizing Voltage VS	kV, primary	IEEE float
136-137(R)	Real Power P	MW, primary	IEEE float
138-139(R)	Reactive Power Q	MVAR, primary	IEEE float

SEL-151/251,-1,-2,-3; SEL-151C/251C,-1,-2,-3:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current IA	A, primary	IEEE float
110-111(R)	Phase Current IB	A, primary	IEEE float
112-113(R)	Phase Current IC	A, primary	IEEE float
114-115(R)	Residual Current IR	A, primary	IEEE float
116-117(R)	Negative-Sequence Current 3I2	A, primary	IEEE float
118-119(R)	Real Power P	MW, primary	IEEE float
120-121(R)	Reactive Power Q	MVAR, primary	IEEE float
122-123(R)	Phase Voltage VA	V, primary	IEEE float
124-125(R)	Phase Voltage VB	V, primary	IEEE float
126-127(R)	Phase Voltage VC	V, primary	IEEE float
128-129(R)	Zero-Sequence Voltage 3V0	V, primary	IEEE float
130-131(R)	Difference Voltage VAB	V, primary	IEEE float
132-133(R)	Difference Voltage VBC	V, primary	IEEE float
134-135(R)	Difference Voltage VCA	V, primary	IEEE float
136-137(R)	Negative-Sequence Voltage 3V2	V, primary	IEEE float

FOR SEL-151D/251D,-1,-3; SEL-151CD/251CD,-1,-3:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current IA	A, primary	IEEE float
110-111(R)	Phase Current IB	A, primary	IEEE float
112-113(R)	Phase Current IC	A, primary	IEEE float
114-115(R)	Residual Current IR	A, primary	IEEE float
116-117(R)	Negative-Sequence Current 3I2	A, primary	IEEE float
118-119(R)	Real Power P	MW, primary	IEEE float
120-121(R)	Reactive Power Q	MVAR, primary	IEEE float
122-123(R)	Difference Voltage VAB	V, primary	IEEE float
124-125(R)	Difference Voltage VBC	V, primary	IEEE float
126-127(R)	Difference Voltage VCA	V, primary	IEEE float

SEL-167/267,-2,-4,-5:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current IA	A, primary	IEEE float
110-111(R)	Phase Current IB	A, primary	IEEE float
112-113(R)	Phase Current IC	A, primary	IEEE float
114-115(R)	Difference Current IAB	A, primary	IEEE float
116-117(R)	Difference Current IBC	A, primary	IEEE float
118-119(R)	Difference Current ICA	A, primary	IEEE float
120-121(R)	Demand Phase Current IAD	A, primary	IEEE float
122-123(R)	Demand Phase Current IBD	A, primary	IEEE float
124-125(R)	Demand Phase Current ICD	A, primary	IEEE float
126-127(R)	Peak-Demand Phase Current IAP	A, primary	IEEE float
128-129(R)	Peak-Demand Phase Current IBP	A, primary	IEEE float
130-131(R)	Peak-Demand Phase Current ICP	A, primary	IEEE float
132-133(R)	Phase Voltage VA	kV, primary	IEEE float
134-135(R)	Phase Voltage VB	kV, primary	IEEE float
136-137(R)	Phase Voltage VC	kV, primary	IEEE float
138-139(R)	Difference Voltage VAB	kV, primary	IEEE float
140-141(R)	Difference Voltage VBC	kV, primary	IEEE float
142-143(R)	Difference Voltage VCA	kV, primary	IEEE float
144-145(R)	Real Power P	MW, primary	IEEE float
146-147(R)	Reactive Power Q	MVAR, primary	IEEE float

SEL-167D/267D:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current IA	A, primary	IEEE float
110-111(R)	Phase Current IB	A, primary	IEEE float
112-113(R)	Phase Current IC	A, primary	IEEE float
114-115(R)	Demand Phase Current IAD	A, primary	IEEE float
116-117(R)	Demand Phase Current IBD	A, primary	IEEE float
118-119(R)	Demand Phase Current ICD	A, primary	IEEE float
120-121(R)	Peak-Demand Phase Current IAP	A, primary	IEEE float
122-123(R)	Peak-Demand Phase Current IBP	A, primary	IEEE float
124-125(R)	Peak-Demand Phase Current ICP	A, primary	IEEE float
126-127(R)	Difference Voltage VAB	kV, primary	IEEE float
128-129(R)	Difference Voltage VBC	kV, primary	IEEE float
130-131(R)	Difference Voltage VCA	kV, primary	IEEE float
132-133(R)	Real Power P	MW, primary	IEEE float
134-135(R)	Reactive Power Q	MVAR, primary	IEEE float

SEL-187V/287V:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Voltage VAX	V, secondary	IEEE float
110-111(R)	Phase Voltage VBX	V, secondary	IEEE float

112-113(R)	Phase Voltage VCX	V, secondary	IEEE float
114-115(R)	Phase Voltage VAY	V, secondary	IEEE float
116-117(R)	Phase Voltage VBY	V, secondary	IEEE float
118-119(R)	Phase Voltage VCY	V, secondary	IEEE float
120-121(R)	Differential Voltage VAD	V, secondary	IEEE float
122-123(R)	Differential Voltage VBD	V, secondary	IEEE float
124-125(R)	Differential Voltage VCD	V, secondary	IEEE float

SEL-279:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Voltage V1	V, secondary	IEEE float
110-111(R)	Phase Voltage V3	V, secondary	IEEE float
112-113(R)	Phase Voltage V5	V, secondary	IEEE float
114-115(R)	Phase Voltage V2	V, secondary	IEEE float
116-117(R)	Phase Voltage V4	V, secondary	IEEE float
118-119(R)	Phase Voltage V6	V, secondary	IEEE float
120-121(R)	Differential Voltage V12D	V, secondary	IEEE float
122-123(R)	Differential Voltage V34D	V, secondary	IEEE float
124-125(R)	Differential Voltage V56D	V, secondary	IEEE float

SEL-279H,-1,-2:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Bus Positive Sequence Voltage VPB	V, secondary	IEEE float
110-111(R)	Phase Voltage V1	V, secondary	IEEE float
112-113(R)	Phase Voltage V3	V, secondary	IEEE float
114-115(R)	Phase Voltage V5	V, secondary	IEEE float
116-117(R)	Line Positive Sequence Voltage VPL	V, secondary	IEEE float
118-119(R)	Phase Voltage V2	V, secondary	IEEE float
120-121(R)	Phase Voltage V4	V, secondary	IEEE float
122-123(R)	Phase Voltage V6	V, secondary	IEEE float
124-125(R)	Differential Voltage V12D	V, secondary	IEEE float
126-127(R)	Differential Voltage V34D	V, secondary	IEEE float
128-129(R)	Differential Voltage V56D	V, secondary	IEEE float

SEL-501:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current IAX	A, primary	IEEE float
110-111(R)	Phase Current IBX	A, primary	IEEE float
112-113(R)	Phase Current ICX	A, primary	IEEE float
114-115(R)	Phase Current IAY	A, primary	IEEE float
116-117(R)	Phase Current IBY	A, primary	IEEE float
118-119(R)	Phase Current ICY	A, primary	IEEE float
120-121(R)	Negative-Sequence Current 3I2X	A, primary	IEEE float
122-123(R)	Residual Current IRX	A, primary	IEEE float

124-125(R)	Negative-Sequence Current 3I2Y	A, primary	IEEE float
126-127(R)	Residual Current IRY	A, primary	IEEE float

II. Data from Relays with Binary Fast Meter Format

SEL-121/221,-10,-16,-17; SEL-121B/221B,-1; SEL-121C/221C,-1; SEL-121G/221G,-3,-4,-5,-6,-7,-8,-9; SEL-121H/221H; SEL-121S/221S; SEL-PG10/2PG10,-7,-8; SEL-151/251,-1,-2,-3; SEL-151C/251C,-1,-2,-3; SEL-321-1, -2 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current Magnitude IA	A, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IB	A, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude IC	A, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Phase Voltage Magnitude VA	V, primary	IEEE float
122-123(R)	Phase Voltage Angle	Degrees	IEEE float
124-125(R)	Phase Voltage Magnitude VB	V, primary	IEEE float
126-127(R)	Phase Voltage Angle	Degrees	IEEE float
128-129(R)	Phase Voltage Magnitude VC	V, primary	IEEE float
130-131(R)	Phase Voltage Angle	Degrees	IEEE float
132-133(R)	Difference Current Magnitude IAB	A, primary	IEEE float
134-135(R)	Difference Current Angle	Degrees	IEEE float
136-137(R)	Difference Current Magnitude IBC	A, primary	IEEE float
138-139(R)	Difference Current Angle	Degrees	IEEE float
140-141(R)	Difference Current Magnitude ICA	A, primary	IEEE float
142-143(R)	Difference Current Angle	Degrees	IEEE float
144-145(R)	Difference Voltage Magnitude VAB	V, primary	IEEE float
146-147(R)	Difference Voltage Angle	Degrees	IEEE float
148-149(R)	Difference Voltage Magnitude VBC	V, primary	IEEE float
150-151(R)	Difference Voltage Angle	Degrees	IEEE float
152-153(R)	Difference Voltage Magnitude VCA	V, primary	IEEE float
154-155(R)	Difference Voltage Angle	Degrees	IEEE float
156-157(R)	Phase Real Power PA	MW, primary	IEEE float
158-159(R)	Phase Reactive Power QA	MVAR, primary	IEEE float
160-161(R)	Phase Real Power PB	MW, primary	IEEE float
162-63(R)	Phase Reactive Power QB	MVAR, primary	IEEE float
164-165(R)	Phase Real Power PC	MW, primary	IEEE float
166-167(R)	Phase Reactive Power QC	MVAR, primary	IEEE float
168-169(R)	Three Phase Real Power P	MW, primary	IEEE float
170-171(R)	Three Phase Reactive Power Q	MVAR, primary	IEEE float
172-173(R)	Zero-Sequence Current Magnitude I0	A, primary	IEEE float
174-175(R)	Zero-Sequence Current Angle	Degrees	IEEE float
176-177(R)	Positive-Sequence Current Magnitude I1	A, primary	IEEE float
178-179(R)	Positive-Sequence Current Angle	Degrees	IEEE float
180-181(R)	Negative-Sequence Current Magnitude I2	A, primary	IEEE float
182-183(R)	Negative-Sequence Current Angle	Degrees	IEEE float
184-185(R)	Zero-Sequence Voltage Magnitude V0	V, primary	IEEE float
186-187(R)	Zero-Sequence Voltage Angle	Degrees	IEEE float
188-189(R)	Positive-Sequence Voltage Magnitude V1	V, primary	IEEE float
190-191(R)	Positive-Sequence Voltage Angle	Degrees	IEEE float
192-193(R)	Negative-Sequence Voltage Magnitude V2	V, primary	IEEE float
194-195(R)	Negative-Sequence Voltage Angle	Degrees	IEEE float

SEL-121F/221F,-1,-2,-3,-8 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23

104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current Magnitude IA	A, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IB	A, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude IC	A, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Phase Voltage Magnitude VA	V, primary	IEEE float
122-123(R)	Phase Voltage Angle	Degrees	IEEE float
124-125(R)	Phase Voltage Magnitude VB	V, primary	IEEE float
126-127(R)	Phase Voltage Angle	Degrees	IEEE float
128-129(R)	Phase Voltage Magnitude VC	V, primary	IEEE float
130-131(R)	Phase Voltage Angle	Degrees	IEEE float
132-133(R)	Synchronizing Voltage Magnitude VS	V, primary	IEEE float
134-135(R)	Synchronizing Voltage Angle	Degrees	IEEE float
136-137(R)	Difference Current Magnitude IAB	A, primary	IEEE float
138-139(R)	Difference Current Angle	Degrees	IEEE float
140-141(R)	Difference Current Magnitude IBC	A, primary	IEEE float
142-143(R)	Difference Current Angle	Degrees	IEEE float
144-145(R)	Difference Current Magnitude ICA	A, primary	IEEE float
146-147(R)	Difference Current Angle	Degrees	IEEE float
148-149(R)	Difference Voltage Magnitude VAB	V, primary	IEEE float
150-151(R)	Difference Voltage Angle	Degrees	IEEE float
152-153(R)	Difference Voltage Magnitude VBC	V, primary	IEEE float
154-155(R)	Difference Voltage Angle	Degrees	IEEE float
156-157(R)	Difference Voltage Magnitude VCA	V, primary	IEEE float
158-159(R)	Difference Voltage Angle	Degrees	IEEE float
160-161(R)	Phase Real Power PA	MW, primary	IEEE float
162-163(R)	Phase Reactive Power QA	MVAR, primary	IEEE float
164-165(R)	Phase Real Power PB	MW, primary	IEEE float
166-167(R)	Phase Reactive Power QB	MVAR, primary	IEEE float
168-169(R)	Phase Real Power PC	MW, primary	IEEE float
170-171(R)	Phase Reactive Power QC	MVAR, primary	IEEE float
172-173(R)	Three Phase Real Power P	MW, primary	IEEE float
174-175(R)	Three Phase Reactive Power Q	MVAR, primary	IEEE float
176-177(R)	Zero-Sequence Current Magnitude I0	A, primary	IEEE float
178-179(R)	Zero-Sequence Current Angle	Degrees	IEEE float
180-181(R)	Positive-Sequence Current Magnitude I1	A, primary	IEEE float
182-183(R)	Positive-Sequence Current Angle	Degrees	IEEE float
184-185(R)	Negative-Sequence Current Magnitude I2	A, primary	IEEE float
186-187(R)	Negative-Sequence Current Angle	Degrees	IEEE float
188-189(R)	Zero-Sequence Voltage Magnitude V0	V, primary	IEEE float
190-191(R)	Zero-Sequence Voltage Angle	Degrees	IEEE float
192-193(R)	Positive-Sequence Voltage Magnitude V1	V, primary	IEEE float
194-195(R)	Positive-Sequence Voltage Angle	Degrees	IEEE float
196-197(R)	Negative-Sequence Voltage Magnitude V2	V, primary	IEEE float
198-199(R)	Negative-Sequence Voltage Angle	Degrees	IEEE float

SEL-151D/251D,-1,-3; SEL-151CD/251CD,-1,-3; SEL-167D/267D Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current Magnitude IA	A, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IB	A, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude IC	A, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Difference Voltage Magnitude VAB	V, primary	IEEE float

122-123(R)	Difference Voltage Angle	Degrees	IEEE float
124-125(R)	Difference Voltage Magnitude VBC	V, primary	IEEE float
126-127(R)	Difference Voltage Angle	Degrees	IEEE float
128-129(R)	Difference Voltage Magnitude VCA	V, primary	IEEE float
130-131(R)	Difference Voltage Angle	Degrees	IEEE float
132-133(R)	Difference Current Magnitude IAB	A, primary	IEEE float
134-135(R)	Difference Current Angle	Degrees	IEEE float
136-137(R)	Difference Current Magnitude IBC	A, primary	IEEE float
138-139(R)	Difference Current Angle	Degrees	IEEE float
140-141(R)	Difference Current Magnitude ICA	A, primary	IEEE float
142-143(R)	Difference Current Angle	Degrees	IEEE float
144-145(R)	Three Phase Real Power P	MW, primary	IEEE float
146-147(R)	Three Phase Reactive Power Q	MVAR, primary	IEEE float
148-149(R)	Zero-Sequence Current Magnitude I0	A, primary	IEEE float
150-151(R)	Zero-Sequence Current Angle	Degrees	IEEE float
152-153(R)	Positive-Sequence Current Magnitude I1	A, primary	IEEE float
154-155(R)	Positive-Sequence Angle	Degrees	IEEE float
156-157(R)	Negative-Sequence Current Magnitude I2	A, primary	IEEE float
158-159(R)	Negative-Sequence Angle	Degrees	IEEE float
160-161(R)	Zero-Sequence Voltage Magnitude V0	V, primary	IEEE float
162-163(R)	Zero-Sequence Voltage Angle	Degrees	IEEE float
164-165(R)	Positive-Sequence Voltage Magnitude V1	V, primary	IEEE float
166-167(R)	Positive-Sequence Voltage Angle	Degrees	IEEE float
168-169(R)	Negative-Sequence Voltage Magnitude V2	V, primary	IEEE float
170-171(R)	Negative-Sequence Voltage Angle	Degrees	IEEE float

SEL-300G0 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108-109(R)	Phase Current Magnitude IA	Amps, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IB	Amps, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude IC	Amps, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Neutral Current Magnitude IN	A, primary	IEEE float
122-123(R)	Neutral Current Angle	Degrees	IEEE float
124-125(R)	Phase Voltage Magnitude VA	V, primary	IEEE float
126-127(R)	Phase Voltage Angle	Degrees	IEEE float
128-129(R)	Phase Voltage Magnitude VB	V, primary	IEEE float
130-131(R)	Phase Voltage Angle	Degrees	IEEE float
132-133(R)	Phase Voltage Magnitude VC	V, primary	IEEE float
134-135(R)	Phase Voltage Angle	Degrees	IEEE float
136-137(R)	Neutral Voltage Magnitude VN	V, primary	IEEE float
138-139(R)	Neutral Voltage Angle	Degrees	IEEE float
140-141(R)	Frequency Magnitude	Hertz	IEEE float
142-143(R)	Frequency Angle	Degrees	IEEE float (0.0)
144-145(R)	Battery Voltage Magnitude VBAT	V, primary	IEEE float
146-147(R)	Battery Voltage Angle	Degrees	IEEE float (0.0)
148-149(R)	Line Current Magnitude IAB	Amps, primary	IEEE float
150-151(R)	Line Current Angle	Degrees	IEEE float
152-153(R)	Line Current Magnitude IBC	Amps, primary	IEEE float
154-155(R)	Line Current Angle	Degrees	IEEE float
156-157(R)	Line Current Magnitude ICA	Amps, primary	IEEE float
158-159(R)	Line Current Angle	Degrees	IEEE float
160-161(R)	Line Voltage Magnitude VAB	V, primary	IEEE float
162-163(R)	Line Voltage Angle	Degrees	IEEE float
164-165(R)	Line Voltage Magnitude VBC	V, primary	IEEE float
166-167(R)	Line Voltage Angle	Degrees	IEEE float
168-169(R)	Line Voltage Magnitude VCA	V, primary	IEEE float
170-171(R)	Line Voltage Angle	Degrees	IEEE float

172-173(R)	Phase Real Power PA	MW, primary	IEEE float
174-175(R)	Phase Reactive Power QA	MVAR, primary	IEEE float
176-177(R)	Phase Real Power PB	MW, primary	IEEE float
178-179(R)	Phase Reactive Power QB	MVAR, primary	IEEE float
180-181(R)	Phase Real Power PC	MW, primary	IEEE float
182-183(R)	Phase Reactive Power QC	MVAR, primary	IEEE float
184-185(R)	Three Phase Real Power PMW	MW, primary	IEEE float
186-187(R)	Three Phase Reactive Power QMVAR	MVAR, primary	IEEE float
188-189(R)	Zero-Sequence Current Magnitude I0	A, primary	IEEE float
190-191(R)	Zero-Sequence Current Angle	Degrees	IEEE float
192-193(R)	Positive-Sequence Current Magnitude I1	A, primary	IEEE float
194-195(R)	Positive-Sequence Current Angle	Degrees	IEEE float
196-197(R)	Negative-Sequence Current Magnitude I2	A, primary	IEEE float
198-199(R)	Negative-Sequence Current Angle	Degrees	IEEE float

(Remaining data can not be accessed through this Modbus map.)

SEL-300G1 (Differential Option) Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current Magnitude IA	Amps, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IB	Amps, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude IC	Amps, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Neutral Current Magnitude IN	Amps, primary	IEEE float
122-123(R)	Neutral Current Angle	Degrees	IEEE float
124-125(R)	Phase Voltage Magnitude VA	V, primary	IEEE float
126-127(R)	Phase Voltage Angle	Degrees	IEEE float
128-129(R)	Phase Voltage Magnitude VB	V, primary	IEEE float
130-131(R)	Phase Voltage Angle	Degrees	IEEE float
132-133(R)	Phase Voltage Magnitude VC	V, primary	IEEE float
134-135(R)	Phase Voltage Angle	Degrees	IEEE float
136-137(R)	Neutral Voltage Magnitude VN	V, primary	IEEE float
138-139(R)	Neutral Voltage Angle	Degrees	IEEE float
140-141(R)	Diff. Current Magnitude IA87	Amps, primary	IEEE float
142-143(R)	Diff. Current Angle	Degrees	IEEE float
144-145(R)	Diff. Current Magnitude IB87	Amps, primary	IEEE float
146-147(R)	Diff. Current Angle	Degrees	IEEE float
148-149(R)	Diff. Current Magnitude IC87	Amps, primary	IEEE float
150-151(R)	Diff. Current Angle	Degrees	IEEE float
152-153(R)	Frequency Magnitude	Hertz	IEEE float
154-155(R)	Frequency Angle	Degrees	IEEE float (0.0)
156-157(R)	Battery Voltage Magnitude VBAT	V, primary	IEEE float
158-159(R)	Battery Voltage Angle	Degrees	IEEE float (0.0)
160-161(R)	Line Current Magnitude IAB	Amps, primary	IEEE float
162-163(R)	Line Current Angle	Degrees	IEEE float
164-165(R)	Line Current Magnitude IBC	Amps, primary	IEEE float
166-167(R)	Line Current Angle	Degrees	IEEE float
168-169(R)	Line Current Magnitude ICA	Amps, primary	IEEE float
170-171(R)	Line Current Angle	Degrees	IEEE float
172-173(R)	Line Voltage Magnitude VAB	V, primary	IEEE float
174-175(R)	Line Voltage Angle	Degrees	IEEE float
176-177(R)	Line Voltage Magnitude VBC	V, primary	IEEE float
178-179(R)	Line Voltage Angle	Degrees	IEEE float
180-181(R)	Line Voltage Magnitude VCA	V, primary	IEEE float
182-183(R)	Line Voltage Angle	Degrees	IEEE float
184-185(R)	Phase Real Power PA	MW, primary	IEEE float
186-187(R)	Phase Reactive Power QA	MVAR, primary	IEEE float
188-189(R)	Phase Real Power PB	MW, primary	IEEE float
190-191(R)	Phase Reactive Power QB	MVAR, primary	IEEE float

192-193(R)	Phase Real Power PC	MW, primary	IEEE float
194-195(R)	Phase Reactive Power QC	MVAR, primary	IEEE float
196-197(R)	Three Phase Real Power PMW	MW, primary	IEEE float
198-199(R)	Three Phase Reactive Power QMVAR	MVAR, primary	IEEE float

(Remaining data can not be accessed through this Modbus map.)

SEL-351; SEL-351R Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108-109(R)	Phase Current Magnitude IA	Amps, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IB	Amps, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude IC	Amps, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Neutral Current Magnitude IN	A, primary	IEEE float
122-123(R)	Neutral Current Angle	Degrees	IEEE float
124-125(R)	Phase Voltage Magnitude VA	V, primary	IEEE float
126-127(R)	Phase Voltage Angle	Degrees	IEEE float
128-129(R)	Phase Voltage Magnitude VB	V, primary	IEEE float
130-131(R)	Phase Voltage Angle	Degrees	IEEE float
132-133(R)	Phase Voltage Magnitude VC	V, primary	IEEE float
134-135(R)	Phase Voltage Angle	Degrees	IEEE float
136-137(R)	Synchronizing Voltage Magnitude VS	V, primary	IEEE float
138-139(R)	Synchronizing Voltage Angle	Degrees	IEEE float
140-141(R)	Frequency Magnitude	Hertz	IEEE float
142-143(R)	Frequency Angle	Degrees	IEEE float (0.0)
144-145(R)	Battery Voltage Magnitude VBAT	V, primary	IEEE float
146-147(R)	Battery Voltage Angle	Degrees	IEEE float (0.0)
148-149(R)	Line Current Magnitude IAB	Amps, primary	IEEE float
150-151(R)	Line Current Angle	Degrees	IEEE float
152-153(R)	Line Current Magnitude IBC	Amps, primary	IEEE float
154-155(R)	Line Current Angle	Degrees	IEEE float
156-157(R)	Line Current Magnitude ICA	Amps, primary	IEEE float
158-159(R)	Line Current Angle	Degrees	IEEE float
160-161(R)	Line Voltage Magnitude VAB	V, primary	IEEE float
162-163(R)	Line Voltage Angle	Degrees	IEEE float
164-165(R)	Line Voltage Magnitude VBC	V, primary	IEEE float
166-167(R)	Line Voltage Angle	Degrees	IEEE float
168-169(R)	Line Voltage Magnitude VCA	V, primary	IEEE float
170-171(R)	Line Voltage Angle	Degrees	IEEE float
172-173(R)	Phase Real Power PA	MW, primary	IEEE float
174-175(R)	Phase Reactive Power QA	MVAR, primary	IEEE float
176-177(R)	Phase Real Power PB	MW, primary	IEEE float
178-179(R)	Phase Reactive Power QB	MVAR, primary	IEEE float
180-181(R)	Phase Real Power PC	MW, primary	IEEE float
182-183(R)	Phase Reactive Power QC	MVAR, primary	IEEE float
184-185(R)	Three Phase Real Power PMW	MW, primary	IEEE float
186-187(R)	Three Phase Reactive Power QMVAR	MVAR, primary	IEEE float
188-189(R)	Zero-Sequence Current Magnitude I0	A, primary	IEEE float
190-191(R)	Zero-Sequence Current Angle	Degrees	IEEE float
192-193(R)	Positive-Sequence Current Magnitude I1	A, primary	IEEE float
194-195(R)	Positive-Sequence Current Angle	Degrees	IEEE float
196-197(R)	Negative-Sequence Current Magnitude I2	A, primary	IEEE float
198-199(R)	Negative-Sequence Current Angle	Degrees	IEEE float

(Remaining data can not be accessed through this Modbus map.)

SEL-352 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12

101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Voltage Magnitude VAX	V, primary	IEEE float
110-111(R)	Phase Voltage Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IA	A, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Voltage Magnitude VAY	V, primary	IEEE float
118-119(R)	Phase Voltage Angle	Degrees	IEEE float
120-121(R)	Phase Voltage Magnitude VBX	V, primary	IEEE float
122-123(R)	Phase Voltage Angle	Degrees	IEEE float
124-125(R)	Phase Current Magnitude IB	A, primary	IEEE float
126-127(R)	Phase Current Angle	Degrees	IEEE float
128-129(R)	Phase Voltage Magnitude VBY	V, primary	IEEE float
130-131(R)	Phase Voltage Angle	Degrees	IEEE float
132-133(R)	Phase Voltage Magnitude VCX	V, primary	IEEE float
134-135(R)	Phase Voltage Angle	Degrees	IEEE float
136-137(R)	Phase Current Magnitude IC	A, primary	IEEE float
138-139(R)	Phase Current Angle	Degrees	IEEE float
140-141(R)	Phase Voltage Magnitude VCY	V, primary	IEEE float
142-143(R)	Phase Voltage Angle	Degrees	IEEE float
144-145(R)	Difference Current Magnitude IAB	Amps, primary	IEEE float
146-147(R)	Difference Current Angle	Degrees	IEEE float
148-149(R)	Difference Current Magnitude IBC	Amps, primary	IEEE float
150-151(R)	Difference Current Angle	Degrees	IEEE float
152-153(R)	Difference Current Magnitude ICA	Amps, primary	IEEE float
154-155(R)	Difference Current Angle	Degrees	IEEE float
156-157(R)	Difference Voltage Magnitude VAB1	V, primary	IEEE float
158-159(R)	Difference Voltage Angle	Degrees	IEEE float
160-161(R)	Difference Voltage Magnitude VBC1	V, primary	IEEE float
162-163(R)	Difference Voltage Angle	Degrees	IEEE float
164-165(R)	Difference Voltage Magnitude VCA1	V, primary	IEEE float
166-167(R)	Difference Voltage Angle	Degrees	IEEE float
168-169(R)	Phase Real Power PA	MW, primary	IEEE float
170-171(R)	Phase Reactive Power QA	MVAR, primary	IEEE float
172-173(R)	Phase Real Power PB	MW, primary	IEEE float
174-175(R)	Phase Reactive Power QB	MVAR, primary	IEEE float
176-177(R)	Phase Real Power PC	MW, primary	IEEE float
178-179(R)	Phase Reactive Power QC	MVAR, primary	IEEE float
180-181(R)	Three Phase Real Power P	MW, primary	IEEE float
182-183(R)	Three Phase Reactive Power Q	MVAR, primary	IEEE float
184-185(R)	Difference Voltage Magnitude VAB2	V, primary	IEEE float
186-187(R)	Difference Voltage Angle	Degrees	IEEE float
188-189(R)	Difference Voltage Magnitude VBC2	V, primary	IEEE float
190-191(R)	Difference Voltage Angle	Degrees	IEEE float
192-193(R)	Difference Voltage Magnitude VCA2	V, primary	IEEE float
194-195(R)	Difference Voltage Angle	Degrees	IEEE float
196-197(R)	Zero-Sequence Current Magnitude I0	A, primary	IEEE float
198-199(R)	Zero-Sequence Current Angle	Degrees	IEEE float

(Remaining data cannot be accessed through this Modbus map.)

SEL-387 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current Magnitude IAW1	A, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IBW1	A, primary	IEEE float

114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude ICW1	A, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Phase Current Magnitude IAW2	A, primary	IEEE float
122-123(R)	Phase Current Angle	Degrees	IEEE float
124-125(R)	Phase Current Magnitude IBW2	A, primary	IEEE float
126-127(R)	Phase Current Angle	Degrees	IEEE float
128-129(R)	Phase Current Magnitude ICW2	A, primary	IEEE float
130-131(R)	Phase Current Angle	Degrees	IEEE float
132-133(R)	Phase Current Magnitude IAW3	A, primary	IEEE float
134-135(R)	Phase Current Angle	Degrees	IEEE float
136-137(R)	Phase Current Magnitude IBW3	A, primary	IEEE float
138-139(R)	Phase Current Angle	Degrees	IEEE float
140-141(R)	Phase Current Magnitude ICW3	A, primary	IEEE float
142-143(R)	Phase Current Angle	Degrees	IEEE float
144-145(R)	Phase Current Magnitude IAW4	A, primary	IEEE float
146-147(R)	Phase Current Angle	Degrees	IEEE float
148-149(R)	Phase Current Magnitude IBW4	A, primary	IEEE float
150-151(R)	Phase Current Angle	Degrees	IEEE float
152-153(R)	Phase Current Magnitude ICW4	A, primary	IEEE float
154-155(R)	Phase Current Angle	Degrees	IEEE float
156-157(R)	Zero-Sequence Current Magnitude I0W1	A, primary	IEEE float
158-159(R)	Zero-Sequence Current Angle	Degrees	IEEE float
160-161(R)	Positive-Sequence Current Magnitude I1W1	A, primary	IEEE float
162-163(R)	Positive-Sequence Current Angle	Degrees	IEEE float
164-165(R)	Negative-Sequence Current Magnitude I2W1	A, primary	IEEE float
166-167(R)	Negative-Sequence Current Angle	Degrees	IEEE float
168-169(R)	Zero-Sequence Current Magnitude I0W2	A, primary	IEEE float
170-171(R)	Zero-Sequence Current Angle	Degrees	IEEE float
172-173(R)	Positive-Sequence Current Magnitude I1W2	A, primary	IEEE float
174-175(R)	Positive-Sequence Current Angle	Degrees	IEEE float
176-177(R)	Negative-Sequence Current Magnitude I2W2	A, primary	IEEE float
178-179(R)	Negative-Sequence Current Angle	Degrees	IEEE float
180-181(R)	Zero-Sequence Current Magnitude I0W3	A, primary	IEEE float
182-183(R)	Zero-Sequence Current Angle	Degrees	IEEE float
184-185(R)	Positive-Sequence Current Magnitude I1W3	A, primary	IEEE float
186-187(R)	Positive-Sequence Current Angle	Degrees	IEEE float
188-189(R)	Negative-Sequence Current Magnitude I2W3	A, primary	IEEE float
190-191(R)	Negative-Sequence Current Angle	Degrees	IEEE float
192-193(R)	Zero-Sequence Current Magnitude I0W4	A, primary	IEEE float
194-195(R)	Zero-Sequence Current Angle	Degrees	IEEE float
196-197(R)	Positive-Sequence Current Magnitude I1W4	A, primary	IEEE float
198-199(R)	Positive-Sequence Current Angle	Degrees	IEEE float

(Remaining data cannot be accessed through this Modbus map.)

SEL-501,-1,-2 Binary Fast Meter Format

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108-109(R)	Phase Current Magnitude IAX	A, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IBX	A, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude ICX	A, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Phase Current Magnitude IAY	A, primary	IEEE float
122-123(R)	Phase Current Angle	Degrees	IEEE float
124-125(R)	Phase Current Magnitude IBY	A, primary	IEEE float
126-127(R)	Phase Current Angle	Degrees	IEEE float
128-129(R)	Phase Current Magnitude ICY	A, primary	IEEE float
130-131(R)	Phase Current Angle	Degrees	IEEE float
132-133(R)	Difference Current Magnitude IABX	A, primary	IEEE float

134-135(R)	Difference Current Angle	Degrees	IEEE float
137-137(R)	Difference Current Magnitude IBCX	A, primary	IEEE float
138-139(R)	Difference Current Angle	Degrees	IEEE float
140-141(R)	Difference Current Magnitude ICAX	A, primary	IEEE float
142-143(R)	Difference Current Angle	Degrees	IEEE float
144-145(R)	Difference Current Magnitude IABY	A, primary	IEEE float
146-147(R)	Difference Current Angle	Degrees	IEEE float
148-149(R)	Difference Current Magnitude IBCY	A, primary	IEEE float
150-151(R)	Difference Current Angle	Degrees	IEEE float
152-153(R)	Difference Current Magnitude ICAY	A, primary	IEEE float
154-155(R)	Difference Current Angle	Degrees	IEEE float
156-157(R)	Zero-Sequence Current Magnitude IOX	A, primary	IEEE float
158-159(R)	Zero-Sequence Current Angle	Degrees	IEEE float
160-161(R)	Positive-Sequence Current Magnitude I1X	A, primary	IEEE float
162-163(R)	Positive-Sequence Current Angle	Degrees	IEEE float
164-165(R)	Negative-Sequence Current Magnitude I2X	A, primary	IEEE float
166-167(R)	Negative-Sequence Current Angle	Degrees	IEEE float
168-169(R)	Zero-Sequence Current Magnitude IOY	A, primary	IEEE float
170-171(R)	Zero-Sequence Current Angle	Degrees	IEEE float
172-173(R)	Positive-Sequence Current Magnitude I1Y	A, primary	IEEE float
174-175(R)	Positive-Sequence Current Angle	Degrees	IEEE float
176-177(R)	Negative-Sequence Current Magnitude I2Y	A, primary	IEEE float
178-179(R)	Negative-Sequence Current Angle	Degrees	IEEE float

SEL-551 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108-109(R)	Phase Current Magnitude IA	A, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IB	A, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude IC	A, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Neutral Current Magnitude IN	A, primary	IEEE float
122-123(R)	Neutral Current Angle	Degrees	IEEE float
124-125(R)	Difference Current Magnitude IAB	A, primary	IEEE float
126-127(R)	Difference Current Angle	Degrees	IEEE float
128-129(R)	Difference Current Magnitude IBC	A, primary	IEEE float
130-131(R)	Difference Current Angle	Degrees	IEEE float
132-133(R)	Difference Current Magnitude ICA	A, primary	IEEE float
134-135(R)	Difference Current Angle	Degrees	IEEE float

SEL-587 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108-109(R)	Phase Current Magnitude IAW1	A, primary	IEEE float
110-111(R)	Phase Current Angle	Degrees	IEEE float
112-113(R)	Phase Current Magnitude IBW1	A, primary	IEEE float
114-115(R)	Phase Current Angle	Degrees	IEEE float
116-117(R)	Phase Current Magnitude ICW1	A, primary	IEEE float
118-119(R)	Phase Current Angle	Degrees	IEEE float
120-121(R)	Phase Current Magnitude IAW2	A, primary	IEEE float
122-123(R)	Phase Current Angle	Degrees	IEEE float
124-125(R)	Phase Current Magnitude IBW2	A, primary	IEEE float

126-127(R)	Phase Current Angle	Degrees	IEEE float
128-129(R)	Phase Current Magnitude ICW2	A, primary	IEEE float
130-131(R)	Phase Current Angle	Degrees	IEEE float
132-133(R)	Difference Current Magnitude IAB	A, primary	IEEE float
134-135(R)	Difference Current Angle	Degrees	IEEE float
136-137(R)	Difference Current Magnitude IBC	A, primary	IEEE float
138-139(R)	Difference Current Angle	Degrees	IEEE float
140-141(R)	Difference Current Magnitude ICA	A, primary	IEEE float
142-143(R)	Difference Current Angle	Degrees	IEEE float
144-145(R)	Difference Current Magnitude IAB	A, primary	IEEE float
146-147(R)	Difference Current Angle	Degrees	IEEE float
148-149(R)	Difference Current Magnitude IBC	A, primary	IEEE float
150-151(R)	Difference Current Angle	Degrees	IEEE float
152-153(R)	Difference Current Magnitude ICA	A, primary	IEEE float
154-155(R)	Difference Current Angle	Degrees	IEEE float
156-157(R)	Zero-Sequence Current Magnitude I0W1	A, primary	IEEE float
158-159(R)	Zero-Sequence Current Angle	Degrees	IEEE float
160-161(R)	Positive-Sequence Current Magnitude I1W1	A, primary	IEEE float
162-163(R)	Positive-Sequence Current Angle	Degrees	IEEE float
164-165(R)	Negative-Sequence Current Magnitude I2W1	A, primary	IEEE float
166-167(R)	Negative-Sequence Current Angle	Degrees	IEEE float
168-169(R)	Zero-Sequence Current Magnitude I0W2	A, primary	IEEE float
170-171(R)	Zero-Sequence Current Angle	Degrees	IEEE float
172-173(R)	Positive-Sequence Current Magnitude I1W2	A, primary	IEEE float
174-175(R)	Positive-Sequence Current Angle	Degrees	IEEE float
176-177(R)	Negative-Sequence Current Magnitude I2W2	A, primary	IEEE float
178-179(R)	Negative-Sequence Current Angle	Degrees	IEEE float

Table 7.2: Register Maps for Meter Data, Integer Type

This set of maps is the same as those presented in Table 7.1 except that all floating-point data is given in an integer format. If a value ever exceeds the range of an integer, the maximum allowed value will be given. Be sure to carefully check the units to make sure you scale the data appropriately.

Reg.#	Description	Units	Range

I. Data from Relays with ASCII Meter Format.

SEL-49; SEL-121/221,-1,-2,-2A,-3,-4,-5,-6,-8; SEL-121/221,-10,-16,-17; SEL-121B/221B,-1; SEL-121C/ 221C,-1; SEL-121G/221G,-3,-4,-5,-6,-7,-8,-9; SEL-121H/221H; SEL-121S/221S; SEL-BFR/2BFR,-1, SEL-PG10/ 2PG10,-7,-8; SEL-321:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current IA	A, primary	0-32767 A, pri
109(R)	Phase Current IB	A, primary	0-32767 A, pri
110(R)	Phase Current IC	A, primary	0-32767 A, pri
111(R)	Difference Current IAB	A, primary	0-32767 A, pri
112(R)	Difference Current IBC	A, primary	0-32767 A, pri
113(R)	Difference Current ICA	A, primary	0-32767 A, pri
114(R)	Phase Voltage VA	kV/10, primary	0.0-3276.7 kV, pri
115(R)	Phase Voltage VB	kV/10, primary	0.0-3276.7 kV, pri
116(R)	Phase Voltage VC	kV/10, primary	0.0-3276.7 kV, pri
117(R)	Difference Voltage VAB	kV/10, primary	0.0-3276.7 kV, pri
118(R)	Difference Voltage VBC	kV/10, primary	0.0-3276.7 kV, pri
119(R)	Difference Voltage VCA	kV/10, primary	0.0-3276.7 kV, pri
120(R)	Real Power P	MW/10, primary	±3276.7 MW, pri
121(R)	Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri

SEL-121D/221D:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current IA	A, primary	0-32767 A, pri
109(R)	Phase Current IB	A, primary	0-32767 A, pri
110(R)	Phase Current IC	A, primary	0-32767 A, pri
111(R)	Difference Voltage VAB	kV/10, primary	0.0-3276.7 kV, pri
112(R)	Difference Voltage VBC	kV/10, primary	0.0-3276.7 kV, pri
113(R)	Difference Voltage VCA	kV/10, primary	0.0-3276.7 kV, pri
114(R)	Real Power P	MW/10, primary	±3276.7 MW, pri
115(R)	Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri

SEL-121F/221F,-1,-2,-3,-8:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current IA	A, primary	0-32767 A, pri
109(R)	Phase Current IB	A, primary	0-32767 A, pri
110(R)	Phase Current IC	A, primary	0-32767 A, pri
111(R)	Difference Current IAB	A, primary	0-32767 A, pri
112(R)	Difference Current IBC	A, primary	0-32767 A, pri
113(R)	Difference Current ICA	A, primary	0-32767 A, pri
114(R)	Residual Current IR	A, primary	0-32767 A, pri
115(R)	Phase Voltage VA	kV/10, primary	0.0-3276.7 kV, pri
116(R)	Phase Voltage VB	kV/10, primary	0.0-3276.7 kV, pri
117(R)	Phase Voltage VC	kV/10, primary	0.0-3276.7 kV, pri
118(R)	Difference Voltage VAB	kV/10, primary	0.0-3276.7 kV, pri
119(R)	Difference Voltage VBC	kV/10, primary	0.0-3276.7 kV, pri
120(R)	Difference Voltage VCA	kV/10, primary	0.0-3276.7 kV, pri
121(R)	Synchronizing Voltage VS	kV/10, primary	0.0-3276.7 kV, pri
122(R)	Real Power P	MW/10, primary	±3276.7 MW, pri
123(R)	Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri

SEL-151/251,-1,-2,-3; SEL-151C/251C,-1,-2,-3:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current IA	A, primary	0-32767 A, pri
109(R)	Phase Current IB	A, primary	0-32767 A, pri
110(R)	Phase Current IC	A, primary	0-32767 A, pri
111(R)	Residual Current IR	A, primary	0-32767 A, pri
112(R)	Negative-Sequence Current 3I2	A, primary	0-32767 A, pri
113(R)	Real Power P	MW/10, primary	±3276.7 MW, pri
114(R)	Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri
115(R)	Phase Voltage VA	kV/10, primary	0.0-3276.7 kV, pri
116(R)	Phase Voltage VB	kV/10, primary	0.0-3276.7 kV, pri
117(R)	Phase Voltage VC	kV/10, primary	0.0-3276.7 kV, pri
118(R)	Zero-Sequence Voltage 3V0	kV/10, primary	0.0-3276.7 kV, pri

119(R)	Difference Voltage VAB	kV/10, primary	0.0-3276.7 kV, pri
120(R)	Difference Voltage VBC	kV/10, primary	0.0-3276.7 kV, pri
121(R)	Difference Voltage VCA	kV/10, primary	0.0-3276.7 kV, pri
122(R)	Negative-Sequence Voltage 3V2	kV/10, primary	0.0-3276.7 kV, pri

FOR SEL-151D/251D,-1,-3; SEL-151CD/251CD,-1,-3:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current IA	A, primary	0-32767 A, pri
109(R)	Phase Current IB	A, primary	0-32767 A, pri
110(R)	Phase Current IC	A, primary	0-32767 A, pri
111(R)	Residual Current IR	A, primary	0-32767 A, pri
112(R)	Negative-Sequence Current 3I2	A, primary	0-32767 A, pri
113(R)	Real Power P	MW/10, primary	±3276.7 MW, pri
114(R)	Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri
115(R)	Difference Voltage VAB	kV/10, primary	0.0-3276.7 kV, pri
116(R)	Difference Voltage VBC	kV/10, primary	0.0-3276.7 kV, pri
117(R)	Difference Voltage VCA	kV/10, primary	0.0-3276.7 kV, pri

SEL-167/267,-2,-4,-5:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current IA	A, primary	0-32767 A, pri
109(R)	Phase Current IB	A, primary	0-32767 A, pri
110(R)	Phase Current IC	A, primary	0-32767 A, pri
111(R)	Difference Current IAB	A, primary	0-32767 A, pri
112(R)	Difference Current IBC	A, primary	0-32767 A, pri
113(R)	Difference Current ICA	A, primary	0-32767 A, pri
114(R)	Demand Phase Current IAD	A, primary	0-32767 A, pri
115(R)	Demand Phase Current IBD	A, primary	0-32767 A, pri
116(R)	Demand Phase Current ICD	A, primary	0-32767 A, pri
117(R)	Peak-Demand Phase Current IAP	A, primary	0-32767 A, pri
118(R)	Peak-Demand Phase Current IBP	A, primary	0-32767 A, pri
119(R)	Peak-Demand Phase Current ICP	A, primary	0-32767 A, pri
120(R)	Phase Voltage VA	kV/10, primary	0.0-3276.7 kV, pri
121(R)	Phase Voltage VB	kV/10, primary	0.0-3276.7 kV, pri
122(R)	Phase Voltage VC	kV/10, primary	0.0-3276.7 kV, pri
123(R)	Difference Voltage VAB	kV/10, primary	0.0-3276.7 kV, pri
124(R)	Difference Voltage VBC	kV/10, primary	0.0-3276.7 kV, pri
125(R)	Difference Voltage VCA	kV/10, primary	0.0-3276.7 kV, pri
126(R)	Real Power P	MW/10, primary	±3276.7 MW, pri
127(R)	Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri

SEL-167D/267D:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current IA	A, primary	0-32767 A, pri

109(R)	Phase Current IB	A, primary	0-32767 A, pri
110(R)	Phase Current IC	A, primary	0-32767 A, pri
111(R)	Demand Phase Current IAD	A, primary	0-32767 A, pri
112(R)	Demand Phase Current IBD	A, primary	0-32767 A, pri
113(R)	Demand Phase Current ICD	A, primary	0-32767 A, pri
114(R)	Peak-Demand Phase Current IAP	A, primary	0-32767 A, pri
115(R)	Peak-Demand Phase Current IBP	A, primary	0-32767 A, pri
116(R)	Peak-Demand Phase Current ICP	A, primary	0-32767 A, pri
117(R)	Difference Voltage VAB	kV/10, primary	0.0-3276.7 kV, pri
118(R)	Difference Voltage VBC	kV/10, primary	0.0-3276.7 kV, pri
119(R)	Difference Voltage VCA	kV/10, primary	0.0-3276.7 kV, pri
120(R)	Real Power P	MW/10, primary	±3276.7 MW, pri
121(R)	Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri

SEL-187V/287V:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Voltage VAX	V/100, secondary	0.00-327.67 V, sec
109(R)	Phase Voltage VBX	V/100, secondary	0.00-327.67 V, sec
110(R)	Phase Voltage VCX	V/100, secondary	0.00-327.67 V, sec
111(R)	Phase Voltage VAY	V/100, secondary	0.00-327.67 V, sec
112(R)	Phase Voltage VBY	V/100, secondary	0.00-327.67 V, sec
113(R)	Phase Voltage VCY	V/100, secondary	0.00-327.67 V, sec
114(R)	Differential Voltage VAD	V/100, secondary	0.00-327.67 V, sec
115(R)	Differential Voltage VBD	V/100, secondary	0.00-327.67 V, sec
116(R)	Differential Voltage VCD	V/100, secondary	0.00-327.67 V, sec

SEL-279:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Voltage V1	V/100, secondary	0.00-327.67 V, sec
109(R)	Phase Voltage V3	V/100, secondary	0.00-327.67 V, sec
110(R)	Phase Voltage V5	V/100, secondary	0.00-327.67 V, sec
111(R)	Phase Voltage V2	V/100, secondary	0.00-327.67 V, sec
112(R)	Phase Voltage V4	V/100, secondary	0.00-327.67 V, sec
113(R)	Phase Voltage V6	V/100, secondary	0.00-327.67 V, sec
114(R)	Differential Voltage V12D	V/100, secondary	0.00-327.67 V, sec
115(R)	Differential Voltage V32D	V/100, secondary	0.00-327.67 V, sec
116(R)	Differential Voltage V56D	V/100, secondary	0.00-327.67 V, sec

SEL-279H,-1,-2:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Bus Positive Sequence Voltage VPB	V/100, secondary	0.00-327.67 V, sec
109(R)	Phase Voltage V1	V/100, secondary	0.00-327.67 V, sec
110(R)	Phase Voltage V3	V/100, secondary	0.00-327.67 V, sec
111(R)	Phase Voltage V5	V/100, secondary	0.00-327.67 V, sec

112(R)	Line Positive Sequence Voltage VPL	V/100, secondary	0.00-327.67 V, sec
113(R)	Phase Voltage V2	V/100, secondary	0.00-327.67 V, sec
114(R)	Phase Voltage V4	V/100, secondary	0.00-327.67 V, sec
115(R)	Phase Voltage V6	V/100, secondary	0.00-327.67 V, sec
116(R)	Differential Voltage V12D	V/100, secondary	0.00-327.67 V, sec
117(R)	Differential Voltage V34D	V/100, secondary	0.00-327.67 V, sec
118(R)	Differential Voltage V56D	V/100, secondary	0.00-327.67 V, sec

SEL-501:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108(R)	Phase Current IAX	A, primary	0-32767 A, pri
109(R)	Phase Current IBX	A, primary	0-32767 A, pri
110(R)	Phase Current ICX	A, primary	0-32767 A, pri
111(R)	Phase Current IAY	A, primary	0-32767 A, pri
112(R)	Phase Current IBY	A, primary	0-32767 A, pri
113(R)	Phase Current ICY	A, primary	0-32767 A, pri
114(R)	Negative-Sequence Current 3I2X	A, primary	0-32767 A, pri
115(R)	Residual Current IRX	A, primary	0-32767 A, pri
116(R)	Negative-Sequence Current 3I2Y	A, primary	0-32767 A, pri
117(R)	Residual Current IRY	A, primary	0-32767 A, pri

II. Data from Relays with Binary Fast Meter Format

SEL-121/221,-10,-16,-17; SEL-121B/221B,-1; SEL-121C/221C,-1; SEL-121G/221G,-3,-4,-5,-6,-7,-8,-9; SEL-121H/221H; SEL-121S/221S; SEL-PG10/2PG10,-7,-8; SEL-151/251,-1,-2,-3; SEL-151C/251C,-1,-2,-3; SEL-321-1, -2 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108(R)	Phase Current Magnitude IA	A, primary	0-32767 A, pri
109(R)	Phase Current Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IB	A, primary	0-32767 A, pri
111(R)	Phase Current Angle	Degrees/10	±180.0°
112(R)	Phase Current Magnitude IC	A, primary	0-32767 A, pri
113(R)	Phase Current Angle	Degrees/10	±180.0°
114(R)	Phase Voltage Magnitude VA	kV/10, primary	0.0-3276.7 kV, pri
115(R)	Phase Voltage Angle	Degrees/10	±180.0°
116(R)	Phase Voltage Magnitude VB	kV/10, primary	0.0-3276.7 kV, pri
117(R)	Phase Voltage Angle	Degrees/10	±180.0°
118(R)	Phase Voltage Magnitude VC	kV/10, primary	0.0-3276.7 kV, pri
119(R)	Phase Voltage Angle	Degrees/10	±180.0°
120(R)	Difference Current Magnitude IAB	A, primary	0-32767 A, pri
121(R)	Difference Current Angle	Degrees/10	±180.0°
122(R)	Difference Current Magnitude IBC	A, primary	0-32767 A, pri
123(R)	Difference Current Angle	Degrees/10	±180.0°
124(R)	Difference Current Magnitude ICA	A, primary	0-32767 A, pri
125(R)	Difference Current Angle	Degrees/10	±180.0°
126(R)	Difference Voltage Magnitude VAB	kV/10, primary	0.0-3276.7 kV, pri
127(R)	Difference Voltage Angle	Degrees/10	±180.0°
128(R)	Difference Voltage Magnitude VBC	kV/10, primary	0.0-3276.7 kV, pri
129(R)	Difference Voltage Angle	Degrees/10	±180.0°
130(R)	Difference Voltage Magnitude VCA	kV/10, primary	0.0-3276.7 kV, pri
131(R)	Difference Voltage Angle	Degrees/10	±180.0°
132(R)	Phase Real Power PA	MW/10, primary	±3276.7 MW, pri

133(R)	Phase Reactive Power QA	MVAR/10, primary	±3276.7 MVAR, pri
134(R)	Phase Real Power PB	MW/10, primary	±3276.7 MW, pri
135(R)	Phase Reactive Power QB	MVAR/10, primary	±3276.7 MVAR, pri
136(R)	Phase Real Power PC	MW/10, primary	±3276.7 MW, pri
137(R)	Phase Reactive Power QC	MVAR/10, primary	±3276.7 MVAR, pri
138(R)	Three Phase Real Power P	MW/10, primary	±3276.7 MW, pri
139(R)	Three Phase Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri
140(R)	Zero-Sequence Current Magnitude I0	A, primary	0-32767 A, pri
141(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
142(R)	Positive-Sequence Current Magnitude I1	A, primary	0-32767 A, pri
143(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
144(R)	Negative-Sequence Current Magnitude I2	A, primary	0-32767 A, pri
145(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
146(R)	Zero-Sequence Voltage Magnitude V0	kV/10, primary	0.0-3276.7 kV, pri
147(R)	Zero-Sequence Voltage Angle	Degrees/10	±180.0°
148(R)	Positive-Sequence Voltage Magnitude V1	kV/10, primary	0.0-3276.7 kV, pri
149(R)	Positive-Sequence Voltage Angle	Degrees/10	±180.0°
150(R)	Negative-Sequence Voltage Magnitude V2	kV/10, primary	0.0-3276.7 kV, pri
151(R)	Negative-Sequence Voltage Angle	Degrees/10	±180.0°

SEL-121F/221F,-1,-2,-3,-8 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current Magnitude IA	A, primary	0-32767 A, pri
109(R)	Phase Current Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IB	A, primary	0-32767 A, pri
111(R)	Phase Current Angle	Degrees/10	±180.0°
112(R)	Phase Current Magnitude IC	A, primary	0-32767 A, pri
113(R)	Phase Current Angle	Degrees/10	±180.0°
114(R)	Phase Voltage Magnitude VA	kV/10, primary	0.0-3276.7 kV, pri
115(R)	Phase Voltage Angle	Degrees/10	±180.0°
116(R)	Phase Voltage Magnitude VB	kV/10, primary	0.0-3276.7 kV, pri
117(R)	Phase Voltage Angle	Degrees/10	±180.0°
118(R)	Phase Voltage Magnitude VC	kV/10, primary	0.0-3276.7 kV, pri
119(R)	Phase Voltage Angle	Degrees/10	±180.0°
120(R)	Synchronizing Voltage Magnitude VS	kV/10, primary	0.0-3276.7 kV, pri
121(R)	Synchronizing Voltage Angle	Degrees/10	±180.0°
122(R)	Difference Current Magnitude IAB	A, primary	0-32767 A, pri
123(R)	Difference Current Angle	Degrees/10	±180.0°
124(R)	Difference Current Magnitude IBC	A, primary	0-32767 A, pri
125(R)	Difference Current Angle	Degrees/10	±180.0°
126(R)	Difference Current Magnitude ICA	A, primary	0-32767 A, pri
127(R)	Difference Current Angle	Degrees/10	±180.0°
128(R)	Difference Voltage Magnitude VAB	kV/10, primary	0.0-3276.7 kV, pri
129(R)	Difference Voltage Angle	Degrees/10	±180.0°
130(R)	Difference Voltage Magnitude VBC	kV/10, primary	0.0-3276.7 kV, pri
131(R)	Difference Voltage Angle	Degrees/10	±180.0°
132(R)	Difference Voltage Magnitude VCA	kV/10, primary	0.0-3276.7 kV, pri
133(R)	Difference Voltage Angle	Degrees/10	±180.0°
134(R)	Phase Real Power PA	MW/10, primary	±3276.7 MW, pri
135(R)	Phase Reactive Power QA	MVAR/10, primary	±3276.7 MVAR, pri
136(R)	Phase Real Power PB	MW/10, primary	±3276.7 MW, pri
137(R)	Phase Reactive Power QB	MVAR/10, primary	±3276.7 MVAR, pri
138(R)	Phase Real Power PC	MW/10, primary	±3276.7 MW, pri
139(R)	Phase Reactive Power QC	MVAR/10, primary	±3276.7 MVAR, pri
140(R)	Three Phase Real Power P	MW/10, primary	±3276.7 MW, pri
141(R)	Three Phase Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri
142(R)	Zero-Sequence Current Magnitude I0	A, primary	0-32767 A, pri
143(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
144(R)	Positive-Sequence Current Magnitude I1	A, primary	0-32767 A, pri
145(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°

146(R)	Negative-Sequence Current Magnitude I2	A, primary	0-32767 A, pri
147(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
148(R)	Zero-Sequence Voltage Magnitude V0	kV/10, primary	0.0-3276.7 kV, pri
149(R)	Zero-Sequence Voltage Angle	Degrees/10	±180.0°
150(R)	Positive-Sequence Voltage Magnitude V1	kV/10, primary	0.0-3276.7 kV, pri
151(R)	Positive-Sequence Voltage Angle	Degrees/10	±180.0°
152(R)	Negative-Sequence Voltage Magnitude V2	kV/10, primary	0.0-3276.7 kV, pri
153(R)	Negative-Sequence Voltage Angle	Degrees/10	±180.0°

SEL-151D/251D,-1,-3; SEL-151CD/251CD,-1,-3; SEL-167D/267D Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108(R)	Phase Current Magnitude IA	A, primary	0-32767 A, pri
109(R)	Phase Current Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IB	A, primary	0-32767 A, pri
111(R)	Phase Current Angle	Degrees/10	±180.0°
112(R)	Phase Current Magnitude IC	A, primary	0-32767 A, pri
113(R)	Phase Current Angle	Degrees/10	±180.0°
114(R)	Difference Voltage Magnitude VAB	kV/10, primary	0.0-3276.7 kV, pri
115(R)	Difference Voltage Angle	Degrees/10	±180.0°
116(R)	Difference Voltage Magnitude VBC	kV/10, primary	0.0-3276.7 kV, pri
117(R)	Difference Voltage Angle	Degrees/10	±180.0°
118(R)	Difference Voltage Magnitude VCA	kV/10, primary	0.0-3276.7 kV, pri
119(R)	Difference Voltage Angle	Degrees/10	±180.0°
120(R)	Difference Current Magnitude IAB	A, primary	0-32767 A, pri
121(R)	Difference Current Angle	Degrees/10	±180.0°
122(R)	Difference Current Magnitude IBC	A, primary	0-32767 A, pri
123(R)	Difference Current Angle	Degrees/10	±180.0°
124(R)	Difference Current Magnitude ICA	A, primary	0-32767 A, pri
125(R)	Difference Current Angle	Degrees/10	±180.0°
126(R)	Three Phase Real Power P	MW/10, primary	±3276.7 MW, pri
127(R)	Three Phase Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri
128(R)	Zero-Sequence Current Magnitude I0	A, primary	0-32767 A, pri
129(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
130(R)	Positive-Sequence Current Magnitude I1	A, primary	0-32767 A, pri
131(R)	Positive-Sequence Angle	Degrees/10	±180.0°
132(R)	Negative-Sequence Current Magnitude I2	A, primary	0-32767 A, pri
133(R)	Negative-Sequence Angle	Degrees/10	±180.0°
134(R)	Zero-Sequence Voltage Magnitude V0	kV/10, primary	0 kV, pri
135(R)	Zero-Sequence Voltage Angle	Degrees/10	±180.0°
136(R)	Positive-Sequence Voltage Magnitude V1	kV/10, primary	0.0-3276.7 kV, pri
137(R)	Positive-Sequence Voltage Angle	Degrees/10	±180.0°
138(R)	Negative-Sequence Voltage Magnitude V2	kV/10, primary	0.0-3276.7 kV, pri
139(R)	Negative-Sequence Voltage Angle	Degrees/10	±180.0°

SEL-300G0 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108(R)	Phase Current Magnitude IA	Amps, primary	0-32767 A, pri
109(R)	Phase Current Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IB	Amps, primary	0-32767 A, pri
111(R)	Phase Current Angle	Degrees/10	±180.0°
112(R)	Phase Current Magnitude IC	Amps, primary	0-32767 A, pri
113(R)	Phase Current Angle	Degrees/10	±180.0°

114(R)	Neutral Current Magnitude IN	Amps, primary	0-32767 A, pri
115(R)	Neutral Current Angle	Degrees/10	±180.0°
116(R)	Phase Voltage Magnitude VA	kV/10, primary	0-3276.7 kV, pri
117(R)	Phase Voltage Angle	Degrees/10	±180.0°
118(R)	Phase Voltage Magnitude VB	kV/10, primary	0-3276.7 kV, pri
119(R)	Phase Voltage Angle	Degrees/10	±180.0°
120(R)	Phase Voltage Magnitude VC	kV/10, primary	0-3276.7 kV, pri
121(R)	Phase Voltage Angle	Degrees/10	±180.0°
122(R)	Neutral Voltage Magnitude VN	kV/10, primary	0-3276.7 kV, pri
123(R)	Neutral Voltage Angle	Degrees/10	±180.0°
124(R)	Frequency Magnitude	Hertz/10	0-3276.7 Hz
125(R)	Frequency Angle	Degrees	±180.0° (0.0)
126(R)	Battery Voltage Magnitude VBAT	kV/10, primary	0-3276.7 kV, pri
127(R)	Battery Voltage Angle	Degrees/10	±180.0° (0.0)
128(R)	Line Current Magnitude IAB	Amps, primary	0-32767 A, pri
129(R)	Line Current Angle	Degrees/10	±180.0°
130(R)	Line Current Magnitude IBC	Amps, primary	0-32767 A, pri
131(R)	Line Current Angle	Degrees/10	±180.0°
132(R)	Line Current Magnitude ICA	Amps, primary	0-32767 A, pri
133(R)	Line Current Angle	Degrees/10	±180.0°
134(R)	Line Voltage Magnitude VAB	kV/10, primary	0-3276.7 kV, pri
135(R)	Line Voltage Angle	Degrees/10	±180.0°
136(R)	Line Voltage Magnitude VBC	kV/10, primary	0-3276.7 kV, pri
137(R)	Line Voltage Angle	Degrees/10	±180.0°
138(R)	Line Voltage Magnitude VCA	kV/10, primary	0-3276.7 kV, pri
139(R)	Line Voltage Angle	Degrees/10	±180.0°
140(R)	Phase Real Power PA	MW/10, primary	±3276.7 MW
141(R)	Phase Reactive Power QA	MVAR/10, primary	±3276.7 MVAR
142(R)	Phase Real Power PB	MW/10, primary	±3276.7 MW
143(R)	Phase Reactive Power QB	MVAR/10, primary	±3276.7 MVAR
144(R)	Phase Real Power PC	MW/10, primary	±3276.7 MW
145(R)	Phase Reactive Power QC	MVAR/10, primary	±3276.7 MVAR
146(R)	Three Phase Real Power PMW	MW/10, primary	±3276.7 MW
147(R)	Three Phase Reactive Power QMVAR	MVAR/10, primary	±3276.7 MVAR
148(R)	Zero-Sequence Current Magnitude I0	A, primary	0-32767 A, pri
149(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
150(R)	Positive-Sequence Current Magnitude I1	A, primary	0-32767 A, pri
151(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
152(R)	Negative-Sequence Current Magnitude I2	A, primary	0-32767 A, pri
153(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
154(R)	Zero-Sequence Voltage Magnitude V0	kV/10, primary	0-3276.7 kV, pri
155(R)	Zero-Sequence Voltage Angle	Degrees/10	±180.0°
156(R)	Positive-Sequence Voltage Magnitude V1	kV/10, primary	0-3276.7 kV, pri
157(R)	Positive-Sequence Voltage Angle	Degrees/10	±180.0°
158(R)	Negative-Sequence Voltage Magnitude V2	kV/10, primary	0-3276.7 kV, pri
159(R)	Negative-Sequence Voltage Angle	Degrees/10	±180.0°

SEL-300G1 (Differential Option) Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108(R)	Phase Current Magnitude IA	Amps, primary	0-32767 A, pri
109(R)	Phase Current Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IB	Amps, primary	0-32767 A, pri
111(R)	Phase Current Angle	Degrees/10	±180.0°
112(R)	Phase Current Magnitude IC	Amps, primary	0-32767 A, pri
113(R)	Phase Current Angle	Degrees/10	±180.0°
114(R)	Neutral Current Magnitude IN	Amps, primary	0-32767 A, pri
115(R)	Neutral Current Angle	Degrees/10	±180.0°

116(R)	Phase Voltage Magnitude VA	kV/10, primary	0-3276.7 kV, pri
117(R)	Phase Voltage Angle	Degrees/10	±180.0°
118(R)	Phase Voltage Magnitude VB	kV/10, primary	0-3276.7 kV, pri
119(R)	Phase Voltage Angle	Degrees/10	±180.0°
120(R)	Phase Voltage Magnitude VC	kV/10, primary	0-3276.7 kV, pri
121(R)	Phase Voltage Angle	Degrees/10	±180.0°
122(R)	Neutral Voltage Magnitude VN	kV/10, primary	0-3276.7 kV, pri
123(R)	Neutral Voltage Angle	Degrees/10	±180.0°
124(R)	Diff. Current Magnitude IA87	Amps, primary	0-32767 A, pri
125(R)	Diff. Current Angle	Degrees/10	±180.0°
126(R)	Diff. Current Magnitude IB87	Amps, primary	0-32767 A, pri
127(R)	Diff. Current Angle	Degrees/10	±180.0°
128(R)	Diff. Current Magnitude IC87	Amps, primary	0-32767 A, pri
129(R)	Diff. Current Angle	Degrees/10	±180.0°
130(R)	Frequency Magnitude	Hertz/10	0-3276.7 Hz
131(R)	Frequency Angle	Degrees	±180.0° (0.0)
132(R)	Battery Voltage Magnitude VBAT	kV/10, primary	0-3276.7 kV, pri
133(R)	Battery Voltage Angle	Degrees/10	±180.0° (0.0)
134(R)	Line Current Magnitude IAB	Amps, primary	0-32767 A, pri
135(R)	Line Current Angle	Degrees/10	±180.0°
136(R)	Line Current Magnitude IBC	Amps, primary	0-32767 A, pri
137(R)	Line Current Angle	Degrees/10	±180.0°
138(R)	Line Current Magnitude ICA	Amps, primary	0-32767 A, pri
139(R)	Line Current Angle	Degrees/10	±180.0°
140(R)	Line Voltage Magnitude VAB	kV/10, primary	0-3276.7 kV, pri
141(R)	Line Voltage Angle	Degrees/10	±180.0°
142(R)	Line Voltage Magnitude VBC	kV/10, primary	0-3276.7 kV, pri
143(R)	Line Voltage Angle	Degrees/10	±180.0°
144(R)	Line Voltage Magnitude VCA	kV/10, primary	0-3276.7 kV, pri
145(R)	Line Voltage Angle	Degrees/10	±180.0°
146(R)	Phase Real Power PA	MW/10, primary	±3276.7 MW
147(R)	Phase Reactive Power QA	MVAR/10, primary	±3276.7 MVAR
148(R)	Phase Real Power PB	MW/10, primary	±3276.7 MW
149(R)	Phase Reactive Power QB	MVAR/10, primary	±3276.7 MVAR
150(R)	Phase Real Power PC	MW/10, primary	±3276.7 MW
151(R)	Phase Reactive Power QC	MVAR/10, primary	±3276.7 MVAR
152(R)	Three Phase Real Power PMW	MW/10, primary	±3276.7 MW
153(R)	Three Phase Reactive Power QMVAR	MVAR/10, primary	±3276.7 MVAR
154(R)	Zero-Sequence Current Magnitude I0	A, primary	0-32767 A, pri
155(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
156(R)	Positive-Sequence Current Magnitude I1	A, primary	0-32767 A, pri
157(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
158(R)	Negative-Sequence Current Magnitude I2	A, primary	0-32767 A, pri
159(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
160(R)	Zero-Sequence Voltage Magnitude V0	kV/10, primary	0-3276.7 kV, pri
161(R)	Zero-Sequence Voltage Angle	Degrees/10	±180.0°
162(R)	Positive-Sequence Voltage Magnitude V1	kV/10, primary	0-3276.7 kV, pri
163(R)	Positive-Sequence Voltage Angle	Degrees/10	±180.0°
164(R)	Negative-Sequence Voltage Magnitude V2	kV/10, primary	0-3276.7 kV, pri
165(R)	Negative-Sequence Voltage Angle	Degrees/10	±180.0°

SEL-351; SEL-351R Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current Magnitude IA	Amps, primary	0-32767 A, pri
109(R)	Phase Current Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IB	Amps, primary	0-32767 A, pri
111(R)	Phase Current Angle	Degrees/10	±180.0°

112(R)	Phase Current Magnitude IC	Amps, primary	0-32767 A, pri
113(R)	Phase Current Angle	Degrees/10	±180.0°
114(R)	Neutral Current Magnitude IN	A, primary	0-32767 A, pri
115(R)	Neutral Current Angle	Degrees/10	±180.0°
116(R)	Phase Voltage Magnitude VA	kV/10, primary	0-3276.7 kV, pri
117(R)	Phase Voltage Angle	Degrees/10	±180.0°
118(R)	Phase Voltage Magnitude VB	kV/10, primary	0-3276.7 kV, pri
119(R)	Phase Voltage Angle	Degrees/10	±180.0°
120(R)	Phase Voltage Magnitude VC	kV/10, primary	0-3276.7 kV, pri
121(R)	Phase Voltage Angle	Degrees/10	±180.0°
122(R)	Synchronizing Voltage Magnitude VS	kV/10, primary	0-3276.7 kV, pri
123(R)	Synchronizing Voltage Angle	Degrees/10	±180.0°
124(R)	Frequency Magnitude	Hertz/10	0-3276.7 Hz
125(R)	Frequency Angle	Degrees	±180.0° (0.0)
126(R)	Battery Voltage Magnitude VBAT	kV/10, primary	0-3276.7 kV, pri
127(R)	Battery Voltage Angle	Degrees/10	±180.0° (0.0)
128(R)	Line Current Magnitude IAB	Amps, primary	0-32767 A, pri
129(R)	Line Current Angle	Degrees/10	±180.0°
130(R)	Line Current Magnitude IBC	Amps, primary	0-32767 A, pri
131(R)	Line Current Angle	Degrees/10	±180.0°
132(R)	Line Current Magnitude ICA	Amps, primary	0-32767 A, pri
133(R)	Line Current Angle	Degrees/10	±180.0°
134(R)	Line Voltage Magnitude VAB	kV/10, primary	0-3276.7 kV, pri
135(R)	Line Voltage Angle	Degrees/10	±180.0°
136(R)	Line Voltage Magnitude VBC	kV/10, primary	0-3276.7 kV, pri
137(R)	Line Voltage Angle	Degrees/10	±180.0°
138(R)	Line Voltage Magnitude VCA	kV/10, primary	0-3276.7 kV, pri
139(R)	Line Voltage Angle	Degrees/10	±180.0°
140(R)	Phase Real Power PA	MW/10, primary	±3276.7 MW
141(R)	Phase Reactive Power QA	MVAR/10, primary	±3276.7 MVAR
142(R)	Phase Real Power PB	MW/10, primary	±3276.7 MW
143(R)	Phase Reactive Power QB	MVAR/10, primary	±3276.7 MVAR
144(R)	Phase Real Power PC	MW/10, primary	±3276.7 MW
145(R)	Phase Reactive Power QC	MVAR/10, primary	±3276.7 MVAR
146(R)	Three Phase Real Power PMW	MW/10, primary	±3276.7 MW
147(R)	Three Phase Reactive Power QMVAR	MVAR/10, primary	±3276.7 MVAR
148(R)	Zero-Sequence Current Magnitude I0	A, primary	0-32767 A, pri
149(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
150(R)	Positive-Sequence Current Magnitude I1	A, primary	0-32767 A, pri
151(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
152(R)	Negative-Sequence Current Magnitude I2	A, primary	0-32767 A, pri
153(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
154(R)	Zero-Sequence Voltage Magnitude V0	kV/10, primary	0-3276.7 kV, pri
155(R)	Zero-Sequence Voltage Angle	Degrees/10	±180.0°
156(R)	Positive-Sequence Voltage Magnitude V1	kV/10, primary	0-3276.7 kV, pri
157(R)	Positive-Sequence Voltage Angle	Degrees/10	±180.0°
158(R)	Negative-Sequence Voltage Magnitude V2	kV/10, primary	0-3276.7 kV, pri
159(R)	Negative-Sequence Voltage Angle	Degrees/10	±180.0°

SEL-352 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Voltage Magnitude VA1	kV/10, primary	0-3276.7 kV, pri
109(R)	Phase Voltage Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IA	A, primary	0-32767 A, pri
111(R)	Phase Current Angle	Degrees/10	±180.0°
112(R)	Phase Voltage Magnitude VA2	KV/10, primary	0-3276.7 kV, pri
113(R)	Phase Voltage Angle	Degrees/10	±180.0°

114(R)	Phase Voltage Magnitude VB1	V, primary	0-3276.7 kV, pri
115(R)	Phase Voltage Angle	Degrees/10	±180.0°
116(R)	Phase Current Magnitude IB	A, primary	0-32767 A, pri
117(R)	Phase Current Angle	Degrees/10	±180.0°
118(R)	Phase Voltage Magnitude VB2	KV/10, primary	0-3276.7 kV, pri
119(R)	Phase Voltage Angle	Degrees/10	±180.0°
120(R)	Phase Voltage Magnitude VC1	KV/10, primary	0-3276.7 kV, pri
121(R)	Phase Voltage Angle	Degrees/10	±180.0°
122(R)	Phase Current Magnitude IC	A, primary	0-32767 A, pri
123(R)	Phase Current Angle	Degrees/10	±180.0°
124(R)	Phase Voltage Magnitude VC2	KV/10, primary	0-3276.7 kV, pri
125(R)	Phase Voltage Angle	Degrees/10	±180.0°
126(R)	Difference Current Magnitude IAB	Amps, primary	0-32767 A, pri
127(R)	Difference Current Angle	Degrees/10	±180.0°
128(R)	Difference Current Magnitude IBC	Amps, primary	0-32767 A, pri
129(R)	Difference Current Angle	Degrees/10	±180.0°
130(R)	Difference Current Magnitude ICA	Amps, primary	0-32767 A, pri
131(R)	Difference Current Angle	Degrees/10	±180.0°
132(R)	Difference Voltage Magnitude VAB1	KV/10, primary	0-3276.7 kV, pri
133(R)	Difference Voltage Angle	Degrees/10	±180.0°
134(R)	Difference Voltage Magnitude VBC1	KV/10, primary	0-3276.7 kV, pri
135(R)	Difference Voltage Angle	Degrees/10	±180.0°
136(R)	Difference Voltage Magnitude VCA1	KV/10, primary	0-3276.7 kV, pri
137(R)	Difference Voltage Angle	Degrees/10	±180.0°
138(R)	Phase Real Power PA	MW/10, primary	±3276.7 MW
139(R)	Phase Reactive Power QA	MVAR/10, primary	±3276.7 MVAR
140(R)	Phase Real Power PB	MW/10, primary	±3276.7 MW
141(R)	Phase Reactive Power QB	MVAR/10, primary	±3276.7 MVAR
142(R)	Phase Real Power PC	MW/10, primary	±3276.7 MW
143(R)	Phase Reactive Power QC	MVAR/10, primary	±3276.7 MVAR
144(R)	Three Phase Real Power P	MW/10, primary	±3276.7 MW
145(R)	Three Phase Reactive Power Q	MVAR/10, primary	±3276.7 MVAR
146(R)	Difference Voltage Magnitude VAB2	KV/10, primary	0-3276.7 kV, pri
147(R)	Difference Voltage Angle	Degrees/10	±180.0°
148(R)	Difference Voltage Magnitude VBC2	KV/10, primary	0-3276.7 kV, pri
149(R)	Difference Voltage Angle	Degrees/10	±180.0°
150(R)	Difference Voltage Magnitude VCA2	KV/10, primary	0-3276.7 kV, pri
151(R)	Difference Voltage Angle	Degrees/10	±180.0°
152(R)	Zero-Sequence Current Magnitude I0	A, primary	0-32767 A, pri
153(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
154(R)	Positive-Sequence Current Magnitude I1	A, primary	0-32767 A, pri
155(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
156(R)	Negative-Sequence Current Magnitude I2	A, primary	0-32767 A, pri
157(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
158(R)	Zero-Sequence Voltage Magnitude V01	KV/10, primary	0-3276.7 kV, pri
159(R)	Zero-Sequence Voltage Angle	Degrees/10	±180.0°
160(R)	Positive-Sequence Voltage Magnitude V11	KV/10, primary	0-3276.7 kV, pri
161(R)	Positive-Sequence Voltage Angle	Degrees/10	±180.0°
162(R)	Negative-Sequence Voltage Magnitude V21	KV/10, primary	0-3276.7 kV, pri
163(R)	Negative-Sequence Voltage Angle	Degrees/10	±180.0°
164(R)	Zero-Sequence Voltage Magnitude V02	KV/10, primary	0-3276.7 kV, pri
165(R)	Zero-Sequence Voltage Angle	Degrees/10	±180.0°
166(R)	Positive-Sequence Voltage Magnitude V12	KV/10, primary	0-3276.7 kV, pri
167(R)	Positive-Sequence Voltage Angle	Degrees/10	±180.0°
168(R)	Negative-Sequence Voltage Magnitude V22	KV/10, primary	0-3276.7 kV, pri
169(R)	Negative-Sequence Voltage Angle	Degrees/10	±180.0°

SEL-387 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59

106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108(R)	Phase Current Magnitude IAW1	A, primary	0-32767 A, pri
109(R)	Phase Current Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IBW1	A, primary	0-32767 A, pri
111(R)	Phase Current Angle	Degrees/10	±180.0°
112(R)	Phase Current Magnitude ICW1	A, primary	0-32767 A, pri
113(R)	Phase Current Angle	Degrees/10	±180.0°
114(R)	Phase Current Magnitude IAW2	A, primary	0-32767 A, pri
115(R)	Phase Current Angle	Degrees/10	±180.0°
116(R)	Phase Current Magnitude IBW2	A, primary	0-32767 A, pri
117(R)	Phase Current Angle	Degrees/10	±180.0°
118(R)	Phase Current Magnitude ICW2	A, primary	0-32767 A, pri
119(R)	Phase Current Angle	Degrees/10	±180.0°
120(R)	Phase Current Magnitude IAW3	A, primary	0-32767 A, pri
121(R)	Phase Current Angle	Degrees/10	±180.0°
122(R)	Phase Current Magnitude IBW3	A, primary	0-32767 A, pri
123(R)	Phase Current Angle	Degrees/10	±180.0°
124(R)	Phase Current Magnitude ICW3	A, primary	0-32767 A, pri
125(R)	Phase Current Angle	Degrees/10	±180.0°
126(R)	Phase Current Magnitude IAW4	A, primary	0-32767 A, pri
127(R)	Phase Current Angle	Degrees/10	±180.0°
128(R)	Phase Current Magnitude IBW4	A, primary	0-32767 A, pri
129(R)	Phase Current Angle	Degrees/10	±180.0°
130(R)	Phase Current Magnitude ICW4	A, primary	0-32767 A, pri
131(R)	Phase Current Angle	Degrees/10	±180.0°
132(R)	Zero-Sequence Current Magnitude I0W1	A, primary	0-32767 A, pri
133(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
134(R)	Positive-Sequence Current Magnitude I1W1	A, primary	0-32767 A, pri
135(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
136(R)	Negative-Sequence Current Magnitude I2W1	A, primary	0-32767 A, pri
137(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
138(R)	Zero-Sequence Current Magnitude I0W2	A, primary	0-32767 A, pri
139(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
140(R)	Positive-Sequence Current Magnitude I1W2	A, primary	0-32767 A, pri
141(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
142(R)	Negative-Sequence Current Magnitude I2W2	A, primary	0-32767 A, pri
143(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
144(R)	Zero-Sequence Current Magnitude I0W3	A, primary	0-32767 A, pri
145(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
146(R)	Positive-Sequence Current Magnitude I1W3	A, primary	0-32767 A, pri
147(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
148(R)	Negative-Sequence Current Magnitude I2W3	A, primary	0-32767 A, pri
149(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
150(R)	Zero-Sequence Current Magnitude I0W4	A, primary	0-32767 A, pri
151(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
152(R)	Positive-Sequence Current Magnitude I1W4	A, primary	0-32767 A, pri
153(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
154(R)	Negative-Sequence Current Magnitude I2W4	A, primary	0-32767 A, pri
155(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°

SEL-501,-1,-2 Binary Fast Meter Format

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
108(R)	Phase Current Magnitude IAX	A, primary	0-32767 A, pri
109(R)	Phase Current Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IBX	A, primary	0-32767 A, pri
111(R)	Phase Current Angle	Degrees/10	±180.0°
112(R)	Phase Current Magnitude ICX	A, primary	0-32767 A, pri
113(R)	Phase Current Angle	Degrees/10	±180.0°
114(R)	Phase Current Magnitude IAY	A, primary	0-32767 A, pri

115(R)	Phase Current Angle	Degrees/10	±180.0°
116(R)	Phase Current Magnitude IBY	A, primary	0-32767 A, pri
117(R)	Phase Current Angle	Degrees/10	±180.0°
118(R)	Phase Current Magnitude ICY	A, primary	0-32767 A, pri
119(R)	Phase Current Angle	Degrees/10	±180.0°
120(R)	Difference Current Magnitude IABX	A, primary	0-32767 A, pri
121(R)	Difference Current Angle	Degrees/10	±180.0°
122(R)	Difference Current Magnitude IBCX	A, primary	0-32767 A, pri
123(R)	Difference Current Angle	Degrees/10	±180.0°
124(R)	Difference Current Magnitude ICAX	A, primary	0-32767 A, pri
125(R)	Difference Current Angle	Degrees/10	±180.0°
126(R)	Difference Current Magnitude IABY	A, primary	0-32767 A, pri
127(R)	Difference Current Angle	Degrees/10	±180.0°
128(R)	Difference Current Magnitude IBCY	A, primary	0-32767 A, pri
129(R)	Difference Current Angle	Degrees/10	±180.0°
130(R)	Difference Current Magnitude ICAY	A, primary	0-32767 A, pri
131(R)	Difference Current Angle	Degrees/10	±180.0°
132(R)	Zero-Sequence Current Magnitude I0X	A, primary	0-32767 A, pri
133(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
134(R)	Positive-Sequence Current Magnitude I1X	A, primary	0-32767 A, pri
135(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
136(R)	Negative-Sequence Current Magnitude I2X	A, primary	0-32767 A, pri
137(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
138(R)	Zero-Sequence Current Magnitude I0Y	A, primary	0-32767 A, pri
139(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
140(R)	Positive-Sequence Current Magnitude I1Y	A, primary	0-32767 A, pri
141(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
142(R)	Negative-Sequence Current Magnitude I2Y	A, primary	0-32767 A, pri
143(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°

SEL-551 Binary Fast Meter Format:

100(R)	Meter Date Stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108 (R)	Phase Current Magnitude IA	A, primary	0-32767A, pri
109(R)	Phase Current Angle	Degrees	±180.0°
110(R)	Phase Current Magnitude IB	A, primary	0-32767A, pri
111(R)	Phase Current Angle	Degrees	±180.0°
112(R)	Phase Current Magnitude IC	A, primary	0-32767A, pri
113(R)	Phase Current Angle	Degrees	±180.0°
114(R)	Neutral Current Magnitude IN	A, primary	0-32767A, pri
115(R)	Neutral Current Angle	Degrees	±180.0°
116(R)	Difference Current Magnitude IAB	A, primary	0-32767A, pri
117(R)	Difference Current Angle	Degrees	±180.0°
118(R)	Difference Current Magnitude IBC	A, primary	0-32767A, pri
119(R)	Difference Current Angle	Degrees	±180.0°
120(R)	Difference Current Magnitude ICA	A, primary	0-32767A, pri
121(R)	Difference Current Angle	Degrees	±180.0°

SEL-587 Binary Fast Meter Format:

100(R)	Meter Date stamp	Month	1-12
101(R)	Meter Date stamp	Day of the Month	1-31
102(R)	Meter Date stamp	Year	0-99
103(R)	Meter Time stamp	Hours	0-23
104(R)	Meter Time stamp	Minutes	0-59
105(R)	Meter Time stamp	Seconds	0-59
106(R)	Meter Time stamp	Milliseconds	0-999
107(R)	Meter Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
108(R)	Phase Current Magnitude IAW1	A, primary	0-32767 A, pri
109(R)	Phase Current Angle	Degrees/10	±180.0°
110(R)	Phase Current Magnitude IBW1	A, primary	0-32767 A, pri

111(R)	Phase Current Angle	Degrees/10	±180.0°
112(R)	Phase Current Magnitude ICW1	A, primary	0-32767 A, pri
113(R)	Phase Current Angle	Degrees/10	±180.0°
114(R)	Phase Current Magnitude IAW2	A, primary	0-32767 A, pri
115(R)	Phase Current Angle	Degrees/10	±180.0°
116(R)	Phase Current Magnitude IBW2	A, primary	0-32767 A, pri
117(R)	Phase Current Angle	Degrees/10	±180.0°
118(R)	Phase Current Magnitude ICW2	A, primary	0-32767 A, pri
119(R)	Phase Current Angle	Degrees/10	±180.0°
120(R)	Difference Current Magnitude IAB	A, primary	0-32767 A, pri
121(R)	Difference Current Angle	Degrees/10	±180.0°
122(R)	Difference Current Magnitude IBC	A, primary	0-32767 A, pri
123(R)	Difference Current Angle	Degrees/10	±180.0°
124(R)	Difference Current Magnitude ICA	A, primary	0-32767 A, pri
125(R)	Difference Current Angle	Degrees/10	±180.0°
126(R)	Difference Current Magnitude IAB	A, primary	0-32767 A, pri
127(R)	Difference Current Angle	Degrees/10	±180.0°
128(R)	Difference Current Magnitude IBC	A, primary	0-32767 A, pri
129(R)	Difference Current Angle	Degrees/10	±180.0°
130(R)	Difference Current Magnitude ICA	A, primary	0-32767 A, pri
131(R)	Difference Current Angle	Degrees/10	±180.0°
132(R)	Zero-Sequence Current Magnitude IOW1	A, primary	0-32767 A, pri
133(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
134(R)	Positive-Sequence Current Magnitude I1W1	A, primary	0-32767 A, pri
135(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
136(R)	Negative-Sequence Current Magnitude I2W1	A, primary	0-32767 A, pri
137(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°
138(R)	Zero-Sequence Current Magnitude IOW2	A, primary	0-32767 A, pri
139(R)	Zero-Sequence Current Angle	Degrees/10	±180.0°
140(R)	Positive-Sequence Current Magnitude I1W2	A, primary	0-32767 A, pri
141(R)	Positive-Sequence Current Angle	Degrees/10	±180.0°
142(R)	Negative-Sequence Current Magnitude I2W2	A, primary	0-32767 A, pri
143(R)	Negative-Sequence Current Angle	Degrees/10	±180.0°

Table 7.3: Register Maps for Demand Meter Data, Floating-Point Type

The first eight registers of Modbus demand meter data are the collection date and time stamp. This is the time the SEL-2030 received the demand data.

Reg.#	Description	Units	Range
For SEL-151/251,-1,-2,-3; SEL-151C/251C,-1,-2,-3; SEL-151CD/251CD,-1,-3; SEL-151D/251D,-1,-3:			
2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IA	A, primary	Integer
2309(R)	Phase Current IB	A, primary	Integer
2310(R)	Phase Current IC	A, primary	Integer
2311(R)	Residual Current IR	A, primary	Integer
2312(R)	Negative Sequence 3I2	A, primary	Integer
2313-2314(R)	Real Power P	MW, primary	IEEE float
2315-2316(R)	Reactive Power Q	MVAR, primary	IEEE float
2317(R)	Peak Demand Phase Current IA	A, primary	Integer
2318(R)	Peak Demand Phase Current IB	A, primary	Integer
2319(R)	Peak Demand Phase Current IC	A, primary	Integer
2320(R)	Peak Demand Residual Current IR	A, primary	Integer
2321(R)	Peak Demand Negative Sequence 3I2	A, primary	Integer
2322-2323(R)	Peak Demand Real Power P	MW, primary	IEEE float
2324-2325(R)	Peak Demand Reactive Power Q	MVAR, primary	IEEE float

SEL-167/267,-2,-4,-5:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IA	A, primary	Integer
2309(R)	Phase Current IB	A, primary	Integer
2310(R)	Phase Current IC	A, primary	Integer
2311(R)	Difference Current IAB	A, primary	Integer
2312(R)	Difference Current IBC	A, primary	Integer
2313(R)	Difference Current ICA	A, primary	Integer
2314(R)	Demand Phase Current IA	A, primary	Integer
2315(R)	Demand Phase Current IB	A, primary	Integer
2316(R)	Demand Phase Current IC	A, primary	Integer
2317(R)	Peak Phase Current IA	A, primary	Integer
2318(R)	Peak Phase Current IB	A, primary	Integer
2319(R)	Peak Phase Current IC	A, primary	Integer
2320-2321(R)	Phase Voltage VA	kV, primary	IEEE float
2322-2323(R)	Phase Voltage VB	kV, primary	IEEE float
2324-2325(R)	Phase Voltage VC	kV, primary	IEEE float
2326-2327(R)	Difference Voltage VAB	kV, primary	IEEE float
2328-2329(R)	Difference Voltage VBC	kV, primary	IEEE float
2330-2331(R)	Difference Voltage VCA	kV, primary	IEEE float
2332-2333(R)	Real Power P	MW, primary	IEEE float
2334-2335(R)	Reactive Power Q	MVAR, primary	IEEE float

SEL-167D/267D:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IA	A, primary	Integer
2309(R)	Phase Current IB	A, primary	Integer
2310(R)	Phase Current IC	A, primary	Integer
2311(R)	Demand Phase Current IA	A, primary	Integer
2312(R)	Demand Phase Current IB	A, primary	Integer
2313(R)	Demand Phase Current IC	A, primary	Integer
2314(R)	Peak Phase Current IA	A, primary	Integer
2315(R)	Peak Phase Current IB	A, primary	Integer
2316(R)	Peak Phase Current IC	A, primary	Integer
2317-2318(R)	Phase Voltage VA	kV, primary	IEEE float
2319-2320(R)	Phase Voltage VB	kV, primary	IEEE float
2321-2322(R)	Phase Voltage VC	kV, primary	IEEE float
2323-2324(R)	Real Power P	MW, primary	IEEE float
2325-2326(R)	Reactive Power Q	MVAR, primary	IEEE float

For 300G; SEL-351; SEL-351R:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308-2309(R)	Phase Current IA	A, primary	IEEE float
2310-2311(R)	Phase Current IB	A, primary	IEEE float

2312-2313(R)	Phase Current IC	A, primary	IEEE float
2314-2315(R)	Neutral Current IN	A, primary	IEEE float
2316-2317(R)	Ground Current IG	A, primary	IEEE float
2318-2319(R)	Negative Sequence 3I2	A, primary	IEEE float
2320-2321(R)	Phase Real Power Input PA+	MW, primary	IEEE float
2322-2323(R)	Phase Real Power Input PB+	MW, primary	IEEE float
2324-2325(R)	Phase Real Power Input PC+	MW, primary	IEEE float
2326-2327(R)	3-Phase Real Power Input P3+	MW, primary	IEEE float
2328-2329(R)	Phase Reactive Power Input QA+	MVAR, primary	IEEE float
2330-2331(R)	Phase Reactive Power Input QB+	MVAR, primary	IEEE float
2332-2333(R)	Phase Reactive Power Input QC+	MVAR, primary	IEEE float
2334-2335(R)	3-Phase Reactive Power Input Q3+	MVAR, primary	IEEE float
2336-2337(R)	Phase Real Power Output PA-	MW, primary	IEEE float
2338-2339(R)	Phase Real Power Output PB-	MW, primary	IEEE float
2340-2341(R)	Phase Real Power Output PC-	MW, primary	IEEE float
2342-2343(R)	3-Phase Real Power Output P3-	MW, primary	IEEE float
2344-2345(R)	Phase Reactive Power Output QA-	MVAR, primary	IEEE float
2346-2347(R)	Phase Reactive Power Output QB-	MVAR, primary	IEEE float
2348-2349(R)	Phase Reactive Power Output QC-	MVAR, primary	IEEE float
2350-2351(R)	3-Phase Reactive Power Output Q3-	MVAR, primary	IEEE float

For SEL-387:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308-2309(R)	Phase Current IAW1	A, primary	IEEE float
2310-2311(R)	Phase Current IBW1	A, primary	IEEE float
2312-2313(R)	Phase Current ICW1	A, primary	IEEE float
2314-2315(R)	Negative-Sequence 3I2W1	A, primary	IEEE float
2316-2317(R)	Residual Current IRW1	A, primary	IEEE float
2318-2319(R)	Phase Current IAW2	A, primary	IEEE float
2320-2321(R)	Phase Current IBW2	A, primary	IEEE float
2322-2323(R)	Phase Current ICW2	A, primary	IEEE float
2324-2325(R)	Negative-Sequence 3I2W2	A, primary	IEEE float
2326-2327(R)	Residual Current IRW2	A, primary	IEEE float
2328-2329(R)	Phase Current IAW3	A, primary	IEEE float
2330-2331(R)	Phase Current IBW3	A, primary	IEEE float
2332-2333(R)	Phase Current ICW3	A, primary	IEEE float
2334-2335(R)	Negative-Sequence 3I2W3	A, primary	IEEE float
2336-2337(R)	Residual Current IRW3	A, primary	IEEE float
2338-2339(R)	Phase Current IAW4	A, primary	IEEE float
2340-2341(R)	Phase Current IBW4	A, primary	IEEE float
2342-2343(R)	Phase Current ICW4	A, primary	IEEE float
2344-2345(R)	Negative-Sequence 3I2W4	A, primary	IEEE float
2346-2347(R)	Residual Current IRW4	A, primary	IEEE float

For SEL-501 (ASCII Collection):

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IAX	A, primary	Integer
2309(R)	Phase Current IBX	A, primary	Integer
2310(R)	Phase Current ICX	A, primary	Integer
2311(R)	Phase Current IAY	A, primary	Integer
2312(R)	Phase Current IBY	A, primary	Integer
2313(R)	Phase Current ICY	A, primary	Integer

2314(R)	Negative Sequence Current 3I2X	A, primary	Integer
2315(R)	Residual Current IRX	A, primary	Integer
2316(R)	Negative Sequence Current 3I2Y	A, primary	Integer
2317(R)	Residual Current IRY	A, primary	Integer

For SEL-501,-1,-2 (Binary Format):

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308-2309(R)	Phase Current IAX	A, primary	IEEE float
2310-2311(R)	Phase Current IBX	A, primary	IEEE float
2312-2313(R)	Phase Current ICX	A, primary	IEEE float
2314-2315(R)	Negative-Sequence Current 3I2X	A, primary	IEEE float
2316-2317(R)	Residual Current IRX	A, primary	IEEE float
2318-2319(R)	Phase Current IAY	A, primary	IEEE float
2320-2321(R)	Phase Current IBY	A, primary	IEEE float
2322-2323(R)	Phase Current ICY	A, primary	IEEE float
2324-2325(R)	Negative-Sequence Current 3I2Y	A, primary	IEEE float
2326-2327(R)	Residual Current IRY	A, primary	IEEE float

For SEL-587:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308-2309(R)	Phase Current IAW1	A, primary	IEEE float
2310-2311(R)	Phase Current IBW1	A, primary	IEEE float
2312-2313(R)	Phase Current ICW1	A, primary	IEEE float
2314-2315(R)	Negative Sequence Current 3I2W1	A, primary	IEEE float
2316-2317(R)	Residual Current IRW1	A, primary	IEEE float
2318-2319(R)	Phase Current IAW2	A, primary	IEEE float
2320-2321(R)	Phase Current IBW2	A, primary	IEEE float
2322-2323(R)	Phase Current ICW2	A, primary	IEEE float
2324-2325(R)	Negative Sequence Current 3I2W2	A, primary	IEEE float
2326-2327(R)	Residual Current IRW2	A, primary	IEEE float

Table 7.4: Register Maps for Demand Meter Data, Integer Type

The first eight registers of Modbus demand meter data are the collection date and time stamp. This is the time the SEL-2030 received the demand data.

Reg.#	Description	Units	Range
For SEL-151/251,-1,-2,-3; SEL-151C/251C,-1,-2,-3; SEL-151CD/251CD,-1,-3; SEL-151D/251D,-1,-3:			
2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IA	A, primary	Integer

2309(R)	Phase Current IB	A, primary	Integer
2310(R)	Phase Current IC	A, primary	Integer
2311(R)	Residual Current IR	A, primary	Integer
2312(R)	Negative Sequence 3I2	A, primary	Integer
2313(R)	Real Power P	MW/10, primary	±3276.7 MW, pri
2314(R)	Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri
2315(R)	Peak Demand Phase Current IA	A, primary	Integer
2316(R)	Peak Demand Phase Current IB	A, primary	Integer
2317(R)	Peak Demand Phase Current IC	A, primary	Integer
2318(R)	Peak Demand Residual Current IR	A, primary	Integer
2319(R)	Peak Demand Negative Sequence 3I2	A, primary	Integer
2320(R)	Peak Demand Real Power P	MW/10, primary	±3276.7 MW, pri
2321(R)	Peak Demand Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri

SEL-167/267,-2,-4,-5:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2308(R)	Phase Current IA	A, primary	Integer
2309(R)	Phase Current IB	A, primary	Integer
2310(R)	Phase Current IC	A, primary	Integer
2311(R)	Difference Current IAB	A, primary	Integer
2312(R)	Difference Current IBC	A, primary	Integer
2313(R)	Difference Current ICA	A, primary	Integer
2314(R)	Demand Phase Current IA	A, primary	Integer
2315(R)	Demand Phase Current IB	A, primary	Integer
2316(R)	Demand Phase Current IC	A, primary	Integer
2317(R)	Peak Phase Current IA	A, primary	Integer
2318(R)	Peak Phase Current IB	A, primary	Integer
2319(R)	Peak Phase Current IC	A, primary	Integer
2320(R)	Phase Voltage VA	kV/10, primary	0.0-3276.7 kV, pri
2321(R)	Phase Voltage VB	kV/10, primary	0.0-3276.7 kV, pri
2322(R)	Phase Voltage VC	kV/10, primary	0.0-3276.7 kV, pri
2323(R)	Difference Voltage VAB	kV/10, primary	0.0-3276.7 kV, pri
2324(R)	Difference Voltage VBC	kV/10, primary	0.0-3276.7 kV, pri
2325(R)	Difference Voltage VCA	kV/10, primary	0.0-3276.7 kV, pri
2326(R)	Peak Demand Real Power P	MW/10, primary	±3276.7 MW, pri
2327(R)	Peak Demand Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri

SEL-167D/267D:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2308(R)	Phase Current IA	A, primary	Integer
2309(R)	Phase Current IB	A, primary	Integer
2310(R)	Phase Current IC	A, primary	Integer
2311(R)	Demand Phase Current IA	A, primary	Integer
2312(R)	Demand Phase Current IB	A, primary	Integer
2313(R)	Demand Phase Current IC	A, primary	Integer
2314(R)	Peak Phase Current IA	A, primary	Integer
2315(R)	Peak Phase Current IB	A, primary	Integer
2316(R)	Peak Phase Current IC	A, primary	Integer
2317(R)	Phase Voltage VA	kV/10, primary	0.0-3276.7 kV, pri
2318(R)	Phase Voltage VB	kV/10, primary	0.0-3276.7 kV, pri
2319(R)	Phase Voltage VC	kV/10, primary	0.0-3276.7 kV, pri
2320(R)	Peak Demand Real Power P	MW/10, primary	±3276.7 MW, pri

2321(R)	Peak Demand Reactive Power Q	MVAR/10, primary	±3276.7 MVAR, pri

For SEL-300G; SEL-351; SEL-351R:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IA	A, primary	0-32767 A, pri
2309(R)	Phase Current IB	A, primary	0-32767 A, pri
2310(R)	Phase Current IC	A, primary	0-32767 A, pri
2311(R)	Neutral Current IN	A, primary	0-32767 A, pri
2312(R)	Ground Current IG	A, primary	0-32767 A, pri
2313(R)	Negative Sequence 3I2	A, primary	0-32767 A, pri
2314(R)	Phase Real Power Input PA+	MW/10, primary	±3276.7 MW
2315(R)	Phase Real Power Input PB+	MW/10, primary	±3276.7 MW
2316(R)	Phase Real Power Input PC+	MW/10, primary	±3276.7 MW
2317(R)	3-Phase Real Power Input P3+	MW/10, primary	±3276.7 MW
2318(R)	Phase Reactive Power Input QA+	MVAR/10, primary	±3276.7 MVAR
2319(R)	Phase Reactive Power Input QB+	MVAR/10, primary	±3276.7 MVAR
2320(R)	Phase Reactive Power Input QC+	MVAR/10, primary	±3276.7 MVAR
2321(R)	3-Phase Reactive Power Input Q3+	MVAR/10, primary	±3276.7 MVAR
2322(R)	Phase Real Power Output PA-	MW/10, primary	±3276.7 MW
2323(R)	Phase Real Power Output PB-	MW/10, primary	±3276.7 MW
2324(R)	Phase Real Power Output PC-	MW/10, primary	±3276.7 MW
2325(R)	3-Phase Real Power Output P3-	MW/10, primary	±3276.7 MW
2326(R)	Phase Reactive Power Output QA-	MVAR/10, primary	±3276.7 MVAR
2327(R)	Phase Reactive Power Output QB-	MVAR/10, primary	±3276.7 MVAR
2328(R)	Phase Reactive Power Output QC-	MVAR/10, primary	±3276.7 MVAR
2329(R)	3-Phase Reactive Power Output Q3-	MVAR/10, primary	±3276.7 MVAR

For SEL-387:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IAW1	A, primary	0-32767 A, pri
2309(R)	Phase Current IBW1	A, primary	0-32767 A, pri
2310(R)	Phase Current ICW1	A, primary	0-32767 A, pri
2311(R)	Negative-Sequence 3I2W1	A, primary	0-32767 A, pri
2312(R)	Residual Current IRW1	A, primary	0-32767 A, pri
2313(R)	Phase Current IAW2	A, primary	0-32767 A, pri
2314(R)	Phase Current IBW2	A, primary	0-32767 A, pri
2315(R)	Phase Current ICW2	A, primary	0-32767 A, pri
2316(R)	Negative-Sequence 3I2W2	A, primary	0-32767 A, pri
2317(R)	Residual Current IRW2	A, primary	0-32767 A, pri
2318(R)	Phase Current IAW3	A, primary	0-32767 A, pri
2319(R)	Phase Current IBW3	A, primary	0-32767 A, pri
2320(R)	Phase Current ICW3	A, primary	0-32767 A, pri
2321(R)	Negative-Sequence 3I2W3	A, primary	0-32767 A, pri
2322(R)	Residual Current IRW3	A, primary	0-32767 A, pri
2323(R)	Phase Current IAW4	A, primary	0-32767 A, pri
2324(R)	Phase Current IBW4	A, primary	0-32767 A, pri
2325(R)	Phase Current ICW4	A, primary	0-32767 A, pri
2326(R)	Negative-Sequence 3I2W4	A, primary	0-32767 A, pri
2327(R)	Residual Current IRW4	A, primary	0-32767 A, pri

For SEL-501 (ASCII Format):

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IAX	A, primary	Integer
2309(R)	Phase Current IBX	A, primary	Integer
2310(R)	Phase Current ICX	A, primary	Integer
2311(R)	Phase Current IAY	A, primary	Integer
2312(R)	Phase Current IBY	A, primary	Integer
2313(R)	Phase Current ICY	A, primary	Integer
2314(R)	Negative Sequence Current 3I2X	A, primary	Integer
2315(R)	Residual Current IRX	A, primary	Integer
2316(R)	Negative Sequence Current 3I2Y	A, primary	Integer
2317(R)	Residual Current IRY	A, primary	Integer

For SEL-501,-1,-2 (Binary Format):

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IAX	A, primary	0-32767 A, pri
2309(R)	Phase Current IBX	A, primary	0-32767 A, pri
2310(R)	Phase Current ICX	A, primary	0-32767 A, pri
2311(R)	Negative-Sequence Current 3I2X	A, primary	0-32767 A, pri
2312(R)	Residual Current IRX	A, primary	0-32767 A, pri
2313(R)	Phase Current IAY	A, primary	0-32767 A, pri
2314(R)	Phase Current IBY	A, primary	0-32767 A, pri
2315(R)	Phase Current ICY	A, primary	0-32767 A, pri
2316(R)	Negative-Sequence Current 3I2Y	A, primary	0-32767 A, pri
2317(R)	Residual Current IRY	A, primary	0-32767 A, pri

For SEL-587:

2300(R)	Demand Date stamp	Month	1-12
2301(R)	Demand Date stamp	Day of the Month	1-31
2302(R)	Demand Date stamp	Year	0-99
2303(R)	Demand Time stamp	Hours	0-23
2304(R)	Demand Time stamp	Minutes	0-59
2305(R)	Demand Time stamp	Seconds	0-59
2306(R)	Demand Time stamp	Milliseconds	0-999
2307(R)	Demand Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2308(R)	Phase Current IAW1	A, primary	0-32767 A, pri
2309(R)	Phase Current IBW1	A, primary	0-32767 A, pri
2310(R)	Phase Current ICW1	A, primary	0-32767 A, pri
2311(R)	Negative Sequence Current 3I2W1	A, primary	0-32767 A, pri
2312(R)	Residual Current IRW1	A, primary	0-32767 A, pri
2313(R)	Phase Current IAW2	A, primary	0-32767 A, pri
2314(R)	Phase Current IBW2	A, primary	0-32767 A, pri
2315(R)	Phase Current ICW2	A, primary	0-32767 A, pri
2316(R)	Negative Sequence Current 3I2W2	A, primary	0-32767 A, pri
2317(R)	Residual Current IRW2	A, primary	0-32767 A, pri

Table 7.5: Register Maps for History Data, Floating-Point Type

The first eight registers of the Modbus history data are the collection date and time stamp. This is the time the SEL-2030 received the history data. The data following the collection date and time stamp are a series of history records, from most recent to oldest. The number of history records for each relay are also indicated.

History Map for SEL-49 (Total history records are 5):

Reg.#	Description	Units	Range
200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-5
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219-220(R)	1st Fault Location	Miles or Kilometers	IEEE Float
221(R)	2nd History Record Number	None	1-5
.	.	.	.
.	.	.	.
.	.	.	.
271-272(R)	5th Fault Location	Miles or Kilometers	IEEE Float

History Map for SEL-121/221,-1,-2,-2A,-3,-4,-5,-6,-8,-10,-16,-17; SEL-121D/221D; SEl-121F/221F,-1,-2,-3,-8; SEL-121G/221G,-3,-4,-5,-6,-7,-8,-9; SEL-121H/221H; SEL-121S/221S; SEL-PG10/2PG10,-7,-8 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219-220(R)	1st Fault Location	Miles or Kilometers	IEEE Float
221-222(R)	1st Fault Duration	Cycles	IEEE Float
223(R)	1st Fault Current	A	Integer
224(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
399(R)	12th Fault Current	A	Integer

History Map for SEL-121B/221B,-1 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Group	None	Integer
220-221(R)	1st Fault Location	Miles or Kilometers	IEEE Float
222-223(R)	1st Fault Duration	Cycles	IEEE Float
224(R)	1st Fault Current	A	Integer
225(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
411(R)	12th Fault Current	None	Integer

History Map for SEL-121C/221C,-1 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219-220(R)	1st Fault Location	Miles or Kilometers	IEEE Float
221-222(R)	1st Fault Duration	Cycles	IEEE Float
223(R)	1st Fault Current	A	Integer
224(R)	1st Shot	None	Integer
225(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
411(R)	12th Shot	None	Integer

History Map for SEL-151/251,-1,-2,-3; SEL-151D/251D,-1,-3 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6

208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219-220(R)	1st Fault Location	None	IEEE Float
221(R)	1st Shot	None	Integer
222(R)	1st Fault Current	A	Integer
223(R)	1st Group	None	Integer
224-233(R)	1st Target	None	20 Char
234(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
510-519(R)	12th Target	None	20 Char

History Map for SEL-151C/251C,-1,-2,-3; SEL-151CD/251CD,-1,-3 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Fault Current	A	Integer
220(R)	1st Group	None	Integer
221-230(R)	1st Target	None	20 Char
231(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
474-483(R)	12th Target	None	20 Char

History Map for SEL-167/267,-2,-4,-5; SEL-167D/267D (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219-220(R)	1st Fault Location	Miles or Kilometers	IEEE Float

221-222(R)	1st Fault Duration	Cycles	IEEE Float
223-224(R)	1st Fault Current	A	IEEE Float
225-234(R)	1st Target	None	20 Char
235(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
522-531(R)	12th Target	None	20 Char

History Map for SEL-187V/287V,-1; SEL-279H,-1,-2 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219-228(R)	1st Target	None	20 Char
229(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
450-459(R)	12th Target	None	20 Char

History Map for SEL-BFR/2BFR,-1 (total history records are 100):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-100
209-211(R)	1st Type	None	6 Char
212-213(R)	1st 52A	Cycles	IEEE Float
214-215(R)	1st IV-Time	Cycles	IEEE Float
216-217(R)	1st Energy	MJ	IEEE Float
218(R)	1st History Date Stamp	Month	1-12
219(R)	1st History Date Stamp	Day	1-31
220(R)	1st History Date Stamp	Year	0-99
221(R)	1st History Time Stamp	Hours	0-23
222(R)	1st History Time Stamp	Minutes	0-59
223(R)	1st History Time Stamp	Seconds	0-59
224(R)	1st History Time Stamp	Milliseconds	0-999
225(R)	2nd History Record Number	None	1-100
.	.	.	.
.	.	.	.
.	.	.	.
1906-1907(R)	100th History Time Stamp	Seconds	IEEE Float

History Map for SEL-300G:

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99

203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
208(R)	1st History Record Number	None	1-30
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 char
220(R)	1st Fault Current	A, primary	0-32767A, pri
221-222(R)	1st Fault Frequency	Hertz	IEEE float
223(R)	1st Group	None	Integer
224-252(R)	1st Targets	None	58 char
253(R)	2nd History Record Number	None	1-30
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
1529-1557(R)	30th Targets	None	58 char

History Map for SEL-321-1 (pre 950907) (Total history records are 40):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
208(R)	1st History Record Number	None	1-40
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219-220(R)	1st Fault Location	None	IEEE Float
221(R)	1st Group	None	Integer
222-236(R)	1st Target	None	30 Char
237(R)	2nd History Record Number	None	1-40
.	.	.	.
.	.	.	.
.	.	.	.
1353-1367(R)	40th Target	None	30 Char

History Map for SEL-321-1, -2 (post 950907) (Total history records are 40):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
208(R)	1st History Record Number	None	1-40
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23

213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 Char
220-221(R)	1st Fault Location	None	IEEE Float
222(R)	1st Group	None	Integer
223-245(R)	1st Target	None	46 Char
246(R)	2nd History Record Number	None	1-40
.	.	.	.
.	.	.	.
.	.	.	.
1705-1727(R)	40th Target	None	46 Char

History Map for SEL-351:

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-16
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 char
220-221(R)	1st Fault Location	Miles or Kilometers	IEEE float
222(R)	1st Fault Current	A, primary	0-32767A, pri
223-224(R)	1st Fault Frequency	Hertz	IEEE float
225(R)	1st Group	None	Integer
226(R)	1st Shot Number	None	
227-238(R)	1st Targets	None	24 char
239(R)	2nd History Record Number	None	1-40
.	.	.	.
.	.	.	.
.	.	.	.
691-702(R)	16th Targets	None	24 char

History Map for SEL-351R:

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-29
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 char
220-221(R)	1st Fault Location	Miles or Kilometers	IEEE float
222(R)	1st Fault Current	A, primary	0-32767A, pri
223-224(R)	1st Fault Frequency	Hertz	IEEE float
225(R)	1st Group	None	Integer
226(R)	1st Shot Number	None	

227-235(R)	1st Targets	None	18 char
236(R)	2nd History Record Number	None	1-29
.	.	.	.
.	.	.	.
.	.	.	.
1011-1019(R)	29th Targets	None	18 char

History Map for SEL-352:

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-40
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 char
220(R)	1st Group	None	Integer
221(R)	2nd History Record Number	None	1-40
.	.	.	.
.	.	.	.
.	.	.	.
727(R)	40th Group	None	Integer

History Map for SEL-387 (Total history records are 99):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208-225(R)	Device FID	None	36 char
226(R)	History Month	Month	1-12
227(R)	History Day of Month	Day of the Month	1-31
228(R)	History Year	Year	1980-2080
229(R)	History Time	Hours	0-23
230(R)	History Time	Minutes	0-59
231(R)	History Time	Seconds	0-59
232(R)	History Time	Milliseconds	0-999
233(R)	1st History Record Number	None	1-99
234(R)	1st History Date Stamp	Month	1-12
235(R)	1st History Date Stamp	Day	1-31
236(R)	1st History Date Stamp	Year	1980-2080
237(R)	1st History Time Stamp	Hours	0-23
238(R)	1st History Time Stamp	Minutes	0-59
239(R)	1st History Time Stamp	Seconds	0-59
240(R)	1st History Time Stamp	Milliseconds	0-999
241-244(R)	1st History Event Type	None	8 char
245(R)	1st History Group Number	None	1-6
246-272(R)	1st History Targets	None	54 char
273(R)	2nd History Record Number	None	1-99
.	.	.	.
.	.	.	.
.	.	.	.
2085(R)	47th History Group Number	None	1-6

(Remaining data cannot be accessed through this Modbus map.)

History Map for SEL-501,-1,-2 (Total history records are 20):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-20
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-3
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 Char
220-229(R)	1st Target	None	20 Char
230(R)	2nd History Record Number	None	1-20
.	.	.	.
.	.	.	.
.	.	.	.
638-647(R)	20th Target	None	20 Char

History Map for SEL-551 (Total history records are 20):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-20
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 Char
220(R)	1st Shot Number	None	0-4 or -32768
221(R)	1st Fault Current	A, primary	0-32767A, pri
222-233(R)	1st Targets	None	24 Char
234(R)	2nd History Record Number	None	1-20
.	.	.	.
.	.	.	.
.	.	.	.
716-727(R)	20th Targets	None	24 Char

History Map for SEL-587 (Total history records are 20):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-20
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31

211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Event	None	8 Char
220-229(R)	1st Target	None	20 Char
230(R)	2nd History Record Number	None	1-20
.	.	.	.
.	.	.	.
.	.	.	.
638-647(R)	20th Target	None	20 Char

Table 7.6: Register Maps for History Data, Integer Type

The first eight registers of the Modbus history data are the collection date and time stamp. This is the time the SEL-2030 received the history data. The data following the collection date and time stamp are a series of history records, from most recent to oldest. The number of history records for each relay are also indicated.

History Map for SEL-49 (Total history records are 5):

Reg.#	Description	Units	Range
200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-5
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Fault Location	Miles/10 or Kilometers/10	±3276.7
220(R)	2nd History Record Number	None	1-5
.	.	.	.
.	.	.	.
.	.	.	.
267(R)	5th Fault Location	Miles/10 or Kilometers/10	±3276.7

History Map for SEL-121/221,-1,-2,-2A,-3,-4,-5,-6,-8,-10,-16,-17; SEL-121D/221D; SEl-121F/221F,-1,-2, -3,-8; SEL-121G/221G,-3,-4,-5,-6,-7,-8,-9; SEL-121H/221H; SEL-121S/221S; SEL-PG10/2PG10,-7,-8 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99

212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Fault Location	Miles/10 or Kilometers/10	±3276.7
220(R)	1st Fault Duration	Cycles/10	0.0-3276.7 Cycles
221(R)	1st Fault Current	A, primary	Integer
222(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
375(R)	12th Fault Current	A	Integer

History Map for SEL-121B/221B,-1 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Group	None	Integer
220(R)	1st Fault Location	Miles/10 or Kilometers/10	±3276.7
221(R)	1st Fault Duration	Cycles/10	0.0-3276.7 Cycles
222(R)	1st Fault Current	A, primary	Integer
223(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
387(R)	12th Fault Current	None	Integer

History Map for SEL-121C/221C,-1 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Fault Location	Miles/10 or Kilometers/10	±3276.7
220(R)	1st Fault Duration	Cycles/10	0.0-3276.7 Cycles
221(R)	1st Fault Current	A, primary	Integer
222(R)	1st Shot	None	Integer
223(R)	2nd History Record Number	None	1-12

.	.	.	.
.	.	.	.
.	.	.	.
387(R)	12th Shot	None	Integer

History Map for SEL-151/251,-1,-2,-3; SEL-151D/251D,-1,-3 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Fault Location	Per Unit/10	±3276.7
220(R)	1st Shot	None	Integer
221(R)	1st Fault Current	A, primary	Integer
222(R)	1st Group	None	Integer
223-232(R)	1st Target	None	20 Char
233(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
498-507(R)	12th Target	None	20 Char

History Map for SEL-151C/251C,-1,-2,-3; SEL-151CD/251CD,-1,-3 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Fault Current	A, primary	Integer
220(R)	1st Group	None	Integer
221-230(R)	1st Target	None	20 Char
231(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
474-483(R)	12th Target	None	20 Char

History Map for SEL-167/267,-2,-4,-5; SEL-167D/267D (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Fault Location	Miles/10 or Kilometers/10	±3276.7
220(R)	1st Fault Duration	Cycles/10	0.0-3276.7 Cycles
221(R)	1st Fault Current	A, primary	0-32767 A, pri
222-231(R)	1st Target	None	20 Char
232(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
486-495(R)	12th Target	None	20 Char

History Map for SEL-187V/287V,-1; SEL-279H,-1,-2 (Total history records are 12):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
208(R)	1st History Record Number	None	1-12
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219-228(R)	1st Target	None	20 Char
229(R)	2nd History Record Number	None	1-12
.	.	.	.
.	.	.	.
.	.	.	.
450-459(R)	12th Target	None	20 Char

History Map for SEL-BFR/2BFR,-1 (total history records are 100):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
208(R)	1st History Record Number	None	1-100
209-211(R)	1st Type	None	6 Char
212(R)	1st 52A	Cycles/10	0.0-3276.7 Cycles

213(R)	1st IV-Time	Cycles/10	0.0-3276.7 Cycles
214(R)	1st Energy	MJ/100	0.00-327.67 MJ
215(R)	1st History Date Stamp	Month	1-12
216(R)	1st History Date Stamp	Day	1-31
217(R)	1st History Date Stamp	Year	0-99
218(R)	1st History Time Stamp	Hours	0-23
219(R)	1st History Time Stamp	Minutes	0-59
220(R)	1st History Time Stamp	Seconds	0-59
221(R)	1st History Time Stamp	Milliseconds	0-999
222(R)	2nd History Record Number	None	1-100
.	.	.	.
.	.	.	.
.	.	.	.
1607(R)	100th History Time Stamp	Milliseconds	0-999

History Map for SEL-300G:

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-30
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 char
220(R)	1st Fault Current	A, primary	0-32767A, pri
221(R)	1st Fault Frequency	Hertz/10	Integer
222(R)	1st Group	None	Integer
223-251(R)	1st Targets	None	58 char
252(R)	2nd History Record Number	None	1-30
.	.	.	.
.	.	.	.
.	.	.	.
1499-1527(R)	30th Targets	None	58 char

History Map for SEL-321-1 (pre 950907) (Total history records are 40):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-40
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-218(R)	1st Fault Type	None	6 Char
219(R)	1st Fault Location	Per Unit/10	±3276.7
220(R)	1st Group	None	Integer
221-235(R)	1st Target	None	30 Char
236(R)	2nd History Record Number	None	1-40

.	.	.	.
.	.	.	.
.	.	.	.
1313-1327(R)	40th Target	None	30 Char

History Map for SEL-321-1, -2 (post 950907) (Total history records are 40):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-40
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 Char
220(R)	1st Fault Location	Per Unit/10	±3276.7
221(R)	1st Group	None	Integer
222-244(R)	1st Target	None	46 Char
245(R)	2nd History Record Number	None	1-40
.	.	.	.
.	.	.	.
.	.	.	.
1465-1487(R)	40th Target	None	46 Char

History Map for SEL-351:

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-16
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 char
220(R)	1st Fault Location	Mi/10 or Km/10	Integer
221(R)	1st Fault Current	A, primary	0-32767A, pri
222(R)	1st Fault Frequency	Hertz/10	Integer
223(R)	1st Group	None	Integer
224(R)	1st Shot Number	None	
225-236(R)	1st Targets	None	24 char
237(R)	2nd History Record Number	None	1-16
.	.	.	.
.	.	.	.
.	.	.	.
660-671(R)	16th Targets	None	24 char

History Map for SEL-351R:

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-29
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 char
220(R)	1st Fault Location	Mi/10 or Km/10	Integer
221(R)	1st Fault Current	A, primary	0-32767A, pri
222(R)	1st Fault Frequency	Hertz/10	Integer
223(R)	1st Group	None	Integer
224(R)	1st Shot Number	None	
225-233(R)	1st Targets	None	18 char
234(R)	2nd History Record Number	None	1-29
.	.	.	.
.	.	.	.
.	.	.	.
953-961(R)	29th Targets	None	18 char

History Map for SEL-352:

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-40
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 char
220(R)	1st Group	None	Integer
221(R)	2nd History Record Number	None	1-40
.	.	.	.
.	.	.	.
.	.	.	.
727(R)	40th Group	None	Integer

History Map for SEL-387 (Total history records are 99):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208-225(R)	Device FID	None	36 char

226(R)	History Month	Month	1-12
227(R)	History Day of Month	Day of the Month	1-31
228(R)	History Year	Year	1980-2080
229(R)	History Time	Hours	0-23
230(R)	History Time	Minutes	0-59
231(R)	History Time	Seconds	0-59
232(R)	History Time	Milliseconds	0-999
233(R)	1st History Record Number	None	1-99
234(R)	1st History Date Stamp	Month	1-12
235(R)	1st History Date Stamp	Day	1-31
236(R)	1st History Date Stamp	Year	1980-2080
237(R)	1st History Time Stamp	Hours	0-23
238(R)	1st History Time Stamp	Minutes	0-59
239(R)	1st History Time Stamp	Seconds	0-59
240(R)	1st History Time Stamp	Milliseconds	0-999
241-244(R)	1st History Event Type	None	8 char
245(R)	1st History Group Number	None	1-6
246-272(R)	1st History Targets	None	54 char
273(R)	2nd History Record Number	None	1-99
.	.	.	.
.	.	.	.
.	.	.	.
2085(R)	47th History Group Number	None	1-6

(Remaining data cannot be accessed through this Modbus map.)

History Map for SEL-501,-1,-2 (Total history records are 20):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-20
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-3
211(R)	1st History Date Stamp	Year	0-99
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 Char
220-229(R)	1st Target	None	20 Char
230(R)	2nd History Record Number	None	1-20
.	.	.	.
.	.	.	.
.	.	.	.
638-647(R)	20th Target	None	20 Char

History Map for SEL-551 (Total history records are 20):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-20
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59

215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Fault Type	None	8 Char
220(R)	1st Shot Number	None	0-4 or -32768
221(R)	1st Fault Current	A, primary	0-32676A, pri
222-233(R)	1st Targets	None	24 Char
234(R)	2nd History Record Number	None	1-20
.	.	.	.
.	.	.	.
.	.	.	.
716-727(R)	20th Targets	None	24 Char

History Map for SEL-587 (Total history records are 20):

200(R)	History Date stamp	Month	1-12
201(R)	History Date stamp	Day of the Month	1-31
202(R)	History Date stamp	Year	0-99
203(R)	History Time stamp	Hours	0-23
204(R)	History Time stamp	Minutes	0-59
205(R)	History Time stamp	Seconds	0-59
206(R)	History Time stamp	Milliseconds	0-999
207(R)	History Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
208(R)	1st History Record Number	None	1-20
209(R)	1st History Date Stamp	Month	1-12
210(R)	1st History Date Stamp	Day	1-31
211(R)	1st History Date Stamp	Year	1980-2080
212(R)	1st History Time Stamp	Hours	0-23
213(R)	1st History Time Stamp	Minutes	0-59
214(R)	1st History Time Stamp	Seconds	0-59
215(R)	1st History Time Stamp	Milliseconds	0-999
216-219(R)	1st Event	None	8 Char
220-229(R)	1st Target	None	20 Char
230(R)	2nd History Record Number	None	1-20
.	.	.	.
.	.	.	.
.	.	.	.
638-647(R)	20th Target	None	20 Char

Table 7.7: Register Maps for Relay Target Data, Both Types

The first eight registers of Modbus target data are the collection date and time stamp. Following the date and time stamp is the target string. The bit labels for the target string are also shown in MSB to LSB order. You can obtain these bit labels by typing **MAP n BL,** where **n** is the port number.

These maps apply to both the floating-point and integer only map types.

Reg.#	Description	Units	Range
SEL-121/221,-1,-2,-2A,-3,-5,-6:			
2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

```
EN      A       B       C       G       1       2       3       *       *       CA1     BC1     AB1     C1      B1      A1
*       *       CA2     BC2     AB2     C2      B2      A2      *       *       CA3     BC3     AB3     C3      B3      A3
*       46P     46PH    47P     46Q     47Q     47QH    32Q     *       TRIP    CLOSE   TTI     A       B       C       ALARM
*       *       ET      52A     DC      BT      TT      DT      Z3FT    Z3F     Z2FT    Z2F     Z1F     BPF     GS      GD
ABC     *       21P3    21G3    21P2    21G2    21P1    21G1    *       *       *       *       *       *       *       *

SEL-121/221,-4,-8:

2100(R)      Target Date stamp                         Month                      1-12
2101(R)      Target Date stamp                         Day of the Month           1-31
2102(R)      Target Date stamp                         Year                       0-99
2103(R)      Target Time stamp                         Hours                      0-23
2104(R)      Target Time stamp                         Minutes                    0-59
2105(R)      Target Time stamp                         Seconds                    0-59
2106(R)      Target Time stamp                         Milliseconds               0-999
2107(R)      Target Date stamp                         Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                    None

EN      A       B       C       G       1       2       3       *       *       CA1     BC1     AB1     C1      B1      A1
*       *       CA2     BC2     AB2     C2      B2      A2      *       *       CA3     BC3     AB3     C3      B3      A3
*       46P     46PH    47P     46Q     47Q     47QH    32Q     *       TRIP    CLOSE   TTI     Z1      Z2      Z3      ALARM
*       *       ET      52A     DC      BT      TT      DT      Z3FT    Z3F     Z2FT    Z2F     Z1F     BPF     GS      GD
ABC     *       21P3    21G3    21P2    21G2    21P1    21G1    *       *       *       *       *       *       *       *

SEL-121/221,-10,-16,-17:

2100(R)      Target Date stamp                         Month                      1-12
2101(R)      Target Date stamp                         Day of the Month           1-31
2102(R)      Target Date stamp                         Year                       0-99
2103(R)      Target Time stamp                         Hours                      0-23
2104(R)      Target Time stamp                         Minutes                    0-59
2105(R)      Target Time stamp                         Seconds                    0-59
2106(R)      Target Time stamp                         Milliseconds               0-999
2107(R)      Target Date stamp                         Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2111(R) Target                                    None

EN      PH1     G1      PH2     G2      PH3     G3      51N     Z1P     Z1G     Z2PT    Z2GT    Z3      Z3T     3P21    32Q
67N     51NP    51NT    50NG    50P     50H     IN1     REJO    LOP     TRIP    *       *       *       *       *       *
50G     50N     *       *       Z3G     Z3P     RC      RI      *       *       ET      52A     DC      BT      PT      IN1
*       TRIP    CLOS    A1      A2      A3      A4      ALRM    *       *       *       *       *       *       *       *

SEL-121B/221B,-1:

2100(R)      Target Date stamp                         Month                      1-12
2101(R)      Target Date stamp                         Day of the Month           1-31
2102(R)      Target Date stamp                         Year                       0-99
2103(R)      Target Time stamp                         Hours                      0-23
2104(R)      Target Time stamp                         Minutes                    0-59
2105(R)      Target Time stamp                         Seconds                    0-59
2106(R)      Target Time stamp                         Milliseconds               0-999
2107(R)      Target Date stamp                         Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2110(R) Target                                    None

EN      PH1     G1      PH2     G2      PH3     G3      51N     1ABC    2ABC    3ABC    LOP     50H     50M     50MF    50L
51NT    67N1    67N2    67N3    51NP    Z1P     Z2P     Z3P     Z2PT    Z3PT    Z2GT    Z3GT    ALRM    TRIP    TC      DF
52AT    *       52A     S5      S4      S3      S2      S1      *       TRIP    CLOS    A1      A2      A3      A4      ALRM

SEL-121C/221C:

2100(R)      Target Date stamp                         Month                      1-12
2101(R)      Target Date stamp                         Day of the Month           1-31
2102(R)      Target Date stamp                         Year                       0-99
2103(R)      Target Time stamp                         Hours                      0-23
2104(R)      Target Time stamp                         Minutes                    0-59
2105(R)      Target Time stamp                         Seconds                    0-59
2106(R)      Target Time stamp                         Milliseconds               0-999
2107(R)      Target Date stamp                         Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2111(R) Target                                    None
```

EN	PH1	G1	PH2	G2	PH3	G3	51N	51PT	1ABC	2ABC	3ABC	51PP	50H	50L	LOP
51NT	67N1	67N2	67N3	51NP	Z1P	Z2P	Z3P	DF	DR	Z2GT	Z3GT	50MF	RC	RI	Z3PT
50M	TRIP	TC	DT	52BT	59N	*	*	52AT	*	ET	52A	DC	BT	PT	DT
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121C/221C,-1:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

EN	PH1	G1	PH2	G2	PH3	G3	51N	51PT	1ABC	2ABC	3ABC	51PP	50H	50L	LOP
51NT	67N1	67N2	67N3	51NP	Z1P	Z2P	Z3P	DF	DR	Z2GT	Z3GT	50MF	RC	RI	Z3PT
50M	TRIP	TC	DT	52BT	59N	47XL	47XD	52AT	*	ET	52A	DC	BT	PT	DT
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121D/221D:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

EN	PH1	G1	PH2	G2	PH3	G3	51N	1ABC	2ABC	3ABC	REJO	LOP	50H	50M	50L
51NT	67N1	67N2	67N3	51NP	Z1P	Z2P	Z3P	Z2PT	Z3PT	50G	3P50	50MF	RC	RI	DF
ALRM	TRIP	TC	DT	52BT	52AT	Z2GT	Z3GT	52AT	*	ET	52A	DC	BT	PT	DT
*	TRIP	CLOSE	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121F/221F,-1,-8:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

EN	PH1	G1	PH2	G2	PH3	G3	51N	Z1P	Z1G	Z2PT	Z2GT	Z3	Z3T	3P21	32Q
67N	51NP	51NT	50NG	50P	50H	IN1	REJO	LOP	52BT	27S	27P	59S	59P	SSC	VSC
50G	50N	59PH	25	Z3G	Z3P	RC	RI	*	*	ET	52A	DC	BT	PT	IN1
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121F/221F,-2:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

EN	PH1	G1	PH2	G2	PH3	G3	51N	Z1P	Z1G	Z2PT	Z2GT	Z3	Z3T	3P21	32Q
67N	51NP	51NT	50NG	50P	50H	IN1	REJO	LOP	TRIP	27S	27P	59S	59P	SSC	VSC
50G	50N	59PH	25	Z3G	Z3P	RC	RI	*	*	ET	52A	DC	BT	PT	IN1
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121F/221F,-3:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

EN	PH1	G1	PH2	G2	PH3	G3	51N	Z1P	Z1G	Z2PT	Z2GT	Z3	Z3T	3P21	32Q
67N	51NP	51NT	50NG	50P	50H	IN1	REJO	LOP	BFT	27S	27P	59S	59P	SSC	VSC
50G	50N	59PH	25	Z3G	Z3P	RC	RI	*	*	ET	52A	DC	BT	PT	IN1
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121G/221G,-3,-4:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

EN	PH1	G1	PH2	G2	PH3	G3	51N	1ABC	2ABC	3ABC	4ABC	LOP	50H	50M	50L
51NT	67N1	67N2	67N3	51NP	Z1P	Z2P	Z3P	Z2PT	Z3PT	OSB	3P50	50MF	RC	RI	DF
ALRM	TRIP	TC	DT	52BT	52AT	Z2GT	Z3GT	52AT	*	ET	52A	DC	BT	PT	DT
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121G/221G,-5,-8,-9:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

EN	PH1	G1	PH2	G2	PH3	G3	51N	1ABC	2ABC	3ABC	4ABC	LOP	50H	50M	50L
51NT	67N1	67N2	67N3	51NP	Z1P	Z2P	Z3P	Z2PT	Z3PT	OSB	3P50	50MF	RC	RI	STOP
50N3	TRIP	TC	DT	52BT	Z3X	Z2GT	Z3GT	52AT	*	ET	52A	DC	BT	PT	DT
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121G/221G,-6,-7:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

EN	PH1	G1	PH2	G2	PH3	G3	51N	1ABC	2ABC	3ABC	4ABC	LOP	50H	50M	50L
51NT	67N1	67N2	67N3	51NP	Z1P	Z2P	Z3P	Z2PT	Z3PT	50L3	3P50	50MF	RC	RI	STOP
50N3	TRIP	TC	DT	52BT	Z3X	Z2GT	Z3GT	52AT	*	ET	52A	DC	BT	PT	DT
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121H/221H:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2111(R)	Target	None	

EN	PH1	G1	PH2	G2	PH3	G3	51N	1ABC	2ABC	3ABC	4ABC	LOP	50H	50M	50L
51NT	67N1	67N2	67N3	51NP	Z1P	Z2P	Z3P	Z2PT	Z3PT	Z3RB	KEY	50MF	PTEE	ECTT	DF
ALRM	TRIP	TC	DT	52BT	WFC	Z2GT	Z3GT	52AT	*	ET	52A	DC	BT	PT	DT
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-121S/221S:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2111(R)	Target	None	

EN	A	B	C	G	Z1	Z2	Z3	Z1P	Z1G	Z2PT	Z2GT	Z3P	Z3G	Z3T	50H
67NP	67NT	51NP	51NT	50NG	50P	50G	32Q	FDS	3P21	LOP	52BT	IN1	PO	3PT	*
50N	Z3CG	Z3BG	Z3AG	RC	RI	52A3	52B3	*	*	ET	52AC	52AB	52AA	PT	IN1
*	TRIP	CLOS	A1	TRPA	TRPB	TRPC	ALRM	*	*	*	*	*	*	*	*

SEL-151/251,-2,-3; SEL-151D/251D,-3:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2112(R)	Target	None	

INST	A	B	C	Q	N	RS	LO	51P	50L	50H	51QP	50Q	51NP	50NL	50NH
51T	50LT	50C	51QT	50QT	51NT	50NLT	27	79RS	79CY	79LO	79SH	52AT	52BT	IN6	IN5
PDEM	QDEM	NDEM	TF	CF	TCMA	ST	TRIP	A	B	C	D	E	F	G	H
J	KT	L	V	W	X	Y	ZT	*	*	IN6	IN5	IN4	IN3	IN2	IN1
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-151/251-1; SEL-151D/251D-1:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59

```
2106(R)      Target Time stamp                          Milliseconds              0-999
2107(R)      Target Date stamp                          Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                     None

INST    A     B     C     G     RS    CY     LO    51P   50L   50H   51GP  50G   51NP  50NL  50NH
51T     50LT  50C   51GT  50GT  51NT  50NLT  27    79RS  79CY  79LO  79SH  52AT  52BT  IN6   IN5
PDEM    CLOS  NDEM  TF    CF    TCMA  ST     TRIP  A     B     C     D     E     F     G     H
J       KT    L     V     W     X     Y      ZT    *     *     IN6   IN5   IN4   IN3   IN2   IN1
*       TRIP  CLOSE A1    A2    A3    A4     ALRM  *     *     *     *     *     *     *     *
```

SEL-151C/251C,-2,-3; SEL-151CD/251CD,-3:

```
2100(R)      Target Date stamp                          Month                     1-12
2101(R)      Target Date stamp                          Day of the Month          1-31
2102(R)      Target Date stamp                          Year                      0-99
2103(R)      Target Time stamp                          Hours                     0-23
2104(R)      Target Time stamp                          Minutes                   0-59
2105(R)      Target Time stamp                          Seconds                   0-59
2106(R)      Target Time stamp                          Milliseconds              0-999
2107(R)      Target Date stamp                          Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                     None

INST    A     B     C     Q     N     EN     ALRM  51P   50L   50M   51QP  50Q   51NP  50NL  50NH
51T     50LT  50MT  51QT  50QT  51NT  50NLT  50H   21P   50C   27    *     52AT  52BT  IN6   IN5
PDEM    QDEM  NDEM  TF    CF    TCMA  ST     TRIP  A     B     C     D     E     F     G     H
J       KT    L     V     W     X     Y      ZT    *     *     IN6   IN5   IN4   IN3   IN2   IN1
*       TRIP  CLOSE A1    A2    A3    A4     ALRM  *     *     *     *     *     *     *     *
```

SEL-151C/251C-1; SEL-151CD/251CD-1:

```
2100(R)      Target Date stamp                          Month                     1-12
2101(R)      Target Date stamp                          Day of the Month          1-31
2102(R)      Target Date stamp                          Year                      0-99
2103(R)      Target Time stamp                          Hours                     0-23
2104(R)      Target Time stamp                          Minutes                   0-59
2105(R)      Target Time stamp                          Seconds                   0-59
2106(R)      Target Time stamp                          Milliseconds              0-999
2107(R)      Target Date stamp                          Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                     None

INST    A     B     C     G     BKR   EN     ALRM  51P   50L   50M   *     *     51NP  50NL  50NH
51T     50LT  50MT  *     *     51NT  50NLT  50H   21P   50C   27    *     52AT  52BT  IN6   IN5
PDEM    CLOS  NDEM  TF    CF    TCMA  ST     TRIP  A     B     C     D     E     F     G     H
J       KT    L     V     W     X     Y      ZT    *     *     IN6   IN5   IN4   IN3   IN2   IN1
*       TRIP  CLOSE A1    A2    A3    A4     ALRM  *     *     *     *     *     *     *     *
```

SEL-167/267,-2; SEL-167D/267D:

```
2100(R)      Target Date stamp                          Month                     1-12
2101(R)      Target Date stamp                          Day of the Month          1-31
2102(R)      Target Date stamp                          Year                      0-99
2103(R)      Target Time stamp                          Hours                     0-23
2104(R)      Target Time stamp                          Minutes                   0-59
2105(R)      Target Time stamp                          Seconds                   0-59
2106(R)      Target Time stamp                          Milliseconds              0-999
2107(R)      Target Date stamp                          Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2111(R) Target                                     None

PH1     G1    PH2   G2    PH3   G3    51P    51N   51NP  50N1  50N2  50N3  51PP  50P1  50P2  50P3
DFP     67N1  67N2  67N3  DFG   67P1  67P2   67P3  51NT  Z1GT  Z2GT  Z3GT  51PT  Z1PT  Z2PT  Z3PT
ALRM    TRIP  TC    DT    52BT  SH1   TOCP   DCTH  52AT  *     ET    52A   DC    BT    PT    DT
*       TRIP  CLOS  A1    A2    A3    A4     ALRM  *     *     *     *     *     *     *     *
```

SEL-167/267,-4,-5:

```
2100(R)      Target Date stamp                          Month                     1-12
2101(R)      Target Date stamp                          Day of the Month          1-31
2102(R)      Target Date stamp                          Year                      0-99
```

2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

EN	INST	TIME	A	B	C	G	LO	51NP	50N1	50N2	50N3	51PP	50P1	50P2	50P3
DFP	67N1	67N2	67N3	DFG	67P1	67P2	67P3	51NT	Z1GT	Z2GT	Z3GT	51PT	Z1PT	Z2PT	Z3PT
LOP	TRIP	TC	DT	52BT	SH1	50MF	DCTH	52AT	*	ET	52A	DC	BT	PT	DT
*	TRIP	CLOS	A1	A2	A3	A4	ALRM	*	*	*	*	*	*	*	*

SEL-187V/287V,-1:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

EN	87A	87B	87C	X59T	Y59T	X59I	Y59I	X59A	X59B	X59C	3Y59	Y59A	Y59B	Y59C	3Y59D
X27A	X27B	X27C	LTCH	Y27A	Y27B	Y27C	3Y27	X59P	X59T	Y59P	Y59T	59P1	27P1	59P2	27P2
VH1	VL1	VH2	VL2	VHD1	VLD1	VHD2	VLD2	87H	87HD	LOP	LOPD	VCI1	VCI2	87T	87A
87AT	87AA	87BT	87BA	87CT	87CA	87TD	87AD	*	*	ET2	ET1	LE2	RE2	LE1	RE1
*	TRIP	A1	A2	A3	A4	A5	ALRM	*	*	*	*	*	*	*	*

SEL-279:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

HS	HLDB	DLHB	HLHB	RS	CY	LO	DLDB	27B	27L	59B	59L	HLDB	DLHB	HLHB	DLDB
HLD1	HLD2	DLH1	DLH2	HLHS	HOT	DEAD	52B	DB1	DB2	HL1	HL2	DL1	DL2	HB1	HB2
CLOS	TRIP	HSRN	RSET	CYCL	LOCK	25I	25T	HD1M	HD2M	DH1M	DH2M	CF	TF	HSRT	MTT
DH1	HD2	HD1	EMT	DTL	HSRB	HSRI	52	ALRM	OUT3	OUT2	OUT1	CLOS	DLDB	HLHB	DH2

SEL-279H:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2111(R)	Target	None	

52A1	52A2	RC1	RC2	RS	CY	LO	CLOS	27B	27L	59B	59L	25T1	25T2	CLS1	CLS2
SPC1	SPC2	3PC1	3PC2	RSET	CYCL	LOCK	OTT	52A1	52A2	52BT1	52BT2	79OIT	3PRI	79RST	79SH
LTCH	A	B	C	D	E	ST	L	G	H	I	M	W	X	Y	ZT
SPRI	IN7	IN6	IN5	IN4	IN3	IN2	IN1	ALRM	OUT4	OUT3	OUT2	OUT1	DTL	RE	3PRI

SEL-279H,-1:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2111(R)	Target	None	

52A1	52A2	RC1	RC2	RS	CY	LO	CLOS	27B	27L	59B	59L	25T1	25T2	CLS1	CLS2
SPC1	SPC2	3PC1	3PC2	RSET	CYCL	LOCK	OTT	52A1	52A2	52BT1	52BT2	79OIT	3PRI	SPRI	79SH
LTCH	A	B	C	D	E	ST	L	G	H	I	M	W	X	Y	ZT
RE	IN7	IN6	IN5	IN4	IN3	IN2	IN1	ALRM	OUT4	OUT3	OUT2	OUT1	DTL	RE	3PRI

SEL-279H,-2:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2112(R)	Target	None	

52A1	52A2	RC1	RC2	RS	CY	LO	CLOS	27B	27L	59B	59L	25T1	25T2	CLS1	CLS2
SPC1	SPC2	3PC1	3PC2	RSET	CYCL	LOCK	OTT	52A1	52A2	52BT1	52BT2	79OIT	3PRI	SPRI	79SH
LTCH	A	B	C	D	E	ST	L	G	H	I	M	W	X	Y	ZT
27B3	27L4	59B3	59L4	25T3	25T4	CF1	CF2	RE	IN7	IN6	IN5	IN4	IN3	IN2	IN1
ALRM	OUT4	OUT3	OUT2	OUT1	DTL	RE	3PRI	*	*	*	*	*	*	*	*

SEL-BFR/2BFR:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2111(R)	Target	None	

EN	AL	PF	A	B	C	52A	MOD	FBF	LBF	LPF	50FT	50LD	50MD	52BV	TTF
FOBF	FOPF	59FO	59H	ALRM	TC	TB	TA	PDBF	PDPF	87UA	87UB	87UC	86RS	MTD	CTF
CRFA	CRPA	TRFA	TRPA	CRFB	CRPB	TRFB	TRPB	CRFC	CRPC	TRFC	TRPC	DOPA	DOPB	DOPC	47Q
X	86BF	A1	A2	A3	A4	A5	ALARM	X	X	CLOS	MOD	52A	TPC	TPB	TPA

SEL-BFR/2BFR-1:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2111(R)	Target	None	

EN	AL	PF	A	B	C	52A	MOD	FBF	FPF	BFI	50FT	50LD	50MD	50BV	TTF
FOBF	FOPF	59FO	59H	ALRM	TC	TB	TA	PDBF	PDPF	87UA	87UB	87UC	86RS	MTD	CTF
CRFA	CRPA	TRFA	TRPA	CRFB	CRPB	TRFB	TRPB	CRFC	CRPC	TRFC	TRPC	DOPA	DOPB	DOPC	47Q
*	86BF	A1	A2	A3	A4	A5	ALARM	*	*	CLOS	MOD	52A	TPC	TPB	TPA

SEL-PG10/2PG10,-7,-8:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2109(R)	Target	None	

EN	ALRM	50L	67N	3PH	2PH	INST	TIME	50L	ZABC	ZP	ZPT	67NP	67NT	67NI	67DT
*	*	52A	E3	E2	E1	EXT2	EXT1	*	TRIP	A1	A2	A3	A4	A5	ALRM

SEL-300G0:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2131(R)	Target	None	

*	*	*	STSET	*	*	*	*	EN	BKR	LOP	TRIP	51V	50	51	N
24	27/59	32	40	46	64G	81	87	24TC	24D1	24D1T	24C2	24C2T	24CR	SS1	SS2
27P1	27P2	27PP	27V1	59P1	59P2	59G1	59G2	32PTC	32P1	32P1T	32P2	32P2T	59V1	59Q	59PP
40ZTC	40Z1	40Z1T	40Z2	40Z2T	*	SG1	SG2	46QTC	46Q1	46Q1T	46Q2	46Q2T	46Q2R	INAD	INADT
51PTC	51P	51PT	51PR	51CTC	51C	51CT	51CR	51GTC	51G	51GT	51GR	51NTC	51N	51NT	51NR
51VTC	51V	51VT	51VR	PDEM	QDEM	GDEM	NDEM	50P1	50P1T	50P2	50P2T	50G1	50G1T	50G2	50G2T
50N1	50N1T	50N2	50N2T	CC	CL	CLOSE	ULCL	64GTC	64G1	64G1T	64G2	64G2T	*	60LOP	CLEN
BKMON	BCW	BCWA	BCWB	BCWC	FAULT	DCLO	DCHI	81D1	81D2	81D3	81D4	81D5	81D6	3PO	52A
81D1T	81D2T	81D3T	81D4T	81D5T	81D6T	27B81	50L	ONLINE	BND1A	BND1T	BND2A	BND2T	BND3A	BND3T	BNDA
TRGTR	BND4A	BND4T	BND5A	BND5T	BND6A	BND6T	BNDT	TRIP	TRIP1	TRIP2	TRIP3	TRIP4	OC1	OC2	OC3
TR1	TR2	TR3	TR4	ULTR1	ULTR2	ULTR3	ULTR4	LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB8
RB1	RB2	RB3	RB4	RB5	RB6	RB7	RB8	SET1	SET2	SET3	SET4	SET5	SET6	SET7	SET8
RST1	RST2	RST3	RST4	RST5	RST6	RST7	RST8	LT1	LT2	LT3	LT4	LT5	LT6	LT7	LT8
SV1	SV2	SV3	SV4	SV1T	SV2T	SV3T	SV4T	SV5	SV6	SV7	SV8	SV5T	SV6T	SV7T	SV8T
SV9	SV10	SV11	SV12	SV9T	SV10T	SV11T	SV12T	SV13	SV14	SV15	SV16	SV13T	SV14T	SV15T	SV16T
DP8	DP7	DP6	DP5	DP4	DP3	DP2	DP1	*	*	*	*	*	*	*	*
ER	*	IN106	IN105	IN104	IN103	IN102	IN101	ALARM	OUT107	OUT106	OUT105	OUT104	OUT103	OUT102	OUT101
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

SEL-300G1 (Differential Option):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2131(R)	Target	None	

*	*	*	STSET	*	*	*	*	EN	BKR	LOP	TRIP	51V	50	51	N
24	27/59	32	40	46	64G	81	87	24TC	24D1	24D1T	24C2	24C2T	24CR	SS1	SS2
27P1	27P2	27PP	27V1	59P1	59P2	59G1	59G2	32PTC	32P1	32P1T	32P2	32P2T	59V1	59Q	59PP
40ZTC	40Z1	40Z1T	40Z2	40Z2T	*	SG1	SG2	46QTC	46Q1	46Q1T	46Q2	46Q2T	46Q2R	INAD	INADT
51PTC	51P	51PT	51PR	51CTC	51C	51CT	51CR	51GTC	51G	51GT	51GR	51NTC	51N	51NT	51NR
51VTC	51V	51VT	51VR	PDEM	QDEM	GDEM	NDEM	50P1	50P1T	50P2	50P2T	50G1	50G1T	50G2	50G2T
50N1	50N1T	50N2	50N2T	CC	CL	CLOSE	ULCL	64GTC	64G1	64G1T	64G2	64G2T	*	60LOP	CLEN
BKMON	BCW	BCWA	BCWB	BCWC	FAULT	DCLO	DCHI	81D1	81D2	81D3	81D4	81D5	81D6	3PO	52A
81D1T	81D2T	81D3T	81D4T	81D5T	81D6T	27B81	50L	ONLINE	BND1A	BND1T	BND2A	BND2T	BND3A	BND3T	BNDA
TRGTR	BND4A	BND4T	BND5A	BND5T	BND6A	BND6T	BNDT	TRIP	TRIP1	TRIP2	TRIP3	TRIP4	OC1	OC2	OC3
TR1	TR2	TR3	TR4	ULTR1	ULTR2	ULTR3	ULTR4	LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB8
RB1	RB2	RB3	RB4	RB5	RB6	RB7	RB8	SET1	SET2	SET3	SET4	SET5	SET6	SET7	SET8
RST1	RST2	RST3	RST4	RST5	RST6	RST7	RST8	LT1	LT2	LT3	LT4	LT5	LT6	LT7	LT8
SV1	SV2	SV3	SV4	SV1T	SV2T	SV3T	SV4T	SV5	SV6	SV7	SV8	SV5T	SV6T	SV7T	SV8T
SV9	SV10	SV11	SV12	SV9T	SV10T	SV11T	SV12T	SV13	SV14	SV15	SV16	SV13T	SV14T	SV15T	SV16T
DP8	DP7	DP6	DP5	DP4	DP3	DP2	DP1	*	*	*	*	*	*	*	*
ER	*	IN106	IN105	IN104	IN103	IN102	IN101	ALARM	OUT107	OUT106	OUT105	OUT104	OUT103	OUT102	OUT101
87B	87BL1	87BL2	87BL3	87R	87R1	87R2	87R3	87U	87U1	87U2	87U3	50H1	50H1T	50H2	50H2T
50Q1	50Q1T	50Q2	50Q2T	50R1	50R1T	50R2	50R2T	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

SEL-321: (Model 32101)

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2128(R)	Target	None	

INST	TIME	COMM	SOTF	ZONE1	ZONE2	ZONE2	ZONE4	EN	A	B	C	G	Q	51	50
Z4G	Z3G	Z2G	Z1G	M4P	M3P	M2P	M1P	Z4GT	Z3GT	Z2GT	LOP	M4PT	M3PT	M2PT	OPA
67Q4	67Q3	67Q2	67Q1	67N4	67N3	67N2	67N1	67Q4T	67Q3T	67Q2T	OST	67N4T	67N3T	67N2T	OSB
PD1	3P27	27L	50H	50MF	51NT	51QT	51PT	ZLOAD	SOTFE	TCM	*	3PO	SPO	REJO	PD2
3P50R	51NP	51QP	51PP	50G	50PP	50M	50L	50Q4	50Q3	50Q2	50Q1	50N4	50N3	50N2	50N1
50ABC	X6ABC	X5ABC	3PT	TPC	TPB	TPA	32QF	3P59	59L	59N	59PR	59PB	59QL	59PL	50Q
BTX	*	STOP	START	FIDEN	FSC	FSB	FSA	32QR	Z1X	CC	EKEY	Z3RB	ATB	ECTT	KEY
XAG4	XAG3	XAG2	XAG1	MAG4	MAG3	MAG2	MAG1	XBG4	XBG3	XBG2	XBG1	MBG4	MBG3	MBG2	MBG1
XCG4	XCG3	XCG2	XCG1	MCG4	MCG3	MCG2	MCG1	MBC4	MBC3	MBC2	MBC1	MAB4	MAB3	MAB2	MAB1
SPOC	SPOB	SPOA	*	MCA4	MCA3	MCA2	MCA1	50HH	OSTI	50CA	50BC	50AB	*	*	*
*	*	*	*	*	*	*	TOP	LP1	SS3	SS2	SS1	EXT	DT	BT	PT
EXTUL	PARC	PARB	PARA	SPTE	PTXFR	LP2	LOG	LP3	CLOSE	52AC2	52AC1	52AB2	52AB1	52AA2	52AA1
LP5	LP4	TCMC2	TCMC1	TCMB2	TCMB1	TCMA2	TCMA1	DTA	DTB	DTC	LP6	LP7	LP8	LP9	LP10
ZT	Z	YT	Y	XT	X	W	V	RAG4	RAG3	RAG2	RAG1	MER	MTO	MTU	MTCS
RCG4	RCG3	RCG2	RCG1	RBG4	RBG3	RBG2	RBG1	50AL4	50AL3	50AL2	50AL1	VPOLV	N3PT	L3PT	PTRX
50CL4	50CL3	50CL2	50CL1	50BL4	50BL3	50BL2	50BL1	50G4	50G3	50G2	50G1	50CL	50BL	50AL	*
OSB4	OSB3	OSB2	OSB1	50PP4	50PP3	50PP2	50PP1	TS	TC	TB	TA	*	*	ILOP	50P
SPT_EN	*	*	*	*	52AC	52AB	52AA	50AB4	50AB3	50AB2	50AB1	ATPC	ATPB	ATPA	50PPL
50CA4	50CA3	50CA2	50CA1	50BC4	50BC3	50BC2	50BC1	*	51NR	51QR	51PR	*	*	*	*
OUT1	OUT2	OUT3	OUT4	OUT5	OUT6	OUT7	OUT8	OUT9	OUT10	OUT11	OUT12	OUT13	OUT14	OUT15	!ALARM
IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1	*	*	*	*	*	*	*	*

SEL-321: (Model 32102)

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999

2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2129(R)	Target	None

INST	TIME	COMM	SOTF	ZONE1	ZONE2	ZONE2	ZONE4	EN	A	B	C	G	Q	51	50
Z4G	Z3G	Z2G	Z1G	M4P	M3P	M2P	M1P	Z4GT	Z3GT	Z2GT	LOP	M4PT	M3PT	M2PT	OPA
67Q4	67Q3	67Q2	67Q1	67N4	67N3	67N2	67N1	67Q4T	67Q3T	67Q2T	OST	67N4T	67N3T	67N2T	OSB
PD1	3P27	27L	50H	50MF	51NT	51QT	51PT	ZLOAD	SOTFE	TCM	*	3PO	SPO	REJO	PD2
3P50R	51NP	51QP	51PP	50G	50PP	50M	50L	50Q4	50Q3	50Q2	50Q1	50N4	50N3	50N2	50N1
50ABC	X6ABC	X5ABC	3PT	TPC	TPB	TPA	32QF	3P59	59L	59N	59PR	59PB	59QL	59PL	50Q
BTX	*	STOP	START	FIDEN	FSC	FSB	FSA	32QR	Z1X	CC	EKEY	Z3RB	ATB	ECTT	KEY
XAG4	XAG3	XAG2	XAG1	MAG4	MAG3	MAG2	MAG1	XBG4	XBG3	XBG2	XBG1	MBG4	MBG3	MBG2	MBG1
XCG4	XCG3	XCG2	XCG1	MCG4	MCG3	MCG2	MCG1	MBC4	MBC3	MBC2	MBC1	MAB4	MAB3	MAB2	MAB1
SPOC	SPOB	SPOA	*	MCA4	MCA3	MCA2	MCA1	50HH	OSTI	50CA	50BC	50AB	*	*	*
*	*	*	*	*	*	*	TOP	LP1	SS3	SS2	SS1	EXT	DT	BT	PT
EXTUL	PARC	PARB	PARA	SPTE	PTXFR	LP2	LOG	LP3	CLOSE	52AC2	52AC1	52AB2	52AB1	52AA2	52AA1
LP5	LP4	TCMC2	TCMC1	TCMB2	TCMB1	TCMA2	TCMA1	DTA	DTB	DTC	LP6	LP7	LP8	LP9	LP10
ZT	Z	YT	Y	XT	X	W	V	RAG4	RAG3	RAG2	RAG1	MER	MTO	MTU	MTCS
RCG4	RCG3	RCG2	RCG1	RBG4	RBG3	RBG2	RBG1	50AL4	50AL3	50AL2	50AL1	VPOLV	N3PT	L3PT	PTRX
50CL4	50CL3	50CL2	50CL1	50BL4	50BL3	50BL2	50BL1	50G4	50G3	50G2	50G1	50CL	50BL	50AL	*
OSB4	OSB3	OSB2	OSB1	50PP4	50PP3	50PP2	50PP1	TS	TC	TB	TA	*	*	ILOP	50P
SPT_EN	*	*	*	*	52AC	52AB	52AA	50AB4	50AB3	50AB2	50AB1	ATPC	ATPB	ATPA	50PPL
50CA4	50CA3	50CA2	50CA1	50BC4	50BC3	50BC2	50BC1	*	51NR	51QR	51PR	*	*	*	*
OUT1	OUT2	OUT3	OUT4	OUT5	OUT6	OUT7	OUT8	OUT9	OUT10	OUT11	OUT12	OUT13	OUT14	OUT15	!ALARM
OUT17	OUT18	OUT19	OUT20	OUT21	OUT22	OUT23	OUT24	OUT25	OUT26	OUT27	OUT28	OUT29	OUT30	OUT31	OUT32
IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1	IN16	IN15	IN14	IN13	IN12	IN11	IN10	IN9

SEL-321-1 (Model 32111) (pre 951201):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2120(R)	Target	None	

*	*	*	STSET	STFAIL	STWARN	STEVE	STP	INST	TIME	COMM	SOTF	ZONE1	ZONE2	ZONE3	ZONE4
EN	A	B	C	G	Q	51	50	Z4G	Z3G	Z2G	Z1G	M4P	M3P	M2P	M1P
Z4GT	Z3GT	Z2GT	LOP	M4PT	M3PT	M2PT	OPA	67Q4	67Q3	67Q2	67Q1	67N4	67N3	67N2	67N1
67Q4T	67Q3T	67Q2T	OST	67N4T	67N3T	67N2T	OSB	PD1	3P27	27L	50H	50MF	51NT	51QT	51PT
ZLOAD	SOTFE	TCM	*	3PO	SPO	REJO	PD2	3P50R	51NP	51QP	51PP	50G	50PP	50M	50L
50Q4	50Q3	50Q2	50Q1	50N4	50N3	50N2	50N1	50ABC	X6ABC	X5ABC	3PT	TPC	TPB	TPA	32QF
3P59	59L	59N	59PR	59PB	59QL	59PL	50Q	BTX	*	STOP	START	FIDEN	FSC	FSB	FSA
32QR	Z1X	CC	EKEY	Z3RB	ATB	ECTT	KEY	XAG4	XAG3	XAG2	XAG1	MAG4	MAG3	MAG2	MAG1
XBG4	XBG3	XBG2	XBG1	MBG4	MBG3	MBG2	MBG1	XCG4	XCG3	XCG2	XCG1	MCG4	MCG3	MCG2	MCG1
MBC4	MBC3	MBC2	MBC1	MAB4	MAB3	MAB2	MAB1	SPOC	SPOB	SPOA	*	MCA4	MCA3	MCA2	MCA1
50HH	OSTI	50CA	50BC	50AB	*	*	*	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1
RB16	RB15	RB14	RB13	RB12	RB11	RB10	RB9	OUT1	OUT2	OUT3	OUT4	OUT5	OUT6	OUT7	OUT8
OUT9	OUT10	OUT11	OUT12	OUT13	OUT14	OUT15	!ALARM	IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1

SEL-321-1 (Model 32111) (post 951201):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2121(R)	Target	None	

*	*	*	STSET	STFAIL	STWARN	STEVE	STP	INST	TIME	COMM	SOTF	ZONE1	ZONE2	ZONE3	ZONE4
EN	A	B	C	G	Q	51	50	Z4G	Z3G	Z2G	Z1G	M4P	M3P	M2P	M1P
Z4GT	Z3GT	Z2GT	LOP	M4PT	M3PT	M2PT	OPA	67Q4	67Q3	67Q2	67Q1	67N4	67N3	67N2	67N1
67Q4T	67Q3T	67Q2T	OST	67N4T	67N3T	67N2T	OSB	PD1	3P27	27L	50H	50MF	51NT	51QT	51PT

ZLOAD	SOTFE	TCM	*	3PO	SPO	REJO	PD2	3P50R	51NP	51QP	51PP	50G	50PP	50M	50L
50Q4	50Q3	50Q2	50Q1	50N4	50N3	50N2	50N1	50ABC	X6ABC	X5ABC	3PT	TPC	TPB	TPA	32QF
3P59	59L	59N	59PR	59PB	59QL	59PL	50Q	BTX	*	STOP	START	FIDEN	FSC	FSB	FSA
32QR	Z1X	CC	EKEY	Z3RB	ATB	ECTT	KEY	XAG4	XAG3	XAG2	XAG1	MAG4	MAG3	MAG2	MAG1
XBG4	XBG3	XBG2	XBG1	MBG4	MBG3	MBG2	MBG1	XCG4	XCG3	XCG2	XCG1	MCG4	MCG3	MCG2	MCG1
MBC4	MBC3	MBC2	MBC1	MAB4	MAB3	MAB2	MAB1	SPOC	SPOB	SPOA	*	MCA4	MCA3	MCA2	MCA1
50HH	OSTI	50CA	50BC	50AB	*	*	*	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1
RB16	RB15	RB14	RB13	RB12	RB11	RB10	RB9	OUT1	OUT2	OUT3	OUT4	OUT5	OUT6	OUT7	OUT8
OUT9	OUT10	OUT11	OUT12	OUT13	OUT14	OUT15	!ALARM	TMB8	TMB7	TMB6	TMB5	TMB4	TMB3	TMB2	TMB1
IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1	RMB8	RMB7	RMB6	RMB5	RMB4	RMB3	RMB2	RMB1

SEL-321-1: (Model 32112) (pre 951201):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2122(R)	Target	None	

*	*	*	STSET	STFAIL	STWARN	STEVE	STP	INST	TIME	COMM	SOTF	ZONE1	ZONE2	ZONE3	ZONE4
EN	A	B	C	G	Q	51	50	Z4G	Z3G	Z2G	Z1G	M4P	M3P	M2P	M1P
Z4GT	Z3GT	Z2GT	LOP	M4PT	M3PT	M2PT	OPA	67Q4	67Q3	67Q2	67Q1	67N4	67N3	67N2	67N1
67Q4T	67Q3T	67Q2T	OST	67N4T	67N3T	67N2T	OSB	PD1	3P27	27L	50H	50MF	51NT	51QT	51PT
ZLOAD	SOTFE	TCM	*	3PO	SPO	REJO	PD2	3P50R	51NP	51QP	51PP	50G	50PP	50M	50L
50Q4	50Q3	50Q2	50Q1	50N4	50N3	50N2	50N1	50ABC	X6ABC	X5ABC	3PT	TPC	TPB	TPA	32QF
3P59	59L	59N	59PR	59PB	59QL	59PL	50Q	BTX	*	STOP	START	FIDEN	FSC	FSB	FSA
32QR	Z1X	CC	EKEY	Z3RB	ATB	ECTT	KEY	XAG4	XAG3	XAG2	XAG1	MAG4	MAG3	MAG2	MAG1
XBG4	XBG3	XBG2	XBG1	MBG4	MBG3	MBG2	MBG1	XCG4	XCG3	XCG2	XCG1	MCG4	MCG3	MCG2	MCG1
MBC4	MBC3	MBC2	MBC1	MAB4	MAB3	MAB2	MAB1	SPOC	SPOB	SPOA	*	MCA4	MCA3	MCA2	MCA1
50HH	OSTI	50CA	50BC	50AB	*	*	*	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1
RB16	RB15	RB14	RB13	RB12	RB11	RB10	RB9	OUT1	OUT2	OUT3	OUT4	OUT5	OUT6	OUT7	OUT8
OUT9	OUT10	OUT11	OUT12	OUT13	OUT14	OUT15	!ALARM	OUT17	OUT18	OUT19	OUT20	OUT21	OUT22	OUT23	OUT24
OUT25	OUT26	OUT27	OUT28	OUT29	OUT30	OUT31	OUT32	IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1
IN16	IN15	IN14	IN13	IN12	IN11	IN10	IN9	*	*	*	*	*	*	*	*

SEL-321-1: (Model 32112) (post 951201):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2123(R)	Target	None	

*	*	*	STSET	STFAIL	STWARN	STEVE	STPWR	INST	TIME	COMM	SOTF	ZONE1	ZONE2	ZONE3	ZONE4
EN	A	B	C	G	Q	51	50	Z4G	Z3G	Z2G	Z1G	M4P	M3P	M2P	M1P
Z4GT	Z3GT	Z2GT	LOP	M4PT	M3PT	M2PT	OPA	67Q4	67Q3	67Q2	67Q1	67N4	67N3	67N2	67N1
67Q4T	67Q3T	67Q2T	OST	67N4T	67N3T	67N2T	OSB	PD1	3P27	27L	50H	50MF	51NT	51QT	51PT
ZLOAD	SOTFE	TCM	*	3PO	SPO	REJO	PD2	3P50R	51NP	51QP	51PP	50G	50PP	50M	50L
50Q4	50Q3	50Q2	50Q1	50N4	50N3	50N2	50N1	50ABC	X6ABC	X5ABC	3PT	TPC	TPB	TPA	32QF
3P59	59L	59N	59PR	59PB	59QL	59PL	50Q	BTX	*	STOP	START	FIDEN	FSC	FSB	FSA
32QR	Z1X	CC	EKEY	Z3RB	ATB	ECTT	KEY	XAG4	XAG3	XAG2	XAG1	MAG4	MAG3	MAG2	MAG1
XBG4	XBG3	XBG2	XBG1	MBG4	MBG3	MBG2	MBG1	XCG4	XCG3	XCG2	XCG1	MCG4	MCG3	MCG2	MCG1
MBC4	MBC3	MBC2	MBC1	MAB4	MAB3	MAB2	MAB1	SPOC	SPOB	SPOA	*	MCA4	MCA3	MCA2	MCA1
50HH	OSTI	50CA	50BC	50AB	*	*	*	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1
RB16	RB15	RB14	RB13	RB12	RB11	RB10	RB9	OUT1	OUT2	OUT3	OUT4	OUT5	OUT6	OUT7	OUT8
OUT9	OUT10	OUT11	OUT12	OUT13	OUT14	OUT15	ALARM	OUT17	OUT18	OUT19	OUT20	OUT21	OUT22	OUT23	OUT24
OUT25	OUT26	OUT27	OUT28	OUT29	OUT30	OUT31	OUT32	TMB8	TMB7	TMB6	TMB5	TMB4	TMB3	TMB2	TMB1
IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1	IN16	IN15	IN14	IN13	IN12	IN11	IN10	IN9
RMB8	RMB7	RMB6	RMB5	RMB4	RMB3	RMB2	RMB1	*	*	*	*	*	*	*	

SEL-351:

2100(R)	Target Date stamp	Month	1-12	
2101(R)	Target Date stamp	Day of the Month	1-31	
2102(R)	Target Date stamp	Year	0-99	
2103(R)	Target Time stamp	Hours	0-23	
2104(R)	Target Time stamp	Minutes	0-59	
2105(R)	Target Time stamp	Seconds	0-59	
2106(R)	Target Time stamp	Milliseconds	0-999	
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6		
2108-2131(R)	Target	None		

*	*	*	STSET	*	*	*	*	EN	TRIP	INST	COMM	SOTF	50	51	81
A	B	C	G	N	RS	CY	LO	50A1	50B1	50C1	50A2	50B2	50C2	50A3	50B3
50C3	50A4	50B4	50C4	50AB1	50BC1	50CA1	50AB2	50BC2	50CA2	50AB3	50BC3	50CA3	50AB4	50BC4	50CA4
50A	50B	50C	51A	51AT	51AR	51B	51BT	51BR	51C	51CT	51CR	51P	51PT	51PR	51N
51NT	51NR	51G	51GT	51GR	51Q	51QT	51QR	50P1	50P2	50P3	50P4	50N1	50N2	50N3	50N4
67P1	67P2	67P3	67P4	67N1	67N2	67N3	67N4	67P1T	67P2T	67P3T	67P4T	67N1T	67N2T	67N3T	67N4T
50G1	50G2	50G3	50G4	50Q1	50Q2	50Q3	50Q4	67G1	67G2	67G3	67G4	67Q1	67Q2	67Q3	67Q4
67G1T	67G2T	67G3T	67G4T	67Q1T	67Q2T	67Q3T	67Q4T	50P5	50P6	50N5	50N6	50G5	50G6	50Q5	50Q6
50QF	50QR	50GF	50GR	32VE	32QGE	32IE	32QE	F32P	R32P	F32Q	R32Q	F32QG	R32QG	F32V	R32V
F32I	R32I	32PF	32PR	32QF	32QR	32GF	32GR	27A1	27B1	27C1	27A2	27B2	27C2	59A1	59B1
59C1	59A2	59B2	59C2	27AB	27BC	27CA	59AB	59BC	59CA	59N1	59N2	59Q	59V1	27S	59S1
59S2	59VP	59VS	SF	25A1	25A2	3P27	3P59	81D1	81D2	81D3	81D4	81D5	81D6	27B81	50L
81D1T	81D2T	81D3T	81D4T	81D5T	81D6T	VPOLV	LOP	IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1
LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB8	RB1	RB2	RB3	RB4	RB5	RB6	RB7	RB8
LT1	LT2	LT3	LT4	LT5	LT6	LT7	LT8	SV1	SV2	SV3	SV4	SV1T	SV2T	SV3T	SV4T
SV5	SV6	SV7	SV8	SV5T	SV6T	SV7T	SV8T	SV9	SV10	SV11	SV12	SV9T	SV10T	SV11T	SV12T
SV13	SV14	SV15	SV16	SV13T	SV14T	SV15T	SV16T	79RS	79CY	79LO	SH0	SH1	SH2	SH3	SH4
CLOSE	CF	RCSF	OPTMN	RSTMN	FSA	FSB	FSC	SG1	SG2	SG3	SG4	SG5	SG6	ZLOUT	ZLIN
BCW	50P32	*	*	*	*	*	*	ZLOAD	BCWA	BCWB	BCWC	ALARM	OUT11	OUT10	OUT9
OUT8	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	3PO	SOTFE	Z3RB	KEY	EKEY	ECTT	WFC	PT
PTRX2	PTRX	PTRX1	UBB1	UBB2	UBB	Z3XT	DSTRT	NSTRT	STOP	BTX	TRIP	OC	CC	DCHI	DCLO
67P2S	67N2S	67G2S	67Q2S	PDEM	NDEM	GDEM	QDEM	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

For SEL-351R:

2100(R)	Target Date stamp	Month	1-12	
2101(R)	Target Date stamp	Day of the Month	1-31	
2102(R)	Target Date stamp	Year	0-99	
2103(R)	Target Time stamp	Hours	0-23	
2104(R)	Target Time stamp	Minutes	0-59	
2105(R)	Target Time stamp	Seconds	0-59	
2106(R)	Target Time stamp	Milliseconds	0-999	
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6		
2108-2138(R)	Target	None		

*	*	*	STSET	*	*	*	*	LED10	LED11	LED12	LED13	LED14	LED15	LED16	LED17
LED18	LED19	LED20	LED21	LED22	LED23	LED24	LED25	50A1	50B1	50C1	50A2	50B2	50C2	50A3	50B3
50C3	50A4	50B4	50C4	50AB1	50BC1	50CA1	50AB2	50BC2	50CA2	50AB3	50BC3	50CA3	50AB4	50BC4	50CA4
50A	50B	50C	51P1	51P1T	51P1R	51N1	51N1T	51N1R	51G1	51G1T	51G1R	51P2	51P2T	51P2R	51N2
51N2T	51N2R	51G2	51G2T	51G2R	51Q	51QT	51QR	50P1	50P2	50P3	50P4	50N1	50N2	50N3	50N4
67P1	67P2	67P3	67P4	67N1	67N2	67N3	67N4	67P1T	67P2T	67P3T	67P4T	67N1T	67N2T	67N3T	67N4T
50G1	50G2	50G3	50G4	50Q1	50Q2	50Q3	50Q4	67G1	67G2	67G3	67G4	67Q1	67Q2	67Q3	67Q4
67G1T	67G2T	67G3T	67G4T	67Q1T	67Q2T	67Q3T	67Q4T	50P5	50P6	50N5	50N6	50G5	50G6	50Q5	50Q6
50QF	50QR	50GF	50GR	32VE	32QGE	32IE	32QE	F32P	R32P	F32Q	R32Q	F32QG	R32QG	F32V	R32V
F32I	R32I	32PF	32PR	32QF	32QR	32GF	32GR	27A1	27B1	27C1	27A2	27B2	27C2	59A1	59B1
59C1	59A2	59B2	59C2	27AB	27BC	27CA	59AB	59BC	59CA	59N1	59N2	59Q	59V1	27S	59S1
59S2	59VP	59VS	SF	25A1	25A2	3P27	3P59	81D1	81D2	81D3	81D4	81D5	81D6	27B81	50L
81D1T	81D2T	81D3T	81D4T	81D5T	81D6T	VPOLV	LOP	RCTR	RCCL	IN106	IN105	IN104	IN103	IN102	IN101
LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB8	RB1	RB2	RB3	RB4	RB5	RB6	RB7	RB8
LT1	LT2	LT3	LT4	LT5	LT6	LT7	LT8	SV1	SV2	SV3	SV4	SV1T	SV2T	SV3T	SV4T
SV5	SV6	SV7	SV8	SV5T	SV6T	SV7T	SV8T	SV9	SV10	SV11	SV12	SV9T	SV10T	SV11T	SV12T
SV13	SV14	SV15	SV16	SV13T	SV14T	SV15T	SV16T	79RS	79CY	79LO	SH0	SH1	SH2	SH3	SH4
CLOSE	CF	RCSF	OPTMN	RSTMN	FSA	FSB	FSC	BCW	50P32	NOBATT	59VA	TRGTR	52A	COMMT	CHRGG
SG1	SG2	SG3	SG4	SG5	SG6	ZLOUT	ZLIN	ZLOAD	BCWA	BCWB	BCWC	BCBOK	TOSLP	DISTST	DTFAIL

ALARM	OUT107	OUT106	OUT105	OUT104	OUT103	OUT102	OUT101	3PO	SOTFE	Z3RB	KEY	EKEY	ECTT	WFC	PT
PTRX2	PTRX	PTRX1	UBB1	UBB2	UBB	Z3XT	DSTRT	NSTRT	STOP	BTX	TRIP	OC	CC	CLG	NOMSG
67P2S	67N2S	67G2S	67Q2S	PDEM	NDEM	GDEM	QDEM	PB1	PB2	PB3	PB4	PB5	PB6	PB7	PB8
PB9	PINBD	PINC	PINE	PINF	SW1	DISCHG	LED9	LED1	LED2	LED3	LED4	LED5	LED6	LED7	LED8
OCP	OCG	OLP	OLG	OLS	HTP	HTG	HLP	HLG	CLP	RPP	RPG	RPS	SEQC	3PHV	GTP
RMB8A	RMB7A	RMB6A	RMB5A	RMB4A	RMB3A	RMB2A	RMB1A	TMB8A	TMB7A	TMB6A	TMB5A	TMB4A	TMB3A	TMB2A	TMB1A
RMB8B	RMB7B	RMB6B	RMB5B	RMB4B	RMB3B	RMB2B	RMB1B	TMB8B	TMB7B	TMB6B	TMB5B	TMB4B	TMB3B	TMB2B	TMB1B
LBOKB	CBADB	RBADB	ROKB	LBOKA	CBADA	RBADA	ROKA	OUT201	OUT202	OUT203	OUT204	OUT205	OUT206	OUT207	OUT208
OUT209	OUT210	OUT211	OUT212	OUT213	OUT214	OUT215	OUT216	IN208	IN207	IN206	IN205	IN204	IN203	IN202	IN201
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

For SEL-352:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2147(R)	Target	None	

*	*	*	STSET	STFAIL	STWARN	*	*	EN	PF	86BFT	86RS	TRIP	CLOSE	52A	MOD
FAULT	LOAD	UBAL	FLASH	THERM	A	B	C	Y59L3	X59L3	50LDC	50LDB	50LDA	50FTC	50FTB	50FTA
87THA	87FOA	Y27D3	X27D3	50N	50MDC	50MDB	50MDA	47Q	37OP	25T	46P	87THC	87FOC	87THB	87FOB
X59LC	X59HC	X27DB	X59LB	X59HB	X27DA	X59LA	X59HA	ZERO	Y27DC	Y59LC	Y27DB	Y59LB	Y27DA	Y59LA	X27DC
ONE	50MNC	50MNB	50MNA	87F	87H	87TH	X59H	25M	25C	46C	46B	46A	50MD	50LD	50FT
Y47Q	X47Q	37OPC	37OPB	37OPA	87HC	87HB	87HA	CCMD	TCMD	XNTC	XPTC	XNTB	XPTB	XNTA	XPTA
*	*	YNTC	YPTC	YNTB	YPTB	YNTA	YPTA	D86BF	D7Q	D6Q	D5Q	D4Q	D3Q	D2Q	D1Q
RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB16	RB15	RB14	RB13	RB12	RB11	RB10	RB9
*	*	IN106	IN105	IN104	IN103	IN102	IN101	IN208	IN207	IN206	IN205	IN204	IN203	IN202	IN201
IN216	IN215	IN214	IN213	IN212	IN211	IN210	IN209	IN308	IN307	IN306	IN305	IN304	IN303	IN302	IN301
IN316	IN315	IN314	IN313	IN312	IN311	IN310	IN309	MCLOSE	CLOSE	TRIP3	TRIPC	TRIPB	TRIPA	SS2	SS1
*	LODCT	LOD2	LOD1	MODST	52AC	52AB	52AA	L1CR	L1CS	L1BQ	L1BR	L1BS	L1AQ	L1AR	L1AS
*	T1CD	T1C	T1BD	T1B	T1AD	T1A	L1CQ	*	*	*	*	*	SAC	SAB	SAA
LFAR	LFAS	TTCD	TTC	TTBD	TTB	TTAD	TTA	*	LFCQ	LFCR	LFCS	LFBQ	LFBR	LFBS	LFAQ
*	*	FCCD	FCC	FCBD	FCB	FCAD	FCA	LLBS	LLAQ	LLAR	LLAS	D52Q	DLCQ	DLBQ	DLAQ
LPB	LPAD	LPA	LLCQ	LLCR	LLCS	LLBQ	LLBR	LDC	LDBD	LDB	LDAD	LDA	LPCD	LPC	LPBD
*	APD	AP	L52Q	L52R	L52S	D52	LDCD	*	*	*	DLC	DLB	DLA	AFD	AF
LTAR	LTAS	OPCD	OPC	OPBD	OPB	OPAD	OPA	*	LTCQ	LTCR	LTCS	LTBQ	LTBR	LTBS	LTAQ
*	*	CRMEC	CRMEB	CRMEA	TRMEC	TRMEB	TRMEA	*	KTRK	26TFC	26TFB	26TFA	26CFC	26CFB	26CFA
*	*	26TPC	26TPB	26TPA	26CPC	26CPB	26CPA	F2AD	F2A	F1CD	F1C	F1BD	F1B	F1AD	F1A
F3BD	F3B	F3AD	F3A	F2CD	F2C	F2BD	F2B	LHBQ	LHBR	LHBS	LHAQ	LHAR	LHAS	F3CD	F3C
LVBR	LVBS	LVAQ	LVAR	LVAS	LHCQ	LHCR	LHCS	FPBD	FPB	FPAD	FPA	LVCQ	LVCR	LVCS	LVBQ
FFCD	FFC	FFBD	FFB	FFAD	FFA	FPCD	FPC	*	UPAD	UPA	LUQ	LUR	LUS	UCD	UC
UFBD	UFB	UFAD	UFA	UPCD	UPC	UPBD	UPB	*	*	*	*	*	*	UFCD	UFC
*	*	LT3D	LT3	LT2D	LT2	LT1D	LT1	MCT	RCCD	RCC	RCBD	RCB	RCAD	RCA	RCLS
PCPA	SCTD	SCT	SYNCTD	SYNCT	CCTD	CCT	MCTD	ZCPB	ZCNA	ZCPA	PCNC	PCPC	PCNB	PCPB	PCNA
*	SYNCEN	CTCD	CTBD	CTAD	ZCNC	ZCPC	ZCNB	CAMT	BPF	BDNC	TWO	CWO	52ACV	FCRS	FTRS
*	*	*	BALRM	PTD	SC	ST	MCC	LRTCR	LRTCS	LRTBQ	LRTBR	LRTBS	LRTAQ	LRTAR	LRTAS
*	RT3D	RT3	RT2D	RT2	RT1D	RT1	LRTCQ	L4CR	L4CS	L4BQ	L4BR	L4BS	L4AQ	L4AR	L4AS
L5AS	T3CD	T3C	T3BD	T3B	T3AD	T3A	L4CQ	L5CQ	L5CR	L5CS	L5BQ	L5BR	L5BS	L5AQ	L5AR
L6AR	L6AS	T4CD	T4C	T4BD	T4B	T4AD	T4A	*	L6CQ	L6CR	L6CS	L6BQ	L6BR	L6BS	L6AQ
*	*	*	*	*	SBC	SBB	SBA	UBBF	UBPF	FOBF	FOPF	CTF	TTF	LBF	LPF
RTC	RTB	RTA	CCC	CCB	CCA	LODBF	LODPF	*	*	*	*	*	DCC	DCB	DCA
*	*	*	*	*	*	*	FBF	L1MQ	L1MR	L1MS	M1D	M1	D2MQ	D1MQ	M86T
L3MS	M3D	M3	L2MQ	L2MR	L2MS	M2D	M2	*	*	D2M	D1M	M4D	M4	L3MQ	L3MR
*	*	*	MER	86BFT	86RS	MDT	*	*	D7	D6	D5	D4	D3	D2	D1
*	*	*	*	*	CTC	CTB	CTA	*	*	*	*	*	*	*	*
ALARM	OUT107	OUT106	OUT105	OUT104	OUT103	OUT102	OUT101	OUT201	OUT202	OUT203	OUT204	OUT205	OUT206	OUT207	OUT208
OUT209	OUT210	OUT211	OUT212	OUT213	OUT214	OUT215	OUT216	OUT301	OUT302	OUT303	OUT304	OUT305	OUT306	OUT307	OUT308
OUT309	OUT310	OUT311	OUT312	OUT313	OUT314	OUT315	OUT316	*	*	*	*	*	*	*	*

For SEL-387:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2130(R)	Target	None	

EN	TRIP	INST	87-1	87-2	87-3	50	51	A	B	C	N	W1	W2	W3	W4
50P11	50P11T	50P12	51P1	51P1T	51P1R	PDEM1	OCA	50A13	50B13	50C13	50P13	50A14	50B14	50C14	50P14
50N11	50N11T	50N12	51N1	51N1T	51N1R	NDEM1	OC1	50Q11	50Q11T	50Q12	51Q1	51Q1T	51Q1R	QDEM1	CC1
50P21	50P21T	50P22	51P2	51P2T	51P2R	PDEM2	OCB	50A23	50B23	50C23	50P23	50A24	50B24	50C24	50P24
50N21	50N21T	50N22	51N2	51N2T	51N2R	NDEM2	OC2	50Q21	50Q21T	50Q22	51Q2	51Q2T	51Q2R	QDEM2	CC2
50P31	50P31T	50P32	51P3	51P3T	51P3R	PDEM3	OCC	50A33	50B33	50C33	50P33	50A34	50B34	50C34	50P34
50N31	50N31T	50N32	51N3	51N3T	51N3R	NDEM3	OC3	50Q31	50Q31T	50Q32	51Q3	51Q3T	51Q3R	QDEM3	CC3
50P41	50P41T	50P42	51P4	51P4T	51P4R	PDEM4	*	50A43	50B43	50C43	50P43	50A44	50B44	50C44	50P44
50N41	50N41T	50N42	51N4	51N4T	51N4R	NDEM4	OC4	50Q41	50Q41T	50Q42	51Q4	51Q4T	51Q4R	QDEM4	CC4
87U1	87U2	87U3	87U	87R1	87R2	87R3	87R	2HB1	2HB2	2HB3	5HB1	5HB2	5HB3	TH5	TH5T
87BL1	87BL2	87BL3	87BL	87E1	87E2	87E3	32IE	8701	8702	8703	50GC	50G4	32IR	32IF	REFP
51PC1	51PC1T	51PC1R	51NC1	51NC1T	51NC1R	DC1	DC2	51PC2	51PC2T	51PC2R	51NC2	51NC2T	51NC2R	DC3	DC4
RB1	RB2	RB3	RB4	RB5	RB6	RB7	RB8	RB9	RB10	RB11	RB12	RB13	RB14	RB15	RB16
SG1	SG2	SG3	SG4	SG5	SG6	CHSG	*	*	*	IN106	IN105	IN104	IN103	IN102	IN101
IN208	IN207	IN206	IN205	IN204	IN203	IN202	IN201	IN216	IN215	IN214	IN213	IN212	IN211	IN210	IN209
IN308	IN307	IN306	IN305	IN304	IN303	IN302	IN301	IN316	IN315	IN314	IN313	IN312	IN311	IN310	IN309
S1V1	S1V2	S1V3	S1V4	S1V1T	S1V2T	S1V3T	S1V4T	S1LT1	S1LT2	S1LT3	S1LT4	S2LT1	S2LT2	S2LT3	S2LT4
S2V1	S2V2	S2V3	S2V4	S2V1T	S2V2T	S2V3T	S2V4T	S3V1	S3V2	S3V3	S3V4	S3V5	S3V6	S3V7	S3V8
S3V1T	S3V2T	S3V3T	S3V4T	S3V5T	S3V6T	S3V7T	S3V8T	BCWA1	BCWB1	BCWC1	BCW1	BCWA2	BCWB2	BCWC2	BCW2
BCWA3	BCWB3	BCWC3	BCW3	BCWA4	BCWB4	BCWC4	BCW4	TRIP1	TRIP2	TRIP3	TRIP4	TRIP5	TRIPL	*	TRGTR
CLS1	CLS2	CLS3	CLS4	CF1T	CF2T	CF3T	CF4T	!ALARM	OUT107	OUT106	OUT105	OUT104	OUT103	OUT102	OUT101
OUT201	OUT202	OUT203	OUT204	OUT205	OUT206	OUT207	OUT208	OUT209	OUT210	OUT211	OUT212	OUT213	OUT214	OUT215	OUT216
OUT301	OUT302	OUT303	OUT304	OUT305	OUT306	OUT307	OUT308	OUT309	OUT310	OUT311	OUT312	OUT313	OUT314	OUT315	OUT316

For SEL-501 (APP X=FDR/OC1; Y=FDR/OC1) (ASCII Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

XX	XY	XINST	XA	XB	XC	XQ	XN	*	XXIN	XYIN	XALARM	XXOUT1	XXOUT2	XYOUT1	XYOUT2
X51PT	X51QT	X51NT	X50PT	X50H	X50QT	X50NT	X50NH	X51PP	X51QP	X51NP	X50PP	*	X50QP	X50NP	*
X51PR	X51QR	X51NR	*	*	*	*	*	YX	YY	YINST	YA	YB	YC	YQ	YN
*	YXIN	YYIN	YALARM	YXOUT1	YXOUT2	YYOUT1	YYOUT2	Y51PT	Y51QT	Y51NT	Y50PT	Y50H	Y50QT	Y50NT	Y50NH
Y51PP	Y51QP	Y51NP	Y50PP	*	Y50QP	Y50NP	*	Y51PR	Y51QR	Y51NR	*	*	*	*	*

For SEL-501 (APP X=FDR/OC1; Y=MOT) (ASCII Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

```
XX       XY     XINST  XA     XB     XC     XQ     XN     *      XXIN   XYIN   XALARM XXOUT1 XXOUT2 XYOUT1 XYOUT2
X51PT    X51QT  X51NT  X50PT  X50H   X50QT  X50NT  X50NH  X51PP  X51QP  X51NP  X50PP  *      X50QP  X50NP  *
X51PR    X51QR  X51NR  *      *      *      *      *      YX     YY     YINST  YA     YB     YC     YX     YN
*        YXIN   YYIN   YALARM YXOUT1 YXOUT2 YYOUT1 YYOUT2 Y49    *      YSTL   Y50PT  Y50H   Y50QT  Y50NT  Y50NH
Y49A     Y50L   Y50ST  Y50PP  YLLOSS Y50QP  Y50NP  YLJAM  *      *      *      *      *      *      *      *
```

For SEL-501 (APP X=FDR/OC1; Y=BFR) (ASCII Format):

```
2100(R)      Target Date stamp                     Month                      1-12
2101(R)      Target Date stamp                     Day of the Month           1-31
2102(R)      Target Date stamp                     Year                       0-99
2103(R)      Target Time stamp                     Hours                      0-23
2104(R)      Target Time stamp                     Minutes                    0-59
2105(R)      Target Time stamp                     Seconds                    0-59
2106(R)      Target Time stamp                     Milliseconds               0-999
2107(R)      Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                None

XX       XY     XINST  XA     XB     XC     XQ     XN     *      XXIN   XYIN   XALARM XXOUT1 XXOUT2 XYOUT1 XYOUT2
X51PT    X51QT  X51NT  X50PT  X50H   X50QT  X50NT  X50NH  X51PP  X51QP  X51NP  X50PP  *      X50QP  X50NP  *
X51PR    X51QR  X51NR  *      *      *      *      *      YX     YY     YINST  YA     YB     YC     YQ     YN
*        YXIN   YYIN   YALARM YXOUT1 YXOUT2 YYOUT1 YYOUT2 Y86TR  YRTRP  Y62T   Y50PP  *      *      Y50NP  *
*        *      *      *      *      *      *      *      *      *      *      *      *      *      *      *
```

For SEL-501 (APP X=FDR/OC1; Y=TMR/OFF) (ASCII Format):

```
2100(R)      Target Date stamp                     Month                      1-12
2101(R)      Target Date stamp                     Day of the Month           1-31
2102(R)      Target Date stamp                     Year                       0-99
2103(R)      Target Time stamp                     Hours                      0-23
2104(R)      Target Time stamp                     Minutes                    0-59
2105(R)      Target Time stamp                     Seconds                    0-59
2106(R)      Target Time stamp                     Milliseconds               0-999
2107(R)      Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                None

XX       XY     XINST  XA     XB     XC     XQ     XN     *      XXIN   XYIN   XALARM XXOUT1 XXOUT2 XYOUT1 XYOUT2
X51PT    X51QT  X51NT  X50PT  X50H   X50QT  X50NT  X50NH  X51PP  X51QP  X51NP  X50PP  *      X50QP  X50NP  *
X51PR    X51QR  X51NR  *      *      *      *      *      YX     YY     YINST  YA     YB     YC     YQ     YN
*        YXIN   YYIN   YALARM YXOUT1 YXOUT2 YYOUT1 YYOUT2 *      *      *      *      *      *      *      *
*        *      *      *      *      *      *      *      *      *      *      *      *      *      *      *
```

For SEL-501 (APP X=MOT; Y=MOT) (ASCII Format):

```
2100(R)      Target Date stamp                     Month                      1-12
2101(R)      Target Date stamp                     Day of the Month           1-31
2102(R)      Target Date stamp                     Year                       0-99
2103(R)      Target Time stamp                     Hours                      0-23
2104(R)      Target Time stamp                     Minutes                    0-59
2105(R)      Target Time stamp                     Seconds                    0-59
2106(R)      Target Time stamp                     Milliseconds               0-999
2107(R)      Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                None

XX       XY     XINST  XA     XB     XC     XQ     XN     *      XXIN   XYIN   XALARM XXOUT1 XXOUT2 XYOUT1 XYOUT2
X49      *      XSTL   X50PT  X50H   X50QT  X50NT  X50NH  X49A   X50L   X50ST  X50PP  XLLOSS X50QP  X50NP  XLJAM
*        *      *      *      *      *      *      *      YX     YY     YINST  YA     YB     YC     YQ     YN
*        YXIN   YYIN   YALARM YXOUT1 YXOUT2 YYOUT1 YYOUT2 Y49    *      YSTL   Y50PT  Y50H   Y50QT  Y50NT  Y50NH
Y49A     Y50L   Y50ST  Y50PP  YLLOSS Y50QP  YTPNP  YLJAM  *      *      *      *      *      *      *      *
```

For SEL-501 (APP X=MOT; Y=BFR) (ASCII Format):

```
2100(R)      Target Date stamp                     Month                      1-12
2101(R)      Target Date stamp                     Day of the Month           1-31
2102(R)      Target Date stamp                     Year                       0-99
2103(R)      Target Time stamp                     Hours                      0-23
2104(R)      Target Time stamp                     Minutes                    0-59
2105(R)      Target Time stamp                     Seconds                    0-59
```

2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

XX	XY	XINST	XA	XB	XC	XQ	XN	*	XXIN	XYIN	XALARM	XXOUT1	XXOUT2	XYOUT1	XYOUT2
X49	*	XSTL	X50PT	X50H	X50QT	X50NT	X50NH	X49A	X50L	X50ST	X50PP	XLLOSS	X50QP	X50NP	XLJAM
*	*	*	*	*	*	*	*	YX	YY	YINST	YA	YB	YC	YQ	YN
*	YXIN	YYIN	YALARM	YYOUT1	YYOUT2	YYOUT1	YYOUT2	Y86TR	YRTRP	Y62T	Y50PP	*	*	Y50NP	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

For SEL-501 (APP X=MOT; Y=TMR/OFF) (ASCII Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

XX	XY	XINST	XA	XB	XC	XQ	XN	*	XXIN	XYIN	XALARM	XXOUT1	XXOUT2	XYOUT1	XYOUT2
X49	*	XSTL	X50PT	X50H	X50QT	X50NT	X50NH	X49A	X50L	X50ST	X50PP	XLLOSS	X50QP	X50NP	XLJAM
*	*	*	*	*	*	*	*	YX	YY	YINST	YA	YB	YC	YQ	YN
*	YXIN	YYIN	YALARM	YXOUT1	YXOUT2	YYOUT1	YYOUT2	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

For SEL-501 (APP X=MOT; Y=FDR/OC1) (ASCII Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

XX	XY	XINST	XA	XB	XC	XQ	XN	*	XXIN	XYIN	XALARM	XXOUT1	XXOUT2	XYOUT1	XYOUT2
X49	*	XSTL	X50PT	X50H	X50QT	X50NT	X50NH	X49A	X50L	X50ST	X50PP	XLLOSS	X50QP	X50NP	XLJAM
*	*	*	*	*	*	*	*	YX	YY	YINST	YA	YB	YC	YQ	YN
*	YXIN	YYIN	YALARM	YXOUT1	YXOUT2	YYOUT1	YYOUT2	Y51PT	Y51QT	Y51NT	Y50PT	Y50H	Y50QT	Y50NT	Y50NH
Y51PP	Y51QP	Y51NP	Y50PP	*	Y50QP	Y50NP	*	Y51PR	Y51QR	Y51NR	*	*	*	*	*

For SEL-501 (APP X=BFR; Y=MOT) (ASCII| Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

XX	XY	XINST	XA	XB	XC	XQ	XN	*	XXIN	XYIN	XALARM	XXOUT1	XXOUT2	XYOUT1	XYOUT2
X86TR	XRTRP	X62T	X50PP	*	*	X50NP	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	YX	YY	YINST	YA	YB	YC	YQ	YN
*	YXIN	YYIN	YALARM	YXOUT1	YXOUT2	YYOUT1	YYOUT2	Y49	*	YSTL	Y50PT	Y50H	Y50QT	Y50NT	Y50NH
Y49A	Y50L	Y50ST	Y50PP	YLLOSS	Y50QP	YTPNP	YLJAM	*	*	*	*	*	*	*	*

For SEL-501 (APP X=BFR; Y=FDR/OC1) (ASCII Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

XX	XY	XINST	XA	XB	XC	XQ	XN	*	XXIN	XYIN	XALARM	XXOUT1	XXOUT2	XYOUT1	XYOUT2
X86TR	XRTRP	X62T	X50PP	*	*	X50NP	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	YX	YY	YINST	YA	YB	YC	YQ	YN
*	YXIN	YYIN	YALARM	YXOUT1	YXOUT2	YYOUT1	YYOUT2	Y50PT	Y51QT	Y51NT	Y50PT	Y50H	Y50QT	Y50NT	Y50NH
Y50PP	Y51QP	Y51NP	Y50PP	*	Y50QP	Y50NP	*	Y50PR	Y51QR	Y51NR	*	*	*	*	*

For SEL-501 (APP X=BFR; Y=BFR) (ASCII Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

XX	XY	XINST	XA	XB	XC	XQ	XN	*	XXIN	XYIN	XALARM	XXOUT1	XXOUT2	XYOUT1	XYOUT2
X86TR	XRTRP	X62T	X50PP	*	*	X50NP	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	YX	YY	YINST	YA	YB	YC	YQ	YN
*	YXIN	YYIN	YALARM	YXOUT1	YXOUT2	YYOUT1	YYOUT2	Y86TR	YRTRP	Y62T	Y50PP	*	*	Y50NP	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

For SEL-501 (APP X=BFR; Y=TMR/OFF) (ASCII Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

XX	XY	XINST	XA	XB	XC	XQ	XN	*	XXIN	XYIN	XALARM	XXOUT1	XXOUT2	XYOUT1	XYOUT2
X86TR	XRTRP	X62T	X50PP	*	*	X50NP	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	YX	YY	YINST	YA	YB	YC	YQ	YN
*	YXIN	YYIN	YALARM	YXOUT1	YXOUT2	YYOUT1	YYOUT2	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

For SEL-501 (APP X=TMR/OFF; Y=FDR/OC1) (ASCII Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

```
XX       XY     XINST XA      XB     XC     XQ     XN     *      XXIN   XYIN  XALARM  XXOUT1 XXOUT2 XYOUT1 XYOUT2
*        *      *     *       *      *      *      *      *      *      *     *       *      *      *      *
*        *      *     *       *      *      *      *      YX     YY     YINST YA      YB     YC     YQ     YN
*        YXIN   YYIN  YALARM  YXOUT1 YXOUT2 YYOUT1 YYOUT2 Y51PT  Y51QT  Y51NT Y50PT   Y50H   Y50QT  Y50NT  Y50NH
Y51PP    Y51QP  Y51NP Y50PP   *      Y50QP  Y50NP  *      Y51PR  Y51QR  Y51NR *       *      *      *      *
```

For SEL-501 (APP X=TMR/OFF; Y=MOT) (ASCII Format):

```
2100(R)       Target Date stamp                     Month                        1-12
2101(R)       Target Date stamp                     Day of the Month             1-31
2102(R)       Target Date stamp                     Year                         0-99
2103(R)       Target Time stamp                     Hours                        0-23
2104(R)       Target Time stamp                     Minutes                      0-59
2105(R)       Target Time stamp                     Seconds                      0-59
2106(R)       Target Time stamp                     Milliseconds                 0-999
2107(R)       Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                None
```

```
XX       XY     XINST XA      XB     XC     XQ     XN     *      XXIN   XYIN  XALARM  XXOUT1 XXOUT2 XYOUT1 XYOUT2
*        *      *     *       *      *      *      *      *      *      *     *       *      *      *      *
*        *      *     *       *      *      *      *      YX     YY     YINST YA      YB     YC     YQ     YN
*        YXIN   YYIN  YALARM  YXOUT1 YXOUT2 YYOUT1 YYOUT2 Y49    *      YSTL  Y50PT   Y50H   Y50QT  Y50NT  Y50NH
Y59A     Y50L   Y50ST Y50PP   YLLOSS Y50QP  Y50NP  YLJAM  *      *      *     *       *      *      *      *
```

For SEL-501 (APP X=TMR/OFF; Y=BFR) (ASCII Format):

```
2100(R)       Target Date stamp                     Month                        1-12
2101(R)       Target Date stamp                     Day of the Month             1-31
2102(R)       Target Date stamp                     Year                         0-99
2103(R)       Target Time stamp                     Hours                        0-23
2104(R)       Target Time stamp                     Minutes                      0-59
2105(R)       Target Time stamp                     Seconds                      0-59
2106(R)       Target Time stamp                     Milliseconds                 0-999
2107(R)       Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                None
```

```
XX       XY     XINST XA      XB     XC     XQ     XN     *      XXIN   XYIN  XALARM  XXOUT1 XXOUT2 XYOUT1 XYOUT2
*        *      *     *       *      *      *      *      *      *      *     *       *      *      *      *
*        *      *     *       *      *      *      *      YX     YY     YINST YA      YB     YC     YQ     YN
*        YXIN   YYIN  YALARM  YXOUT1 YXOUT2 YYOUT1 YYOUT2 Y86TR  YRTRP  Y62T  Y50PP   *      *      Y50NP  *
*        *      *     *       *      *      *      *      *      *      *     *       *      *      *      *
```

For SEL-501 (APP X=TMR/OFF; Y=TMR/OFF) (ASCII Format):

```
2100(R)       Target Date stamp                     Month                        1-12
2101(R)       Target Date stamp                     Day of the Month             1-31
2102(R)       Target Date stamp                     Year                         0-99
2103(R)       Target Time stamp                     Hours                        0-23
2104(R)       Target Time stamp                     Minutes                      0-59
2105(R)       Target Time stamp                     Seconds                      0-59
2106(R)       Target Time stamp                     Milliseconds                 0-999
2107(R)       Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                None
```

```
XX       XY     XINST XA      XB     XC     XQ     XN     *      XXIN   XYIN  XALARM  XXOUT1 XXOUT2 XYOUT1 XYOUT2
*        *      *     *       *      *      *      *      *      *      *     *       *      *      *      *
*        *      *     *       *      *      *      *      YX     YY     YINST YA      YB     YC     YQ     YN
*        YXIN   YYIN  YALARM  YXOUT1 YXOUT2 YYOUT1 YYOUT2 *      *      *     *       *      *      *      *
*        *      *     *       *      *      *      *      *      *      *     *       *      *      *      *
```

For SEL-501 (APP X=FDR/OC1; Y=FDR/OC1); SEL-501-1,-2 (Binary Format):

```
2100(R)       Target Date stamp                     Month                        1-12
2101(R)       Target Date stamp                     Day of the Month             1-31
2102(R)       Target Date stamp                     Year                         0-99
2103(R)       Target Time stamp                     Hours                        0-23
2104(R)       Target Time stamp                     Minutes                      0-59
2105(R)       Target Time stamp                     Seconds                      0-59
```

```
2106(R)       Target Time stamp                         Milliseconds               0-999
2107(R)       Target Date stamp                         Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                    None

*        *      *      STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
X51PT    X51QT  X51NT  X50PT  X50H   X50QT  X50NT  X50NH  X51PP  X51QP  X51NP  X50PP  *      X50QP  X50NP  *
X51PR    X51QR  X51NR  *      *      *      *      *      *      Y      INST   A      B      C      Q      N
Y51PT    Y51QT  Y51NT  Y50PT  Y50H   Y50QT  Y50NT  Y50NH* Y51PP  Y51QP  Y51NP  Y50PP  *      Y50QP  Y50NP  *
Y51PR    Y51QR  Y51NR  *      *      *      *      *      *      XIN    YIN    ALARM  XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=FDR/OC1; Y=MOT) (Binary Format):

```
2100(R)       Target Date stamp                         Month                      1-12
2101(R)       Target Date stamp                         Day of the Month           1-31
2102(R)       Target Date stamp                         Year                       0-99
2103(R)       Target Time stamp                         Hours                      0-23
2104(R)       Target Time stamp                         Minutes                    0-59
2105(R)       Target Time stamp                         Seconds                    0-59
2106(R)       Target Time stamp                         Milliseconds               0-999
2107(R)       Target Date stamp                         Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                    None

*        *      *      STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
X51PT    X51QT  X51NT  X50PT  X50H   X50QT  X50NT  X50NH  X51PP  X51QP  X51NP  X50PP  *      X50QP  X50NP  *
X51PR    X51QR  X51NR  *      *      *      *      *      *      Y      INST   A      B      C      Q      N
Y49      *      YSTL   Y50PT  Y50H   Y50QT  Y50NT  Y50NH  Y49A   Y50L   Y50ST  Y50PP  YLLOSS Y50QP  Y50NP  YLJAM
*        *      *      *      *      *      *      *      *      XIN    YIN    ALARM  XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=FDR/OC1; Y=BFR) (Binary Format):

```
2100(R)       Target Date stamp                         Month                      1-12
2101(R)       Target Date stamp                         Day of the Month           1-31
2102(R)       Target Date stamp                         Year                       0-99
2103(R)       Target Time stamp                         Hours                      0-23
2104(R)       Target Time stamp                         Minutes                    0-59
2105(R)       Target Time stamp                         Seconds                    0-59
2106(R)       Target Time stamp                         Milliseconds               0-999
2107(R)       Date Time stamp                           Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                    None

*        *      *      STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
X1PT     X51QT  X51NT  X50PT  X50H   X50QT  X50NT  X50NH  X51PP  X51QP  X51NP  X50PP  *      X50QP  X50NP  *
X51PR    X51QR  X51NR  *      *      *      *      *      *      Y      INST   A      B      C      Q      N
Y86TR    YRTRP  Y62T   Y50PP  *      *      Y50NP  *      *      *      *      *      *      *      *      *
*        *      *      *      *      *      *      *      *      XIN    YIN    ALARM  XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=FDR/OC1; Y=TMR/OFF) (Binary Format):

```
2100(R)       Target Date stamp                         Month                      1-12
2101(R)       Target Date stamp                         Day of the Month           1-31
2102(R)       Target Date stamp                         Year                       0-99
2103(R)       Target Time stamp                         Hours                      0-23
2104(R)       Target Time stamp                         Minutes                    0-59
2105(R)       Target Time stamp                         Seconds                    0-59
2106(R)       Target Time stamp                         Milliseconds               0-999
2107(R)       Target Date stamp                         Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                    None

*        *      *      STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
X51PT    X51QT  X51NT  X50PT  X50H   X50QT  X50NT  X50NH  X51PP  X51QP  X51NP  X50PP  *      X50QP  X50NP  *
X51PR    X51QR  X51NR  *      *      *      *      *      *      Y      INST   A      B      C      Q      N
*        *      *      *      *      *      *      *      *      *      *      *      *      *      *      *
*        *      *      *      *      *      *      *      *      XIN    YIN    ALARM  XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=MOT; Y=MOT) (Binary Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

*	*	*	STSET	*	*	*	*	X	*	INST	A	B	C	Q	N
X49	*	XSTL	X50PT	X50H	X50QT	X50NT	X50NH	X49A	X50L	X50ST	X50PP	XLLOSS	X50QP	X50NP	XLJAM
*	*	*	*	*	*	*	*	*	Y	INST	A	B	C	Q	N
Y49	*	YSTL	Y50PT	Y50H	Y50QT	Y50NT	Y50NH	Y49A	Y50L	Y50ST	Y50PP	YLLOSS	Y50QP	YTPNP	YLJAM
*	*	*	*	*	*	*	*	*	XIN	YIN	ALARM	XOUT1	XOUT2	YOUT1	YOUT2

For SEL-501 (APP X=MOT; Y=BFR) (Binary Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

*	*	*	STSET	*	*	*	*	X	*	INST	A	B	C	Q	N
X49	*	XSTL	X50PT	X50H	X50QT	X50NT	X50NH	X49A	X50L	X50ST	X50PP	XLLOSS	X50QP	X50NP	XLJAM
*	*	*	*	*	*	*		*	Y	INST	A	B	C	Q	N
Y86TR	YRTRP	Y62T	Y50PP	*	*	Y50NP	Y*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	XIN	YIN	ALARM	XOUT1	XOUT2	YOUT1	YOUT2

For SEL-501 (APP X=MOT; Y=TMR/OFF) (Binary Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

*	*	*	STSET	*	*	*	*	X	*	INST	A	B	C	Q	N
X49	*	XSTL	X50PT	X50H	X50QT	X50NT	X50NH	X49A	X50L	X50ST	X50PP	XLLOSS	X50QP	X50NP	XLJAM
*	*	*	*	*	*	*		*	Y	INST	A	B	C	Q	N
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	XIN	YIN	ALARM	XOUT1	XOUT2	YOUT1	YOUT2

For SEL-501 (APP X=MOT; Y=FDR/OC1) (Binary Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2108-2112(R)	Target	None	

```
*        *      *      STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
X49      *      XSTL  X50PT   X50H   X50QT  X50NT  X50NH  X49A   X50L   X50ST X50PP   XLLOSS X50QP  X50NP  XLJAM
*        *      *     *       *      *      *             *      Y      INST  A       B      C      Q      N
Y51PT    Y51QT  Y51NT Y50PT   Y50H   Y50QT  Y50NT  Y50NH  Y51PP  Y51QP  Y51NP Y50PP   *      Y50QP  Y50NP  *
Y51PR    Y51QR  Y51NR *       *      *      *      *      *      XIN    YIN   ALARM   XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=BFR; Y=MOT) (Binary Format):

```
2100(R)       Target Date stamp                        Month                      1-12
2101(R)       Target Date stamp                        Day of the Month           1-31
2102(R)       Target Date stamp                        Year                       0-99
2103(R)       Target Time stamp                        Hours                      0-23
2104(R)       Target Time stamp                        Minutes                    0-59
2105(R)       Target Time stamp                        Seconds                    0-59
2106(R)       Target Time stamp                        Milliseconds               0-999
2107(R)       Target Date stamp                        Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                   None
```

```
*        *      *      STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
X86TR    XRTRP  X62T  X50PP   *      *      X50NP  *      *      *      *     *       *      *      *      *
*        *      *     *       *      *      *      *      *      Y      INST  A       B      C      Q      N
Y49      *      YSTL  Y50PT   Y50H   Y50QT  Y50NT  Y50NH  Y49A   Y50L   Y50ST Y50PP   YLLOSS Y50QP  YTPNP  YLJAM
*        *      *     *       *      *      *      *      *      XIN    YIN   ALARM   XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=BFR; Y=FDR/OC1) (Binary Format):

```
2100(R)       Target Date stamp                        Month                      1-12
2101(R)       Target Date stamp                        Day of the Month           1-31
2102(R)       Target Date stamp                        Year                       0-99
2103(R)       Target Time stamp                        Hours                      0-23
2104(R)       Target Time stamp                        Minutes                    0-59
2105(R)       Target Time stamp                        Seconds                    0-59
2106(R)       Target Time stamp                        Milliseconds               0-999
2107(R)       Target Date stamp                        Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                   None
```

```
*        *      *      STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
X86TR    XRTRP  X62T  X50PP   *      *      X50NP  *      *      *      *     *       *      *      *      *
*        *      *     *       *      *      *             *      Y      INST  A       B      C      Q      N
Y50PT    Y51QT  Y51NT Y50PT   Y50H   Y50QT  Y50NT  Y50NH  Y50PP  Y51QP  Y51NP Y50PP   *      Y50QP  Y50NP  *
Y50PR    Y51QR  Y51NR *       *      *      *      *      *      XIN    YIN   ALARM   XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=BFR; Y=BFR) (Binary Format):

```
2100(R)       Target Date stamp                        Month                      1-12
2101(R)       Target Date stamp                        Day of the Month           1-31
2102(R)       Target Date stamp                        Year                       0-99
2103(R)       Target Time stamp                        Hours                      0-23
2104(R)       Target Time stamp                        Minutes                    0-59
2105(R)       Target Time stamp                        Seconds                    0-59
2106(R)       Target Time stamp                        Milliseconds               0-999
2107(R)       Target Date stamp                        Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R)  Target                                   None
```

```
*        *      *      STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
X86TR    XRTRP  X62T  X50PP   *      *      X50NP  *      *      *      *     *       *      *      *      *
*        *      *     *       *      *      *      *      *      Y      INST  A       B      C      Q      N
Y86TR    YRTRP  Y62T  Y50PP   *      *      Y50NP  *      *      *      *     *       *      *      *      *
*        *      *     *       *      *      *      *      *      XIN    YIN   ALARM   XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=BFR; Y=TMR/OFF) (Binary Format):

```
2100(R)       Target Date stamp                        Month                      1-12
2101(R)       Target Date stamp                        Day of the Month           1-31
2102(R)       Target Date stamp                        Year                       0-99
2103(R)       Target Time stamp                        Hours                      0-23
2104(R)       Target Time stamp                        Minutes                    0-59
2105(R)       Target Time stamp                        Seconds                    0-59
```

```
2106(R)      Target Time stamp                     Milliseconds               0-999
2107(R)      Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                None

*       *      *     STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
X86TR   XRTRP  X62T  X50PP  *      *      X50NP  *      *      *      *      *      *      *      *      *
*       *      *     *      *      *      *      *      *      Y      INST   A      B      C      Q      N
*       *      *     *      *      *      *      *      *      *      *      *      *      *      *      *
*       *      *     *      *      *      *      *      *      XIN    YIN    ALARM  XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=TMR/OFF; Y=FDR/OC1) (Binary Format):

```
2100(R)      Target Date stamp                     Month                      1-12
2101(R)      Target Date stamp                     Day of the Month           1-31
2102(R)      Target Date stamp                     Year                       0-99
2103(R)      Target Time stamp                     Hours                      0-23
2104(R)      Target Time stamp                     Minutes                    0-59
2105(R)      Target Time stamp                     Seconds                    0-59
2106(R)      Target Time stamp                     Milliseconds               0-999
2107(R)      Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                None

*       *      *     STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
*       *      *     *      *      *      *      *      *      *      *      *      *      *      *      *
*       *      *     *      *      *      *      *      *      Y      INST   A      B      C      Q      N
Y51PT   Y51QT  Y51NT Y50PT  Y50H   Y50QT  Y50NT  Y50NH  Y51PP  Y51QP  Y51NP  Y50PP  *      Y50QP  Y50NP  *
Y51PR   Y51QR  Y51NR *      *      *      *      *      *      XIN    YIN    ALARM  XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=TMR/OFF; Y=MOT) (Binary Format):

```
2100(R)      Target Date stamp                     Month                      1-12
2101(R)      Target Date stamp                     Day of the Month           1-31
2102(R)      Target Date stamp                     Year                       0-99
2103(R)      Target Time stamp                     Hours                      0-23
2104(R)      Target Time stamp                     Minutes                    0-59
2105(R)      Target Time stamp                     Seconds                    0-59
2106(R)      Target Time stamp                     Milliseconds               0-999
2107(R)      Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                None

*       *      *     STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
*       *      *     *      *      *      *      *      *      *      *      *      *      *      *      *
*       *      *     *      *      *      *      *      *      Y      INST   A      B      C      Q      N
Y49     *      YSTL  Y50PT  Y50H   Y50QT  Y50NT  Y50NH  Y59A   Y50L   Y50ST  Y50PP  YLLOSS Y50QP  Y50NP  YLJAM
*       *      *     *      *      *      *      *      *      XIN    YIN    ALARM  XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=TMR/OFF; Y=BFR) (Binary Format):

```
2100(R)      Target Date stamp                     Month                      1-12
2101(R)      Target Date stamp                     Day of the Month           1-31
2102(R)      Target Date stamp                     Year                       0-99
2103(R)      Target Time stamp                     Hours                      0-23
2104(R)      Target Time stamp                     Minutes                    0-59
2105(R)      Target Time stamp                     Seconds                    0-59
2106(R)      Target Time stamp                     Milliseconds               0-999
2107(R)      Target Date stamp                     Day of the week (Sunday-0, Monday-1, ...) 0-6
2108-2112(R) Target                                None

*       *      *     STSET  *      *      *      *      X      *      INST   A      B      C      Q      N
*       *      *     *      *      *      *      *      *      *      *      *      *      *      *      *
*       *      *     *      *      *      *      *      *      Y      INST   A      B      C      Q      N
Y86TR   YRTRP  Y62T  Y50PP  *      *      Y50NP  *      *      *      *      *      *      *      *      *
*       *      *     *      *      *      *      *      *      XIN    YIN    ALARM  XOUT1  XOUT2  YOUT1  YOUT2
```

For SEL-501 (APP X=TMR/OFF; Y=TMR/OFF) (Binary Format):

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2112(R)	Target	None	

*	*	*	STSET	*	*	*	*	X	*	INST	A	B	C	Q	N
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	Y	INST	A	B	C	Q	N
*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	XIN	YIN	ALARM	XOUT1	XOUT2	YOUT1	YOUT2

For SEL-551:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2114(R)	Target	None	

*	*	*	STSET	*	*	*	*	EN	INST	A	B	C	N	RS	LO
51P1	51P2	51N1	51G1	51P1T	51P2T	51N1T	51GIT	51Q1	51Q2	51Q1T	51Q2T	50P1	50P2	50P3	50P4
50P5	50P6	50N1	50N2	50G1	50G2	50Q1	50Q2	50A	50B	50C	IN1	IN2	OC	CC	CF
LB1	LB2	LB3	LB4	LB5	LB6	LB7	LB8	RB1	RB2	RB3	RB4	RB5	RB6	RB7	RB8
SV1	SV2	SV3	SV4	SV5	SV6	SV7	SV8	SV9	SV10	SV11	SV12	SV13	SV14	*	*
79RS	79CY	79LO	SHO	SH1	SH2	SH3	SH4	TRIP	CLOSE	51P1R	51P2R	51N1R	51G1R	51Q1R	51Q2R
SV5T	SV6T	SF7T	SV8T	SV9T	SV10T	SV11T	SV12T	SV13T	SV14T	*	ALARM	OUT1	OUT2	OUT3	OUT4

For SEL-587:

2100(R)	Target Date stamp	Month	1-12
2101(R)	Target Date stamp	Day of the Month	1-31
2102(R)	Target Date stamp	Year	0-99
2103(R)	Target Time stamp	Hours	0-23
2104(R)	Target Time stamp	Minutes	0-59
2105(R)	Target Time stamp	Seconds	0-59
2106(R)	Target Time stamp	Milliseconds	0-999
2107(R)	Target Date stamp	Day of the week (Sunday-0, Monday-1, ...) 0-6	
2108-2114(R)	Target	None	

*	*	*	STSET	STFAIL	STWARN	STEVE	STP	EN	87	50	51	A	B	C	N
51P1P	51Q1P	51N1P	51P1T	51Q1T	51N1T	*	RB1	50P1P	50Q1P	50N1P	50P1T	50Q1T	50N1T	50P1H	50N1H
51P2P	51Q2P	51N2P	51P2T	51Q2T	51N2T	*	RB2	50P2P	50Q2P	50N2P	50P2T	50Q2T	50N2T	50P2H	50N2H
87U1	87U2	87U3	87U	87R1	87R2	87R3	87R	2HB1	2HB2	2HB3	5HB1	5HB2	5HB3	87BL	RB3
TH5P	TH5T	PDEM	NDEM	QDEM	TRP1	TRP2	TRP3	OC1	OC2	CC1	CC2	IN1	IN2	52A1	52A2
MTU3	MTU2	MTU1	MER	YT	Y	XT	X	51P1R	51Q1R	51N1R	51P2R	51Q2R	51N2R	*	RB4
*	*	*	ALARM	OUT1	OUT2	OUT3	OUT4	*	*	*	*	*	*	*	*

Table 7.8: Register Maps for Breaker Data, Floating-Point Type

The first eight registers of Modbus breaker data are the collection date and time stamp.

For SEL-151/251,-1,-2,-3; SEL-151C/251C,-1,-2,-3; SEL-151CD/251CD,-1,-3; SEL-151D/251D,-1,-3:

Reg.#	Description	Units	Range
2200(R)	Breaker Date stamp	Month	1-12
2201(R)	Breaker Date stamp	Day of the Month	1-31
2202(R)	Breaker Date stamp	Year	0-99
2203(R)	Breaker Time stamp	Hours	0-23
2204(R)	Breaker Time stamp	Minutes	0-59
2205(R)	Breaker Time stamp	Seconds	0-59
2206(R)	Breaker Time stamp	Milliseconds	0-999
2207(R)	Breaker Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208(R)	Rly Trips	None	Integer
2209(R)	Breaker Last reset Date stamp	Month	1-12
2210(R)	Breaker Last reset Date stamp	Day of the Month	1-31
2211(R)	Breaker Last reset Date stamp	Year	0-99
2212(R)	Breaker Last reset Time stamp	Hours	0-23
2213(R)	Breaker Last reset Time stamp	Minutes	0-59
2214(R)	Breaker Last reset Time stamp	Seconds	0-59
2215-2216(R)	IA	kA	IEEE Float
2217-2218(R)	IB	kA	IEEE Float
2219-2220(R)	IC	kA	IEEE Float
2221(R)	Ext Trips	None	Integer
2222(R)	Breaker Last reset Date stamp	Month	1-12
2223(R)	Breaker Last reset Date stamp	Day of the Month	1-31
2224(R)	Breaker Last reset Date stamp	Year	0-99
2225(R)	Breaker Last reset Time stamp	Hours	0-23
2226(R)	Breaker Last reset Time stamp	Minutes	0-59
2227(R)	Breaker Last reset Time stamp	Seconds	0-59
2228-2229(R)	IA	kA	IEEE Float
2230-2231(R)	IB	kA	IEEE Float
2232-2233(R)	IC	kA	IEEE Float

For SEL-279:

Reg.#	Description	Units	Range
2200(R)	Breaker Date stamp	Month	1-12
2201(R)	Breaker Date stamp	Day of the Month	1-31
2202(R)	Breaker Date stamp	Year	0-99
2203(R)	Breaker Time stamp	Hours	0-23
2204(R)	Breaker Time stamp	Minutes	0-59
2205(R)	Breaker Time stamp	Seconds	0-59
2206(R)	Breaker Time stamp	Milliseconds	0-999
2207(R)	Breaker Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208(R)	Rly Closures	None	Integer
2209(R)	Breaker Last reset Date stamp	Month	1-12
2210(R)	Breaker Last reset Date stamp	Day of the Month	1-31
2211(R)	Breaker Last reset Date stamp	Year	0-99
2212(R)	Breaker Last reset Time stamp	Hours	0-23
2213(R)	Breaker Last reset Time stamp	Minutes	0-59
2214(R)	Breaker Last reset Time stamp	Seconds	0-59
2215(R)	Ext Closures	None	Integer
2216(R)	Breaker Last reset Date stamp	Month	1-12
2217(R)	Breaker Last reset Date stamp	Day of the Month	1-31
2218(R)	Breaker Last reset Date stamp	Year	0-99
2219(R)	Breaker Last reset Time stamp	Hours	0-23
2220(R)	Breaker Last reset Time stamp	Minutes	0-59
2221(R)	Breaker Last reset Time stamp	Seconds	0-59

For SEL-352:

2200(R)	Breaker 2030 Date stamp	Month	1-12
2201(R)	Breaker 2030 Date stamp	Day of the Month	1-31
2202(R)	Breaker 2030 Date stamp	Year	0-99
2203(R)	Breaker 2030 Time stamp	Hours	0-23
2204(R)	Breaker 2030 Time stamp	Minutes	0-59
2205(R)	Breaker 2030 Time stamp	Seconds	0-59
2206(R)	Breaker 2030 Time stamp	Milliseconds	0-999
2207(R)	Breaker 2030 Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208-2225(R)	FID String	None	36 char
2226(R)	Breaker Date stamp	Month	1-12
2227(R)	Breaker Date stamp	Day of the Month	1-31
2228(R)	Breaker Date stamp	Year	0-99
2229(R)	Breaker Time stamp	Hours	0-23
2230(R)	Breaker Time stamp	Minutes	0-59
2231(R)	Breaker Time stamp	Seconds	0-59
2232(R)	Breaker Time stamp	Milliseconds	0-999
2233(R)	Breaker Monitor Cleared Date stamp	Month	1-12
2234(R)	Breaker Monitor Cleared Date stamp	Day of the Month	1-31
2235(R)	Breaker Monitor Cleared Date stamp	Year	0-99
2236-2237(R)	Trip A Number of Operations	None	IEEE float
2238-2239(R)	Trip A Average Electrical Time	Milliseconds	IEEE float
2240-2241(R)	Trip A Average Mechanical Time	Milliseconds	IEEE float
2242-2243(R)	Trip A Last Electrical Time	Milliseconds	IEEE float
2244-2245(R)	Trip A Last Mechanical Time	Milliseconds	IEEE float
2246-2247(R)	Trip A Total Energy	MJoules	IEEE float
2248-2249(R)	Trip A Total Current	Amps	IEEE float
2250-2251(R)	Trip B Number of Operations	None	IEEE float
.	.	.	.
.	.	.	.
.	.	.	.
2276-2277(R)	Trip C Total Current	Amps	IEEE float
2278-2279(R)	Close A Number of Operations	None	IEEE float
2280-2281(R)	Close A Average Electrical Time	Milliseconds	IEEE float
2282-2283(R)	Close A Average Mechanical Time	Milliseconds	IEEE float
2284-2285(R)	Close A Last Electrical Time	Milliseconds	IEEE float
2286-2287(R)	Close A Last Mechanical Time	Milliseconds	IEEE float
2288-2289(R)	Close A Total Energy	MJoules	IEEE float
2290-2291(R)	Close A Total Current	Amps	IEEE float
2292-2293(R)	Close B Number of Operations	None	IEEE float
2294-2295(R)	Close B Average Electrical Time	Milliseconds	IEEE float
2296-2297(R)	Close B Average Mechanical Time	Milliseconds	IEEE float
2298-2299(R)	Close B Last Electrical Time	Milliseconds	IEEE float

(Remaining data cannot be accessed through Modbus using Float map.)

For SEL-387:

2200(R)	Breaker Date stamp	Month	1-12
2201(R)	Breaker Date stamp	Day of the Month	1-31
2202(R)	Breaker Date stamp	Year	0-99
2203(R)	Breaker Time stamp	Hours	0-23
2204(R)	Breaker Time stamp	Minutes	0-59
2205(R)	Breaker Time stamp	Seconds	0-59
2206(R)	Breaker Time stamp	Milliseconds	0-999
2207(R)	Breaker Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208-2225(R)	Relay FID	None	36 char
2226(R)	Breaker Date stamp	Month	1-12
2227(R)	Breaker Date stamp	Day of the Month	1-31
2228(R)	Breaker Date stamp	Year	1980-2080
2229(R)	Breaker Time stamp	Hours	0-23
2230(R)	Breaker Time stamp	Minutes	0-59
2231(R)	Breaker Time stamp	Seconds	0-59
2232(R)	Breaker Time stamp	Milliseconds	0-999
2233(R)	Breaker Number	None	1-4
2234(R)	Internal Trip Count	None	0-32767
2235-2236(R)	IA Internal	kA, primary	IEEE float
2237-2238(R)	IB Internal	kA, primary	IEEE float

2239-2240(R)	IC Internal	kA, primary	IEEE float
2241(R)	External Trip Count	None	0-32767
2242-2243(R)	IA External	kA, primary	IEEE float
2244-2245(R)	IB External	kA, primary	IEEE float
2246-2247(R)	IC External	kA, primary	IEEE float
2248(R)	Pole1 Wear	percent	0-100
2249(R)	Pole2 Wear	percent	0-100
2250(R)	Pole3 Wear	percent	0-100
2251(R)	Last Reset Date Stamp	Month	1-12
2252(R)	Last Reset Date Stamp	Day of the Month	1-31
2253(R)	Last Reset Date Stamp	Year	1980-2080
2254(R)	Last Reset Time Stamp	Hours	0-23
2255(R)	Last Reset Time Stamp	Minutes	0-59
2256(R)	Last Reset Time Stamp	Seconds	0-59
2257(R)	Last Reset Time Stamp	Milliseconds	0-999

For SEL-501,-1,-2:

2200(R)	Breaker Date stamp	Month	1-12
2201(R)	Breaker Date stamp	Day of the Month	1-31
2202(R)	Breaker Date stamp	Year	0-99
2203(R)	Breaker Time stamp	Hours	0-23
2204(R)	Breaker Time stamp	Minutes	0-59
2205(R)	Breaker Time stamp	Seconds	0-59
2206(R)	Breaker Time stamp	Milliseconds	0-999
2207(R)	Breaker Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208(R)	Internal Trips X	None	Integer
2209-2210(R)	IA	kA	IEEE float
2211-2212(R)	IB	kA	IEEE float
2213-2214(R)	IC	kA	IEEE float
2215(R)	External Trips X	None	Integer
2216-2217(R)	IA	kA	IEEE float
2218-2219(R)	IB	kA	IEEE float
2220-2221(R)	IC	kA	IEEE float
2222(R)	Internal Trips Y	None	Integer
2223-2224(R)	IA	kA	IEEE float
2225-2226(R)	IB	kA	IEEE float
2227-2228(R)	IC	kA	IEEE float
2229(R)	External Trips Y	None	Integer
2230-2231(R)	IA	kA	IEEE float
2232-2233(R)	IB	kA	IEEE float
2234-2235(R)	IC	kA	IEEE float

Table 7.9: Register Maps for Breaker Data, Integer Type

The first eight registers of Modbus breaker data are the collection date and time stamp.

Reg.#	Description	Units	Range
For SEL-151/251,-1,-2,-3; SEL-151C/251C,-1,-2,-3; SEL-151CD/251CD,-1,-3; SEL-151D/251D,-1,-3:			
2200(R)	Breaker Date stamp	Month	1-12
2201(R)	Breaker Date stamp	Day of the Month	1-31
2202(R)	Breaker Date stamp	Year	0-99
2203(R)	Breaker Time stamp	Hours	0-23
2204(R)	Breaker Time stamp	Minutes	0-59
2205(R)	Breaker Time stamp	Seconds	0-59
2206(R)	Breaker Time stamp	Milliseconds	0-999
2207(R)	Breaker Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208(R)	Rly Trips	None	Integer
2209(R)	Breaker Last reset Date stamp	Month	1-12
2210(R)	Breaker Last reset Date stamp	Day of the Month	1-31
2211(R)	Breaker Last reset Date stamp	Year	0-99
2212(R)	Breaker Last reset Time stamp	Hours	0-23
2213(R)	Breaker Last reset Time stamp	Minutes	0-59
2214(R)	Breaker Last reset Time stamp	Seconds	0-59

2215(R)	IA	kA/10, primary	0.00-3276.7 kA, pri
2216(R)	IB	kA/10, primary	0.00-3276.7 kA, pri
2217(R)	IC	kA/10, primary	0.00-3276.7 kA, pri
2218(R)	Ext Trips	None	Integer
2219(R)	Breaker Last reset Date stamp	Month	1-12
2220(R)	Breaker Last reset Date stamp	Day of the Month	1-31
2221(R)	Breaker Last reset Date stamp	Year	0-99
2222(R)	Breaker Last reset Time stamp	Hours	0-23
2223(R)	Breaker Last reset Time stamp	Minutes	0-59
2224(R)	Breaker Last reset Time stamp	Seconds	0-59
2225(R)	IA	kA/10, primary	0.00-3276.7 kA, pri
2226(R)	IB	kA/10, primary	0.00-3276.7 kA, pri
2227(R)	IC	kA/10, primary	0.00-3276.7 kA, pri

For SEL-279:

2200(R)	Breaker Date stamp	Month	1-12
2201(R)	Breaker Date stamp	Day of the Month	1-31
2202(R)	Breaker Date stamp	Year	0-99
2203(R)	Breaker Time stamp	Hours	0-23
2204(R)	Breaker Time stamp	Minutes	0-59
2205(R)	Breaker Time stamp	Seconds	0-59
2206(R)	Breaker Time stamp	Milliseconds	0-999
2207(R)	Breaker Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208(R)	Rly Closures	None	Integer
2209(R)	Breaker Last reset Date stamp	Month	1-12
2210(R)	Breaker Last reset Date stamp	Day of the Month	1-31
2211(R)	Breaker Last reset Date stamp	Year	0-99
2212(R)	Breaker Last reset Time stamp	Hours	0-23
2213(R)	Breaker Last reset Time stamp	Minutes	0-59
2214(R)	Breaker Last reset Time stamp	Seconds	0-59
2215(R)	Ext Closures	None	Integer
2216(R)	Breaker Last reset Date stamp	Month	1-12
2217(R)	Breaker Last reset Date stamp	Day of the Month	1-31
2218(R)	Breaker Last reset Date stamp	Year	0-99
2219(R)	Breaker Last reset Time stamp	Hours	0-23
2220(R)	Breaker Last reset Time stamp	Minutes	0-59
2221(R)	Breaker Last reset Time stamp	Seconds	0-59

For SEL-352:

2200(R)	Breaker 2030 Date stamp	Month	1-12
2201(R)	Breaker 2030 Date stamp	Day of the Month	1-31
2202(R)	Breaker 2030 Date stamp	Year	0-99
2203(R)	Breaker 2030 Time stamp	Hours	0-23
2204(R)	Breaker 2030 Time stamp	Minutes	0-59
2205(R)	Breaker 2030 Time stamp	Seconds	0-59
2206(R)	Breaker 2030 Time stamp	Milliseconds	0-999
2207(R)	Breaker 2030 Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208-2225(R)	FID String	None	36 char
2226(R)	Breaker Date stamp	Month	1-12
2227(R)	Breaker Date stamp	Day of the Month	1-31
2228(R)	Breaker Date stamp	Year	0-99
2229(R)	Breaker Time stamp	Hours	0-23
2230(R)	Breaker Time stamp	Minutes	0-59
2231(R)	Breaker Time stamp	Seconds	0-59
2232(R)	Breaker Time stamp	Milliseconds	0-999
2233(R)	Breaker Monitor Cleared Date stamp	Month	1-12
2234(R)	Breaker Monitor Cleared Date stamp	Day of the Month	1-31
2235(R)	Breaker Monitor Cleared Date stamp	Year	0-99
2236(R)	Trip A Number of Operations	None	Integer
2237(R)	Trip A Average Electrical Time	Milliseconds	Integer
2238(R)	Trip A Average Mechanical Time	Milliseconds	Integer
2239(R)	Trip A Last Electrical Time	Milliseconds	Integer
2240(R)	Trip A Last Mechanical Time	Milliseconds	Integer
2241(R)	Trip A Total Energy	MJoules	0-32767 MJ
2242(R)	Trip A Total Current	Amps	0-32767 A, pri
2243(R)	Trip B Number of Operations	None	Integer

.	.	.	.
.	.	.	.
.	.	.	.
2256(R)	Trip C Total Current	Amps	0-32767 A, pri
2257(R)	Close A Number of Operations	None	Integer
2258(R)	Close A Average Electrical Time	Milliseconds	Integer
2259(R)	Close A Average Mechanical Time	Milliseconds	Integer
2260(R)	Close A Last Electrical Time	Milliseconds	Integer
2261(R)	Close A Last Mechanical Time	Milliseconds	Integer
2262(R)	Close A Total Energy	MJoules	0-32767 MJ
2263(R)	Close A Total Current	Amps	0-32767 A, pri
2264(R)	Close B Number of Operations	None	Integer
.	.	.	.
.	.	.	.
.	.	.	.
2277(R)	Close C Total Current	Amps	0-32767 A, pri
2278-2283(R)	Number of Operations Label	None	12 char
2284-2289(R)	Avg Electrical Time Label	None	12 char
2290-2295(R)	Avg Mechanical Time Label	None	12 char
2296-2299(R)	Last Electrical Time Label	None	12 char

(Remaining data cannot be accessed through Modbus.)

For SEL-387:

2200(R)	Breaker Date stamp	Month	1-12
2201(R)	Breaker Date stamp	Day of the Month	1-31
2202(R)	Breaker Date stamp	Year	0-99
2203(R)	Breaker Time stamp	Hours	0-23
2204(R)	Breaker Time stamp	Minutes	0-59
2205(R)	Breaker Time stamp	Seconds	0-59
2206(R)	Breaker Time stamp	Milliseconds	0-999
2207(R)	Breaker Date stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208-2225(R)	Relay FID	None	36 char
2226(R)	Breaker Date stamp	Month	1-12
2227(R)	Breaker Date stamp	Day of the Month	1-31
2228(R)	Breaker Date stamp	Year	1980-2080
2229(R)	Breaker Time stamp	Hours	0-23
2230(R)	Breaker Time stamp	Minutes	0-59
2231(R)	Breaker Time stamp	Seconds	0-59
2232(R)	Breaker Time stamp	Milliseconds	0-999
2233(R)	Breaker Number	None	1-4
2234(R)	Internal Trip Count	None	0-32767
2235(R)	IA Internal	kA/10, primary	0-3276.7 kA, pri
2236(R)	IB Internal	kA/10, primary	0-3276.7 kA, pri
2237(R)	IC Internal	kA/10, primary	0-3276.7 kA, pri
2238(R)	External Trip Count	None	0-32767
2239(R)	IA External	kA/10, primary	0-3276.7 kA, pri
2240(R)	IB External	kA/10, primary	0-3276.7 kA, pri
2241(R)	IC External	kA/10, primary	0-3276.7 kA, pri
2242(R)	Pole1 Wear	percent	0-100
2243(R)	Pole2 Wear	percent	0-100
2244(R)	Pole3 Wear	percent	0-100
2245(R)	Last Reset Date Stamp	Month	1-12
2246(R)	Last Reset Date Stamp	Day of the Month	1-31
2247(R)	Last Reset Date Stamp	Year	1980-2080
2248(R)	Last Reset Time Stamp	Hours	0-23
2249(R)	Last Reset Time Stamp	Minutes	0-59
2250(R)	Last Reset Time Stamp	Seconds	0-59
2251(R)	Last Reset Time Stamp	Milliseconds	0-999

For SEL-501,-1,-2:

2200(R)	Breaker Date stamp	Month	1-12
2201(R)	Breaker Date stamp	Day of the Month	1-31
2202(R)	Breaker Date stamp	Year	0-99
2203(R)	Breaker Time stamp	Hours	0-23
2204(R)	Breaker Time stamp	Minutes	0-59
2205(R)	Breaker Time stamp	Seconds	0-59

2206(R)	Breaker Time stamp	Milliseconds	0-999
2207(R)	Breaker Time stamp	Day of the week (Sunday-0, Monday-1, ...)	0-6
2208(R)	Internal Trips X	None	Integer
2209(R)	IA	kA/10, primary	0.00-3276.7 kA, pri
2210(R)	IB	kA/10, primary	0.00-3276.7 kA, pri
2211(R)	IC	kA/10, primary	0.00-3276.7 kA, pri
2212(R)	External Trips X	None	Integer
2213(R)	IA	kA/10, primary	0.00-3276.7 kA, pri
2214(R)	IB	kA/10, primary	0.00-3276.7 kA, pri
2215(R)	IC	kA/10, primary	0.00-3276.7 kA, pri
2216(R)	Internal Trips Y	None	Integer
2217(R)	IA	kA/10, primary	0.00-3276.7 kA, pri
2218(R)	IB	kA/10, primary	0.00-3276.7 kA, pri
2219(R)	IC	kA/10, primary	0.00-3276.7 kA, pri
2220(R)	External Trips Y	None	Integer
2221(R)	IA	kA/10, primary	0.00-3276.7 kA, pri
2222(R)	IB	kA/10, primary	0.00-3276.7 kA, pri
2223(R)	IC	kA/10, primary	0.00-3276.7 kA, pri

Table 7.10: Register Map for User Data

Reg.#	Description	Units	Range
2400(R)	First User Register	---	---
.	.	.	.
.	.	.	.
.	.	.	.
4446(R)	Last User Register	---	---

Note: The actual number of user region registers available depends on the SET A USER setting on the port.

DISTRIBUTED NETWORK PROTOCOL (DNP) V3.00

Overview

The SEL-2030 supports DNP V3.00 Level 2 protocol on Port 16. It can be used for data access and for control. For a complete description of this protocol refer to the *DNP Basic Four Documentation Set* and the *DNP V3.00 Subset Definition*, both of which are available from the DNP User's Group.

Installation

If you are using the SEL-2030 in a point-to-point DNP connection, simply connect Port 16 to your DNP master. If you are using the SEL-2030 in a multidrop configuration, you will need to connect a transceiver to Port 16. If the transceiver has a Carrier Detect signal, connect it to Port 16's CTS input. Otherwise connect RTS to CTS at Port 16. If the transceiver requires a signal to enable its transmitter, the RTS output on Port 16 can be used for that function.

Configuration

Section 3: Settings lists all of the DNP related settings and their functions. In order to optimally configure the SEL-2030 for DNP operation, you will need to understand the basics of DNP and the capabilities of your DNP master.

Data-Link Operation

There are two important decisions you need to make about your data-link layer operation. One is how you want to handle data-link confirmation. The other is how you want to handle data-link access.

If you have a highly reliable communication link, you can disable data-link confirmation altogether, which significantly reduces communications overhead. Otherwise, you will need to enable confirmation, determine how many retries you want to allow, and what the data-link time-out should be. The noisier your communications channel is, the more likely it is that a message will be corrupted. Thus, you should set your number of retries higher on noisy channels. Set the data-link time-out long enough to allow for the worst-case response of your master plus transmission time.

When the SEL-2030 decides to transmit on the DNP link, it has to wait if the physical connection is in use. The SEL-2030 monitors physical connections by using both its CTS input (treated as a carrier detect) and by monitoring character receipt. Once the physical link goes idle, as indicated by CTS being deasserted and no characters being received, the SEL-2030 will wait a configurable amount of time before beginning a transmission. This hold-off time will be a random time between the MIN_DELAY and MAX_DELAY setting values. This hold-off is random so multiple devices waiting to communicate on the network will not continually collide.

Data Access Method

Based on the capabilities of your system, you will need to determine how you want to retrieve data on your DNP connection. The following table summarizes the main options, from least to most efficient, and indicates the key related settings.

Table 7.11: Data Access Methods

Data Retrieval Method	Description	Relevant SEL-2030 Settings
Polled Static	The master polls for static (Class 0) data only.	Set CLASS = 0, Set UNSOL_REP = N.
Polled Report-by-Exception	The master polls frequently for event data and occasionally for static data.	Set CLASS to a non-zero value, Set UNSOL_REP = N.
Unsolicited Report-by-Exception	The slave devices send unsolicited event data to the master and the master occasionally sends integrity polls for static data.	Set CLASS to a non-zero value, Set UNSOL_REP = Y, Set NUM_EVENT and AGE_TX according to how often you want messages sent.
Quiescent	The master never polls and relies on unsolicited reports only.	Set CLASS to a non-zero value, Set UNSOL_REP = Y, Set NUM_EVENT and AGE_TX according to how often you want messages sent.

Device Profile

Device Profile Document

As required by the *DNP V3.00 Subset Definitions* document, below is the device profile.

DNP V3.00 **DEVICE PROFILE DOCUMENT** This document must be accompanied by a table having the following headings: Object Group / Request Function Codes / Response Function Codes Object Variation / Request Qualifiers / Response Qualifiers Object Name (optional)	
Vendor Name: **Schweitzer Engineering Laboratories, Inc.**	
Device Name: **SEL-2020/2030 Communications Processor**	
Highest DNP Level Supported: For Requests **Level 2** For Responses **Level 2**	Device Function: ☐ Master ☑ Slave
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table): Supports enabling and disabling of unsolicited reports on a class basis	
Maximum Data Link Frame Size (octets): Transmitted 292 Received (must be 292)	Maximum Application Fragment Size (octets): Transmitted 2048 (if >2048, must be configurable) Received 2048 (must be >= 249)
Maximum Data Link Retries: ☐ None ☐ Fixed at ________ ☑ Configurable, range 0 to 15	Maximum Application Layer Retries: ☑ None ☐ Configurable, range _____ to (Fixed is not permitted)
Requires Data Link Layer Confirmation: ☐ Never ☐ Always ☐ Sometimes If 'Sometimes', when? ________ ☑ Configurable If 'Configurable', how? by settings; see ***Section 3: Settings***	

Device Profile Document (continued)

Requires Application Layer Confirmation:

☐ Never
☐ Always (not recommended)
☑ When reporting Event Data (Slave devices only)
☐ When sending multifragment responses (Slave devices only)
☐ Sometimes If 'Sometimes', when? ____________________
☐ Configurable If 'Configurable', how? ____________________

Time-outs while waiting for:

Data Link Confirm	☐ None	☐ Fixed at ________	☐ Variable	☑ Configurable
Complete Appl. Fragment	☑ None	☐ Fixed at ________	☐ Variable	☐ Configurable
Application Confirm	☐ None	☐ Fixed at ________	☐ Variable	☑ Configurable
Complete Appl. Response	☑ None	☐ Fixed at ________	☐ Variable	☐ Configurable

Others ____________________

Attach explanation if 'Variable' or 'Configurable' was checked for any time out

Sends/Executes Control Operations:

WRITE Binary Outputs	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
SELECT/OPERATE	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE - NO ACK	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
Count > 1	☑ Never	☐ Always	☐ Sometimes	☐ Configurable
Pulse On	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
Pulse Off	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
Latch Off	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
Queue	☑ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☑ Never	☐ Always	☐ Sometimes	☐ Configurable

Attach explanation if 'Sometimes' or 'Configurable' was checked for any operation.

FILL OUT THE FOLLOWING ITEM FOR MASTER DEVICES ONLY:

Expects Binary Input Change Events:

☐ Either time-tagged or nontime-tagged for a single event
☐ Both time-tagged and nontime-tagged for a single event
☐ Configurable (attach explanation)

FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY

Reports Binary Input Change Events when no specific variation requested:

☐ Never
☐ Only time-tagged
☑ Only nontime-tagged
☐ Configurable to send both, one or the other (attach explanation)

Reports time-tagged Binary Input Change Events when no specific variation requested:

☑ Never
☐ Binary Input Change With Time
☐ Binary Input Change With Relative Time
☐ Configurable (attach explanation)

Device Profile Document (continued)

Sends Unsolicited Responses: ☐ Never ☑ Configurable (attach explanation) ☐ Only certain objects ☐ Sometimes (attach explanation) ☑ ENABLE/DISABLE UNSOLICITED Function codes supported	Sends Static Data in Unsolicited Responses: ☑ Never ☐ When Device Restarts ☐ When Status Flags Change No other options are permitted.
Default Counter Object/Variation: ☐ No Counters Reported ☐ Configurable (attach explanation) ☑ Default Object 20 ☐ Default Variation 6 ☐ Point-by-point list attached	Counters Roll Over at: ☐ No Counters Reported ☐ Configurable (attach explanation) ☑ 16 Bits ☐ 32 Bits ☐ Other Value ______________ ☐ Point-by-point list attached
Sends Multifragment Responses: ☐ Yes ☑ No	

In all cases within the device profile that an item is configurable, it is controlled by the SEL-2020/2030 settings. See the previous subsection and ***Section 3: Settings*** for more information.

Object Table

Table 7.12: Object Table

OBJECT			REQUEST (supported)		RESPONSE (may generate)	
Obj	**Var** *def	**Description**	**Func Codes (dec)**	**Qual Codes (hex)**	**Func Codes (dec)**	**Qual Codes (hex)**
1	0	Binary Input - All Variations	1	6		
1	1	Binary Input	1	0,1,6,7,8	129	0,1,7,8
1	2*	Binary Input with Status	1	0,1,6,7,8	129	0,1,7,8
2	0	Binary Input Change - All Variations	1	6,7,8		
2	1*	Binary Input Change without Time	1	6,7,8	129,130	17, 28
2	2	Binary Input Change with Time	1	6,7,8	129	17, 28
2	3	Binary Input Change with Relative Time	1	6,7,8	129	17, 28
10	0	Binary Output - All Variations	1	6		
10	1	Binary Output				
10	2*	Binary Output Status	1	0,1,6	129	0,1
12	0	Control Block - All Variations				
12	1	Control Relay Output Block	3, 4, 5, 6	17, 28	129	echo of request
12	2	Pattern Control Block				

OBJECT			REQUEST (supported)		RESPONSE (may generate)	
Obj	Var *def	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)
12	3	Pattern Mask				
20	0	Binary Counter - All Variations	1	6		
20	1	32-Bit Binary Counter				
20	2	16-Bit Binary Counter				
20	3	32-Bit Delta Counter				
20	4	16-Bit Delta Counter				
20	5	32-Bit Binary Counter without Flag	1	0,1,6,7,8	129	0,1,7,8
20	6*	16-Bit Binary Counter without Flag	1	0,1,6,7,8	129	0,1,7,8
20	7	32-Bit Delta Counter without Flag				
20	8	16-Bit Delta Counter without Flag				
21	0	Frozen Counter - All Variations				
21	1	32-Bit Frozen Counter				
21	2	16-Bit Frozen Counter				
21	3	32-Bit Frozen Delta Counter				
21	4	16-Bit Frozen Delta Counter				
21	5	32-Bit Frozen Counter with Time of Freeze				
21	6	16-Bit Frozen Counter with Time of Freeze				
21	7	32-Bit Frozen Delta Counter with Time of Freeze				
21	8	16-Bit Frozen Delta Counter with Time of Freeze				
21	9	32-Bit Frozen Counter without Flag				
21	10	16-Bit Frozen Counter without Flag				
21	11	32-Bit Frozen Delta Counter without Flag				
21	12	16-Bit Frozen Delta Counter without Flag				
22	0	Counter Change Event - All Variations	1	6		
22	1	32-Bit Counter Change Event without Time	1	6,7,8	129	17, 28
22	2*	16-Bit Counter Change Event without Time	1	6,7,8	129,130	17, 28
22	3	32-Bit Delta Counter Change Event without Time				
22	4	16-Bit Delta Counter Change Event without Time				
22	5	32-Bit Counter Change Event with Time	1	6,7,8	129	17,28
22	6	16-Bit Counter Change Event with Time	1	6,7,8	129	17,28
22	7	32-Bit Delta Counter Change Event with Time				
22	8	16-Bit Delta Counter Change Event with Time				
23	0	Frozen Counter Event - All Variations				

OBJECT			REQUEST (supported)		RESPONSE (may generate)	
Obj	Var *def	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)
23	1	32-Bit Frozen Counter Event without Time				
23	2	16-Bit Frozen Counter Event without Time				
23	3	32-Bit Frozen Delta Counter Event without Time				
23	4	16-Bit Frozen Delta Counter Event without Time				
23	5	32-Bit Frozen Counter Event with Time				
23	6	16-Bit Frozen Counter Event with Time				
23	7	32-Bit Frozen Delta Counter Event with Time				
23	8	16-Bit Frozen Delta Counter Event with Time				
30	0	Analog Input - All Variations	1	6		
30	1	32-Bit Analog Input	1	0,1,6,7,8	129	0,1,7,8
30	2	16-Bit Analog Input	1	0,1,6,7,8	129	0,1,7,8
30	3*	32-Bit Analog Input without Flag	1	0,1,6,7,8	129	0,1,7,8
30	4*	16-Bit Analog Input without Flag	1	0,1,6,7,8	129	0,1,7,8
31	0	Frozen Analog Input - All Variations				
31	1	32-Bit Frozen Analog Input				
31	2	16-Bit Frozen Analog Input				
31	3	32-Bit Frozen Analog Input with Time of Freeze				
31	4	16-Bit Frozen Analog Input with Time of Freeze				
31	5	32-Bit Frozen Analog Input without Flag				
31	6	16-Bit Frozen Analog Input without Flag				
32	0	Analog Change Event - All Variations	1	6,7,8		
32	1*	32-Bit Analog Change Event without Time	1	6,7,8	129,130	17,28
32	2*	16-Bit Analog Change Event without Time	1	6,7,8	129,130	17,28
32	3	32-Bit Analog Change Event with Time	1	6,7,8	129	17,28
32	4	16-Bit Analog Change Event with Time	1	6,7,8	129	17,28
33	0	Frozen Analog Event - All Variations				
33	1	32-Bit Frozen Analog Event without Time				
33	2	16-Bit Frozen Analog Event without Time				
33	3	32-Bit Frozen Analog Event with Time				
33	4	16-Bit Frozen Analog Event with Time				
40	0	Analog Output Status - All Variations	1	0,1,6		
40	1	32-Bit Analog Output Status	1	0,1,6,7,8	129	0,1,7,8
40	2*	16-Bit Analog Output Status	1	0,1,6,7,8	129	0,1,7,8
41	0	Analog Output Block - All Variations				
41	1	32-Bit Analog Output Block				

OBJECT			REQUEST (supported)		RESPONSE (may generate)	
Obj	Var *def	Description	Func Codes (dec)	Qual Codes (hex)	Func Codes (dec)	Qual Codes (hex)
41	2	16-Bit Analog Output Block	3,4,5,6	17,28	129	echo of reques t
50	0	Time and Date - All Variations				
50	1	Time and Date	2	07, quan-tity=1		
			1	07, quan-tity=1	129	07, quan-tity=1
50	2	Time and Date with Interval				
51	0	Time and Date CTO - All Variations				
51	1	Time and Date CTO				
51	2	Unsynchronized Time and Date CTO				07, quan-tity=1
52	0	Time Delay - All Variations				
52	1	Time Delay Coarse				
52	2	Time Delay Fine			129	07, quan-tity=1
60	0					
60	1	Class 0 Data	1	06		
60	2	Class 1 Data	1,20, 21	06,07,08		
60	3	Class 2 Data	1,20, 21	06,07,08		
60	4	Class 3 Data	1,20 ,21	06,07,08		
70	1	File Identifier				
80	1	Internal Indications	2	00 index=7		
81	1	Storage Object				
82	1	Device Profile				
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				
90	1	Application Identifier				
100	1	Short Floating Point				
100	2	Long Floating Point				
100	3	Extended Floating Point				
101	1	Small Packed Binary-Coded Decimal				
101	2	Medium Packed Binary-Coded Decimal				
101	3	Large Packed Binary-Coded Decimal				
		No object	13,14			

Object Definitions

Input Objects

Binary input, counter, and analog input objects are fully configurable by the user. To make data visible to DNP, it must be moved to the User Region on port 16 using the SET M process to establish what data is moved and how it is to be treated. See ***Section 3*: *Settings*** for more information on using SET M. To determine the DNP map once these settings are in place, use the DNPMAP command. See ***Section 2: Commands*** for more information on this command.

Since the only data visible to DNP is that moved by SET M, the event time stamps associated with changed data are the time stamps of when the data changed within the User Region. This may be significantly delayed from when the data item changed within the IED. Therefore, event time stamps should not be used for precise sequence-of-events purposes, but it may be used for approximate timing.

Output Objects

There are 1452 binary output objects supported, of which only the first 84 are readable. Within the control relay output block used to control the binary outputs, only the code field within the control code byte is used; all other fields are ignored. The Latch On/Off and Pulse On/Off codes can be used with each binary output object, however their meaning is specific to the item, as shown in the following Table 7.13. For more information on these bits, see ***Section 6: Database***. The first 8 bits are in the Global Region and the remaining ones are in the Local Region.

Table 7.13: Binary Object Operations

Relative		Operation Code			
Index	Bit Label	Latch On	Latch Off	Pulse On	Pulse Off
0-7	R1-R8	Set	Clear	Set	Clear
0-7	CMD1-CMD8	Set	Do nothing	Set	Do nothing
8-11	SBO1-SBO4	Set	Do nothing	Set	Do nothing
12-27	SBR1-SBR16	Set	Do nothing	Set	Do nothing
28-43	SRB1-SRB16	Set	Do nothing	Set	Do nothing
44-59	CBR1-CBR16	Set	Do nothing	Set	Do nothing
60-75	CRB1-CRB16	Set	Do nothing	Set	Do nothing

Table 7.14 lists the complete output object references. Use the relative indexes from Table 7.13 to determine specific bit locations. Objects 8-83 are unique from other objects because the actual port being mapped to is determined by the analog output object. This yields two ways in which binary output objects can be operated: directly using indexes 0-7 and 84-1451 or by reference by writing to analog output object 0 and binary output object 8-83 at the same time. The bits can only be read using the analog output object to select the data to read.

Table 7.14: Binary Output Objects

Index Range	Applicable Port	Covered Bits
0-7	N/A	R1-R8
8-83	Selected by Analog Object Index 0	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
84-159	Port 1	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
160-235	Port 2	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
236-311	Port 3	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
312-387	Port 4	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
388-463	Port 5	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
464-539	Port 6	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
540-615	Port 7	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
616-691	Port 8	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
692-767	Port 9	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
768-843	Port 10	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
844-919	Port 11	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
920-995	Port 12	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
996-1071	Port 13	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
1072-1147	Port 14	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
1148-1223	Port 15	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
1224-1299	Port 16	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16

Index Range	Applicable Port	Covered Bits
1300-1375	Port 17	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16
1376-1451	Port 18	CMD1-CMD8, SBO1-SBO4, SBR1-SBR16, SRB1-SRB16, CBR1-CBR16, CRB1-CRB16

Internal Indication Object

Within the Internal Indications (IIN) object, the bits are used as specified within the DNP standard. When TIME_SRC=DNP within the Global settings, the SEL-2030 requests time synchronization every 15 minutes. Bit 4 within the IIN object will be set and remain set until the SEL-2030 receives a time synchronization. If the SEL-2030 receives a time synchronization, it will clear the bit and then set it again 15 minutes later. The SEL-2030 does not have local/remote states, so the local/remote bit indicates whether or not SELOGIC Control Equations are running. If SELOGIC Control Equations are not running, the status is indicated as local since the DNP data will not be updated by SET M while SELOGIC Control Equations are not running.

Timing

Maximum data-link response time (without confirmation): 150 milliseconds.
Maximum class 0 request response time (without confirmation): 300 milliseconds.
Maximum data-link confirm time: 150 milliseconds.
Maximum application confirm time (without data-link confirmation): 150 milliseconds.

Time Synchronization

When TIME_SRC=DNP within the Global settings, you can perform Time Synchronization via DNP by executing a write to the Date/Time object (object 50). The DNP protocol assumes that the time value sent by the master device is the time at which the first bit of the first byte of the write request is received by the slave (SEL-2030). It is the responsibility of the master to account for transmission delay between sending the request and the SEL-2030 receipt of the request. In many systems this transmission delay will be 0. For example, in a simple point-to-point connection, the moment the first bit is transmitted by the master, it is received by the slave device. In configurations where the communication link may introduce delays, the master may perform a Delay Measurement command and then calculate the transmission delay based on the result of the Delay Measurement. The master can then add this calculated transmission delay time to the time value that it sends to the SEL-2030 when it writes the time. When time synchronization is performed, the SEL-2030 will synchronize itself to within 5 milliseconds (+3/-2) of the given time. When the Delay Measurement command is performed, the value reported by the SEL-2030 is accurate to 10 milliseconds (+5/-5). So, disregarding errors external to the SEL-2030, a time synchronization that uses a Delay Measurement calculation is accurate to within 15 milliseconds (+8/-7).

"Job Done" Example

This example demonstrates how to configure the SEL-2030 to provide data to a DNP master. For this example we will have two SEL-121F relays connected to the SEL-2030, on ports 1 and 2. The following procedure explains how to set the SEL-2030 and collect data.

1. Connect the two relays to ports 1 and 2 of the SEL-2030. Establish basic communications settings to the first relay by auto-configuring it using the SET P 1 command. Use SET A 1 to enable operate control and to collect meter and target data. Use COPY 1 2 with auto-configuration to establish settings with the second relay.

2. Determine how you want to operate the DNP connection and configure it using SET P 1. For this example we will assume polled static operation only.

```
*>>SET P 16<ENTER>

Port communications settings for Port 16


Device Type (U=Unused, S=SEL IED, O=Other IED,
             P=Printer, M=Master)             DEVICE  = S     ? M<ENTER>

Communications Type (S=SEL, L=LMD, M=MODBUS, D=DNP)PROTOCOL= S     ? D<ENTER>

DNP Address (0-65534 or 0-FFFEh)            ADDRESS = 0     ? 5<ENTER>

Class for event data (0 for no event data,1,2,3)CLASS   = 2     ? 0<ENTER>                 1

Use 16 or 32-bit default variations for analog inputs (16/32)16BIT   = 32    ? 16<ENTER>     2

Select/Operate time-out interval, seconds (0.0-30.0)SO_TIMEOUT= 1.0   ? <ENTER>             3

Number of data-link retries (0 for no confirmation, 1-15)DL_CONFIRM= 3     ? 0<ENTER>

Minimum Delay from DCD to transmission (0-1000 msec)MIN_DELAY= 50    ? <ENTER>

Maximum Delay from DCD to transmission (0-1000 msec)MAX_DELAY= 100   ? <ENTER>

Transmission delay from RTS assertion (0-30000 milliseconds) SETTLE1=0 ? <ENTER>

Post-transmit RTS deassertion delay (0-30000 milliseconds) SETTLE2=0 ? <ENTER>

Allow Unsolicited Reporting (Y/N)           UNSOL_REP= N     ? <ENTER>

Port Identification String
PORTID  =""
 ? DNP port<ENTER>


Communications Settings

Baud Rate (300, 600, 1200, 2400, 4800, 9600,
           19200, 38400)                    BAUD    = 9600  ? <ENTER>

Transparent Communications Termination Sequence

PORT:16
DEVICE  = M
PROTOCOL= D
ADDRESS = 5
```

(continued on next page)

```
                              (continued from previous page)
CLASS    = OFF
16BIT    = 16
SO_TIMEOUT= 1.0
DL_CONFIRM= 0
MIN_DELAY= 50
MAX_DELAY= 100
SETTLE1  = 0
SETTLE2  = 0
UNSOL_REP= N
PORTID  ="DNP port"
BAUD    = 9600

Save changes (Y/N) ? Y<ENTER>

Port 16 Settings Changed

*>>
```

Notes:

1. Set CLASS to 0 because we want to operate in polled-static mode. If we wanted to have event data available, we would have set this to the class we wanted event data available in.
2. Set default variation to 16 in case master device does not support 32-bit variations.
3. Set DL_CONFIRM to 0 because we assume a high reliability link. If we thought errors were probable, we would set this to a non-zero value and specify a data-link time-out using the DL_TIMEOUT setting.

Move meter and target data of interest to the port 16 User Region using the SET M 16 command:

```
*>>SET M 16<ENTER>

Mathematical/move equation settings for Port 16

  1
 ? 0=1:METER:IA<ENTER>
  2
 ? 1=1:METER:IB<ENTER>
  3
 ? 2=1:METER:IC<ENTER>
  4
 ? 3=1:METER:VA/100<ENTER>
  5
 ? 4=1:METER:VB/100<ENTER>
  6
 ? 5=1:METER:VC/100<ENTER>
  7
 ? 6,P=1:TARGET:TARGET;7<ENTER>
  8
 ? 10=2:METER:IA<ENTER>
  9
 ? 11=2:METER:IB<ENTER>
 10
 ? 12=2:METER:IC<ENTER>
 11
 ? 13=2:METER:VA/100<ENTER>
 12
 ? 14=2:METER:VB/100<ENTER>

                              (continued on next page)
```

```
                                          (continued from previous page)
 13
 ? 15=2:METER:VC/100<ENTER>
 14
 ? 16,P=2:TARGET:TARGET;7<ENTER>
 15
 ? <ENTER>

  1 000h = 1:METER:IA(A)
  2 001h = 1:METER:IB(A)
  3 002h = 1:METER:IC(A)
  4 003h = 1:METER:VA(V)/100
  5 004h = 1:METER:VB(V)/100
  6 005h = 1:METER:VC(V)/100
  7 006h,P = 1:TARGET:TARGET;7
  8 00Ah = 2:METER:IA(A)
  9 00Bh = 2:METER:IB(A)
 10 00Ch = 2:METER:IC(A)
 11 00Dh = 2:METER:VA(V)/100
 12 00Eh = 2:METER:VB(V)/100
 13 00Fh = 2:METER:VC(V)/100
 14 010h,P = 2:TARGET:TARGET;7

Save changes (Y/N) ? Y<ENTER>

USER database region too small: Current size = 0  Size needed = 20
Attempting to allocate larger USER region... Done.

Port 16 Settings Changed


*>>
```

Notice that we divided the voltage data by 100, so the read value will be in tenths of kilovolts.

4. Use the DNPMAP command to determine the object types and indexes of the binary input, counter, and analog input objects you have selected:

```
*>>DNPMAP<ENTER>

                                            Date: 01/01/95    Time: 00:22:03

DNP Address:  0005h

Object Type     Index      Default Variation      Label
     01          0-63           02                1:TARGET:TARGET
     01         64-127          02                2:TARGET:TARGET
     30          0              04                1:METER:IA(A)
     30          1              04                1:METER:IB(A)
     30          2              04                1:METER:IC(A)
     30          3              04                1:METER:VA(V)
     30          4              04                1:METER:VB(V)
     30          5              04                1:METER:VC(V)
     30          6              04                2:METER:IA(A)
     30          7              04                2:METER:IB(A)
     30          8              04                2:METER:IC(A)
     30          9              04                2:METER:VA(V)
     30         10              04                2:METER:VB(V)
     30         11              04                2:METER:VC(V)

*>>
```

5. The data are now ready to be read. Configure your master to perform Class 0 polls to read all of the static data. You can also selectively read data. Use the map obtained above with the DNPMAP command to interpret the data.

6. You can also perform control using this interface by writing to binary outputs. The binary outputs are not configurable; they are listed in Table 7.13 and Table 7.14 above. Thus, to cause the relay on port 1 to open its breaker, you need to pulse the 1:SBR1 bit by performing a latch on or pulse on operation (direct operate or select-before-operate) to the binary output object 96. Similarly, to cause the relay on port 1 to close its breaker, you need to pulse the 1:CBR1 bit by operating the binary output object 128.

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APPENDIX A: FIRMWARE VERSIONS

This manual covers SEL-2030 Communications Processors that contain firmware bearing the following part numbers and revision numbers (most recent firmware listed at top):

Firmware Part/Revision No.	Description of Firmware
SEL-2030-R114-V0-Z000001-D20010619	Add FLEX parsing option. Improve data handling for HIH and HIL SETM processing.

To find the firmware revision number in your Communications Processor, use the ID command. The first line is an FID number. The following is an example FID with the Part/Revision number in bold:

FID=**SEL-2030-R113-**V0-Z000000-D20010122

The following table shows firmware that does not precisely match this manual:

Firmware Part/Revision No.	Description of Firmware
SEL-2030-R113-V0-Z000000-D20010122	Add support for the SEL-2701 Ethernet Processor. Add virtual terminal client and server capability, including TERTIME1, TERTIME2, TERSTRING, TIMEOUT, and XON_XOFF settings in **SET P** for Ports 17 and 18. Add SENDTIME (new definition) setting to **SET P** for Ports 17 and 18. Add CCIN and CCOUT elements for Ports 17 and 18, **CARD** command to view them, and **SET O** for the CCOUT SELOGIC® Control Equation settings. Add NOCONN setting to **SET A** settings, and NOCONN element and rows 18 and 19 to the local database elements. Add USER setting to Ports 17 and 18 **SET A** settings. Enhance security to better prevent unauthorized access and strengthen wording of message for third unsuccessful **ACC** attempt.
SEL-2030-R112-V0-D000221	Improve performance of SET M operations. Performance was decreased by enhancements made in version R110.
SEL-2030-R111-V0-D000120	Add support for SEL-2600 RTD Module.

Firmware Part/Revision No.	Description of Firmware
SEL-2030-R110-V0-D991222	Add TIME_SRC setting for selection of time synchronization source. Correct problem that caused inaccuracy in DNP time synchronization (problem in versions R108 and R109 only). Correct problem that could cause reporting of incorrect bit values to SEL-2711 via Modbus® Plus Global Data.
SEL-2030-R109-V0-D991021	Correct problem with ASCII-Hexadecimal-to-Integer conversions (H1L and H1H data types within SET M). Correct Modbus problem that caused automatic assignment of address 02 to Port 17 (regardless of settings).
SEL-2030-R108-V0	Add support of Binary SER messages. Add SET R for defining SER elements. Add support for C (clear) and R (reset) parameters with STATUS command. Add VT and WT timers. Support multiple \W…/ strings within a single message. Expand SET M to 600 lines maximum. Add math operators (add, subtract, multiply, divide) and ASCII hexadecimal data types to SET M syntax. Support Direct Transparent mode (PORT n D).
SEL-2030-R107-V0	Increase maximum value of TIMEOUT setting to 120 minutes. Enhance relay support for SEL-701 Relay.
SEL-2030-R106-V0	Add Unsolicited Write message string (\W;saddr;n,daddr/). Add new registers in Local database region for Unsolicited Write statistics. Improve efficiency of Fast Meter calculations so that SEL-2030 performs better when collecting Fast Meter data from several relays. Change DNP settings so CONFIRM_TO setting is accessible as long as CLASS is not set to 0. Previously, CONFIRM_TO was hidden unless UNSOL_REP was set to YES. Also changed lower limit on CONFIRM_TO setting from 0 to 50 milliseconds. On power-up auto-configuration, allow for a single auto-configuration retry in the case where

Firmware Part/Revision No.	Description of Firmware
	the port begins to auto-configure for the relay but then fails (ConfigFail status). Fix problem where DNP port would not function at all if Master was polling it during power-up initialization. Fix problem that could cause the wrong (inverted) value of the SEL-321-1 Alarm bit (!ALRM) to be moved to the User region via SET M. This was correctable using the FREEZE and RELEASE operations. It is no longer an issue, so FREEZE/RELEASE are not necessary. Fix problem that could cause SEL-2030 SELOGIC (SET A, SET G, SET L) that is based on bits in the Port 17 or 18 D1 region to evaluate to FALSE (0) permanently.
SEL-2030-R105-V0	Fix Shared Memory arbitration problem that could cause SEL-2030 lockup. Fix problem with clearing Archive data via the Automatic Message string \Fp:An;c/. Address memory loss caused by failed modem dial-out messages (\Idstr/).
SEL-2030-R104-V0	Add DNP time synchronization.
SEL-2030-R103-V0	Support new features in protocol card. Change processing sequence for local intermediate logic (see ***Section 4: SELOGIC® Control Equations***).
SEL-2030-R102-V0	Make sure RTS asserted when SEL-2030 powers up in SELBoot mode. Fix problem with Modbus bit reads from Target region.
SEL-2030-R101-V0	Original issue of SEL-2030.

APPENDIX B: ASCII REFERENCE TABLE

Table B.1: ASCII Reference Table

Decimal Code	Hexadecimal Code	Character	Keystroke
0	00	NUL	
1	01	SOH	CTRL-A
2	02	STX	CTRL-B
3	03	ETX	CTRL-C
4	04	EOT	CTRL-D
5	05	ENQ	CTRL-E
6	06	ACK	CTRL-F
7	07	BEL	CTRL-G
8	08	BS	CTRL-H
9	09	HT	CTRL-I
10	0A	LF	CTRL-J
11	0B	VT	CTRL-K
12	0C	FF	CTRL-L
13	0D	CR	CTRL-M
14	0E	SO	CTRL-N
15	0F	SI	CTRL-O
16	10	DLE	CTRL-P
17	11	DC1 (XON)	CTRL-Q
18	12	DC2	CTRL-R
19	13	DC3 (XOFF)	CTRL-S
20	14	DC4	CTRL-T
21	15	NAK	CTRL-U
22	16	SYN	CTRL-V
23	17	ETB	CTRL-W
24	18	CAN	CTRL-X
25	19	EM	CTRL-Y
26	1A	SUB	CTRL-Z
27	1B	ESC	ESC

Decimal Code	Hexadecimal Code	Character	Keystroke
28	1C	FS	
29	1D	GS	
30	1E	RS	
31	1F	US	
32	20	SP	SPACE
33	21	!	!
34	22	"	"
35	23	#	#
36	24	$	$
37	25	%	%
38	26	&	&
39	27	'	'
40	28	(	(
41	29	)	)
42	2A	*	*
43	2B	+	+
44	2C	,	,
45	2D	-	-
46	2E	.	.
47	2F	/	/
48	30	0	0
49	31	1	1
50	32	2	2
51	33	3	3
52	34	4	4
53	35	5	5
54	36	6	6
55	37	7	7
56	38	8	8
57	39	9	9
58	3A	:	:

Decimal Code	Hexadecimal Code	Character	Keystroke
59	3B	;	;
60	3C	<	<
61	3D	=	=
62	3E	>	>
63	3F	?	?
64	40	@	@
65	41	A	A
66	42	B	B
67	43	C	C
68	44	D	D
69	45	E	E
70	46	F	F
71	47	G	G
72	48	H	H
73	49	I	I
74	4A	J	J
75	4B	K	K
76	4C	L	L
77	4D	M	M
78	4E	N	N
79	4F	O	O
80	50	P	P
81	51	Q	Q
82	52	R	R
83	53	S	S
84	54	T	T
85	55	U	U
86	56	V	V
87	57	W	W
88	58	X	X
89	59	Y	Y

Decimal Code	**Hexadecimal Code**	**Character**	**Keystroke**
90	5A	Z	Z
91	5B	[	[
92	5C	\	\
93	5D	]	]
94	5E	_	_
95	5F	_	_
96	60	`	`
97	61	a	a
98	62	b	b
99	63	c	c
100	64	d	d
101	65	e	e
102	66	f	f
103	67	g	g
104	68	h	h
105	69	i	i
106	6A	j	j
107	6B	k	k
108	6C	l	l
109	6D	m	m
110	6E	n	n
111	6F	o	o
112	70	p	p
113	71	q	q
114	72	r	r
115	73	s	s
116	74	t	t
117	75	u	u
118	76	v	v
119	77	w	w
120	78	x	x

<table>
<tr><th>Decimal Code</th><th>Hexadecimal Code</th><th>Character</th><th>Keystroke</th></tr>
<tr><td>121</td><td>79</td><td>y</td><td>y</td></tr>
<tr><td>122</td><td>7A</td><td>z</td><td>z</td></tr>
<tr><td>123</td><td>7B</td><td>{</td><td>{</td></tr>
<tr><td>124</td><td>7C</td><td>|</td><td>|</td></tr>
<tr><td>125</td><td>7D</td><td>}</td><td>}</td></tr>
<tr><td>126</td><td>7E</td><td>~</td><td>~</td></tr>
<tr><td>127</td><td>7F</td><td>DEL</td><td>DEL</td></tr>
</table>

APPENDIX C: PLANNING SHEETS

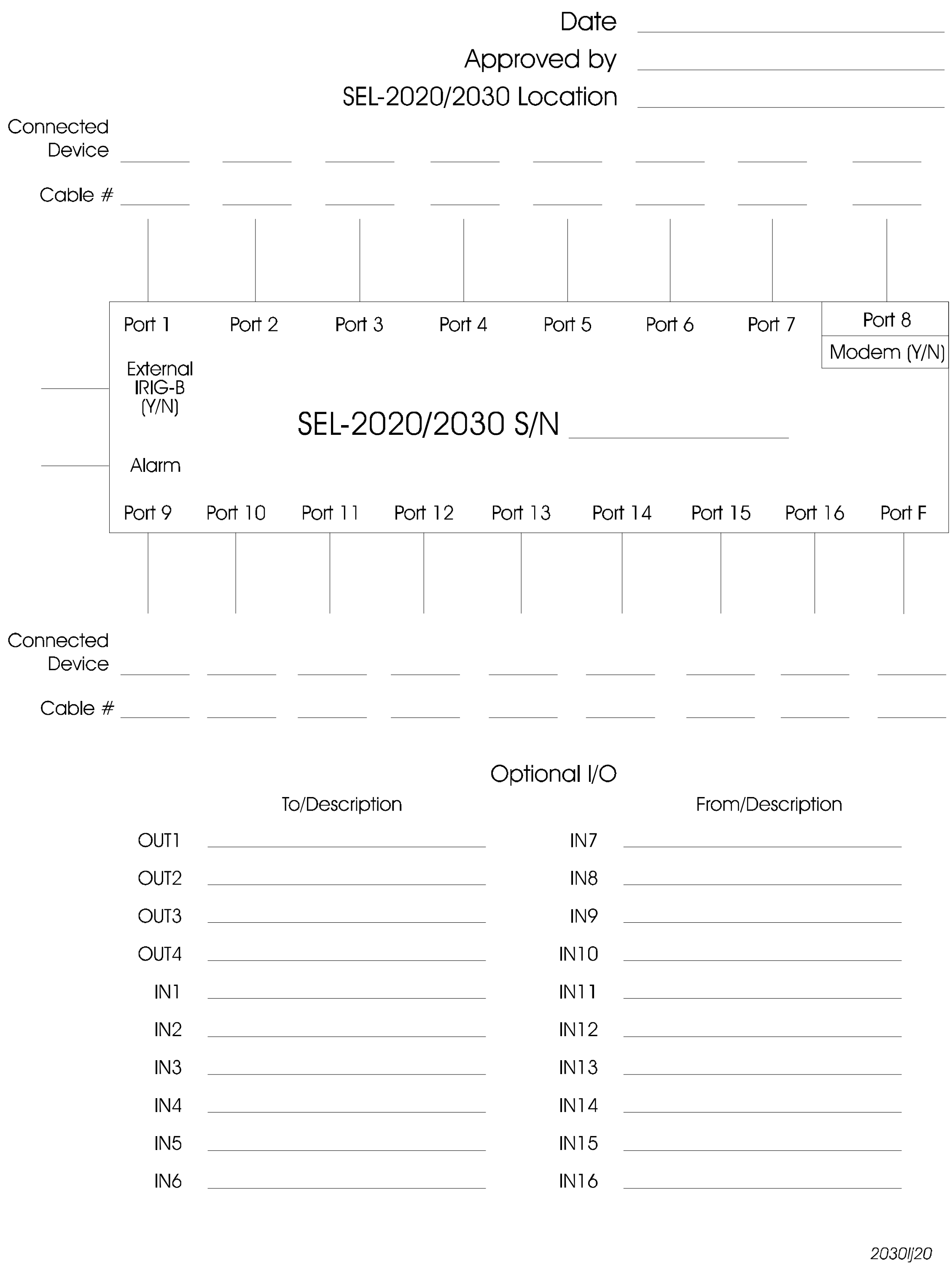

Figure C.1: SEL-2020/2030 Device Connection Plan

Calculate Memory Usage

Nonvolatile Flash Memory Usage Estimation

The total nonvolatile Flash memory available for archive storage is 8,192 blocks. (A block is 256 bytes.) Table C.1 shows the memory requirements for various types of data. Each item requires one to five blocks of overhead, plus 1/7 to 240 blocks per record stored, as indicated in the table.

Table C.1: "20" Message Archive Requirements in Blocks

Relay	Meter	Fast Meter	Demand	Target	Status	Breaker	History	EVENT	EVENTS	EVENT L
49	1/3 n+ 2	---	---	---	2n+1	---	n+2	11n+3	25n+1	---
121	1/3 n+ 2	---	---	1/6 n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
121-10	1/ n+ 2	n+4	---	1/7 n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
121B	1/ n+ 2	n+4	---	1/7 n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
121C	1/3 n+ 2	n+4	---	1/ n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
121D	1/4 n+ 2	---	---	1/ n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
121F	1/3 n+ 3	n+4	---	1/ n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
121G	1/3 n+ 2	n+4	---	1/ n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
121H	1/3 n+ 2	n+4	---	1/ n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
121S	1/3 n+ 2	n+4	---	1/ n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
151	1/3 n+ 3	n+4	1/3 n+ 2	1/6 n+ 1	2n+1	1/2 n+ 3	3n+2	11n+3	25n+1	---
151C	1/3 n+ 3	n+4	1/3 n+ 2	1/6 n+ 1	2n+1	1/2 n+ 3	3n+2	11n+3	25n+1	---
151CD	1/4 n+ 2	n+3	1/3 n+ 2	1/6 n+ 1	2n+1	1/2 n+ 3	3n+2	11n+3	25n+1	---
151D	1/4 n+ 2	n+3	1/3 n+ 2	1/6 n+ 1	2n+1	1/2 n+ 3	3n+2	11n+3	25n+1	---
167	1/3 n+ 3	---	1/3 n+ 3	1/ n+ 1	2n+1	---	3n+2	11n+3	25n+1	---
167D	1/3 n+ 2	n+3	1/3 n+ 2	1/ n+ 1	2n+1	---	3n+2	11n+3	25n+1	---
187V	1/3 n+ 2	---	---	1/6 n+ 1	2n+1	---	3n+2	12n+3	25n+1	---
279	1/3 n+ 2	---	---	1/ n+ 1	2n+1	1/4 n+ 2	---	---	---	---
279H	1/3 n+ 2	---	---	1/6 n+ 1	2n+1	---	3n+2	13n+3	25n+1	---
BFR	1/3 n+ 2	---	---	1/ n+ 1	2n+1	---	14n+2	16n+3	48n+1	---
300G	---	n+5	1/2 n+ 4	1/4 n+ 1	2n+4	---	11n+1	31n+4	48n+1	240n+1
PG10	1/ n+ 2	n+4	---	1/ n+ 1	2n+1	---	2n+2	11n+3	25n+1	---
321	1/ n+ 2	n+5	---	1/ n+ 1	2n+1	---	10n+2	11n+3	48n+1	240n+1
321-1*	---	n+3	---	1/ n+ 1	n+3	---	12n+2	9n+2	48n+1	240n+1
351	---	n+6	n+5	1/ n+ 1	2n+4	---	5n+4	31n+5	48n+1	240n+1
351R	---	n+5	1/ n+ 4	1/3 n+ 1	2n+5	---	7n+3	36n+5	48n+1	240n+1
352	---	2n+6	---	1/2 n+ 1	2n+4	2n+3	5n+3	16n+4	48n+1	240n+1
387	---	n+4	n+3	1/4 n+ 1	2n+5	1/2 n+ 4	32n+3	22n+4	48n+1	240n+1
501	1/5 n+ 2	n+3***	1/5 n + 2	1/ n+ 1	2n+1	1/3 n+ 3	4n+2	14n+3	48n+1	---
551	---	1/3 n+ 2	---	1/ n+ 1	n+3	---	5n+2	17n+3	48n+1	---
587	---	n+4	1/3 n + 2	1/ n+ 1	n+4**	---	4n+2**	23n+5**	48n+1**	---

* Only applies to SEL-321-1 Relays with a date code later than 950907. Older SEL-321-1 Relays have same sizes as SEL-321 Relays.
** Only available in SEL-587 Relays with a date code later than 950907.
*** Only applies to SEL-501 Relays with a date code later than 960101.

To determine the Flash memory required, perform the following steps, using Table C.3 as a planning sheet:

1. Estimate the desired maximum number of records (n) of each type on each port.
2. For "20" message archive regions, determine the memory requirements using the records estimated as "n" in Table C.1. For regions in which you use generic parsing, follow the process in Table C.2 to find the archive requirements.
3. Calculate the blocks required per region (rounding all fractions up to the nearest integer) and enter in Table C.3. Sum to determine total requirement.
4. If total requirement exceeds 8,192 blocks, you must use more than one SEL-2030, or reduce the amount of data you archive.

Table C.2: Generic Parsing Archive Requirements

a)	If you are using CHAR_STRING parsing, each record will require S=28+NUM bytes where NUM is your size setting for the region. If you are using INT_STRING or ASCII_INT parsing, each record will require S=28+2·NUM bytes. If you are using ASCII_FLOAT parsing, each record will require S=28+4·NUM.
b)	If the size determined in bytes is greater than 254, the number of blocks required per record is the record size in bytes plus 2 divided by 256 and rounded up: $A = \left\lceil \frac{S+2}{256} \right\rceil$
c)	If the size determined in bytes is less than 128, the number of records that will fit in a block is 254 divided by the record size and rounded down: $A = \frac{1}{\left\lfloor \frac{254}{S} \right\rfloor}$
d)	If the size determined is greater than 128 bytes and less than 254, you will get one record per block: $A = 1$
e)	The archive memory requirements are: $An+1$

Table C.3: Archive Memory Usage Estimation

	Archive 1			Archive 2			Archive 3		
Port	**No. Of Records**	**Record Size**	**No. Of Blocks**	**No. Of Records**	**Record Size**	**No. Of Blocks**	**No. Of Records**	**Record Size**	**No. Of Blocks**
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Total A1 Blocks ________ Total A2 Blocks ________ Total A3 Blocks ________

A1 Blocks + A2 Blocks + A3 Blocks = ________

(Max. available: 8,192 blocks)

For example, consider the case where you want to collect demand meter data from an SEL-151 Relay every 15 minutes and want the SEL-2030 to store up to 10 days worth of this data. This yields a total desired number of records of 960. From Table C.1, the memory requirement for 151 demand meter data is $\frac{1}{3}n + 2$. Thus, the total number of blocks is $\frac{1}{3}(960) + 2 = 322$.

RAM Usage Estimation

In the SEL-2030, either 256 kbytes or 1 Mbyte of shared RAM is available. Of this, all but 4 kbytes is available to the database. To determine the memory used by your planned functions, sum the memory used for all database regions, including archive regions.

User Region Memory

Memory requirements for the User region are 30 bytes + twice the USER setting you enter with the **SET A** command. (Be aware that the USER setting may automatically increase when you use the **SET M** command.) If you are using **SET M**, there will be an additional memory requirement of 30 bytes per line in your **SET M** settings.

Data Region Usage

To estimate Data Region (D1 through D8 and A1 through A3) memory usage for "20" data collection, use the record sizes directly from Table C.4. For non "20" data collection, you determine the record sizes from the PARSE and NUM settings:

S=128+NUM	if PARSE=CHAR_STRING
S=128+2·NUM	if PARSE=INT_STRING or PARSE=ASCII_INT
S=128+4·NUM	if PARSE=ASCII_FLOAT

Table C.4: Data Record Sizes (Bytes) by Relay and Record Type

SEL Relay	Record Type								
	Fast Meter	Meter	Demand	Target	Status	Breaker	History	EVENT	EVENTS
49		52			408		138	2682	6148
121		52		427	408		392	2682	6148
121-10	1054	52		361	408		392	2672	6148
121B	1054	52		328	408		428	2770	6148
121C	1054	52		361	408		416	2770	6148
121D		34		361	408		392	2770	6148
121F	1092	58		361	408		392	2770	6148
121G	1054	52		361	408		392	2770	6148
121H	1054	52		361	408		392	2770	6148
121S	1054	52		361	408		392	2772	6148
151	1054	58	44	427	408	60	632	2672	6148
151C	1054	58	44	427	408	60	560	2668	6148
151CD	850	38	44	427	408	60	560	2668	6148
151D	850	38	44	427	408	60	632	2672	6148
167		64	64	361	408		656	2770	6148
167D	850	46	46	361	408		656	2770	6148
187V		44		427	408		512	2864	6148
279		44		394	408	36			
279H		52		427	408		512	3120	6148
BFR		52		394	408		3408	3868	12400
PG1O	1054	52		262	408		392	2770	6148
300G	1472		980	1794	1360		3248	8728	12288
321*	1282	52		1902	488/906		2328/ 3296	2672/ 2764	12400
351	1514		1242	1884	1206		1946	8738	12400
351R	1368		980	2638	1548		2310	10172	12288
352	1582			3186	1310	948	1720	4720	12400
387	1010		778	2014	1428	1008	8638	6506	12400
501	782***	28	28/438***	460	488	64	888	3414	12400
551	364			694	962		1498	4612	12400
587	1100		438	660	1082**		1390**	6838**	12400**

* For columns with two numbers, the first number applies to the SEL-321 and to SEL-321-1 Relays with a date code earlier than 950907. The second number applies to newer SEL-321-1 Relays.

** Only available in SEL-587 Relays with a date code later than 950907.

*** Only applies to SEL-501 Relays with a date code later than 960101.

APPENDIX D: SEL-2020/2030 COMPATIBILITY

The SEL-2020 and SEL-2030 are designed to work with and were tested with SEL relays listed in the table below, plus all SEL relays released after December 1994. Each should work with most older relay firmware versions, but some firmware will not be compatible. If you have an old version of relay firmware and experience difficulties using it with the SEL-2020/2030, you should upgrade the relay firmware to the current version. The date code is a part of the FID string found at the top of each long event report.

Relays	Date Codes
49	881007
49E*	881007
121, -1, -2, -2A, -3, -4, -6, -8	920522
121-10, -16, -17	930420
121B/221B, -1	940722
121C-1/221C, -1	930708
121D/221D	931102
121F/221F, -1, -2, -3, -8	930420
121G/221G, -3, -4, -5, -6, -7, -8, -9	941021
121H/221H, -3	940126
121S/221S	921102
151/251, -1, -2, -3	940901
151C/251C, -1, -2, -3	940901
251CD, -1, -3	940901
151D/251D, -1, -3	940901
167/267, -2, -4, -5	931026
167D/267D, -3	940830
187V/287V, -1	940820
279	941110
279H, -1,. -2	941107
BFR/2BFR, -1	940125
PG10/2PG10, -7, -8	930830
300G	All
311	All
321	940927
321-1	941114
321-5	960807
351	All
351A	All
351R	All
352	All
387	All
501,-2	941108
551	All
587	950510l
701	All

* Only works at speeds of 2,400 bps or below.

APPENDIX E: SEL-2030 PHYSICAL CHARACTERISTICS

This appendix provides a summary of the physical characteristics of the SEL-2030. This includes cut-out drawings, front and rear panel drawings, and the layout of the main board and optional I/O board. See the ***SEL-2030 User's Guide; Section 3: Installation*** for a complete description of installing, configuring, and connecting the SEL-2030.

The front of the SEL-2030 has 38 LEDs and an LED test button. This includes 17 transmit and 17 receive LEDs, which simply illuminate whenever the corresponding port signal goes high. Their purpose is to indicate port activity. The Power LED indicates that power is applied to the unit. The Alarm LED is lit whenever the Alarm contact is asserted. (See ***SEL-2030 User's Guide; Section 6: Troubleshooting*** for a description of possible alarm conditions.) The card 1 and card 2 LEDs indicate the status of the two plug-in protocol cards: if lit solid, the corresponding protocol card is in initialization or a failure mode; if not lit, no card is detected in that slot; and if flashing, the corresponding protocol card is running normally. The LED test button causes all of the LEDs to be illuminated while the button is depressed.

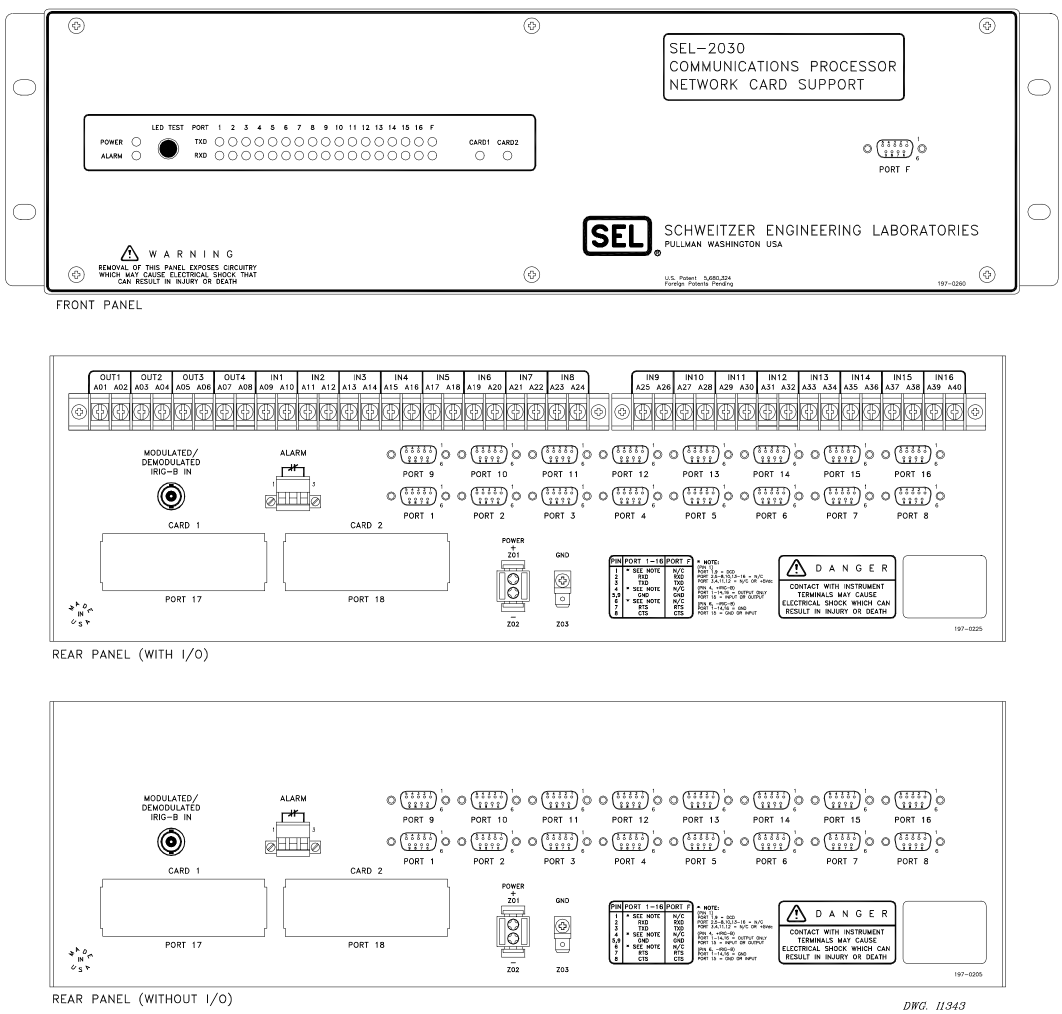

Figure E.1: SEL-2030 Front and Rear Panels

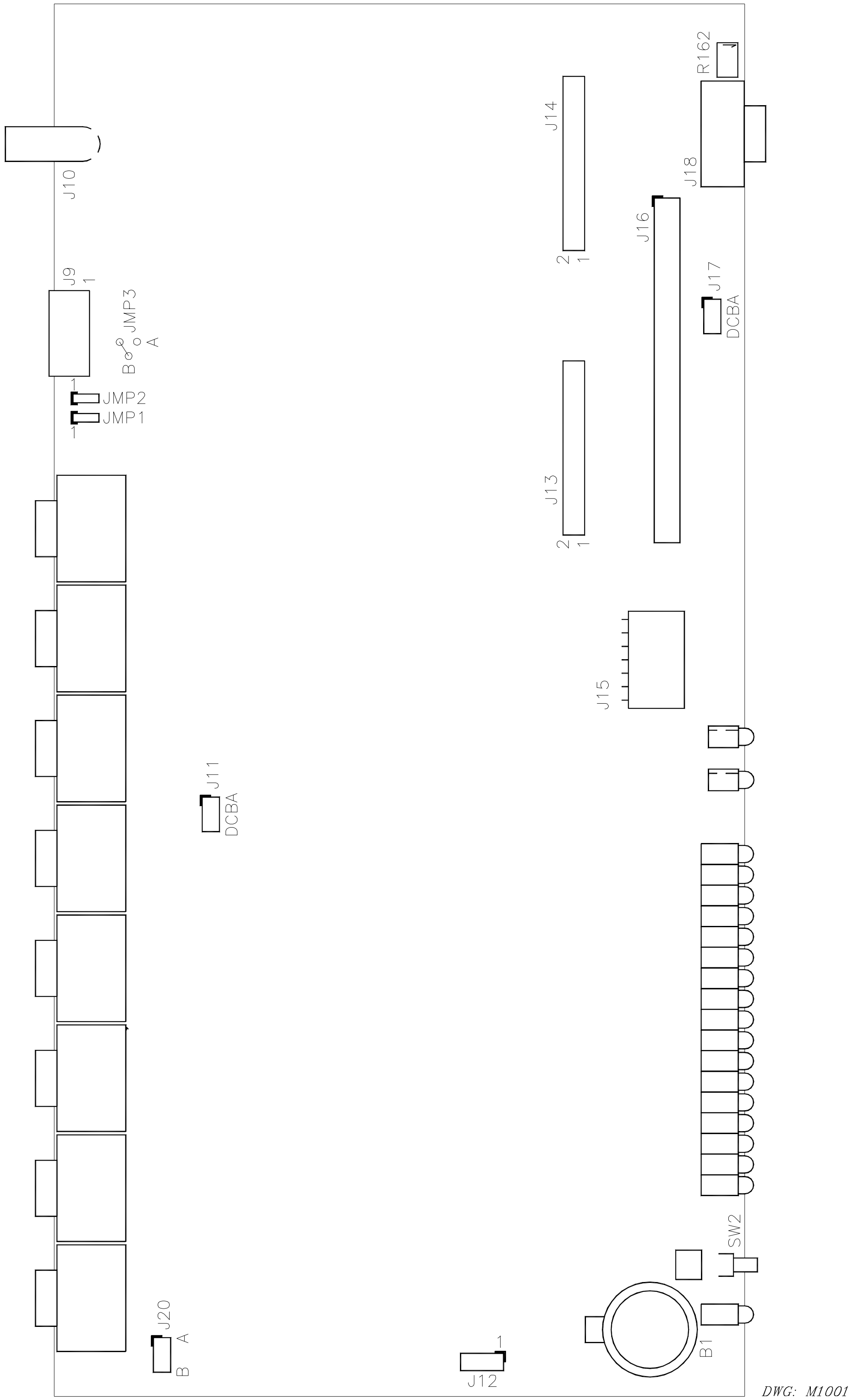

Figure E.2: SEL-2030 Main Board Jumper Location

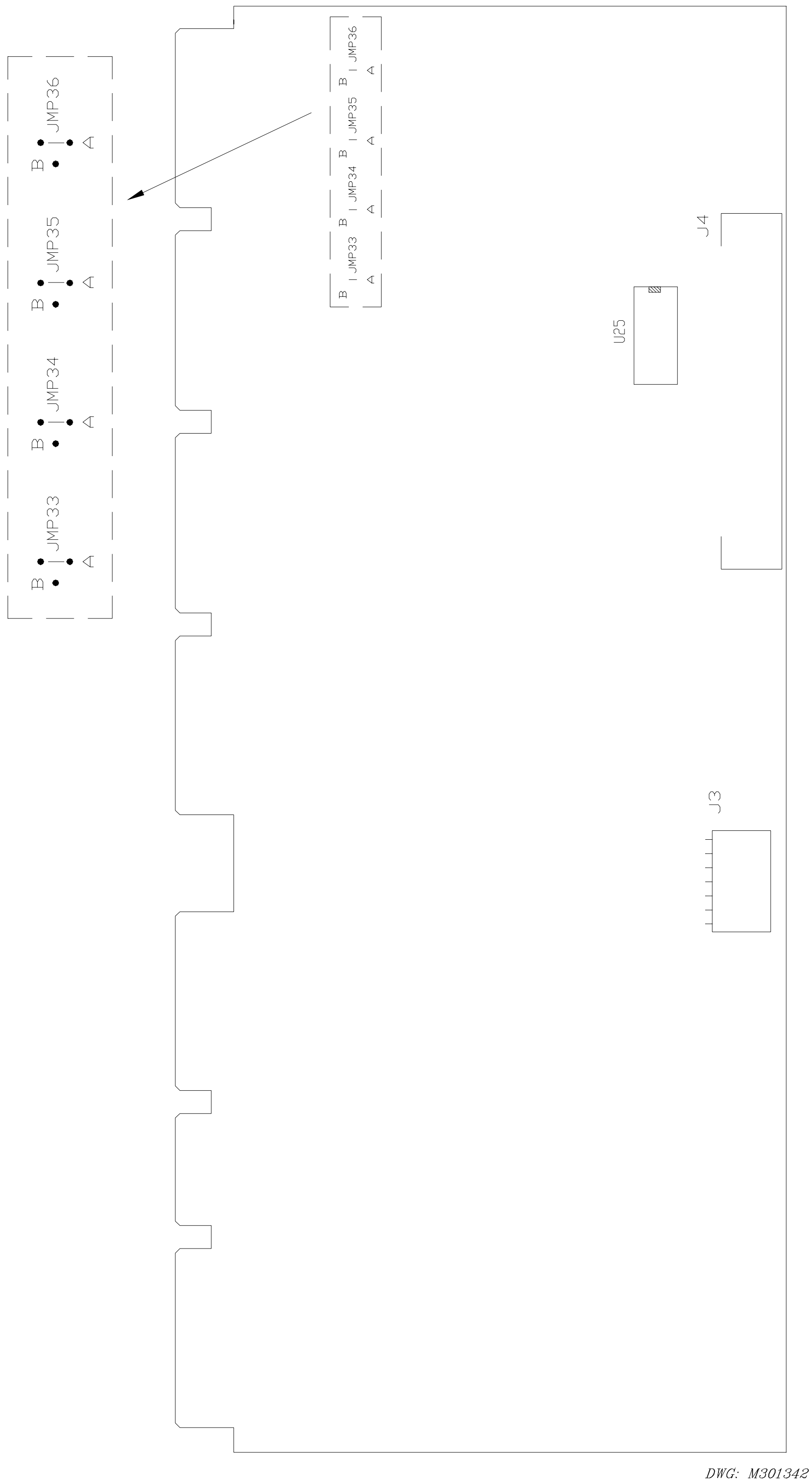

Figure E.3: SEL-2030 Optional I/O Board Jumper Location

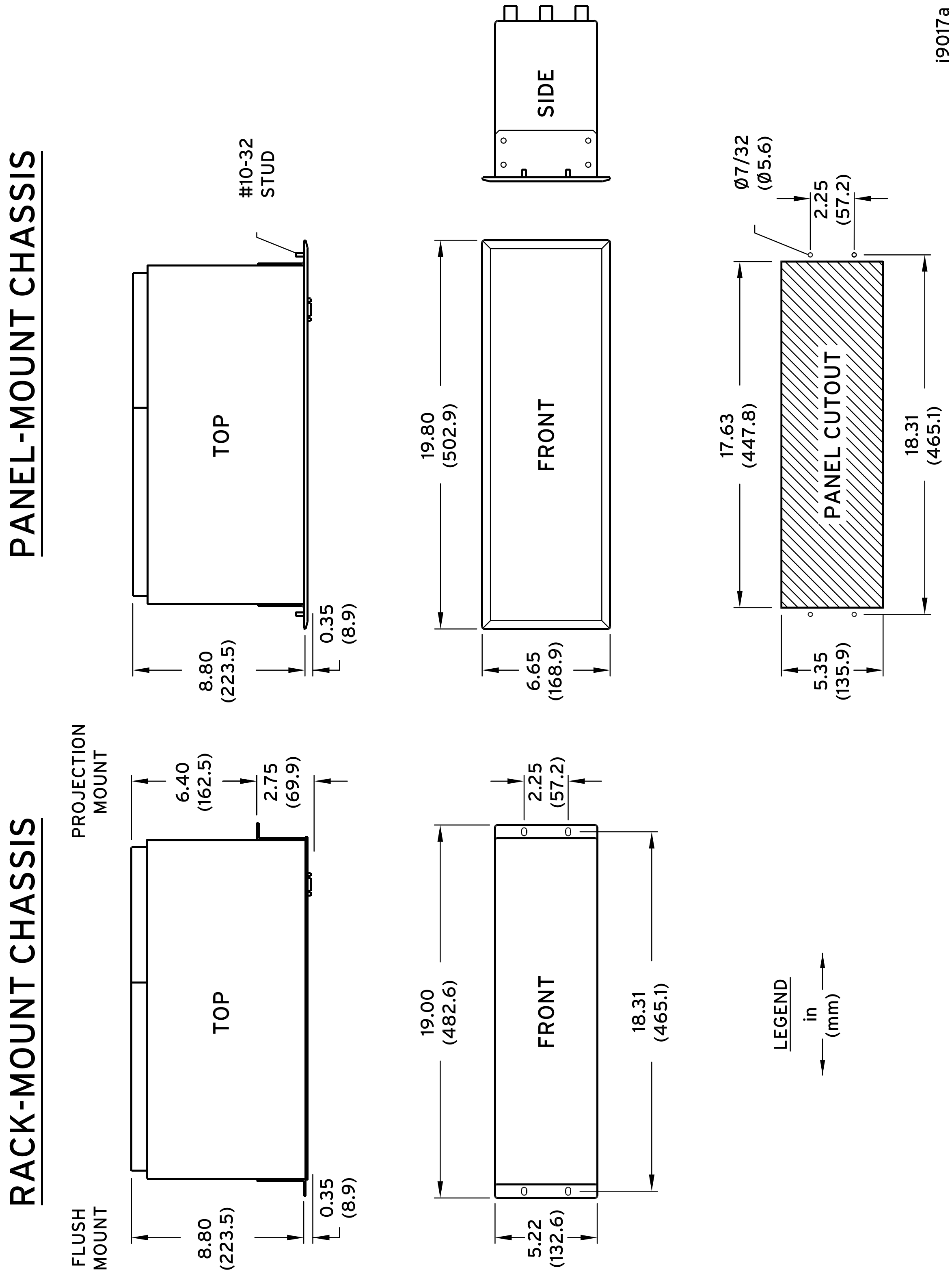

Figure E.4: SEL-2030 Dimensions and Panel-Mount Cutout

SEL-2030 COMMAND SUMMARY

Access Level 0

ACCESS	Use this command to enter Access Level 1. Access Level 1 provides you with interrogate, read-only capability. You will be prompted for the Level 1 Password if the SEL-2030 password disable jumper is removed.
HELP	Lists all commands available at the current access level. Use with a command as its parameter and it will provide the syntax and a brief description of the command.
ID	Displays SEL-2030 current ID, as set in the global settings, and the firmware identification string (FID string). (See also WHO and STATUS commands.)
QUIT	Causes the SEL-2030 to return control to Access Level 0 from Level 1 or 2. The command displays the SEL-2030 ID, date, and time of QUIT command execution.

Access Level 1

2ACCESS	Use to enter Access Level 2. Access Level 2 provides you with the ability to change SEL-2030 settings. You will be prompted for the Level 2 Password if the password disable jumper is removed.
AUTO n	Displays the results of auto-configuration on selected port.
BROADCAST	Establish direct communications with all IED ports simultaneously. To terminate communications and return to command operation, use the termination sequence set for your port. (<CTRL-D> is the default termination sequence.)
CARD	Displays the value of the Control Input and Control Output elements for the protocol card ports (Ports 17 and 18).
CLEAR m:n	Clears data from the unsolicited message queue or from the archive data regions of an intelligent electronic device (IED) port. Parameter m specifies which port (1-16). Parameter n may be BUF for the unsolicited message queue or A1, A2, or A3 for the archive data regions. CLEAR m:BUF clears all messages stored in the Port m buffer. Clearing an archive entry removes the oldest item from that queue; subsequent entries remain. To completely clear an archive queue, add the parameter A (CLEAR 4:A2 A).
DATE	Displays the date stored by the internal calendar/clock. Use a date parameter to change the date: DATE mm/dd/yy.
DNPMAP	Displays map of data available on DNP port.
IRIG	Directs the SEL-2030 to read IRIG-B time-code input at the IRIG-B port. It updates the internal clock/calendar time and date to the time code.
MAP m:n	Displays the data structure and format for data stored in a port database. Parameter m = port number (1-18). Parameter n = data region (GLOBAL, LOCAL, BUF, D1-D8, or A1-A3). Gives port data structure and format if only port number is given. With both parameters, shows data region structure and data address format.
MEMORY	Displays the status of memory usage.
PORT n i	Establishes transparent communication between the master port issuing the command and the designated port n. To terminate communications and return to command operation, use the termination sequence set for your port. (<CTRL-D> is the default termination sequence.) With Ports 17 and 18, use parameter i to specify a network address.
SHOWSET n	Displays settings for the specified class or port number. Settings cannot be entered or modified with this command. Change settings with the SET command in Access Level 2.
STATUS	Shows SEL-2030 self-test status and the configuration, communication, and data performance of each port. Type STATUS 4 to view the status information four times. Type STATUS C or STATUS R to view status information and clear port statistics.

TARGET n m	Displays global element or port-specific element information. Enter G for parameter n to display global elements or enter 1-18 to display port-specific elements (the front-panel port has no elements). For parameter m, enter the element row number you want displayed or enter ALL to show all of the elements. You may add a repeat count as the third parameter.
TIME	Displays and sets time for the internal clock. To set the clock, type TIME and the desired setting, then press <ENTER>. Separate the hours, minutes, and seconds with colons, semicolons, spaces, commas, or slashes.
VIEW m:n	Shows data stored in a port's database. Parameter m specifies which port (1-18). Parameter n specifies what data to view: an address range in decimal or hex; a specific region of the database; GLOBAL for global data region, LOCAL for local data region, BUF for auto-message buffer, D1-D8 for automatic data collection regions, or A1-A3 for archived data regions; or you can specify the data type directly, i.e., METER, TARGET, HISTORY, etc.); or an element. If you are viewing a region, you can add BL to the command strings to request the SEL-2030 to display element bits with their bit labels.
WHO	Shows what is connected to each port. Gives a table showing, for each port, the connected device type (specific relay type if it is an SEL relay port, otherwise simply the port device type), protocol, baud rate, data bits, stop bits, parity, and a device identification.

Access Level 2

CONTROL m	Parameter m specifies the global elements, R1 through R8, you will operate. You are then prompted to enter one of three control operations: SRB sets a specified bit; CRB clears a specified bit; and PRB pulses a specified bit. You specify the bit (1-8) following the operation. To pulse, supply a time as a second parameter or a one-second time is the default.
COPY m n	Copies port-specific settings (classes P, A, M, U, and L) from Port m to Port n (m and n equal any combination of 1-18). Type COPY m ALL<ENTER> if you wish to copy the Port m settings to all other rear-panel port.
DEFRAGMENT	Defragments EEPROM.
L_D	Causes SEL-2030 to enter SELBoot mode. This is used when you want to load new code into the SEL-2030.
PASSWORD	Shows or sets passwords. PASSWORD 1 BIKE<ENTER> changes Level 1 password to BIKE. The ALARM contact closes for approximately one second and transmits the response "Set."
SET n	Parameter n specifies the specific class: SET G enters global settings; SET C enters calibration settings; SET A enters automatic message settings; SET U enters user-defined command settings; SET P enters port settings, SET M enters data movement settings, and SET L enters logic settings. SET A, SET U, SET P, SET M, SET L, and SET O must have an additional parameter to designate the port (1-18, F).
STORE m:n d	Stores data directly into a database. Parameter m specifies the port number (Port F is not a valid option); parameter n specifies the starting database address; and parameter d is a data stream with each item consisting of data as characters, strings, decimal integers, hexadecimal integers, or single-precision floating point numbers.
SWAP n m	Switches all port-specific settings (P, A, M, U, and L settings) between two ports. Confirmation is requested. The involved ports are reset.
TOGGLE m	Toggles a specified element bit, m. You specify global elements by their name. Port-specific elements need the port number preceding the element label (i.e., 4:D2).

Note: All commands accepted by the SEL-2030 are of the form <command><CR> or <command><CR><LF> (<command><ENTER>) where <command> consists of:

- Commands truncated to the first three characters (SHO 1 = SHOWSET 1)
- Upper- and lower-case characters, without distinction, except in passwords
- Arguments separated from commands by spaces, commas, semicolons, colons, or slashes

SEL-2030 STRINGS

Special Characters for Use in Strings

Character	Use	Comment
\"	A	Quote character. Use to insert a quote character in a string.
\\	A	Backslash character. Insert a backslash character in a string.
\n	A	New line character (CR/LF combination, just CR on SEL IED ports).
\0xx	A	Insert any 8-bit character. xx = A character value in hex; (e.g., \004 is ASCII EOT character. See ***Appendix B: ASCII Reference Table*** for ASCII conversion table.)
\<ENTER>	A	Use this sequence to continue a string to the next line.
\At/	I*	Register address. t= specifies the address format: b=binary (2 bytes) a=ASCII-hex (4 digits)
\Csx/	O	Begin checksum calculation x specifies checksum type c=CRC-16 b=8-bit checksum w=16-bit checksum
\CE/	O	Stop checksum calculation
\COyz/	O	Output checksum y specifies format a=ASCII-hexadecimal b=binary x=binary with XON/XOFF encoding z specifies byte order h=high byte first l=low byte first
\DA[C][P]n/	O	DA=output unsolicited message queue data for Port n; C= if included, clear the queue after the read; the data are handled as set of characters. P= only output characters not previously output; mutually exclusive with C parameter.
\Dt/	I* or READACK	D=data item t=specifies the data format: b=binary word (2 bytes), c=binary bytes (1 byte), h=ASCII-hex word (4 digits), g=ASCII-hex byte (2 digits).
\Fp:r[;C[A]]/	O	F=Output formatted region data. p= the port number. r= the data region. ;C= clear archive item after it is read; CA=read the entire queue of records from an archive region and clear them as they are read.
\Idstr[:h]/	O	Initiate a phone call using the given dial string. Only applies to modem ports. dstr= a dial string of up to 40 characters. Typically consists of ATDT and phone number. h= hang up flag. Y to hang up at end of message, N to stay on-line.
\M	O	Issue modem escape sequence. Only applies to modem ports.
\Pt/	I*	P=Port number t=specifies the port number format: b=binary (1 byte), a=ASCII-hex (2 digits)

Character	Use	Comment
\Rt;saddr[;n]/	O	R=Output register contents t=specifies the data format: b=binary word (2 bytes), c=binary byte (1 byte) g=ASCII-hex byte (2 digits), h=ASCII-hex word (4 digits) f=float in ASCII i=integer in ASCII u=unsigned integer in ASCII x=binary byte with XON/XOFF encoding y=binary word with XON/XOFF encoding saddr=register address, using any valid register access method. n= specifies how many items to read. Data items are delimited by spaces for all except b and c formats. One is assumed if you do not specify.
\SP/	O	Suppress prompt (on Master port). Do not display new prompt after message contents.
\Td/	O	Time delay; use this code to place a delay within string output; d=time in seconds and may be specified as decimal fraction. Time must be in the range of 0.03 to 2047.
\W;saddr;n,daddr/	O	Unsolicited database write. Applies only to ports where DEVICE=MASTER or SEL, and PROTOCOL=SEL. saddr= Source register starting address, using any valid register access method. The source address range may be any database region other than the Archive regions (A1-A3). n= Specifies how many registers to write. Number of registers must not exceed 115. daddr= Destination SEL-2020/2030 User region address, using any valid User region address (F800h-FFFFh).
\X[X]/	I	X= Ignore character. \X/ indicates ignore one character. \XX/ indicates ignore all characters following until the next defined character is encountered.

Use code:

A=All messages I=Input messages O=Output messages

*Only usable in special-purpose user-defined commands.

Pre-Defined Strings for Auto-Messages With Auto-Configured SEL Relays

String	Comment
20METER	Send ASCII meter or *Fast Meter* command, as appropriate.
20DEMAND	Send ASCII demand meter or fast demand meter command, as appropriate.
20TARGET	Send ASCII target command sequence or *Fast Meter*, as appropriate.

Note: When the SEL-2020/2030 collects target data from relays that do not have *Fast Meter* capability, the TARGET commands sent by the SEL-2020/2030 may modify the front-panel targets on the relays--just as if you were sending the target command to the relay without the SEL-2020/2030.

String	Comment
20HISTORY	Send ASCII history command.
20STATUS	Send ASCII status command.
20BREAKER	Send ASCII breaker command.
20EVENT	Send ASCII event command. Store in parsed format.
20EVENTS	Send ASCII event command. Store in literal format.
20EVENTL	Send ASCII long event command. Store in literal format.

Pre-Defined Strings for Auto-Messages

String	Comment
20USER	Copy user region data to this region.

Pre-Defined Strings for General-Purpose User-Defined Commands With SEL IEDs

String	Comment
20EVENT	Recognize summary event reports received from SEL IEDs (delay between triggers).
20EVENTQ	Recognize summary event reports received from SEL IEDs (trigger immediately).
20STATUS	Recognize status messages received from SEL IEDs.
20GROUP	Recognize group switch commands from SEL IEDs.