SEL-2030

COMMUNICATIONS PROCESSOR

USER'S GUIDE

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CAUTION: Never work on the SEL-2030 with the front or top cover removed, when the SEL-2030 is energized.

CAUTION: The SEL-2030 contains devices sensitive to electrostatic discharge (ESD). When working on the device with front or top cover removed, work surfaces and personnel must be properly grounded or equipment damage may result.

CAUTION: There is danger of explosion if the battery is incorrectly replaced. Replace only with Ray-O-Vac® no. BR2335 or equivalent recommended by manufacturer. Dispose of used batteries according to the manufacturer's instructions.

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.

WARNING: Do not rely upon pins 5 and 9 for safety grounding, because their current-carrying capacity is less than control power short circuit and protection levels

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

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

ATTENTION: Ne jamais travailler sur le SEL-2030 avec le panneau avant ou du dessus enlevé, quand le SEL-2030 est sous-tension.

ATTENTION: Le SEL-2030 contient des composants sensibles aux décharges électrostatiques(DES). Quand on travaille sur l'appareil avec le panneau avant ou du dessus enlevé, les surfaces de travail et le personnel doivent être correctement mis à la terre pour éviter les dommages à l'équipement.

ATTENTION: Il y a un danger d'explosion si la pile électrique n'est pas correctement remplacée. Utiliser exclusivement Ray-O-Vac® No. BR2335 ou un équivalent recommandé par le fabricant. Se débarrasser des piles usagées suivant les instructions du fabricant.

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.

AVERTISSEMENT: Ne pas se fier aux broches 5 et 9 pour une mise à la terre sécuritaire: leur limite de support en courant est inférieure au niveau de court-circuit assuré par la protection.

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

USER'S GUIDE 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 ***User's Guide 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	Data Sheet, **Specifications**–Specified temperature range of external wires for CSA certification. Section 2, **Data Parsing Options**–Added Flexible Parsing (Parse 6) option, corrected drawing, reissued entire section. Appendix A, **Firmware Versions**–Additions.
20010122	Reverse of the title page, added Cautions, Warnings, and Dangers in English and French. Section 2, added references to virtual terminal and CCIN and CCOUT elements; added CCIN and CCOUT element description and Table 2.3; added **CARD** command summary; added settings class "O" references and NOCONN setting to ***Settings*** section; provided new **WHO** screen capture. Section 3, added fiber-optic communications paragraph, password security warning; updated ***Firmware Upgrades*** section with new protocol card information. Section 4, added new Job Done® Example 1; updated **SET A** and **WHO** screen captures. Section 5, updated ***Battery Replacement*** section. Command Summary Card, added **CARD** and **SET O** commands.
20000508	Section 3, **Figure 3.2** – Additions
20000221	Appendix A, **Firmware Versions -** Additions
20000120	Appendix A, **Firmware Versions -** Additions
991222	Section 3, **SEL-2030 Firmware Upgrade Instructions -** Additions Appendix A, **Firmware Versions -** Additions
991021	Appendix A, **Firmware Versions -** Additions

Revision Date	Summary of Revisions
990805	Edit all reference to the SEL-2030 Reference Manual - Reissue complete manual Section 2, - Additions Section 3, Table 3.1 - Additions, Table 3.4 - Additions, Figure 3.2 - Additions Section 4, Additions Appendix A - Added new firmware versions
990719	Section 4, Examples 1, 2, and 8 - Updated TIMEOUT setting range Appendix A - Added new firmware version
990319	Section 2, 5 Vdc on Rear Ports – Corrections Section 3, Table 3.4 – Corrections Appendix A - Added new firmware versions
981203	Section 3, Firmware Upgrades – Correction Appendix A - Added new firmware versions
980626	Section 3, Table 3.2 – Correction
980515	Appendix A - Added new firmware versions
980416 980406	Section 3, Add Firmware Upgrades (pgs 17-18) Section 2, Database Structure - Correction to cross reference Section 3, Alarm Contact Connection, Baud Rate, and Passwords - Correction to cross references (pgs 2, 8, 9) Section 4, Example 1, and Example 4 - Correction to cross references (pgs 11, 13, 41, 44) Section 5, Introduction – Correction Appendix A - Added new firmware versions
980116	Appendix A - Added new firmware versions
971222	Appendix A – Correction

SEL-2030 USER'S GUIDE
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TABLE OF CONTENTS

SECTION 1: INTRODUCTION

This section provides a useful introduction to this manual and to the SEL-2030 Communications Processor. This section includes four parts: an Overview of the Manual; a List of Acronyms, Abbreviations, and Glossary Terms; Procedure for Initial Checkout; and an ***SEL-2030 Data Sheet*** with specifications.

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.
- Pullout lists on SEL-2030 commands and on special characters and predefined strings.

Section Highlights

The following list summarizes the main purpose of each section:

- ***Section 2: General Description***, describes the SEL-2030's special features and their benefits to the user.
- ***Section 3: Installation***, includes information and procedures you should be familiar with to install the SEL-2030 safely and effectively.
- ***Section 4: Job Done® Examples***, describes SEL-2030 operations and user interface with 10 examples that include a variety of common applications.
- ***Section 5: Maintenance***, describes the minimal maintenance steps you should follow to keep the SEL-2030 operating properly. This section also includes a guide to troubleshooting and alarm diagnosis.
- ***Section 6: Troubleshooting,*** overviews common problems with the SEL-2030 and how to correct them.

A separate manual, the ***SEL-2030 Reference Manual***, contains detailed information on the operation of the SEL-2030. Information on plug-in protocol cards can be found in separate instruction manuals for the specific cards.

Appendices

The following appendix provide supplemental reference information:

- ***Appendix A: Firmware Versions***

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
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

INITIAL CHECKOUT

Perform the following steps:

1. Visually inspect the SEL-2030 for loose or damaged parts.
2. Connect and apply power to the SEL-2030. (See the PWR SUP field on the rear-panel nameplate for power requirements.) If you do not have the proper voltage source available, use a power supply, like the SEL-LPS, to power the unit.
3. Press and hold the LED TEST button and confirm that all LEDs illuminate.
4. Connect a terminal (or computer equipped with terminal emulation software) to the front-panel connector Port F of the SEL-2030 using an SEL-C234A cable or equivalent.
5. Set the computer terminal or emulation software to operate at:
    - 2,400 baud
    - 8 data bits
    - 1 stop bit
    - no parity
6. Press **<ENTER>** and verify that a "*" prompt is returned.
7. Type **ACCESS<ENTER>** to change to Access Level 1. If you have not yet changed the password, enter the factory-set password by typing **OTTER<ENTER>** at the password prompt. You will see a screen similar to the following, with the password shown instead of @@@@@:

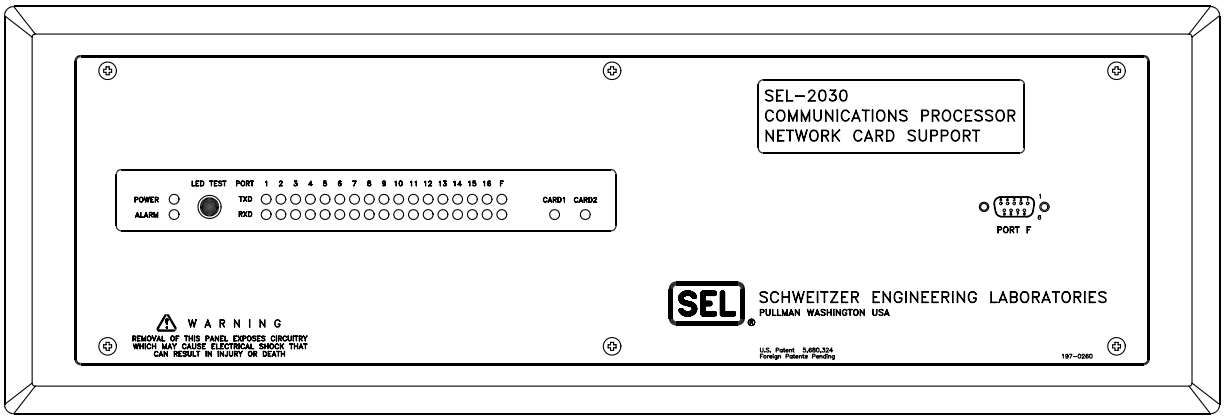
```
*ACCESS<ENTER>

Password: ? @@@@@<ENTER>


EXAMPLE 2030 - S/N 94153001                Date: 10/31/97    Time: 13:45:03

Level 1

*>
```

8. Type **STATUS<ENTER>** and verify that a status report similar to the one below appears on your terminal. The RAM memory size should be 512 kb. The Shared-RAM size should be 256 kb or 1,024 kb. If you ordered optional Flash memory, verify that Flash reports 2,048 kb. If you did not order optional Flash memory, Absent is reported as in the screen below. Confirm that IRIG-B input and I/O board configurations match your expectations. Confirm any plug-in protocol cards show up as expected in Port 17 or 18. Refer to the **STATUS** command explanation in ***SEL-2030 Reference Manual; Section 2: Commands*** for more detailed information.

```
*>>STATUS<ENTER>
COMMUNICATIONS PROCESSOR - S/N 95012004     Date: 10/31/97    Time: 13:46:43
FID=SEL-2030-R100-V0-D971031                FID=SLBT-2030-R100-V0-D971031


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: Absent
I/O Board: Absent

Port   Status           Success Rate   SET M     Database
1      Active                100%      None
2      Inactive                        None
3      Inactive                        None
4      Inactive                        None
5      Inactive                        None
6      Inactive                        None
7      Inactive                        None
8      Active                          None
9      Active                          None
10     Inactive                        None
11     Inactive                        None
12     Inactive                        None
13     Inactive                        None
14     Inactive                        None
15     Inactive                        None
16     Inactive                        None
17     Sole Node(100h)       NORM      None
F      Active                100%      None


*>>
```

Refer to the ***SEL-2030 Data Sheet*** in this section of the instruction manual, and ***Section 2: General Description*** for more information about the operation and features of the SEL-2030.

SEL-2030 Communications Processor



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Data Sheet

General Description: The SEL-2030 Communications Processor is a breakthrough for substation communication and integration. It combines multiport communications, high-speed communications cards, databases and processing, nonvolatile memory, timekeeping and synchronization, alarm monitoring, and auxiliary control into one compact, powerful, economical, easy-to-use, and rugged device.

- Automatically maintains databases for metering, events, and targets.
- Powerful 32-bit computer simultaneously supports 38,400 bps on all master ports and 19,200 bps on all other ports.
- Two plug-in slots allow support of two high-speed communications cards.
- SELOGIC® Control Equations coordinate commands, messages, and I/O.
- Auto-configuration features simplify application settings with SEL relays.
- Versatile data-processing power handles most relays, meters, and SCADA systems.
- One device integrates most small substations.
- Easily cascaded for economical large-station solutions.
- Communications processing reduces burden on SCADA and other equipment.
- Handles binary and ASCII communications for versatile application.
- Can be a Modbus® RTU or Distributed Network Protocol (DNP) 3.00 Level 2 Slave to ease data collection and system control.

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PRODUCT OVERVIEW

SEL-2030 Description

The SEL-2030 Communications Processor provides many special features needed in today's substations to communicate with a variety of microprocessor-based devices, including digital fault recorders, sequential event recorders, digital meters, and digital relays. The SEL-2030 can function as a simple, but intelligent, port switch. Or it can provide sophisticated communication and data handling capability required for advanced substation integration projects. Data are collected, processed, and stored in the SEL-2030 database, permitting quick distribution of selected data to an RTU (remote terminal unit) or another device. Figure 2 shows an example block diagram configuration of the SEL-2030 with SEL relays and peripheral devices connected.

Enhanced/Intelligent Port Switching

Unlike conventional port switches, the SEL-2030 can support communications on all active ports — simultaneously — at speeds up to 19,200 or 38,400 bps depending on port configuration. This means that you can communicate locally through the SEL-2030 with one connected IED (intelligent electronic device) at the same time that someone else is communicating remotely through the same SEL-2030 to another connected IED. Other intelligent features, like the SEL-2030 auto-configuration function, make setup and operation much easier than with simple port switches. In advanced applications, where the SEL-2030 is used to collect, store, and distribute information, the simultaneous communication function provides an uninterrupted flow of information from all active IEDs to an RTU or station integration computer. At the same time you can communicate through the SEL-2030, either locally or remotely, with one of the connected relays or IEDs.

Data Collection, Processing, Storage, Distribution

You can collect, store, process, and distribute target, meter, event, status, sequential events records, and other information — virtually all information available from an SEL relay and a variety of information available from other IEDs — with the SEL-2030, using a simple, but powerful, set of communication commands. Likewise, the SEL-2030 reduces the processing burden for these external devices by separating selected data from IEDs so that only the essential information is delivered and in the form and format required.

Substation Integration and Network Interface

Communication and information handling features make the SEL-2030 ideal for small substation integration projects, eliminating the need for separate substation network architecture. On larger integration projects, the SEL-2030 reduces or eliminates the need for costly network interface devices, otherwise required for each IED. Inclusion of Modbus and DNP support eases integration with systems that support Modbus or DNP. The ability to add protocol cards allows the use of high-speed networks and allows your protocol choice to change in the future with minimal hardware impact.

Time Synchronization

The SEL-2030 can synchronize the time clocks in attached devices, such as SEL relays, that accept a demodulated IRIG-B time signal. The demodulated IRIG-B signal is regenerated in the SEL-2030 from an external modulated or demodulated source, such as a GOES or GPS satellite clock receiver. If no IRIG-B source is available, the demodulated IRIG-B time signal is generated internally by the SEL-2030. A setting allows you to select the external IRIG-B signal, or network command to set the SEL-2030 clock.

Optional Expanded Long-Term Information Storage

Long-term information storage, for such functions as alarms, event reports, and load profiles, can be accommodated using optional nonvolatile archive memory.

Optional Input/Output

Optional I/O, consisting of four programmable output contacts and 16 optoisolated inputs, is available for monitoring, control, and sequential events recording (SER). You can use SELOGIC Control Equations, written in the SEL-2030 settings, to perform basic control functions such as consolidating alarms and switching adaptive relay setting groups. Jumper configure each output contact as form A or form B through soldered jumper connections.

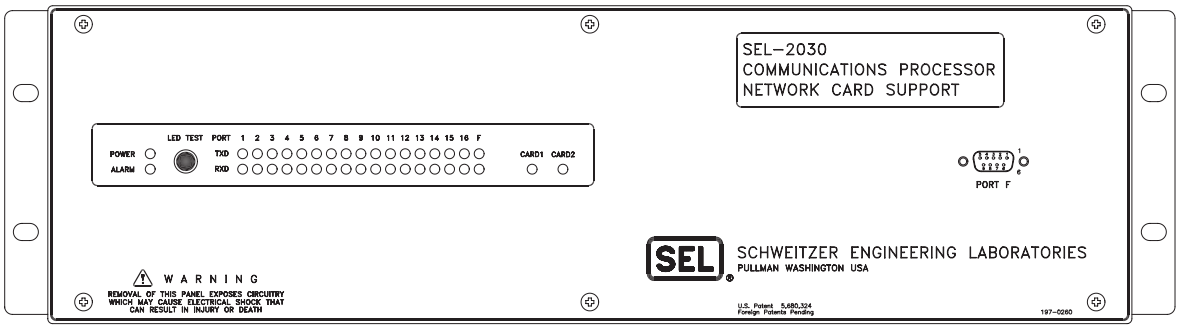
Compact Design

The SEL-2030 is available with two mounting styles; one is for mounting in panels, and one is for racks. You can reverse the mounting ears on the rack-mount case for projection mounting. Figure 1 shows the SEL-2030 front and rear panels, both with and without the optional I/O board. Refer to Figure 5 for dimensions and drill plans.

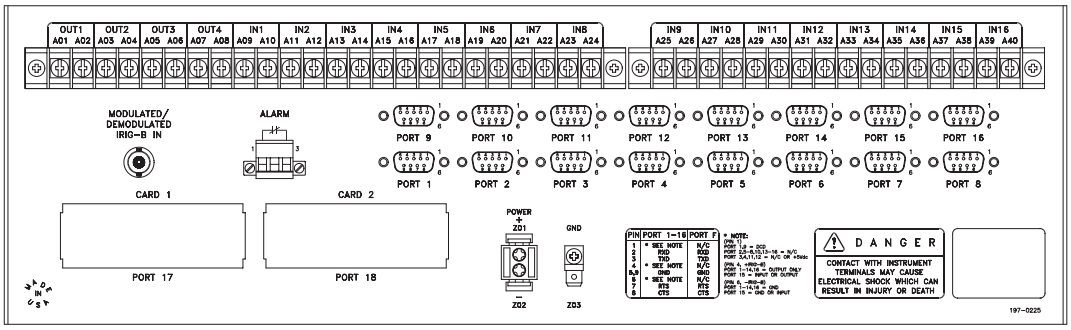
Optional Communication Cards

The SEL-2030 has two card slots that each accept SEL-2700 series cards. Each card has 64 incoming control points, set by the card, and 64 outgoing control points that are set by the SEL-2030.

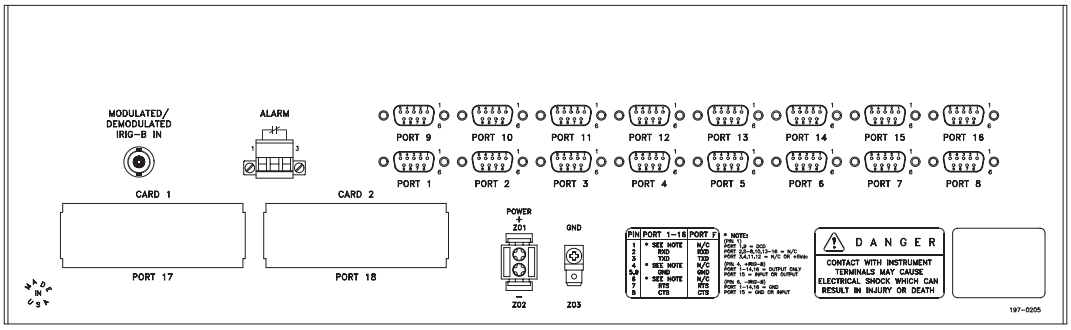
The SEL-2030 also supports virtual terminal connections through the optional communications card slots. For example, with an SEL-2701 Ethernet Processor installed, Ethernet users can establish Telnet sessions through the card, issue a **PORT** command, and communicate with an IED connected to the SEL-2030.



FRONT PANEL



REAR PANEL (WITH I/O)



REAR PANEL (WITHOUT I/O)

DWG. II343

Figure 1: SEL-2030 Front and Rear Panels

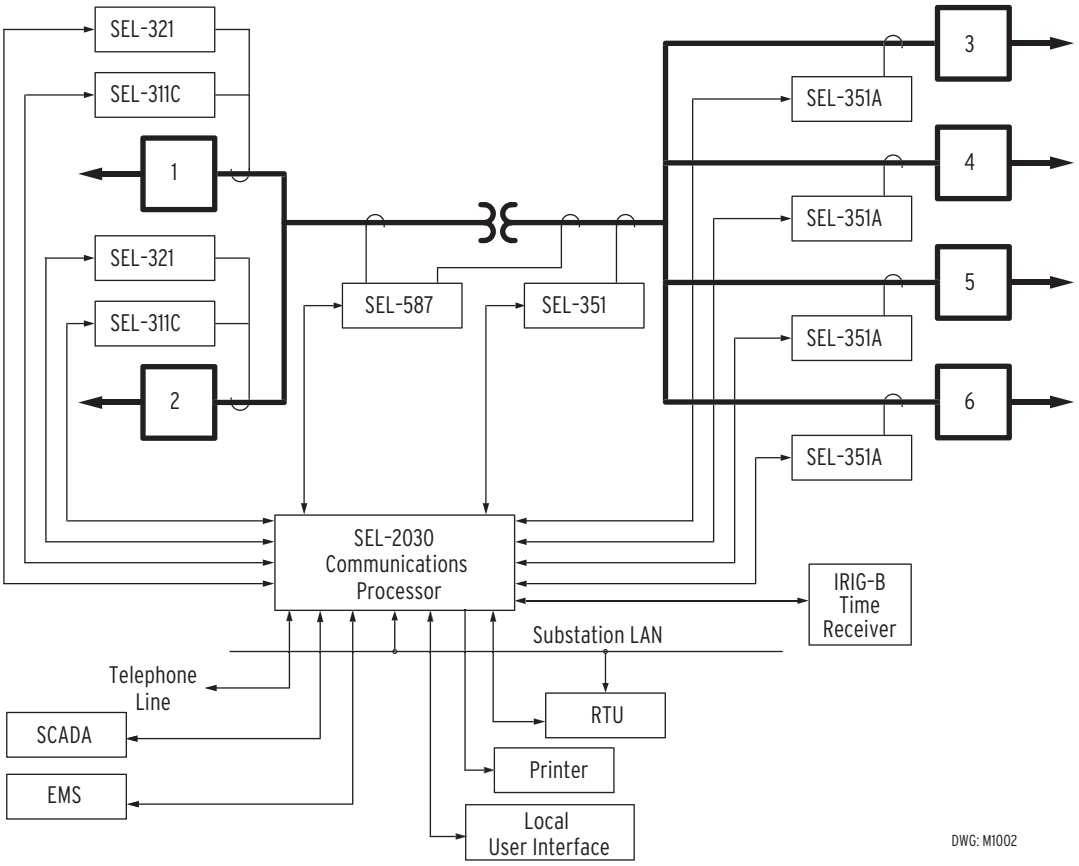


Figure 2: SEL-2030 Example Configuration Diagram

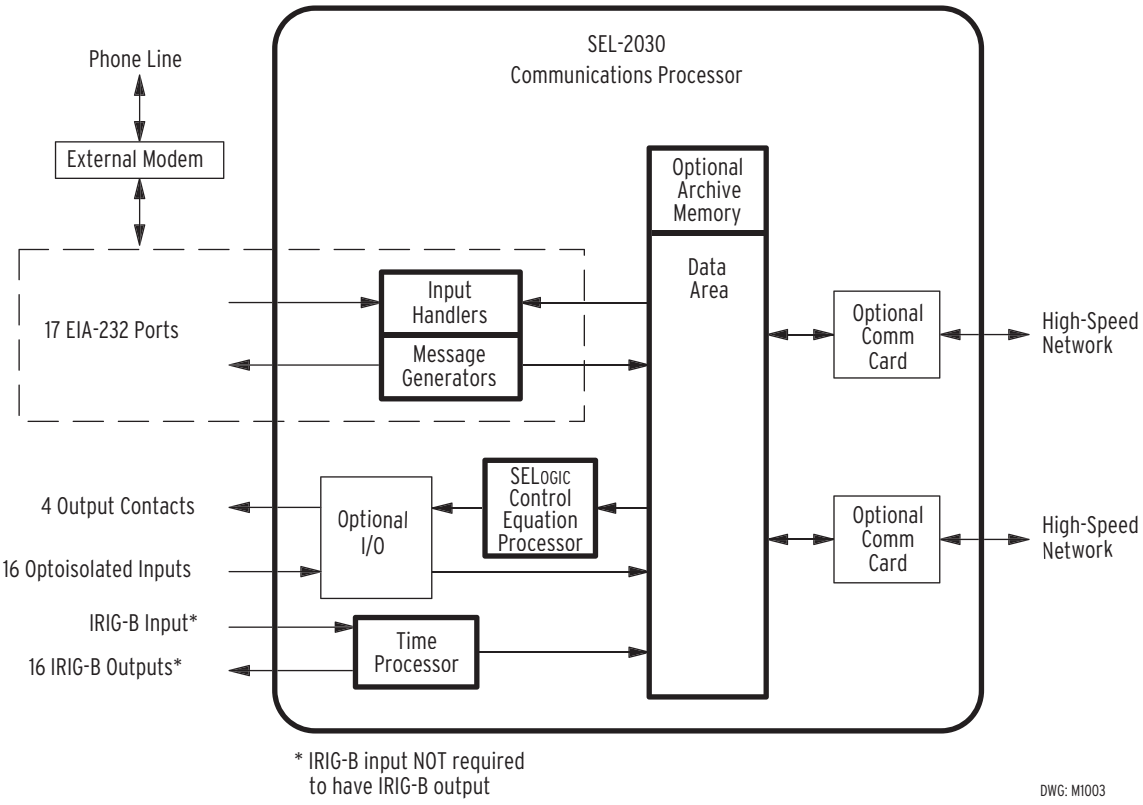


Figure 3: SEL-2030 Functional Model

Functional Model

Figure 3 shows a functional model of the SEL-2030 including the Input Handlers, Message Generators, Data Area, SELOGIC Control Equations Processor, Time Processor, optional I/O, and optional nonvolatile archive memory.

Input Handler/Message Generator

There is an Input Handler and Message Generator for each serial port. When you communicate with the SEL-2030 using the command set, the Input Handler separates the commands into their basic components. The Input Handler sends data to the Data Area and directs the Message Generator to make a response based on the SEL-2030 settings that you have defined.

When you use the SEL-2030 as a port switch, the Input Handler places collected data in the Data Area, and the Message Generator reads and outputs these data to a designated port. The Input Handler also stops communication when it recognizes the default termination condition or a termination condition you have defined in settings.

Messages are predefined responses that may include data, responses to special-purpose user-defined commands, and automatic messages that you have defined in settings and that are triggered by SELOGIC Control Equations. You can use relay automatic messages to initiate data collection by setting the SEL-2030 to collect and store data when an unsolicited message is received. For example, receiving a summary event report could trigger the SEL-2030 to send the **EVENT** command back to the relay. The relay would respond with the long event report, and the SEL-2030 could then save it. You can store the data in volatile RAM or in the optional nonvolatile archive memory.

When enabled, based on SEL-2030 settings, the Input Handler receives binary sequential events recorder (SER) messages from SEL relays and places them in temporary data storage. These messages are then forwarded by the Message Generator along with SER messages generated by the change-of-state (COS) of the SEL-2030 local I/O.

Data Area With Automatic Database

The Data Area is divided into regions of volatile (RAM) and nonvolatile memory. The SEL-2030 stores settings in nonvolatile memory. The SEL-2030 is unique in its ability to receive, parse, store, and distribute data. The SEL-2030 automatically parses data from SEL relays, and has several parsing options for data from other devices. Additional nonvolatile archive memory is an option you can use for long-term data storage.

SELOGIC Control Equations Processor

The SELOGIC Control Equations Processor executes Boolean equations that you write to trigger transmission of messages. The Boolean values in the equations can be logic bits from the Data Area or comparisons against the present time. You can program the SEL-2030 to recognize user-defined commands and to set a bit in the Data Area when it receives one of these commands. The SELOGIC Control Equations Processor can then use this bit to initiate another operation, such as collecting data or transmitting a message. The SELOGIC Control Equations Processor also controls the optional I/O.

Time Processor

The Time Processor keeps the date and time, reads IRIG-B time input (if it is present), and broadcasts demodulated IRIG-B time code to all rear-panel serial ports. It also time-tags data stored in the Data Area and supplies time of day and day of the week input to the SELOGIC Control Equations Processor.

Optional Input/Output

If the optional I/O is installed, the inputs and outputs operate with the Data Area and the SELOGIC Control Equations Processor. Optoisolated inputs feed directly into the Data Area as logic bits, which you can view using SEL-2030 commands. You can program SELOGIC Control Equations to use the logic bits. The SELOGIC Control Equations Processor controls the output contacts on the I/O board. These outputs can be programmed to operate based on Data Area bits or time comparisons. This powerful capability lets you build adaptive relay schemes, automate responses to alarms, and directly control power apparatus.

Optional Communication Cards

The optional communication cards allow the SEL-2030 to be connected to high-speed networks. See additional product model number SEL-27XX data sheets for descriptions of the specific high-speed networks available.

SPECIFICATIONS

Output Contacts
IEEE C37.90 Tripping Output Performance Requirements.
30 A make.
6 A carry.
MOV protected: 250 Vac RMS/330 Vdc continuous.
Per IEC 255-0-20: 1974, using the simplified method of assessment.
50 A for one second.

Optoisolated Input Ratings
The optoisolated inputs each draw 4 mA when nominal control voltage is applied.
Level-Sensitive Inputs (Sixteen inputs total, with optional I/O board)
48 Vdc: Operate (pickup) 38.4–60 Vdc; Dropout 28.8 Vdc
125 Vdc: Operate (pickup) 105–150 Vdc; Dropout 75 Vdc
250 Vdc: Operate (pickup) 200–300 Vdc; Dropout 150 Vdc

Tightening Torque
Minimum: 7-in-lb (0.8 Nm)
Maximum: 12-in-lb (1.4 Nm)

Terminal Connections
Terminals or stranded copper wire. Ring terminals are recommended.
Minimum temperature rating of 105°C.

Power Supply

Rated:	125/250 Vdc or Vac
Range:	85–350 Vdc or 85–264 Vac
Burden:	<25 W
Rated:	48/125 Vdc or 125 Vac
Range:	38–200 Vdc or 85–140 Vac
Burden:	<25 W
Rated:	24/48 Vdc
Range:	20–60 Vdc polarity dependent
Burden:	<25 W

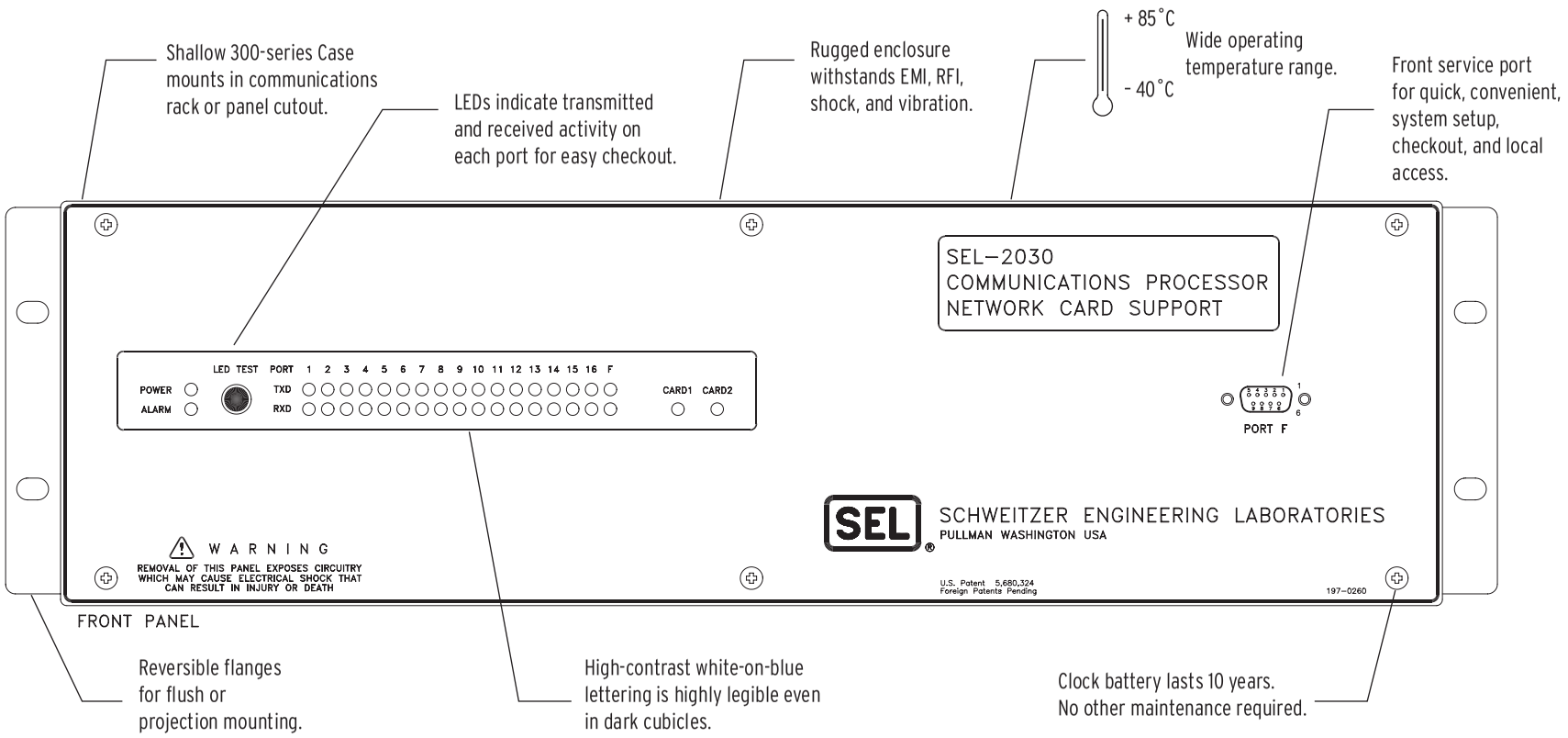
Production Dielectric Strength
Power supply, logic inputs, and output contacts: 3,100 Vdc for10 seconds.

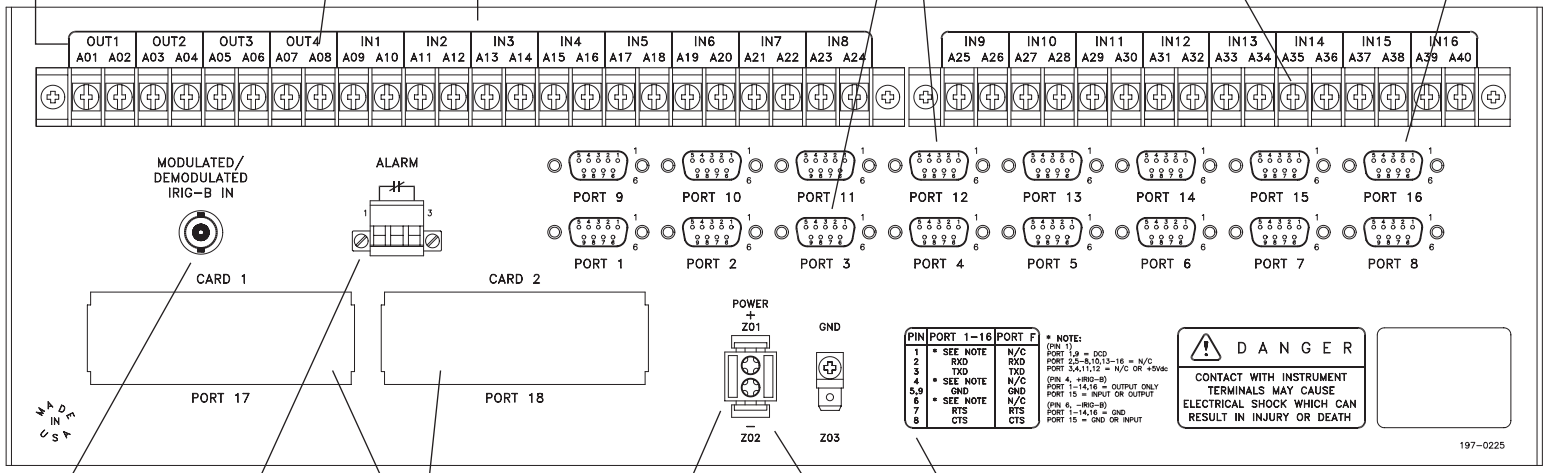
Operating Temp.
–40° to 185°F (–40° to 85°C).

Unit Weight
7 lb, 12 oz (3.50 kg).

Dimensions
5.22" H x 19.00" W x 9.00" D (13.26 cm x 48.26 cm x 22.86 cm).

Integrate New and Existing Substations Today Using the SEL-2030 Communications Processor





REAR PANEL (WITH I/O)

All terminals are clearly numbered and lettered for precise wiring and testing.

Programmable I/O integrates control, protection, and communication.

High-contrast white-on-blue lettering is highly legible even in dark cubicles.

Ports handle SEL relays and virtually all other IEDs, as well as computers, printers, RTUs and modems.

Screw terminals accept ring lugs with wires up to AWG #10.

All rear ports provide communications and time code.

Internal clock generates time code, and syncs to modulated or demodulated time-code input.

Alarm contacts signal self-test status.

Supports two plug-in protocol cards.

Consumes only 12 watts.

Wide-range power supply.

All DB-9 connector pin assignments are clearly identified.

SPECIFICATIONS (CONTINUED)

Type Tests and Standards

IEEE C37.90-1989 IEEE Standards for Relays and Relay Systems Associated with Electrical Power Apparatus, Section 8: Dielectric Tests.
Severity Level: 2500 Vac on optoisolated inputs and output contacts; 3100 Vdc on power supply.

IEEE C37.90.1-1989 IEEE Standard Surge Withstand Capability (SWC) Test.
Severity Level: 2.5–3.0 kV oscillatory, 4.0–5.0 kV fast transient on optoisolated inputs, output contacts and power supply.

IEEE C37.90.2 (Issued for trial use December 1987) Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
Severity Level: 10 V/m

Exceptions:

5.5.2(2)	Performed with 200 frequency steps per octave
5.5.3	Digital Equipment Modulation Test not performed
5.5.4	Test signal turned off between frequency steps to simulate keying

IEC 68-2-1: 1990 Test Ad: Cold.
Severity Level: 16 hours at –40°C.

IEC 68-2-2: 1974 Dry heat.
Severity Level: 16 hours at +85°C.

IEC 68-2-30: 1980 Damp heat, cyclic (12 + 12-hour cycle).
Severity Level: 55°C, 6 cycles.

IEC 255-5: 1977 Insulation tests for electrical relay.
Section 6: Dielectric Tests
Severity Level: Series C (2500 Vac on optoisolated inputs and output contacts; 3100 Vdc on power supply).
Section 8: Impulse Voltage Tests
Severity Level: 0.5 Joule, 5000 Volt.

IEC 255-21-1: 1988 Vibration test (sinusoidal).
Severity Level: Class 1

IEC 255-21-2: 1988 Shock and bump tests.
Severity Level: Class 1

IEC 255-21-3: 1993 Method A seismic tests (not tested below 5 Hz).
Severity Level: Class 2

IEC 255-22-1: 1988 1 MHz burst disturbance tests.
Severity Level: 2.5 kV peak common mode, 1.0 kV peak differential mode.

IEC 255-22-2: 1996 Electrostatic discharge tests.
Severity Level: IV (8 kV contact discharge to logic inputs, output contacts, time-code input, power supply and EIA-232 port shells; 16 kV air discharge to EIA-232 ports).

Exception:
Using contact discharge where applicable per IEC 801-2 (1991-04).

IEC 255-22-3: 1989 Radiated electromagnetic field disturbance tests.
Severity Level: 10 V/m

Exception:
4.3.2.2 Frequency sweep approximated with 200 frequency steps per octave.

IEC 255-22-4: 1992-03 Fast transient disturbance test.
Severity Level: 4 (4 kV @ 2.5 kHz on power supply, 2 kV @ 5 kHz on EIA-232 ports, optoisolated inputs and output contacts).

EN 61000-4-2: 1995 Electrostatic discharge immunity test.
Severity Level: IV (8 kV contact discharge to logic inputs, output contacts, time-code input, power supply and EIA-232 port shells; 16 kV air discharge to EIA-232 ports).

EN 61000-4-4: 1995 Electrical fast transient/burst immunity test.
Severity Level: 4 (4 kV @ 2.5 kHz on power supply, 2 kV @ 5 kHz on EIA-232 ports, optoisolated inputs and output contacts).

Serial Ports 1 front-panel/16 rear-panel ports, DB-9 connectors, MOV protected.

Real-Time Clock/ Calendar
Battery Type: IEC No. BR2335 Lithium.
Battery Life: 10 years.
Clock Accuracy: ±20 min/yr @ 25°C (without power applied).
±1 min/yr @ 25°C (with power applied).
±1 ms with IRIG-B time-code input.

Serial Data Speeds 300; 600; 1,200; 2,400; 4,800; 9,600; 19,200; 38,400 bps.

Time-Code Input
Connector: Female BNC and pin-in port 15 connector.
Time Code: Modulated IRIG-B 1000 Vdc isolation.
Demodulated IRIG-B TTL-compatible.
Automatically sets SEL-2030 real-time clock/calendar.

Time-Code Output
Pinout: Pin 4 TTL-level signal.
Pin 6 Chassis ground reference.
Connectors: All 16 rear DB-9 port connectors.
Outputs are generated from IRIG-B input (when present) or generated by CPU from real-time clock/calendar.

Optional Memory
Base memory: 256 kB shared RAM, 64 kB EEPROM.
Expanded RAM: 1 MB of shared RAM, 64 kB EEPROM.
Expanded RAM, Archive (Flash): 1 MB of shared RAM, 64 kB EEPROM, 2 MB Flash.

Plug-in Card Slots: 2 rear-panel card slots, SEL standard shared memory data interface, and virtual terminal support.

APPLICATIONS

Collect and Format Data From Relays for SCADA Systems

You can use strings that you define to instruct the SEL-2030 to collect and format relay data for SCADA systems. Simple settings enable you to individually configure SEL-2030 ports to define their data retrieval and storage attributes. Instruct the SEL-2030 to automatically interrogate connected devices for data collection. The SEL-2030 can also provide a uniform data interface to the SCADA devices, so that the SCADA software does not have to specifically accommodate each IED type.

Access Data Through Multiple Paths

Different departments in a utility may be interested in different data and different data rates. For example, a system operator may be interested in metering and contact data every 5 or 10 seconds and fault location shortly after a fault. A protection engineer is usually interested in setting relays, and analyzing a full event report after a fault occurs. You can accommodate these needs by connecting one port on the SEL-2030 to a SCADA RTU for the operator and a telephone modem to another port for the protection engineer.

Program the SEL-2030 Database Functions

Use the SEL-2030 settings and SELOGIC Control Equations to build a database of load profiles and event reports and to store them in nonvolatile memory. Define commands so different devices can retrieve appropriately formatted data.

Perform Programmable Logic Controller (PLC) Functions

Use Boolean and arithmetic operators to create logical schemes to produce and forward information or perform control to eliminate auxiliary devices.

Synchronize All Relay Clocks Within a Substation

The SEL-2030 receives an IRIG-B time-code input from a single IRIG-B receiver or local clock and distributes it to the devices connected to any of the 16 serial ports. The SEL-2030 supports modulated or demodulated time-code input.

If there is no external signal, the SEL-2030 generates an IRIG-B signal using an internal clock so you can synchronize device clocks without an IRIG-B receiver or local clock.

Create Station-Wide SER

Monitor local input contacts to timestamp COS of discrete contacts, and create and queue an SER message for each occurrence. The SEL-2030 can then forward these SER messages, and route SER messages received from relays, to a host.

Use Events to Switch Relay Setting Groups

Program the SEL-2030 to use the time of day, day of the week, or a specific event, such as a relay alarm output, to switch relay setting groups.

Monitor Relay Alarm Contacts

With the optional I/O installed, you can program the SEL-2030 to monitor relay alarm contacts. Instruct the SEL-2030 to send predetermined messages or initiate an action you designate, like closing an output contact based on these inputs.

Log Messages On a Local Printer

You can set the SEL-2030 to print selected messages, including control actions, diagnostic status messages, short event reports, and demand meter data.

Drive a Local Human-Machine Interface With Relay Data

Connect a computer to the SEL-2030 through the computer serial port. Using your own human-machine interface (HMI) software, you can build screens and specify the HMI data definition. You can create commands that instruct the SEL-2030 to send selected data to the standard serial port interface for the HMI package.

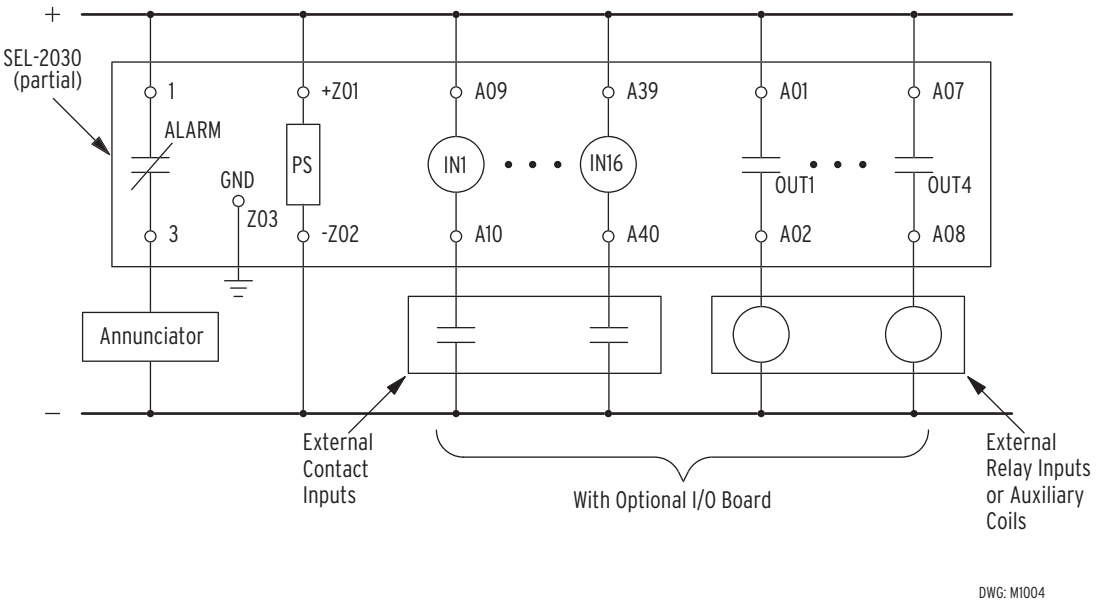


Figure 4: SEL-2030 Typical DC Wiring Diagram

SEL-5020 Settings Assistant Software for Learning, Setting, and Communicating With the SEL-2030 Communications Processor

The SEL-5020 Settings Assistant is a graphical user interface that provides an intuitive Windows® environment for setting and communicating with the SEL-2030 Communications Processor. The Settings Assistant helps the user create or edit settings and establish communications (using a serial connection) between the Settings Assistant on the PC and the SEL-2030. Complex strings and SELOGIC Control Equations are facilitated using String and Expression Builders in the SEL-5020. While special software is not required to communicate with and set the SEL-2030, the SEL-5020 Settings Assistant can be a valuable tool, especially when setting multiple SEL-2030s.

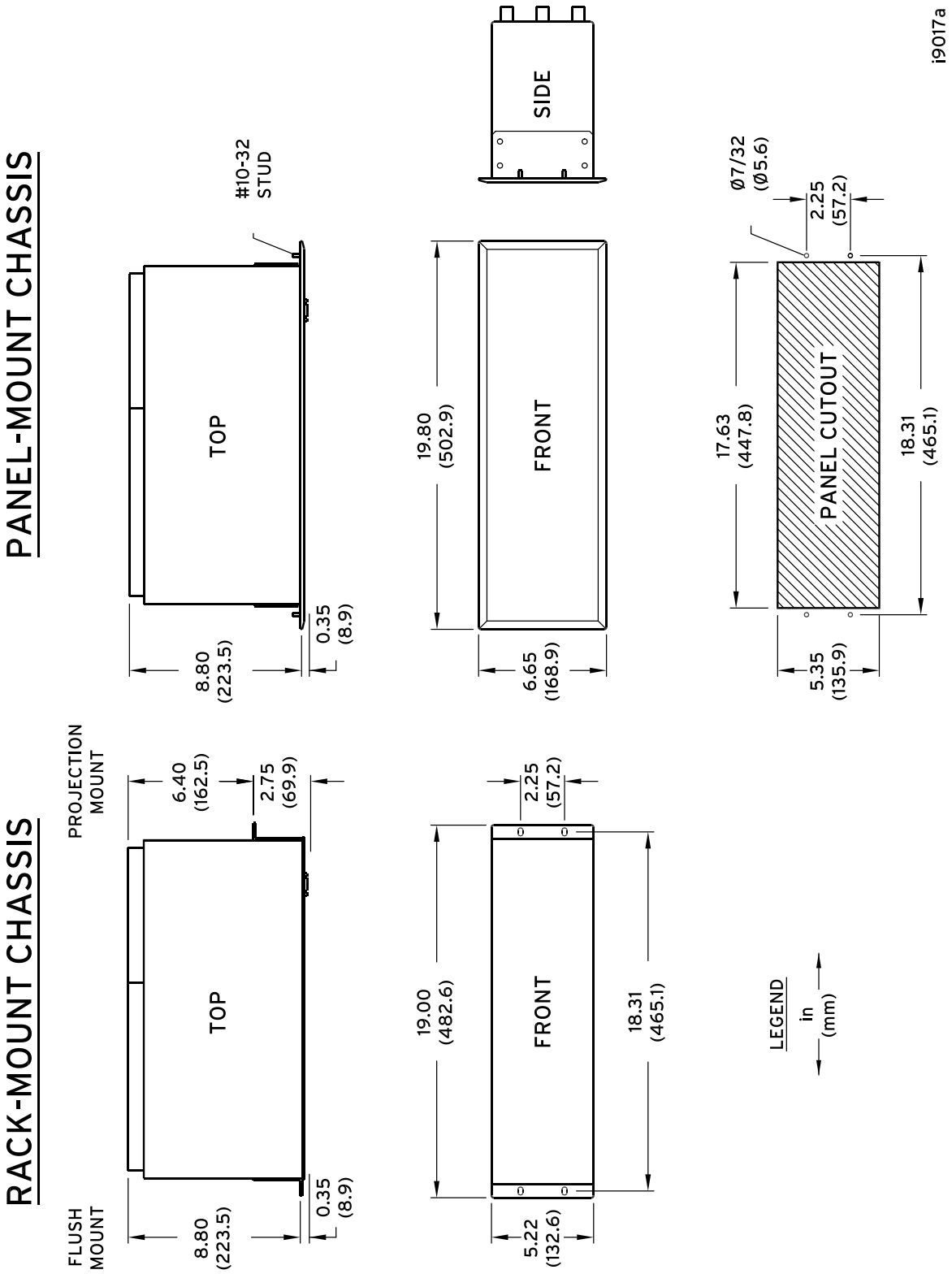


Figure 5: SEL-2030 Dimensions and Panel-Mount Cutout

FACTORY ASSISTANCE

The employee-owners of Schweitzer Engineering Laboratories are dedicated to making electric power safer, more reliable, and more economical.

We appreciate your interest in SEL products, and we are committed to making sure you are satisfied. If you have any questions, please contact us at:

Schweitzer Engineering Laboratories
2350 NE Hopkins Court
Pullman, WA USA 99163-5603
Tel: (509) 332-1890
Fax: (509) 332-7990

We provide prompt, courteous, and professional service.

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

SEL-2030 Communications Processor Data Sheet Date Code 20010619

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SECTION 2: GENERAL DESCRIPTION

INTRODUCTION

The SEL-2030 Communications Processor provides many special features needed in today's substations to communicate with a variety of microprocessor-based devices. The SEL-2030 can function as a simple, but intelligent, port switch. Or it can provide sophisticated communication and data handling capability required for advanced substation integration projects. The following pages describe the SEL-2030's features and their benefits to the user.

BASIC (BUT POWERFUL) FUNCTIONS

The SEL-2030's unique design and powerful features make it useful for a variety of functions. It can serve as an intelligent port switch, a synchronizing time source, a communications processor, a network interface, a SELOGIC® Control Equations programmable controller, and an automatic database.

- **Intelligent Port Switch**: The SEL-2030, in its most basic role, is a port switch. Several features of the SEL-2030 improve significantly on that role, such as its multi-tasking/ multi-user capability, auto-configuration, wide range of settable baud rates (300 baud to 38400 baud), and complete selection of communication parameters (data bits, parity, stop bits, RTS/CTS, and XON/XOFF).

- **Synchronizing Time Source**: The SEL-2030 distributes a demodulated IRIG-B signal through Ports 1 to 16. This signal can be used by any attached device that recognizes the IRIG-B code by connecting the proper cable to the SEL-2030. The signal can be distributed to SEL relays that accept IRIG-B input, simply by using a special cable designed for both communication and IRIG-B signals. The SEL-2030 internally generates the IRIG-B signal, unless you connect an external source of modulated or demodulated IRIG-B to the SEL-2030. If the connected device does not accept IRIG-B, you can program the SEL-2030 to send a date and time message to the device.

- **Communications Processor:** The SEL-2030 can send and receive message strings and codes in several different formats, permitting communication with a variety of devices, including SEL relays, PCs, modems, RTUs, printers, other IEDs, and other SEL-2030s. The built-in command set facilitates communication to and through the SEL-2030 using any communication software that supports ASCII terminal emulation. You can also develop user-defined command strings to communicate to and from non-SEL devices.

- **Network Gateway:** The SEL-2030 can connect to a variety of networks. Natively, the SEL-2030 can communicate as a Slave on a Modbus® RTU or DNP 3.00 network. It also supports two plug-in protocol cards for connection to high-speed networks. These features make the SEL-2030 an ideal gateway between IEDs and networks.

- **SELOGIC Control Equations Programmable Controller**: The SEL-2030 includes powerful SELOGIC Control Equations that can be used to trigger messages, commands, and control functions.

- **Automatic Database**: The SEL-2030 is unique in its ability to receive, parse, store, and distribute data. The SEL-2030 automatically parses data from SEL relays. Several parsing options are available to parse data from devices other than SEL relays. Selected portions of the parsed data can be collected from each port's data region to reduce the processing burden for downstream devices.

INTELLIGENT PORT SWITCH

You can configure the SEL-2030 as a port switch simply by using the **SET P** command to activate and configure each port that has a device connected. Port F on the front and Port 8 on the rear panel are configured as Master ports at the factory, so you can connect your PC or terminal to either of these to communicate with the SEL-2030. The default communication parameters for Port F are 2,400 baud, 8 data bits, 1 stop bit, and no parity. For Port 8, the default is 9,600 baud, 8 data bits, 2 stop bits, and no parity.

Once you have configured each port using the **SET P** command, you can enter transparent communication with the device on any port using the **PORT n** command, where n is the number of the port. To quit transparent communication, simply use the default disconnect sequence, **<CTRL-D>**, by holding down the Control key and pressing D on your keyboard.

The following features make the SEL-2030 a very intelligent port switch.

Sixteen EIA-232 Rear Ports and One EIA-232 Front Port

Front and rear ports provide connection space for numerous types of devices, including SEL relays, other types of IEDs, PCs, printers, modems, and even other SEL-2030s. You can independently configure each port of the SEL-2030 to match the communication parameters of the attached device. All communication parameters are software settable. Baud rates can be set up to 38,400 baud.

Multi-Tasking/Multi-User Operating System

The powerful SEL-2030 operating system allows operations to occur on all ports simultaneously. This capability allows multiple users to communicate with, or through, the SEL-2030 at the same time; other functions, like printing and modem dial-out, can also occur on different ports. In addition, on ports connected to SEL relays that support *Fast Meter* data collection, the SEL-2030 continues to collect meter data while the port is being used for normal ASCII operation: either ASCII data collection or transparent operation.

Who's Who Port Directory

The **WHO** command provides you with a list of all of the ports, the type of relay or device connected to each port, the current communication parameters, and a port ID string that describes the device or application. The device type and port ID string are entered automatically during the auto-configuration process when the connected device is an SEL relay.

Multi-Level Password Security

Passwords are required to gain access to the various communication levels of the SEL-2030. One level allows interrogation of settings and data only. Access to a second level is required to change settings.

Auto-Configuration

Setting the SEL-2030 communication parameters for a port is simplified through the SEL-2030's auto-configuration process. This process determines the proper baud to communicate with the connected device. The SEL-2030 also determines the startup string, relay type, *Fast Meter* capability, and relay ID for any SEL relay connected to its port. You should use the **SET P** command to activate and configure each port that has a connected device.

SYNCHRONIZING TIME SOURCE

You can synchronize the attached devices to an external time source or to the SEL-2030 built-in battery-backed clock.

Accepts External IRIG-B Input

The SEL-2030 accepts a modulated or demodulated IRIG-B signal through a rear-panel BNC connector. A setting, available with **SET G**, selects between modulated and demodulated IRIG-B operation. An internal database element asserts when the SEL-2030 receives an IRIG-B signal.

Generates IRIG-B Internally

If no external IRIG-B signal is applied, the SEL-2030 internal clock/calendar generates an IRIG-B signal. The SEL-2030 includes an internal battery-backed clock/calendar that maintains correct time with or without external power. The lithium-type battery has an expected life of 10 years. The internal clock is accurate to within 1 minute per year with power applied. You can easily reset the clock and calendar using the SEL-2030 **TIME** and **DATE** commands.

Distributes IRIG-B through Ports 1-16

The SEL-2030 distributes a demodulated IRIG-B signal through all of its 16 rear ports. You can use this to synchronize any type of device, such as a relay, fault recorder, or meter, that can decode the IRIG-B signal. To use this feature, you need only to connect the device to the desired SEL-2030 port using a special cable designed for both communication and IRIG-B signal. For devices that do not have an IRIG-B port or cannot decode the IRIG-B signal, the SEL-2030 can send time and date messages on a periodic or time basis to keep their clocks synchronized.

COMMUNICATIONS PROCESSOR

The SEL-2030 has a distinct and significant advantage over simple port switches because of its sophisticated and powerful communications processing capabilities.

Send Messages Triggered by SELOGIC Control Equations

Messages sent from the SEL-2030 can be used to request data from other devices, or to control other devices. Use "20" messages, such as 20METER and 20TARGET, to request SEL relay data that are recognized by the SEL-2030 and are automatically parsed upon arrival. Use non-"20" messages for other data collection and control purposes. On SEL IED ports, you can also have relay operate commands (**OPEN**, **CLOSE**) sent automatically.

Receive Messages and Data

The SEL-2030 can receive, buffer, parse, store, and act upon solicited and unsolicited messages and data.

Unsolicited Messages

Unsolicited messages are strings that are sent to the SEL-2030 without being solicited by the SEL-2030. These messages include:

SEL-2030 Command Set. The SEL-2030 command set consists of predefined messages, 28 in all, that the SEL-2030 recognizes, understands, and responds to. You can send these commands, such as **ACCESS**, **PORT**, and **VIEW**, from an ASCII terminal or PC using any communication program that supports ASCII terminal emulation. The SEL-2030 command set can be disabled on a port where user-defined commands are used.

IED Auto-Messages. IEDs may send data to the SEL-2030 without it being requested. These messages can be buffered and activities can be triggered based on specific messages. SEL relays send auto-messages to report specific activity or conditions. These include the SEL Event Report Summary issued through the SEL relay auto port when an event record is stored, the SEL Status Report issued to report a warning or failure, and the SEL Group Switch Report issued when a change in group settings occurs on a relay with multiple groups.

User-Defined Commands. You can define commands using the **SET U** command procedure. Receipt of one of these commands sets a command element that can be used in a SELOGIC Control Equation to initiate action defined in an associated message string. You can set the SEL-2030 to use these commands on IED ports to watch for unsolicited messages or on Master ports to supplement or replace the standard SEL-2030 command set. Use the **SET U** command to create User-Defined commands. **SET U** can also be used to instruct the SEL-2030 to watch for one, or more, of the standard SEL relay auto-messages. (See ***SEL-2030 Reference Manual; Section 3: Settings.***)

Modbus Protocol. You can select Ports 12, 14, and 16 of an SEL-2030 as Modbus ports. The network master (receiver) can access the database of all SEL-2030 ports through a Modbus port.

DNP Protocol. The SEL-2030 supports Distributed Network Protocol (DNP) 3.00 Level 2 Slave on Port 16. It can be used for data access and for control.

Solicited Messages and Data

A message received in response to an SEL-2030 automatic message is called a solicited message. The SEL-2030 can recognize a solicited message response in two ways:

"20" Message Response. The "20" message responses are automatically parsed based on the SEL-2030's knowledge of the data format. The SEL-2030 uses these messages with SEL relays to collect relay data such as meter, target, event, and history. Meter and target data are transferred from the SEL relay to the SEL-2030 in binary format if the relay has *Fast Meter* capabilities.

These capabilities offer substantial advantages. *Fast Meter* data received from SEL relays consist of raw voltage and current samples. In many cases, the SEL-2030 calculates more output quantities from the raw data than the SEL relay that sampled the original data; these additional output quantities include current and voltage phasor angles, per-phase megawatts and megavars, and complete sequence components.

Fast Meter binary data are collected at a much higher speed than ASCII formatted data. Binary data transfer is not interrupted during transparent port communications, nor is it interrupted by ASCII data collection; ASCII data transfer is interrupted by transparent port communication. We highly recommend using relays with *Fast Meter* capability with the SEL-2030.

Non-"20" messages. Non-"20" responses can be ignored or parsed using any one of six parsing options: ASCII Integer, ASCII Floating point, Character string, Integer string, Integer string with XON/XOFF encoding, and Flexible Parsing. Non-"20" messages are primarily for use with devices other than SEL relays (see ***SEL-2030 Reference Manual; Section 5: Message Strings*** for more information).

You can use the **SET A** command to create SELOGIC Control Equations for message triggering and the associated message strings. Also use **SET A** to set the AUTOBUF switch that determines if unsolicited messages will be stored or ignored. (See ***SEL-2030 Reference Manual; Section 3: Settings.)***

NETWORK GATEWAY

The SEL-2030 has two plug-in slots in which protocol cards can be installed. This allows the SEL-2030 to connect up to 16 serial devices to 2 high-speed networks. Contact Schweitzer Engineering Laboratories for information on available network cards.

The SEL-2030 also supports virtual terminal connections through the optional communications card slots. For example, with an SEL-2701 Ethernet Processor installed, Ethernet users can establish Telnet sessions through the card, issue a **PORT** command, and communicate with an IED connected to the SEL-2030.

SELOGIC CONTROL EQUATIONS CONTROL EQUATIONS PROGRAMMABLE CONTROLLER

You can trigger messages and control action with SELOGIC Control Equations.

The SEL-2030 issues messages when a user-defined condition for issuing the message is true. The condition is defined for each message by a SELOGIC Control Equation using:

- Time (Thh:mm:ss.s)
- Period (Phh:mm:ss.s with optional start and stop time)

- Internal trigger using any bit in the SEL-2030 Database, including:
  - Global elements: Day-of-week, intermediate logic elements (V, W, X, Y, Z, VT, WT, XT, YT, and ZT), remote bits, alarm bit, protocol card failure bit, and external inputs (from optional I/O board)
  - Local elements: User-defined command elements, select-before-operate elements, database triggers, and relay operate elements
  - Relay elements: from SEL TARGET data

or any logical combination of the above.

SELOGIC Control Equations use OR (+), AND (*), and NOT(!) operations to combine terms. The SEL-2030 Global region includes intermediate variables V, W, X, Y, and Z to provide additional SELOGIC Control Equation message capability. The intermediate variables have associated timers to provide even greater control capability and flexibility. (See ***SEL-2030 Reference Manual; Section 4: SELOGIC® Control Equations.)***

Twelve message groups are available per port. Messages 1 to 8 have associated data buffers to store responses. Four message groups, Messages 9 to 12, are for messages only, having no associated data buffer.

The **SET A**, automatic message setting command, establishes the message count, 0 to 12, of active triggering equations and message strings used on each port. You are then prompted to create the SELOGIC Control Equations for message triggering and associated messages within the framework of the **SET A** setting. (See ***SEL-2030 Reference Manual; Section 3: Settings.***)

The SEL-2030 also supports 32 set/clear bits on each port. These bits can be controlled by SELOGIC Control Equations, or directly using Modbus, DNP, or *Fast Operate* protocols. (See ***SEL-2030 Reference Manual; Section 7: Protocols.***) Define the SELOGIC Control Equation with the **SET L** command. (See ***SEL-2030 Reference Manual; Section 3: Settings.***)

The plug-in card ports (17 and 18) each have 64 Control Input bits that are set by the plug-in card and are accessed as local elements by SELOGIC Control Equations. Ports 17 and 18 each have 64 Control Output bits; define their SELOGIC Control Equations with the **SET O** command.

AUTOMATIC DATABASE

Database Structure

The SEL-2030 Data Area includes a database structured as shown in Figure 2.1 consisting of the following defined regions: Global (GLOBAL), Local (LOCAL), Buffer (BUF), Data (D1-D8), Archive (A1-A3), and User (USER). For a more complete description of the database, see ***SEL-2030 Reference Manual; Section 6: Database***.

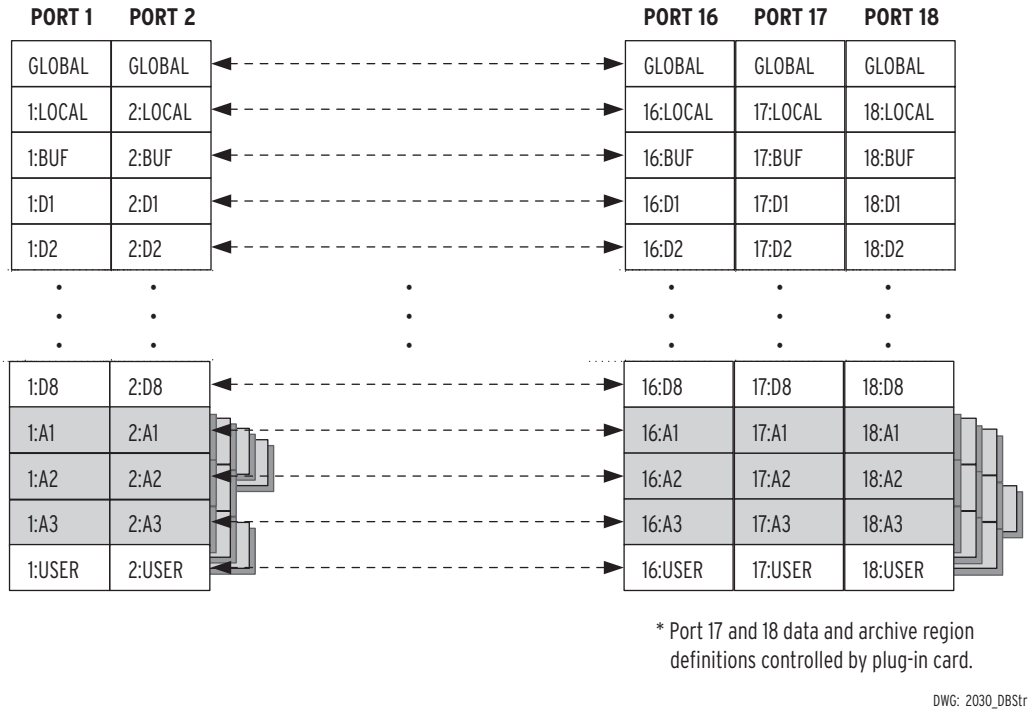

Figure 2.1: SEL-2030 Database Structure

Global Region

The Global region includes the following data that are common to all ports:

> SEL-2030 FID String, Status and Configuration information, Date and Time, Global elements, protocol card status, and Port F status.

Global elements are logical "1" when asserted or true, and "0" if not asserted or false. The Global elements, as the name implies, are stored in the Global data region, which is available for use by all ports. These elements can be used in any SELOGIC Control Equation to define a trigger condition. When the condition is true, the SEL-2030 sends the message associated with the SELOGIC Control Equation, such as requesting data or issuing a control command.

Table 2.1 lists the Global elements as they are stored in the Global data region. A brief description of these elements and their function follows the table.

Table 2.1: SEL-2030 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	*	PCFHI	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 external IRIG-B status element 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 elements, 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); there has been at least one data collection missed since the last **STATUS** command (SDLY); a protocol card has failed to initialize (PCFHI); a SELOGIC Control Equation generated alarm has occurred (ALARM); and alarm pulse (SALARM).

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). These elements are controlled by SELOGIC Control Equations. Timer bits, VT and WT, assert when the pickup timer times out until the dropout timer times out.

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

Local Region

The Local region includes the following information that is unique to each serial port (1–16) and each network port (17–18):

Status and Configuration, Archive Counter (nonvolatile Flash memory only), Local elements, Special Command Registers (SBO and CMD), FID String of attached device, and Port Identification String.

Local elements are logical "1" when asserted or true, and "0" if not asserted or false. The Local elements, as the name implies, reside in the Local data region on each port. These elements can be used in any SELOGIC Control Equation to define a trigger condition. When the condition is true, the SEL-2030 will send the message associated with the SELOGIC Control Equation, such as requesting data or issuing a control command.

Table 2.2 lists the SEL-2030 Local elements associated with each port. A brief description of these elements and their functions follows the table.

Table 2.2: SEL-2030 Local Elements for Each Port (1–18)

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) elements 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) elements 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.

Rows 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.

Table 2.3 lists additional elements available for Ports 17 and 18. A brief description of these elements and their functions follows the table.

Table 2.3: 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	CCOUT4	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.

BUF Region

The BUF region contains buffered unsolicited messages from its associated port if you have set AUTOBUF to Yes. The buffer accumulates messages until it is full, at which point the newest message overwrites the oldest message. The buffer can be read and cleared in a number of ways both manually and automatically.

D1 to D8 Regions

For all ports, except the front port, the database includes data regions D1 to D8, allocated for data solicited by the SEL-2030. The first four registers of each region hold the date and time the data were collected. The remainder of each region is for the collected data. How the information is parsed, or separated into useful groups, will depend on the type of data and how it is collected. Each data region is associated with a message created using the **SET A** command. For example, the response from Message 1 will be captured in data region D1 and Message 2 response in data

region D2. Responses from "20" messages, which include the following, are parsed automatically:

20METER, 20TARGET, 20DEMAND, 20HISTORY, 20STATUS, 20BREAKER, 20EVENT, 20EVENTS, and 20EVENTL.

Data received in response to non-"20" messages are parsed according to the parsing option you selected in the SET A automatic message settings. Non-"20" message parsing options include the following:

Ignore, ASCII Integer, ASCII Floating-Point, Character String, Integer String, and Integer String with XON/XOFF encoding.

Each response is time-tagged by the SEL-2030 at the time it begins receiving the message. Data collected in regions D1 to D8 are held until the next data are received; the new data overwrite the old data. The SEL-2030 will assign a data label to each data region, depending on the message content and parsing method you choose. For example, if you set Message 1 on Port 1 to collect meter data from an SEL relay using the **20METER** command, the region 1:D1 will be assigned a data label of METER. This label can be very helpful when you address the region to **MAP** or **VIEW** the data, or to retrieve specific data items from the data region.

A1 to A3 Regions

The archive data regions, A1 to A3, are only available if the SEL-2030 is equipped with optional nonvolatile Flash memory. These regions are designed for long-term storage of information, such as SEL relay long event reports and meter demand data. Each archive data region works on a First-In-First-Out (FIFO) basis. The number of records that can be stored in each region depends on the size of each record. Individual records can be viewed, retrieved, and cleared.

User Region

The User region is available on each port for any purpose you desire. You can write data to this area from a master device using the **STORE** command or the special user-defined data **WRITE** command. You can also copy data here from other regions for centralization and custom organization using the **SET M** command. Any port can then use data in this region to construct messages.

Database Tools

The SEL-2030 command set contains several commands to help you check that requested data are placed in the proper database location and to prevent interference between data requests and responses.

AUTO

This SEL-2030 command provides a list of supported operate and "20" commands on auto-configured SEL IED ports. You can use this to confirm that the desired commands exist for the relay you are using.

MAP

This SEL-2030 command provides a method to look at the structure and addresses of a database region on a port-by-port basis, or at specific regions within each port's database. When this command is applied to a port, the SEL-2030 responds with a list of database regions, their data names, and the number of archive records. You can also use the **MAP** command to look at the database structure within a region. When this command is applied to a region, the SEL-2030 responds with a list of data item labels, their addresses, and the type and number of data.

VIEW

This SEL-2030 database tool enables you to look at the data that are being collected, parsed, and stored in a database region on a specific port. Several variations of this command allow you to view all, part, or specific items within the data region.

TARGET

You can use the **TARGET** command to view the status of the SEL-2030 Global and Local elements and the status of any relay elements that are received from an SEL relay. The relay elements will appear to be appended to the Local elements. The **TARGET** command, like the SEL relay **TARGET** command, includes variations that permit you to request all elements or a selected row of elements, and to automatically repeat the request a specified number of times.

CARD

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.

STATUS

The **STATUS** command provides you with an overview of the SEL-2030 performance and a port-by-port analysis of communication and database performance. Any problems with data collection or database delays occurring in any specific region will be identified on this report. This information will help you determine if data are being requested faster than can be accommodated by the attached device, or if multiple requests are interfering with each other. The status display also identifies ports in transparent communication.

MEM

The **MEM** command indicates the status of the RAM, Shared RAM, EEPROM, and FLASH memory pools. You can use this to determine if you are in danger of running out of memory.

Data Parsing Options

The SEL-2030 database stores data that are parsed, or separated, into the smallest useful items. Parsing data in the SEL-2030 reduces communication and processing burdens 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 performs the data parsing in several ways:

"20" Message Response

The SEL-2030 automatically parses data that are recognized. These data are requested using the "20" message format. The type of response will depend on the attached device's capability. If it has *Fast Meter* capability, the responses to 20METER messages are in binary format and the responses to 20DEMAND and 20TARGET messages may also be in a binary format.

Non-"20" Message Response

Message responses that are not recognized as SEL data can be ignored or parsed by one of five techniques:

ASCII Integer (Parse = 1). Parses numbers only; every number separated by a space, comma, decimal, or any other character becomes a separate item.

ASCII Float (Parse = 2). Parses numbers only, but retains decimals as part of each number.

Character String (Parse = 3). Retains all numbers and characters in a character string.

Integer String (Parse = 4). Stores each pair of received bytes in a register, most-significant-byte first. This option is primarily useful for capturing data from devices that send data in binary words.

Integer String with XON/XOFF encoding (Parse = 5). Same as **Integer String** except special 2-byte encoding sequences used to represent XON (11h) and XOFF (13h) characters are translated back to the single-byte codes for XON and XOFF. This option is necessary when capturing binary data while using XON/XOFF flow control.

Flexible Parsing (Parse = 6). Parses received bytes based on the DECODE equation. This option is especially useful when the incoming data types can be either numbers or text.

SIMPLE SETTINGS

SET command variations allow you to configure and control the SEL-2030's operation. These include **SET P** for port configuration and communication settings, **SET A** for automatic messages, **SET U** for user-defined commands, **SET L** for SELOGIC Control Equation settings, **SET M** for data movement and scaling, **SET G** for global settings, **SET R** for sequential events recorder settings, **SET C** for calibration settings, and **SET O** for SELOGIC Control Equation

settings for the CCOUT bits. See the ***SEL-2030 Reference Manual, Section 3: Settings*** for more detailed information about this group of commands.

SET P - Port Configuration Choices (Ports F, 1-18)

You can use the SET P settings to establish each port's configuration and communication parameters. The configuration options are designed to make the SEL-2030 compatible with almost any device that has an EIA-232 port. This is the only setting command required to use the SEL-2030 as a port switch.

You should use the **SET P** command to configure each port. The first prompt from the SEL-2030 requests you to identify the type of device connected to the port. Port F can only be configured as a Master port. Ports 17 and 18 correspond to the protocol cards and are automatically set to match the installed card. The choices for Ports 1 to 16 include:

U (Unused)

The U response indicates that there is no device connected to the port. Accepting the setting with this choice deactivates the port.

S (SEL IED)

The S response indicates that an SEL relay or SEL-2030 is connected to the port (for other SEL devices, such as a PRTU, select O for Other IED). The SEL-2030 then asks you if the SEL-2030 should perform an auto-configuration with the relay on the port. If you respond YES, the SEL-2030 will automatically attempt to configure the port with information from the attached SEL relay. The SEL-2030 will determine the baud rate, relay type, relay ID, and if the SEL relay supports *Fast Meter* and *Fast Operate* data transfers. You will then be prompted for additional communication options and preferences.

O (Other IED)

The O response indicates there is an IED connected (possibly through a modem) to the port, but not an SEL relay. The SEL-2030 will ask you if the SEL-2030 should perform auto-baud with the device on the port. If selected, the auto-baud function will attempt to determine the correct baud rate needed to communicate with the attached IED. You will then be prompted for information about the device and other communication options and preferences.

P (Printer)

The P response indicates there is a serial printer attached to the SEL-2030. With this choice, you will be prompted for an ID string and several communication options and preferences.

M (Master)

The M response identifies the connected device as a master that can send messages to the SEL-2030 and receive messages from the SEL-2030. Master devices include PCs, RTUs, and modems. The SEL-2030 will prompt you with several configuration options and communication options and preferences.

SET A - Auto-Message Settings (Ports 1-18)

The **SET A** command prompts you for the following settings that control messages and data on each port:

AUTOBUF

You can save unsolicited messages to the port's buffer with AUTOBUF = Y. If AUTOBUF=N, the SEL-2030 does not store unsolicited messages received on the port.

STARTUP

STARTUP sets the startup string (such as **ACCESS** command and password) that the SEL-2030 must send to the device in order to access the device on that port to retrieve data or issue commands.

SEND_OPER

Use this setting on SEL IED ports to associate available operate commands (**OPEN**, **CLOSE**, **CONTROL**) and binary *Fast Operate*, as determined during auto-configuration, with the breaker (BR1 - BR16) and remote bit (RB1 - RB16) elements.

REC_SER

Use this setting on SEL IED ports to enable automatic Sequential Events Recorder data collection from the IED. Not all SEL IEDs support this feature.

NOCONN

Use this setting to allow or limit modem, transparent, and virtual terminal connections to or through this port. Use NA to allow these connections or a SELOGIC Control Equation to disable connections.

MSG_CNT

With the MSG_CNT setting you enter a number from 0 to 12 to tell the SEL-2030 how many messages you plan on setting for a given port. For each message, the following settings are repeated, where "n" is the message number. These include the trigger condition for each message, and the message string that will be sent out of the SEL-2030 port. These settings also determine how each message response is treated by the SEL-2030. Messages and data received in response to standard SEL-2030 messages ("20" messages) are parsed automatically into the database. Alternate parsing options are available for nonstandard messages (non-"20" messages).

ISSUEn

You use the ISSUE setting to write a SELOGIC Control Equation that defines at what time, period, or other logical condition the message will be sent to the attached device.

MESGn

You use the MESGn setting to define the message string that will be sent when the ISSUEn message trigger condition is asserted or true.

PARSEn

For MESG1 through MESG8, the response from the attached device can be stored in a data region associated with the port. If the message requests data that the SEL-2030 can recognize, the data will be automatically parsed in that data region. If not, the SEL-2030 will ask you to select a parsing option using the PARSEn setting.

DECODEn

This setting is available for FLEX parsing (PARSE = 6). Enter the Decode Equation to apply against the received characters. Data matching the Decode Equation are stored in the database region. See ***Data Parsing Options*** in ***Section 3: Settings*** of the ***SEL-2030 Reference Manual***.

NUMn

If you choose to store the unrecognized data using one of the parsing options in the PARSEn setting, the SEL-2030 will prompt you to set a limit on the amount of data stored using the NUMn setting.

DELAYn

This setting is used with non-"20" messages to determine the method for detecting the end of the incoming message. When communicating with SEL devices and DELAY is set to ON, the SEL-2030 will wait for a 15-second idle time before considering the message to be complete. The idle time is 5 seconds on other IED ports. When set OFF, the SEL-2030 will wait until it has received the desired number of data items or until a predetermined internal timer expires. See also ***Pausing Delays*** in the ***SETA*** section of the ***SEL-2030 Reference Manual***.

CHECKn

If the message being parsed contains a checksum, use this and the related settings that follow to enable the SEL-2030 to verify the message contents. This setting specifies the type of checksum that will be used to verify the message (8-bit, 16-bit, or CRC-16) as well as the checksum format (ASCII hexadecimal or binary). If the message does not contain a checksum or you do not care to verify it, this setting should be set to NONE.

ORDERn

If CHECKn is set for 16-bit checksum or CRC-16, this setting specifies the byte order of the checksum in the received message: high byte first or low byte first.

STARTn

This setting specifies a position in the received message where the checksum calculation begins. A numeric position in the string, or a specific character or character code, can be used to specify this setting.

STOPn

This setting specifies the position in the received message where the checksum calculation ends. Like the STARTn setting, this setting can be set using either a numeric position or a character code

CHKPOSn

This setting specifies the checksum location in the received message. Either a character code or a numeric position in the string can be used to specify the location.

ACKn

This setting specifies the Acknowledge string to be sent when the checksum in the received message is valid.

NACKn

If the connected device watches for Acknowledge/Negative Acknowledge strings for message confirmation, use the NACKn setting to set the Negative Acknowledge string to be sent whenever the checksum verification fails.

ARCH_EN

The ARCH_EN setting prompt is only presented if optional nonvolatile Flash memory is available. Set ARCH_EN=Y to enable the use of the nonvolatile Flash memory for this port. Other prompts will then be presented to request ISSUEnA and MESGnA settings for the Archive data areas.

USER

You use the USER setting to establish the size of a message area for temporarily storing data. The **STORE** command is used separately to place the message string and other data in the USER data region of a particular port. Even if you do not set the USER setting, the **SET M** command will, if necessary, automatically increase the size of the message area to accommodate the **SET M** settings.

SET U - User-Defined Commands (Ports 1-16)

The **SET U** command allows you to create user-defined commands that other devices send to the SEL-2030. You can also use this setting to trigger action from selected SEL relay auto-messages (Event, Status, and Group). The user-defined commands can supplement or replace the pre-

programmed SEL-2030 command set. This may be helpful if the device sending messages has some of the same commands as the SEL-2030, but different action is desired from the SEL-2030.

SET L - Logic (Ports 1-18)

The **SET L** command allows you to define control equations for all port-specific set and clear bits (SBR1 - SBR16, SRB1 - SRB16, CBR1 - CBR16, and CRB1 - CRB16).

SET M - Data Movement (Ports 1-18)

The **SET M** command allows you to scale and move data to a User region. This allows you to customize data scaling and organization in a central location. This can significantly reduce data access time by reducing the number of requests necessary to get the data of interest. On Port 16, the **SET M** command also defines what data is visible to DNP.

SET G - Global Settings

You use the **SET G** command to set global parameters that are used by all ports including the SEL-2030 ID string, intermediate logic variable settings, general logic timer settings,and the control equations for optional I/O board output contacts.

Use the TIME_SRC setting to specify the source for setting the time.

SET R – Sequential Events Recorder Elements

The **SET R** command allows you to specify the SEL-2030 contact inputs to include in the Sequential Events Recorder.

SET C - Calibration

There is normally no need for you to calibrate the SEL-2030 because it is fully calibrated at the factory. Calibration checks are only needed if you change EPROMs to upgrade the SEL-2030 firmware, and even then it is unlikely that any changes will be needed.

SET O Output Logic (Ports 17-18)

The **SET O** command allows you to define SELOGIC Control Equations for the 64 CCOUT bits (CCOUT1 - CCOUT64).

JOB DONE EXAMPLE

To demonstrate the power and simplicity of the SEL-2030, set the SEL-2030 to collect relay meter data from an SEL-251 Relay as follows:

1. Connect the SEL-251 Relay to an SEL-2030 port; this example uses Port 1. 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 Port 2R on the SEL-251 Relay because Port 2 on 200-series relays is capable of *Fast Meter* data transfer. 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 1 on the SEL-2030.

2. Access Level 2 on the SEL-2030 and issue the command **SET P 1** to configure Port 1. The SEL-2030 will prompt for the type of device connected to the port. Enter **S** for SEL IED, **Y** to auto-configure the port, and press the **<ENTER>** key to confirm the configuration prompts. The SEL-2030 will establish communication with the relay; determine the type of 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.

3. Next, issue the command **SET A 1** to set an auto-message to collect relay meter data. Respond to prompts about saving unsolicited messages (AUTOBUF), the STARTUP string, operate command enable (**SENDOPER**), and receive SER enable (**RECSER**). Press **<ENTER>** to confirm the defaults for all of these. 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 1 LEDs on the SEL-2030 will begin to flash as the SEL-2030 requests and receives meter data every second.

4. Verify connection, configuration, and data transfer using SEL-2030 commands **WHO**, **MAP**, **VIEW**, and **STATUS** as follows:

    a) Verify that the relay is connected to the desired port and configured properly by issuing the **WHO** command. The SEL-2030 responds to this command with some basic information about the SEL-2030 and a list of the devices and device identification strings associated with each port. In this case, the list shows that an SEL-151 device is connected to Port 1. The report lists the "151" and not "251" because the 151 firmware is used in both the 100 series and 200 series hardware packages.

```
*>WHO<ENTER>

                                        Date: 01/25/01    Time: 11:06:56
FID=SEL-2030-R113-V0-Z000000-D20010122    FID=SLBT-2030-R103-V0-Z000000-D20010122

Port#  Device    Protocol   Parameters  Identification
1      SEL-151   SEL        9600,8,2,N  Example 21.6 kV Line
2      SEL-IED   SEL        9600,8,2,N
3      SEL-IED   SEL        9600,8,2,N
4      SEL-IED   SEL        9600,8,2,N
5      SEL-IED   SEL        9600,8,2,N
6      SEL-IED   SEL        9600,8,2,N
7      SEL-IED   SEL        9600,8,2,N
8      Master    SEL        38400,8,2,N
9      Printer   ASCII      9600,8,2,N  Printer
10     SEL IED   SEL        9600,8,2,N
11     SEL IED   SEL        9600,8,2,N
12     SEL IED   SEL        300,8,1,N
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     SEL IED   SEL        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

*>
```

The displayed response to the **WHO** command also identifies that Master port currently in use by an '*' next to its port number: Port F in the current example.

b) Verify the location and type of data being collected on Port 1 of the SEL-2030 by issuing the command string **MAP 1**. The SEL-2030 responds with a database map of the Port 1 data regions. This map shows that meter data are being collected in Port 1 region D1, which is associated with Port 1 Message 1. The B METER indicates that the SEL-2030 is receiving binary, or *Fast Meter*, data from the SEL-251 Relay. If the SEL-251 Relay did not have *Fast Meter* capability, there would be an "A" next to METER, indicating that the data are transferred in ASCII format.

```
*>>MAP 1<ENTER>
Port 1 Database Assignments
  Region    Data Type   # Records
  GLOBAL    --
  LOCAL     --
  BUF       --
  D1      B METER
  D2        Unused
  D3        Unused
  D4        Unused
  D5        Unused
  D6        Unused
  D7        Unused
  D8        Unused
  A1        Unused
  A2        Unused
  A3        Unused
  USER      Unused

*>>
```

You can refer to the specific data region by the region name, D1, or the data name, METER.

c) Verify the various metering quantities that are being collected and stored in the SEL-2030 by issuing the command string **MAP 1:METER** or **MAP 1:D1**. The SEL-2030 responds with a map of the specific data region, including a listing of the data item names, the starting address for each data item, and the type of data stored at each address.

```
*>>MAP 1:METER<ENTER>
Port 1,  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]
IAB(A)       201Ch             float[2]
IBC(A)       2030h             float[2]
ICA(A)       2024h             float[2]
VAB(V)       2028h             float[2]
VBC(V)       202Ch             float[2]

                                    (continued on next page)
```

```
                                  (continued from previous page)

VCA(V)       2030h             float[2]
PA(MW)       2034h             float
QA(MVAR)     2036h             float
PB(MW)       2038h             float
QB(MVAR)     203Ah             float
PC(MW)       203Ch             float
QC(MVAR)     203Eh             float
P(MW)        2040h             float
Q(MVAR)      2042h             float
IO(A)        2044h             float[2]
I1(A)        2048h             float[2]
I2(A)        204Ch             float[2]
VO(A)        2050h             float[2]

V1(A)        2054h             float[2]
V2(A)        2058h             float[2]


*>>
```

Notice in this case that all of the currents and voltages contain two floating-point numbers, one for magnitude, the other for phase angle. The magnitudes and phase angles are calculated from *Fast Meter* sample data. ASCII data includes only voltage and current magnitude.

d) View the data stored in the Port 1 METER data region by issuing the command string **VIEW 1:METER** or **VIEW 1:D1**. The SEL-2030 responds with a data "dump" showing the data stored in the data region at the time of the request with the respective data item labels. In this example, the data in this data region are updated once each second.

```
*>>VIEW 1:METER <ENTER>

Port 1,  Data Region METER   Data

_YEAR = 1997  DAY_OF_YEAR = 304 (10/31)  TIME = 13:19:37.859
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  IO(A) =      7.170,   135.000
  I1(A) =   2365.875,   102.106  I2(A) =      5.750,    40.418
VO(V) =      7.299,   -80.537  V1(V) =  11279.251,   103.546
V2(V) =     13.106,   163.608


*>>
```

Note that all current and voltages are reported in primary system quantities.

e) Check the communication and data retrieval performance by issuing the SEL-2030 **STATUS** command. The SEL-2030 responds with SEL-2030 general information, optional equipment information, and communication performance, including a listing of

ports with their respective communication status, communication success rate, and database delays. In this example, the SEL-251 Relay is connected to the SEL-2030's Port 1, which is shown with active status and 100% communication success rate. If the relay is disconnected or turned off, the status changes to inactive. If database delays were encountered on this port, the specific region, or regions, affected would be listed under database delays. If these delays were a problem, you could adjust the data collection period or times to prevent overrunning data that can cause database delays.

```
*>>STATUS<ENTER>
COMMUNICATIONS PROCESSOR - S/N 95012004     Date: 01/25/01    Time: 13:46:43
FID=SEL-2030-R113-V0-Z000000-D20010122      FID=SLBT-2030-R103-V0-Z000000-D20010122


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: Absent
I/O Board: Absent

Port   Status           Success Rate   SET M     Database
1      Active                100%      None
2      Inactive                        None
3      Inactive                        None
4      Inactive                        None
5      Inactive                        None
6      Inactive                        None
7      Inactive                        None
8      Active                          None
9      Active                          None
10     Inactive                        None
11     Inactive                        None
12     Inactive                        None
13     Inactive                        None
14     Inactive                        None
15     Inactive                        None
16     Inactive                        None
17     Sole Node(100h)       NORM      None
F      Active                100%      None


*>>
```

JOB DONE

Refer to ***Section 4: Job Done® Examples*** for additional Job Done examples using the SEL-2030.

SEL-2030 ROBUST DESIGN

The SEL-2030 is designed to provide reliable service in a wide variety of electrical, physical and environmental conditions.

Wide Temperature Operating Range

The SEL-2030 is designed for operation with an ambient temperature between –40° and +85°C (–40° and +185°F). Plug-in protocol cards may have more restrictive temperature ranges. Check the instruction manual of any plug-in protocol card to confirm its temperature range.

Wide Voltage Range Power Supply

Two power supply voltage ranges are available. The 125/250 volt power supply will operate with a voltage range of 85 to 350 Vdc, or 85 to 264 Vac. The 24/48 volt power supply will operate with a voltage range of 20 to 60 Vdc.

Meets Tough IEEE & IEC Standards

The SEL-2030 is designed to meet tough IEEE and IEC electrical, environmental, and vibration standards, making the SEL-2030 suitable for application in hostile environments such as substations and power plants, in relay and control houses, or in outdoor cabinets and enclosures.

USER-FRIENDLY FEATURES

The SEL-2030 includes the following features that make it easy to use and apply with other devices.

Auto-Help

The SEL-2030 command set is forgiving, permitting you to enter some command strings in alternate sequences. However, if you make an entry that is not valid, the SEL-2030 automatically provides a list of acceptable commands. If part of your command is recognized, the SEL-2030 provides help by showing the proper command string format. Or you can type HELP for a complete list of the available commands. For the experienced user, Auto-Help can be disabled.

COPY Command

You can use the **COPY** command to copy settings from one port to another. This capability can speed the setting process where identical or very similar settings are used on multiple ports. The command has an option to copy settings from one port to all ports, but the SEL-2030 requests confirmation of the copy function for each port before performing the copy operation.

SWAP Command

You can use the **SWAP** command to swap settings between two ports. This capability may be handy when swapping port connections between two devices.

TOGGLE Command

You can use the **TOGGLE** command to toggle one of the Global or Local elements. This feature can be very helpful when testing SELOGIC Control Equation triggers, intermediate logic equations, or contact outputs.

Self-Testing

The SEL-2030 continually performs a number of self-test operations to ensure that it is functioning properly. You use the **STATUS** command to access results for the RAM, ROM, EEPROM, nonvolatile Flash memory, power supply, settings, and clock battery tests. The SEL-2030 is equipped with an alarm contact to provide an external indication of a failure.

5 Vdc on Rear Ports

Internal jumpers for Ports 3, 4, 11, 12, 14, and 16 control the availability of 5 Vdc to power an external device, such as an external modem. The default position of the jumpers is open.

OPTIONS

Three options are available to meet additional customer needs:

Input/Output Board

Sixteen optoisolated input terminals and four output contacts provide additional sensing and control capability to the SEL-2030. The input voltages are selected based on your ordering options. Output contacts are trip rated and can be individually configured as form A or form B using soldered board jumpers.

Memory Choices

The basic memory options provides 256k bytes of shared memory and no nonvolatile Flash memory. The second memory option expands the shared memory to 1M byte. If the SEL-2030 needs to store a large number of databases, this option makes it possible. Two megabytes of nonvolatile Flash memory are available with the third option. This addition expands the capabilities of the SEL-2030 to permit long-term data storage without risk of losing the data if power to the SEL-2030 is turned off.

Plug-In Protocol Cards

The SEL-2030 supports up to two optional plug-in protocol cards. Contact Schweitzer Engineering Laboratories for information on available network cards.

APPLICATIONS

The SEL-2030's features make it extremely versatile and powerful. The most obvious applications include:

Intelligent Port Switch

Flexible communications parameters make the SEL-2030 a great choice for almost any port switching application. The multi-tasking/multi-user capability and data handling capability make the SEL-2030 more of a self-contained network hub than a port switch, but it is still an economical choice for port switching applications. The time synchronization capabilities of the SEL-2030 add to its value in this application.

Substation Integrator

The SEL-2030's communication processing and database capability are designed to collect and store data from numerous devices, parse it into useful pieces, and distribute just the needed data to other devices or systems. This is the fundamental purpose of substation integration, making the SEL-2030 a natural choice for this application. Its networking capabilities allow it to be the communication network for small substation integration projects, or it can serve as a sub-network integrator with one or more ties to a larger substation network.

SCADA Interface

The SEL-2030 can be interfaced with a variety of devices, including RTUs. The SEL-2030 can serve as a data concentrator, to be polled by a local RTU, or it can be connected to a dedicated SCADA communication circuit and polled by a central device.

TABLE OF CONTENTS

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FIGURES

SECTION 3: INSTALLATION

INTRODUCTION

Planning should be the first step you take before installing any new device, and it is equally essential for successful installation and operation of the SEL-2030 Communications Processor. This section of the SEL-2030 instruction manual includes information and procedures you should be familiar with to install the SEL-2030 safely and effectively. Safe and effective installation of the SEL-2030 requires proper mounting, connection, communications, and setup. The instructions in this section assume that you have successfully performed the initial checkout on the SEL-2030 and that you can install the SEL-2030 per the specifications, both as described in ***Section 1: Introduction.***

MOUNTING AND CONNECTIONS

This subsection provides details about the physical mounting and connection requirements for the SEL-2030 Communications Processor.

Mounting

The SEL-2030 Communications Processor is designed to be permanently mounted in a dry, indoor location. The SEL-2030 chassis includes reversible flanges that permit the unit to be flush mounted or projection mounted in a 19-inch relay rack or on a switchboard panel. The SEL-2030 can be mounted horizontally or vertically, although the front- and rear-panel stencils are designed to be read with the unit mounted horizontally. Use four #10 screws for mounting. Front- and rear-panel drawings, mounting dimensions, and drilling details are included in the ***SEL-2030 Communications Processor Data Sheet*** in ***Section 1: Introduction***.

Frame Ground Connection

You must connect the grounding terminal labeled "GND" on the rear panel to a frame ground, preferably using a ½" flat braid, for proper safety and performance. This terminal connects directly to the internal chassis ground of the instrument.

Power Connections

The terminals labeled "POWER" on the rear panel must be connected to a power source that matches the power supply (POW SUP) characteristics specified on the rear panel nameplate of your SEL-2030. If you provide a dc power source, you must connect the source with the proper polarity as indicated by the "+" and "–" labels on the power connector. The SEL-2030 internal power supply has very low power consumption and a wide voltage tolerance. See the ***SEL-2030 Communications Processor Data Sheet*** in ***Section 1: Introduction*** for complete power supply specifications.

Alarm Contact Connection

The SEL-2030 includes an alarm output contact connected to pins 1 and 3 on the rear panel. At the factory, the alarm contact is configured to be closed for an alarm condition, and open for normal operation. This is a "Form B" contact because it is closed when there is no power. To invert the alarm output to close under normal conditions, change soldered jumper, JMP3, on the main board to select "Form A" contact usage. See Table 3.4 and Figure 3.2 for jumper settings.

The alarm contact asserts when no power is connected to the SEL-2030, the power supply fails, or self-test diagnostics detect a failure. Self-test diagnostic failures include memory failures, power supply failures, and invalid setting failures. See the **STATUS** command subsection in the ***SEL-2030 Reference Manual; Section 2: Commands*** for a discussion on these failures. With the default ALARM setting (part of SET G), the alarm contact is pulsed when Level 2 communication is accessed, or when an SEL-2030 setting change is accepted.

The ALARM LED will light whenever the alarm contact asserts, unless there is a loss of power to the LED.

IRIG-B Input Connection

The SEL-2030 accepts a modulated or demodulated IRIG-B signal through a rear-panel BNC connector labeled "MODULATED/DEMODULATED IRIG-B IN." An internal setting selects between modulated and demodulated IRIG-B (SET G). The factory default setting is demodulated IRIG-B time input.

The SEL-2030 can also accept IRIG-B on the IRIG-B pins of Port 15. By default, the IRIG on Port 15 is configured as an output, but it can also be used as a demodulated IRIG-B input. To do this, set JMP1 and JMP2 in the 2-3 position. Also, the IRIG setting must be set to demodulated. See Table 3.4 and Figure 3.2 for the main-board jumper positions for setting-up the Port 15 IRIG-B.

Use a modulated IRIG-B signal for the input to the SEL-2030 if it is available. The modulated signal is isolated by a transformer. The demodulator in the SEL-2030 includes automatic gain control. You can use a demodulated signal, but it may not be adequate if the cable to the source is too long. A maximum cable length of 50 ft (15 meters) is recommended for satisfactory performance.

An internal element asserts in the SEL-2030 Global database region when an adequate IRIG-B input signal is received. If no external IRIG-B input signal is applied, the SEL-2030 generates an IRIG-B signal. The SEL-2030 includes an internal battery-backed clock/calendar that maintains correct time with or without external power.

IRIG-B Output Connection

The SEL-2030 distributes a demodulated IRIG-B output signal through all of its 16 rear ports. You can use this feature to synchronize any type of device, such as a relay, fault recorder, or meter that can decode the IRIG-B signal; you need only to connect the device to the desired SEL-2030 rear serial communication port using a special cable designed for both communication and IRIG-B signal. The IRIG-B signal is on pins 4 and 6 of the 9-pin, subminiature "D" connector (see Figure 3.1 and Table 3.1).

Where distance between the SEL-2030 and a device exceeds the cable length recommended for conventional EIA-232 metallic conductor cables, you can use modems to provide isolation and to establish communications to remote locations. Unfortunately, conventional short-haul, fiber-optic, and telephone modems do not support IRIG-B signal transmission, so their use requires that you use some other method to synchronize the remote IED. However, special fiber-optic modems (like the SEL-2810) are available that include a channel for the IRIG-B time code; these modems enable you to synchronize more precisely devices capable of receiving IRIG-B time code, even with a fiber-optic communication link.

The IRIG-B signal includes code for day-of-year and time-of-day. It does not include a code to identify the year. To set the device calendar to the proper year, you need to set the date on each device receiving an IRIG-B signal. Most SEL relays store the year for the set date with the relay settings in nonvolatile memory, so once the date is properly set, the relay will maintain the proper year even if relay power is cycled off and on.

Communication Circuit Connections

The SEL-2030 Communications Processor is equipped with 16 rear-panel serial communication ports, labeled “PORT 1” through “PORT 16” and one front-panel serial communication port, labeled “PORT F.” The data connection for each SEL-2030 serial communication port uses EIA-232 standard signal levels in a 9-pin, subminiature "D" connector (see Figure 3.1 and Table 3.1). EIA-232 interfaces are supported by almost all modern relays, meters, computer, and communications devices.

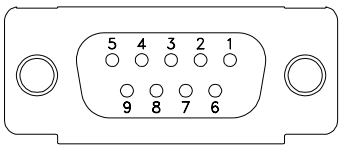

Figure 3.1: 9-Pin Connector Pin Number Convention (female chassis connector, as viewed from outside panel)

WARNING

Do not rely upon pins 5 and 9 for safety grounding, because their current carrying capacity is less than control power short circuit and protection levels.

The communication circuits are protected internally by low-energy, low-voltage MOVs and passive RC filters.

You should keep the length of the communication cables as short as possible to minimize communication circuit interference and also to minimize the magnitude of hazardous ground potential differences that can develop during abnormal power system conditions. See ***Communication Cables*** for additional details and restrictions.

Table 3.1: Serial Port Connector Pin Definitions

Pin	Ports 1-16	Port F
1	See **Note 1**	N/C
2	RXD	RXD
3	TXD	TXD
4	See **Note 2**	N/C
5, 9	GND	GND
6	See **Note 3**	N/C
7	RTS	RTS
8	CTS	CTS

Note 1 (pin 1): Port 1, 9 = DCD; Port 2, 5-8, 10, 13, 15 = N/C; Port 3, 4, 11, 12, 14, 16 = N/C or +5 Vdc if appropriate internal jumper is installed.

Note 2 (pin 4): Port 1-14, 16 = +IRIG-B Output; Port 15 = +IRIG-B Input or Output depending on internal jumper configuration.

Note 3 (pin 6): Port 1-14, 16 = -IRIG-B Output; Port 15 = -IRIG-B Input or Output depending on internal jumper configuration.

Fiber-Optic Cables

A benefit of applying the SEL-2030 is that as the hub of a star topology, it enables low cost, point-to-point fiber-optic connections. The SEL-2800 family of Fiber-Optic Transceivers connects directly to the serial port connectors on the rear of the SEL-2030. Fiber-optic links improve safety by isolating the equipment from hazardous and damaging ground-potential rise, eliminate instrumentation system ground-loop problems, reduce susceptibility to RFI and EMI, and allow longer signal paths than metallic EIA-232 connections.

Communication Cables

Standard SEL communication cables available for your use with the SEL-2030 are listed in Table 3.2. Using an improper cable can cause numerous problems, so you must be sure to specify the proper cable for the application. Please call the SEL factory if you have any questions about cables and cable connections.

Never use standard null-modem cables with the SEL-2030. Using any non-SEL cable can cause severe power and ground problems involving pins 1, 4, and 6 on the SEL-2030 communication ports.

Table 3.2: Communication Cables for Devices Attached to SEL-2030

SEL Cable #	Connect SEL-2030 to:	Remote Connector (on cable)	Port Type	RTS/CTS Supported	IRIG-B Included
C157A	Existing SEL-PRTU Relay Cable retrofit	9-pin Con-X-All (female)		no	no
C222	25-pin DCE devices: Standard modem, ABB 25-pin PONI module	DB-25P	DCE	no	no
C223A	25-pin DTE devices: Beckwith M0420 (25-pin) Black Box COS Port Switch GE 90-70 and 90-30 PCM (PLC), GEC Optimho Relay, GE DLP/DFM	DB-25P	DTE	no	no
C225	9-pin DCE devices: 9-pin modem	DB-9P	DCE	no	no
C226	25-pin DCE devices w/RTS/CTS/DCD Standard modem (for SEL-2030 Ports 1 and 9)	DB-25P	DCE	yes	no
C227A	25-pin DTE devices: Standard 25-pin computer	DB-25S	DTE	no	no
C234A	9-pin DTE devices: Standard computer	DB-9S	DTE	no	no
C239	9-pin DTE devices w/ IRIG-B: SEL-200/321 Series Relays	DB-9P, DB-9P	DTE/ IRIG-B	yes	yes
C241	25-pin DCE devices: ABB SADI, Black Box COS Port Switch (DCE), Baytech Port Switch	DB-25P	DCE	no	no
C245A	9-pin DCE devices: RFL-9660 Digital Port Switch	DB-9S	DCE	yes	no
C247	25-pin DTE devices Systems Northwest RTU	DB-25P	DTE	no	no
C255	Quantum Meter	DB-25P	N/A	no	no
C272A	9-pin DTE devices: ABB DPU2000R	DB-9P	DTE	no	no
C273A	9-pin DTE devices w/ IRIG: SEL-500 Series, SEL-300 Series except SEL321	DB-9P	DTE/ IRIG-B	yes	yes
C276	9-pin DTE device w/ IRIG: SEL-2030 EIA-232 and IRIG-B	DB-9P, BNC	DTE/ IRIG-B	yes	yes
C277	9-pin DTE devices: MODICON 9-pin DTE	DB-9P	DTE	no	no
C278	Scientific Columbus JEM-10 Meter w/ Curo Style Connector	No connector (tinned wires)	N/A	no	no
C279	25-pin DTE device w/ IRIG: GE-DLP EIA-232 and IRIGB	DB-25P, BNC	DTE/ IRIG-B	no	yes

SEL Cable #	Connect SEL-2030 to:	Remote Connector (on cable)	Port Type	RTS/CTS Supported	IRIG-B Included
C280	Harris WESDAC D20M RFL-9300	DB-9S	DTE	no	no
C281	9-pin DTE devices: Standard computer, RFL-9745, ABB 9-pin PONI Module (DTE), Beckwith M0420 (9-pin)	DB-9S	DTE	yes	no
C282	9-pin DTE devices: Tasnet 9-pin DTE, Beckwith M3430 Dranetz SER	DB-9P	DTE	yes	no
C285	9-pin DCE with flow control: ABB 9-pin PONI Module (DCE), ABB FOCUS Data Module Basler 9-pin DCE	DB-9P	DCE	yes	no
C288	9-pin DCE devices: Rochester Instrument Sys, CIU,	DB-9P	DCE	no	no
C339	9-pin Round Con-X-All devices w/ IRIG: SEL-100 Series Relays/SEL-PRTU	9-pin Con-X-ALL (male), 9-pin Con-X-ALL (male)	N/A	yes	yes

The following list provides additional rules and practices you should follow for successful communication using EIA-232 serial communication devices and cables:

- You should keep the length of the communication cables as short as possible to minimize communication circuit interference and also to minimize the magnitude of hazardous ground potential differences that can develop during abnormal power system conditions.
- EIA-232 communication cable lengths should never exceed 50 feet, and you should always use shielded cables for communication circuit lengths greater than 10 feet.
- Modems are required for communication over long distances and to provide isolation from ground potential differences between device locations.
- Route communication cables well away from power and control circuits. Switching spikes and surges in power and control circuits can cause noise in the communications circuits if not adequately separated.
- Lower baud rate communication is less susceptible to interference and will transmit greater distances over the same medium than with higher baud rates. You should use the lowest baud rate that provides adequate data transfer speed.

Network Connections

See the instruction manual for your plug-in protocol cards to determine appropriate connection methods for their networks.

COMMUNICATIONS

This subsection describes how you can optimize the communications interface between the SEL-2030 and other devices it will communicate with.

Modems

If electrical interference is a problem, consider using point-to-point fiber-optic transceivers to provide electrical isolation and noise immunity. We recommend the SEL-2800/2810 Fiber-Optic Transceivers for these applications. The connection between the SEL-2030 and the modem is EIA-232. The connection between the remote transceiver and the remote device is also EIA-232. Optical fibers connect the two transceivers.

For sites where the main issue is cable length, you can use short-haul modems connected by wire. This alternative is a compromise between the low cost and short cable for direct EIA-232 connections and the isolation and noise immunity of higher-cost fiber-optic links.

You must provide power to any modem that you install between the SEL-2030 and another device. You can use the SEL-2030 to power some types of modems connected to its rear-panel ports. With the proper jumper connections, the Port 3, 4, 11, and 12 EIA-232 outputs of the SEL-2030 will support modems, which accept +5 Vdc power. The total current drawn by all of the external modems powered by one SEL-2030 should not exceed 0.5 A. See Table 3.4 and Figure 3.2 for the +5 Vdc power jumper settings for each port. None of these jumpers are installed at the factory. Some modems power themselves from the control and data lines. These modems do not require connection to the +5 Vdc power.

Telephone Line Communications

A telephone dial-up link is one option for off-site communications with an SEL-2030. Use a modem to convert from the audio telephone line to an EIA-232 interface on the SEL-2030. You can use an external modem connected to any of the rear-panel ports. (Ports 1 and 9 have a DCD control line in addition to the RTS/CTS control lines, so these two ports will work best with external modems.) You can set the SEL-2030 to answer the phone and to initiate calls based on conditions that you select.

You should use telephone line protection equipment where the line enters the building for improved personnel safety and reduced damage to equipment from ground-potential rise and other hazardous conditions. Connect the line protection equipment to the modem following standard commercial telephone wiring standards.

If you use one telephone line for both voice and SEL-2030 communications, set the SEL-2030 modem port to ignore a specified number of rings before answering, so that personnel at the site can answer the phone before the modem answers. You can also provide a hook-switch in the phone line, so on-site personnel can disconnect the telephone line from the modem; however, you may want to use some type of timer instead to disconnect the line to prevent them from leaving the modem disconnected.

If you have one telephone line to communicate with a mix of telephones and modems in a site, you typically use a telephone port switch. Connect the protection equipment to the telephone port switch, and the telephone port switch to the SEL-2030 modem and other devices with standard telephone wiring.

Data Flow Control

All SEL devices, including the SEL-2030, support XON/XOFF software data flow control. You should select this option, or accept the XON/XOFF = Y default for any communication setting where the SEL-2030 is connected to another SEL device. Set RTS/CTS = N to connect an SEL-2030 to any SEL device.

The SEL-2030 also supports RTS/CTS hardware data flow control. You should select the RTS/CTS option only if the connected device uses RTS/CTS, and does not use XON/XOFF flow control. 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 has conductors for RTS/CTS.

Baud Rate

The default baud rate for the SEL-2030 front port, Port F, is 2,400 baud. You can change the Port F baud rate and the other Port F communication parameters using the **SET P** command. You can force the Port F baud rate to 2,400 baud by hardware jumper selection (see Table 3.4).

The default baud rate for all rear-panel communication ports is 9,600 baud. You can change the baud rate for each of these ports and the associated communication parameters with the **SET P** setting command. With an SEL relay attached to one of the rear ports, the SEL-2030 will automatically set the baud rate to match the relay baud rate when you request the SEL-2030 to perform auto-configuration. With other IEDs attached to the ports, the SEL-2030 baud rate may be automatically set to match the attached IED baud rate when you request the SEL-2030 to perform the auto-baud function.

To change the communication baud rate with a device, you should change the baud rate on the device first, either by baud rate jumper, dip switch or software setting, then you should change the baud rate setting on the associated SEL-2030 port using the **SET P** command. (See ***SEL-2030 Reference Manual; Section 3: Settings*** for more information on making settings changes.)

Master Device to SEL-2030 Communication

Some Master devices, such as RTUs, cannot accept unsolicited messages, requiring that they only receive a response to a request they send. When you interface the SEL-2030 with such a device, you must make sure that the SEL-2030 does not send any auto-messages to the device unless the SEL-2030 first receives a request. Use the **SET U** command to create user-defined commands that will trigger the appropriate auto-message response.

You must use the same precaution when you interface the SEL-2030 with a master device using the LMD protocol.

Passwords

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.

You can set your own passwords with the **PASSWORD** command, or you can disable the password protection with jumper selection (see Table 3.4). (See Job Done Example #1 in ***Section 4: Job Done® Examples*** for more information on access levels and password control.)

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. You should consider first 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 3.3 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.

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.

Table 3.3: 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.

JUMPER SETTINGS

This subsection describes the hardware jumper selections available on the SEL-2030 Communications Processor, and the recommended procedures for making the jumper setting changes.

Main Board Jumpers

Set the main board jumpers to meet your requirements. See Table 3.4 for jumper functions and positions. See Figure 3.2 for jumper locations on the main board.

Table 3.4: Main Board Jumper Positions

Function	Install Jumpers At:
Connect +5 Vdc to pin 1 on: Port 3/ /Port 4 Port 11/ /Port 12 Port 14/ /Port 16 (factory setting = all off)	 **J11,** Position **A/ /J11,** Position **C** **J11,** Position **B/ /J11,** Position **D** **J20,** Position **B/ /J20,** Position **A**
Alarm Contact Form Form A Form B (factory setting)	JMP**3** (20 AWG wire) **A** to Common (20 AWG wire) **B** to Common
Port 15 IRIG-B Direction Input Output (factory setting)	 JMP**1** Position 2-3; JMP**2** Position 2-3 JMP**1** Position 1-2; JMP**2** Position 1-2
Port F Baud Rate 2,400 baud, RTS/CTS = N, XON/XOFF = Y Selected by SET P settings (factory setting)	(This jumper is read on power-up.) **J17 A** Installed **J17 A** Removed
Password Disable Password Enable (factory setting)	**J17 B** Installed **J17 B** Removed
Unused	**J17 C** **J17 D**

Input/Output Connections

If your SEL-2030 is equipped with the optional I/O board, it has a terminal strip that extends nearly the full width of the SEL-2030, near the top of the rear panel.

Configure the Inputs for 48 V, 125 V or 250 V

The selection of input operating range is made at ordering time and cannot be modified by the user. The inputs on the SEL-2030 are level-sensitive; they are designed to not operate if the input is inadvertently grounded.

Configure the Output Contact Form

The SEL-2030 I/O board is shipped from the factory with form A output contacts. You may reconfigure the contacts by desoldering and then resoldering the 20 AWG jumper wire for each contact. Table 3.5 and Figure 3.3 show the jumper positions required to configure the contacts.

Table 3.5: Optional I/O Board Contact Form Jumper Positions

Output Contact	Jumper	Jumper Setting	
		Form A contact	Form B contact
OUT1 OUT2 OUT3 OUT4	JMP36 JMP35 JMP34 JMP33	Connect A to Common with 20 AWG wire (factory setting)	Connect B to Common with 20 AWG wire

Open the SEL-2030 to Access Internal Jumpers

After you have decided on the appropriate SEL-2030 hardware configuration, you are ready to reconfigure the SEL-2030 if the default configuration does not meet your needs. Perform the following steps to gain access to internal jumpers:

1. Disconnect power from the SEL-2030.

   CAUTION Never work on the SEL-2030 with front or top cover removed, when the SEL-2030 is energized.

2. Remove the screws attaching the front panel and remove the front panel.

   CAUTION The SEL-2030 contains devices sensitive to electrostatic discharge (ESD). When working on the device with front or top cover removed, work surfaces and personnel must be properly grounded or equipment damage may result.

3. If the optional I/O board is installed, disconnect any cables joining the I/O board to the main board and disconnect the power cable from the SEL-2030 main board. Disconnect any cables connected to the rear of the main board.

4. Remove the main board by sliding it out. Remove the I/O board by sliding it out.

Set Jumpers

See Figure 3.2 for main board jumper locations. Configure the following main board jumpers according to the selections you have made:

- Port 15 as IRIG-B input or output.
- Alarm contact form: A or B.
- Serial port +5 Vdc power output for each rear port.
- Port F baud rate jumper.
- Password disable jumper.

See Figure 3.3 for I/O board jumper locations. While the I/O board is removed, configure the following jumpers according to the selections you have made:

- Select output contact form: A or B.

Reassemble the SEL-2030

After configuring jumpers, reassemble the SEL-2030 as follows:

1. Replace the main and I/O boards.
2. Reconnect any cables that were disconnected.
3. Replace the front panel and front-panel screws and tighten them securely.

INSTALLATION

Before you install the SEL-2030, you should perform the initial checkout procedure found in ***Section 1: Introduction*** and set the configuration jumpers according to your installation requirements per the instructions outlined earlier in this section. Install the SEL-2030 according to the following step-by-step instructions:

1. Mount the SEL-2030 in the desired panel location. Mounting information, including chassis, cutout, and drilling dimensions are shown in the data sheet included in ***Section 1: Introduction***.
2. Connect the devices you desire to the SEL-2030 rear-panel DB9 communication ports using SEL cables or their equivalents. Cable information is located near the beginning of this section.
3. Connect power and ground, alarm, IRIG-B, and optional I/O on the rear panel.
4. Connect a terminal (or computer equipped with terminal emulation software) to the front-panel connector Port F of the SEL-2030 using an SEL-C234A cable or equivalent.
5. Set the computer terminal or emulation software to operate at:
    - 2,400 baud, 8 data bits, 1 stop bit, no parity.
6. Press **<ENTER>** and verify that a "*" prompt is returned.
7. Type **ACCESS<ENTER>** to change to Access Level 1. Enter the factory-set password by typing **OTTER<ENTER>** at the password prompt. You will see a screen similar to the following:

```
*ACCESS<ENTER>

Password: ? OTTER<ENTER>


COMMUNICATIONS PROCESSOR - S/N 97212004     Date: 10/31/97    Time: 14:33:52

Level 1
*>
```

8. Type **STATUS<ENTER>** and verify that a status report similar to the one below appears on your terminal. The RAM memory size should be 512 kb. The shared RAM memory size should be 256 kb or 1,024 kb. If you ordered optional nonvolatile Flash memory, verify that Flash reports 2,048 kb. If you did not order optional nonvolatile Flash memory, Absent is reported as in the screen below. Confirm that IRIG-B input and I/O board are indicated properly. If you have an optional plug-in protocol card, confirm that it shows-up as expected. Also, the card LED on the front of the SEL-2030 should be flashing once the card is up and initialized. This step completes installation of the SEL-2030.

```
*>>STATUS<ENTER>
COMMUNICATIONS PROCESSOR - S/N 97300004     Date: 01/25/01    Time: 13:46:43
FID=SEL-2030-R113-V0-Z000000-D20010122      FID=SLBT-2030-R103-V0-Z000000-D20010122


SELF-TESTS

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

IRIG-B Input: Absent
I/O Board: Absent

Port   Status           Success Rate   SET M     Database
1      Active                100%      None
2      Inactive                        None
3      Inactive                        None
4      Inactive                        None
5      Inactive                        None
6      Inactive                        None
7      Inactive                        None
8      Active                          None
9      Active                          None
10     Inactive                        None
11     Inactive                        None
12     Inactive                        None
13     Inactive                        None
14     Inactive                        None
15     Inactive                        None
16     Inactive                        None
17     Sole Node(100h)       NORM      None
F      Active                100%      None


*>>
```

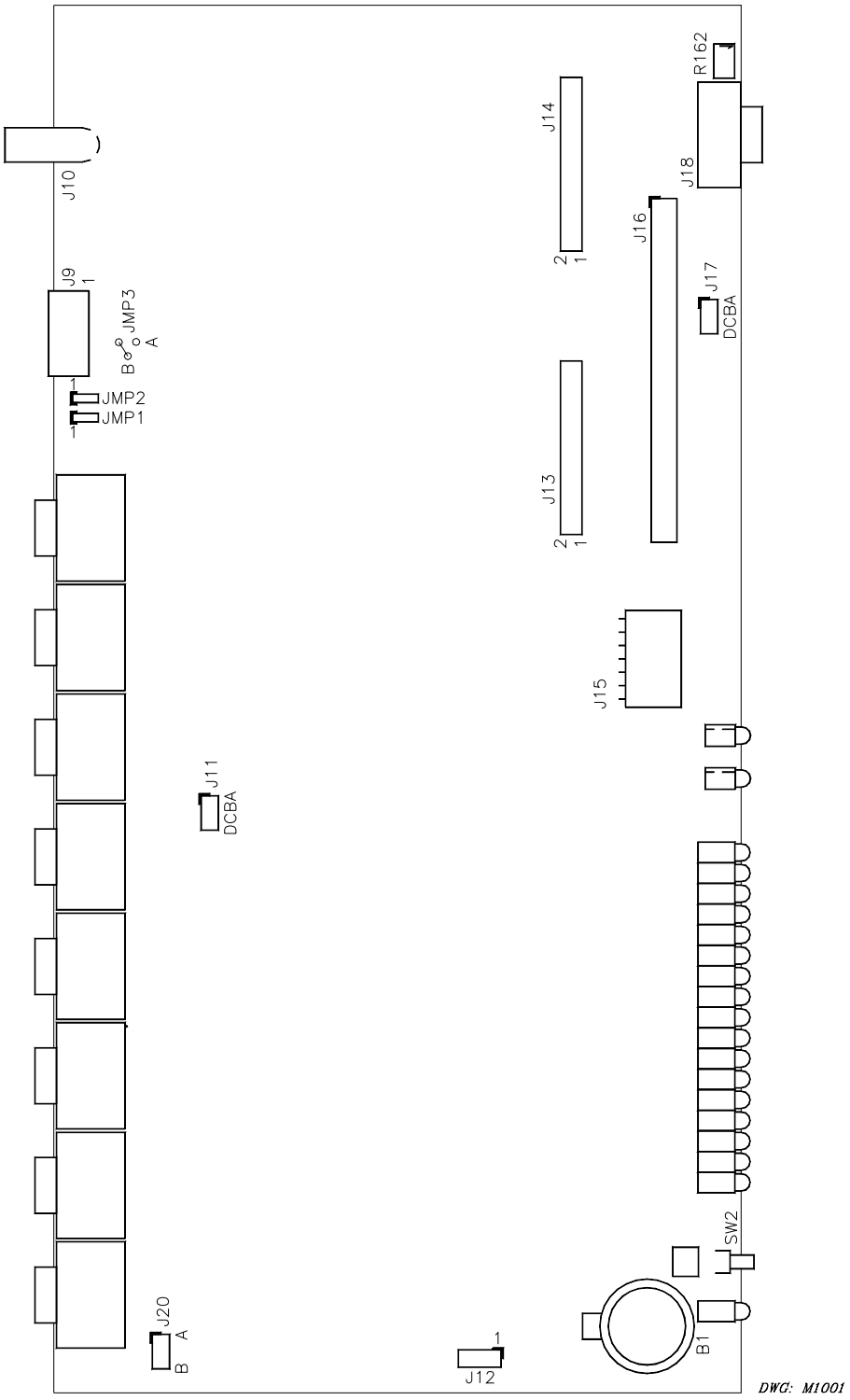

Figure 3.2: SEL-2030 Main Board Jumper Location

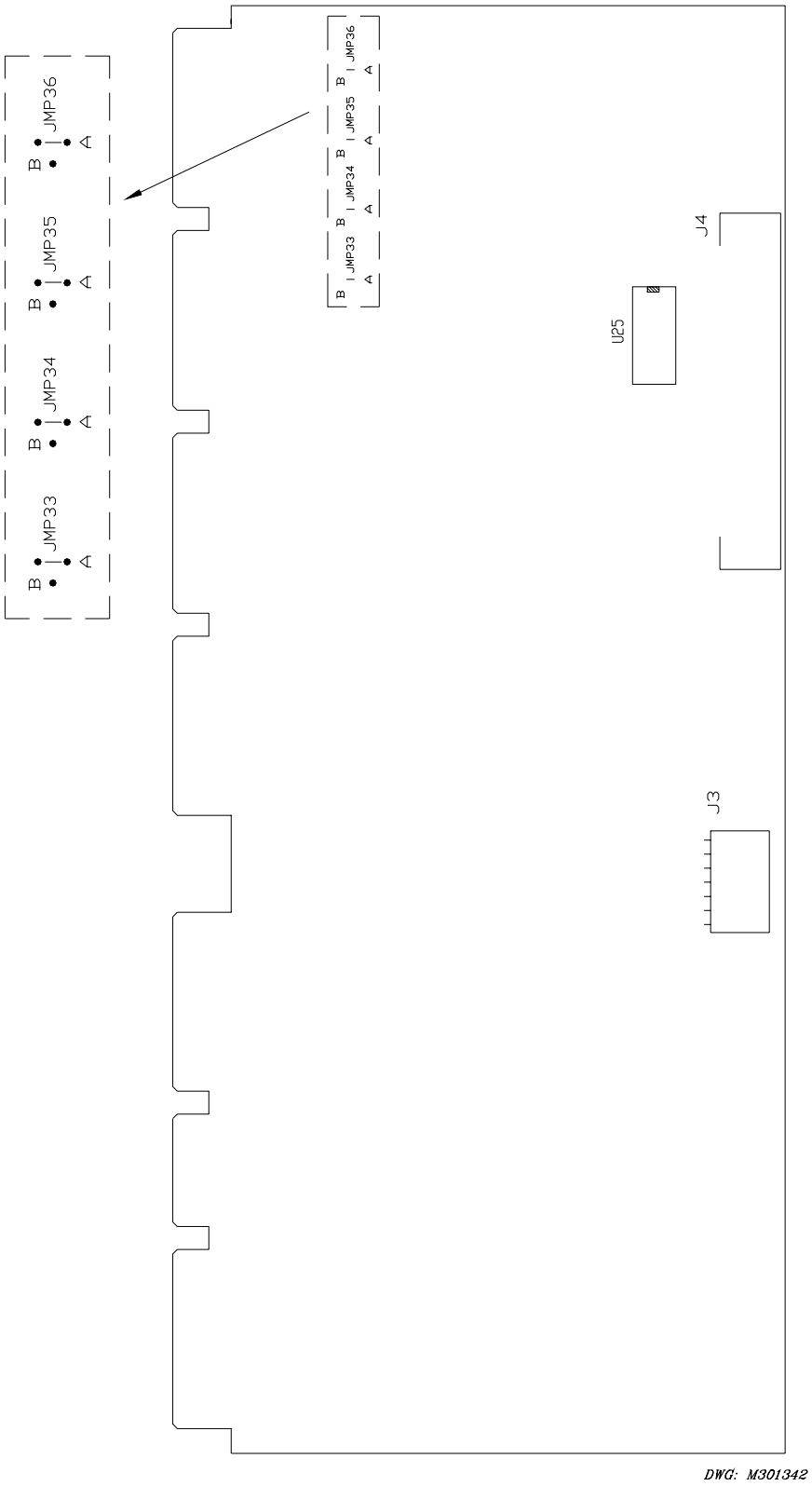

Figure 3.3: SEL-2030 Optional I/O Board Jumper Location

FIRMWARE UPGRADES

The programs (firmware) that run in the SEL-2030 and SEL-2700 family of cards reside in Flash memory. To load new firmware versions, follow the instructions below. The SEL-2030 has two programs that you may need to upgrade: the regular, or "executable" program, and the "SELBoot" program. Throughout these instructions, the plug-in cards are referred to as SEL-27xx, where xx in 27xx is the placeholder for a complete card number; for example, if you are loading firmware for an SEL-2701 Ethernet Processor card, substitute SEL-2701 for all references to SEL-27xx. See ***Appendix A: Firmware Versions*** to determine what programs you should upgrade to obtain optimal functionality from the latest version of the SEL-2030 and SEL-27xx. If the SELBoot program needs to be upgraded, the ***Description of Firmware*** section in ***Appendix A*** will explicitly indicate that need.

Firmware Upgrade Files

Product	File Name	File Type
SEL-2030	SEL-2030.S19	S-Record Text File (Can be downloaded to SEL-2030).
SEL-2030 SELBoot	SLBT2030.S19	S-Record Text File (Can be downloaded to SEL-2030).
SEL-27xx	SEL-27xx.S19	S-Record Text File (Can be downloaded to SEL-27xx).
SEL-27xx SELBoot	SLBT27xx.S19	S-Record Text File (Can be downloaded to SEL-27xx).
Compressed File	SEL2030.EXE	Self-Extracting Executable (CanNOT be downloaded to SEL-2030 or SEL-27xx).

Compressed Files - Firmware upgrades may come in a compressed format. This allows the entire firmware file to be shipped on a single floppy disk. The compressed file must be uncompressed prior to downloading to the SEL-2030 or associated protocol card.

Instructions:

1. Copy the EXE file from the floppy disk to a temporary location on the PC hard drive.
2. Run the EXE file. This extracts the S-Record Text file(s) from the compressed file.
3. Follow the instructions below to upgrade firmware.

SEL-2030 Firmware Upgrade Instructions

1. Establish a serial connection with the front-panel port on the SEL-2030. Make sure your communications software is capable of performing XMODEM file transfers.
2. Use the **ACCESS** and **2ACCESS** commands to enter Access Level 2 on the SEL-2030.

3. Enter the **L_D** command and respond by entering **Yes** at the verification prompt. This places the SEL-2030 in SELBoot mode, where it can receive new program code for itself or a connected protocol card. While in SELBoot mode, you can enter the **HELP** command to receive a description of the available commands.

4. Use the **BAU** command to set the port baud rate. Set the port at 38,400 bits per second by entering **BAU 38400**. Change the baud rate parameter in your communications software to match and then re-establish communications.

5. If you are upgrading the SEL-2030:
   Type the **REC** command. Respond by entering **Y** at the confirmation prompt. When the SEL-2030 is ready to receive the new code, it prompts you to press any key to initiate the firmware download. Press a key and then use an XMODEM file transfer to send the new SEL-2030 code.

   If you are upgrading the SEL-27xx:
   Type the **REC n** command, where n is the protocol card port (e.g., if the card is on Port 17, then enter **REC 17**). Respond by entering **Y** to the confirmation prompt. When the SEL-2030 is ready to receive the new code, it prompts you to press any key to initiate the firmware download. Press a key and then use an XMODEM file transfer to send the new protocol card code.

   If you are upgrading the SEL-27xx SELBoot code:
   Type the **REC boot n** command, where n is the protocol card port (e.g., if the card is on Port 17, then enter **REC boot 17**). Respond by entering **Y** at the confirmation prompt. When the SEL-2030 is ready to receive the new code, it prompts you to press any key to initiate the firmware download. Press a key and then use an XMODEM file transfer to send the new SEL-2030 SELBoot code.

   If you are upgrading the SEL-2030 SELBoot code:
   Type the **REC boot** command. Respond by entering **Y** at the confirmation prompt. When the SEL-2030 is ready to receive the new code, it prompts you to press any key to initiate the firmware download. Press a key and then use an XMODEM file transfer to send the new SEL-2030 SELBoot code.

6. When the transfer is complete, the SEL-2030 and SEL-27xx indicate whether they received the new code successfully. If the transfer was not successful, repeat step 5. When the transfer succeeds, repeat step 5 if you are upgrading multiple programs and/or multiple protocol cards. Once all upgrades are complete, enter the command **EXI** to return the SEL-2030 and associated protocol cards to normal operation.

7. To communicate with the SEL-2030, use the baud rate you used to establish communications in step 1.

8. New firmware versions may contain new functions and new settings. It may be necessary to modify settings to achieve operation that is the equivalent of operation before the upgrade. Study the documentation that came with the upgrade to determine if you need to make any setting changes.

Firmware Upgrade Command Summary

Command	Description	Example
L_D	Put SEL-2030 into SELBoot Mode.	**L_D** and **Yes** at the verification prompt. The L_D command is only available from Access Level 2. Once in SELBoot mode, the prompt is an exclamation point (**!**).
HELP	List of commands available within SELBoot mode.	**HELP** displays a list of available commands.
BAU	Change baud rate for the SEL-2030 port.	**BAU 38400** sets the SEL-2030 baud rate to 38,400. This is the highest available baud rate and is recommended.
REC	Set the SEL-2030 in the "ready to receive executable file" mode.	**REC** and **Yes** at the verification prompt. Now the SEL-2030 is ready to receive an S-Record file via the XMODEM protocol.
REC n	Set the protocol card in the "ready to receive executable file" mode.	**REC 17** and **Yes** at the verification prompt. Now the SEL-2030 is ready to receive an S-Record file via the XMODEM protocol for the protocol card on Port 17.
REC boot	Set the SEL-2030 in the "ready to receive SELBoot executable file" mode.	**REC boot** and **Yes** at the verification prompt. Now the SEL-2030 is ready to receive a new SELBoot S-Record file via the XMODEM protocol.
REC boot n	Set the protocol card in the "ready to receive SELBoot executable file" mode.	**REC boot 17** and **Yes** at the verification prompt. Now the protocol card is ready to receive a new SELBoot S-Record file via the XMODEM protocol.
EXI	Exit SELBoot mode	**EXI** to exit SELBoot mode and return the SEL-2030 to normal operation.

Troubleshooting

Problem	Possible Cause	Action
No Prompt	Incorrect Baud Rate.	Verify baud rate in communication software. Default baud rate for the SEL-2030 is 2,400.
SEL-2030 not accepting **REC** command	Not in the SELBoot mode	Enter **L_D** to get into the SELBoot mode. When in SELBoot mode, the prompt is an exclamation point.
Protocol card not accepting **REC n** command	SEL-2030 and protocol card are not in the SELBoot mode	Enter **L_D** to get into the SELBoot mode. When in SELBoot mode, the prompt is an exclamation point. Also see next problem to force SELBoot mode.
Unknown communication problem	Incompatible firmware in SEL-2030 and protocol card. Device not in SELBoot mode.	Force SEL-2030 into SELBoot mode using the following procedure: Cycle Power on the SEL-2030 while depressing the LED TEST button on the SEL-2030. Note - the SEL-2030 will enable with the default baud rate of 2,400.

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SECTION 4: JOB DONE® EXAMPLES

INTRODUCTION

This section describes SEL-2030 operations and user interface with examples that include a variety of common applications. In this manual, commands you type appear in bold/uppercase: **ACC**. Keys you press appear in bold/uppercase/brackets: **<ENTER>**. SEL-2030 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.

Each example assumes you have successfully performed the ***Initial Checkout*** described in ***Section 1: Introduction***, and you have configured the SEL-2030 hardware by placing jumpers according to the instructions in the ***Installation*** subsection in ***Section 3: Installation***. The examples include an introduction to the problem or task, identification of the problem, overview or definition of the solution, and the step-by-step procedure you should follow to accomplish the solution with the SEL-2030.

See ***SEL-2030 Reference Manual; Section 7:*** Protocols for additional Job Done examples specific to the Modbus® and DNP applications.

Job Done examples are also available for plug-in protocol card applications. See the instruction manual of each protocol card for examples of using the card-specific protocols and operations.

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EXAMPLE 1: CONNECTING TO THE FRONT PORT AND CHANGING THE DEFAULT PASSWORDS

INTRODUCTION

This example demonstrates how to connect your PC or terminal to the front port (Port F), establish serial I/O communications, and change the factory-default password settings on the SEL-2030. You will need your SEL-2030, a PC or terminal with a serial port, and an SEL-234A cable to connect the PC or terminal to Port F on the front panel of the SEL-2030. If you are using a PC, you will also need a terminal emulation program such as HyperTerminal, CROSSTALK®, or Procomm®.

USING STRONG PASSWORDS

It is important that you establish strong password protection to safeguard against unauthorized persons setting or resetting 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 ***SEL-2030 Reference Manual; 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 or 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.

SET THE PASSWORDS, STEP-BY-STEP

1. Follow the SEL 2030 installation instructions listed in ***Section 3***: ***Installation*** of this manual.
2. Connect one end of the SEL-234A cable to the serial port on your PC or terminal, and connect the other end to Port F on the front panel of the SEL-2030.
3. The default factory settings for Port F are: 2,400 baud, 8 data bits, 1 stop bit, and no parity. Set your PC or terminal communication parameters to the same settings and set your terminal emulation program to vt100 or vt52 emulation. Start a connection.
4. Press a carriage return, **<ENTER>,** and verify that a "*****" prompt is returned. The "*****" indicates that you are in Access Level 0.

5. If you do not get a "*" with each carriage return, then something is wrong with your connection. Terminate your serial connection, check your cable connections and your communications parameters, and restart your serial I/O connection.

6. When you receive the "*" prompt, you can type HELP <ENTER> for a description of the commands available at Access Level 0. The following example shows a successful connection followed by the HELP and ID commands.

```
*

*HELP

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
"FID=SEL-2030-R110-V0-D991222","FID=SLBT-2030-R101-V0-D980121","0DD5"
"COMMUNICATIONS PROCESSOR - S/N 98205023","0A73"

*
```

7. To change passwords you need to move through Access Level 1 to Access Level 2. Type **ACC <ENTER>** to go to Access Level 1. The SEL 2030 will respond with:

   Password: ? @@@@@@

8. The default factory password for Access Level 1 is OTTER, so type **OTTER <ENTER>** and the SEL 2030 will respond with the Level 1 access notification and the "*>" prompt indicating that you are in Access Level 1.

9. Type **2AC <ENTER>** to go to Access Level 2. The SEL 2030 will respond with the same password prompt. The default factory password for Access Level 2 is TAIL, so type **TAIL <ENTER>** and the SEL 2030 will respond with the Level 2 access notification and the "*>>" prompt indicating that you are in Access Level 2. The following example demonstrates changing from Access Level 0 to Access Level 2.

```
*ACC

Password: ? OTTER@

COMMUNICATIONS PROCESSOR - S/N 98205023     Date: 10/06/00    Time: 14:14:22

Level 1

*>2AC

Password: ? TAIL@@

COMMUNICATIONS PROCESSOR - S/N 98205023     Date: 10/06/00    Time: 14:14:45

Level 2

*>>
```

10. The **PAS** command is used to view and set passwords. Type **PAS <ENTER>** to see the existing passwords settings. Another form of the **PAS** command is used to set passwords. 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.

11. 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 with an automated password cracker.

```
*>>

*>>PAS

1:OTTER
2:TAIL

*>>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

*
```

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EXAMPLE 2: USING THE SEL-2030 AS A PORT SWITCH

INTRODUCTION

This example assumes your substation has an SEL-2030, seven SEL-251 Relays, an IRIG-B source, and a telephone line. Also, you have SEL-C239 cables of the appropriate length to connect the SEL-2030 to each relay. You have a PC or terminal and an SEL-234A cable to communicate with the SEL-2030. You will connect all of these as shown in Figure 4.1, below.

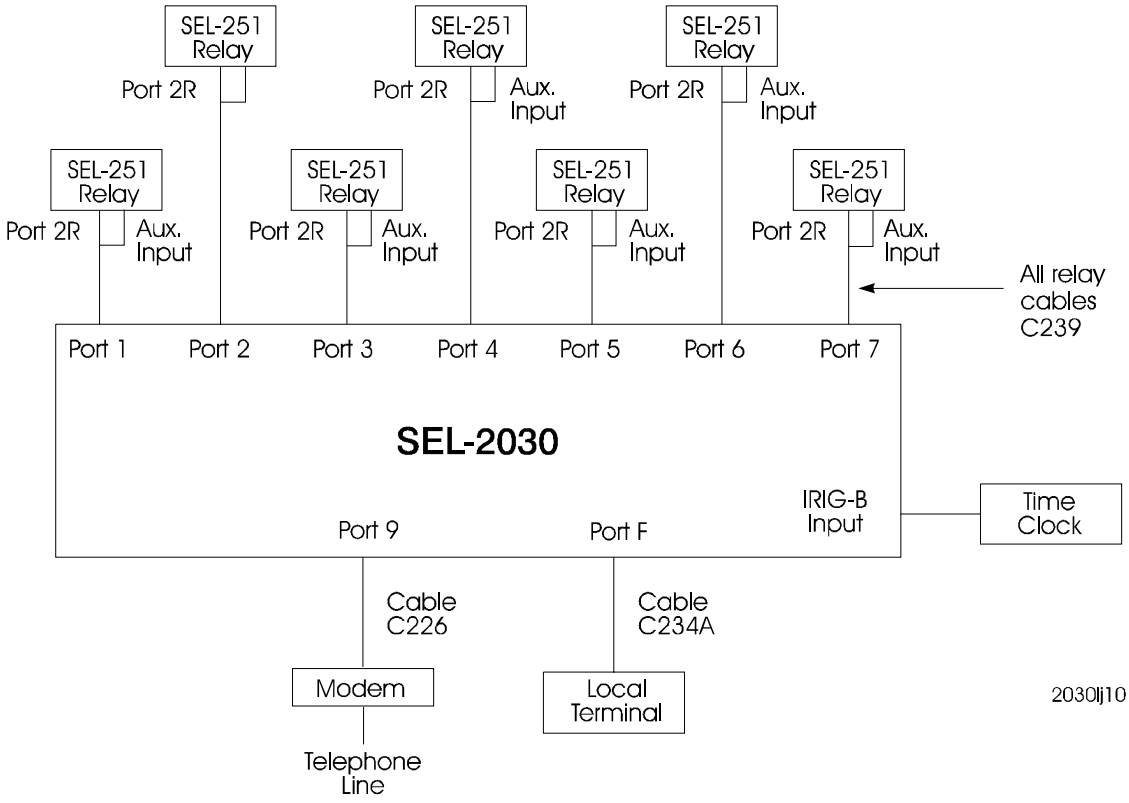

Figure 4.1: SEL-2030 Configured With Seven SEL-251 Relays, External Modem, and IRIG-B Source

IDENTIFYING THE PROBLEM

Your objective in Example 2 is to accomplish the following tasks:

- You want the SEL-2030 to time-synchronize all IEDs with the IRIG-B source.
- You want to send date messages to the relays even though they receive IRIG-B time code, so if power is cycled on a relay, the appropriate date (including year) is available as a reference.
- You want to access information in all the IEDs through the telephone port.

DEFINING THE SOLUTION

Complete Hardware Connections

1. Connect each SEL-251 Relay as follows:

a. On the relay, install cable SEL-C239 connectors to Port 2R and AUX INPUT.

b. Plug the other end of cable SEL-C239 into the desired SEL-2030 serial port.

2. Connect the IRIG-B time source to the SEL-2030 IRIG-B input. (You need to know if the time source has a modulated or demodulated IRIG-B signal. Set IRIG setting accordingly.)

3. Connect the modem to Port 9 using cable SEL-C226 and connect a telephone line to the phone line connector on the modem.

4. Connect your computer's serial port to the SEL-2030's Port F with an SEL-C234A cable.

Note: You do not need to modify the baud rate of Port 2 at the relay; the SEL-2030 will match the baud rate during auto-configuration.

Set the SEL-2030

1. Issue the **ACCESS** and **2ACCESS** commands and associated passwords to go to Access Level 2.

2. Use **SET P F** to set Port F parameters.

3. Set Port 1 configuration communications options using the **SET P 1** command.

4. Use **SET A 1** to define a timed trigger condition in the form of (Thh:mm:ss) to send a date message at a specific time once each day to the relay connected to Port 1.

5. Use the **COPY 1 ALL** command to copy Port 1 settings to the other ports (2, 3, 4, 5, 6, and 7) with devices attached.

6. Use **SET P 9** to set Port 9 as a modem port.

Verify and Test All Communication Paths

1. Use the **STATUS** command to check that IRIG-B signal is present and devices are connected to ports as expected.

2. Check transparent communication with each port. Use **PORT n** command to enter transparent communication with Port n, where n is any port number (1-16); use **<CTRL-D>** to end transparent communication.

3. Check that all SEL relays are receiving proper IRIG-B signal from the SEL-2030, that all relays have their Port 2 set to issue auto-messages, and that the relay Port 2 time-out is OFF.

- Enter Transparent Communication with each port, Access Level 1, and issue the **IRIG** command.
- Issue the **SHO** command to check the relay's AUTO and TIME settings.
- Exit transparent communication using the default disconnect sequence, **<CTRL-D>.**

4. Check that the SEL-2030 issues the correct date code to each relay. Change the relay date to the wrong year; use the **TOGGLE** command to issue the SEL-2030 date message.
5. Check modem communication. Have someone call; the SEL-2030 modem should answer by the fourth ring. The remote caller can enter transparent communication, and you can watch the communication using front-panel LEDs and the **STATUS** command.

SET THE SEL-2030, STEP-BY-STEP

1. Issue the **ACCESS** and **2ACCESS** commands and associated passwords to go to Access Level 2.
2. Use **SET P F** to set Port F parameters.

   You should have the following screen:

```
*>>SET P F<ENTER>

Port communications settings for Port F


Port Identification String
PORTID  =""                                                              1
 ? Service port<ENTER>


Modem Settings

Modem Control (Y/N)                          MODEM   = N     ? <ENTER>


Communications Settings

Baud Rate (300, 600, 1200, 2400, 4800, 9600) BAUD    = 2400  ? <ENTER>

Parity (N,O,E)                               PARITY  = N     ? <ENTER>

Enable RTS/CTS handshaking (Y/N)             RTS_CTS = N     ? <ENTER>

Enable XON/XOFF flow control (Y/N)           XON_XOFF= Y     ? <ENTER>

Port Time-out in minutes (0.0-120.0)           TIMEOUT = OFF  ? <ENTER>

Automatic help messages enabled (Y/N)        AUTO_HELP= Y    ? <ENTER>


Transparent Communications Termination Sequence

First delay time (0-600 seconds)             TERTIME1= 1   ?<ENTER>

Termination string
TERSTRING="\004"                                                        2
 ? <ENTER>

Second delay time (0-600 seconds)            TERTIME2= OFF   ? <ENTER>

PORT:F
PORTID  ="Service port"
MODEM   = N
BAUD    = 2400
PARITY  = N
RTS_CTS = N    XON_XOFF=                                                3
TIMEOUT = OFF
AUTO_HELP= Y
TERTIME1= 1
TERSTRING="\004"
TERTIME2= OFF

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

Port F Setting Changed

*>>
```

Notes:

1. Enter a Port ID description.
2. Default TERSTRING = "\004" is ASCII hexadecimal code for keystroke **<CTRL-D>**. Use **<CTRL-D>** to end or quit transparent communication with a port.
3. Review all settings and accept the changes by typing **Y<ENTER>**.

3. Note that the STARTUP string in the following example reflects that you have not changed the relay passwords from the factory defaults. If you change the passwords, you should modify the startup strings in the SEL-2030 to match the new passwords.

   Set Port 1 communications options using the **SET P** command.

   You should have the following screen:

```
*>>SET P 1<ENTER>

Port communications settings for Port1

Device Type (U=Unused, S=SEL IED, O=Other IED,
             P=Printer, M=Master)              DEVICE  = S     ? <ENTER>

Auto-configure port (Y/N)                    CONFIG  = N     ? Y<ENTER>                  1

Attempting auto-configuration...

FID:      FID=SEL-151-R412-V656rp1rqys-D941208-E2
DEVICE ID: Example 21.6 kV Line
BAUD RATE: 9600
OPERATE SUPPORT:  ASCII (1 Breakers, 0 Remote Bits)
LEVEL 1 PASSWORD:  OTTER
LEVEL 2 PASSWORD:  TAIL
COMMANDS SUPPORTED:
  B 2OMETER
  A 2OTARGET
  A 2OHISTORY
  A 2OSTATUS
  A 2OEVENT
  A 2OEVENTS

Port Identification String
PORTID  ="Example 21.6 kV Line"
 ? <ENTER>

Communications Settings

Baud Rate (300, 600, 1200, 2400, 4800, 9600,
           19200)                            BAUD    = 9600  ? <ENTER>

Number data bits (7,8)                       DATABIT = 8     ? <ENTER>

Stop Bits (1,2)                              STOPBIT = 2     ? <ENTER>

Parity (N,O,E,1,0)                           PARITY  = N     ? <ENTER>

Enable RTS/CTS handshaking (Y/N)             RTS_CTS = N     ? <ENTER>

Port Time-out in minutes (0.0-120.0)           TIMEOUT = OFF   ? 30<ENTER>               2

PORT:1
DEVICE  = S
CONFIG  = Y

PORTID  ="Example 21.6 kV Line"
BAUD    = 9600
DATABIT = 8    STOPBIT = 2    PARITY  = N
RTS_CTS = N
TIMEOUT = 30.0

Save changes (Y/N) ? Y<ENTER>                                                            3

Port 1 Settings Changed

*>>
```

Notes: 1 Type **Y<ENTER>** to auto-configure the port.

2 Set port time-out to 30 minutes to automatically disconnect transparent communication.

3 Accept new settings by typing **Y <ENTER>** to save changes.

4. Use **SET A** to define a timed trigger condition in the form of (Thh:mm:ss) to send a date message at a specific time once each day to the relay connected to Port 1.

   This setting sequence uses the **SET A** command to set a message trigger and a message in Port 1 of the SEL-2030. This example sets the SEL-2030 to issue the date command to the relay attached to Port 1 once each day. Even though you supply IRIG-B time to the relays, if a relay is powered down for any reason, it may need this date information to establish the current year because the year is not supplied by IRIG-B. The date is retrieved from the SEL-2030 Global data region and formatted in a message string that the relay will recognize.

   The SEL-2030 maintains date and time information in the Global data region. You can access this information using the **VIEW** command. Use the labels displayed by the **VIEW** command when you define the date message sequence with the **SET A** command. For an interpretation of the labels shown in the **VIEW** screen, see the description of the Global data region in ***SEL-2030 Reference Manual; Section 6: Database***.

   To see the Global data format, type **VIEW 1:GLOBAL<ENTER>** to display Global database information.

   Your screen should look like this:

```
*>>VIEW 1:GLOBAL<ENTER>

Port 1,  Data Region GLOBAL   Data

FID = FID=SEL-2030-R113-V0-Z000000-D20010122
STATUS = 0100h  CONFIG = 0CA0h  __YEAR = 1997  DAY_OF_YEAR = 304 (10/01)
MONTH = 10  DATE = 31  TIME = 14:12:03.598
ELEMENTS = 04h,00h,00h,20h,FFh,FFh,00h
REMOTE_BIT_REG = 0000h  REMOTE_BITS = 00h  _YEARS = 97
_HOURS = 14  _MINS = 12  _SECS = 3
CARD1_FID = FID=SEL-2711-R100-V0-D971031
CARD1_SERVICES =       64  CARD1_STATUS = 0021h  CARD1_CONFIG = 0001h
  CARD1_STEST_ERR = 0082h
CARD2_FID =
CARD2_SERVICES =        0  CARD2_STATUS = 0000h  CARD2_CONFIG = 0000h
  CARD2_STEST_ERR = 0000h  PORT_STATUS = 0004h  ALT_PORT = 255
NUM_MESGS = 20  BAD_MESGS = 0

*>>
```

   Now, type **SET A 1** to define a timed trigger condition and a message to send the date message to the relay connected to Port 1 at a specific time once each day. Enter the information and follow the prompts as shown in the following screen image. Note that this example screen reflects that you have not changed the relay passwords from the factory defaults. Your screen should look like this:

```
*>>SET A 1<ENTER>

Automatic message settings for Port 1

Save Unsolicited Messages (Y/N)              AUTOBUF = Y    ? <ENTER>

Port Startup String
STARTUP ="ACC\n0TTER\n2AC\nTAIL\n"
 ? <ENTER>

Block external connections to this port

                                    (continued on next page)
```

```
                                  (continued from previous page)
NOCONN  = NA
 ? <ENTER>

Send Operate command on Logic bit transition (Y/N) SEND_OPER=N    ? <ENTER>

Enable Automatic Sequential Events Recorder Collection (Y/N) REC_SER = N  ? <ENTER>

Auto-message Settings
How many auto-message sequences (0-12)       MSG_CNT = 0     ? 1<ENTER>

Item 1 trigger D1
ISSUE1  = NA
 ? T1:00<ENTER>

Item 1 message
MESG1   = ""
 ? DATE \RI;1:GLOBAL:MONTH//\RI;1:GLOBAL:DATE//\RI;1:GLOBAL:_YEAR/\N<ENTER>

Item 1 response parsing method (0=IGNORE,
 1=ASCII_INT, 2=ASCII_FLOAT, 3=CHAR_STRING, 4=INT_STRING)PARSE1  = 0     ? <ENTER>
Time delay to allow response to complete (OFF, ON)DELAY1  = ON      ? <ENTER>

Archive Settings

Enable use of archive data items (Y/N)       ARCH_EN = N      ? <ENTER>

Size of user-defined data space in registers USER    = 0     ? <ENTER>

AUTOBUF = Y
STARTUP ="ACC\nOTTER\n2AC\nTAIL\n"
NOCONN = NA
SEND_OPER=N

REC_SER =N
MSG_CNT = 1

ISSUE1  = T01:00:00.0
MESG1   = "DATE \RI;01:GLOBAL:MONTH//\RI;01:GLOBAL:DATE//\RI;01:GLOBAL:_YEAR/\
n"
PARSE1  = 0
DELAY1 = ON

ARCH_EN = N
USER    = 0

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

Port 1 Settings Changed

*>>
```

Notes:

1. Set AUTOBUF=Yes to permit the SEL-2030 to collect and store unsolicited messages from the relay, like summary event reports and group switch reports.
2. Leave automatic operate control disabled for this example.
3. Set MSG_CNT=1 so SEL-2030 prompts for one message trigger and message.
4. Set ISSUE1=T01:00 to trigger MESG1 at 1:00 a.m. every day.
5. Set MESG1=(as shown) to send the date command to the relay with the current date, i.e., DATE MM/DD/YYYY <CR>.
6. Leave DELAY1=ON so response to DATE message will not be interpreted as a response to a following message request.

5. Use the **COPY** command to copy Port 1 settings to the other ports (2, 3, 4, 5, 6, and 7) with devices attached.

   The above step results in the following screen. Port settings were not copied beyond Port 7. If you know that all SEL IEDs are identical, you may type **N<ENTER>** when asked for auto-configuration and simply enter the Port ID for each port since auto-configuration information will be the same. Sometimes settings are lost during copying because of device incompatibilities. Therefore, whenever you use the **COPY** command you should check all settings using the **SHOWSET** command on each port (e.g., SHO 2).

```
*>>COPY 1 ALL<ENTER>                                                    1

Copy settings from Port 1 to Port 2 (Y/N) ? Y<ENTER>
Perform auto-configuration on Port 2 (Y/N) ? Y<ENTER>
Attempting auto-configuration...Done.
Port 2 Settings Changed

Copy settings from Port 1 to Port 3 (Y/N) ? Y<ENTER>
Perform auto-configuration on Port 3 (Y/N) ? Y<ENTER>
Attempting auto-configuration...Done.
Port 3 Settings Changed

Copy settings from Port 1 to Port 4 (Y/N) ? Y<ENTER>
Perform auto-configuration on Port 4 (Y/N) ? Y<ENTER>
Attempting auto-configuration...Done.
Port 4 Settings Changed

Copy settings from Port 1 to Port 5 (Y/N) ? Y<ENTER>
Perform auto-configuration on Port 5 (Y/N) ? Y<ENTER>
Attempting auto-configuration...Done.
Port 5 Settings Changed

Copy settings from Port 1 to Port 6 (Y/N) ? Y<ENTER>
Perform auto-configuration on Port 6 (Y/N) ? Y<ENTER>
Attempting auto-configuration...Done.
Port 6 Settings Changed

Copy settings from Port 1 to Port 7 (Y/N) ? Y<ENTER>
Perform auto-configuration on Port 7 (Y/N) ? Y<ENTER>
Attempting auto-configuration...Done.
Port 7 Settings Changed

Copy settings from Port 1 to Port 8 (Y/N) ? N<ENTER>
Copy settings from Port 1 to Port 9 (Y/N) ? N<ENTER>
Copy settings from Port 1 to Port 10 (Y/N) ? N<ENTER>
Copy settings from Port 1 to Port 11 (Y/N) ? N<ENTER>
Copy settings from Port 1 to Port 12 (Y/N) ? N<ENTER>
Copy settings from Port 1 to Port 13 (Y/N) ? N<ENTER>
Copy settings from Port 1 to Port 14 (Y/N) ? N<ENTER>
Copy settings from Port 1 to Port 15 (Y/N) ? N<ENTER>
Copy settings from Port 1 to Port 16 (Y/N) ? N<ENTER>

*>>
```

Note: 1 Use the COPY 1 ALL as a shortcut to copy settings on Port 1 to all other ports.

6. Use **SET P** to set Port 9 as a modem port.

Your screen should appear similar to the following:

```
*>>SET P 9<ENTER>

Port communications settings for Port 9

Device Type (U=Unused, S=SEL IED, O=Other IED,
             P=Printer, M=Master)               Device   = M     ? <ENTER>

Communications Type (S=SEL, L=LMD)             PROTOCOL = S     ? <ENTER>

Enable Fast Operate commands on this port (Y/N)FAST_OP = N        ? <ENTER>

Port Identification String
PORTID  =""
 ? MODEM<ENTER>

Modem Settings

Modem Control (Y/N)                            MODEM    = N     ? Y<ENTER>

Start-up String
MSTR    ="ATXOE0&DOS0=4"
 ? <ENTER>

Modem Carrier Detect connected to CTS input (Y/N) CD_CTS  = N     ? <ENTER>

DCD_FLOW = y

Communications Settings

Baud Rate (300, 600, 1200, 2400, 4800, 9600,
           19200, 38400)                       BAUD     = 9600  ? 38400<ENTER>

Number data bits (7,8)                         DATABIT = 8     ? <ENTER>

Stop Bits (1,2)                                STOPBIT = 2     ? <ENTER>

Parity (N,O,E,1,0)                             PARITY   = N     ? <ENTER>

Enable RTS/CTS handshaking (Y/N)               RTS_CTS = N     ? <ENTER>

Enable XON/XOFF flow control (Y/N)             XON_XOFF= Y     ? <ENTER>

Port Time-out in minutes (0.0-120.0)             TIMEOUT = 5.0   ? 30 <ENTER>

                                      (continued on next page)
```

Notes:

1. Leave *Fast Operate* commands disabled for this example. See ***SEL-2030 Reference Manual; Section 7: Protocols*** for a complete discussion of these commands.
2. Enter “MODEM” or some other description to identify the port as a modem port.
3. Accept the default modem startup initialization string.
4. The default baud rate for all rear ports is 9,600. Set the baud rate to 38,400 baud to take full advantage of the modem’s maximum baud rate. When you call the substation from a remote location, the modem on your PC and the SEL-2030 modem will negotiate the highest possible baud rate.

```
                                  (continued from previous page)


Echo received characters (Y/N)               ECHO    = Y     ? <ENTER>

Automatic help messages enabled (Y/N)        AUTO_HELP= Y     ? <ENTER>

Transparent Communications Termination Sequence

First delay time (0-600 seconds)             TERTIME1= 1   ? <ENTER>

Termination string
TERSTRING="\004"
 ? <ENTER>

Second delay time (0-600 seconds)            TERTIME2= OFF   ? <ENTER>

PORT:9
DEVICE  = M
PROTOCOL= S
FAST_OP = Y
PORTID  ="MODEM"
MODEM   = Y
MSTR    ="ATX0E0&D0S0=4"
CD_CTS  = N     DCD_FLOW= Y
BAUD    = 38400
DATABIT = 8     STOPBIT = 2    PARITY  = N
RTS_CTS = N     XON_XOFF= Y
TIMEOUT = 30.0  ECHO    = Y
AUTO_HELP= Y
TERTIME1= 1
TERSTRING="\004"
TERTIME2= OFF

Save changes (Y/N) ? Y<ENTER>                                                  5

Port 9 Settings Changed

*>>
```

Note: 5 Type **Y<ENTER>** to accept port setting changes.

VERIFY AND TEST ALL COMMUNICATION PATHS

The remainder of this example verifies proper communication with the SEL-251 Relays attached to each port of the SEL-2030.

1. Issue the **STATUS** command to check that IRIG-B signal is present and devices are connected as expected. Your screen should look similar to the following:

```
*>>STATUS<ENTER>
COMMUNICATIONS PROCESSOR - S/N 95012004     Date: 01/25/01    Time: 13:46:43
FID=SEL-2030-R113-V0-Z000000-D20010122      FID=SLBT-2030-R103-V0-Z000000-D20010122


SELF-TESTS

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

IRIG-B Input: Absent
I/O Board: Absent

Port   Status           Success Rate   SET M     Database
1      Active                100%      None
2      Active                100%      None
3      Active                100%      None
4      Active                100%      None
5      Active                100%      None
6      Active                100%      None
7      Active                100%      None
8      Inactive                        None
9      Active                          None
10     Inactive                        None
11     Inactive                        None
12     Inactive                        None
13     Inactive                        None
14     Inactive                        None
15     Inactive                        None
16     Inactive                        None
17     Sole Node(100h)       NORM      None
F      Active                100%      None


*>>
```

2. Initiate transparent communications to the relay on Port 1 by typing **PORT 1<ENTER>**. Press **<ENTER>** a second time to receive the relay system prompt. You will see the following screen:

```
*>>PORT 1<ENTER>
Transparent Communications to Port 1 established

<ENTER>

=
```

   You can now communicate with the relay attached to Port 1 as though your terminal were directly connected to the relay. The relay will be at Access Level 0, as indicated by the "=" prompt. If you do not see the "Transparent Communication Established" message or the relay prompt, check the cable connection and the relay status. See ***Section 6: Troubleshooting*** for more detailed information.

3. Use the **ACCESS** command and relay password to get to Access Level 1. At the "=>" relay prompt, issue the **IRIG** command. IRIG directs the relay to read the demodulated IRIG-B time-code input on the AUX input power panel port. If the relay reads the time code successfully, the relay updates the internal clock/calendar time and date and transmits a message with relay ID string, date, and time. If no IRIG-B signal is present, or the code

cannot be read successfully, the relay sends the error message “IRIG B DATA ERROR.” If you receive an error message, check the cable connection between the SEL-2030 and the relay AUX input port and consult ***Section 6: Troubleshooting***.

Issue the **SHOWSET** command (**SHO** for short) to view the relay settings. You should see relay setting information similar to the following:

```
=>SHO<ENTER>
Settings for group 1

Example 21.6 kV Feeder - S/N 93245011
CTR  =120.00  PTR  =180.00
R1   =0.58    X1   =1.50    R0   =1.44    X0   =4.56
RS   =0.00    XS   =0.00    LL   =2.42
DATC =15      PDEM =12.00   QDEM =12.00   NDEM =0.99
79OI1=60      79OI2=600     79OI3=900     79OI4=0
79RST=1800    M79SH=00000
50C  =99.99   27L  =0.00    27H  =0.00    27C  =2       TCI  =0
50Q  =99.99   50QT =0
51QP =6.00    51QTD=15.00   51QC =3       51QRS=N
50NL =20.01   50NLT=2       50NH =99.99
51NP =1.50    51NTD=2.00    51NC =3       51NRS=N
50L  =99.99   50LT =0       50H  =39.99
51P  =6.00    51TD =6.00    51C  =3       51RS =N
52APU=1200    52ADO=0       TSPU =0       TSDO =0
TKPU =0       TKDO =0       TZPU =0       TZDO =0

PRESS RETURN ? <ENTER>

SELogic Equations

S(123)  =
A(12)   =
B(12)   =50NLT
C(12)   =50NL
D(12)   =
E(34)   =79RS+79CY+52AT
F(34)   =IN6
G(34)   =
H(34)   =
J(1234) =
K(1234) =
L(1234) =
A1(1234)=TF
A2(1234)=NDEM

PRESS RETURN ? <ENTER>

V(56)   =B*E*F
W(56)   =C*E*F
X(56)   =
Y(56)   =
Z(56)   =
A3(1346)=79CY
A4(2346)=
TR(1246)=50H+51T+51NT+V
RC(1246)=50H+TF
ER(1246)=51P+51QP+51NP+TF+W
SEQ(1)  =
ETC(1)  =
ITC(1)  =

                                    (continued on next page)
```

```
                                   (continued from previous page)
Global settings
DEMR =Y       CFT  =60      TDUR =4       TFT  =30      TGR  =180  ITT  =5       TIME1=15
TIME2=0       AUTO =2       RINGS=3    IN1  =SS1     IN2  =DT      IN3  =RE      IN4  =
IN5  =52A     IN6  =

=>
```

While you have the relay global settings on the screen, verify that:

TIME2=0

AUTO=2 or 3 (setting 2 is for Port 2 and setting 3 is for both Ports 1 and 2)

These settings allow the SEL-2030 to continue to receive automatic messages from the relay without the port timing out. If these two settings are not as shown above, go to Access Level 2 and use the relay **SET** command to change them.

Quit transparent communication using the default disconnect sequence or keystroke **<CTRL-D>**.

Note: After transparent communications with the relay, the SEL-2030 will reissue the STARTUP string to the relay to return it to the access level needed for proper operation. If you change a relay password, modify the port's startup string to match. If you use an SEL-501 Relay and change one of the relay type settings, reconfigure afterwards so that the SEL-2030 maintains a correct target list.

You should see the following:

```
=><CTRL-D>

Transparent Communications to Port 1 terminated

*>>
```

4. Use the **TOGGLE** command, as shown in the following screen image, to send the date message previously defined as MESG1 in the SEL-2030 As shown here, you toggle the state of the D1 element to trigger the associated message MESG1. The SELOGIC® Control Equation in ISSUE1 normally does this, but the **TOGGLE** command lets you test the process without waiting for the SELOGIC Control Equation condition to become true.

```
*>>TOGGLE 1:D1<ENTER>

Bit toggled

*>>
```

Reestablish transparent communications with the relay and verify that the date matches the date in the SEL-2030. Use the **DATE** command to change the date and year in the relay (DATE MM/DD/YY); exit transparent communication and issue the **TOGGLE** command again. Enter transparent communication and again verify that the date matches the date in

the SEL-2030. If the date does not match, exit transparent communication and double-check the SEL-2030 MESG1 setting to make sure that the message string exactly matches the string in the **SET A** example shown earlier.

5. Check modem communication.

   Have someone call the phone number of the telephone line connected to the SEL-2030 modem. The modem should answer on the fourth ring. The caller's communication program should be set for an 8-bit word, no parity, and 2 stop bits. Any baud rate can be used, up to the maximum baud rate of the caller's and local modems.

   The remote caller can enter transparent communication with any of the relays attached to the SEL-2030 using the **PORT** command, just as you did earlier. You can monitor the communication using the LEDs on the SEL-2030 front panel and using the **STATUS** command. The **STATUS** screen shows the ports that are in transparent communication and the port number they are in transparent communication with. For instance, if Port 9 is in transparent communication with Port 1, the status of Port 9 will show TRANS1, and the status of Port 1 will show TRANS9.

   The remote caller should use the same procedure to quit transparent communication as he or she did earlier. If, for some reason, remote communication is cut off before the remote caller quits transparent communication, the TIMEOUT on the SEL-2030 modem port will disconnect transparent communication automatically in 30 minutes.

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EXAMPLE 3: PRINT RELAY MESSAGES

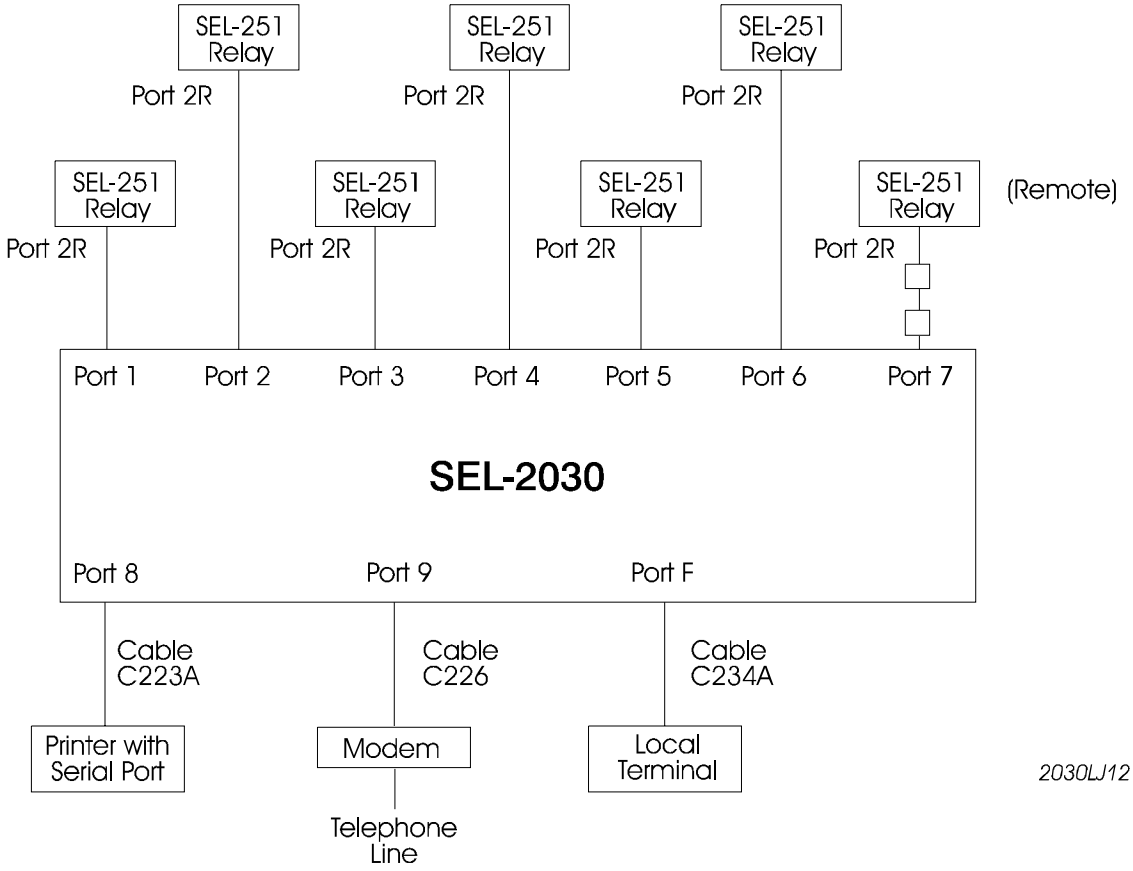

Figure 4.2: SEL-2030 with Relays and Printers

INTRODUCTION

Example 3 is similar to Example 2, but minor changes and additions have been made to demonstrate additional SEL-2030 features and capabilities. The cable for the relay connected to the SEL-2030 Port 7 is replaced with a short-haul modem that supports communication, but not IRIG-B signal, and a serial printer is added to SEL-2030 Port 8.

IDENTIFYING THE PROBLEM

Your objective in Example 3 is to accomplish the following tasks:

- You want the SEL-2030 to print all unsolicited messages (e.g., summary event reports, power-up messages) that are generated by the relays connected to the SEL-2030.

- You want to time-synchronize the clock/calendars on all of the connected relays, including one that cannot accept IRIG-B because it is remotely connected through short-haul modems.

DEFINING THE SOLUTION

Complete Hardware Connections

1. Configure each SEL-251 Relay as in Example 2, except for the following:
   - The SEL-251 on Port 7 is now connected through short-haul modems. Consequently, there is no IRIG-B connection and we must supply the time using an ASCII command.
2. The computer connected to Port F and the configuration of Port F remain as in Example 1.
3. Connect a serial port printer to SEL-2030 Port 8 using an SEL-C223A cable or equivalent. Ports 1 through 7 and 9 of the SEL-2030 remain configured as in Example 1.

Set the SEL-2030

1. Set SEL-2030 Port 7 to send a time and date command to the relay.
2. Use the **SET P** command to configure Port 8 as a printer port.
3. Use the **SET A** command to enable printing of unsolicited messages on Port 8 and clear the buffers after printing.

Verify and Test All Communication Paths

1. Use the **STATUS** command to check that IRIG-B signal is present and devices are connected to ports as expected. Also use the **WHO** command to see a list of connected devices.
2. Test the connection with each port using the **PORT** command to enter transparent communication. Check the connection with the printer by sending a message to Port 8. Use the default disconnect sequence **<CTRL-D>** to terminate transparent communication.
3. Use the **TOGGLE** command to issue the time and date command to the relay on Port 7.

SET THE SEL-2030 STEP-BY-STEP

1. Note that the STARTUP string in the following example reflects that you have not changed the relay passwords from the factory defaults. If you change the passwords, you should modify the startup strings in the SEL-2030 to match the new passwords.

   Set Port 7 to send a time command to the relay as shown on the following screen image:

```
*>>SET A 7<ENTER>

Automatic message settings for Port 7

Save Unsolicited Messages (Y/N)              AUTOBUF = Y     ? <ENTER>

Port Startup String
STARTUP ="ACC\nOTTER\n2AC\nTAIL\n"
 ? <ENTER>

Block external connections to this port
NOCONN  = NA
 ? <ENTER>

Send operate command on logic bit transition (Y/N) SEND_OPER=N ? <ENTER>

Enable Automatic Sequential Events Recorder Collection (Y/N) REC_SER = N   ? <ENTER>

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 1     ? <ENTER>

Item 1 trigger D1
ISSUE1  = T01:00:00.0
 ? <ENTER>

Item 1 message
MESG1   = "DATE \RI;07:GLOBAL:MONTH//\RI;07:GLOBAL:DATE//\RI;07:GLOBAL:_YEAR/\n"
 ? TIME \RI;7:GLOBAL:_HOURS/:\RI;7:GLOBAL:_MINS/:\<ENTER>                    [1] [2]

 ? \RI;7:GLOBAL:_SECS/\N DATE \RI;7:GLOBAL:MONTH//\<ENTER>

 ? \RI;7:GLOBAL:DATE//\RI;7:GLOBAL:_YEAR/\N<ENTER>

Item 1 response parsing method (0=IGNORE,
 1=ASCII_INT, 2=ASCII_FLOAT, 3=CHAR_STRING, 4=INT_STRING)PARSE1  = 0     ? <ENTER>

Time delay to allow response to complete (OFF,ON)  DELAY1  = ON     ? <ENTER>


Archive Settings

Enable use of archive data items (Y/N)       ARCH_EN = N     ? <ENTER>

Size of user-defined data space in registers USER    = 0    ? <ENTER>

AUTOBUF = Y
STARTUP ="ACC\nOTTER\n2AC\nTAIL\n"
NOCONN = NA
SEND_OPER=N

REC_SER = N
MSG_CNT = 1


ISSUE1  = T01:00:00.0
MESG1   = "TIME \RI;07:GLOBAL:_HOURS/:\RI;07:GLOBAL:_MINS/:\RI;07:GLOBAL:_SECS
/\n DATE \RI;07:GLOBAL:MONTH//\RI;07:GLOBAL:DATE//\RI;07:GLOBAL:_YEAR/\n"
PARSE1  = 0
DELAY1  = ON

ARCH_EN = N
USER    = 0

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

Port 7 Settings Changed
*>>
```

Notes: [1] Combine the TIME and DATE command in the same message as shown in this example, or separate the two commands into separate messages.

[2] Use the \<ENTER> special character sequence at the end of a line to continue on a second line.

2. Use the **SET P** command to configure Port 8 as a printer port.

```
*>>SET P 8<ENTER>

Port communications settings for Port 8


Device Type (U=Unused, S=SEL IED, O=Other IED,
             P=Printer, M=Master)             DEVICE  = P     ? <ENTER>

Port Identification String
PORTID  =""
 ? Line Printer<ENTER>


Communications Settings

Baud Rate (300, 600, 1200, 2400, 4800, 9600,
           19200)                             BAUD    = 9600  ? <ENTER>

Number data bits (7,8)                        DATABIT = 8     ? <ENTER>

Stop Bits (1,2)                               STOPBIT = 2     ? <ENTER>

Parity (N,O,E,1,O)                            PARITY  = N     ? <ENTER>

Enable RTS/CTS handshaking (Y/N)              RTS_CTS = N     ? <ENTER>

Enable XON/XOFF flow control (Y/N)            XON_XOFF= Y     ? <ENTER>

Port Time-out in minutes (0.0-120.0)            TIMEOUT = OFF   ? 30 <ENTER>

PORT:8
DEVICE  = P
PORTID  ="Line Printer"
BAUD    = 9600
DATABIT = 8    STOPBIT = 2    PARITY  = N
RTS_CTS = N    XON_XOFF= Y
TIMEOUT = 30.0


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

Port 8 Settings Changed

*>>
```

1 2 3

Notes:
1 Enter **P** to identify the device type as a printer.
2 Enter an identification for the SEL-2030 port directory.
3 Enter communication parameters compatible with the printer.

3. Use the **SET A** command to enable printing of unsolicited messages on Port 8 and to clear the buffers after printing.

You should see the following screen:

```
*>>SET A 8<ENTER>

Automatic message settings for Port 8


Port Startup String
STARTUP =""
 ? <ENTER>                                                              [1]


Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 0     ? 1<ENTER>

Print all buffered unsolicited messages (Y/N)PRINT_ALL= N     ? Y<ENTER>
                                                                        [2]
Clear unsolicited message buffer after print (Y/N)CLEAR_BUF= N     ? Y<ENTER>

Size of user-defined data space in registers USER    = 0     ? <ENTER>

STARTUP =""

MSG_CNT = 1

PRINT_ALL= Y
CLEAR_BUF= Y
USER    = 0

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

Port 8 Settings Changed


*>>
```

Notes: [1] Your printer may require a power-up initialization. If it does, you enter it as a startup string. The startup string is issued to the printer when you power up the SEL-2030.

[2] You enable printing unsolicited messages and set the SEL-2030 to clear the unsolicited message buffers as the messages are printed. The PRINT_ALL setting automatically gives the printer access to unsolicited messages received and stored on all ports.

VERIFY AND TEST ALL COMMUNICATION PATHS

1. Issue the **STATUS** command to check that IRIG-B signal is present and devices are connected to ports as expected. This command was used in Example 2. You can also use the **WHO** command to see a list of all devices connected to SEL-2030 ports. The SEL-2030 response to the **WHO** command should look similar to the following screen image:

```
*>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
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

*>
```

2. Once you have established the port settings for the printer, test the connection by using the **PORT** command and issuing a message as follows:

```
*>>PORT 8 E<ENTER>

Transparent Communications to Port 8 established

This is a test <ENTER>
This is the second line.<ENTER>

<CTRL-L><CTRL-D>

Transparent Communications to Port 8 terminated

*>>
```

This example prints the following two lines of text on the printer and then form feeds the printer.

> This is a test.
> This is the second line.

Some printers print as they receive each character, some print only when they receive a complete line, and some do not print until they receive an entire page. This example should result in output on any of these types of printers. The **<CTRL-L>** is the form feed from most keyboards.

3. Use the **TOGGLE** command to issue the time and date command stored in MESG1 on Port 7 to the relay on Port 7.

```
*>>TOGGLE 7:D1<ENTER>

Bit Toggled

*>>
```

Record the time you toggled the bit. Enter transparent communication with the relay on Port 7 and check the time on the relay. The relay time should be the recorded time plus the number of seconds since you toggled the message trigger bit. This synchronization technique is not as accurate as with IRIG-B. You can expect the time on the relay to be synchronized within three seconds of the SEL-2030 clock.

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Example 4: SEL-2030 Applied to SCADA RTU Data Access

INTRODUCTION

Example 4 is similar to Examples 2 and 3, except an RTU is added in this example to demonstrate the database and data transfer capabilities of the SEL-2030.

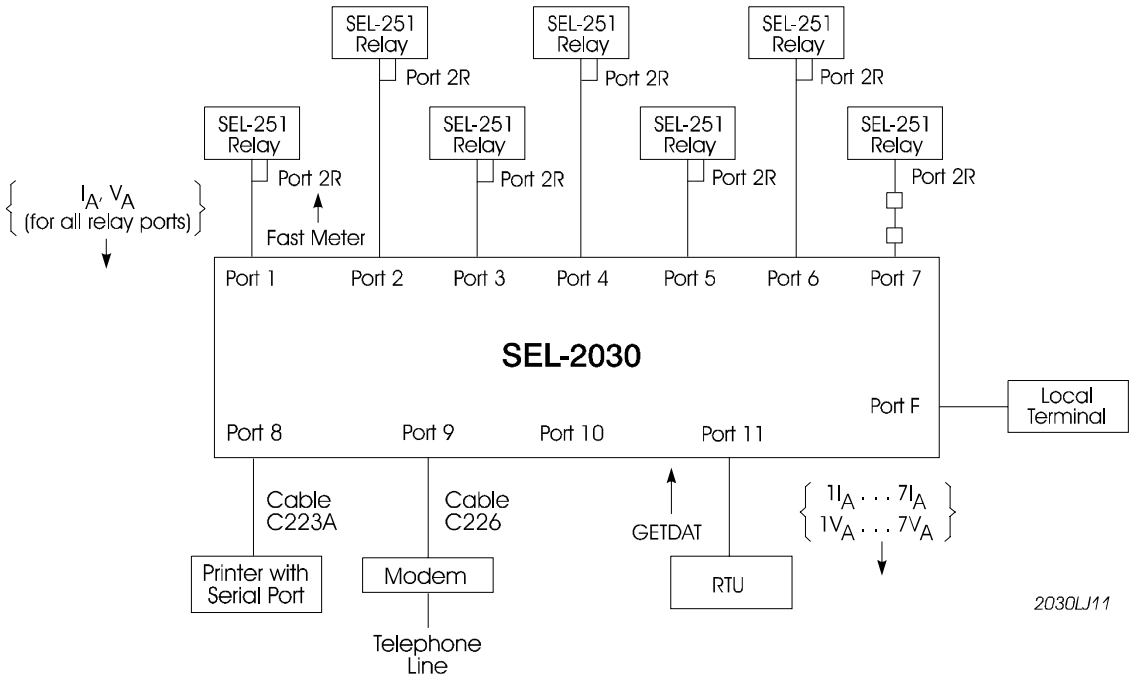


Figure 4.3: SCADA RTU Configuration Diagram

IDENTIFYING THE PROBLEM

Your objective in Example 4 is to collect A-phase voltage and current information from the substation feeders for the SCADA system. After evaluating several options, you decide that the most cost-effective method is to use the SEL-2030 to collect metering data from the seven substation relays. You want the SEL-2030 to collect data every second to avoid data latency when the RTU requests data at 1.5-second intervals.

DEFINING THE SOLUTION

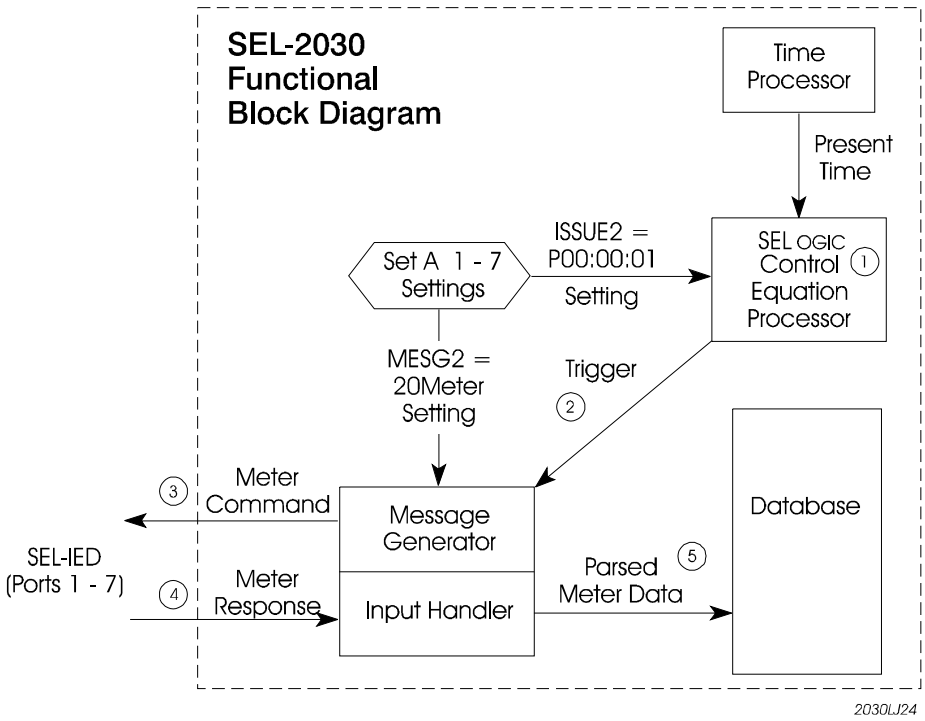
The solution is to use the automatic database features of the SEL-2030. Figure 4.3 shows the SEL-2030 installation, with the RTU connected to Port 11.

Complete Hardware Connections

1. The SEL-251 Relays remain configured as in the previous example.
2. Connect the EIA-232 port on the RTU to Port 11 of the SEL-2030 with a proper communication cable.
3. Retain the configuration for SEL-2030 Ports 1 through 9 from previous examples.

Set the SEL-2030

1. Use the **SET P** command to configure Port 11 as a Master port for the RTU.
2. Use the **SET A** command to define a trigger condition (P00:00:01.0) on Port 1 that periodically triggers a message (see Figure 4.4). Create a message to send a meter command (using 20METER setting) to relays when the trigger condition exists.



① The SELOGIC® Control Equation Processor compares the Time Processor input to the timed issue condition set for Ports 1 through 7. You previously set the timed issue condition to ISSUE2 = P00:00:01 using the SET A command.

② When the SELOGIC Control Equation Processor detects a match between the time and the issue condition (once each second in the example) it sets the D2 trigger bit.

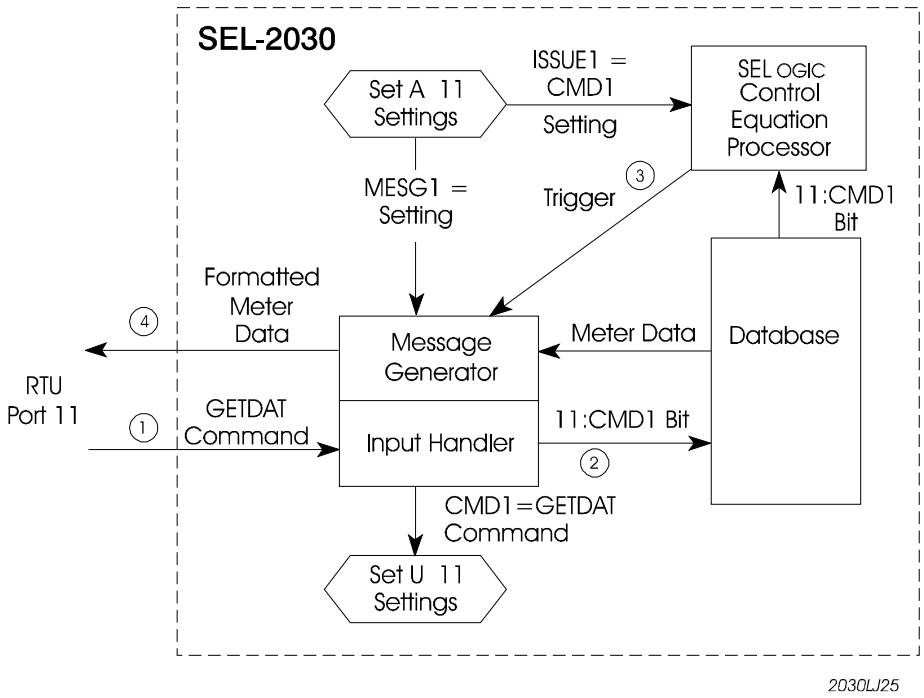
③ The Message Generator detects the D2 bit set and issues MESG2. You previously set MESG2 = 20METER using the SET A command. The SEL-2030 is programmed to send the METER command appropriate for the connected SEL relay.

④ The relay sends meter data to the SEL-2030.

⑤ Because you auto-configured this port (in a previous example), the SEL-2030 is programmed to parse the response. The SEL-2030 parses the response and stores it in the port database.

Figure 4.4: Trigger P00:00:01 and 20METER Setting in SET A

3. Use the **COPY 1 ALL** command to copy settings from Port 1 to Ports 2 through 6. You cannot copy the settings to Port 7, because Port 7 has the additional date and time message. Repeat step 2 on Port 7 to define the trigger and message on that port.



① An RTU attached to Port 11 sends the GETDAT command to the SEL-2030. You previously defined this command (CMD1="GETDAT") using the SET U command.

② The Input Handler detects GETDAT and asserts the 11:CMD1 bit in the database.

③ The SELOGIC Control Equation Processor detects the 11:CMD1 bit and asserts the D1 trigger because you previously set ISSUE1=11:CMD1 using the SET A command for Port 11.

④ The Message Generator detects D1 bit set and issues MESG1. MESG1 instructs the SEL-2030 to retrieve A-phase current and voltage data from Ports 1 through 7 databases and transmit these data through Port 11. You previously defined MESG1=\Rf;O1:METER:IA/,\Rf;O1:METER:VA/...\Rf;O7:METER:IA/,\Rf;O7:METER:VA/ using the SET A command

Figure 4.5: Define CMD1="GETDAT" in SET U

4. Define a command (GETDAT) that the RTU will send to the SEL-2030 to request meter data (see Figure 4.5). Use **SET U** to define this user-defined command on Port 11 (CMD1="GETDAT").

5. Use the **SET A** command to define a trigger condition (CMD1 is asserted) and a message it triggers on Port 11. The message (MESG1) is a string you build that requests current and voltage meter data from the Port 1 through 7 databases.

Verify and Test All Communication Paths

1. Verify that the SEL-2030 is requesting meter data from each relay every second and receiving meter data in response to that request.

2. Verify that the relay meter data is parsed and stored in the SEL-2030 database.

3. Verify that the SEL-2030 will respond to the user-defined "**GETDAT**" command with the proper meter data from all seven relay port databases.

SET THE SEL-2030, STEP-BY-STEP

Use the **SET P** command to configure Port 11 as a Master port for the RTU.

You should have the following screen:

```
*>>SET P 11<ENTER>

Port communications settings for Port 11


Device Type (U=Unused, S=SEL IED, O=Other IED,
             P=Printer, M=Master)              DEVICE  = S     ? M<ENTER>          1

Communications Type (S=SEL, L=LMD)           PROTOCOL= S     ? <ENTER>

Enable Fast Operate Commands on this port (Y/N) FAST_OP=N      ? <ENTER>

Port Identification String
PORTID  =""
 ? RTU<ENTER>                                                                     2


Modem Settings

Modem Control (Y/N)                          MODEM   = N     ? <ENTER>


Communications Settings

Baud Rate (300, 600, 1200, 2400, 4800, 9600,
           19200, 38400)                     BAUD    = 9600  ? <ENTER>           3

Number data bits (7,8)                       DATABIT = 8     ? <ENTER>

Stop Bits (1,2)                              STOPBIT = 2     ? <ENTER>

Parity (N,O,E,1,O)                           PARITY  = N     ? END<ENTER>

PORT:11
DEVICE  = M
PROTOCOL= S
FAST_OP = N
PORTID  ="RTU"
MODEM   = N
BAUD    = 9600
DATABIT = 8    STOPBIT = 2    PARITY  = N
RTS_CTS = N    XON_XOFF= Y
TIMEOUT = OFF  ECHO    = Y
AUTO_HELP= Y
TERTIME1= 1
TERSTRING="\004"
TERTIME2= OFF

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

Port 11 Settings Changed

*>>
```

Notes:

1. Set the device type to Master.
2. Enter an ID to indicate this port is connected to an RTU.
3. Accept the default baud rate and associated communication parameters if they are compatible with the RTU. If these parameters are not compatible, make changes as necessary.

2. Define automatic message settings for Port 1 with the **SET A** command. Note that the STARTUP string in the following example reflects that you have not changed the relay passwords from the factory defaults. If you change the passwords, you should modify the startup strings in the SEL-2030 to match the new passwords.

   Your screen should look like this:

```
*>>SET A 1<ENTER>

Automatic message settings for Port 1

Save Unsolicited Messages (Y/N)              AUTOBUF = Y      ? <ENTER>

Port Startup String
STARTUP ="ACC\nOTTER\n2AC\nTAIL\n"
 ? <ENTER>

Block external connections to this port
NOCONN  = NA
 ? <ENTER>

Send operate command on logic bit transition (Y/N) SEND_OPER = N     ? <ENTER>

Enable Automatic Sequential Events Recorder Collection (Y/N) REC_SER = N  ? <ENTER>

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 1     ? 2<ENTER>                    1

Item 1 trigger D1
ISSUE1  = T01:00:00.0
 ? <ENTER>

Item 1 message
MESG1   = "DATE \RI;01:GLOBAL:MONTH//\RI;01:GLOBAL:DATE//\RI;01:GLOBAL:_YEAR/\n"
 ? <ENTER>

Item 1 response parsing method (0=IGNORE,
 1=ASCII_INT, 2=ASCII_FLOAT, 3=CHAR_STRING, 4=INT_STRING)PARSE1  = 0     ? <ENTER>

Time delay to allow response to complete (OFF,ON) DELAY1  = ON       ? <ENTER>

Item 2 trigger D2
ISSUE2  = NA
 ? P00:00:01<ENTER>                                                              2

Item 2 message
MESG2   = ""                                                                     3
 ? 2OMETER<ENTER>

Archive Settings

Enable use of archive data items (Y/N)       ARCH_EN = N     ? <ENTER>

Size of user-defined data space in registers USER    = 0     ? <ENTER>

                                    (continued on next page)
```

```
                                    (continued from previous page)

AUTOBUF = Y
STARTUP ="ACC\n0TTER\n2AC\nTAIL\n"
NOCONN = NA
SEND_OPER=N


REC_SER = N
MSG_CNT = 2

ISSUE1  = T01:00:00.0
MESG1   = "DATE \RI;01:GLOBAL:MONTH//\RI;01:GLOBAL:DATE//\RI;01:GLOBAL:_YEAR/\n"
PARSE1  = O
DELAY1  = ON
ISSUE2  = P00:00:01.0
MESG2   = 20METER



ARCH_EN = N
USER    = O

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

Port 1 Settings Changed

*>>
```

Notes:

1. Change the message count from 1 to 2 to add a trigger and message setting on this port.
2. Set the trigger condition to issue the message periodically (P) every second (00 hrs:00 minutes:01 seconds).
3. Set the message to request meter data from the relay. The 20METER message is a special “20” message for SEL relays.

3. Use the **COPY 1 ALL** command to copy settings from Port 1 to Ports 2 through 6. In Example 4, you do not copy to Port 7 because it has a long string message that you do not want to reenter. Use the **SET A** command to define a trigger condition (P00:00:01.0) on Port 7 that periodically triggers a message to send a meter command (using 20METER setting) to relays when the trigger condition exists, just like Ports 1 through 6.

   You should see a screen similar to the following when you use the **COPY** command:

```
*>>COPY 1 ALL<ENTER>

Copy settings from Port 1 to Port 2 (Y/N) ? Y<ENTER>

Perform auto-configuration on Port 2 (Y/N) ? N<ENTER>
Port 2 Settings Changed                                              1

Copy settings from Port 1 to Port 3 (Y/N) ? Y<ENTER>

Perform auto-configuration on Port 3 (Y/N) ? N<ENTER>
Port 3 Settings Changed

Copy settings from Port 1 to Port 4 (Y/N) ? Y<ENTER>

                                       (continued on next page)
```

```
                                  (continued from previous page)

Perform auto-configuration on Port 4 (Y/N) ? N<ENTER>
Port 4 Settings Changed


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

Copy settings from Port 1 to Port 6 (Y/N) ? Y<ENTER>

Perform auto-configuration on Port 6 (Y/N) ? N<ENTER>
Port 6 Settings Changed

Copy settings from Port 1 to Port 7 (Y/N) ? N<ENTER>

Copy settings from Port 1 to Port 8 (Y/N) ? N<ENTER>

Copy settings from Port 1 to Port 9 (Y/N) ? N<ENTER>

Copy settings from Port 1 to Port 10 (Y/N) ? N<ENTER>

Copy settings from Port 1 to Port 11 (Y/N) ? N<ENTER>

Copy settings from Port 1 to Port 12 (Y/N) ? N<ENTER>

Copy settings from Port 1 to Port 13 (Y/N) ? N<ENTER>

Copy settings from Port 1 to Port 14 (Y/N) ? N<ENTER>

Copy settings from Port 1 to Port 15 (Y/N) ? N<ENTER>

Copy settings from Port 1 to Port 16 (Y/N) ? N<ENTER>

*>>
```

Note: 1 You do not need to perform auto-configuration if all port devices are identical. However, you may need to reset port IDs on all ports that settings are copied to, if port IDs were different on each port.

4. Define a command (**GETDAT**) that the RTU will send to the SEL-2030 to request meter data (see Figure 4.5). Use **SET U** to define this user-defined command (**CMD1="GETDAT"**).

Your screen should show the following:

```
*>>SET U 11<ENTER>

User settings for Port 11

Warning:  setting CMD_EN=N will disable SEL-2030 commands on this port

Enable SEL-2030 Commands (Y/N)              CMD_EN  = Y     ? N<ENTER>

Command termination character              CMD_CH  = \00D  ? <ENTER>


General-Purpose User-Defined Input Commands

Number of general purpose commands (0-8)    CMD_CNT = 0     ? 1<ENTER>

Command String 1
CMD1    = ""
 ? GETDAT<ENTER>


Special-Purpose User-Defined Input Commands

Enable use of special purpose commands (Y/N) STR_EN  = N     ? <ENTER>

CMD_EN  = N    CMD_CH  = \00D
CMD_CNT = 1
CMD1    = "GETDAT"
STR_EN  = N

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

Port 11 Settings Changed
*>>
```

Notes:

1. Disable the SEL-2030 command set on this port because you don't want the SEL-2030 to recognize any message from the RTU, other than the "GETDAT" command you defined.
2. When you disable the SEL-2030 command set, the SEL-2030 prompts you for a command termination character. The default is "\00D", which is the ASCII string for carriage return (**<CR>**).
3. Enter CMD_CNT=1 to set one user-defined command.
4. Set CMD1=GETDAT; the user-defined command the RTU will send to the SEL-2030.
5. The SEL-2030 prompts you to enable special purpose commands TRANS, WRITE, and READ. No special purpose commands are used in this example.

5. Use the **SET A 11** command to define a trigger condition (CMD1 is asserted) and a message the SEL-2030 sends to the RTU on Port 11. The message (MESG1) is a string you build that extracts current and voltage meter data from Ports 1 through 7.

Your screen should look similar to the following:

```
*>>SET A 11<ENTER>

Automatic message settings for Port 11


Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 0     ? 1<ENTER>

Item 1 trigger D1
ISSUE1  = NA
 ? CMD1<ENTER>

Item 1 message
MESG1   = ""
 ? \Rf;1:METER:IA/,\Rf;1:METER:VA/,\Rf;2:METER:IA/,\Rf;2:METER:VA/,\<ENTER>

 ? \Rf;3:METER:IA/,\Rf;3:METER:VA/,\Rf;4:METER:IA/,\Rf;4:METER:VA/,\<ENTER>

 ? \Rf;5:METER:IA/,\Rf;5:METER:VA/,\Rf;6:METER:IA/,\Rf;6:METER:VA/,\<ENTER>

 ? \Rf;7:METER:IA/,\Rf;7:METER:VA/\n<ENTER>

Archive Settings

Enable use of archive data items (Y/N)       ARCH_EN = N     ? <ENTER>

Size of user-defined data space in registers USER    = 0     ? <ENTER>

MSG_CNT = 1


ISSUE1  = 11:CMD1
MESG1   ="\RF;01:METER:IA/,\RF;01:METER:VA/,\RF;02:METER:IA/,\RF;02:METER:VA/
,\RF;03:METER:IA/,\RF;03:METER:VA/,\RF;04:METER:IA/,\RF;04:METER:VA/
,\RF;05:METER:IA/,\RF;05:METER:VA/,\RF;06:METER:IA/,\RF;06:METER:VA/,
\RF;07:METER:IA/,\RF;07:METER:VA/\n"

ARCH_EN = N
USER    = 0

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

Port 11 Settings Changed

*>>
```

1 2 3

Notes:

1 Enter 1 because you want to define one message trigger and one message.

2 Set ISSUE1=CMD1 to trigger MESG1 when the SEL-2030 CMD1 element asserts.

3 Set MESG1 as shown in the above screen to retrieve the A-phase current and voltage data stored in the database on each of the SEL relay ports, 1 through 7. Data are defined with a string format of \Rf;(Port number):(Data region label):(Data item label)/, where \Rf:...../ requests the data in floating-point format.

This same thing could have been accomplished by using **SET M** to copy the data of interest to a user region. With the data all in one place, the above message string could have been replaced with a very simple string. See ***SEL-2030 Reference Manual; Section 3: Settings*** for additional information on using **SET M**.

VERIFY AND TEST ALL COMMUNICATION PATHS

1. Verify that the SEL-2030 is requesting meter data from each relay every second and receiving meter data in response to that request.

   - Visually check the front panel Light Emitting Diodes (LEDs); the green transmit (TXD) LEDs should illuminate once every second on Ports 1 through 7 to indicate that the SEL-2030 is sending a message to the relay at that rate; the red receive (RXD) LEDs should illuminate at the same rate, but with a slight delay following illumination of the green LED. This indicates that the SEL relay is responding to the message sent by the SEL-2030.
   - Use the **STATUS** command to see how each port is operating:

   Success Rate column should show 100% for each port. If not, the SEL-2030 is getting unexpected responses. Database Delays should not show any region labels (e.g., D2, A1). Each designator shows a request for data with a previous request pending. Some reasons for database delays are given in the **STATUS** command subsection of ***SEL-2030 Reference Manual; Section 2: Commands.***

   You should see a screen similar to the following:

```
*>>STATUS<ENTER>

COMMUNICATIONS PROCESSOR - S/N 97300004     Date: 01/25/01    Time: 13:46:43
FID=SEL-2030-R113-V0-Z000000-D20010122      FID=SLBT-2030-R103-V0-Z000000-D20010122


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: Absent
I/O Board: Absent

Port   Status           Success Rate   SET M     Database
1      Active               100%       None
2      Active               100%       None
3      Active               100%       None
4      Active               100%       None
5      Active               100%       None
6      Active               100%       None
7      Active               100%       None
8      Active                          None
9      Active                          None
10     Inactive                        None
11     Active                          None
12     Inactive                        None
13     Inactive                        None
14     Inactive                        None
15     Inactive                        None
16     Inactive                        None
17     Sole Node(100h)      NORM       None
F      Active               100%       None

*>>
```

- Use the **MAP 1** command to view the Port 1 database. B METER indicates binary or *Fast Meter* data collection. A METER would indicate ASCII or conventional meter data collection.

```
*>>MAP 1<ENTER>

Port 1 Database Assignments

  Region    Data Type   # Records

  GLOBAL    --
  LOCAL     --
  BUF       --
  D1        Unused
  D2      B METER
  D3        Unused
  D4        Unused
  D5        Unused
  D6        Unused
  D7        Unused
  D8        Unused
  A1        Unused
  A2        Unused
  A3        Unused
  USER      Unused

*>>
```

2. Verify that the relay meter data is parsed and stored in the SEL-2030 database. Determine how data are stored within the data region with the **MAP 1:METER** command.

   You should see a screen similar to the following:

```
*>>MAP 1:METER <ENTER>

Port 1,  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]
IAB(A)       201Ch              float[2]
IBC(A)       2030h              float[2]
ICA(A)       2024h              float[2]
VAB(V)       2028h              float[2]
VBC(V)       202Ch              float[2]
VCA(V)       2030h              float[2]
PA(MW)       2034h              float
QA(MVAR)     2036h              float
PB(MW)       2038h              float
QB(MVAR)     203Ah              float
PC(MW)       203Ch              float
QC(MVAR)     203Eh              float
P(MW)        2040h              float
Q(MVAR)      2042h              float

                                      (continued on next page)
```

```
                                   (continued from previous page)

IO(A)        2044h             float[2]
I1(A)        2048h             float[2]
I2(A)        204Ch             float[2]
VO(V)        2050h             float[2]
V1(V)        2054h             float[2]
V2(V)        2058h             float[2]

*>>
```

Examine collected meter data using the **VIEW** command.

You should see a screen similar to the following:

```
*>>VIEW 1:METER <ENTER>

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  IO(A) =      7.170,   135.000
  I1(A) =   2365.875,   102.106  I2(A) =      5.750,    40.418
VO(V) =      7.299,   -80.537  V1(V) =  11279.251,   103.546
V2(V) =     13.106,   163.608


*>>
```

3. Verify that the SEL-2030 will respond to the user-defined "**GETDAT**" command with the proper meter data from all seven ports. Use a terminal to send the GETDAT messages to Port 11 on the SEL-2030.

```
*>>GETDAT<ENTER>

*>>593.91,12013.22,598.34,12111.33,587.96,12131.22,597.65,12045.34,601.43,12011.34,596.12,12102.33,5
95.11,12045.52

*>>
```

In the screen above, the GETDAT response is a message consisting of an ASCII string of 14 numbers. The first number is the A-phase amps for Port 1, the second the A-phase volts for Port 1. Similarly, there are six more pairs of readings for the other six relays.

Now, you must program the RTU to send the **GETDAT** command whenever it wants an update of the meter information and to interpret the comma-delimited data stream it receives in response. This example shows the user-defined command and the response string as ASCII messages. You may also define binary user-defined commands. See ***SEL-2030 Reference Manual; Section 5: Message Strings*** for more detailed information about requesting other data formats.

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EXAMPLE 5: ARCHIVE EVENT REPORTS TO NONVOLATILE FLASH MEMORY

INTRODUCTION

This example assumes you have SEL relays connected to several of the SEL-2030 ports, as in the previous examples, and also that the SEL-2030 is equipped with optional nonvolatile Flash memory. The nonvolatile Flash memory is required for long-term data storage capable of archiving multiple records. This example demonstrates another unique feature of the SEL-2030: the ability to count the number of summary event reports received from an SEL relay and then retrieve that number of long event reports to store in the SEL-2030 database.

IDENTIFYING THE PROBLEM

In response to summary event reports, you want the SEL-2030 to request long event reports from all attached relays and archive them as unique records in nonvolatile memory.

DEFINING THE SOLUTION

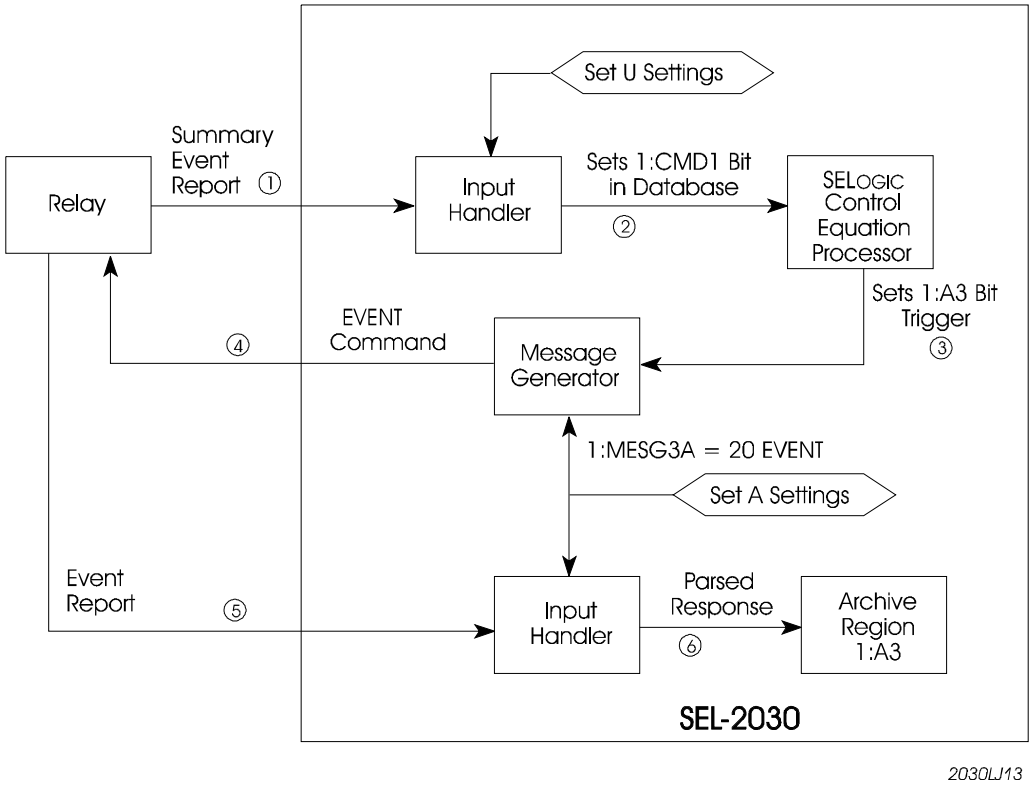
Set the SEL-2030

Figure 4.6 is a functional model showing how long event reports can be archived in SEL-2030 memory. To accomplish this function, follow these steps:

1. Use the **SET U** command to enable the predefined user-defined command 20EVENT on Port 1. 20EVENT is a predefined string for user-defined commands that asserts the corresponding CMDx bit when the SEL-2030 receives a summary event report. See ***SEL-2030 Reference Manual; Section 5: Message Strings*** for a list of predefined strings and more detailed information about strings.

2. On Port 1, use the **SET A** command to enable archiving of data, and to define the issue condition CMD1 to trigger event report collection (using the 20EVENT setting).

3. Use the **COPY ALL** command, as in previous examples, to copy these settings to all ports where you want event report data collected. If connected IEDs are not identical, auto-configure the ports. If they are identical, adjust port IDs and check all settings.



① The SEL relay on Port 1 sends a summary event report to the SEL-2030. You must ensure that the relay port is set to "AUTO" to send summary event reports to the SEL-2030.

② The SEL-2030 recognizes this event report because you set CMD1=20EVENT using the SET U command. The Input Handler therefore sets the CMD1 bit in the Port 1 database.

③ The SELOGIC Control Equation Processor reads the 1:CMD1 bit set and sets the 1:A3 bit, which triggers the message generator to send a preset message. You defined the 1:A3 trigger condition as ISSUE3A=CMD1 using the SET A command.

④ The Message Generator requests an event report from the relay. You defined this message as: MESG3A=20EVENT using the SET A command. The command the SEL-2030 sends is the EVENT command appropriate to that relay.

⑤ The relay responds by sending the long event report to the SEL-2030.

⑥ Because Port 1 was auto-configured from a previous example, the SEL-2030 is programmed to parse the response from the relay. The SEL-2030 parses the response and stores the report in Archive Region 1:A3.

Figure 4.6: Functional Model of Message Archive Function for Port 1

Test the Operation

1. Use the **MAP** command to see the general database structure including the number of archive records stored.
2. Force an event on a relay and wait a couple of minutes for it to be retrieved.
3. View the contents of each port archive data region individually using the **VIEW** command.

SET THE SEL-2030, STEP-BY-STEP

Set all SEL-2030 ports that you want to collect event reports using the following steps:

1. Use the **SET U** command to enable the predefined user-defined command 20EVENT on Port 1. 20EVENT is a predefined string for user-defined commands that asserts the corresponding CMD bit when the SEL-2030 receives a summary event report. See ***SEL-2030 Reference Manual; Section 5: Message Strings*** for a list of predefined strings.

You should see the following screen:

```
*>>SET U 1<ENTER>

User settings for Port 1



General-Purpose User-Defined Input Commands

Number of general purpose commands (0-4)     CMD_CNT = 0     ? 1<ENTER>                    1

Command String 1
CMD1    = ""
 ? 20EVENT<ENTER>                                                                         2

CMD_CNT = 1
CMD1    = 20EVENT

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

Port 1 Settings Changed


*>>
```

Notes:

1. Set CMD_CNT to 1 to open one user-defined command setting. Because this port was configured as an SEL IED port in the previous examples, only four commands can be set. Master ports have eight (8) command settings available.
2. Set CMD1=20EVENT. This settings tells the SEL-2030 to look for summary event reports. When it receives a summary report, the CMD1 element on this port is asserted.

2. On Port 1, use the **SET A** command to enable archiving of data, and to define the issue condition CMD1 to trigger event report collection (using the 20EVENT setting). Note that the STARTUP string in the following example reflects that you have not changed the relay passwords from the factory defaults. If you change the passwords, you should modify the startup strings in the SEL-2030 to match the new passwords.

   You should see the following screen:

```
*>>SET A 1<ENTER>

Automatic message settings for Port 1

Save Unsolicited Messages (Y/N)              AUTOBUF = Y     ? <ENTER>

Port Startup String
STARTUP ="ACC\nOTTER\n2AC\nTAIL\n"
 ? <ENTER>
                                      (continued on next page)
```

```
                                    (continued from previous page)

Block external connections to this port
NOCONN  = NA
 ? <ENTER>

Send Operate command on Logic bit transition (Y/N) SEND_OPER=N     ?<ENTER>

Enable Automatic Sequential Events Recorder Collection (Y/N) REC_SER = N   ? <ENTER>

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 2      ? <ENTER>

Item 1 trigger D1
ISSUE1  = T01:00:00.0
 ? <ENTER>

Item 1 message
MESG1 = "DATE \RI;01:GLOBAL:MONTH//\RI;01:GLOBAL:DATE//\RI;01:GLOBAL:_YEAR/\n
 ? <ENTER>

Item 1 response parsing method (0=IGNORE,
 1=ASCII_INT, 2=ASCII_FLOAT, 3=CHAR_STRING, 4=INT_STRING)PARSE1  = 0     ? <ENTER>

Time delay to allow response to complete (OFF, ON) DELAY1   = ON    ? <ENTER>

Item 2 trigger D2
ISSUE2  = P00:00:01.0
? <ENTER>

Item 2 message
MESG2   = 20METER
 ? <ENTER>


Archive Settings

Enable use of archive data items (Y/N)        ARCH_EN = N     ? Y<ENTER>                    1

Archive 1 trigger ARCH1
ISSUE1A = NA
 ? <ENTER>

Archive 2 trigger ARCH2
ISSUE2a = NA
 ? <ENTER>

Archive 3 trigger ARCH3
ISSUE3A = NA
 ? CMD1<ENTER>                                                                        2

Archive 3 message
MESG3A  = ""
 ? 20EVENT<ENTER>                                                                     3

Size of user-defined data space in registers  USER    = 0     ? <ENTER>

AUTOBUF = Y
STARTUP ="ACC\n0TTER\n2AC\nTAIL\n"
NOCONN = NA
SEND_OPER= N
                                        (continued on next page
```

```
                                    (continued from previous page)

REC_SER = N
MSG_CNT = 2


ISSUE1  = T01:00:00.0
MESG1   = "DATE \RI;01:GLOBAL:MONTH//\RI;01:GLOBAL:DATE//\RI;01:GLOBAL:_YEAR/\n"
PARSE1  = 0
DELAY1  = ON

ISSUE2  = P00:00:01.0

MESG2   = 20METER

ARCH_EN = Y

ISSUE1A = NA

Press RETURN to continue<ENTER>

ISSUE2A = NA

ISSUE3A = 1:CMD1
MESG3A  = 20EVENT
USER    = 0

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

Port 1 Settings Changed


*>>
```

Notes:

1. Enable use of the archival data regions by setting ARCH_EN=Y.
2. Set ISSUE 3A=CMD1 to initiate MESG3A when the CMD1 element asserts on this port.
3. Set MESG3A=20EVENT to collect a long event report from the SEL relay on this port when the CMD1 element asserts. MESG3A is used in preference to MESG1A and MESG2A because data region A3 is the only archive data region large enough to hold a record the length of a standard event report. Alternately, you could use the predefined string 20EVENTS to collect a literal event report. Use 20EVENTS if you use an external program, which requires the event report format provided by the relay.

3. Use the **COPY ALL** command, as in previous examples, to copy these settings to all ports where you want event report data collected. If connected IEDs are not identical, auto-configure the ports. If they are identical, adjust port IDs and check all settings.

   If the SEL-2030 receives multiple SEL relay summary event reports on the same port in rapid succession, the SEL-2030 will retrieve one long event report every five minutes until all of the long event reports have been collected.

   In the above procedure, you use Archive 3 because it is the only archive region large enough to hold a long event report. Other archive regions consist of 2048 registers; Archive region 3 contains 30,720 registers. See ***SEL-2030 Reference Manual; Section 6: Database*** for a description of the database regions and their sizes.

You must read and remove reports from the archive occasionally to ensure adequate Flash memory is available for new event reports. If the archive memory becomes full, the SEL-2030 will not collect any new reports until some old ones are removed. See ***SEL-2030 Reference***

Manual; Appendix C: Planning Sheets for a method to compute how many event reports can be archived. Use the **MEM** command to determine how much of the Flash memory is in use to see if you are getting close to running out.

TEST THE OPERATION

1. Use the **MAP** command to see the general database structure including the number of archive records stored.

```
*>>MAP 1<ENTER>

Port 1 Database Assignments

  Region    Data Type   # Records

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


*>>
```

2. Force an event on a relay and wait a couple of minutes for it to be retrieved.

3. View the contents of each port archive data region individually using the **VIEW** command. Clear the entire contents of each archive data region with the **CLEAR** command, or add C to the end of the **VIEW** command to clear an individual record (e.g., **VIEW 1:A3 C**).

The following screen shows an actual event report captured on Port 1 and then displayed using the **VIEW** command. The first date and time are SEL-2030 date and time stamp; the second row of date and time are relay-supplied information. The main body of the report includes sampled analog and digital status data. Fault type and fault location are included at the end of the report.

20EVENT report data are parsed automatically for the SEL-2030's database. You can collect the complete literal event report with complete header, footer, and setting data by setting MESGA3 to 20EVENTS for a 4-sample/cycle report or 20EVENTL for a 16-sample/cycle report.

```
*>>VIEW 1:EVENT C<ENTER>

Port 1,  Data Region EVENT   Data

_YEAR = 1997  DAY_OF_YEAR = 304 (10/31)  TIME = 13:20:16.886
MONTH = 10  DAY = 31  YEAR = 97  HOUR = 13  MIN = 19  SECONDS =     36.862

IR(A) IA(A) IB(A) IC(A)     VA(V)     VB(V)     VC(V) Digital status
    0   219   375  -594   4233.00   7794.00 -12164.00 .... .. ... . L. .... ...
    5  -555   467    92 -11255.00   9222.00   2199.00 .... .. ... . L. .... ...
    0  -219  -375   594  -4233.00  -7802.00  12164.00 .... .. ... . L. .... ...
   -5   555  -467   -92  11263.00  -9215.00  -2206.00 .... .. ... . L. .... ...

    0   219   375  -596   4218.00   7802.00 -12157.00 .... .. ... . L. .... ...
    2  -555   467    95 -11263.00   9215.00   2206.00 .... .. ... . L. .... ...
    2  -219  -375   596  -4211.00  -7802.00  12157.00 .... .. ... . L. .... ...
   -2   555  -467   -95  11263.00  -9215.00  -2206.00 .... .. ... . L. .... ...

   -2   219   375  -596   4211.00   7809.00 -12157.00 .... .. ... . L. .... ...
    2  -555   467    95 -11263.00   9208.00   2214.00 .... .. ... . L. .... ...
    2  -219  -375   596  -4211.00  -7816.00  12157.00 .... .. ... . L. .... ...
   -2   555  -467   -95  11270.00  -9201.00  -2221.00 .... .. ... . L. .... ...

   -2   216   375  -596   4204.00   7816.00 -12157.00 .... .. ... . L. .... ...
    5  -555   467    95 -11277.00   9201.00   2221.00 .... .. ... . L. .... ...
    0  -214  -375   596  -4196.00  -7816.00  12157.00 .... .. ... . L. .... ...
   -5   555  -467   -95  11277.00  -9201.00  -2228.00 .... .. ... . L. .... ...

    0   216   375  -596   4196.00   7823.00 -12157.00 .... .. ... . L. .... ...
    2  -557   467    95 -11277.00   9193.00   2235.00 .... .. ... . L. .... ...
    2  -216  -375   596  -4196.00  -7831.00  12157.00 .... .. ... . L. .... ...
   -2   557  -467   -95  11277.00  -9186.00  -2235.00 .... .. ... . L. .... ...

   -2   214   375  -596   4189.00   7831.00 -12157.00 .... .. ... . L. .... ...
    5  -555   467    95 -11277.00   9186.00   2242.00 .... .. ... . L. .... ...
    0  -214  -377   596  -4175.00  -7831.00  12150.00 .... .. ... . L. .... ...
   -2   555  -465   -97  11277.00  -9186.00  -2250.00 .... .. ... . L. .... ...

   -2   216   377  -594   4168.00   7831.00 -12142.00 .... .. ... . L. .... ...
    2  -557   465    97 -11277.00   9186.00   2250.00 .... .. ... . L. .... ...
    2  -216  -377   594  -4168.00  -7838.00  12150.00 .... .. ... . L. .... ...
   -5   557  -465   -97  11284.00  -9179.00  -2257.00 .... .. ... . L. .... ...

    0   214   377  -594   4160.00   7845.00 -12157.00 .... .. ... . L. .... ...
    5  -555   465    97 -11292.00   9172.00   2264.00 .... .. ... . L. .... ...
    0  -214  -377   594  -4153.00  -7845.00  12157.00 .... .. ... . L. .... ...
   -5   557  -465   -97  11292.00  -9172.00  -2271.00 .... .. ... . L. .... ...

    0   212   377  -594   4153.00   7845.00 -12150.00 .... .. ... . L. .... ...
    5  -557   465    97 -11292.00   9172.00   2278.00 .... .. ... . L. .... ...
    0  -212  -377   594  -4153.00  -7852.00  12142.00 .... .. ... . L. .... ...
   -5   557  -465   -97  11292.00  -9164.00  -2278.00 .... .. ... . L. .... ...

    0   212   379  -594   4153.00   7859.00 -12142.00 .... .. ... . L. .... ...
    5  -557   462    97 -11292.00   9157.00   2278.00 .... .. ... . L. .... ...
    0  -212  -379   594  -4153.00  -7859.00  12150.00 .... .. ... . L. .... ...
   -5   557  -462   -97  11299.00  -9157.00  -2286.00 .... .. ... . L. .... ...

    0   212   379  -594   4139.00   7859.00 -12150.00 .... .. ... . L. .... ...
    5  -557   462    97 -11299.00   9157.00   2293.00 .... .. ... . L. .... ...
    0  -212  -379   594  -4124.00  -7867.00  12142.00 .... .. ... . L. .... ...
   -2   557  -462   -97  11292.00  -9150.00  -2300.00 .... .. ... . L. .... ...

TYPE = TRIG
FAULT LOC = $$$$$$$$$$

*>>
```

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EXAMPLE 6: PRINT ARCHIVED EVENT REPORTS

INTRODUCTION

Example 6 assumes you have an SEL-2030 with relays and printer connected and configured as in Example 3, and that you have collected long event reports from the SEL relay connected to SEL-2030 Port 1, as described in Example 5. Example 6 shows yet another way you can control data with the SEL-2030 Communications Processor.

IDENTIFYING THE PROBLEM

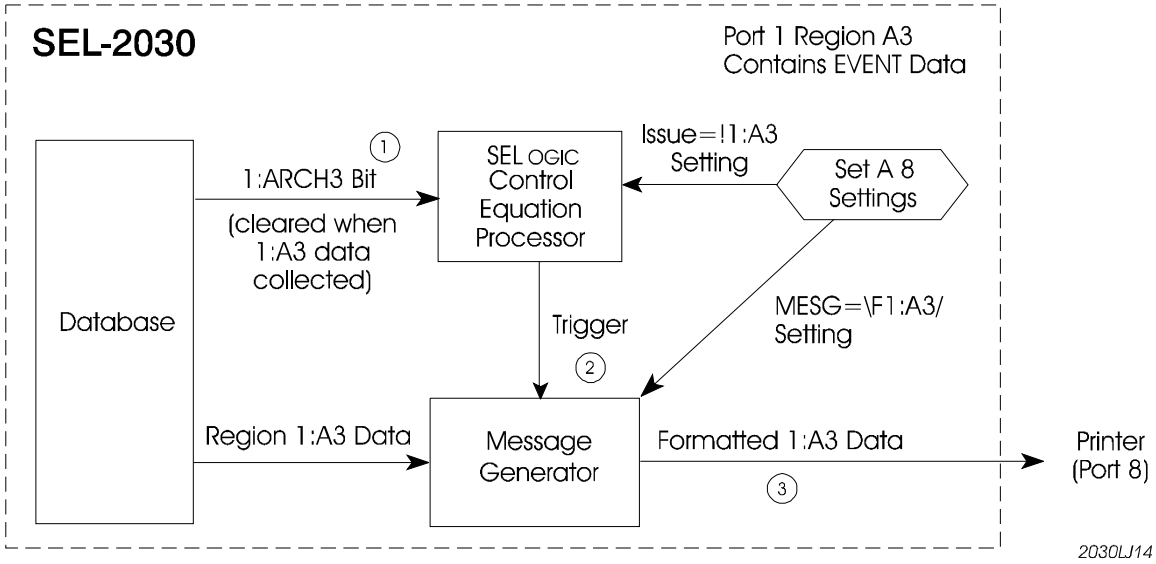
You want to print the long event reports collected from the SEL relay on your SEL-2030 Port 1 and stored in the A3 Archive data region of the SEL-2030 Port 1 database.

DEFINING THE SOLUTION

Set the SEL-2030

1. For the printer on Port 8, use SET A 8 to control printing of the long event report.

In Example 5, we set Ports 1 through 7 to collect a long event report whenever the SEL-2030 received an unsolicited summary event report from the SEL relays on those ports. In this example, we print the collected reports using a control sequence diagrammed and described in Figure 4.7.



① 1An event report is collected and archived to 1:A3 database. The 1:ARCH3 bit is asserted each time a long event record is received. After the event report is received, the SEL-2030 clears the 1:ARCH3 bit.

② 2The SELOGIC Control Equation Processor detects the !1:ARCH3 condition and sets the D2 bit. You previously defined this issue condition as ISSUE2=!1:ARCH3 using the SET A command for Port 8.

③ 3The Message Generator detects the D2 bit is set and issues MESG2. This message retrieves data from Archive Region A3 and sends it to the printer on Port 8, then clears the A3 region. You previously defined MESG2 as MESG2=\F1:A3;C/ using the SET A command for Port 8.

Figure 4.7: Functional Model of Printing Archived Reports

SET THE SEL-2030, STEP-BY-STEP

For the printer on Port 8, use **SET A 8** to output the long event report.

You should see the following screen:

```
*>>SET A 8<ENTER>

Automatic message settings for Port 8


Port Start-Up String
STARTUP =""
 ? <ENTER>


Auto Message Settings

How many auto-message sequences (0-12)         MSG_CNT = 1     ? 2<ENTER>                  1

Print all buffered unsolicited messages (Y/N)  PRINT_ALL= Y     ? <ENTER>

Clear unsolicited message buffer after print (Y/N)CLEAR_BUF= Y     ? <ENTER>

Item 2 trigger D2
ISSUE2  =NA                                                                              2
 ? !1:ARCH3<ENTER>

Item 2 message
MESG2   =""                                                                              3
 ? \F1:A3;C/<ENTER>

Size of user-defined data space in registers   USER    = 0     ? <ENTER>

STARTUP =""

MSG_CNT = 2
PRINT_ALL= Y
CLEAR_BUF= Y


ISSUE2  =!1:ARCH3
MESG2   ="\F01:A3;C/"
USER    = 0

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

Port 8 Settings Changed


*>>
```

Notes:

1 Set MESG_CNT=2 to add a new message trigger and message on Port 8.

2 Set ISSUE2=!1:ARCH3 to trigger MESG2 when the A3 data region bit, ARCH3, on Port 1 deasserts at the conclusion of a long event report storage sequence.

3 Set MESG2=\F1:A3;C/ to send the formatted output from the Port 1, A3 data region to the printer. When this transfer is complete, clear the Port 1, A3 data region. Depending on your printer, you may want to issue a form feed after the printing process is completed. You can do this simply by adding the ASCII form feed character sequence (\00C) to the end of the MESG2 message string.

To print long event reports from all seven Port A3 archive data regions, you set Port 8 ISSUE 2=:

!1:ARCH3*!2:ARCH3*!3:ARCH3*!4:ARCH3*!5:ARCH3*!6:ARCH3*!7:ARCH3

for the SELOGIC Control Equation defining the trigger condition, and set Port 8 MESG2=:

\F1:A3;C/\F2:A3;C/\F3:A3;C/\F4:A3;C/\F5:A3;C/\F6:A3;C/\F7:A3;C/

for the message definition.

EXAMPLE 7: COLLECT EVENT REPORTS BY MODEM

INTRODUCTION

Example 7 expands on the SEL-2030 data and communication processing capabilities developed and described in the previous examples. This example demonstrates the ability to transfer data via a modem and telephone link to a remote computer at specified times and days of the week.

IDENTIFYING THE PROBLEM

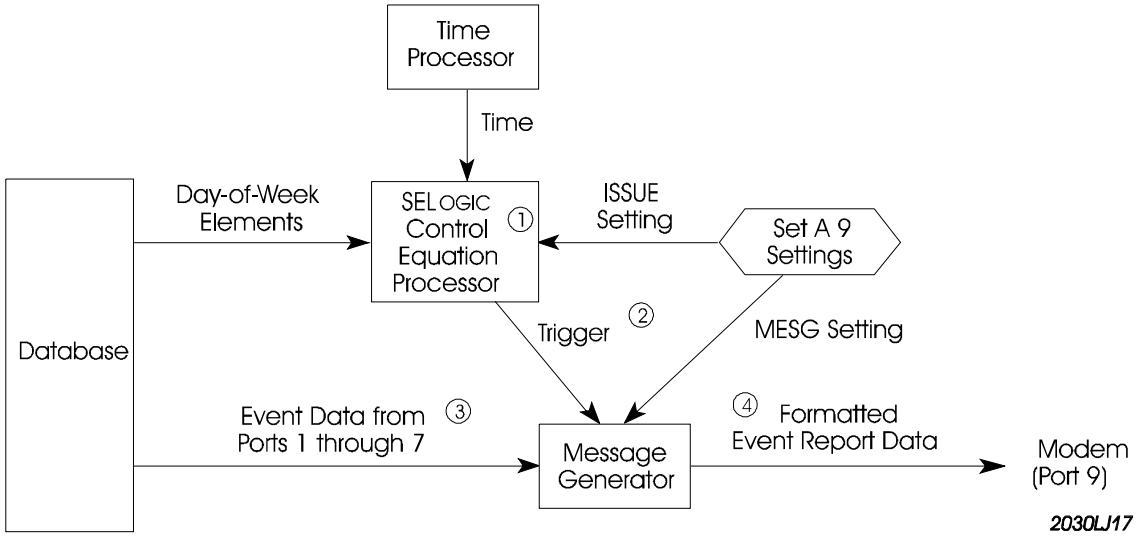
In this example, you must transfer the SEL relay long event reports to a remote computer at a specified time each weekday. You will continue to collect, store, and locally print the long event reports as you did in Example 6, except you will not clear the long event report records from the archive data region as the records are printed.

DEFINING THE SOLUTION

Maintain the SEL-2030 settings to collect long event reports as shown in Examples 5 and 6.

Set the SEL-2030

1. Use **SET A 9** to supply Port 9 with the timed trigger condition and the message to retrieve contents of the A3 Data Region on Ports 1 through 7.
2. Change the printer settings made in Example 6 so event report records are not cleared after printing.



① 4The SELOGIC Control Equation Processor compares time from the Time Processor and Day-of-Week elements from the database to the issue conditions. In Example 4, you set the SEL-2030 to collect event reports. You defined the message trigger condition (ISSUE1) using the SET A command for Port 9.

② When message trigger conditions in item5 ① above are met, the SELOGIC Control Equation Processor sets the D1 trigger bit.

③ The Message Generator detects the D1 bit set and issues MESG1, which instructs the SEL-2030 to dial the modem using the number specified in the \I string.

④ The SEL-2030 sends formatted event data to the device attached to Port 9.

Figure 4.8: Functional Model of Collection by Modem

SET THE SEL-2030, STEP-BY-STEP

Use **SET A 9** to supply Port 9 with the timed trigger condition and the message to retrieve contents of the A3 Data Region on Ports 1 through 7.

You should see the following screen:

```
*>>SET A 9<ENTER>

Automatic message settings for Port 9

Block external connections to this port
NOCONN  = NA
 ? <ENTER>

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 0     ? 1<ENTER>                    [1]

Item 1 trigger D1
ISSUE1  = NA
 ? T7:00 * MON + T7:00 * TUE + T07:00 * WED + T07:00 * THU + T07:00 * FRI<ENTER>        [2]

Item 1 message
MESG1   = ""
 ? \IATDT3321890/\F1:A3;CA/\F2:A3;CA/\F3:A3;CA/\F4:A3;CA/\F5:A3;CA/\<ENTER              [3]
 ? \F6:A3;CA/F7:A3;CA/<ENTER>

Archive Settings

Enable use of archive data items (Y/N)      ARCH_EN = N       ? <ENTER>

Size of user-defined data space in registers USER  = 0     ? <ENTER>
NOCONN = NA
MSG_CNT = 1


ISSUE1  = T07:00:00.0 * MON + T07:00:00.0 * TUE + T07:00:00.0 *
WED + T07:00:00.0 * THU + T07:00:00.0 * FRI
MESG1   = "\IATDT3321890/\F01:A3;CA/\F02:A3;CA/\F03:A3;CA/\F04:A3;CA/\F05:A3;CA/\F06:A3;CA
/\F07:A3;CA/"

ARCH_EN = N
USER    = 0

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

Port 9 Settings Changed


*>>
```

Notes:

[1] Set MESG_CNT=1 to add a new message trigger and message on Port 9.

[2] Set ISSUE 1 as shown to trigger MESG1 every weekday morning, Monday through Friday, at 7:00 a.m.

[3] Set MESG1 as shown to initiate a phone call to a remote computer, and send the formatted long event report records stored in the A3 archive data region on Ports 1 through 7, clearing the archive region records as the records are read and sent. The \I character string initiates the phone call using the given number. The records in each of the A3 archive data regions on Ports 1 through 7 are read and cleared using the \F.../ string that outputs formatted data. The ;CA appended to the Port #:A3 address instructs the SEL-2030 to read all records in the queue and clear them as they are read.

2. Change the printer settings made in Example 6 so event report records are no longer cleared after printing. The records will remain in the archive data region until they are sent to the modem every weekday morning.

   You should see the following screen:

```
*>>SET A 8<ENTER>

Automatic message settings for Port 8


Port Startup String
STARTUP =""
 ? <ENTER>

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 2     ? <ENTER>

Print all buffered unsolicited messages (Y/N)PRINT_ALL= Y     ? <ENTER>

Clear unsolicited message buffer after print (Y/N)CLEAR_BUF= Y     ? <ENTER>

Item 2 trigger D2
ISSUE2   = !1:ARCH3 * !2:ARCH3 * !3:ARCH3 * !4:ARCH3 * !5:ARCH3 *
!6:ARCH3 * !7:ARCH3
 ? <ENTER>

Item 2 message
MESG2    = "\F01:A3;C/\F02:A3;C/\F03:A3;C/\F04:A3;C/\F05:A3;C/\F06:A3;C/\F07:A3;C/"          1
 ? \F01:A3/\F02:A3/\F03:A3/\F04:A3/\F05:A3/\F06:A3/\F07:A3/ <ENTER>

Size of user-defined data space in registers USER    = 0     ? <ENTER>

STARTUP =""

MSG_CNT = 2

PRINT_ALL= Y
CLEAR_BUF= Y

ISSUE2   = !1:ARCH3 * !2:ARCH3 * !3:ARCH3 * !4:ARCH3 * !5:ARCH3 *
!6:ARCH3 * !7:ARCH3
MESG2    = "\F01:A3/\F02:A3/\F03:A3/\F04:A3/\F05:A3/\F06:A3/\F07:A3/"
USER     = 0

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

Port 8 Settings Changed

*>>
```

Note: 1 Change the \F:.../ string so it no longer clears the record queue when the records are sent to the printer.

OPERATION

On each day (Monday through Friday) at 7:00 a.m., the SEL-2030 dials the number specified with the \I string in the MESG1 setting, transfers event reports stored in the database on Ports 1 through 7, and then deletes the reports from the database.

After initiating the dial string, the SEL-2030 modem waits 60 seconds for a connection. If a connection is not established in 60 seconds, the SEL-2030 hangs up the modem and tries the call again in two minutes.

EXAMPLE 8: SWITCH GROUP SETTINGS ON ALL RELAYS

Example 8 demonstrates the SEL-2030's ability to send commands to other devices, in this case other SEL relays, using a command string that you store in the User data region on one port. This example uses the SEL relay **GROUP** command to change group settings on several SEL-251 Relays attached to the SEL-2030, all at the same time with a single command. You could change group settings on individual ports with separate command and message combinations, each combination issuing one change. But the method shown here allows you to switch between any number of group settings on all relays by creating just one command and one message.

This example, like the previous examples, assumes that you have an SEL-2030 with seven SEL-251 Relays attached to Ports 1 through 7, as shown below in Figure 4.9.

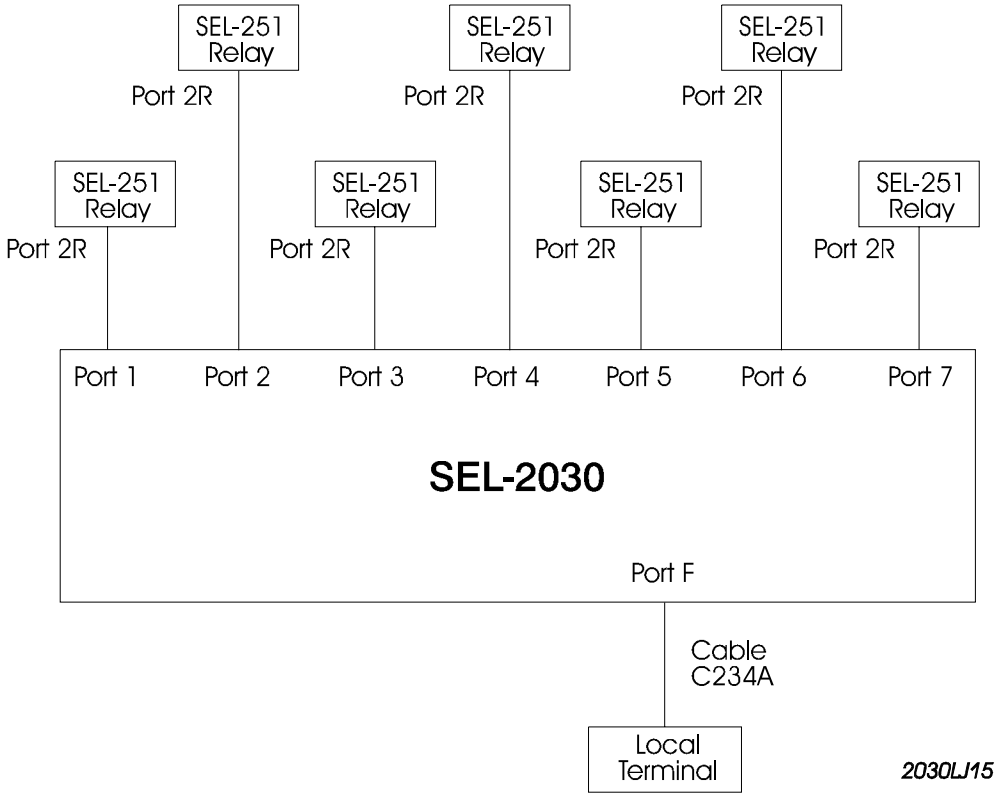


Figure 4.9: Group Switch Configuration Diagram

IDENTIFYING THE PROBLEM

Your objective in this example is to switch settings from Group 2 to Group 3 on all SEL-251 relays attached to the SEL-2030. Later, you must switch the settings from Group 3 back to Group 2, again, on all SEL-251 Relays attached to the SEL-2030.

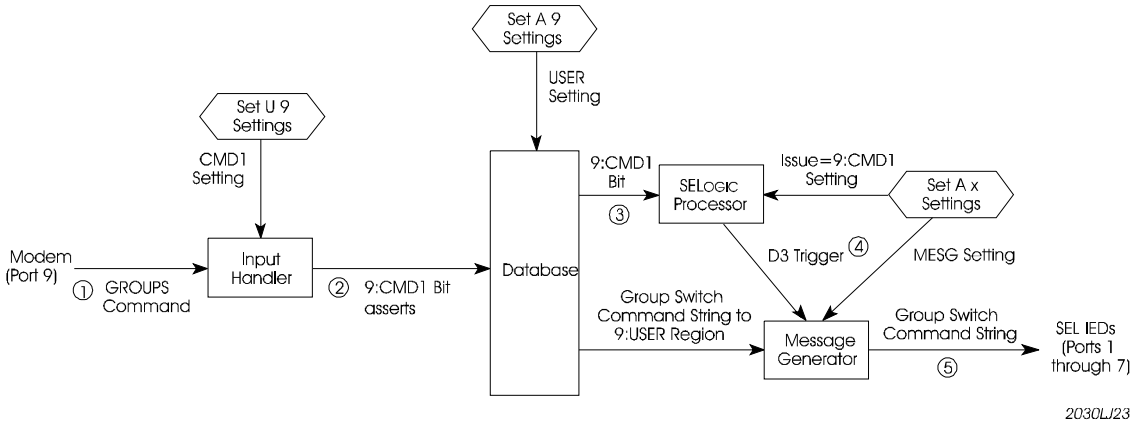
DEFINING THE SOLUTION

Set the SEL-2030

1. Reserve memory in the User region of Port 9 with the **SET A** command. This space will be used for a message you will create.
2. Also for Port 9, use the **SET U** command to tell the SEL-2030 to watch for the **GROUPS** command.
3. Create the automatic message that is sent in response to the user-defined command.
4. Use the **COPY ALL** command to copy these settings to Ports 2 through 7 as in previous example.

Operation

1. Establish remote communication with the SEL-2030 through the modem connected to Port 9.
2. Use the **STORE** command to store a group switch command in the Port 9 User region.
3. Send the **GROUPS** command that you defined to trigger the SEL-2030 to send the group switch command to Ports 1 through 7.



① 6You send the GROUPS command. You defined the GROUPS command string (CMD1="GROUPS") using the SET U command for Port 9.

② 7The Input Handler sets the 9:CMD1 bit.

③ 8The SELOGIC Control Equation Processor reads the 9:CMD1 bit. You set the ISSUE3 condition to be 9:CMD1 using the SET A command for Port 1. You then copied these settings to Ports 2 through 7 using the COPY ALL command.

④ 9The SELOGIC Control Equation Processor sets the D3 trigger bit on Ports 1 through 7 in response to the 9:CMD1 bit.

⑤ 10The Message Generator is triggered by the D3 bit and sends MESG3 instructing the Message Generator to fetch the string from Port 9 User Region that sends the stored GROUP switch command to the relays on Ports 1 through 7.

Figure 4.10: Group Switch Functional Diagram

SET THE SEL-2030, STEP-BY-STEP

1. Use the **SET A** command to reserve memory in the User data region of Port 9 for a message you will create.

   Your screen should look like this:

```
*>>SET A 9<ENTER>

Automatic message settings for Port 9

Block external connections to this port
NOCONN  = NA
 ? <ENTER>

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 1     ? <ENTER>

Item 1 trigger D1
ISSUE1  = T07:00:00.0 * MON + T07:00:00.0 * TUE + T07:00:00.0 *
WED + T07:00:00.0 * THU + T07:00:00.0 * FRI
 ? <ENTER> >

Item 1 message
MESG1   = "\IATDT3321890/\F01:A3;CA/\F02:A3;CA/\F03:A3;CA/\F04:A3;CA/\F05:A3;CA/\F06:A3;CA
/\F07:A3;CA/"
 ? <ENTER>


Archive Settings

Enable use of archive data items (Y/N         ARCH_EN = N       ? <ENTER>

Size of user-defined data space in registers  USER    = 0       ? 40<ENTER>                  1

MSG_CNT = 1

ISSUE1  = T07:00:00.0 * MON + T07:00:00.0 * TUE + T07:00:00.0 *
WED + T07:00:00.0 * THU + T07:00:00.0 * FRI
MESG1   = "\IATDT3321890/\F01:A3;CA/\F02:A3;CA/\F03:A3;CA/\F04:A3;CA/\F05:A3;CA/\F06:A3;CA
/\F07:A3;CA/"

NOCONN = NA
ARCH_EN = N
USER    = 40

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

Port 9 Settings Changed

*>>
```

Note: 1 Reserve space for 40 characters in the User data region on Port 9. You will later store the command string that the SEL-2030 will issue to change group settings in this region on the attached SEL relays.

2. Also for Port 9, use the **SET U** command to tell the SEL-2030 to watch for the **GROUPS** command.

   You should see the following screen:

```
*>>SET U 9<ENTER>

User settings for Port 9

Warning:  setting CMD_EN=N will disable SEL-2030 commands on this Port

Enable SEL-2030 Commands (Y/N)              CMD_EN  = Y     ? <ENTER>


General-Purpose User-Defined Input Commands

Number of general purpose commands (0-8)    CMD_CNT = 0     ? 1<ENTER>                  1

Command String 1
CMD1    = ""
 ? GROUPS<ENTER>                                                                       2


Special-Purpose User-Defined Input Commands

Enable use of special purpose commands (Y/N) STR_EN  = N     ? <ENTER>

CMD_EN  = Y
CMD_CNT = 1
CMD1    = "GROUPS"
STR_EN  = N

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

Port 9 Settings Changed


*>>
```

Notes: 1 Set CMD_CNT=1 to add a new general-purpose user-defined command.

2 Set CMD1 = GROUPS to establish a command you will send to the SEL-2030 to change group settings on all attached relays.

3a. Create the command string you will use to perform the group switch. To execute the group switch you must cause the relay to:

- Go to Access Level 2.
- Issue and confirm the group switch command.
- Return to Access Level 1.

Assuming the Level 2 password is TAIL, and x is the group number, the complete command string is:

"2AC\nTAIL\nGROUP x\nY\nACC\n"

Since each \n encodes one character, the total length of the string is 23 characters.

3b. Use the **SET A** command to create the automatic message on Port 1 that is sent in response to the user-defined command. Note that the STARTUP string in the following example reflects that you have not changed the relay passwords from the factory defaults. If you change the passwords, you should modify the startup strings in the SEL-2030 to match the new passwords.

Your screen should look like this:

```
*>>SET A 1<ENTER>

Automatic message settings for Port 1

Save Unsolicited Messages (Y/N)              AUTOBUF = Y     ? <ENTER>

Port Startup String
STARTUP ="ACC\nOTTER\n2AC\nTAIL\n"
 ? <ENTER>

Block external connections to this port
NOCONN  = NA
 ? <ENTER>

Send Operate command on Logic bit transition (Y/N)SEND_OPER=N      ? <ENTER>

Enable Automatic Sequential Events Recorder Collection (Y/N) REC_SER = N   ? <ENTER>

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 2     ? 3 <ENTER>                    1

Item 1 trigger D1
ISSUE1  = T01:00:00.0
 ? <ENTER>

Item 1 message
MESG1 = "DATE \RI;01:GLOBAL:MONTH//\RI;01:GLOBAL:DATE//\RI;01:GLOBAL:_YEAR/\n"
 ? <ENTER>

Item 1 response parsing method (0=IGNORE,
 1=ASCII_INT, 2=ASCII_FLOAT, 3=CHAR_STRING, 4=INT_STRING)PARSE1  = 0     ? <ENTER>

Time delay to allow response to complete (OFF, ON) DELAY1  = ON       ? <ENTER>

Item 2 trigger D2
ISSUE2  = P00:00:01.0
 ? <ENTER>

Item 2 message
MESG2   = 20METER
 ? <ENTER>

Item 3 trigger D3
ISSUE3 = NA
 ? 9:CMD1<ENTER>                                                                        2

Item 3 message
MESG3  = ""                                                                             3
? \RC;9:USER:0;23/<ENTER>

Item 3 response parsing method (0=IGNORE,
 1=ASCII_INT, 2 =ASCII_FLOAT, 3=CHAR_STRING, 4=INT_STRING)PARSE3  = 0        ? <ENTER>

Time delay to allow response to complete (OFF, ON) DELAY3  = ON       ? <ENTER>

Archive Settings

Warning:  Setting ARCH_EN = N will result in the loss of all Archive data and Archive settings for
          this port.

Enable use of archive data items (Y/N)       ARCH_EN = Y     ? <ENTER>
```

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```
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Archive 1 trigger ARCH1
ISSUE1A = NA
 ? <ENTER>

Archive 2 trigger ARCH2
ISSUE2A = NA
 ? <ENTER>

Archive 3 trigger ARCH3
ISSUE3A = 1:LOCAL:CMD1
 ? <ENTER>

Archive 3 message
MESG3A  = 20EVENT
 ? <ENTER>

Size of user-defined data space in registers USER    = 0     ? <ENTER>

AUTOBUF = Y
STARTUP ="ACC\n0TTER\n2AC\nTAIL\n"
NOCONN = NA
SEND_OPER= N

REC_SER = N
MSG_CNT = 3


ISSUE1  = T01:00:00
MESG1   = "DATE \RI;01:GLOBAL:MONTH//\RI;01:GLOBAL:DATE//\RI;01:GLOBAL:_YEAR/\n"
PARSE1  = 0
DELAY1  = ON

ISSUE2  = P00:00:01.0
MESG2   = 20METER

ISSUE3  = 9:CMD1
MESG  = "\RC;09:USER:0000h;23/"
PARSE3  = 0
DELAY3  = ON


Press RETURN to continue <ENTER>

ARCH_EN = Y

ISSUE1A = NA

ISSUE2A = NA

ISSUE3A = 1:CMD1
MESG3A  = 20EVENT
USER    = 0

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

Port 1 Settings Changed


*>>
```

Notes: 1 Set MESG_CNT=3 to add a 3rd message.

2 Set ISSUE 3=9:CMD1 to initiate MESG3 when the CMD1 element on Port 9 asserts. This element is asserted when the “GROUPS” command is received on Port 9.

3 Set MESG3A=\Rc;09:USER:0;23/ to send the message stored in the Port 9 User data region when the ISSUE 3 message trigger condition asserts. The format of the message is \Rc;(port number):(data region):(starting address);(number of characters)/, where the \Rc;..../ string requests the register data from that address.

4. Use the **COPY ALL** command to copy these settings to Ports 2 through 7 as in previous examples.

OPERATION

To make the group switch to Group 3, send the following two commands to the SEL-2030 from a connected modem:

STORE 9:USER:0 "2AC\nTAIL\nGROUP 3\nY\nACC\n"<ENTER>
GROUPS<ENTER>

To switch back to setting Group 2, send the following two commands to the SEL-2030 from a connected modem:

STORE 9:USER:0 "2AC\nTAIL\nGROUP 2\nY\n\ACC\n"<ENTER>
GROUPS<ENTER>

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EXAMPLE 9: GETTING DATA FROM A NON-SEL IED

Example 9 demonstrates the SEL-2030's ability to communicate with non-SEL IEDs using the nearly universal EIA-232 communications interface. The EIA-232 interface is a standard with specified electrical signal parameters that ensures compatibility between two devices. For devices that use this standard, you must know how to make the proper electrical connection between the two devices to permit communication. Additionally, each of these devices must recognize the "language" that the other "speaks;" therefore, you need the "dictionary," or command set, that defines each language.

In this example, the SEL-2030 communicates with a DGH 1000 RTD Interface Module. This example assumes that you have connected the DGH 1000 to Port 12 on the SEL-2030, as shown in Figure 4.11, using the proper cable, and that you know the communication parameters (baud rate, data bits, parity, stop bits, and flow control) required by the DGH 1000. The example also assumes that you have the command set, or "dictionary" of terms, for each device. In this case you know that when you send the message string "$1RD" to the DGH 1000, the device returns the temperature as an ASCII floating-point number.

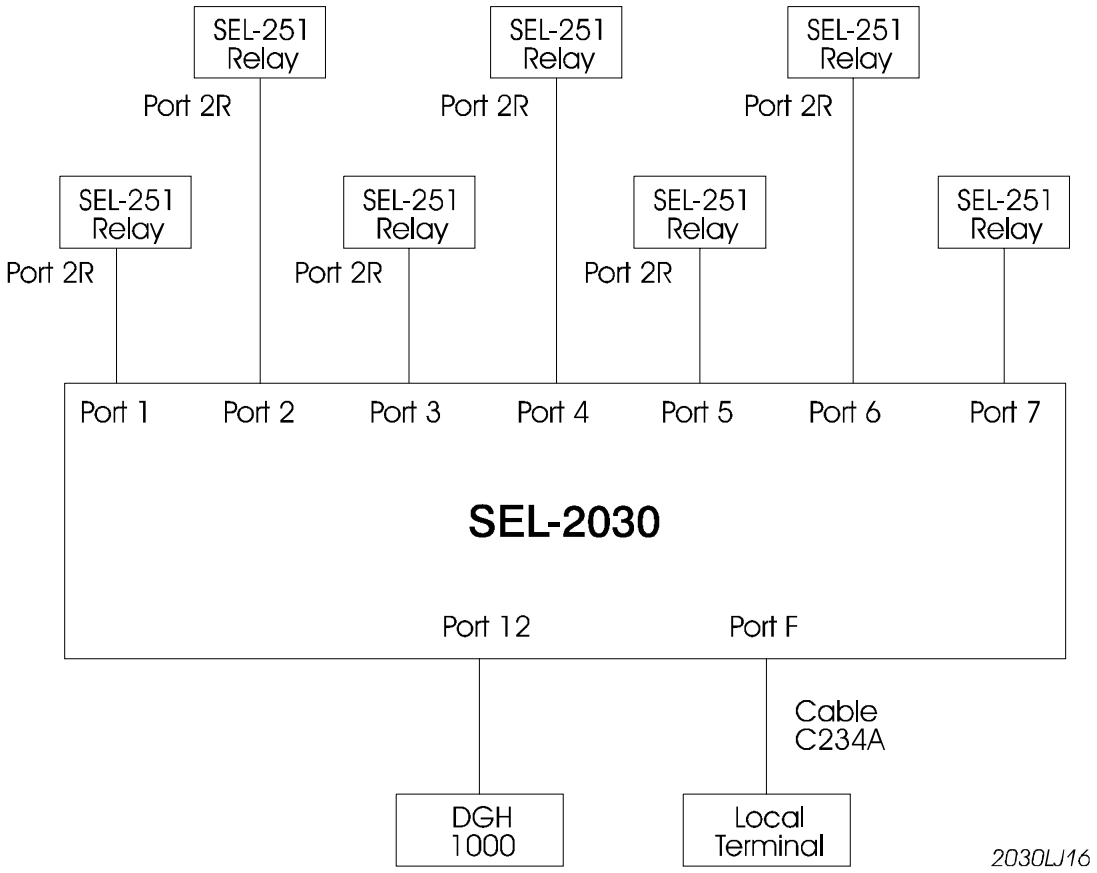

Figure 4.11: Non-SEL IED Attached to Port 12

IDENTIFYING THE PROBLEM

Your objective in this example is to use the SEL-2030 to retrieve temperature data from a remote thermal device (RTD) interface module called the DGH 1000. The DGH 1000 is connected to the SEL-2030's Port 12 and you want to collect these data every 30 seconds.

DEFINING THE SOLUTION

Set the SEL-2030

1. Use **SET P 12** to configure Port 12 as an "Other IED" port with the DGH 1000 communication parameters. Use the **SET A 12** command to make the following settings:
    - Set AUTOBUF=N so Port 12 does not store unsolicited messages.
    - Define message trigger ISSUE1 to send a message every 30 seconds.
    - Create a message, $1RD\00D, that is sent to the DGH 1000 when triggered.
    - Set PARSE and NUM to accept one floating-point number.

Test the Operation

1. Use the **TOGGLE** command to force data collection and the **VIEW** command to view the collected data.

SET THE SEL-2030, STEP-BY-STEP

1. Use **SET P 12** to configure Port 12 as an "Other IED" port with the DGH 1000 communication parameters.

You should have the following screen:

```
*>>SET P 12<ENTER>

Port communications settings for Port 12


Device Type (U=Unused, S=SEL IED, O=Other IED,
             P=Printer, M=Master)              DEVICE  = S     ? O<ENTER>

Modem Settings

Modem Control (Y/N)                           MODEM    = N     ? <ENTER>

Attempt to detect port baud rate (Y/N)        AUTO_BAUD= N     ? <ENTER>

Communications Type (A=ASCII, B=Binary)       PROTOCOL= INVALID ? A<ENTER>

Port Identification String
PORTID  =""
 ? DGH1000<ENTER>


Communications Settings

Baud Rate (300, 600, 1200, 2400, 4800, 9600,
           19200)                             BAUD    = 9600  ? 300<ENTER>

Number data bits (7,8)                        DATABIT = 8     ? <ENTER>

Stop Bits (1,2)                               STOPBIT = 2     ? 1<ENTER>

Parity (N,O,E,1,0)                            PARITY  = N     ? <ENTER>

Enable RTS/CTS handshaking (Y/N)              RTS_CTS = N     ? <ENTER>

Enable XON/XOFF flow control (Y/N)            XON_XOFF= Y     ? N<ENTER>

Port Time-out in minutes (0.0-120.0)            TIMEOUT = OFF   ? <ENTER>

PORT:12
DEVICE  = O
MODEM   = N
AUTO_BAUD= N
PROTOCOL= A
PORTID  ="DGH1000"
BAUD    = 300
DATABIT = 8    STOPBIT = 1    PARITY  = N
RTS_CTS = N    XON_XOFF= N
TIMEOUT = OFF


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

Port 12 Settings Changed


*>>
```

1 2 3 4

Notes:

1. Set DEVICE=O to reconfigure the port device type as “Other IED”.
2. Set PROTOCOL=A to allow ASCII and binary communications.
3. Enter the name of the device for port identification.
4. Enter communication parameters compatible with the DGH 1000.

2. Set the SEL-2030 with the **SET A 12** command to collect data from the DGH 1000 every 30 seconds.

You should see the following screen:

```
*>>SET A 12<ENTER>

Automatic message settings for Port 12


Save Unsolicited Messages (Y/N)              AUTOBUF = N     ? <ENTER>

Port Startup String
STARTUP =""
 ? <ENTER>

Block external connections to this port
NOCONN  = NA
 ? <ENTER>

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 0     ? 1<ENTER>                    1

Item 1 trigger D1
ISSUE1  = NA
 ? P00:00:30<ENTER>                                                                        2

Item 1 message
MESG1   = ""
 ? $1RD\00D<ENTER>                                                                         3

Item 1 response parsing method (0=IGNORE,
 1=ASCII_INT, 2=ASCII_FLOAT, 3=CHAR_STRING, 4=INT_STRING)PARSE1  = 0     ? 2<ENTER>      4

Item 1 number of data items                  NUM1    = 1     ? <ENTER>                     5

Time delay to allow response to complete (OFF, ON) DELAY1  = ON     ? <ENTER>              6


Archive Settings

Enable use of archive data items (Y/N)       ARCH_EN = N     ? <ENTER>

Size of user-defined data space in registers USER    = 0     ? <ENTER>

AUTOBUF = N
STARTUP =""
NOCONN = NA
MSG_CNT = 1


ISSUE1  = P00:00:30.0
MESG1   = "$1RD\00D"
PARSE1  = 2
NUM1    = 1
DELAY1  = ON

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```

```
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ARCH_EN = N
USER    = 0

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

Port 12 Settings Changed


*>>
```

Notes:

1. Set MSG_CNT=1 to add a new message trigger and message.
2. Set ISSUE1=P00:00:30 to periodically trigger MESG1 every 30 seconds.
3. Set MESG1=$1RD\00D to send the command $1RD to request temperature data from the DGH 1000. The carriage return, \00D, is required to complete the command sequence.
4. Select PARSE=2 to select the ASCII_FLOAT parsing method because you know the temperature is in floating-point format.
5. Set NUM1=1 to accept one item because you know only one number is returned from the DGH1000.
6. Since we know only one data item is coming in, we could set DELAY1 to OFF. If we wanted to collect data more often than every 5 seconds, we would need to set it OFF to avoid the idle time check. Since we are only collecting the data every 30 seconds, the value of the setting does not matter.

TEST THE OPERATION

1. Test the operation by forcing a data collection and viewing the results.

```
*>>TOGGLE 12:D1<ENTER>                                                    1

Bit toggled

*>>VIEW 12:D1<ENTER>                                                      2

Port 12,  Data Region FLOAT   Data

_YEAR = 1995  DAY_OF_YEAR = 65 (03/06)  TIME = 18:53:18.857
FLOAT =      27.000


*>>
```

Notes:

1. Use the TOGGLE command to assert the D1 bit on Port 12. The D1 message (MESG1) is sent when the D1 bit is asserted. This should result in one data collection operation.
2. Use the VIEW command to view the data collected from the DGH 1000. The data are parsed and stored in the D1 data region on Port 12 in floating-point format. The data are time-tagged at the time the SEL-2030 begins to receive the data.

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EXAMPLE 10: SEL-2030 APPLIED TO SCADA RTU CONTROL

INTRODUCTION

Example 10 is similar to the previous examples, but we add the capability to open and close breakers by commanding the SEL-251 relays through the SCADA system.

IDENTIFYING THE PROBLEM

Your objective in this example is to be able to rapidly open and close breakers via SCADA RTU command.

DEFINING THE SOLUTION

The solution is to use the built-in operate support of the SEL-2030. To get the best response from the relay, we will use SEL-251-3 relays because they support *Fast Operate* commands. *Fast Operate* commands are short binary commands that cause the SEL-251-3 to open or close within 16 milliseconds of receiving the message. If we used conventional SEL-251 relays, the SEL-2030 would have to issue **ASCII OPEN** and **CLOSE** commands, which can take many seconds to function.

The following steps will have to be taken:

1. Make sure *Fast Operate* commands are enabled in the SEL-251.
2. Enable operate control of the SEL-251 relays using the **SET A** command on each SEL-251 port.
3. Establish SELOGIC Control Equations for opening and closing using SET L on each SEL-251 port.
4. Verify connection by sending various operate commands to relays.

SET THE SEL-2030 STEP-BY-STEP

Verify that the operate jumper on the relay is in the operate enable position. On some relays, such as the SEL-321-1, you will also need to confirm that the *Fast Operate* enable setting is set to yes.

Note that the STARTUP string in the following example reflects that you have not changed the relay passwords from the factory defaults. If you change the passwords, you should modify the startup strings in the SEL-2030 to match the new passwords.

Once you have confirmed that the relay is configured to support *Fast Operate*, use the **SET A** command on Port 1 to enable direct operate control:

```
*>>SET A 1<ENTER>

Automatic message settings for Port 1


Save Unsolicited Messages (Y/N)              AUTOBUF = Y     ? <ENTER>

Port Startup String
STARTUP ="ACC\nOTTER\n2AC\nTAIL\n"
 ? <ENTER>

Block external connections to this port
NOCONN  = NA
 ? <ENTER>

Send Operate command on Logic bit transition (Y/N)SEND_OPER= N     ? Y<ENTER>

Enable Automatic Sequential Events Recorder Collection (Y/N) REC_SER = N   ? <ENTER>

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 3     ? END<ENTER>

AUTOBUF = Y
STARTUP ="ACC\nOTTER\n2AC\nTAIL\n"
NOCONN = NA
SEND_OPER= Y

REC_SER = N
MSG_CNT = 3


ISSUE1  = T01:00:00.0
MESG1   = "DATE \RI;01:GLOBAL:MONTH//\RI;01:GLOBAL:DATE//\RI;01:GLOBAL:_YEAR/\n"
PARSE1  = 0
DELAY1  = ON

ISSUE2  = P00:00:01.0
MESG2   = 20METER

ISSUE3  = 8:CMD1
MESG3   = "\RC;08:USER:0000h;23/"
PARSE3  = 0
DELAY3  = ON

Press RETURN to continue<ENTER>


ARCH_EN = Y

ISSUE1A = NA

ISSUE2A = NA

ISSUE3A = 1:CMD1
MESG3A  = 20EVENT
USER    = 0

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

Port 1 Settings Changed


*>>
```

Notes: 1 Set SEND_OPER=Y to enable direct operate control via logic bits.

Repeat this process for Ports 2-7.

This operation will associate the port BR1 bit with the relay breaker. Whenever the SBR1 bit asserts, the SEL-2030 will issue an OPEN command to the relay. Whenever the CBR1 bit asserts, the SEL-2030 will issue a CLOSE command. These two bits can be controlled by SELOGIC Control Equations or by master port *Fast Operate* commands. For this example, we will use CMD bits to control the SBR1 and CBR1 bits. See ***SEL-2030 Reference Manual; Section 7: Protocols*** for more information on using *Fast Operate* commands to trigger these operations.

Using the following steps to set the SELOGIC Control Equations for Port 1:

```
*>>SET L 1<ENTER>

Logic settings for Port 1


SBR1    = NA
 ? CMD1<ENTER>


CBR1    = NA
 ? CMD2<ENTER>


SBR2    = NA
 ? END<ENTER>

SBR1    = CMD1
CBR1    = CMD2

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

Port 1 Settings Changed


*>>
```

Repeat this process on Ports 2-7. The system should now be ready for operation.

TEST THE OPERATION

To test the operation, we can trigger various CMD bits and confirm that the relay properly closes its TRIP or CLOSE contact. The ASCII command to open a breaker will be:

STORE 1:081Dh 1 sets 1:CMD1

and to close a breaker will be:

STORE 1:081Dh 2 sets 1:CMD2

The commands for the other ports will be similar.

Use a terminal or your RTU to issue one of these commands while monitoring the trip and close contacts of the relay being operated. Confirm that the operations take place as expected.

If you are controlling the SEL-2030 from the RTU using Modbus or DNP, you can operate the SBR1 and CBR1 bits directly. See ***SEL-2030 Reference Manual; Section 7: Protocols*** for more information.

TABLE OF CONTENTS

SECTION 5: MAINTENANCE

INTRODUCTION

This section describes the minimal maintenance steps you should follow to keep the SEL-2030 operating properly.

CALIBRATION

Schweitzer Engineering Laboratories (SEL) performs a calibration of the SEL-2030 clock at the factory. You do not need to periodically calibrate the clock.

BATTERY REPLACEMENT

A battery maintains the clock (date and time) if the external DC source is lost or removed. The battery is a 3 V lithium coin cell. At room temperature (25°C) the battery will operate nominally for 10 years at rated load.

The battery experiences a low self-discharge rate when the SEL-2030 is powered from an external source. If the source is lost or disconnected, the battery discharges to keep the internal clock going. The battery cannot be recharged.

CAUTION

There is danger of explosion if the battery is incorrectly replaced. Replace only with Ray-O-Vac® no. BR2335 or equivalent recommended by manufacturer. Dispose of used batteries according to the manufacturer's instructions.

Perform the battery replacement procedure if the SEL-2030 reports a battery failure. You will also notice that the time and date are incorrect. To change the battery, perform the following steps:

1. Remove power from the SEL-2030.
2. Remove any cables connected to Port F of the SEL-2030.
3. Remove the front-panel screws and front panel.

CAUTION

The SEL-2030 contains devices sensitive to electrostatic discharge (ESD). When working on the device with front or top cover removed, work surfaces and personnel must be properly grounded or equipment damage may result.

4. Locate the battery on the front left-hand side of the main board.
5. Remove the battery from beneath the clip and install a new one. The positive side (+) of the battery faces up.
6. Replace the front panel and front-panel screws and tighten securely.
7. Replace any cables removed from the SEL-2030.

8. Apply power to the SEL-2030, and set the date and time again. A battery failure will be reported the first time you power-up with a new battery because the date and time reported by the battery-backed clock will not be valid.

SEL-2030 FIRMWARE UPGRADES

SEL may occasionally offer upgrades to improve the performance of this device. To install software upgrades, refer to the instructions supplied with the firmware upgrades.

RELAY FIRMWARE UPGRADES

When you upgrade the firmware for an SEL relay attached to the SEL-2030, perform the following:

1. Take the relay out of service. The SEL-2030 will show this port's status as Inactive and will no longer collect data.
2. Upgrade the relay according to its upgrade instructions.
3. Apply power to relay and reset its settings, as necessary.
4. Perform any relay testing that your practices require.
5. Reconnect the relay to the SEL-2030, if necessary.
6. Connect a terminal to the SEL-2030 and go to Access Level 2.
7. Execute a **SET P** command on the relay port and auto-configure the port. Save these settings.
8. Confirm that the SEL-2030 is now communicating as before.
9. Place relay back in service.

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TABLES

SECTION 6: TROUBLESHOOTING

INTRODUCTION

This section describes various common problems and their resolution.

ALARM CONDITIONS

The SEL-2030 will assert the ALARM contact for a variety of conditions automatically, and it will also be asserted based on the ALARM SELOGIC® Control Equation. The ALARM equation is assigned to SALARM. Table 6.1 lists the various conditions that cause ALARM contact and SALARM operations.

Table 6.1: Alarm Conditions

Command or Condition	Asserts ALARM Contact	Asserts SALARM Bit	Comment
2ACCESS		Yes	One-second pulse when entering Access Level 2 and if password is entered incorrectly on three successive attempts.
ACCESS		Yes	One-second pulse if password is entered incorrectly on three successive attempts.
PASSWORD		Yes	One-second pulse when password is changed.
SET		Yes	One-second pulse on settings change.
COPY		Yes	One-second pulse on settings change.
SWAP		Yes	One-second pulse on settings change.
Self-Test Failure	Yes	No	Latches if SEL-2030 fails a self-test (contact the factory).
Invalid Settings	Yes	No	CVALID setting is set to No. Clear alarm by setting CVALID to Yes using SET C.

SELF-TESTS

The SEL-2030 continually runs the following self-tests. Any test failure causes an alarm to be latched and the status report to be issued on Port F.

- **RAM.** The SEL-2030 continually performs read-write test of RAM, both local and shared.
- **Code Flash.** The SEL-2030 continually computes and checks a checksum of ROM.
- **EEPROM/Archive Flash.** The SEL-2030 continually validates data blocks using checksums.
- **Power supply.** Threshold comparators (+/- 15 V) are continually checked for tolerance.

TROUBLESHOOTING

Power System Problems

Table 6.2 describes typical SEL-2030 power system problems and solutions.

Table 6.2: Power System Problems

Symptom	Probable Cause	Corrective Action
All front-panel LEDs remain dark when LED TEST button is pressed.	No power to rear-panel power terminals.	Supply power to rear-panel power terminals.
	Internal power supply defective.	Remove power and contact the factory.
+5 Vdc not supplied to pin 1 of rear-panel communication port(s).	Jumper(s) not installed on main board.	See the jumper settings in ***Section 3: Installation***.

Communications Problems

Refer to Table 6.3 for some troubleshooting for some basic communications problems.

Table 6.3: Communications Problems

Symptom	Probable Cause	Corrective Action
SEL-2030 does not communicate with PC.	Serial cable damaged or wrong cable connected.	Inspect the cabling for damage and proper connection.
	SEL-2030 baud rate default jumper installed.	1. Set the PC terminal to 2,400 baud to communicate with the SEL-2030. 2. Using the SET command, set the SEL-2030 baud rate. 3. Access the main board using steps 1 through 3 in ***Battery Replacement*** subsection of ***Section 5: Maintenance***. 4. Remove jumper J17 A. Place the jumper on one pin of the connector for safekeeping. 5. Set the baud rate of the PC terminal to match the SEL-2030. 6. Cycle SEL-2030 power and reconnect.
	Port and baud rate settings of PC may be incorrect.	Set the port and baud rate settings of the PC terminal to match the SEL-2030. If you do not know what the settings are, install the baud rate jumper and then make the settings.
SEL-2030 does not communicate with connected IED.	Serial cable damaged or wrong cable connected.	Inspect the cabling for damage and proper connection. Make sure appropriate cable is connected (see Table 3.2).
	Port settings do not match the IED settings.	Using the **SET** command, set the port settings to match those of the IED connected to the port.
	Port may be locked up due to hardware handshaking.	Reset IED and/or reset port settings using SET P and accepting settings.
	Component failure. Port F LED(s) illuminates but others do not illuminate when port is addressed.	Remove power and contact the factory.

FACTORY ASSISTANCE

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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.

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.

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.