SEL-2711

MODBUS PLUS ADAPTER CARD

INSTRUCTION MANUAL

SCHWEITZER ENGINEERING LABORATORIES
2350 NE HOPKINS COURT
PULLMAN, WA USA 99163-5603
TEL: (509) 332-1890 FAX: (509) 332-7990

MANUAL CHANGE INFORMATION

The date code at the bottom of each page of this manual 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 manual to date are summarized below (most recent revisions listed at top).

Revision Date	Summary of Revisions
The ***Manual Change Information*** section has been created to begin a record of revisions to this manual. All changes will be recorded in this Summary of Revisions table.	
20010105	Section 4 - made typographical corrections. Appendix A - Updated firmware to work with SEL-2030 Communications Processor interface changes.
981030	Section 4, Target Type - updated information
980601	Section 4 - Added Summary Card
980420	All Sections updated to describe new features in firmware release SEL-2711-R102
971218	Appendix A - Correction

SEL-2711 INSTRUCTION MANUAL
TABLE OF CONTENTS

TABLE OF CONTENTS

SECTION 1: INTRODUCTION

This section provides an introduction to the manual. This section includes a list of references, an overview of the manual, a list of conventions used within this manual, and a list of acronyms, abbreviations, and glossary terms.

We, the employee-owners of Schweitzer Engineering Laboratories, Inc., are devoted to making electric power safer, more reliable, and more economical. The SEL-2711 Modbus Plus Adapter Card is designed to assist in meeting this objective.

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-2711 or this manual, please contact us at:

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

We guarantee prompt, courteous, and professional service.

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

REFERENCES

SEL-2030 Communications Processor User's Guide

SEL-2020/2030 Communications Processor Reference Manual

Modbus Plus™ Network Planning and Installation Guide

MANUAL OVERVIEW

Background Information

This manual is designed to help you make the most effective use of the SEL-2711 Modbus Plus Communications Adapter. Each section begins with a detailed table of contents followed by a short paragraph summarizing the main areas of the section. For more information on the SEL-2030 or Modbus Plus networks, please see the references listed above.

If you are new to Modbus Plus networks you will want to read sections 2 and 3 to get a good overview of Modbus Plus and of the SEL-2711. If you are already familiar with Modbus Plus networks, you can skip directly to section 4 and use section 3 for reference.

Section Highlights

The following list summarizes the main purpose of each section:

- ***Section 2: General Description***, provides an overview of Modbus Plus networking and a description of the SEL-2711.
- ***Section 3: Operation and Network Configuration***, describes SEL-2711 operation and configuration.
- ***Section 4: Operation Within SEL-2030***, provides detailed information on how to use the SEL-2711 within the SEL-2030 including data maps.
- ***Appendix A: Firmware Versions***, lists the firmware versions this manual applies to.
- ***Appendix B: Error Codes and Messages***, lists the error codes and messages the SEL-2711 generates along with a description of why they might occur.
- ***Appendix C: Modbus Plus Message Example***, illustrates how Modbus Plus application messages are constructed.

CONVENTIONS

Numbers within this manual are generally shown as decimal values. When a number is shown in hexadecimal, the letter 'h' is appended to the number. For instance, 11 is the decimal number eleven, but 11h is the hexadecimal number eleven, which is equal to the decimal value 17.

Commands to be entered at a terminal are shown in bold all-caps. Literal terminal screen captures are shown in a box, like the following example:

```
*>SET P 17<ENTER>
.
.
.
```

ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Acronym/ Abbreviation	Definition
CPU	Central Processing Unit
LED	Light Emitting Diode
LSB	Least Significant Byte
Modbus Plus™	A 1 Megabit/sec, token-passing network proprietary to Schneider Automation
MSB	Most Significant Byte
node	A device connected to the network
RAM	Random Access Memory
SEL	Schweitzer Engineering Laboratories

TABLE OF CONTENTS

TABLES

FIGURES

SECTION 2: GENERAL DESCRIPTION

This section provides overviews of Modbus Plus networks and of the SEL-2711 Modbus Plus Adapter functionality.

NETWORK OVERVIEW

This subsection provides an overview of Modbus Plus. See ***Modbus Plus Network Planning and Installation Guide*** for a more complete description of Modbus Plus networks.

Basic Network Topologies

Each device on a Modbus Plus network is a peer node, handling the token in its assigned address sequence. Potentially, any node can exchange data with any other node. Figure 2.1 shows a typical network configuration. More complex schemes are possible using bridges and repeaters. See ***Modbus Plus Network Planning and Installation Guide*** for more information about Modbus Plus networks and connection possibilities.

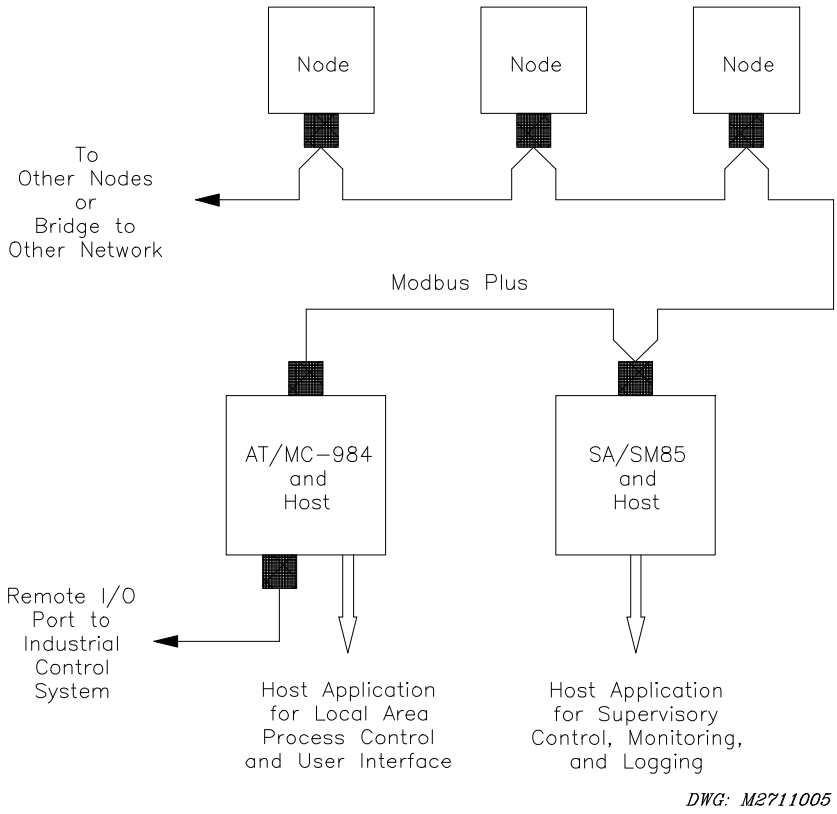


Figure 2.1: Application Overview

Modbus Plus Message Routing

Each device establishes itself as a node on the Modbus Plus network. Up to 64 nodes can be present on a single network, each with a unique address from 1 to 64. Multiple networks can be joined through Bridge Plus devices.

Modbus Plus Routing Paths

Nodes address each other using a routing path field of five bytes. The path is embedded in the Modbus Plus message frame as sent from the originating node. The five bytes of routing allow destination nodes to be addressed up to four networks away from the originating node. The routing bytes are used by each type of device in a specific way, as illustrated in Figure 2.2.

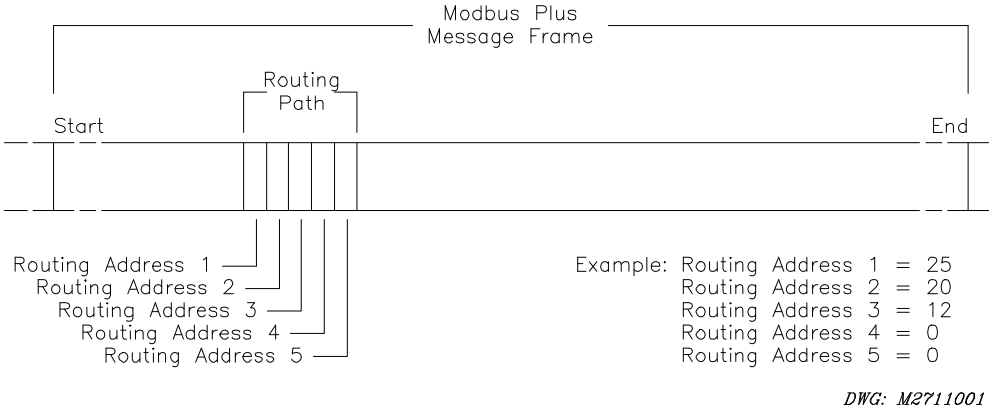


Figure 2.2: Message Frame Routing Path

The example in Figure 2.2 shows routing to a controller through three networks that are joined by a pair of Bridge Plus devices. Using the routing bytes in the example, the message will be sent first to node 25, a Bridge Plus on the local network. That bridge forwards the message to a second Bridge Plus at node address 20 on the second network. The second bridge forwards the message to its final destination, a controller at node address 12 on the third network. The zero contents of bytes 4 and 5 specify that no further routing will occur.

The routing path contents are specific to the type of device at the destination. Routing path methods for various networked devices are outlined below. For further details about message routing paths, see your ***Modbus Plus Network Planning and Installation Guide (GM-MBPL-001).***

Paths to Programmable Controllers

For 984 programmable controllers, including the AT-984 and M-984, the last non-zero byte in the routing specifies the network node address of the controller (range: 1 ... 64). For example, the path 5.0.0.0.0 specifies a controller node at address 5 on the local network (the network to which the host is attached).

Paths to Network Adapters

For host-based network adapters such as the SA85, and SM85, the next-to-last non-zero byte specifies the adapter's network node address (range: 1 … 64). The last non-zero byte specifies an application task number (range: 1 … 8) to which the message is to be assigned. For example, if an adapter is at node address 35 on the local network, the path 35.8.0.0.0 specifies routing to task 8 in that adapter.

Paths to Bridge Multiplexers

For BM85 bridge multiplexers, the routing field contents are specific to the slave device configuration at the multiplexer's Modbus port. Either a single slave device or a network of slave devices can be connected at the port.

A single slave device at a multiplexer's Modbus port is addressed using two bytes. The next-to-last non-zero byte addresses the multiplexer node (range: 1 … 64). The last non-zero byte specifies the port (range: 1 … 4) to which the slave device is attached. Specifying the port automatically addresses the device at that port. For example, if a BM85 is at node address 25 on the local network, 25.1.0.0.0 routes a message to the single slave device at the multiplexer's port 1.

A networked slave device at the multiplexer's port is addressed using three bytes. The third-from-last non-zero byte addresses the multiplexer node (range: 1 ... 64). The next-to-last non-zero byte specifies the port (range: 1 ... 4) to which the network is attached. The last non-zero byte specifies the Modbus address of the slave device (range: 1 ... 247). For example, 25.2.200.0.0 routes a message to multiplexer node address 25, port 2, slave device 200.

Modbus Plus Transactions

With multiple node devices processing messages asynchronously on the network, an individual device might have several concurrent transactions in process. Each device has multiple internal paths of various types to allow concurrent processing of transactions. It opens a path when a transaction begins, keeps it open during processing of the transaction, and closes it when the transaction terminates. When the path is closed, it becomes available to another transaction.

Both the originating and destination devices open paths for a mutual transaction and maintain the paths until the transaction completes. If the transaction passes through Bridge Plus devices to a destination on another network, each bridge opens and maintains a path at each of its two network ports. Thus, a logical path is established between the originating and destination devices and maintained until the transaction is finished. When the transaction is completed, all of the paths it has used will be freed.

Path Types

Each Modbus Plus device contains the following types of paths:

Data Master (DM) Path This type of path is opened for data reads and writes, and for get and clear remote statistics, as they are originated in the device.

Data Slave (DS) Path This type of path is opened for data reads and writes as they are received by the device.

Program Master (PM) Path This type of path is opened for programming commands as they are originated in the device.

Program Slave (PS) Path This type of path is opened for programming commands as they are received by the device.

Each path is independent of the others. Activity in one path does not affect the performance of the other paths.

Path Quantities

The following path quantities are available in the Modbus Plus devices:

Path	Host Based 984s	BM85	BP85	SA85/SM85/SQ85	SEL-2711
Data Master	8*	4	8	8	8
Data Slave	4	4	8	8	8
Program Master	8*	4	8	8	0
Program Slave	1	4	8	8	0

* Because the host-based controllers have a virtual network adapter capability built in, their path quantities are different from other types of 984 controllers.

Queuing

If all DS paths are active in a device, new incoming transactions will be queued. Transactions will remain queued until a path is available, and will then be removed from the queue and given the path. A final data response will not be returned to the originating application until a full path is available from origin to destination.

When the destination node removes a transaction from its queue, it will wait for the network token and then will request the command again from the originating node. The originator will retransmit the command while the destination retains the token. This process occurs transparently, eliminating the need for polling between the origin and destination devices in the application.

BP85 Bridge Plus Queuing Messages which must pass through multiple bridges will be queued (if necessary) within the first bridge, but will not be queued within any subsequent bridges. An attempt to queue in a second bridge will return an error code, which can be tested by the application program in the originating node. This prevents unpredictable delays from queuing across several networks. The originating application can determine how to proceed with outstanding tasks, rather than having to wait through multiple levels of queuing. Tasks that are currently in progress can be allowed to continue or can be aborted in favor of a higher priority task.

Modbus Data Access Commands

Transactions to or from programmable controller nodes are based on Modbus data access commands that are embedded into Modbus Plus frames. These commands are recognized by controllers for reading and writing coils and registers and for reporting status. The following Modbus commands are used:

Table 2.1: Modbus Data Access Commands

Function Code (Decimal)	Command Name
1**	Read Discrete Output Status (0xxxx)
2	Read Discrete Input Status (1xxxx)
3**	Read Output Register (4xxxx)
4**	Read Input Register (3xxxx)
5**	Force Single Coil (0xxxx)
6	Preset Single Register (4xxxx)
7	Read Exception Status
8*	Get/Clear Network Statistics (Subfunction 21)
15	Force Multiple Coils (0xxxx)
16	Preset Multiple Registers (4xxxx)
17	Report Slave ID

* Use only subfunction 21 of function 8 for Modbus Plus networking data.
** These function codes are supported by the SEL-2711

Modbus Data Addressing

Modbus Plus addresses typically have the following ranges:

Coils (Output Status)	1	-	9999
Input Status	10001	-	19999
Input Registers	30001	-	39999
Holding (Output) Registers	40001	-	49999

These address ranges imply what function codes can be used on the data. For instance, holding registers can be accessed using function codes 3, 6, and 16 (see Table 2.1).

The actual addresses passed in the Modbus Plus messages start at 0. For example, for holding registers, the address within the message is 40001 less than what is viewed by the user.

See ***Appendix C: Modbus Plus Message Example*** to see how an actual Modbus Plus message is structured.

PRODUCT OVERVIEW

The SEL-2711 allows a remote Modbus Plus device to read meter, demand meter, target, and history information available from the host system. It also allows User Region data to be read. The SEL-2711 can be configured to send user-configurable Modbus Plus global data. The SEL-2711 captures all Modbus Plus global data from the network and stores it to a data region so it is available to the host system. The SEL-2711 accepts control operations; the host system

defines their specific function. The SEL-2711 can also issue control commands to other nodes based on control indications from the host system.

In ***Section 3: Operation and Network Configuration***, there is a complete description of data access methods and SEL-2711 operation. In ***Section 4: Operation Within SEL-2030***, there is a description of the register addresses applicable to this data.

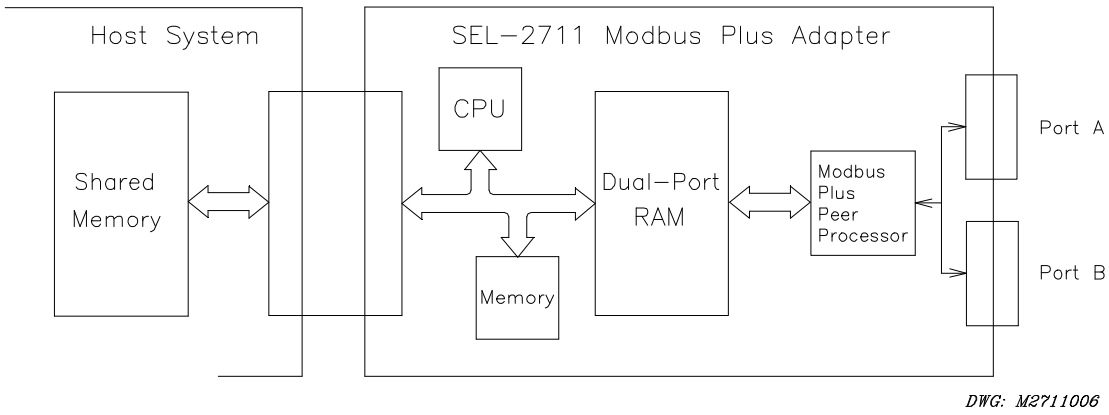


Figure 2.3: SEL-2711 Block Diagram

Figure 2.3 shows a block diagram of the SEL-2711. To communicate with the host system, the SEL-2711 talks to a block of shared memory that is resident on the host system. The SEL-2711 can then operate on the data using its local CPU and memory. The Modbus Plus Peer Processor controls the Modbus Plus network operations. It interacts with the local CPU using a small dual-port RAM.

TABLE OF CONTENTS

TABLES

FIGURES

SECTION 3: OPERATION AND NETWORK CONFIGURATION

INTRODUCTION

This section describes the operation of the SEL-2711, including how to access data, LED interpretation, self-tests, device configuration, and network configuration. This section is intended primarily as a reference section. See ***Section 4: Operation Within SEL-2030*** for information on installation and initial checkout.

DATA ACCESS

The SEL-2711 supports eight data slave paths (addresses 1 - 8) for access of data using Modbus Plus. Thus, in a system with multiple hosts, each can access a different slave path, preventing contention over access to the SEL-2711. The SEL-2711 also supports eight data master paths which it uses to issue control commands to other nodes.

Data can be read from the SEL-2711 as holding registers using the Modbus Read Holding Register function code (3). Using this function code, up to 125 consecutive registers can be read at once. To read more than 125 registers requires multiple requests. See ***Appendix C: Modbus Plus Message Example*** for an example of one of these messages.

Most devices that poll the SEL-2711 reference holding registers as starting at address 40001 (4x reference). Some devices may reference using an offset value starting at 1, so you must subtract 40000 from the 4x reference address to determine the address to use. Other devices may reference the data using a Modbus offset value which starts at 0 (this corresponds to how the holding register address is actually transmitted on the network), so you must subtract 40001 from the 4x reference address to determine the address to use.

From many Modicon PLCs, holding registers are read using a MSTR ladder logic function. The MSTR instruction references holding register offset values, not absolute 4x addresses. Therefore, you must subtract 40000 from the 4x addresses indicated in this manual.

Data can also be read from the SEL-2711 as input registers using the Modbus Read Input Register function code (4). Using this function code, up to 125 consecutive registers can be read at once. To read more requires multiple accesses. Input registers start at address 30001 (3x reference). Similar to holding registers, it may be necessary to subtract 30000 or 30001 from the absolute 3x address to determine the address to use within your system.

The state of coils can be read from the SEL-2711 using the Modbus Read Coil function code (1). Using this function code, up to 2000 coils can be read at once. Coil addresses start at address 1 (0x reference). Most systems will use the coil address directly, but those that use a 0-based reference will require you to subtract 1 one from the specified coil address.

In addition to reading data, it is possible to control some coils using the Modbus Force Single Coil function code (5). You can set a coil ON or OFF, which corresponds to setting or clearing a control point in the host system. Coil addressing for control is the same as for reading, as described in the previous paragraph.

The SEL-2711 will respond with the data for read requests, an echo of the message for control requests, or with one of the following error codes:

Error Code	Description
1 - Illegal Function Code	A Modbus function code other than 3 was received
2 - Illegal Data Address	Some portion of the requested registers is undefined
3 - Illegal Data Value	Force single coil command had invalid operate indication
6 - Busy, Rejected Message	The SEL-2711 is unable to respond in a timely fashion; the requesting device should try again

If a register that is unused is read, the data value -32768 (8000h) will be returned.

LED USAGE

The SEL-2711 has three LEDs which are visible from the rear of the host device, as shown in Figure 3.1. There is a red LED associated with each connector (A and B) to indicate which cable segment has a fault. If a red LED blinks momentarily, it indicates that a message error was detected on that cable path. If it is not on, then there is a hard fault either in the cable or in the connected device. The red LED for a port will also be off if it is not connected. The red LED will be on steady if the port is functioning properly. See ***Modbus Plus Network Planning and Installation Guide*** for more information on using redundant connections in a Modbus Plus network.

The green LED indicates network status. The possible patterns are:

Six flashes per second. The node's normal operating state. The node is successfully receiving and passing the token. All nodes on the network should be flashing this pattern.

One flash per second. The node is off line after just being powered up, or after exiting the four flashes per second mode. In this state, the node monitors the network and builds a table of active nodes and token-holding nodes. It remains in this state for five seconds, then attempts to go to its normal operating state.

Two flashes, then off for two seconds. The node is hearing the token being passed among other nodes, but is never receiving the token. Check the network for an open circuit or defective termination.

Three flashes, then off for 1.7 seconds. The node is not hearing any other nodes. It is periodically claiming the token, but finding no other node to which to pass it. Check the network for an open circuit or defective termination.

Four flashes, then off for 1.4 seconds. The node has heard a valid message from another node that is using the same address as this node. The node remains in this state as long as it continues to hear the duplicate address. If the duplicate address is not heard for five seconds, the node then changes to the pattern of one flash every second.

SELF-TESTS

The SEL-2711 performs a number of self-tests, including RAM, Flash, EEPROM, dual-port RAM, and Modbus Plus processor checks. If a problem is detected, it is reported to the host. See ***Section 4: Operation Within SEL-2030*** for information on how to access the SEL-2711 self-test status. See ***Appendix B: Error Codes and Messages*** for details on the possible error conditions.

DEVICE CONFIGURATION

Associated with the SEL-2711 are a number of configuration parameters. These are listed in the following table. See ***Section 4: Operation Within SEL-2030*** for information on how to access these settings using the SEL-2030.

Table 3.1: SEL-2711 Settings

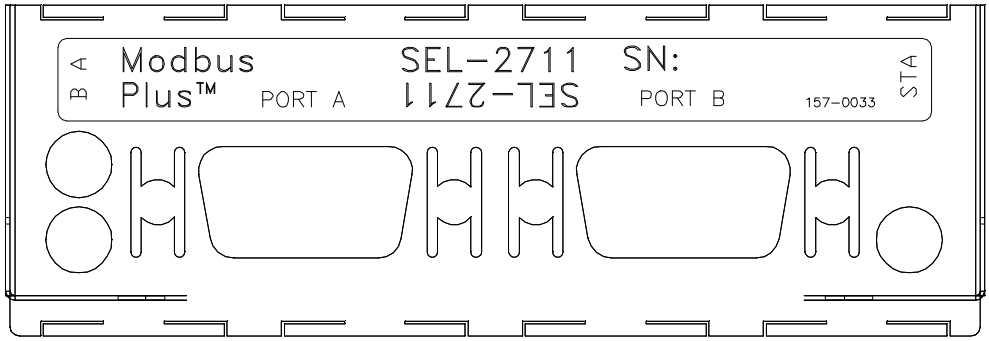
Prompt	Description
ADDRESS	**Prompt**: Modbus Plus node Address (1-64) **Discussion**: Select the Modbus Plus node address for the SEL-2711.
MAP_IR	**Prompt**: Map Input Registers to Holding Registers (Y/N) **Discussion**: Two maps are available for the holding registers. If you select N, the standard holding register map is used, which contains specific maps for meter, demand meter, target, and history information. If you select Y, the holding register accesses will access the exact same data as the input register accesses. See ***Section 4: Operation Within SEL-2030*** for a description of these maps.
PATH_*1-64*	**Prompt**: Control Point *1-64* routing path (Address range 1-247, 0=OFF) **Discussion**: For each outgoing control point you are using, set a Modbus Plus node address to direct the control operation to. This must consist of a valid Modbus Plus routing path with one to five address values separated by periods (.). Depending on the capabilities of the host system, not all 64 of these may be available.
COIL_*1-64*	**Prompt**: Control Point *1-64* Modbus coil number? **Discussion**: For each outgoing control point you are using, select a coil number to be operated. The SEL-2711 will issue ON or OFF commands to this coil whenever it receives a set or clear command from the host device. Depending on the capabilities of the host system, not all 64 of these may be available).

Note: The actual number of PATH and COIL settings available is limited by the number of control points supported in the host system. For instance, the SEL-2030 only has 16 available control points, so only 16 PATH and COIL settings will be available within the SEL-2030.

NETWORK CONFIGURATION

The SEL-2711 has two connectors which are accessible from the rear of the host device, as shown in Figure 3.1. The connectors provide for redundant Modbus Plus connections and are referred to as ports A and B. See ***Modbus Plus Network Planning and Installation Guide*** for more information on using redundant connections in a Modbus Plus network. In a typical non-redundant system, either port may be used.

There are many considerations when planning a Modbus Plus network. See ***Modbus Plus Network Planning and Installation Guide*** for complete information on designing and connecting Modbus Plus network.



DWG: M2711007

Figure 3.1: SEL-2711 Panel with Label

TABLE OF CONTENTS

SECTION 4: OPERATION WITHIN SEL-2030 4-1

TABLES

SECTION 4: OPERATION WITHIN SEL-2030

INTRODUCTION

This section explains all the details of using an SEL-2711 within an SEL-2030, including installation, device configuration, checkout, and data mapping. This section concludes with an example of accessing relay data using the SEL-2711 and SEL-2030.

INSTALLATION

If you receive an SEL-2711 separate from the SEL-2030, you will need to install it. To install the SEL-2030, perform the following steps.

This procedure requires that you handle components sensitive to Electrostatic Discharge (ESD). If your facility is not equipped to work with these components, we recommend that you return the SEL-2030 and SEL-2711 to SEL for installation.

1. Remove power from the SEL-2030. Disconnect all serial ports, output contacts, the alarm contact, and the IRIG-B input.
2. Remove the SEL-2030 front panel.
3. Disconnect the power and interface board cables from the SEL-2030 main board.
4. Carefully draw out the main board.
5. Attach the snap-on standoffs to the 80-position connector side of the SEL-2711 (the standoffs are included in the materials shipped with the SEL-2711). Insert the SEL-2711 80-position connector pins into an available 80-pin port on the SEL-2030 main board, taking the following precautions:

   - Ensure that the SEL-2711 80-position connector pins align with the guide holes to the SEL-2030 80-pin port.
   - Apply firm pressure while inserting the SEL-2711 80-position connector pins into the SEL-2030, but do not force the connection. If you encounter resistance, recede the connector try again. A slight rocking motion of the SEL-2711 card may help in aligning the pins of the connector.

   Monitor the SEL-2030 80-pin port on the opposite side of the SEL-2030 main board for pin protrusion. The pins from the SEL-2711 connector should come through as a unit. If some pins do not protrude or the protrusion of the 80 pins is uneven, damage to the connector may have occurred. Recede the 80-position connector and examine it.
6. Reach into the SEL-2030 unit and remove the blank plate covering the rear-panel hole that the SEL-2711 will project through.
7. Reinstall the SEL-2030 main board. Connect its power and interface board cables.

8. Attach the front panel.
9. Reattach all external cables.
10. Apply power to the unit.

FIRMWARE UPGRADES

The programs (firmware) that run in the SEL-2711 are stored in Flash memory. New programs can be stored to the SEL-2711 via a file transfer to the SEL-2030. To load the new version of the SEL-2711, follow the instructions below. The SEL-2711 and SEL-2030 each have two programs that may need to be upgraded: the regular, or "executable" program, and the "SELBOOT" program. See ***Appendix A: Firmware Versions*** to find out what programs you should upgrade to make the latest version of the SEL-2711 function optimally.

SEL-2711/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. If it is not, then switch to software that has this capability.
2. Use the ACCESS and 2ACCESS commands to gain Level 2 Access to the SEL-2030.
3. Enter the command "L_D" and then verify by responding "Yes" to the verification prompt. This places the SEL-2030 in SELBOOT mode where it is ready to 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 as high as possible (38400 maximum). To set the port at 38400, enter "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-2711:
   Type the command "REC n", where n is the SEL-2711 protocol card port (e.g. if the card is on port 17, then enter "REC 17"). Respond "Y" to the confirmation prompt. Once the SEL-2030 is ready to receive the new code, it will display another prompt indicating that you may press any key to initiate the firmware download. Press a key and then send the new SEL-2711 code using an XMODEM file transfer.

   If you are upgrading the SEL-2030:
   Type the command "REC ". Respond "Y" to the confirmation prompt. Once the SEL-2030 is ready to receive the new code, it will display another prompt indicating that you may press any key to initiate the firmware download. Press a key and then send the new SEL-2030 code using an XMODEM file transfer.

   If you are upgrading the SEL-2711 SELBOOT code:
   Type the command "REC boot n", where n is the SEL-2711 protocol card port (e.g. if the card is on port 17, then enter "REC boot 17"). Respond "Y" to the confirmation prompt. Once the SEL-2030 is ready to receive the new code, it will display another prompt indicating

that you may press any key to initiate the firmware download. Press a key and then send the new SEL-2711 SELBOOT code using an XMODEM file transfer.

If you are upgrading the SEL-2030 SELBOOT code:
Type the command "REC boot". Respond "Y" to the confirmation prompt. Once the SEL-2030 is ready to receive the new code, it will display another prompt indicating that you may press any key to initiate the firmware download. Press a key and then send the new SEL-2030 SELBOOT code using an XMODEM file transfer.

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

7. In order to communicate with the SEL-2030, you will need to change the baud rate on your communications software back to the value that is set in your SEL-2030 Front panel port settings. This should be the same baud rate as was used in establishing communications in step 1.

CONFIGURING SEL-2711

There are a number of settings associated with the SEL-2711. To access these settings, use the SET P 17 or SET P 18 command in the SEL-2030. (The SEL-2711 is installed as Port 17 or 18 in the SEL-2030; examine the rear panel or use the STATUS command to determine which slot it is in.) The following screen capture shows what the setting process looks like:

```
*>>SET P 17<ENTER>

Port communications settings for Port 17

Modbus Plus node Address (1-64)
                                        ADDRESS = 1 ? 17<ENTER>
Map Input Registers to Holding Registers(Y/N)
                                        MAP_IR = "N"
 ? <ENTER>
Control Point 1 routing path(Address range 1-247,0=OFF)
                                        PATH_1 = "00.00.00.00.00"
 ? <ENTER>
Control Point 1 Modbus coil number
                                        COIL_1 = 1 ? <ENTER>
Control Point 2 routing path(Address range 1-247,0=OFF)
                                        PATH_2 = "00.00.00.00.00"
 ? END<ENTER>
 ADDRESS = 17
  MAP_IR = "N"
  PATH_1 = "00.00.00.00.00"
  COIL_1 = 1
  PATH_2 = "00.00.00.00.00"
  COIL_2 = 1
  PATH_3 = "00.00.00.00.00"
  COIL_3 = 1
  PATH_4 = "00.00.00.00.00"
  COIL_4 = 1

                                    (continued on next page)
```

```
                                  (continued from previous page)

   PATH_5 = "00.00.00.00.00"
   COIL_5 = 1
   PATH_6 = "00.00.00.00.00"
   COIL_6 = 1
   PATH_7 = "00.00.00.00.00"
   COIL_7 = 1
   PATH_8 = "00.00.00.00.00"
   COIL_8 = 1
   PATH_9 = "00.00.00.00.00"
   COIL_9 = 1

Press RETURN to continue<ENTER>

  PATH_10 = "00.00.00.00.00"
  COIL_10 = 1
  PATH_11 = "00.00.00.00.00"
  COIL_11 = 1
  PATH_12 = "00.00.00.00.00"
  COIL_12 = 1
  PATH_13 = "00.00.00.00.00"
  COIL_13 = 1
  PATH_14 = "00.00.00.00.00"
  COIL_14 = 1
  PATH_15 = "00.00.00.00.00"
  COIL_15 = 1
  PATH_16 = "00.00.00.00.00"
  COIL_16 = 1


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

Settings accepted.

*>>
```

The factory default value for the address is 1.

INITIAL CHECKOUT

The first thing you will want to check after installing the SEL-2711 is that it is properly detected by the SEL-2030 and that is reporting no self-test failures. Use the WHO command to confirm that the SEL-2711 is properly detected as Port 17 or 18. Use the STATUS command to confirm that no self-test errors are reported. If a self-test failure is listed, see ***Appendix B: Error Codes and Messages*** for a detailed description of the failure.

Once the SEL-2711 is configured, confirm it is talking to the network by examining its status LED. It should be blinking 6 times per second, indicating a successful network connection. If this is not the case, refer to ***Section 3: Operation and Network Configuration*** for more information on LED interpretation.

After confirming successful network connection, you should attempt to read from the SEL-2711 to confirm you can collect data from it. Configure some other device on the network to request one or more holding registers starting from address 40001 (index 0 using function code 3). The SEL-2711 should return a value of 8000h (-32768) for these registers.

If you get a network error response, you are probably not using the correct device address or routing path. If you get an invalid function code response, then you are not properly requesting holding registers using function code 3. If you get an illegal data address error response, you are not properly reading the initial registers. If you get a busy error response, try again.

Once you get successful responses, you can configure the SEL-2030 to collect the data of interest and you can configure your host devices to read this data.

ROUTING PATHS

The SEL-2711 is a host-based network adapter. To make a successful Modbus Plus request to the SEL-2711, the last non-zero digit in your routing path must specify an application task number. This is also referred to as a Data Slave path number. The SEL-2711 supports 8 Data Slave paths, so the last non-zero digit in the routing path must be in the range 1-8. For example, if your SEL-2711 has a Modbus Plus node address of 12, then other Modbus Plus nodes on the same network should use a routing path such as 12.1.0.0.0. See ***Section 3: Operation and Network Configuration*** for more information on routing paths.

STATUS ACCESS

The SEL-2030 provides status information on the SEL-2711 in two ways. The STATUS command shows the state of the SEL-2711 and indicates any errors. ***Appendix B: Error Codes and Messages*** lists the possibilities.

The Global Region within the SEL-2030 also has status information. See ***Section 6: Database*** in the ***SEL-2020/2030 Reference Manual*** for additional information on this data.

CONFIGURING RELAY PORTS

There are many kinds of relay data in the SEL-2030 that can be accessed by the SEL-2711. To make this data available to the SEL-2711, the SEL-2030 must be configured to collect this data. The ***SEL-2030 User's Guide*** describes how to configure the SEL-2030 to read this data. The following screen capture shows a typical configuration sequence based on using an SEL-251-3 relay on Port 2 of the SEL-2030:

```
*>>SET P 2<ENTER>

Port communications settings for Port 2


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>

Attempting auto-configuration...Done.


                                        (continued on next page)
```

```
                                    (continued from previous page)

FID:       FID=SEL-251-3-R601-V656rn1rqyb-D950906-E2
DEVICE ID: 251-3 TEST RELAY (NEGATIVE SEQUENCE)
BAUD RATE: 9600
OPERATE SUPPORT: Binary (1 Breakers, 0 Remote Bits)
COMMANDS SUPPORTED:
  B 20METER
  A 20DEMAND
  B 20TARGET
  A 20HISTORY
  A 20STATUS
  A 20BREAKER
  A 20EVENT
  A 20EVENTS

Port Identification String
PORTID  ="251-3 TEST RELAY (NEGATIVE SEQUENCE)"
 ? END<ENTER>

PORT:2
DEVICE  = S
CONFIG  = Y

PORTID  ="251-3 TEST RELAY (NEGATIVE SEQUENCE)"
BAUD    = 9600
DATABIT = 8    STOPBIT = 2    PARITY  = N
RTS_CTS = N    XON_XOFF= Y
TIMEOUT = OFF

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

Port 2 Settings Changed

**>>SET A 2<ENTER>

Automatic message settings for Port 2

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

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

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

Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 0     ? 4<ENTER>

Item 1 trigger D1
ISSUE1  = NA
 ? P00:00:01<ENTER>

Item 1 message
MESG1   = ""
 ? 20METER<ENTER>

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

Item 2 message
MESG2   = ""
 ? 20TARGET<ENTER>

                                    (continued on next page)
```

```
                                (continued from previous page)

Item 3 trigger D3
ISSUE3  = NA
 ? P00:01<ENTER>

Item 3 message
MESG3   = ""
 ? 20DEMAND<ENTER>

Item 4 trigger D4
ISSUE4  = NA
 ? P00:01<ENTER>

Item 4 message
MESG4   = ""
 ? 20HISTORY<ENTER>

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

AUTOBUF = Y
STARTUP ="ACC\n"
SEND_OPER= N

MSG_CNT = 4

ISSUE1  = P00:00:01.0
MESG1   = 20METER

ISSUE2  = P00:00:01.0
MESG2   = 20TARGET

ISSUE3  = P00:01:00.0
MESG3   = 20DEMAND

ISSUE4  = P00:01:00.0
MESG4   = 20HISTORY
USER    = 0

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

Port 2 Settings Changed

**>>
```

SEL-2030 User Region data can also be read using the SEL-2711. Use SET M on the appropriate port to configure this data.

Port remote bits can be set and cleared via Modbus Plus. Set SELOGIC® Control Equations within the SEL-2030 to use these Remote Bits for control purposes.

In the next example, we will consider an SEL-2030 with an SEL-2711 installed as Port 18, an SEL-251-3 connected to Port 1, an SEL-321-1 connected to Port 2, and an SEL-351 connected to Port 3. We want to collect data via Modbus Plus from these three relays, and control their breakers.

The first step is to confirm that the SEL-2711 is operating as expected. The STATUS command provides this confirmation, as shown below.

```
**>>STATUS<ENTER>

                                          Date: 10/06/97    Time: 15:07:11
FID=SEL-2030-X013-V0-D970922              FID=SLBT-2030-XRAM-V0-970314

SELF-TESTS

RAM      SRAM     CODE     ARCH     EEPROM   P.S.     SET      BATTERY
512 kb   256 kb   OK       Absent   OK       OK       OK       OK

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

Port   Status            Success Rate   SET M     Database Delays
1      Active                           None
2      Inactive               87%       None      D1 D2 D3 D4
3      Inactive                         None
4      Inactive                         None
5      Inactive                         None
6      Inactive                         None
7      Inactive                         None
8      Inactive                         None
9      Inactive                         None
10     Inactive                         None
11     Inactive                         None
12     Inactive                         None
13     Inactive                         None
14     Inactive                         None
15     Inactive                         None
16     Inactive                         None
18     Normal(100h)           NORM       Running
F      Active                 98%       None
```

Once the status has been confirmed, the SEL-2711 address must be set, and the three relay ports must be configured to capture the data of interest. The following screens illustrate this process.

```
*>>SET P 18<ENTER>

Port communications settings for Port 18

Modbus Plus node Address (1-64)
                                          ADDRESS = 1 ? 12<ENTER>
Map Input Registers to Holding Registers(Y/N)
                                          MAP_IR = "N"
 ? END<ENTER>
 ADDRESS = 12
  MAP_IR = "N"
  PATH_1 = "00.00.00.00.00"
  COIL_1 = 1
  PATH_2 = "00.00.00.00.00"
  COIL_2 = 1
  PATH_3 = "00.00.00.00.00"
  COIL_3 = 1
  PATH_4 = "00.00.00.00.00"
  COIL_4 = 1
  PATH_5 = "00.00.00.00.00"
  COIL_5 = 1
  PATH_6 = "00.00.00.00.00"
  COIL_6 = 1
  PATH_7 = "00.00.00.00.00"
  COIL_7 = 1

                                       (continued on next page)
```

```
                                   (continued from previous page)

  PATH_8 = "00.00.00.00.00"
  COIL_8 = 1
  PATH_9 = "00.00.00.00.00"
  COIL_9 = 1

Press RETURN to continue<ENTER>

 PATH_10 = "00.00.00.00.00"
 COIL_10 = 1
 PATH_11 = "00.00.00.00.00"
 COIL_11 = 1
 PATH_12 = "00.00.00.00.00"
 COIL_12 = 1
 PATH_13 = "00.00.00.00.00"
 COIL_13 = 1
 PATH_14 = "00.00.00.00.00"
 COIL_14 = 1
 PATH_15 = "00.00.00.00.00"
 COIL_15 = 1
 PATH_16 = "00.00.00.00.00"
 COIL_16 = 1


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

Settings accepted.

**>>SET P 1<ENTER>

Port communications settings for Port 1

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

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

Attempting auto-configuration...Done.

FID:       FID=SEL-251-3-R601-V656rn1rqyb-D950906-E2
DEVICE ID: 251-3 TEST RELAY (NEGATIVE SEQUENCE)
BAUD RATE: 9600
OPERATE SUPPORT: Binary (1 Breakers, 0 Remote Bits)
COMMANDS SUPPORTED:
  B 2OMETER
  A 2ODEMAND
  B 2OTARGET
  A 2OHISTORY
  A 2OSTATUS
  A 2OBREAKER
  A 2OEVENT
  A 2OEVENTS


Port Identification String
PORTID  ="251-3 TEST RELAY (NEGATIVE SEQUENCE)"
 ? END<ENTER>

PORT:1
DEVICE  = S
CONFIG  = Y


                                     (continued on next page)
```

```
                                (continued from previous page)

PORTID  ="251-3 TEST RELAY (NEGATIVE SEQUENCE)"
BAUD    = 9600
DATABIT = 8    STOPBIT = 2    PARITY  = N
RTS_CTS = N    XON_XOFF= Y
TIMEOUT = OFF

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

Port 1 Settings Changed


**>>SET A 1<ENTER>

Automatic message settings for Port 1


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

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

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


Auto-message Settings

How many auto-message sequences (0-12)       MSG_CNT = 0     ? 4<ENTER>

Item 1 trigger D1
ISSUE1  = NA
 ? P00:00:01<ENTER>

Item 1 message
MESG1   = ""
 ? 20METER<ENTER>

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

Item 2 message
MESG2   = ""
 ? 20TARGET<ENTER>

Item 3 trigger D3
ISSUE3  = NA
 ? P00:02<ENTER>

Item 3 message
MESG3   = ""
 ? 20DEMAND<ENTER>

Item 4 trigger D4
ISSUE4  = NA
 ? P00:02<ENTER>

Item 4 message
MESG4   = ""
 ? 20HISTORY<ENTER>

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


                                (continued on next page)
```

(continued from previous page)

```
AUTOBUF = Y
STARTUP ="ACC\n"
SEND_OPER= Y

MSG_CNT = 4


ISSUE1  = P00:00:01.0
MESG1   = 20METER

ISSUE2  = P00:00:01.0
MESG2   = 20TARGET

ISSUE3  = P00:02:00.0
MESG3   = 20DEMAND

ISSUE4  = P00:02:00.0
MESG4   = 20HISTORY
USER    = 0

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

Port 1 Settings Changed

*>>SET L 1<ENTER>

Logic settings for Port 1



SBR1    = NA
 ? SRB1<ENTER>


CBR1    = NA
 ? CRB1<ENTER>


SBR2    = NA
 ? END<ENTER>

SBR1    = 1:SRB1
CBR1    = 1:CRB1

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

Port 1 Settings Changed

**>>COPY 1 2<ENTER>

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.

FID:       FID=SEL-321-1-R413-V656112pb-D960731
DEVICE ID: EXAMPLE: BUS B, BREAKER 3
BAUD RATE: 2400
OPERATE SUPPORT: Binary (1 Breakers, 16 Remote Bits S-C)
LEVEL 1 PASSWORD: OTTER
COMMANDS SUPPORTED:
```

(continued on next page)

```
                                (continued from previous page)

  B 2OMETER
  B 2OTARGET
  A 2OHISTORY
  A 2OSTATUS
  A 2OEVENT
  A 2OEVENTS
  A 2OEVENTL

Port 2:
Warning: Current device does not support some Automatic Message settings
Automatic Message settings not supported by the new device were lost
Port 2 Settings Changed

**>>COPY 1 3<ENTER>

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.

FID:       FID=SEL-351-R101-VM-D970616
DEVICE ID: FEEDER 1
BAUD RATE: 2400
OPERATE SUPPORT: Binary (1 Breakers, 8 Remote Bits S-C-P)
COMMANDS SUPPORTED:
  B 2OMETER
  B 2ODEMAND
  B 2OTARGET
  A 2OHISTORY
  A 2OSTATUS
  A 2OEVENT
  A 2OEVENTS
  A 2OEVENTL

Port 3 Settings Changed

**>>
```

Once the three relay ports are set up to collect data, we can extract this data using Modbus Plus. Simply connect a Modbus Plus master to the SEL-2711 and begin collecting data using the data maps provided later in this section. We can now also control the breakers by operating on RB1 on each of the relay ports.

CONFIGURING SEL-2711 PORT

On the SEL-2711 port, we can define global data to be transmitted, monitor for incoming global data, and create control operations to issue to other nodes on the network.

To configure global data to be sent on the network, use the SET M command on the SEL-2711 port (Port 17 or 18). The first 32 registers used in the User Region will be sent onto the network as Global Data. The first 500 registers of the User Region are also visible as the final 500 holding registers in the standard holding register map.

Global data from other nodes on the network are automatically placed in region D1 on the SEL-2711 port. The first 32 registers are the global data from node 1, the next 32 are from 2,…

Data corresponding to non-existent nodes or to non-existent portions of a node's global data will be reported as 8000h (-32768).

The sixteen breaker bits on the SEL-2711 port can be used for issuing control commands to other nodes on the network. To enable this, for every control point you wish to use, you must assign a destination routing address and coil number using the SET P command. (Note that in the settings, coil 1 corresponds to BR16, coil 2 to BR15,…, and coil 16 to BR1.) Once the settings are established, the SEL-2711 will issue a force single coil ON command whenever there is a rising edge on a SBR bit and will issue a force single coil OFF command whenever there is a rising edge on a CBR bit. This allows the SEL-2030 to control up to 16 coils on the network.

To illustrate the above concepts, let's extend the previous example to include global data and control. The first step is to create SET M equations on Port 18 for the global data we wish to transmit. For this example, we will send the phase currents and voltages from the three relays. The following screen capture illustrates this process.

```
*>>SET M 18<ENTER>

Mathematical/move equation settings for Port 18

 1
? 0 = 1:METER:IA<ENTER>
 2
? 1 = 1:METER:IB<ENTER>
 3
? 2 = 1:METER:IC<ENTER>
 4
? 3 = 1:METER:VA<ENTER>
 5
? 4 = 1:METER:VB<ENTER>
 6
? 5 = 1:METER:VC<ENTER>
 7
? 6 = 2:METER:IA<ENTER>
 8
? 7 = 2:METER:IB<ENTER>
 9
? 8 = 2:METER:IC<ENTER>
10
? 9 = 2:METER:VA<ENTER>
11
? 10 = 2:METER:VB<ENTER>
12
? 11 = 2:METER:VC<ENTER>
13
? 12 = 3:METER:IA<ENTER>
14
? 13 = 3:METER:IB<ENTER>
15
? 14 = 3:METER:IC<ENTER>
16
? 15 = 3:METER:VA<ENTER>
17
? 16 = 3:METER:VB<ENTER>
18
? 17 = 3:METER:VC<ENTER>
19
? <ENTER>

                                    (continued on next page)
```

```
                                  (continued from previous page)

  1 000h = 1:METER:IA(A)
  2 001h = 1:METER:IB(A)
  3 002h = 1:METER:IC(A)
  4 003h = 1:METER:VA(V)
  5 004h = 1:METER:VB(V)
  6 005h = 1:METER:VC(V)
  7 006h = 2:METER:ia
  8 007h = 2:METER:ib
  9 008h = 2:METER:ic
 10 009h = 2:METER:va
 11 00Ah = 2:METER:vb
 12 00Bh = 2:METER:vc
 13 00Ch = 3:METER:IA
 14 00Dh = 3:METER:IB
 15 00Eh = 3:METER:IC
 16 00Fh = 3:METER:VA
 17 010h = 3:METER:VB
 18 011h = 3:METER:VC

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

USER database region too small: Current size = 0  Size needed = 18
Attempting to allocate larger USER region... Done.

Port 18 Settings Changed


*>>
```

The SEL-2711 will now automatically send this data to all the other nodes on the network.

Global data from the other nodes on the network is available in region D1. Simply VIEW this data to see what is coming from the other nodes.

```
*>>VIE 18 2060H NR 32<ENTER>

18:2060h

000Ch 0000h FFFFh FFFFh FFFFh FFFFh 0000h 0000h
0000h 0000h 0000h 0000h 0000h 0000h 0000h 0000h
0000h 0000h 0000h 0000h 0000h 0000h A39Ch 8000h
8000h 8000h 8000h 8000h 8000h 8000h 8000h 8000h

*>>
```

You will need to know the organization of the global data from each node to make use of it. You can use this data in SET M equations or SELOGIC Control Equations. In the above example, we viewed only the 32 registers of global data for the Modbus Plus node with address 4. See the discussion of Incoming Global Data later in this chapter for more information.

To enable control operations, we must set up the destinations using SET P and also set up the source of the control using SET L. To illustrate this, let's create a control point that issues commands to node 2.5.0.0.0 and coil 37 based on the state of the SALARM bit. The following illustrates this.

```
*>>SET P 18<ENTER>

Port communications settings for Port 18

Modbus Plus node Address (1-64)
                                        ADDRESS = 12 ? <ENTER>
Map Input Registers to Holding Registers(Y/N)
                                        MAP_IR = "N"
 ? <ENTER>
Control Point 1 routing path(Address range 1-247,0=OFF)
                                        PATH_1 = "00.00.00.00.00"
 ? 2.5.0<ENTER>
Control Point 1 Modbus coil number
                                        COIL_1 = 1 ? 36
Control Point 2 routing path(Address range 1-247,0=OFF)
                                        PATH_2 = "00.00.00.00.00"
 ? END<ENTER>
 ADDRESS = 12
  MAP_IR = "N"
  PATH_1 = "2.5.0"
  COIL_1 = 36
  PATH_2 = "00.00.00.00.00"
  COIL_2 = 1
  PATH_3 = "00.00.00.00.00"
  COIL_3 = 1
  PATH_4 = "00.00.00.00.00"
  COIL_4 = 1
  PATH_5 = "00.00.00.00.00"
  COIL_5 = 1
  PATH_6 = "00.00.00.00.00"
  COIL_6 = 1
  PATH_7 = "00.00.00.00.00"
  COIL_7 = 1
  PATH_8 = "00.00.00.00.00"
  COIL_8 = 1
  PATH_9 = "00.00.00.00.00"
  COIL_9 = 1

Press RETURN to continue<ENTER>

 PATH_10 = "00.00.00.00.00"
 COIL_10 = 1
 PATH_11 = "00.00.00.00.00"
 COIL_11 = 1
 PATH_12 = "00.00.00.00.00"
 COIL_12 = 1
 PATH_13 = "00.00.00.00.00"
 COIL_13 = 1
 PATH_14 = "00.00.00.00.00"
 COIL_14 = 1
 PATH_15 = "00.00.00.00.00"
 COIL_15 = 1
 PATH_16 = "00.00.00.00.00"
 COIL_16 = 1


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

Settings accepted.

*>>
```

(continued on next page)

```
                                (continued from previous page)

*>>SET L 18 SBR16<ENTER>

Logic settings for Port 18



SBR16   = NA
 ? SALARM<ENTER>


CBR16   = NA
 ? !SALARM<ENTER>


SRB1    = NA
 ? END<ENTER>

SBR16   = SALARM
CBR16   = !SALARM

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

Port 18 Settings Changed


*>>
```

You can test this using the TOG 18:SBR16 and TOG 18:CBR16 commands.

COIL DATA MAPPING

Various SEL-2030 control points are available as coils that can be both operated on and read. These control points map to remote bits within the SEL-2030. A Modbus Force Single Coil ON message causes the corresponding SRB bit to be pulsed. A Modbus Force Single Coil OFF message causes the corresponding CRB bit to be pulsed. These bits can be used within the SEL-2030 for whatever control purpose you desire. When reading control points, the SEL-2711 responds with the state corresponding to the most recent Modbus Plus operation; it does not necessarily correspond to the state of the remote bit within the SEL-2030 because it may be modified by other operations. The following table lists these control points.

Table 4.1: Standard Coil Map

Coil Number	SEL-2030 Control Bit
1	1:RB16
2	1:RB15
3	1:RB14
4	1:RB13
5	1:RB12
6	1:RB11
7	1:RB10
8	1:RB9

Coil Number	SEL-2030 Control Bit
9	1:RB8
10	1:RB7
11	1:RB6
12	1:RB5
13	1:RB4
14	1:RB3
15	1:RB2
16	1:RB1

Coil Number	SEL-2030 Control Bit
17	2:RB16
18	2:RB15
19	2:RB14
20	2:RB13
21	2:RB12
22	2:RB11
23	2:RB10
24	2:RB9
25	2:RB8
26	2:RB7
27	2:RB6
28	2:RB5
29	2:RB4
30	2:RB3
31	2:RB2
32	2:RB1
33	3:RB16
34	3:RB15
35	3:RB14
36	3:RB13
37	3:RB12
38	3:RB11
39	3:RB10
40	3:RB9
41	3:RB8
42	3:RB7
43	3:RB6
44	3:RB5
45	3:RB4
46	3:RB3
47	3:RB2
48	3:RB1
49	4:RB16
50	4:RB15
51	4:RB14
52	4:RB13
53	4:RB12
54	4:RB11
55	4:RB10
56	4:RB9
57	4:RB8
58	4:RB7
59	4:RB6
60	4:RB5

Coil Number	SEL-2030 Control Bit
61	4:RB4
62	4:RB3
63	4:RB2
64	4:RB1
65	5:RB16
66	5:RB15
67	5:RB14
68	5:RB13
69	5:RB12
70	5:RB11
71	5:RB10
72	5:RB9
73	5:RB8
74	5:RB7
75	5:RB6
76	5:RB5
77	5:RB4
78	5:RB3
79	5:RB2
80	5:RB1
81	6:RB16
82	6:RB15
83	6:RB14
84	6:RB13
85	6:RB12
86	6:RB11
87	6:RB10
88	6:RB9
89	6:RB8
90	6:RB7
91	6:RB6
92	6:RB5
93	6:RB4
94	6:RB3
95	6:RB2
96	6:RB1
97	7:RB16
98	7:RB15
99	7:RB14
100	7:RB13
101	7:RB12
102	7:RB11
103	7:RB10
104	7:RB9

Coil Number	SEL-2030 Control Bit
105	7:RB8
106	7:RB7
107	7:RB6
108	7:RB5
109	7:RB4
110	7:RB3
111	7:RB2
112	7:RB1
113	8:RB16
114	8:RB15
115	8:RB14
116	8:RB13
117	8:RB12
118	8:RB11
119	8:RB10
120	8:RB9
121	8:RB8
122	8:RB7
123	8:RB6
124	8:RB5
125	8:RB4
126	8:RB3
127	8:RB2
128	8:RB1
129	9:RB16
130	9:RB15
131	9:RB14
132	9:RB13
133	9:RB12
134	9:RB11
135	9:RB10
136	9:RB9
137	9:RB8
138	9:RB7
139	9:RB6
140	9:RB5
141	9:RB4
142	9:RB3
143	9:RB2
144	9:RB1
145	10:RB16
146	10:RB15
147	10:RB14
148	10:RB13

Coil Number	SEL-2030 Control Bit
149	10:RB12
150	10:RB11
151	10:RB10
152	10:RB9
153	10:RB8
154	10:RB7
155	10:RB6
156	10:RB5
157	10:RB4
158	10:RB3
159	10:RB2
160	10:RB1
161	11:RB16
162	11:RB15
163	11:RB14
164	11:RB13
165	11:RB12
166	11:RB11
167	11:RB10
168	11:RB9
169	11:RB8
170	11:RB7
171	11:RB6
172	11:RB5
173	11:RB4
174	11:RB3
175	11:RB2
176	11:RB1
177	12:RB16
178	12:RB15
179	12:RB14
180	12:RB13
181	12:RB12
182	12:RB11
183	12:RB10
184	12:RB9
185	12:RB8
186	12:RB7
187	12:RB6
188	12:RB5
189	12:RB4
190	12:RB3
191	12:RB2
192	12:RB1

Coil Number	SEL-2030 Control Bit
193	13:RB16
194	13:RB15
195	13:RB14
196	13:RB13
197	13:RB12
198	13:RB11
199	13:RB10
200	13:RB9
201	13:RB8
202	13:RB7
203	13:RB6
204	13:RB5
205	13:RB4
206	13:RB3
207	13:RB2
208	13:RB1
209	14:RB16
210	14:RB15
211	14:RB14
212	14:RB13
213	14:RB12
214	14:RB11
215	14:RB10
216	14:RB9
217	14:RB8
218	14:RB7
219	14:RB6
220	14:RB5
221	14:RB4
222	14:RB3
223	14:RB2
224	14:RB1
225	15:RB16
226	15:RB15
227	15:RB14
228	15:RB13
229	15:RB12
230	15:RB11
231	15:RB10
232	15:RB9
233	15:RB8
234	15:RB7
235	15:RB6
236	15:RB5

Coil Number	SEL-2030 Control Bit
237	15:RB4
238	15:RB3
239	15:RB2
240	15:RB1
241	16:RB16
242	16:RB15
243	16:RB14
244	16:RB13
245	16:RB12
246	16:RB11
247	16:RB10
248	16:RB9
249	16:RB8
250	16:RB7
251	16:RB6
252	16:RB5
253	16:RB4
254	16:RB3
255	16:RB2
256	16:RB1
257	17:RB16
258	17:RB15
259	17:RB14
260	17:RB13
261	17:RB12
262	17:RB11
263	17:RB10
264	17:RB9
265	17:RB8
266	17:RB7
267	17:RB6
268	17:RB5
269	17:RB4
270	17:RB3
271	17:RB2
272	17:RB1
273	18:RB16
274	18:RB15
275	18:RB14
276	18:RB13
277	18:RB12
278	18:RB11
279	18:RB10
280	18:RB9

Coil Number	SEL-2030 Control Bit
281	18:RB8
282	18:RB7
283	18:RB6

Coil Number	SEL-2030 Control Bit
284	18:RB5
285	18:RB4
286	18:RB3
287	18:RB2
288	18:RB1

The coil numbers passed within the Modbus messages are actually one less than those shown in the above table.

There is also a set of 16 coils corresponding to the 16 control commands the SEL-2711 can issue. These are based on the 16 breaker bits (BRx bits) on the port in which the SEL-2711 card is installed (17 or 18). These coils can only be read, not operated. They indicate the status of the last issued operation. These will normally correspond to the values of the BRx bits within the SEL-2030. The following table lists the coil numbers for these bits.

Table 4.2: Read-Only Coil Map

Coil Number	SEL-2030 Bit
289	BR16
290	BR15
291	BR14
292	BR13
293	BR12
294	BR11
295	BR10
296	BR9
297	BR8
298	BR7
299	BR6
300	BR5
301	BR4
302	BR3
303	BR2
304	BR1

INPUT REGISTER DATA MAPPING

All of the User Region data within the SEL-2030 is available as input registers. The following map lists the correspondence between the User Regions and the Input Register addresses. In this table, offset addresses are used. To determine a 3x reference from this table, add 30000 to the given offset address. Be aware that only the first 9999 registers will be available using 3x references.

Table 4.3: Input Register Map

Input Register Offset Address	User Region
1 - 2048	Port 1 User Region
2049 - 4096	Port 2 User Region
4097 - 6144	Port 3 User Region
6145 - 8192	Port 4 User Region
8193 - 10,240	Port 5 User Region
10,241 - 12,288	Port 6 User Region
12,289 - 14,336	Port 7 User Region
14,337 - 16,384	Port 8 User Region
16,385 - 18,432	Port 9 User Region
18,433 - 20,480	Port 10 User Region
20,481 - 22,528	Port 11 User Region
22,529 - 24,576	Port 12 User Region
24,577 - 26,624	Port 13 User Region
26,625 - 28,672	Port 14 User Region
28,673 - 30,720	Port 15 User Region
30,721 - 32,768	Port 16 User Region
32,769 - 34,816	Port 17 User Region
34,817 - 36,864	Port 18 User Region

The addresses shown in this table are one greater than those passed in the actual Modbus messages.

To determine the specific input register offset address of a specific User Region register, add the User Region offset address to the beginning input register for that port. For example, if you want to access register F932h on Port 13, first subtract the User Region base address to determine a offset value:

F932h - F800h = 132h = 306.

Then add this to the beginning address for the Port 13 input registers:

306 + 24,577 = **24,813**.

HOLDING REGISTER DATA MAPPING

Holding registers can be mapped one of two ways, based on the MAP_IR setting. If this is set to yes, the map will be identical to that listed in the previous section, except that to determine normal 4x references, you will need to add 40000 to the values given in the table. If the MAP_IR setting is set to N, then the map will be as described below.

The holding register map is broken into two main segments. The first 10000 registers (those accessible using 4x references) are broken into 500 register blocks with data from each port in an appropriate block. The second segment consists of 36,864 registers which correspond to the User Regions of all 18 ports.

In the first segment, the first 500 register block is a general block, the next 18 blocks are specific to relays attached to the ports of the SEL-2030, and the final 500 registers correspond to the first 500 registers in the User Region of the port in which the SEL-2711 is installed (Port 17 or 18). Table 4.4 shows the mapping of this first segment. To determine a 4x reference from this table, add 40000 to the given offset address.

Table 4.4: Base Holding Register Map

Holding Register Offset Address	Description
1 - 499	Unused - always returns 8000h for all registers
500 - 999	Port 1 Relay Data
1000 - 1499	Port 2 Relay Data
1500 - 1999	Port 3 Relay Data
2000 - 2499	Port 4 Relay Data
2500 - 2999	Port 5 Relay Data
3000 - 3499	Port 6 Relay Data
3500 - 3999	Port 7 Relay Data
4000 - 4499	Port 8 Relay Data
4500 - 4999	Port 9 Relay Data
5000 - 5499	Port 10 Relay Data
5500 - 5999	Port 11 Relay Data
6000 - 6499	Port 12 Relay Data
6500 - 6999	Port 13 Relay Data
7000 - 7499	Port 14 Relay Data
7500 - 7999	Port 15 Relay Data
8000 - 8499	Port 16 Relay Data
8500 - 8999	Port 17 Relay Data - Always appears as no relay
9000 - 9499	Port 18 Relay Data - Always appears as no relay
9500 - 9999	Port 17 or 18 User Region first 500 registers

The addresses shown in this table are one greater than those passed in the actual Modbus messages.

Within each relay data block, the data is organized as shown in Table 4.5. This is a general map; not all relays contain all of the listed data. If the data is not available for a specific relay, a value of 8000h will be returned. A summary map is available on the summary card at the end of this manual.

Table 4.5: Relay Data Holding Register Map

Relative Address	Description
0	Type - an unsigned integer which encodes the relay type; see following subsection for details
1 - 39	Reserved - always returns 8000h
40 - 59	Meter data - must be collecting meter data from relay for this data to be available; see Table 4.8 for details

Relative Address	Description
60 - 79	Demand meter data - must be collecting demand data from relay for this data to be available; see Table 4.9 for details
80 - 85	Data collection date/time stamp - must be collecting meter data from relay for this data to be available; see Table 4.10 for details
86 - 159	Reserved - always returns 8000h
160 - 209	Relay word data - complete set of relay elements; must be collecting target data from relay for this data to be available; see Table 4.11 for details
210 - 239	Event data - information on most recent event; must be collecting history data from relay for this to be available; see Table 4.12 for details
240 - 259	Reserved - always returns 8000h
260 - 499	History data - must be collecting history data from relay for this to be available; see Table 4.13 for details

Beyond the first 10000 registers exist registers that map to all the User Region data. These registers function the same as the input register set described in the previous subsection. The following table shows the map.

Table 4.6: Extended Holding Register Map

Holding Register Offset Address	User Region
10001 - 12,048	Port 1 User Region
12,049 - 14,096	Port 2 User Region
14,097 - 16,144	Port 3 User Region
16,145 - 18,192	Port 4 User Region
18,193 - 20,240	Port 5 User Region
20,241 - 22,288	Port 6 User Region
22,289 - 24,336	Port 7 User Region
24,337 - 26,384	Port 8 User Region
26,385 - 28,432	Port 9 User Region
28,433 - 30,480	Port 10 User Region
30,481 - 32,528	Port 11 User Region
32,529 - 34,576	Port 12 User Region
34,577 - 36,624	Port 13 User Region
36,625 - 38,672	Port 14 User Region
38,673 - 40,720	Port 15 User Region
40,721 - 42,768	Port 16 User Region
42,769 - 44,816	Port 17 User Region
44,817 - 46,864	Port 18 User Region

Relay Type

The relay type field is the first register in each block of relay data. It encodes the relay type. There are two classes of relay types: fixed encodings which have values less than 10000 and translated encodings which have a value greater than 10000. Table 4.7 lists all of the fixed encodings.

Table 4.7: Relay Type Encodings

Relay Type Code	Relay Type
0	Not an auto-configured SEL IED port
1	SEL-151
2	SEL-251
3	SEL-151C/251C
4	SEL-151D/251D
5	SEL-121H/221H
6	SEL-321
7	SEL-BFR/2BFR
8	SEL-279H
9	SEL-151D-1/251D-1
10	SEL-151CD-1/251CD-1
1000	SEL-PG10/2PG10
1001	SEL-PG10-7/2PG10-7
1002	SEL-PG10-8/2PG10-8
1010	SEL-BFR-1/2BFR-1
1020	SEL-121-10
1021	SEL-121-16/221-16
1022	SEL-121-17
1023	SEL-121-2A
1030	SEL-49
1031	SEL-49E
2000	SEL-2020
2001	SEL-2030
9999	Unrecognized SEL IED

SEL relays that are not listed in the table above are encoded according to the following rules:

1. The first 3 digits are the relay number;
2. The fourth digit encodes relay character code as: 0=no character, 1=B, 2=C, 3=D, 4=CD, 5=F, 6=G, 7=H, 8=S, 9=V; and
3. The fifth digit is the dash number, or zero if there is no dash number.

For example, the SEL-587 is encoded as 58700, the SEL-251-3 is encoded as 25103, and the SEL-221G-6 is encoded as 22166.

Meter Data

The meter data differs significantly between relays. Therefore, the data stored in a specific register depends on the data available from the attached relay. All meter data is primary quantities, unless otherwise indicated. Table 4.8 lists the possible quantities for each register.

Some quantities have the whole and fractional parts separated into two registers. In these cases, the second register contains the fractional part multiplied by 10000. For example, a power of 73.1274 MW would be reported as 73 in register 44 and 1274 in register 45. Similarly, a reactive power of -8.2390 MVAR would be reported as -8 in register 46 and -2390 in register 47.

For this data to be available, the SEL-2030 must be set to perform 20METER collection with the attached relay.

Table 4.8: Relay Meter Data Holding Register Map

Relative Address	Description
40	IA, IAX, IAW1, or IA1 in amps; or dVA or dV12 in secondary V/100
41	IB, IBX, IBW1, or IB1 in amps; or dVB or dV34 in secondary V/100
42	IC, ICX, ICW1, or IC1 in amps; or dVC or dV56 in secondary V/100
43	IR, I0, I0_1, or IRX in amps
44	P or P1 whole part in MW
45	P or P1 fractional part in MW/10000
46	Q or Q1 whole part in MVAR
47	Q or Q1 fractional part in MVAR/10000
48	3I2, I2 as 3I2, 3I2X, or I2_1 as 3I2_1 in amps
49	VA or VA1 in kV/10; or V1 or VAX in secondary V/100; or IAY, IAW2, or IA2 in amps
50	VB or VB1 in kV/10; or V3 or VBX in secondary V/100; or IBY, IBW2, or IB2 in amps
51	VC or VC1 in kV/10; or V5 or VCX in secondary V/100; or ICY, ICW2, or IC2 in amps
52	3V0, V0 as 3V0, or V0_1 as 3V0_1 in kV/10; VPL in secondary V/100; or IRY or I0_2 in amps
53	VAB or VAB1 in kV/10; V2 or VAY in secondary V/100; or IABY or IAB2 in amps
54	VBC or VBC1 in kV/10; V4 or VBY in secondary V/100; or IBCY or IBC2 in amps
55	VCA or VCA1 in kV/10; V6 or VCY in secondary V/100; or ICAY or ICA2 in amps

Relative Address	Description
56	3V2, V2 as 3V2, or V2_1 as 3V2_1 in kV/10; VPB in secondary V/100; or 3I2Y or I2_2 as 3I2_2 in amps
57	IAB or IAB1 in amps
58	IBC or IBC1 in amps
59	ICA or ICA1 in amps

Demand Meter Data

The demand meter data is only available if 20DEMAND collection is occurring with the attached relay.

Table 4.9: Relay Demand Meter Data Holding Register Map

Relative Address	Description
60	Demand IA, IAX, or IAW1 in amps
61	Demand IB, IBX, or IBW1 in amps
62	Demand IC, ICX, or ICW1 in amps
63	Demand IR, IRX, or IRW1 in amps
64	Whole part of demand P in MW; or demand IAY or IAW2 in amps
65	Fractional part of demand P in MW/10000; or demand IBY or IBW2 in amps
66	Whole part of demand Q in MVAR; or demand ICY or ICW2 in amps
67	Fractional part of demand Q in MVAR/10000; or demand IRY or IRW2 in amps
68	Demand 3I2, 3I2X, or 3I2W1 in amps
69	Demand 3I2Y or 3I2W2 in amps
70	Peak IA in amps
71	Peak IB in amps
72	Peak IC in amps
73	Peak IR in amps
74	Peak P, whole part in MW
75	Peak P, fractional part in MW/10000
76	Peak Q, whole part in MVAR

Relative Address	Description
77	Peak Q, fractional part in MVAR/10000
78	Peak 3I2 in amps
79	Reserved - always returns 8000h

Date/Time Stamp

The extracted date/time stamp is the time when the last meter data acquisition occurred. 20METER data collection must be occurring with the attached relay for this data to be available.

Table 4.10: Date/Time Stamp Holding Register Map

Relative Address	Description
80	Month of last meter data acquisition (1 - 12)
81	Day of last meter data acquisition (1 - 31)
82	Year of last meter data acquisition (1900 - 2100)
83	Hour of last meter data acquisition
84	Minute of last meter data acquisition
85	Second of last meter data acquisition

Relay Word Data

The relay word data is directly copied from the results of the 20TARGET acquisition. To confirm exactly what data is being reported, use the **VIEW *n* TARGET BL** command on the port of interest. The reported data will start at the beginning of the actual data (after the date/time stamp) and the data will be packed two data bytes per register, MSB first.

Table 4.11: Relay Word Data Holding Register Map

Relative Address	Description
160	First two bytes of target data, organized MSB first
161	Second two bytes of target data, organized MSB first
.	.
.	.
.	.

Relative Address	Description
160+(*n*/2)	Last row or two of target data; if there is an odd number of bytes of data, the MSB will contain the last item; if there is an even number, the LSB will contain the last item
161+(*n*/2)-209	Reserved - always returns 8000h

Event Data

The event data is extracted from the first history record. 20HISTORY collection must be occurring with the relay for this data to be available.

Table 4.12: Relay Event Data Holding Register Map

Relative Address	Description
210	Month of last event
211	Day of last event
212	Year of last event
213	Hour of last event
214	Minute of last event
215	Second of last event
216	Millisecond of last event
217	52 A time in cyc/100
218	IV-Time in cyc/100
219	Energy in MJ/10
220	Event type - see ***Event Type*** subsection below
221	Shot
222	Fault location - whole part
223	Fault location - fractional part multiplied by 10000
224	Targets - see ***Target Type*** subsection below
225 - 233	Unused - always 8000h
234	Fault current - whole part in amps
235	Fault current - fractional part in amps/10000
236	Duration - whole part in seconds; for 50 Hz relays, must multiply this value by 6/5 to get seconds

Relative Address	Description
237	Duration - fractional part in seconds/10000
238 - 239	Unused - always 8000h

History Data

Table 4.13 shows the breakdown of history records in the holding register map. For this data to be available, 20HISTORY collection must be occurring with the connected relay. If there is not a full set of 12 records, the unused records will report with 8000h data values.

Table 4.13: Relay History Data Holding Register Map

Relative Address	Description
260 - 279	History Record 1 data - see Table 4.14 for detailed breakdown
280 - 299	History Record 2 data - see Table 4.14 for detailed breakdown
300 - 319	History Record 3 data - see Table 4.14 for detailed breakdown
320 - 339	History Record 4 data - see Table 4.14 for detailed breakdown
340 - 359	History Record 5 data - see Table 4.14 for detailed breakdown
360 - 379	History Record 6 data - see Table 4.14 for detailed breakdown
380 - 399	History Record 7 data - see Table 4.14 for detailed breakdown
400 - 419	History Record 8 data - see Table 4.14 for detailed breakdown
420 - 439	History Record 9 data - see Table 4.14 for detailed breakdown
440 - 459	History Record 10 data - see Table 4.14 for detailed breakdown
460 - 479	History Record 11 data - see Table 4.14 for detailed breakdown
480 - 499	History Record 12 data - see Table 4.14 for detailed breakdown

Table 4.14: Relay History Record Holding Register Map

Relative Address	Description
0	Month
1	Day
2	Year
3	Hour
4	Minute
5	Second
6	Millisecond
7	Event - see ***Event Type*** subsection below
8	Distance/location - whole part
9	Distance/location - fractional part multiplied by 10000
10	Shot
11	52 A in cycles/100
12	Group
13	Target - see ***Target Type*** subsection below
14	Duration - whole part in seconds; for 50 Hz relays, must multiply this value by 6/5 to get seconds
15	Duration - fractional part in seconds/10000
16	Fault current - whole part in amps
17	Fault current - fractional part in amps/10000
18	IV Time in cycles/100
19	Energy in MJ/10

Event Type

Event strings in the History region of the SEL-2030 can be many values. The following table lists the possibilities with corresponding encodings in alphabetical order.

Event	Code
!L	61
!M	65
?AB	7003
?ABC	7001
?ABCT	7101
?ABG	7002
?ABGT	7102
?ABT	7103
?AG	7004
?AGT	7104
?BC	7006
?BCG	7005
?BCGT	7105
?BCT	7106
?BG	7007
?BGT	7107
?CA	7009
?CAG	7008
?CAGT	7108
?CAT	7109
?CG	7010
?CGT	7110
1AB	1003
1ABC	1001
1ABCT	1101
1ABG	1002
1ABGT	1102

Event	Code
1ABT	1103
1AG	1004
1AGT	1104
1BC	1006
1BCG	1005
1BCGT	1105
1BCT	1106
1BG	1007
1BGT	1107
1CA	1009
1CAG	1008
1CAGT	1108
1CAT	1109
1CG	1010
1CGT	1110
1OUT	88
1OUT X	9035
1OUT Y	9036
25T1	34
25T2	35
27B	30
27L	31
2AB	2003
2ABC	2001
2ABCT	2101
2ABG	2002
2ABGT	2102

Event	Code
2ABT	2103
2AG	2004
2AGT	2104
2BC	2006
2BCG	2005
2BCGT	2105
2BCT	2106
2BG	2007
2BGT	2107
2CA	2009
2CAG	2008
2CAGT	2108
2CAT	2109
2CG	2010
2CGT	2110
2OUT	89
2OUT X	9037
2OUT Y	9038
3AB	3003
3ABC	3001
3ABCT	3101
3ABG	3002
3ABGT	3102
3ABT	3103
3AG	3004
3AGT	3104
3BC	3006

Event	Code
3BCG	3005
3BCGT	3105
3BCT	3106
3BG	3007
3BGT	3107
3CA	3009
3CAG	3008
3CAGT	3108
3CAT	3109
3CG	3010
3CGT	3110
3PC1	40
3PC2	41
3PRI	51
4AB	4003
4ABC	4001
4ABCT	4101
4ABG	4002
4ABGT	4102
4ABT	4103
4AG	4004
4AGT	4104
4BC	4006
4BCG	4005
4BCGT	4105
4BCT	4106
4BG	4007
4BGT	4107
4CA	4009
4CAG	4008
4CAGT	4108

Event	Code
4CAT	4109
4CG	4010
4CGT	4110
52A1	46
52A2	47
52BT1	48
52BT2	49
59B	32
59L	33
5AB	5003
5ABC	5001
5ABCT	5101
5ABG	5002
5ABGT	5102
5ABT	5103
5AG	5004
5AGT	5104
5BC	5006
5BCG	5005
5BCGT	5105
5BCT	5106
5BG	5007
5BGT	5107
5CA	5009
5CAG	5008
5CAGT	5108
5CAT	5109
5CG	5010
5CGT	5110
6AB	8003
6ABC	8001

Event	Code
6ABCT	8101
6ABG	8002
6ABGT	8102
6ABT	8103
6AG	8004
6AGT	8104
6BC	8006
6BCG	8005
6BCGT	8105
6BCT	8106
6BG	8007
6BGT	8107
6CA	8009
6CAG	8008
6CAGT	8108
6CAT	8109
6CG	8010
6CGT	8110
79OIT	50
79RST	52
79SH	53
86BFT	20
86TR	85
86TR X	9027
86TR Y	9028
A	55
AB	3
ABC	1
ABCT	101
ABG	2
ABGT	102

Event	Code
ABT	103
AG	4
AGT	104
B	56
BC	6
BCG	5
BCGT	105
BCT	106
BFI	83
BFI X	9023
BFI Y	9024
BG	7
BGT	107
C	57
CA	9
CAG	8
CAGT	108
CAT	109
CG	10
CGT	110
CLOSE	28
CLOSE X	9007
CLOSE Y	9008
CLS1	36
CLS2	37
CYCL	43
D	58
DT	11
E	59
ER	12
ER1	90

Event	Code
ER2	91
ET	13
ET1	71
ET2	72
EXT	18
EXT X	9029
EXT Y	9030
EXTC	17
FAULT	75
FAULT X	9003
FAULT Y	9004
G	62
H	63
HAB	6003
HABC	6001
HABCT	6101
HABG	6002
HABGT	6102
HABT	6103
HAG	6004
HAGT	6104
HBC	6006
HBCG	6005
HBCGT	6105
HBCT	6106
HBG	6007
HBGT	6107
HCA	6009
HCAG	6008
HCAGT	6108
HCAT	6109

Event	Code
HCG	6010
HCGT	6110
I	64
INT	29
LJAM	81
LJAM X	9019
LJAM Y	9020
LLOSS	82
LLOSS X	9021
LLOSS Y	9022
LOCK	44
LTCH	54
MER	70
OPEN	14
OPEN X	9005
OPEN Y	9006
OTT	45
PULSE	92
RETRIP	84
RETRIP X	9025
RETRIP Y	9026
RSET	42
RUN	76
RUN X	9009
RUN Y	9010
SPC1	38
SPC2	39
SPRI	74
ST	60
START	77
START X	9011

Event	Code
START Y	9012
STL	80
STL X	9017
STL Y	9018
STOP	78
STOP X	9013
STOP Y	9014
THERM	79
THERM X	9015
THERM Y	9016
TIMER1	86
TIMER1 X	9031
TIMER1 Y	9032
TIMER2	87

Event	Code
TIMER2 X	9033
TIMER2 Y	9034
TR	16
TRI	73
TRIG	15
TRIG X	9001
TRIG Y	9002
TRIP	19
TRIP1	96
TRIP2	97
TRIP3	27
TRIP4	98
TRIPA	21
TRIPAB	24

Event	Code
TRIPB	22
TRIPBC	25
TRIPC	23
TRIPCA	26
TRP1	93
TRP2	94
TRP3	95
W	66
X	67
Y	68
ZT	69
other	9999

Target Type

Certain relays record the front-panel target status at the time of each event. Relays of this type save the event target information as a separate field of every event record. The SEL-2711 includes these event targets as a part of Relay Data Holding Register Event and History records. The table below illustrates the possible event targets and bit associations. The relay type dictates the available targets and therefore each bit meaning. Use the table to locate your relay front panel targets and determine the resulting bit associations.

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
INST	TIME	COMM	SOTF	ZONE1	ZONE2	ZONE3	ZONE4
	X	Y					CY*

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
EN	A	B	C	G	Q	50	51
CLOS	LO#	CY#	RS#	N	RC1	RS#	LO*
PH1	G1	87B	87C	RC2	87	52A2	ALARM
P1	87A	PH2	G2	X59T	Y59T	X59I	52A1
		P2		PH3	G3	BKR	Y59I
				P3	81	51P	ALRM
							51N

SEL-279H only
* all relays except SEL-279H

Example Relay Maps

The following tables show how the above maps work for a few SEL relays. Maps for any other relay can easily be determined by mapping the meter, demand meter, and history data within the SEL-2030 to determine the available data and then matching it against the above tables.

SEL-251-3

SEL-251-3 using binary *Fast Meter* data acquisition.

Relative Address	Description	Units	Range
0	Relay Type - 25103		0-65535
1-39	Reserved - always 8000h		
40	Phase A current (IA)	amps, primary	0-32767 A
41	Phase B current (IB)	amps, primary	0-32767 A
42	Phase C current (IC)	amps, primary	0-32767 A
43	Zero-sequence current (IO)	amps, primary	0-32767 A
44	Power, whole part (P)	MW, primary	-32767-32767 MW
45	Power, fractional part (P)	MW/10000, primary	-0.9999-0.9999 MW
46	Reactive power, whole part (Q)	MVAR, primary	-32767-32767 MVAR
47	Reactive power, fractional part (Q)	MVAR/10000, primary	-0.9999-0.9999 MVAR
48	Negative-sequence current (3I2)	amps, primary	0-32767 A
49	Phase A voltage (VA)	kV/10, primary	0.0-3276.7 kV
50	Phase B voltage (VB)	kV/10, primary	0.0-3276.7 kV
51	Phase C voltage (VC)	kV/10, primary	0.0-3276.7 kV
52	Zero-sequence voltage (3V0)	kV/10, primary	0.0-3276.7 kV
53	AB differential voltage (VAB)	kV/10, primary	0.0-3276.7 kV
54	BC differential voltage (VBC)	kV/10, primary	0.0-3276.7 kV
55	CA differential voltage (VCA)	kV/10, primary	0.0-3276.7 kV
56	Negative-sequence voltage (3V2)	kV/10, primary	0.0-3276.7 kV
57	AB difference current (IAB)	amps, primary	0-32767 A
58	BC difference current (IBC)	amps, primary	0-32767 A
59	CA difference current (ICA)	amps, primary	0-32767 A
60	Phase A demand current (IA)	amps, primary	0-32767 A
61	Phase B demand current (IB)	amps, primary	0-32767 A
62	Phase C demand current (IC)	amps, primary	0-32767 A
63	Residual demand current (IR)	amps, primary	0-32767 A
64	Power demand, whole part (P)	MW, primary	-32767-32767 MW
65	Power demand, fractional part (P)	MW/10000, primary	-0.9999-0.9999 MW
66	Reactive power demand, whole part (Q)	MVAR, primary	-32767-32767 MVAR
67	Reactive power demand, fractional part (Q)	MVAR/10000, primary	-0.9999-0.9999 MVAR
68	Negative-sequence demand current (3I2)	amps, primary	0-32767 A

Relative Address	Description	Units	Range
69	Unused, always 8000h		
70	Phase A peak demand current (IA)	amps, primary	0-32767 A
71	Phase B peak demand current (IB)	amps, primary	0-32767 A
72	Phase C peak demand current (IC)	amps, primary	0-32767 A
73	Residual peak demand current (IR)	amps, primary	0-32767 A
74	Power peak demand, whole part (P)	MW, primary	-32767-32767 MW
75	Power peak demand, fractional part (P)	MW/10000, primary	-0.9999-0.9999 MW
76	Reactive power peak demand, whole part (Q)	MVAR, primary	-32767-32767 MVAR
77	Reactive power peak demand, fractional part (Q)	MVAR/10000, primary	-0.9999-0.9999 MVAR
78	Negative-sequence peak demand current (3I2)	amps, primary	0-32767 A
79	Unused, always 8000h		
80	Month of last meter data acquisition	months	1-12
81	Day of last meter data acquisition	days	1-31
82	Year of last meter data acquisition	years	1900-2100
83	Hour of last meter data acquisition	hours	0-23
84	Minute of last meter data acquisition	minutes	0-59
85	Second of last meter data acquisition	seconds	0-59
86-159	Reserved - always 8000h		
160	Relay word rows 0 and 1		
161	Relay word rows 2 and 3		
162	Relay word rows 4 and 5		
163	Relay word rows 6 and 7		
164	Relay word row 8 with LSB always 0		
165-209	Reserved - always 8000h		
210	Month of most recent event	months	1-12
211	Day of month of most recent event	days	1-31
212	Year of most recent event	years	1900-2100
213	Hour of most recent event	hours	0-23
214	Minute of most recent event	minutes	0-59
215	Second of most recent event	seconds	0-59
216	Millisecond of most recent event	milliseconds	0-999
217-219	Unused - always 8000h		
220	Event type	TBD	TBD
221	Shot		
222	Fault location, whole part		-32767-32767
223	Fault location, fractional part		-0.9999-0.9999
224	Fault targets of most recent fault	TBD	
225-233	Unused - always 8000h		
234	Fault current of most recent fault	amps, primary	0-32767 A
235	Fault current of most recent fault, fractional part, always 0	amps, primary	0
236-239	Unused - always 8000h		
240-259	Reserved - always 8000h		
260	1st event month	months	1-12
261	1st event day of month	days	1-31
262	1st event year	years	1900-2100
263	1st event hour	hours	0-23
264	1st event minute	minutes	0-59
265	1st event second	seconds	0-59
266	1st event millisecond	milliseconds	0-999
267	1st event type	TBD	
268	1st event fault location, whole part		-32767-32767
269	1st event fault location, fractional part		-0.9999-0.9999
270-271	Unused - always 8000h		
272	1st event group number		1-6
273	1st event targets	TBD	
274-275	Unused - always 8000h		
276	1st event fault current, whole part	amps, primary	0-32767 A
277	1st event fault current, fractional part, always 0	amps, primary	0
278-279	Unused - always 8000h		
280	2nd event month	months	1-12
.	.	.	.
.	.	.	.
.	.	.	.
497	12th event fault current, fractional part, always 0	amps, primary	0
498-499	Unused - always 8000h		

SEL-287V

Relative Address	Description	Units	Range
0	Relay Type - 18790		0-65535
1-39	Reserved - always 8000h		
40	Phase A differential voltage (dVA)	volts/100, secondary	0.00-327.67 V
41	Phase B differential voltage (dVB)	volts/100, secondary	0.00-327.67 V
42	Phase C differential voltage (dVC)	volts/100, secondary	0.00-327.67 V
43-48	Unused - always 8000h		
49	Phase A voltage, X side (VAX)	V/100, secondary	0.00-327.67 V
50	Phase B voltage, X side (VBX)	V/100, secondary	0.00-327.67 V
51	Phase C voltage, X side (VCX)	V/100, secondary	0.00-327.67 V
52	Unused - always 8000h		
53	Phase A voltage, Y side (VAY)	V/100, secondary	0.00-327.67 V
54	Phase B voltage, Y side (VBY)	V/100, secondary	0.00-327.67 V
55	Phase C voltage, Y side (VCY)	V/100, secondary	0.00-327.67 V
56-79	Unused - always 8000h		
80	Month of last meter data acquisition	months	1-12
81	Day of last meter data acquisition	days	1-31
82	Year of last meter data acquisition	years	1900-2100
83	Hour of last meter data acquisition	hours	0-23
84	Minute of last meter data acquisition	minutes	0-59
85	Second of last meter data acquisition	seconds	0-59
86-159	Reserved - always 8000h		
160	Relay word rows 0 and 1		
161	Relay word rows 2 and 3		
162	Relay word rows 4 and 5		
163	Relay word rows 6 and 7		
164	Relay word row 8 with LSB always 0		
165-209	Reserved - always 8000h		
210	Month of most recent event	months	1-12
211	Day of month of most recent event	days	1-31
212	Year of most recent event	years	1900-2100
213	Hour of most recent event	hours	0-23
214	Minute of most recent event	minutes	0-59
215	Second of most recent event	seconds	0-59
216	Millisecond of most recent event	milliseconds	0-999
217-219	Unused - always 8000h		
220	Event type	TBD	TBD
221-223	Unused - always 8000h		
224	Fault targets of most recent fault	TBD	
225-239	Unused - always 8000h		
240-259	Reserved - always 8000h		
260	1st event month	months	1-12
261	1st event day of month	days	1-31
262	1st event year	years	1900-2100
263	1st event hour	hours	0-23
264	1st event minute	minutes	0-59
265	1st event second	seconds	0-59
266	1st event millisecond	milliseconds	0-999
267	1st event type	TBD	
268-272	Unused - always 8000h		
273	1st event targets	TBD	
274-279	Unused - always 8000h		
280	2nd event month	months	1-12
.	.	.	.
.	.	.	.
.	.	.	.
493	12th event targets	TBD	
494-499	Unused - always 8000h		

SEL-321-1 (Model 32111)

Relative Address	Description	Units	Range
0	Relay Type - 32101		0-65535
1-39	Reserved - always 8000h		
40	Phase A current (IA)	amps, primary	0-32767 A
41	Phase B current (IB)	amps, primary	0-32767 A
42	Phase C current (IC)	amps, primary	0-32767 A
43	Zero-sequence current (IO)	amps, primary	0-32767 A
44	Power, whole part (P)	MW, primary	-32767-32767 MW
45	Power, fractional part (P)	MW/10000, primary	-0.9999-0.9999 MW
46	Reactive power, whole part (Q)	MVAR, primary	-32767-32767 MVAR
47	Reactive power, fractional part (Q)	MVAR/10000, primary	-0.9999-0.9999 MVAR
48	Negative-sequence current (3I2)	amps, primary	0-32767 A
49	Phase A voltage (VA)	kV/10, primary	0.0-3276.7 kV
50	Phase B voltage (VB)	kV/10, primary	0.0-3276.7 kV
51	Phase C voltage (VC)	kV/10, primary	0.0-3276.7 kV
52	Zero-sequence voltage (3V0)	kV/10, primary	0.0-3276.7 kV
53	AB differential voltage (VAB)	kV/10, primary	0.0-3276.7 kV
54	BC differential voltage (VBC)	kV/10, primary	0.0-3276.7 kV
55	CA differential voltage (VCA)	kV/10, primary	0.0-3276.7 kV
56	Negative-sequence voltage (3V2)	kV/10, primary	0.0-3276.7 kV
57	AB difference current (IAB)	amps, primary	0-32767 A
58	BC difference current (IBC)	amps, primary	0-32767 A
59	CA difference current (ICA)	amps, primary	0-32767 A
60	Phase A demand current (IA)	amps, primary	0-32767 A
61	Phase B demand current (IB)	amps, primary	0-32767 A
62	Phase C demand current (IC)	amps, primary	0-32767 A
63	Residual demand current (IR)	amps, primary	0-32767 A
64	Power demand, whole part (P)	MW, primary	-32767-32767 MW
65	Power demand, fractional part (P)	MW/10000, primary	-0.9999-0.9999 MW
66	Reactive power demand, whole part (Q)	MVAR, primary	-32767-32767 MVAR
67	Reactive power demand, fractional part (Q)	MVAR/10000, primary	-0.9999-0.9999 MVAR
68	Negative-sequence demand current (3I2)	amps, primary	0-32767 A
69-89	Unused, always 8000h		
90-159	Reserved - always 8000h		
160	Status byte and Relay word row 0		
161	Relay word rows 1 and 2		
.	.		
.	.		
.	.		
172	Last row of output status and input status		
173-209	Reserved - always 8000h		
210	Month of most recent event	months	1-12
211	Day of month of most recent event	days	1-31
212	Year of most recent event	years	1900-2100
213	Hour of most recent event	hours	0-23
214	Minute of most recent event	minutes	0-59
215	Second of most recent event	seconds	0-59
216	Millisecond of most recent event	milliseconds	0-999
217-219	Unused - always 8000h		
220	Event type	TBD	TBD
221	Unused - always 8000h		
222	Fault location, whole part		-32767-32767
223	Fault location, fractional part		-0.9999-0.9999
224	Fault targets of most recent fault	TBD	
225-239	Unused - always 8000h		
240-259	Reserved - always 8000h		
260	1st event month	months	1-12
261	1st event day of month	days	1-31
262	1st event year	years	1900-2100
263	1st event hour	hours	0-23
264	1st event minute	minutes	0-59
265	1st event second	seconds	0-59
266	1st event millisecond	milliseconds	0-999
267	1st event type	TBD	
268	1st event fault location, whole part		-32767-32767
269	1st event fault location, fractional part		-0.9999-0.9999
270-271	Unused - always 8000h		

Relative Address	Description	Units	Range
272	1st event group number		1-6
273	1st event targets	TBD	
274-279	Unused - always 8000h		
280	2nd event month	months	1-12
.	.	.	.
.	.	.	.
.	.	.	.
493	12th event targets	TBD	
494-499	Unused - always 8000h		

SEL-351

Relative Address	Description	Units	Range
0	Relay Type - 3510O		0-65535
1-39	Reserved - always 8000h		
40	Phase A current (IA)	amps, primary	0-32767 A
41	Phase B current (IB)	amps, primary	0-32767 A
42	Phase C current (IC)	amps, primary	0-32767 A
43	Zero-sequence current (IO)	amps, primary	0-32767 A
44	Power, whole part (P)	MW, primary	-32767-32767 MW
45	Power, fractional part (P)	MW/10000, primary	-0.9999-0.9999 MW
46	Reactive power, whole part (Q)	MVAR, primary	-32767-32767 MVAR
47	Reactive power, fractional part (Q)	MVAR/10000, primary	-0.9999-0.9999 MVAR
48	Negative-sequence current (3I2)	amps, primary	0-32767 A
49	Phase A voltage (VA)	kV/10, primary	0.0-3276.7 kV
50	Phase B voltage (VB)	kV/10, primary	0.0-3276.7 kV
51	Phase C voltage (VC)	kV/10, primary	0.0-3276.7 kV
52	Zero-sequence voltage (3V0)	kV/10, primary	0.0-3276.7 kV
53	AB differential voltage (VAB)	kV/10, primary	0.0-3276.7 kV
54	BC differential voltage (VBC)	kV/10, primary	0.0-3276.7 kV
55	CA differential voltage (VCA)	kV/10, primary	0.0-3276.7 kV
56	Negative-sequence voltage (3V2)	kV/10, primary	0.0-3276.7 kV
57	AB difference current (IAB)	amps, primary	0-32767 A
58	BC difference current (IBC)	amps, primary	0-32767 A
59	CA difference current (ICA)	amps, primary	0-32767 A
60	Phase A demand current (IA)	amps, primary	0-32767 A
61	Phase B demand current (IB)	amps, primary	0-32767 A
62	Phase C demand current (IC)	amps, primary	0-32767 A
63-67	Unused - always 8000h		
68	Negative-sequence demand current (3I2)	amps, primary	0-32767 A
69-79	Unused, always 8000h		
80	Month of last meter data acquisition	months	1-12
81	Day of last meter data acquisition	days	1-31
82	Year of last meter data acquisition	years	1900-2100
83	Hour of last meter data acquisition	hours	0-23
84	Minute of last meter data acquisition	minutes	0-59
85	Second of last meter data acquisition	seconds	0-59
86-159	Reserved - always 8000h		
160	Status byte and relay word row 0		
161	Relay word rows 1 and 2		
.	.		
.	.		
.	.		
183	Relay word rows 45 and 46		
184-209	Reserved - always 8000h		
210	Month of most recent event	months	1-12
211	Day of month of most recent event	days	1-31
212	Year of most recent event	years	1900-2100
213	Hour of most recent event	hours	0-23
214	Minute of most recent event	minutes	0-59
215	Second of most recent event	seconds	0-59
216	Millisecond of most recent event	milliseconds	0-999
217-219	Unused - always 8000h		
220	Event type	TBD	TBD
221	Shot		

Relative Address	Description	Units	Range
222	Fault location, whole part		-32767-32767
223	Fault location, fractional part		-0.9999-0.9999
224	Fault targets of most recent fault	TBD	
225-229	Unused - always 8000h		
230	Fault frequency, whole part	Hz	30-100 Hz
231	Fault frequency, fractional part	Hz/10000	0.0000-0.9999 Hz
232-233	Unused - always 8000h		
234	Fault current of most recent fault	amps, primary	0-32767 A
235	Fault current of most recent fault, fractional part, always 0	amps, primary	0
236-239	Unused - always 8000h		
240-259	Reserved - always 8000h		
260	1st event month	months	1-12
261	1st event day of month	days	1-31
262	1st event year	years	1900-2100
263	1st event hour	hours	0-23
264	1st event minute	minutes	0-59
265	1st event second	seconds	0-59
266	1st event millisecond	milliseconds	0-999
267	1st event type	TBD	
268	1st event fault location, whole part		-32767-32767
269	1st event fault location, fractional part		-0.9999-0.9999
270-271	Unused - always 8000h		
272	1st event group number		1-6
273	1st event targets	TBD	
274-275	Unused - always 8000h		
276	1st event fault current, whole part	amps, primary	0-32767 A
277	1st event fault current, fractional part, always 0	amps, primary	0
278-279	Unused - always 8000h		
280	2nd event month	months	1-12
.	.	.	.
.	.	.	.
.	.	.	.
497	12th event fault current, fractional part, always 0	amps, primary	0
498-499	Unused - always 8000h		

SEL-501

SEL-501 using binary *Fast Meter* data acquisition.

Relative Address	Description	Units	Range
0	Relay Type - 50100		0-65535
1-39	Reserved - always 8000h		
40	Phase A, X side current (IAX)	amps, primary	0-32767 A
41	Phase B, X side current (IBX)	amps, primary	0-32767 A
42	Phase C, X side current (ICX)	amps, primary	0-32767 A
43	Zero-sequence, X side current (IOX)	amps, primary	0-32767 A
44-47	Unused - always 8000h		
48	Negative-sequence, X side current (3I2X)	amps, primary	0-32767 A
49	Phase A, Y side current (IAY)	amps, primary	0-32767 A
50	Phase B, Y side current (IBY)	amps, primary	0-32767 A
51	Phase C, Y side current (ICY)	amps, primary	0-32767 A
52	Zero-sequence, Y side current (IOY)	amps, primary	0-32767 A
53	AB, Y side difference current (IABY)	amps, primary	0-32767 A
54	BC, Y side difference current (IBCY)	amps, primary	0-32767 A
55	CA, Y side difference current (ICAY)	amps, primary	0-32767 A
56	Negative-sequence, Y side current (3I2Y)	amps, primary	0-32767 A
57	AB, X side difference current (IABX)	amps, primary	0-32767 A
58	BC, X side difference current (IBCX)	amps, primary	0-32767 A
59	CA, X side difference current (ICAX)	amps, primary	0-32767 A
60	Phase A, X side demand current (IAX)	amps, primary	0-32767 A
61	Phase B, X side demand current (IBX)	amps, primary	0-32767 A
62	Phase C, X side demand current (ICX)	amps, primary	0-32767 A

Relative Address	Description	Units	Range
63	Residual, X side demand current (IRX)	amps, primary	0-32767 A
64	Phase A, Y side demand current (IAY)	amps, primary	0-32767 A
65	Phase B, Y side demand current (IBY)	amps, primary	0-32767 A
66	Phase C, Y side demand current (ICY)	amps, primary	0-32767 A
67	Residual, Y side demand current (IRY)	amps, primary	0-32767 A
68	Negative-sequence, X side demand current (3I2X)	amps, primary	0-32767 A
69	Negative-sequence, X side demand current (3I2X)	amps, primary	0-32767 A
70-79	Unused, always 8000h		
80	Month of last meter data acquisition	months	1-12
81	Day of last meter data acquisition	days	1-31
82	Year of last meter data acquisition	years	1900-2100
83	Hour of last meter data acquisition	hours	0-23
84	Minute of last meter data acquisition	minutes	0-59
85	Second of last meter data acquisition	seconds	0-59
86-159	Reserved - always 8000h		
160	Status register and X Relay word row 0		
161	X Relay word rows 1 and 2		
162	X Relay word row 3 and Y Relay word row 0		
163	Y Relay word rows 1 and 2		
164	Y Relay word row 3 and I/O status register		
165-209	Reserved - always 8000h		
210	Month of most recent event	months	1-12
211	Day of month of most recent event	days	1-31
212	Year of most recent event	years	1900-2100
213	Hour of most recent event	hours	0-23
214	Minute of most recent event	minutes	0-59
215	Second of most recent event	seconds	0-59
216	Millisecond of most recent event	milliseconds	0-999
217-219	Unused - always 8000h		
220	Event type	TBD	TBD
221-223	Unused - always 8000h		
224	Fault targets of most recent fault	TBD	
225-239	Unused - always 8000h		
240-259	Reserved - always 8000h		
260	1st event month	months	1-12
261	1st event day of month	days	1-31
262	1st event year	years	1900-2100
263	1st event hour	hours	0-23
264	1st event minute	minutes	0-59
265	1st event second	seconds	0-59
266	1st event millisecond	milliseconds	0-999
267	1st event type	TBD	
268-272	Unused - always 8000h		
273	1st event targets	TBD	
274-279	Unused - always 8000h		
280	2nd event month	months	1-12
.	.	.	.
.	.	.	.
.	.	.	.
493	12th event targets		
494-499	Unused - always 8000h		

SEL-BFR

Relative Address	Description	Units	Range
0	Relay Type - 7		0-65535
1-39	Reserved - always 8000h		
40	Phase A current (IA)	amps, primary	0-32767 A
41	Phase B current (IB)	amps, primary	0-32767 A
42	Phase C current (IC)	amps, primary	0-32767 A
43	Unused - always 8000h		
44	Power, whole part (P)	MW, primary	-32767-32767 MW
45	Power, fractional part (P)	MW/10000, primary	-0.9999-0.9999 MW
46	Reactive power, whole part (Q)	MVAR, primary	-32767-32767 MVAR
47	Reactive power, fractional part (Q)	MVAR/10000, primary	-0.9999-0.9999 MVAR

Relative Address	Description	Units	Range
48	Unused - always 8000h		
49	Phase A voltage (VA)	kV/10, primary	0.0-3276.7 kV
50	Phase B voltage (VB)	kV/10, primary	0.0-3276.7 kV
51	Phase C voltage (VC)	kV/10, primary	0.0-3276.7 kV
52	Unused - always 8000h		
53	AB difference voltage (VAB)	kV/10, primary	0.0-3276.7 kV
54	BC difference voltage (VBC)	kV/10, primary	0.0-3276.7 kV
55	CA difference voltage (VCA)	kV/10, primary	0.0-3276.7 kV
56	Unused - always 8000h		
57	AB difference current (IAB)	amps, primary	0-32767 A
58	BC difference current (IBC)	amps, primary	0-32767 A
59	CA difference current (ICA)	amps, primary	0-32767 A
60-79	Unused, always 8000h		
80	Month of last meter data acquisition	months	1-12
81	Day of last meter data acquisition	days	1-31
82	Year of last meter data acquisition	years	1900-2100
83	Hour of last meter data acquisition	hours	0-23
84	Minute of last meter data acquisition	minutes	0-59
85	Second of last meter data acquisition	seconds	0-59
86-159	Reserved - always 8000h		
160	Relay word rows 0 and 1		
161	Relay word rows 2 and 3		
162	Relay word rows 4 and 5		
163	Relay word rows 6 and 7		
164-209	Reserved - always 8000h		
210	Month of most recent event	months	1-12
211	Day of month of most recent event	days	1-31
212	Year of most recent event	years	1900-2100
213	Hour of most recent event	hours	0-23
214	Minute of most recent event	minutes	0-59
215	Second of most recent event	seconds	0-59
216	Millisecond of most recent event	milliseconds	0-999
217	52A time	cyc/100	0.00-327.67 cyc
218	IV time	cyc/100	0.00-327.67 cyc
219	Energy	MJ/10	0.0-3276.7 MJ
220	Event type	TBD	TBD
221-239	Unused - always 8000h		
240-259	Reserved - always 8000h		
260	1st event month	months	1-12
261	1st event day of month	days	1-31
262	1st event year	years	1900-2100
263	1st event hour	hours	0-23
264	1st event minute	minutes	0-59
265	1st event second	seconds	0-59
266	1st event millisecond	milliseconds	0-999
267	1st event type	TBD	
268-270	Unused - always 8000h		
271	1st event 52A time	cyc/100	0.00-327.67 cyc
272-277	Unused - always 8000h		
278	1st event IV time	cyc/100	0.00-327.67 cyc
279	1st event Energy	MJ/10	0.0-3276.7 MJ
280	2nd event month	months	1-12
.	.	.	.
.	.	.	.
.	.	.	.
499	12th event energy	MJ/10	0.0-3276.7 MJ

OUTGOING GLOBAL DATA

The SEL-2030 can place user-configurable data on the network as Modbus Plus Global Data. The SEL-2711 treats the first 32 registers of its port's User Region as the global data. This data can be configured using the SET M command within the SEL-2030. (See the ***SEL-2030 User's Guide*** and ***SEL-2020/2030 Reference Manual*** for more information on using SET M to configure a User Region.) The SEL-2711 checks this data every ½ second, which corresponds to the SET M update interval, and sets updated global data onto the network if any of the values have changed. Use this global data to share frequently accessed data or for expanded control capability.

INCOMING GLOBAL DATA

The SEL-2711 places global data received from other nodes on the network in the D1 Region of the local port (Port 17 or 18) database. This data can then be used within the SEL-2030 by SET M Equations or by SELOGIC Control Equations. Portions of the D1 region that correspond to non-existent nodes or to non-existent portions of global data of existing nodes will contain the value 8000h (-32768).

However, if a node is removed from the network, the last data that it reported will remain in the D1 region of the SEL-2030. The non-data code 8000h is written only on initial configuration of the D1 region. Once global data is written to this region, it will remain until it is over-written by new data. The incoming global data from all nodes is written to the D1 region of the host SEL-2030 every ½ second. If global data from another node changes several times between updates, only the latest reported value will be stored in SEL-2030 database. The following table illustrates how the data is organized within the D1 region.

Table 4.15: D1 Region Map

Database Address	Corresponding Network Node
2000h	1
2020h	2
2040h	3
2060h	4
2080h	5
20A0h	6
20C0h	7
20E0h	8
2100h	9
2120h	10
2140h	11
2160h	12
2180h	13
21A0h	14
21C0h	15
21E0h	16
2200h	17
2220h	18
2240h	19
2260h	20
2280h	21
22A0h	22
22C0h	23
22E0h	24
2300h	25
2320h	26
2340h	27
2360h	28
2380h	29
23A0h	30
23C0h	31
23E0h	32

Database Address	Corresponding Network Node
2400h	33
2420h	34
2440h	35
2460h	36
2480h	37
24A0h	38
24C0h	39
24E0h	40
2500h	41
2520h	42
2540h	43
2560h	44
2580h	45
25A0h	46
25C0h	47
25E0h	48
2600h	49
2620h	40
2640h	51
2660h	52
2680h	53
26A0h	54
26C0h	55
26E0h	56
2700h	57
2720h	58
2740h	59
2760h	60
2780h	61
27A0h	62
27C0h	63
27E0h	64

Notice that each node is assigned 32 (20h) registers of the D1 data region. To find any specific register, determine where the data of the node of interest is at, using the above table, and then offset into this area according to which register of the node's global data you are interested in.

SEL-2030/2711 DATA MAP SUMMARY

Coil Map

Coil Offset Address	Corresponding Bits
1 - 16	1:RB16 - 1:RB1
17 - 32	2:RB16 - 2:RB1
33 - 48	3:RB16 - 3:RB1
49 - 64	4:RB16 - 4:RB1
65 - 80	5:RB16 - 5:RB1
81 - 96	6:RB16 - 6:RB1
97 - 112	7:RB16 - 7:RB1
113 - 128	8:RB16 - 8:RB1
129 - 144	9:RB16 - 9:RB1
145 - 160	10:RB16 - 10:RB1
161 - 176	11:RB16 - 11:RB1
177 - 192	12:RB16 - 12:RB1
193 - 208	13:RB16 - 13:RB1
209 - 224	14:RB16 - 14:RB1
225 - 240	15:RB16 - 15:RB1
241 - 256	16:RB16 - 16:RB1
257 - 272	17:RB16 - 17:RB1
273 - 288	18:RB16 - 18:RB1
289 - 304*	*n*:BR16 - *n*:BR1

* The last 16 coils can only be read, not operated.

Input Register Map
Holding Register Map if MAP_IR=Y

Input Register Offset Address	Corresponding Data
1 - 2048	Port 1 User Region
2049 - 4096	Port 2 User Region
4097 - 6144	Port 3 User Region
6145 - 8192	Port 4 User Region
8193 - 10,240	Port 5 User Region
10,241 - 12,288	Port 6 User Region
12,289 - 14,336	Port 7 User Region
14,337 - 16,384	Port 8 User Region
16,385 - 18,432	Port 9 User Region
18,433 - 20,480	Port 10 User Region
20,481 - 22,528	Port 11 User Region
22,529 - 24,576	Port 12 User Region
24,577 - 26,624	Port 13 User Region
26,625 - 28,672	Port 14 User Region
28,673 - 30,720	Port 15 User Region
30,721 - 32,768	Port 16 User Region
32,769 - 34,816	Port 17 User Region
34,817 - 36,864	Port 18 User Region

Add 300,000 to theses addresses to obtain a 3x input register reference. Add 400,000 to obtain a 4x holding register reference.

Holding Register Map if MAP_IR=N

Holding Register Offset Address	Description
1 - 499	Unused
500 - 999	Port 1 Relay Data*
1000 - 1499	Port 2 Relay Data*
1500 - 1999	Port 3 Relay Data*
2000 - 2499	Port 4 Relay Data*
2500 - 2999	Port 5 Relay Data*
3000 - 3499	Port 6 Relay Data*
3500 - 3999	Port 7 Relay Data*
4000 - 4499	Port 8 Relay Data*
4500 - 4999	Port 9 Relay Data*
5000 - 5499	Port 10 Relay Data*
5500 - 5999	Port 11 Relay Data*
6000 - 6499	Port 12 Relay Data*
6500 - 6999	Port 13 Relay Data*
7000 - 7499	Port 14 Relay Data*
7500 - 7999	Port 15 Relay Data*
8000 - 8499	Port 16 Relay Data*
8500 - 8999	Port 17 Relay Data*
9000 - 9499	Port 18 Relay Data*
9500 - 9999	Port *n* User Region first 500 registers

* See specific layout in following table

Holding Register Offset Address	Description
10,000	Unused
10,001 - 12,048	Port 1 User Region
12,049 - 14,096	Port 2 User Region
14,097 - 16,144	Port 3 User Region
16,145 - 18,192	Port 4 User Region
18,193 - 20,240	Port 5 User Region
20,241 - 22,288	Port 6 User Region
22,289 - 24,336	Port 7 User Region
24,337 - 26,384	Port 8 User Region
26,385 - 28,432	Port 9 User Region
28,433 - 30,480	Port 10 User Region
30,481 - 32,528	Port 11 User Region
32,529 - 34,576	Port 12 User Region
34,577 - 36,624	Port 13 User Region
36,625 - 38,672	Port 14 User Region
38,673 - 40,720	Port 15 User Region
40,721 - 42,768	Port 16 User Region
42,769 - 44,816	Port 17 User Region
44,817 - 46,864	Port 18 User Region

Add 400,000 to these address to obtain a 4x reference.

Relay Data Holding Register Map

	0	1	2	3	4	5	6	7	8	9
0	Relay Type	--	--	--	--	--	--	--	--	--
10-30	--	--	--	--	--	--	--	--	--	--
40[1]	IA	IB	IC	IR	P(whole)	P(frac)	Q(whole)	Q(part)	3I2	VA
50[1]	VB	VC	3V0	VAB	VBC	VCA	3V2	IAB	IBC	ICA
60[2]	Dem IA	Dem IB	Dem IC	Dem IR	Dem P	Dem P	Dem Q	Dem Q	Dem 3I2	Dem 3I2Y
70[3]	Peak IA	Peak IB	Peak IC	Peak IR	Peak P	Peak P	Peak Q	Peak Q	Peak 3I2	--
80[4]	Month	Day	Year	Hour	Minute	Second	--	--	--	--
90-150	--	--	--	--	--	--	--	--	--	--
160-200[5]	Target	Target	Target	Target	Target	Target	Target	Target	Target	Target
210[6]	Month	Day	Year	Hour	Minute	Second	Msec	52A	IVTime	Energy
220[6]	Event Type	Shot	Fault Loc	Fault Loc	Targets	--	--	--	--	--
230[6]	--	--	--	--	Flt Curr	Flt Curr	Duration	Duration	--	--
240-250	--	--	--	--	--	--	--	--	--	--
260[7]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
270[7]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
280[8]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
290[8]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
300[9]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
310[9]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
320[10]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
330[10]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
340[11]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
350[11]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
360[12]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
370[12]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
380[13]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
390[13]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
400[14]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
410[14]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
420[15]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
430[15]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
440[16]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
450[16]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
460[17]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
470[17]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
480[18]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
490[18]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy

[1]Meter Data
[2]Demand Meter Data
[3]Peak Demand Meter Data
[4]Date/Time Stamp
[5]Relay Word Data
[6]Most Recent Event Data
[7]First History Record
[8]Second History Record
[9]Third History Record
[10]Fourth History Record
[11]Fifth History Record
[12]Sixth History Record
[13]Seventh History Record
[14]Eighth History Record
[15]Ninth History Record
[16]Tenth History Record
[17]Eleventh History Record
[18]Twelveth History Record

NOTE: This table is only a summary and does not include all possibilities for every register. See ***Section 4: Operation Within SEL-2030*** for complete details of this map.

D1 Region Map of Network Global Data

Database Address	Network Node
2000h	1
2020h	2
2040h	3
2060h	4
2080h	5
20A0h	6
20C0h	7
20E0h	8
2100h	9
2120h	10
2140h	11
2160h	12
2180h	13
21A0h	14
21C0h	15
21E0h	16

Database Address	Network Node
2200h	17
2220h	18
2240h	19
2260h	20
2280h	21
22A0h	22
22C0h	23
22E0h	24
2300h	25
2320h	26
2340h	27
2360h	28
2380h	29
23A0h	30
23C0h	31
23E0h	32

Database Address	Network Node
2400h	33
2420h	34
2440h	35
2460h	36
2480h	37
24A0h	38
24C0h	39
24E0h	40
2500h	41
2520h	42
2540h	43
2560h	44
2580h	45
25A0h	46
25C0h	47
25E0h	48

Database Address	Network Node
2600h	49
2620h	50
2640h	51
2660h	52
2680h	53
26A0h	54
26C0h	55
26E0h	56
2700h	57
2720h	58
2740h	59
2760h	60
2780h	61
27A0h	62
27C0h	63
27E0h	64

TABLE OF CONTENTS

TABLES

APPENDIX A: FIRMWARE VERSIONS

This manual covers SEL-2711s 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-2711-R103-V0-Z000000-D20010105	Updated to work with SEL-2030 Communications Processor interface changes. Note SEL-2711-R103 is required for SEL-2030 revision R113 and higher.
SEL-2711-R102	Adds support for coils, input registers, User Regions as holding registers, outgoing control, and global data. Requires SLBT-2711-R101 or later release of boot firmware. Requires SEL-2030-R103 or later release of SEL-2030 firmware to enable all new features.
SLBT-2711-R101	Support changes to SEL-2711 firmware
SLBT-2711R-100	Original Boot Firmware Release.

To find the firmware revision number in your SEL-2711 within an SEL-2030, use the ID command on the appropriate port (17 or 18). The SEL-2711 has two firmware revision numbers, one for SELBOOT and one for the main executable. These FIDs have the following format:

SLBT-2711-R100-V0-D971114
SEL-2711-R100-V0-D971114

The following table shows firmware that does not precisely match this manual.

Firmware Part/Revision No.	Description of Firmware
SEL-2711-R101	Original Firmware Release.

APPENDIX B: ERROR CODES AND MESSAGES

This appendix describes the coding that the SEL-2711 uses to tell the host its status and any error conditions that may exist. See ***Section 4: Operation With SEL-2030*** for information on how to access this information. For information on Modbus Plus error codes, see ***Section 3: Operation and Network Configuration.***

SELF-TEST FAILURE CODES

When the SEL-2711 reports an error, it provides both an error code and an error string. The error code is a binary encoded 16-bit number. The bit positions have the following meanings:

Bit 0: 2711 RAM Checks	0 = RAM OK 1 = RAM Failed
Bit 1: 2711 EEPROM Checks	0 = EEPROM OK 1 = EEPROM Failed
Bit 2: 2711 Flash Checks	0 = Flash OK 1 = Flash Failed
Bit 3: Modbus Plus Dual Port RAM	0 = Dual Port RAM OK 1 = Dual Port RAM Failed
Bit 4: Modbus Plus Peer Processor	0 = Peer Processor OK 1 = Internal Failure in Processor
Bit 5: Cause of Peer Processor Failure	0 = SEL-2711 Firmware 1 = Modbus Plus Hardware

Note: Bit 5 has no meaning if Bit 4 is not set.

Bit 6: Shared Memory Interface Failure	0 = No Error 1 = Interface Failure
Bits 7-9: Modbus Plus Network Condition	000 = Normal Link Operation 001 = Monitor Link Operation 011 = Never Getting Token 010 = Sole Station 101 = Duplicate Station
Bits 10-11: Cause of last SEL-2711 Reset	00 = No Error 01 = Watchdog Timer Expired 10 = Loss of Crystal

Most of these are self-explanatory. Bit 3 indicates the condition of the dual port RAM that makes up the interface between the SEL-2711 and the Modicon Modbus Plus peer processor.

Bit 4 indicates there is an error in the peer processor. Bit 5 is used to indicate if the error is caused by the peer processor hardware or the SEL-2711 software.

ERROR MESSAGES

In addition to the above error code, there will be a character string giving more detail as to the type of failure. Possible strings are:

Error Message	Description
2711 RAM	2711 RAM failure - Bit 0 of error code will be set.
DPRAM Bad	2711 Dual-port RAM failure - Bit 3 of error code will be set.
EEPROM Bad	SEL-2711 EEPROM failure - Bit 1 of error code will be set.
Flash Bad	SEL-2711 Flash failure - Bit 2 of error code will be set.
Interf Bad	The interface between the SEL-2711 and the host is bad - Bit 6 of error code will be set.
MB+: *n*	Modbus Plus error - Bit 4 of error code will be set. If bit 5 of error code is clear, a SEL-2711 software problem is indicated and the code *n* is listed in Table B.1. Otherwise a peer processor internal problem is the cause of the failure and the code *n* is listed in table B.2.
MB+Fail	A general failure of the network processor has occurred - Bit 4 and/or 5 of error code will be set.
MONITORING	2711 is monitoring the Modbus Plus network. This message corresponds to the 1 flash per second of the network LED described in section 3.
NO TOKEN	This Modbus Plus node is never receiving the token. Corresponds to the 2 flash per second of the network LED.
NORMAL	SEL-2711 is working normally in that it is successfully receiving and passing the token. Corresponds to rapid flashing of the network LED.
SOLE NODE	This node isn't hearing any other nodes. Corresponds to the 3 flash per second of the network LED.
TIMEOUT	The network processor did not respond to a command from the SEL-2711 in a timely manner.
DUPLICATE	This node has heard a valid packet from another node on the network using the same address as this node. Corresponds to the 4 flash per second of the network LED.

Table B.1: SEL-2711 Software Errors

Hexadecimal Code	Description
01h	2.0-sec interface timeout
02h	bad interface opcode
03h	interface data error
04h	interface test error
05h	interface xfer-done error
06h	bad interface path
07h	bad transfer state
08h	bad transfer length
09h	global-data length error
0Ah	global-data address error
0Bh	global-data not present

Table B.2: Peer Processor Internal Failures

Hexadecimal Code	Description
81h	prom checksum error
82h	int-ram data test error
83h	ext-ram data test error
84h	ext-ram addr test error
85h	bad confidence test index
86h	ext-int0 event error
87h	ext-int1 event error
88h	dma-int0 event error
89h	comm-int event error
8Ah	xmit-no-good event error
8Bh	no-rsp timeout MAC-state
8Ch	no-rsp timeout MAC-idle
8Dh	receive-ok MAC-state
8Eh	transmit-ok MAC-state
8Fh	no receive buffer free
90h	bad input-transfer length

Hexadecimal Code	Description
91h	reserved rcv-buf error
92h	bad trans-control state
93h	bad work request bit
94h	node-queue overflow
95h	bad data-queue error
96h	empty data-path error
97h	bad path search index
98h	bad data-slave path

APPENDIX C: MODBUS PLUS MESSAGE EXAMPLE

This appendix illustrates a common Modbus Plus message. For example, we will have a host read holding resisters 40540 - 40559 (meter data from port 1 relay). The request message will have the following structure:

03h	-	function code - read holding register
02h 1Bh	}	starting address 539; 40540 starting address less the 40001 base for holding registers
00h 14h	}	register count - 20; registers 40540 to 40559 inclusive

There are two response messages possible. An error response will have the following format:

83h	-	error function code - error with read holding register
xx	-	error code - value depends on error type

A normal response will have the following format:

03h	-	function code - read holding register
28h	-	byte count 40; number of data bytes in 20 registers
xx xx . . . xx	}	data - 40 bytes (20 registers) of data

SEL-2030/2711 DATA MAP SUMMARY

Coil Map

Coil Offset Address	Corresponding Bits
1 - 16	1:RB16 - 1:RB1
17 - 32	2:RB16 - 2:RB1
33 - 48	3:RB16 - 3:RB1
49 - 64	4:RB16 - 4:RB1
65 - 80	5:RB16 - 5:RB1
81 - 96	6:RB16 - 6:RB1
97 - 112	7:RB16 - 7:RB1
113 - 128	8:RB16 - 8:RB1
129 - 144	9:RB16 - 9:RB1
145 - 160	10:RB16 - 10:RB1
161 - 176	11:RB16 - 11:RB1
177 - 192	12:RB16 - 12:RB1
193 - 208	13:RB16 - 13:RB1
209 - 224	14:RB16 - 14:RB1
225 - 240	15:RB16 - 15:RB1
241 - 256	16:RB16 - 16:RB1
257 - 272	17:RB16 - 17:RB1
273 - 288	18:RB16 - 18:RB1
289 - 304*	*n*:BR16 - *n*:BR1

* The last 16 coils can only be read, not operated.

Input Register Map
Holding Register Map if MAP_IR=Y

Input Register Offset Address	Corresponding Data
1 - 2048	Port 1 User Region
2049 - 4096	Port 2 User Region
4097 - 6144	Port 3 User Region
6145 - 8192	Port 4 User Region
8193 - 10,240	Port 5 User Region
10,241 - 12,288	Port 6 User Region
12,289 - 14,336	Port 7 User Region
14,337 - 16,384	Port 8 User Region
16,385 - 18,432	Port 9 User Region
18,433 - 20,480	Port 10 User Region
20,481 - 22,528	Port 11 User Region
22,529 - 24,576	Port 12 User Region
24,577 - 26,624	Port 13 User Region
26,625 - 28,672	Port 14 User Region
28,673 - 30,720	Port 15 User Region
30,721 - 32,768	Port 16 User Region
32,769 - 34,816	Port 17 User Region
34,817 - 36,864	Port 18 User Region

Add 300,000 to theses addresses to obtain a 3x input register reference. Add 400,000 to obtain a 4x holding register reference.

Holding Register Map if MAP_IR=N

Holding Register Offset Address	Description
1 - 499	Unused
500 - 999	Port 1 Relay Data*
1000 - 1499	Port 2 Relay Data*
1500 - 1999	Port 3 Relay Data*
2000 - 2499	Port 4 Relay Data*
2500 - 2999	Port 5 Relay Data*
3000 - 3499	Port 6 Relay Data*
3500 - 3999	Port 7 Relay Data*
4000 - 4499	Port 8 Relay Data*
4500 - 4999	Port 9 Relay Data*
5000 - 5499	Port 10 Relay Data*
5500 - 5999	Port 11 Relay Data*
6000 - 6499	Port 12 Relay Data*
6500 - 6999	Port 13 Relay Data*
7000 - 7499	Port 14 Relay Data*
7500 - 7999	Port 15 Relay Data*
8000 - 8499	Port 16 Relay Data*
8500 - 8999	Port 17 Relay Data*
9000 - 9499	Port 18 Relay Data*
9500 - 9999	Port *n* User Region first 500 registers

* See specific layout in following table

Holding Register Offset Address	Description
10,000	Unused
10,001 - 12,048	Port 1 User Region
12,049 - 14,096	Port 2 User Region
14,097 - 16,144	Port 3 User Region
16,145 - 18,192	Port 4 User Region
18,193 - 20,240	Port 5 User Region
20,241 - 22,288	Port 6 User Region
22,289 - 24,336	Port 7 User Region
24,337 - 26,384	Port 8 User Region
26,385 - 28,432	Port 9 User Region
28,433 - 30,480	Port 10 User Region
30,481 - 32,528	Port 11 User Region
32,529 - 34,576	Port 12 User Region
34,577 - 36,624	Port 13 User Region
36,625 - 38,672	Port 14 User Region
38,673 - 40,720	Port 15 User Region
40,721 - 42,768	Port 16 User Region
42,769 - 44,816	Port 17 User Region
44,817 - 46,864	Port 18 User Region

Add 400,000 to these address to obtain a 4x reference.

Relay Data Holding Register Map

	0	1	2	3	4	5	6	7	8	9
0	Relay Type	--	--	--	--	--	--	--	--	--
10-30	--	--	--	--	--	--	--	--	--	--
40[1]	IA	IB	IC	IR	P(whole)	P(frac)	Q(whole)	Q(part)	3I2	VA
50[1]	VB	VC	3V0	VAB	VBC	VCA	3V2	IAB	IBC	ICA
60[2]	Dem IA	Dem IB	Dem IC	Dem IR	Dem P	Dem P	Dem Q	Dem Q	Dem 3I2	Dem 3I2Y
70[3]	Peak IA	Peak IB	Peak IC	Peak IR	Peak P	Peak P	Peak Q	Peak Q	Peak 3I2	--
80[4]	Month	Day	Year	Hour	Minute	Second	--	--	--	--
90-150	--	--	--	--	--	--	--	--	--	--
160-200[5]	Target	Target	Target	Target	Target	Target	Target	Target	Target	Target
210[6]	Month	Day	Year	Hour	Minute	Second	Msec	52A	IVTime	Energy
220[6]	Event Type	Shot	Fault Loc	Fault Loc	Targets	--	--	--	--	--
230[6]	--	--	--	--	Flt Curr	Flt Curr	Duration	Duration	--	--
240-250	--	--	--	--	--	--	--	--	--	--
260[7]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
270[7]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
280[8]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
290[8]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
300[9]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
310[9]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
320[10]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
330[10]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
340[11]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
350[11]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
360[12]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
370[12]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
380[13]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
390[13]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
400[14]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
410[14]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
420[15]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
430[15]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
440[16]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
450[16]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
460[17]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
470[17]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy
480[18]	Month	Day	Year	Hour	Minute	Second	Msec	Event Type	Flt Loc	Flt Loc
490[18]	Shot	52A	Group	Targets	Duration	Duration	Flt Curr	Flt Curr	IV Time	Energy

[1]Meter Data
[2]Demand Meter Data
[3]Peak Demand Meter Data
[4]Date/Time Stamp
[5]Relay Word Data
[6]Most Recent Event Data
[7]First History Record
[8]Second History Record
[9]Third History Record
[10]Fourth History Record
[11]Fifth History Record
[12]Sixth History Record
[13]Seventh History Record
[14]Eighth History Record
[15]Ninth History Record
[16]Tenth History Record
[17]Eleventh History Record
[18]Twelveth History Record

NOTE: This table is only a summary and does not include all possibilities for every register. See ***Section 4: Operation Within SEL-2030*** for complete details of this map.

D1 Region Map of Network Global Data

Database Address	Network Node
2000h	1
2020h	2
2040h	3
2060h	4
2080h	5
20A0h	6
20C0h	7
20E0h	8
2100h	9
2120h	10
2140h	11
2160h	12
2180h	13
21A0h	14
21C0h	15
21E0h	16

Database Address	Network Node
2200h	17
2220h	18
2240h	19
2260h	20
2280h	21
22A0h	22
22C0h	23
22E0h	24
2300h	25
2320h	26
2340h	27
2360h	28
2380h	29
23A0h	30
23C0h	31
23E0h	32

Database Address	Network Node
2400h	33
2420h	34
2440h	35
2460h	36
2480h	37
24A0h	38
24C0h	39
24E0h	40
2500h	41
2520h	42
2540h	43
2560h	44
2580h	45
25A0h	46
25C0h	47
25E0h	48

Database Address	Network Node
2600h	49
2620h	50
2640h	51
2660h	52
2680h	53
26A0h	54
26C0h	55
26E0h	56
2700h	57
2720h	58
2740h	59
2760h	60
2780h	61
27A0h	62
27C0h	63
27E0h	64