GE Power Management

C30 Controller

UR Series Instruction Manual

C30 Revision: 2.6X

Manual P/N: 1601-0088-**B3** (GEK-106259)

NOTE

This relay is shipped from the factory with preset LED Panel indicators – see the 'Settings \ Product Setup \ User-Programmable LEDs' section for details and user options.

GE Power Management

215 Anderson Avenue, Markham, Ontario

Canada L6E 1B3

Tel: (905) 294-6222 Fax: (905) 294-8512

Internet: http://www.GEindustrial.com/pm

Manufactured under an
ISO9000 Registered system.

ADDENDUM

This Addendum contains information that relates to the C30 relay, revision 2.6X. This addendum lists a number of information items that appear in the instruction manual GEK-106259 (1601-0088-B3) but are not included in the current C30 operations.

The following functions/items are not yet available with the current version of the C30 relay:

- RTD inputs (availability is pending for this release)
- Setting Groups feature

NOTE:

- The UCA2 specifications are not yet finalized. There will be changes to the object models described in the Appendix - UCA/MMS.

GE Power Management

215 Anderson Avenue, Markham, Ontario

Canada L6E 1B3

Tel: (905) 294-6222 Fax: (905) 294-8512

Internet: http://www.GEindustrial.com/pm

TABLE OF CONTENTS

Please read this chapter for information to help guide you through the initial steps of organizing the setting up of your new relay.

1.1.1 CAUTIONS AND WARNINGS

WARNING CAUTION

Before attempting to install or use the relay, it is imperative that all WARNINGS and CAUTIONS in this manual are reviewed to help prevent personal injury, equipment damage, and/or downtime.

1.1.2 INSPECTION CHECKLIST

- Open the relay packaging and inspect the relay for physical damage.
- Check that the battery tab is intact on the power supply module (for more details, see the section BATTERY TAB in this chapter).
- View the rear name-plate and verify that the relay is the correct model ordered.

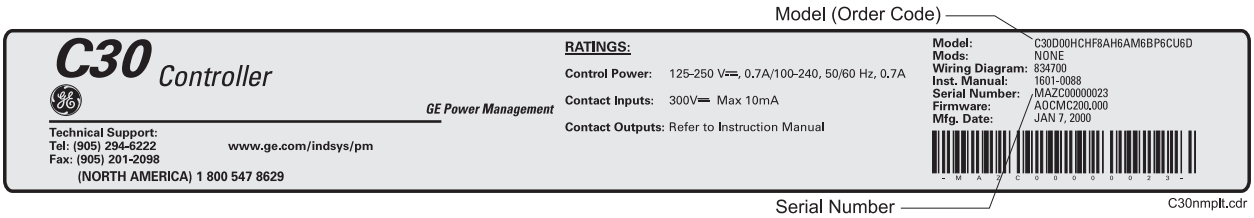


Figure 1–1: REAR NAME-PLATE (Example)

- Ensure that the following items have been included with the relay:
  - Instruction Manual
  - Products CD (includes UR PC software)
  - mounting screws
  - registration card (attached as the last page of the manual)
- Fill out the registration form and mail it back to GE Power Management (include the serial number located on the rear name-plate).
- For product information, instruction manual updates, and the latest software updates, please visit the GE Power Management Home Page.

NOTE

If there is any physical damage noticed on the relay, or any of the contents listed are missing, please contact GE Power Management immediately.

GE Power Management contact information and Call Center for product support:

GE Power Management
215 Anderson Avenue
Markham, Ontario
Canada L6E 1B3

Telephone: (905) 294-6222, 1-800-547-8629 (North America only)
Fax: (905) 201-2098
Email: info.pm@indsys.ge.com
Home Page: http://www.ge.com/indsys/pm or http://www.GEindustrial.com/pm

1.2.1 INTRODUCTION TO THE UR RELAY

Historically substations were designed with protection, control and metering functions performed by electromechanical equipment. This first generation of equipment was in time replaced in various degrees by analog electronic equipment, most of which emulated the single function approach required in the electromechanical precursors. Both of these technologies require a lot of expensive cabling and auxiliary equipment to produce functioning systems.

Recently digital electronic equipment has been applied to the purposes outlined above. Initially this equipment was either single function or had very limited multi-function capability, and did not significantly reduce the amount of cabling and auxiliary equipment required. Recent digital relays have become quite multi-functional, reducing cabling and auxiliaries even more. These devices also transfer data to central control facilities and Human Machine Interfaces, using electronic communications. The functions performed by these products have become so broad that many users now prefer the term IED (Intelligent Electronic Device).

It is obvious to station designers that the amount of cabling and auxiliary equipment installed in stations can be even further reduced, to 20% to 70% of the levels common in 1990, to achieve large cost reductions. This requires placing even more functions in the IEDs.

Users of power equipment are also interested in reducing cost by improving power quality and personnel productivity, and as always, in increasing system reliability and efficiency. These objectives are realized through software which is used to perform functions at both the station and supervisory levels. The use of these systems is growing rapidly.

High speed communications are required to meet the data transfer rates required by the automatic control and monitoring systems of today. In the near future, very high speed communications will be required to perform protection signaling with a performance target response time for a command signal between two IEDs, from transmission to reception, of less than 5 milliseconds as has been established by the Electric Power Research Institute, a collective body of many American and Canadian power utilities, in their Utilities Communications Architecture 2 (MMS/UCA2) project. In late 1998 some European utilities began to show an interest in this ongoing initiative.

IEDs with the capabilities outlined will also provide a lot more data on the power system than is presently available, enhance operations and maintenance, and permit the use of adaptive system configuration for protection and control systems. This new generation of equipment must also be easily incorporated into automation systems, at both the station and enterprise levels. The Universal Relay (UR) has been developed to meet these goals.

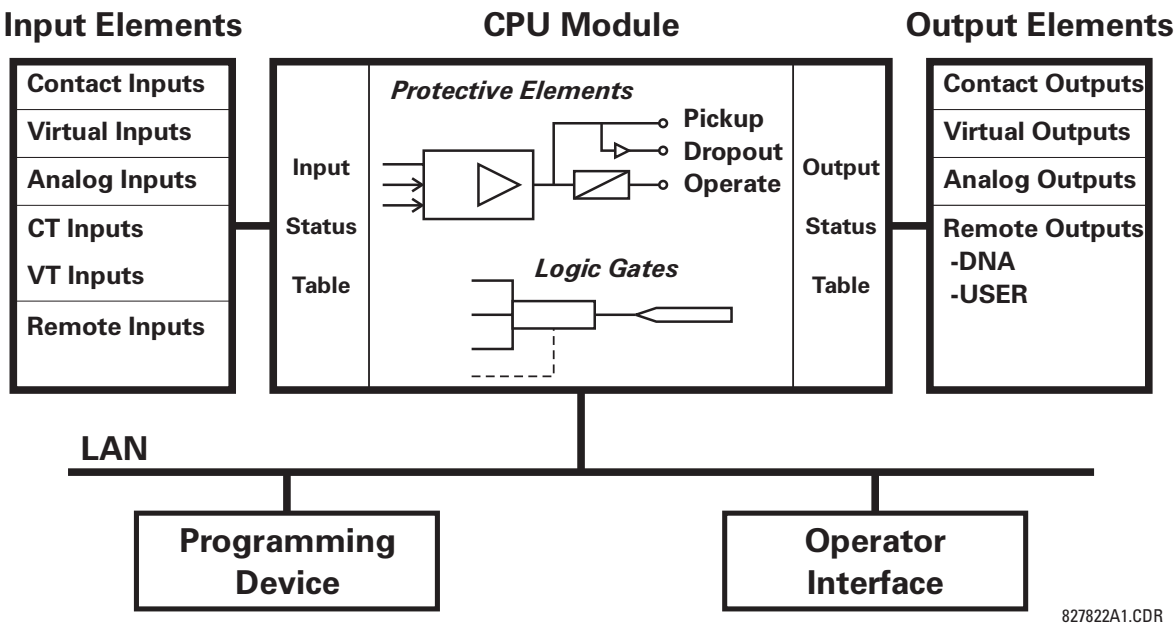


Figure 1–2: UR CONCEPT BLOCK DIAGRAM

a) UR BASIC DESIGN

The UR is a digital-based device containing a central processing unit (CPU) which handles multiple types of input and output signals. The UR device can communicate over a local area network (LAN) with an operator interface, a programming device, or another UR device.

The **CPU module** contains firmware which provides protection elements in the form of logic algorithms, and programmable logic gates, timers, and latches for control features.

Input elements accept a variety of analog or digital signals from the field, isolate and convert the signals into logic signals which can be used by the relay.

Output elements convert and isolate the logic signals generated by the relay, into digital or analog signals that can be used to control field devices.

b) UR SIGNAL TYPES

The **contact inputs and outputs** are digital signals associated with connections to hard-wired contacts. Both 'wet' and 'dry' contacts are supported.

The **virtual inputs and outputs** are digital signals associated with the UR internal logic signals. Vitual inputs include signals generated by the local user interface. The virtual outputs are outputs of FlexLogic™ equations used to customize the UR device. Virtual outputs can also serve as virtual inputs to FlexLogic™ equations.

The **analog inputs and outputs** are signals that are associated with transducers such as Resistance Temperature Detectors (RTDs), etc.

The **CT and VT inputs** refer to analog current transformer and voltage transformer signals used to monitor AC power lines. The UR supports 1 A or 5 A CTs.

The **remote inputs and outputs** provide a means of sharing digital point state information between remote UR devices. The remote outputs interface to the remote inputs of other UR devices. Remote outputs are FlexLogic™ operands inserted into UCA2 GOOSE messages and are of two assignment types; DNA standard functions and USER defined functions.

c) UR SCAN OPERATION

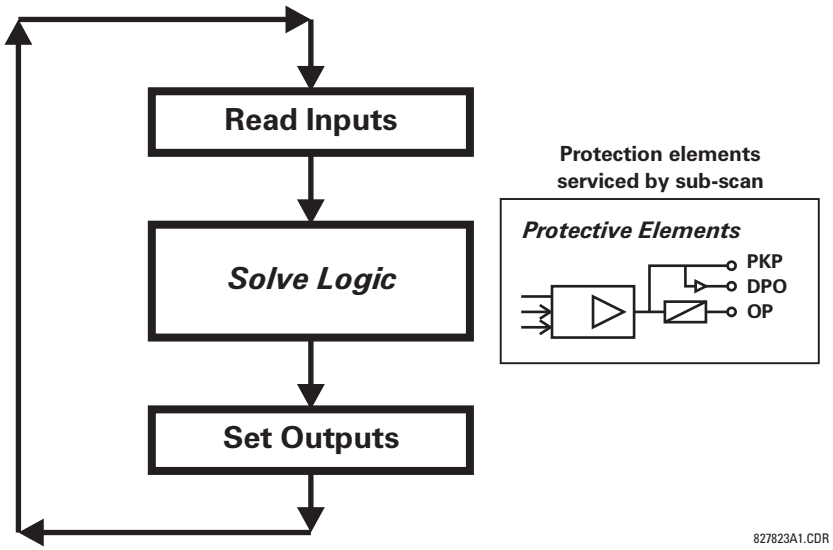


Figure 1–3: UR SCAN OPERATION

The UR device operates in a cyclic scan fashion. The UR reads the inputs into an input status table, solves the logic program (FlexLogic™ equation), and then sets each output to the appropriate state in an output status table. Any resulting task execution is priority interrupt-driven.

1.2.3 UR SOFTWARE ARCHITECTURE

The firmware (software embedded in the relay) is designed in functional modules which can be installed in any relay as required. This is achieved with Object-Oriented Design and Programming (OOD/OOP) techniques.

Object-Oriented techniques involve the use of ‘objects’ and ‘classes’. An ‘object’ is defined as “a logical entity that contains both data and code that manipulates that data”. A ‘class’ is the generalized form of similar objects. By using this concept, one can create a Protection Class with the Protection Elements as objects of the class such as Time Overcurrent, Instantaneous Overcurrent, Current Differential, Undervoltage, Overvoltage, Underfrequency, Distance, etc. These objects represent software modules that are completely self-contained. The same object-class concept can be used for Metering, I/O Control, HMI, Communications, or for any functional entity in the system.

Employing OOD/OOP in the software architecture of the Universal Relay achieves the same features as for the hardware architecture; modularity, scalability, and flexibility. The application software for any Universal Relay (e.g. Feeder Protection, Transformer Protection, Distance Protection, etc.) is constructed by combining objects from the various functionality classes. This results in a ‘common look and feel’ across the entire family of UR platform-based applications.

1.2.4 IMPORTANT UR CONCEPTS

As described above, the architecture of the UR relay is different from previous devices. In order to achieve a general understanding of this device, some sections of Chapter 5 are quite helpful. The most important functions of the relay are contained in "Elements". A description of UR elements can be found in the INTRODUCTION TO ELEMENTS section. An example of a simple element, and some of the organization of this manual, can be found in the DIGITAL ELEMENTS MENU section. An explanation of the use of inputs from CTs and VTs is in the INTRODUCTION TO AC SOURCES section. A description of how digital signals are used and routed within the relay is contained in the INTRODUCTION TO FLEXLOGIC™ section.

1.3.1 PC REQUIREMENTS

The Faceplate keypad and display or the URPC software interface can be used to communicate with the relay.

The URPC software interface is the preferred method to edit settings and view actual values because the PC monitor can display more information in a simple comprehensible format.

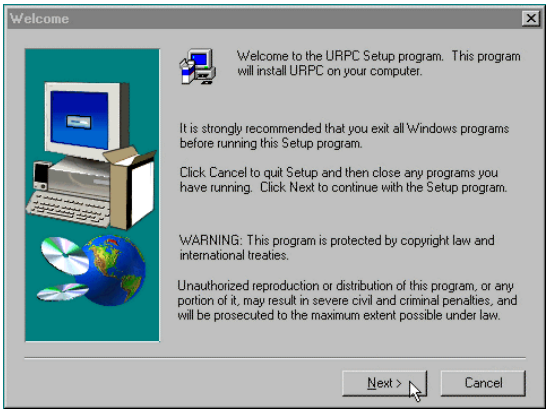
The following minimum requirements must be met for the URPC software to properly operate on a PC.

Processor:	Intel® Pentium 200 MMX
RAM Memory:	32 Mb (64 Mb recommended)
Hard Disk:	20 Mb free space required before installation of URPC software
O/S:	Windows® NT 4.x or Windows® 9x
Device:	CD ROM drive
Port:	COM1(2) / Ethernet

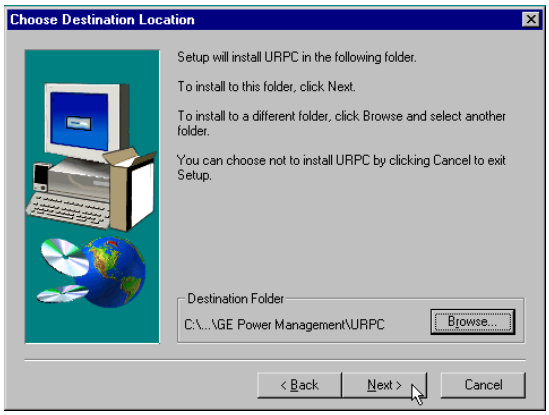
1.3.2 SOFTWARE INSTALLATION

Refer to the following instructions to install the URPC software onto a PC:

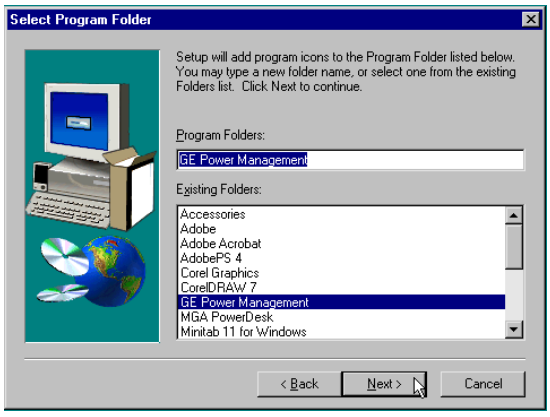
1. **Start** the **Windows®** program.
2. **Insert** the URPC software CD into the CD ROM drive.
3. If the installation program does not start automatically, choose **Run** from the Windows® **Start** menu and type D:\SETUP.EXE. Press Enter to start the installation.
4. Follow the on-screen instructions to install the URPC software. When the **Welcome** window appears, click on **Next** to continue with the installation procedure.



5. When the **Choose Destination Location** window appears and if the software is not to be located in the default directory, click **Browse** and type in the complete path name including the new directory name.
6. Click **Next** to continue with the installation procedure.



7. The default program group where the application will be added to is shown in the **Select Program Folder** window. If it is desired that the application be added to an already existing program group, choose the group name from the list shown.
8. Click **Next** to begin the installation process.



9. To launch the URPC application, click Finish in the Setup Complete window.
10. Subsequently, double click on the URPC software icon to activate the application.

NOTE

Refer to the HUMAN INTERFACES chapter in this manual and the URPC Software Help program for more information about the URPC software interface.

This section is intended as a quick start guide to using the URPC software. Please refer to the URPC Help File and the HUMAN INTERFACES chapter for more information.

a) CONFIGURING AN ETHERNET CONNECTION

Before starting, verify that the Ethernet network cable is properly connected to the Ethernet port on the back of the relay.

1. Start the URPC software. Enter the password "URPC" at the login password box.
2. Select the **Help > Connection Wizard** menu item to open the Conection Wizard. Click "Next" to continue.
3. Click the "New Interface" button to open the Edit New Interface window.
   - Enter the desired interface name in the **Enter Interface Name** field.
   - Select the "Ethernet" interface from the drop down list and press "Next" to continue.
4. Click the "New Device" button to open the Edit New Device Window.
   - Enter the desired name in the **Enter Interface Name** field.
   - Enter the Modbus address of the relay (from **S1 PRODUCT SETUP \ COMMUNICATIONS \ MODBUS PROTOCOL \ MODBUS SLAVE ADDRESS**) in the the **Enter Modbus Address** field.
   - Enter the IP address (from **S1 PRODUCT SETUP \ COMMUNICATIONS \ NETWORK \ IP ADDRESS**) in the **Enter TCPIP Address** field.
5. Click the "4.1 Read Device Information" button then "OK" when the relay information has been received. Click "Next" to continue.
6. Click the "New Site" button to open the Edit Site Name window.
   - Enter the desired site name in the **Enter Site Name** field.
7. Click the "OK" button then click "Finish". The new Site List tree will be added to the Site List window (or Online window) located in the top left corner of the main URPC window.

The Site Device has now been configured for Ethernet communications. Proceed to Section c) CONNECTING TO THE RELAY below to begin communications.

b) CONFIGURING AN RS232 CONNECTION

Before starting, verify that the RS232 serial cable is properly connected to the RS232 port on the front panel of the relay.

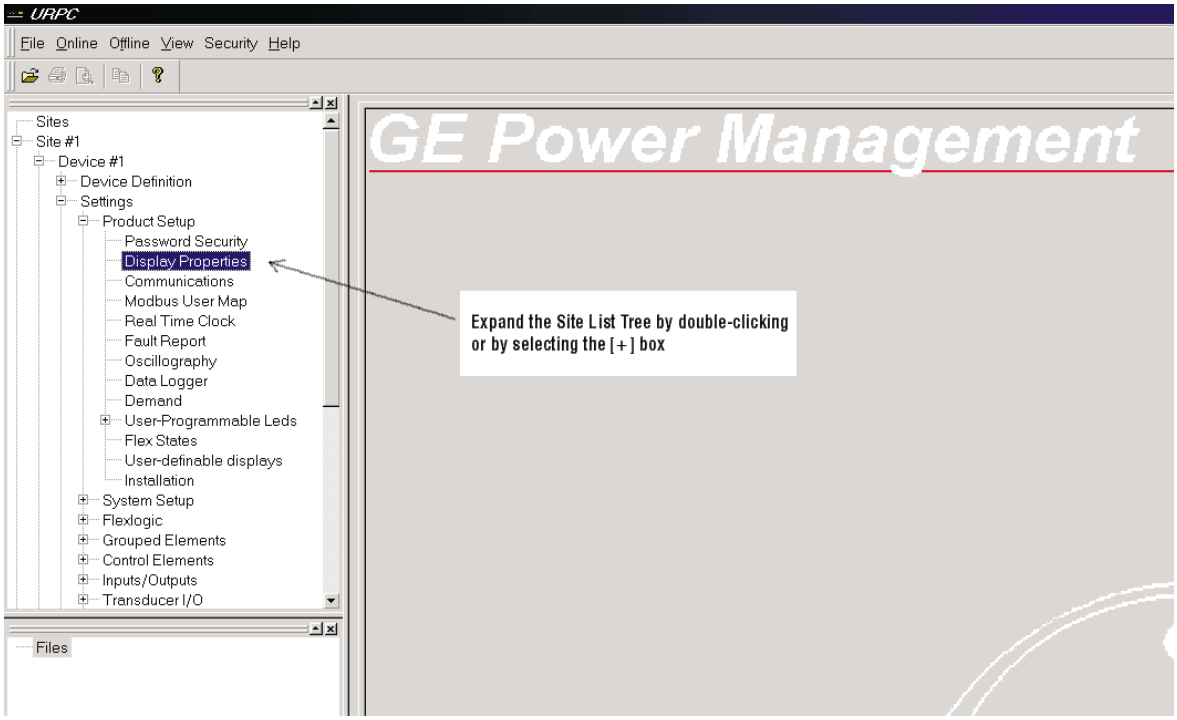
1. Start the URPC software. Enter the password "URPC" at the login password box.
2. Select the **Help > Connection Wizard** menu item to open the Conection Wizard. Click "Next" to continue.
3. Click the "New Interface" button to open the Edit New Interface window.
   - Enter the desired interface name in the **Enter Interface Name** field.
   - Select the "RS232" interface from the drop down list and press "Next" to continue.
4. Click the "New Device" button to open the Edit New Device Window.
   - Enter the desired name in the **Enter Interface Name** field.
   - Enter the PC COM port number in the **COM Port** field.
5. Click "OK" then click "Next" to continue.

6. Click the "New Site" button to open the Edit Site Name window.
   - Enter the desired site name in the **Enter Site Name** field.
7. Click the "OK" button then click "Finish". The new Site List tree will be added to the Site List window (or Online window) located in the top left corner of the main URPC window.

The Site Device has now been configured for RS232 communications. Proceed to Section c) CONNECTING TO THE RELAY below to begin communications.

c) CONNECTING TO THE RELAY

1. Select the Display Properties window through the Site List tree as shown below:



2. The Display Properties window will open with a flashing status indicator.
   - If the indicator is red, click the Connect button (the lightning bolt) in the menu bar of the Displayed Properties window.
3. In a few moments, the flashing light should turn green, indicating that URPC is communicating with the relay.

NOTE

Refer to the HUMAN INTERFACES chapter in this manual and the URPC Software Help program for more information about the URPC software interface.

1.4.1 MOUNTING AND WIRING

Please refer to the HARDWARE chapter for detailed relay mounting and wiring instructions. Review all **WARNINGS and CAUTIONS**.

1.4.2 COMMUNICATIONS

The URPC software can communicate to the relay via the faceplate RS232 port, or the rear panel RS485 or Ethernet ports. To communicate with the relay via the faceplate RS232 port, a standard “straight through” serial cable is used. The DB-9 male end is connected to the relay and the DB-9 or DB-25 female end is connected to the PC COM1 or COM2 port as described in the HARDWARE chapter.

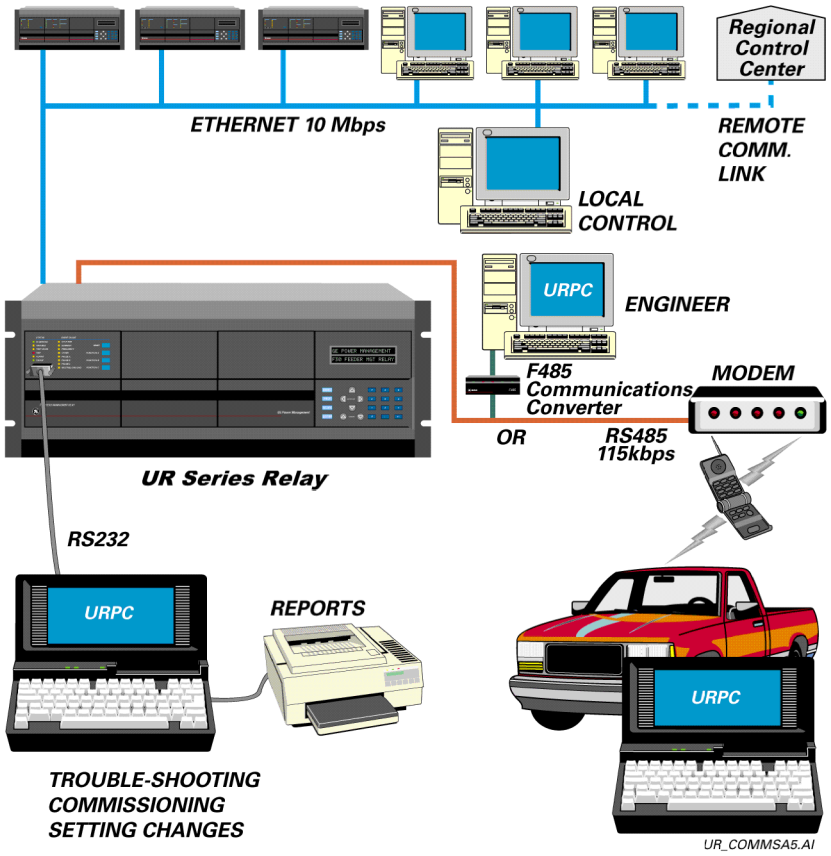


Figure 1–4: RELAY COMMUNICATIONS OPTIONS

To communicate through the relay’s rear RS485 port from a PC RS232 port, the GE Power Management RS232/RS485 converter box is required. This device (catalog number F485) connects to the computer using a "straight-through" serial cable. A shielded twisted-pair (20, 22, or 24 AWG) connects the F485 converter to the UR rear communications port. The converter terminals (+, –, GND) are connected to the UR communication module (+, –, COM) terminals. Refer to the CPU COMMUNICATION PORTS section in the HARDWARE chapter for option details. The line should be terminated with an R-C network (i.e. 120 Ω, 1 nF) as described in the HARDWARE chapter.

1.4.3 FACEPLATE DISPLAY

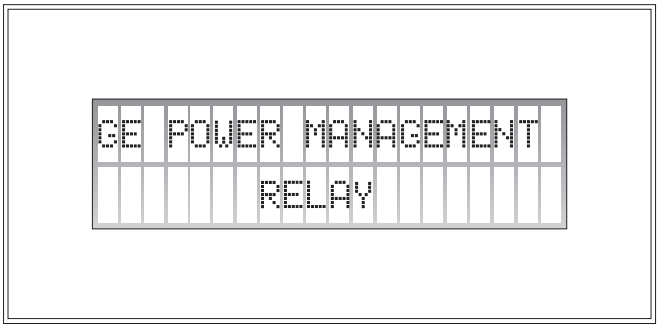


Figure 1–5: DISPLAY

All messages are displayed on a 2 × 20 character vacuum fluorescent display to make them visible under poor lighting conditions. Messages are displayed in English and do not require the aid of an instruction manual for deciphering. While the keypad and display are not actively being used, the display will default to defined messages. Any high priority event driven message will automatically override the default message and appear on the display.

1.4.4 FACEPLATE KEYPAD

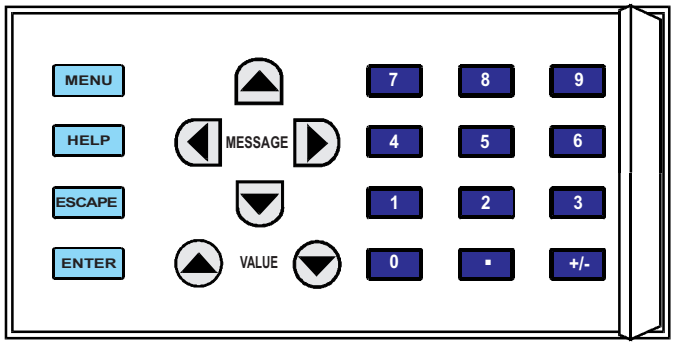


Figure 1–6: KEYPAD

Display messages are organized into 'pages' under the main headings, Actual Values, Settings, Commands, and Targets. The MENU key is used to navigate through the main heading pages. Each main heading page is further broken down into logical subgroup messages.

The ▲ ◀ MESSAGE ▶ ▼ keys are used to navigate through the subgroups.

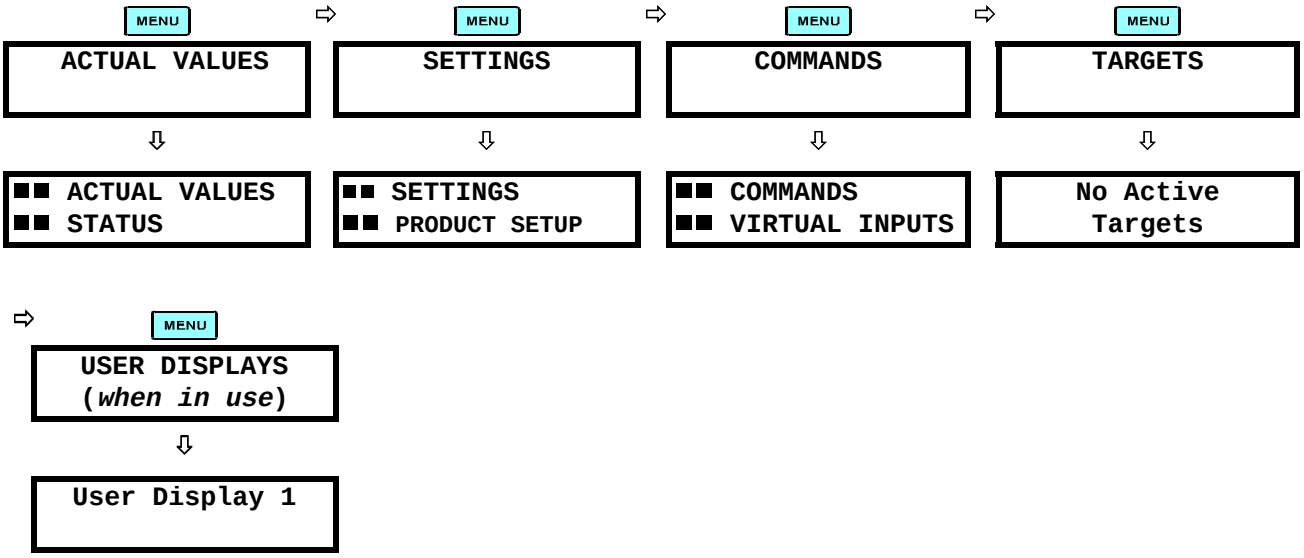
The ▲ VALUE ▼ keys are used to scroll through variables in the settings programming mode to increment or decrement numerical setting values. These keys are also used to scroll through alphanumeric values in the text edit mode. Alternatively, values may be entered with the numeric keypad.

The . key is used to initiate and advance to the next character in text edit mode or to enter a decimal point.

The HELP key may be pressed at any time for context sensitive help messages. The ENTER key is used to store altered setting values.

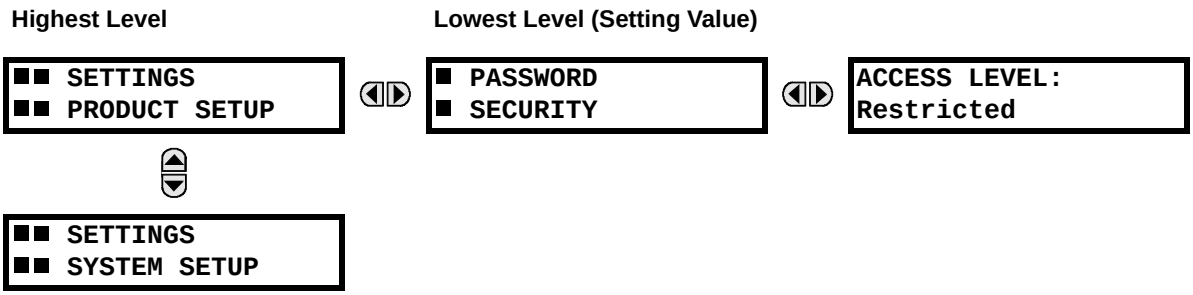
1.5.1 MENU NAVIGATION

Press the MENU key to select the desired header display page (top-level menu). The header title will appear momentarily and then a header display page menu item will appear on the display. Each press of the MENU key advances through the main heading pages as illustrated below.



a) MENU HIERARCHY

The setting and actual value messages are set up in a hierarchical format. The header display pages are indicated by the double scroll bar characters (■■), while sub-header pages are indicated by a single scroll bar character (■). The header display pages are at the highest level of the hierarchy and the sub-header display pages fall below this level. The MESSAGE ⏶ and MESSAGE ⏷ keys are used to move within a group of headers, sub-headers, setting values or actual values. Continually pressing the MESSAGE ⏵ key from a header display, displays more specific information for the header category. Conversely, continually pressing the ⏴ MESSAGE key from a setting value or actual value display will return to the header display.



1.5.2 RELAY ACTIVATION

The relay is defaulted to the 'Not Programmed' state before it leaves the factory. This safeguards against the installation of a relay whose settings have not been entered. When powered up successfully, the TROUBLE indicator will be on and the IN SERVICE indicator off. The relay in the 'Not Programmed' state will block signaling of any output relay. These conditions will remain until the relay is explicitly put in the 'Programmed' state.

Select the menu message SETTINGS PRODUCT SETUP \ INSTALLATION \ RELAY SETTINGS:

```
RELAY SETTINGS:
Not Programmed
```

To put the relay in the 'Programmed' state, press either of the VALUE keys once and then press ENTER. The faceplate TROUBLE indicator will turn off and the IN SERVICE indicator will turn on.

The settings for the relay can be set up manually (refer to the SETTINGS chapter) via the Faceplate Interface or remotely (refer to the URPC Help program) via the URPC Software Interface.

1.5.3 BATTERY TAB

The battery tab is installed in the power supply module before it is shipped from the factory. The purpose of the battery tab is to prolong the life of the battery in the event the relay is powered down for long periods of time before installation. The battery is responsible for backing up event records, oscillography, data logger, and real-time clock information when the relay is powered off. The battery failure self-test error generated by the relay is a minor self-test error and should not affect the functionality of the relay. When the relay is installed and ready for commissioning, the tab should be removed. If required, contact the factory for a replacement battery.

1.5.4 RELAY PASSWORDS

It is recommended that passwords be set up on the relay for each security level and assigned to specific personnel. There are two user password SECURITY access levels:

1. **COMMAND**

The COMMAND access level restricts the user from making any settings changes, but allows the user to perform the following operations:

- operate breakers via faceplate pushbuttons
- change state of virtual inputs
- clear event records
- clear oscillography records

2. **SETTING**

The SETTING access level allows the user to make any changes to any of the setting values.

Refer to the HUMAN INTERFACES chapter, CHANGING SETTINGS section for complete instructions on setting up security level passwords.

1.5.5 FLEXLOGIC™ CUSTOMIZATION

FlexLogic™ equation editing is required for setting up user-defined logic for customizing the relay operations. See section FLEXLOGIC™ in the SETTINGS chapter.

1.5.6 COMMISSIONING

Templated tables for charting all the required settings before entering them via the keypad are available in the COMMISSIONING chapter.

2.1.1 OVERVIEW

The C30 Relay is a microprocessor-based relay designed for power substation control and monitoring.

Diagnostic features include a sequence of records capable of storing 1024 time-tagged events. The internal clock used for time-tagging can be synchronized with an IRIG-B signal. This precise time stamping allows the sequence of events to be determined throughout the system. Events can also be programmed (via FlexLogic™ equations) to trigger oscillography data capture which may be set to record the measured parameters before and after the event for viewing on a portable computer (PC). These tools will significantly reduce troubleshooting time and simplify report generation in the event of a system fault.

A faceplate RS232 port may be used to connect to a PC for the programming of settings and for the monitoring of actual values. A variety of communications modules are available. Two rear RS485 ports are standard to allow independent access by operating and engineering staff. All serial ports use the Modbus® RTU protocol. The RS485 ports may be connected to system computers with baud rates up to 115.2 kbps. The RS232 port has a fixed baud rate of 19.2 kbps. Optional communications modules include a 10BaseF Ethernet interface which can be used to provide fast, reliable communications in noisy environments. Another option provides two 10BaseF fiber optic ports for redundancy. The Ethernet port supports MMS/UCA2, Modbus®/TCP, and TFTP protocols, and allows access to the relay via any standard web browser (UR web pages). The DNP 3.0 protocol is supported on a user-specified port, including serial and Ethernet ports.

The relay uses flash memory technology which allows field upgrading as new features are added.

Table 2–1: C30 FUNCTIONS

FUNCTION
Contact Inputs (up to 96)
Contact Outputs (up to 64)
Data Logger
Digital Counters (8)
Digital Elements (16)
Event Recorder
FlexLogic Equations
MMS/UCA Communications
MMS/UCA Remote I/O (“GOOSE”)
ModBus Communications
ModBus User Map
DNP 3.0
Oscillography
Transducer I/O
User Definable Displays
User Programmable LEDs
Virtual Inputs (32)
Virtual Outputs (64)

2.1.2 ORDERING

The relay is available as a 19-inch rack horizontal mount unit or as a reduced size (¾) vertical mount unit, and consists of five UR module functions: Power Supply, CPU, CT/VT DSP, Digital Input/Output, and Transducer Input/Output. Each of these modules can be supplied in a number of configurations which must be specified at the time of ordering. The information required to completely specify the relay is provided in the following table (full details of available relay modules are contained in the HARDWARE chapter).

Table 2–2: ORDER CODES

	C30 - *	00 -	H	C * -	F ** -	H ** -	M ** -	P ** -	U ** -	W **			For Full Sized Horizontal Mount
	C30 - *	00 -	V	F * -	F ** -	H ** -	M ** -	P **	|	|			For Reduced Size Vertical Mount
Base Unit	C30	|	|	|	|	|	|	|	|	|	|	|	Base Unit
CPU		A	|	|	|	|	|	|	|	|	|	|	RS485 + RS485 (Modbus RTU, DNP)
		C	|	|	|	|	|	|	|	|	|	|	RS485 + 10BaseF (MMS/UCA2, ModBus TCP/IP, DNP)
		D	|	|	|	|	|	|	|	|	|	|	RS485 + Redundant 10BaseF (MMS/UCA2, ModBus TCP/IP, DNP)
Software Options			00	|	|	|	|	|	|	|	|	|	|	No Software Options
Mount/ Faceplate				H	C	|	|	|	|	|	|	|	|	Horizontal (19" rack)
				V	F	|	|	|	|	|	|	|	|	Vertical (3/4 size)
Power Supply						H	|	|	|	|	|	|	|	125 / 250 V AC/DC
						L	|	|	|	|	|	|	|	24 to 48 V (DC only)
Digital I/O[1]							|	XX	XX	XX	XX	XX	No module
							6A	6A	6A	6A	6A	6A	2 Form-A (Voltage w/ opt Current) & 2 Form-C Outputs, 8 Digital Inputs
							6B	6B	6B	6B	6B	6B	2 Form-A (Voltage w/ opt Current) & 4 Form-C Outputs, 4 Digital Inputs
							6C	6C	6C	6C	6C	6C	8 Form-C Outputs
							6D	6D	6D	6D	6D	6D	16 Digital Inputs
							6E	6E	6E	6E	6E	6E	4 Form-C Outputs, 8 Digital Inputs
							6F	6F	6F	6F	6F	6F	8 Fast Form-C Outputs
							6G	6G	6G	6G	6G	6G	4 Form-A (Voltage w/ opt Current) Outputs, 8 Digital Inputs
							6H	6H	6H	6H	6H	6H	6 Form-A (Voltage w/ opt Current) Outputs, 4 Digital Inputs
							6K	6K	6K	6K	6K	6K	4 Form-C & 4 Fast Form-C Outputs
							6L	6L	6L	6L	6L	6L	2 Form-A (Current w/ opt Voltage) & 2 Form-C Outputs, 8 Digital Inputs
							6M	6M	6M	6M	6M	6M	2 Form-A (Current w/ opt Voltage) & 4 Form-C Outputs, 4 Digital Inputs
							6N	6N	6N	6N	6N	6N	4 Form-A (Current w/ opt Voltage) Outputs, 8 Digital Inputs
							6P	6P	6P	6P	6P	6P	6 Form-A (Current w/ opt Voltage) Outputs, 4 Digital Inputs
							6R	6R	6R	6R	6R	6R	2 Form-A (No Monitoring) & 2 Form-C Outputs, 8 Digital Inputs
							6S	6S	6S	6S	6S	6S	2 Form-A (No Monitoring) & 4 Form-C Outputs, 4 Digital Inputs
							6T	6T	6T	6T	6T	6T	4 Form-A (No Monitoring) Outputs, 8 Digital Inputs
							6U	6U	6U	6U	6U	6U	6 Form-A (No Monitoring) Outputs, 4 Digital Inputs
Transducer I/O[1]							5C	5C	5C	5C	5C	5C	8 RTD Inputs
(maximum of 4 per unit)							5E	5E	5E	5E	5E	5E	4 RTD Inputs, 4 dcmA Inputs
							5F	5F	5F	5F	5F	5F	8 dcmA Inputs

[1] **Custom I/O configurations available. Consult factory with requirements.**

The following table displays the appropriate order codes of individual modules if replacement modules need to be ordered separately.

NOTE

When ordering a replacement CPU module or Faceplate, please provide the serial number of your existing unit.

Table 2–3: ORDER CODES FOR ORDERING REPLACEMENT MODULES

	UR - ** -	
Power Supply	1H	125 / 250 V AC/DC
	1L	24 - 48 V (DC only)
CPU	9A	RS485 + RS485 (ModBus RTU, DNP 3.0)
	9C	RS485 + 10BaseF (MMS/UCA2, ModBus TCP/IP, DNP 3.0)
	9D	RS485 + Redundant 10BaseF (MMS/UCA2, ModBus TCP/IP, DNP 3.0)
Faceplate	3C	Horizontal Faceplate with Display & Keypad
	3F	Vertical Faceplate with Display & Keypad
Digital I/O	6A	2 Form-A (Voltage w/ opt Current) & 2 Form-C Outputs, 8 Digital Inputs
	6B	2 Form-A (Voltage w/ opt Current) & 4 Form-C Outputs, 4 Digital Inputs
	6C	8 Form-C Outputs
	6D	16 Digital Inputs
	6E	4 Form-C Outputs, 8 Digital Inputs
	6F	8 Fast Form-C Outputs
	6G	4 Form-A (Voltage w/ opt Current) Outputs, 8 Digital Inputs
	6H	6 Form-A (Voltage w/ opt Current) Outputs, 4 Digital Inputs
	6K	4 Form-C & 4 Fast Form-C Outputs
	6L	2 Form-A (Current w/ opt Voltage) & 2 Form-C Outputs, 8 Digital Inputs
	6M	2 Form-A (Current w/ opt Voltage) & 4 Form-C Outputs, 4 Digital Inputs
	6N	4 Form-A (Current w/ opt Voltage) Outputs, 8 Digital Inputs
	6P	6 Form-A (Current w/ opt Voltage) Outputs, 4 Digital Inputs
	6R	2 Form-A (No Monitoring) & 2 Form-C Outputs, 8 Digital Inputs
	6S	2 Form-A (No Monitoring) & 4 Form-C Outputs, 4 Digital Inputs
	6T	4 Form-A (No Monitoring) Outputs, 8 Digital Inputs
	6U	6 Form-A (No Monitoring) Outputs, 4 Digital Inputs
CT/VT DSP	8A	Standard 4CT/4VT
	8B	Sensitive Ground 4CT/4VT
	8C	Standard 8CT
	8Z	HI-Z 4CT
L60 Inter-Relay Communications	7U	110/125 V, 20 mA Input/Output Channel Interface
	7V	48/60 V, 20 mA Input/Output Channel Interface
	7Y	125 V Input, 5V Output, 20 mA Channel Interface
	7Z	5 V Input, 5V Output, 20 mA Channel Interface
L90 Inter-Relay Communications	7A	820 nm, multi-mode, LED, 1 Channel
	7B	1300 nm, multi-mode, LED, 1 Channel
	7C	1300 nm, single-mode, ELED, 1 Channel
	7D	1300 nm, single-mode, LASER, 1 Channel
	7H	820 nm, multi-mode, LED, 2 Channels
	7I	1300 nm, multi-mode, LED, 2 Channels
	7J	1300 nm, single-mode, ELED, 2 Channels
	7K	1300 nm, single-mode, LASER, 2 Channels
	7L	Channel 1 - RS422; Channel 2 - 820 nm, multi-mode, LED
	7M	Channel 1 - RS422; Channel 2 - 1300 nm, multi-mode, LED
	7N	Channel 1 - RS422; Channel 2 - 1300 nm, single-mode, ELED
	7P	Channel 1 - RS422; Channel 2 - 1300 nm, single-mode, LASER
	7R	G.703, 1 Channel
	7S	G.703, 2 Channels
	7T	RS422, 1 Channel
	7W	RS422, 2 Channels
Transducer I/O	5C	8 RTD Inputs
	5E	4 dcmA Inputs, 4 RTD Inputs
	5F	8 dcmA Inputs

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

2.2.1 MONITORING

OSCILLOGRAPHY

Max. No. of Records:	64
Sampling Rate:	64 samples per power cycle
Triggers:	Any element pickup, dropout or operate Digital input change of state Digital output change of state FlexLogic™ equation
Triggers:	DV, DI, DF, digital points
Data:	Element state Digital input state Digital output state
Data Storage:	In non-volatile memory

EVENT RECORDER

Capacity:	1024 events
Time-tag:	To 1 microsecond
Triggers:	Any element pickup, dropout or operate Digital input change of state Digital output change of state Self-test events
Data Storage:	In non-volatile memory

DATA LOGGER

Number of Channels:	1 to 16
Parameters:	Any analog Actual Value available in the relay
Sampling Rate:	1 sec.; 1, 5, 10, 15, 20, 30, 60 min.
Storage Capacity:	(NN is dependent on memory)
1-second rate:	01 channel for NN days 16 channels for NN days
↓	↓
60-minute rate:	01 channel for NN days 16 channels for NN days

2.2.2 INPUTS

CONTACT INPUTS

Dry Contacts:	1000 Ω Maximum
Wet Contacts:	300 V DC Maximum
Selectable Thresholds:	16 V, 30 V, 80 V, 140 V
Recognition Time:	< 5 ms

IRIG-B INPUT

Amplitude Modulation:	1 to 10 Vp-p
DC Shift:	TTL
Input Impedance:	22 kOhms

DCMA INPUTS

Current Input (mAdc):	0 to –1, 0 to +1, –1 to +1, 0 to 5, 0 to 10, 0 to 20, 4 to 20 (programmable)
Input Impedance:	379 Ω ±10%
Conversion Range:	–1 to + 20 mAdc
Accuracy:	±0.2% of full scale
Type:	Passive

RTD INPUTS

Types (3-wire):	100 Ω Platinum, 100 & 120 Ω Nickel, 10 Ω Copper
Sensing Current:	5 mA
Range:	–50 to +250 °C
Accuracy:	± 2°C
Isolation:	36 V pk-pk

2.2.3 POWER SUPPLY

LOW RANGE

Nominal DC Voltage: 24 to 48 at 3 A
Min./Max. DC Voltage: 20 / 60
NOTE: Low range is DC only.

HIGH RANGE

Nominal DC Voltage: 125 to 250 at 0.7 A
Min./Max. DC Voltage: 88 / 300
Nominal AC Voltage: 100 to 240 at 50/60 Hz, 0.7 A
Min./Max. AC Voltage: 88 / 265 at 48 to 62 Hz

ALL RANGES

Volt Withstand: 2 x Highest Nominal Voltage for 10 ms
Voltage Loss Hold-Up: 50 ms duration at nominal
Power Consumption: Typical = 35 VA, Max. = 75 VA

INTERNAL FUSE

RATINGS

Low Range Power Supply: 7.5A/600V
High Range Power Supply: 5A/600V

INTERRUPTING CAPACITY

AC: 100,000 A RMS symmetrical
DC: 10,000 A

2.2.4 OUTPUTS

FORM-A RELAY

Make and Carry for 0.2 sec: 30 A as per ANSI C37.90
Carry Continuous: 6 A
Break @ L/R of 40 ms: 0.25 A DC max.
Operate Time: < 4 ms
Contact Material: Silver alloy

FORM-A VOLTAGE MONITOR

Applicable Voltage: approx. 15 to 250 V DC
Trickle Current: approx. 1 to 2.5 mA

FORM-A CURRENT MONITOR

Threshold Current: approx. 80 to 100 mA

FORM-C AND CRITICAL FAILURE RELAY

Make and Carry for 0.2 sec: 10 A
Carry Continuous: 6 A
Break @ L/R of 40 ms: 0.1 ADC max.
Operate Time: < 8 ms
Contact Material: Silver alloy

FAST FORM-C RELAY

Make and Carry: 40 mA @ 48 V DC
Operate Time: < 0.6 ms
INTERNAL LIMITING RESISTOR:
Power: 2 Watts
Resistance: 100 ohms

CONTROL POWER EXTERNAL OUTPUT (for Dry Contact Input)

Capacity: 100 mA DC at 48 VDC
Isolation: ± 300 Vpk

2.2.5 COMMUNICATIONS

RS232

Front Port: 19.2 kbps, Modbus® RTU

RS485

1 or 2 Rear Ports: Up to 115 kbps, Modbus® RTU, isolated together at 36 Vpk
Typical Distance: 1200 m

ETHERNET PORT

10BaseF: 820 nm, multi-mode, half-duplex fiber optic with ST connector
Redundant 10BaseF: 820 nm, multi-mode, half-duplex fiber optic with ST connector
Power Budget: 10 db
Max Optical Ip Power: –7.6 dBm
Typical Distance: 1.65 km

2.2.6 ENVIRONMENTAL

Operating Temperatures:
–10°C to +60°C

Ambient StorageTemperatures:
–40° C to +80° C

Humidity (noncondensing):
Up to 95%

Altitude: Up to 2000 m

Installation Category: II

2.2.7 TYPE TESTS

Electrical Fast Transient:
ANSI/IEEE C37.90.1
EN 61000-4-4

Oscillatory Transient: ANSI/IEEE C37.90.1

Insulation Resistance: IEC 255-5

Dielectric Strength: IEC 255-6, Series C 2240V
ANSI/IEEE C37.90

Electrostatic Discharge:
EN 61000-4-2

Surge Immunity: EN 61000-4-5

RFI Susceptibility: ANSI/IEEE C37.90.2
EN 61000-4-3

NOTE

Type test report available upon request.

2.2.8 PRODUCTION TESTS

DIELECTRIC STRENGTH

ANSI/IEEE C37.90:

AC: CT, VT, Control Power, and Contact Inputs

DC: Contact Outputs

2.2.9 APPROVALS

APPROVALS

UL Certification applied for.

CSA Certification applied for.

Manufactured under an ISO9000 Registered system.

CE: 73/23/EEC, 89/336/EEC
IEC 947-1
IEC 1010-1:1990+ A 1:1992+ A 2:1995
CISPR 11 / EN 55011:1997
EN 50082-2:1997
IEC 1000-4-3 / EN 61000-4-3
EN 61000-4-6

2.2.10 MAINTENANCE

CLEANING

Normally, cleaning is not required; but for situations where dust has accumulated on the faceplate display, a dry cloth can be used.

3.1.1 PANEL CUTOUT

The relay is available as a 19 inch rack horizontal mount unit or as a reduced size (¾) vertical mount unit, with a removable faceplate. The modular design allows the relay to be easily upgraded or repaired by a qualified service person. The faceplate is hinged to allow easy access to the removable modules, and is itself removable to allow mounting on doors with limited rear depth. There is also a removable dust cover that fits over the faceplate, which must be removed when attempting to access the keypad or RS232 communications port.

The vertical and horizontal case dimensions are as shown in the dimension drawings below, along with panel cutout details for panel mounting. When planning the location of your panel cutout, ensure that provision is made for the faceplate to swing open without interference to or from adjacent equipment.

The relay must be mounted such that the faceplate sits semi-flush with the panel or switchgear door, allowing the operator access to the keypad and the RS232 communications port. The relay is secured to the panel with the use of four screws supplied with the relay.

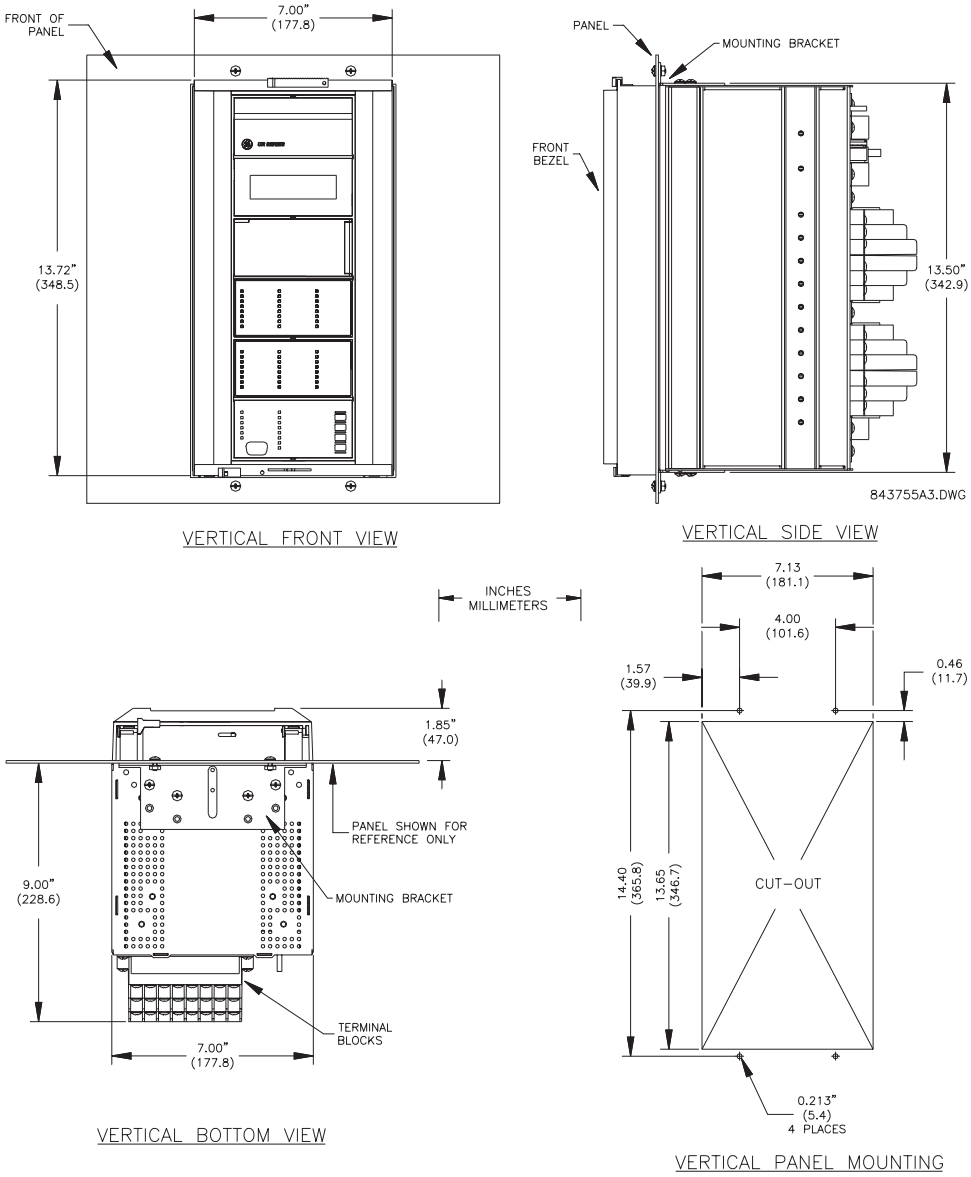


Figure 3–1: UR VERTICAL MOUNTING AND DIMENSIONS

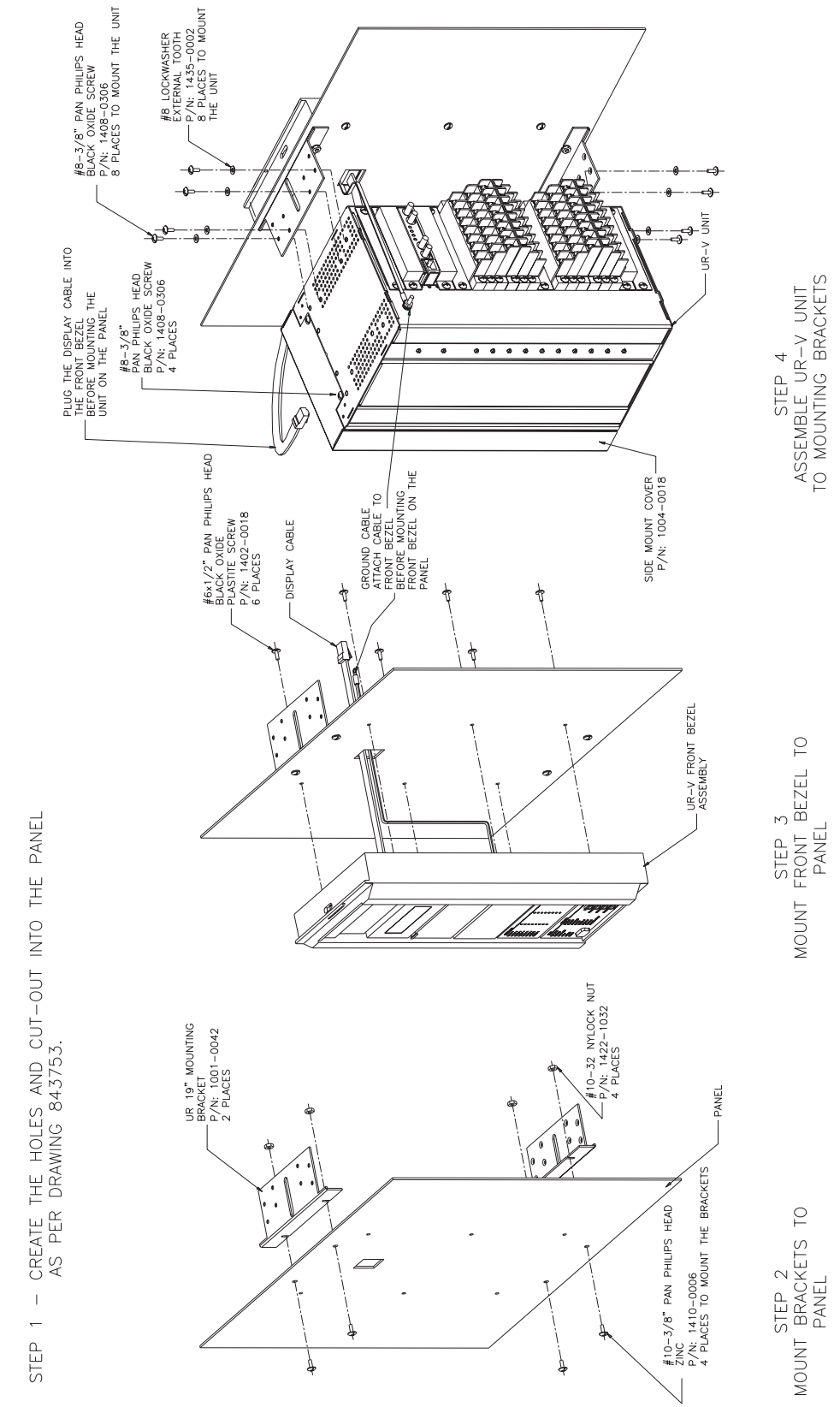


Figure 3–2: UR VERTICAL SIDE MOUNTING INSTALLATION

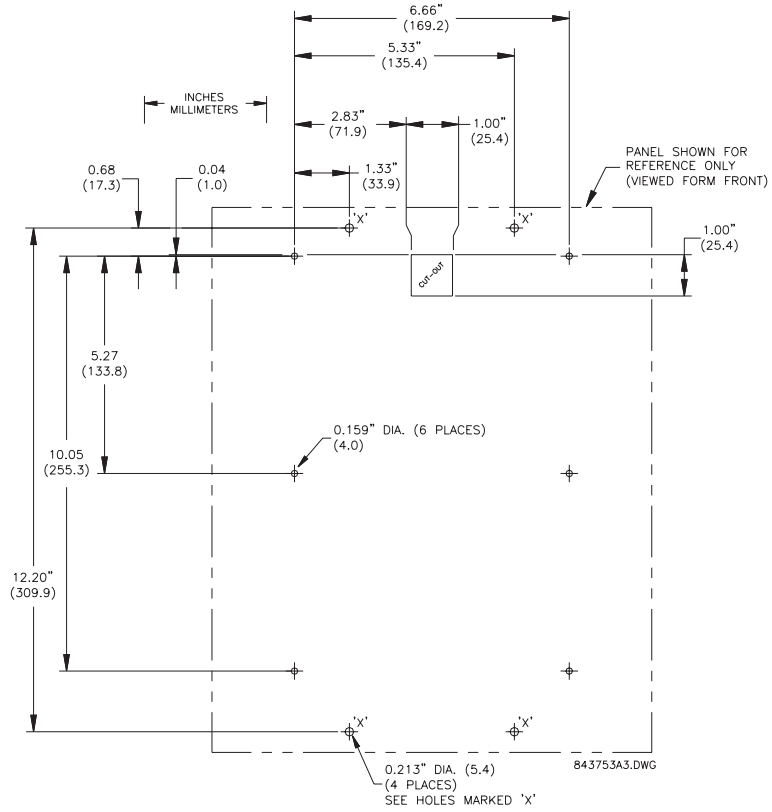


Figure 3–3: UR VERTICAL SIDE MOUNTING REAR DIMENSIONS

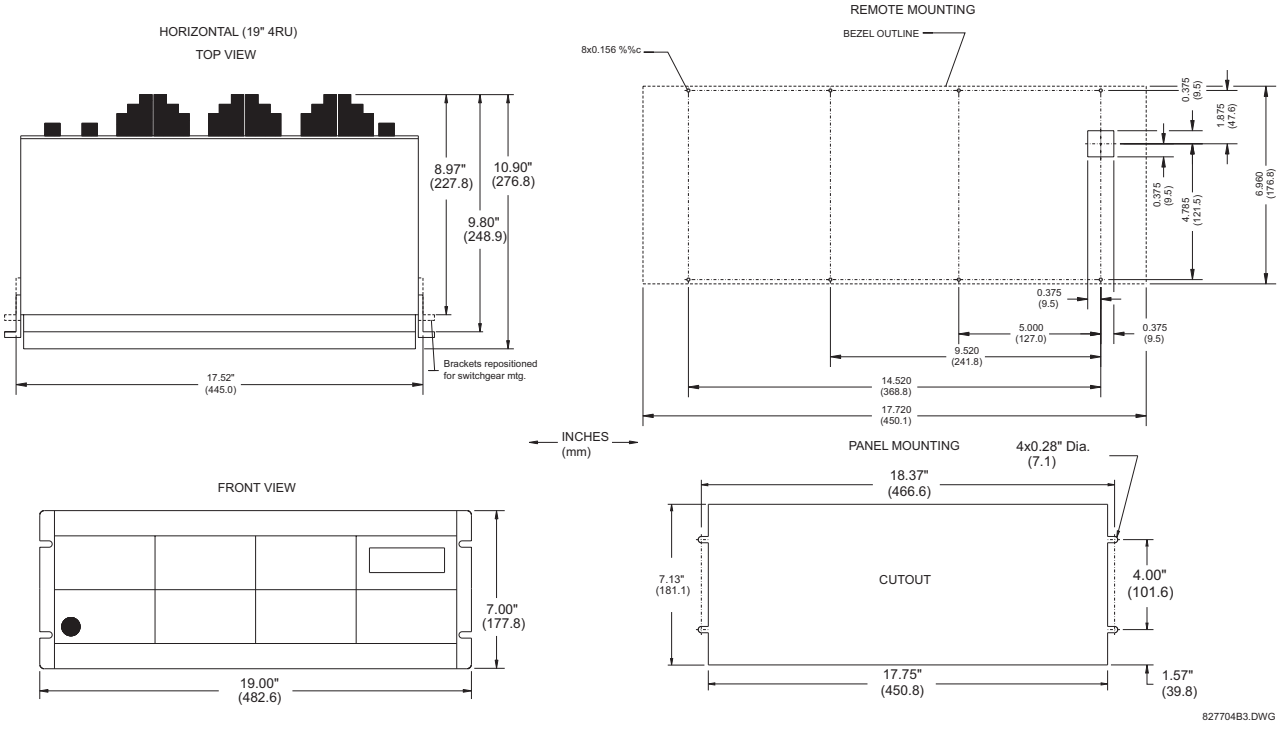


Figure 3–4: UR HORIZONTAL MOUNTING AND DIMENSIONS

WARNING

Module withdrawal and insertion may only be performed when control power has been removed from the unit. Inserting an incorrect module type into a slot may result in personal injury, damage to the unit or connected equipment, or undesired operation!

WARNING

Proper electrostatic discharge protection (i.e. static strap) must be used when coming in contact with modules while the relay is energized!

The relay, being modular in design, allows for the withdrawal and insertion of modules. Modules must only be replaced with like modules in their original factory configured slots.

The faceplate can be opened to the left, once the sliding latch on the right side has been pushed up, as shown in the figure below. This allows for easy accessibility of the modules for withdrawal.

Figure 3–5: UR MODULE WITHDRAWAL/INSERTION

WITHDRAWAL: The ejector/inserter clips, located at the top and bottom of each module, must be pulled simultaneously to release the module for removal. Before performing this action, **control power must be removed from the relay**. Record the original location of the module to ensure that the same or replacement module is inserted into the correct slot.

INSERTION: Ensure that the **correct** module type is inserted into the **correct** slot position. The ejector/inserter clips located at the top and at the bottom of each module must be in the disengaged position as the module is smoothly inserted into the slot. Once the clips have cleared the raised edge of the chassis, engage the clips simultaneously. When the clips have locked into position, the module will be fully inserted.

NOTE

Type 9C and 9D CPU modules are equipped with 10BaseT and 10BaseF Ethernet connectors for communications. These connectors must be individually disconnected from the module before the module can be removed from the chassis.

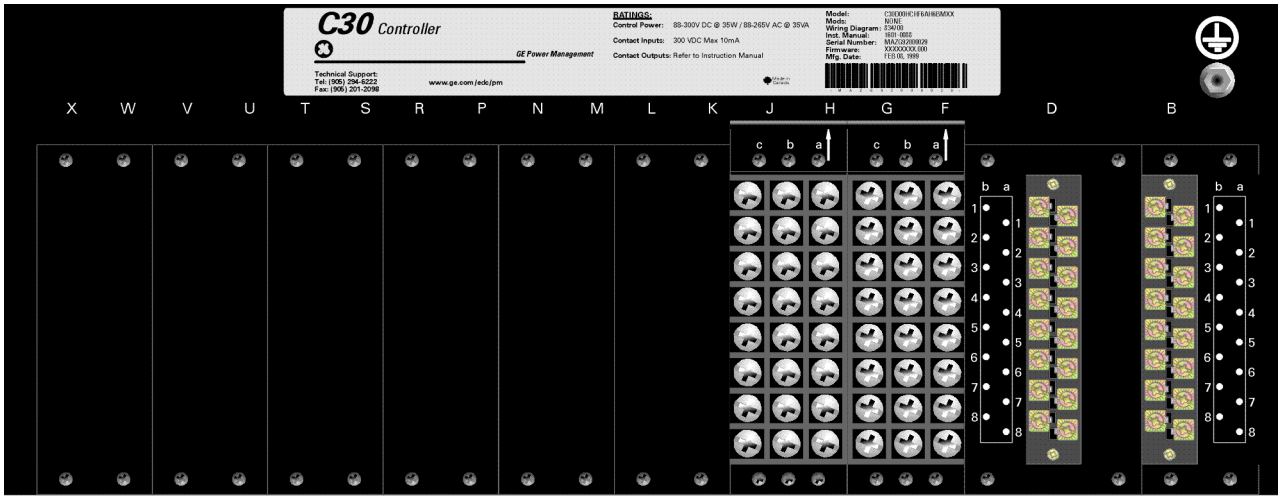


Figure 3–6: REAR TERMINAL VIEW

Do not touch any rear terminals while the relay is energized!

WARNING

a) REAR TERMINAL ASSIGNMENTS

The relay follows a convention with respect to terminal number assignments which are three characters long assigned in order by module slot position, row number, and column letter. Two-slot wide modules take their slot designation from the first slot position (nearest to CPU module) which is indicated by an arrow marker on the terminal block. See the following figure for an example of rear terminal assignments.

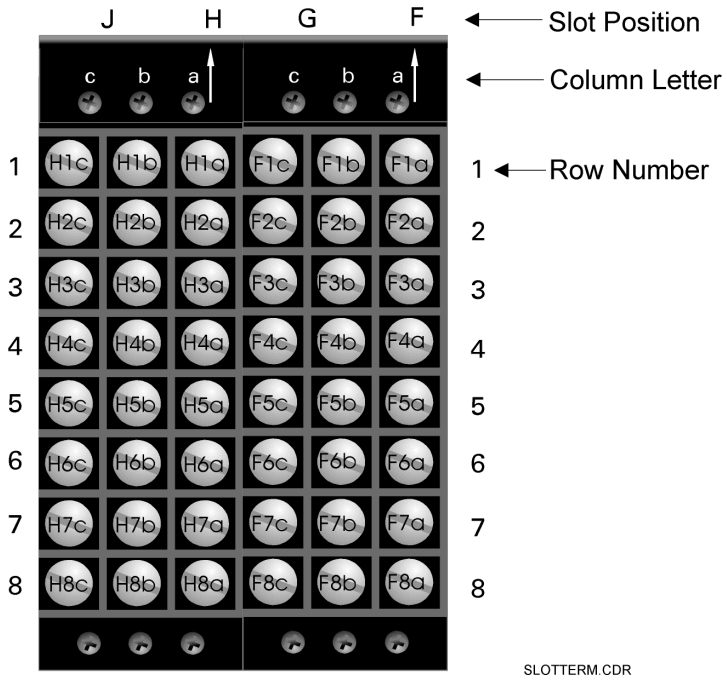
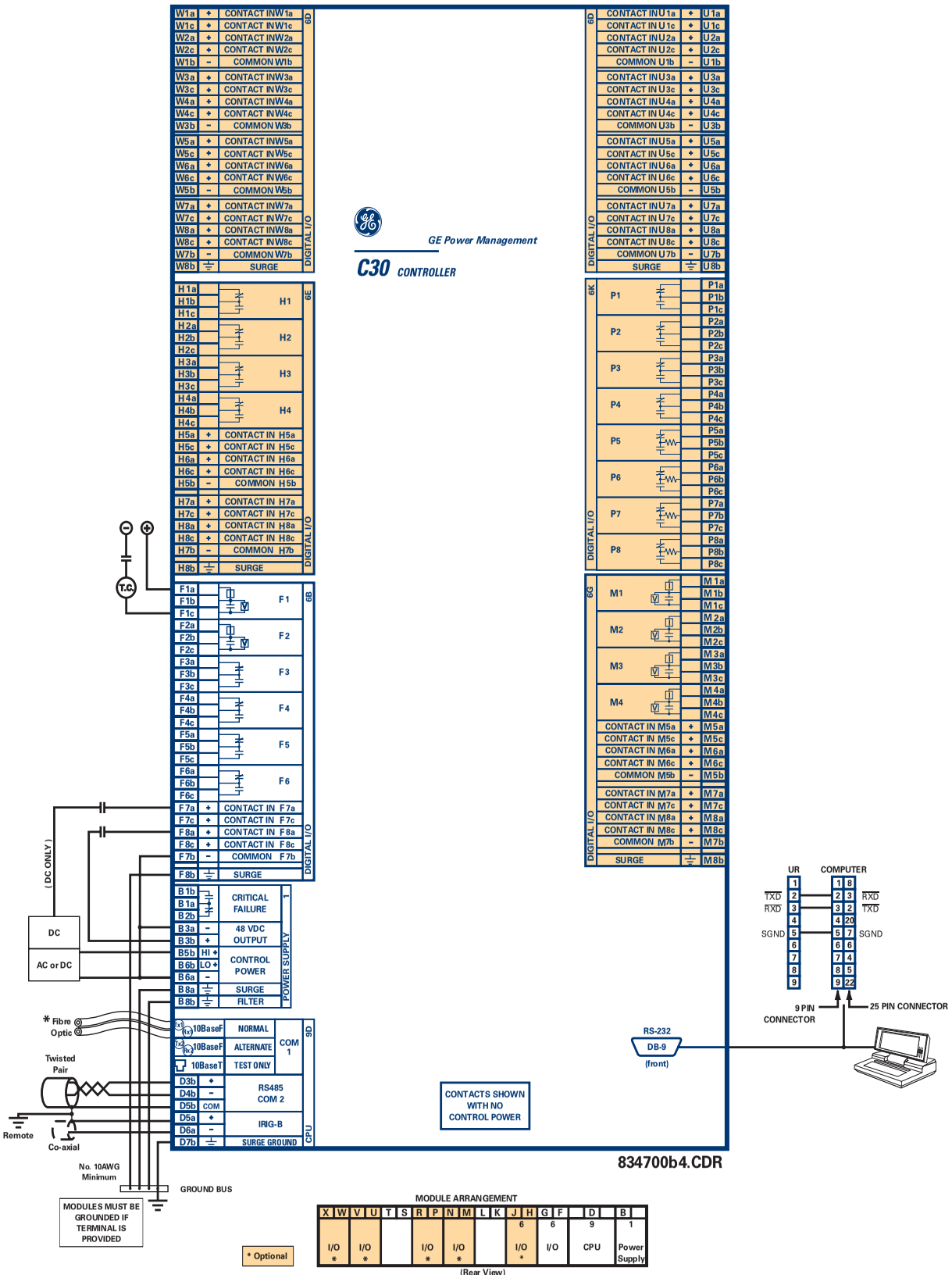


Figure 3–7: EXAMPLE OF MODULES IN F & H SLOTS



CAUTION

This diagram is based on the following order code: C30-D00-HCH-F6B-H6E-M6G-P6K-U6D-W6D.

The purpose of this diagram is to provide an example of how the relay is typically wired, not specifically how to wire your own relay. Please refer to the following pages for examples to help you wire your relay correctly based on your own relay configuration and order code.

Figure 3–8: TYPICAL WIRING DIAGRAM

3.2.2 DIELECTRIC STRENGTH RATINGS AND TESTING

a) RATINGS

The dielectric strength of UR module hardware is shown in the following table:

Table 3–1: DIELECTRIC STRENGTH OF UR MODULE HARDWARE

MODULE TYPE	MODULE FUNCTION	TERMINALS		DIELECTRIC STRENGTH (AC)
		FROM	TO	
1	Power Supply	High(+); Low(+); (–)	Chassis	2000 V AC for 1 min. (See Precaution 1)
1	Power Supply	48 VDC (+) and (–)	Chassis	2000 V AC for 1 min. (See Precaution 1)
1	Power Supply	Relay Terminals	Chassis	2000 VAC for 1 min. (See Precaution 1)
2	Reserved for Future	N/A	N/A	N/A
3	Reserved for Future	N/A	N/A	N/A
4	Reserved for Future	N/A	N/A	N/A
5	Analog I/O	All except 8b	Chassis	< 50 V DC
6	Digital I/O	All (See Precaution 2)	Chassis	2000 V AC for 1 min.
7R	L90 G.703	All except 2b,3a,7b,8a	Chassis	2000 V AC for 1 min.
7T	L90 RS422	All except 6a, 7b, 8a	Chassis	< 50 V DC
8	CT/VT	All	Chassis	2000 V AC for 1 min.
9	CPU	All except 7b	Chassis	< 50 VDC

b) TESTING

Filter networks and transient protection clamps are used in module hardware to prevent damage caused by high peak voltage transients, radio frequency interference (RFI) and electromagnetic interference (EMI). These protective components **can be damaged** by application of the ANSI/IEEE C37.90 specified test voltage for a period longer than the specified one minute. For testing of dielectric strength where the test interval may exceed one minute, always observe the following precautions:

Test Precautions:

1. The connection from ground to the Filter Ground (terminal 8b) and Surge Ground (terminal 8a) must be removed before testing.
2. Some versions of the digital I/O module have a Surge Ground connection on terminal 8b. On these module types, this connection must be removed before testing.

CAUTION

CONTROL POWER SUPPLIED TO THE RELAY MUST BE CONNECTED TO THE MATCHING POWER SUPPLY RANGE OF THE RELAY. IF THE VOLTAGE IS APPLIED TO THE WRONG TERMINALS, DAMAGE MAY OCCUR!

The power supply module can be ordered with either of two possible voltage ranges. Each range has a dedicated input connection for proper operation. The ranges are as shown below (see the Technical Specifications section for details).

Table 3–2: CONTROL POWER VOLTAGE RANGE

RANGE	NOMINAL VOLTAGE
LO	24 to 48 V (DC only)
HI	125 to 250 V

The power supply module provides power to the relay and supplies power for dry contact input connections.

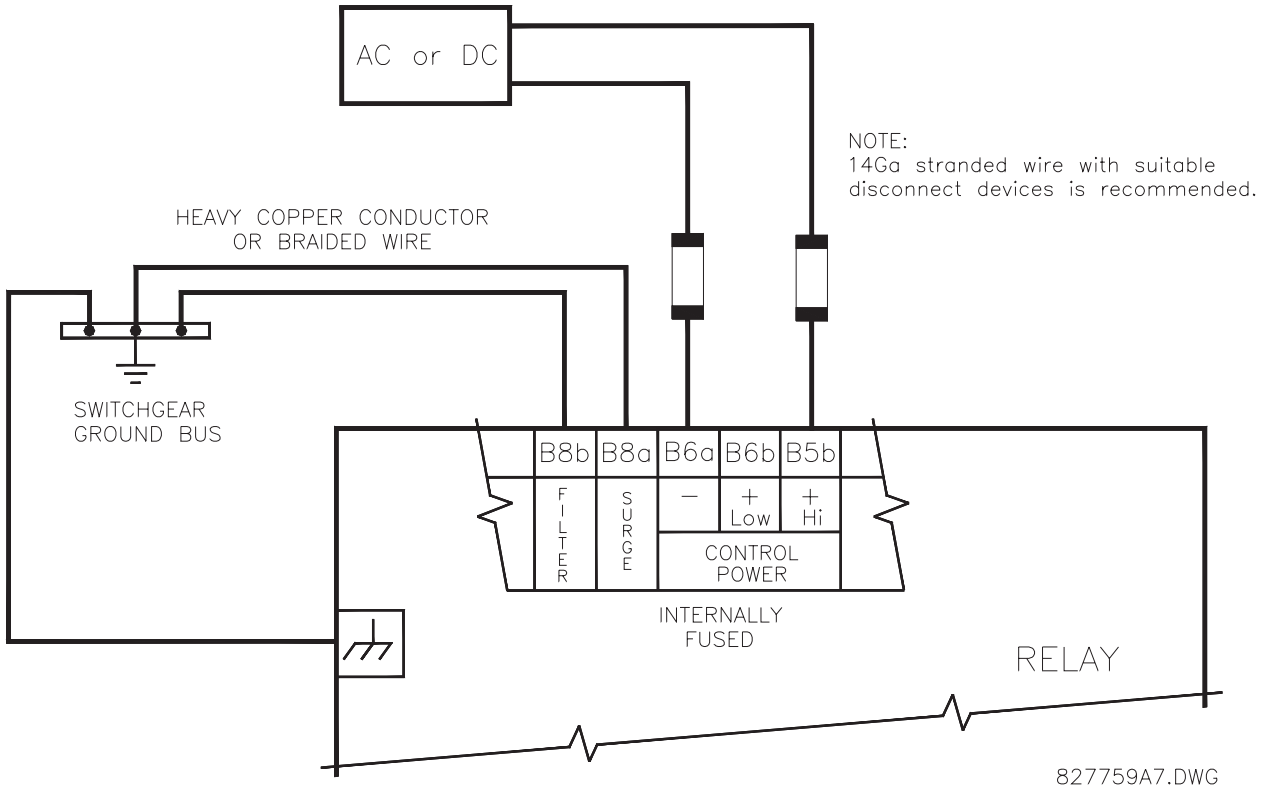


Figure 3–9: CONTROL POWER CONNECTION

The power supply module provides 48 V DC power for dry contact input connections and a critical failure relay (see TYPICAL WIRING DIAGRAM). The critical failure relay is a Form-C that will be energized once control power is applied and the relay has successfully booted up with no critical self-test failures. If any of the on-going self-test features detect a critical failure or control power is lost, the relay will de-energize.

3.2.4 CONTACT INPUTS/OUTPUTS

Every digital I/O module has 24 terminal connections. They are arranged as 3 terminals per row, with 8 rows in total. A given row of three terminals may be used for the outputs of one relay. For example, for Form-C relay outputs, the terminals connect to the normally open (NO), normally closed (NC), and common contacts of the relay. For a Form-A output, there are options of using current or voltage detection for feature supervision, depending on the module ordered. The terminal configuration for contact inputs is different for the two applications. When a digital I/O module is ordered with contact inputs, they are arranged in groups of four and use two rows of three terminals. Ideally, each input would be totally isolated from any other input. However, this would require that every input have two dedicated terminals and limit the available number of contacts based on the available number of terminals. So, although each input is individually optically isolated, each group of four inputs uses a single common as a reasonable compromise. This allows each group of four outputs to be supplied by wet contacts from different voltage sources (if required) or a mix of wet and dry contacts.

The following tables and diagrams below illustrate the module types (6A, etc.) and contact arrangements that may be ordered for the relay. Since an entire row is used for a single contact output, the name is assigned using the module slot position and row number. However, since there are two contact inputs per row, these names are assigned by module slot position, row number, and column position.

UR RELAY FORM-A OUTPUT CONTACTS

Some Form-A outputs include circuits to monitor the DC voltage across the output contact when it is open, and the DC current through the output contact when it is closed. Each of the monitors contains a level detector whose output is set to logic “On = 1” when the current in the circuit is above the threshold setting. The voltage monitor is set to “On = 1” when the current is above about 1 to 2.5 mA, and the current monitor is set to “On = 1” when the current exceeds about 80 to 100 mA. The voltage monitor is intended to check the health of the overall trip circuit, and the current monitor can be used to seal-in the output contact until an external contact has interrupted current flow. The block diagrams of the circuits are shown below for the Form-A outputs with:

a) optional voltage monitor

b) optional current monitor

c) with no monitoring

The operation of voltage and current monitors is reflected with the corresponding FlexLogic™ operands (Cont Op # Von, Cont Op # Voff, Cont Op # Ion, and Cont Op # Ioff) which can be used in protection, control and alarm logic. The typical application of the voltage monitor is Breaker Trip Circuit Integrity monitoring; a typical application of the Current monitor is seal-in of the control command. Refer DIGITAL ELEMENTS section for an example of how Form A contacts can be applied for Breaker Trip Circuit Integrity Monitoring.

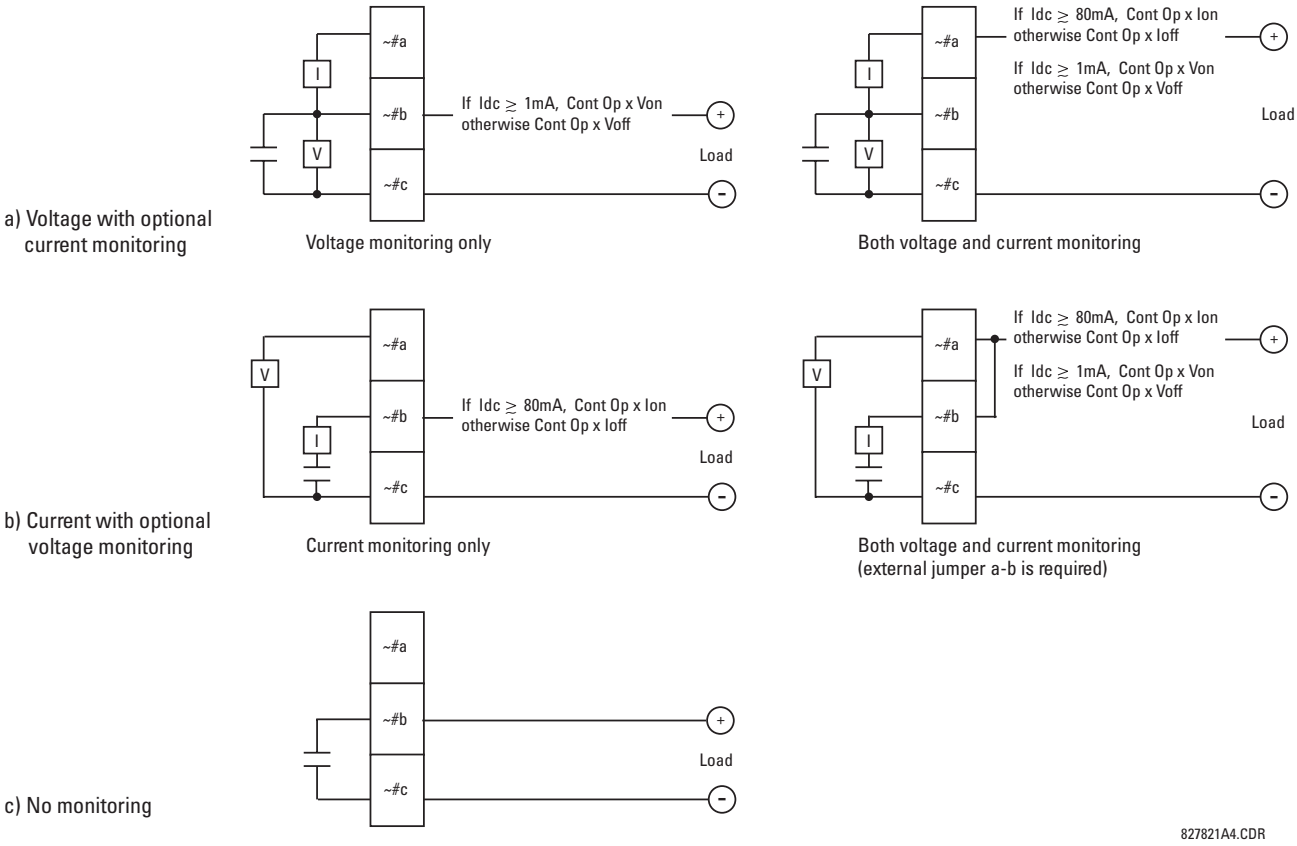


Figure 3–10: FORM-A CONTACT FUNCTIONS

NOTE: Use of Form-A Outputs in High Impedance Circuits

For Form-A output contacts that are internally equipped with a voltage measuring cIrcuit across the contact, the circuit has an impedance that can cause a problem when used in conjunction with external high input impedance monitoring equipment such as modern relay test set trigger circuits. These monitoring circuits may continue to read the Form-A contact as being closed after it has closed and subsequently opened, when measured as an impedance.

The solution to this problem is to use the voltage measuring trigger input of the relay test set, and connect the Form-A contact through a voltage-dropping resistor to a DC voltage source. If the 48 V DC output of the power supply is used as a source, a 500 Ω, 10 W resistor is appropriate. In this configuration, the voltage across either the Form-A contact or the resistor can be used to monitor the state of the output.

NOTE

Wherever a tilde "~" symbol appears, substitute with the Slot Position of the module.

Table 3–3: DIGITAL I/O MODULE ASSIGNMENTS

~6A I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-C
~4	Form-C
~5a, ~5c	2 Inputs
~6a, ~6c	2 Inputs
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6B I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-C
~4	Form-C
~5	Form-C
~6	Form-C
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6C I/O MODULE	
Terminal Assignment	**Output**
~1	Form-C
~2	Form-C
~3	Form-C
~4	Form-C
~5	Form-C
~6	Form-C
~7	Form-C
~8	Form-C

~6D I/O MODULE	
Terminal Assignment	**Input**
~1a, ~1c	2 Inputs
~2a, ~2c	2 Inputs
~3a, ~3c	2 Inputs
~4a, ~4c	2 Inputs
~5a, ~5c	2 Inputs
~6a, ~6c	2 Inputs
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6E I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-C
~2	Form-C
~3	Form-C
~4	Form-C
~5a, ~5c	2 Inputs
~6a, ~6c	2 Inputs
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6F I/O MODULE	
Terminal Assignment	**Output**
~1	Fast Form-C
~2	Fast Form-C
~3	Fast Form-C
~4	Fast Form-C
~5	Fast Form-C
~6	Fast Form-C
~7	Fast Form-C
~8	Fast Form-C

~6G I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-A
~4	Form-A
~5a, ~5c	2 Inputs
~6a, ~6c	2 Inputs
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6H I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-A
~4	Form-A
~5	Form-A
~6	Form-A
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6K I/O MODULE	
Terminal Assignment	**Output**
~1	Form-C
~2	Form-C
~3	Form-C
~4	Form-C
~5	Fast Form-C
~6	Fast Form-C
~7	Fast Form-C
~8	Fast Form-C

~6L I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-C
~4	Form-C
~5a, ~5c	2 Inputs
~6a, ~6c	2 Inputs
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6M I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-C
~4	Form-C
~5	Form-C
~6	Form-C
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6N I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-A
~4	Form-A
~5a, ~5c	2 Inputs
~6a, ~6c	2 Inputs
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6P I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-A
~4	Form-A
~5	Form-A
~6	Form-A
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6R I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-C
~4	Form-C
~5a, ~5c	2 Inputs
~6a, ~6c	2 Inputs
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6S I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-C
~4	Form-C
~5	Form-C
~6	Form-C
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6T I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-A
~4	Form-A
~5a, ~5c	2 Inputs
~6a, ~6c	2 Inputs
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

~6U I/O MODULE	
Terminal Assignment	**Output or Input**
~1	Form-A
~2	Form-A
~3	Form-A
~4	Form-A
~5	Form-A
~6	Form-A
~7a, ~7c	2 Inputs
~8a, ~8c	2 Inputs

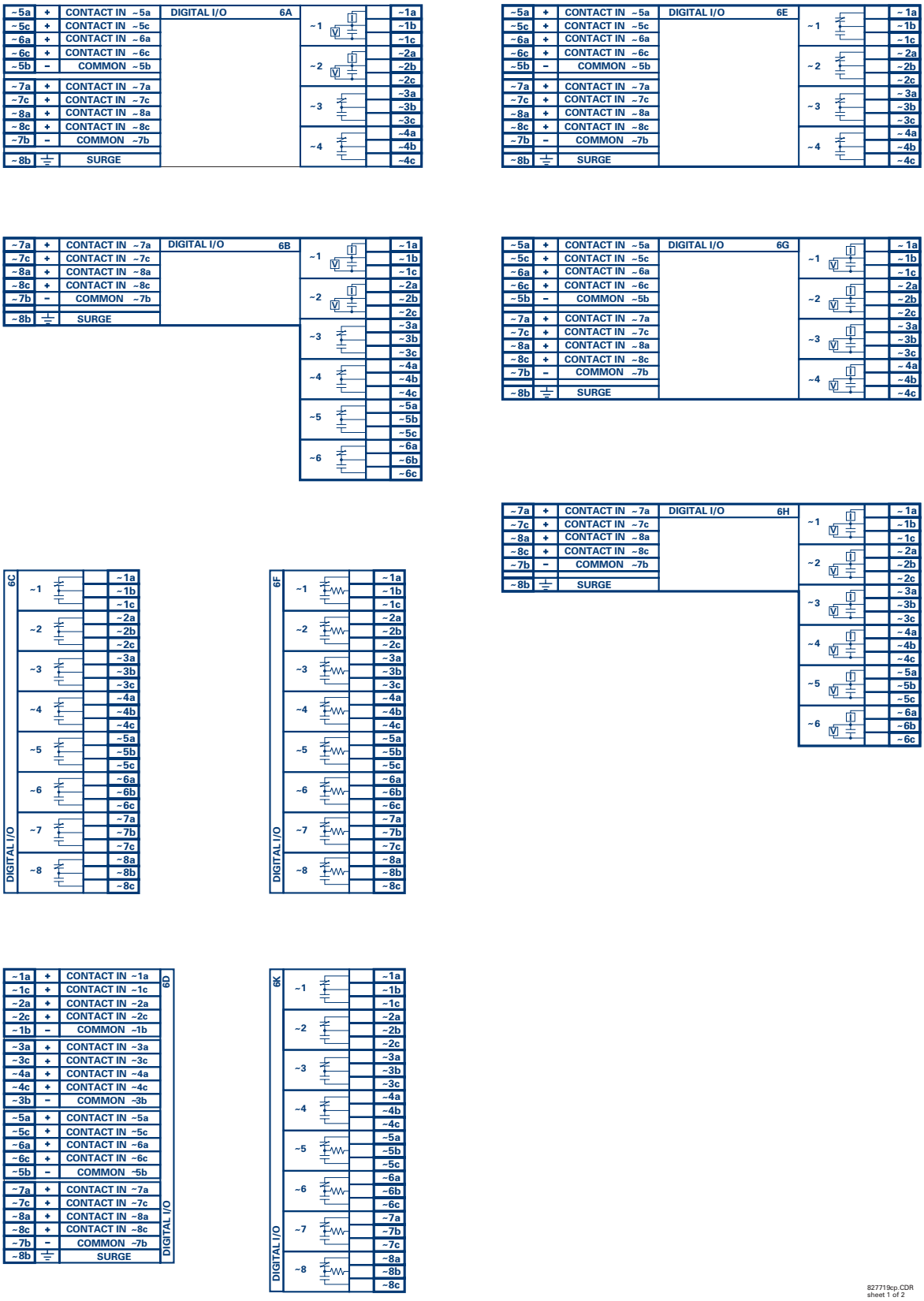


Figure 3–11: DIGITAL I/O MODULE WIRING (*Sheet 1 of 2*)

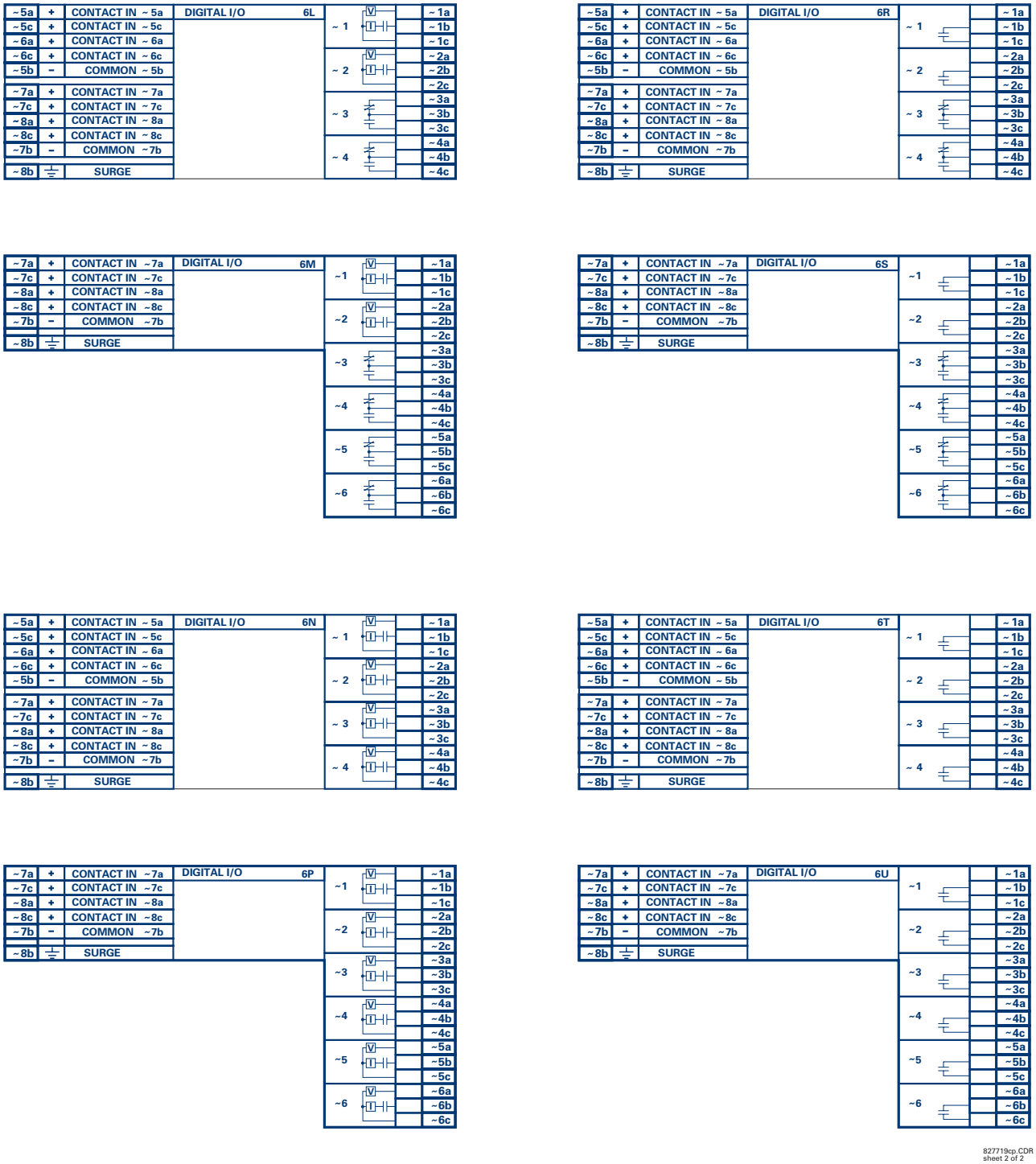


Figure 3–12: DIGITAL I/O MODULE WIRING (*Sheet 2 of 2*)

CAUTION

CORRECT POLARITY MUST BE OBSERVED FOR ALL CONTACT INPUT CONNECTIONS OR EQUIPMENT DAMAGE MAY RESULT.

A dry contact has one side connected to terminal B3b. This is the positive 48 VDC voltage rail supplied by the power supply module. The other side of the dry contact is connected to the required contact input terminal. Each contact input group has its own common (negative) terminal which must be connected to the DC negative terminal (B3a) of the power supply module. When a dry contact closes, a current of 1 to 3 mA will flow through the associated circuit.

A wet contact has one side connected to the positive terminal of an external DC power supply. The other side of this contact is connected to the required contact input terminal. In addition, the negative side of the external source must be connected to the relay common (negative) terminal of each contact input group. The maximum external source voltage for this arrangement is 300 V DC.

The voltage threshold at which each group of four contact inputs will detect a closed contact input is programmable as 16 V DC for 24 V sources, 30 V DC for 48 V sources, 80 V DC for 110 to 125 V sources, and 140 V DC for 250 V sources.

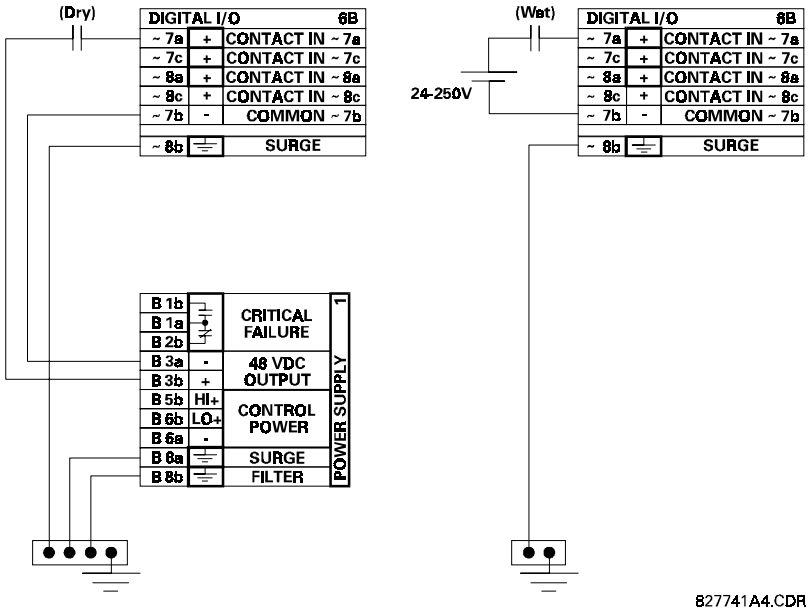


Figure 3–13: DRY AND WET CONTACT INPUT CONNECTIONS

Wherever a tilde "~" symbol appears, substitute with the Slot Position of the module.

NOTE

Contact outputs may be ordered as Form-A or Form-C. The Form A contacts may be connected for external circuit supervision. These contacts are provided with voltage and current monitoring circuits used to detect the loss of DC voltage in the circuit, and the presence of DC current flowing through the contacts when the Form-A contact closes. If enabled, the current monitoring can be used as a seal-in signal to ensure that the Form-A contact does not attempt to break the energized inductive coil circuit and weld the output contacts.

3.2.5 TRANSDUCER INPUTS/OUTPUTS

Transducer input/output modules can receive input signals from external dcmA output transducers (DCMA INPUT) or resistance temperature detectors (RTD INPUT). Hardware and software is provided to receive signals from these external transducers and convert these signals into a digital format for use as required.

Every transducer input/output module has a total of 24 terminal connections. These connections are arranged as three terminals per row with a total of eight rows. A given row may be used for either inputs or outputs, with terminals in column "a" having positive polarity and terminals in column "c" having negative polarity. Since an entire row is used for a single input/output channel, the name of the channel is assigned using the module slot position and row number.

Each module also requires that a connection from an external ground bus be made to terminal 8b.

The figure below illustrates the transducer module types (5F, etc.) and channel arrangements that may be ordered for the relay.

NOTE

Wherever a tilde "~" symbol appears, substitute with the Slot Position of the module.

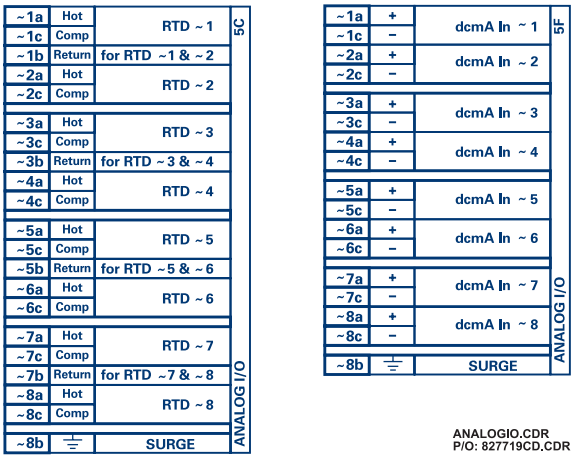


Figure 3–14: TRANSDUCER I/O MODULE WIRING

3.2.6 RS232 FACEPLATE PROGRAM PORT

A 9 pin RS232C serial port is located on the relay's faceplate for programming with a portable (personal) computer. All that is required to use this interface is a personal computer running the URPC software provided with the relay. Cabling for the RS232 port is shown in the following figure for both 9 pin and 25 pin connectors.

Note that the baud rate for this port is fixed at **19200 bps**.

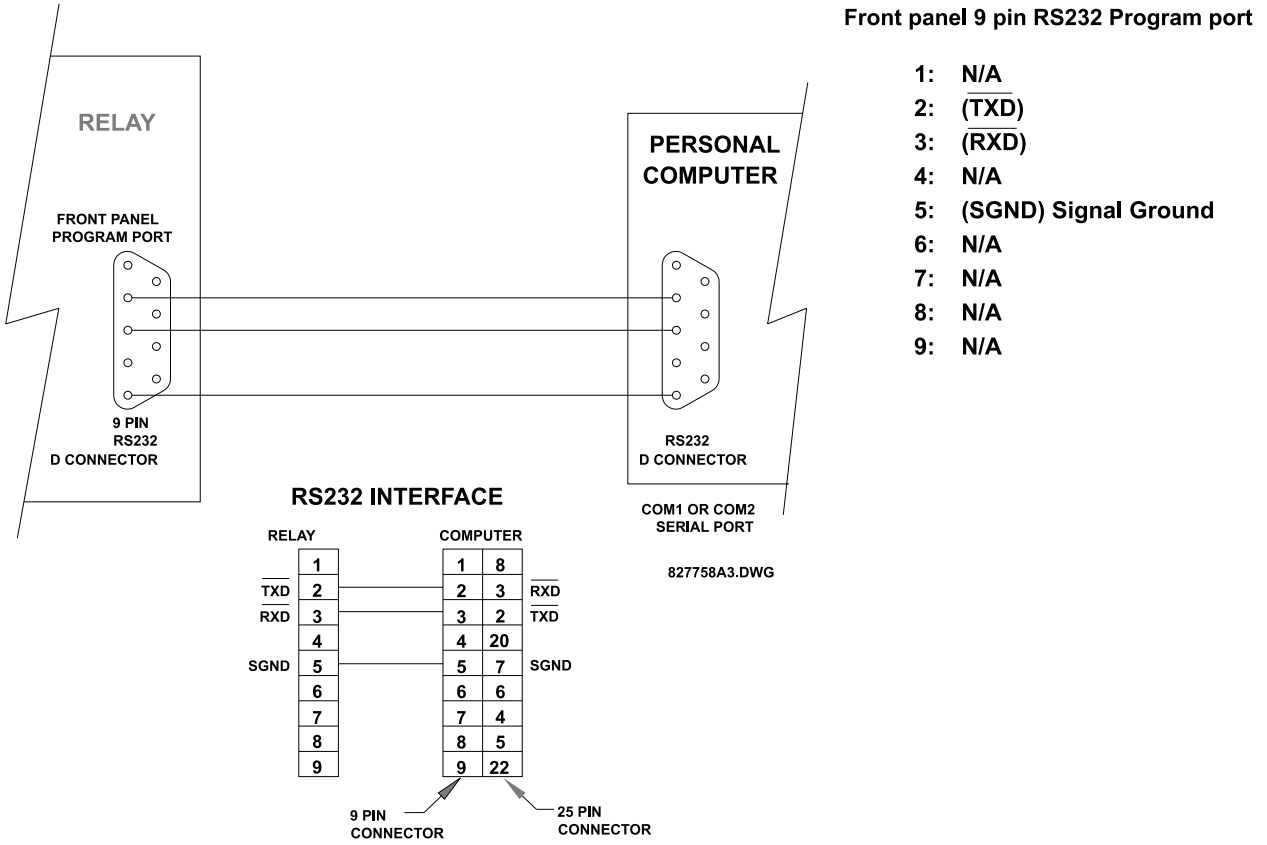


Figure 3–15: RS232 FACEPLATE PORT CONNECTION

3.2.7 CPU COMMUNICATION PORTS

In addition to the RS232 port on the faceplate, the relay provides the user with two additional communication port(s) depending on the CPU module installed.

Table 3–4: CPU COMMUNICATION PORT OPTIONS

CPU TYPE	COM 1	COM 2
9A	RS485	RS485
9C	10BASE-F	RS485
9D	Redundant 10BASE-F	RS485

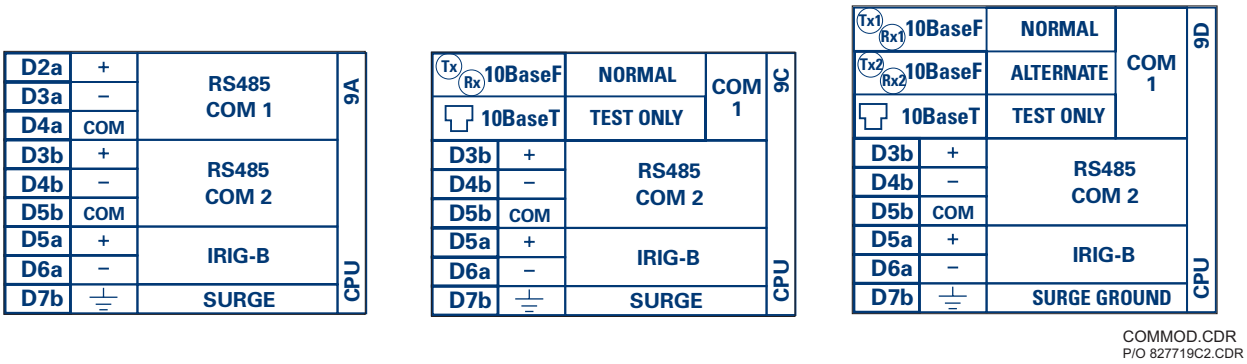


Figure 3–16: CPU MODULE COMMUNICATIONS WIRING

a) RS485 PORTS

RS485 data transmission and reception are accomplished over a single twisted pair with transmit and receive data alternating over the same two wires. Through the use of these port(s), continuous monitoring and control from a remote computer, SCADA system or PLC is possible.

To minimize errors from noise, the use of shielded twisted pair wire is recommended. Correct polarity must also be observed. For instance, the relays must be connected with all RS485 “+” terminals connected together, and all RS485 “-” terminals connected together. The COM terminal should be connected to the common wire inside the shield, when provided. To avoid loop currents, the shield should be grounded at one point only. Each relay should also be daisy chained to the next one in the link. A maximum of 32 relays can be connected in this manner without exceeding driver capability. For larger systems, additional serial channels must be added. It is also possible to use commercially available repeaters to increase the number of relays on a single channel to more than 32. Star or stub connections should be avoided entirely.

Lightning strikes and ground surge currents can cause large momentary voltage differences between remote ends of the communication link. For this reason, surge protection devices are internally provided at both communication ports. An isolated power supply with an optocoupled data interface also acts to reduce noise coupling. To ensure maximum reliability, all equipment should have similar transient protection devices installed.

Both ends of the RS485 circuit should also be terminated with an impedance as shown in the figure: RS485 SERIAL CONNECTION.

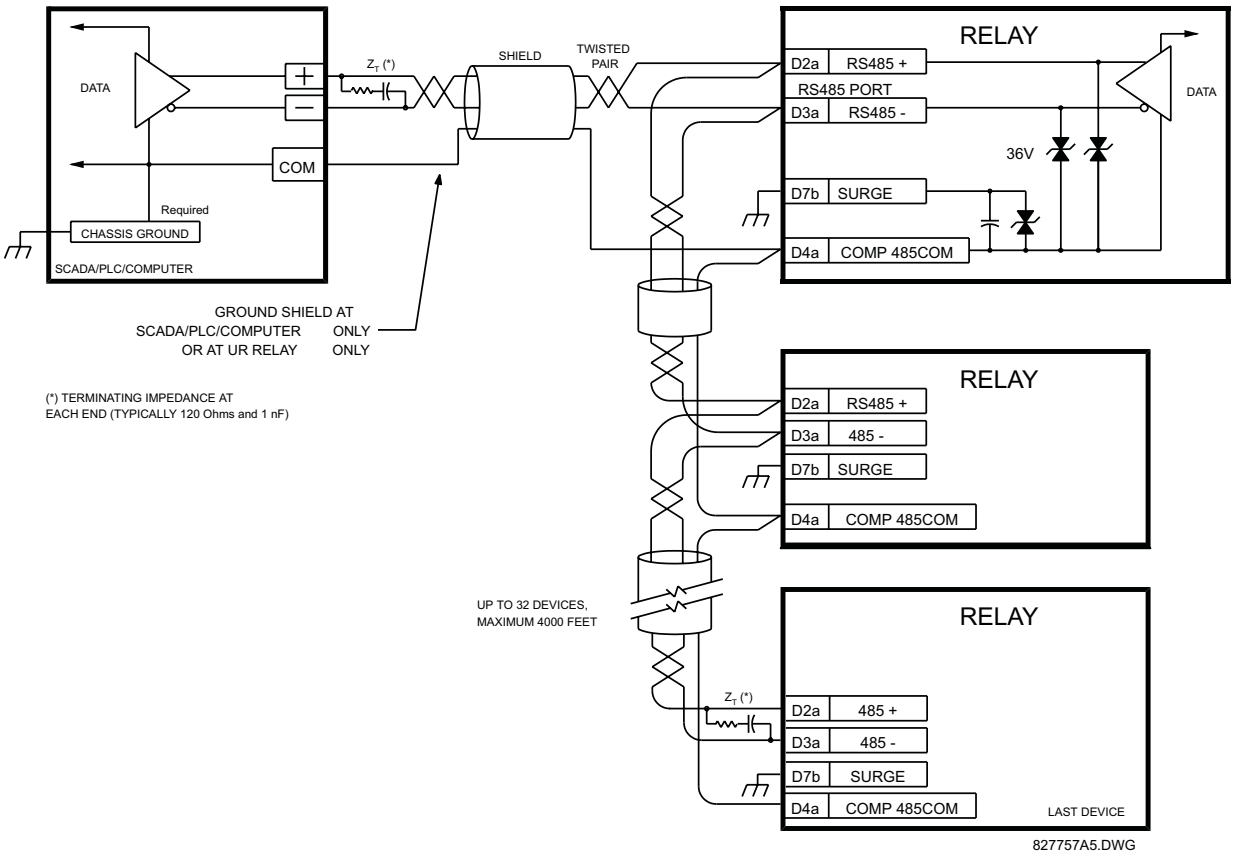


Figure 3–17: RS485 SERIAL CONNECTION

b) 10BASE-F FIBER OPTIC PORT

CAUTION

ENSURE THE DUST COVERS ARE INSTALLED WHEN THE FIBER IS NOT IN USE. DIRTY OR SCRATCHED CONNECTORS CAN LEAD TO HIGH LOSSES ON A FIBER LINK.

CAUTION

OBSERVING ANY FIBER TRANSMITTER OUTPUT MAY CAUSE INJURY TO THE EYE.

The fiber optic communication ports allow for fast and efficient communications between relays at 10 Mbps. Optical fiber may be connected to the relay supporting a wavelength of 820 nanometers in multimode. Optical fiber is only available for CPU types 9C and 9D. The 9D CPU has a 10BaseF transmitter and receiver for optical fiber communications and a second pair of identical optical fiber transmitter and receiver for redundancy.

The optical fiber sizes supported include 50/125 µm, 62.5/125 µm and 100/140 µm. The fiber optic port is designed such that the response times will not vary for any core that is 100 µm or less in diameter. For optical power budgeting, splices are required every 1 km for the transmitter/receiver pair (the ST type connector contributes for a connector loss of 0.2 dB). When splicing optical fibers, the diameter and numerical aperture of each fiber must be the same. In order to engage or disengage the ST type connector, only a quarter turn of the coupling is required.

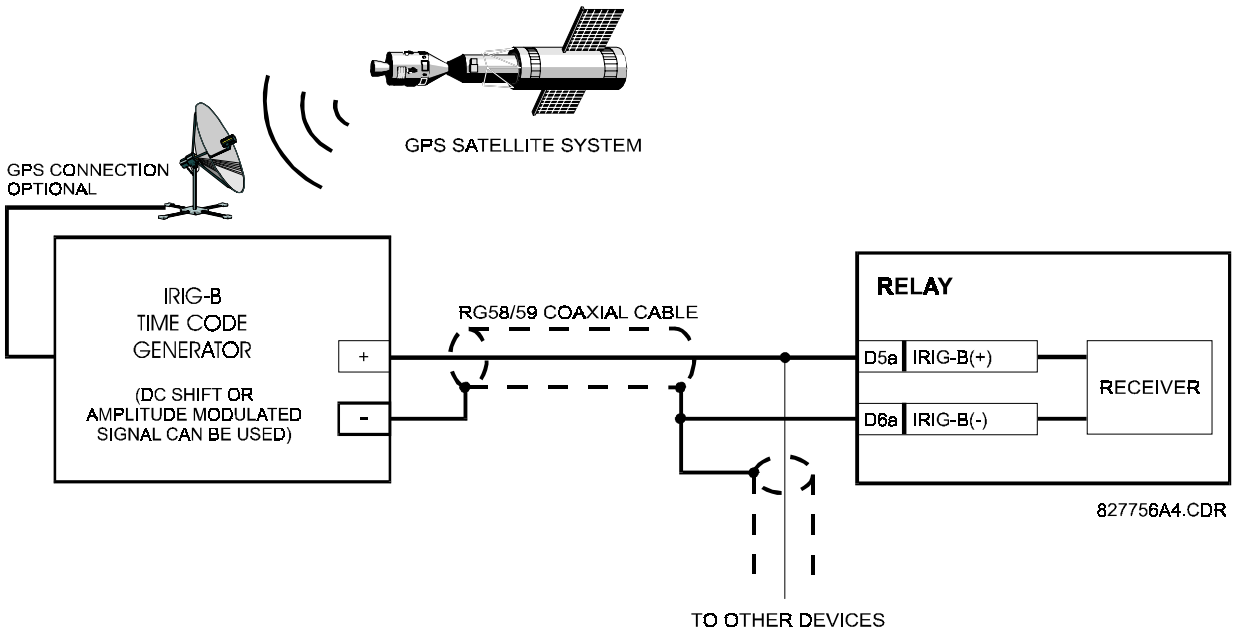


Figure 3–18: IRIG-B CONNECTION

IRIG-B is a standard time code format that allows stamping of events to be synchronized among connected devices within 1 millisecond. The IRIG time code formats are serial, width-modulated codes which can be either DC level shifted or amplitude modulated (AM). Third party equipment is available for generating the IRIG-B signal; this equipment may use a GPS satellite system to obtain the time reference so that devices at different geographic locations can also be synchronized.

The URPC software provides a graphical user interface (GUI) as one of two human interfaces to a UR device. The alternate human interface is implemented via the device's faceplate keypad and display (see FACEPLATE INTERFACE section in this chapter).

The URPC software program provides users with a single facility to configure, monitor, maintain and trouble-shoot the operation of relay functions, connected over local or wide area communication networks.

The URPC software interface can be used while disconnected (i.e. off-line) or connected (i.e. on-line) to a UR device. In off-line mode, you can prepare a file of the device's parameter settings for eventual downloading to the device. In on-line mode, you can communicate with the device in real-time.

The URPC® software, provided with every UR device, can be run from any computer supporting Microsoft® Windows® 95, 98, or NT.

The following figure illustrates an example URPC software screen showing example Site List and Settings List control bar tree menus, and the URPC Help window. This chapter provides a summary of the basic URPC® software interface features. The URPC Help program provides details for getting started and using the URPC® software interface.

a) CREATING A SITE LIST

To start using the URPC program, a Site List must first be created. See the instructions in the URPC Help program under the topic "Creating a Site List".

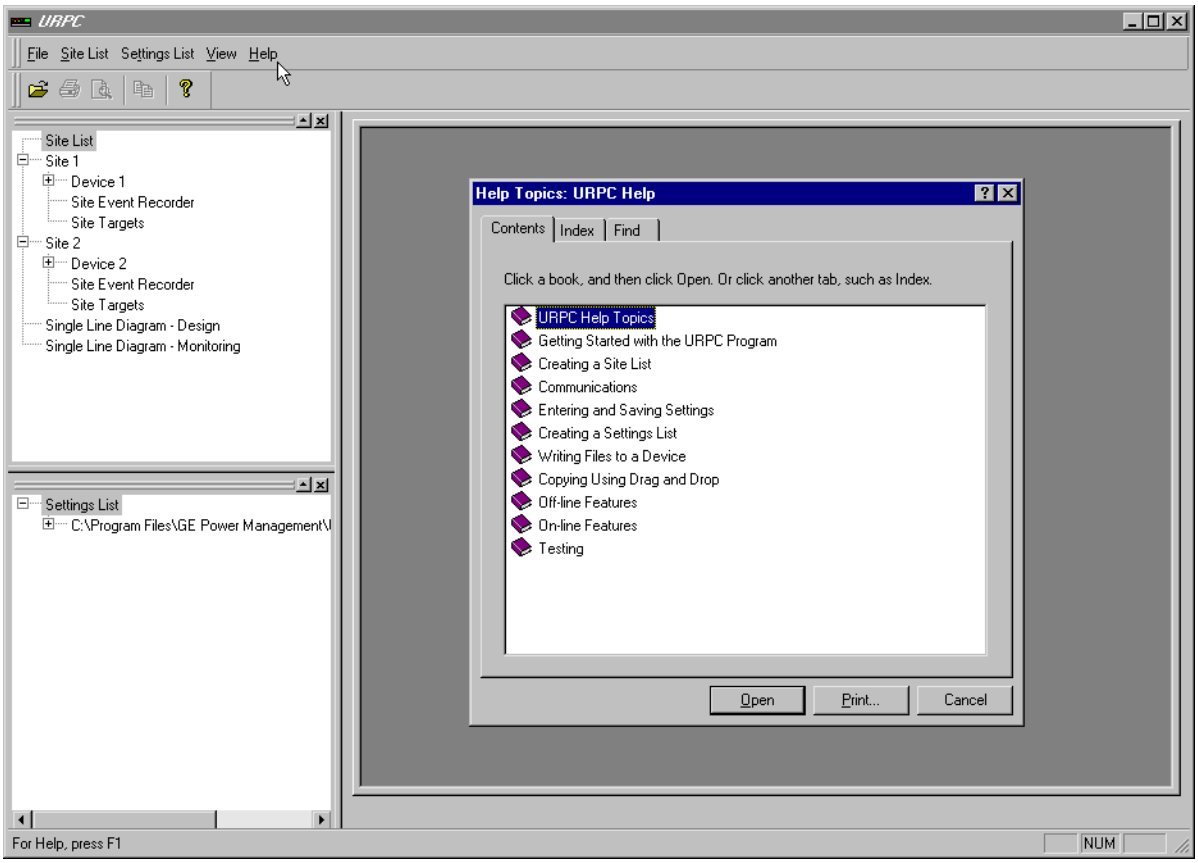


Figure 4–1: EXAMPLE URPC SOFTWARE SCREEN

a) ENGAGING A COMMUNICATING DEVICE

You can use the URPC® software interface in on-line mode (relay connected) to directly communicate with a UR relay.

Communicating relays are organized and grouped by communication interfaces and into sites. Sites may contain any number of relays selected from the UR product series.

b) USING SETTINGS FILES

The URPC® software interface supports three ways of handling changes to relay settings:

- You can initially use the URPC software interface in off-line mode (relay disconnected) to create or edit relay settings files for later writing to communicating relays.
- You can use the interface while connected to a communicating relay to directly modify any relay settings via relay data view windows, and then save the settings to the relay.
- You can create/edit settings files and then write them to the relay while the interface is connected to the relay.

Settings files are organized on the basis of file names assigned by the user. A settings file contains data pertaining to the following types of relay settings:

- Device Definition
- Product Setup
- System Setup
- FlexLogic
- Grouped Elements
- Control Elements
- Inputs/Outputs
- Testing

Factory default values are supplied and can be restored after any changes.

c) CREATING / EDITING FLEXLOGIC™ EQUATIONS

You can create or edit a FlexLogic™ equation in order to customize the relay. You can subsequently view the automatically generated logic diagram.

d) VIEWING ACTUAL VALUES

You can view real-time relay data such as input/output status and measured parameters.

e) VIEWING TRIGGERED EVENTS

While the interface is in either on-line or off-line mode, you can view and analyze data generated by triggered specified parameters, via:

- **Event Recorder facility**

  The event recorder captures contextual data associated with the last 1024 events, listed in chronological order from most recent to oldest.

- **Oscillography facility**

  The oscillography waveform traces and digital states are used to provide a visual display of power system and relay operation data captured during specific triggered events.

f) CREATING INTERACTIVE SINGLE LINE DIAGRAMS

The URPC® software provides an icon-based interface facility for designing and monitoring electrical schematic diagrams of sites employing UR relays.

g) FILE SUPPORT

- **Execution**

  Any URPC file which is double clicked or opened will launch the application, or provide focus to the already opened application. If the file was a settings file (*.urs) which had been removed from the Settings List tree menu, it will be added back to the Settings List tree menu.

- **Drag and Drop**

  The Site List and Settings List control bar windows are each mutually a drag source and a drop target for device-order-code-compatible files or individual menu items. Also, the Settings List control bar window and any Windows Explorer directory folder are each mutually a file drag source and drop target.

  New files which are dropped into the Settings List window are added to the tree which is automatically sorted alphabetically with respect to settings file names.

  Files or individual menu items which are dropped in the selected device menu in the Site List window will automatically be sent to the on-line communicating device.

h) UR FIRMWARE UPGRADES

The firmware of a UR device can be upgraded, locally or remotely, via the URPC® software. The corresponding instructions are provided by the URPC® Help program under the topic “Upgrading Firmware”.

4.1.3 URPC® SOFTWARE MAIN WINDOW

The URPC software main window supports the following primary display components:

a. Title bar which shows the pathname of the active data view

b. Main window menu bar

c. Main window tool bar

d. Site List control bar window

e. Settings List control bar window

f. Device data view window(s), with common tool bar

g. Settings File data view window(s), with common tool bar

h. Workspace area with data view tabs

i. Status bar

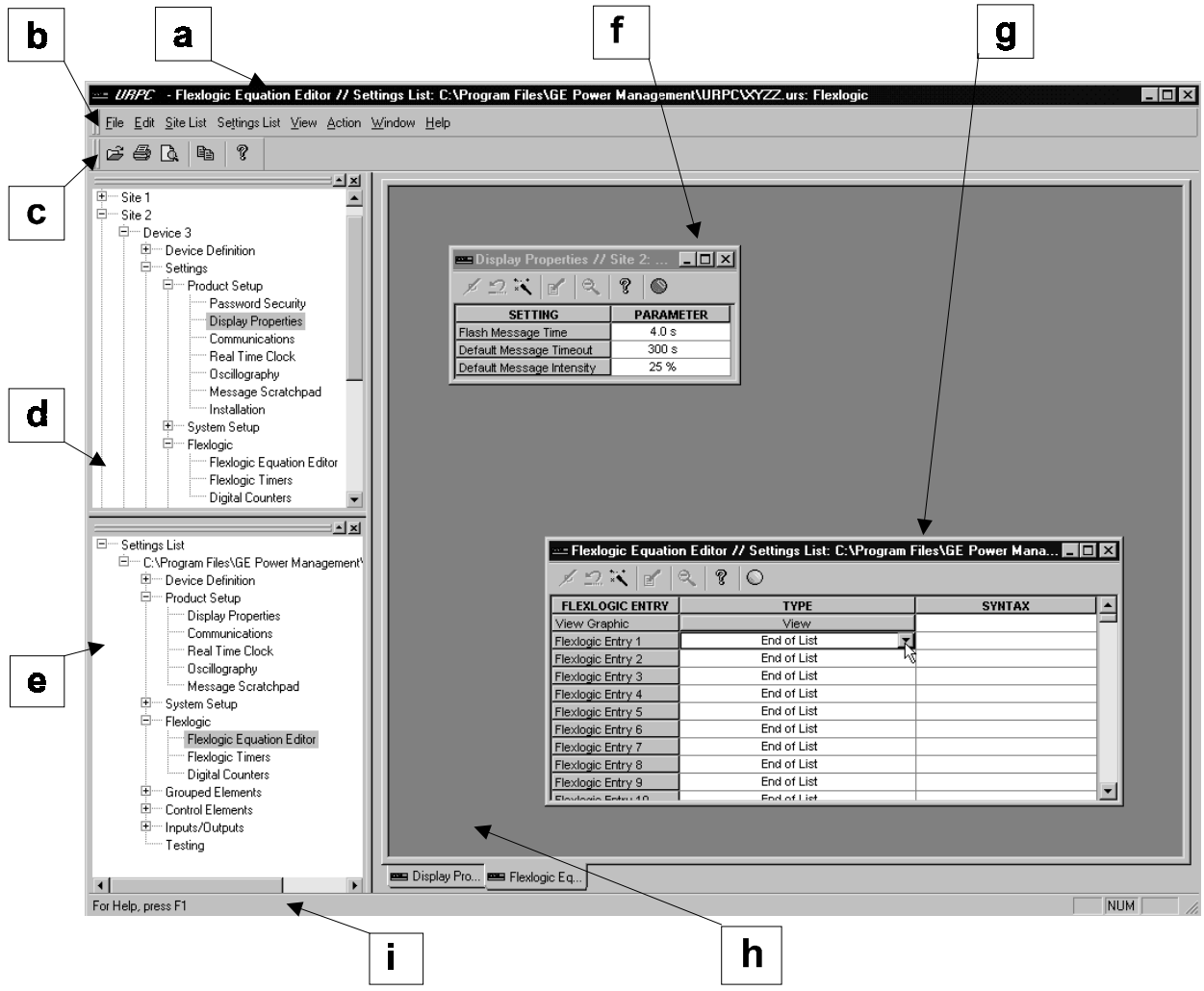


Figure 4–2: URPC SOFTWARE MAIN WINDOW

4.2.1 FACEPLATE

The UR faceplate Keypad/Display/LEDs interface is one of two alternate human interfaces supported. The alternate human interface is implemented via the URPC software. The UR faceplate interface is available in either of two configurations; horizontal or vertical. The faceplate interface consists of several functional panels.

The faceplate is hinged to allow easy access to the removable modules. There is also a removable dust cover that fits over the faceplate which must be removed in order to access the keypad panel.

The following two figures show the horizontal and vertical arrangements of faceplate panels.

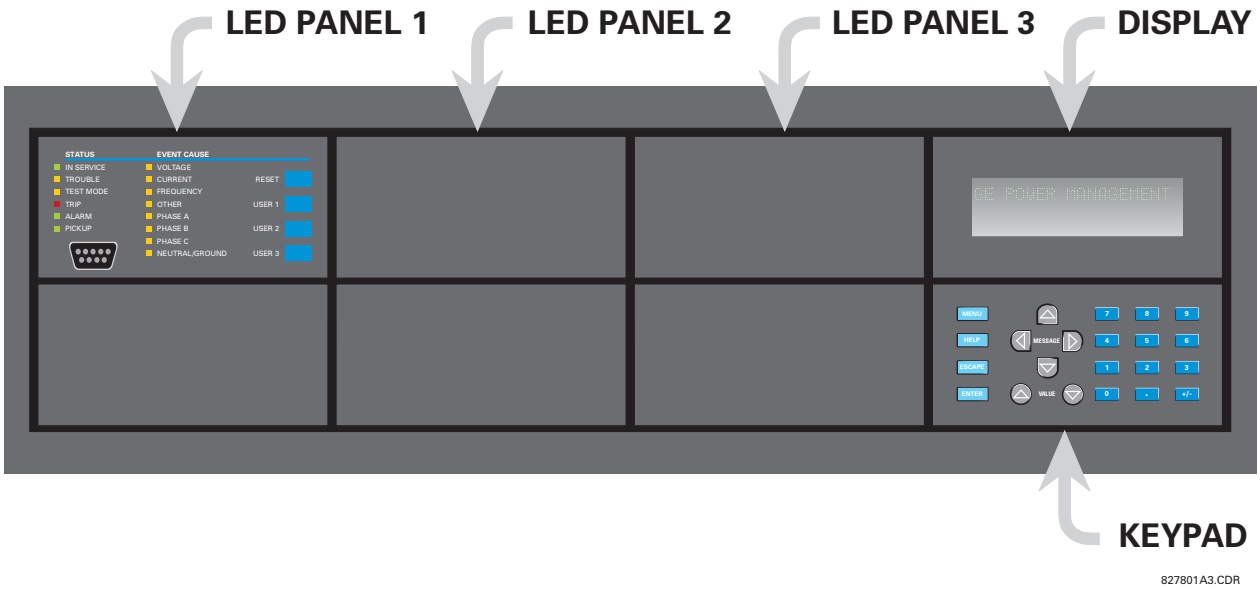


Figure 4–3: UR HORIZONTAL FACEPLATE PANELS

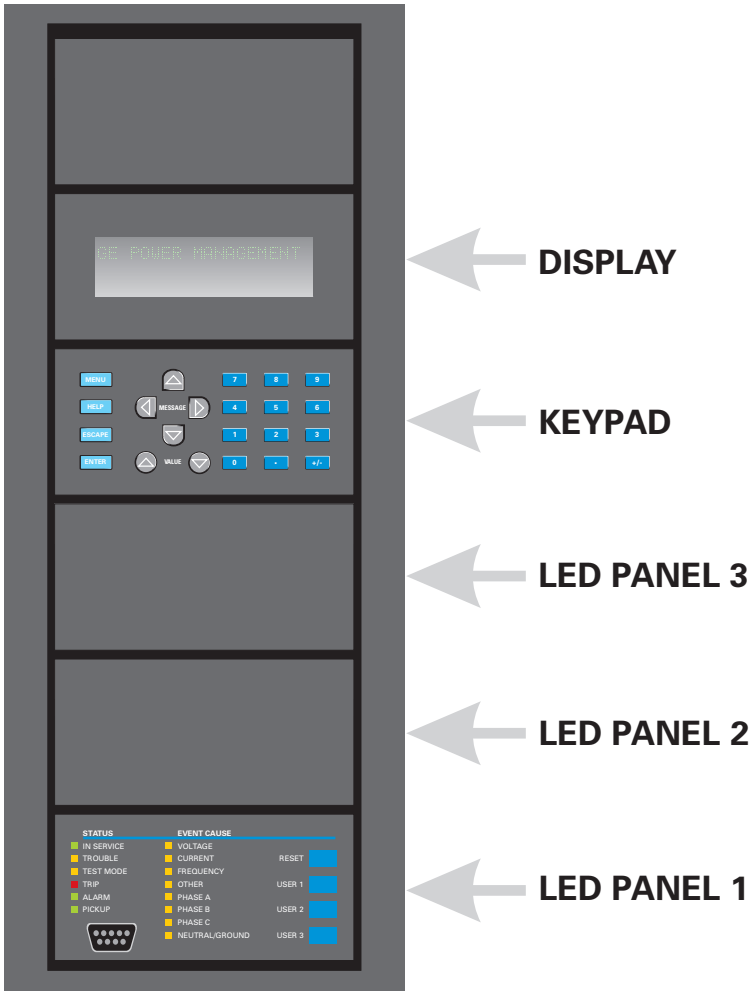


Figure 4–4: UR VERTICAL FACEPLATE PANELS

a) LED PANEL 1

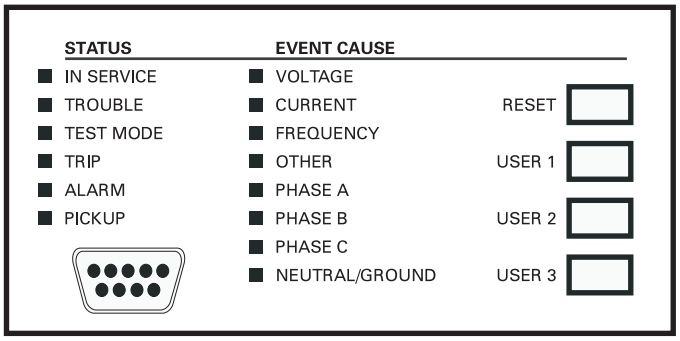


Figure 4–5: LED PANEL 1

This panel provides several groups of LED indicators, several keys, and a communications port. The RESET key is used to reset any latched LED indicator or target message, once the condition has been cleared (these latched conditions can also be reset via the SETTINGS \ PRODUCT SETUP \ RESETTING menu). The USER keys are not used in this relay. The RS232 port is intended for connection to a portable PC.

STATUS INDICATORS:

- **IN SERVICE**: Indicates that control power is applied; all monitored I/O and internal systems are OK; the relay has been programmed.
- **TROUBLE**: Indicates that the relay has detected an internal problem.
- **TEST MODE**: Indicates that the relay is in test mode.
- **TRIP**: Indicates that the selected FlexLogic™ operand serving as a Trip switch has operated. This indicator always latches; the RESET command must be initiated to allow the latch to be reset.
- **ALARM**: Indicates that the selected FlexLogic™ operand serving as an Alarm switch has operated. This indicator is never latched.
- **PICKUP**: Indicates that an element is picked up. This indicator is never latched.

EVENT CAUSE INDICATORS:

Indicate the input type that was involved in a condition detected by an element that is operated or has a latched flag waiting to be reset.

- **VOLTAGE**: Not used.
- **CURRENT**: Not used.
- **FREQUENCY**: Not used.
- **OTHER**: Indicates a Digital Element was involved.
- **PHASE A**: Not used.
- **PHASE B**: Not used.
- **PHASE C**: Not used.
- **NEUTRAL/GROUND**: Not used.

b) LED PANELS 2 & 3

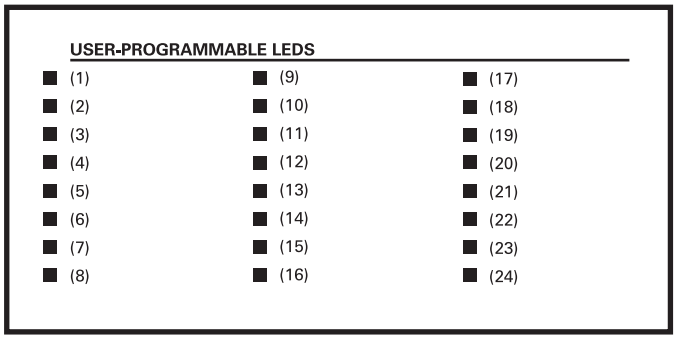


Figure 4–6: LED PANEL 2 (INDEX TEMPLATE)

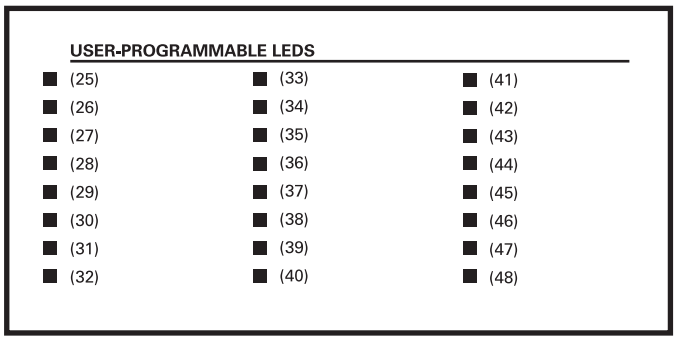


Figure 4–7: LED PANEL 3 (INDEX TEMPLATE)

These panels provide 48 amber LED indicators whose operation is controlled by the user. When shipped from the factory, the LEDs on these panels will have been labeled and programmed with defaults to operate appropriately for each specific type of UR relay. The default settings controlling LED operation can be changed by the end user; and as well, support for applying a customized label beside every LED is provided.

User customization of LED operation is of maximum benefit in installations where languages other than English are used to communicate with operators.

Refer to Chapter 5, the 'PRODUCT SETUP \ USER-PROGRAMMABLE LEDS' section, for the settings used to program the operation of the LEDs on these panels.

c) CUSTOM LABELING OF LEDs

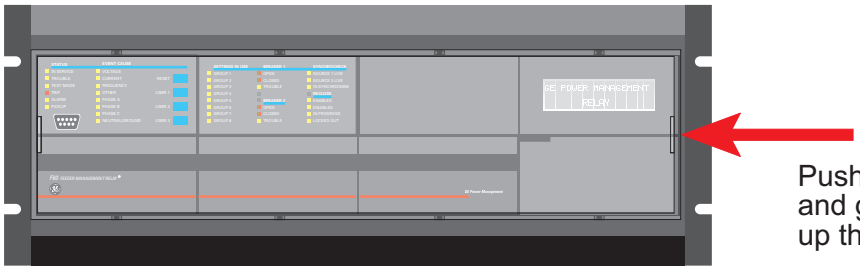
Custom labeling of an LED-only panel is facilitated by downloading a 'zip' file from

http://www.ge.com/indsys/pm/drawings/ur/custmod.zip.

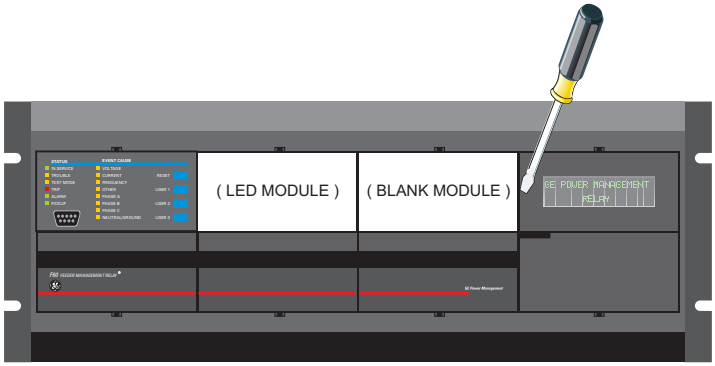
Opening this file will provide templates and instructions for creating appropriate labeling for the LED panel. The following three figures show the information in the downloadable file. The 'CorelDRAW' panel-templates provide relative LED locations and located example-text (x) edit boxes. The figure below shows how to install/uninstall the custom panel labeling.

HOW TO INSTALL THE UR CUSTOMIZED DISPLAY MODULE ON THE FRONT PANEL:

1-Remove the clear LEXAN FRONT COVER (P/N:1502-0014)



2-Pop out LED MODULE and/or BLANK MODULE with a screwdriver as the picture shows. (Be careful not to damage the plastic)



3-First place the left side of the customized module back to the front panel frame, then snap back the right side.

4-Put the clear LEXAN FRONT PANEL back to its place.

827366A3.CDR

Figure 4–8: CUSTOMIZED LED PANEL INSTALLATION

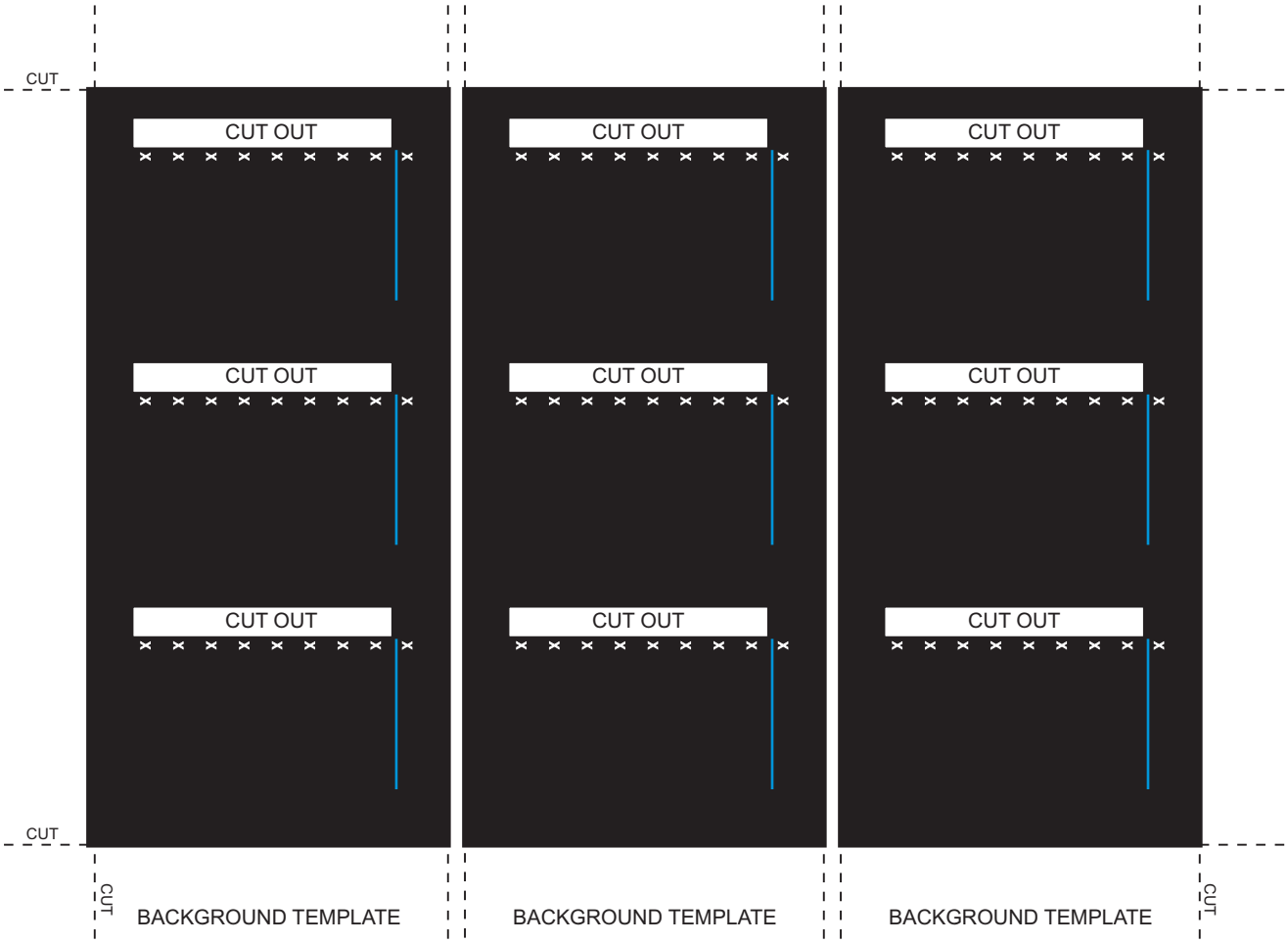


Figure 4–9: LED PANEL CUSTOMIZATION TEMPLATES

Instruction for how to customize the UR Display module

YOU NEED:

-Access to black and white or color printer (color preferred).
-CorelDRAW version 5 or later software package

Quantity	Material
1	8.5”x11” White paper
1	Exacto knife
1	Ruler
1	Custom display module (P/N: 1513-0069)
1	Custom module cover (P/N: 1502-0015)

HOW TO EDIT:

Add text in place of the Xs on the TEMPLATE(S) with **Edit Text...** from **Text** pull down menu. Delete the X place holders as required.

HOW TO PRINT:

Print one copy on the **White paper**.

1-Select **File** pull down menu.
2-Select **Print** from pull down menu.
3-Select the appropriate color printer.
4-Press **Properties...** button. On **Page Setup** tab for
 -**Paper Size:** choose Letter
 -**Orientation:** choose ◉ **Landscape**
 -Press **OK**
5-Press **Options...** button. On **Layout** tab for
 -**Position and size:** choose ☑ **Center image**
 and ☑ **Maintain aspect ratio**
 -Press **OK**
6-And **OK** again.

HOW TO CUT:

1-From the print out cut out the **BACKGROUND TEMPLATE** and the **3 WINDOWS** (Using the cropmarks as a guide).

HOW TO ASSEMBLE:

1-Put the **BACKGROUND TEMPLATE** on top of the **Custom display module**.
2-Snap the clear **Custom module cover (P/N:1502-0015)** over the **Custom display module (P/N:1513-0069)** and templates.

827366A3.CDR

Figure 4–10: LED PANEL CUSTOMIZATION DETAILED INSTRUCTIONS

4.2.3 DISPLAY

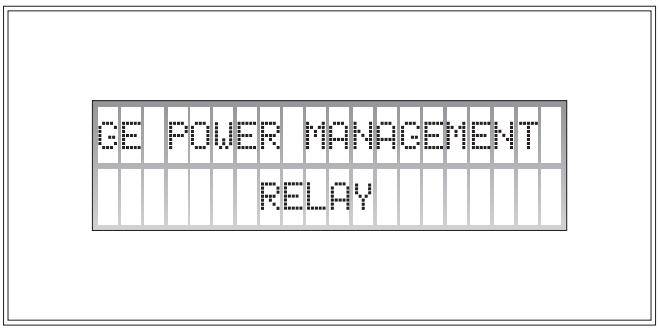


Figure 4–11: DISPLAY

All messages are displayed on a 2 × 20 character vacuum fluorescent display to make them visible under poor lighting conditions. Messages are displayed in English and do not require the aid of an instruction manual for deciphering. While the keypad and display are not actively being used, the display will default to defined messages. Any high priority event driven message will automatically override the default message and appear on the display.

4.2.4 KEYPAD

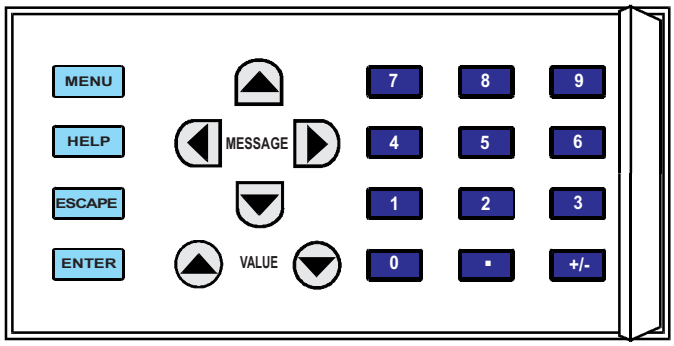


Figure 4–12: KEYPAD

Display messages are organized into 'pages' under the main headings, Actual Values, Settings, Commands, and Targets. The MENU key is used to navigate through the main heading pages. Each main heading page is further broken down into logical subgroup messages.

The ▲ ◀ MESSAGE ▶ ▼ keys are used to navigate through the subgroups.

The ▲ VALUE ▼ keys are used to scroll through variables in the settings programming mode to increment or decrement numerical setting values. These keys are also used to scroll through alphanumeric values in the text edit mode. Alternatively, values may be entered with the numeric keypad.

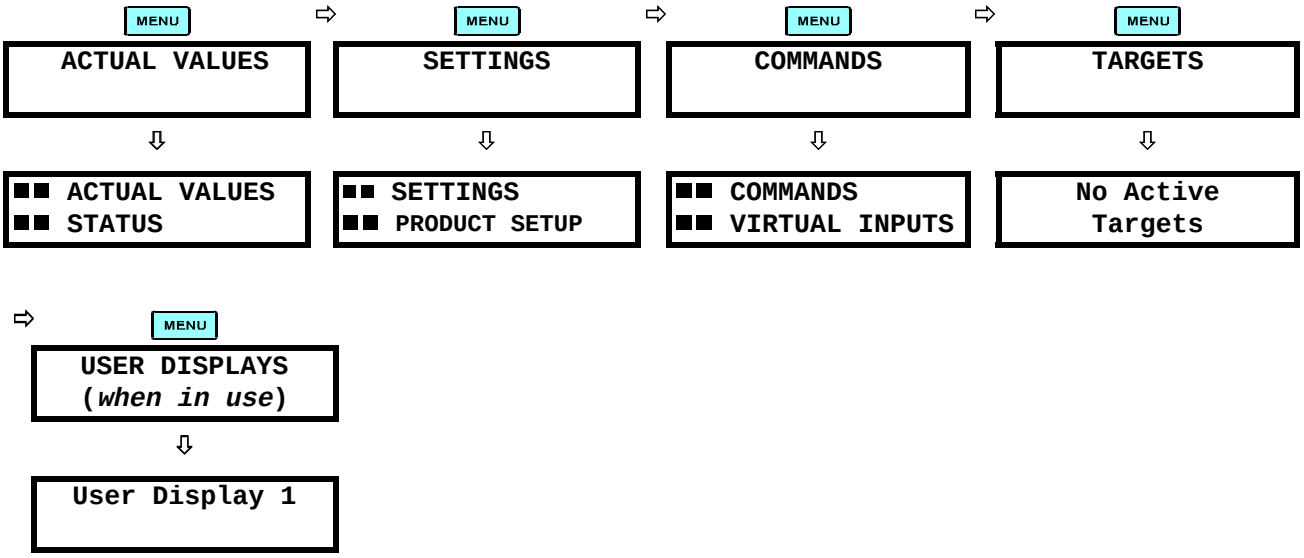
The . key is used to initiate and advance to the next character in text edit mode or to enter a decimal point.

The HELP key may be pressed at any time for context sensitive help messages. The ENTER key is used to store altered setting values.

4.2.5 MENUS

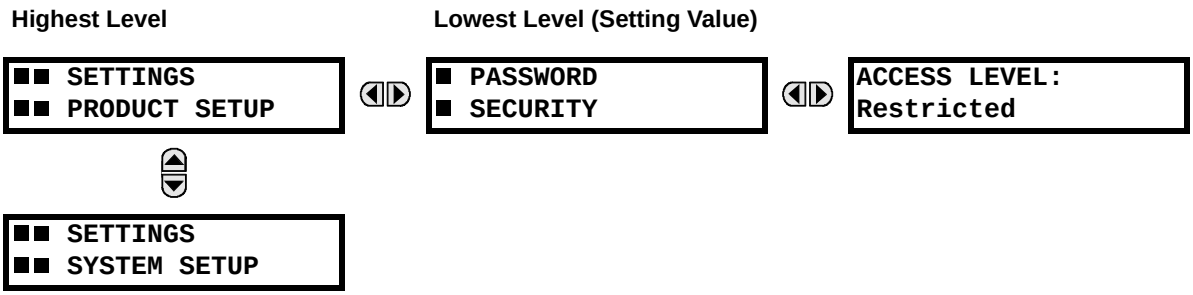
a) NAVIGATION

Press the MENU key to select the desired header display page (top-level menu). The header title will appear momentarily and then a header display page menu item will appear on the display. Each press of the MENU key advances through the main heading pages as illustrated below.



b) HIERARCHY

The setting and actual value messages are set up in a hierarchical format. The header display pages are indicated by the double scroll bar characters (■■), while sub-header pages are indicated by a single scroll bar character (■). The header display pages are at the highest level of the hierarchy and the sub-header display pages fall below this level. The MESSAGE ⏶ and MESSAGE ⏷ keys are used to move within a group of headers, sub-headers, setting values or actual values. Continually pressing the MESSAGE ⏵ key from a header display, displays more specific information for the header category. Conversely, continually pressing the ⏴ MESSAGE key from a setting value or actual value display will return to the header display.



EXAMPLE MENU NAVIGATION SCENARIO:

■■ ACTUAL VALUES ■■ STATUS	Press the MENU key until the header for the first Actual Values page appears. This page contains system and relay status information. Repeatedly press the ▲ ◄ MESSAGE ► ▼ keys to display the other actual value headers.
⇩	
■■ SETTINGS ■■ PRODUCT SETUP	Press the MENU key until the header for the first page of Settings appears. This page contains settings to configure the relay.
⇩	
■■ SETTINGS ■■ SYSTEM SETUP	Press the MESSAGE ▼ key to move to the next Settings page. This page contains settings for system setup. Repeatedly press the ▲ MESSAGE ▼ keys to display the other setting headers and then back to the first Settings page header.
⇩	
■ PASSWORD ■ SECURITY	From the Settings page one header (Product Setup), press the MESSAGE ► key once to display the first sub-header (Password Security).
⇩	
ACCESS LEVEL: Restricted	Press the MESSAGE ► key once more and this will display the first setting for Password Security. Pressing the MESSAGE ▼ key repeatedly will display the remaining setting messages for this sub-header.
⇩	
■ PASSWORD ■ SECURITY	Press the MESSAGE ◄ key once to move back to the first sub-header message.
⇩	
■ DISPLAY ■ PROPERTIES	Pressing the MESSAGE ▼ key will display the second setting sub-header associated with the Product Setup header.
⇩	
FLASH MESSAGE TIME: 1.0 s	Press the MESSAGE ► key once more and this will display the first setting for Display Properties.
⇩	
DEFAULT MESSAGE INTENSITY: 25%	To view the remaining settings associated with the Display Properties sub-header, repeatedly press the MESSAGE ▼ key. The last message appears as shown.

a) ENTERING NUMERICAL DATA

Each numerical setting has its own minimum, maximum, and increment value associated with it. These parameters define what values are acceptable for a setting.

```
FLASH MESSAGE
TIME:  1.0 s
```

⇩

For example, select the message PRODUCT SETUP \ DISPLAY PROPERTIES \ FLASH MESSAGE TIME.

```
MINIMUM:   0.5
MAXIMUM:  10.0
```

Press the HELP key to view the minimum and maximum values. Press the HELP key again to view the next context sensitive help message.

Two methods of editing and storing a numerical setting value are available.

- **0 to 9** and . (decimal point): The relay numeric keypad works the same as that of any electronic calculator. A number is entered one digit at a time. The leftmost digit is entered first and the rightmost digit is entered last. Pressing the MESSAGE ◀ key or pressing the ESCAPE key, returns the original value to the display.
- ▲ **VALUE** ▼: The VALUE ▲ key increments the displayed value by the step value, up to the maximum value allowed. While at the maximum value, pressing the VALUE ▲ key again will allow the setting selection to continue upward from the minimum value. The VALUE ▼ key decrements the displayed value by the step value, down to the minimum value. While at the minimum value, pressing the VALUE ▼ key again will allow the setting selection to continue downward from the maximum value.

```
FLASH MESSAGE
TIME:  2.5 s
```

⇩

As an example, set the flash message time setting to 2.5 seconds. Press the appropriate numeric keys in the sequence '2 . 5'. The display message will change as the digits are being entered.

```
NEW SETTING
HAS BEEN STORED
```

Until the ENTER key is pressed, editing changes are not registered by the relay. Therefore, press the ENTER key to store the new value in memory. This flash message will momentarily appear as confirmation of the storing process. Numerical values which contain decimal places will be rounded-off if more decimal place digits are entered than specified by the step value.

b) ENTERING ENUMERATION DATA

Enumeration settings have data values which are part of a set, whose members are explicitly defined by a name. A set is comprised of two or more members.

ACCESS LEVEL: **Restricted**

For example, the selections available for the PASSWORD SECURITY \ ACCESS LEVEL are 'Restricted', 'Command', 'Setting', and ‘Factory Service’.

Enumeration type values are changed using the VALUE keys. The VALUE key displays the next selection while the VALUE key displays the previous selection.

ACCESS LEVEL: **Setting**

If the ACCESS LEVEL needs to be set to 'Setting', press the VALUE keys until the proper selection is displayed. Press the HELP key at any time for the context sensitive help messages.

⇩

NEW SETTING **HAS BEEN STORED**

Until the ENTER key is pressed, editing changes are not registered by the relay. Therefore, press the ENTER key to store the new value in memory. This flash message will momentarily appear as confirmation of the storing process.

c) ENTERING ALPHANUMERIC TEXT

Text settings have data values which are fixed in length, but user-defined in character. They may be comprised of upper case letters, lower case letters, numerals, and a selection of special characters.

In order to allow the relay to be customized for specific applications, there are several places where text messages may be programmed. One example is the MESSAGE SCRATCHPAD. To enter alphanumeric text messages, the following procedure should be followed:

Example: to enter the text, “Breaker #1”

1. Press to enter text edit mode.
2. Press the VALUE or VALUE key until the character 'B' appears; press to advance the cursor to the next position.
3. Repeat step 2 for the remaining characters: r,e,a,k,e,r, ,#,1.
4. Press ENTER to store the text.
5. If you have any problem, press the HELP key to view the context sensitive help. Flash messages will sequentially appear for several seconds each. For the case of a text setting message, the HELP key displays how to edit and store a new value.

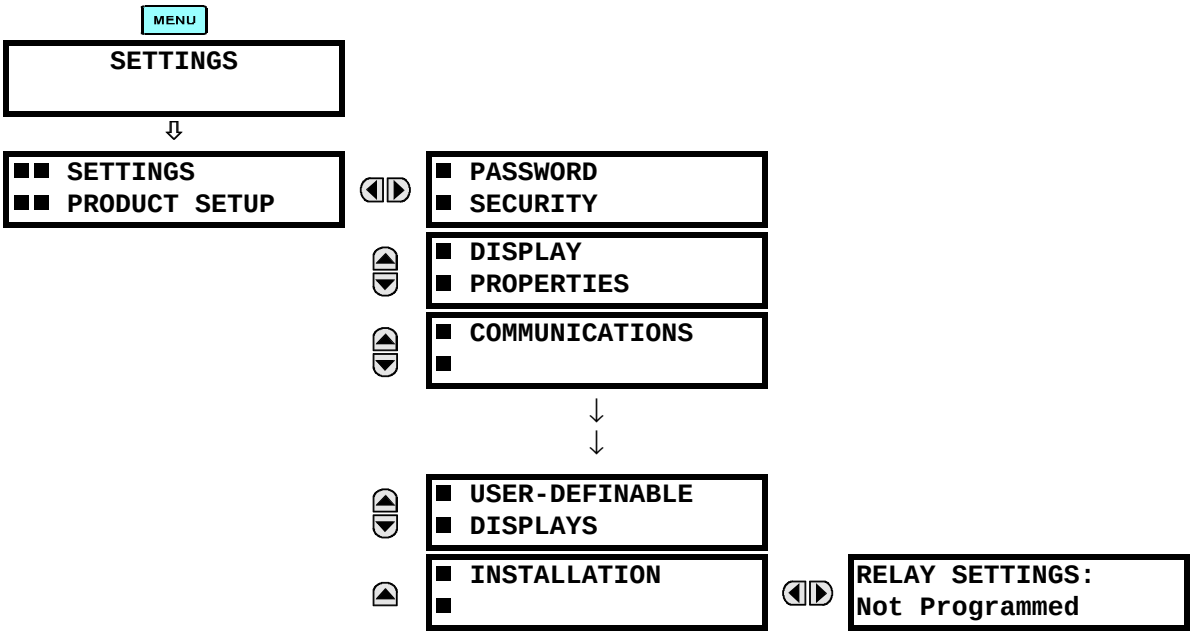
d) ACTIVATING THE RELAY

RELAY SETTINGS: Not Programmed

When the relay is powered up, the TROUBLE indicator will be on, the IN SERVICE indicator off, and this message displayed. This indicates that the relay is in the 'Not Programmed' state and is safeguarding (output relays blocked) against the installation of a relay whose settings have not been entered. This message will remain until the relay is explicitly put in the 'Programmed' state.

To change the 'RELAY SETTINGS: Not Programmed' mode to 'Programmed', proceed as follows:

1. Press the MENU key until the 'SETTINGS' header flashes momentarily and the 'SETTINGS PRODUCT SETUP' message appears on the display.
2. Press the MESSAGE ▷ key until the 'PASSWORD SECURITY' message appears on the display.
3. Press the MESSAGE ▽ key until the 'INSTALLATION' message appears on the display.
4. Press the MESSAGE ▷ key until the 'RELAY SETTINGS: Not Programmed' message is displayed.



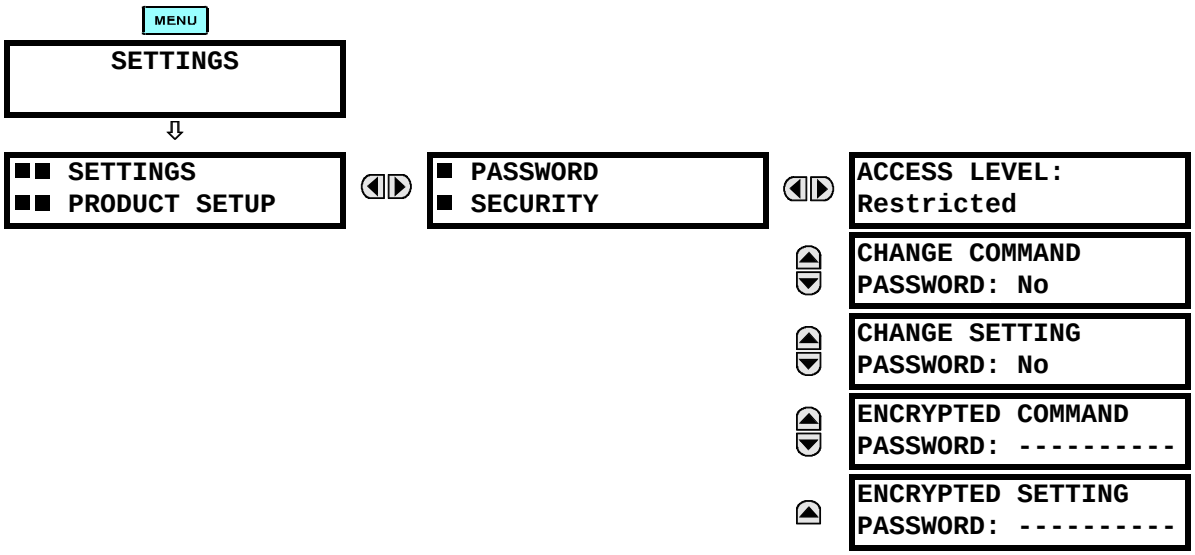
5. After the 'RELAY SETTINGS: Not Programmed' message appears on the display, press the VALUE △ key or the VALUE ▽ key to change the selection to 'Programmed'.
6. Press the ENTER key.

7. When the 'NEW SETTING HAS BEEN STORED' message appears, the relay will be in 'Programmed' state and the 'IN SERVICE' indicator will turn on.

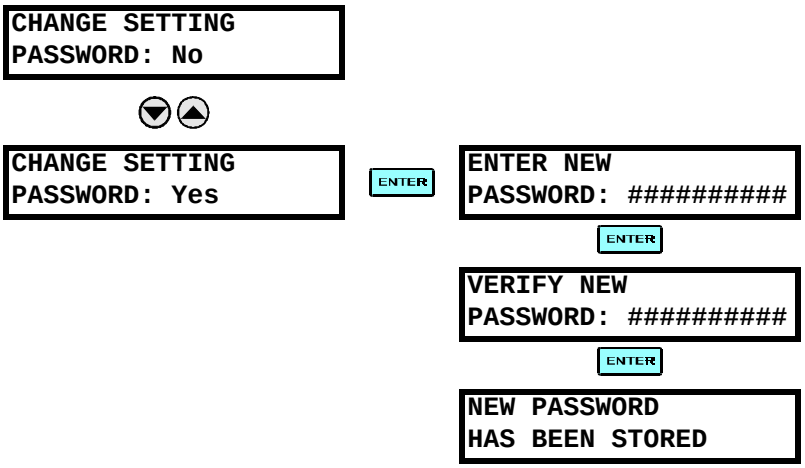
e) ENTERING INITIAL PASSWORDS

To enter the initial SETTING (or COMMAND) PASSWORD, proceed as follows:

1. Press the MENU key until the 'SETTINGS' header flashes momentarily and the 'SETTINGS PRODUCT SETUP' message appears on the display.
2. Press the MESSAGE ▷ key until the 'ACCESS LEVEL:' message appears on the display.
3. Press the MESSAGE ▽ key until the 'CHANGE SETTING (or COMMAND) PASSWORD:' message appears on the display.



4. After the 'CHANGE...PASSWORD' message appears on the display, press the VALUE △ key or the VALUE ▽ key to change the selection to Yes.
5. Press the ENTER key and the display will prompt you to 'ENTER NEW PASSWORD'.
6. Type in a numerical password (up to 10 characters) and press the ENTER key.
7. When the 'VERIFY NEW PASSWORD' is displayed, re-type in the same password and press ENTER.



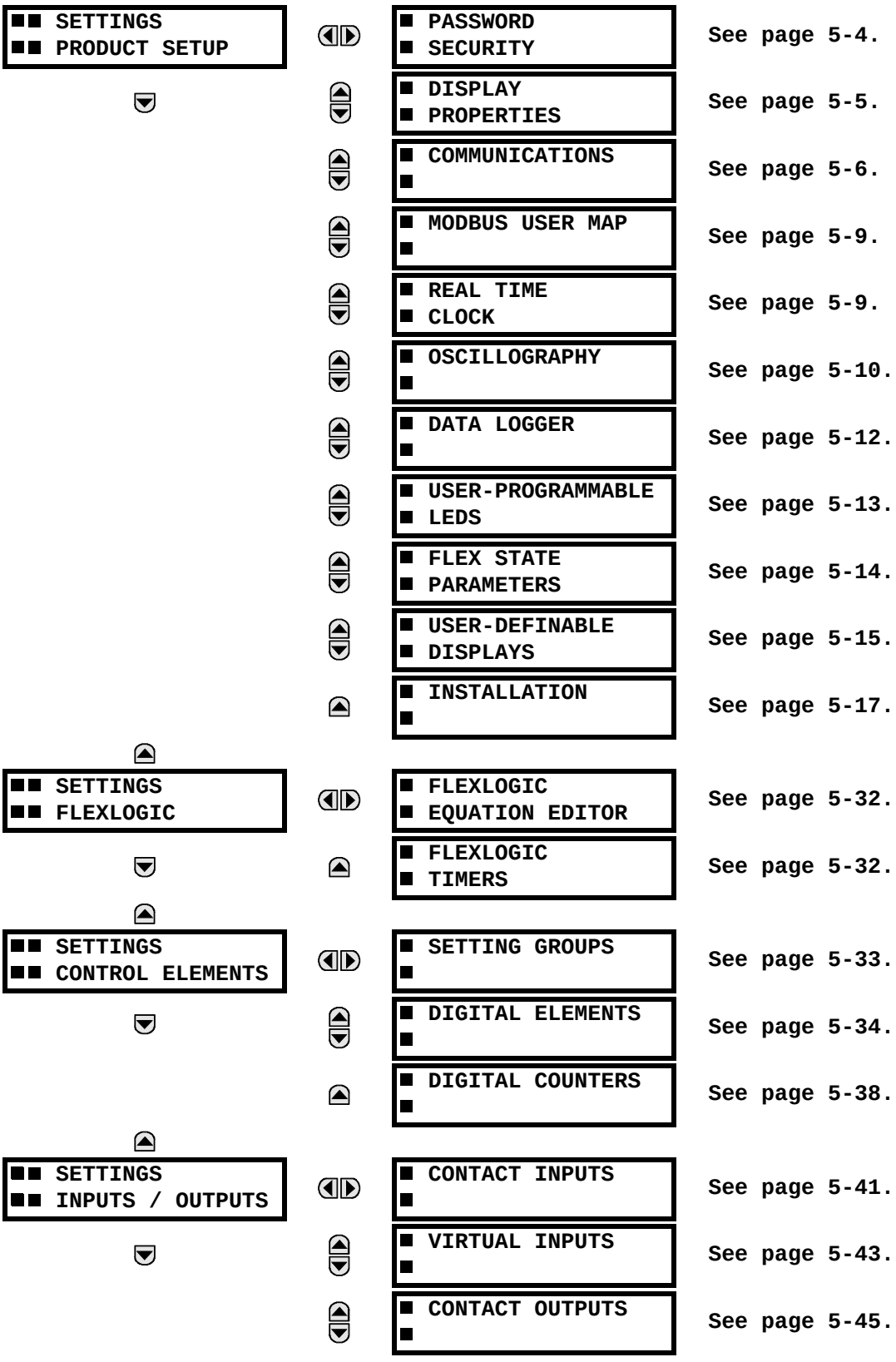
8. When the 'NEW PASSWORD HAS BEEN STORED' message appears, your new SETTING (or COMMAND) PASSWORD will be active.

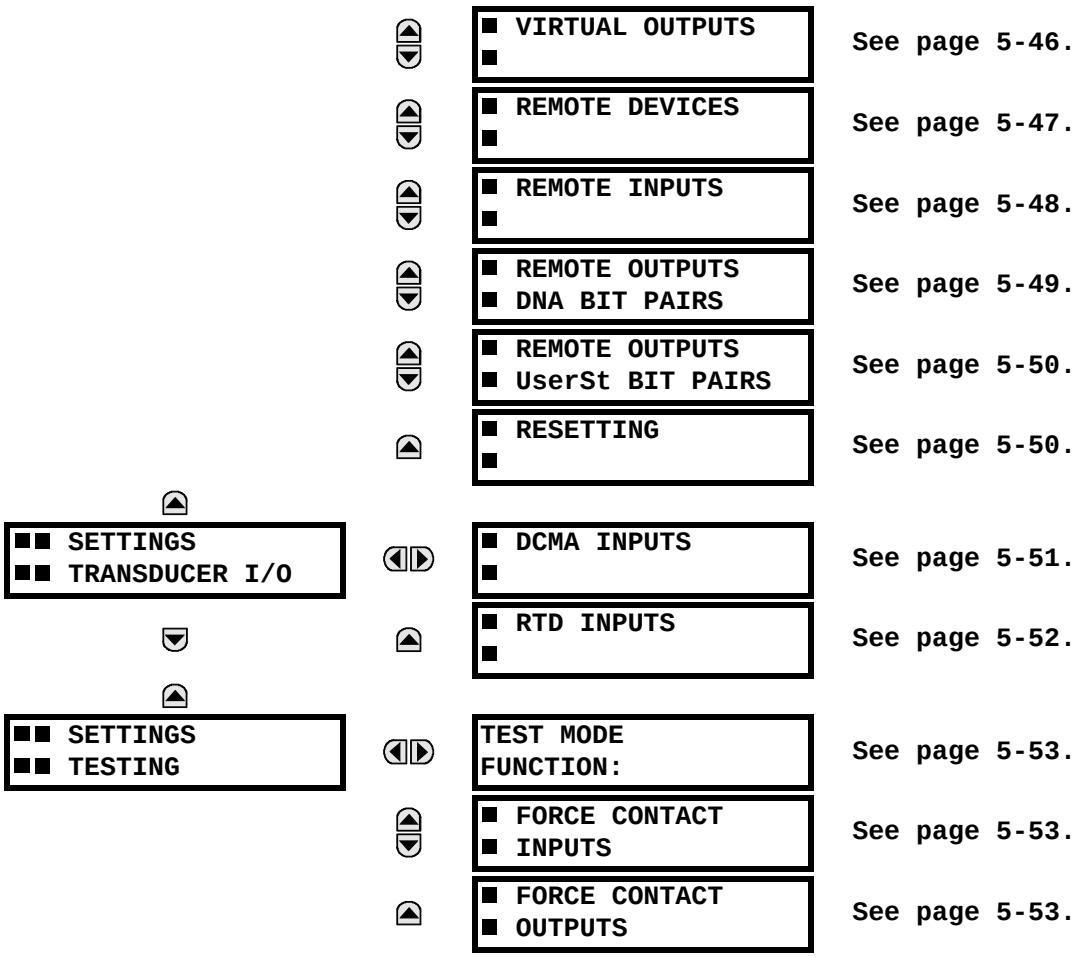
f) CHANGING EXISTING PASSWORD

To change an existing password, follow the instructions in the previous section with the following exception. A message will prompt you to type in the existing password (for each security level) before a new password can be entered.

In the event that a password has been lost (forgotten), submit the corresponding Encrypted Password from the PASSWORD SECURITY menu to the Factory for decoding.

5.1.1 SETTINGS MAIN MENU




VIRTUAL OUTPUTS
See page 5-46.
REMOTE DEVICES
See page 5-47.
REMOTE INPUTS
See page 5-48.
REMOTE OUTPUTS
DNA BIT PAIRS
See page 5-49.
REMOTE OUTPUTS
UserSt BIT PAIRS
See page 5-50.
RESETTING
See page 5-50.
SETTINGS
TRANSDUCER I/O
DCMA INPUTS
See page 5-51.
RTD INPUTS
See page 5-52.
SETTINGS
TESTING
TEST MODE
FUNCTION:
See page 5-53.
FORCE CONTACT
INPUTS
See page 5-53.
FORCE CONTACT
OUTPUTS
See page 5-53.

The main characteristics of an element are shown on the element scheme logic diagram. This includes the input(s), settings, fixed logic, and the output operands that are generated (abbreviations used on scheme logic diagrams are defined in the ABBREVIATIONS Appendix).

FUNCTION Setting

This setting is used to program the element to be operational when selected as Enabled. The factory default is Disabled. Once programmed to Enabled, any element associated with the Function becomes active and all options become available.

NAME Setting

This setting is used to uniquely identify the element.

PICKUP DELAY Setting

This setting is used to set a time-delay-on-pickup, or on-delay, for the duration between the Pickup and Operate output states.

RESET DELAY Setting

This setting is used to set a time-delay-on-dropout, or off-delay, for the duration between the Operate output state and the return to logic 0 after the input transits outside the defined pickup range.

BLOCK Setting

The default output operand state of all comparators is a logic 0 or “flag not set”. The comparator remains in this default state until a logic 1 is asserted at the RUN input, allowing the test to be performed. If the RUN input changes to logic 0 at any time, the comparator returns to the default state. The RUN input is used to supervise the comparator. The BLOCK input is used as one of the inputs to RUN control.

TARGET Setting

This setting is used to define the operation of an element target message. When set to Disabled, no target message or illumination of a faceplate LED indicator is issued upon operation of the element. When set to Self-Reset, the target message and LED indication follow the Operate state of the element, and self-resets once the operate element condition clears. When set to Latched, the target message and LED indication will remain visible after the element output returns to logic 0 - until a RESET command is received by the relay.

EVENTS Setting

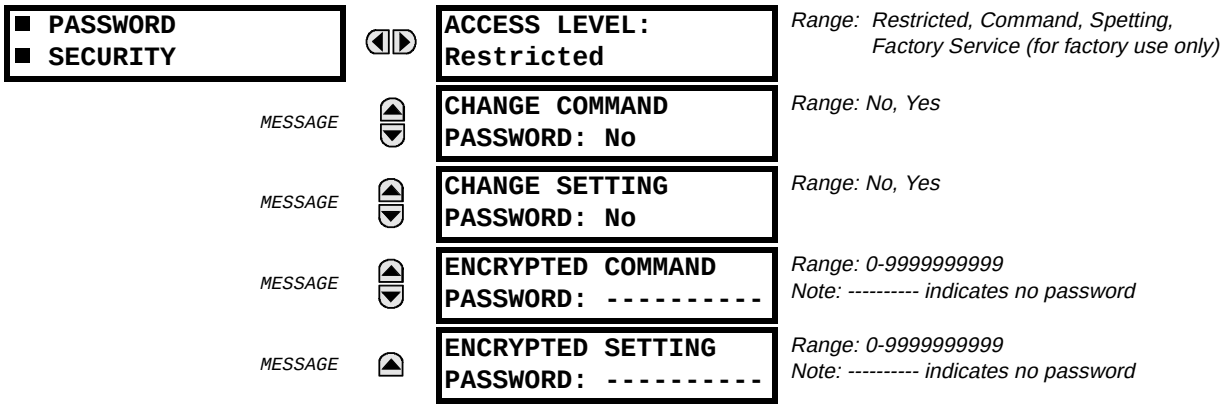
This setting is used to control whether the Pickup, Dropout or Operate states are recorded by the event recorder. When set to Disabled, element pickup, dropout or operate are not recorded as events.

When set to Enabled, an event is created for:

- (Element) PKP (pickup)
- (Element) DPO (dropout)
- (Element) OP (operate)

The DPO event is created when the measure and decide comparator output transits from the pickup state (logic 1) to the dropout state (logic 0). This could happen when the element is in the operate state if the reset delay time is not ‘0’.

PATH: SETTINGS ⇩ PRODUCT SETUP ⇨ PASSWORD SECURITY



There are two user levels of password security in the relay; Command and Setting. Operations under the supervision of the passwords are:

COMMAND:

- Changing the state of virtual inputs,
- Clearing the event records,
- Clearing the oscillography records.

SETTING:

- Changing any setting.

When the relay is shipped from the factory, the Command and Setting passwords are defaulted to 'Null'. When a password is 'Null', the password security feature is disabled.

Programming a password code is required to enable each access level. A password consists of 1 to 10 numerical characters. When a ‘CHANGE ... PASSWORD’ message is set to ‘Yes’, the following message sequence is invoked:

1. ENTER NEW PASSWORD: _____
2. VERIFY NEW PASSWORD: _____
3. NEW PASSWORD HAS BEEN STORED

To gain write access to a ‘Restricted’ setting, select the ACCESS LEVEL ‘Setting’ value and then change the setting, or attempt to change the setting, and follow the prompt to enter the programmed password. If the password is correctly entered, access will be allowed. If no keys are pressed for longer than 30 minutes or control power is cycled, accessibility will automatically revert to the ‘Restricted’ level.

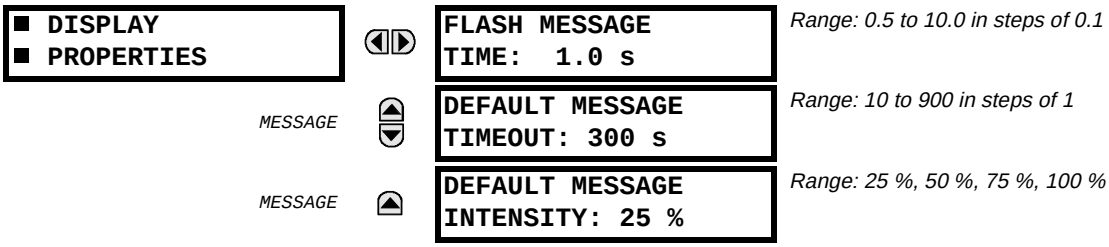
If an entered password is lost (or forgotten), consult the factory service department with the corresponding Encrypted Password number from the PASSWORD SECURITY menu.

NOTE

If the Setting password and Command password are set the same, the one password will allow access to commands and settings.

5.2.2 DISPLAY PROPERTIES

PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ DISPLAY PROPERTIES



Some of the relay messaging characteristics can be modified to suit different situations using the display properties settings.

Flash messages are status, warning, error, or information messages displayed for several seconds in response to certain key presses during setting programming. These messages override any normal messages. The time a flash message remains on the display can be changed to accommodate different reading rates.

If no keys are pressed for a period of time, the relay will automatically display a default message. This time can be modified to ensure messages remain on the screen long enough during programming or reading of actual values.

To extend the life of the phosphor in the vacuum fluorescent display, the brightness of the display can be attenuated when default messages are being displayed. When interacting with the display using the faceplate keys, the display will always operate at full brightness.

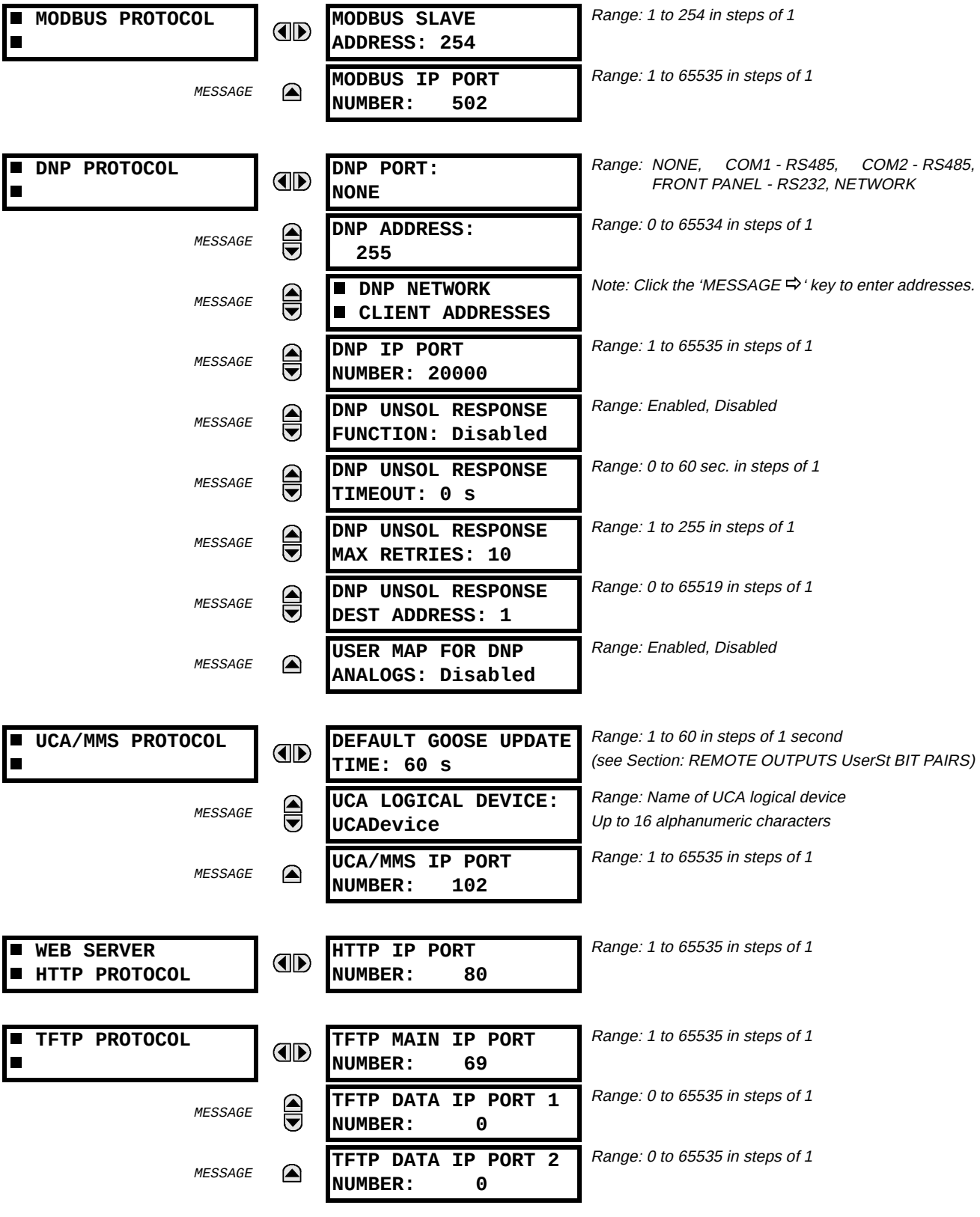
5.2.3 COMMUNICATIONS

PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ COMMUNICATIONS

■ COMMUNICATIONS ■		■ SERIAL PORTS ■
	MESSAGE	■ NETWORK ■
	MESSAGE	■ MODBUS PROTOCOL ■
	MESSAGE	■ DNP PROTOCOL ■
	MESSAGE	■ UCA/MMS PROTOCOL ■
	MESSAGE	■ WEB SERVER ■ HTTP PROTOCOL
	MESSAGE	■ TFTP PROTOCOL ■

■ SERIAL PORTS ■		RS485 COM1 BAUD RATE: 19200	*Range: 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200; Only active if CPU type 9A is ordered*
	MESSAGE	RS485 COM1 PARITY: None	*Range: None, Odd, Even* *Only active if CPU type 9A is ordered*
	MESSAGE	RS485 COM1 RESPONSE MIN TIME: 0 ms	*Range: 0 to 1000 in steps of 10* *Only active if CPU type 9A is ordered*
	MESSAGE	RS485 COM2 BAUD RATE: 19200	*Range: 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200*
	MESSAGE	RS485 COM2 PARITY: None	*Range: None, Odd, Even*
	MESSAGE	RS485 COM2 RESPONSE MIN TIME: 0 ms	*Range: 0 to 1000 in steps of 10* *Only active if CPU type 9A is ordered*

■ NETWORK ■		IP ADDRESS: 0.0.0.0	*Only active if CPU type 9C or 9D is ordered*
	MESSAGE	SUBNET IP MASK: 0.0.0.0	*Only active if CPU type 9C or 9D is ordered*
	MESSAGE	GATEWAY IP ADDRESS: 0.0.0.0	*Only active if CPU type 9C or 9D is ordered*
	MESSAGE	■ OSI NETWORK ■ ADDRESS (NSAP)	*Note: Click the 'MESSAGE ⇨' key to enter address.* *Only active if CPU type 9C or 9D is ordered*
	MESSAGE	ETHERNET PRI LINK MONITOR: Disabled	*Range: Disabled, Enabled* *Only active if CPU type 9C or 9D is ordered*
	MESSAGE	ETHERNET SEC LINK MONITOR: Disabled	*Range: Disabled, Enabled* *Only active if CPU type 9C or 9D is ordered*


■ MODBUS PROTOCOL
■
MODBUS SLAVE ADDRESS: 254
Range: 1 to 254 in steps of 1
MESSAGE
MODBUS IP PORT NUMBER: 502
Range: 1 to 65535 in steps of 1
■ DNP PROTOCOL
■
DNP PORT: NONE
Range: NONE, COM1 - RS485, COM2 - RS485, FRONT PANEL - RS232, NETWORK
MESSAGE
DNP ADDRESS: 255
Range: 0 to 65534 in steps of 1
MESSAGE
■ DNP NETWORK
■ CLIENT ADDRESSES
Note: Click the 'MESSAGE ⇨' key to enter addresses.
MESSAGE
DNP IP PORT NUMBER: 20000
Range: 1 to 65535 in steps of 1
MESSAGE
DNP UNSOL RESPONSE FUNCTION: Disabled
Range: Enabled, Disabled
MESSAGE
DNP UNSOL RESPONSE TIMEOUT: 0 s
Range: 0 to 60 sec. in steps of 1
MESSAGE
DNP UNSOL RESPONSE MAX RETRIES: 10
Range: 1 to 255 in steps of 1
MESSAGE
DNP UNSOL RESPONSE DEST ADDRESS: 1
Range: 0 to 65519 in steps of 1
MESSAGE
USER MAP FOR DNP ANALOGS: Disabled
Range: Enabled, Disabled
■ UCA/MMS PROTOCOL
■
DEFAULT GOOSE UPDATE TIME: 60 s
Range: 1 to 60 in steps of 1 second
(see Section: REMOTE OUTPUTS UserSt BIT PAIRS)
MESSAGE
UCA LOGICAL DEVICE: UCADevice
Range: Name of UCA logical device
Up to 16 alphanumeric characters
MESSAGE
UCA/MMS IP PORT NUMBER: 102
Range: 1 to 65535 in steps of 1
■ WEB SERVER
■ HTTP PROTOCOL
HTTP IP PORT NUMBER: 80
Range: 1 to 65535 in steps of 1
■ TFTP PROTOCOL
■
TFTP MAIN IP PORT NUMBER: 69
Range: 1 to 65535 in steps of 1
MESSAGE
TFTP DATA IP PORT 1 NUMBER: 0
Range: 0 to 65535 in steps of 1
MESSAGE
TFTP DATA IP PORT 2 NUMBER: 0
Range: 0 to 65535 in steps of 1

The relay is equipped with up to 3 independent serial ports. The faceplate **RS232** port is intended for local use and will respond regardless of the slave address programmed. The rear COM1 port type will depend on the CPU type ordered - it may be either an Ethernet port or an RS485 port. The rear COM2 port is RS485.

The **RS232** port may be connected to a personal computer running URPC. Its baud rate is fixed at **19200** and parity is fixed as '**None**'. The software may be used for downloading or uploading setting files, viewing measured parameters, and upgrading the relay firmware to the latest revision.

For **RS485** communications (supporting a subset of the **Modbus® RTU Protocol**), each relay must have a unique address from 1 to 254. Address 0 is the broadcast address which all relays listen to. Addresses do not have to be sequential, but no two relays can have the same address or conflicts resulting in errors will occur. Generally, each relay added to the link will use the next higher address starting at 1. A maximum of 32 relays can be daisy-chained and connected to a DCS, PLC or PC using the RS485 ports.

NOTE

For each RS485 port, the minimum time before the port will transmit after receiving data from a host can be set. This feature allows operation with hosts which hold the RS485 transmitter active for some time after each transmission.

The IP address setting messages will only appear if a relay is ordered with an **Ethernet** card. The Ethernet PRI & SEC Link Monitor settings refer to the Primary & Secondary Fibre Channel link monitors. The IP addresses are used with DNP/Network, Modbus/TCP/IP and MMS/UCA2 protocols. The NSAP address is used with MMS/UCA2 protocol over the OSI(CLNP/TP4) stack only.

Each TCP/IP protocol has a setting for the **IP PORT NUMBER**. These settings are only used in advanced network configurations. They should normally be left at their default values, but may be changed if required; for example, to allow access to multiple URs behind a router. By setting a different IP port number for a given protocol on each UR, the router can map the URs to the same external IP address. The client software (URPC, for example) must be configured to use the correct port number if these settings are used.

WARNING

Do not set more than one protocol to use the same IP Port Number, as this will result in unreliable operation of those protocols.

NOTE

When the NSAP address, any IP Port Number, or any User Map setting (when used with DNP) is changed, it will not become active until power to the relay has been cycled (OFF - ON).

DNP PROTOCOL:

The **DNP PORT** setting is used to select the communications port assigned to the DNP protocol. DNP can be assigned to a single port. Once DNP is assigned to a serial port, the Modbus protocol is disabled on that port. Note that COM1 can be used only in non-Ethernet UR relays.

The **DNP ADDRESS** setting is the DNP slave address. This number identifies the UR on a DNP communications link. Each DNP slave on a communications link should be assigned a unique address.

The **DNP NETWORK CLIENT ADDRESS** settings can be used to force the UR to respond only to specific DNP masters.

The **DNP UNSOL RESPONSE TIMEOUT** setting sets the time that the relay waits for a DNP master to confirm an unsolicited response.

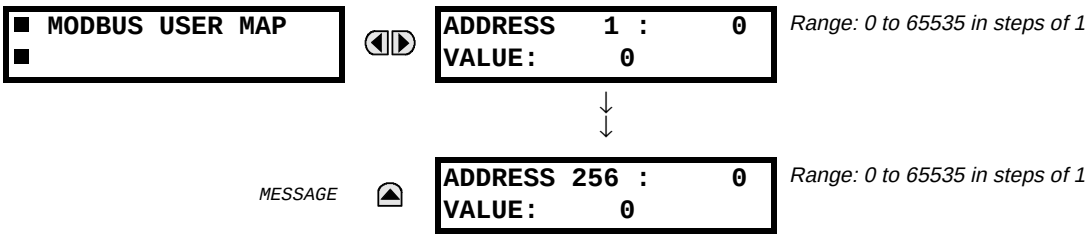
The **DNP UNSOL RESPONSE FUNCTION** setting should be set to "Disabled" for RS485 applications since there is no collision avoidance mechanism.

The **DNP UNSOL RESPONSE DEST ADDRESS** setting is the DNP address to which all unsolicited responses are sent. The IP address to which unsolicited responses are sent is determined from either the current DNP TCP connection or the most recent UDP message.

The **DNP UNSOL RESPONSE MAX RETRIES** setting determines the number of times the relay will retransmit an unsolicited response without receiving a confirmation from the master. A value of 255 allows infinite re-tries. See Appendix E for a description of the USER MAP FOR DNP ANALOGS setting.

5.2.4 MODBUS USER MAP

PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ MODBUS USER MAP



The Modbus® User Map provides up to 256 REGISTERS with read only access.

To obtain a value for a memory map address at a specific location, enter the desired location in the **ADDRESS** line (value must be converted from hex to decimal format). The corresponding value from the Modbus® Memory Map will be displayed in the **VALUE** line. A value of "0" in subsequent register **ADDRESS** lines will automatically return a value for the previous **ADDRESS** line incremented by "1". An address value of "0" in the initial register means "none" and values of "0" will be displayed for all registers.

Different **ADDRESS** values can be entered as required in any of the register positions.

NOTE

These settings can also be used with the DNP protocol. See the DNP ANALOG INPUT POINTS section in Appendix E for details.

5.2.5 REAL TIME CLOCK

PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ REAL TIME CLOCK

The date and time for the relay clock can be synchronized to other relays using an IRIG-B signal. It has the same accuracy as an electronic watch, approximately ±1 minute per month.

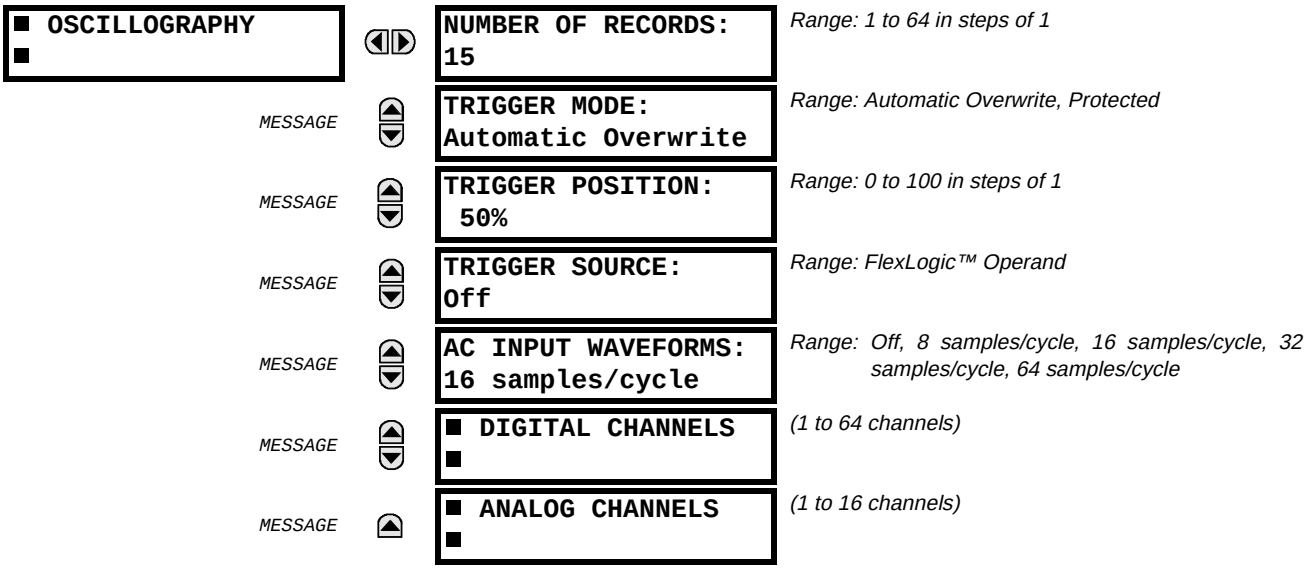
An IRIG-B signal may be connected to the relay to synchronize the clock to a known time base and to other relays. If an IRIG-B signal is used, only the current year needs to be entered.

If the relay serial communication link is used, then all the relays can keep time in synchronization with each other. A new clock time is loaded into the relay via the communications port by a remote computer broadcast (address 0) for all the relays connected on the communications channel. Then all relays in the system begin timing at approximately the same instant (± a few milliseconds).

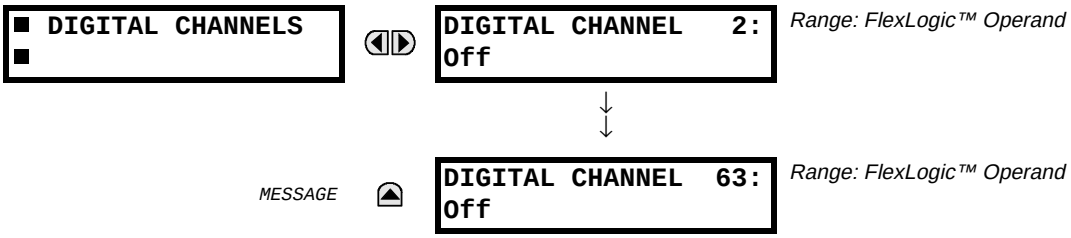
See also the **COMMANDS ⇩ SET DATE AND TIME** menu for manually setting the relay clock.

5.2.6 OSCILLOGRAPHY

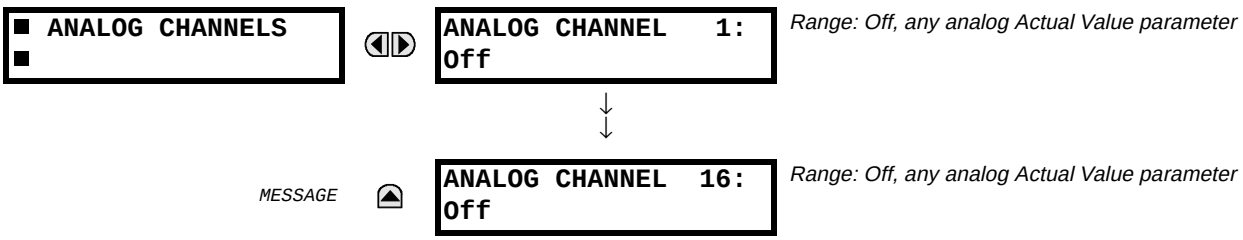
PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ OSCILLOGRAPHY



PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ OSCILLOGRAPHY ⇨⇩ DIGITAL CHANNELS



PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ OSCILLOGRAPHY ⇨⇩ ANALOG CHANNELS



Oscillography records contain waveforms captured at the sampling rate as well as other relay data at the point of trigger. Oscillography records are triggered by a programmable FlexLogic™ operand. Multiple oscillography records may be captured simultaneously.

The **NUMBER OF RECORDS** is selectable, but the number of cycles captured in a single record varies considerably based on other factors such as sample rate and the number of operational CT/VT modules. There is a fixed amount of data storage for oscillography; the more data captured, the less the number of cycles captured

per record. See the **ACTUAL VALUES \ RECORDS \ OSCILLOGRAPHY** menu to view the number of cycles captured per record. The following table provides sample configurations with corresponding cycles/record.

Table 5–1: OSCILLOGRAPHY CYCLES/RECORD EXAMPLE

# RECORDS	# CT/VTs	SAMPLE RATE	# DIGITALS	# ANALOGS	CYCLES/ RECORD
1	1	8	0	0	1872.0
1	1	16	16	0	1685.0
8	1	16	16	0	266.0
8	1	16	16	4	219.5
8	2	16	16	4	93.5
8	2	16	64	16	93.5
8	2	32	64	16	57.6
8	2	64	64	16	32.3
32	2	64	64	16	9.5

A new record may automatically overwrite an older record if **TRIGGER MODE** is set to 'Automatic Overwrite'.

The **TRIGGER POSITION** is programmable as a percent of the total buffer size (e.g. 10%, 50%, 75%, etc.). A trigger position of 25% consists of 25% pre- and 75% post- trigger data.

The **TRIGGER SOURCE** is always captured in oscillography and may be any FlexLogic™ parameter (element state, contact input, virtual output, etc.). The relay sampling rate is 64 samples per cycle.

NOTE

To maximize the number of files saved when using multiple triggers, the relay deletes pre-trigger data that spans multiple buffers in a record. Only the pre-trigger data in the current buffer is saved. For example, if a 60 second record has the trigger set to 50% (30 seconds pre-trigger, 30 seconds post-trigger), a subsequent trigger 40 seconds later reports only 40 – 30 = 10 seconds of pre-trigger data in the newest record.

The **AC INPUT WAVEFORMS** setting determines the sampling rate at which AC input signals (i.e. current and voltage) are stored. Reducing the sampling rate allows longer records to be stored. This setting has no effect on the internal sampling rate of the relay which is always 64 samples per cycle, i.e. it has no effect on the fundamental calculations of the device.

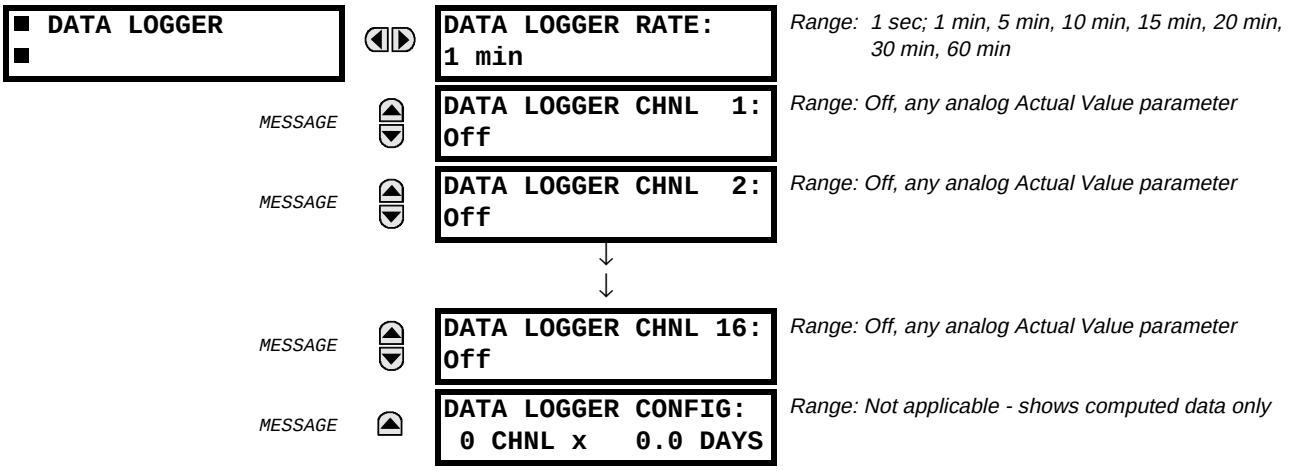
An **ANALOG CHANNEL** setting selects the metering actual value recorded in an oscillography trace. The length of each oscillography trace depends in part on the number of parameters selected here. Parameters set to 'Off' are ignored. The parameters available in a given relay are dependent on: (a) the type of relay, (b) the type and number of CT/VT hardware modules installed, and (c) the type and number of Analog Input hardware modules installed. Upon startup, the relay will automatically prepare the parameter list. Tables of all possible analog metering actual value parameters are presented in Appendix A: FLEXANALOG PARAMETERS. The parameter index number shown in any of the tables is used to expedite the selection of the parameter on the relay display. It can be quite time-consuming to scan through the list of parameters via the relay keypad/display - entering this number via the relay keypad will cause the corresponding parameter to be displayed.

All eight channels per CT/VT module are stored in the oscillography file. The CT/VT module analog channels are named '<*slot letter*><*terminal number*>-<*I* or *V*><*phase A, B, or C*; or *4th input*>'. The fourth current input in a bank is called IG, and the fourth voltage input in a bank is called VX. For example, F2-IB designates the IB signal on terminal 2 of the CT/VT module in slot F.

If there are no CT/VT modules and Analog Input modules, no analog traces will appear in the file; only the digital traces will appear.

5.2.7 DATA LOGGER

PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ DATA LOGGER



The data logger is used to sample and record up to sixteen analog parameters at a sampling rate that is defined by the user. This recorded data may be downloaded to the URPC software where it is displayed with 'parameters' on the vertical axis and 'time' on the horizontal axis. All data is stored in non-volatile memory which means that the information is retained when power to the relay is lost.

For a fixed sampling rate, the data logger can be configured with a few channels over a long period or a larger number of channels for a shorter period. The relay will automatically partition the available memory between the channels that are in use.

NOTE

Changing any setting affecting Data Logger operation will clear any data that is currently in the log.

a) SETTINGS

DATA LOGGER RATE:

This setting selects the time interval at which the actual value data will be recorded.

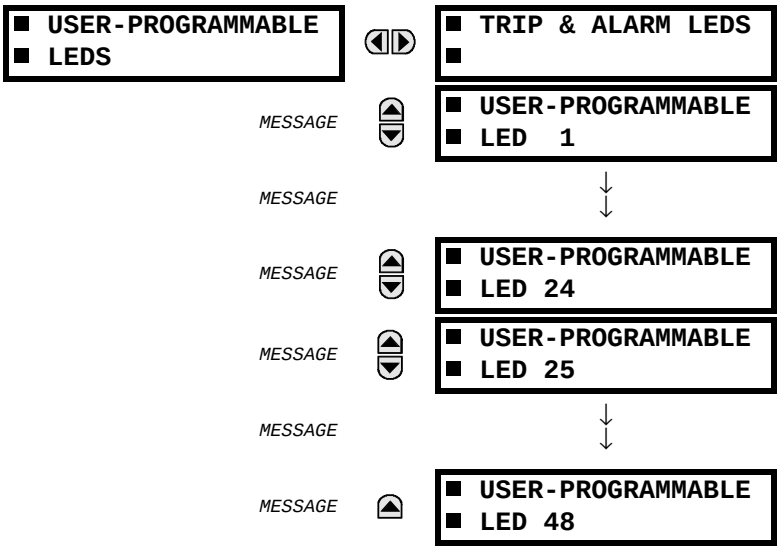
DATA LOGGER CHNL 1(16):

This setting selects the metering actual value that is to be recorded in channel 1(16) of the data log. The parameters available in a given relay are dependent on: (a) the type of relay, (b) the type and number of CT/VT hardware modules installed, and (c) the type and number of Analog Input hardware modules installed. Upon startup, the relay will automatically prepare the parameter list. Tables of all possible analog metering actual value parameters are presented in Appendix A: FLEXANALOG PARAMETERS. The parameter index number shown in any of the tables is used to expedite the selection of the parameter on the relay display. It can be quite time-consuming to scan through the list of parameters via the relay keypad/display – entering this number via the relay keypad will cause the corresponding parameter to be displayed.

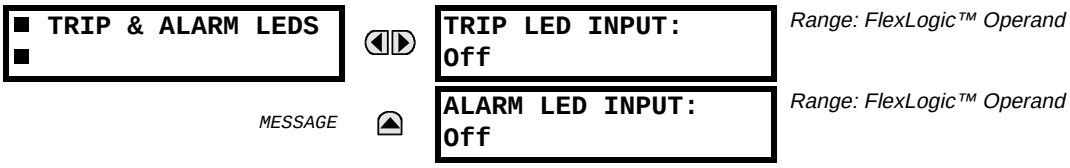
DATA LOGGER CONFIG:

This display presents the total amount of time the Data Logger can record the channels not selected to "Off" without over-writing old data.

PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ USER-PROGRAMMABLE LEDS

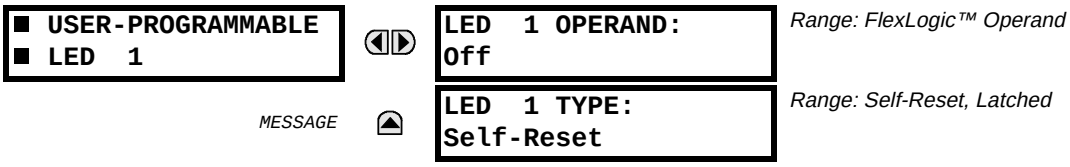


PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ USER-PROGRAMMABLE LEDS ⇨ TRIP & ALARM LEDS



The TRIP and ALARM LEDs are on the faceplate LED panel 1. Each of these indicators can be programmed to become illuminated when the selected FlexLogic™ operand is in the logic 1 state.

PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ USER-PROGRAMMABLE LEDS ⇨ USER PROGRAMABLE LED 1(48)



There are 48 amber LEDs across 2 relay faceplate LED panels. Each of these indicators can be programmed to become illuminated when the selected FlexLogic™ operand is in the logic 1 state.

LEDs 1 through 24 inclusive are on LED panel 2.

LEDs 25 through 48 inclusive are on LED panel 3.

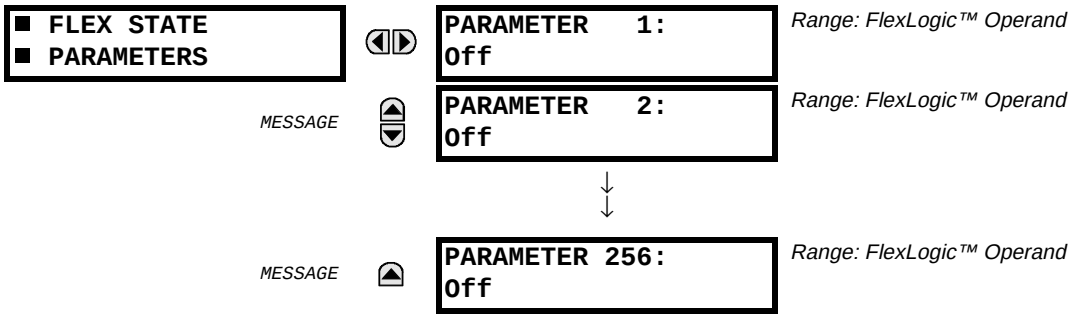
Refer to Chapter 4 on Human Interfaces (LED INDICATORS section) for the locations of these indexed LEDs.

This menu is used to individually select the operands that control these LEDs. Support for applying user-customized labels to these LEDs is provided - see the LED INDICATORS section for details.

If the LED TYPE setting is ‘Self-Reset’ (default setting), the LED illumination will track the state of the selected LED operand. If the LED TYPE setting is ‘Latched’, the LED, once lit, will remain lit until reset by a command from the faceplate RESET pushbutton, from a remote device via a communications channel, or from any programmed operand, even if the LED operand state de-asserts.

5.2.9 FLEX STATE PARAMETERS

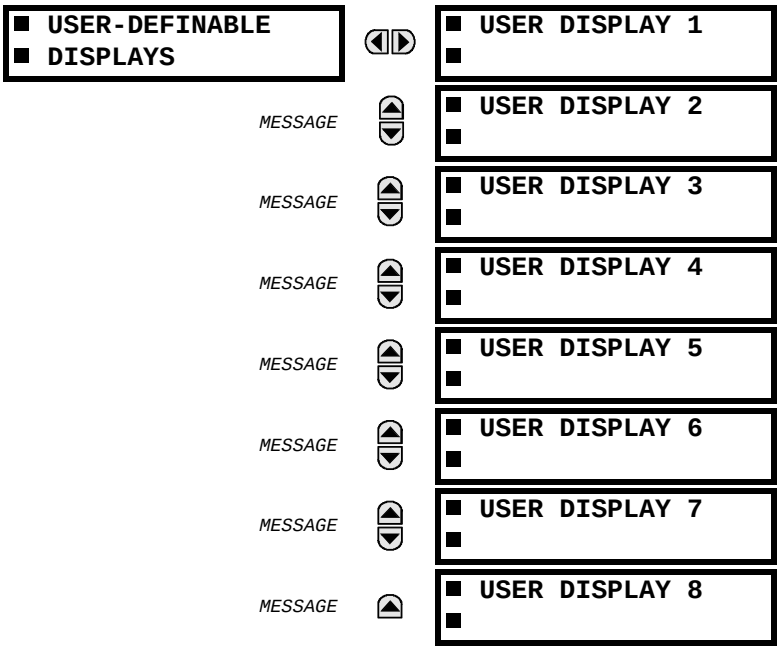
PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ FLEX STATE PARAMETERS



This feature provides a mechanism where any of 256 selected FlexLogic™ operand states can be used for efficient monitoring. The feature allows user-customized access to the FlexLogic™ operand states in the relay. The state bits are packed so that 16 states may be read out in a single Modbus register. The state bits can be configured so that all of the states which are of interest to the user are available in a minimum number of Modbus registers.

The state bits may be read out in the "Flex States" register array beginning at Modbus address 900 hex. 16 states are packed into each register, with the lowest-numbered state in the lowest-order bit. There are 16 registers in total to accommodate the 256 state bits.

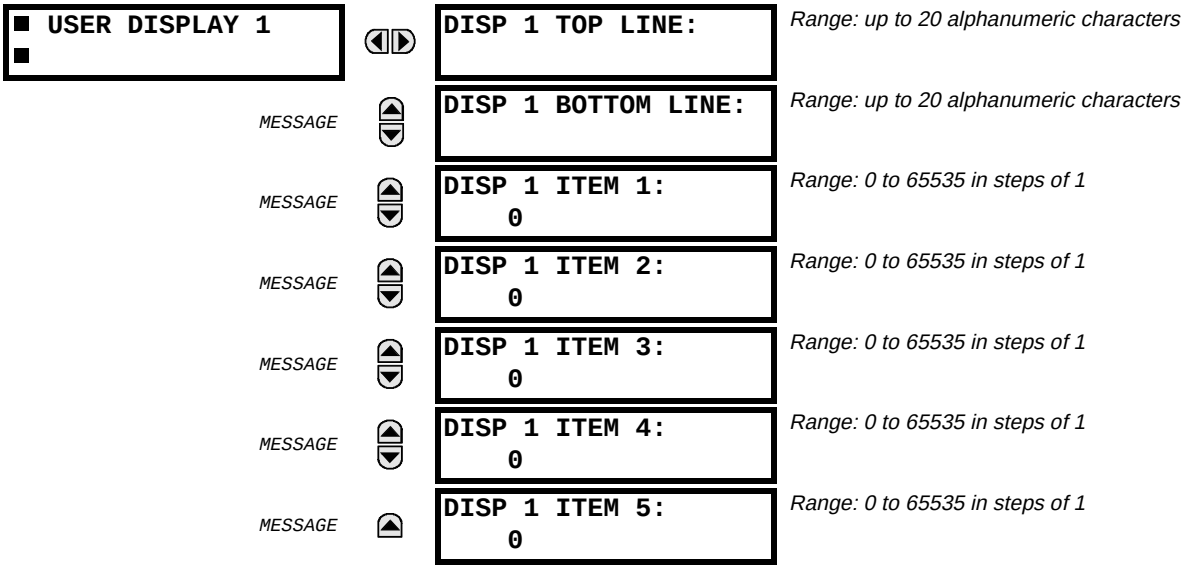
PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ USER-DEFINABLE DISPLAYS



This menu provides a mechanism for manually creating up to 8 user-defined information displays in a convenient viewing sequence in the USER DISPLAYS menu (between the TARGETS and ACTUAL VALUES top-level menus). The sub-menus facilitate text entry and Modbus Register data pointer options for defining the User Display content.

Also, any existing system display can be automatically copied into an available User Display by selecting the existing display and pressing the ENTER key. The display will then prompt "ADD TO USER DISPLAY LIST?". After selecting 'Yes', a message will indicate that the selected display has been added to the user display list. When this type of entry occurs, the sub-menus are automatically configured with the proper content - this content may subsequently be edited.

PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ USER-DEFINABLE DISPLAYS ⇨ USER DISPLAY 1(8)



This menu is used **to enter** user-defined text and/or user-selected Modbus-registered data fields into the particular User Display. Each User Display consists of two 20-character lines (TOP & BOTTOM). The Tilde (~) character is used to mark the start of a data field - the length of the data field needs to be accounted for. Up to 5 separate data fields (ITEM 1...5) can be entered in a User Display - the nth Tilde (~) refers to the nth ITEM.

A User Display may be entered from the faceplate keypad or the URPC interface (preferred for convenience).

To enter text characters in the TOP LINE and BOTTOM LINE from the faceplate keypad:

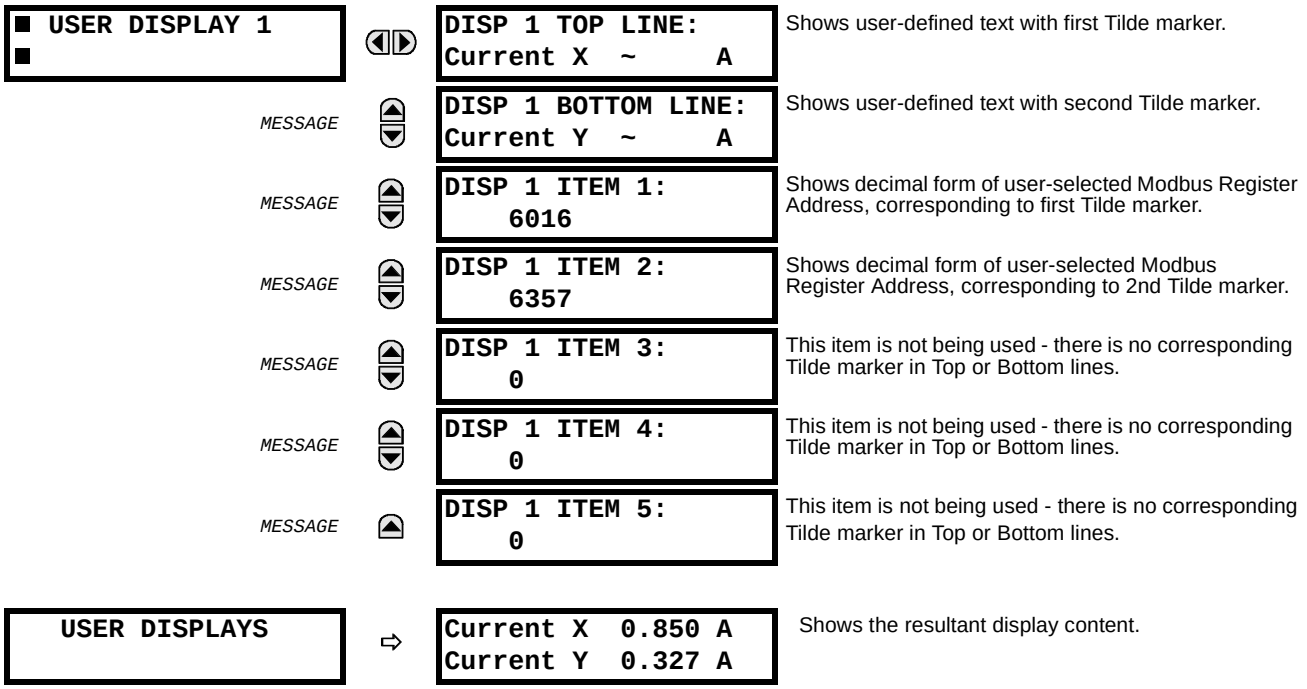
1. Select the line to be edited.
2. Press the key to enter text edit mode.
3. Use either VALUE key to scroll through the characters. A space is selected like a character.
4. Press the key to advance the cursor to the next position.
5. Repeat step 3 and continue entering characters until the desired text is displayed.
6. The HELP key may be pressed at any time for context sensitive help information.
7. Press the ENTER key to store the new settings.

To enter a numerical value for any of the 5 ITEMs (the decimal form of the selected Modbus Register Address) from the faceplate keypad, use the number keypad. Use the value of '0' for any ITEMs not being used. Use the HELP key at any selected system display (Setting, Actual Value, or Command) which has a Modbus address, to view the hexadecimal form of the Modbus Register Address, then manually convert it to decimal form before entering it (URPC usage would conveniently facilitate this conversion).

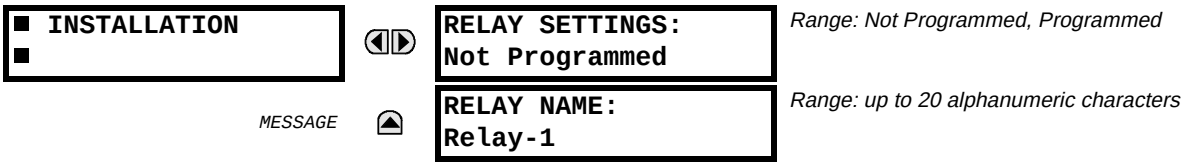
5

Using the MENU key, go to the USER DISPLAYS menu **to view** the user-defined content. The current User Displays will show in sequence, changing to the next display every 4 seconds. While viewing a User Display, press the ENTER key and then select the 'Yes" option **to remove** the display from the user display list. Use the MENU key again **to exit** the USER DISPLAYS menu.

a) EXAMPLE USER DISPLAY SETUP & RESULT



PATH: SETTINGS ⇩ PRODUCT SETUP ⇨⇩ INSTALLATION



To safeguard against the installation of a relay whose settings have not been entered, the unit will not allow signaling of any output relay until **RELAY SETTINGS** is set to "Programmed". This setting is defaulted to "Not Programmed" when the relay leaves the factory. The UNIT NOT PROGRAMMED self-test error message is displayed automatically until the relay is put into the Programmed state.

The **RELAY NAME** setting allows the user to uniquely identify a relay. This name will appear on generated reports. This name is also used to identify specific devices which are engaged in automatically sending/receiving data over the Ethernet communications channel using the MMS/UCA2 protocol.

5.3.1 INTRODUCTION TO FLEXLOGIC™

In order to provide maximum flexibility to the user of a UR (Universal Relay) device, the arrangement of internal digital logic combines fixed and user-programmed parameters. Logic upon which individual features are designed is fixed, and all other logic from digital input signals through elements or combinations of elements to digital outputs, is variable. The user has complete control of all variable logic through FlexLogic™. In general, the system receives analog and digital inputs which it uses to produce analog and digital outputs. The major sub-systems of a generic UR relay involved in this process are shown in the following figure.

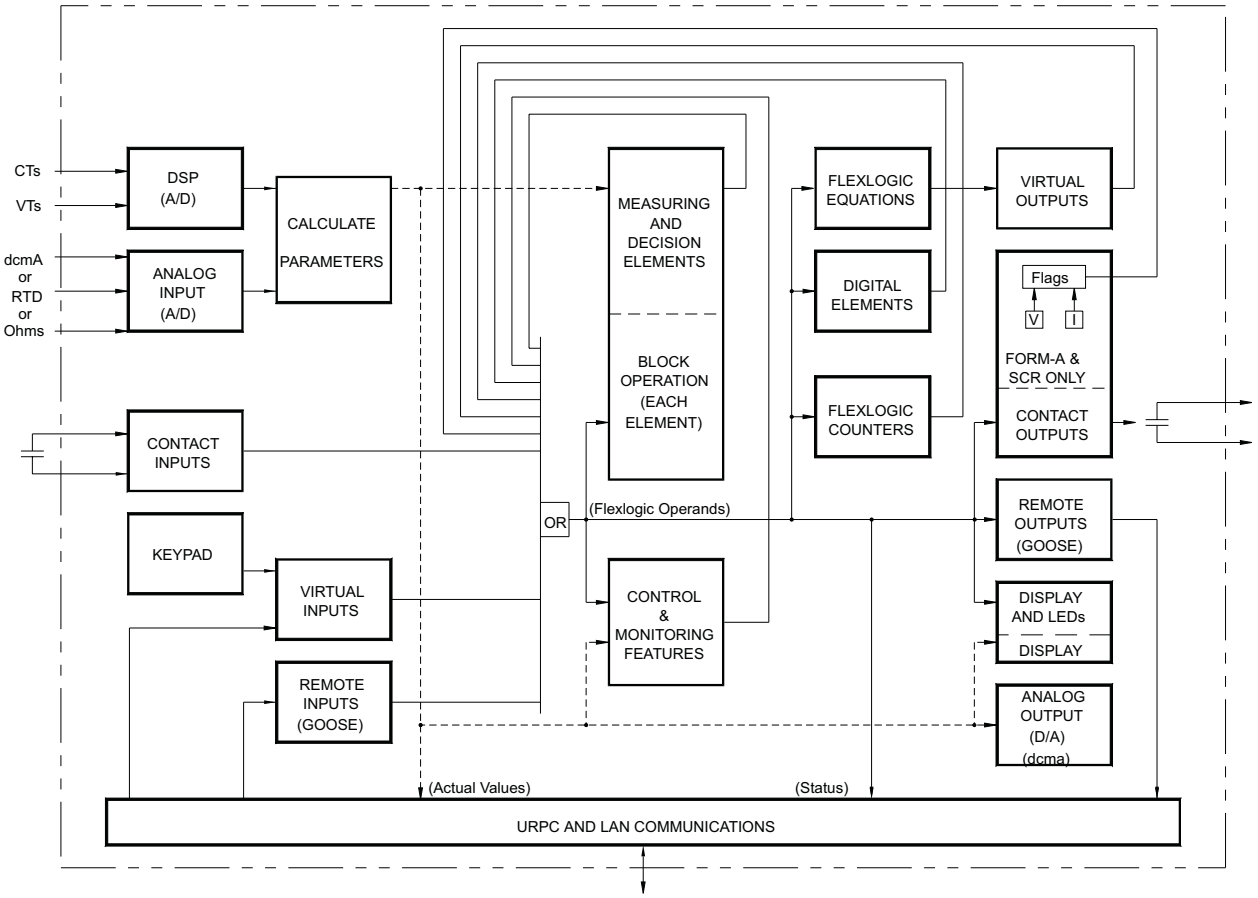


Figure 5–1: UR ARCHITECTURE OVERVIEW

The states of all digital signals used in a UR relay are represented by flags (or FlexLogic™ operands, which are described in a later section). A digital "1" is represented by a 'set' flag. Any external contact change-of-state can be used to block an element from operating, as an input to a control feature in a FlexLogic™ equation, or to operate a contact output. The state of the contact input can be displayed locally or viewed remotely via the communications facilities provided. If it is desired to have a simple scheme where a contact input is used to block an element, this selection is made when programming the element. This capability also applies to the other features that set flags: elements, virtual inputs, remote inputs, schemes, and human operators.

If more logic that is more complex than that presented above is required, it is implemented via FlexLogic™. For example, if it is desired to have the closed state of contact input H7a and the operated state of the phase undervoltage element block the operation of the phase time overcurrent element, the two control input states are programmed in a FlexLogic™ equation. This equation ANDs the two control inputs to produce a "virtual output" which is then selected when programming the phase time overcurrent to be used as a blocking input. Virtual outputs can only be created by FlexLogic™ equations.

Traditionally, protective relay logic has been relatively limited. Any unusual applications involving interlocks, blocking, or supervisory functions had to be hardwired using contact inputs and outputs. FlexLogic™ minimizes the requirement for auxiliary components and wiring while making more complex schemes possible.

The logic that determines the interaction of inputs, elements, schemes and outputs is field programmable through the use of logic equations that are sequentially processed. The use of virtual inputs and outputs in addition to hardware is available internally and on the communication ports for other relays to use (distributed FlexLogic™).

FlexLogic™ allows users to customize the relay through a series of equations that consist of operators and operands. The operands are the states of inputs, elements, schemes and outputs. The operators are logic gates, timers and latches (with set and reset inputs). A system of sequential operations allows any combination of specified operands to be assigned as inputs to specified operators to create an output. The final output of an equation is a numbered register called a virtual output. Virtual outputs can be used as an input operand in any equation, including the equation that generates the output, as a seal-in or other type of feedback.

A FlexLogic™ equation consists of parameters that are either operands or operators. Operands have a logic state of 1 or 0. Operators provide a defined function, such as an AND gate or a Timer. Each equation defines the combinations of parameters to be used to set a VIRTUAL OUTPUT flag. Evaluation of an equation results in either a 1 (= ON, i.e. flag set) or 0 (= OFF, i.e. flag not set). Each equation is evaluated at least 4 times every power system cycle.

Some types of operands are present in the relay in multiple instances; e.g. contact and remote inputs. These types of operands are grouped together (for presentation purposes only) on the faceplate display. The characteristics of the different types of operands are listed in the table: FLEXLOGIC™ OPERAND TYPES.

Table 5–2: FLEXLOGIC™ OPERAND TYPES

OPERAND TYPE	STATE	EXAMPE FORMAT	CHARACTERISTICS [Input Is '1' (= ON) if...]
Element (Digital)	Pickup	Dig Element 1 PKP	The input operand is at logic 1.
	Dropout	Dig Element 1 DPO	This operand is the logical inverse of the above PKP operand.
	Operate	Dig Element 1 OP	The input operand has been at logic 1 for the programmed pickup delay time, or has been at logic 1 for this period and is now at logic 0 but the reset timer has not finished timing.
Element (Digital Counter)	Higher than	Counter 1 HI	The number of pulses counted is above the set number.
	Equal to	Counter 1 EQL	The number of pulses counted is equal to the set number.
	Lower than	Counter 1 LO	The number of pulses counted is below the set number.
Contact Input	On	Cont Ip On	Voltage is presently applied to the input (external contact closed).
	Off	Cont Ip Off	Voltage is presently not applied to the input (external contact open).
Virtual Input	On	Virt Ip 1 On	The virtual input is presently in the ON state.
Remote Input	On	REMOTE INPUT 1 On	The remote input is presently in the ON state.
Contact Output (type Form-A contact only)	Voltage On	Cont Op 1 VOn	Voltage exists across the contact.
	Voltage Off	Cont Op 1 VOff	Voltage does not exists across the contact.
	Current On	Cont Op 1 IOn	Current is flowing through the contact.
	Current Off	Cont Op 1 IOff	Current is not flowing through the contact.
Virtual Output	On	Virt Op 1 On	The virtual output is presently in the set state (i.e. evaluation of the equation which produces this virtual output results in a "1").
Fixed	On	On	Logic 1
	Off	Off	Logic 0

The operands available for this relay are listed in the following table: FLEXLOGIC™ OPERANDS.

Table 5–3: FLEXLOGIC™ OPERANDS (Sheet 1 of 2)

OPERAND TYPE	OPERAND SYNTAX	OPERAND DESCRIPTION
ELEMENT (Digital Element)	Dig Element 1 PKP Dig Element 1 OP Dig Element 1 DPO ↓ Dig Element 16 PKP Dig Element 16 OP Dig Element 16 DPO	Digital Element 1 is picked up Digital Element 1 is operated Digital Element 1 is dropped out ↓ Digital Element 16 is picked up Digital Element 16 is operated Digital Element 16 is dropped out
ELEMENT (Digital Counter)	Counter 1 HI Counter 1 EQL Counter 1 LO ↓ Counter 8 HI Counter 8 EQL Counter 8 LO	Digital Counter 1 output is ‘more than’ comparison value Digital Counter 1 output is ‘equal to’ comparison value Digital Counter 1 output is ‘less than’ comparison value ↓ Digital Counter 8 output is ‘more than’ comparison value Digital Counter 8 output is ‘equal to’ comparison value Digital Counter 8 output is ‘less than’ comparison value
RESETTING	RESET OP RESET OP (COMMS) RESET OP (OPERAND) RESET OP (PUSHBUTTON)	Reset command is operated (set by all 3 operands below) Communications source of the reset command Operand source of the reset command Reset key (pushbutton) source of the reset command
FIXED	Off	Logic = 0. Does nothing and may be used as a delimiter in an equation list; used as ‘Disable’ by other features.
	On	Logic = 1. Can be used as a test setting.
CONTACT INPUT	Cont Ip 1 On Cont Ip 2 On ↓ Cont Ip 1 Off Cont Ip 2 Off ↓	(will not appear unless ordered) (will not appear unless ordered) ↓ (will not appear unless ordered) (will not appear unless ordered) ↓
VIRTUAL INPUT	Virt Ip 1 On ↓ Virt Ip 32 On	Flag is set, logic=1 ↓ Flag is set, logic=1
REMOTE INPUT	REMOTE INPUT 1 On ↓ REMOTE INPUT 32 On	Flag is set, logic=1 ↓ Flag is set, logic=1
REMOTE DEVICE	REMOTE DEVICE 1 On ↓ REMOTE DEVICE 16 On	Flag is set, logic=1 ↓ Flag is set, logic=1
	REMOTE DEVICE 1 Off ↓ REMOTE DEVICE 16 Off	Flag is set, logic=1 ↓ Flag is set, logic=1
CONTACT OUTPUT (voltage) From detector on Form-A output only	Cont Op 1 VOn Cont Op 2 VOn ↓	(will not appear unless ordered) (will not appear unless ordered) ↓
	Cont Op 1 VOff Cont Op 2 VOff ↓	(will not appear unless ordered) (will not appear unless ordered) ↓

Table 5–3: FLEXLOGIC™ OPERANDS (Sheet 2 of 2)

OPERAND TYPE	OPERAND SYNTAX	OPERAND DESCRIPTION
CONTACT OUTPUT (current) From detector on Form-A output only	Cont Op 1 IOn Cont Op 2 IOn ↓	(will not appear unless ordered) (will not appear unless ordered) ↓
	Cont Op 1 IOff Cont Op 2 IOff ↓	(will not appear unless ordered) (will not appear unless ordered) ↓
VIRTUAL OUTPUT	Virt Op 1 On ↓ Virt Op 64 On	Flag is set, logic=1 ↓ Flag is set, logic=1
SELF-DIAGNOSTICS	ANY MAJOR ERROR ANY MINOR ERROR ANY SELF-TEST LOW ON MEMORY WATCHDOG ERROR PROGRAM ERROR EEPROM DATA ERROR PRI ETHERNET FAIL SEC ETHERNET FAIL BATTERY FAIL SYSTEM EXCEPTION UNIT NOT PROGRAMMED EQUIPMENT MISMATCH FLEXLGC ERROR TOKEN PROTOTYPE FIRMWARE UNIT NOT CALIBRATED NO DSP INTERRUPTS DSP ERROR IRIG-B FAILURE REMOTE DEVICE OFFLINE	Any of the major self-test errors generated (major error) Any of the minor self-test errors generated (minor error) Any self-test errors generated (generic, any error) See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter. See description in the COMMANDS chapter.

Some operands can be re-named by the user. These are the names of the breakers in the breaker control feature, the ID (identification) of contact inputs, the ID of virtual inputs, and the ID of virtual outputs. If the user changes the default name/ID of any of these operands, the assigned name will appear in the relay list of operands. The default names are shown in the FLEXLOGIC™ OPERANDS table above.

The characteristics of the logic gates are tabulated in FLEXLOGIC™ GATE CHARACTERISTICS table, and the operators available in FlexLogic™ are listed in the FLEXLOGIC™ OPERATORS table.

Table 5–4: FLEXLOGIC™ GATE CHARACTERISTICS

GATES	NUMBER OF INPUTS	OUTPUT IS '1' (= ON) IF...
NOT	1	input is '0'
OR	2 to 16	any input is '1'
AND	2 to 16	all inputs are '1'
NOR	2 to 16	all inputs are '0'
NAND	2 to 16	any input is '0'
XOR	2	only one input is '1'

Table 5–5: FLEXLOGIC™ OPERATORS

OPERATOR TYPE	OPERATOR SYNTAX	DESCRIPTION	NOTES
Editor	INSERT	Insert a parameter in an equation list.	
	DELETE	Delete a parameter from an equation list.	
End	END	The first END encountered signifies the last entry in the list of FlexLogic™ parameters that is processed.	
One Shot	POSITIVE ONE SHOT	One shot that responds to a positive going edge.	A 'one shot' refers to a single input gate that generates a pulse in response to an edge on the input. The output from a 'one shot' is True (positive) for only one pass through the FlexLogic™ equation. There is a maximum of 32 'one shots'.
	NEGATIVE ONE SHOT	One shot that responds to a negative going edge.	
	DUAL ONE SHOT	One shot that responds to both the positive and negative going edges.	
Logic Gate	NOT	Logical Not	Operates on the previous parameter.
	OR(2) ↓ OR(16)	2 input OR gate ↓ 16 input OR gate	Operates on the 2 previous parameters. ↓ Operates on the 16 previous parameters.
	AND(2) ↓ AND(16)	2 input AND gate ↓ 16 input AND gate	Operates on the 2 previous parameters. ↓ Operates on the 16 previous parameters.
	NOR(2) ↓ NOR(16)	2 input NOR gate ↓ 16 input NOR gate	Operates on the 2 previous parameters. ↓ Operates on the 16 previous parameters.
	NAND(2) ↓ NAND(16)	2 input NAND gate ↓ 16 input NAND gate	Operates on the 2 previous parameters. ↓ Operates on the 16 previous parameters.
	XOR(2)	2 input Exclusive OR gate	Operates on the 2 previous parameters.
	LATCH (S,R)	Latch (Set, Reset) - reset-dominant	The parameter preceding LATCH(S,R) is the Reset input. The parameter preceding the Reset input is the Set input.
Timer	TIMER 1 ↓ TIMER 32	Timer as configured with FlexLogic™ Timer 1 settings. ↓ Timer as configured with FlexLogic™ Timer 32 settings.	The timer is started by the preceding parameter. The output of the timer is TIMER #.
Assign Virtual Output	= Virt Op 1 ↓ = Virt Op 64	Assigns previous FlexLogic™ parameter to Virtual Output 1. ↓ Assigns previous FlexLogic™ parameter to Virtual Output 64.	The virtual output is set by the preceding parameter

a) FLEXLOGIC™ RULES

When forming a FlexLogic™ equation, the sequence of entries in the linear array of parameters must follow these general rules:

1. Operands must precede the operator which uses the operands as inputs.
2. Operators have only one output. The output of an operator must be used to create a virtual output if it is to be used as an input to two or more operators.
3. Assigning the output of an operator to a Virtual Output terminates the equation.
4. A timer operator (e.g. "TIMER 1") or virtual output assignment (e.g. " = Virt Op 1") may only be used once. If this rule is broken, a syntax error will be declared.

b) FLEXLOGIC™ EVALUATION

Each equation is evaluated in the order in which the parameters have been entered.

FLEXLOGIC™ PROVIDES LATCHES WHICH BY DEFINITION HAVE A MEMORY ACTION, REMAINING IN THE SET STATE AFTER THE SET INPUT HAS BEEN ASSERTED. HOWEVER, THEY ARE VOLATILE; I.E. THEY RESET ON THE RE-APPLICATION OF CONTROL POWER.

WHEN MAKING CHANGES TO PROGRAMMING, ALL FLEXLOGIC™ EQUATIONS ARE RE-COMPILED WHEN ANY NEW SETTING IS ENTERED, SO ALL LATCHES ARE AUTOMATICALLY RESET. IF IT IS REQUIRED TO RE-INITIALIZE FLEXLOGIC™ DURING TESTING, FOR EXAMPLE, IT IS SUGGESTED TO POWER THE UNIT DOWN AND THEN BACK UP.

c) FLEXLOGIC™ PROCEDURE EXAMPLE

An example of the process used to implement a particular set of logic required in an application follows. The sequence of the steps outlined is quite important, as it should minimize the work necessary to develop the settings to be applied to the relay. Note that the example presented below in the figure: EXAMPLE LOGIC SCHEME, is intended to demonstrate the procedure, not to solve a specific application situation.

In the logic example, it is assumed that some logic has already been programmed to produce Virtual Output 1 and Virtual Output 2, and is only a part of the full set of equations used. When using FlexLogic™, it is important to make a note when each Virtual Output is used - a Virtual Output designation (1 to 64) can only be properly assigned once.

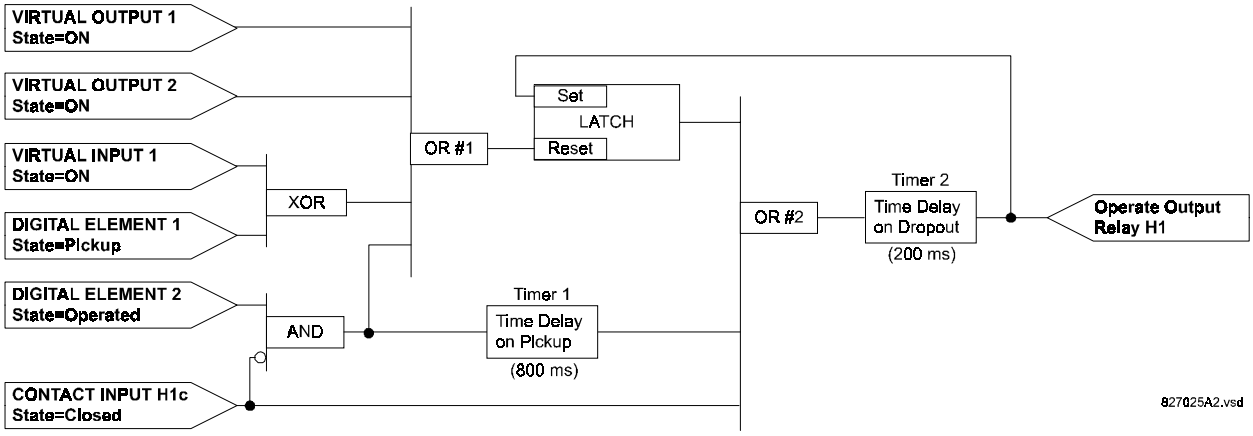


Figure 5–2: EXAMPLE LOGIC SCHEME

STEP 1:

The initial step in the process is to inspect the example logic diagram to determine that the required logic can be implemented with the types of operators provided by FlexLogic™. If this is not possible, the logic will have to be altered until this condition is satisfied. Once this is done, count the inputs to each gate to check that the number of inputs does not exceed the limits available in FlexLogic™, which is unlikely but possible. If the number of inputs is too high, subdivide the inputs into multiple gates to produce an equivalent. For example, if it is required to have 25 inputs to an AND gate, connect inputs 1 through 16 to one AND(16), 17 through 25 to another AND(9), and the outputs from these two gates to an AND(2).

Inspect each operator between the initial operands and final virtual outputs to determine if the output from the operator is used as an input to more than one following operator. If so, the output of this operator must be assigned as a Virtual Output.

In the example shown in the figure: EXAMPLE LOGIC SCHEME, the output of the AND gate is used as an input to both OR #1 and Timer 1, and must therefore be made a Virtual Output and be assigned the next available number (i.e. Virtual Output 3). The final output must also be assigned to a Virtual Output as Virtual Output 4, which will be programmed in the contact output section to operate relay H1 (i.e. Output Contact H1).

It is now determined that the required logic can be implemented in FlexLogic™ with two FlexLogic™ equations, with outputs of Virtual Output 3 and Virtual Output 4 as shown in the figure: LOGIC EXAMPLE WITH VIRTUAL OUTPUTS.

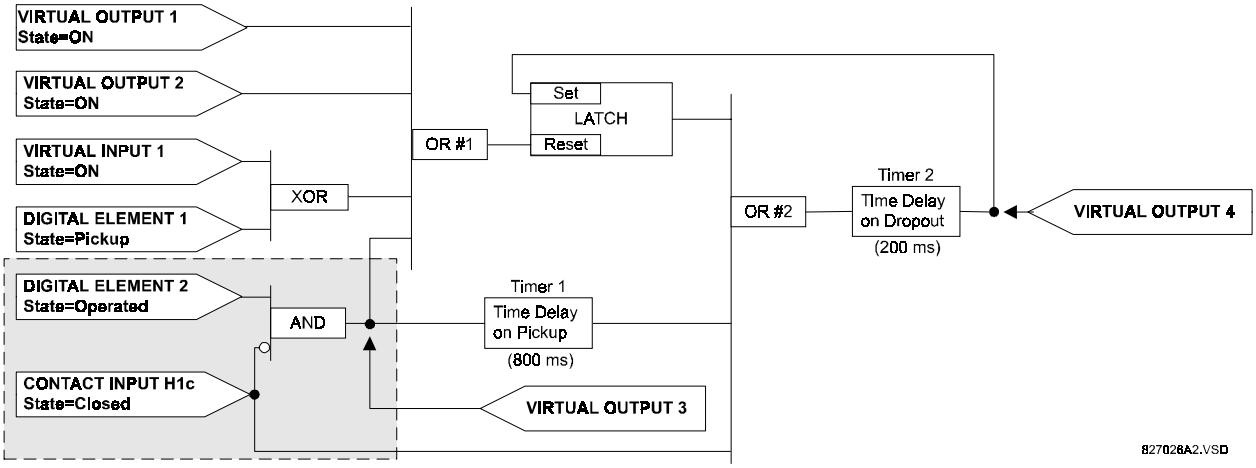


Figure 5–3: LOGIC EXAMPLE WITH VIRTUAL OUTPUTS

STEP 2:

The next step is to prepare a logic diagram for the equation to produce Virtual Output 3, as this output will be used later as an operand in the equation for Virtual Output 4. (Create the equation for every output which will be used as an operand first, so that when these operands are required they will already have been evaluated and assigned to a specific Virtual Output.) The logic for Virtual Output 3 is shown in the figure: LOGIC FOR VIRTUAL OUTPUT 3, with the final output assigned.

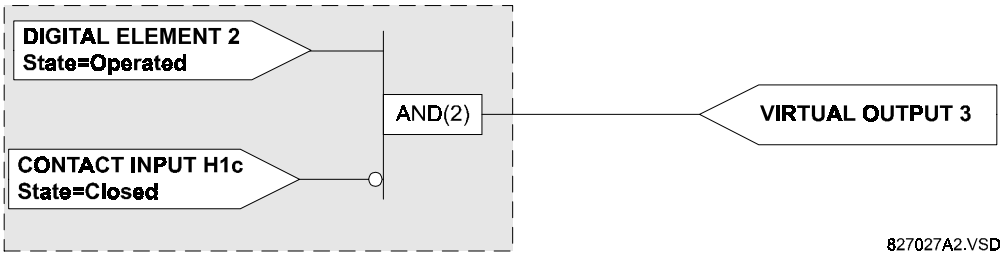


Figure 5–4: LOGIC FOR VIRTUAL OUTPUT 3

STEP 3:

Next, prepare a logic diagram for Virtual Output 4, while replacing the logic ahead of Virtual Output 3 with a symbol identified as Virtual Output 3, as shown in the figure: LOGIC FOR VIRTUAL OUTPUT 4.

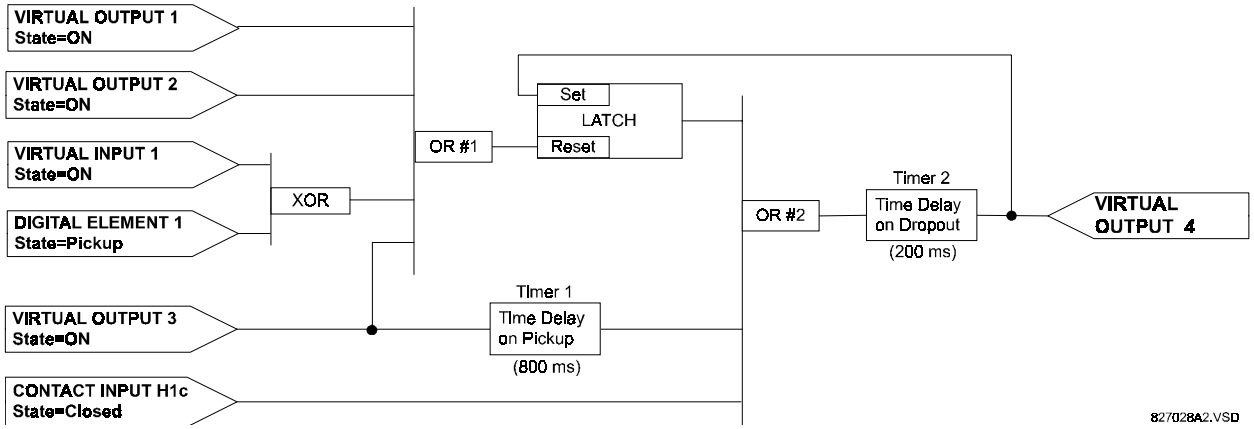


Figure 5–5: LOGIC FOR VIRTUAL OUTPUT 4

STEP 4:

Now program the FlexLogic™ equation for Virtual Output 3 by translating the logic into the available FlexLogic™ parameters. The equation is formed one parameter at a time, until the required logic is complete. It is generally easier to start at the output end of the equation and work back towards the input in this process, as shown in the following steps. It is also recommended to list operator inputs from bottom to top. For demonstration, the final output will be arbitrarily identified as parameter 99, and each preceding parameter decremented by one in turn. Until one is accustomed to using FlexLogic™, it is suggested that a worksheet with a series of cells marked with the arbitrary parameter numbers be prepared, as shown in the figure: FLEXLOGIC™ WORKSHEET.

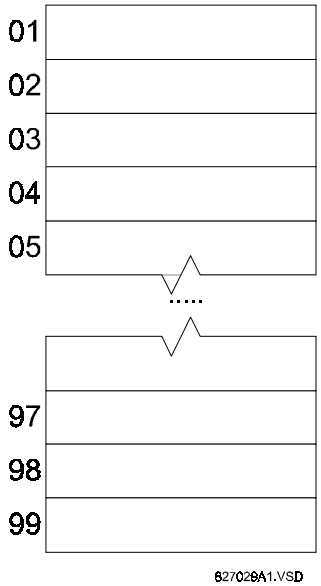


Figure 5–6: FLEXLOGIC™ WORKSHEET

STEP 5:

Following the procedure outlined, start with parameter 99, as follows:

99: The final output of the equation is Virtual Output 3, which is created by the operator "= Virt Op n". This parameter is therefore "= Virt Op 3."

98: The gate preceding the output is an AND, which in this case requires two inputs. The operator for this gate is a 2-input AND so the parameter is “AND(2)”. Note that FlexLogic™ rules require that the number of inputs to most types of operators must be specified to identify the operands for the gate. As the 2-input AND will operate on the two operands preceding it, these inputs must be specified, starting with the lower.

97: This lower input to the AND gate must be passed through an inverter (the NOT operator) so the next parameter is “NOT”. The NOT operator will act upon the operand immediately preceding it, so next specify the input to the inverter.

96: The input to the NOT gate is to be contact input H1c. The ON state of a contact input can be programmed to be set when the contact is either open or closed. Assume for this example the state is to be ON for a closed contact. The operand is therefore "Cont Ip H1c On".

95: The last step in the procedure is to specify the upper input to the AND gate, the operated state of digital element 2. This operand is "DIG ELEM 2 OP".

Writing the parameters in numerical order can now form the equation for VIRTUAL OUTPUT 3:

- [95] DIG ELEM 2 OP
- [96] Cont Ip H1c On
- [97] NOT
- [98] AND(2)
- [99] = Virt Op 3

It is now possible to check that this selection of parameters will produce the required logic by converting the set of parameters into a logic diagram. The result of this process is shown in figure FLEXLOGIC™ EQUATION & LOGIC FOR VIRTUAL OUTPUT 3, which is compared to figure: LOGIC FOR VIRTUAL OUTPUT 3 as a check.

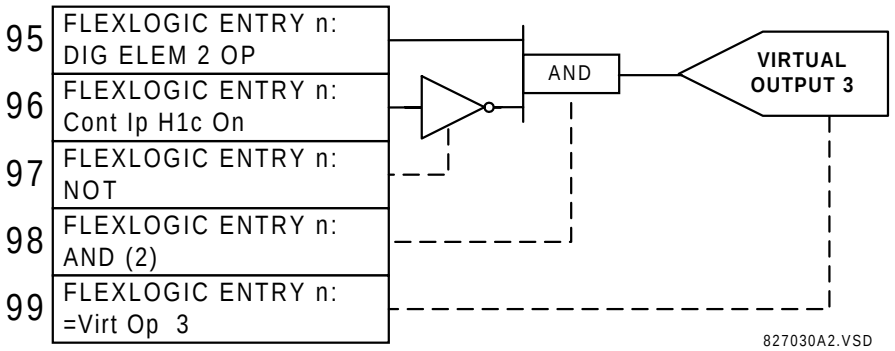


Figure 5–7: FLEXLOGIC™ EQUATION & LOGIC FOR VIRTUAL OUTPUT 3

STEP 6:

Repeating the process described for VIRTUAL OUTPUT 3, select the FlexLogic™ parameters for VIRTUAL OUTPUT 4.

99: The final output of the equation is VIRTUAL OUTPUT 4 which is parameter “= Virt Op 4".

98: The operator preceding the output is Timer 2, which is operand “TIMER 2". Note that the settings required for the timer are established in the timer programming section.

97: The operator preceding Timer 2 is OR #2, a 3-input OR, which is parameter “OR(3)”.

96: The lowest input to OR #2 is operand “Cont Ip H1c On”.

95: The center input to OR #2 is operand “TIMER 1".

94: The input to Timer 1 is operand “Virt Op 3 On".

93: The upper input to OR #2 is operand “LATCH (S,R)”.

92: There are two inputs to a latch, and the input immediately preceding the latch reset is OR #1, a 4-input OR, which is parameter “OR(4)”.

91: The lowest input to OR #1 is operand “Virt Op 3 On".

90: The input just above the lowest input to OR #1 is operand “XOR(2)”.

89: The lower input to the XOR is operand “DIG ELEM 1 PKP”.

88: The upper input to the XOR is operand “Virt Ip 1 On".

87: The input just below the upper input to OR #1 is operand “Virt Op 2 On".

86: The upper input to OR #1 is operand “Virt Op 1 On".

85: The last parameter is used to set the latch, and is operand “Virt Op 4 On".

The equation for VIRTUAL OUTPUT 4 is:

- [85] Virt Op 4 On
- [86] Virt Op 1 On
- [87] Virt Op 2 On
- [88] Virt Ip 1 On
- [89] DIG ELEM 1 PKP
- [90] XOR(2)
- [91] Virt Op 3 On
- [92] OR(4)
- [93] LATCH (S,R)
- [94] Virt Op 3 On
- [95] TIMER 1
- [96] Cont Ip H1c On
- [97] OR(3)
- [98] TIMER 2
- [99] = Virt Op 4

It is now possible to check that the selection of parameters will produce the required logic by converting the set of parameters into a logic diagram. The result of this process is shown in figure: FLEXLOGIC™ EQUATION & LOGIC FOR VIRTUAL OUTPUT 4, which is compared to figure: LOGIC FOR VIRTUAL OUTPUT 4, as a check.

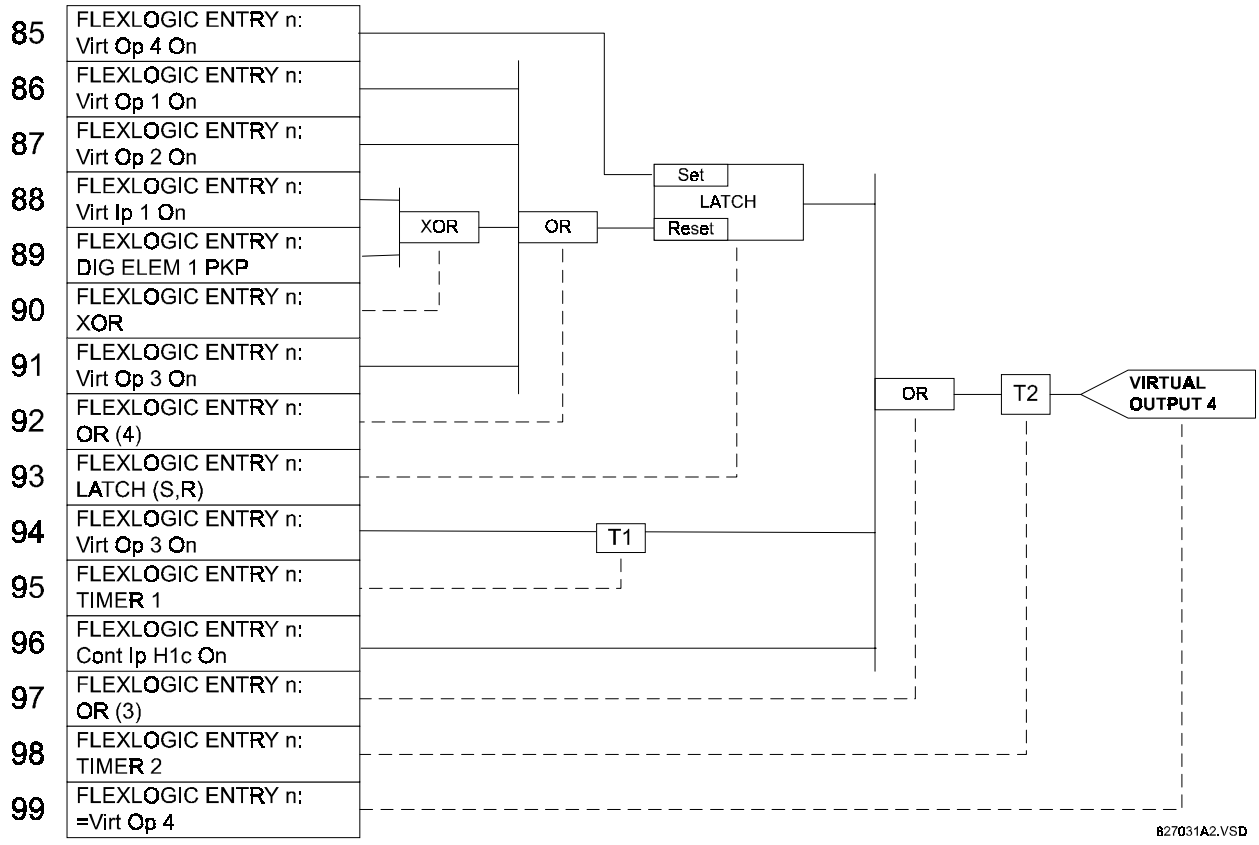


Figure 5–8: FLEXLOGIC™ EQUATION & LOGIC FOR VIRTUAL OUTPUT 4

STEP 7:

Now write the complete FlexLogic™ expression required to implement the required logic, making an effort to assemble the equation in an order where Virtual Outputs that will be used as inputs to operators are created before needed. In cases where a lot of processing is required to perform considerable logic, this may be difficult to achieve, but in most cases will not cause problems because all of the logic is calculated at least 4 times per power frequency cycle. The possibility of a problem caused by sequential processing emphasizes the necessity to test the performance of FlexLogic™ before it is placed in service.

In the following equation, VIRTUAL OUTPUT 3 is used as an input to both Latch 1 and Timer 1 as arranged in the order shown below:

- DIG ELEM 2 OP
- Cont Ip H1c On
- NOT
- AND(2)
- = Virt Op 3
- Virt Op 4 On
- Virt Op 1 On
- Virt Op 2 On
- Virt Ip 1 On
- DIG ELEM 1 PKP
- XOR(2)
- Virt Op 3 On
- OR(4)
- LATCH (S,R)
- Virt Op 3 On
- TIMER 1
- Cont Ip H1c On
- OR(3)
- TIMER 2
- = Virt Op 4
- END

In the expression above, the VIRTUAL OUTPUT 4 input to the 4-input OR is listed before it is created. This is typical of a form of feedback, in this case, used to create a seal-in effect with the latch, and is correct.

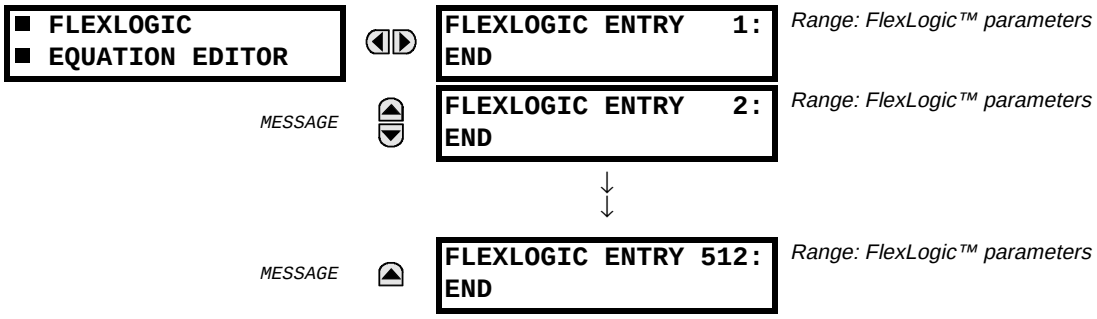
STEP 8:

The logic should always be tested after it is loaded into the relay, in the same fashion as has been used in the past. Testing can be simplified by placing an "END" operator within the overall set of FlexLogic™ equations. The equations will then only be evaluated up to the first "END" operator.

The "On" and "Off" operands can be placed in an equation to establish a known set of conditions for test purposes, and the "INSERT" and "DELETE" commands can be used to modify equations.

5.3.2 FLEXLOGIC™ EQUATION EDITOR

PATH: SETTINGS ⇩ FLEXLOGIC ⇨ FLEXLOGIC EQUATION EDITOR



There are 512 FlexLogic™ entries available, numbered from 1 to 512, with default 'END' entry settings.

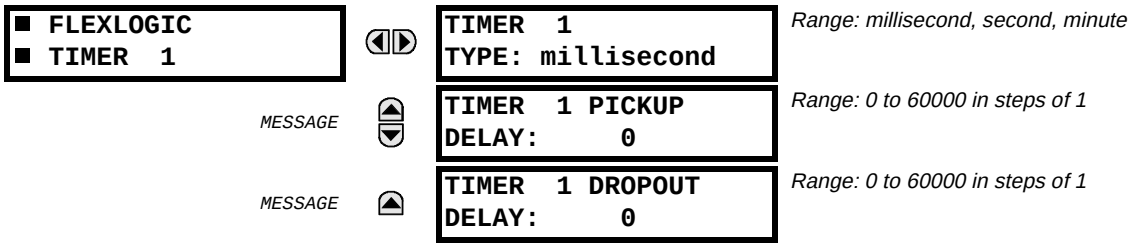
If a 'disabled' Element is selected as a FlexLogic™ entry, the associated state flag will never be set to '1'.

The '+/-' key may be used when editing FlexLogic™ equations from the keypad to quickly scan through the major parameter types.

5.3.3 FLEXLOGIC™ TIMERS

5

PATH: SETTING ⇩ FLEXLOGIC ⇨⇩ FLEXLOGIC TIMERS ⇨ FLEXLOGIC TIMER 1(32)



There are 32 identical FlexLogic™ timers available, numbered from 1 to 32.

These timers can be used as operators for FlexLogic™ equations.

TIMER 1 TYPE:

This setting is used to select the time measuring unit.

TIMER 1 PICKUP DELAY:

This setting is used to set the time delay to pickup. If a pickup delay is not required, set this function to '0'.

TIMER 1 DROPOUT DELAY:

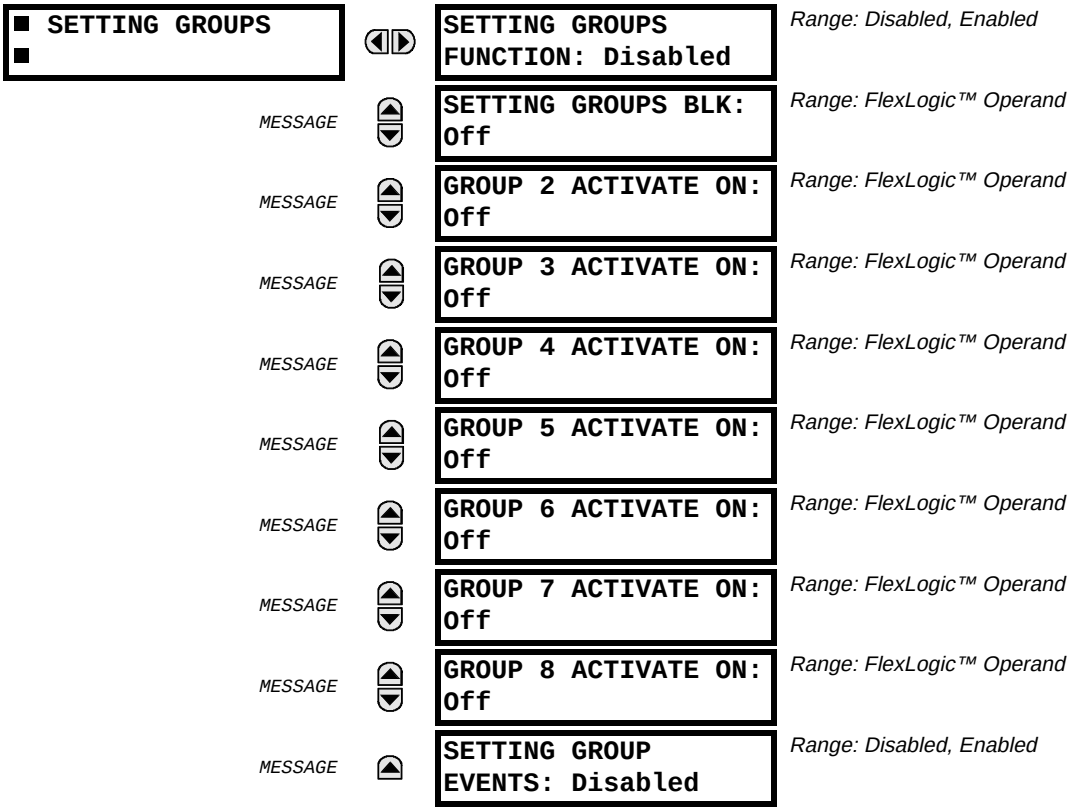
This setting is used to set the time delay to dropout. If a dropout delay is not required, set this function to '0'.

5.4.1 OVERVIEW

CONTROL elements are generally used for control rather than for protection. See the INTRODUCTION TO ELEMENTS section at the front of this chapter for further information.

5.4.2 SETTING GROUPS MENU

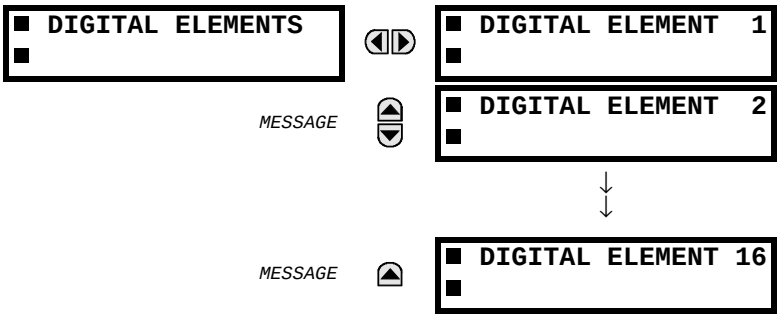
PATH: SETTINGS ⇩ CONTROL ELEMENTS ⇨ SETTINGS GROUPS



NOTE

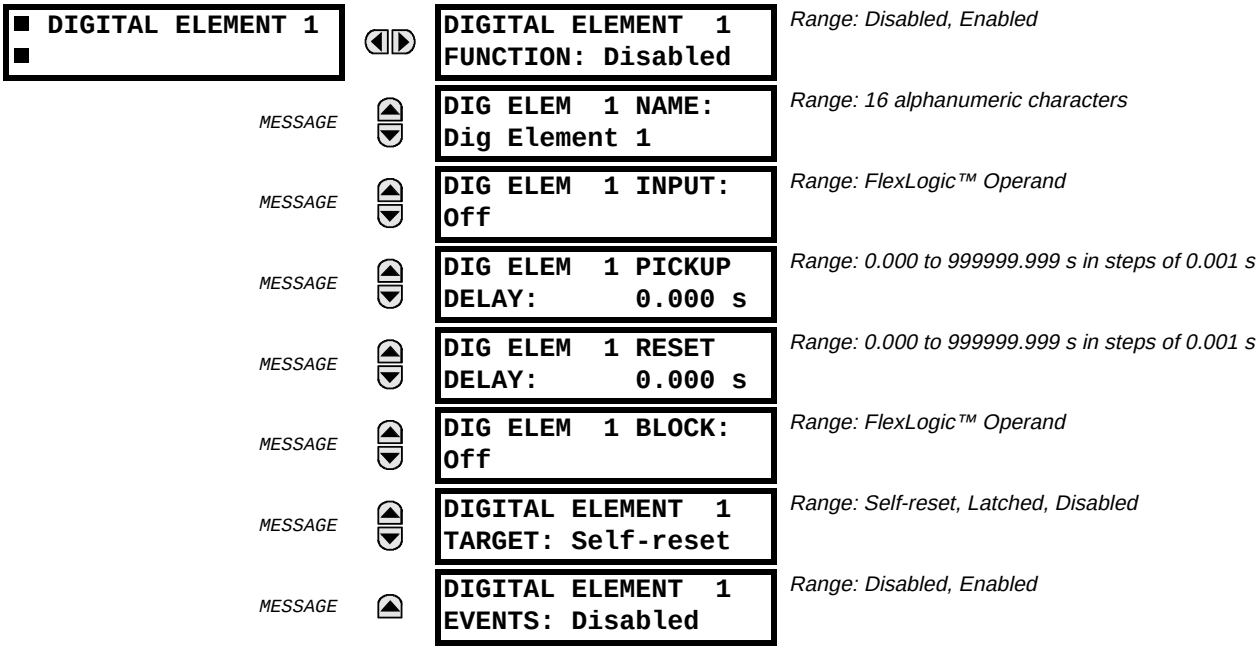
Althougth the Settings Groups menu is displayed, this version of the C30 Controller does not use the Setting Groups feature since there are no DSP functions. As such, the Setting Groups menu functions do not operate at this time.

PATH: SETTINGS ⇩ CONTROL ELEMENTS ⇨⇩ DIGITAL ELEMENTS



a) DIGITAL ELEMENT 1

PATH: SETTINGS ⇩ CONTROL ⇨⇩ DIGITAL ELEMENTS ⇨ DIGITAL ELEMENT 1(16)



There are 16 identical Digital Elements available, numbered from 1 to 16.

A Digital Element can be used to monitor any FlexLogic™ operand, and to present a target message and/or enable events recording depending on the output operand state. The digital element settings include a 'name' which will be referenced in any target message, a blocking input from any selected FlexLogic™ operand, and a timer for pickup and reset delays for the output operand.

DIGITAL ELEMENT 1 INPUT:

This setting is used to select a FlexLogic™ operand to be monitored by the Digital Element.

DIGITAL ELEMENT 1 PICKUP DELAY:

This setting is used to set the time delay to pickup. If a pickup delay is not required, set this function to '0'.

DIGITAL ELEMENT 1 RESET DELAY:

This setting is used to set the time delay to reset. If a reset delay is not required, set this function to '0'.

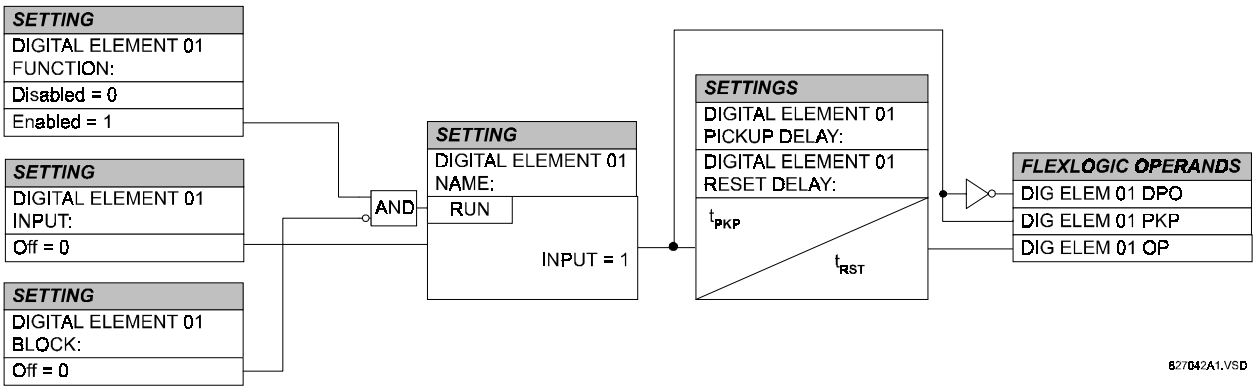


Figure 5–9: DIGITAL ELEMENT SCHEME LOGIC

b) CIRCUIT MONITORING APPLICATIONS

Some versions of the digital input modules include an active Voltage Monitor circuit connected across Form-A contacts. The Voltage Monitor circuit limits the trickle current through the output circuit (see Technical Specifications for Form-A).

As long as the current through the Voltage Monitor is above a threshold (see Technical Specifications for Form-A), the FlexLogic™ operand "Cont Op # VOn" will be set. (# represents the output contact number).

If the output circuit has a high resistance or the DC current is interrupted, the trickle current will drop below the threshold and the FlexLogic™ operand "Cont Op # VOff" will be set.

Consequently, the state of these operands can be used as indicators of the integrity of the circuits in which Form-A contacts are inserted.

BREAKER TRIP CIRCUIT INTEGRITY MONITORING:

In many applications it is desired to monitor the breaker trip circuit integrity so problems can be detected before a trip operation is required. The circuit is considered to be healthy when the Voltage Monitor connected across the trip output contact detects a low level of current, well below the operating current of the breaker trip coil. If the circuit presents a high resistance, the trickle current will fall below the monitor threshold and an alarm would be declared.

Example 1:

In most breaker control circuits, the trip coil is connected in series with a breaker auxiliary contact which is open when the breaker is open (see TRIP CIRCUIT EXAMPLE 1 diagram). To prevent unwanted alarms in this situation, the trip circuit monitoring logic must include the breaker position.

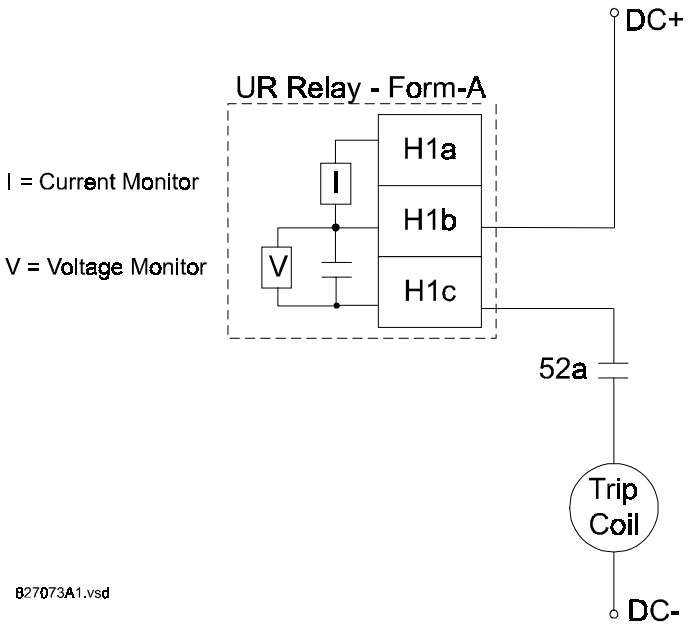


Figure 5–10: TRIP CIRCUIT - EXAMPLE 1

Assume the output contact H1 is a trip contact. Using the contact output settings, this output will be given an ID name, e.g. "Cont Op 1".

Assume a 52a breaker auxiliary contact is connected to contact input H7a to monitor breaker status. Using the contact input settings, this input will be given an ID name, e.g. "Cont Ip 1" and will be set "ON" when the breaker is closed. Using Digital Element 1 to monitor the breaker trip circuit, the settings will be:

■ DIGITAL ELEMENT 1 ■	DIGITAL ELEMENT 1 FUNCTION: Enabled
MESSAGE	DIG ELEM 1 NAME: Bkr Trip Cct Out
MESSAGE	DIG ELEM 1 INPUT: Cont Op 1 VOff
MESSAGE	DIG ELEM 1 PICKUP DELAY: 0.200 s
MESSAGE	DIG ELEM 1 RESET DELAY: 0.100 s
MESSAGE	DIG ELEM 1 BLOCK: Cont Ip 1
MESSAGE	DIGITAL ELEMENT 1 TARGET: Self-reset
MESSAGE	DIGITAL ELEMENT 1 EVENTS: Enabled

NOTE

The PICKUP DELAY setting should be greater than the operating time of the breaker to avoid nuisance alarms.

Example 2:

If it is required to monitor the trip circuit continuously, independent of the breaker position (open or closed), a method to maintain the monitoring current flow through the trip circuit when the breaker is open must be provided (as shown in Figure: TRIP CIRCUIT - EXAMPLE 2). This can be achieved by connecting a suitable resistor (as listed in the VALUES OF RESISTOR 'R' table) across the auxiliary contact in the trip circuit. In this case, it is not required to supervise the monitoring circuit with the breaker position - the BLOCK setting is selected to Off. In this case, the settings will be:

```
■ DIGITAL ELEMENT  1
■
```

```
DIGITAL ELEMENT  1
FUNCTION: Enabled
```

MESSAGE

```
DIG ELEM  1 NAME:
Bkr Trip Cct Out
```

MESSAGE

```
DIG ELEM  1 INPUT:
Cont Op 1 VOff
```

MESSAGE

```
DIG ELEM  1 PICKUP
DELAY:      0.200 s
```

MESSAGE

```
DIG ELEM  1 RESET
DELAY:      0.100 s
```

MESSAGE

```
DIG ELEM  1 BLOCK:
Off
```

MESSAGE

```
DIGITAL ELEMENT  1
TARGET: Self-reset
```

MESSAGE

```
DIGITAL ELEMENT  1
EVENTS: Enabled
```

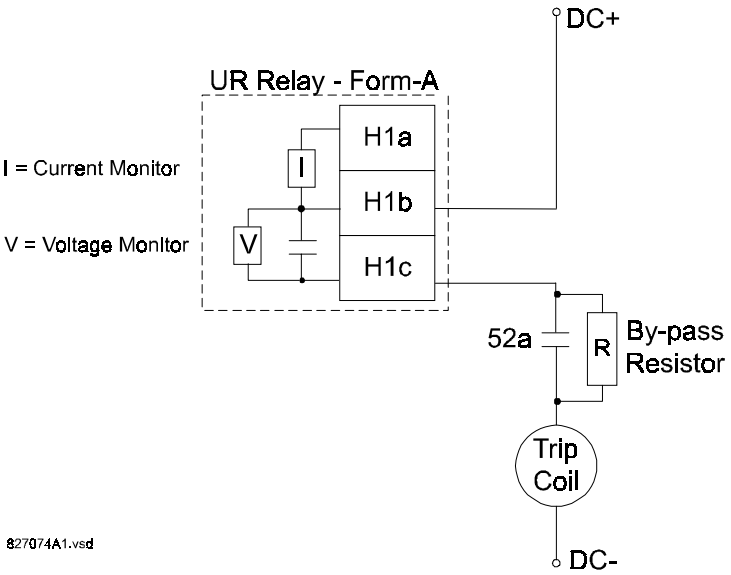
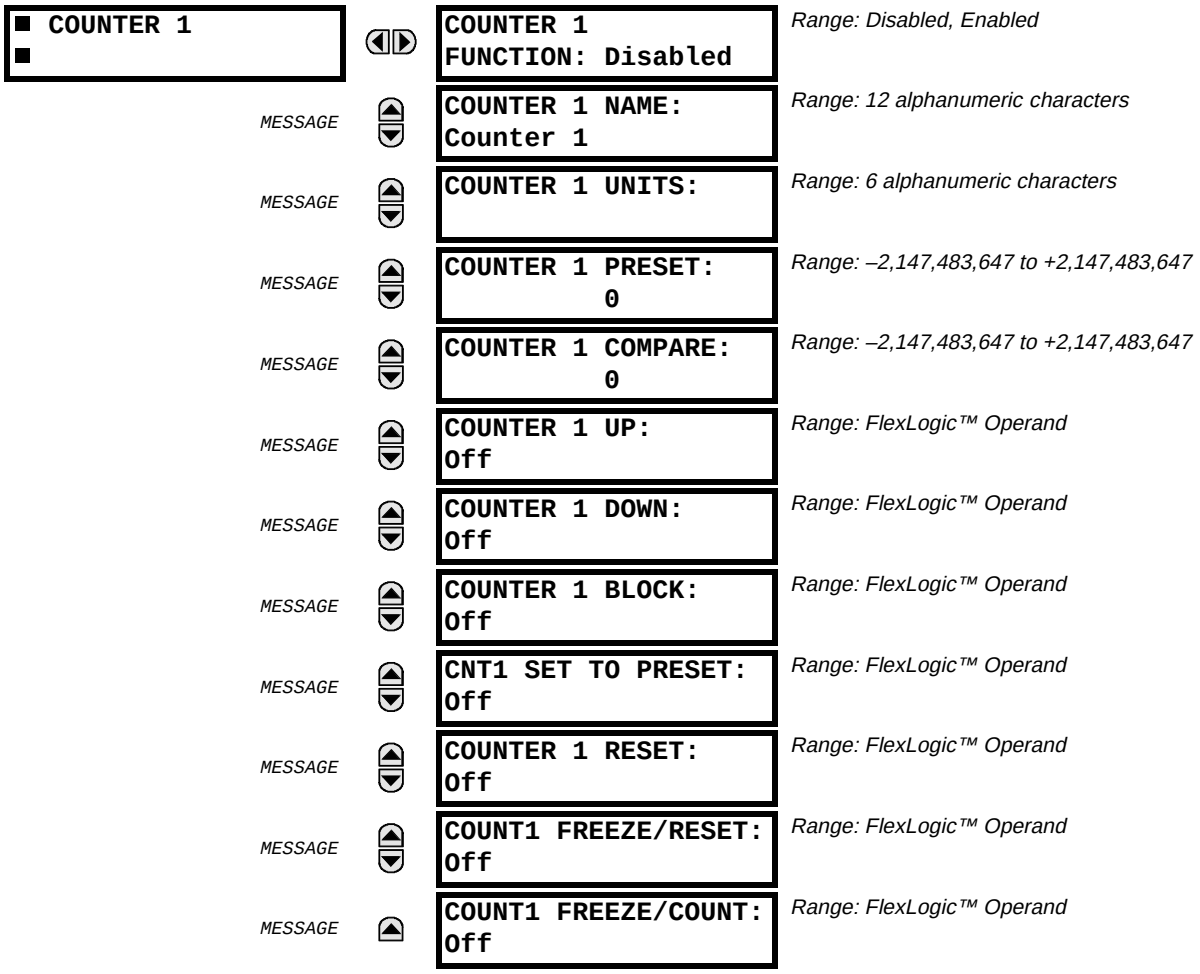


Table 5–6: VALUES OF RESISTOR 'R'

POWER SUPPLY (V DC)	RESISTANCE (Ohms)	POWER (Watts)
24	1000	2
30	5000	2
48	10000	2
110	25000	5
125	25000	5
250	50000	5

Figure 5–11: TRIP CIRCUIT - EXAMPLE 2

PATH: SETTINGS ⇩ CONTROL ELEMENTS ⇨⇩ DIGITAL COUNTERS ⇨ COUNTER 1(8)



There are 8 identical digital counters available, numbered from 1 to 8.

A digital counter counts the number of state transitions from Logic 0 to Logic 1. The counter can be used to count operations such as the pickups of an element, the changes of state of an external contact such as a breaker auxiliary switch, or pulses from a watt-hour meter, etc.

COUNTER 1 UNITS:

This setting is used to assign a label to identify the unit of measure pertaining to the digital transitions to be counted. The units label will appear in the corresponding Actual Values status.

COUNTER 1 PRESET:

This setting is used to set the count to a required preset value before counting operations begin, as in the case where a substitute relay is to be installed in place of an in-service relay, or while the counter is running.

COUNTER 1 COMPARE:

This setting is used to set the value to which the accumulated count value is compared. Three FlexLogic™ output operands are provided to indicate if the present value is "more than (HI)", "equal to (EQL)", or "less than (LO)" the set value.

COUNTER 1 UP:

This setting is used to select the FlexLogic™ operand for incrementing the counter. If an enabled UP input is received when the accumulated value is at the limit of +2,147,483,647 counts, the counter will rollover to –2,147,483,647.

COUNTER 1 DOWN:

This setting is used to select the FlexLogic™ operand for decrementing the counter. If an enabled DOWN input is received when the accumulated value is at the limit of -2,147,483,647 counts, the counter will rollover to +2,147,483,647.

COUNTER 1 BLOCK:

This setting is used to select the FlexLogic™ operand for blocking the counting operation.

CNT1 SET TO PRESET:

This setting is used to select the FlexLogic™ operand used to set the count to the preset value. The counter will be set to the preset value in the following situations:

1. When the counter is enabled and the "CNT1 SET TO PRESET" operand has the value 1. (When the counter is enabled and the "CNT1 SET TO PRESET" operand has the value 0, the counter will be set to 0.)
2. When the counter is running and the "CNT1 SET TO PRESET" operand changes the state from 0 to 1. (The change of state of the "CNT1 SET TO PRESET" operand from 1 to 0 while the counter is running has no effect on the count.)
3. When a reset or reset/freeze command is sent to the counter and the "CNT1 SET TO PRESET" operand has the value 1. (When a reset or reset/freeze command is sent to the counter and the "CNT1 SET TO PRESET" operand has the value 0, the counter will be set to 0.)

COUNTER 1 RESET:

This setting is used to select the FlexLogic™ operand for setting the count to either ‘0’ or the preset value depending on the state of the "CNT1 SET TO PRESET" operand.

COUNTER 1 FREEZE/RESET:

This setting is used to select the FlexLogic™ operand for capturing (freezing) the accumulated count value into a separate register with the date and time of the operation, and resetting the count to ‘0’ or the preset value.

COUNTER 1 FREEZE/COUNT:

This setting is used to select the FlexLogic™ operand for capturing (freezing) the accumulated count value into a separate register with the date and time of the operation, and continuing counting.

The present accumulated value and captured frozen value with the associated date/time stamp are available as Actual Values. If control power to the relay is interrupted, the accumulated and frozen values will be saved into non-volatile memory during the powerdown operation.

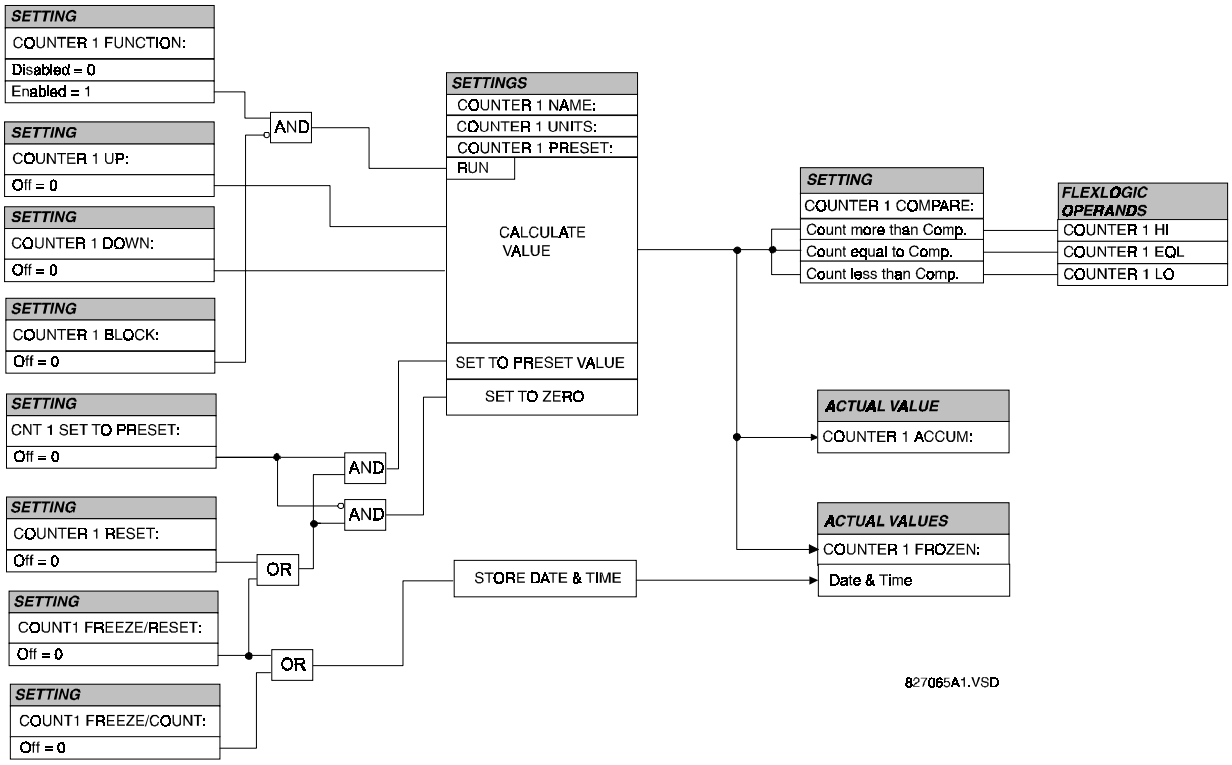
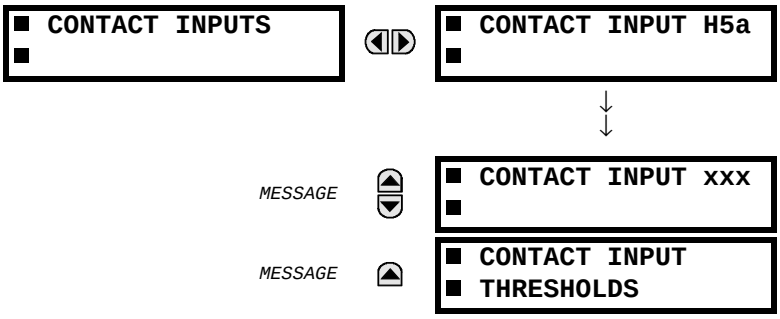


Figure 5–12: DIGITAL COUNTER SCHEME LOGIC

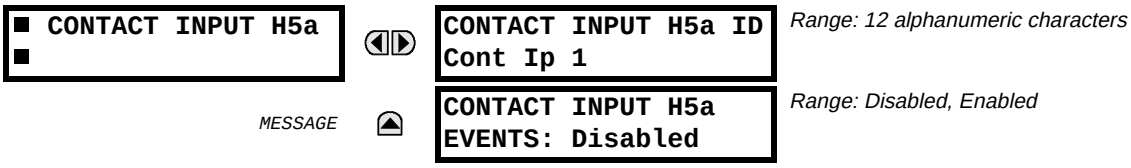
PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨ CONTACT INPUTS



The contact inputs menu consists of configuration settings for each individual contact input as well as voltage thresholds for each group of four contact inputs. Upon startup of the relay, the main processor will determine, from an assessment of the modules installed in the chassis, which contact inputs are available and then display settings for only those inputs.

a) CONTACT INPUT EXAMPLE

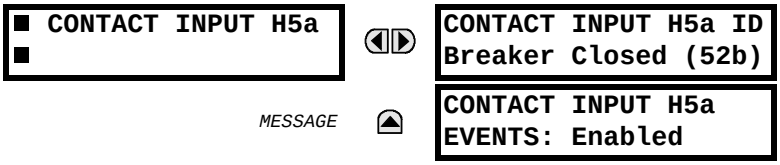
PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨ CONTACT INPUTS ⇨ CONTACT INPUT H5a



An alphanumeric ID may be assigned to a contact input, which will be used for diagnostic purposes. The contact input 'ON' (Logic 1) state corresponds to the contact input being closed. If the contact input events is set to Enabled, every change in the contact input state will trigger an event.

APPLICATION EXAMPLE:

To use contact input H5a as a status input from the breaker 52b contact to seal-in the trip relay and record it in the Event Records menu, program it as follows:

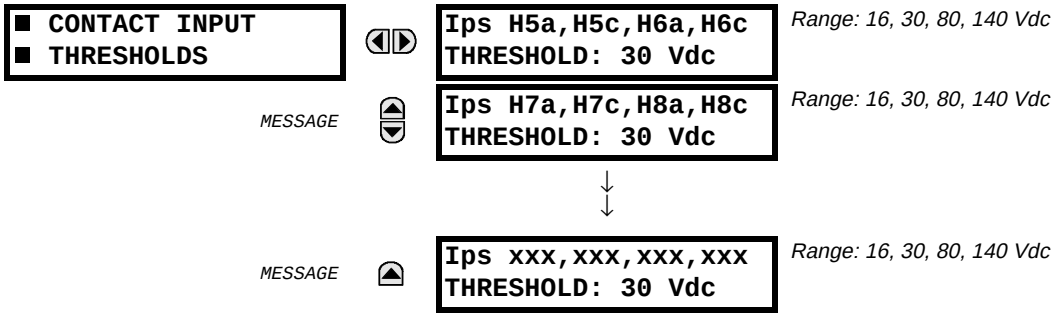


NOTE

The 52b contact is closed when the breaker is open and open when the breaker is closed.

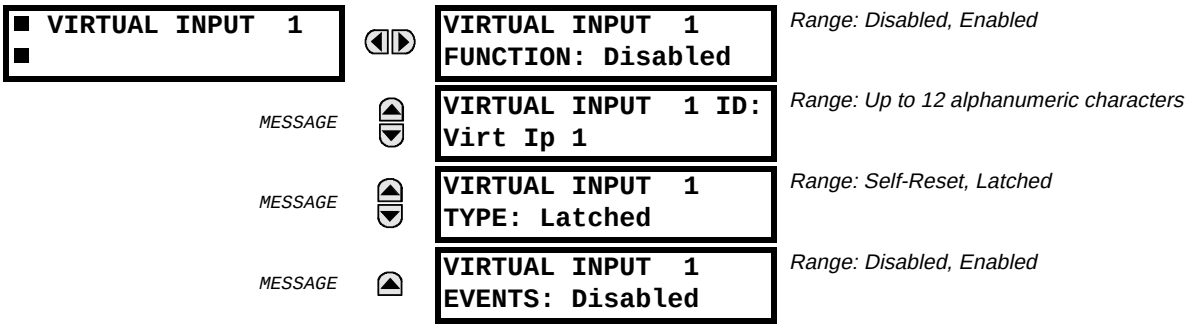
b) CONTACT INPUT THRESHOLDS

PATH: SETTINGS ⇩ INPUTS/OUPTUTS ⇨ CONTACT INPUTS ⇨⇩ CONTACT INPUT THRESHOLDS



Contact inputs are isolated in groups of four to allow connection of wet contacts from different voltage sources for each group. The contact input threshold determines the minimum voltage required to detect a closed contact input. This value should be selected according to the following criteria: 16 for 24 V sources, 30 for 48 V sources, 80 for 110 to 125 V sources and 140 for 250 V sources.

PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨⇩ VIRTUAL INPUTS ⇨ VIRTUAL INPUT 1(32)



There are 32 virtual inputs that can be individually programmed to respond to input signals from the keypad (COMMANDS menu) and non-UCA2 communications protocols only. All virtual input operands are defaulted to OFF = 0 unless the appropriate input signal is received.

Note: virtual input states are preserved through a control power loss.

VIRTUAL INPUT 1 FUNCTION:

If set to Disabled, the input will be forced to 'OFF' (Logic 0) regardless of any attempt to alter the input. If set to Enabled, the input will operate as shown on the scheme logic diagram, and generate output FlexLogic™ operands in response to received input signals and the applied settings.

VIRTUAL INPUT 1 TYPE:

There are two types of operation, Self-Reset and Latched. If set to Self-Reset, when the input signal transits from OFF = 0 to ON = 1, the output operand will be set to ON = 1 for only one evaluation of the FlexLogic™ equations and then return to OFF = 0. If set to Latched, the virtual input sets the state of the output operand to the same state as the most recent received input, ON =1 or OFF = 0.

NOTE

Virtual Input operating mode Self-Reset generates the output operand for a single evaluation of the FlexLogic™ equations. If the operand is to be used anywhere other than internally in a FlexLogic™ equation, it will most probably have to be lengthened in time. A FlexLogic™ Timer with a delayed reset can perform this function.

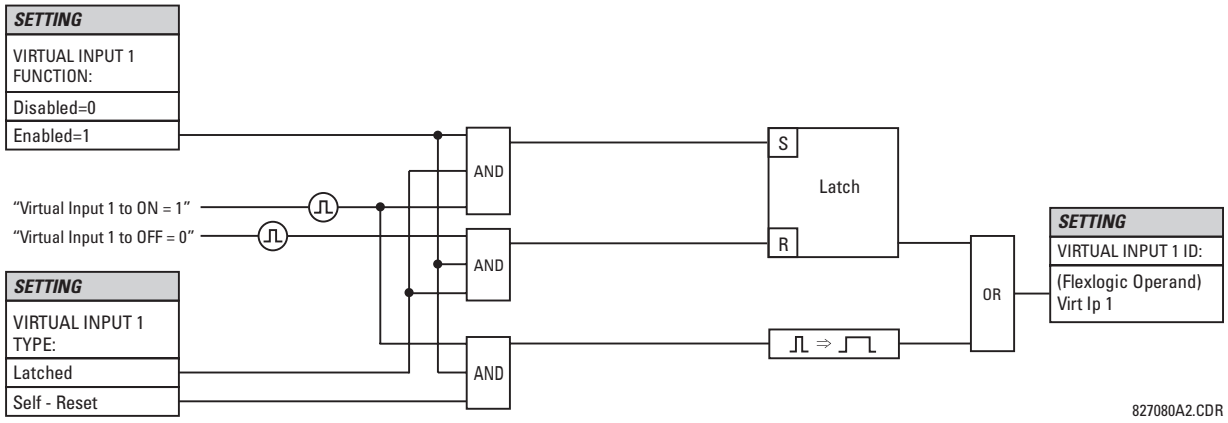


Figure 5–13: VIRTUAL INPUTS SCHEME LOGIC

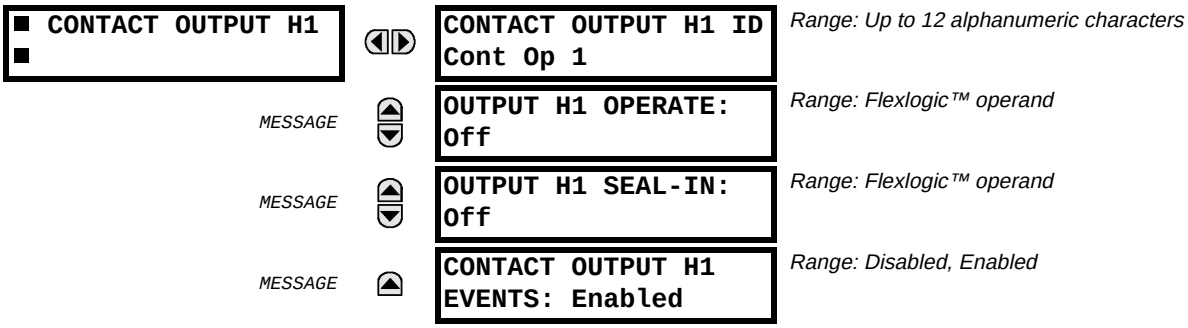
a) UCA SBO TIMER

PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨⇩ VIRTUAL INPUTS ⇨⇩ UCA SBO TIMER

Range: 1 to 60 s in steps of 1 s

The Select-Before-Operate timer sets the interval from the receipt of an Operate signal to the automatic deselection of the virtual input, so that an input does not remain selected indefinitely (this is used only with the UCA Select-Before-Operate feature).

PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨⇩ CONTACT OUTPUTS ⇨ CONTACT OUTPUT H1



Upon startup of the relay, the main processor will determine from an assessment of the modules installed in the chassis which contact outputs are available and present the settings for only these outputs.

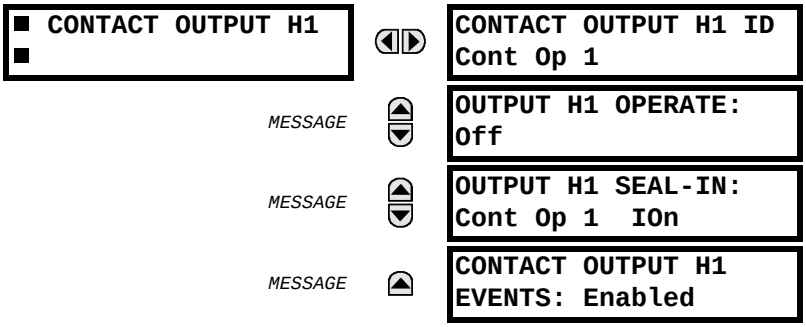
An ID may be assigned to each contact output. The signal that can OPERATE a contact output may be any FlexLogic™ operand (virtual output, element state, contact input, or virtual input). An additional FlexLogic™ operand may be used to SEAL-IN the relay. Any change of state of a contact output can be logged as an Event if programmed to do so.

EXAMPLE:

The trip circuit current is monitored by providing a current threshold detector in series with some Form-A contacts (see the TRIP CIRCUIT - EXAMPLE figures in the DIGITAL ELEMENTS section). The monitor will set a flag (see Technical Specifications for Form-A). The name of the FlexLogic™ operand set by the monitor, consists of the output relay designation, followed by the name of the flag; e.g. 'Cont Op 1 IOn' or 'Cont Op 1 IOff'.

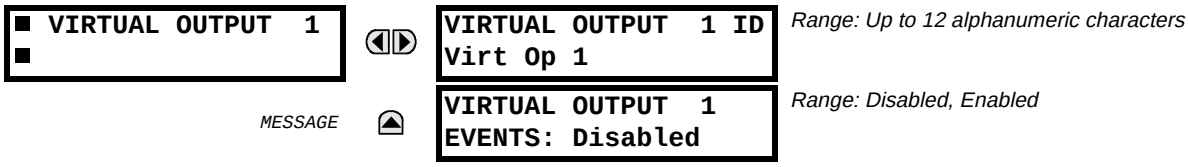
In most breaker control circuits, the trip coil is connected in series with a breaker auxiliary contact used to interrupt current flow after the breaker has tripped, to prevent damage to the less robust initiating contact. This can be done by monitoring an auxiliary contact on the breaker which opens when the breaker has tripped, but this scheme is subject to incorrect operation caused by differences in timing between breaker auxiliary contact change-of-state and interruption of current in the trip circuit. The most dependable protection of the initiating contact is provided by directly measuring current in the tripping circuit, and using this parameter to control resetting of the initiating relay. This scheme is often called "trip seal-in".

In UR relays, this can be realized using the 'Cont Op 1 IOn' FlexLogic™ operand to seal-in the Contact Output. For example,



5.5.4 VIRTUAL OUTPUTS

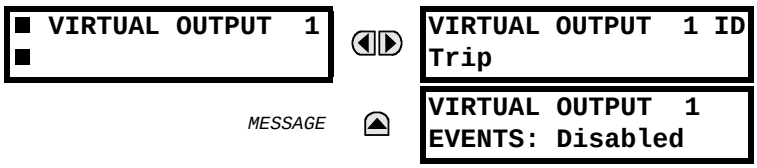
PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨⇩ VIRTUAL OUTPUTS ⇨ VIRTUAL OUTPUT 1



There are 64 virtual outputs that may be assigned via FlexLogic™. If not assigned, the output will be forced to 'OFF' (Logic 0). An ID may be assigned to each virtual output. Virtual outputs are resolved in each pass through the evaluation of the FlexLogic™ equations. Any change of state of a virtual output can be logged as an event if programmed to do so.

EXAMPLE:

If Virtual Output 1 is the trip signal from FlexLogic™ and the trip relay is used to signal events, the settings would be programmed as follows:



5

5.5.5 REMOTE DEVICES

a) REMOTE INPUTS/OUTPUTS - OVERVIEW

Remote inputs and outputs, which are a means of exchanging information regarding the state of digital points between remote devices, are provided in accordance with the Electric Power Research Institute's (EPRI) UCA2 "Generic Object Oriented Substation Event (GOOSE)" specifications.

NOTE

The UCA2 specification requires that communications between devices be implemented on Ethernet communications facilities. For UR relays, Ethernet communications is provided only on the type 9C and 9D versions of the CPU module.

The sharing of digital point state information between GOOSE equipped relays is essentially an extension to FlexLogic™ to allow distributed FlexLogic™ by making operands available to/from devices on a common communications network. In addition to digital point states, GOOSE messages identify the originator of the message and provide other information required by the communication specification. All devices listen to network messages and capture data from only those messages that have originated in selected devices.

GOOSE messages are designed to be short, high priority and with a high level of reliability. The GOOSE message structure contains space for 128 bit pairs representing digital point state information. The UCA specification provides 32 "DNA" bit pairs, which are status bits representing pre-defined events. All remaining bit pairs are "UserSt" bit pairs, which are status bits representing user-definable events. The UR implementation provides 32 of the 96 available UserSt bit pairs.

The UCA2 specification includes features that are used to cope with the loss of communication between transmitting and receiving devices. Each transmitting device will send a GOOSE message upon a successful power-up, when the state of any included point changes, or after a specified interval (the "default update" time) if a change-of-state has not occurred. The transmitting device also sends a "hold time" which is set to three times the programmed default time, which is required by the receiving device.

Receiving devices are constantly monitoring the communications network for messages they require, as recognized by the identification of the originating device carried in the message. Messages received from remote devices include the message "hold" time for the device. The receiving relay sets a timer assigned to the originating device to the "hold" time interval, and if it has not received another message from this device at time-out, the remote device is declared to be non-communicating, so it will use the programmed default state for all points from that specific remote device. This mechanism allows a receiving device to fail to detect a single transmission from a remote device which is sending messages at the slowest possible rate, as set by its "default update" timer, without reverting to use of the programmed default states. If a message is received from a remote device before the "hold" time expires, all points for that device are updated to the states contained in the message and the hold timer is restarted. The status of a remote device, where 'Offline' indicates 'non-communicating', can be displayed.

b) LOCAL DEVICES - ID of Device for Transmitting GOOSE Messages

In a UR relay, the device ID that identifies the originator of the message is programmed in the setting 'RELAY NAME' under the heading 'INSTALLATION' in the 'SETTINGS / PRODUCT SETUP' section.

c) REMOTE DEVICES - ID of Device for Receiving GOOSE Messages

PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨⇩ REMOTE DEVICES ⇨ REMOTE DEVICE 1(16)

```
■ REMOTE DEVICE  1
■
```

⇔

```
REMOTE DEVICE  1 ID:
Remote Device 1
```

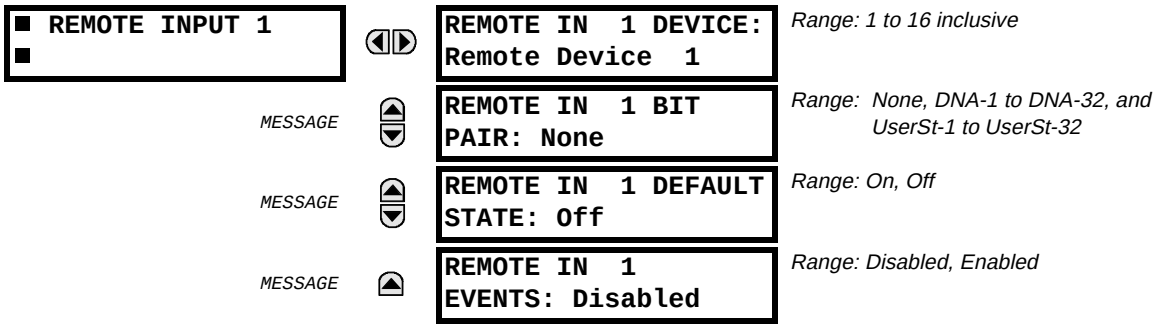
Range: Up to 20 alphanumeric characters

Sixteen Remote Devices, numbered from 1 to 16, can be selected for setting purposes.

A receiving relay must be programmed to capture messages from only those originating remote devices of interest. This setting is used to select specific remote devices by entering (bottom row) the exact identification (ID) assigned to those devices.

5.5.6 REMOTE INPUTS

PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨⇩ REMOTE INPUTS ⇨ REMOTE INPUT 1(32)



Remote Inputs which create FlexLogic™ operands at the receiving relay, are extracted from GOOSE messages originating in remote devices. The relay provides 32 Remote Inputs, each of which can be selected from a list consisting of 64 selections: DNA-1 through DNA-32 and UserSt-1 through UserSt-32. The function of DNA inputs is defined in the UCA2 specifications and is presented in the UCA2 DNA ASSIGNMENTS table in the section on Remote Outputs. The function of UserSt inputs is defined by the user selection of the FlexLogic™ operand whose state is represented in the GOOSE message. A user must program a DNA point from the appropriate operand.

5

Remote Input 1 must be programmed to replicate the logic state of a specific signal from a specific remote device for local use. This programming is performed via the three settings shown above.

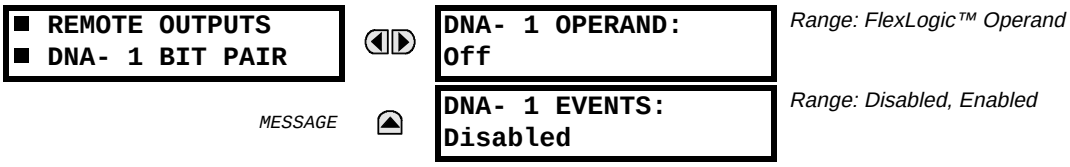
Setting 'REMOTE IN 1 DEVICE' is used to select the number (1-16) of the Remote Device which originates the signal required, as previously assigned to the remote device via the setting 'REMOTE DEVICE nn ID' (see the REMOTE DEVICES section). Setting 'REMOTE IN 1 BIT PAIR' is used to select the specific bits of the GOOSE message required. Setting 'REMOTE IN 1 DEFAULT STATE' is used to select the logic state that will be used for this point if the local relay has just completed startup or the remote device sending this point is declared to be non-communicating.

NOTE

For more information on GOOSE specifications, see REMOTE INPUTS/OUTPUTS – OVERVIEW in the REMOTE DEVICES section.

5.5.7 REMOTE OUTPUTS - DNA BIT PAIRS

PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨⇩ REMOTE OUTPUTS DNA BIT PAIRS ⇨ REMOTE OUPUTS DNA- 1 BIT PAIR



Remote Outputs (1-32) are FlexLogic™ operands inserted into GOOSE messages that are transmitted to remote devices on a LAN. Each digital point in the message must be programmed to carry the state of a specific FlexLogic™ operand. The above operand setting represents a specific DNA function (as shown in the UCA2 DNA ASSIGNMENTS table) to be transmitted.

Table 5–7: UCA DNA2 ASSIGNMENTS

DNA	DEFINITION	INTENDED FUNCTION	LOGIC 0	LOGIC 1
1	OperDev		Trip	Close
2	Lock Out		LockoutOff	LockoutOn
3	Initiate Reclosing	Initiate remote reclose sequence	InitRecloseOff	InitRecloseOn
4	Block Reclosing	Prevent/cancel remote reclose sequence	BlockOff	BlockOn
5	Breaker Failure Initiate	Initiate remote breaker failure scheme	BFIOff	BFIOn
6	Send Transfer Trip	Initiate remote trip operation	TxXfrTripOff	TxXfrTripOn
7	Receive Transfer Trip	Report receipt of remote transfer trip command	RxXfrTripOff	RxXfrTripOn
8	Send Perm	Report permissive affirmative	TxPermOff	TxPermOn
9	Receive Perm	Report receipt of permissive affirmative	RxPermOff	RxPermOn
10	Stop Perm	Override permissive affirmative	StopPermOff	StopPermOn
11	Send Block	Report block affirmative	TxBlockOff	TxBlockOn
12	Receive Block	Report receipt of block affirmative	RxBlockOff	RxBlockOn
13	Stop Block	Override block affirmative	StopBlockOff	StopBlockOn
14	BkrDS	Report breaker disconnect 3-phase state	Open	Closed
15	BkrPhsADS	Report breaker disconnect phase A state	Open	Closed
16	BkrPhsBDS	Report breaker disconnect phase B state	Open	Closed
17	BkrPhsCDS	Report breaker disconnect phase C state	Open	Closed
18	DiscSwDS		Open	Closed
19	Interlock DS		DSLockOff	DSLockOn
20	LineEndOpen	Report line open at local end	Open	Closed
21	Status	Report operating status of local GOOSE device	Offline	Available
22	Event		EventOff	EventOn
23	Fault Present		FaultOff	FaultOn
24	Sustained Arc	Report sustained arc	SustArcOff	SustArcOn
25	Downed Conductor	Report downed conductor	DownedOff	DownedOn
26	Sync Closing		SyncClsOff	SyncClsOn
27	Mode	Report mode status of local GOOSE device	Normal	Test
28→32	Reserved			

NOTE

For more information on GOOSE specifications, see REMOTE INPUTS/OUTPUTS – OVERVIEW in the REMOTE DEVICES section.

5.5.8 REMOTE OUTPUTS - UserSt BIT PAIRS

PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨⇩ REMOTE OUTPUTS UserSt BIT PAIRS ⇨ REMOTE OUTPUTS UserSt- 1 BIT PAIR

```
■ REMOTE OUTPUTS
■ UserSt- 1 BIT PAIR
```

```
UserSt- 1 OPERAND:
Off
```

Range: FlexLogic™ Operand

MESSAGE

```
UserSt- 1 EVENTS:
Disabled
```

Range: Disabled, Enabled

Remote Outputs 1 to 32 originate as GOOSE messages to be transmitted to remote devices. Each digital point in the message must be programmed to carry the state of a specific FlexLogic™ operand. The setting above is used to select the operand which represents a specific UserSt function (as selected by the user) to be transmitted.

The following setting represents the time between sending GOOSE messages when there has been no change of state of any selected digital point. This setting is located under the menu heading COMMUNICATIONS in the SETTINGS \ PRODUCT SETUP section.

```
DEFAULT GOOSE UPDATE
TIME: 60 s
```

Range: 1 to 60 in steps of 1 second

NOTE

For more information on GOOSE specifications, see REMOTE INPUTS/OUTPUTS – OVERVIEW in the REMOTE DEVICES section.

5

5.5.9 RESETTING

PATH: SETTINGS ⇩ INPUTS/OUTPUTS ⇨⇩ RESETTING

```
■ RESETTING
■
```

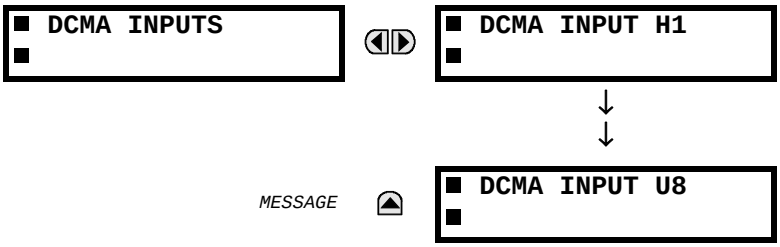
```
RESET OPERAND:
Off
```

Range: FlexLogic™ Operand

Some events can be programmed to latch the faceplate LED event indicators and the target message on the display. Once set, the latching mechanism will hold all of the latched indicators or messages in the set state after the initiating condition has cleared until a RESET command is received to return these latches (not including FlexLogic™ latches) to the reset state. The RESET command can be sent from the faceplate RESET pushbutton, a remote device via a communications channel, or any programmed operand.

When the RESET command is received by the relay, two FlexLogic™ operands are created. These operands, which are stored as events, reset the latches if the initiating condition has cleared. The three sources of RESET commands each create the FlexLogic™ operand "RESET OP". Each individual source of a RESET command also creates its individual operand "RESET OP (PUSHBUTTON), RESET OP (COMMS) or RESET OP (OPERAND) to identify the source of the command. The setting shown above selects the operand that will create the RESET OP (OPERAND) operand.

PATH: SETTINGS ⇩ TRANSDUCER I/O ⇨⇩ DCMA INPUTS



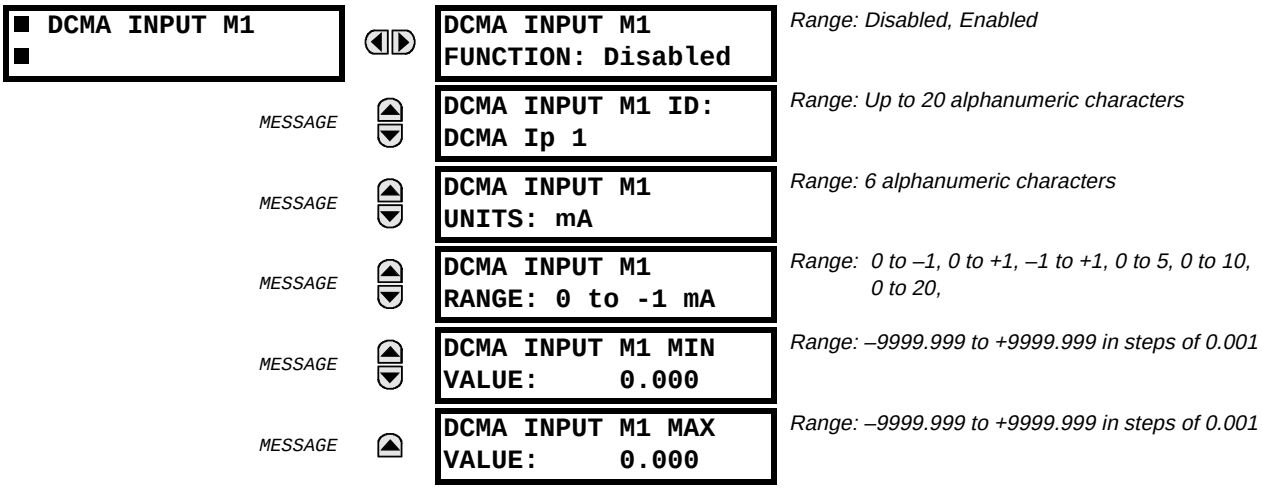
Hardware and software is provided to receive signals from external transducers and convert these signals into a digital format for use as required. The relay will accept inputs in the range of –1 to +20 mA DC, suitable for use with most common transducer output ranges; all inputs are assumed to be linear over the complete range. Specific hardware details are contained in the HARDWARE chapter.

Before the DCMA input signal can be used, the value of the signal measured by the relay must be converted to the range and quantity of the external transducer primary input parameter, such as DC voltage or temperature. The relay simplifies this process by internally scaling the output from the external transducer and displaying the actual primary parameter.

DCMA input channels are arranged in a manner similar to CT and VT channels. The user configures individual channels with the settings shown here.

The channels are arranged in sub-modules of two channels, numbered from 1 through 8 from top to bottom. On power-up, the relay will automatically generate configuration settings for every channel, based on the order code, in the same general manner that is used for CTs and VTs. Each channel is assigned a slot letter followed by the row number, 1 through 8 inclusive, which is used as the channel number. The relay generates an actual value for each available input channel.

Settings are automatically generated for every channel available in the specific relay as shown below for the first channel of a type 5F transducer module installed in slot M.

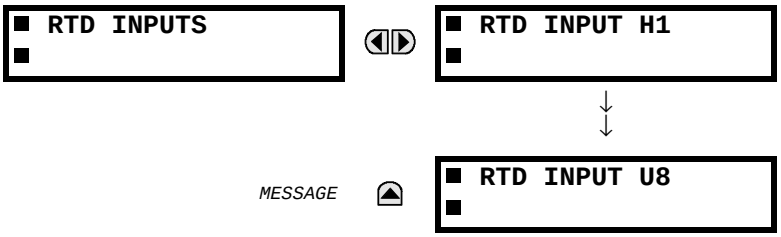


The function of the channel may be either "Enabled" or "Disabled." If Disabled, there will not be an actual value created for the channel. An alphanumeric "ID" is assigned to the channel - this ID will be included in the display of the channel actual value, along with the programmed "UNITS" associated with the parameter measured by the transducer, such as Volt, °C, MegaWatts, etc. This ID is also used to reference the channel as the input parameter to features designed to measure this type of parameter. The RANGE setting is used to select the specific mA DC range of the transducer connected to the input channel.

The MIN VALUE and MAX VALUE settings are used to program the span of the transducer in primary units. For example, a temperature transducer might have a span from 0 to 250°C; in this case the MIN value would be 0 and the MAX value 250. Another example would be a Watt transducer with a span from –20 to +180 MW; in this case the MIN value would be –20 and the MAX value 180. Intermediate values between the MIN and MAX are scaled linearly.

5.6.2 RTD INPUTS

PATH: SETTINGS ⇩ TRANSDUCER I/O ⇨⇩ RTD INPUTS

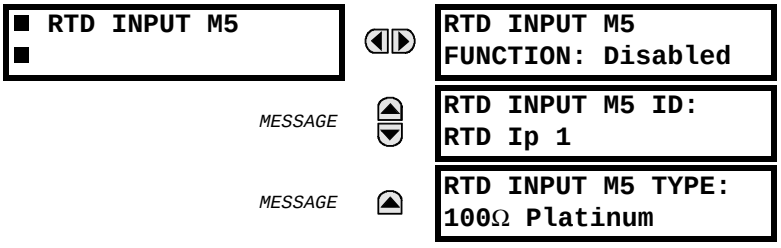


Hardware and software is provided to receive signals from external Resistance Temperature Detectors and convert these signals into a digital format for use as required. These channels are intended to be connected to any of the RTD types in common use. Specific hardware details are contained in the HARDWARE chapter.

RTD input channels are arranged in a manner similar to CT and VT channels. The user configures individual channels with the settings shown here.

The channels are arranged in sub-modules of two channels, numbered from 1 through 8 from top to bottom. On power-up, the relay will automatically generate configuration settings for every channel, based on the order code, in the same general manner that is used for CTs and VTs. Each channel is assigned a slot letter followed by the row number, 1 through 8 inclusive, which is used as the channel number. The relay generates an actual value for each available input channel.

Settings are automatically generated for every channel available in the specific relay as shown below for the first channel of a type 5C transducer module installed in slot M.



The function of the channel may be either "Enabled" or "Disabled." If Disabled, there will not be an actual value created for the channel. An alphanumeric "ID" is assigned to the channel - this ID will be included in the display of the channel actual value. This ID is also used to reference the channel as the input parameter to features designed to measure this type of parameter. Selecting the type of RTD connected to the channel configures the channel.

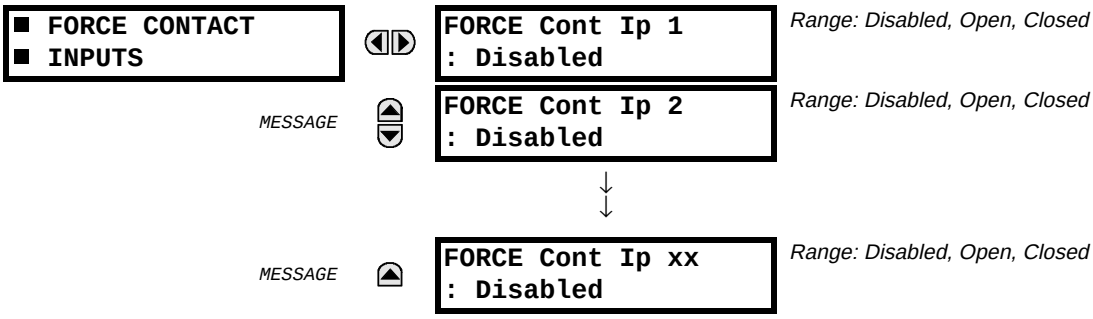
5.7.1 TEST MODE

PATH: SETTINGS ⇩ TESTING ⇨ TEST MODE

The relay provides test settings to verify that the relay is functional using simulated conditions to test all contact inputs and outputs. While the relay is in **TEST MODE** (FUNCTION Enabled), the feature being tested overrides normal functioning of the relay. During this time the TEST MODE LED will remain on. Once out of TEST MODE (FUNCTION Disabled), the normal functioning of the relay will be restored.

5.7.2 FORCE CONTACT INPUTS

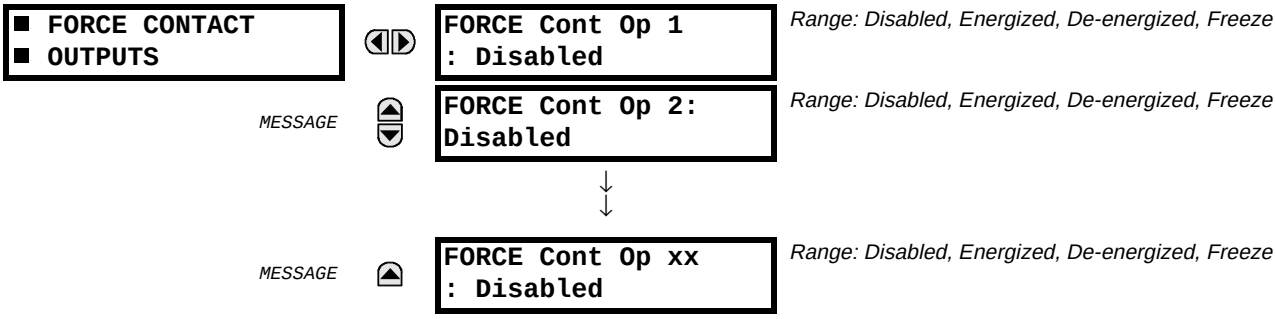
PATH: SETTINGS ⇩ TESTING ⇨⇩ FORCE CONTACT INPUTS



The Force Contact Inputs test feature of the relay provides a method of performing checks on the function of all contact inputs. Once enabled, the relay will be placed into Test Mode, allowing this feature to override the normal function of contact inputs. The TEST MODE LED will be ON indicating that the relay is in test mode. The state of each contact input may be programmed as Disabled, Open or Closed. All contact input operations return to normal when all settings for this feature are disabled.

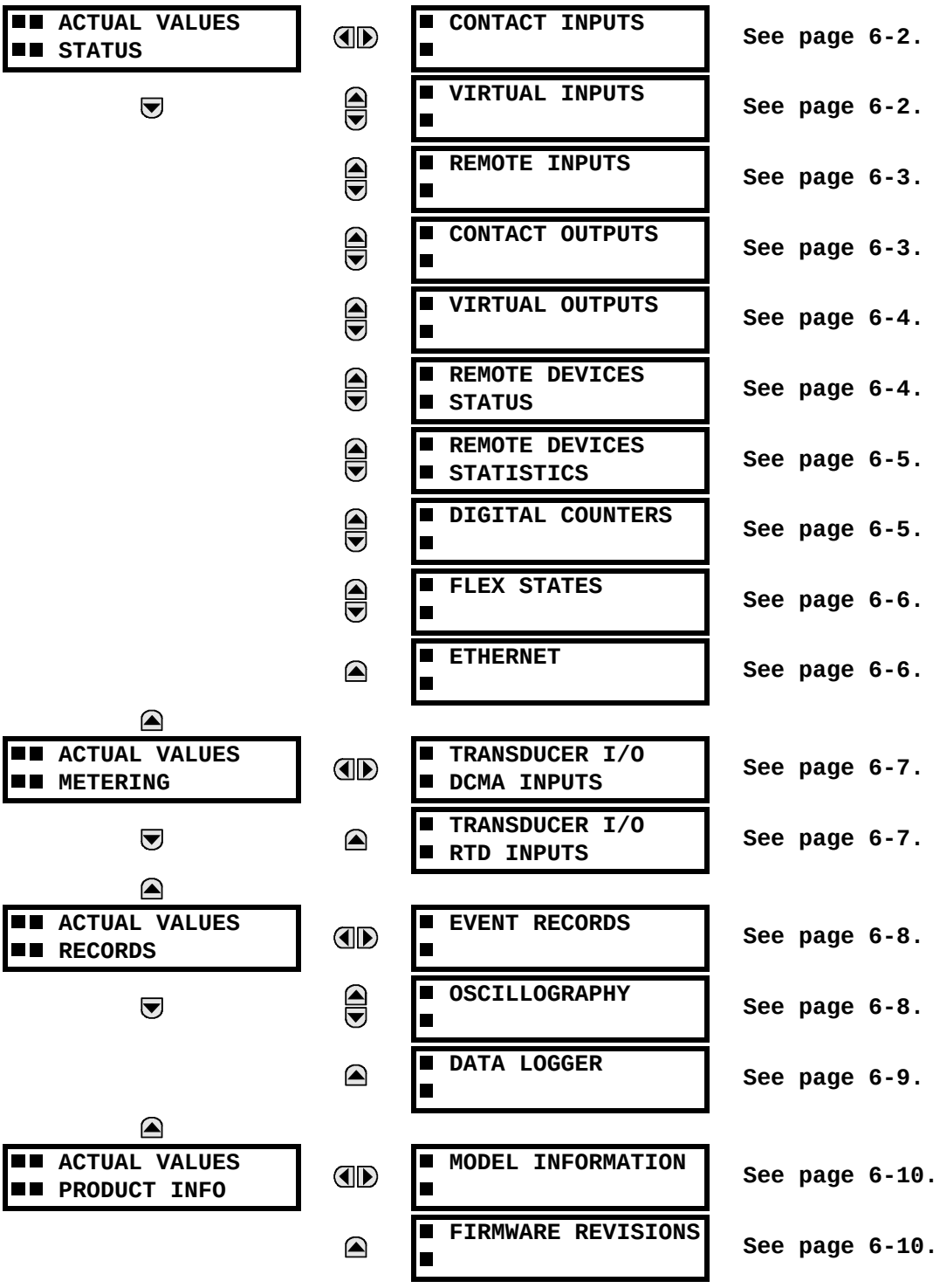
5.7.3 FORCE CONTACT OUTPUTS

PATH: SETTINGS ⇩ TESTING ⇨⇩ FORCE CONTACT OUTPUTS



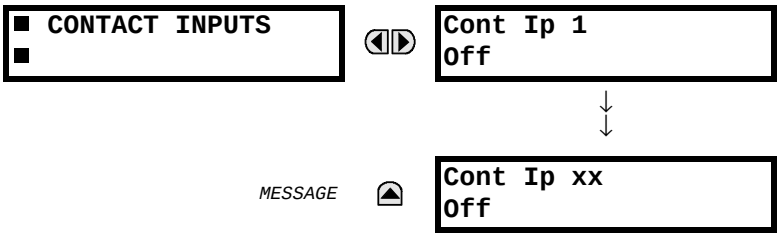
The Force Contact Output test feature of the relay, provides a method of performing checks on all contact outputs. Once enabled, the relay will be placed into a Test Mode, allowing this feature to override the normal function of contact outputs. The TEST MODE LED will be ON. The state of each contact output may be programmed as Disabled, Energized, De-energized or Freeze. The Freeze option maintains the output contact in the state at which it was frozen. All contact output operations return to normal when all the settings for this feature are disabled.

6.1.1 ACTUAL VALUES MAIN MENU



6.2.1 CONTACT INPUTS

PATH: ACTUAL VALUES ⇩ STATUS ⇨ CONTACT INPUTS



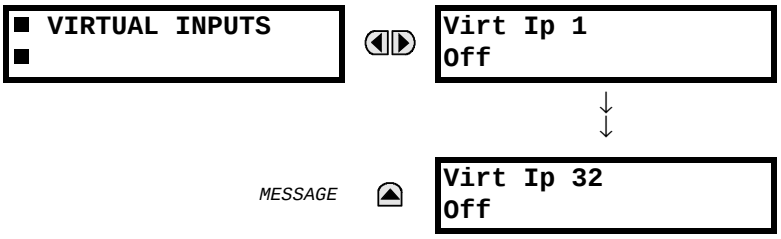
The present status of the contact inputs is shown here.

The first line of a message display indicates the ID of the contact input. For example, 'Cont Ip 1' refers to the contact input in terms of the default name-array index.

The second line of the display indicates the logic state of the contact input.

6.2.2 VIRTUAL INPUTS

PATH: ACTUAL VALUES ⇩ STATUS ⇨ ⇩ VIRTUAL INPUTS



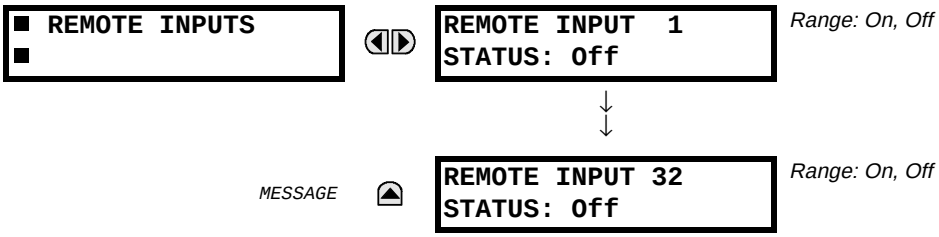
The present status of the 32 virtual inputs is shown here.

The first line of a message display indicates the ID of the virtual input. For example, 'Virt Ip 1' refers to the virtual input in terms of the default name-array index.

The second line of the display indicates the logic state of the virtual input.

6.2.3 REMOTE INPUTS

PATH: ACTUAL VALUES ⇩ STATUS ⇨⇩ REMOTE INPUTS

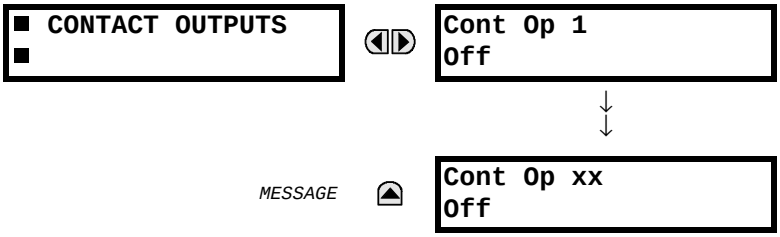


The present state of the 32 remote inputs is shown here.

The state displayed will be that of the remote point unless the remote device has been established to be "Offline" in which case the value shown is the programmed default state for the remote input.

6.2.4 CONTACT OUTPUTS

PATH: ACTUAL VALUES ⇩ STATUS ⇨⇩ CONTACT OUTPUTS



The present state of the contact outputs is shown here.

The first line of a message display indicates the ID of the contact output. For example, ‘Cont Op 1’ refers to the contact output in terms of the default name-array index.

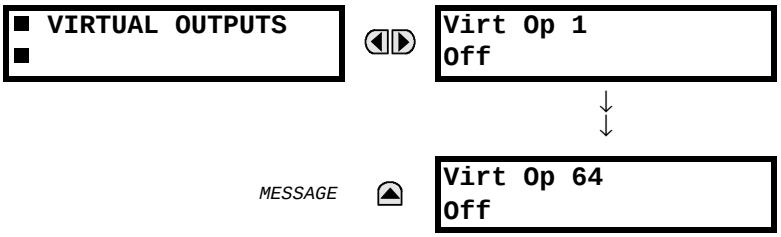
The second line of the display indicates the logic state of the contact output.

NOTE

For Form-A outputs, the state of the voltage(V) and/or current(I) detectors will show as: Off, VOff, IOff, On, VOn, and/or IOn. For Form-C outputs, the state will show as Off or On.

6.2.5 VIRTUAL OUTPUTS

PATH: ACTUAL VALUES ⇩ STATUS ⇨⇩ VIRTUAL OUTPUTS



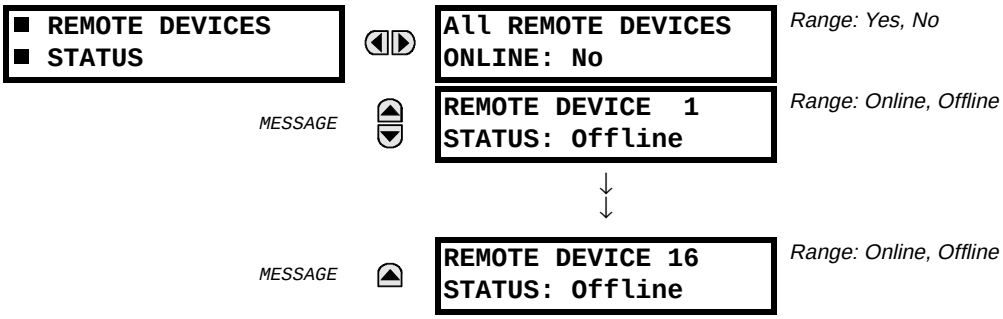
The present state of up to 64 virtual outputs is shown here.

The first line of a message display indicates the ID of the virtual output. For example, 'Virt Op 1' refers to the virtual output in terms of the default name-array index.

The second line of the display indicates the logic state of the virtual output, as calculated by the FlexLogic™ equation for that output.

6.2.6 REMOTE DEVICES STATUS

PATH: ACTUAL VALUES ⇩ STATUS ⇨⇩ REMOTE DEVICES STATUS

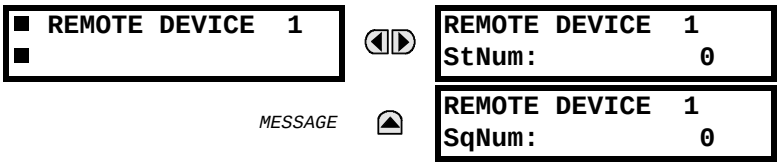


The present state of up to 16 programmed Remote Devices is shown here.

The ALL REMOTE DEVICES ONLINE message indicates whether or not all programmed Remote Devices are online. If the corresponding state is 'No', then at least one required Remote Device is not online.

6.2.7 REMOTE DEVICES STATISTICS

PATH: ACTUAL VALUES ⇩ STATUS ⇨⇩ REMOTE DEVICES STATISTICS ⇨ REMOTE DEVICE 1(16)

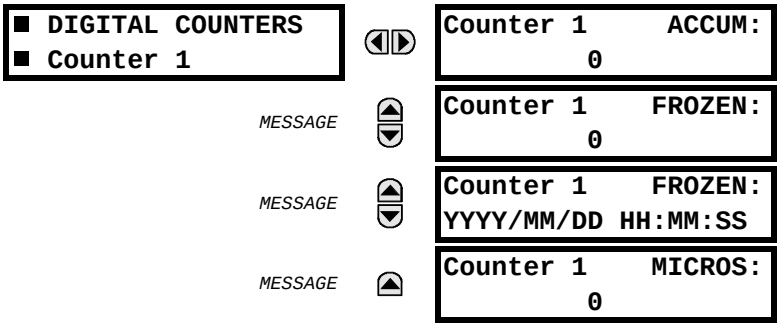


Statistical data (2 types) for up to 16 programmed Remote Devices is shown here.

- The 'StNum' number is obtained from the indicated Remote Device and is incremented whenever a change of state of at least one DNA or UserSt bit occurs.
- The 'SqNum' number is obtained from the indicated Remote Device and is incremented whenever a GOOSE message is sent. This number will rollover to zero when a count of 4,294,967,295 is incremented.

6.2.8 DIGITAL COUNTERS

PATH: ACTUAL VALUES ⇩ DIGITAL COUNTERS ⇨⇩ DIGITAL COUNTERS ⇨ DIGITAL COUNTERS Counter 1(8)

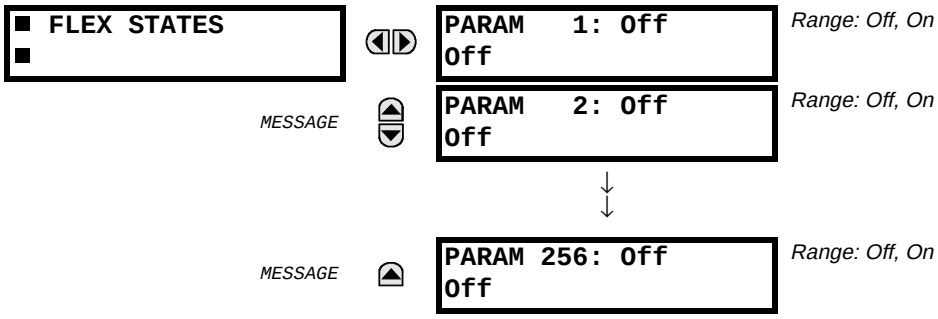


The present status of the 8 digital counters is shown here.

The status of each counter, with the user-defined counter name, includes the accumulated and frozen counts (the count units label will also appear). Also included, is the date/time stamp for the frozen count. The 'MICROS' value refers to the microsecond portion of the time stamp.

6.2.9 FLEX STATES

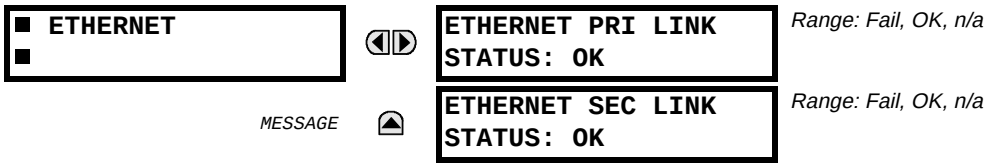
PATH: ACTUAL VALUES ⇩ STATUS ⇨⇩ FLEX STATES



There are 256 FlexState bits available, numbered from 1 to 256. The second line value indicates the state of the given FlexState bit.

6.2.10 ETHERNET

PATH: ACTUAL VALUES ⇩ STATUS ⇨⇩ ETHERNET



6

a) DCMA INPUTS

PATH: ACTUAL VALUES ⇩ METERING ⇨⇩ TRANSDUCER I/O DCMA INPUTS ⇨ DCMA INPUT xx

Actual values for each DCMA input channel that is Enabled are displayed with the top line as the programmed channel "ID" and the bottom line as the value followed by the programmed units.

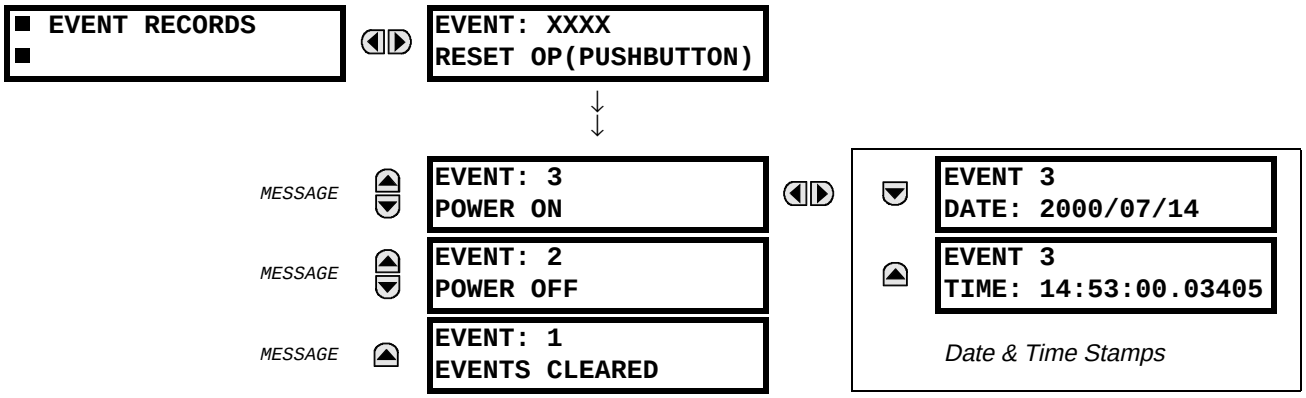
b) RTD INPUTS

PATH: ACTUAL VALUES ⇩ METERING ⇨⇩ TRANSDUCER I/O RTD INPUTS ⇨ RTD INPUT xx

Actual values for each RTD input channel that is Enabled are displayed with the top line as the programmed channel "ID" and the bottom line as the value.

6.4.1 EVENT RECORDS

PATH: ACTUAL VALUES ⇩ RECORDS ⇨⇩ EVENT RECORDS



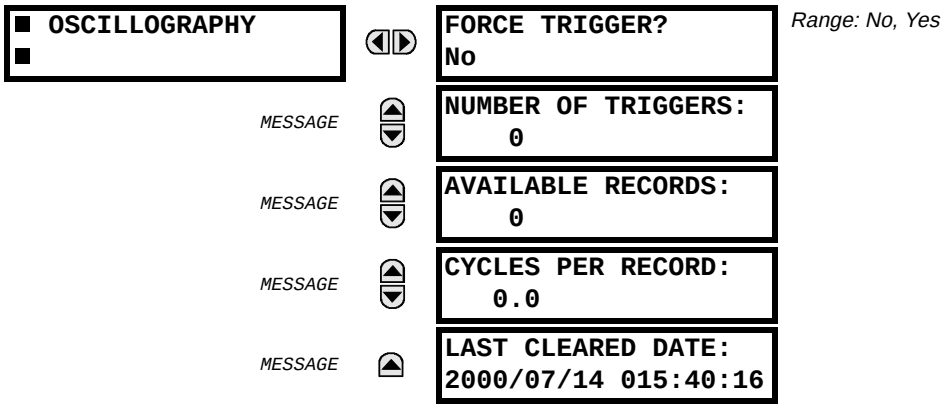
The Event Records menu shows the contextual data associated with up to the last 1024 events, listed in chronological order from most recent to oldest. If all 1024 event records have been filled, the oldest record will be removed as a new record is added.

Each event record will show the event identifier/sequence number, cause, and date/time stamp associated with the event trigger.

Refer to the COMMANDS CLEAR RECORDS menu for clearing event records.

6.4.2 OSCILLOGRAPHY

PATH: ACTUAL VALUES ⇩ RECORDS ⇨⇩ OSCILLOGRAPHY



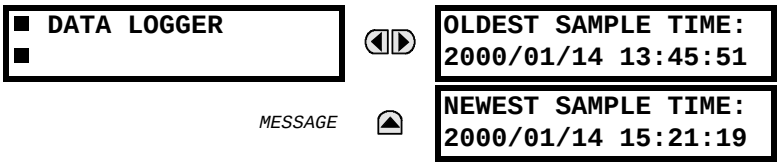
This menu allows the user to view the number of triggers involved and number of oscillography traces available. The 'cycles per record' value is calculated to account for the fixed amount of data storage for oscillography. See also the SETTINGS \ PRODUCT SETUP \ OSCILLOGRAPHY section.

A trigger can be forced here at any time by setting 'Yes' to the FORCE TRIGGER? command.

Refer to the COMMANDS CLEAR RECORDS menu for clearing the oscillography records.

6.4.3 DATA LOGGER

PATH: ACTUAL VALUES ⇩ RECORDS ⇨⇩ DATA LOGGER



Oldest Sample Time is the time at which the oldest available samples were taken. It will be static until the log gets full, at which time it will start counting at the defined sampling rate.

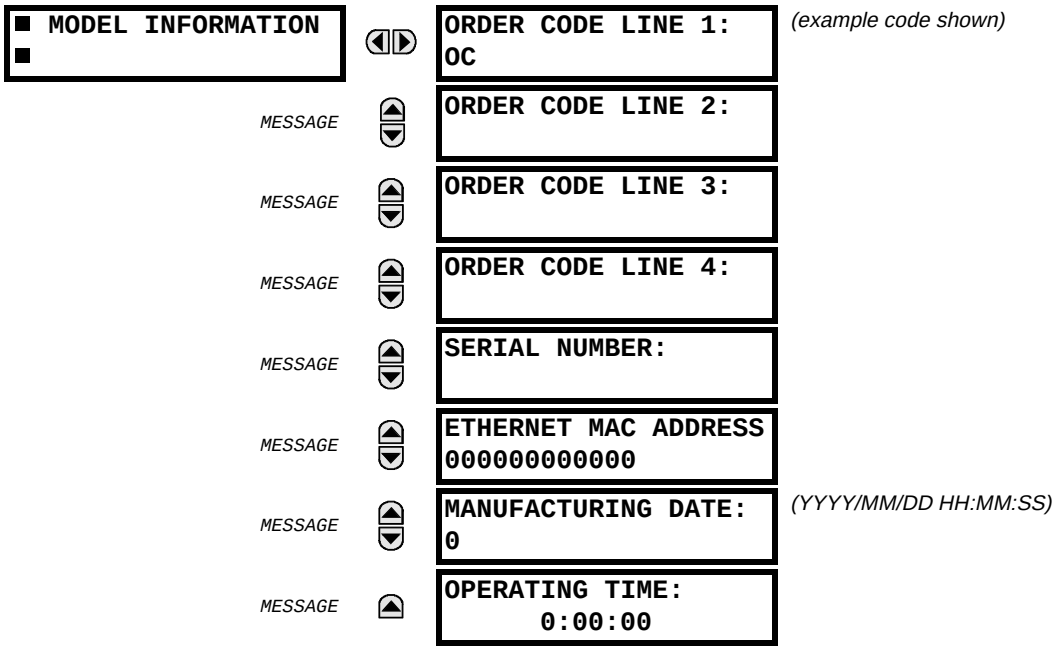
Newest Sample Time is the time at which the most recent samples were taken. It counts up at the defined sampling rate.

If no channels are defined for Data Logger, both Times are static.

Refer to the COMMANDS CLEAR RECORDS menu for clearing data logger records.

6.5.1 MODEL INFORMATION

PATH: ACTUAL VALUES ⇩ PRODUCT INFO ⇨ MODEL INFORMATION

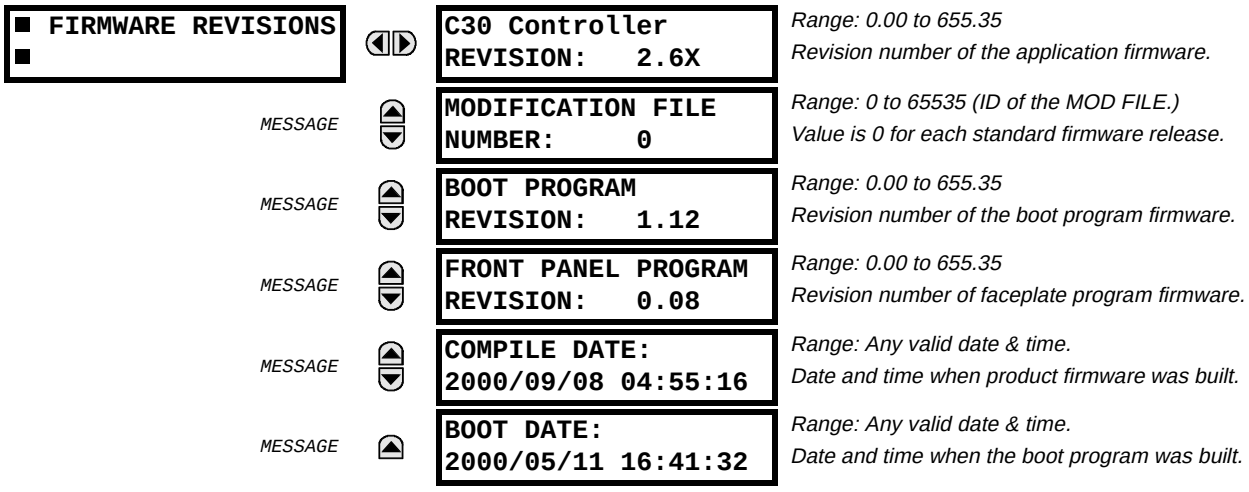


The product order code, serial number, Ethernet MAC address, date/time of manufacture, and operating time are shown here.

6

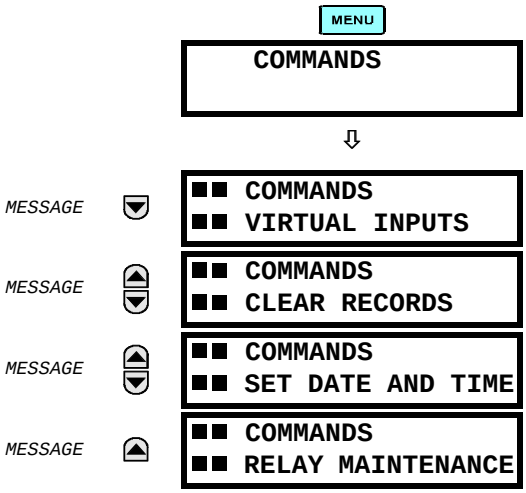
6.5.2 FIRMWARE REVISIONS

PATH: ACTUAL VALUES ⇩ PRODUCT INFO ⇨⇩ FIRMWARE REVISIONS



The shown data is illustrative only. A modification file number of 0 indicates that, currently, no modifications have been installed.

7.1.1 COMMANDS MENU



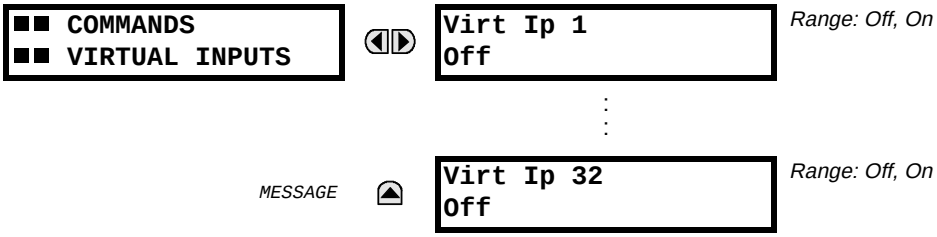
The COMMANDS menu contains directives to the relay intended to be available to operations personnel.

All commands can be protected from unauthorized access via the Command Password; see the Password Security menu description in the Settings \ Product Setup section.

After successfully entering any command, the following flash message will appear:

7.1.2 VIRTUAL INPUTS

PATH: COMMANDS ⇩ VIRTUAL INPUTS

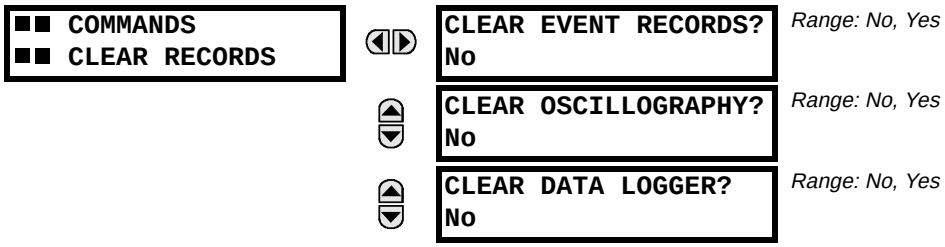


The states of up to 32 virtual inputs may be changed here.

The first line of the display indicates the ID of the virtual input. The second line indicates the current or selected status of the virtual input. This status will be a logical state ‘Off’ (0) or ‘On’ (1).

7.1.3 CLEAR RECORDS

PATH: COMMANDS ⇩ COMMANDS CLEAR RECORDS

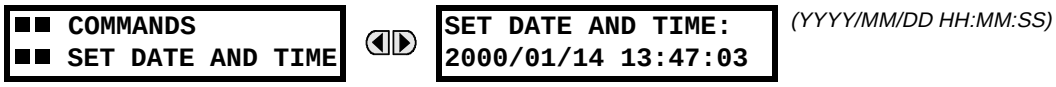


This menu contains commands for clearing historical data such as the Event Records.

Changing a command setting to 'Yes' and then clicking the ENTER key will clear the corresponding data. The command setting will then automatically revert to 'No'.

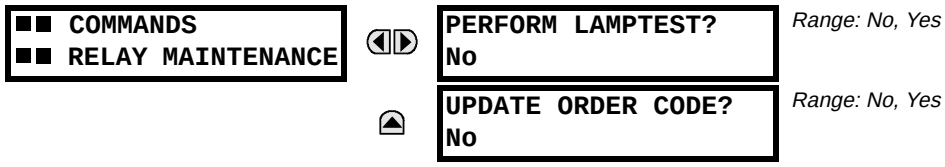
7.1.4 SET DATE AND TIME

PATH: COMMANDS ⇩ SET DATE AND TIME



The date and time can be entered here via the faceplate keypad, provided that the IRIG-B signal is not being used. The time setting is based on the 24-hour clock. The complete date, as a minimum, must be entered to allow execution of this command. The new time will take effect at the moment the ENTER key is clicked.

PATH: COMMANDS ⇩ RELAY MAINTENANCE



This menu contains commands for relay maintenance purposes.

Changing a command setting to 'Yes' and then clicking the ENTER key will activate the command. The command setting will then automatically revert to 'No'.

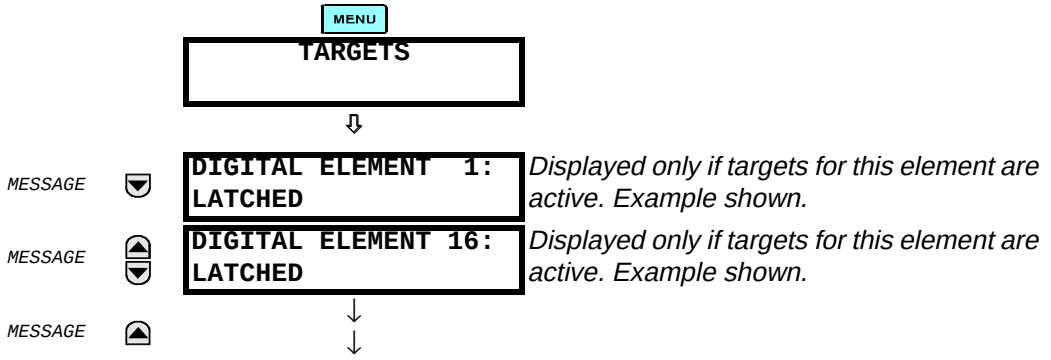
The **PERFORM LAMPTEST** command turns on all faceplate LEDs and display pixels for a short duration.

The **UPDATE ORDER CODE** command causes the relay to scan the backplane for the hardware modules and update the order code to match. If an update occurs, the following message will be shown.

```
UPDATING...
PLEASE WAIT
```

There will be no impact if there have been no changes to the hardware modules. When an update does not occur, the following message will be shown.

```
ORDER CODE
NOT UPDATED
```



The status of any active targets will be displayed in the TARGETS menu. If no targets are active, the display will be:

```
No Active
Targets
```

a) TARGET MESSAGES

When there are no active targets, the first target to become active will cause the display to immediately default to that message. If there are active targets and the user is navigating through other messages, and when the default message timer times out (i.e. the keypad has not been used for a determined period of time), the display will again default back to the target message.

The range of variables for the target messages is described below. Phase information will be included if applicable. If a target message status changes, the status with the highest priority will be displayed.

7

Table 7–1: TARGET MESSAGE PRIORITY STATUS

PRIORITY	ACTIVE STATUS	DESCRIPTION
1	OP	element operated and still picked up
2	PKP	element picked up and timed out
3	LATCHED	element had operated but has dropped out

If a self test error is detected, a message appears indicating the cause of the error.

For example:

```
UNIT NOT PROGRAMMED
:Self Test Error
```

7.2.2 RELAY SELF-TESTS

The relay performs a number of self-test diagnostic checks to ensure device integrity. There are two types of self-tests, major and minor, which are listed in the tables below. When either type of self-test error has occurred the TROUBLE indicator will be on and a target message will be displayed. All errors record an event in the event recorder. Latched errors can be cleared by pressing the RESET key, providing the condition is no longer present.

Major self-test errors also result in the following:

- the critical fail relay on the power supply module is de-energized
- all other output relays are de-energized and are prevented from further operation
- the faceplate IN SERVICE indicator is turned off
- a RELAY OUT OF SERVICE event is recorded

Table 7–2: MAJOR SELF-TEST ERROR MESSAGES

SELF-TEST ERROR MESSAGE	LATCHED TARGET MSG	DESCRIPTION OF PROBLEM	WHAT TO DO
UNIT NOT PROGRAMMED	No	PRODUCT SETUP \ INSTALLATION setting indicates relay is not in a programmed state.	Program all settings (especially those under PRODUCT SETUP \ INSTALLATION).
EQUIPMENT MISMATCH with 2nd-line detail message	No	Configuration of modules does not match the order code stored in the CPU.	Check all module types against the order code; make sure they are inserted properly, and cycle the control power (if problem persists, contact the factory).
UNIT NOT CALIBRATED	No	Settings indicate the unit is not calibrated.	Contact the factory.
FLEXLOGIC ERR TOKEN with 2nd-line detail message	No	FlexLogic equations do not compile properly.	Finish all equation editing and use self test to debug any errors.
FLASH PROGRAMMING	No	Firmware is being upgraded into flash memory.	Do not cycle power. Allow the upgrade to complete.
PROGRAM MEMORY Test Failed	Yes	Error was found while checking Flash memory.	Contact the factory.

Table 7–3: MINOR SELF-TEST ERROR MESSAGES

SELF-TEST ERROR MESSAGE	LATCHED TARGET MSG	DESCRIPTION OF PROBLEM	WHAT TO DO
EEPROM CORRUPTED	Yes	The non-volatile memory has been corrupted.	Contact the factory.
IRIG-B FAILURE	No	Bad IRIG-B input signal.	• Check to ensure that the IRIG-B cable is connected to the relay. • Check the functionality of the cable (i.e. look for physical damage or perform a continuity test). • Check to ensure the IRIG-B receiver is functioning properly. • Check the input signal level; it may be lower than specification. If none of the above items apply, contact the factory.
PRIM ETHERNET FAIL	No	Primary Ethernet connection failed	Check connections.
SEC ETHERNET FAIL	No	Secondary Ethernet connection failed	Check connections.
BATTERY FAIL	No	Battery is not functioning.	Replace the battery.
PROTOTYPE FIRMWARE	Yes	A prototype version of the firmware is loaded.	Contact the factory.
SYSTEM EXCEPTION	Yes	System discrepancy detected.	Contact the factory.
LOW ON MEMORY	Yes	Memory is close to 100% capacity	Contact the factory.
WATCHDOG ERROR	No	Some tasks are behind schedule	Contact the factory.
REMOTE DEVICE OFFLINE	Yes	One or more GOOSE devices are not responding	Check GOOSE setup

The following tables are provided to keep a record of settings to be used on a relay.

8.1.1 SETTINGS

Table 8–1: PRODUCT SETUP (Sheet 1 of 16)

SETTING	VALUE
PASSWORD SECURITY	
Access Level	
Command Password	
Setting Password	
Encrypted Command Password	
Encrypted Setting Password	
DISPLAY PROPERTIES	
Flash Message Time	
Default Message Timeout	
Default Message Intensity	
REAL TIME CLOCK	
IRIG-B Signal Type	
COMMUNICATIONS > SERIAL PORTS	
RS485 COM1 Baud Rate	
RS485 COM1 Parity	
RS485 COM2 Baud Rate	
RS485 COM2 Parity	
COMMUNICATIONS > NETWORK	
IP Address	
Subnet IP Mask	
Gateway IP Address	
OSI Network Address (NSAP)	
Ethernet Primary Link Monitor	
Ethernet Secondary Link Monitor	
COMMUNICATIONS > MODBUS PROTOCOL	
Modbus Slave Address	
Modbus IP Port Number	
COMMUNICATIONS > DNP PROTOCOL	
DNP Port	
DNP Address	
DNP Network Client Address 1	
DNP Network Client Address 2	
DNP IP Port Number	

Table 8–1: PRODUCT SETUP (Sheet 2 of 16)

SETTING	VALUE
DNP Unsol Response Function	
DNP Unsol Response Timeout	
DNP Unsol Response Max Retries	
Unsol Response Dest Address	
User Map for DNP Analogs	
COMMUNICATIONS > UCA/MMS PROTOCOL	
Default GOOSE Update Time	
UCA Logical Device	
UCA/MMS IP Port Number	
COMMUNICATIONS > WEB SERVER HTTP PROT.	
HTTP IP Port Number	
COMMUNICATIONS > TFTP PROTOCOL	
TFTP Main IP Port Number	
TFTP Data IP Port 1 Number	
TFTP Data IP Port 2 Number	
OSCILLOGRAPHY	
Number of Records	
Trigger Mode	
Trigger Position	
Trigger Source	
AC Input Waveforms	
OSCILLOGRAPHY > DIGITAL CHANNELS	
Digital Channel 1	
Digital Channel 2	
Digital Channel 3	
Digital Channel 4	
Digital Channel 5	
Digital Channel 6	
Digital Channel 7	
Digital Channel 8	
Digital Channel 9	
Digital Channel 10	
Digital Channel 11	

Table 8–1: PRODUCT SETUP (Sheet 3 of 16)

SETTING	VALUE
Digital Channel 12	
Digital Channel 13	
Digital Channel 14	
Digital Channel 15	
Digital Channel 16	
Digital Channel 17	
Digital Channel 18	
Digital Channel 19	
Digital Channel 20	
Digital Channel 21	
Digital Channel 22	
Digital Channel 23	
Digital Channel 24	
Digital Channel 25	
Digital Channel 26	
Digital Channel 27	
Digital Channel 28	
Digital Channel 29	
Digital Channel 30	
Digital Channel 31	
Digital Channel 32	
Digital Channel 33	
Digital Channel 34	
Digital Channel 35	
Digital Channel 36	
Digital Channel 37	
Digital Channel 38	
Digital Channel 39	
Digital Channel 40	
Digital Channel 41	
Digital Channel 42	
Digital Channel 43	
Digital Channel 44	
Digital Channel 45	
Digital Channel 46	
Digital Channel 47	
Digital Channel 48	
Digital Channel 49	
Digital Channel 50	

Table 8–1: PRODUCT SETUP (Sheet 4 of 16)

SETTING	VALUE
Digital Channel 51	
Digital Channel 52	
Digital Channel 53	
Digital Channel 54	
Digital Channel 55	
Digital Channel 56	
Digital Channel 57	
Digital Channel 58	
Digital Channel 59	
Digital Channel 60	
Digital Channel 61	
Digital Channel 62	
Digital Channel 63	
Digital Channel 64	
OSCILLOGRAPHY > ANALOG CHANNELS	
Analog Channel 1	
Analog Channel 2	
Analog Channel 3	
Analog Channel 4	
Analog Channel 5	
Analog Channel 6	
Analog Channel 7	
Analog Channel 8	
Analog Channel 9	
Analog Channel 10	
Analog Channel 11	
Analog Channel 12	
Analog Channel 13	
Analog Channel 14	
Analog Channel 15	
Analog Channel 16	
DATA LOGGER	
Rate	
Channel 1	
Channel 2	
Channel 3	
Channel 4	
Channel 5	
Channel 6	

Table 8–1: PRODUCT SETUP (Sheet 5 of 16)

SETTING	VALUE
Channel 7	
Channel 8	
Channel 9	
Channel 10	
Channel 11	
Channel 12	
Channel 13	
Channel 14	
Channel 15	
Channel 16	
USER PROGRAMMABLE LEDS	
Trip LED Input	
Alarm LED Input	
LED 1 Operand	
LED 1 Type	
LED 2 Operand	
LED 2 Type	
LED 3 Operand	
LED 3 Type	
LED 4 Operand	
LED 4 Type	
LED 5 Operand	
LED 5 Type	
LED 6 Operand	
LED 6 Type	
LED 7 Operand	
LED 7 Type	
LED 8 Operand	
LED 8 Type	
LED 9 Operand	
LED 9 Type	
LED 10 Operand	
LED 10 Type	
LED 11 Operand	
LED 11 Type	
LED 12 Operand	
LED 12 Type	
LED 13 Operand	
LED 13 Type	

Table 8–1: PRODUCT SETUP (Sheet 6 of 16)

SETTING	VALUE
LED 14 Operand	
LED 14 Type	
LED 15 Operand	
LED 15 Type	
LED 16 Operand	
LED 16 Type	
LED 17 Operand	
LED 17 Type	
LED 18 Operand	
LED 18 Type	
LED 19 Operand	
LED 19 Type	
LED 20 Operand	
LED 20 Type	
LED 21 Operand	
LED 21 Type	
LED 22 Operand	
LED 22 Type	
LED 23 Operand	
LED 23 Type	
LED 24 Operand	
LED 24 Type	
LED 25 Operand	
LED 25 Type	
LED 26 Operand	
LED 26 Type	
LED 27 Operand	
LED 27 Type	
LED 28 Operand	
LED 28 Type	
LED 29 Operand	
LED 29 Type	
LED 30 Operand	
LED 30 Type	
LED 31 Operand	
LED 31 Type	
LED 32 Operand	
LED 32 Type	
LED 33 Operand	

Table 8–1: PRODUCT SETUP (Sheet 7 of 16)

SETTING	VALUE
LED 33 Type	
LED 34 Operand	
LED 34 Type	
LED 35 Operand	
LED 35 Type	
LED 36 Operand	
LED 36 Type	
LED 37 Operand	
LED 37 Type	
LED 38 Operand	
LED 38 Type	
LED 39 Operand	
LED 39 Type	
LED 40 Operand	
LED 40 Type	
LED 41 Operand	
LED 41 Type	
LED 42 Operand	
LED 42 Type	
LED 43 Operand	
LED 43 Type	
LED 44 Operand	
LED 44 Type	
LED 45 Operand	
LED 45 Type	
LED 46 Operand	
LED 46 Type	
LED 47 Operand	
LED 47 Type	
LED 48 Operand	
LED 48 Type	
FLEX STATE PARAMETERS	
Flex State Parameter 1	
Flex State Parameter 2	
Flex State Parameter 3	
Flex State Parameter 4	
Flex State Parameter 5	
Flex State Parameter 6	
Flex State Parameter 7	

Table 8–1: PRODUCT SETUP (Sheet 8 of 16)

SETTING	VALUE
Flex State Parameter 8	
Flex State Parameter 9	
Flex State Parameter 10	
Flex State Parameter 11	
Flex State Parameter 12	
Flex State Parameter 13	
Flex State Parameter 14	
Flex State Parameter 15	
Flex State Parameter 16	
Flex State Parameter 17	
Flex State Parameter 18	
Flex State Parameter 19	
Flex State Parameter 20	
Flex State Parameter 21	
Flex State Parameter 22	
Flex State Parameter 23	
Flex State Parameter 24	
Flex State Parameter 25	
Flex State Parameter 26	
Flex State Parameter 27	
Flex State Parameter 28	
Flex State Parameter 29	
Flex State Parameter 30	
Flex State Parameter 31	
Flex State Parameter 32	
Flex State Parameter 33	
Flex State Parameter 34	
Flex State Parameter 35	
Flex State Parameter 36	
Flex State Parameter 37	
Flex State Parameter 38	
Flex State Parameter 39	
Flex State Parameter 40	
Flex State Parameter 41	
Flex State Parameter 42	
Flex State Parameter 43	
Flex State Parameter 44	
Flex State Parameter 45	
Flex State Parameter 46	

Table 8–1: PRODUCT SETUP (Sheet 9 of 16)

SETTING	VALUE
Flex State Parameter 47	
Flex State Parameter 48	
Flex State Parameter 49	
Flex State Parameter 50	
Flex State Parameter 51	
Flex State Parameter 52	
Flex State Parameter 53	
Flex State Parameter 54	
Flex State Parameter 55	
Flex State Parameter 56	
Flex State Parameter 57	
Flex State Parameter 58	
Flex State Parameter 59	
Flex State Parameter 60	
Flex State Parameter 61	
Flex State Parameter 62	
Flex State Parameter 63	
Flex State Parameter 64	
Flex State Parameter 65	
Flex State Parameter 66	
Flex State Parameter 67	
Flex State Parameter 68	
Flex State Parameter 69	
Flex State Parameter 70	
Flex State Parameter 71	
Flex State Parameter 72	
Flex State Parameter 73	
Flex State Parameter 74	
Flex State Parameter 75	
Flex State Parameter 76	
Flex State Parameter 77	
Flex State Parameter 78	
Flex State Parameter 79	
Flex State Parameter 80	
Flex State Parameter 81	
Flex State Parameter 82	
Flex State Parameter 83	
Flex State Parameter 84	
Flex State Parameter 85	

Table 8–1: PRODUCT SETUP (Sheet 10 of 16)

SETTING	VALUE
Flex State Parameter 86	
Flex State Parameter 87	
Flex State Parameter 88	
Flex State Parameter 89	
Flex State Parameter 90	
Flex State Parameter 91	
Flex State Parameter 92	
Flex State Parameter 93	
Flex State Parameter 94	
Flex State Parameter 95	
Flex State Parameter 96	
Flex State Parameter 97	
Flex State Parameter 98	
Flex State Parameter 99	
Flex State Parameter 100	
Flex State Parameter 101	
Flex State Parameter 102	
Flex State Parameter 103	
Flex State Parameter 104	
Flex State Parameter 105	
Flex State Parameter 106	
Flex State Parameter 107	
Flex State Parameter 108	
Flex State Parameter 109	
Flex State Parameter 110	
Flex State Parameter 111	
Flex State Parameter 112	
Flex State Parameter 113	
Flex State Parameter 114	
Flex State Parameter 115	
Flex State Parameter 116	
Flex State Parameter 117	
Flex State Parameter 118	
Flex State Parameter 119	
Flex State Parameter 120	
Flex State Parameter 121	
Flex State Parameter 122	
Flex State Parameter 123	
Flex State Parameter 124	

Table 8–1: PRODUCT SETUP (Sheet 11 of 16)

SETTING	VALUE
Flex State Parameter 125	
Flex State Parameter 126	
Flex State Parameter 127	
Flex State Parameter 128	
Flex State Parameter 129	
Flex State Parameter 130	
Flex State Parameter 131	
Flex State Parameter 132	
Flex State Parameter 133	
Flex State Parameter 134	
Flex State Parameter 135	
Flex State Parameter 136	
Flex State Parameter 137	
Flex State Parameter 138	
Flex State Parameter 139	
Flex State Parameter 140	
Flex State Parameter 141	
Flex State Parameter 142	
Flex State Parameter 143	
Flex State Parameter 144	
Flex State Parameter 145	
Flex State Parameter 146	
Flex State Parameter 147	
Flex State Parameter 148	
Flex State Parameter 149	
Flex State Parameter 150	
Flex State Parameter 151	
Flex State Parameter 152	
Flex State Parameter 153	
Flex State Parameter 154	
Flex State Parameter 155	
Flex State Parameter 156	
Flex State Parameter 157	
Flex State Parameter 158	
Flex State Parameter 159	
Flex State Parameter 160	
Flex State Parameter 161	
Flex State Parameter 162	
Flex State Parameter 163	

Table 8–1: PRODUCT SETUP (Sheet 12 of 16)

SETTING	VALUE
Flex State Parameter 164	
Flex State Parameter 165	
Flex State Parameter 166	
Flex State Parameter 167	
Flex State Parameter 168	
Flex State Parameter 169	
Flex State Parameter 170	
Flex State Parameter 171	
Flex State Parameter 172	
Flex State Parameter 173	
Flex State Parameter 174	
Flex State Parameter 175	
Flex State Parameter 176	
Flex State Parameter 177	
Flex State Parameter 178	
Flex State Parameter 179	
Flex State Parameter 180	
Flex State Parameter 181	
Flex State Parameter 182	
Flex State Parameter 183	
Flex State Parameter 184	
Flex State Parameter 185	
Flex State Parameter 186	
Flex State Parameter 187	
Flex State Parameter 188	
Flex State Parameter 189	
Flex State Parameter 190	
Flex State Parameter 191	
Flex State Parameter 192	
Flex State Parameter 193	
Flex State Parameter 194	
Flex State Parameter 195	
Flex State Parameter 196	
Flex State Parameter 197	
Flex State Parameter 198	
Flex State Parameter 199	
Flex State Parameter 200	
Flex State Parameter 201	
Flex State Parameter 202	

Table 8–1: PRODUCT SETUP (Sheet 13 of 16)

SETTING	VALUE
Flex State Parameter 203	
Flex State Parameter 204	
Flex State Parameter 205	
Flex State Parameter 206	
Flex State Parameter 207	
Flex State Parameter 208	
Flex State Parameter 209	
Flex State Parameter 210	
Flex State Parameter 211	
Flex State Parameter 212	
Flex State Parameter 213	
Flex State Parameter 214	
Flex State Parameter 215	
Flex State Parameter 216	
Flex State Parameter 217	
Flex State Parameter 218	
Flex State Parameter 219	
Flex State Parameter 220	
Flex State Parameter 221	
Flex State Parameter 222	
Flex State Parameter 223	
Flex State Parameter 224	
Flex State Parameter 225	
Flex State Parameter 226	
Flex State Parameter 227	
Flex State Parameter 228	
Flex State Parameter 229	
Flex State Parameter 230	
Flex State Parameter 231	
Flex State Parameter 232	
Flex State Parameter 233	
Flex State Parameter 234	
Flex State Parameter 235	
Flex State Parameter 236	
Flex State Parameter 237	
Flex State Parameter 238	
Flex State Parameter 239	
Flex State Parameter 240	
Flex State Parameter 241	

Table 8–1: PRODUCT SETUP (Sheet 14 of 16)

SETTING	VALUE
Flex State Parameter 242	
Flex State Parameter 243	
Flex State Parameter 244	
Flex State Parameter 245	
Flex State Parameter 246	
Flex State Parameter 247	
Flex State Parameter 248	
Flex State Parameter 249	
Flex State Parameter 250	
Flex State Parameter 251	
Flex State Parameter 252	
Flex State Parameter 253	
Flex State Parameter 254	
Flex State Parameter 255	
Flex State Parameter 256	
USER DISPLAY 1	
Top Line	
Bottom Line	
Item 1	
Item 2	
Item 3	
Item 4	
Item 5	
USER DISPLAY 2	
Top Line	
Bottom Line	
Item 1	
Item 2	
Item 3	
Item 4	
Item 5	
USER DISPLAY 3	
Top Line	
Bottom Line	
Item 1	
Item 2	
Item 3	
Item 4	
Item 5	

Table 8–1: PRODUCT SETUP (Sheet 15 of 16)

SETTING	VALUE
USER DISPLAY 4	
Top Line	
Bottom Line	
Item 1	
Item 2	
Item 3	
Item 4	
Item 5	
USER DISPLAY 5	
Top Line	
Bottom Line	
Item 1	
Item 2	
Item 3	
Item 4	
Item 5	
USER DISPLAY 6	
Top Line	
Bottom Line	
Item 1	
Item 2	
Item 3	
Item 4	
Item 5	
USER DISPLAY 7	
Top Line	
Bottom Line	
Item 1	
Item 2	
Item 3	
Item 4	
Item 5	
USER DISPLAY 8	
Top Line	
Bottom Line	
Item 1	
Item 2	
Item 3	
Item 4	

Table 8–1: PRODUCT SETUP (Sheet 16 of 16)

SETTING	VALUE
Item 5	
INSTALLATION	
Relay Settings	
Relay Name	

Table 8–2: FLEXLOGIC™ (Sheet 1 of 17)

SETTING	VALUE
FLEXLOGIC EQUATION EDITOR	
FlexLogic Entry 1	
FlexLogic Entry 2	
FlexLogic Entry 3	
FlexLogic Entry 4	
FlexLogic Entry 5	
FlexLogic Entry 6	
FlexLogic Entry 7	
FlexLogic Entry 8	
FlexLogic Entry 9	
FlexLogic Entry 10	
FlexLogic Entry 11	
FlexLogic Entry 12	
FlexLogic Entry 13	
FlexLogic Entry 14	
FlexLogic Entry 15	
FlexLogic Entry 16	
FlexLogic Entry 17	
FlexLogic Entry 18	
FlexLogic Entry 19	
FlexLogic Entry 20	
FlexLogic Entry 21	
FlexLogic Entry 22	
FlexLogic Entry 23	
FlexLogic Entry 24	
FlexLogic Entry 25	
FlexLogic Entry 26	
FlexLogic Entry 27	
FlexLogic Entry 28	
FlexLogic Entry 29	
FlexLogic Entry 30	
FlexLogic Entry 31	
FlexLogic Entry 32	
FlexLogic Entry 33	
FlexLogic Entry 34	
FlexLogic Entry 35	

Table 8–2: FLEXLOGIC™ (Sheet 2 of 17)

SETTING	VALUE
FlexLogic Entry 36	
FlexLogic Entry 37	
FlexLogic Entry 38	
FlexLogic Entry 39	
FlexLogic Entry 40	
FlexLogic Entry 41	
FlexLogic Entry 42	
FlexLogic Entry 43	
FlexLogic Entry 44	
FlexLogic Entry 45	
FlexLogic Entry 46	
FlexLogic Entry 47	
FlexLogic Entry 48	
FlexLogic Entry 49	
FlexLogic Entry 50	
FlexLogic Entry 51	
FlexLogic Entry 52	
FlexLogic Entry 53	
FlexLogic Entry 54	
FlexLogic Entry 55	
FlexLogic Entry 56	
FlexLogic Entry 57	
FlexLogic Entry 58	
FlexLogic Entry 59	
FlexLogic Entry 60	
FlexLogic Entry 61	
FlexLogic Entry 62	
FlexLogic Entry 63	
FlexLogic Entry 64	
FlexLogic Entry 65	
FlexLogic Entry 66	
FlexLogic Entry 67	
FlexLogic Entry 68	
FlexLogic Entry 69	
FlexLogic Entry 70	
FlexLogic Entry 71	

Table 8–2: FLEXLOGIC™ (Sheet 3 of 17)

SETTING	VALUE
FlexLogic Entry 72	
FlexLogic Entry 73	
FlexLogic Entry 74	
FlexLogic Entry 75	
FlexLogic Entry 76	
FlexLogic Entry 77	
FlexLogic Entry 78	
FlexLogic Entry 79	
FlexLogic Entry 80	
FlexLogic Entry 81	
FlexLogic Entry 82	
FlexLogic Entry 83	
FlexLogic Entry 84	
FlexLogic Entry 85	
FlexLogic Entry 86	
FlexLogic Entry 87	
FlexLogic Entry 88	
FlexLogic Entry 89	
FlexLogic Entry 90	
FlexLogic Entry 91	
FlexLogic Entry 92	
FlexLogic Entry 93	
FlexLogic Entry 94	
FlexLogic Entry 95	
FlexLogic Entry 96	
FlexLogic Entry 97	
FlexLogic Entry 98	
FlexLogic Entry 99	
FlexLogic Entry 100	
FlexLogic Entry 101	
FlexLogic Entry 102	
FlexLogic Entry 103	
FlexLogic Entry 104	
FlexLogic Entry 105	
FlexLogic Entry 106	
FlexLogic Entry 107	
FlexLogic Entry 108	
FlexLogic Entry 109	
FlexLogic Entry 110	

Table 8–2: FLEXLOGIC™ (Sheet 4 of 17)

SETTING	VALUE
FlexLogic Entry 111	
FlexLogic Entry 112	
FlexLogic Entry 113	
FlexLogic Entry 114	
FlexLogic Entry 115	
FlexLogic Entry 116	
FlexLogic Entry 117	
FlexLogic Entry 118	
FlexLogic Entry 119	
FlexLogic Entry 120	
FlexLogic Entry 121	
FlexLogic Entry 122	
FlexLogic Entry 123	
FlexLogic Entry 124	
FlexLogic Entry 125	
FlexLogic Entry 126	
FlexLogic Entry 127	
FlexLogic Entry 128	
FlexLogic Entry 129	
FlexLogic Entry 130	
FlexLogic Entry 131	
FlexLogic Entry 132	
FlexLogic Entry 133	
FlexLogic Entry 134	
FlexLogic Entry 135	
FlexLogic Entry 136	
FlexLogic Entry 137	
FlexLogic Entry 138	
FlexLogic Entry 139	
FlexLogic Entry 140	
FlexLogic Entry 141	
FlexLogic Entry 142	
FlexLogic Entry 143	
FlexLogic Entry 144	
FlexLogic Entry 145	
FlexLogic Entry 146	
FlexLogic Entry 147	
FlexLogic Entry 148	
FlexLogic Entry 149	

Table 8–2: FLEXLOGIC™ (Sheet 5 of 17)

SETTING	VALUE
FlexLogic Entry 150	
FlexLogic Entry 151	
FlexLogic Entry 152	
FlexLogic Entry 153	
FlexLogic Entry 154	
FlexLogic Entry 155	
FlexLogic Entry 156	
FlexLogic Entry 157	
FlexLogic Entry 158	
FlexLogic Entry 159	
FlexLogic Entry 160	
FlexLogic Entry 161	
FlexLogic Entry 162	
FlexLogic Entry 163	
FlexLogic Entry 164	
FlexLogic Entry 165	
FlexLogic Entry 166	
FlexLogic Entry 167	
FlexLogic Entry 168	
FlexLogic Entry 169	
FlexLogic Entry 170	
FlexLogic Entry 171	
FlexLogic Entry 172	
FlexLogic Entry 173	
FlexLogic Entry 174	
FlexLogic Entry 175	
FlexLogic Entry 176	
FlexLogic Entry 177	
FlexLogic Entry 178	
FlexLogic Entry 179	
FlexLogic Entry 180	
FlexLogic Entry 181	
FlexLogic Entry 182	
FlexLogic Entry 183	
FlexLogic Entry 184	
FlexLogic Entry 185	
FlexLogic Entry 186	
FlexLogic Entry 187	
FlexLogic Entry 188	

Table 8–2: FLEXLOGIC™ (Sheet 6 of 17)

SETTING	VALUE
FlexLogic Entry 189	
FlexLogic Entry 190	
FlexLogic Entry 191	
FlexLogic Entry 192	
FlexLogic Entry 193	
FlexLogic Entry 194	
FlexLogic Entry 195	
FlexLogic Entry 196	
FlexLogic Entry 197	
FlexLogic Entry 198	
FlexLogic Entry 199	
FlexLogic Entry 200	
FlexLogic Entry 201	
FlexLogic Entry 202	
FlexLogic Entry 203	
FlexLogic Entry 204	
FlexLogic Entry 205	
FlexLogic Entry 206	
FlexLogic Entry 207	
FlexLogic Entry 208	
FlexLogic Entry 209	
FlexLogic Entry 210	
FlexLogic Entry 211	
FlexLogic Entry 212	
FlexLogic Entry 213	
FlexLogic Entry 214	
FlexLogic Entry 215	
FlexLogic Entry 216	
FlexLogic Entry 217	
FlexLogic Entry 218	
FlexLogic Entry 219	
FlexLogic Entry 220	
FlexLogic Entry 221	
FlexLogic Entry 222	
FlexLogic Entry 223	
FlexLogic Entry 224	
FlexLogic Entry 225	
FlexLogic Entry 226	
FlexLogic Entry 227	

Table 8–2: FLEXLOGIC™ (Sheet 7 of 17)

SETTING	VALUE
FlexLogic Entry 228	
FlexLogic Entry 229	
FlexLogic Entry 230	
FlexLogic Entry 231	
FlexLogic Entry 232	
FlexLogic Entry 233	
FlexLogic Entry 234	
FlexLogic Entry 235	
FlexLogic Entry 236	
FlexLogic Entry 237	
FlexLogic Entry 238	
FlexLogic Entry 239	
FlexLogic Entry 240	
FlexLogic Entry 241	
FlexLogic Entry 242	
FlexLogic Entry 243	
FlexLogic Entry 244	
FlexLogic Entry 245	
FlexLogic Entry 246	
FlexLogic Entry 247	
FlexLogic Entry 248	
FlexLogic Entry 249	
FlexLogic Entry 250	
FlexLogic Entry 251	
FlexLogic Entry 252	
FlexLogic Entry 253	
FlexLogic Entry 254	
FlexLogic Entry 255	
FlexLogic Entry 256	
FlexLogic Entry 257	
FlexLogic Entry 258	
FlexLogic Entry 259	
FlexLogic Entry 260	
FlexLogic Entry 261	
FlexLogic Entry 262	
FlexLogic Entry 263	
FlexLogic Entry 264	
FlexLogic Entry 265	
FlexLogic Entry 266	

Table 8–2: FLEXLOGIC™ (Sheet 8 of 17)

SETTING	VALUE
FlexLogic Entry 267	
FlexLogic Entry 268	
FlexLogic Entry 269	
FlexLogic Entry 270	
FlexLogic Entry 271	
FlexLogic Entry 272	
FlexLogic Entry 273	
FlexLogic Entry 274	
FlexLogic Entry 275	
FlexLogic Entry 276	
FlexLogic Entry 277	
FlexLogic Entry 278	
FlexLogic Entry 279	
FlexLogic Entry 280	
FlexLogic Entry 281	
FlexLogic Entry 282	
FlexLogic Entry 283	
FlexLogic Entry 284	
FlexLogic Entry 285	
FlexLogic Entry 286	
FlexLogic Entry 287	
FlexLogic Entry 288	
FlexLogic Entry 289	
FlexLogic Entry 290	
FlexLogic Entry 291	
FlexLogic Entry 292	
FlexLogic Entry 293	
FlexLogic Entry 294	
FlexLogic Entry 295	
FlexLogic Entry 296	
FlexLogic Entry 297	
FlexLogic Entry 298	
FlexLogic Entry 299	
FlexLogic Entry 300	
FlexLogic Entry 301	
FlexLogic Entry 302	
FlexLogic Entry 303	
FlexLogic Entry 304	
FlexLogic Entry 305	

Table 8–2: FLEXLOGIC™ (Sheet 9 of 17)

SETTING	VALUE
FlexLogic Entry 306	
FlexLogic Entry 307	
FlexLogic Entry 308	
FlexLogic Entry 309	
FlexLogic Entry 310	
FlexLogic Entry 311	
FlexLogic Entry 312	
FlexLogic Entry 313	
FlexLogic Entry 314	
FlexLogic Entry 315	
FlexLogic Entry 316	
FlexLogic Entry 317	
FlexLogic Entry 318	
FlexLogic Entry 319	
FlexLogic Entry 320	
FlexLogic Entry 321	
FlexLogic Entry 322	
FlexLogic Entry 323	
FlexLogic Entry 324	
FlexLogic Entry 325	
FlexLogic Entry 326	
FlexLogic Entry 327	
FlexLogic Entry 328	
FlexLogic Entry 329	
FlexLogic Entry 330	
FlexLogic Entry 331	
FlexLogic Entry 332	
FlexLogic Entry 333	
FlexLogic Entry 334	
FlexLogic Entry 335	
FlexLogic Entry 336	
FlexLogic Entry 337	
FlexLogic Entry 338	
FlexLogic Entry 339	
FlexLogic Entry 340	
FlexLogic Entry 341	
FlexLogic Entry 342	
FlexLogic Entry 343	
FlexLogic Entry 344	

Table 8–2: FLEXLOGIC™ (Sheet 10 of 17)

SETTING	VALUE
FlexLogic Entry 345	
FlexLogic Entry 346	
FlexLogic Entry 347	
FlexLogic Entry 348	
FlexLogic Entry 349	
FlexLogic Entry 350	
FlexLogic Entry 351	
FlexLogic Entry 352	
FlexLogic Entry 353	
FlexLogic Entry 354	
FlexLogic Entry 355	
FlexLogic Entry 356	
FlexLogic Entry 357	
FlexLogic Entry 358	
FlexLogic Entry 359	
FlexLogic Entry 360	
FlexLogic Entry 361	
FlexLogic Entry 362	
FlexLogic Entry 363	
FlexLogic Entry 364	
FlexLogic Entry 365	
FlexLogic Entry 366	
FlexLogic Entry 367	
FlexLogic Entry 368	
FlexLogic Entry 369	
FlexLogic Entry 370	
FlexLogic Entry 371	
FlexLogic Entry 372	
FlexLogic Entry 373	
FlexLogic Entry 374	
FlexLogic Entry 375	
FlexLogic Entry 376	
FlexLogic Entry 377	
FlexLogic Entry 378	
FlexLogic Entry 379	
FlexLogic Entry 380	
FlexLogic Entry 381	
FlexLogic Entry 382	
FlexLogic Entry 383	

Table 8–2: FLEXLOGIC™ (Sheet 11 of 17)

SETTING	VALUE
FlexLogic Entry 384	
FlexLogic Entry 385	
FlexLogic Entry 386	
FlexLogic Entry 387	
FlexLogic Entry 388	
FlexLogic Entry 389	
FlexLogic Entry 390	
FlexLogic Entry 391	
FlexLogic Entry 392	
FlexLogic Entry 393	
FlexLogic Entry 394	
FlexLogic Entry 395	
FlexLogic Entry 396	
FlexLogic Entry 397	
FlexLogic Entry 398	
FlexLogic Entry 399	
FlexLogic Entry 400	
FlexLogic Entry 401	
FlexLogic Entry 402	
FlexLogic Entry 403	
FlexLogic Entry 404	
FlexLogic Entry 405	
FlexLogic Entry 406	
FlexLogic Entry 407	
FlexLogic Entry 408	
FlexLogic Entry 409	
FlexLogic Entry 410	
FlexLogic Entry 411	
FlexLogic Entry 412	
FlexLogic Entry 413	
FlexLogic Entry 414	
FlexLogic Entry 415	
FlexLogic Entry 416	
FlexLogic Entry 417	
FlexLogic Entry 418	
FlexLogic Entry 419	
FlexLogic Entry 420	
FlexLogic Entry 421	
FlexLogic Entry 422	

Table 8–2: FLEXLOGIC™ (Sheet 12 of 17)

SETTING	VALUE
FlexLogic Entry 423	
FlexLogic Entry 424	
FlexLogic Entry 425	
FlexLogic Entry 426	
FlexLogic Entry 427	
FlexLogic Entry 428	
FlexLogic Entry 429	
FlexLogic Entry 430	
FlexLogic Entry 431	
FlexLogic Entry 432	
FlexLogic Entry 433	
FlexLogic Entry 434	
FlexLogic Entry 435	
FlexLogic Entry 436	
FlexLogic Entry 437	
FlexLogic Entry 438	
FlexLogic Entry 439	
FlexLogic Entry 440	
FlexLogic Entry 441	
FlexLogic Entry 442	
FlexLogic Entry 443	
FlexLogic Entry 444	
FlexLogic Entry 445	
FlexLogic Entry 446	
FlexLogic Entry 447	
FlexLogic Entry 448	
FlexLogic Entry 449	
FlexLogic Entry 450	
FlexLogic Entry 451	
FlexLogic Entry 452	
FlexLogic Entry 453	
FlexLogic Entry 454	
FlexLogic Entry 455	
FlexLogic Entry 456	
FlexLogic Entry 457	
FlexLogic Entry 458	
FlexLogic Entry 459	
FlexLogic Entry 460	
FlexLogic Entry 461	

Table 8–2: FLEXLOGIC™ (Sheet 13 of 17)

SETTING	VALUE
FlexLogic Entry 462	
FlexLogic Entry 463	
FlexLogic Entry 464	
FlexLogic Entry 465	
FlexLogic Entry 466	
FlexLogic Entry 467	
FlexLogic Entry 468	
FlexLogic Entry 469	
FlexLogic Entry 470	
FlexLogic Entry 471	
FlexLogic Entry 472	
FlexLogic Entry 473	
FlexLogic Entry 474	
FlexLogic Entry 475	
FlexLogic Entry 476	
FlexLogic Entry 477	
FlexLogic Entry 478	
FlexLogic Entry 479	
FlexLogic Entry 480	
FlexLogic Entry 481	
FlexLogic Entry 482	
FlexLogic Entry 483	
FlexLogic Entry 484	
FlexLogic Entry 485	
FlexLogic Entry 486	
FlexLogic Entry 487	
FlexLogic Entry 488	
FlexLogic Entry 489	
FlexLogic Entry 490	
FlexLogic Entry 491	
FlexLogic Entry 492	
FlexLogic Entry 493	
FlexLogic Entry 494	
FlexLogic Entry 495	
FlexLogic Entry 496	
FlexLogic Entry 497	
FlexLogic Entry 498	
FlexLogic Entry 499	
FlexLogic Entry 500	

Table 8–2: FLEXLOGIC™ (Sheet 14 of 17)

SETTING	VALUE
FlexLogic Entry 501	
FlexLogic Entry 502	
FlexLogic Entry 503	
FlexLogic Entry 504	
FlexLogic Entry 505	
FlexLogic Entry 506	
FlexLogic Entry 507	
FlexLogic Entry 508	
FlexLogic Entry 509	
FlexLogic Entry 510	
FlexLogic Entry 511	
FlexLogic Entry 512	
FLEXLOGIC TIMER 1	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 2	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 3	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 4	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 5	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 6	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 7	
FlexLogic Timer Type	
FlexLogic Timer Pickup	

Table 8–2: FLEXLOGIC™ (Sheet 15 of 17)

SETTING	VALUE
Dropout Delay	
FLEXLOGIC TIMER 8	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 9	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 10	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 11	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 12	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 13	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 14	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 15	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 1	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 16	
FlexLogic Timer Type	

Table 8–2: FLEXLOGIC™ (Sheet 16 of 17)

SETTING	VALUE
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 17	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 18	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 19	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 20	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 21	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 22	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 23	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 24	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 25	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	

Table 8–2: FLEXLOGIC™ (Sheet 17 of 17)

SETTING	VALUE
FLEXLOGIC TIMER 26	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 27	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 28	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 29	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 30	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 31	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	
FLEXLOGIC TIMER 32	
FlexLogic Timer Type	
FlexLogic Timer Pickup	
Dropout Delay	

Table 8–3: CONTROL ELEMENTS (Sheet 1 of 7)

SETTING	VALUE
SETTINGS GROUPS	
Setting Groups Function	
Setting Groups Block	
Group 2 Activate On	
Group 3 Activate On	
Group 4 Activate On	
Group 5 Activate On	
Group 6 Activate On	
Group 7 Activate On	
Group 8 Activate On	
Setting Group Events	
DIGITAL ELEMENT 1	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 2	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 3	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	

Table 8–3: CONTROL ELEMENTS (Sheet 2 of 7)

SETTING	VALUE
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 4	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 5	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 6	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 7	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	

Table 8–3: CONTROL ELEMENTS (Sheet 3 of 7)

SETTING	VALUE
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 8	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 9	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 10	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 11	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	

Table 8–3: CONTROL ELEMENTS (Sheet 4 of 7)

SETTING	VALUE
DIGITAL ELEMENT 12	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 13	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 14	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 15	
Digital Element Function	
Digital Element Name	
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL ELEMENT 16	
Digital Element Function	
Digital Element Name	

Table 8–3: CONTROL ELEMENTS (Sheet 5 of 7)

SETTING	VALUE
Digital Element Input	
Digital Element Pickup Delay	
Digital Element Reset Delay	
Digital Element Block	
Digital Element Target	
Digital Element Events	
DIGITAL COUNTER 1	
Counter 1 Function	
Counter 1 Name	
Counter 1 Units	
Counter 1 Preset	
Counter 1 Compare	
Counter 1 Up	
Counter 1 Down	
Counter 1 Block	
Counter 1 Set to Preset	
Counter 1 Reset	
Counter 1 Freeze/Reset	
Counter 1 Freeze/Count	
DIGITAL COUNTER 2	
Counter 2 Function	
Counter 2 Name	
Counter 2 Units	
Counter 2 Preset	
Counter 2 Compare	
Counter 2 Up	
Counter 2 Down	
Counter 2 Block	
Counter 2 Set to Preset	
Counter 2 Reset	
Counter 2 Freeze/Reset	
Counter 2 Freeze/Count	
DIGITAL COUNTER 3	
Counter 3 Function	
Counter 3 Name	
Counter 3 Units	
Counter 3 Preset	
Counter 3 Compare	
Counter 3 Up	

Table 8–3: CONTROL ELEMENTS (Sheet 6 of 7)

SETTING	VALUE
Counter 3 Down	
Counter 3 Block	
Counter 3 Set to Preset	
Counter 3 Reset	
Counter 3 Freeze/Reset	
Counter 3 Freeze/Count	
DIGITAL COUNTER 4	
Counter 4 Function	
Counter 4 Name	
Counter 4 Units	
Counter 4 Preset	
Counter 4 Compare	
Counter 4 Up	
Counter 4 Down	
Counter 4 Block	
Counter 4 Set to Preset	
Counter 4 Reset	
Counter 4 Freeze/Reset	
Counter 4 Freeze/Count	
DIGITAL COUNTER 5	
Counter 5 Function	
Counter 5 Name	
Counter 5 Units	
Counter 5 Preset	
Counter 5 Compare	
Counter 5 Up	
Counter 5 Down	
Counter 5 Block	
Counter 5 Set to Preset	
Counter 5 Reset	
Counter 5 Freeze/Reset	
Counter 5 Freeze/Count	
DIGITAL COUNTER 6	
Counter 6 Function	
Counter 6 Name	
Counter 6 Units	
Counter 6 Preset	
Counter 6 Compare	
Counter 6 Up	

Table 8–3: CONTROL ELEMENTS (Sheet 7 of 7)

SETTING	VALUE
Counter 6 Down	
Counter 6 Block	
Counter 6 Set to Preset	
Counter 6 Reset	
Counter 6 Freeze/Reset	
Counter 6 Freeze/Count	
DIGITAL COUNTER 7	
Counter 7 Function	
Counter 7 Name	
Counter 7 Units	
Counter 7 Preset	
Counter 7 Compare	
Counter 7 Up	
Counter 7 Down	
Counter 7 Block	
Counter 7 Set to Preset	
Counter 7 Reset	
Counter 7 Freeze/Reset	
Counter 7 Freeze/Count	
DIGITAL COUNTER 8	
Counter 8 Function	
Counter 8 Name	
Counter 8 Units	
Counter 8 Preset	
Counter 8 Compare	
Counter 8 Up	
Counter 8 Down	
Counter 8 Block	
Counter 8 Set to Preset	
Counter 8 Reset	
Counter 8 Freeze/Reset	
Counter 8 Freeze/Count	

Table 8–4: CONTACT INPUTS

CONTACT INPUT	ID	EVENTS	THRESHOLD

Table 8–5: VIRTUAL INPUTS

VIRTUAL INPUT	FUNCTION	ID	TYPE	EVENTS
Virtual Input 1				
Virtual Input 2				
Virtual Input 3				
Virtual Input 4				
Virtual Input 5				
Virtual Input 6				
Virtual Input 7				
Virtual Input 8				
Virtual Input 9				
Virtual Input 10				
Virtual Input 11				
Virtual Input 12				
Virtual Input 13				
Virtual Input 14				
Virtual Input 15				
Virtual Input 16				
Virtual Input 17				
Virtual Input 18				
Virtual Input 19				
Virtual Input 20				
Virtual Input 21				
Virtual Input 22				
Virtual Input 23				
Virtual Input 24				
Virtual Input 25				
Virtual Input 26				
Virtual Input 27				
Virtual Input 28				
Virtual Input 29				
Virtual Input 30				
Virtual Input 31				
Virtual Input 32				

Table 8–6: UCA SBO TIMER

SETTING	VALUE
UCA SBO TIMER	
UCA SBO Timeout	

Table 8–7: CONTACT OUTPUTS

CONTACT OUTPUT	ID	OPERATE	SEAL-IN	EVENTS

8

Table 8–8: VIRTUAL OUTPUTS (Sheet 1 of 2)

VIRTUAL OUTPUT	ID	EVENTS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		

Table 8–8: VIRTUAL OUTPUTS (Sheet 2 of 2)

VIRTUAL OUTPUT	ID	EVENTS
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		
61		
62		
63		
64		

Table 8–9: REMOTE DEVICES

REMOTE DEVICE	ID
Remote Device 1	
Remote Device 2	
Remote Device 3	
Remote Device 4	
Remote Device 5	
Remote Device 6	
Remote Device 7	
Remote Device 8	
Remote Device 9	
Remote Device 10	
Remote Device 11	
Remote Device 12	
Remote Device 13	
Remote Device 14	
Remote Device 15	
Remote Device 16	

Table 8–10: REMOTE INPUTS

REMOTE INPUT	REMOTE DEVICE	BIT PAIR	DEFAULT STATE	EVENTS
Remote Input 1				
Remote Input 2				
Remote Input 3				
Remote Input 4				
Remote Input 5				
Remote Input 6				
Remote Input 7				
Remote Input 8				
Remote Input 9				
Remote Input 10				
Remote Input 11				
Remote Input 12				
Remote Input 13				
Remote Input 14				
Remote Input 15				
Remote Input 16				
Remote Input 17				
Remote Input 18				
Remote Input 19				
Remote Input 20				
Remote Input 21				
Remote Input 22				
Remote Input 23				
Remote Input 24				
Remote Input 25				
Remote Input 26				
Remote Input 27				
Remote Input 28				
Remote Input 29				
Remote Input 30				
Remote Input 31				
Remote Input 32				

Table 8–11: REMOTE OUTPUTS (Sheet 1 of 2)

REMOTE OUTPUT	OPERAND	EVENTS
REMOTE OUTPUTS – DNA		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		

Table 8–11: REMOTE OUTPUTS (Sheet 2 of 2)

REMOTE OUTPUT	OPERAND	EVENTS
REMOTE OUTPUTS – UserSt		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		

Table 8–12: RESETTING

SETTING	VALUE
RESETTING	
Reset Operand	

Table 8–13: DCMA INPUTS

DCMA INPUT	FUNCTION	ID	UNITS	RANGE	VALUES	
					MIN	MAX

Table 8–14: RTD INPUTS

RTD INPUT	FUNCTION	ID	TYPE

Table 8–15: FORCE CONTACT INPUTS

FORCE CONTACT	INPUT

Table 8–16: FORCE CONTACT OUTPUTS

FORCE CONTACT	OUTPUT

Table A–1: FLEXANALOG PARAMETER LIST

NUMERIC VALUE	DISPLAY TEXT	DESCRIPTION
0	Off	Placeholder for unused settings
40960	Communications Group	Communications Group
40971	Current Setting Group	Current Setting Group

A

B.1.1 INTRODUCTION

The UR type relays communicate with other computerized equipment such as programmable logic controllers, personal computers, or plant master computers, by using the AEG Modicon or **Modbus® RTU Protocol**. Following are some general notes:

- The units always act as slave devices, meaning that they never initiate communications; they only listen and respond to requests issued by a master computer.
- For Modbus®, a subset of the Remote Terminal Unit (RTU) format of the protocol is supported which allows extensive monitoring, programming and control functions using read and write register commands.

B.1.2 PHYSICAL LAYER

The Modbus® RTU protocol is hardware-independent so that the physical layer can be any of a variety of standard hardware configurations including RS232, RS485, fiber optics, 10BaseT or 10BaseF Ethernet, etc. The relay unit includes a faceplate (front panel) RS232 port and two rear terminal communications ports, which may be configured as RS485, fiber optic, 10BaseT, or 10BaseF. Data flow is half duplex in all configurations. See Chapter 3: HARDWARE for details on wiring.

Each data byte is transmitted in an asynchronous format consisting of 1 start bit, 8 data bits, 1 stop bit, and possibly 1 parity bit. This produces a 10 or 11 bit data frame. This is important for transmission through modems at high bit rates (11 bit data frames are not supported by many modems at baud rates greater than 300).

The baud rate and parity are independently programmable for each communications port. Baud rates of 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 bps are available. Even, odd, and no parity are available. See Chapter 5: SETTINGS \ PRODUCT SETUP \ COMMUNICATIONS for further details.

The master device in any system must know the address of the slave device with which it is to communicate. The unit will not act on a request from a master if the address in the request does not match the relay's slave address (unless the address is the broadcast address -- see below).

A single setting selects the slave address used for all ports, with the exception that for the faceplate port, the relay will accept any address when the Modbus® RTU protocol is used. The slave address is otherwise the same regardless of the protocol in use, but note that the broadcast address is 0 for Modbus®. The relay recognizes and processes a master request (under conditions that are protocol-specific) if the broadcast address is used but never returns a response.

B.1.3 DATA LINK LAYER

Communications takes place in packets which are groups of asynchronously framed byte data. The master transmits a packet to the slave and the slave responds with a packet. The end of a packet is marked by 'dead-time' on the communications line. The following describes general format for both transmit and receive packets. For exact details on packet formatting, refer to subsequent sections describing each function code.

Table B–1: MODBUS PACKET FORMAT

DESCRIPTION	SIZE
SLAVE ADDRESS	1 byte
FUNCTION CODE	1 byte
DATA	N bytes
CRC	2 bytes
DEAD TIME	3.5 bytes transmission time

SLAVE ADDRESS

This is the address of the slave device that is intended to receive the packet sent by the master and to perform the desired action. Each slave device on a communications bus must have a unique address to prevent bus contention. All of the relay's ports have the same address which is programmable from 1 to 254; see Chapter 5 for details. Only the addressed slave will respond to a packet that starts with its address. Note that the faceplate port is an exception to this rule; it will act on a message containing any slave address.

A master transmit packet with a slave address of 0 indicates a broadcast command. All slaves on the communication link will take action based on the packet, but none will respond to the master. Broadcast mode is only recognized when associated with FUNCTION CODE 05h. For any other function code, a packet with broadcast mode slave address 0 will be ignored.

FUNCTION CODE

This is one of the supported functions codes of the unit which tells the slave what action to perform. See the SUPPORTED FUNCTION CODES section for complete details. An exception response from the slave is indicated by setting the high order bit of the function code in the response packet. See the EXCEPTION RESPONSES section for further details.

DATA

This will be a variable number of bytes depending on the function code. This may include actual values, settings, or addresses sent by the master to the slave or by the slave to the master.

CRC

This is a two byte error checking code. The RTU version of Modbus® includes a 16 bit cyclic redundancy check (CRC-16) with every packet which is an industry standard method used for error detection. If a Modbus® slave device receives a packet in which an error is indicated by the CRC, the slave device will not act upon or respond to the packet thus preventing any erroneous operations. See the CRC-16 ALGORITHM section for a description of how to calculate the CRC.

DEAD TIME

A packet is terminated when no data is received for a period of 3.5 byte transmission times (about 15 ms at 2400 bps, 2 ms at 19200 bps, and 300 µs at 115200 bps). Consequently, the transmitting device must not allow gaps between bytes longer than this interval. Once the dead time has expired without a new byte transmission, all slaves start listening for a new packet from the master except for the addressed slave.

B.1.4 CRC-16 ALGORITHM

The CRC-16 algorithm essentially treats the entire data stream (data bits only; start, stop and parity ignored) as one continuous binary number. This number is first shifted left 16 bits and then divided by a characteristic polynomial (11000000000000101B). The 16 bit remainder of the division is appended to the end of the packet, MSByte first. The resulting packet including CRC, when divided by the same polynomial at the receiver will give a zero remainder if no transmission errors have occurred. This algorithm requires the characteristic polynomial to be reverse bit ordered. The most significant bit of the characteristic polynomial is dropped, since it does not affect the value of the remainder.

Note: A C programming language implementation of the CRC algorithm will be provided upon request.

Table B–2: CRC-16 ALGORITHM

SYMBOLS:	-->	data transfer	
	A	16 bit working register	
	Alow	low order byte of A	
	Ahigh	high order byte of A	
	CRC	16 bit CRC-16 result	
	i,j	loop counters	
	(+)	logical EXCLUSIVE-OR operator	
	N	total number of data bytes	
	Di	i-th data byte (i = 0 to N-1)	
	G	16 bit characteristic polynomial = 1010000000000001 (binary) with MSbit dropped and bit order reversed	
	shr (x)	right shift operator (th LSbit of x is shifted into a carry flag, a '0' is shifted into the MSbit of x, all other bits are shifted right one location)	
ALGORITHM:	1.	FFFF (hex) --> A	
	2.	0 --> i	
	3.	0 --> j	
	4.	Di (+) Alow --> Alow	
	5.	j + 1 --> j	
	6.	shr (A)	
	7.	Is there a carry?	No: go to 8 Yes: G (+) A --> A and continue.
	8.	Is j = 8?	No: go to 5 Yes: continue
	9.	i + 1 --> i	
	10.	Is i = N?	No: go to 3 Yes: continue
	11.	A --> CRC	

B.2.1 SUPPORTED FUNCTION CODES

Modbus® officially defines function codes from 1 to 127 though only a small subset is generally needed. The relay supports some of these functions, as summarized in the following table. Subsequent sections describe each function code in detail.

FUNCTION CODE		MODBUS® DEFINITION	GE POWER MANAGEMENT DEFINITION
HEX	DEC		
03	3	Read Holding Registers	Read Actual Values or Settings
04	4	Read Holding Registers	Read Actual Values or Settings
05	5	Force Single Coil	Execute Operation
06	6	Preset Single Register	Store Single Setting
10	16	Preset Multiple Registers	Store Multiple Settings

B.2.2 FUNCTION CODE 03H/04H - READ ACTUAL VALUES OR SETTINGS

This function code allows the master to read one or more consecutive data registers (actual values or settings) from a relay. Data registers are always 16 bit (two byte) values transmitted with high order byte first. The maximum number of registers that can be read in a single packet is 125. See the section MODBUS® MEMORY MAP for exact details on the data registers.

Since some PLC implementations of Modbus® only support one of function codes 03h and 04h, the relay interpretation allows either function code to be used for reading one or more consecutive data registers. The data starting address will determine the type of data being read. Function codes 03h and 04h are therefore identical.

The following table shows the format of the master and slave packets. The example shows a master device requesting 3 register values starting at address 4050h from slave device 11h (17 decimal); the slave device responds with the values 40, 300, and 0 from registers 4050h, 4051h, and 4052h, respectively.

Table B–3: MASTER AND SLAVE DEVICE PACKET TRANSMISSION EXAMPLE

MASTER TRANSMISSION	
PACKET FORMAT	EXAMPLE (hex)
SLAVE ADDRESS	11
FUNCTION CODE	04
DATA STARTING ADDRESS - hi	40
DATA STARTING ADDRESS - lo	50
NUMBER OF REGISTERS - hi	00
NUMBER OF REGISTERS - lo	03
CRC - lo	A7
CRC - hi	4A

SLAVE RESPONSE	
PACKET FORMAT	EXAMPLE (hex)
SLAVE ADDRESS	11
FUNCTION CODE	04
BYTE COUNT	06
DATA #1 - hi	00
DATA #1 - lo	28
DATA #2 - hi	01
DATA #2 - lo	2C
DATA #3 - hi	00
DATA #3 - lo	00
CRC - lo	0D
CRC - hi	60

B.2.3 FUNCTION CODE 05H - EXECUTE OPERATION

This function code allows the master to perform various operations in the relay. Available operations are in the table SUMMARY OF OPERATION CODES.

The following table shows the format of the master and slave packets. The example shows a master device requesting the slave device 11H (17 dec) to perform a reset. The hi and lo CODE VALUE bytes always have the values 'FF' and '00' respectively and are a remnant of the original Modbus® definition of this function code.

Table B–4: MASTER AND SLAVE DEVICE PACKET TRANSMISSION EXAMPLE

MASTER TRANSMISSION	
PACKET FORMAT	**EXAMPLE (hex)**
SLAVE ADDRESS	11
FUNCTION CODE	05
OPERATION CODE - hi	00
OPERATION CODE - lo	01
CODE VALUE - hi	FF
CODE VALUE - lo	00
CRC - lo	DF
CRC - hi	6A

SLAVE RESPONSE	
PACKET FORMAT	**EXAMPLE (hex)**
SLAVE ADDRESS	11
FUNCTION CODE	05
OPERATION CODE - hi	00
OPERATION CODE - lo	01
CODE VALUE - hi	FF
CODE VALUE - lo	00
CRC - lo	DF
CRC - hi	6A

Table B–5: SUMMARY OF OPERATION CODES (Function Code 05h)

OPERATION CODE (hex)	DEFINITION	DESCRIPTION
0000	NO OPERATION	Does not do anything.
0001	RESET	Performs the same function as the faceplate *RESET* key.
0005	CLEAR EVENT RECORDS	Performs the same function as the faceplate *CLEAR EVENTS RECORD* menu command.
0006	CLEAR OSCILLOGRAPHY	Clears all oscillography records.
1000 to 101F	VIRTUAL IN 1-32 ON/OFF	Sets the states of Virtual Inputs 1 to 32 either "ON" or "OFF".

B.2.4 FUNCTION CODE 06H - STORE SINGLE SETTING

This function code allows the master to modify the contents of a single setting register in an relay. Setting registers are always 16 bit (two byte) values transmitted high order byte first.

The following table shows the format of the master and slave packets. The example shows a master device storing the value 200 at memory map address 4051h to slave device 11h (17 dec).

Table B–6: MASTER AND SLAVE DEVICE PACKET TRANSMISSION EXAMPLE

MASTER TRANSMISSION	
PACKET FORMAT	**EXAMPLE (hex)**
SLAVE ADDRESS	11
FUNCTION CODE	06
DATA STARTING ADDRESS - hi	40
DATA STARTING ADDRESS - lo	51
DATA - hi	00
DATA - lo	C8
CRC - lo	CE
CRC - hi	DD

SLAVE RESPONSE	
PACKET FORMAT	**EXAMPLE (hex)**
SLAVE ADDRESS	11
FUNCTION CODE	06
DATA STARTING ADDRESS - hi	40
DATA STARTING ADDRESS - lo	51
DATA - hi	00
DATA - lo	C8
CRC - lo	CE
CRC - hi	DD

B.2.5 FUNCTION CODE 10H - STORE MULTIPLE SETTINGS

This function code allows the master to modify the contents of a one or more consecutive setting registers in a relay. Setting registers are 16-bit (two byte) values transmitted high order byte first. The maximum number of setting registers that can be stored in a single packet is 60. The following table shows the format of the master and slave packets. The example shows a master device storing the value 200 at memory map address 4051h, and the value 1 at memory map address 4052h to slave device 11h (17 dec).

Table B–7: MASTER AND SLAVE DEVICE PACKET TRANSMISSION EXAMPLE

MASTER TRANSMISSION	
PACKET FORMAT	**EXAMPLE (hex)**
SLAVE ADDRESS	11
FUNCTION CODE	10
DATA STARTING ADDRESS - hi	40
DATA STARTING ADDRESS - lo	51
NUMBER OF SETTINGS - hi	00
NUMBER OF SETTINGS - lo	02
BYTE COUNT	04
DATA #1 - high order byte	00
DATA #1 - low order byte	C8
DATA #2 - high order byte	00
DATA #2 - low order byte	01
CRC - low order byte	12
CRC - high order byte	62

SLAVE RESPONSE	
PACKET FORMAT	**EXMAPLE (hex)**
SLAVE ADDRESS	11
FUNCTION CODE	10
DATA STARTING ADDRESS - hi	40
DATA STARTING ADDRESS - lo	51
NUMBER OF SETTINGS - hi	00
NUMBER OF SETTINGS - lo	02
CRC - lo	07
CRC - hi	64

B.3.1 EXCEPTION RESPONSES

Programming or operation errors happen because of illegal data in a packet, hardware or software problems in the slave device, etc. These errors result in an exception response from the slave. The slave detecting one of these errors sends a response packet to the master with the high order bit of the function code set to 1.

The following table shows the format of the master and slave packets. The example shows a master device sending the unsupported function code 39h to slave device 11.

Table B–8: MASTER AND SLAVE DEVICE PACKET TRANSMISSION EXAMPLE

MASTER TRANSMISSION	
PACKET FORMAT	**EXAMPLE (hex)**
SLAVE ADDRESS	11
FUNCTION CODE	39
CRC - low order byte	CD
CRC - high order byte	F2

SLAVE RESPONSE	
PACKET FORMAT	**EXAMPLE (hex)**
SLAVE ADDRESS	11
FUNCTION CODE	B9
ERROR CODE	01
CRC - low order byte	93
CRC - high order byte	95

B.4.1 OBTAINING UR FILES USING MODBUS® PROTOCOL

The UR relay has a generic file transfer facility, meaning that you use the same method to obtain all of the different types of files from the unit.

The Modbus® registers that implement file transfer are found in the "Modbus File Transfer (Read/Write)" and "Modbus File Transfer (Read Only)" modules, starting at address 3100 in the Modbus® Memory Map. To read a file from the UR relay, use the following steps:

1. Write the filename to the "Name of file to read" register using a write multiple registers command. If the name is shorter than 80 characters, you may write only enough registers to include all the text of the filename. Filenames are not case sensitive.
2. Repeatedly read all the registers in "Modbus File Transfer (Read Only)" using a read multiple registers command. It is not necessary to read the entire data block, since the UR relay will remember which was the last register you read. The "position" register is initially zero and thereafter indicates how many bytes (2 times the number of registers) you have read so far. The "size of..." register indicates the number of bytes of data remaining to read, to a maximum of 244.
3. Keep reading until the "size of..." register is smaller than the number of bytes you are transferring. This condition indicates end of file. Discard any bytes you have read beyond the indicated block size.
4. If you need to re-try a block, read only the "size of.." and "block of data", without reading the position. The file pointer is only incremented when you read the position register, so the same data block will be returned as was read in the previous operation. On the next read, check to see if the position is where you expect it to be, and discard the previous block if it is not (this condition would indicate that the UR relay did not process your original read request).

The UR relay retains connection-specific file transfer information, so files may be read simultaneously on multiple modbus connections.

a) OBTAINING FILES FROM THE UR USING OTHER PROTOCOLS

All the files available via Modbus® may also be retrieved using the standard file transfer mechanisms in other protocols.

b) COMTRADE, OSCILLOGRAPHY AND DATA LOGGER FILES

Oscillography and data logger files are formatted using the COMTRADE file format per IEEE PC37.111 Draft 7c (02 September 1997). The files may obtained in either text or binary COMTRADE format.

c) READING OSCILLOGRAPHY FILES

In order to understand the description that follows, familiarity with the oscillography feature is required: refer to Chapter 5 SETTINGS \ PRODUCT SETUP \ OSCILLOGRAPHY for details.

The Oscillography_Number_of_Triggers register is incremented by one every time a new oscillography file is triggered (captured). Oscillography_Number_of_Triggers register is cleared to zero when oscillography data is cleared. When a new trigger occurs, the associated oscillography file is assigned a file identifier number equal to the incremented value of this register; the newest file will have a number equal to the Oscillography_Number_of_Triggers register. This register can be used to determine if any new data has been captured by periodically reading it to see if the value has changed; if the number has increased then there is new data available.

The Oscillography_Number_of_Records setting specifies the maximum number of files (and the number of cycles of data per file) that can be stored in memory of the relay. The Oscillography_Available_Records register specifies the actual number of files that are stored and still available to be read out of the relay.

Writing ‘Yes’ (i.e. the value 1) to the Oscillography_Clear_Data register clears oscillography data files, clears both Oscillography_Number_of_Triggers and Oscillography_Available_Records registers to zero, and sets the Oscillography_Last_Cleared_Date to the present date and time.

To read binary COMTRADE oscillography files, read the following filenames:

- OSCnnnn.CFG
- OSCnnn.DAT

Replace "nnn" with the desired oscillography trace number.

For ascii format, use the following file names

- OSCAnnnn.CFG
- OSCAnnn.DAT

d) READING DATA LOGGER FILES

In order to understand the description that follows, familiarity with the data logger feature is required: refer to Chapter 5 SETTINGS \ PRODUCT SETUP \ DATA LOGGER for details.

To read the entire data logger in binary COMTRADE format, read the following files.

- datalog.cfg
- datalog.dat

To read the entire data logger in ascii COMTRADE format, read the following files.

- dataloga.cfg
- dataloga.dat

To limit the range of records to be returned in the COMTRADE files, append the following to the filename before writing it:

To read from a specific time to the end of the log: <space> startTime

To read a specific range of records: <space> startTime <space> endTime

Replace <startTime> and <endTime> with Julian dates (seconds since Jan. 1 1970) as numeric text.

e) READING EVENT RECORDER FILES

To read the entire event recorder contents in ascii format (the only available format), use the following filename:

- EVT.TXT

To read from a specific record to the end of the log, use the following filename:

- EVTnnn.TXT

Replace "nnn" with the desired starting record number.

f) FILE FORMATS

"Normal" file format:

FORMAT,SHORT_EVENT,Event Number,Date/Time,Cause <Hex>,Cause <text>

e.g.: SHORT_EVENT,1,May 12 2000 14:17:31.000123,7C00,EVENTS CLEARED

B.4.2 MODBUS® PASSWORD OPERATION

The COMMAND password can be set up at memory location 4000. Storing a value of zero removes the COMMAND password protection. When reading the password setting, the encrypted value (zero if no password is set) will be returned. COMMAND security is required to change the COMMAND password. Similarly, the SETTING password can be set up at memory location is 4002. These are the same settings and encrypted values found in the Settings / Product Setup / Password Security menu via the faceplate keypad/display. Enabling password security for the faceplate display will also enable it for Modbus®, and vice-versa.

To gain COMMAND level security access, the COMMAND password must be entered at memory location 4008. To gain SETTING level security access, the SETTING password must be entered at memory location 400A. The entered SETTING password must match the current SETTING password setting, or must be zero, to change settings or download firmware.

COMMAND and SETTING passwords each have a 30-minute timer. Each timer starts when you enter the particular password, and is re-started whenever you “use” it. For example, writing a setting re-starts the SETTING password timer and writing a command register or forcing a coil re-starts the COMMAND password timer.

The value read at memory location 4010 can be used to confirm whether a COMMAND password is enabled or disabled (0 for Disabled). The value read at memory location 4011 can be used to confirm whether a SETTING password is enabled or disabled.

COMMAND or SETTING password security access is restricted to the particular port or particular TCP/IP connection on which the entry was made. Passwords must be entered when accessing the relay through other ports or connections, and the passwords must be re-entered after disconnecting and re-connecting on TCP/IP.

Table B–9: C30 MEMORY MAP SUMMARY (Sheet 1 of 2)

MODULE	START ADDRESS	LAST ADDRESS	NUMBER OF REGISTERS	GAP TO NEXT MODULE
Product Information (Read Only)	0000	0002	3	13
Product Information (Read Only -- Written by Factory)	0010	00FF	240	256
Self Test Targets (Read Only)	0200	0203	4	0
Front Panel (Read Only)	0204	0247	68	56
Keypress Emulation (Read/Write)	0280	0280	1	383
Virtual Input Commands (Read/Write Command)[32 modules]	0400	041F	32	992
Digital Counter States (Read Only Non-Volatile)[8 modules]	0800	083F	64	192
FlexStates (Read Only)	0900	090F	16	1776
Element States (Read Only)	1000	103F	64	64
User Displays Actuals (Read Only)	1080	111F	160	224
Modbus User Map Actuals (Read Only)	1200	12FF	256	448
Element Targets (Read Only)	14C0	14C1	2	0
Element Targets (Read/Write)	14C2	14C2	1	0
Element Targets (Read Only)	14C3	14D6	20	41
Digital I/O States (Read Only)	1500	1533	52	12
Remote I/O States (Read Only)	1540	1550	17	0
Remote Device Status (Read Only)[16 modules]	1551	1590	64	127
Ethernet Fibre Channel Status (Read/Write)	1610	1611	2	6
Data Logger Actuals (Read Only)	1618	161D	6	5346
Expanded FlexStates (Read Only)	2B00	2BFF	256	256
Expanded Digital I/O states (Read Only)	2D00	2E3F	320	192
Expanded Remote I/O Status (Read Only)	2F00	2F9F	160	96
Oscillography Values (Read Only)	3000	3004	5	0
Oscillography Commands (Read/Write Command)	3005	3011	13	238
Modbus File Transfer (Read/Write)	3100	3127	40	216
Modbus File Transfer (Read Only)	3200	327C	125	387
Event Recorder (Read Only)	3400	3405	6	0
Event Recorder (Read/Write Command)	3406	3406	1	185
DCMA Input Values (Read Only)[24 modules]	34C0	34EF	48	0
RTD Input Values (Read Only)[48 modules]	34F0	351F	48	0
Ohm Input Values (Read Only)[2 modules]	3520	3521	2	2782
Passwords (Read/Write Command)	4000	4001	2	0
Passwords (Read/Write Setting)	4002	4003	2	4
Passwords (Read/Write)	4008	400B	4	4
Passwords (Read Only)	4010	4011	2	62
Preferences (Read/Write Setting)	4050	4052	3	43
Communications (Read/Write Setting)	407E	40C7	74	168
Data Logger Commands (Read/Write Command)	4170	4170	1	15
Data Logger (Read/Write Setting)	4180	4190	17	15
Clock (Read/Write Command)	41A0	41A1	2	0

Table B–9: C30 MEMORY MAP SUMMARY (Sheet 2 of 2)

MODULE	START ADDRESS	LAST ADDRESS	NUMBER OF REGISTERS	GAP TO NEXT MODULE
Clock (Read/Write Setting)	41A2	41A6	5	25
Oscillography (Read/Write Setting)	41C0	423E	127	33
Trip and Alarm LEDs (Read/Write Setting)	4260	4261	2	30
User Programmable LEDs (Read/Write Setting)[48 modules]	4280	42DF	96	256
Installation (Read/Write Setting)	43E0	43EA	11	1557
Modbus User Map (Read/Write Setting)	4A00	4AFF	256	256
User Displays Settings (Read/Write Setting)[8 modules]	4C00	4CFF	256	768
Flexlogic (Read/Write Setting)	5000	51FF	512	1536
Flexlogic Timers (Read/Write Setting)[32 modules]	5800	58FF	256	6656
DCMA Inputs (Read/Write Setting)[24 modules]	7300	753F	576	0
RTD Inputs (Read/Write Setting)[48 modules]	7540	783F	768	0
Ohm Inputs (Read/Write Setting)[2 modules]	7840	785F	32	4000
FlexState Settings (Read/Write Setting)	8800	88FF	256	5888
Setting Groups (Read/Write Setting)	A000	A00A	11	0
Setting Groups (Read Only)	A00B	A00B	1	4084
Digital Elements (Read/Write Setting)[16 modules]	B000	B1FF	512	256
Digital Counter (Read/Write Setting)[8 modules]	B300	B3FF	256	3072
Contact Inputs (Read/Write Setting)[96 modules]	C000	C3BF	960	576
Contact Input Thresholds (Read/Write Setting)	C600	C617	24	104
Virtual Inputs Global Settings (Read/Write Setting)	C680	C680	1	15
Virtual Inputs (Read/Write Setting)[32 modules]	C690	C88F	512	1024
Virtual Outputs (Read/Write Setting)[64 modules]	CC90	D08F	1024	496
Mandatory (Read/Write Setting)	D280	D280	1	15
Contact Outputs (Read/Write Setting)[64 modules]	D290	D68F	1024	368
Reset (Read/Write Setting)	D800	D800	1	175
Force Contact Inputs (Read/Write Setting)	D8B0	D90F	96	0
Force Contact Outputs (Read/Write Setting)	D910	D94F	64	1712
Remote Devices (Read/Write Setting)[16 modules]	E000	E09F	160	96
Remote Inputs (Read/Write Setting)[32 modules]	E100	E17F	128	1152
Remote Output DNA Pairs (Read/Write Setting)[32 modules]	E600	E67F	128	0
Remote Output UserSt Pairs (Read/Write Setting)[32 modules]	E680	FFFF	128	0

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 1 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F001	UR_UINT16	UNSIGNED 16 BIT INTEGER
F002	UR_SINT16	SIGNED 16 BIT INTEGER
F003	UR_UINT32	UNSIGNED 32 BIT INTEGER (2 registers)
		High order word is stored in the first register. Low order word is stored in the second register.
F004	UR_SINT32	SIGNED 32 BIT INTEGER (2 registers)
		High order word is stored in the first register. Low order word is stored in the second register.
F005	UR_UINT8	UNSIGNED 8 BIT INTEGER
F006	UR_SINT8	SIGNED 8 BIT INTEGER
F011	UR_UINT16	FLEXCURVE DATA (120 POINTS)
		A FlexCurve is an array of 120 consecutive data points (x,y) which are interpolated to generate a smooth curve. The y-axis is the user defined trip or operation time setting; the x-axis is the pickup ratio and is pre-defined. Refer to format F119 for a listing of the pickup ratios; the enumeration value for the pickup ratio indicates the offset into the FlexCurve base address where the corresponding time value is stored.
F012	DISPLAY_SCALE	DISPLAY SCALING (UNSIGNED 16 BIT INTEGER)
		MSB indicates the SI units as a power of ten. LSB indicates the number of decimal points to display. Example: Current values are stored as 32 bit numbers with three decimal places and base units in Amps. If the retrieved value is 12345.678 A and the display scale equals 0x0302 then the displayed value on the unit is 12.35 kA.
F013	POWER_FACTOR	POWER FACTOR (SIGNED 16 BIT INTEGER)
		Positive values indicate lagging power factor; negative values indicate leading.
F040	UR_UINT48	48-BIT UNSIGNED INTEGER
F050	UR_UINT32	TIME and DATE (UNSIGNED 32 BIT INTEGER)
		Gives the current time in seconds elapsed since 00:00:00 January 1, 1970.
F051	UR_UINT32	DATE in SR style format (alternate format for F050)
	first 16 bits	(MM/DD/xxxx); Month (1=January, 2=February,..., 12=December); Day (1 to 31 in steps of 1)
	last 16 bits	Year (xx/xx/YYYY); 1970 to 2106 in steps of 1
F052	UR_UINT32	TIME in SR style format (alternate format for F050)
	first 16 bits	Hours/Minutes (HH:MM:xx.xxx), Hours (0=12am, 1=1am,..., 12=12pm, ..., 23=11pm), Minutes(0 to 59 in steps of 1)
	last 16 bits	Seconds (xx:xx:.SS.SSS), (0=00.000s, 1=00.001,..., 59999=59.999s)
F060	FLOATING_POINT	IEE FLOATING POINT (32 bits)
F070	HEX2	2 BYTES - 4 ASCII DIGITS
F071	HEX4	4 BYTES - 8 ASCII DIGITS
F072	HEX6	6 BYTES - 12 ASCII DIGITS
F073	HEX8	8 BYTES - 16 ASCII DIGITS
F074	HEX20	20 BYTES - 40 ASCII DIGITS
F100	ENUMERATION	VT CONNECTION TYPE
	0	Wye
	1	Delta
F101	ENUMERATION	MESSAGE DISPLAY INTENSITY
	0	25%
	1	50%
	2	75%
	3	100%

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 2 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F102	**ENUMERATION**	**DISABLED/ENABLED**
	0	Disabled
	1	Enabled
F103	**ENUMERATION**	**CURVE SHAPES**
	0	IEEE Moderately Inverse
	1	IEEE Very Inverse
	2	IEEE Extremely Inverse
	3	IEC Curve A
	4	IEC Curve B
	5	IEC Curve C
	6	IEC Short Inverse
	7	IAC Extremely Inverse
	8	IAC Very Inverse
	9	IAC Inverse
	10	IAC Short Inverse
	11	I2t
	12	Definite Time
	13	Flexcurve A
	14	Flexcurve B
F104	**ENUMERATION**	**RESET TYPE**
	0	Instantaneous
	1	Timed
F105	**ENUMERATION**	**LOGIC INPUT**
	0	Disabled
	1	Input 1
	2	Input 2
F106	**ENUMERATION**	**PHASE ROTATION**
	0	ABC
	1	ACB
F108	**ENUMERATION**	**OFF/ON**
	0	OFF
	1	ON
F109	**ENUMERATION**	**CONTACT OUTPUT OPERATION**
	0	Self-Reset
	1	Latched
	2	Disabled
F110	**ENUMERATION**	**CONTACT OUTPUT LED CONTROL**
	0	Trip
	1	Alarm
	2	None

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 3 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F112	**ENUMERATION**	**RS485 BAUD RATES**
	0	300 baud
	1	1200 baud
	2	2400 baud
	3	4800 baud
	4	9600 baud
	5	19200 baud
	6	38400 baud
	7	57600 baud
	8	115200 baud
F113	**ENUMERATION**	**PARITY**
	0	None
	1	Odd
	2	Even
F114	**ENUMERATION**	**IRIG-B SIGNAL TYPE**
	0	None
	1	DC Shift
	2	Amplitude Modulated
F117	**ENUMERATION**	**NUMBER OF OSCILLOGRAPHY RECORDS**
	0	1 x 72 cycles
	1	3 x 36 cycles
	2	7 x 18 cycles
	3	15 x 9 cycles
F118	**ENUMERATION**	**OSCILLOGRAPHY MODE**
	0	Automatic Overwrite
	1	Protected
F119	**ENUMERATION**	**FLEXCURVE PICKUP RATIOS**
	0	0
	1	0.05
	2	0.1
	3	0.15
	4	0.2
	5	0.25
	6	0.3
	7	0.35
	8	0.4
	9	0.45
	10	0.48
	11	0.5
	12	0.52
	13	0.54
	14	0.56
	15	0.58

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 4 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F119 continued	16	0.6
	17	0.62
	18	0.64
	19	0.66
	20	0.68
	21	0.7
	22	0.72
	23	0.74
	24	0.76
	25	0.78
	26	0.8
	27	0.82
	28	0.84
	29	0.86
	30	0.88
	31	0.9
	32	0.91
	33	0.92
	34	0.93
	35	0.94
	36	0.95
	37	0.96
	38	0.97
	39	0.98
	40	1.03
	41	1.05
	42	1.1
	43	1.2
	44	1.3
	45	1.4
	46	1.5
	47	1.6
	48	1.7
	49	1.8
	50	1.9
	51	2
	52	2.1
	53	2.2
	54	2.3
	55	2.4
	56	2.5
	57	2.6
	58	2.7
	59	2.8
	60	2.9

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 5 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F119 continued	61	3
	62	3.1
	63	3.2
	64	3.3
	65	3.4
	66	3.5
	67	3.6
	68	3.7
	69	3.8
	70	3.9
	71	4
	72	4.1
	73	4.2
	74	4.3
	75	4.4
	76	4.5
	77	4.6
	78	4.7
	79	4.8
	80	4.9
	81	5
	82	5.1
	83	5.2
	84	5.3
	85	5.4
	86	5.5
	87	5.6
	88	5.7
	89	5.8
	90	5.9
	91	6
	92	6.5
	93	7
	94	7.5
	95	8
	96	8.5
	97	9
	98	9.5
	99	10
	100	10.5
	101	11
	102	11.5
	103	12
	104	12.5
	105	13

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 6 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F119 continued	106	13.5
	107	14
	108	14.5
	109	15
	110	15.5
	111	16
	112	16.5
	113	17
	114	17.5
	115	18
	116	18.5
	117	19
	118	19.5
	119	20
F122	**ENUMERATION**	**ELEMENT INPUT SIGNAL TYPE**
	0	Phasor
	1	RMS
F123	**ENUMERATION**	**CT SECONDARY**
	0	1 A
	1	5 A
F124	**ENUMERATION**	**LIST OF ELEMENTS**
	0	PHASE IOC1
	1	PHASE IOC2
	2	PHASE IOC3
	3	PHASE IOC4
	4	PHASE IOC5
	5	PHASE IOC6
	6	PHASE IOC7
	7	PHASE IOC8
	8	PHASE IOC9
	9	PHASE IOC10
	10	PHASE IOC11
	11	PHASE IOC12
	16	16 = PHASE TOC1
	17	17 = PHASE TOC2
	18	18 = PHASE TOC3
	19	19 = PHASE TOC4
	20	20 = PHASE TOC5
	21	PHASE TOC6
	24	PH DIR1
	25	PH DIR2
	32	NEUTRAL IOC1
	33	NEUTRAL IOC2
	34	NEUTRAL IOC3
	35	NEUTRAL IOC4

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 7 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F124 continued	36	NEUTRAL IOC5
	37	NEUTRAL IOC6
	38	NEUTRAL IOC7
	39	NEUTRAL IOC8
	40	NEUTRAL IOC9
	41	NEUTRAL IOC10
	42	NEUTRAL IOC11
	43	NEUTRAL IOC12
	48	NEUTRAL TOC1
	49	NEUTRAL TOC2
	50	NEUTRAL TOC3
	51	NEUTRAL TOC4
	52	NEUTRAL TOC5
	53	NEUTRAL TOC6
	56	NTRL DIR OC1
	57	NTRL DIR OC2
	60	NEG SEQ DIR OC1
	61	NEG SEQ DIR OC2
	64	GROUND IOC1
	65	GROUND IOC2
	66	GROUND IOC3
	67	GROUND IOC4
	68	GROUND IOC5
	69	GROUND IOC6
	70	GROUND IOC7
	71	GROUND IOC8
	72	GROUND IOC9
	73	GROUND IOC10
	74	GROUND IOC11
	75	GROUND IOC12
	80	GROUND TOC1
	81	GROUND TOC2
	82	GROUND TOC3
	83	GROUND TOC4
	84	GROUND TOC5
	85	GROUND TOC6
	86	RESTD GND FT1
	87	RESTD GND FT2
	88	RESTD GND FT3
	89	RESTD GND FT4
	90	RESTD GND FT5
	91	RESTD GND FT6
	96	NEG SEQ IOC1
	97	NEG SEQ IOC2
	112	NEG SEQ TOC1

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 8 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F124 continued	113	NEG SEQ TOC2
	128	HI-Z
	129	BUS 1
	130	BUS 2
	144	PHASE UV1
	145	PHASE UV2
	152	PHASE OV1
	160	PH DIST Z1
	161	PH DIST Z2
	162	PH DIST Z3
	163	PH DIST Z4
	168	LINE PICKUP
	176	GND DIST Z1
	177	GND DIST Z2
	178	GND DIST Z3
	179	GND DIST Z4
	184	DUTT
	185	PUTT
	186	POTT
	187	HYBRID POTT
	188	BLOCK SCHEME
	208	XFMR INST DIFF
	209	XFMR PCNT DIFF
	224	SRC1 VT FUSE FAIL
	225	SRC2 VT FUSE FAIL
	226	SRC3 VT FUSE FAIL
	227	SRC4 VT FUSE FAIL
	228	SRC5 VT FUSE FAIL
	229	SRC6 VT FUSE FAIL
	232	SRC1 50DD
	233	SRC2 50DD
	234	SRC3 50DD
	235	SRC4 50DD
	236	SRC5 50DD
	237	SRC6 50DD
	240	87L DIFF
	242	OPEN POLE
	244	50DD
	245	CONT MONITOR
	246	CT FAIL
	247	CT TROUBLE1
	248	CT TROUBLE2
	249	87L TRIP
	250	STUB BUS
	256	87PC

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 9 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F124 continued	272	BREAKER 1
	273	BREAKER 2
	280	BKR FAIL 1
	281	BKR FAIL 2
	288	BKR ARC 1
	289	BKR ARC 2
	304	AR 1
	305	AR 2
	306	AR 3
	307	AR 4
	308	AR 5
	309	AR 6
	312	SYNC 1
	313	SYNC 2
	320	COLD LOAD 1
	321	COLD LOAD 2
	336	SETTING GROUP
	337	RESET
	352	UNDERFREQ 1
	353	UNDERFREQ 2
	354	UNDERFREQ 3
	355	UNDERFREQ 4
	356	UNDERFREQ 5
	357	UNDERFREQ 6
	512	DIG ELEM 1
	513	DIG ELEM 2
	514	DIG ELEM 3
	515	DIG ELEM 4
	516	DIG ELEM 5
	517	DIG ELEM 6
	518	DIG ELEM 7
	519	DIG ELEM 8
	520	DIG ELEM 9
	521	DIG ELEM 10
	522	DIG ELEM 11
	523	DIG ELEM 12
	524	DIG ELEM 13
	525	DIG ELEM 14
	526	DIG ELEM 15
	527	DIG ELEM 16
	544	COUNTER 1
	545	COUNTER 2
	546	COUNTER 3
	547	COUNTER 4

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 10 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F124 continued	548	COUNTER 5
	549	COUNTER 6
	550	COUNTER 7
	551	COUNTER 8
F125	ENUMERATION	ACCESS LEVEL
	0	Restricted
	1	Command
	2	Setting
	3	Factory Service
F126	ENUMERATION	NO/YES CHOICE
	0	No
	1	Yes
F127	ENUMERATION	LATCHED OR SELF-RESETTING
	0	Latched
	1	Self-Reset
F128	ENUMERATION	CONTACT INPUT THRESHOLD
	0	16 Vdc
	1	30 Vdc
	2	80 Vdc
	3	140 Vdc
F129	ENUMERATION	FLEXLOGIC TIMER TYPE
	0	millisecond
	1	second
	2	minute
F130	ENUMERATION	SIMULATION MODE
	0	Off
	1	Pre-Fault
	2	Fault
	3	Post-Fault
F131	ENUMERATION	FORCED CONTACT OUTPUT STATE
	0	Disabled
	1	Energized
	2	De-energized
	3	Freeze
F133	ENUMERATION	PROGRAM STATE
	0	Not Programmed
	1	Programmed
F134	ENUMERATION	PASS/FAIL
	0	Fail
	1	OK
	2	n/a
F135	ENUMERATION	GAIN CALIBRATION
	0	x1
	1	x16

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 11 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F136	**ENUMERATION**	**NUMBER OF OSCILLOGRAPHY RECORDS**
	0	31 x 8 cycles
	1	15 x 16 cycles
	2	7 x 32 cycles
	3	3 x 64 cycles
	4	1 x 128 cycles
F138	**ENUMERATION**	**OSCILLOGRAPHY FILE TYPE**
	0	Data File
	1	Configuration File
	2	Header File
F140	**ENUMERATION**	**CURRENT, SENS CURRENT, VOLTAGE, DISABLED**
	0	Disabled
	1	Current 46A
	2	Voltage 280V
	3	Current 4.6A
	4	Current 2A
	5	Notched 4.6A
	6	Notched 2A
F141	**ENUMERATION**	**SELF TEST ERROR**
	0	Any Self-Tests
	1	IRIG-B FAILURE
	2	DSP ERROR
	4	NO DSP INTERRUPTS
	5	UNIT NOT CALIBRATED
	7	CLOCK NOT SET
	8	FACTORY SERVICE MODE
	9	PROTOTYPE FIRMWARE
	10	FLEXLOGIC ERR TOKEN
	11	EQUIPMENT MISMATCH
	12	RAM CODE FAILURE
	13	UNIT NOT PROGRAMMED
	14	SYSTEM EXCEPTION
	15	SYNCHRONIZING
F141 continued	16	CHANNEL 1 FAILED
	17	CHANNEL 2 FAILED
	18	FLASH PROGRAMMING
	19	BATTERY FAIL
	20	PRI ETHERNET FAIL
	21	SEC ETHERNET FAIL
	22	EEPROM DATA ERROR
	23	SRAM DATA ERROR
	24	PROGRAM MEMORY
	25	WATCHDOG ERROR
	26	LOW ON MEMORY
	27	REMOTE DEVICE OFF

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 12 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F142	**ENUMERATION**	**EVENT RECORDER ACCESS FILE TYPE**
	0	All Record Data
	1	Headers Only
	2	Numeric Event Cause
F143	**UR_UINT32**	**32 BIT ERROR CODE (F141 specifies the bit number)**
		A bit value of 0 = no error, 1 = error
F144	**ENUMERATION**	**FORCED CONTACT INPUT STATE**
	0	Disabled
	1	Open
	2	Closed
F145	**ENUMERATION**	**ALPHABET LETTER**
	0	null
	1	A
	2	B
	↓	↓
	26	Z
F146	**ENUMERATION**	**MISC. EVENT CAUSES**
	0	EVENTS CLEARED
	1	OSCILLOGRAPHY TRIG'D
	2	DATE/TIME CHANGED
	3	DEF SETTINGS LOADED
	4	TEST MODE ON
	5	TEST MODE OFF
	6	POWER ON
	7	POWER OFF
	8	RELAY IN SERVICE
	9	RELAY OUT OF SERVICE
	10	WATCHDOG RESET
	11	OSCILLOGRAPHY CLEAR
F155	**ENUMERATION**	**REMOTE DEVICE STATE**
	0	Offline
	1	Online

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 13 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F156	ENUMERATION	REMOTE INPUT BIT PAIRS
	0	None
	1	DNA-1
	2	DNA-2
	3	DNA-3
	4	DNA-4
	5	DNA-5
	6	DNA-6
	7	DNA-7
	8	DNA-8
	9	DNA-9
	10	DNA-10
	11	DNA-11
	12	DNA-12
	13	DNA-13
	14	DNA-14
	15	DNA-15
	16	DNA-16
	17	DNA-17
	18	DNA-18
	19	DNA-19
	20	DNA-20
	21	DNA-21
	22	DNA-22
	23	DNA-23
	24	DNA-24
	25	DNA-25
	26	DNA-26
	27	DNA-27
	28	DNA-28
	29	DNA-29
	30	DNA-30
	31	DNA-31
	32	DNA-32
	33	UserSt-1
	34	UserSt-2
	35	UserSt-3
	36	UserSt-4
	37	UserSt-5
	38	UserSt-6
	39	UserSt-7
	40	UserSt-8
	41	UserSt-9

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 14 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F156 continued	42	UserSt-10
	43	UserSt-11
	44	UserSt-12
	45	UserSt-13
	46	UserSt-14
	47	UserSt-15
	48	UserSt-16
	49	UserSt-17
	50	UserSt-18
	51	UserSt-19
	52	UserSt-20
	53	UserSt-21
	54	UserSt-22
	55	UserSt-23
	56	UserSt-24
	57	UserSt-25
	58	UserSt-26
	59	UserSt-27
	60	UserSt-28
	61	UserSt-29
	62	UserSt-30
	63	UserSt-31
	64	UserSt-32
F166	ENUMERATION	AUXILIARY VT CONNECTION TYPE
	0	Vn
	1	Vag
	2	Vbg
	3	Vcg
	4	Vab
	5	Vbc
	6	Vca
F170	ENUMERATION	LOW/HIGH OFFSET & GAIN TRANSDUCER I/O SELECTION
	0	LOW
	1	HIGH
F171	ENUMERATION	TRANSDUCER CHANNEL INPUT TYPE
	0	dcmA IN
	1	OHMS IN
	2	RTD IN
	3	dcmA OUT

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 15 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F172	**ENUMERATION**	**SLOT LETTERS**
	0	F
	1	G
	2	H
	3	J
	4	K
	5	L
	6	M
	7	N
	8	P
	9	R
	10	S
	11	T
	12	U
	13	V
	14	W
	15	X
F173	**ENUMERATION**	**TRANSDUCER DCMA INPUT/OUTPUT RANGE**
	0	0 to -1 mA
	1	0 to 1 mA
	2	–1 to 1 mA
	3	0 to 5 mA
	4	0 to 10 mA
	5	0 to 20 mA
	6	4 to 20 mA
F174	**ENUMERATION**	**TRANSDUCER RTD INPUT TYPE**
	0	100 Ohm Platinum
	1	120 Ohm Nickel
	2	100 Ohm Nickel
	3	10 Ohm Copper
F175	**ENUMERATION**	**PHASE LETTERS**
	0	A
	1	B
	2	C
F177	**ENUMERATION**	**COMMUNICATION PORT**
	0	None
	1	COM1 - RS485
	2	COM2 - RS485
	3	Front Panel - RS232
	4	Network

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 16 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F178	**ENUMERATION**	**DATA LOGGER RATES**
	0	1 sec
	1	1 min
	2	5 min
	3	10 min
	4	15 min
	5	20 min
	6	30 min
	7	60 min
F180	**ENUMERATION**	**PHASE/GROUND**
	0	Phase
	1	Ground
F181	**ENUMERATION**	**ODD/EVEN/NONE**
	0	Odd
	1	Even
	2	None
F183	**ENUMERATION**	**AC INPUT WAVEFORMS**
	0	Off
	1	8 samples/cycle
	2	16 samples/cycle
	3	32 samples/cycle
	4	64 samples/cycle
F185	**ENUMERATION**	**PHASE A,B,C, GROUND SELECTOR**
	0	A
	1	B
	2	C
	3	G
F186	**ENUMERATION**	**MEASUREMENT MODE**
	0	Phase to Ground
	1	Phase to Phase

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 17 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F190	**ENUMERATION**	**SIMULATED KEYPRESS**
	0	No key -- use between real keys
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8
	9	9
	10	0
	11	Decimal Point
	12	Plus/Minus
	13	Value Up
	14	Value Down
	15	Message Up
	16	Message Down
	17	Message Left
	18	Message Right
	19	Menu
	20	Help
	21	Escape
	22	Enter
	23	Reset
	24	User 1
	25	User 2
	26	User 3
F200	**TEXT40**	**40 CHARACTER ASCII TEXT**
		20 registers -16 Bits: 1st Char MSB, 2nd Char. LSB
F201	**TEXT8**	**8 CHARACTER ASCII PASSCODE**
		4 registers -16 Bits: 1st Char MSB, 2nd Char. LSB
F202	**TEXT20**	**20 CHARACTER ASCII TEXT**
		10 registers -16 Bits: 1st Char MSB, 2nd Char. LSB
F203	**TEXT16**	**16 CHARACTER ASCII TEXT**
F204	**TEXT80**	**80 CHARACTER ASCII TEXT**
F205	**TEXT12**	**12 CHARACTER ASCII TEXT**
F206	**TEXT6**	**6 CHARACTER ASCII TEXT**
F207	**TEXT4**	**4 CHARACTER ASCII TEXT**
F208	**TEXT2**	**2 CHARACTER ASCII TEXT**
F222	**ENUMERATION**	**TEST ENUMERATION**
	0	Test Enumeration 0
	1	Test Enumeration 1
F230	**ENUMERATION**	**DIRECTIONAL POLARIZING**
	0	Voltage
	1	Current
	2	Dual

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 18 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F300	UR_UINT16	**FLEXLOGIC BASE TYPE (6 bit type)**
		The flexlogic BASE type is 6 bits and is combined with a 9 bit descriptor and 1 bit for protection element to form a 16 bit value. The combined bits are of the form : PTTTTTTDDDDDDDDD where P bit if set, indicates that the flexlogic type is associated with a protection element state and T represents bits for the BASE type, and D represents bits for the descriptor. The values in square brackets indicate the base type with P prefix [PTTTTTT] and the values in round brackets indicate the descriptor range. [0] Off(0) this is boolean FALSE value [0] On (1)This is boolean TRUE value [2] CONTACT INPUTS (1 - 96) [3] CONTACT INPUTS OFF (1-96) [4] VIRTUAL INPUTS (1-64) [6] VIRTUAL OUTPUTS (1-64) [10] CONTACT OUTPUTS VOLTAGE DETECTED (1-64) [11] CONTACT OUTPUTS VOLTAGE OFF DETECTED (1-64) [12] CONTACT OUTPUTS CURRENT DETECTED (1-64) [13] CONTACT OUTPUTS CURRENT OFF DETECTED (1-64) [14] REMOTE INPUTS (1-32) [28] INSERT (Via Keypad only) [32] END [34] NOT (1 INPUT) [36] 2 INPUT XOR (0) [38] LATCH SET/RESET (2 INPUTS) [40] OR (2-16 INPUTS) [42] AND (2-16 INPUTS) [44] NOR (2-16 INPUTS) [46] NAND (2-16 INPUTS) [48] TIMER (1-32) [50] ASSIGN VIRTUAL OUTPUT (1 - 64) [52] SELF-TEST ERROR (See F141 for range) [56] ACTIVE SETTING GROUP (1-8) [62] MISCELLANEOUS EVENTS (See F146 for range) [64-127] ELEMENT STATES (Refer to Memory Map Element States Section)
F400	UR_UINT16	**CT/VT BANK SELECTION**
	0	Card 1 Contact 1 to 4
	1	Card 1 Contact 5 to 8
	2	Card 2 Contact 1 to 4
	3	Card 2 Contact 5 to 8
	4	Card 3 Contact 1 to 4
	5	Card 3 Contact 5 to 8
F500	UR_UINT16	**PACKED BITFIELD**
		First register indicates I/O state with bits 0(MSB)-15(LSB) corresponding to I/0 state 1-16 Second register indicates I/O state with bits 0-15 corresponding to I/0 state 17-32 Third register indicates I/O state with bits 0-15 corresponding to I/0 state 33-48 Fourth register indicates I/O state with bits 0-15 corresponding to I/0 state 49-64 A bit value of 0 = Off, 1 = On
F501	UR_UINT16	**LED STATUS**
		Low byte of register indicates LED status with bit 0 representing the top LED and bit 7 the bottom LED. A bit value of 1 indicates the LED is on, 0 indicates the LED is off.
F502	BITFIELD	**ELEMENT OPERATE STATES**
		Each bit contains the operate state for an element. See the F124 format code for a list of element IDs. The operate bit for element ID X is bit [X mod 16] in register [X/16].

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 19 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F504	**BITFIELD**	**3 PHASE ELEMENT STATE**
	0	Pickup
	1	Operate
	2	Pickup Phase A
	3	Pickup Phase B
	4	Pickup Phase C
	5	Operate Phase A
	6	Operate Phase B
	7	Operate Phase C
F505	**BITFIELD**	**CONTACT OUTPUT STATE**
	0	Contact State
	1	Voltage Detected
	2	Current Detected
F506	**BITFIELD**	**1 PHASE ELEMENT STATE**
	0	Pickup
	1	Operate
F507	**BITFIELD**	**COUNTER ELEMENT STATE**
	0	Count Greater Than
	1	Count Equal To
	2	Count Less Than
F509	**BITFIELD**	**SIMPLE ELEMENT STATE**
	0	Operate
F511	**BITFIELD**	**3 PHASE SIMPLE ELEMENT STATE**
	0	Operate
	1	Operate A
	2	Operate B
	3	Operate C

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 20 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
F512	**ENUMERATION**	**HARMONIC NUMBER**
	0	2ND
	1	3RD
	2	4TH
	3	5TH
	4	6TH
	5	7TH
	6	8TH
	7	9TH
	8	10TH
	9	11TH
	10	12TH
	11	13TH
	12	14TH
	13	15TH
	14	16TH
	15	17TH
	16	18TH
	17	19TH
	18	20TH
	19	21ST
	20	22ND
	21	23RD
	22	24TH
	23	25TH
F600	**UR_UINT16**	**FLEXANALOG PARAMETER**
		The 16-bit value corresponds to the modbus address
		of the value to be used when this parameter is selected.
		Only certain values may be used as FlexAnalogs
		(basically all the metering quantities used in protection)
MMI_FLASH	**ENUMERATION**	**FLASH MESSAGE DEFINITIONS FOR FRONT PANEL MMI**
	0	
	1	ADJUSTED VALUE HAS BEEN STORED
	2	ENTERED PASSCODE IS INVALID
	3	COMMAND EXECUTED
	4	DEFAULT MESSAGE HAS BEEN ADDED
	5	DEFAULT MESSAGE HAS BEEN REMOVED
	6	INPUT FUNCTION IS ALREADY ASSIGNED
	7	PRESS [ENTER] TO ADD AS DEFAULT
	8	PRESS [ENTER] TO REMOVE MESSAGE
	9	PRESS [ENTER] TO BEGIN TEXT EDIT
	10	ENTRY MISMATCH - CODE NOT STORED
	11	PRESSED KEY IS INVALID HERE
	12	INVALID KEY: MUST BE IN LOCAL MODE
	13	NEW PASSWORD HAS BEEN STORED

Table B–10: MODBUS® MEMORY MAP DATA FORMATS (Sheet 21 of 21)

FORMAT CODE	FORMAT TYPE/ BITMASK	FORMAT DEFINITION
MMI_FLASH continued	14	PLEASE ENTER A NON-ZERO PASSCODE
	15	NO ACTIVE TARGETS (TESTING LEDS)
	16	OUT OF RANGE - VALUE NOT STORED
	17	RESETTING LATCHED CONDITIONS
	18	SETPOINT ACCESS IS NOW ALLOWED
	19	SETPOINT ACCESS DENIED (PASSCODE)
	20	SETPOINT ACCESS IS NOW RESTRICTED
	21	NEW SETTING HAS BEEN STORED
	22	SETPOINT ACCESS DENIED (SWITCH)
	23	DATA NOT ACCEPTED
	24	NOT ALL CONDITIONS HAVE BEEN RESET
	25	DATE NOT ACCEPTED IRIGB IS ENABLED
	26	NOT EXECUTED
	27	DISPLAY ADDED TO USER DISPLAY LIST
	28	DISPLAY NOT ADDED TOUSER DISPLAY LIST
	29	DISPLAY REMOVED FROMUSER DISPLAY LIST
MMI_PASSWORD_TYPE	**ENUMERATION**	**PASSWORD TYPES FOR DISPLAY IN PASSWORD PROMPT**
	0	NO
	1	MASTER
	2	SETTING
	3	COMMAND
	4	FACTORY
MMI_SETTING_TYPE	**ENUMERATION**	**SETTING TYPES FOR DISPLAY IN WEB PAGES**
	0	Unrestricted Setting
	1	Master-accessed Setting
	2	Setting
	3	Command
	4	Factory Setting

B

Table B–11: MODBUS® MEMORY MAP (Sheet 1 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
Product Information (Read Only)						
0000	UR Product Type	0 to 65535	---	1	F001	0
0002	Product Version	0 to 655.35	---	0.01	F001	1
Product Information (Read Only – Written by Factory)						
0010	Serial Number	---	---	---	F203	"0"
0020	Manufacturing Date	0 to 4294967295	---	1	F050	0
0022	Modification Number	0 to 65535	---	1	F001	0
0040	Order Code	---	---	---	F204	"Order Code x "
0090	Ethernet MAC Address	---	---	---	F072	0
0093	Reserved (13 items)	---	---	---	F001	0
00A0	CPU Module Serial Number	---	---	---	F203	(none)
00B0	CPU Supplier Serial Number	---	---	---	F203	(none)
00C0	Ethernet Sub Module Serial Number (8 items)	---	---	---	F203	(none)
Self Test Targets (Read Only)						
0200	Self Test States (2 items)	0 to 4294967295	0	1	F143	0
Front Panel (Read Only)						
0204	LED Column x State (9 items)	0 to 65535	---	1	F501	0
0220	Display Message	---	---	---	F204	(none)
Keypress Emulation (Read/Write)						
0280	Simulated keypress -- write zero before each keystroke	0 to 26	---	1	F190	0 (No key; use between real key)
Virtual Input Commands (Read/Write Command) (32 modules)						
0400	Virtual Input x State	0 to 1	---	1	F108	0 (Off)
0401	...Repeated for module number 2					
0402	...Repeated for module number 3					
0403	...Repeated for module number 4					
0404	...Repeated for module number 5					
0405	...Repeated for module number 6					
0406	...Repeated for module number 7					
0407	...Repeated for module number 8					
0408	...Repeated for module number 9					
0409	...Repeated for module number 10					
040A	...Repeated for module number 11					
040B	...Repeated for module number 12					
040C	...Repeated for module number 13					
040D	...Repeated for module number 14					
040E	...Repeated for module number 15					
040F	...Repeated for module number 16					
0410	...Repeated for module number 17					
0411	...Repeated for module number 18					
0412	...Repeated for module number 19					
0413	...Repeated for module number 20					
0414	...Repeated for module number 21					
0415	...Repeated for module number 22					
0416	...Repeated for module number 23					

Table B–11: MODBUS® MEMORY MAP (Sheet 2 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
0417	...Repeated for module number 24					
0418	...Repeated for module number 25					
0419	...Repeated for module number 26					
041A	...Repeated for module number 27					
041B	...Repeated for module number 28					
041C	...Repeated for module number 29					
041D	...Repeated for module number 30					
041E	...Repeated for module number 31					
041F	...Repeated for module number 32					
Digital Counter States (Read Only Non-Volatile) (8 modules)						
0800	Digital Counter x Value	-2147483647 to 2147483647	---	1	F004	0
0802	Digital Counter x Frozen	-2147483647 to 2147483647	---	1	F004	0
0804	Digital Counter x Frozen Time Stamp	0 to 4294967295	---	1	F050	0
0806	Digital Counter x Frozen Time Stamp us	0 to 4294967295	---	1	F003	0
0808	...Repeated for module number 2					
0810	...Repeated for module number 3					
0818	...Repeated for module number 4					
0820	...Repeated for module number 5					
0828	...Repeated for module number 6					
0830	...Repeated for module number 7					
0838	...Repeated for module number 8					
FlexStates (Read Only)						
0900	FlexState Bits (16 items)	0 to 65535	---	1	F001	0
Element States (Read Only)						
1000	Element Operate States (64 items)	0 to 65535	---	1	F502	0
User Displays Actuals (Read Only)						
1080	Formatted user-definable displays (8 items)	---	---	---	F200	(none)
Modbus User Map Actuals (Read Only)						
1200	User Map Values (256 items)	0 to 65535	---	1	F001	0
Element Targets (Read Only)						
14C0	Target Sequence	0 to 65535	---	1	F001	0
14C1	Number of Targets	0 to 65535	---	1	F001	0
Element Targets (Read/Write)						
14C2	Target to Read	0 to 65535	---	1	F001	0
Element Targets (Read Only)						
14C3	Target Message	---	---	---	F200	"."
Digital I/O States (Read Only)						
1500	Contact Input States (6 items)	0 to 65535	---	1	F500	0
1508	Virtual Input States (2 items)	0 to 65535	---	1	F500	0
1510	Contact Output States (4 items)	0 to 65535	---	1	F500	0
1518	Contact Output Current States (4 items)	0 to 65535	---	1	F500	0
1520	Contact Output Voltage States (4 items)	0 to 65535	---	1	F500	0
1528	Virtual Output States (4 items)	0 to 65535	---	1	F500	0
1530	Contact Output Detectors (4 items)	0 to 65535	---	1	F500	0
Remote I/O States (Read Only)						
1540	Remote Device x States	0 to 65535	---	1	F500	0

Table B–11: MODBUS® MEMORY MAP (Sheet 3 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
1542	Remote Input x States (2 items)	0 to 65535	---	1	F500	0
1550	Remote Devices Online	0 to 1	---	1	F126	0 (No)
Remote Device Status (Read Only) (16 modules)						
1551	Remote Device x StNum	0 to 4294967295	---	1	F003	0
1553	Remote Device x SqNum	0 to 4294967295	---	1	F003	0
1555	...Repeated for module number 2					
1559	...Repeated for module number 3					
155D	...Repeated for module number 4					
1561	...Repeated for module number 5					
1565	...Repeated for module number 6					
1569	...Repeated for module number 7					
156D	...Repeated for module number 8					
1571	...Repeated for module number 9					
1575	...Repeated for module number 10					
1579	...Repeated for module number 11					
157D	...Repeated for module number 12					
1581	...Repeated for module number 13					
1585	...Repeated for module number 14					
1589	...Repeated for module number 15					
158D	...Repeated for module number 16					
Ethernet Fibre Channel Status (Read/Write)						
1610	Ethernet Primary Fibre Channel Status	0 to 2	---	1	F134	0 (Fail)
1611	Ethernet Secondary Fibre Channel Status	0 to 2	---	1	F134	0 (Fail)
Data Logger Actuals (Read Only)						
1618	Data Logger Channel Count	0 to 16	CHNL	1	F001	0
1619	Time of oldest available samples	0 to 4294967295	seconds	1	F050	0
161B	Time of newest available samples	0 to 4294967295	seconds	1	F050	0
161D	Data Logger Duration	0 to 999.9	DAYS	0.1	F001	0
Expanded FlexStates (Read Only)						
2B00	FlexStates, one per register (256 items)	0 to 1	---	1	F108	0 (Off)
Expanded Digital I/O states (Read Only)						
2D00	Contact Input States, one per register (96 items)	0 to 1	---	1	F108	0 (Off)
2D80	Contact Out States, one per register (64 items)	0 to 1	---	1	F108	0 (Off)
2E00	Virtual Output States, one per register (64 items)	0 to 1	---	1	F108	0 (Off)
Expanded Remote I/O Status (Read Only)						
2F00	Remote Device States, one / register (16 items)	0 to 1	---	1	F155	0 (Offline)
2F80	Remote Input States, one per register (32 items)	0 to 1	---	1	F108	0 (Off)
Oscillography Values (Read Only)						
3000	Oscillography Number of Triggers	0 to 65535	---	1	F001	0
3001	Oscillography Available Records	0 to 65535	---	1	F001	0
3002	Oscillography Last Cleared Date	0 to 400000000	---	1	F050	0
3004	Oscillography Number Of Cycles Per Record	0 to 65535	---	1	F001	0
Oscillography Commands (Read/Write Command)						
3005	Oscillography Force Trigger	0 to 1	---	1	F126	0 (No)
3011	Oscillography Clear Data	0 to 1	---	1	F126	0 (No)
Modbus File Transfer (Read/Write)						
3100	Name of file to read	---	---	---	F204	(none)

Table B–11: MODBUS® MEMORY MAP (Sheet 4 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
Modbus File Transfer (Read Only)						
3200	Character position of current block within file	0 to 4294967295	---	1	F003	0
3202	Size of currently-available data block	0 to 65535	---	1	F001	0
3203	Block of data from requested file (122 items)	0 to 65535	---	1	F001	0
Event Recorder (Read Only)						
3400	Events Since Last Clear	0 to 4294967295	---	1	F003	0
3402	Number of Available Events	0 to 4294967295	---	1	F003	0
3404	Event Recorder Last Cleared Date	0 to 4294967295	---	1	F050	0
Event Recorder (Read/Write Command)						
3406	Event Recorder Clear Command	0 to 1	---	1	F126	0 (No)
DCMA Input Values (Read Only) (24 modules)						
34C0	DCMA Inputs x Value	-9999.999 to 9999.999	---	0.001	F004	0
34C2	...Repeated for module number 2					
34C4	...Repeated for module number 3					
34C6	...Repeated for module number 4					
34C8	...Repeated for module number 5					
34CA	...Repeated for module number 6					
34CC	...Repeated for module number 7					
34CE	...Repeated for module number 8					
34D0	...Repeated for module number 9					
34D2	...Repeated for module number 10					
34D4	...Repeated for module number 11					
34D6	...Repeated for module number 12					
34D8	...Repeated for module number 13					
34DA	...Repeated for module number 14					
34DC	...Repeated for module number 15					
34DE	...Repeated for module number 16					
34E0	...Repeated for module number 17					
34E2	...Repeated for module number 18					
34E4	...Repeated for module number 19					
34E6	...Repeated for module number 20					
34E8	...Repeated for module number 21					
34EA	...Repeated for module number 22					
34EC	...Repeated for module number 23					
34EE	...Repeated for module number 24					
RTD Input Values (Read Only) (48 modules)						
34F0	RTD Inputs x Value	-32768 to 32767	°C	1	F002	0
34F1	...Repeated for module number 2					
34F2	...Repeated for module number 3					
34F3	...Repeated for module number 4					
34F4	...Repeated for module number 5					
34F5	...Repeated for module number 6					
34F6	...Repeated for module number 7					
34F7	...Repeated for module number 8					
34F8	...Repeated for module number 9					
34F9	...Repeated for module number 10					
34FA	...Repeated for module number 11					

Table B–11: MODBUS® MEMORY MAP (Sheet 5 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
34FB	...Repeated for module number 12					
34FC	...Repeated for module number 13					
34FD	...Repeated for module number 14					
34FE	...Repeated for module number 15					
34FF	...Repeated for module number 16					
3500	...Repeated for module number 17					
3501	...Repeated for module number 18					
3502	...Repeated for module number 19					
3503	...Repeated for module number 20					
3504	...Repeated for module number 21					
3505	...Repeated for module number 22					
3506	...Repeated for module number 23					
3507	...Repeated for module number 24					
3508	...Repeated for module number 25					
3509	...Repeated for module number 26					
350A	...Repeated for module number 27					
350B	...Repeated for module number 28					
350C	...Repeated for module number 29					
350D	...Repeated for module number 30					
350E	...Repeated for module number 31					
350F	...Repeated for module number 32					
3510	...Repeated for module number 33					
3511	...Repeated for module number 34					
3512	...Repeated for module number 35					
3513	...Repeated for module number 36					
3514	...Repeated for module number 37					
3515	...Repeated for module number 38					
3516	...Repeated for module number 39					
3517	...Repeated for module number 40					
3518	...Repeated for module number 41					
3519	...Repeated for module number 42					
351A	...Repeated for module number 43					
351B	...Repeated for module number 44					
351C	...Repeated for module number 45					
351D	...Repeated for module number 46					
351E	...Repeated for module number 47					
351F	...Repeated for module number 48					
Ohm Input Values (Read Only) (2 modules)						
3520	Ohm Inputs x Value	0 to 65535	Þ	1	F001	0
3521	...Repeated for module number 2					
Passwords (Read/Write Command)						
4000	Command Password Setting	0 to 4294967295	---	1	F003	0
Passwords (Read/Write Setting)						
4002	Setting Password Setting	0 to 4294967295	---	1	F003	0
Passwords (Read/Write)						
4008	Command Password Entry	0 to 4294967295	---	1	F003	0
400A	Setting Password Entry	0 to 4294967295	---	1	F003	0

Table B–11: MODBUS® MEMORY MAP (Sheet 6 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
Passwords (Read Only)						
4010	Command Password Status	0 to 1	---	1	F102	0 (Disabled)
4011	Setting Password Status	0 to 1	---	1	F102	0 (Disabled)
Preferences (Read/Write Setting)						
4050	Flash Message Time	0.5 to 10	s	0.1	F001	10
4051	Default Message Timeout	10 to 900	s	1	F001	300
4052	Default Message Intensity	0 to 3	---	1	F101	0 (25 %)
Communications (Read/Write Setting)						
407E	COM1 minimum response time	0 to 1000	ms	10	F001	0
407F	COM2 minimum response time	0 to 1000	ms	10	F001	0
4080	Modbus Slave Address	1 to 254	---	1	F001	254
4083	RS485 Com1 Baud Rate	0 to 11	---	1	F112	8 (115200)
4084	RS485 Com1 Parity	0 to 2	---	1	F113	0 (None)
4085	RS485 Com2 Baud Rate	0 to 11	---	1	F112	8 (115200)
4086	RS485 Com2 Parity	0 to 2	---	1	F113	0 (None)
4087	IP Address	0 to 4294967295	---	1	F003	56554706
4089	IP Subnet Mask	0 to 4294967295	---	1	F003	4294966272
408B	Gateway IP Address	0 to 4294967295	---	1	F003	56554497
408D	Network Address NSAP	---	---	---	F074	0
4097	Default GOOSE Update Time	1 to 60	s	1	F001	60
4098	Ethernet Primary Fibre Channel Link Monitor	0 to 1	---	1	F102	0 (Disabled)
4099	Ethernet Secondary Fibre Channel Link Monitor	0 to 1	---	1	F102	0 (Disabled)
409A	DNP Port	0 to 4	---	1	F177	0 (NONE)
409B	DNP Address	0 to 65519	---	1	F001	1
409C	DNP Client Address (2 items)	0 to 4294967295	---	1	F003	0
40A0	IP port number for the Modbus protocol	1 to 65535	---	1	F001	502
40A1	IP Port Number for the DNP Protocol	1 to 65535	---	1	F001	20000
40A2	IP Port Number for the UCA/MMS Protocol	1 to 65535	---	1	F001	102
40A3	IP Port No. for the HTTP (Web Server) Protocol	1 to 65535	---	1	F001	80
40A4	Main IP Port Number for the TFTP Protocol	1 to 65535	---	1	F001	69
40A5	Data Transfer IP Port Numbers for the TFTP Protocol (zero means "automatic") (2 items)	0 to 65535	---	1	F001	0
40A7	DNP Unsolicited Responses Function	0 to 1	---	1	F102	0 (Disabled)
40A8	DNP Unsolicited Responses Timeout	0 to 60	s	1	F001	0
40A9	DNP Unsolicited Responses Max Retries	1 to 255	---	1	F001	10
40AA	DNP Unsolicited Responses Destination Address	0 to 65519	---	1	F001	1
40AB	Ethernet Operation Mode	0 to 1	---	1	F192	0 (Half-Duplex)
40AC	Communications Reserved (20 items)	0 to 1	---	1	F001	0
40C0	UCA Logical Device Name	0 to 65534	---	1	F203	"UCADevice"
Data Logger Commands (Read/Write Command)						
4170	Clear Data Logger	0 to 1	---	1	F126	0 (No)
Data Logger (Read/Write Setting)						
4180	Data Logger Rate	0 to 7	---	1	F178	1 (1 min.)
4181	Data Logger Channel Settings (16 items)	---	---	---	F600	0
Clock (Read/Write Command)						
41A0	RTC Set Time	0 to 235959	---	1	F003	0
Clock (Read/Write Setting)						
41A2	SR Date Format	0 to 4294967295	---	1	F051	0

Table B–11: MODBUS® MEMORY MAP (Sheet 7 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
41A4	SR Time Format	0 to 4294967295	---	1	F052	0
41A6	IRIG-B Signal Type	0 to 2	---	1	F114	0 (None)
Oscillography (Read/Write Setting)						
41C0	Oscillography Number of Records	1 to 64	---	1	F001	15
41C1	Oscillography Trigger Mode	0 to 1	---	1	F118	0 (Auto Overwrite)
41C2	Oscillography Trigger Position	0 to 100	%	1	F001	50
41C3	Oscillography Trigger Source	0 to 65535	---	1	F300	0
41C4	Oscillography AC Input Waveforms	0 to 4	---	1	F183	2 (16 samps./cyc)
41D0	Oscillography Analog Channel X (16 items)	0 to 65535	---	1	F600	0
4200	Oscillography Digital Channel X (63 items)	0 to 65535	---	1	F300	0
Trip and Alarm LEDs (Read/Write Setting)						
4260	Trip LED Input FlexLogic Operand	0 to 65535	---	1	F300	0
4261	Alarm LED Input FlexLogic Operand	0 to 65535	---	1	F300	0
User Programmable LEDs (Read/Write Setting) (48 modules)						
4280	FlexLogic Operand to Activate LED	0 to 65535	---	1	F300	0
4281	User LED type (latched or self-resetting)	0 to 1	---	1	F127	1 (Self-Reset)
4282	...Repeated for module number 2					
4284	...Repeated for module number 3					
4286	...Repeated for module number 4					
4288	...Repeated for module number 5					
428A	...Repeated for module number 6					
428C	...Repeated for module number 7					
428E	...Repeated for module number 8					
4290	...Repeated for module number 9					
4292	...Repeated for module number 10					
4294	...Repeated for module number 11					
4296	...Repeated for module number 12					
4298	...Repeated for module number 13					
429A	...Repeated for module number 14					
429C	...Repeated for module number 15					
429E	...Repeated for module number 16					
42A0	...Repeated for module number 17					
42A2	...Repeated for module number 18					
42A4	...Repeated for module number 19					
42A6	...Repeated for module number 20					
42A8	...Repeated for module number 21					
42AA	...Repeated for module number 22					
42AC	...Repeated for module number 23					
42AE	...Repeated for module number 24					
42B0	...Repeated for module number 25					
42B2	...Repeated for module number 26					
42B4	...Repeated for module number 27					
42B6	...Repeated for module number 28					
42B8	...Repeated for module number 29					
42BA	...Repeated for module number 30					
42BC	...Repeated for module number 31					
42BE	...Repeated for module number 32					

Table B–11: MODBUS® MEMORY MAP (Sheet 8 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
42C0	...Repeated for module number 33					
42C2	...Repeated for module number 34					
42C4	...Repeated for module number 35					
42C6	...Repeated for module number 36					
42C8	...Repeated for module number 37					
42CA	...Repeated for module number 38					
42CC	...Repeated for module number 39					
42CE	...Repeated for module number 40					
42D0	...Repeated for module number 41					
42D2	...Repeated for module number 42					
42D4	...Repeated for module number 43					
42D6	...Repeated for module number 44					
42D8	...Repeated for module number 45					
42DA	...Repeated for module number 46					
42DC	...Repeated for module number 47					
42DE	...Repeated for module number 48					
Installation (Read/Write Setting)						
43E0	Relay Programmed State	0 to 1	---	1	F133	0 (Not Progm'd)
43E1	Relay Name	---	---	---	F202	"Relay-1"
Modbus User Map (Read/Write Setting)						
4A00	Modbus Addr Settings for User Map (256 items)	0 to 65535	---	1	F001	0
User Displays Settings (Read/Write Setting) (8 modules)						
4C00	User display top line text	---	---	---	F202	" "
4C0A	User display bottom line text	---	---	---	F202	" "
4C14	Modbus addresses of displayed items (5 items)	0 to 65535	---	1	F001	0
4C19	Reserved (7 items)	---	---	---	F001	0
4C20	...Repeated for module number 2					
4C40	...Repeated for module number 3					
4C60	...Repeated for module number 4					
4C80	...Repeated for module number 5					
4CA0	...Repeated for module number 6					
4CC0	...Repeated for module number 7					
4CE0	...Repeated for module number 8					
Flexlogic (Read/Write Setting)						
5000	FlexLogic Entry (512 items)	0 to 65535	---	1	F300	16384
Flexlogic Timers (Read/Write Setting) (32 modules)						
5800	Timer x Type	0 to 2	---	1	F129	0 (millisecond)
5801	Timer x Pickup Delay	0 to 60000	---	1	F001	0
5802	Timer x Dropout Delay	0 to 60000	---	1	F001	0
5803	Timer x Reserved (5 items)	0 to 65535	---	1	F001	0
5808	...Repeated for module number 2					
5810	...Repeated for module number 3					
5818	...Repeated for module number 4					
5820	...Repeated for module number 5					
5828	...Repeated for module number 6					
5830	...Repeated for module number 7					
5838	...Repeated for module number 8					

Table B–11: MODBUS® MEMORY MAP (Sheet 9 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
5840	...Repeated for module number 9					
5848	...Repeated for module number 10					
5850	...Repeated for module number 11					
5858	...Repeated for module number 12					
5860	...Repeated for module number 13					
5868	...Repeated for module number 14					
5870	...Repeated for module number 15					
5878	...Repeated for module number 16					
5880	...Repeated for module number 17					
5888	...Repeated for module number 18					
5890	...Repeated for module number 19					
5898	...Repeated for module number 20					
58A0	...Repeated for module number 21					
58A8	...Repeated for module number 22					
58B0	...Repeated for module number 23					
58B8	...Repeated for module number 24					
58C0	...Repeated for module number 25					
58C8	...Repeated for module number 26					
58D0	...Repeated for module number 27					
58D8	...Repeated for module number 28					
58E0	...Repeated for module number 29					
58E8	...Repeated for module number 30					
58F0	...Repeated for module number 31					
58F8	...Repeated for module number 32					
DCMA Inputs (Read/Write Setting) (24 modules)						
7300	DCMA Inputs x Function	0 to 1	---	1	F102	0 (Disabled)
7301	DCMA Inputs x ID	---	---	---	F205	"DCMA Ip 1 "
7307	DCMA Inputs x Reserved 1 (4 items)	0 to 65535	---	1	F001	0
730B	DCMA Inputs x Units	---	---	---	F206	"mA"
730E	DCMA Inputs x Range	0 to 6	---	1	F173	6 (4 to 20 mA)
730F	DCMA Inputs x Minimum Value	-9999.999 to 9999.999	---	0.001	F004	4000
7311	DCMA Inputs x Maximum Value	-9999.999 to 9999.999	---	0.001	F004	20000
7313	DCMA Inputs x Reserved (5 items)	0 to 65535	---	1	F001	0
7318	...Repeated for module number 2					
7330	...Repeated for module number 3					
7348	...Repeated for module number 4					
7360	...Repeated for module number 5					
7378	...Repeated for module number 6					
7390	...Repeated for module number 7					
73A8	...Repeated for module number 8					
73C0	...Repeated for module number 9					
73D8	...Repeated for module number 10					
73F0	...Repeated for module number 11					
7408	...Repeated for module number 12					
7420	...Repeated for module number 13					
7438	...Repeated for module number 14					

Table B–11: MODBUS® MEMORY MAP (Sheet 10 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
7450	...Repeated for module number 15					
7468	...Repeated for module number 16					
7480	...Repeated for module number 17					
7498	...Repeated for module number 18					
74B0	...Repeated for module number 19					
74C8	...Repeated for module number 20					
74E0	...Repeated for module number 21					
74F8	...Repeated for module number 22					
7510	...Repeated for module number 23					
7528	...Repeated for module number 24					
RTD Inputs (Read/Write Setting) (48 modules)						
7540	RTD Inputs x Function	0 to 1	---	1	F102	0 (Disabled)
7541	RTD Inputs x ID	---	---	---	F205	"RTD Ip 1 "
7547	RTD Inputs x Reserved 1 (4 items)	0 to 65535	---	1	F001	0
754B	RTD Inputs x Type	0 to 3	---	1	F174	0 (100Ω Platinum)
754C	RTD Inputs x Reserved 2 (4 items)	0 to 65535	---	1	F001	0
7550	...Repeated for module number 2					
7560	...Repeated for module number 3					
7570	...Repeated for module number 4					
7580	...Repeated for module number 5					
7590	...Repeated for module number 6					
75A0	...Repeated for module number 7					
75B0	...Repeated for module number 8					
75C0	...Repeated for module number 9					
75D0	...Repeated for module number 10					
75E0	...Repeated for module number 11					
75F0	...Repeated for module number 12					
7600	...Repeated for module number 13					
7610	...Repeated for module number 14					
7620	...Repeated for module number 15					
7630	...Repeated for module number 16					
7640	...Repeated for module number 17					
7650	...Repeated for module number 18					
7660	...Repeated for module number 19					
7670	...Repeated for module number 20					
7680	...Repeated for module number 21					
7690	...Repeated for module number 22					
76A0	...Repeated for module number 23					
76B0	...Repeated for module number 24					
76C0	...Repeated for module number 25					
76D0	...Repeated for module number 26					
76E0	...Repeated for module number 27					
76F0	...Repeated for module number 28					
7700	...Repeated for module number 29					
7710	...Repeated for module number 30					
7720	...Repeated for module number 31					
7730	...Repeated for module number 32					

Table B–11: MODBUS® MEMORY MAP (Sheet 11 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
7740	...Repeated for module number 33					
7750	...Repeated for module number 34					
7760	...Repeated for module number 35					
7770	...Repeated for module number 36					
7780	...Repeated for module number 37					
7790	...Repeated for module number 38					
77A0	...Repeated for module number 39					
77B0	...Repeated for module number 40					
77C0	...Repeated for module number 41					
77D0	...Repeated for module number 42					
77E0	...Repeated for module number 43					
77F0	...Repeated for module number 44					
7800	...Repeated for module number 45					
7810	...Repeated for module number 46					
7820	...Repeated for module number 47					
7830	...Repeated for module number 48					
Ohm Inputs (Read/Write Setting) (2 modules)						
7840	Ohm Inputs x Function	0 to 1	---	1	F102	0 (Disabled)
7841	Ohm Inputs x ID	---	---	---	F205	"Ohm Ip 1 "
7847	Ohm Inputs x Reserved (9 items)	0 to 65535	---	1	F001	0
7850	...Repeated for module number 2					
FlexState Settings (Read/Write Setting)						
8800	FlexState Parameters (256 items)	---	---	---	F300	0
Setting Groups (Read/Write Setting)						
A000	Setting Group for Comms (0 means group 1)	0 to 7	---	1	F001	0
A001	Setting Groups Block	0 to 65535	---	1	F300	0
A002	FlexLogic Ops to Activate Groups 2 to 8 (7 items)	0 to 65535	---	1	F300	0
A009	Setting Group Function	0 to 1	---	1	F102	0 (Disabled)
A00A	Setting Group Events	0 to 1	---	1	F102	0 (Disabled)
Setting Groups (Read Only)						
A00B	Current Setting Group	0 to 7	---	1	F001	0
Digital Elements (Read/Write Setting) (16 modules)						
B000	Digital Element x Function	0 to 1	---	1	F102	0 (Disabled)
B001	Digital Element x Name	---	---	---	F203	"Dig Element 1 "
B015	Digital Element x Input	0 to 65535	---	1	F300	0
B016	Digital Element x Pickup Delay	0 to 999999.999	s	0.001	F003	0
B018	Digital Element x Reset Delay	0 to 999999.999	s	0.001	F003	0
B01A	Digital Element x Block	0 to 65535	---	1	F300	0
B01B	Digital Element x Target	0 to 2	---	1	F109	0 (Self-reset)
B01C	Digital Element x Events	0 to 1	---	1	F102	0 (Disabled)
B01D	Digital Element x Reserved (3 items)	---	---	---	F001	0
B020	...Repeated for module number 2					
B040	...Repeated for module number 3					
B060	...Repeated for module number 4					
B080	...Repeated for module number 5					
B0A0	...Repeated for module number 6					
B0C0	...Repeated for module number 7					

Table B–11: MODBUS® MEMORY MAP (Sheet 12 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
B0E0	...Repeated for module number 8					
B100	...Repeated for module number 9					
B120	...Repeated for module number 10					
B140	...Repeated for module number 11					
B160	...Repeated for module number 12					
B180	...Repeated for module number 13					
B1A0	...Repeated for module number 14					
B1C0	...Repeated for module number 15					
B1E0	...Repeated for module number 16					
Digital Counter (Read/Write Setting) (8 modules)						
B300	Digital Counter x Function	0 to 1	---	1	F102	0 (Disabled)
B301	Digital Counter x Name	---	---	---	F205	"Counter 1 "
B307	Digital Counter x Units	---	---	---	F206	(none)
B30A	Digital Counter x Block	0 to 65535	---	1	F300	0
B30B	Digital Counter x Up	0 to 65535	---	1	F300	0
B30C	Digital Counter x Down	0 to 65535	---	1	F300	0
B30D	Digital Counter x Preset	-2147483647 to 2147483647	---	1	F004	0
B30F	Digital Counter x Compare	-2147483647 to 2147483647	---	1	F004	0
B311	Digital Counter x Reset	0 to 65535	---	1	F300	0
B312	Digital Counter x Freeze/Reset	0 to 65535	---	1	F300	0
B313	Digital Counter x Freeze/Count	0 to 65535	---	1	F300	0
B314	Digital Counter Set To Preset	0 to 65535	---	1	F300	0
B315	Digital Counter x Reserved (11 items)	---	---	---	F001	0
B320	...Repeated for module number 2					
B340	...Repeated for module number 3					
B360	...Repeated for module number 4					
B380	...Repeated for module number 5					
B3A0	...Repeated for module number 6					
B3C0	...Repeated for module number 7					
B3E0	...Repeated for module number 8					
Contact Inputs (Read/Write Setting) (96 modules)						
C000	Contact Input x Name	---	---	---	F205	"Cont Ip 1 "
C006	Contact Input x Events	0 to 1	---	1	F102	0 (Disabled)
C007	Contact Input x Reserved (3 items)	---	---	---	F001	0
C00A	...Repeated for module number 2					
C014	...Repeated for module number 3					
C01E	...Repeated for module number 4					
C028	...Repeated for module number 5					
C032	...Repeated for module number 6					
C03C	...Repeated for module number 7					
C046	...Repeated for module number 8					
C050	...Repeated for module number 9					
C05A	...Repeated for module number 10					
C064	...Repeated for module number 11					
C06E	...Repeated for module number 12					
C078	...Repeated for module number 13					

Table B–11: MODBUS® MEMORY MAP (Sheet 13 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
C082	...Repeated for module number 14					
C08C	...Repeated for module number 15					
C096	...Repeated for module number 16					
C0A0	...Repeated for module number 17					
C0AA	...Repeated for module number 18					
C0B4	...Repeated for module number 19					
C0BE	...Repeated for module number 20					
C0C8	...Repeated for module number 21					
C0D2	...Repeated for module number 22					
C0DC	...Repeated for module number 23					
C0E6	...Repeated for module number 24					
C0F0	...Repeated for module number 25					
C0FA	...Repeated for module number 26					
C104	...Repeated for module number 27					
C10E	...Repeated for module number 28					
C118	...Repeated for module number 29					
C122	...Repeated for module number 30					
C12C	...Repeated for module number 31					
C136	...Repeated for module number 32					
C140	...Repeated for module number 33					
C14A	...Repeated for module number 34					
C154	...Repeated for module number 35					
C15E	...Repeated for module number 36					
C168	...Repeated for module number 37					
C172	...Repeated for module number 38					
C17C	...Repeated for module number 39					
C186	...Repeated for module number 40					
C190	...Repeated for module number 41					
C19A	...Repeated for module number 42					
C1A4	...Repeated for module number 43					
C1AE	...Repeated for module number 44					
C1B8	...Repeated for module number 45					
C1C2	...Repeated for module number 46					
C1CC	...Repeated for module number 47					
C1D6	...Repeated for module number 48					
C1E0	...Repeated for module number 49					
C1EA	...Repeated for module number 50					
C1F4	...Repeated for module number 51					
C1FE	...Repeated for module number 52					
C208	...Repeated for module number 53					
C212	...Repeated for module number 54					
C21C	...Repeated for module number 55					
C226	...Repeated for module number 56					
C230	...Repeated for module number 57					
C23A	...Repeated for module number 58					
C244	...Repeated for module number 59					
C24E	...Repeated for module number 60					

Table B–11: MODBUS® MEMORY MAP (Sheet 14 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
C258	...Repeated for module number 61					
C262	...Repeated for module number 62					
C26C	...Repeated for module number 63					
C276	...Repeated for module number 64					
C280	...Repeated for module number 65					
C28A	...Repeated for module number 66					
C294	...Repeated for module number 67					
C29E	...Repeated for module number 68					
C2A8	...Repeated for module number 69					
C2B2	...Repeated for module number 70					
C2BC	...Repeated for module number 71					
C2C6	...Repeated for module number 72					
C2D0	...Repeated for module number 73					
C2DA	...Repeated for module number 74					
C2E4	...Repeated for module number 75					
C2EE	...Repeated for module number 76					
C2F8	...Repeated for module number 77					
C302	...Repeated for module number 78					
C30C	...Repeated for module number 79					
C316	...Repeated for module number 80					
C320	...Repeated for module number 81					
C32A	...Repeated for module number 82					
C334	...Repeated for module number 83					
C33E	...Repeated for module number 84					
C348	...Repeated for module number 85					
C352	...Repeated for module number 86					
C35C	...Repeated for module number 87					
C366	...Repeated for module number 88					
C370	...Repeated for module number 89					
C37A	...Repeated for module number 90					
C384	...Repeated for module number 91					
C38E	...Repeated for module number 92					
C398	...Repeated for module number 93					
C3A2	...Repeated for module number 94					
C3AC	...Repeated for module number 95					
C3B6	...Repeated for module number 96					
Contact Input Thresholds (Read/Write Setting)						
C600	Contact Input x Threshold (24 items)	0 to 3	---	1	F128	1 (30 Vdc)
Virtual Inputs Global Settings (Read/Write Setting)						
C680	Virtual Inputs SBO Timeout	1 to 60	s	1	F001	30
Virtual Inputs (Read/Write Setting) (32 modules)						
C690	Virtual Input x Function	0 to 1	---	1	F102	0 (Disabled)
C691	Virtual Input x Name	---	---	---	F205	"Virt Ip 1 "
C69B	Virtual Input x Programmed Type	0 to 1	---	1	F127	0 (Latched)
C69C	Virtual Input x Events	0 to 1	---	1	F102	0 (Disabled)
C69D	Virtual Input x UCA SBOClass	1 to 2	---	1	F001	1
C69E	Virtual Input x UCA SBOEna	0 to 1	---	1	F102	0 (Disabled)

Table B–11: MODBUS® MEMORY MAP (Sheet 15 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
C69F	Virtual Input x Reserved	---	---	---	F001	0
C6A0	...Repeated for module number 2					
C6B0	...Repeated for module number 3					
C6C0	...Repeated for module number 4					
C6D0	...Repeated for module number 5					
C6E0	...Repeated for module number 6					
C6F0	...Repeated for module number 7					
C700	...Repeated for module number 8					
C710	...Repeated for module number 9					
C720	...Repeated for module number 10					
C730	...Repeated for module number 11					
C740	...Repeated for module number 12					
C750	...Repeated for module number 13					
C760	...Repeated for module number 14					
C770	...Repeated for module number 15					
C780	...Repeated for module number 16					
C790	...Repeated for module number 17					
C7A0	...Repeated for module number 18					
C7B0	...Repeated for module number 19					
C7C0	...Repeated for module number 20					
C7D0	...Repeated for module number 21					
C7E0	...Repeated for module number 22					
C7F0	...Repeated for module number 23					
C800	...Repeated for module number 24					
C810	...Repeated for module number 25					
C820	...Repeated for module number 26					
C830	...Repeated for module number 27					
C840	...Repeated for module number 28					
C850	...Repeated for module number 29					
C860	...Repeated for module number 30					
C870	...Repeated for module number 31					
C880	...Repeated for module number 32					
Virtual Outputs (Read/Write Setting) (64 modules)						
CC90	Virtual Output x Name	---	---	---	F205	"Virt Op 1 "
CC9A	Virtual Output x Events	0 to 1	---	1	F102	0 (Disabled)
CC9B	Virtual Output x Reserved (5 items)	---	---	---	F001	0
CCA0	...Repeated for module number 2					
CCB0	...Repeated for module number 3					
CCC0	...Repeated for module number 4					
CCD0	...Repeated for module number 5					
CCE0	...Repeated for module number 6					
CCF0	...Repeated for module number 7					
CD00	...Repeated for module number 8					
CD10	...Repeated for module number 9					
CD20	...Repeated for module number 10					
CD30	...Repeated for module number 11					
CD40	...Repeated for module number 12					

Table B–11: MODBUS® MEMORY MAP (Sheet 16 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
CD50	...Repeated for module number 13					
CD60	...Repeated for module number 14					
CD70	...Repeated for module number 15					
CD80	...Repeated for module number 16					
CD90	...Repeated for module number 17					
CDA0	...Repeated for module number 18					
CDB0	...Repeated for module number 19					
CDC0	...Repeated for module number 20					
CDD0	...Repeated for module number 21					
CDE0	...Repeated for module number 22					
CDF0	...Repeated for module number 23					
CE00	...Repeated for module number 24					
CE10	...Repeated for module number 25					
CE20	...Repeated for module number 26					
CE30	...Repeated for module number 27					
CE40	...Repeated for module number 28					
CE50	...Repeated for module number 29					
CE60	...Repeated for module number 30					
CE70	...Repeated for module number 31					
CE80	...Repeated for module number 32					
CE90	...Repeated for module number 33					
CEA0	...Repeated for module number 34					
CEB0	...Repeated for module number 35					
CEC0	...Repeated for module number 36					
CED0	...Repeated for module number 37					
CEE0	...Repeated for module number 38					
CEF0	...Repeated for module number 39					
CF00	...Repeated for module number 40					
CF10	...Repeated for module number 41					
CF20	...Repeated for module number 42					
CF30	...Repeated for module number 43					
CF40	...Repeated for module number 44					
CF50	...Repeated for module number 45					
CF60	...Repeated for module number 46					
CF70	...Repeated for module number 47					
CF80	...Repeated for module number 48					
CF90	...Repeated for module number 49					
CFA0	...Repeated for module number 50					
CFB0	...Repeated for module number 51					
CFC0	...Repeated for module number 52					
CFD0	...Repeated for module number 53					
CFE0	...Repeated for module number 54					
CFF0	...Repeated for module number 55					
D000	...Repeated for module number 56					
D010	...Repeated for module number 57					
D020	...Repeated for module number 58					
D030	...Repeated for module number 59					

Table B–11: MODBUS® MEMORY MAP (Sheet 17 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
D040	...Repeated for module number 60					
D050	...Repeated for module number 61					
D060	...Repeated for module number 62					
D070	...Repeated for module number 63					
D080	...Repeated for module number 64					
Mandatory (Read/Write Setting)						
D280	Test Mode Function	0 to 1	---	1	F102	0 (Disabled)
Contact Outputs (Read/Write Setting) (64 modules)						
D290	Contact Output x Name	---	---	---	F205	"Cont Op 1 "
D29A	Contact Output x Operation	0 to 65535	---	1	F300	0
D29B	Contact Output x Seal In	0 to 65535	---	1	F300	0
D29C	Reserved	---	---	1	F001	0
D29D	Contact Output x Events	0 to 1	---	1	F102	1 (Enabled)
D29E	Reserved (2 items)	---	---	---	F001	0
D2A0	...Repeated for module number 2					
D2B0	...Repeated for module number 3					
D2C0	...Repeated for module number 4					
D2D0	...Repeated for module number 5					
D2E0	...Repeated for module number 6					
D2F0	...Repeated for module number 7					
D300	...Repeated for module number 8					
D310	...Repeated for module number 9					
D320	...Repeated for module number 10					
D330	...Repeated for module number 11					
D340	...Repeated for module number 12					
D350	...Repeated for module number 13					
D360	...Repeated for module number 14					
D370	...Repeated for module number 15					
D380	...Repeated for module number 16					
D390	...Repeated for module number 17					
D3A0	...Repeated for module number 18					
D3B0	...Repeated for module number 19					
D3C0	...Repeated for module number 20					
D3D0	...Repeated for module number 21					
D3E0	...Repeated for module number 22					
D3F0	...Repeated for module number 23					
D400	...Repeated for module number 24					
D410	...Repeated for module number 25					
D420	...Repeated for module number 26					
D430	...Repeated for module number 27					
D440	...Repeated for module number 28					
D450	...Repeated for module number 29					
D460	...Repeated for module number 30					
D470	...Repeated for module number 31					
D480	...Repeated for module number 32					
D490	...Repeated for module number 33					
D4A0	...Repeated for module number 34					

Table B–11: MODBUS® MEMORY MAP (Sheet 18 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
D4B0	...Repeated for module number 35					
D4C0	...Repeated for module number 36					
D4D0	...Repeated for module number 37					
D4E0	...Repeated for module number 38					
D4F0	...Repeated for module number 39					
D500	...Repeated for module number 40					
D510	...Repeated for module number 41					
D520	...Repeated for module number 42					
D530	...Repeated for module number 43					
D540	...Repeated for module number 44					
D550	...Repeated for module number 45					
D560	...Repeated for module number 46					
D570	...Repeated for module number 47					
D580	...Repeated for module number 48					
D590	...Repeated for module number 49					
D5A0	...Repeated for module number 50					
D5B0	...Repeated for module number 51					
D5C0	...Repeated for module number 52					
D5D0	...Repeated for module number 53					
D5E0	...Repeated for module number 54					
D5F0	...Repeated for module number 55					
D600	...Repeated for module number 56					
D610	...Repeated for module number 57					
D620	...Repeated for module number 58					
D630	...Repeated for module number 59					
D640	...Repeated for module number 60					
D650	...Repeated for module number 61					
D660	...Repeated for module number 62					
D670	...Repeated for module number 63					
D680	...Repeated for module number 64					
Reset (Read/Write Setting)						
D800	FlexLogic operand which initiates a reset	0 to 65535	---	1	F300	0
Force Contact Inputs (Read/Write Setting)						
D8B0	Force Contact Input x State (96 items)	0 to 2	---	1	F144	0 (Disabled)
Force Contact Outputs (Read/Write Setting)						
D910	Force Contact Output x State (64 items)	0 to 3	---	1	F131	0 (Disabled)
Remote Devices (Read/Write Setting) (16 modules)						
E000	Remote Device x ID	---	---	---	F202	"Remote Device 1 "
E00A	...Repeated for module number 2					
E014	...Repeated for module number 3					
E01E	...Repeated for module number 4					
E028	...Repeated for module number 5					
E032	...Repeated for module number 6					
E03C	...Repeated for module number 7					
E046	...Repeated for module number 8					
E050	...Repeated for module number 9					
E05A	...Repeated for module number 10					

Table B–11: MODBUS® MEMORY MAP (Sheet 19 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
E064	...Repeated for module number 11					
E06E	...Repeated for module number 12					
E078	...Repeated for module number 13					
E082	...Repeated for module number 14					
E08C	...Repeated for module number 15					
E096	...Repeated for module number 16					
Remote Inputs (Read/Write Setting) (32 modules)						
E100	Remote Input x Device	1 to 16	---	1	F001	1
E101	Remote Input x Bit Pair	0 to 64	---	1	F156	0 (None)
E102	Remote Input x Default State	0 to 1	---	1	F108	0 (Off)
E103	Remote Input x Events	0 to 1	---	1	F102	0 (Disabled)
E104	...Repeated for module number 2					
E108	...Repeated for module number 3					
E10C	...Repeated for module number 4					
E110	...Repeated for module number 5					
E114	...Repeated for module number 6					
E118	...Repeated for module number 7					
E11C	...Repeated for module number 8					
E120	...Repeated for module number 9					
E124	...Repeated for module number 10					
E128	...Repeated for module number 11					
E12C	...Repeated for module number 12					
E130	...Repeated for module number 13					
E134	...Repeated for module number 14					
E138	...Repeated for module number 15					
E13C	...Repeated for module number 16					
E140	...Repeated for module number 17					
E144	...Repeated for module number 18					
E148	...Repeated for module number 19					
E14C	...Repeated for module number 20					
E150	...Repeated for module number 21					
E154	...Repeated for module number 22					
E158	...Repeated for module number 23					
E15C	...Repeated for module number 24					
E160	...Repeated for module number 25					
E164	...Repeated for module number 26					
E168	...Repeated for module number 27					
E16C	...Repeated for module number 28					
E170	...Repeated for module number 29					
E174	...Repeated for module number 30					
E178	...Repeated for module number 31					
E17C	...Repeated for module number 32					
Remote Output DNA Pairs (Read/Write Setting) (32 modules)						
E600	Remote Output DNA x Operand	0 to 65535	---	1	F300	0
E601	Remote Output DNA x Events	0 to 1	---	1	F102	0 (Disabled)
E602	Remote Output DNA x Reserved (2 items)	0 to 1	---	1	F001	0
E604	...Repeated for module number 2					

Table B–11: MODBUS® MEMORY MAP (Sheet 20 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
E608	...Repeated for module number 3					
E60C	...Repeated for module number 4					
E610	...Repeated for module number 5					
E614	...Repeated for module number 6					
E618	...Repeated for module number 7					
E61C	...Repeated for module number 8					
E620	...Repeated for module number 9					
E624	...Repeated for module number 10					
E628	...Repeated for module number 11					
E62C	...Repeated for module number 12					
E630	...Repeated for module number 13					
E634	...Repeated for module number 14					
E638	...Repeated for module number 15					
E63C	...Repeated for module number 16					
E640	...Repeated for module number 17					
E644	...Repeated for module number 18					
E648	...Repeated for module number 19					
E64C	...Repeated for module number 20					
E650	...Repeated for module number 21					
E654	...Repeated for module number 22					
E658	...Repeated for module number 23					
E65C	...Repeated for module number 24					
E660	...Repeated for module number 25					
E664	...Repeated for module number 26					
E668	...Repeated for module number 27					
E66C	...Repeated for module number 28					
E670	...Repeated for module number 29					
E674	...Repeated for module number 30					
E678	...Repeated for module number 31					
E67C	...Repeated for module number 32					
Remote Output UserSt Pairs (Read/Write Setting) (32 modules)						
E680	Remote Output UserSt x Operand	0 to 65535	---	1	F300	0
E681	Remote Output UserSt x Events	0 to 1	---	1	F102	0 (Disabled)
E682	Remote Output UserSt x Reserved (2 items)	0 to 1	---	1	F001	0
E684	...Repeated for module number 2					
E688	...Repeated for module number 3					
E68C	...Repeated for module number 4					
E690	...Repeated for module number 5					
E694	...Repeated for module number 6					
E698	...Repeated for module number 7					
E69C	...Repeated for module number 8					
E6A0	...Repeated for module number 9					
E6A4	...Repeated for module number 10					
E6A8	...Repeated for module number 11					
E6AC	...Repeated for module number 12					
E6B0	...Repeated for module number 13					
E6B4	...Repeated for module number 14					

Table B–11: MODBUS® MEMORY MAP (Sheet 21 of 21)

ADDR	REGISTER NAME	RANGE	UNITS	STEP	FORMAT	DEFAULT
E6B8	...Repeated for module number 15					
E6BC	...Repeated for module number 16					
E6C0	...Repeated for module number 17					
E6C4	...Repeated for module number 18					
E6C8	...Repeated for module number 19					
E6CC	...Repeated for module number 20					
E6D0	...Repeated for module number 21					
E6D4	...Repeated for module number 22					
E6D8	...Repeated for module number 23					
E6DC	...Repeated for module number 24					
E6E0	...Repeated for module number 25					
E6E4	...Repeated for module number 26					
E6E8	...Repeated for module number 27					
E6EC	...Repeated for module number 28					
E6F0	...Repeated for module number 29					
E6F4	...Repeated for module number 30					
E6F8	...Repeated for module number 31					
E6FC	...Repeated for module number 32					

C.1.1 UCA

The **Utility Communications Architecture** (UCA) version 2 represents an attempt by utilities and vendors of electronic equipment to produce standardized communications systems. There is a set of reference documents available from the Electric Power Research Institute (EPRI) and vendors of UCA/MMS software libraries that describe the complete capabilities of the UCA. Following, is a description of the subset of UCA/MMS features that are supported by the UR relay. The reference document set includes:

- Introduction to UCA version 2
- Generic Object Models for Substation & Feeder Equipment (GOMSFE)
- Common Application Service Models (CASM) and Mapping to MMS
- UCA Version 2 Profiles

These documents can be obtained from ftp://www.sisconet.com/epri/subdemo/uca2.0. It is strongly recommended that all those involved with any UCA implementation obtain this document set.

COMMUNICATION PROFILES:

The UCA specifies a number of possibilities for communicating with electronic devices based on the OSI Reference Model. The UR relay uses the seven layer OSI stack (TP4/CLNP and TCP/IP profiles). Refer to the "UCA Version 2 Profiles" reference document for details.

The TP4/CLNP profile requires the UR relay to have a network address or Network Service Access Point (NSAP) in order to establish a communication link. The TCP/IP profile requires the UR relay to have an IP address in order to establish a communication link. These addresses can be set in the COMMUNICATIONS \ NETWORK submenu of the SETTINGS \ PRODUCT SETUP menu. Note that the UR relay supports UCA operation over the TP4/CLNP or the TCP/IP stacks and also supports operation over both stacks simultaneously. It is possible to have up to two simultaneous connections. This is in addition to DNP and Modbus/TCP (non-UCA) connections.

C.1.2 MMS

The UCA specifies the use of the **Manufacturing Message Specification** (MMS) at the upper (Application) layer for transfer of real-time data. This protocol has been in existence for a number of years and provides a set of services suitable for the transfer of data within a substation LAN environment. Data can be grouped to form objects and be mapped to MMS services. Refer to the “GOMSFE” and “CASM” reference documents for details.

SUPPORTED OBJECTS:

The "GOMSFE" document describes a number of communication objects. Within these objects are items, some of which are mandatory and some of which are optional, depending on the implementation. The UR relay supports the following GOMSFE objects:

• DI (device identity)	• PHIZ (high impedance ground detector)
• GCTL (generic control)	• PIOC (instantaneous overcurrent relay)
• GIND (generic indicator)	• POVR (overvoltage relay)
• GLOBE (global data)	• PTOC (time overcurrent relay)
• MMXU (polyphase measurement unit)	• PUVR (under voltage relay)
• PBRL (phase balance current relay)	• PVPH (volts per hertz relay)
• PBRO (basic relay object)	• ctRATO (CT ratio information)
• PDIF (differential relay)	• vtRATO (VT ratio information)
• PDIS (distance)	• RREC (reclosing relay)
• PDOC (directional overcurrent)	• RSYN (synchronizing or synchronism-check relay)
• PFRQ (frequency relay)	• XCBR (circuit breaker)

UCA data can be accessed through the "UCADevice" MMS domain.

PEER-TO-PEER COMMUNICATION:

Peer-to-peer communication of digital state information, using the UCA GOOSE data object, is supported via the use of the UR Remote Inputs/Outputs feature. This feature allows digital points to be transferred between any UCA conforming devices.

FILE SERVICES:

MMS file services are supported to allow transfer of Oscillography, Event Record, or other files from a UR relay.

COMMUNICATION SOFTWARE UTILITIES:

The exact structure and values of the implemented objects implemented can be seen by connecting to a UR relay with an MMS browser, such as the “MMS Object Explorer and AXS4-MMS DDE/OPC” server from Sisco Inc.

NON-UCA DATA:

The UR relay makes available a number of non-UCA data items. These data items can be accessed through the "UR" MMS domain. UCA data can be accessed through the "UCADevice" MMS domain.

a) PROTOCOL IMPLEMENTATION AND CONFORMANCE STATEMENT (PICS)

NOTE

The UR relay functions as a server only; a UR relay cannot be configured as a client. Thus, the following list of supported services is for server operation only:

The MMS supported services are as follows:

CONNECTION MANAGEMENT SERVICES:

- Initiate
- Conclude
- Cancel
- Abort
- Reject

VMD SUPPORT SERVICES:

- Status
- GetNameList
- Identify

VARIABLE ACCESS SERVICES:

- Read
- Write
- InformationReport
- GetVariableAccessAttributes
- GetNamedVariableListAttributes

OPERATOR COMMUNICATION SERVICES:

(none)

SEMAPHORE MANAGEMENT SERVICES:

(none)

DOMAIN MANAGEMENT SERVICES:

- GetDomainAttributes

PROGRAM INVOCATION MANAGEMENT SERVICES:

(none)

EVENT MANAGEMENT SERVICES

(none)

JOURNAL MANAGEMENT SERVICES

(none)

FILE MANAGEMENT SERVICES

- ObtainFile
- FileOpen
- FileRead
- FileClose
- FileDirectory

The following MMS parameters are supported:

- STR1 (Arrays)
- STR2 (Structures)
- NEST (Nesting Levels of STR1 and STR2) - 1
- VNAM (Named Variables)
- VADR (Unnamed Variables)
- VALT (Alternate Access Variables)
- VLIS (Named Variable Lists)
- REAL (ASN.1 REAL Type)

b) MODEL IMPLEMENTATION CONFORMANCE (MIC)

This section provides details of the UCA object models supported by the UR relay. Note that not all of the protective device functions are applicable to all UR relays.

Table C–1: DEVICE IDENTITY – DI

NAME	M/O	RWEC
Name	m	rw
Class	o	rw
d	o	rw
Own	o	rw
Loc	o	rw
VndID	m	r
CommID	o	rw

Table C–2: GENERIC CONTROL – GCTL

FC	NAME	CLASS	RWECS	DESCRIPTION
ST	BO<n>	SI	rw	Generic Single Point Indication
CO	BO<n>	SI	rw	Generic Binary Output
CF	BO<n>	SBOCF	rw	SBO Configuration
DC	LN	d	rw	Description for brick
	BO<n>	d	rw	Description for each point

NOTE

Actual instantiation of GCTL objects is as follows:

GCTL1 = Virtual Inputs (32 total points – SI1 to SI32); includes SBO functionality.

Table C–3: GENERIC INDICATOR – GIND

FC	NAME	CLASS	RWECS	DESCRIPTION
ST	SIG<n>	SIG	r	Generic Indication (block of 16)
DC	LN	d	rw	Description for brick
RP	BrcbST	BasRCB	rw	Controls reporting of STATUS

NOTE

Actual instantiation of GIND objects is as follows:

GIND1 = Contact Inputs (96 total points – SIG1 to SIG6)
GIND2 = Contact Outputs (64 total points – SIG1 to SIG4)
GIND3 = Virtual Inputs (32 total points – SIG1 to SIG2)
GIND4 = Virtual Outputs (64 total points – SIG1 to SIG4)
GIND5 = Remote Inputs (32 total points – SIG1 to SIG2)
GIND6 = Flexstates (16 total points – SIG1 representing Flexstates 1 to 16)

Table C–4: GLOBAL DATA – GLOBE

FC	OBJECT NAME	CLASS	RWECS	DESCRIPTION
ST	ModeDS	SIT	r	Device is: in test, off-line, available, or unhealthy
	LocRemDS	SIT	r	The mode of control, local or remote (DevST)
	ActSG	INT8U	r	Active Settings Group
	EditSG	INT8u	r	Settings Group selected for read/write operation
CO	CopySG	INT8U	w	Selects Settings Group for read/writer operation
	IndRs	BOOL	w	Resets ALL targets
CF	ClockTOD	BTIME	rw	Date and time
RP	GOOSE	PACT	rw	Reports IED Inputs and Ouputs

Table C–5: MEASUREMENT UNIT (POLYPHASE) – MMXU

OBJECT NAME	CLASS	RWECS	DESCRIPTION
V	WYE	rw	Voltage on phase A, B, C to G
PPV	DELTA	rw	Voltage on AB, BC, CA
A	WYE	rw	Current in phase A, B, C, and N
W	WYE	rw	Watts in phase A, B, C
TotW	AI	rw	Total watts in all three phases
Var	WYE	rw	Vars in phase A, B, C
TotVar	AI	rw	Total vars in all three phases
VA	WYE	rw	VA in phase A, B, C
TotVA	AI	rw	Total VA in all 3 phases
PF	WYE	rw	Power Factor for phase A, B, C
AvgPF	AI	rw	Average Power Factor for all three phases
Hz	AI	rw	Power system frequency
All MMXU.MX	ACF	rw	Configuration of ALL included MMXU.MX
LN	d	rw	Description for brick
All MMXU.MX	d	rw	Description of ALL included MMXU.MX
BrcbMX	BasRCB	rw	Controls reporting of measurements

NOTE

Actual instantiation of MMXU objects is as follows:

1 MMXU per Source (as determined from the ‘product order code’)

Table C–6: PROTECTIVE ELEMENTS

FC	OBJECT NAME	CLASS	RWECS	DESCRIPTION
ST	Out	BOOL	r	1 = Element operated, 2 = Element not operated
	Tar	PhsTar	r	Targets since last reset
	FctDS	SIT	r	Function is enabled/disabled
	PuGrp	INT8U	r	Settings group selected for use
CO	EnaDisFct	DCO	w	1 = Element function enabled, 0 = disabled
	RsTar	BO	w	Reset ALL Elements/Targets
	RsLat	BO	w	Reset ALL Elements/Targets
DC	LN	d	rw	Description for brick
	ElementSt	d	r	Element state string

The following GOMSFE objects are defined by the object model described via the above table:

- PBRO (basic relay object)
- PDIF (differential relay)
- PDIS (distance)
- PDOC (directional overcurrent)
- PFRQ (frequency relay)
- PHIZ (high impedance ground detector)
- PIOC (instantaneous overcurrent relay)
- POVR (over voltage relay)
- PTOC (time overcurrent relay)
- PUVR (under voltage relay)
- RSYN (synchronizing or synchronism-check relay)
- POVR (overvoltage)
- PVPH (volts per hertz relay)
- PBRL (phase balance current relay)

NOTE

Actual instantiation of these objects is determined by the number of the corresponding elements present in the UR as per the ‘product order code’.

Table C–7: CT RATIO INFORMATION – ctRATO

OBJECT NAME	CLASS	RWECS	DESCRIPTION
PhsARat	RATIO	rw	Primary/secondary winding ratio
NeutARat	RATIO	rw	Primary/secondary winding ratio
LN	d	rw	Description for brick

NOTE

Actual instantiation of ctRATO objects is as follows:

1 ctRATO per Source (as determined from the ‘product order code’).

Table C–8: VT RATIO INFORMATION – vtRATO

OBJECT NAME	CLASS	RWECS	DESCRIPTION
PhsVRat	RATIO	rw	Primary/secondary winding ratio
LN	d	rw	Description for brick

NOTE

Actual instantiation of vtRATO objects is as follows:

1 vtRATO per Source (as determined from the ‘product order code’).

Table C–9: RECLOSING RELAY – RREC

FC	OBJECT NAME	CLASS	RWECS	DESCRIPTION
ST	Out	BOOL	r	1 = Element operated, 2 = Element not operated
	FctDS	SIT	r	Function is enabled/disabled
	PuGrp	INT8U	r	Settings group selected for use
SG	ReclSeq	SHOTS	rw	Reclosing Sequence
CO	EnaDisFct	DCO	w	1 = Element function enabled, 0 = disabled
	RsTar	BO	w	Reset ALL Elements/Targets
	RsLat	BO	w	Reset ALL Elements/Targets
CF	ReclSeq	ACF	rw	Configuration for RREC.SG
DC	LN	d	rw	Description for brick
	ElementSt	d	r	Element state string

NOTE

Actual instantiation of RREC objects is determined by the number of autoreclose elements present in the UR as per the ‘product order code’.

Also note that the SHOTS class data (i.e. Tmr1, Tmr2, Tmr3, Tmr4, RsTmr) is specified to be of type INT16S (16 bit signed integer); this data type is not large enough to properly display the full range of these settings from the UR. Numbers larger than 32768 will be displayed incorrectly.

c) UCA REPORTING

A built-in TCP/IP connection timeout of two minutes is employed by the UR to detect "dead" connections. If there is no data traffic on a TCP connection for greater than two minutes, the connection will be aborted by the UR. This frees up the connection to be used by other clients. Therefore, when using UCA reporting, clients should configure BasRCB objects such that an integrity report will be issued at least every 2 minutes (120000 ms). This ensures that the UR will not abort the connection. If other MMS data is being polled on the same connection at least once every 2 minutes, this timeout will not apply.

Table D–1: UR PRODUCT STANDARD ABBREVIATIONS (Sheet 1 of 7)

ABBREVIATION	MEANING
A	ampere
AC	alternating current
A/D	analog to digital
AE	accidental energization
AE	application entity
AMP	ampere
ANSI	american national standards institute
AR	automatic reclosure
AUTO	automatic
AUX	auxiliary
AVG	average
BER	bit error rate
BF	breaker fail
BFI	breaker failure initiate
BKR	breaker
BLK	block
BLKG	blocking
BPNT	breakpoint of a characteristic
CAP	capacitor
CC	coupling capacitor
CCVT	coupling capacitor voltage transformer
CFG	configure / configurable
.CFG	file name extension for oscillography files
CHK	check
CHNL	channel
CLS	close
CLSD	closed
CMND	command
CMPRSN	comparison
CO	contact output
COM	communication
COMM	communications
COMP	compensated
CONN	connection
CO-ORD	coordination
CPU	central processing unit
CRT, CRNT	current

Table D–1: UR PRODUCT STANDARD ABBREVIATIONS (Sheet 2 of 7)

ABBREVIATION	MEANING
CT	current transformer
CVT	capacitive voltage transformer
D/A	digital to analog
DC (dc)	direct current
DD	disturbance detector
DFLT	default
DGNST	diagnostics
DI	digital input
DIFF	differential
DIR	directional
DISCREP	discrepancy
DIST	distance
DMD	demand
DPO	dropout
DSP	digital signal processor
DTT	direct transfer trip
DUTT	direct under-reaching transfer trip
EPRI	Electric Power Research Institute
.EVT	file name extension for event recorder files
EXT	extension
F	field
FAIL	failure
FD	fault detector
FDH	fault detector high-set
FDL	fault detector low-set
FLA	full load current
FO	fiber optic
FREQ	frequency
FSK	frequency-shift keying
FWD	forward
G	generator
GE	General Electric
GND	ground
GNTR	generator
GOOSE	general object oriented substation event
HARM	harmonic / harmonics
HGF	high-impedance ground fault (CT)

Table D–1: UR PRODUCT STANDARD ABBREVIATIONS (Sheet 3 of 7)

ABBREVIATION	MEANING
HIZ	high-impedance & arcing ground
HMI	human-machine interface
HYB	hybrid
I	instantaneous
I_0	zero sequence current
I_1	positive sequence current
I_2	negative sequence current
IA	phase A current
IAB	phase A minus B current
IB	phase B current
IBC	phase B minus C current
IC	phase C current
ICA	phase C minus A current
ID	identification
IEEE	Institute of Electrical & Electronic Engineers
IG	ground (not residual) current
Igd	differential ground current
IN	CT residual current (3Io) or input
INC SEQ	incomplete sequence
INIT	initiate
INST	instantaneous
INV	inverse
I/O	input/output
IOC	instantaneous overcurrent
IOV	instantaneous overvoltage
IRIG	inter-range instrumentation group
IUV	instantaneous undervoltage
K0	zero sequence current compensation
kA	kiloAmpere
kV	kiloVolt
LED	light emitting diode
LEO	line end open
LOOP	loopback
LPU	line pickup
LRA	locked-rotor current
LTC	load tap-changer
M	machine

Table D–1: UR PRODUCT STANDARD ABBREVIATIONS (Sheet 4 of 7)

ABBREVIATION	MEANING
mA	milliAmpere
MAN	manual / manually
MMI	man machine interface
MMS	Manufacturing Message Specification
MSG	message
MTA	maximum torque angle
MTR	motor
MVA	MegaVolt-Ampere (total 3-phase)
MVA_A	MegaVolt-Ampere (phase A)
MVA_B	MegaVolt-Ampere (phase B)
MVA_C	MegaVolt-Ampere (phase C)
MVAR	MegaVar (total 3-phase)
MVAR_A	MegaVar (phase A)
MVAR_B	MegaVar (phase B)
MVAR_C	MegaVar (phase C)
MVARH	MegaVar-Hour
MW	MegaWatt (total 3-phase)
MW_A	MegaWatt (phase A)
MW_B	MegaWatt (phase B)
MW_C	MegaWatt (phase C)
MWH	MegaWatt-Hour
N	neutral
N/A, n/a	not applicable
NEG	negative
NMPLT	nameplate
NOM	nominal
NTR	neutral
O	over
OC, O/C	overcurrent
O/P, Op	output
OP	operate
OPER	operate
OPERATG	operating
O/S	operating system
OSB	out-of-step blocking
OUT	output
OV	overvoltage
OVERFREQ	overfrequency

Table D–1: UR PRODUCT STANDARD ABBREVIATIONS (Sheet 5 of 7)

ABBREVIATION	MEANING
OVLD	overload
P	phase
PC	phase comparison, personal computer
PCNT	percent
PF	power factor (total 3-phase)
PF_A	power factor (phase A)
PF_B	power factor (phase B)
PF_C	power factor (phase C)
PHS	phase
PKP	pickup
PLC	power line carrier
POS	positive
POTT	permissive over-reaching transfer trip
PRESS	pressure
PROT	protection
PSEL	presentation selector
pu	per unit
PUIB	pickup current block
PUIT	pickup current trip
PUTT	permissive under-reaching transfer trip
PWM	pulse width modulated
PWR	power
R	rate, reverse
REM	remote
REV	reverse
RI	reclose initiate
RIP	reclose in progress
ROD	remote open detector
RST	reset
RSTR	restrained
RTD	resistance temperature detector
RTU	remote terminal unit
RX (Rx)	receive, receiver
s	second
S	sensitive
SAT	CT saturation
SBO	select before operate
SEL	select / selector / selection

Table D–1: UR PRODUCT STANDARD ABBREVIATIONS (Sheet 6 of 7)

ABBREVIATION	MEANING
SENS	sensitive
SEQ	sequence
SIR	source impedance ratio
SRC	source
SSB	single side band
SSEL	session selector
STATS	statistics
SUPN	supervision
SUPV	supervise / supervision
SV	supervision
SYNCHCHK	synchrocheck
T	time, transformer
TC	thermal capacity
TD MULT	time dial multiplier
TEMP	temperature
THD	total harmonic distortion
TOC	time overcurrent
TOV	time overvoltage
TRANS	transient
TRANSF	transfer
TSEL	transport selector
TUC	time undercurrent
TUV	time undervoltage
TX (Tx)	transmit, transmitter
U	under
UC	undercurrent
UCA	Utility Communications Architecture
UNBAL	unbalance
UR	universal relay
.URS	file name extension for settings files
UV	undervoltage
V/Hz	Volts per Hertz
V_0	zero sequence voltage
V_1	positive sequence voltage
V_2	negative sequence voltage
VA	phase A voltage
VAB	phase A to B voltage
VAG	phase A to ground voltage

Table D–1: UR PRODUCT STANDARD ABBREVIATIONS (Sheet 7 of 7)

ABBREVIATION	MEANING
VARH	var-hour voltage
VB	phase B voltage
VBA	phase B to A voltage
VBG	phase B to ground voltage
VC	phase C voltage
VCA	phase C to A voltage
VCG	phase C to ground voltage
VF	variable frequency
VIBR	vibration
VT	voltage transformer
VTFF	voltage transformer fuse failure
VTLOS	voltage transformer loss of signal
WDG	winding
WH	Watt-hour
w/ opt	with option
WRT	with respect to
X	reactance
XDUCER	transducer
XFMR	transformer
Z	impedance

D

E.1.1 DNP V3.00 DEVICE PROFILE

The following table provides a "Device Profile Document" in the standard format defined in the DNP 3.0 Subset Definitions Document.

Table E–1: DNP V3.00 DEVICE PROFILE (Sheet 1 of 3)

(Also see the IMPLEMENTATION TABLE in the following section)	
Vendor Name: **General Electric Power Management**	
Device Name: **UR Series Relay**	
Highest DNP Level Supported: For Requests: **Level 2** For Responses: **Level 2**	**Device Function:** ☐ Master ☒ **Slave**
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table): **Binary Inputs (Object 1)** **Binary Input Changes (Object 2)** **Binary Outputs (Object 10)** **Binary Counters (Object 20)** **Frozen Counters (Object 21)** **Counter Change Event (Object 22)** **Frozen Counter Event (Object 23)** **Analog Inputs (Object 30)** **Analog Input Changes (Object 32)** **Analog Deadbands (Object 34)**	
Maximum Data Link Frame Size (octets): Transmitted: **292** Received: **292**	**Maximum Application Fragment Size (octets):** Transmitted: **240** Received: **2048**
Maximum Data Link Re-tries: ☐ **None** ☒ Fixed at 2 ☐ Configurable	**Maximum Application Layer Re-tries:** ☒ None ☐ Configurable
Requires Data Link Layer Confirmation: ☒ Never ☐ Always ☐ Sometimes ☐ Configurable	

Table E–1: DNP V3.00 DEVICE PROFILE (Sheet 2 of 3)

Requires Application Layer Confirmation:

- ☐ Never
- ☐ Always
- ☒ When reporting Event Data
- ☒ When sending multi-fragment responses
- ☐ Sometimes
- ☐ Configurable

Timeouts while waiting for:

Data Link Confirm:	☐ None	☒ **Fixed at 3 s**	☐ Variable	☐ Configurable
Complete Appl. Fragment:	☒ **None**	☐ Fixed at ____	☐ Variable	☐ Configurable
Application Confirm:	☐ None	☒ **Fixed at 10 s**	☐ Variable	☐ Configurable
Complete Appl. Response:	☒ **None**	☐ Fixed at ____	☐ Variable	☐ Configurable

Others:

Transmission Delay:	**No intentional delay**
Inter-character Timeout:	**50 ms**
Need Time Delay:	**24 hours**
Select/Operate Arm Timeout:	**10 s**
Binary input change scanning period:	**8 times per power system cycle**
Packed binary change process period:	**1 s**
Analog input change scanning period:	**500 ms**
Counter change scanning period:	**500 ms**
Frozen counter event scanning period:	**500 ms**
Unsolicited response notification delay:	**500 ms**
Unsolicited response retry delay	**configurable 0 to 60 sec.**

Sends/Executes Control Operations:

WRITE Binary Outputs	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
SELECT/OPERATE	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable
DIRECT OPERATE	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable
DIRECT OPERATE – NO ACK	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable

Count > 1	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
Pulse On	☐ Never	☐ Always	☒ **Sometimes**	☐ Configurable
Pulse Off	☐ Never	☐ Always	☒ **Sometimes**	☐ Configurable
Latch On	☐ Never	☐ Always	☒ **Sometimes**	☐ Configurable
Latch Off	☐ Never	☐ Always	☒ **Sometimes**	☐ Configurable

Queue	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable

Explanation of 'Sometimes': Object 12 points are mapped to UR Virtual Inputs. The persistence of Virtual Inputs is determined by the VIRTUAL INPUT X TYPE settings in the UR. Both "Pulse On" and "Latch On" operations perform the same function in the UR; that is, the appropriate Virtual Input is put into the "ON" state. If the Virtual Input is set to SELF-RESET, it will reset after one pass of FlexLogic™. The On/Off times and Count value are ignored.

Table E–1: DNP V3.00 DEVICE PROFILE (Sheet 3 of 3)

Reports Binary Input Change Events when no specific variation requested: ❒ Never ☒ **Only time-tagged** ❒ Only non-time-tagged ❒ Configurable	**Reports time-tagged Binary Input Change Events when no specific variation requested:** ❒ Never ☒ Binary Input Change With Time ❒ Binary Input Change With Relative Time ❒ Configurable (attach explanation)
Sends Unsolicited Responses: ❒ **Never** ☒ Configurable ❒ Only certain objects ❒ Sometimes (attach explanation) ☒ ENABLE/DISABLE unsolicited Function codes supported	**Sends Static Data in Unsolicited Responses:** ☒ Never ❒ When Device Restarts ❒ When Status Flags Change No other options are permitted.
Default Counter Object/Variation: ❒ No Counters Reported ❒ Configurable (attach explanation) ☒ **Default Object: 20** **Default Variation: 1** ☒ **Point-by-point list attached**	**Counters Roll Over at:** ❒ No Counters Reported ❒ Configurable (attach explanation) ☒ **16 Bits (Counter 8)** ☒ **32 Bits (Counters 0 to 7, 9)** ❒ Other Value: _____ ☒ **Point-by-point list attached**
Sends Multi-Fragment Responses: ☒ **Yes** ❒ No	

E.2.1 IMPLEMENTATION TABLE

The following table identifies the variations, function codes, and qualifiers supported by the UR in both request messages and in response messages.

For static (non-change-event) objects, requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests sent with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event objects, qualifiers 17 or 28 are always responded.

Table E–2: IMPLEMENTATION TABLE (Sheet 1 of 4)

OBJECT			REQUEST		RESPONSE	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
1	0	Binary Input (Variation 0 is used to request default variation)	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
	1	Binary Input	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	2	Binary Input with Status *(default – see Note 1)*	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
2	0	Binary Input Change (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
	1	Binary Input Change without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp.)	17, 28 (index)
	2	Binary Input Change with Time *(default – see Note 1)*	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response 130 (unsol. resp.)	17, 28 (index)
10	0	Binary Output Status (Variation 0 is used to request default variation)	1 (read)	00, 01(start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
	2	Binary Output Status *(default – see Note 1)*	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
12	1	Control Relay Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)	129 (response)	echo of request

Table E–2: IMPLEMENTATION TABLE (Sheet 2 of 4)

OBJECT			REQUEST		RESPONSE	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
20	0	Binary Counter (Variation 0 is used to request default variation)	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01(start-stop) 06(no range, or all) 07, 08(limited qty) 17, 28(index)		
	1	32-Bit Binary Counter *(default – see Note 1)*	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	2	16-Bit Binary Counter	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	5	32-Bit Binary Counter without Flag	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	6	16-Bit Binary Counter without Flag	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
21	0	Frozen Counter (Variation 0 is used to request default variation)	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
	1	32-Bit Frozen Counter *(default – see Note 1)*	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	2	16-Bit Frozen Counter	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	9	32-Bit Frozen Counter without Flag	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	10	16-Bit Frozen Counter without Flag	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
22	0	Counter Change Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
	1	32-Bit Counter Change Event *(default – see Note 1)*	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp.)	17, 28 (index)
	5	32-Bit Counter Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp.)	17, 28 (index)

Table E–2: IMPLEMENTATION TABLE (Sheet 3 of 4)

OBJECT			REQUEST		RESPONSE	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
23	0	Frozen Counter Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
	1	32-Bit Frozen Counter Event *(default – see Note 1)*	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp.)	17, 28 (index)
	5	32-Bit Frozen Counter Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp.)	17, 28 (index)
30	0	Analog Input (Variation 0 is used to request default variation)	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
	1	32-Bit Analog Input *(default – see Note 1)*	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	2	16-Bit Analog Input	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	3	32-Bit Analog Input without Flag	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	4	16-Bit Analog Input without Flag	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	5	short floating point	1 (read) 22 (assign class)	00, 01 (start-stop) 06(no range, or all) 07, 08(limited qty) 17, 28(index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
32	0	Analog Change Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
	1	32-Bit Analog Change Event without Time *(default – see Note 1)*	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp.)	17, 28 (index)
	2	16-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp.)	17, 28 (index)
	3	32-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp.)	17, 28 (index)
	4	16-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp.)	17, 28 (index)
34	0	Analog Input Reporting Deadband (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
	1	16-bit Analog Input Reporting Deadband (default – see Note 1)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
			2 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		

Table E–2: IMPLEMENTATION TABLE (Sheet 4 of 4)

OBJECT			REQUEST		RESPONSE	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
34 con't	2	32-bit Analog Input Reporting Deadband (default – see Note 1)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
			2 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
	3	Short floating point Analog Input Reporting Deadband	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
50	0	Time and Date	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
	1	Time and Date (default – see Note 1)	1 (read) 2 (write)	00, 01 (start-stop) 06 (no range, or all) 07 (limited qty=1) 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index) *(see Note 2)*
52	2	Time Delay Fine			129 (response)	07 (limited qty) (qty = 1)
60	0	Class 0, 1, 2, and 3 Data	1 (read) 20 (enable unsol) 21 (disable unsol) 22 (assign class)	06 (no range, or all)		
	1	Class 0 Data	1 (read) 22 (assign class)	06 (no range, or all)		
	2	Class 1 Data	1 (read) 20 (enable unsol) 21 (disable unsol) 22 (assign class)	06 (no range, or all) 07, 08 (limited qty)		
	3	Class 2 Data	1 (read) 20 (enable unsol) 21 (disable unsol) 22 (assign class)	06 (no range, or all) 07, 08 (limited qty)		
	4	Class 3 Data	1 (read) 20 (enable unsol) 21 (disable unsol) 22 (assign class)	06 (no range, or all) 07, 08 (limited qty)		
80	1	Internal Indications	2 (write)	00 (start-stop) (index must =7)		
---		No Object (function code only) – *see Note 3*	13 (cold restart)			
---		No Object (function code only)	14 (warm restart)			
---		No Object (function code only)	23 (delay meas.)			

Note 1: **A Default variation refers to the variation responded when variation 0 is requested and/or in class 0, 1, 2, or 3 scans. Type 30 (Analog Input) data is limited to data that is actually possible to be used in the UR, based on the product order code. For example, Signal Source data from source numbers that cannot be used is not included. This optimizes the class 0 poll data size.**

Note 2: **For static (non-change-event) objects, qualifiers 17 or 28 are only responded when a request is sent with qualifiers 17 or 28, respectively. Otherwise, static object requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01 (for change-event objects, qualifiers 17 or 28 are always responded.)**

Note 3: **Cold restarts are implemented the same as warm restarts – the UR is not restarted, but the DNP process is restarted.**

E.3.1 BINARY INPUT POINTS

The following table lists both Binary Counters (Object 20) and Frozen Counters (Object 21). When a freeze function is performed on a Binary Counter point, the frozen value is available in the corresponding Frozen Counter point.

BINARY INPUT POINTS

Static (Steady-State) Object Number: **1**

Change Event Object Number: **2**

Request Function Codes supported: **1 (read), 22 (assign class)**

Static Variation reported when variation 0 requested: **2 (Binary Input with status)**

Change Event Variation reported when variation 0 requested: **2 (Binary Input Change with Time)**

Change Event Scan Rate: **8 times per power system cycle**

Table E–3: BINARY INPUTS (Sheet 1 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
0	Virtual Input 1	2
1	Virtual Input 2	2
2	Virtual Input 3	2
3	Virtual Input 4	2
4	Virtual Input 5	2
5	Virtual Input 6	2
6	Virtual Input 7	2
7	Virtual Input 8	2
8	Virtual Input 9	2
9	Virtual Input 10	2
10	Virtual Input 11	2
11	Virtual Input 12	2
12	Virtual Input 13	2
13	Virtual Input 14	2
14	Virtual Input 15	2
15	Virtual Input 16	2
16	Virtual Input 17	2
17	Virtual Input 18	2
18	Virtual Input 19	2
19	Virtual Input 20	2
20	Virtual Input 21	2
21	Virtual Input 22	2
22	Virtual Input 23	2
23	Virtual Input 24	2
24	Virtual Input 25	2
25	Virtual Input 26	2
26	Virtual Input 27	2
27	Virtual Input 28	2
28	Virtual Input 29	2

Table E–3: BINARY INPUTS (Sheet 2 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
29	Virtual Input 30	2
30	Virtual Input 31	2
31	Virtual Input 32	2
32	Virtual Output 1	2
33	Virtual Output 2	2
34	Virtual Output 3	2
35	Virtual Output 4	2
36	Virtual Output 5	2
37	Virtual Output 6	2
38	Virtual Output 7	2
39	Virtual Output 8	2
40	Virtual Output 9	2
41	Virtual Output 10	2
42	Virtual Output 11	2
43	Virtual Output 12	2
44	Virtual Output 13	2
45	Virtual Output 14	2
46	Virtual Output 15	2
47	Virtual Output 16	2
48	Virtual Output 17	2
49	Virtual Output 18	2
50	Virtual Output 19	2
51	Virtual Output 20	2
52	Virtual Output 21	2
53	Virtual Output 22	2
54	Virtual Output 23	2
55	Virtual Output 24	2
56	Virtual Output 25	2
57	Virtual Output 26	2

Table E–3: BINARY INPUTS (Sheet 3 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
58	Virtual Output 27	2
59	Virtual Output 28	2
60	Virtual Output 29	2
61	Virtual Output 30	2
62	Virtual Output 31	2
63	Virtual Output 32	2
64	Virtual Output 33	2
65	Virtual Output 34	2
66	Virtual Output 35	2
67	Virtual Output 36	2
68	Virtual Output 37	2
69	Virtual Output 38	2
70	Virtual Output 39	2
71	Virtual Output 40	2
72	Virtual Output 41	2
73	Virtual Output 42	2
74	Virtual Output 43	2
75	Virtual Output 44	2
76	Virtual Output 45	2
77	Virtual Output 46	2
78	Virtual Output 47	2
79	Virtual Output 48	2
80	Virtual Output 49	2
81	Virtual Output 50	2
82	Virtual Output 51	2
83	Virtual Output 52	2
84	Virtual Output 53	2
85	Virtual Output 54	2
86	Virtual Output 55	2
87	Virtual Output 56	2
88	Virtual Output 57	2
89	Virtual Output 58	2
90	Virtual Output 59	2
91	Virtual Output 60	2
92	Virtual Output 61	2
93	Virtual Output 62	2
94	Virtual Output 63	2
95	Virtual Output 64	2
96	Contact Input 1	1
97	Contact Input 2	1
98	Contact Input 3	1
99	Contact Input 4	1
100	Contact Input 5	1
101	Contact Input 6	1
102	Contact Input 7	1
103	Contact Input 8	1
104	Contact Input 9	1

Table E–3: BINARY INPUTS (Sheet 4 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
105	Contact Input 10	1
106	Contact Input 11	1
107	Contact Input 12	1
108	Contact Input 13	1
109	Contact Input 14	1
110	Contact Input 15	1
111	Contact Input 16	1
112	Contact Input 17	1
113	Contact Input 18	1
114	Contact Input 19	1
115	Contact Input 20	1
116	Contact Input 21	1
117	Contact Input 22	1
118	Contact Input 23	1
119	Contact Input 24	1
120	Contact Input 25	1
121	Contact Input 26	1
122	Contact Input 27	1
123	Contact Input 28	1
124	Contact Input 29	1
125	Contact Input 30	1
126	Contact Input 31	1
127	Contact Input 32	1
128	Contact Input 33	1
129	Contact Input 34	1
130	Contact Input 35	1
131	Contact Input 36	1
132	Contact Input 37	1
133	Contact Input 38	1
134	Contact Input 39	1
135	Contact Input 40	1
136	Contact Input 41	1
137	Contact Input 42	1
138	Contact Input 43	1
139	Contact Input 44	1
140	Contact Input 45	1
141	Contact Input 46	1
142	Contact Input 47	1
143	Contact Input 48	1
144	Contact Input 49	1
145	Contact Input 50	1
146	Contact Input 51	1
147	Contact Input 52	1
148	Contact Input 53	1
149	Contact Input 54	1
150	Contact Input 55	1
151	Contact Input 56	1

Table E–3: BINARY INPUTS (Sheet 5 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
152	Contact Input 57	1
153	Contact Input 58	1
154	Contact Input 59	1
155	Contact Input 60	1
156	Contact Input 61	1
157	Contact Input 62	1
158	Contact Input 63	1
159	Contact Input 64	1
160	Contact Input 65	1
161	Contact Input 66	1
162	Contact Input 67	1
163	Contact Input 68	1
164	Contact Input 69	1
165	Contact Input 70	1
166	Contact Input 71	1
167	Contact Input 72	1
168	Contact Input 73	1
169	Contact Input 74	1
170	Contact Input 75	1
171	Contact Input 76	1
172	Contact Input 77	1
173	Contact Input 78	1
174	Contact Input 79	1
175	Contact Input 80	1
176	Contact Input 81	1
177	Contact Input 82	1
178	Contact Input 83	1
179	Contact Input 84	1
180	Contact Input 85	1
181	Contact Input 86	1
182	Contact Input 87	1
183	Contact Input 88	1
184	Contact Input 89	1
185	Contact Input 90	1
186	Contact Input 91	1
187	Contact Input 92	1
188	Contact Input 93	1
189	Contact Input 94	1
190	Contact Input 95	1
191	Contact Input 96	1
192	Contact Output 1	1
193	Contact Output 2	1
194	Contact Output 3	1
195	Contact Output 4	1
196	Contact Output 5	1
197	Contact Output 6	1
198	Contact Output 7	1

Table E–3: BINARY INPUTS (Sheet 6 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
199	Contact Output 8	1
200	Contact Output 9	1
201	Contact Output 10	1
202	Contact Output 11	1
203	Contact Output 12	1
204	Contact Output 13	1
205	Contact Output 14	1
206	Contact Output 15	1
207	Contact Output 16	1
208	Contact Output 17	1
209	Contact Output 18	1
210	Contact Output 19	1
211	Contact Output 20	1
212	Contact Output 21	1
213	Contact Output 22	1
214	Contact Output 23	1
215	Contact Output 24	1
216	Contact Output 25	1
217	Contact Output 26	1
218	Contact Output 27	1
219	Contact Output 28	1
220	Contact Output 29	1
221	Contact Output 30	1
222	Contact Output 31	1
223	Contact Output 32	1
224	Contact Output 33	1
225	Contact Output 34	1
226	Contact Output 35	1
227	Contact Output 36	1
228	Contact Output 37	1
229	Contact Output 38	1
230	Contact Output 39	1
231	Contact Output 40	1
232	Contact Output 41	1
233	Contact Output 42	1
234	Contact Output 43	1
235	Contact Output 44	1
236	Contact Output 45	1
237	Contact Output 46	1
238	Contact Output 47	1
239	Contact Output 48	1
240	Contact Output 49	1
241	Contact Output 50	1
242	Contact Output 51	1
243	Contact Output 52	1
244	Contact Output 53	1
245	Contact Output 54	1

Table E–3: BINARY INPUTS (Sheet 7 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
246	Contact Output 55	1
247	Contact Output 56	1
248	Contact Output 57	1
249	Contact Output 58	1
250	Contact Output 59	1
251	Contact Output 60	1
252	Contact Output 61	1
253	Contact Output 62	1
254	Contact Output 63	1
255	Contact Output 64	1
256	Remote Input 1	1
257	Remote Input 2	1
258	Remote Input 3	1
259	Remote Input 4	1
260	Remote Input 5	1
261	Remote Input 6	1
262	Remote Input 7	1
263	Remote Input 8	1
264	Remote Input 9	1
265	Remote Input 10	1
266	Remote Input 11	1
267	Remote Input 12	1
268	Remote Input 13	1
269	Remote Input 14	1
270	Remote Input 15	1
271	Remote Input 16	1
272	Remote Input 17	1
273	Remote Input 18	1
274	Remote Input 19	1
275	Remote Input 20	1
276	Remote Input 21	1
277	Remote Input 22	1
278	Remote Input 23	1
279	Remote Input 24	1
280	Remote Input 25	1
281	Remote Input 26	1
282	Remote Input 27	1
283	Remote Input 28	1
284	Remote Input 29	1
285	Remote Input 30	1
286	Remote Input 31	1
287	Remote Input 32	1
288	Remote Device 1	1
289	Remote Device 2	1
290	Remote Device 3	1
291	Remote Device 4	1
292	Remote Device 5	1

Table E–3: BINARY INPUTS (Sheet 8 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
293	Remote Device 6	1
294	Remote Device 7	1
295	Remote Device 8	1
296	Remote Device 9	1
297	Remote Device 10	1
298	Remote Device 11	1
299	Remote Device 12	1
300	Remote Device 13	1
301	Remote Device 14	1
302	Remote Device 15	1
303	Remote Device 16	1
304	PHASE IOC1 Element OP	1
305	PHASE IOC2 Element OP	1
306	PHASE IOC3 Element OP	1
307	PHASE IOC4 Element OP	1
308	PHASE IOC5 Element OP	1
309	PHASE IOC6 Element OP	1
310	PHASE IOC7 Element OP	1
311	PHASE IOC8 Element OP	1
312	PHASE IOC9 Element OP	1
313	PHASE IOC10 Element OP	1
314	PHASE IOC11 Element OP	1
315	PHASE IOC12 Element OP	1
316	Not Used	---
317	Not Used	---
318	Not Used	---
319	Not Used	---
320	PHASE TOC1 Element OP	1
321	PHASE TOC2 Element OP	1
322	PHASE TOC3 Element OP	1
323	PHASE TOC4 Element OP	1
324	PHASE TOC5 Element OP	1
325	PHASE TOC6 Element OP	1
326	Not Used	---
327	Not Used	---
328	PH DIR1 Element OP	1
329	PH DIR2 Element OP	1
330	Not Used	---
↓	↓	↓
335	Not Used	---
336	NEUTRAL IOC1 Element OP	1
337	NEUTRAL IOC2 Element OP	1
338	NEUTRAL IOC3 Element OP	1
339	NEUTRAL IOC4 Element OP	1
340	NEUTRAL IOC5 Element OP	1
341	NEUTRAL IOC6 Element OP	1
342	NEUTRAL IOC7 Element OP	1

Table E–3: BINARY INPUTS (Sheet 9 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
343	NEUTRAL IOC8 Element OP	1
344	NEUTRAL IOC9 Element OP	1
345	NEUTRAL IOC10 Element OP	1
346	NEUTRAL IOC11 Element OP	1
347	NEUTRAL IOC12 Element OP	1
348	Not Used	---
349	Not Used	---
350	Not Used	---
351	Not Used	---
352	NEUTRAL TOC1 Element OP	1
353	NEUTRAL TOC2 Element OP	1
354	NEUTRAL TOC3 Element OP	1
355	NEUTRAL TOC4 Element OP	1
356	NEUTRAL TOC5 Element OP	1
357	NEUTRAL TOC6 Element OP	1
358	Not Used	---
359	Not Used	---
360	NTRL DIR OC1 Element OP	1
361	NTRL DIR OC2 Element OP	1
362	Not Used	---
363	Not Used	---
364	NEG SEQ DIR OC1 Elem OP	1
365	NEG SEQ DIR OC2 Elem OP	1
366	Not Used	---
367	Not Used	---
368	GROUND IOC1 Element OP	1
369	GROUND IOC2 Element OP	1
370	GROUND IOC3 Element OP	1
371	GROUND IOC4 Element OP	1
372	GROUND IOC5 Element OP	1
373	GROUND IOC6 Element OP	1
374	GROUND IOC7 Element OP	1
375	GROUND IOC8 Element OP	1
376	GROUND IOC9 Element OP	1
377	GROUND IOC10 Element OP	1
378	GROUND IOC11 Element OP	1
379	GROUND IOC12 Element OP	1
380	Not Used	---
381	Not Used	---
382	Not Used	---
383	Not Used	---
384	GROUND TOC1 Element OP	1
385	GROUND TOC2 Element OP	1
386	GROUND TOC3 Element OP	1
387	GROUND TOC4 Element OP	1
388	GROUND TOC5 Element OP	1
389	GROUND TOC6 Element OP	1

Table E–3: BINARY INPUTS (Sheet 10 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
390	RESTD GND FT1 Element OP	1
391	RESTD GND FT2 Element OP	1
392	RESTD GND FT3 Element OP	1
393	RESTD GND FT4 Element OP	1
394	RESTD GND FT5 Element OP	1
395	RESTD GND FT6 Element OP	1
396	Not Used	---
397	Not Used	---
398	Not Used	---
399	Not Used	---
400	NEG SEQ IOC1 Element OP	1
401	NEG SEQ IOC2 Element OP	1
402	Not Used	---
↓	↓	↓
415	Not Used	---
416	NEG SEQ TOC1 Element OP	1
417	NEG SEQ TOC2 Element OP	1
418	Not Used	---
↓	↓	↓
423	Not Used	---
424	NEG SEQ OV Element OP	1
425	Not Used	---
↓	↓	↓
431	Not Used	---
432	HI-Z Element OP	1
433	BUS 1 Element OP	1
434	BUS 2 Element OP	1
435	Not Used	---
↓	↓	↓
447	Not Used	---
448	PHASE UV1 Element OP	1
449	PHASE UV2 Element OP	1
450	Not Used	---
↓	↓	↓
455	Not Used	---
456	PHASE OV1 Element OP	1
457	Not Used	---
↓	↓	↓
463	Not Used	---
464	PH DIST Z1 Element OP	1
465	PH DIST Z2 Element OP	1
466	PH DIST Z3 Element OP	1
467	PH DIST Z4 Element OP	1
468	Not Used	---
469	Not Used	---
470	Not Used	---
471	Not Used	---

Table E–3: BINARY INPUTS (Sheet 11 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
472	LINE PICKUP Element OP	1
473	Not Used	---
↓	↓	↓
479	Not Used	---
480	GND DIST Z1 Element OP	1
481	GND DIST Z2 Element OP	1
482	GND DIST Z3 Element OP	1
483	GND DIST Z4 Element OP	1
484	Not Used	---
485	Not Used	---
486	Not Used	---
487	Not Used	---
488	DUTT Element OP	1
489	PUTT Element OP	1
490	POTT Element OP	1
491	HYBRID POTT Element OP	1
492	BLOCK SCHEME Element OP	1
493	Not Used	---
494	POWER SWING Element OP	1
495	Not Used	
496	DATA TRIG 1 Element OP	1
497	DATA TRIG 2 Element OP	1
498	DATA TRIG 3 Element OP	1
499	DATA TRIG 4 Element OP	1
500	Not Used	---
↓	↓	↓
511	Not Used	---
512	XFRMR INST DIFF Elemnt OP	1
513	XFRMR PCNT DIFF Elemnt OP	1
514	VOLTS PER HERTZ Elem. OP	1
515	STATOR DIFF Element OP	1
516	Not Used	---
↓	↓	↓
527	Not Used	---
528	SRC1 VT FUSE FAIL Elem OP	1
529	SRC2 VT FUSE FAIL Elem OP	1
530	SRC3 VT FUSE FAIL Elem OP	1
531	SRC4 VT FUSE FAIL Elem OP	1
532	SRC5 VT FUSE FAIL Elem OP	1
533	SRC6 VT FUSE FAIL Elem OP	1
534	Not Used	---
535	Not Used	---
536	SRC1 50DD Element OP	1
537	SRC2 50DD Element OP	1
538	SRC3 50DD Element OP	1
539	SRC4 50DD Element OP	1
540	SRC5 50DD Element OP	1

Table E–3: BINARY INPUTS (Sheet 12 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
541	SRC6 50DD Element OP	1
542	Not Used	---
543	Not Used	---
544	87L DIFF Element OP	1
545	Not Used	---
546	OPEN POLE Element OP	1
547	Not Used	1
548	50DD Element OP	1
549	CONT MONITOR Element OP	1
550	CT FAIL Element OP	1
551	CT Trouble 1	1
552	CT Trouble 2	1
553	87l TRIP Element OP	1
554	STUB BUS Element OP	1
555	Not Used	---
↓	↓	↓
559	Not Used	---
560	87PC Element OP	1
561	Not Used	---
562	Not Used	---
563	Not Used	---
564	MOTOR Element OP	1
565	Not Used	---
↓	↓	↓
575	Not Used	---
576	BREAKER 1 Element OP	1
577	BREAKER 2 Element OP	1
578	Not Used	---
↓	↓	↓
583	Not Used	---
584	BKR FAIL 1 Element OP	1
585	BKR FAIL 2 Element OP	1
586	Not Used	---
↓	↓	↓
591	Not Used	---
592	BKR ARC 1 Element OP	1
593	BKR ARC 2 Element OP	1
594	Not Used	---
↓	↓	↓
607	Not Used	---
608	AR 1 Element OP	1
609	AR 2 Element OP	1
610	AR 3 Element OP	1
611	AR 4 Element OP	1
612	AR 5 Element OP	1
613	AR 6 Element OP	1
614	Not Used	---

Table E–3: BINARY INPUTS (Sheet 13 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
615	Not Used	---
616	SYNC 1 Element OP	1
617	SYNC 2 Element OP	1
618	Not Used	---
↓	↓	↓
623	Not Used	---
624	COLD LOAD 1 Element OP	1
625	COLD LOAD 2 Element OP	1
626	Not Used	---
627	Not Used	---
628	AMP UNBALANCE 1 Elem. OP	1
629	AMP UNBALANCE 2 Elem. OP	1
630	Not Used	---
↓	↓	↓
639	Not Used	---
640	SETTING GROUP Element OP	1
641	RESET Element OP	1
642	Not Used	---
↓	↓	↓
654	Not Used	---
655	OVERFREQ Element OP	1
656	UNDERFREQ 1 Element OP	1
657	UNDERFREQ 2 Element OP	1
658	UNDERFREQ 3 Element OP	1
659	UNDERFREQ 4 Element OP	1
660	UNDERFREQ 5 Element OP	1
661	UNDERFREQ 6 Element OP	1
662	Not Used	---
↓	↓	↓
815	Not Used	---
816	DIG ELEM 1 Element OP	1
817	DIG ELEM 2 Element OP	1
818	DIG ELEM 3 Element OP	1
819	DIG ELEM 4 Element OP	1
820	DIG ELEM 5 Element OP	1
821	DIG ELEM 6 Element OP	1
822	DIG ELEM 7 Element OP	1
823	DIG ELEM 8 Element OP	1
824	DIG ELEM 9 Element OP	1
825	DIG ELEM 10 Element OP	1
826	DIG ELEM 11 Element OP	1
827	DIG ELEM 12 Element OP	1
828	DIG ELEM 13 Element OP	1
829	DIG ELEM 14 Element OP	1
830	DIG ELEM 15 Element OP	1
831	DIG ELEM 16 Element OP	1
832	Not Used	---

Table E–3: BINARY INPUTS (Sheet 14 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
↓	↓	↓
847	Not Used	---
848	COUNTER 1 Element OP	1
849	COUNTER 2 Element OP	1
850	COUNTER 3 Element OP	1
851	COUNTER 4 Element OP	1
852	COUNTER 5 Element OP	1
853	COUNTER 6 Element OP	1
854	COUNTER 7 Element OP	1
855	COUNTER 8 Element OP	1
856	Not Used	---
↓	↓	↓
863	Not Used	---
864	LED State 1 (IN SERVICE)	1
865	LED State 2 (TROUBLE)	1
866	LED State 3 (TEST MODE)	1
867	LED State 4 (TRIP)	1
868	LED State 5 (ALARM)	1
869	LED State 6(PICKUP)	1
870	Not Used	---
↓	↓	↓
879	Not Used	---
880	LED State 9 (VOLTAGE)	1
881	LED State 10 (CURRENT)	1
882	LED State 11 (FREQUENCY)	1
883	LED State 12 (OTHER)	1
884	LED State 13 (PHASE A)	1
885	LED State 14 (PHASE B)	1
886	LED State 15 (PHASE C)	1
887	LED State 16 (NTL/GROUND)	1
888	Not Used	---
↓	↓	↓
895	Not Used	---
896	CHANNEL 1 FAILED	1
897	CHANNEL 2 FAILED	1
898	FLASH PROGRAMMING	1
899	BATTERY FAIL	1
900	PRI ETHERNET FAIL	1
901	SEC ETHERNET FAIL	1
902	EPROM DATA ERROR	1
903	SRAM DATA ERROR	1
904	PROGRAM MEMORY	1
905	WATCHDOG ERROR	1
906	LOW ON MEMORY	1
907	REMOTE DEVICE OFF	1
908	Not Used	----
909	Not Used	----

Table E–3: BINARY INPUTS (Sheet 15 of 15)

POINT INDEX	NAME/DESCRIPTION	CHANGE EVENT CLASS (1/2/3/none)
910	Any Major Error	1
911	Any Minor Error	1
912	Any Self-Tests	1
913	IRIG-B FAILURE	1
914	DSP ERROR	1
915	Not Used	
916	NO DSP INTERUPTS	1
917	UNIT NOT CALIBRATED	1
918	Not Used	---
919	CLOCK NOT SET	1
920	FACTORY SERVICE MODE	1
921	PROTOTYPE FIRMWARE	1
922	FLEXLOGIC ERR TOKEN	1
923	EQUIPMENT MISMATCH	1
924	RAM CODE FAILURE	1
925	UNIT NOT PROGRAMMED	1
926	SYSTEM EXCEPTION	1
927	SYNCHRONIZING	1

E.3.2 BINARY OUTPUT AND CONTROL RELAY OUTPUT

Supported Control Relay Output Block fields: Pulse On, Pulse Off, Latch On, Latch Off, Paired Trip, Paired Close.

BINARY OUTPUT STATUS POINTS

Object Number: **10**

Request Function Codes supported: **1 (read)**

Default Variation reported when variation 0 requested: **2 (Binary Output Status)**

CONTROL RELAY OUTPUT BLOCKS

Object Number: **12**

Request Function Codes supported: **3 (select), 4 (operate), 5 (direct operate), 6 (direct operate, noack)**

Table E–4: BINARY/CONTROL OUTPUT POINT LIST

POINT INDEX	NAME/DESCRIPTION
0	Virtual Input 1
1	Virtual Input 2
2	Virtual Input 3
3	Virtual Input 4
4	Virtual Input 5
5	Virtual Input 6
6	Virtual Input 7
7	Virtual Input 8
8	Virtual Input 9
9	Virtual Input 10
10	Virtual Input 11
11	Virtual Input 12
12	Virtual Input 13
13	Virtual Input 14
14	Virtual Input 15
15	Virtual Input 16

Table E–4: BINARY/CONTROL OUTPUT POINT LIST

POINT INDEX	NAME/DESCRIPTION
16	Virtual Input 17
17	Virtual Input 18
18	Virtual Input 19
19	Virtual Input 20
20	Virtual Input 21
21	Virtual Input 22
22	Virtual Input 23
23	Virtual Input 24
24	Virtual Input 25
25	Virtual Input 26
26	Virtual Input 27
27	Virtual Input 28
28	Virtual Input 29
29	Virtual Input 30
30	Virtual Input 31
31	Virtual Input 32

E.3.3 COUNTERS

The following table lists both Binary Counters (Object 20) and Frozen Counters (Object 21). When a freeze function is performed on a Binary Counter point, the frozen value is available in the corresponding Frozen Counter point.

BINARY COUNTERS

Static (Steady-State) Object Number: **20**

Change Event Object Number: **22**

Request Function Codes supported: **1 (read), 7 (freeze), 8 (freeze noack), 9 (freeze and clear), 10 (freeze and clear, noack), 22 (assign class)**

Static Variation reported when variation 0 requested: **1 (32-Bit Binary Counter with Flag)**

Change Event Variation reported when variation 0 requested: **1 (32-Bit Counter Change Event without time)**

FROZEN COUNTERS

Static (Steady-State) Object Number: **21**

Change Event Object Number: **23**

Request Function Codes supported: **1 (read)**

Static Variation reported when variation 0 requested: **1 (32-Bit Frozen Counter with Flag)**

Change Event Variation reported when variation 0 requested: **1 (32-Bit Frozen Counter Event without time)**

Table E–5: BINARY and FROZEN COUNTERS

POINT INDEX	NAME/DESCRIPTION
0	Digital Counter 1
1	Digital Counter 2
2	Digital Counter 3
3	Digital Counter 4
4	Digital Counter 5
5	Digital Counter 6
6	Digital Counter 7
7	Digital Counter 8
8	Oscillography Trigger Count
9	Events Since Last Clear

Note that a counter freeze command has no meaning for counters 8 and 9.

E.3.4 ANALOG INPUTS

The following table lists Analog Inputs (Object 30). It is important to note that 16-bit and 32-bit variations of Analog Inputs are transmitted through DNP as signed numbers. Even for analog input points that are not valid as negative values, the maximum positive representation is 32767. This is a requirement of DNP.

The deadbands for all Analog Input points are in the same units as the Analog Input quantity. For example, an Analog Input quantity measured in volts has a corresponding deadband in units of volts. This is in conformance with DNP Technical Bulletin 9809-001 Analog Input Reporting Deadband. Default deadbands are set to relatively high values to prevent the generation of unexpected change events. Deadbands can be changed using DNP Object 34.

When using the UR in DNP systems with limited memory, the long ANALOG INPUT POINTS LIST below may be replaced with a user-definable list. This user-definable list uses the same settings as the Modbus User Map and can be configured with the MODBUS USER MAP settings. When used with DNP, each entry in the Modbus User Map represents the starting Modbus address of a data item available as a DNP Analog Input point. To enable use of the Modbus User Map for DNP Analog Input points, set the USER MAP FOR DNP ANALOGS setting to Enabled (this setting is in the PRODUCT SETUP \ COMMUNICATIONS \ DNP PROTOCOL menu). The new DNP Analog points list can be checked via the "DNP Analog Input Points List" webpage, accessible from the "Device Information menu" webpage.

NOTE

After changing the USER MAP FOR DNP ANALOGS setting, the relay must be powered off and then back on for the setting to take effect.

In the following table, only applicable Source data values are included in class 0 polls. The product order code is used to determine the maximum number of AC Signal Sources and this information is used to determine which Source values are included in class 0 polls.

Units for Analog Input points are as follows:

- Current: A
- Voltage: V
- Real Power: W
- Reactive Power: var
- Apparent Power: VA
- Energy: Wh, varh
- Frequency: Hz
- Angle: degrees
- Ohm Input: Ohms
- RTD Input: degrees C

Static (Steady-State) Object Number: **30**

Change Event Object Number: **32**

Request Function Codes supported: **1 (read), 2 (write, deadbands only), 22 (assign class)**

Static Variation reported when variation 0 requested: **1 (32-Bit Analog Input)**

Change Event Variation reported when variation 0 requested: **1 (Analog Change Event w/o Time)**

Change Event Scan Rate:Defaults to 500 ms**.**

Table E–6: ANALOG INPUTS

POINT INDEX	NAME/DESCRIPTION
0	Communications Group
1	Current Setting Group

F.1.1 REVISION HISTORY

Table F–1: REVISION HISTORY

MANUAL P/N	C30 REVISION	RELEASE DATE	ECO
1601-0088-A1	1.5X	19 February 1999	N/A
1601-0088-A2	1.6X	10 August 1999	URC-003
1601-0088-A3	1.8X	29 October 1999	URC-004
1601-0088-A4	1.8X	15 November 1999	URC-008
1601-0088-A5	2.0X	17 December 1999	URC-009
1601-0088-A6	2.2X	12 May 2000	URC-011
1601-0088-A7	2.2X	14 June 2000	URC-013
1601-0088-A7a	2.2X	28 June 2000	URC-013a
1601-0088-B1	2.4X	08 September 2000	URC-015
1601-0088-B2	2.4X	03 November 2000	URC-017
1601-0088-B3	2.6X	09 March 2001	URC-019

F.1.2 CHANGES TO C30 MANUAL

Table F–2: MAJOR UPDATES FOR C30 MANUAL-B3

PAGE (B2)	CHANGE	DESCRIPTION
Title	Update	Manual part number from B2 to B3
1-7	Add	Added section for connecting URPC with the C30.
2-1	Update	Updated FUNCTIONS table to include User-Definable Displays
2-3	Update	Updated ORDER CODES table to include Transducer I/O options.
3-10, 3-11	Updated	Updated Section 3.2.6: CONTACT INPUTS/OUTPUTS Updated FORM-A CONTACT FUNCTIONS diagram from 827821A2 to 827821A4
5-12	Add	Added DNP unsolicited response settings to the SETTINGS \ PRODUCT SETUP \ COMMUNICATIONS \ DNP PROTOCOL menu
5-16	Update	Updated the DIGITAL CHANNELS settings to range from 2 to 63.
B-33	Update	MODBUS MEMORY MAP updated for version 2.6X firmware
C-1	Update	Appendix C: UCA/MMS updated
E-1	Update	Updated DNP DEVICE PROFILE DOCUMENT for Counter 9, Analog Deadbands (Object 34), Sends Unsolicited Response values, and additional timeouts.
E-5	Update	Added Object 34 and Function Code 22 to DNP IMPLEMENTATION TABLE.
E-9	Updated	Updated BINARY INPUTS table.
E-17	Update	Updated BINARY AND FROZEN COUNTERS table for Index 9, Events Since Last Clear.

Table F–3: MAJOR UPDATES FOR C30 MANUAL-B2

PAGE (OLD)	CHANGE	FROM	TO (NEW PAGE)
Title	Updated	P/N …B1	P/N …B2
E-	Updated		DNP Implementation Table

Table F–4: MAJOR UPDATES FOR C30 MANUAL-B1

PAGE (OLD)	CHANGE	FROM	TO (NEW PAGE)
Title	Updated	C30 Revision: 2.2X	C30 Revision: 2.4X
Title	Updated	P/N …A7a	P/N …B1
Title	Updated		ISO references
Addendum	Updated		
1-	Added		**Battery Tab** information (page 1-11)
2-	Added		Order Codes for new **Digital I/O modules,** (page 2-2,3)
2-6	Updated		ISO reference
4-	Added		**UR Vertical Faceplate** drawing (page 4-6)
4-9,10	Updated		Custom Labeling of LEDs (page 4-10,11)
5-6	Updated		Settings> Product Setup>**Communications**
5-12	Updated		Settings>Product Setup >**User Programmable LEDS** (page 5-)
5-13	Replaced	Settings> Product Setup>Message Scratchpad	Settings> Product Setup>**User-Definable Displays** (page 5-)
5-18	Updated		FlexLogic Operands (page 5-)
5-	Added		FlexLogic Operators (One Shots) (page 5-)
5-41	Updated		Settings>Inputs/Outputs >**Virtual Inputs** (page 5-)
5-43	Updated		Settings>Inputs/Outputs >**Contact Outputs** (page 5-)
6-10	Updated		Actual Values>**Product Info** (page 6-)
C-1	Updated		UCA/MMS

G.1.1 LIST OF FIGURES

G.1.2 LIST OF TABLES

GE POWER MANAGEMENT RELAY WARRANTY

General Electric Power Management Inc. (GE Power Management) warrants each relay it manufactures to be free from defects in material and workmanship under normal use and service for a period of 24 months from date of shipment from factory.

In the event of a failure covered by warranty, GE Power Management will undertake to repair or replace the relay providing the warrantor determined that it is defective and it is returned with all transportation charges prepaid to an authorized service centre or the factory. Repairs or replacement under warranty will be made without charge.

Warranty shall not apply to any relay which has been subject to misuse, negligence, accident, incorrect installation or use not in accordance with instructions nor any unit that has been altered outside a GE Power Management authorized factory outlet.

GE Power Management is not liable for special, indirect or consequential damages or for loss of profit or for expenses sustained as a result of a relay malfunction, incorrect application or adjustment.

For complete text of Warranty (including limitations and disclaimers), refer to GE Power Management Standard Conditions of Sale.

Numerics

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

U

V

W