G60	- * **	- *	*	- F **	- H **	- M **	- P/R **		Reduced Size Vertical Mount (see note regarding P/R slot below)
MOUNT/COATING	V								Vertical (3/4 rack)
	B								Vertical (3/4 rack) with harsh environmental coating
FRONT PANEL + INTERFACE		F							English display
		D							French display
		R							Russian display
		A							Chinese display
		K							Enhanced front panel with English display
		M							Enhanced front panel with French display
		Q							Enhanced front panel with Russian display
		U							Enhanced front panel with Chinese display
		L							Enhanced front panel with English display and user-programmable pushbuttons
		N							Enhanced front panel with French display and user-programmable pushbuttons
		T							Enhanced front panel with Russian display and user-programmable pushbuttons
		V							Enhanced front panel with Chinese display and user-programmable pushbuttons
		W							Enhanced front panel with Turkish display
		Y							Enhanced front panel with Turkish display and user-programmable pushbuttons
		I							Enhanced front panel with German display
		J							Enhanced front panel with German display and user-programmable pushbuttons
POWER SUPPLY			H						125 / 250 V AC/DC power supply
			L						24 to 48 V (DC only) power supply
PROCESS BUS MODULE					81				Eight-port digital process bus module
CONTACT INPUTS/OUTPUTS				XX		XX		XX	No Module
								4A	4 Solid-State (no monitoring) MOSFET outputs
								4B	4 Solid-State (voltage with optional current) MOSFET outputs
								4C	4 Solid-State (current with optional voltage) MOSFET outputs
								4D	16 Contact inputs with Auto-Burnishing (maximum of three modules within a case)
								4L	14 Form-A (no monitoring) Latching outputs
								67	8 Form-A (no monitoring) outputs
								6A	2 Form-A (voltage with optional current) and 2 Form-C outputs, 8 contact inputs
								6B	2 Form-A (voltage with optional current) and 4 Form-C outputs, 4 contact inputs
								6C	8 Form-C outputs
								6D	16 Contact inputs
								6E	4 Form-C outputs, 8 contact inputs
								6F	8 Fast Form-C outputs
								6G	4 Form-A (voltage with optional current) outputs, 8 contact inputs
								6H	6 Form-A (voltage with optional current) outputs, 4 contact inputs
								6K	4 Form-C and 4 Fast Form-C outputs
								6L	2 Form-A (current with optional voltage) and 2 Form-C outputs, 8 contact inputs
								6M	2 Form-A (current with optional voltage) and 4 Form-C outputs, 4 contact inputs
								6N	4 Form-A (current with optional voltage) outputs, 8 contact inputs
								6P	6 Form-A (current with optional voltage) outputs, 4 contact inputs
								6R	2 Form-A (no monitoring) and 2 Form-C outputs, 8 contact inputs
								6S	2 Form-A (no monitoring) and 4 Form-C outputs, 4 contact inputs
								6T	4 Form-A (no monitoring) outputs, 8 contact inputs
								6U	6 Form-A (no monitoring) outputs, 4 contact inputs
								6V	2 Form-A outputs, 1 Form-C output, 2 Form-A (no monitoring) latching outputs, 8 contact inputs
								6W	30 Contact inputs - pin terminals (max 4 modules)
								6X	18 Form-A (no monitoring) outputs - pin terminals (max 4 modules)
INTER-RELAY COMMUNICATIONS (select a maximum of 1 per unit For the last module, rear slot P is used for digital input/output modules; rear slot R is used for inter-relay communications modules.								2A	C37.94SM, 1300 nm single-mode, ELED, 1 channel single-mode
								2B	C37.94SM, 1300 nm single-mode, ELED, 2 channel single-mode
								2E	Bi-phase, single channel
								2F	Bi-phase, dual channel
								2G	IEEE C37.94, 820 nm, 128 kbps, multimode, LED, 1 Channel
								2H	IEEE C37.94, 820 nm, 128 kbps, multimode, LED, 2 Channels
								2I	Channel 1 - IEEE C37.94, MM, 64/128 kbps; Channel 2 - 1300 nm, single-mode, Laser
								2J	Channel 1 - IEEE C37.94, MM, 64/128 kbps; Channel 2 - 1500 nm, single-mode, Laser
								72	1550 nm, single-mode, Laser, 1 Channel
								73	1550 nm, single-mode, Laser, 2 Channel
								74	Channel 1 - RS422; Channel 2 - 1550 nm, single-mode, Laser
								75	Channel 1 - G.703; Channel 2 - 1550 nm, single-mode Laser
								76	IEEE C37.94, 820 nm, 64 kbps, multimode, LED, 1 Channel
								77	IEEE C37.94, 820 nm, 64 kbps, multimode, LED, 2 Channels
								7A	820 nm, multimode, LED, 1 Channel
								7B	1300 nm, multimode, LED, 1 Channel
								7C	1300 nm, single-mode, ELED, 1 Channel
								7D	1300 nm, single-mode, Laser, 1 Channel
								7E	Channel 1 - G.703; Channel 2 - 820 nm, multimode
								7F	Channel 1 - G.703; Channel 2 - 1300 nm, multimode
								7G	Channel 1 - G.703; Channel 2 - 1300 nm, single-mode ELED
								7H	820 nm, multimode, LED, 2 Channels
								7I	1300 nm, multimode, 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, multimode, LED
								7M	Channel 1 - RS422; Channel 2 - 1300 nm, multimode, LED
								7N	Channel 1 - RS422; Channel 2 - 1300 nm, single-mode, ELED
								7P	Channel 1 - RS422; Channel 2 - 1300 nm, single-mode, Laser
								7Q	Channel 1 - G.703; 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

2.3.3 Replacement modules

Replacement modules can be ordered separately. When ordering a replacement CPU module or front panel, provide the serial number of your existing unit.

Not all replacement modules apply to the G60 relay. The modules specified in the order codes for the G60 are available as replacement modules for the G60.

The order codes shown here are subject to change without notice. See the web page for the product for the latest options.

2

Table 2-8: UR order codes for replacement modules, horizontal units

	UR - **	- *	
POWER SUPPLY	SH	A	125 / 300 V AC/DC
redundant supply only available in horizontal units and must be same type as main supply	SL	H	24 to 48 V (DC only)
CPU	T		RS485 with 3 100Base-FX Ethernet, multimode, SFP with LC
	U		RS485 with 1 100Base-TX Ethernet, SFP RJ-45 + 2 100Base-FX Ethernet, multimode, SFP with LC
	V		RS485 with 3 100Base-TX Ethernet, SFP with RJ-45
	W		RS485 with 2 100Base-FX Ethernet, multimode ST + 10/100Base-TX Ethernet, RJ-45
FRONT PANEL + INTERFACE	3C		Horizontal front panel with keypad and English display
	3D		Horizontal front panel with keypad and French display
	3R		Horizontal front panel with keypad and Russian display
	3A		Horizontal front panel with keypad and Chinese display
	3P		Horizontal front panel with keypad, user-programmable pushbuttons, and English display
	3G		Horizontal front panel with keypad, user-programmable pushbuttons, and French display
	3S		Horizontal front panel with keypad, user-programmable pushbuttons, and Russian display
	3B		Horizontal front panel with keypad, user-programmable pushbuttons, and Chinese display
	3K		Enhanced front panel with English display
	3M		Enhanced front panel with French display
	3Q		Enhanced front panel with Russian display
	3U		Enhanced front panel with Chinese display
	3L		Enhanced front panel with English display and user-programmable pushbuttons
	3N		Enhanced front panel with French display and user-programmable pushbuttons
	3T		Enhanced front panel with Russian display and user-programmable pushbuttons
	3V		Enhanced front panel with Chinese display and user-programmable pushbuttons
	3I		Enhanced front panel with German display
	3J		Enhanced front panel with German display and user-programmable pushbuttons
	3H		Enhanced front panel with Polish display
	3O		Enhanced front panel with Polish display and user-programmable pushbuttons
	3Z		Enhanced front panel with Japanese display
	3X		Enhanced front panel with Japanese display and user-programmable pushbuttons
	3E		7" Graphical front panel display in multiple languages with USB front port and user-programmable pushbuttons
CONTACT INPUTS AND OUTPUTS	4A		4 Solid-State (no monitoring) MOSFET outputs
	4B		4 Solid-State (voltage with optional current) MOSFET outputs
	4C		4 Solid-State (current with optional voltage) MOSFET outputs
	4D		16 Contact inputs with Auto-Burnishing
	4L		14 Form-A (no monitoring) Latching outputs
	67		8 Form-A (no monitoring) outputs
	6A		2 Form-A (voltage with optional current) and 2 Form-C outputs, 8 contact inputs
	6B		2 Form-A (voltage with optional current) and 4 Form-C outputs, 4 contact inputs
	6C		8 Form-C outputs
	6D		16 Contact inputs
	6E		4 Form-C outputs, 8 contact inputs
	6F		8 Fast Form-C outputs
	6G		4 Form-A (voltage with optional current) outputs, 8 contact inputs
	6H		6 Form-A (voltage with optional current) outputs, 4 contact inputs
	6K		4 Form-C and 4 Fast Form-C outputs
	6L		2 Form-A (current with optional voltage) and 2 Form-C outputs, 8 contact inputs
	6M		2 Form-A (current with optional voltage) and 4 Form-C outputs, 4 contact inputs
	6N		4 Form-A (current with optional voltage) outputs, 8 contact inputs
	6P		6 Form-A (current with optional voltage) outputs, 4 contact inputs
	6R		2 Form-A (no monitoring) and 2 Form-C outputs, 8 contact inputs
	6S		2 Form-A (no monitoring) and 4 Form-C outputs, 4 contact inputs
	6T		4 Form-A (no monitoring) outputs, 8 contact inputs
	6U		6 Form-A (no monitoring) outputs, 4 contact inputs
	6V		2 Form-A outputs, 1 Form-C output, 2 Form-A (no monitoring) latching outputs, 8 contact inputs
	6W		30 Contact inputs - pin terminals (max 4 modules)
	6X		18 Form-A (no monitoring) outputs - pin terminals (max 4 modules)
CT/VT MODULES	8L		Standard 4CT/4VT with enhanced diagnostics
(not available for the C30)	8N		Standard 8CT with enhanced diagnostics
	8M		Sensitive Ground 4CT/4VT with enhanced diagnostics
	8R		Sensitive Ground 8CT with enhanced diagnostics
INTER-RELAY COMMUNICATIONS	2A		C37.94SM, 1300 nm single-mode, ELED, 1 channel single-mode
	2B		C37.94SM, 1300 nm single-mode, ELED, 2 channel single-mode
	2E		Bi-phase, single channel
	2F		Bi-phase, dual channel
	2G		IEEE C37.94, 820 nm, 128 kbps, multimode, LED, 1 Channel
	2H		IEEE C37.94, 820 nm, 128 kbps, multimode, LED, 2 Channels
	2I		Channel 1 - IEEE C37.94, multimode, 64/128 kbps; Channel 2 - 1300 nm, single-mode, Laser
	2J		Channel 1 - IEEE C37.94, multimode, 64/128 kbps; Channel 2 - 1550 nm, single-mode, Laser
	72		1550 nm, single-mode, Laser, 1 Channel
	73		1550 nm, single-mode, Laser, 2 Channel
	74		Channel 1 - RS422; Channel 2 - 1550 nm, single-mode, Laser
	75		Channel 1 - G.703; Channel 2 - 1550 nm, single-mode Laser
	76		IEEE C37.94, 820 nm, multimode, LED, 1 Channel
	77		IEEE C37.94, 820 nm, multimode, LED, 2 Channels
	7A		820 nm, multimode, LED, 1 Channel
	7B		1300 nm, multimode, LED, 1 Channel
	7C		1300 nm, single-mode, ELED, 1 Channel
	7D		1300 nm, single-mode, Laser, 1 Channel
	7E		Channel 1 - G.703; Channel 2 - 820 nm, multimode
	7F		Channel 1 - G.703; Channel 2 - 1300 nm, multimode
	7G		Channel 1 - G.703; Channel 2 - 1300 nm, single-mode ELED
	7H		820 nm, multimode, LED, 2 Channels
	7I		1300 nm, multimode, 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, multimode, LED
	7M		Channel 1 - RS422; Channel 2 - 1300 nm, multimode, LED
	7N		Channel 1 - RS422; Channel 2 - 1300 nm, single-mode, ELED
	7P		Channel 1 - RS422; Channel 2 - 1300 nm, single-mode, Laser
	7Q		Channel 1 - G.703; 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 INPUTS/OUTPUTS	5A		4 DCmA inputs, 4 DCmA outputs (only one 5A or 5D module is allowed)
	5C		8 RTD inputs
	5D		4 RTD inputs, 4 DCmA outputs (only one 5A or 5D module is allowed)
	5E		4 DCmA inputs, 4 RTD inputs
	5F		8 DCmA inputs

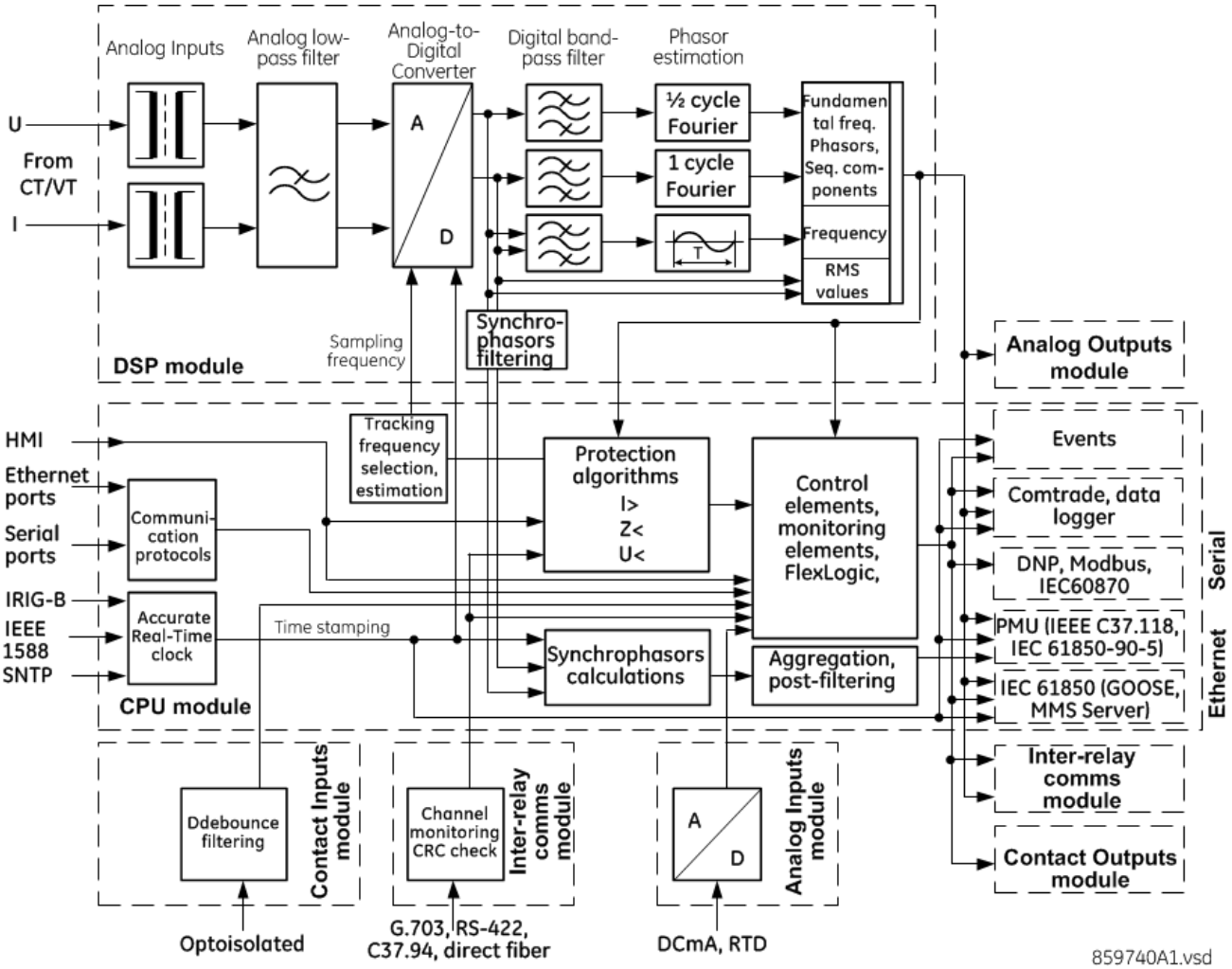
2.4 Signal processing

2.4.1 UR signal processing

The UR series relays are microprocessor-based protective relays that are designed to measure power system conditions directly via CT and VT inputs and via other sources of information, such as analog inputs, communications inputs, and contact inputs. The following figure shows the overall signal processing in URs.

An analog low pass anti-aliasing filter with a 3 dB corner frequency is set at 2.4 kHz and is used for current and voltage analog filtering as well as signal conditioning. The same filtering is applied for phase, ground currents, phase-to-phase (when applicable), and auxiliary voltages. The 2.4 kHz cut-off frequency applies to both 50 Hz and 60 Hz applications and fixed in the hardware, and thus is not dependent on the system nominal frequency setting.

Figure 2-4: UR signal processing



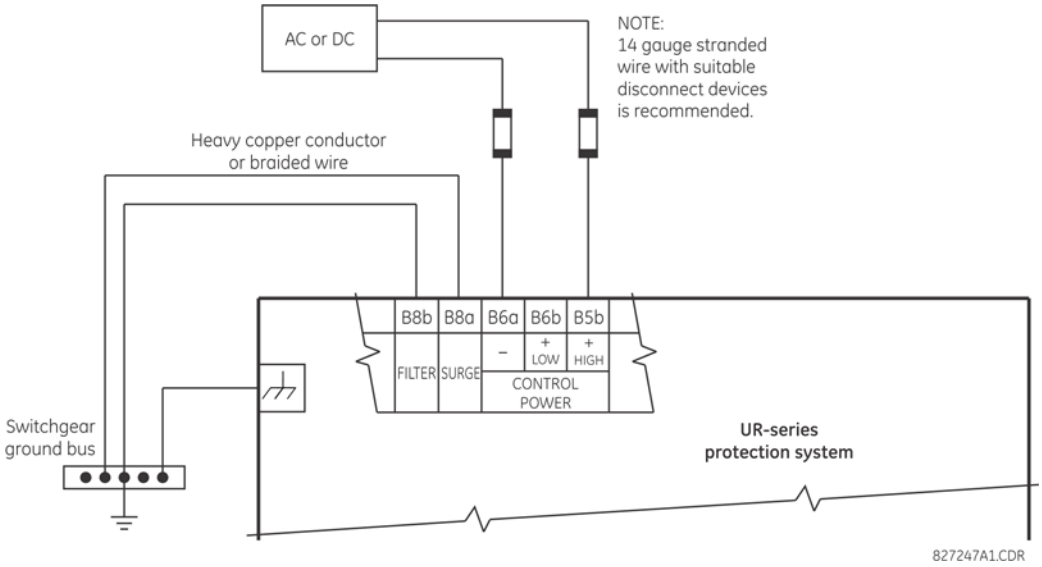
The UR samples its AC signals at 64 samples per cycle, that is, at 3840 Hz in 60 Hz systems, and 3200 Hz in 50 Hz systems. The sampling rate is dynamically adjusted to the actual system frequency by an accurate and fast frequency tracking system.

The analog/digital converter has the following ranges of AC signals:

Table 3-2: Power supply LED on module

LED indication	Power supply
Continuous on	OK
On/off cycling	Failure
Off	Failure or no power

Figure 3-16: Control power connection



NOTE When using a G60 with a HardFiber system, before powering off the G60, save data in the compact flash memory using **Commands > Relay Maintenance > Save Non-Volatile Data**. When not saved or the relay loses power, up to the last two minutes of data is not saved to the compact flash memory.

When using an SH power supply module, after disconnecting power and powering up again, some measured values displayed can change from that last displayed. This is because there is not enough time for the compact flash to store data. Upon power up the last stored value displays.

3.3.4 CT/VT modules

The CT and VT inputs are analog current transformer and voltage transformer signals used to monitor AC power lines. The UR-series relays support 1 A and 5 A CTs.

A CT/VT module can have current or voltage inputs on channels 1 through 4 inclusive, or channels 5 through 8 inclusive. Channels 1 and 5 are intended for connection to phase A, and are labelled as such in the relay. Likewise, channels 2 and 6 are intended for connection to phase B, and channels 3 and 7 are intended for connection to phase C.

Channels 4 and 8 are intended for connection to a single-phase source. For voltage inputs, these channels are labelled as auxiliary voltage (VX). For current inputs, these channels are intended for connection to a CT between system neutral and ground, and are labelled as ground current (IG).

NOTICE Verify that the connection made to the relay terminals for nominal current of 1 A or 5 A matches the secondary rating of the connected CTs. Unmatched CTs can result in equipment damage or inadequate protection.

To connect to the module, size 12 American Wire Gauge (AWG) is used commonly; the maximum size is 10 AWG.

CT/VT modules can be ordered with a standard ground current input that is the same as the phase current input. Each AC current input has an isolating transformer and an automatic shorting mechanism that shorts the input when the module is withdrawn from the chassis. There are no internal ground connections on the current inputs. Current transformers with 1 to 50000 A primaries and 1 A or 5 A secondaries can be used.

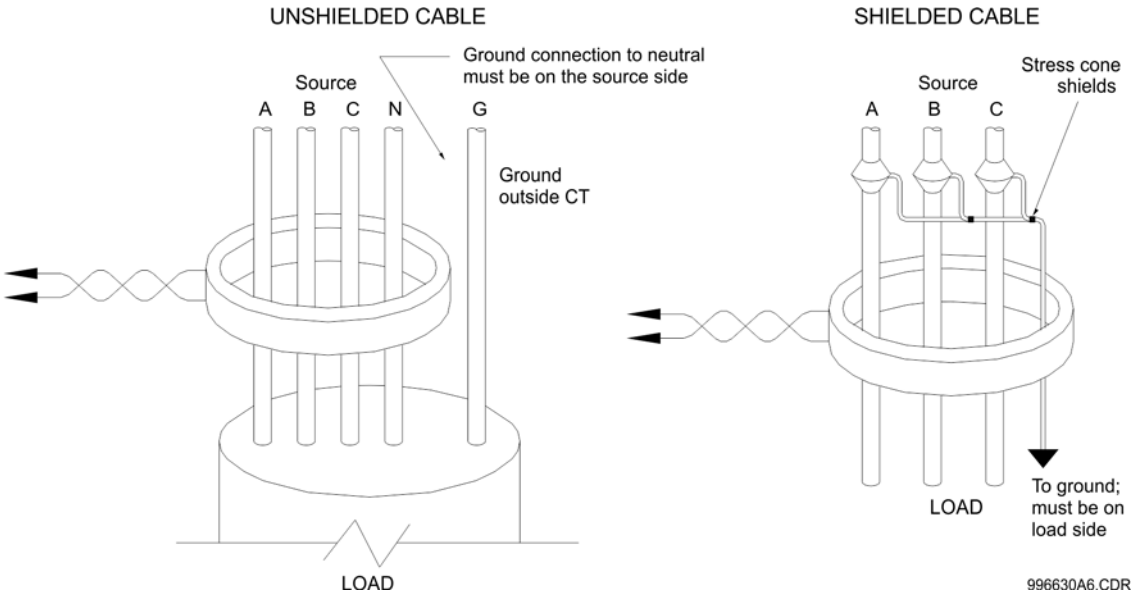
CT/VT modules with a sensitive ground input are also available. The ground CT input of the sensitive ground modules is 10 times more sensitive than the ground CT input of standard CT/VT modules. However, the phase CT inputs and phase VT inputs are the same as those of regular CT/VT modules.

These modules have enhanced diagnostics that can automatically detect CT/VT hardware failure and take the relay out of service.

CT connections for both ABC and ACB phase rotations are identical, as shown in the Typical Wiring Diagram.

The exact placement of a zero-sequence core balance CT to detect ground fault current is shown as follows. Twisted-pair cabling on the zero-sequence CT is recommended.

Figure 3-17: Zero-sequence core balance CT installation

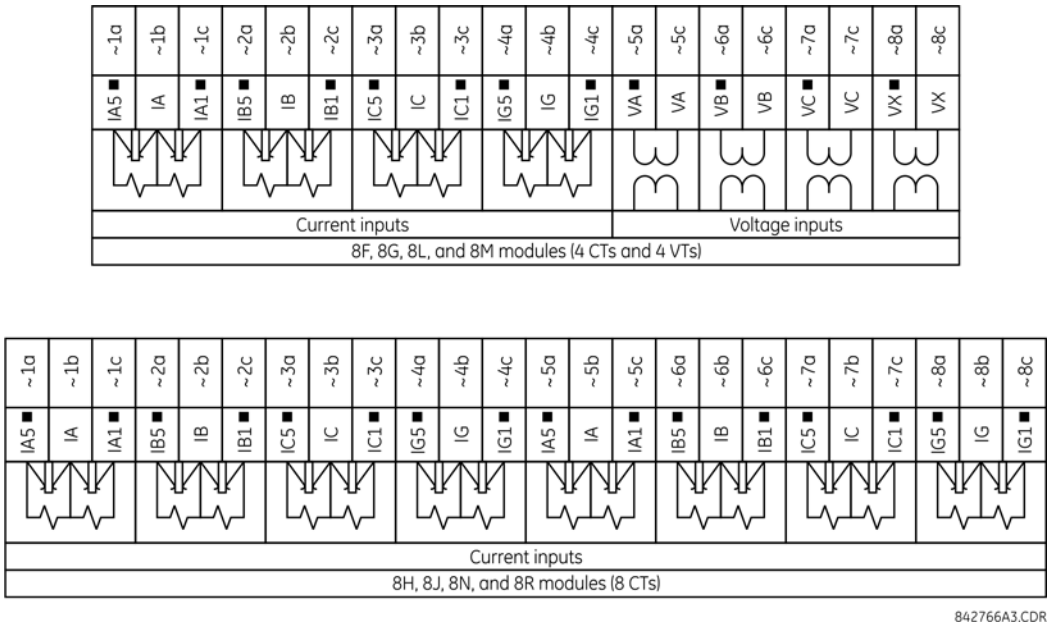


The phase voltage channels are used for most metering and protection purposes. The auxiliary voltage channel is used as input for the synchrocheck and volts-per-hertz features, which are optional features for some UR models.

NOTE

Substitute the tilde "~" symbol with the slot position of the module in the following figure.

Figure 3-18: CT/VT module wiring



3.3.5 Process bus modules

The G60 can be ordered with a process bus interface module. The module interfaces with the HardFiber Process Bus System, or HardFiber Brick, allowing bidirectional IEC 61850 fiber-optic communications with up to eight HardFiber Bricks. The HardFiber system integrates seamlessly with the existing UR-series applications, including protection functions, FlexLogic, metering, and communications.

This process bus system offers the following benefits:

- Reduces labor associated with design, installation, and testing of protection and control applications using the UR by reducing the number of individual copper terminations
- Integrates seamlessly with existing UR applications, since the IEC 61850 process bus interface module replaces the traditional CT/VT modules
- Communicates using open standard IEC 61850 messaging

For details on the HardFiber system, see its Instruction Manual.

3.3.6 Contact inputs and outputs

Nearly all contact input/output modules have 24 terminal connections. The connections are arranged typically as three terminals per row, with eight rows in total. A given row of three terminals can 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.

The contact inputs are grouped with a common return. The input/output modules have three versions of grouping: four inputs per common return, five inputs per common return on a high-density module, and two inputs per common return. When a contact input/output module is ordered, four inputs per common is used. If the inputs must be isolated per row, then two inputs per common return are selected (4D module). If the space limitation in the relay requires use of a high-density input module (6W), five inputs share one common return and the module has six banks of inputs.

The tables and diagrams that follow illustrate the module types (6A and so on) and contact arrangements that can 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.

panel, then check that the graphical front panel is plugged into the upper connection, not the lower silver connection on the CPU module.

To upgrade software and firmware.

1. Upgrade the EnerVista software as outlined in this chapter.
2. Input the IP address and subnet mask of the relay on the front panel under **Settings > Product Setup > Communications > Network**, and input the gateway address under **Default IPv4 Route**.
3. Upgrade the firmware in the EnerVista software as outlined in this chapter, for example under **Maintenance > Update Firmware**.

   If you see error messages after the upgrade, disconnect power to the relay and shut down the software, then start both again. If you see a flashing message about front panel communications trouble, check the connection of the graphical front panel to the CPU module.
4. In the EnerVista software, click the **Device Setup** button and refresh the order code for the device.
5. Set the relay to Programmed mode under **Settings > Product Setup > Installation**.
6. Update the EnerVista software to recognize the graphical front panel under **Maintenance > Change Front Panel**. This setting does not display for units already with a graphical front panel.

11.11 Replace module

This section outlines how to replace a module.

⚠WARNING **Withdraw or insert a module only when control power has been removed from the unit, and be sure to insert only the correct module type into a slot, else personal injury, damage to the unit or connected equipment, or undesired operation can result.**

NOTICE To avoid damage to the equipment, use proper electrostatic discharge protection (for example, a static strap) 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. Replace modules only with like modules in their original factory configured slots.

To replace a module:

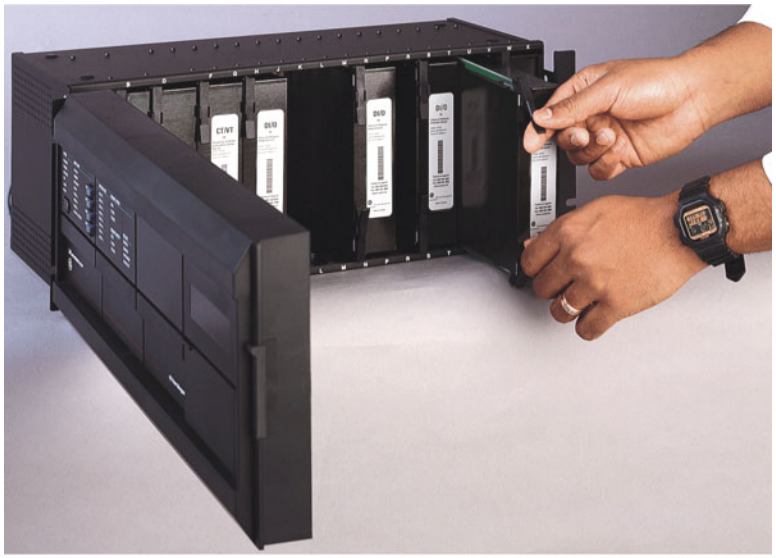
1. Open the enhanced front panel to the left once the thumb screw has been removed. This allows for easy access of the modules for withdrawal. The new wide-angle hinge assembly in the enhanced front panel opens completely and allows easy access to all modules in the G60.

Figure 11-26: Modules inside relay with front cover open (enhanced front panel)



The standard front panel can be opened to the left once the black plastic sliding latch on the right side has been pushed up, as shown below.

Figure 11-27: Removing module (standard front panel)



2. With power to the unit off, disconnect individually the connections at the front and back of the module before removing the module from the chassis.

   For any Process Card/process bus module in slot H for use with a HardFiber Brick, also remove the two screws at the back that attach the module to the chassis.

3. To properly remove a module, pull simultaneously the ejector/inserter clips, located at the top and bottom of the module. Record the original location of the module to ensure that the same or replacement module is inserted into the correct slot. While modules with current input provide automatic shorting of external CT circuits, for CT/VT modules it is recommended to short/isolate external circuits accordingly for maximum safety.

4. To properly insert a module, 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 is fully inserted.

NOTE When adding a module (versus replacing a module), check that settings have not changed. Depending on the module, settings can reset to default values.

NOTE The new CT/VT modules can only be used with new CPUs; similarly, old CT/VT modules can only be used with old CPUs. In the event that there is a mismatch between the CPU and CT/VT module, the relay does not function and a DSP ERROR or HARDWARE MISMATCH error displays.

11.12 Battery

A battery powers the real time clock on startup of the device.

When required, the battery can be replaced. The power supply module contains the battery. The battery type is 3 V cylindrical.

11.12.1 Replace battery for SH/SL power supply

When required, the battery can be replaced. The power supply module contains the battery.