Littelfuse
STARTCO

3714 Kinnear Place Saskatoon, SK Canada S7P 0A6 Ph: (306) 373-5505 Fx: (306) 374-2245 www.littelfuse.com/relayscontrols

EL731 MANUAL

AC/DC SENSITIVE EARTH-LEAKAGE RELAY

REVISION 6-F-032816



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Document Number: PM-1005-EN
Printed in Canada.

Factory default password is 1111

New Password

See Section 3.2.4.

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1 INTRODUCTION

1.1 GENERAL

The EL731 is a microprocessor-based earth-leakage relay for AC, DC, combined AC/DC, and variable-frequency power circuits supplied by solidly or resistance-earthed systems that require earth-leakage detection as low as 30 mA (under default configuration). Earth-leakage metering and two setting levels (alarm and trip) are provided. It is uniquely suited for sensitive earth-fault protection for adjustable-speed drive (ASD) circuits that often operate at low speeds. A temperature-sensor input provides metering and protection for a motor or ASD.

Settings and configuration selections provide frequency-response ranges of 0 to 90 Hz, 20 to 90 Hz, 190 to 6,000 Hz, 20 to 6,000 Hz, 20 to 3,000 Hz and 0 to 6,000 Hz.

Three Form-C (changeover) output relays with normally closed and normally open contacts can be programmed for various functions and can be set to operate in the fail-safe or non-fail-safe modes for undervoltage or shunt-trip applications.

Additional features include a 2 x 16-character OLED alphanumeric display, current and temperature metering, programming and menu-navigation push buttons, password security, LED trip and alarm indication, auto-reset alarms and latching trips with front-panel and remote reset, trip memory, 4- to 20-mA analog output, CT verification with LED indication, and conformal-coated circuits.

Earth-leakage current is sensed by one or two EFCT-series core-balance zero-sequence current transformers. The alarm- and trip-level ranges of the earth-leakage circuit are 30 to 5,000 mA. To modify this range, firmware settings for each CT input allow configuring the number of phase-conductor turns that are passed through the CT-primary window – the lowest pickup configuration is 6 to 1,000 mA, with a setting of five turns. With two CT's connected, the EL731 performs independent metering. The trip-time delay has a definite-time characteristic and is configurable from instantaneous to two seconds in millisecond increments.

1.2 EL731 FEATURES

1.2.1 PROTECTIVE FUNCTIONS

- AC earth overcurrent (50G/51G, 50N/51N)
- DC earth overcurrent (76G)
- PTC overtemperature (49)
- RTD temperature (38, 49)

1.2.2 METERING

- Earth-leakage current, CT1 and CT2
- RTD temperature or PTC status

1.2.3 DATA LOGGING

- Trip counters
- Alarm counters

1.2.4 INPUTS AND OUTPUTS

- AC earth-leakage current transformer (CT2)
- AC/DC earth-leakage current transformer (CT1)
- Remote reset input (one shot operation)
- Network communications (optional)
- 4-20-mA analog output, programmable, loop powered
- Temperature-sensor input, Pt100 RTD or PTC
- Three output relays, programmable

1.2.5 OPERATOR INTERFACE

- 2 x 16 OLED alphanumeric display
- Display-control and programming buttons
- LED status indication

1.2.6 COMMUNICATIONS INTERFACE

The EL731 interface for optional network communications adapters supports DeviceNet™, Profibus®, EtherNet/IP®, and Modbus® TCP. Units purchased without a communications adapter can be field-upgraded.

An optional firmware upgrade module is available for firmware upgrades.

For ordering information, see Section 7.

2. INSTALLATION

Outline and details for panel-mounting an EL731 are shown in Fig. 1. Insert the EL731 through the cutout and slip the panel-mount clamp over the EL731 body. Slide the panel-mount clamp forward to engage the latch tabs with the mating body retainer grooves. Lock the unit in place by tightening the four clamp screws against the panel.

NOTE: Do not over tighten the clamp screws as this might deform the clamp and release the latch tabs. The maximum recommended torque is 0.28 N·m (2.5 lbf·in).

Outline and details for surface-mounting the EL731 are shown in Fig. 2. A detailed instruction sheet is included with the optional AC700-SMK Surface-Mounting Hardware Kit.

If an optional AC700-CVR-00 Weatherproof Cover is used, follow the included installation instructions. See Figs. 5 and 6.

2.1 SYSTEM WIRING

A typical connection diagram for the EL731 is shown in Fig. 4 and terminal-layout diagrams are shown in Fig. 3.

A minimum 75°C (167°F) wire-temperature rating is required.

2.1.1 SUPPLY VOLTAGE

Provide supply voltage from the line side of the controller or from an independent source. Connect supply voltage to terminals 14 and 15 (L1, L2/N) as shown in Figs. 3 and 4. In 120-Vac systems, L2/N is designated as the neutral conductor. For direct-current power supplies, use L1 for the positive terminal and L2/N as the negative terminal. Connect terminal 16 (⏚) to earth.

2.1.2 CURRENT SENSOR CONNECTIONS

This earth-leakage relaying system consists of an EL731 earth-leakage relay and one or two EFCT-series current sensors connected as shown in Fig. 4. The system can use CT1 and CT2 individually or combined. See Section 4.

Pass the phase conductors through the CT window(s) and position them in the centre of the opening (for 4-wire and single-phase systems, also pass the neutral conductor through the CT window). Do not pass earth conductors through the CT window. In applications that require shields or drain wires to pass through the CT window, return them through the CT window before connecting them to earth. For applications utilizing the primary-turns feature, pass the phase conductors through the opening additional times as required (maximum of 5).

Using shielded twisted-pair cable, connect CT1 to terminals 7 and 8 and connect the shield to terminal 6. Current-sensor connections are not polarity sensitive. See Figs. 9, 10 and 11 for current-sensor dimensional drawings.

Using shielded twisted-pair cable, connect CT2 to terminals 10 and 11 and connect the shield to terminal 9. Current-sensor connections are not polarity sensitive. See Figs. 9, 10 and 11 for current-sensor dimensional drawings.

Each EFCT-series sensor includes 6 m (19.2') of cable.

NOTE: CT1 emits an audible tone when operating properly.

2.1.3 ANALOG OUTPUT

The 4-20-mA analog output is loop powered. Connect as shown in Fig. 4. The analog output is isolated to 120 Vac from all other EL731 terminals.

2.1.4 PTC OR RTD INPUT

The temperature-sensor input can be configured for either RTD or PTC operation. Connect as shown in Fig. 4.

Select the sensor type in the *Setup* | *Hardware* | *Temp Sensor* menu.

2.1.5 COMMUNICATIONS (OPTIONAL)

The EL731 supports optional communications upgrade adapters which install through the side of the enclosure as shown in Fig. 7.

To field-install an AC700-CUA-series Communications Upgrade Adapter, follow this procedure:

- Remove supply voltage from the EL731.
- Remove the adapter access cover on the side of the EL731.
- Insert the adapter, and retain with the supplied screws.
- Apply supply voltage to the EL731.

With an EtherNet/IP or Modbus TCP communications adapter installed, a standard RJ45 network cable can be used to connect the EL731 to an EtherNet/IP or Modbus TCP network. Configure the interface using the IP Configuration Tool (IP Config) available at www.littelfuse.com/relayscontrols. The software requires a Microsoft Windows™ operating system. The Ethernet interface supports 10/100-Mbit, full- or half-duplex operation.

Connect the EL731 to the network using a standard Ethernet patch cable. Use of a crossover cable to connect the EL731 directly to the computer running IP Config is not recommended. A typical router will assign an IP address to all connected computers that are using DHCP. The EL731 is not configured to accept an IP address using DHCP.

If the EL731 is being set up for first time, it is recommended to only have one EL731 connected to the network to prevent communication errors.

With a DeviceNet communications adapter installed, a standard open-style device cable can be used to connect the EL731 to a DeviceNet network. Configure the address and baud rate through the EL731 front-panel interface or with Rockwell Automation's RSNetWorx software. The DeviceNet interface supports baud rates of 125, 250, and 500 kbps.

2.1.6 REMOTE RESET

If required, connect a normally open momentary switch to the remote-reset input (terminals 12 & 13) as shown in Fig. 4.

2.1.7 RELAY OUTPUTS

The EL731 has three programmable Form-C (changeover) relay outputs. Functional assignments are Trip, Alarm, Watchdog or Current Detected. See Section 3.2.3.3.

2.2 CALIBRATION

If the low-frequency CT1 input is used, the EL731 must be calibrated in order to ensure an accurate current measurement.

To calibrate, connect an EFCT-series current sensor to the EL731 and ensure that no CT-primary current is present. Apply EL731 supply voltage and navigate to menu item *Setup* | *Protection* | *CT1 Earth Fault* | *Calibrate.* Press Enter to begin the calibration process. The CT LED will flash, during the calibration process, which takes about 30 seconds.

If the CT is replaced, this procedure must be repeated to maintain current-measurement accuracy.

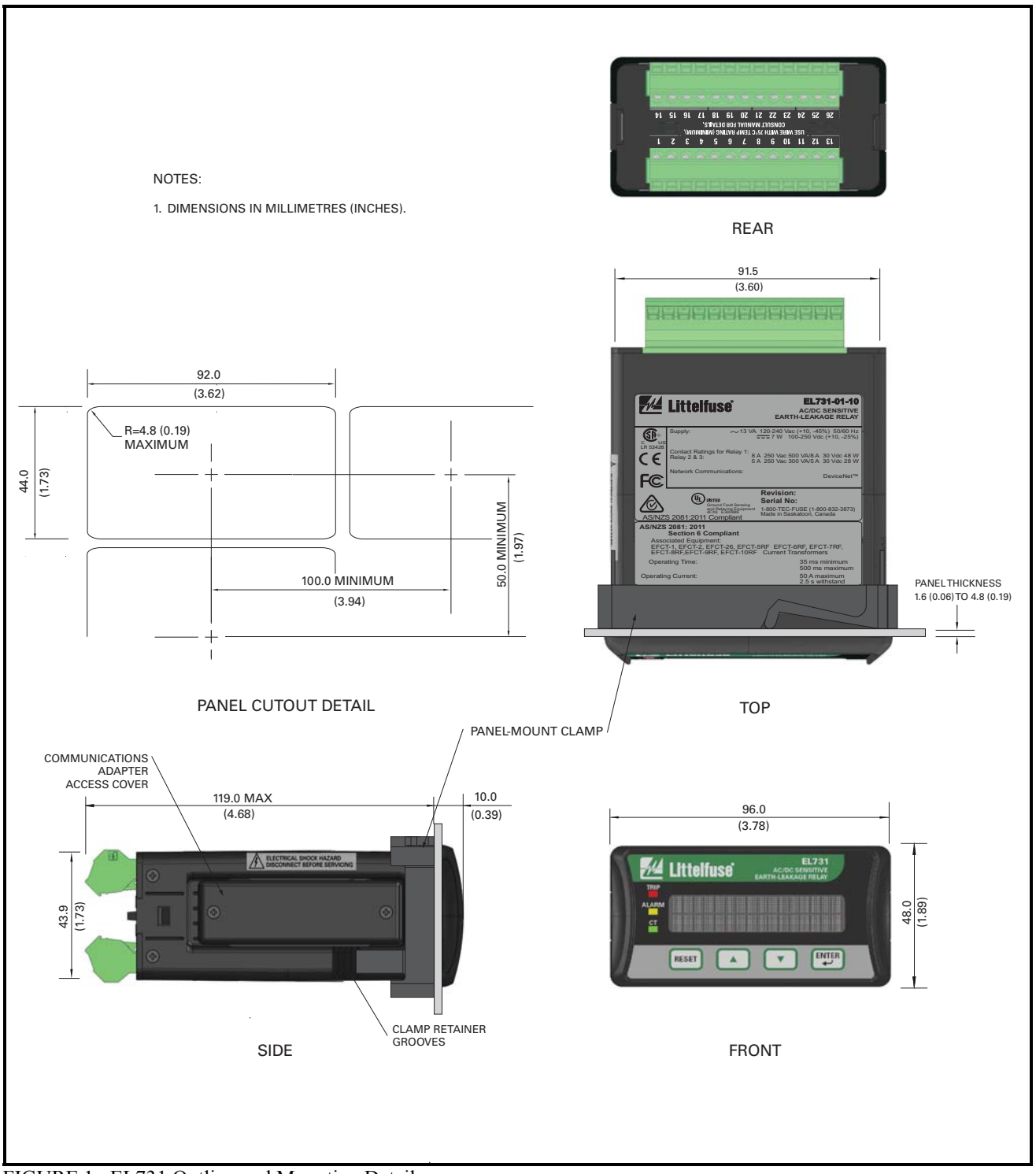


FIGURE 1. EL731 Outline and Mounting Details.

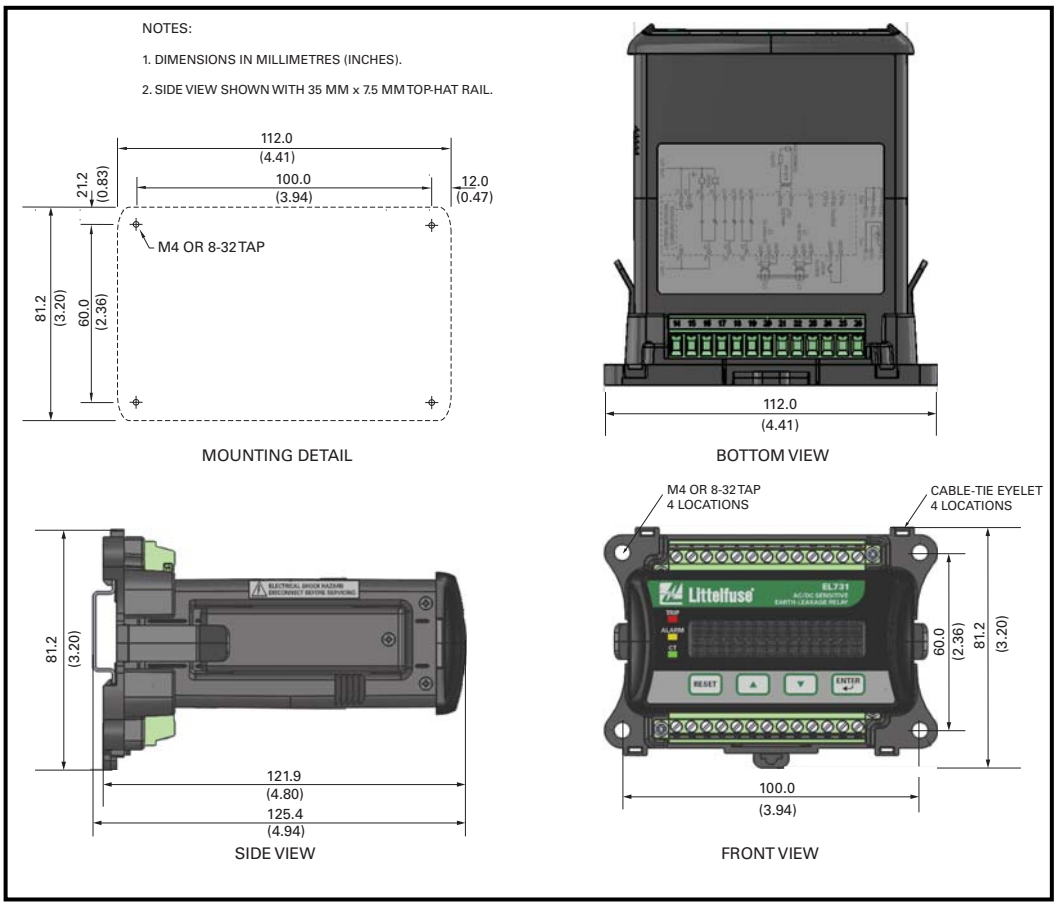


FIGURE 2. AC700-SMK Outline and Mounting Details.

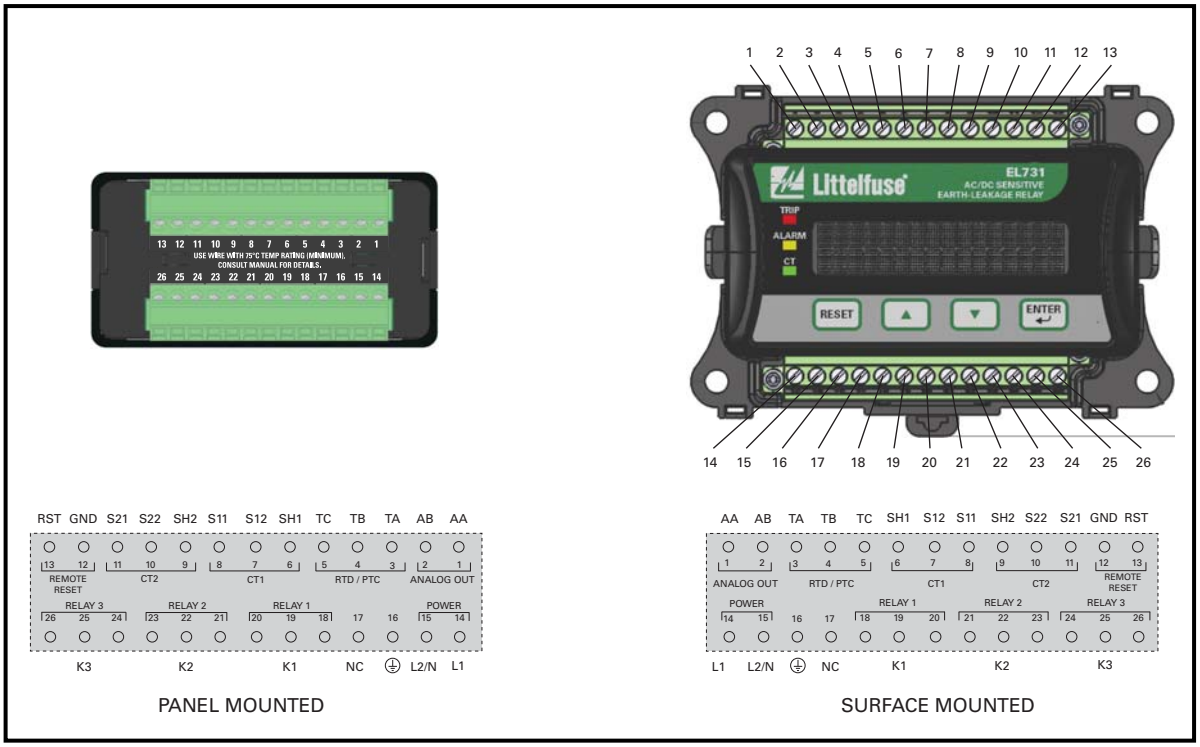


FIGURE 3. Panel and Surface Mounting Connections.

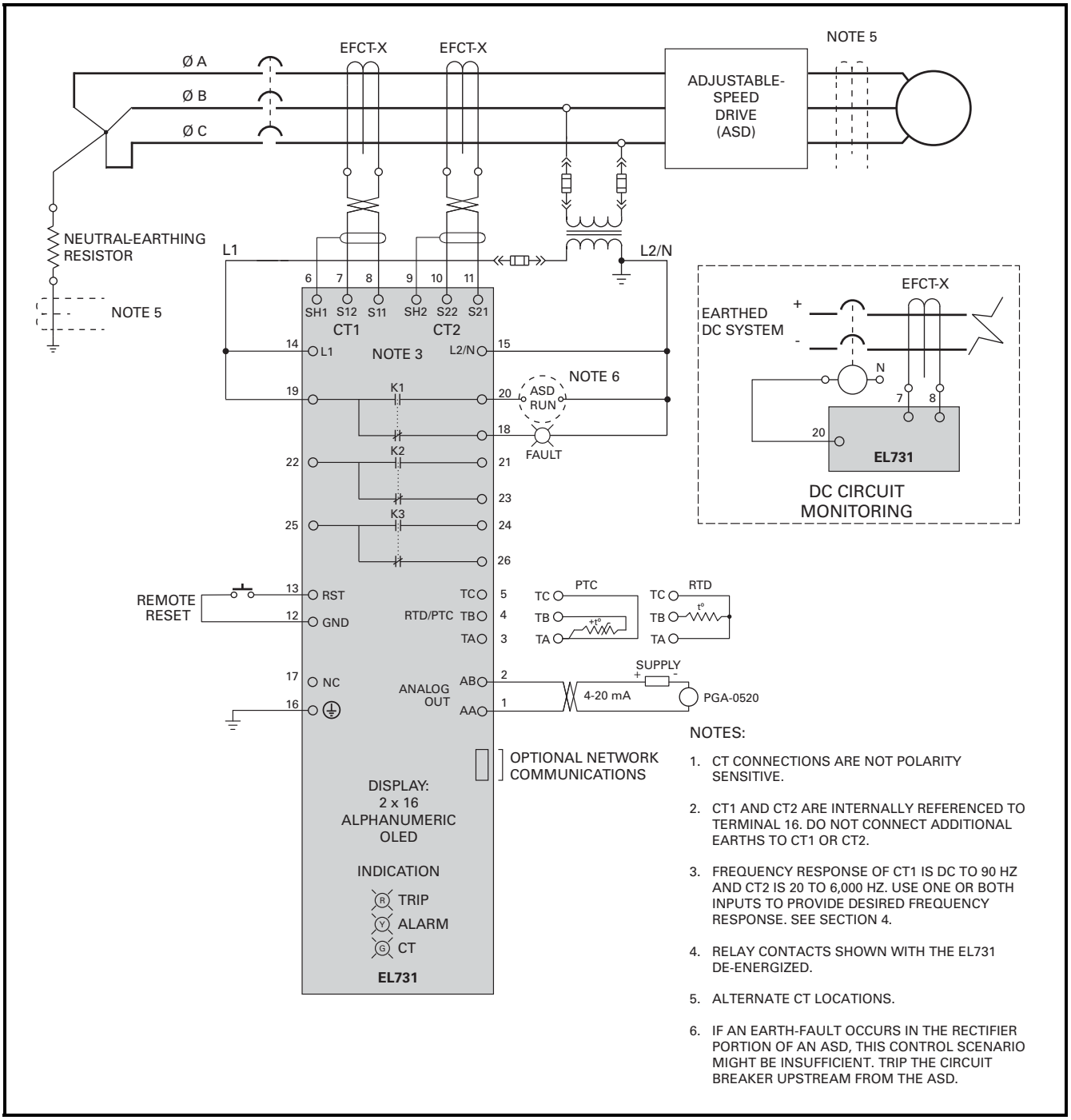
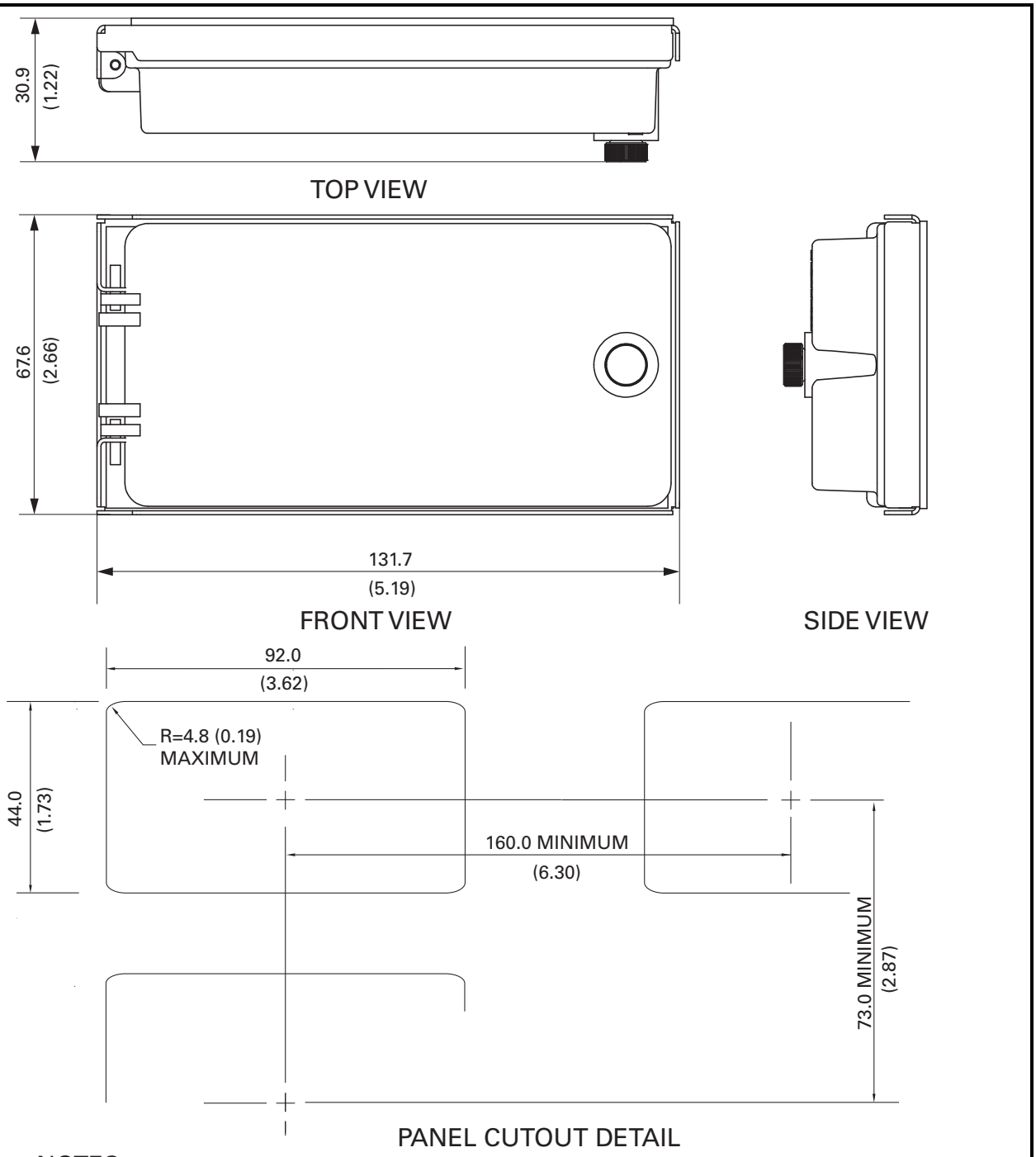


FIGURE 4. Connection Diagram.



NOTES:

1. DIMENSIONS SHOWN IN MILLIMETRES (INCHES).
2. TIGHTENING TORQUE 0.02 N·M (0.18 LBF·IN).
3. POLYCARBONATE FRONT COVER CAN BE CLEANED USING WATER, METHANOL, OR ETHANOL.

FIGURE 5. AC700-CVR-00 Weatherproof Cover Outline.

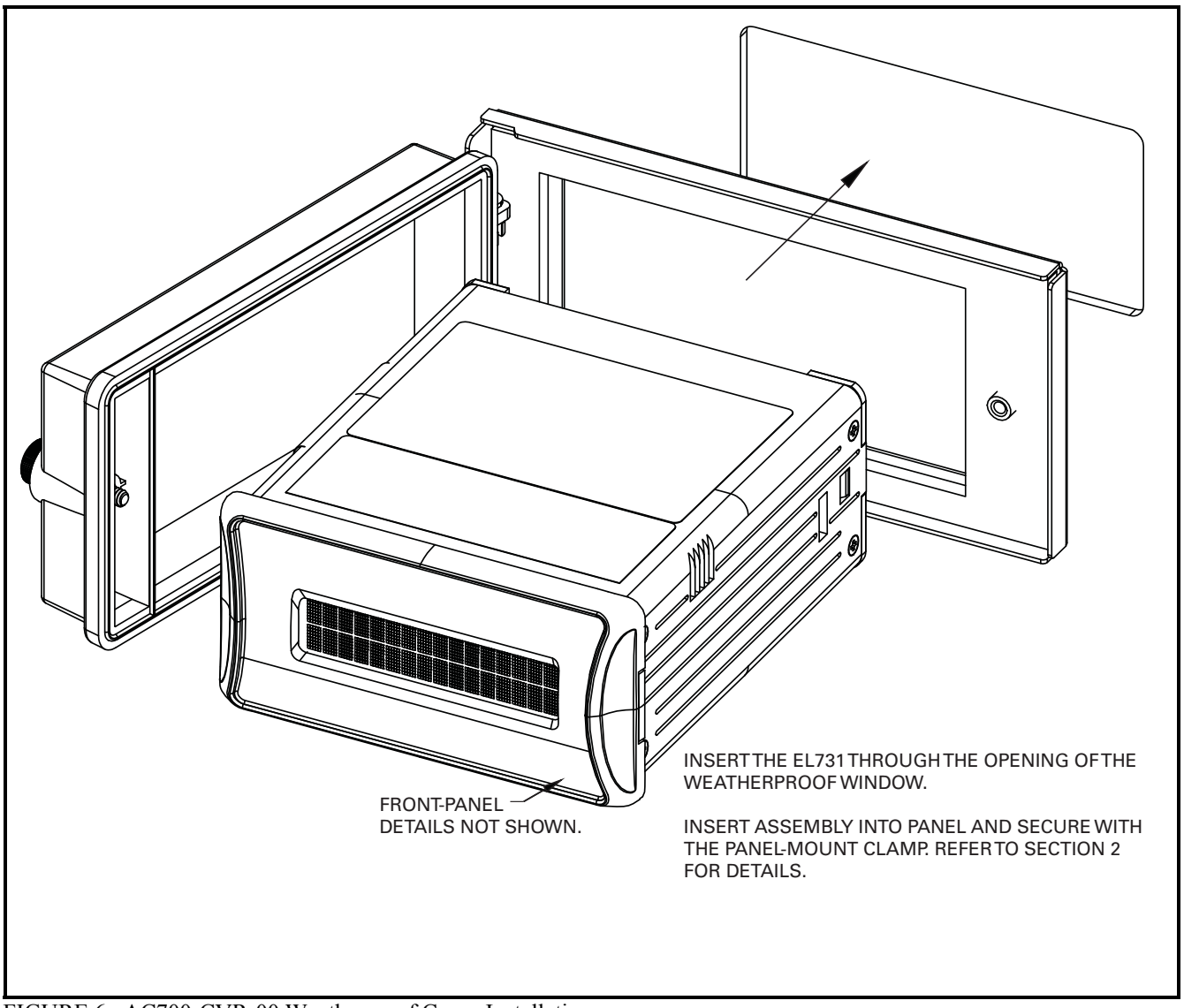


FIGURE 6. AC700-CVR-00 Weatherproof Cover Installation.



FIGURE 7. EL731 with installed EtherNet/IP™ Communications Upgrade Adapter (AC700-CUA-03).



FIGURE 8. EL731 with Firmware Upgrade Module (AC700-CUA-00).

3. OPERATION AND SETUP

3.1 DISPLAY AND INDICATION

The EL731 front panel has three LED's, a 2-line x 16-character alphanumeric OLED display and four push buttons to navigate through programming, status, and system-information menus. The display will revert to screen-saver mode after 10 minutes. Press any button to exit the screen saver.

The RESET button is used to clear an earth-leakage or overtemperature trip. The fault condition must no longer be present to allow a reset. Continually pressing the reset button will not prevent a trip.

The RESET button has a second function that is useful when navigating the menus. If the button is pressed for a short time, upon release the active menu item will exit, either returning to the previous menu item or the status screen.

The up and down arrow buttons (▲▼) are used to navigate the menu system or modify settings.

The ENTER button is used to select menu items and to choose settings.

All EL731 settings can be accessed using the EL731 menu system or the optional network communications interface. In the following sections, menu items and setup parameters are listed in italics and are shown in the format displayed on the OLED display.

Menu selection is in the following format:

Menu 1 | *Sub Menu 1* | *Sub Menu 2* | *Sub Menu 3* |…

When browsing a selection list, an asterisk (*) indicates the active item. If the intent is to exit the list and not to change the setting, press ENTER on the selection that has the asterisk (*).

If the item is a string (or numerical) input and no change is desired, press ENTER until the display returns to the menu system. To exit a main-menu list, scroll and select *Exit*, or press the RESET button.

A menu map is provided in Appendix A at the end of this manual.

3.1.1 FRONT-PANEL LED INDICATION

3.1.1.1 TRIP

The red LED labelled TRIP indicates a trip condition when flashing. Refer to Table 1 for applicable flash codes.

TABLE 1. TRIP LED FLASH CODES

FAULT	CODES
CT1 Earth Fault	1 Short, 1 Long
CT2 Earth Fault	2 Short, 1 Long
CT1 Detection Failure	3 Short, 1 Long
CT2 Detection Failure	4 Short, 1 Long
NVRAM Error	5 Short, 1 Long
CT1 Calibration Failure	6 Short, 1 Long
RTD/PTC Trip	7 Short, 1 Long
User Test	8 Short, 1 Long
Watchdog	Fast Flash

Trip cause is also available on the OLED display through the *Messages* | *State* menu item.

3.1.1.2 CT STATUS

The green LED labelled CT will flash during CT1 calibration. It will be solid green when CT connections are correct, and off when a CT is connected incorrectly.

3.1.1.3 ALARM

The yellow LED labelled ALARM will be on when measured current is above the alarm setting.

3.1.2 COMMUNICATIONS-MODULE LED INDICATION AND STATUS

See the associated interface manual, available at www.littelfuse.com/relayscontrols.

3.2 MAIN MENUS

The "top" menu item (select *Exit* in the main menu) displays earth-leakage current(s) as a numeric percentage of full scale (5 A, depending upon the primary turns setting) and as a bar graph.

3.2.1 METERING

Menu: *Metering*

With *Metering* selected in the main menu, press the ENTER button to display a list of metering options. Use the Up and Down arrow buttons to scroll through the options list. Press the ENTER button to display the selected information.

Information available: CT1 primary current (mA), CT2 primary current (mA), combined CT1 and CT2 current (mA), internal EL731 temperature (°C and °F), PTC status, and RTD temperature (°C and °F).

The CT2 metering range is trip-level dependent. When the CT2 trip level is set to less than 250 mA, the CT2 meter range is 0 to 2.5 A. When the CT2 trip level is set to greater than or equal to 250 mA, the meter range is 0 to 5 A.

3.2.2 MESSAGES

Menu: *Messages*

Selecting this menu item allows the trip state, alarm state, trip counter, alarm counter, system uptime, and running time to be viewed.

System uptime is the amount of time since the last restart or supply voltage cycle. Running time is the total amount of time the system has been in operation, and is retained through power cycles.

3.2.3 SETUP

See Appendix B for a Setup Summary and Setting Record.

3.2.3.1 EARTH-FAULT PROTECTION

Menu: *Setup* | *Protection* | *CTx Earth Fault*

The Earth Fault *Enable/Disable* menu enables or disables current monitoring through the selected CT input. When enabled, the system checks to ensure the CT is connected properly. A trip will occur if an EFCT is not connected. See Section 3.1.1.1.

The *Primary Turns* menu sets the number of passes through the CT primary by the phase conductors. The range is 1 to 5 turns, where 1 is the default. If set to another value, ensure the phase conductors pass through the CT window the correct number of times. This setting affects the trip/alarm range.

The *Trip Time* menu sets the trip delay. The range is 0 to 2 seconds in millisecond increments where 0 indicates that as soon as current is detected above the Trip Level, a trip occurs.

The *Trip Level* menu sets the trip level. The default setting range is 30 mA to 5 A, but this is affected by the Primary Turns setting. The *Alarm Level* setting range is the same as the *Trip Level* range. Trips are latched, requiring a local or remote reset input, and alarms auto-reset.

The *Calibrate* menu applies to CT1 (0 to 90 Hz). When CT1 is used, the EL731 must be calibrated after installation. See Section 2.2.

The *Input Filter* menu applies to CT2 (20 to 6,000 Hz) and allows selection of different input filters. The available filters and their descriptions are shown in Table 2.

TABLE 2. CT2 INPUT FILTERS

FILTER	FREQUENCY RESPONSE
Full Range (Default)	20 to 6,000 Hz
90 Hz Low Pass Filter	20 to 90 Hz
190 Hz High Pass Filter	190 to 6,000 Hz
3 kHz Low Pass Filter	20 to 3,000 Hz

For full-spectrum protection, use CT1 and CT2 and select the 190 Hz High Pass Filter to avoid frequency overlap between the inputs.

3.2.3.2 TEMPERATURE PROTECTION

Menu: *Setup* | *Protection* | *PTC Local Temp*

Menu: *Setup* | *Protection* | *RTD Local Temp*

Menu: *Setup* | *Hardware* | *Temp Sensor*

The temperature-sensor input, at terminals 3, 4, and 5, can be configured as a PTC thermistor or a 100-ohm-platinum RTD (or disabled) in the *Setup* | *Hardware* | *Temp Sensor* menu. Overtemperature alarm and trip actions can be selected in the *Setup* | *Protection* | *PTC Temperature* menu, or in the *Setup* | *Protection* | *RTD Temperature* menu.

3.2.3.3 OUTPUT-RELAY ASSIGNMENTS

Menu: *Setup* | *Relay Outputs* | *Relay x*

Each of the three output relays can be assigned to one of the functions listed in Table 3. More than one output can be assigned the same function.

TABLE 3. OUTPUT-RELAY FUNCTIONS

FUNCTION	ASSIGNMENT OR ACTION	DEFAULT ASSIGNMENT
Trip	Relay de-energized in fail-safe mode when trip occurs. Fail-safe or non-fail-safe[1] mode selection is available.	Relay 1, Fail-safe Mode
Alarm	Relay de-energized in fail-safe mode when alarm is present. Fail-safe or non-fail-safe[1] mode selection is available.	Relay 2, Fail-safe Mode
Watchdog	Relay is energized in fail-safe mode when the supply voltage is applied and the EL731 is operating properly. Fail-safe or non-fail-safe mode selection is available.	Relay 3, Fail-safe Mode
Current Detected	Relay is energized in fail-safe mode when current is detected on CT1 or CT2. Fail-safe or non-fail-safe mode selection is available.	Fail-safe Mode

[1] Fail-safe only for AS/NZS 2081:2011 option.

The *Fail-safe Mode* setting for each output relay allows the individual output relay to be configured as fail-safe (normally energized) or non-fail-safe (normally de-energized).

The *Test* function performs a test of the specified relay. During the test, the relay is energized for one second and de-energized for one second. This sequence is performed once per test.

3.2.3.4 ANALOG OUTPUT

Menu: *Setup* | *Analog Output*

A 4–20-mA programmable current output is provided.

When *Analog % Level* is enabled the output is configured such that 20 mA corresponds to full scale of the selected CT Trip Level. When disabled it corresponds to the full scale of the selected CT.

CT Select selects which CT measurement will be represented by the analog output. The selections are *CT1*, *CT2*, and *Full Current*. When set to *Full Current*, the current measured by each CT makes up 50% of the total *Analog Output* level.

Output Filter passes the output through an averaging filter, providing a smoother analog output signal in noisier applications.

3.2.3.5 MISCELLANEOUS CONFIGURATION

Menu: *Setup* | *System Config*

Used to access additional system configuration elements described in the following sections.

3.2.3.5.1 PASSWORD

Menu: *Setup* | *System Config* | *Change Password*

Menu: *Setup* | *System Config* | *Password Enable*

Used to enable and change the EL731 password (four-character numeric field). When enabled, the password must be entered to change a set point. The default password is 1111.

3.2.3.5.2 RESET PASSWORD

Menu: *Setup* | *System Config* | *Chg Reset Pwd*

Menu: *Setup* | *System Config* | *Reset Pwd En*

Used to enable and change the EL731 reset password (four-character numeric field). When enabled, the reset password must be entered to reset the EL731. The default reset password is 1111.

3.2.3.5.3 MENU TIMEOUT

Menu: *Setup* | *System Config* | *Menu Timeout*

Used to set the time before the system times out due to lack of activity and the menu system returns to the main menu display (See Section 3.2). In *password* mode the password entered will be cleared. The timeout is measured from the last button press.

The display will revert to screen-saver mode 10 minutes after the menu timeout occurs.

3.2.3.5.4 DISPLAY FILTER

Menu: *Setup* | *System Config* | *Display Filter*

Used to enable an averaging filter for current displayed on the display through the metering menu. See Section 3.2.1.

3.2.3.5.5 MAINTENANCE

Menu: *Setup* | *System Config* | *Maintenance*

Used to clear trip and alarm counters, load defaults, restart the system, and display the model option, firmware version, build date, and serial number.

3.2.4 PASSWORD

Menu: *Password*

With password security active, all set points are locked. To enable programming, the password must be entered through the *Password* menu.

While navigating through the menus when a valid password has been entered, an asterisk (*) is shown at the beginning of the first line of the display.

3.3 TRIP RESET

The RESET button will clear a trip when pressed for 2.5 s if the fault is no longer present. Keeping RESET pressed will not prevent an alarm or trip. If the reset password is enabled, reset will not function until the password has been entered through the Password menu.

Momentarily connect Remote Reset terminals 12 and 13 for 2.5 s to reset a trip when the fault is no longer present.

If an optional network adapter is installed, an EL731 trip can be reset with a network command when the fault is no longer present, even if a reset password is enabled.

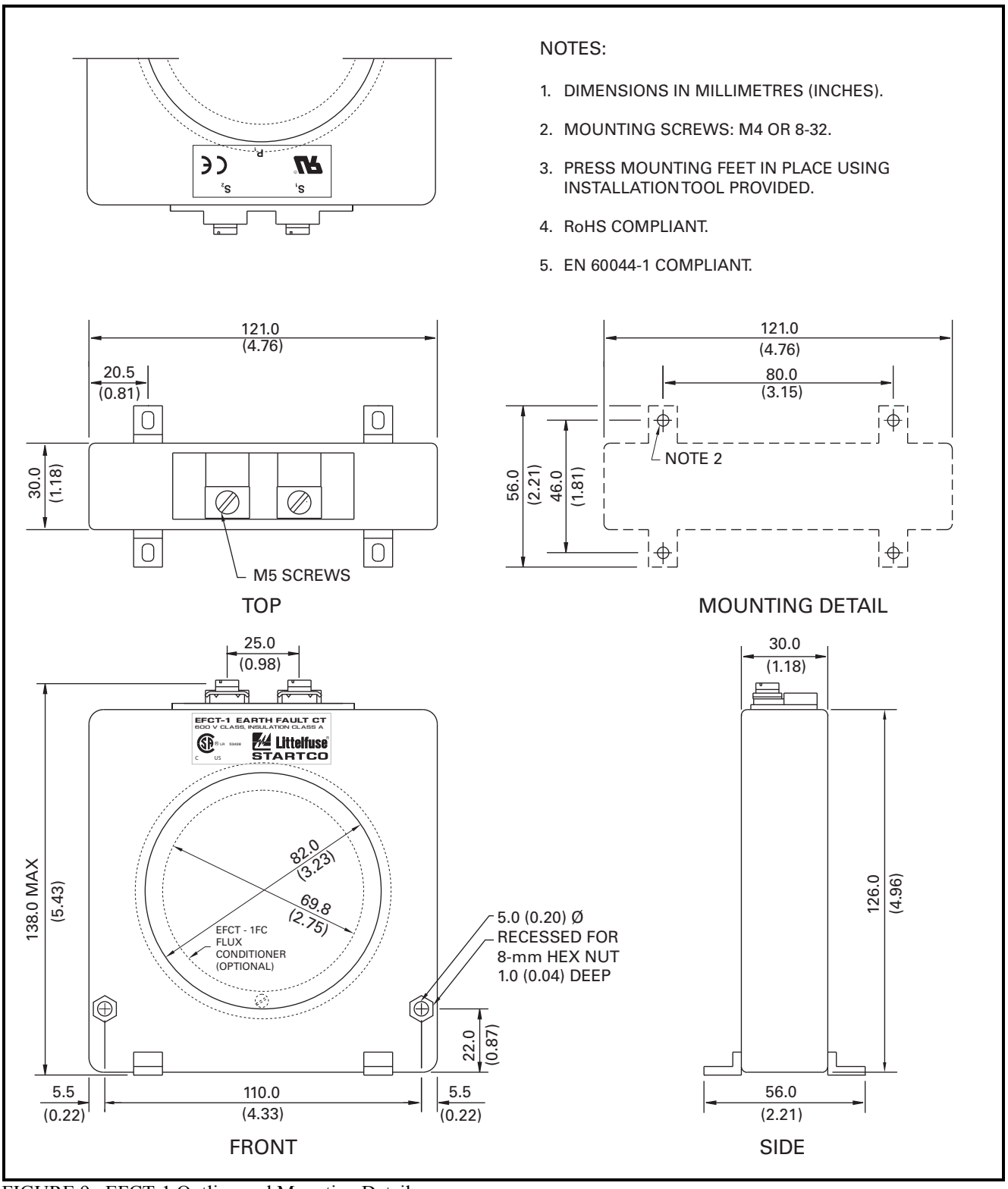


FIGURE 9. EFCT-1 Outline and Mounting Details.

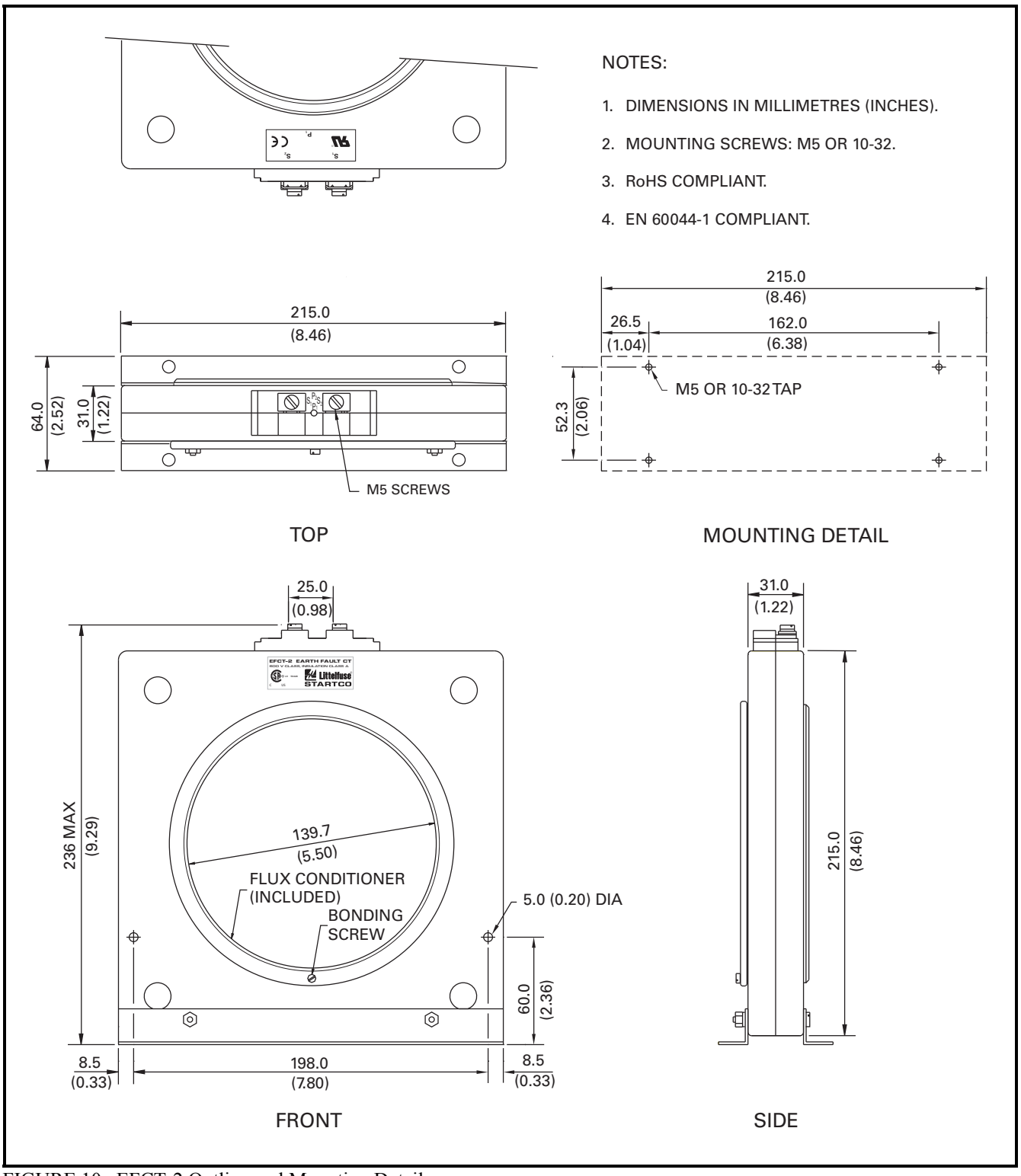
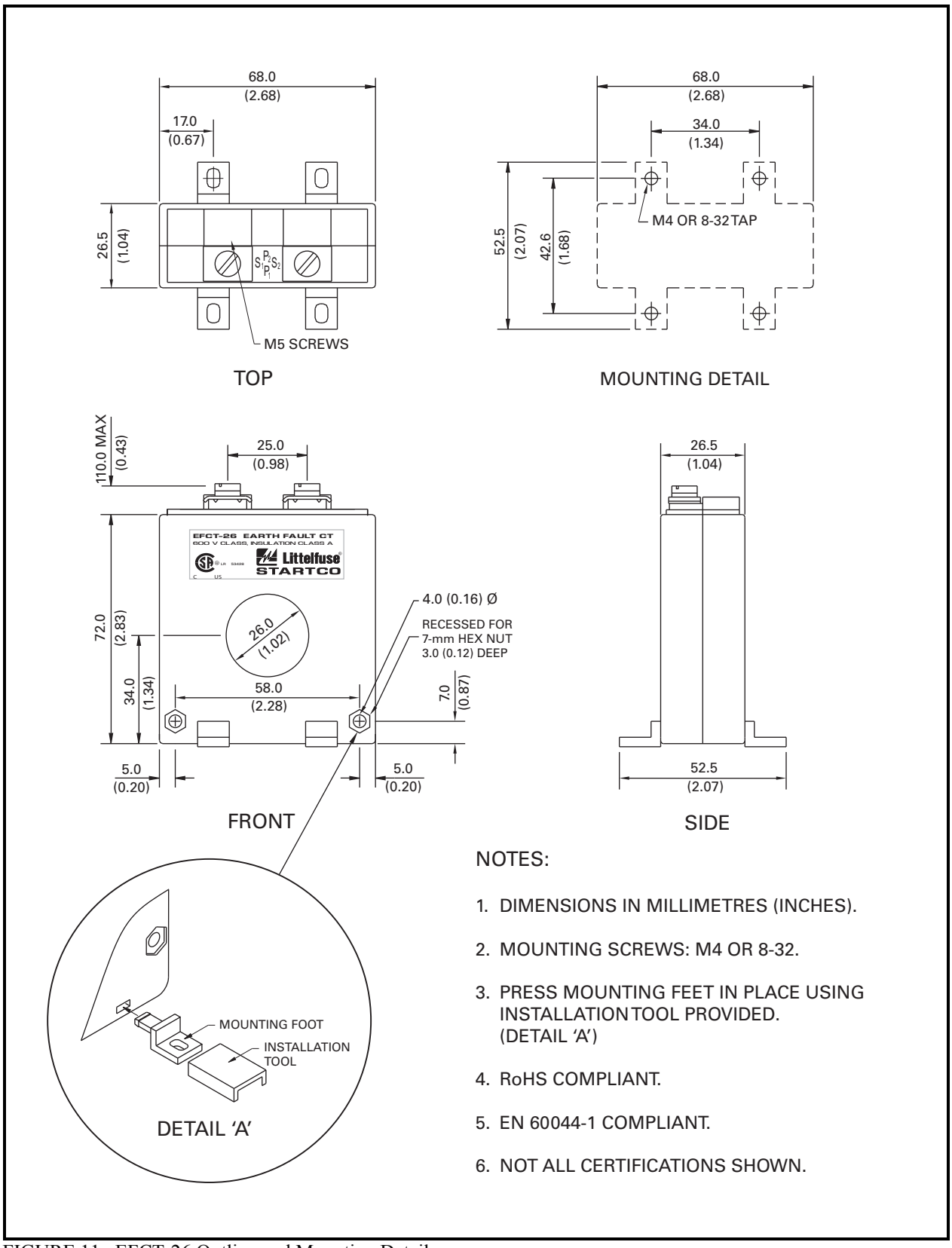


FIGURE 10. EFCT-2 Outline and Mounting Details.



NOTES:

1. DIMENSIONS IN MILLIMETRES (INCHES).
2. MOUNTING SCREWS: M4 OR 8-32.
3. PRESS MOUNTING FEET IN PLACE USING INSTALLATION TOOL PROVIDED. (DETAIL 'A')
4. RoHS COMPLIANT.
5. EN 60044-1 COMPLIANT.
6. NOT ALL CERTIFICATIONS SHOWN.

FIGURE 11. EFCT-26 Outline and Mounting Details.

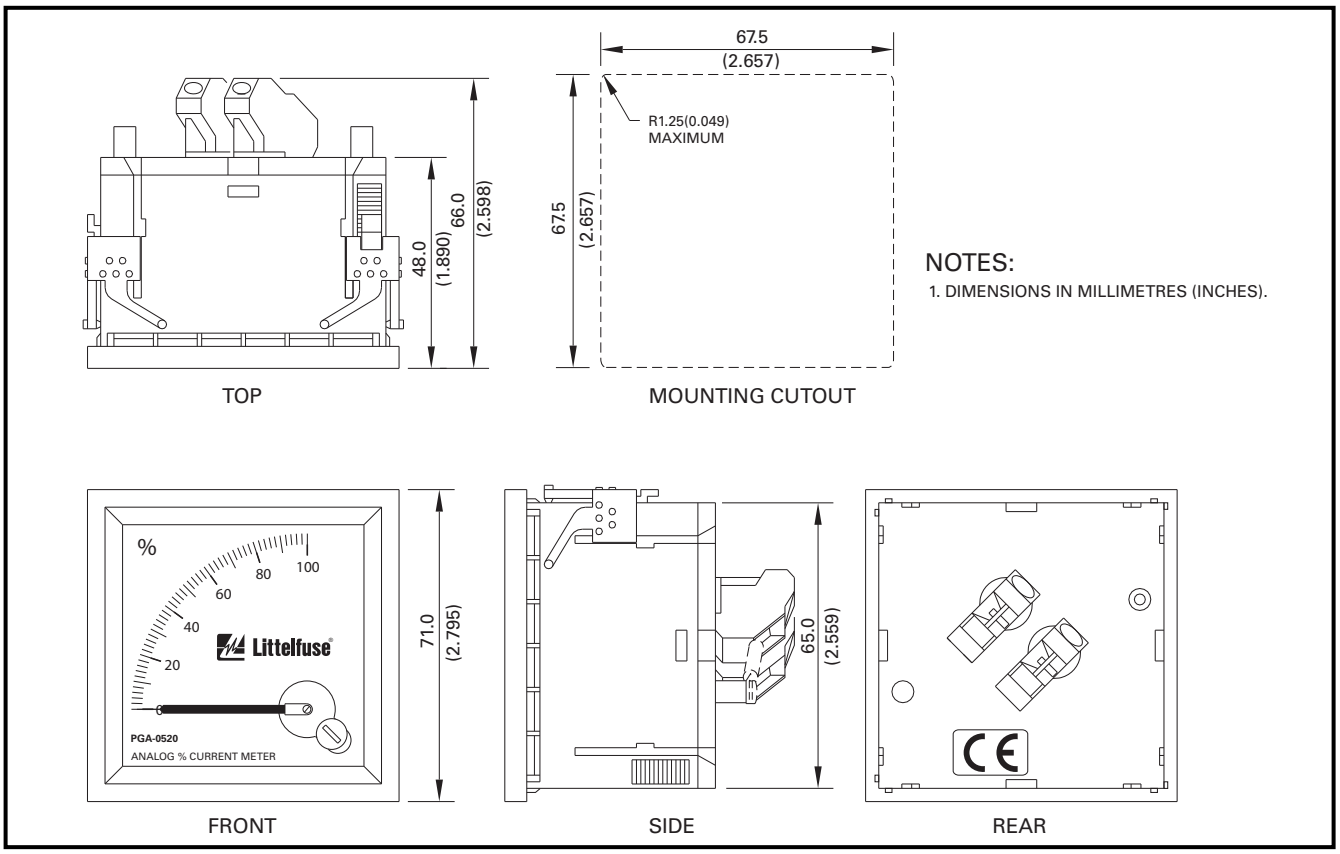


FIGURE 12. PGA-0520 Analog Percent Current Meter.

4. THEORY OF OPERATION

CT1 and CT2 have independent Trip and Alarm current-level and time-delay set points and independent metering. This enables different protection levels and separate metering for the high- and low-frequency ranges.

Full-current metering, summing CT1 and CT2 metering, is provided as an OLED metering selection, an analog output selection, and in optional network communications. To improve full-current-metering accuracy by avoiding band overlap, select the CT2 high-pass filter.

For CT-location and adjustable-speed-drive-application information, see Technical Note GF-11 "Ground-Fault Monitoring in Adjustable-Speed Drive Applications" located at www.littelfuse.com/relayscontrols.

4.1 CT1 THEORY OF OPERATION

The EL731 applies a known signal to the secondary winding of the EFCT-series sensor connected to input CT1. Current flowing in the EFCT primary affects this signal, and its magnitude can be accurately measured across a wide frequency range. The EL731 can measure current as low as 30 mA (6 mA with primary turns setting) in a frequency range of 0 to 90 Hz. If an open or short EFCT connection is detected, a trip occurs.

Compatible CT's include the EFCT-1, EFCT-2, and EFCT-26. See Section 7.

4.2 CT2 THEORY OF OPERATION

CT2 is a core-balance zero-sequence current-transformer application, with digital filtering to enable a wide spectrum of detection.

There are four digital-filter ranges: Full Range, 90 Hz Low Pass, 3 kHz Low Pass, and 190 Hz High Pass.

If an open or short EFCT connection is detected, a trip occurs. See Table 1.

Compatible CT's include the EFCT-1, EFCT-2, EFCT-26, and the EFCT-xRF series. See Section 7.

4.2.1 CT2 FULL RANGE FILTER

The *Full Range* filter selection configures the EL731 to respond to the entire frequency spectrum that CT2 is capable of monitoring–20 to 6,000 Hz.

4.2.2 CT2 90 HZ LOW PASS FILTER

The *90 Hz Low Pass* filter selection configures the EL731 to respond to only the low end of its frequency range–20 to 90 Hz.

4.2.3 CT2 3 kHz Low Pass Filter

The *3 kHz Low Pass* filter selection configures the EL731 to respond to the 20 to 3,000 Hz frequency range.

4.2.4 CT2 190 Hz High Pass Filter

The *190 Hz High Pass* filter selection configures the EL731 to respond to only the high end of its frequency range, 190 to 6,000 Hz.

5. Personal Computer Interface

5.1 Flash Memory Upgrade

The EL731 control program is stored in flash memory. This allows field upgrades to be made through the upgrade module (optional). The following are required:

- Windows PC with a USB interface and the SE-Flash program installed; SE-Flash is available at www.littelfuse.com/relayscontrols
- File containing the EL731 control program (.s19 file)
- USB cable or a TIA232 (through a CA-945 converter) with Ethernet cable
- AC700-CUA-00 Firmware Upgrade Module

6. Technical Specifications

6.1 EL731

Supply:
- Option 0 ..... 13 VA, 120 to 240 Vac (+10, - 45%), 50/60 Hz; 7 W, 100 to 250 Vdc (+10, - 25%)
- Option 1 ..... 7 W, 32 to 60 Vdc (+20,-25%), Nominal 48 Vdc; 9 VA, 24 to 44 Vac (±10%), 50/60 Hz
- Option 2 ..... 7 W, 16 to 30 Vdc (+20,-25%), Nominal 24 Vdc

DC and Low Frequency (Current Transformer 1):
- Frequency Response ..... DC to 90 Hz
- Measurement Method ..... True RMS
- Detection Method ..... CT Driven Oscillator
- Trip-Level Setting ..... 30 to 5,000 mA
  - Trip-Level Primary Turns
  - Lowest Alternate Range ... 6 to 1,000 mA
- Alarm-Level Setting ..... 30 to 5,000 mA
  - Alarm-Level Primary Turns
  - Lowest Alternate Range ... 6 to 1,000 mA
- Trip-Time Settings ..... 0 to 2 s
  - AS/NZS 2081 Option ..... 0 to 500 ms
- Trip Accuracies:
  - Trip Level ..... Maximum of 10%
  - Time Delay[1] ..... - 5% setting + 35 ms
- CT ..... EFCT series
- Cable Resistance ..... 1 Ω Maximum
- Thermal Withstand:
  - Continuous ..... 25 A Earth-Fault Current
  - 1 second ..... 400 A Earth-Fault Current
- Detection ..... CT Open & Short

AC/Carrier (Current Transformer 2):
- Frequency Response:
  - Full Range Filter ..... 20 to 6,000 Hz
  - 90 Hz Low Pass Filter ..... 20 to 90 Hz
  - 190 Hz High Pass Filter ... 190 to 6,000 Hz
  - 3 kHz Low Pass Filter ..... 20 to 3,000 Hz
- Measurement Method ..... True RMS
- Detection ..... CT Open & Short
- Meter Range:
  - Trip Level < 250 mA ..... 0 to 2.5 A
  - Trip Level ≥ 250 mA ..... 0 to 5 A
- Trip Level Setting ..... 30 to 5,000 mA
- Trip-Level Primary Turns
- Lowest Alternate Range ..... 6 to 1,000 mA
- Alarm Level Setting ..... 30 to 5,000 mA
- Alarm-Level Primary Turns
- Lowest Alternate Range ..... 6 to 1,000 mA
- Trip-Time Settings ..... 0 to 2 s
  - AS/NZS 2081 Option ..... 0 to 500 ms
- Trip Accuracies:
  - Trip Level:
    - 30 to 5,000 mA ..... Maximum of 10% (at 50/60 Hz)
  - Trip Time[1] ..... - 5% setting + 25 ms (at 50/60 Hz)
- CT ..... EFCT and EFCT-RF[2] series
- Cable Resistance ..... 1 Ω Maximum
- Thermal Withstand:
  - Continuous ..... 25 A Earth-Fault Current
  - 1 second ..... 400 A Earth-Fault Current
- Detection ..... CT Open, Short, and Saturation

Output Relays:
- Relay 1:
  - Contact configuration ..... N.O. and N.C., Form-C, changeover
  - Operating Mode ..... Fail-Safe/Non-Fail-Safe
  - CSA/UL Rating ..... 8 A Resistive, 250 Vac, 8 A Resistive, 30 Vdc
  - AS/NZS 2081 Rating ..... 8 A Resistive, 250 Vac, 500 VA; 8 A Resistive, 30 Vdc, 48 W
  - Supplemental Contact Ratings
    - Make/Carry 0.2 s ..... 30 A
    - Rating Code B300

Break:
dc ..... 50 W Resistive, 150 Vdc
ac ..... 2,500 VA (PF=1.0)
360 VA (PF=0.4)
Subject to maximums of 8 A and 250 V (ac or dc)

Relays 2 & 3:
Contact configuration ..... N.O. and N.C., Form-C changeover
Operating Mode ..... Fail-Safe/Non-Fail-Safe
CSA/UL Rating ..... 5 A Resistive, 250 Vac, 5 A Resistive, 30 Vdc
AS/NZS 2081 Rating ..... 5 A Resistive, 250 Vac, 300 VA
5 A Resistive, 30 Vdc, 28 W
Supplemental Contact Ratings:
Make/Carry 0.2 s ..... 30 A
Rating Code B300, R300
Break:
dc ..... 28 W Resistive
ac ..... 1,500 VA (PF=1.0)
360 VA (PF=0.4)
Subject to maximums of 5 A and 250 V (ac or dc)

Terminals ..... Wire Clamping, 24 to 12 AWG (0.2 to 3.3 mm^2) conductors
Tightening Torque ..... 0.50 N·m (4.4 lbf·in)

4-20 mA-Analog Output:
Type ..... Loop Powered
Range ..... 4 to 20 mA
Full Scale (20 mA) ..... 5 A or trip level
Loop Voltage ..... 8 to 26 Vdc
Load ..... 500 Ω (maximum with 24-Vdc supply)
Isolation ..... 120 Vac
Parameter ..... CT1, CT2, or Combined Current

Communication Options:
Network Protocol ..... See Ordering Options

Display Type ..... 2x16 OLED, yellow alphanumeric

Dimensions (Body):
Height ..... 44 mm (1.7")
Width ..... 92 mm (3.6")
Depth ..... 100 mm (3.9")

Dimensions (Bezel):
Height ..... 48 mm (1.9")
Width ..... 96 mm (3.8")
Projection ..... 14 mm (0.5")

Shipping Weight ..... 0.45 kg (1 lb)

PTC-Thermistor Input:
Cold Resistance ..... 1,500 Ω maximum at 20°C (68°F)
Trip Level ..... 2,800 Ω ± 100 Ω
Reset Level ..... 1,500 Ω ± 100 Ω
Sensor Current ..... 1 mA maximum

RTD Input:
RTD Type 3-wire Pt100
Range ..... -40 to 200°C (-40 to 392°F) with open and short detection
Sensor Current ..... 1 mA
Lead Compensation ..... 25 Ω maximum
Accuracy ..... 3°C (37°F)

Environment:
Operating Temperature ..... -40 to 60°C (-40 to 140°F)
Storage Temperature ..... -55 to 80°C (-67 to 160°F)
Humidity ..... 85% Non-Condensing
Enclosure Rating IP20
Vibration ..... EN60255-21-1 (Vibration, shock, and seismic)
EN60255-21-2 (Shock and bump)
Altitude ..... 2,000 m (6,562') maximum
Overvoltage Category II
Pollution Degree 3

PWB Conformal Coating ..... MIL-1-46058 qualified
UL QMJU2 recognized

NOTES:
(1) Trip Time at 1.5 x trip-level setting.
(2) Use SE-EFVC for prospective current >70 A. Accuracy applies for settings > 100 mA.

6.2 EMC TESTS

Verification tested in accordance with EN 60255-26:2013.

Radiated and Conducted Emissions ..... CISPR 11:2009, CISPR 22:2008, EN 55022:2010 Class A

Current Harmonics and Voltage Fluctuations ..... IEC 61000-3-2 and IEC 61000-3-3 Class A

Electrostatic Discharge ..... IEC 61000-4-2
± 6 kV contact discharge (direct and indirect)
± 8 kV air discharge

Radiated RF Immunity ..... IEC 61000-4-3
10 V/m, 80-1,000 MHz, 80% AM (1 kHz)
10 V/m, 1.0 to 2.7 GHz, 80% AM (1 kHz)

Fast Transient ..... IEC 61000-4-4
Zone B
± 2 kV (power supply port), ± 1 kV (all other ports)

Surge Immunity ..... IEC 61000-4-5
Zone B
± 1 kV differential mode
± 2 kV common mode

Conducted RF Immunity .... IEC 61000-4-6
10 V, 0.15-80 MHz, 80% AM (1 kHz)

Magnetic Field Immunity ..... IEC 61000-4-8
50 Hz and 60 Hz
30 A/m and 300 A/m

Power Frequency(1) ..... IEC 61000-4-16
Zone A: differential mode
100 Vrms
Zone A: common mode
300 Vrms

1 MHz Burst ..... IEC 61000-4-18
± 1 kV differential mode (line-to-line)
± 2.5 kV common mode

Voltage Interruption ..... IEC 61000-4-11, IEC 61000-4-29
0% for 10, 20, 30, 50 ms (dc)
0% for 0.5, 1, 2.5, 5 cycles (60 Hz)
IEC 61000-4-17
Level 4, 15% of rated dc value

NOTES:
(1) Remote-reset wiring is limited to 10 m (32').

6.3 CERTIFICATION

Certification ..... CSA, Canada and USA

LR 53428
C US
UL Listed
LISTED
Ground Fault Sensing and Relaying Equipment
4FX9 E340889
Australia
CE, European Union
FCC

CSA C22.2 No.14 Industrial Control Equipment
UL 508 Industrial Control Equipment
UL 1053 Ground Fault Sensing and Relaying Equipment
Australia, Regulatory Compliance Mark (RCM)
CE Low Voltage Directive
IEC 61010-1:2010 (3rd Edition)
FCC CFR47, Part 15, Subpart B, Class A – Unintentional Radiators

Compliance ..... AS/NZS 2081:2011

Surge Withstand ..... ANSI/IEEE C37.90.1-2002 (Oscillatory and Fast Transient)

6.4 CURRENT SENSORS

Environment:
- Operating Temperature ..... -40 to 60°C (-40 to 140°F)
- Storage Temperature ..... -55 to 80°C (-67 to 160°F)

EFCT-1
- Current Ratio ..... 5:0.05 A
- Insulation ..... 600-V Class
- Window Diameter ..... 82 mm (3.2")
- Shipping Weight ..... 0.9 kg (2.0 lb)

EFCT-2
- Current Ratio ..... 5:0.05 A
- Insulation ..... 600-V Class
- Window Diameter ..... 139.7 mm (5.5")
- Shipping Weight ..... 2.7 kg (6.0 lb)

EFCT-26
Current Ratio ..... 5:0.05 A
Insulation ..... 600-V Class
Window Diameter ..... 26 mm (1.0”)
Shipping Weight ..... 0.5 kg (1.0 lb)

Certification ..... CSA, Canada and USA



UL Recognized



CE, European Union



Compliance ..... RoHS
EN 60044-1

7. ORDERING INFORMATION

EL731-□□-□0

- Future Use
- AS/NZS 2081:2011 Compliant
  - 0 No
  - 1 Yes
- Communications:
  - 0 None
  - 1 DeviceNet™
  - 2 Profibus®
  - 3 EtherNet/IP™
  - 4 Modbus® TCP
- Supply:
  - 0 Universal AC/DC Supply
  - 1 48 Vdc/24 Vac Supply
  - 2 24 Vdc Supply

EFCT-1 ..... Earth-Fault CT, 82 mm (3.2”) window
EFCT-2 ..... Earth-Fault CT, with Flux Conditioner 139-mm (5.5”) window
EFCT-26 ..... Earth-Fault CT, 26 mm (1.0”) window
EFCT-1FC ..... Flux Conditioner, 70 mm (2.7”) window

PGA-0520 ..... Analog Percent Current Meter

AC700-SMK ..... DIN Rail and Surface-Mount Adapter

AC700-CVR-00 ..... Watertight Cover (IP66) for Panel-Mount Applications

AC700-CUA-0□(1) Communications Upgrade Adapter

- Adapter Type
  - 0 Firmware Upgrade Module
  - 1 DeviceNet™
  - 2 Profibus®
  - 3 EtherNet/IP™
  - 4 Modbus® TCP

NOTES:
(1) Communications adapters can be ordered separately to field upgrade EL731-X0-X0 models.

Startco Pty. Australian Current Transformers (CT2 Input Only)

EFCT-5RF ..... Earth-Fault CT, 60 mm (2.4”) window
EFCT-6RF ..... Earth-Fault CT, 85 mm (3.3”) window
EFCT-7RF ..... Earth-Fault CT, 112 mm (4.4”) window
EFCT-8RF ..... Earth-Fault CT, 140 mm (5.5”) window
EFCT-9RF ..... Earth-Fault CT, 160 mm (6.3”) window
EFCT-10RF ..... Earth-Fault CT, 200 mm (7.9”) window

8. WARRANTY

The EL731 Earth-Leakage Relay is warranted to be free from defects in material and workmanship for a period of 5 years from the date of purchase.

Littelfuse Startco will (at Littelfuse Startco’s option) repair, replace, or refund the original purchase price of an EL731 that is determined by Littelfuse Startco to be defective if it is returned to the factory, freight prepaid, within the warranty period. This warranty does not apply to repairs required as a result of misuse, negligence, an accident, improper installation, tampering, or insufficient care. Littelfuse Startco does not warrant products repaired or modified by non-Littelfuse Startco personnel.

9. PERFORMANCE TEST

Some jurisdictions require periodic earth-fault performance tests. A test record form is provided for recording the date and the result of the performance tests. The following earth-fault system tests are to be conducted by qualified personnel.

a) Evaluate the interconnected system in accordance with the overall equipment manufacturer's detailed instructions.

b) Verify proper location of the EFCT current sensors. Ensure the cables pass through the current-sensor window. This check can be done visually with knowledge of the circuit. The connection of the current-sensor secondary to the EL731 is not polarity sensitive.

c) Verify that the system is correctly earthed and that alternate earth paths do not exist that bypass the current sensor. High-voltage testers and resistance bridges can be used to determine the existence of alternate earth paths.

d) Verify proper reaction of the circuit-interrupting device in response to a simulated or controlled earth-fault current. To simulate earth-fault current, use CT-primary current injection. Fig. 13 shows a test circuit using an SE-400 Ground-Fault-Relay Test Unit. The SE-400 has a programmable output of 0.5 to 9.9 A for a duration of 0.1 to 9.9 seconds. Fig. 13 shows two possible test configurations. Resistors can be used to reduce the injected current from the SE-400. Set the test current to 120% of the EL731 setting. Inject the test current through the current-sensor window. Verify that the circuit under test has reacted properly. Correct any problems and re-test until the proper reaction is verified.

e) Record the date and the results of the test on the attached test-record form.

NOTE: Do not inject test current directly into current-sensor-input terminals 7, 8, 10, and 11.

NOTE: If the EL731 is used in a manner that is fundamentally different than what is shown in this manual, its intended performance may be reduced.

10. MAINTENANCE

NOTE: Follow local safety procedures to ensure the location is safe before attempting any maintenance procedures. If possible, remove the equipment from service before cleaning.

Annual maintenance is recommended for the EL731. However, a more frequent schedule may be necessary depending on conditions of the installation environment.

To clean the EL731, use a micro-fiber cloth to gently remove dust from the surface. If necessary, spray warm water on the cloth (avoid excessive moisture). Do not spray liquids directly on the EL731.

Repairs should always be performed by Littelfuse Startco. See Section 8.

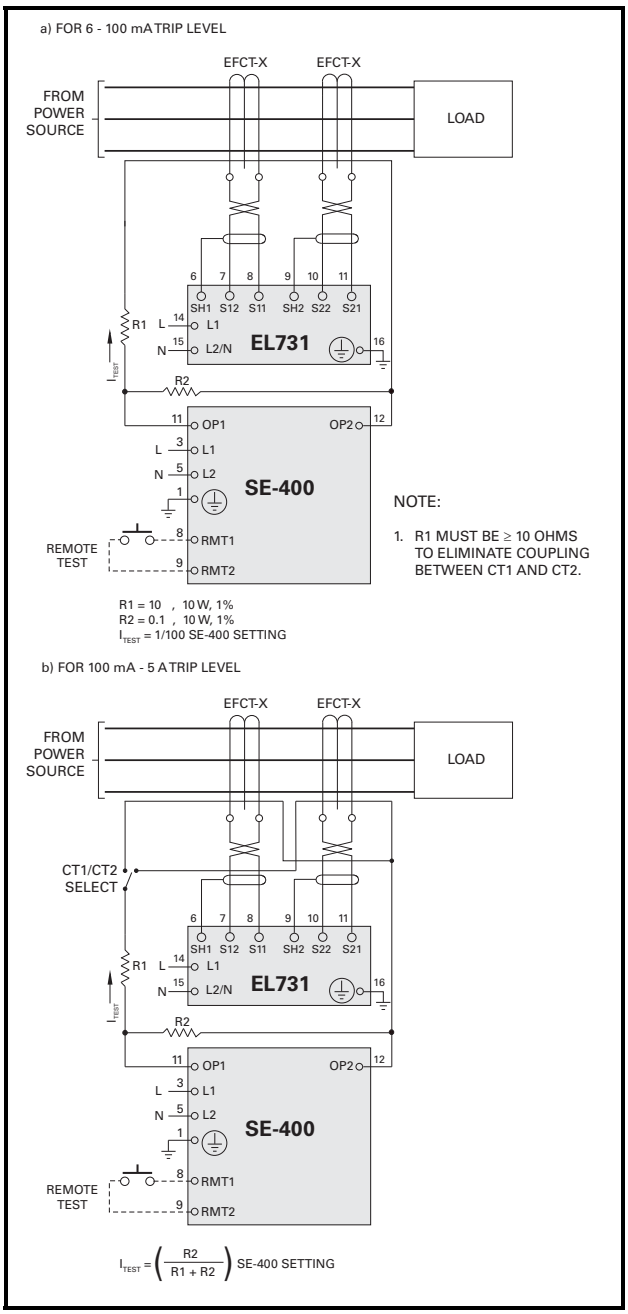


FIGURE 13. Earth-Fault-Test Circuit.

TABLE 4. EARTH-FAULT-TEST RECORD

DATE	TEST RESULTS

APPENDIX A
EL731 MENU MAP

- Earth Leakage Current→ {CT1 and/or CT2 current in percent as value and bar graph}
- Metering ▸
  - CT1 Current→ {CT1 Current in Milliamperes}
  - CT2 Current→ {CT2 Current in Milliamperes}
  - Full Current→ {CT1+CT2 Current in Milliamperes}
  - Internal Temp→ {EL731 Temperature Measurement in Celsius & Fahrenheit }
  - PTC Status→ {PTC state}
  - RTD Temperature→ {RTD Temperature in Celsius & Fahrenheit}
  - Exit→ {Return to Previous Menu}
- Messages ▸
  - Trip State→ {Trip Status}
  - Alarm State→ {Alarm Status}
  - Trip Counter→ {Trip Counter}
  - Alarm Counter→ {Alarm Counter}
  - System Uptime→ {System Uptime}
  - Running Time→ {Running Hours}
  - Exit→ {Return to Previous Menu}
- Setup ▸
  - Protection ▸
    - CT1 Earth Fault ▸
      - Enable/Disable→ [E/D]
      - Primary Turns→ [X]
      - Trip Time→ [X]
      - Trip Level→ [X]
      - Alarm Level→ [X]
      - Calibrate→ [P]
      - Exit→ {Return to Previous Menu}
    - CT2 Earth Fault ▸
      - Enable/Disable→ [E/D]
      - Primary Turns→ [X]
      - Trip Time→ [X]
      - Trip Level→ [X]
      - Alarm Level→ [X]
      - Input Filter→ [L]
      - Exit→ {Return to Previous Menu}
    - PTC Local Temp ▸
      - Trip Action→ [E/D]
      - Alarm Action→ [E/D]
      - Exit→ {Return to Previous Menu}
    - RTD Local Temp ▸
      - Trip Action→ [E/D]
      - Trip Level→ [X]
      - Alarm Action→ [E/D]
      - Alarm Level→ [X]
      - Exit→ {Return to Previous Menu}
    - Exit→ {Return to Previous Menu}

- Relay Outputs ▸
  - Relay 1 ▸
    - Function→ [L]
    - Fail-safe Mode→ [E/D]
    - Test→ [P]
    - Exit→ {Return to Previous Menu}
  - Relay 2 ▸
    - Function→ [L]
    - Fail-safe Mode→ [E/D]
    - Test→ [P]
    - Exit→ {Return to Previous Menu}
  - Relay 3 ▸
    - Function→ [L]
    - Fail-safe Mode→ [E/D]
    - Test→ [P]
    - Exit→ {Return to Previous Menu}
  - Exit→ {Return to Previous Menu}
- Analog Output ▸
  - Analog % Level→ [L]
  - CT Select→ [L]
  - Output Filter→ [E/D]
  - Exit→ {Return to Previous Menu}
- Hardware ▸
  - Temp. Sensor→ [PTC Sensor / RTD Sensor / Disabled]
  - Exit→ {Return to Previous Menu}
- System Config ▸
  - Change Password→ [S]
  - Password Enable→ [E/D]
  - Chg Reset Pswd→ [S]
  - Reset Pswd En.→ [E/D]
  - Menu Timeout→ [X]
  - Display Filter→ [E/D]
  - Maintenance→
    - Clear Counters→ [P]
    - Load Defaults→ [P]
    - Restart System→ [P]
    - Model Option→ [P]
    - Firmware Ver.→ [P]
    - Platform Ver.→ [P]
    - ROM Version→ [S]
    - Build Date→ [S]
    - Serial Number→ [S]
    - Exit→ {Return to Previous Menu}
  - Exit→ {Return to Previous Menu}
- Exit→ {Return to Main Menu}

Password→ [S]
Exit→ {Return to Main Menu}

LEGEND

▸: This menu item has a sub menu, press ENTER button to view sub menu.
→: Last menu, press ENTER button to view data.
[P]: Prompt for response from user.
[Y/N]: Yes/No.
[X]: Numeric.
[S]: String. Specific string format may be required.
[L]: Selection is from a list of values.
[EA]: Ethernet Address (xxx.xxx.xxx.xxx).
[E/D]: Enable/Disable.

NOTE: To exit, select Exit Menu item or press RESET.

APPENDIX B
SYSTEM PARAMETERS & SETUP RECORD

PARAMETER AND SETTINGS	MIN	DEFAULT	MAX	UNIT	PROGRAM SELECTION	
CT1 Earth Fault						
Enable/Disable		Enable			❑ Enable	❑Disable
Primary Turns	1	1	5			
Trip Time (AS/NZS 2081 Option)	0 (0)	30 (30)	2,000 (500)	ms		
Trip Level	30	60	5,000	mA		
Alarm Level	30	30	5,000	mA		
CT2 Earth Fault						
Enable/Disable		Enable			❑ Enable	❑Disable
Primary Turns	1	1	5			
Trip Time (AS/NZS 2081 Option)	0 (0)	30 (30)	2,000 (500)	ms		
Trip Level	30	60	5,000	mA		
Alarm Level	30	30	5,000	mA		
Input Filter		Full Range			❑Full Range ❑190 Hz High Pass	❑90 Hz Low Pass ❑3 kHz Low Pass
PTC Local Temp						
Trip Action		Disabled			❑Enabled	❑Disabled
Alarm Action		Disabled			❑Enabled	❑Disabled
RTD Local Temp						
Trip Action		Disabled			❑Enabled	❑Disabled
Trip Level	40	150	200	°C		
Alarm Action		Disabled			❑Enabled	❑Disabled
Alarm Level	40	125	200	°C		
Relay Outputs						
Relay 1: Function		Trip			❑Trip ❑Current	❑Watchdog ❑Alarm
Fail-Safe Mode		Enabled			❑Enable	❑Disable[(1)]
Relay 2: Function		Alarm			❑Trip ❑Current	❑Watchdog ❑Alarm
Fail-Safe Mode		Enabled			❑Enable	❑Disable[(1)]
Relay 3: Function		Watchdog			❑Trip ❑Current	❑Watchdog ❑Alarm
Fail-Safe Mode		Enabled			❑Enable	❑Disable[(1)]
Analog Output						
CT Select		CT1 Current			❑CT1 Current ❑Full Current	❑CT2 Current
Analog % Level		Disabled			❑Enable	❑Disable
Output Filter		Disabled			❑Enable	❑Disable
Hardware						
Temp Sensor		Disabled			❑Disable ❑RTD Sensor	❑PTC Sensor
System Config						
Change Password	0000	1111	9999			
Password Enable (AS/NZS 2081 Option)		Disabled (Enabled)			❑Enable	❑Disable
Menu Timeout	1	10	60	minutes	❑Enable	❑Disable
Display Filter		Disabled			❑Enable	❑Disable

NOTES:
(1) With AS/NZS 2081 Option, Fail-Safe Mode cannot be disabled when the relay function is set to Trip or Alarm.

APPENDIX C
EL731 REVISION HISTORY

MANUAL RELEASE DATE	MANUAL REVISION	HARDWARE REVISION (REVISION NUMBER ON PRODUCT LABEL)	FIRMWARE REVISION
March 28, 2016	6-F-032816	03	1.60
September 10, 2015	6-E-091015		1.59
January 19, 2015	6-D-011915	02C (EL731-XX-10: AS/NZS 2081 models) 01C (all other models)	1.57
December 8, 2014	6-C-120814		
October 25, 2013	6-B-102513		1.55
April 26, 2013	6-A-042613	02B (EL731-XX-10: AS/NZS 2081 models) 01B (all other models)	1.54
March 1, 2013	5	02A (EL731-XX-10: AS/NZS 2081 models) 01A (all other models)	1.53

MANUAL REVISION HISTORY

REVISION 6-F-032816

SECTION 2
AC700-CVR-00 added.
Figs. 5 and 6 added.

SECTION 6
RCM certification added.

APPENDIX B
Relay outputs fail-safe-mode note added.

REVISION 6-E-091015

SECTION 1
Section 1.2 updated.

SECTION 2
Figs. 1 and 3 updated.

SECTION 3
Section 3.2.1 and 3.2.3.4 updated.
Table 3 updated.
Fig. 10 added.

SECTION 4
CT2 metering range updated.

SECTION 6
CE certification added.
Analog output range maximum updated.
Section 6.2 added.

SECTION 10
Maintenance section added.

REVISION 6-D-011915

SECTION 6
Updated trip level accuracies.

REVISION 6-C-120814

SECTION 3

Table 3 and Section 3.2.3.3 updated.
Reset password added (Section 3.2.3.5.2).
Figs. 7 and 8 updated.

SECTION 6

UR Recognized certification added to Current Sensors (Section 6.2).

APPENDIX A

EL731 menu map updated.

REVISION 6-B-102513

SECTION 2

Updated Section 2.1.5 with DeviceNet™ connection method.
Fig. 4 updated.

SECTION 6

Cable resistance specification added.

SECTION 9

Fig. 10 updated.

REVISION 6-A-042613

SECTION 2

Note added in Fig. 4 and Section 2.1.2.

SECTION 4

Added Section 4.2.4.

SECTION 6

Added AS/NZS 2081 Option CT2 Trip Level Setting specification.
Updated CT1, CT2 Trip Level Accuracy specifications.

SECTION 7

Added EL731 Ordering Information options.

APPENDIX C

Revision history added.

REVISION 5

SECTION 1

Updated frequency response ranges.

SECTION 3

Updated Table 2.

SECTION 4

Updated digital filter ranges.

SECTION 6

Updated CT1 Trip Level Accuracy specification.
Added CT2 Filter 4 specification.

HARDWARE REVISION HISTORY

HARDWARE REVISION 03

CE-compliant hardware.
EL731 now shipped with different connector configuration (see Fig. 1).

HARDWARE REVISION 01C/02C

Remote reset connectivity improved.
Communication cover screws changed to Phillips for improved user access.

HARDWARE REVISION 01B/02B

Design updated to incorporate manufacturing process improvements.
Improved CT1 noise immunity.

HARDWARE REVISION 01A/02A

CT2 input corner frequency reduced to 6 kHz.
Improved CT1 noise immunity.

FIRMWARE REVISION HISTORY

FIRMWARE REVISION 1.60

Profibus communications support added.

FIRMWARE REVISION 1.59

CT2 meter range changed. See Section 3.2.1 and 6.1.
Improved menu functionality.
Improved analog output functionality.

FIRMWARE REVISION 1.57

Reset password protection added.
Corrected relay test operation for all relay function settings.
Increased relay test time to 1 s.

FIRMWARE REVISION 1.55

Trip levels less than 30 mA are retained (when primary turns are configured from two to five turns).

FIRMWARE REVISION 1.54

Changed minimum CT2 Trip Level to 50 mA for AS/NZS 2081 Option.

FIRMWARE REVISION 1.53

Added 3 kHz Low Pass Filter selection for CT2 input.

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