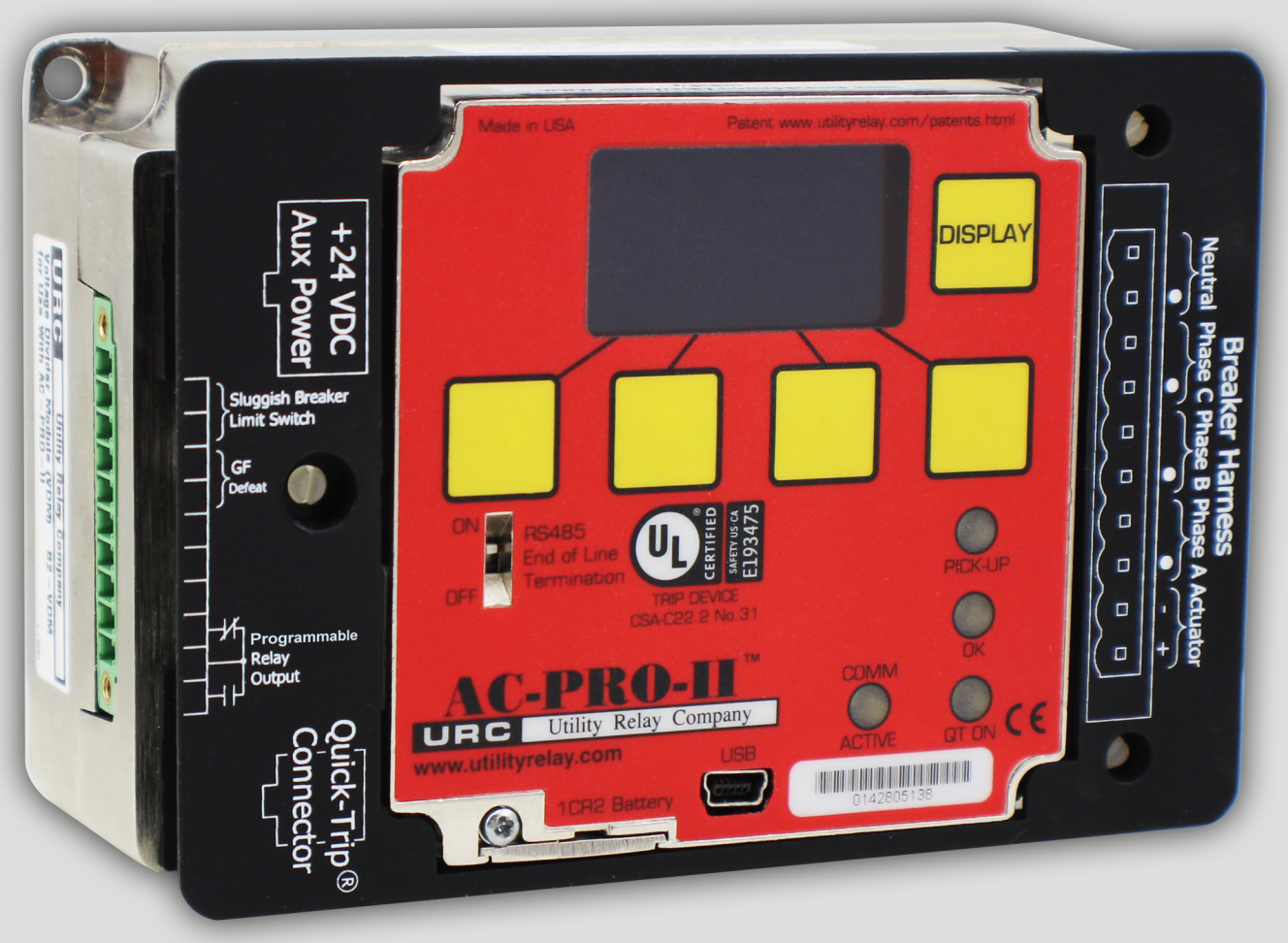
INSTRUCTION MANUAL

AC Trip Unit
Manual v4.1

AC-PRO-II®



State of the Art Technology for
Low Voltage Circuit Breaker Modernization

URC Utility Relay Company
UTILITYRELAY.COM

10100 QUEENS WAY
CHAGRIN FALLS, OH 44023
USA
888.289.2864

Manual Revision 4.1 – April 2024 – Firmware version 4.0

Table of Contents

List of Tables

Tables **Page**

Utility Relay Company
10100 Queens Way
Chagrin Falls, OH 44023
www.utilityrelay.com
Phone 888-289-2864

For latest version, visit:
http://www.utilityrelay.com/Side_Bar/Instruction_Manuals.html

List of Figures

1.0 Introduction and Product Overview

The AC-PRO-II® is a state of the art, micro-controller based trip unit for use on three phase, 600 Volt class, AC circuit breakers on 50 Hertz or 60 Hertz systems. The AC-PRO-II features a rotatable 128 x 64 Multi-line, Organic Light Emitting Diode (OLED) Display, smart buttons, and LEDs.

The standard AC-PRO-II provides:

- Overload and fault protection
- RS485 communications
- QUICK-TRIP® arc flash hazard reduction
- Patented Sluggish Breaker® detection
- Time stamped trip history with waveform capture
- InfoPro-AC™ software interface
- Ready for the SAFE-T-TRIP® hand-held remote trip device
- And many other features

Additionally, with the optional Voltage Divider Module (VDM™), the AC-PRO-II can provide advanced voltage protection and power metering.

The AC-PRO-II is 55% smaller than the original AC-PRO® and includes more features and more flexibility. The smaller form factor allows application on a wider range of breakers. The trip unit features versatile user settings that allow setting the frequency (50 Hz or 60 Hz), CT secondary rating, and Ground Fault type in the field, eliminating the need for a special factory-configured trip unit and simplifying the kit ordering process.

The AC-PRO-II is backwards compatible with existing AC-PRO CTs, actuators, wiring harness, and settings, making direct replacements easy. Similar to AC-PRO, the AC-PRO-II settings are entered using simple parameters. No percentages or multipliers are required. AC-PRO-II settings are programmed using the easy-to-read multi-line OLED display.

1.1 Current Protection and Functions

The AC-PRO-II includes the following Current-based features:

- CT Polarity Correction
- Long Time (LT)
- Short Time (ST)
- Instantaneous (I)
- Ground Fault (GF)
- Thermal Memory (for LT, ST, & GF)
- Neutral Protection (NLSI)
- Phase Current Unbalance (U/B %)
- QUICK-TRIP Instantaneous (QT-I)
- QUICK-TRIP Ground Fault (QT-GF)
- Current Metering
- Overload (Long Time pickup) Alarm
- Instantaneous Override (I-OVRD) (factory setting – based on breaker)
- Instantaneous on Close (I-CLOS) (factory setting – normally enabled)

The AC-PRO-II measures the true RMS current through each of the breaker's three poles.

AC-PRO-II settings include a Ground Fault type setting, which allows the user to select either Residual Ground Fault protection (vector sum), or Ground Return Ground Fault protection (measures GF directly).

The QUICK-TRIP Instantaneous and QUICK-TRIP Ground Fault protective settings are available to minimize downstream Arc Flash Hazard.

The AC-PRO-II uses a unique algorithm to determine if the RMS currents are greater than 12 times the CT rating where the CTs may be saturated. The AC-PRO-II then corrects the effect of CT saturation on the Long Time and Short Time trip functions.

1.2 Voltage and Power Features - optional Voltage Divider Module (VDM)

The AC-PRO-II can be provided with an optional Voltage Divider Module (VDM) attached to the back of the trip unit. When configured with the VDM, the AC-PRO-II offers the following Voltage-based features:

- Rated for up to 600V three-phase systems
- Voltage metering and protection
  - Firmware v1: Line to Neutral
  - Firmware v2 or later: Line to Line
- Under-Voltage trip & alarm
- Over-Voltage trip & alarm
- Phase Loss/Reversal trip & alarm (firmware v2 & later)
- Reverse Power trip & alarm (firmware v4)
- Power metering:
  KW, KVA, KWHr, KVAHr, Power Factor, KW Demand, KVA Demand
- VDM provides continuous trip unit power even when the breaker is open and not carrying current, allowing for communications, even without CT power.

1.3 Additional Features

In addition, the AC-PRO-II also features the following: (features are standard for all AC-PRO-II trip units unless noted otherwise)

- Programmable relay output (form C) – can be used for alarms or Closing E/O breaker or Zone-Block signal
- Self-Test
- Front USB port for data upload and download, SAFE-T-TRIP remote trip device, auxiliary power and firmware updates
- OLED multi-line display
- RS-485 Modbus RTU communications
- Versatile user settings provide more flexibility than the original AC-PRO:
  - 50 Hz or 60 Hz operation
  - Phase CT secondary ratings:
    1A, 0.5A, 0.4A, 0.25A, 0.2A
  - Neutral CT secondary ratings:
    2A, 1.5A, 1A, 0.5A, 0.4A, 0.25A, 0.2A, 0.18A
  - Ground Fault type can be set to "Residual" or "Ground Return" depending on the CT location & Ground Fault scheme.
- Compactness allows AC-PRO-II on a wide range of breakers, including more insulated case breakers.
- Backwards compatibility with AC-PRO actuators, CT's, wiring harness, and settings.
- Waveform capture
- Sluggish Breaker Detection™, Breaker Cycle Counter
- Time-stamping of Trip events
- Scheduled Service Reminder

The trip unit stores the trip history data for the last 8 trip events and the trip log data in a non-volatile FRAM memory for later recall. All the settings are stored in non-volatile memory. Battery backup is not required.

The trip unit does not require external power to operate. Power is derived from the current transformers (CTs). An internal battery provides power to review and change protection settings when CT power is not available.

The AC-PRO-II trip unit is manufactured under multiple patents. See the link below for additional information:
http://www.utilityrelay.com/patents.html

NOTE: this manual is written based on version 4 firmware. See the following for details:
http://www.utilityrelay.com/Side_Bar/Firmware_versions.html

2.0 UL/ULC Classification & CE Mark

AC-PRO-II® is currently UL and ULC classified for use on the following low voltage AC power circuit breakers:

Square D/Westinghouse DS-206, DS-416, DS-632, DB-50
Schneider H-3 Series
General Electric AKR-75, AK-2-50, AK-2-75
ITE K-600, K-800, K-1600, K-3000, KB Steel
Siemens/Allis-Chalmers LA-1600

UL and ULC classification is in accordance with UL1066, CSA C22.2, IEEE C37.59 as well as appropriate sections of ANSI C37.17 and C37.50.

The AC-PRO-II has the CE Mark.

AC-PRO-II was tested by an independent laboratory and found in compliance with the following standards:

IEEE C37.90.1, Surge Withstand
IEEE C37.90.2, RF Susceptibility
EN 61000-4-3, RF Immunity
EN 61000-4-4, Fast Transient
EN 61000-4-5, Surge Immunity
EN 61000-4-2, Electrostatic Discharge Immunity
EN 55011, Radiated Emissions

3.0 Trip Unit Power

The AC-PRO-II can be powered in 5 different ways: CTs, internal battery, USB port, 24VDC auxiliary, or by the Voltage Divider Module (VDM).

The AC-PRO-II is normally powered from the breaker phase CT's if at least one phase current is above the CT power-up threshold. See Table 3-A for CT power-up values. If the current is not high enough to power the trip unit, the trip unit will power down. If the unit is powered down and a fault occurs requiring rapid response, the high current of the fault provides CT power and the trip unit performs as published in the Time Current Curves.

If the trip unit is connected to a Voltage Divider Module (VDM), USB, or 24VDC auxiliary power, these sources provide constant power.

During normal operation (in service), if the trip unit is powered by current or voltage and no errors are present, the OK LED should be blinking (V4 firmware & later) or ON (V1, V2 and V3 firmware). If current is too low or if voltage (via VDM) is not present, pressing the "DISPLAY" Push button will temporarily power up the trip unit and display using the internal battery. The OK LED should then be on.

3.1 Current Transformer (CT) Power

The AC-PRO-II derives both the signal and power from the breaker phase CTs. For 1-Amp CT's, the trip unit will power-up with less than 6% of the rated CT tap current through a single CT. See complete table below:

Phase CT Secondary Rating	Current required to power AC-PRO-II (in % of CT Primary Rating)
1.0 Amp	6%
0.5 Amp	12%
0.4 Amp	15%
0.25 Amp	24%
0.2 Amp	30%

Table 3-A: CT Power-up values
(without VDM installed)

3.2 Battery Power

A 3-Volt, 850 mAh, CR2, long life Lithium battery is used in the trip unit. There are no restrictions on transport and no special methods of disposal required with this battery.

The AC-PRO-II design uses the battery for the following functions / features:

1) Allows the user to commission (program) the trip unit without using the auxiliary power pack.
2) Allows the user to recall last trip data even if the breaker is open and without using the auxiliary power.
3) Maintains the internal clock for accurate time and date stamping for trip history and on-demand waveforms.
4) Allows resetting (unlatching) the programmable relay when no other power source is available.

Press the "DISPLAY" push button to turn the trip unit on under battery power.

When on battery power, the trip unit will automatically turn off 60 seconds after the last button is pushed to conserve battery energy.

**** NOTE ****
The battery is NOT involved in the protective functions of the trip unit. The trip unit will provide protection even if the battery is removed.
The battery is NOT required for the trip unit to maintain any of its memory including the user programmed pick-up and delay settings and the last trip data.
If the battery voltage is low, the internal date/time clock will not be correct.

See Section 21.0 for battery data and instructions on replacing the battery.

3.3 USB Power

The AC-PRO-II® is equipped with a mini-USB port on the face of the trip unit and it can be used to power the trip unit display with the USB 5Vdc supplied by a computer, USB wall-pack, etc.
Note: USB power is NOT sufficient for powering AC-PRO-II when using a relay (secondary injection) test set.

3.4 24VDC Auxiliary Power

The AC-PRO-II® includes a 24VDC auxiliary power input, for connection to the B-292 Secondary Injection Test Set, and other auxiliary power sources.

URC 24VDC Accessories:
24VDC wall-pack: URC Part # T-490-ASM
24VDC harness: URC Part #CA-AC2-24VDC

24VDC Auxiliary power requirements:
Voltage: 23-28VDC with correct polarity
Power supply sizing: 3 watts minimum per AC-PRO-II
Protection: protect each AC-PRO-II with 1A fuses
Use a minimum of 1 power supply per lineup.
Do not ground the minus of the 24VDC system

3.5 Voltage Divider Module (VDM) Power

The AC-PRO-II® trip unit is available with an optional Voltage Divider Module (VDM). The VDM provides breaker 3-Phase voltage used for power information and also provides power for the trip unit independently from the CTs. See Section 8.0 for more information on the Voltage Divider Module (VDM).

4.0 AC-PRO-II® Pictures and Configurations

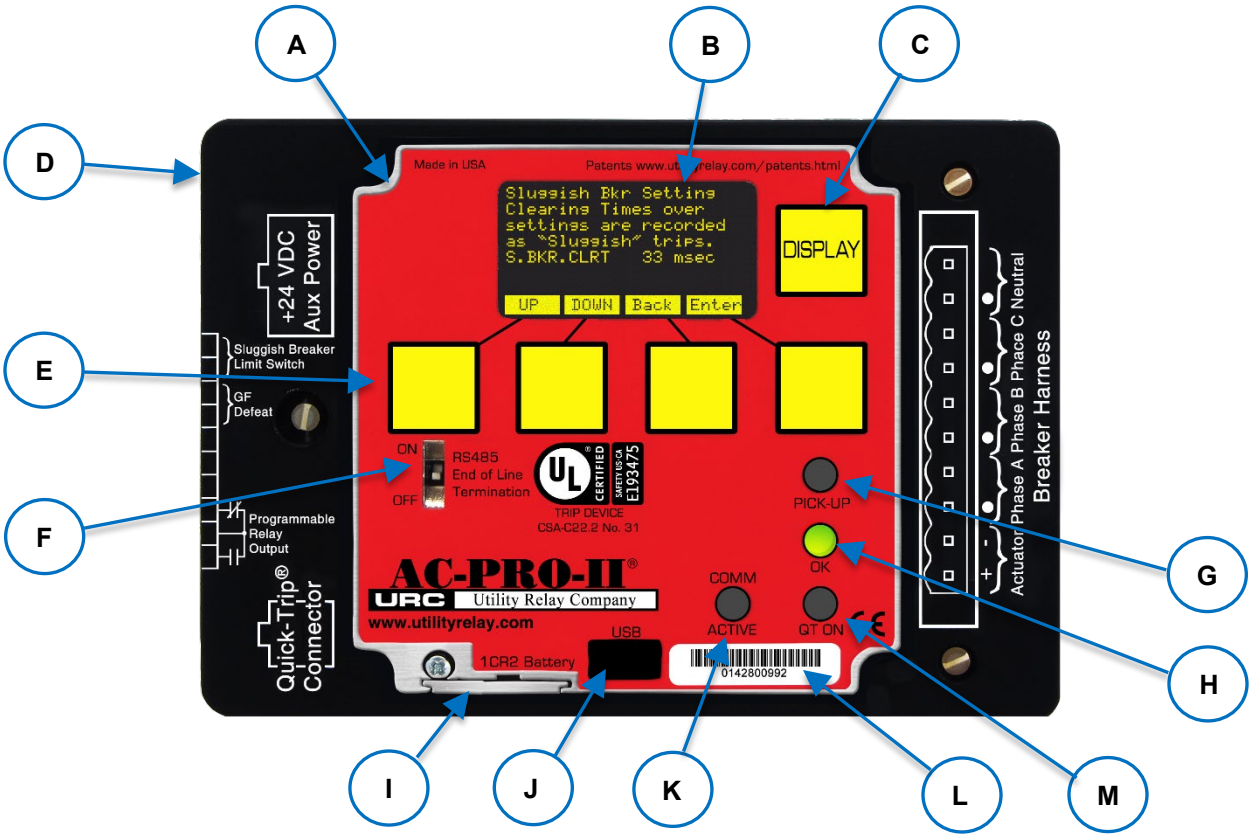


Figure 4.1 AC-PRO-II Front View - Horizontal Configuration

A. Local Display (rotatable)
The Local Display is normally mounted to the trip unit. It can be rotated or separated from the trip unit for specific breakers where space is limited.

B. OLED Display
The display is normally off. Pushing the "DISPLAY" button (C) turns on the display. The OLED displays the following information. Refer to Section 6.0 for menu navigation.

C. DISPLAY Push Button
Pushing the "DISPLAY" button will turn on the display. If no buttons are pushed for 60 seconds, the display will turn off.

D. Removable wire cover
Cover with printed connection labels. See Section 5.0 for external connections (behind cover).

E. "Smart" Push Buttons
These push buttons perform the functions indicated on the bottom of the OLED display. These buttons are used for all menu navigation.

F. RS-485 Line Termination Switch
This switch should be placed in the ON position only if the trip unit is the last in the RS-485 communications wiring run.

G. Red PICK-UP LED (red)
This LED will illuminate if the current exceeds the LT pick-up setting.

H. Green OK (Self-Test) LED
When the trip unit is powered up, this LED is on and blinking unless a problem is detected. (Note: Firmware prior to Version 4.0 used a solid LED to indicate "OK".) If the trip unit is not powered up, the OK LED will not be on. If the "DISPLAY" button is pressed, the OK LED should come on, unless a problem is detected. See Section 11.1 for Trip Unit Power and Section 20.0 for Errors.

I. Battery Cover
To replace the battery, remove the single screw and slide battery cover out, remove the old battery and insert a new CR2, 3-Volt Lithium battery. Replace the battery cover and screw. See Section 21.0.

J. Mini-USB Port (shown with cover removed)
The electrically isolated mini-USB port is available for connection to a laptop/ personal computer for uploading & downloading of settings, information, and firmware; SAFE-T-TRIP remote trip device operation; or USB wall pack for auxiliary power.

K. COMM ACTIVE LED (green)
The communications active LED illuminates when the trip unit is transmitting information via Communications.

L. AC-PRO-II Serial Number

M. Quick-Trip LED (red)
This LED will illuminate if a Quick-Trip switch (Arc Flash hazard reduction / ERMS) is connected and on the ON position.

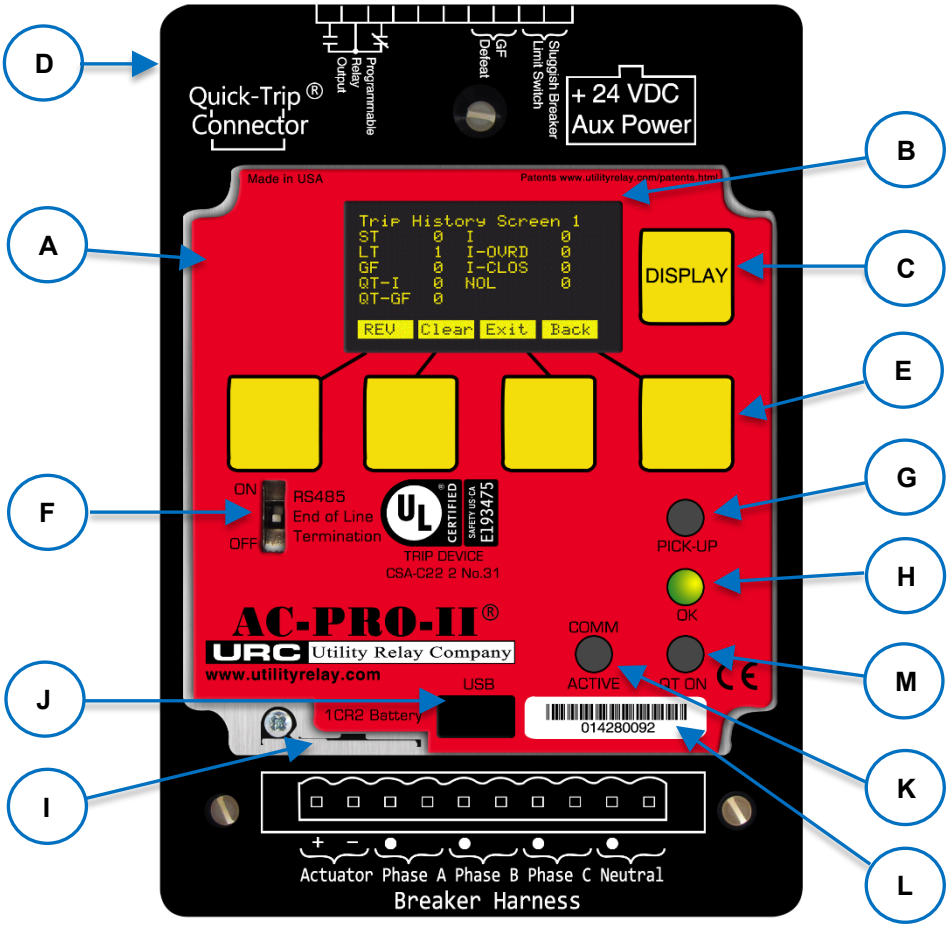


Figure 4.2: AC-PRO-II Front View - Vertical Configuration with Breaker Harness at bottom

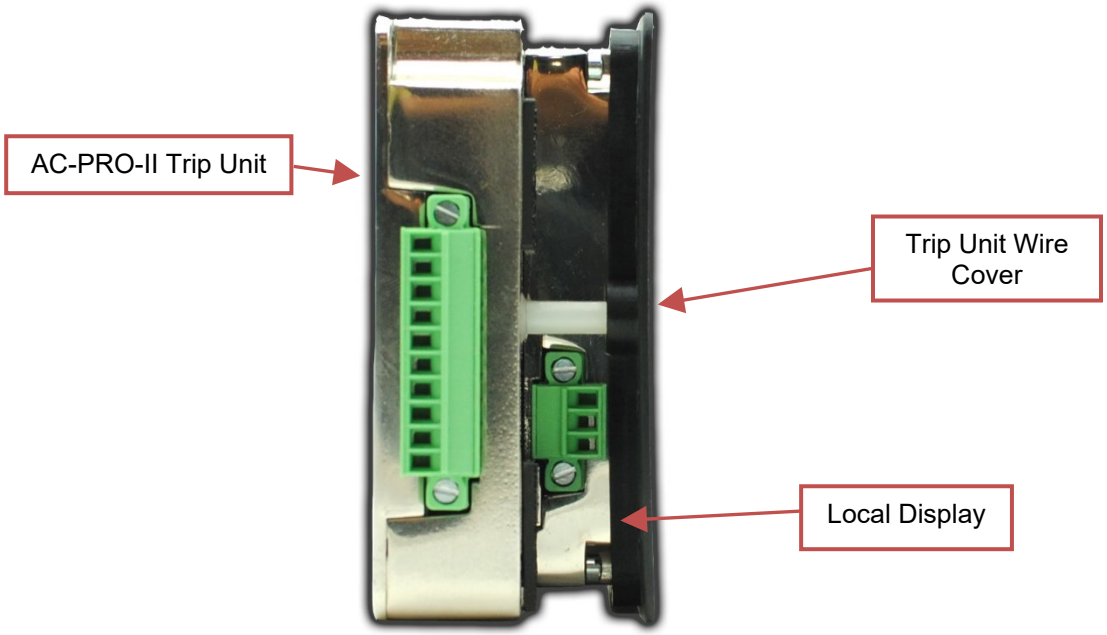
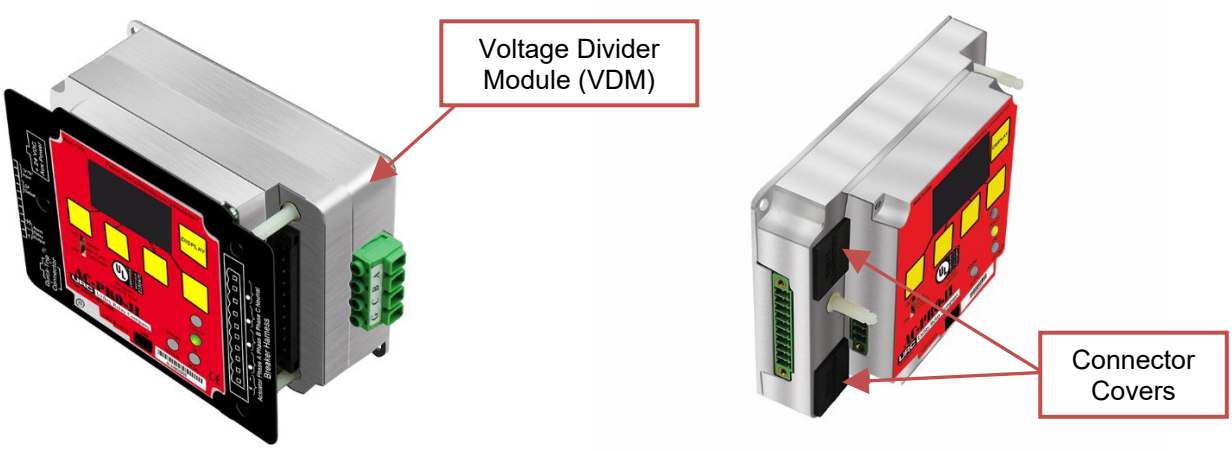


Figure 4.3: AC-PRO-II Side View (without VDM)



Shown with VDM and wire cover **Shown without VDM and without wire cover**

Figure 4.4: AC-PRO-II Angled Views – with and without VDM

Breaker Harness and connector

Optional Neutral CT Cable and connector assembly

Optional Communications Cable and connector assembly

USB Extension cable (provided with behind door kits) See Section 5.6.1

Quick-Trip Cable (4/C) (for optional QT2-Switch)

optional 24VDC Cable (2/C) (for connecting customer-suppled 24VDC)

Figure 4.5: AC-PRO-II connectors and cables

5.0 External Connections

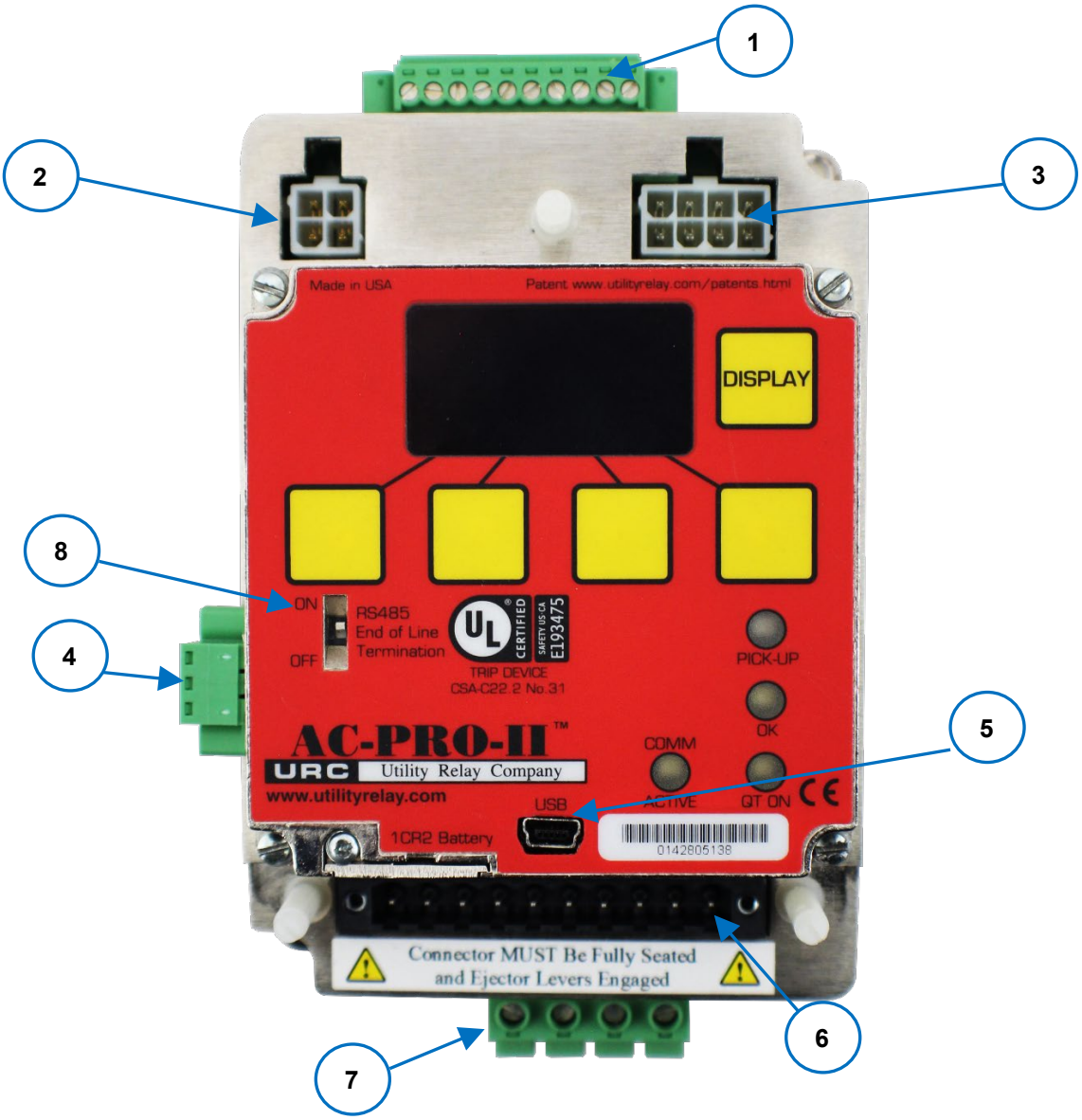


Figure 5.1: AC-PRO-II (with VDM) External Connections - Vertical Bottom Configuration (Breaker Harness at bottom, shown with wiring cover off)

1. Auxiliary Terminal Block
   a. Programmable relay output
   b. Ground Fault Defeat input
   c. Breaker limit switch contact input
2. QUICK-TRIP connector
3. 24VDC Auxiliary power connector
4. RS-485 Communications terminal block
5. Mini-USB port – shown with cover removed
6. Breaker wiring harness connection
7. VDM connection (VDM is optional)
8. RS-485 End of Line Termination switch – shown with switch ON

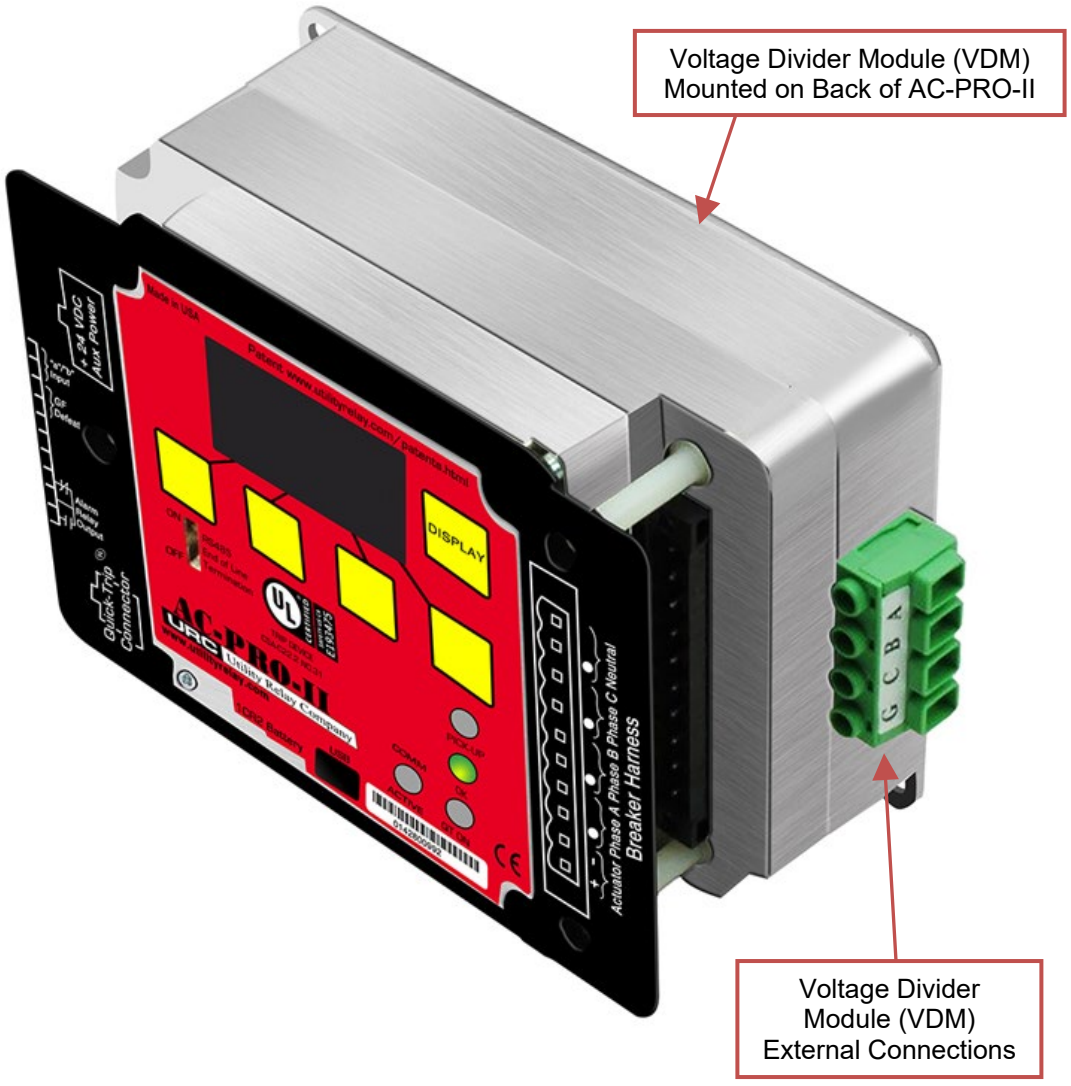


Figure 5.2: Voltage Divider Module (VDM) External Connections

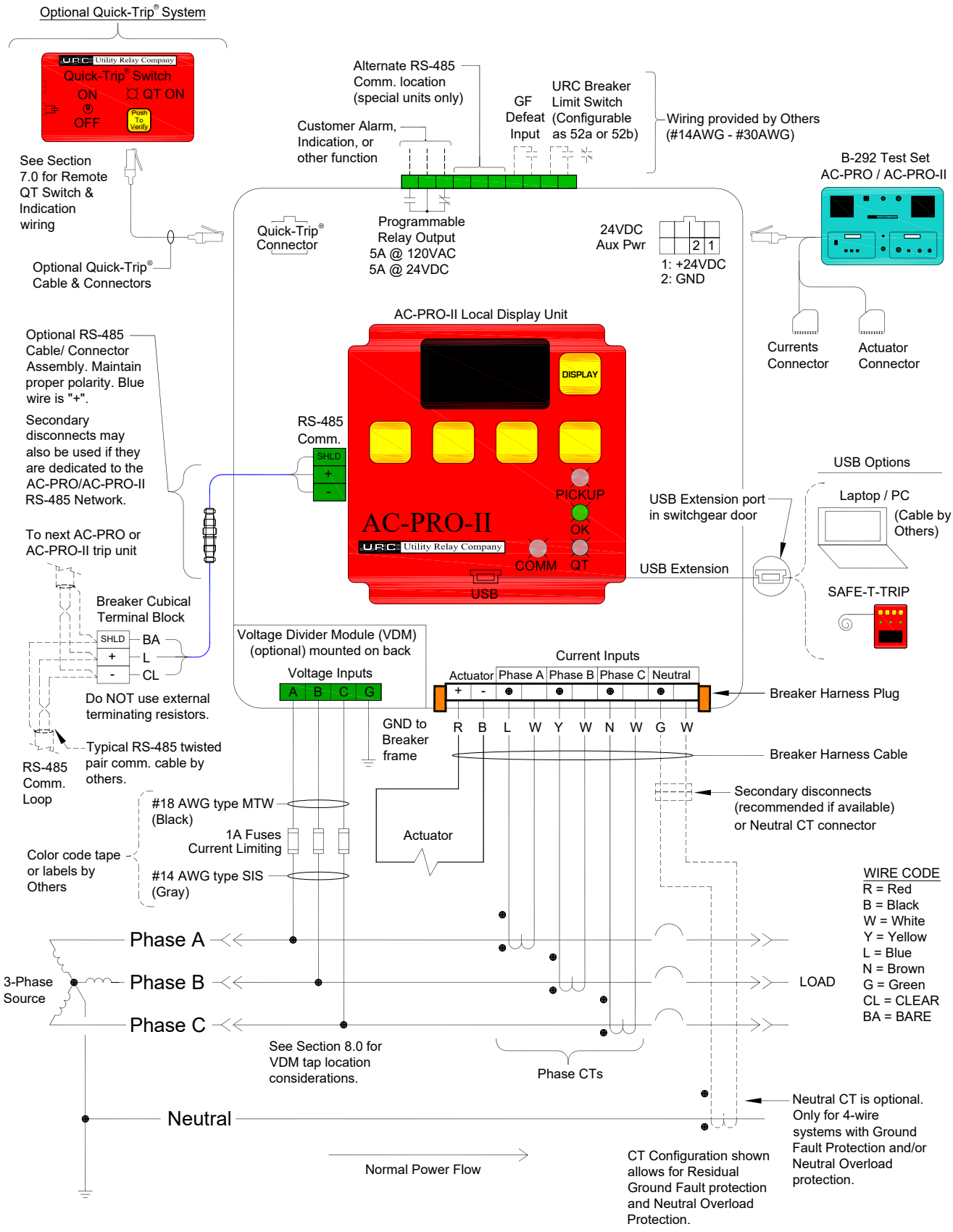


Figure 5.3: AC-PRO-II Typical Wiring Diagram

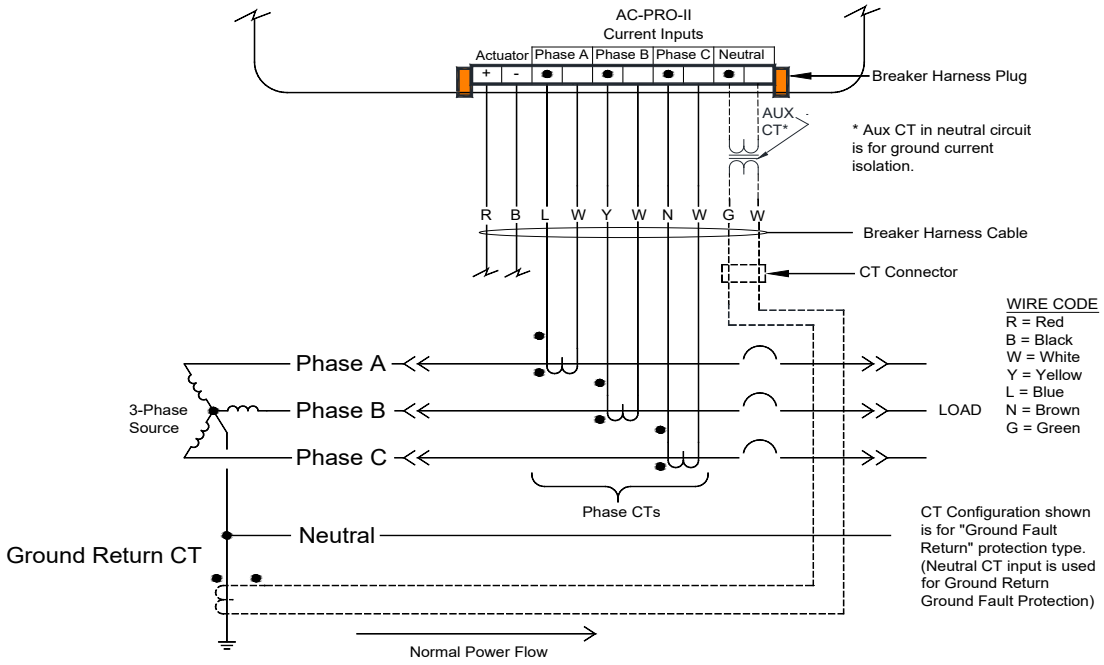


Figure 5.4: AC-PRO-II Typical Ground Return Wiring Diagram

5.1 Breaker Wiring Harness

The breaker wiring harness connects the trip unit to the CTs and actuator. The wiring harness plugs into the 10-pin connector on the front of the trip unit. The breaker wiring harness includes wires for the Actuator, Phase A CT, Phase B CT, Phase C CT, and optional Neutral CT. Two ejector levers are provided to help in disconnecting the harness connector. The ejector levers also lock the connector in place.

A neutral CT wiring harness is provided as part of the neutral CT installation kit. The neutral CT kit is required for units applied to 4-wire systems where Ground Fault protection is desired or required. The ground fault function on a 3-wire system does not require a neutral CT. Additionally, this connection method allows Neutral Overload Protection to be implemented.

The breaker wiring harness connection to the AC-PRO-II is compatible with existing AC-PRO breaker wiring harness.

5.1.1 Ground Fault Wiring Configurations

The AC-PRO-II is compatible with multiple types of existing Ground Fault protection schemes.

Figure 5.3 shows a residual Ground Fault wiring diagram. For this configuration, the AC-PRO-II calculates the residual Ground Fault current. If the system is a 4-wire (3-phase + neutral), the neutral CT must be provided if Ground Fault protection is desired.

Figure 5.4 shows a ground return Ground Fault wiring diagram. For this configuration, the AC-PRO-II directly measures the Ground Return current on the neutral current input. An Aux CT is supplied for current isolation in the ground circuit. This configuration only applies to 4-wire systems where Ground Fault protection is required. Neutral Overload protection cannot be implemented if the Ground Fault type is Ground Return.

See Section 11.14 for Ground Fault settings.

Contact Utility Relay Company if your Ground Fault Protection scheme is different than the typical schemes shown above.

**** NOTE ****
For Ground Fault protection at Mains & Ties of 4-wire double-ended substations, see Technical Bulletin #1A at the link below:
http://www.utilityrelay.com/Side_Bar/Technical_Bulletins.html

5.2 QUICK-TRIP® Connector

All AC-PRO-II trip units are equipped with the capability of connecting to an AC-PRO-II QUICK-TRIP Switch (Arc Flash hazard reduction / ERMS), which provides arc flash hazard reduction. Refer to Section 7.0 for QUICK-TRIP system information.

5.3 Auxiliary Connections

The auxiliary terminal block is available for the alarm relay output, Ground Fault defeat Input, and breaker position input. See the terminal labels in Figure 5.3.

Wiring for the auxiliary terminal block is not furnished in AC-PRO-II retrofit kits.

The auxiliary terminal block features set-screw connections and accepts #14 AWG - #30 AWG conductors.

5.3.1 Programmable Relay Output

The AC-PRO-II is equipped with an internal programmable relay that has (1) Form C output contact for external customer wiring. The output contacts are rated 5A max @ 120VAC or 5A max @ 24VDC or 0.2A max @ 125 VDC.

The configuration of this relay (and associated dry contact) is included in the settings menu in Section 11. This output relay can be configured to operate for “Alarms” conditions, OR to operate for “Zone Block” (current > Inst, ST, or GF Pickup) conditions for indication to upstream non-URC

devices, OR to operate for Remote Close of an E/O (electrically operated) breaker..

5.3.1.1 Alarm Operation

If used for Alarms, all related alarms and errors result in a specific message on the display screen. The relay can be configured to operate for any combination of the conditions listed in Table 5-A. The reset method for each alarm condition is also listed in the Table below.

Alarm Condition	Reset Method
Trip	Manual reset
Internal Error	Auto reset
Actuator Open Error	Auto reset
Sluggish Breaker	Manual reset
UnderVoltage	Manual reset
OverVoltage	Manual reset
LT Pickup	Auto reset
Phase Loss/Rev (V2 and later)	Auto reset
Reverse Power (V4 and later)	Auto reset
Ground Fault (V2 and later)	Manual reset
Service Reminder	Manual reset

"Manual" = reset by user
"Auto" = trip unit resets when condition no longer present

Table 5-A: Alarm Configuration

The alarms listed as "Manual Reset" can be reset at the alarm screens. Additionally, the alarms can be manually reset using the "More" menu. See Section 20.0 for the alarm screens and Section 20.3 for the manual alarm reset screen.

**** NOTE ****

If no other power source is available, the battery is used to manually reset the relay. (applies to manual resets of alarm conditions only) Note: the relay can be used for one function only [Alarm or Zone Block or Close E/O Breaker].

See Section 20 for additional information.

5.3.1.2 Zone Block Operation

1. When the Programmable Relay Function is set to "Zone Block" (See Section 11), the relay contact will operate rapidly when current exceeds the respective pickup setting.
2. The user must set the "Programmable Relay Function" setting to "Zone Block".
3. The user must then set the "Zone Block Relay Contact Operation" setting to operate for the "ST Pickup", and/or "Inst (Instantaneous) Pickup", and/or "GF Pickup" condition(s).
4. Typical Zone Block Relay Contact operation for Instantaneous Pickup condition (**24VDC Aux power required**. See note 6a below):
    a. Once AC-PRO-II detects an Instantaneous overcurrent event, it will commit to Instantaneously trip the breaker and it will operate the Zone Block relay contact.
    b. The Zone Block relay contact will operate ~6-10ms after the start of the Instantaneous overcurrent event.
    c. The Zone Block relay contact will remain in the operated position while the current is greater than the pickup setting, plus at least an additional ~30-60ms.
5. Typical Zone Block Relay Contact operation for Short Time (ST) or Ground Fault Pickup (GF) condition (**24VDC Aux power required**. See note 6a below):
    a. Once AC-PRO-II detects an ST or GF overcurrent event, it will begin timing for that trip function, and it will operate the Zone Block relay contact.
    b. The Zone Block relay contact will operate ~6-16ms after the start of a ST overcurrent event, or ~16-40ms after the start of a GF overcurrent event.
    c. The Zone Block relay contact will remain in the operated position while the current is greater than the pickup setting, plus at least an additional ~30-60ms.
6. Zone Block (customer) requirements:
    a. Supply 24VDC auxiliary power to each AC-PRO-II. (required for rapid operation and for automatic reset of relay contact). (allow 3 watts per AC-PRO-II)
    b. Supply wiring and voltage for/from upstream relay digital input. (AC-PRO-II Zone block contact is a dry contact).

    See Section 11.16.2 for additional information.

5.3.1.3 Close E/O Breaker Control

1. When the Programmable Relay Function is set to "Close E/O Breaker" (See 11.16.3), the relay contact will operate to initiate a closing signal into the electrically operated (E/O) breaker's closing circuitry.
2. The user must set the "Programmable Relay Function" setting to "Close E/O Breaker".
3. The Programmable Relay Output must be Set to "Close E/O Breaker" to allow remote closing of electrically operated breakers. (Note – additional control wiring is required – contact URC for details/examples.)
4. Once this feature is set, there are two methods for using the trip unit to close an Electrically Operated (E/O) breaker. Using the URC Smart 1-Line HMI Breaker Close command and via InfoPro-AC (USB) software. The Breaker Close command requires input of Security Code.

See Section 11.16.3 for additional information.

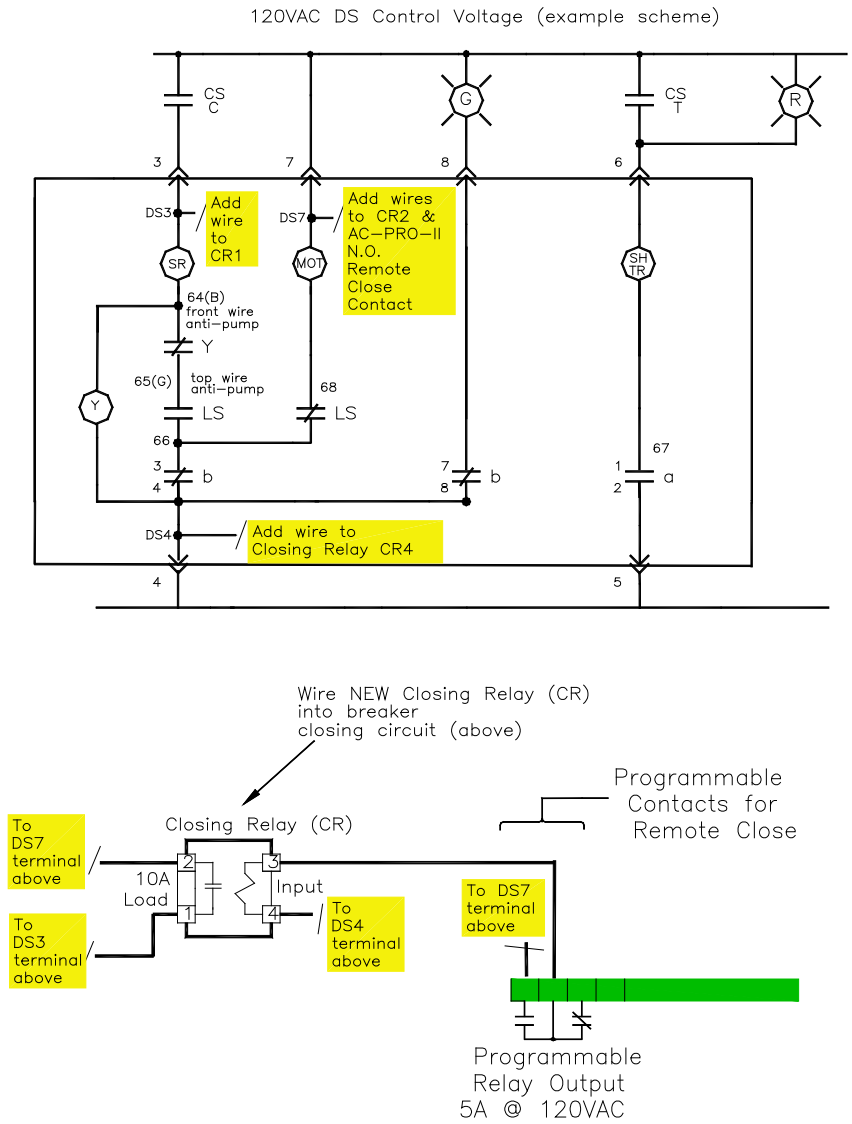


Figure 5.5: Example DS Breaker Close E/O Breaker Control Schematic (typical)

Notes:

Before Implementing:
1. Diagram is for example. Review actual breaker schematic for feasibility as features vary.
2. Ensure breaker has close coil and required E/O wiring.
3. Review electrical or mechanical interlocks that could affect operation.
4. Test operation with InfoPro-AC software

Before issuing Close command:
1. Ensure springs are fully charged.
2. Ensure breaker is not being racked in/out
3. Ensure a standing shunt trip command is not present.
4. Ensure the breaker is not being mechanically operated.

5.3.2 Ground Fault Defeat Input

The Ground Fault defeat input is used to temporarily disable Ground Fault protection. Defeating Ground Fault protection is necessary for some protective schemes, for example double-ended switchgear that is operated with the tie breaker closed.

When the Ground Fault defeat input is open, the Ground Fault protective function will operate normally.
When the Ground Fault defeat input terminals are shorted, the Ground Fault current (if any) will be calculated and displayed, however Ground Fault trips will not occur.

Note: If the GF Defeat input is opened during a Ground Fault event, the Ground Fault protection function will begin functioning and timing as soon as the Ground Fault Defeat input is opened.

5.3.3 Sluggish Breaker Limit Switch

If a breaker position limit switch was provided by URC with the breaker retrofit kit, it can be wired to the breaker position contact “a/b” input for breaker position indication, and also to allow the patented Sluggish Breaker® detection feature to operate with low or no breaker current. The type of limit switch contact used is configured in the settings menu. The limit switch type can be set as 52a (contact is open when the breaker is open), or 52b (contact is closed when the breaker is open).

5.4 RS-485 Communications Terminal Block

The RS-485 communications terminal block on the AC-PRO-II provides communication using the industry standard MODBUS RTU protocol through a single shielded twisted pair cable. Refer to the Communications Section of this manual for additional information.

5.5 24VDC Auxiliary Power

The 24VDC auxiliary power port is available for connection to the following sources:

1) B-292 Secondary Injection Test Set.
2) T-490-ASM 24VDC Power Supply.
3) Customer supplied auxiliary power. See Section 3.4.

5.6 USB Port

The USB Port (mini-USB) on the front of the trip unit is electrically isolated and available for the following connection options:

1) Laptop or personal computer with InfoPro-AC software:
   (See Section 23.0 for more information.)

2) SAFE-T-TRIP remote trip device.

A rubber cover is provided for the USB port.

**** IMPORTANT ****
Replace the USB port cover after use.

If the AC-PRO-II is installed on a breaker where the face of the trip unit is not concealed by a cubicle door, the USB port on the face of the trip unit itself can be safely accessed.

If the AC-PRO-II is installed on a breaker concealed behind a cubicle door, the kit will include a USB extender cable that mounts flush in the door. This allows the USB port to be used without opening the door. See Section 5.6.1 for USB extension cable information.

5.6.1 USB Extension cable

If AC-PRO-II is installed on a breaker that is located behind a cubicle door, a USB panel mount extension cable and legend plate is provided in the retrofit kit. This provides a permanent USB connection from the AC-PRO-II to a USB port that is accessible at the cubicle door. The cable (5/C, 6 feet long) features a right angle mini-USB connector for the AC-PRO-II and a USB port with cover, and a threaded nut for securing to the cubicle door.

Figure 5.6: USB Extension cable

5.6.2 USB Extension Cable Installation

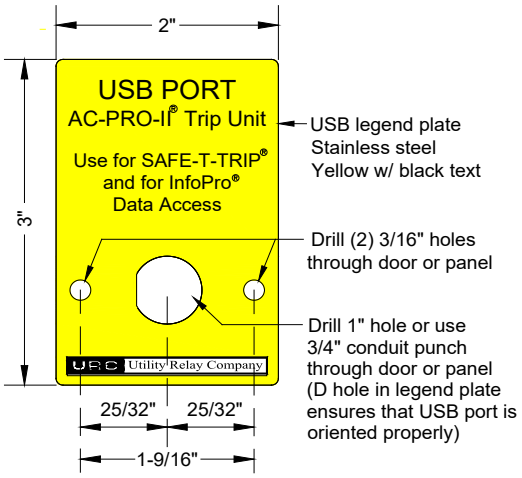


Figure 5.7: USB Extension Plate Drilling

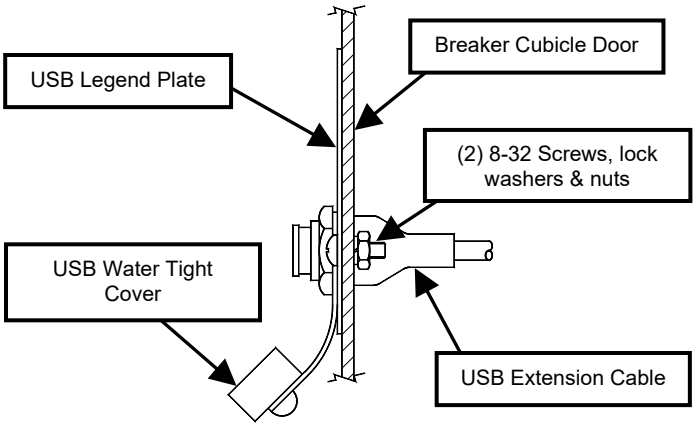


Figure 5.8: USB Extension Plate & Cable Installation

To install the USB Extension cable:

1. Find a suitable location on the cubicle door and mark the three (3) holes using the dimensions in Figure 5.7.
2. Drill two (2) 3/16" mounting holes.
3. For the center hole, cut a 1" diameter hole using a hole saw or alternately, use a 3/4" conduit knockout punch.
4. Attach the USB legend plate to the front of the cubicle door using the supplied two (2) 8-32 screws, nuts, and lock washers.
5. Connect the right-angle USB connector to the AC-PRO-II. Route the cable so it does not interfere with the opening or closing of the cubical door or with the racking of the breaker between connect and disconnect positions. Use the supplied cable ties and holders to hold the cable in position.
6. Position the USB port through the 1" opening and through the opening in the legend plate. Ensure one rubber washer is on the interior of the door / panel, and the threaded USB cover and rubber washer are on the exterior.
7. Thread the plastic nut onto the USB port connector, securing it to the door / panel.

5.7 VDM Connections (optional)

The optional Voltage Divider Module (VDM) is available for voltage-based protection and information functions. The VDM requires connection to the line-side bus of the breaker for Phase A, B, and C, as well as a connection to the breaker frame for Ground. Refer to Section 8.0 for additional Voltage Divider Module (VDM) information.

6.0 Menu Navigation

AC-PRO-II settings and information can be navigated using the push buttons on the face of the trip unit. Pressing the "DISPLAY" button wakes the display up from its power saving mode. After the display is on, all menu navigation is accomplished using the screen prompts and (4) smart buttons below the display. The smart button labels appear at the bottom of the screen.

In normal operation, the main screen is the first screen displayed after waking the display up. The main screen provides actual values for Phase A, B, and C current, as well as Neutral and Ground Fault currents. For Phase currents below 10% of the CT rating, "LOW" will be displayed. Neutral and Ground Fault fields will be blanked when these currents are below 10% of the CT rating.

Additionally, if a Voltage Divider Module (VDM) is present, the main screen also displays voltages for Phase A, B, and C. The main screen also provides access to four (4) main menus via smart buttons. See the main screen example below along with list of menus and sub-menus:

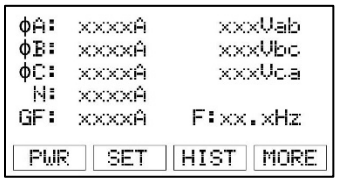


Figure 6.1: Main Screen
(Optional voltage values shown)

1) PWR (Power Menu): This menu provides access to power values, which become available if the optional Voltage Divider Module (VDM) is connected.
2) SET (Settings Menu).
   a. REV (Review Settings sub-menu): This sub-menu allows review of all user settings without the option of changing the settings.
   b. CHNG (Change Settings sub-menu): This sub-menu allows the user to change all protection, alarm, and breaker information settings.
   c. TEST (Test Mode): See Section 14.1.1.
3) HIST (Trip History Menu): This menu provides access to trip history information for up to eight (8) trips.
4) MORE (Trip Unit Information Menu): This menu includes serial number(s), time & date settings, battery status, URC contact info, etc.
5) QT – When at the Main Screen, pressing the DISPLAY button will change the bottom labels at the bottom of the screen. This will allow access to the QUICK-TRIP® mode control. See Section 7.0 for additional information.

See Section 13.0 for information on values displayed on readings screens.

For reference, see the following table for common smart buttons and associated actions, which may appear depending on the specific screen.

Smart Button Label	Action
Next	Proceed to next screen or next setting
Back	Return the previous screen or previous setting
Exit	Return to the Main Screen
Up	Increase setting value or toggle to next setting value.
Down	Decrease setting value or toggle to previous setting value.
ON	Turn function or feature ON.
OFF	Turn function or feature OFF.

Table 6-A: Common Smart Button Actions

See Figure 6.2 for a simple view menu navigation map.

6.1 Power Menu

If the AC-PRO-II is equipped with the optional Voltage Divider Module (VDM), the power menu becomes available. The power menu is accessed from the main screen by pressing the “PWR” smart button. The smart buttons allow navigation to subsequent screens, which display power information, as well as the capability of resetting energy usage values. The figure below shows the flow of the Power Menu.

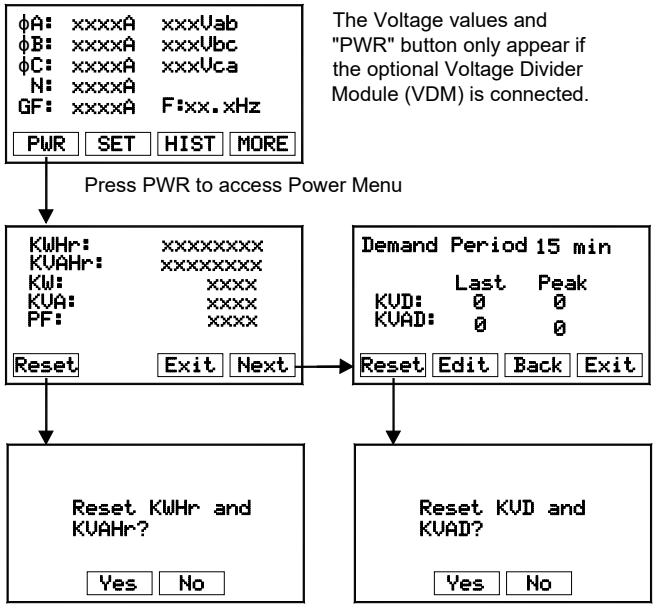


Figure 6.2: Power Menu Screens
Note: Power Menu only appears if the optional VDM is connected.

6.1.1 Power Demand Period

Choose Edit Menu key to modify the Demand Period. It can be adjusted from a 5 to 60 minute rolling window with 15 minutes being the default demand period. Kilowatt Demand (KWD) and Kilovoltamps-Demand (KVAD) are recorded with “Last” and “Peak” values logged. Use Reset to clear the Power Demand Peak values.

See Section 13.0 for information on values displayed on the readings screens.

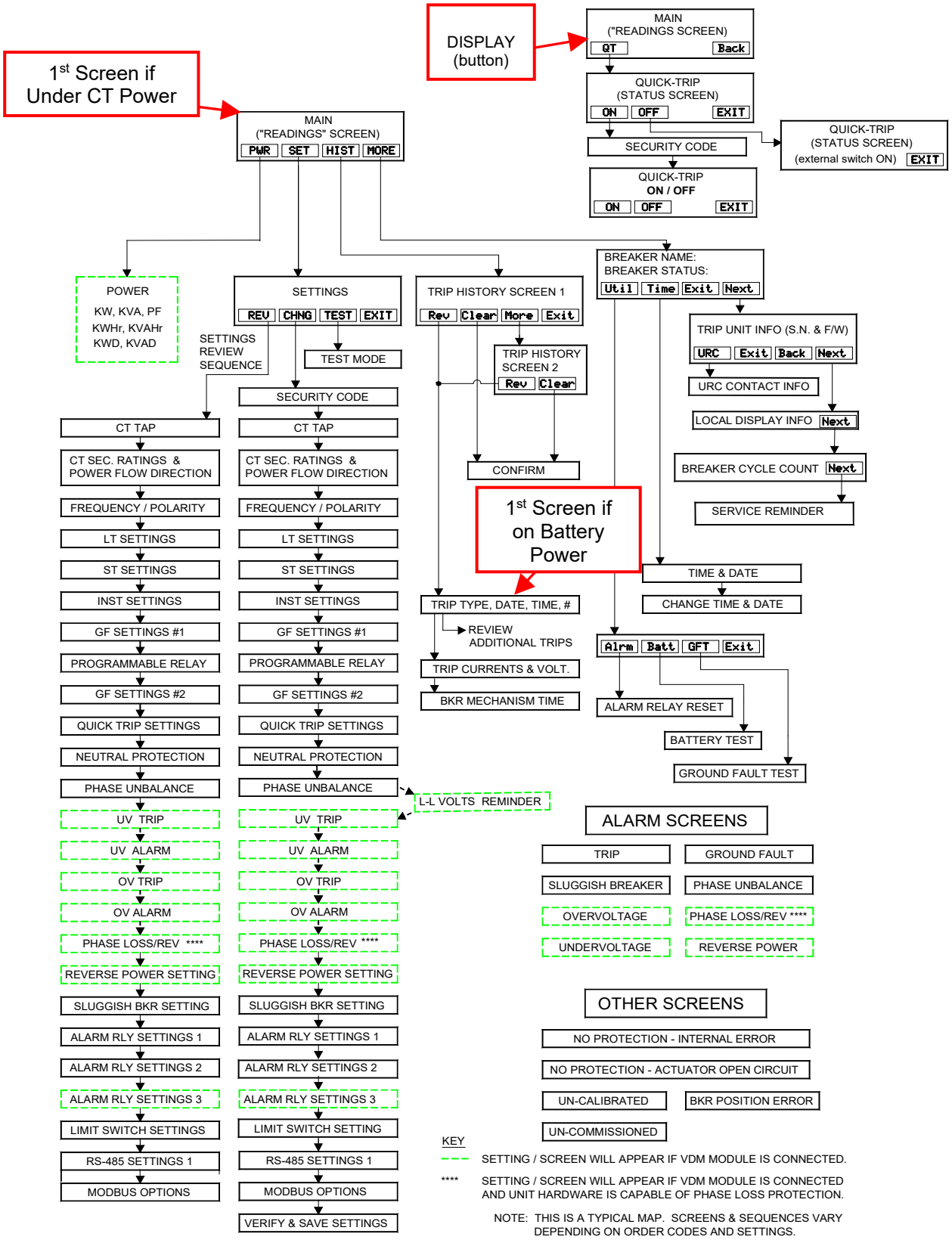


Figure 6.3: Typical AC-PRO-II Menu Navigation Map - Simple View

6.2 Settings Menu

The settings menu provides the ability to review and modify settings. The first settings menu screen provides access to the following settings sub-menus by pressing the associated smart push buttons: review settings sub-menu, change settings sub-menu, and RS-485 settings sub-menu. See the settings menu first screen in the following figure:

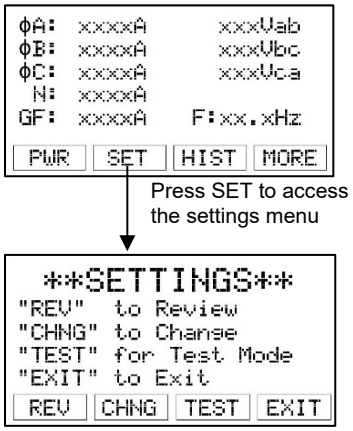


Figure 6.4: Settings Menu first screen

For details regarding Settings, refer to Section 11.0.

6.3 Trip History Menu

The AC-PRO-II stores data from the last eight (8) trips. The trip history menu displays this information. The trip unit stores trip counts, types, time stamps, and currents. If a VDM is connected, voltages will also be stored in the trip history. Additionally, the breaker mechanism times for all trips are stored. Refer to Section 12.0 for details regarding trip history and navigating the trip history menu. (Use InfoPro-AC software to view current and voltage waveforms. See Section 23.0.)

6.4 More Menu

The more menu provides access to the following trip unit information and functions:

1) Breaker Name (use InfoPro-AC to set)
2) Breaker Status (requires limit switch)
3) Trip unit serial number.
4) Local display serial number (this is separately provided since the local display can be separated from the trip unit).
5) Trip unit firmware revision number and VDM version number (if applicable).
6) Local display firmware revision number.
7) Viewing and setting time and date.
8) Manually reset the alarms.
9) Battery test and status.
10) Utility Relay Company contact information.(More/Next/Next/URC button)
11) Perform a Ground Fault Trip Test
12) Breaker Cycle Counter
13) Scheduled Service Reminder (see below)

6.4.1 Time and Date Setting

The time and date setting is accessed via the MORE menu, by pressing the MORE button at the main screen, then the time button, then the change button, as shown and noted below in **Error! Reference source not found.**.

The time and date setting is important, as trip events and waveform captures are time stamped.

**** IMPORTANT ****

The time and date must be set after commissioning the AC-PRO-II or after replacing the battery to ensure the time stamps (of trips and on-demand waveforms) are recorded and are correct.

In order for the time and date to remain accurate after setting, a fresh battery must be in place.

There is no provision for daylight savings time.

6.4.2 Utilities

6.4.2.1 Alarms

See Section 5.3.1 Alarm Operation for all alarms. Use screen to Reset.

6.4.2.2 Battery Test and Status

The trip unit internal battery state can be tested and viewed using the MORE menu. Press “MORE”, then press “Util”, then “Batt” as shown below. “Test” displays voltage.

6.4.2.3 Ground Fault Trip Test

The trip unit can perform a Ground Fault trip test. This simulates a measured Ground Fault condition, and tests the trip unit’s ability to perform a trip. Ground Fault Protection or Quick-Trip Ground Fault Protection must be turned on to perform a Ground Fault Test Trip. See **Error! Reference source not found.**.

6.4.3 Breaker Cycle Counter

If the Sluggish Breaker Position Indicator 52a / 52b limit switch is active (See 5.3.3), the “Breaker Cycle Counter” will log the number of operations of the breaker that occurred **while the trip unit was powered up**. Choose the DISPLAY key, More, Next (3) times. The Breaker Cycle Counter can be RESET at same menu and via InfoPro-AC. (Note: the trip unit must be powered via CTs, VDM, USB or Aux Power to log breaker operations.)

6.4.4 Scheduled Service Reminder

This feature allows the user to program a “reminder” date for breaker service. The user can also program a company name and contact info. On the reminder date, a “Service Reminder” screen will appear with the company name and contact info, if entered.

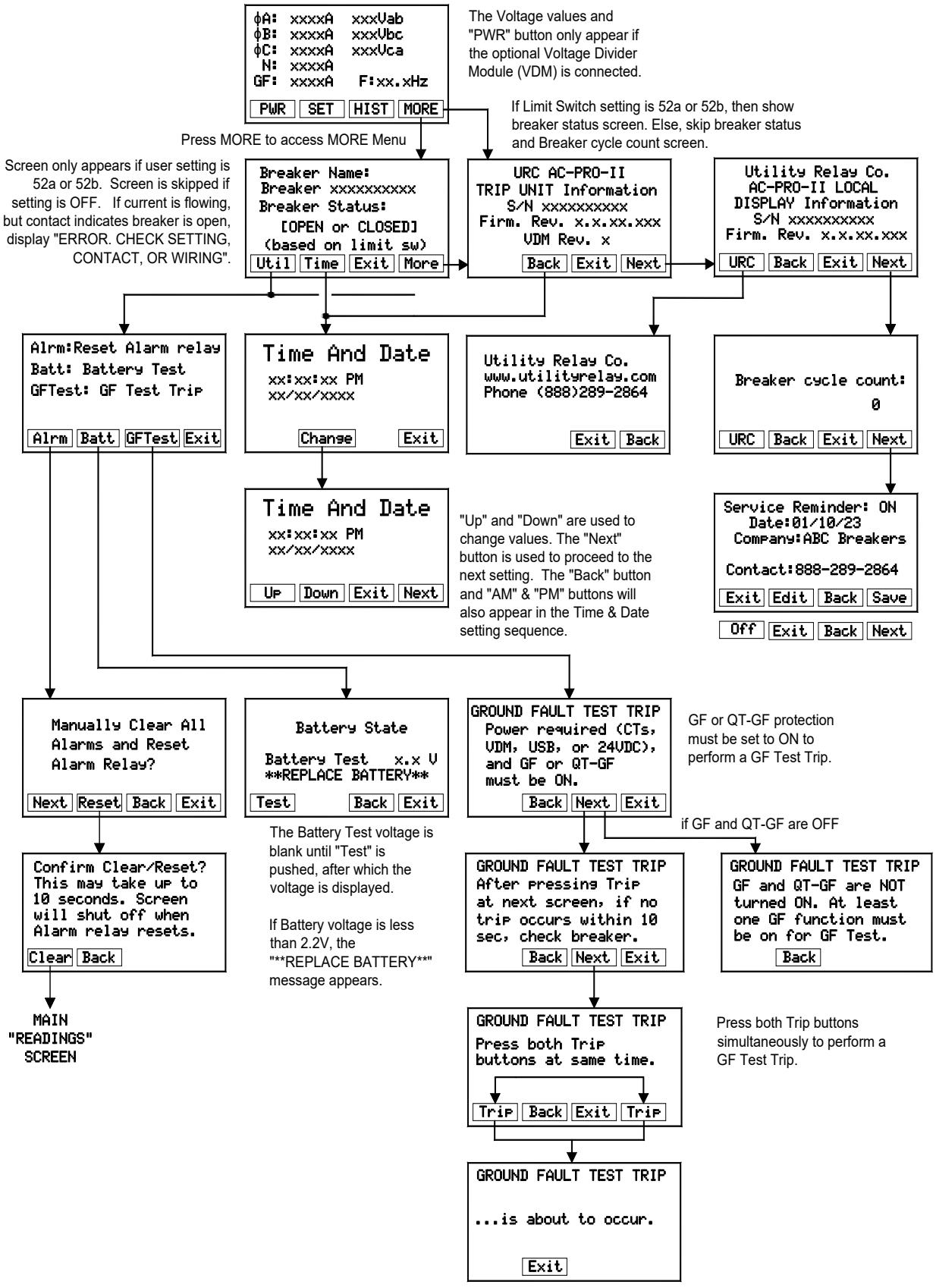


Figure 6.5: MORE Menu

7.0 QUICK-TRIP® (Arc Flash hazard reduction / ERMS)

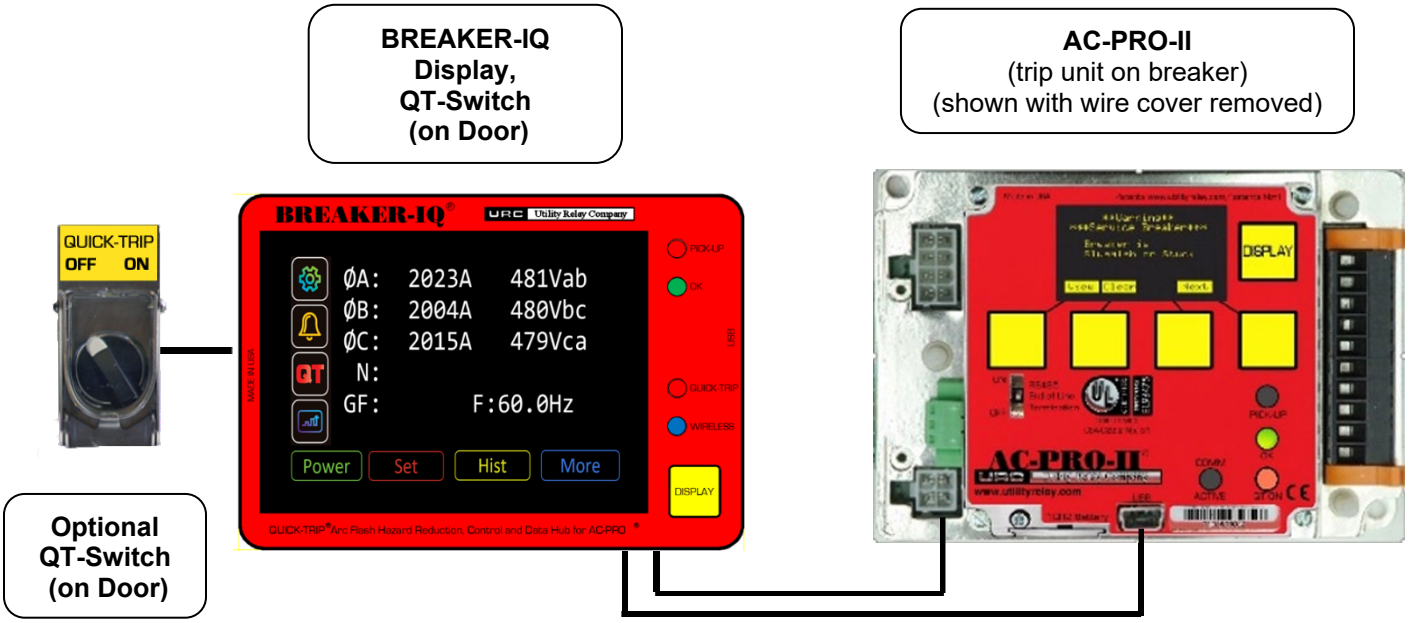


Figure 7.1: QUICK-TRIP System and Connections (Option #1, includes BREAKER-IQ display)

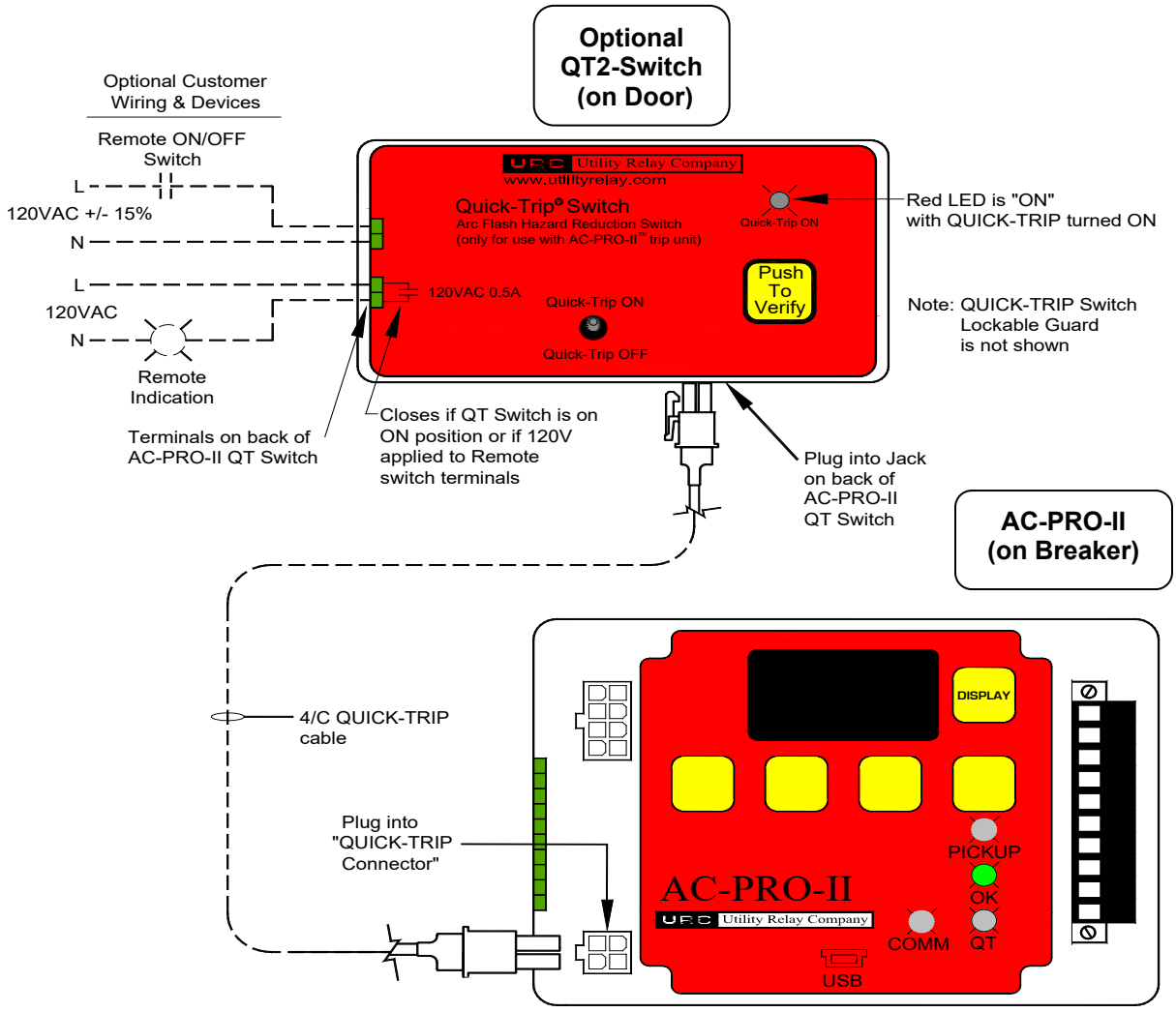


Figure 7.2: QT2-Switch Connections (Option #2, no display)

7.1 QUICK-TRIP® Basics & Operation

The QUICK-TRIP system is a manually controlled arc flash hazard reduction system; otherwise known as an Energy Reducing Maintenance Switch (ERMS). It can reduce trip times when turned on and allows selective coordination between circuit breakers when turned off.

If maintenance personnel must work on energized equipment, they will first turn the QUICK-TRIP system on at the upstream breaker feeding the equipment. If a fault now occurs, the upstream breaker will trip quickly based on the QUICK-TRIP settings **reducing the Arc Flash Hazard to personnel.**

When the maintenance work is finished, the QUICK-TRIP system is turned off and the original selective coordination is back in effect.

The QUICK-TRIP mode can now be controlled with physical switches or by "soft" means. It is recommended that only one or the other means is used. See Section 7.5 for additional information.

**** IMPORTANT ****

Local indication of the QUICK-TRIP ON/OFF status is required by the National Electrical Code. If the AC-PRO-II trip unit (shipped Dec 2017 or later with integral QT LED) is not accessible when the breaker door is closed (e.g. a "through-door" breaker), than an additional visible means of local indication (QT2-Switch, BREAKER-IQ Display, Smart 1-Line, or other means) must be installed.

The QUICK-TRIP system consists of the following options:

Option #1: AC-PRO-II trip unit, BREAKER-IQ Display, and optional QUICK-TRIP Switch (pad-lockable)((includes cubilcle door display). Shown in Figure 7.1: QUICK-TRIP System and Connections (Option #1, includes BREAKER-IQ display). See BREAKER-IQ at Utility Relay Company. See http://www.utilityrelay.com/products/QUICK-TRIP.html for additional information. For installation instructions, see I-breaker-iq.pdf (utilityrelay.com)

Option #2: AC-PRO-II:QT2-Switch (padlockable), and 4/C cable. Shown in Figure 7.2: QT2-Switch Connections (Option #2, no display).
See http://www.utilityrelay.com/products/QUICK-TRIP.html for additional information. See this document for installation.

Option #3: Soft Quick-Trip (front Keypad or USB InfoPro-AC software or Smart 1-Line HMI)
See Section 7.5 below for additional information.

When QUICK-TRIP is **ON**, the following settings are enabled:

- QUICK-TRIP Instantaneous (QT-I)
- QUICK-TRIP Ground Fauly (QT-GF) (if QT-GF enabled in settings)

These are standard AC-PRO-II settings. All other settings remain in effect. Refer to Section 6.2.

The "QUICK-TRIP ON LED" provides positive indication that the QUICK-TRIP settings are active if the LED is on.
If the AC-PRO-II is not powered up (by current, voltage (VDM), USB or 24VDC Aux.), the QUICK-TRIP Switch "Push-to-Verify" button is available. Pressing this button will "wake up" the trip unit using the AC-PRO-II battery, and the QUICK-TRIP ON LED will illuminate, providing positive indication that the QUICK-TRIP switch or remote QUICK-TRIP switch is in the ON position.

**** IMPORTANT ****

A qualified engineer must determine the QUICK-TRIP settings, calculate the incident energy levels and determine the Hazard Risk Categories (HRC).

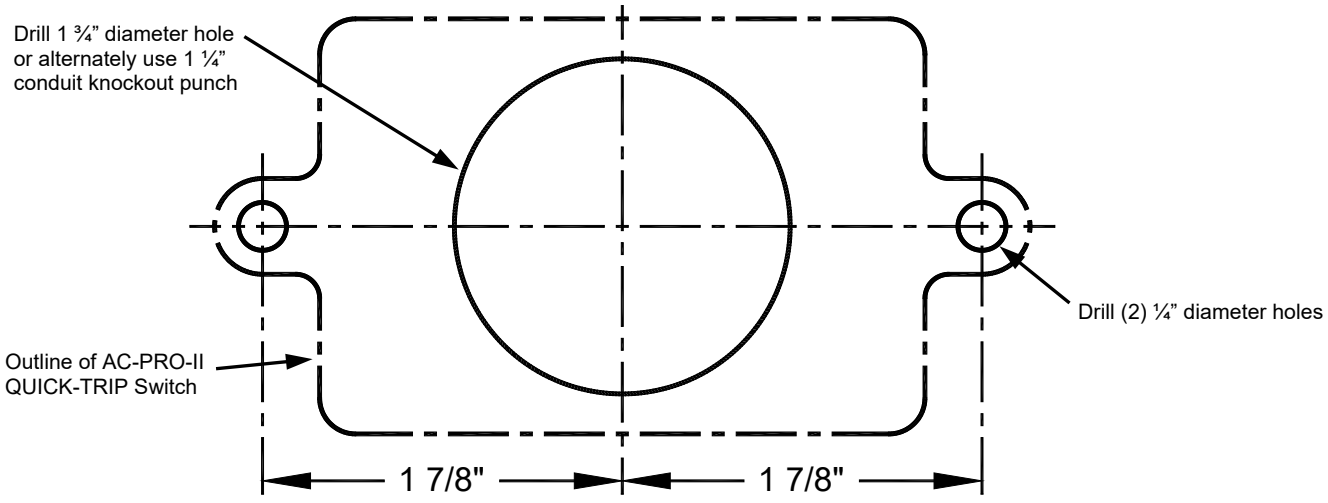


Figure 7.3: AC-PRO-II QT2-Switch Drilling Plan
(Verify Printer Scaling prior to Drilling)

7.2 AC-PRO-II QT2-Switch Mounting

To install the QT2-Switch:

1. Find a suitable location on the cubicle door and mark the location of the three (3) holes using the dimensions in Figure 7.2.
2. Drill two (2) 1/4" mounting holes.
3. For the center hole, cut a 1-3/4" diameter hole using a hole saw or alternately, use a 1-1/4" conduit knockout punch (1.73" D).
4. Attach the QUICK-TRIP Switch to the front of the cubicle door using the two (2) supplied 10-32 screws and lock washers.
5. Connect the QUICK-TRIP Switch to the AC-PRO-II trip unit by plugging one end of the 4/C cable provided into the jack on the back of the QUICK-TRIP Switch. Plug the other end of the cable into the "QT" jack on the front of the AC-PRO-II.
6. Route the cable so it does not interfere with the opening or closing of the cubical door or with the racking of the breaker between connect and disconnect positions. Use cable ties and holders to hold the cable in position.

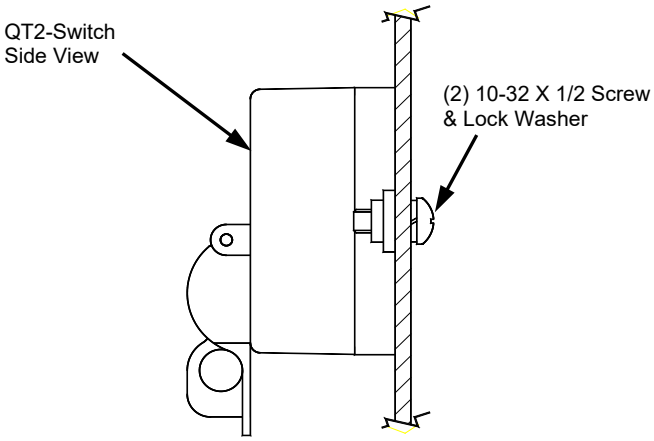


Figure 7.4: QT2-Switch Mounting

Figure 7.5: AC-PRO-II QT2-Switch

7.3 Remote QUICK-TRIP® Switch

The BREAKER-IQ can be wired to a remote QUICK-TRIP switch (provided by others). Refer to Figure 7.6: BREAKER-IQ Display with Remote QT Switch.

Alternatively, the AC-PRO-II QT2-Switch includes terminals on the rear for connection to a remote QUICK-TRIP switch (provided by others). Refer to Figure 7.2: QT2-Switch Connections (Option #2, no display).

If 120VAC (+/- 15%) is applied to the QT2-Switch remote QUICK-TRIP switch terminals, the QUICK-TRIP settings are activated. (Alternatively, 120Vac, 24Vdc and 125Vdc can be utilized for the QT2-SwitchXV version.)

**** NOTE ****
QUICK-TRIP can be activated (by applying 120VAC to the remote Quick Trip switch terminals) even when the AC-PRO-II QUICK-TRIP toggle switch is in the OFF position. Therefore, if a remote QUICK-TRIP switch is installed, URC recommends installing label(s) or nameplate(s) that indicate the presence and location of the remote QUICK-TRIP switch.

7.4 QUICK-TRIP® Remote Indication

The BREAKER-IQ is provided with terminals on the rear for connection to a customer supplied remote QUICK-TRIP indicating light or other device. See Figure 7.6: BREAKER-IQ Display with Remote QT Switch and Indication.

AC-PRO-II QT2-Switch includes terminals on the rear for connection to a customer-supplied remote QUICK-TRIP indicating light or other device. Refer to Figure 7.2: QT2-Switch Connections (Option #2, no display).

If the QUICK-TRIP System is activated (ON), the Remote QUICK-TRIP trip Indication contacts close. The contacts are rated 120VAC, 0.3A for the QT2-Switch; and also rated 24 Vdc, 0.3A and 125 Vdc, 0.3A for the QT2-SwitchXV model.

See additional information on remote Quick-Trip uising the Breaker-IQ at: [I-breaker-iq.pdf (utilityrelay.com)]

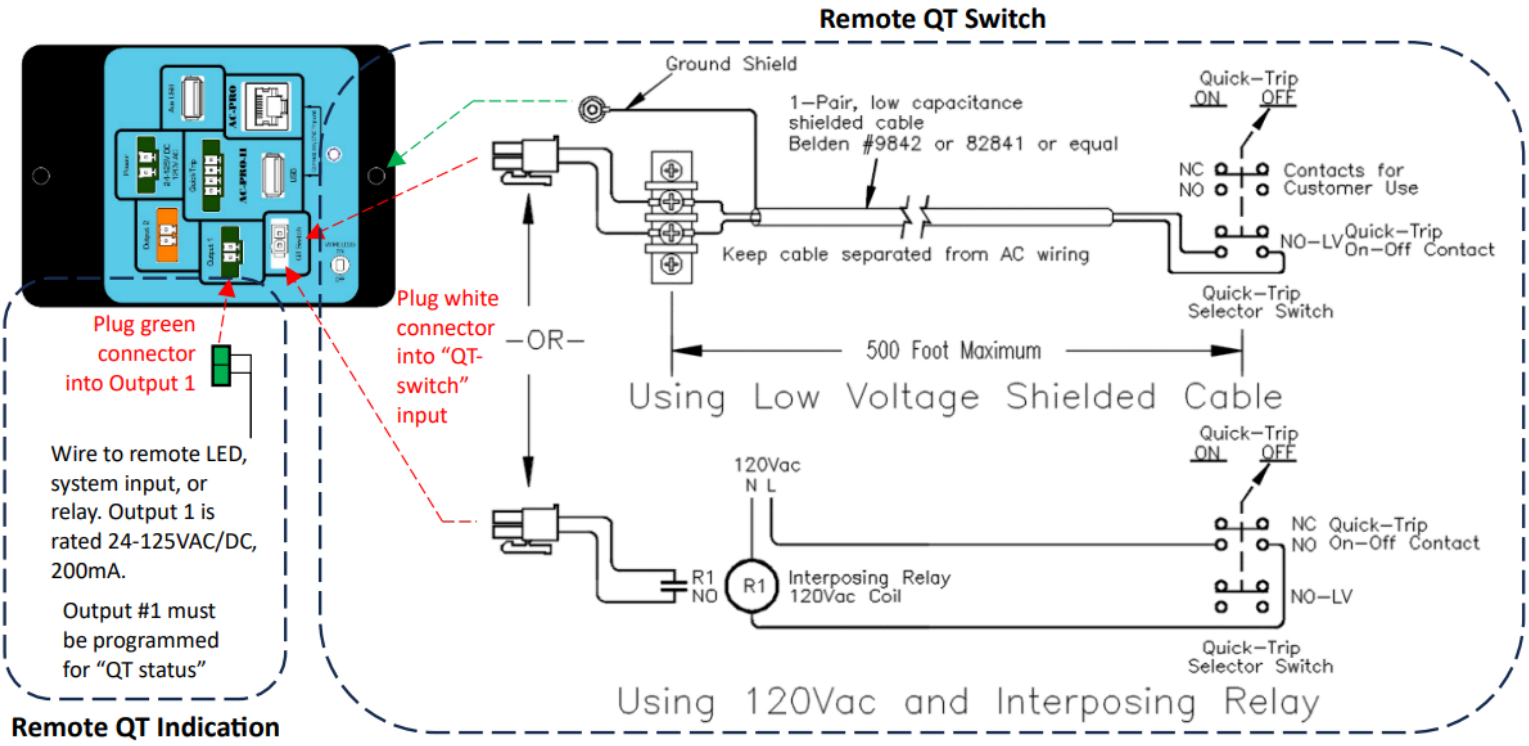


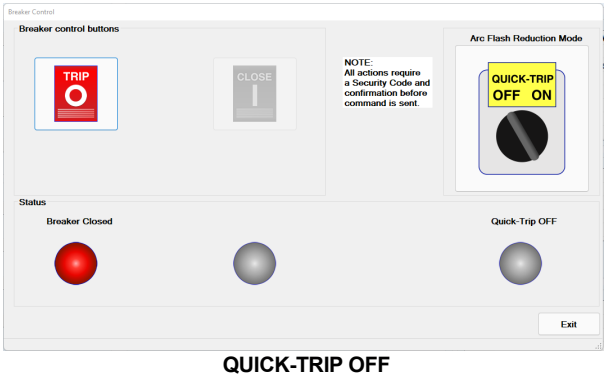
Figure 7.6: BREAKER-IQ Display with Remote QT Switch & Indication

7.5 QUICK-TRIP® ON / OFF Control

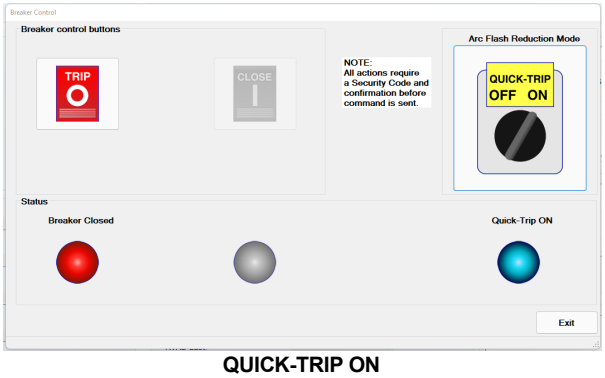
QUICK-TRIP® arc flash hazard reduction can be activated using local or remote switches (See Sections 7.1 and 7.3) or via three (3) other "soft" methods including the AC-PRO-II front Keypad, via InfoPro-AC (USB), or the Smart 1-Line HMI. (See Figure 7.7: Breaker Control and Figure 7.8: Front Panel QUICK-TRIP ON/OFF Control.) URC recommends using only one means or the other (use either physical switches OR use a "soft" method).

Control and Logic Notes:

1. If a physical QT switch is connected and in the ON position:
   a. The only way to turn QUICK-TRIP OFF is by switching the physical switch to the OFF position.
   b. All "soft" QT control methods are not available.
2. If a physical QT switch is not present or is connected but in the OFF position, then QUICK-TRIP can be turned ON or OFF by using one of the "soft" methods (AC-PRO-II front panel, InfoPro-AC (USB) software, or Smart 1-Line via RS-485 communications).



QUICK-TRIP OFF



QUICK-TRIP ON

Figure 7.7: Breaker Control Window (InfoPro-AC or Smart 1-Line)

Note: To allow remote Quick-Trip control with Smart 1-Line (RS-485), the "Soft QT SW" Modbus option (permission setting) must be enabled locally at the AC-PRO-II.

To control QUICK-TRIP® mode via the keypad, when at the Main Readings screen, press the "DISPLAY" button, then select "QT", and then turn Quick-Trip ON or OFF using the buttons below. You will need to enter the Security Code (last 4 sigits of serial number) and then confirm you wish to make the setting adjustment. The Quick-Trip Indicating LED on the trip unit will be lit if trip unit is in QT mode.

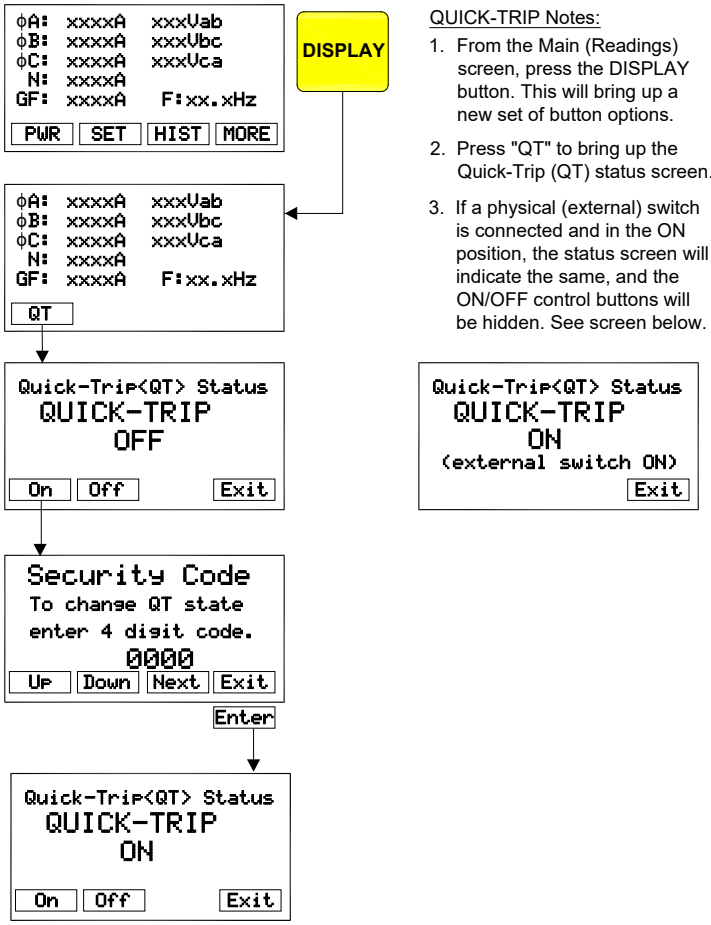


Figure 7.8: Front Panel QUICK-TRIP ON/OFF Control

8.0 Voltage Divider Module (VDM) (optional)

The optional Voltage Divider Module (VDM) provides the following voltage-based protection and voltage and power calculations:

- Voltage Metering
  - Line-to-Line (v2 & later firmware)
  - Line-to-Neutral (v1 firmware)
- Power Metering: (KW, KVA, KWHr, KVAHr, PF, KWD, KVAD)
- Under-Voltage Trip & Alarm
- Over-Voltage Trip & Alarm
- Phase Loss/Reverse Trip and Alarm (requires VDM rev 2)
- Reverse Power Trip and Alarm (requires VDM rev 2)

The VDM is rated for up to 600V three-phase power systems. In addition, the VDM provides continual power to the AC-PRO-II when the breaker line side is energized (when Phase A-B voltage is greater than 90V), allowing the trip unit to communicate breaker status even if the breaker is open or not carrying sufficient current. For that reason, the VDM option is recommended if the trip unit will be incorporated in a communications system to avoid possibility of intermittent communications.

The VDM mounts directly to the back of the AC-PRO-II and connects to the trip unit via an internal ribbon cable.

See Figure 5.2 for VDM picture and Figure 5.3 for a diagram.

**** IMPORTANT ****

The normal location for the VDM taps is the line side of the breaker. This results in continuous trip unit power when the breaker is racked into an energized cubicle, even when the breaker is open. This is desirable for communications applications where breaker position indication is desired.
For fused breakers where Phase Loss protection (for blown fuse conditions) is desired, the VDM taps must be located on the load side of the fuses. If continuous trip unit power is desired in these conditions, 24VDC Auxiliary power is recommended.

**** NOTE ****

In multi-source applications (i.e. Main-Tie-Main): Phase Loss protection will NOT provide blown fuse protection on tie breakers, or on main breakers where sources can be paralleled, since the VDM taps may be on "wrong" side of the fuse, since multiple sources exist.

8.1 Voltage-Based Protection

When equipped with the Voltage Divider Module (VDM), the AC-PRO-II can be used to provide voltage-based protection using the UnderVoltage, OverVoltage, and Phase Loss/Reverse features.

IMPORTANT: The AC-PRO-II with VDM voltage-based protection capabilities depend on the version of AC-PRO-II firmware and the version of the VDM. The VDM and Firmware version information can be viewed on the screen. See the Table 8-A for voltage features based on firmware and VDM versions.

NOTE: The AC-PRO-II Firmware version and the "VDM Rev" can be viewed on the AC-PRO-II screen in the "More" menu. See Figure 8.1: VDM Version Screen**Error! Reference source not found.**. From the "Main/Readings screen", press "More" for information.

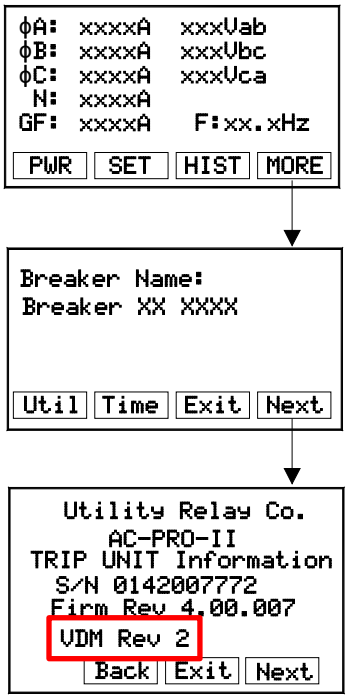


Figure 8.1: VDM Version Screen

	VDM (Hardware) Version	
Firmware Version	**"VDM rev 1"**	**"VDM rev 2"**
v1.x	Line-Neutral Voltages "**Basic** Voltage protection"	Line-Neutral Voltages "**Basic** Voltage protection"
v2.x	Line-Line Voltages "**Basic** Voltage protection"	Line-Line Voltages "**Advanced** Voltage protection"

Table 8-A: Voltage-based protection versions

"Basic Voltage Protection" is defined as OverVoltage and Brownout UnderVoltage. Basic voltage protection (using VDM rev 1) requires voltage to be present at the VDM (at least 90V between Va and Vb). See Sections 11.20.1 and 11.21.

"Advanced Voltage Protection" is defined as OverVoltage, UnderVoltage, Phase Loss/Reverse and Reverse Power Protection. Advanced Voltage Protection (using VDM rev 2 and firmware v2) requires CT power (10% current or greater), OR voltage at the VDM (>90V between Va and Vb), or 24VDC Auxiliary power. Applying 24VDC Auxiliary power is recommended. This will allow the AC-PRO-II with VDM to provide advanced voltage-based protection, even when CT power or VDM power is not available (for example, in the event of a total power loss). See Sections 11.20.2, 11.21, 11.22 and 11.23.

**** IMPORTANT ****

If line voltage is the only source to the trip unit (no current, no 24VDC aux power), it must be present for 5 seconds before a voltage-based trip can occur.

**** IMPORTANT – PHASE LOSS & UV ****

Reminder: Although AC-PRO-II derives power from the system current (CTs) and from system voltage (VDM), there are some UnderVoltage (UV) or Phase Loss circumstances (i.e. a total power loss, Phase Loss with no current, etc) where the AC-PRO-II is not powered by the CTs or the VDM. Therefore, if Phase Loss or UV protection is desired in these circumstances, reliable 24VDC Auxiliary power to AC-PRO-II is recommended.

9.0 SAFE-T-TRIP™ (optional)

The SAFE-T-TRIP remote trip device is available for the AC-PRO-II. The SAFE-T-TRIP allows an operator to trip open a breaker without standing in front of the breaker. It also provides a way to obtain the breaker mechanism operation speed for the important **first operation**. This is accomplished using the patented Sluggish Breaker feature in the AC-PRO-II.

The SAFE-T-TRIP device is furnished with a permanently connected 30-foot USB cable, allowing the breaker to be tripped without standing directly in front of the breaker, thus reducing the arc flash hazard risk.

The SAFE-T-TRIP device connects directly to the trip unit Mini-USB port or the door-mounted USB Extender.

⚠CAUTION

The SAFE-T-TRIP device should not be operated while standing in front of a racked in breaker or breaker cubicle. The SAFE-T-TRIP is supplied with a 9V lithium battery, the attached USB cable with magnetic cable wrap (for stress relief), and Instructions, in a durable, waterproof case.

Figure 9.1: SAFE-T-TRIP

Figure 9.2: SAFE-T-TRIP in case

10.0 Sluggish Breaker™ Detection

The AC-PRO-II patented Sluggish Breaker Detection feature captures the breaker mechanism time when a trip occurs that was initiated by the trip unit. If the breaker mechanism time is in excess of the Sluggish Breaker mechanism time setting (see Section 11.24), an alarm message will appear, and if set, the programmable relay will operate.

All AC-PRO-II trip units are capable of Sluggish Breaker Detection. URC recommends installing the limit switch if it is included in the Kit. If a limit switch is not included in the Kit, the AC-PRO-II can use the "Zero-Current" method to measure the mechanism time.

If a "sluggish" trip occurs, breaker mechanism maintenance is required.

When the AC-PRO-II sends a trip pulse to the breaker actuator, the Sluggish Breaker timer starts. The trip unit determines the breaker mechanism time by one of two methods:

1) Zero Current Method: If a limit switch is NOT wired into the trip unit, the limit switch user setting should be set to "None", and the trip unit will record the breaker mechanism time by monitoring the current values. The Sluggish Breaker timer stops when the current is zero. This method records the breaker mechanism time for each breaker pole.

**** NOTE ****
When using the zero current method, the Sluggish Breaker feature requires the pre-trip primary current to be 10% of the CT rating or greater.

2) URC Limit Switch Method: If a limit switch is wired into the trip unit, the limit switch user setting should set to "52a" or "52b", and the trip unit will record the breaker mechanism time based on the change in state of the limit switch. The Sluggish Breaker timer stops when the limit switch changes state. This method records one breaker mechanism time and reports the same value for each pole.

Figure 10.1: Sluggish Breaker Screen

11.0 Commissioning the AC-PRO-II®

Before the AC-PRO-II trip unit is put into service, it must first be commissioned so it will function. This requires the user to enter all of the pick-up and delay settings into the unit.

The commissioning process normally takes less than a few minutes to complete.

The AC-PRO-II can be commissioned using the local display screen, or using the InfoPro-AC software application. For commissioning using the local display screen, continue reading this section. For commissioning using the InfoPro-AC software application, see Section 23.0, and the InfoPro-AC help guide included in the application.

⚠ WARNING

**** IMPORTANT ****

The trip unit will NOT FUNCTION as it is shipped from the factory. The user must first COMMISSION the unit as outlined in this Section or Section 11.3 to make it functional.

11.1 Powering-Up the Trip Unit for Commissioning

In normal service, the AC-PRO-II is powered directly from the breaker mounted CT's.For commissioning, the trip unit can be powered up in any of the following ways:

11.1.1 Internal Battery

Press the "DISPLAY" button to power-up the trip unit using the internal battery.

The trip unit is designed to shut off automatically if none of the push buttons on the face of the unit are pressed for 60 seconds. It is best to have all the desired settings readily available before commissioning the unit when using the battery.

If the unit shuts down before the commissioning process is completed, the process must be started again from the beginning.

11.1.2 USB Power

Connect a laptop, PC, or USB wallpack to the front mini-USB port of the AC-PRO-II, or the USB extension port. The unit will be powered continuously, regardless of the power system current and voltage.

11.1.3 24VDC Auxiliary Power

Apply 24 VDC to the "+24VDC Aux Power" connector located on the front of the trip unit, primarily for the Secondary Injection Test Set. Refer to Section 15.0 for additional sources.(NOTE: 24VDC can only be applied to the specific pins identified in Figure 5.3.)

11.2 Un-commissioned Screens

After the AC-PRO-II is installed on the breaker and powered up, it must be commissioned as follows:

1) Press the "DISPLAY" button to turn on the display.
2) The "Un-commissioned" message will appear (see figure below).

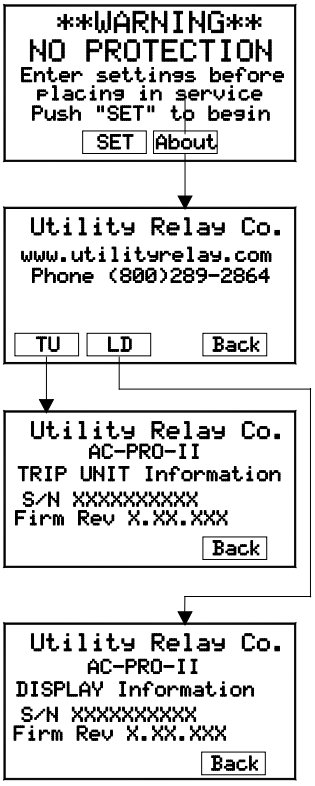


Figure 11.1: Un-commissioned Screens

Pressing "SET" will start the user settings process. See Section 11.3.Pressing "About" will go to the "URC" menu. The URC menu has links to the Trip Unit ["TU"] and Local Display ["LD"] Firmware Versions. See Figure 11.1: Un-commissioned Screen above.

11.3 Entering & Changing Settings locally

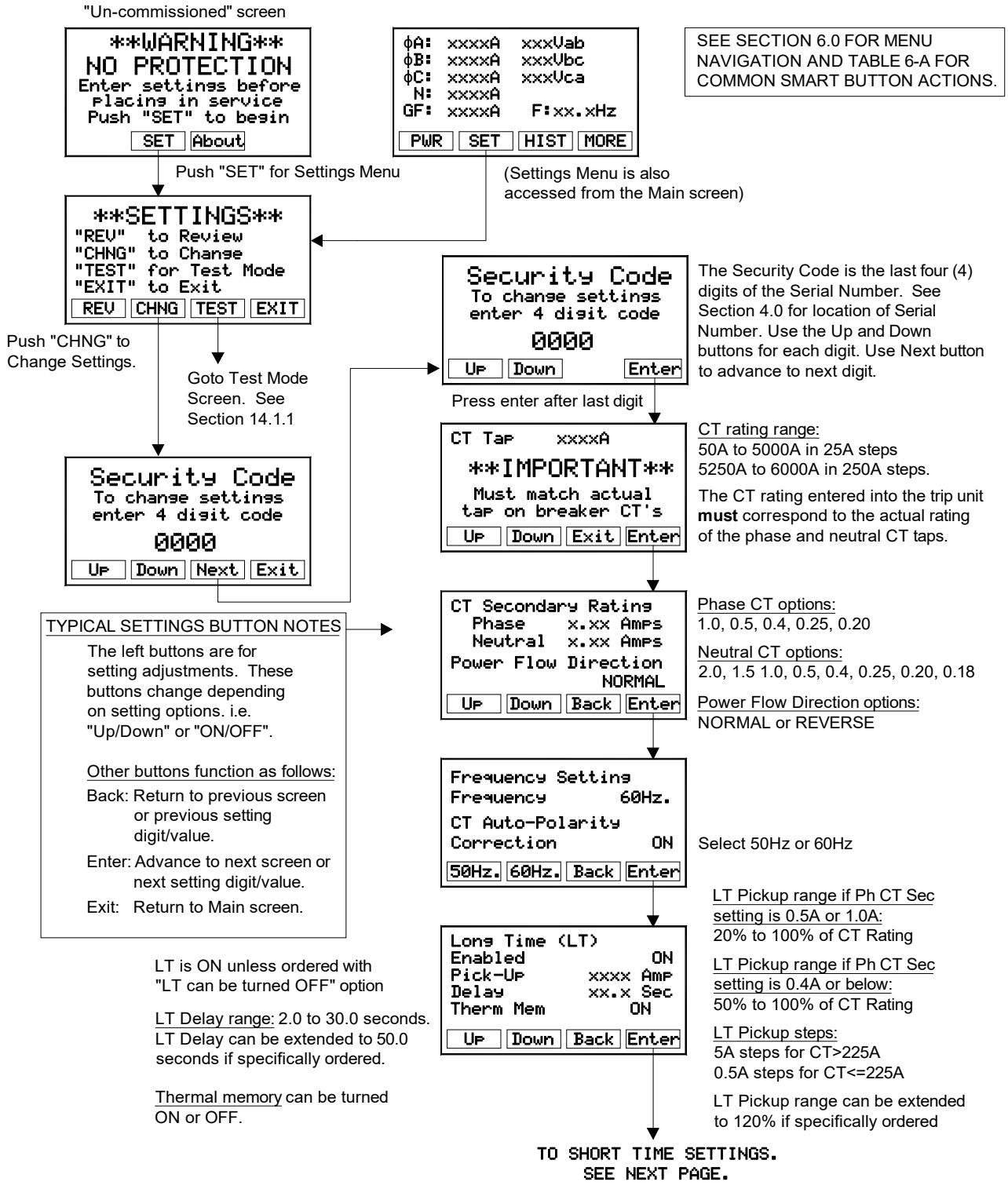


Figure 11.2: Change Settings Menu - Part 1

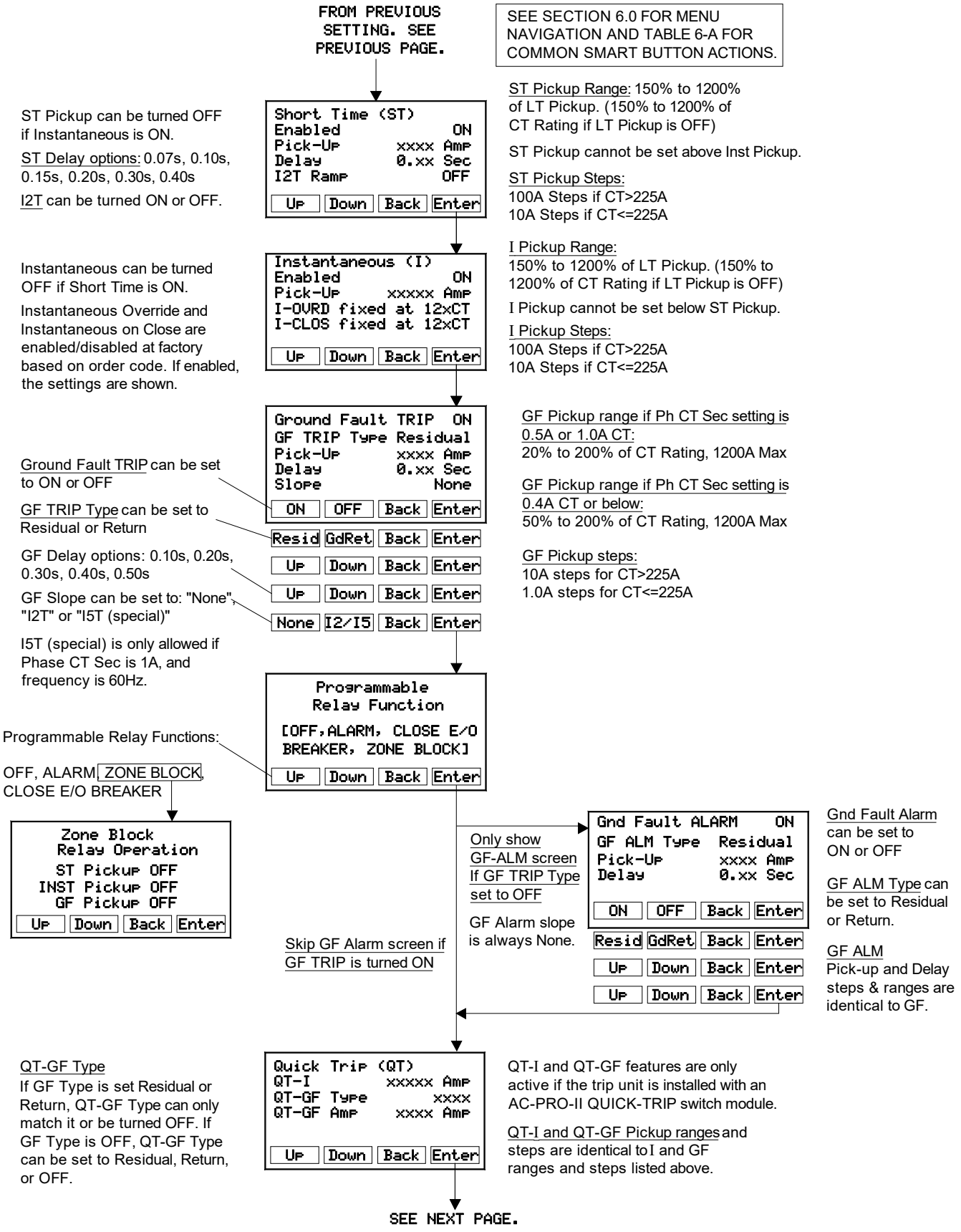


Figure 11.3: Change Settings Menu - Part 2

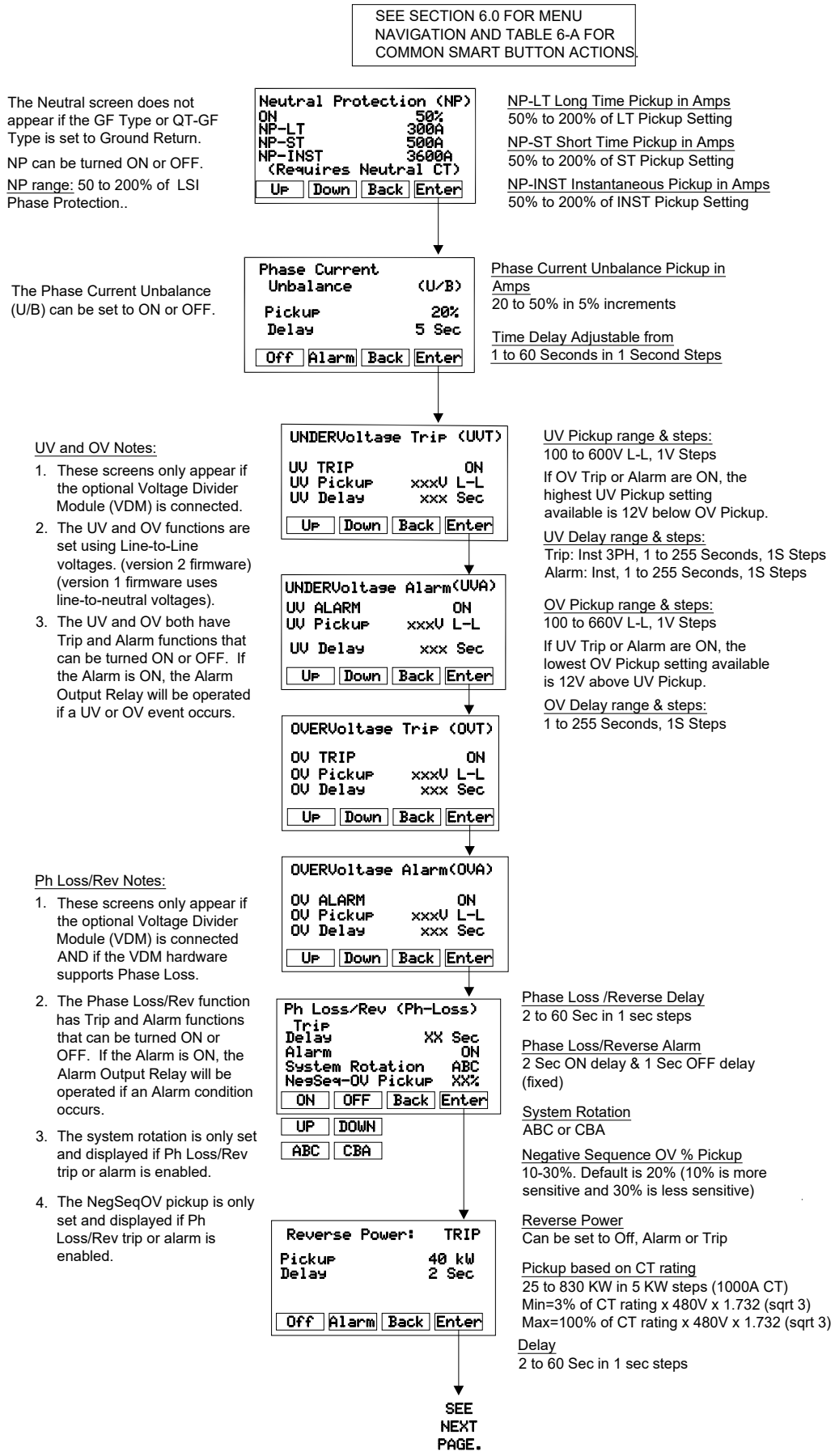


Figure 11.4: Change Settings Menu - Part 3

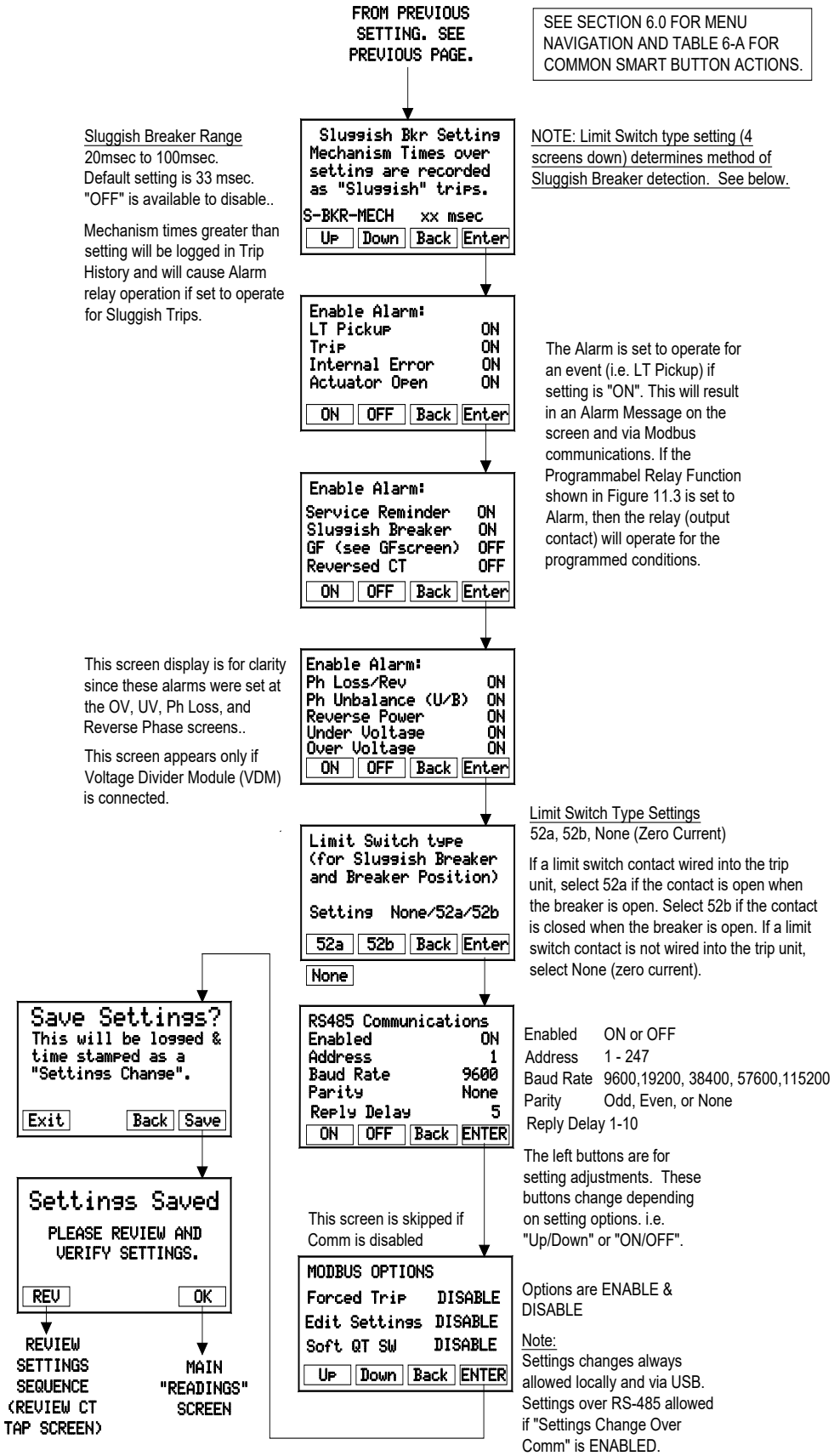


Figure 11.5: Change Settings Menu - Part 4

11.4 Security Code

The security code is the last four (4) digits of the serial number. See Section 4.0 for location of serial number. See Figure 11.2.

NOTE: For convenience, the AC-PRO-II offers a "Test Mode". When the AC-PRO-II is in Test Mode, the need for the Security Code is disabled for one (1) hour, after it is entered once. See Section 14.1.1

11.5 CT Tap

After the Security Code is entered, the first setting is the CT Tap (rating) in amps. The CT tap can range from 50 amps to 5,000 amps in 25 amp steps.

The CT rating entered into the trip unit **must** correspond to the actual rating of the phase and neutral CT taps. See Figure 11.2.

11.6 CT Secondary Rating

The CT secondary rating settings are entered in Amps and **must** correspond to the actual CT ratings. See Figure 11.2.

The Phase CT secondary rating is set in Amps with the following setting options:

1.0, 0.5, 0.4, 0.25, 0.20 Amp

The Neutral CT secondary rating is set in Amps with the following setting options:

2.0, 1.5, 1.0, 0.5, 0.4, 0.25, 0.20, 0.18 Amp

Note: the 0.18 CT secondary rating is an abbreviated representation of 0.185. The associated settings and performance are based on 0.185.

11.7 Power Flow Direction

The power flow direction setting only applies when a VDM is connected. When the CT wiring polarity matches Figure 5.3, the power flow direction should be set to "NORMAL". When the CT wiring polarity is the opposite of Figure 5.3, the power flow Direction should be set to "REVERSE".

Note: This setting affects the KVA, KVAHr and KVD values displayed by the trip unit. See Section 13.0. See Section 13.0. The Power Flow direction also affects the Reverse Power calculation. See Section 11.23.

11.8 Frequency

Set the AC-PRO-II frequency to match the power system frequency. The setting options are 50 Hertz and 60 Hertz. See Figure 11.2

11.9 CT Auto-Polarity Correction

Firmware 4.0 and later include a user selectable feature that can turn CT polarity correction "ON" or "OFF". If set to "ON", the Phase and Neutral CTs are checked to determine whether the polarity may be reversed from expected rotation and corrected if reversed. A reversed polarity for a Phase CT would typically show up as curred Ground current on an unfaulted system. (Note – Ground Fault (GF) type would need to be set to "Residual" for polarity sensing which utilizes the vector summation of the three phase CTs minus the Neutral CT current for 4-wire systems.) This incorrect Phase polarity appears to be GF current when in reality there is a polarity issue between the three Phase CTs. If the Neutral CT polarity is reversed from the Phase CTs (adding instead of subtracting), the trip unit may measure GF current that is twice the Neutral current when in reality there is no GF current. The CT auto-polarity setting of ON will correct this false GF current due to a Neutral CT polarity issue. (Please be aware for the polarity detection, a minimum of 10% of the CT sensor rating is required.) See Figure 11.2.

11.10 Long Time (LT)

The Long Time (LT) settings screen includes the following settings: Enabled (ON or OFF), pick-up, delay, and thermal memory.

See Figure 11.2 for Long Time protection settings notes, ranges, steps, and options.

Long Time (LT) protection is ON, unless the trip unit is ordered with the "LT can be turned OFF" option.

Please note that the LT trip time is not a constant value, but is a function of breaker current. For lower currents the trip time is longer, and for higher currents the trip time is shorter. See Figure 18.1 for Time Current Curve.

See Section 18.1 for LT Trip Times.

11.11 Thermal Memory

The AC-PRO-II trip unit has a thermal memory feature for the following protective functions:

- Long Time (LT) (set at Long Time screen)
- Short Time (ST)
- Ground Fault (GF) (always on)
- Neutral Overload (set at Neutral Overload screen)

The thermal memory feature for LT and ST can be turned on or off at the LT screen. See Figure 11.2.

Thermal memory for the GF function is always on and cannot be turned off. The GF thermal memory feature provides protection against "sputtering" ground faults.

Except for unusual conditions, it is recommended that the thermal memory feature for LT and ST should be turned on.

Cycling overloads that are not above the LT Pick-Up long enough to cause a trip can still lead to thermal damage to wiring and equipment. With thermal memory turned on, a cycling overload can still produce a LT trip to protect cables and equipment even if any individual overload event did not persist long enough to directly cause a LT trip.

With thermal memory turned off, an overload that drops below the LT Pick-Up will reset the LT trip register. If the current goes above the LT Pick-Up again, the LT trip register starts from zero.

11.12 Short-Time (ST)

The Short Time (ST) settings screen includes the following settings: enabled (ON/OFF), pick-up, delay, and I^2T ramp (ON/OFF).

See Figure 11.3 for ST protection settings, notes, ranges, steps, and options.

**** NOTE ****
The trip unit does not allow setting both the ST and Instantaneous to be set to OFF at the same time.

See Figure 18.1 for the Time Current Curve.
See Section 18.2 for ST Trip Times.

11.13 Instantaneous (I)

The Instantaneous (I) settings screen includes the following settings: enabled (ON/OFF) and pick-up.

See Figure 11.3 for Instantaneous settings, ranges, and steps.

**** NOTE ****
The trip unit does not allow setting both the ST and Instantaneous to be set to OFF at the same time.

See Figure 18.1 for the Time Current Curve.

In addition, the Instantaneous settings screen displays the Instantaneous override and Instantaneous-on-close features if they are enabled. These features are fixed and set at the factory. See below:Instantaneous Override (I-OVRD): The AC-PRO-II is configured at the factory with this feature either ON or OFF. If the feature is ON, a fixed Instantaneous pickup of 12 times the CT rating is applied. In some applications, this feature is enabled at the factory to protect the specific breaker this trip unit is paired with. Additionally, this feature can be enabled if requested at the time of order. Unless specified or specifically required to protect the breaker, AC-PRO-II trip units are normally configured with this feature OFF.

Instantaneous-on-Close (I-CLOS): The AC-PRO-II is configured at the factory with this feature ON or OFF. If this feature is ON, a fixed Instantaneous pickup of 12 times the CT rating is applied for only the first 6 cycles (96ms for 60Hz) after initial current flow: after the trip unit powers up, or after the current transitions from very low current (less than 2.5% of CT rating), to current greater than 12 times the CT rating. Unless specified at the time of order, AC-PRO-II trip units are normally configured with this feature ON.

Note: The AC-PRO-II uses a unique algorithm to determine if RMS currents greater than 12 times the CT rating are present, in which case the CTs may be saturated. The AC-PRO-II then corrects the effect of CT saturation on the LT and ST trip functions.

11.14 Ground Fault (GF) Protection

The Ground Fault screens include the following settings: GF trip type, pick-up, delay, slope. In addition, if the GF trip function is turned OFF, a GF Alarm function can be turned ON.

GF type can be set to residual, ground return, or OFF)
The residual GF method calculates a vector sum of the three phase currents (and neutral current if applicable) and determines the fundamental frequency component.
The ground return method is used for applications where a ground return CT directly measures the GF current, and the AC-PRO-II calculates the fundamental value.
See Section 5.1.1 for typical wiring diagrams of the two ground fault methods.

See Figure 11.3 for Ground Fault settings notes, ranges, steps, and options.

See Figure 18.2 for Ground Fault Time Current Curve.

**** NOTE ****
On a 4-wire system, a neutral CT must be installed to avoid nuisance GF trips.

**** NOTE ****
Due to possible CT saturation, RMS currents greater than 12 times the CT rating are not considered in the GF protection calculations. The ST and/or Instantaneous functions will provide protection for these currents.

**** IMPORTANT ****
To implement GF protection on the main breakers and the tie breaker of a double ended 4-wire substation, see the following Technical Bulletin:
http://www.utilityrelay.com/Side_Bar/Technical_Bulletins.html

11.15 Phase Current Unbalance (U/B)

The Phase Current Unbalance setting should not be confused with the Ground Fault (GF) function. The Phase Current Unbalance function is a motor protection function and should only be used on breakers feeding large balanced motor loads where currents are normally balanced.

See Figure 11.4: Change Settings Menu - Part 3 for Settings notes, ranges, steps and options. See Figure 18.5 for Phase Current Unbalance Time-Current Curve.

11.16 Programmable Relay Output

The Programmable Relay Output can be set to operate for “Alarm” conditions, or to operate for “Zone Block (*ZB)”, or to operate for Remote “Close E/O Breaker”. (*ZB requires current > Inst, ST, or GF Pickup) conditions to block upstream non-URC devices.) The Programmable Relay Output can also be disabled by setting it to “OFF”. for additional information.

11.16.1 Alarm

If the Programmable relay function is set to “Alarm”, then the relay will operate based on Alarm settings. See Figure 11.3: Change Settings Menu - Part 2 and Section 5.3.1 for additional information. .

11.16.2 Zone Block Relay Operation

If the Programmable relay function is set to “Zone Block”, then the Zone Block Relay

If the Programmable relay function is set to “Zone Block”, then the Zone Block Relay Operation screen will appear. The relay (dry contact) can be programmed for (current > Inst, ST, or GF Pickup) conditions to block upstream non-URC devices.

See Figure 11.3: Change Settings Menu - Part 2 and Section 5.3.1.2 for additional information.

11.16.3 Close E/O Breaker

If the Programmable relay function is set to “Close E/O Breaker”, then the Close E/O Breaker screen will appear. The relay (dry contact) can be wired to close an electrically operated (E/O) breaker. Contact URC for wiring details/examples.

See Figure 11.3: Change Settings Menu - Part 2 and Section 5.3.1.3 for additional information.

11.17 Neutral Protection (NP) Settings

For Firmware Version 4.0 & later, Neutral Protection can be set to Trip based on a percentage of the Long, Short and Instantaneous Pickup Settings. The Neutral Protection range is adjustable from 50% to 200% of LSI. (Note: this protection requires a neutral CT.) Long, Short and Instantaneous functions, if turned OFF, will be turned OFF for Neutral Protection (NP).

See Section 18.5 for Neutral Protection (NP) Example. See Figure 18.1 for the Neutral Protection Time Current Curves (TCC) as the Neutral Protection is the same as the Overload LSI curve multiplied by the Neutral Pickup (NP) Setting.

If Firmware prior to Version 4.0, the neutral overload (NOL) screen includes the following settings: enabled (ON/OFF), pick-up, delay, and NOL thermal memory.

See Figure 18.3: NOL Overload (NOL) TCC for the AC-PRO-II Firmware prior to Version 4.0.

The previous NOL thermal memory feature operates the same as the LT and ST thermal memory feature. See Section 11.11 for a description.

**** NOTE ****
Neutral Protection (NP) or Neutral Overload (NOL) cannot be enabled if the Ground Fault (GF) type is set to ground return. This is because with the ground return method, the neutral CT input is used for GF protection and thus cannot be used for NOL protection.

11.18 QUICK-TRIP® Instantaneous (QT-I)

The QT-I pickup range and steps are the same as the Instantaneous pickup range and steps.

See Figure 18.4 for the QUICK-TRIP Time Current Curves (TCC).

The QT- I function does not have an OFF setting. Quick-Trip is turned ON or OFF using the QUICK-TRIP ON-OFF selector switch. If the AC-PRO-II QUICK-TRIP switch module is not installed, then this function can be turned on from the front panel or via Modbus or the Smart 1-Line. See Section 7 for additional information.

11.19 QUICK-TRIP Ground Fault (QT-GF)

The QUICK-TRIP GF feature has two settings: QT-GF type and QT-GF pick-up.

If GF type is set to OFF, QT-NG type can be set to residual, return, or OFF. If GF type is set to residual or return, the QT-GF type can only match it or be turned OFF.

The QT-GF pick-up range and steps are the same as the GF pickup range and steps.

If the AC-PRO-II QUICK-TRIP switch module is not installed, then this function can be turned on from the front panel or via Modbus or the Smart 1-Line. See Section 7 for additional information.

See Figure 18.4 for the QUICK-TRIP Time Current Curves (TCC).

11.20 Undervoltage (UV)

This setting only applies if the AC-PRO-II is installed with the optional Voltage Divider Module (VDM).

The Undervoltage (UV) function of the AC-PRO-II utilizes RMS voltages and a definite time delay, to provide three-phase UV protection.

See Table 8-A in Section 8.1 for determining if your unit has "Basic" or "Advanced" voltage-based protection.

The UV function is disabled under the following conditions:
- If a Secondary Injection Test set is connected.
- After a UV trip, repeated UV trips are blocked until current is re-established, until the limit switch changes state (if used), or until the UV condition goes away. (firmware v1 only uses current re-established)
- When the AC-PRO-II is in "Test Mode". See Section 14.1.1 (v2 firmware only)
- If (2) Phase currents are "LOW" (v1 firmware only)

11.20.1 Basic Undervoltage

Basic UnderVoltage (UV) protection is offered in units that have v1 firmware and/or VDM rev 1 hardware. Use the "More" menu to view firmware and VDM version.
Basic Undervoltage protection uses voltage magnitude only, which provides "brownout" protection, using adjustable UnderVoltage pickup and delay settings. "Brownouts" are when system voltage is still present, but the voltages are lower than the nominal system voltage. UnderVoltage protection is not intended to be "Phase Loss" protection and will not operate reliably in the event of a total phase loss, or total system outage. Firmware v1 uses line-to-neutral voltages. Firmware v2 uses line-to-line voltages.

Basic UnderVoltage IMPORTANT ****
For Undervoltage trips and alarms to occur, **both** of the following conditions must be present:
1. At least (2) phase currents must be greater than 10% of the CT rating. (v1 firmware only)
2. The Phase A-to-B voltage must be greater than 90V.

**** IMPORTANT ****
The Basic Undervoltage function will not operate in the event of a total phase loss or total system outage. The UnderVoltage function is not "Phase Loss" protection.

**** IMPORTANT ****
Use caution when using the Undervoltage (UV) Trip function on Non-solidly grounded systems. (v1 firmware uses line-to-neutral voltages).

11.20.2 Advanced Undervoltage

Advanced UnderVoltage (UV) function is available in units that have v2 or later firmware, and VDM rev 2 or later.
Advanced UnderVoltage protection uses line-to-line voltage magnitude only, with adjustable UnderVoltage pickup and delay settings.
See Figure 11.4 for settings information.

The UV function is disabled under the following conditions:
- If a Secondary Injection Test set is connected.
- After a UV trip, repeated UV trips are blocked until current is re-established, until the limit switch changes state (if used), or until the UV condition goes away.
- When the AC-PRO-II is in "Test Mode". See Section 14.1.1 (v2 firmware only)

***Advanced UnderVoltage **IMPORTANT ***
For Undervoltage trips and/or alarms to occur, **at least one** (1) of the following conditions must be present:
1. The Phase A-to-B voltage must be greater than 90V, OR
2. At least (1) phase current must be greater than 10% of the CT rating, OR
3. 24VDC Auxiliary power must be present.

**** IMPORTANT ****

Firmware version 4 adds a "3PH INST" option to the UnderVoltage feature delay settings. If this setting is selected by the user, this allows a UV trip to occur in the event of a total power loss. If all 3 phases are lost (blackout), a trip will instantaneously occur while the unit is powering down. All 3 phases must be below the pickup setting for at least 0.13 seconds to guarantee a trip will occur.
If all 3 phases are interrupted for only 0.06 seconds or less, a trip will not occur. (the unit will ride through)

11.21 Overvoltage (OV)

This setting only applies if the AC-PRO-II is installed with the optional Voltage Divider Module (VDM).

The Overvoltage (OV) function of the AC-PRO-II utilizes voltage and a definite time delay, to provide three-phase OV protection.

Version 1 firmware uses Line-to-Neutral voltages.
Version 2 firmware uses Line-to-Line voltages.

See Figure 11.4 for OV settings notes, ranges, steps, and options.

The OV function is disabled under the following condition:
- After an OV trip, repeated OV trips are blocked until current is re-established, until the limit switch changes state, or until the UV condition goes away. (firmware v1 only uses current re-established).
- When the AC-PRO-II is in "Test Mode". See Section 14.1.1. (v2 firmware & later only)

**** IMPORTANT ****

Use caution when using the Overvoltage (OV) Trip function on Non-solidly grounded systems. (v1 firmware uses line-to-neutral voltages)

11.22 Phase Loss / Reverse (Φ-LOSS)

This setting only applies if the AC-PRO-II is installed with the optional Rev 2 Voltage Divider Module (VDM).

The Phase Loss / Reverse (Φ-LOSS) feature utilizes Negative Sequence Overvoltage calculations to determine if a Phase Loss or Reverse Phase condition is present.

See Figure 11.4 for Phase Loss / Reverse settings notes, ranges, steps, and options.

The Phase Loss/Reverse function is disabled under the following conditions:

- If a Secondary Injection Test set is connected.
- After a Phase Loss/Reverse trip, repeated trips are blocked until current is re-established, until the limit switch changes state (if used), or until the Phase Loss condition goes away.
- When the AC-PRO-II is in "Test Mode". See Section 14.1.1 (v2 & later firmware only)

**** IMPORTANT ****

For Phase Loss/Reverse trips and alarms to occur, at least one the following conditions must be present:
1. At least (1) phase current must be greater than 10% of the CT rating, OR
2. The Phase A-to-B voltage must be greater than 90V, OR
3. 24VDC Auxiliary power must be present.

In order to provide Phase Loss / Reverse protection, the power "System Rotation" setting of "ABC" or "CBA" must be entered correctly. If the system rotation is not known, the Phase Loss/Reverse Alarm feature can be used as a check, without initiating a trip.

Determining System Rotation:
1. Remove the breaker from service.
2. Ensure the VDM phasing is wired correctly (i.e. Phase A breaker stab through fuse block to AC-PRO-II VDM phase A, etc).
3. Set Phase Loss/Reverse Trip to OFF.
4. Set Phase Loss/Reverse Alarm to ON.
5. Set System Rotation to ABC.
6. Set NegSeq-OV Pickup to 20%.
7. Save Settings.
8. Rack the breaker into the connected position.
9. Verify the VDM reads 3-phase voltage.
10. If a Phase Loss/Reverse Alarm occurs, then the System Rotation setting is not correct. If a Phase Loss/Reverse Alarm does not occur, then the System Rotation ABC setting is correct.

**** NOTE ****

In multi-source applications (i.e. Main-Tie-Main): Phase Loss protection will NOT provide blown fuse protection on tie breakers, or on main breakers where sources can be paralleled, since the VDM taps may be on "wrong" side of the fuse, since multiple sources exist.

11.23 Reverse Power

This setting only applies if the AC-PRO-II is installed with the optional Rev 2 Voltage Divider Module (VDM).

The Reverse Power Setting can be set to TRIP, ALARM or OFF. The range is 3 to 100% of the rated Full Load KW. The Reverse Power Trip / Alarm Time Delay range is 2 to 60 seconds.

See Figure 11.4 for setting screen.

11.24 Sluggish Breaker Setting

The Sluggish Breaker setting range is 20ms – 100ms. The default setting is 33ms.

The following steps are recommended for determining the Sluggish Breaker setting on a recently serviced breaker with a mechanism in good operating condition:

1. Perform Primary or Secondary Injection to initiate a ST or LT trip; or use the SAFE-T-TRIP device to initiate a trip. If using SAFE-T-TRIP on a breaker that does not have primary current flowing through it, or if using Secondary Injection, a 52a or 52b limit switch must be wired to AC-PRO-II.
2. Use the trip history menu to review the recorded breaker mechanism times of the trip initiated in step 1 above. The breaker mechanism times should be in the 20ms to 100ms range. The total trip time (different than breaker mechanism time) should conform to the Time Current Curve in Figure 18.1.
3. URC recommends setting the Sluggish Breaker time to be 17ms greater than the recorded mechanism time from step 2.

See Figure 11.5 for Sluggish Breaker setting screen.

See Section 10.0 for additional information about the Sluggish Breaker feature.

11.25 Alarm Settings

The Alarm settings configuration occurs via two alarm settings screens, where the alarm relay can be set to occur for any combination of events. If the setting is “ON”, the relay will operate for that particular event/condition. See Figure 11.3, Figure 11.4, and Figure 11.5 for alarm relay settings options and notes.

Refer to Section 5.3.1 and Table 5-A for additional information about the programmable relay.

11.26 Limit Switch Type Setting

If a limit switch is wired to the AC-PRO-II, the contact type is set at this screen. If the limit switch contact is open when the breaker is open, select 52a. If the limit switch contact is closed when the breaker is open, select 52b. Refer to the breaker-specific AC-PRO-II kit installation manual supplied with the kit. If a limit switch is not wired into the trip unit, this setting should be None. See Figure 11.4.

Note that this setting affects the Sluggish Breaker detection method. See Section 10.0.

11.27 Communication Settings

The AC-PRO-II is capable of communicating over an RS485 network via Modbus RTU protocol. The RS485 communications screen includes the following settings:

Communications Enabled: Set to ON if RS485 communications is desired.

Address: Each trip unit that shares the same twisted pair must have a unique address. The address identifies each individual trip unit connected to the same twisted pair.

Note: two trip units can have the same Address as long as they are not connected to the network via the same twisted pair cable.

The address is selectable from 1 to 247, in increments of 1. In most applications, only addresses 1 through 32 will be used due to the limitations of RS485 communications.

Baud Rate should be selected to match the baud rate of the master communicating device (i.e. PC, gateway, etc.).

Parity should be set to match the parity of the master communicating device (i.e. PC, gateway, etc.).

Forced Trip: If enabled, this feature permits tripping of the breaker via a forced trip command over RS485 communications.

Settings Change Over Communications: If enabled, this feature permits the user to make settings changes via the communications network. Otherwise, settings can only be changed at the AC-PRO-II using the smart buttons or using the local USB connection.
NOTE: The CT settings can only be changed at the AC-PRO-II.

See Figure 11.5 for setting options and Section 24.0 for additional Communications information.

11.28 Saving Settings

Once the last setting is entered, the “Save Settings?” screen will appear. The save settings screen also provides a reminder that if the “Save” button is pressed, the settings will be saved, logged, and time stamped as a “Settings Change”. The settings change time stamp is stored and available via Modbus communications.

Pressing “Exit” will return to the Main screen.
Pressing “Back” will return to the previous setting screen.

11.29 Settings Verification

Once the settings are saved, the “REV” and “OK” buttons are available at the “Settings Saved” screen.

Pressing “REV” will lead to the review settings sequence.
Pressing “OK” will lead to the main screen.

To complete the entering or changing settings process, press “REV” to review and confirm all settings entered.

The settings review sequence is very similar to the settings change sequence, except the settings are only viewed and cannot be changed. The existing settings are viewed and navigated with the “Next” and “Back” buttons.
See below and Figure .

11.30 Settings Review

Settings can also be changed, reviewed, saved, and printed using the InfoPro-AC software application.

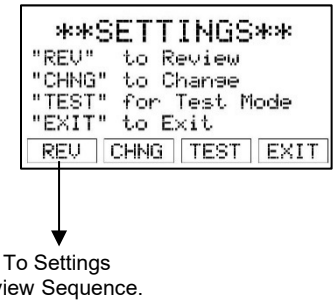


Figure 11.6: Settings Screen - Review Button

See Figure 6. for the settings review sequence.

11.31 Time & Date Settings

See Section 6.4.1 for the time & date Settings.
NOTE: It is important to set the time & date for time stamping of events.

12.0 Trip History

The AC-PRO-II stores the trip data for the last 8 trip events. The stored trip data includes the following:

1. Trip counts
2. Trip type (see Table 12-A for types)
3. Time stamp (date and time).
4. Trip number (1-8, assigned by trip unit) (if trip is the “Last trip”, this will be identified on the screen).
5. Phase currents and voltages
6. Neutral and ground currents
7. Breaker mechanism time for each phase
8. Waveforms can be viewed using InfoPro-AC software application only. See Section 23.0.

This data can be accessed using the Trip History Menu. See Figure 12.1.

NOTE: The date and time must be set properly, and a fresh battery must be installed to ensure accurate trip history date and time stamps.

Trip Type Abbreviation	Trip Type Description
LT	Long Time
ST	Short Time
I	Instantaneous
I-OVRD	Instantaneous Override
I-CLOS	Instantaneous on Close
GF	Ground Fault
NP	Neutral Protection (NP)
QT-I	QUICK-TRIP Instantaneous
QT-GF	QUICK-TRIP Ground Fault
U/B	Phase Current Unbalance
UV	Under Voltage
OV	Over Voltage
Forced	Modbus Communications trip
SAFE-T	SAFE-T-TRIP Hand held device trip
Ph Loss/Rev	Phase Loss / Reverse (NSOV) (v2)
Rev Power	Reverse Power (v4)
GFT	Ground Fault Test Trip (v2)

Table 12-A: Trip Types

The trip history data, including the associated waveform capture data, can be viewed, saved and printed using the InfoPro-AC software application. All trip unit data is also available via RS485 Modbus RTU communications.

To ensure accurate recording of breaker mechanism times, and proper Sluggish Breaker™ Detection, the breaker position contact user setting must be set properly. See Sections 10.0 and **Error! Reference source not found.**.

The AC-PRO-II uses multiple methods to determine trip currents and voltages. However, some Instantaneous trips may occur too rapidly for AC-PRO-II to report RMS trip values. For these trips, AC-PRO-II will report “> Pickup value” for the current values for all three phases.

See Figure 12.1 for the trip history screens navigation map.

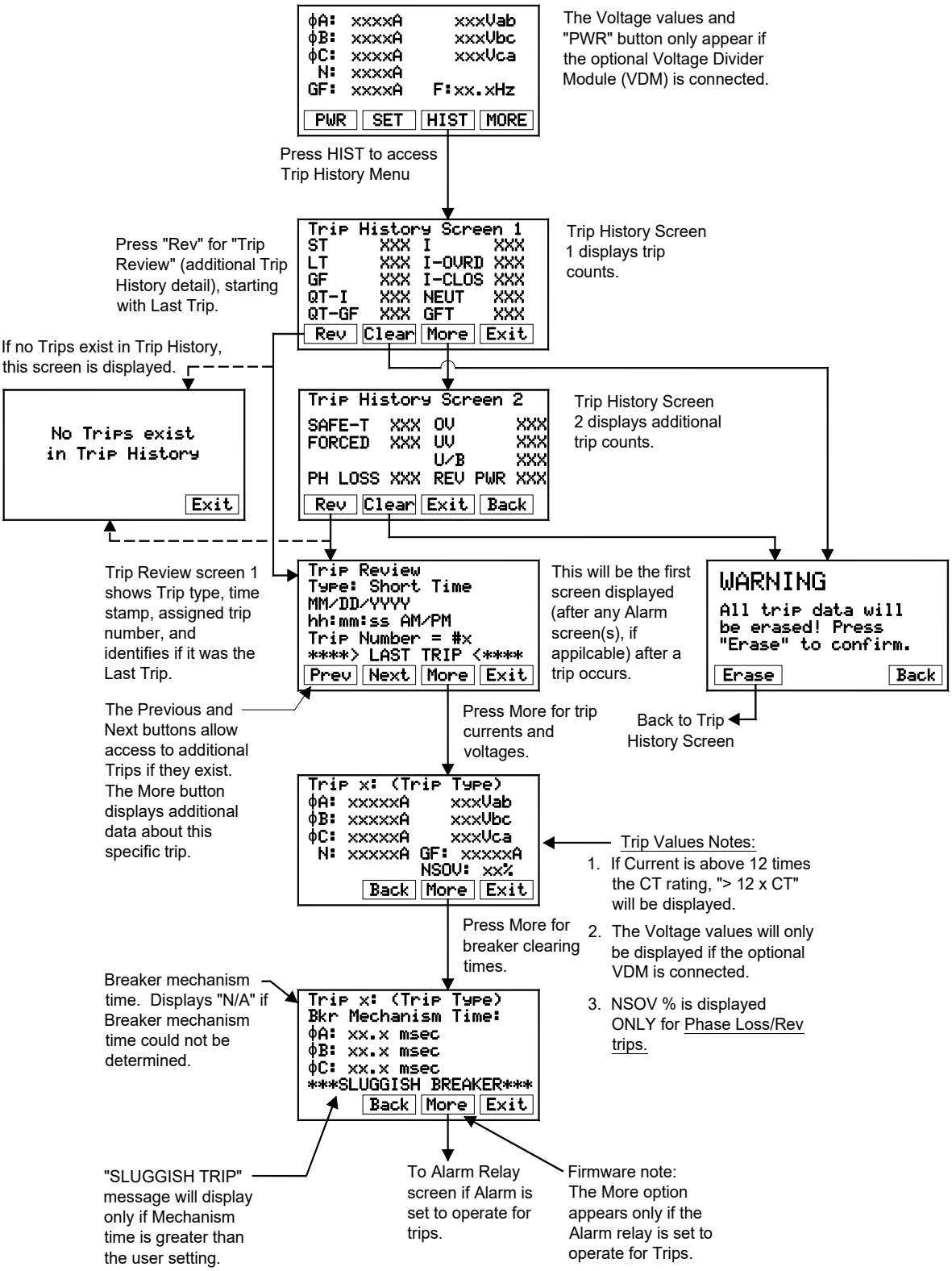


Figure 12.1: Trip History Menu

13.0 Normal Operations & Readings

During normal operation, the trip unit display screen will be off and in its power saving mode. See Section 11.1 for trip unit power information. When the "DISPLAY" button is pressed during normal operation (no trips, errors, alarms, etc), the trip unit will display current and voltage (if equipped with VDM) readings. The neutral and GF currents will only be displayed if neutral or GF protective functions are turned on. See below. The "XXXX" digits will display actual readings.

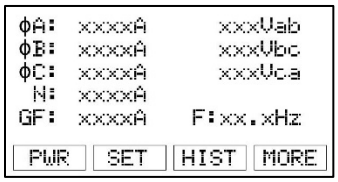


Figure 13.1: Main ("Readings") Screen

- The left column displays Currents in Amps for Phases A, B, C, Neutral and Ground Fault.
- The right column displays Voltages and Frequency

Breaker Current Less than 10% of CT Rating:
When the currents are less than about 10% of the CT rating, the display will display "LOW" for currents.

Breaker Current Greater than 10% of CT Rating:
If the breaker current is greater than about 10% of the CT rating, the current readings will be displayed.

Line-to-Line Voltages (if equipped with VDM):
"LOW" will be displayed if the Line-to-Line voltage is 90V or below.
"N/A" will be displayed if the Voltage cannot be determined.

Note: If voltages and voltage labels ("Vab, Vbc, Vca") do not display, the AC-PRO-II is either not equipped with a VDM, or the VDM is not properly connected to the AC-PRO-II. Contact URC.

See Section 8.0 for additional information about the Voltage Divider Module (VDM).

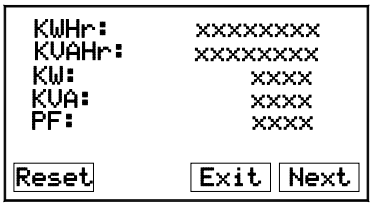


Figure 13.2: Power and Energy screen (if equipped with VDM)

- KWHr: Total Real Energy usage, measured in KiloWatt-Hours. This value increments and decrements depending on the power flow direction and Power Flow Direction user setting. See Section 11.7.
- KVAHr: Total Apparent Energy usage, measured in KiloVoltAmpere-Hours. This value only increments.
- KW: Total Real Power, measured in KiloWatts.
- KVA: Total Apparent Power, measured in KiloVoltAmperes.
- PF: Total Power Factor
- Demand Period: Time Period Peak Demand is calculated.
- KWD: Kilowatt Demand (Last, Peak)
- KVAD: Kilovar Demand (Last, Peak)
- Demand values =
    - (KWHrs for period) / Period
    - (KVAHrs for period) / Period

Instantaneous Power Values (if equipped with VDM):

- "LOW" or "N/A" is displayed if the power cannot be determined, most likely because system voltage (i.e. 480V) is not present at the VDM, or if voltage or current is too low.
- The KW values are affected by the direction of the power flow, and the Power Flow Direction user setting. See Section 11.7.

Energy Values (if equipped with VDM):

- Energy values increment if the current for a particular phase is above 3% of the CT rating and the phase voltage is above 90V.

Frequency is displayed based on Phase A current.

14.0 Testing

A "primary injection" test is recommended as the final test of the AC-PRO-II retrofit.

If residual GF is used, it must be temporarily turned off when testing the other trip functions.

14.1 Commission the Trip Unit

Before proceeding with the normal primary injection tests, the trip unit must be commissioned to make it functional. See Section 11.0 for the commissioning procedure.

It is best to use the final pick-up and time delay settings if they are known. If not, use typical settings for the primary injection test.

14.1.1 Test Mode

For Testing convenience, AC-PRO-II offers a "Test Mode". When the AC-Pro-II is in Test Mode, all Voltage Protection is temporarily disabled, and the need to enter the Security Code to change settings is temporarily disabled. Though Test Mode is automatically turned OFF after 60 minutes, it should always be manually turned OFF after testing is complete. See the screens in Figure 14.1.

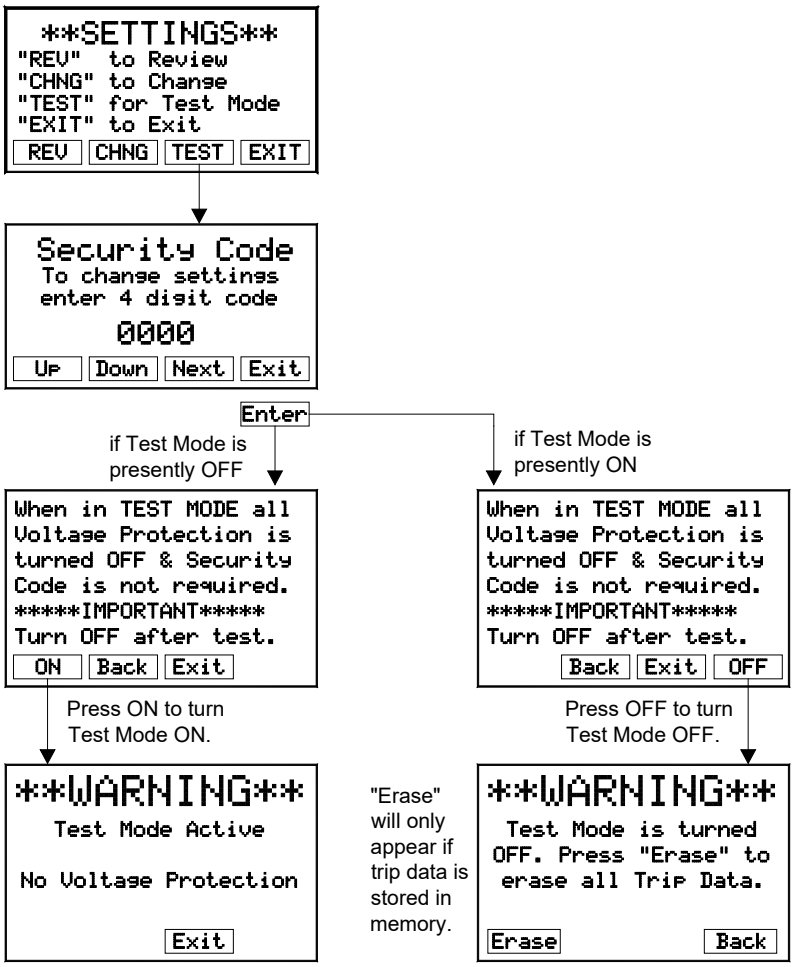


Figure 14.1: Test Mode Screens

14.2 Long Time Trip Test

If residual GF is used, make sure it is temporarily turned off.

To test the LT Pick-Up, increase the current until the "Pick-Up" LED illuminates.

The injected current should correspond to the programmed LT pick-up setting. Verify that the correct phase is indicated on the display.

To test the LT trip time, first calculate the trip time based on the value of the test current that will be applied. Use the formula in Section 18.1 or the chart in Section 15.3.

**** NOTE ****

A simple shortcut is to note that the trip time (center of the curve) at 3 times the LT pick-up current is 4 times the LT Delay setting.

For example:

If LT Pick-Up is 1600A and Delay is 10.0S, then the trip time at 4800A (3 times 1600A) is 40 sec. (4 times 10 sec).

14.3 Short Time Trip Test

If residual GF is used, make sure it is temporarily turned off.

To test the ST pick-up, temporarily set ST I^2T off and apply a short pulse of current that is 10% or 20% less than the ST pick-up setting. Continue applying short pulses of current while increasing the current for each pulse until a ST trip occurs. The first current where a ST trip occurred is the ST pick-up.

To test the ST delay, turn ST I^2T on again (if applicable) and apply a current that is at least 10% greater than the ST pick-up current.

The trip time should fall within the time band shown on the Time-Current-Curves.

**** NOTE ****

To bypass Instantaneous-on-Close (I-CLOS) when primary injection testing at high currents, power the AC-PRO-II prior to applying current using USB power via a laptop or a mini-USB wallpack. See section 11.13 for I-CLOS description.

14.4 Instantaneous Trip Test

If residual GF is used, make sure it is temporarily turned off.

Test the Instantaneous pick-up and trip time in the same manner as ST in Section 14.3.

14.5 Neutral Protection (NP) Trip Test

If residual GF is used, make sure it is temporarily turned off.

If Ground Return GF is used, NP cannot be used.

To perform a primary injection test of the NP function, temporarily shift the Phase C CT secondary wires to the neutral CT input terminals on the AC-PRO-II. Connect a laptop, PC, or USB wallpack to the front mini-USB port of the display to power the trip unit. Primary injection into Phase C will simulate neutral current. If this testing method is not preferred, the NP function can be tested using the Secondary Injection Test Set. See Section 15.0.

Test the Neutral LSI Pick-up and trip time in the same manner as LT in Section 14.2 based on the Neutral Protection pickup setting percentage.

For older NOL firmware, refer to Neutral Overload formula in Section 18.5.

**** NOTE ****

Only Phase current will power the AC-PRO-II. When doing primary injection testing of the NP or NOL, the AC-PRO-II must be powered via 24VDC or the USB port.

14.6 Ground Fault Trip Tests

14.6.1 Residual Ground Fault Trip Test

When the AC-PRO-II is set for residual GF protection, the trip unit calculates ground fault current.

With GF Pick-Up and Delay set to the required values, primary injection testing any one of the three poles will provide a GF trip.

Test the GF Pick-Up and trip time in the same manner as ST in Section 14.3.

14.6.2 Ground Return Fault Trip Test

When the AC-PRO-II is set for ground return GF protection, the neutral current input is used for direct measurement of the GF current.

To perform a primary injection test of ground return GF protection, temporarily shift the Phase C CT secondary wires to the Neutral CT input terminals on the AC-PRO-II. Connect a laptop, PC, or 24VDC wallpack to the front mini-USB port of the display to power the trip unit. Primary injection into Phase C will simulate ground return current. If this testing method is not preferred, the ground return GF function can be tested using the Secondary Injection Test Set. See Section 15.0.

Test the GF pick-up and trip time in the same manner as ST in Section 14.3.

14.7 QT-GF Trip Test

To test QT-GF the AC-PRO-II QUICK-TRIP switch module must be connected to the trip unit as shown in Figure 7.1.

With QT-GF pick-up set to the required value and the QUICK-TRIP selector switch turned to the on position, testing any one of the three poles will provide a QT-GF trip.

Test the QT-GF pick-up and trip time in the same manner as the normal GF function.

14.8 CT Phasing Test for GF

Proper breaker CT polarity is always recommended, and is required for residual GF and residual QUICK-TRIP GF protection. Without proper CT polarity wiring, a nuisance GF trip will probably occur. **With the breaker in service on a 3-phase system, the last trip data with a reversed polarity phase CT will show the GF current magnitude as approximately two times the phase current of the CT connected in reverse polarity**.

Since primary injection testing normally tests only one phase at a time, a breaker CT with reversed polarity will not be detected with the normal tests. By using the following method, a primary injection test set can be used to test for proper CT polarity.

Figure 14.2 and Figure 14.3 show a method to verify that the breaker CT polarities match. The setup in Figure 14.1 verifies that the CT polarities of Phase A and Phase B match. The setup in Figure 14.3 verifies that the CT polarities of Phase B and Phase C match.

It is only necessary to inject a current slightly greater than the GF Pick-Up setting and to verify that a GF trip does not occur.

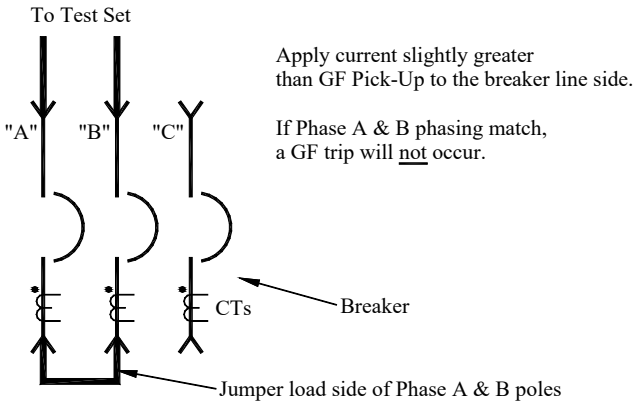


Figure 14.2: Phase A & B, CT Polarity Test

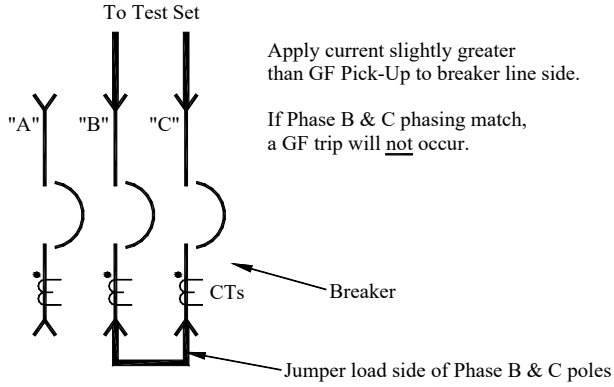


Figure 14.3: Phase B & C, CT Polarity Test

If a GF trip does occur, determine which CT has the reversed polarity. Reverse the secondary connections at the CT to correct the reversed polarity.

The breakers shown in the Figures above have the CTs on the load side. Use exactly the same method if the CTs are on the breaker line side or if they are staggered.

If a neutral CT is used, its polarity must match the polarity of the breaker mounted CTs.

14.9 QT-I Trip Test

To test QT-I the AC-PRO-II QUICK-TRIP switch module must be connected to the trip unit as shown in Figure 7.1 or the Quick-Trip mode must be active from the front screen or via Smart 1-Line or Modbus. See Section

With QT- I pick-up set to the required value and the QUICK-TRIP selector switch turned to the on position, test all three breaker poles in the same manner as the normal Instantaneous function.

14.10 Phase Current Unbalance Trip Test

The Phase Current Unbalance trip function is not easy to test with a single phase, high current test set.

Figure 14.4 illustrates a method to test the U/B trip function. It requires using cable or bus to jumper the breaker poles as shown. This generates an unbalanced current of 50% or slightly more depending on how equally the current is split between the two poles.

It is only necessary to inject a current equal to 20% or 30% of the CT rating for this test. It is only possible to test the Current Unbalance trip time and not the Current Unbalance Pick-Up with this method.

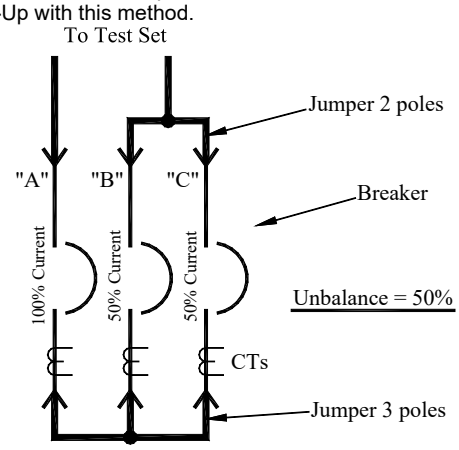


Figure 14.4: Phase Current Unbalance Test

14.11 Undervoltage (UV) Test

To test the UV trip or alarm function, a primary injection current test set, a voltage source, and a timer is needed.

NOTE: For Firmware Version 2, current does not need to be applied.

Since both a current test set and a voltage source will be used, ensure the AC-PRO-II voltage connections are isolated from the breaker poles by removing the fuses from the fuse block that feeds the VDM (Voltage Divider Module). Make the temporary testing connections shown in Figure 14.5. The voltage source can be 120VAC (voltage must be at least 90VAC). Verify that the Phase A voltage is indicated on the display. Reminder: firmware version v1 uses line-to-neutral voltages, and firmware version v2 uses line-to-line voltages.

The UV delay feature can be tested with a timer. The UV function is “definite time”, so the delay remains the same regardless of the severity of the undervoltage.

**** IMPORTANT ****
If line voltage is the only source to the trip unit (no current, no 24VDC aux power), it must be present for 5 seconds before a voltage-based trip can occur.

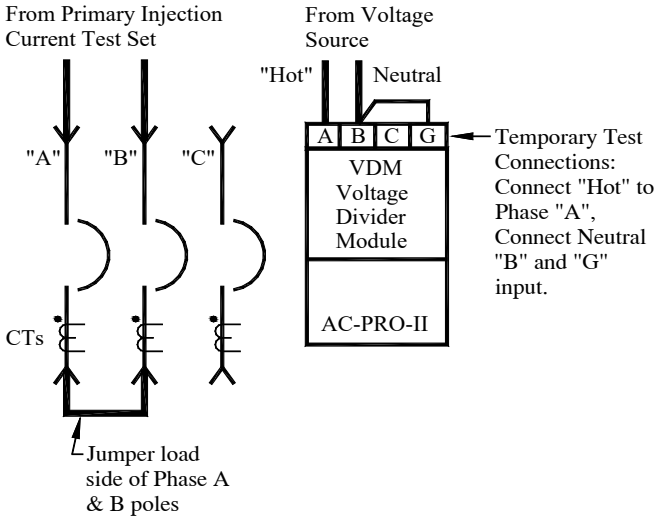


Figure 14.5: Undervoltage Test (temporary connections)

Undervoltage Test Notes:
1) In addition to the voltage source, current must be above 10% of the CT rating on any two phases for a UV Trip or Alarm to occur. (v1 firmware only).
2) UV is disabled if a Secondary Injection Test Set is connected.
3) After a UV trip occurs, repeated UV trips are blocked until current is re-established, or until the breaker is closed (if a 52a or 52b limit switch is connected and v2 firmware is installed).
4) If a UV alarm occurs, it is latched and must be reset using the display and push buttons.
5) Refer to Section 11.20 for additional Undervoltage information.

**** IMPORTANT ****
The Undervoltage function will not operate in the event of a total phase loss or total system outage. The UnderVoltage function is not “Phase Loss” protection.

Undervoltage Test Procedure:
1) Set the AC-PRO-II UnderVoltage Trip or Alarm setting to ON.
2) Apply 120VAC across terminals A & B. (must be at least 90VAC)
3) Apply current greater than 10% of the CT rating on two phases and start the timer. (current does not need to be applied for firmware version 2).
   NOTE: as soon as current is applied to any two phases (v1 firmware only), the AC-PRO-II internal UV pickup timer will start since the voltages applied to Phases B & C are both “Low”.
4) The UV trip or alarm should occur within +/- 0.25 seconds of the UV time delay setting.

**** IMPORTANT ****
If line voltage is the only source to the trip unit (no current, no 24VDC aux power), it must be present for 5 seconds before a voltage-based trip can occur.

14.12 Overvoltage (OV) Test

To test the OV trip or alarm function, a variable voltage source, and a timer is needed.

Make the temporary connections shown in Figure 14.6. The maximum voltage of the variable voltage test source should be at least 10% above the programmed OV pick-up setting. Verify that the Phase A voltage is indicated on the display. Reminder: firmware version v1 uses line-to-neutral voltages, and firmware version v2 uses line-to-line voltages.

The OV delay feature can be tested with a timer. The OV function is definite time, so the delay remains the same regardless of the severity of the overvoltage.

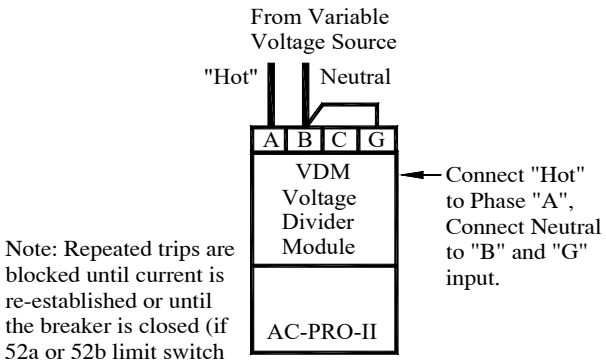


Figure 14.6: Overvoltage Test (temporary connections)

Overvoltage Test Notes:
1) After an OV trip or occurs, repeated OV trips are blocked until current is re-established, or until the breaker is closed (if 52a or 52b limit switch is connected and v2 firmware is installed).
2) If an OV alarm occurs, it is latched and must be reset using the display and push buttons.
3) OV is disabled if the Secondary Injection Test Set auxiliary power is connected to AC-PRO-II.

Overvoltage Test Procedure:
1) Apply voltage at least 10% below the OV Pickup setting.
2) No OV trip should occur.
3) Increase the voltage to at least 10% above the OV Pickup setting and start the timer.
4) An OV trip should occur within +/- 0.25 seconds of the OV time delay setting.

NOTE: with firmware version v1 ONLY: At least one phase current (at least 10% of the CT rating) must be present during OverVoltage testing.
If using URC Secondary Injection tet set, apply 75% of CT rating, and temporarily disconnect the Auxiliary power (from the test set) to the AC-PRO-II, during the Overvoltage test.

14.13 Phase Loss / Reverse Test

To test the Phase Loss / Reverse function, a 3-phase voltage source and a timer is needed. 24VDC Auxiliary power is recommended.

Phase Loss/Reverse Test Notes:
1) After an Phase Loss/Reverse trip or occurs, repeated Phase Loss trips are blocked until current is re-established, or until the Phase Loss condition goes away, or until the breaker is closed (if a limit switch is installed for the AC-PRO-II).
2) If a Phase Loss/Reverse alarm occurs, it is automatically reset when the condition goes away.

Phase Loss Test Procedure:
1) For safety, temporarily disconnect the breaker stabs from the VDM fuses.
2) Recommended step: Apply 24VDC auxiliary power to the AC-PRO-II. See Section 3.4 for additional information about 24VDC Auxiliary Power.
3) Connect the 3-phase voltage source to the AC-PRO-II VDM, at the line side of the VDM fuses.
4) The voltages should be equal magnitude (120VAC minimum), 120 degrees apart.
5) No Phase Loss trip should occur. Correct Line-to-Line voltages should be displayed on the AC-PRO-II.
6) Disconnect one phase voltage by safely pulling the VDM fuse for that phase and start the timer.
   NOTE/REMINDER: If primary current is not flowing through the breaker (for CT power), and 24VDC auxiliary power is not applied, this test can only be performed by disconnecting Phase C voltage. (since AC-PRO-II derives VDM power from Phase A-B voltage).
7) A Phase Loss/Reverse trip should occur within +/- 0.25 seconds of the Phase Loss/Reverse time delay setting.

14.14 Reverse Power Test

To test the Reverse Power function, a Relay Test Set and a timer is needed. 24VDC Auxiliary power is recommended.

Reverse Power Test Notes:
1) After an Reverse Power trip or occurs, repeated Reverse Power trips are blocked until current is re-established, or until the Reverse Power condition goes away, or until the breaker is closed (if a limit switch is installed for the AC-PRO-II).
2) If a Reverse Power alarm occurs, it is automatically reset when the condition goes away.

Reverse Power Test Procedure:
1) For safety, temporarily disconnect the breaker stabs from the VDM fuses.
2) Recommended step: Apply 24VDC auxiliary power to the AC-PRO-II. See Section 3.4 for additional information about 24VDC Auxiliary Power.
3) Connect the Relay Test Set to the AC-PRO-II VDM, at the line side of the VDM fuses.
4) Inject current in the primary stabs above pickup.
5) A trip should not occur.
6) Inject current in the load stabs.
7) A Reverse Power trip should occur within +/- 0.25 seconds of the Reverse Power time delay setting.

15.0 Secondary Injection Testing

Although primary injection testing is the recommended and preferred method to test an AC-PRO-II installation, secondary injection testing can also be used.

15.1 Secondary Injection Test Set

The B-292 secondary inection test set (with blue panel) can test both the original AC-PRO and AC-PRO-II trip units. The B-291 secondary injection test set (with red panel) cannot test the AC-PRO-II trip unit.

**** IMPORTANT ****

The B-292 test set displays Current in Amps, which is most suitable for AC-PRO-II with CT secondary settings of 1-Amp. If the AC-PRO-II Phase and Neutral CT secondary settings are not 1-Amp, this must be considered when determining the equivalent primary current. Additionally, if the Phase and Neutral CT secondary settings are different values, these settings should be temporarily changed for secondary injection testing purposes.

Figure 15.1: B-292 Secondary Injection Test Set

15.2 Standard Relay Test Set

Special care must be used when using a standard relay test set to secondary injection test the AC-PRO-II trip unit. (See Technical Bulletin #2: Using Standard Relay Test Sets with URC trip units".)

The following are required:
- 24VDC Power Supply (URC Part #T-490-ASM) to power up the AC-PRO-II trip unit so that it will accept current Note: 24VDC must be used. (USB power is NOT adequate for this purpose).
- Relay test set with a 0 to 12 Amp range
- True RMS ammeter in the test set or externally connected
- Method to stop the relay test set and test set timer when the breaker trips
- Isolation CT rated 1:1 (URC recommends CT-10473.)

Test procedure:
1. Power up the AC-PRO-II trip unit with 24VDC power so it will accept current.
2. Temporarily turn off GF.
3. Connect the output leads from the relay test set to the Phase "A" CT terminals (it is not necessary to disconnect the CT)
4. Proceed with pick-up and time testing of Phase "A"
5. When finished, similarly test Phase "B" & "C"
6. Turn GF on (if desired) and test by injecting current on any one of the Phases

**** IMPORTANT ****

The CT circuits are internally grounded to the AC-PRO-II case. **If any of the CT wires are externally grounded, the AC-PRO-II will not read current correctly.**

Some relay test sets have a grounded current output. To secondary injection test the AC-PRO-II trip unit with this type of test set, the AC-PRO-II trip unit must be isolated from the test set ground. See Technical Bulletin #2.

15.3 LT Delay Testing Chart

This chart provides trip times in Seconds for the LT delay settings at 3.0X, 4.0X and 6.0X where "X" is in multiples of the LT pick-up setting.

The Maximum, Minimum and Nominal trip times are given for each LT delay setting and the three listed test currents.

The Time-Current Curves in Figure 18.2 along with the equations in Section 18.1 can be used to determine the trip times of the other trip functions.

LT Delay Setting	Trip Time Range	Test Current 3.0X	4.0X	6.0X
2.0	Max	9.88	5.56	2.47
	Nominal	8.00	4.50	2.00
	Min	6.61	3.72	1.65
2.5	Max	12.35	6.94	3.09
	Nominal	10.00	5.63	2.50
	Min	8.26	4.65	2.07
3.0	Max	14.81	8.33	3.70
	Nominal	12.00	6.75	3.00
	Min	9.92	5.58	2.48
3.5	Max	17.28	9.72	4.32
	Nominal	14.00	7.88	3.50
	Min	11.57	6.51	2.89
4.0	Max	19.75	11.11	4.94
	Nominal	16.00	9.00	4.00
	Min	13.22	7.44	3.31
4.5	Max	22.22	12.50	5.56
	Nominal	18.00	10.13	4.50
	Min	14.88	8.37	3.72
5.0	Max	24.69	13.89	6.17
	Nominal	20.00	11.25	5.00
	Min	16.53	9.30	4.13
5.5	Max	27.16	15.28	6.79
	Nominal	22.00	12.38	5.50
	Min	18.18	10.23	4.55
6.0	Max	29.63	16.67	7.41
	Nominal	24.00	13.50	6.00
	Min	19.83	11.16	4.96
6.5	Max	32.10	18.06	8.02
	Nominal	26.00	14.63	6.50
	Min	21.49	12.09	5.37
7.0	Max	34.57	19.44	8.64
	Nominal	28.00	15.75	7.00
	Min	23.14	13.02	5.79
7.5	Max	37.04	20.83	9.26
	Nominal	30.00	16.88	7.50
	Min	24.79	13.95	6.20
8.0	Max	39.51	22.22	9.88
	Nominal	32.00	18.00	8.00
	Min	26.45	14.88	6.61
8.5	Max	41.98	23.61	10.49
	Nominal	34.00	19.13	8.50
	Min	28.10	15.81	7.02
9.0	Max	44.44	25.00	11.11
	Nominal	36.00	20.25	9.00
	Min	29.75	16.74	7.44
9.5	Max	46.91	26.39	11.73
	Nominal	38.00	21.38	9.50
	Min	31.40	17.67	7.85
10.0	Max	49.38	27.78	12.35
	Nominal	40.00	22.50	10.00
	Min	33.06	18.60	8.26
10.5	Max	51.85	29.17	12.96
	Nominal	42.00	23.63	10.50
	Min	34.71	19.52	8.68
11.0	Max	54.32	30.56	13.58
	Nominal	44.00	24.75	11.00
	Min	36.36	20.45	9.09
11.5	Max	56.79	31.94	14.20
	Nominal	46.00	25.88	11.50
	Min	38.02	21.38	9.50
12.0	Max	59.26	33.33	14.81
	Nominal	48.00	27.00	12.00
	Min	39.67	22.31	9.92
12.5	Max	61.73	34.72	15.43
	Nominal	50.00	28.13	12.50
	Min	41.32	23.24	10.33
13.0	Max	64.20	36.11	16.05
	Nominal	52.00	29.25	13.00
	Min	42.98	24.17	10.74
13.5	Max	66.67	37.50	16.67
	Nominal	54.00	30.38	13.50
	Min	44.63	25.10	11.16
14.0	Max	69.14	38.89	17.28
	Nominal	56.00	31.50	14.00
	Min	46.28	26.03	11.57
14.5	Max	71.60	40.28	17.90
	Nominal	58.00	32.63	14.50
	Min	47.93	26.96	11.98
15.0	Max	74.07	41.67	18.52
	Nominal	60.00	33.75	15.00
	Min	49.59	27.89	12.40
15.5	Max	76.54	43.06	19.14
	Nominal	62.00	34.88	15.50
	Min	51.24	28.82	12.81
16.0	Max	79.01	44.44	19.75
	Nominal	64.00	36.00	16.00
	Min	52.89	29.75	13.22
16.5	Max	81.48	45.83	20.37
	Nominal	66.00	37.13	16.50
	Min	54.55	30.68	13.64
17.0	Max	83.95	47.22	20.99
	Nominal	68.00	38.25	17.00
	Min	56.20	31.61	14.05
17.5	Max	86.42	48.61	21.60
	Nominal	70.00	39.38	17.50
	Min	57.85	32.54	14.46
18.0	Max	88.89	50.00	22.22
	Nominal	72.00	40.50	18.00
	Min	59.50	33.47	14.88
18.5	Max	91.36	51.39	22.84
	Nominal	74.00	41.63	18.50
	Min	61.16	34.40	15.29
19.0	Max	93.83	52.78	23.46
	Nominal	76.00	42.75	19.00
	Min	62.81	35.33	15.70
19.5	Max	96.30	54.17	24.07
	Nominal	78.00	43.88	19.50
	Min	64.46	36.26	16.12
20.0	Max	98.77	55.56	24.69
	Nominal	80.00	45.00	20.00
	Min	66.12	37.19	16.53
20.5	Max	101.23	56.94	25.31
	Nominal	82.00	46.13	20.50
	Min	67.77	38.12	16.94
21.0	Max	103.70	58.33	25.93
	Nominal	84.00	47.25	21.00
	Min	69.42	39.05	17.36
21.5	Max	106.17	59.72	26.54
	Nominal	86.00	48.38	21.50
	Min	71.07	39.98	17.77
22.0	Max	108.64	61.11	27.16
	Nominal	88.00	49.50	22.00
	Min	72.73	40.91	18.18
22.5	Max	111.11	62.50	27.78
	Nominal	90.00	50.63	22.50
	Min	74.38	41.84	18.60
23.0	Max	113.58	63.89	28.40
	Nominal	92.00	51.75	23.00
	Min	76.03	42.77	19.01
23.5	Max	116.05	65.28	29.01
	Nominal	94.00	52.88	23.50
	Min	77.69	43.70	19.42
24.0	Max	118.52	66.67	29.63
	Nominal	96.00	54.00	24.00
	Min	79.34	44.63	19.83
24.5	Max	120.99	68.06	30.25
	Nominal	98.00	55.13	24.50
	Min	80.99	45.56	20.25
25.0	Max	123.46	69.44	30.86
	Nominal	100.00	56.25	25.00
	Min	82.64	46.49	20.66
25.5	Max	125.93	70.83	31.48
	Nominal	102.00	57.38	25.50
	Min	84.30	47.42	21.07
26.0	Max	128.40	72.22	32.10
	Nominal	104.00	58.50	26.00
	Min	85.95	48.35	21.49
26.5	Max	130.86	73.61	32.72
	Nominal	106.00	59.63	26.50
	Min	87.60	49.28	21.90
27.0	Max	133.33	75.00	33.33
	Nominal	108.00	60.75	27.00
	Min	89.26	50.21	22.31
27.5	Max	135.80	76.39	33.95
	Nominal	110.00	61.88	27.50
	Min	90.91	51.14	22.73
28.0	Max	138.27	77.78	34.57
	Nominal	112.00	63.00	28.00
	Min	92.56	52.07	23.14
28.5	Max	140.74	79.17	35.19
	Nominal	114.00	64.13	28.50
	Min	94.21	53.00	23.55
29.0	Max	143.21	80.56	35.80
	Nominal	116.00	65.25	29.00
	Min	95.87	53.93	23.97
29.5	Max	145.68	81.94	36.42
	Nominal	118.00	66.38	29.50
	Min	97.52	54.86	24.38
30.0	Max	148.15	83.33	37.04
	Nominal	120.00	67.50	30.00
	Min	99.17	55.79	24.79

Table 15-A: Long Time Delay Test Chart

15.4 Neutral Protection Testing Chart

The LT chart in previous section can also be used for NP Long Time testing. NP ST and INST will follow the time-current curves multiplied by a pickup percentage.

16.0 Ratings & Physical Information

Ambient Temperature:
- Trip Unit:
  - -4°F (-20°C) to 158°F (70°C)
- Trip Unit with Voltage Divider Module (VDM):
  - Serial #0142800497 and above:
  - -4°F (-20°C) to 158°F (70°C)
  - Serial #0142800497 and below:
  - -4°F (-20°C) to 140°F (60°C)
- OLED Display:
  - -22°F (-30°C) to 185°F (85°C)
- Battery:
  - -40°F (-40°C) to 158°F (70°C)

Humidity:
- 95% non-condensing

Conformal Coating (on circuit boards):
- Acrylic conformal coating, HumiSeal type 1A33

Contamination resistant membrane keypad

AC-PRO-II without VDM:
- Die-cast Aluminum enclosure with bright nickel finish:
- Nominal overall dimensions:
- Maximum dimensions: 3.5 x 5 x 1.52 inches
  88.9 x 127 x 38.5 Millimeters

AC-PRO-II with VDM:
- Die-cast Aluminum enclosure with bright nickel finish:
- Maximum dimensions: 3.5 x 5 x 2.28 inches
  88.9 x 127 x 57.8 Millimeters

QUICK-TRIP Switch:
- Die-cast Aluminum enclosure with electroless nickel finish:
- See Drawings below for Dimensions.

Battery:
- See Section 21.0

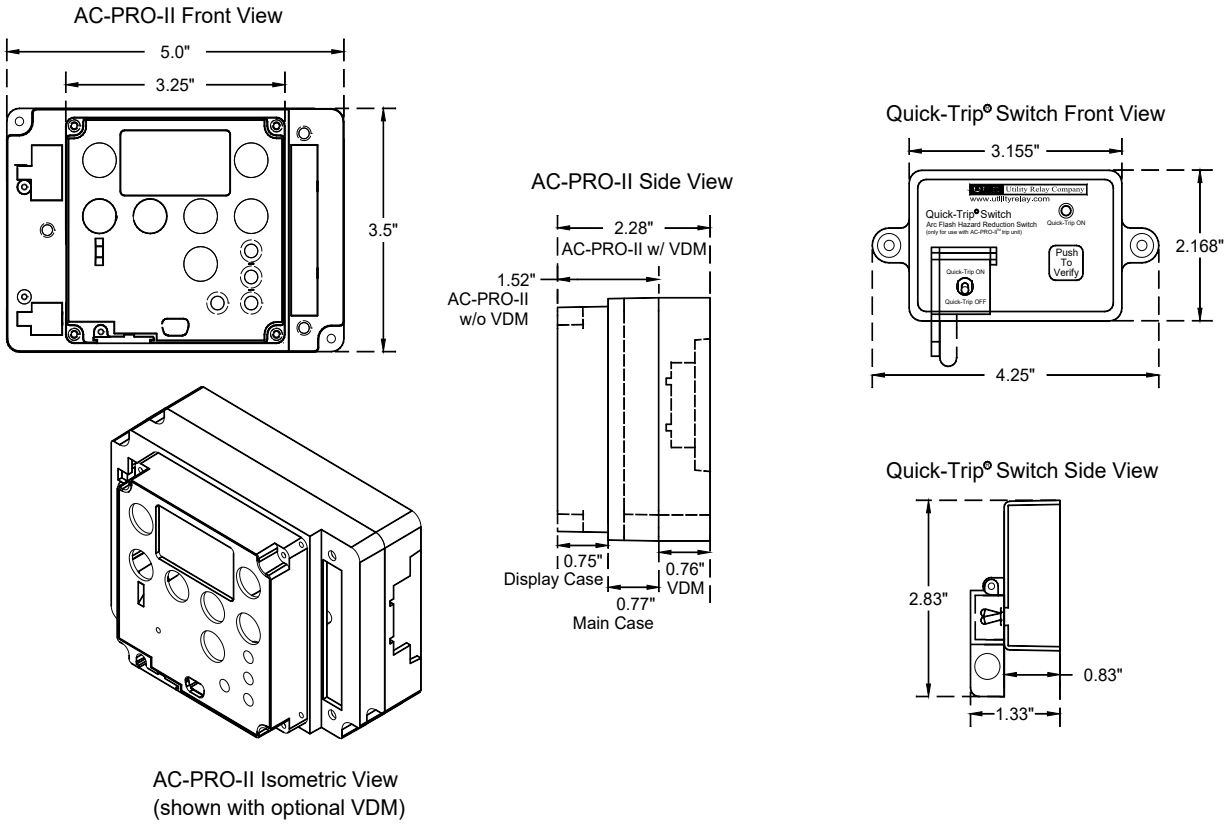


Figure 16.1: AC-PRO-II & Quick Trip Switch Drawings and Dimensions

17.0 Warranty

A conditional 2-year warranty is offered with each AC-PRO-II trip unit.

Contact Utility Relay Company for full details.

18.0 Time-Current Curves (TCC)

The TCCs are shown in Figures 18.1, 18.2, 18.3 and 18.4.

AC-PRO-II TCCs are similar to AC-PRO TCCs, except with improvements.

The AC-PRO-II TCCs offers the following improvements and/or updates:
- Narrower ST bands now allow coordination between the 0.2, 0.3, and 0.4 ST bands.
- Improved power-up times.
- GF I^2T ON affects currents up to 0.6xCT instead of 2xCT.

The curves are shown on log-log graph with seconds in the vertical direction and current in the horizontal direction.

Overload and fault currents are shown as multiples of the LT pick-up setting. GF current is shown as a percentage of the CT rating.

Tolerances for the Pick-Up bands are ± 10% (or +/-10A, whichever is greater) in the current direction. Tolerance for LT, ST I^2 T and GF I^2 T trip times are + 23% and -17% in the time direction. Tolerance for GF I^5T trip times are +69% and -38% in the time direction.

Instantaneous pick-up tolerance is ± 10% for 1A and 0.5A CTs. Instantaneous pickup tolerance is ± 20% for 0.4A, 0.25A, and 0.2A CTs. . For primary injection, see below.

Primary Injection Instantaneous pick-up tolerance: -20% to +10%. AC-PRO-II Instantaneous protection utilizes fast analog peak detection. Most Primary Injection test sets display RMS current. Due to possible asymmetry (offset) in primary test set output, and possible CT remanence associated with primary injection testing, the minus (-) tolerance is extended to -20% for primary injection testing only.

The curves for the following time bands:
Long Time (LT)
Short Time (ST) with I^2T ON
Ground Fault (GF) with I^2T ON
Neutral Overload (NOL)
are based on the following equation:

I^2T = Constant

Where: I is current in amps
T is time to trip in seconds (center of the band)

When performing trip-timing tests using a primary injection test set, the trip time at various test currents can be determined by calculation as explained in Sections 18.1, 18.2, 18.3 and 18.4.

The TCCs are based on a total actuator operating time plus breaker opening time in the 16ms to 33ms range.

18.1 Long Time (LT) Trip Time

For overload currents, the "I^2T = Constant" equation can be restated as follows:

$$\mathbf{T} = \frac{\mathbf{TBC_{LT}}}{\mathbf{X^2}}$$

Where: **T** = time to trip in seconds (center of the band)
X = current in multiples of the LT pick-up setting
$\mathbf{TBC_{LT}}$ = the LT Time Band Constant
= 36 X LT time band setting

**** NOTE ****
The LT Time Band Constant (TBC_{LT}) is by definition 36 times the LT Time Band Setting in seconds.

EXAMPLE #1:
CT Rating 1600A
LT pick-up 1200A
LT time band 20.0S
Overload Current 3600A

TBC_{LT} = 36 X LT Time Band Setting
= 36 X 20.0
= 720

and $X = \frac{\text{overload current}}{\text{LT Pick-Up}} = \frac{3600A}{1200A} = 3$

therefore:
trip time = $T = \frac{TBC_{LT}}{X^2}$ or $\frac{720}{3^2} = \frac{720}{9}$
= 80 seconds

**** IN SUMMARY ****
To calculate the LT trip time:
1) Calculate the LT Time Band Constant (TBC_{LT})
2) Calculate "X" where
$X = \frac{\text{overload current}}{\text{LT Pick-Up Setting}}$
3) Solve the equation:
$\text{trip time(sec)} = \frac{TBC_{LT}}{X^2}$

18.2 Short Time (ST) Trip Time

With I^2T off or for currents greater than 10 X LT pick-up setting, the ST trip time is a constant equal to the ST time band setting.

With I^2T on and for currents less than 10 X LT pick-up setting, the ST trip time is determined by the following equation:

$$\mathbf{T} = \frac{\mathbf{TBC_{ST}}}{\mathbf{X^2}}$$

Where: **T** = time to trip in seconds (center of the band)
X = current in multiples of the LT pick-up
$\mathbf{TBC_{ST}}$ = the ST Time Band Constant

**** NOTE ****
The ST Time Band Constant (TBC_{ST}) =
40 for the .40S Time Band
30 for the .30S Time Band
20 for the .20S Time Band
15 for the .15S Time Band
10 for the .10S Time Band
7 for the .07S Time Band

EXAMPLE #2:

CT Rating 1600A
LT pick-up 1200A
ST pick-up 6000A
ST delay .20S I^2T ON
Overload Current 7200A

$TBC_{ST} = 20$

and $X = \frac{\text{overload current}}{\text{LT Pick-Up}} = \frac{7200A}{1200A} = 6$

therefore:

trip time = $T = \frac{TBC_{ST}}{X^2}$ or $\frac{20}{6^2} = \frac{20}{36}$

= .556 seconds

**** IN SUMMARY ****

To calculate the ST I^2T trip time:

1) Determine the ST Time Band Constant (TBC_{ST})
2) Calculate "X" where
   $X = \frac{\text{overload current}}{\text{LT Pick-Up}}$
3) Solve the equation:
   trip time(sec) = $\frac{TBC_{ST}}{X^2}$

18.3 Ground Fault (GF) Trip Time

With the GF slope set to OFF, the GF trip time is a constant equal to the GF Time Band setting.

With the GF slope set to I^2T:

For GF currents greater than 0.6 times the CT rating, the GF trip time is a constant equal to the GF Time Band setting.

For GF currents less than 0.6 times the CT rating, the GF trip time is determined by the equations below.

With the GF slope set to I^5T:

For GF currents greater than 4.0 times the GF Pickup, the GF trip time is a constant equal to the GF Time Band setting.

For GF currents less than 4.0 times the GF Pickup, the GF trip time is determined by the equations below:

$\mathbf{T} = \frac{\mathbf{TB2C_{GF}}}{\mathbf{X_{GF}^2}}$ for I^2T OR $\mathbf{T} = \frac{\mathbf{TB5C_{GF}}}{\mathbf{X5_{GF}^5}}$ for I^5T

Where: **T** = time to trip in seconds (center of the band)

$\mathbf{X_{GF}} = \frac{\text{ground fault current}}{\text{CT rating}}$

$\mathbf{X5_{GF}} = \frac{\text{ground fault current}}{\text{GF Pickup}}$

$\mathbf{TB2C_{GF}}$ = the GF I^2T Time Band Constant
$\mathbf{TB5C_{GF}}$ = the GF I^5T Time Band Constant

**** NOTE ****

The GF I^2T Time Band Constant ($TB2C_{GF}$) =
0.18 for the .50S Time Band
0.144 for the .40S Time Band
0.108 for the .30S Time Band
0.072 for the .20S Time Band
0.036 for the .10S Time Band

**** NOTE ****

The GF I^5T Time Band Constant ($TB5C_{GF}$) =
512 for the .50S Time Band
409.6 for the .40S Time Band
307.2 for the .30S Time Band
204.8 for the .20S Time Band
102.4 for the .10S Time Band

EXAMPLE #3 (I^2T Slope):

CT Rating 1600A
LT pick-up 1200A
GF pick-up 640A
GF time band .20S I^2T Slope
Ground Fault Current 800A

$TB2C_{GF} = 0.072$

and $X_{GF} = \frac{\text{ground fault current}}{\text{CT Rating}} = \frac{800A}{1600A}$

= 0.5

therefore:

trip time = $T = \frac{TB2C_{GF}}{X_{GF}^2}$ or $\frac{0.072}{(0.5)^2} = \frac{0.072}{0.25}$

= 0.288 sec

**** IN SUMMARY ****

To calculate the GF I^2T trip time:

1) Determine the GF Time Band Constant ($TB2C_{GF}$)
2) Calculate "X_{GF}" where
   $X_{GF} = \frac{\text{ground fault current}}{\text{CT Rating}}$
3) Solve the equation:
   trip time(sec) = $\frac{TB2C_{GF}}{X_{GF}^2}$

EXAMPLE #4 (I^5T Slope):

CT Rating 2000A
LT pick-up 2000A
GF pick-up 800A
GF time band .30S I^5T Slope
Ground Fault Current 2400A

$TB5C_{GF} = 307.2$

and $X5_{GF} = \frac{\text{ground fault current}}{\text{GF Pickup}} = \frac{2400A}{800A}$

= 3.0

therefore:

trip time = $T = \frac{TB5C_{GF}}{X5_{GF}^5}$ or $\frac{307.2}{(3.0)^5} = \frac{307.2}{243}$

= 1.264 sec

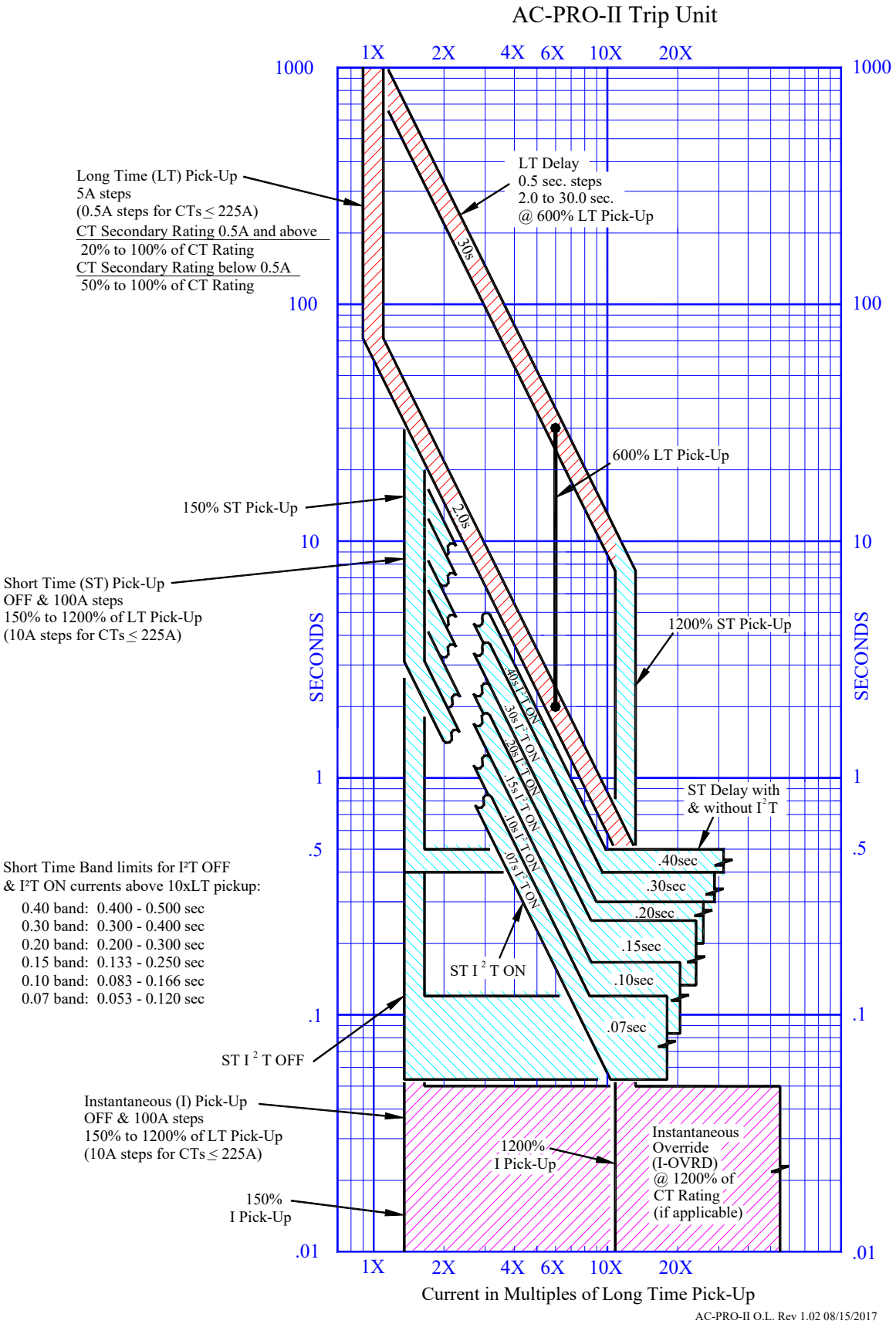


Figure 18.1: Overload TCC

18.4 Phase Current U/B Trip Time

Phase Current Unbalance is calculated as follows:

$$U/B = \frac{(I_{NL} - I_{NS})\ X\ 100\%}{I_{NL}}$$

Where:
I_{NL} = Largest Phase current
I_{NS} = Smallest Phase current

The Phase Unbalaance function is defeated if any two phase currents are less than 10% of the CT rating.

The tolerance for the Phase Unbalance Pick-Up is ± 10 percentage points. A Phase Current Unbalance Pick-Up of 20% would have a tolerance of 10% to 30% unbalance. An Phase Unbalance Pick-Up of 50% would have a tolerance of 40% to 60% unbalance.

The Phase Current Unbalance trip time is a definite time as shown on the U/B TCC in Figure 18.5

The tolerance for the U/B trip time is ± 10% of the setting.

**** NOTE ****
The U/B function should not be confused with the GF function.

The U/B function is a motor protection function and should ONLY be used on breakers feeding a large 3-phase motor where currents are normally balanced.

EXAMPLE #5 (Phase Current U/B):

CT Rating	800A
LT Pickup	600A
Motor FLC	429A
Motor Start Time	22 Sec

Unbalance Pickup set to protect windings from negative sequence currents due to unbalance

U/B pick-up	35%

U/B is 0.35 x 429A or 150A difference between phases.

Unbalance delay set to ride thru motor starting time:

U/B time delay	30 Sec > 22 Sec is adequate

18.5 Neutral Protection (NP) and Neutral Overload (NOL) Trip Times

The NP LSI tripping times are calculated in the same manner as the Overload LSI curves multiplied by a Percentage of Pickup. Range is 50% to 200%.

EXAMPLE #6 (Neutral Protection NP):

CT Rating	1600A
LT Pickup	1400A
ST Pickup	2400A
INST Pickup	7200A

Neutral Protection (NP): Set at 50% as neutral is only rated for half the Phase Conductors.

NP-LT	1400A x .50 = 700A
NPT-ST	2400A x .50 = 1200A
NP-INST	7200A x .50 = 3600A

(The previous firmware prior to V.4 for NOL trip time follows the LT trip time.)

For firmware prior to V.4, the NOL currents, the "I²T = Constant" equation is as follows:

$$\mathbf{T} = \frac{\mathbf{TBC_{NOL}}}{\mathbf{X^2}}$$

Where: **T** = time to trip in seconds (center of the band)
X = current in multiples of the NOL pick-up setting
$\mathbf{TBC_{NOL}}$ = the NOL Time Band Constant
= 36 X NOL time band setting

**** NOTE ****
The NOL Time Band Constant (TBC_{NOL}) is by definition 36 times the NOL Time Band Setting in seconds.

EXAMPLE #7:

CT Rating	1600A
NOL pick-up	800A
NOL time band	15.0S
NOL Current	2400A

TBC_{NOL} = 36 X NOL Time Band Setting
= 36 X 15.0
= 540

and $X = \frac{\text{overload current}}{\text{NOL pick-up}} = \frac{2400A}{800A} = 3$

therefore:
trip time = $T = \frac{TBC_{NOL}}{X^2}$ or $\frac{540}{3^2} = \frac{540}{9}$
= 60 seconds

**** IN SUMMARY ****
To calculate the NOL trip time:
1) Calculate the NOL Time Band Constant (TBC_{NOL})
2) Calculate "X" where
$X = \frac{\text{overload current}}{\text{NOL pick-up Setting}}$
3) Solve the equation:
$\text{trip time(sec)} = \frac{TBC_{NOL}}{X^2}$

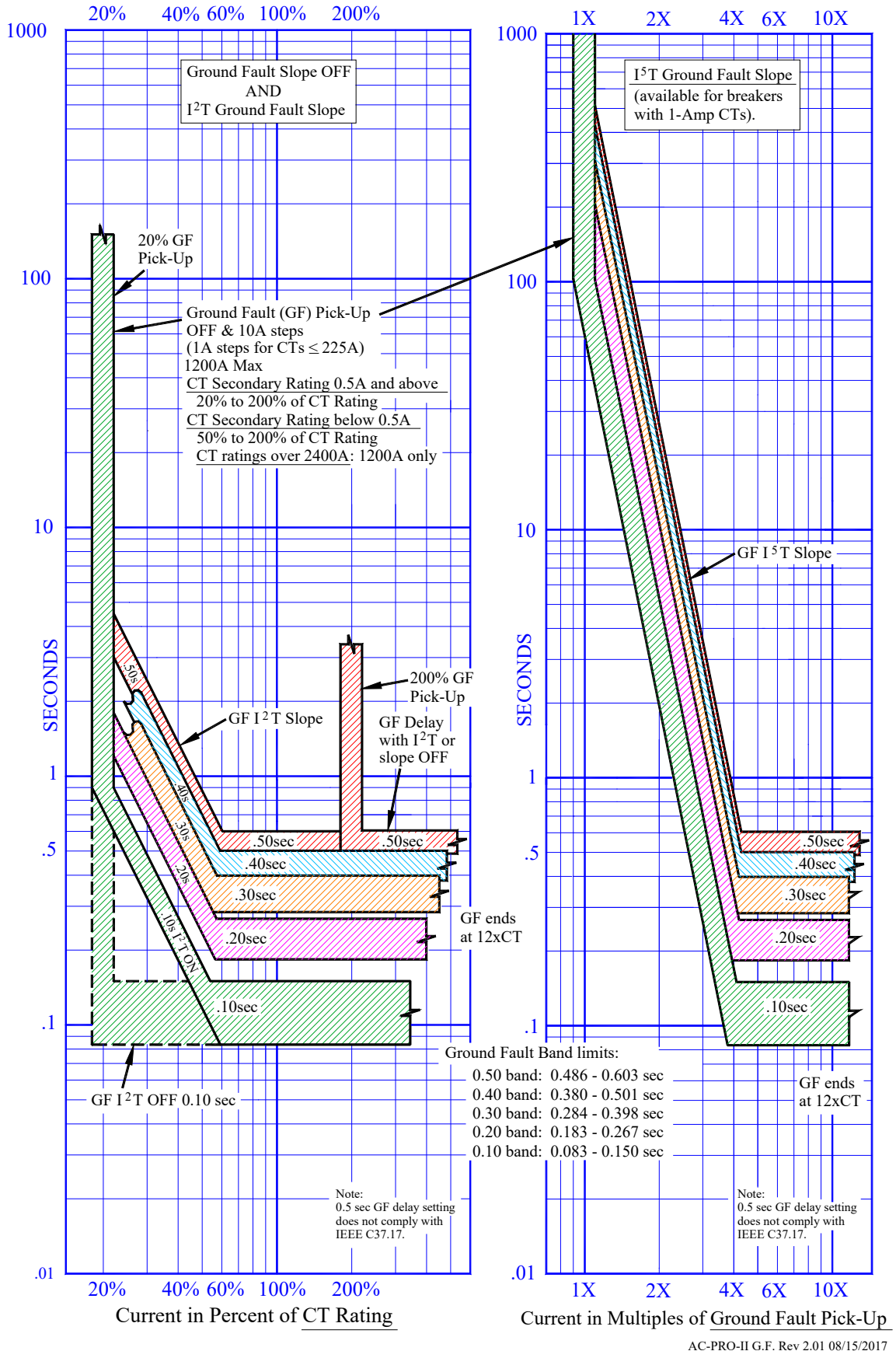


Figure 18.2: Ground Fault (GF) TCC

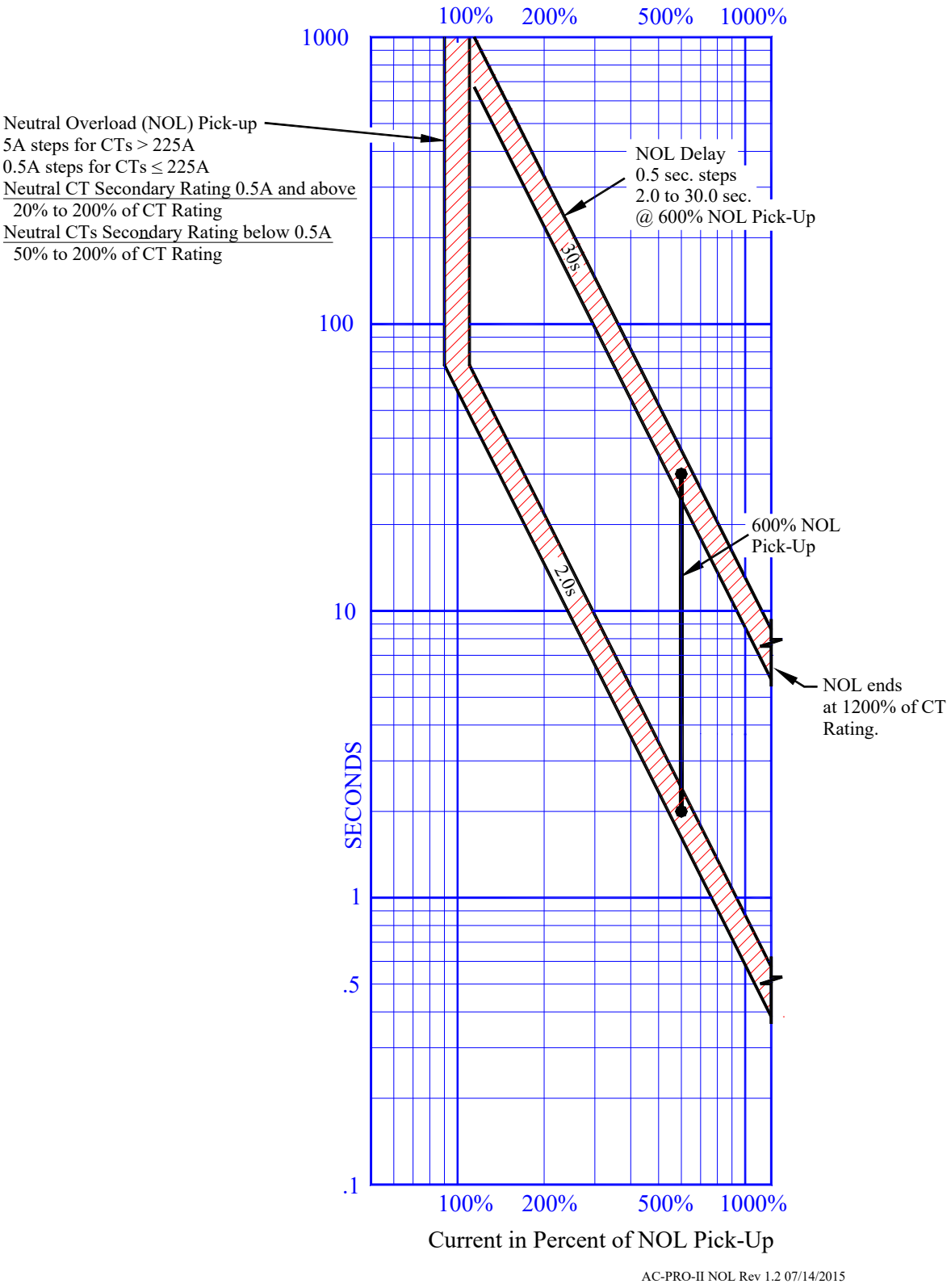
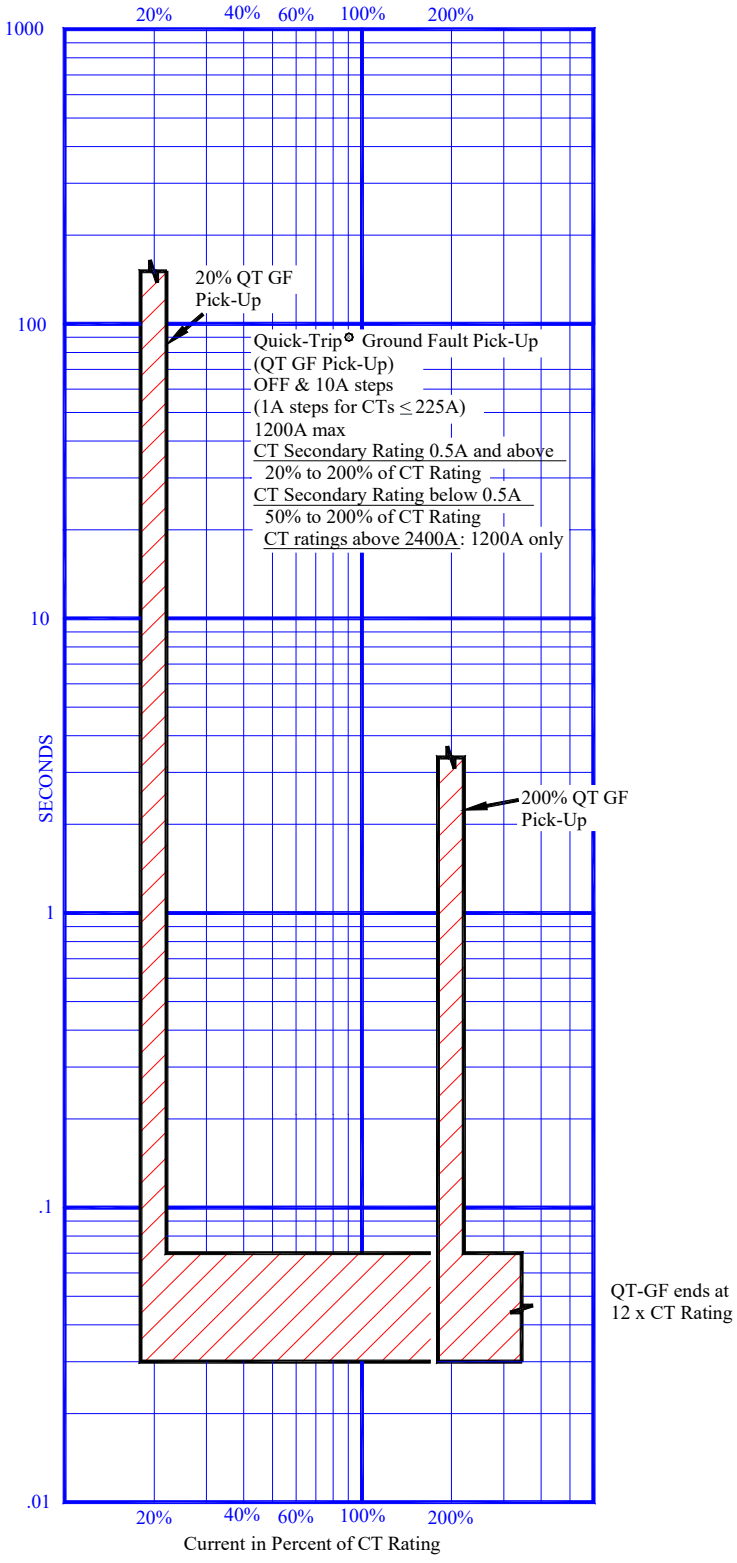
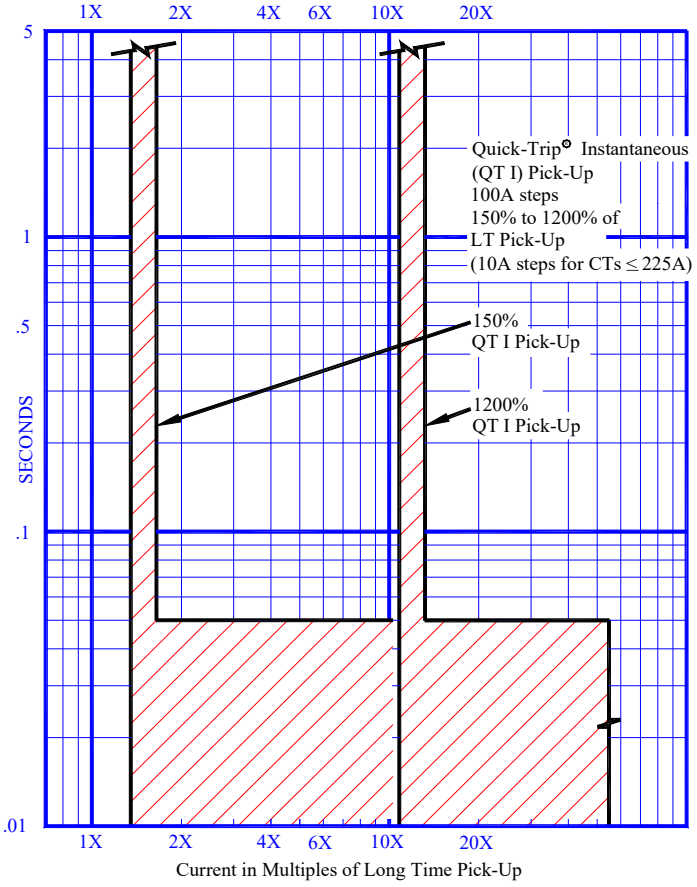


Figure 18.3: NOL Overload (NOL) TCC
Applies to trip units with Firmware prior to V4.0



Quick-Trip® Ground Fault Time Current Curve



Quick-Trip® Instantaneous Time Current Curve

AC-PRO-II Q.T. Rev 1.02 01/15/2015

Figure 18.4: QUICK-TRIP Ground Fault and QUICK-TRIP Instantaneous TCCs

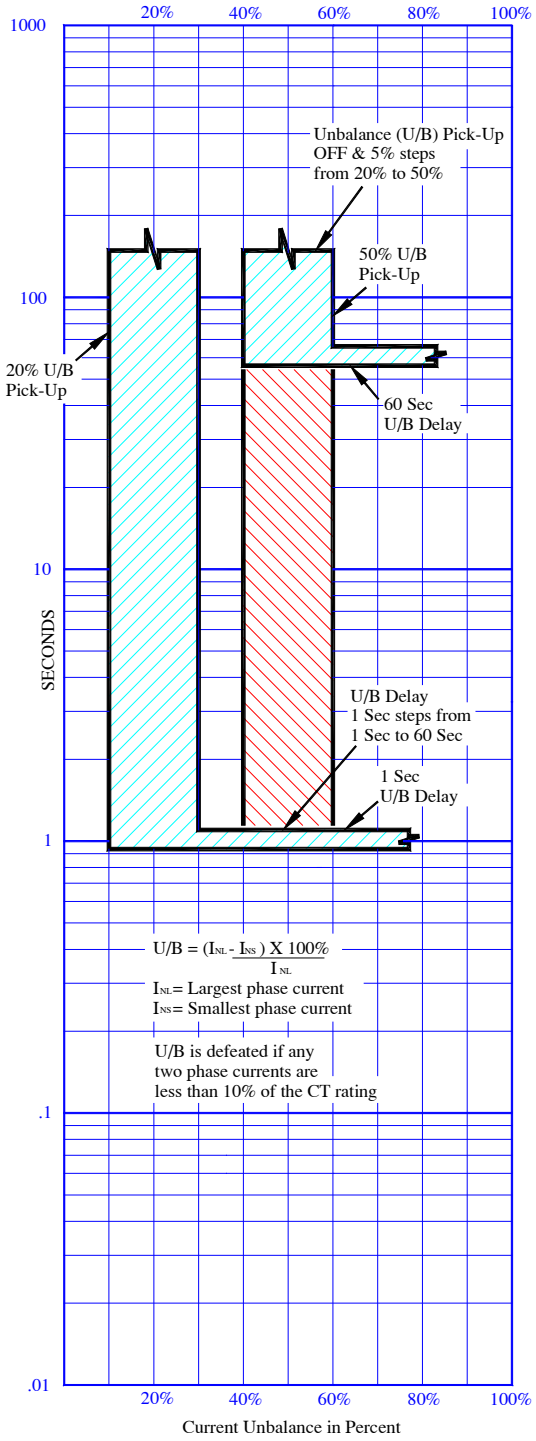


Figure 18.5: Phase Current Unbalance TCC

18.6 Current Metering Accuracy

For 1-Amp and 0.5-Amp secondary CTs:
+ /- 2% (or +/- 10A, whichever is greater) for currents between 20% and 150% of CT Rating

For CTs with secondary below 0.5A:
+ /- 2% (or +/- 10A, whichever is greater) for currents between 50% and 150% of CT Rating

19.0 Voltage & Power Calculations

Voltage accuracy:
+/- 1.5% for 80V and greater, +/- 1.2V for 0 – 80V.

Power accuracy (Instantaneous values)
+/- 5% for currents between 10% and 150% of CT rating

Energy calculations: Refer to Section 13.0.

20.0 Error and Alarms

20.1 Internal Error

If an internal error occurs in the AC-PRO-II, the OK LED will not be lit and the screen below will appear. *(Note: For V.4 & later firmware, the OK LED flashes if trip unit is fully functional. Prior to V.4, the OK LED did not flash but remained solid to indicate proper self-diagnostics.)*

Figure 20.1: Internal Error Screen

If this screen appears and persists, please contact URC.

If configured in user settings, the programmable relay will operate for this condition. The “Exit” button is available and allows bypassing this screen for temporary menu navigation. If the condition is still present, this screen will re-appear the next time the display is turned on.

20.2 Actuator Open Circuit

If the AC-PRO-II detects an open circuit at the actuator terminals, the OK led will not be ON and the following screen will appear, indicating an actuator open circuit condition, in which case the trip unit will not trip the breaker. Repair the actuator connection.

Figure 20.2: Actuator Open screen

If configured in user settings, the programmable relay will operate for this condition.

The “Exit” button allows bypassing this screen for temporary menu navigation. If the condition is still present, this screen will appear the next time the display is turned on.

20.3 Alarm Screens

If configured in user settings, the programmable relay will operate when a Trip Alarm, OV Alarm, UV Alarm, Phase Loss Alarm, or Ground Fault Alarm occurs and an “Alarm” screen will appear.
NOTE: the Programmable Relay will only operate for Alarms if the Programmable Relay setting is set to “Alarm”. The word “Relay” will only appear in the screens below if the Programmable Relay setting is set to “Alarm”.

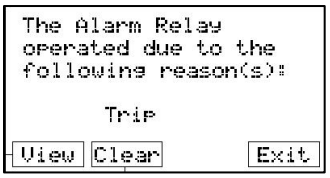


Figure 20.3: Alarm Screen (example shown is Trip Alarm)

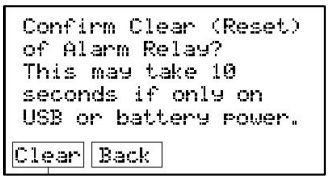


Figure 20.4: Clear Alarms Screen

Pressing the “View” button will show the trip history information. Pressing the “Clear” button will show the clear alarm screen. Pressing “Exit” will temporarily bypass this screen for temporary menu navigation. If the condition is still present, this screen will appear the next time the display is turned on.

Refer to Section 5.3.1 and Table 5-A.

20.4 Un-Calibrated

If the following screen appears, do not place the trip unit in service. Please contact URC.

Figure 20.5: Un-Calibrated Screen

21.0 Battery

21.1 Checking the Battery Voltage

See Section 6.4.2.

21.2 Battery Replacement

For best performance, replace the battery with the following 3-volt lithium battery:

Panasonic CR2 Industrial Lithium battery 3V
#CR15H270

A replacement battery can be purchased from:

- Utility Relay Co. Part # T-125
- Digi-Key Part # P157-ND
  www.digikey.com
- Newark Part #15R3550
  www.newark.com

Lithium battery ratings:

- 850 mAh Capacity

Figure 21.1: Battery Door

To replace the battery:

- The breaker must be out of service and de-energized for safety.
- Remove the black wiring cover by pulling the wiring cover off the three (3) standoff posts.
- Loosen the single #2-56 x 1/4 screw with a screwdriver.
- Remove the screw and associated locking washer.
- Before sliding the battery door forward, place hand below the battery door, as the battery contact spring will push the battery out.
- Slide the battery door forward.
- Remove the old battery.
- Check battery markings and insert positive (+) nub end of the battery into the trip unit first (the positive (+) nub should be up when trip unit is upright, flat (-) end should be down).
- Replace Battery door, washer and screw.
- If applicable, to reset low battery state, perform manual battery test using the MORE Menu. See **Error! Reference source not found.** for MORE Menu.

**** IMPORTANT ****

For best performance, replace the battery with the recommended Panasonic CR2 3-volt lithium battery.

The breaker must be removed from service before replacing the battery.

The replacement battery must be inserted with the proper polarity.

For proper contact, the battery door screw must be in place and hand-tightened.

After replacing battery, Time and Date must be set. See Section 6.4.1.

22.0 Rotating the Display

The AC-PRO-II trip unit consists of a main case and a display case. Refer to Figure 4.3. The trip unit orientation can be modified by rotating the display case. Refer to the AC-PRO-II retrofit kit installation manuals for breaker-specific trip unit orientation options. The AC-PRO-II can be configured in the three (3) normal orientations listed below.

1. Horizontal (breaker harness connection at right). All units are shipped in this orientation.
2. Vertical bottom (breaker harness connection at bottom).
3. Vertical top (breaker harness connection at top).

To rotate the Display Case:

- The breaker must be out of service and de-energized for safety.
- Ensure the person rotating the display is properly grounded and takes special care to avoid static discharge onto trip unit and display internal components.
- Remove the black wiring cover by pulling the wiring cover off the three (3) standoff posts.
- NOTE: the display case is connected to the main case via the following
  - One (1) Ribbon cable. See Figure 22.2.
  - Four (4) captive screws. See Figure 22.1
- Loosen the four (4) captive screws with a screwdriver.
- Leave the ribbon cable connected. Do not disconnect the ribbon cable.
- Rotate the display to one of the three options listed at the beginning of this section. Be careful not to damage, pinch, or disconnect the ribbon cable.
- Tighten the four (4) captive screws.
- Press the “DISPLAY” button and smart buttons to confirm operation.
- Refer back to the AC-PRO-II retrofit kit Instructions for additional breaker specific steps.

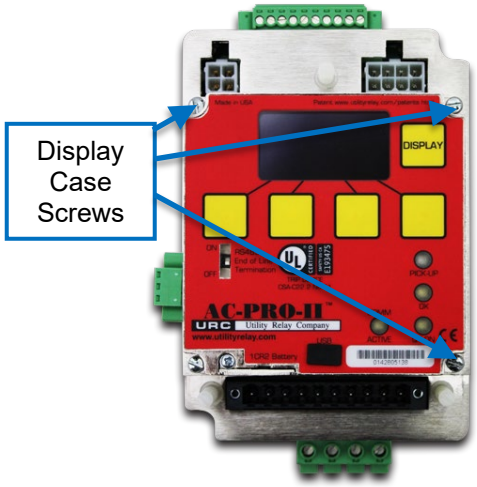


Figure 22.1: Display Case Screw locations

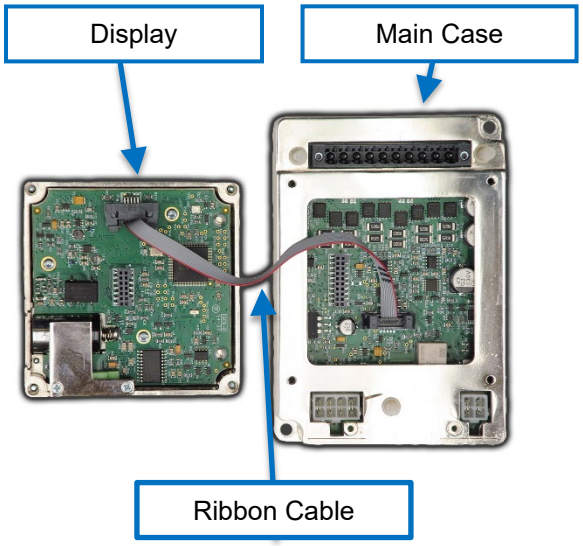


Figure 22.2: Trip Unit and Display (separated)

23.0 InfoPro-AC™ Software Application

InfoPro-AC is a software application that can be used with AC-PRO-II for the following:

- Settings – upload, download, view, save, and print.
- Trip history including waveforms – view, save, and print.
- Waveforms (on-demand) – view, save, and print.
- Current, voltage, & power readings – view.
- Alarms and trip unit status Information
- Trip unit info: serial number, firmware versions, breaker name.
- Firmware updates
- Time-Current curves and Test Reports
- Breaker Control (Trip & Close)
- QUICK-TRIP® ON/OFF Control

Recommended Operating System:
Microsoft Windows 10 or 11.

Connection:
mini-USB (cable not included)
NOTE: if AC-PRO-II is located behind a cubicle door, a USB panel mount extension was provided with the retrofit kit. (See Section 5.6.1).

The InfoPro-AC™ software application is available for download at:
http://www.utilityrelay.com/Side_Bar/Downloads.html

Open the downloaded file and follow the instructions to install the application.

**** IMPORTANT ****

InfoPro-AC needs the correct USB device driver to communicate with AC-PRO-II. Microsoft Windows often already includes these drivers. However, if this driver is not already installed:

1) Ensure your PC is connected to the Internet.
2) Connect AC-PRO-II to your PC with the USB cable.
3) Automatic driver update process:
   a) After you connect the AC-PRO-II, if you have an internet connection and administrative rights on your PC, Microsoft Windows should install the driver automatically after a few minutes.
4) Manual driver update process:
   a) Open Windows Device Manager
   b) Right click on the AC-PRO-II device. It will be located under Ports or under Other Devices.
   c) Choose the “Update Driver Software” option.
   d) Choose the “Search automatically” option.
   e) After the driver is installed, close and then reopen the InfoPro-AC Application.

NOTE: Any pending Microsoft Windows updates can interfere with the driver installation process.

For more detailed instructions with screenshots, contact URC.

Refer to the InfoPro-AC™ Help Guide within the InfoPro—AC application for specific information and instructions.

23.1 Firmware Versions and Updates

To determine which firmware version is currently installed on your AC-PRO-II, use the MORE menu.
See Figure 6.5**Error! Reference source not found.**.

The InfoPro-AC application can be used to update AC-PRO-II firmware in the field using the USB port. AC-PRO-II Firmware update instructions can be found in the InfoPro-AC Help Menu. For firmware version information see the following link:

http://www.utilityrelay.com/Side_Bar/Firmware_versions.html

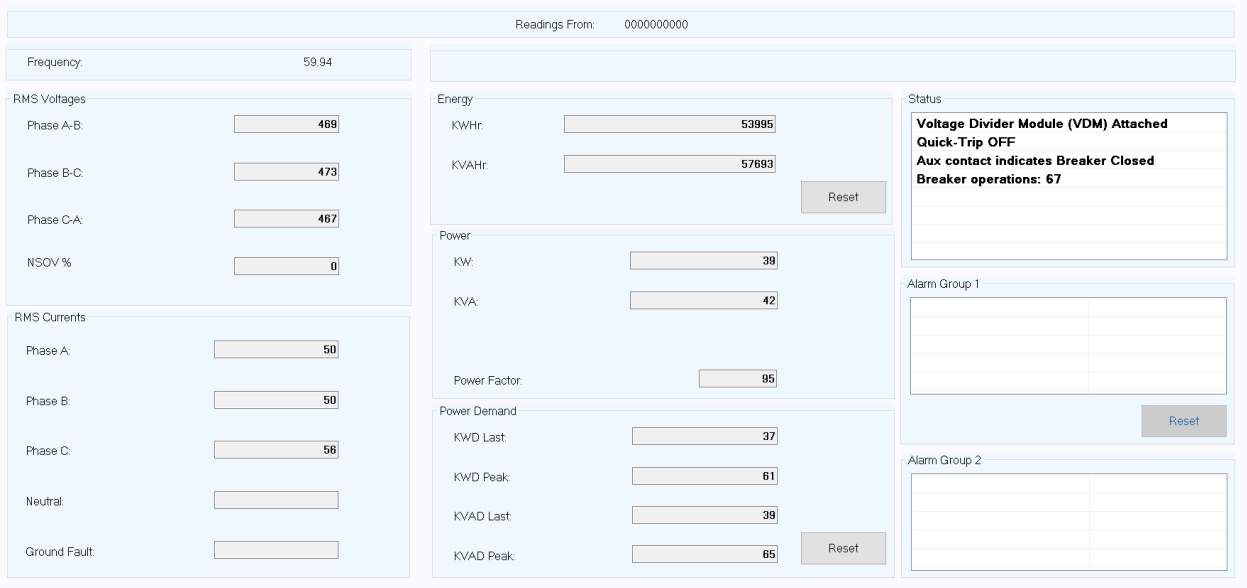


Figure 23.1: InfoPro-AC Readings Tab

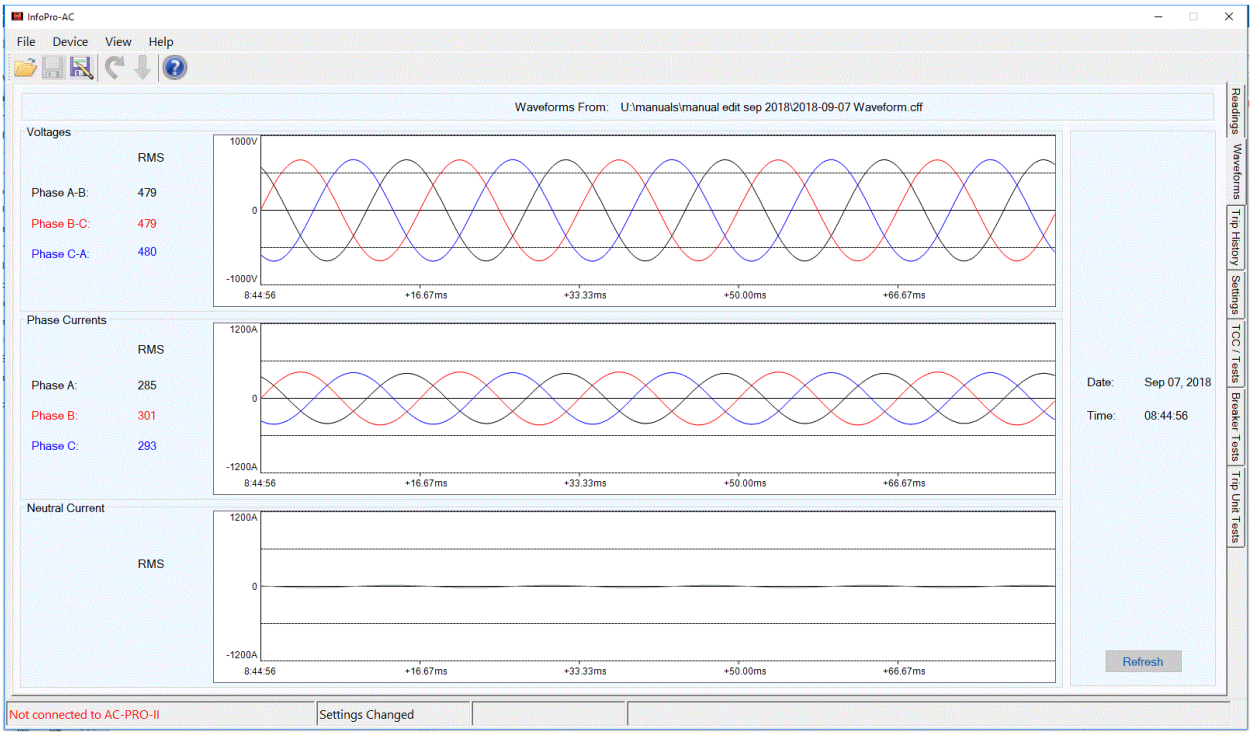


Figure 23.2: InfoPro-AC Waveform Tab

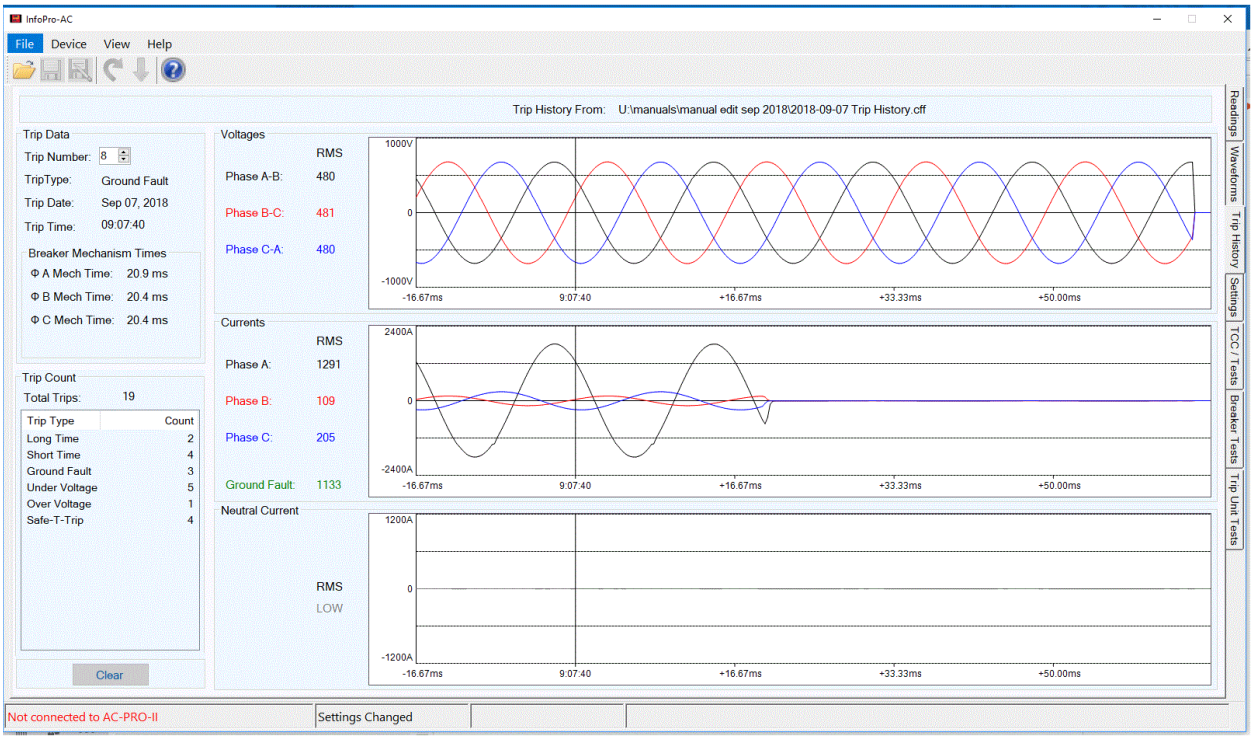


Figure 23.3: InfoPro-AC Trip History Tab

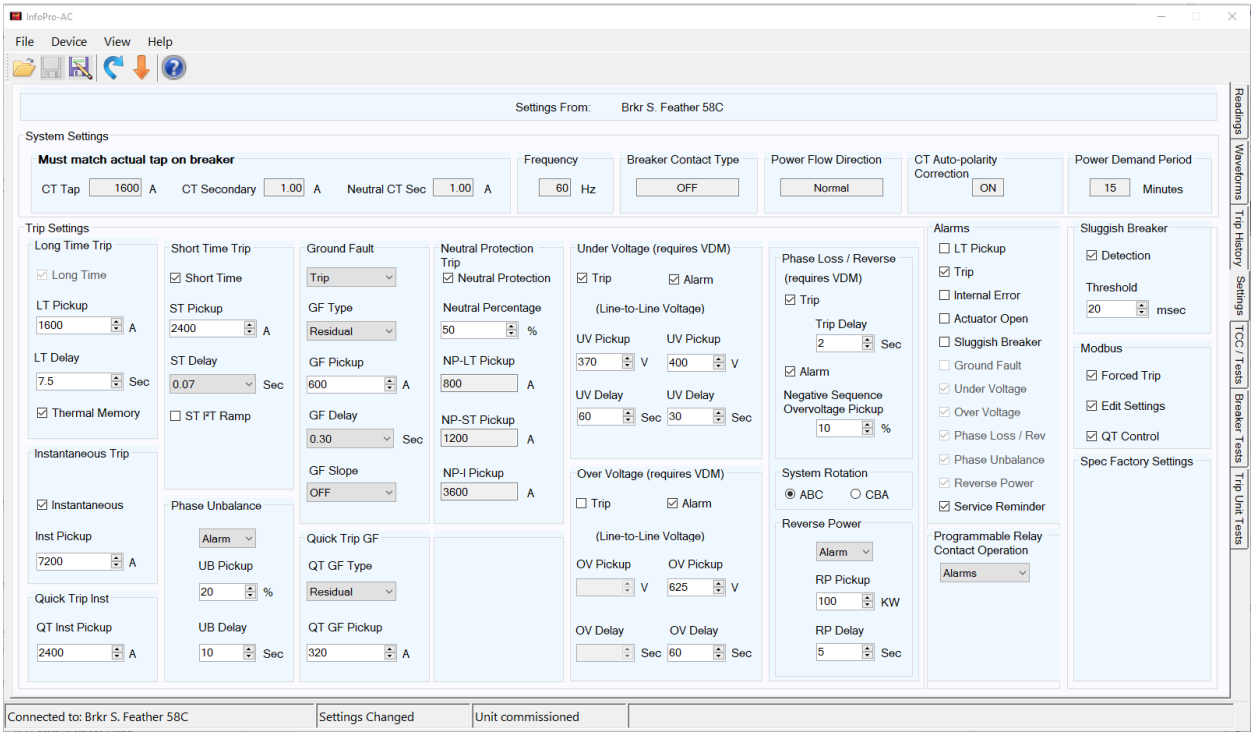


Figure 23.4: InfoPro-AC Settings Tab

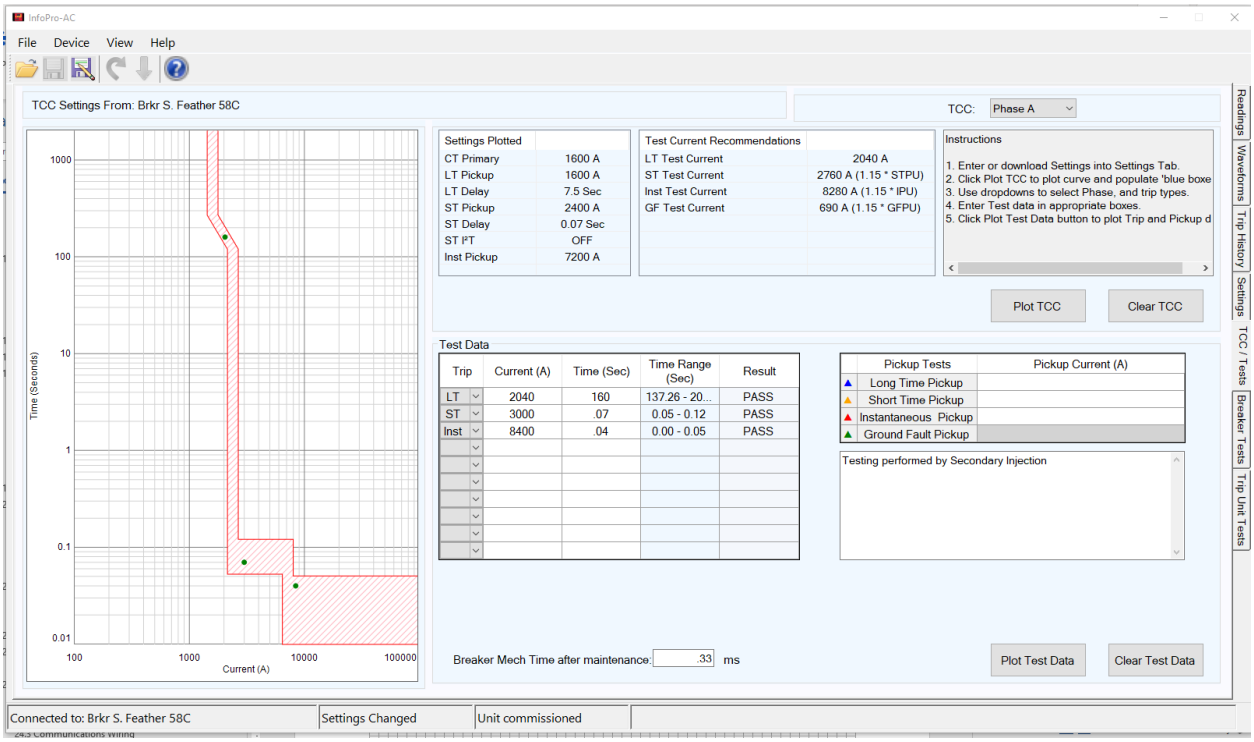
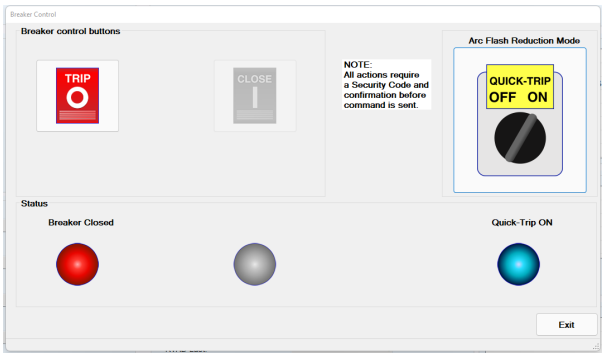
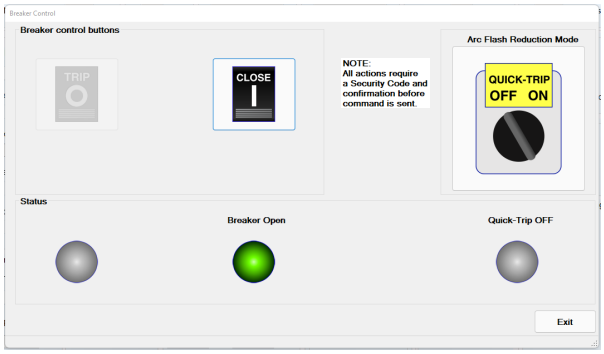


Figure 23.5: InfoPro-AC TCC / Tests Tab



Breaker Closed, Quick-Trip ON



Breaker Open, Quick-Trip OFF

Figure 23.6: InfoPro-AC Breaker Control Window

24.0 Communications

24.1 Communications Introduction

Creating a complete power monitoring and communications system for a low voltage power distribution system is easy with Utility Relay Company's AC-PRO-II. The standard AC-PRO-II trip unit communicates using industry standard Modbus RTU protocol through a single shielded twisted pair wire connected to the RS485 port. A number of trip units can be daisy-chained together to simplify installation.

AC-PRO-II communications features and information:

- Currents, 3-phase (±2% accuracy for currents between 20% and 150% of the CT rating)
- Review and change all settings ("Changing settings over Comm" user setting must be enabled at trip unit).
- Voltages, 3-phase
- KW, 3-phase & total (±5% accuracy for currents between 10% and 150% of the CT rating)
- KWHr, total
- KVA, 3-phase & total
- KVAHr, total
- KWD, KVAD
- Power Factor data
- Breaker position status (open or closed)
- Trip unit alarms and status information
- Sluggish-Breaker indication
- QUICK-TRIP ON /OFF status
- Trip history data for the last 8 trips
  - Trip counts
  - Trip type (reason for trip)
  - Trip dates & timestamps
  - Trip currents & voltages
  - Breaker mechanism times
- Trip unit time and date
- Trip unit Information: serial number, firmware revision.
- Forced trip ("Forced trip over Comm" user setting must be enabled at trip unit).

NOTE: Voltage Divider Module (VDM) is required for voltage and power information.

A host PC running HMI software with Modbus device drivers collects information from the trip units. The driver interrogates each trip unit individually and reports that information back to the host PC applications on a continual basis. Additional trip units can be added to the system by simply providing the new trip unit's ADDRESS to the HMI software.

AC-PRO-II trip units are compatible with the Modbus RTU communication protocol supplied with most HMI systems such as Inductive Automation's Ignition, Siemens WinPM; Wonderware' s *InTouch*™, *Intellution*™; Schneider *PowerLogic SMS-3000*™,*ION Enterprise*™, and PME (Power Monitor Expert); Eaton Power Xpert; GE EnerVista; and Power Measurements *PEGASYS*™.

24.2 Communications Components

An AC-PRO-II Modbus Communications system consists of the following hardware components:

1. AC-PRO-II trip unit and breaker retrofit components.
2. Host PC (supplied by others).
3. Cabling topology (supplied by others).

Additional components to consider include:

1. OPC software with Modbus device drivers (supplied by others).
2. Modbus RTU/Ethernet converter (supplied by others).
3. Human-Machine Interface (HMI) System (supplied by others) or Smart 1-Line (HMI) supplied by URC (See Section 24.4.2). These systems are used to view trip unit information graphically and often contain their own compatible Modbus Driver.

24.3 Communications Wiring

Although all AC-PRO-II trip units are capable of communications, units that are specifically ordered for communications are furnished with quick-disconnect communications cable assemblies. The cable assembly features a heavy-duty twist-lock connector and a terminal block, which mounts inside the switchgear.

The purpose of the terminal block is to provide a connection location for the twisted pair wire as it is daisy-chained from cell to cell in a switchgear lineup. This enables any individual communicating AC-PRO-II (mounted on a circuit breaker) to be removed without disrupting communications between the other communicating AC-PRO-II trip units.

See Figure 5.3 for wiring diagram. If replacing an existing AC-PRO with AC-PRO-II, remove the existing 2-piece AC-PRO communications cable from the cubicle, and use the new 2-piece cable shipped with the AC-PRO-II.

NOTE: The RS485 End of Line Termination switch should be in the on position on the AC-PRO-II that is the last device in the RS-485 loop. See Figure 4.1.

****IMPORTANT****
Do NOT use external termination resistors or circuits with AC-PRO-II.

24.4 System Components & Computer Hardware

URC trip units communicate over the RS485 interface at 9600, 19200, 38400, 57600 or 115200 Baud, with 8 data bits, 1 stop bit and no parity using the Modbus RTU communications protocol.

24.4.1 Ethernet

With the addition of an RS485 to Ethernet Converter an existing Local Area Network (LAN) can be used to carry data between trip units and the PC. Converters are widely available from a variety of industrial computer manufacturers.

RS485 to Ethernet Converters are designed to be compatible with a TCP/IP network environment and typically connect to a LAN using standard 10Base-T modular CAT-5 cabling. These converters offer a relatively inexpensive means of connecting to a LAN. (See Figure 24.1: Typical Communications Configuration Example).

24.4.2 Smart 1-Line

The Smart 1-Line is a field-configurable electronic 1-Line diagram with real-time data obtained via Modbus communications, allowing you to determine LV substation status at a glance. The Smart-1-Line can display currents, voltages, power, frequency, energy, trip-unit settings, waveforms, alarms, breaker open/close status along with remote tripping of breakers, and much more. It ships with software already installed, ready for connecting to your AC-PRO-II Modbus Communications network, with minimal basic setup required. (See Figure 24.2: Smart 1-Line Communication Solution).

24.5 Modbus Registers

The AC-PRO-II Modbus Register Map is available for download at the following location:

http://www.utilityrelay.com/PDFs/Product_Manuals/I-AC2-COMM.pdf

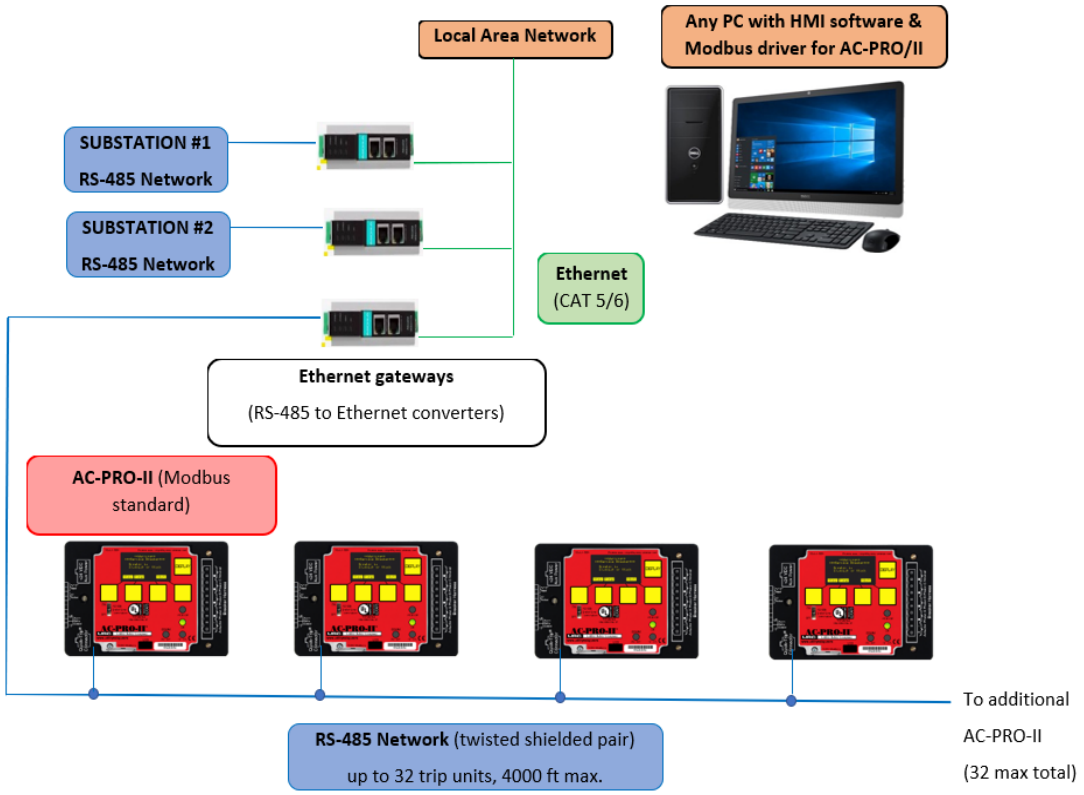


Figure 24.1: Typical Communications Configuration Example

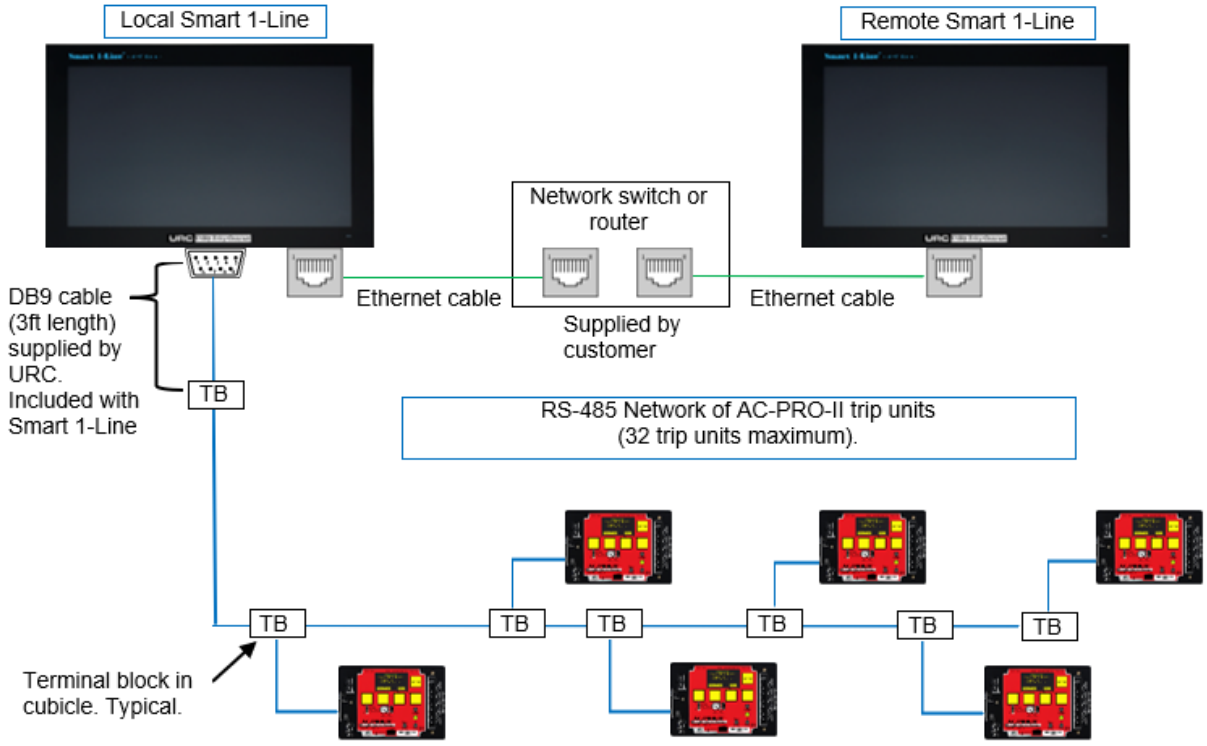


Figure 24.2: Smart 1-Line Communication Solution

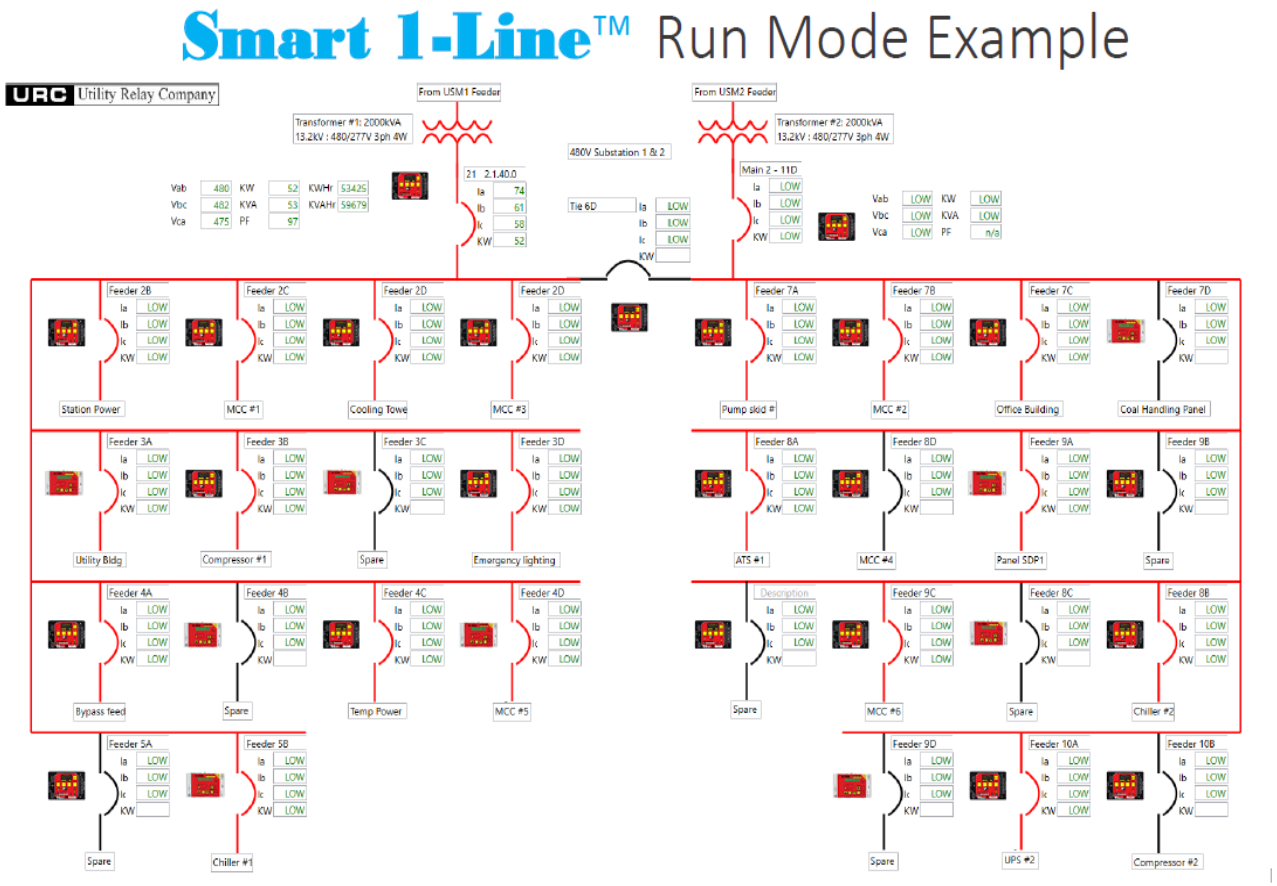


Figure 24.3: Smart 1-Line / Run Mode Example

Smart 1-Line™

Some of the information that can be displayed in the electronic 1-Line diagram:

- Currents
- Voltage, Power, Energy
- Breaker status
- Breaker and load ID/name
- Alarms
- Quick-Trip Status

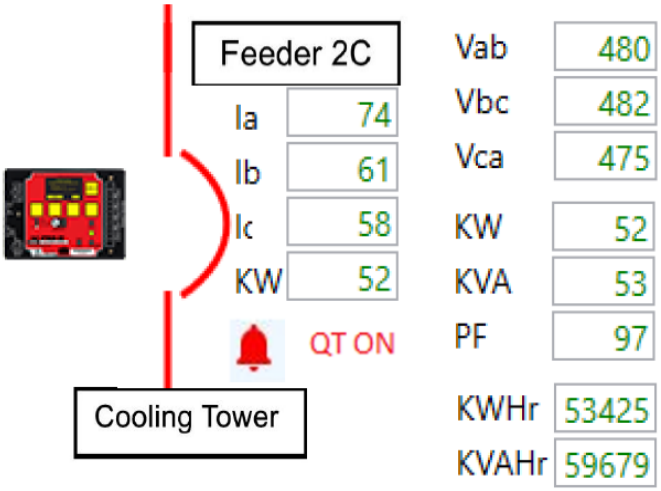


Figure 24.4: Smart 1-Line / Breaker Status and Alarms Screen

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UTILITYRELAY.COM

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URC Utility Relay Company

10100 QUEENS WAY
CHAGRIN FALLS, OH 44024
USA
888.289.2864