Note: this equipment has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
1.0 Introduction:

The etc-12 Q-Series is a product intended to replace the Merlin Gerin / Square D / Schneider Electric type STR trip controllers that were originally supplied on their MASTERPACT® M series breakers. The etc-12 Q-Series can be configured to replicate the settings of STR-18M, STR-28D, STR-38S and STR-58U the following breakers:

- MP08 H1
- MP12 H1
- MP16 H1
- MP20 H1
- MP25 H1
- MP30 H1
- MP40 H1
- MP50 H1
- MP63 H1

- MP08 H2
- MP12 H2
- MP16 H2
- MP20 H2
- MP25 H2
- MP30 H2
- MP40 H2
- MP50 H2
- MP63 H2

- MC08 N1
- MC16 N1

In a typical installation, the etc-12 Q-Series will be connected to the OEM current transformers, flux trip device and wiring harness. This universal plug and play approach allows for rapid conversion without significant expense or downtime.

The etc-12 Q-Series is compatible with both 3 and 4 wire residual sensing ground fault systems. The device can be factory configured to work with the less common ground strap sensing or zero sequence protection schemes which were designated by the OEM as Type W ground.

In addition to the core LSIG protective functions, the etc-12 Q-Series provides several advanced features that can be used to improve safety and versatility. These features include:

- MODBUS RTU communications*
- Pre-trip contacts.
- Latching trip contacts*
- Arc-flash reducing flashSAFE maintenance mode.
- Patented Test Mode.
- Phase current imbalance protection.

The etc-12 Q-Series can also be factory configured with a number of options including:

- Selective zone interlocks .
- Lockable activation module for flashSAFE.
- Hardware settings lock.
- Remote trip device.

The instructions provided in this manual are intended to serve as guidelines to individuals with circuit breaker maintenance experience to configure, test and operate the etc-12 Q-Series trip unit on MASTERPACT® Universal Power Circuit Breakers. Installation requires familiarity with circuit breaker operation and maintenance, careful workmanship and compliance with all instructions and standards.

The conversion requires removal of the existing trip unit and its replacement with the etc-12 Q-Series. After installation, the breaker must be fully performance tested.

Note that this retrofit kit is not intended to increase the interrupting capacity of a breaker. The converted breaker must be applied within its original short-circuit ratings.

* The etc-12Q.series receives all of the power for its protective functions from the current transformers on the breaker. It does not require additional control power except to utilize the indicated advanced features. In these instances, the breaker must have an additional 24VDC control power source. This power source is usually connected through the FI(-) and F2(+) secondary disconnects.
WARNING!!
TO PREVENT ELECTRICAL SHOCK OR INJURY, DISCONNECT THE BREAKER FROM ALL PRIMARY AND SECONDARY POWER SOURCES AND CONFIRM THAT THE BREAKER IS OPEN AND THE CHARGING SPRINGS ARE DISCHARGED BEFORE DOING ANY WORK.
REFER TO NFPA-70E FOR COMPREHENSIVE ELECTRICAL SAFETY GUIDELINES.

IMPORTANT!!
RETROFITTED BREAKERS MUST BE PERFORMANCE TESTED BEFORE BEING RETURNED TO SERVICE. PRIMARY INJECTION TESTING IS STRONGLY RECOMMENDED. REFER TO THE TESTING SECTION IN THE SECTION II MANUAL FOR DETAILED INSTRUCTIONS.
2.0 **Hardware Overview:**

![Diagram of etc-12Q.series]

**Table 1B, Notable Hardware Features Shown in figure 1**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Reset</td>
<td>This button projects when the breaker trips on an overcurrent. The breaker will not reclose until this button is depressed.</td>
</tr>
<tr>
<td>1B</td>
<td>Serial number and date code</td>
<td></td>
</tr>
<tr>
<td>1C</td>
<td>Pickup LED</td>
<td>Illuminates in red when the etc-12Q.series is timing to trip the breaker.</td>
</tr>
<tr>
<td>1D</td>
<td>Monitoring LED</td>
<td>Illuminates in green when current flowing through breaker is greater than 15% of the sensor rating ($I_n$) (40% for single phase). At lower currents, the LED can be off even though the etc-12Q.series is providing protection.</td>
</tr>
<tr>
<td>1E</td>
<td>Display</td>
<td>Shows phase current when the unit is in service. Settings and trip details can also be viewed. Power key activates backlight.</td>
</tr>
<tr>
<td>1F</td>
<td>Soft keys</td>
<td>4 button keypad. Functions of individual keys are displayed on the screen above the key. The second key from the left (POWER) turns on the display when there is no current flowing through the breaker.</td>
</tr>
<tr>
<td>1G</td>
<td>Battery access</td>
<td>9V lithium manganese battery required to power the display when no current is flowing through breaker. Protective functions do not require the battery. See sources, table 1A.</td>
</tr>
<tr>
<td>1J</td>
<td>Test port</td>
<td>Mates though an interface to etc pts w/ pts adapter or etc-pts2 for secondary injection testing. Unit does not need to be removed from breaker to test.</td>
</tr>
</tbody>
</table>

**Table 1A, Sources for 9V Lithium Manganese Batteries.**

<table>
<thead>
<tr>
<th>Company</th>
<th>Part Number</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grainger</td>
<td>2LBJ8</td>
<td>(888) 361-8649</td>
</tr>
<tr>
<td>McMaster-Carr</td>
<td>7745K56</td>
<td>(609) 223-4200</td>
</tr>
<tr>
<td>MSC Industrial Supply</td>
<td>67463752</td>
<td>(800) 645-7270</td>
</tr>
<tr>
<td>Radio Shack</td>
<td>23-665</td>
<td>(800) 843-7422</td>
</tr>
</tbody>
</table>

**FIGURE 1, Front view of etc-12Q.series Showing Notable Hardware Features**
Table 2, Notable Hardware Features Shown in figure 2

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>Neutral CT</td>
<td>Connects to neutral CT through existing harness on breaker.</td>
</tr>
<tr>
<td>2B</td>
<td>Phase 1 CT</td>
<td>Connects to phase 1 CT through existing harness on breaker.</td>
</tr>
<tr>
<td>2C</td>
<td>Phase 2 CT</td>
<td>Connects to phase 2 CT through existing harness on breaker.</td>
</tr>
<tr>
<td>2D</td>
<td>Phase 3 CT</td>
<td>Connects to phase 3 CT through existing harness on breaker.</td>
</tr>
<tr>
<td>2E</td>
<td>Auxiliary</td>
<td>Access to MODBUS communications, trip alarm and pre-trip alarm contacts. Refer to figure / table 3.</td>
</tr>
<tr>
<td>2F</td>
<td>MOC</td>
<td>Connects to existing harness that mates to DINF connector on original trip unit. This input monitors a switch on the breakers operating mechanism to indicate whether it is open or closed. Connection to this switch is not required for the protective functions of the trip unit. The etc-12Q.series will indicate the state of this switch when polled through its MODBUS interface.</td>
</tr>
<tr>
<td>2G</td>
<td>24 V control power</td>
<td>Connection to breaker control power. Control power is not required to operate the protective features of the etc-12.Q series but is required to utilize MODBUS communications or the trip alarm on the auxiliary port. This control power is usually connected to the Fi(-) and F2(+) secondary disconnects.</td>
</tr>
<tr>
<td>2H</td>
<td>Flux</td>
<td>Connects to the flux transfer trip solenoid.</td>
</tr>
<tr>
<td>2I</td>
<td>TH</td>
<td>Connects to existing thermal device on breaker. Thermal memory, when enabled on the etc-12Q.series is performed by software calculation. Use of this feature on the etc-12Q.series does not require connection to the breaker thermal device.</td>
</tr>
</tbody>
</table>
### Table 3 Auxiliary Connector

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A</td>
<td>MODBUS interface</td>
<td>Requires breaker to have 24VDC control power. Individual units must be assigned a unique ID through before they are connected to a network with multiple units. ID #210 is universal and cannot be polled when multiple units are connected on a network.</td>
</tr>
<tr>
<td>3B</td>
<td>Trip Alarm</td>
<td>Requires breaker to have 24VDC control power. Normally open contacts change state when etc-12Q.series initiates a breaker trip. Contacts do not change state when breaker is open manually or through shunt trip. Contacts are reset by pressing the CLEAR softkey that appears on the display after a trip. Contacts are also reset by closing the breaker onto more than 1 phase of current. Contacts are rated at 6A, 250 VAC.</td>
</tr>
<tr>
<td>3C</td>
<td>Pre-Trip Alarm</td>
<td>Normally open, optically coupled contacts that change state when current approaches long-time pickup. Trigger value is factory set at 90% of the long-time pickup value provided that this current is at least 35% of the breaker CT rating (In). Value can be field customized through MODBUS port. Contacts are rated at 200mA, 120V.</td>
</tr>
</tbody>
</table>

**FIGURE 3, Close-up View of Auxiliary Port and Connector**
3.0 Trip Unit Selection

3.1. The etc-12 Q-Series is compatible with all breaker frame sizes and is supplied with all basic protective functions available (LSIG). Functions that are not needed for a specific application can be shut off. If the trip unit being replaced has ground fault protection enabled, it must be determined if a residual protection scheme or a source return / zero sequence protection scheme is used. Original trip units identified residual protection as “TYPE T” and source return / zero sequence as “TYPE W”. The type of protection is indicated as a “T” or “W” to the right of the ground fault settings switches as shown in figure 4.

3.2. Standard etc-12 Q-Series trip units are directly interchangeable with STR trip units having a Type T ground for both 3 and 4 wire systems. In order to replace an OEM trip unit with Type W ground, the etc-12 Q-Series must be specially configured by the factory.

- FIGURE 4, FRONT VIEW OF STR TRIP UNIT SHOWING GROUND FAULT SCHEME
### TABLE 4A. Settings Information Required for Setup

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range of Settings</th>
<th>Notes</th>
<th>Value for this application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breaker type</td>
<td>H1 Standard IC, H2 High IC, N1 Special IC</td>
<td>See figure 9.</td>
<td></td>
</tr>
<tr>
<td>Long-time pickup</td>
<td>From 25 to 110% of the current sensor tap ratings, in increments of 5% of the tap rating.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long time delay</td>
<td>16, 24, 32, 40, 48, 56, 64, 72, 80, 96, 112, 128, 144, 160, 176, 192, 208, 224, 240, 256, 272, 288, 304, 320, 336, 352, 368, 384, 400, 416, 432, 448, 464, 480 seconds</td>
<td>OEM STR-28D™ and STR-38S™ trip units have factory set delays. The closest equivalent delay is 128 seconds at 1.5L.</td>
<td></td>
</tr>
<tr>
<td>Short circuit protection type</td>
<td>Short-time, instantaneous or both.</td>
<td></td>
<td>OEM STR-28D™ and STR-38S™ trip units have factory set delays. The closest equivalent delay is 128 seconds at 1.5L.</td>
</tr>
<tr>
<td>Short time pickup</td>
<td>From 150 to 1000% of long time pickup, in increments of 25% of the long time pickup value.</td>
<td>May be defeated if instantaneous is enabled.</td>
<td></td>
</tr>
<tr>
<td>Short time I²t</td>
<td>Constant delay or I²t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous pickup</td>
<td>.070, .100, .150, .200, .300, .400, .500, .seconds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground fault pickup</td>
<td>From 20 to 200% of the sensor tap rating, provided that this value is not greater than 1200A. Increments are of 5% of the sensor tap rating up to 100% of tap rating. Above 100% of tap rating, increments are in 10% of tap rating.</td>
<td>May be defeated. Not available on 6300A frame size.</td>
<td></td>
</tr>
<tr>
<td>Ground fault delay mode</td>
<td>Constant or I²t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground fault delay</td>
<td>.100, .150, .200, .300, .400, .500 seconds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 4B, Advanced Features

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range of Settings</th>
<th>Notes</th>
<th>Default Value</th>
<th>Value for this application</th>
</tr>
</thead>
<tbody>
<tr>
<td>flashSAFE Instantaneous Pickup</td>
<td>150 to 1200% of the long time pickup value.</td>
<td>May be defeated. Must be lower than the previously entered instantaneous pickup. May be enabled even if instantaneous is defeated.</td>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>flashSAFE Ground fault pickup.</td>
<td>From 10 to 200% of the sensor tap rating, provided that this value is not greater than 1200A. Increments are of 5% of the sensor tap rating up to 100% of tap rating. Above 100% of tap rating, increments are in 10% of tap rating.</td>
<td>May be defeated. Must be lower than the previously entered ground fault pickup. May be enabled even if ground fault is defeated.</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Phase imbalance pickup</td>
<td>Current differentials between 15% and 50%.</td>
<td>May be defeated.</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Phase imbalance delay</td>
<td>From 1 to 10 seconds in 1 second intervals, from 12 to 20 seconds in 2 second intervals, from 25 to 50 in 5 second intervals, from 60 to 90 in 10 second intervals.</td>
<td></td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Long time thermal memory</td>
<td>On or Off</td>
<td>May be defeated.</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Ground fault thermal memory</td>
<td>On or Off</td>
<td>May be defeated.</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Selective Zone Interlocks – Main Menu</td>
<td>Select or Skip</td>
<td>Requires additional hardware (not field upgradable)</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Selective Zone Interlocks – Send restraint signal on short-time pickup</td>
<td>On or Off</td>
<td></td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Selective Zone Interlocks – Send restraint signal on ground-fault pickup</td>
<td>On or Off</td>
<td></td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Selective Zone Interlocks – Restrain short-time trip upon receipt of signal</td>
<td>On or Off</td>
<td></td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Selective Zone Interlocks – Restrain ground fault trip upon receipt of signal</td>
<td>On or Off</td>
<td></td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>

### TABLE 4C, Options

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range of Settings</th>
<th>Notes</th>
<th>Default Value</th>
<th>Value for this application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>50 or 60 Hz</td>
<td></td>
<td>60 Hz</td>
<td></td>
</tr>
<tr>
<td>Allow settings changes when in service.</td>
<td>Yes or No</td>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Permit activation of flashSAFE from front panel.</td>
<td>Yes or No</td>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Permit shunt trip from front panel.</td>
<td>Yes or No</td>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Permit display of ground fault current</td>
<td>Yes or No</td>
<td></td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
4.0 Modes of Operation

In order to simplify setup and use, the etc-12 Q-Series is designed to operate six distinct modes of operation. Each mode allows the user to input settings or view specific information. These modes are:

- Setup Mode
- Monitoring Mode
- View Settings Mode
- Trip History
- Utilities
- Breaker Info

The user may navigate through these modes using the keypad on the device. The following sections are detailed descriptions of the features and functions available in each of these modes.

5.0 Setup Mode

5.1. Setup mode allows the user to input or change trip settings and configure advanced features and options. It is necessary to enter initial settings before placing the breaker in service. If the etc-12 Q-Series is placed into service before settings are input, the unit will trip the breaker immediately.

Settings information is retained into non-volatile memory and will be preserved even after the programmer is disconnected from all power sources.

While in setup mode, the programmer will prompt the user for the breaker settings information listed in table 4A. This information must be available before the breaker is placed in service and should be obtained from the most recent coordination study performed by a qualified engineer. Tables 4B and 4C contain additional settings which are required for advanced features or customizing options. The user may choose to skip this part of the setup routine and accept the default values.

When a new trip unit is received from the factory, pressing the POWER button will energize the device and bring up the main menu screen.

To enter setup, the user must press the use the arrow keys until SETUP MODE is displayed. Pressing ENTER will then initialize setup mode.

A unit that is sensing current on more than one phase or on one phase plus neutral is considered to be in service. Setup mode can be accessed on in-service breakers if both of the following conditions are met:

a) The permissive to allow in-service settings is selected in the OPTIONS menu prior to the breaker being placed in service.

b) Setup is not locked with a hardware interlock.

When setup mode is accessed for in-service breakers, the option to change sensor tap is not available.

5.2. Serial Number: When setup mode is first entered, the serial number and software version number are displayed on the LCD as shown in figure 8. If a unique MODBUS ID has been assigned to the unit, it will also be shown on this screen. The user may select “QUIT” to exit to the main menu or “NEXT” to continue with setup.
5.3. Breaker Type: The next screen prompts the user to select the type of breaker on which the unit will be installed. The etc-12 Q-Series uses this information to limit the choice of settings to values that were within the OEM’s published range for that breaker type. The type number is printed on the nameplate of the breaker in the area indicated in figure 9.

Note: On in-service breakers, protective functions, including flashSAFE are temporarily disabled when in SETUP MODE. Care must be taken to ensure that in-service settings changes are made a safe and expeditious manner.

5.4. Frame Size: The next screen prompts the user to select the frame size of the breaker on which the unit will be installed. This information is also used to determine what settings should be available. The frame size is printed on the breaker nameplate and can be seen in figure 9.

5.5. Current Sensor Tap: The current sensor primary tap rating is input in the next screen. The up and down arrows can be used to scroll through the available tap options. The sensor tap rating is shown on the rating plug of the original unit and is designated \( I_n \). This is shown in figure 12.
5.6. Long-Time Pickup (LT): The screen shown in figure 14 permits the long-time pickup to be set. The LTP value is displayed on the screen both as a percentage of the current sensor tap and in actual amps. When matching the settings on a STR™ trip unit, the following parameters determine the LTP:
- Rating plug size (Io)
- Long time dial setting (Ir)

The long time pickup OEM trip units can be determined by multiplying the rating plug size, Io by the long-time dial setting.

\[ LTP \text{ (in Amps)} = Io \times Ir \]

Note that on some versions of STR™ trip units have a dial that sets Io instead of a physical rating plug. Long-time pickup is determined in the same manner regardless of if the unit has a plug or a dial.

5.7. LONG-TIME DELAY (LTD): The next screen in the setup mode allows the user to select the long-time delay. This parameter is defined as the time to trip when current is equal to 150% of the long-time pickup value.

The long time delay is inversely proportional to the square of the current. This means that the delay will be much longer low current magnitudes and that the unit will respond more quickly when current is higher. Time to trip at any current above pickup can be approximated using the following equation:

\[ t = \frac{2.25 \times LTD}{I^2} \]

Where:
- \( t \) = time to trip in seconds
- LTD = long time delay expressed in seconds at 150% of pickup
- I = current in amps
5.8. Short-Circuit Protection: The next screen permits the user to select whether the short-time, instantaneous or both of these protection bands will be active.

5.9. Short-Time Pickup (STP): If the short-time band was selected on the previous screen, the user is then prompted to enter the short-time pickup on the screen shown in figure 17. OEM trip units designate this parameter as $I_m$ and it is expressed as a multiple of the long-time pickup.

When short-time $I^2t$ is enabled, the etc-12 Q-Series trips in accordance with an inverse $I^2t$ curve.

Time to trip at any current between the short-time pickup point and 10L can be approximated using the following equation:

$$t = \frac{(10x \text{ STD})}{I^2}$$

Where:

- $t$ = time to trip in seconds
- $\text{STD}$ = short-time time delay expressed in seconds at 10x short-time pickup
- $I$ = current in amps

Note: The ramped delay of the short-time $I^2t$ curve ends when current exceeds 10 times LTP. At or above these currents, the trip time will be a constant value equal to the short-time delay setting.

5.11. Short-Time Delay (STD): After configuring the short-time pickup, the user is asked to select a delay value. This value is defined as the amount of time that the etc-12 Q-Series will count down after the short-time pickup is exceeded and before initiating a breaker trip. If current drops below the preset pickup point at any time during the delay period, the delay counter will be reset. The available delays are .070, .100, .150, .200, .300, .400, .500s. The arrow and Select keys can be used to display and choose the appropriate value.
5.12. Instantaneous Pickup: If the instantaneous protection option has been selected in section 5.8, the screen shown in figure 18 will be displayed. If this option hasn’t been selected, the setup routine will proceed with Ground Fault Selection as detailed in 5.13 This screen prompts the user to enter an instantaneous pickup point. When current exceeds this set-point, the etc-12 will initiate a breaker trip without intentional delay (less than 3 cycles). The pickup point is expressed in both amps and multiples of the LTP. The arrow keys can be used to scroll through the available choices. The Select key is used to choose the displayed value.

**NOTE:** The etc-12Q.series defines the instantaneous pickup to be a multiple of LTP. OEM STR™ series trip units define instantaneous pickup to be a multiple of the sensor tap. If the LTP is not set the same as the sensor tap, the instantaneous must be adjusted using the following formula:

\[
I_{etc-12Q} = I_{STR}(I_n/LTP)
\]

Where:

\[
I_{etc-12Q} = \text{Instantaneous pickup of etc-12Q expressed as a multiple of LTP}
\]

\[
I_{STR} = \text{Instantaneous pickup of STR™ expressed as a multiple of CT rating.}
\]

\[
I_n = \text{CT primary rating expressed in amps}
\]

\[
LTP = \text{Long-time pickup expressed in amps}
\]

5.13. Ground Fault Selection: After the short-circuit setup is complete, the ground fault selection screen shown in figure 19 is displayed. This screen allows the user to enable or defeat the ground fault protection feature. If ground fault protection is not required, select “DISABLE” and the setup routine will proceed to Advanced Features setup as described in section 6.0

**NOTE:** The etc-12Q.series is compatible with residual ground fault for both 3 and 4 wire systems. The OEM designated these systems as “Type W” ground. Source return or zero sequence sensing schemes, designated as “Type T” by the OEM, require an etc-12Q.series specially configured in the factory. See section 3.2.

5.14. Ground Fault Pickup: If ground fault protection is enabled, the etc will display the screen shown in figure 20, prompting the user to enter a pickup setting. The ground fault pickup is the current at which the etc-12 Q-Series begins to time to trip against the ground fault delay. The pickup values are based on multiples of the current sensor tap value.
The arrow and select keys can be used to select the desired pickup current.

<table>
<thead>
<tr>
<th>GROUND FAULT PICKUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 AMPS</td>
</tr>
<tr>
<td>= 0.40 TAP</td>
</tr>
</tbody>
</table>

FIGURE 20, GROUND FAULT PICKUP

5.15. Ground Fault Delay Mode: The screen shown in figure 21 is displayed. This screen prompts the user to select either a constant or a ramped delay based on the inverse $I^2t$ curve.

The $I^2t$ function enables a sloped delay curve that provides a longer delay for low level events but permits high magnitude faults to be quickly cleared. This function can be effectively employed to filter spurious noise and eliminate nuisance ground fault trips, particularly in older power distribution systems.

The approximate time to trip when ground fault current is between the ground fault pickup value and 2x the current sensor rating can be calculated using:

$$ t = \frac{(4 \times GFD)}{(I_{GF}/I_n)^2} $$

Where:

- $t$ = time to trip in seconds
- $GFD$ = ground fault delay, expressed as time to trip when current is 2x sensor rating.
- $I_{GF}$ = ground fault current in amps
- $I_n$ = current sensor tap rating

Note: The ramped delay of the ground-fault $I^2t$ curve ends when current exceeds 2 times the sensor rating ($I_n$). At or above these currents, the etc-12 Q-Series will trip at a constant value equal to the ground-fault delay setting.

<table>
<thead>
<tr>
<th>GROUND FAULT DELAY MODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I2T ENERGY</td>
</tr>
</tbody>
</table>

FIGURE 21, GROUND FAULT DELAY MODE

If the $I^2t$ delay is selected, the option to enable ground fault thermal memory will be available in the Advanced Features menu. The ground fault thermal memory feature is designed to protect against repetitive, short duration sputtering faults.

The arrow and select keys can be used to choose the desired option.

5.16. Ground Fault Delay Time: After selecting a constant delay or a ramped, $I^2t$ delay, the screen shown in figure 22 is displayed. This prompts the user select a ground fault delay. Available delays are .100, .150, .200, .300, .400, .500 seconds.

<table>
<thead>
<tr>
<th>GND FAULT DELAY TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10 SEC</td>
</tr>
</tbody>
</table>

FIGURE 22, GROUND FAULT DELAY
6.0 Advanced Features:

6.1. After completing the setup of the basic LSIG protective functions, the screen shown in figure 23 is displayed. If SKIP is selected, the setup routine will proceed to the OPTIONS menu as described in 7.0. If the unit was not previously setup, the default values shown in table 4B will be loaded. If the unit was set up previously, these settings will be preserved. Pressing the SELECT key will allow the user to configure advanced features such as flashSAFE arc-flash reduction, phase imbalance protection, thermal memory and selective zone interlocks.

6.2. flashSAFE Instantaneous: The flashSAFE feature is designed to provide a means to reduce the destructive potential of an arc-flash by allowing the remote activation of additional fast-acting protection bands. By enabling these bands while equipment is energized in-rush conditions can often be ignored. Because of this, lower pickups and delays can used. This allows for faster breaker response in a fault situation. Since the magnitude of the incident energy in an arc-flash is directly proportional to the time duration of the event, decreasing the breaker response time also diminishes the severity of the event.

Once flashSAFE settings have been entered, they must be activated in order for them to take effect. This activation can be achieved through one of the following three methods.

![FIGURE 23, ADVANCED FEATURES MENU](image)

**WARNING!!**

flashSAFE settings must be determined by a qualified engineer after short circuit and arc-flash studies have been completed. Improper settings can result in injury or death to personnel, equipment damage and nuisance tripping.

This device is intended to augment an existing safety system and does not eliminate the need for personnel to be trained and equipped with appropriate levels of PPE. Refer to NFPA-70E for comprehensive guidelines for workplace electrical safety.

It is vital that breakers are suitably adjusted and maintained as any advantage gained by faster response from the trip unit will be negated by improper mechanical operation.

When properly used, flashSAFE can reduce the arc-flash hazard levels at locations electrically downstream from where it is applied. Arc-flash danger is NOT decreased at the breaker flashSAFE is installed OR upstream of the device.
1) Making a selection in the UTILITIES menu (this option must be selected prior to placing the breaker into service).

2) Through the MODBUS communications interface.

3) Using the optional flashSAFE switch box.

Although any one of the above methods can be used to activate flashSAFE, there must be a unanimous agreement in order to deactivate this feature.

The first screen of the ADVANCED FEATURES menu, shown in figure 24, enables the setup of the flashSAFE instantaneous element. This feature can be used even if the instantaneous protection is defeated.

If “NO” is selected, the setup routine will skip to the flashSAFE ground fault setup as described in 6.3

If instantaneous flashSAFE is selected, the screen shown in figure 26 will be displayed. This screen allows the user to input a pickup value that is between 1.5L and the maximum pickup value for the particular breaker frame provided that this value is less than the instantaneous pickup value. The option to enter a flashSAFE instantaneous pickup is available even if the instantaneous function is normally disabled.

If “DISABLE” is selected, the setup routine will skip to the phase imbalance section as detailed in paragraph 6.5

6.3. The screen shown in figure 26 allows for the selection of flashSAFE ground fault. This feature can be used even if ground fault is defeated when the etc-12 is not in flashSAFE mode. Any pickup point between 10% of the sensor tap value to two times the sensor tap value or 1200 A (whichever is lower) may be selected for flashSAFE ground fault. The delay for this feature is not user adjustable and is fixed at .100 seconds.

6.4. flashSAFE Ground Fault Pickup

The flashSAFE ground fault pickup point is entered through the screen shown in figure 27. This pickup is only enabled when the flashSAFE function is activated. The arrow keys scroll through the available settings and the select key configures the etc-12 Q-Series for operation at this pickup point.

6.5. Phase Imbalance Pickup: The phase imbalance feature provides protection in situations where phase currents are normally balanced. This feature should not be confused with ground fault protection. The screen shown in figure
28 allows the user to configure this feature. Selecting NO will cause the setup routine skip this feature and proceed with thermal memory setup as detailed in section 6.7

**Figure 28, PHASE IMBALANCE SELECTION**

The screen shown in figure 28 allows the user to set the phase imbalance pickup point. When the magnitude of current imbalance between any two phases exceeds this value, the etc-12 will begin timing to trip. The percentage phase imbalance is calculated per the following equation:

$$\phi_{IMB} = 100\% \left( \frac{I_{MAX}-I_{MIN}}{I_{MAX}} \right)$$

*Where:

$\phi_{IMB}$ = phase imbalance expressed as a percentage

$I_{MAX}$ = highest phase current

$I_{MIN}$ = lowest phase current

*Pickups between 15 and 50% are available in 5% increments. The arrow keys are used to scroll through the available values. The select key will configure the etc-12 for operation at the displayed pickup value.

**Figure 28, PHASE IMBALANCE PICKUP**

6.6. Phase Imbalance Delay: The phase imbalance delay is set using the screen shown in figure 29. Delays between 1 and 90 seconds are available. The arrow and select keys are used to display and select the desired delay.

**Figure 29, PHASE IMBALANCE DELAY**

6.7. Thermal Memory: The etc-12 Q-Series offers the option of applying thermal memory to both the long-time and ground fault functions. These functions can be enabled independently of each other. When thermal memory is enabled, trip timers are not immediately reset when current drops below the pickup point. Instead, timers reset based on the calculated rate of heat dissipation in the bus. If the pickup threshold is exceeded before the timer completely resets, the etc-12 Q-Series will resume the trip countdown from a lower time based on amount of heat energy remaining in the system.

When enabled with long-time protection, thermal memory guards against over currents that are the result of cycling loads. Thermal memory offers protection against persistent “sputtering” faults when applied to ground fault protection.

The screen shown in figures 30 and 31 allow the user to enable thermal memory for long-time and /or ground fault.

**Figure 30 LONG-TIME THERMAL MEMORY**
6.8. Zone Interlocks: Selective zone interlocks allow for tighter power system coordination by disabling the trip function on upstream breakers if a downstream breaker is timing to clear a fault.

If zone interlocks are enabled, the etc-12 Q-Series can be configured to transmit a restraint signal when in pickup for either short-time, ground fault or both short-time and ground fault. If this signal is received by another etc-12 Q-Series configured for zone interlocking, tripping for these two functions is suppressed until the signal ceases. The system is designed so that the restraint signal ceases when the etc-12 Q-Series initiates a breaker trip. In the unlikely event that a breaker does not open due to a mechanical failure, the upstream breaker will clear the fault based on its pre-entered short-time or ground fault setting.

If this feature is not required, the user may press the skip key shown in figure 32 to proceed with the OPTIONS menu.

Note: In order to use this function, etc-12Q.series trip unit must factory configured. Inter-cell wiring is also required. The zone interlock feature is not compatible with OEM trip units so both the unit sending and receiving the restraint signal must be etc-12 Q-Series units.
The screens shown in figures 35 and 36 allow the unit to be configured to restrain trips on the short-time and/or ground-fault bands. When these options are selected and an etc-12 Q-Series receives a restraint signal from a downstream unit, it will postpone starting its trip timer while it permits the downstream device to clear the fault.

7.0 OPTIONS MENU

7.1. After the Advanced Features setup is either skipped or completed, the screen shown in figure 37 is displayed. This permits the user to either enter Options setup. If the SKIP is pressed, the default options listed in table 4C will be loaded if the unit was not previously set up. If the unit has been set up in the past these settings will be retained. If the SELECT is pressed, the unit will show the frequency selection screen.

![Figure 32, OPTIONS MENU](image)

7.2. Frequency: The etc-12 is designed for operation on both 50 and 60 Hz systems. The arrow and select keys can be used to configure the unit for operation at the desired frequency.

![Figure 33, FREQUENCY SELECTION](image)

7.3. In-Service Setup Changes: In order to protect against unintended changes to settings, the etc-12 Q-Series locks out the setup menu if the unit senses more than 1 phase of current. Figure 34 shows the screen that can be used to override this default. If the breaker is placed in service without the permissive set to allow in-service settings changes, this screen will not be available once the breaker is energized.

![Figure 34, ENABLING IN-SERVICE CHANGES](image)

An optional hardware interlock permits in-service settings changes only the interlock is engaged. If this device is used, the option to allow in-service changes must be set to YES.

![Figure 35, ENABLING FRONT-PANEL flashSAFE ACTIVATION](image)

7.4. Front-Panel flashSAFE activation: All etc-12 controllers are equipped with the flashSAFE arc-flash reduction system. If settings for this feature have been entered in the Advanced Features menu,
the screen shown in figure 35 will be displayed. From this screen, the user can select whether flashSAFE can be activated through a selection in the Utilities menu. If the NO option is selected, activation can only be achieved through the optional flashSAFE toggle or through MODBUS communications. Note that the etc-12 Q-Series must be factory configured to operate with the flashSAFE lockout toggle.

7.5. The etc-12 Q-Series can be configured to display a menu button that will trip the breaker through its flux trip mechanism. To use this feature, enough current must be flowing through the breaker to power the display. By default, this feature is disabled. Figure 36 shows the screen used to make this function available. If this function is enabled, the trip can be initiated through a selection in the Utilities menu.

![Figure 36, ENABLING VIRTUAL SHUNT TRIP](image)

**Figure 36, ENABLING VIRTUAL SHUNT TRIP**

With the addition of optional hardware, it is possible to utilize the etc-12 to trip a breaker through an external contact closure. If a unit is configured in this manner, the hardware initiated trip can be performed regardless of whether the front panel shunt trip is enabled.

7.6. The etc-12/etd is capable of displaying real-time ground current. This option can be utilized only if ground fault protection is used and can be enabled in the screen shown in figure 37.

![Figure 37, Ground Current Display](image)

**Figure 37, Ground Current Display**

7.7. **Saving Settings:** After the setup routine is complete, the unit will display the screen shown in figure 38. This screen permits the user to either accept all of the changes made during setup or discard all of these changes.

If the etc-12 Q-Series was setup previously and only a few parameters require modification, the user opt to **QUIT** the setup routine after the specific changes have been made. If the user presses the **QUIT** key that is available on most **SETUP** screens, they will be given an option to either save or discard all of the settings that were made in the **SETUP** routine.

![Figure 38, SAVING SETTINGS](image)

**Figure 38, SAVING SETTINGS**

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**IMPORTANT!!**

RETROFITTED BREAKERS MUST BE PERFORMANCE TESTED BEFORE BEING RETURNED TO SERVICE. PRIMARY INJECTION TESTING IS STRONGLY RECOMMENDED.