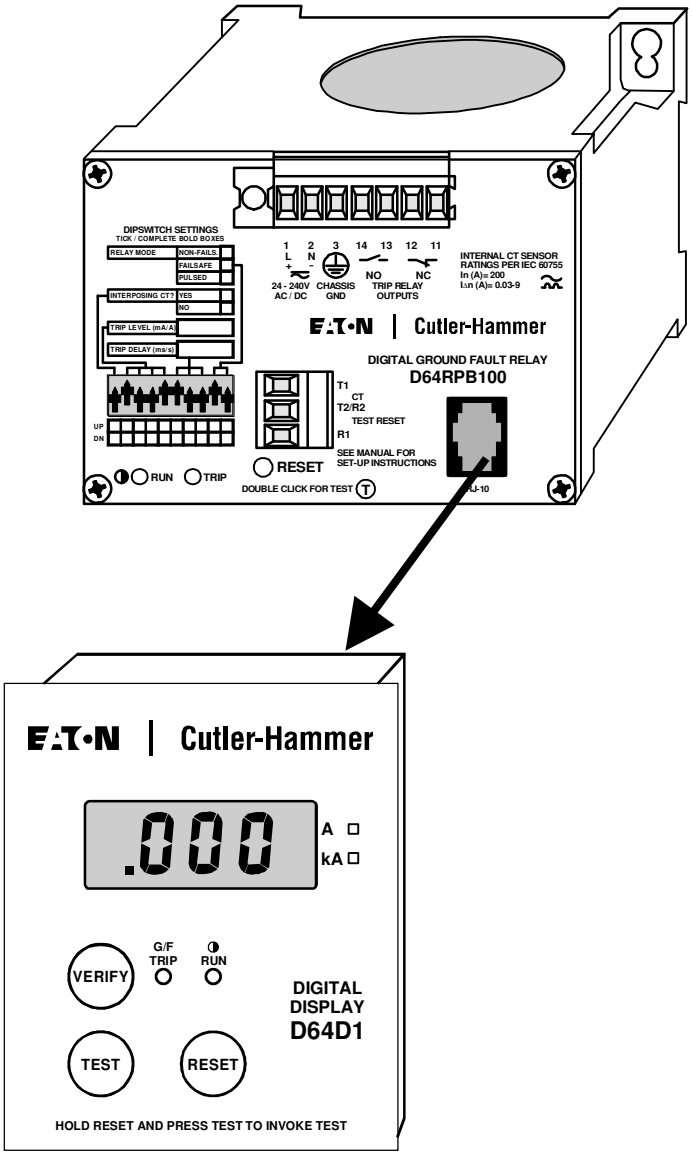
D64RPB100 SERIES B1 DIGITAL GROUND FAULT RELAY

D64RPB100 INSTRUCTION MANUAL



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1. GENERAL DESCRIPTION

The D64RPB100 is a microprocessor based ground fault relay for use on solidly grounded or resistance grounded systems. This innovative digital electronic relay measures ground fault current using a built-in 1.81" zero sequence current transformer (CT).

The D64RPB100 reacts to alternating current only and will reject direct current signals. It will maintain accuracy over a frequency range of 40 to 450 Hz., making it suitable for variable frequency drive applications.

660 Volts is the maximum system operating voltage for the D64RPB100 when passing the system power conductors through the built-in CT. However, by using any Eaton's Cutler-Hammer C311CT 500:1 ratio CT and connecting the secondary to CT input terminals T1 & T2 or, by using any suitably rated, commercially available, interposing CT with 5 Amp secondary, and passing the secondary lead through the built-in CT, the relay can be used on any system voltage.

The ground fault current trip level is set on a front accessible binary DIPswitch array. Using the built-in 1.81" CT or, by using any Cutler-Hammer C311CT 500:1 ratio CT and connecting the secondary to CT input terminals T1 & T2, trip currents from 30 milliamps - 9 Amps can be selected in 14 discrete steps. By using an interposing CT with 500:5 ratio, the trip current settings become 3 – 900 Amps. Or, by using an interposing CT with 5000:5 ratio, the trip current settings become 30 – 9000 Amps. The trip level can be set just above the charging current[1]. Any deterioration in the circuit will trip the relay. This also permits scheduled field testing of the relay (by lowering the trip level).

[1] The capacitance-to-ground charging current on a system will vary depending on: the overall length of the cables; the types of loads; the quality of insulation on the phase conductors; the surrounding equipment grounding, cable trays, junction boxes, etc.; and, the type of transformer.

A "Rule-of-Thumb" for systems 600 Volts and lower: The charging current is 0.5 Amps per 1000 kVA of transformer capacity.

The response time on ground fault trip is set on a front accessible binary DIPswitch array. The range is 20 ms - 5.00 second in 8 discrete steps.

The output relay has Form "Z" (4 terminal) N.O. and N.C. contacts which may be used to operate the upstream protective device and to indicate a failure of the system. The relay can be set to operate in any one of the following modes: Failsafe; Non-failsafe; or Pulsed Output Auto Reset, by means of front accessible DIPswitches.

By double clicking the cover mounted RESET button a functional test of the D64RPB100 is invoked. A single press of the RESET button resets the relay after a trip. A green RUN LED flashes to indicate when control power is applied to terminals 1 & 2. A red TRIP LED indicates that the D64RPB100 has sensed a ground fault current higher than the trip level for a period longer than the trip time and that the output contacts have operated.

7 point and 3 point pull-apart terminal blocks simplifies connection of field wiring. A captive screw secures the 7 point block to the relay, safe from the effects of shock and vibration. Terminals are provided for a remote TEST/REST pushbutton.

A communications port provides access for remote displays (D64D1 or D64D2), computer interface, or custom interface control modules.

The D64RPB100 operates on any control voltage from 24 – 240 Volts ac or dc.

2. OPERATION

2.1 GLOSSARY OF TERMS

Manual Reset:

The RESET pushbutton on the front of the D64RPB100 or, the remote TEST/RESET pushbutton connected to terminals R1 & R2, must be pressed once to reset the output relay after a trip, providing the ground fault has been cleared or the measured values are within the preset limits.

Non-Failsafe:

The output relay N.O. contact is closed when tripped and the N.C. contact is open when tripped.

The output relay does not change state when control power is applied to terminals 1 & 2.

With control voltage on terminals 1 & 2 (Green RUN LED flashing), when the measured values reach or exceed the DIPswitch settings for current and time, the output relay changes state (trips) and the red TRIP LED lights.

If control voltage is maintained on terminals 1 & 2 after a ground fault trip, the RESET button must be pressed to reset the relay after clearing the ground fault.

If control voltage is remove from terminals 1 & 2 while a ground fault is detected, the output relay resets and the red TRIP LED is turned off.

If the ground fault has not been cleared when control voltage is restored, the relay will trip and the red TRIP LED will light after 500 milliseconds, regardless of the time delay set on the Trip Delay DIPswitches.

If the ground fault has been cleared when control voltage is restored, the relay will remain reset.

The Non-Failsafe mode can be used when the output relay is operating undervoltage devices. This includes: contactor coils; starter coils and, circuit breakers equipped with UV trip coils.

Failsafe:

The output relay N.O. contact is closed when tripped and the N.C. contact is open when tripped.

The output relay contacts change state 500 ms after control voltage is applied to terminals 1 & 2.

The output relay trips when either or both of the following conditions occur:

- The measured values reach or exceed the DIPswitch settings for current and time. In this condition the red TRIP LED lights.
- Control voltage is removed from terminals 1 & 2. In this condition the red TRIP LED does not light.

If control voltage is maintained on terminals 1 & 2 after a ground fault trip, the RESET button must be pressed to reset the relay after clearing the ground fault.

If control voltage is removed from terminals 1 & 2 after a ground fault is detected, the output relay remains tripped.

If the ground fault has not been cleared when control voltage is restored, the relay remains tripped.

If the ground fault has been cleared when control voltage is restored, the relay contacts will change state 500 ms after control voltage is applied to terminals 1 & 2.

The Failsafe mode can be used when the output relay is operating undervoltage devices. This includes: contactor coils; starter coils; and circuit breakers equipped with UV trip coils provided that the control voltage to the D64RPB100 is not interrupted by the action of the UV trip.

Pulsed (Trip) Auto Reset:

The output relay N.O. contact is closed when tripped and the N.C. contact is open when tripped.

The output relay does not change state when control power is applied to terminals 1 & 2.

With control voltage on terminals 1 & 2 (green RUN LED flashing), the output relay changes state (trips) and the red TRIP LED lights when the measured values reach or exceed the DIPswitch settings for current and time. The output relay will remain tripped until one of the following conditions is met:

- Three seconds after the ground fault current drops below the trip current set point the relay will reset and the red TRIP LED is turned off. This is, in effect, pulsed Auto Reset.
- If the control voltage is removed by the trip action of the output relay (i.e. it operates the shunt trip of the breaker that is providing the control voltage), the relay will reset with a short delay and the red TRIP LED is turned off. This is, in effect, Auto Reset.

If the ground fault has not been cleared when control voltage is restored, the relay will trip and the red TRIP LED will light after 500 milliseconds, regardless of the time delay set on the Trip Delay DIPswitches, and the above cycle will be repeated.

If the ground fault has been cleared when control voltage is restored, the relay will remain reset.

The Pulsed Trip Auto Reset mode can be used when the application calls for Auto Reset.

The Pulsed Trip Auto Reset mode is designed for applications where the output relay is operating a shunt trip device. The D64RPB100 resets automatically 3 seconds after the ground fault current is interrupted by the tripping action of the circuit breaker. The output contact to the shunt trip coil opens. This prevents damage to the internal mechanism of the circuit breaker in the event that the operator tries to reset the circuit breaker. When the control voltage to the D64RPB100 is interrupted by action of the shunt trip, the D64RPB100 resets with a short delay.

External Current Transformer:

A Current Transformer with the two secondary terminals of the external CT connected to terminals T1 and T2 of the D64RPB100.

External current transformers (CTs) are required on applications where:

- The ground fault trip current setting levels must be 30 mA – 9 Amps, plus any of the following:
- The size of the power conductors on which the D64RPB100 is being applied is too large for the 1.81” built-in CT.
- The system voltage on which the D64RPB100 is being applied is higher than 660 Volts.
- The system primary phase current on which the D64RPB100 is being applied exceeds 200 Amps continuous.

Any Eaton’s Cutler-Hammer C311CT with 500:1 ratio may be used when the above requirements dictate the use of an external CT. The ground fault trip current setting range of 30 mA – 9 Amps is the same. The maximum continuous primary phase current is to be 1000 Amps.

Interposing Current Transformer

A Current Transformer with the 5 Amp secondary of the CT passing through the window of the built-in CT of the D64RPB100.

Interposing current transformers (CTs) are required on applications where:

- The ground fault trip current setting levels are higher than the 30 mA –9 Amp range available with the built-in 1.81" CT, plus any of the following.
- The size of the power conductors on which the D64RPB100 is being applied is too large for the 1.81" built-in CT.
- The system voltage on which the D64RPB100 is being applied is higher than 660 Volts.
- The system primary phase current on which the D64RPB100 is being applied exceeds 200 Amps continuous.

An Interposing CT with 500:5 ratio is to be used to give a ground fault trip current setting range of 3 – 900 Amps. The maximum continuous primary phase current is to be 1000 Amps

An Interposing CT with 5000:5 ratio is to be used to give a ground fault trip current setting range of 30 – 9000 Amps. The maximum continuous primary phase current is to be 10,000 Amps

Chassis Ground

Chassis ground is the ground to which all of the non-current carrying metal equipment is connected/bonded. Typically, equipment grounding is provided by means of a ground bus. A solid connection is to be made from terminal 3 of the D64RPB100 to the nearest chassis ground to ensure the relay complies with the specified Electromagnetic Compatibility (EMC) standards.

2.2 DIPSWITCH SETTINGS

FOR MAXIMUM SAFETY THE SETTINGS DESCRIBED IN THIS SECTION SHOULD BE MADE WITH CONTROL VOLTAGE REMOVED FROM THE D64RPB100 RELAY.

The DIPswitches are mounted inside of the relay and are accessible through the front cover. It is recommended that all of the DIPswitches be set at one time.

Should it be necessary to make changes to the DIPswitch settings when the D64RPB100 relay is energized, this can be done without having any adverse effect on the performance of the relay.

Please Refer to Table 1. This provides a list of the 10 DIPswitches, the function of each group, and the values related to each setting. This table is reproduced on the side of each D64RPB100 in the form of a self-adhesive label.

The DIPswitches are numbered from 1 to 10, left to right. U = Up, D = Down.

A DIPswitch setting chart on the front cover provides blank boxes for each DIPswitch. After setting the DIPswitches, use a permanent marker to check the corresponding boxes on the chart.

2.2.1 CT CONFIGURATION – DIPSWITCH NO. 1

The D64RPB100 is capable of measuring ground fault currents from 10 mA – 10000 Amps with trip level settings in three ranges:

30 mA – 9.0 Amps with the system power conductors passing through the built-in 1.81" CT.

30 mA – 9.0 Amps with the system power conductors passing through an external C311CT with a windings ratio of 500:1with its secondary terminals connected to terminals T1 & T2.

3.0 – 900 Amps by passing the 5 Amp secondary of an interposing CT with a windings ratio of 500:5 through the built-in 1.81" CT.

30 – 9000 Amps by passing the 5 Amp secondary of an interposing CT with a windings ratio of 5000:5 through the built-in 1.81" CT.

Determine which of the four configurations is to be used for the application. Referring to table 1 set DIPswitch No. 1 to match the selected configuration:

- **D**own for 30 mA – 9.0 Amps with the system power conductors passing through the built-in 1.81" CT
- **D**own for 30 mA – 9.0 Amps with the system power conductors passing through an external C311CT with a windings ratio of 500:1with its secondary terminals connected to terminals T1 & T2.
- **U**p for 3.0 – 900 Amps passing the 5 Amp secondary of an interposing CT with a windings ratio of 500:5 through the built-in 1.81" CT.
- **D**own for 30 – 9000 Amps passing the 5 Amp secondary of an interposing CT with a windings ratio of 5000:5 through the built-in 1.81" CT. (The values displayed on the D64D1 Digital Display Unit, if installed, will read 0.03 – 9.0 kA)

2.2.2 GROUND FAULT TRIP CURRENT LEVEL - DIPSWITCHES 2, 3, 4, & 5

The ground fault TRIP LEVEL is 30 mA - 9000 Amps in three ranges. Table 1 provides a listing of the fourteen TRIP LEVEL settings in each of three ranges, which can be made on DIPswitches 2, 3, 4, & 5, depending on the CT configuration selected in 2.2.1.

As indicated in the General Description, it is recommended that the ground fault TRIP LEVEL setting be kept as close to the charging current as possible. This will provide maximum safety for operating personnel and equipment protection. On resistance grounded systems, the TRIP LEVEL setting should be set lower than 20% of the Neutral Grounding Resistor let-through current.

If the measured ground fault current exceeds the TRIP LEVEL setting, the output relay changes state after the pre-selected TRIP DELAY time.

2.2.3 GROUND FAULT TRIP DELAY TIME - DIPSWITCHES 6, 7, & 8

The ground fault TRIP DELAY time range is 20 milliseconds - 5.0 second. Table 1 provides a listing of the eight TRIP DELAY settings, which can be made with DIPswitches 6, 7, & 8.

The TRIP DELAY time begins when the ground fault trip level setting is reached or is exceeded.

Set the ground fault TRIP DELAY time to provide the desired delay before the output relay changes state when the ground fault TRIP LEVEL setting is reached or exceeded.

The setting should be selected to co-ordinate with other ground-fault devices connected on the same transformer secondary: set shorter than upstream devices; set longer than downstream devices. If no other ground-fault devices are connected, set for the shortest time.

2.2.4 OUTPUT RELAY OPERATING MODE - DIPSWITCHES 9 & 10

Referring to the Glossary of Terms, determine if FAILSAFE, NON-FAILSAFE, or PULSED AUTO RESET operation of the output relay is required. The factory setting is NON-FAILSAFE with DIPswitches 9 & 10 in the **D**own position.

Refer to Table 1 for DIPswitch settings for FAILSAFE and PULSED AUTO RESET operation.

2.3 OUTPUT RELAY CONTACT STATE

The output relay contact state is determined by the operating mode selected and the sensing condition of the D64RPB100 relay. This is shown in Table 2. Use this table when deciding on field connections. Refer to the CONNECTION section.

2.4 INDICATION

There are two LED's on the front of the D64RPB100.

Green RUN LED	Flashing:	Okay
	Off:	No control voltage or D64RPB100 defective
	Steady on:	Control voltage too low or D64RPB100 defective
Red TRIP LED	Off:	No trip
	Steady on:	Trip

2.5 RESET

The D64RPB100 has a built in momentary RESET button and two terminals, R1 & R2, for a remote N.O. TEST/RESET button. After a trip, the electronics remain in the tripped state until the ground fault has been cleared and the RESET button has been pressed, or the control voltage is removed from terminals 1 & 2.

It is **NOT** necessary to press the RESET button after the ground fault has been cleared when the D64RPB100 is set in the Pulsed Auto Reset mode. In this mode the relay will reset in 3 seconds.

2.6 GROUND FAULT TEST

Double clicking the RESET button on the front of the relay or double clicking the remote TEST/RESET button connected to terminals R1 & R2 invokes a relay test. A simulated current equal to the trip current set on the Trip Level DIPswitches replaces the measured current. After the trip delay time set on the Trip Delay DIPswitches has elapsed, the unit should trip. This procedure tests the functionality of the unit. Up to the time of trip the test can be cancelled by pressing RESET. The trip current and, therefore, the set point can be read at the D64D1 display, if connected to the D64RPB100.

A "Test Record Form" is included in this instruction manual. This form provides spaces to record the date the test was performed and the results. Those in charge of the building's electrical installation should retain the form in order to be available to the authority having jurisdiction.

3. INSTALLATION INSTRUCTIONS

Place the D64RPB100 in a clean dry enclosure. Try to keep the exposure to mechanical shock and vibration to a minimum, even though the internal electronics have been encapsulated in epoxy to improve the performance in high vibration environments.

Locate the relay close to the isolating device (circuit breaker or contactor) that is protecting the circuit being monitored. If using an external or interposing CT keep the distance between the relay & CT as short as possible.

Provide maximum clearance between the D64RPB100 (and the external or interposing CT if being used) and any strong magnetic flux producing devices such as power transformers, autotransformers, control transformers, reactors, and high power conductors and buswork.

CAUTION: For reliable ground fault detection by the D64RPB100 use one CT configuration only: Built-in CT; External CT; or, Interposing CT. (i.e. do not pass power conductors through the built-in CT when using an external CT or an interposing CT.)

3.1 MOUNTING

Refer to Figure 4 for mounting dimensions of the D64RPB100 relay. It is designed to be mounted with either mounting screws or 35 mm DIN rail.

Two #8-32 x 3/4" (M4 x 20) mounting screws are required for screw mounting.

For DIN rail mounting the rail should be bolted to a flat surface. Install the DIN rail horizontally. Allow at least ¾" (20 mm) of rail to extend beyond each end of the relay.

Secure the relay to the DIN rail ensuring the white release latch at the bottom of the relay engages the rail. If the relay is to be mounted in any other position take appropriate steps to prevent the relay from becoming disengaged from the DIN rail.

3.2 BUILT-IN CURRENT TRANSFORMER

The D64RPB100 has a built-in current transformer (CT) with 1.81" (46 mm) opening. Conductors must be insulated for the system voltage when it is higher than 660 Volts.

Refer to Figure 1. Pass the phase conductors through the CT window. If the neutral conductor is carrying single phase current, it is to be passed through the window. Do not pass ground conductors through the CT window. In applications that require shielded wires to pass through the CT window, return the shields through the CT window before connecting them to ground.

Verify that the polarity of the conductors is correct when they pass through the CT. Verify that ground paths do not exist that would bypass the CT.

The D64RPB100 Trip Level range is 30 mA to 9.0 Amps when using the built-in CT. The maximum continuous primary phase current is to be 200 Amps.

3.3 EXTERNAL CURRENT TRANSFORMER

Refer to the Glossary of Terms to determine if an external Current Transformer is required for the application.

The D64RPB100 will work with Eaton's Cutler-Hammer C311CT current transformers having a turns ratio of 500:1. These are epoxy molded to give exceptional mechanical properties and have high-grade silicon iron cores for excellent coupling characteristics.

Refer to section 5 to select the catalog number of the C311CT current transformer with the opening required for the application.

Phase conductors must be insulated for the system voltage when it is higher than 660 Volts.

Refer to Figure 2. Pass the phase conductors through the CT window. If the neutral conductor is being connected downstream, it is to be passed through the window. Do not pass ground conductors through the CT window. In applications that require shielded wires to pass through the CT window, return the shields through the CT window before connecting them to ground.

Verify that the polarity of the conductors is correct when they pass through the CT. Verify that ground paths do not exist that would bypass the CT.

Position power cables in the center of the current transformer opening. Keep cables and buswork clear of the split on split core current transformers.

The two secondary terminals of the external CT are to be connected to terminals T1 and T2 of the D64RPB100.

3.4 INTERPOSING CURRENT TRANSFORMER

Refer to the Glossary of Terms to determine if an interposing Current Transformer is required for the application.

The D64RPB100 will work with any commercially available 500:5 or 5000:5 ratio CT.

Phase conductors must be insulated for the system voltage when it is higher than 660 Volts.

Refer to Figure 3. Pass the phase conductors through the CT window. If the neutral conductor is being connected downstream, it is to be passed through the window. Do not pass ground conductors through the CT window. In applications that require shielded wires to pass through the CT window, return the shields through the CT window before connecting them to ground.

Verify that the polarity of the conductors is correct when they pass through the CT. Verify that ground paths do not exist that would bypass the CT.

Position power cables in the center of the current transformer opening. Keep cables and buswork clear of the split on split core current transformers.

The 5 Amp secondary lead from the interposing CT is to pass through the window of the built-in CT of the D64RPB100.

3.5 CONNECTIONS

All connections to the D64RPB100 are by means of screw clamp terminals rated 10 Amps, 300 Volts. Terminals will accept #26-12 AWG solid or stranded conductors.

The terminals are pull apart. A screw mounted locking block is located at the left end of the 7 point terminal block for maximum security.

Connect ac or dc control power to terminals 1 and 2.

In order to meet the Electromagnetic Compatibility (EMC) requirements a chassis bond is required between terminal 3 and the nearest ground point. This distance should be kept to an absolute minimum. If the D64RPB100 is mounted on 35 mm DIN rail a DIN rail mounted ground terminal block can be installed beside the relay to act as the chassis ground point. Use a minimum 14 AWG stranded conductor.

Refer to Figures 1, 2, and 3 and Table 2. Decide on the connection of field devices to control voltage and output relay contact terminals by comparing the desired control of the field devices under various operating conditions.

Figure 1 shows a typical connection of an ac motor starter coil (1M) to the N.C. contacts of the output relay (terminals 11 and 12). Comparing the output relay contact states, it can be seen that this could be used with the NON-FAILSAFE operating mode. The N.C. contact, terminals 11 & 12, would be used for the starter coil circuit. The N.O. contact, terminals13 and 14, control the remote red TRIP light. Note the remote TEST/RESET pushbutton.

Figure 2 shows the D64RPB100 using an external current transformer (C311CT 500:1 ratio) and a typical connection of a circuit breaker with a shunt trip coil (ST). With the 500:1 ratio CT, the trip level range of the D64RPB100 remains at 30 mA – 9 Amps. (Pulsed Trip Auto Reset operating mode has been selected on DIPswitches 9 and 10). Comparing the operating mode and the relay contact states in Table 2, it can be seen that the N.O. contact, terminals 13 and 14, would be used for the shunt trip coil. The D64RPB100 will reset automatically as soon as the ground fault current is interrupted by the tripping action of the circuit breaker.

Connect the secondary leads of the external C311CT current transformer to terminals T1 & T2 of the D64RPB100, using 14 AWG (minimum). Twist the leads to optimize electromagnetic immunity.

Please note that terminal T2/R2 is internally connected to terminal 3 of the D64RPB100. Since terminal 3 must be grounded, it means that the C311CT secondary circuit will be grounded automatically. If separate grounding is required by electrical regulations, the C311CT terminal connected to T2 should be connected to the same grounding point as terminal 3 of the D64RPB100. This will avoid ground loops and nuisance tripping.

Figure 3 shows the D64RPB100 using an interposing current transformer (500:5 ratio) and a typical connection of a circuit breaker with a shunt trip coil (ST). With the 500:5 ratio CT, the trip level range of the D64RPB100 is now 3 – 900 Amps. (Pulsed Trip Auto Reset operating mode has been selected on DIPswitches 9 and 10). Comparing the operating mode and the relay contact states in Table 2, it can be seen that the N.O. contact, terminals 13 and 14, would be used for the shunt trip coil. The D64RPB100 will reset automatically as soon as the ground fault current is interrupted by the tripping action of the circuit breaker.

The 5 Amp secondary lead from the interposing CT is to pass through the window of the built-in CT of the D64RPB100. Twist the leads to optimize electromagnetic immunity.

Either side of the secondary circuit on the interposing CT may be grounded where required by electrical regulations. This ground connection should be made to the same grounding point as terminal 3 of the D64RPB100. This will avoid ground loops and nuisance tripping.

3.5.1 CONNECTING MORE THAN ONE D64RPB100 TO REMOTE TEST/RESET

Up to 25 D64RPB100 relays in the same enclosure may share a common remote Test/Reset button. Connect one terminal of the button to terminal T2/R2 of **one** of the units, and connect the other terminal of the button to terminals R1 of **all** the units in parallel.

4. COMMUNICATIONS AND OPTIONAL EXTERNAL DISPLAYS/INDICATOR UNITS

The D64RPB100 has a communication port. This may be used for connection to the D64D1 remote display, the D64D2 Remote Indicator Unit, or for other options such as a computer interface or a custom communications module. This is a modular 4 pole RJ-10 connector carrying 7.5 Volts dc supply voltage, 2 data signals, and common. The supply voltage is short circuit protected. The maximum cable length is 30 feet (10m).

4.1 D64D1 DIGITAL DISPLAY UNIT

The D64D1 Digital Display Unit is connected to the D64RPB100 by up to 30 feet/10m of low cost 4-wire telephone type cable. It provides the following remote indications and functions:

- Continuous reading of actual ground fault current, employing auto ranging.
- Display of the pre-trip ground fault current, after a trip has occurred (flashing display).
- Display of the trip current setting, after a Test Trip has been activated.

Green RUN LED	Flashing:	Okay
	Off:	No control voltage, control voltage too low, or D64RPB100 defective
	Steady on:	Control voltage too low or D64RPB100 defective
Red TRIP LED	Off:	No trip
	Steady on:	Trip

RESET: To reset relay and LED after a trip.

TEST: (See 2.6 Ground Fault Test for a description of the test procedure).

The RESET button must be held pressed before the TEST is pressed to invoke the test procedure. The function of this button can be enabled/disabled by inserting the interconnecting cable from the D64RPB100 relay into one of two sockets, TEST ON or TEST OFF, on the right side of the display. If the feature is disabled and the RESET and TEST buttons are pressed, the display shows ‘OFF’ for 1 second, and the red ‘G/F TRIP’ LED on the display flashes twice.

VERIFY: By pushing the VERIFY button on the Remote Display the D64D1 will show if the D64RPB100 to which it is connected tripped due to a ground fault prior to loss of its control voltage by lighting the red TRIP LED. If there was no ground fault trip prior to loss of control voltage the green RUN LED will light. This feature is especially useful when pulse tripping a breaker that also supplies control voltage to the D64RPB100. This indication will remain available for at least ten hours. The D64D1 will reset automatically when control voltage is restored.

The Numerical LCD window displays actual ground fault current in Amps. When a 5000:5 ratio interposing CT is used, all displayed values are to be interpreted as kAmps rather than Amps.

2 blank boxes to the right of the LCD display window are marked “A” and “kA”. Use a permanent marker to check the appropriate box as follows:

“A” – when using the built-in CT, a 500:1 ratio C311CT external CT, or a 500:5 ratio interposing CT

“kA” – when using a 5000:5 ratio interposing CT

A current exceeding the maximum range of the system displays as ‘OUt’. (This means the measured ground fault current is higher than the measuring range of the D64RPB100.)

Refer to Figure 5 for dimensions, door cutout and mounting provision. A bracket and two #10-24 (M5) bolts are supplied with each D64D1.

4.2 D64D2 REMOTE INDICATOR UNIT

The D64D2 Remote Indicator Unit is connected to the D64RPB100 by up to 30 feet/10m of low cost 4-wire telephone type cable. It provides the following remote indications and functions:

Green RUN LED	Flashing:	Okay
	Off:	No control voltage, control voltage too low, or D64RPB100 defective
	Steady on:	Control voltage too low or D64RPB100 defective
Red TRIP LED	Off:	No trip
	Steady on:	Trip

RESET: To reset relay and LED after a trip.

TEST: (See 2.6 Ground Fault Test for a description of the test procedure).

The RESET button must be held pressed before the TEST is pressed to invoke the test procedure. The function of this button can be enabled/disabled by inserting the interconnecting cable from the D64RPB100 relay into one of two sockets, TEST ON or TEST OFF, on the right side of the display. If the feature is disabled and the RESET and TEST buttons are pressed, the test will not take place and the red ‘G/F TRIP’ LED on the display flashes twice.

VERIFY: By pushing the VERIFY button on the Remote Display the D64D2 will show if the D64RPB100 to which it is connected tripped due to a ground fault prior to loss of its control voltage by lighting the red TRIP LED. If there was no ground fault trip prior to loss of control voltage the green RUN LED will light. This feature is especially useful when pulse tripping a breaker that also supplies control voltage to the D64RPB100. This indication will remain available for at least ten hours. The D64D2 will reset automatically when control voltage is restored.

5. CATALOG NUMBERS

D64RPB100	Series B1 Ground Fault Relay with built-in 1.81” (46mm) CT, 24 - 240 Volt ac or dc control voltage, for use on 660 Volts maximum, 50/60 Hz power system. Terminal blocks for external CT and remote Test/Reset pushbutton
D64D1	Digital Display Unit with LCD display and 1 meter interconnecting cable, for use with D64RPB100
D64D2	Remote Indicator Unit with1 meter interconnecting cable, for use with D64RPB100

Zero Sequence Current Transformers with 500:1 ratio:

C311CT1	1.81" (46 mm) inside diameter, Toroidal
C311CT2	3.54" (90 mm) inside diameter, Toroidal
C311CT3	5.9" x 6.7" (150 x 170 mm) rectangular, Split Core
C311CT4	3.94" x 13.78" (100 x 350 mm) rectangular, Split Core
C311CT5	5.7" (145 mm) inside diameter, Toroidal
C311CT6	9.45" (240 mm) inside diameter, Toroidal
C311CT7	11.8" x 11.8" (300 x 300 mm) square, Split core
C311CT8	1.1" (28 mm) inside diameter, Toroidal
C311CT9	2.56" (65 mm) inside diameter, Toroidal
C311CT28	1.1" (28 mm) inside diameter, Toroidal – with wire leads

For mounting dimensions and additional information on C311CT current transformers refer to the current Eaton's Cutler-Hammer catalog.

6. TECHNICAL SPECIFICATION

Control Voltage..... 24 – 240 Volts ac or dc
0.6 VA @ 24 Vac
0.8 VA @ 120 Vac
1.1 VA @ 240 Vac
0.5 Watts @ dc Voltages

- Operating voltage tolerance..... 80% to 110% of rated voltage 24 -32 V ac
  55% to 110% of rated voltage 32 – 240 V ac
  80% to 110% of rated voltage 24 – 240 V dc
- Isolation voltage..... 400V rms. 50-60 Hz 1min, 2.5 kV impulse
- Under voltage tolerance (no impaired operation):

DC voltage ≥ 38V:	withstands loss of supply up to 50 ms
DC voltage ≥ 80V:	withstands loss of supply up to 180 ms
DC voltage ≥ 138V:	withstands loss of supply up to 400 ms
AC voltage ≥ 38V:	withstands loss of supply up to 70 ms
AC voltage ≥ 80V:	withstands loss of supply up to 250 ms
AC voltage ≥ 138V:	withstands loss of supply up to 600 ms

- Power Up Time..... 500 milliseconds

Maximum System Voltage & Frequency.....660 Volts ac, 45 to 450 Hz

The D64RPB100 may be applied on higher voltage circuits providing the power conductors are insulated for the system voltage.

Output Relay:

Contacts: Maximum UL rating:
5 A @ 125 and 250 V ac, general use
5 A @ 30 V dc, resistive
1/6 hp, 125 and 250 V ac
3 A, 360 VA, @ 120 V ac, pilot duty
1.5 A, 360 VA, @ 240 V ac, pilot duty

EN 60947-5-1 rating:
5 A @ 250 Vac, Utilization category AC-12
4 A @ 250 Vac, Utilization category AC-13
3 A @ 250 Vac, Utilization category AC-14, AC15

(Continued on next page)

Output Relay (cont'd):

Contacts: EN 60947-5-1 rating: 5 A @ 30 Vdc, Utilization category DC-12
3 A @ 24 Vdc, Utilization category DC-13

Maximum fusing under EN 60947-5-1: ..... 13 A

Isolation voltage ..... 3 kV rms, 50-60 Hz, 1 min.
Between open contacts ..... 1 kV rms, 50-60 Hz, 1 min.
Between contact sets ..... 2 kV rms, 50-60 Hz, 1 min.

Configuration ..... Voltage free form "Z" 1 N.O. and 1 N.C. (4 terminals)

Operating Mode (Selected on DIPswitches 9 & 10) ..... Non-Failsafe

Failsafe

Pulsed Auto Reset

Functional Test:

A simulated current equal to the trip current set on the Trip Level DIPswitches replaces the measured current. This tests all internal electronics and secondary winding of the built-in current transformer. No external power supply or additional wiring is required.

Local Test ..... Double click RESET button on front of relay

Remote Test ..... Double click button connected to terminals R1 and R2
Or via D64D1 or D64D2

Reset ..... RESET button on front of relay

Remote Reset ..... Single push of button connected to terminals R1 and R2
Or via D64D1 or D64D2

Reset mode ..... Manual or Pulsed Auto Reset

Ground Fault Circuit:

Ground Fault Trip Time Delay ..... 20 milliseconds - 5.00 Seconds

Setting within Range ..... DIPswitches 6, 7, & 8 on front of relay

Ground Fault Trip Time Delay Accuracy:

Trip Current Level Set between 0.030 – 2.5 Amps (3 – 250 A, 0.030 – 2.5 kA)

Trip delay setpoint	@ 1.2 x Ground Fault setpoint	@ 2 x Ground Fault setpoint	@ 4 x Ground Fault setpoint	@ ≥6 x Ground Fault setpoint
20 ms	57 – 90 ms	34 – 53 ms	23 – 40 ms	17 – 34 ms
50 ms	87 – 120 ms	64 – 83 ms	53 – 70 ms	47 – 64 ms
100 ms	137 – 170 ms	114 – 133 ms	103 – 120 ms	97 – 114 ms
200 ms	237 – 270 ms	214 – 233 ms	203 – 220 ms	197 – 214 ms
500 ms	531 – 581 ms	507 – 544 ms	497 – 531 ms	491 – 525 ms
1.0 s	1031 – 1081 ms	1007 – 1044 ms	997 – 1031 ms	991 – 1025 ms
2.0 s	2031 – 2081 ms	2007 – 2044 ms	1997 – 2031 ms	1991 – 2025 ms
5.0 s	4890 – 5081 ms	4867 – 5044 ms	4856 – 5031 ms	4850 – 5025 ms

Ground Fault Trip Time Delay Accuracy (cont'd):

Trip Current Level set at 4 Amps (400 A, 4 kA)

Trip delay setpoint	@ 1.2 x Ground Fault setpoint	@ 2 x Ground Fault setpoint	@ ≥3.7 x Ground Fault setpoint
20 ms	57 – 90 ms	34 – 53 ms	20 – 37 ms
50 ms	87 – 120 ms	64 – 83 ms	50 – 67 ms
100 ms	137 – 170 ms	114 – 133 ms	100 – 117 ms
200 ms	237 – 270 ms	214 – 233 ms	200 – 217 ms
500 ms	531 – 581 ms	507 – 544 ms	494 – 528 ms
1.0 s	1031 – 1081 ms	1007 – 1044 ms	994 – 1028 ms
2.0 s	2031 – 2081 ms	2007 – 2044 ms	1994 – 2028 ms
5.0 s	4890 – 5081 ms	4867 – 5044 ms	4853 – 5028 ms

Trip Current Level set at 6 Amps (600 A, 6 kA)

Trip delay setpoint	@ 1.2 x Ground Fault setpoint	@ 2 x Ground Fault setpoint	@ ≥2.5 x Ground Fault setpoint
20 ms	57 – 90 ms	34 – 53 ms	24 – 46 ms
50 ms	87 – 120 ms	64 – 83 ms	54 – 76 ms
100 ms	137 – 170 ms	114 – 133 ms	104 – 126 ms
200 ms	237 – 270 ms	214 – 233 ms	204 – 226 ms
500 ms	531 – 581 ms	507 – 544 ms	498 – 537 ms
1.0 s	1031 – 1081 ms	1007 – 1044 ms	998 – 1037 ms
2.0 s	2031 – 2081 ms	2007 – 2044 ms	1998 – 2037 ms
5.0 s	4890 – 5081 ms	4867 – 5044 ms	4857 – 5037 ms

Trip Current Level set at 9 Amps (900 A, 9 kA)

Trip delay setpoint	@ 1.2 x Ground Fault setpoint	@ 1.7 x Ground Fault setpoint
20 ms	57 – 90 ms	33 – 55 ms
50 ms	87 – 120 ms	63 – 85 ms
100 ms	137 – 170 ms	113 – 135 ms
200 ms	237 – 270 ms	213 – 235 ms
500 ms	531 – 581 ms	507 – 546 ms
1.0 s	1031 – 1081 ms	1007 – 1046 ms
2.0 s	2031 – 2081 ms	2007 – 2046 ms
5.0 s	4890 – 5081 ms	4866 – 5046 ms

Ground Fault Trip Current Level 30 mA - 9000 Amps in three ranges

Sensing Ranges Vs Trip Current Level Settings:

10 mA – 10 Amp with built-in CT ..... 30 mA – 9 Amp

10 mA – 10 Amp with 500:1 external CT on terminals T1 & T2 ..... 30 mA – 9 Amp

1 - 1000 Amp with 500:5 interposing CT .....3 – 900 Amp

10 - 10000 Amp with 5000:5 interposing CT .....30 – 9000 Amp

Selection of each Range .....DIPswitch 1 on front of relay and interposing CT

Setting within each Range..... DIPswitches 2, 3, 4, & 5 on front of relay

Trip Current Accuracy .....+0%, -15% of trip setting

Note: The accuracy of the trip point refers to the value of the real world current (assuming a purely sinusoidal wave shape) that just causes a trip, with respect to the specified value in the table.

Frequency Response Range .....45 - 450 Hz

Thermal Characteristics:

Short Time Withstand:

1000A .....1 second

2000A .....0.1 second

Environment:

Operating Temperature.....-20°C to +50°C

Storage.....-40°C to +80°C

Humidity .....85% (No Condensation)

Shock resistance..... 10G (no malfunction)

Vibration resistance..... 10G, 10-55 Hz at 1.5 mm double amplitude (no malfunction)

Ingress protection.....IP20

Dimensions (refer to Figure 4):

Height..... 2.76" (70 mm)

Width..... 3.94" (100 mm)

Depth (not including terminal blocks)..... 4.02" (102 mm)

Depth (including terminal blocks)..... 4.85" (123 mm)

Mounting (refer to Figure 4):

DIN rail .....35 mm

Two Screw.....#8 x 3/4" (M4 x 20 mm)

Weight:

Open..... 1.88 lbs. (0.85 kg)

Packaged ..... 2.43 lbs. (1.10 kg)

Applicable Standards:

EN 61000-6-3	Electromagnetic compatibility (EMC) - Part 6-3 Generic standards– Emission standard for residential, commercial and light-industrial environments (note: = lowest levels): 30-230 MHz 30 dBµV at 10m distance 230-1000 MHz 37 dBµV at 10m distance
EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2 Generic standards– Immunity standard for industrial environments (note: = highest levels): 80-1000 MHz with 80% AM modulation up to 10 V/m at 3m distance from source
EN 61000-4-2	Electromagnetic compatibility (EMC) for industrial-process measurement and control equipment – Part 4-2: Electrostatic discharge (ESD) immunity
EN 61000-4-3	Electromagnetic compatibility (EMC) for industrial-process measurement and control equipment – Part 4-3: Radiated electromagnetic field immunity
EN 61000-4-4	Electromagnetic compatibility (EMC) for industrial-process measurement and control equipment – Part 4-4: Electrical fast transient/burst immunity
EN 61000-4-5	Electromagnetic compatibility (EMC) for industrial-process measurement and control equipment – Part 4-5: Surge immunity
EN 61000-4-6	Electromagnetic compatibility (EMC) for industrial-process measurement and control equipment – Part 4-6: Conducted radio frequency field immunity
EN 61000-4-11	Electromagnetic compatibility (EMC) for industrial-process measurement and control equipment – Part 4-11: Voltage dips/drops/variations immunity
EN 60947-5-1	Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices
IEC 60755	General requirements for residual current operated protective devices
UL	UL 1053 Ground-Fault Sensing and Relaying Equipment, Class 1
	UL File E195341
CSA	C22.2 No. 144-M91 Ground Fault Circuit Interrupters
	CSA File 700103
CE	CE mark – Declaration of Conformity

D64D1 Digital Display Unit and D64D2 Remote Indicator Unit:

Environment:

- Operating Temperature ..... -20°C to +50°C
- Storage ..... -40°C to +80°C
- Humidity ..... 85% (No Condensation)

Shock resistance ..... 10G (no malfunction)

Vibration resistance ..... 10G, 10-55 Hz at 1.5 mm double amplitude (no malfunction)

Ingress protection IP55

Dimensions (refer to Figure 5):

- Height ..... 3.74" (95 mm)
- Width ..... 3.19" (81 mm)
- Depth ..... 1.5" (38 mm)

Mounting (refer to Figure 5):

- Through the door, bracket and mounting screws supplied ..... #10-24 (M5)

Weight:

- Open ..... 0.4 lbs. (0.18 kg)
- Packaged ..... 0.95 lbs. (0.43 kg)

External Current Transformer (when required)

Use Eaton's Cutler-Hammer C311CT series with 500:1 ratio, listed in section 5 – Catalog Numbers.

Interposing Current Transformer (when required)

Ratio for 1 – 1000 Amp sensing range 500:5

Ratio for 10 – 10000 Amp sensing range 5000:5

Any commercial grade current transformer may be used.

TABLE 1 – DIPSWITCH SETTINGS

In the table below 'D' denotes down and 'U' denotes up.

Switch	Function	Set to	Meaning
1	CT configuration	D	No interposing CT, With 500:1External CT, or With 5000:5 interposing CT
		U	With 500:5 interposing CT
2 3 4 5	Ground fault trip current limit		W/O interp. CT / 500:5 / 5000:5
		D D D D	0.030 A / 3 A / 0.030 kA
		D D D U	0.040 A / 4 A / 0.040 kA
		D D U D	0.060 A / 6 A / 0.060 kA
		D D U U	0.090 A / 9 A / 0.090 kA
		D U D D	0.150 A / 15 A / 0.150 kA
		D U D U	0.250 A / 25 A / 0.250 kA
		D U U D	0.40 A / 40 A / 0.40 kA
		D U U U	0.60 A / 60 A / 0.60 kA
		U D D D	0.90 A / 90 A / 0.90 kA
		U D D U	1.50 A / 150 A / 1.50 kA
		U D U D	2.50 A / 250 A / 2.50 kA
		U D U U	4.00 A / 400 A / 4.00 kA
		U U D D	6.00 A / 600 A / 6.00 kA
		U U D U	9.00 A / 900 A / 9.00 kA
6 7 8	Ground fault trip time delay	D D D	20 ms
		D D U	50 ms
		D U D	100 ms
		D U U	200 ms
		U D D	500 ms
		U D U	1000 ms
		U U D	2000 ms
		U U U	5000 ms
9 10	Trip relay operation mode	D D	Non-failsafe, continuous operation
		D U	Failsafe, continuous operation
		U D	Pulsed Auto Reset operation (Pulse turns off 3 sec after G/F removed)

TABLE 2 – OUTPUT CONTACT STATES

STATE OF OUTPUT RELAY CONTACTS UNDER VARIOUS OPERATING CONDITIONS
WITH DIPSWITCHES 9 & 10 IN SELECTED POSITIONS

OPERATING CONDITIONS		NON-FAILSAFE 9-Down, 10-Down		FAILSAFE 9-Down, 10-Up		PULSED AUTO RESET 9-Up, 10-Down	
		13 14	11 12	13 14	11 12	13 14	11 12
1.CONTROL POWER OFF							
2.CONTROL POWER ON				 + 500 ms = 	 + 500 ms = 		
3.CONTROL POWER ON, FAULT CURRENT ABOVE TRIP SETTING & TRIP TIME							
4.CONTROL POWER ON, FAULT CLEARED	NO RESET REQUEST					 3 Sec Pulse 	 3 Sec Pulse 
	RESET REQUEST					Not Required	Not Required
5.CONTROL POWER OFF, FAULT STILL ON SYSTEM							
6.CONTROL POWER RESTORED, FAULT STILL ON SYSTEM		 + 500 ms = 	+ 500 ms =			+ 500 ms =	+ 500 ms =
7.CONTROL POWER RESTORED, FAULT CLEARED WHILE CONTROL POWER OFF, WITH OR WITHOUT RESET				+ 1 s =	+ 1 s =		

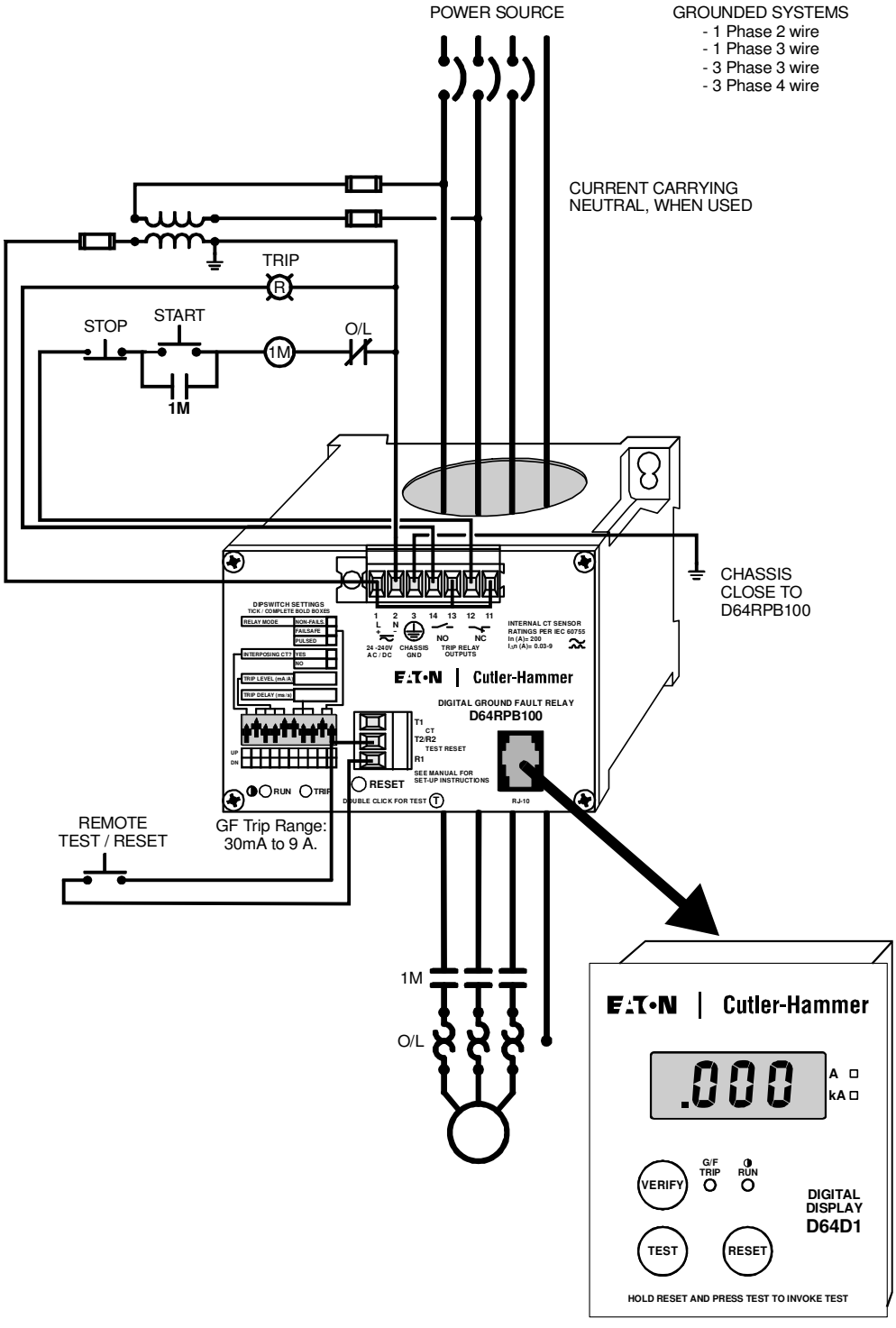


FIGURE 1 - TYPICAL FIELD CONNECTION USING BUILT IN CURRENT TRANSFORMER AND REMOTE TEST / RESET

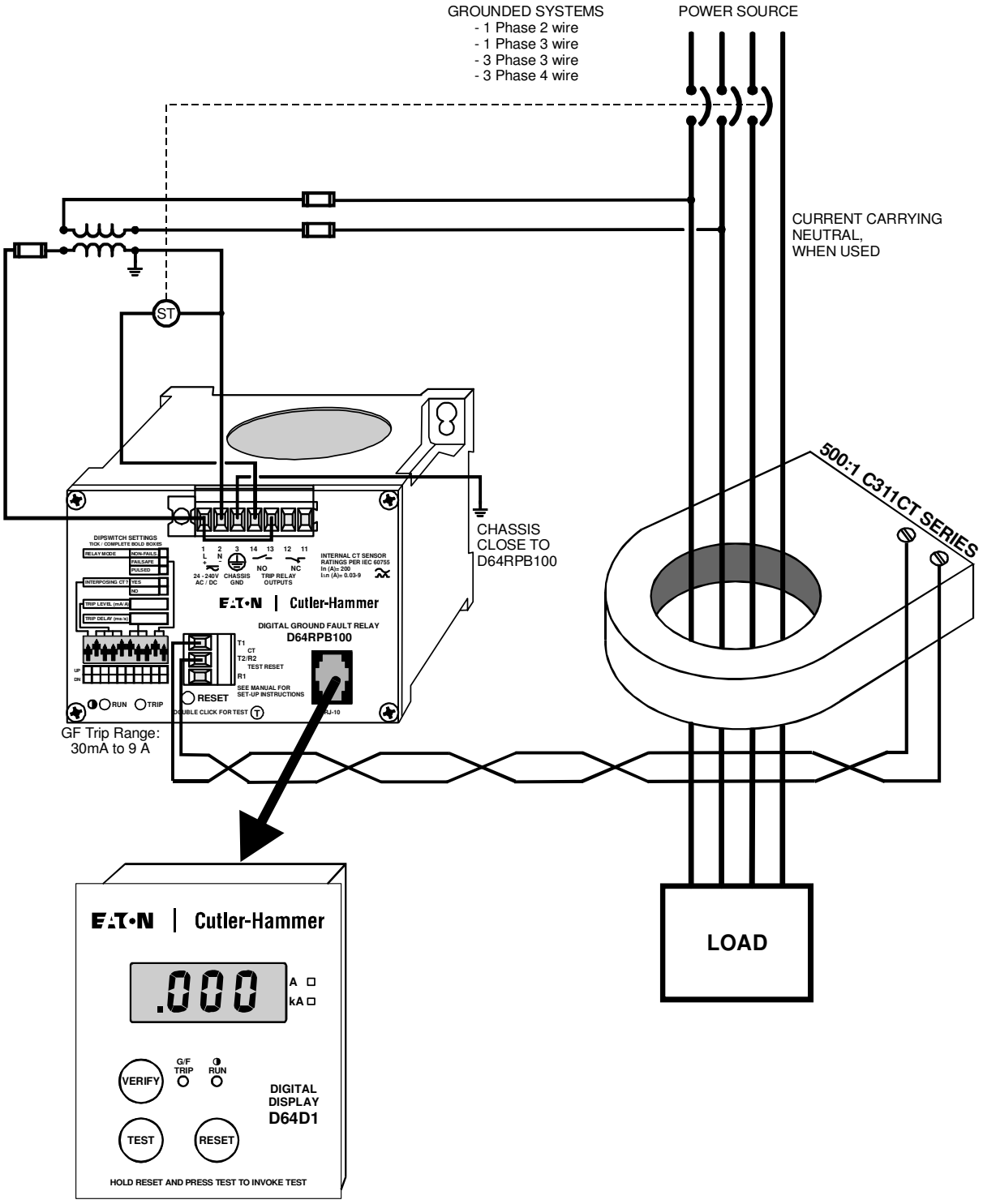


FIGURE 2 - TYPICAL FIELD CONNECTION WITH EXTERNAL 500:1 CURRENT TRANSFORMER (C311CT SERIES) PULSED TRIP-AUTO RESET FOR SHUNT TRIP BREAKER

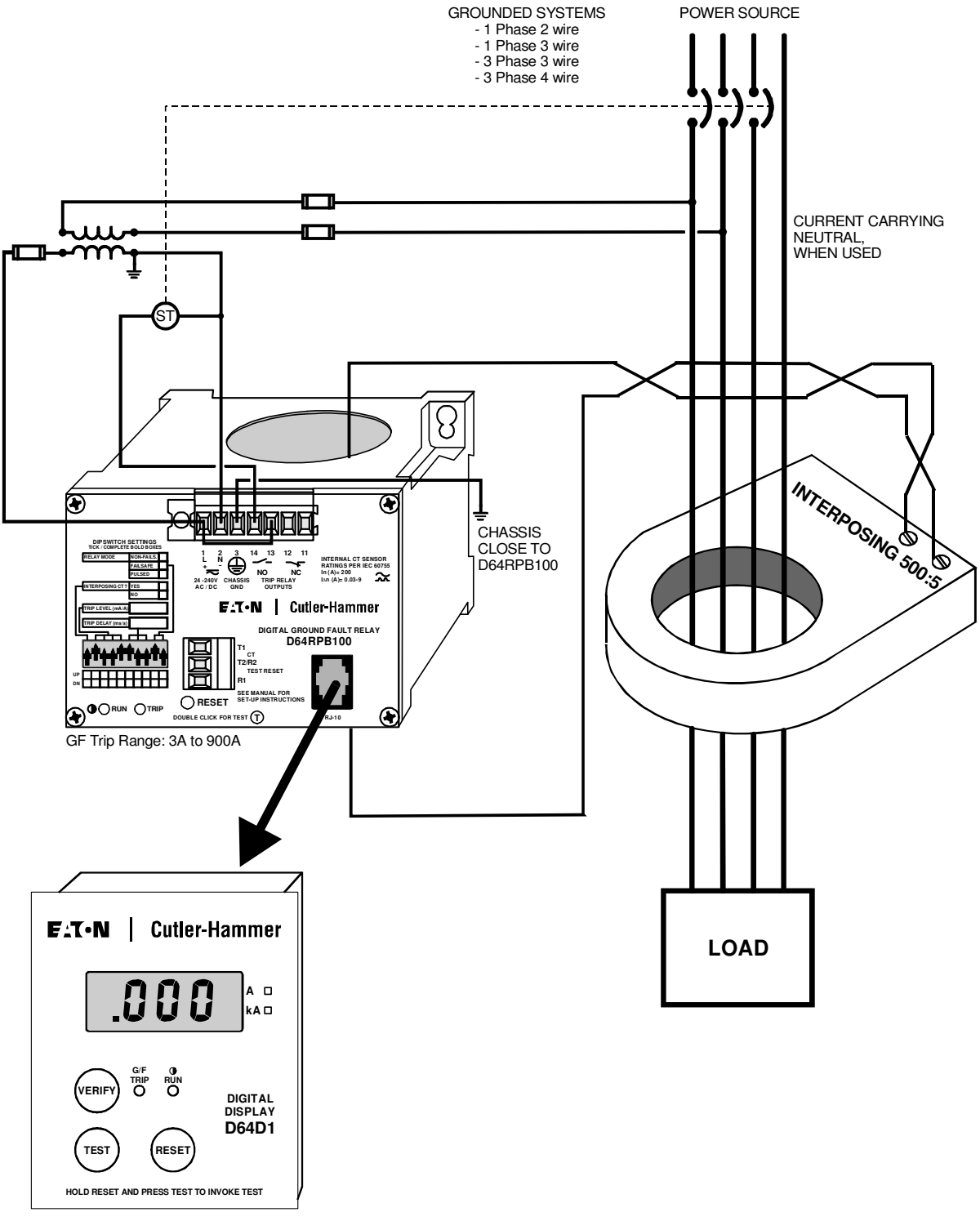
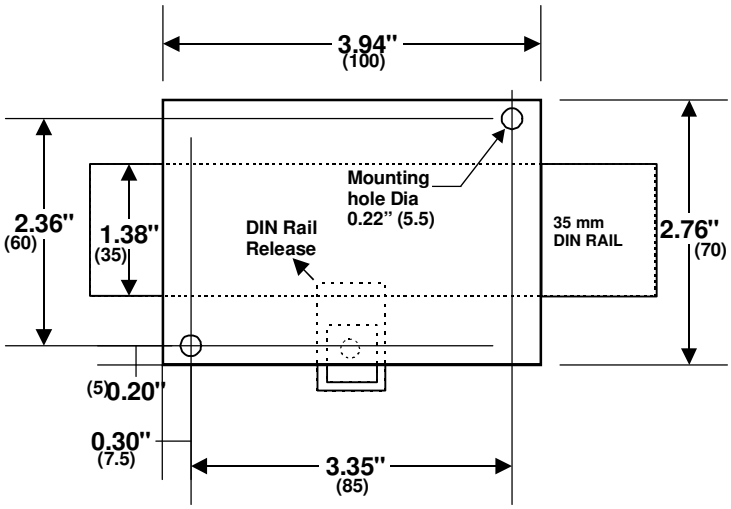
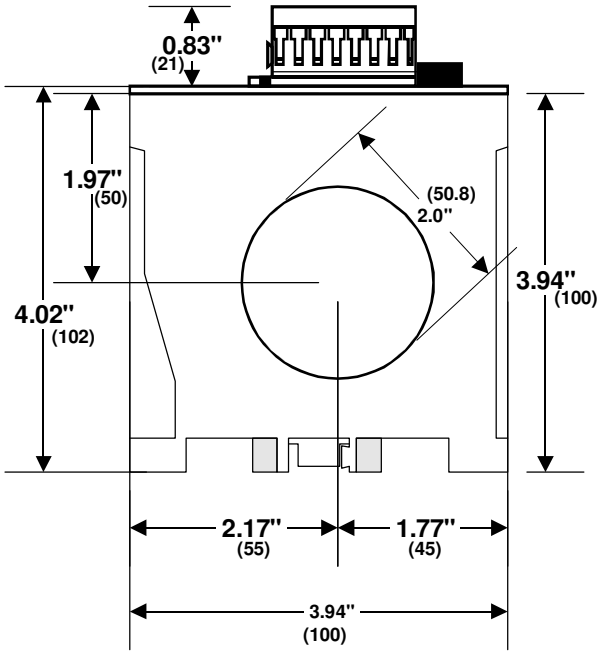


FIGURE 3 - TYPICAL FIELD CONNECTION WITH INTERPOSING 500:5 CURRENT TRANSFORMER. PULSED TRIP-AUTO RESET FOR SHUNT TRIP BREAKER

FIGURE 4 - DIMENSIONS AND WEIGHTS
D64RPB100



REAR PANEL MOUNTING
DIN RAIL OR 2 SCREW

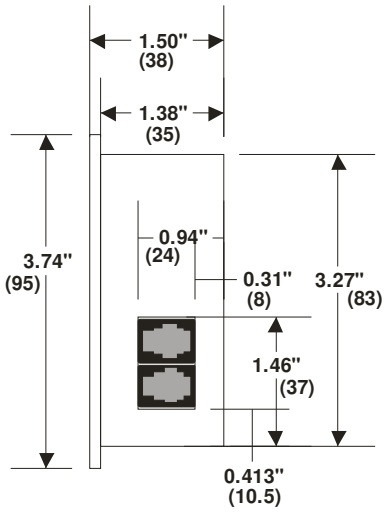


BOTTOM SIDE VIEW

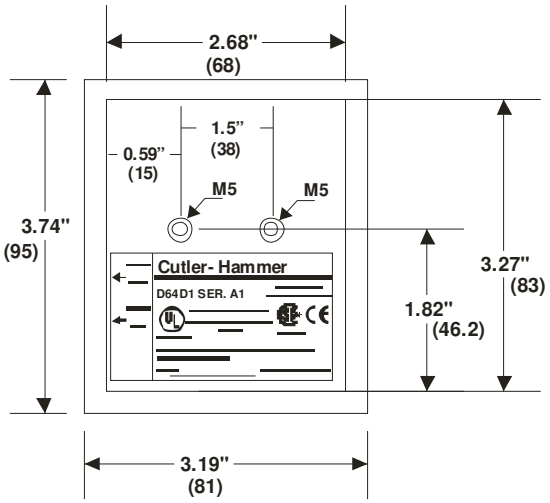
OPEN WEIGHT: 1.88 LBS. (.85KG)
PACKAGED WEIGHT: 2.43 LBS. (1.10 KG)

DIMENSIONS ARE IN INCHES (MM IN BRACKETS)

FIGURE 5- DIMENSIONS AND WEIGHTS D64D1 AND D64D2



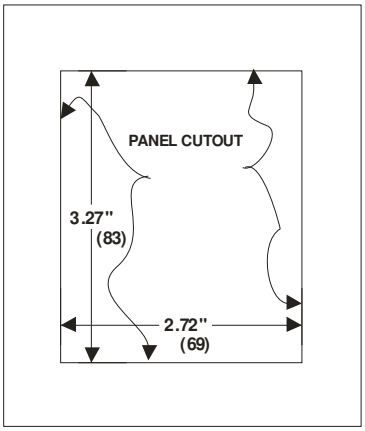
RIGHT SIDE VIEW



BOTTOM SIDE VIEW

A "U" SHAPED MOUNTING BRACKET AND 2#10-24 (M5) SCREWS ARE SUPPLIED WITH EACH D64D1 AND D64D2

A 1 METER LONG 4 CONDUCTOR MODULAR CABLE WITH 2 CLAMPED ON 4P4C PLUGS IS INCLUDED WITH EACH D64D1 AND D64D2



THROUGH-THE-PANEL MOUNTING

OPEN WEIGHT: 0.40 LBS. (0.18 KG)
PACKAGED WEIGHT: 0.95 LBS. (0.43 KG)

DIMENSIONS ARE IN INCHES (MM IN BRACKETS)

FORM 1 - TEST RECORD

GROUND FAULT TEST – D64RPB100

Double clicking the RESET button on the front of the relay invokes a relay test. A simulated current equal to the trip current set on the Trip Level DIPswitches replaces the measured current. After the trip delay time set on the Trip Delay DIPswitches has elapsed, the unit should trip and the red TRIP LED should light. This procedure tests the functionality of the unit. Up to the time of trip the test can be cancelled by pressing RESET.

After the trip, press the RESET button on the front of the D64RPB100 to reset the relay.

The D64D1 digital display unit or the D64D2 remote indicator unit can be used to test the D64RPB100 as follows:

The interconnecting cable from the D64RPB100 must be inserted in the TEST ON socket on the right side of the D64D1 display or the D64D2 unit.

Press and hold the RESET button before pressing the TEST button. This combination will invoke the test procedure from the D64R1 or the D64D2 unit. After the trip delay time set on the Trip Delay DIPswitches has elapsed, the D64RPB100 should trip and the red TRIP LED on the D64RPB100 and the red G/F TRIP LED on the D64D1 or the D64D2 unit should light.

Press the RESET button on the D64D1 or the D64D2 unit to reset the D64RPB100

This form provides spaces to record the date the test was performed and the results. Those in charge of the building's electrical installation should retain the form in order to be available to the authority having jurisdiction.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.