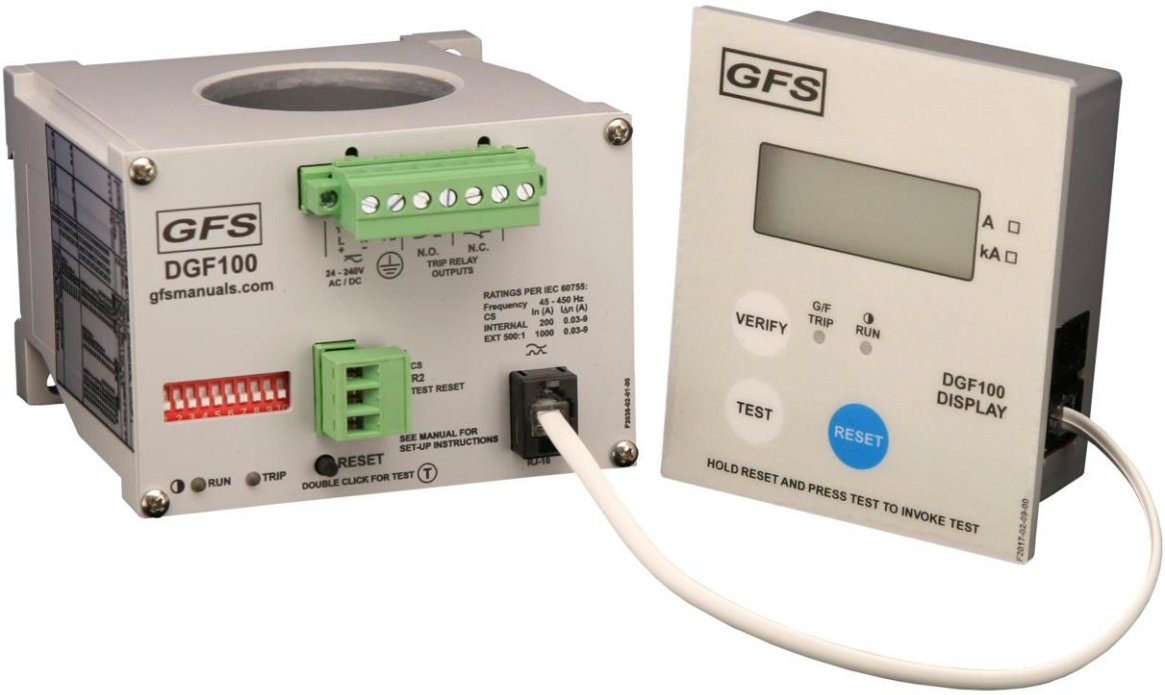
DGF100 Digital Ground Fault unit reference manual



Ground Fault Systems bv

Ground Fault Systems B.V.
Rigtersbleek-Aalten 4B15
7521 RB Enschede
The Netherlands

www.groundfaultsystems.com
info@groundfaultsystems.com
Tel: +31 53 4318628
CofC: 55400914

1. GENERAL DESCRIPTION

The DGF100 is a microprocessor based ground fault unit for use on solidly grounded or resistance grounded systems. This innovative digital electronic unit measures ground fault current using a built-in 46 mm zero sequence Current Sensor (CS), or an external Current Sensor. With Control Voltage on, when the measured value reaches or exceeds the setting for current, during the delay time, the unit trips. External Current Sensors with different cable windows, round or square and split core, and various current ratios are available.

The system will react to alternating current (AC) only and will reject direct current (DC) signals. Accuracy will be maintained over a frequency range of 45 - 450 Hz, making it suitable for variable frequency drive applications. The DGF100 is a Class A device as defined in the IEC 60755 standard; it is therefore fully characterized for operation with sinusoidal AC and pulsating DC currents.

The maximum system operating voltage for the DGF100 is 660 V, when passing the system power conductors through the built-in CS. However, by using any GFS external CS and insulating the busbars, or by using any suitably rated, commercially available, interposing CT and passing the secondary lead through the built-in CS, the relay can be used on any system voltage.

The DGF100 houses an isolated universal power supply from 24 - 240 V AC or DC and is equipped with form 'Z' (4 connections) isolated NO and NC contact sets to operate the upstream protection device and to indicate a failure of the system. The Ground Fault (G/ F) Current Trip level (30 mA – 9 A, 14 steps), Trip Delay Time (20 ms – 5 s, 8 steps) and the Relay Operating Mode (Continuous Non-Failsafe, continuous Failsafe, Pulsed Auto Reset and Pulsed Non-Failsafe) are set on a front accessible dipswitch array.

A single press of the 'RESET' button, or an external, voltage free, momentary pushbutton resets the relay after a trip. A functional test of the DGF100 is started by either double clicking the cover mounted or external button, or by invoking a test on the DGF100 Display.

A green 'RUN' LED flashes, alternating one second on and off, to indicate that sufficient Control Voltage is applied (Power OK).
A red 'TRIP' LED indicates that the DGF100 has sensed a Ground Fault and that the output contacts have operated.

7 point and 3 point pull-apart terminal blocks simplify connection of field wiring. A captive screw secures the 7 point block to the relay, safe from the effects of shock and vibration.

A communications port provides access for a remote display. The remote DGF100 Display shows the actual ground fault current during normal running of the systems. After a trip the ground fault current just prior to the trip is displayed. If the DGF100 Display was connected to the DGF100 at the moment of a trip and the DGF100's Control Voltage is turned off, pressing the 'VERIFY' button will show a red LED indicating a ground fault. If no fault was present the green LED will light.
For all features, see section 2.6 or the Instruction Manual for the DGF100 Display.

To ensure that the DGF100 will function in all circumstances, it is encapsulated in polyurethane (PUR) to make sure it is not vulnerable to mechanical shock, vibration nor weather.

2. FUNCTIONALITY

2.1 Dipswitch settings

FOR MAXIMUM SAFETY OF PERSONNEL AND EQUIPMENT, THE SETTINGS SHOULD BE MADE WITH THE SYSTEM POWER SWITCHED OFF.

Should it be necessary to make changes to the dipswitch settings when the DGF100 is energised, this can be done without having any adverse effect on the performance of the unit.

The DGF100 has dipswitches to set the desired Trip Current level, Trip Delay time, Relay Operating Mode and CS configuration. Below is a summary of the different options. See table 1 for the setting values.

2.1.1 CS configuration / Dipswitch 1

The DGF100 is capable of measuring primary ground fault currents from 10 mA - 10000 A with trip level settings in different ranges:

- 30 mA – 9,0 A with the system power conductors passing through the built-in 46 mm CS.
- 30 mA – 9,0 A with the system power conductors passing through an external CS with a current ratio of 500:1 with its secondary terminals connected to terminals T1 & T2.
- 60 mA – 18,0 A with the system power conductors passing through an external CS with a current ratio of 1000:1 with its secondary terminals connected to terminals T1 & T2.
- 120 mA – 36,0 A with the system power conductors passing through an external CS with a current ratio of 2000:1 with its secondary terminals connected to terminals T1 & T2.
- 600 mA – 180 A with the system power conductors passing through an external CS with a current ratio of 10.000:1 with its secondary terminals connected to terminals T1 & T2.
- 3,0 - 900 A by passing the 5 A secondary of an interposing CT with a current ratio of 500:5 through the built-in 46 mm CS.
- 30 - 9000 A by passing the 5 A secondary of an interposing CT with a current ratio of 5000:5 through the built-in 46 mm CS.

See Table 1 for the values and corresponding settings.

2.1.2 Ground Fault Trip Current level – dipswitches 2, 3, 4 & 5

The DGF100 has fourteen fixed trip points between 30 mA and 9A. The preferred trip point can be set with dipswitches 1 – 3. For values see table 1. The selected CS configuration from dipswitch 1 and the CS ratios influence these values. See table 2.

It is recommended that the Ground Fault Trip level is kept as close as possible to the charging current of the system the DGF100 is protecting. This will provide maximum safety for operating personnel and equipment.

On resistance grounded systems, the Trip Current level 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 unit will trip after the pre-selected Trip Delay.

2.1.3 Ground Fault Trip Delay Time – dipswitches 6, 7 & 8

The ground fault Trip Delay time range is 20 ms – 5,0 s. Table 1 provides a list of the eight Trip Delay time settings, which can be made with dipswitches 6, 7 and 8.

Set the Ground Fault Trip Delay time to provide the desired delay before the output relay changes state when the ground fault Trip Delay level is reached or exceeded.

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

2.1.4 Operating modes – dipswitches 9 & 10

The DGF100 user can select one of four distinct Operating Modes for the device.
All modes have in common:

- In the 'reset state' of the relay the NO[1] contact is open and the NC[1] contact is closed.
- In the 'tripped state' of the relay the NO contact is closed and the NC contact is open.

See Table 1 for the corresponding dipswitch settings.

The different modes are listed below:

1. Continuous Non-Failsafe, power-down-reset operation (used for Under Voltage devices)
   If during normal operation Control Voltage is removed, the output relay does not change state. When Control Voltage is restored, the relay remains untripped.
   If the unit is tripped when Control Voltage is removed, the unit will reset.
   If the fault is still present when Control Voltage is restored, the unit will trip after its power-up time.
2. Continuous Failsafe, power-on-reset operation (used for Under Voltage devices)
   If during normal operation Control Voltage is removed the relay goes to the tripped state unconditionally. When Control Voltage is restored and there is no fault present, the unit will reset after its power-up time.
   If there is a fault present when Control Voltage is removed or restored the unit stays tripped.
3. Auto Reset, Non-Failsafe (used for shunt trip devices)
   If during normal operation Control Voltage is removed, the output relay does not change state. When Control Voltage is restored, the relay remains untripped.
   The unit resets under one of the following conditions:
   - Three seconds after the fault current falls below Trip Level.
   - After a short delay after Control Voltage is removed.
   - Three second after a test has been performed.
   If the fault is still present when Control Voltage is restored, the unit will trip after its power-up time.
   Note: if wired as seen in figure 2 this operating mode is used as pulsed trip for the breaker. The pulsed trip prevents damage to the internal mechanism of the circuit breaker in the event that the operator tries to reset the circuit breaker while the trip contact is still closed.
4. Pulsed Non-failsafe Operation (used for shunt controlled breakers)
   When a trip occurs, the relay goes to the tripped state for 0,5 s, and then reverts back. Should the measured current remain above the set G/F trip level, then this pulse is repeated every 3 s. The red LED remains active (until one of the reset buttons is pressed or there is no fault present when Control Voltage is removed) enabling the user to verify which DGF100 tripped its associated breaker. If one forgets to reset the unit, then the functionality of the trip circuit is not impaired; in other words, in case of a trip condition the relay will correctly issue a pulse, even if the red LED is active. When Control Voltage is removed the relay will not issue a pulse.

The green LED will indicate normal running operation and the red LED will indicate a trip.
See section 2.2 for LED indicators.

Application information:

- The Continuous Failsafe and Non-Failsafe modes can be used when the output relay is operating undervoltage devices. This includes: contactor coils, starter coils and circuit breakers equipped with Under Voltage Release (UVR) trip coils.
- The Auto Reset, Non-Failsafe and Pulsed Non-Failsafe modes are designed for applications where the output relay is operating a shunt trip device. The output contact to the shunt trip coil opens after a successful trip. This prevents damage to the internal mechanism of the circuit breaker in the event that the operator tries to reset the circuit breaker while the trip contact is still closed.

If the DGF100 is to be used for alarm only purposes (rather than to interrupt ongoing processes), and the alarm has to have an auto-resetting nature, then one has to use one of the Pulsed modes. The pulses will be repeated as long as the current is above the set G/F level.

Back to Reset/Test pushbutton Back to Control Voltage.

[1] (NO = Normally Open, NC = Normally Closed)

2.2 LED Indicators

There are two LEDs on the front of the DGF100:

- A green LED showing sufficient Control Voltage by slowly flashing (1 s on / 1 s off).
- A red LED, if steady on, indicating a trip.

Back to Operating Modes.

2.3 Reset/Test pushbutton

Either the built-in or an external, normally open, momentary pushbutton, connected to terminals R1 and T2/R2, is used to reset the internal relay and/or the red LED (depending on the Operating Mode, see section 2.1.4). The external reset button must be a momentary normally open voltage-free contact; no external power supply is required. See section 6.2.

A reset will only be granted if the cause of the trip is cleared. Otherwise the relay will remain activated without glitches.

With the unit in Auto Reset, the relay and LED electronics reset automatically in 3 seconds. The reset button does not have to be pressed.

Double-clicking the local or remote button invokes a test which switches an AC test-voltage onto the built-in processor's CS input. The voltage is scaled to simulate a residual current of 1,5 - 3 times the G/F trip level. The unit will trip on G/F after the set delay (plus 0,4 s). The red LED turns on solidly. A button needs to be pressed again to reset the device.

Back to DGF100 Display.

2.4 External Current Sensor

Each CS series sensor is epoxy moulded for exceptional mechanical properties and has a high-grade silicon iron core for excellent coupling characteristics under all temperature situations. All CS series current sensors are protected against emitting high voltages when the secondary output is not properly connected. The maximum voltage is 25 V RMS.

The DGF100 can work with an external CS, which is useful in the situation where the cables together are bigger than the 46 mm of the internal CS window allows, or when higher than 660V system voltages are needed. See section 5 for the available options and table 2 for the various trip values.

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

Position power cables in the centre of the current sensor's window. Keep cables and buswork clear of the split on split core current sensors.

2.5 Frame Bonding/Chassis Ground

For optimum EMC performance and safety, the FB (Frame Bond) terminal must be firmly connected to the local frame or chassis ground. The chassis ground must not be more than 50 mm away from the unit.

If the DGF100 is mounted on a 35 mm DIN rail, a 'DIN rail ground terminal block' can be installed beside the unit to act as the chassis ground point. Use a 2 - 2,5 mm2 (14 AWG) stranded conductor.

Back to Connections and precautions.

2.6 DGF100 Display

The door mounted DGF100 Display is connected to the DGF100 by up to 10 m of RJ-10 type, 4-wire telephone type cable. It provides the following remote indications and functions:

- Continuous reading of actual ground fault current, employing auto ranging.
- 'RESET' pushbutton. To reset the unit after a trip.
- 'VERIFY' pushbutton. By pushing the 'VERIFY' button on the DGF100 Display, it will show if the DGF100, to which it was connected at the time of trip, tripped due to a ground fault prior to loss of its Control Voltage by lighting the red 'G/ F 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 DGF100. This indication will remain available for at least ten hours. The DGF100 Display will reset automatically when Control Voltage is restored.
- 'TEST' pushbutton. (See section 2.3 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 DGF100 base unit 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.
- Display of the pre-trip ground fault current, after a trip has occurred (flashing display).
- When the G/F current exceeds the system's measuring range, the display shows *Out* , meaning 'Out of range'.
- Power over datalink, no external power supply needed
- There are two LEDs present, green and red, showing which state the DGF100 base unit is in.

  - Green 'RUN' LED — Flashing: Okay; Off: No Control Voltage, Control Voltage too low
  - Red 'G/F TRIP' LED — Off: No trip; Steady on: Trip

  After loss of Control Voltage the DGF100 base unit will show if it tripped because of a ground fault, by lighting the red LED, or if it was a loss of Control Voltage without a trip, by lighting the green LED.

The Numerical LCD window displays actual ground fault current in A. When a 5000:5 ratio interposing CT is used, all displayed values are to be interpreted as kA rather than A.
Two 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 CS, an external CS, or a 500:5 ratio interposing CT.

'kA' - when using a 5000:5 ratio interposing CT.

Back to General Description.

3. CONTROL VOLTAGE

The DGF100 has a universal, isolated power supply, accepting nominal voltages between 24 and 240 V AC or DC with -20% / +10% tolerances. The total range of accepted voltages is therefore 19,2 to 264 V AC or DC. Power consumption is a mere 1,2 VA maximum with AC voltages and 0,5 W maximum with DC voltages.

For optimum EMC performance and safety, the FB (Frame Bond) terminal must be firmly connected to the local frame or chassis ground. The chassis ground must not be more than 50 mm away from the unit. If the DGF100 is mounted on a 35 mm DIN rail, a 'DIN rail ground terminal block' can be installed beside the unit to act as the chassis ground point. Use a 2 - 2,5 mm^2 (14 AWG) stranded conductor.

Control voltage is subsequently presented to the L+ and N- terminals.
For good EMC behaviour it is important (as in any installation) to run all wiring close along the chassis or in metal ducts, avoiding excess lengths and coiled up wires.

4. CONNECTIONS AND PRECAUTIONS

Please consult the following checklist when applying the DGF100.

1. Please review Figures 1, 2 and 3 for typical field connections.
2. If the DGF100 is used for alarming only purposes, or if the G/F Trip Delay Time is set to 1 s or higher, verify that the DGF100 cannot be subjected to conditions exceeding its Thermal Withstand Capability (see section 6.1).
3. Place the DGF100 in a clean dry enclosure. Locate the unit in the vicinity of the isolating device (circuit breaker or contactor) that is protecting the circuit being monitored.
4. Provide maximum clearance between the DGF100 (plus the external CS if used) and any strong magnetic flux producing devices such as power transformers, autotransformers, control transformers, reactors, high power conductors, contactors and other buswork.
5. Lead the power conductors of the circuit being monitored, (including Neutral if any and excluding the ground wire) through the internal OR external CS's window. WARNING: Never lead conductors through both the internal and the external CS at the same time.
6. All connections to the DGF100 are by means of screw clamp pull-apart terminals rated 10 A, 300 V. Terminals will accept 0,14 – 4,0 mm^2, (26 - 12 AWG) solid or stranded conductors. The user may want to identify the following terminals:
   - L+ for connecting AC or DC Control Voltage's 'hot' side.
   - N- for connecting AC or DC Control Voltage's 'cold' side.
   - FB for providing an absolute ground reference to the system (refer to section 2.5), use 2-2,5 mm^2, 14 AWG stranded wire.
   - 13 and 14 for connecting the normally open (NO) contact of the relay.
   - 11 and 12 for connecting the normally closed (NC) contact of the relay.
   - T1 and T2 for connecting an external CS, use 2 - 2,5 mm^2, 14 AWG stranded wire.
   - R1 and R2 for connecting an external momentary, NO, voltage free, pushbutton.
7. See National Electrical Code for minimum required wire gauges.
8. In order to meet the Electromagnetic Compatibility (EMC) requirements a firm and short connection is required between terminal FB and the chassis ground point. The chassis ground must not be more than 50 mm away from the unit.
9. If the DGF100 is mounted on a 35 mm DIN rail, a 'DIN rail ground terminal block' can be installed beside the unit to act as the chassis ground point.
10. For good EMC behaviour it is important (as in any installation) to run all wiring, especially if unshielded, close along the chassis or in metal ducts, avoiding excess lengths and coiled up wires.
11. Integrate the relay contacts into the control circuit. Apply appropriate fusing to protect the contacts (13 A maximum).
12. If an external CS is being used, connect the two secondary terminals of the CS to terminals T1 and T2 of the DGF100 using 2 mm^2 (14 AWG) shielded twisted pair cable. Connect the shield to chassis ground by means of a clamp, close to the DGF100 (where the FB terminal is bonded to chassis ground as well). From the clamp to terminals T1 and T2 the wires can be left unshielded. Please note that terminal T2/R2 is internally connected to terminal FB of the DGF100. Since terminal FB must be grounded, it means that the external CS will be grounded automatically. If separate grounding is required by electrical regulations, the external CS terminal connected to T2 should be connected to the same grounding point as terminal FB of the DGF100. This will avoid ground loops and nuisance tripping.
13. Secure the unit to the DIN rail ensuring the white release latch at the bottom of the unit engages the rail. If the unit is to be mounted in any other position take appropriate steps to prevent the unit from becoming disengaged from the DIN rail.

14. If an external Reset pushbutton is being used, connect it to terminals R1 and T2/R2 of the DGF100 using twisted pair cable (of any gauge accepted by the terminals). If the distance between the button and the DGF100 exceeds 1 m, shielded cable is recommended, the shield being connected to chassis ground by means of a clamp, close to the DGF100 (where the FB terminal is bonded to chassis ground as well). From the clamp to the terminals the wires can be left unshielded.
    The external reset button must be a voltage-free NO contact; no external power supply is required. See section 6.2.
15. Up to six DGF100 units in the same enclosure may share a common remote Reset/Test 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. See figure 5.
16. Position power cables in the centre of the current sensor window. Keep cables and buswork clear of the split on split core current sensors.
17. Verify that the polarity of the conductors is correct when they pass through the CS. Verify that ground paths do not run through the CS, except when applications require shielded wires to pass through the CS window, in that case return the shields through the CS window before connecting them to ground.
18. Phase Conductors must be insulated for the system voltage when it is higher than 660 V.

NOTE: Use the correct type of CS as specified in section 5. The use of standard type of core balance current transformers, connected to the external CS input, may lead to catastrophic failure of the DGF100.

5. CATALOGUE NUMBERS

DGF100	Ground Fault Protection unit with built-in 46 mm CS, 24 - 240 V AC or DC Control Voltage, for use on 660 V maximum, 45 - 450 Hz power systems. Optional: external CS, remote Reset/Test pushbutton and DGF100 Display.
DGF100 Display	Digital Display Unit with LCD display and interconnecting cable, for use with DGF100
CS5-028	Zero sequence current sensor, 28 mm window, 500:1 ratio
CS5-050	Zero sequence current sensor, 50 mm window, 500:1 ratio
CS5-065	Zero sequence current sensor, 65 mm window, 500:1 ratio
CS5-090	Zero sequence current sensor, 90 mm window, 500:1 ratio
CS5-150	Zero sequence current sensor, 150 mm window, 500:1 ratio
CS5-240	Zero sequence current sensor, 240 mm window, 500:1 ratio
CS5-1517	Zero sequence current sensor, 150 x 170 mm window, 500:1 ratio *
CS5-1025	Zero sequence current sensor, 100 x 250 mm window, 500:1 ratio *
CS5-1035	Zero sequence current sensor, 100 x 350 mm window, 500:1 ratio *
CS5-2028	Zero sequence current sensor, 200 x 280 mm window, 500:1 ratio
CS5-3030	Zero sequence current sensor, 300 x 300 mm window, 500:1 ratio *
CS10-095	Zero sequence current sensor, 95 mm window, 1000:1 ratio
CS10-144	Zero sequence current sensor, 144 mm window, 1000:1 ratio
CS10-240	Zero sequence current sensor, 240 mm window, 1000:1 ratio
CS10-1025	Zero sequence current sensor, 100 x 250 mm window, 1000:1 ratio *
CS10-1035	Zero sequence current sensor, 100 x 350 mm window, 1000:1 ratio *
CS10-2028	Zero sequence current sensor, 200 x 280 mm window, 1000:1 ratio
CS20-095	Zero sequence current sensor, 95 mm window, 2000:1 ratio
CS20-144	Zero sequence current sensor, 144 mm window, 2000:1 ratio
CS20-240	Zero sequence current sensor, 240 mm window, 2000:1 ratio
CS20-1025	Zero sequence current sensor, 100 x 250 mm window, 2000:1 ratio *
CS20-1035	Zero sequence current sensor, 100 x 350 mm window, 2000:1 ratio *
CS20-2028	Zero sequence current sensor, 200 x 280 mm window, 2000:1 ratio
CS100-095	Zero sequence current sensor, 95 mm window, 10.000:1 ratio
CS100-144	Zero sequence current sensor, 145 mm window, 10.000:1 ratio
CS100-240	Zero sequence current sensor, 240 mm window, 10.000:1 ratio
CS100-2028	Zero sequence current sensor, 200 x 280 mm window, 10.000:1 ratio

* These current sensors are also available as a split core version, which adds /S to the name, e.g. when ordered the name is CS5-1517/S.

Note 1: all the CS5, CS10, CS20 and CS100 type Current Sensors are for use with Ground Fault Systems devices only.

Note 2: all Ground Fault Systems devices can only be used with CS series sensors.

Note 3: all CS series current sensors are protected against high voltages when the secondary output is open circuit. Maximum voltage is 25 V RMS.

Back to External Current Sensor. Back to Connections and precautions. Back to 6.1.

6. TECHNICAL SPECIFICATIONS

6.1 Ground fault circuit

G/F Trip Level (settable)	30 – 40 – 60 – 90 – 150 – 250 – 400 – 600 - 900 mA 1,50 - 2,50 - 4,00 - 6,00 - 9,00 A
Accuracy of G/F trip point	-15% / +0% of Trip Level [1]
G/F Trip Delay (settable)	20 – 50 – 100 – 200 - 500 ms and 1,00 - 2,00 - 5,00 s
Accuracy of G/F trip delay	See Tables 3 for correct trip delay values and accuracy.
Thermal withstand capability	300 A infinitely 1500 A 500 ms 500 A 2000 ms ≥ 2000 A 300 ms 1000 A 700 ms
Thermal withstand capability with external CS Ratio 500:1	300 A infinitely 2000 A 125 ms 500 A 2000 ms 5000 A 20 ms 1000 A 500 ms
Thermal withstand capability with external CS Ratio 10.000:1	10.000 A 3,00 s 50.000 A 1,00 s 200.000 A 0,05 s
Suitable external CS types	Different sizes with 500:1, 1000:1, 2000:1 and 10.000:1 ratio, including split rectangular sensors. See section 5.

[1] The accuracy of the trip point refers to the value of the real world leakage current (assuming a purely sinusoidal wave shape) that just causes a trip when slowly increased from zero.

Back to Connections and precautions.

6.2 Trip Time Accuracy

The ground fault detection mechanism has a 'thermal' behaviour for greatly reduced noise sensitivity: the quoted delays are valid for sinusoidal currents exceeding the setpoint by >10 times. For reduced current excursions the delay increases as follows:

Trip current settings exceeded by a factor of:	1,2	2	4	>6
Increased Delay by:	80 ms	30 ms	13 ms	7 ms

For IEC 60755 'pulsating DC' currents, the delay increases by a further 50 ms maximum.

6.3 External pushbutton circuit

Type of pushbutton	Single pole, voltage free, normally open, momentary.
Voltage across / current through contact	5 V DC, 1 mA
Maximum number of units that can be controlled in parallel from one voltage-free button	6, all in the same enclosure.

Back to Reset/ Test pushbutton. Back to Connections and precautions.

6.4 Control Voltage

Voltage range	Nominal: 24 – 240 V AC/DC
Operating voltage tolerance:	80% to 110% of rated AC/DC voltage Total range: 19,2 - 264 V AC/DC
Frequency range on AC	45 - 450 Hz
Power consumption	0,6 VA @ 24 V AC 1,1 VA @ 240 V AC 0,8 VA @ 120 V AC 0,5 W @ DC voltages
Isolation voltage	400V RMS. 50-60 Hz 1min, 2,5 kV impulse
Loss of supply tolerance (no impaired operation)	50 ms @ ≥ 38 V DC 180 ms @ ≥ 80 V DC 400 ms @ ≥ 138 V DC 70 ms @ ≥ 38 V AC 250 ms @ ≥ 80 V AC 600 ms @ ≥ 138 V AC
Power-up time	500 ms for G/F detection [1]

[1] If a ground fault causing a residual current above the G/F Trip Current Level, is already present when Control Voltage is applied, the system trips just as soon as possible, irrespective of the G/F Trip Delay time setting (rationale: the fault may be present much longer than the delay set).

6.5 System power

Voltage and current range (internal CS)	0 - 660 V AC, 0 - 100 A
Voltage and current range (external CS)	Any, providing the power conductors are insulated for the system voltage.
Frequency range	45 – 450 Hz
Isolation voltage (internal CS)	2,5 kV RMS, 1 minute

6.6 Terminals

Type	Pull-apart
c-UL-us rating	300 V AC, 10 A
VDE rating	250 V AC, 12 A, pollution degree 3, over-voltage category III.
Insulation stripping length	7 mm
Torque	0,4 - 0,6 Nm
Field wiring *See National Electrical Code for minimum required wire gauges.*	0,14 – 4,0 mm^2 (VDE) 26 - 12 AWG (UL), Cu or Al, solid or stranded.

6.7 Relay contacts

Configuration	Voltage free, 1 NO and 1 NC contact, 4 terminals.
c-UL-us rating	5 A @ 250 V AC, general use 5 A @ 30 V DC, resistive 1/6 hp, 250 V AC 2 A, 250 VA, @ 125 V AC, pilot duty 1 A, 250 VA, @ 250 V AC, pilot duty 0,88 A, 26,4 VA, @ 30 V DC, pilot duty B300: 30 A, 3600 VA make, 3 A 360 VA break @ 120 V AC 15 A, 3600 VA make, 1,5 A 360 VA break @ 240 V AC
EN 60947 rating	5 A @ 250 V AC utilization category AC-12 4 A @ 250 V AC utilization category AC-13 3 A @ 250 V AC utilization category AC-14 3 A @ 250 V AC utilization category AC-15 5 A @ 30 V DC utilization category DC-12 3 A @ 24 V DC utilization category DC-13 Maximum fuse rating 13 A (EN 60947-5-1)
Isolation voltage between contacts and coil	3 kV RMS, 50 - 60 Hz, 1 minute
Breakdown voltage between open contacts	1 kV RMS, 50 - 60 Hz, 1 minute
Between contact sets	2 kV RMS, 50 - 60 Hz, 1 minute

6.8 Mechanical properties (installed)

See figure 4.

Height	70 mm
Width	100 mm
Depth (not including terminal blocks)	102 mm
Depth (including terminal blocks)	123 mm
Internal CS window diameter	46 mm
DIN rail if DIN rail mounted	35 mm
Screws if screw mounted	M5 x 20 (2 needed)
Weight (open)	0,67 kg
Weight (packaged)	0,70 kg

6.9 Display datalink circuit

Display datalink voltage	Max. 10 V DC
Maximum total length	10 m, within one enclosure.
Terminals	RJ-10 telephone connector.

6.10 Environment

Operating temperature	-20 °C to +50 °C
Storage temperature	-40 °C to +80 °C
Humidity	85% max (no condensation)
Ingress protection	IP20
Mechanical shock resistance (no malfunction)	10 G
Vibration resistance (no malfunction)	10 G, 10 - 55 Hz at 1,5 mm double amplitude.

The DGF100 is encapsulated in polyurethane (PUR) to keep the exposure to mechanical shock and vibration to a minimum.

7. APPLICABLE STANDARDS

EN 61000-6-3	Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential (=lowest levels). 30- 230 MHz 30 dBμV at 10 m distance 230-1000 MHz 37 dBμV at 10 m distance
EN 61000-6-4	Electromagnetic compatibility (EMC) Part 6-4: Generic standards - Emission standard for industrial environments.
EN 61000-6-8	Electromagnetic compatibility (EMC) – Part 6-8: Generic standards – Emission standard for professional equipment in commercial and light-industrial locations.
EN 61000-6-2	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments (=highest levels) 80-1000 MHz with 80% AM modulation up to 10 V/m at 3 m distance from source.
EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test.
EN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.
EN 61000-4-4	Electromagnetic compatibility (EMC) Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test.
EN 61000-4-5	Electromagnetic compatibility (EMC) Part 4-5: Testing and measurement techniques - Surge immunity test.
EN 61000-4-6	Electromagnetic compatibility (EMC) Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.
EN 61000-4-11	Electromagnetic compatibility (EMC) Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase.
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
c-UL-us	UL 1053 UL standard for Safety Ground-Fault Sensing and Relaying Equipment, Class 1. CSA C22.2 NO. 144-M1991 CSA standard for Ground Fault Circuit Interrupters. File E203514
CE	CE mark – Declaration of Conformity

8. TABLES AND FIGURES

8.1 Table 1 - Dipswitch settings

'D' denotes down and 'U' denotes up.
Values are primary currents for a 500:1 ratio internal or external Current Sensor.
For other ratio's see Table 2.

Switch no.	Function	Set to	Meaning
1	CS configuration	D ♦	No interposing CT, With External CS, or with 5000:5 interposing CT
		U	With 500:5 interposing CT
2 3 4 5	Ground Fault Trip level	D D D D ♦	0,030 A
		D D D U	0,040 A
		D D U D	0,060 A
		D D U U	0,090 A
		D U D D	0,150 A
		D U D U	0,250 A
		D U U D	0,40 A
		D U U U	0,60 A
		U D D D	0,90 A
		U D D U	1,50 A
		U D U D	2,50 A
		U D U U	4,00 A
		U U D D	6,00 A
		U U D U	9,00 A
6 7 8	Ground Fault Trip Delay time	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	Operation Mode	D D ♦	Continuous Non-Failsafe operation
		D U	Continuous Failsafe operation
		U D	Pulsed Auto Reset operation (Pulse turns off 3 sec after G/F removed)
		U U	Pulsed Non-Failsafe operation
♦ Factory settings			

Back to Dipswitch settings. Back to Operating Modes.

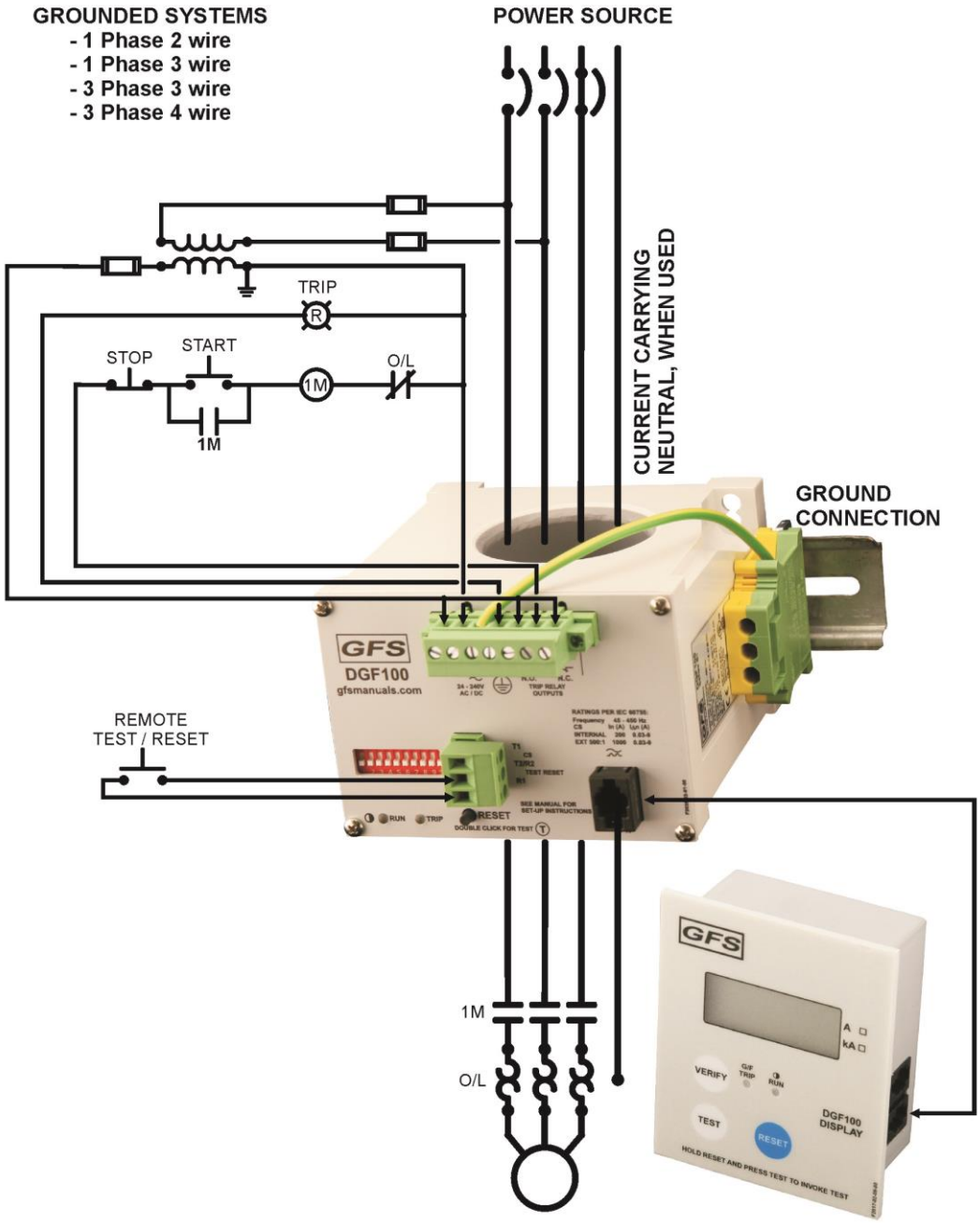
8.2 Table 2 - Primary current Trip Level

Values are primary currents.

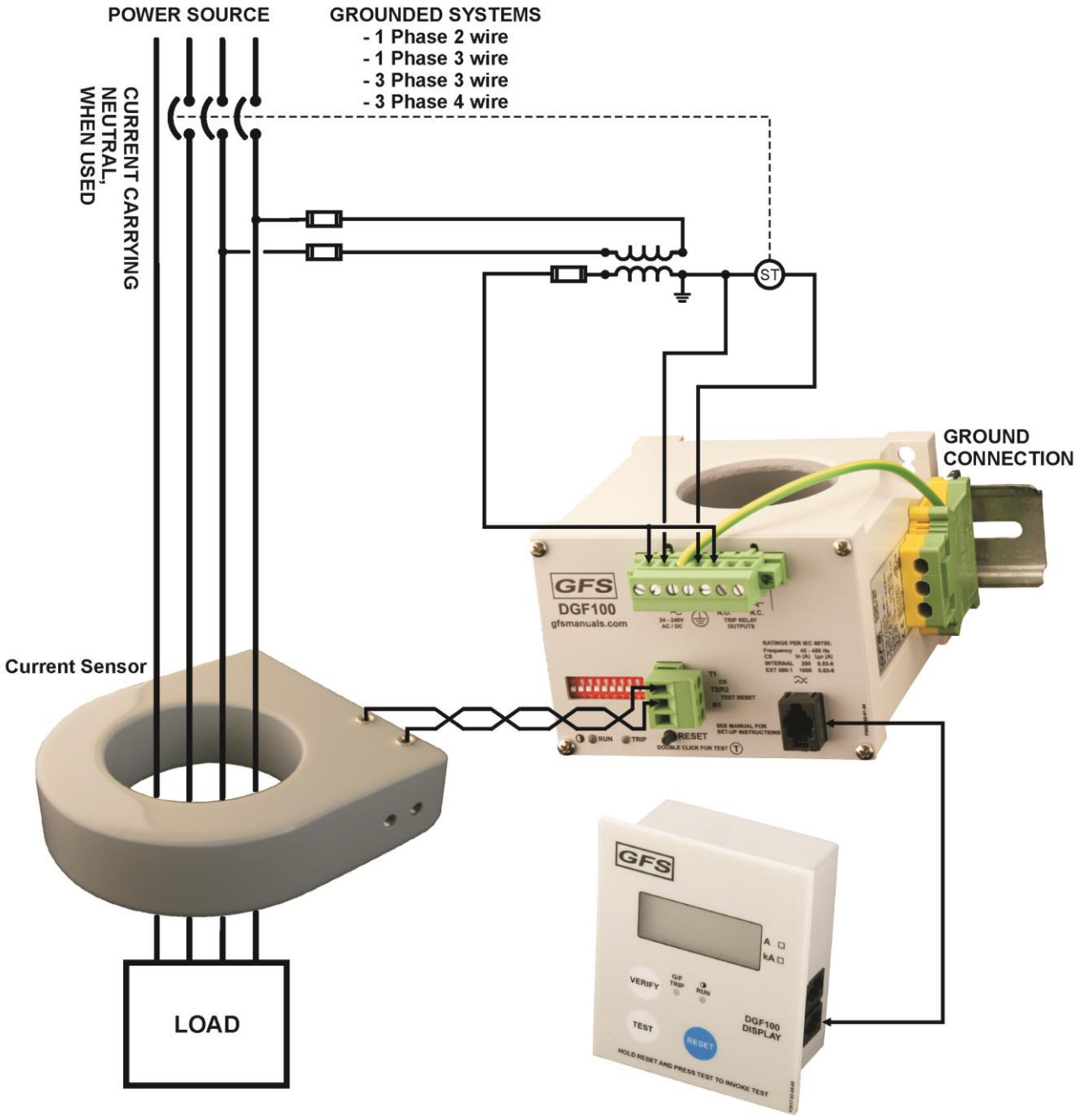
DGF100 Setting	External Current Sensor ratio's				Interposing CT ratio's	
	500:1	1000:1	2000:1	10.000:1	500:5	5000:5
0,030 A	0,030 A	0,060 A	0,120 A	0,60 A	3 A	0,030 kA
0,040 A	0,040 A	0,080 A	0,160 A	0,80 A	4 A	0,040 kA
0,060 A	0,060 A	0,120 A	0,240 A	1,20 A	6 A	0,060 kA
0,090 A	0,090 A	0,180 A	0,360 A	1,80 A	9 A	0,090 kA
0,150 A	0,150 A	0,300 A	0,60 A	3,0 A	15 A	0,150 kA
0,250 A	0,250 A	0,50 A	1,00 A	5,0 A	25 A	0,250 kA
0,40 A	0,40 A	0,80 A	1,60 A	8,0 A	40 A	0,40 kA
0,60 A	0,60 A	1,20 A	2,40 A	12,0 A	60 A	0,60 kA
0,90 A	0,90 A	1,80 A	3,60 A	18,0 A	90 A	0,90 kA
1,50 A	1,50 A	3,00 A	6,00 A	30,0 A	150 A	1,50 kA
2,50 A	2,50 A	5,00 A	10,00 A	50,0 A	250 A	2,50 kA
4,00 A	4,00 A	8,00 A	16,00 A	80,0 A	400 A	4,00 kA
6,00 A	6,00 A	12,00 A	24,00 A	120,0 A	600 A	6,00 kA
9,00 A	9,00 A	18,00 A	36,00 A	180,0 A	900 A	9,00 kA

Back to Dipswitch settings. Back to External Sensor. Back to Table 1.

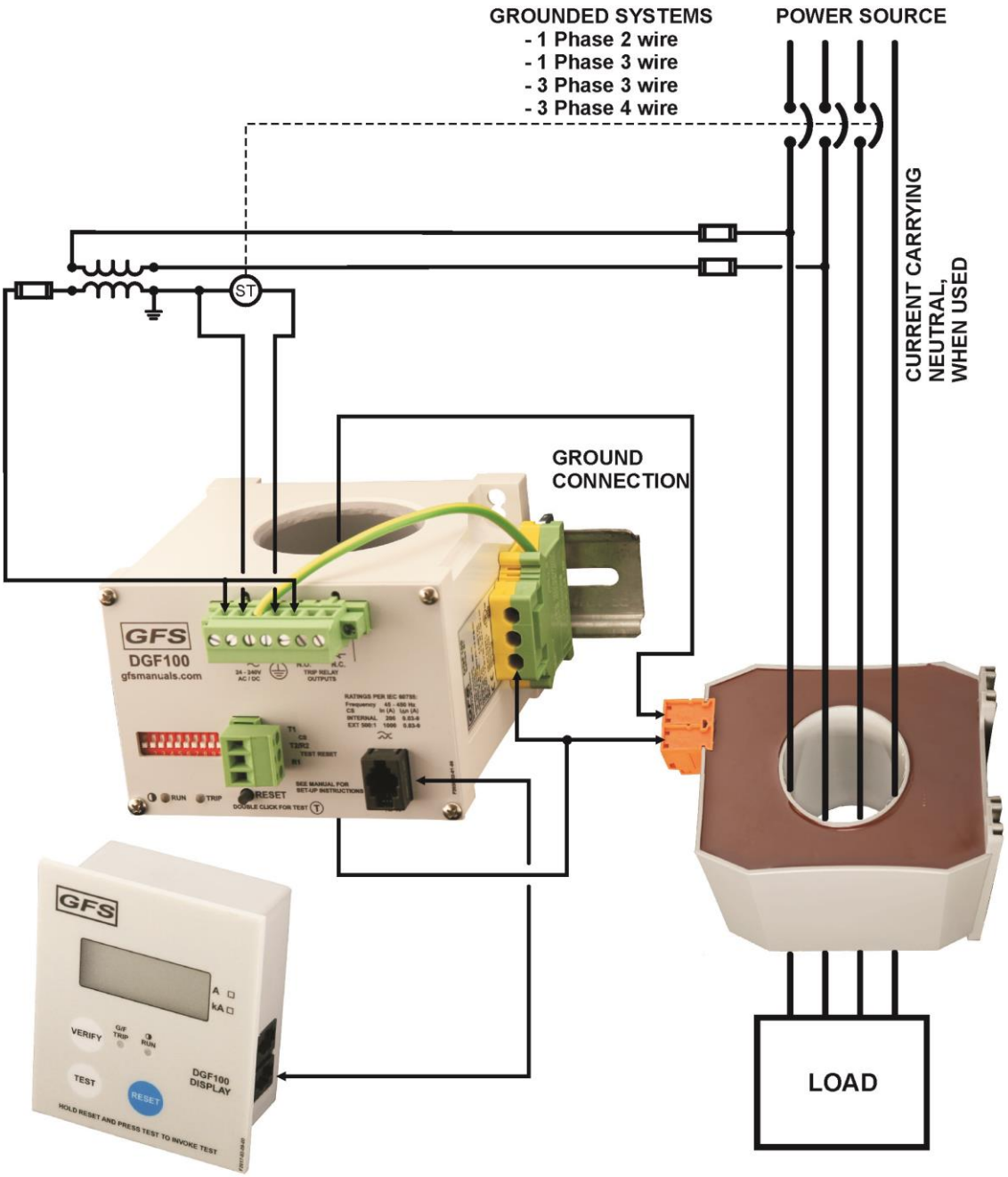
8.3 Figure 1 - Typical field connection using built-in Current Sensor, remote test/reset and DGF100 Display



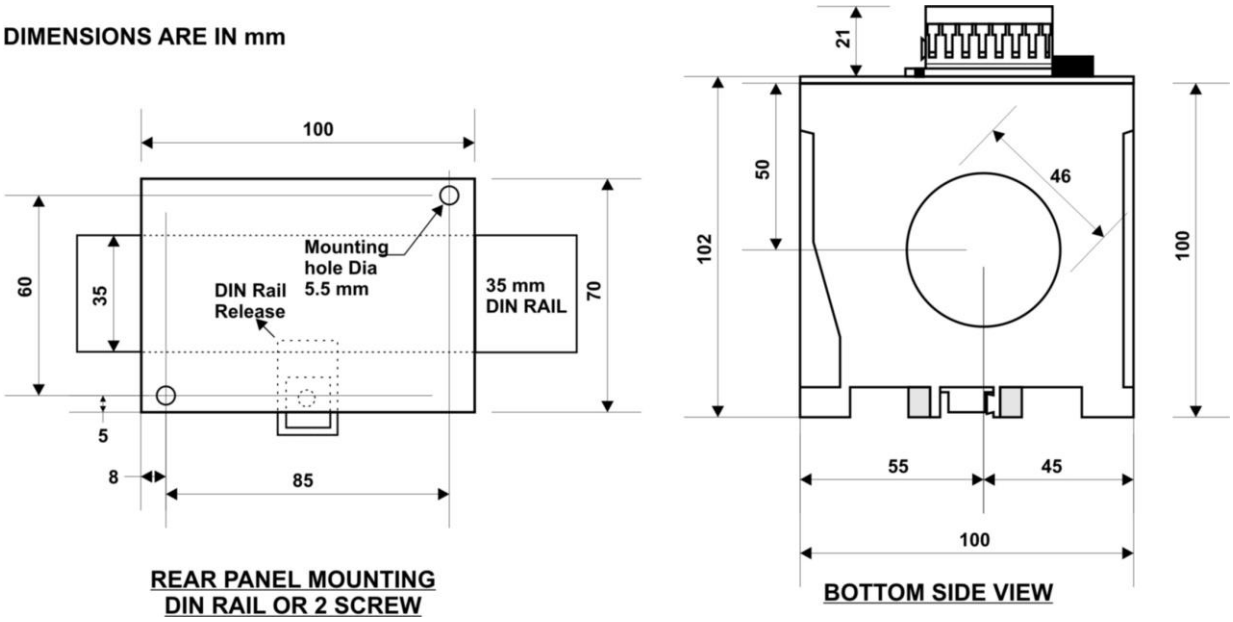
8.4 Figure 2 - Typical field connection with external Current Sensor and DGF100 display



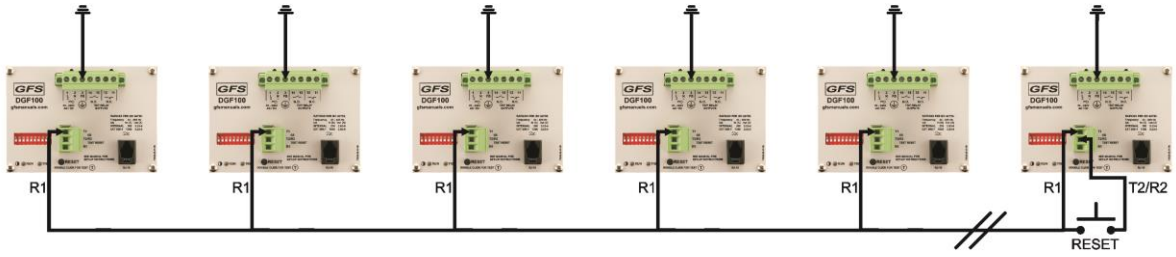
8.5 Figure 3 - Typical field connection with interposing Current Transformer and DGF100 display



8.6 Figure 4 - Dimensions DGF100



8.7 Figure 5 - Reset/Test connection multiple DGF100s



Connection of up to six DGF100s
in the same enclosure
with one Reset/Test button