GFU20 Digital Ground Fault Protection reference manual

Ground Fault Systems bv

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1. GENERAL DESCRIPTION

The GFU20 is a ground fault protection unit for use on solidly grounded or resistance grounded systems. This innovative digital electronic unit measures ground fault current using the zero sequence Current Sensors (CS) series with a ratio of 10.000:1 or 500:1. With Control Voltage on, when the measured value reaches or exceeds the setting for current, during the delay time, the unit trips.

The GFU20 reacts to alternating current only and will reject direct current signals. It will maintain accuracy over a frequency range of 40 - 200 Hz, making it suitable for variable frequency drive applications.

The GFU20 houses an isolated universal power supply from 110 - 240 V AC or DC.

The Trip Delay Time (25 ms – 1 s, 14 steps), Ground Fault Trip Current level (2,5 A - 60 A with 500:1 ratio and 50 A - 1200 A with 10.000:1, both in 25 steps), Trip Inhibit mode (enabled/ disabled, the values depend on the trip level settings) and the Relay Operating Mode (Non-Failsafe and Failsafe) are set on a front accessible dipswitch array. The dipswitch array is made 'tamper proof', meaning that manipulating the switches will not change the settings, unless a special procedure is followed. If the procedure is not followed correctly the red and green LEDs will flash alternately, indicating an attempt to illegally change the settings. The original settings will stay valid until the entire procedure is followed.

The measured current is compared against two setpoints. The lower one is the Ground Fault (G/F) setpoint, the higher one is the High Current (H/C) setpoint.
The user can select the operation of the unit to be 'Trip Inhibited'. Together with an upstream tripping device (fuses or breaker) it can protect local contactor contacts in the case of H/C currents. In this case the unit does not trip initially when the measured current exceeds the H/C setpoint, but waits for the upstream device to take care of current interruption and then trips. The latter trip flags the location of the fault to the user and also allows, after inspection on welded contacts, fast re-closure of the upstream tripping device. Should the upstream device fail to perform, then automatic backup protection makes the GFU20 trip, as a last resort, one second after the H/C occurred. This makes it possible to design a Type 2 coordinated installation, according to the IEC 60755 standard. See Table 2 for values.

The GFU20 is suitable for use on Service Protection Equipment applications.

The GFU20 has an internal voltage-operated tripping device with an external toggle handle.

The GFU20 constantly supervises the connection to the external CS. Open wires are detected and, as it no longer protects the system, will cause a trip. Please note that the GFU20 does not employ any DC injection to implement this, since even small DC current sent through the secondary windings of a CS can bias its core enough to shift the trip point outside specification on sensitive settings. For the CS supervision to work a CS series sensor with a ratio of 10.000:1 or 500:1 must be installed, as specified in section 2.7.

The cover mounted 'RESET' button can be pressed to reset a trip or double pressed to invoke a functional test of the GFU20, the red LED will signal 'TEST' with a solid indication in this situation. Provision is also made for an external test button to do a system test including the CS monitoring feature, the red LED will signal 'CS FAULT' by 4 consecutive flashes.

A green 'RUN' LED shows correct operation by slowly flashing (1 s on/ 1 s off).
A red 'LAST TRIP' LED indicates that the GFU20 has sensed a fault and that the output contacts have operated. The blinking sequence of the red LED indicates the type of fault. When the Control Voltage to the GFU20 is removed, pressing the cover mounted reset button will show the green LED solidly on when no fault was detected before power-down. If a fault was present before power-down, the red LED will indicate the fault by the blinking sequence.

The Pull-apart terminal block simplifies connection of field wiring. It has two, 12 AWG screw clamps per pole with 90° and 270° orientations. Captive screws secure the blocks to the unit, safe from the effects of shock and vibration.

To ensure that the GFU20 will function in severe 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

The GFU20 has dipswitches to set the desired Trip Delay time, Trip Current Level, Trip Inhibit and Relay Operating Mode. Below is a summary of the different options. See table 1 and table 2 for the setting values and section 2.1.6 about tamper proof dipswitches.

Warning: due to the procedure of setting up the dipswitches the installation will trip while changing the settings.

2.1.1 Ground Fault Trip Delay time – dipswitches 1, 2, 3 & 4

The Ground Fault Trip Delay time can be set between 25 ms and 1 s. Table 1 provides settings for dipswitches 1, 2, 3 & 4.

Set the Ground Fault Trip Delay time to provide the desired delay before the output contacts change state when the Ground Fault Trip Level is reached or exceeded.

The setting should be selected to co-ordinate with other ground fault protection 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.

2.1.2 Ground Fault Trip Current level – dipswitches 5, 6, 7, 8 & 9

The GFU20 has 25 fixed trip points between 2,5 A and 60 A of primary fault current with a 500:1 ratio sensor and, in case of a 10.000:1 ratio sensor, between 50 A and 1200 A of primary fault current.
The preferred trip point can be set with dipswitches 5 to 9. For 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 GFU20 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 Dipswitch 10

Not used.

2.1.4 Trip Inhibit mode – dipswitch 11

The Trip Inhibit function can be enabled or disabled with dipswitch 11.
See section 2.2 for more information on trip inhibit.

2.1.5 Operating modes – dipswitch 12

The GFU20 user can select one of two distinct Operating Modes for the device.
All modes have in common:

- In the 'reset state' of the relay the N.O.[1] contact is open and the N.C.[1] contact is closed.
- In the 'tripped state' of the relay the N.O. contact is closed and the N.C. contact is open.

See Table 1 for the corresponding dipswitch settings.

The different modes are listed below:

1. Non-Failsafe operation (used for shunt controlled breakers)
   When Control Voltage is removed (and subsequently restored) the internal tripping memory remains in the pre-power down state. After a trip the red LED remains active until a reset button is pressed. The internal tripping device remains in the tripped state until it is reset manually.
2. Failsafe operation (used for Under Voltage devices)
   When Control Voltage is removed the internal tripping device goes to the tripped state unconditionally. After a trip the internal tripping device remains in the tripped state and after the return of the Control Voltage the red LED remains active until a reset button is pressed. The internal tripping device has to be reset manually.

The green LED will indicate normal running operation, the red LED will indicate a fault code. This fault code can be viewed when the unit is on or while pressing the cover mounted button when Control Voltage is removed. See section 2.4 for LED indicators and section 2.5 for Memory after loss of Control Voltage.

Application information:

- The Non-Failsafe mode is recommended to trip the circuit breaker when being used with shunt trip devices. The circuit breaker should be equipped with a coil clearing contact in its shunt trip circuit.
- The Failsafe mode is recommended to trip the circuit breaker when being used with undervoltage devices. This includes: contactor coils; starter coils; and circuit breakers equipped with UV trip coils.

Back to Memory after loss of Control Voltage.

2.1.6 Tamper proof dipswitches

Eleven of the twelve dipswitches enable the user to tailor the GFU20 to the installations needs. However, to discourage unauthorized manipulation, settings (as opposed to switches) can only be changed by going through a procedure. When an attempt is made to change the settings without going through the procedure, the green and red LEDs start to blink alternately until the switches are returned to their original positions. Should the switches be left deviating from the original positions, the original settings, stored in non-volatile memory, remain valid.

Contact us at info(@)groundfaultsystems.com for the procedure or look in the paper manual included with the unit.

Back to Dipswitch settings. Back to LED indicators. Back to Table 1.

2.2 Trip Inhibit

Contactors are not designed to interrupt high fault currents. The Trip Inhibit function is useful when the Ground Fault unit is used to trip a contactor or motor starter on a solidly grounded system. In this

[1] (N.O. = Normally Open, N.C. = Normally Closed)

application, there is no defined limit to the magnitude of the ground fault current should a bolted ground fault occur. Under these conditions the upstream short circuit protective device, fuses or circuit breaker, should interrupt the fault. If the ground fault current exceeds the inhibit level, the output circuit will be inhibited from tripping until the ground fault current drops below the inhibit level. However, should the current fail to drop within 1,2 s, then, as a last resort, the unit will trip, showing the cause of the trip on its red LED ('BACKUP TRIP', two flashes).

The inhibit level is related to the ground fault trip level over a range of 10 A to 100 A, when using CS series zero sequence current sensors with a ratio of 500:1. The inhibit level is related to the ground fault trip level over a range of 200 A to 2000 A when using the CS series zero sequence current sensors with a ratio of 10.000:1 and can be enabled or disabled by means of dipswitch no. 11. See Table 1 and table 2.

In relation to IEC standard 60947-4-1 it is now possible to construct a 'Type 2 coordinated' installation:

- Only minor welding of the contactor or starter contacts is permissible and the contacts must be easily separated.
- Following Type 2 coordination tests, the switchgear and control gear functions must be fully operational.

It is advisable to inspect the contactor after a Trip Inhibit event occurred since it was used to break a current, possibly outside its rating. Even if the current was inside the rating, minor welding of the contacts can occur. The cause of the trip and the location of the trip are indicated so, after a quick inspection of the affected contactor, the power on the remaining part of the installation can be restored.

Back to 2.1.4 Trip Inhibit mode – dipswitch 11.

2.2.1 UL Standards

- These requirements cover ground-fault current sensing devices, relaying equipment, or combinations of ground-fault current sensing devices and relaying equipment or equivalent protection equipment for use in ordinary locations that will operate to cause a disconnecting device to open all ungrounded conductors at predetermined values of ground-fault current, in accordance with the National Electrical Code, ANSI/NFPA 70.
- These requirements cover equipment intended for use in circuits that are solidly grounded.
- These requirements do not cover equipment intended to be powered from single-phase circuits operating at more than 600 volts or three-phase circuits operating at more than 600 volts phase-to-phase.
- These requirements do not cover ground-fault circuit-interrupters.
- These devices are intended to operate with shunt-trip circuit breakers, electrically tripped bolted pressure contact switches and the like that constitute the disconnecting means.
- Class I ground-fault protection device is one that does not incorporate means to prevent opening of the disconnecting means at high levels of fault current and is intended for use with the following:
  a. Circuit breakers,
  b. Fused circuit breakers,
  c. Fused switches having an interrupting rating not less than 12 times their ampere rating, or
  d. Fused switches having integral means to prevent disconnecting at levels of fault current exceeding the contact interrupting rating of the switch.
- A Class II ground-fault protection device is one that incorporates means to prevent initiation of opening of the disconnecting device if the fault current exceeds the contact interrupting capability of the disconnecting device with which it is intended to be used.
- These requirements cover enclosed-type devices and also cover open-type devices that are intended for use in other equipment, such as panelboards, switchboards, and the like.

The GFU20 is a Class I ground-fault protection device if Trip Inhibit is not enabled.

Enabling Trip Inhibit makes the GFU20 a Class II ground-fault protection device.

2.3 Internal tripping device and tripping conditions

An internal voltage-operated tripping device with an external toggle handle is used as the output device. It provides a visual indication of the status of its output contacts. The output relay has Form "C" N.O. - N.C. voltage free contacts. They may be used to operate the upstream protective device and indicate a failure of the system. The internal tripping device mechanism is trip free; meaning the internal operating of the contacts cannot be stopped by manipulating the external toggle.
Manual reset of the internal tripping device toggle will restore the output contacts to the normal state.

The internal tripping device toggle in the tripped position indicates that the GFU20 has detected a ground fault current higher than the trip level for a period longer than the trip time or that the CS has open wires, as discussed further on, and that the output contacts have operated, or, if in the Failsafe mode, it will also indicate that the Control Voltage has been removed from terminals L+ & N-.

The internal tripping device can be placed in the 'NORMAL' (ON) position with or without Control Voltage being applied on terminals L+ & N-. Control Voltage must be applied in order for the unit to detect a trip condition.
With Control Voltage on terminals L+ & N- (green 'RUN' LED flashing), the internal tripping device will trip and the output contacts will change state when the following conditions occur:

- The measured values reach or exceed the dipswitch settings for current and time.
- The CS has open wires. (This can be used to perform an external test)
- An internal test is invoked
- Loss of Control Voltage, if the operating mode is set to Failsafe mode.

2.4 LED indicators

The unit has a green 'RUN' LED showing correct operation by slowly flashing (1 s flashes).
When the unit is executing a test request the green LED goes in to a fast flashing mode (0,25 s flashes).

In case of a fault, the unit will trip and the red 'LAST TRIP' LED shows short 0,25 s flashes as a code indicating the cause of the trip:

- 1 flash = 'GROUND FAULT'. Residual current exceeded the set G/F limit.
- 2 flashes = 'BACKUP TRIP'. Normal external trip failed within 1,2 s.
  The contactor should be inspected since its contacts may well be damaged.
- 4 flashes = 'CS'. External CS connection failure. Open wires to the External CS. This error is latched, so intermittent failures are captured.
- 5 flashes = 'F/S CV LOSS'. When in Failsafe mode, trip on loss of Control Voltage.
- Continuous flashing = 'TRIP FAILED' alarm. A trip state on top of one of the possible trips described above. Residual current remained high after a trip. Pressing reset clears this trip state, but not yet the original trip state, such that the red LED will now show the original trip's flashing code.
- Solid = Tripped after a Test Request.

If the green and red LED blink alternately the tamper proof dipswitch function is active.
See section 2.1.6.
Please note that the red LED is a convenient indicator only. It does not affect the operation of the internal tripping device. After a fault is cleared, the user may or may not decide to reset the LED.
A subsequent fault will cause the indication to be updated in either case.

Back to Operating modes.

2.5 Memory after loss of Control Voltage

When Control Voltage is removed from the GFU20, the condition of the LEDs will be memorized (for at least one week or until the memory is read by pressing the reset button). Pressing the reset pushbutton before restoring Control Voltage will light either the green LED or the red LED, green indicating no trip was registered and red indicating the opposite. The green LED will light continuously, whereas the red LED will give a sequence of short flashes as described in section 2.4 indicating the cause of trip or turn on solidly if a test was invoked before power down.

Back to Operating modes.

2.6 Reset/Test pushbutton

The GFU20 has a cover mounted pushbutton for reset of the internal memory and internal test.

2.6.1 Reset

To reset the system, the internal tripping device toggle has to be moved to 'NORMAL' position manually. The built-in 'RESET' pushbutton is used to reset the red 'LAST TRIP' LED in the GFU20.

2.6.2 Internal Test – Ground Fault

Double-clicking the built-in 'RESET' pushbutton invokes a test which switches an AC voltage onto the processor's CS input. The voltage is scaled to simulate a ground fault current of approximately 1,5 times the Ground Fault trip level. The internal tripping device will trip on ground fault after the set delay (plus 0,4 s) and the AC test voltage will be switched off. The red LED will turn on solidly, meaning trip after 'TEST'. This proves that the internal electronics and tripping device are functioning. Pressing the reset button again will reset the red LED enabling the green 'RUN' LED. Reclose the internal tripping device manually to the 'NORMAL' position.

WARNING: invoking a test will and must trip the installation!

2.7 External Current Sensor

The GFU20 is designed to operate with either a CS series zero sequence current sensor with a ratio of 500:1 or a ratio of 10.000:1. Each CS series sensor is epoxy moulded for exceptional mechanical properties and has a high-grade silicon iron core for excellent coupling characteristics. All CS series current sensors are protected against high voltages when the secondary output is not properly connected. The maximum voltage is 25 V RMS.

With any G/F protection scheme using an external CS there is an inherent risk that ground faults will not be detected because of a bad or deteriorated connection to the CS. Open wires on the CS connection will prevent detection of a ground fault current. Therefore, the conventional practice is to prove correct tripping regularly by means of current injection. This is an annoying procedure disrupting normal plant

operation. The GFU20 solves this problem by constantly supervising the connection to the external CS. Open wires are detected and will cause a trip.

Please note that the GFU20 does not employ any DC injection to implement this feature. Even small DC currents sent through the secondary of a CS can bias its core enough to shift the trip point outside specification on sensitive settings. For the CS supervision feature to work the proper Current Sensors, as described in section 5, must be used. See table 1 and table 2 for the various trip values.

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

Refer to Figure 1 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 as well. 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.

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2.8 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 GFU20 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.

Back to Connections and precautions. Back to Control Voltage.

2.9 Mounting

The GFU20 is designed for trough-the-door and rear panel mounting.
Refer to Figure 3 for the mounting dimensions.

2.9.1 Through-the-door mounting

Four holes in the flanged cover of the unit permit bolting to the door.
A 102 mm high x 72 mm wide cut-out is required.
Remove the pull-apart terminal block from the GFU20 to permit the unit to be inserted through the cut-out. From the front of the door, insert the unit through the cut-out. Mount the unit cover to the front of the door using mounting hardware (four bolts/screws (M4), washers and nuts).

2.9.2 Rear panel mounting

The GFU20 may be attached to the rear panel with either mounting screws or 35 mm DIN rail.

Two M5 x 20 mm screws are required for screw mounting.

For DIN rail mounting, the rail should be bolted to a flat surface. Install the DIN rail vertically. Allow at least 25 mm of rail to extend beyond each end of the relay. Install a stop block on the DIN rail to keep the GFU20 in position. Secure the unit to the DIN rail ensuring the white release latch fully engages the rail.

3. CONTROL VOLTAGE

The GFU20 has a universal, isolated power supply, accepting nominal voltages between 120 and 240 V with -45% / +10% tolerances with AC and -20% / +10% tolerances with DC. The total range of accepted voltages is therefore 66 to 264 V AC and 96 to 264 V DC.
Power consumption is a mere 2 VA maximum with AC voltages and 1 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 GFU20 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 installing the GFU20.

1. Please review Figures 1 and 2 for typical field connections.
2. Place the GFU20 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.
3. Provide maximum clearance between the GFU20 plus the external CS and any strong magnetic flux producing devices such as power transformers, autotransformers, control transformers, reactors, high power conductors, contactors and other buswork.
4. Lead the power conductors of the circuit being monitored (including Neutral if any and excluding the ground wire) through the external CS's window.
5. All connections to the GFU20 are by means of screw clamp pull-apart terminals rated 10 A, 300 V. The terminals have two 12 AWG screw clamps per pole with 90° and 270° orientation. 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:
   - T1 for connecting the external CS, use 2-2,5 mm^2, 14 AWG stranded wire. See figures 1 and 2.
   - FB for providing an absolute ground reference to the system (refer to section 2.8), use 2-2,5 mm^2, 14 AWG stranded wire.
   - N- for connecting AC or DC Control Voltage's 'cold' side. (N.B. isolated power supply) See figures 1 and 2.
   - L+ for connecting AC or DC Control Voltage's 'hot' side.
   - 11 and 12 for connecting the normally closed (N.C.) contact of the internal tripping device, used for the shunt trip coil circuit.
   - 11 and 14 for connecting the normally open (N.O.) contact of the internal tripping device, used for undervoltage devices.
6. See National Electrical Code for minimum required wire gauges.
7. 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.
8. The GFU20 can be either mounted through-the-door or on the rear panel.
   a. Make a cut-out in the door, remove the terminal block, place the unit through the front of the door and attach it with M4 bolts/screws, washers and nuts. See figure 3 for the dimensions.
   b. If the GFU20 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.
      Secure the unit to the DIN rail ensuring the white release latch fully 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.
   c. The GFU20 can also be mounted on the rear panel using 2 M5 x 20 mm screws.
9. 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.
10. Integrate the relay contacts into the projected control circuit. Apply appropriate fusing to protect the contacts (10 A maximum).
11. Connect the two secondary terminals of the CS to terminals T1 and T2 of the GFU20 using 2 mm^2 (14 AWG) shielded twisted pair cable. Connect the shield to chassis ground by means of a clamp, close to the GFU20 (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.
    CAUTION: DO NOT connect the external sensor to ground at any other point.
12. Position power cables in the centre of the current sensor window. Keep cables and buswork clear of the split on split core Current Sensors.

13. Verify that the polarity of the conductors is correct when they pass through the CS. Verify that no ground paths bypass the CS.
14. 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 GFU20.

Back to External Current Sensor.

5. CATALOGUE NUMBERS

GFU20	Ground Fault Unit with 110 - 240 Volt AC or DC Control Voltage, for use on 660 V maximum, 45 – 200 Hz power systems, with toggle operated internal tripping device, for use with service protection equipment.
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 *
CS5-3030	Zero sequence current sensor, 300 x 300 mm window, 500:1 ratio *
CS5-2028	Zero sequence current sensor, 200 x 280 mm window, 500:1 ratio
CS100-095	Zero sequence current sensor, 95 mm window, 10.000:1 ratio
CS100-144	Zero sequence current sensor, 144 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 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 Technical Specifications.

6. TECHNICAL SPECIFICATIONS

6.1 Ground fault circuit

Ground Fault Trip Level (settable) with 500:1 ratio CS	2,5 – 3 – 3,5 – 4 – 4,5 – 5 – 6 – 7 – 8 – 9 – 10 – 12,5 – 15 – 17,5 – 20 – 22,5 – 25 – 27,5 – 30 – 35 – 40 – 45 – 50 – 55 - 60 A
Ground Fault Trip Level (settable) with 10.000:1 ratio CS	50 – 60 – 70 – 80 – 90 – 100 – 120 – 140 – 160 – 180 – 200 – 250 – 300 – 350 – 400 – 450 – 500 – 550 – 600 – 700 – 800 – 900 – 1000 – 1100 – 1200 A
Accuracy of Ground Fault trip point	±15% including CS accuracy
Accuracy of Trip Current repeat	±1%
G/F Trip Delay Time (settable)	25 – 65 – 100 – 130 – 160 – 190 – 225 – 255 – 375 – 500 – 625 – 750 – 875 ms and 1 s
Accuracy of G/F Trip Delay Time	-2 / +5 ms or ±2,5% of Trip Delay Time, whichever is greater at > 10 times setting See also section 6.2.
Trip Inhibit	Enabled/ disabled
Trip Inhibit Trip Delay Time	5 ±2 ms
Accuracy of Trip Inhibit	± (10 % + 2 A)
Thermal withstand capability with external CS Ratio 500:1	300 A infinitely 500 A 2000 ms 1000 A 1 s 2000 A 0,1 s 5000 A 20 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 Current Sensor types	Different sizes with 500:1 and 10.000:1 ratio, including split rectangular sensors. See section 5.

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:	60 ms	20 ms	8 ms	3 ms

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

6.3 External Current Sensor Supervision circuit

CS loop resistance causing an open wire fault	> 1 kΩ
CS Fault Trip Delay Time	1,5 s

6.4 External button

Type of button	Single pole, single throw (SPST), normally closed, momentary, 3 A @ 10 V AC.

6.5 Control Voltage

Voltage range	Nominal: 110 – 240 V AC/DC,
Operating voltage tolerance:	55% to 110% of rated AC voltage 80% to 110% of rated DC voltage Total range: 66 - 264 V AC 96 - 264 V DC
Frequency range on AC voltages	45 – 450 Hz
Power consumption	2 VA @ AC, 1 W @ DC
Isolation voltage	400V RMS. 50-60 Hz 1min, 2,5 kV impulse
Memory after loss of Control Voltage	1 week minimum (until the memory is read by pressing the reset button)

6.6 System power

Voltage and current range (external CS)	Any, providing the power conductors are insulated for the system voltage
Frequency range	40 - 200 Hz

6.7 Terminals

Type	Pull-apart
UL/CSA 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, solid or stranded

6.8 Relay contacts/ Internal Tripping Device

Configuration	Voltage free form 'C', 1 N.O. – 1 N.C. (3 terminals)
Maximum UL rating	3 A @ 250 V AC, resistive
EN 60947-5-1 rating	1 A @ 125 V AC, Utilization category AC-12
Maximum fusing under EN 60947-5-1	10 A
Endurance	Greater than 10.000 operations
Dielectric strength (contacts to coil)	3750 V AC at 60 Hz
Dielectric strength (between contacts)	600 V AC at 60 Hz

6.9 Mechanical properties (installed)

See figure 3.

Height, unit	100 mm
Height, including terminal block	118 mm
Width	70 mm
Depth	99 mm
Height front cover	125 mm
Width front cover	95 mm
Thickness front cover	5 mm
Screws if through-the-door mounted	M4 x 15 mm (raster 80 x 110 mm)
DIN rail if DIN rail mounted	35 mm
Screws if screw mounted (rear panel)	M5 x 20 mm (2 needed)
Weight (open)	0,75 kg

6.10 Environment

Operating temperature	-35 °C to +66 °C
Storage temperature	-50 °C to +80 °C
Humidity	85% max (no condensation)
Ingress protection	IP20

The GFU20 is encapsulated in polyurethane (PUR) to keep the exposure to mechanical shock, vibration and weather 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 - Ground Fault Trip Delay time, Trip Inhibit and Operating modes

'R' denotes right and 'L' denotes left.

Switch no.	Parameter	Set to	Meaning
1 2 3 4	Ground Fault Trip Delay time	L L L L ♦ L L L R L L R L L L R R L R L L L R L R L R R L L R R R R L L L R L L R R L R L R L R R R R L L R R L R	25 ms 65 ms 100 ms 130 ms 160 ms 190 ms 225 ms 255 ms 375 ms 500 ms 625 ms 750 ms 875 ms 1000 ms
5 6 7 8 9	Ground Fault Trip level	See Table 2	
10	Not used	-	-
11	Trip Inhibit	L ♦ R	Disabled Enabled
12	Operating mode	L ♦ R	Non-Failsafe Failsafe
♦ Factory settings			

To discourage unauthorized manipulation, settings can only be changed by going through a procedure. See Tamper proof dipswitches.

Back to Dipswitch settings.
Back to Trip Inhibit.
Back to Operating modes.
Back to External Current Sensors.

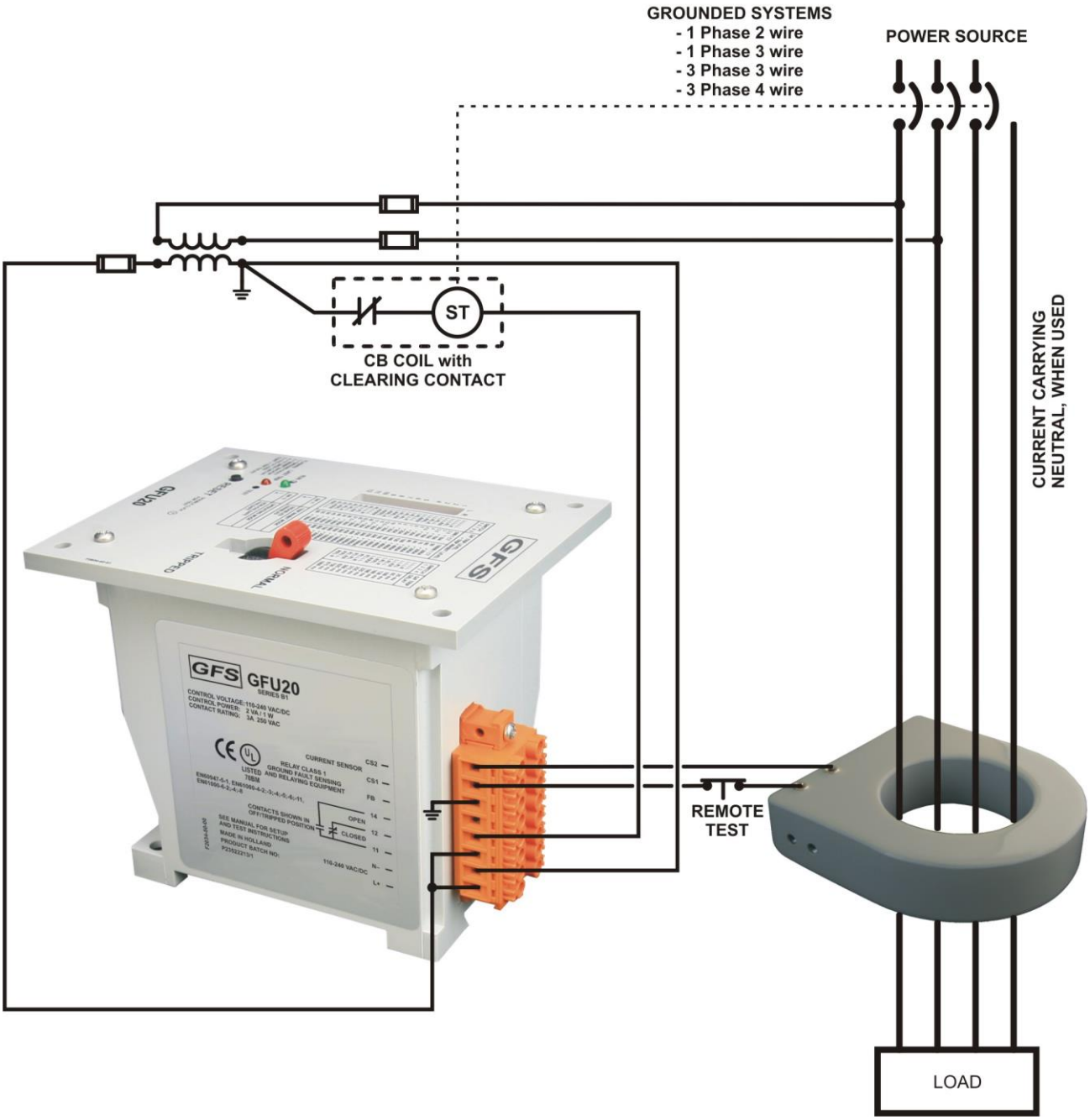
8.2 Table 2 - Dipswitch settings - Ground Fault Trip level and Inhibit level

'R' denotes right and 'L' denotes left. Values are primary currents.

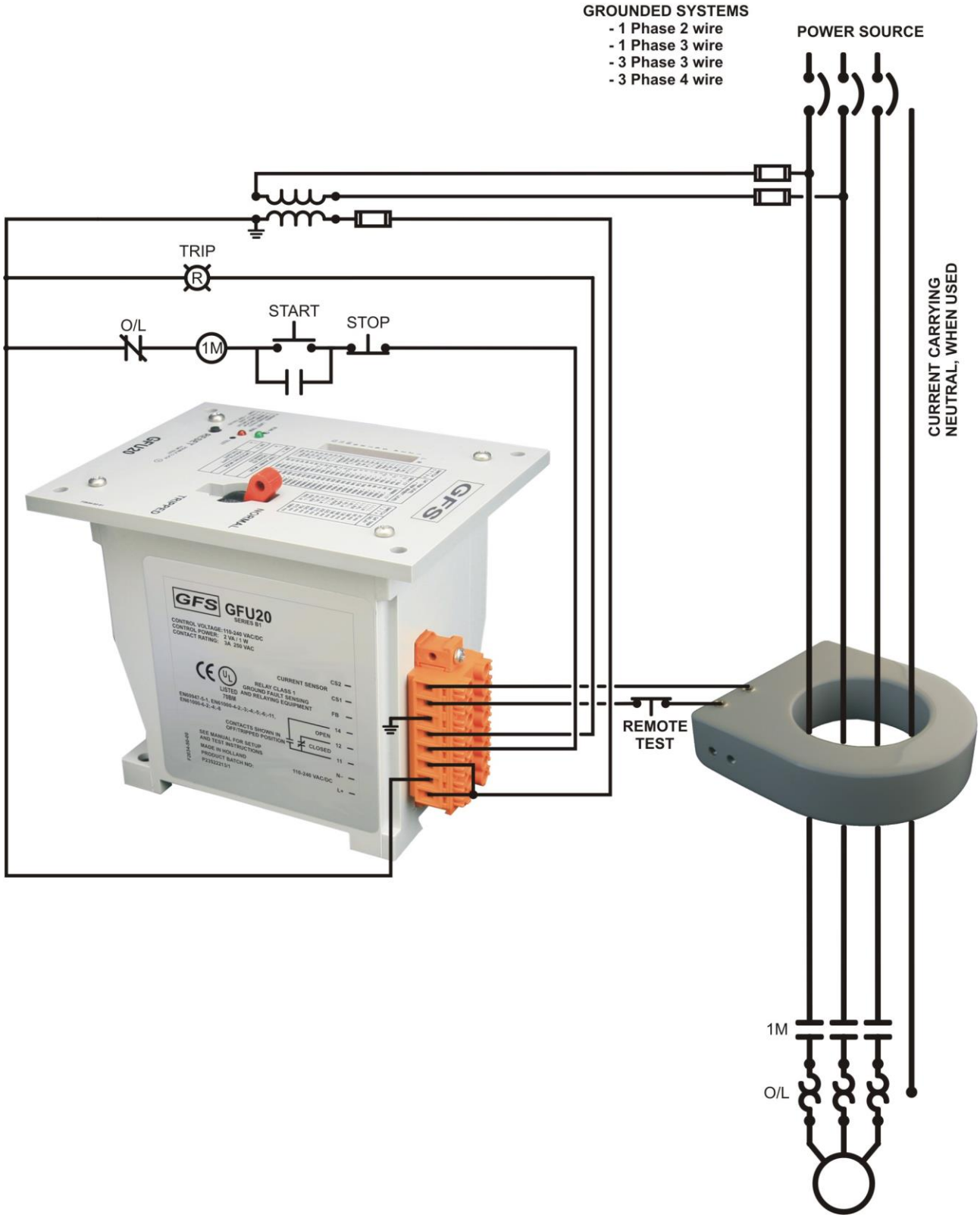
							CS ratio 500:1		**CS ratio 10.000:1**	
Switch No.	5	6	7	8	9		Trip level	Inhibit level	Trip level	Inhibit level
Set to	L	L	L	L	L	♦	2,5 A	10 A	50 A	200 A
	L	L	L	L	R		3,0 A	10 A	60 A	200 A
	L	L	L	R	L		3,5 A	10 A	70 A	200 A
	L	L	L	R	R		4,0 A	10 A	80 A	200 A
	L	L	R	L	L		4,5 A	10 A	90 A	200 A
	L	L	R	L	R		5,0 A	20 A	100 A	400 A
	L	L	R	R	L		6,0 A	20 A	120 A	400 A
	L	L	R	R	R		7,0 A	20 A	140 A	400 A
	L	R	L	L	L		8,0 A	20 A	160 A	400 A
	L	R	L	L	R		9,0 A	20 A	180 A	400 A
	L	R	L	R	L		10,0 A	20 A	200 A	400 A
	L	R	L	R	R		12,5 A	50 A	250 A	1000 A
	L	R	R	L	L		15,0 A	50 A	300 A	1000 A
	L	R	R	L	R		17,5 A	50 A	350 A	1000 A
	L	R	R	R	L		20,0 A	50 A	400 A	1000 A
	L	R	R	R	R		22,5 A	50 A	450 A	1000 A
	R	L	L	L	L		25,0 A	50 A	500 A	1000 A
	R	L	L	L	R		27,5 A	50 A	550 A	1000 A
	R	L	L	R	L		30,0 A	100 A	600 A	2000 A
	R	L	L	R	R		35,0 A	100 A	700 A	2000 A
	R	L	R	L	L		40,0 A	100 A	800 A	2000 A
	R	L	R	L	R		45,0 A	100 A	900 A	2000 A
	R	L	R	R	L		50,0 A	100 A	1000 A	2000 A
	R	L	R	R	R		55,0 A	100 A	1100 A	2000 A
	R	R	L	L	L		60,0 A	100 A	1200 A	2000 A
♦ Factory settings										

Back to General Description
Back to Dipswitch settings.
Back to Trip Inhibit.
Back to External Current Sensors.

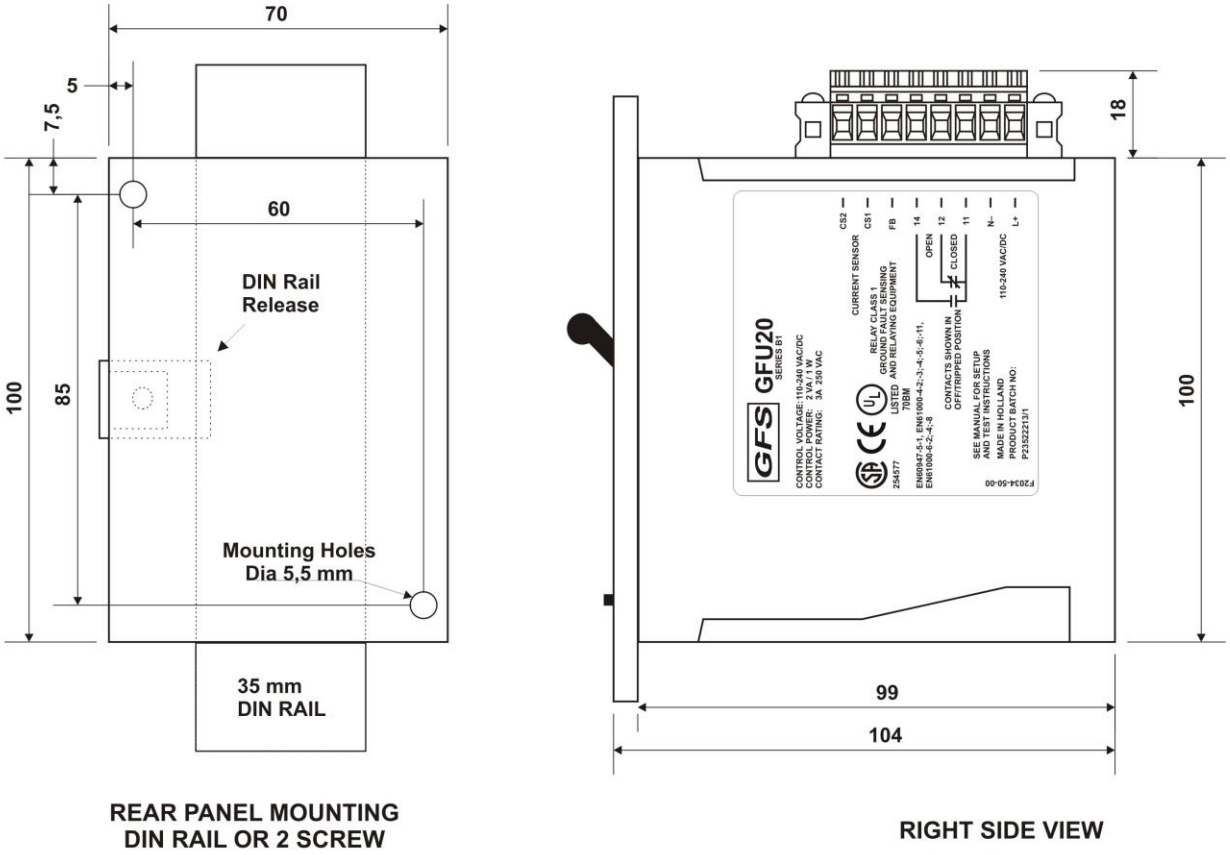
8.3 Figure 1 - Typical Field Connection with a shunt trip device



8.4 Figure 2 - Typical Field Connection with a start/stop device



8.5 Figure 3 - Dimensions GFU20



DIMENSIONS IN mm