

DGF5 Digital Ground Fault Protection reference manual



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1. GENERAL DESCRIPTION

The DGF5 is a microprocessor based ground fault unit for use on solidly grounded or resistance grounded systems. This digital electronic unit measures ground fault current using a built-in 28 mm zero sequence Current Sensor (CS).

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 DGF5 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 DGF5 is 660 V, when passing the system power conductors through the built-in CS.

The DGF5 houses a non-isolated universal power supply of 24 – 48 V AC or DC and is equipped with form 'C' (3-wire), changeover contacts. The relay operating mode is Pulsed Output Auto Reset. The Ground Fault Current Trip level is factory set at 500 mA, the Trip Delay Time is factory set at 500 ms.

By pressing the remote 'TEST' button, a functional test of the DGF5 is invoked, three seconds later the unit resets.

Seven coloured wires simplifies connection of field wiring.

To insure that the DGF5 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 Ground Fault Trip Current level

The DGF5 has a factory set Trip Current Level of 500 mA.

2.2 Ground Fault Trip Delay Time

The Trip Delay Time is factory set at 500 ms.

2.3 Operating mode

The DGF5 works in Pulsed Trip/Auto Reset mode.

The output relay does not change state when Control Voltage is applied to the L+ (black) and FB (white) wire leads.

With Control Voltage on the L+ (black) and FB (white) wire leads, when the measured ground fault current value reaches or exceeds 500 mA for 500 ms, or a test is invoked, the output relay changes state (trips). The output relay will remain tripped until one of the following conditions is met:

- Three seconds after the unit has tripped because a ground fault current exceeded 500 mA or a test was invoked, the relay will reset.
- If the Control Voltage is removed by the trip action of the output relay (i.e. it operates the shunt trip coil of the breaker that is providing the Control Voltage), the relay will reset after 20 ms.

If the ground fault has not been cleared when Control Voltage is restored, the relay will trip after 500 ms, 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 is designed for applications where the output relay is operating a shunt trip device.

2.4 Reset

The DGF5 resets after Control Voltage is removed, the ground fault current drops below the Trip Current Level or after three seconds.

2.5 Test

The DGF5 can be connected to a remote momentary ,voltage free, N.O. button for a relay test (see [section 6.2](#)), using the T1 (grey) and T2 (blue) wire leads. A simulated current of 600 mA (1,2 times the Trip Current) replaces the measured current. After 500 ms have elapsed, the unit trips. This procedure is used to test the functionality of the total system.

After the trip, the output relay will reset after three seconds.

2.6 Frame Bonding/Chassis Ground

For optimum EMC performance and safety, the FB (white) wire 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.

3. CONTROL VOLTAGE

The DGF5 has a universal power supply input, accepting nominal voltages between 24 and 48 V AC or DC with a -45% / +10% tolerance for AC and -20% / + 10% for DC. The total range of accepted voltages is therefore 15,6 to 52,8 V AC and 19,2 to 52,8 V DC. Power consumption is a mere 0,15 W maximum with AC voltages.

Note that the built-in power supply circuit is non-isolated. There is no electrical isolation between the Control Voltage input and the internal electronics, which therefore share a common ground reference. This reference is applied to the system through the FB wire (white) which must be firmly connected to local frame or chassis ground with a maximum of 50 mm distance from the unit for safety and proper EMC behaviour.

Control Voltage is applied to the L+ (black) and FB (white) wire leads. 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. Cut the wires to the desired length.

4. CONNECTIONS AND PRECAUTIONS

Please consult the following checklist when installing the DGF5.

1. Please review [Figure 1](#) for typical field connections.
2. Place the DGF5 in a clean dry enclosure. Locate the relay in the vicinity of the isolating device (circuit breaker or contactor) that is protecting the circuit being monitored.
3. Provide maximum clearance between the DGF5 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 internal CS's opening.
5. Connections
 - FB White for connecting AC or DC Control Voltage's 'cold' side.
 - L+ Black for connecting AC or DC Control Voltage's 'hot' side.
 - N.O. Red for connecting to the normally open (N.O.) contact of the relay.
 - C Yellow for connecting to common contact of the relay.
 - N.C. Brown for connecting to the normally closed (N.C.) contact of the relay.
 - T2 Blue for connecting an external momentary, N.O., voltage free, pushbutton.
 - T1 Grey for connecting an external momentary, N.O., voltage free, pushbutton.
6. In order to meet the Electromagnetic Compatibility (EMC) requirements a firm and short connection is required between the FB (white) wire lead and the chassis ground point. The chassis ground must not be more than 50 mm away from the unit.
7. 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. Cut the wires to the desired length.
8. Integrate the relay contacts into the projected control circuit. Apply appropriate fusing to protect the contacts (13 A maximum).
9. If an external test button is being used, connect it to the T1 (grey) and T2 (blue) wire leads. If the distance between the button and the DGF5 exceeds 1 m, shielded cable is recommended, the shield being connected to chassis ground by means of a clamp, close to the DGF5 (where the FB terminal is bonded to chassis ground as well).
NOTE: Terminals T1 and T2 are NOT isolated. Terminal T2 is internally connected to terminal FB. The external reset button must be a voltage-free N.O. contact; no external power supply is required. See [section 6.2](#).
10. Position power cables in the centre of the current sensor opening.
11. Verify that the polarity of the conductors is correct when they pass through the internal CS. Verify that ground paths do not exist that would bypass the internal CS.
12. Phase Conductors must be insulated for the system voltage when it is higher than 660 V.

5. CATALOGUE NUMBERS

DGF5 Ground Fault Protection Unit with built-in 28 mm current sensor, 24 – 48 V AC Control Voltage, for use on 660 V maximum, 45 - 450 Hz power systems. Can be expanded with remote test button.

6. TECHNICAL SPECIFICATIONS

6.1 Ground fault circuit

G/F Trip Level	500 mA
Accuracy of G/F trip point	-15% / +0% of 500 mA ¹
G/F Trip Delay Time	500 ms
Accuracy of G/F Trip Delay Time	± 10%

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.

6.2 External button

Type of button	Single pole, voltage free, normally open, momentary.
Voltage across / current through contact	5 V DC, 1 mA

[Back to Test pushbutton.](#)

[Back to Connections and precautions.](#)

6.3 Control Voltage

Voltage range	Nominal: 24 – 48 V AC/DC
Operating voltage tolerance:	65% to 110% of rated AC voltage 80% to 110% of rated DC voltage Total range: 15,6 – 52,8 V AC 19,2 – 52,8 V DC
Frequency range on AC voltages	45 – 450 Hz
Power consumption	0,15 W @ AC
Isolation voltage	Not electrically isolated from electronics
Loss of supply tolerance (no impaired operation)	100 ms
Power-up time	Max 500 ms for G/F detection

6.4 System power

Voltage and current range	0 – 660 V AC, 0 – 100 A
Frequency range	45 - 450 Hz
Isolation voltage	2,5 kV RMS, 1 minute

6.5 Wires

UL norm	Appliance Wiring Material
c-UL-us rating	18 AWG 0,75 mm ² 300 V AC, 15 A, 80 °C

6.1 Relay contacts

Configuration	Voltage free, 1 N.O. and 1 N.C. contact, 3 wires
c-UL-us rating	8 A @ 250 V AC, general use 8 A @ 30 V DC, resistive 1/6 hp 125 V AC, 1/4 hp, 125 V AC 1/3 hp 250 V AC, 1/4 hp, 250 V AC 600 W, 120 V AC 530 VA, @ 20 - 265 V AC max 2 A, pilot duty 43,2 VA, @ 30 V DC, pilot duty
EN/IEC VDE	7 A, 250 V AC ($\cos\phi = 1$) 3,5 A, 250 V AC ($\cos\phi = 0,4$)
EN/IEC TÜV	8 A, 250 V AC ($\cos\phi = 1$) 3,5 A, 250 V AC ($\cos\phi = 0,4$) 8 A, 30 V DC (L/R = 0 ms)
Isolation voltage between contacts and coil	2 kV AC, 50 – 60 Hz, 1 minute
Between contacts of the same polarity	1 kV RMS, 50 – 60 Hz, 1 minute
Between contacts of different polarity	2 kV RMS, 50 - 60 Hz, 1 minute

6.2 Mechanical properties (installed)See [figure 2](#).

Height	68 mm
Width (not including mounting bracket)	35 mm
Width (including mounting bracket)	55 mm
Depth	82 mm
Internal CS opening diameter	28 mm
Screws for screw mounting	Suitable for 6,5 mm holes (2 needed)
Weight (open)	0,38 kg
Weight (packaged)	0,42 kg

6.3 Environment

Operating temperature	-35 °C to +60 °C
Storage temperature	-40 °C to +80 °C
Humidity	85% max (no condensation)

Ingress protection	IP20
Shock resistance (no malfunction)	10 G
Vibration resistance (no malfunction)	10 G , 10 – 55 Hz at 1,5 mm double amplitude

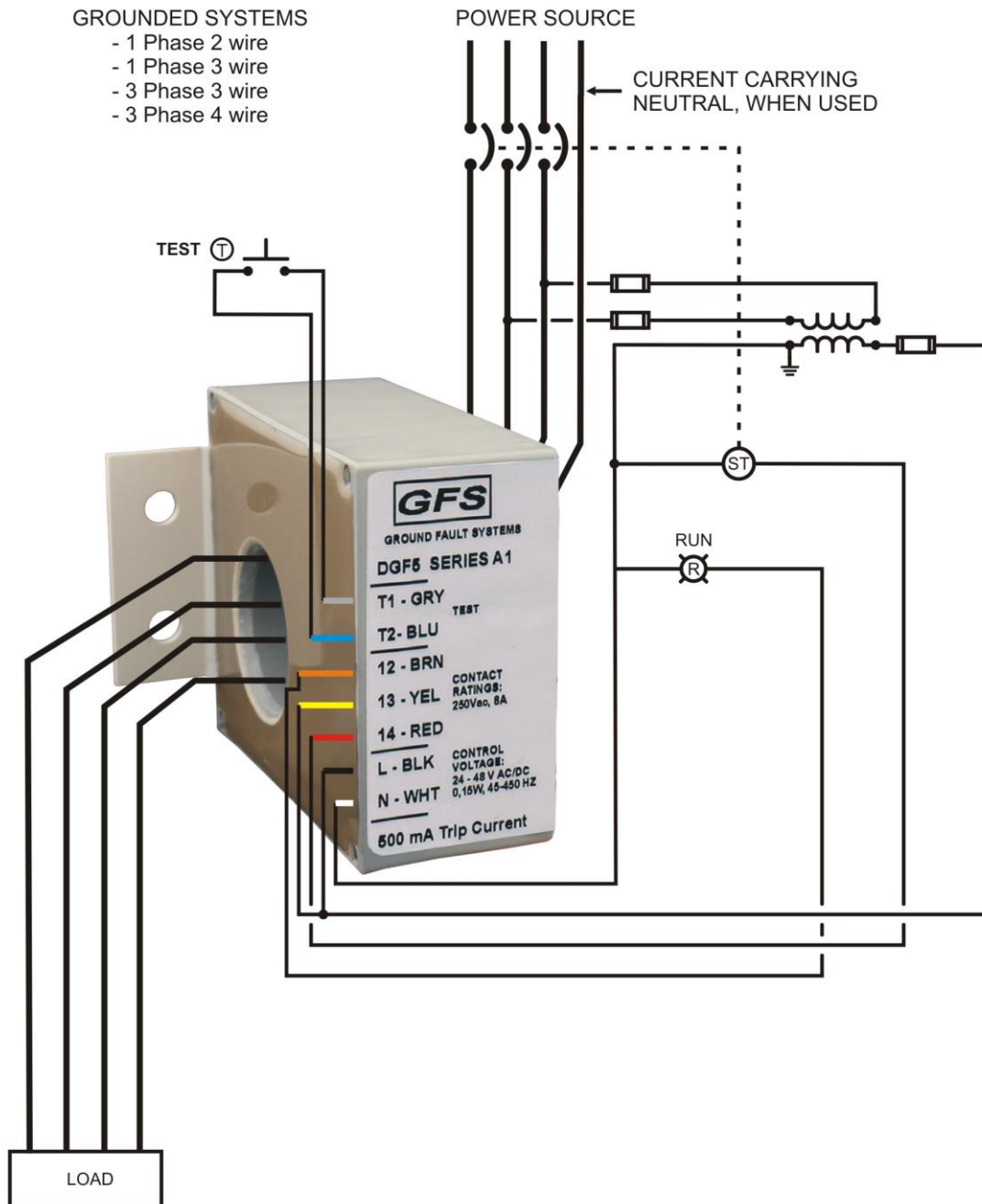
The DGF5 is encapsulated in polyurethane (PUR) to keep the exposure to mechanical shock, vibration and weather to a minimum.

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 dB μ V at 10 m distance 230-1000 MHz 37 dB μ V 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 Figure 1 - Typical Field Connection



8.2 Figure 2 - Dimensions DGF5

