

GFGC Protection Panel

Universal Zero-Sequence Current and Loop Monitoring Panel
For 120 VAC to 600 VAC Grounded Systems



Universal Zero-Sequence Current and Loop Monitoring Panel

Universal Voltage 120... 600 V
for Grounded AC Systems



Protection Panel GFGC

Device features

- Universal voltage selection between 120 and 600 V
- Features zero-sequence current detection, loop monitoring, and power interruption in case of alarm
- Predefined settings from factory
- 6 mA trip level
- Inverse time curve for interrupting circuit
- Adjustable continuity trip level between 0.1 Ω - 100 Ω (preset to 3 Ω)
- NEMA 12 painted steel enclosure
- External test and reset buttons
- External LED indication for power and alarms

Product description

The GFGC series of panels is an all-in-one solution for zero-sequence current detection, loop monitoring, and interruption in case of an alarm. Utilizing the latest in technology, the GFGC panels can detect zero-sequence currents down to 6 mA without the problems associated with high sensitivity nuisance tripping. The GFGC unit also verifies loop connection integrity over a widely adjustable range. The universal voltage selection allows use of this panel on systems from 120 VAC to 600 VAC. 30 A, 60 A, and 100 A units are available.

Bender GFGC protection panels are Listed Enclosed Industrial Control Panels certified to UL 508A.

Residual Current Monitoring: The internal residual current monitor RCMA421H detects zero-sequence current in both AC and DC systems, as well as through all stages of power conversion, such as with variable frequency drives. The RCMA421H combines a trip level of 6 mA with protection against nuisance tripping through operation on an inverse time curve, as well as exceptional noise filtering.

Open loop detection: The internal loop monitor GM420 adds an additional layer of protection by continuously monitoring the integrity of the PE conductor line. A wide adjustable range from 0.1 Ω to 100 Ω ensures the proper level of protection for nearly every application. In addition, the GM420 monitors for extraneous voltages between its connection points.

Applications

- Loading docks
- Fueling stations
- Systems requiring frequent user connections / disconnections

Function

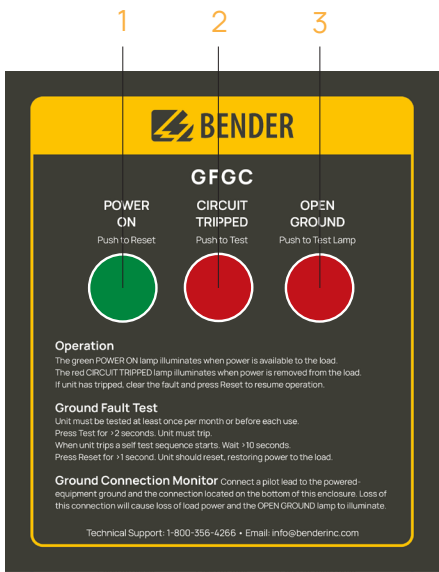
The GFGC series of panels is designed to interrupt power to a circuit when either an excessive zero-sequence current or an open loop is detected. The entire solution is contained inside a NEMA 4 painted steel enclosure. Light indicators as well test/reset buttons on the front of the enclosure allow for functionality without requiring access inside the panel. Settings are preset; only a simple internal wiring is required.

When zero-sequence current is detected, the contactor will trip the main circuit based on an inverse time curve relative to the preset 6 mA value. The inverse time curve assists in alleviating potential nuisance tripping issues.

If an open loop is detected, the same contactor will trip the main circuit. The loop monitor utilizes a ground connection, as well as a field pilot wire connection on the exterior of the enclosure. This connection is required for proper operation. The loop monitor will not allow the contactor to remain pulled in without a proper field connection.

Device adjustability and preset values		
Type	Adjustability	Preset defaults
Zero-sequence current, trip value	6 mA, fixed	6 mA
Zero-sequence current, time delay	Inverse time curve	Inverse time curve
Open loop, trip value	0.1...100 Ω	3 Ω
Open loop, time delay	0...99 s	0 s

Technical data: GFGC enclosure front (drawing not to scale)



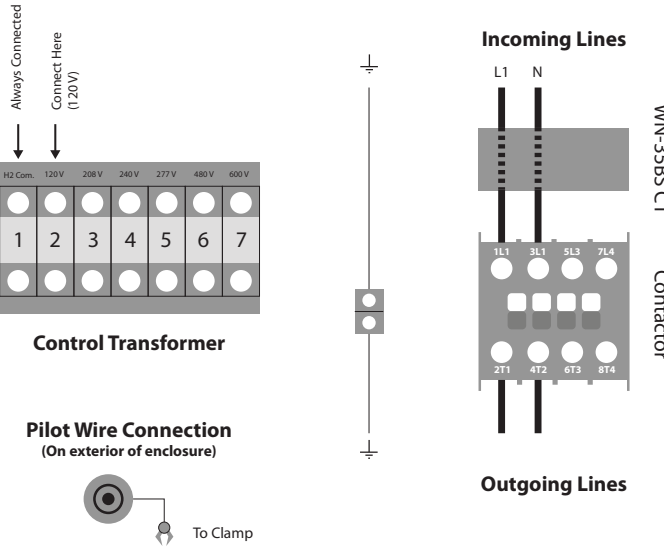
Procedure for wiring GFGC assembly into system

- Locate the wiring diagram specific to the line voltage. Be sure to select the voltage and phase type specific to the point at where the GFGC panel is connecting.
- Connect the incoming lines to the contactor, being sure to have all phases going through the WN-35BS current transformer (including the neutral if one exists). Order of conductors is important.
- When connecting to the contactor, placement of the neutral is important. Connect the outgoing lines in the same manner.
- Do not pass the ground conductor through the current transformer or connect it to the contactor!
- Connect the incoming and outgoing ground wires to the ground lug.
- Locate the control transformer. Terminal 1 (“Com. H2”) should already be connected. Connect it if it is not.
- Connect the other wire to the terminal specific to the line voltage being protected. For instance, if the system is a 208/120 V system, and the GFGC assembly is connected on the 208 V portion of the circuit, connect the wire to the terminal labeled “208.”
- Connect the ground pilot wire clamp to the connector on the outside of the enclosure.

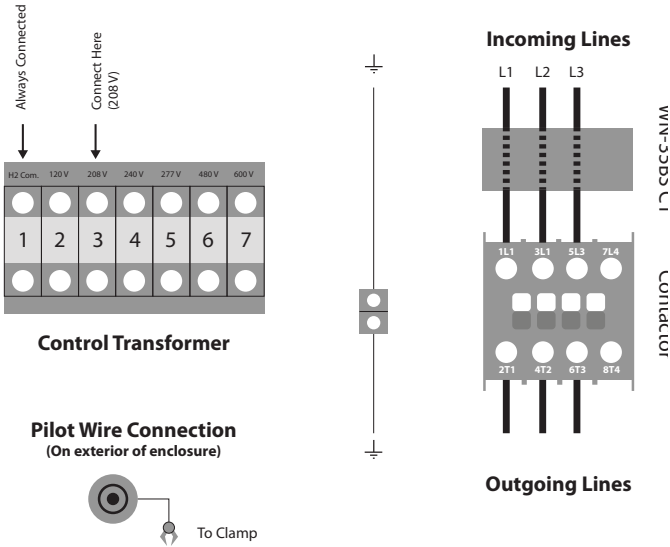
Description of pushbuttons / lights

- 1 - Power ON light / Reset pushbutton
Light illuminates when power is received to the device and not in an alarm state.
Pushing the button for > 1 second resets the device. (Must wait for test to complete!)
- 2 - Circuit tripped light / Test pushbutton
Light illuminates when the circuit has been tripped due to zero-sequence current.
Pushing the button for > 2 seconds runs a test on the residual current monitor.
- 3 - Open ground light / Light test pushbutton
Light illuminates when the loop monitor has detected an open loop.
Pushing the button runs a test on the loop monitor.

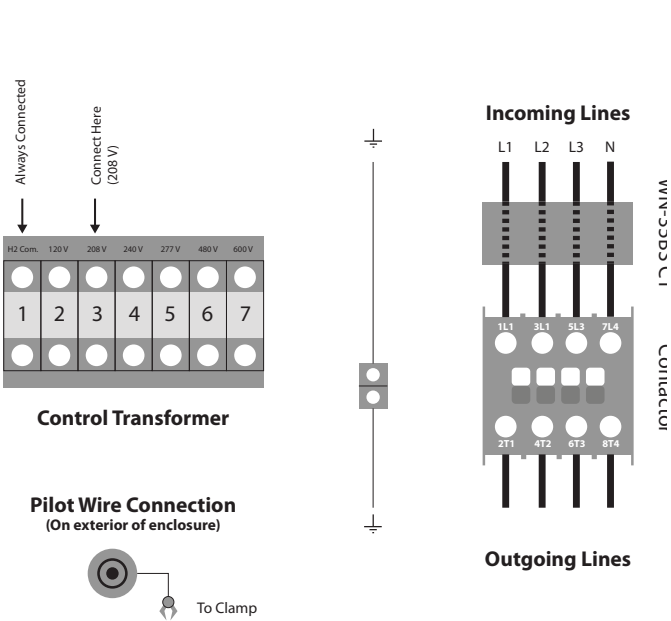
Wiring diagram: 120 V, single phase, with N (L, N)



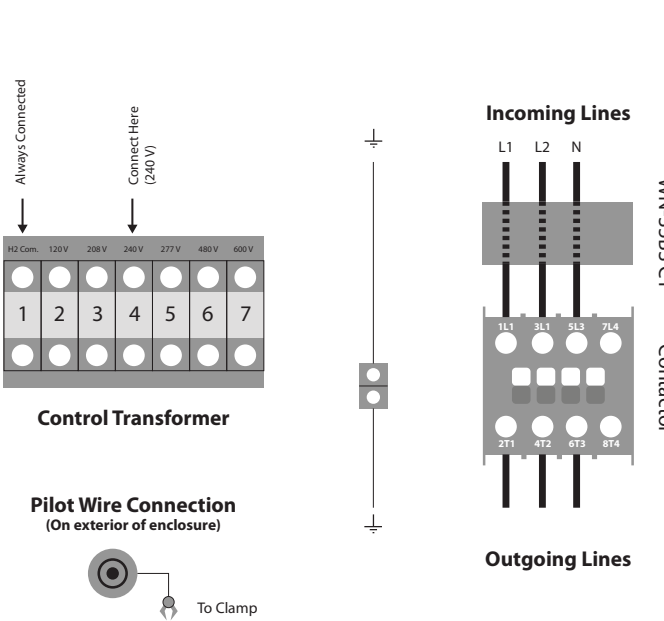
Wiring diagram: 208 V, three-phase, no N (L1, L2, L3)



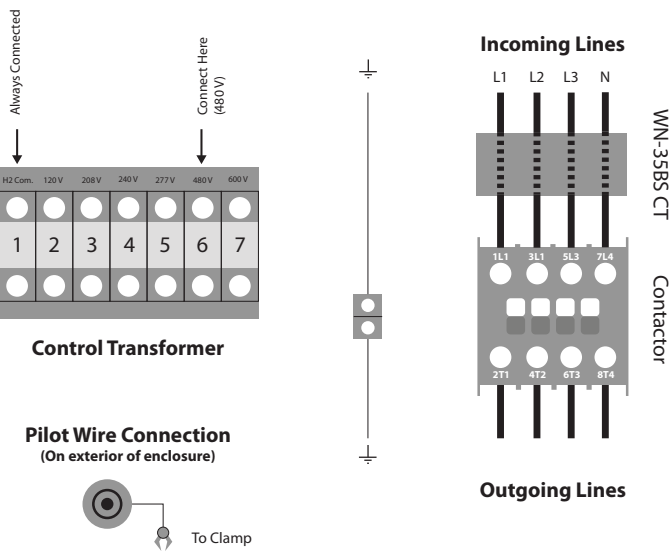
Wiring diagram: 208/120 V, three-phase, with N (L1, L2, L3, N)



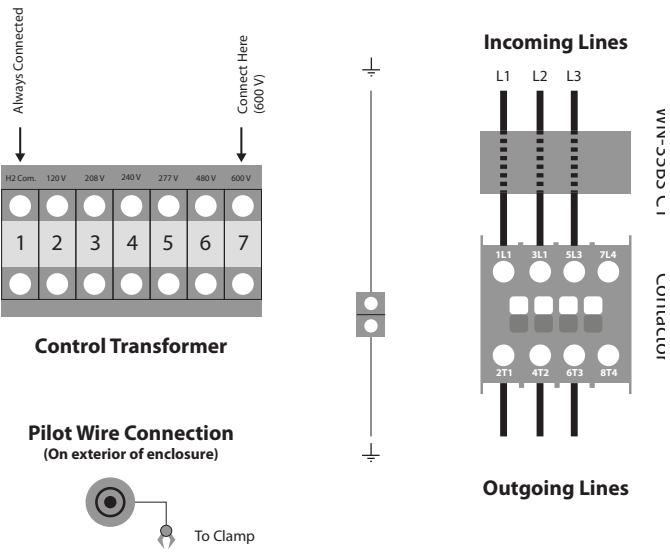
Wiring diagram: 240/120 V, single-phase, with N (L1, L2, N)



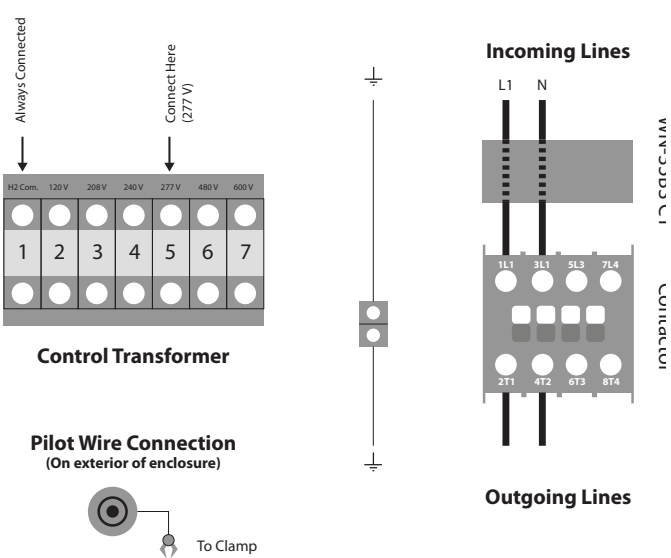
Wiring diagram: 480/277 V, three-phase, with N (L1, L2, L3, N)



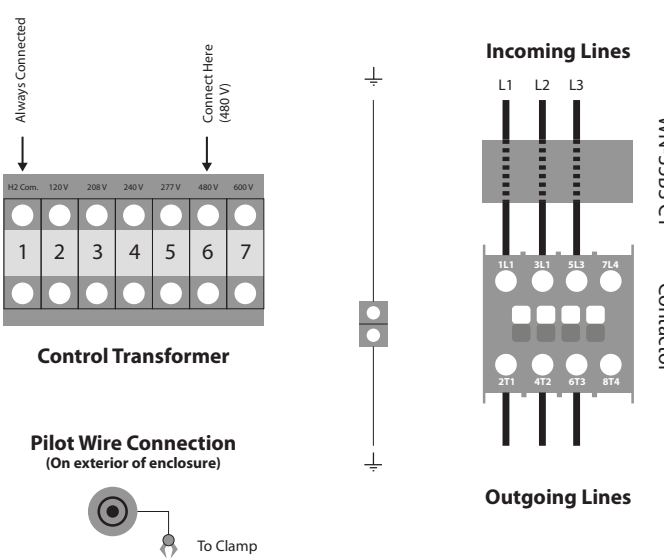
Wiring diagram: 600 V, three-phase, no N (L1, L2, L3)



Wiring diagram: 277 V, single-phase, with N (L1, N)



Wiring diagram: 480 V, three-phase, no N (L1, L2, L3)



Installation troubleshooting tips

- The fault alarm trips instantly on a consistent basis. Near-instant tripping may also indicate a significant zero-sequence current in the system.
Ensure that the following items are correct:
 - The transformer and contactor are wired properly per the above wiring diagrams based on the voltage being used.
 - All phases (including the neutral if one is being used) are going through the WN-35BS current transformer. Improper wiring can cause an incorrect reading of the zero-sequence current.
 - The ground conductor must not pass through the current transformer.
 - There are no neutral-ground bonds downstream of the device. Having a neutral-ground bond downstream of the device will activate the grounded neutral protection alarm.

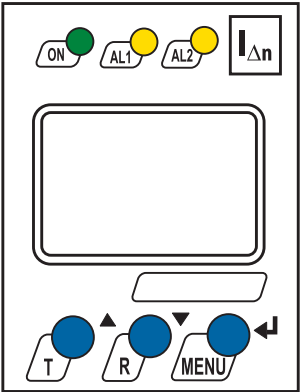
The panel must be reset manually via the door-mounted RESET button in order to clear the trip.

- The alarm trips on a consistent basis, but not instantly. Ensure all of the above items are correct. Ensure there are no ground faults on the system. A non-instant trip is an indication that the total zero-sequence current from many different sources is adding up to approximately 6 mA. Consult the manufacturer for more information and technical support.
- The open ground alarm trips on a consistent basis. Ensure that the following items are correct:
 - There is a proper pilot wire connection to the connector on the outside of the enclosure.
 - There is a proper connection between the clamp and the vehicle/object.
 - There are no broken ground connections in the system being protected.

The panel must be reset manually via the door-mounted RESET button in order to clear the alarm.

Installation troubleshooting tips (continued)

RCMA421H Residual Current Monitor



The RCMA421H is labeled with “IΔn” in the top right corner. Possible messages displayed on the screen include:

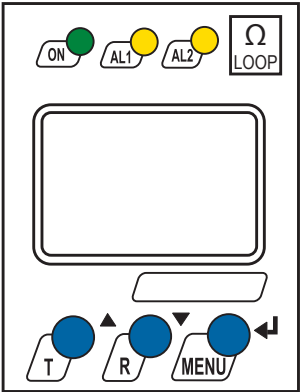
- “X mA”: The amount of zero-sequence current (in mA) read by the device.
- “E 01”: Connection alarm (consult the manufacturer if this alarm appears).
- “E 02”: Connection alarm (consult the manufacturer if this alarm appears).

If the RCMA421H has gone into the alarm state, and is not displaying an error code, follow these steps to retrieve the mA value:

- Hold the MENU button for > 1.5 s to enter the main menu.
- Press the down-arrow button until “HiS” (history) is reached.
- Press the enter/MENU button.

Use this value to assist in determining the source of the fault. If any error codes appear on the unit, consult the manufacturer for more information.

GM420 Loop Monitor



The GM420 is labeled with “Ω LOOP” in the top right corner. Possible messages displayed on the screen include:

- “X Ω”: The resistance of the loop in ohms.
- “OL”: Overload alarm (open connection).

If the GM420 goes into the alarm state, a reading of “X Ω” generally indicates a present, but faulty ground connection. A reading of “OL” generally indicates a nonexistent ground connection. Use these values to troubleshoot the loop connection.

If any error codes appear on the unit, consult the manufacturer for more information.

Commissioning

Before commissioning, check that the GM420 is wired correctly and carry out the functional tests. During initial commissioning, the GM420 executes the preset function (see manual).

Functional tests

The system operator is obliged to have the loop monitor checked for proper functioning at regular intervals by a qualified electrician, see also IEC 60364-6 (6.5 Periodic verification). Bender recommends a recurring inspection at least every 6 months, although national or normative regulations may regulate other inspection periods. The following functional tests must be carried out as a minimum:

- a) Alarm relays
- Switching the alarm relays by a manual self-test. The function is to be checked or proven by means of measurement. If necessary, a parameter adjustment in the out menu for r1 and r2 is required in advance for this. The set mode of operation of the alarm relays must be taken into account.
- b) Conductor loop resistance
- Check the conductor loop resistance by means of (manual) measurement and testing of the loop interruption detection:
1. Switch off the supply voltage U_S.
 2. Remove the connections E and KE.
 3. Determine the resistance of the conductor loop by means of (manual) measurement. The measured loop resistance should approximately correspond to the reference value (< 100 Ω).
 4. Switch on U_S.
 5. Switch off U_S.
 6. Connect E and KE to the GM420 according to the wiring diagram.
 7. Switch on U_S.

Display		
LEDs	ON, AL1	ON
GM420 ok?		



Technical data: RCMA421H-D-2 and current transformer WN-35BS

Insulation coordination acc. to IEC 60664-1 / IEC 60664-3

Rated insulation voltage	AC 250 V
Rated impulse voltage / pollution degree	2.5 kV / 3
Protective Separation (reinforced insulation) between	(A1, A2) - (k/I, T/R) - (21, 22, 24)
Voltage tests to IEC 61010-1	2.21 kV

Supply voltage

Supply voltage Us	AC/DC 70...300 V
Frequency range of Us	42...460 Hz
Power consumption	≤ 4.5 VA

Measuring circuit

External measuring current transformer	WN-35BS
Rated voltage (current transformer)	2.5 kV
Rated frequency	0...150 Hz
AC/DC measuring range	0...40 mA
Relative percentage error (0...20 Hz)	-33 %...+100 %
Relative percentage error (20...90 Hz)	0...- 33 %
Relative percentage error (90...150 Hz)	+ - 17.5 %

Operating value

Rated zero-sequence current threshold	6 mA
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Time behavior

Operating time t _{ae} per UL943	See diagram
Starting delay t	Operating time t _{ae} + 3.2 s

Display and memory

Display range (measured value)	0...40 mA
Maximum operating error (0...20 Hz)	-33 / +100% / +- 2 digits
Maximum operating error (20...90 Hz)	0...20 % / +- 2 digits
Maximum operating error (I _Δ < 2 mA)	+ - 7 digits
Measured value memory capacity	Measured alarm value set

Connections

Connection type specification for screw terminals

Rigid/flexible conductor sizes	AWG 24...12 / 24...14
Stripped length	0.31...0.35 in (8...9 mm)
Tightening torque	0.36...0.44 ft-lb (0.5...0.6 N-m)

Connection type specification for push-wire terminals

Rigid/flexible conductor sizes	AWG 24...14
Flexible with core end sleeve	AWG 24...16
Stripped length	0.39 in (10 mm)
Opening force	11.2 lb (50 N)
Test opening, diameter	0.1 in (2.1 mm)

Switching elements

Number of switching elements	1 SPDT contact				
Operating principle, adjustable	normally energized operation				
Electrical service life under rated operating conditions	10,000 switching cycles				
Contact data acc. to IEC 60947-5-1					
Utilization category	AC-13	AC-14	DC-12	DC-12	DC-12
Rated operational voltage	230 V	230 V	24 V	110 V	220 V
Rated operational current	5 A	3 A	1 A	0.2 A	0.1 A
Minimum contact load	1 mA at AC / DC ≥ 10 V				
Fault memory behavior	Latching operation				

General data

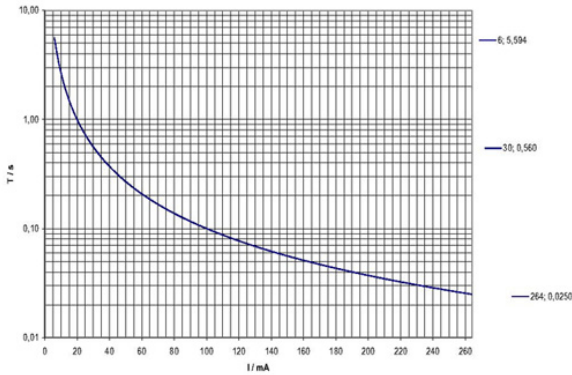
Operating mode	continuous duty
Position of normal use	display-oriented
Protection class, internal components (IEC 60529)	IP30, NEMA 1
Protection class, terminals (IEC 60529)	IP20, NEMA 1
Enclosure material	polycarbonate
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94V-0
Weight: RCMA421H	≤ 0.33 lb (150 g)
Weight: WN-35BS	≤ 0.78 lb (355 g)

Environment

Operating temperature	- 31 °F...+ 150 °F (- 35 °C...+ 66 °C)
Climatic class acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3K5 (except condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (except condensation and formation of ice)
Long-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)

Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Inverse time curve operation (including contactor)



Technical data: Loop monitor GM420

Insulation coordination acc. to IEC 60664-1 / IEC 60664-3

Rated voltage	AC 400 V
Rated impulse voltage / pollution degree	4 kV / 3
Protective Separation (reinforced insulation	(A1, A2) - (E, KE) - (11, 12, 14) - (21, 22, 24)
Voltage tests to IEC 61010-1:	
(E, KE) - [(A1, A2), (11, 12, 14)]	3.32 kV
(E, KE) - (21, 22, 24)	2.21 kV
(A1, A2) - (11, 12, 14) - (21, 22, 24)	2.21 kV

Supply voltage

Supply voltage Us	AC/DC 70...300 V
Frequency range of Us	15...460 Hz
Power consumption	≤ 3.5 VA

Measuring circuit

Loop resistance R _m :	
Measuring range R _m	0...100 Ω
Measuring current I _m	DC 20 mA
Measuring voltage U _m	≤ DC 24 V
Extraneous voltage U _f :	
Measuring range U _f	AC 0...50 V
Rated frequency f _n	42...460 Hz
Measuring loop disconnection at U _f	≥ 12 V
Measuring loop reconnection	≤ 10 V
Extraneous voltage U _f	≤ 440 V
Permissible extraneous DC voltage without measurement influence DC 0 V	

Response values

Loop resistance > Alarm 1	0.1...100 Ω
Resolution of setting R = 0...10 Ω	0.1 Ω
Resolution of setting R = 10...100 Ω	1 Ω

Time behavior

Start-up delay t	Adjustable 0...99 s
Response delay t _{on1/2}	Adjustable 0...99 s
Delay on release t _{off}	Adjustable 0...99 s

Operating time

t _{ae} in case of open loop connection (R > 50 k Ω)	≤ 40 ms
t _{ae} in case of closed loop connection (>R)	≤ 500 ms
t _{ae} in case of extraneous voltage (> V) and overload (OL)	≤ 100 ms
Response time t _{an}	t _{an} = t _{ae} + t _{on1/2}
Recovery time t _{an}	≤ 300 ms
Recovery time t _{ab} after disconnection for safety reasons	≤ 1 s

Technical data: GFGC panels

System voltage (universal)	120 , 208 , 208/120, 277, 480, 480/277, 600 V
Enclosure rating	NEMA 4
Enclosure size, 30 A panel	12" x 12" x 6"
Enclosure size, 60 A and 100 A panel	16" x 12" x 6"
Fuse Rating	Class CC Time Delay Fuse, 8/10 A, 600 VAC

Switching elements

Number of switching elements	2 SPDT contacts
Operating principle, adjustable	normally energized or de-energized operation

Electrical service life under rated operating conditions	10,000 switching cycles
Contact data acc. to IEC 60947-5-1	
Utilization category	AC-13 AC-14 DC-12 DC-12 DC-12
Rated operational voltage	230 V 230 V 24 V 110 V 220 V
Rated operational current	5 A 3 A 1 A 0.2 A 0.1 A
Minimum contact load	1 mA at AC / DC ≥ 10 V
Fault memory behavior	Latching or non-latching operation

General data

Operating mode	continuous duty
Mounting	any position
Protection class, internal components (IEC 60529)	IP30, NEMA 1
Protection class, terminals (IEC 60529)	IP20, NEMA 1
Enclosure material	polycarbonate
Screw mounting	2 x M4
DIN rail mounting acc. to	IEC 60715
Flammability class	UL94V-0
Weight	≤ 0.33 lb (150 g)

Environment / EMC

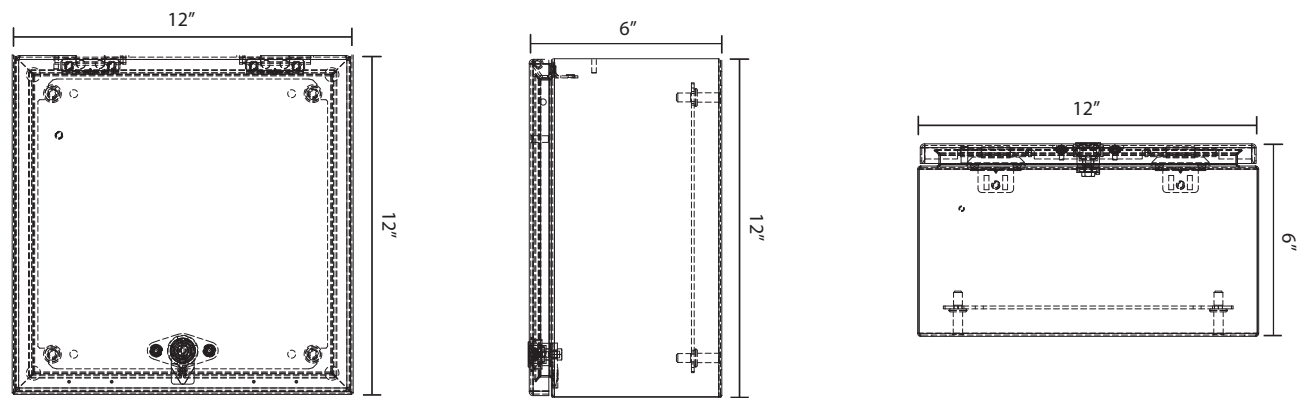
EMC	IEC 61326
Operating temperature	- 13 °F...+ 131 °F (- 25 °C...+ 55 °C)
Climatic class acc. to IEC 60721	
Stationary use (IEC 60721-3-3)	3K5 (except condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (except condensation and formation of ice)
Long-time storage (IEC 60721-3-1)	1K4 (except condensation and formation of ice)

Classification of mechanical conditions IEC 60721	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

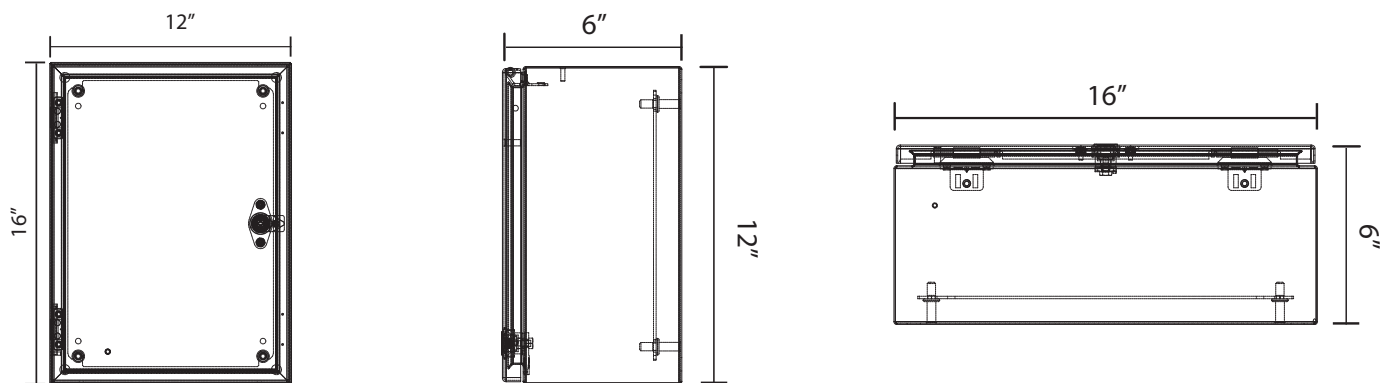
Connections

Connection type specification for:	Screw terminals
Rigid/flexible conductor sizes	AWG 24...12 / 24...14
Stripped length	0.31...0.35 in (8...9 mm)
Tightening torque	0.36...0.44 ft-lb (0.5...0.6 N-m)
Connection type specification for:	Push-wire terminals
Rigid/flexible conductor sizes	AWG 24...14
Flexible with core end sleeve	AWG 24...16

Dimensions: GFGC-30 enclosure



Dimensions: GFGC-60 and GFGC-100 enclosure



Ordering Information

Load Ampere Rating	Mfg. Reference No.	Type	Ordering Number
30 A	LG30-600-120-3/4-4-PA-CH-XSLU	GFGC-30	B541300044
60 A	LG60-600-120-3/4-4-PA-CH-XSLU	GFGC-60	B541300045
100 A	LG100-600-120-3/4-4-PA-CH-XSLU	GFGC-100	B541300046



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