

## GC-200 Ground-Fault Relay System with GC2DSP Display

### Class 600

### Introduction

The GC-200 Ground-Fault Relay System protects a distribution system from low-level ground faults and arcing faults, which conventional circuit breakers and fuses often cannot detect until serious damage has been done. It is estimated that approximately 80–85% of all faults begin as ground faults.

Ground faults are unintentional current paths to the system ground, frequently due to reduced insulation or physical damage to insulation. They may occur in main, feeder, or branch circuits. If they are not detected and corrected, ground faults can lead to equipment damage or injury to personnel.

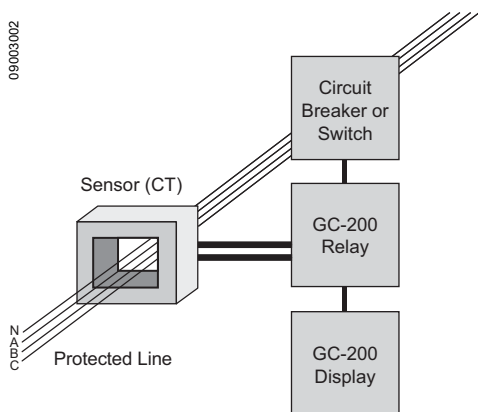
### Additional References

Bulletin 48049-212-05 Instruction bulletin for GC-200 Ground Fault Relay  
Bulletin S1A43091 Instructions for GC2DSP Display  
Bulletin 0600DB0001 Reducing Fault Stress with Zone-Selective Interlocking

### Ground-Fault System

A typical ground-fault protection system (Figure 1) includes the following (the relay, display, and sensors are described in greater detail later in this bulletin):

**Figure 1: A Typical Ground-Fault Protection System**



- a ground-fault sensor (current transformer) installed around all phases and neutral (the selection of toroid or open-frame models available from Schneider Electric™ is discussed later);
- a GC-200 Ground-Fault Relay to detect ground-fault current (three pickup ranges are available, as specified in Table 1);
- a disconnect device such as a circuit breaker with shunt trip or a bolted pressure switch with trip solenoid to open the circuit on which the ground fault is detected (this can be existing hardware or a new device installed in conjunction with the GC-200 relay);
- a GC2DSP Ground-Fault Display and cables (optional);
- an optional restraint interface module (RIM) when using zone-selective interlocking (ZSI) with other devices (for more information on ZSI see data bulletin 0600DB0001, “Reducing Fault Stress with Zone-selective Interlocking”).

The GC-200 product line includes three models of relays with pickup settings ranging from 3 A to 1200 A to provide low-level or high-level ground-fault detection for several purposes:

- to meet National Electrical Code (NEC) requirements for ground-fault protection of main service over 150 volts and 1000 A or more;
- to avoid shutting down an entire facility when only a feeder or branch circuit breaker has a ground fault; and
- to better protect sensitive equipment located far downstream of the main circuit breaker.

Typical applications of ground-fault relays include manufacturing, refrigeration, mining, and fire protection; they can be found in utility stations and substations, steel and aluminum mills, malls and stores, and on construction sites.

## Equipment Ground-Fault Protection

Equipment ground-fault protection is a subject that is often overlooked when designing a protection scheme for an electrical system. Often, the only question asked is, “Does the NEC require it?” However, the minimum NEC requirements specify only that “ground-fault protection of equipment [be] provided for solidly grounded wye electrical services of more than 150 volts to ground, but not exceeding 600 volts phase-to-phase for each service disconnect rated 1000 amperes or more” (NEC 230-95, 215-10, 240-13).

The real question that should be asked when specifying a circuit breaker for overcurrent protection is, “Wouldn’t one also need ground-fault protection to protect equipment against the most common of all faults?”

A common rationale for not applying ground-fault relays is, “The overcurrent devices will take out the fault.” However, this is not necessarily true in the case of an arcing fault, which may have a current level below the overcurrent pickup level.

Ground-Fault protection is recommended at more levels than the minimum required by the NEC for these reasons:

- to avoid shutting down an entire facility when only a branch or feeder circuit breaker has a ground fault;
- to protect equipment located far downstream of the main circuit breaker;
- to supplement normal overcurrent protection—it is estimated that 80–85% of faults begin as ground faults.

The GC-200 relay and peripheral equipment are suitable for the following solidly-grounded electrical environments:

- any low-voltage power distribution system, from main circuit breakers to downstream locations
- single-phase and three-phase 50/60 Hz
- industrial and commercial installations

Providing coordinated ground-fault protection at the feeder and branch circuit breaker levels can minimize the costs of having a production shutdown because of an isolated ground fault at a feeder or branch circuit breaker level.

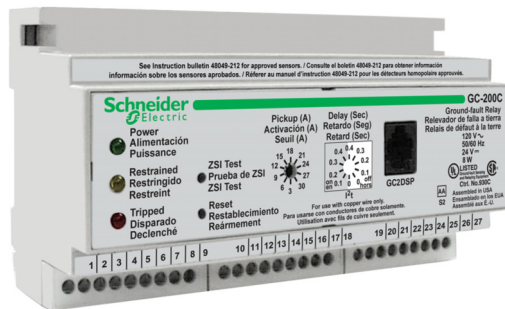
Costs of troubleshooting and replacing damaged circuits or equipment due to sustained, arcing, low-level ground faults can be minimized with a comprehensive ground-fault detection and protection system.

## GC-200 Ground-Fault Relay

The heart of the GC-200 Ground-Fault Relay System is the GC-200 Ground-Fault Relay. The relay receives the zero-sequence signal (composite of phases A, B, C, and Neutral) from the sensor and compares it to its pickup settings. If a ground-fault occurs, the relay operates its output contacts to cause an associated switch or circuit breaker to interrupt the faulted circuit (or alarm only, if so implemented).

The product line includes three models to cover the range from low-level branch circuit breakers to high-level feeder or main circuit breakers, with pickup settings from 3 A up to 1200 A, as listed in Table 1. Each model has ten switch-selectable pickup settings within its range. The pickup settings in the GC-200D and GC-200E relays can be further fine-tuned by using the GC2DSP display (in increments of 1 A for the 200D and 10 A for the 200 E).

Figure 2: GC-200 Ground-Fault Relay



Key features of the relay include:

- adjustable ground-fault current pickup (up to ten levels)
- time delay switch with instantaneous setting, four fixed-time delay settings, and four inverse I<sup>2</sup>t time delay settings
- two output contacts: 10 A Form A for disconnect of faulted circuit and 5 A Form C for alarm signal
- zone-selective interlocking (ZSI) for optimizing the response of coordinated circuit breakers and/or relays at other levels
- current sensors, including toroid (some with split core) and rectangular window current transformers (some with open frame)
- an optional GC2DSP display with LCD for viewing magnitude of ground-fault currents and setting of parameters
- 120 Vac and/or 24 Vdc power supply to provide flexibility
- DIN rail mounting of compact enclosure
- compact design
- full compatibility with Square D by Schneider Electric circuit breakers with Micrologic™ trip units (see Page 7)

Table 1: Relay Catalog Numbers and Applications

Catalog Number	Pickup Range (A)	Pickup Settings (A)	Typical Load (A)	Delay Range	Application
GC-200C	3.0–30.0	3, 6, 9, 12, 15, 18, 21, 24, 27, 30	1000–3000	Instantaneous, 0.1, 0.2, 0.3, 0.4 sec. (Fixed and inverse)	Branch circuit protection for motors or for coordination with upstream ground fault relays
GC-200D	30.0–300.0	30, 90, 90, 120, 150, 180, 210, 240, 270, 300	1000–3000	Same as above	Feeder circuits, cable protection, and to coordinate with mains
GC-200E	120.0–1200.0	120, 240, 360, 480, 600, 720, 840, 960, 1080, 1200	3000–6000	Same as above	Main circuits per NEC

The GC-200 Ground-Fault System is the culmination of years of experience in ground-fault protection by Schneider Electric™.

The GC-200 Ground-Fault Relay is the latest addition to a family of Schneider Electric™ products used to satisfy the need for equipment ground-fault protection. These products include:

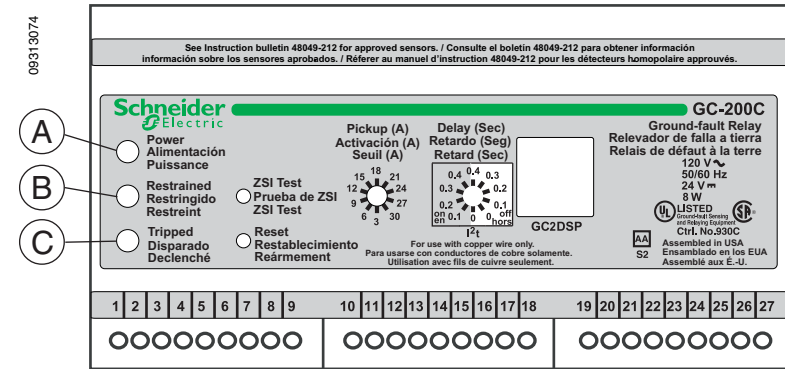
- HOM-GFI Homeline™ ground-fault interrupter
- QO-GFI ground-fault interrupter
- QO-EPD and HOM-EPD equipment protection devices
- Type GA Ground-Censor™
- Micrologic™ circuit breakers
- Micrologic add-on ground-fault modules
- Masterpact™ circuit breakers with electronic trip units, with options for ZSI and a neutral transformer

## Indicator Lights

The front panel of the GC-200 relay has three indicating lights to show status:

- Power (**A**): Green LED indicates relay is powered
- Restrained (**B**): Yellow LED indicates the relay is receiving a restraint signal from a downstream relay or a Micrologic trip unit or is self-restrained
- Tripped (**C**): Red LED indicates relay has tripped on a ground fault

**Figure 3: GC-200 Indicator Lights**



The Restrained light is used in conjunction with the ZSI test push button to verify ZSI wiring in the field. If the wiring is intact, operation of a downstream ZSI test button will cause the first upstream relay to indicate Restrained.

## Reset Functions

The relay may be reset in four ways:

- by pressing the Reset button on the front of the GC-200 relay;
- by interrupting the control power to the relay;
- externally, by using a remote normally open (NO) push-button switch wired to the Reset input terminals of the relay; or
- by pressing the OK to Reset button on the GC2DSP display.

## Auxiliary Trip

The GC-200 relay can be used by other devices to interrupt the load current by means of the Auxiliary Input terminals. For example, an external device such as a Programmable Logic Controller output could apply a 120 Vac signal to cause an immediate trip of the relay and the associated switch or circuit breaker.

## GC2DSP Ground-Fault Display

The optional GC2DSP Ground-Fault Display is a versatile unit that provides a local or remote alphanumeric read-out of the relay settings. The display allows adjustment of the pickup settings on the GC-200D and GC-200E models in smaller increments—for more accurate coordination—than the selector switch alone on the GC-200 relay allow.

**Figure 4: GC2DSP Ground-Fault Display**



Use the GC2DSP to:

- Configure parameters for the GC-200 Series 2 Relay.
- Display information about the GC-200 Relay configuration and operation.
- Monitor ground fault trips detected by the GC-200 Relay.
- Control the GC-200 Relay remotely.

The display screen is continuously backlit. Contrast and brightness is adjustable by using the Service menu.

The GC2DSP display connects to the GC-200 relay using a cable with RJ45 connectors on each end.

Cables are available in three lengths:

- 1 m (3.28 ft)
- 3 m (9.84 ft)
- 5 m (16.4 ft)
- 10 m (32.8 ft)

The GC-200 relays can be used as stand-alone units without the display in cost-sensitive applications.

Additional GC2DSP features include:

- remote testing of ground-fault relay, with or without circuit breaker operation;
- a trip test to activate the trip indicator, auxiliary relay, and, if selected, tripping relay;
- remote resetting of the ground-fault relay;
- English, Spanish, or French display—user selects;
- surface-mountable option
- Powered from the GC-200 relay.

## Sensors

A variety of current transformers (CTs) may be used as sensors, including rectangular window CTs with open frame or toroids for smaller conductors. All phases and neutral conductors (but not ground) of the line being protected must pass through the sensor in order to provide the zero-sequence sensing required by the GC-200 relay. Sensors available from Schneider Electric™ include those in Table 2.

The test circuit inputs of these sensors allow injection of test signals to simulate ground faults and diagnose the system. The test signals may be obtained from a temporary test set or a permanent test setup including a control transformer and push button.

Figure 5: Sensors

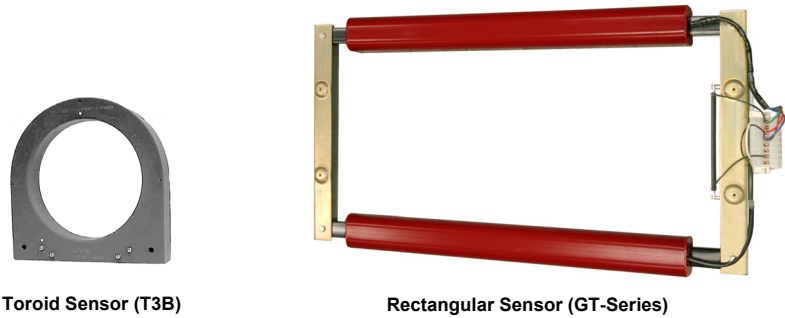


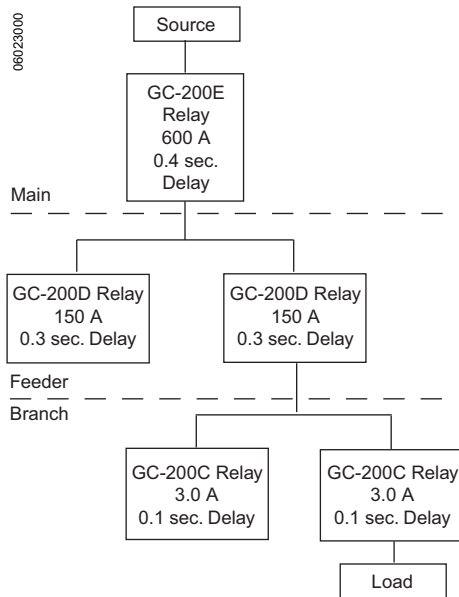
Table 2: Sensors for GC-200 Ground-Fault Relays

Relay Cat. No.	Sensor Cat. No.	Sensor Type	CT Ratio	Sensitivity	Overall Length	Overall Width	Thickness	Actual Window Length or Dia.	Actual Window Width
					in. (mm)	in. (mm)		in. (mm)	in. (mm)
GC-200C GC-200D	T2A	Toroid	1000:1	200 mA to 1200 A	4.1 (104)	4.1 (104)	1.8 (46)	1.875 (48) Dia.	—
	T3A	Toroid	1000:1		5.3 (135)	5.3 (135)	1.8 (46)	2.75 (70) Dia.	—
	T3A-S	Toroid, split-core	1000:1		5.6 (142)	7.5 (191)	2.0 (51)	2.625 (67) Dia.	—
	T6A	Toroid	1000:1		8.3 (211)	8.4 (213)	1.5 (38)	5.75 (146) Dia.	—
	T6A-S	Toroid, split-core	1000:1		8.6 (218)	9.8 (249)	2.0 (51)	5.75 (146) Dia.	—
GC-200D	T9A	Toroid	1000:1	12.0 (305)	12.0 (305)	2.0 (51)	8.75 (222) Dia.	—	
	R7-13A	Rectangular	1000:1	200 mA to 1200 A	17.0 (432)	12.0 (305)	2.0 (51)	13.5 (343)	7.5 (191)
	R4-17A		1000:1		20.8 (528)	7.5 (191)	2.0 (51)	17.6 (447)	4.25 (108)
R8-26A	1000:1		30.3 (977)		13.1 (333)	2.3 (58)	26.5 (673)	8.0 (203)	
GC-200E	All "A"-type sensors above, plus:	See above						Usable Window Length <sup>1</sup>	Usable Window Width <sup>1</sup>
								in. (mm)	in. (mm)
	RZ 5-11	Rectangular, open frame	1000:1	100 A to 1200 A	15.4 (391)	9.5 (241)	2.9 (74)	9.0 (229)	2.5 (64)
	RZ 5-21		1000:1		25.4 (645)	9.5 (241)	2.9 (74)	19.0 (483)	2.5 (64)
	RZ 5-31		1000:1		35.4 (899)	9.5 (241)	2.9 (74)	29.0 (737)	2.5 (64)
	RZ 5-35		1000:1		37.0 (940)	9.5 (241)	1.8 (48)	33.0 (838)	2.5 (64)
	RZ 10-11	Rectangular, open frame	600:1	100 A to 1200 A	15.4 (391)	15.5 (394)	2.9 (74)	9.0 (229)	2.5 (64)
	RZ 10-21		600:1		23.0 (584)	15.5 (394)	2.9 (74)	19.0 (483)	8.5 (216)
	RZ 10-31		600:1		35.4 (899)	15.5 (394)	2.9 (74)	29.0 (737)	8.5 (216)
	GT-912	Rectangular, open frame	600:1	100 A to 1200 A	16.3 (414)	13.0 (330)	3.0 (76)	8.5 (216)	8.5 (216)
	GT-918		600:1		22.3 (566)	13.0 (330)	3.0 (76)	14.5 (368)	5.5 (140)
	GT-930		600:1		34.3 (871)	13.0 (330)	3.0 (76)	26.5 (673)	5.5 (140)
	GT-1218		600:1		22.3 (566)	16.0 (406)	3.0 (76)	14.5 (368)	5.5 (140)
GT-1224	600:1		28.3 (719)		16.0 (406)	3.0 (76)	20.5 (521)	8.5 (216)	
GT-1230	600:1		34.3 (871)		16.0 (406)	3.0 (76)	26.5 (673)	8.5 (216)	
GT-1327	600:1		31.3 (795)		15.2 (386)	3.0 (76)	24.0 (610)	8.5 (216)	
GT-1330	600:1		34.3 (871)		15.2 (386)	2.8 (71)	27.0 (686)	9.5 (241)	
GT-1530	600:1		34.3 (871)		19.0 (483)	3.0 (76)	26.0 (660)	11.0 (279)	

<sup>1</sup> NOTE: Usable window length and width dimensions deduct 1 in. (25.4 mm) on each side of the actual window length or width dimension

## System Implementation

**Figure 6: Coordination of Multiple Levels of Ground-Fault Protection**



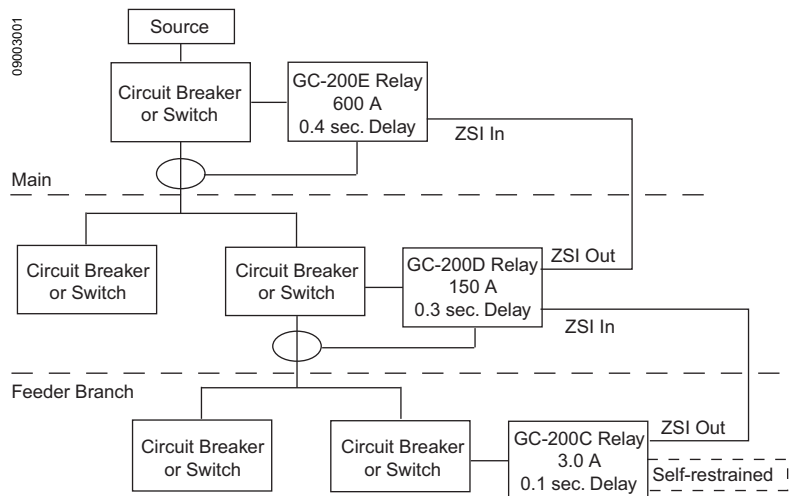
When designing a ground-fault protection system, consideration must be given to two conflicting requirements, namely, maximizing the continuity of service in as much of the system as possible, yet minimizing potential damage to equipment from thermal stress. The GC-200 system allows this optimization.

The first requirement can be provided by coordination of the ground-fault protection scheme. Coordination involves setting longer time delays and higher fault current pickups on upstream devices so as to allow downstream devices to trip first, thus localizing the interruption of service at the lowest level possible. The GC-200 allows fine tuning of the pickup and delay settings to allow greater flexibility in coordination with both upstream and downstream devices. See Figure 6.

The second requirement can be provided by using the ZSI feature of the GC-200 relays. ZSI allows a relay detecting a ground fault to send a ZSI signal to other relays or circuit breakers at higher levels, causing them to restrain from tripping until the fault duration exceeds their time delay settings. The relay at the lowest level detecting a fault will not receive a ZSI signal and therefore will operate without intentional delay (instantaneous). This clears the fault at the lowest level possible (minimizing the scope of the outage) and in the shortest time possible (minimizing the stress on the power system). See Figure 7.

The ZSI signals of the GC-200 relay are compatible with PG, PJ, PL, RG, RJ, RL, and Masterpact™ circuit breakers with Micrologic™ series 5.0 A trip units and higher and other GC-200 relays. For other signal levels, large quantities of devices or long signal wiring, an optional S48890 or S48895 Restraint Interface Module (RIM) may be required. For more information on ZSI see data bulletin 0600DB0001, “Reducing Fault Stress with Zone-selective Interlocking.”

**Figure 7: ZSI in a Coordinated System of Ground-Fault Relays and Circuit Breakers**



A need to set up the relay for an alarm only (but not protection), may be encountered in situations where an automatic shutdown would introduce additional hazards and therefore an operator must make the shutdown decision (for example, continuous industrial processes or a fire pump circuit).

## Applications of Ground-Fault Protection

In many applications, the GC-200 relay should be applied for multi-zone protection and not just for main circuit breaker protection. The relay is intended to protect against arcing ground faults, which can not necessarily be detected with overcurrent circuit breakers and fuses until serious damage has been done.

**NOTE:** The GC-200 Ground-Fault Relay may be used if the application requires one or more of the following:

- equipment protection, including motors, transformers, cables, and bus duct;
- ground-fault protection at any level—main, feeder, or branch circuit breakers;
- self-protection of the substation, switchboard, or distribution system from damage caused by arcing ground faults;
- a ground-fault alarm for emergency systems, per the NEC; or
- coordinated ground-fault protection to avoid nuisance tripping at a level upstream of the ground fault.

**NOTE:** Do NOT use the GC-200 Ground-Fault Relay if any of the following apply:

- a shunt trip can not be added to existing circuit breaker or switch;
- the thermal-magnetic circuit breaker includes ground-fault protection;
- people protection (4-6 mA, per UL) is required; or
- the NEC or another code disallows it—for example, emergency supplies, U.S. Coast Guard vessels, etc.

**NOTE:** The GC-200 Ground-Fault Relay may NOT be needed if any of the following apply:

- the electronic trip circuit breaker includes a ground-fault function;
- the electronic trip circuit breaker can have ground-fault option added economically;
- the user is content to allow the main circuit breaker to trip on a ground-fault at the feeder or branch level (nuisance tripping); or
- the user is content to allow extensive damage at lower levels due to high trip level at a main circuit breaker.



## Replacing a GC-100 Ground-Fault Relay with a GC-200 Ground-Fault Relay

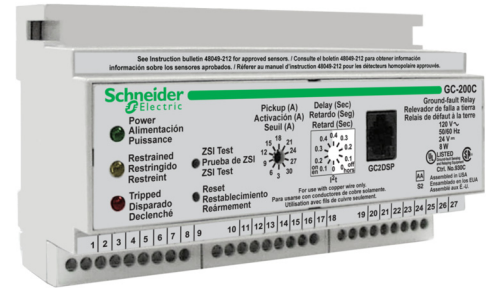
The GC-200 Ground-Fault Relay meets or exceeds all of the functional specifications of its predecessor, the GC-100 Ground-Fault Relay. Thus the GC-200 relay can be used as a replacement for the GC-100 relay, but with the following considerations:

- 1. Mounting Space:** the GC-200 relay is 6.4 in (162.56 mm) wide and 3.54 in. (89.916 mm) high; the GC-100 relay is 5.6 in. (142.24 mm) wide and 9.6 in. (243.84 mm) high. If horizontal space is limited, the GC-200 relay can be rotated 90 degrees.
- 2. Mounting of Relay:** The GC-200 relay mounts on a 35 mm DIN rail. The rail requires different mounting holes than the GC-100 relay.
- 3. Connections:** Refer to the wiring diagrams for the new GC-200 relay and the old GC-100 relay before proceeding with wiring.
- 4. Monitor Module:** The existing test and reset buttons may be used for those functions of the GC-200 relay, except they will not allow a test without tripping.  
**NOTE:** The GC2DSP Display provides a test of the relay electronics in either “no trip test” or “trip test” modes.
- 5. ZSI:** The ZSI function of the GC-200 relay is not compatible with the GC-100 relay and other devices linked to it. The GC-200 can be used only by adding an S48890 or S48895 RIM to provide compatible interface with existing devices.
- 6. GC2DSP Display:** This provides functions not available in the GC-100 relay. These functions can be added to the GC-200 relay with this optional display.

Figure 8: Ground-Fault Relays



GC-100 Ground-Fault Relay



GC-200 Ground-Fault Relay  
(DIN Rail Mounted)

## Specifications

**Table 3: Specifications**

Pickup Range (A)	Three models covering range from 3 A to 1200 A; see Table 1	
Time Delay Settings	Instantaneous plus both fixed and inverse I <sup>2</sup> t time delays of 0.1, 0.2, 0.3, and 0.4 sec.	
Output Contacts	Main trip	10 A @ 120 V resistive, Form A
	Alarm contacts	5 A @120 V resistive, Form C
Sensors	1000:1 CT, 600:1 CT, or 700:1 CT; or modified differential ground-fault (MDGF) input	
Inputs	Auxiliary trip input 120 Vac operating	
Pickup Accuracy:	± 10%	
Metering Accuracy	10% of I <sub>G</sub> + one digit	
Max. I <sub>G</sub> Accuracy	10%	
Maximum Readings	GC-200C	999.9 A
	GC-200D and GC-200E	9999 A
ZSI Signals	See page 7 for compatibility details.	
Power Requirements	120 Vac (+20/-45%) or 24 Vdc; 15 W	
Frequency of Operation	50/60 Hz	
Temperature Operating Range	GC-200 relay	-31°F to 176°F (-35°C to +80°C)
	GC2DSP display	Inside cabinet: -4°F to 140°F (-20 to + 60°C) Outside cabinet: -4°F to 131°F (-20 to +55°C)
Dimensions: in. (mm)	GC-200 Relay	6.3 (160.0) W x 3.54 (89.9) H x 57.4 (2.28) D; 35 mm DIN rail-mountable
	GC2DSP Display	4.67 (117) W x 2.76 (70) H x 2.19 (55) D
	Sensor	Variable ( <b>NOTE:</b> Table 2 on page 6 provides overall dimensions and window size dimensions for conductors)
Weight	GC-200 Relay	1.25 lbs. (0.57 kg)
	GC2DSP Display	0.88 lbs. (0.40 kg)
	Sensors	Variable
Performance Characteristics	See Trip Curve, Figure 10	
Standards	UL 1053; ANSI C37.90; CAN CSA C22.2 No. 144; FCC; RFI; EN6100; EMII: EN55022A	
UL File No.	E48368	

## GC-200 Relay Wiring

**Table 4: GC-200 Sensor Terminals**

Sensor Modules	Secondary Terminals		Test Signal Terminals	
	Signal	Common	Signal	Common
T Series	Sec.	Sec.	Test	Test
R Series	Sec.	Sec.	Test	Test
RZ Series	W1	W2	R3	R4
GT Series	X1 X3	X2 X4	X6	9

**Table 5: GC-200 Relay Terminals**

1	Trip Solenoid NO	10	Ground-Fault Sensor Input Common	19	Reset Input
2	Trip Solenoid Common	11	No connection	20	Reset Input Common
3	Alarm Contact NO	12	1000:1 Ground-Fault Sensor Input	21	Auxiliary Trip Input
4	Alarm Contact NC	13	No connection	22	Auxiliary Trip Input Common
5	Alarm Contact Common	14	600:1 or 700:1 Ground-Fault Sensor Input	23	24 Vdc -
6	ZSI IN Signal Z3	15	No connection	24	24 Vdc +
7	ZSI IN Ground-Fault Z5	16	MDGF Signal Input	25	120 Vac Input
8	ZSI OUT Z2	17	No connection	26	No connection
9	ZSI OUT Signal Z1	18	MDGF Signal Common	27	120 Vac Common

Figure 9: Connections Diagram for GC-200 Ground-Fault Relays

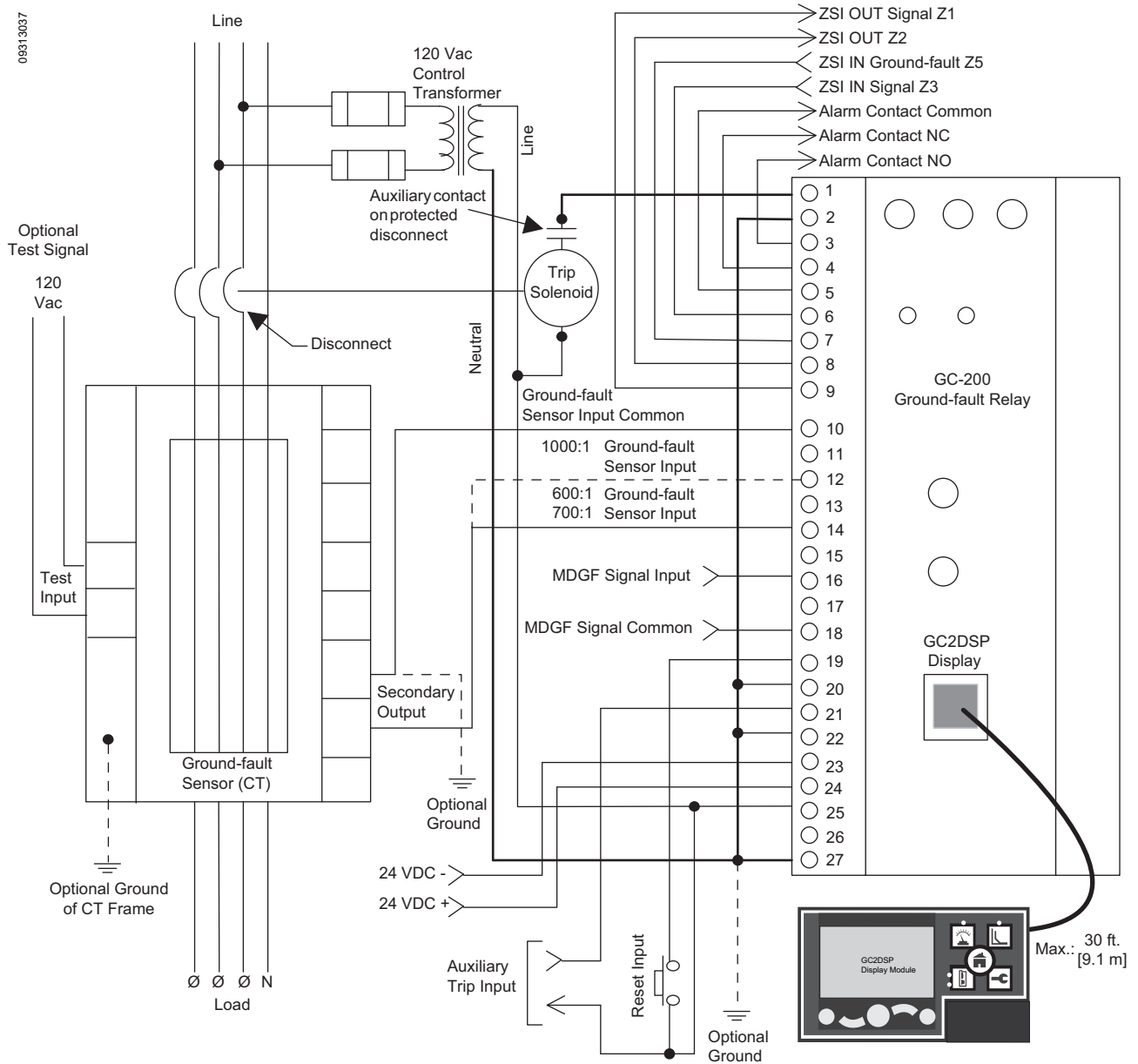
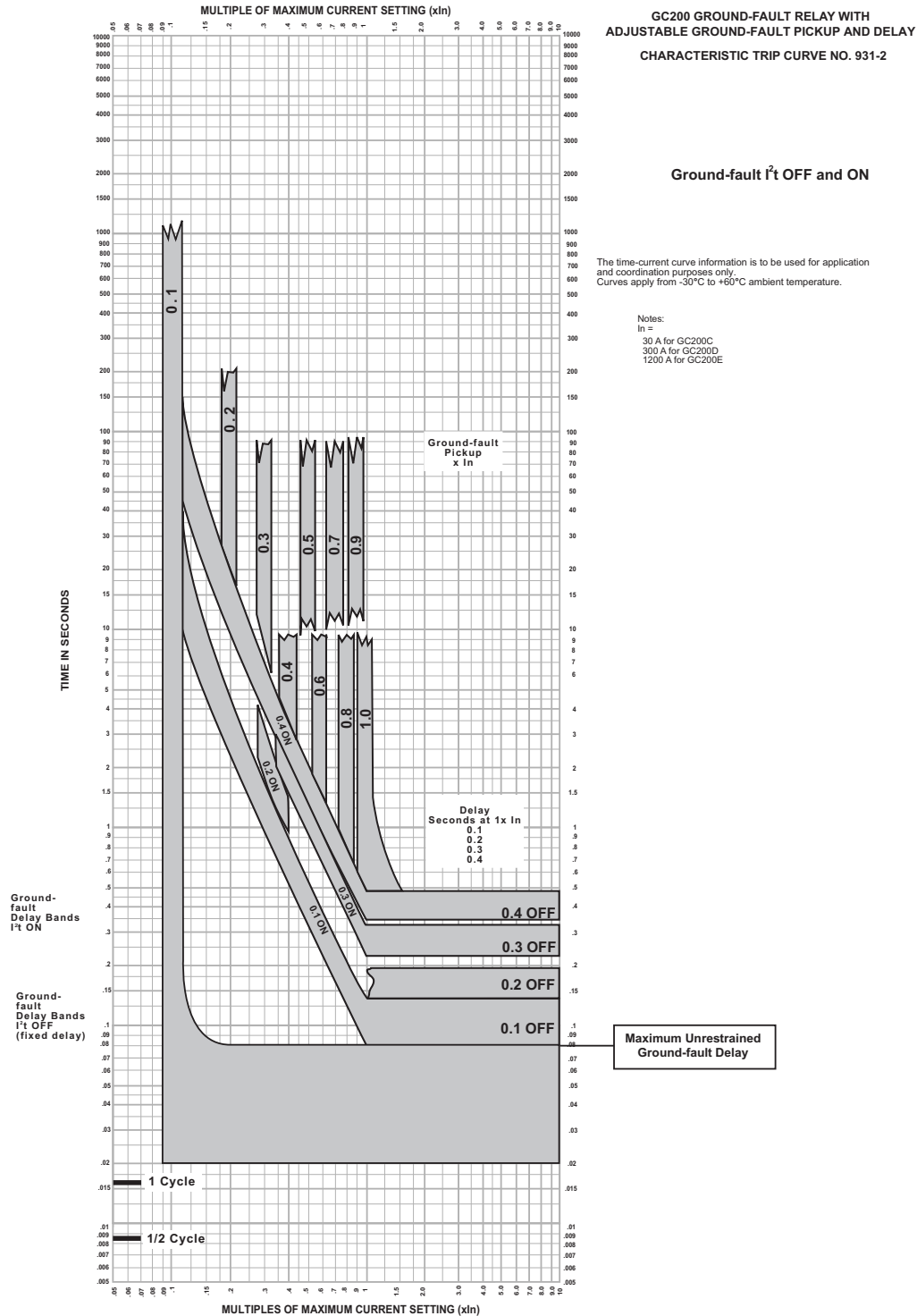


Figure 10: GC-200 Relay Trip Curve



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