

ABOUT I-GARD

I-Gard's commitment to electrical safety provides both industrial and commercial customers with the products needed to protect their electrical equipment and the people that operate them.

As the only electrical-safety focused company whose product portfolio includes neutral grounding resistors, high-resistance grounding systems and optical arc mitigation, we take pride in our technologies that reduce the frequency and impact of electrical hazards, such as arc flash and ground faults.

For those customers who have purchased from us over the last 30 years, you know us for the quality and robustness of our products, our focus on customer service and technical leadership. We build on this foundation by investing in developing new products in electrical safety education - including EFC scholarship program - by actively participating in the IEEE community programs on technical and electrical safety standard, and working with local universities at discovering new technologies. We remain unrelenting in our goal of improving electrical safety in the workplace.

Our commitment to excellence is validated by long-standing relationships with industry leaders in fields as diverse as petroleum and gas, hospitals, automotive, data centers, food processing, aerospace, water and waste water plants, and telecommunications. We provide our customers with the product and application support required to ensure that their electrical distribution system is safe and reliable.

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1. INTRODUCTION

IMPORTANT: Each GCHK-100 relay and its auxiliary part is carefully inspected before being packed for shipping. The unit should be examined immediately upon receipt. If damage or indication of rough handling is apparent, I-Gard should be notified promptly if replacements for damaged goods are necessary. If units received are not to be installed immediately they should be stored in their original packaging in an area free of dust and moisture.

To service the special needs of the mining industry I-Gard developed the GCHK-100 ground fault relay to protect personnel and equipment in underground or above ground applications.

The GCHK-100 is state of the art protection for mobile, trailing cable equipment, providing superior accuracy and flexibility to the user. The micro controller based design reduces the likelihood of false tripping. The relay automatically operates in three distinct modes:

- Ground Fault Detection and control
- Ground resistance checking and control through the use of an auxiliary pilot wire
- Frame touch voltage detection and control

Designed for use with resistance grounded systems up to 4160V. It could also be used with any grounded system in branch circuit applications.

The relay can also be used with an external remote indicator (mGARD-SYM), capable of remotely displaying readings and allowing remote RESET and TEST. The mGARD-SYM can monitor up to 50 GCHK-100 relays and provides an isolated connection to an external modbus network. Alternatively, a standard LED based remote indicator (GCHK-DRI) can be used for remote indication.

Ground fault detection requires the use of current sensors, and the GCHK-100 is designed to operate with I-Gard TxA type sensors or a wide variety of sensors with ratios of 1000:1, 600:1 and 40:1 (200:5). The sensors are typically mounted in the substation where the GCHK-100 is installed. Detection of ground faults is important to prevent arcing faults in equipment where electric shock and fire can occur and cause serious equipment and personnel hazards.

Operator safety from electrical shock depends to a large extent on the integrity of the grounding of energized equipment. Therefore, it is vital to know if grounding has been compromised. To do this an auxiliary conductor (pilot wire) is used in trailing cable to mobile equipment. The GCHK-100 monitors the loop resistance and trips when it exceeds a preset value.

Additionally the relay detects if the ground loop has been shorted as can happen when the trailing cable is cut accidentally. For this purpose a pilot wire terminator is connected between the pilot wire and ground. I-Gard provides a special zener package for this purpose (GCHK-ZT).

I-Gard offers two versions of the GCHK-100 relay; the standard GCHK-100 and the GCHK-100-Z12V. The -Z12V is ideal for systems with high induced frame voltages, this relay requires a 12V zener termination as opposed to the 6V termination.

In the event of a ground connection failure and internal leakage within the mobile equipment, it is possible for the frame of the equipment to become live and present a shock hazard to personnel in the vicinity. The GCHK-100 has the capability to monitor and control dangerous frame voltages.

2. CATALOGUE NUMBER

Table 2.1 indicates the product group for the GCHK-100 family from I-Gard.

Table 2.1 Catalogue Numbers

CATALOGUE	DESCRIPTION	NO REQUIRED/SYSTEM
GCHK-100	Mining relay (for 6V termination)	1
GCHK-100-Z12V	Mining relay (for 12V termination)	1
GCHK-DRI	LED based remote indicator	1*
GCHK-ZT	6V ground check zener terminator	1
mGARD-SYM	Remote Indicator	1*
T SERIES	ZSCS current sensors	1

*Either GCHK-DRI or mGARD-SYM can be used (or both if desired), however it is not necessary; in fact, the GCHK-100 can be used without either of them.

The GCHK-100 relays can accept standard 5 or 50 Watt zener diodes as terminators. Part numbers are shown in table 2.2.

Table 2.2 Pilot Wire Terminations

GCHK-100	VALUE	5W	50W
Standard	5.6V, 5%	1N5339B	1N4553B
-Z12V	12V, 1%	Not Recommended	1N3311D

*The 1N5339B zener diode is included with the GCHK-100 relay.

3. CURRENT SENSORS

Ground fault detection is achieved by the use of an external zero sequence current sensor (ZSCS). The relay supports the following zero sequence current sensors or current transformers:

Any I-Gard T type sensors (e.g. T2A, T3A, T6A and T9A)

1000:1

10:0.0167 (600:1) Bender

200:5 (40:1) Startco

Surge protection is built into the relay; please refer to the electrical specifications data for withstand ratings. ZSCS with, or without, built-in protection can be used with the GCHK-100 relay. The terminal block provides a common ground and a terminal location for each of the three sensor types.

*Note: Only one type of ZSCS can be used at a time.

4. PILOT WIRE TERMINATOR

This terminating diode is standard throughout the industry. It has two terminals marked GC and G. The GC terminal is connected to the pilot wire inside the mobile equipment enclosure. The G terminal of the GCHK-ZT is connected to the frame ground of the mobile equipment. The purpose of the diode is to allow the ground fault relay to determine if the ground loop has been shorted. A shorted ground loop would appear as normal loop impedance if this were allowed to happen, while in fact, the mobile equipment may be completely ungrounded. Loss of zener voltage therefore causes the TRIP relay to operate and disconnect the power.

The GCHK-100 uses a 6V (5.6) terminator whereas the GCHK-100-Z12V relay uses a 12V terminator. Both are zener diode type terminations.

5. REMOTE INDICATION

GHCK-DRI

A simple remote indicator is available as an option, which provides indication of the status of the GCHK-100. The GCHK-DRI has all three status lights that are normally visible on the GCHK-100 as well as a reset button. This allows the relay to be monitored conveniently and RESET if necessary. The relay may also be tested by pressing the RESET/TEST button twice quickly.

The GCHK-DRI is flush-mounted in a panel with four ½ in x 6-32 screws with nuts. A rectangular opening of 82 x 51 mm (3 ¼ x 2 in) is required for mounting as shown in Figure 11.3.

A 5-conductor cable with 22 gauge or larger conductors may be used to connect the GCHK-DRI to the GCHK-100 relay. No shielding is required. No additional power supply is required to power the indicator.

Figure 5.1 shows the faceplate of the GCHK-DRI. This simple indicator extends the 3 red LED's and yellow push button on the GCHK-100 to a panel or remote location. Press the yellow button once to reset the relay or twice quickly to test (Warning: a test will cause the GCHK-100 to trip). The ground check LED is normally on. If the relay trips on a ground check condition, this LED will turn off. The ground fault and frame voltage LED's are normally off and only turn on if a fault occurs.

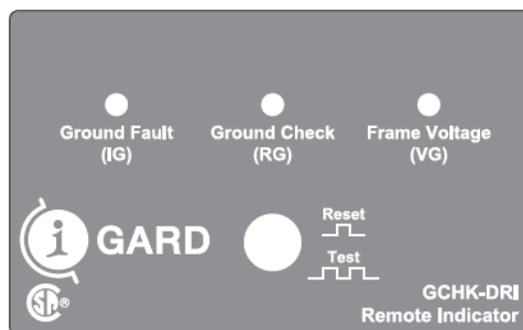


Figure 5.1 GCHK-DRI label

mGARD -SYM

The mGARD-SYM is a remote display indicator that is used in conjunction with I-Gard Corporation relays. The indicator has the capability to interconnect with up to 50 GCHK-100 relays in a bus network topology and provides detailed device status information.

The display has a 4-line screen that shows a list of connected devices. A device can be selected and viewed in detail. The relay mode, delay and trip level settings can be viewed (but not altered). The reset and test functions can be performed directly from the display.

Fault levels are displayed as a percentage of the selected trip level. If the trip level is 1 Amp and there is a 500 mA fault current, the reading on the display will appear as 50%. Ground check resistance and frame voltage are also displayed as a percentage of the trip setting. Screen navigation is done using a 4-button interface. The menus are displayed on the right side of the LCD, the left side is reserved for viewing relay information.

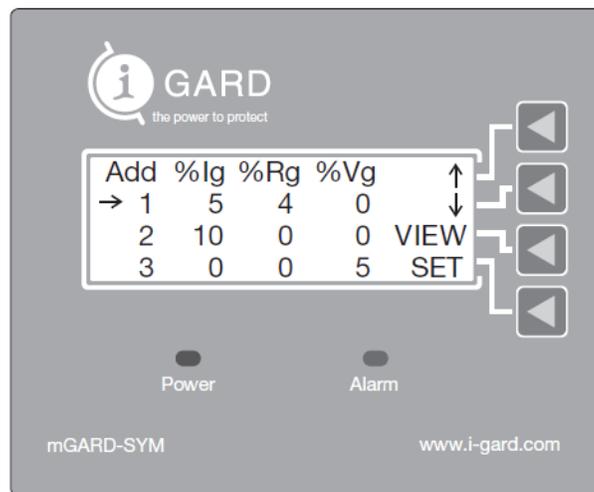


Figure 5.2 mGARD-SYM label

The mGARD-SYM also provides an isolated connection to an external Modbus RTU network. All 50 devices can be monitored remotely using a single configurable modbus address. Built in isolation protects the modbus network from hazardous voltages or transients. The display is compatible with several modbus speeds: 1200, 2400, 4800, 9600, 19200 and 38400 baud. Stop bits are selectable (1 or 2). Data available through modbus includes relay status and fault levels as well as remote reset.

For more information on the mGARD-SYM display refer to the mGARD-SYM manual (C-416EM).

6. INSTALLATION

Mounting

The GCHK-100 is supplied with a surface-mounting back-plate to provide simple 4-hole mounting, compatible with existing units. If holes do not exist, drill 4 holes in the mounting location for 4 No. 6 self-tapping or sheet metal screws.

Remote Units

The remote indicators are intended for flush mounting in a visible place. They require cutout areas in the mounting panels. See dimensional drawings for details.

Wiring (See Figure 6.2 Connection Diagram, and Figure 6.3 Relay Terminals)

Control Power

Control power is required for the GCHK-100 relay. The power may be either AC or DC and between 100 and 250V. A source should be rated at least 5VA in capacity (10VA for the GCHK-100-Z12V).

Control transformers may be connected to the LINE side of the protective breaker through protective fuses or any other reliable source of power. Failsafe operation cannot be achieved with LOAD side connection since the breaker would trip before the GCHK-100 had energized the TRIP relay thus preventing closure. Furthermore, indication would be defeated with the breaker tripped and the power removed.

Line terminals (12,13) are internally bonded and can be used interchangeably as are the neutral terminals (10,11). The additional terminals are available to simplify field wiring. When using the control voltage to also power the shunt trip coil or under voltage coil, a wire jumper can be used from one of the additional terminals. This is shown in Figure 6.1.

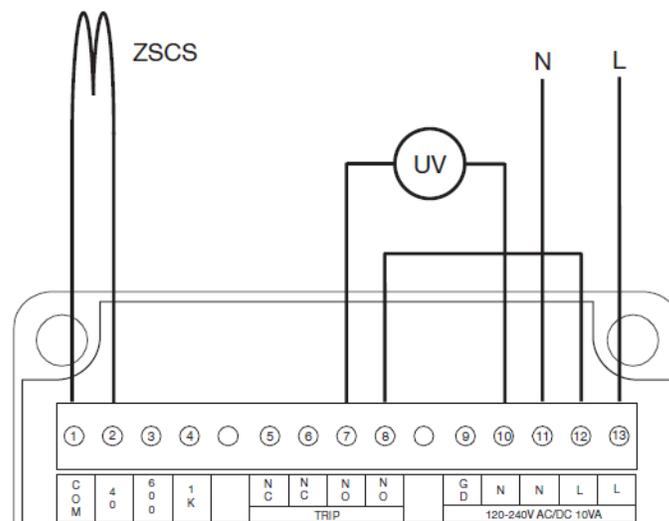


Figure 6.1 GCHK-100 with under-voltage coil, failsafe operating mode

Current Sensors

There are no restrictions on the location of the ZSCS sensor, No.14 unshielded wire may be used to connect the SEC terminals of the T type sensor to the 1000 Terminal and SENSOR ground as shown in Figure 6.2 connection diagram. For other sensor types, the 600 or 40 Terminal would be used depending on the ratio of the chosen sensor.

All phases supplied to the trailing cable must pass through the window of the ZSCS, which must be sized accordingly. I-Gard sensors range from 2in. to 9in. in diameter. Neither the ground conductor, nor the pilot ground conductors pass through the sensor; otherwise the ground fault detection would be disabled.

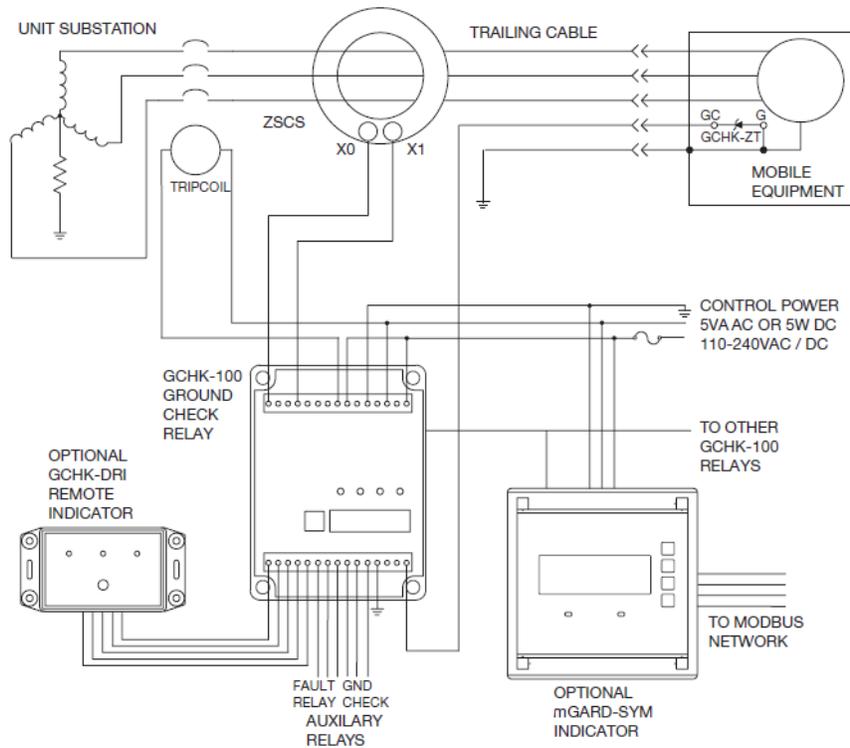


Figure 6.2 Connection Diagram shows the shunt trip coil of the protective circuit breaker connected to the NO contacts of the GCHK-100 relay. This is the non-failsafe connection. The NC contacts of the Form Z relay are not used in this case, but would be required in case of failsafe mode of operation.

Ground Check

Ground check is achieved by the use of a pilot wire (GC). This wire is usually a part of the power cable. It is used to carry a monitoring current to the machine being monitored. The pilot wire must be properly terminated at its end point (the machine being monitored). A zener diode terminator such as the GCHK-ZT or equivalent is required.

The ground terminal must be connected to a reliable system ground. This provides a return path for the current and completes the ground check loop. Ensure that all wires are firmly connected to eliminate adding resistance to the system.

Frame Voltage

The frame voltage monitor is an additional feature that is monitored through the ground-check pilot wire. No additional wiring is required for the frame voltage monitor.

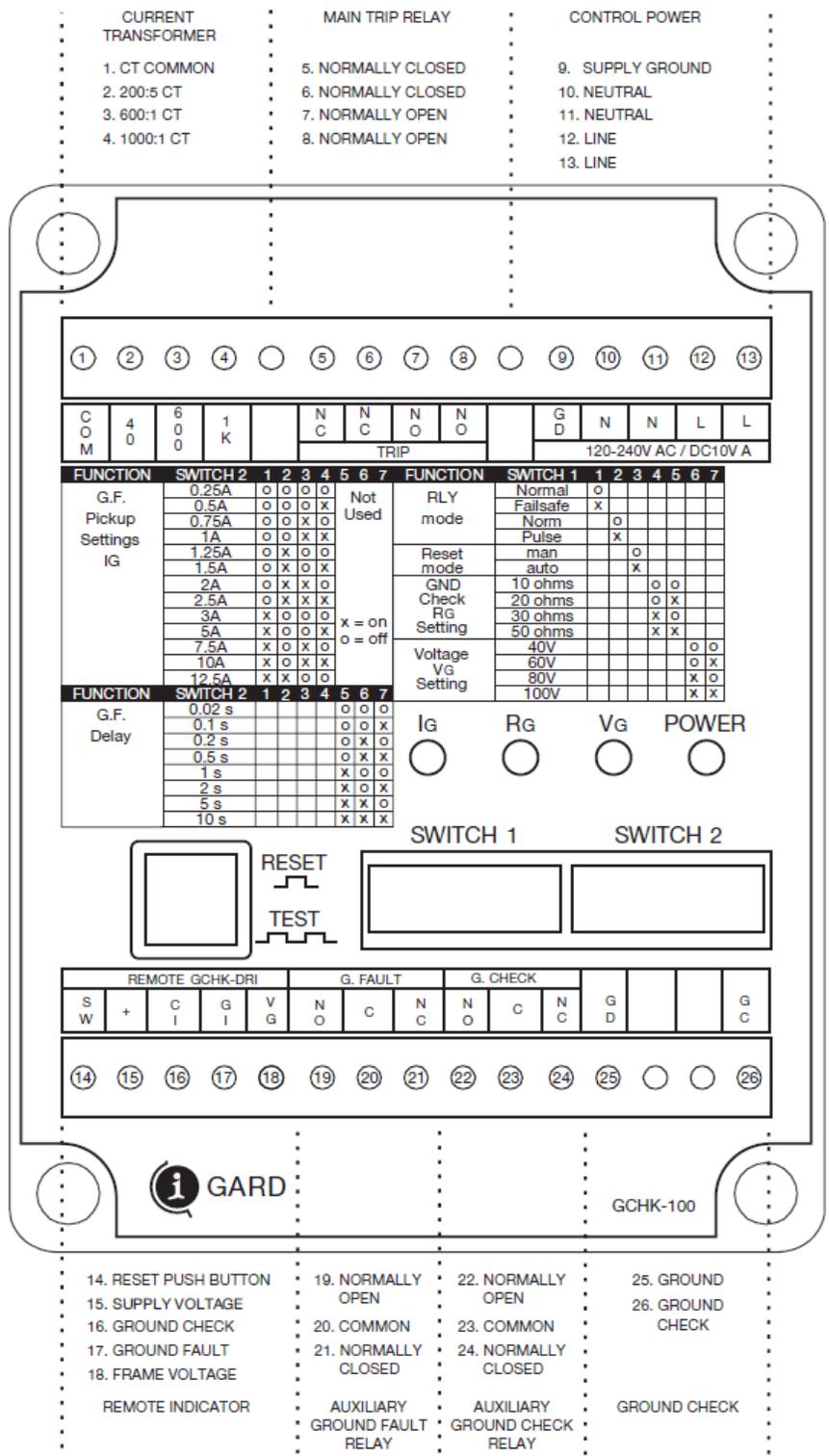


Figure 6.3 Relay Terminal Drawing

7. SETUP

Two DIP switches labelled SWITCH 1 and SWITCH 2 are accessible through the front faceplate. These are used to configure all GCHK-100 settings and modes of operation as shown below in Figure 7.1. The GCHK-100 can be operated in different modes selectable with Switch 1. See Table 7.1.

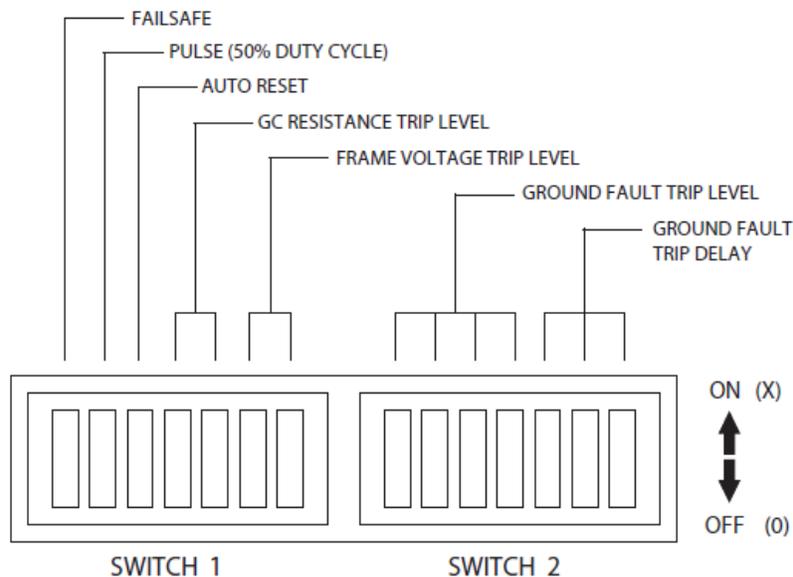


Figure 7.1 DIP Switch Setup

Normal mode is with a non-energized TRIP relay which becomes energized when the trip level is exceeded for a duration exceeding the selected time delay. Alternatively, the FAILSAFE mode can be selected which allows operation with an energized TRIP relay. This permits disconnection of the TRIP device in the event that power is interrupted in the case (for example) of loss of a control fuse. Note for failsafe operation, the control power must be connected to a source that is not interrupted by the breaker trip operation.

Table 7.1 Modes of Operation (Switch 1)

FUNCTION	1	2	3	4	5	6	7
Normal Mode	0						
Failsafe Mode	X						
Normal Trip		0					
Pulse Trip		X					
Manual Reset			0				
Auto Reset			X				

Note: X indicates switch is on.

Note: Failsafe operation does not apply to the auxiliary relays – only the TRIP relay.

TRIP operation can be modified by use of Switch 1 position 2. When ON the contacts of the TRIP relay are pulsed instead of continuous. This function reduces the duty cycle of TRIP coils which are not continuously rated and do not have auxiliary contacts which open and remove the trip current.

For a ground check trip condition only, the GCHK-100 TRIP relay, and its auxiliary relay, may be automatically reset upon the removal of the fault condition without operator intervention. Otherwise all relays are manually reset by pressing the RESET push buttons on the relay or on the remote indicators.

Ground Fault

The GCHK-100 is set-up by DIP switches for different modes of operation and trip Levels.

The ground fault pickup settings are set using switches 1, 2, 3, and 4 on DIP Switch 2.

The following pickup settings are available:

Table 7.2 Ground Fault Pickup Settings

FUNCTION	SETTING	1	2	3	4	5	6	7
Switch 2 Ground Fault Pickup Settings I_G	0.25A	0	0	0	0			
	0.5A	0	0	0	X			
	0.75A	0	0	X	0			
	1A	0	0	X	X			
	1.25A	0	X	0	0			
	1.5A	0	X	0	X			
	2A	0	X	X	0			
	2.5A	0	X	X	X			
	3A	X	0	0	0			
	5A	X	0	0	X			
	7.5A	X	0	X	0			
	10A	X	0	X	X			
	12.5A	X	X	0	0			

Note: X indicates switch is on.

Pickup Setting Tolerance: -15% / + 0% (in accordance with UL, CSA and IEC requirements)

When a ground fault is detected, two relays are operated i.e. the main TRIP relay (Form Z) and an auxiliary relay with form C contacts.

Ground Fault Trip Delay

Switches 5, 6, 7 on DIP Switch 2 are used to select the ground fault trip delay (See Table 7.3) This is the interval between detecting a fault and tripping the relay. The delay will be cancelled if the fault clears before the delay expires, thus preventing unnecessary trip operation.

Table 7.3 Ground Fault Trip Delay Settings

FUNCTION	SETTING	1	2	3	4	5	6	7
Switch 2 Ground Fault Delay Settings	0.02s					0	0	0
	0.1s					0	0	X
	0.2s					0	X	0
	0.5s					0	X	X
	1s					X	0	0
	2s					X	0	X
	5s					X	X	0
	10s					X	X	X

Note: X indicates switch is on.

Trip Delay Tolerance: -2 / +5 ms or $\pm 2.5\%$ of trip delay, whichever is greater.

Once a ground fault is detected, the trip delay counter begins to time the trip interval. If the ground fault disappears for the duration specified in the table below or more, the timer is reset and the relay does not trip.

Table 7.4 Ground Fault Delay Reset Intervals

TRIP DELAY	CLEARANCE INTERVAL (duration of time, fault-free, that is required to prevent triggering a GF trip)
0.02s	Does not clear
0.1s	18.3ms
0.2s	38.3ms
0.5s	98.3ms
1s	196.6ms
2s	398.3ms
5s	398.3ms
10s	398.3ms

Ground Check

The ground check trip level can be adjusted using DIP Switch 1, switches 4 and 5. Four resistance levels are available as shown in Table 7.5. Avoid using the 10 Ohm setting with a 50W termination.

Table 7.5 Ground Check Settings

FUNCTION	1	2	3	4	5	6	7
10 Ohms				0	0		
20 Ohms				0	X		
30 Ohms				X	0		
*50 Ohms				X	X		

Note: actual *level includes the impedance of the zener diode as well as the wire resistance.

Note: X indicates switch is on.

The TRIP relay will operate when the ground loop resistance exceeds the setting for a period between 150 ms to 300 ms. Also the RG indicator LED on the relay and remote indicator will turn off.

The current ground check resistance can be monitored using the mGARD-SYM remote indicator. The indicator displays the ground resistance as a percentage of the current trip level. A ground check trip can be seen on both the mGARD-SYM and on the GCHK-DRI (light will turn off).

Frame Voltage Operation

To provide a greater degree of operator protection, a voltage sensing function is included in the operation of the GCHK-100 relay to detect if the frame to ground voltage of the mobile equipment has exceeded preset levels. The voltage detection will operate within 100 ms (quicker than the ground check resistance detection) and within 30ms if the frame voltage exceeds 100V AC. The intent is to provide a greater safety margin for the operator and others in the vicinity of the equipment.

Frame voltage can be monitored using the mGARD-SYM remote indicator. The indicator displays the frame voltage as a percentage of the current trip level. A frame voltage trip can be seen on both the mGARD-SYM and on the GCHK-DRI (red LED will light).

A flashing VG light indicates a thermal overload, due to an elevated frame voltage (greater than 30 VAC, for an extended period of time). The relay cannot be reset until it cools down to an acceptable internal operating temperature.

Note: for higher frame voltages, the built in fuse may open prior to the thermal overload tripping. Replacement fuse type should be Buss FNQ-1/2 or equivalent 1/2 A time delay fuse.

The frame voltage trip level can be adjusted to different levels as per Table 7.6 below

Table 7.6 Frame Voltage Settings

FUNCTION	1	2	3	4	5	6	7
40V						0	0
60V						0	X
80V						X	0
100V						X	X

Note: X indicates switch is on.

8. MAINTENANCE AND TESTING

DANGER

Hazard of Electrical Shock, Burn or Explosion

All installation, servicing and testing referred to in this manual must be performed by qualified personnel. All power should be disconnected prior to removing covers or enclosures and where live conductors may otherwise be exposed.

Failure to observe these precautions may result in death or severe personal injury and damage to equipment. Before placing an intentional ground fault on the power system, check that a fault does not already exist. Any test ground fault equipment must be rated for full system voltage and be fused for protection.

Due to the solid state design and the use of sealed components, it is not necessary to service the GCHK-100 other than occasionally dusting with a damp cloth or vacuum cleaner during regular switchboard maintenance.

To test the GCHK-100 relay and remote indication, the RESET/TEST button is pressed twice quickly in succession.

The relay will trip, the ground fault, frame voltage LEDs will turn on and the ground check LED will turn off. This state will hold until RESET (by a single push of the RESET/TEST button). All relays will operate.

If annual inspection calls for more elaborate testing, this can be performed by primary injection of test current through the window of the ZSCS and verifying that the pickup settings are within tolerance. Testing should be done with a source of current, which is sinusoidal, has accurate metering and has a frequency of 50/60 Hz.

Time delays may be measured with a digital storage oscilloscope. This can be done many ways but one way is to apply a test “fault” resistor to the system with the oscilloscope connected to a current transformer arranged to measure “fault” current. The delay time will be the time that the current flows through the test “fault”. Note that the resistor must be rated for continuous current at the rated voltage.

9. SERVICE

For assistance in installation, set-up or testing please call I-Gard toll free at the following number:

1-888-737-4787 (1-888-RESISTR)

There are no recommended, user-serviceable parts in the GCHK-100 other than replacement of the Pilot Wire fuse. This fuse is a 600V rated 0.5A FNQ-1/2 by Bussman.

All other service should be referred to qualified factory representatives, other than direct replacement of entire modules to I-Gard. Please visit the I-Gard website for information regarding field service representatives in your area.

Note: Please ensure that proper authorisation is obtained from I-Gard should the need to return any material occurs.

10. SPECIFICATIONS

Control Power:

GCHK-100

5VA AC or 5W DC
110-240 V AC/DC, 50/60Hz
Maximum Range:
-45% to + 10% (60-264 V AC/DC)

GCHK-100-Z12V

10VA AC or 10W DC
110-240 V AC/DC, 50/60Hz
Maximum Range:
-30% to + 10% (75-264 V AC/DC)

Temperature Range (Celsius):

Operating Temperature: -40 to +60
Storage Temperature: -40 to +80

Dielectric:

Relay contacts to chassis:

1480V rms. for 1 minute

Control terminals to chassis:

1480V rms. for 1 minute

Ground Fault:

Pickup Settings (Amps):

1/4, 1/2, 3/4, 1, 1 1/4, 1 1/2, 2, 2 1/2, 3, 5, 7 1/2, 10, 12 1/2

Pickup Tolerance:

-15%, +0%

Delay Settings (Sec.):

0.02, 0.1, 0.2, 0.5, 1, 2, 5, 10

Delay Tolerance:

-2, +5 ms or $\pm 2.5\%$ whichever is greater

Thermal Withstand:

5000 Amps for 1/3 seconds

Harmonic Filter:

Low pass analog filter

Zero Sequence Sensors:

Toroidal, with window diameter up to 225 mm.

Ratios supported:

Any I-Gard T type ZSCS (e.g. T2-A, T3-A, T6-A and T9-A) 1000:1, 600:1 and 40:1 (Input impedance 50, 50 and 1 ohm respectively.)

Ground Check:

Pickup Settings (Ohms):

10, 20, 30, 50 ohms

Pickup Tolerance:

±20% or 3 Ohms

Delay (for open loop and/or shorted terminator):

150 ms to 300 ms

Termination:

GCHK-100 6V (5.6)

GCHK-100-Z12V 12V

Fuse (½ Amp, time-delay):

Bussman FNQ ½

Littelfuse FLQ ½

Edison MEQ ½

Operating Mode:

Manual Reset or Auto Reset

Induced AC Withstand:

30V Continuous (at 25°C ambient)

50V for 10 minutes (at 25°C ambient)

60V for 5 minutes (at 25°C ambient)

100V for 20s

Frame Voltage:

Pickup Settings (AC Volts rms.):

40, 60, 80, 100

Pickup Tolerance:

-15%, +0%

Delay (Sec.):

0.1 ±5% if voltage < 100 V AC.

Less than 0.03 if voltage ≥ 100 V AC.

Output Contacts:

Main Trip Relay:

Type: Form Z (NO and NC pair)

Rating:

10A @ 250V AC,

10A @ 30V DC,

½ HP @ 240V AC

Auxiliary Ground Fault Relay:

Type: 1 Form C (NO/NC)

Rating:

10A @ 240V AC,

8A @ 24V DC, ½ HP @ 240V AC

Auxiliary Ground Check Relay:

Type: 1 Form C (NO/NC)

Rating:

10A @ 240V AC,

8A @ 24V DC,

½ HP @ 240V AC

Terminal Contact Material:

Clamping screw: nickel-plated brass

Plug contacts: tin-plated bronze

Physical:

Weight: GCHK-100 855g

GCHK-DRI 45g

mGARD-SYM 600g

GCHK-ZT 35g

Dimension: See Figs. 11.1 to 11.4

Standards: CSA

I-Gard reserves the right to change specifications of its products without notice.

11. OUTLINE DIMENSIONS

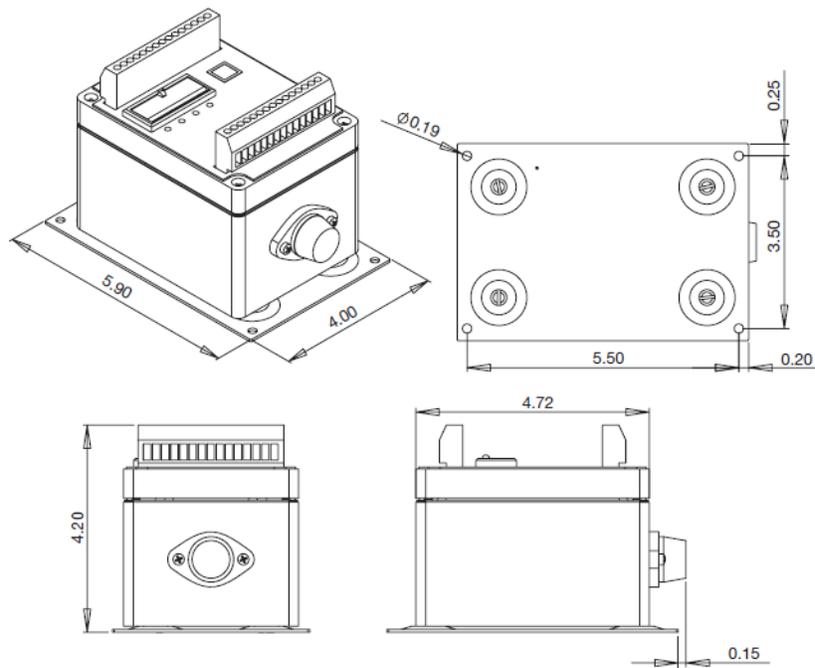


Figure 11.1 GCHK-100 Main Relay Outline Dimensions (inches)

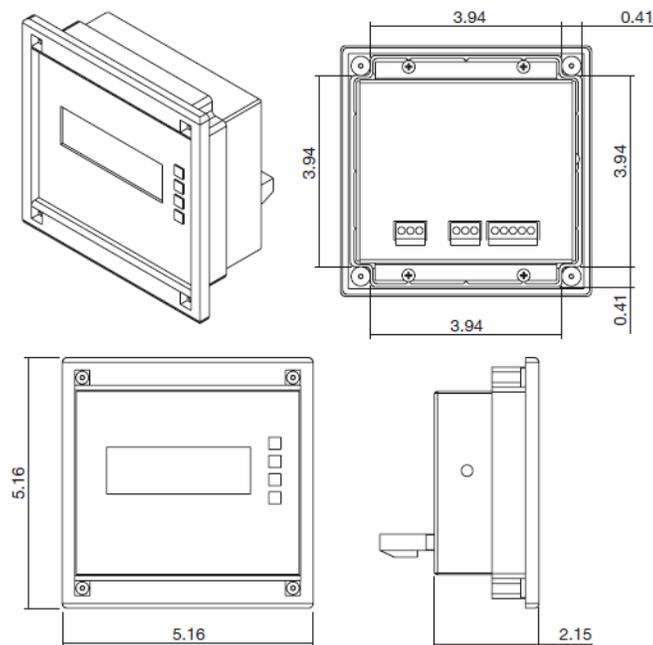


Figure 11.2 mGARD-SYM LCD Remote Indicator Dimensions (inches)

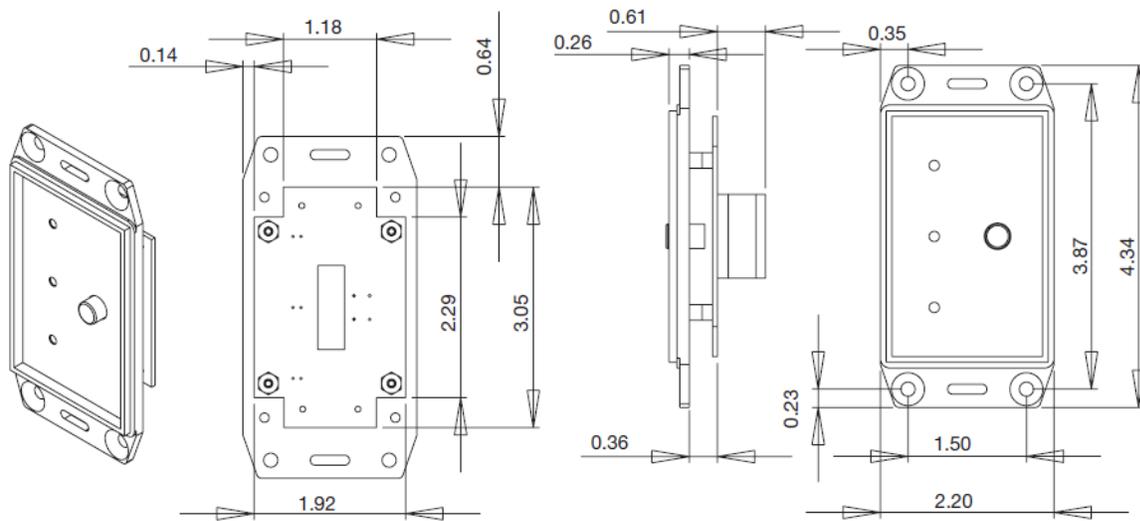


Figure 11.3 GCHK-DRI LED Remote Indicator Dimensions (inches)

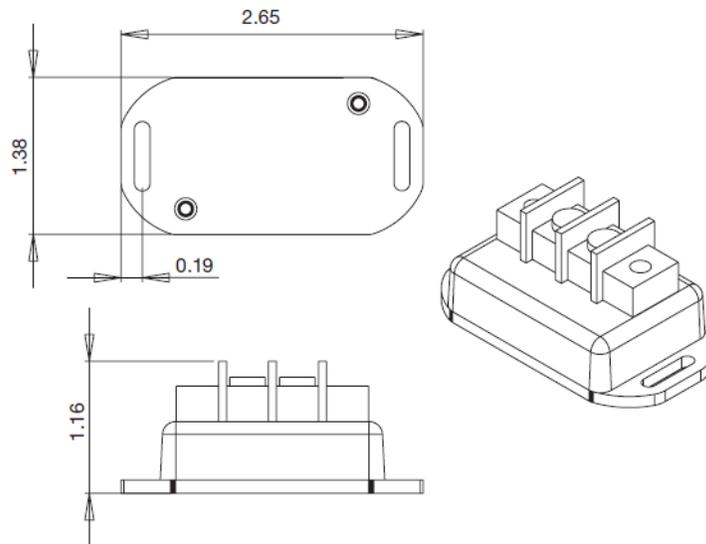


Figure 11.4 GCHK-ZT Zener Diode Line Terminator Outline Dimensions (inches)



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Unparalleled Protection

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