Industrial Solutions

EntelliGuard* G Circuit Breakers

Application Guide

*Trademark of ABB Company

by ABB

Hazard classifications

The following important highlighted information appears throughout this document to warn of potential hazards or to call attention to information that clarifies a procedure.
Carefully read all instructions and become familiar with the devices before trying to install, operate, service or maintain this equipment.

DANGER
Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION
Failure to comply with these instructions may result in product damage.

NOTICE
Indicates important information that must be remembered and aids in job performance.

Trademarks

EntelliGuard®	WavePro®
Power Break®	Power +®
MicroVersaTrip®	EPIC®
ProTrip®	HPC™ Switch, New Generation

Warranty

This document is based on information available at the time of its publication. While efforts have been made to ensure accuracy, the information contained herein does not cover all details or variations in hardware and software, nor does it provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described herein that are not present in all hardware and software systems. ABB Industrial Solutions assumes no obligation of notice to holders of this document with respect to changes subsequently made. ABB Industrial Solutions makes no representation or warranty, expressed, implied, or statutory, with respect to, and assumes no responsibility for the accuracy, completeness, sufficiency, or usefulness of the information contained herein. No warrantees of merchantability or fitness for purpose shall apply.
Contact your local sales office if further information is required concerning any aspect of EntelliGuard G, AKR, Power Break, Power Break II, New HPC, and WavePro circuit breaker operation or maintenance.

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Section 1.
General description

EntelliGuard G circuit breakers are the newest line of low voltage power circuit breakers (LVPCBs) evolved from the exceptional designs and practices of GE legacy breakers. EntelliGuard G breakers offer a truly global product platform that meets industry standards throughout the Americas, Europe and Asia (ANSI, UL, cUL, IEC, Lloyds Register of Shipping, etc.).
Breakers are available to OEMs in 3- and 4-pole designs from 400A to 6400A (IEC) with fault interruption ratings up to 200kA. New, state-of-the-art EntelliGuard Trip Units enable the breakers with advanced technology that provides system protection, local and remote monitoring, relaying and communications. EntelliGuard Trip Units may be supplied with either Modbus or Profibus communications protocols. The ArcWatch* enabled system delivers superior circuit protection without compromising selectivity or arc flash protection. The EntelliGuard system is yet another evolution of GE core competences in reliable electric power distribution, circuit protection and arc flash protection.
EntelliGuard G 3-pole breakers are the standard in GE AKD-20 Low Voltage Switchgear. The breakers are suitable for 280Vac, 480Vac and 600Vac applications, and they provide advanced circuit protection, limit arc fault energy and preserve system coordination without sacrificing any of these critical functions (Table 1.1; see Section 8 for details).

Table 1.1 Device Standards and References

ANSI® Certified Low-Voltage Power Circuit Breaker	UL® Listed Insulated Case Circuit Breaker	IEC® Rated Circuit Breaker	IEC® Extreme Atmospheric Conditions
C37.13	UL 489	IEC 60947-1	IEC 68-2-1: Dry cold at -55°C
	UL489B DC for Photovoltaic		IEC 68-2-2: Dry heat at 85°C
		IEC 60947-2	IEC 68-2-30: Damp heat (55°C, 95% RH)
	NEMA AB1		
C37.16	CSA 22.2 NO 5.1	IEC 60947-3	IEC 68-2-52 Level 2: salt mist
C37.17			
C37.20			
C37.50			
UL 1066			
NEMA SG3&5			

EntelliGuard G devices are available in all standard, 100% rated, ANSI, UL and IEC ratings in both fixed and drawout designs. Standard devices are also offered in 4 pole designs. No compromise (e.g., derating) is necessary in the system protection scheme as the EntelliGuard G Neutral poles are fully rated. Front and rear access connections are available (Table 1.2), and all configurations can be manually or electrically operated with multiple and redundant accessories (optional).

Table 1.2 Device Ratings

Standard	Sensors Available			
	Envelope 1	Envelope 2	Envelope 2.5	Envelope 3
ANSI/UL 1066	400A - 2000A	400A - 3200A	800A - 4000A	3200A - 5000A
UL 489	400A - 2000A	400A - 3000A	800A - 4000A	3000A - 6000A
IEC	400A - 2000A	400A - 4000A		3200A - 6400A

EntelliGuard G short circuit and interrupting ratings are given in Table 1.3 through Table 1.8.

Table 1.3 Interrupting Rating Tier ANSI/UL1066 Devices, LVPCB

					Envelope 1		Envelope 2		Envelope 2.5	Envelope 3	
Type	254V	508V	635V	1/2S With-stand	400, 800, 1200	400, 800, 1200, 1600, 2000	2500, 3200	400 – 3200	800 – 4000	3200	4000 – 5000
S	65,000	65,000	50,000	50,000	X						
N	65,000	65,000	65,000	65,000		X	X				
P	100,000	100,000	65,000	65,000		X					
E	85,000	85,000	85,000	85,000				X			X[1]
M	100,000	100,000	100,000	85,000				X			X
U	130,000	100,000	100,000	100,000					X		
L	150,000	150,000	100,000	100,000						X	X
W	200,000	200,000	100,000	100,000						X	X

1. Restricted

Table 1.4 Interrupting Rating Tier ANSI/UL 1066 Device, Non-Auto LVPCB

		Envelope 1		Envelope 2	Envelope 2.5	Envelope 3
Type	254V – 635V	800 – 1200	800, 1600, 2000	800, 1600 – 3200	2000 – 4000	3200 – 5000
S[1]	42	X				
N	42/65		X			
M	65/100			X		
U[1]	65				X	
B	100					X

1. 3 pole only.

Table 1.5 Interrupting Rating Tier UL489 Devices, ICCB

						Envelope 1		Envelope 2		Envelope 2.5	Envelope 3	
Type	240V	480V	600V	690V (IEC 60947-2)	1/2S Withstand	400 – 1200	400 – 2000	2500 – 3000	400 – 3000	800 – 4000	3000	4000-6000
S	65,000	65,000	50,000	40,000[1]	42,000	X						
N	65,000	65,000	65,000	50,000[1]	42,000		X	X				
P	100,000	100,000	65,000		50,000		X					
M	100,000	100,000	100,000	85,000[1]	65,000				X			X
U	130,000	100,000	100,000		85,000					X		
L	150,000	150,000	100,000	100,000[1]	85,000						X	X
W	200,000	200,000	100,000		85,000						X	X

1. Icu=Ics=Icw

Table 1.6 Interrupting Rating Tier UL 489 Device, Molded Case Switches

		Envelope 1		Envelope 2	Envelope 2.5	Envelope 3
Type	240V – 600V	800 – 1200	800 – 2000	800, 3000	2000, 3000, 4000	3000 – 6000
S[1]	42	X				
N	42		X			
M	65			X		
U[1]	65				X	
B	100					X

1. 3 pole only.

Section 1.
General description

Table 1.7 Endurance Rating – ANSI/UL 1066 Devices

		Rated Endurance		
Envelope	Max Amps	Minimum Mechanical Endurance	Minimum Electrical Endurance at 480V	Minimum Electrical Endurance at 600V
1	1600	16,000	10,000	7,500
1	2000	16,000	7,500	5,000
2	3200	11,000	5,000	5,000
2.5	4000	5,000	3,000	2,000
3	4000	7,000	3,000	2,000
3	5000	7,000	2,000	1,500

Table 1.8 Endurance Rating - UL 489 Devices

		Rated Endurance		
Envelope	Max Amps	Minimum Mechanical Endurance	Minimum Electrical Endurance at 480V	Minimum Electrical Endurance at 600V
1	1600	16,000	10,000	7,500
1	2000	16,000	7,500	5,000
2	3000	11,000	5,000	5,000
2.5	4000	5,000	3,000	2,000
3	4000	7,000	3,000	2,000
3	5000	7,000	3,000	1,500
3	6000	7,000	1,500	1,000

Table 1.9 Endurance Rating - UL 489B DC Switches

				Rated Endurance		
Envelope	Type	Amps	Short Interrupting Current (kA)	Minimum Mechanical Endurance	Minimum Electrical Endurance at 600 Vdc	Minimum Electrical Endurance at 1000 Vdc
2	M	800 - 3000	125	10,000	500	500

- Configurations available for 600V DC and 1000V DC with or without isolating both DC legs.
- See “Flat Front Terminations,” page 53, for Bus Bar Configurations. Note: Bus Bars must be ordered separately.
- Time Constant (L/R) = 15msec, Rated calibration temperature: 50 degree C.
- Suitable for use in Photovoltaic system in accordance with article 690 of the NEC.

Altitudes and closing times

See Section 7. Table 7.2 and Table 7.3.

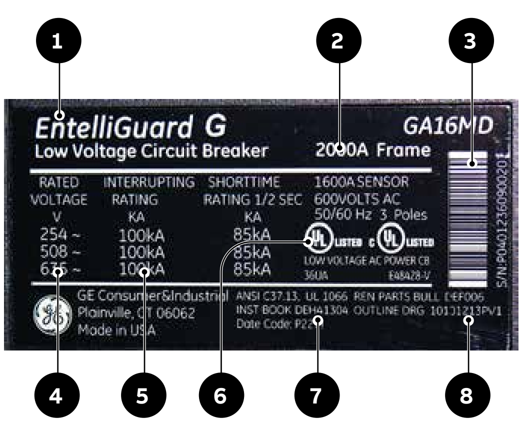
Dimensions and weights

See Section 7. Table 7.2 and Table 7.3.

Figure 1.1 Breaker construction

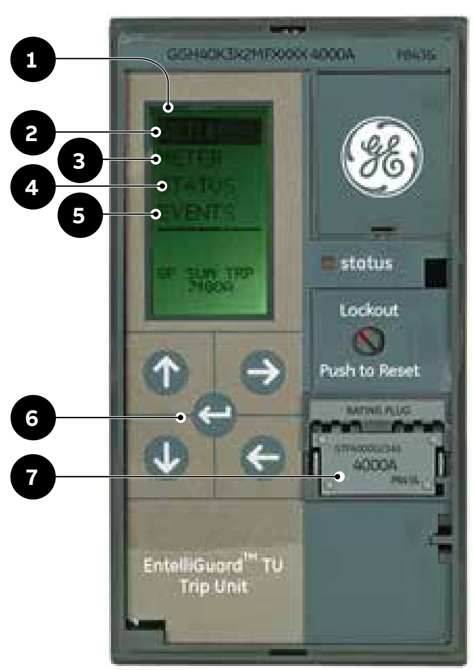
1 B-disconnect
2 Secondary disconnects – combination terminals
3 Detailed, factory-assembled side label
4 EntelliGuard TU trip unit
5 Rating plug
6 Operating buttons: ON/OFF
7 Optional factory- installed interlocks — Drawout Breaker's Key Interlocks are installed in the Cassette
8 Complete, factory-assembled catalog number
9 A-disconnect, always provided
10 Accessory window (Close/Command Close Coils, Shunt Trips, UVRs
11 Padlock provision
12 Retractable handle for manual spring charging
13 Electrically closed button
14 Spring discharge
15 Breaker status: OPEN/CLOSED Closing spring status: CHARGED/DISCHARGED
16 Ready-to-close
17 Spring charged indicator
18 Mechanical operations counter
19 Tamper-proof breaker label

Figure 1.2 Label



1 Product family
2 Current rating
3 Bar code with manufacturing data
4 Voltage ratings
5 Short circuit ratings
6 Certification & standards
7 Manufacturing date
8 Interruption tier color code (IEC only)

Figure 1.3 EntelliGuard TU Trip Unit



1 Main screen with…
2 **Setup** – allows adjustment of settings and parameters
3 **Meter** – displays full measurement values
4 **Status** – indicates breaker main contact position settings, pick-up, errors, RELT, firmware version
5 **Event log** – shows history of trip, cause, overcurrent level
6 Cursor-driven setting/selection system
7 Rating plug

Section 2.
Features and characteristics

Standard and optional features

Thermal Performance
ANSI C37 and UL 489 designs are 100% rated up to 40ºC when applied in recommended enclosure sizes. IEC 60947 versions are 100% rated in free air up to 50ºC. IP31 enclosure/switchboard rating is based on size, recommended up to 50ºC ambient with rear vertical bus connection (Table 2.1).

Table 2.1 Enclosure Requirements

		Minimum Specified Cubicle Space (inches)			Minimum Specified Cubicle Ventilation - No of Vent Slots[2]		
Frame Size[1]	No. of Poles	W	H	D	Top Wall	Bottom Wall	Rear Wall
1200A (Env 1)	3	20	21	16.5	12	16	-
1200A (Env 1)	4	22	21	16.5	12	16	-
2000A (Env 1)	3	20	16.4/21[3]	16.5	12	16	-
2000A (Env 1)	4	22	16.4/21[3]	16.5	12	16	-
3000A/3200A (Env 2)	3	22	21	16.5	16	16	8
3000A/3200A (Env 2)	4	25	21	16.5	20	16	8
4000A (Env 2.5)	3	28	21	16.5	20	16	8
6000A (Env 3)	3	32	30	16.5	24	20	20
6000A (Env 3)	4	41	30	16.5	30	24	20

1. Applies to all amp ratings for the frame.
2. Slot dimensions. ¾” by 5¼” minimum for each slot.
3. Side-mounted/top-mounted secondary disconnects.

Reverse Feed
EntelliGuard G devices can be fed from top or bottom terminals.

Two-Step Stored Energy Mechanism
EntelliGuard G operates via stored energy mechanisms that can be manually charged (MO) or electrically charged (EO) by the Spring Charging Motor. Closing time is less than five cycles. Closing and opening can be initiated remotely or via the front cover push buttons. An Open-Close-Open cycle is possible without recharging. (Charge after close). The breaker operating mechanism is a trip-free mechanism and is furnished with an integrated anti-pumping system.

Field Installable Trip Units and Accessories
EntelliGuard G devices have provisions for four accessory operating coils. The four positions can be filled by the following four devices: one Close Coil (CC) or one Command Close Coil (CCC), one Shunt Trip Coil (ST), one Undervoltage Release (UVR), and the fourth position can either be a 2nd ST Coil or a UVR.
The closing coil is a “one-shot” electronic closed circuit. Shunt trip (ST) coils are continuous rated. (Note: No Red Indicating Light on Shunt Trip)
Undervoltage relays (UVR) are available with a fixed time delay (3 Cycles at down to 50% system voltage; 1.2 Cycles below 50% system voltage). The time delay module (TDM) is available as a shipped loose accessory for remote installation (in equipment). Optional Coil Signaling contact modules for the CC, CCC, ST, UVR, and NI's provide coil status (energize/de-energize) via the secondary disconnects or trip unit through Modbus or Profibus Comm.

Coils
EntelliGuard G devices have provisions for four accessory operating coils. The four positions can be filled by the following four devices: one Close Coil (CC or CCC), one Shunt Trip Coil, one UVR (Undervoltage Release), and the fourth position can either be a Shunt Trip Coil or a UVR. The closing coil is a “one-shot” electronic closed circuit. Shunt trip (ST) coils are continuous rated. Undervoltage relays (UVR) are available with a fixed time delay (50ms at down to 50% system voltage; 20ms below 50% system voltage). The time delay module (TDM) is available as a shipped-loose accessory for remote installation (in equipment). Optional status contact modules for the ST, CC and UVRs provide coil status (energize/de-energize) via the secondary disconnects and trip unit.

Breaker/Main Contact Status
OPEN/CLOSED, ON/OFF indication is provided on the front cover.

Motor Operator
Heavy duty, motor/gearbox unit; easily accessible with a full range of voltages.

Electrical Closing Button
Located on the front cover between the Open and Close button; used to electronically close the breaker when a Command Close Coil is selected.

Ready to Close Indicator
Provides visible indication/readiness for close operation.

Mounting Straps/Accessories
Kits are available to mount and connect fixed/stationary breakers in either a rear connected (Vertical) or a flat front connected.

Auxiliary Switches
Four available designs:
- Power rated (3NO+3NC) (Standard)
- Power rated (3NO+3NC) + low signal (Hi-Fi) (2NO+2NC)
- Power rated (8NO+8NC)
- Power rated (4NO+4NC) + low signal (Hi-Fi) (4NO+4NC)

Interlocks
Standard interlocks include:
- Drawout Breaker: prevents the breaker from being closed unless it is in the TEST or CONNECT positions
- Drawout Breaker/Main Contacts: prevent withdrawal/removal of the breaker unless the main contacts are OPEN. Access to the drawout mechanism racking screw is blocked when the breaker is CLOSED.
- Spring Discharge Interlock: Automatically discharges the closing springs when the breaker is moved from the DISCONNECT to the WITHDRAWN position. This prevents withdrawing a breaker from the cubicle with the closing springs charged.

Breaker Status Indicators
Standard Indicators include:
- The breaker status indicator shows the condition of the main contacts (OPEN, CLOSED).
- The status of the closing springs is indicated as CHARGED or DISCHARGED.
- The drawout position indicator displays whether the breaker is in the CONNECT, TEST, or DISCONNECT position.
- The breaker also includes a switch that provides main contact status indication that can be wired to a remote monitoring system.
- The optional Reduced Energy Let-Through (RELT) is provided with an ON/OFF contact closure to positively indicate whether the RELT setting is enabled or not.

Rejection Feature
A factory-installed rejection feature prevents mismatching breakers and cassettes/substructures. This prevents (a) inserting a breaker with a lower interrupting rating into a higher rated cassette/substructure and (b) inserting a higher current rated breaker into a lower rated cassette/substructure.

Through-Door Racking
The breaker racking mechanism is accessible through the front of the cassette and permits safely disconnecting/withdrawing the circuit breaker without opening the door and exposing personnel to live parts during the process.

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Features and characteristics

Padlocking Devices
The padlocking device is standard on breakers and allows up to three padlocks with 1/4" to 3/8" diameter shanks to secure the breaker in the OPEN/TRIP FREE position. A padlock provision on the front panel of the cassette/substructure permits locking access to the racking screw. Racking access can be locked with the breaker in the CONNECT, TEST, DISCONNECT position with up to three padlocks.

Key Interlock
Up to four optional key interlocks are available (Kirk, Ronis, Profalux, Castell). Switchgear applications utilize a Kirk key interlock mounted in the cassette. A maximum of two key interlocks may fit in the cassette.

Shutters
Optional lockable shutters are available (factory installed).

Carriage Position Switch
This optional cassette/substructure device permits local or remote indication of the circuit breaker status (CONNECTED, TEST, DISCONNECTED), 2NO/2NC single pole, double throw contacts are available for each position.

Lifting Beam
Optional Lifting Beams/bars with separate slings are available for all breaker sizes. A Universal Lifting Beam is also available capable of lifting a 3 Pole Envelope 1

IP Covers
Optional IP54 covers (protects against harmful amounts of dust and splashing water) are available for all breaker sizes.

Mechanical Counter
Provides local record of the cumulative number of complete breaker closing operations.

Cable Interlocks (OEM Applications Only)
Available for fixed and drawout breakers, these units enable direct interlocking of EntelliGuard G circuit breakers.

Bell Alarm Contact
Available with or without a mechanical lockout feature, the bell alarm operates whenever the breaker trips due to a protective function (electrical fault).
Breakers ordered from the factory without Bell Alarm Accessory will have Automatic Reset Functionality when the Bell Alarm Accessory is installed. To convert from Automatic to Manual Reset on the Bell Alarm, a new trip unit is required.

Section 3.
Entelliguard TU Trip Unit System

The EntelliGuard TU Trip Unit offers optimum circuit protection and optimum system reliability simultaneously with little or no compromise to either of these critical functions. Reliability and arc flash protection, in one package, at the same time, all the time.

EntelliGuard TU series trip units are available as the standard controller for new production EntelliGuard G ANSI/UL 1066, UL 489 and IEC circuit breakers. EntelliGuard TU designs are also available as direct, functional replacements for GE PowerBreak*, PowerBreak II, WavePro*, AKR, and AK circuit breakers. EntelliGuard TU trip units are also available in kit form for many popular non-GE and older GE low voltage power circuit breakers (Refer to DEH-4567 and DET-722). The EntelliGuard TU technology is also available in GE's molded case Spectra Breaker line 400A-1200A. Optional features of Spectra MET (microEntelliGuard*) include the innovative RELT and Zone Selective Interlocking-Instantaneous feature. New, on-board features and communications capabilities enable equipment enhancements, improved operational performance and life extension programs. Performance will vary based on associated circuit breaker and equipment conditions. All EntelliGuard TU Trip Units are Conformal Coated for increased reliability in humid/damp environments.

This section describes the functions as implemented in the EntelliGuard G UL 489 and ANSI/UL 1066 circuit breakers. References or comparisons to other GE circuit breakers are for informational purposes only.

Reliability without compromising protection
Reliable protection of circuits and equipment has always been the circuit breaker's primary mission. Providing appropriate protection of the conductors, while preserving selective coordination, has been the primary focus of most system designers. However, what was acceptable in the past is no longer the standard today. Modern economic reality, coupled with strict regulatory requirements, demand optimal system performance with increased sensitivity to the inherent power system hazards that face operating and maintenance personnel. Safety agencies, local authorities and owner-operators demand better personnel protection and state-of-the-art capabilities to minimize hazards while simultaneously preserving critical loads and system capabilities.

These requirements often seem to be, and sometimes are, in conflict, pitting the speed and sensitivity required to improve arc flash protection against the delays and deliberate decision making required to maximize power system reliability. The EntelliGuard TU, along with the EntelliGuard family of circuit breakers, offers flexible solutions for demanding circuit protection and circuit preservation environments. The EntelliGuard TU is designed to provide the utmost in system protection and reliability simultaneously, with little or no compromise.

Arc flach and the EntelliGuard TU Trip Unit
Reducing arc flash hazard should be a primary concern in many power system designs. The best way to ensure the lowest possible hazard for a particular distribution system is to consider the hazard as the system is designed and make careful selection of the system's topology, circuit sizes, equipment sizes and protective devices to minimize hazard for the operating and maintenance personnel that will need to interact with the system for years to come.

The EntelliGuard TU, especially in conjunction with the EntelliGuard G circuit breaker, provides significant flexibility towards solving arc flash hazard problems without excessive sacrifice of system reliability, in terms of selectivity.

The next few pages are an overview of the EntelliGuard TU's novel features enabling Arc Flash mitigation and selectivity at the same time. When the downstream breaker/fuse is current limiting, the Waveform Recognition Selective Instantaneous is used to achieve lower Instantaneous pickup settings while maintaining selectivity. This is very effective for 250A and below devices. For Feeder devices above 250A in MCCs (600A for panels/switchboards), the Instantaneous Zone Selective Interlocking (I-ZSI) feature is used to achieve selectivity and arc flash mitigation at the same time. The I-ZSI feature is available on Spectra MET and EntelliGuard TU in the following breakers: EntelliGuard G, Power Break II, WavePro, AK/AKR, and Conversion Kits. By combining the Waveform Recognition Selective Instantaneous and I-ZSI, a system with a 100KAIC bolted fault current can achieve an 8 cal/cm2 or less incident energy level. One way to lower potential incident energy is to ensure that circuit breakers are able to interrupt using their Instantaneous trips for all expected arcing faults. Figure 3.1 shows the expected arcing

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Section 3.
Entelliguard TU Trip Unit System

currents for 480V systems for various arc gaps representative of switchgear (32mm), switchboards (25mm), MCCs (25mm) and panelboards (13mm). These values were determined using IEEE standard 1548, Guide for Performing Arc-Flash Hazard Calculations, 2002.

Figure 3.1 Arcing Current

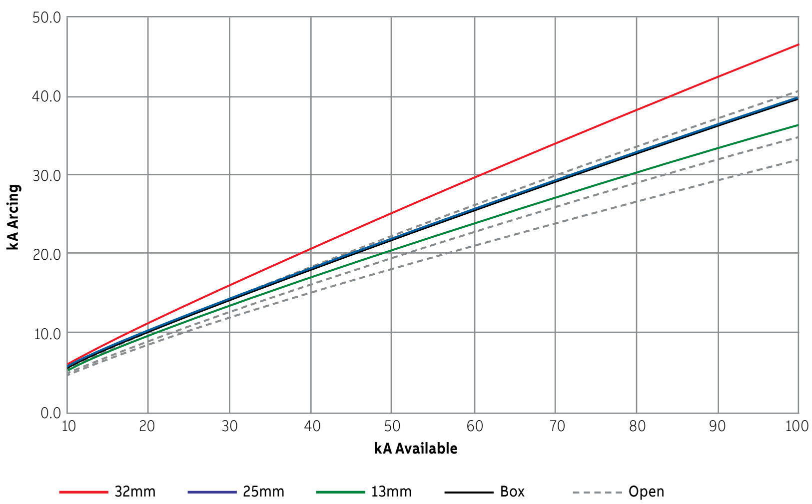


Figure 3.1 demonstrates the wide range of possible arcing currents predicted by the IEEE standard's calculations. The actual arcing currents may be lower or higher when consideration is given to the potential error in short circuit calculations, fault current data provided by the utility company, and variance in the actual arcing gap or enclosure's geometry where the arc occurs. Of particular concern should be the lower end of the possible range of current that may fall below the Instantaneous pickup of a circuit breaker or the current limiting threshold of a fuse. Dangerous incident energy may quickly increase when interruption time increases from a few cycles to a few seconds, even for low arcing current.

New for 2013.. firmware versions 08.00.26 and later

Certain EntelliGuard trip units come integrated with Threshold-Zone-Selective-Interlocking capability (T-ZSI). This allows the short time and instantaneous operating times and thresholds to overlap while maintaining selectivity. This further expands the trip unit's capability of providing system reliability and safety.

Furthermore, EntelliGuard trip units have built-in ZSI test capability as a standard feature on all the ones equipped with ZSI. It allows users to test interconnected wiring and TIM modules to ensure the ZSI scheme is fully functional.

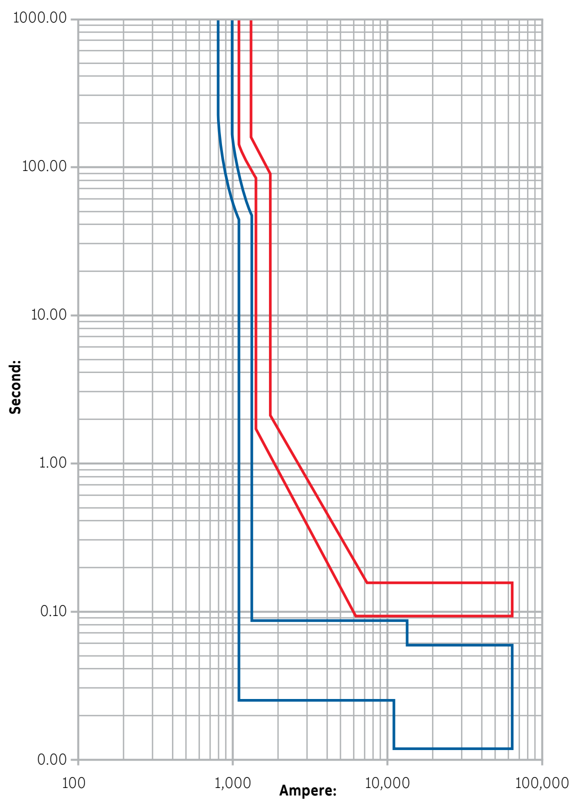
Selectivity with molded case circuit breakers and other devices

The EntelliGuard TU trip unit's Waveform Recognition Selective Instantaneous provides a unique selectivity capability. When used in conjunction with current limiting devices downstream, the trip unit may be set low, and still maintain significant levels of selectivity. See publication DET-760 for the list of the minimum instantaneous settings above specific GE circuit breakers and the levels of selectivity achieved. Testing and documentation of the selectivity capability of the EntelliGuard trip unit will be expanded as more test data become available. Always consult GE Selectivity reference publication DET-760 for the latest information or contact your GE sales representative for up to date information. Selectivity above current limiting fuses may also be expected. The required minimum setting may be estimated by examining the peak let-through curve for the fuse. Find the peak let-through current value that is 1.41 times the prospective RMS current. The trip unit should be set such that the instantaneous pickup is above that peak value. The circuit breaker and fuse may then be selective up to the values identified in DET-760. The fuse and circuit breaker combinations have not been tested so performance cannot be guaranteed at this time; however, selectivity is expected for arcing and bolted faults up to the values indicated in the above selectivity publication.

Protection between circuit breakers using the EntelliGuard TU trip unit may be further improved using zone-selective interlocking. The trip unit's unique instantaneous zone-selective-interlocking which can increase selectivity for UL 489 EntelliGuard G mains while allowing to trip instantaneously for faults within their zone of protection allows significant selectivity and arc flash protection at the same time. As mentioned above, the NEW threshold-zone-selective-interlocking (T-ZSI) allows thresholds for short time and instantaneous to also overlap providing even more sensitive protection in upstream buses.

Selectivity for an EntelliGuard TU ground fault function and a circuit breaker below may be enhanced by the trip unit's selective ground fault function and zone selective interlocking. Figure 3.2 demonstrates an 800A circuit breaker under a 1200A ground fault set to be fully selective. See also DET-760 for the tables that identify the maximum instantaneous pickup multipliers possible for various types and sizes of GE circuit breakers and a complete listing of all selectivity functionalities.

Figure 3.2 Selectivity Curve



Above downstream feeders

The EntelliGuard TU trip unit has Short Time bands under 100msec designed to optimally fit above the Instantaneous clearing times of various GE circuit breakers.

Table 3.1 lists the suggested Short Time band that may be used above specific GE circuit breakers for the fastest coordination and consequently fastest EntelliGuard G circuit breaker interruption.

Also listed is the Hazard Risk Category for various available fault currents calculated at the listed Short Time band clearing times and Instantaneous clearing times provided by the EntelliGuard TU trip unit's Waveform Recognition Selective Instantaneous and its Reduced Energy Let-Through (RELT) Instantaneous trip. The Hazard Risk Category (HRC) levels shown are calculated for a solidly grounded, 480V system, 32mm arc gap, 18 in. working distance and arc in box. Using the optimized Short Time band allows the system to stay at HRC2 most of the time and always less than HRC4. However, use of the RELT Instantaneous trip allows the system to protect at HRC1 or 2 for available fault currents as high as 90kA.

The waveform recognition selective instantaneous

The Instantaneous algorithm in the EntelliGuard TU trip unit will allow a large switchboard or switchgear circuit breaker to be set low yet maintain selectivity. For example, when set to protect the conductors to a motor control center, an 800A feeder circuit breaker's Instantaneous may be set as low as 8kA nominal. This should provide complete selectivity above the typical 150A and smaller circuit breakers or fuses found in a motor control center.

Allowing for 10% pickup tolerance in the Instantaneous pickup of the feeder circuit breaker would indicate that the feeder would pick up Instantaneously for arcing fault currents approximately 9kA or higher. From Figure 3.1 it can be seen that fault currents of 20-25kA and higher would seem to reliably produce arcing current above 9kA in a variety of configurations. From Table 3.1 it can be seen that an EntelliGuard G circuit breaker clearing instantaneously can maintain HRC1 in a system with up to 42kA available and HRC2 in systems with up to 100kA available – excellent arc flash protection and selectivity simultaneously!

Note:

These incident energy calculations do not take into account motor contribution or other factors that may affect expected levels of incident energy or hazard. For a thorough understanding of the incident energy available in a power distribution system, an Arc Flash Study should be conducted by engineering personnel qualified to provide such analysis.

Section 3.
Entelliguard TU Trip Unit System

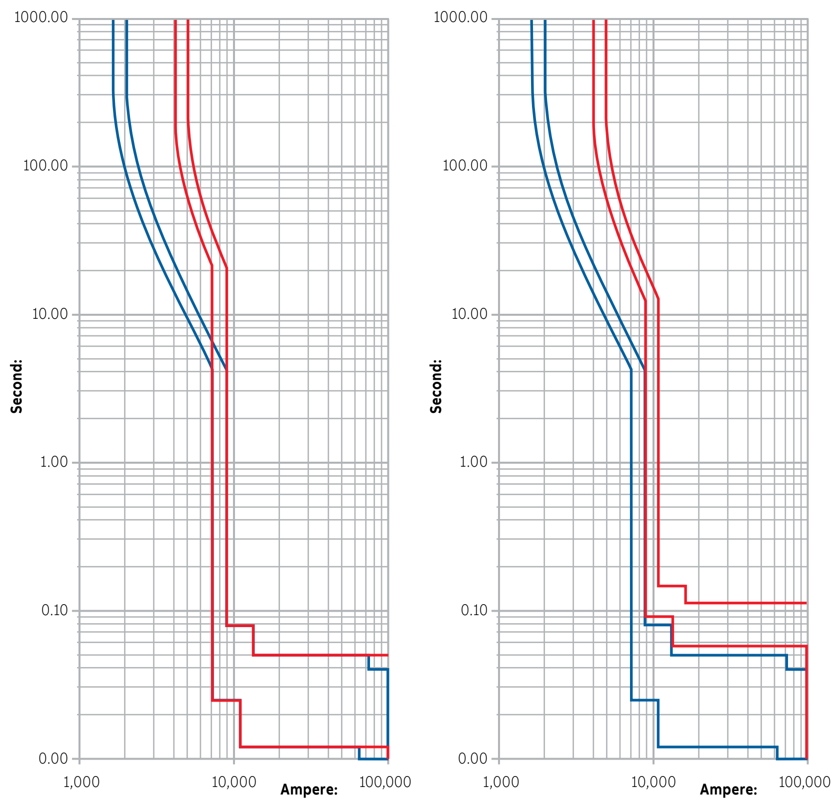
Table 3.1 Minimum Selective Clearing Times for an EntelliGuard G Circuit Breaker Above Selected GE Circuit Breakers, and Related HRC Levels at Various Fault Circuits

GE Molded Case Circuit Breaker Family	Circuit Breaker Type	Minimum EntelliGuard TU Short Time Band	Clearing Time	480V, 32mm, 24in Working Distance, Arc in a Box - HRC @ Ibf=						
				35kA	42kA	50kA	60kA	75kA	90kA	100kA
FB, FC, TEY, THQL	TM, LP	0.025sec	0.08sec	2	2	2	2	3	3	3
TED, TEC	TM-GP, MCP	0.025sec	0.08sec	2	2	2	2	3	3	3
TF, TJ, TK	TM-GP	0.025sec	0.08sec	2	2	2	2	3	3	3
Spectra E, F, G Frame	E-GP	0.025sec	0.08sec	2	2	2	2	3	3	3
Spectra K Frame	E-GP	0.033sec	0.088sec	2	2	2	2	3	3	3
Spectra G, K with MVT trip	AE-GP	0.025sec	0.08sec	2	2	2	2	3	3	3
Record Plus G Frame	E, AE-GP	0.042sec	0.097sec	2	2	2	2	3	3	3
Record Plus E Frame	E-GP	0.033sec	0.088sec	2	2	2	2	3	3	3
Power Break with MVT	AE-GP	0.058sec	0.113sec	2	2	2	3	3	3	3
Instantaneous Clearing Time		instantaneous	0.050sec	1	1	1	2	2	2	2
RELT Clearing Time		RELT Instantaneous	0.042sec	1	1	1	1	2	2	2

TM = Thermal Magnetic.
E = Electronic.
AE = Adjustable Electronic.
LP = Lighting Panel Application.
GP = General Purpose Application.
MCP = Motor Circuit Protector.
HRC = Hazard Risk Category (See NFPA 70E).

Above Other Power Circuit Breakers
Using the EntelliGuard TU trip unit's novel Instantaneous Zone Selective Interlocking (I-ZSI), the main circuit breaker also can be set to interrupt selectively for faults in its zone of protection. However, the pickup level must be nested to prevent a nuisance trip at the main. Allowing for a 10% tolerance in the pickup current of both trips, the upper boundary of the main's trip may be estimated at approximately 11kA. Again, Figure 3.1 shows that available fault currents above 25kA will generally produce arcing currents above 11kA.
Table 3.1 shows a system with fault currents from 35kA to 100kA, the feeder and main circuit breaker will provide protection at HRC1 or HRC2 selectively above most circuit breakers using short time bands. Coordinated instantaneous settings would provide even better protection while still maintaining selectivity with select feeder breakers. To this capability one can add the RELT instantaneous setting that provides more sensitive and faster protection when needed.
Users have the option of T-ZSI for short time and instantaneous protection functions when programing T-ZSI and I-ZSI enabled trip units (firmware version 08.00.26 and later). T-ZSI allows the short time pickups of two circuit breakers to completely overlap while still maintaining selectivity. A novel algorithm within the trip units will arbitrate fault location and shift the upstream device in time and threshold to ensure the downstream device operates as set and that the upstream device provides backup protection as fast as possible in case the downstream device fails to operate.
The figure below shows the TCC for two circuit breakers implementing Short Time, Instantaneous, and Threshold Zone-Selective-Interlocking at the same time. When the downstream trip unit senses a fault current it causes the upstream trip unit to shift both the short time and instantaneous thresholds to the right, as well as restraining the operation in time to allow the downstream circuit breaker to protect its zone of protection, selectively.
The user only sets one threshold for each function. The trip unit automatically calculates the needed rightward shift (23%). Similarly for Instantaneous-Zone–Selective-Interlocking, the user only selects to enable it and selects the protection current threshold. The trip unit automatically calculates the needed restraint in time to maintain selectivity when needed. For short time-Zone-Selective-Interlocking the user must select both the unrestrained protective timing and the restrained backup timing band

Figure 3.3 TCC for Two Circuit Breakers Implementing Short Time, Instantaneous, and Threshold ZSI



Terminology

In: Trip plug rating in amperes. This is the current rating of the rating plug installed in the trip unit. This is the maximum Long Time pickup a trip unit can have with a specific plug installed. A sensor can usually be applied with plugs between 37.5% or 40% to 100% of the sensor rating. Plugs are labeled in amperes.

Ir: Overload current setting. Current setting of an adjustable overload release.

Note:

In case of a non-adjustable overload release, this value is equal to nominal current In.

X: X is a multiplier that may be applied in front of any rating value to denote a fraction of that rating. Example: The Long Time Pickup may be set at 0.5X of In.

HSIOC: High Set Instantaneous Overcurrent, also known as the Override. This is an Instantaneous protection setting applied near the circuit breaker's withstand rating required to clear high magnitude faults quickly. In UL489 circuit breakers this is fixed; in UL1066 CBs the override may vary, if present at all.

MCR: Making Current Release. A setting provided with each trip unit, based on the specific circuit breaker size, used to protect the circuit against closing on high magnitude faults. The MCR function immediately trips/opens the circuit breaker if high magnitude fault current is sensed at the instant the circuit breaker is closed.

ICW: Short-circuit withstand rating of a particular circuit breaker in amperes. The withstand rating is defined differently within different standards, but it is always the value of current that a circuit breaker can withstand for some period of time without interrupting.

ICS, or the service breaking capacity per IEC 60947-2, is the breaking capacity that a breaker can safely interrupt and be operational after interrupting at least one time. (GE recommends always conducting an inspection of the main contacts after any short circuit event.)

ICU, or the ultimate breaking capacity per IEC 60947-2, is the breaking capacity that a breaker can safely interrupt, but may not remain operational after interrupting one time.

Hi-Fi: High fidelity refers to gold-plated contacts. Use for signal level outputs (10 mA min to 100 mA max., 8 Vdc to 30 Vdc, 125 Vac).

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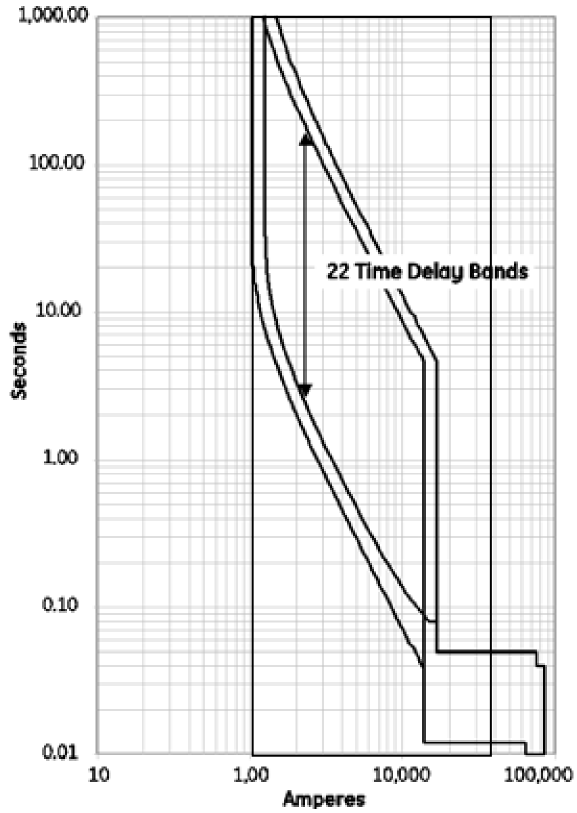
Long time protection

The EntelliGuard TU offers two different shapes for Long Time protection curves. Each type of curve is available with 22 different time delays. The shapes may be described as thermal type I2t characteristics and fuse-shaped I4t lines.
The nominal Long Time pickup is computed from the trip rating plug value (In) multiplied by the Long Time pickup setting. Long Time pickup setting multipliers are user settings and may range from 0.5 to 1.0 in increments of 0.05.
The actual Long Time pickup is 112% of the nominal setting (Ir). 112% is to compensate for the Long Time Pickup Tolerance of ±10% that is drawing as "actual value/1+ tolerance." For a nominal 1000A Long Time pickup, the actual trip setting is 1120A, drawn as a vertical band between 1120/1.1 and 1120/0.9, or 1018A and 1244A.

Thermal long time overcurrent

The thermal I2t shape is similar to the typical curve of a thermal magnetic circuit breaker and matches the shape of many overcurrent devices used in industry today. The typical shape and range of settings may be seen in Figure 3.4. The range of time delays is shown in Table 3.2 at various multiples of nominal (100%) current setting. Drawn bands also include a mechanical constant time to account for circuit breaker operating and clearing time, which causes the slight widening of the band evident at the lower (right) end of the faster (lower) bands.

Figure 3.4 Thermal Characteristic: Maximum and Minimum Long Time Delay Bands for a 1000A Long Time Pickup



Breaker Type	TCC
EntelliGuard G:	DES-090
WavePro, PBII, PBI, AK, AKR, Conv Kits	DES-095

Table 3.2 Thermal Characteristic: Nominal Clearing and Commit Times for X Multipliers of Nominal Pickup

X=	1.5	7.2	10	12	15					
	Commit	Clear	Commit	Clear	Commit	Clear	Commit	Clear	Commit	Clear
Min CB	4.25	8.04	0.139	0.239	0.072	0.137	0.050	0.104	0.038	0.080
C-2	12.7	24.1	0.417	0.656	0.215	0.352	0.149	0.253	0.095	0.172
C-3	25.5	48.1	0.83	1.28	0.430	0.674	0.298	0.476	0.190	0.315
C-4	34.0	64.1	1.11	1.70	0.57	0.89	0.40	0.62	0.254	0.410
C-5	51.0	96.2	1.67	2.53	0.86	1.32	0.60	0.92	0.38	0.60
C-6	67.9	128	2.22	3.4	1.15	1.75	0.79	1.22	0.51	0.79
C-7	84.9	160	2.78	4.2	1.43	2.18	0.99	1.52	0.63	0.98
C-8	102	192	3.33	5.0	1.72	2.61	1.19	1.81	0.76	1.17
C-9	119	224	3.89	5.9	2.01	3.03	1.39	2.11	0.89	1.36
C-10	136	256	4.44	6.7	2.29	3.46	1.59	2.41	1.02	1.55
C-11	153	289	5.00	7.5	2.58	3.89	1.79	2.71	1.14	1.74
C-12	170	321	5.56	8.4	2.87	4.32	1.99	3.00	1.27	1.93
C-13	204	385	6.67	10.0	3.44	5.18	2.38	3.60	1.52	2.31
C-14	238	449	7.78	11.7	4.01	6.04	2.78	4.19	1.78	2.69
C-15	272	513	8.89	13.4	4.59	6.90	3.18	4.79	2.03	3.07
C-16	306	577	10.0	15.0	5.16	7.76	3.58	5.38	2.29	3.45
C-17	340	641	11.1	16.7	5.73	8.61	3.97	5.98	2.54	3.83
C-18	374	705	12.2	18.4	6.30	9.47	4.37	6.57	2.79	4.21
C-19	408	769	13.3	20.0	6.88	10.3	4.77	7.17	3.05	4.59
C-20	442	833	14.4	21.7	7.45	11.2	5.17	7.76	3.30	4.97
C-21	476	898	15.6	23.4	8.02	12.0	5.56	8.36	3.56	5.35
Max CB	510	962	16.7	25.1	8.60	12.9	5.96	8.95	3.81	5.73

- Algorithm will not commit below 1.5 cycles, clearing time will not be less than 0.08sec.
- Maximum LT curve is 15XLTPU for Envelope 1 and 2 devices, 10XLTPU for Envelope 3 devices.
- Actual Long Time pickup is 112% of nominal pickup.

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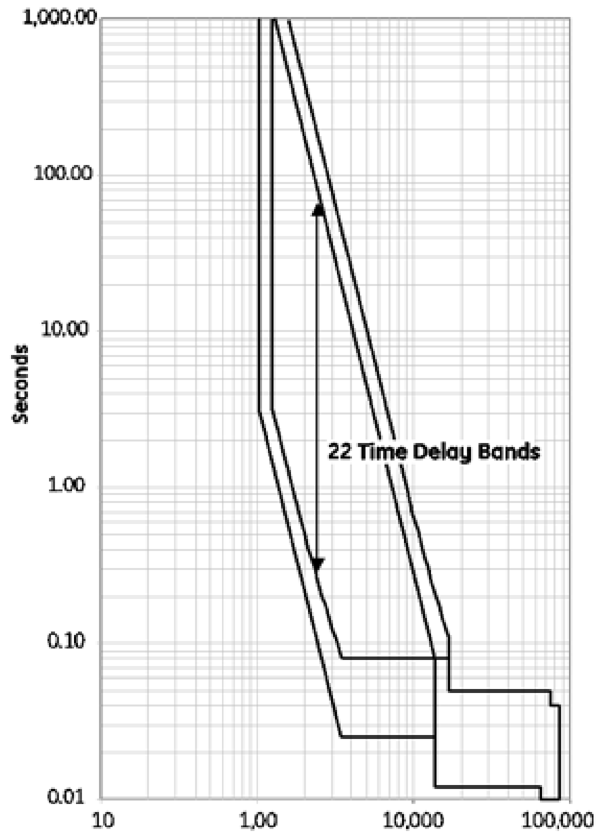
Fuse-shaped steep long time overcurrent
The optional steeper fuse characteristic is a straight line K=I4t shape for application in systems where fuses and circuit breakers are used together. Twenty-two different time bands are available in each trip unit.
Figure 3.5 displays minimum and maximum bands. Table 3.3 displays the nominal time delays for each of the 22 bands at various multiples of nominal current pickup.
Drawn bands also include a 30 ms constant time, which accounts for the slight widening evident in the time current curve at the lower (right) end of the faster (lower) time bands.

Figure 3.5 Fuse Characteristic: Maximum and Minimum Long Time Delay Bands for a 1000A Long Time Pickup



Breaker Type	TCC
EntelliGuard G:	DES-091
WavePro, PBII, PBI, AK, AKR, Conv Kits	DES-096

Table 3.3 Fuse Characteristic: Nominal Clearing and Commit Times for X Multipliers of Nominal Pickup

X=	1.5	7.2	10	12	15					
	Commit	Clear	Commit	Clear	Commit	Clear	Commit	Clear	Commit	Clear
Min Fuse	0.675	1.51	0.025	0.080	0.025	0.080	0.025	0.080	0.025	0.080
F-2	1.96	4.37	0.025	0.080	0.025	0.080	0.025	0.080	0.025	0.080
F-3	3.56	7.95	0.025	0.080	0.025	0.080	0.025	0.080	0.025	0.080
F-4	5.57	12.4	0.025	0.080	0.025	0.080	0.025	0.080	0.025	0.080
F-5	8.07	18.0	0.025	0.080	0.025	0.080	0.025	0.080	0.025	0.080
F-6	11.2	25.0	0.025	0.080	0.025	0.080	0.025	0.080	0.025	0.080
F-7	15.1	33.7	0.028	0.080	0.025	0.080	0.025	0.080	0.025	0.080
F-8	20.0	44.7	0.038	0.084	0.025	0.080	0.025	0.080	0.025	0.080
F-9	26.1	58.3	0.049	0.110	0.025	0.080	0.025	0.080	0.025	0.080
F-10	33.8	75.4	0.064	0.142	0.025	0.080	0.025	0.080	0.025	0.080
F-11	43.3	96.7	0.082	0.182	0.025	0.080	0.025	0.080	0.025	0.080
F-12	55.3	123	0.104	0.232	0.028	0.080	0.025	0.080	0.025	0.080
F-13	70.2	157	0.132	0.295	0.036	0.080	0.025	0.080	0.025	0.080
F-14	88.9	198	0.167	0.374	0.045	0.100	0.025	0.080	0.025	0.080
F-15	112	251	0.211	0.472	0.057	0.127	0.027	0.080	0.025	0.080
F-16	141	316	0.266	0.595	0.072	0.160	0.035	0.080	0.025	0.080
F-17	178	397	0.335	0.748	0.090	0.201	0.043	0.097	0.025	0.080
F-18	224	499	0.421	0.940	0.113	0.252	0.055	0.122	0.025	0.080
F-19	280	626	0.528	1.179	0.142	0.317	0.068	0.153	0.028	0.080
F-20	352	785	0.663	1.479	0.178	0.397	0.086	0.192	0.035	0.080
F-21	441	984	0.830	1.853	0.223	0.498	0.108	0.240	0.044	0.098
Max Fuse	540	1204	1.017	2.269	0.273	0.610	0.132	0.294	0.054	0.120

- Algorithm will not commit below 1.5 cycles, clearing time will not be less than 0.08sec.
- Maximum LT curve is 15XLTPU for Envelope 1 and 2 devices, 10XLTPU for Envelope 3 devices.
- Actual Long Time pickup is 112% of nominal pickup.

Thermal memory

The Long Time and Short Time pickup algorithm also includes a cooling cycle that keeps track of current if it oscillates in and out of pickup range. This Thermal Memory is also active in case the circuit breaker trips on Long Time or Short Time to account for residual heating in conductors. If a circuit breaker is closed soon after a Long Time trip or Short Time trip, a subsequent trip may happen faster than indicated by the time current curve due to the residual cable Thermal Memory effect. In trips without control power, the Thermal Memory is powered from the Trip Unit battery. The cooling algorithm requires up to 14 minutes to fully reset to zero.

Short time protection

Short Time Pickup

The EntelliGuard TU provides a wide range of Short Time pickup settings, I2t characteristics and time bands to optimize selectivity while not sacrificing clearing time unnecessarily. Short Time pickup settings range from 1.5 to 12 times the Long Time pickup setting for the EntelliGuard G circuit breakers in Envelopes 1 and 2. The maximum Short Time pickup for Envelope 3 is 10 times. In Power Break, WavePro, AKR and other circuit breakers, the maximum Short Time pickup may be lower. The transition between Long Time band and Short Time function may happen at the horizontal Short Time Delay Band rather than the vertical Short Time pickup, depending on the following:

- How fast or what type of Long Time band is chosen
- What Short Time pickup is selected
- What Short Time Delay is selected

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An example of this may be seen in Figure 3.6 for the combination of Long Time Delay Band and Short Time Delay Band shown in Figure 3.7, any Short Time pickup setting larger than 6X will result in the Long Time band intersecting with the horizontal Short Time delay band rather the vertical Short Time pickup.

Short Time Bands

The EntelliGuard TU comes with a wide range of adjustable Time Delay Bands, ranging from a minimum of 25ms (clears in 80ms, 55ms for Sensing, Operating and Clearing Time) to 417ms (clears in 472ms). The bands are specially designed to pick up above various circuit breakers and trip systems to provide required selectivity while not sacrificing any more clearing time than required to provide the superior arc flash protection.
The time bands are shown in Table 3.4 and Figure 3.8.

Figure 3.7 Short Time Transition

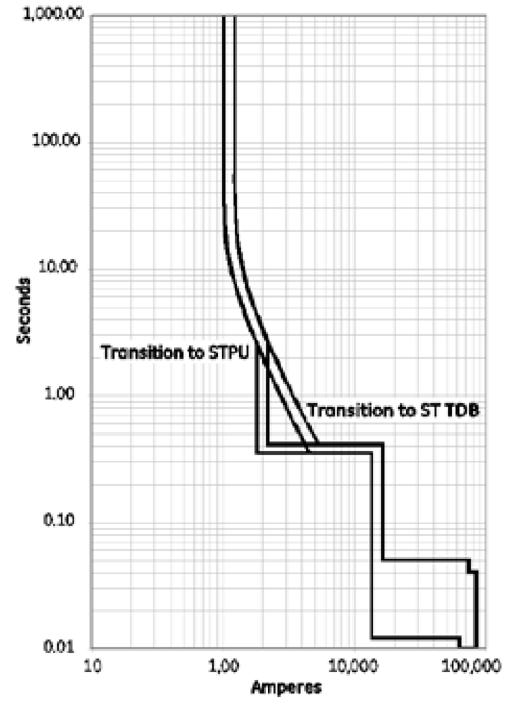


Figure 3.6 Short Time Pickup

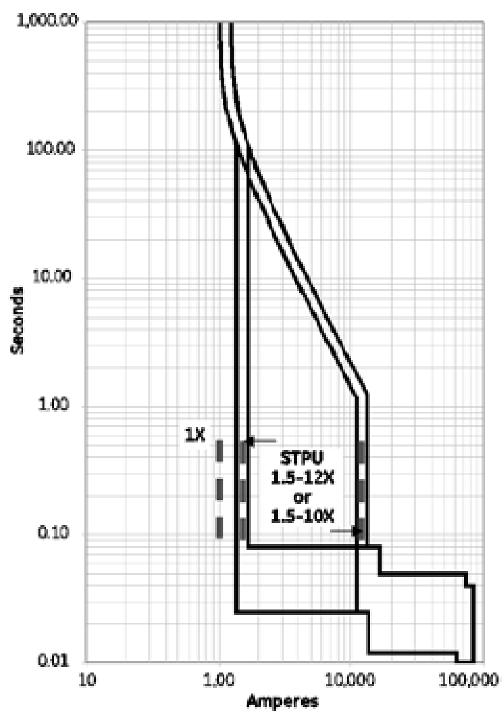
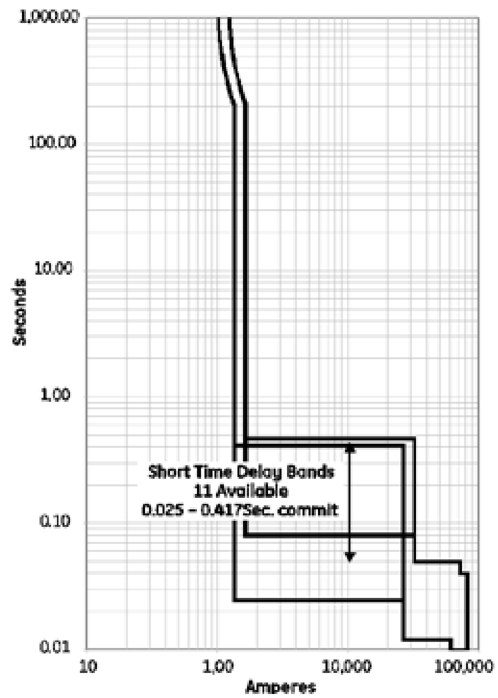


Table 3.4 Short Time Delay Bands

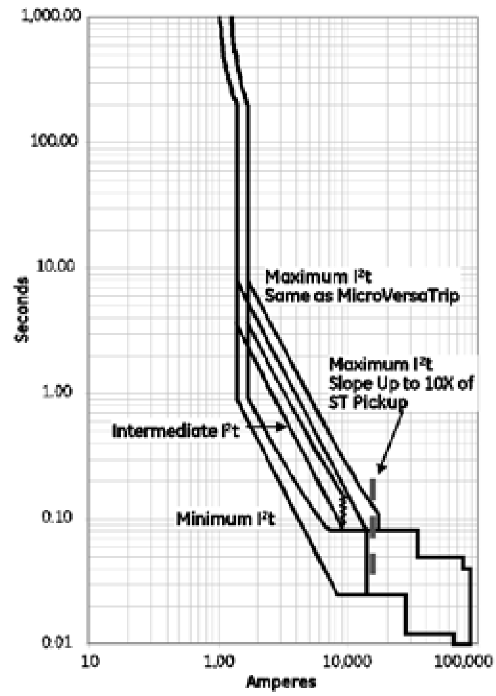
Label	Pickup	Clearing
Minimum	0.025	0.080
2nd	0.033	0.088
3rd	0.042	0.097
4th	0.058	0.113
5th	0.092	0.147
6th	0.117	0.172
7th	0.158	0.213
8th	0.183	0.238
9th	0.217	0.272
10th	0.350	0.405
Maximum	0.417	0.472

Figure 3.8 Short Time Delay



Breaker Type	TCC
EntelliGuard G:	DES-092
WavePro, PBII, PBI, AK, AKR, Conv Kits	DES-097

Figure 3.9 Short I²t (In or Out)



Short Time I²t Slopes

The EntelliGuard Trip Unit offers three different Short Time I2t characteristics to allow optimized settings for selectivity and fast protection whenever possible. When using the EntelliGuard Trip Unit in systems that also employ older GE MVT trip units, the EntelliGuard Trip Unit's maximum I2t characteristic is equal to the Short Time I2t characteristic in the MVT trip.

The position of the I2t slopes varies with the Long Time pickup of the respective circuit breaker. The intersection of the Short Time pickup and the Short Time delay band with the I2t slope varies with the Short Time pickup and time delay band.

The three positions for the Short Time It band are shown in Figure 3.9. The bands may be defined by the formula K = I2t, where K equals 18, 8 and 2 times the nominal Long Time pickup squared. A 30msec fixed time is added to account for circuit breaker mechanical operation, clearing time and variance. Pickup tolerance is 10% of current.

The maximum (upper) Short Time I2t band may not be used with the minimum Long Time thermal band. Use of the fuse shaped Long Time bands also inhibits use of the Short Time I2t bands. Only the definite Short Time pickup characteristic may be used with the fuse shaped Long Time curves.

Ground fault protection

The EntelliGuard TU trip unit offers the ultimate in Ground Fault protection. Each trip unit may be provided with the ability to accept a neutral sensor signal and generate an internal Zero Sequence phasor for Ground Fault protection. It may also be equipped with the ability to accept a Zero Sequence phasor signal from an external Zero Sequence CT or residual summation scheme using current transformers. Either Ground Fault method may be used to provide Ground Fault trip or Ground Fault alarm. Four pole circuit breakers may also provide Ground Fault protection based on an external Zero Sequence input signal or a residual sum of all four internal sensors.

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Internal residual summation
The EntelliGuard TU trip unit uses internal air core sensors for current sensing, and the signals are residually summed using advanced digital electronics. A neutral sensor may be located remotely and connected to the trip unit. The connection is limited to 10m (33ft). Due to the air core sensor's ability to handle a wide range of primary currents without distortion, Ground Fault sensing is accurate for a wide range of phase and current inputs.

External zero sequence input
The EntelliGuard TU trip unit is able to accept input from an externally calculated Ground Fault current. The Ground Fault current may be derived using a single Zero Sequence CT or multiple phase CTs connected in a residual summation scheme. External CE marked Zero Sequence or ground return CTs are available for IEC applications, but are not UL Listed. Phase CTs used for a summation connection are UL Listed. Applications for this capability include sensing at the ground return connection for a transformer or generator as well as application in multiple source grounded systems.

Ground fault pickup settings
All UL 489 and UL 1066 circuit breakers are limited to a maximum nominal pickup setting of 1200A per the UL standard. The minimum setting is 20% of sensor size. The available maximum settings per sensor may be seen in Table 3.5.

Table 3.5 Ground Fault Time Delay Bands

Sensor	Minimum	Maximum
400	0.2	1.0
600	0.2	1.0
800	0.2	1.0
1200	0.2	1.0
1600	0.2	0.75
2000	0.2	0.60
2500	0.2	0.48
3000	0.2	0.40
3200	0.2	0.37
4000	0.2	0.30
5000	0.2	0.24
6000	0.2	0.20

Ground fault time delay bands
Ground Fault Time Delay Bands used in the EntelliGuard G circuit breakers range from 42msec to 942msec.
The available minimum settings per circuit breaker type are shown in Table 3.6. The maximum Time Delay Band setting for all circuit breakers is 0.940sec with a 1sec clear.

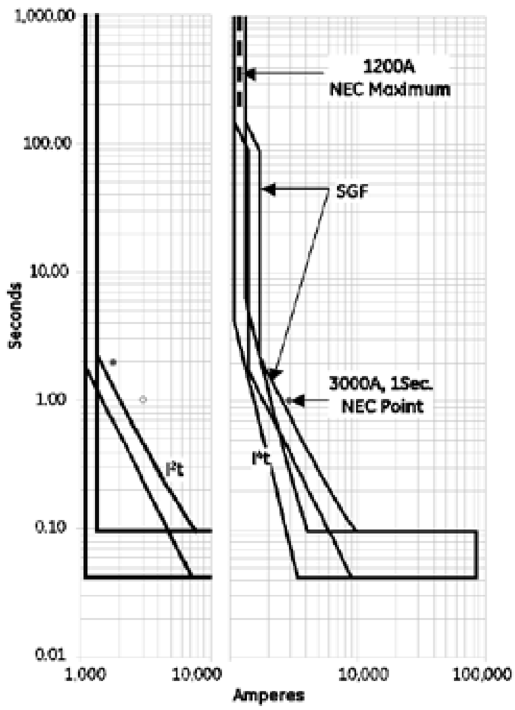
Table 3.6 Minimum Ground Fault Pickup and Clear Time

Setting	EntelliGuard G
Minimum pickup	0.042 sec
Minimum clear	0.097 sec
Maximum pick	0.940 sec
Maximum clear	1.000 sec

Ground fault protection curves
The EntelliGuard TU trip unit offers four different shapes for the ground fault function:
- Definite time with adjustable time delay.
- I2t slope with adjustable time delay.
- I4t slope (fuse shaped) with adjustable time delay.
- Selective double break I2t with adjustable time delay.

The definite time and I2t characteristics provide the traditional GF curve shapes. The I4t characteristic provides a shape more in line with downstream fuses. GE's novel selective double break I2t characteristic provides the most selective setting possible while still meeting the applicable UL and NEC standards. In many cases, an 800A circuit breaker may be used under a 1200A ground fault curve selectively (Figure 3.10).

Figure 3.10 Ground Fault Characteristics



Instantaneous protection

The EntelliGuard TU trip unit may provide several types of Instantaneous protection, depending on the circuit breaker in which it is installed. The different types of Instantaneous protection are as follows:

- Adjustable Selective Instantaneous: Provided on Power Break, Power Break II, WavePro, AK, AKR, Conv Kits and EntelliGuard G.
- Extended Range Adjustable Selective Instantaneous: An available option on ANSI EntelliGuard G circuit breakers.
- High Set Instantaneous Overcurrent Trip: Provided on Power Break II and some EntelliGuard G circuit breakers, also called an override.
- Making Current Release (MCR): Provided on all EntelliGuard G circuit breakers.
- Reduced Energy Let-Through Instantaneous Trip: An available option on Power Break, Power Break II, WavePro, AK, AKR, Conv Kits, and EntelliGuard G circuit breakers.

Each of these Instantaneous trips provides optimum protection, selectivity or both as required for different applications, subject to the capabilities of the respective circuit breakers in which the trip units are installed.

Adjustable selective instantaneous

The EntelliGuard TU uses an exclusive algorithm, developed by GE, to recognize the wave shape of fault current within a cycle. With the improved analysis of the fault current wave shape, the trip unit allows the circuit breaker to trip immediately yet provide superior selectivity when used above current limiting circuit breakers or fuses. In many cases, the trip unit's Instantaneous pickup may be set quite low yet allow for complete selectivity up to the circuit breaker's full withstand level. For a list of possible selective combinations of GE circuit breakers employing the EntelliGuard TU trip unit and various downstream overcurrent devices, see GE publication DET-760.

The EntelliGuard TU trip unit can be furnished with one of two Instantaneous adjustment ranges. The standard adjustable range may be as high as 15X the trip plug value on all UL 489 or UL 1066 circuit breakers. An optional Extended Range Adjustable Selective Instantaneous, as high as 30X, may be provided for UL 1066 Listed Low Voltage Power Circuit Breakers (LVPCBs). LVPCBs also allow for this adjustable Instantaneous trip to be turned off. The minimum adjustable Instantaneous pickup setting for all circuit breakers is 2X the trip plug rating. The available maximum pickup settings are described in Table 3.7. The maximum Instantaneous pickup is limited by the circuit breaker's withstand rating.

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Table 3.7 Maximum Adjustable Instantaneous Pickup for EntelliGuard G Circuit Breakers with Normal or Extended Range Option

"In" (Plug Rating, A)	Withstand Rating									
	42		50		65		85		100	
	Normal Range	Extended Range	Normal Range	Extended Range	Normal Range	Extended Range [1]	Normal Range	Extended Range [1]	Normal Range	Extended Range [1]
150-2,000	15		15		15	30	15	30	15	30
2,200			15		15	28	15	30	15	30
2,400			15		15	25	15	30	15	30
2,500			15		15	24	15	30	15	30
3,000			15		15	20	15	26	15	30
3,200					15	19	15	25	15	29
3,600					15	17	15	22	15	26
4,000					15	15	15	20	15	23
5,000							15	16	15	19
6,000							13			

1. Available in ANSI/UL1066 CB only

The Adjustable Selective Instantaneous will clear a fault in three cycles when used in 60Hz or 50Hz applications. Zone Selective Interlocking (I-ZSI) may be used with this Instantaneous function, allowing several breakers with overlapping Instantaneous protection to be selective with each other. Because each circuit breaker is set to trip Instantaneously for faults within their respective zones of protection, fast protection and selectivity are achieved simultaneously.

The special selective Instantaneous algorithm allows any circuit breaker above current limiting devices to be set with a relatively low Instantaneous pickup and still achieve significant selectivity. The system may be able to provide Instantaneous protection for most faults, including high impedance arcing fault, while maintaining significant levels of selectivity. Figure 3.12 and Figure 3.13 later in this document demonstrate the performance of the Instantaneous ZSI capability.

Table 3.8 Time Current Curves

Breaker Type	TCC
EntelliGuard G: Selective Instantaneous & RELT	DES-094
Power CB: Selective Instantaneous & RELT	DES-101
Power Break: Instantaneous	DES-099
Power Break II: Selective Instantaneous and HSIOC (Override)	DES-100

High set instantaneous overcurrent (HSIOC)

The EntelliGuard TU trip unit's HSIOC pickup is similar to the fixed override used by other trip units and circuit breakers in the industry. In EntelliGuard G, the HSIOC setting is changed automatically by the trip unit if the normal adjustable Instantaneous is turned off (LVPCB only). When adjustable Instantaneous setting is turned off, HSIOC nominal setting becomes 98% of the circuit breaker's Short Time withstand setting. In all other cases, in the EntelliGuard G family of circuit breakers, the HSIOC is set high enough to allow full selectivity up to the circuit breaker's short time withstand rating.

For circuit breakers with an HSIOC trip function, the location of the HSIOC trip is shown by the line that reaches the 0.01sec axis at the bottom of the TCC. The location of that line is shown in Section 5.: Catalog Numbering Guide, "Digit 5 – EntelliGuard G Short Circuit and Interrupting Ratings." In many applications, the EntelliGuard G circuit breaker with an EntelliGuard TU trip unit will be completely selective up to the HSIOC pickup or the circuit breaker's full short circuit rating, even with the adjustable Instantaneous on.

Making current release (mcr)
This form of Instantaneous protection is provided on all EntelliGuard G circuit breakers. This function provides protection in case the circuit breaker is closed on an unusually high current. A circuit breaker that experiences 15 times (15x) or more its plug rating is possibly closing in on a fault caused by incorrectly wired conductors, forgotten grounding cables or some other type of unusual low impedance fault.
Alternatively, it is closing on a very low impedance arcing fault. In either case, there is a possibility that equipment may be damaged by the high fault current or an arc flash hazard has been inadvertently created. The MCR provides very fast protection when the circuit breaker is closed and for the first six cycles thereafter. After the six cycles have elapsed, the MCR is turned off and the circuit breaker reverts to its adjustable Instantaneous pickup and HSIOC if provided. The MCR will clear fault current in 40msec or less.

Reduced energy let-through (RELT) instantaneous trip
The EntelliGuard TU trip unit provides an optional second, user-adjustable, RELT Instantaneous trip, which allows a circuit breaker to be temporarily set to a more sensitive pickup to provide better protection, only when better protection is needed and some selectivity may be sacrificed. The RELT pickup is adjustable from 1.5X to 15X of plug rating, independently of the normal adjustable selective Instantaneous. It may be set higher or lower than the selective Instantaneous.
The user must make two entries at the trip unit: (1) Pickup settings (1.5-15X of the plug) and (2) ON, OFF or REMOTE. ON/OFF enables or disables the pickup setting. REMOTE allows the RELT Instantaneous pickup to be enabled via application of 24Vdc or Vac at the RELT input terminals or serial communications via the Modbus or Profibus communication port. The RELT pickup may be enabled via serial communication or remote 24V signal, but both need to be indicating “OFF” for the RELT Instantaneous pickup to be disabled. The RELT input command may be wired to a manual switch, automatic sensor or, via external logic, to one or more signal sources.

When the EntelliGuard TU trip unit has the RELT Instantaneous pickup enabled, the trip unit provides a feedback signal via an optically isolated dry contact and serial communication. This provides positive feedback that the trip unit has received and reacted to the RELT Enable command. The EntelliGuard TU trip unit’s RELT capability provides the ultimate in user flexibility for wiring and controlling an alternate Instantaneous setting for temporary use to reduce personnel hazard. The RELT Instantaneous pickup clears fault current in 42msec or less at 60Hz.
RELT capability may be provided on a trip unit with or without control power. If 24V is provided to the RELT input, the trip unit will use the RELT Instantaneous trip setting. However, without control power connected to the trip unit permanently, indication that the trip unit is in the RELT mode may not be reliably communicated. If reliable communication that the trip unit is in the RELT mode is desired, it is suggested that the trip unit be permanently connected to 24Vdc control power.

Reduced energy let-through switch wiring
The RELT switch may be connected to a manually operated two-position switch, a remote sensor, or both simultaneously. The EntelliGuard TU trip unit provides a feedback capability directly from the trip so the user is able to verify that the signal was received by the trip unit and the settings have changed. Optionally, an indicating light may also be connected to the source of control power so the user knows if control power is available to change the setting. The trip unit does not require its own control power to accept a RELT input and change the Instantaneous trip pickup according to the user settings. However, if control power is available to the trip unit, the feedback signal will function immediately, rather than when the trip unit becomes self-powered through its load current (Figure 3.11).

[2] RELT, a.k.a. maintenance switch, fullfills the requirements of the NEC, article 240.87.

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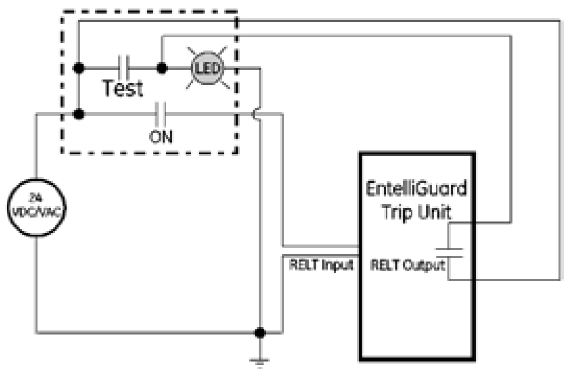
Figure 3.11 Integrated Switch and LED, Spring Return from "Test" to "Off," Latched in "On"



- This configuration provides positive indication that the trip unit has received and processed the RELT "On" signal. It Also provides a control power check. Caution: It is recommended that RELT output be wired to an appropriate annunciation when remote activation control of RELT is used.

Note:
When using the RELT function in conjunction with remote enable/disable control, it is strongly recommended that the trip unit be provided with permanently connected control power and that the RELT status output be assigned to a trip output contact. The trip output contact should be wired to appropriately located annunciation. The trip unit will accept a command to enable the RELT instantaneous pickup setting via local HMI control, a 24Vac/dc voltage applied at the input terminals or serial communication. Regardless how the enable command is received, the trip unit will be in the RELT mode when protection is required. However, the status indicating contacts will only close if the trip unit is powered through the internal current transformers or 24Vdc control power. Lack of 24Vdc control power could provide unreliable indication of RELT status due to low load conditions on the circuit breaker.

Zone selective interlocking (ZSI)
The EntelliGuard TU trip unit's ZSI capability differs from that found in other circuit breaker trips in two significant ways:
1. It allows independent and separate settings of the unrestrained (in zone protection) and the restrained (back up protection) bands.
2. It provides simultaneous and independent ZSI of both the Short Time and Instantaneous protection. This allows each circuit breaker to zone interlock with upper tier circuit breakers between ST band to ST band, Instantaneous to Instantaneous, or Instantaneous to Short Time.

The EntelliGuard TU trip unit's fast ZSI system is able to interlock Ground Fault, Short Time and Instantaneous. When required for feeder selectivity the main is able to be set faster than the feeder without any sacrifice in selectivity. As long as the main breaker's pickup is set above the feeder's pickup the two devices will remain selective. Each circuit breaker in a ZSI scheme allows separate user settings for the restrained (backup) and unrestrained (in zone protections) for ground fault and short time protection. For the lowest tier device in the scheme the restrained and unrestrained are set to the same values. For instantaneous protection there is only one pickup setting required.
Instantaneous protection may also be interlocked such that all circuit breakers above the one whose zone has the fault will shift from Instantaneous clearing to a 0.058msec time band. Since it is expected that faults of enough magnitude to engage the Instantaneous pickup are dangerously high, all zone selective interlocked Instantaneous trips that receive a restraint signal are shifted to the same band. Should the bottom circuit breaker fail to clear for whatever reason, quick back up protection from both ties and feeders is provided.
Threshold-zone-selective-interlocking (T-ZSI) allows thresholds for short time and instantaneous to also overlap and provide more sensitive protection in upstream buses. The downstream trip unit issues a blocking signal that accounts for trip unit sensing tolerance and consequently is able to make up for possible sensing variance. This then allows the user to set multiple circuit breakers' trip units at the exact same short time and instantaneous pickup and maintain full selectivity without the need to desensitize upstream devices.

T-ZSI is available with GTU firmware version 08.00.26 and above.
Short Time and Ground Fault bands for zone interlocked circuit breakers may be set to any band available to the trip. Figure 3.12 shows two circuit breakers set to protect at their unrestrained settings. Figure 3.13 shows the same two circuit breakers while a fault is detected below the lower circuit breaker in the system and after a restraint signal is received by the upper circuit breaker's trip unit. The upper circuit breaker's Short Time band has shifted from the user setting of 0.025sec to a user set restrained band of 0.092sec. The Instantaneous has shifted from the adjustable selective Instantaneous band clearing in 0.050sec to the fixed restrained band of 0.058sec, clearing in 0.113sec. This allows the lower circuit breaker to clear faults within their zone of protection above 7,000A RMS and 11,000A RMS respectively, clearing under 100msec, while maintaining full selectivity for faults up to 85,000A.

Note:
For I-ZSI functionalities on EntelliGuard TU trip units in ANSI and UL EntelliGuard G circuit breakers, see publication DET-760.

Figure 3.12 Zone Selective Interlocked CB, Upper CB Shown "Unrestrained"

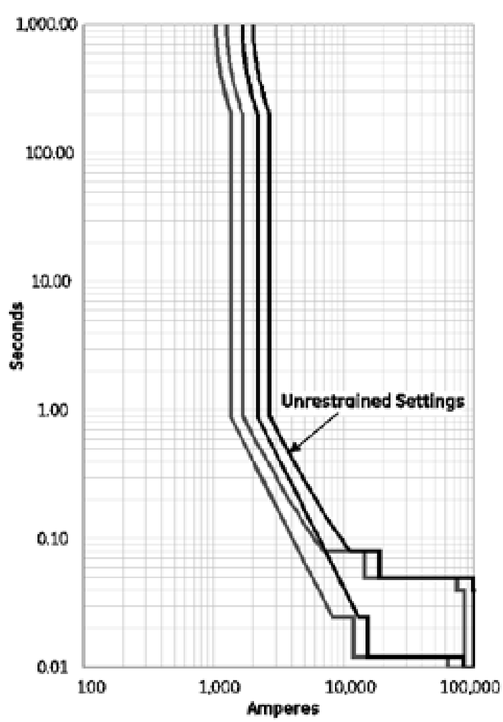
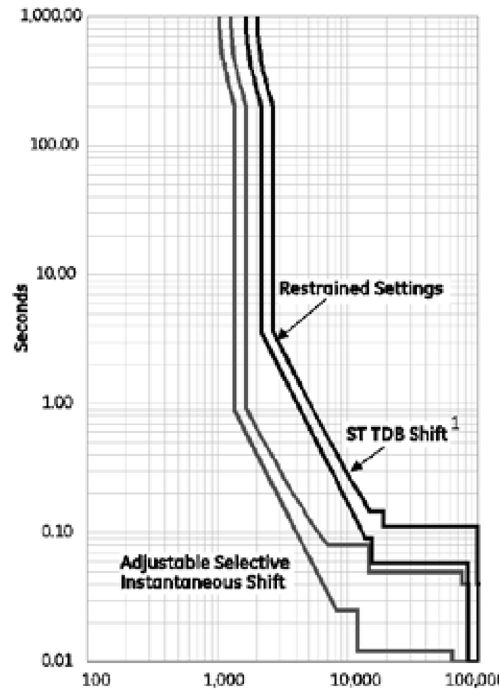


Figure 3.13 Zone Selective Interlocked CB, Upper CB Shown "Restrained"



Universal trip rating plugs
The EntelliGuard TU trip system is composed of trip units and trip rating plugs along with the sensors and wiring provided in the EntelliGuard G circuit breaker to support the trip. Rating plugs are used to lower the Long Time adjustment range of the sensor provided in the circuit breaker.
The EntelliGuard TU trip rating plugs are unique in that they can be used with multiple trip units and circuit breakers within a specific sensor range, rather than only with a single specific sensor. The trip rating plug catalog number, shown in Figure 3.14, identifies the rating as well as the minimum and maximum sensor rating the plug may be used with. Table 3.9 lists the two-digit codes used within the trip rating plug catalog numbers and the sensor current ratings to which they are mapped. Table 3.10 lists trip rating plugs available for each sensor.

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Figure 3.14 EntelliGuard Trip Unit Rating Plug Catalog Number

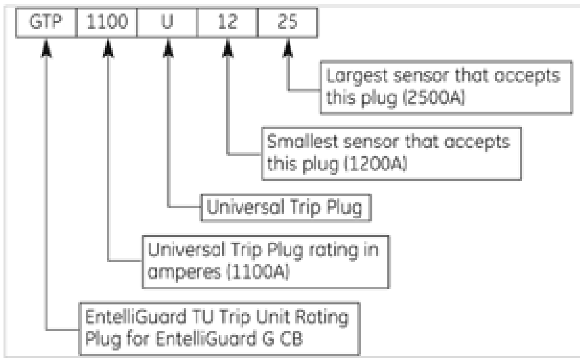

Table 3.9 Trip Rating Plug Codes

Code	Sensor Rating	Code	Sensor Rating
01	150A1	16	1600A
02	200A2	20	2000A
03	225A4	25	2500A
04	400A	30	3000A
06	600A	32	3200A
07	630A3	40	4000A
08	800A	50	5000A
10	1000A	60	6000A
12	1200A	64	6400A3
13	1250A3		

1 Sensor available in WavePro and AKR only.
2 Sensor available in Power Break only.
3 Sensor available in IEC listed circuit breaker only.
4 Used on Conv Kits

Table 3.10 Trip Rating Plug Specifications

Trip Plug Catalog Number	Plug Rating	May Be Used With	
		Minimum Sensor	Maximum Sensor
GTP0060U0101	60A[1]	150A[3]	150A3
GTP0080U0101	80A[1]	150A[3]	200A[4]
GTP0100U0103	100A[2]	150A[3]	200A[4]
GTP0125U0103	125A[1]	150A[3]	200A[4]
GTP0150U0404	150A	150AV	400A
GTP0200U0404	200A	200A[4]	400A
GTP0225U0406	225A	400A	600A
GTP0250U0407	250A	400A	630A[5]
GTP0300U0408	300A	400A	800A
GTP0350U0408	350A	400A	800A
GTP0400U0410	400A	400A	1000A
GTP0450U0612	450A	600A	1200A
GTP0500U0613	500A	600A	1250A[5]
GTP0600U0616	600A	600A	1600A
GTP0700U0816	700A	800A	1600A
GTP0750U0820	750A	800A	2000A
GTP0800U0820	800A	800A	2000A
GTP0900U1020	900A	1000A	2000A
GTP1000U1025	1000A	1000A	2500A
GTP1100U1225	1100A	1200A	2500A
GTP1200U1232	1200A	1200A	3200A
GTP1500U1640	1500A	1600A	4000A
GTP1600U1640	1600A	1600A	4000A
GTP1900U2050	1900A	2000A	5000A
GTP2000U2050	2000A	2000A	5000A
GTP2200U2550	2200A	2500A	5000A
GTP2400U2564	2400A	2500A	6400A[5]
GTP2500U2564	2500A	2500A	6400A[5]
GTP3000U3064	3000A	3000A	6400A[5]
GTP3200U3264	3200A	3200A	6400A[5]
GTP3600U4064	3600A	4000A	6400A[5]
GTP4000U4064	4000A	4000A	6400A[5]
GTP4000K4040[6]	4000A	4000A	4000A
GTP5000U5064	5000A	5000A	6400A[5]
GTP6000U6064	6000A	6000A	6400AV

1 WavePro & AKR only. EntelliGuard G min. trip plug is 150A.
2 PowerBreak only. EntelliGuard G min. trip plug is 150A.
3 WavePro & AKR only. EntelliGuard G min. sensor is 400A.
4 PowerBreak only. EntelliGuard G min. sensor is 400A.
5 IEC only sensor, UL equivalents are 600A.
6 Used on ITE and Allis Chalmers Conv Kits

Table 3.11 lists the plugs available for each sensor in the various circuit breakers in which the EntelliGuard TU may be installed.

Table 3.11 EntelliGuard G Rating Plug Logic (UL 489, UL 1066, IEC)

Breaker Frame/Sensor (A)														
All	**IEC**	**All**	**All**	**UL/ ANSI**	**IEC**	**All**	**All**	**All**	**UL**	**IEC/ ANSI**	**All**	**All**	**UL/ ANSI**	**IEC**
400	630	800	1000	1200	1250	1600	2000	2500	3000	3200	4000	5000	6000	6400
150														
200														
225														
250	250													
300	300	300												
350	350	350												
400	400	400	400											
	450	450	450	450										
	500	500	500	500	500									
	600	600	600	600	600	600								
	630	630	630	630	630	630								
		700	700	700	700	700								
		750	750	750	750	750	750							
		800	800	800	800	800	800							
			900	900	900	900	900							
			1000	1000	1000	1000	1000	1000						
				1100	1100	1100	1100	1100						
				1200	1200	1200	1200	1200	1200	1200				
					1250	1250	1250	1250	1250	1250				
						1500	1500	1500	1500	1500	1500			
						1600	1600	1600	1600	1600	1600			
							1900	1900	1900	1900	1900	1900		
							2000	2000	2000	2000	2000	2000		
								2200	2200	2200	2200	2200		
								2400	2400	2400	2400	2400	2400	2400
								2500	2500	2500	2500	2500	2500	2500
									3000	3000	3000	3000	3000	3000
										3200	3200	3200	3200	3200
											3600	3600	3600	3600
											4000	4000	4000	4000
												5000	5000	5000
													6000	6000
														6400

Section 3.
Entelliguard TU Trip Unit System

Universal Spare Trip Unit

EntelliGuard G circuit breakers will accept a Universal Spare Trip Unit. This unique trip unit may be used in any EntelliGuard G circuit breaker regardless of frame size, sensor size, short circuit rating or whether the circuit breaker is listed under UL 489, ANSI/UL 1066 or IEC 947 standards. Should any circuit breaker's trip unit fail to operate for any reason, this one universal trip unit may be used as a replacement.

Once an EntelliGuard TU trip unit, including the Universal Spare Trip Unit, is associated with a specific EntelliGuard G circuit breaker, it may only be used with that specific circuit breaker. If swapping between EntelliGuard G circuit breakers is required, a trip unit may only be swapped between circuit breakers with equal sensor ratings, short circuit ratings and standard listing. Before the circuit breaker may be used with a swapped or new trip unit, the trip unit must be mapped to the circuit breaker.

The Re-mapping procedure is done by Pressing simultaneously the "Right", "Left", and "Up" Arrow all at the same time (should be able to do with one hand). "BIM OK" will be flashing in the upper left hand corner of the LCD when this is performed.

Another Method is to use Modbus Command 107 "Upload BIM" Either procedure requires the trip unit to be mounted to the breaker and control power be provided to the trip unit from permanently connected control power or a portable power supply via the front port.

Front 24VDC Power is provided by either the GTUTK20 Test Kit or the Portable Battery Pack, TVPBP and TVPBPACC.

All Universal Trip units have the following format G1X00-----RXXXX. The middle 5 digits describe the trip unit protection options and features.

Universal Trip Units may be ordered with a limited set of options. It is suggested that they be ordered with the widest range of options used within a facility, as any unnecessary functions can always be disabled or turned off (except for Ground Fault) during set up by the user. The user-selected options for the Universal Trip Unit are listed in Table 3.12.

Table 3.12 Universal Spare Trip Unit Options (User-Selected)

Feature	#	Option
Long Time	1	Standard (Circuit Breaker Curves)
	2	Standard and Fuse Curves
Instantaneous	1	Standard
	2	Extended Range[1]
Ground Fault[2]	1	None
	2	Standard (Internal GF)
	3	Ground Input
Arc Flash Protection	1	No RELT
	2	RELT
Zone Selective Interlocking	1	Short Time and Ground Fault
	2	Short Time, Ground Fault, Instantaneous, and Threshold
Communications	1	None
	2	Modbus
	3	Profibus
Metering	1	Standard (ammeter)
	2	Advanced (A, V, E and P)
	3	Diagnostic (Advanced and WFC)

1. Available in ANSI/UL1066 CB only.
2. Mains and ties in solidly grounded multiple source substations will usually require ground input type ground fault protection. Feeders will use standard internal ground fault protection.

Example Universal Trip Cat#: G1X00L4T6MRXXXX

Description: Universal EntelliGuard TU Trip unit for a EntelliGuard G Breaker with LSIG, Zone Selective Interlocking (Short Time, Ground Fault, Instantaneous), Threshold, Modbus, Full Metering, Waveform Capture, RELT, and Bell Alarm with Lockout/Manual reset.

Table 3.13 Relay Functions Available in EntelliGuard G Circuit Breakers with EntelliGuard TU Trip Units

	Functions	Trip	Alarm	Display	Output Contact[2]	Serial Comm.	Output[3]		
							1	2	Dedicated
Protective						yes	X	X	
	Undervoltage	yes	yes	yes	yes	yes	X	X	
	Overvoltage	yes	yes	yes	yes	yes	X	X	
	Current Unbalance	yes	yes	yes	yes	yes	X	X	
	Power Reversal	yes	yes	yes	yes	yes	X	X	
Protective	Current Level Alarm, 2 Settings Available	no	yes	yes	yes	yes	X	X	
	Health Indication (Bad)	no	yes	yes	yes	yes	X	X	
	Health Indication (Good)	no	yes	yes	yes	yes	X	X	
	RELT ON Status[3]	no	no	yes	yes	yes	X		
	Ground Fault Alarm Status	no	no	yes	yes	yes	X	X	
	ZSI Output /Input	no	no	yes	yes	yes			X
Diagnostics	Trip Target	no	no	yes	no	yes			
	Trip Information	no	no	yes	no	yes			
	Trip Counter	no	no	yes	no	yes			
	Event Logging (Trips, Alarms, I/O)	no	no	yes	no	yes			
	Waveform Capture	no	no	yes	no	yes			
	Trip mechanism self-timing[4]	no	no	no	no	yes			
	Built-in ZSI testing[4]	no	no	yes	no5	no			
Metering	Current (Phases A, B, C, N)	no	no	yes	no	yes			
	Voltage (Phase A, B, C)[1]	no	no	yes	no	yes			
	Energy (kWh, Total)	no	no	yes	no	yes			
	Real Power (Watts, Per Phase and Total)	no	no	yes	no	yes			
	Apparent Power (Watts, Per Phase and Total)	no	no	yes	no	yes			
	Reactive Power	no	no	yes	no	yes			

1. User set to PH-N or PH-PH.
2. Output contacts are low signal (Hi-Fi).
3. When top unit has RELT, output 1 is dedicated to RELT ON status.
4. Available with GTU's firmware version 08.00.26 and above.
5. When ZSI testing is activated, the downstream breaker sends ZSI signal to upstream breaker.

Relay & diagnostic functions

EntelliGuard TU offers various protective and alarm relay functions that may be displayed on the LCD screen, assigned contact outputs or communicated serially (Table 3.13).

Protective relays

Protection relays may be set by the user to alarm, trip the circuit breaker or both. Alarms and trips are displayed on the local LCD trip and communicated serially. Alarms may also be assigned to one of two output contacts. The Trip Alarm settings are independently set for each relay function.

Voltage-unbalance relay

This function compares the highest or lowest phase voltage with the average of all three phases and initiates a trip if the difference exceeds the set point. The true RMS voltage is computed for each phase (Table 3.14).

Table 3.14 Voltage Unbalance Settings

Setting	Option
Voltage unbalance pickup	Adjustable from 10% to 50% in increments of 1%.
Voltage unbalance delay	User adjustable from 1sec to 15sec in increments of 1sec. Setting this value to zero (0) will disable the relay.

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Current unbalance relay

This function compares the true RMS current in the highest or lowest phase with the average of all three phases and initiates a trip if the difference exceeds the set point (Table 3.15).

Table 3.15 Current Unbalance Settings

Item	Options
Current unbalance pickup	Adjustable from 10% to 50% in increments of 1%.
Current unbalance delay setting	User adjustable from 1sec to 15sec in increments of 1sec. Setting this value to zero (0) will disable the relay.

Undervoltage relay

This function measures the true RMS voltage in all phases and initiates a trip if any phase voltage drops below the set point.

Undervoltage relay zero-volt trip enable

This function determines if the relay trips when all three-phase voltages drop to zero volts. Uses the same timing set for the Undervoltage Relay (Table 3.16).

Table 3.16 Undervoltage Settings

Item	Options
Undervoltage pickup	Adjustable from 50% to 90% in increments of 1%.
Undervoltage delay setting	User adjustable from 1sec to 15sec in increments of 1sec. Setting this value to zero (0) will disable the relay.

Overvoltage relay

This function measures the true RMS voltage in all phases and initiates a trip if any phase voltage exceeds the set point. See Table 3.17

Table 3.17 Overvoltage Settings

Item	Options
Overvoltage pickup	User adjustable from 110% to 150% in increments of 1%.
Overvoltage delay setting	User adjustable from 1sec to 15sec in increments of 1sec. Setting this value to zero (0) will disable the relay.

Power-reversal relay

This function measures the direction of power flow through the breaker and initiates a trip if a sufficient magnitude of reverse power is detected (Table 3.18).

Table 3.18 Power-Reversal Settings

Item	Options
Power reversal pickup	User adjustable from 10 kW to 1990 kW in increments of 10 kW.
Power reversal delay setting	User adjustable from 1sec to 15sec in increments of 1sec. Setting this value to zero (0) will disable the relay.

Power-direction setup

This function selects the normal power flow direction for the breaker, either from line to load or from load to line. This direction setup also affects the sign of the normal power metering displays.

Potential transformer primary voltage

The Trip Unit gets its voltage input from an externally mounted central module, called a Voltage Conditioner. The Voltage Conditioner is wired to each trip unit in a lineup. Voltage Conditioner Cat#: PLVC1G01

Potential transformer connection

Select the appropriate potential transformer connection, either line-to-line (Ph-Ph) or line-to-neutral (Ph-N).

Power demand intervals

This function sets the power demand interval, which can be in the range of 5min to 60min, in steps of 5min. This set-point specifies the time interval for power demand averaging. The trip unit calculates a rolling average of breaker power over this time interval.

Current alarm

The Trip unit provides two types of current alarm: Current Alarm 1 and Current Alarm 2. The current alarm's ON/OFF pickup settings are user adjustable from 0.5 to 1.0 xIn in steps of 0.05. The trip unit does not allow the current alarm OFF set-point to be set above the ON threshold. If the highest measured phase current goes above the current alarm 1 or current alarm 2 ON set-point, and then remains above the set-point for more than 60sec, the output will close if assigned to either of these alarms. If the current falls below the current alarm 1 or current alarm 2 set-point for more than 60sec, the output, if assigned to the current alarm, will open. This is a definite time function with a 60sec delay and a 60sec cool down period. Both periods are fixed.

Trip logic inputs

The trip unit is able to receive two hardwired input signals. Either can be a 24Vac or Vdc signal. The inputs can be assigned to three main functions:

- Reduced Energy Let Through "RELT" instantaneous protection "ON".
- Breaker "Trip"
- Breaker "RESET"

Table 3.19 shows the assignment for the inputs.

Table 3.19 Input Assignments Possible

Input	Assignment	Summary Description
1	OFF	No action taken.
	TRIP	Will cause the circuit breaker to trip
	RELT	Input causes the unit to use the RELT set-point as long as input is active. Note: RELT must be set to REMOTE at the Trip HMI or via serial communications.
	RESET	Input causes Output Contacts (non RELT) to open. This will also clear the event information from the front screen. Enables the ability to open the Alarm Output contacts remotely.
2	OFF	No action taken.
	TRIP	Will cause the circuit breaker to trip
	RESET	Input causes Output Contacts (non RELT) to open. This will also clear the event information from the front screen. Enables the ability to open the Alarm Output contacts remotely.

Note:

When RELT is Optioned, Input1 is dedicated to RELT. Contacts are rated for 30 VDC/25 VAC MAX, 1 Amp.

Outputs for EntelliGuard G Circuit Breakers

The number of outputs available varies by breaker. The EntelliGuard G circuit breaker has three. These outputs are relay contact outputs to secondary disconnect. Each output can be configured per Table 3.20.

Table 3.20 Output Configuration

Function	Group #	Summary Description
GF alarm	1	Closes when GF alarm is activated. Relays 1 or 2.
Over-current trip (GF, INST, LT, ST)	2	Overvoltage trip closes the relay. Relays 1 or 2.
RELT on	7	Closes relay when Reduced Energy Let Through Instantaneous pickup setting is enabled. Relays 1 or 2.
Any protective relay	3	Closes relays when protective the relay is in pickup. Relays 1 or 2.
Current alarm 1	4	Exceeding current alarm pick-up closes relay. Relays 1 or 2.
Current alarm 2	5	Exceeding current alarm pick-up closes relay. Relays 1 or 2.
Health status. NO or NC may be assigned to Health OK via serial communication	6	Relay contact will change state when the Health Monitoring algorithm senses a change. Relays 1 or 2.

Waveform capture

When a fault has taken place, it is important to visualize the event. The Waveform Capture option included in the advanced trip unit can track and visualize any fault event. The device tracks eight cycles, four before and four after the event, with resolution of 48 samples per cycle at 60Hz and stores the results in memory. It registers events in all three phases and the neutral. After the event, the waveform is stored in COMTrade format and can be accessed by using the waveform client module of the Enervista software. When the upload into this software is complete, the trip unit will reset this function and be available to register the next event.

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Circuit breaker self-timing
Trip units implementing software revision 08.00.26 and newer (post September 2013) will include standard tripping mechanism self-timing. This feature will consist of 8 Modbus registers with values. One register will be populated at the factory where the trip and circuit breaker are combined and the next two registers, when the breaker is tripped with auxiliary power. The other five Modbus registers will include the same operating timing for the last 5 tripping operations. When an 8th operation is measured, the first of the 5 registers with tripping operation time information will be refreshed in a First-In-First-Out (FIFO) fashion. The first three Modbus registers will remain as benchmark times for comparison purposes.
A Power Management Control System (PMCS) can pull the information from these Modbus registers and continuously monitor if the circuit breaker mechanism is showing any signs of slowing due to wear, lack of lubrication, or other conditions. The time recorded does not include protective algorithm time, or current interruption (arcing) time. It includes a proxy for the mechanism mechanical movement time measured from the time the operating solenoid receives a trip signal to the time the contact arms have finished moving and fully opened the contact tips. The time measured should not be considered an exact representation for the operating time, but should be considered as a proxy for the operation time that also includes additional time for the signal switch and driving mechanism for the switch.

Entelliguard trip unit performance characteristics
Table 3.21 provides an overview of the trip unit features, characteristics, specifications and accuracy.

Table 3.21 EntelliGuard Trip Unit Summary

Feature	Characteristic	Specification	Accuracy
Protection Curves	I4t Slopes	22	
	I4t Slopes	22	
	IEEE MV (2)	no	
	IEC MV (2)	no	
Neutral	Neutral Over Current Protection	yes	
Long Time PU (Ir) and Delays	Pick Up Range	0.5-1.0 (0.05 steps x Plug	
	I2t Range Delays at 6 X	0.5sec – 22sec	
	I4t Range Delays at 6 X	0.004sec – 3.09 sec	
	Long Time Thermal Memory	yes	
Short Time Pick and Delays	Pick Up Range	1.5-12X	
	ST Delay Band Range (Commit Time)	0.025sec - 0.417sec	
	Band Width	55msec	
	ST Delay Bands	11 (UL), 17 (IEC)	
	I2T Slopes	3	
	I2T Adjustment	with LT pick up	
Instantaneous Protection	Adjustable IPU Range (3)	1.5-15X & OFF	
	Extended Range Adjustable IPU	1.5-30A & OFF	
	Making Current Release	yes	
	Override	yes	
	Alternate IPU with Remote Enable	yes (RELT IPU)	
	Selective Instantaneous	yes	
Ground Fault Protection	Pick Up Range	0.1/0.2 – 10	
	External Zero Seq. (Gnd Return) CT Input	1A = 100%	
	Delay Band Range	0.042/0.058-0.417/0.0917sec	
	Delay Bands	9/7/2015	
	I2t Slopes	2	
	I4t Slopes	1	
	GF Alarm Option	yes	

Feature	Characteristic	Specification	Accuracy
Zone-Selective Interlocking	Short time	yes	
	Ground Fault	yes	
	Separate ZSI Band Settings	yes	
	Instantaneous	yes	
	ZSI testing function1	yes	
	T-ZSI-ST[1]	yes	
	T-ZSI-I[1]	yes	
Protective Relays	Current Unbalanced	10% - 50% difference between highest & lowest phase compared to average, 1% steps; 1 to 15sec delay in 1sec steps	2%, ±0.1sec on delay
	Overvoltage	110% - 115% of line voltage in 1% Steps; 1-15sec delay in 1sec steps	2%, ±0.1sec on delay
	Undervoltage	30% - 85% of line voltage in 1% Steps; 1-15 Second Delay in 1 sec steps	2%, ±0.1sec on delay
	Voltage Unbalance	10% - 50% difference between highest & lowest phase compared to average, 1% steps; 1 to 15sec delay in 1sec steps	2%, ±0.1sec on delay
	Power Reversal	Line to Load OR Load to Line, From 10 to 990kW in 10kW steps	2%
	Current Level (Alarm/Load Management)	2	
Metering, Diagnostic, and Miscellaneous Functions	Current (A)	A, B, C & neutral	0000 Resolution, 2%
	Voltage (V)	A, B, & C	0000 resolution, 2%
	Real Power (kW)	A, B, C and total	000.000 resolution, 4%
	Reactive Power (KVAr)	A, B, C and total	000.000 resolution, 4%
	Apparent Power (kVA)	A, B, C and total	000.000 resolution, 4%
	Energy (KWh)	A, B, C and total	000.000 resolution, 4%
	Frequency (Hz)	yes	00 resolution, 1 cycle
	Real Demand (kW)	total	000.000 resolution, 4%
	Power Factor (%)	A, B, C	00 resolution, 4%
	Peak Power Demand (KW)	A, B, C	000.000 resolution, 4%
	Waveform Capture (COMTrade)	yes (requires PMCS)	
	Trip Operations Counter	yes	
	Mechanism self-timing1	yes	
	Event Log	last 10 events	
Serial Comm.	Open Protocols (13)	Modbus RTU, Profibus DP	
	Front Port for Local Comm	yes – standard	
I/O	Programmable Relays	4	
	Health Monitoring Relay	1	
Flexibility	Universal Trip Plugs (16)	yes	
	Adjustable (20%-100%) Trip Plug	yes	
	Universal Spare Trip Unit	yes	
	Interchangeable Trip Unit	with = sensor & process	

1. Available with GTU firmware version 08.00.26 and above

Section 3.
Entelliguard TU Trip Unit System

All Settings can be performed via the front of the trip unit. Free setup software is downloadable from geindustrial.com. Download and upload trip unit settings. Ability to download and view the waveform captured by the trip unit. Also has the ability to store settings in an Offline file and then compare it to the current settings. Requires the EntelliGuard TU Test Kit, GTUTK20.

Table 3.22 Metering Data Startup Levels for breaker with EntelliGuard Trip Unit with 24 VDC

Parameter	Phase	Unit	Startup Level
Current	Phase A,B,C, neutral	A	> 3 % Rating Plug Current
Voltage	Phase L1,L2,L3	V	> 15 V for all Voltage Ranges
Real Power	Phase L1,L2,L3 and total	kW	> 7% Rating Plug Current or > 15 Volts
Reactive Power	Phase L1,L2,L3 and total	kVAR	> 7% Rating Plug Current or > 15 Volts
Apparent Power	Phase L1,L2,L3 and total	kVA	> 7% Rating Plug Current or > 15 Volts
Peak Demand Power	Total	Auto-ranging from 0.00 kWH to 999mWH	> 7% Rating Plug Current or > 15 Volts
Energy	Phase A,B,C and total	Auto-ranging from 0.00 kWH to 999mWH	> 7% Rating Plug Current or > 15 Volts
Frequency		Hz	> 10% of Line Voltage
Power Factor		%	> 7% Rating Plug Current or > 15 Volts

Note: Metering Data for breaker with EntelliGuard Trip Unit without 24 VDC requires 20% sensor current and then all metering will be available

Table 3.23 Accuracy as a Percent of Sensor Rating

Load % of Sensor (A)	Accuracy - % of Reading
20% - 50%	+/- 10%
50% – 85%	+/- 5%
85 -100%	+/- 2%

Note: For selected sensor performance characteristics see publications DES-090, DES-091, DES-092, DES-093, DES-094

Section 4. Accessories

A wide range of optional accessories are interchangeable across all EntelliGuard G power circuit breakers, regardless of nominal rating or envelope/frame size. As shown in Figure 4.1, each accessory incorporates easy-fit design features for quick installation, either at the factory or in the field.

Note:
Replacement accessories have an “R” at the end of the catalog number as shown in the tables. All coils are conformal coated for increased reliability in humid/damp environments

Motorized spring charging unit
The unique motor/gearbox unit is specially designed to operate with the full range of EntelliGuard G breakers. It is easily installed with three heavy-duty bolts. After a breaker close operation, the unit automatically recharges the spring and makes it ready for immediate re-close should the need arise. High speed recharging ensures that the springs are fully charged within approximately three seconds following a release. All electrically operated (EO) ANSI/UL breakers are equipped with “Spring Charged” contacts for status indication (Table 4 1).

Circuit breaker closing coils – standard and command
Two, easy-to-fit, clip-on closing coil options with simple, plug-in connections are available. Both options offer electrical remote release of the spring charged closing mechanism. Both options include a standard anti-pump safety feature ensuring that the close signal must be released before further close commands are allowed. The Command Close Coil additionally provides for local breaker close and remote breaker close over communications via the EntelliGuard Trip Unit (Table 4 2).

Figure 4.1 Accessory Mounting

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Accessories

Table 4.1 Motor Operators

Envelope	Power Consumption	Nominal Control Voltage	IEC Range (85% to 110%)	ANSI Range (85% to 110%)	UL Range	Cat No.
1	DC – 300W	24Vdc/30Vdc	20.4V to 26.4V		20.4V to 26.4V	GM01024DR
		48Vdc	40.8V to 52.87V	38V to 56V	40.8V to 52.87V	GM01048DR
		60Vdc	51V to 66V		51V to 66V	GM01060DR
		72Vdc	61.2V to 79.2V		61.2V to 79.2V	GM01072DR
		110Vdc/130Vdc	106.25V to 137.5V	100V to 140V	106.25V to 137.5V	GM01110DR
		250Vdc	212.5V to 275V	200V to 280V	212.5V to 275V	GM01250DR
	AC – 350VA	48Vac	40.8V to 52.87V		40.8V to 52.87V	GM01048AR
		120Vac	102V to 132V	104V to 127V	102V to 132V	GM01120AR
		240Vac	204V to 264V	208V to 254V	204V to 264V	GM01240AR
		277Vac	235.5V to 304.7V		235.5V to 304.7V	GM01277AR
2, 2.5, 3	DC – 480W	24Vdc/30Vdc	20.4V to 26.4V		20.4V to 26.4V	GM02024DR
		48Vdc	40.8V to 52.87V	38V to 56V	40.8V to 52.87V	GM02048DR
		60Vdc	51V to 66V		51V to 66V	GM02060DR
		72Vdc	61.2V to 79.2V		61.2V to 79.2V	GM02072DR
		110Vdc/130Vdc	106.25V to 137.5V	100V to 140V	106.25V to 137.5V	GM02110DR
		250Vdc	212.5V to 275V	200V to 280V	212.5V to 275V	GM02250DR
	AC – 560VA	48Vac	40.8V to 52.87V		40.8V to 52.87V	GM02048AR
		120Vac	102V to 132V	104V to 127V	102V to 132V	GM02120AR
		240Vac	204V to 264V	208V to 254V	204V to 264V	GM02240AR
		277Vac	235.5V to 304.7V		235.5V to 304.7V	GM02277AR

- Spring charge contact is power rated only, as shown below.

AC Ratings		DC Ratings	
Voltage	Amps	Voltage	Amps
110-130V	AC21-15A	24V	DC21-15A
	AC23-10A	110-130V	DC21-10A
220-240V	AC21-10A	250V	DC21-5A
	AC23-5A		

- Spring charge time = 3sec max.
- Recommended fuse amps: contact factory.
- Duty cycle = 2/min.
- Envelope 1 motors: running VA ~ 300VA; inrush = 2 to 3 times.
- Envelope 2 and 3 motors: running VA ~ 450VA; inrush = 2 to 3 times.

Table 4.2 Closing Coil Characteristics

Type	Power Consumption	Nominal Control Voltage	Catalog Number
Closing Coil	DC: 350W, 20 W (sealed) AC: 350W (inrush), 20W (sealed)	24V	DC21-15A
		24Vdc	GCCN024DR
		48Vac/dc	GCCN048R
		60 to 72Vdc	GCCN060DR
		110-130 Vac/dc	GCCN120R
		208Vac	GCCN208AR
		220Vdc/240Vac	GCCN240R
		250Vdc/277Vac	GCCN277R
Command Operated Closing Coil	DC: 350W, 20W (sealed) AC: 350W (inrush), 20W (sealed)	24Vdc	GCCC024DR
		48Vac/dc	GCCC048R
		60 to 72Vdc	GCCC060DR
		110-130 Vac/dc	GCCC120R
		208Vac	GCCC208AR

- Duty cycle = 2/min.
- Closing coil inrush = 350VA.
- DC signal to contact make:
- Envelopes 1 & 2 – 45 msec.
- Envelope 3 – 80 msec.

Table 4.2.1 Command Shunt Releases

Nominal Control Voltage	**Catalog Number**
Factory Fitted:	Field Installable:
24V DC - GCST024D	24V DC - GCST024DR
30V DC - GCST030D	30V DC - GCST030DR
48V AC-DC - GCST048	48V AC-DC - GCST048R
120V AC-DC - GCST120	120V AC-DC - GCST120R
240V AC-DC - GCST240	240V AC-DC - GCST240R
277V AC-DC - GCST277	277V AC-DC - GCST277R

Command operation module

This module energizes the closing coil to cause the breaker to close whenever control power is applied to the accessory and when commanded from the breaker trip unit or breaker front panel push button (electrical closing).

Shunt trip

Energizing the shunt trip (ST), via local or remote input, will instantaneously activate the circuit breaker mechanism, ensuring a rapid open operation. The shunt trip is continuously rated and does not require an auxiliary switch in series with the coil. The shunt trip is a straightforward, field installable accessory available in wide range of voltages. See Table 4.3.

Table 4.3 Extended Range Shunt Trip for UL Ground Fault and ANSI DC Rating Applications

Catalog Number	Nominal Control Voltage	Rating
GSST024DR	24Vdc	Momentary
GSST120R	110Vdc – 130Vdc 110Vac – 130Vac	Momentary
GSST240R	220Vdc – 240Vac 220Vac – 240Vac	Momentary
GSTG024DR	24Vdc	Continuous
GSTG048R	48Vac/dc	Continuous
GSTG072R	70Vdc - 72Vdc	Continuous
GSTG120R	110Vdc – 125Vdc/ 120Vac – 125Vac	Continuous
GSTG208AR	208 Vac	Continuous
GSTG240R	220Vdc/240Vac	Continuous
GSTG250DR	250Vdc/277Vac	Continuous

- Pickup range = 55%-110%
- Duty cycle = 2/min.
- Inrush = 480VA (ac), 480W (dc)
- Holding = 60VA (ac), 50W (dc).
- Momentary rated shunt trip requires wiring one or more normally open (NO) breaker aux contacts in series with the accessory to avoid coil damage.
- DC signal to contacts parting – 20 msec.
- Potential arcing time – 16 msec.

Status indication switch (coil signaling contact)

A plug-in module is available to provide status indication via the secondary disconnects and trip unit. Coil Signaling Contacts are available for closing coils, shunt trips and undervoltage releases (Table 4.4). Contact is mounted on top of the Accessory Device. One of the low-signal (Hi-Fi) contacts is always wired to the trip unit.

Table 4.4 Coil Signaling Contact Module

Type and Configuration	Rating			Cat. No.
1 Power rated + 1 Low signal (Hi-Fi) (1NO contact each)	AC	120Vac	6A	GCSP1R
		250Vac	6A	
	DC	125Vac	0.5A	
		250Vdc	0.25A	
	AC	125Vac	0.1A	
	DC	30Vdc	0.1A	
2 Low signal (Hi-Fi) (1NO contact each)	AC	125Vac	0.1A	GCSP2R

- DC signal to switch change:
  - Shunt trip & close coil – 12 msec
  - UVR – 60 msec

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Undervoltage release (UVR) with fixed time delay
The UVR instantaneously activates the circuit breaker trip mechanism when the source voltage drops below the low voltage threshold. The UVR is also a simple, field installable device.

Note:
This accessory acts as a permissive; it is a no-voltage/no-close device. The circuit breaker cannot be closed (manually or electrically) unless the undervoltage release coil is energized above the required threshold. The undervoltage release with fixed time delay is specifically intended for applications where a delay period (ride-through) is required due to potential voltage events. The delays are 50msec when system voltage drops to 50% and 20msec when system voltage drops below 50% (Table 4.5).

Table 4.5 UVR Operating Characteristics

Power Consumption	Nominal Control Voltage	Catalog Number
	Catalog	GUVT024DR
	Number	GUVT030DR
	40Vdc; 48Vac/dc	GUVT048R
DC: 350W,	60Vdc	GUVTO60DR
2 W (sealed)	110 Vdc/130 Vdc;	Continuous
AC: 350W (inrush),	120 Vac	GUVT120R
20W (sealed	208Vac	GUVT208AR
	220Vdc/240Vac	GUVT240R
	250Vdc/277Vac	GUVT277R
	250Vdc/277Vac	Continuous

- Duty cycle = 2/min.
- Inrush = 350VA (ac), 350W (dc).
- Holding = 60VA (ac), 50W (dc).
- DC signal to contacts parting – 70 msec.

Time delay module (TDM) for uvr (externally mounted)
The de-energized operation of the Undervoltage release can be delayed. This optional, externally mounted module has an adjustable time delay of 0 sec to 3 sec. The device can be implemented to prevent undesired breaker tripping due to momentary voltage interruptions and is connected in series with the Undervoltage release. The time delay is in addition to the time delay from the breaker mounted UVR accessory. The time delay module starts counting at 50% of rated voltage (Figure 4.2 and Table 4.6).

Figure 4.2 Time Delay Module

Table 4.6 TDM Characteristics

Nominal Control Voltage	Catalog No.
48Vdc	GTDM048D
48Vac	GTDM048A
60Vdc	GTDM060D
125Vdc	GTDM120D
120Vac	GTDM120A
208Vac	GTDM208A
240Vdc	GTDM240D
240Vac	GTDM240A
250Vdc	GTDM250D
277Vac	GTDM277A

Remote operation coil combination

Each breaker accepts a maximum of four coils in the combinations shown in Table 4-7. The four positions can be filled by the following four devices: one Close Coil, one Shunt, one UVR, and the final fourth position can either be a Shunt Trip or a UVR. All coils are mounted from the front and snap onto the mechanism after the fascia is removed. All Coils are Conformal Coated for increased reliability in humid/damp environments.

Table 4.7 Remote Operation Coil Combination

Combination	Coil Position on Fascia (from left)			
	1	2	3	4
1		shunt	CC	UV
2	shunt	shunt	CC	UV
3	shunt	UV	CC	UV

Ready to close contact

The contacts, shown in Table 4.8, indicate that the following conditions are met and the circuit breaker can be closed:

- The circuit breaker is open
- The closing springs are charged
- The circuit breaker in not locked/interlocked in open position
- There is no standing closing or opening signal

Table 4.8 Ready to Close Contacts

Rating		Description	Catalog Number	
			1 NO Contact	**1 NC Contact**
125Vac	6A	Power rated to secondary disconnect	GRTC1R	GRTC4R
250Vac	6A			
125Vac	0.1A	Signal rated to secondary disconnect	GRTC2R	GRTC5R
30Vdc	0.1A			
125Vac	0.1A	Signal rated to trip unit	GRTC3R	GRTC6R

Auxiliary switches

Auxiliary switches indicate breaker main contact position. They change their state in the same time sequence as the breaker main contacts. See Table 4.9 and Table 4.10 for available combinations and ratings, and Table 4.11 through Table 4.14 for contact information.

Table 4.9 Auxiliary Switches

Contact Configuration	Cat. No.
Power rated (3NO+3NC)	GAUX3R
Power rated (3NO+3NC) + low signal (Hi-Fi) (2NO+2NC)	GAUX5R
Power rated (8NO+8NC)	GAUX6R
Power rated (4NO+4NC) + low signal (Hi-Fi) (4NO+4NC)	GAUX8R

Table 4.10 Auxiliary Switch Ratings and Secondary Disconnect Points

Contact Configuration	Power Rated	Hi-Fi	Cat. No.
Power rated (3NO+3NC)	A14 - A25		GAUX3R
Power rated (3NO+3NC) + low signal (Hi-Fi) (2NO+2NC)	A14 - A25	B10 - B13, B23 - B26	GAUX5R
Power rated (8NO+8NC) 1	A14 - A25, B4 - B13, B17 - B26		GAUX6R
Power rated (4NO+4NC) + low signal (Hi-Fi) (4NO+4NC) [1]	A14 - A25, B12 - B13, B25 - B26	B4 - B11, B17 - B24	GAUX8R

1. Options are not available for side mounted sec disc blocks.
   - High Fidelity refers to gold-plated contacts. Use for signal level outputs (10mA min to 100mA max., 8Vdc to 30Vdc, 125Vac.

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Table 4.11 Power Rated (3NO/3NC) (Ref Drawing 10099230)

Normally Open			Normally Closed			
Switch Contact	Secondary Disconnect	Connector	Switch Contact	Secondary Disconnect	Connector	
1	A25	PL1	3	A19	PL2	Power Rated
2	A24		4	A18		
5	A23		7	A17		
6	A22		8	A16		
9	A21		11	A15		
10	A20		12	A14		

Table 4.12 Power Rated (8NO/8NC) (Ref Drawing 10099228)

Normally Open			Normally Closed			
Switch Contact	Secondary Disconnect	Connector	Switch Contact	Secondary Disconnect	Connector	
1	A25	PL1	3	A19	PL5	Power Rated
2	A24		4	A18		
5	A23		7	A17		
6	A22		8	A16		
9	A21		11	A15		
10	A20		12	A14		
13	B26	PL3	15	B13	PL7	
14	B25		16	B12		
17	B24	PL4	19	B11	PL8	
18	B23		20	B10		
21	B22	PL2	23	B9	PL6	
22	B21		24	B8		
25	B20		27	B7		
26	B19		28	B6		
29	B18		31	B5		
30	B17			B4		

Table 4.13 Power Rated (3NO/3NC) Low Signal (Hi-Fi) (2NO/2NC) (Ref Drawing 10099232)

Normally Open			Normally Closed			
Switch Contact	Secondary Disconnect	Connector	Switch Contact	Secondary Disconnect	Connector	
1	A25	PL3	3	A19	PL6	Power Rated
2	A24		4	A18		
5	A23		7	A17		
6	A22		8	A16		
9	A21		11	A15		
10	A20		12	A14		
13	B26	PL1	15	B13	PL4	Hi-Fi
14	B25		16	B12		
17	B24	PL2	19	B11	PL5	
18	B23			B10		

Table 4.14 Power Rated (4NO/4NC) + Low Signal (Hi-Fi) (4NO/4NC) (Ref Drawing 10099234)

Normally Open			Normally Closed			
Switch Contact	Secondary Disconnect	Connector	Switch Contact	Secondary Disconnect	Connector	
1	A25	PL1	3	A19	PL5	Power Rated
2	A24		4	A18		
5	A23		7	A17		
6	A22		8	A16		
9	A21		11	A15		
10	A20		12	A14		
13	B26	PL2	15	B13	PL6	
14	B25		16	B12		
17	B24	PL4	19	B11	PL8	Hi-Fi
18	B23		20	B10		
21	B22	PL3	23	B9	PL7	
22	B21		24	B8		
25	B20		27	B7		
26	B19		28	B6		
29	B18		31	B5		
30	B17		32	B4		

- 15A max. current, 440V max.

Circuit breaker - key interlock facility

This option supplies factory-installed or field installable key interlock mounting provisions (baseplates and mechanism) on the front of the breaker fascia. Key interlocks ensure that a circuit breaker cannot be closed unless the dedicated key has been inserted and secured within the lock. Circuit breakers accept ready-to-fit interlocking device kits such as Castell, Ronis, Kirk and Profalux for installation between related, separate circuit breakers.

Table 4.15 Key Interlocks and Door Interlocks

Description	Catalog Number	
	Breaker Mounted[1]	Cassette Mounted[2]
Mounting Provision for Kirk Locks	GBKRKR	GCKRKR
Cylinder lock and keys for Kirk	GKRK	—[3]
Mounting Provision for Ronis Locks	GBRONR	GCRONR
Cylinder lock and keys for Ronis	GRON	GRON
Mounting Provision for Castell Locks	GBCAS	
Cylinder lock and keys for Castell	GCAS	
Mounting Provision for Profalux Locks	GBPRO	GCPRO
Cylinder lock and keys for Profalux	GPRO	GPRO
Key Interlock Conversion Kit[4]		GCCONV
Door interlock (left side)	GLHDR	
Door interlock (right side)	GRHDR	

1. Fixed breaker only, for drawout breaker applications, key interlocks must be mounted on the cassette.
2. Cassette mounted key interlocks are not factory-installed; ordered separately for field installation.
3. Cylinder locks and keys are currently not provided by GE. Please order separately from your local supplier, cat.no: KCAMXXX10S (extended) or KCAMXXX11S (withdrawn). "S" indicates that the key designation (A, B, etc.) is to be stamped on the lock and the key.
4. Key interlock conversion kit is required for cassettes with single piece mid-casting, manufactured prior to 2013, and to be used with key interlocks.
5 Use key CN22.

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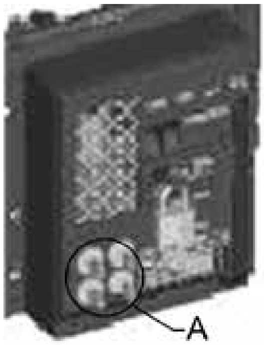
Figure 4.3 Breaker-Mounted Key Interlock



A Key interlock mounting locations

Figure 4.4 Cassette-Mounted Key Interlock

A Key interlock mounting locations

Carriage position switch (TOC)

Available as an option for mounting within the base of the cassette/substructure, the carriage position switch provides six single-pole changeover contacts (single pole, double throw) for local or remote electrical indication of the circuit breaker status: CONNECTED, TEST and DISCONNECTED. The DISCONNECTED position is indicated only when minimum isolating distances between contacts on both the main and auxiliary circuits have been achieved. This option is in addition to the mechanical indicators, which are fitted as standard.
When installed, the carriage switch is IP2X protected. For use with drawout breakers/cassettes Table 4.16 and Table 4.17).

Table 4.16 Carriage Position Switches

Switch Configuration	Catalog Number
1 NO/NC switch per position	GCPS1R
Set of 2 NO/NC switches per position	GCPS2R
Set of 6 NO/NC switches per position	GCPS3R

Table 4.17 Carriage Position Switch Ratings (Common NO/NC Contact Configuration)

	Ratings	
AC	120Vac	6A
	250Vac	6A
DC	125Vac	0.5A
		0.25A

Cassette/substructure

The drawout mechanism allows the breaker to be racked in four distinct positions (CONNECTED, TEST, DISCONNECTED, WITHDRAWN).

Mechanical interlocks (cable/rod) (oem applications only)

Available for fixed and drawout circuit breakers, these units enable the direct interlocking of EntelliGuard G circuit breakers, either mounted side-by-side or stacked. The interlocking mechanisms are connected by a specially designed cable or rod in a 1 from 2, 1 from 3, and 2 from 3 configuration, and any mix of current ratings/pole configurations can be accommodated Table 4.18).

Table 4.18 Mechanical Interlock (Cable/Rod)

Interlock Type	Number of Cables Required	Breaker Type	Interlock Scheme Breaker # [1]	Catalog Number [2] (one per breaker)
2 Way – Type A	2	withdrawable	B1 & B2	GI2WAD
		fixed	B1 & B2	GI2FAD
1 from 3 Way – Type B	6	withdrawable fixed	B1, B2 & B3	GI3WB
			B1, B2 & B3	GI3FB
2 from 3 Way – Type C	6	withdrawable fixed	B1, B2 & B3	GI3WC
			B1, B2 & B3	GI3FC
1 from 3 Way – Type D	4	withdrawable	B1 & B3	GI2WAD
			B2	GI3WDT
		fixed	B1 & B3	GI2FAD
			B2	GI3FDT

1. See Table 4.20 Interlock Configurations.
2. Same catalog number for 3 and 4 pole. See publications DEH-41451 (fixed breaker) or DEH-41455 (withdrawable breaker) for installation instructions.

- Contact factory for availability.

Cables

Standard cable lengths are shown in Table 4.19. (Cables ordered separately. Please contact our technical customer service department if longer length is required.)

Mechanical interlocks can be fitted to electrical systems and can link two and/or three circuit breakers. Any nominal rating, frame size, number of poles or type (fixed pattern or drawout) can be interlocked.

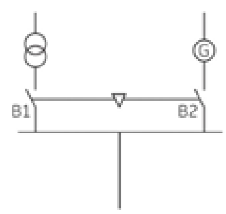
Table 4.19 Cables for Mechanical Interlocks

Length		Catalog Number
Meters	Inches	
1	39.4	GCB1
1.6	63	GCB2
2	78.7	GCB3
2.5	98.4	GCB4
3	118.1	GCB5
3.5	137.8	GCB6
4	157.5	GCB7

• Contact factory for availability.

Table 4.20 Interlock Configurations

Typical Circuit | Interlock Configuration | Possible Combinations

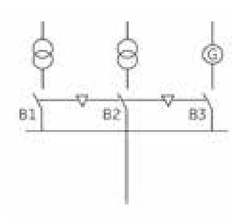


Type A
1 from 2 interlock
2 cable configuration
Interlocking between two circuit breakers

One normal power supply
One generator (emergency) supply

B1	B2
O	O
1	O
O	1

B1 can close only if B2 is open.
B2 can close only if B1 is open.



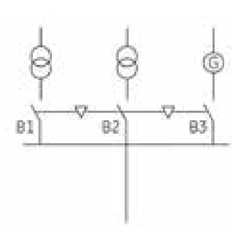
Type B
1 from 3 interlock
6 cable configuration
Interlocking among three circuit breakers

Three power supplies (generator or transformers) feeding the same busbar but parallel operation is prevented.

Available on request.

B1	B2	B3
O	O	O
1	O	O
O	1	O
O	O	1

Only 1 of 3 breakers can be closed.



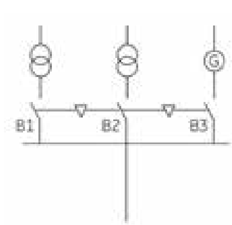
Type C
2 from 3 interlock
6 cable configuration
Interlocking among three circuit breakers

Two bus sections can be powered by single transformer (bus tie breaker closed) or both transformers (bus tie breaker open).

Available on request.

B1	B2	B3
O	O	O
1	O	O
O	O	1
O	1	O
1	1	O
O	1	1
1	O	1

• Any two from three breakers can be closed.
• Any one from three breakers can be closed.
• Two breakers must be closed to prevent the third breaker from closing



Type D
1 from 3 interlock
4 cable configuration
Interlocking between three circuit breakers

Two normal power supplies cannot be connected in parallel. One power supply may assist the priority circuit.

Available on request.

B1	B2	B3
O	O	O
1	O	O
O	O	1
1	O	1
O	1	O

• B1 and/or B3 can be closed only if B2 is open.
• B2 can only be closed if B1 and B3 are both open.

• Contact factory for availability.

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Accessories

Bell alarm with lockout
The Bell Alarm provides remote indication that the circuit breaker has opened because of an electrical fault. The Lockout feature is integral to the trip unit. When a Bell Alarm is supplied with the breaker, the Trip Unit dial is set and locked to the manual position. In order to re-close the breaker, the Lockout button must be pushed in/reset on the Trip Unit 1-Form C contact (Table 4.21 and Table 4.23).
See "Bell Alarm Contact" on page 8 for more detail.
A kit is also available for converting to automatic lockout reset (see Table 4.22).

Table 4.21 Bell Alarm Switches

Switch Configuration	Cat. No.
1 Form C, Power Rated	GBAT1R
1 Form C, Signal Rated	GBATS1R
2 Form C, Power Rated	GBAT2R

Table 4.22 Bell Alarm Lockout Kits for Trip Units

Description	Cat. No.
Automatic reset trip unit lockout kit	GLKAR
Manual reset trip unit lockout kit	GLKMR

Table 4.23 Bell Alarm Ratings

Current	Power-rated Bell Alarm Ratings		Signal-rated Bell Alarm Ratings	
AC	120Vac	6A	125Vac	0.1A
	250Vac	6A		
DC	125Vdc	0.5A	30Vdc	0.1A
	250Vdc	0.25A		

Charging spring status indicator
Factory-installed on the motor, this auxiliary switch indicates that the circuit breaker is charged and is standard with the spring-charging motor (Table 4.24).

Table 4.24 Spring Charged Contact (1 NO)

Ratings			Catalog Number
AC	120Vac	6A	GSCC1R
	250Vac	6A	
DC	125Vdc	0.5A	
	250Vdc	0.25A	

Secondary disconnects (factory-installed/field installable)
Inputs and outputs to the circuit breaker are wired through secondary disconnects located on either the top or the side (Envelope 1 only) of the breaker. The plug-style secondary disconnects engage mating disconnects in the breaker cubicle when the breaker is in the TEST or CONNECT position. Up to 78 points are available so that all breaker accessories can be wired to dedicated disconnect points (Table 4.26 through Table 4.31).
Side mounted fixed breakers and drawout breakers and cassettes that come with breaker block B are always mounted at the factory. Top mounted fixed breakers and drawout breakers come with the block B mounted on the breaker, if required by accessories selected. For drawout breaker cassettes, block B must be ordered separately, catalog number GSDWCR

Table 4.25 Secondary Disconnect Options

Description	Catalog Number
Secondary Disconnect Block B, drawout breaker end	GSDWTR
Secondary Disconnect Block drawout cassette end	GSDWCR

- Secondary Disconnect Block B is required when:
  - Any "zone selective interlocking" options are selected in breaker/trip unit catalog digit 18.
  - Any "advanced features" are selected in breaker/trip unit catalog digit 19.
  - A coil signaling contact option is selected, digit 12.
  - A ready to close signal via the trip unit is selected, digit 13.
  - Digit 12 may contain any of these optional aux. Contact switches:
    - 8No/nc power rated
    - 3No/nc power rated + 2no/nc hi-fi
    - 4No/nc power rated + 4no/nc hi-fi

Table 4.26 Secondary Disconnect Block Locations

		Top Disconnect	
		Block B	Block A
Side Disconnect	Block A	120Vac	6A
		Block B	6A
	Block B	125Vdc	0.5A
		250Vdc	0.25A

Table 4.27 Wiring Schematic for Block-A (Three Layer Secondary Disconnect with Basic GTU and Basic Accessories)

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13
	Motor	**Motor**	**Spr NO/ RTC NO**	**Spr NO/ RTC NO**	**ST1**	**ST1**	**UV1**	**UV1**	**CC COM**	**CC IMM**	**CC CMD**	**ST2/ UV2**	**ST2/ UV2**
Max. Current (I)	14.8A	14.8A	10A	10A	1.9A	1.9A	1.9A	1.9A	1.9A	1.9A	1.9A	1.9A	1.9A
Max. Voltage (V)	440V	440V	240V	240V	440V	440V	440V	440V	440V	440V	440V	440V	440V
	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26
	NC3	NC3	NC2	NC2	NC1	NC1	NO3	NO3	NO2	NO2	NO1	NO1	
Max. Current (I)	15A	15A	15A	15A	15A	15A	15A	15A	15A	15A	1A	15A	
Max. Voltage (V)	440V	440V	440V	440V	440V	440V	440V	440V	440V	440V	440V	440V	
	A27	A28	A29	A30	A31	A32	A33	A34	A35	A36	A37	A38	A39
	O/P1a	O/P1b	O/P2a	O/P2b	24 V+	24 V-	BA NC	BA NO	BA COM	N-RC-	N-RC+	Eleg-CT	Eleg-CT
Max. Current (I)	1A	1A	1A	1A	<500mA	<500mA	10A	10A	10A	<50mA	<50mA	5A	5A
Max. Voltage (V)	30Vdc/ 25Vac	30Vdc/ 25Vac	30Vdc/ 25Vac	30Vdc/ 25Vac	30V	30V	240V	240V	240V	480mV	480mV	2V	2V

Table 4.28 Wiring Schematic for Block-B (Three Layer Secondary Disconnect to be Added for GTU with Full I/O and Additional Accessory Signals)

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13
	INPUT1	**INPUT2**	**I/P COM**	**ST1 NO/ NC8**	**ST1 COM/ NC8**	**UV1 NO/ NC7**	**UV1 COM/ NC7**	**NC6**	**NC6**	**NC5**	**NC5**	**NC4**	**NC4**
Max. Current (I)	<50mA	<50mA	<50mA	10A/15A	10A/15A	10A/15A	10A/15A	15A	15A	15A	15A	15A	15A
Max. Voltage (V)	30Vdc/ 25Vac	30Vdc/ 25Vac	30Vdc/ 25Vac	240V/ 440V	240V/ 440V	240V/ 440V	240V/ 440V	440V	440V	440V	440V	440V	440V
	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	B24	B25	B26
	BA2 NC	BA2 NO	BA2 COM	CC NO/ NO8	CC COM/ NO8	ST2 NO/ UV2 NO/ NO7	ST2 COM/ UV2 COM/ NO7	NO6	NO6	NO5	NO5	NO4	NO4
Max. Current (I)	<50mA	<500mA	-	10A/ 15A	10A/ 15A	10A/ 15A	10A/ 15A	15A	15A	15A	15A	15A	15 A
Max. Voltage (V)	5V	0.1V	-	240V/ 440V	240V/ 440V	240V/ 440V	240V/ 440V	440V	440V	440V	440V	440V	440V
	B27	B28	B29	B30	B31	B32	B33	B34	B35	B36	B37	B38	B39
	ZSI out+	ZSI out+	ZSI out+	ZSI out+	ISO GND	5V ISO	TX EN 1	RX	TX	GND Volt-IN	Volt-A	Volt-B	Volt-C
Max. Current (I)	<50mA	<50mA	<50mA	<50mA	<500mA	<500 mA	<50mA	<50mA	<50mA	<500mA	<50mA	<50mA	<50mA
Max. Voltage (V)	28Vdc	28Vdc	30Vdc	30Vdc	0.1V	5V	5V	5V	5V	0.1V	1.76V	1.76V	1.76V

Table 4.29 Wiring Schematic for Block-C – Internal to the breaker, not used by customer (Two Layer Intermediate Secondary Disconnect at the Top for the Side Mounted Secondary Disconnect)

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21
BA NC	BA NO	BA COM	ST1 NO	ST1 COM	UV1 NO	UV1 COM	CC NO	CC COM	ST2/ UV2 NO	ST2/ UV2 COM	NO5	NO5	NO4	NO4	NC3	NC3	NC2	NC2	NC1	NC1
C22	C23	C24	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35	C36	C37	C38	C39	C40	C41	C42
Spr NO/ RTC NO	Spr NO/ RTC NO	ST1	ST1	UV1	UV1	CC COM	CC IMM	CC CMD	ST2/ UV2	ST2/ UV2	NC5	NC5	NC4	NC4	NO3	NO3	NO2	NO2	NO1	NO1

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Table 4.30 Wiring Schematic Nomenclature Definitions

Pin	Nomenclature	Description
A1 A2	Motor Motor	power input to motor operator
A3 A4	SPR NO/RTC NO SPR NO/RTC NO	spring charge status contact/ ready to close signaling contact
A5 A6	ST1 ST1	power input to shunt trip 1
A7 A8	UV1 UV1	undervoltage release 1
A9	CC COM	closing coil neutral wire-common (CC or CCC)
A10	CC IMM	closing coil (CC), continuous control power (CCC)
A11	CC CMD	closing coil close signal (CCC)
A12 A13	ST2/UV2 ST2/UV2	power input to shunt trip 2/ undervoltage release 2
A14 A15	NC3 NC3	normally closed contact 3
A16 A17	NC2 NC2	normally closed contact 2
A18 A19	NC1 NC1	normally closed contact 1
A20 A21	NO3 NO3	normally open contact 3
A22 A23	NO2 NO2	normally open contact 2
A24 A25	NO1 NO1	normally open contact 1
A26		
A27	O/P1a	relay output 1 from trip unit
A28	O/P1b	relay output 1 from trip unit
A29	O/P2a	relay output 2 from trip unit
A30	O/P2b	relay output 2 from trip unit
A31 A32	24 V+ 24 V-	auxiliary power supply to trip unit
A33 A34 A35	BA NC BA NO BA COM	bell alarm switch
A36 A37	N-RC- N-RC+	neutral Rogowski coil
A38 A39	Eleg-CT Eleg-CT	earth leg CT (multi-source ground fault)
B1	Input 1	relay input to trip unit
B2	Input 2	relay input to trip unit
B3	I/P COM	relay input to trip unit
B4 B5	ST1 NO/NC8 ST1 COM/NC8	shunt trip 1 signaling contact/normally open contact 8
B6 B7	UV1 NO/NC7 UV1 COM/NC7	undervoltage release 1 signaling contact/ normally closed contact 7
B8 B9	NC6 NC6	normally closed contact 6
B10 B11	NC5 NC5	normally closed contact 5
B12 B13	NC4 NC4	normally closed contact 4
B14		
B15		
B16		
B17 B18	CC NO/NO8 CC COM/NO8	closing coil signaling contact/normally open contact 8
B19 B20	ST2 NO/UV2 NO/NO7 ST2 COM/UV2 COM/NO7	shunt trip 2 signaling contact/ undervoltage release 2 signaling contact/ normally open contact 7
B21 B22	NO6 NO6	normally open contact 6
B23 B24	NO5 NO5	normally open contact 5
B25 B26	NO4 NO4	normally open contact 4
B27 B28	ZSI out+ ZSI out-	zone selective interlock output
B29 B30	ZSI in+ ZSI in-	zone selective interlock input
B31 B32 B33 B34 B35	ISO GND 5V Iso TX EN 1 RX TX	trip unit communication
B36	Voltage Input GND	ground point for voltage input to trip unit
B37 B38 B39	Volt-A Volt-B Volt-C	system phase voltage signals

Ground fault

The EntelliGuard TU Trip Unit provides a non-core CT input for zero sequence or residual summation current. The expected ratio is 1A = 100%.

Neutral rogowski

The Neutral Rogoswki CTs are used to measure the Neutral Current and is required when Internal Ground Fault is selected on the trip unit. There are two types available:

1. Encased with Terminal Screws: The Rogowski coil is encased with two terminal screws. No additional mounting hardware is required as the encasing is molded to the mounting dimensions (Table 4.31)
2. Loose Rogowski Coil with separate mounting hardware: The coil and mounting hardware are separate. The coil comes with the two wire leads for connection to a terminal block. See Table 4.31a.
3. Large Window Rogowski CTs: The Rogowski coil provides a larger window (6.57 x 2.56 inches) for larger busbars. See Table 4-31b.

Table 4.31 Neutral Rogowski CTs (Encased with Terminal Screws)

Envelope	Current Rating	Cat. No.
1	400 A	G04HNRCE
	630 A	G07HNRCE
	800 A	G08HNRCE
	1200/1250 A	G13HNRCE
	1600 A	G16HNRCE
	2000 A	G20HNRCE
2	400 A	G04MNRCE
	630 A	G07MNRCE
	800 A	G08MNRCE
	1200/1250 A	G13MNRCE
	1600 A	G16MNRCE
	2000 A	G20MNRCE
	2500 A	G25MNRCE
	3000/3200 A	G32MNRCE
3	3000/3200 A (1600 A x 2)	G32LNRCE
	4000 A (2000 A x 2)	G40LNRCE
	5000 A (2500 A x 2)	G50LNRCE
	6000/6400 A (3200 A x 2)	G64LNRCE

Table 4.31a Neutral Rogowski CTs (Loose Rogowski Coil and mounting hardware)

Envelope	Current Rating	Cat. No.
1	400 A	G04HNRC
	630 A	G07HNRC
	800 A	G08HNRC
	1200/1250 A	G13HNRC
	1600 A	G16HNRC
	2000 A	G20HNRC
2	400 A	G04MNRC
	630 A	G07MNRC
	800 A	G08MNRC
	1200/1250 A	G13MNRC
	1600 A	G16MNRC
	2000 A	G20MNRC
	2500 A	G25MNRC
	3000/3200 A	G32MNRC
3	3000/3200 A (1600 A x 2)	G32LNRC
	4000 A (2000 A x 2)	G40LNRC
	5000 A (2000 A x 2)	G50LNRC
	6000/6400 A (3200 A x 2)	G64LNRC

Table 4.31b Large Window Rogowski

Current Rating	Cat. No.
1000A - G101	NRC
1200/1250A	G131NRC
2000A	G201NRC
2500A	G251NRC
3000/3200A	G321NRC
4000A	G401NRC
5000A	G501NRC
6000A	G601NRC

Sealed door panel escutcheon
An optional complete IP54 front door panel is available when a higher degree of protection is needed (Table 4.32).

Mechanical operations counter
Used with either manual or motor charged circuit breakers, the counter provides an accurate record of the cumulative number of complete breaker closing operations (Table 4.32).

Table 4.32 Miscellaneous Accessories

Description	Cat. No.
Racking handles: OEM breakers AKD-20 breakers	 GRHNR ENTGRH
IP54 Door Escutcheon, Fixed and Drawout	GGDEFD
Mechanical Operations Counter	GMCNR
ACB Lifting Truck	GE-1000
Breaker lifting Beams for 3P Envelope 1 and 2 for 3P Envelope 3 for 4P Envelope 1 and 2 for 4P Envelope 3	 GLD3F12 GLD3F3 GLD4F12 GLD4F3
Door Flange – Fixed Breaker	GDPRF
Door Flange – Withdrawable Breaker	GDPRW
Contact Wear Indicator	GCNTW
Finger Cluster Pliers	GUNI

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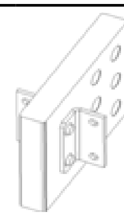
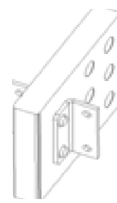
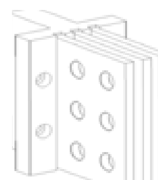
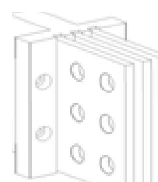
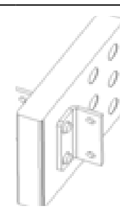
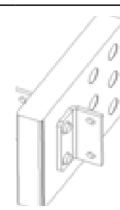
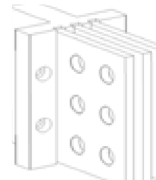
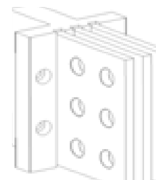
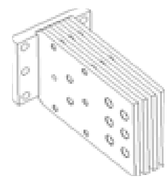
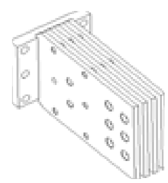
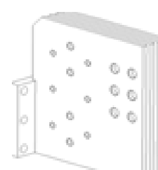
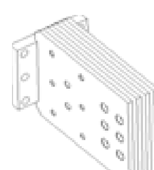
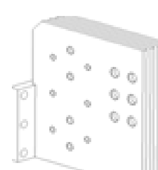
Door interlocks
See Table 4.33.

Table 4.33 Door Interlocks

Mounting	Catalog Number
Right mounted	GRHDR
Left mounted	GLHDR

Table 4.34 Back-connected Terminations for Cassette

Envelope Size	Description	Type	Catalog Number	Drawing	Qty/kit
1	Up to 1600 A	3 Pole	GBB216TBBC3		6
		4 Pole	GBB216TBBC4		8
	2000 A	3 Pole	GBB220TBBC3		6
		4 Pole	GBB220TBBC4		8
2	Up to 1600 A	3 Pole	GBB216TBBC3		6
		4 Pole	GBB216TBBC4		8

Envelope Size	Description	Type	Catalog Number	Drawing	Qty/kit
	2000 A	3 Pole	GBB220TBBC3		6
		4 Pole	GBB220TBBC4		8
	2500A &	3 Pole	GBB230TBBC3		6
2		3000A UL	GBB230TBBC4		8
	3200A ANSI	3 Pole (Bottom Side)	GBB216TBBC3		6
		3 Pole (Bottom Side)	GBB232TBC3		
		4 Pole (Top Side)	GBB216TBBC4		8

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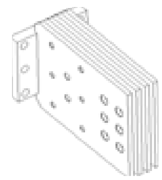
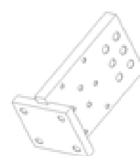
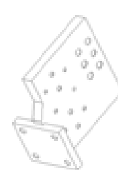
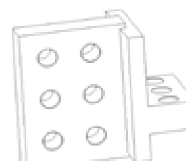
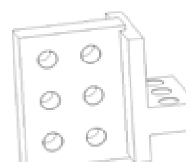
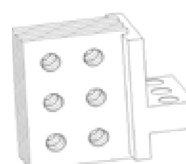
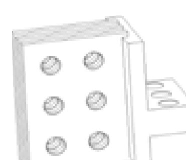
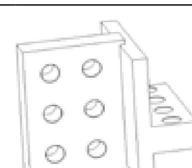
Envelope Size	Description	Type	Catalog Number	Drawing	Qty/kit
2		4 Pole (Bottom Side)	GBB232BBC4		4
2.5	Up to 4000A	3 Pole (Top/Bottom)	GBBN40TBC3		6
3	3000A – 6000A	3 Pole (Top Side, 2 per pole)	GBB360TBC3		6
		3 Pole (Bottom Side)	GBB360BBC3		6
		4 Pole (Top Side, 2 per pole)	GBB360TBC4		8
		4 Pole (Bottom Side, 2 per pole)	GBB360BBC4		8

Table 4.35 Back-connected Terminations

Envelope Size	Description	Type	Catalog Number	Drawing	Qty/kit
1	Up to 1200 A – 5th character “S” only	3 Pole (Top Side)	GBB112TBB3		3
		3 Pole (Bottom Side)	GBB112BBB3		3
		4-Pole (Top Side)	GBB112TBB4		4
		4-Pole (Bottom Side)	GBB112BBB4		4
	Up to 1600 A	3 Pole	GBB116TBB3		6
		4 Pole	GBB116TBB4		8
1	2000 A	3 Pole	GBB120TBB3		6
		4 Pole	GBB120TBB4		8
2	Up to 2000 A	3 Pole	GBB220TBB3		6

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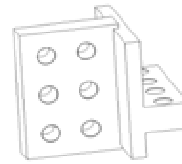
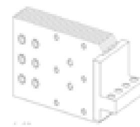
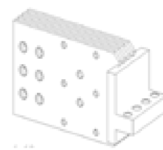
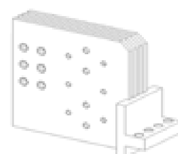
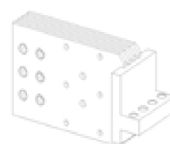
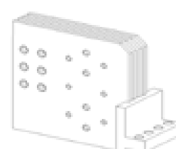
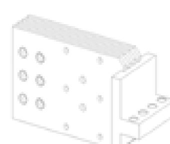
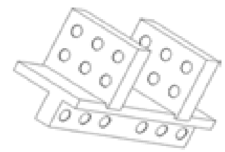
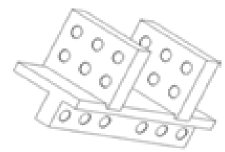
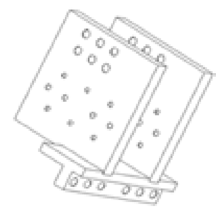
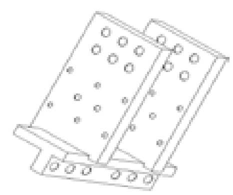
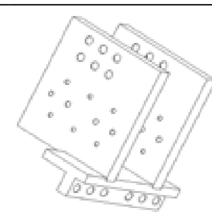
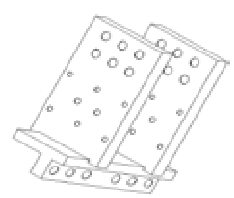
Envelope Size	Description	Type	Catalog Number	Drawing	Qty/kit
2		4 Pole	GBB220TBB4		8
	3000A UL	3 Pole	GBB230TBB3		6
		4-Pole	GBB230TBB4		8
	3200A ANSI	3 Pole (Top Side)	GBB232TBB3		3
		3 Pole (Bottom Side)	GBB232BBB3		3
		4 Pole (Top/Bottom)	GBB232TBB4		4
		4 Pole (Bottom Side)	GBB232BBB4		4
2.5	Up to 4000 A	3 Pole (Top/Bottom)	GBBN40TBB3		6

Envelope Size	Description	Type	Catalog Number	Drawing	Qty/kit
3	Up to 4000 A	3 Pole	GBB340TBB3		6
		3 Pole	GBB340TBB4		8
	6000A	3 Pole (Top Side)	GBB360TBB3		3
		3 Pole (Bottom Side)	GBB360BBB3		3
		4 Pole (Top Side)	GBB360TBB4		4
		4 Pole (Bottom Side)	GBB360BBB4		4

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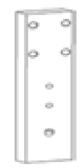
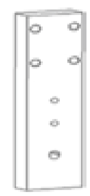
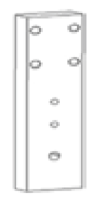
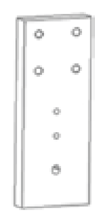
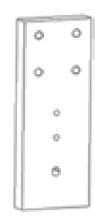
Accessories

Flat front terminations

The EntelliGuard G Fixed mounted breaker comes standard with Back-connected Terminations. Optional Flat Front terminations are available for front access mounting (Table 4.36).

Table 4.36 Optional Flat Front Terminations

Envelope Size	Description	Type	Catalog Number	Drawing	Qty/kit
1	400 A – 1200 A	Type S, Flat Front Fixed 3 Pole Breaker Bus Bar Terminations (Top/Bottom)	GBB1STBF3		6
	800 A – 2000 A	Type N&H, Flat Front Fixed 3 Pole Breaker Bus Bar Terminations (Top/Bottom)	GBB1TBF3		6
	800 A – 2000A	Type N&H, Flat Front Fixed 4 Pole Breaker Bus Bar Terminations (Top/Bottom)	GBB1TBF4		8
2	800 A – 3000 A	Flat Front Fixed 3 Pole Breaker Bus Bar Terminations (Top/Bottom)	GBB2TBF3		6
	800 A – 3000 A	Flat Front Fixed 4 Pole Breaker Bus Bar Terminations (Top/Bottom)	GBB2TBF4		8

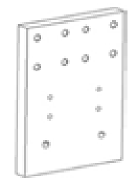
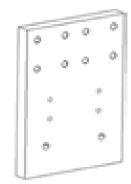
Envelope Size	Description	Type	Catalog Number	Drawing	Qty/kit
2,5	800 A – 4000 A	Flat Front UL489 Fixed 3 Pole Breaker Bus Bar Terminations (Top/Bottom)	GBBNTBF3		6
3	4000 A -6000 A	Flat Front Fixed 3 Pole Breaker Bus Bar Terminations (Top/Bottom)	GBB3TBF3		8
	4000 A -6000 A	Flat Front Fixed 4 Pole Breaker Bus Bar Terminations (Top/Bottom)	GBB3TBF4		4

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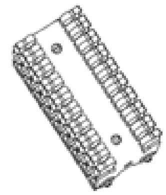
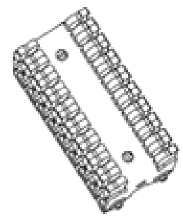
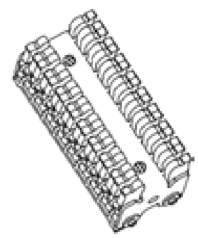
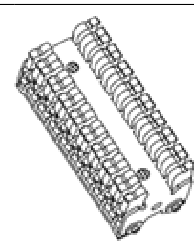
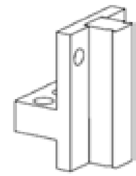
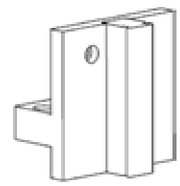
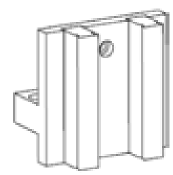
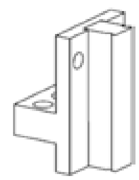
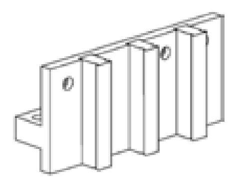
Table 4.37 Cluster

Envelope	Description	Catalog Number		Qty/kit
1,	36 finger (95x20 mm) Qty 1	G20NCLS		6
2.5	36 finger (95x20 mm) Qty 1	G20MCLS[1]		
	36 finger (95x15 mm) Qty 1	G32ECLS		8
3	36 finger (95x15 mm) Qty 1	G64LCLS		4

1. Used for breakers with the following nomenclature: 6th digit being "S" or a combination of the following:
   - 3rd and 4th digit being 04, 06, 08, 16, or 20
   - 5th digit being ("E" or "M")
   - 6th digit not equal to "D"

Table 4.38 Cluster Pad

Envelope	Description	Catalog Number	Drawing	Qty/kit
1	Cluster Pad (one set per phase)	GBB120TBD		2
2	Cluster Pad (single cluster) 2000A	GBB220TBD1		2
	Cluster Pad (double cluster) 2500A-3200A	GBB232TBD		2
2.5	Cluster Pad (two sets per phase)	GBB120TBD		2
3	Cluster Pad	GBB360TBD		2

1. Used for breakers with the following nomenclature: 6th digit being “S” or a combination of the following:
   - 3rd and 4th digit being 04, 06, 08,16, or 20
   - 5th digit being “E” or “M”
   - 6th digit not equal to “D”

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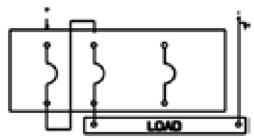
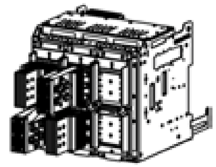
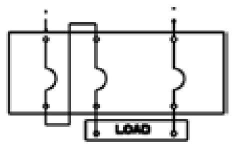
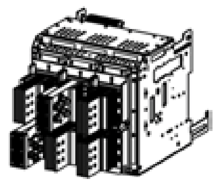
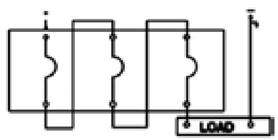
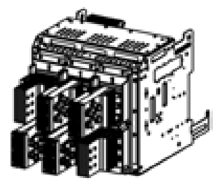
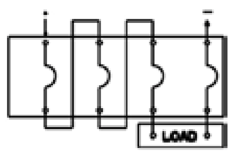
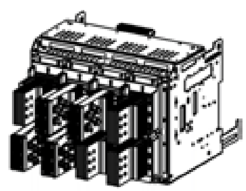
Accessories

Figure 4.5 Terminations for DC Switches UL 489B

Application	Circuit diagram	Isometric view of termination	Catalog number
600C DC Without neutral isolation 3P, Env2			Stationary GBB2TBF1DC Drawout GBB230TBBC1DC
600C DC Without neutral isolation 3P, Env2			Stationary GBB2TBF2DC Drawout GBB230TBBC2DC
1000C DC Without neutral isolation 3P, Env2			Stationary GBB2TBF3DC Drawout GBB230TBBC3DC
1000C DC Without neutral isolation 4P, Env2			Stationary GBB2TBF4DC Drawout GBB230TBBC4DC

scale:2.1

Remote racker

The remote racking operator allows the user to move a draw out circuit breaker between the CONNECT and DISCONNECT positions via an electric racking gear head motor and the Cassette housing the breaker. The remote racking operator requires 115VAC, 60Hz control power. A control box connected to the operator with a 30 ft. cord permits control from a remote location.

Table 4.39 Remote Racker Catalog Listing

Description	Catalog #
Remote Racker	EGGRRLV

Grounding/earthing device (iec only)

All EntelliGuard G circuit breakers can be fitted with a grounding/earthing device, which has a short circuit rating equal to the breaker withstand rating. This permits either the feeder cables or the busbar to be safely grounded and locked during system maintenance operations (Table 4.40).

Table 4.40 Earthing Devices (IEC only)

Envelope	Current Rating	Poles
1	400 to 1600/3P	3
	400 to 1600/4P	4
	2000/3P	3
	2000/4P	4
2	400 to 4000/3P	3
	400 to 4000/4P	4
3	3200 to 6300/3P	3
	3200 to 6300/4P	4

Rejection device

A factory-installed rejection feature prevents mismatching breakers and cassettes/substructures. This prevents (a) inserting a breaker with a lower rating into a higher rated cassette/substructure and (b) inserting a higher rated breaker into a lower rated cassette/substructure. Mis-insertion Interlock catalog number is GREPM.

Replacement top cover

Table 4.41 Replacement Top Covers

Breaker Type	Catalog #
ANSI Breakers	EGACOVER
IEC Breakers	GFA4
ENTELLI Breakers	EGECOVER
RETRO Breakers	EGRCOVER
UL Breakers	EGUCOVER

- Special handling and order entry are required to preserve UL Listing of the breaker. Contact Post Sales Service for details and order entry assistance.

Section 5.
Catalog numbering guide

EntelliGuard G ANSI/UL489 circuit breaker catalog number guide

Sample	G	A	16	M	1	H	E	R	X	5	R	A	X	X	L4	X	6	V
Digit	1	2	3&4	5	6	7	8	9	10	11	12	13	14	15	16&17	18	19	20
	Circuit Breaker Family	Breaker Switch Type	Current Rating Sensors	Short Circuit Withstand Rating	Mounting	Spring Charge Motor	Closing Devices	Shunt Trip	UVR	2nd Shunt Trip, 2nd UVR	Auxiliary Switch, Coil Signaling Contact	Bell Alarm, Mechanical Counter, Trip Annunciation	Key Interlock and Padlock Device	Mechanical Interlock	Overcurrent Protection Ground Fault	ZSI	Advanced Features and Communications	Rating Plug

Digit 1 – Circuit Breaker Family	
Device Series/Line	**Code**
EntelliGuard G Breaker/Switch	G

Digit 2 – Device & Type		
Breaker/Switch Type, Secondary Mounting	**Envelope 1**	**Envelopes 2, 2.5 & 3**
	Top	**Top**
ANSI/UL1066 Circuit Breaker	N	A
UL489 Circuit Breaker	U	B
ANSI Non-auto CB		
(ANSI Switch)	M	C
UL489 Non-auto CB		
(UL Switch)	S	D
UL 489B DC Switch		L

1. Top = Top Mounted Secondary Disconnects (TSD).
2. N, U, M, S characters are for Envelope 1 only with top mounted secondary disconnects (TSD).
3. Codes N, U, M, S are not valid for Envelopes 2 & 3.
4. Envelope 1 (Type N and H, 400A – 2000A).
5. DC Ratings; trip unit not included. DC Rated Circuit Breakers require external control devices (e.g., Type 37 or Type 76 DC Relays).
6. Side Secondary Disconnects are specifically intended for 5-High ("high density") equipment designs.
7. UL 489B DC Switches are available only in M interruption ratings.

Digits 3 & 4 – Current Rating/Sensors					
Current Sensor Rating (A)	**Circuit Breaker**		**Switches[1]**		**DC Switches[2]**
	ANSI	**UL489**	**ANSI**	**UL489**	**UL489B**
400	04	04			
800	08	08	08	08	08
1200	12	12	12	12	
1600	16	16	16	16	16
2000	20	20	20	20	20
2500	25	25		25	
3000		30		30	30
3200	32		32		
4000	40	40	40	40	
5000	50	50	50	50	
6000		60		60	

1. Switches (Digit 2 = M, S, C, D) do not have current Sensors or a trip unit.
2. DC Switches (Digit 2 = L) do not have current Sensors or a trip unit.

Section 5.
Catalog numbering guide

Digit 5 – EntelliGuard G Short Circuit and Interrupting Ratings

Interrupting Rating Tier ANSI/UL1066 Devices, LVPCB

Code	254V	508V	635V	1/2S Withstand	HSIOC	Override No Inst.	Override w/Inst.	Code
S[1]	65,000	65,000	50,000	50,000	50,000	49,000	53,500	S
N	65,000	65,000	65,000	65,000				N
H	85,000	85,000	65,000	65,000	65,000	63,700	69,500	H
P[1]	100,000	100,000	65,000	65,000	65,000	63,700	69,550	P
E	85,000	85,000	85,000	85,000				E
M	100,000	100,000	100,000	85,000	85,000	83,800	90,950	M
U[1]	130,000	100,000	100,000	100,000	100,000	98,000	107,000	U
L	150,000	150,000	100,000	100,000	100,000	98,000	107,000	L
W	200,000	200,000	100,000	100,000	100,000	98,000	107,000	W

Interrupting Rating Tier UL489 Devices ICCB

	240V	480V	600V	690V (IEC 60947-2)	1/2S Withstand	HSIOC	Override No Inst.	Override w/Inst.	400-1200
S[1]	65,000	65,000	50,000	40,000[3]	42,000	42,000		44,940	S
N	65,000	65,000	65,000	50,000[3]	42,000	42,000		44,940	N
H	85,000	85,000	65,000		50,000	50,000		53,500	H
P[1]	100,000	100,000	65,000		50,000	50,000		53,500	P
M	100,000	100,000	100,000	85,000[3]	65,000	65,000		69,550	M
U[1]	130,000	100,000	100,000		85,000	85,000		90,950	U
L	150,000	150,000	100,000	100,000[3]	85,000	85,000		90,950	L
W	200,000	200,000	100,000		85,000	85,000		90,950	W

Close and Latch ratings (MCR set accordingly)

UL/ANSI 1	42,000
UL/ANSI 2	65,000
UL/ANSI 2.5	85,000
UL/ANSI 3	100,000

	S	N	H	M	E	L
IEC 1	42,000	42,000	42,000			
IEC 2		50,000	50,000	65,000	65,000	
IEC 3				100,000		100,000

ANSI Non-Automatic Switches | **30 Cycle Withstand Ratings**

	254V	580V	635V	
S[1]	42,000	42,000	42,000	S
N	42,000	42,000	42,000	N
M	65,000	65,000	65,000	M
U[1]	85,000	85,000	85,000	U
B	100,000	100,000	100,000	B

UL489 Non-Automatic Switches

	254V	580V	635V	
S[1]	42,000	42,000	42,000	S
N	42,000	42,000	42,000	N
M	65,000	65,000	65,000	M
U[1]	85,000	85,000	85,000	U
B	100,000	100,000	100,000	B

Note: Non-automatic switches are provided with no internal sensing or tripping mechanism and cannot be applied above their respective withstand levels. If a non-automatic device is required at ratings above the available switches is required, it is recommended that a circuit breaker set with maximum setting be employed using external control or protection as required by the application.

1. Available as 3-pole only
2. Restricted
3. Icu = Ics = Icw

	Envelope 1		Envelope 2		Envelope 3	Envelope 4	
	400, 800, 1200	400, 800, 1200, 1600, 2000	2500, 3200	400-3200	800-4000	3200	4000-5000
	X						
		X	X				
		X					
		X					
				X			X[2]
				X			X
					X		
						X	X
						X	X

	Envelope 1		Envelope 2		Envelope 2.5	Envelope 3	
	400-1200	400-2000	2500-3000	400-3000	800-4000	3000	4000-6000
	X						
		X	X				
		X					
		X					
				X			X
					X		
						X	X
						X	X

Notes: Override has 7 % pick up tolerance. Nominal setting is 98% of Icw if no other instantaneous is on, or 107% of Icw if any other instantaneous is on.

UL 489 CB always has other instantaneous protection on. MCR set at 78% Close and Latch rating with -10% tolerance.

	Envelope 1		Envelope 2	Envelope 2.5	Envelope 3
	800-1200	800-2000	800-3200	800-4000	3200-5000
	X				
		X			
			X		
				X	
					X

	Envelope 1		Envelope 2	Envelope 2.5	Envelope 3
	800-1200	800-2000	800-3000	800-4000	3000-6000
	X				
		X			
			X		
				X	
					X

Section 5.
Catalog numbering guide

Digit 6 – Mounting Type Poles			
Designation	Mounting	Poles	Code
OEM	drawout	3	1
		4, right	2
		4, left	3
	stationary	3	4
		4, right	5
		4, left	6
		3, no rear copper	X
		4, right, no rear copper	Y
		4, left, no rear copper	Z
GE Equipment	drawout	3	D[1]
	drawout	3	S[1]
	stationary	3	F

1. Use code "S" (single cluster construction) for new orders of Envelope 2, 2000A and less, interruptions rating tier E and M; otherwise, use "D"

- Right, Left indicates the location of the fourth pole, typically used to switch the neutral.
- Stationary and drawout breakers come with and without back connected terminations. Optional flat front terminations are available. See "Flat Front Terminations," page 53.
- P type circuit breaker available only in 3-pole.

Digit 7 – Spring Charging Motor		
Spring Charging Motor (EO)		Code
DC	24/30Vdc	A
	48Vdc	B
	60Vdc	C
	72Vdc	D
	110/130Vdc	E
	250Vdc	F
AC	48Vac	G
	120Vac	H
	240Vac	J
	277Vac	K
Blank/none[1]		X

1. An "X" (Blank/None) denotes a Manually Operated device (MO) Spring Charge Contact, GSCC1, included with all Motor Operators.

- When a Spring Charging Motor is selected, a Closing Device must be selected from Closing Devices for Digit 8, and a Shunt Trip Device must be selected from Shunt Trip 1 Devices for Digit 9.
- Shunt Trip 1 with a coil voltage different from the Spring Charge Motor may be user-selected.

Digit 8 – Closing Devices		
Closing Coil Type		Code
Closing Coil (CC)[1]	24Vdc	A
	30Vdc	B
	48Vac/dc	C
	60 – 72Vdc	D
	110Vdc/130Vdc; 120Vac	E
	208Vac	F
	220Vdc; 240Vac	G
	250Vdc; 277Vac	H
Command Operated Closing Coil (CCC)[2]	24Vdc	M
	30Vdc	N
	48Vac/dc	P
	60 – 72 Vdc	Q
	110Vdc/130Vdc; 120Vac	R
	208Vac	S
	220Vdc; 240Vac	T
Blank/none		X

1. The Closing Coil (CC) permits either local or remote release of the spring charged closing mechanism by electrical operation.
2. The Command Operated Closing Coil (CCC) includes an additional anti-pumping safety feature to ensure that the electrical closing signal must be released before further closure is attempted, a shut off is initiated if the closing signal is maintained.

- Manual button through breaker cover is included as standard assembly.
- When a Spring Charging Motor is selected (Digit 7), a Closing Device must be selected from Closing Devices for Digit 8, and a Shunt Trip Device must be selected from Shunt Trip 1 Devices for Digit 9.
- Select one device only.

Digit 9 – Shunt Trip 1		
Extended Range Shunt Trip (ANSI/UL)1	Code	Ratings
24Vdc	F	Momentary
110-130Vdc/ac	J	Momentary
220-240Vdc/ac	U	Momentary
24Vdc	M	Continuous
48Vac/dc	P	Continuous
70 – 72Vdc	Q	Continuous
110/125Vdc; 120Vac	R	Continuous
208Vac	S	Continuous
220Vdc; 240Vac	T	Continuous
250Vdc; 277 Vac	V	Continuous
Blank/none	X	

1. The Extended Range Shunt Trip is specifically intended and required for UL ANSI Ground Fault applications. The pickup range is 55-110% of the ST coil voltage.

- When a motor is selected from the Spring Charging Motor (Digit 7) a Shunt Trip 1 must be selected.
- Select one device only.

Digit 10 – Undervoltage Release (UVR)	
UVR with Fixed Time Delay1	Code
24Vdc	1
30Vdc	2
48Vac/dc	3
60-72Vdc	4
110/130Vdc; 120Vac	5[1]
208Vac	6
220Vdc; 240Vac	7
250Vdc; 277Vac	8
Blank/none	X

1. The UVR with Fixed Time Delay is specifically intended for applications where a delay period, or "ride-through," is required due to potential voltage events. The design delays are 50 msec when system voltage drops to 50% and 20 msec when system voltage drops below 50%.

- An optional External UVR Time Delay Module is available in a 1 – 3 sec delay.
- Select one device only.

Digit 11 – 2nd Shunt Trip or UVR		
Type		Code
2nd UVR with Fixed Time Delay1	24Vdc	1
	48Vac/dc	3
	72Vdc	4
	110Vdc/130Vdc; 120Vac	5
	208Vac	6
	220Vdc; 240Vac	7
	250Vdc; 277Vac	8
2nd Extended Range Shunt Trip (ANSI/UL) 2	24Vdc	M
	48Vac/dc	P
	70 – 72Vdc	Q
	110/125Vdc; 120Vac	R
	208Vac	S
	240Vac	T
	250Vdc	V
Blank/none		X

1. The UVR with Fixed Time Delay is specifically intended for applications where a delay period, or "ride-through," is required due to potential voltage events. The design delays are 50 msec when system voltage drops to 50% and 20 msec when system voltage drops below 50%.
2. The Extended Range Shunt Trip is specifically intended and required for UL ANSI Ground Fault applications. The pickup range is 55-110% of the ST coil voltage.

- An optional External UVR Time Delay Module is available in a 1 – 3sec delay.
- Select one device only.

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Digit 12 – Auxiliary Switch		
Contact Configuration		Code
Auxiliary Switch, 3NO+3NC (Power Rated)1 STANDARD/INCLUDED		2
Auxiliary Switch, 8NO+8NC (Power Rated) 4		4
Aux. Switch, 3NO/3NC (Power Rated) + 2NO/2NC low signal (Hi-Fi)		6
Aux. Switch, 4NO/4NC (Power Rated) + 4NO/4NC low signal (Hi-Fi) 4		8
Auxiliary Switch, 3NO+3NC (Power Rated)	CSC, PR, (1 NO on SD) – Close Coil or CCC	A
	CSC, Hi-Fi via Trip Unit – Close Coil or CCC2,3	B
	CSC, PR, (1 NO on SD) – 1st Shunt Trip	C
	CSC, Hi-Fi via Trip Unit – 1st Shunt Trip2,3	D
	CSC, PR, (1 NO on SD) – 1st UVR	E
	CSC, Hi-Fi via Trip Unit – 1st UVR2,3	F
	CSC, PR, (1 NO on SD) – 2nd ST or 2nd UVR	G
	CSC, Hi-Fi via Trip Unit – 2nd ST or 2nd UVR2,3	H
Aux. Switch, 3NO/3NC (PR) + 2NO/2NC Low Signal (Hi-Fi)	CSC, PR, (1 NO on SD) – Close Coil or CCC	J
	CSC, Hi-Fi via Trip Unit – Close Coil or CCC2,3	K
	CSC, PR, (1 NO on SD) – 1st Shunt Trip	L
	CSC, Hi-Fi via Trip Unit – 1st Shunt Trip2,3	M
	CSC, PR, (1 NO on SD) – 1st UVR	N
	CSC, Hi-Fi via Trip Unit – 1st UVR2,3	P
	CSC, PR, (1 NO on SD) – 2nd ST or 2nd UVR	Q
	CSC, Hi-Fi via Trip Unit – 2nd ST or 2nd UVR2,3	R
Auxiliary Switch, 3NO+3NC (Power Rated)	CSC, PR, (1 NO on SD) – All Installed Devices	S
	CSC, Hi-Fi via Trip Unit – All Installed Devices2,3	T
Aux. Switch, 3NO/3NC (PR) + 2NO/2NC Low Signal (Hi-Fi)	CSC, PR, (1 NO on SD) – All Installed Devices	U
	CSC, Hi-Fi via Trip Unit – All Installed Devices2,3	V

CCC = Command Operated Close Coil
CSC = Coil Signaling Contact
Hi-Fi = High Fidelity
PR = Power Rated
SD = Secondary Disconnect

1. The 3NO/3NC scheme is STANDARD (INCLUDED, CODE 2) and is wired to Secondary Disconnect Block A, all other selections require Secondary Disconnect Block B.
2. In order to output the Coil Signaling status Hi-Fi via trip unit (options B, D, F, H, K, M, P,R, T, and V) a communications package must be selected in Advanced Features (Digit 19; options 2, 3, 6, 7, 8, 9). This option requires Secondary Disconnect Block B.
3. If a UL or ANSI Switch is selected in Digit 2 (C, D, M, S), the Hi-Fi via Trip Unit options are not valid (options B, D, F, H, K, M, P, R, T, V).
4. For Side-mounted Secondary Disconnect Blocks, all options are available EXCEPT options 4 and 8.

- The term “Hi-Fi” refers to gold-plated contacts used for signal level outputs (10mA minimum – 100mA maximum, 5-30Vdc, 125Vac).
- If no devices were selected in Digit 8, 9, 10, 11 (Codes = “X”), then Options A – V are invalid.
- Options A-V are only valid if the corresponding device to be monitored by the Coil Signaling Contact (CSC) is selected in digits 8, 9, 10, 11.

Digit 13 – Bell Alarm/Trip Annunciation	
Bell Alarm and Trip Annunciation	**Code**
BACL Power Rated (1NO/1NC)	A[3]
BACL Power Rated (1NO/1NC) & MOC	C[3]
BACL Power Rated (1NO/1NC) & RTC Power Rated Contacts on SD	D[3]
BACL Power Rated (1NO/1NC) & RTC Signal Rated (Hi-Fi) Contacts on SD	E[3]
BACL Power Rated (1NO/1NC) & RTC Signal Rated (Hi-Fi) through Trip Unit	F[1,2,3]
BACL Power Rated (1NO/1NC), MOC & RTC Power Rated on SD	G[3]
BACL Power Rated (1NO/1NC), MOC & RTC Signal Rated (Hi-Fi) through Trip Unit	J[1,2]
BACL Power Rated (1NO/1NC), MOC & RTC Signal Rated on SD	H[3]
BACL Power Rated (2NO/2NC) & MOC	7
BACL Power Rated (2NO/2NC), MOC & RTC Power Rated on SD	8
BACL Power Rated (2NO/2NC), MOC & RTC Signal Rated (Hi-Fi) through Trip Unit	Q
BACL Power Rated (2NO/2NC), MOC & RTC Signal Rated on SD	9
BACL Signal Rated	N
BACL Signal Rated & MOC	T
BACL Signal Rated & RTC Power Rated Contacts on SD	P
BACL Signal Rated & RTC Signal Rated (Hi-Fi) Contacts on SD	R
BACL Signal Rated & RTC Signal Rated (Hi-Fi) through Trip Unit	S
BACL Signal Rated, MOC and RTC Power Rated on SD	U
BACL Signal Rated, MOC & RTC Signal Rated (Hi-Fi) through Trip Unit	Y
BACL Signal Rated, MOC & RTC Signal Rated on SD	V
MOC	B
MOC and RTC Power Rated (1NO) on SD	K
MOC and RTC Signal Rated (1NO) on SD1	L
MOC and RTC Signal Rated (Hi-Fi)(1NO) through Trip Unit	M[1,2]
RTC Power Rated Contacts (1NC) on SD	4
RTC Power Rated Contacts (1NO) on SD	1
RTC Signal Rated (Hi-Fi) Contacts (1NC) on SD	5
RTC Signal Rated (Hi-Fi) Contacts (1NC) through Trip Unit	6[1,2]
RTC Signal Rated (Hi-Fi) Contacts (1NO) on SD	2
RTC Signal Rated (Hi-Fi) Contacts (1NO) through Trip Unit	3[1,2]
Blank/none	X

BACL = Bell Alarm Contact with Lockout
Hi-Fi = High Fidelity
MOC = Mechanical Operations Counter
RTC = Ready To Close Contacts
SD = Secondary Disconnect

1. To output the RTC contact output via Trip Unit a communications package must be selected in Advanced Features (Code 19/Step 16); which requires Secondary Disconnect Block B.
2. If a UL or ANSI Switch is selected, the (Hi-Fi Through Trip Unit) is not valid.
3. Bell Alarm Contact with Lockout comes with the Trip Unit set to Manual LO Enabled.

- The term “Hi-Fi” refers to gold-plated contacts use for signal level outputs (10mA minimum – 100mA maximum, 5-30Vdc, 125vac).
- Option “B”, “I”, “2”, “3”, “K”, “L”, “M”, and “X” are the only valid options when a Switch is selected in Digit 2.

Digit 14 – Key Interlock	
Key Interlock (Breaker Mounted)	**Code**
Profalux Key Lock Provision	P
Ronis Key Lock Provision	R
Kirk Key Lock Provision	K
Castell Key Lock Provision	c
Pushbutton Padlock Device	L
Profalux Key Lock Provision and Push Button Padlock Device	4
Ronis Key Lock Provision and Push Button Padlock Device	3
Kirk Key Lock Proviion and Push Button Padlock Device	2
Castell Key Lock Provision and Push Button Padlock Device	1
Profalux Key Lock	Q
Ronis Key Lock	S
Kirk Key Lock	D
Castell Key Lock	F
Profalux Key Lock and Push Button Padlock Device	6
Ronis Key Lock and Push Button Padlock Device	7
Kirk Key Lock and Push Button Padlock Device	J
Castell Key Lock and Push Button Padlock Device	N
Blank/none	X

- This option provides factory installed interlocking devices for installation between separate circuit breakers (baseplates and mechanism). This safeguard ensures that a circuit breaker cannot be closed unless the dedicated key has been inserted and secured within the lock.
- If selecting a Draw Out Breaker (Digit 6), the key interlock must be mounted on the cassette (see Table 4.15). This enables the ability to swap breakers without having to change the key interlocks.

Digit 15 – Mechanical Interlocks	
Mechanical Interlocks	**Code**
Blank/None DEFAULT	X

Mechanical Interlocks are field mountable only.

- Some installations use multiple power sources that are required to supply energy simultaneously, alternately, or, in a specified sequence. EntelliGuard G Circuit Breakers can be used to interconnect these sources and be electrically and mechanically interlocked to provide the necessary transition and protection. Mechanical Interlocks are available for fixed and draw out circuit breakers. The interlocks enable directly interlocking breakers that are mounted side by side or in vertical stacks. The interlocks consist of two components: (A) The factory-installed bracket fitted to the breaker (fixed breakers) or the cassette (drawout breakers), and (B) The field-installable interconnecting cables available in lengths of 1.0, 1.6, 2.0, 2.5, 3.0, 3.5 and 4.0m (ordered separately). Refer to Section 4. for interlocking schemes.
- Contact factory for availability.

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Catalog numbering guide

Digits 16 & 17 – Overcurrent Protection Package			
Type		**Over Current (OC) Protection Package**	**Code**
EntelliGuard G ANSI/UL OC Protection with Fuse Settings	Standard Range Instantaneous	LSI (S, switchable) (I, switchable ANSI only)	L3
		LSIG (S, switchable) (I, switchable ANSI only)	L4
		LSIGA (S, switchable) (I, switchable ANSI only) (G, Alarm Only)	L5
		LSIC (S, switchable) (I, switchable ANSI only)	L6
		LSICA (S, switchable) (I, switchable ANSI only) (C, Alarm Only)	L7
		LSIGDA (S, G, A switchable) (I, switchable ANSI only)	L8
		LSIGCDA (S, G, C, A all switchable) (I, switchable ANSI only)	L9
		LSHGDA (S, G, A switchable) (H, switchable ANSI only)	LH
		LSHGCDA (S, G, C, A all switchable) (H, switchable ANSI only)	LK
EntelliGuard G ANSI/UL OC Protection with Fuse Settings From 1/1/12: Included in I type trip units (For reference only)	Standard Range Instantaneous	JSI (S, switchable) (I, switchable ANSI only)	J3
		JSIG (S, switchable) (I, switchable ANSI only)	J4
		JSIGA (S, switchable) (I, switchable ANSI only) (G, Alarm Only)	J5
		JSIC (S, switchable) (I, switchable ANSI only)	J6
		JSICA (S, switchable) (I, switchable ANSI only) (C, Alarm Only)	J7
		JSIGDA (S, G, A all switchable) (I, switchable ANSI only)	J8
		JSIGCDA (S, G, C, A all switchable) (I, switchable ANSI only)	J9
	Extended Range Adjustable Instantaneous	JSH (S, switchable) (H, switchable ANSI only)	JC
		JSHG (S, switchable) (H, switchable ANSI only)	JD
		JSHGA (S, switchable) (H, switchable ANSI only) (G, Alarm Only)	JE
		JSHC (S, switchable) (H, switchable ANSI only)	JF
		JSHCA (S, switchable) (H, switchable ANSI only) (C, Alarm Only)	JG
		JSHGDA (S, G, A all switchable) (H, switchable ANSI only)	JH
		JSHGCDA (S, G, C, A all switchable) (H, switchable ANSI only)	JK
None – (For Switch Only)			XX

A = Ground Fault, External Ground Fault, Alarm only
C = External CT for ground fault detection (AKD20 and LV Switchboard application: input from external summing CTs, used for multiple source ground fault detection. OEM application: Zero Sequence Input of 1A = 100%)
D = Defeatable/Switchable Ground Fault, UL listed with GTU version 08.00.26 and above
G = Ground Fault Protection (GFP, 3-wire or 4-wire, internal summing)
H = Extended Range Adjustable Instantaneous, (IOC, 2x-30x), switchable ANSI only
I = Standard Range Adjustable Instantaneous, (IOC, 2x-15x), switchable ANSI only
J = Long Time (L, I2T) + Fuse Settings (I4T)
L = Long Time (I2T, all trip unit)
S = Short Time (Switchable if Instantaneous (I) protection is enabled)
CA = External Ground Fault Alarm Only
GA = Ground Fault Alarm Only
GDA, GCDA = Ground Fault Trip and Ground Fault Alarm (all switchable, UL listed with GTU version 08.00.26 and above)

- Option “XX” is the only valid option when a Switch is selected in Digit 2.

Digit 18 – Zone Selective Interlocking (ZSI)	
Zone Selective Interlocking	**Code**
Z + I–ZSI + T-ZSI1; user selectable	T
Blank/none	X

1. T-ZSI is available on GTU versions 08.00.26 and above.
- ZSI selections require Secondary Disconnect Block B and 24Vdc control power. Control power recommended for instantaneous ZSI.

Digit 19 – Advanced Features and Communications	
Advanced Features and Communications	**Code**
Reduced Energy Let-Through (RELT)	**1**
Modbus Protocol + RELT	**2**
Monitoring + RELT, NO Communication	**4**
Monitoring + Data Acquisition, Modbus Protocol + RELT	**6**
Monitoring + Data Acquisition, Profibus Protocol + RELT	**7**
Monitoring + Data Acquisition + Relay Package, Modbus + RELT	**8**
Monitoring + Data Acquisition + Relay Package, Profibus + RELT	**9**
None	**X**

- All Advanced Feature selections require Secondary Disconnect Block B and 24Vdc control Power.
- Option "X" is the only valid option when a Switch is selected in Digit 2.
- RELT = Reduced Energy Let Through, requires dedicated input and output on the CB Monitoring = Advanced Metering.
- Data Acquisition = Waveform Capture and Harmonic Analysis.
- In order to output the Coil Signaling status HiFi via trip unit (Digit 12, Options B, D, F, H, K, M, P, R, T, and V) a communications package must be selected in Advanced Features (Digit 19; options 2, 3, ,7, 8, 9). This option requires Secondary Disconnect Block B.
- In order to output the RTC contact output via Trip Unit (Digit 13; Options 3, F, J, M) a communications package must be selected in Advanced Features (Code 19/Step 16); this requires Secondary Disconnect Block B.

Digit 20 – Rating Plug		
Rating Plug	Catalog Number	Code
150	GTP0150U0104	B
200	GTP0200U0204	C
225	GTP0225U0306	D
250	GTP0250U0407	E
300	GTP0300U0408	F
350	GTP0350U0408	G
400	GTP0400U0410	H
450	GTP0450U0612	I
500	GTP0500U0613	J
600	GTP0600U0616	K
700	GTP0700U0816	M
750	GTP0750U0820	N
800	GTP0800U0820	O
900	GTP0900U1020	P
1000	GTP1000U1025	Q
1100	GTP1100U1225	R
1200	GTP1200U1232	S
1500	GTP1500U1640	U
1600	GTP1600U1640	V
1900	GTP1900U2050	W
2000	GTP2000U2050	Y
2200	GTP2200U2550	Z
2400	GTP2400U2564	1
2500	GTP2500U2564	2
3000	GTP3000U3064	3
3200	GTP3200U3264	4
3600	GTP3600U4064	5
4000	GTP4000U4064	6
5000	GTP5000U5064	7
6000	GTP6000U6064	8
Rating plug not required/non auto switch		X

- See Section 3. for further details on rating plugs and sensors.
- Option "X" is the only valid option when a switch is selected in Digit 2.

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EntelliGuard G ANSI/UL489 circuit breaker catalog number guide

Sample	G	A	16	M	2	S
Digit	**1**	**2**	**3&4**	**5**	**6**	**7**
	Circuit Breaker Cassette Family	Breaker Switch Type	Current Rating	Cassette AIC Rating	# of Poles	Shutters

Digits 3 & 4 – Cassette Current Rating[1]			
Current Rating (A)	**Circuit Breaker/Switch**		**DC Switch**
	ANSI	**UL489**	**UL489B**
800	08[2]	08[2]	08[2]
1200	12[3]	12[3]	
1600	16	16	16
2000	20	20	20
3000		30	30
3200	32		
5000	50		
6000		60	

1. Select Current Rating equal to or the next higher of the Circuit Breaker or Switch Current Rating.
2. Not available for interrupting tier "S."
3. Available only for interrupting tiers "S" or "U."

Digit 1 – Cassette Family	
Device Series/Line	**Code**
EntelliGuard G Breaker/Switch	G

Digit 2 – Cassette Device & Type			
Cassette Type, Secondary Mounting	**Envelope 1**		**Envelopes 2, 2.5 & 3**
	Side	**Top**	**Top**
ANSI/UL1066 Circuit Breaker	A	N	A
UL489 Circuit Breaker	B	U	B
ANSI Non-auto CB (ANSI Switch)	C	M	C
UL489 Non-auto CB (UL Switch)	D	S	D
UL 489B Non-auto CB1			L

1. Available only in M interruption rating.
11. Top = Top Mounted Secondary Disconnects (TSD).
12. Side = Side Mounted Secondary Disconnects (SSD). (Available on Envelope 1 only.)
13. N, U, M, S characters are for Envelope 1 only with top mounted secondary disconnects (TSD).
14. When ordering codes A, B, C, D, Side Secondary Disconnects (SSD) are supplied as standard on Envelope 1.
15. Codes N, U, M, S are not valid for Envelopes 2 & 3.
16. Envelope 1 (Type N and H, 400A – 2000A).
17. DC Ratings; trip unit not included. DC Rated Circuit Breakers require external control devices (e.g., Type 37 or Type 76 DC Relays).
18. Side Secondary Disconnects are specifically intended for 5-High (“high density”) equipment designs.
19. With Side Mounted Disconnects (SSD), the following aux switches are not valid (In Digit 12); Auxiliary Switch, 8 NO+8 NC (Power Rated) or Aux. Switch, 4 NO/4 NC (Power Rated) + 4 NO/4 NC low signal (Hi-Fi

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Catalog numbering guide

Digit 5 – Cassette Envelope Size

Interrupting Rating Tier ANSI/UL1066 Devices, LVPCB

Code	254V	508V	635V	1/2S Withstand	HSIOC	Override No Inst.	Override w/Inst.	Code
S[1]	65,000	65,000	50,000	50,000	50,000	49,000	53,500	S
N	65,000	65,000	65,000	65,000				N
H	85,000	85,000	65,000	65,000	65,000	63,700	69,500	H
P[1]	100,000	100,000	65,000	65,000	65,000	63,700	69,550	P
E	85,000	85,000	85,000	85,000				E
M	100,000	100,000	100,000	85,000	85,000	83,800	90,950	M
U[1]	130,000	100,000	100,000	100,000	100,000	98,000	107,000	U
B	100,000	100,000	100,000	100,000				B
L	150,000	150,000	100,000	100,000	100,000	98,000	107,000	L
W	200,000	200,000	100,000	100,000	100,000	98,000	107,000	W

Interrupting Rating Tier UL489 Devices ICCB

	240V	480V	600V	690V (IEC 60947-2)	1/2S Withstand	HSIOC	Override No Inst.	Override w/Inst.	400-1200
S[1]	65,000	65,000	50,000	40,000[3]	42,000	42,000		44,940	S
N	65,000	65,000	65,000	50,000[3]	42,000	42,000		44,940	N
H	85,000	85,000	65,000		50,000	50,000		53,500	H
P[1]	100,000	100,000	65,000		50,000	50,000		53,500	P
M	100,000	100,000	100,000	85,000[3]	65,000	65,000		69,550	M
U[1]	130,000	100,000	100,000		85,000	85,000		90,950	U
L	150,000	150,000	100,000	100,000[3]	85,000	85,000		90,950	L
W	200,000	200,000	100,000		85,000	85,000		90,950	W

ANSI Non-Automatic Switches

	254V	580V	635V	30 Cycle Withstand Ratings
S[1]	42,000	42,000	42,000	S
N	42,000	42,000	42,000	N
M	65,000	65,000	65,000	M
U[1]	85,000	85,000	85,000	U
B	100,000	100,000	100,000	B

UL489 Non-Automatic Switches

	254V	580V	635V	
S[1]	42,000	42,000	42,000	S
N	42,000	42,000	42,000	N
M	65,000	65,000	65,000	M
U[1]	85,000	85,000	85,000	U
B	100,000	100,000	100,000	B

Note: Non-automatic switches are provided with no internal sensing or tripping mechanism and cannot be applied above their respective withstand levels. If a non-automatic device is required at ratings above the available switches is required, it is recommended that a circuit breaker set with maximum settings be employed using external control or protection as required by the application.

1. Available as 3-pole only
2. Restricted
3. Icu = Ics = Icw

	Envelope 1		Envelope 2		Envelope 3	Envelope 4	
	400, 800, 1200	400, 800, 1200, 1600, 2000	3200	400-3200	800-4000	3200	4000-5000
	X						
		X	X				
		X					
		X					
				X			X[2]
				X			X
					X		
						X	X
						X	X
						X	X

	Envelope 1		Envelope 2		Envelope 2.5	Envelope 3	
	400-1200	400-2000	2500-3000	400-3000	800-4000	3000	4000-6000
	X						
		X	X				
		X	X				
		X					
				X			X
					X		
						X	X
						X	X

	Envelope 1		Envelope 2	Envelope 2.5	Envelope 3
	800-1200	800-2000	800-3200	800-4000	3200-5000
	X				
		X			
			X		
				X	
					X

	Envelope 1		Envelope 2	Envelope 2.5	Envelope 3
	800-1200	800-2000	800-3000	800-4000	3000-6000
	X				
		X			
			X		
				X	
					X

Digit 6 – Cassette Type & Number of Poles	
Device Series/Line	**Code**
OEM Cassette – 3 Pole	2
OEM Cassette – 4 Pole	5
GE Equipment Cassette – 3 Pole[1]	7
OEM Cassette – 3 Pole, No Rear Termination[2]	X
OEM Cassette – 4 Pole, No Rear Termination[2]	Y

Digit 7 – Shutter	
Shutters with Locks	**Code**
Shutter and Shutter Lock – Factory Installed	S
None	X

1. GE Equipment cassette designed specifically for AKD20 Switchgear. These cassettes are NOT available for OEMs.
2. Available only for UL489B; UL/ANSI Envelope 2 > 2000A; or Envelope 3.

Section 5.
Catalog numbering guide

EntelliGuard TU trip unit for EntelliGuard G breakers

Sample	GG	M	16	L4	X	6	A	XXXX
Digit	1&2	3	4&5	6&7	8	9	10	11-14
	EntelliGuard Trip Unit Form	Frame Rating	Sensor Rating	Overcurrent Ground Fault Protection	ZSI	Adv. Features and Comm.	Manual Auto Trip Reset	Future Use

Circuit Breaker Type	Code
Power Break 1 (UL)	GA
Power Break 2 (UL)	GB
AKR (ANSI)	GC
WP (ANSI)	GW
Mpact Low (IEC)	GL
Mpact 24-48V (IEC)	GH
Mpact 120-240V (IEC)	GQ
EntelliGuard G ACB (ANSI)	GG
EntelliGuard G ACB (UL)	GU
EntelliGuard G ACB (IEC)	GT
EntelliGuard G Universal Spare Trip	G1
Type A Conversion Kits (ANSI)	G2
EntelliGuard G Switch (IEC)	G3

- This Application Guide documents the EntelliGuard TU Trip Unit for EntelliGuard G Circuit Breakers.
- GE Legacy ANSI, UL Circuit Breakers are documented in DEH-4567.

Digits 1 & 2 – Trip Unit Form/Family

Digit 3 – EntelliGuard G Frame Rating

Code	240V	480V	600V	690V (IEC 60947-2)	1/2S Withstand	HSIOC	Override	
No Inst.	Override with Inst.							
			Interrupting Rating Tier, ANSI/UL1066 Devices LVPCB					
S	65,000	65,000	50,000		50,000	50,000	49,000	53,500
N	65,000	65,000	65,000		65,000			
H	85,000	85,000	65,000		65,000	65,000	63,700	69,500
P	100,000	100,000	65,000		65,000	65,000	63,700	69,500
E	85,000	85,000	85,000		85,000			
M	100K/130K[2]	100,000	85K/100K[2]		85K/100K2	85K/100K2	83.3K/98K2	90.95K/107K2
B	100,000	100,000	100,000		100,000			
L	150K/200K3/130K[2]	150K/200K[3]/100K[2]	100,000		100,000	100,000	98,000	107,000
			Interrupting Rating Tier, UL489 Devices ICCB					
S	65,000	65,000	50,000	40,0001	42,000	42,000		44,940
N	65,000	65,000	65,000	50,0001	42,000	42,000		44,940
H	85,000	85,000	65,000		50,000	50,000		53,500
P	100,000	100,000	65,000		50,000	50,000		53,500
M	100K/130K[2]	100,000	85K/100K[2]	85,0001	65K/85K2	65K/85K2		69.55K/90.95K2
L	150K/200K[3]/130K[2]	150K/200K[3]/100K[2]	100,000	100,0001	85,000	85,000		90,950

1. Icu = Ics = Icw
2. For U type interruption tier breakers only
3. For W type interruption tier breakers only

- Refer to GEH-4567 for other circuit breaker types.
- Codes E and B are for ANSI EntelliGuard G circuit breakers only.
- For universal trip unit use “X” in digit 3 (EntelliGuard G Only). Universal trip unit reads interrupt ratings from breaker BIM module.

Digits 4 & 5 – Sensor Rating	
Sensor Rating	Code
UNIV[1]	00
400	04
600[2]	06
800	08
1000[2]	10
1200[2]	12
1600	16
2000	20
2500[2]	25
3000[2]	30
3200[3]	32
4000	40
5000	50
6000[2]	60

1. Universal Spare Trip Unit.
2. UL only.
3. ANSI only.

Section 5.
Catalog numbering guide

Digits 6 & 7 – Overcurrent Protection Package (for EntelliGuard G Breakers)			
Type		**Over Current (OC) Protection Package**	Code
EntelliGuard G ANSI/UL OC Protection with Fuse Settings	Standard Range Instantaneous	LSI (S, switchable) (I, switchable ANSI only)	L3
		LSIG (S, switchable) (I, switchable ANSI only)	L4
		LSIGA (S, switchable) (I, switchable ANSI only) (G, alarm only)	L5
		LSIC (S, switchable) (I, switchable ANSI only)	L6
		LSICA (S, switchable) (I, switchable ANSI only) (C, alarm only)	L7
		LSIGDA (S, G, A switchable) (I, switchable ANSI only)	L8
		LSIGCDA (S, G, C, A all switchable) (I, switchable ANSI only)	L9
	Extended Range Adjustable Instantaneous	LSH (S, switchable) (H, switchable ANSI only)	LC
		LSHG (S, switchable) (H, switchable ANSI only)	LD
		LSHGA (S, switchable) (H, switchable ANSI only) (G, alarm only)	LE
		LSHC (S, switchable) (H, switchable ANSI only)	LF
		LSHCA (S, switchable) (H, switchable ANSI only) (C, alarm only)	LG
		LSHGDA (S, G, A switchable) (H, switchable ANSI only)	LH
		LSHGCDA (S, G, C, A all switchable) (H, switchable ANSI only)	LK
EntelliGuard G ANSI/UL OC Protection with Fuse Settings FROM 1/1/12: INCLUDED IN L TYPE TRIP UNITS	Standard Range Instantaneous	JSI (S, switchable) (I, switchable ANSI only)	J3
		JSIG (S, switchable) (I, switchable ANSI only)	J4
		JSIGA (S, switchable) (I, switchable ANSI only) (G, Alarm Only)	J5
		JSIC (S, switchable) (I, switchable ANSI only)	J6
		JSICA (S, switchable) (I, switchable ANSI only) (C, Alarm Only)	J7
		JSIGDA (S, G, A all switchable) (I, switchable ANSI only)	J8
		JSIGCDA (S, G, C, A all switchable) (I, switchable ANSI only)	J9
	Extended Range Adjustable Instantaneous	JSH (S, switchable) (H, switchable ANSI only)	JC
		JSHG (S, switchable) (H, switchable ANSI only)	JD
		JSHGA (S, switchable) (H, switchable ANSI only) (G, Alarm Only)	JE
		JSHC (S, switchable) (H, switchable ANSI only)	JF
		JSHCA (S, switchable) (H, switchable ANSI only) (C, Alarm Only)	JG
		JSHGDA (S, G, A all switchable) (H, switchable ANSI only)	JH
		JSHGCDA (S, G, C, A all switchable) (H, switchable ANSI only)	JK
None (for switch only)			XX

A = Ground Fault, External Ground Fault, Alarm only.
C = External CT for ground fault detection (AKD20 and LV Switchboard application: input from external summing CTs, used for multiple source ground fault detection. OEM Application: Zero Sequence Input of 1A = 100%).
D = Defeatable/Switchable Ground Fault , UL listed with GTU version 08.00.26 and above.
G = Ground Fault Protection (GFP, 3-wire or 4-wire, internal summing).
H = Extended Range Adjustable Instantaneous, (IOC, 2x-30x), switchable ANSI only.
I = Standard Range Adjustable Instantaneous, (IOC, 2x-15x), switchable ANSI only.
J = Long Time (L, I2t) + Fuse Settings (I4t).
L = Long Time (I2t, all trip unit).
S = Short Time (Switchable if Instantaneous (I) protection is enabled).
GA = Ground Fault Alarm only.
CA = External Ground Fault Alarm only.
GDA, GCDA = Ground Fault Trip and Ground Fault Alarm (all switchable, UL listed with GTU version 08.00.26 and above).

Digit 8 – Zone Selective Interlocking (ZSI)	
Zone Selective Interlocking	**Code**
Z + I- ZSI + T-ZSI[1]; user selectable	T
Blank/None	X

1. T-ZSI is available on GTU versions 08.00.26 and above.

- ALL ZSI selections require Secondary Disconnect Block B and 24Vdc control power.
- Control power recommended for instantaneous ZSI.

Digit 9 – Advanced Features and Communications	
Advanced Features & Communications	**Code**
Reduced Energy Let-Through (RELT)	1
Modbus Protocol + RELT	2
Profibus Protocol + RELT	3
Monitoring + RELT, NO Communication	4
Monitoring + Relay Package + RELT	5
Monitoring + Data Acquisition, Modbus Protocol + RELT	6
Monitoring + Data Acquisition, Profibus Protocol + RELT	7
Monitoring + Data Acquisition + Relay Package, Modbus + RELT	8
Monitoring + Data Acquisition + Relay Package, Profibus + RELT	9
None	X

- All Advanced Feature selections require Secondary Disconnect Block B and 24Vdc control Power.
- RELT = Reduced Energy Let Through.
- Monitoring = Advanced Metering.
- Data Acquisition = Waveform Capture and Harmonic Analysis.

Digit 10 – Manual/Auto Trip Reset	
Manual Auto Trip Reset	**Code**
Manual Lockout	M
Auto Reset/Reclose	A
Auto/Manual Lockout (Selectable)	S
None (Defaults to Auto Reset/Reclose)	X

- When Bell Alarm with Lockout is selected on the EntelliGuard G Circuit Breaker, then Code M must be selected.
- X is only valid on GE Legacy Circuit Breakers and Conversion Kits.
- M is valid on EntelliGuard G Breakers when a Bell Alarm is selected.
- A is valid on EntelliGuard G Breakers when a Bell Alarm is not selected.
- S is IEC Only

Digit 11 – Factory or Field Installed	
Manual Auto Trip Reset	**Code**
Factory Installed Trip Unit (Original)	F
Replacement Trip Unit (shipped loose)	R

EntelliGuard TU Trip Unit Rating Plugs

Sample	GTP	1600	U	16	40
Digit	1,2,3,4	5,6,7,8	9	10,11	12,13
	EntelliGuard Trip Unit Rating Plug	Universal Trip Unit Rating Plug (Rating in Amperes)	Universal Trip Plug	Smallest Sensor that accepts this plug (1600A)	Largest Sensor that accepts this plug (4000A)

Section 6.
Application data

The EntelliGuard G family of circuit breakers and related switching devices is a truly global line of protection and switching devices. It was designed from the ground up to provide reliable protection and operation in a wide range of power distribution systems. Combined with the EntelliGuard TU family of trip devices, EntelliGuard G circuit breakers provide superior protection and reliability with a maximum of flexibility and a minimum of compromise for your power protection and switching needs.
This section provides an overview of the circuit breaker's capability under UL 489 and UL 1066 standards.

Key features

There are three product families:
UL1066 Low Voltage Power Circuit Breakers
- 800-5000A frames in three physical sizes.
- 400-5000A sensors with rating plugs as low as 150A and trip settings as low as 75A.
- Short circuit ratings as high as 150kA at 480V (tested at 508V).
- Withstand capability and selectivity as high as 100kA
- Continuously adjustable selective instantaneous as high as 30X the circuit breaker's rating.

UL489 Stored Energy Insulated Case Circuit Breakers
- 800-6000A frames in three physical sizes.
- 400-6000A sensors with rating plugs as low as 150A and trip settings as low as 75A.
- Short circuit ratings as high as 150kA at 480V.
- Withstand capability and selectivity as high as 85kA.
- Continuously adjustable selective instantaneous to 15X on all but the largest circuit breakers.
- Drawout and stationary mounted, 100% rated.

IEC Rated Circuit Breakers for IEC Equipment and Applications
- 800-6400A frames in three physical sizes.
- 400-6400A sensors adjustable to 20% of sensor size.
- Short circuit ratings as high as 150kA at 440V, 100kA at 690V, 80kA at 1000V.
- Rated breaking capacity 100%, Ics = Icu for all frames.
- Withstand capability and selectivity as high as 100kA for 1sec.
- Continuously adjustable selective instantaneous as high as 30X the circuit breaker's rating.

All Types
- Stationary mounting capability with rear or front connections.
- Drawout mounting with cassette and automatic shutter mechanism.
- Complete closed door operation capability – UL489, ANSI or IEC.
- Two-step stored energy mechanism for manual or electrically operated circuit breakers, suitable for fast throw-over or generator paralleling applications
- Remote racking device allowing maintenance personnel to rack circuit breakers in and out while standing outside the arc flash boundary.
- 3 and 4 pole configurations with the neutral on either side.
- Suitable for UL1008 transfer switch applications
- Alternate, settable and remote controllable instantaneous pickup with positive feedback.
- GE's novel fully controllable ZSI restrained and unrestrained settings.
- GE's novel fully selective instantaneous trip with selectivity enhancing ZSI capability.
- Field installable accessories with labels that may be seen through the circuit breaker's escutcheon.
- Easily accessible terminal contacts at the top or side of circuit breaker for use by installer – permanently labeled, color coded and interlocked with harnesses for fast, efficient, mistake-proof wiring.
- Advanced protection algorithms that allow maximum selectivity and protection at the same time with minimized need to sacrifice protection to get system reliability or vice versa.
- Trip curves and algorithms to optimally accommodate downstream fuses, older slower power circuit breakers, ultra-fast current limiting devices or other EntelliGuard circuit breakers without sacrificing any more protection than absolutely necessary to achieve significant selectivity.

Ratings and sizes
The EntelliGuard G family of overcurrent devices is available in 3 or 4 pole versions, in 3 physical sizes referred to as "envelopes" 1, 2 and 3. Four pole versions may have the neutral on the right- or left-most pole. The envelope and the number of poles are the main determinants for physical size and the space the device will require when installed in equipment or enclosures.

The circuit breakers and switches are further divided into “frame” sizes. The frame sizes follow the guidelines defined under the applicable UL, IEC and ANSI standards as shown in the various ratings tables. Switchgear equipment is typically sized to match the frame ratings and physical size. Switchboards may be sized to match the installed circuit breaker’s sensor rating.
Equipment cubicles or device mounting provisions are normally mechanically interlocked such that equivalent frames may be installed within a specific cubicle or space. When exchanging circuit breakers for maintenance purposes, care should be exercised so that there is no attempt to install a circuit breaker with a rating higher than what the equipment was designed to accommodate, even if the physical size seems similar.

Short circuit interrupting ratings
The EntelliGuard G family of UL devices is available with short circuit ratings as high as 150kA at 480V, and withstand ratings as high as 100kA. UL1066 and ANSI C32 ratings are based on various tests performed at rated voltage plus 6%. Hence it is common to see low voltage circuit breakers listed as suitable for 254, 508 and 635V. Any UL 1066 listed device must be tested at these higher voltages if listed at the normal nominal voltage of 240, 480 and 600V. UL489 circuit breakers are tested at the nominal voltage. Both circuit breakers are subject to dielectric testing after interrupting faults to ensure the ability to sustain voltage.
Short circuit interrupting ratings are a measurement of the circuit breaker’s ability to interrupt a particular value of fault current at a maximum power factor (also expressed as X/R ratio). For fault currents above 20,000A RMS, UL489 circuit breakers are tested at 20% power factor and UL1066 circuit breakers are tested at 15% power factor. When fault currents have power factors lower (higher X/R) than the test power factor, the circuit breaker’s short circuit rating must be adjusted to compensate for the fault’s lower PF. The adjustment is performed as shown in Figure 6.1. Table 6.2 shows various asymmetrical peak ratios for various power factors and X/R ratios. A power factor of 100% yields a symmetrical fault and hence the peak over RMS ratio is 1.41.

Figure 6.1 Short Circuit Rating Adjustment Equation

$$\frac{\text{CB's Test Peak}}{\text{Fault Peak}} = \text{Derate Ratio}$$

Table 6.1 First Half-Cycle Peak at Specific Fault X/R Ratios (excerpted from UL489)

Power Factor	X/R ratio	Maximum Peak at 1/2 Cycle
5%	20.0	2.63
6%	16.6	2.59
7%	14.3	2.55
8%	12.5	2.52
9%	11.7	2.50
9%	11.1	2.49
10%	10.0	2.46
11%	9.0	2.42
12%	8.3	2.39
13%	7.6	2.36
14%	7.1	2.34
15%	6.6	2.31
16%	6.2	2.28
17%	5.8	2.26
18%	5.5	2.23
19%	5.2	2.21
20%	4.9	2.18
100%	0.0	1.41

Consider a system where the fault current has an X/R ratio of 10 and the calculated RMS value is 92,000. A circuit breaker with a stated interrupting capability of 100,000 is being considered. Since the fault’s X/R ratio is higher than the UL489 rating at 4.9, the circuit breaker’s rating, 100kA, must be multiplied by 2.18/2.46 (from Table 6.1). The ratio is .89. Hence, the circuit breaker must be considered as if it is only rated for 89,000A. The UL489 100kA rated circuit breaker is not suitable for the application because its de-rated 89kA rating is below the available fault current of 92kA.
Consider an equivalent UL1066 circuit breaker tested at an X/R ratio of 6.6. The UL1066 circuit breaker must be de-rated by 2.31/2.46, which yields 0.94. The UL1066 circuit breaker is then de-rated to 0.94 times 100kA. The UL1066 circuit breaker is rated higher than the available fault current of 92kA and hence could be considered for the application.

Withstand ratings, selective waveform recognition-, relt- and override-instantaneous protection
Instantaneous adjustment capability for any circuit breaker is intrinsically connected to the circuit breaker’s withstand rating and the trip system’s sensing methods. In the case of the EntelliGuard G family of circuit breakers, high withstand ratings allow for a broad range of instantaneous trip options.

Section 6.
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The trip system relies on high accuracy air core sensors not encumbered by the saturation concerns associated with iron core sensors used in many other trip systems. This allows the EntelliGuard trip system to take full advantage of the circuit breaker's withstand rating, providing adjustable settings and full selectivity right up to the circuit breaker's high withstand level.
EntelliGuard G circuit breakers, in conjunction with EntelliGuard TU trip units with GE's unique "selective instantaneous" algorithm, allow selectivity capability as high as 100kA with instantaneous on, and set at surprisingly low values. The EntelliGuard family of devices provides multiple solutions for your selectivity and protection problems.
Low Voltage Power Circuit Breakers (LVPCBs) listed to UL1066 have defined fault current withstand currents. EntelliGuard G UL489 Insulated Case Circuit Breakers also have substantial withstand ratings. The stated withstand current (Icw) allows the instantaneous protection of LVPCBs to be turned off or set at very high values, and it's what allows the short time bands of both types of circuit breakers to be delayed as much as 0.5sec.
EntelliGuard G UL1066 LVPCBs with EntelliGuard TU trip units are available with two different instantaneous adjustment ranges to take full advantage of this capability.
The standard instantaneous adjustment range is 2-15X, adjustable in 1/2X increments on all UL 489 and UL1066 circuit breakers. EntelliGuard TU trips offer, for UL1066 LVPCBs only, an extended Instantaneous adjustment range that allows the instantaneous pickup to be continuously adjusted up to 30X, adjustable in 1X increments above 15X the rating plug. The maximum adjustable pickup setting is limited to approximately 95% of the circuit breaker's withstand rating, or 30X trip plug current rating, whichever is lower.
The EntelliGuard G's wide range of instantaneous adjustability allows for maximum flexibility in providing the settings that are required for selectivity or for optimum protection. Its capability is limited by its withstand rating and the instantaneous override. An instantaneous override is used in some circuit breakers to ensure that, if a fault exceeds the circuit breakers withstand capability, the circuit breaker trips quickly. In all UL489 EntelliGuard circuit breakers, the override protection is designed such that selectivity up to 100% of the stated circuit breaker's withstand rating is possible.
In UL1066 LVPCBs, maximum selective capability is achieved by using the adjustable instantaneous algorithm, even if it is set at maximum. When the adjustable instantaneous is enabled, regardless of setting, the override protection is set so that it will not trip for faults below the circuit breaker's withstand rating. If the adjustable instantaneous is disabled (turned off), then the override automatically adjusts downward by approximately 9%. This lowers the maximum selective capability to 91% of the circuit breaker's withstand rating.
The EntelliGuard G LVPCB may be selective up to the full withstand current with adjustable instantaneous on and 91% of withstand rating with adjustable instantaneous off.
The EntelliGuard TU trip unit also offers a second adjustable instantaneous trip called the Reduced Energy Let-Through (RELT) instantaneous pickup. This trip offers a faster algorithm suitable for application as alternate instantaneous pickup setting for temporary use when faster and more sensitive instantaneous protection is desired. The RELT setting is determined by the user and may be adjusted from 1.5X to 15X rating plug. Once set, the RELT function may be enabled or disabled locally at the trip unit or remotely via a 24Vac/dc signal, or serial communications.
When the trip unit receives a RELT enable command, it issues a feedback signal indicating the RELT setting is now active. The user may connect the RELT enable input to any 24Vac/dc source, such as a manual switch, automatic sensor, or both. The feedback signal may be connected to any desired signaling means with the proper ratings. For further details see Section 3. of this application guide.

Close and latch ratings and making current release (MCR) instantaneous TRIP
EntelliGuard G circuit breakers have defined close and latch ratings as shown in Table 6.2 through Table 6.4. The close and latch rating is a measurement of the circuit breaker's ability to close and latch closed on a fault. This value must be high enough to allow a circuit breaker to handle large transient inrush currents associated with certain types of loads, such as energy efficient motors or large capacitor banks.

Table 6.2 EntelliGuard G Circuit Breaker Close and Latch Ratings, UL489 Listed

Envelope	Amps	Type	Close and Latch Rating (kA)
1	800 – 2000	S, N, H, P	42
2	800 – 3000	N, H, M	65
2.5	800 – 4000	U	85
3	4000 – 6000	M	85
		L	100

Table 6.3 EntelliGuard G Circuit Breaker Close and Latch Ratings, UL1066 Listed

Envelope	Amps	Type	Close and Latch Rating (kA)
1	800 - 2000	S, N, H, P	42
2	800 - 3000	N, E, M	65
2.5	800 – 4000	U	85
3	4000 - 6000	M, B	85
		L	100

Table 6.4 EntelliGuard G Non-Automatic Switch Close, Latch, and Withstand Ratings, UL489 Listed

Envelope	Amps	Type	Close and Latch Rating (kA)
1	800 - 2000	N	42
2	800-3000	M	65
2.5	2000 – 4000	U	85
3	4000 - 6000	B	100
		L	100

EntelliGuard G circuit breakers are provided with values that are high relative to the circuit breaker's load carrying capacity. The trip system provides a type of instantaneous protection called a Making Current Release (MCR) to provide more sensitive protection when closing. Should the trip system measure higher current than the MCR setting, it is very likely that the circuit breaker has been closed on a bolted fault, or low impedance, arcing fault. If that is the case, the MCR instantaneous will provide very fast protection, minimizing damage and hazard.

Operations

EntelliGuard G circuit breakers are designed to provide long life, even in operationally difficult environments. However, different standards have different ways of measuring and qualifying circuit breaker operations, hence slightly different numbers may apply to similar circuit breakers when defined within the context of different standards. Table 6.5 and Table 6.6 describe the endurance parameters for the circuit breaker family.

Table 6.5 Operational Ratings, UL 489 Circuit Breakers

Envelope	Frame	Mechanical Operations	Electrical Operations at 508V	Electrical Operations at 635V
1	400-1600A	12500	10000	7500
	2000A	12500	7500	5000
2	400-3000A	10000	5000	5000
2.5	800 – 4000	5000	3000	2000
3	3000-4000A	5000	3000	2000
	6000A	5000	1500	1000

Table 6.6 Operational Ratings, UL1066/ANSI Circuit Breakers

Envelope	Frame	Mechanical Operations	Electrical Operations at 508V	Electrical Operations at 635V
1	400-1600A	12500	10000	7500
	2000A	12500	7500	5000
2	400-3200A	10000	5000	5000
2.5	800 – 4000	5000	3000	2000
3	3200-4000A	5000	3000	2000
	5000A	5000	2000	1500

Per industry standards, operations are listed based on no maintenance during the testing. However, if some maintenance is done of some of the current carrying parts and arc chute, then over 20,000 electrical and mechanical operations are possible.

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Application data

Selecting a circuit breaker for an application
There are six application factors to consider in selecting current rating for a circuit breaker:

1. Size of the cable or bus used in the line and load connections.
2. Actual installed ambient temperature.
3. System operating frequency.
4. Altitude of the installation.
5. Type of loading of the protected circuit.
6. Design safety factor.

The following simple relationship combines these six application factors into a single equation:

CR = IA x A x B x C x D x E x F

CR Required circuit breaker current rating, amps
IA Actual load current, amps
A Cable or bus sizing factor
B Ambient temperature rating factor
C Frequency rating factor
D Altitude rating factor
E Load class rating factor
F Safety factor

Cable or Bus Size – Factor A
The thermal design of a circuit breaker takes into account the ability of the line and load cables or buses to act as heat sinks. For UL489 Listed circuit breakers, UL has assigned specific cable or bus sizes for each current rating. Generally, these assignments are coordinated with specific conductor temperature ratings. When using a conductor with an increased temperature rating, the higher rating decreases both the cross-sectional area and its ability to conduct heat from the circuit breaker. If an EntelliGuard G circuit breaker is used with cables directly connected, contact your GE application engineer for information to ensure proper cabling information. Cable with insulation ratings above 75°C may be used, providing it is sized to 75°C ampacity per the NEC or other applicable codes.

Ambient Temperature – Factor B
Ambient temperatures have a wide effect on the rating of the breaker-cable system. While the internal sensing and tripping circuitry in EntelliGuard TU trip units are ambient insensitive, high-ambient temperatures may cause internal components to exceed operating temperature limits. Low temperatures substantially increase the current-carrying capabilities of the breaker-cable system until other limiting factors occur (e.g., lubrication problems or mechanical binding of internal parts due to differential contraction). The ambient temperature around an EntelliGuard G breaker should not be less than -20°C nor exceed 70°C.
Ambient temperature always refers to the temperature of the air immediately surrounding the breaker and not the temperature of the air outside the breaker's enclosure. Room or outside air temperatures only establish the thermal floor to which all other heating is added.
To convert breaker ambient from room ambient, it is necessary to know the temperature rise within the equipment housing the breaker. Temperature rise is a function of several variables, including heating caused by other equipment, ventilation, solar heating, factors relating to group mounting and the free surface area of the breaker's enclosure. Once the device's ambient temperature is determined, select Factor B from Table 6.7.

Table 6.7 Ambient Temperature Rating-Factor B

Ambient Temperature, °C[1]	Maximum Wire Insulating Rating C[2]	AC Factor B	DC Factor B
25	75	1	1
40	90	1	1
50	105	1	11
60	125	1.1	1.15
70	125	1.15	

1 Average air temperature over a 24-hour period outside the breaker's insulated case, but inside the enclosure.
2 Cable (wire) must be based on 75°C current rating per Table 3.10-16, current National Electrical Code.

Operating Frequency – Factor C
All UL EntelliGuard circuit breakers may be applied at their published ratings on 50Hz and 60Hz power systems. At nominal system frequencies less than 50Hz but above direct current, digital solid-state trip may become inaccurate. On direct current systems, digital solid-state trip units are completely inoperative. EntelliGuard G circuit breakers may be used on DC applications, but EntelliGuard TU trip units may not.
System operating frequencies above 60Hz may change the performance and ratings of circuit breakers by heating metallic parts and significantly reducing interrupting capacity. EntelliGuard TU trip units are not suitable for applications at 400Hz.

For operating frequencies of both 50Hz and 60Hz, the operating frequency rating Factor C = 1.00. For operating frequencies other than 50Hz and 60Hz, contact your GE applications engineer.

Altitude – Factor “D”
EntelliGuard G UL circuit breakers are designed for operation at altitudes from sea level to 6000ft (1800m). Reduced air densities at altitudes above 6000ft affect the ability of the circuit breaker to both transfer heat and interrupt short circuits. Determine the altitude of the breaker’s installation, and select the altitude rating - factor D from Table 6.8.

Table 6.8 Altitude Rating – Factor D

Altitude		Factor B
Feet	Meters	
100 - 6,000	30 - 1,800	1
6,001 - 10,000	1,801 - 3,000	1.04
>10,001	>3,001	1.08

Load Class Rating – Factor E
The type of load and its duty cycle must be considered in the application of EntelliGuard G circuit breakers. Loads such as capacitors and electromagnets require a substantial and continuous de-rating factor if the breaker is normally used to switch the load. With loads such as resistance welders, the breaker’s continuous current rating must be no less than 125% of the welder’s 100% duty-cycle rating.
In general, circuit breakers are intended for the protection of insulated cable. Where a circuit breaker is intended to protect load equipment, prudent engineering practices call for obtaining factory review and concurrence with the selection of a specific protective device. Load class selection Factor E for typical applications are listed in Table 6.9.

Table 6.9 Load Class Rating – Factor E

Load Type	Factor E
Switching Electromagnets	1.5
Single Motor Branch Circuit Protection (Normal Duty) [1]	1.5
Switching Capacitors	1.5
Single Motor Branch Circuit Protection (Heavy Duty) [1]	>3,001 1.75
All Other load Types (Normal Duty)	1

1. Use this factor to either plugging duty or starting more than 25 times per hour, where the rms current cannot be easily calculated.

Safety – Factor F
A safety factor is used to provide a design margin between the rating of a circuit breaker and the derived operating current using all of the applicable selection factors. A safety factor of at least 10% is often used to ensure the circuit breaker is adequately sized. In addition it may be useful to consider future growth.

Other Factors that Influence Circuit Breaker Sizing
100% vs. 80% Ratings
All EntelliGuard G circuit breakers are 100% rated. Circuit breakers that are 100% rated are not required to be sized at 125% of the expected load. However, it is recommended that a safety factor, as described above, always be considered when selecting overcurrent device sizes.
An important consideration may be the circuit breaker’s desired selective and protection performance within the context of the system where it is installed. Certain settings are functions of the trip plugs, others of the sensors. In Table 3.10 you will find the sensors available on a per frame basis. Table 3.9 identifies the trip rating plugs available for each sensor. Table 6.10 identifies the relationship between specific circuit breakers and trip parameters.

Table 6.10 Circuit Breaker and Trip Parameters

Adjustment or Capability	Abbreviation	Trip Designation	Setting or Range
Trip Current Rating Plug	In	In	~37.5-100% of sensor
Long Time Pickup	LTPU	LTPU	Plug x pickup setting
Short Time Pickup	STPU	STPU	1.5X - 12X of the LTPU
Instantaneous Pickup	IPU	I	2X -15 or 30X of the trip current rating plug
Maximum Achievable Selectivity	= Icw		Function of the withstand rating
Ground Fault Pickup	GF	GF	20-60% sensor, <1200A
Override Pickup	HSIOC		Function of the withstand rating
Making Current Release	MCR		Function of the close and latch rating

Section 7.
Physical data

Dimensions and weights
To download detailed dimensional drawings like those shown in

Figure 7.1, visit www.geindustrial.com.

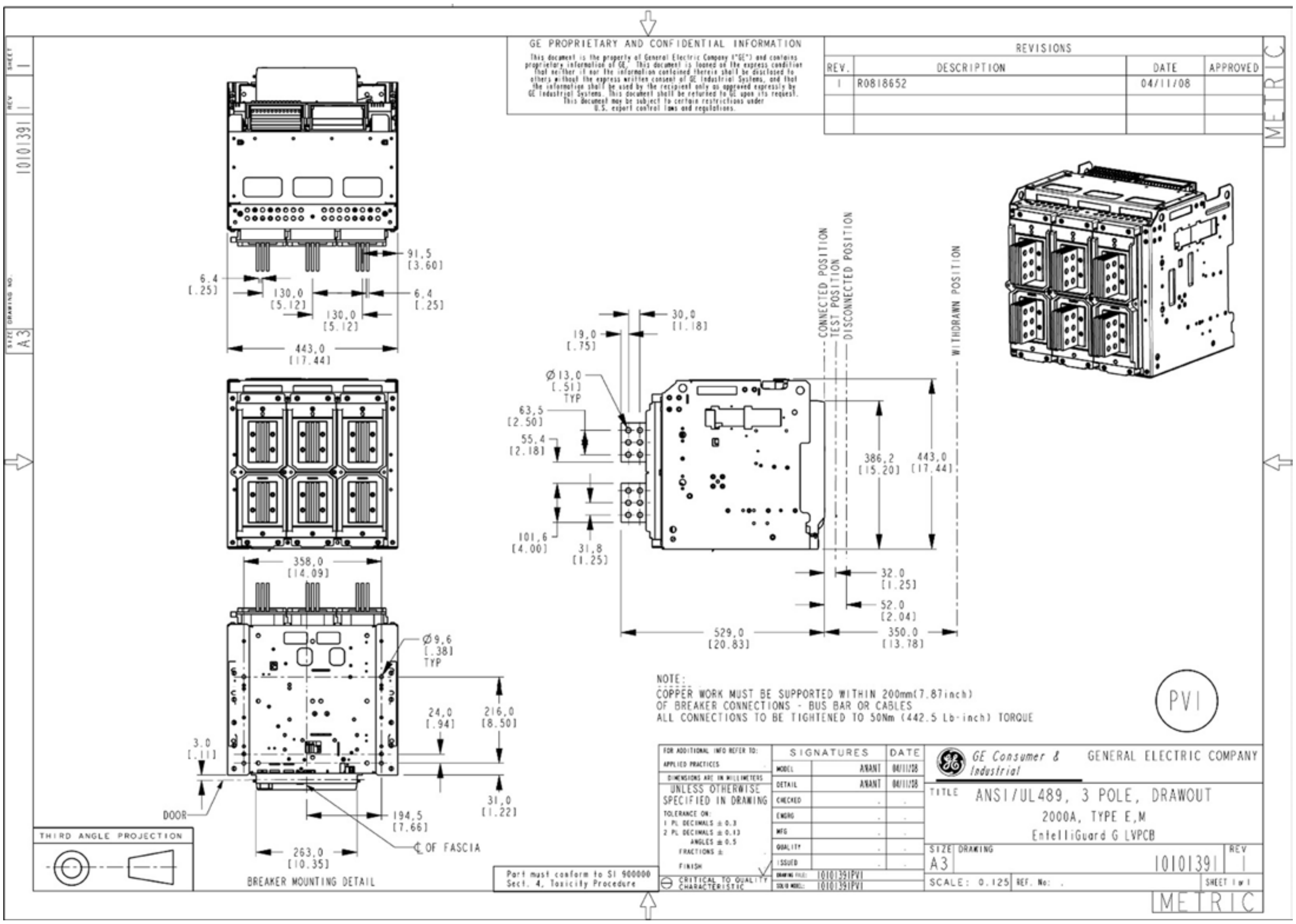

Table 7.1 Drawing Index

Description	Mounting Location of Secondary Disconnect	Assembly #
400 - 1600A, Type N & H, 3-pole, drawout, ANSI/UL	Side	10101387
400 - 1600A, Type E & M, 3-pole, drawout, ANSI/UL	Top	10101422
2000A, Type N & H, 3-pole, drawout, ANSI/UL	Side	10101388
2000A, Type E & M, 3-pole, drawout, ANSI/UL	Top	10101391
2500 - 3200A, Type N, E & M, 3-pole, drawout, ANSI	Top	10101393
2500 - 3000A, Type N, H & M, 3-pole, drawout, UL	Top	10101392
3000 - 6000A, Type B, M & L, 3-pole, drawout, ANSI/UL	Top	10101397
400 - 1600A, Type N & H, 3-pole, fixed, ANSI/UL	Top	10101389
400 - 2000A, Type E & M, 3-pole, fixed, ANSI/UL	Top	10101394
2000A, Type N & H, 3-pole, fixed, ANSI/UL	Top	10101390
2500 - 3200A, Type N, E & M, 3-pole, fixed, ANSI	Top	10101396
2500 - 3000A, Type N, H & M, 3-pole, fixed, UL	Top	10101395
3000 - 4000A, Type B, M & L, 3-pole, fixed, ANSI/UL	Top	10101399
5000 - 6000A, Type M, B & L, 3-pole, fixed, ANSI/UL	Top	10101398
400 - 2000A, Type N & H, 3-pole, front access, UL	Top	10101452
3000A, Type E & M, 3-pole, front access, UL	Top	10101453
6000A, Type B & L, 3-pole, front access, UL	Top	10101454
400 - 1600A, Type N & H, 4-pole, drawout, ANSI/UL	Side	10101456
400 - 1600A, Type E & M, 4-pole, drawout, ANSI/UL	Top	10101471
2000A, Type N & H, 4-pole, drawout, ANSI/UL	Side	10101457
2000A, Type E & M, 4-pole, drawout, ANSI/UL	Top	10101462
2500 - 3200A, Type N, E & M, 4-pole, drawout, ANSI	Top	10101464
2500 - 3000A, Type N, H & M, 4-pole, drawout, UL	Top	10101463
3000 - 6000A, Type B, M & L, 4-pole, drawout, ANSI/UL	Top	10101458
400 - 1600A, Type N & H, 4-pole, fixed, ANSI/UL	Top	10101460
400 - 2000A, Type E & M, 4-pole, fixed, ANSI/UL	Top	10101465
2000A, Type N & H, 4-pole, fixed, ANSI/UL	Top	10101461
2500 - 3200A, Type N, E & M, 4-pole, fixed, ANSI	Top	10101467
2500 - 3000A, Type N, H & M, 4-pole, fixed, UL	Top	10101466
3000 - 4000A, Type B, M & L, 4-pole, fixed, ANSI/UL	Top	10101468
5000 - 6000A, Type M, B & L, 4-pole, fixed, ANSI/UL	Top	10101469
400 - 2000A, Type N & H, 4-pole, front access, UL	Top	10101474
3000A, Type E & M, 4-pole, front access, UL	Top	10101475
6000A, Type B & L, 4-pole, front access, UL	Top	10101476
Door Cutout Detail for a Fixed Breaker		10101498
Door Cutout Detail for a Drawout Breaker		10101499
400 - 1600A, Type N & H, 3-pole, drawout, ANSI/UL, Top Mounted Secondary Disconnects	Top	10101848
2000A, Type N & H, 3-pole, drawout, ANSI/UL, Top Mounted Secondary Disconnects	Top	10101849
400 - 1600A, Type N & H, 4-pole, drawout, ANSI/UL, Top Mounted Secondary Disconnects	Top	10101850
2000A, Type N & H, 4-pole, drawout, ANSI/UL, Top Mounted Secondary Disconnects	Top	10101851
400 - 3200A, Type N, E & M, 3-pole, Fixed Breaker, ANSI without rear terminal adaptors	Top	10110735
800 – 3000A, Type M, 3-Pole, Fixed UL489B Switch	Top	10102173PV3
800 – 3000A, Type M, 4-Pole, Fixed UL489B Switch	Top	10102173PV4

Section 7.
Physical data

Description	Mounting Location of Secondary Disconnect	Assembly #
800 - 4000A, Type U, 3-pole, fixed, ANSI/UL	Top	10114225
800 - 4000A, Type U, 3-pole, Drawout, ANSI/UL	Top	10114226
800 - 4000A, Type U, 3-pole, Front access, UL	Top	200059613
3000 - 6000A, Type W, 3-pole, Drawout, ANSI/UL	Top	10112605
3000 - 6000A, Type W, 4-pole, Drawout, ANSI/UL	Top	10112606

Note: For latest drawings (including those for Type S and P), visit www.geindustrial.com.

Dimensions & weights

Table 7.2 3-pole, UL/ANSI

Type	Design	Width		Depth		Height		Weight	
		in.	mm	in.	mm	in.	mm	lbs.	kg
Envelope 1, Top Mounted, UL/ANSI	Fixed breaker – back connected	13.50	343	17.17	436	17.40	442	136.7	62
	Drawout breaker - Moving portion	13.07	332	16.34	415	17.24	438	149.9	68
	Cassette/substructure	13.50	343	20.83	529	17.44	443	110.2	50
Envelope 1, Side Mounted, UL/ANSI	Fixed breaker – back connected	16.14	410	17.17	436	15.98	406	136.7	62
	Drawout breaker - Moving portion	15.35	390	16.34	415	15.83	402	149.9	68
	Cassette/substructure	15.83	402	20.83	529	15.98	406	110.2	50
Envelope 2, Up to 2000A, UL/ANSI	Fixed breaker – back connected	17.17	436	17.17	436	17.40	442	165.3	75
	Drawout breaker - Moving portion	17.01	432	16.34	415	17.24	438	176.4	80
	Cassette/substructure	17.44	443	20.83	529	17.44	443	114.6	52
Envelope 2, Up to 3000A, UL	Fixed breaker – back connected	17.17	436	22.17	563	17.40	442	253.5	115
	Drawout breaker - Moving portion	17.01	432	16.34	415	17.24	438	209.4	95
	Cassette/substructure	17.44	443	26.14	664	17.44	443	231.5	105
Envelope 2, Up to 3200A, ANSI	Fixed breaker – back connected	17.17	436	22.17	563	17.40	442	275.6	125
	Drawout breaker - Moving portion	17.01	432	16.34	415	17.24	438	209.4	95
	Cassette/substructure	17.44	443	26.14	664	17.44	443	246.9	112
Envelope 2.5, Up to 4000A UL/ANSI	Fixed breaker – back connected	24.86	631.5	22.16	562.8	17.38	442	372.5	169
	Drawout breaker - Moving portion	24.7	627.5	16.34	415	17.24	438	271.1	123
	Cassette/substructure	25.14	638.5	26.14	664	20.47	520	282.1	128
Envelope 3, Up to 4000A, ANSI/UL	Fixed breaker – back connected	28.98	736	17.17	436	17.40	442	286.6	130
Envelope 3, Up to 5000A ANSI/6000A UL	Fixed breaker – back connected	28.98	736	22.17	563	17.40	442	463.0	210
Envelope 3, All Ratings	Drawout breaker - Moving portion	28.82	732	16.34	415	17.24	438	330.7	150
	Cassette/substructure	29.25	743	26.14	664	17.44	443	396.8	180

Table 7.3 4-pole, UL/ANSI

Type	Design	Width		Depth		Height		Weight	
		in.	mm	in.	mm	in.	mm	lbs.	kg
Envelope 1, Top Mounted, UL/ANSI	Fixed breaker – back connected	17.44	443	17.17	436	17.40	442	180.8	82
	Drawout breaker - Moving portion	17.01	432	16.34	415	17.24	438	198.4	90
	Cassette/substructure	17.44	443	20.83	529	17.44	443	143.3	65
Envelope 1, Side Mounted, UL/ANSI	Fixed breaker – back connected	20.08	510	17.17	436	15.98	406	180.8	82
	Drawout breaker - Moving portion	19.29	490	16.34	415	15.83	402	198.4	90
	Cassette/substructure	19.76	502	20.83	529	15.98	406	143.3	65
Envelope 2, Up to 2000A, UL/ANSI	Fixed breaker – back connected	22.28	566	17.17	436	17.40	442	220.5	100
	Drawout breaker - Moving portion	22.13	562	16.34	415	17.24	438	242.5	110
	Cassette/substructure	22.56	573	20.83	529	17.44	443	154.3	70
Envelope 2, Up to 3000A, UL	Fixed breaker – back connected	22.28	566	22.17	563	17.40	442	330.7	150
	Drawout breaker - Moving portion	22.13	562	16.34	415	17.24	438	275.6	125
	Cassette/substructure	22.56	573	26.14	664	17.44	443	308.6	140
Envelope 2, Up to 3200A, ANSI	Fixed breaker – back connected	22.28	566	22.17	563	17.40	442	363.8	165
	Drawout breaker - Moving portion	22.13	562	16.34	415	17.24	438	275.6	125
	Cassette/substructure	22.56	573	26.14	664	17.44	443	330.7	150
Envelope 3, Up to 4000A, ANSI/UL	Fixed breaker – back connected	38.03	966	22.17	563	17.40	442	385.8	175
Envelope 3, Up to 5000A ANSI/6000A UL	Fixed breaker – back connected	38.03	966	22.17	563	17.40	442	617.3	280
Envelope 3, All Ratings	Drawout breaker - Moving portion	37.87	962	16.34	415	17.24	438	440.9	200
	Cassette/substructure	38.31	973	26.14	664	17.44	443	529.1	240

Section 8.
Standards and references

Organizations

Underwriters Laboratories® (UL)
UL 489 and UL 489-SB2 - Standard for Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 1066 - Standard for Safety Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

Order from:
UL Publication Stock
333 Pfingsten Road
Northbrook, IL 60062 USA

National Electrical Manufactures Association (NEMA)
AB-1/2002 Standards Publication - Molded Case Circuit Breakers and Molded Case Switches
SG3/1995 - Standards and Ratings for the Application of Low-Voltage Power Circuit Breakers
SG5/1995 – Power Switchgear Assemblies

Order from:
NEMA Publication
155 East 44th Street
New York, NY 10017 USA

Canadian Standards Association (CSA)
CSA 22.2 NO 5.1 – Standards for Branch Circuit Protection

Order from:
Canadian Standards Association
178 Rexdale Blvd.
Rexdale, Ontario, Canada M9WR3

Institute of Electrical and Electronics Engineers (IEEE)
IEEE 693 – Recommended Practices for Seismic Design of Substations

Order from:
IEEE
345 East 47th Street,
New York, NY 10017 USA

American National Standard Institute (ANSI)
ANSI C37.13/1990 - Low-Voltage AC Power Circuit Breaker Used in Enclosures (600-Volt Insulation Class)

ANSI C37.16/2000 - Recommendations for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors, Preferred Ratings, Related Requirements, and Application

ANSI C37.17/1990 - American National Standard for Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers

ANSI C37.20.1/2000 - Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
ANSI C37.50/1989 (R1995) – Test Procedures for Low-Voltage AC Power Circuit Breakers Used in Enclosures

ANSI/IEEE C37.90.1/1993 - IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

ANSI/IEEE C37.90.2/1993 - Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceiver

Order from:
ANSI
11 West 42nd Street,
New York, NY 10036 USA

International Electrotechnical Committee (IEC)
IEC 60947-1 (Ed. 4/2004) - Electrical Equipment for Low Voltage, High Power Switching Equipment (Also applies to Electromagnetic Compatibility

IEC 60947-2 (Ed. 4/2006) - Electrical Equipment for Low Voltage, High Power Switching Equipment (Also applies to Electromagnetic Compatibility

IEC 60947-3 (Ed. 4, Am 1, Am 2/2002) - Electrical equipment for Low voltage, high power switching equipment (Also applies to Electromagnetic Compatibility

IEC 68-2-1 (Am 1/1993) – Environmental Testing Standards/Dry Cold at –55°C Operational Tem perature

IEC 68-2-2 (Am 1/1993) – Environmental Testing Standards/Dry Heat at +85°C Operational Temperature

IEC 68-2-30 - (Am 1/1985) – Environmental Testing Standards/Operational Temperature and Humidity (temp. +55°C, rel. humidity 95%)

IEC 68-2-52 Level 2 - (Am 1/1996) – Environmental Testing Standards/Salt Mist-Corrosion

IEC 801-2 2nd Edition 1991-04 - Electromagnetic Compatibility for Industrial-Process, Measurement and Control Equipments
Part 2: Electrostatic Discharge Requirements

Order from:
Bureau Central de la Commission
Electrotechnique Internationale
3 rue de Varamb'e Geneve, SUISSE

National Electrical Code®
Order from:
National Fire Protection Association
Batterymarch Park
Quincy, MA 02269 USA

American Society for Testing and Materials (ASTM)
ASTM B117-73 (Reapproved 1979)
Standard Method of Salt Spray (Fog) Testing

Order from:
ASTM
1916 Race Street Philadelphia,
PA 19103 USA

Military Standard (MIL-STD)
MIL-STD-810E - Environmental Test Methods and Engineering Guidelines

Order from:
Defense Printing Service
700 Robbins Avenue,
Bldg. 4D
Philadelphia, PA 19111-5094 USA

Seismic Qualifications to All Major Building Code Standards
IBC - International Building Code
UBC - Uniform Building Code
BOCA – Building Officials and Code Administrators
CBC – California Building Code
SBC – Standard Building Code

Other
IEC Environmental: 68-2-1,-2,-3,-6,-11,-14,-14,-27,-29,-30,-31

IEC Environmental: 721

Lloyds Register of Shipping, Germanischer Lloyds, ABS (American Bureau of Shipping)

European ROHS Directives

GE Consumer & Industrial Engineering Test Procedures (ETPs) and Standing Instructions (S.I.s)
Standing Instructions (S .I .s): S.I. 900001S001 - Program Technical Review Discipline

Section 8.
Standards and references

EntelliGuard G Publications

To download publications like those shown below, visit www.geindustrial.com

Publications	Pub #
EntelliGuard G IOM	DEH-41304
Time Current Curves: EntelliGuard TU Trip Unit for EntelliGuard G; Long-Time Circuit Breaker Characteristics	DES-090
Time Current Curves: EntelliGuard TU Trip Unit for EntelliGuard G; Long-Time Fuse-Like Characteristics	DES-091
Time Current Curves: EntelliGuard TU Trip Unit for EntelliGuard G; Short-Time Pickup and Delay Bands	DES-092
Time Current Curves: EntelliGuard TU Trip Unit for EntelliGuard G; Ground Fault	DES-093
Time Current Curves: EntelliGuard TU Trip Unit for EntelliGuard G; Instantaneous, Override (HSIOC), Reduced Energy Let-Through Instantaneous (RELT)	DES-094
Guide to Instantaneous Selectivity	DET-760
Undervoltage Release User Manual	DEH-41361
Time Delay Module User Manual	DEH-41362
Motor Operator User Manual	DEH-41366
Electrical Close Switch	DEH-41374
Spring Charge Contact	DEH-41375
Castell Lock Kit	DEH-41376
Door Interlock User Manual	DEH-41377
Cassette Ronis Lock User Manual	DEH-41380
Contact Wear Indicator User Manual	DEH-41382
Wall Mounting Kit	DEH-41383
IP54 Door	DEH-41384
Escutcheon Kit	DEH-41386
Arcing Contacts Assembly	DEH-41390
Racking Handle	DEH-41392
Cluster Contacts User Manual	DEH-41394
Cluster Pliers Assembly	DEH-41395
Secondary Disconnects - Drawout	DEH-41401
CT Mounting for External Ground Fault	DEH-41402
Position Switch Kit	DEH-41403
Back Connected Terminations	DEH-41404
Front Connected Terminations	DEH-41405
Time Delay Module	DEH-41406
Key Interlock Kit - Breaker Mounted	DEH-41407
Door Interlock Kit	DEH-41408
Bell Alarm w/ Lockout	DEH-41409
Undervoltage Device	DEH-41410
Shunt Trip	DEH-41411
Remote Close Accessory Close Coil	DEH-41412
Motor Operator	DEH-41413
Pushbutton Padlock Device	DEH-41414
Aux Switch	DEH-41415
Operations Counter	DEH-41416

Publications	Pub #
Secondary Disconnects - Fixed	DEH-41417
Command Close Coil	DEH-41418
Ready To Close (RTC)	DEH-41419
Coil Signaling Contacts	DEH-41420
Back Connected Terminations for Cassette	DEH-41430
	DEH-41431
	DEH-41433
	DEH-41434
	DEH-41437
Back Connected Terminations for Breaker	DEH-41439
	DEH-41440
	DEH-41441
	DEH-41442
	DEH-41443
	DEH-41444
	DEH-41445
	DEH-41608
Contact Wear Indicator	DEH-41446
Cluster pad Assembly	DEH-41447
	DEH-41448
	DEH-41449
	DEH-41450
Mechanical Interlocks (Fixed)	DEH-41451
Mechanical Interlocks (Drawout)	DEH-41455
Cassette Interlock User Manual	DEH-41459
Clusters	DEH-41460
Flat Front Termination ANSI/UL	DEH-41463
Remote Racking Operator	DEH-41467
Key Interlock Casste Mounted	DEH-41500
CVCB Coil Signal Status	DEH-41517
Neutral Sensor Kit – Rogowski	DEH-41387
24 Vdc Power Supply	GEH-6492
Arc Chute Kit	DEH-41389
Earthing Device Kit	DEH-41379
EntelliGuard TU Rating Plugs	DEH-41318
Anti-Bounce System	DEH-41667
Gas Channel Assembly	DEH-41668
EntelliGuard TU Lock Out Kit Installation	DEH-41688
EntelliGuard TU Test Kit	DEH-4568
EntelliGuard TU Trip Unit IOM	DEH-4567

Notes:

Notes:

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