

EntelliGuard® G Power Circuit Breaker

Application Guide



imagination at work

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EntelliGuard® G Power Circuit Breaker

Section 1. Introduction

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, CSA, IEC, Lloyds Register of Shipping, etc.).

Breakers are available in 3 and 4 pole designs from 400A to 6400A (IEC) with fault interruption ratings up to 150kAmps. 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 breaker-trip unit system delivers superior circuit protection without compromising selectivity or arc flash protection. The EntelliGuard system is yet another evolution of GE's core competencies in reliable electric power distribution, circuit protection and safety.

EntelliGuard G breakers are the standard in GE AKD-20 Low Voltage Switchgear. The breakers are suitable for 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.

**ANSI® Certified
Low-Voltage
Power Circuit
Breaker**
C3-7.13
C3-7.16
C3-7.17
C3-7.20
C3-7.50
UL 1066
NEMA SG3&5

**UL® Listed
Insulated Case
Circuit Breaker**
UL 489
NEMA AB1
CSA 22.2 NO 5.1

**IEC® Rated
Circuit Breaker**
IEC 60947-1
IEC 60947-2
IEC 60947-3

IEC® Extreme Atmospheric Conditions
IEC 68-2-1: Dry cold at -55°C
IEC 68-2-2: Dry heat at +85°C
IEC 68-2-30: Damp heat (temp. +55°C,
rel. humidity 95%)
IEC 68-2-52 Level 2: Salt mist

EntelliGuard G devices are available in all standard, 100% rated, ANSI, UL and IEC ratings in both fixed and draw-out 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, and all configurations can be manually or electrically operated with multiple and redundant accessories (optional).

Device Ratings (Amperes)

Standard	Current Range (A)		
	Envelope 1 (N, H)	Envelope 2 (E, M)	Envelope 3 (B, L)
ANSI/UL	400 - 2000	2000 - 3200	3200 - 5000

EntelliGuard G short circuit & interrupting ratings

ANSI/UL1066

Interrupting Rating Tier ANSI/UL1066 Devices, LVPCB					Envelope 1	Envelope 2		Envelope 3	
Type	240V	480V	600V	1/2S Withstand	400-2000	3200	400-3200	3200	4000-5000
N	65,000	65,000	65,000	65,000	X	X			
H	85,000	85,000	65,000	65,000	X				
E	85,000	85,000	85,000	85,000			X		
M	100,000	100,000	85,000	85,000			X		X
B	100,000	100,000	100,000	100,000				X	X
L	150,000	150,000	100,000	100,000				X	X

UL489

Interrupting Rating Tier UL489 Devices, ICCB					Envelope 1	Envelope 2		Envelope 3		
Type	240V	480V	600V	1/2S Withstand	400-2000	2500-3000	400-3000	3000	4000	5000-6000
N	65,000	65,000	65,000	42,000	X	X				
H	85,000	85,000	65,000	50,000	X	X				
M	100,000	100,000	85,000	65,000			X		X	
L	150,000	150,000	100,000	85,000				X	X	X

Non-Automatic Circuit Breaker – ANSI Version

Envelope	Type	Amps	Rated Interrupting Current	Rated Endurance		
				Minimum Mechanical Endurance	Minimum Electrical Endurance at 480V	Minimum Electrical Endurance at 600V
1	N	800	42	12,500	10,000	7,500
1	N	1600	42	12,500	10,000	7,500
1	N	2000	42	12,500	7,500	5,000
2	H	3200	65	5,000	5,000	5,000
3	L	4000	100	5,000	3,000	2,000
3	L	5000	100	5,000	2,000	1,500

NOTE: GE internal quality testing requirements exceeded 20,000 mechanical operations.

Non-Automatic Circuit Breaker/Molded Case Switch – UL Version

Envelope	Type	Amps	Short Interrupting Current	Rated Endurance		
				Minimum Mechanical Endurance	Minimum Electrical Endurance at 480V	Minimum Electrical Endurance at 600V
1	N	800	42	12,500	10,000	7,500
1	N	1600	42	12,500	10,000	7,500
1	N	2000	42	12,500	7,500	5,000
2	H	3000	65	5,000	5,000	5,000
3	L	4000	100	5,000	3,000	2,000
3	L	5000	100	5,000	3,000	1,500
3	L	6000	100	5,000	2,000	1,000

NOTE: GE internal quality testing requirements exceeded 20,000 mechanical operations.

Type E = Sq. Rated (ICW = ICU) 400-2000A, 85kAIC @ 480/508V

Type B = Sq. Rated (ICW = ICU) 3200-6000A, 100kAIC @ 480/508V

Type N = 65kAIC @ 480/508/600/635V

Type H = 85kAIC @ 480/508V, 65kAIC @ 600/635V

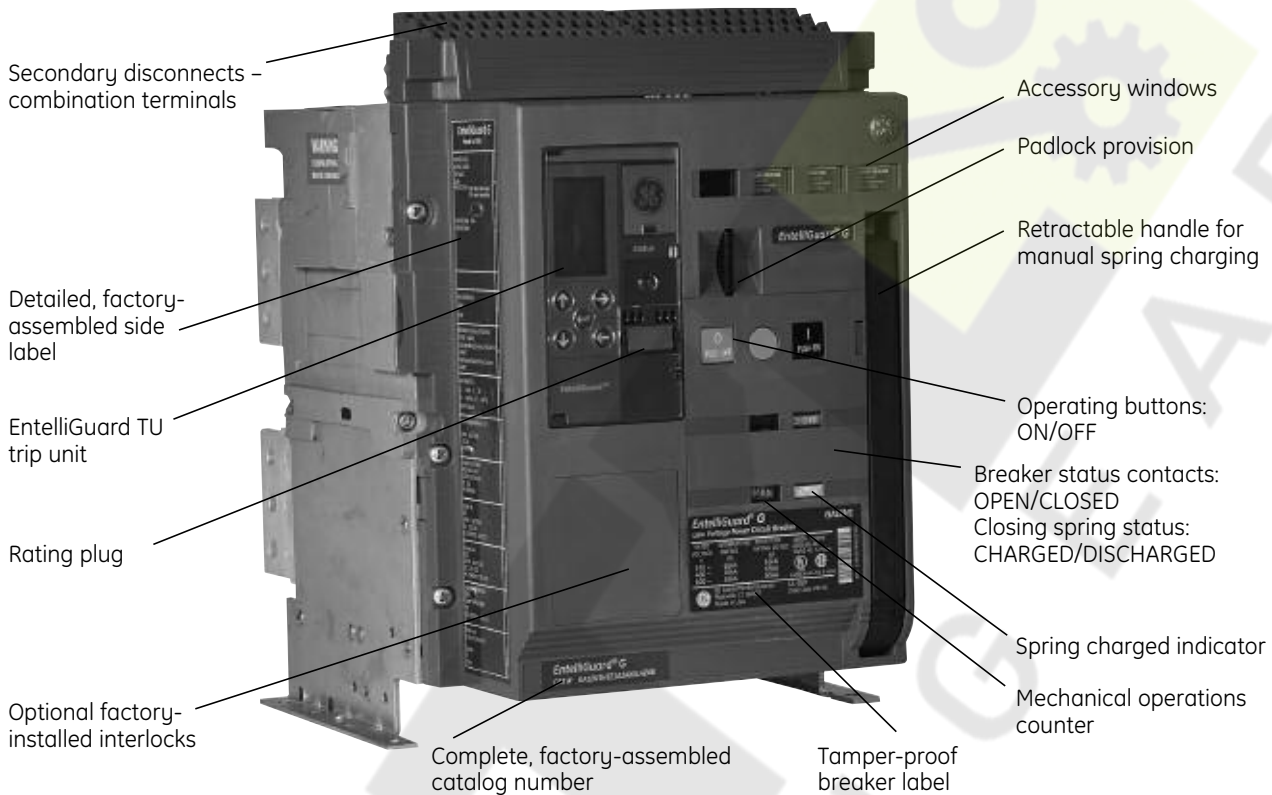
Type M = 100kAIC @ 480/508V, 85kAIC @ 600/635V

Type L = 150kAIC @ 480/508V, 100kAIC @ 600/635V

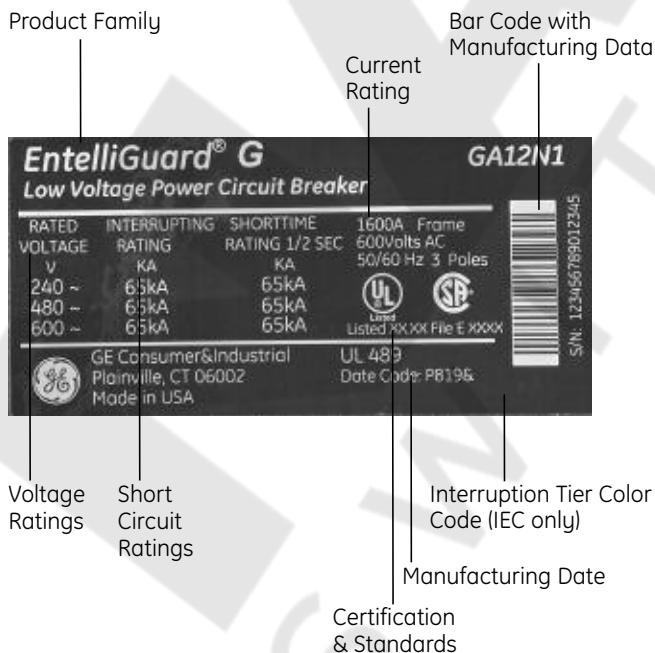
EntelliGuard G Power Circuit Breaker

Section 2. Features and Characteristics

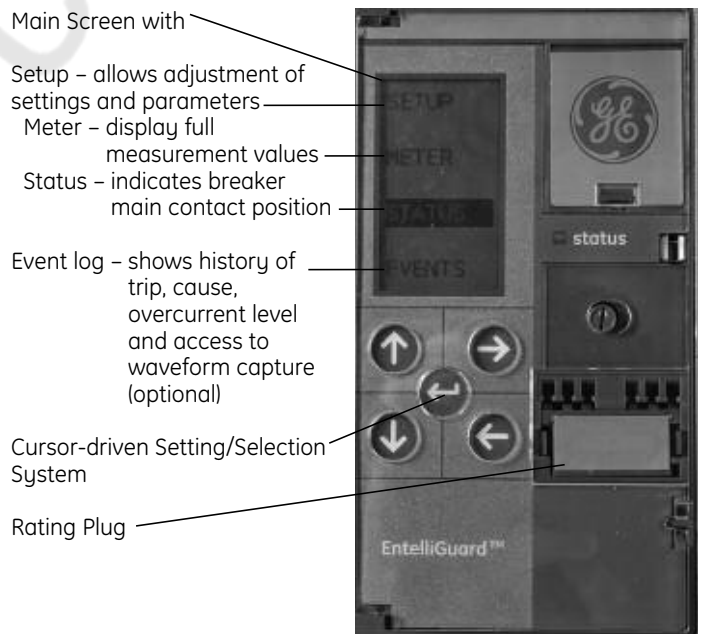
EntelliGuard G at a glance



Label



EntelliGuard TU Trip Unit



Standard and Optional Features

Short Time Rating

Up to 100kA for 1 sec

Short Circuit/High Interruption Rating

150kA@600v, 100kA@690v (IEC only)

Thermal Performance

ANSI C37 & UL 489 designs are 100% rated up to 40°C when applied in recommended enclosure sizes. IEC 60947 versions are 100% rated in free air up to 50°C. IP31 enclosure / switchboard rating is based on size, recommended up to 50°C ambient with rear vertical bus connection.

Standard	Current Range (A)		
	Envelope 1 (N, H)	Envelope 2 (E, M)	Envelope 3 (B, L)
ANSI/UL	400 - 2000	2000 - 3200	3200 - 5000

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 O-C-O cycle is possible without recharging. The breaker operating mechanism is a trip-free and may be furnished with an integrated anti-pumping system.

Field Installable Trip Units & Accessories

Field-installable accessories are common to all breaker envelopes.

Coils

EntelliGuard G devices have provisions for 4 coils. Two shunt trip coils or 2 UVR coils can be mounted along with closing coil. The closing coil is a "one-shot" electronic closed circuit. Shunt trip (ST) coils are continuous rated. Under voltage relays (UVR) are available with a fixed time delay (50mS @ 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 modules for the ST, CC and UVRs provide coil 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.

Electrical Closing Button

Located on the front cover; electrically closes breaker.

Ready to Close Indicator

Provides visible indication/readiness for close operation.

Mounting Straps/Accessories

Kits are available to mount and connect fixed/stationary breakers.

Thermal Sensing

One sensor per pole continuously monitors the temperature of the current path (optional). The temperature sensing function monitors breaker bus (phase) temperatures continuously at a range of 0°C–200°C. Temperature readings are available locally (trip unit LCD) or remotely (communications).

Auxiliary Switches (Optional)

4 available designs:

- Power contacts, 3NO & 3NC (standard/included)
- Power contacts, 8NO & 8NC
- Power contacts, 3NO & 3NC + high fidelity 2NO & 2NC
- Power contacts, 6NO & 6NC + high fidelity 2NO & 2NC

Interlocks

Standard interlocks include:

- Draw-out Breaker: prevents the breaker from being closed unless it is in the TEST or CONNECT positions
- Draw-out Breaker/Main Contacts: prevents withdrawal/removal of the breaker unless the main contacts are OPEN. Access to the draw-out 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 TEST to the DISCONNECT position. This prevents withdrawing a breaker from the cubicle with the closing springs charged. (Commonly referred to as “crash.”)

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 draw-out 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 to the POWER LEADER™ Power Management System.

Rejection Feature

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.

Though-door Racking

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

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 the breaker in either the TEST or DISCONNECT position with up to three padlocks.

Key Interlock

Up to 4 optional key interlocks are available (Kirk, Ronis, Profalux, Castel).

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, 6 single-pole changeover contacts).

Lifting truck

Optional lifting tool with separate slings is available for all breaker sizes.

IP Covers

Optional IP54 covers are available for all breaker sizes.

Mechanical Counter

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

Cable Interlocks

Available for fixed and draw-out 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.

EntelliGuard G Power Circuit Breaker

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 safety, 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's PowerBreak®, Power Break II, WavePro® and AKR circuit breakers. 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.

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 Safety

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 safety 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 Flash and the EntelliGuard TU Trip Unit

Reducing arc flash hazard is 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 use the system for years to come.

The EntelliGuard TU trip unit, 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.

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

Figure 3.1 demonstrates the wide range of possible arcing currents predicted by the IEEE standard's calculations. The actual range of arcing currents may be larger 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 pick up 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 the low arcing current.

Above downstream feeders

The EntelliGuard TU trip unit has multiple Short Time bands under 100 milliseconds 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.

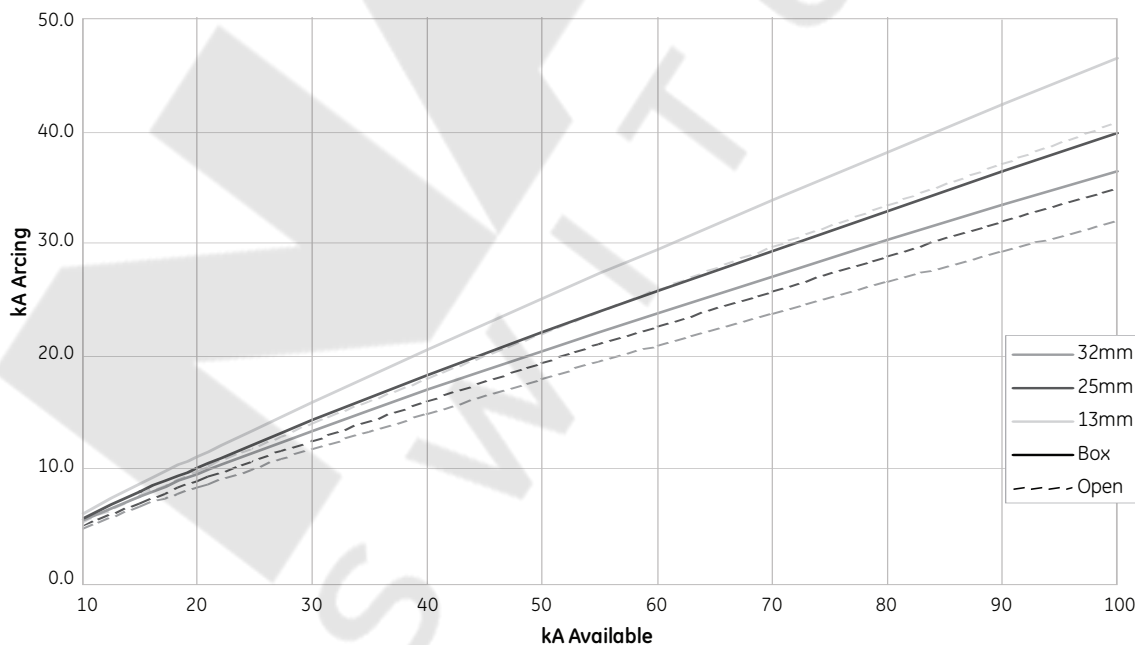
Also listed is the Hazard Risk Category for various available fault currents calculated at the listed Short Time band clearing times and Instantaneous clearing times provided by the EntelliGuard TU trip unit's Adjustable Selective Instantaneous and its Reduced Energy Let-Through (RELT) Instantaneous trip. The Hazard Risk Category (HRC) levels shown are calculated for a solidly grounded, 480-volt system, 32mm arc gap, 18" 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 Adjustable Selective

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% pick up tolerance in the Instantaneous pick up 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 90kA available – excellent arc flash protection and selectivity!

Figure 3.1



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 or HRC in a power distribution system, an Arc Flash Study should be conducted by engineering personnel qualified to provide such analysis.

Above Other Power Circuit Breakers

Using the EntelliGuard TU trip unit’s unique Instantaneous Zone Selective Interlocking (ZSI), the main circuit breaker also can be set to interrupt selectively for faults in its zone of protection. However, the pick up level must be nested to prevent a nuisance trip at the main. Allowing for a 10% tolerance in the pick up 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 that, in a system with fault currents from 25kA to 90kA, the feeder and main circuit breaker will provide protection at HRC1 or HRC2 selectively. To this capability one can add the RELT setting that provides more sensitive and faster protection when needed.

Flexibility

The EntelliGuard TU was designed with solution flexibility from the start. Examples of this flexibility can be seen in some of its key capabilities and characteristics, including:

- Availability to choose two different industry-recognized open protocols – Modbus RTU or Profibus DP – that almost any building management, power management or process software can use. No closed protocols, no proprietary software, only flexibility to create the right solution for each system’s needs.
- The industry’s only universal spare trip unit (patent pending). An EntelliGuard TU Universal Spare Trip Unit can be installed in any EntelliGuard G circuit breaker, regardless of frame size, sensor size, short circuit rating or even if the circuit breaker is a UL, ANSI or IEC model. Upon powering of the trip unit, it automatically knows in what circuit breaker it is installed and automatically acquires that device’s personality.
- The industry’s only universal trip rating plug. Any rating plug can be installed in any circuit breaker within the acceptable sensor range. In other words, for a specific rating, only one plug is necessary,

Table 3.1

GE Molded Case Circuit Breaker Family	Circuit Breaker Type ¹	Minimum EntelliGuard TU Short Time Band	Clearing Time	480V, in box, 32mm HRC @ lbf=					
				35kA	42kA	50kA	60kA	75kA	90kA
FB, FC, TEY & THQL	TM-LP	0.025	0.080	2	2	2	2	3	3
TED, TEC	TM-GP & MCP	0.025	0.080	2	2	2	2	3	3
TF, TJ, TK	TM-GP	0.025	0.080	2	2	2	2	3	3
Spectra E, F & G Frame	E-GP	0.025	0.080	2	2	2	2	3	3
Spectra K Frame	E-GP	0.033	0.088	2	2	2	3	3	3
Spectra with MVT, G & K Frame	AE-GP	0.025	0.080	2	2	2	2	3	3
Record Plus G Frame	E & AE-GP	0.042	0.097	2	2	3	3	3	3
Record Plus E Frame	E-GP	0.033	0.088	2	2	2	3	3	3
Power Break with MVT	AE-GP	0.058	0.113	2	3	3	3	3	3
Instantaneous Clearing Time			0.050	1	2	2	2	2	2
RELT Clearing Time			0.042	1	2	2	2	2	2

¹ TM = Thermal Magnetic
 E = Electronic
 AE = Adjustable Electronic
 LP = Lighting Panel Application
 GP = General Purpose Application
 MCP = Motor Circuit Protection Application

Section 3. EntelliGuard TU Trip Unit System

whether it used for a retrofit kit on a 20 year old ANSI circuit breaker or for a new production EntelliGuard G circuit breaker.

- Traditional fuse shaped curves and thermal circuit breaker type curves are now available. Regardless of what mix of protective devices your system includes – electronic trips, thermal magnetic circuit breaker or fuses – the EntelliGuard TU has the right curve shape to fit your system’s needs.
- Ground Fault
- Short Time bands every 1/2 cycle where you need them to optimize selectivity without sacrificing any more protection than absolutely necessary.
- The industry’s only true Zone Selective Interlocking (ZSI) that works for Ground Fault, Short Time and Instantaneous; with the ability to set the exact clearing time of each circuit breaker when restrained or unrestrained.
- A special Instantaneous algorithm that provides the ability to use standard protection and simultaneously achieve selectivity while providing the highest possible response and clearing. This Instantaneous algorithm can be combined with the ability to set an alternate Instantaneous setting for maximum protection only when most

needed, thus providing arc flash hazard control while preserving complete selectivity.

Terms

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 pick up 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.

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 UL 489 CBs this is fixed, in UL 1066 CBs this may vary, if present at all.

MCR: Making Current Release (MCR). A setting provided with each trip unit, based on the specific circuit breaker size, used to protect the circuit

Figure 3.2
Maximum & Minimum Long Time Delay Bands
for a 1000A Long Time Pickup

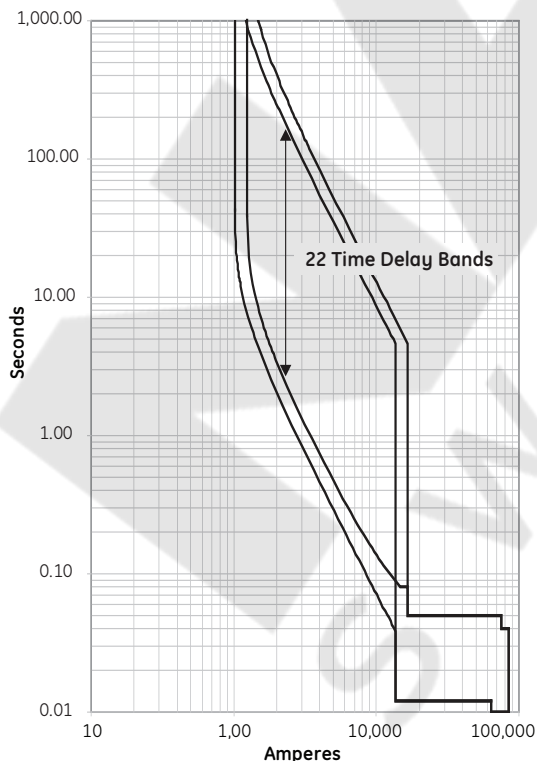
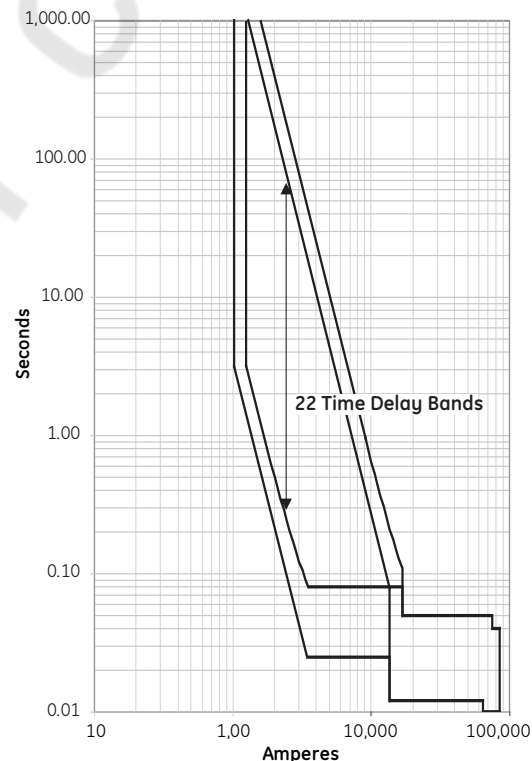


Figure 3.3
Maximum & Minimum Long Time Delay Bands
for a 1000A Long Time Pickup



Section 3. EntelliGuard TU Trip Unit System

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.

I_{cw}: *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.

I_{cu}: *Short Circuit Interrupting Rating (I_{sc})*, or ultimate interrupting rating (*I_{cu}*) in IEC terms. The maximum short-circuit interrupting rating of a circuit breaker in amperes.

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 curves and fuse shaped I⁴T straight lines.

Long Time pickup is computed from the trip rating plug value (*I_n*) multiplied by the Long Time pickup

setting. Long Time pickup setting multipliers are user settings and may range from 0.05 to 1.0 in increments of 0.05.

The actual Long Time pick up is 112% of the nominal setting (*I_r*). The Long Time pick up has 10% tolerance that is drawn as “actual value/(1± tolerance)”. For a nominal 1000A Long Time pick up, 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 3.2. 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.

Table 3.2
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 0.08 seconds.
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.

Fuse Shaped Steep Long Time Overcurrent

The optional steeper fuse characteristic is a straight line $K=I^2t$ 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 3.3 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 pick up.

Drawn bands also include a 30 millisecond 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.

Thermal Memory

The Long Time and Short Time pick up algorithm also includes a cooling cycle that keeps track of current if it oscillates in and out of pick up 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 battery. The cooling algorithm requires up to 14 minutes to fully reset to zero.

Short Time Protection

Short Time Pick up

The EntelliGuard TU provides a very wide range of Short Time pickup settings, I^2t slopes 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 pick up setting for the EntelliGuard G circuit breakers in Envelopes 1 and 2. The maximum Short Time pick up for Envelope 3 is 10. In Power Break, WavePro, AKR and other circuit breakers, the maximum Short Time pick up may be lower.

Depending on how fast or what type of Long Time band is chosen, what Short Time pick up is selected and what Short Time delay is selected, the transition

Table 3.3
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 0.08 seconds.
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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between Long Time band and Short Time function may happen at the horizontal Short Time Delay Band rather than the vertical Short Time pick up. An example of this may be seen in Figure 3.4.

For the combination of Long Time Delay Band and Short Time Delay Band shown in Figure 3.5, any Short Time pick up setting larger than 6X will result in the Long Time band intersecting with the horizontal Short Time delay band rather than the vertical Short Time pick up.

Short Time Bands

The EntelliGuard TU comes with a wide range of adjustable Time Delay Bands, ranging from a minimum of 25 milliseconds (clears in 80mS) to 417 milliseconds (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 best possible arc flash protection.

The time bands may be seen in Table 3.4 and Figure 3.6.

Table 3.4
Short Time Delay Bands

Label	Pick Up	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

Short Time I²t Slopes

The EntelliGuard Trip Unit offers three different Short Time I²t slopes 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 slope is equal to the Short Time I²t slope in the MVT trip.

The position of the I²t slopes varies with the Long Time pick up of the respective circuit breaker. The

Figure 3.4

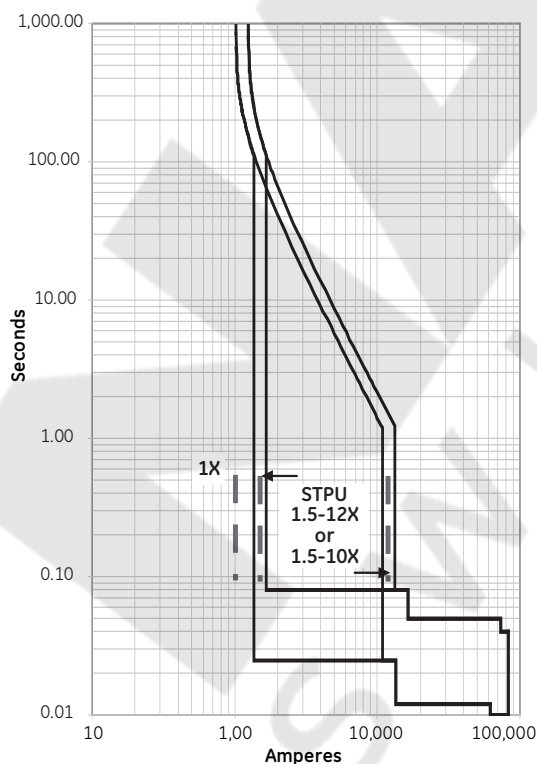
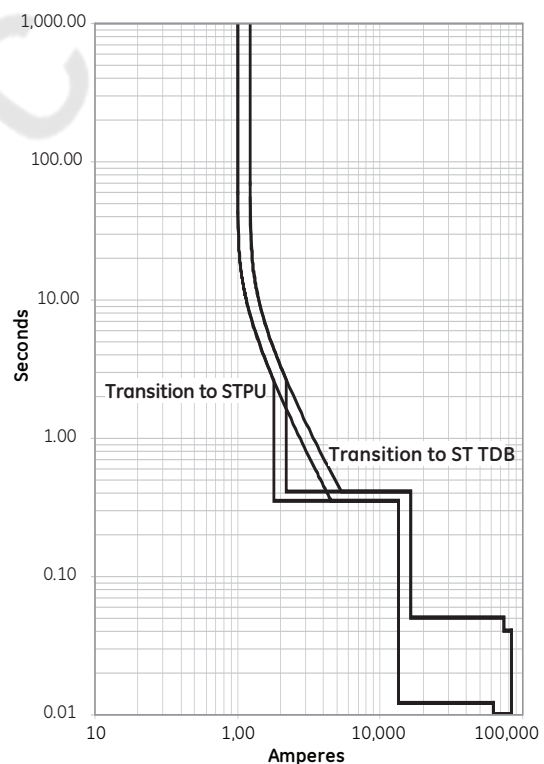


Figure 3.5



intersection of the Short Time pick up and the Short Time delay band with the I^2t slope varies with the Short Time pick up and time delay band.

The three positions for the Short Time I^2t band may be seen in Figure 3.7. The slopes may be defined by the formula $K = I^2t$, where K equals 18, 8 and 2 times the nominal Long Time pick up, squared. A 30 millisecond fixed time is added to account for circuit breaker mechanical operation, clearing time and variance. Pick up tolerance is 10% of current.

The maximum (upper) Short Time I^2t 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 I^2t bands. Only the definite time Short Time pick up 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. 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.

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 10 meters or 33 feet.

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

Figure 3.6

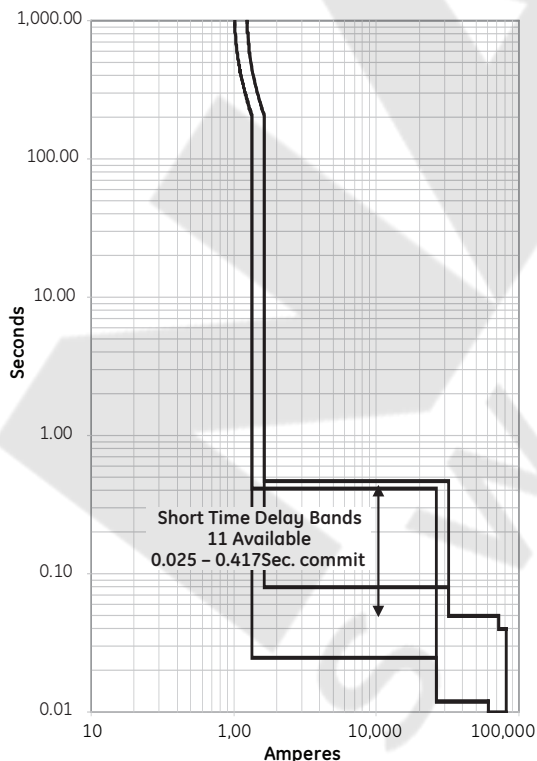
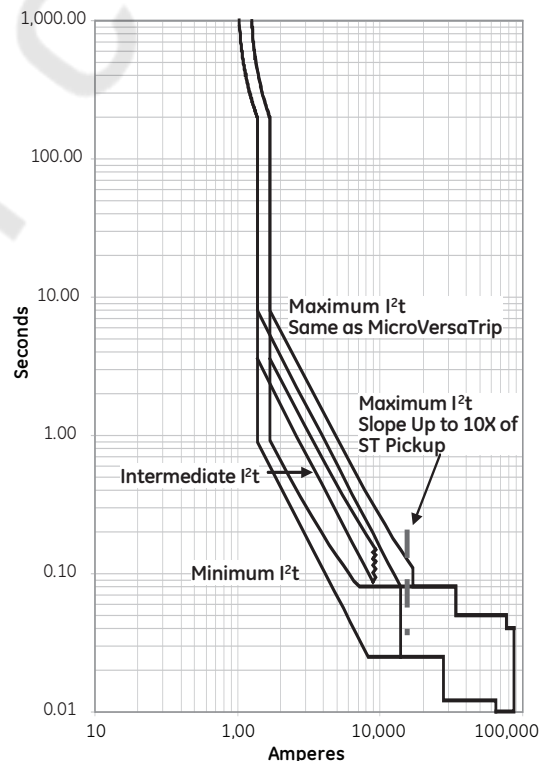


Figure 3.7



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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. For multiple source connection schemes and diagrams, see the Appendix.

Ground Fault Pick Up Settings

All UL 489 and UL 1066 circuit breakers are limited to a maximum nominal pick up setting of 1200 amperes per the National Electrical Code or 60% of the sensor size, whichever is lower. The minimum setting is 20% of sensor size. The available maximum settings per sensor may be seen in Table 3.5.

Ground Fault Time Delay Bands

Ground Fault Time Delay Bands used in the EntelliGuard G circuit breakers range from 42 milliseconds to 942 milliseconds. In Power Break I, Power Break II, WavePro and AKR circuit breakers, the minimum GF Time Delay Band is 58 milliseconds and the maximum is 417 milliseconds.

Table 3.5
Short Time Delay Bands

Sensor	Minimum	Maximum
400	0.2	0.60
600	0.2	0.60
800	0.2	0.60
1200	0.2	0.60
1600	0.2	0.60
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

Continuously adjusted in 0.01 increments.

Table 3.6
Minimum Pick Up and Clear Time

	Power Break I & II, AKR & WavePro	EntelliGuard G
Minimum Pick Up	0.058 Sec.	0.042 Sec.
Minimum Clear	0.113 Sec.	0.097 Sec.
Maximum Pick	0.417 Sec.	0.940 Sec.
Maximum Clear	0.470 Sec.	1.000 Sec.

The available minimum settings per circuit breaker type may be seen in Table 3.6. The maximum Time Delay Band setting for all circuit breakers is 0.940 seconds with a 1 second clear.

Ground Fault Sloped Bands

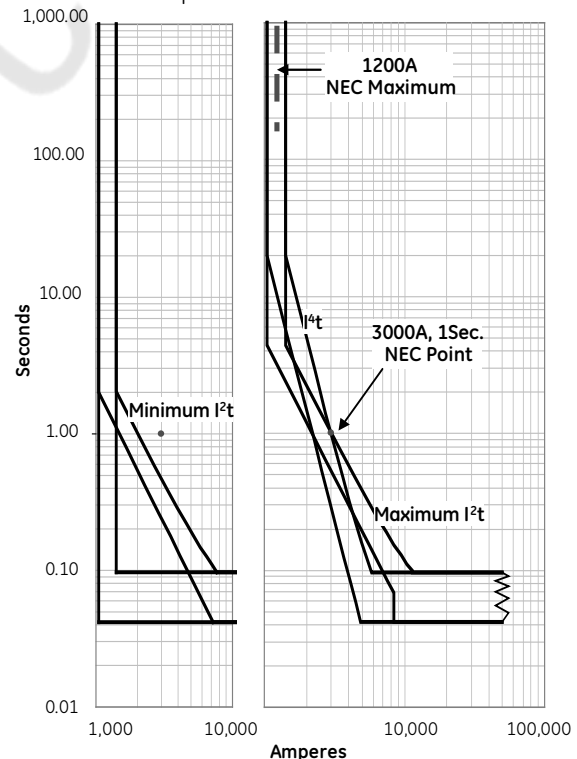
The Ground Fault function may be shaped as a definite time function (pick up and delay) or with one of two I^2t slopes or one I^4t slope. The I^4t slope provides easier selectivity with downstream fuses and may also facilitate selectivity with some circuit breaker curves. An 800A EntelliGuard G circuit breaker may be used under a 1200A GF setting selectively using the I^4t sloped GF characteristic. The dual I^2t slopes allow for optimized protection and maximum selective capability simultaneously.

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 II, WavePro, AKR and EntelliGuard G.
- *Extended Range Adjustable Selective Instantaneous:* An available option on ANSI EntelliGuard G circuit breakers.

Figure 3.8
Ground Fault Slopes



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- *High Set Instantaneous Overcurrent Trip*: Provided on Power Break II and some EntelliGuard G circuit breakers.
- *Making Current Release (MCR)*: Provided on all EntelliGuard G circuit breakers.
- *Reduced Energy Let-Through Instantaneous Trip*: An available option on Power Break II, WavePro, AKR 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 pick up 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-536.

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 891 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 pick up 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 pick up is limited by the circuit breaker's withstand rating.

The Adjustable Selective Instantaneous will clear a fault in 3 cycles when used in 60 Hz or 50 Hz applications. Zone Selective Interlocking (ZSI) may be used with this Instantaneous function, allowing several breakers with overlapping Instantaneous

Table 3.7

Maximum Adjustable Instantaneous Pick-up for EntelliGuard G CBs 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	Normal Range	Extended Range	Normal Range	Extended Range
150-2,000	15	N/A	15	N/A	15	30	15	30	15	30
2,200	N/A	N/A	15	N/A	15	28	15	30	15	30
2,400	N/A	N/A	15	N/A	15	25	15	30	15	30
2,500	N/A	N/A	15	N/A	15	24	15	30	15	30
3,000	N/A	N/A	15	N/A	15	20	15	26	15	30
3,200	N/A	N/A	N/A	N/A	15	19	15	25	15	29
3,600	N/A	N/A	N/A	N/A	15	17	15	22	15	26
4,000	N/A	N/A	N/A	N/A	15	15	15	20	15	23
5,000	N/A	N/A	N/A	N/A	N/A	N/A	15	16	15	19
6,000	N/A	N/A	N/A	N/A	N/A	N/A	13	N/A	N/A	N/A

Extended Rating only available in ANSI/UL1066 EntelliGuard G CB.
 6,000A Sensor only available in UL489 CB.
 42 & 50kA Withstand Tiers only available in UL489 CB.

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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. Figures 3.9 and 3.10 demonstrate the performance of the Instantaneous ZSI capability.

High Set Instantaneous Overcurrent (HSIOC)

The EntelliGuard TU Trip Unit’s High Set Instantaneous Overcurrent (HSIOC) pick up 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 a HSIOC trip function, the location of the HSIOC trip is shown by the line that reaches the 0.01 seconds axis at the bottom of the TCC. The location of that line is shown in Table 3.8.

In many applications, the EntelliGuard G circuit breaker with an EntelliGuard TU trip unit will be completely selective up to the HSIOC pick up or the circuit breaker’s full short circuit rating, even with the adjustable Instantaneous on.

Table 3.8

Short Circuit Tier	Interrupting Rating					UL489 Override	UL1066 Override
	240V	480V	600V	UL489 I _{cw}	UL1066 I _{cw}		
N	65,000	65,000	65,000	42,000	65,000	42,000	None
H	85,000	85,000	65,000	50,000	65,000	50,000	65,000
E	85,000	85,000	85,000	N/A	85,000	N/A	None
M	100,000	100,000	85,000	65,000	85,000	65,000	85,000
B	100,000	100,000	100,000	N/A	100,000	N/A	None
L	150,000	150,000	100,000	85,000	100,000	85,000	10,000

All UL Overrides are -0% tolerance, ANSI Override pickup at -0% or -9% based on Adjustable Selective Instantaneous being on or off.

Figure 3.9
Zone Selective Interlocked CB, Upper CB Shown “Unrestrained”

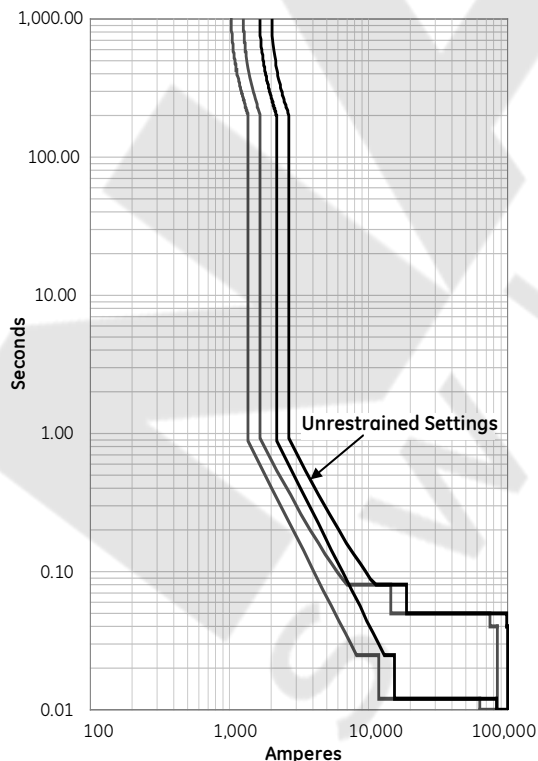
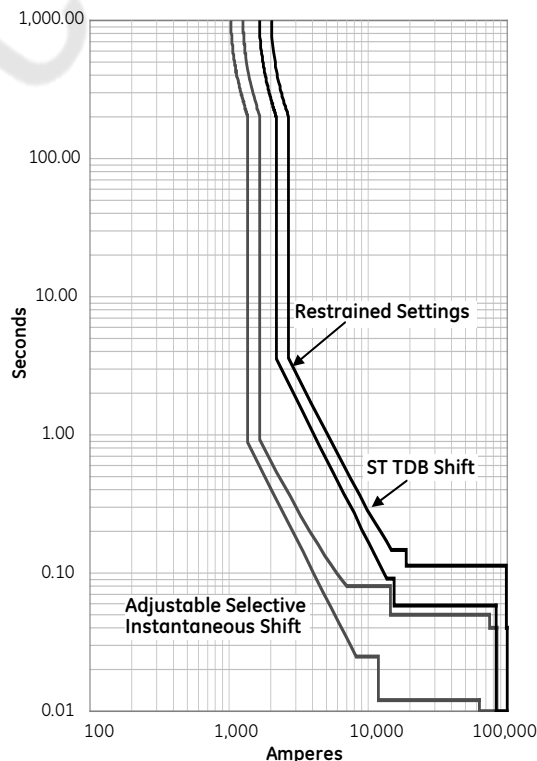


Figure 3.10
Zone Selective Interlocked CB, Upper CB Shown “Restrained”



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 Making Current Release (MCR) provides very fast protection when the circuit breaker is closed and for the first 6 cycles thereafter. After the 6 cycles have elapsed, the Making Current Release (MCR) is turned off and the circuit breaker reverts to its adjustable Instantaneous pick up and HSIOC if provided.

The Making Current Release (MCR) will clear fault current in 40 milliseconds or less.

Reduced Energy Let-Through (RELT) Instantaneous Trip

The EntelliGuard TU trip unit provides an optional second, user-adjustable, RELT Instantaneous trip. This trip provides an alternate Instantaneous setting that allows a user to temporarily set a circuit breaker to a more sensitive pick up to provide better protection, only when better protection is needed and some selectivity may be sacrificed. The RELT pick up 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 pick up to be enabled via application of 24vdc or ac 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 pick up 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 pick up 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 pick up clears fault current in 42 milliseconds or less.

RELT capability may be provided on a trip unit with or without control power. If 24 volts 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 24v dc control power.

Zone Selective Interlocking (ZSI)

The EntelliGuard TU trip unit's Zone Selective Interlocking (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 may offer the fastest Zone Selective Interlocking (ZSI) system in the industry. It is able to interlock Ground Fault, Short Time and Instantaneous clearing times, and to allow for separately set bands, including the sloped I²t bands for both Short Time and Ground Fault. The trip unit allows independent setting of time bands so any circuit breaker will have a base, unrestrained time band and a restrained time

band, both set by the user, for both Ground Fault and Short Time protection.

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 0.058 millisecond time band. Since it is expected that faults of sufficient magnitude to engage the Instantaneous pick up 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.

Short Time and Ground Fault bands for zone interlocked circuit breakers may be set to any band available to the trip. Figure 3.9 shows two circuit breakers set to protect at their unrestrained settings. Figure 3.10 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 0.025 seconds to a user set restrain band of 0.092 seconds. The Instantaneous has shifted from the adjustable selective Instantaneous band clearing in 0.050 seconds to the fixed restrained band of 0.058 seconds, clearing in 0.113 seconds.

This allows the lower circuit breaker to clear faults within their zone of protection above 7,000 amperes RMS and 11,000 amperes RMS respectively, clearing under 100mS, while maintaining full selectivity for faults up to 85,000 amperes.

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 identifies the rating as well as the minimum and maximum sensor rating

the plug may be used with. Table 3.9 lists trip rating plugs available for each sensor. Table 3.10 lists the two-digit codes used within the trip rating plug catalog numbers and the sensor current ratings to which they are mapped.

Table 3.9

Trip Plug Catalog No.	Plug Rating	May Be Used With	
		Minimum Sensor	Maximum Sensor
GTP0060U0101	60A ¹	150A ³	150A ³
GTP0080U0102	80A ¹	150A ³	200A ⁴
GTP0100U0102	100A ²	150A ³	200A ⁴
GTP0125U0102	125A ¹	150A ³	200A ⁴
GTP0150U0404	150A	150A ³	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
GTP5000U5064	5000A	5000A	6400A ⁵
GTP6000U6064	6000A	6000A	6400A ⁵

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 600

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Table 3.10

Sensor Designation	Sensor Rating
01	150A ¹
02	200A ²
04	400A
06	600A
07	630A ³
08	800A
10	1000A
12	1200A
13	1250A ³
16	1600A
20	2000A
25	2500A
30	3000A
32	3200A
40	4000A
50	5000A
60	6000A
64	6400A ³

- 1 Sensor available in WavePro and AKR only.
- 2 Sensor available in Power Break only.
- 3 Sensor available in IEC listed circuit breaker only.

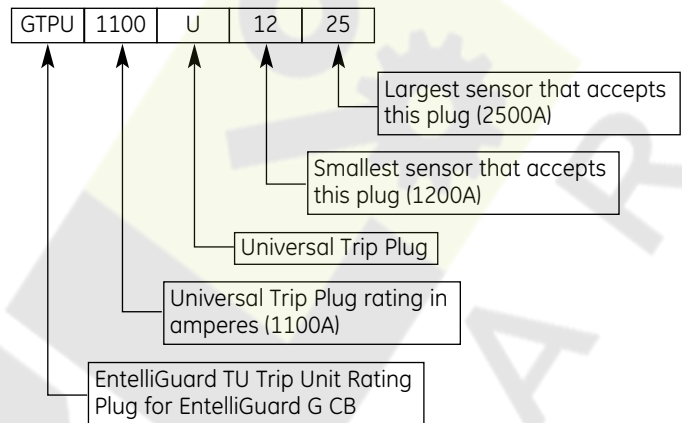


Table 3.11 lists the plugs available for each sensor in the various circuit breakers in which EntelliGuard TU may be installed.

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

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

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, 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 mapping procedure is described in the trip unit instruction book and requires that control power be provided to the trip unit from permanently connected control power or a portable power supply

that may be connected via the trip unit’s front test and communication connection.

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 Universal Trip Unit are listed in Table 3.12.

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

Long Time	1	Standard
	2	Standard and Fuse
Instantaneous	1	Standard
	2	Extended Range
Ground Fault	1	None
	2	Standard
	3	Ground Input
Safety	1	No RELT
	2	RELT
Zone Selective Interlocking	1	Short Time and Ground Fault
	2	Short Time, Ground Fault and Instantaneous
Communications	1	None
	2	Modbus
	3	Profibus
Metering	1	Standard (ammeter)
	2	Advanced (A, V, E and P)
	3	Diagnostic (Advanced and WFC)

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		
							1	2	Dedicated
Protective	Voltage Unbalance	Yes	Yes	Yes	Yes	Yes	X	X	-
	Under-Voltage	Yes	Yes	Yes	Yes	Yes	X	X	-
	Over-Voltage	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	-
Status	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	No	No	Yes	Yes	Yes	X	X	-
	Ground Fault Alarm Status	No	No	Yes	Yes	Yes	X	X	-
	ZSI Output	No	No	Yes	Yes	No	-	-	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	-	-	-
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 rated ??.

Relay Functions

The Entelliguard TU offers various protective and alarm relay functions that may be displayed on the LCD screen, assigned contact outputs or communicated serially. They are shown in 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.

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
Voltage Unbalance Settings

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

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
Current Unbalance Settings

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

Under-Voltage Relay

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

Under-Voltage 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 Under-Voltage Relay.

Table 3.16
Under-Voltage Settings

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

Over-Voltage Relay

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

Table 3.17
Over-Voltage Settings

Item	Options
Over-voltage pickup	User adjustable from 110% to 150% in increments of 1%.
Over-voltage delay setting	User adjustable from 1 second to 15 seconds in increments of 1S. 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
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 1 second to 15 seconds in increments of 1S. 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

Enter the primary voltage rating of the potential transformer. The range of values is 120 to 600 volts, in 1 volt increments.

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 5 minutes to 60 minutes, in steps of 5 minutes. 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 60 seconds, 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 60 seconds, the output, if assigned to the current alarm, will open. This is a definite time function with a 60 second delay and a 60 second 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 24V AC or DC signal. The inputs can be assigned to two main functionalities:

- Reduce Let Thru Energy (RELT) instantaneous protection "ON"
- Breaker "TRIP"

Table 3.19 shows the assignment for the inputs.

Outputs for Entelliguard G Circuit Breakers

The number of outputs available varies by breaker. The Entelliguard G circuit breaker has 3. These outputs are relay contact outputs to secondary disconnect. Each output can be configured per Table 3.20.

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 to 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.
2	OFF	No action taken.
	TRIP	Will cause the circuit breaker to trip.

Table 3.20
Output Configuration

Function	Summary Description
GF alarm	Closes when GF alarm is activated. Relays 1 or 2.
Over-current trip (GF, INST, LT, ST)	Over-voltage trip closes the relay. Relays 1 or 2.
RELT on	Closes relay when Reduced Let Through Energy Instantaneous pickup setting is enabled. Relays 1 or 2.
Any protective relay	Closes relays when protective the relay is in pick up. Relays 1 or 2.
Current alarm 1	Exceeding current alarm pick-up closes relay. Relays 1 or 2.
Current alarm 2	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	Relay contact will change state when the Health Monitoring algorithm senses a change. Relays 1 or 2.

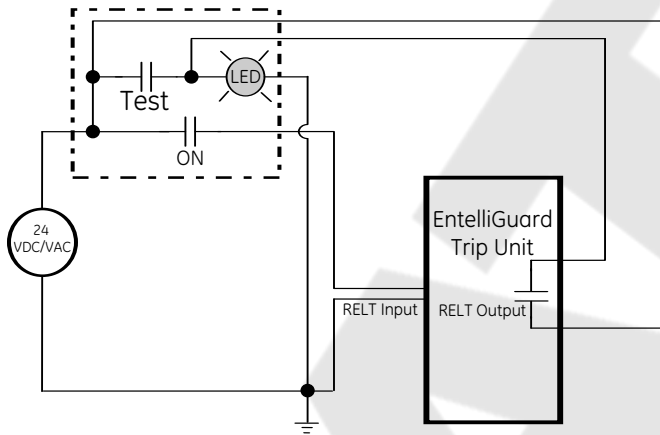
Output contacts are rated ??

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 you know the signal got to 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

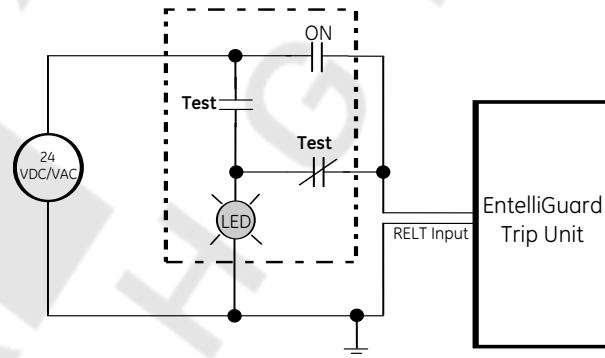
is available to change the setting. The trip unit does not require its own control power to accept a RELT input and change the Instantaneous trip pickup according to the user settings. However, if control power is available to the trip unit, the feedback signal will function immediately, rather than when the trip unit becomes self-powered through its load current.

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



This configuration provides positive indication from the trip that the trip has received and processed the RELT "On" signal. Also provides a control power check.

Figure 3.12
Integrated Switch & LED, Spring Return from "Test" to "Off," Latched in "On"

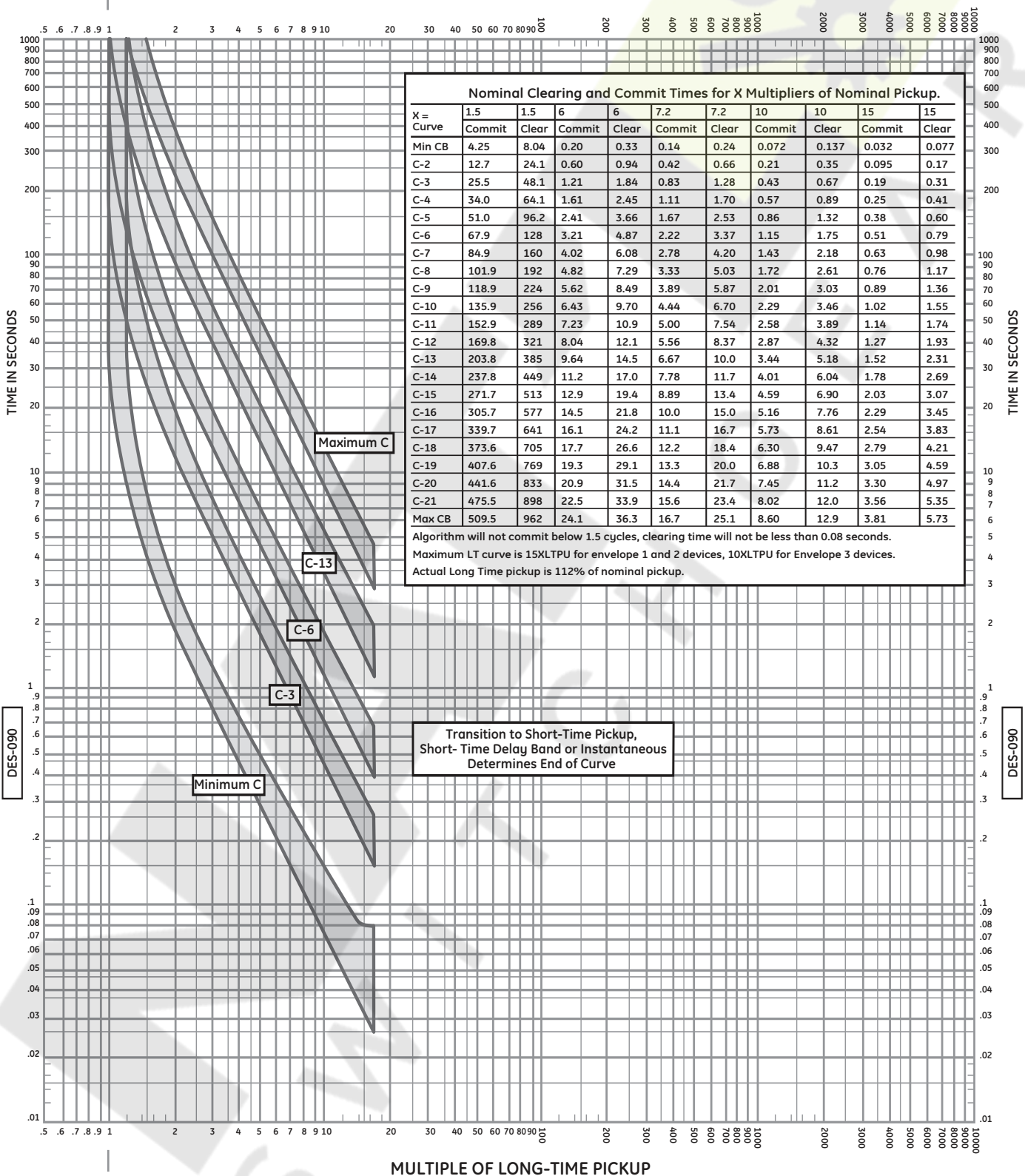


This configuration does not provide positive indication from the trip that the trip has received the signal. Does provide a control power check and local indication that the RELT mode switch has been turned "On."

Section 3. EntelliGuard TU Trip Unit System

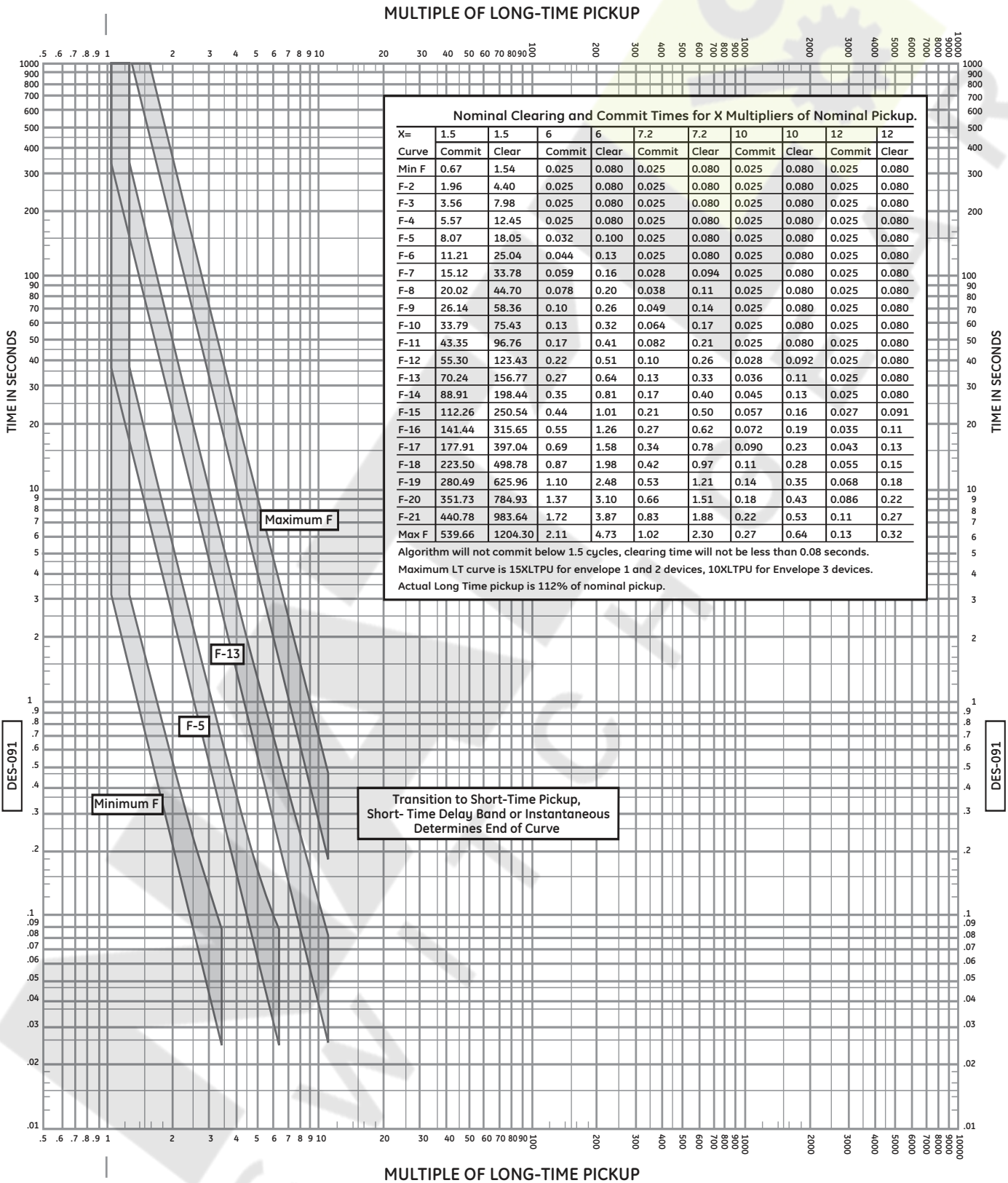
Figure 3.13
Long Time "Thermal Type" Delay Bands.

MULTIPLE OF LONG-TIME PICKUP



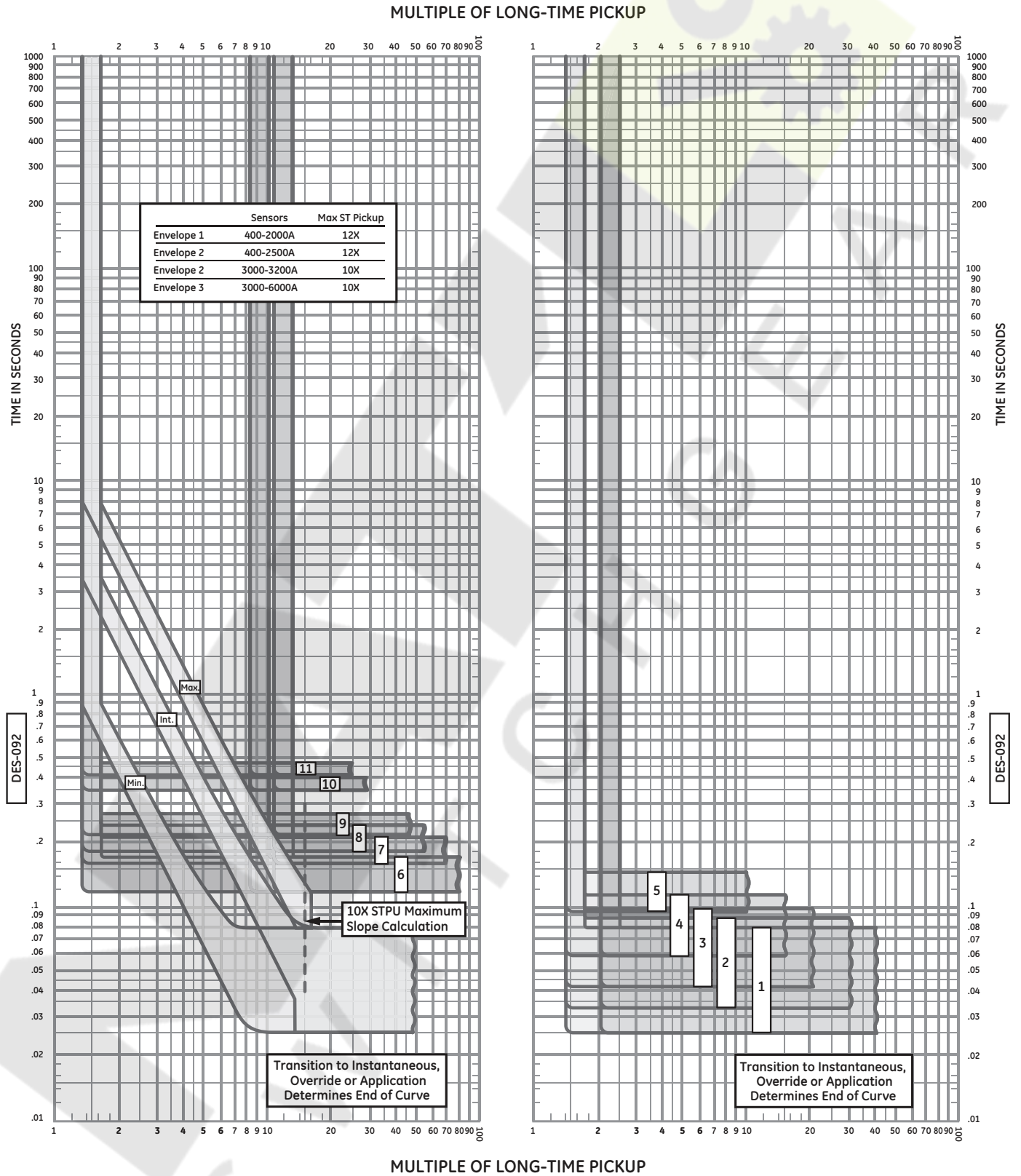
Section 3. EntelliGuard TU Trip Unit System

Figure 3.14
Long Time "Fuse" Delay Bands.



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Figure 3.15
Short Time Bands



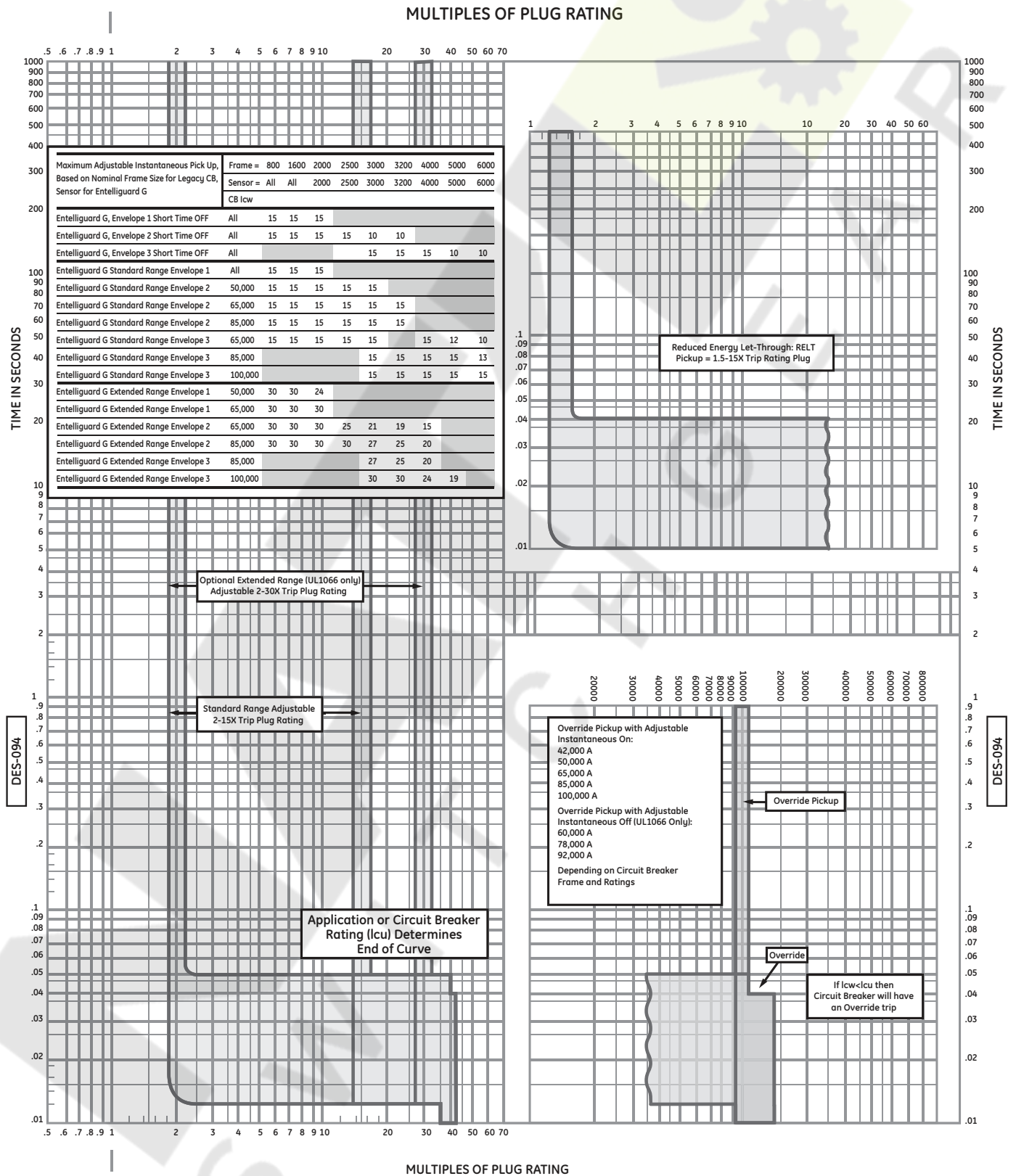
Section 3. EntelliGuard TU Trip Unit System

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Section 3. EntelliGuard TU Trip Unit System

Figure 3.16
Instantaneous, Override (HSIOC), Reduced Energy Let-Through Instantaneous (RELT)





EntelliGuard G Power Circuit Breaker Section 4. Accessories

Figure 4.1
Accessory Mounting



A wide range of optional accessories are interchangeable across all EntelliGuard G power circuit breakers, regardless of nominal rating or envelope/frame size. Each one incorporates easy-fit design features for quick installation, either at the factory or in the field. NOTE: When ordering REPLACEMENT accessories, add "R" to the end of the catalog number shown.

Motorized Spring Charging Unit

The unique motor/gearbox unit is specially designed to operate with the full range of EntelliGuard G. It is easily fitted with three heavy-duty bolts. After a breaker close operation, the unit automatically recharges the spring and makes it ready for immediate open and 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. See Table 4.1.

Duty Cycle 2 / Minute
Spring Charge Time 3 Seconds Max

Circuit Breaker Closing Coil

The closing coil is an easy-to-fit, clip-on unit with simple plug-in connectors. This permits either local or remote release of the spring charged closing mechanism by electrical operation. The standard anti-pumping safety feature ensures that the

Table 4.1
Motor Operators

Envelope	Power Consumption	Nominal Control Voltage	IEC Range (85%-110%)	ANSI Range	UL Range (85-110%)	Cat. No.
1	DC - 300W	24 /30 Vdc	20.4V-26.4V	-	20.4V-26.4V	GMO124D
		48 Vdc	40.8V-52.87V	38V-56V	40.8V-52.87V	GMO1048D
		60 Vdc	51V-66V	-	51V-66V	GMO1060D
		72 Vdc	61.2V-79.2V	-	61.2V-79.2V	GMO1072D
		110/130 Vdc	106.25V-137.5	100V-140V	106.25V-137.5	GMO1130D
		250 Vdc	212.5V-275V	200V-280V	212.5V-275V	GMO1250D
	AC - 350VA	48 Vac	40.8V-52.87V	-	40.8V-52.87V	GMO1048A
		120 Vac	102V-132V	104V-127V	102V-132V	GMO1120A
		240 Vac	204V-264V	208V-254V	204V-264V	GMO1240A
		277 Vac	235.5V-304.7V		235.5V-304.7V	GMO1277A
		346 Vac				GMO1346A
		380/400 Vac	323V-440V	-	323V-440V	GMO1400A
		440 Vac	374V-528V	-	374V-528V	GMO1440A
2 & 3	DC - 480W	24 /30 Vdc	20.4V-26.4V	-	20.4V-26.4V	GMO224D
		48 Vdc	40.8V-52.87V	38V-56V	40.8V-52.87V	GMO2048D
		60 Vdc	51V-66V	-	51V-66V	GMO2060D
		72 Vdc	61.2V-79.2V	-	61.2V-79.2V	GMO2072D
		110/130 Vdc	106.25V-137.5	100V-140V	106.25V-137.5	GMO2130D
		250 Vdc	212.5V-275V	200V-280V	212.5V-275V	GMO2250D
	AC - 560VA	48 Vac	40.8V-52.87V	-	40.8V-52.87V	GMO2048A
		120 Vac	102V-132V	104V-127V	102V-132V	GMO2120A
		240 Vac	204V-264V	208V-254V	204V-264V	GMO2240A
		277 Vac	235.5V-304.7V		235.5V-304.7V	GMO2277A
		346 Vac				GMO2346A
		380/400 Vac	323V-440V	-	323V-440V	GMO2400A
		440 Vac	374V-528V	-	374V-528V	GMO2440A

Section 4. Accessories

electrical closing signal must be released before further close commands are attempted; a cut-off is initiated if the closing signal is maintained. See Table 4.2.

Duty Cycle 2 / Minute

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 standard auxiliary switch ensures automatic isolation whenever the circuit breaker is open. The shunt trip release is a straightforward, field installable accessory available in wide range of voltages. See Table 4.3.

Pick Up Range 55%-110 %
 Duty Cycle 2 / Minute
 Inrush 480VA (ac), 480W (dc)
 Holding 60VA (ac), 50W (dc)

Status Indication Switch

A plug in module is available to provide status

indication via the secondary disconnects and trip unit. Status indication switches are available for closing coils, shunt trip and under voltage release.

Under Voltage Release (UVR)

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 UVR shunt trip 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 50mS when system voltage drops to 50% and 20mS when system voltage drops below 50%. See Table 4.4.

Duty Cycle 2 / Minute
 Inrush 350VA (ac), 350W (dc)
 Holding 60VA (ac), 50W (dc)

Table 4.2
Closing Coil Characteristics

Type	Power Consumption	Nominal Control Voltage	Cat. No.
Closing Coil	DC- 350W, 20W (Sealed). AC - 350W (Inrush), 20W (Sealed)	24/30 Vdc	GCCN24D
		40 Vdc ; 48 Vac/dc	GCCN048
		60 Vdc	GCCN060D
		70-72 Vac/dc	GCCN072
		110 Vdc / 130 Vdc / 120Vac	GCCN120
		208 Vac	GCCN208A
		220 Vdc / 240 Vac	GCCN240
		250 Vdc / 277 Vac	GCCN277
		346 Vac	GCCN346A
		380/400/440 Vac	GCCN440A
Command Operated Closing Coil	DC- 350W, 20W (Sealed). AC - 350W (Inrush), 20W (Sealed)	24/30Vdc	GCCC24D
		40 Vdc / 48 Vac/dc	GCCC048
		60 Vdc	GCCC060D
		70-72 Vac/dc	GCCC072
		110Vdc / 130 Vdc / 120 Vac	GCCC120
		208 Vac	GCCC208A
		220-250 Vdc / 240 Vac	GCCC240
		277 Vac	GCCC277A
		346 Vac	GCCC346A
		380/400/415/440 Vac	GCCC440A

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

Nominal Control Voltage	Cat. No.
24 Vac/dc	GSTG24
48 Vac/dc	GSTG048
70/72 Vac/dc	GSTG072
110Vdc / 120 Vac	GSTG120
125 Vdc	GSTG125D
208 Vac	GSTG208A
240 Vac	GSTG240
250 Vdc	GSTG277

Time Delay Module (TDM) for UVR

An optional time-delay version of the UVR sets an adjustable time delay before the device trips the circuit breaker, preventing nuisance tripping from a momentary voltage drop. The TDM supplies regulated control voltage to the breaker UVR for a period between zero and 3 seconds in the event of an under-voltage fault. The voltage level supplied during the time delay period must be sufficient to maintain the breaker UVR in the energized state. The time delay is in addition to the minimum time delay provided by the breaker UVR accessory, i.e., 50 milliseconds for voltage drops up to 50% of rated voltage and 20 milliseconds for voltage drops more than 50% of rated voltage. See Table 4.6.

Duty Cycle	2 / Minute
Inrush	350VA (ac), 350W (dc)
Holding	60VA (ac), 50W (dc)
Time Delay Band	

Remote Operation Coil Combination

Each breaker accepts a maximum of four coils in the combinations shown in Table 4.7. All coils are mounted from the front and snap onto the mechanism after the fascia is removed.

Auxiliary Switches

Auxiliary switches indicate breaker main contact position. They change their state in the same time sequence as the breaker main contacts. See Tables 4.8 and 4.9 for available combinations and ratings.

Circuit Breaker - Key Interlock Facility

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

Table 4.4
Under Voltage Release Operating Characteristics

Power Consumption	Nominal Control Voltage	Cat. No.
DC- 350W, 20W (Sealed). AC - 350W (Inrush), 20W (Sealed)	24/30 Vdc	GUVT030D
	40 Vdc, 48 Vac/dc	GUVT048
	60 Vdc	GUVT060D
	110 Vdc / 130 Vdc / 120 Vac	GUVT130
	208 Vac	GUVT208A
	220 Vdc / 240 Vac	GUVT240
	250 Vdc / 277 Vac	GUVT277
	346 Vac	GUVT346A
	380/400/440 Vac	GUVT440A

Table 4.6
Time Delay Module Characteristics

Power Consumption	Nominal Control Voltage	Cat. No.
DC- 350W, 20W (Sealed). AC - 350W (Inrush), 20W (Sealed)	24/30 Vdc	GTDM030D
	40 Vdc, 48 Vac/dc	GTDM048
	60 Vdc	GTDM060D
	110 Vdc / 130 Vdc / 120 Vac	GTDM130
	208 Vac	GTDM208A
	220 Vdc / 240 Vac	GTDM240
	250 Vdc / 277 Vac	GTDM277
	346 Vac	GTDM346A
	380/400/440 Vac	GTDM440A

Table 4.5
Coil Signaling Contact Module

Type & Configuration	Ratings			Cat. No.
1 Power rated + 1 High Fidelity (1 NO contact each)	AC	120Vac	6A	GCSP1
		250Vac	6A	
	DC	125Vdc	0.5A	
		250Vdc	0.25A	
	AC	125Vac	0.1A	
	DC	30Vdc	0.1A	
2 High Fidelity (1 NO contact each)	AC	125Vac	0.1A	GCSP2
	DC	30Vdc	0.1A	

Table 4.7
Accessories and Mounting

Combination	Coil Position on Fascia (from left)			
	1	2	3	4
1	Network Interlock	CC	UV	
2	Shunt	Shunt	CC	UV
3	Shunt	UV	CC	UV
4	Network Interlock	CC	Shunt	

Section 4. Accessories

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. NOTE: Locks and keys are not supplied by GE. Please order separately from your local supplier.

Lock and key types

- Castell: Type FS1 lock with key type FK4 key, 45° clockwise rotation to trap the key, 7/8"x3/8" square spindle.
- Ronis: Type 1104B lock with standard key, 1/4" turn rotation to trap the key, compulsory spindle size.
- Profalux: Type B20D4Y lock with key type S1 (without cam), 1/4" turn rotation to trap the key, compulsory spindle size.

Table 4.10
Key Interlocks

Description	Cat. No.
Baseplate & Mechanism for Castell Locks	GBPCAS
Baseplate & Mechanism for Ronis & Profalux Locks	GBPRONP
Baseplate & Mechanism for Kirk Key Locks	GBPKK
Castell Key Breaker Interlock (Supplied Loose) (1)	GBRKCAS
Kirk Key Breaker Interlock (Supplied Loose) (1)	GBRKKK
Profalux Key Breaker Interlock (Supplied Loose) (1)	GBRKPRO
Ronis Key Breaker Interlock (Supplied Loose) (1)	GBRKRON
Ronis Key Cassette Interlock (Supplied Loose) (1)	GCASRON
Profalux Key Cassette Interlock (Supplied Loose) (1)	GCASPRO
Door Interlock (Left Side)	GLHD
Door Interlock (Right Side)	GRHD
Circuit Breaker Mis-Insertion Interlock	GREPM

Grounding/Earthing Device

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 safety grounded and locked during system maintenance operations. See Table 4.11.

Table 4.8
Auxiliary Switches

Contact Configuration	Cat. No.
Power rated 3NO+3NC Standard	GAUX3
Power rated 8NO+8NC (Optional)	GAUX8
Power rated 3NO+3NC + High Fidelity (2NO+2NC)	GAUX5
Power rated 6NO+6NC + High Fidelity (2NO+2NC)	GAUX6

Table 4.9
Auxiliary Switch Ratings

Type	Volts	Amps		
		Non Inductive	Inductive	
Power duty	AC 50/60Hz	110/120/130V	15	10
		220/240/250V	10	5
		380/440V	5	2.5
	DC	24	15	-
		125	10	-
		250	5	-
High Fidelity	AC 50/60Hz	125V	0.1 max.	-
	DC	8-30V	0.1 max.	-

DC ratings possible only with contacts connected in series as in specs. 8-30V - 0.1 A min.

Table 4.11
Earthing Devices

Envelope	Current Rating	Poles	Cat. No.
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	

Carriage Position Switch

Available as an option for mounting within the base of the cassette/substructure, the carriage position switch provides six single-pole changeover contacts 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 and includes wiring to a terminal block located on the left side of the cassette.

Table 4.12
Carriage Position Switches

Switch configuration	Cat. No.
One Switch per Position	GCPS1
Set of 2 Switches per Position (Mpack style)	GCPS2

Table 4.13
Carriage Position Switch Ratings (Common NO-NC Contact Configuration)

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

Table 4.14
Cable Interlocks

Interlock Type	Breaker Type	Poles	Cat. No.
2 Way - Type A	Withdrawable	3	GI3WAD
		4	GI4WAD
	Fixed	3	GI3FAD
		4	GI4FAD
1 from 3 Way - Type B	Withdrawable	3	GI3WB
		4	GI4WB
	Fixed	3	GI3FB
		4	GI4FB
1 from 3 Way - Type C	Withdrawable	3	GI3WC
		4	GI4WC
	Fixed	3	GI3FC
		4	GI4FC
1 from 3 Way - Type D	Withdrawable	3	GI3WDT
		4	GI4WDT
	Fixed	3	GI3FDT
		4	GI4FDT

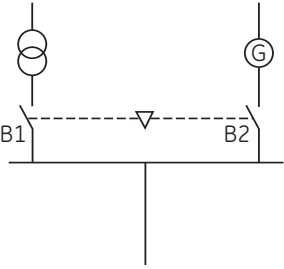
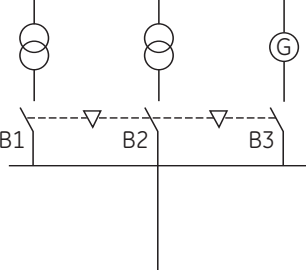
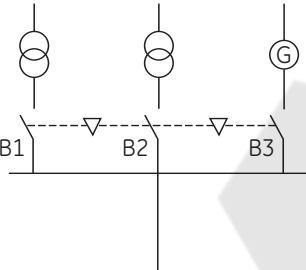
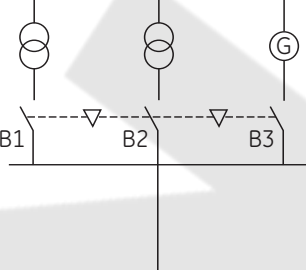

Mechanical Interlocks (Cable/Rod)

Available for fixed and draw-out 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. Standard cable lengths available: 1.0, 1.6, 2.0, 2.5, 3.0, 3.5 and 4.0 meters. (Please contact our technical customer service department if longer length is required.)

Mechanical interlocks can be fitted to electrical systems as shown in Table 4.14 and can link 2 and/or 3 circuit breakers. Any nominal rating, frame size, number of poles or type (fixed pattern or draw-out) can be interlocked.

Section 4. Accessories

Table 4.15
Interlock Configurations

Typical Circuit	Interlock Configuration	Possible Combinations																								
	<p>Type A 1 from 2 way interlock 2 cable configuration Interlocking between 2 circuit breakers</p> <p>1 normal power supply 1 generator (emergency) supply</p>	<table border="1" data-bbox="1122 338 1386 436"> <thead> <tr> <th>B1</th> <th>B2</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> </tr> </tbody> </table> <p>Circuit breaker B1 can close only if B2 is open Circuit breaker B2 can close only if B1 is open</p>	B1	B2	0	0	1	0	0	1																
B1	B2																									
0	0																									
1	0																									
0	1																									
	<p>Type B 1 from 3 way interlock 6 cable configuration Interlocking among 3 circuit breakers</p> <p>3 power supplies (generator or transformers) feeding the same busbar but parallel operation is prevented.</p> <p>Available on request</p>	<table border="1" data-bbox="1057 659 1451 779"> <thead> <tr> <th>B1</th> <th>B2</th> <th>B3</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p>Only 1 of 3 breakers can be closed</p>	B1	B2	B3	0	0	0	1	0	0	0	1	0	0	0	1									
B1	B2	B3																								
0	0	0																								
1	0	0																								
0	1	0																								
0	0	1																								
	<p>Type C 2 from 3 way interlock 6 cable configuration Interlocking among 3 circuit breakers</p> <p>2 bus sections can be powered by single transformer (bus coupler closed) or both transformers (bus coupler open).</p> <p>Available on request</p>	<table border="1" data-bbox="1057 980 1451 1163"> <thead> <tr> <th>B1</th> <th>B2</th> <th>B3</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> </tbody> </table> <p>Any 2 from 3 breakers can be closed Any 1 from 3 breakers can be closed 2 breakers must be closed to prevent the 3rd breaker from closing</p>	B1	B2	B3	0	0	0	1	0	0	0	0	1	0	1	0	1	1	0	0	1	1	1	0	1
B1	B2	B3																								
0	0	0																								
1	0	0																								
0	0	1																								
0	1	0																								
1	1	0																								
0	1	1																								
1	0	1																								
	<p>Type D 1 from 3 way interlock variant 4 cable configuration (2 cable for bus coupler) Interlocking among 3 circuit breakers</p> <p>2 normal power supplies not set in parallel 1 power supply may assist the priority circuit</p> <p>Available on request</p>	<table border="1" data-bbox="1057 1358 1451 1499"> <thead> <tr> <th>B1</th> <th>B2</th> <th>B3</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> </tbody> </table> <p>Circuit breaker B1 and/or B3 can be closed only if B2 is open Circuit breaker B2 can only be closed if B1 and B2 are both open</p>	B1	B2	B3	0	0	0	1	0	0	0	0	1	1	0	1	0	1	0						
B1	B2	B3																								
0	0	0																								
1	0	0																								
0	0	1																								
1	0	1																								
0	1	0																								
	<p>Type E 2 from 3 way "specific" interlock 4 cable configuration Interlocking among 3 circuit breakers</p> <p>2 normal power supplies can be set in parallel 1 generator (emergency) supply</p> <p>Available on request</p>	<table border="1" data-bbox="1057 1680 1451 1820"> <thead> <tr> <th>B1</th> <th>B2</th> <th>B3</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> </tr> </tbody> </table>	B1	B2	B3	0	0	0	1	0	0	0	1	0	1	1	0	0	0	1						
B1	B2	B3																								
0	0	0																								
1	0	0																								
0	1	0																								
1	1	0																								
0	0	1																								

Bell Alarm

The bell alarm provides remote indication that the circuit breaker has opened because of an electrical fault.

Table 4.16
Bell Alarm Switches

Switch configuration	Cat. No.
One Switch	GBAT1
Set of 2 Switches	GBAT2

Table 4.17
Bell Alarm Ratings (Common NO-NC Contact Configuration)

AC Ratings	120Vac	6A
	250Vac	6A
DC Ratings	125Vdc	0.5A
	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 4.18
Spring Charged Contact (1 NO)

Ratings			Cat. No.
AC	120Vac	6A	GSCC1
	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 the top 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 4.19
Secondary Disconnect Block B

Terminals	Type	Cat. No.
Terminals 39 - 78	Side Mounted, Fixed/Stationary Breakers 400 - 2000A N, H	GSDSFR
Terminals 39 - 78	Top Mounted, Fixed/Stationary Breakers 2500 - 6000A N, H, M, E, B, L	GSDTFR
Terminals 39 - 78 (Breaker-Cassette Pair)	Side Mounted, Draw Out Breakers 400 - 2000A N, H	GSDSWR
Terminals 39 - 78 (Breaker-Cassette Pair)	Top Mounted, Draw Out Breakers, 2000A E, M (Standard Depth Cassette)	GSDTWR
Terminals 39 - 78 (Breaker-Cassette Pair)	Top Mounted, Draw Out Breakers, 2500 - 3200A N, H (Standard Depth Cassette)	GSDTWR
Terminals 39 - 78 (Breaker-Cassette Pair)	Top Mounted, Draw Out Breakers, 3200 - 6000A E, L, B, M (Standard Depth Cassette)	GSDTWR
Terminals 39 - 78 (Breaker-Cassette Pair)	Top Mounted, Draw Out Breakers, 400 - 6000A (Extended Depth Cassette)	GSDTWR

Section 4. Accessories

Table 4.20

Secondary Disconnect Block A Wiring Diagram and Terminals
3 Layer Secondary Disconnect with Basic GTU & Basic Accessories

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	
A1	Motor	Motor	Spr NO/RTC NO	Spr NO/RTC NO	ST2/UV2	ST2/UV2	ST1	ST1	CC Nu	CC Ph	CC Ph	UV1	UV1	A13
A14	NC3	NC3	NC2	NC2	NC1	NC1	NO3	NO3	NO2	NO2	NO1	NO1		A26
A27	O/P1a	O/P1b	O/P2a	O/P2b	24V+	24V-	BA NC	BA NO	BA COM	N-RC-	N-RC+	Eleg-CT	Eleg-CT	A39
	A27	A28	A29	A30	A31	A32	A33	A34	A35	A36	A37	A38	A39	

Table 4.21

Secondary Disconnect Block B Wiring Diagram and Terminals
3 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	
B1	GND	Volt-A	Volt-B	Volt-C	INPUT1	INPUT2	I/P com	NC6	NC6	NC5	NC5	NC4	NC4	B13
B14	Iso GND	TX_EN_1	RX	TX	Arc Flash	Com		NO6	NO6	NO5	NO5	NO4	NO4	B26
B27	GFZout+	GFZout-	GFZin+	GFZin-		ST1 NO	ST1 Com	CC NO	CC Com	UV NO	UV Com	ST2 NO	ST2 Com	B39
	B27	B28	B29	B30	B31	B32	B33	B34	B35	B36	B37	B38	B39	

Key			
24V +/-	Auxiliary Power supply to trip unit	NC	Auxiliary switch - normally closed contact
Arc Flash	Arc flash signal input	N-CT	Neutral CT
BA	Bell alarm switch contact common terminal	NO	Auxiliary switch - normally open contact
BA NC	Bell alarm switch NC contact terminal	N-RC	Neutral Rogowski
BA NO	Bell alarm switch NO contact terminal	O/P	Relay output from trip unit
CC	Power input to closing coil	RTC NO	Ready to close signaling contacts
CC NO/Com	Closing coil signaling contacts	RX	Trip unit communication
CC Nu	Closing coil neutral wire	Spr NO	Spring charge status contacts
CC Ph	Closing coil phase wire	ST1	Power input to shunt trip coil
Com	Trip unit communication	ST1 NO/Com	Shunt1 coil signaling contacts
Eleg-CT	Earth leg CT	ST2 NO/Com	Shunt2/UV2 coil signaling contacts
GFZin+/-	GF zone selective interlock input	ST2/UV2	Power input to second shunt trip coil/ under voltage coil
GFZout+/-	GF zone selective interlock output		
GND	Ground point for voltage input to Trip Unit	TX	Trip unit communication
Input1/2/Com	Relay input to Trip unit	TX_EN_1	Trip unit communication
Iso GND	Trip unit communication	UV NO/Com	UV1 coil signaling contacts
Motor	Power input to motor	UV1	Power input to under voltage coil
		Volt-A/B/C	System phase voltage signals

Neutral Rogowski

Table 4.20

Envelope	Current Rating (A)	Cat. No.
1	400	GNRC04H
	600/630	GNRC07H
	800	GNRC08H
	1000	GNRC10H
	1200/1250	GNRC13H
	1600	GNRC16H
	2000	GNRC20H
2	400	GNRC04M
	600/ 630	GNRC07M
	800	GNRC08M
	1000	GNRC10M
	1200/1250	GNRC13M
	1600	GNRC16M
	2000	GNRC20M
	2500	GNRC25M
	3000/3200	GNRC32H
	4000	GNRC40H
3	3000/3200 (1600A x 2)	GNRC32G
	4000 (2000A x 2)	GNRC40M
	5000 (2500A x 2)	GNRC50M
	6000/6400 (3200 x 2)	GNRC64M

Neutral CTs

Table 4.21

Envelope	Current Rating (A)	Cat. No.
1	400	GNCT04H
	630	GNCT07H
	800	GNCT08H
	1000/1250	GNCT13H
	1600	GNCT16H
	2000	GNCT20H
2	400	GNCT04M
	630	GNCT07M
	800	GNCT08M
	1000/1250	GNCT13M
	1600	GNCT16M
	2000	GNCT20M
	2500	GNCT25M
	3000/3200	GNCT32H
4000	GNCT40H	
3	3000/3200 (1600 x 2)	GNCT32G
	4000 (2000A x 2)	GNCT40M
	5000 (2500A x 2)	GNCT50M
	6000/6400 (3200 x 2)	GNCT64M

Earth Leg CTs

Table 4.22

Current Rating (A)	Cat. No.
400	GELCT04
630	GELCT07
800	GELCT08
1000/1250	GELCT13
1600	GELCT16
2000	GELCT20
2500	GELCT25
3000/3200	GELCT32
4000	GELCT40
3000/3200 (1600 x 2)	GELCT32
4000 (2000A x 2)	GELCT40
5000 (2500A x 2)	GELCT50
6000/6400 (3200 x 2)	GELCT64

Ready To Close Contact

This contact indicates 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 is not locked/interlocked in open position
- There is no standing closing order
- There is no standing opening order

Table 4.23

Ready To Close Contacts (1 NO)

Ratings			Cat. No.
AC	120Vac	6A	GRTC2
	250Vac	6A	GRTC2
DC	125Vdc	0.5A	GRTC1
	250Vdc	0.25A	GRTC3

Sealed Door Panel Escutcheon

An optional complete IP54 front door panel is available when a higher degree of protection is needed. See Table 4.24.

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. See Table 4.24.

Cassette/Substructure

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

Position Indicators

Position indicators provide a positive mechanical indication of CONNECTED, TEST and DISCONNECTED positions of the breaker.

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.

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).

Table 4.24
Miscellaneous Accessories

Description	Cat. No.
IP54 Door Panel - Withdrawable Type	GF54DR
IP54 Door Panel - Fixed Pattern	GW54DR
Mechanical Operations Counter	GMCNT
ACB Lifting Truck	ACBLIFT
Titan Truck Adapter Kit	

EntelliGuard G Power Circuit Breaker

Section 5. Catalog Numbering Guide

EntelliGuard G Circuit Breaker Catalog Number Guide

See following pages for details.

Sample Cat. No.	G	A	10	M	D	H	E	E	X	5	2	A	D	X	L4	X	6	O
Digit	1	2	3 & 4	5	6	7	8	9	10	11	12	13	14	15	16 & 17	18	19	20
	ACB Family	Device & Type	Current Rating / Sensors	AIC Rating	Mounting	Spring Charging Motor	Closing Devices	Shunt Trip 1	UVR	2nd Shunt Trip or UVR	Auxiliary Switch	Bell Alarm/Trip Annunciation	Key Interlock	Future Use	Overcurrent Protection Package	Zone Selective Interlock (ZSI)	Advanced Features & Communications	Rating Plug

Section 5. Catalog Numbering Guide

Digit 1 ACB Family

Device Series/Line	Code
EntelliGuard G Breaker/Switch	G

Digit 2 Device & Type

Breaker/Switch Type	Code
ANSI/UL 1066 Circuit Breaker - TSD1	N
UL 489 Circuit Breaker - TSD1	U
ANSI Non-auto. CB (ANSI Switch) - TSD1*	M
UL Non-auto. CB (UL Switch) - TSD1	S
ANSI/UL 1066 Circuit Breaker - SSD2	A
UL 489 Circuit Breaker - SSD2	B
ANSI Non-auto. CB (ANSI Switch) - SSD2*	C
UL Non-auto. CB (UL Switch) - SSD2	D

*Ground Fault Relay version for EntelliGuard G switches (future)

NOTES:

- Top-mounted Secondary Disconnects (TSD) are the standard configuration for small envelope EntelliGuard G breakers (Type N and H, 400-2000A); pricing per Side Mounted pricing sheets (A, B, C, D).
- Side-mounted Secondary Disconnects (SSD) are the ALTERNATE configuration for small envelope EntelliGuard G breakers (Type N and H, 400-2000A); the side-mounted design is specifically intended for 5-high ('high density') equipment designs.
- IEC Devices are 100% rated up to 4000A
- DC trip unit not included. DC Rated Circuit Breakers require external control devices (e.g., Type 37 or Type 76 DC Relays).
- AK/AKR Roll-in Replacement Breakers (retrofits) available for legacy GE LVS (AKD-5, 6 & 8). NOTE: Application and installation requirements vary greatly. Engineering Services may be necessary for complete installation and re-start.

Digit 3 & 4 Current Rating / Sensors

Current Sensor Rating (A)	Code
400	04
600	06
800	08
1000	10
1200	12
1600	16
2000	20
2500	25
3000	30
3200	32
4000	40
5000	50
6000	60

Digit 5 AIC Rating

AIC Tier					
ANSI/UL1066 Devices, LVPCB	240V	480V	1/2S Withstand		Code
N	65,000	65,000	65,000		N
H	85,000	85,000	65,000		H
E	85,000	85,000	85,000		E
M	100,000	100,000	85,000		M
B	100,000	100,000	100,000		B
L	150,000	150,000	100,000		L
UL489 Devices, ICCB	240V	480V	1/2S Withstand		Code
N	65,000	65,000	42,000		N
H	85,000	85,000	50,000		H
M	100,000	100,000	65,000		M
L	150,000	150,000	85,000		L
IEC Devices	440/500V	690V	Withstand 1 & 3 Sec.		Code
S	50,000	40,000	50,000	40,000	S
N	65,000	50,000	65,000	50,000	N
H	85,000	65,000	65,000	50,000	H
E	85,000	85,000	85,000	50,000	E
M	100,000	85,000	85,000	50,000	M
M	100,000	100,000	100,000	85,000	M
L	150,000	100,000	100,000	85,000	L

Digit 6 Mounting

Mounting and Designation	Code
OEM Draw Out - 3 pole	1
OEM Draw Out - 4 pole, right	2
OEM Draw Out - 4 pole, left	3
OEM Stationary - 3 pole	4
OEM Stationary - 4 pole right	5
OEM Stationary - 4 pole left	6

Digit 7 Spring Charging Motor

Spring Charging Motor (EO)		Code
DC	24/30 Vdc	A
	48 Vdc	B
	60 Vdc	C
	72 Vdc	D
	110/130 Vdc	E
	250 Vdc	F
AC	48 Vac	G
	120 Vac	H
	240 Vac	J
	277 Vac	K
Blank/None*		X
Spring Charged Contact Only**		Z

*An "X" (Blank/None) denotes a Manually Operated device (MO).

**Spring Charged Contact only for non-automatic circuit breakers (switches).

Spring Charged Contact included with all Motor Operators.

NOTE:

When a Spring Charging Motor is selected, a Closing Device MUST be selected from Closing Devices for Digit 8. A DEFAULT Shunt Trip 1 (Digit 9) will be included with the same coil voltage. A Shunt Trip 1 with a coil voltage different from the Spring Charging Motor may be user-selected.

Section 5. Catalog Numbering Guide

Digit 8 Closing Devices

Type	Code	
Closing Coil (CC)*	24 Vdc	A
	30 Vdc	B
	40 Vdc; 48V	C
	60 - 72 Vdc	D
	110 Vdc/130 Vdc; 120 Vac	E
	208 Vac	F
	220 Vdc; 240 Vac	G
	250 Vdc; 277 Vac	H
Command Operated Closing Coil (CCC)**	24 Vdc	M
	30 Vdc	N
	40 Vdc; 48V	P
	60 - 72 Vdc	Q
	110 Vdc/130 Vdc; 120 Vac	R
	208 Vac	S
	220 Vdc; 240 Vac	T
250 Vdc; 277 Vac	U	
Blank/None	X	

*The Closing Coil (CC) permits either local or remote release of the spring charged closing mechanism by electrical operation.

**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.

NOTE:

Manual button through breaker cover is included as standard assembly. **SELECT ONE DEVICE ONLY.**

Digit 9 Shunt Trip 1

Extended Range Shunt Trip (ANSI/UL)	Code
24V	M
48V	P
70 - 72V	Q
110/125 Vdc; 120 Vac	R
208 Vac	S
240 Vac	T
250 Vdc	V
Blank/None	X

NOTES

The Extended Range Shunt Trip is specifically intended and required for UL ANSI Ground Fault applications. The pick up range is 55-110% of the ST coil voltage. When a motor is selected from the Spring Charging Motor (Digit 7), a DEFAULT Shunt Trip 1 will be included with the same coil voltage. **SELECT ONE DEVICE ONLY.**

Digit 10 UVR

UVR 1 with Fixed Time Delay	Code
24 Vdc	1
30 Vdc	2
40 Vdc; 48V ac/dc	3
60-72 Vdc	4
110/130 Vdc; 120 Vac	5
208 Vac	6
220 Vdc; 240 Vac	7
250 Vdc; 277 Vac	8
Blank/None	X

Digit 11 2nd Shunt Trip or UVR

Type	Code	
2nd UVR with Fixed Time Delay	24 Vdc	1
	30 Vdc	2
	40 Vdc; 48V	3
	60 - 72 Vdc	4
	110 Vdc/130 Vdc; 120 Vac	5
	208 Vac	6
	220 Vdc; 240 Vac	7
	250 Vdc; 277 Vac	8
2nd Extended Range Shunt Trip (ANSI/UL)*	24V AC/DC	M
	48V AC/DC	P
	70 - 72V	Q
	110/125 Vdc; 120 Vac	R
	208 Vac	S
	240 Vac	T
250 Vdc	V	
Blank/None	X	

*The Extended Range Shunt Trip is specifically intended and required for UL ANSI Ground Fault applications. The pick up range is 55-110% of the shunt trip coil voltage. **SELECT ONE DEVICE ONLY.**

Digit 12 Auxiliary Switch

Contact Configuration	Code
3NO+3NC (PR) STANDARD/INCLUDED	2
8NO+8NC (PR)	4
3NO/3NC (PR) + 2NO/2NC (HiFi)	6
4NO/4NC (PR) + 4NO/4NC (HiFi)	8
3NO+3NC (PR) & CSC, PR (1 NO on SD) - CC or CCC	A
3NO+3NC (PR) & CSC, HiFi via Trip Unit - CC or CCC	B
3NO+3NC (PR) & CSC, PR (1 NO on SD) - 1st ST	C
3NO+3NC (PR) & CSC, HiFi via Trip Unit - 1st ST	D
3NO+3NC (PR) & CSC, PR (1 NO on SD) - 1st UVR	E
3NO+3NC (PR) & CSC, HiFi via Trip Unit - 1st UVR	F
3NO+3NC (PR) & CSC Power (1 NO on SD) - 2nd ST or 2nd UVR	G
3NO+3NC (PR) & CSC, HiFi via Trip Unit - 2nd ST or 2nd UVR	H
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, PR (1 NO on SD) - CC or CCC	J
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, HiFi via Trip Unit - CC or CCC	K
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, PR (1 NO on SD) - 1st ST	L
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, HiFi via Trip Unit - 1st ST	M
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, PR (1 NO on SD) - 1st UVR	N
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, HiFi via Trip Unit - 1st UVR	P
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, PR (1 NO on SD) - 2nd ST or 2nd UVR	Q
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, HiFi via Trip Unit - 2nd ST or 2nd UVR	R
3NO+3NC (PR) & CSC, PR (1 NO on SD) - All Installed Devices	S
3NO+3NC (PR) & CSC, HiFi via Trip Unit - All Installed Devices	T
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, PR (1 NO on SD) - All Installed Devices	U
3NO/3NC (PR) + 2NO/2NC (HiFi) & CSC, HiFi via Trip Unit - All Installed Devices	V

Abbreviations:

CC = Closing Coil
 CCC = Command Operated Closing Coil
 HiFi = High Fidelity
 PR = Power Rated
 SD = Secondary Disconnect

Section 5. Catalog Numbering Guide

Digit 13 Bell Alarm / Trip Annunciation

Bell Alarm / Trip Annunciation	Code
Bell Alarm Contact (1NO/1NC) With Lockout	A
Mechanical Operations Counter	B
Bell Alarm Contact With Lockout and MOC	C
RTC Power Rated Contacts on SD	1
RTC Signal Rated (HiFi) Contacts on SD	2
RTC Signal Rated (HiFi) Contacts Through Trip Unit	3
Bell Alarm Contact With Lockout and RTC Power Rated Contacts on SD	D
Bell Alarm Contact With Lockout and RTC Signal Rated (HiFi) Contacts on SD	E
Bell Alarm Contact With Lockout and RTC Signal Rated (HiFi) Through Trip Unit	F
Bell Alarm Contact With Lockout, MOC and RTC Power Rated on SD	G
Bell Alarm Contact With Lockout, MOC and RTC Signal Rated on SD	H
Bell Alarm Contact With Lockout, MOC and RTC Signal Rated (HIFI) Through Trip Unit	J
MOC and RTC Power Rated on SD	K
MOC and RTC Signal Rated on SD	L
MOC and RTC Signal Rated (HIFI) Through Trip Unit	M
Blank/None	X

Abbreviations:

HiFi = High Fidelity

MOC = Mechanical Operations Counter

SD = Secondary Disconnect

Digit 14 Key Interlock

Key Interlock (Breaker Mounted)	Code
Castell Key Interlock	C
Kirk Key Interlock	K
Ronis Key Interlock	R
Profalux Key Interlock	P
Pushbutton Padlock Device	L
Castell Key Interlock and Push Button Padlock Device	1
Kirk Key Interlock and Push Button Padlock Device	2
Ronis Key Interlock and Push Button Padlock Device	3
Blank/None	X

NOTES:

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. **Locks and keys are NOT supplied by GE.**

Digit 15 Future Use

Mechanical Interlocks	Code
Blank/None DEFAULT	X
Mechanical Interlock - Type A	1
Mechanical Interlock - Type B	2
Mechanical Interlock - Type C	3
Mechanical Interlock - Type D	4

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 4.0 meters (ordered separately). Refer to Section 4 for interlocking schemes.

Digit 16 & 17 Overcurrent Protection Package

Type	Package	Code
EntelliGuard G ANSI/UL	LSI (S, switchable) (I, switchable ANSI only)	L3
	LSIG (S, switchable) (I, switchable ANSI only)	L4
	LSIGA (S, switchable) (I, switchable ANSI only)	L5
	LSIC (S, switchable) (I, switchable ANSI only)	L6
	LSICA (S, switchable) (I, switchable ANSI only)	L7
	LSIGDA* (S, G, A all switchable) (I, switchable ANSI only)	L8
	LSIGCDA* (S, G, C, A all switchable) (I, switchable ANSI only)	L9
	LSH (S, switchable) (H, switchable ANSI only)	LC
	LSHG (S, switchable) (H, switchable ANSI only)	LD
	LSHGA (S, switchable) (H, switchable ANSI only)	LE
	LSHC (S, switchable) (H, switchable ANSI only)	LF
	LSHCA (S, switchable) (H, switchable ANSI only)	LG
	LSHGDA* (S, G, A all switchable) (H, switchable ANSI only)	LH
	LSHGDA* (S, G, C, A all switchable) (H, switchable ANSI only)	LK
	G (PB II Switch and EntelliGuard Switch GF Relay only, FUTURE)	LW
	GA (PB II Switch and EntelliGuard Switch GF Relay only, FUTURE)	LY
EntelliGuard G ANSI/UL with Fuse Settings	JSI (S, switchable) (I, switchable ANSI only)	J3
	JSIG (S, switchable) (I, switchable ANSI only)	J4
	JSIGA (S, switchable) (I, switchable ANSI only)	J5
	JSIC (S, switchable) (I, switchable ANSI only)	J6
	JSICA (S, switchable) (I, switchable ANSI 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
	JSH (S, switchable) (H, switchable ANSI only)	JC
	JSHG (S, switchable) (H, switchable ANSI only)	JD
	JSHGA (S, switchable) (H, switchable ANSI only)	JE
	JSHC (S, switchable) (H, switchable ANSI only)	JF
	JSHCA (S, switchable) (H, switchable ANSI only)	JG
	JSHGDA* (S, G, A all switchable) (H, switchable ANSI only)	JH
JSHGDA* (S, G, C, A all switchable) (H, switchable ANSI only)	JK	

*Function combination is NOT UL Listed

NOTES:

OC and protection definitions:

L = Long Time (I²T, all trip units)

J = Long Time Protection (L) + Fuse Settings (Selectable I²T or Fuse Setting)

S = Short Time (switchable if Instantaneous (I) protection is enabled)

I = Standard Range Adjustable Instantaneous, (IOC, 2x-15x)

H = Extended Range Adjustable Instantaneous (IOC, 2x-30x)

G = Ground Fault Protection (GFP, 3-wire or 4-wire, internal summing)

C = External CT for ground fault detection (input from external summing CTs, used for multiple source ground fault detection)

D = Ground Fault Protection, or GF/Earth CT internal summation or external CT, Defeatable/Switchable. Not UL listed

A = Ground Fault, or GF/Earth CT internal summation or external CT, Alarm only

Refer to EntelliGuard Trip Unit Application Guide for detailed descriptions and configuration.

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Digit 18 Zone Selective Interlocking (ZSI)

Zone Selective Interlocking	Code
ZSI, Short time and GF; user selectable	Z
Z + IOC or HIOC ZSI; user selectable	T
Blank/None	X

NOTE:
ALL ZSI selections require Secondary Disconnect Block B and 24Vdc control power.

Digit 19 Advanced Features & Communications

Advanced Features & Communications	Code
Reduced Energy Let-Through (RELT) and Thermal Sensing*	1
Modbus Protocol Only	2
Profibus Protocol Only	3
Monitoring & Data Acquisition, Modbus Protocol	6
Monitoring & Data Acquisition, Profibus Protocol	7
Monitoring & Data Acquisition + Relay Package, Modbus	8
Monitoring & Data Acquisition + Relay Package, Profibus	9

*Option 1 is included in all other Code selections.
NOTE:
ALL Advanced Feature selections require Secondary Disconnect Block B and 24Vdc control power.

Digit 20 Rating Plug

Rating Plug	Cat. No.	Code
150	GTP0150U0404	A
200	GTP0200U0404	B
225	GTP0225U0406	C
250	GTP0250U0407	D
300	GTP0300U0408	E
350	GTP0350U0408	F
400	GTP0400U0410	G
450	GTP0450U0612	H
500	GTP0500U0613	I
600	GTP0600U0616	J
700	GTP0700U0816	L
750	GTP0750U0820	M
800	GTP0800U0820	N
900	GTP0900U1020	O
1000	GTP1000U1025	P
1100	GTP1100U1225	Q
1200	GTP1200U1232	R
1500	GTP1500U1640	T
1600	GTP1600U1640	U
1900	GTP1900U2050	V
2000	GTP2000U2050	W
2200	GTP2200U2550	Y
2400	GTP2400U2564	Z
2500	GTP2500U2564	1
3000	GTP3000U3064	2
3200	GTP3200U3264	3
3600	GTP3600U4064	4
4000	GTP4000U4064	5
5000	GTP5000U5064	6
6000	GTP6000U6064	7
UNIVERSAL	GTP0000U00UU	8

NOTE:
See Section 3 for further details on rating plugs and sensors.



EntelliGuard G Power Circuit Breaker

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:

UL 1066 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 85kA
- Continuously adjustable selective instantaneous as high as 30X the circuit breaker's rating

UL 489 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
- Draw-out 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%, $I_{cs} = I_{cu}$ for all frames
- Withstand capability and selectivity as high as 100kA for 1 second
- Continuously adjustable selective instantaneous as high as 30X the circuit breaker's rating

All Types

- Stationary mounting capability with rear or front connections
- Draw-out mounting with cassette and automatic shutter mechanism
- Complete closed door operation capability – UL 489, 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 UL 1008 transfer switch applications
- Alternate, settable and remote controllable instantaneous pick up with positive feedback
- Industry's only fully controllable ZSI restrained and unrestrained settings
- Industry's only 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 visa 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. UL 1066 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 635 volts. Any UL 1066 listed device must be tested at these higher voltages if listed at the normal nominal voltage of 240, 480 and 600 Volts. UL 489 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.

Figure 6.1

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

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, UL 489 circuit breakers are tested at 20% power factor and UL 1066 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 $\sqrt{2}$, 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 UL 489 rating at

Table 6.1

First Half-Cycle Peak at Specific Fault X/R Ratios
(excerpted from UL 489)

Power Factor	X/R ratio	Maximum Peak @ 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

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 UL 489 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 UL 1066 circuit breaker tested at an X/R ratio of 6.6. The UL 1066 circuit breaker must be de-rated by 2.31/2.46, which yields 0.94. The UL 1066 circuit breaker is then de-rated to 0.94 times 100kA. The UL 1066 circuit breaker is rated higher than the available fault current of 92kA and hence could be considered for the application.

Withstand Ratings, Selective Adjustable-, 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. 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 UL 1066 have defined fault current withstand currents. EntelliGuard G UL 489 Insulated Case Circuit Breakers also have substantial withstand ratings. The stated withstand current (I_{cw}) 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 1/2 second. EntelliGuard G UL 1066 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 UL 1066 circuit breakers. EntelliGuard TU trips offer, for UL 1066 LVPCBs only, an extended instantaneous adjustment range that allows the instantaneous pick up to be continuously adjusted up to 30X, adjustable in 1X increments above 15X the rating plug. The maximum adjustable pick up 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 UL 489 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 UL 1066 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 pick up. This trip offers a faster algorithm suitable for application as alternate instantaneous pick up setting for temporary use when faster and more

Section 6. Application Data

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 24V ac/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 24V ac/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 Tables 6.2A-C. 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 6.2A

EntelliGuard G Circuit Breaker Close and Latch Ratings, UL 489 Listed

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

Table 6.2B

EntelliGuard G Circuit Breaker Close and Latch Ratings, UL 1066 Listed

Envelope	Amps	Type	Close and Latch Rating (kA)
1	800 - 2000	N, H	42
2	800 - 3000	N, E, M	65
3	4000 - 6000	M, B	85
		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. Tables 6.3A-C describe the endurance parameters for the circuit breaker family.

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.

Table 6.2C

EntelliGuard G Non-Automatic Switch Close and Latch Ratings, UL 489 Listed

Envelope	Amps	Type	Close and Latch Rating (kA)
1	800 - 2000	N	42
2	3000	H	65
3	4000 - 6000	L	85

Selecting a Circuit Breaker for an Application

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

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:

$$CR = I_A \times A \times B \times C \times D \times E \times F$$

CR Required circuit breaker current rating, amps

I_A 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 UL 489 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 of an EntelliGuard G breaker should not be less than -20°C nor exceed +70°C.

Table 6.3A

Operational Ratings, UL 489 Circuit Breakers

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

Table 6.3B

Operational Ratings, UL 1066/ANSI Circuit Breakers

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

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 6.4.

Operating Frequency – Factor “C”

All UL EntelliGuard circuit breakers may be applied at their published ratings on 50 Hz and 60 Hz power systems. At nominal system frequencies less than 50 Hz 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 60 Hz 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 50 Hz and 60 Hz, the operating frequency rating Factor “C” = 1.00. For operating frequencies other than 50 Hz and 60 Hz, contact your GE applications engineer.

Altitude – Factor “D”

EntelliGuard G UL circuit breakers are designed for operation at altitudes from sea level to 6000 feet (1800 meters). Reduced air densities at altitudes above 6000 feet 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 6.5.

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 application are listed in Table 6.6.

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 except for the 6000A stationary mounted UL 489 circuit breaker. 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 over-current 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 3.11 you will find the sensors available on a per frame basis. Table 3.9 identifies the trip rating plugs available for each sensor. Table 6.7 identifies the relationship between specific circuit breakers and trip parameters.

Section 6. Application Data

Table 6.3C

Operational Ratings, IEC Circuit Breakers

Envelope	Frame	Mechanical Operations - No Maintenance	Mechanical Operations - With Maintenance	Electrical Operations - No Maintenance		
				440V AC	690V AC	1000V AC
1	400-1600A	12500	20000	10000	8000	500
	2000A	12500	20000	8000	6000	500
2	800-1600A	10000	20000	10000	8000	500
	800-1600A	5000	10000	5000	5000	500
	2000-2500A	10000	20000	6000	5000	500
	2000-2500A	5000	10000	5000	5000	500
	3200-4000A	10000	20000	5000	2500	500
	3200-4000A	5000	10000	5000	2500	500
3	4000A	5000	10000	2500	1500	500
	5000A	5000	10000	1500	1000	300
	6400A	5000	10000	1500	1000	300

Table 6.4

Factor "B" – Ambient Temperature Rating Factor

Ambient Temperature, °C ¹	Maximum Wire Insulating Rating °C ²	Factor B
25	75	1
40	90	1
50	105	1
60	125	1.1
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.

Table 6.5

Factor "D" – Altitude

Altitude		Factor D
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

Table 6.6

Factor "E" – Load Class Rating

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	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.

Table 6.7

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 Pick Up	LTPU	LTPU	Plug x pick up setting
Short Time Pick Up	STPU	STPU	1.5X - 12X of the LTPU
Instantaneous Pick Up	IPU	I	2X -15 or 30X of the trip current rating plug
Maximum Achievable Selectivity	= I _{cw}	N/A	Function of the withstand rating
Ground Fault Pick Up	GF	GF	20-60% sensor, <1200A
Override Pick Up	HSIOC	N/A	Function of the withstand rating
Making Current Release	MCR	N/A	Function of the close and latch rating



EntelliGuard G Power Circuit Breaker Section 7. Physical Data

Dimensions & Weights

To download detailed drawings, visit www.geelectrical.com.

Dimensions in inches are approximate and rounded. Dimensional tolerances are ± 1 mm.

3-pole, UL/ANSI

Type	Design	Width		Depth		Height		Weight	
		in.	mm	in.	mm	in.	mm	lbs	kg
Envelope 1, Side-mounted Secondary Disconnects (400 - 2000A, Type N, H)	Fixed/Stationary	13	342	14	356	15	387	95	43
	Draw-out	13	342	16	416	15	387	106	48
	Cassette/Substructure	16	409	17	430	16	406	75	34
Envelope 1, Top-mounted Secondary Disconnects (400 - 2000A, Type N, H)	Fixed/Stationary								
	Draw-out								
	Cassette/Substructure								
Envelope 2 (400 - 3200A, Type E, M)	Fixed/Stationary	17	432	14	356	17	442	117	53
	Draw-out	17	432	16	416	17	442	139	63
	Cassette/Substructure	17	443	17	430	17	444	150	68
Envelope 3 (3000 - 6000, Type M, B, L)	Fixed/Stationary	29	737	14	356	17	442	172	78
	Draw-out	23	573	16	416	17	442	190	86
	Cassette/Substructure	29	743	17	430	17	444	198	90

4-pole, UL/ANSI

Type	Design	Width		Depth		Height		Weight	
		in.	mm	in.	mm	in.	mm	lbs	kg
Envelope 1, Side-mounted Secondary Disconnects (400 - 2000A, Type N, H)	Fixed/Stationary	17	442	14	356	15	387	119	54
	Draw-out	17	442	16	416	15	387	130	59
	Cassette/Substructure	20	509	17	430	16	406	90	41
Envelope 1, Top-mounted Secondary Disconnects (400 - 2000A, Type N, H)	Fixed/Stationary								
	Draw-out								
	Cassette/Substructure								
Envelope 2 (400 - 3200A, Type E, M)	Fixed/Stationary	22	562	14	356	17	442	150	68
	Draw-out	22	562	16	416	17	442	172	78
	Cassette/Substructure	23	573	17	430	17	444	190	86
Envelope 3 (3000 - 6000, Type M, B, L)	Fixed/Stationary	38	967	14	356	17	442	231	105
	Draw-out	29	743	16	416	17	442	254	115
	Cassette/Substructure	38	973	17	430	17	444	254	115



EntelliGuard G Power Circuit Breaker Section 8. Standards and References

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 Manufacturers 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 Temperature

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 Lloyd, 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





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