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Power Xpert IGX 5-38 kV, compact arc-resistant medium-voltage switchgear

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General Description

Eaton's Power Xpert® IGX compact switchgear provides centralized control and protection of medium-voltage power equipment and circuits in industrial, commercial and utility installations involving generators, motors, feeder circuits, and transmission and distribution lines. Eaton's Power Xpert IGX compact switchgear is an integrated assembly of switches, bus and vacuum circuit breakers. All structures use single-high breaker arrangements.

Power Xpert IGX uses an isolated-phase design for medium-voltage components, where all major primary circuit components are isolated from each other by grounded metal barriers. An isolated phase design minimizes the likelihood of arcing faults and propagation of faults between compartments containing primary circuit components.

Ratings

- Maximum voltage:
  5 kV, 15 kV, 27 kV, 38 kV
- Interrupting ratings:
  25 kA, 31.5 kA, 40 kA
- Continuous current—circuit breakers:
  1200 A, 2000 A, 2500 A, 3000 A
- Continuous current—main bus:
  1200 A, 2000 A, 2500 A, 3000 A
- Frequency: 50/60 Hz

Additional medium-voltage switchgear offerings:

- 5–38 kV XGIS compact switchgear
- 5–38 kV metal-clad switchgear
- 5–38 kV arc resistant metal-clad switchgear

Power Xpert IGX Compact Switchgear

Standards and Certifications

- IEEE® C37.20.9
- IEEE C37.20.7Type 2B
- IEEE C37.20.4
- IEEE Std 693
- CSA® C22.2 No 31
- IEC 62271-1
- IEC 62271-100
- IEC 62271-102
- IEC 62271-200, LSC2B and AFLR
- IEC 60529, IP3X, IP4X
- UL® listed
- IBC/CBC seismic qualification

Features and Benefits

- Reduced footprint
- Option for installation against a wall reduces installation footprint on-site
- Maintenance requirements are minimized by long-life vacuum interrupters sealed from environment
- Hermetically sealed medium-voltage components are maintenance-free for the life of the equipment
- IGX uses exterior steel enclosure
  - ❏ Rodent-proof
  - ❏ Rear, side and top arc duct
  - ❏ Front-accessible low-voltage controls and operating mechanisms
  - ❏ No plenum

Advantages

Eaton has been manufacturing medium-voltage switchgear for over 60 years. Eaton's vacuum interrupters are second to none, with hundreds of thousands currently in operation. With reliability as a fundamental goal, Eaton engineers have simplified the IGX switchgear design to minimize risk and maximize performance. Special attention was given to material quality and maximum use of components proven over the years in Eaton's extensive medium-voltage switchgear product portfolio.

Arc-Resistant Switchgear

Eaton is the first major manufacturer to design, test and manufacture arc-resistant switchgear in accordance with IEEE C37.20.7.

Arc-Resistant Switchgear—Accessibility Types

Arc-resistant switchgear performance is defined by its accessibility type in accordance with IEEE test guide C37.20.7 as follows:

- Type 1—Switchgear with arc-resistant designs or features at the freely accessible front of the equipment only
- Type 2—Switchgear with arc-resistant designs or features at the freely accessible exterior (front, back and sides) of the equipment only (Type 2 incorporates Type 1)
- Type 2B—Switchgear with Type 2 accessibility plus arc-resistant in front of the instrument/control compartment with the instrument/control compartment door opened (Type 2B incorporates Type 2)

Eaton's 5, 15, 27 and 38 kV Power Xpert IGX switchgear is designed and tested for IEEE Type 2B accessibility.

Arc-resistant features are intended to provide an additional degree of protection to the personnel performing normal operating duties in close proximity to the equipment while the equipment is operating under normal conditions. The normal operating conditions for proper application of arc-resistant switchgear designs are as follows:

- All covers providing access to high-voltage components are properly installed
- The fault energy available to the equipment does not exceed the rating of the equipment (short-circuit current and duration)
- There are no obstructions around the equipment that could direct the arc fault products into an area intended to be protected
- The equipment is properly grounded

The user should also refer to documents such as NFPA 70E® for safety training and safe work practices and methods of evaluating safe work distances from energized equipment based on the potential flash hazard, and use proper personnel protective equipment (PPE) when working on or near energized equipment with the door/cover opened or not properly secured

Eaton's compact switchgear conforms to IEEE C37.20.9 and is tested as such for short time and momentary short-circuit withstand for through bolted fault. In addition, the enclosure is also tested in accordance with IEEE guide C37.20.7 for withstand against the effects of internal arcing faults as shown in **Figure 12.2-1**.

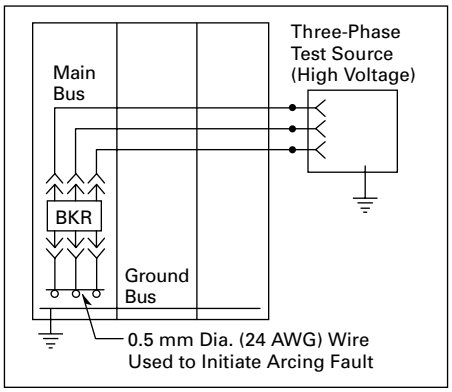


Figure 12.2-1. Arc-Resistant Switchgear Enclosure Internal Arcing Test Circuit

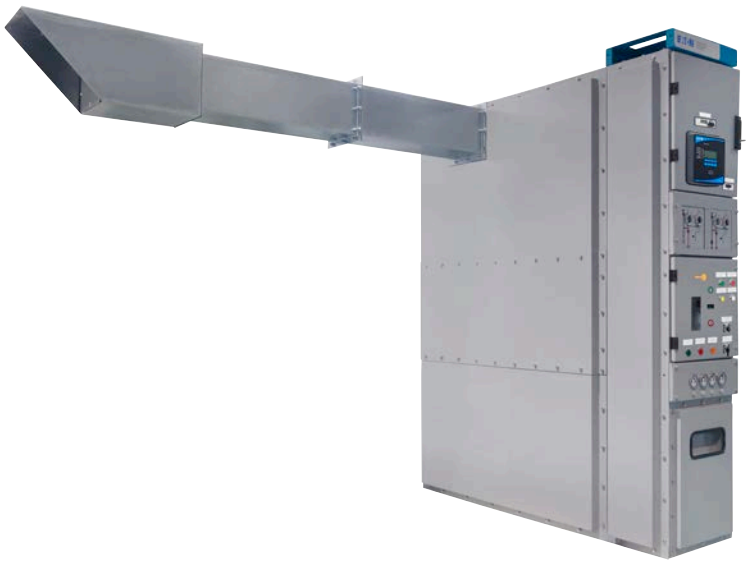
Internal arcing faults are those faults occurring in air, phase-to-phase or phase-to-ground, within the confines of the switchgear enclosure. Arcing faults can occur within a switchgear compartment as a result of insulation failure or human error. The arcing fault produces a tremendous release of heat energy at the point of the fault, which heats and expands the air volume within the enclosure, and may decompose or vaporize materials exposed to an arc or involved in its path.

The effects of this type of fault vary depending on enclosure volume, arc duration, arc voltage and available short-circuit current. If the switchgear is not designed and tested to withstand effects of internal arcing faults, enclosure parts can be ejected along with discharge of hot decomposed matter, gaseous or particulate, causing injury to personnel that may be present in its vicinity. Arc-resistant switchgear is designed to channel and control effects of the arcing fault and its enclosure is tested for withstand against such fault in accordance with IEEE guide C37.20.7.

Arc-Resistant Enclosure and Arc Exhaust

IGX arc-resistant switchgear is designed to withstand effects of internal arcing faults up to its rated arc short-circuit current and duration. Following are standard design features built into each arc-resistant switchgear assembly.

- The formed steel enclosure design provides sealed joints under fault conditions; this prevents smoke and gas (hazardous bi-products) from escaping the enclosure
- Integral, pressure relief devices provide a controlled release of arc-created overpressure, fire, smoke, gases and molten material out of the assembly without affecting structural integrity, protecting personnel who might be present in the vicinity of the switchgear
- Fully enclosed bottom plates do not require a cable vault for arc exhaust and prevent hazardous byproducts from entering cable areas



Arc-Resistant Enclosure and Arc Exhaust

Switchgear Construction

Eaton's Power Xpert IGX medium-voltage switchgear is an integrated assembly of vacuum circuit breaker, three-position switch, main bus voltage transformer, medium-voltage cable compartment and low-voltage controls. The assembly uses an isolated phase construction, fully isolating each phase bus, switch and breaker from adjacent phases. All low-voltage controls and device-operating mechanisms are front accessible.

Medium-voltage circuit breakers are fixed in sealed compartments and do not need to be accessed for routine maintenance. Medium-voltage circuit breakers have single-high configurations. IGX is built to allow replacement of vertical structures without displacing adjacent vertical structures.

Low-voltage compartments are located at the front of the switchgear and house all necessary components and controls including meters and relays.

Additional height can be added to the structure to increase the size of the low-voltage compartment. Additional control equipment that exceeds the available space in the low-voltage compartment can be installed in an additional vertical structure(s) designated for low-voltage devices. Above the low-voltage compartment is a horizontal wireway where low-voltage conductors can enter the switchgear.

Access to operate, monitor and view device status is completely front accessible, removing the need for rear or side access.

The medium-voltage cable compartment is in the lower section of the switchgear and all medium-voltage cable connections are bottom entry. A bolted cover is used to access connected cables. Each structure requires additional space underneath the equipment for cable entry and installation once on-site. This additional cable space can be accomplished with a cable vault, raising the equipment and/or electrical house above grade, or installing the switchgear on a platform to raise it above the floor. For more information, see Application Details section.

Power Xpert IGX compact arc-resistant switchgear is available for application at voltages up to 38 kV, 50 Hz or 60 Hz. Refer to **Table 12.2-1** for complete list of available ratings.

Table 12.2-1. Power Xpert IGX Compact Arc-Resistant MV Switchgear Ratings ①

Rated Maximum Voltage	Rated Short-Time Short-Circuit Current Withstand (3-second)	Lightning Impulse Withstand Voltage (BIL)	Power Frequency Withstand	Rated Main Bus Continuous Current Amperes
kV rms	kA rms Sym.	kV Peak	kV rms	Amperes
4.76	40	60	19	1200
	40	60	19	2000
	40	60	19	2500
	40	60	19	3000 ②
15	40	95	36	1200
	40	95	36	2000
	40	95	36	2500
	40	95	36	3000 ②
27	40	125	60	1200
	40	125	60	2000
	40	125	60	2500
	40	125	60	3000 ②
38	40	200	80	1200
	40	200	80	2000
	40	200	80	2500
	40	200	80	3000 ②

① Switchgear assemblies can be supplied with UL/CSA label.
② Contact Eaton for 3000 A.

Usual and Unusual Service Conditions

Usual Service Conditions

Usual service conditions for operation of IGX switchgear are as follows:

- Altitude does not exceed 3300 feet (1000 m)
- Ambient temperature within the limits of –5 °C and +40 °C (+23 °F and +104 °F)
- The effect of solar radiation is not significant

Unusual Service Conditions

Applications of switchgear at other than usual altitude or temperature, or where solar radiation is significant, require special consideration. Other unusual service conditions that may affect design and application include:

- Exposure to salt air, hot or humid climate, excessive dust, dripping water, falling dirt, or other similar conditions
- Unusual transportation or storage conditions
- Switchgear assemblies when used as the service disconnecting means
- Installations accessible to the general public
- Exposure to seismic shock
- Exposure to nuclear radiation

Applications Above 3300 Feet (1006 m)

Equipment utilizing sealed interrupting devices (such as vacuum interrupters) does not require derating of rated maximum voltage. The rated one-minute power frequency withstand voltage, the impulse withstand voltage and the continuous current rating must be multiplied by the appropriate correction factor in **Table 12.2-2** to obtain modified ratings that must equal or exceed the application requirements.

Note: Intermediate values may be obtained by interpolation.

Table 12.2-2. Altitude Derating Factors

Altitude Above Sea Level in Feet (m)	Altitude Correction Factor to be Applied to Rated Continuous Current
3300 (1006) (and Below)	1.0
4000 (1219)	0.995
5000 (1524)	0.991
6000 (1829)	0.987
6600 (2012)	0.985
7000 (2137)	0.98
8000 (2438)	0.97
9000 (2743)	0.965
10,000 (3048)	0.96
12,000 (3658)	0.95
13,200 (4023)	0.94
14,000 (4267)	0.935
16,000 (4877)	0.925
16,400 (5000)	0.92

Applications Above or Below 40 °C Ambient

Refer to ANSI C37.20.2, Section 8.4 for load current-carrying capabilities under various conditions of ambient temperature and load.

Applications at Frequencies Less Than 60 Hz

Rated Short-Circuit Current

Based on series of actual tests performed on Eaton circuit breakers and analysis of these test data and physics of vacuum interrupters, it has been found that the current interruption limit for Eaton circuit breakers is proportional to the square root of the frequency. **Table 12.2-3** provides derating factors, which must be applied to breaker interrupting current at various frequencies.

Table 12.2-3. Derating Factors

Interrupting Current Derating Factors			
50 Hz	**25 Hz**	**16 Hz**	**12 Hz**
None	0.65	0.52	0.45

Rated Short-Time and Close and Latch Currents

No derating is required for short time and close and latch current at lower frequency.

Rated Continuous Current

Because the effective resistance of circuit conductors is less at lower frequency, continuous current through the circuit can be increased somewhat. **Table 12.2-4** provides nominal current rating for IGX breakers when operated at frequencies below 60 Hz.

Table 12.2-4. Current Ratings

Rated Continuous Current at 60 Hz	Nominal Current at Frequency Below 60 Hz			
	50 Hz	**25 Hz**	**16 Hz**	**12 Hz**
1200 A	1243	1410	1519	1589
2000 A	2075	2374	2573	2703
2500 A	2597	2985	3248	3421
3000 A	3119	3597	3923	4139

Power Frequency and Impulse Withstand Voltage Ratings

No derating is required for lower frequency.

Current Transformers, Voltage Transformers, Relays and Instruments

Application at frequency other than rated frequency must be verified for each device on an individual basis.

IGX Circuit Breakers

Eaton's Power Xpert IGX medium-voltage circuit breakers offer the latest in vacuum technology, providing superior control and protection of medium-voltage power equipment in utility, industrial, commercial, mining and marine installations. Built in a state-of-the-art ISO® 9002 certified facility, Power Xpert IGX meets or exceeds all IEEE and IEC requirements. Eaton's vacuum circuit breakers are a result of our ongoing commitment to research and development, which have resulted in significant breakthrough technologies.

The circuit breaker and three-position switch are both mechanically and electrically interlocked. While the breaker is in the closed position, the three-position switch cannot be operated manually or electrically. See **Table 12.2-6** for circuit breaker ratings.

IGX Circuit Breaker Standard Features

- Eaton's maintenance-free vacuum interrupters
- Front-accessible operating mechanism
- Electrically operated trip-free, spring-stored energy mechanism
- Provisions for manual charging of closing springs
- Manual close and trip pushbuttons
- Operations counter
- Closing spring charged/discharged indicator
- Circuit breaker Open/Closed indicator
- Auxiliary switch with 8A/8B spare contacts for breaker status
- Auxiliary switch 2A/2B spare contacts for closing spring charge status
- Spring charging motor, close coil, trip coil, latch check switch and anti-pump relay
- Vacuum interrupters are in sealed compartment
- The spring charging mechanisms can be accessed by opening the bolted hinged steel circuit breaker cover
- Circuit breaker contacts must return to the open position and remain there when an opening operation follows a closing operation, regardless of whether the closing signal is maintained
- Interlock mechanism to prevent unintentional tripping the breaker while assembly is grounded

Three-Position Switch

The three-position switch is in a sealed cast enclosure and the operating mechanism is located on the front of the enclosure. The switch has three distinct limit positions: connect, disconnect and ready-to-ground. It is a non-load-break device, intended to provide visual indication of no-load (isolated circuit) conditions. The switch can be operated electrically by front-accessible controls remotely or manually by T-handle accessory provided with the switchgear. See **Table 12.2-5** for three-position switch ratings.

A camera system is provided to observe the status of the three-position switch. The camera allows you to view the status of the switch in real time and can be accessed through an Ethernet port located on the front of the structure. The camera system viewer software is provided with each switchgear assembly.

Table 12.2-5. Three-Position Switch Ratings

Rated Maximum Voltage kV rms	Continuous Current Amperes	Mechanical Operations
5, 15, 27, 38	1200	2000
5, 15, 27, 38	2000, 2500, 3000	2000

Voltage Detection System

Each vertical structure contains a voltage detection system to detect the voltage presence at medium-voltage cable connections. The voltage detection system is standard on the cable side of main and feeder breakers. For main-tie-main configurations, voltage detection is standard on both sides of the tie. A voltage detection system for main bus is optional.

The voltage detection system interacts directly with circuit breaker interlocks to prevent closing the circuit breaker when the three-position switch is in the ground position and voltage is present on the portion of the circuit intended to be grounded.

Table 12.2-6. Available Vacuum Circuit Breaker Types Rated on Symmetrical Current Rating Basis, Per IEEE C37.04 and C37.09 Standards

Rated Maximum Voltage kV rms	Rated Continuous Current Amperes	Rated Short-Time Short-Circuit Current Withstand (3-second) kA rms Sym.	Peak Withstand Current kA	Breaking Capacity kA	Mechanical Operations	Cable Charging Current Amperes	Back-to-Back Capacitor Bank Inrush Current Peak kA	Back-to-Back Capacitor Bank Inrush Current Frequency Hz	Back-to-Back Capacitor Bank Current Amperes
5, 15, 27, 38 5, 15, 27, 38	1200 2000	40 40	104 104	40 40	10,000 10,000	50 50	6 6	500 500	1000 1000
5, 15, 27, 38 5, 15, 27, 38	2500 3000 ①	40 40	104 104	40 40	10,000 10,000	50 50	6 6	500 500	1000 1000

① Contact Eaton for 3000 A.

Switchgear Meters

Switchgear Meters

Eaton's Power Xpert Power and Energy Meters, and Power Xpert Dashboard products allow switchgear owners and operators to interface with their equipment at varying levels of sophistication. To learn more about these devices, visit Eaton.com.

Protective Relays

Protective Relays

Eaton can provide a wide range of protective relays to meet your most complex protection and system needs.

Instrument Transformers

Instrument transformers are used to protect personnel and secondary devices from high voltage, and permit use of reasonable insulation levels for relays, meters and instruments. The secondaries of standard instrument transformers are rated at 5 A and/or 120 V, 60 Hz.

Voltage Transformers

Power Xpert IGX voltage transformers (VTs) are designed according to IEEE standards. VTs are metal-encased single-pole transformers, insulated and cast with epoxy resin. The resin body is covered with a welded grounded aluminum box. The VTs are suitable for installation inside or remote of the switchgear and meet all relevant standards.

IGX VTs are furnished with primary fuses per IEEE. VTs can be top mounted, remote mounted or bottom mounted as space allows within each vertical structure.

Top-mounted VTs are hard bus connected to main bus. VTs are contained in an enclosed top-accessible auxiliary compartment to allow removal of the VT or fuse, if required. Main bus, top-mounted VTs can be isolated or grounded with a dedicated three-position switch. Remote-mounted and bottom-mounted VTs are cable connected. See **Table 12.2-7** for VT three-position switch information.

Selection of the ratio for VTs is seldom a question because the primary rating should be equal to or higher than the system line-to-line voltage.

VTs are connected line-to-ground and provide phase-to-phase (Vab, Vbc, Vca), as well as phase-to-ground (Va, Vb, Vc) voltages for metering and relaying.

Table 12.2-7. VT Three-Position Switch Operations

Rated Maximum Voltage kV rms	Mechanical Operations
5, 15, 27, 38	1000

Current Transformers

Power Xpert IGX current transformers (CTs) are designed according to IEEE standards. Instrument transformers can be mounted on the cable side and on the main bus. See **Table 12.2-8** and **Table 12.2-9** for CT options.

The CT ratio is generally selected so that the maximum load current will read about 70% full scale on a standard 5 A coil ammeter. Therefore, the CT primary rating should be 140–150% of the maximum load current.

Maximum system fault current can sometimes influence the CT ratio selection because the connected secondary devices have published one-second ratings.

The zero-sequence CT is used for sensitive ground fault relaying or self-balancing primary current type machine differential protection. The zero-sequence CT is available with a nominal ratio of 50/5 or 100/5 and available opening size for power cables of 7.25 inches (184.2 mm). Special zero-sequence transformers with larger windows are also available.

The minimum number of CTs for circuit relaying and instruments is three—one for each phase or two-phase connected CTs and one zero-sequence CT. Separate sets of CTs are required for differential relays.

The minimum pickup of a ground relay in the residual of three-phase connected CTs is primarily determined by the CT ratio. The relay pickup can be reduced by adding one residual-connected auxiliary CT. This connection is very desirable on main incoming and tie circuits of low resistance grounded circuits. Standard accuracy CTs are normally more than adequate for most standard applications of microprocessor-based protective relays and meters. See **Table 12.2-8** and **Table 12.2-9** for CT accuracy information.

Table 12.2-8. IGX Current Transformers for Main Bus Applications ①②③

Current Ratio	ANSI Relay Class	ANSI Metering Accuracy					Thermal Rating Factor at 30 °C	CT Depth Inches (mm)
		B0.1	B0.2	B0.5	B0.9	B1.8		
100/5	C10	1.2	2.4	4.8	—	—	2.00	3.00 (76.2)
150/5	C10	0.6	1.2	2.4	4.8	—	2.00	3.00 (76.2)
200/5	C20	0.6	0.6	1.2	2.4	4.8	2.00	3.00 (76.2)
250/5	C20	0.6	0.6	1.2	2.4	2.4	2.00	3.00 (76.2)
300/5	C20	0.3	0.3	0.6	1.2	2.4	2.00	3.00 (76.2)
400/5	C20	0.3	0.3	0.6	0.6	1.2	2.00	3.00 (76.2)
500/5	C50	0.3	0.3	0.3	0.6	1.2	2.00	3.00 (76.2)
600/5	C50	0.3	0.3	0.3	0.3	0.6	2.00	3.00 (76.2)
750/5	C50	0.3	0.3	0.3	0.3	0.6	2.00	3.00 (76.2)
800/5	C50	0.3	0.3	0.3	0.3	0.6	2.00	3.00 (76.2)
1000/5	C100	0.3	0.3	0.3	0.3	0.3	1.50	3.00 (76.2)
1200/5	C100	0.3	0.3	0.3	0.3	0.3	1.50	3.00 (76.2)
1500/5	C100	0.3	0.3	0.3	0.3	0.3	1.50	3.00 (76.2)
1600/5	C100	0.3	0.3	0.3	0.3	0.3	1.50	3.00 (76.2)
2000/5	C100	0.3	0.3	0.3	0.3	0.3	1.33	3.00 (76.2)
2500/5	C200	0.3	0.3	0.3	0.3	0.3	1.00	3.00 (76.2)
3000/5	C200	0.3	0.3	0.3	0.3	0.3	1.00	3.00 (76.2)
3200/5	C200	0.3	0.3	0.3	0.3	0.3	1.00	3.00 (76.2)
3500/5	C200	0.3	0.3	0.3	0.3	0.3	1.00	3.00 (76.2)
4000/5	C200	0.3	0.3	0.3	0.3	0.3	1.00	3.00 (76.2)
50/5	C10	2.4	4.8	—	—	—	1.33	3.50 (88.9)
75/5	C10	1.2	2.4	4.8	—	—	1.33	3.50 (88.9)
100/5	C20	1.2	1.2	4.8	4.8	—	1.33	3.50 (88.9)
150/5	C20	0.6	0.6	1.2	2.4	4.8	1.33	3.50 (88.9)
200/5	C20	0.3	0.6	1.2	1.2	2.4	1.33	3.50 (88.9)
250/5	C50	0.3	0.3	0.6	0.6	1.2	1.33	3.50 (88.9)
300/5	C50	0.3	0.3	0.6	0.6	1.2	1.33	3.50 (88.9)
400/5	C100	0.3	0.3	0.3	0.6	0.6	1.33	3.50 (88.9)
500/5	C100	0.3	0.3	0.3	0.3	0.6	1.33	3.50 (88.9)
600/5	C100	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
800/5	C200	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
1000/5	C200	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
1200/5	C200	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
1500/5	C200	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
1600/5	C200	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
2000/5	C200	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
2500/5	C400	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
3000/5	C400	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
3200/5	C400	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)
4000/5	C400	0.3	0.3	0.3	0.3	0.3	1.33	3.50 (88.9)

① Maximum quantity of main bus CTs between a 20-inch (500 mm) and 32-inch (800 mm) wide structure is two.
② Maximum quantity of main bus CTs between two 32-inch (800 mm) wide structures is four.
③ Main bus CTs are not available between 20-inch (500 mm) wide structures.

Table 12.2-9. IGX Current Transformers for Cable Applications ①②

Current Ratio	ANSI Relay Class	ANSI Metering Accuracy at 60 Hz					Thermal Rating Factor at 30 °C	CT Depth Inches (mm)
		B0.1	B0.2	B0.5	B0.9	B1.8		
300/5	C20	0.6	1.2	2.4	2.4	—	1.50	3.75 (95.3)
400/5	C50	0.3	0.6	1.2	1.2	2.4	1.50	4.73 (120.1)
600/5	C50	0.3	0.3	1.2	1.2	2.4	1.50	3.75 (95.3)
600/5 MR	C50	0.3	0.3	1.2	1.2	2.4	1.50	3.75 (95.3)
800/5	C50	0.3	0.3	0.3	0.6	1.2	1.50	3.75 (95.3)
1200/5	C100	0.3	0.3	0.3	0.3	0.3	1.50	4.73 (120.1)
1200/5 MR	C100	0.3	0.3	0.3	0.3	0.6	1.50	3.75 (95.3)
1500/5	C100	0.3	0.3	0.3	0.3	0.3	1.50	3.75 (95.3)
2000/5	C100	0.3	0.3	0.3	0.3	0.3	1.50	2.76 (70.1)
2000/5 MR	C100	0.3	0.3	0.3	0.3	0.3	1.50	2.76 (70.1)
3000/5	C100	0.3	0.3	0.3	0.3	0.3	1.33	2.76 (70.1)
3000/5 MR	C100	0.3	0.3	0.3	0.3	0.3	1.33	2.76 (70.1)
3500/5	C100	0.3	0.3	0.3	0.3	0.3	1.33	2.76 (70.1)
4000/5	C100	0.3	0.3	0.3	0.3	0.3	1.33	2.76 (70.1)
4000/5 MR	C100	0.3	0.3	0.3	0.3	0.3	1.33	2.76 (70.1)
600/5	C100	0.3	0.3	0.6	0.6	1.2	1.50	5.25 (133.4)
600/5 MR	C100	0.3	0.3	0.6	0.6	0.6	1.50	5.25 (133.4)
800/5	C100	0.3	0.3	0.3	0.6	0.6	1.50	5.25 (133.4)
1200/5	C200	0.3	0.3	0.3	0.3	0.3	1.50	5.25 (133.4)
1200/5 MR	C200	0.3	0.3	0.3	0.3	0.3	1.50	5.25 (133.4)
1500/5	C200	0.3	0.3	0.3	0.3	0.3	1.50	5.25 (133.4)
2000/5	C300	0.3	0.3	0.3	0.3	0.3	1.50	5.25 (133.4)
2000/5 MR	C300	0.3	0.3	0.3	0.3	0.3	1.50	5.25 (133.4)
3000/5	C400	0.3	0.3	0.3	0.3	0.3	1.33	5.25 (133.4)
3000/5 MR	C400	0.3	0.3	0.3	0.3	0.3	1.33	5.25 (133.4)
3500/5	C400	0.3	0.3	0.3	0.3	0.3	1.33	5.25 (133.4)
4000/5	C400	0.3	0.3	0.3	0.3	0.3	1.33	5.25 (133.4)
4000/5 MR	C400	0.3	0.3	0.3	0.3	0.3	1.33	5.25 (133.4)

① Maximum available depth for mounting CTs on a small cable drum is 10.50 inches (266.7 mm). Any combination of CTs can be used as long as the sum of total depth does not exceed this maximum available depth dimension.

② Maximum available depth for mounting CTs on a large cable drum is 7.50 inches (190.5 mm). Any combination of CTs can be used as long as the sum of total depth does not exceed this maximum available depth dimension.

Standard Layouts

Typical Application Layouts

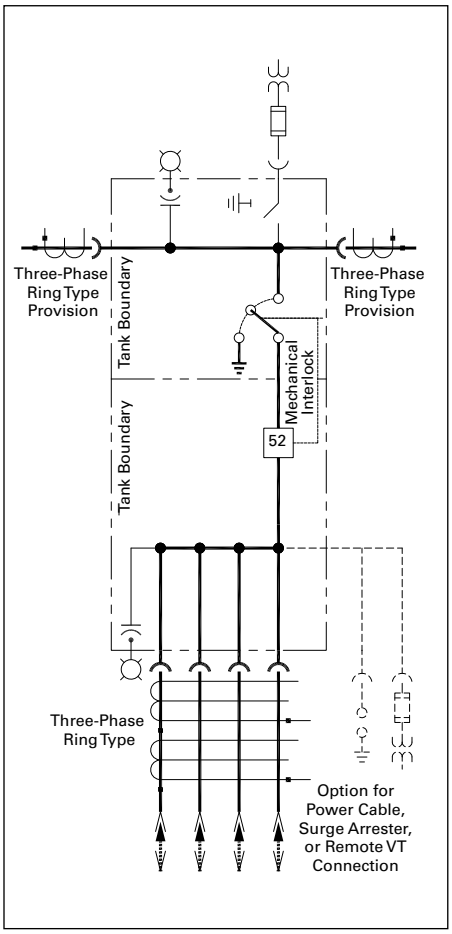


Figure 12.2-2. Main/Feeder With Main Bus VT

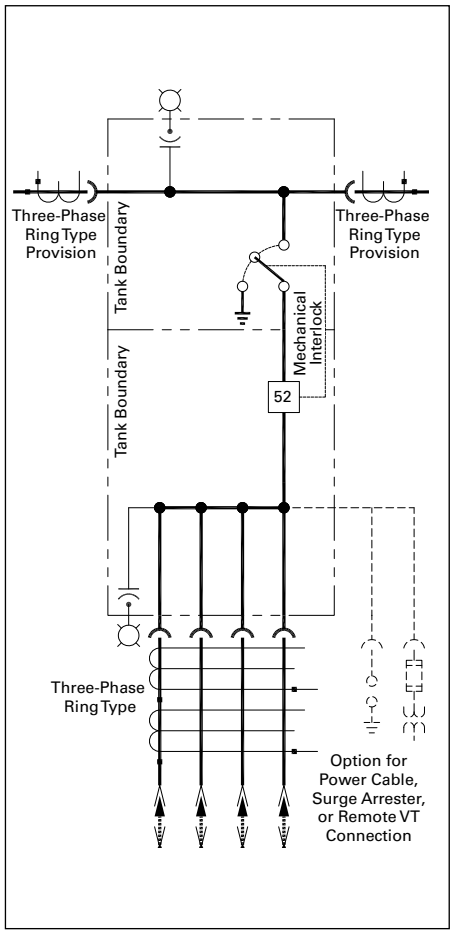


Figure 12.2-3. Main/Feeder

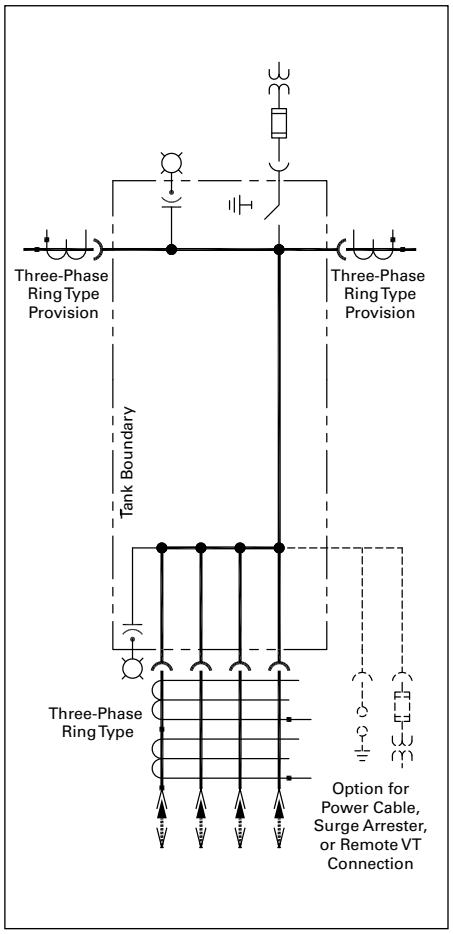


Figure 12.2-4. Direct Cable Connection With Main Bus VT

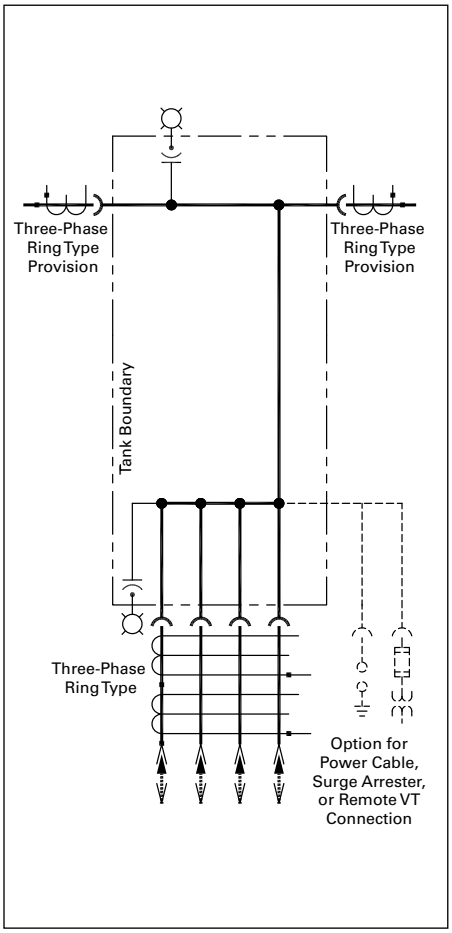


Figure 12.2-5. Direct Cable Connection to Main Bus

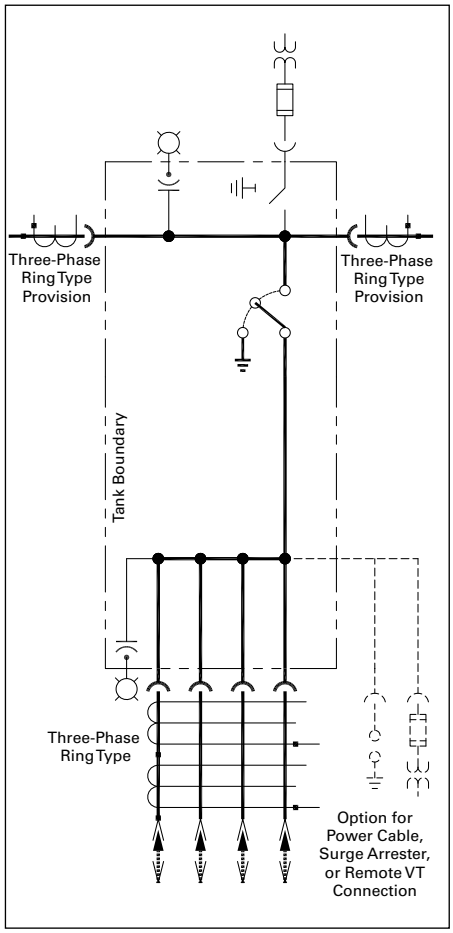


Figure 12.2-6. Cable Connection to Main Bus With Three-Position Switch and Main Bus VT

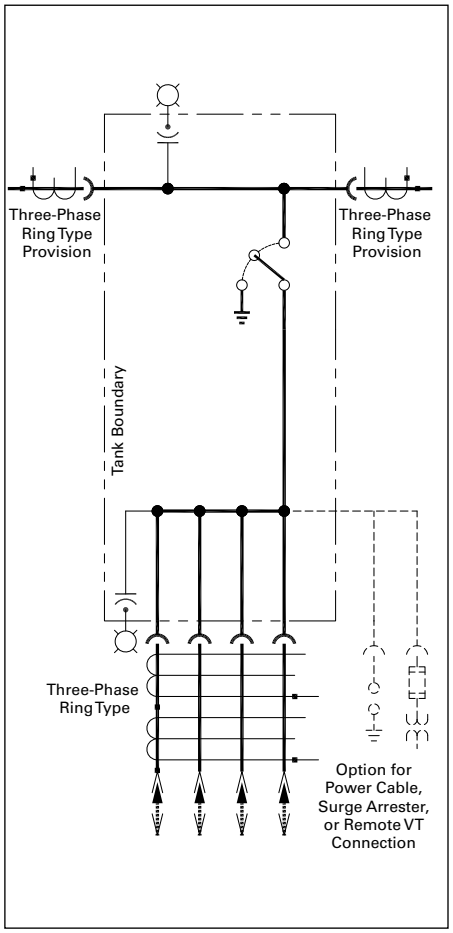


Figure 12.2-7. Cable Connection to Main Bus With Three-Position Switch

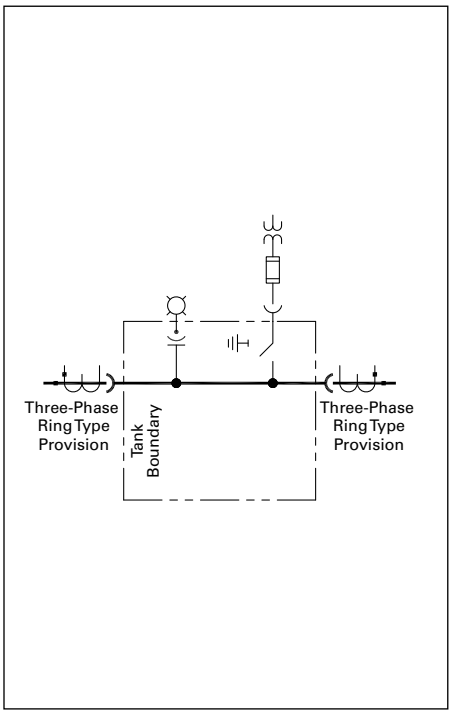


Figure 12.2-8. Main Bus With Main Bus VT

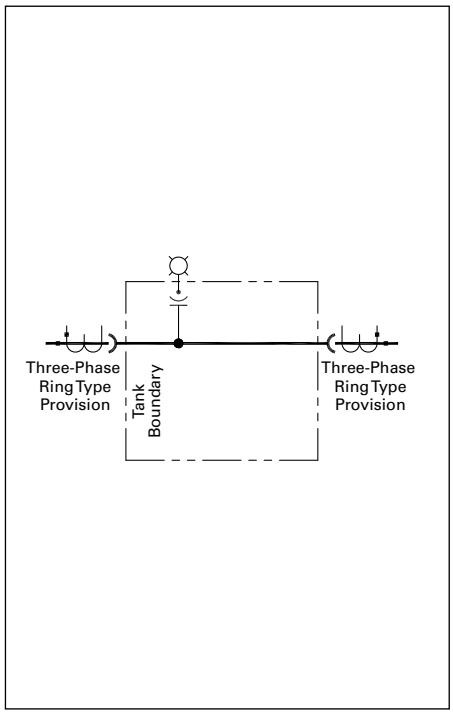


Figure 12.2-9. Main Bus

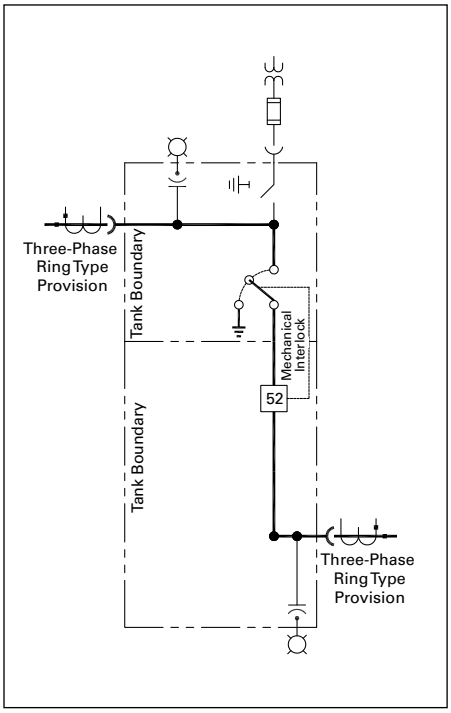


Figure 12.2-10. Tie Bus With Three-Position Switch and Main Bus VT

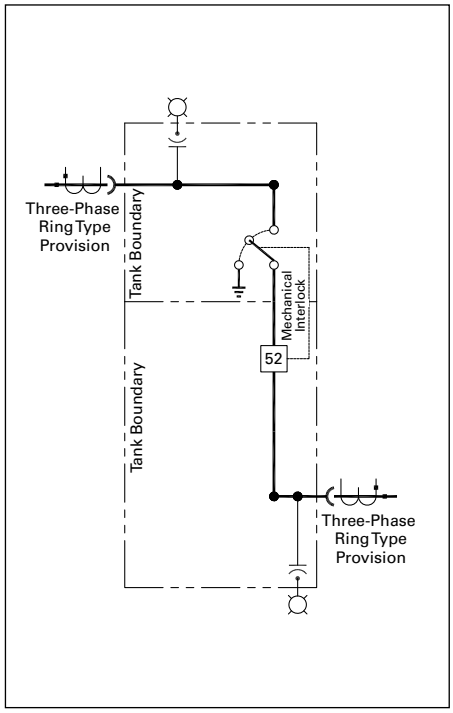


Figure 12.2-11. Tie Bus With Three-Position Switch

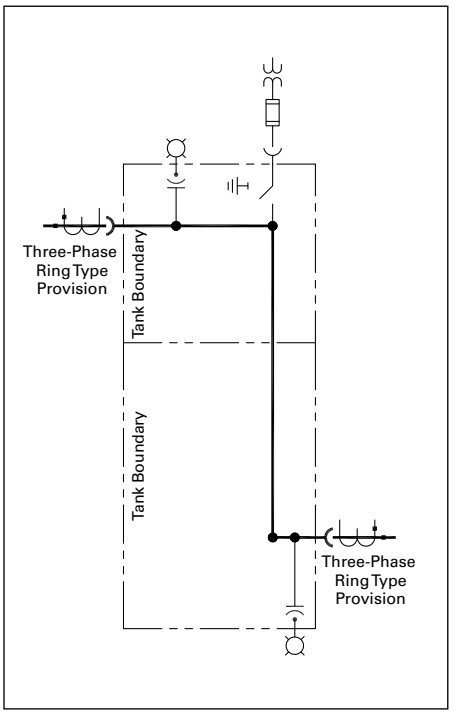


Figure 12.2-12. Transition Bus With Main Bus VT

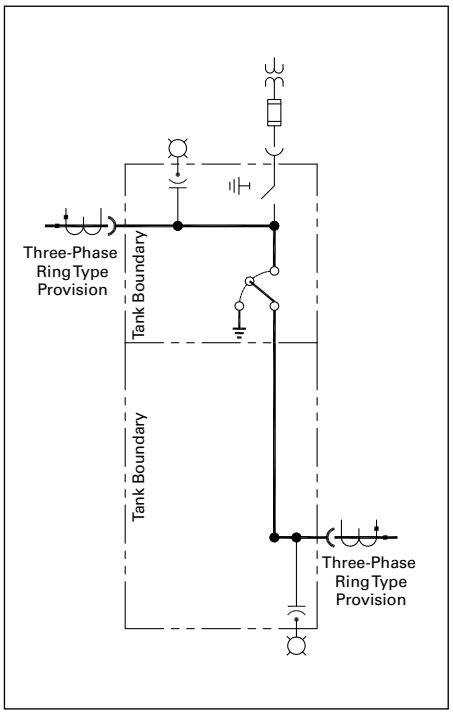


Figure 12.2-13. Riser Bus With Three-Position Switch and Main Bus VT

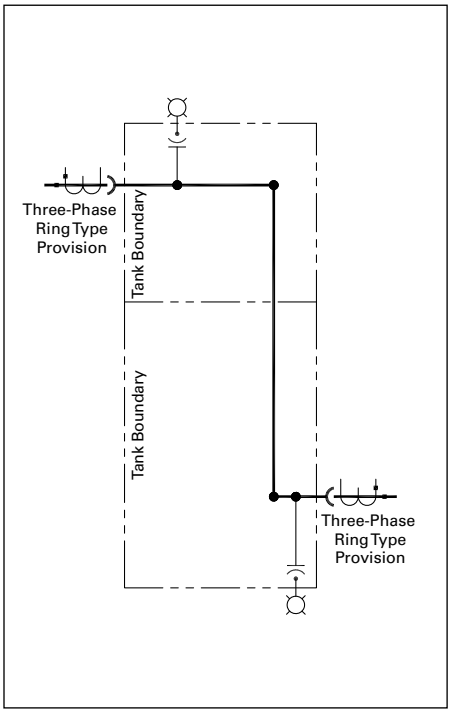


Figure 12.2-14. Transition Bus

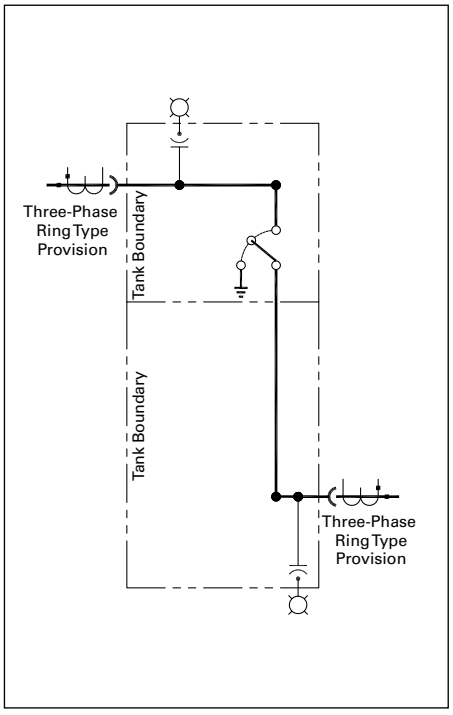


Figure 12.2-15. Riser Bus With Three-Position Switch

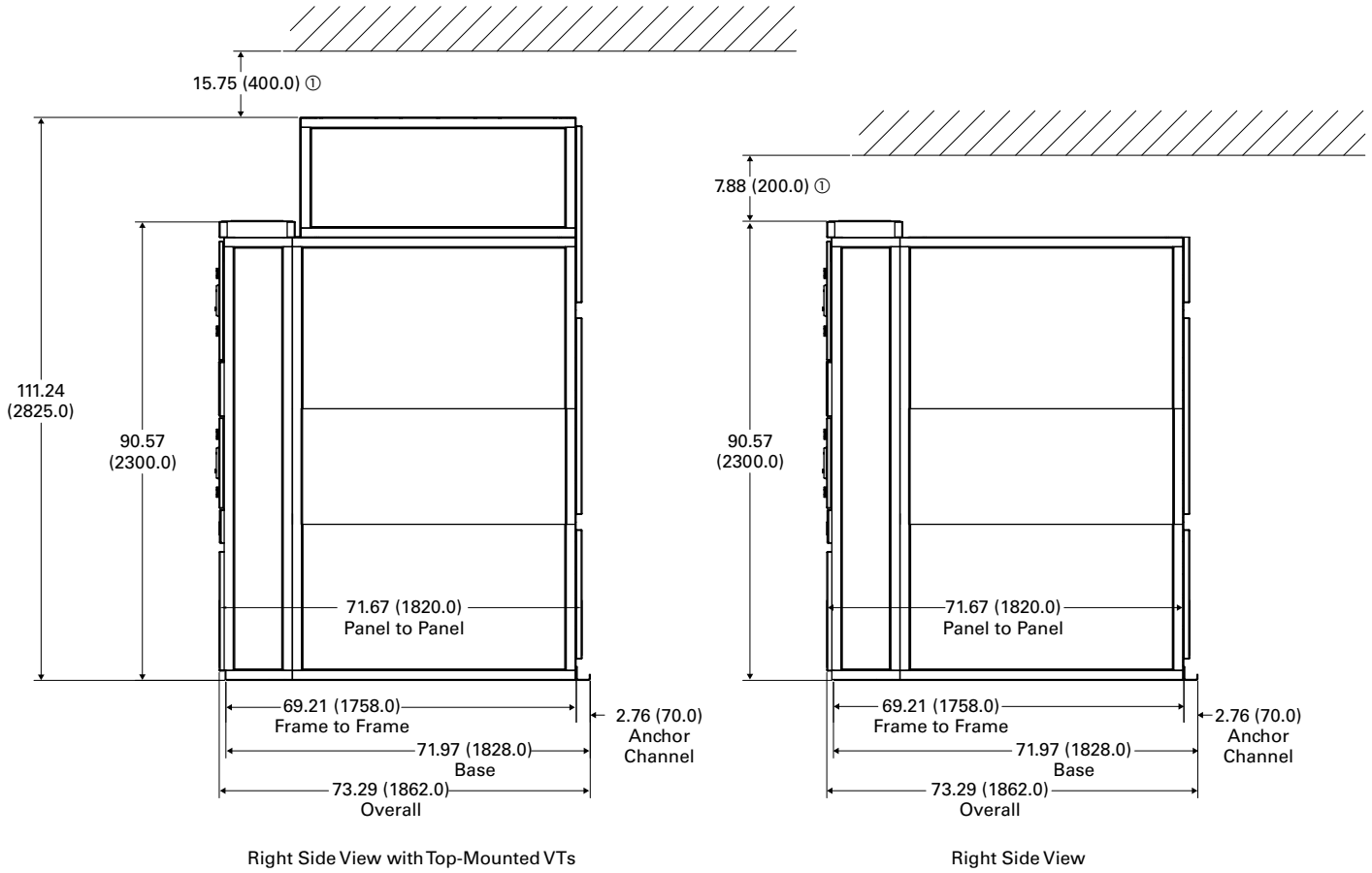


Figure 12.2-16. Typical Side Views—Dimensions in Inches (mm)

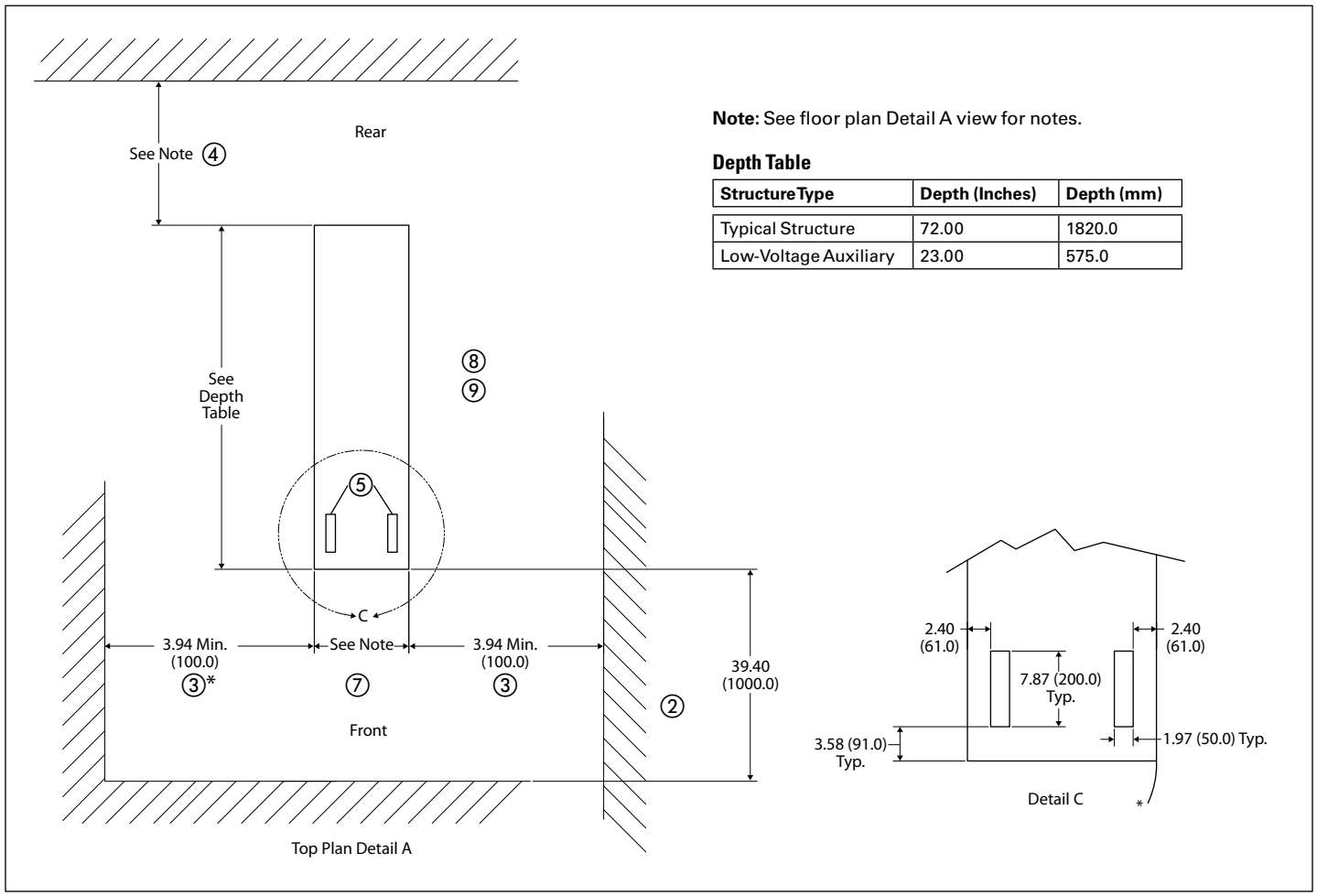
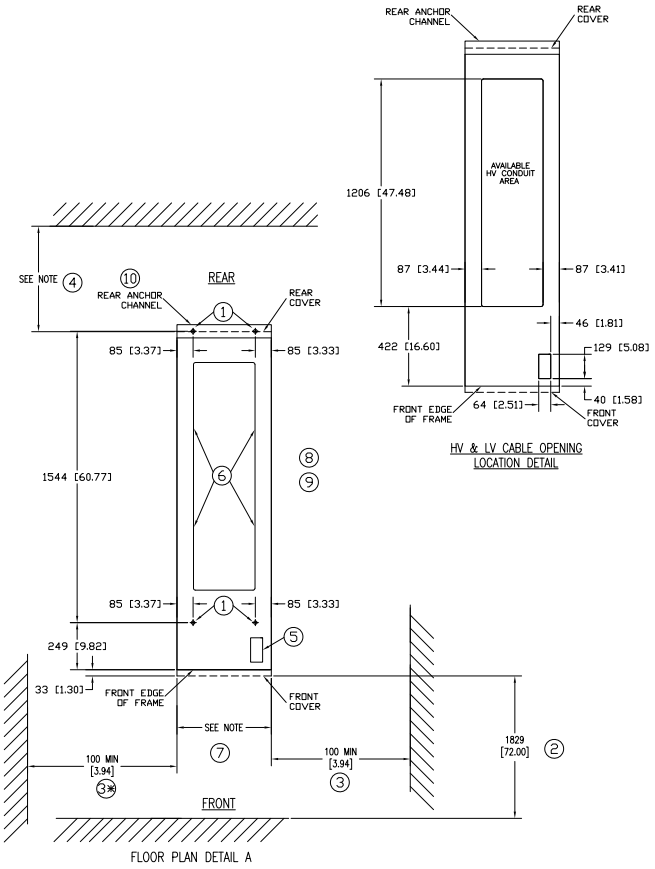


Figure 12.2-17. Typical Top Views—Dimensions in Inches (mm)



NOTE:

1. THESE ARE THE LOCATIONS OF 18 [0.71] DIAMETER MOUNTING HOLES FOR SECURING A POWER XPERT IGX SWITCHGEAR ASSEMBLY VERTICAL SECTION TO A FINISHED FOUNDATION. USE OF 16 [0.63] DIAMETER SAE GRADE 5 HARDWARE TIGHTENED 183 N-M [135 FT-LB] IS RECOMMENDED. USE OF OTHER POST-INSTALLED MECHANICAL ANCHOR SYSTEMS, BONDED/ADHESIVE TYPE SYSTEMS, PRE-INSTALLED CAST-IN-PLACE SYSTEMS SUCH AS SHEAR LUGS, L-BOLTS, AND J-BOLTS OR PLUG WELDING THE IGX SWITCHGEAR VERTICAL SECTION AT THE MOUNTING HOLE LOCATIONS TO CAST-IN-PLACE STRUCTURAL STEEL MATERIALS OR TO A STEEL HOUSE FOUNDATION IS SOLE RESPONSIBILITY OF OTHERS. ALTERNATIVE MOUNTING SYSTEMS MUST HAVE EQUAL OR GREATER AVERAGE ULTIMATE TENSILE AND SHEAR LOAD CAPABILITIES AS SAE GRADE 5 HARDWARE. IN ADDITION TO LOAD CAPABILITIES OF THE MOUNTING SYSTEM, THE BEARING STRENGTH AND BEARING SURFACE AT EACH XGIS SWITCHGEAR VERTICAL SECTION MOUNTING HOLE LOCATION MUST BE TAKEN INTO ACCOUNT. ALTERNATIVE MOUNTING SYSTEMS MUST PROVIDE EQUAL OR GREATER BEARING PROPERTIES AS A KEY BELLEVILLES, INC., K1125-E-125 WASHER OR OTHER MANUFACTURER'S EQUAL DEVICE USED WITH SAE GRADE 5 HARDWARE AT EACH POWER XPERT IGX ANCHOR LOCATION. CONSULT A LICENSED STRUCTURAL OR CIVIL ENGINEER PRIOR TO SELECTING A MOUNTING SYSTEM IF A SYSTEM OTHER THAN THAT RECOMMENDED IS PREFERRED.

2. MINIMUM FRONT CLEARANCE SUGGESTED. THE LOCAL AUTHORITY HAVING JURISDICTION MAY ALSO REQUIRE A LARGER DISTANCE.

3. MINIMUM LEFT OR RIGHT CLEARANCE ALONG ENDS OF LINEUP. SEE THE POWER XPERT IGX ASSEMBLY SPECIFIC FLOOR PLAN TO DETERMINE APPLICABLE DIMENSIONS. * LEFT SIDE MAY REQUIRE GREATER DISTANCE DEPENDING ON DOOR SWING REQUIREMENTS. THE LOCAL AUTHORITY HAVING JURISDICTION MAY REQUIRE A LARGER DISTANCE.

4. THE MINIMUM REAR CLEARANCE REQUIRED FOR NON-ACCESSABLE REAR IS 50 [2.00]. FOR REAR ACCESSABLE GEAR, THE MINIMUM CLEARANCE IS 800 [31.50]. THE LOCAL AUTHORITY HAVING JURISDICTION MAY REQUIRE A LARGER DISTANCE.

5. LOCATION OF LOW VOLTAGE CONTROL CONDUIT WIRING OPENINGS. CONDUITS ARE LIMITED TO A PROJECTION OF 25.4 [1.00] ABOVE THE FINISHED FLOOR OR INSIDE THE TOP COVER WHEN SUCH CONDUIT ENTRY IS FROM THE TOP. MAXIMUM CONDUIT SIZE IS 31.8 [1.25].

6. LOCATION OF HIGH VOLTAGE CABLE CONDUIT ENTRY. CONDUIT PROJECTION MUST NOT EXCEED 76 [3.00].

7. FOR APPLICATIONS UP TO 2000 A, SECTION WIDTH OPTIONS ARE 500 [19.68] OR 800 [31.50]. FOR APPLICATIONS ABOVE 2000 A, SECTION WIDTH IS 800 [31.50].

8. THE INTER-UNIT TIE FASTENERS TO JOIN THE SHIPPING GROUPS TOGETHER MUST BE INSTALLED AND PROPERLY TIGHTENED WHEN A POWER XPERT IGX ASSEMBLY IS INSTALLED ON THE FOUNDATION. FAILURE TO JOIN THE SHIPPING GROUPS TOGETHER COULD RESULT IN DAMAGE TO THE EQUIPMENT DURING AN EARTHQUAKE. A MINIMUM OF TWO SWITCHGEAR SECTIONS ARE REQUIRED TO MEET THE SEISMIC CAPABILITY.

9. THE FINISHED FOUNDATION SURFACE SHALL BE FLAT AND LEVEL WITHIN X MM [0.XX INCHES] XXX MM [XX.X INCHES] IN ANY DIRECTION, LEFT TO RIGHT, FRONT TO BACK, AND DIAGONALLY. ALTERNATIVELY A LOCAL FLATNESS VALUE OF 50 OR VALUE OF 37 TO 40 AS DEFINED IN INDUSTRY STANDARD ASTM-E1155-96 AND HIGHER AND AN ACCOMPANYING INDUSTRY STANDARD ACI 117-90 MAY BE USED TO ESTABLISH THE FLATNESS AND LEVELNESS OF THE FINISHED FOUNDATION. IT IS RECOMMENDED BUT NOT NECESSARY TO FINISH THE FOUNDATION TO THE SAME REQUIREMENTS IN FRONT OF THE IGX SWITCHGEAR ASSEMBLY IN A TRAFFIC AREA DEFINED BY THE END USER. THE MINIMUM RECOMMENDED FOUNDATION AND ANCHORING SYSTEM REQUIREMENTS ARE SUFFICIENT TO WITHSTAND THE COMBINED TENSILE AND OVERTURNING REACTIVE FORCES IMPOSED ON THE FOUNDATION AT THE IGX SWITCHGEAR ASSEMBLY MOUNTING POINTS DURING A SEISMIC EVENT. ANY DEVIATION FROM THESE RECOMMENDATIONS IS THE SOLE RESPONSIBILITY OF END USER. CONSULT WITH A LICENSED STRUCTURAL OR CIVIL ENGINEER IF SOME OTHER FOUNDATION METHODS ARE TO BE CONSIDERED.

10. REAR ANCHOR CHANNEL NOT REQUIRED FOR WALL-MOUNT (NON-ACCESSIBLE REAR SIDE) INSTALLATIONS

Figure 12.2-18. Typical Top Plan—Dimensions in mm (inches)

Installation Requirements

Cable Vault

The Power Xpert IGX switchgear is designed for installation in an electrical room over cable vaults. It is very important that the installed lineup be level and mounted on the same plane. Eaton recommends that the electrical room design include steel rails embedded in the vault concrete for mounting the IGX switchgear. See **Figure 12.2-16 – Figure 12.2-18** for details on minimum ceiling height requirements, as heights vary based on application. Contact Eaton for additional information on cable vault requirements.

Cable Connections

A typical configuration 2000 A and below allows four cable terminations per phase up to 750 kcmil. Each surge arrester and cable-connected voltage transformer will use one cable termination point of the four available per phase.

A typical configuration 2500 A and above allows four cable terminations up to 1000 kcmil and includes a dedicated auxiliary connection (not rated for continuous current) for surge arresters and voltage transformers. Each additional surge arrester and voltage transformer connection will use one cable termination point of the four available per phase.

All cable termination connectors are provided by others and installed in the field.

Cable Connections

Typical Weights

Table 12.2-10. Assembly Weights Including Breakers

Vertical Structure Type	Ampere Rating	Basic Vertical Section (lb)	Set of 3 Main Bus VTs (lb)	Set of 3 Cable Side CTs (lb)	Set of 3 Bus Side CTs (lb)
Breaker	1200 2000 2500 3000	2430 2475 2570 3060	875	225	100
Tie Breaker	1200 2000 2500 3000	2590 2635 2730 3060	875	—	100
Sectionalizer	1200 2000 2500 3000	2460 2505 2600 2935	875	—	100
Cable Connection to Main Bus with Three-Position Switch	1200 2000 2500 3000	2045 2090 2185 2680	875	225	100
Direct Cable Connection to Main Bus	1200 2000 2500 3000	2000 2045 2140 2635	875	225	100
Main Bus	1200 2000 2500 3000	1805 1850 1850 1850	875	—	100
Main Bus, Bottom-Mounted VTs and Cable Connection	1200 2000 2500 3000	2780 2830 2830 2830	875	—	100
Bus Transition	1200 2000 2500 3000	2460 2505 2600 2935	875	—	100

Heat Loss

Table 12.2-11. Heat Loss in Watts at Full Rating, at 60 Hz

Switchgear Assembly	Breaker Rating	1200 A	2000 A	2500 A	3000 A
IGX	5, 15, 27, 38 kV	740 W	975 W	1322 W	1670 W
Other Components					
Each Cable Standard Accuracy CT Each Cable High Accuracy CT	50 W 100 W	— —	— —	— —	— —
Each Main Bus Standard Accuracy CT Each Main Bus High Accuracy CT	50 W 100 W	— —	— —	— —	— —
Space Heater—Each	250 W	—	—	—	—

Control Power Requirements

Control power must be supplied external from Power Xpert IGX switchgear, such as from a panelboard or a switchboard within the same room, a battery system, or a remote-mounted control power transformer.

General Description

Loss of Service Continuity (LSC)

Eaton's Power Xpert IGX medium-voltage switchgear meets all of the following categories of the LSC2 family, with LSC2B being the most stringent:

- LSC2—Functional unit having at least an accessible compartment for the high-voltage connection (called connection compartment), such that, when this compartment is open, at least one busbar can remain energized and all other functional units of the switchgear can be operated normally
- **LSC2A**—Functional unit of category LSC2 such that, when any accessible compartment (other than the busbar compartment of single busbar switchgear) is open, at least one busbar can remain energized and all other functional units of the switchgear can be operated normally
- **LSC2B**—Functional unit of category LSC2A, where the high-voltage connections (e.g., cable connections) to the functional unit can remain energized when any other accessible high-voltage compartment of the corresponding functional unit is open

The LSC category describes the extent to which the switchgear is intended to remain operational in case access to a high-voltage compartment is provided. For each functional unit of switchgear, the LSC category describes the extent to which other high-voltage compartments and/or functional units may remain energized when a main circuit compartment of this functional unit is opened.

Compartments deemed accessible within a Power Xpert IGX functional unit are connection compartment and upper voltage transformer compartment; compartments deemed non-accessible within a Power Xpert IGX functional unit are busbar compartment and three-position switch/breaker compartment (gas tank).

See IEC Standard 62271-200 for additional information regarding LSC categories.

Ratings

- Rated voltage (Ur): 5 kV, 15 kV, 27 kV, 36 kV
- Interrupting ratings (rated short-circuit breaking current): 40 kA – 3 seconds
- Rated normal current—circuit breakers: 1250 A, 2000 A, 2500 A or 3150 A
- Rated normal current—main bus: 1250 A, 2000 A, 2500 A or 3150 A
- Rated frequency: 50/60 Hz
- Rated altitude: 5000 m

Degrees of Protection (IP)

Eaton's Power Xpert IGX medium-voltage switchgear is available with IP rating of IP3X and optional IP4X.

IP classifications are intended to define the degrees of protection provided by switchgear enclosures of electrical equipment with regards to:

- Protection of persons against access to hazardous parts inside the enclosure
- Protection of the equipment inside the enclosure against ingress of solid foreign objects
- Protection of the equipment inside the enclosure against harmful effects due to the ingress of water

See IEC Standard 60529 for additional information regarding IP classifications.

Standards and Certifications

- IEC 62271-1
- IEC 62271-100
- IEC 62271-102
- IEC 62271-200
- LSC2B according to IEC 62271-200
- Internal Arc Classification (IAC) guidelines of IEC 62271-200

Instrument Transformers

Voltage Transformers

Power Xpert IGX voltage transformers are designed according to IEEE and IEC standards. Voltage transformers can be furnished as either fused IEEE or unfused IEC units.

Current Transformers

Power Xpert IGX current transformers are designed according to IEEE and IEC standards.

Table 12.2-12. IEC Current Transformers for Main Bus Applications ①②③

Current Ratio	IEC Protection Class 50/60 Hz					IEC Metering Class 50/60 Hz					Thermal Rating Factor at 30 °C	CT Depth Inches (mm)
	2.5	5	10	15	30	2.5	5	10	15	30		
150/1	5P20	10P15	10P5	—	—	1.0	3.0	3.0	—	—	1.50	3.00 (76.2)
300/1	5P30	5P20	5P15	5P10	10P5	0.5	0.5	1.0	1.0	3.0	1.50	3.00 (76.2)
400/1	5P30	5P30	5P15	5P10	5P5	0.2	0.5	1.0	1.0	1.0	1.50	3.00 (76.2)
600/1	5P30	5P30	5P20	5P15	5P5	0.2	0.2	0.5	0.5	1.0	1.50	3.00 (76.2)
800/1	5P30	5P30	5P20	10P20	5P10	0.2	0.2	0.2	0.5	0.5	1.50	3.00 (76.2)
1200/1	5P30	5P30	5P30	5P20	5P15	0.2	0.2	0.2	0.2	0.2	1.33	3.00 (76.2)
1500/1	5P30	5P30	5P30	5P20	5P15	0.2	0.2	0.2	0.2	0.2	1.33	3.00 (76.2)
2000/1	5P30	5P30	5P30	5P30	5P20	0.2	0.2	0.2	0.2	0.2	1.33	3.00 (76.2)
2500/1	5P30	5P30	5P30	5P30	5P20	0.2	0.2	0.2	0.2	0.2	1.20	3.00 (76.2)
3000/1	5P30	5P30	5P30	5P30	5P25	0.2	0.2	0.2	0.2	0.2	1.20	3.00 (76.2)
3200/1	5P30	5P30	5P30	5P30	5P25	0.2	0.2	0.2	0.2	0.2	1.20	3.00 (76.2)
150/1	5P30	5P20	10P10	10P5	—	0.5	1.0	3.0	3.0	—	1.50	3.50 (88.9)
300/1	5P30	5P30	5P20	5P15	5P10	0.5	0.5	0.5	1.0	1.0	1.50	3.50 (88.9)
400/1	5P30	5P30	10P30	5P20	5P10	0.2	0.2	0.5	0.5	1.0	1.50	3.50 (88.9)
600/1	5P30	5P30	5P30	10P30	5P15	0.2	0.2	0.2	0.5	0.5	1.50	3.50 (88.9)
800/1	5P30	5P30	5P30	5P30	5P15	0.2	0.2	0.2	0.2	0.5	1.50	3.50 (88.9)
1200/1	5P30	5P30	5P30	5P30	5P20	0.2	0.2	0.2	0.2	0.2	1.33	3.50 (88.9)
1500/1	5P30	5P30	5P30	5P30	5P20	0.2	0.2	0.2	0.2	0.2	1.33	3.50 (88.9)
2000/1	5P30	5P30	5P30	5P30	5P20	0.2	0.2	0.2	0.2	0.2	1.33	3.50 (88.9)
2500/1	5P30	5P30	5P30	5P30	5P25	0.2	0.2	0.2	0.2	0.2	1.20	3.50 (88.9)
3000/1	5P30	5P30	5P30	5P30	5P30	0.2	0.2	0.2	0.2	0.2	1.20	3.50 (88.9)
3200/1	5P30	5P30	5P30	5P30	5P30	0.2	0.2	0.2	0.2	0.2	1.20	3.50 (88.9)

① Maximum quantity of main bus CTs between a 20-inch (500 mm) and 32-inch (800 mm) wide structure is two.
② Maximum quantity of main bus CTs between two 32-inch (800 mm) wide structures is four.
③ Main bus CTs are not available between 20-inch (500 mm) wide structures.

Table 12.2-13. IEC Current Transformers for Cable Applications ①②

Current Ratio	IEC Protection Class 50/60 Hz					IEC Metering Class 50/60 Hz					Thermal Rating Factor at 30 °C	CT Depth Inches (mm)
	2.5	5	10	15	30	2.5	5	10	15	30		
150/1	10P20	10P20	—	—	—	3.0	3.0	—	—	—	1.50	3.75 (95.3)
300/1	5P30	10P20	10P10	5P5	—	0.5	1.0	3.0	3.0	—	1.50	3.75 (95.3)
400/1	5P30	5P30	5P15	5P10	10P5	0.5	0.5	1.0	1.0	3.0	1.50	4.73 (120.1)
600/1	5P30	5P20	5P15	5P10	5P5	0.5	0.5	1.0	1.0	1.0	1.50	3.75 (95.3)
800/1	5P30	5P30	5P20	5P15	5P10	0.5	0.5	0.5	0.5	0.5	1.50	3.75 (95.3)
1200/1	5P30	5P30	5P30	5P30	5P15	0.2	0.2	0.2	0.2	0.5	1.50	4.73 (120.1)
1500/1	5P30	5P30	5P30	5P20	5P15	0.2	0.2	0.5	0.5	0.5	1.50	3.75 (95.3)
2000/1	5P30	5P30	5P20	5P20	5P10	0.2	0.2	0.2	0.2	0.5	1.50	2.76 (70.1)
2500/1	5P30	5P30	10P30	5P20	5P15	0.2	0.2	0.2	0.2	0.2	1.33	2.76 (70.1)
3000/1	5P30	5P30	5P30	5P20	5P15	0.2	0.2	0.2	0.2	0.2	1.33	2.76 (70.1)
3200/1	5P30	5P30	5P30	5P20	5P10	0.2	0.2	0.2	0.2	0.2	1.33	2.76 (70.1)
3500/1	5P30	5P20	5P20	5P20	5P10	0.2	0.2	0.2	0.2	0.2	1.33	2.76 (70.1)
4000/1	5P30	5P20	5P20	5P20	5P10	0.2	0.2	0.2	0.2	0.2	1.33	2.76 (70.1)

① Maximum available depth for mounting CTs on a small cable drum is 10.50 inches (266.7 mm). Any combination of CTs can be used as long as the sum of total depth does not exceed this maximum available depth dimension.
② Maximum available depth for mounting CTs on a large cable drum is 7.50 inches (190.5 mm). Any combination of CTs can be used as long as the sum of total depth does not exceed this maximum available depth dimension.

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