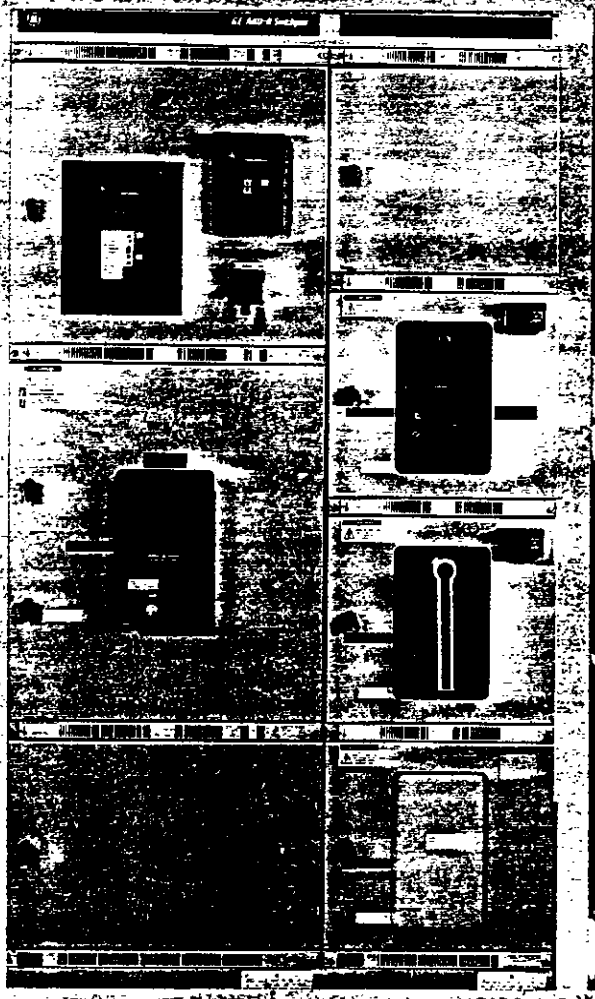
GE Electrical Distribution & Control



AKD 8 APPLICATION GUIDE

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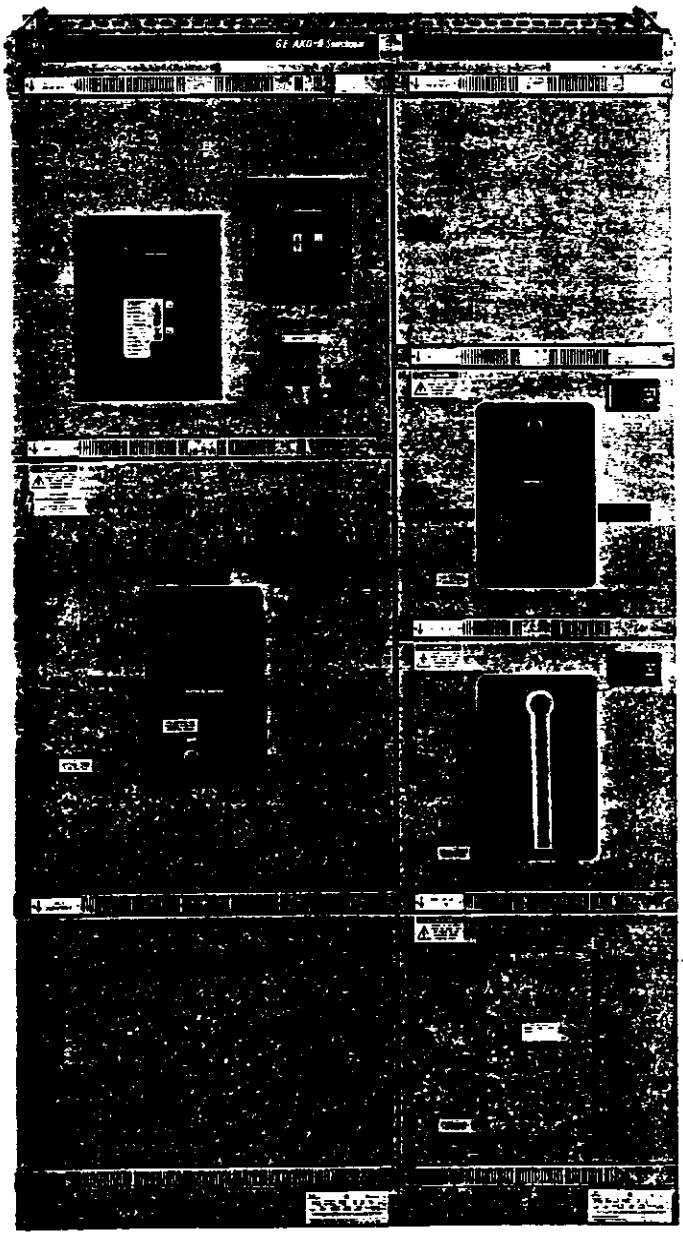


General description

AKD-8 Switchgear is industrial-duty equipment built to ANSI standards and uses 100% rated Low-Voltage AKR Power Circuit Breakers. It is designed to have more margin within its ratings to provide maximum continuity of service for those applications subject to severe duty, such as repetitive switching encountered with motor starting, power factor correction, demand control, load shedding, etc.

A major factor contributing to this extended continuity of service is the availability of renewal parts complete with detailed maintenance instructions and original equipment documentation. From a coordination standpoint, type AKR circuit breakers provide full selectivity with each other and with other protective devices. The bus sizing is based on temperature rise rather than on current density (as with switchboard construction).

AKD-8 switchgear is available with the following maximum nominal ratings:
- 600 Vac, 250 Vdc
- 5000 Aac, 6000 Adc
- 50/60 Hz

AKD-8 switchgear sections are provided in either 22", 30" or 38" widths.

It is designed to be operated in an ambient temperature between -30°C and 40°C.

Type AKR low-voltage power circuit breakers are available for AKD-8 switchgear in six frame sizes:
- 800A AKR-30, 30H, 30L
- 1600A AKR-50, 50H
- 2000A AKRT-50H
- 3200A AKR-75, 75H
- 4000A AKR-100
- 5000A AKR-125

All breakers can be equipped with current limiting fuses. AKRU-30 and AKRU-50 are provided with integrally mounted fuses, while a separate fuse carriage is required for AKRT-50H, AKR-75, AKR-100, and AKR-125.

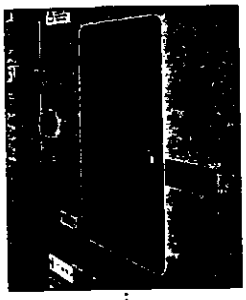
Low-voltage circuit breakers rated 800/1600/2000 amps can be stacked in four-high combinations resulting in reduced floor space requirements. The 11-gauge, bolted modular-designed steel frame permits flexibility in arrangements of breakers and associated components.

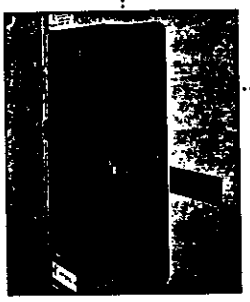
circuit breakers, instrumentation, and other auxiliary circuit protective devices in single or multiple source configurations. AKD-8 switchgear can be applied either as a power distribution unit or as part of a unit substation in indoor or outdoor construction.

AKD-8 switchgear is manufactured in GE's ISO 9002 certified facility in Burlington, Iowa. It complies with ANSI standards C37.20.1 and NEMA SG-5, and it is UL listed to standard 1558, file no. E76012. The switchgear has been conformance tested according to ANSI C37.51.

ANSI standards require that switchgear operate at the ratings of devices installed. Switchgear short circuit ratings are based on two 30-cycle withstand tests with 15-second interval, performed at 15% power factor and 635 Vac maximum. For switchboards, a single 3-cycle withstand test at 20% power factor and 600 Vac maximum is performed.

General Electric's AKD-8 low-voltage switchgear can help you meet today's challenges for greater productivity, increased





Safety and reliability features

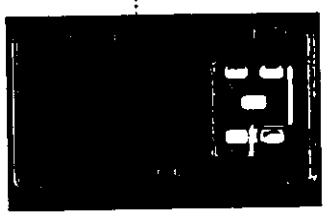
Standard and optional features are available with AKD-8 switchgear in order to meet the increasing industry emphasis on system reliability and operating personnel safety:

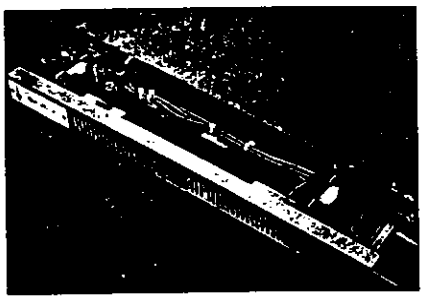
- **Closed-door operation**
  Breaker compartment doors have no ventilation openings, thus protecting operators from hot ionized gases vented by the breaker during circuit interruption.

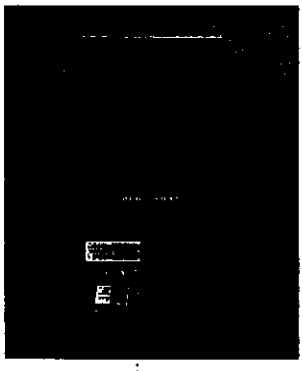
- **Closed-door drawout**
  True closed-door drawout construction is standard with all AKD-8 equipment. The breaker compartment doors remain stationary and closed while the breaker is racked out from the connected position, through test, to the disconnected position. Doors are secured with rugged ¼-turn latches.

- **Closed-door control circuit accessibility**
  A standard slide-out instrumentation tray is located above each breaker compartment, minimizing cross-hinge wiring. When required, indicating lights and test switches can be mounted on the front of the tray. Fuses for close and trip circuits can be mounted inside the tray and are accessible with the tray pulled out. Routine wiring inspections and fuse checks or fuse replacements can be performed with the breaker compartment door closed, protecting operators from energized primary circuits.

- **Closed-door trip unit setup and display**
  Optional MicroVersaTrip™ Remote Display provides safe, closed-door access to the AKR breaker's MicroVersaTrip Plus or MicroVersaTrip PM trip unit metering, status and setup functions.



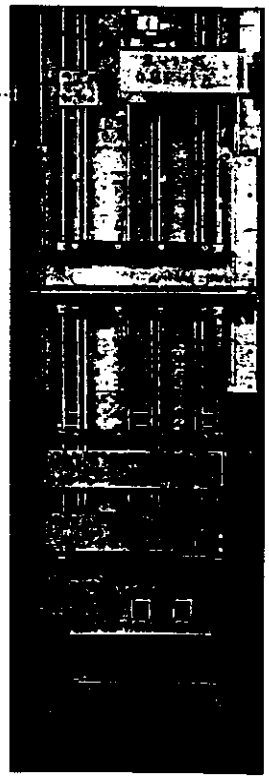




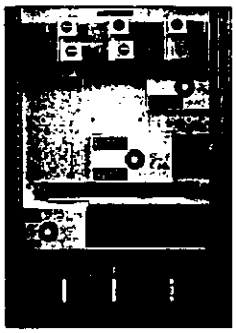
Easy-to-use breaker interlocking and locking features minimize the risk of operational errors:

- **Low-voltage power circuit breaker locking**
  As a standard feature, the low-voltage power circuit breaker can be padlocked in the open position with a ⅜" shank padlock to prevent unauthorized closing and racking.

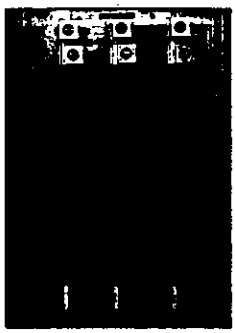
- **Breaker insertion and withdrawal interlocks**
  Interlocks prevent racking of the breaker in or out when the breaker contacts are closed. Breakers are trip free when not in the connect or test position.



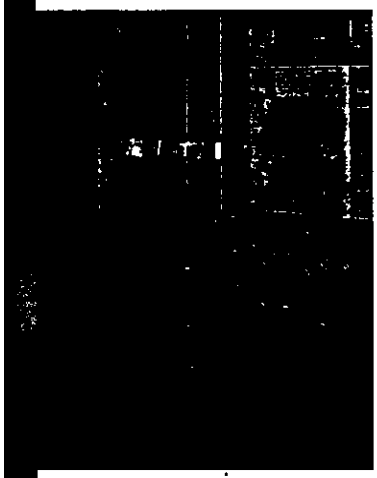
A superior bus system offers different levels of protection:



- **Fully tin-plated copper bus**
  Fully tin-plated copper main and riser bus is a standard feature on AKD-8 equipment. Tin plating provides superior corrosion protection, especially for application for the pulp and paper and waste treatment industries where corrosive agents routinely exist. GE's bus bars are tin-plated after forming and punching to ensure completely plated bolt holes and bar edges. Sliding contact surfaces, such as breaker stab ups, are fully silver-plated. Silver-plated bolted connections are available as an option.



- **Bus system**
  Bare bus is provided as standard on AKD-8 switchgear. In this configuration, there are no covers to remove, so all bus connections are easily accessible for maintenance. Note that a horizontal isolation barrier is provided between the vertical buses and every main and tie breaker for added safety in the event of a fault. An insulated/isolated bus system that fully insulates the horizontal main bus with a fluidized epoxy coating and isolates each phase of the vertical riser bus is available as an option. Accessibility to main bus joints is provided by replaceable covers and no live connections are reachable from the rear except the breaker load side terminals. Bus compartmentation is also available as an optional feature on AKD-8 switchgear.

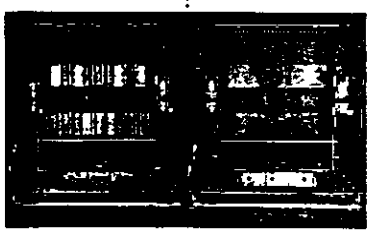


Safety and reliability features *(continued)*

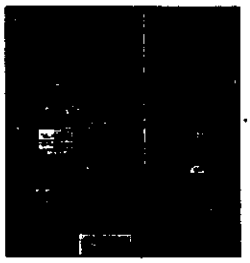
The breaker compartment is designed to provide operator and system safety options:

- **Isolated breaker compartment**
  Each circuit breaker is located in a completely enclosed ventilated compartment with grounded steel barriers to minimize the possibility of fault communication between compartments. A breaker position switch is optionally available.

- **Safety shutters**
  Safety shutters are optionally available in breaker compartments. They protect operators from accidental contact with live conductors when the breaker is withdrawn. Safety shutters are provided as a standard feature on reverse fed breakers.



- **Defeatable door interlock**
  This option prevents inadvertent opening of the compartment door unless the breaker is in the disconnect position. This provision is made for authorized defeat of interlock.

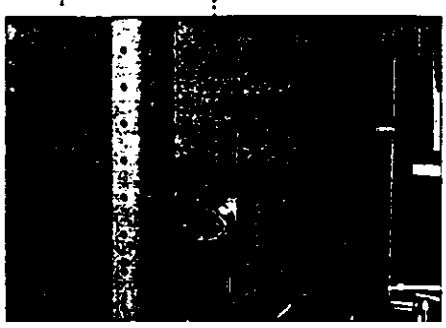


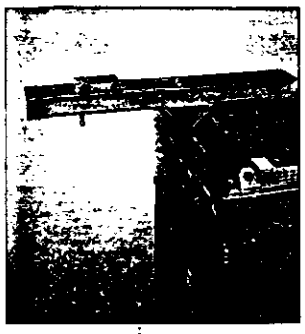
- **Padlockable door latch**
  This optional feature enables padlocking of the door latch in order to prevent unauthorized entry into the breaker compartment.

- **Breaker rejection feature**
  A rejection system is provided as standard in each breaker compartment to prevent the insertion of a breaker with inadequate short circuit and/or incorrect continuous current ratings.

- **Drawout padlock provision**
  A mechanism padlock device is provided as standard to lock out the drawout mechanism in test or disconnect position. This provision will accept up to three padlocks with a $\frac{3}{8}$"shank.

- **Key interlocks**
  This option provides for compulsory locking of the breaker in the open, trip-free position when fully connected. Applicable schemes would be mechanical interlocking of two breakers so only one can be closed at a time, or, in load center unit substations, interlocking of the primary switch and secondary main breaker such that the secondary main must be open before the primary switch can be operated. Single and double key locks are available. Key locking does not prevent operation when the breaker is in test or disconnect position.





Installation and maintenance are made easy with these design features:

- **Accessibility**

  Accessibility to equipment compartments provides easy maintenance of the breaker compartment area and control circuit elements (located in drawout tray), as well as convenient inspection of the bolted bus connections.

- **Cable space**

  Conduit entrance area meets NEC requirements. Extended depth frame options are available in 7" and 14" sizes for applications requiring additional cable space.

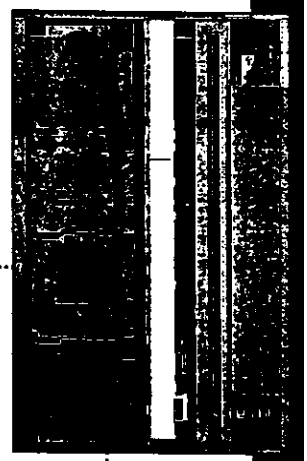
- **Breaker lifting device**

  Installed on top of the switchgear, this rail mounted hoist provides the means for installing and removing breakers from the equipment. This is a standard feature on outdoor walk-in construction and an optional feature on indoor construction.

- **Control circuit isolation**

  Control wires are run between compartments in steel riser channels ❶. Customer terminal blocks are located in metal enclosed wire troughs in the rear cable area ❷. Intercubicle wiring is run in a wireway on top of the switchgear where interconnection terminal blocks are located ❸.

❶



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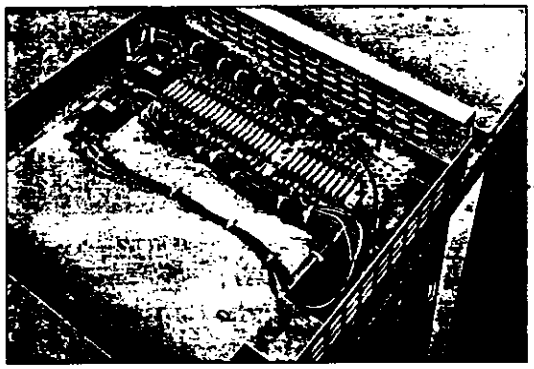

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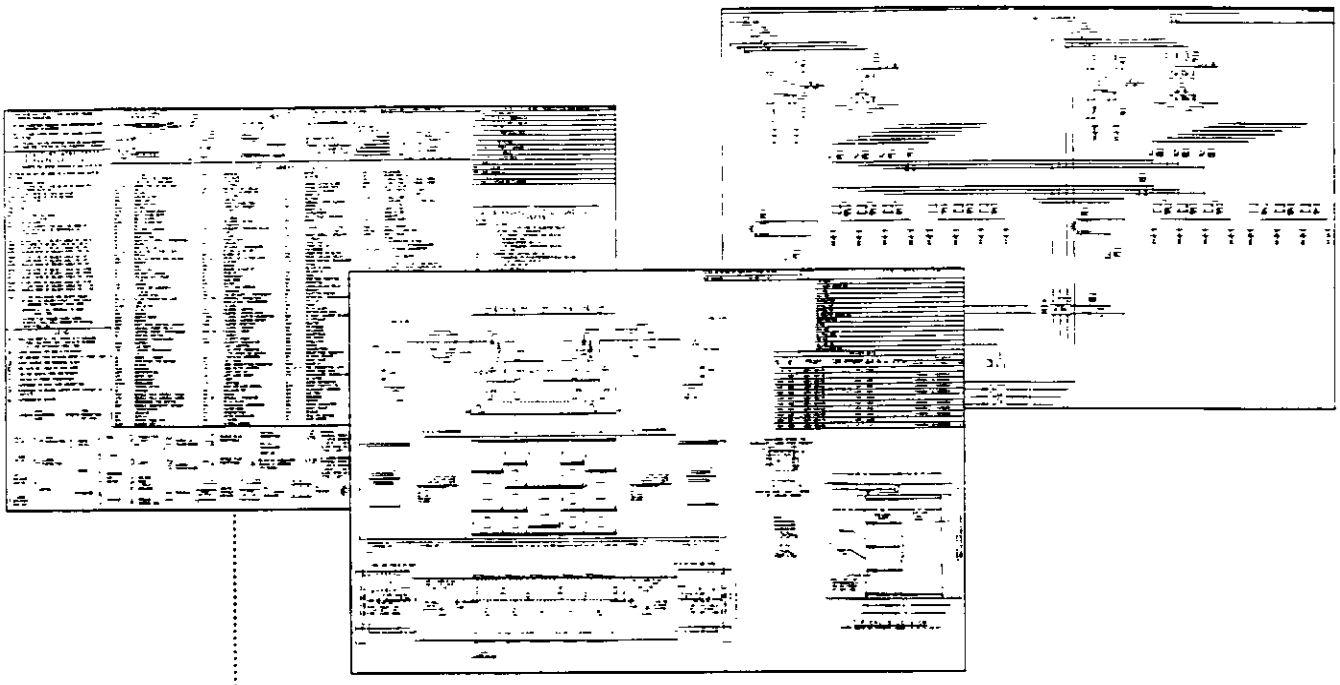


Safety and reliability features *(continued)*

GE's manufacturing processes and testing set the quality standards in the switchgear industry:

- **Paint finish**

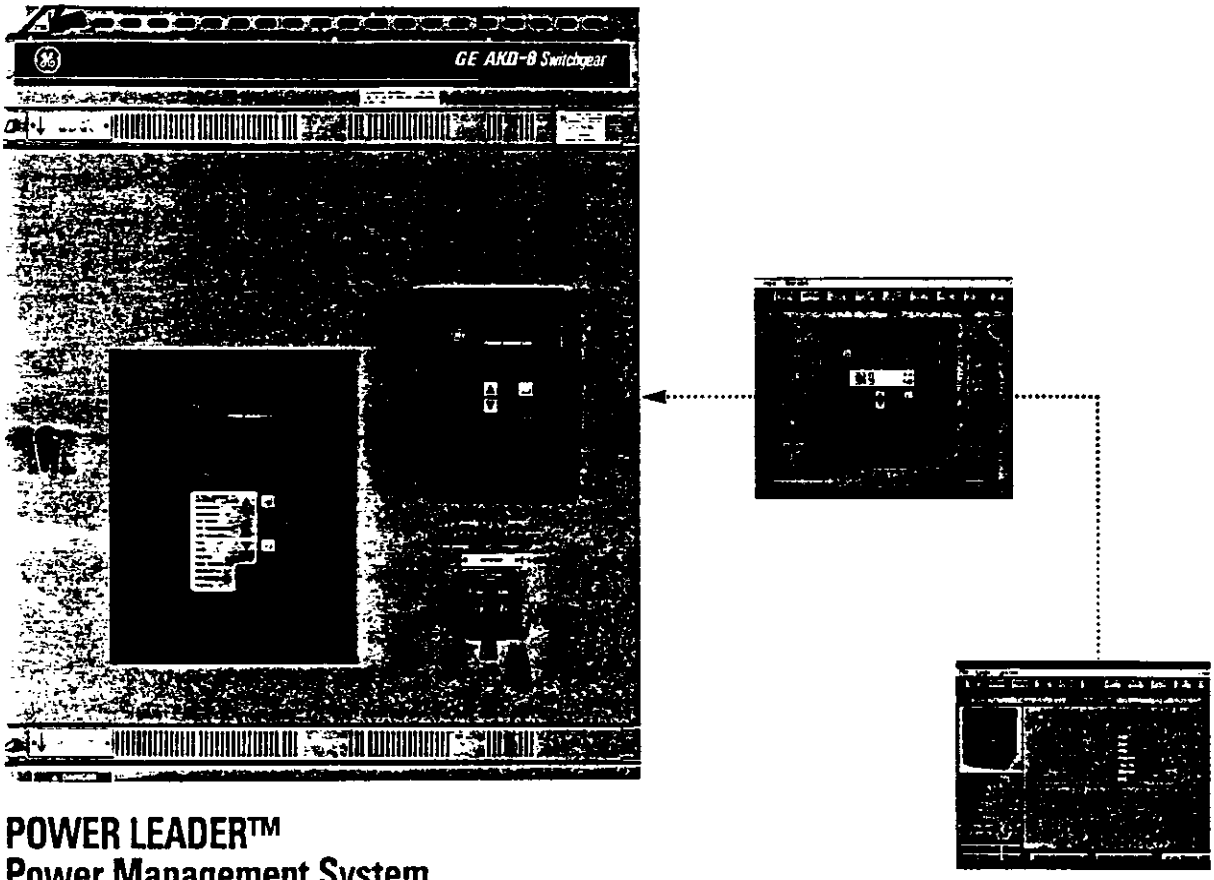
  AKD-8 switchgear is protected by the "E-coat" paint system consisting of a "cathodic electrodeposition" process employing the same principle used in electroplating: An electrically charged object immersed in a bath of oppositely charged particles will attract and become coated with those particles. In the process, switchgear parts are conveyed through a seven-stage washing process, where they are thoroughly cleaned, surface prepared, chrome-sealed and thoroughly rinsed. Next, the parts are immersed in an electrocoating tank, where they receive an epoxy coating 0.7 to 0.8 mils thick on every surface. After a rinse, the parts enter a curing oven, where the coating is baked, fusing it to the metal and ensuring a hard, uniform finish. The resulting ANSI-61 light gray paint finish far exceeds the requirements of UL 1558 and ANSI C37.20.1, which requires, at a minimum, passing a 200-hour salt spray test. Periodic testing by an independent laboratory subjected the "E-coat" to 1,000 hours of a salt spray, 2,000 hours in a humidity cabinet, plus acid and alkaline resistance tests, spot and stain tests, marring tests and impact and flexibility tests. These tests proved that AKD-8 switchgear can handle different severe operating environments.

- **Seismic test**

  The AKD-8 equipment has been seismically tested for Zone 4 to certify its capability to withstand the most severe earthquake conditions and that it meets seismic requirements of the USA Uniform Building Code.

- **Complete and accurate documentation**

  The AKD-8 design makes extensive use of computer-aided engineering and design. All customer documentation is generated via linked engineering and production systems for seamless ordering of materials and manufacturing of parts. This integration and linking of systems assures consistently accurate customer and manufacturing documentation and optimized equipment designs, all driven by the



POWER LEADER™ Power Management System

Power management at its best

Inside every switchgear lineup flows a large amount of information. The data is in the form of power (volts, amps, waveform) passing through the equipment. With the proper devices, you can selectively access this wealth of information, and use it to become more efficient and more productive. This is what power management systems are all about. With a system in place you can benefit from:

- Reduced energy costs
- Less downtime
- Improved predictive maintenance
- Faster corrective maintenance
- Increased safety
- Higher productivity
- Improved power quality

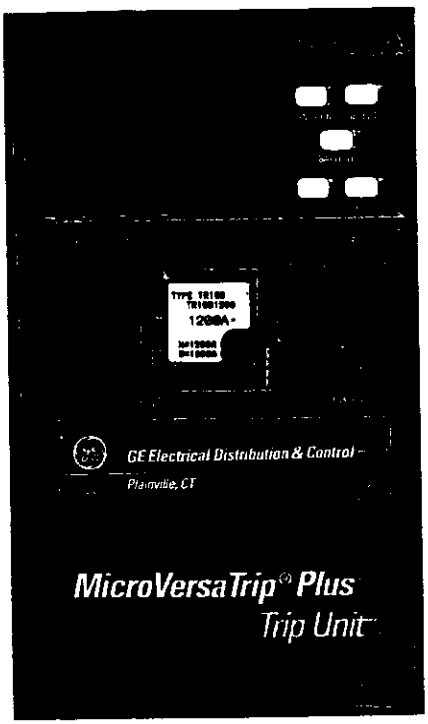
It should come as no surprise that virtually all switchgear is now shipped with power management features. What began as an option is fast becoming an absolute necessity. The POWER LEADER family of products offers all the power management benefits stated above, along with extensive growing capability, easy upgrade through open architecture and a complete range of services such as technical assistance, start-up support, and

The POWER LEADER system is specifically designed to grow with your needs. Because the system is easily expandable, you can add to its capabilities as your needs grow, eliminating the risk of having to start over with a whole new system sometime in the future.

As newer technologies become available, you are also assured of a convenient, cost-effective migration path, should you wish to upgrade your POWER LEADER system.

The POWER LEADER system also offers the components necessary to monitor, protect and control devices and equipment operating in two or more locations, giving you even greater freedom to expand your system. Key capabilities include:

- System monitoring and metering
- Alarm management
- Reporting and trending
- Power distribution and device control
- Cost management
- Predictive maintenance
- Power quality analysis
- Dynamic, real-time graphic displays of component status



MicroVersaTrip Plus and MicroVersaTrip PM trip unit systems

The enhanced MicroVersaTrip Plus and MicroVersaTrip PM system for AKR Low-Voltage Power Circuit Breakers consists of the trip unit, the trip actuator, current sensors and rating plugs. The term "trip unit systems" applies to the combination of these four components, which form the solid-state circuit breaker tripping system.

MicroVersaTrip Plus and MicroVersaTrip PM trip units continue to use GE's proven technique of measuring the true RMS currents (and voltages for MicroVersaTrip PM trip units) of both sinusoidal and harmonically distorted waveforms. The frequent sampling (64 times per cycle) allows precise calculations of the true RMS current. The sampling rate allows waveform measurements up to the 31st harmonic to achieve accuracy of 99%. True RMS sensing avoids potential underprotection or overprotection problems associated with peak-sensing tripping systems.

MicroVersaTrip Plus and MicroVersaTrip PM trip units provide a complete range of standard and optional functions. All trip units utilize a series of interchangeable rating plugs.

Standard functions:

Protection

- Long-time
- Instantaneous

Status

- Trip target (trip type)
- Trip information (magnitude and phase)
- Trip operations counters

Metering display

- Phase current (selectable among phases)

Optional functions:

- Short-time protection, with selectable I^2t.
- Ground Fault protection, with selectable I^2t.
- Defeatable ground fault, with selectable I^2t.
- Switchable instantaneous, short time and ground fault.
- High-range (fixed) instantaneous overcurrent protection.
- Zone-selective interlock, for ground fault only or for both ground fault and short-time protection.

Additional functions are available only with MicroVersaTrip PM trip unit:

- Communication and metering
- Communication, metering and protective relaying

Communication:

Remote communication with POWER LEADER™ communication network (commnet)

Metering:

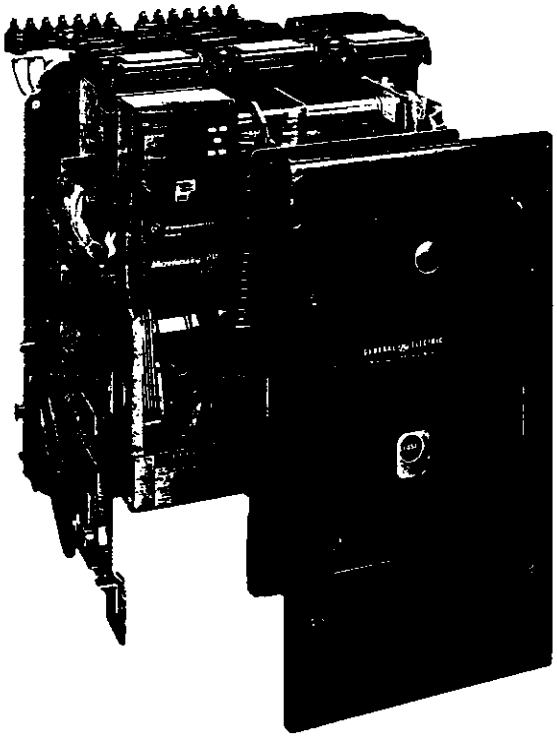
- Voltage (V)
- Energy (kWh, MWh, GWh)
- Real power (kW, MW)
- Total power (kVA, MVA)
- Demand power (kW, MW)
- Peak demand power (kW, MW)
- Frequency (Hz)

Protective relaying

- Undervoltage
- Overvoltage
- Voltage unbalance
- Current unbalance
- Power reversal

Application data

Basic ratings



Type AKR low-voltage power circuit breakers with MicroVersaTrip Plus and PM trip units are rated for short-time withstand current and interrupting capacity (RMS symmetrical). AKR circuit breakers are 100% ANSI rated. Table 11.1 shows the maximum short-time rating for 30-cycle duration at 50/60 Hz.

Table 11.1 Summary of breaker ratings

Rated voltage (Nominal) 60 Hz	Breaker type	Frame size (amps)	Short circuit ratings RMS symmetrical kA		
			Short-time	With instantaneous trip	Without instantaneous trip
600	AKR-30	800	30	30	30
	AKR-30H	800	42	42	42
	AKR-30L	800	42	65	42
	AKR-50	1600	42	42	42
	AKR-50H	1600	65	65	65
	AKRT-50H	2000	65	65	65
	AKR-75	3200	65	65	65
	AKR-75H	3200	85	85	85
	AKR-100	4000	85	85	85
	AKR-125	5000	85	85	85
480	AKR-30	800	30	30	30
	AKR-30H	800	42	42	42
	AKR-30L	800	65	65	65
	AKR-50	1600	50	50	50
	AKR-50H	1600	65	65	65
	AKRT-50H	2000	65	65	65
	AKR-75	3200	65	65	65
	AKR-75H	3200	85	85	85
	AKR-100	4000	85	85	85
	AKR-125	5000	85	85	85
240	AKR-30	800	30	42	30
	AKR-30H	800	42	50	42
	AKR-30L	800	65	65	65
	AKR-50	1600	50	65	50
	AKR-50H	1600	65	65	65
	AKRT-50H	2000	65	65	65
	AKR-75	3200	65	85	65

Table 11.2 Overcurrent trip device current ratings in amperes

Breaker frame	MicroVersaTrip Plus & PM	
	Sensor rating (amps)	Rating plug (amps)
AKR-30	150	60, 80, 100, 125, 150
AKR-30H	400	150, 200, 225, 250, 300, 400
AKR-30L	800	300, 400, 450, 500, 600, 700, 800
AKR-50	800	300, 400, 450, 500, 600, 700, 800
AKR-50H	1600	600, 800, 1000, 1100, 1200, 1600
AKRT-50H	2000	750, 800, 1000, 1200, 1500, 1600, 2000
AKR-75 AKR-75H	3200	1200, 1600, 2400, 3200
AKR-100	4000	1600, 2000, 2500, 3000, 3600, 4000,
AKR-125	5000	3200, 4000, 5000

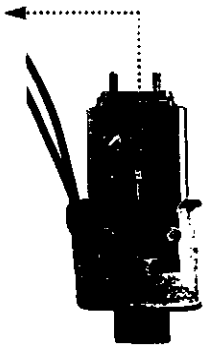
X= Rating plug amps S= Sensor amp rating

Table 11.3 Fused breaker ratings (Maximum 600Vac 50/60 Hz)

Breaker type	Frame size (amps)	Fuse rating (amps)		Interrupting rating (kA) RMS sym.
		Min.	Max. ❶	
AKRU-30	800	300	1600	200
AKRU-50	1600	450	2500	200
AKRT-50H ❷	2000	2000	2500	200
AKR-75 ❷	3200	2000	4000	200
AKR-100 ❷	4000	2000	5000	200
AKR-125 ❷	5000	5000	5000	200

❶ The maximum fuse rating is the largest fuse which tests show will result in proper performance of the breaker and fuse in combination under short circuit conditions. Only Gould Shawmut fuses should be used for proper coordination.

Accessories



Undervoltage trip device

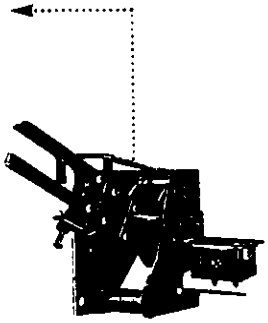
The undervoltage trip device protects against harmful drops in line voltage by automatically tripping the breaker. This device is set to pick up at approximately 85% of bus voltage, and drop out between 30% and 60%.

The UV device is also available with an optional static time-delay unit. This unit offers a field-adjustable two- to six-second delay between undervoltage occurrence and breaker trip to prevent potential nuisance tripping due to momentary loss of voltage.

The time-delay unit is mounted externally to the breaker. It is rated 125Vdc or 250Vdc or 208/240Vac, 50 or 60 Hz. For any other AC source voltage, a control power transformer with a 240V secondary rated at least 100 VA is required.

Table 12.1 Undervoltage trip device operating currents

Nominal control voltage	Frequency Hz	Operating voltage range	Current (amps)	
			Inrush open	Sealed closed
24	DC	Pickup at 80% of nominal control voltage drop out at 30-60% of nominal control voltage	0.38	0.38
48	DC		0.19	0.19
125	DC		0.08	0.08
250	DC		0.04	0.04
120	60		0.66	0.24
240	60		0.37	0.12



Bell alarm (with or without lockout)

The bell alarm is available as one or two "a," one or two "b," or one "a" and one "b." It is activated when the breaker is tripped by any means (automatic) other than the manual trip button or the shunt trip device. The contacts may be used for remote indication of an automatic trip. The lockout feature is available to mechanically lock the breaker "open" when the device is activated. "Reset" is accomplished through operation of the manual trip button. The bell alarm is available without the lockout feature when so specified.

Table 12.2 Bell alarm contact ratings

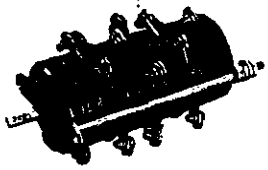
Control voltage		Rating (amperes)	
		Inrush	Continuous
DC	125	2.5	2.5
	250	0.9	0.9
60 Hz AC	120	30	10
	240	15	5
	480	7	3

Remote close solenoid (for manually-operated AKR-30, AKR-50, AKRT-50H breakers)

The solenoid provides a means to electrically close the above breakers from a remote location. It may be controlled by a switch or push button for five-cycle closing. Breaker must be charged locally.

Table 12.3 Remote close solenoid ratings

Control voltage		Rating (amperes)	
		Inrush	Continuous
DC	48	2.7	0.58
	125	1.3	0.32
	250	0.68	0.15
60 Hz AC	120	2.0	0.4
	240	1.0	0.2



Auxiliary switch

The auxiliary switch is used for indication of breaker main contact position. It is available on manually operated circuit breakers in groupings of four or ten contacts (2 or 5 "a" and 2 or 5 "b"), and on electrically operated breakers in groupings of 6 or 12 contacts (3 or 6 "a" and 3 or 6 "b"). All contacts feature rugged double break construction.❷

Table 13.1 Auxiliary switch control ratings and contact sequence

Auxiliary switch control ratings ❶

Control voltage		Rating (Amperes) Non-inductive	Inductive
DC	48	25	—
	125	11	6.3
	250	2	1.8
60 Hz AC	115	75	50
	240	50	25
	480	25	12

Auxiliary switch contact sequence

CB main contacts	"A" contact	"B" contact
Open or tripped	Open	Closed
Closed	Closed	Open

❶ Limited to 20A continuous ratings of switch on all breakers and to 15A continuous rating of #16 wire on draw-out breakers.

❷ Shunt tip requires one "a" contact; remote close requires one "b" contact; closing circuit requires one "b" contact.

Shunt trip

The shunt trip offers remote electrical tripping of the breaker. It is usually controlled by a switch or push-button and may also be used in conjunction with protective relays for automatic tripping.

The shunt trip coil is rated for intermittent duty. When factory installed it is supplied with a cutoff switch that automatically removes control power following a breaker trip.

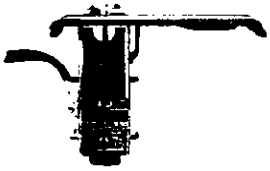
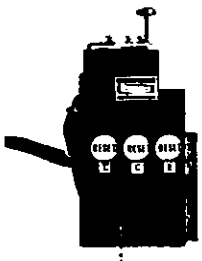


Table 13.2 Shunt trip operating currents

Nominal control voltage	Frequency Hz	Operating voltage range		Current (Amperes) Inrush open	Sealed closed
24	DC	14	30	8.3	8.3
48	DC	28	60	4.5	4.5
125	DC	70	140	2.0	2.0
250	DC	140	280	1.0	1.0
120	60	95	127	12.3	10.8
240	60	190	254	3.9	3.4

Electrical lockout device (manual breakers only)

The electric lockout device provides a means to electrically enable or disable manual closing of a circuit breaker. This electromechanical device consists of a coil with winding that must be energized to close the breaker. Once the breaker is closed, loss of voltage will not trip the breaker. A manual bypass interlock is provided for initial startup. Refer to the UV device for ratings and coil characteristics. (Note: Interlocking of electrically operated circuit breakers does not require an electric lockout device.)



Key interlock provision

Key interlock prevents closing of the circuit breaker unless the key is inserted in the key interlock. With the key removed, the breaker is held in a mechanically trip-free condition.

Operation counter

The operation counter mounts on the breaker as a five-digit, non-resettable counter actuated by the breaker cam shaft.

Open-fuse lockout device

The open-fuse lockout device (provided with any fused breaker) automatically trips the breaker if one of the fuses opens. The breaker is locked open until the fuse is replaced and the reset button of the phase

Electrical characteristics (low-voltage circuit breakers)

Table 14.1 Charging and closing operating currents

Nominal control voltage	Freq. Hz	Voltage range	Motor current (amps)		Anti-pump Relay "W"			Control Relay "X"			Closing Solenoid			Fuse selection (amps)	Charging time (sec.)
					Min.	Rated amps		Min.	Rated Amps		Min.	Rated amps			
			Inrush	Sustained	(volts) pickup	Inrush open	Sealed closed	(volts) pickup	Inrush open	Sealed closed	(volts) pickup	Inrush open	Sealed closed		
AKR-30/50/T50															
48V	DC	38-56	40	10	38	0.063	0.063	30	4.10	4.10	38	3.58	3.58	15	1.5
125V	DC	100-140	27	5	85	0.024	0.024	90	1.05	1.05	100	1.75	1.75	6	1.0
250V	DC	200-280	13	3	170	0.015	0.015	180	0.53	0.53	200	0.88	0.88	6	1.0
120V	60	104-127	25	5	95	0.090	0.052	95	1.00	0.14	98	2.60	0.35	6	0.9
240V	60	208-254	12	3	190	0.064	0.036	190	0.50	0.07	196	1.30	0.17	6	0.9
AKR-75/100/125															
48V	DC	38-56	22.0	16.5	38	0.063	0.063	30	4.10	4.10	38	2.70	2.70	20	2.0
125V	DC	100-140	25.0	7.0	85	0.024	0.024	90	1.05	1.05	100	1.30	1.30	10	1.7
250V	DC	200-280	13.0	3.2	170	0.015	0.015	180	0.53	0.53	200	0.68	0.68	10	1.7
120V	60	104-127	25.0	8.1	95	0.090	0.052	95	1.00	0.14	98	2.60	0.35	10	1.5
240V	60	208-254	11.7	3.5	190	0.064	0.036	190	0.50	0.07	196	1.30	0.17	10	1.3

Table 14.2 Coil resistance - DC Ohms @ 25°C (AKR-30/50/T50/75/100/125)

Nominal control voltage	Frequency Hz	Anti-pump relay "W"	Control relay "X"	Shunt trip	Undervoltage
24V	DC	N/A	N/A	3	64
48V	DC	802	12	11	240
125V	DC	5000	119	64	1600
250V	DC	16400	476	260	6700
120V	60	450	54	3.9	25.4
240V	60	1450	300	25.4	100

Repetitive duty

Circuit breakers are designed primarily to perform the function of circuit interruption under short-circuit conditions. Nevertheless, modern circuit breakers' mechanisms are capable of many operations under full-load operation and in-rush conditions such as those encountered in motor starting applications. Industry standards have been established for the minimum performance, as indicated in Table 14.3. With adequate maintenance, GE breakers can be expected to exceed the standards.

Power-operated circuit breakers, when operating under usual service conditions, shall be capable of operating the number of times specified in the following table. The operating conditions and the permissible effect of such operations upon the breaker are listed below and in the footnotes of Table 14.3. For instance, the breaker should be operated with rated control voltage applied. The frequency of operation should not exceed 20 in 10 minutes or 30 in an hour (rectifiers or other auxiliary devices may further limit the frequency of operation). Servicing consisting of adjusting, cleaning, lubricating, tightening, etc., as recommended by the maintenance manual is to be done at no greater interval than shown in the column titled "Number of operations between servicing" in Table 14.3. No functional parts should require replacement during the listed operations, least one opening operation at rated short-circuit current. After completion of this series of operations, functional part replacement and general servicing may be necessary.

This standard applies to all parts of a circuit breaker that function during normal operation. It does not apply to other parts, such as overcurrent tripping devices that function only during infrequent abnormal circuit conditions.

Table 14.3 Repetitive duty and normal maintenance

Circuit breaker frame size (amperes)	Number of operations between servicing ❶	Number of operations rated continuous current switching ❶❷❸	Number of operations no-load closing and opening ❶	Number of operations in-rush current switching ❹❺
800	1750	2800	9700	1400
1600	500	800	3200	400
2000	500	800	3200	400
3200	250	400	1100	—
4000	250	400	1100	—
5000	250	400	1100	—

❶ Servicing consists of adjusting, cleaning, lubricating, tightening, etc., as recommended by the manufacturer. When current is interrupted, dressing of contacts may be required as well. The operations listed are on the basis of servicing at intervals of six months or less.

❷ With closing and opening currents up to the continuous current rating of the circuit breaker at voltages up to the rated maximum voltage (85% or higher power factor).

❸ The number of operations was determined with closing currents up to 600% and opening currents up to 100% (80% power factor or higher) of the continuous current rating of the circuit breaker at voltages up to the rated maximum voltage. With closing and opening currents up to 600% (50% power factor or less) of the continuous current rating of the circuit breaker at voltages up to rated maximum voltage, the number of operations shown should be reduced to 10% of the number listed in the column.

❹ If a fault operation occurs before the completion of the listed number of operations

Design considerations

Standards and testing

Type AKR low-voltage power circuit breakers are designed and tested to meet ANSI Standards C37.13, C37.14, C37.16, C37.50 and UL 1066. The breakers are UL-listed and labeled to certify compliance with the above-referenced standards. Circuit breaker interrupting capacity may require derating for power factor lower than test values.

Power factors lower than test values affect the circuit breaker's short-circuit current rating. The test circuit X/R ratio and power factor required by ANSI C37.13 is 6.6 and 15% for unfused breakers and 4.9 and 20% for fused breakers..

Table 15.1 Derating factor for systems with power factors lower than test values

System short-circuit power factor (%)	System X/R ratio	Multiple factors for breaker short-circuit current rating	
		Unfused	Fused
20	4.90	1.000	1.000
15	6.60	1.000	0.938
12	8.27	0.966	0.902
10	9.95	0.938	0.875
8.5	11.72	0.920	0.847
7	14.25	0.902	0.826
5	20.00	0.875	0.794

Temperature derating factors

The continuous current rating of AKR breakers is based on their use in an enclosure at 40° C ambient temperature and 105° C maximum breaker temperature for Class A insulation. Continuous current ratings of AKR breakers must be derated for ambient temperatures above 40° C. (If MicroVersaTrip programmer is used, the programmer ambient is limited to 70° C.)

Table 15.2 Continuous derating factors

Ambient temperature (°C)	Derating factor
40	1.00
45	0.95
50	0.89
55	0.84❶
60	0.77
65	0.71
70	0.63

❶ MicroVersaTrip maximum

Altitude correction factors

When applying low-voltage power circuit breakers at altitudes greater than 6,600 feet, their continuous current rating must be modified because a higher temperature use will be experienced for a given current rating. The voltage ratings must also be modified because of the lower dielectric strength of the air. The short-time and short-circuit current ratings are not affected by altitude. However, the short-circuit current ratings shall not exceed that of the voltage class before derating.

Table 15.3 Altitude correction factors (as listed in ANSI C37.13)

Altitude		Rating correction factor	
Meters	Feet	Continuous current	Voltage
2000	6600(and below)	1.00	1.00
2600	8500	0.99	0.95
3900	13000	0.96	0.80

Humidity and fungus

Ferrous parts are zinc-plated for corrosion protection except for some parts made from alloy steels that are inherently corrosion resistant. Current-carrying parts are silver- or tin-plated for corrosion protection and to assure electrical continuity.

Table 15.4 Insulation values (Dielectric test)

	kV
Breaker	2.2
Control Wiring	1.5
Closing Motor	0.9

Table 15.5 Operating time (Same for all frame sizes)

Close Time from energizing closing circuit until contacts touch	Electrically operated	5 Cycles
Open Maximum clearing time	With instantaneous overcurrent trip	3 Cycles
	With shunt trip	3.5 Cycles

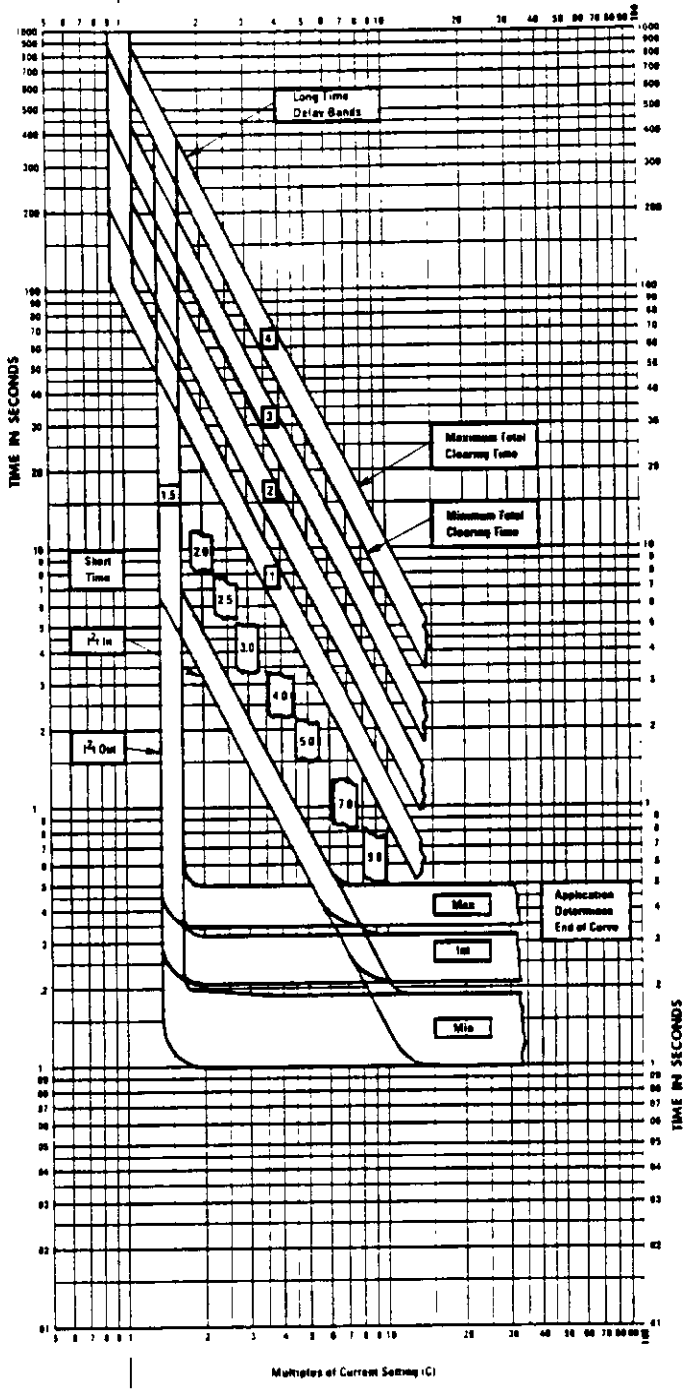
Time current tripping characteristics

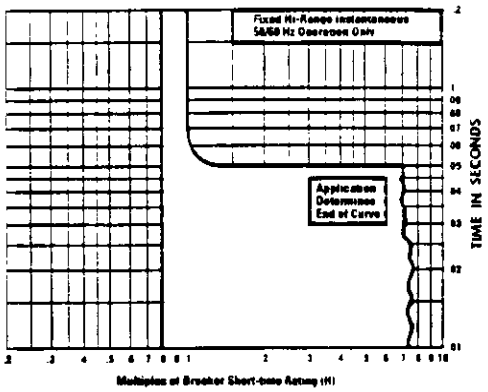
AKR low-voltage power circuit breaker time current curves are the engineering documents that define technical performance characteristics of the devices. Multiples of circuit breaker trip rating are shown on the top and bottom horizontal axis, with time in seconds on the vertical axis. Approximate minimum and maximum clearing time is readily determined

Table 15.6 Time current curves

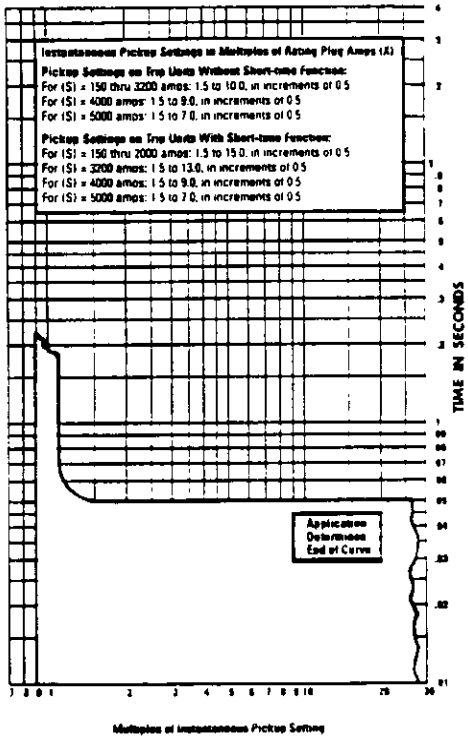
Trip device	Trip elements	Curve
MicroVersaTrip Plus™	LSI	GES-9910
MicroVersaTrip PM™	G	GES-9911

Time current tripping characteristics





Breaker Type	Short-time Rating (H) (Amps, rms symmetrical)		
	240Vac	480Vac	600Vac
AKR-30S	22000	22000	22000
AKR-30	30000	30000	30000
AKR-30H	42000	42000	42000
AKR-50	50000	50000	50000
AKR-50H/AKRT-50H	65000	65000	65000
AKR-75	65000	65000	65000
AKR-100	85000	85000	85000
AKR-125	85000	85000	85000



GE Electrical Distribution & Control

GES-9910

Available Ratings (Amperes)

Breaker Type	Breaker Model	Breaker Frame	Current Sensor (S)	Rating Plug (A)
LVPCB	AKR 30,30S,30H	600	50	40 80 100 125 150
			400	150 200 225 250 300 400
			600	300 400 500 600 700 800
	AKR 50/50H	600	800	300 400 500 600 700 800
			600	600 800 1000 1200 600
	AKRT 50H	800	2000	800 1000 1200 600 2000
	AKR 75	800	3200	1000 1600 2400 3200
	AKR 100	1600	4000	1600 2000 2500 3000 4000
	AKR 125	2000	5000	3200 4000 5000

Voltage Ratings: to 600 volts a.c. max. mum

Low Voltage Power Circuit Breakers
Type AKR
with Enhanced MicroVersa Trip Plus™
or MicroVersa Trip PM™ (Series RMS-9C)
Digital RMS Trip Units

Long-time Delay, Short-time Delay, and Instantaneous Time-current Curves

- Curves apply at 50 to 400 Hertz and from -20°C to +55°C breaker ambient

Note: Operation above 60 Hertz requires thermal and interrupting derating of the circuit breaker

Adjustments

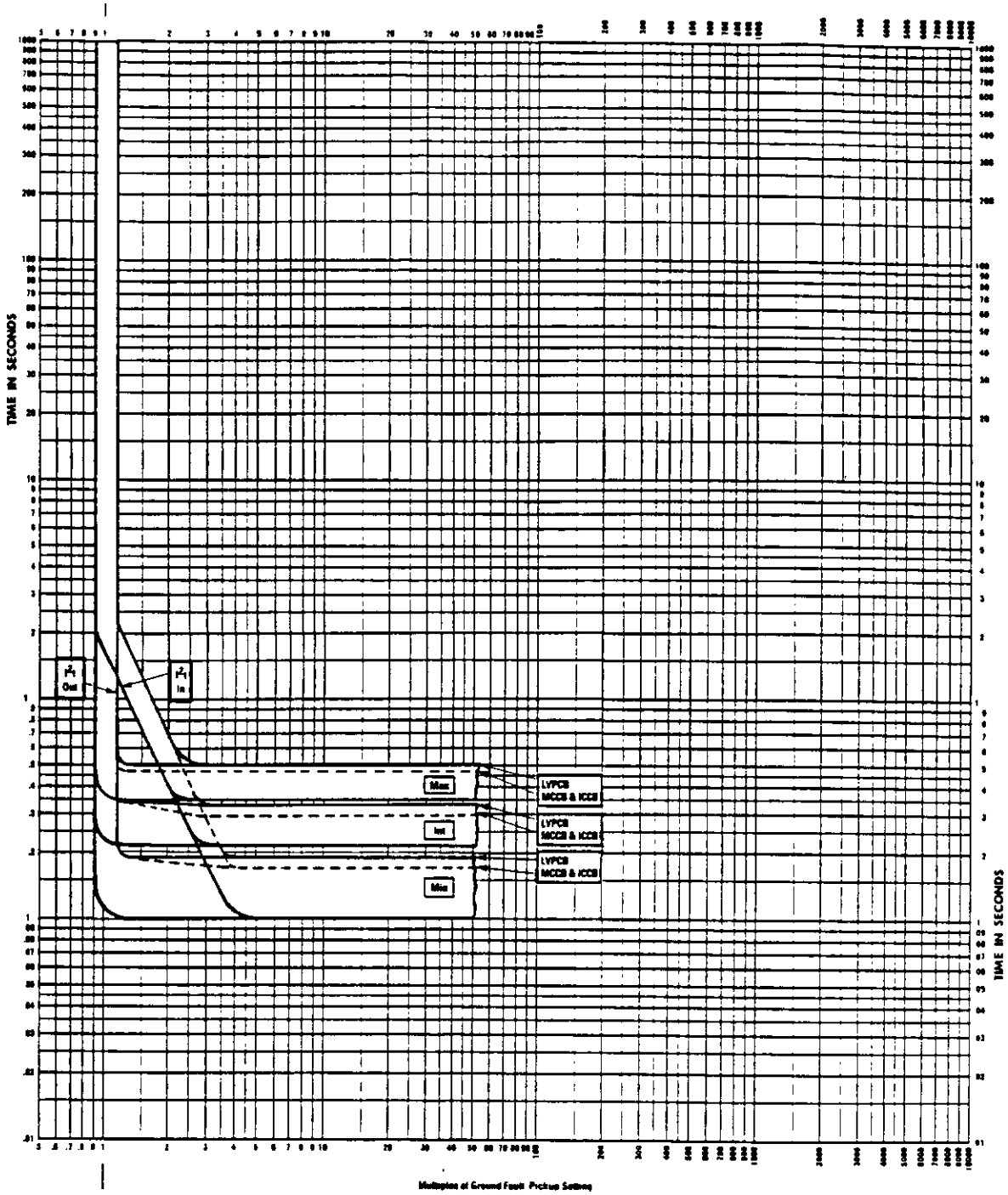
Long-time function:
- Current settings (C): 0.50 to 1.0 in 0.05 increments
  multiples of rating plug amps (A)
  Delay Bands: 1, 2, 3 and 4

Short-time function:
- Pickup settings: 1.5 to 9.0 in 0.5 increments
  multiples of current setting (C)
  Delay Bands: Min, Int, Max, I^2t In / I^2t Out

Instantaneous function:
- See table with curve above

Settings Glossary

S = Current Sensor Rating in amps	A = Rating Plug Rating in amps
C = Current Setting in amps	H = Breaker Short-time Ampere Rating



GE Electrical Distribution & Control

GES-9911

Low Voltage Power Circuit Breakers
Type AKR
Insulated Case Circuit Breakers
Types TP, THP, TC, THC
Molded Case Circuit Breakers
R-Frame
with Enhanced MicroVersa Trip Plus™ or MicroVersa Trip PM™ (Series RMS-9C)
Digital RMS Trip Units

Available Ratings (Amperes)

Type	Breaker Model	Frame	Current (sensor (s))
MCCB	TRU/TRIP	1600	100 1600
		2000	1200
ICCB	TP/THP/TC/THC	800	30 400 800
		1600	100 1600
		2000	1200
		2500	100 2000 2500
		3000	1200
		4000	4000
LVPCB	AKR 30S/30H	800	30 400 800
	SKR-50/50H	600	200 1600
	AKRT-50H	2000	1200
	AKR 75	3200	1200
	AKR-100	4000	4000
	AKR-125	5000	1200

Ground Fault Time-Current Curves

- Curves apply at 50 to 400 Hertz and from -20°C to +55°C breaker ambient

Note: Operation above 60 Hertz requires thermal and interrupting derating of the circuit breaker.

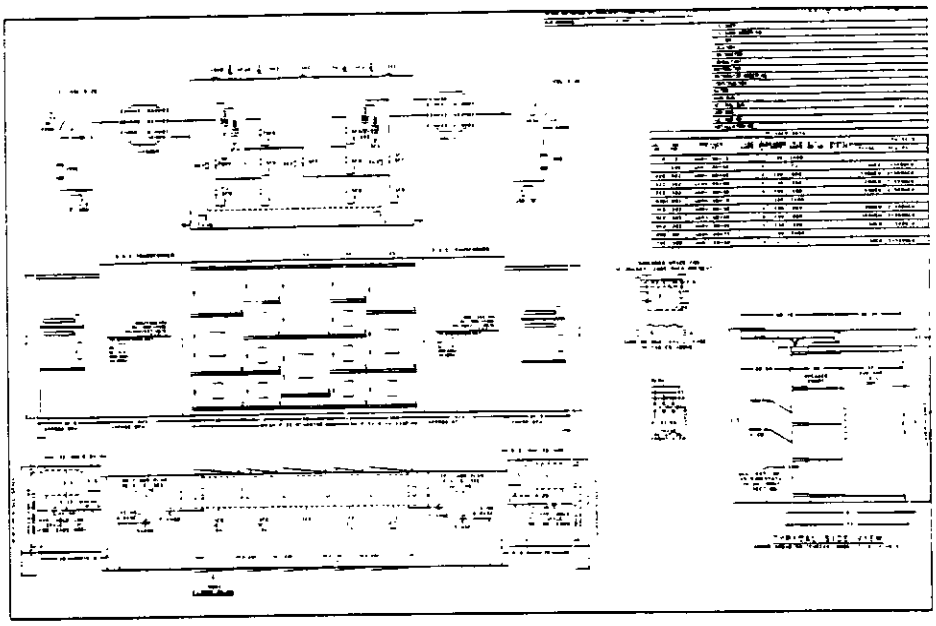
Adjustments

Ground Fault function.

- Pickup settings are in multiples of Current Sensor Rating (S)
  - For (S) = 150 thru 2000 amps
    Pickup setting 0.20 to 0.60 in 0.01 increments
  - For (S) = 2500 thru 3200 amps
    Pickup setting 0.20 to 0.37 in 0.01 increments
  - For (S) = 4000 amps
    Pickup setting 0.20 to 0.30 in 0.01 increments
  - For (S) = 5000 amps
    Pickup setting 0.20 to 0.24 in 0.01 increments
- Delay Bands: Min Int Max (t in I²t Out

Settings Glossary

S = Current Sensor Rating in amps



The Load Center Principle

Pioneered by General Electric, load center unit substations provide reliable equipment for power distribution in industrial plants and commercial buildings, power station auxiliaries and other applications requiring continuity of service.

GE offers a complete line of load center unit substations for indoor or outdoor installations. The unit consists of an incoming line, a transformer and low-voltage sections. Load center unit substations are handled as a single packaged system, simplifying engineering coordination and application.

Standard design eliminates unnecessary purchasing and engineering details. Factory assembly reduces installation time and cost.

Mechanical and electrical coordination results in greater reliability. Expert field engineering is available to ensure proper application, installation and operation.

How to select switchgear

The application tables on the following pages provide a list of low-voltage power circuit breakers available for load center unit substation applications. The air power circuit breakers are coordinated with transformers and system capacities (electrically, thermally and mechanically). For analysis procedures on motor starting and DC machine circuit applications, fused breakers, overcurrent trip details, short-circuit ratings, etc., refer to ANSI C37.13 and ANSI C37.16.

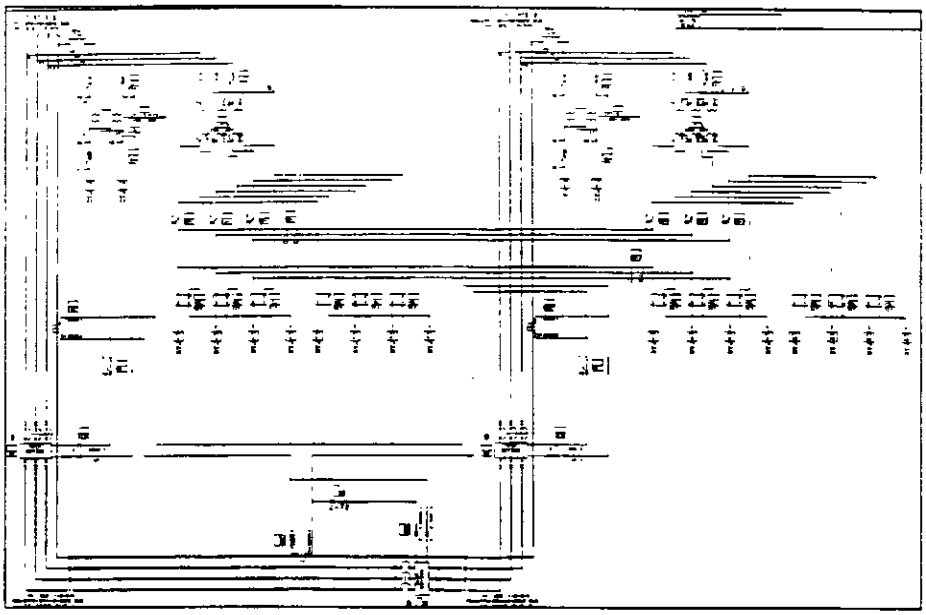
These tables should be used only as guidelines, taking into consideration voltage, temperature, power factor, altitude and particular power system. For instance, under certain circuit arrangements, the total running motor short-circuit current contribution may be greater than that shown in the motor contribution tables. This condition might exist for unit substations having a high ratio of running motor nameplate horsepower to actual demand, such as may occur in heavy machining or stamping press operations. This condition could also exist when a secondary selective system operates with one main breaker open and one main and one tie breaker closed so that the feeder breaker can see "twice" the normal motor contribution to a short circuit.

For these types of systems, the use of higher-rated or AKRU fused circuit breakers may be required to stay within the short-circuit rating of the feeder breaker.

Power circuit breakers are available with various combinations of long-time delay, short-time delay and instantaneous trip elements. Care should be taken to specify the combination of trips that will provide the balance of selectivity and protection required by the power system.

A selectively coordinated substation uses main and tie breakers with long-time and short-time trip characteristics (LS) to delay the opening of the main circuit breaker until the faulted feeder has had an opportunity to clear. This provides service continuity for all but the faulted circuit and generally allows coordination of main and tie breakers with the various trip characteristics (LS) (LSI) (LI) available on feeder circuit breakers.

Selectivity can be carried a step further in the substation by specifying selective feeder circuit breakers that incorporate long-time, short-time and high-range instantaneous (LSH) to



A refinement of the selective feeder incorporates the long-time, short-time and instantaneous characteristics to provide selectivity without sacrificing instantaneous fault protection at high short-circuit currents. This combination of trip characteristics permits application of short-time delay trips to override inrush currents to down stream loads and coordinate with downstream current devices for lower fault current values. It also permits the use of instantaneous trips to provide maximum system protection for high values of fault current. This is called the zone-selective arrangement and is often desirable when the load-center feeder serves a motor control center or other large load.

Long-time and instantaneous trip characteristics (LI) are often used on feeder breakers when short-time delay is not required to coordinate with downstream devices. Depending on the magnitude of fault current and the circuit impedance between breakers, a feeder breaker with LI trips may also be able to coordinate (at least partially) with a similar downstream breaker also having LI trip characteristics.

Breakers with LI trips are sometimes referred to as fully rated since they may have higher interrupting capabilities when provided with instantaneous trips (LI or LSI characteristics). The majority of breakers manufactured today, however, have the same interrupting rating regardless of the trip characteristic. Long-time and instantaneous trips (LI) could also be used on main breakers when minimum breaker interrupting time is required for the rare occurrence of a fault on the switchgear main bus, or when the system design does not require selective coordination.

Application tables

Application tables are based on the following factors:

substation

- Transformer impedance listed in table (only source of power to the bus is the substation transformer)
- Total connected motor kVA does not exceed 50% of transformer rating at 208Y/120 volts and 100% of transformer rating at 240, 480, and 600 volts
- The motor contribution is taken as 2.0 times the rated current of the transformer at 208Y/120 volts and 4.0 times the rated current at 240, 480 and 600 volts
- Tabulated values of short-circuit current are in terms of RMS symmetrical current per NEMA Standard SG-3
- Tables estimate short circuit duty (Reference GET-3550 for short circuit calculation)

Example

The application tables make it easy to select the proper General Electric breakers for use with distribution systems using various trip devices. For example, a 1500kVA transformer, with 750MVA maximum primary short-circuit available and a 480V secondary, requires at least an AKRT-50 main secondary breaker shown in column 7 of the 480V application table.

Full utilization of a load center transformer with dual temperature rise (such as 55, 65°C) capability or forced (fan) cooling capability would require a larger frame size breaker — or an AKR-75 in this example.

The appropriate feeder circuit breaker is found in columns 8, 9 or 10, depending on the combination of long-time, short-time and instantaneous trips required by the system design. In this example, the same type breakers (AKR-30H) are required regardless of the type of trip device utilized, although a larger frame breaker may be required in order to meet the

Power circuit breaker selection tables

Table 20.1 Transformer forced cooled ratings

Transformer type	Self-cooled kVA	% increase with fans
Liquid filled: 65° C rise	750-2000	15%
	2500-5000	25%
Liquid filled: 55/65° C rise	750-2000	15% (fans) + 12% (65° C)
	2500-5000	25% (fans) + 12% (65° C)
Ventilated dry	750-2500	33%
Cast coil	500-2500	40%
	3000-5000	25%

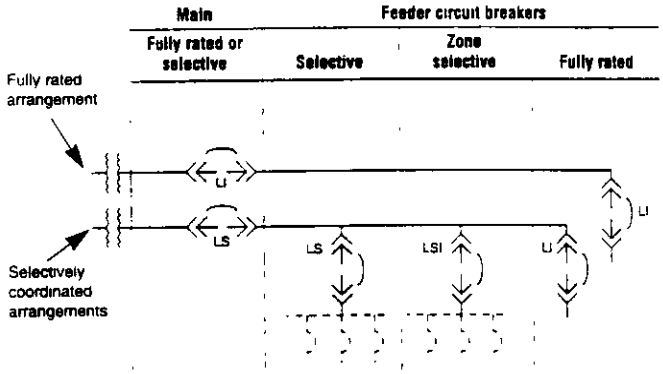


Table 20.2 208 volts, three phase

Transformer rating 3-phase kVA and impedance percent	Max short-circuit MVA available from primary system	Full load continuous current (amperes) ❶❹	Short-circuit rating sym current (A)			Long-time inst. or long-time short-time ❶	Long-time short-time	Long-time short-time inst.	Long-time inst.
			Transformer alone	100% Motor load	Combined				
300 4.5%❷	50	833	16300	1700	18000	AKR-50	AKR-30	AKR-30	AKR-30
	100		17300		19000				
	150		17700		19400				
	250		18000		19700				
	500		18300		20000				
	750		18300		20000				
	Unlimited		18500		20200				
500 4.5%❷	50	1388	25200	2800	28000	AKR-50	AKR-30	AKR-30	AKR-30
	100		27800		30600		AKR-30H		
	150		28700		31500				
	250		29500		32300				
	500		30200		33000				
	750		30400		33200				
	Unlimited		30800		33600				
750 5.75%	50	2082 ❹(2915)	28700	4200	32900	AKR-75	AKR-30H	AKR-30	AKR-30
	100		32000		36200				
	150		33300		37500				
	250		34400		38600				
	500		35300		39500				
	750		35600		39800				
	Unlimited		36200		40400				
1000 5.75%	50	2776 ❹(3886)	35800	5600	41400	AKR-75	AKR-30L	AKR-30H	AKR-30
	100		41100		46700				AKR-30H
	150		43300		48900				
	250		45100		50700			AKR-30L	AKR-30L
	500		46700		52300				
	750		47200		52800				
	Unlimited		48300		53900				
1500 5.75%	50	4164	47600	8300	55900	AKR-125	AKR-75H	AKR-75	AKR-75
	100		57400		65700				
	150		61700		70000				
	250		65600		73900				
	500		68800		77100				
	750		70000		78300				
	Unlimited		72400		80700				

❶ With transformer operating on base temperature rise without fans. Larger frame size main breaker may be required when dual temperature rise for forced cooled transformers are used.
❷ Minimum impedance.
❹ Maximum forced cooled rating indicated in parentheses.

L = Long-time delay trip (overload tripping)
S = Short-time delay trip (selective fault tripping)
I = Instantaneous trip (high fault current fast tripping)

Table 21.1 Transformer forced cooled ratings

Transformer type	Self-cooled kVA	% increase with fans
Liquid filled: 65° C rise	750-2000 2500-5000	15% 25%
Liquid filled: 55/65° C rise	750-2000 2500-5000	15% (fans) + 12% (65° C) 25% (fans) + 12% (65° C)
Ventilated dry	750-2500	33%
Cast coil	500-2500 3000-5000	40% 25%

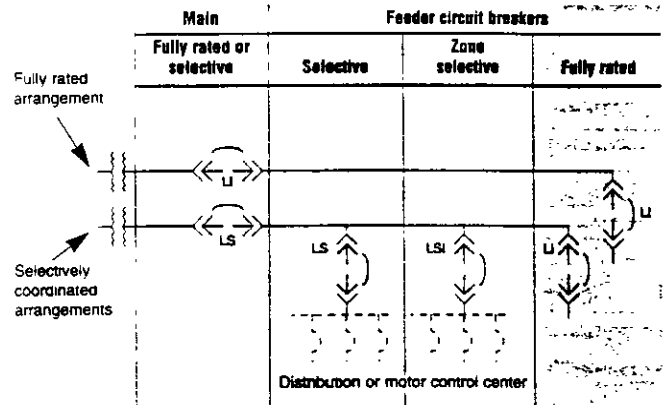


Table 21.2 240 volts, three phase

Transformer rating 3-phase kVA and impedance percent	Max short-circuit MVA available from primary system	Full load continuous current (amperes) ①②	Short-circuit rating sym current (A)			Long-time inst. or long-time short-time ①	Long-time short-time	Long-time short-time inst.	Long-time inst.
			Transformer alone	100% Motor load	Combined				
300 4.5%②	50	722	14200	2900	17100	AKR-30	AKR-30	AKR-30	AKR-30
	100		15000		17900				
	150		15400		18300				
	250		15600		18500				
	500		15800		18700				
	750		15900		18800				
	Unlimited		16000		18900				
500 4.5%②	50	1203	21900	4800	26700	AKR-50	AKR-30	AKR-30	AKR-30
	100		24100		28900				
	150		24900		29700				
	250		25600		30400		AKR-30H		
	500		26100		30900				
	750		26300		31100				
	Unlimited		26700		31500				
750 5.75%	50	1804 ③(2526)	24900	7200	32100	AKRT-50H	AKR-30H	AKR-30	AKR-30
	100		27800		35000				
	150		28900		36100				
	250		29800		37000				
	500		30600		37800				
	750		30800		38000				
	Unlimited		31400		38600				
1000 5.75%	50	2406 ③(3368)	31000	9600	40600	AKR-75	AKR-30H	AKR-30	AKR-30
	100		35600		45200		AKR-30L	AKR-30H	AKR-30H
	150		37500		47100				
	250		39100		48700				
	500		40400		50000			AKR-30L	AKR-30L
	750		40900		50500				
	Unlimited		41800		51400				
1500 5.75%	50	3608 ③(5052)	41200	14400	55600	AKR-100	AKR-30L	AKR-30L	AKR-30L
	100		49800		64200				
	150		53500		67900		AKR-75H	AKR-75	AKR-75
	250		56800		71200				
	500		59600		74000				
	750		60600		75000				
	Unlimited		62800		77200				
2000 5.75%	50	4811	49300	19200	68500	AKR-125	AKR-75H	AKR-75	AKR-75
	100		62100		81300				
	150		67900		87100		Fused breaker	AKR-75H	AKR-75H
	250		73500		92700				
	500		78200		97400				
	750		80000		99200				
	Unlimited		83700		102900				

① With transformer operating on base temperature rise without fans. Larger frame size main breaker may be required when dual temperature rise for forced cooled transformers are used.

② Minimum impedance

L = Long-time delay trip (overload tripping)
S = Short-time delay trip (selective fault tripping)
I = Instantaneous trip (high fault current fast tripping)

Power circuit breaker selection tables *(continued)*

Table 22.1 Transformer forced cooled ratings

Transformer type	Self-cooled kVA	% increase with fans
Liquid filled: 65° C rise	750-2000	15%
	2500-5000	25%
Liquid filled: 55/65° C rise	750-2000	15% (fans) + 12% (65° C)
	2500-5000	25% (fans) + 12% (65° C)
Ventilated dry	750-2500	33%
Cast coil	500-2500	40%
	3000-5000	25%

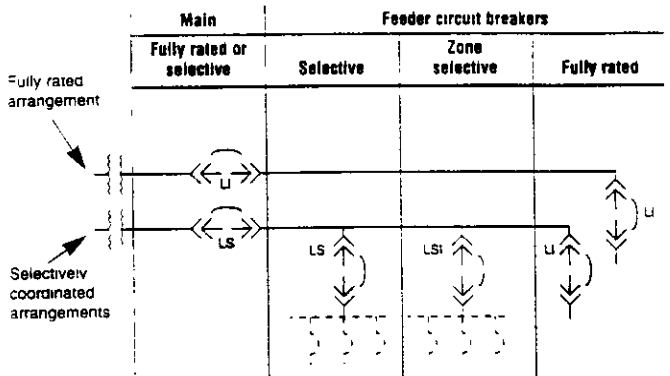


Table 22.2 480 volts, three phase

Transformer rating 3-phase kVA and impedance percent	Max short-circuit MVA available from primary system	Full load continuous current (amperes) ❶❷	Short-circuit rating sym current (A)			Long-time inst. or long-time short-time ❶	Long-time short-time	Long-time short-time inst.	Long-time inst.
			Transformer alone	100% Motor load	Combined				
500 4.5%❸	50	601	10900	2400	13300	AKR-30	AKR-30	AKR-30	AKR-30
	100		12000		14400				
	150		12400		14800				
	250		12800		15200				
	500		13100		15500				
	750		13200		15600				
	Unlimited		13400		15800				
750 5.75%	50	902 ❸ (1263)	12400	3600	16000	AKR-50	AKR-30	AKR-30	AKR-30
	100		13900		17500				
	150		14400		18000				
	250		14900		18500				
	500		15300		18900				
	750		15400		19000				
	Unlimited		15700		19300				
1000 5.75%	50	1203 ❸ (1684)	15500	4800	20300	AKR-50	AKR-30	AKR-30	AKR-30
	100		17800		22600				
	150		18700		23500				
	250		19600		24400				
	500		20200		25000				
	750		20400		25200				
	Unlimited		20900		25700				
1000 8%	50	1203 ❶ (1684)	12000	4800	16800	AKR-50	AKR-30	AKR-30	AKR-30
	100		13400		18200				
	150		13900		18700				
	250		14300		19100				
	500		14700		19500				
	750		14800		19600				
	Unlimited		15000		19800				
1500 5.75%	50	1804 ❶ (2526)	20600	7200	27800	AKRT-50H	AKR-30	AKR-30	AKR-30
	100		24900		32100		AKR-30H	AKR-30H	AKR-30H
	150		26700		33900				
	250		28400		35600				
	500		29800		37000				
	750		30300		37500				
	Unlimited		31400		38600				
2000 5.75%	50	2406 ❸ (3368)	24700	9600	34300	AKR-75	AKR-30H	AKR-30H	AKR-30H
	100		31000		40600				
	150		34000		43600		AKR-30L	AKR-30L	AKR-30L
	250		36700		46300				
	500		39100		48700				
	750		40000		49600				
	Unlimited		41800		51400				
2500 5.75%	50	3007 ❸ (4210)	28000	12000	40000	AKR-75	AKR-30H	AKR-30H	AKR-30H
	100		36400		48400				
	150		40500		52500		AKR-30L	AKR-30L	AKR-30L
	250		44500		56500				
	500		48100		60100				
	750		49400		61400				
	Unlimited		52300		64300				
3000 5.75%	50	3608 ❺ (5052)	30700	14400	45100	AKR-100	AKR-30L	AKR-30L	AKR-30L
	100		41200		55600				
	150		46600		61000		AKR-75H	AKR-75H	AKR-75H
	250		51900		66300				
	500		56800		71200				
	750		58700		73100				
	Unlimited		62800		77200				
3750 5.75%	50	4511	34000	18000	52000	AKR-125	AKR-30L	AKR-30L	AKR-30L
	100		47500		65500				
	150		54700		72700		AKR-75H	AKR-75H	AKR-75H
	250		62200		80200				
	500		69400		87400				
	750		72200		90200		Fused breaker	Fused breaker	Fused breaker
	Unlimited		78400		96400				

❶ With transformer operating on base temperature rise without fans. Larger frame size [illegible] temperature rise for forced cooled trans-

L = Long-time delay trip (overload tripping)
S = Short-time delay trip (selective fault tripping)

Table 23.1 Transformer forced cooled ratings

Transformer type	Self-cooled kVA	% increase with fans
Liquid filled: 65° C rise	750-2000	15%
	2500-5000	25%
Liquid filled: 55/65° C rise	750-2000	15% (fans) + 12% (65° C)
	2500-5000	25% (fans) + 12% (65° C)
Ventilated dry	750-2500	33%
Cast coil	500-2500	40%
	3000-5000	25%

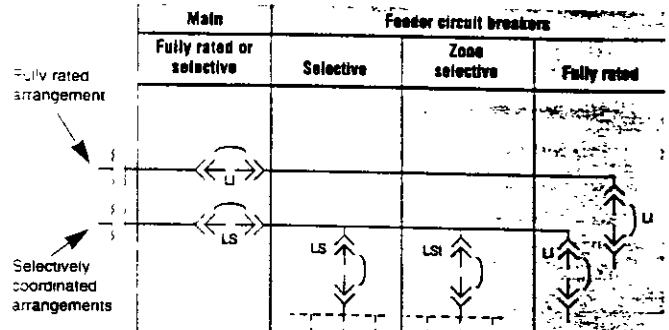


Table 23.2 600 volts, three phase

Transformer rating 3-phase kVA and impedence percent	Max short-circuit MVA available from primary system	Full load continuous current (amperes) ❶❷	Short-circuit rating sym current (A)			Main	Feeder circuit breakers		
			Transformer alone	100% Motor load	Combined	Long-time inst. or long-time short-time ❸	Long-time short-time	Long-time short-time inst.	Long-time inst.
500 4.5% ❹	50	481 ❸ (674)	8700	1900	10600	AKR-30	AKR-30	AKR-30	AKR-30
	100		9600		11500				
	150		10000		11900				
	250		10200		12100				
	500		10500		12400				
	750		10500		12400				
	Unlimited		10700		12600				
750 5.75%	50	722 ❸ (1010)	10000	2900	12900	AKR-30	AKR-30	AKR-30	AKR-30
	100		11100		14000				
	150		11500		14400				
	250		11900		14800				
	500		12200		15100				
	750		12300		15200				
	Unlimited		12600		15500				
1000 5.75%	50	962 ❸ (1347)	12400	3800	16200	AKR-50	AKR-30	AKR-30	AKR-30
	100		14300		18100				
	150		15000		18800				
	250		15600		19400				
	500		16200		20000				
	750		16400		20200				
	Unlimited		16700		20500				
1500 5.75%	50	1443 ❸ (2021)	16500	5800	22300	AKR-50	AKR-30	AKR-30	AKR-30
	100		19900		25700				
	150		21400		27200				
	250		22700		28500				
	500		23900		29700				
	750		24300		30100		AKR-30H	AKR-30H	AKR-30H
	Unlimited		25100		30900				
2000 5.75%	50	1925 ❸ (2694)	19700	7700	27400	AKRT-50H	AKR-30	AKR-30	AKR-30
	100		24800		32500				
	150		27200		34900				
	250		29400		37100		AKR-30H	AKR-30H	AKR-30H
	500		31300		39000				
	750		32000		39700				
	Unlimited		33500		41200				
2500 5.75%	50	2406 ❸ (3368)	22400	9600	32000	AKR-75	AKR-30H	AKR-30H	AKR-30H
	100		29200		38800				
	150		32400		42000				
	250		35600		45200		AKR-50H	AKR-30L	AKR-30L
	500		38500		48100				
	750		39500		49100				
	Unlimited		41800		51400				
3000 5.75%	50	2887 ❸ (4041)	24600	11500	36100	AKR-75	AKR-30H	AKR-30H	AKR-30H
	100		33000		44500				
	150		37200		48700				
	250		41500		53000		AKR-50H	AKR-30L	AKR-30L
	500		45500		57000				
	750		46900		58400				
	Unlimited		50200		61700				
3750 5.75%	50	3608 ❸ (5051)	27200	14400	41600	AKR-100	AKR-30H	AKR-30H	AKR-30H
	100		38000		52400				
	150		43700		58100		AKR-50H	AKR-30L	AKR-30L
	250		49800		64200				
	500		55500		69900				
	750		57700		72100		AKR-75H	AKR-75H	AKR-75H
	Unlimited		62800		77200				
5000 5.75%	50	4811	30500	19200	49700	AKR-125	AKR-50H	AKR-30L	AKR-30L
	100		44800		64000				
	150		53000		72200		AKR-75H	AKR-75H	AKR-75H
	250		62100		81300				
	500		71300		90500				
	750		75000		94200		Fused breaker	Fused breaker	Fused breaker
	Unlimited		83700		102900				

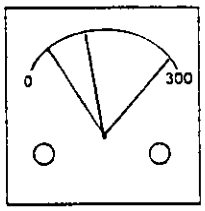
❶ With transformer operating on base temperature rise without fans. Larger frame

❸ = Long-time delay (trip overload tripping)

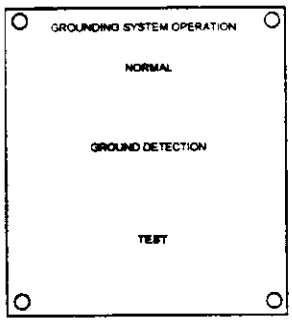
Ground detection considerations

High resistance pulsing ground detection system

This system provides a means for grounding the neutral of an ungrounded power system, utilizing the "high-resistance" method. It allows the switchgear to operate as an "ungrounded" system but eliminates the danger of high transient overvoltage during certain types of ground faults. For delta systems, a set of grounding transformers is provided for connection of the grounding resistor.



The high-resistance pulsing ground detection system uses a voltmeter relay with an adjustable set point to detect abnormal ground current through the grounding resistor. A green indicating light shows normal conditions, and a red indicating light indicates the presence of a phase-to-ground fault. Alarm contacts allow remote indication of the ground condition. The location of the fault is quickly determined using a pulsing current in conjunction with a sensitive clamp-on ammeter. This permits clearance of the ground fault before a second phase-to-ground fault causes an outage. After the fault is located and cleared, the system is reset and ready to detect the next ground fault.



Ground detection on ungrounded systems

This system provides visual indication of the presence of a phase-to-ground condition on a delta ungrounded system. Ground detection on ungrounded systems consists of one set of three potential transformers rated for full phase-to-phase voltage on the primary winding and 120-volt secondary winding. The primary is connected wye. The secondary connection is dependent on the type of ground indicators and alarm devices used. A loading or stabilizing resistor in the potential transformer primary connection to ground is used to prevent ferroresonance with the distributed capacitance of the system. Ground indication and alarm can be accomplished as described in the following tables:

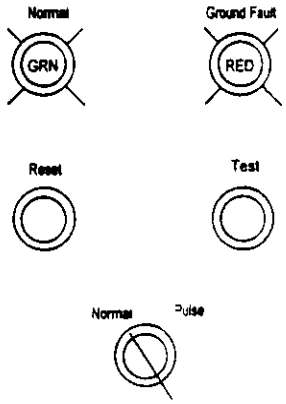


Table 24.1 Operation with lights or voltmeters

Standard	Option	Operational description
Three 120V indicating lights with clear lenses (one per phase). Potential transformers with wye connected secondaries.	Three voltmeters instead of indicating lights. Potential transformers with wye connected secondaries.	Assuming rated system voltage on the primary of the potential transformers, the three lamps would glow about equally at subnormal brilliancy because the voltage across each lamp is 69.3 volts. Similarly, if voltmeters are used instead of lamps, each would read 69.3 volts. If one phase of the system becomes grounded, the potential transformer on the grounded phase would be short-circuited, and the voltage on the other two transformers would rise to approximately full phase-to-phase voltage. The lamp on the grounded phase would be dark and the other two lamps would glow at normal brilliancy. Similarly, the voltmeter on the grounded phase would read zero and the other two voltmeters would read 120 volts.

Table 25.1 Operation with alarm relay

Option	Operational description
An overvoltage relay coil rating of 199 to 208V, pick-up range of 16-64V or 70-140V. Potential transformers with broken delta connected secondaries. *Note that either of the above mentioned indicating lights or voltmeters can be used as ground indicators with this option.*	Operation with the alarm relay is the same as described in Table 24.1, although the connections are different. Assuming rated system voltage on the potential transformers' primary, the three secondary voltages add up vectorially to zero. Thus, there is normally no voltage on the relay. If one phase of the system becomes grounded, the potential transformer on the grounded phase would be short-circuited and the voltages on the other two transformers would rise to full phase-to-phase voltage. The secondary voltages would also rise to the phase-to-phase values (120 volts). Because these two voltages are in series at an angle of 60 degrees under ground fault conditions, the voltage imposed on the relay is three times the voltage on each potential transformer secondary under normal conditions (208 volts).

Table 25.2 Operation with test switch

Option	Operational description
Test switch. (For either lamp test or test-for-ground.)	The lamp test feature is performed using the normally closed contact of the test switch. The test for ground feature is performed using the normally open contract. The user must specify which test feature is to be furnished

Ground fault protection on solidly grounded systems

The preferred method of providing ground fault protection on AKR power circuit breakers is using the ground fault function on the MicroVersaTrip Plus or MicroVersaTrip PM trip unit. This is referred to as integral ground fault protection and requires no external relaying or control power. Integral ground fault is applicable to 3-phase, 3-wire or 4-wire systems with single or multiple sources.

When multiple source systems are encountered, each source can be grounded upstream of the main secondary breakers in accordance with the NEC, eliminating the need for complex ground and neutral bus systems required for single-point grounding of the source neutrals.

Special consideration must be given to power systems having continuously paralleled sources or operating as networks. In some of these cases, ground fault protection is best accomplished by using the Ground Break system. This system consists of current sensors for each phase and/or neutral conductors, a relay with separate current pick-up and time delay settings, and a fault indicator/reset device. As an option, the fault indicator/reset device can be replaced by a Monitor Panel. In addition to providing the fault indication and reset functions, the Monitor Panel provides a feature that allows tripping or no tripping of the circuit breaker(s) in the ground fault scheme during testing. The Ground Break system requires a control power source and shunt trips on the circuit breakers.

General note

A combination of ground indication and metering or relaying on the same set of potential transformers is not recommended. Metering not only may require different primary and/or secondary connections; it also increases the probability of faults in the secondary circuits with consequent false indications of grounds on the primary system.

Automatic transfer (throwover) equipment

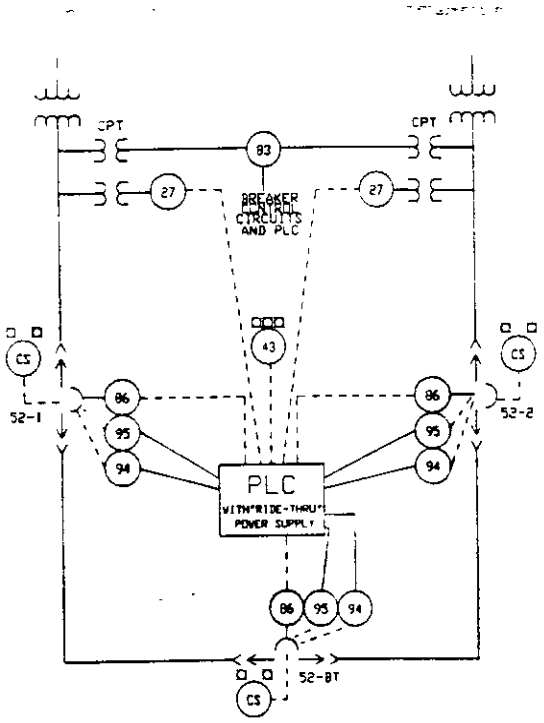
Relay and control equipment can be provided to maximize continuity of service to a switchgear load bus by transferring the load bus to an alternate or emergency power source in the event of problems with the primary power source (undervoltage, loss of phase, etc.) Detection is typically provided by voltage relays (single- or three-phase undervoltage, phase sequence/undervoltage, voltage unbalance, or a combination of these). Breaker close and trip sequences are determined by hard-wired relay logic or by way of a programmable logic controller (PLC) installed in the switchgear. The PLC provides the maximum flexibility for modifications to the control sequence without the addition of relays, switches and control wiring.

Interposing relays are provided for interfacing the PLC outputs with the circuit breaker close and trip circuits. If the control power source for the PLC is AC derived from within the switchgear, a dedicated power supply is provided for the PLC to ride through any momentary switching of the control power sources. The PLC programs are executed without interruption during an undervoltage (or loss of phase) condition.

After the undervoltage (or loss of phase) condition has been corrected, return to normal can be manual or automatic with a time delay. A closed transition with momentary paralleling can be provided as an option for return to normal and/or for maintenance of the main and bus tie breakers (synchronism check relay may be required).

Interlocking

AKR power circuit breakers can be interlocked in several ways to prevent closing one breaker until another breaker is open. Manually and electrically operated breakers can be supplied with one single- or double-barrel lock mounted in the breaker compartment. Key interlocks may be used to prevent paralleling sources in a double-ended switchgear line-up. Only two keys are used for the three interlocked breakers (two main and one tie). The interlock without a key keeps the breaker mechanically trip-free, thus allowing only two of the three breakers to be closed at any given time.



Key interlocks can also be provided on substation main secondary breakers for interlocking with a transformer primary air switch. Operation of the primary air switch (open or close) is blocked until the main secondary breaker is opened and locked out. The key from the main breaker interlock is then removed and inserted in the primary switch interlock thus allowing operation of the switch.

Electrical interlocks

In lieu of mechanical key interlocks, electrically operated breakers can be provided with hard-wired electrical interlocking using a combination of breaker auxiliary contacts (MOC) and position switch contacts (TOC). These contacts are wired in the breaker close circuits such that closing of a tie breaker, for example, is blocked or disabled until one of the main breakers is opened. The position switch contacts allow normal operation of the breakers during maintenance situations where one or more of the interlocked breakers may be racked out to the test or disconnect position or withdrawn from the compartment.

A form of electrical interlocking can also be provided on manually operated breakers for control situations that require an electrical contact closure before closing the breaker. The electric lockout option on the circuit breaker blocks operation of the closing mechanism until the coil of the electric lockout is energized. De-energizing this coil after the breaker is closed does not trip the breaker.

PLC inputs

- Source voltage status (as sensed by the voltage relays)
- Main and tie breaker status (open, closed, tripped on fault)
- Main and tie breaker drawout position (connected, test/disconnect)
- Transfer system status (automatic/manual)

PLC outputs

- Close signal to main and bus tie breakers
- Trip signal to main and bus tie breakers
- Additional outputs and indicating lights can be provided for local identification of transfer scheme status (auto-blue/manual-white) and PLC fault (amber)

Basic features of the PLC logic

- Interlocking of the main and bus tie breakers to prevent paralleling sources
- Time delay for initiating a transfer upon an undervoltage (or loss of phase) condition.
- Blocking transfer if either of the main or bus tie breakers trips due to a fault.

Sizing and dimensional data

Typical AC switchgear sections, 635V maximum, 50/60 Hz

Switchgear depth:

AKD-8 low-voltage switchgear height is 92" (97" over the top wiring trough). The available breaker stacking space is 84". Optional 78"-high indoor equipment is also available (contact factory for details). Breaker size and depth influences depth of section (see Table 27.1).

AKD-8 vertical section width is determined by the width of the largest device in the section (see Table 27.2).

Table 27.1 Enclosure depth options

Enclosure type	Available depth options
Indoor	60", 67", 74", 81"
Front compartment	30", 37"
Rear compartment	30", 37", 44"
Outdoor (total indoor frame depth)	60", 74"
Walk-in (total enclosure)	108", 122"
Non-walk-in (total enclosure)	68", 82"

Table 27.2 Breaker compartment size

Breaker type	Frame size (amperes)	Vertical Breaker unit height	Minimum section width	lineup depth
AKR-30	800	21"	22"	60"
AKR-30				
AKR-30H				
AKR-30L				
AKRU-30				67"
AKR-50	1600			60"
AKR-50H				
AKRU-50H				67"
AKRT-50H	2000			60"
AKR-75	3200	35"	30"	
AKR-75H				
AKR-75 with fused rollout		84"	38"	
AKR-100	4000	35"	30"	
AKR-100 with fused rollout		84"	38"	67"
AKR-125	5000	35"		74"
AKR-125 ❶ with fused rollout				

❶ Breaker and fused rollout must be mounted in separate vertical sections.

Table 27.3 Switchgear weights (lbs)

Procedure:

A) Add the weight of every vertical section in the lineup

B) Add the weight of each breaker in the lineup

C) Add the weight of each fused breaker and fused rollout in the lineup

Vertical section weights (lbs)				Breaker weights (lbs)			Fused breakers & rollout weights (lbs)			
Section width	# of breaker compartments❶ in vertical section	Enclosure type		Breaker type	Breaker operator		Breaker type	Breaker operator		Fused rollout
		Indoor	Outdoor		Manual	Electric		Manual	Electric	
22"	1	940	1610	AKR-30	200	205	AKRU-30	245	250	N/A❻
	2	1100	1770	AKR-30H	200	205	AKRU-50	255	260	N/A❻
	3	1270	1940	AKR-30L	200	205	AKRT-50H	N/A❻	N/A❻	300
	4	1440	2110	AKR-50	210	215	AKR-75	N/A❻	N/A❻	300
30"	1	1300	2100	AKR-50H	210	215	AKR-100	N/A❻	N/A❻	400
	2	1400	2300	AKRT-50H	220	225	AKR-125	N/A❻	N/A❻	425
38"	1	1660	2600	AKR-75	420	480				
	2	1900	2830	AKR-100	485	555				
22" or 30"	Auxiliary section	1170	1800	AKR-125	515	575				

❶ Also includes number of fused rollouts in the vertical section

❷ Fuses are part of the fused breaker

❸ This breaker type uses a separate fused rollout

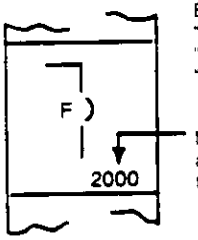
Switchgear layout and sizing

Layout considerations

1) Any breaker compartment shown on the stack drawings can be made blank for more device mounting space.
2) The amp rating shown beside each breaker indicates the maximum frame size allowed in that compartment. This takes into consideration the temperature rise in the stack due to breaker loading.
3) Customer-allowable cumulative loading is as recommended in ANSI C37.20.1
4) Devices such as meters, relays, PTs, CPTs, lights, selector, and control switches cannot be mounted on breaker doors (remote display is mounted on breaker door).
5) Any blank compartment greater than 7" high can be used for instrumentation (except vent compartments).
6) 3200A, 4000A and 5000A fuse rollouts (fuse trucks) are the same size as the 3200A, 4000A and 5000A breaker respectively, therefore any compartment shown with a 3200A, 4000A or 5000A breaker will also accommodate a fuse roll-out.
7) Use of fused breakers do not necessarily require 200KA bus bracing. Bus bracing should be based on the available short-circuit current on the switchgear bus.
8) 200KA bus bracing limits feeder breaker placement. It does not allow adjacent 22" wide sections.
9) Factory review of layout is required for bus bracing higher than 100KA.
10) Front busway connection to a breaker requires a blank compartment above the breaker (for busway above) or below the breaker (for busway below).

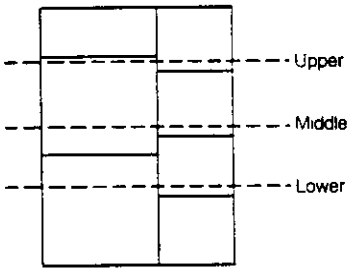
Legend

A broken line (- - - -) identifies a possible Main Bus location



Breaker Function
"F" - Feeder
"M" - Main
"T" - Tie

Max. frame size of breaker (in amperes) which is permitted in this location

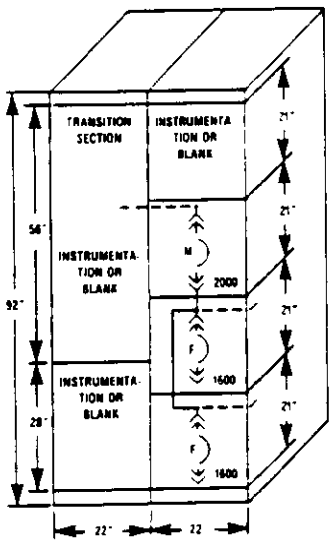


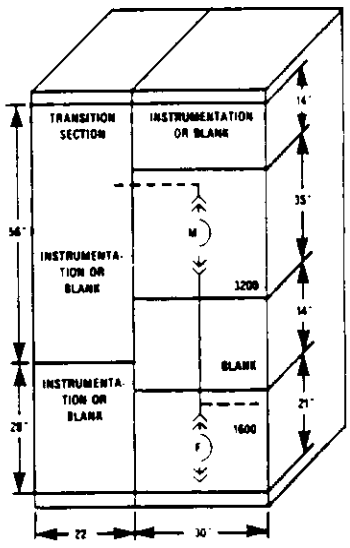
Note: All layouts show the maximum number of devices/options that a section can accommodate.

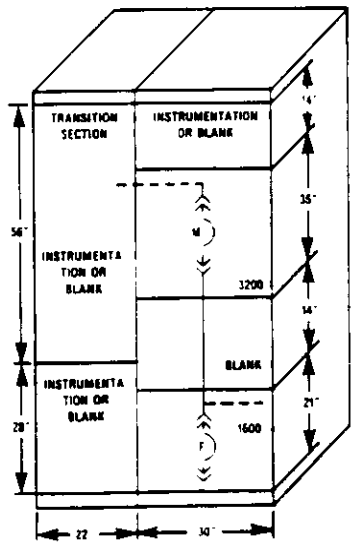
Main Sections

Main Sections appear with Transition Sections

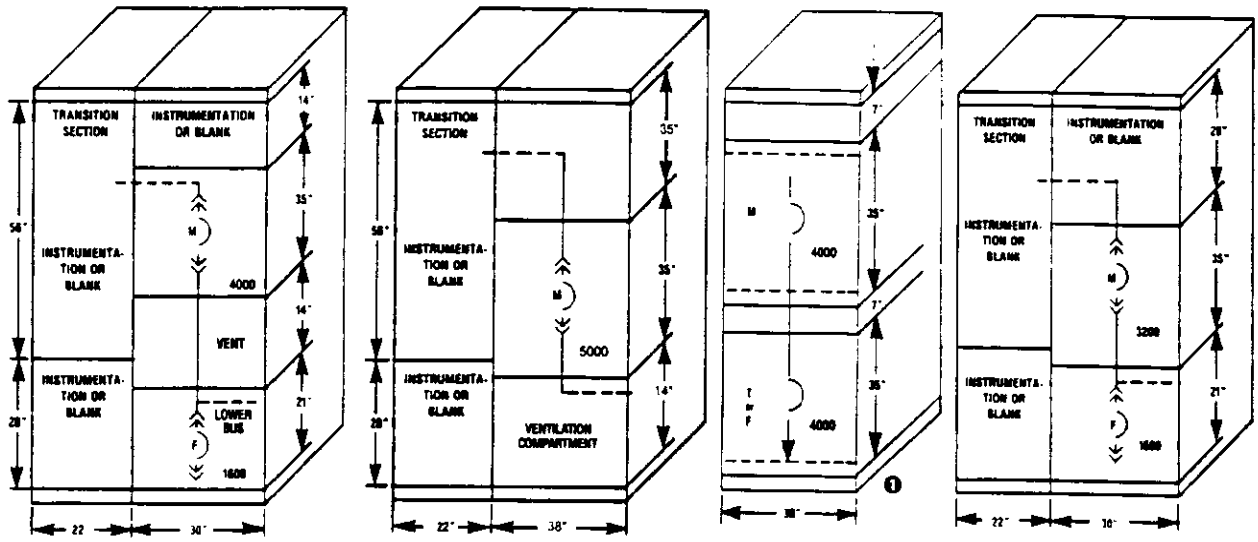
Transformer Fed (Right or left hand feed available: left hand shown.)





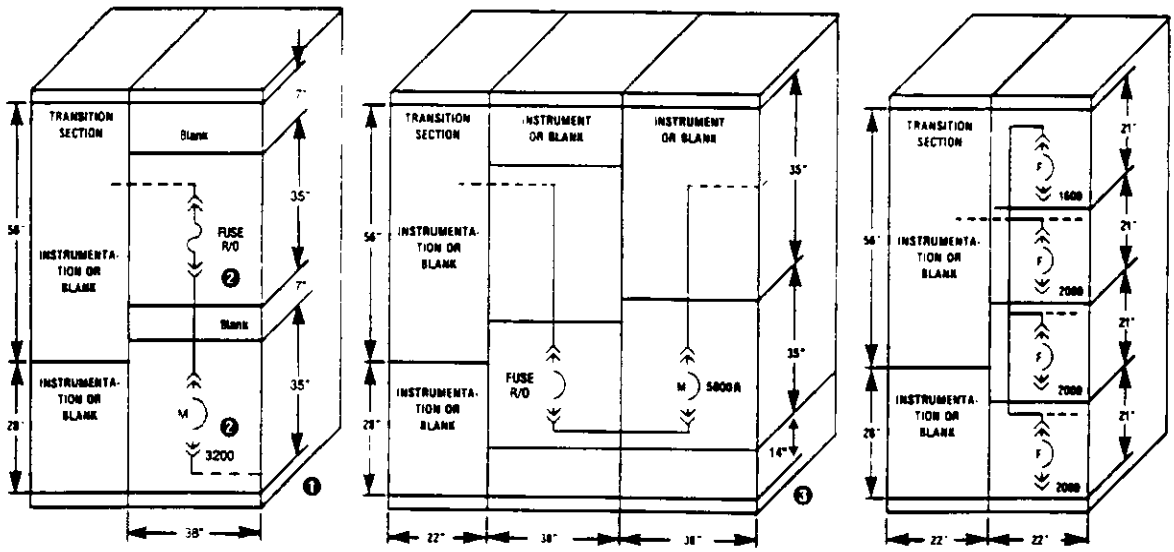


Section	A		B		C	
Main	AKR 30/30H/30L/50/50M, AKRT50H, AKRU 30/50		AKR 75/75H		AKR 75/75H/100	
Feeder	AKR 30/30H/30L/50/50H, AKRU 30/50, or Blank		AKR 30/30H/30L/50/50H, AKRU 30/50, or Blank		AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50	
Connecting Sections	Feeder	Tie	Feeder	Tie	Feeder	Tie
	S,U,V,W,X	BB,CC	S,T,U,V,W,X,Y,Z,AA	DD,EE,FF,GG	S,T,U,V,W,X,Y,Z,AA	DD,EE,FF,GG



Section	D		E		F	G
Main	AKR 75/75H/100		AKR-125		AKR 75/75H/100	AKR 75/75H
Feeder	AKR 30/30H/30L/50/50H, AKRU 30/50		None		AKR 75/75H/100	AKR 30/30H/30L/50/50H (Tie)
Connecting Sections	Feeder	Tie	Feeder	Tie	Feeder	Tie
	S,T,U,V,W,X,Y,Z,AA	DD,EE,FF,GG	S,T,U,V,W,X,Y,Z,AA	DD,EE,FF,GG	S,T,U,V,W,X,Y,Z	None

❶ Stacked 4000A devices require min. 67" equipment depth.



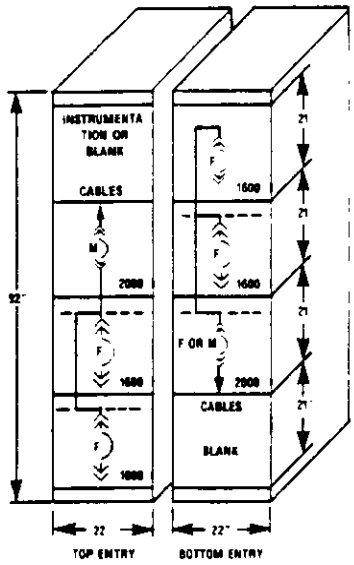
Section	H		I		J	
Main	AKR 75, AKR-100 with fused rollout		AKR-125 with fused rollout		None	
Feeder	None		None		AKR 30/30H/30L/50/50H, AKRT-50H, AKRU-50, or Blank	
Connecting Sections	Feeder	Tie	Feeder	Tie	Feeder	Tie
	S,T,U,V,W,Y	DD,EE,FF,GG	S,T,U,V,W,Y	DD,EE,FF,GG	S,U,V,W,X,	None

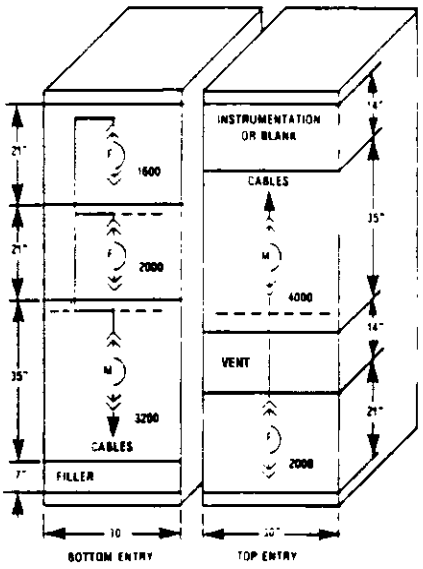
❷ Fused rollout and breaker can be interchanged

Switchgear layout and sizing

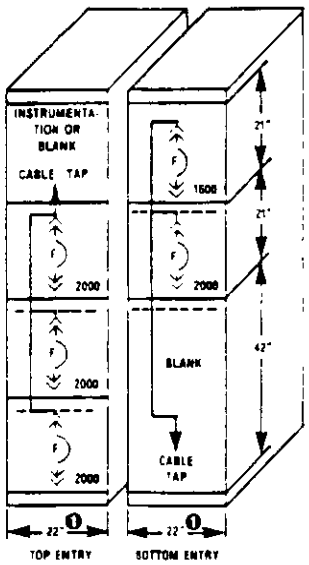
Main Sections *(continued)*

Cable Fed

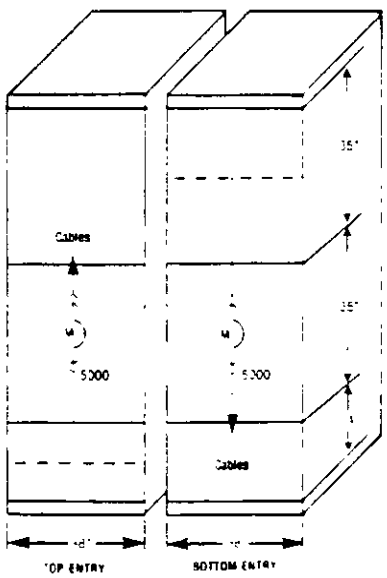




Section	K		L	
Main	AKR 30/30H/30L/50/50H. AKRT 50H. AKRU 30/50		AKR 75/75H/100	
Feeder	AKR 30/30H/30L/50/50H. AKRU 30/50. or Blank		AKR 30/30H/30L/50/50H. AKRT 50H. AKRU 30/50	
Connecting Sections	Feeder	Tie	Feeder	Tie
	S,U,V,W,X	BB,CC	S,U,V,X,Z,AA	BB,CC,DD,FF,GG

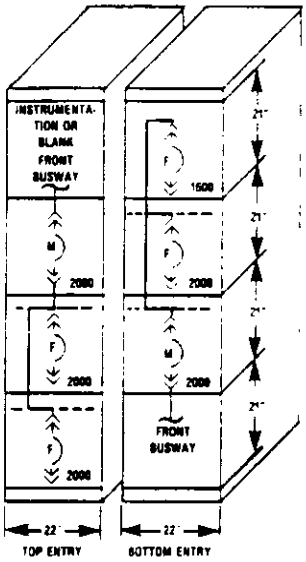


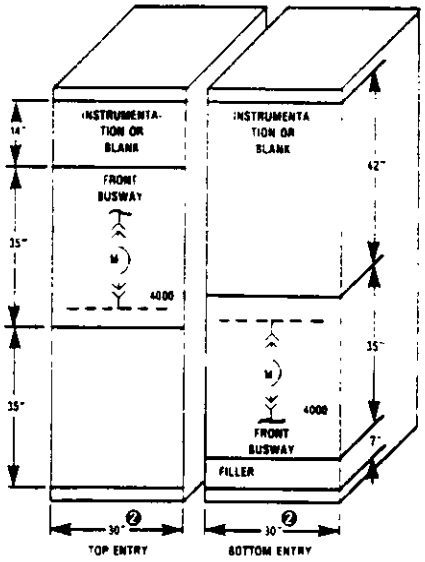
❶ Section width must be 30" if main cabling over 2000A



Section	M		N	
Main	None		AKR-125	
Feeder	AKR 30/30H/30L/50/50H. AKRT-50H		None	
Connecting Sections	Feeder	Tie	Feeder	Tie
	S,U,V,W,X	None	S,U,V,W,X	BB,CC,DD,EE,FF,GG

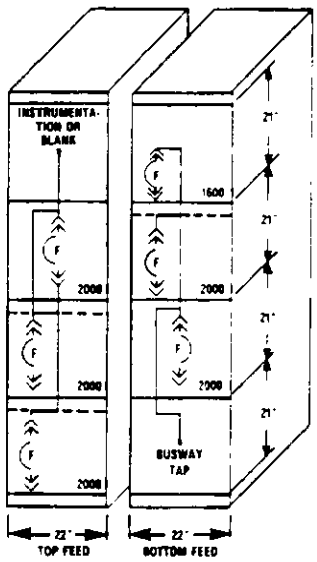
Busway Fed

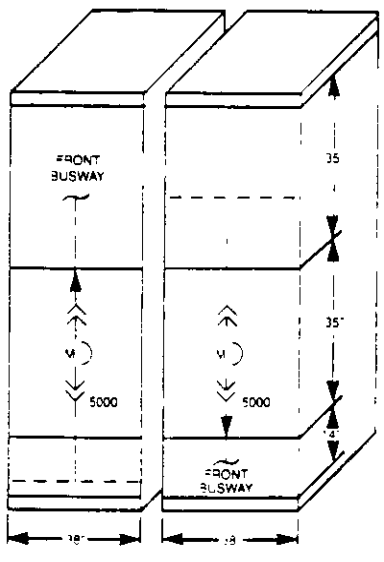




❷ Section width must be 30" for Spectra Busway and 38" for NSP busway

Section	O		P	
Main	AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50		AKR 75/75H/100	
Feeder	AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50		N/A	
Connecting Sections	Feeder	Tie	Feeder	Tie
	S,U,V,W,X	BB,CC	S,T,U,V,W,X,Y,Z,AA	DD,EE,FF,GG



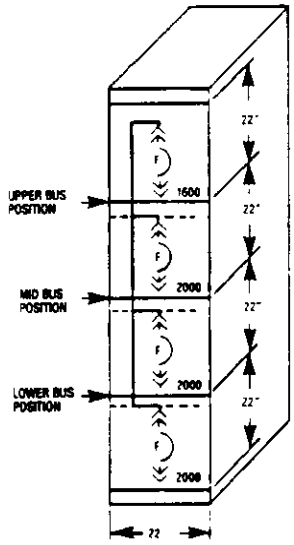


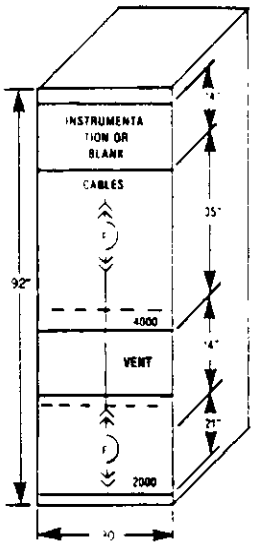
Section	Q		R	
Main	None		AKR-125	
Feeder	AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50, or Blank		N/A	
Connecting Sections	Feeder	Tie	Feeder	Tie
	S,U,V,W,X	None	S,T,U,V,W,X,Y,Z,AA	DD,EE,FF,GG

Switchgear layout and sizing *(continued)*

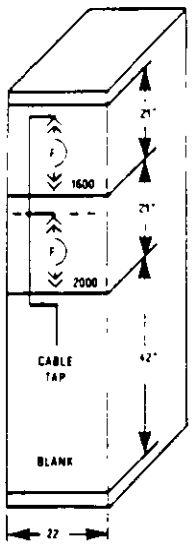
Feeder Sections

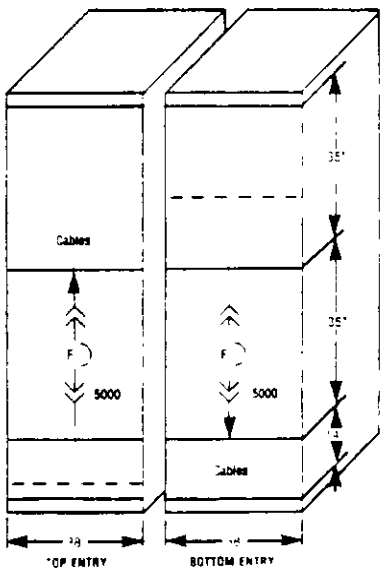
Outgoing Cables





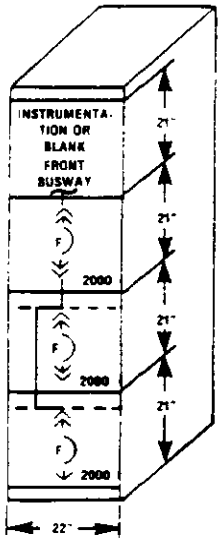
Section	S	T
Feeder	AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50, or Blank	One AKR 30/30H/30L, AKR 50/50H, AKRT 50H, AKRU 30/50, and one AKR 75 or 100
Connecting Sections	Feeder	Feeder
	S,T,U,V,W,X,Y,Z,AA	S,T,U,V,W,X,Y,Z,AA

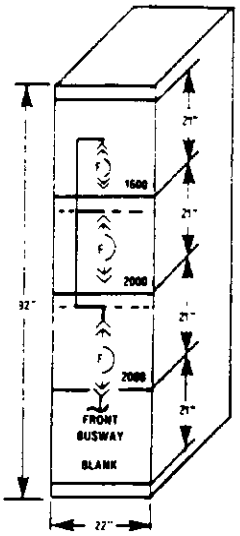


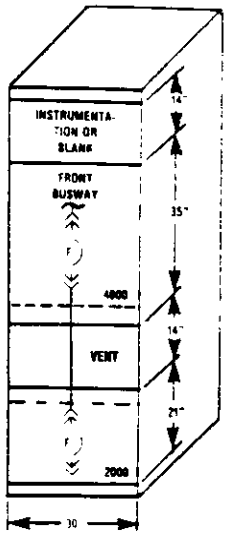


Section	U	V
Feeder	AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50, or Blank	AKR-125
Connecting Sections	Feeder	Feeder
	S,T,U,V,W,X,Y,Z,AA	S,T,U,V,W,X,Y,Z,AA

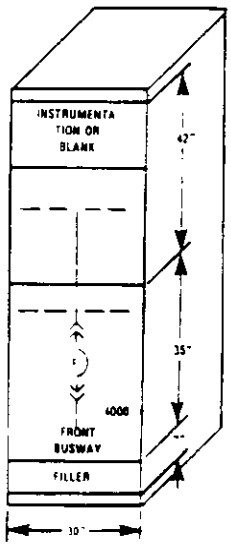
Outgoing Busways

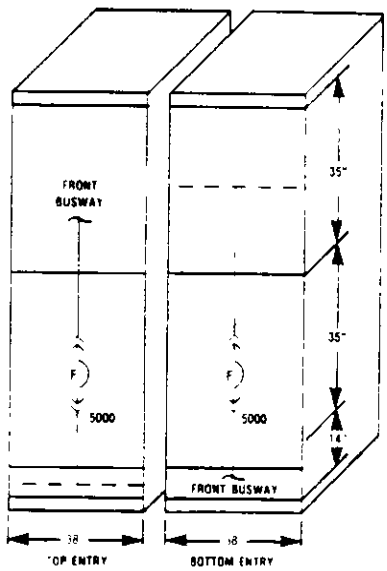






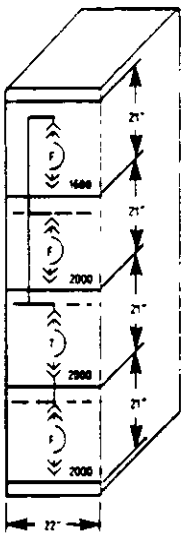
Section	W	X	Y
Feeder	AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50, or Blank	AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50, or Blank	One AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50, one AKR 75/75H or 100
Connecting Sections	Feeder	Feeder	Feeder
	S,T,U,V,W,X,Y,Z,AA	S,T,U,V,W,X,Y,Z,AA	S,T,U,V,W,X,Y,Z,AA

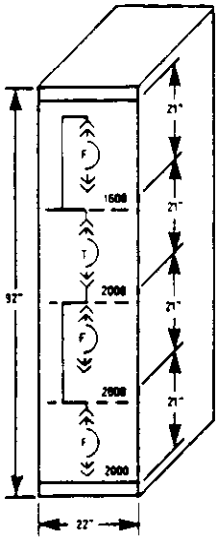


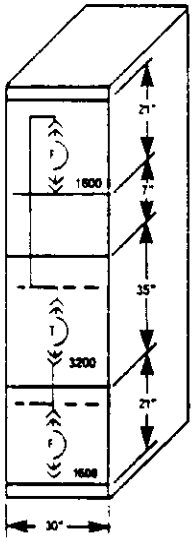


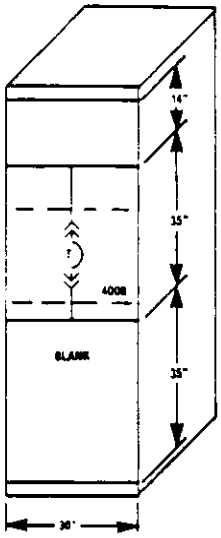
Section	Z	AA
Feeder	AKR 75/100	AKR-125
Connecting Sections	Feeder	Feeder
	S,T,U,V,W X,Y,Z,AA	S,T,U,V,W,X,Y,Z,AA

Switchgear layout and sizing *(continued)*
Tie Sections

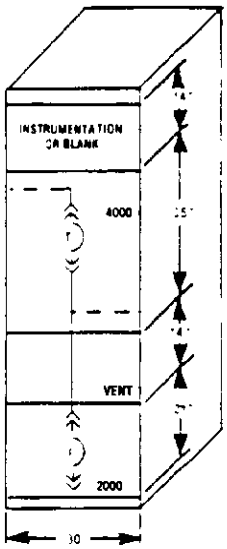


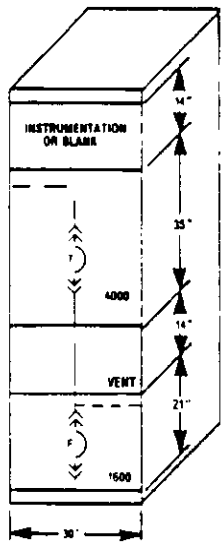


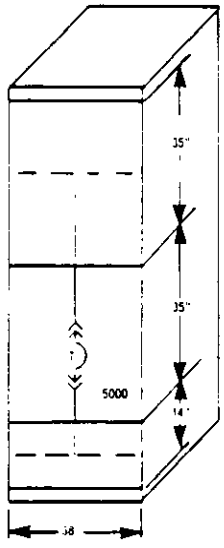




Section	BB	CC	DD	EE
Tie	AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30/50	AKR30/30H/30L/50/50H, AKRT 50H, AKRU 30/50	AKR 75/75H	AKR 75/75H/100
Feeder	AKR 30/30H/30L/50/50H, AKRT-50H AKRU30/50	AKR 30/30H/30L/50/50H, AKRT-50H AKRU 30/50	AKR 30/30H/50/50H, AKRU 30/50	Blank
Connecting Sections	Feeder	Feeder	Feeder	Feeder
	S,U,V,W,X	S,U,V,W,X	S,T,U,V,W,X,Y,Z,AA	S,T,U,V,W,X,Y,Z,AA



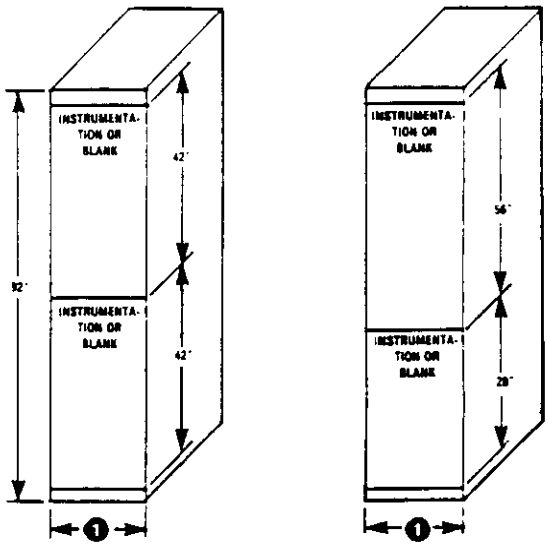




Section	FF	GG	HH
Tie	AKR 75/75H/100	AKR 75/75H/100	AKR-125
Feeder	AKR 30/30H/30L/50/50H, AKRT 50H, AKRU 30	AKR 30/30H/30L/50/50H, AKRU 30/50	None
Connecting Sections	Feeder	Feeder	Feeder
	S,T,U,V,W,X,Y,Z,AA	S,T,U,V,W,X,Y,Z,AA	S,T,U,V,W,X,Y,Z,AA

Auxiliary Section

Incoming busway or cable — top or bottom entrance



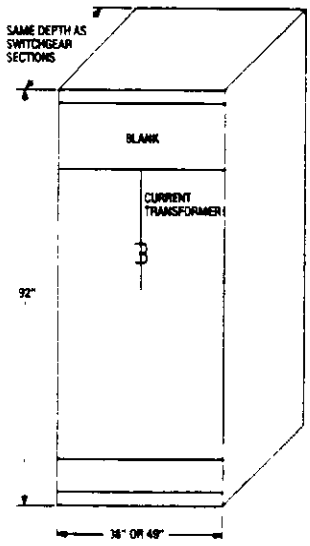
Auxiliary sections connect to all main, feeder, tie and utility sections

NSP Busway Rating	Spectra Busway Rating	Cable Tap Rating	Width ❶
2500 and below	3200A and below	2000A	22"
3200	4000A	2500A 3200A 4000A	30"
4000	5000A	5000A	38"

❶ Transition to non-GE switchgear 22" wide (contact factory for details). Matching and line-up transition to existing indoor GE AKD, AKD-5 and AKD-6 switchgear is 12" wide.

Utility Metering Sections

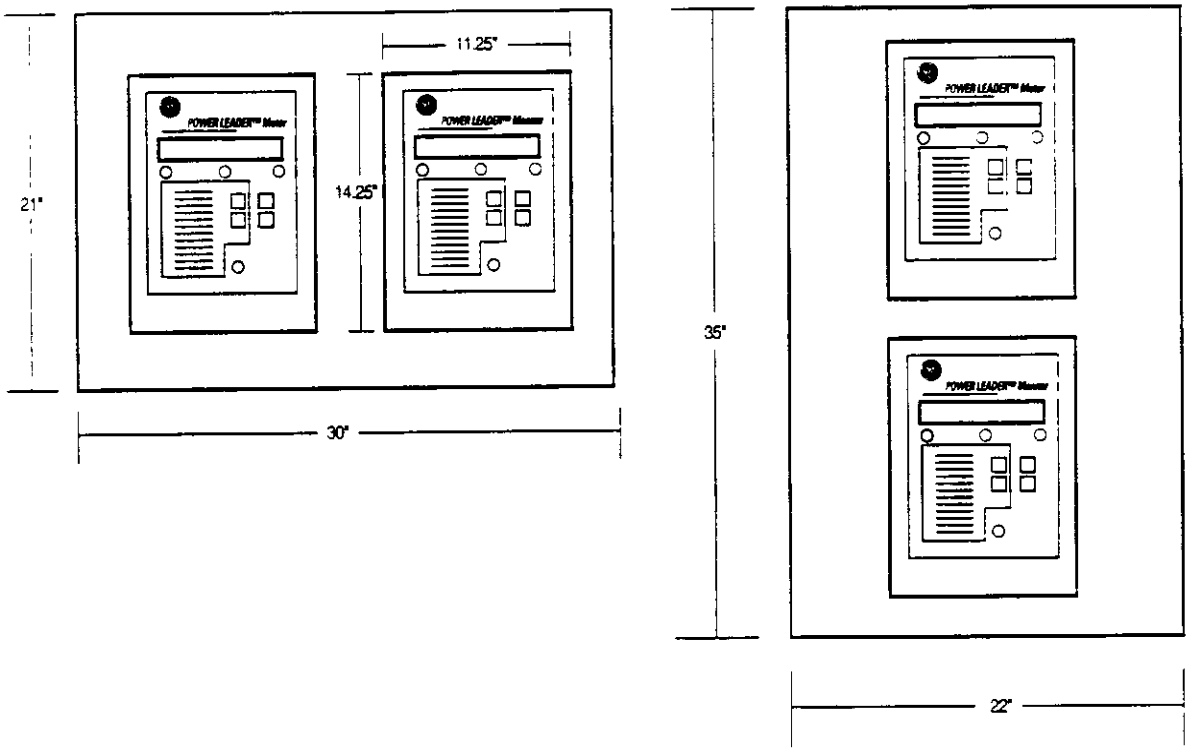
Incoming busways or cables — Top fed



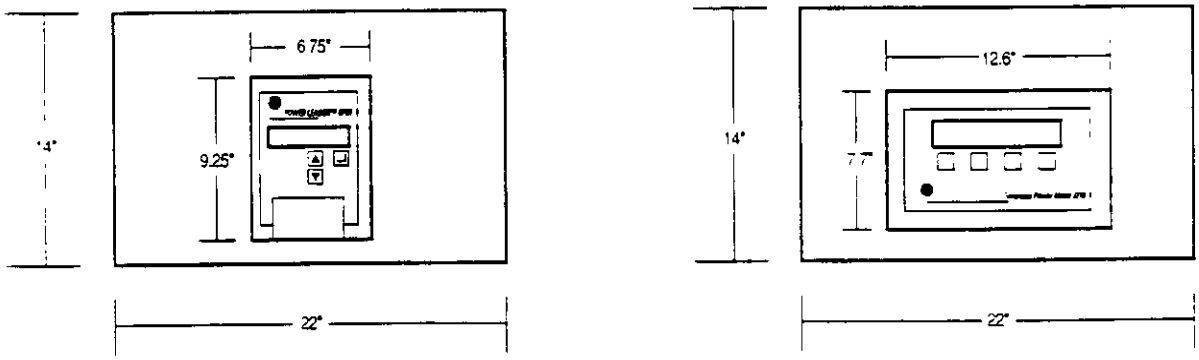
Section	JJ	
Connecting Sections	Feeder	Main
	S,T,U,V,W,X,Y,Z,AA	A,B,C,D,E,F,G,H,I without transition section

POWER LEADER instrument panel (minimum compartment size)

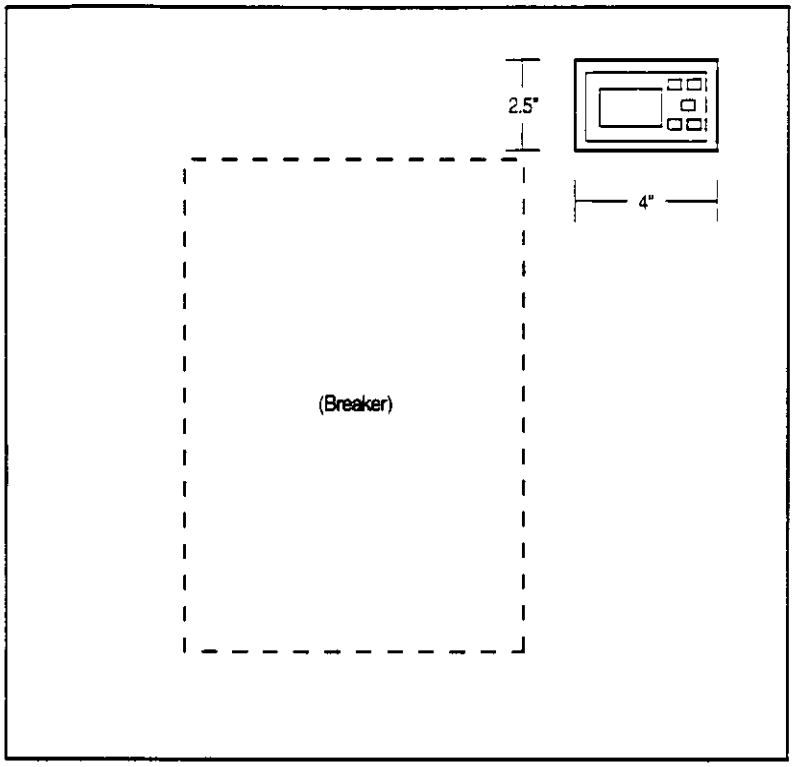
Meter and Monitor



Electronic Power Meters

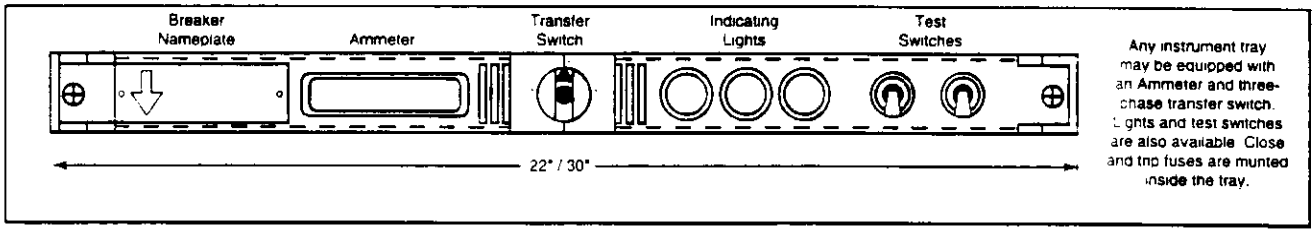


Remote Display



Breaker Door

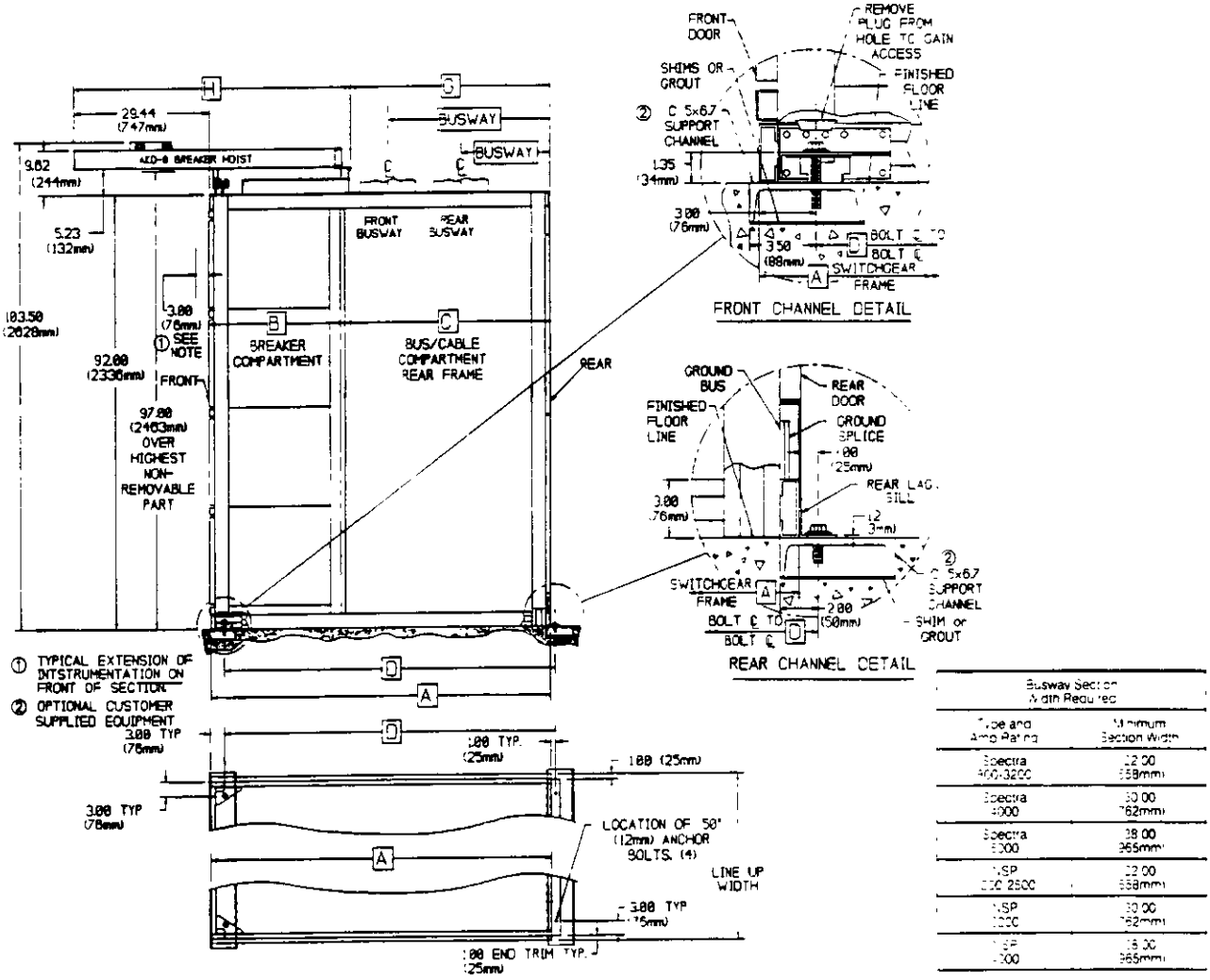
Instrument Tray



Floor plans and side views

AKD-8 Model 3

NEMA 1 indoor — side view and anchoring details

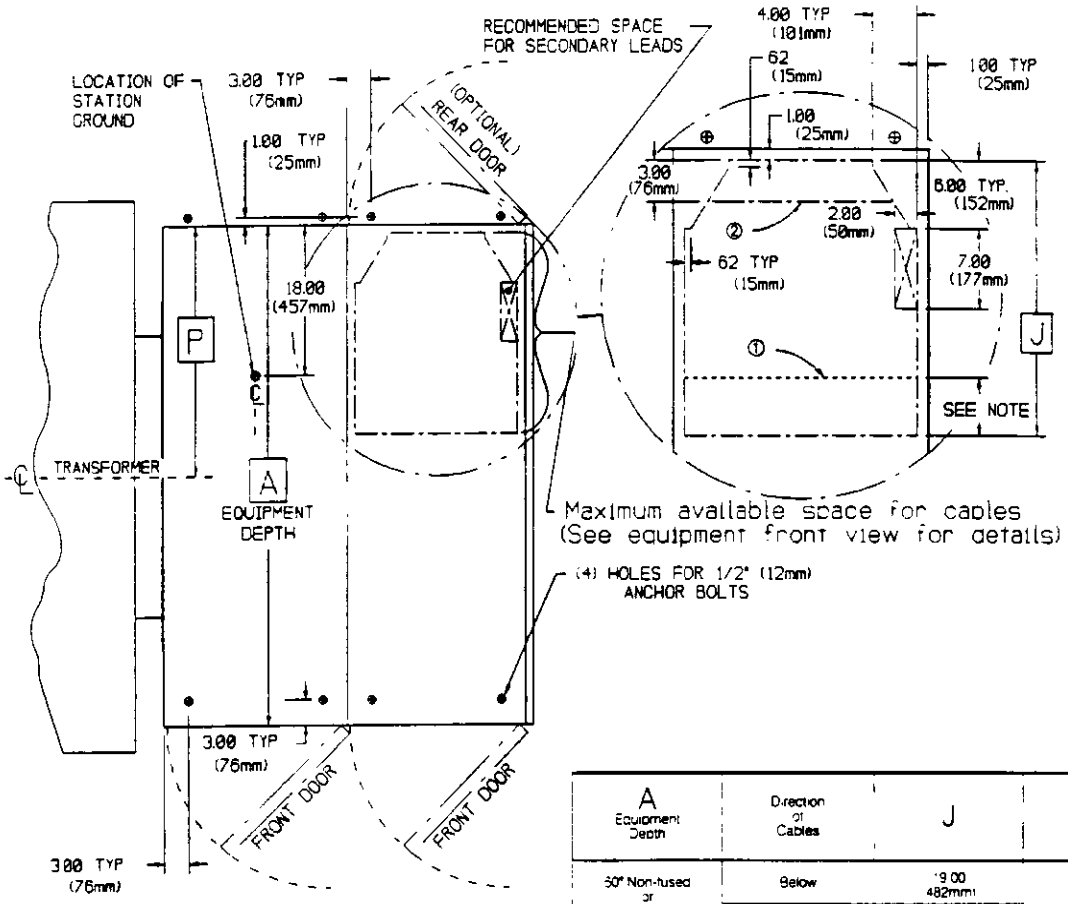


Busway Section Width Required	
Type and Amp Rating	Minimum Section Width
Spectra 400-3200	22.00 (558mm)
Spectra 4000	30.00 (762mm)
Spectra 5000	38.00 (965mm)
NSP 800-2500	22.00 (558mm)
NSP 3200	30.00 (762mm)
NSP 4000	38.00 (965mm)

A Equipment Depth	B Breaker Compartment	C Rear Frame Depth	D Anchor Bolt Spacing	G Back of Hoist to Rear Frame	H Hoist Length	Busway Locations: Front — Spectra 800-4000 Amp / NSP 1200-3200 Amp	Front — NSP 800-2000 Amp	Rear — Spectra 800-3200 Amp	Rear — Spectra 4000 Amp	Rear — NSP 800-3200A
60.00 (1524mm)	30.00 (762mm)	30.00 (762mm)	58.00 (1473mm)	29.34 (745mm)	60.10 (526mm)	21.50 (546mm)	9.50 (495	N/A	9.50 (24	N/A
67.00 (1701mm)	30.00 (762mm)	37.00 (938mm)	65.00 (1651mm)	36.34 (923mm)	60.10 (1526mm)	28.50 (723mm)	16.50 (673	22.50 (596	9.50 (49	12.50 (31
67.00 ③ (1701mm)	37.00 ③ (939mm)	30.00 ③ (762mm)	65.00 ③ (1651mm)	29.34 ③ (745mm)	67.10 ③ (1704mm)	21.50 ③ (546mm)	9.50 ③ (495	N/A ③	9.50 ③ (24	N/A ③
74.00 (1879mm)	30.00 (762mm)	44.00 (1117mm)	72.00 (1828mm)	43.34 (1100mm)	60.10 (1526mm)	35.50 (901mm)	23.50 (850	30.50 (773	23.50 (596)	19.50 (495)
74.00 ④ (1879mm)	37.00 ④ (939mm)	37.00 ④ (939mm)	72.00 ④ (1828mm)	36.34 ④ (923mm)	67.10 ④ (1704mm	28.50 ④ (723mm)	16.50 ④ (673	23.50 ④ (596	9.50 ④ (49	12.50 ④ (31
81.00 ④ (2057mm)	37.00 ④ (939mm)	44.00 ④ (1117mm)	79.00 ④ (2006mm)	43.34 ④ (1100mm)	67.10 ④ (1704mm	35.50 ④ (901mm	23.50 ④ (850	30.50 ④ (773	23.50 ④ (596)	9.50 ④ (495)

③ Fused AKRU-30/50 Only
④ Fused AKRU-30/50 or AKR-125 Only

NEMA 1 indoor — floor plan and cable space details



NOTES

① CABLES ABOVE - AVAILABLE SPACE FOR CABLES REDUCED BY 5.00" (127mm) IF BUS COMPARTMENT BARRIERS ARE PROVIDED
CABLES BELOW - AVAILABLE SPACE FOR CABLES REDUCED BY 4.00" (101mm) IF 800-2000A BREAKER IS LOCATED IN BOTTOM COMPARTMENT.

② SPACE REQUIRED FOR UPPER NEUTRAL WITH LEADS ABOVE OR LOWER NEUTRAL WITH LEADS BELOW

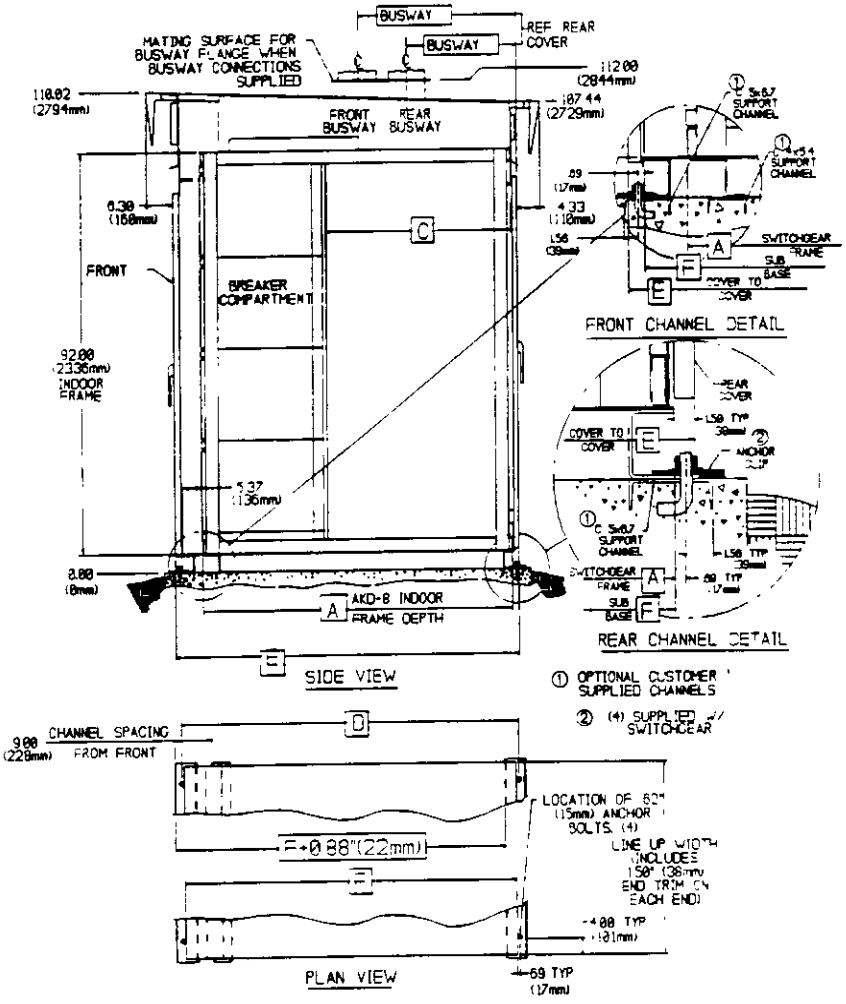
A Equipment Depth	P Transformer C To Rear or Switchgear
60.00 (1524mm)	Consult Factory
67.00 (1701mm)	Consult Factory
74.00 (1879mm)	Consult Factory
81.00 (2057mm)	Consult Factory

A Equipment Depth	Direction of Cables	J	Rear Extension Depth
60" Non-fused or 67" with Fused AKRU-30/50	Below	19.00 (482mm)	None
	Above	24.00 (609mm)	
67" Non-fused or 74" with Fused AKRU-30/50	Below	26.00 (660mm)	7.00 (177mm)
	Above	31.00 (787mm)	
74" Non-fused or 81" with Fused AKRU-30/50	Below	33.00 (838mm)	14.00 (355mm)
	Above	38.00 (965mm)	
74" with AKR-125	Below	9.00 (482mm)	None
	Above	24.00 (609mm)	
81" with AKR-125	Below	26.00 (660mm)	7.00 (177mm)
	Above	31.00 (787mm)	
67" 5000 Amp Bus w/o AKR-125 w/o AKRU-30/50	Below	19.00 (482mm)	None
	Above	24.00 (609mm)	
74" 5000 Amp Bus w/o AKR-125 w/o AKRU-30/50	Below	26.00 (660mm)	7.00 (177mm)
	Above	31.00 (787mm)	

Floor plans and side views

AKD-8 Model 3 *(continued)*

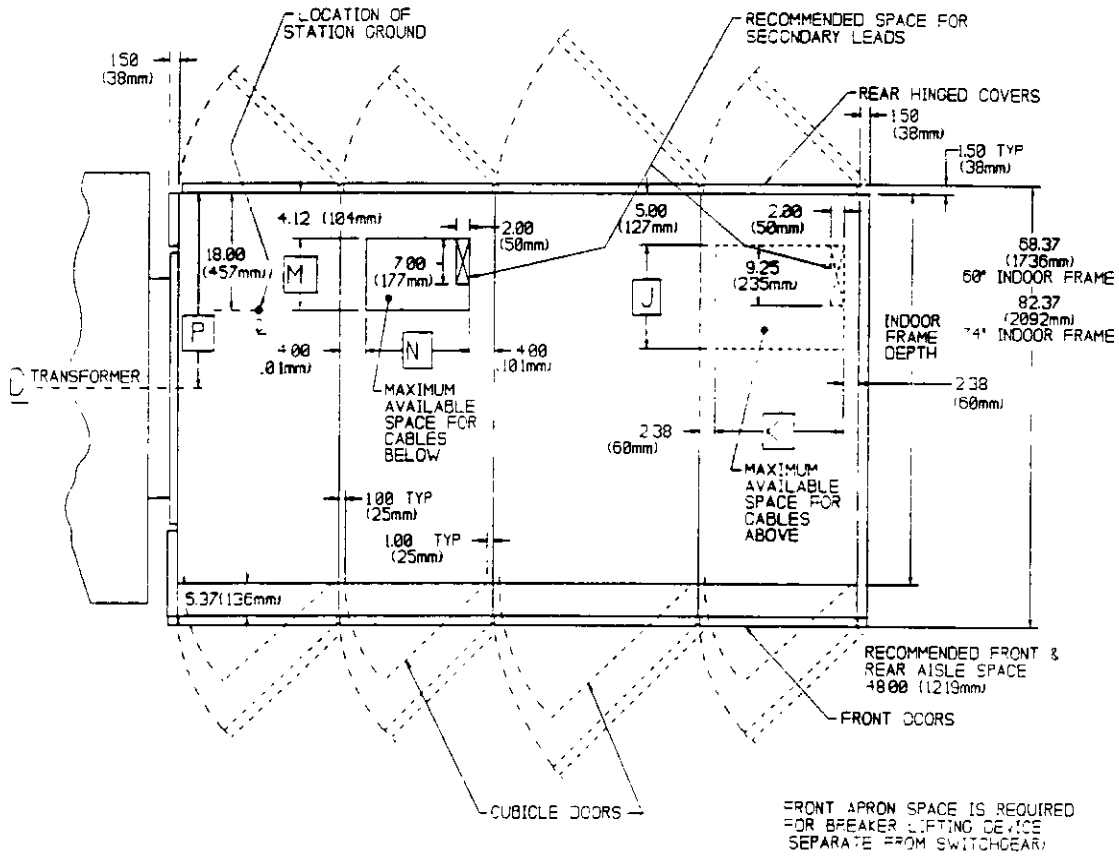
NEMA 3R outdoor, non-walk-in — side view and anchoring details



Busway Section Width Required	
Type and Amp Rating	Minimum Section Width
Spectra 800-3200	22.00 558mm
Spectra 4000	30.00 762mm
Spectra 5000	38.00 965mm
NSP 1200-2500	22.00 558mm
NSP 3200	30.00 762mm
NSP 4000	38.00 965mm

A Depth of Indoor Switchgear	C Rear Frame Depth	D Anchor Bolt Spacing	E Depth of Outdoor Switchgear	F Sub Base Depth	Busway Locations: Front — Spectra 800-4000C Amp NSP 1200-3200 Amp	Front — NSP 4000 Amp	Front — Spectra 5000 Amp	Rear — Spectra 800-4000A
60.00 (1524mm)	30.00 762mm	106.00 2692mm	107.62 2733mm	104.62 2657mm	23.00 584mm	21.00 533)	N/A	11.00 279)
74.00 1889mm	37.00 939mm	120.00 3048mm	121.62 3089mm	118.62 3012mm	30.00 762mm	28.00 711	25.00 635)	18.00 457)
	44.00 1117mm)				37.00 939mm	35.00 889)	32.00 812)	25.00 635)

NEMA 3R outdoor, non-walk-in — floor plan and cable space details



Section Width	K	N
24" 609mm)	19.25 489mm)	16.00 406mm)
32" 812mm)	27.25 692mm	24.00 609mm)
40" 1016mm)	35.25 895mm)	32.00 812mm)

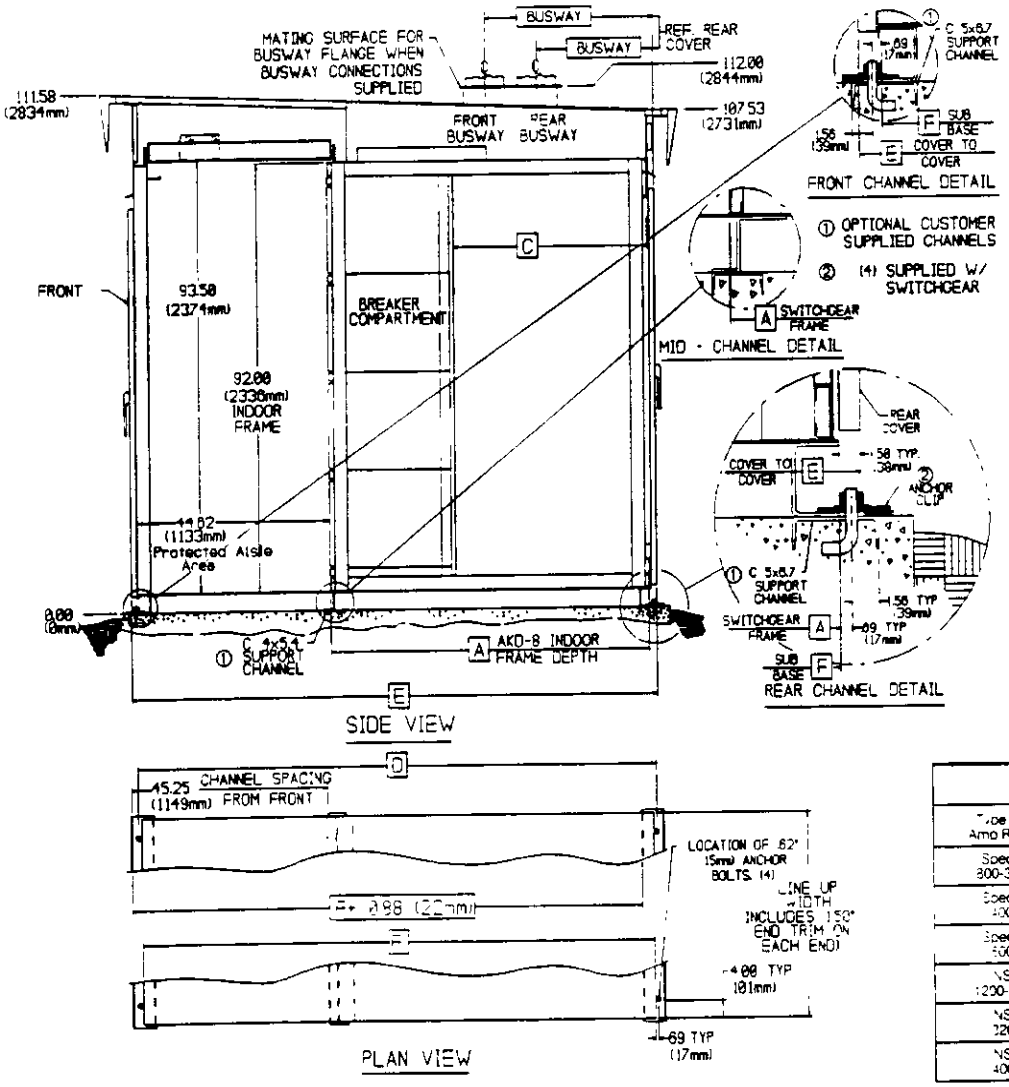
Door Frame	J	M	P
60" 1524mm)	21.00 533mm)	11.00 279mm)	Consult Factory
74" ① 1879mm)	35.00 889mm)	25.00 635mm)	Consult Factory
74" ② (1879mm)	28.00 711mm)	18.00 457mm)	Consult Factory
74" ③ (1879mm)	21.00 533mm)	11.00 279mm)	Consult Factory
74" ④ (1879mm)	28.00 711mm)	18.00 457mm)	Consult Factory

① Non-fused breakers – 14" rear extension
② With AKRU 30 50 – 7" rear extension
③ With 5000 Amp Main Bus and AKR-125
④ 5000 Amp Bus w/o AKR-125 and w/o AKRU-30/50 – 7" rear extension

Floor plans and side views

AKD-8 Model 3 *(continued)*

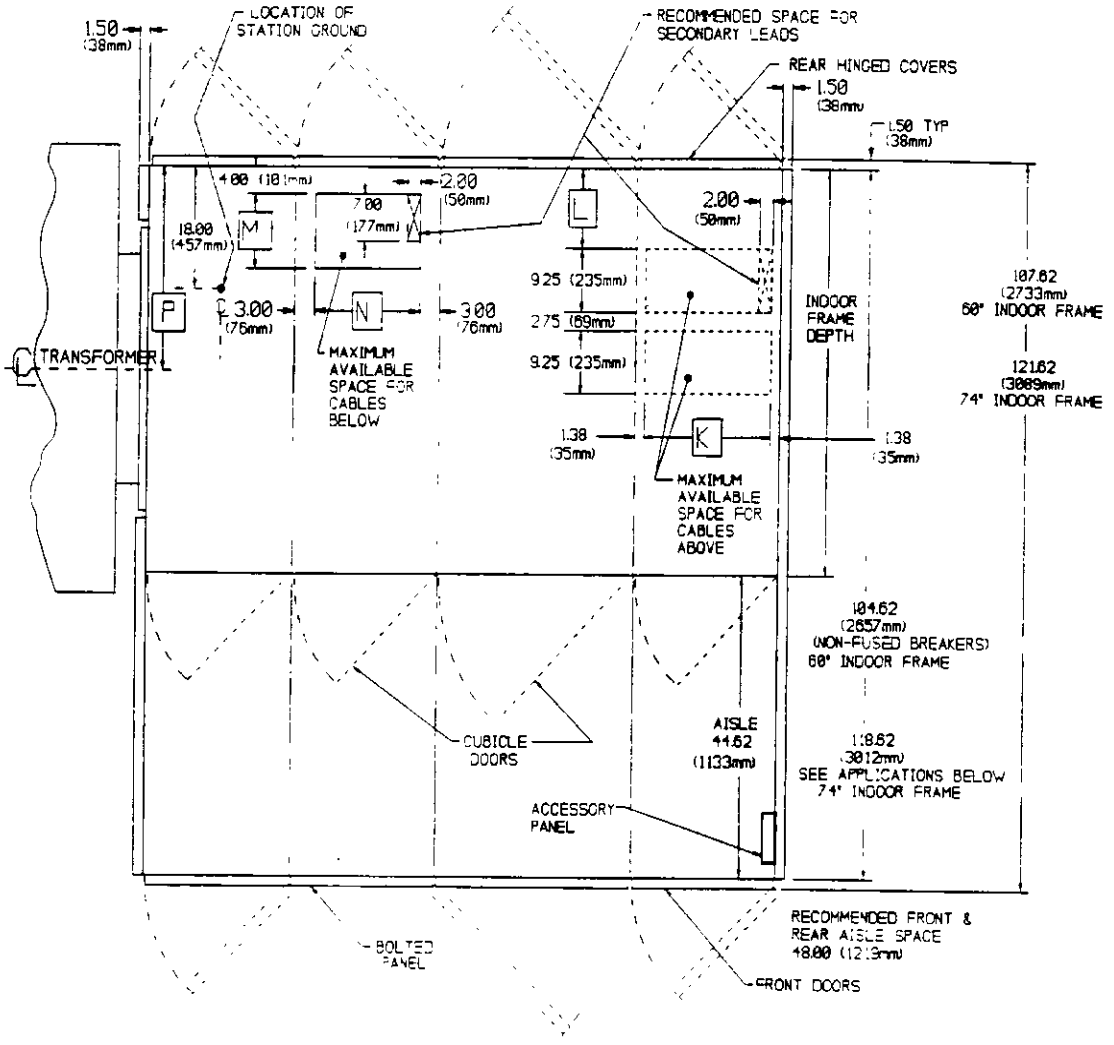
NEMA 3R outdoor, walk-in protected aisle — side view and anchoring details



Busway Section Width Required	
Type and Amp Rating	Minimum Section Width
Spectra 800-3200	24.00 609mm
Spectra 4000	32.00 812mm
Spectra 5000	40.00 1016mm
NSP 1200-2500	24.00 609mm
NSP 3200	32.00 812mm
NSP 4000	40.00 1016mm

A Depth of Indoor Switchgear	C Rear Frame Depth	D Anchor Bolt Spacing	E Depth of Outdoor Switchgear	F Sub Base Depth	Busway Locations: Front — Spectra 800-4000 Amp NSP 1200-3200 Amp	Front — NSP 4000 Amp	Front — Spectra 5000 Amp	Rear — Spectra 800-4000A
60.00 1524mm	30.00 762mm	66.38 1686mm	68.37 1736mm	65.00 1651mm	23.00 584mm	21.00 533)	N/A	11.00 279)
74.00 1889mm	37.00 939mm	80.38 2041mm	82.37 2092mm	79.00 2006mm	30.00 762mm	28.00 711)	25.00 635)	18.00 457)
	44.00 1117mm				37.00 939mm	35.00 889)	32.00 812)	25.00 635)

NEMA 3R outdoor, walk-in protected aisle — floor plan and cable space details



Section Width	K	N
22" 558mm	9.25 489mm	3.00 76mm
30" 762mm	13.25 [illegible]	3.00 76mm
38" 965mm	17.25 [illegible]	3.00 76mm

Indoor Frame	L	M	P
60" 1524mm	4.88 124mm	11.00 279mm	Consult Factory
74" 1879mm	9.88 479mm	26.00 [illegible]	Consult Factory
74" 2 1879mm	11.88 301mm	18.00 457mm	Consult Factory
74" 3 1879mm	4.88 124mm	11.00 279mm	Consult Factory
74" 4 1879mm	11.88 301mm	18.00 457mm	Consult Factory

1. Non-fused breakers – 14" rear extension
2. With AKRU-30 50 – 7" rear extension
3. With 5000 Amp Main Bus and AKR-125
4. 5000 Amp Bus w/o AKR-125 and w/o AKRU-30 50 – 7" rear extension

Guideform Specifications

Legend

[a/b/c] — Required items or features (Must select either a, b, or c)

< > — Optional items or features (May select one or more of these items)

( ) — Specification notes, clarifications (No selection applicable)

Rating

The type AKD-8 Low-Voltage Switchgear shall be rated ( ) Volts, 3-phase, [3-wire/4-wire with 50% neutral/4-wire with 100% neutral], [50/60] Hz.

Enclosure

The switchgear shall be furnished with an [indoor NEMA 1 non-walk-in outdoor NEMA 3R/walk-in outdoor NEMA 3R] enclosure.

General

The switchgear shall be completely factory assembled and metal enclosed. It shall consist of functionally compartmentalized units for the removable power circuit breaker elements. The switchgear structure and breaker shall be the product of a single manufacturer.

Standards

Equipment shall be designed, manufactured, and tested in accordance with ANSI C37.20.1 and NEMA SG-5 switchgear standards. CSA certified and listed by Underwriter's Laboratories Inc. Low-voltage power circuit breakers shall conform to ANSI C37.13 and NEMA SG-3 standards and UL listed (labeled where possible).

Utility metering

A utility metering compartment shall be supplied to meet the requirements of (name of the utility).

Service entrance

service entrance requirements which include service entrance label, incoming line isolation barriers, and neutral connection to switchgear ground.

Incoming line section

Incoming line section shall be [3-wire/4-wire], [800A/1600A/2000A/3200A/4000A/5000A], [main cable connection with [mechanical/compression] lugs/transition to a GE transformer Spectra buswav connection which will include cutout in the switchgear top plate.

Main metering

Provide hinged instrument panel for main metering in the top compartment. The instrument panel shall contain the following devices:

Multi-function digital devices *(select all that apply):*

- POWER LEADER Meter
- POWER LEADER Monitor
- POWER LEADER Electronic Power Meter
- POWER LEADER EPM 3710
- POWER LEADER EPM 3720

Discrete analog devices *(select all that apply):*

- Ammeter switchboard type, 1% ANSI Accuracy, 250° scale
- Voltmeter switchboard type, 1% ANSI Accuracy, 250° scale
- Ammeter switch
- Voltmeter switch
- Wattmeter
- Varmeter
- Power factor meter
- Watthour meter (2 2½ 3) elements <with demand register>
- Current voltage test block and plug PK-2
- Potential transformers with primary fuses
- Current transformer (Primary rating) to 5A
- Transducer <current> <voltage> <Watts> <Vars>

Structure

The structure shall be listed under UL-1558 and be labeled where possible. All live components shall be contained in a grounded metal enclosure 92" high and [60/67 74/81] inches deep. Individual vertical sections 22", 30" and 38" wide shall be constructed of bolted 11-gauge modular designed steel frames with removable plates. Each breaker compartment shall be isolated completely from other breaker compartments by grounded metal barriers. Barriers shall isolate the breaker compartment from the busbar system.

The switchgear shall be provided with <UL service entrance label> <incoming line isolation> < side barriers between section>.

<Pull boxes shall be supplied for the width and depth of the cable compartment and shall be [15/22/29] inches high and include screw cover plates>

<Cable support for each vertical section shall be provided.> <Drip-proof roof for the indoor equipment is to be provided.> Note: LEADS out below only and no integral breaker lifting device when drip-proof construction is supplied. <Integral breaker lifting device shall be rail mounted on top of equipment, hand-operated and movable.>

[Bolted covers Hinged covers which can be bolted closed] shall be provided for each cable compartment. A front hinged door with quarter-turn latch <and padlock provision> shall be provided for each breaker and metering compartment.

Space heaters shall be provided in each vertical section (1000W 240V@ 120V).>

electrodeposition ANSI 61. Paint qualification test shall be per UL-1558 and ANSI C37.20.1.

Auxiliary/transition section(s) shall be supplied and equipped with [devices as shown on the appropriate drawings/ devices as herein described/all necessary devices requested to perform the specified breaker and equipment functions] including <auxiliary relays> <primary and control circuit fuse blocks> <potential transformers> <control power transformer>. The section(s) shall have hinged doors over each compartment.

Rear cable and terminal compartment for cable installation and termination shall be provided. The cable bending space shall meet the requirements of the National Electrical Code.

Outdoor switchgear

Outdoor switchgear shall be similar to indoor, except that it shall be fully weatherproof, housed in a factory assembled outdoor enclosure, have lifting plates at the base of the structure, hinged aisle doors with rubber gaskets and padlocking provisions, asphalt base undercoating on the exterior bottom, interior lights, space heater in each vertical section, ground-fault circuit interrupter receptacle, light switch, and space heater switch. Provide walk-in enclosure to include front aisle space for breaker maintenance and inspection running the full length of the equipment, sloping roof, rear bolted hinged doors, breaker lifting device and storage provision for the hoist operation crank <hinged rear doors with lockable T-handle and three point catch>. Provide <wire mesh over louvers and rodent guards> <thermostat> <humidistat> <[3/5/7.5/10] kVA control power transformer>.

Bus bars

Main bus and riser bus will be fully isolated from the breaker, instrument and auxiliary compartments. The bus un-plated after fabrication, bolted at the connections between the vertical bus and horizontal bus, and at the point of connection on the vertical bus where the bus bars supply power to the circuit breaker compartments. All bolted joints for bus, interconnections and external connections to the equipment shall be tin-plated copper. The bus arrangement shall be designed to permit future additions.

The vertical bus shall be held rigid in a support structure of non-hygroscopic and flame retardant molded glass reinforced polyester.

<An insulated and isolated bus system which fully insulates the horizontal main bus and isolates each phase of the vertical riser bus shall be provided. Main bus joints shall be accessible through replaceable covers. No live connections shall be accessible from the rear except the breaker load side terminals.>

<Vertical and horizontal buses shall be isolated from the cable compartment [by glass reinforced polyester barriers. No live connections shall be accessible from the rear except the breaker load side termination. Accessibility to joints shall be provided by removable covers.>

Continuous current rating will be determined by temperature rise and limited by ANSI standards and will be demonstrated by design tests. If a main circuit breaker, bus tie circuit breaker, or an incoming bus duct or cable is provided, the continuous rating of the bus shall be equivalent to the frame size rating of the main breaker, bus tie breaker or incoming bus duct or cable. All line and load side bussing shall be rated to carry the full frame size continuous current rating of the breaker to which they are connected. In addition, breaker load side bars shall be insulated.

Breaker primary connections shall be

The bus bars of the main bus are to be braced to withstand mechanical forces exerted during a short circuit of [65kA/100kA/150kA/200kA] RMS symmetrical. Other buswork shall be braced to withstand mechanical forces exerted during a short circuit equivalent to the maximum interrupting capacity of the associated circuit breakers, or the maximum let-through current in the case of the load side of a fused circuit breaker.

Where a bus sectionalizing breaker is present, the buses on the two sides of that breaker will be isolated from each other. Where an incoming line or main breaker is present, the incoming line conductors shall be isolated from the main bus.

Breaker compartment

Each low-voltage power circuit breaker will be mounted in an individual compartment with grounded metal barriers at the top, bottom, front and sides and with flame retardant, track resistant glass reinforced polyester base barrier at the rear. Each compartment shall be equipped with drawout rails, stationary breaker contacts, mechanical interlocks, and necessary control and indicating devices.

The drawout mechanism shall retain the removable element in the connected position and shall overcome the mechanical resistance of making and breaking the contacts of the self coupling primary and secondary disconnects. Positive mechanical interlocks shall prevent the breaker from being racked in or out unless the breaker is open, and shall prevent the breaker from being closed while it is being racked in or out. The circuit breaker cannot be closed except in the connected, test, or disconnected position.

The drawout mechanism shall provide for four distinct positions of the circuit breaker: connected, test, disconnected,

be capable of being operated without opening the door over the circuit breaker and an indicator shall be provided to show the position of the circuit breaker. Breaker doors shall be provided without ventilation slots.

Grounding of the breaker frame to the switchgear shall be maintained throughout the travel of the drawout mechanism.

Padlocking provisions on the rack-out rails shall permit locking of the breaker in either the test or disconnected position.
<Compartment doors shall be capable of being padlocked>
<Position switch with [2, 6] a b contacts shall be provided.>
Shutters shall be supplied to cover breaker primary line and load disconnects when the breaker <and fuse carriage> is removed from its compartment on main <and tie> breaker compartments of double ended substations <and all feeder breakers>>.

The breaker compartment shall be equipped with <MicroVersaTrip remote display> <ammeter> <ammeter selector switch> <pilot light for breaker open/closed indication>. Control circuitry, feeder metering, breaker close and trip fuses, indicating lights, rotary phase selector switch, and ammeter shall be accessible for routine maintenance from the front of the switchgear without opening associated breaker cubicle door by a slide-out instrument tray mounted above its associated breaker, eliminating cross-hinge wiring.

Each breaker cubicle shall be designed so that only the breaker frame for which the cubicle was designed can be inserted.

When specified for future breaker, the compartment shall be completely equipped for the future addition of a power circuit breaker element including all specified electrical connections. A metal barrier shall be bolted and the opening in the breaker compartment door shall be closed.

Circuit breakers
Power circuit breakers shall conform to ANSI C37.13, C37.16, and NEMA SG-3. Each breaker element will consist of a 3-pole electrically and mechanically trip-free power circuit breaker with self-aligning primary and secondary disconnecting contacts, integral solid state over-current trip unit, arc quenchers, manual or electrical stored-energy closing mechanism, position indicator, and equipped for mounting on the drawout mechanism in the circuit breaker compartment.

The low-voltage power circuit breaker shall be able to interrupt its full current rating without the use of a making current release.

Manual or electrical closing mechanisms shall employ the stored energy principle by interposing an energy storage spring between the operator and the breaker contacts. This spring provides consistent closing speed not influenced by the operator or control power voltage level.

Manually operated breakers shall have front mounted handles for charging the closing springs. Closing the breakers shall be accomplished by depressing a mechanical close button on the breaker escutcheon or by operating the breaker handle. Opening of the breaker shall be accomplished be depressing a mechanical trip button located on the breaker escutcheon.

Electrically operated breaker shall utilize a motor to automatically charge the closing springs. An electrical close push-button shall be mounted on the breaker escutcheon.> Opening of the breaker shall be accomplished by a mechanical trip button located on the breaker escutcheon <and or shall be accomplished by a shunt trip mounted in the breaker and activated remotely> shall be provided for manual charging of the breaker and for the slow-closing motion required for contact adjustment procedures.

Fused breakers
Fused power circuit breakers shall conform to ANSI C37.13 and NEMA SG-3. Circuit breakers shall be equipped with current limiting fuses, integrally or separately mounted and coordinated with trip devices, so that faults within the rating of the circuit breaker will be interrupted by the breaker itself, while faults in excess of the breaker rating, will be interrupted by the fuses.

Separately mounted fuses shall be mounted inside a drawout carriage similar to that used for the breaker. A hinged panel make of perforated steel shall be positioned in front of the fuses so that they cannot be reached if the compartment door is opened. The perforated steel panel shall be so interlocked to prevent it from being swung open unless the fuse rollout is fully withdrawn. A key interlock system shall be installed in the associated breaker compartment so as to keep the fuse rollout carriage in the connected or disconnected position unless the breaker associated with it is locked open. The fuse rollout carriage compartment shall be equipped with shutters to cover the line and load disconnects when the carriage is removed from its compartment.> A ejection feature shall be furnished so that only the correct carriage can be inserted in a compartment.

Fused breakers shall be equipped with open fuse lockout device and indicator to protect against single phasing and prevent reclosing until lockout device is reset.

Trip unit system
All AC rated circuit breakers shall be equipped with GE MicroVersaTrip Plus or PM true RMS sensing trip unit system to protect against overloads, short

unit shall have current metering capabilities <and also voltage, energy, total power, real and reactive power, power demand and frequency metering capabilities.> <The trip unit shall also have the following protective relaying capabilities: undervoltage, overvoltage, voltage unbalance, current unbalance, and power reversal.> <The trip unit shall have communication capabilities.> The trip unit system shall be integral to the circuit breaker frame and consist of the following: trip unit, rating plug, trip actuator, current sensors. The trip unit shall be equipped with a liquid crystal display and a five-button key pad for easy setup and fault trip indication and with a battery allowing for non-volatile trip targets display and cold setup capability.

The trip unit shall be self-contained, and require no external relaying, power supply nor accessories. Its printed circuit cards shall resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed within a metallic enclosure to protect against high-fault interruption arc, magnetic interference, dust and other contaminants.

Current sensors shall be mounted on the breaker frame and shall be constructed of molded epoxy to protect against damage and moisture. The sensor rating shall be fixed. For four wire ground fault, a fourth current sensor shall be mounted on the neutral bar in the cable compartment and shall be constructed similar to the phase current sensors.

Ground fault function shall contain a memory circuit which integrates arcing fault current with time, essentially summing intermittent ground-current spikes.

Devices

Switchgear will include all protective devices and equipment as listed on drawings with necessary interconnec-

Wiring

Control wiring shall be #14 type SIS, enclosed in top and vertical metal wiring troughs. Necessary fuse blocks within the switchgear shall be furnished when required. Terminal blocks for external connections shall be mounted in the rear cable compartment, easily accessible, away from the runbacks and cable terminals, and be provided with a bolted steel cover over the terminal blocks.

Control wires leaving the switchgear shall be terminated on terminal blocks with suitable numbering strips. <Marking sleeves shall be provided on all switchgear control wiring and shall be heat stamped with the wire origin and/or destination information.>

Interconnection control wiring across shipping splits shall be accomplished by terminal blocks in the control wiring trough on the top of the equipment.

Ground bus

A copper [800A/1600A] ground bus is to be provided and secured to each vertical section structure. It shall extend the entire length of the switchgear and be equipped with a 4 0 terminal for connection to purchaser's ground system. A lug strap shall be provided for feeder ground terminals.

Handling

Switchgear shall be provided with adequate lifting means and shall be capable of being rolled or moved into installation position and bolted directly to the floor without the use of floor sills.

Protection and control

The automatic throwover equipment shall be provided to transfer a load bus to an alternate source [immediately with a time delay] after detection of an abnormal condition on the normal source. Return to normal shall be [manual/automatic with time delay]. The transfer scheme shall include [two main 3-breaker system/the normal main breaker and the emergency main in a 2-breaker system].

Miscellaneous

<A portable breaker lifting device shall be provided.>

<A portable static full function test set to check the time current characteristics or the trip unit shall be provided.>

Prints

Standard print package shall include front view, floor plan, single-line diagram, installation diagram, elementary diagram showing power metering and control circuits, switchgear internal wiring diagrams, and equipment bill of material.

Standards and references

Underwriters' Laboratories, Inc.

UL 1558 Metal-enclosed low-voltage power circuit breaker switchgear.

Order from:

UL Publications Stock
333 Pfingsten Road
Northbrook, IL 60062

National Electrical Manufacturers Association (NEMA)

SG-5 — Power switchgear assemblies:

SG-3 — Low-voltage power circuit breakers.

Order from:

NEMA Publications
155 East 44th Street
New York, NY 10017

Canadian Standards Association (CSA)

CSA-C22.2 — Switchgear Assemblies

Order from:

Canadian Standards Association
178 Rexdale Blvd.
Rexdale, Ontario, Canada M9W R3

American National Standards Institute (ANSI)

ANSI C37.20.1 - Metal-enclosed low-voltage power circuit breaker switchgear.

ANSI C37.51 - Conformance testing of metal-enclosed low-voltage AC power circuit breaker switchgear assemblies.

ANSI C37.13 - Low-voltage AC power circuit breakers used in enclosures.

ANSI C37.50 - Test procedure for low-voltage AC power circuit breakers used in enclosures.

ANSI C37.16 - Preferred ratings, related requirements and application. Recommendations for low-voltage power circuit breakers and AC power circuit protectors.

Order from:

Sales Department
American National Standards Institute
1430 Broadway
New York, NY 10018

National Electrical Code (NEC)

Order from:

National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

Other appropriate publications

Technical bulletins

GET-6218 — Type AKR Low-Voltage Power Circuit Breakers
DE-412A — AKR Breakers with MicroVersa Trip Plus and MicroVersa Trip PM units
GEH-6273 — MicroVersa Trip Plus and MicroVersa Trip PM units
DE-412A — AKR Breakers with MicroVersa Trip Plus and MicroVersa Trip PM Trip Units
DEP-041 — MicroVersa Trip Plus and MicroVersa Trip PM Remote Display
DEA-018 — POWER LEADER Power Management System

General installation and maintenance

GEH-4674 — AKD-8 Low-Voltage Switchgear
GEK-64459 — AKR-30/50/T50
GEK-64460 — AKR-75, 100

Installation and operating instructions

GEI-86150 — AKR-30/50/T50
GEI-86151 — AKR-75, 100

Renewal parts bulletins

GEF-4527 — AKR-30/50/T50
GEF-4552 — AKR-75, 100