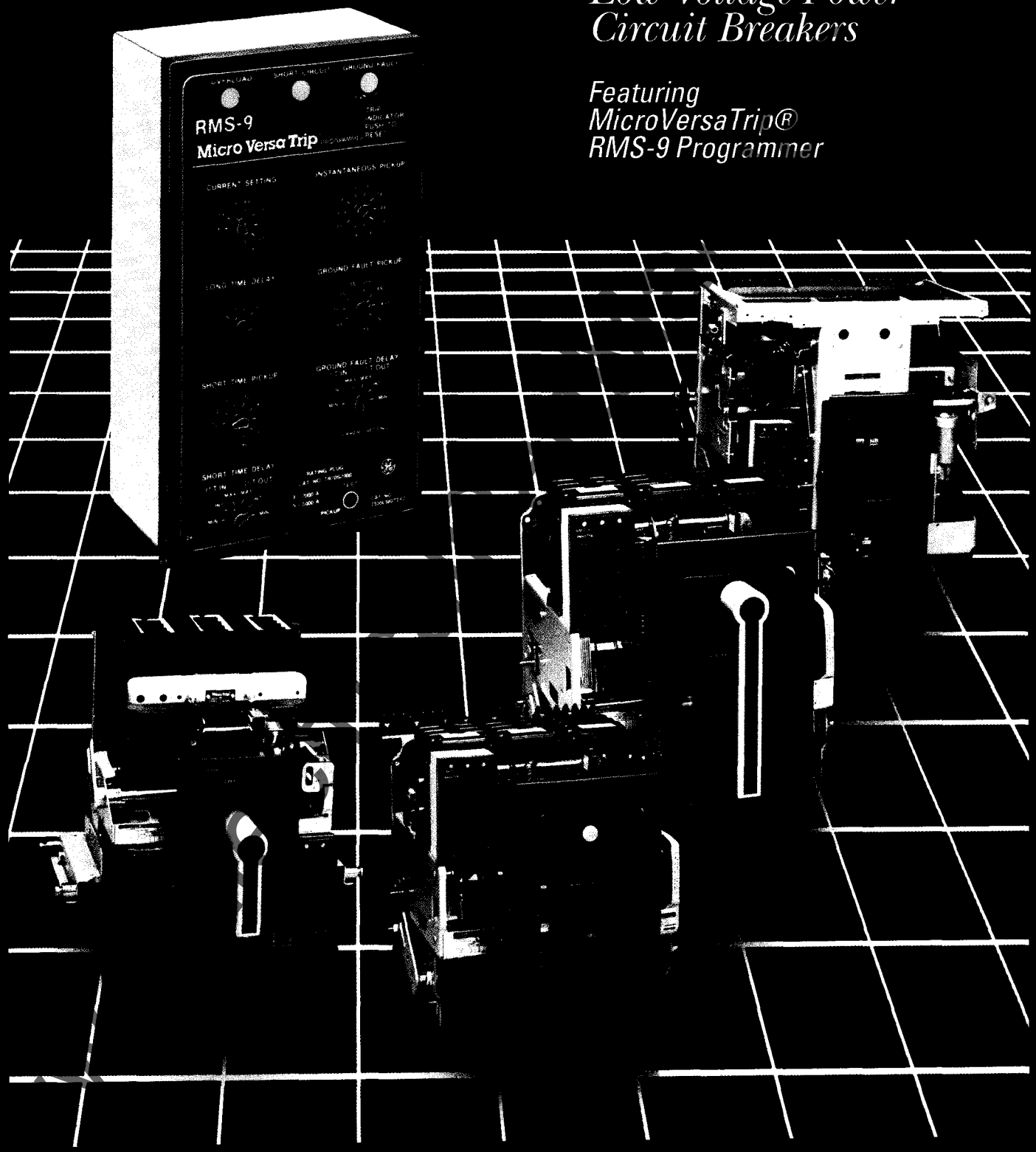
Type AKR

Low Voltage Power Circuit Breakers

Featuring
MicroVersaTrip®
RMS-9 Programmer



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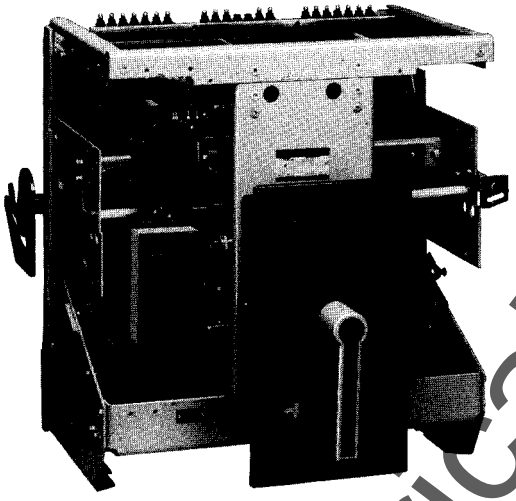
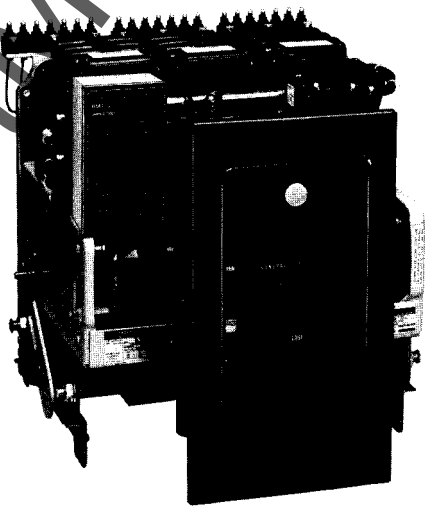
Type AKR
Low Voltage
Power Circuit Breakers

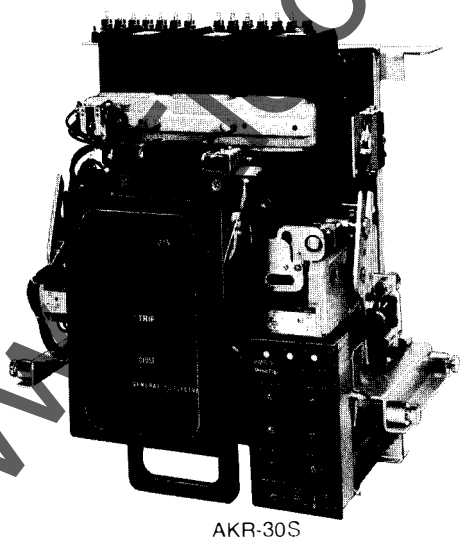
The General Electric line of Type AKR Low Voltage Power Circuit Breakers (LVPCB) are intended for use in commercial, industrial, and utility applications. Built to withstand intense service conditions, these circuit breakers provide for the ultimate in system selectivity due to their short time capabilities. These breakers are UL listed to ANSI standards for low voltage power circuit breakers. The AKR breaker consists of five frame sizes: AKR-30S, -30H, AKR-50, AKRT-50, AKR-75 and AKR-100; 800 through 4000 Amperes with short circuit ratings through 200,000 Amperes.



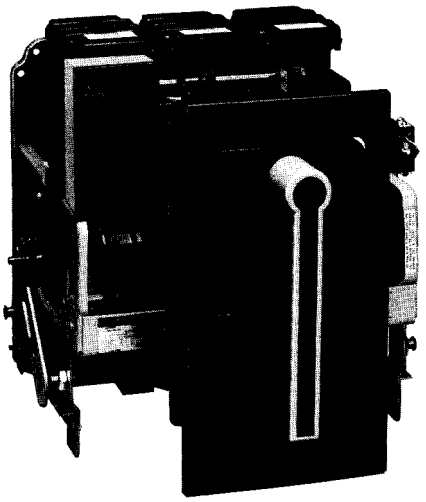
AKR-75



AKR-50



AKR-30S



AKR-30H

Table 3.1
Ampere Ratings and Overcurrent Trip Devices

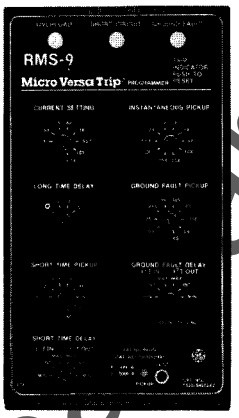
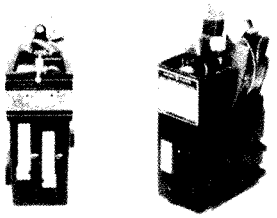
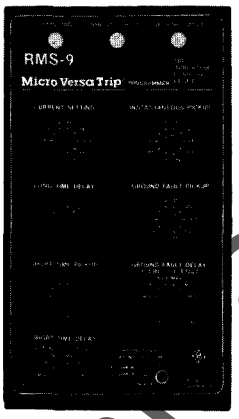
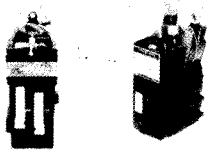
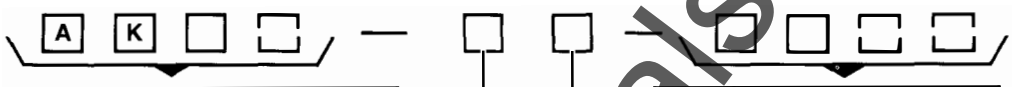
Breaker Type	600V ac 50 / 60 Hz		250V dc	
	Frame Size (Amps)	Solid State Trip Device	Frame Size (Amps)	Electromechanical Trip Device
AKR-30S	800		—	
AKR-30, 30H	800		800	
AKR-50, -50H	1600		2000	
AKRT-50H	2000		—	
AKR-75	3200		4000	
AKR-100	4000		6000	

Table 4.2
Ampere Ratings and Overcurrent Trip Devices

Breaker Type	600V ac 50 / 60 Hz		250V dc	
	Frame Size (Amps)	Solid State Trip Device	Frame Size (Amps)	Electromechanical Trip Device
AK-25	600		600	
AKS-50	1600		2000	
AKST-50	2000		—	
AKR-75	3000		4000	
AKR-100	4000		6000	

Breaker Designations Legend



Code	General Type
AK	Old style LVPCB
AKS	AKR replacement for AK-50, AKJ-50
AKST	AKRT replacement for AKT-50, AKJT-50
AKSU	AKRU replacement for AKU-50, AKJU-50
AKR	New style LVPCB
AKRT	2000A frame
AKRU	Integrally fused version of AKR-30/50
AKU	Integrally fused version of AK-25/50

Code ①	Frame Size in Amperes	
	ac	dc
25	600	600
30S	800	—
30, 30H	800	800
50, 50H	1600, 2000	2000
75	3200	4000
100	4000	6000

① Suffix D is affixed to AKR designations to identify non-automatic dc models, e.g. AKR-NB-30D

Code	Trip Device Type
2	EC
3 ②	Power Sensor
4 ②	ECS
5 ②	SST
6	MicroVersaTrip
7	MicroVersaTrip® RMS-9
8	Epic MicroVersaTrip™
N	Non-automatic

② Discontinued

Code	Mounting Type
Blank	Draw out AKD Switchgear
A	Draw out AKD-5/6 Switchgear
B	Draw out AKR OEM Substructure
C	Draw out AKD-6 Switchgear (AKR-75/100 only)
D	Draw out AKD-8 Switchgear and OEM Substructure
S	Stationary
W	33″ Wide Stationary (AKR-100 only)
F	OEM Substructure AKR-75/100 only)

Example of Nameplate Designation

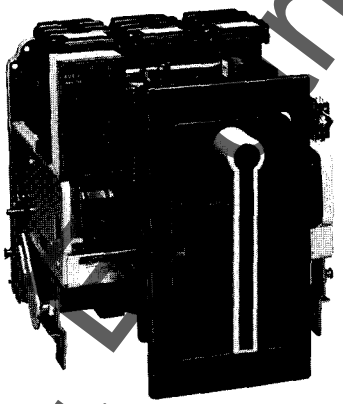
AKR Type	MicroVersa-Trip Device	800A Frame Size
↓	↓	↓
AKR	6 D	30S
	For Draw Out Substructure Mounting	

Manual Opening — All Breakers

All breakers, manual and electrical, are equipped with a mechanical TRIP button located on the breaker escutcheon. Manual opening is accomplished by displacing a mechanism latch that allows the toggle linkage, which holds the breaker's moveable contacts in the closed position, to collapse.

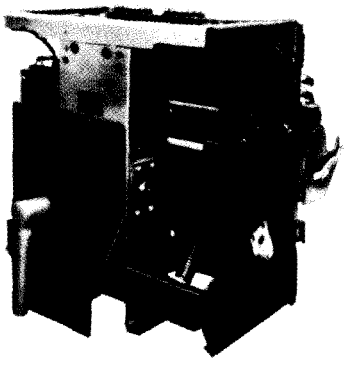
Manual Stored Energy Closing AKR-30, -50 and AKRT-50

This circuit breaker has a closing spring which is charged by a number of handle strokes (from one to four) depending on the angle through which the handle is rotated. Upon completion of the charging action, the springs are "propped" in the fully charged position and are discharged only by removing the "prop," releasing the spring to close the breaker. Closing is initiated by depressing a mechanical close button on the escutcheon.



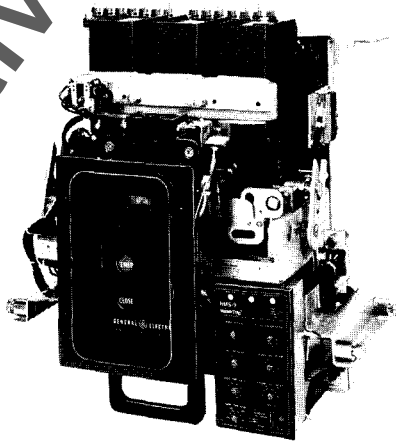
Manual Stored Energy Closing AKR-75 and -100

This circuit breaker requires four handle strokes to charge the springs. Unlike the smaller AKR frame sizes, the breaker's contacts close during the fourth handle stroke. Initiation of closing by separate close button is not available.



Manual Stored Energy Closing AKR-30S and AKR-30S

This circuit breaker is closed by first rotating the handle counterclockwise approximately 100 degrees; this resets the mechanism and partially charges the closing spring. Returning the handle clockwise to the normal position completes the spring charging and drives the toggle mechanism over-center, closing the contacts.

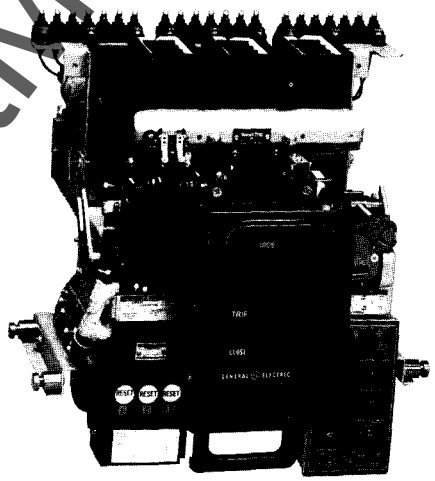


Electrical Opening

All breakers, manual and electrical, are equipped with a mechanical TRIP button located on the breaker escutcheon. Electrical breakers include a shunt trip device for remote opening.

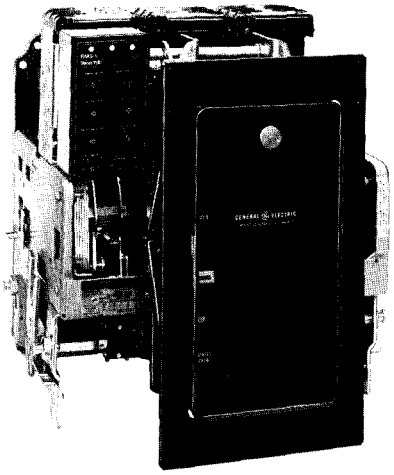
Electrical Stored Energy Closing
AK-25 and AKR(U)-30S

This electrically operated breaker closes whenever the closing solenoid coil is energized. This causes an upward movement of the solenoid armature which charges the springs to a predetermined over-center point for closing. (For typical electrical circuit see pg. 38.)



Electrical Stored Energy Closing
AKR-30, -50, -75 & 100

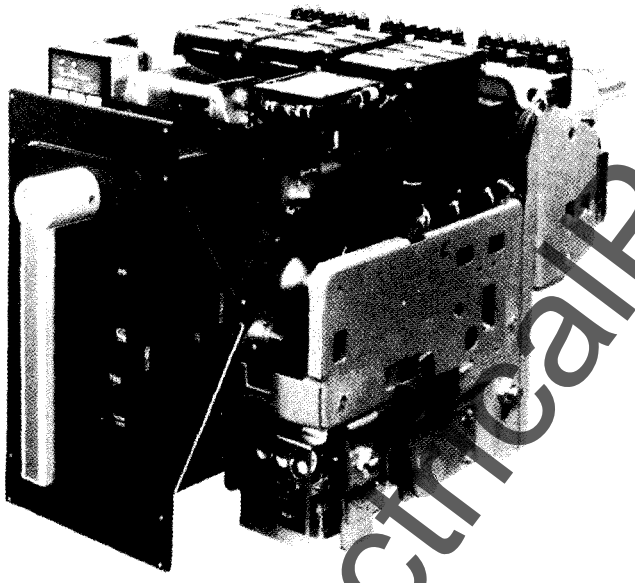
This electrically operated breaker utilizes a motor to automatically keep the closing springs in a charged state. Whenever the control solenoid is energized, its operation releases the closing springs, closing the breaker contacts. (For typical electrical circuit see pg. 38.)



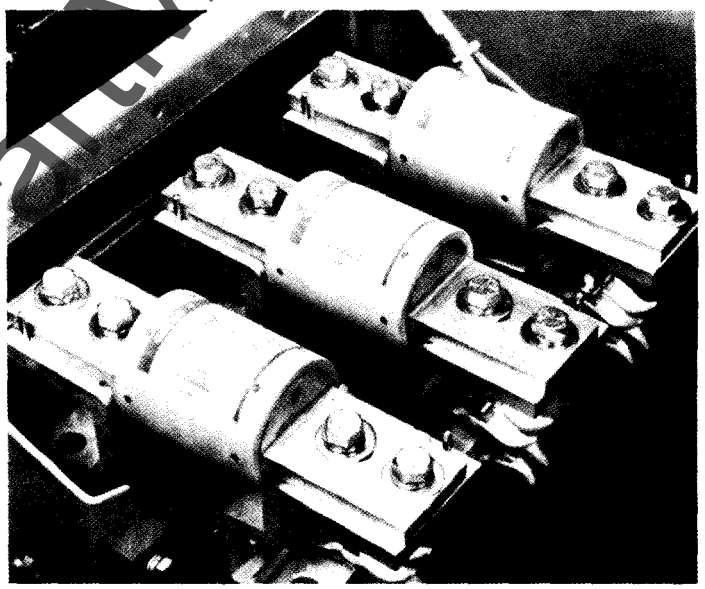
The initiation of the closing operation for both of the above types of breakers is by closing of a contact of a remote switch, relay or a close button in the front escutcheon if the breaker is so equipped. The breakers control schemes have an anti-pump feature which allows only one closure of the breaker for a single operation of the closing contact no matter how long the contact may be held closed. This prevents the repeated operations that would ensue if one of the automatic trip devices was activated at the time of closing. A manual closing handle is provided for maintenance purposes. All electrically operated breakers close within five cycles.

The fused low voltage power circuit breaker meets NEMA standard SG3 and ANSI C37.13, and C37.28. They provide protection for systems with available fault current to 200,000 Amperes RMS symmetrical. Current limiting fuses are provided as an integral part of the fused draw out breakers in the 800 and 1600 Ampere frame sizes. The 3200 and 4000 Ampere frames are available with coordinated fuses separately mounted in a draw out fuse carriage or fuse roll out element (stationary mounted fused breakers are not available.)

An open fuse lock out device is an integral part of all fused power circuit breakers. This device prevents single phasing by monitoring the fuses. Should any fuse blow, this direct acting device trips the breaker, opening all three poles simultaneously. Individual phase indicators pin point the blown fuse. The breaker remains locked out until the fuse is replaced and the device is reset.



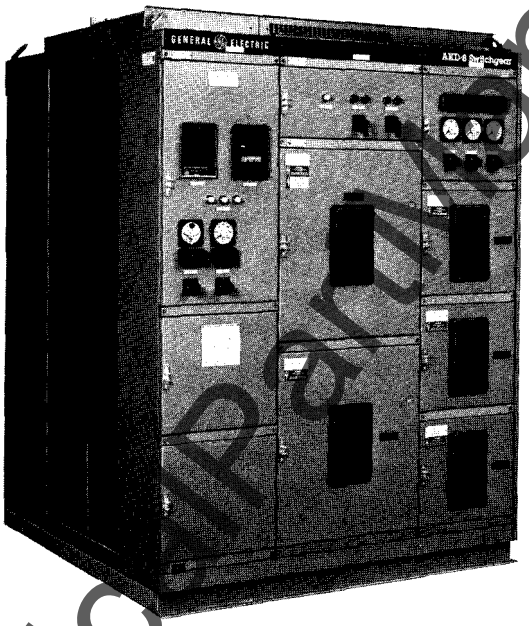
Open Fuse Lock Out Indicators



AKRU-50 Fuses

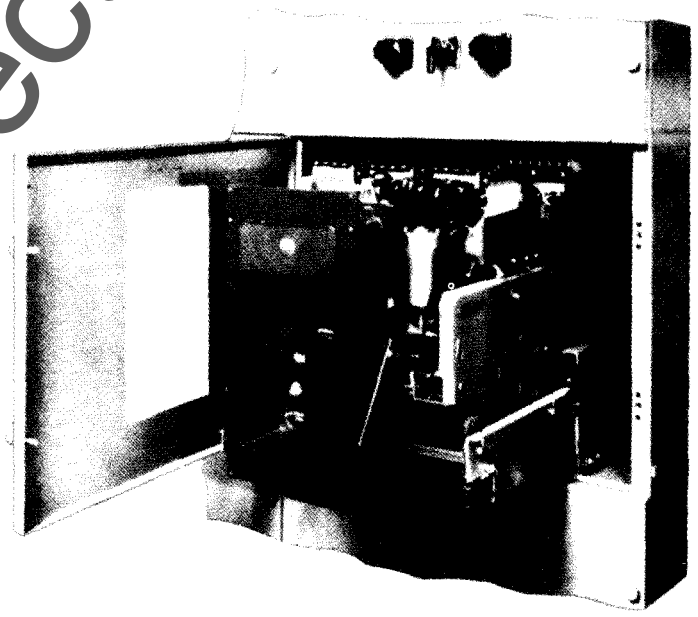
Metal-Enclosed Low Voltage Power Circuit Breaker AKD-8 Switchgear

Type AKR draw out LVPCB's are furnished in AKD-8 low voltage switchgear with integrated short circuit ratings. The equipment is designed, manufactured and tested to NEMA SG5, ANSI C37.20.1 and UL1558.



AV-LINE® Switchboards

Type AKR breakers are furnished as stationary mounted or draw out substructure mounted in AV-LINE® switchboards with integrated short circuit ratings. The equipment is designed, manufactured and tested to NEMA PB-2 and UL 891.

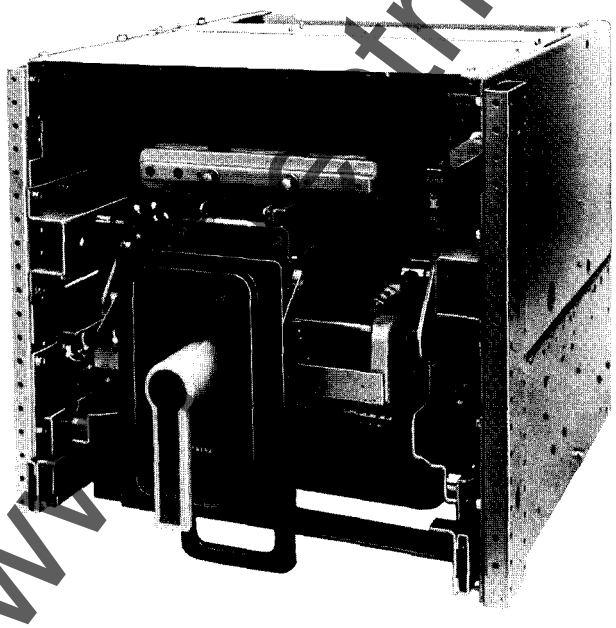


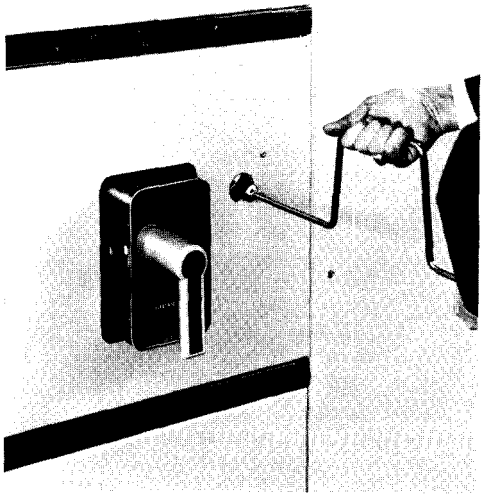
Type AKR breakers, both for stationary and substructure draw out mounted designs are available, and are UL-listed to ANSI C37.16 standards. The substructure is the equipment mounted component of a closed-door draw out breaker unit. Serving as the stationary receptacle, it provides means for mounting and connecting (both primary and secondary) the draw out breaker (removable element). The basic substructure is a self-contained, factory-aligned frame-work designed for convenient mounting as individual breaker compartments of switchboard or switchgear equipments. In conjunction with a line of accessories, it offers the equipment builder all the mechanical and electrical components necessary to outfit a compartment for closed-door draw out AKR breakers.

All AKR substructure breakers (draw out mounting type "D" for AKR-30 and -50 and type "F" for AKR-75 and 100) are equipped with extended ("deep") escutcheons. This configuration allows the breaker to be racked between the CONNECTED, TEST, and DISCONNECT positions without the need to open the compartment door.

On all frame sizes the draw out mechanism is breaker mounted. The racking handle is inserted through the breaker escutcheon on AKR-30 and -50, and through the compartment door on the AKR-30S, -75, and -100. As the rack out handle is turned, it rotates slotted racking arms or cams on each side of the breaker frame. The cams engage fixed pins mounted on both sides of the substructure, moving the breaker in and out.

The draw out operation features four positions. In the CONNECTED position the primary and secondary disconnects are fully engaged. The breaker must be opened before it can be racked in or out of this position. When in the TEST position, the primary disconnects are disengaged, but the secondary disconnects remain engaged. This permits breaker operation without energizing the primary circuit. In the DISCONNECT position neither primary nor secondary disconnects are engaged. Breakers may be racked between these three positions with the compartment door closed. Each position is clearly identified by markings which appear on the left side of the escutcheon as it emerges through the door cut out. With the door open, the breaker can be pulled out manually from the disconnected position.





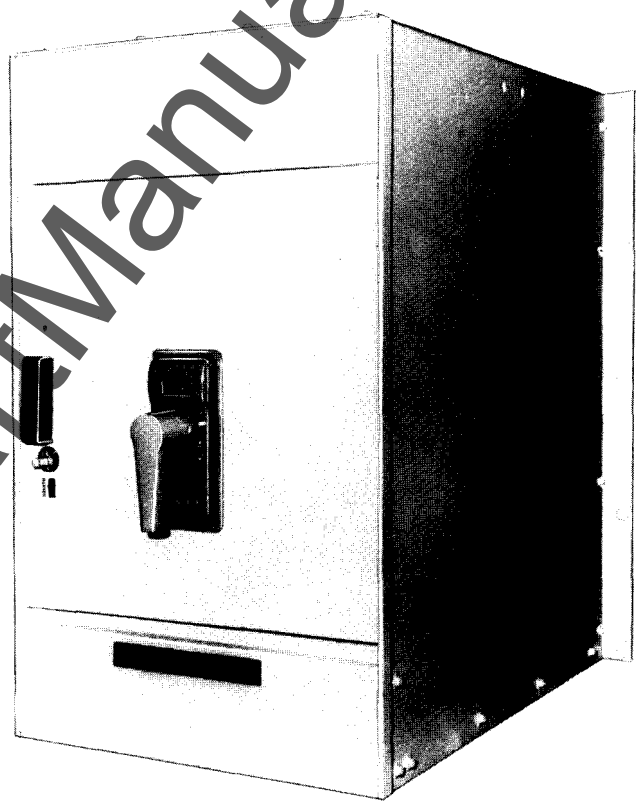
Draw Out General Purpose Enclosure — NEMA 1

For indoor use, the one-high closed door draw out steel housing is complete with a draw out breaker (draw out mounting type letter "A"). The unit is wall-mounted in the AKR-30 and -50 sizes, floor-mounted in the AKR-75 and -100 sizes.

The draw out operation features the same four positions and functions in the same manner as described earlier for draw out AKR substructures. Breaker position, though, is clearly identified by a rotary indicator visible through a door opening.

With the door open, the breaker can be pulled out manually from the DISCONNECT to the WITHDRAWN position so that the breaker is completely out of its compartment and ready for removal.

The draw out mechanism is externally operated by a removable racking handle. Two mechanism types are employed. A breaker-mounted, screw / traveling nut type services the AKR-30 and -50 frames, and the racking handle is inserted through an opening in the breaker escutcheon. The equipment mounted type mechanism is employed on the AKR-75 and -100 models (mounting type "A" breakers), and the racking handle is inserted through an opening in the left side of the door. In both mechanism types the breaker is supported by two pins protruding from each side of its frame, these engaging slots in the telescoping rails fastened to the enclosure walls.



The RMS-9 MicroVersaTrip system for AKR low voltage power circuit breakers consists of four parts: plug-in protection programmer, flux-shift trip device, current sensors and rating plugs.

The programmer contains a current sensor-powered, solid-state logic unit and incorporates rotary adjustment switches for up to nine functions, as well as targets for mechanical fault trip indication.

MicroVersaTrip RMS-9 represents the latest technology in digital solid-state programmers.

RMS Digital Sensing of Sinusoidal and Non-sinusoidal

The RMS-9 provides accurate overload protection for both sinusoidal and non-sinusoidal currents by direct measurement of the true rms content of the current wave. This is accomplished by microprocessor digital sampling techniques. Therefore, the solid state microprocessor is not affected by component tolerance and does not require compensation for signal distortion. Since the design is based on complimentary metal oxide (CMOS) technology, it is less sensitive to extraneous noise produced by lighting, instrumentation, radio, etc.

The solid state microprocessor technology and fast analog to digital converters make it possible to measure the magnitude of the phase current over a number of time periods within the cycle. The RMS-9 sampling rate of 27 per cycle for each phase allows for errors of less than 1% on systems with distortions through the 13th harmonic. This digital sampling technique provides the most accurate system protection for distribution systems that include ac and dc variable speed drives, rectifiers, induction heating, and other loads that cause non-sinusoidal currents.

A Full Function Trip Unit Available with Various Combinations of Protection Features.

The RMS-9 trip line of programmers provides maximum breaker to breaker selectivity and custom load protection. Short-time and Ground Fault functions include the flexibility of coordination with and without an I^2T ramp. Type AKR power circuit breakers are available with High Range Instantaneous, No Instantaneous, or Switchable (OFF) Instantaneous, and Ground Fault. All programmers include a clear plastic cover with provisions for sealing for tamper-proof installation.

Flux-shift Trip Device

The flux-shifter is a low energy, positive action tripping device that is automatically powered and controlled by the protection programmer. The low energy signal from the programmer counteracts the strength of a permanent magnet in the flux-shifter, allowing a spring to unseal the magnet and trip the breaker.

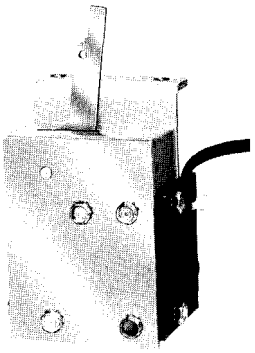
Current Sensors

Three toroidal current sensors provide maximum flexibility and reliability with minimum signal error. Current sensor ratios are shown in Table 30.1, page 30.

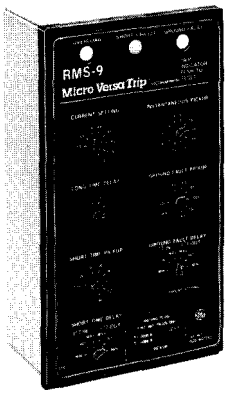
Rating Plugs Provide Convenient Flexibility in Matching Load Requirements

All RMS-9 programmers utilize a broad range of field installable rating plugs for future uprating capability, minimum size cable selection, and an extra degree of coordination flexibility.

Fixed Current Sensor

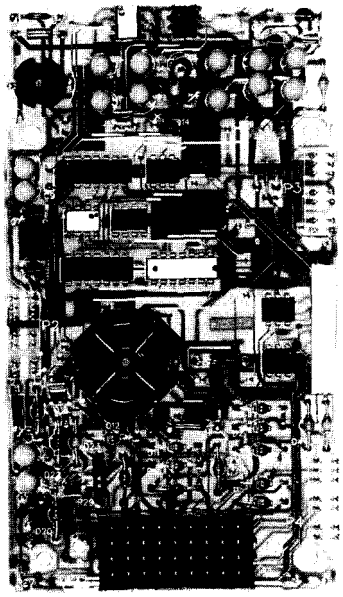


Flux-Shift Trip Device

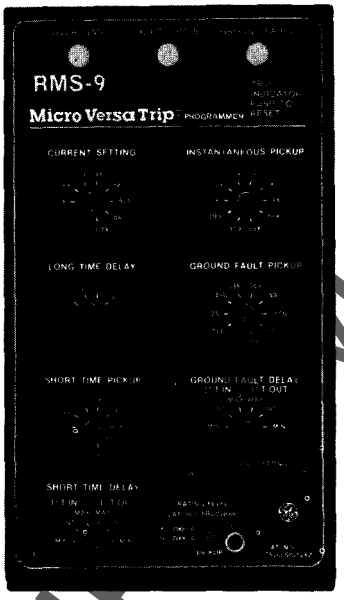


Protection Programmer

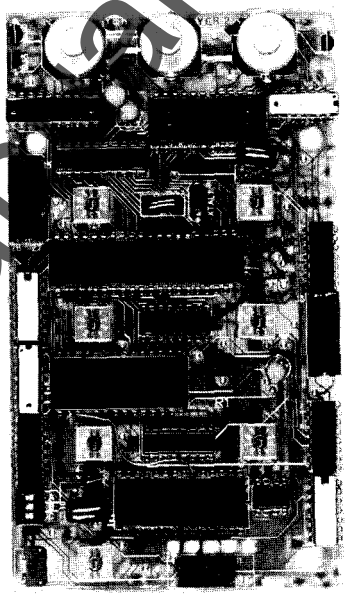
MicroVersaTrip® RMS-9 System Components



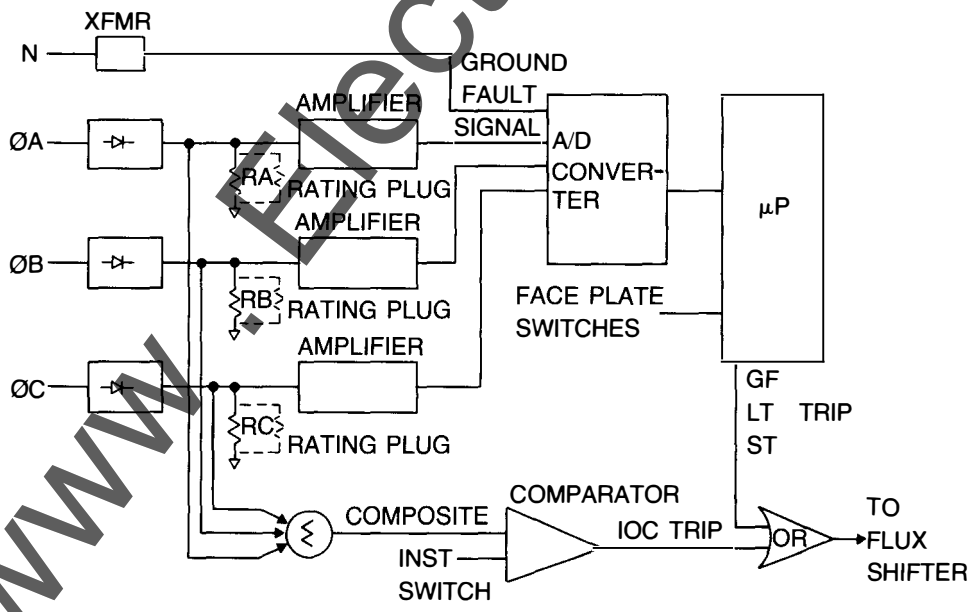
Power Supply Board



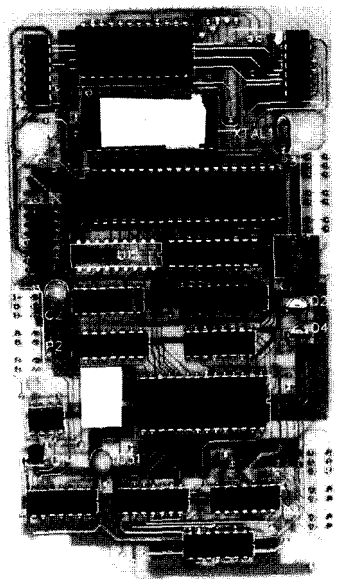
Programmer Faceplate



Logic Board



MicroVersaTrip® RMS-9 block diagram.



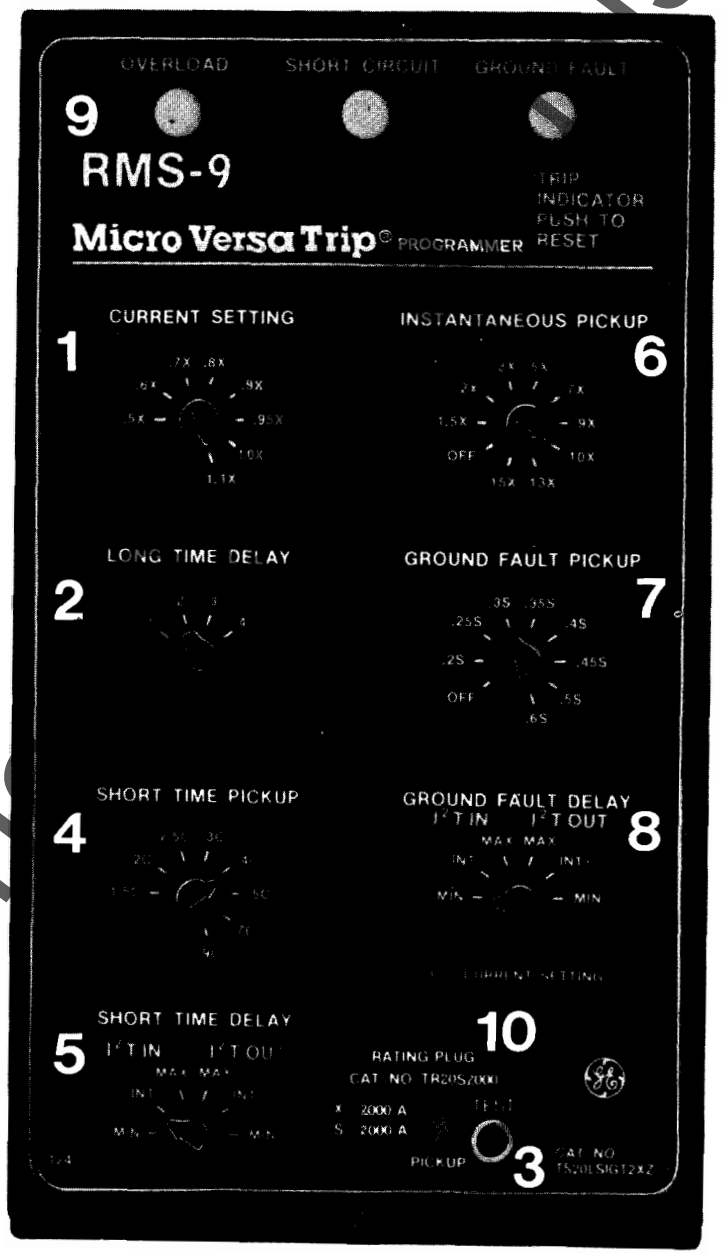
Epic MicroVersaTrip™ Board (when used)

1. Current Setting
   —Standard
2. Long-Time Delay
   —Standard
3. Long-Time Pickup Light
   —Standard
4. Short-Time Pickup
   —Optional
5. Adjustable Short-Time
   Delay—Optional
6. Instantaneous Pickup
   —Standard
7. Ground Fault Pickup
   —Optional
8. Ground Fault Delay
   —Optional
9. Fault Trip Annunciator
   (Local)
   —Optional
10. Rating Plug
    Not shown:

Adjustable High Range Instantaneous
—Optional

Zone Selective Interlock
—Optional

The quantity of these functions in any given breaker is determined by complete catalog number.



MicroVersaTrip RMS-9 Programmer

Table 15.1 MicroVersaTrip® RMS-9 Programmer Function Settings

Frame Size	Max. Amp Rating	Sensor Rating (Amps) (S)	Current Setting (Multiple of Rating Plug Amps) (X)	Long-time		Short-time	
				Pick Up (Multiple of Current Setting) (C)	Delay① (Seconds)	Pick Up (Multiple of current Setting) (C)	Delay (Seconds)
AKR-30S AKR-30H	800	150, 400, 800	.5, .6, .7, .8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.9, 9.8, 20	1.5, 2.0, 2.5, 3.0, 4,.0, 5.0, 7.0, 9.0	I^2T in.① .40 I^2T out② .10, .21, .35
AKR-50	1600	800, 1600	.5, .6, .7, .8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.9, 9.8, 20		
AKRT-50	2000	2000	.5, .6, .7, .8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.9, 9.8, 20		
AKR-75	3200	3200	.5, .6, .7, .8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.9, 9.8, 20		
AKR-100	4000	4000	.5, .6, .7, .8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.9, 9.8, 20		

Frame Size	Adjustable Instantaneous Pick Up without ST (Multiple of Rating Plug Amps) (X)	Adjustable Instantaneous Pick Up with ST (Multiple of Rating Plug Amps) (X)	High Range Instantaneous (Multiple of Frame Short-Time③ Rating) (H)	Triple Selective Trip, Fixed High Range Instantaneous ④⑤	Ground Fault		
					Pickup (Multiple of Sensor amp Rating) (S)	Delay with I^2T (Seconds)	Delay⑥ without I^2 (Seconds)
AKR-30S AKR-30H	1.5, 2, 3, 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9, 10, 13, 15	.4, .6, .8, 1.0	+0 22kA −20%	.2, .25, .3, .35, .4, .45, .5, .6	.40 at 200% of pick up at lower limit of band	.10, .21, .35
AKR-50	1.5, 2, 3, 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9, 10, 13, 15	.4, .6, .8, 1.0	NA	.2, .25, .3, .35, .4, .45, .5, .6		.10, .21, .35
AKRT-50	1.5, 2, 3, 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9, 10, 13, 15	.4, .6, .8, 1.0	NA	.2, .25, .3, .35, .4, .45, .5, .6		.10, .21, .35
AKR-75	1.5, 2, 3, 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9, 10, 13	.4, .6, .8, 1.0	NA	.2, .22, .24, .26, .28, .30, .34, .37		.10, .21, .35
AKR-100	1.5, 2, 3, 5, 7, 9	1.5, 2, 3, 5, 7, 9	.4, .6, .8, 1.0	NA	.2, .22, .24, .26, .28, .3		.10, .21, .35

① Time delay shown at 600% of current setting at lower limit of band.
② Time delay shown at lower limit of each band. All pickup tolerances are ± 10%.
③ Refer to BuyLog catalog Table 1, page 6-3 for frame short-time ratings.
④ For AKR-30S only.
⑤ Triple selective trip is standard when long-time/short-time only is required.
⑥ Time delay shown at lower limit of each band. Ground fault pick up not to exceed 1200 amps.
X = Rating plug amps
S = Sensor amp rating
C = Current setting
H = Short-time rating

Table 15.2 MicroVersaTrip® RMS-9 Programmer-Available Combinations (Add Suffix to Basic Catalog Number)

Programmer Suffix	Long-time (L)	Short-time (S)	Adj. Inst. (I)	Adj. High Inst. (H)	Fixed High Inst. (K)	Ground Fault (G)	OL/SC Targets (T1)	OL/SC/GF Targets (T2)	GF③ Zone Interlock (Z1)	GF/ST③ Zone Interlock (Z2)	Switch Inst/GF (X)
Adjustable Instantaneous											
L1	X		X								
LIT1	X		X				X				
LIGT2	X		X			X		X			
LIGT2Z1	X		X			X		X	X		
LSIT1	X	X	X				X				
LSIGT2	X	X	X			X		X			
LSIGT2Z1	X	X	X				X		X		
LSIGT2Z2	X	X	X			X		X		X	
Adjustable High Instantaneous											
LSHT1	X	X		X			X				
LSHGT2	X	X		X		X		X			
LSHGT2Z1	X	X		X		X		X	X		
LSHGT2Z2	X	X		X		X		X		X	
Fixed High Instantaneous②											
LSKT1	X	X			X		X				
LSKGT2	X	X			X	X		X			
LSKGT2Z1	X	X			X	X		X	X		
LSKGT2Z2	X	X			X	X		X		X	
No Instantaneous①											
LST1	X	X					X				
LSGT2	X	X				X		X			
LSGT2Z1	X	X				X		X	X		
LSGT2Z2	X	X				X		X		X	
Switchable Instantaneous/Ground Fault①④											
LSIGT2X	X	X	X			X		X			X

① Not available for AKD-7D-30S or AKRU-7D-30S.
② Only available for AKR-7D-30S or AKRU-7D-30S.
③ Requires zone selective interlock module types TIM1 (120V ac control voltage) or TIM2 (125V dc control voltage).
④ Not UL Listed.

Long-Time Function

Moving from left to right on the current axis, Figure 16.1, the upper part of the time current curve is the long-time pickup. This is the function used to protect a circuit against low magnitude overcurrents. The breaker trips because the current has exceeded the long-time setting. If a breaker is protecting a motor, the start-up surge (in-rush current) can be accommodated by setting the breaker to allow for a momentary delay while the motor has a chance to reach its normal operating speed or full load current.

Short-Time Function

The middle portion of the curve is the short-time function. It is used to protect against higher magnitude overcurrents and low-level short circuit faults. Overcurrent due to short circuits is generally in the order of 10 or more times full-load current, and is measured as symmetrical RMS (root mean square) short-circuit current.

Instantaneous Function

At the bottom of the time current curve is the protective device's instantaneous function. The instantaneous trip point determines the level at which the breaker will trip without an intentional time delay. This immediate interruption occurs only as a result of a severe overcurrent condition, such as a high-level short circuit, that would damage the electrical system if not interrupted. An instantaneous trip can be adjustable, depending upon the application.

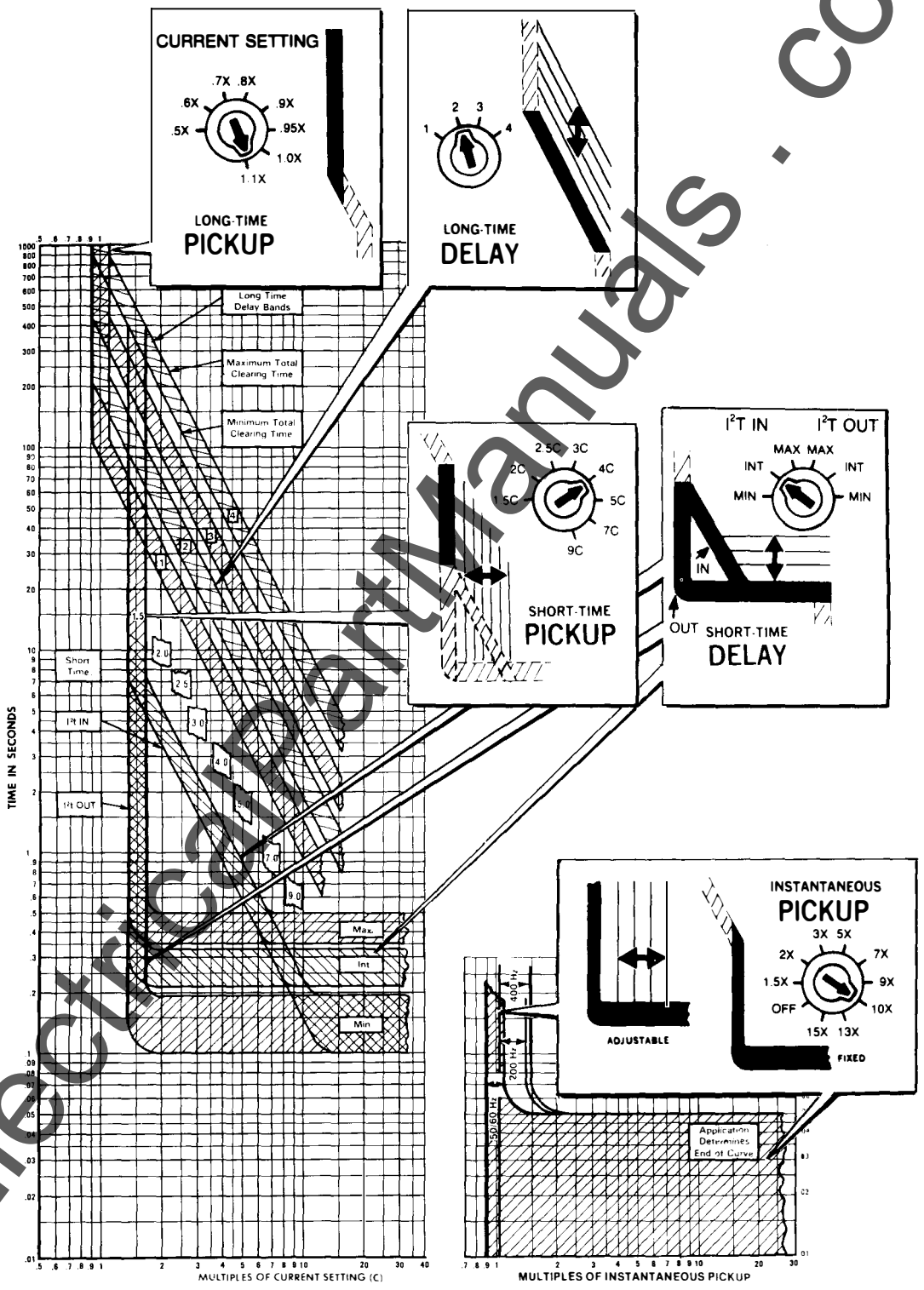


Fig. 16.1 Time Current Curve Definition — Overload and Short Circuit

I^2t Function

An I^2t function is available with MicroVersaTrip.® This provides a ramp function (I^2t = constant) in the short-time and ground fault characteristic (See Fig. 16.1) that allows maximum coordination with downstream thermal-magnetic protective devices that follow a curve instead of a square path. The I^2t function also allows tighter motor protection by accommodating the transient inrush while the short-time pickup remains just slightly higher than the steady state starting current. In other words, the path follows the hypotenuse instead of the right angle. When the square short-time path might intersect with a downstream fuse or breaker, the I^2t function permits the short-time delay path to veer in front of the time current curve for the downstream device. Without this function, coordination and selectivity would be difficult to attain.

Ground Fault Protection

A ground fault is unintentional current flowing from a circuit through a conducting path to ground. It is usually of a low magnitude (less than the long-time pickup value) and not sensed by the protective device. Using modern electronic trip devices, protection against ground faults can be built into a distribution protection system with ground fault pickup and delay functions added to the circuit breaker's fault interrupting capability. Before electronic trips came on the scene, a complex collection of external relays and current sensors were needed to sense a ground fault and signal a breaker to trip. Eight ground fault pickup levels and three delay bands with I^2t in and out to allow full selectivity, insuring that only the breaker closest to the ground fault will trip. Addition of zone selective interlocking for the ground fault function further enhances this protection by permitting "timed" tripping and closer back-up protection.

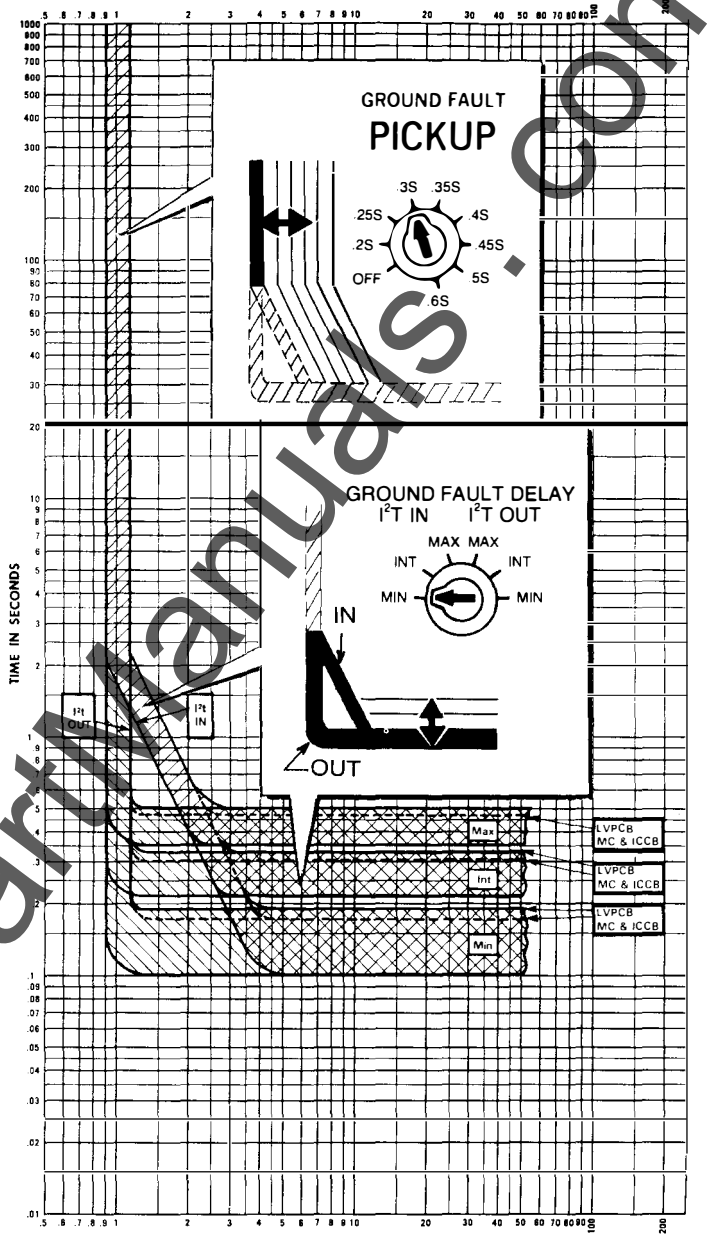
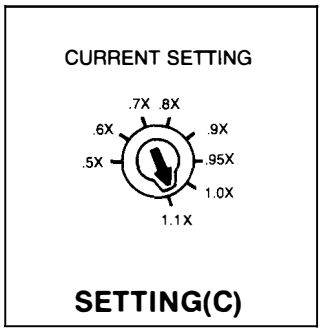
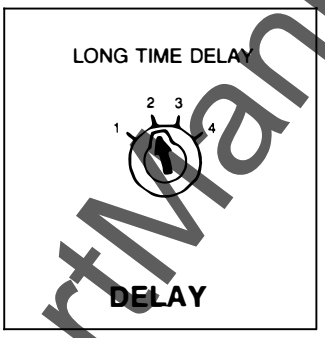


Fig 17.1 Time Current Curve Definition Ground Fault

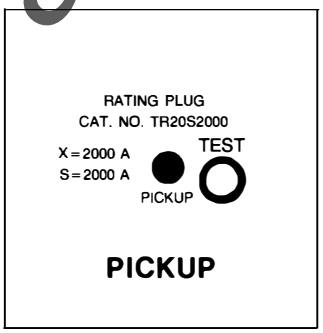
Current Setting (Standard)
The adjustable current setting determines the nominal long time current setting with a ±10% band width. With a 1.1 setting the breaker will carry indefinitely without tripping the rating plug rating. Changing the setting changes the norminal current rating for the breaker.



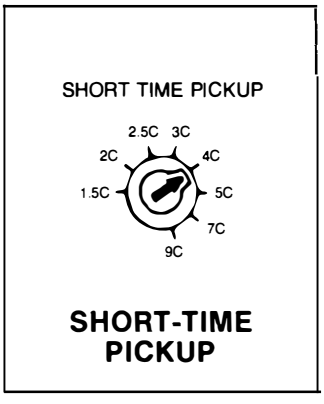
Long-Time Delay (Standard)
This long-time delay adjustment varies the time it will take the breaker to trip under sustained overload conditions. It provides the function of withstanding momentary overloads such as motor starting, welding, or other overcurrent conditions without interrupting the service.

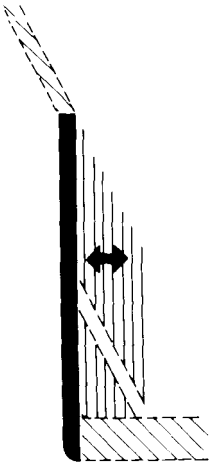


Long-Time Pickup Light (Standard)
The long-time pickup light provides visual indication that the breaker is experiencing an overload condition. Indication is provided by a light-emitting diode (LED) which is only activated prior to trip-out and during long-time time-out. Saves test and system start up time.



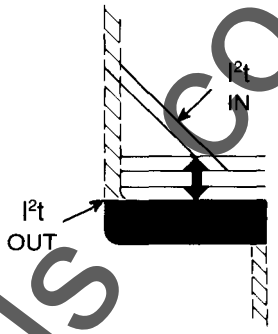
Short-Time Pickup (Optional)
This short-time pickup adjustment controls the level of high current the breaker can carry for short periods of time without tripping. Permits downstream breakers to clear short circuit faults without tripping out the upstream protective device.





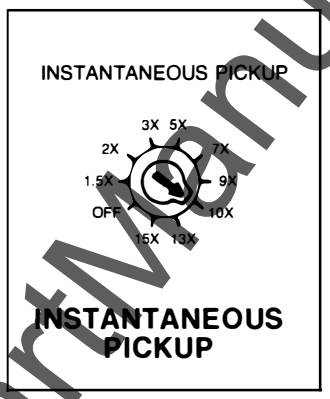
Short-Time Delay (Optional)

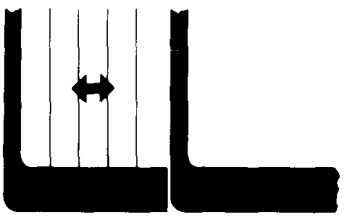
The short-time delay adjustment is used in conjunction with the short-time pickup setting to provide a further refinement of coordination between circuit breakers. It establishes the time interval the breaker will wait before responding to the short-circuit current level selected on the short-time trip point adjustment.



Adjustable Instantaneous Pickup (Standard)

The instantaneous trip point determines the level at which the breaker will trip without intentional time delay (0.025 seconds or less). This immediate interruption occurs only as a result of a severe overcurrent condition, thereby minimizing damage to the electrical system and equipment.





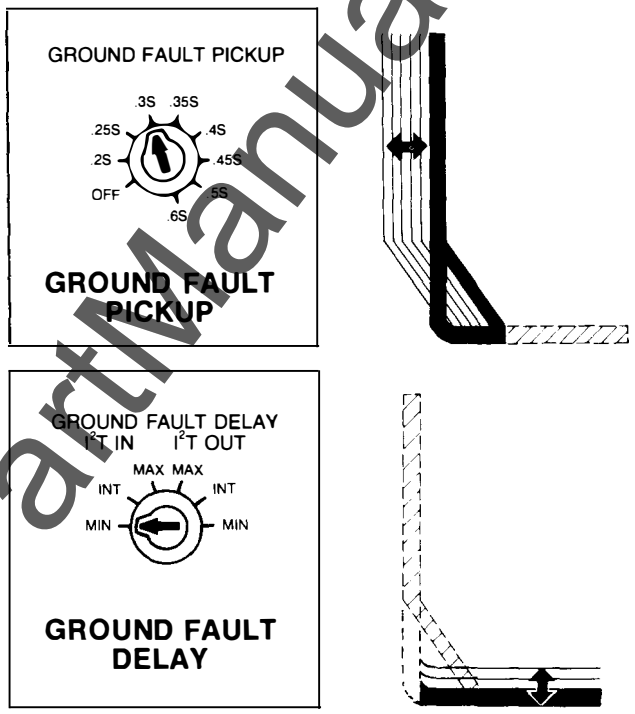
High Range Instantaneous

Includes adjustable short-time pickup, adjustable short-time delay and a high-level instantaneous setting is adjustable in four steps from 40 to 100 percent of the circuit breaker frame short-time rating permitting maximum use of the breaker's short-time capability. This high level instantaneous function increases system protection without losing selectivity.

Ground Fault Pickup and Ground Fault Delay (Optional)

The ground fault pickup adjustment controls the level of ground fault current at which circuit interruption will occur. To comply with the 1981 National Electrical Code (NEC 230-95), no trip point exceeds 1200 amperes. The common square knee of the curve can be replaced with an I^2t function to facilitate coordination with downstream devices such as thermal-magnetic breakers and fuses whose time-current curves do not easily relate to the square-shape sensing characteristics common to solid state trip devices.

The ground fault delay adjustment is used to add a pre-determined delay in time to the trip point once the ground fault pickup level has been reached. This provides tripping selectivity between main and feeder or other downstream breakers. The ground fault unit also includes as standard an inverse I^2t ramp to substantially improve coordination with downstream protective devices such as fuses and thermal magnetic circuit breakers.



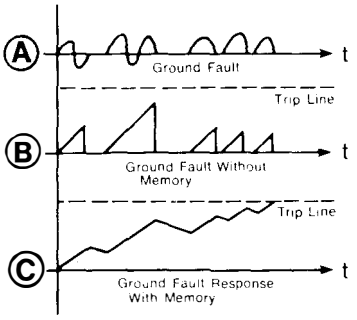
Memory Circuit

Because of the highly intermittent and erratic nature of arcing ground faults, a memory circuit has been incorporated in all MicroVersaTrip ground fault sensing circuits as standard. The memory circuit integrates arcing fault current with time, essentially summing the intermittent ground current spikes. In the diagrams, it can be seen how the memory function works.

Diagram A shows a typical ground fault with half-cycles, whole cycles and multiple cycles missing, as normally occurs.

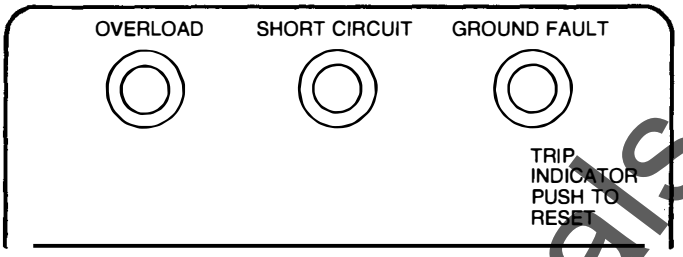
Diagram B shows trip response of a typical ground fault function which does not include memory. The breaker never trips because the time delay circuits are reset with every missing cycle.

Diagram C shows response of MicroVersaTrip ground fault circuits to the same ground fault; the circuit's memory carries through the missing cycles and generates a trip signal after the preset time delay.



Fault Trip Indicators

Indicators are designed to reduce system downtime by analyzing any overcurrent fault and identifying its cause. Mechanical pop-out type indicators are available on the programmer for identifying overload or short circuit overcurrent faults when breakers are ordered without integral ground fault protection. Indicators are available to identify overload, short circuit and ground fault trips — for breakers supplied with integral ground fault protection.



Zone Selective Interlocking

The standard means of obtaining selectivity between main and feeder breakers is by incorporating programmers with time-coordinated trip characteristics. This consists of setting the farthest downstream breaker with a small time delay, and progressively increasing the time delay as you get closer to the main protective device. The disadvantage in this method is that the system must now endure the stress of the high current fault until time-out occurs.

The Zone Selective Interlock module, Figure 21.1, receives a signal from a downstream MicroVersaTrip programmer (Logic 0) which causes the module to transmit a low-level interlock signal to a MicroVersaTrip programmer upstream. The interlock signal activates the LED portion of an LED-Transistor Opto-isolator in the upstream programmer causing the fixed delay band to shift from "MIN" to the programmer delay band setting Figure 14.1. Both the Short-Time and Ground Fault functions are capable of being interlocked.

Zone Selective Interlocking is available for the short-time function and the ground fault function, or for the ground fault function only.

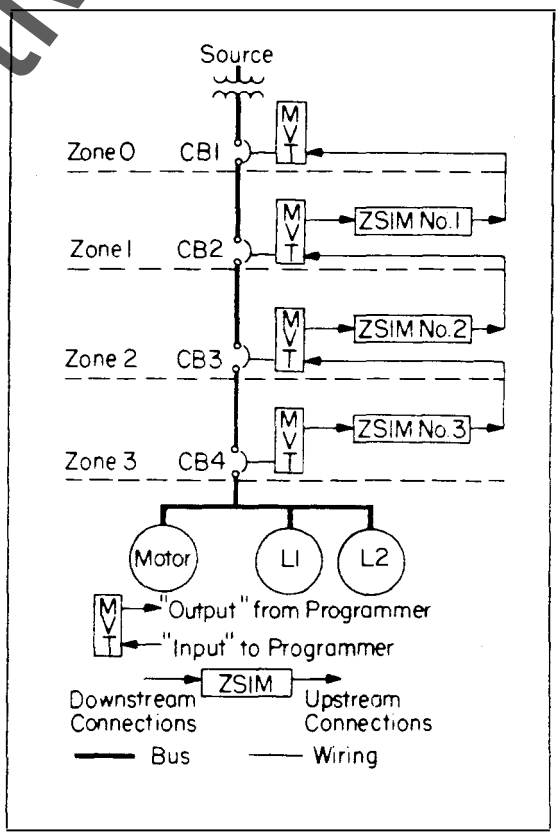


Fig. 21.1 Multi-Zone Interlocking

Trip Devices
EC Trip Devices
DC Applications

General
Type EC overcurrent trip devices are magnetically operated, using a series coil (or single conductor and an associated magnetic structure) to provide tripping force. Three basic characteristics: long-time delay, short-time delay and instantaneous, can be used in various combinations to suit the application.

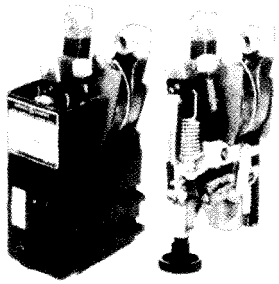
Long-Time Delay is accomplished with a positive-displacement oil piston. Sealing of the assembly eliminates variations caused by atmospheric contamination, and silicone oil minimizes variations in time delay due to changes in ambient temperature.

Short-Time Delay is accomplished with a rugged mechanical escapement.

Instantaneous tripping is obtained when a tension spring yields to the force exerted on the magnetic armature at short circuit current levels, permitting the armature to move independently of the time delay piston.

AKR breakers with EC trips are for use on DC system voltages, and are available in ratings of 40–6000 amperes. One EC trip device is mounted in each breaker pole and contains functional adjustments, overcurrent detection and tripping hardware.

EC trip devices are available as type EC-2A (standard for frames through 2000A), EC-1 (optional for frames through 2000A) and EC-1B (standard for 4000 and 6000A frames). Trip characteristics are described in the table below.

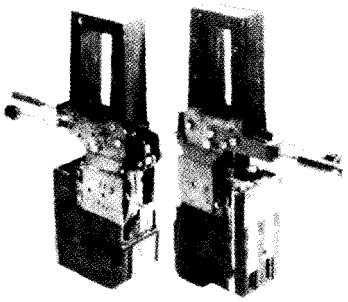


Type EC-2A

Trip Device for 600–2000 amp frame breakers. Available in combinations of long-time and instantaneous elements, or instantaneous alone.

Type EC-1

Trip Device for 600–2000 amp frame breakers. Combines long-time and short-time elements for intentional delay up to the short-time rating of the breaker. Instantaneous may be added.



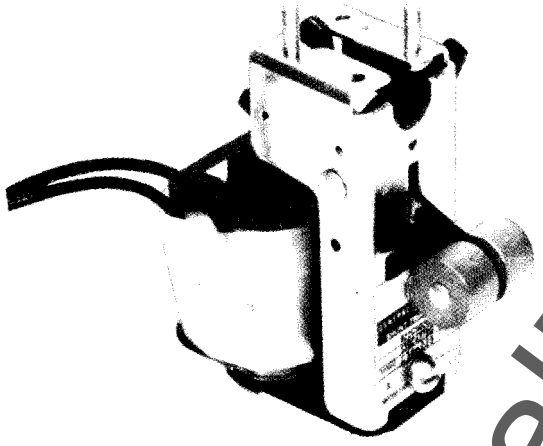
Type EC-1B

Trip Device for 4000 and 6000 amp frame breakers. Combines long-time and short-time elements for intentional delay up to the short-time rating of the breaker. Instantaneous may be added.

Table 22.1
Adjustment Ranges for EC Trip Devices

Trip Device	Long-Time		Short-Time		Instantaneous Pickup
	Pickup ①	Delay ②	Pickup	Delay ③	
EC-2A	80–160%X (±10%)	(1A) MAX — adj 15–38 sec or (1B) INTER — adj 7.5–18 sec or (1C) MIN — adj 33–82 sec	—	—	4–9X 6–12X 9–15X or 80–250% X ④
EC-1	80–160%X (±10%)	(1A) MAX — 30 sec or (1B) INTER — 15 sec or (1C) MIN — 5 sec	2–5X 3–7X or 4–10X	(2A) MAX — 23 sec or (2B) INTER — 15 sec or (2C) MIN — 07 sec	High Set up to 15X Non-Adjustable
EC-1B	80–160%X (±15%)	(1BB) MAX — 45 sec or (1CC) MIN — 2 sec	2–5X 3–7X or 4–10X	(2AA) MAX — 20 sec or (2BB) INTER — 13 sec or (2CC) MIN — 07 sec	4–9X 6–12X 9–15X or 80–250% X ④

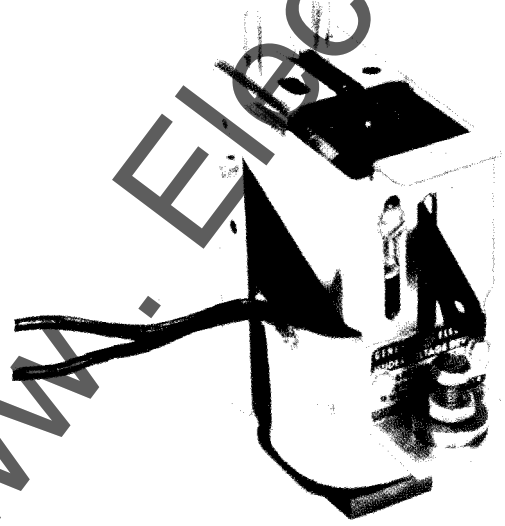
① X = Trip device ampere rating. If trip devices are set above 100% for coordination purposes, such settings do not increase the breaker's continuous current rating.
② At lower limit of band at 6 times pickup setting.
③ At lower limit of band at 2½ times pickup setting.
④ Low-set instantaneous. Not available in combination with long time delay.



Shunt Trip

The shunt trip offers remote electrical tripping of breaker. It is usually controlled by a switch or pushbutton 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 which automatically removes control power following a breaker trip.

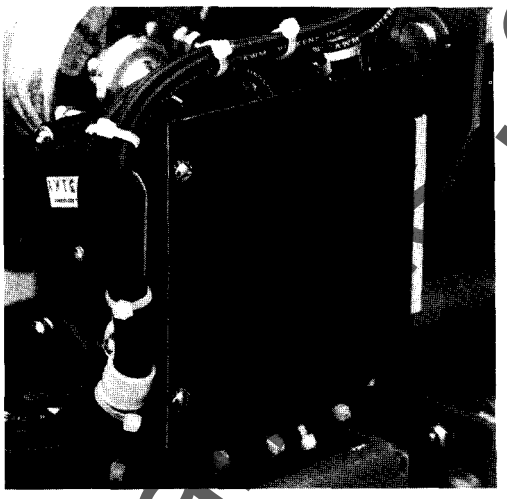


Undervoltage Trip

The undervoltage trip 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 offers a field-adjustable two to six second delay between undervoltage fault and breaker trip to prevent potential nuisance tripping due to momentary loss of voltage.

The time delay unit is mounted external to the breaker. It is rated 125 or 250V dc or 208/240V ac, 50 or 60 Hz. For any other ac source voltage, a control power transformer with a 240 Volt secondary rated at least 100 Va is required.

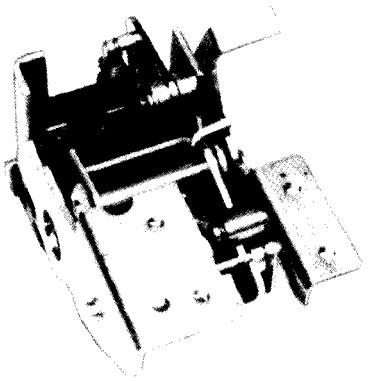


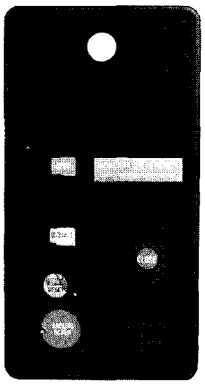
Auxiliary Switch
The auxiliary switch is used for remote indication of breaker main contact position. It is available in groupings of four contacts (two stages) or ten contacts (five stages). Each stage is composed of one "a" Type (N.O.) contact and one "b" Type (N.C.) contact. All contacts feature rugged double-break construction.

Electric Lock Out Device
The electric lock out device provides a means of electrically interlocking breakers so that two cannot be closed at the same time. This electromechanical device consists of a coil whose winding must be energized to close the breaker. Once the breaker is closed, loss of voltage will not trip the breaker. A bypass interlock is provided for initial startup. Refer to the UV device for ratings and coil characteristics. Auxiliary switches for cross-interlocking breakers must be ordered separately.

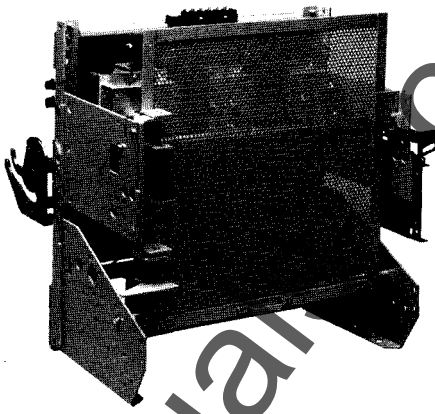
Key Interlock Provision
Prevents operation of a remote function unless the breaker has been tripped. Provision is made to accept a lock assembly furnished by purchaser (Kirk or Superior.)

Bell Alarm Switch
The bell alarm operates one "a" and one "b" contact, two "a's", or two "b's". 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 lock out feature is available to mechanically lock the breaker "Open" when the device is activated. "Reset" is accomplished through operation of the manual trip button or shunt trip device. The bell alarm is available without the lock out feature when so specified.



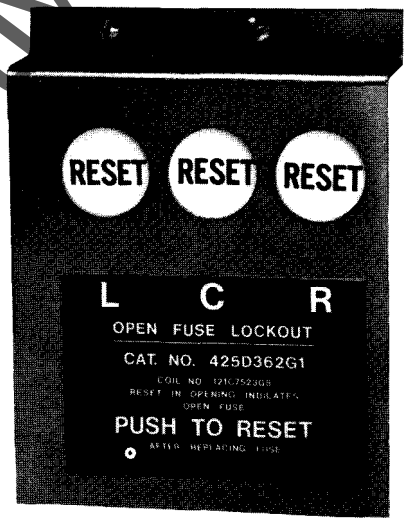


Close Button
The AKR electrically operated breaker is furnished as standard without operating handle and is closed by receipt of a signal provided by the remote momentary closure of a contact of a relay or switch. A close button escutcheon, mounted, momentary contact is available when specified.



Fuse Roll Out
The AKR-75 and -100 draw out AKRU breakers require a separate fuse roll out. All fuse roll outs accept Class L fuses 800-4000A. The draw out breaker elements used in conjunction with these fuse roll out elements should be equipped with an open fuse lock out device. The breaker component should have provisions for key interlock.

Open Fuse Lock Out Device
The open fuse lock out device automatically trips the breaker if one of the fuses opens. The breaker is locked open until the reset button of the phase involved is reset.

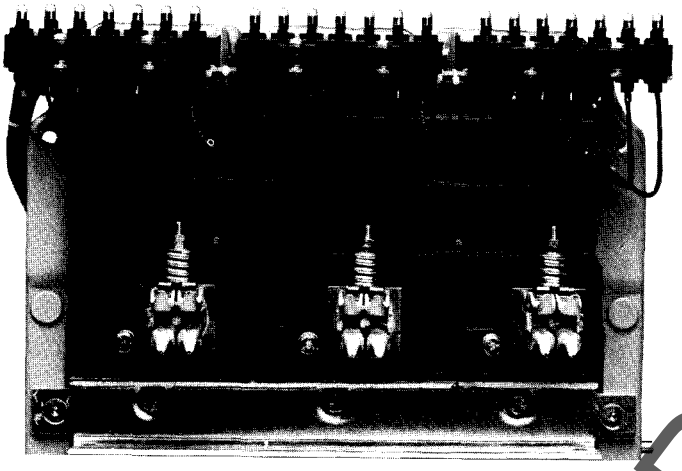


Remote Close Solenoid (For manually-operated AKR-30H, -50, AKRT-50H breakers)
The solenoid provides a means to electrically close the above breakers from a remote location. It may be controlled by a switch or pushbutton for five-cycle closing. Breaker must be charged locally. Available ratings: See Table 39.2, page 39 — not available on AKR-30S.

Maintenance Closing Handle
The maintenance closing handle is furnished as standard (one handle for up to five breakers.) The maintenance handle is provided for the slow closing motion required during contact adjustment procedures (not required on manually operated AKR-75 and 100 breakers.)

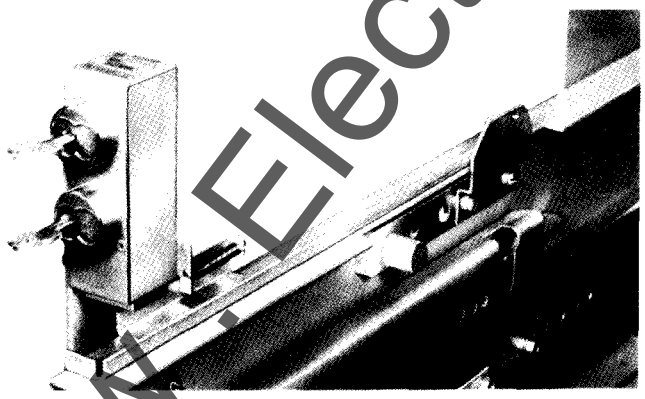
Reverse Current Device
The reverse current device is available for dc breakers only. It is designed to trip the breaker if current reverses direction.

Operations Counter
This accessory mounts on the breaker as a five digit, non-resettable counter actuated by the breaker cam shaft.

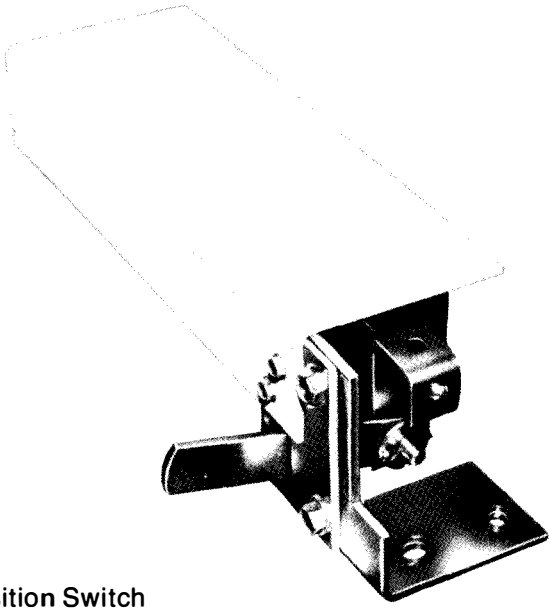


Secondary Disconnects
Breakers may be ordered with up to twenty-one draw out control disconnect points furnished in groups of seven. Seven circuit disconnect block kits and mounting brackets for up to three blocks are available for mounting in the substructure.

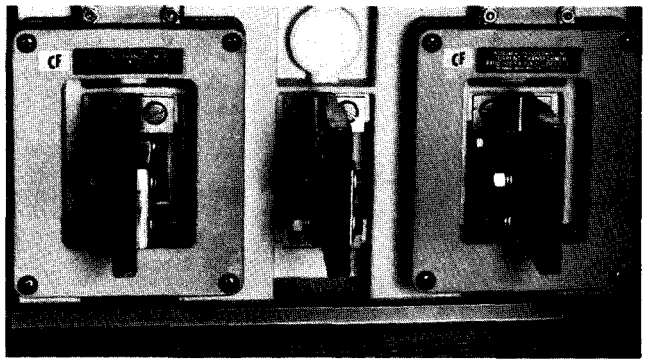
Fourth Wire Disconnect
Fourth wire disconnect kits for use when three phase, four wire ground fault protection is required provides for connection to fourth wire neutral sensor.



Keylock Provision
Keylock accessory kit provides mechanism interlock assembly for mounting a single or double multiple lock.

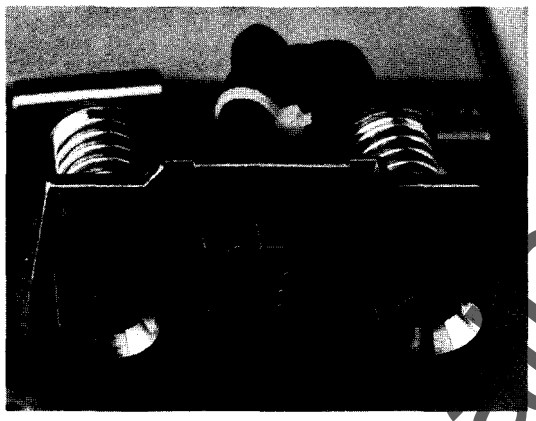


Position Switch
The position switch is activated by the AKR breaker when the breaker is in its connected position and then contacts of the switch change state when moved to the test position.

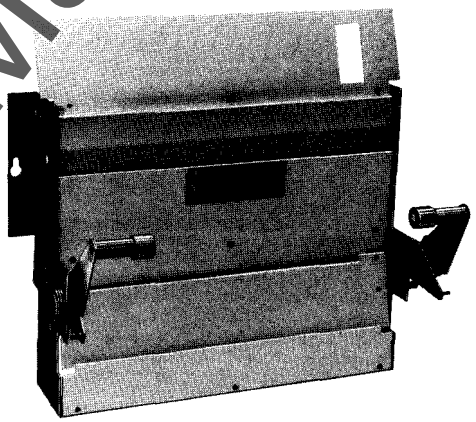


Current Transformer Mounting Hardware
Provides the necessary mounting hardware for mounting applicable current transformers in the substructure.

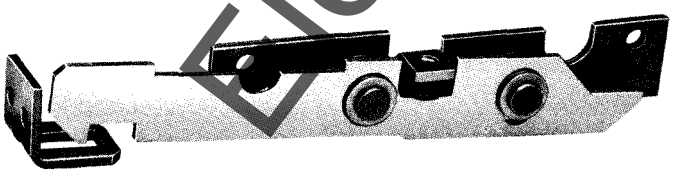
2000A "T" Connector
(For 1600A and 2000A substructures.)
Provides alternate means for bus connecting to the substructure.



Programmer Secondary Disconnect
Required when programmer on breaker has zone selective interlocking.



Shutter Kit
Shutters to cover primary disconnects when breaker is moved to the test position.



Door Interlock Kit
Provides for interlocking door (hinges left or right) such that breaker must be in the disconnect position before door can be opened. Interlock is defeatable for authorized access.

Provisions for Padlocking Breaker in Disconnect Position
Padlock assembly engages with the breaker mounting bracket in the substructure. It prevents the breaker from being moved from the disconnected to the test or connected positions. The padlock slot will accept three, 3/8 inch diameter hasps.

Basic Ratings
AKR LVPCB with MicroVersaTrip® RMS-9 programmer is rated for short-time withstand current and interrupting capacity (rms symmetrical). The maximum short-time rating is shown for 30 cycle duration at 50/60 Hz.

For dc applications, electromechanical EC type trip devices are available for dc ratings up to 250Vdc.

Table 28.1 Summary of Breaker Ratings

Rated Voltage (Nominal) 60 Hz	Breaker Type	Frame Size (Amperes)	Short Circuit Ratings RMS Symmetrical kA Short-Time	With Instantaneous Trip	Without Instantaneous Trip
600	AK-25	600	22	22	22
	AKR-30S	800	22	22	22 ⑤
	AKR-30	800	30	30	30
	AKR-30H		42	42	42
	AKS/AKR-50	1600	42	42	42
	AKS/AKR-50H		65	65	65
	AKST/AKRT-50H	2000	65	65	65
	AKR-75	3200	65	65	65
	AKR-100	4000	85	85	85
480	AK-25	600	22	30	22
	AKR-30S	800	22	30	30 ⑤
	AKR-30	800	30	30	30
	AKR-30H		42	42	42
	AKS/AKR-50	1600	50	50	50
	AKS/AKR-50H		65	65	65
	AKST/AKRT-50H	2000	65	65	65
	AKR-75	3200	65	65	65
	AKR-100	4000	85	85	85
240	AK-25	600	22	42	22
	AKR-30S	800	22	42	42 ⑤
	AKR-30	800	30	42	30
	AKR-30H		42	50	42
	AKS/AKR-50	1600	50	65	50
	AKS/AKR-50H		65	65	65
	AKST/AKRT-50H	2000	65	65	65
	AKR-75	3200	65	85	65
	AKR-100	4000	85	130	85

① 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 fuses should be used for proper coordination.
② Fuses are mounted on separate fuse roll-out element.
③ Refer to time-current curves GES-6000 (for EC-1) and GES-6005 (for EC-1B).
④ Observe Table 5 minimum overcurrent trip ratings.
⑤ Only dual ratio sensors are available on AKR-30S when programmers are furnished with High-Range Instantaneous or Triple Selective Trip.
⑥ Triple Selective Trip at 1X short-time rating when standard Instantaneous Trip is omitted.

Table 28.2 — Overcurrent Trip Device Current Ratings in Amperes

Breaker Frame	MicroVersaTrip® RMS-9 50/60 Hz ac Sensor Rating Amps (s)	Rating Plug Amps (x)	EC Device Rating dc ④
AK-25	Tapped 70, 100, 150, 225 200, 300, 400, 600	Fixed Plug Rating Equals Sensor Tap	40, 50, 70, 90, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 500, 600
AKR-30S, AKR-30 AKR-30H	150	60, 80, 100, 125, 150	NOT AVAILABLE ON AKR-30S 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 500, 600, 800
	400	150, 200, 225, 250, 300, 400	
	800	300, 400, 500, 600, 700, 800	
AKR-50 AKR-50H	800	300, 400, 500, 600, 700, 800	200, 225, 250, 300, 350, 400, 500, 600, 800, 1000, 1200, 1600, 2000
	1600	600, 800, 1000, 1200, 1600	
AKRT-50H	2000	800, 1000, 1200, 1500, 1600, 2000	—
AKR-75	3200	1200, 1000, 2400, 3200	2000, 2500, 3000, 4000
AKR-100	4000	1500, 2000, 2500, 3000, 4000	2000, 2500, 3000, 4000, 5000, 6000

x = Rating plug amps s = Sensor amp rating

Table 28.3 Fused Breaker Ratings — Maximum 600V ac 50/60 Hz

Breaker Type	Frame Size Amperes	Fuse Rating Amperes ① Min.	Max.	Interrupting Rating RMS Symmetrical kA
AKU-25	600	300	1200	200
AKRU-30S	800	300	1600	200
AKRU-30	800	300	1600	200
AKRU-50	1600	450	2500	200
AKRU-75 ②	3200	2000	3000	200
AKR-100 ②	4000	2000	4000	200

Table 28.4 250V dc Current Ratings — with EC Trip Device Only

Breaker Type	Frame Size Amperes	Short Circuit kA
AK-25	600	25
AKR-30	800	25
AKR-50	2000	50
AKR-75	4000	75
AKR-100	6000	100

Table 28.5 Minimum EC Trip Ratings — Amperes at 250V dc

Breaker Type	With Instantaneous Trip	With Short-Time Trip Characteristic ③ 2C	2B	2A
AK-25	40	175	200	250
AKR-30	100	175	200	250
AKR-50	200	350	400	500
		2CC	2BB	2AA
AKR-75 AKR-100	2000	2000	2000	2000

Temperature Derating Factors

The continuous current rating of AKR breakers is based on their use in an *enclosure in a 40°C ambient* and on a maximum breaker temperature of 105°C 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 29.1 Continuous Current Derating Factors

Ambient Temperature	Derating Factor
40°C	1.00
45°C	.95
50°C	.89
55°C	.84 (MicroVersaTrip Maximum)
60°C	.77
65°C	.71
70°C	.63

Altitude Correction Factors

When applying low voltage power circuit breakers at altitudes greater than 6600 ft., 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. The short-time and short circuit current ratings are not affected by altitude. However, the short circuit current rating shall not exceed that of the voltage class prior to derating.

Rating correction factor for low voltage power circuit breakers are as listed in ANSI C37.13.1981.

Table 29.2 Altitude Correction Factors

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

Standards and Testing

Type AKR low voltage power circuit breakers are designed to meet ANSI standards C37.13 and C37.16 and are tested to ANSI C37.50 and C37.14. The breakers are UL listed and labeled certifying compliance with the referenced ANSI standards.

The test circuit X/R ratio and power factor required by ANSI C37.13 for unfused breakers is 6.6 with 15% power factor; for fused breakers is 4.9 with 20% power factor.

Table 29.3 Interrupting Capacity Multiplying Factors for Power Factor Lower than Test Values

System Short Circuit Power Factor %	System X/R Ratio	Multiplying Factor for Breaker Short Circuit Rating	
		Unfused LVPCB	Fused LVPCB
20	4.9	1.00	1.00
15	6.6	1.00	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	20.0	0.875	0.794

Humidity and Fungus

Ferrous parts are cadmium or zinc plated for corrosion protection with the exception of some parts that are made from alloy steels and are inherently corrosion resistant.

Current-carrying parts are silver or tin plated for corrosion protection and to assure electrical connections.

Tropical treatment is available and consists of the application of a fungus resistant varnish to those insulating materials that are not inherently fungus proof.

Table 30.1
Current Sensor Ratios

Breakers [1]	Sensor Ampere Rating	Sensor Turns Ratio	Secondary Output Current at Rated Input Current
AKR-30S AKR-30, 30H AKR-50, AKRT-50H	Fixed 150 800 1600 2000	750:1 4000:1 8000:1 10000:1	200 mA
AKR-75 AKR-100	Fixed 3200 4000	8000:1 10000:1	400 mA

[1] See Table 28.2 page 28 for applicable sensors.

Table 31.1
Gould-Shawmut —
GE AKRU Fused Breaker Fuse Cross Reference

Fuse Class	Ampere Rating	Obsolete General Electric Cat. No.	Gould, Inc. Equiv. Cat. No.
J	150	GF8B150	A4J150
	200	200	200
	225	225	225
	250	250	250
	300	300	300
	350	350	350
	400	400	400
	450	450	450
	500	500	500
	600	GF8B600	A4J600
L	601	GF8B601	A4BY601
	650	650	650
	700	700	700
	800	800	800
	1000	1000	1000 BG ①
	1200	1200	1200 BG ①
	1400	1400	—
	1600	1600	1600 BG ①
	2000	2000	2000
	2500 STD	GF8B2500	A4BY2500
	2500 SPEC	GF9F2500 AK ②	A4BX2500 GE ②
	3000	GF8F3000	A4BY3000 ③
	4000	GF8F4000	A4BY4000 ④

① Suffix or type BG denotes cut-out on tang.
② Not class L fuse — this is a special "limiter" in size and electrical properties (has only short circuit protection).
③ Used on TAK8SS02 fuse carriage.
④ Used on TAK9SS02 fuse carriage.

General Electric Type J and L fuses are now obsolete, and no longer used in type AKRU low-voltage power circuit breakers. Gould-Shawmut fuses are now used. The chart cross-references the obsolete GE catalog number and the replacement Gould-Shawmut catalog numbers.

Table 31.2
Gould-Shawmut —
GE Special "Welder" Limiters
for AKRU-30, -50 Circuit Breakers

Ampere Rating	Obsolete GE Cat. No.	Gould, Inc. Equiv. Cat. No.
800	GF30W8	A4BX800
1000	GF30W10	A4BX1000 BG ②
1200	GF30W12	A4BX1200 BG ②
1600	GF30W16	A4BX1600 BG ②
2000	GF30W20	A4BX2000

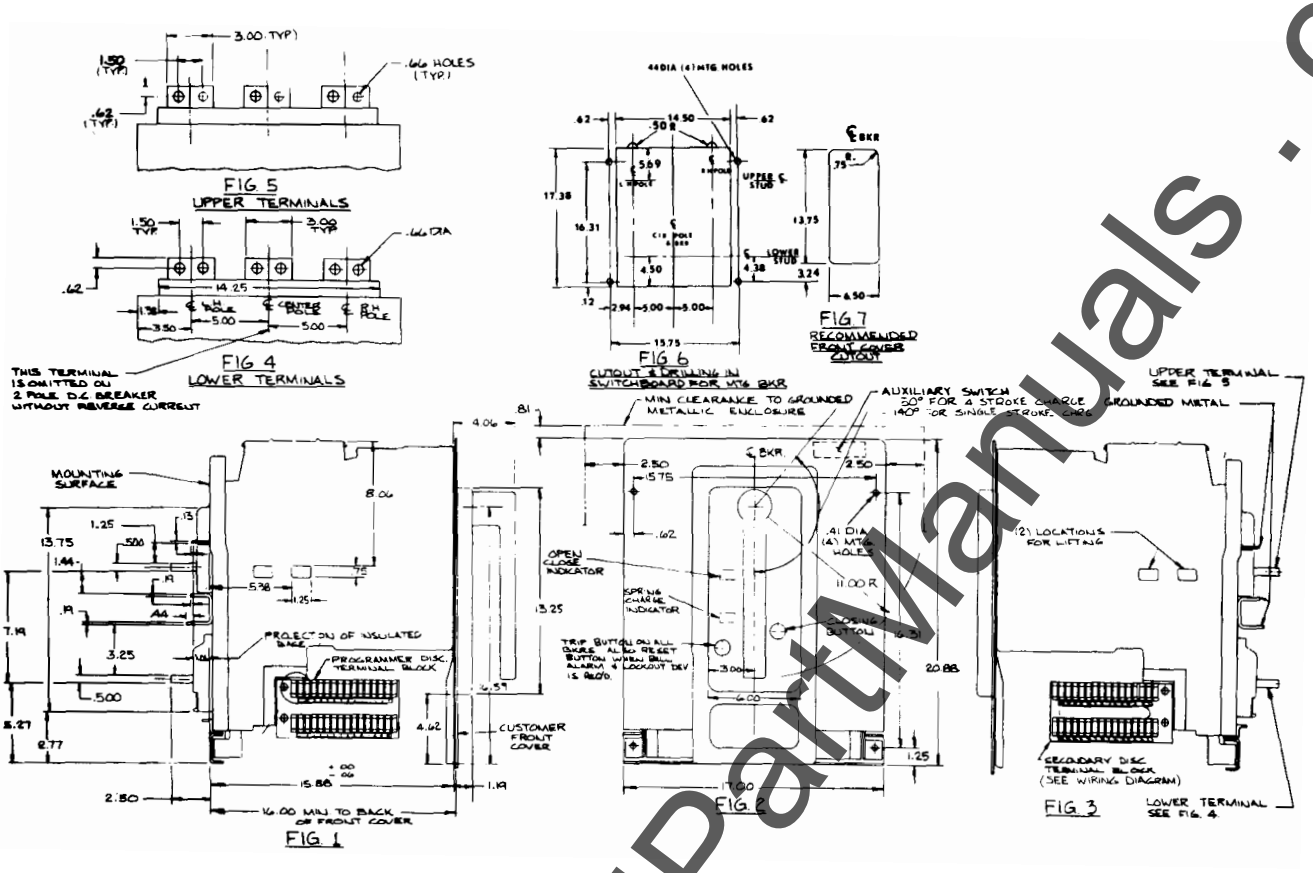
① The "limiters" are identical in size to the standard class L fuses; however they provide only short circuit protection. No overcurrent protection is provided.
② Suffix or type BG denotes cut-out on fuse tang.

Table 31.3
Allowable Fuse Sizes

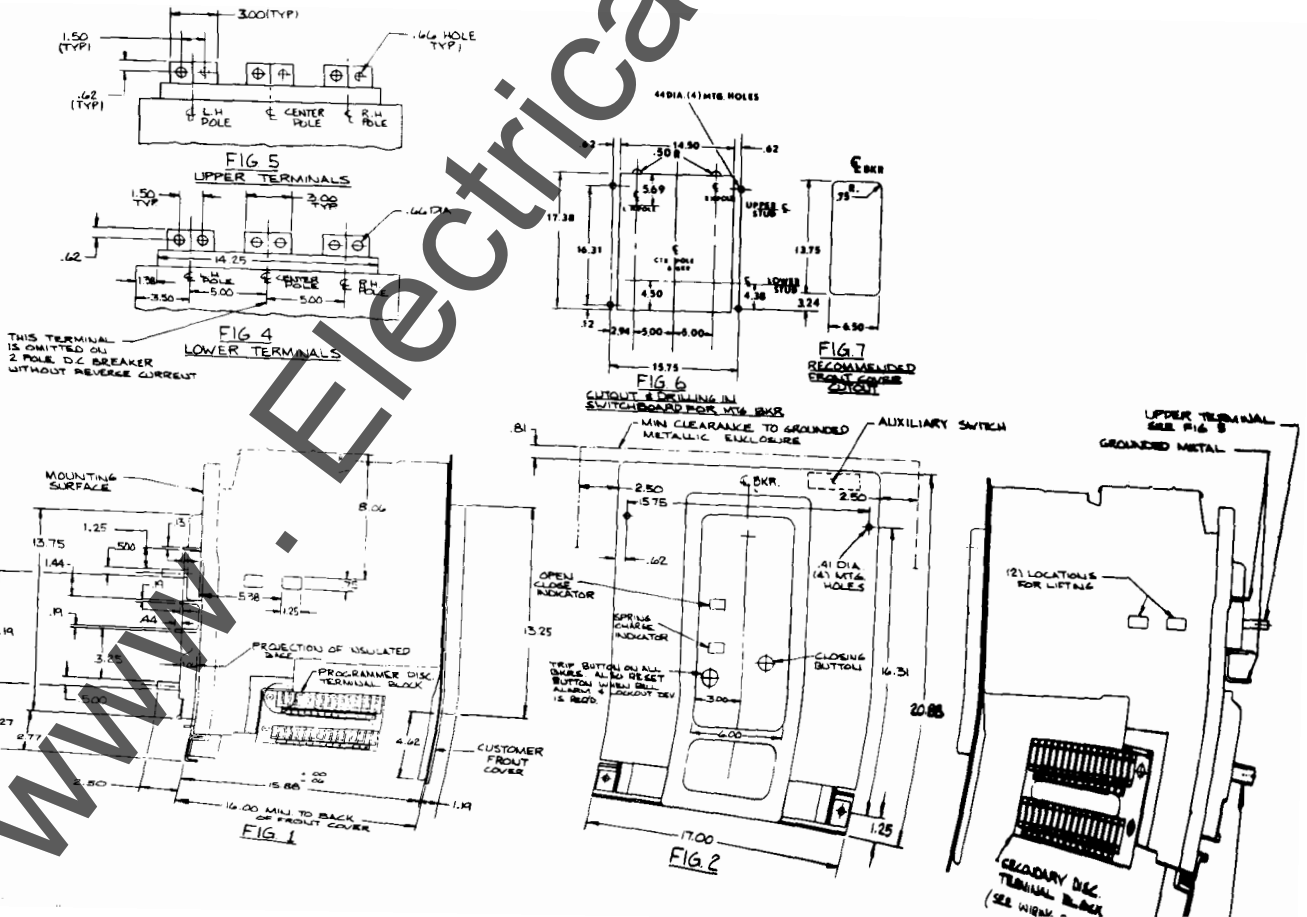
Breaker Type	Frame Size	Rating Plug Rating	Maximum Gould-Shawmut Class "L" Fuse Size	Minimum Gould-Shawmut Class "L" Fuse	Minimum Gould-Shawmut Class "J" Fuse
AKU-25	600A	600A and Below	1200A	800A	300A
AKRU-30, 30S	800A	800A	1600A	1000A	—
		700A	1600A	800A	—
		600A	1600A	800A	600A
		400A	1600A	—	400A
		300A	1600A	—	300A
		225A and Below	1600A	—	300A
AKRU-50	1600A	1600A	2500A	2500A	—
		1200A	2500A	1600A	—
		1000A	2500A	1000A	—
		800A	2500A	800A	—
		700A	2500A	700A	—
		600A	2500A	—	600A
		500A	2500A	—	500A
		400A and Below	2500A	—	450A
AKRU-75	3200A	3200A and Below	3000A	2000A	—
AKRU-100	4000A	4000A and Below	4000A	2000A	—

Outline Drawings Continued

AKR-( )S 50 Manual



AKR-( )S 50 Electric



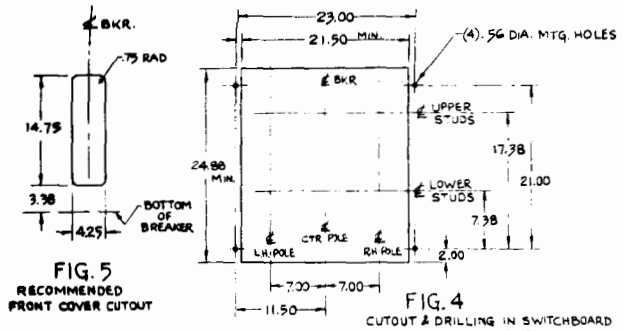


FIG. 5
RECOMMENDED FRONT COVER CUTOUT

FIG. 4
CUTOUT & DRILLING IN SWITCHBOARD FOR MOUNTING BREAKER

PT NO.	UPPER STUD	LOWER STUD
1	VERT.	VERT.
2	HOR.	HOR.
3	VERT.	HOR.
4	HOR.	VERT.

NOTE 2 - PT 4 (UPPER STUD HOR. - LOWER STUD VERT.) IS FURNISHED UNLESS OTHERWISE SPECIFIED

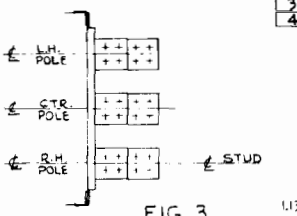
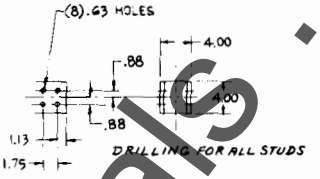


FIG. 3



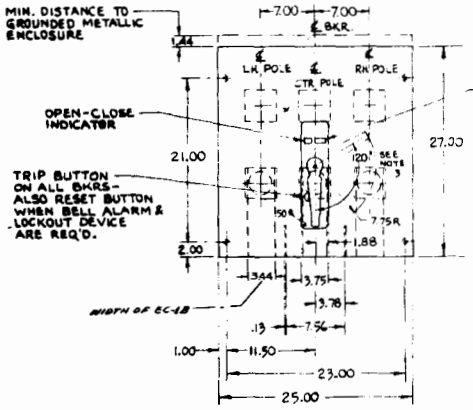


FIG. 2

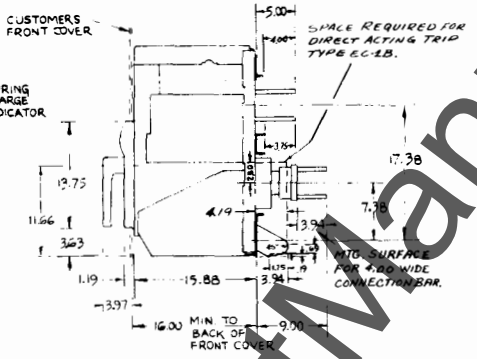


FIG. 1

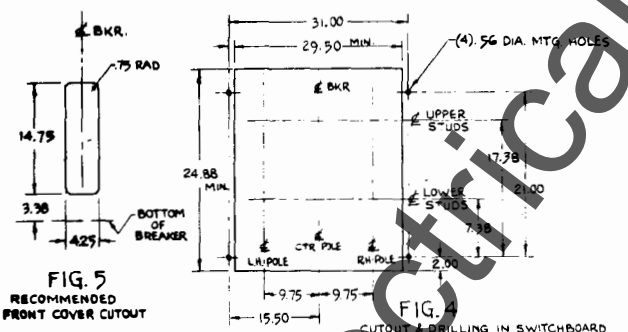


FIG. 5
RECOMMENDED FRONT COVER CUTOUT

FIG. 4
CUTOUT & DRILLING IN SWITCHBOARD FOR MOUNTING BREAKER

PT NO.	UPPER STUD	LOWER STUD
1	VERT.	VERT.
2	HOR.	HOR.
3	VERT.	HOR.
4	HOR.	VERT.

NOTE 2 - PT 4 (UPPER STUD HOR. - LOWER STUD VERT.) IS FURNISHED UNLESS OTHERWISE SPECIFIED

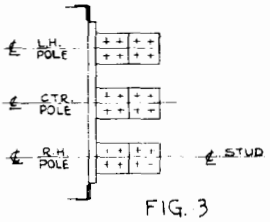
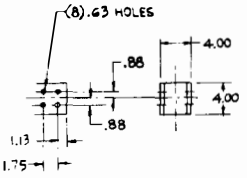


FIG. 3



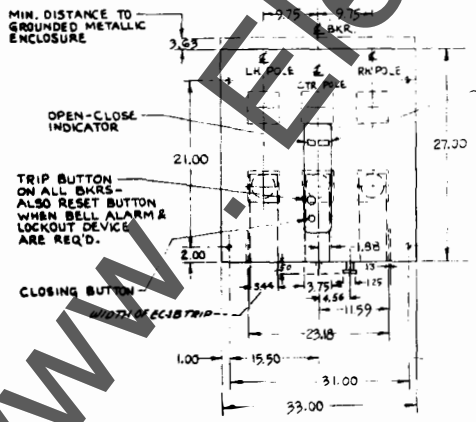


FIG. 2

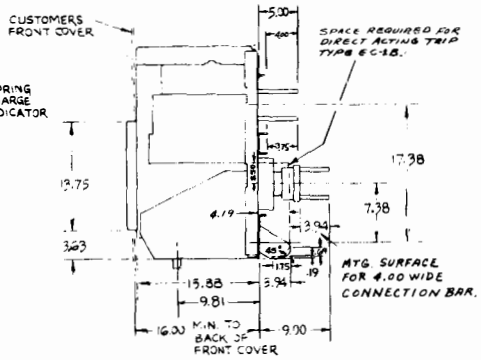
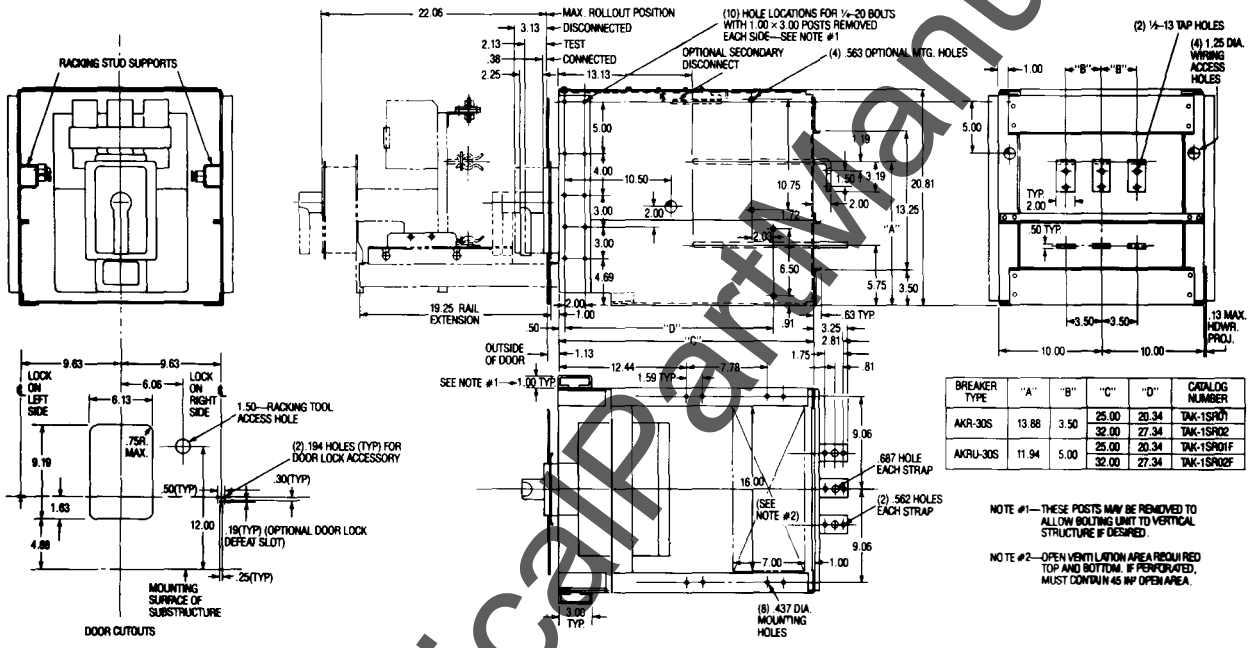


FIG. 1

Outline Drawings
Continued

Draw Out Breaker Substructure Drawings
Substructure outline drawings shown are for breakers with MicroVersaTrip® RMS-9 trips. Refer to page 57 for a complete list of other outlines available.

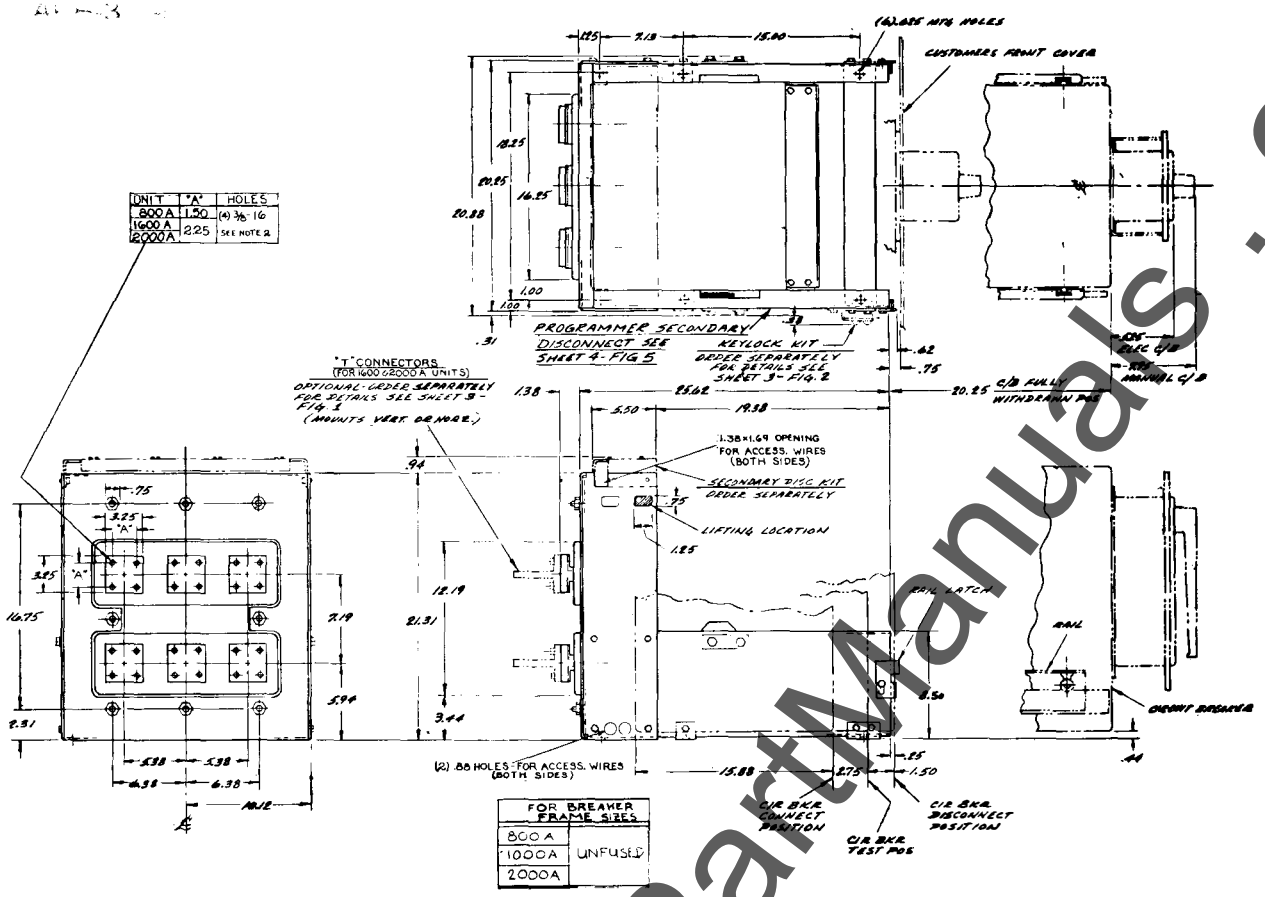
(AKR-30S)

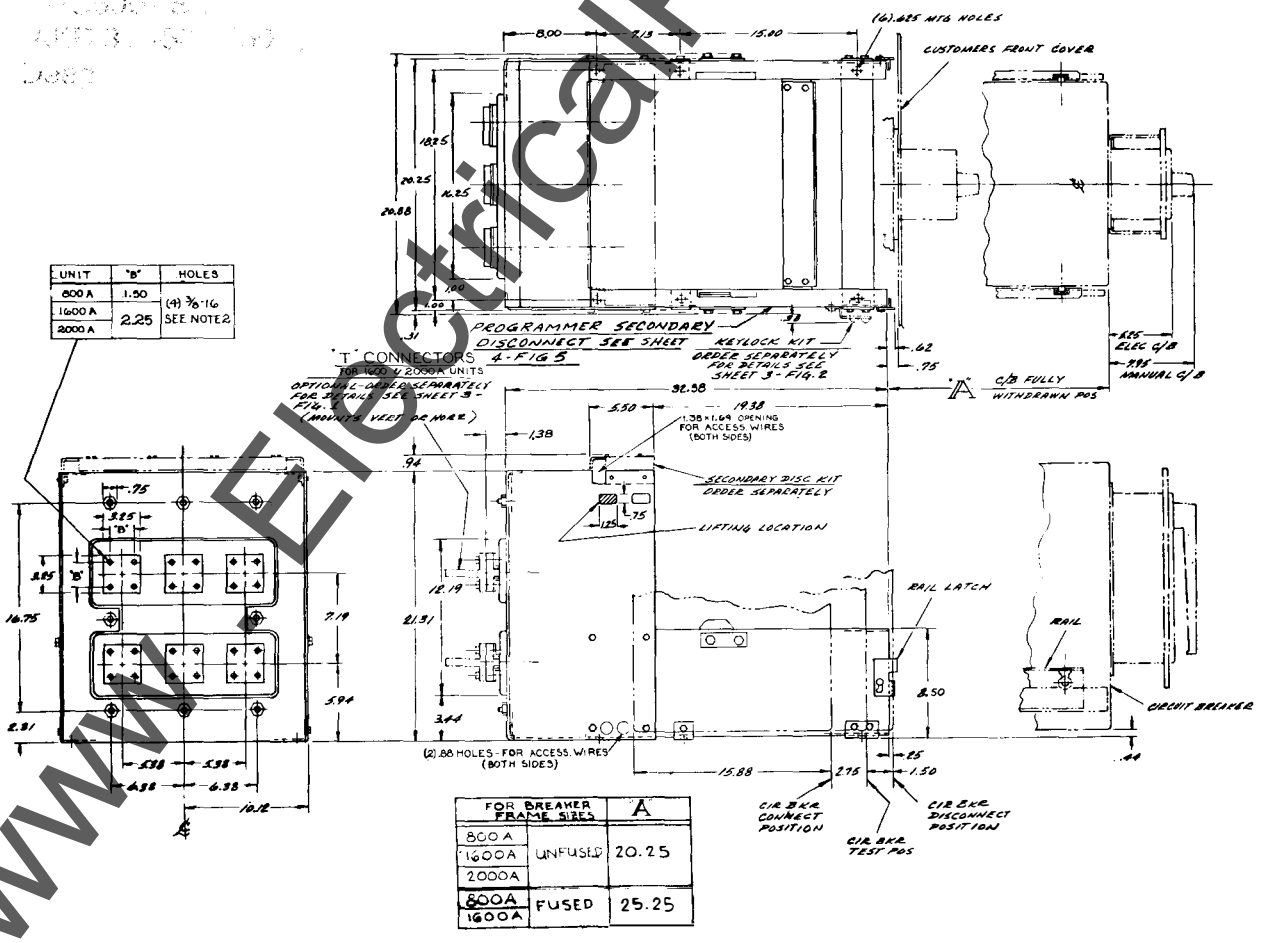


BREAKER TYPE	"A"	"B"	"C"	"D"	CATALOG NUMBER
AKR-30S	13.88	3.50	25.00	20.34	TAK-1SR01
			32.00	27.34	TAK-1SR02
AKRU-30S	11.94	5.00	25.00	20.34	TAK-1SR01F
			32.00	27.34	TAK-1SR02F

NOTE #1—THESE POSTS MAY BE REMOVED TO ALLOW BOLTING UNIT TO VERTICAL STRUCTURE IF DESIRED.

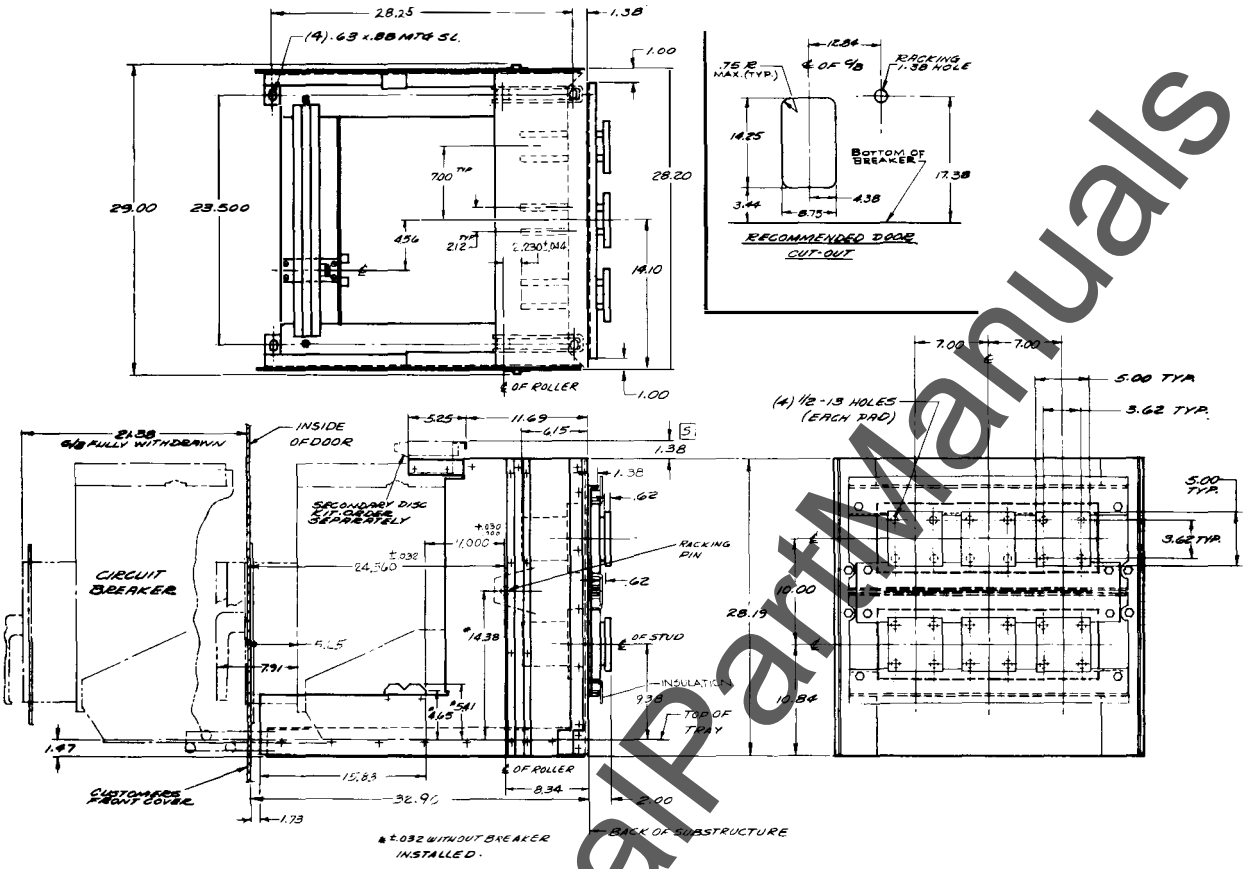
NOTE #2—OPEN VENTILATION AREA REQUIRED TOP AND BOTTOM. IF PERFORATED, MUST CONTAIN 45 IN² OPEN AREA.





Outline Drawings
Continued

AKR-75, -100



Type AKR	Dimension Drawing Number
AKR-6D-30S Manual, Electric	139C5317
AKRU-6D-30S Manual, Electric	139C5318
AKR-6S-30S Manual, Electric	139C5319
AKR-6D-30 Manual	139C4976
AKR-ND-30 Manual	139C4976
AKR-6D-30H Electric	139C4975
AKR-ND-30H Electric	139C4975
AKRU-6D-30 Manual	139C4980
AKRU-6D-30 Electric	139C4979
AKR-6S-30 Manual	139C5073
AKR-NS-30 Manual	139C5073
AKR-6S-30H Electric	139C5074
AKR-NS-30H Electric	139C5074
AKR-6D-50 Manual	139C4978
AKR-ND-50 Manual	139C4978
AKR-6D-50H Electric	139C4977
AKR-ND-50H Electric	139C4977
AKRU-6D-50 Manual	139C4982
AKRU-6D-50 Electric	139C4981
AKRU-6D-50 Manual	139C4984
AKRU-6D-50 Electric	139C4983
AKR-6S-50 Manual	139C5075
AKR-NS-50 Manual	139C5075
AKR-6S-50H Electric	139C5076
AKR-NS-50H Electric	139C5076
AKRT-6D-50H Manual	139C4978
AKRT-ND-50H Electric	139C4977
AKRT-6S-50H Manual	139C5075
AKRT-NS-50H Electric	139C5076
AKR-6F-75 Manual	139C4572
AKR-NF-75 Electric	139C4573
AKR-6S-75 Manual	139C4560
AKR-NS-75 Electric	139C4563
AKR-6F-100 Manual	139C4574
AKR-NF-100 Electric	139C4575
AKR-6S-100 Manual	139C4560
AKR-NS-100 Electric	139C4563
AKR-2D-30 Manual	139C4999
AKR-ND-30D Electric	139C5000
AKR-2S-30 Manual	139C5073
AKR-NS-30D Electric	139C5074
AKR-2D-50 Manual	139C4997
AKR-ND-50D Electric	139C4998
AKR-2S-50 Manual	139C5075
AKR-NS-50D Electric	139C5076
AKR-2F-75 Manual	139C4572
AKR-NF-75D Electric	139C4573
AKR-2S-75 Manual	139C4560
AKR-NS-75D Electric	139C4563
AKR-2F-100 Manual	139C4574
AKR-NF-100D Electric	139C4575
AKR-2S-100 Manual	139C4560
AKR-NS-100D Electric	139C4563

Draw Out Substructure	Dimension Drawing Number
TAK1SR01	75C149359
TAK1SR01F	75C149359
TAK1SR02	75C149359
TAK1SR02F	75C149359
TAK3SR01	139C5001SH1,3,4
TAK3SRH1	139C5001SH1,3,4
TAK3SR01D3	139C5001SH1,3,4
TAK3SR02	139C5001SH2,3,4
TAK3SRH2	139C5001SH2,3,4
TAK3SR02D3	139C5001SH2,3,4
TAK3SRF2	139C5001SH2,3,4
TAK5SR01	139C5001SH1,3,4
TAK5SRH3	139C5001SH1,3,4
TAK5SR01D3	139C5001SH1,3,4
TAK5SR02	139C5001SH2,3,4
TAK5SRH4	139C5001SH2,3,4
TAK5SR02D3	139C5001SH2,3,4
TAK5SRF2	139C5001SH2,3,4
TAK6SRH1	139C5001SH1,3,4
TAK6SRH2	139C5001SH2,3,4
TAK8SS02	139C4595SH1,2
TAK8SS0203	139C4595SH1,2
TAK9SS02	139C4595SH1,2
TAK9SS0293	139C4595SH1,2
General Purpose Enclosures	
AKR-30, AKR-50	245C764
AKR-75, AKR-100	0134C3052
Fuse Rollout Element	
TAK83FCB	139C4584
TAK94FCB	139C4585
Fuse Rollout Substructures	
TAK8SS02FC	139C4898
TAK9SS02FC	139C4585
Metering CT's	
343L693G1 - 343L693G12	193A1253
Neutral Sensors	
TSVG303B - TSVG620B	139C5016SH1
TSVG830B - TSVG940B	139C5016SH2
Substructure Accessories	
343L691G1 T-Connector	139C4455
343L671G1 4 in. Wire Disc.	192A9904

Table 54.1
Shipping Weights (lbs)

Draw Out Breaker Element	Net		Shipping	
	Manual	Electrical	Manual	Electrical
AKR-30S AKRU-30S	70 90	90 110	80 100	100 120
AKR-30 AKRU-30	200 245	205 250	225 275	230 280
AKR-50 AKRU-50	210 255	215 260	235 285	240 290
AKRT-50	215	220	240	245
AKR-75	420	435	470	485
AKR-100 (25″ wide)	525	540	575	590
AKR-100 (33″ wide)	540	555	615	630

Table 54.2
Electrical Formula -- For Obtaining kW, kVA, Horsepower and Amperes

Wanted	Alternating Current Single Phase	Two Phase, Four Wire	Direct Three Phase	Current
Kilowatts	$\frac{I \times E \times PF}{1000}$	$\frac{I \times E \times 2 \times PF}{1000}$	$\frac{I \times E \times 1.73 \times PF}{1000}$	$\frac{I \times E}{1000}$
kVA	$\frac{I \times E}{1000}$	$\frac{I \times E \times 2}{1000}$	$\frac{I \times E \times 1.73}{1000}$	$\frac{I \times E}{1000}$
Horsepower	$\frac{I \times E \times \%\,Eff. \times PF}{746}$	$\frac{I \times E \times 2 \times \%\,Eff. \times PF}{746}$	$\frac{I \times E \times 1.83 \times \%\,Eff. \times PF}{746}$	$\frac{I \times E \times \%\,Eff.}{746}$
Amperes from kVA	$\frac{kVA \times 1000}{E}$	$\frac{kVA \times 1000}{2 \times E}$	$\frac{kVA \times 1000}{1.73 \times E}$	$\frac{kVA \times 1000}{E}$
Amperes from kW	$\frac{kW \times 1000}{E \times PF}$	$\frac{kW \times 1000}{2 \times E \times PF}$	$\frac{kW \times 1000}{1.73 \times E \times PF}$	$\frac{kW \times 1000}{E}$
Amperes from Hp	$\frac{Hp \times 746}{E \times \%\,Eff. \times PF}$	$\frac{Hp \times 746}{2 \times E \times \%\,Eff. \times PF}$	$\frac{Hp \times 746}{1.73 \times E \times \%\,Eff. \times PF}$	$\frac{Hp \times 746}{E \times \%\,Eff.}$

KEY
E = Volts
I = Amperes
% Eff. = Percent Efficiency
PF = Power Factor

Circuit breakers are designed primarily to perform the function of circuit interruption under short-circuit conditions. Nevertheless, modern circuit breaker mechanisms are capable of many operations under full-load operation and in-rush conditions such as encountered in motor starting applications. Industry standards have been established for the minimum performance which is indicated in the table below. 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 given in the following lettered paragraphs. For each column, all paragraphs listed in the column heading must be given consideration. 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 55.1
Repetitive Duty and Normal Maintenance

Circuit Breaker Frame Size (Amperes)	Number of Operations Between Servicing	Number of Operations Related Continuous Current Switching (A) (C) (D) (E) (F) (G) (H) and (J)	Number of Operations No-Load Closing and Opening (A) (B) (C) (D) (E) (F) and (G)	Number of Operations In-Rush Current Switching (C) (D) (E) (F) (G) (I) and (J)
225	2500	4000	10000	2000
800	1750	2800	9700	1400
1600	500	800	3200	400
2000	500	800	3200	400
3200	250	400	1100	—
4000	250	400	1100	—

(A) 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.

(B) When closing and opening no-load.

(C) With rated control voltage applied.

(D) Frequency of operation not to exceed 20 in ten minutes or 30 in an hour. Rectifiers or other auxiliary devices may further limit the frequency of operation.

(E) Servicing at no greater intervals than shown in second column above.

(F) No functional parts should have been replaced during the listed operations.

(G) The circuit breaker should be in a condition to carry its rated continuous current at rated maximum voltage and perform at 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.

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

(I) When 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.

When closing currents up to 600% 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 shall be reduced to 10% of the number listed.

(J) If a fault operation occurs before the completion of the listed operations, servicing is recommended and possible functional part replacements may be necessary, depending on previous accumulated duty, fault magnitude, and expected future operations.

Transformer Short Circuit Current Curves

Fig. 56.1 Transf: 500kVA, 208V, 4.5%Z

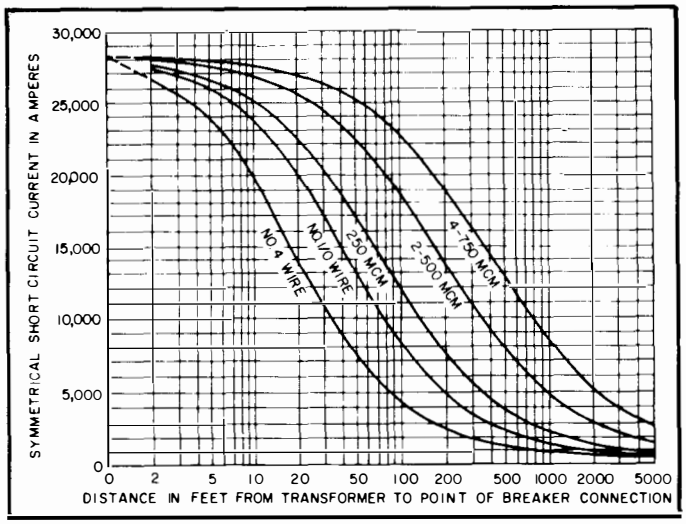


Fig. 56.2 Transf: 500kVA, 240V, 4.5%Z

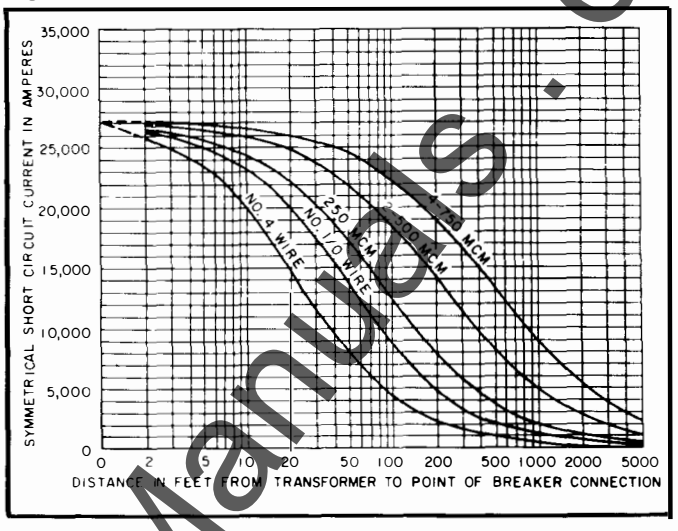


Fig. 56.3 Transf: 500kVA, 480V, 4.5%Z

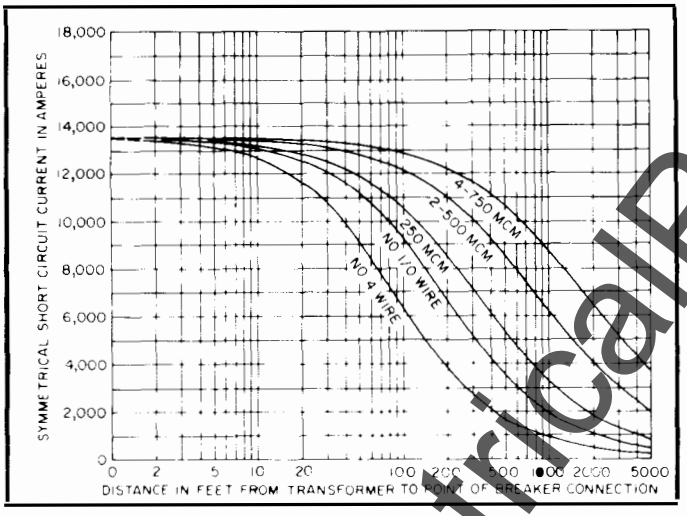


Fig. 56.4 Transf: 500kVA, 600V, 4.5%Z

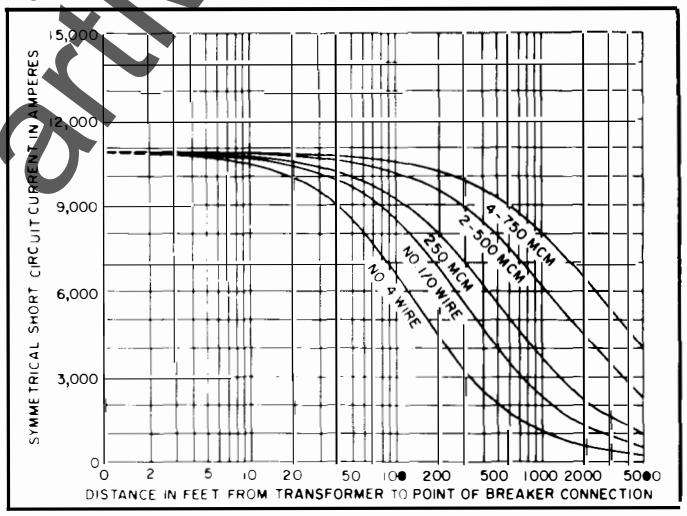


Fig. 56.5 Transf: 750kVA, 208V, 5.75%Z

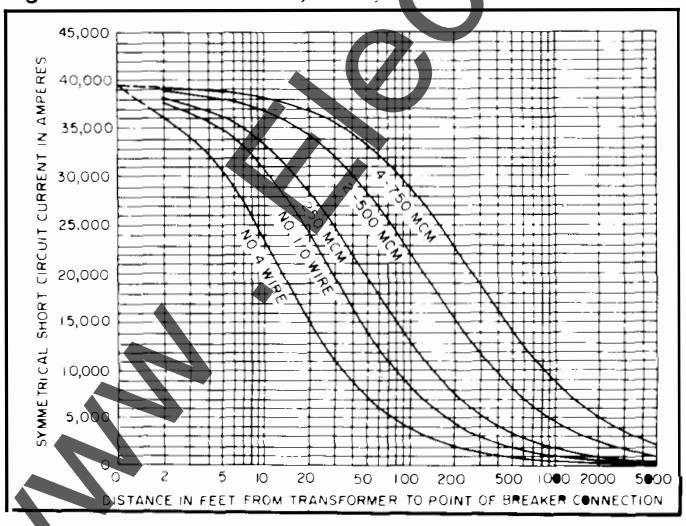


Fig. 56.6 Transf: 750kVA, 240V, 5.75%Z

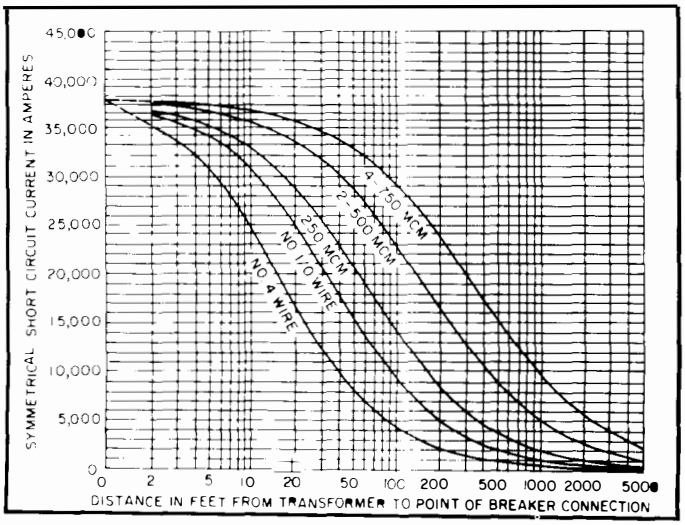


Fig. 57.1 Transf: 750kVA, 480V, 5.75%Z

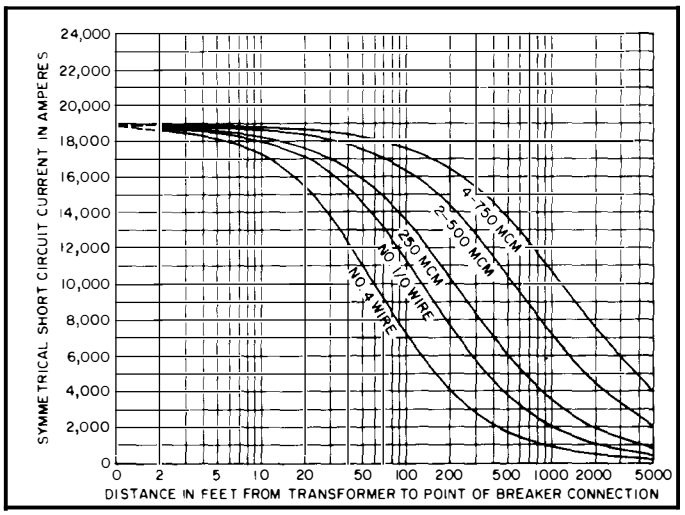


Fig. 57.2 Transf: 750kVA, 600V, 5.75%Z

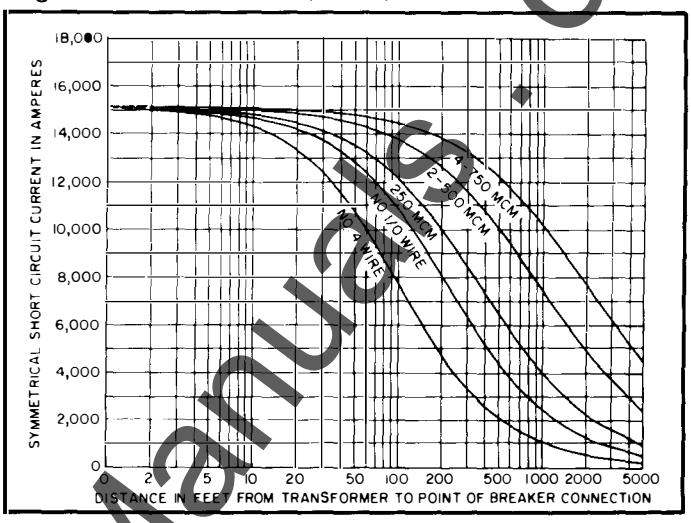


Fig. 57.3 Transf: 1000kVA, 208V, 5.75%Z

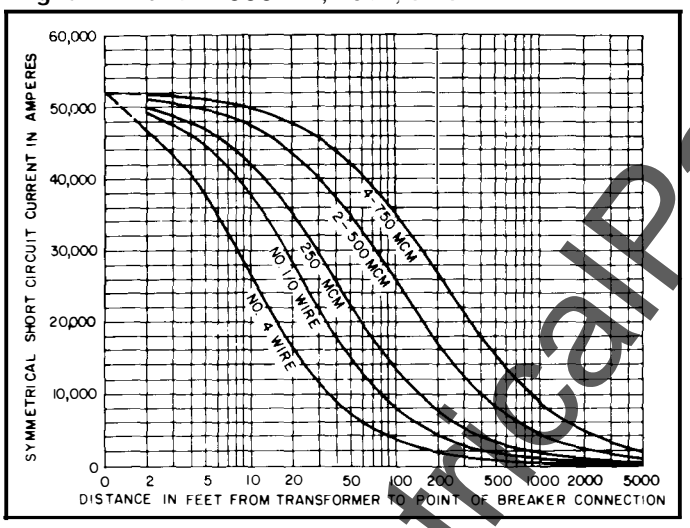


Fig. 57.4 Transf: 1000kVA, 240V, 5.75%Z

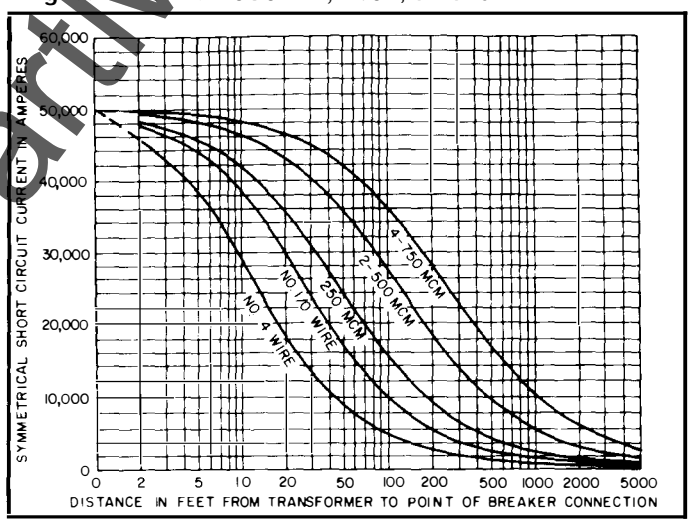


Fig. 57.5 Transf: 1000kVA, 480V, 5.75%Z

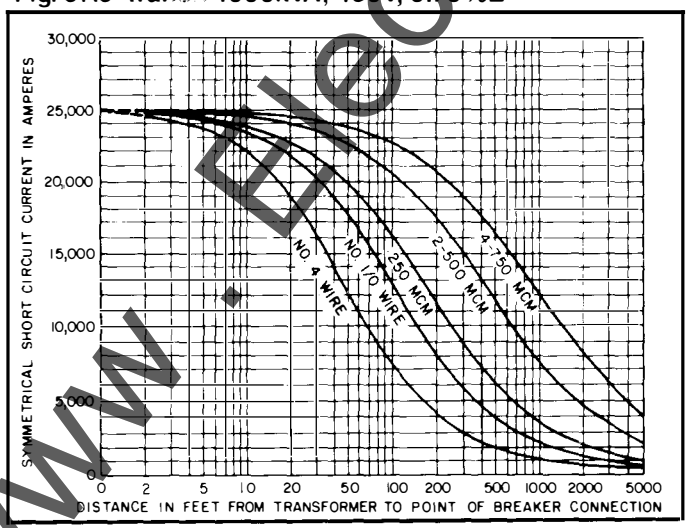
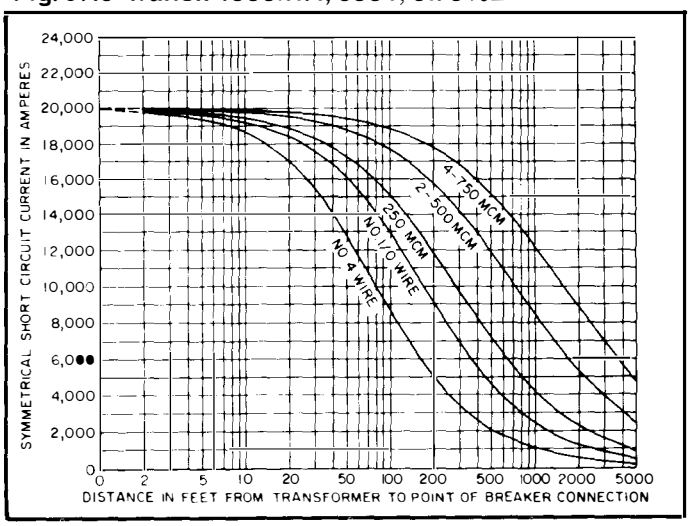


Fig. 57.6 Transf: 1000kVA, 600V, 5.75%Z



Transformer Short Circuit Current Curves
Continued

Fig. 58.1 **Transf: 1500kVA, 208V, 5.75%Z**

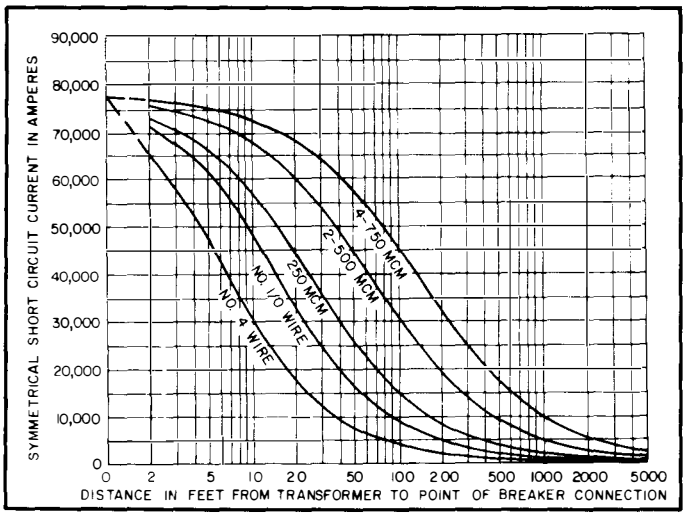


Fig. 58.2 **Transf: 1500kVA, 240V, 5.75%Z**

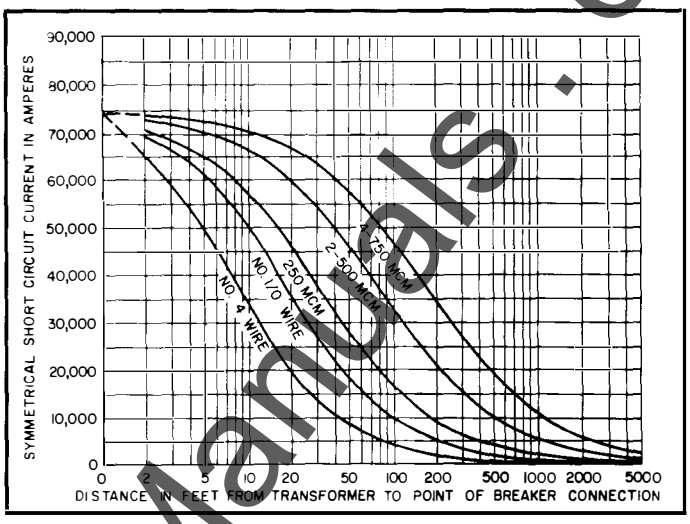


Fig. 58.3 **Transf: 1500kVA, 480V, 5.75%Z**

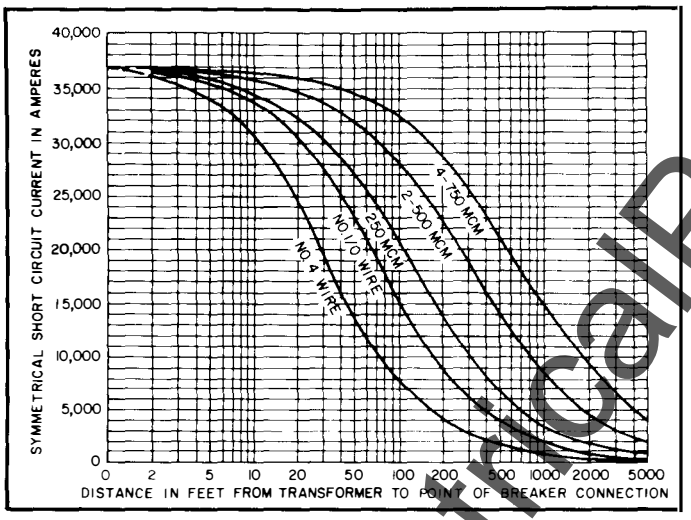


Fig. 58.4 **Transf: 1500kVA, 600V, 5.75%Z**

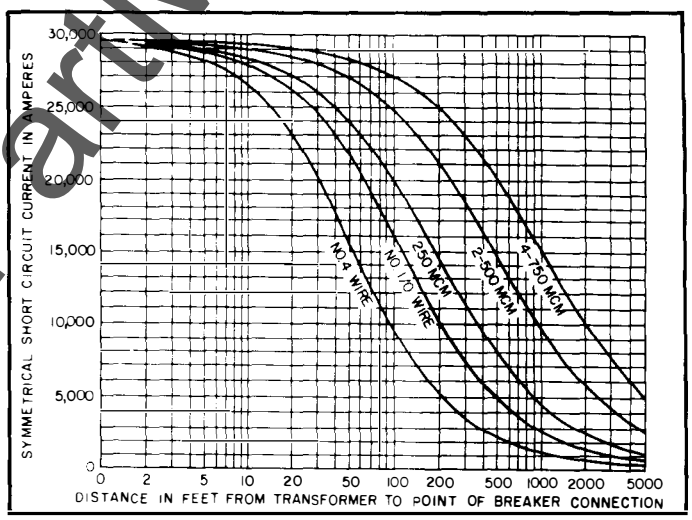


Fig. 58.5 **Transf: 2000kVA, 480V, 5.75%Z**

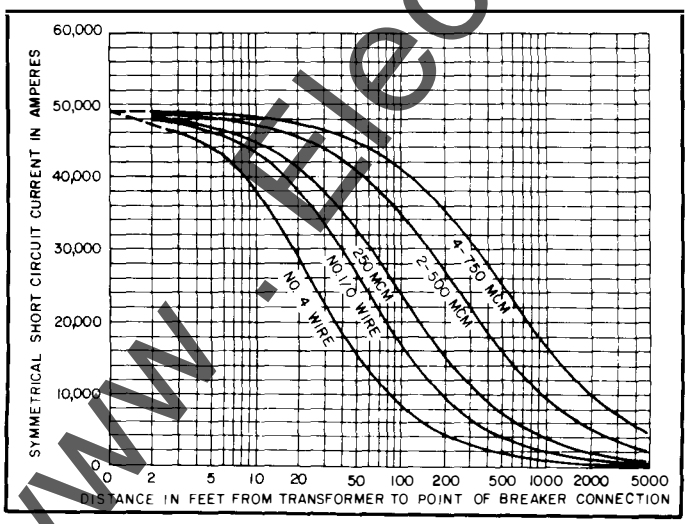
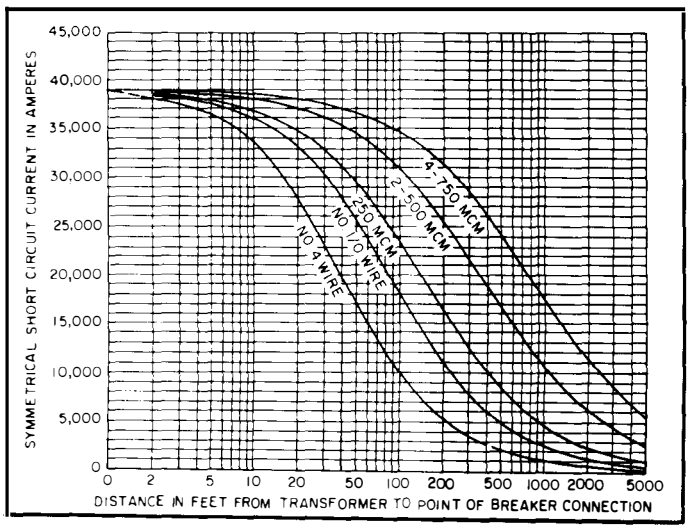


Fig. 58.6 **Transf: 2000kVA, 600V, 5.75%Z**



American National Standards Institute (ANSI)

In Enclosures, Low-Voltage AC Power Circuit Breakers Used, ANSI / IEEE C37.13-1981.

In Enclosures, Test Procedures for Low-Voltage AC Power Circuit Breakers Used, ANSI C37.50-1981.

Low-Voltage AC Non-Integrally Fused Power Circuit Breakers (Using Separately Mounted Current-Limiting Fuses), Application Guide for, ANSI / IEEE C37.27-1972.

Low-Voltage DC Power Circuit Breakers Used in Enclosures, ANSI / IEEE C37.14-1979.

Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors, Preferred Ratings, Related Requirements and Application Recommendations for, ANSI / IEEE C37.16-1980.

Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies, Conformance Testing of, ANSI C37.51-1979.

Trip Devices for AC and General Purpose DC Low-Voltage Power Circuit Breakers, ANSI C37.17-1979.

Order from:

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

National Electrical Manufacturers Association (NEMA)

SG-3 1971 Low-Voltage Power Circuit Breakers

Order from:

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

Institute of Electrical and Electronics Engineering (IEEE)

No. 45 Recommended Practice for Electrical Installation on Shipboard.

Order from:

IEEE Service Center
445 Hoes Lane
Piscataway, New Jersey 08854

National Electrical Code (NEC)

1984 Issue.

Order from:

National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

Guide Form Specifications

General

The individually mounted low voltage power circuit breaker shall consist of an electrically and mechanically trip-free circuit breaker element.

The circuit breaker shall be of the draw-out type capable of being racked to the disconnect position with the door closed.

The circuit breaker shall meet ANSI C37.13, C37.16 and C37.50 and be UL listed.

Interlocks will be provided to prevent connecting or disconnecting the circuit breaker unless the breaker is open. The breaker shall be prevented from being closed during any racking operation. A test position shall be provided to permit operating the breaker while it is disconnected from the power circuit.

MicroVersaTrip RMS-9 trip devices shall include:

- True rms current sensing for long time characteristics.
- Time current characteristic adjustments of the fixed-point type, gold plated for maximum reliability and setting accuracy.
- All internal solid-state circuitry of epoxy conformal coated to resist environmental contamination.
- Rating plugs for application flexibility.
- Adjustable current setting of 0.5 to 1.1 of sensor tap.
- Adjustable long-time delay with four bands.
- Integral long-time timing light.
- Adjustable instantaneous.
- Integral test provisions.

Optional characteristics

- True rms sensing for short time characteristics
- Short-time pick up and delay with I^2t in or out
- High range instantaneous
- Ground fault pick up and delay with I^2t in or out
- Self-powered overload, short circuit, and ground fault target indicators that continue to give indication even when control power has been lost
- Zone selective interlocking

Detailed

- This specification covers General Electric Company low voltage power circuit breakers, types AKR, AKRT, or AKRU.
- The continuous current frame ratings shall be 800, 1600, 2000, 3200, 4000.
- Circuit breakers shall be manually or electrically operated.
- Control voltage for electrically operated breakers shall be: _____
- Volts:
  AC _____ Cycles _____
  3ϕ-3W _____ 3ϕ-4W _____
- Circuit breakers rms symmetrical interrupting ratings:
  240VAC kA _____
  480VAC kA _____
  600VAC kA _____
  250VDC kA _____
- Overcurrent trip devices shall be solid-state type MicroVersaTrip® RMS-9.
- Each solid-state trip unit shall be equipped with the following field adjustable time current characteristics.
  —Adjustable current, and long-time delay
  —Integral long-time timing light
  —Instantaneous, standard or high range
  —Short-time pick up and delay with I^2t in or out
  —Ground fault pick up and delay with I^2t in or out
  —Target indicators, overload, short-circuit, and ground fault
- Each circuit breaker shall be equipped with the following accessories:
  —Shunt trip—Voltage _____
  —Undervoltage release—
  Voltage _____
  —Undervoltage release with time delay—
  Voltage _____
  —Overload bell alarm switch
  —Lockout device
  —Auxiliary Switch:
  Number of contacts:
  Normally open "a" type _____
  Normally closed "b" type _____
  —Operation counter
- Portable MicroVersaTrip RMS-9 test kit

Other AKR Circuit Breaker Publications

General Installation and Maintenance

GEH-5019	AKR-30S, AKRU-30S
GEK-64459	AKR-30/50/T50
GEK-64460	AKR-75/100 and AKS-50
GEI-50299	AK-25
GEK-7303	AK-50, AKT-50, AK-75, -100
GEI-86135	ECS/SST Supplement
GEK-7310	AKR-3/3A-50

Installation and Operating Installations

GEK-7302	AK-25/50, AKT-50, AK-75/100
GEI-86150	AKR-30/50, AKRT-50
GEI-86151	AKR-75/100
GEI-86160	AKS-50, AKST-50
GEI-86157	ECS, 1B, 2A Trip Devices

Testing Instructions

GEK-64464	MicroVersaTrip Test Set TVTS1
GEK-73300	ECS/SST Test Set TAK-TS2
GEK-64454	ECS/SST Test Set TAK-TS1
GEK-7309	Power Sensor High Current Testing
GEK-7301	Power Sensor Test Set

Renewal Parts

GEF-4527	AKR-30/50/T50
GEF-4552	AKR-75/100
GEF-4149	AK-25
GEF-4150	AK-50
GEF-4395	AK-75
GEF-4396	AK-100