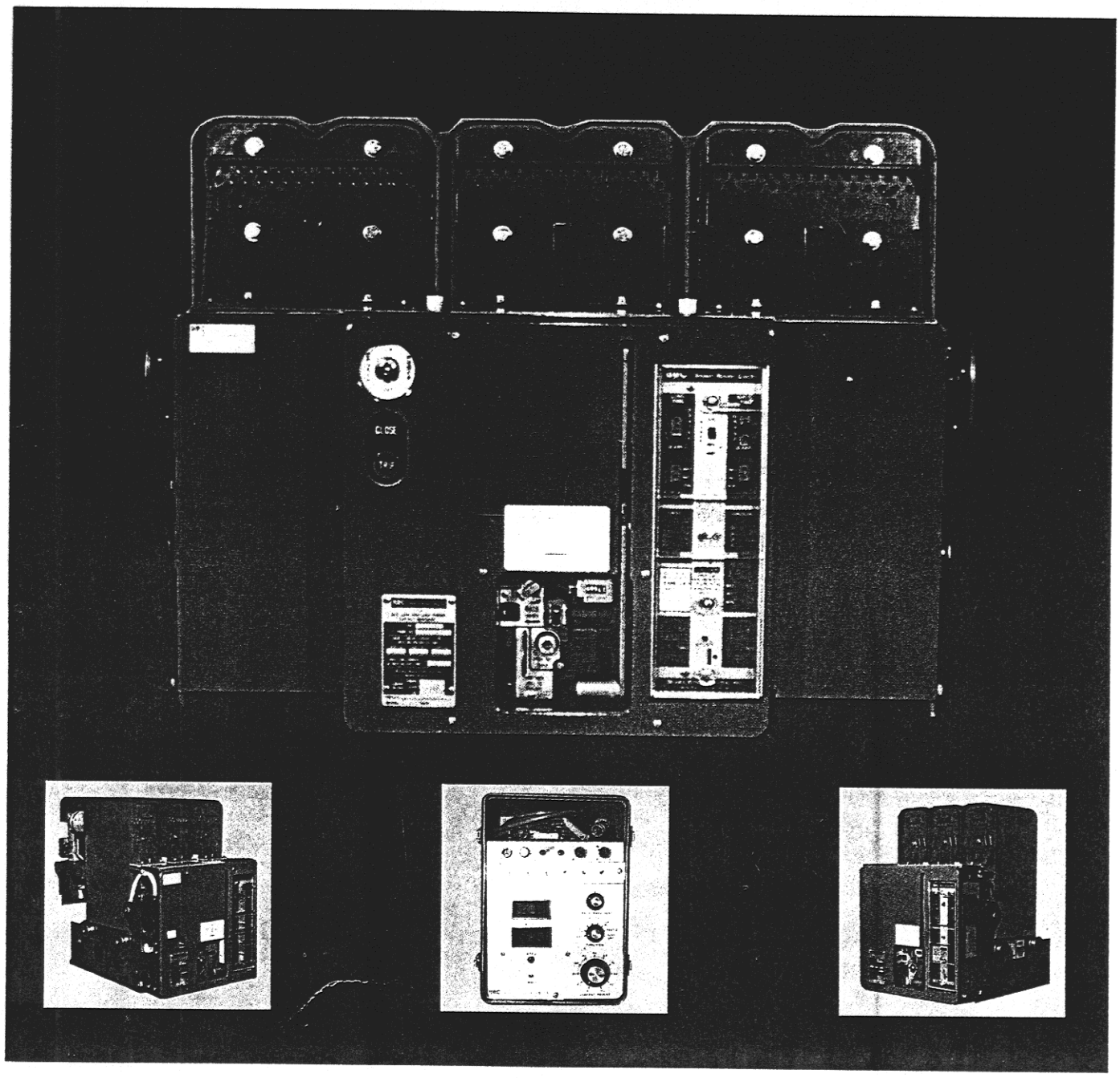
BBC
BROWN BOVERI

I-T-E Type LK Low Voltage AC Power Circuit Breakers

208 thru 600 VAc
up to 4200 A. Continuous
30 thru 200 kA IC

Bulletin 6.1.1-1B



Brown Boveri Electric

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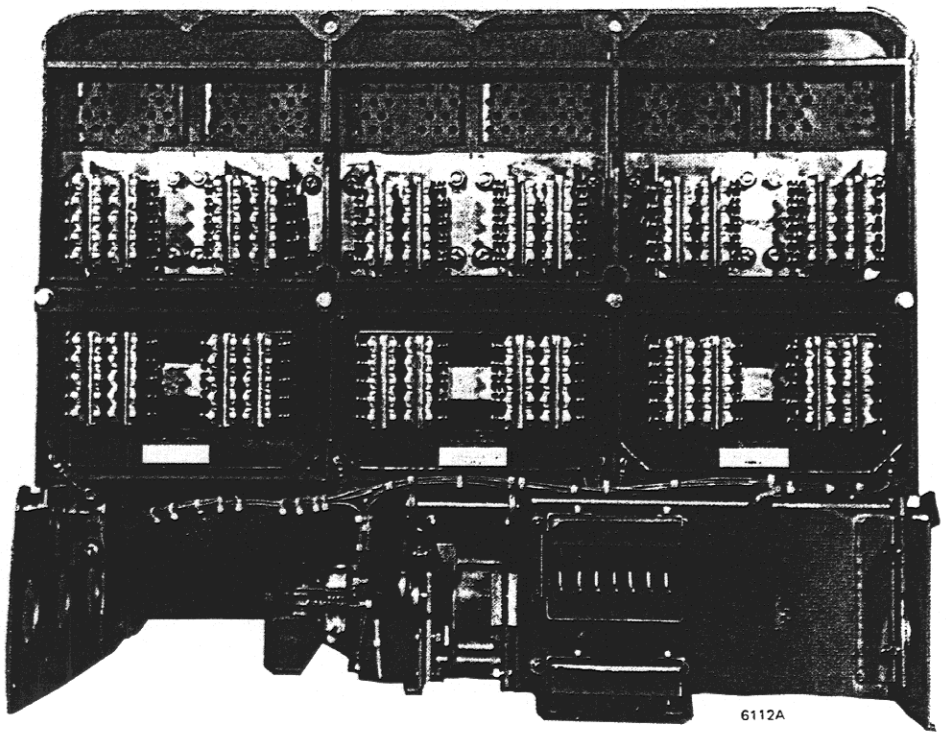
A new generation of *true* power circuit breakers



Rear view LK 25 electrically operated circuit breaker.

Product Leadership

Since the turn of the century, I-T-E has stood for leadership in designing, engineering and manufacturing protective electrical devices. K-Line power circuit breakers set the industry's standard of excellence. Today, with the I-T-E LK circuit breaker family, these standards have advanced to new heights.

LK Power Circuit Breakers Maintain the I-T-E Quality Tradition with These Proven Features:

- **Design reliability**
- **Stored energy operation**
- **Air magnetic arc interruption principle**
- **Drawout maintenance flexibility**
- **Rugged cradle design**
- **Automatic secondary disconnects**
- **Solid-state trip systems**
- **Manual or electrical operation**
- **High quality polyester glass insulation**
- **Meets or exceeds ANSI, NEMA & IEEE standards**

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Description

Protection to 200,000A in a Single, Total Breaker Design

The entire family of I-T-E LK power circuit breakers is designed with care and forethought to fill your total requirements today, tomorrow, and for years to come. LK breakers are designed to meet the complex and ever-growing needs for electrical protection and versatility of application and control.

LK
Standard interrupting ratings from 30,000 to 130,000A, 800 to 4200A continuous.

LKE
Extended interrupting ratings from 42,000 to 130,000A, 800 to 4200A continuous.

LKD
Integral fused current limiting, 200,000A interrupting rating, 800 and 1600A continuous.

Two Physical Sizes Cover All Continuous Ratings

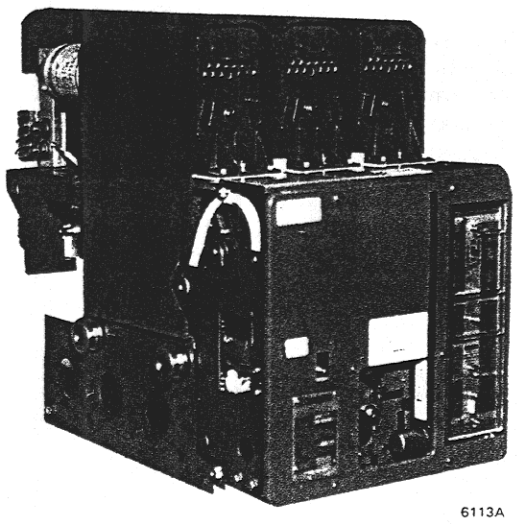
All LK and LKE frame sizes have the same depth for compartment standardization. LKD circuit breakers are 8 inches deeper. Two compartment widths accommodate all the circuit breakers. Uniform height of the LK circuit breaker family enables four-high construction for all frame sizes.

Sharing of Standardized Parts For All Ratings

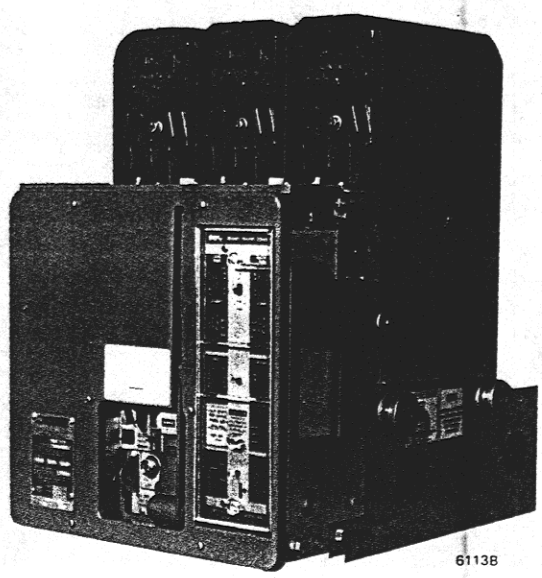
Commonality of parts throughout the LK family provides an additional benefit. The need for large renewal parts inventory is eliminated since many replacement parts are interchangeable.

Ratings

Circuit Breaker Type	Maximum Continuous, A	Symmetrical RMS A Interrupting Capacity @ 240V	480V	600V
LK	800 to 4200	42,000 to 130,000	30,000 to 100,000	30,000 to 100,000
LKE	800 to 4200	50,000 to 130,000	50,000 to 130,000	42,000 to 130,000
LKD	800 and 1600	200,000	200;000	200,000



LKD 8 manually operated circuit breaker.



LK 16 manually operated circuit breaker.

LK Is The Total Breaker

Brown Boveri Electric, manufacturer of I-T-E electrical power equipment, provides innovative low voltage Ac power circuit breakers, designed to satisfy this decade's increasingly sophisticated systems with higher load densities, coordination control and protective requirements.

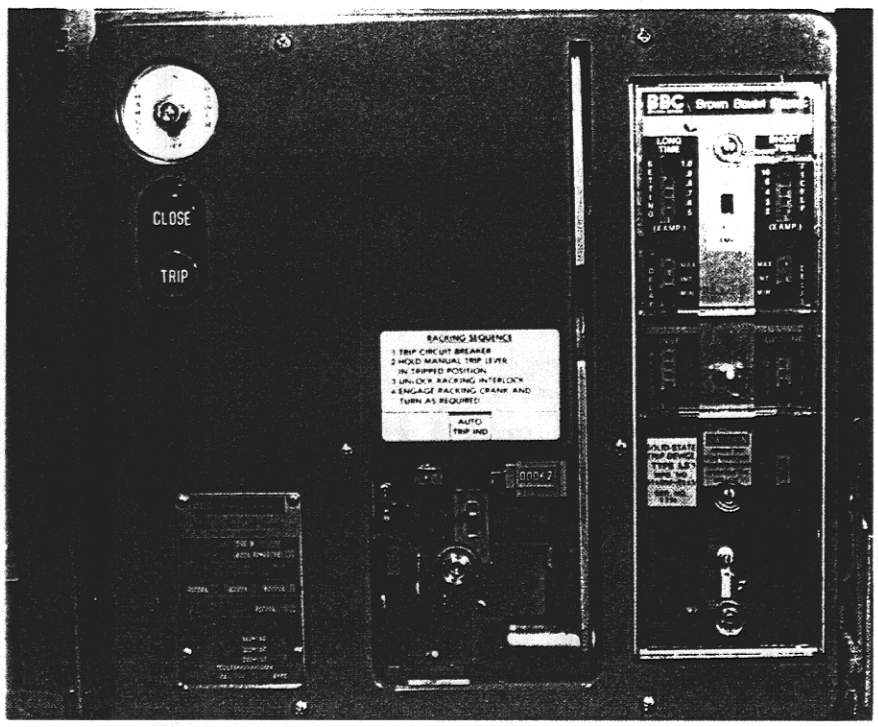
The LK family with functional ampacity designed to match transformer kVA ratings, is economically available with 2500, 3200 and 4200A continuous ratings and higher interrupting ratings for all frame sizes. These are some of the features that give LK, LKE and LKD circuit breakers broader selectivity and overall usability.

The LK Power-Shield® solid-state trip system is totally self-powered. It provides complete choice of settings, including the exclusive ampere range selector, as well as common pickup and time delay settings. A maximum of four targets are available, one for each separate trip element specified.

Circuit breaker application has been expanded greatly by the availability of the 2500, 3200, and 4200A frame sizes. The addition of the new extended interrupting rating LKE breakers makes this family the most flexible ever offered. The familiar cradle design provides complete freedom in applying LK, LKE and LKD circuit breakers to a variety of switchgear applications.

15 Outstanding LK Features

- Higher interrupting ratings
- Functional ampacity
- Solid-state trip system
- Ampere range selector
- Automatic trip indication
- Field test features
- Two step stored energy mechanism
- Uniform cradle depths
- Three cycle closing
- Main and arcing contact design
- Integral manual spring charging handle
- Parts commonality
- Cradle mounted accessories
- Protective shutters
- Accessibility
- Positive racking positions



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Front view LK 8 electrically operated circuit breaker.

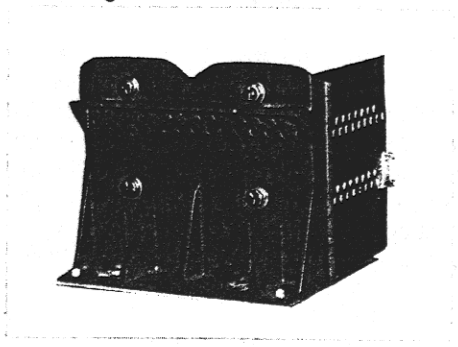
Convenience, Protection, Efficiency — Features You Want and Need

100% Solid-state tripping — each protective element incorporates the state of the art technology for maximum system protection and coordination.

Convenient controls — all grouped in one location, adjacent to a built-in charging handle for the two-step, stored energy mechanism.

68D

Arc chutes — The I-T-E type LK, LKE and LKD arc chutes employ proven design for effective arc extinction in a minimum amount of space. A system of baffles and deflectors confines the interrupting to the arc chute and controls arc-product discharge until after they have been cooled and de-ionized. The resulting interruption is very fast and efficient. Because arc products are de-ionized within the arc chute and wraparound base molding, even at the maximum rated short circuit currents, the LK family of circuit breakers require no overhead clearance to ground. Two arc chutes are common throughout all frame sizes. Arc chutes are front accessible and easily removed for inspection of the main and arcing contacts.



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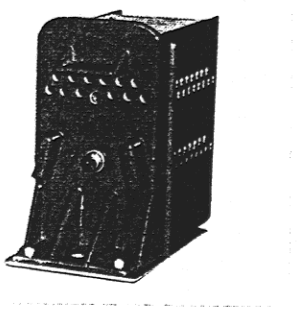
LK 25, 32 & 42 arc chute



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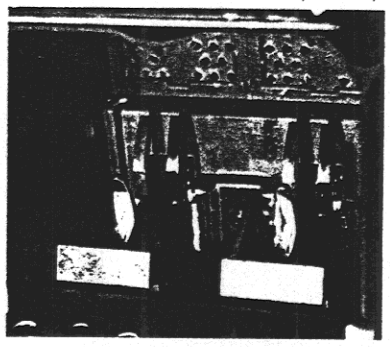
LK 8 & 16 arc chute

Contact Structures — main and arcing contact structures are a completely new design across the entire LK family of circuit breakers. Contact parts are common to all circuit breakers. The 1600, 2500, 3200 and 4200 ampere frame sizes use multiple sets of the same contact structures with minor modifications. This design features self-aligning, self-cleaning, wiping action main and arcing contacts for more uniform closing and superior service life. The arcing contacts are made of a durable, high temperature alloy which has both high conductivity and arc resisting properties. The main contacts are heavy silverplated copper. The contact structure is mounted on an impact resistant wraparound base molding which serves as an insulated barrier between current carrying parts and the grounded frame.



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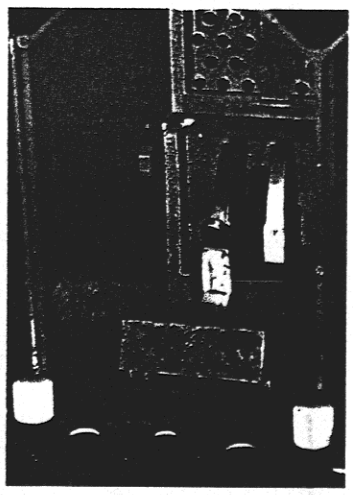
LK 32 arcing contact structure



6115 D

LK 8 arcing contact structure

Table 1 — LK, LKE and LKD Power Circuit Breaker Ratings

Circuit Breaker Type	Maximum Continuous Current, A	Symmetrical RMS A Interrupting Capacity @ 240V	480V	600V	Short-Time or Delayed Trip, A
LK 8	800	42,000	30,000	30,000	30,000
LK 16	1600	65,000	50,000	50,000	50,000
LK 25	2500	100,000	85,000	85,000	85,000
LK 32	3200	100,000	85,000	85,000	85,000
LK 42	4200	130,000	100,000	100,000	100,000
LKE 8	800	50,000	50,000	42,000	42,000
LKE 16	1600	65,000	65,000	65,000	65,000
LKE 25	2500	100,000	100,000	100,000	100,000
LKE 32	3200	100,000	100,000	100,000	100,000
LKE 42	4200	130,000	130,000	130,000	130,000
LKD 8	800	200,000	200,000	200,000	200,000
LKD 16	1600	200,000	200,000	200,000	200,000

LK Circuit Breaker Features
Offer Unique Switchgear Design Opportunities

Exclusive new features
Insulated shutters and true closed door racking enable personnel to work with greater confidence and flexibility than ever before. The LK mechanism provides "on demand" control of the closing, tripping, and spring energy storage of the LK circuit breaker with complete separate control of each operation.

Convenience
Grouping all breaker control functions allows complete accessibility via an access port in the closed compartment door.

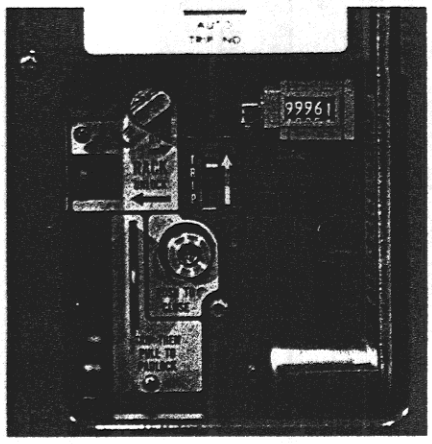
Front access control wiring
Polyester glass shutters providing a barrier over the upper and lower stationary primary disconnects in conjunction with reduced circuit breaker and cradle widths, make this feature feasible.

Manual control
The mechanical close pushbutton and mechanical trip lever are located on the circuit breaker control center where they are easily accessible through an access port in the compartment door. The racking shaft; racking release lever; padlock hasp; open-closed position, spring charged-discharged, automatic trip and drawout position indicators are all accessible through the access port. The padlock hasp accommodates up to three padlocks. When padlocked, it mechanically locks the operating mechanism open, prevents racking and secures the circuit breaker in the selected position with the contacts open.

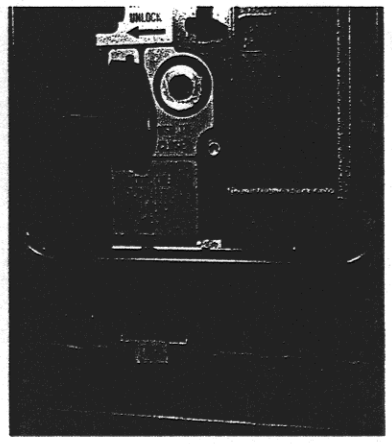
Positive racking positions
Racking can be conveniently performed through an access port. The racking shaft, manual mechanical trip, racking release lever and the racking position indicator can be readily operated or easily observed. The racking mechanism automatically stops and locks precisely in position with an audible "click" whenever "connected," "test" or "disconnected" positions are reached. The manual trip lever must be raised and the racking release level must be moved to the left before racking may proceed.

Emergency trip
Prominently located on the cradle and can be actuated with the compartment door closed or open.

Convenient Control Center



Emergency Trip



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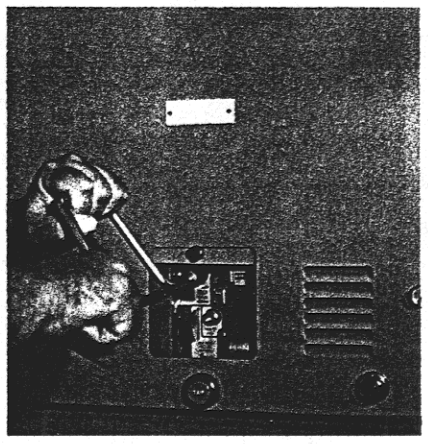
Closed Door Racking



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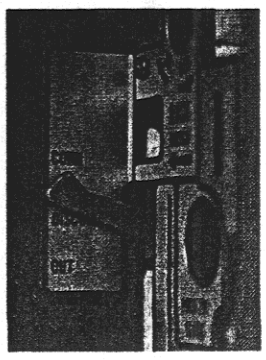
Positive Racking Positions



Connected

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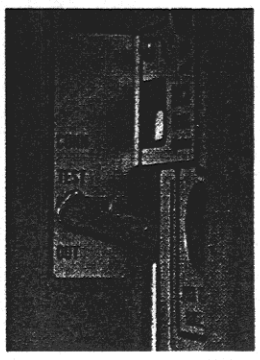

Test

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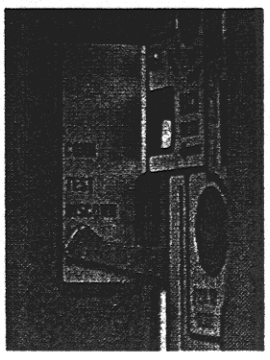

Disconnected

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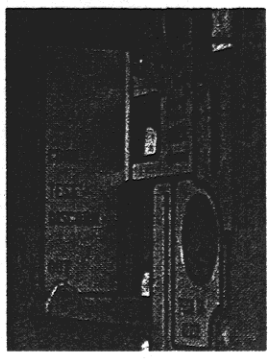

Out

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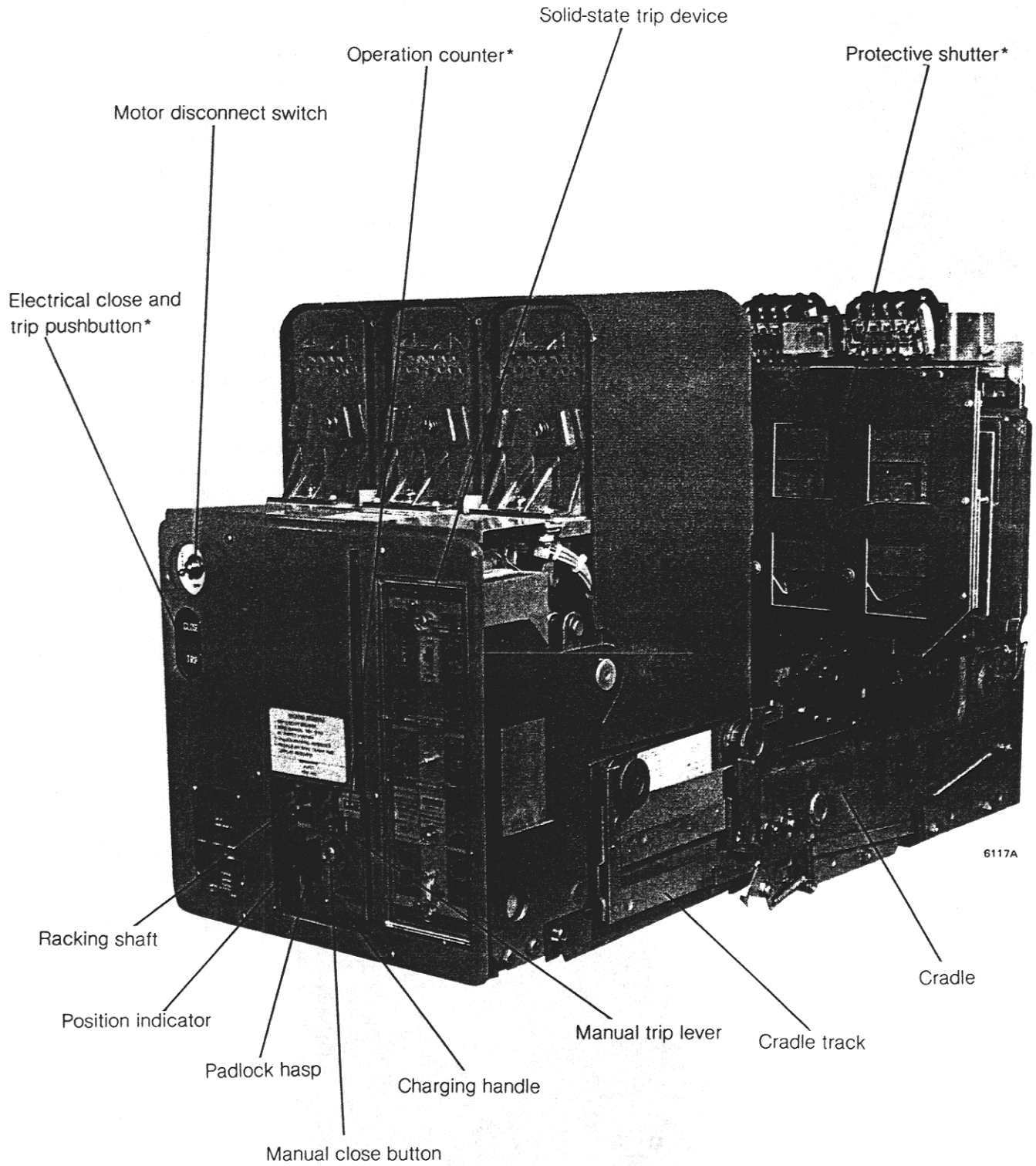
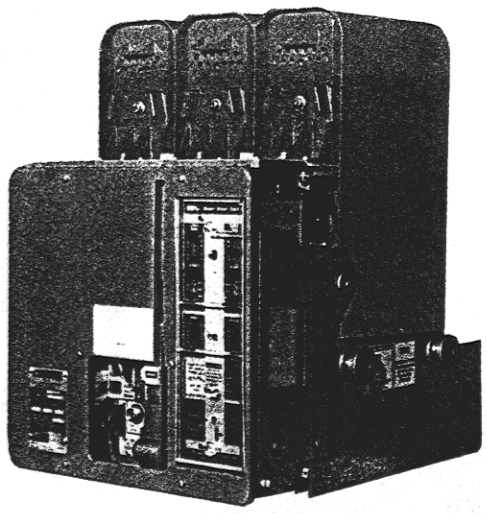

Solid-state trip device
Operation counter*
Protective shutter*
Motor disconnect switch
Electrical close and trip pushbutton*
6117A
Racking shaft
Position indicator
Padlock hasp
Charging handle
Manual close button
Manual trip lever
Cradle track
Cradle

*Optional

Manual or Electrical Operation



LK 16 manually operated circuit breaker

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Manual Operation

"On-demand" control of the closing and tripping operation has been designed into the stored energy operating mechanism of the manually operated LK family of circuit breakers.

The built-in spring charging handle, which stores flush with the front of the circuit breaker, is readily available to charge the closing springs. Pumping the handle will charge the closing springs; and, when fully charged, will produce an audible "click." The spring charged indicator will now read "charged." The closing springs remain fully charged until released by the manual close pushbutton or the optional electric close release.

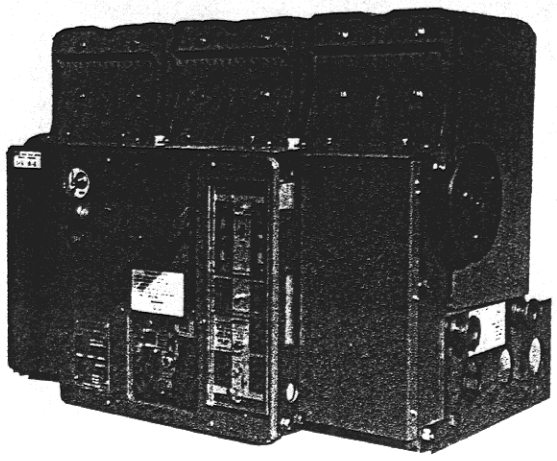
The closing springs stored energy provides sufficient force to close and latch the breaker safely under any conditions within the circuit breaker's rating. The tripping springs are charged during the closing motion. Their energy is released by a manual mechanical trip lever, optional shunt trip or by the Power-Shield solid-state automatic trip system.

LK manually operated breakers equipped with short-time elements may be safely applied in selective systems where the available fault current does not exceed the short-time rating of the breaker. Manual breakers equipped with an instantaneous element may be safely applied to their maximum interrupting rating.

Electrical Operation

Electrically operated LK, LKE and LKD circuit breakers are selected whenever complete electrical control is required. Electrically operated breakers feature the same two-step stored energy mechanism as the manually operated, to assure positive close and latch of the mechanism under delayed trip conditions, but with the added features of closing spring charging by an electric motor and the inclusion of associated electrical close and trip control devices. Closing springs remain fully charged until released by the manual mechanical close push-button or the electrical close release coil. Tripping springs are charged during the closing operation. They discharge and open the circuit breaker whenever the Power-Shield solid-state trip system or a manual or electrical trip operation is initiated. Charging springs are automatically charged immediately following a trip operation of the circuit breaker. As an option, automatic spring charging after close is available.

A charging handle is also built-in for manual spring charging when desired or if control power is not available. The frontplate of the circuit breaker also includes a charging motor disconnect switch and optional close and trip push-buttons, in addition to all the features included in the control center.



LK 32 electrically operated circuit breaker with built-in charging handle extended.

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Standard LK, LKE, LKD Features

- Two-step stored energy mechanism
- Manual mechanical close pushbutton
- Spring charged-discharged indicator
- Integral manual charging handle
- Manual mechanical trip lever
- Circuit breaker open-closed position indicator
- Circuit breaker racking position indicator
- Racking interlocks
- Positive racking positions
- Padlock hasp
- Interchangeability interference interlock
- General Purpose Power-Shield solid-state trip device with long-time and instantaneous elements
- Automatic trip indicator
- Primary disconnect assemblies
- Secondary disconnect assemblies (as required)
- Ground disconnect assembly
- Closing spring automatic discharge between disconnected and withdrawn positions
- Amp-Trap® current limiting fuses (LKD only)
- Open fuse trip and lockout (LKD only)
- Open fuse indicator (LKD only)

® Amp-Trap - Gould Inc.

Electrical Only

- Automatic spring charging following trip operation
- Electric close
- Electric trip
- Anti-pump control
- Charging motor disconnect switch
- Secondary disconnect assemblies
- Integral auxiliary switches for remote red and green indicating lights

Optional LK, LKE, LKD Features

- Local electrical close and trip push buttons (E.O. only)
- Any combination of solid-state trip elements
- Power-Shield operation targets
- Power-Shield load alarm contacts
- Power-Shield ground alarm contact
- Mechanical lockout on automatic trip
- Circuit breaker actuated, cradle mounted open-closed indicator
- Automatic trip alarm contacts
- Undervoltage trip alarm contacts
- Open fuse trip alarm contact (LKD only)
- Instantaneous undervoltage trip
- Time delay undervoltage trip
- Undervoltage lock open
- Undervoltage trip defeator
- Operation counter
- Automatic spring charge after close (E.O. only)
- Door interlock
- Mechanical transfer interlock
- Operate-position-only (O.P.) secondary disconnect contact
- Test-position-only (T.P.) secondary disconnect contact
- Kirk Key® interlocks
- Protective shutter

Manual Only

- Shunt trip with four contact auxiliary switch
- Remote electrical close release assembly

Power-Shield® Solid-State Trip Systems

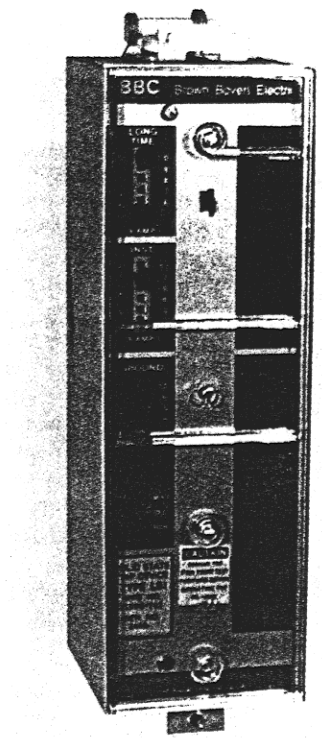
Solid-state trip systems have been supplied on I-T-E low voltage power circuit breakers since 1968. This on-line experience is incorporated into the manufacture of the reliable Power-Shield tripping system featured on all LK circuit breakers to protect your power system in the event of overloads or faults.

The completely self-powered Power-Shield system takes the tripping energy from the primary current flowing through the circuit breaker without the need for an additional power supply.

The system includes the current sensors, solid-state trip unit, magnetic latch and the interconnecting wiring. A current sensor is integrally mounted on each phase of the circuit breaker and supplies current to the solid-state trip unit. This current has a value directly proportional to the current flowing in the primary circuit. If the current value flowing in the primary exceeds the settings for a given interval of time, the trip unit sends a signal to the magnetic latch and trips the circuit breaker.

The Power-Shield trip unit is available in "General Purpose" and "Total Purpose" types. Four basic trip elements perform the protective functions: long-time, short-time, instantaneous and ground. All applicable combinations of these elements are offered in the "Total Purpose" Power-Shield. Some combinations of these elements are offered in the "General Purpose" Power-Shield. Selection is based on the protective and coordination requirements of the particular system. Consult Table 2 for available combinations.

The Power-Shield trip device provides a full range of settings for precise protection and coordination. All settings are visible through a transparent cover with a sealable feature that also inhibits tampering. Settings that will remain stable over long operating periods are readily made with positive tap selector plugs. The available settings are listed in Table 3. The exclusive ampere range selector doubles the



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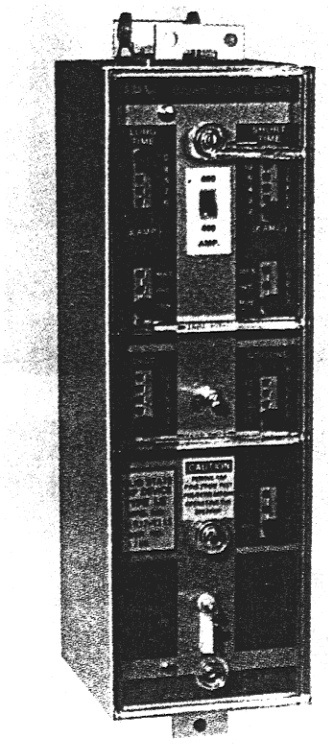
General Purpose



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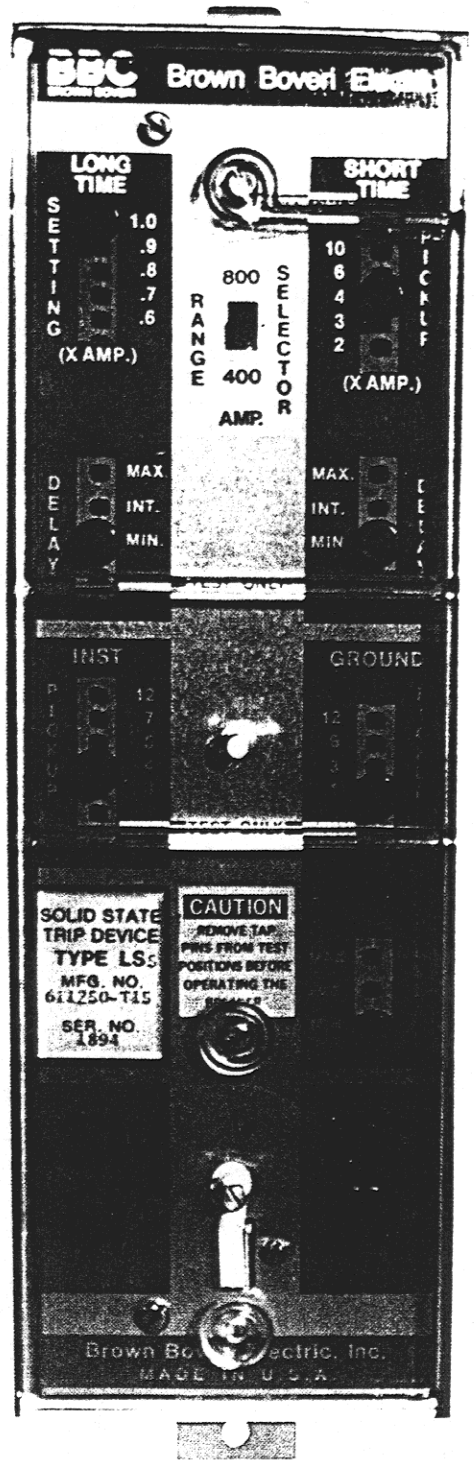
Total Purpose



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Close-up of Total Purpose

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adjustment settings of the basic protective elements: long-time, short-time, and instantaneous. The ampere range selector in providing a broader range of coverage reduces the number of different sensors substantially. As a result, only six sensors are required for long-time settings ranging from 60 to 4200A.

All LK, LKE and LKD circuit breakers utilize the Power-Shield Type LSS trip unit. The long-time settings assure full use of the circuit breaker continuous current capability by not actuating the solid-state long-time trip pickup unless 100% of the selected ampere rating is exceeded. Accordingly, above unity or above margin settings are not required to assure that the circuit breaker will carry 100% of its setting continuously. Application is made simpler and more positive. This exclusive feature assures users full use of their investment for its intended purpose. A portable test set is available for field testing.

Special tap positions are provided on the front panel of the Power-Shield trip device to facilitate testing. These test positions modify the associated trip element characteristics to assure discrimination of trip function to the element undergoing test.

A transparent cover protects the Power-Shield trip device and may be sealed to inhibit unauthorized changes of settings. As a reminder, this cover also has a built-in interference bar to prevent replacing the cover should any tap plugs be left in a test position. If, however, a tap plug is left in a test position without replacing the transparent cover, fault protection is still provided. Should a tap plug be left out completely, the setting automatically reverts to its lowest value. In this event, nuisance tripping will probably occur calling the operator's attention to this abnormal condition. These features provide additional safety and reliability.

The ground fault element incorporates controlled reset of the ground fault function to cause proper response to arcing ground faults and thereby provide optimum protection.

Each trip unit is completely tested before shipping. There are no mechanical devices to readjust after shipment. Only the required settings need be made prior to placing the unit in service.

Standard Features

- Two-position ampere range selector
- Independently adjustable trip functions
- Flexible settings for precise protection and coordination
- True 100% current carrying capability of long-time settings
- Selectable time-current characteristics
- Transparent protective cover facilitates inspection and inhibits tampering
- Completely self-powered (additional power source unnecessary)
- Solid-state reliability and long life
- Long-time and instantaneous protective elements
- Convenient location on circuit breaker front panel
- Interchangeability to serve any size LK, LKE and LKD circuit breaker
- Shaped instantaneous characteristic for optimum coordination

Table 2 — Available Power-Shield Trip Unit Types

TYPE		TRIP FUNCTIONS							TIME CURRENT CHARACTERISTICS CURVE
		LONG-TIME		SHORT-TIME		INST.	GROUND FAULT		
		SETTING	DELAY	PICK-UP	DELAY		PICK-UP	DELAY	
LSS-1	GP	5A	NA			5A			TD-9058
LSS-1G	GP	5A	NA			5A	4A	3A	TD-9058, TD-9062
LSS-2	GP	5A	NA	5A	3A				TD 9068
LSS-4	TP	5A	3A	5A	3A				TD-9060
LSS-4G	TP	5A	3A	A	3A		4A	3A	TD-9060, TD-9062
LSS-5	TP	5A	3A	5A	3A	5A			TD-9060
LSS-5G	TP	5A	3A	5A	3A	5A	4A	3A	TD-9060, TD-9062
LSS-6	TP	5A	3A			5A			TD-9059
LSS-6G	TP	5A	3A			5A	4A	3A	TD-9059, TD-9062

5A—No. of Adjustments
NA—Non Adjustable
GP—General Purpose
TP—Total Purpose

NOTE: The Power-Shield trip unit is completely tested prior to shipment. Since there are no mechanical devices which may have lost adjustment during shipment, no readjustments, other than making the required settings, need be made prior to placing in service.

Features of Different Power-Shield Types

Table 3 — Power-Shield Type LSS Trip Unit Time Delay Settings

Type	Trip Function	Time Delay Band	Time Delay	
LSS-1*	Long Time	Non-Adjustable	Long Time	† 4.0 Sec.
LSS-1G* ▲	Long Time	Non-Adjustable		
	Ground Fault	Maximum	Short Time	△ 0.35 Sec.
		Intermediate		△ 0.20 Sec.
		Minimum		△ 0.08 Sec.
LSS-2	Long Time	Non-Adjustable		
	Short Time	Maximum	Ground Fault	△ 0.35 Sec.
		Intermediate		△ 0.20 Sec.
		Minimum		△ 0.08 Sec.
LSS-4 LSS-4G ▲ LSS-5* LSS-5G* ▲	Long Time Short Time Ground Fault	Maximum Intermediate Minimum	Long Time	† 15.0 Sec. † 5.0 Sec. † 2.0 Sec.
LSS-6* LSS-6G* ▲	Long Time Ground Fault	Maximum Intermediate Minimum	Short Time	△ 0.35 Sec. △ 0.20 Sec. △ 0.08 Sec
			Ground Fault	△ 0.35 Sec. △ 0.20 Sec. △ 0.08 Sec.

Measured at six (6) times range selector amperes at the lower limit of the time delay band
Measured at the lower limit of the maximum, intermediate, or minimum short-time and ground time delay bands at any point above pickup (Definite Time Delay)
Includes adjustable pick-up instantaneous trip function
Includes ground fault trip function

Table 4 — LK, LKE and LKD Phase Sensor Ampere Ratings, Settings and Ground Pick-Up Settings

Circuit Breaker Type	Available Sensor Rating, A	SETTINGS	PICKUP		Primary Ground Pickup, A
		Long-Time	Short-Time	Instantaneous	
		Times Range Selector Amperes			
K,LKE&LKD 6	200,800	1.0	10	12	1200
		0.9	6	7	600
		0.8	4	5	300
		0.7	3	4	100
		0.6	2	3	
K,LKE&LKD 16	200, 800, 1600	1.0	10	12	1200 △
		0.9	6	7	600 △
		0.8	4	5	300 △
		0.7	3	4	100 △
		0.6	2	3	1200 †
					900 †
					600 †
					300 †
K&LKE 25	2500	1.0	10	12	1200
		0.9	6	7	900
		0.8	4	5	600
		0.7	3	4	300
		0.6	2	3	
K&LKE 32	3200	1.0	10	12	1200
		0.9	6	7	1000
		0.8	4	5	800
		0.7	3	4	500
		0.6	2	3	
K&LKE 42	4200	1.0	10	12	1200
		0.9	6	7	1000
		0.8	4	5	800
		0.7	3	4	500
		0.6	2	3	

△ 200 or 800A sensor † 1600A sensor

Table 5 — Features of Different Power-Shield Types

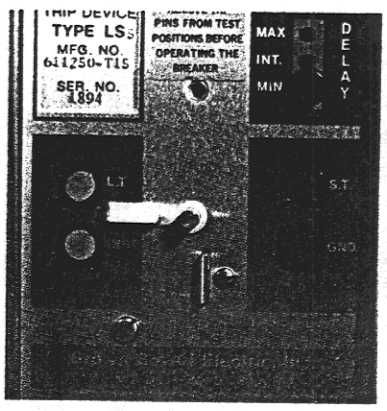
	GENERAL PURPOSE		TOTAL PURPOSE		
	LSS-1, 1G	LSS-2	LSS-4, 4G,	LSS-5, 5G,	LSS-6, 6G
5 adjustable long-time carry settings 1	X	X	X	X	X
Non-adjustable long-time delay	X	X	No	No	No
3 adjustable long-time delay taps	No	No	X	X	X
5 adjustable instantaneous pickup taps 1	X	No	No	X	X
4 adjustable ground pickup taps	O	No	O	O	O
3 adjustable ground delay taps	O	No	O	O	O
5 adjustable short-time pickup taps	No	X	X	X	No
3 adjustable short-time delay taps	No	X	X	X	No
Electromechanical target for each element selected, up to 4	No	No	O	O	O
Test provisions (with optional Type 505 Portable Test Set)	X	X	X	X	X
Load alarm contact	No	No	O	O	O
Ground-trip alarm contact	No	No	No	O	O
Hi-set instantaneous (24 times range selector amperes)	O	No	No	O	No

1 - Multiples of Amp Range Selector
O - Optional X - Standard feature

Optional Power-Shield Features

Targets

Optional electromechanical targets are available on total purpose trip units only. If targets are specified, one will be provided for each tripping function: long-time, short-time, instantaneous and ground. Therefore up to four targets will be supplied, depending on the number of tripping functions on the particular unit. When a trip occurs, the target for that function will show orange until it is manually reset to black. The target position is not affected by shock or vibration and is independent of control power.



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Load Alarm Contact

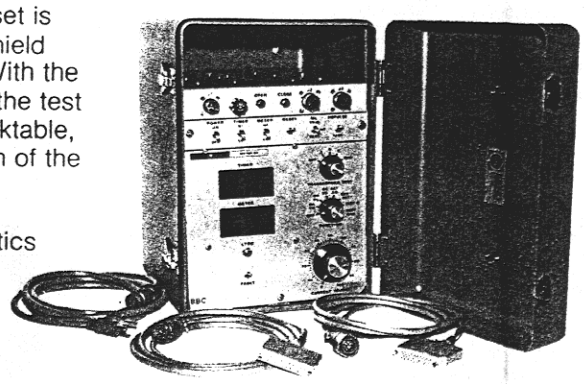
A load alarm contact is available with one normally open contact that closes when the primary current exceeds the set value. The load alarm contact setting is adjustable from 50 to 100% of the range selector amperes. This contact is brought out to a terminal where remote alarm circuit may be connected. For contact rating see Table 10.

Ground Alarm Contact

This feature provides a momentary contact closure when a ground trip operation occurs. This contact is brought out to a terminal where a remote alarm circuit may be connected. Contacts are suitably rated for use with a remote mounted annunciator. For contact rating see Table 10.

Power-Shield Portable Test Set (Type 505)

A compact, portable test set is available to test all Power-Shield Type LSS trip units on-site. With the circuit breaker drawn out to the test position or removed to a worktable, this test set verifies operation of the Power-Shield Trip System in accordance with the settings selected and the characteristics desired.



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Optional Circuit Breaker Mounted Features

Undervoltage Trip Device Ⓐ

This single-phase voltage detection device automatically trips the circuit breaker when voltage applied to its operating coil decreases to 30-60% of its rated value. It will not allow circuit breaker closing until the coil voltage is approximately 80% of rated value. The undervoltage trip device has either instantaneous trip operation or a factory-adjusted time delay trip of 0-15 seconds, and can be either factory or field installed. Alarm contacts are available as an additional option if specified. See Table 11, for additional data.

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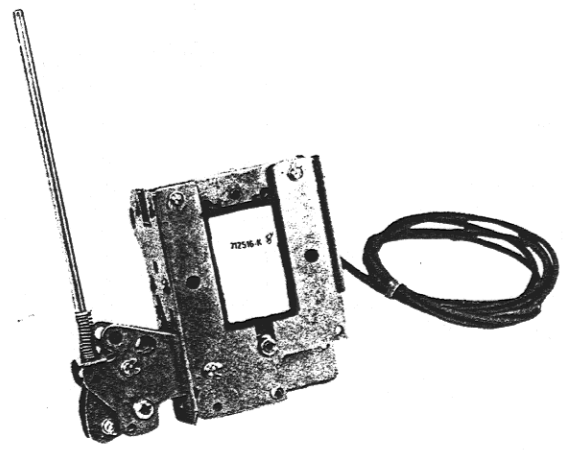

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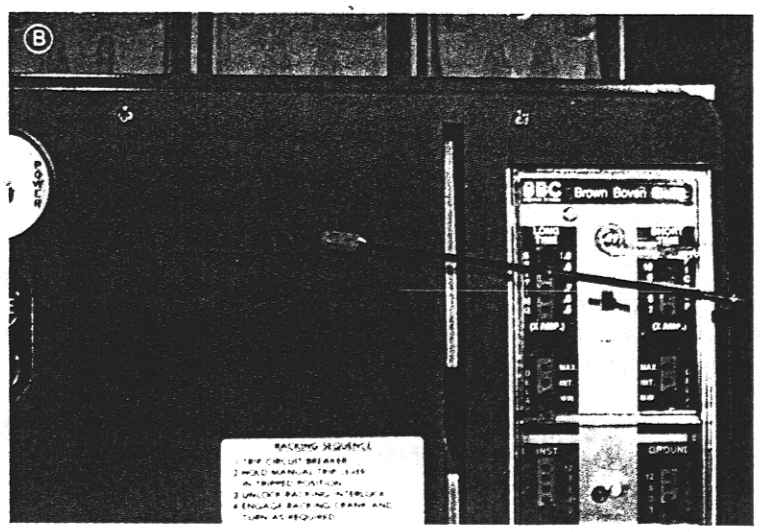
Undervoltage Trip Defeat Ⓑ

During maintenance procedures, it is useful to defeat the undervoltage trip device. The undervoltage trip device can be defeated by inserting an Allen wrench in the location provided on the circuit breaker front plate and rotating it clockwise three turns. To reinstate the trip defeat, insert the Allen wrench and rotate counterclockwise three turns.



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Undervoltage Lock Open Device

The undervoltage lock open device utilizes single phase voltage detection to keep the circuit breaker open. It will not allow circuit breaker closing until the coil voltage is approximately 80% of rated value. However, this device does not trip the circuit breaker on conditions of low or loss of voltage. Alarm contacts are available as an additional option if specified.

Shunt Trip Ⓒ (Optional on M.O.)

The shunt trip provides electrical tripping of the circuit breaker. It is available for use with all common standard control voltages as shown in Table 12. It acts directly on the trip mechanism to assure dependable and trouble-free opening of the

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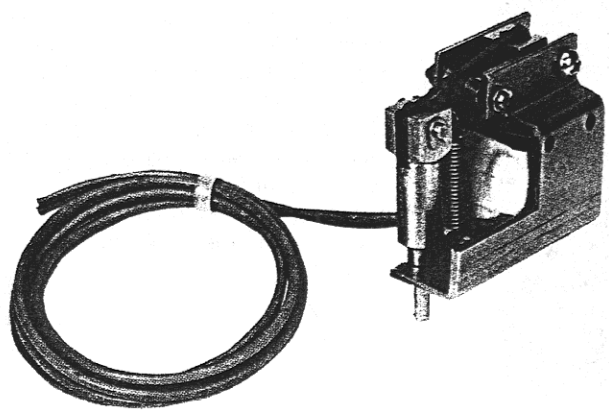

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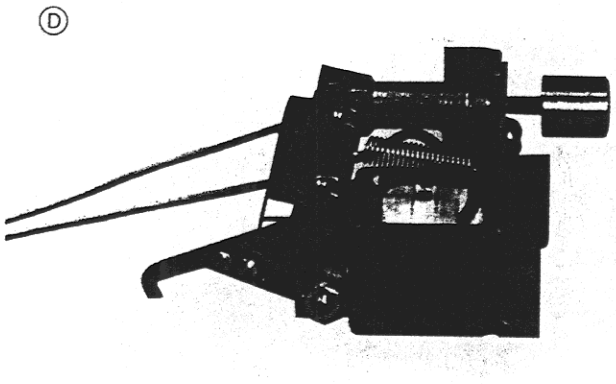

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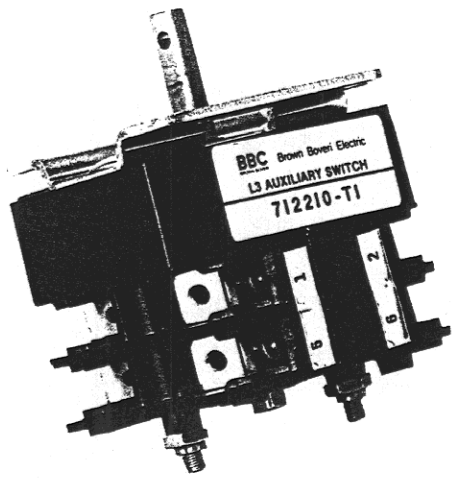

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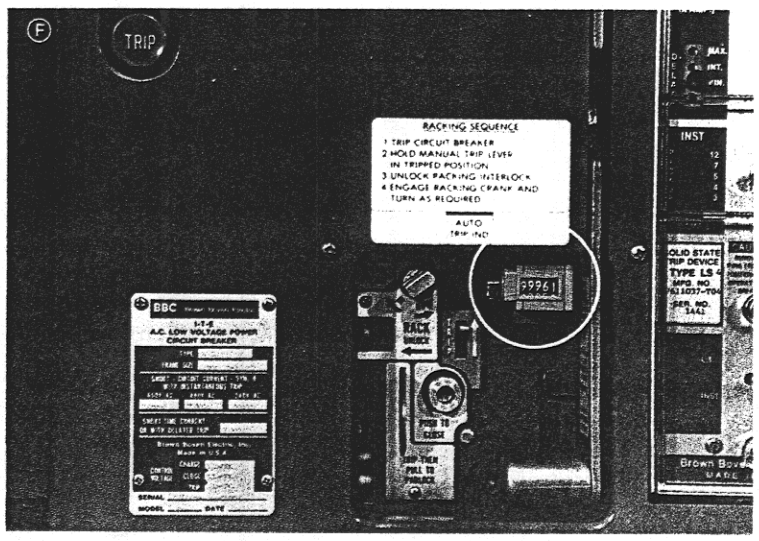

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circuit breaker contacts. It is standard on electrically operated breakers and optional on manually operated breakers. Whenever a shunt trip is supplied an internally mounted auxiliary switch is also provided.

Electrical Close Release Ⓓ (Optional on M.O.)

The electrical close release provides electrical release of the closing spring stored energy to permit electrical closing of a manually operated breaker. It is available for use with all common standard control voltages. Whenever an electrical close release is supplied an internally mounted auxiliary switch is also provided.

Auxiliary Switches Ⓔ (Optional on M.O.)

An internally mounted multi-contact auxiliary switch is used to complete electrical circuits for internal circuit breaker control. It is mechanically operated by the circuit breaker. The auxiliary switch has contacts which may be open or closed when the circuit breaker is open. For electrically operated circuit breakers one normally open (N.O.) and one normally closed (N.C.) contact is available for operation of remote red and green breaker contact position indicating lights. When supplied with manually operated breakers incorporating an optional shunt trip or electrical close release, up to three contacts are available for other than breaker control. These contacts are wired out to a terminal for connection to external wiring as required.

Operation Counter Ⓕ

The operation counter is a non-resettable five (5) digit device that maintains a cumulative total of circuit breaker opening operations.

680

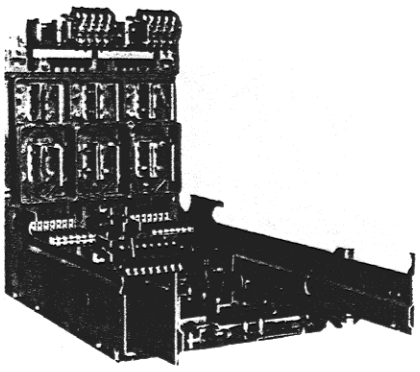
›radle and Optional Mounted Features

ircuit Breaker Cradle

The base mounting assembly for ıe LK family of circuit breakers is specially designed cradle. The ·adle provides the interface be- veen the circuit breaker and its xternal connections. The circuit reaker cradle contains stationary rimary, ground, and secondary sconnects, interference block, nergency trip lever, and, all other awout equipment, in a complete elf-aligning rigid assembly. There no dependence on the mounting ame for any critical alignment.

Optional cradle mounted quipment includes the mechanism operated cell auxiliary contacts (MOC), truck operated cell auxiliary contacts (TOC), current transformers, mechanical interlocks, Kirk Key interlocks, and door interlocks. Additional stationary secondary disconnects will be required when alarm switches, undervoltage devices, local close & trip pushbuttons and 4-wire ground requirements are specified.

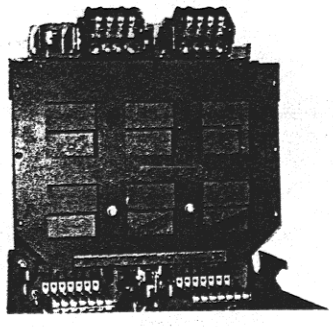
Any size cradle can be installed into any compartment its own size or larger. The circuit breaker cradle is designed to accommodate either front or rear control wiring.



61116A

;hutters

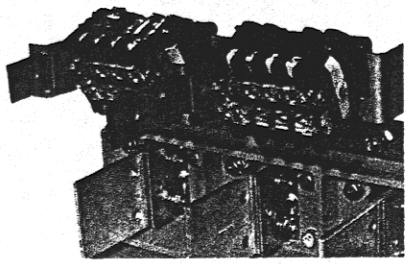
For personnel protection, the LK ımily of circuit breakers feature olyester glass insulating shutters hich automatically cover the rimary stationary contacts when- ver the circuit breaker is with- awn, or removed, shielding the perator from the live primary contacts. The shutter covers both upper and lower stationary primary contacts when the circuit breaker is withdrawn. As the circuit breaker is racked in, the shutter opens to allow the contacts to engage. This feature is another LK family design innovation.



61116B

ruck Operated Cell TOC) Switch

The TOC switch is a multi- ontact auxiliary switch for remote ndication of the circuit breaker's rawout position. It is available in ither a four or eight contact arrangement and offers a choice of operation between the connected and test or between the test and disconnected positions. See Table 10 for contact ratings.



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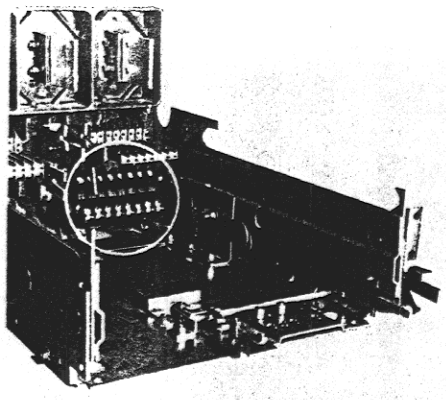

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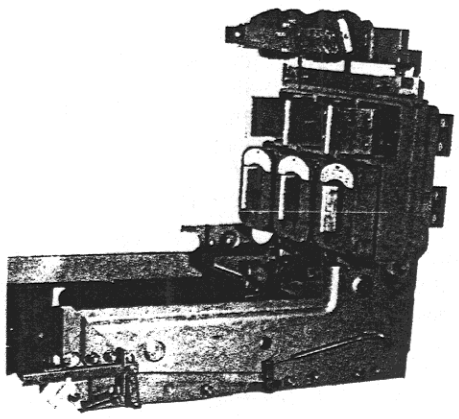
Mechanism Operated Cell (MOC) Switch

The MOC switch is a multi-contact auxiliary switch that changes position whenever the position of the circuit breaker primary contacts change. These auxiliary contacts are used for electrical interlocking and indicating circuits. MOC switches are available in either a four or eight contact arrangement which operate only in the connected position. An optional arrangement can be specified to require the MOC switch operation in both the connected and test positions. See Table 10, for contact ratings.



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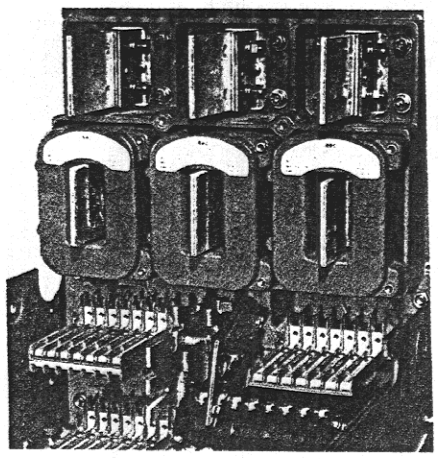
Kirk Key® Interlock Linkage

Provisions for Kirk® key interlocking permit circuit breaker operation only in a pre-arranged sequence. This interlocking can be used to assure safe working conditions, by preventing an authorized person from committing an unauthorized act.

The Kirk key interlock linkage is cradle mounted and the keyed cylinder (supplied by others) is accessible through an opening in the closed compartment door. Normally, the key can be removed only when the circuit breaker is locked open in the connected position. The breaker cannot be closed until the key is inserted and turned, thereby unblocking the trip mechanism.



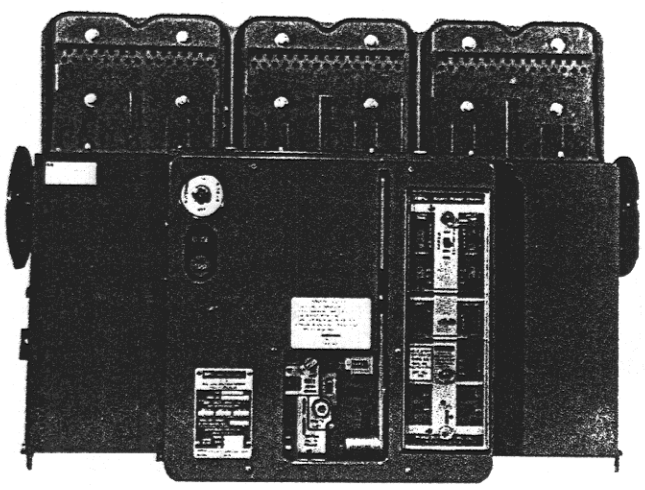
61117C

Current Transformers

Fully insulated, high-dielectric, toroidal current transformers can be located around the stationary primary contacts of the circuit breaker cradle. Their location eliminates the need for mounting CTs on the bus in the power cable termination compartment.

Standard low voltage current transformers have metering accuracies that conform wiith ANSI Standard C37.20.

Provisions are made for mounting one current transformer per phase around the lower primary disconnects of the 800A and 1600A cradles. They are designed for mounting around each of the upper primary disconnects on the 2500A, 3200A and 4200A cradles.



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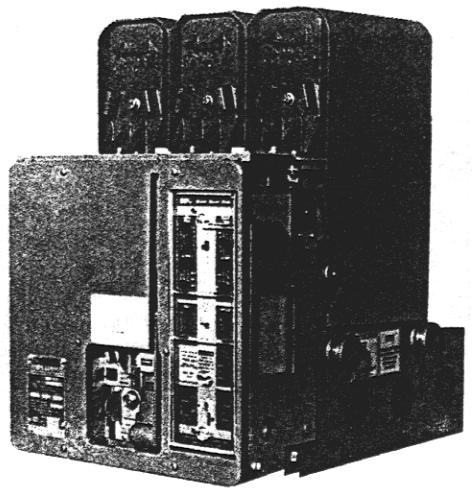


61118B

Selection of Breaker Tripping Characteristics

The degree of service continuity provided by a low voltage distribution system depends on the degree of coordination between circuit breaker tripping characteristics and the load.

Two methods of tripping coordination are in general use. Each represents a different degree of service continuity, and initial cost.

These methods, or systems, combine circuit breaker ratings and tripping characteristics as follows:

Non-Selective System

A non-selective system is one in which both the main, tie (if applicable) and the feeder circuit breakers have adequate interrupting capacity for the fault current available at the point of application.

Each circuit breaker is equipped with non-selective long-time delay and instantaneous overcurrent trips. On low level faults normally the circuit breaker nearest the fault will open. However, should the fault current exceed the breaker's instantaneous trip setting, even though a circuit breaker nearer to the fault is in the process of tripping, any breaker including the main will trip. Service continuity will be broken.

Selective System

In a selective system the main, tie (if applicable) and the feeder circuit breakers each have adequate interrupting capacity for the fault current available at the point of application.

All LK low voltage power circuit breakers have a short-time rating as well as delayed trip, up to a maximum of 30 cycles, with full close, latch and carry capability. These characteristics offer the ultimate in selective application and continuity in modern electrical systems.

In a selective system only the breakers furthest downstream are supplied with instantaneous trip elements. All other upstream breakers are provided with overcurrent trip devices having long-time delay and short-time delay elements.

Coordinated short-time delay is selected in lieu of instantaneous tripping to allow adequate time for the circuit breaker nearest the fault to trip. Maximum service continuity is maintained through all other circuit breakers.

Normally the feeder circuit breakers are equipped with overcurrent trip devices having long-time delay and instantaneous functions, unless they are required to be selective with other protective devices nearer the load. In that case, the feeder circuit breakers are equipped with overcurrent trip devices having long-time and short-time delay functions. Any fault on a feeder circuit would then cause the instantaneous trip on the downstream circuit breaker to operate, while the delayed main and feeder circuit breakers would remain closed due to the selected time delay. Depending upon application requirements as many as three short-time delay equipped circuit breakers could be in series for selective operation.

The selective system offers a maximum of service continuity at a slightly higher initial cost than the non-selective system. For applications where downtime must be minimized or operating costs or problems become prohibitive the selective system is demanded. There are many factors to consider when selecting the proper low voltage air magnetic circuit breaker.

68 R

Selection and Application LK Circuit Breakers

(See Table 7)

Selection

After system requirements have been established, four basic factors determine circuit breaker selection.

1. System voltage and frequency
2. Continuous load currents
3. Available fault current (short-circuit, short-time, close and latch)
4. Service Conditions

System Voltage and Frequency

All LK circuit breakers are designed to operate on AC power systems at the interrupting ratings shown in Table 1, which apply at the following maximum voltages.

Maximum Voltage
Volts — AC 50/60 Hertz
254, 508, 635

Continuous Current

The rated continuous current is the designated limit in RMS amperes which the circuit breaker will carry continuously, based on an average air temperature outside the enclosure which does not exceed 40°C ambient by more than 15°C. Circuit breakers are maximum rated devices and can never be applied to carry current in excess of their continuous current rating, including any one or two hour overload. Refer to Table 1 for LK current ratings.

An important consideration in circuit breaker application is the long-time overcurrent setting associated with the specific tripping device used. All LK circuit breakers use the Power-Shield Type LSS trip unit. This device assures full use of the circuit breaker continuous current capability by not actuating the solid-state long-time trip pick-up unless 100% of the selected ampere rating is exceeded. Accordingly, above unity or above margin settings are not required in order to assure that the circuit breaker will carry 100% of its setting continuously. Application is made simpler and more positive. This assures the users full use of their investment for its intended purpose. Refer to Table 3 and Table 4.

Available Fault Current

The rated short-circuit current (interrupting rating) is the highest current in RMS symmetrical amperes at rated maximum voltage which the circuit breaker can interrupt during the operating duty of "open", wait 15 seconds and the "close"—"open" operation.

These values are shown in Table 1. No circuit breaker should be applied in a circuit at any point in which the available short-circuit current is greater than interrupting capacity of the circuit breaker. LK circuit breakers, which are equipped with either instantaneous trip or short-time elements may be safely applied up to their full respective interrupting rating. The LK circuit breaker family has a minimum short-circuit rating of 30,000 amperes symmetrical with the LKE designation given to those with extended short-circuit current ratings beyond ANSI standard. Note that all LK frame sizes have a corresponding LKE extended rating for broader application. Should the circuit requirements exceed the LKE ratings, the LKD, integrally fused current limiting circuit breaker with 200,000 ampere interrupting ratings for all sizes may be applied. LKD circuit breakers incorporate all the features of the LK family in addition to integrally mounted, completely coordinated current limiting fuses in series for 800 and 1600 ampere frame sizes.

The rated short-time current of a low voltage power circuit breaker is the RMS symmetrical current at rated maximum voltage ½ cycle after fault initiation, which the circuit breaker is required to carry for two periods of ½ second duration each with a 15 second interval of zero current between these ½ second periods. See Table 1 for those ratings. This rating is applied when using external means for tripping the circuit breaker; for example, relay tripping. Also, LK and LKE circuit breakers, equipped with short-time delay, may be safely applied in selective systems where the available fault current does not exceed the short-time rating of the circuit breaker.

The close, latch, and carry rating permits the circuit breaker to provide system coordination even as it closes on a fault. The delayed trip test establishes this rating as the highest current in RMS symmetrical amperes at rated maximum voltage which the circuit breaker is required to carry during the operating duty of "open" wait 15 sec. "close-open" without instantaneous trip elements and the short-time delay set at maximum time delay.

All LK and LKE circuit breakers are rated for close, latch and carry operation and can be safely applied in selective systems where available fault current does not exceed the delayed trip rating of the circuit breaker. See Table 1.

Service Conditions

The service conditions affecting low-voltage power circuit breaker application include:

a. Ambient temperature
Low voltage power circuit breakers are designed for use within their rating where the outside ambient temperature does not exceed 40°C (104°F).

b. Altitude
Low voltage power circuit breakers are for use within their rating where the altitude does not exceed 2000 meters (6,600 feet). When using circuit breakers above this altitude, the dielectric, voltage and current ratings shall be multiplied by the factors in Table 6 to obtain new ratings for the altitude at which the breakers will be applied.

c. Unusual Service Conditions
Unusual service conditions may require unusual construction or operation, and these should be brought to the attention of those responsible for the application, manufacture and operation of the circuit breaker. Wherever possible, steps should be taken at the site of the installation to nullify the deleterious effects of unusual service conditions. Among such unusual conditions are.

68.5

1. Exposure to damaging fumes or vapor
2. Exposure to steam
3. Exposure to salt air
4. Exposure to oil vapors
5. Exposure to dripping moisture
6. Exposure to hot and humid climate
7. Seasonal or infrequent use
8. Exposure to extreme temperatures, or sudden change in temperatures
9. Exposure to excessive abrasive magnetic or metallic dust
10. Exposure to explosive mixtures of dust or gases
11. Exposure to water in the form of a steam such as is used for cleaning, etc.
12. Exposure to submersion
13. Exposure to abnormal vibration, shocks or tilting
14. Exposure to unusual transportation or storage
15. Unusual space limitations
16. Unusual insulation requirements
17. Unusual configuration of enclosing rooms, causing hot air pockets, rooms not having normal ventilation or rooms containing large amounts of magnetic material or stray magnetic fields
18. Unusual operating duty, frequency of operation or difficulty of maintenance
19. Operation at unstable control voltages
20. Unusual or special operation requirements
21. Exposure to extreme sun temperatures

Operating Conditions

(See Table 16)

The various operating conditions are outlined here and should be used with the appropriate tables.

(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 10 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 Column 2.

(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% power factor or higher for AC circuits.

(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 the 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.

Table 6 — Low Voltage Power Circuit Breaker Altitude Derating Factors

	Correction Factor			
Altitude Feet	Interrupting Capacity	Voltage	Current	Dielectric
6,600	1.00	1.00	1.00	1.00
8,500	1.00	.95	.99	.95
13,000	1.00	.80	.96	.80

Note: Value for intermediate altitudes may be derived by linear interpolation

68 T

Selection and Application

LKD Circuit Breakers
(See Tables 7, 8, & 9)

The following step by step procedure is to be used as a guide for proper circuit breaker and fuse selection.

1. Determine the system short-circuit capacity in symmetrical RMS amperes.
2. Determine from Table 7, columns 3, 4 and 5 respectively the approximate continuous current rating and the time-delay and instantaneous overcurrent trip settings.
3. Select from Table 7, columns 1, 2, 3 and 4 respectively the frame size, trip system rating, time-delay and instantaneous settings as follows:
   (a) When there is a choice of breaker frame size the larger will provide maximum flexibility in case of load growth.
   (b) The trip system rating should be equal to or greater than the value determined in Table 7, column 3.
   (c) Time-delay setting should be set at a value nearest to that determined in Table 7, column 4.
   (d) Instantaneous setting should be set at a value nearest to that determined in Table 7, column 5. However, this value may have to be adjusted downward to coordinate with Amp-Trap to be selected.

Amp-Trap® Selection

Table 8 is to be used for selecting the correct fuse sizes to coordinate the instantaneous and long time settings of the solid state trip device to provide proper coordination between the circuit breaker and fuse. It was developed to provide the greatest range of coordination possible, taking advantage of maximum fuse sizes whose let-thru current can be withstood by the circuit breaker. Refer to Fig. 3 for typical breaker Amp-Trap coordination curve.

Fig. 1, page 22, is a second aid in the selection of the proper Amp-Trap fuse sizes. However, Fig. 1 is not to be used as the only criterion if, as in the case of molded-case circuit breakers, there is an I^2t limitation in the equipment to be protected by the fuse (See Fig. 2).

Table 7 — LK Circuit Breaker Application

1	2	3	4	5
			Recommended Settings of Solid-State Trip Device	
Type of Application	Purpose of Circuit Breaker	Continuous Current Rating of Circuit Breaker	Time Delay	Instantaneous
Service entrance (general)	(a) To protect source transformer windings from overheating due to overload or fault current flow. (b) To protect circuit conductors from effects of overcurrent flow. (c) To provide safe and rapid means for connecting and disconnecting of load circuit.	Based upon 125% of the current rating	125% of the transformer current rating	700%
Service feeder (general)	(a) To protect circuit conductors from effects of overcurrent flow. (b) To protect connected electrical equipment from effects of fault current flow.	Based upon 115% of estimated load current	115% of estimated load current	700%
Individual Motor Circuit	(a) To protect motor windings from overheating due to overcurrent or fault current flow. (b) To protect circuit conductors and other connected electrical equipment from oversized or fault current flow. (c) To provide safe and rapid means of connecting and disconnecting motor circuit.	Based upon 115% of rated full-load current of motor	115% of rated full-load current of motor	1200%
Group motor circuit	(a) To protect circuit conductors from overheating. (b) To protect circuit conductors, motor windings and other connected electrical equipment from fault current flow. (c) To provide safe and rapid means of connecting and disconnecting common motor circuit from supply source.	Based upon 115% of largest motor full-load current plus sum of other motor currents	100% of circuit-breaker current rating	1200%
Combined motor and lighting	(a) To protect circuit conductors from overheating. (b) To protect circuit conductors, motor windings and other connected electrical equipment from fault current flow. (c) To provide safe and rapid means of connecting and disconnecting common load circuit from supply source.	Based upon 115% of largest motor full-load current plus sum of other motor and lighting load currents	100% of circuit-breaker current rating other motor	1200%
Lighting circuit	(a) To protect circuit conductors from effects of overload or fault current flow. (b) To provide safe and rapid means of connecting and disconnecting lighting circuit from supply source.	Based upon 125% of estimated maximum lighting current	100% of circuit-breaker current rating	700%

68U

There are two basic considerations in selecting Amp-Trap fuse size.

1. The peak let-thru current must not exceed the withstand capability of the equipment to be protected by the LKD circuit breaker.
   a. If the equipment protected by the circuit breaker has a peak current withstand capability at least equal to that of the circuit breaker*, fuse size selection may be made by using Tables 8 and 9.
   b. If the equipment protected by the circuit breaker has a peak current withstand capability less than the circuit breaker, Fig. 1, must be used to determine the maximum fuse size.

   Draw a vertical line on Fig. 1, representing the available symmetrical RMS amperes. Establish the intersection of this line with the peak amperes that the equipment is capable of withstanding. The fuse size represented by the fuse let-thru curve passing below this intersection is the maximum fuse size that should be used. Of course, the smallest fuse size, consistent with coordination, provides the best protection.

NOTE:
Low voltage power circuit breakers are tested for interruption in a circuit having a power factor of 0.15. This means that the peak short circuit current will equal 2.3 times the circuit breaker RMS symmetrical short-circuit rating. Other 600V equipment such as molded-case circuit breakers, is tested using a high power factor and, therefore, is provided to withstand a peak current of less than 2.3 times its RMS symmetrical rating.

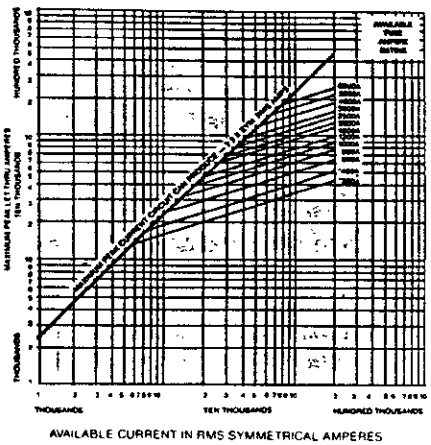


Figure 1 — Amp Trap Let-Thru Curves

2. The second consideration is that the fuse size coordinates with the circuit breaker solid-state trip device time current characteristics. Proper application of Tables 8 and 9 and its associated notes will assure coordination and, therefore, avoid needless fuse replacements for current levels within the interrupting rating of the breaker.

For application using special instantaneous settings, a breaker-fuse coordination curve should be drawn.

Fuse curves are normally plotted with time as the ordinate and current in amperes as the abscissa. However, the abscissa of the solid-state trip device time-current curves is in multiples of the range selector amperes and pickup setting. There are so many combinations of settings as to render it completely impractical to publish general coordination curves for fuses and solid-state trip devices.

When it is desired to plot specific coordination curves, the following procedure is suggested.

a. Replot the overcurrent device curve using actual amperes as the abscissa based on range selector amperes and pick-up settings selected. The curves may be moved right or left to accommodate settings not plotted on published curves. A transparent overlay is helpful in this procedure.

b. Enter the fuse melting time-current curve from Fig. 2, page 23, on this newly plotted overcurrent device curve and examine for proper coordination.

c. When fuse size is dictated by protection needs, the fuse curve should be plotted first and the overcurrent device settings are then determined by trial and error by replotting the overcurrent device curves.

When fused circuit breakers are used on high-inrush circuits such as motor starting, for extended periods, the maximum allowable fuse size from Tables 8 and 9 should be used regardless of instantaneous setting. Otherwise these fuses and other unblown fuses, after a short-circuit, may have melting times less than "when new". In this case, fuse replacement should be considered if the coordination is critical.

In order to obtain selection protection when fuses are applied in series, it is necessary that the fuse nearer the source have a current rating at least two times that of the fuse nearer the load, providing that both fuses are Chase-Shawmut, Type AL. The two-times ratio is applied to fuse ratings up to 2000A, but for fuse ratings of 2500A to 6000A the ratio may be reduced to 1½ times.

To illustrate the use of Fig. 1, Amp-Trap Let-Thru Curves, assume a fault current of 80,000 Amp symmetrical using a 300 Amp current-limiting fuse. Enter table at 80,000 Amp sym. and project to the intersection of this line with the curve for the 300 Amp fuse; then project this point horizontally to a value of 30,000 peak let-thru amp.

*LKD8-115,000 A peak
LKD16-150,000 A peak
LK25-230,000 A peak
LK32-230,000 A peak
LK42-299,000 A peak

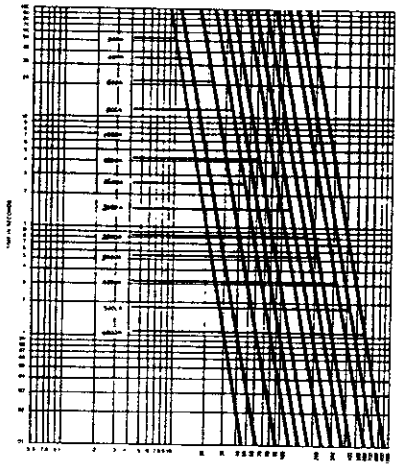
Notes for Tables 8 and 9 (page 23)

1. The maximum fuse for the frame size will not coordinate with the instantaneous trip setting listed. (See Note 3.)
2. The instantaneous setting selected should not be less than five nor more than fifteen times the long-time pickup setting selected.
3. When the selected settings and indicated fuse size will not coordinate, the following applies:
   a. Determine the degree of overlap by drawing a breaker-fuse coordination curve.
   b. If the degree of overlap is not deemed critical (low probability needless fuse blowing), accept the overlap.
   c. If the degree of overlap is deemed critical, utilize a short-time delay element in conjunction with the long-time and instantaneous elements to achieve coordination.
4. The coordinating fuse size is based on the range selector setting. If a higher setting is planned for future load growth, the maximum fuse size for the trip system range should be used to maintain proper coordination.
   The maximum fuse size in the table protects the circuit breaker with 200kA RMS symmetrical current available.

68 V

Table 8 — Type LSS-1 Trip Device with Amp-Trap Fuses

Circuit Breaker Type	Trip System Rating Amps.	Range Selector Amps.	Long-Time Setting X Range Selector	Instantaneous Pickup Setting X Range Selector	Coordinating Fuse Size (See Note 4) Min. Amps.	Max. Amps.
1	2	3	4	5	6	7
LKD-8	200	100	0.6, 0.7, 0.8, 0.9, 1.0	3, 4, 5, 7, 12	300	1600
		200	0.6, 0.7, 0.8, 0.9	3, 4, 5, 7	300	1600
		200	0.6, 0.7, 0.8, 0.9	12	400	1600
		200	1.0	3, 4, 5, 7	400	1600
		200	1.0	12	600	1600
	800	400	0.6, 0.7, 0.8, 0.9, 1.0	3, 4, 5, 7	600	1600
		400	0.6, 0.7, 0.8, 0.9	12	800	1600
		400	1.0	12	1000	1600
		800	0.6, 0.7	3, 4, 5, 7	1000	1600
		800	0.8, 0.9, 1.0	3, 4, 5, 7	1200	1600
		800	0.6, 0.7, 0.8, 0.9, 1.0	12	1600	1600
LKD-16	200	100	0.6, 0.7, 0.8, 0.9, 1.0	3, 4, 5, 7, 12	300	2500
		200	0.6, 0.7, 0.8, 0.9	3, 4, 5, 7	300	2500
		200	0.6, 0.7, 0.8, 0.9	12	400	2500
		200	1.0	3, 4, 5, 7	400	2500
		200	1.0	12	600	2500
	800	400	0.6, 0.7, 0.8, 0.9, 1.0	3, 4, 5, 7	600	2500
		400	0.6, 0.7, 0.8, 0.9	12	800	2500
		400	1.0	12	1000	2500
		800	0.6, 0.7	3, 4, 5, 7	1000	2500
		800	0.8, 0.9, 1.0	3, 4, 5, 7	1200	2500
		800	0.6, 0.7, 0.8, 0.9, 1.0	12	1600	2500
	1600	800	0.6, 0.7	3, 4, 5, 7	1000	2500
		800	0.8, 0.9, 1.0	3, 4, 5, 7	1200	2500
		800	0.6, 0.7, 0.8, 0.9, 1.0	12	1600	2500
		1600	0.6, 0.7, 0.8	3, 4, 5, 7	2000	2500
		1600	0.9, 1.0	3, 4, 5, 7	2500	2500
		1600	0.6, 0.7, 0.8, 0.9, 1.0	12	See Note 1	



CURRENT IN AMPERES X 100

Figure 2 — Melting Time-Current Characteristic Curves

Table 9 — Coordination of LK Circuit Breakers and Separately Mounted Fuses†

LK 25	2500	1250	0.6, 0.7	3, 4, 5, 7	1600	6000
			0.8, 0.9, 1.0	3, 4, 5, 7	2000	6000
			0.6	12	2000	6000
			0.7, 0.8, 0.9, 1.0	12	2500	6000
		2500	0.6	3, 4, 5, 7	3000	6000
			0.7, 0.8, 0.9, 1.0	3, 4, 5, 7	4000	6000
			0.6, 0.7, 0.8, 0.9, 1.0	12	5000	6000
LK 32	3200	1600	0.6, 0.7, 0.8, 0.9	3, 4, 5, 7	2000	6000
			1.0	3, 4, 5, 7	2500	6000
			0.5	12	2500	6000
			0.7, 0.8, 0.9, 1.0	12	3000	6000
		3200	0.6, 0.7	3, 4, 5, 7	4000	6000
			0.8, 0.9, 1.0	3, 4, 5, 7	5000	6000
			0.6	12	5000	6000
			0.7, 0.8, 0.9, 1.0	12	6000	6000
LK 42	4200	2100	0.6, 0.7, 0.8, 0.9, 1.0	3, 4, 5, 7, 12	6000	6000
		4200	0.6, 0.7, 0.8, 0.9, 1.0	3, 4, 5, 7, 12	6000	6000

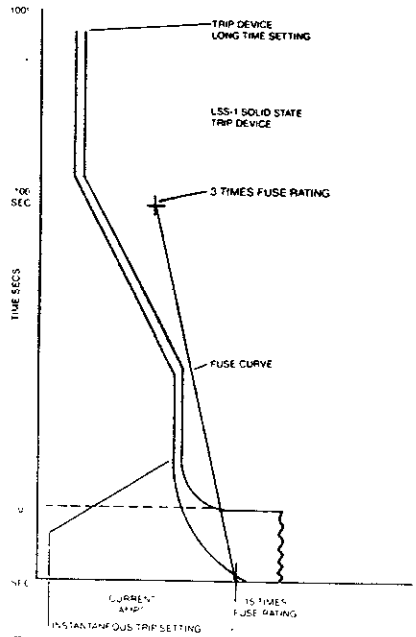


Figure 3 — Typical Breaker Amp-Trap Coordination Curve

†A drawout fuse carriage incorporating provisions for Kirk Key interlocking with its associated circuit breaker is available

Operating Sequence

Electrically Operated

With the circuit breaker open, the closing springs discharged and the control power source energized, when the motor disconnect switch (MDS) is placed in the "ON" position (closed), the following operations occur:

1. Immediately upon availability of control power, the spring charging motor (M) is energized, which in turn charges the closing springs. When the closing springs reach the fully charged condition (a) limit switch LS/1 opens to deenergize the charging motor (M), (b) limit switch LS/3 closes to set up the closing circuit, (c) the operating linkage of limit switch LS/2 is released to close contact LS/2 but if the "Y" relay (Y) is energized closing of the LS/2 contact will be blocked until the "Y" relay (Y) is deenergized.
2. Operation of the "close" switch simultaneously energizes the "Y" relay (Y) and the close coil (X) through the circuit breaker auxiliary switch "b" contact and the limit switch contacts LS/2 and LS/3. The close coil (X) releases the closing latch permitting the closing springs to discharge and close the circuit breaker.
3. When the "Y" relay (Y) is energized the limit switch LS/2 is latched open, as long as, a close signal is maintained immediately following a closing spring operation. Upon release of the closing signal the "Y" relay (Y) is deenergized and LS/2 contact closes. The purpose of the "Y" relay (Y) is to prevent pumping of the closing mechanism when closing against a faulted circuit. A second close operation can not occur until the "Y" relay (Y) is deenergized and a close signal is reapplied.
4. When the circuit breaker closes, all auxiliary switch "b" contacts open and all auxiliary switch "a" contacts close.
5. When the springs discharge, limit switch contact LS/1 closes, contact LS/3 opens, and the operating linkage of limit switch LS/2 opens contact LS/2.
6. On maintained control, the close signal must be interrupted to permit deenergizing of the "Y" relay (Y) in order to unlatch the limit switch LS/2 linkage to close limit switch LS/2 contact. On momentary control the "Y" relay (Y) is deenergized as soon as the close signal is removed allowing limit switch LS/2 to close.
7. The circuit breaker can be tripped by operation of the "trip" control switch which energizes the circuit breaker trip coil (TC) through the auxiliary switch "a" contact.
8. The closing springs recharge when the circuit breaker is in the open or tripped position (except as otherwise noted) because the auxiliary switch "b" contact closes.

Manually Operated

With the circuit breaker open, the closing springs discharged, the manual spring charging handle is pumped to charge the springs.

1. The circuit breaker may be closed locally at the breaker by pushing the manual close button.
2. The circuit breaker may be tripped locally by the manual trip lever on the circuit breaker control center, the emergency trip on the cradle, or it may be tripped remotely when provided with an electrical shunt trip feature.
3. The closing springs may be charged manually when the circuit breaker is in the open or closed position.

General

1. The undervoltage device, if applicable, provides a direct acting lockopen and undervoltage tripping feature. This device must be energized to initially close the breaker, and also to maintain the circuit breaker in a closed position.
2. The undervoltage lock open feature (optional) locks the circuit breaker open until control power is available. It also does not trip the circuit breaker on loss of control power.

G8 X

Control Circuit Diagrams

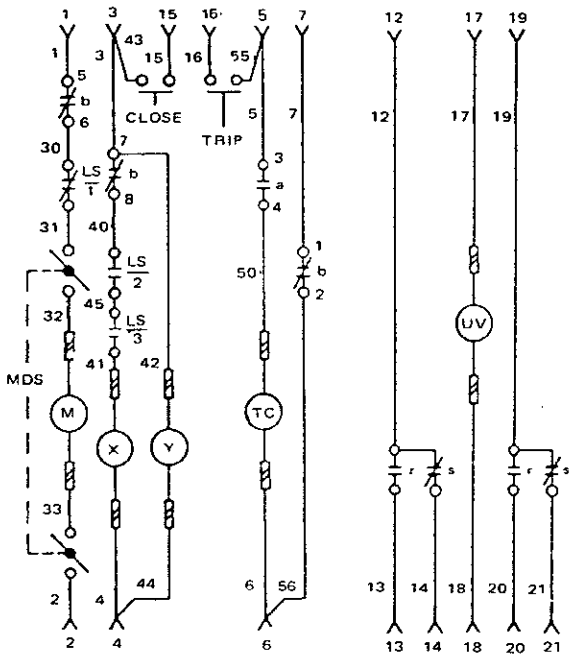


Figure 4 — Typical Schematic Wiring Diagram of Control Circuit, 3-wire Scheme

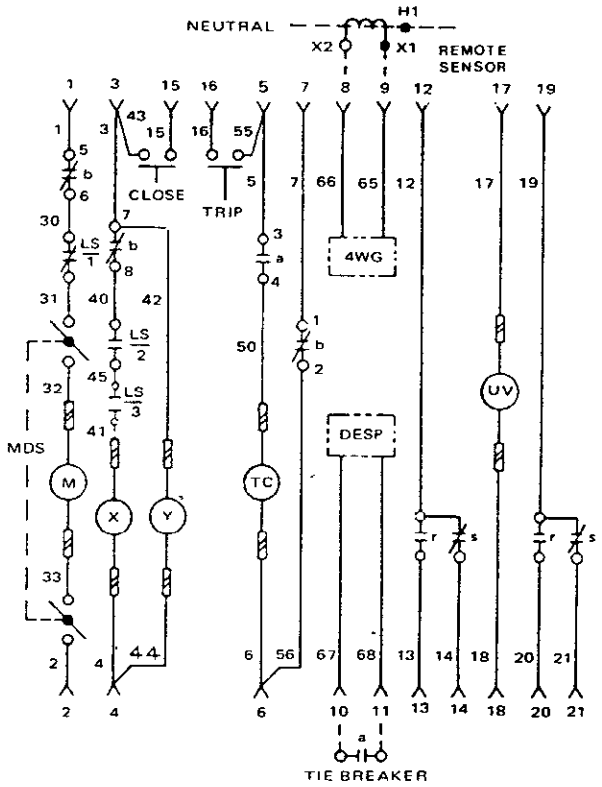


Figure 5 — Typical Schematic Wiring Diagram of Control Circuit, 4-wire Scheme with Doubled Ended Substation Protection.

SYMBOL	DESCRIPTION
a	AUXILIARY SWITCH CONTACT, OPEN WHEN BREAKER IS OPEN.
b	AUXILIARY SWITCH CONTACT, CLOSED WHEN BREAKER IS OPEN.
LS/2	LIMIT SWITCH CONTACT. CONTACT OPEN WHEN CLOSING SPRINGS ARE DISCHARGED AND IS LATCHED OPEN WHEN "Y" COIL IS ENERGIZED. CONTACT UNLATCHED CLOSED WHEN "Y" COIL IS DE-ENERGIZED.
CLOSE	LOCAL ELECTRICAL CLOSE PUSHBUTTON
TRIP	LOCAL ELECTRICAL TRIP PUSHBUTTON.
LS/1	LIMIT SWITCH CONTACT. CLOSED WHEN SPRINGS ARE DISCHARGED. OPEN WHEN SPRINGS ARE CHARGED.
LS/3	LIMIT SWITCH CONTACT. OPEN WHEN SPRINGS ARE DISCHARGED CLOSED WHEN SPRINGS ARE CHARGED.
M	MOTOR, CLOSING SPRING CHARGING.
MDS	MOTOR DISCONNECT SWITCH.
r	ALARM CONTACT CLOSES ON OVERCURRENT (AND/OR GROUND) TRIP, MANUALLY RESET.
r(uv)	UNDERVOLTAGE ALARM SWITCH CONTACT. CLOSES ON UV TRIP OPEN WHEN UV PICKS UP
s	ALARM CONTACT OPENS ON OVERCURRENT (AND/OR GROUND) TRIP, MANUALLY RESET
TC	SHUNT TRIP COIL
UV	UNDERVOLTAGE DEVICE (TRIP OR LOCK OPEN)
SS ALARM	SOLID-STATE ALARM SWITCH (GROUND TRIP ALARM OR HIGH LOAD ALARM FUNCTION)
AR	ALARM RELAY COIL (GROUND TRIP ALARM OR HIGH LOAD ALARM FUNCTION)
X	CLOSE COIL, CLOSING LATCH RELEASE
Y	"Y" RELAY COIL (PREVENTS PUMPING)

□	TERMINAL BLOCK
-⊠-	WIRE DISCONNECTS
⋋	MOVABLE SECONDARY DISCONNECT CONTACTS.
HI	PRIMARY SIDE OF NEUTRAL SENSORS.
X1 & X2	SECONDARY SIDE OF NEUTRAL SENSORS
■	POLARITY MARK — ORIENT NEUTRAL SENSOR PRIMARY POLARITY (HI) TOWARD SOURCE IF BREAKER UPPER TERMINALS ARE SOURCE TERMINALS REVERSE IF BREAKER UPPER TERMINALS ARE LOAD TERMINALS.
4WG	4 WIRE GROUND TRIP FUNCTION
DESP	DOUBLE ENDED SUB-PROTECTION 4 WIRE GROUND FUNCTION

NOTE a AND b CONTACTS FOR CUSTOMER USE ARE MOUNTED ON CRADLE AND WIRED DIRECTLY

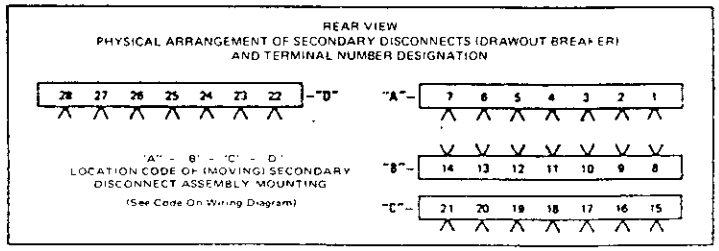


Figure 6 — Wiring Diagram Legend

Ratings

Table 10— Electrical Ratings of Auxiliary* and Alarm Contacts

Nominal Control Voltage	Contact Rating, A: Load Alarm, Ground Alarm	Contact Rating, A: Auto Trip Alarm, Undervoltage Alarm, Open Fuse Trip Alarm	MOC TOC
110-120 V ac 50/50 HZ	5**	11 4 (Lamp Load)	30
208-240 V ac 50/50 HZ	N/A	11	20
480 V ac 50/50 HZ	N/A	N/A	10
600 V ac 50/50 HZ	N/A	N/A	7
24 V dc	5**	6.0 10 Lamp Load	20
48 V dc	5**	2.5	15
125 Vdc	5**	.5	10
250 V dc	N/A	.25	5

*Integral auxiliary switch on breaker applicable for red and green lights only

**Shown is make and carry current. Make and break current is 1 Ampere

N/A — Not applicable.

Table 11 — Undervoltage Trip Device

Nominal Control Voltage	Current at Voltage, A	Minimum Pick-up Voltage, A	Dropout Voltage Range: Minimum V	Dropout Voltage Range: Maximum V
120 V ac	.44	102	36	72
240 V ac	.22	204	72	144
480 V ac*	.11	408	144	288
600 V ac*	.09	510	180	360
48 V dc	.33	41	14	29
125 V dc	.14	106	38	75
250 V dc	.07	212	75	150

*Ratings of 440/480 V ac and 550/600 V ac are not recommended. Local codes may require segregated wiring and current limiting fuses connected to the power source.

Table 12 — Circuit Breaker Control Power Requirements

Circuit Breaker Type	Nominal Control Voltage	Average Charging Motor Current, A	Shunt Trip Current, A	Close Current, A: Anti-Pump Y Coil	Close Current, A: Release X Coil	Closing Circuit Range, V	Trip Circuit Range, V	Recommended Control Circuit Fuse Size, A
LK, LKE & LKD 8	120V ac	10	9.0	.36	9.0	104-127	104-127†	10
LK, LKE & LKD 16	240V ac	5	4.5	.18	4.5	208-254	208-254	10
LK & LKE 25	48V dc	15	6.6	24	6.6	38-56	28-56	15
LK & LKE 32	125V dc	6	2.6	.12	2.6	100-140	70-140	10
LK & LKE 42	250V dc	3	1.3	.06	1.3	200-280	140-280	10

†Special shunt trip available for ground fault relay tripping

Table 13 — LK, LKE and LKD Circuit Breaker Load Switching Time (60 HZ Base)

Circuit Breaker Type	Charging*	Closing	Opening †
LK, LKE & LKD 8	2.0 Seconds	2.5 Cycles	2.0 Cycles
LK, LKE & LKD 16	2.0 Seconds	2.5 Cycles	2.0 Cycles
LK & LKE 25	2.5 Seconds	3.0 Cycles	2.0 Cycles
LK & LKE 32	2.5 Seconds	3.0 Cycles	2.0 Cycles
LK & LKE 42	2.5 Seconds	3.0 Cycles	2.0 Cycles

* Electrically operated spring charging motor
†No load mechanical

Table 14 — LK, LKE and LKD Circuit Breaker and Cradle Weights (Lbs.)*

Circuit Breaker Type	Manual Operation	Electrical Operation	Cradle
LK & LKE 8	152	167	89
LK & LKE 16	170	185	104
LK & LKE 25	280	295	158
LK & LKE 32	290	305	173
LK & LKE 42	294	309	177
LKD 8	228	243	109
LKD 16	266	281	124

*Circuit breakers and cradles weighed fully equipped

Table 15 — Integral Fused Current Limiting Power Circuit Breaker Ratings

Circuit Breaker Type	Frame Size, A	System Voltage AC, V	Maximum Continuous Current, A	Maximum Interrupting Symmetrical Rating, RMS A	Range of Circuit Breaker Pickup, A	Amp-trap Continuous Rating, A
LKD 8	800	Up to 600	800	200,000	50-800	300-1600
LKD 16	1600	Up to 600	1600	200,000	50-1600	300-2500

Table 16 — Circuit Breaker Operations for Repetitive Duty and Maintenance

Circuit Breaker Frame Size, A Col. 1	Number of Operations Between Servicing Col. 2		Number of Operations					
			No Load Mechanical Col. 3		Rated Continuous Current Col. 4		Inrush Current Switching Col. 5	
Operating Conditions (See Page 20)	*Para. A	▲ Brown Boveri Electric	*Para. A thru G	▲ Brown Boveri Electric	*Para. A, C thru H and J	▲ Brown Boveri Electric	*Para. C thru G I and J	▲ Brown Boveri Electric
800	1750	1750	9700	9700	2800	2800	1400	1400
1600	500	500	3200	3200	800	800	400	400
2500	250	500	1100	3200	400	800	★	400
3200	250	500	1100	3200	400	800	★	400
4200	250	500	1100	3200	400	800	★	400

* Per ANSI Standard C37.16-1973
★ Not included in the standard
▲ All LK, LKE and LKD circuit breakers are built to meet and exceed industry standards. Table indicates the capabilities of the LK design when operated under usual service conditions. The excerpt from the ANSI standards, specifically paragraphs A to J inclusive list the conditions which must be considered in order to achieve the number of circuit breaker operations shown.

Ordering Information

Color denotes choice of alternates or specific information to be supplied. Control voltage and frequency must be given for close and trip coils, spring charging motor and any other voltage auxiliary device. (Cross out items not required):

Circuit Breakers —
_____ Quantity three pole; (600) (480) (240) (208) Volt, (50) (60) Hz.; Drawout circuit breakers; Type LK, LKE, (8) (16) (25) (32) (42), LKD (8) (16); (Manual) (Electrical) operation, control voltage _____ Trip, _____ Close, _____ Spring Charge Motor; (200) (800) (1600) (2500) (3200) (4200) A current sensors for AC Power-Shield trip unit with (long-time), (short-time) (instantaneous) (ground), (3W), (4W) trip functions. Targets (are) (are not) required for each function specified.

When ordering circuit breakers (LK25, 32, 42) with separately mounted fuses, add an extra secondary disconnect for open fuse trip unit to energize the shunt trip circuit. Order the associated cradle with type "D" key interlock provision. The separately mounted fuses are ordered by description which includes the fuse size and the secondary disconnect to energize the shunt trip of the associated circuit breaker.

Add description for circuit breaker optional features:
Alarm Switches
- Automatic trip (1r & 1s) or (2r & 2s) contacts
- High Load (no trip), 1-N.O. contact
- Undervoltage trip, 1-N.O. contact
- Ground Trip, 1-N.O. contact (momentary)
- Open fuse trip (LKD only), 1-N.O. contact

Local electrical close and trip pushbuttons
Overcurrent lockout (manual reset)
Undervoltage trip — Instantaneous (_____ V _____ Hz)
Undervoltage trip — Factory set Time Delay 0-15 sec. (_____ V _____ Hz)
Shunt Trip (_____ V _____ Hz)
Operation Counter
Wiring change to charge close springs after close
Additional secondary disconnects _____ (up to 28 total)
Test set for Power-Shield type LSS — Solid-state trip unit

Drawout Cradles —
_____ Quantity three pole for Type LK, LKE (8) (16) (25) (32) (42) LKD (8) (16) (Manual) (Electrical) operation, (800) (1600) (2500) (+3000) (3200) (+4000) (4200) A continuous current rating; system voltage (208/120) (240) (480) (480/277) (550) (600) A.C. (50) (60) Hz.

+ NOTE: sensor to coordinate LK32, 42 with separately mounted fuses.

Add description for cradle optional features:
Auxiliary switches
- MOC—4 or 8 contacts, 4 (2a & 2b), 8 (4a & 4b)
- TOC—4 or 8 contacts, 4 (2h & 2s), 8 (4h & 4s), all to operate between connect and test or test and disconnect positions or (4 to operate between connect and test and 4 to operate between test and disconnect positions).

Key interlock (provisions)
Circuit breaker contact position indicator (operates in connected or connected and test positions).
Mechanical transfer interlock (between two adjacent breakers).
Additional secondary disconnects _____ (up to 28 total)
Secondary disconnects—connected (op) or test (tp) positions

In addition to completely specifying the required circuit breaker and cradle information, include any unusual conditions concerning application, required shipping date, method of shipment, and any other considerations that are applicable.

Example No. 1 —
One (1), three pole; 480V, 60Hz; drawout circuit breaker; Type LK16; manual operation; control voltage — none; 800 A current sensors for AC Power-Shield trip unit General Purpose, Type LSS-1 with Long-time and Instantaneous trip functions; Targets are not required.

Example No. 2 —
One (1), three pole; 480V, 60Hz; drawout circuit breaker; Type LK8; electrical operation, control voltage 120 Volts, 60Hz trip, close, spring charge motor; 200 A current sensors for AC Power-Shield trip unit Total Purpose, Type LSS-5G with Long-time, Short-time, Instantaneous, Ground, 3W, trip functions; Targets are required for each trip function supplied.

Example No. 3 (cradle for Example No. 2) —
One (1), three pole drawout cradle for Type LK8; Electrical Operation; 800 A continuous current rating; system voltage 480 Volts AC, 60Hz.

Additional Technical Data:

IB 6.1.1.7-1
RP 6.1.1.8-1
Test Set IB 6.1.1.7-2
Time Current Characteristic Curves:

LSS-1	TD-9058
LSS-2	TD-9068
LSS-4	TD-9060
LSS-5	TD-9060
LSS-6	TD-9059
LSS-1G thru 6G	TD-9062

C-8323

( ) denotes choice of alternates or specific information to be added by the specification writer.

AC Power circuit breakers shall be three (3) pole, 635 volts maximum service at 50/60 Hz. The arcing contacts shall be made of silver molybdenum alloy and the main contacts to be made of heavy silverplated copper with both sets operating with a wiping, self-cleaning action. The (Manual) (Electrical) operating mechanism is to be of the (Manual) (Motor) spring charged, stored energy type with an integral manual charging handle supplied on all manually operated or electrically operated breakers. The closing operation shall be separate from the charging operation and shall be initiated after charging by a manual closing push button which releases the spring energy to close the circuit breaker contacts. A control center shall be provided as part of the breaker front plate containing manual trip lever, manual close push button, primary contact position indicator, automatic trip indicator, and padlock hasp which receives up to three padlocks when the breaker is in the open position positively preventing unauthorized closing of the breaker. The control center shall be accessible through an access port in the circuit breaker compartment door.

The circuit breakers shall be of the drawout type using a proven cradle design with self-aligning primary and secondary disconnecting contacts. The drawout mechanism shall hold the circuit breaker rigidly in the connected, test, disconnected and out positions. The cradle rails shall extend forward from the cell and allow the circuit breaker to be withdrawn to the out position and rotated to expose both the back and the bottom of the breaker for maintenance and inspection. Interlocks shall prevent racking of the breaker to any of the drawout positions unless the main contacts are open. Provisions shall be made for padlocking the breaker open and in any of the positions noted above. Racking of the breaker shall be controlled by a positive stop latch in connected, test and disconnected positions. This stop latch must be released by a racking release lever in order to rack breaker from one position to the next. All racking provisions including cranking, racking release lever, and breaker position indicator shall be located in the control center and be accessible through an access port with breaker compartment door closed.

The drawout cradle shall include provisions to mount up to three (3) current transformers (one per phase) around the stationary primary contacts and an interference block to allow only the circuit breaker with correct frame rating to be inserted into the cradle.

Each electrically operated circuit breaker shall be equipped with a spring charging motor _____ volts (AC) (DC) _____ Hz., and closed by using either the manual close push button or the electrical closing coil assembly _____ Volts (AC) (DC) _____ Hz (energized by a pushbutton on the front plate) (and/or a remote breaker control switch) shall be included to electrically open the circuit breaker. A charging motor disconnect switch will be provided on the frontplate to facilitate maintenance and emergency test operation with the motor disconnected.

Each circuit breaker shall be provided with a solid-state trip device equipped with (Long Time) (Short Time) (Instantaneous) (3W) (4W) (Ground Fault) trip elements coordinated with (Long Time) (Short Time) (Ground Fault) time delay adjustments, each capable of being set using accurate, easy to use tap plugs. A target is to be provided with each trip element supplied and is to be displayed independent of control power. All solid-state trip devices are to be capable of being tested using a portable test set which can also be used to test the automatic trip indicator.

Add for Fused (LKD) Circuit Breakers
Circuit breakers shall include current limiting Amp-Trap fuses integrally mounted and coordinated with the solid-state trip device so as to avoid unnecessary operation of the current limiting fuses. All fused breakers will be equipped with an open fuse trip lockout device that is visible from the front plate and trips the breaker when a fuse opens. The open fuse indicator shall display which fuse has opened and its associated lockout shall prevent the breaker from being reclosed until the fuses are replaced and the lockout is manually reset.

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Supersedes Issue A
Printed in USA 10 M 1083

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