Systems Pow-R Breaker With Pow-R TRIP 7

Introduction

The Westinghouse Systems Pow-R Breaker, the worlds first encased power breaker, is not just an extension of existing technology. It represents the biggest breakthrough in circuit protection since the invention of the DE-ION® principle of arc extinguishing (also a Westinghouse first) in 1927.

The Systems Pow-R Breaker is an entirely new concept in circuit protection, designed to meet the increasingly demanding parameters of today's complex distribution systems. In designing to these parameters, the Westinghouse philosophy was to first define the needs of Consulting Engineers, Switchboard Assemblers, and the end user, and then set out to meet those needs.

Application

Systems Pow-R Breakers can be applied in switchboards as mains, ties and feeder breakers. Because they combine high interrupting capacity with short-time delay tripping, Systems Pow-R Breakers can be applied in fully rated, selective systems while providing full selectivity through the applied breaker's short time rating.

Individual breakers in separate enclosures can be applied in low voltage distribution systems through 600 volts Ac, 50/60 Hertz.

In addition, the many individual design and construction features of the Systems Pow-R Breaker satisfy application requirements of a broad range of important industries.

Construction Industry

Systems Pow-R Breaker features most beneficial to the Construction Industry are:

- Underwriters' Laboratory label
- High interrupting capacity without fuses
- Increased short time ratings for system continuity
- 100% ratings
- Application flexibility of "options oriented" design
- Safety considerations for personnel and equipment
- Maximum five cycle closing
- Compact size and layout flexibility
- Compliance with various local and national codes

Offshore Industry

Application of the Systems Pow-R Breaker in this industry refers primarily to generator paralleling and Thyristor Drive Protection. In addition:

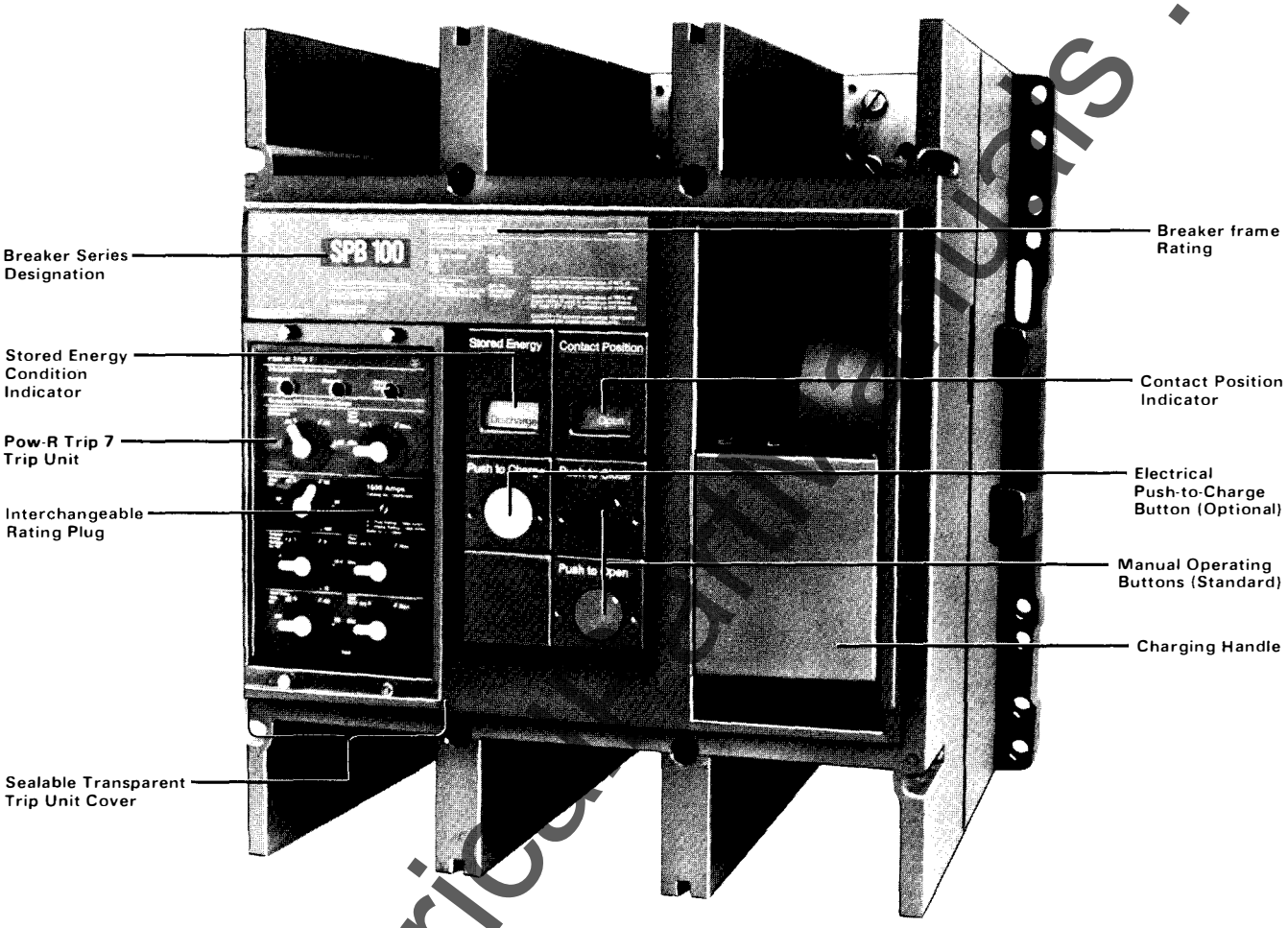
- Compact size is vital due to space limitations
- Rugged construction of the breaker and its drawout assembly is essential
- True-two step stored energy mechanism with maximum five cycle closing in either manual or electrically operated units
- Same physical size for both manual or electrically operated units

Stand-by Emergency Power Industry

This industry is primarily concerned with generator paralleling, and the following Systems Pow-R Breaker features are most beneficial:

- True two-step stored energy mechanism with maximum five cycle closing in either manually or electrically operated mode.
- Same compact size for both manual or electrically operated units
- Availability of 800 amp physical frame

Description



The Systems Pow-R Breaker family consists of three physical frame sizes: 800, 1600 and 3000 amperes. The 800 ampere frame covers ratings of 250 and 800 amps; the 1600 amp frame has a single rating of 1600 amps; and the 3000 amp frame includes ratings of 2000 and 2500 amps as well as 3000 amps. All three physical frames have the same width, depth and pole spacing with height being the only dimensional variation.

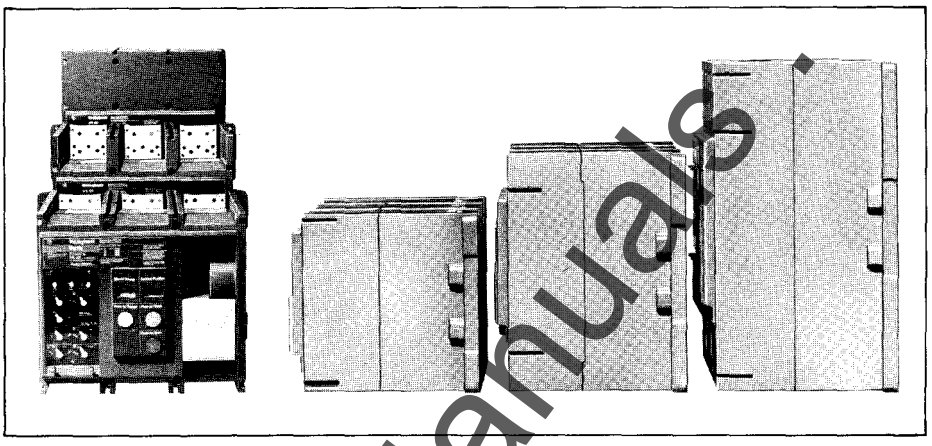
Systems Pow-R Breakers are identified by four series: SPB-50, SPB-65, SPB-100 and SPB-150. The numbers after SPB refer to the interrupting capacity in RMS symmetrical amps at 480 volts Ac without fuses. Thus, in the SPB-100 series, any breaker from 250 to 3000 amps may be supplied with a UL Listed interrupting capacity of 100,000 amps at 480 volts Ac without fuses. Complete I.C. ratings are shown in Table A.

Standard Features

UL Listing for 100% Application All Systems Pow-R Breakers are suitable for continuous operation at 100% of the frame rating. Thus, the Systems Pow-R Breaker, including the load side bus or cable, can be sized to the connected load, eliminating need for oversizing as with conventional over-current devices.

Uniform Appearance, Compact Size All Systems Pow-R Breaker ratings-160 to 3000 amperes-have same depth, width and pole spacings for both manual and electrically operated units, permitting simplified bus arrangements and layout of assemblies.

True Two-Step Stored Energy Mechanism Both mechanically and electrically operated versions feature a true two-step stored energy mechanism with no change in dimensions. This mechanism allows maximum five cycle closing usually required for generator paralleling

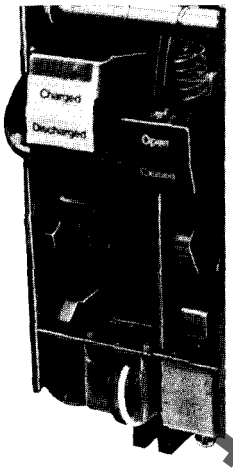


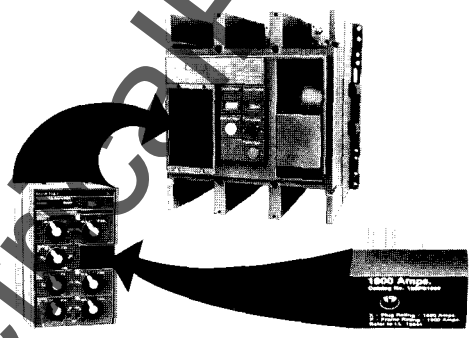
Each of the three Systems Pow-R Breaker frame sizes features the same width and depth, whether manual or electrical operated.

Safety Interlocking Systems Pow-R Breakers offer multiple layers of protective interlocking: (1) rating plugs and trip units are keyed to insure that they cannot be inserted in any trip unit or frame except the correct one: (2) attempting to remove a rating plug while the breaker is closed will trip the breaker; and (3) a breaker cannot be closed unless a rating plug is installed.

Durability Systems Pow-R Breakers are capable of 4000 operations at rated load followed by 4000 operations at no load without maintenance.

Ease of Maintenance Draw-out Systems Pow-R Breakers may be rotated 180° in fully withdrawn position for access to main and secondary disconnects. Main contacts and Pow-R Trip 7 sensor units are field replaceable.





Main contacts

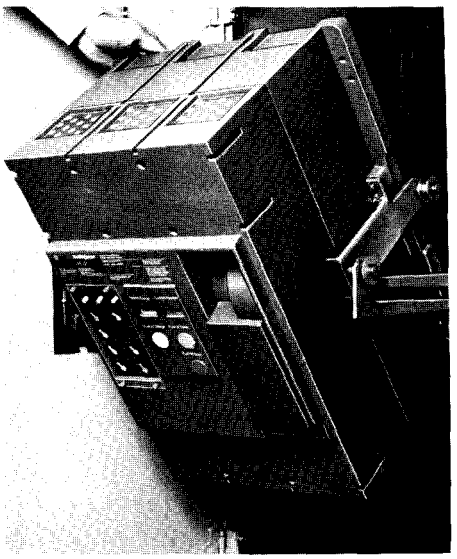
Solid State Trip Unit Pow-R Trip 7 trip units for Systems Pow-R Breakers are solid state, totally enclosed devices that plug into the front of the breaker and are interchangeable between compatible breaker frames.

Continuous Rating Rating plugs establish the nominal maximum continuous ampere rating of the breaker. They plug into the trip unit and are interchangeable between compatible trip units.

Breaker Status Indicators Color coded visual indicators are provided to indicate position of contacts (Open or Closed), as well as status of closing springs (Charged or Discharged).

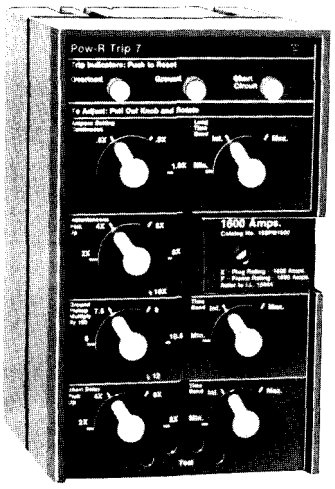
Anti-Pump Provisions to prevent unwanted closing or reclosing operations when used with a maintained closed contact in the close circuit, anti-pump provisions are provided as standard on electrically operated breakers, and can be supplied on manually operated breakers with spring release solenoid.

Common Wiring Diagram All Systems Pow-R Breakers use the same wiring diagram regardless of the number of attachments requested. The common wiring diagram simplifies the equipment assemblers' task of preparing his schematic diagram.



Breaker being tilted out for inspection.

Operation
Pow-R Trip 7 Solid State Trip Unit



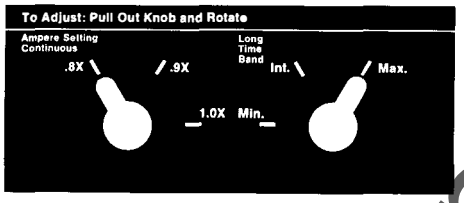
The solid state trip unit and sensor package is the heart of the Systems Pow-R Breaker. It provides the breaker's tripping function; it features up to seven time/current systems-coordination adjustments; it contains the rating plug which establishes the breaker's continuous ampere rating; and, as an option, it can provide up to three resettable visual indicators to define reason for breaker's tripping-overload, short-circuit, or ground fault. Trip units are interchangeable between compatible breaker frames.

Trip Method
Automatic breaker tripping operations are accomplished through the use of a special low-energy, flux-transfer shunt trip that requires no external control power. A conventional shunt trip device can be factory or field mounted if remote opening of the breaker is desired.

Time/Current System Coordination Adjustments
The standard Pow-R Trip 7 trip unit provides the following system coordination adjustments: adjustable ampere setting, adjustable long time delay, and adjustable instantaneous trip.

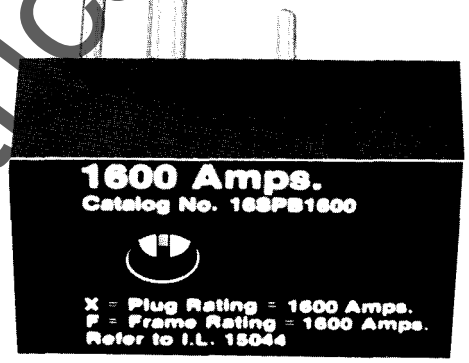
Other adjustments available in various combinations with the standard adjustments are short time pick-up, short-time delay, ground fault pick-up and ground fault delay. For selective tripping applications, the instantaneous adjustment may be omitted when the short time adjustments are selected.

All adjustments are made using non-removable, discrete step, high reliability switching plugs to assure positive, accurate adjustments.



To prevent tampering once the adjustment plugs have been set, the transparent cover over the face of the trip unit can be sealed.

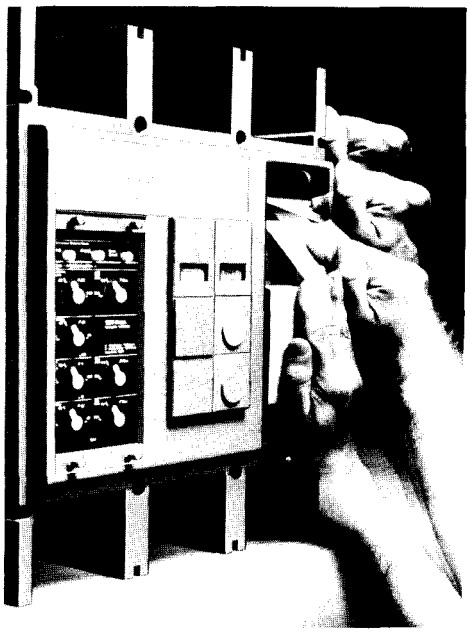
Rating Plugs
The continuous ampere rating of Systems Pow-R Breakers is determined by a rating plug which is inserted in the trip unit. Rating plugs are available as listed below to permit close matching of the breaker and load side conductor to the actual load.



Breaker Frame Ampere Rating	Plug Ampere Ratings
250	200, 225, 250
800	300, 400, 500, 600, 700, 800
1600	1000, 1200, 1600
2000	2000
2500	2500
3000	3000

The rating plug is interlocked with the tripping mechanism to automatically open the breaker when the plug is removed, and the breaker remains "trip free" until the plug is replaced. Rating plugs are interchangeable between compatible trip units, and are keyed to prevent their being inserted in incorrect trip units.

Charging and Closing of Stored Energy Mechanism
The two-step stored energy system employed by the Systems Pow-R Breaker provides maximum five cycle closing, either manually or electrically operated. The charging and closing actions in the mechanism utilize separate operating shafts, which allows design optimizing of the components in each portion of the mechanism.

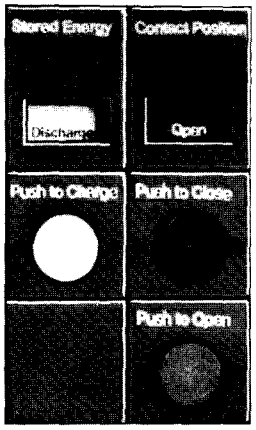


Manual charging of breaker

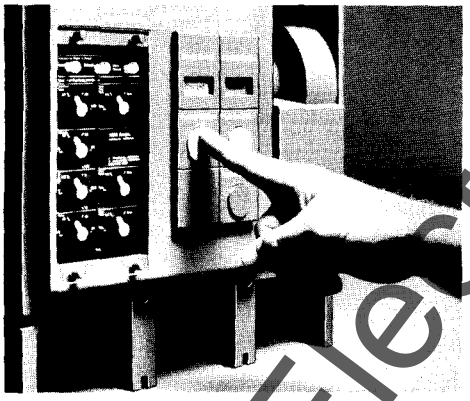
Manual charging, above, is accomplished by a constant-force charging handle, using four full strokes or several partial inching strokes as desired. Electrical charging by a motor-driven operator is available as an option.

Both manual and electrically operated breakers have multiple charge-close provisions which makes possible the charge-close-recharge-open-close-open sequence. As a safety feature, the stored energy can be discharged without closing the breaker.

Construction Features *Continued*
Color coded status indicators on the breaker front cover, below, indicate stored energy condition and main contacts position. The stored energy indicator will not read "charged" until the mechanism is completely charged and ready to close.



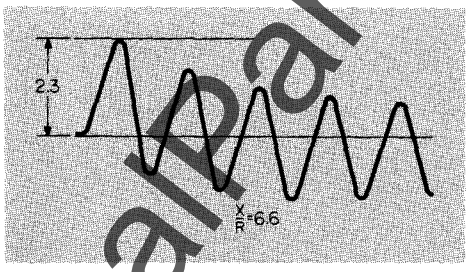
Closing operations, below, can be accomplished by a manual pushbutton on the breaker front, or by a remote close circuit using an optional spring release solenoid. Electrically operated breakers have anti-pump provisions as standard. The same anti-pump provisions are available as an option on manually operated breakers using spring release solenoids for remote closing operation.



Optional Systems Coordinating Adjustments

Short Time Ratings
Short time ratings are the key to systems coordination. Systems Pow-R Breaker short time ratings vary with the frame rating selected. Values of 25,000, 35,000 and 51,000 amps RMS Symmetrical are available (See Table 1). For selective coordination purposes, short time delay settings up to a maximum of 18 cycles (0.3 seconds) in three discreet steps are available.

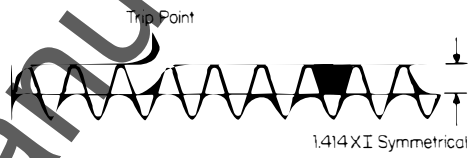
The design and test parameters of Systems Pow-R Breakers are based on a 600 volt distribution system with an X/R ratio of 6.6, which equates to a test power factor of 15%. In a system having these characteristics, the maximum peak offset in the first one-half cycle of a "worst case" condition can be as much as 2.3 times the RMS symmetrical value of the fault. By using these design parameters, no decrease in the specified short time ratings occur.



15% Power Factor Test Parameters

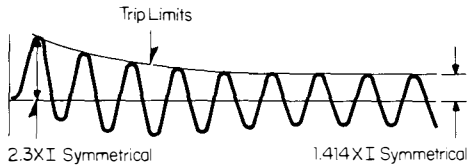
The reason that the short time rating does not decrease is the unique optional selective override circuit of the Systems Pow-R Breaker. This feature differs greatly from instantaneous override or fixed instantaneous trip circuits.

Instantaneous override or fixed instantaneous trip circuits respond only to a fixed RMS Symmetrical peak current, which equals the stated RMS symmetrical short time rating times 1.4.4 (i.e. $\sqrt{2}$). These types of circuits are not capable of making allowances for the assymetrical offset which occurs in all faults and thus result in some decrease of their short time rating. The amount of derating is a direct factor of the system power factor.



Instantaneous Override

The selective override circuit in a Systems Pow-R Breaker allows the breaker to ride thru a fully offset fault within its short time rating. Selective coordination is provided with the down stream device which clears the fault, and continuity of service is maintained for all other unfaulted feeders.



Selective Override

Note: The selective override circuit is included in the Pow-R Trip 7 only when the instantaneous adjustment is omitted. In order to take full advantage of the outstanding Short Time Ratings and selectivity built into the Systems Pow-R Breaker, it is recommended that the Instantaneous adjustment be omitted in trip units including optional Short Time Adjustments. Should the adjustable instantaneous circuit be retained, the trip unit would respond at the peak value of the symmetrical current determined by the pick up setting and system selectively would be lost at a much lower value than is otherwise possible with selective override.

Table 1: Interrupting/Short-Time Ratings

Series		SPB-50		SPB-65	SPB-100						SPB-150					
Frame Ampere Rating		250 A	800 A	1600 A	250 A	800 A	1600 A	2000 A	2500 A	3000 A	250 A	800 A	1600 A	2000 A	2500 A	3000 A
Short Time Rating①		25 KA	25 KA	35 KA	25 KA	25 KA	35 KA	35 KA	35 KA	35 KA	25 KA	25 KA	35 KA	51 KA	51 KA	51 KA
Max. Short Time Delay②		18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Interrupting	240 V	65	65	85	100	100	100	100	100	100	200	200	200	200	200	200
Capacity	480 V	50	50	65	100	100	100	100	100	100	150	150	150	150	150	150
(kA rms symmetrical)	600 V	42	42	50	65	65	65	85	85	85	100	100	100	100	100	100

① Short-time rating (rms symmetrical amps) in 600 V, 50/60-Hz system with X/R ratio of 6.6.
② Maximum short time delay setting in cycles.

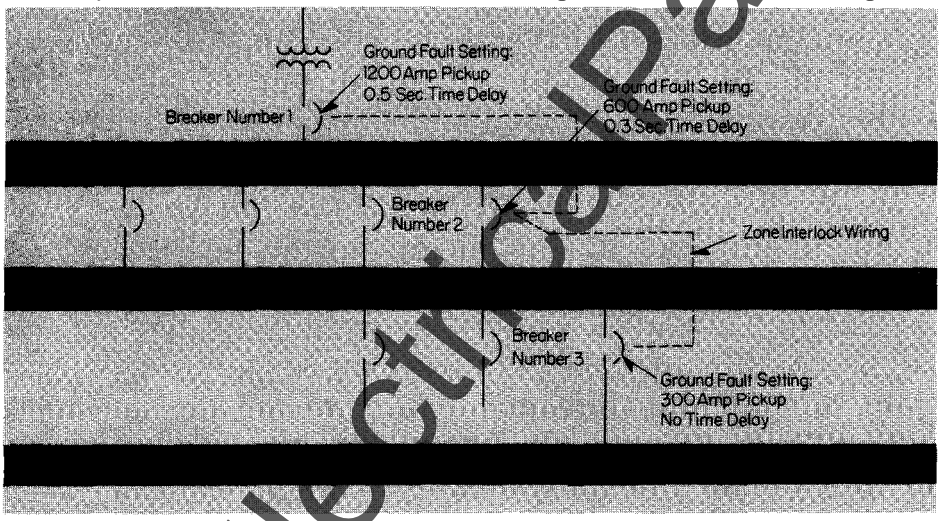
Built-in Ground Fault Protection

The Pow-R Trip 7 ground fault function features adjustable current pick-up settings to a maximum of 1200 amps, in accordance with the National Electrical Code. It also has adjustable time delays in three discreet steps with maximum breaker clearing times of 0.1, 0.3 and 0.5 seconds, and a memory circuit to compensate for the erratic nature of arcing ground faults.

External terminations that can be reconnected are provided to satisfy the grounding conditions for simple and complex distribution systems. Residual is standard. Source ground connections are applicable, as is zero sequence with external sensors, in various physical configurations to match the system requirements.

Integral Zone Selective Interlocking, a standard feature of the Systems Pow-R Breaker with Ground Fault, and available only from Westinghouse, is desirable for complex ground fault systems, such as hospitals where multiple levels of ground fault protection are required by the code.

Multi-Layer Ground Fault Protection Scheme Using Zone Selective Interlocking

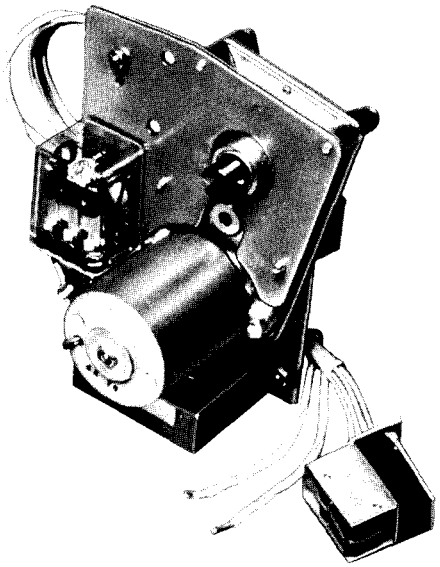


With Zone Selective Interlocking, proper system coordination is maintained for down stream faults. To minimize equipment damage while providing the greatest degree of system continuity, the Zone Selective Interlocking system locates the fault and opens the nearest upstream breaker at the minimal time setting, regardless of preset settings, without losing coordination with upstream devices. Such a loss of coordination could cause nuisance or unwanted tripping operations on the upstream devices.

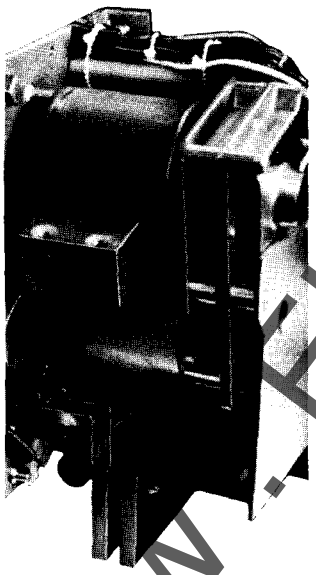
Optional Features

Electrical Operation

The electrical operator is mounted internally, with the result that there is no dimensional difference between manually and electrically operated units. Manually operated breakers are easily field convertible to electrical operation by adding a plug-in motor operator. UL Listing is not voided by field installation of motor operator.



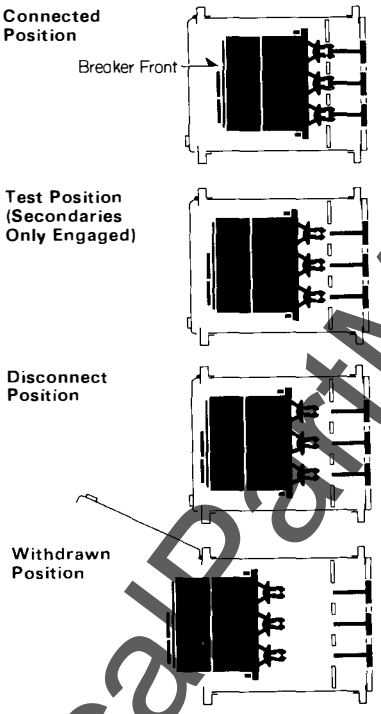
Motor Operator

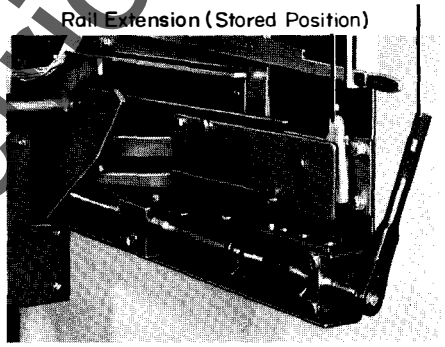


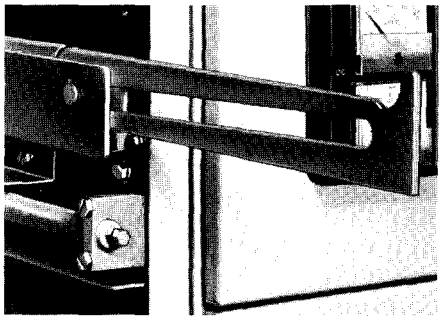
Motor operator installed in breaker

Drawout Mounting

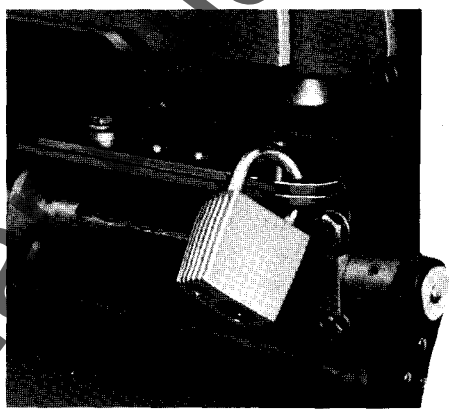
Systems Pow-R Breaker drawout assemblies consist of a stationary frame and a moving carriage with four position stops: Connected, Test, Disconnected and fully withdrawn. Extension rails, the racking mechanism and operating handle are part of the draw-out assembly and are self-contained. The draw-out mechanism is mechanically interlocked with the breaker drawout element, so that the breaker cannot be racked into or out of any position with its main contacts closed, or in the spring charged position.







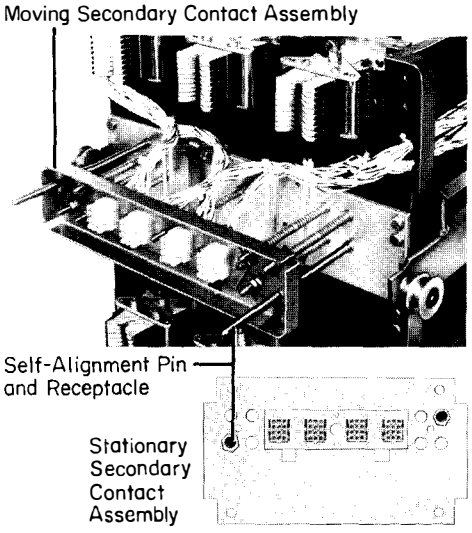
Extension rail drawn-out



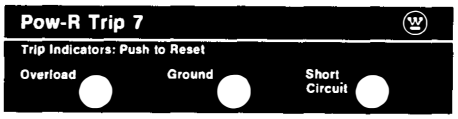
Padlocking of draw-out element

For safety, breaker draw-out elements can be padlocked in any of the three draw-out positions, as well as in a tripped open position.

Secondary contacts having a maximum of 48 points are located at the rear of the draw out element. Engagement of secondary contacts is assured by automatic self-alignment and positive contact of mating parts.

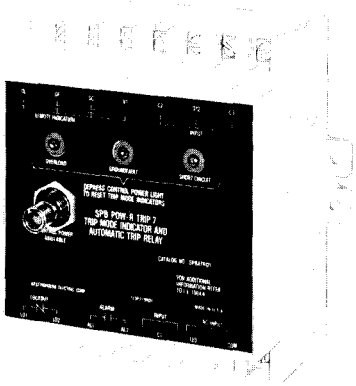


Trip Indicators



Indication of automatic trip operation is optional on Systems Pow-R Breakers. Pow-R Trip 7 trip units are available with resettable indicators that indicate the reason the breaker tripped: overload, ground fault or short circuit.

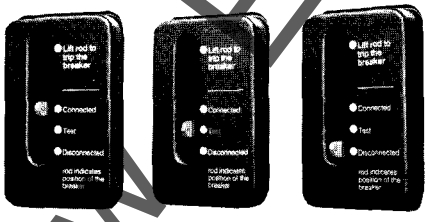
In addition, an automatic trip relay is available to indicate breaker tripping. One version of the relay indicates simply (by LED) that the breaker has tripped and also provides alarm and lock-out contacts. A second version of the relay indicates (by LED's) the cause of tripping (overload, ground fault or short circuit) as well as providing alarm and lock-out contacts.



Automatic trip relay

Door Mounted Breaker Drawout Position Indicators

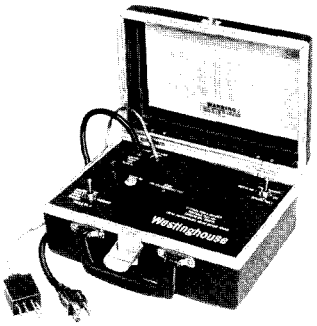
An external breaker position indicator is available for mounting on the breaker cell door to provide visual indication of the drawout position of the breaker behind the door.



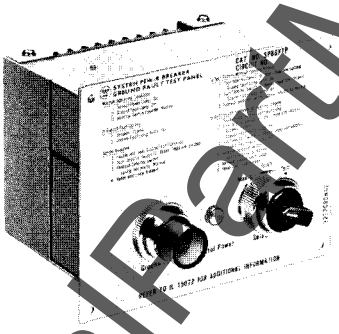
Breaker Connected | **Breaker in test position** | **Breaker Disengaged**

Accessories

In-service Testing



A small hand held test kit permits functional testing of the breaker while it is in service.



In addition, a separately mounted test panel is available for testing ground fault protective circuits.

Mechanical Interlocking

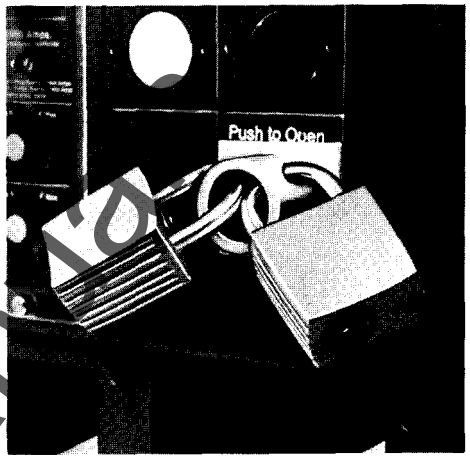
Mechanical interlocking of adjacent fixed or draw out breakers is available, as well as provision for key interlocking.

Spring Release Solenoid

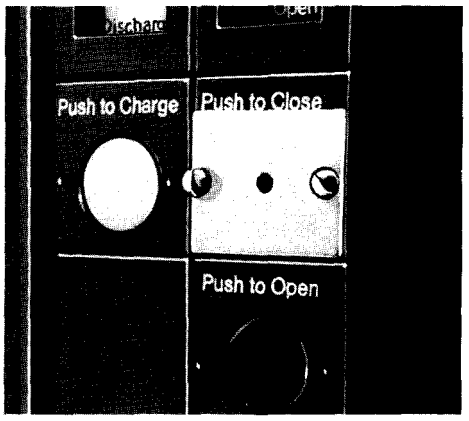
For remote closing of a precharged breaker, a spring release is available. An auxillary contact to denote spring charged position remotely is another feature furnished as standard with all spring release options.

Other Available Accessories

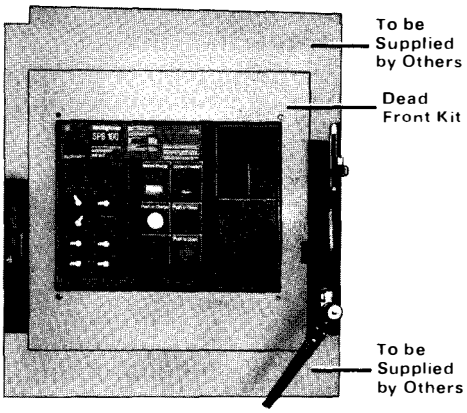
- Shunt trip device
- Undervoltage release – Instantaneous
- Undervoltage release – Time Delay up to .5 seconds
- Auxiliary switches (six max) in combination of 2, 4 or 6 Make/Break arrangements.
- Provisions for blocking the manual "close" pushbutton
- Provisions for padlocking
- Cell switches
- UL Listed "deadfront" kit.



Padlocking push-to-open button



Manual push-to-close button blocked off

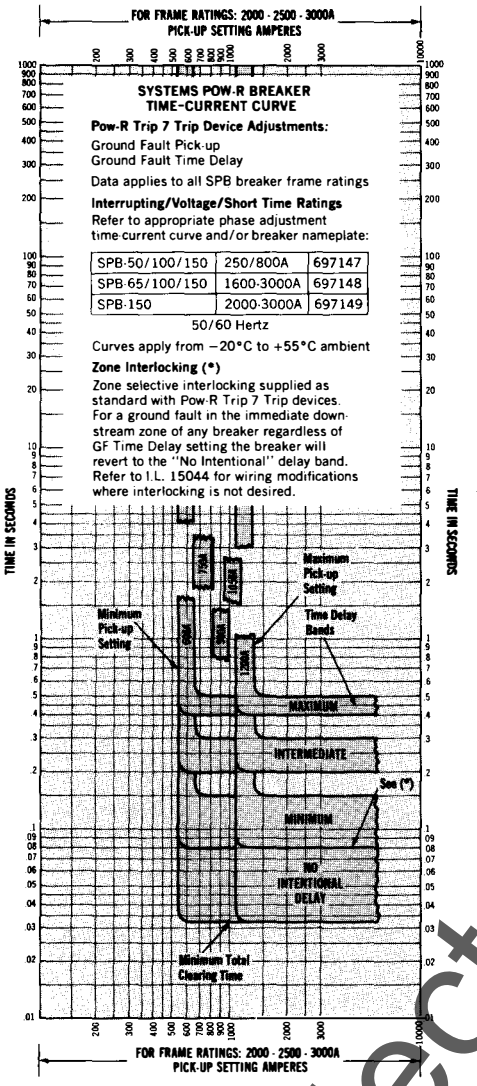


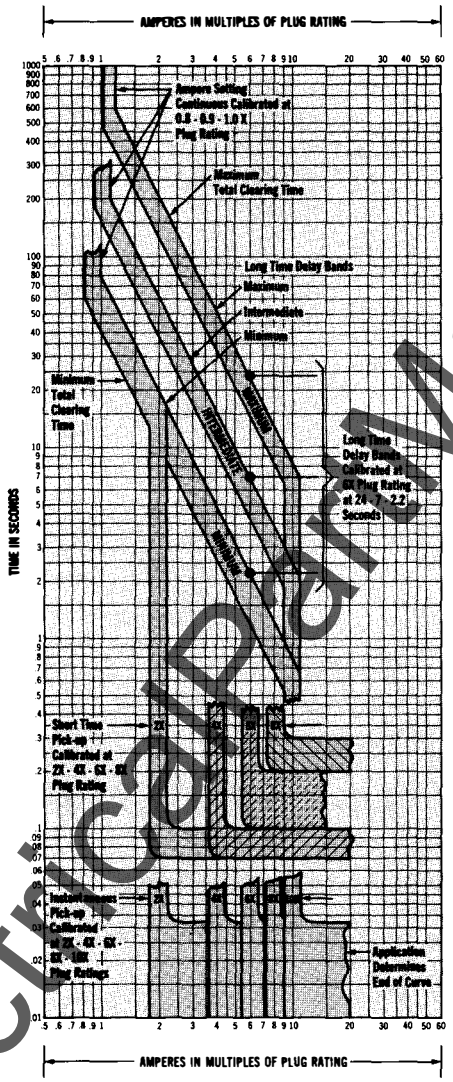
Dead-front kit in position

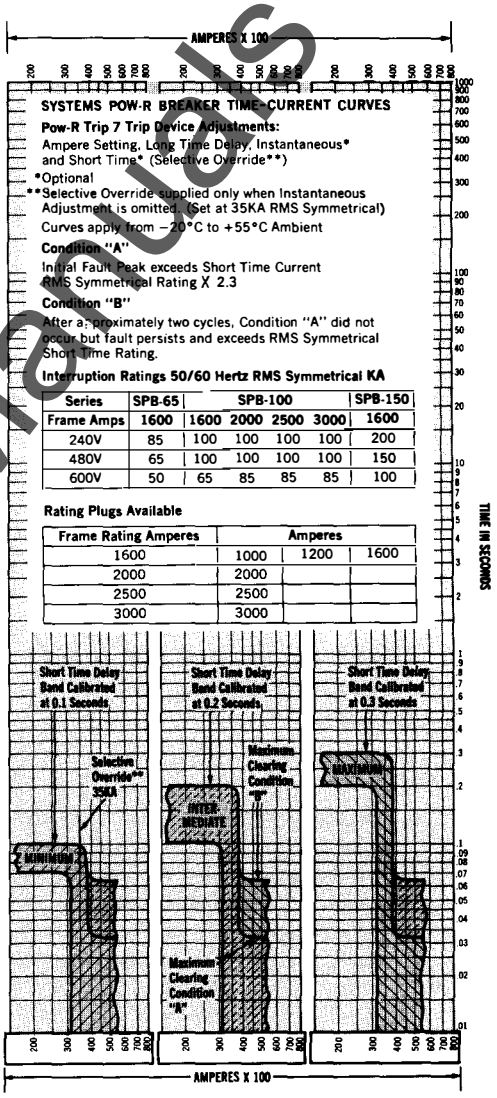
Application Information

(A) Curve Shaping Adjustments

A maximum of seven curve shaping adjustments can be obtained on the Pow-R Trip 7.







Ground Fault Adjustments

As the trip curve shows, adjustments can be made in discrete steps for:

- Ampere Setting: Adjustable in three steps; i.e. 80%, 90% and 100% of the rating plug
- Long Time Delay Bands:① Adjustable at 600% current in three settings:
  Min: 2.2 seconds
  Int: 7 seconds
  Max: 24 seconds
- Ground Time Delay Band:① Adjustable in three steps: 0.1, 0.3 and 0.5 secs. (i.e. 6, 18 and 30 cycles).
- Ground Fault Pickup: For the 250, 800 and 1600 Amp. frame there are six discrete settings based on the frame ratings: .2, .3, .4, .5, .6 and .75 times the frame rating.

Phase Adjustments

For the 2000, 2500 and 3000 Amp. frames there are five discreet settings at 600, 750, 900, 1050 and 1200 Amps.

- Short Delay Pickup: Adjustable to 2, 4, 6 or 8 times the rating plug
- Short Time Delay Bands:① Adjustable in three steps 0.1, 0.2 and 0.3 seconds (i.e. 6, 12 and 18 cycles)
- Instantaneous Pickup: Adjustable at 2, 4, 6, 8 or 10 times the rating plug

① Time value adjustments are calibrated points and denote "total clearing times".

Typical Specification for the Systems Pow-R Breaker

Circuit breakers shall be encased Westinghouse Systems Pow-R Breakers.

All breakers shall be UL Listed for application in their intended enclosure for 100% of their continuous ampere rating. Frame ampere ratings shall be 250, 800, 1600, 2000, 2500, or 3000 amperes as shown on the drawings.

The amperes interrupting capacity (I.C.) and short time ratings shall be as follows:

SPB-50 (250/800 Amp. Frame)
I.C.: 50,000 amps at 480 volts
Short Time Rating: 25,000 amps (RMS Sym.)

SPB-65 (1600 Amp. Frame)
I.C.: 65,000 amps at 480 volts
Short Time Rating: 35,000 amps (RMS Sym.)

SPB-100 (250/800/1600/2000/2500/3000 Amp. Frame)
I.C.: 100,000 amps at 480 volts without fuses
Short Time Rating: 25,000 amps (RMS Sym.) for 250 and 800 amp. frame; 35,000 amps (RMS Sym.) for 1600 amp. and above.

SPB-150 (250/800/1600/1200/2500/3000 Amp. Frame)
I.C.: 150,000 amps at 480 volts without fuses
Short Time Rating: 25,000 amps (RMS Sym.) for 800 amp. frame; 35,000 amps (RMS Sym.) for 1600 amp. frame
51,000 Amps (RMS Sym.) for 2000 Amp. Frame and larger

Short time ratings shall be based on a 600 volt, 50/60 Hz system with an X/R ratio of 6.6.

A selective override circuit shall be provided on breakers having short time adjustments, but without instantaneous adjustments that will allow the breaker to be applied at its maximum interrupting capacity while providing full selectivity up to its RMS Symmetrical short time rating.

All breakers shall be provided with a true, two-step stored energy mechanism which allows closing in a maximum of 5 cycles whether the breaker is manually or motor operated. Both manual and motor operated breaker shall have identical physical dimensions. Manually operated breakers shall be field convertible to motor operation without voiding the UL label on it. As a safety feature, anti-pump provisions shall be provided as standard for motor operated breakers and optional for manual breakers with spring release solenoids. Both manual and motor operated breakers shall have multiple charge/close provisions providing the following sequence: Charge-Close-Recharge-Open-Close-Open.

The breaker control face plate shall include color coded visual indicators to indicate contact and stored energy status. Local control pushbuttons shall be provided for opening and "closing" the breaker. For motor operated breakers, a local "charge" pushbutton shall be provided as standard.

The continuous ampere rating of the breaker shall be determined by the insertion of an interchangeable rating plug that matches the load and cable requirements. The rating plug shall be interlocked with the tripping mechanism to automatically "open" the breaker when the plug is removed. The breaker shall remain "trip free" with the plug removed. In addition, rating plugs shall be keyed to prevent incorrect application between different frame ratings. Complete system selective coordination shall be provided by the addition of the following time/current curve shaping adjustments: (1) Ampere Setting (2) Long Time Delay (3) Short Time Pickup (4) Short Time Delay (5) Ground Fault Pickup (6) Ground Fault Time Delay. All adjustments shall be made using non-removable discreet step, high reliability switching plugs for precise settings. A sealable transparent cover shall be provided over the adjustments to prevent tampering.

Ground fault protection shall be provided as an integral part of the breaker. A ground fault memory circuit shall be provided to compensate for the erratic nature of arcing ground faults and provide for positive tripping actions. A residual scheme shall be used as standard for detecting ground fault currents.

Where more complex systems require alternate sensing methods, the Pow-R Trip 7 shall be reconnectable for either a source ground or zero sequence detection scheme as required. Integral Zone Selective Interlocking shall be provided as a standard feature.

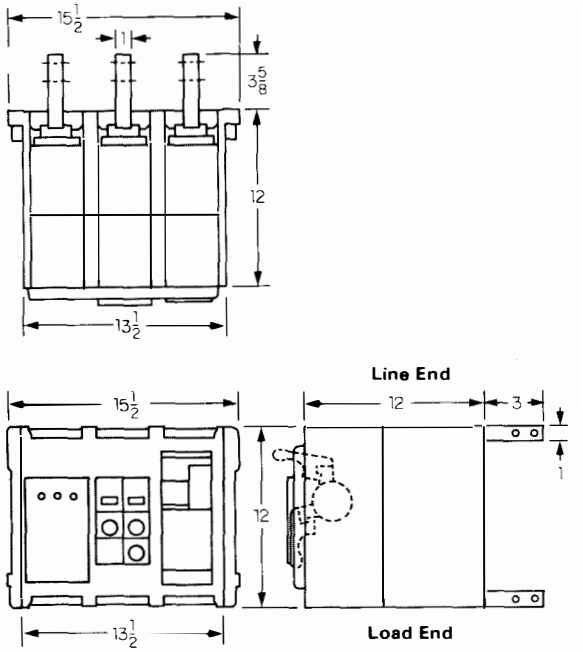
The Pow-R Trip 7 devices shall be provided with up to three visual indicators to indicate the automatic tripping mode of the breaker (i.e. Overload, Short Circuit or Ground Fault). In addition the Pow-R Trip devices shall be provided with terminals that can be wired to an optional remote auxillary package to provide the above type of indication.

A separate mounted test panel shall be available to permit the testing of the ground fault circuit by either tripping the breaker or not tripping the breaker.

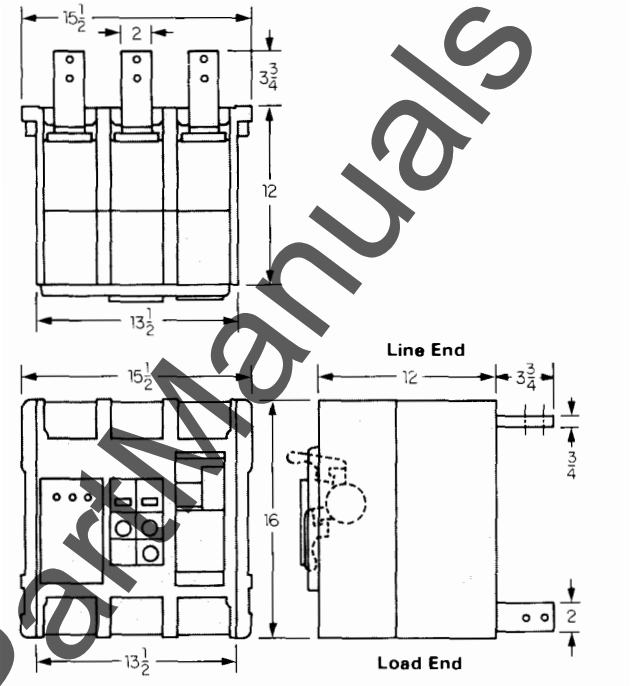
All breakers shall be provided with test points for in-service functional testing of the long time, instantaneous and ground fault circuits by means of a small hand held test kit.

The breakers shall be capable of a minimum of 4000 interruptions of rated current followed by 4000 operations at no load without maintenance. Further, the breaker shall be equipped with field replaceable contacts.

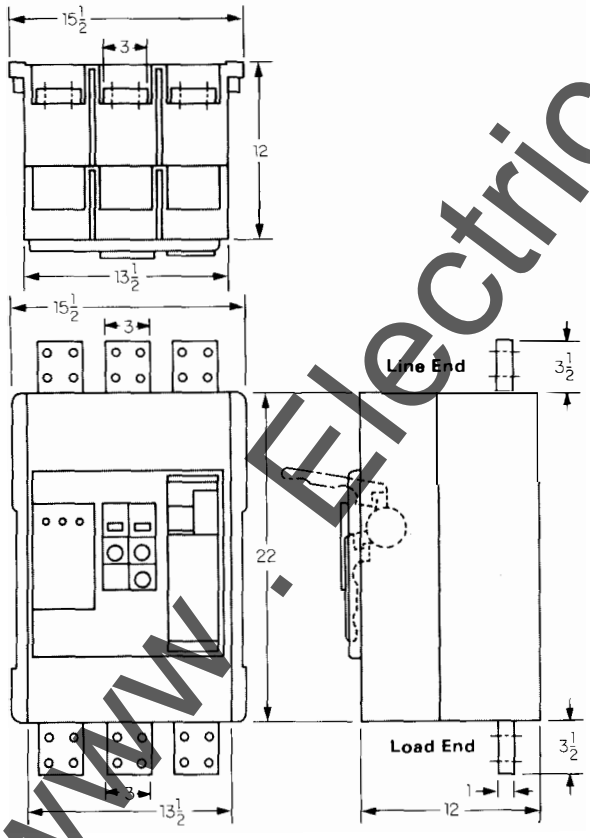
Dimensions, Inches *Not to be used for construction purposes unless approved.*
SPB Breakers, Fixed Mounted



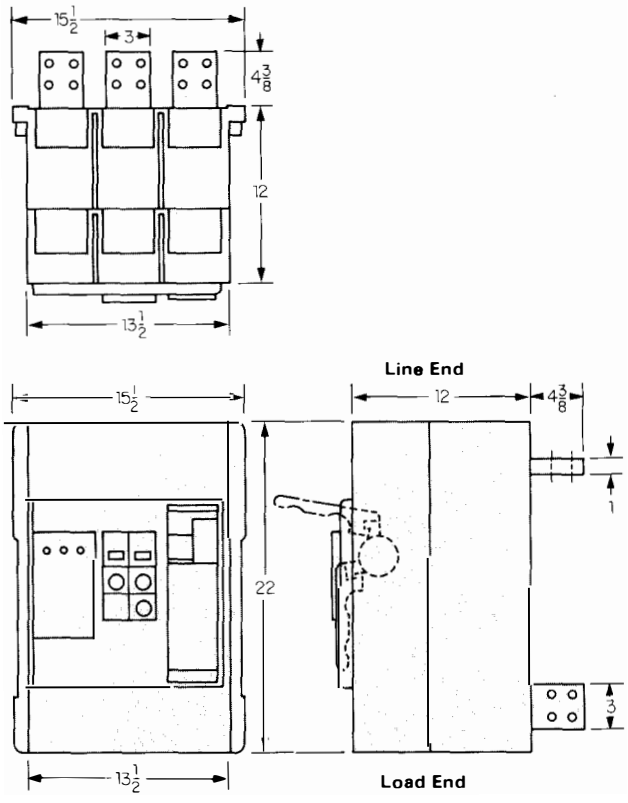
250 and 800 Amp (Fixed Front and Rear Connected)



1600 Amp (Fixed Front and Rear Connected)

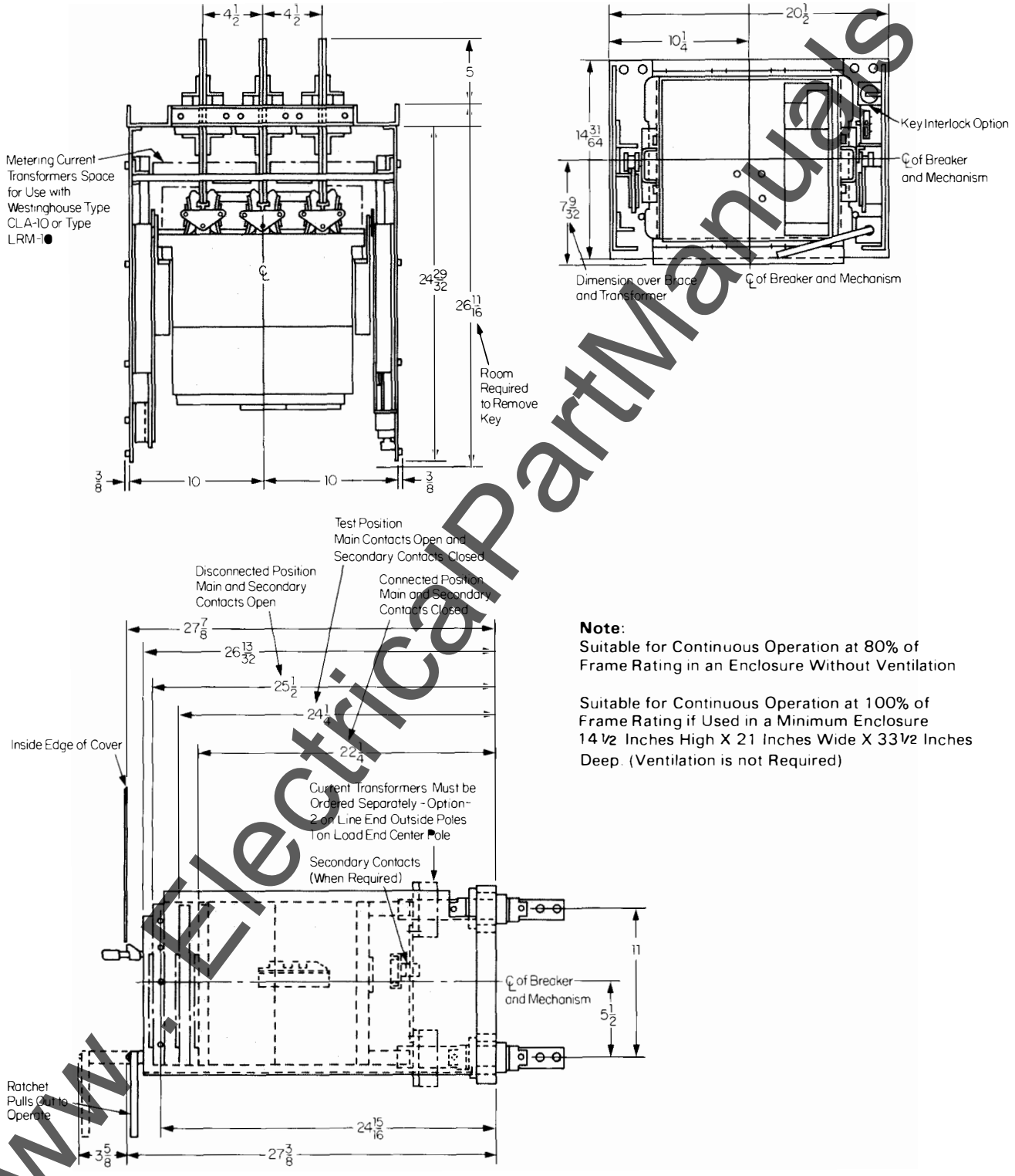


3000 Amp (Fixed Front Connected)



3000 Amp (Fixed Rear Connected)

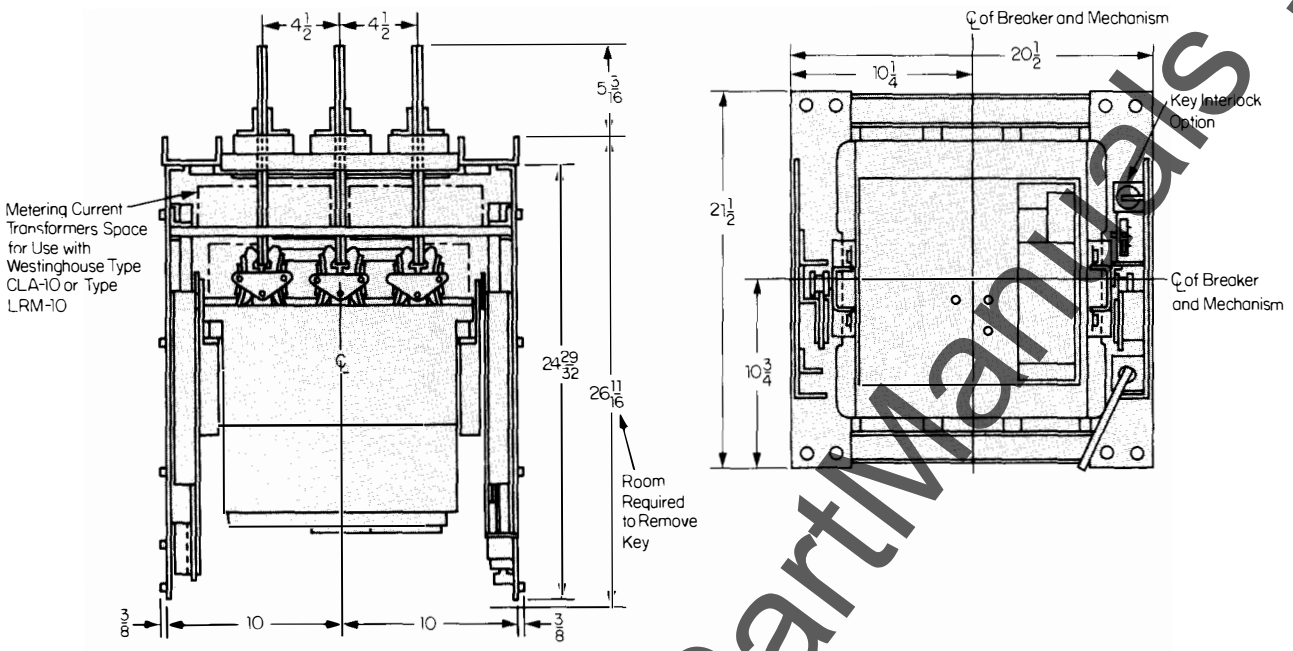
Dimensions, Inches *Not to be used for construction purposes unless approved.*
SPB 800 Ampere Breaker for Drawout Mounting

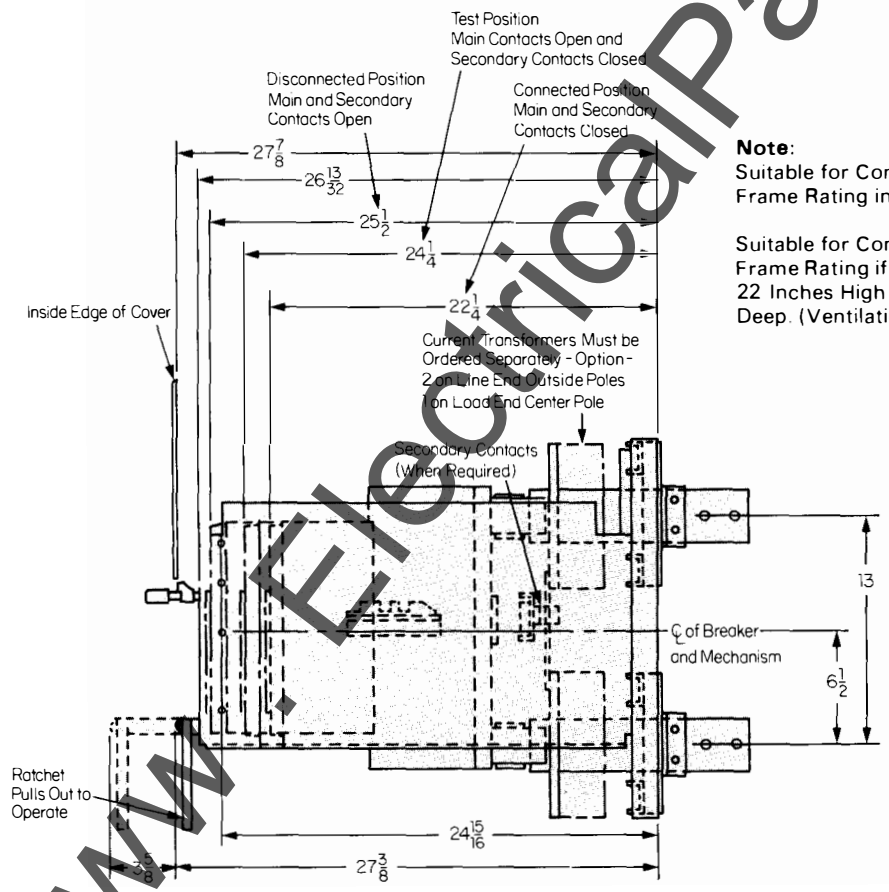


Note:
Suitable for Continuous Operation at 80% of Frame Rating in an Enclosure Without Ventilation

Suitable for Continuous Operation at 100% of Frame Rating if Used in a Minimum Enclosure 14 1/2 Inches High X 21 Inches Wide X 33 1/2 Inches Deep. (Ventilation is not Required)

Dimensions, Inches *Not to be used for construction purposes unless approved.*
SPB 1600 Ampere Breaker for Drawout Mounting

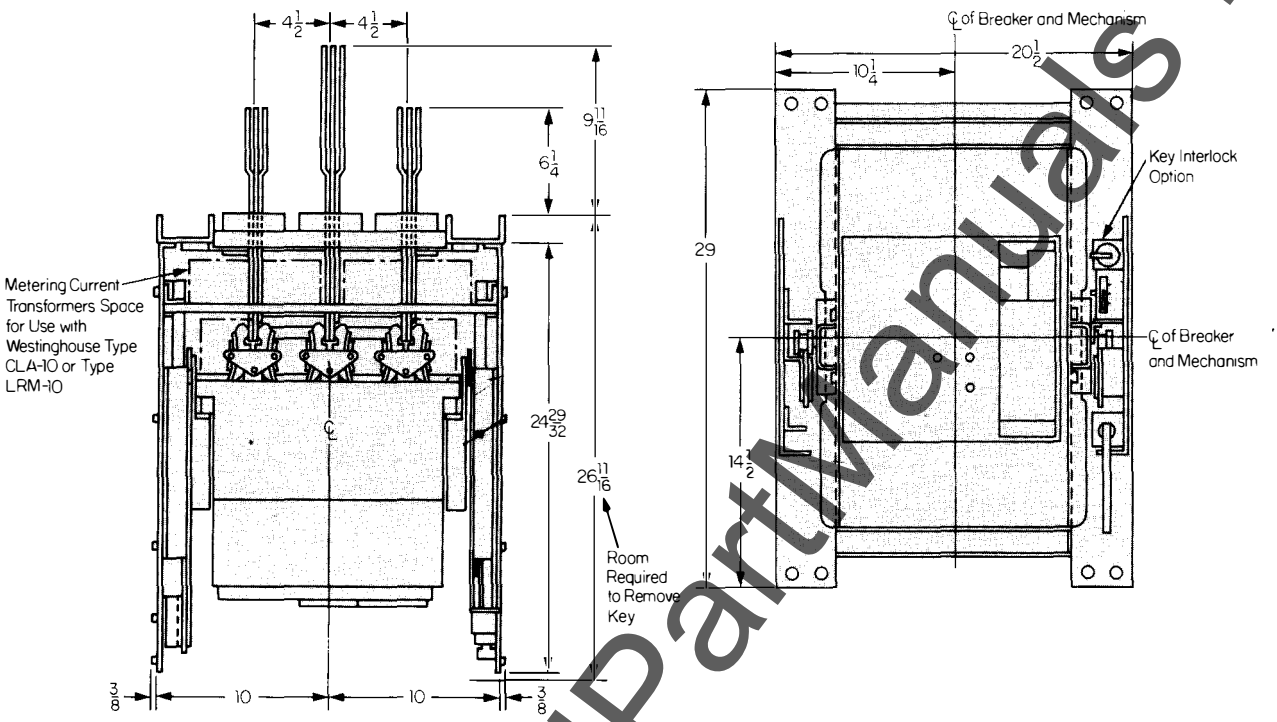


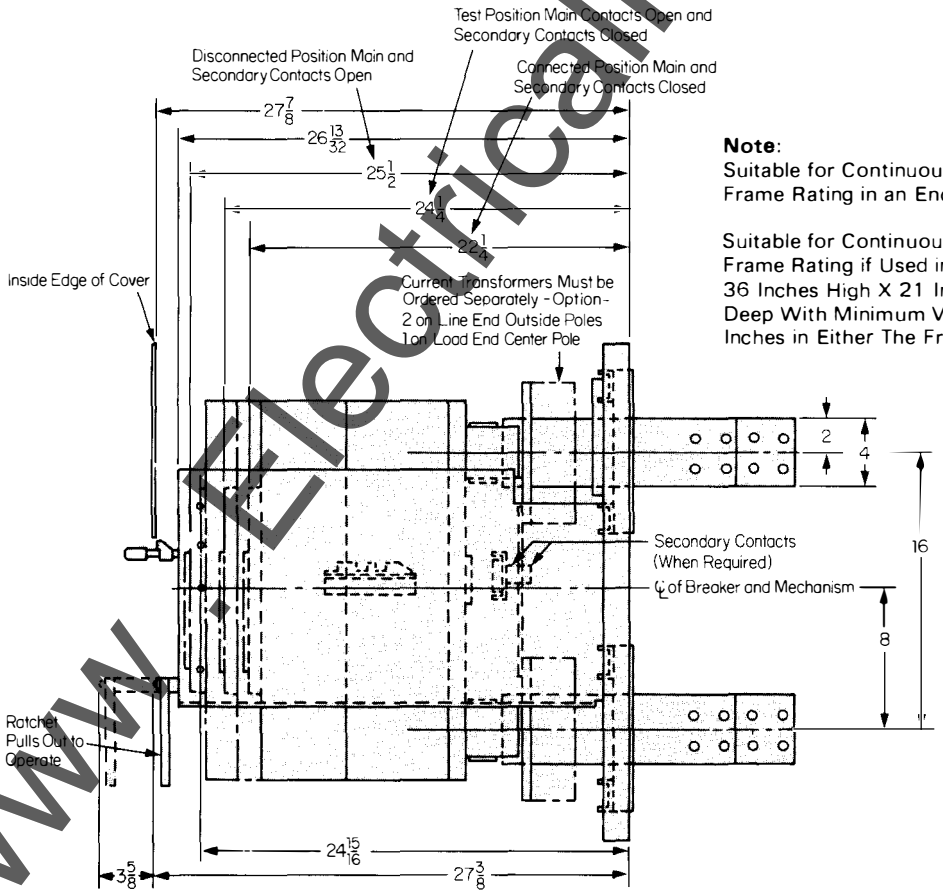


Note:
Suitable for Continuous Operation at 80% of Frame Rating in an Enclosure Without Ventilation.

Suitable for Continuous Operation at 100% of Frame Rating if Used in a Minimum Enclosure 22 Inches High X 21 Inches Wide X 33 1/2 Inches Deep. (Ventilation is not Required)

Dimensions, Inches *Not to be used for construction purposes unless approved.*
SPB 3000 Ampere Breaker for Drawout Mounting





Note:
Suitable for Continuous Operation at 80% of Frame Rating in an Enclosure Without Ventilation

Suitable for Continuous Operation at 100% of Frame Rating if Used in a Minimum Enclosure 36 Inches High X 21 Inches Wide X 38 Inches Deep With Minimum Ventilation of 160 Square Inches in Either The Front or Side of The Enclosure.

Approximate Weights, Lbs.

Frame Rating Amperes	Fixed Mounted Breakers	Drawout Mounted Breakers	
		Drawout Element Only	Drawout Stationary Frame
250-800	100	110	85
1600	120	133	95
2000-3000	185	207	105

Further Information
List Prices: Price List 29-820

Printed in USA

Westinghouse Electric Corporation
Low Voltage Breaker Division
Beaver, Pennsylvania U.S.A. 15009