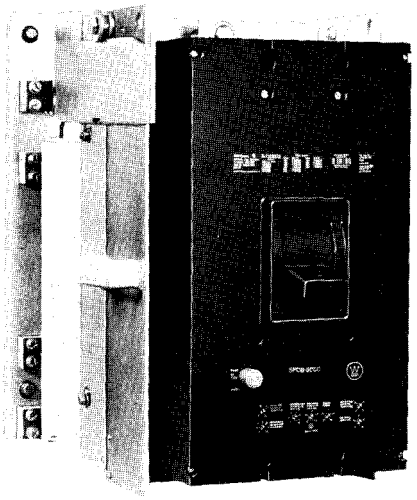
Westinghouse Electric Corporation
Low Voltage Breaker Division
Beaver, Pennsylvania 15009

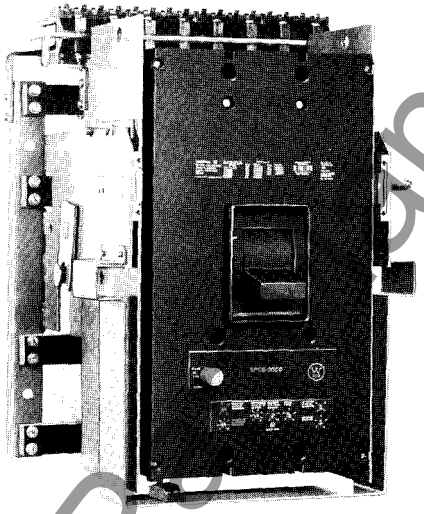
October, 1976
Supersedes Application Data 29-860
dated June, 1973
Mailed to: E, D, C/1901, 1923, 1929/DB

250-3000 Amperes, 3 Poles Only
600 Volts Ac Maximum

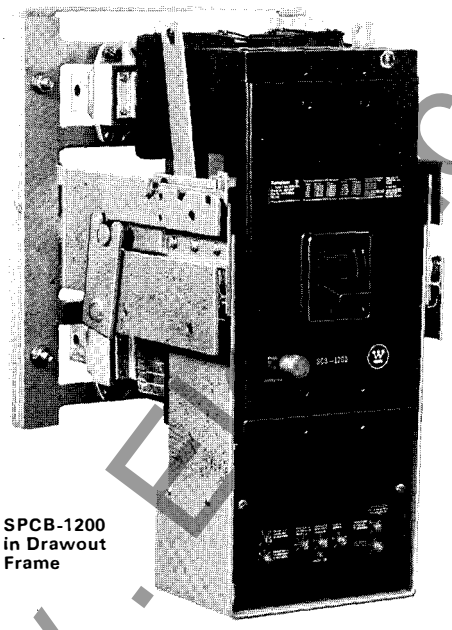
SCB-II Systems Circuit Breakers



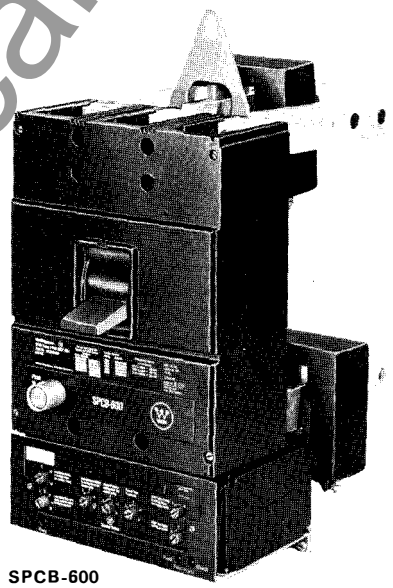
SPCB-3000
Fixed Mounting, Front Removable



SPCB-3000
Drawout Mounting



SPCB-1200
in Drawout
Frame



SPCB-600
Fixed Pre-Assembled
Rear Connected
Breaker

General Application

Systems Circuit Breakers are a simple solution to a complex problem – coordinated systems protection. They are designed for use in switchboards, motor control centers and other electrical assemblies. They provide selective tripping and ground fault protection, as well as excellent coordination between breakers and other devices in a system. The breakers have provisions for fixed or three-position drawout mounting, for manual or electrical operation and will accept many modifications and accessories.

Systems Circuit Breakers are designed for operation on Ac distribution systems of up to 600 volts.

Distribution System Protective Arrangements

There are two basic distribution-system protective arrangements: a fully rated nonselective system and a selective-tripping system. Westinghouse Systems Circuit Breakers are recommended for use on either system.

A fully rated system is one in which all breakers – main, tie and branch – have adequate interrupting current capacity for the maximum fault current available at the point of application of the breaker in the system. For such a system, the Systems Circuit Breaker's static sensor need provide only long-delay and instantaneous tripping.

A selective-tripping system is one in which circuit breakers are applied so that, of the breakers carrying the fault current, only the breaker nearest the fault opens to isolate the faulted circuit from the rest of the power system. This system results in maximum continuity of service.

Component Parts

The basic Systems Circuit Breaker has four major parts: a frame, a static sensor, current monitors, and a flux transfer shunt trip.

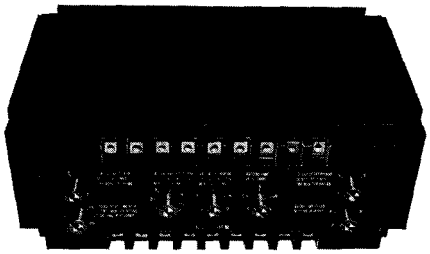
Frame

The frame includes the breaker contacts, De-ion® arc quenchers, and associated moving parts that open and close the breaker contacts, all enclosed in a glass polyester case.

Static Sensor

The static sensor contains a number of solid state circuits which act on signals received from the current monitors. As the

current monitors detect overload currents, short-circuit current, and ground fault currents, signals are passed to the sensor which act to trip the breaker at the desired time and current point. The sensor operates solely from breaker load current, is not dependent on any outside power source.



Static Sensor

The standard static sensor is provided with three adjustments: long time pick-up, long time delay, and instantaneous pick-up. Optional static sensors are available with additional adjustments: short-delay pick-up②, short-delay time②, ground fault pick-up, and ground fault time-delay. These adjustments can be varied to shape the breakers' characteristic tripping curve to provide the coordination and or selective tripping requirements of the distribution system.

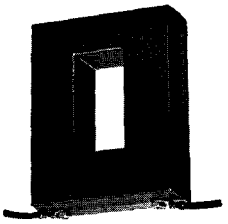
In addition to the above adjustments, static sensors are also available with the following optional circuits requiring separate 120/60 control power to the sensor:

- ground fault trip indicator circuit④
- instantaneous trip indicator circuit④
- circuit to utilize flux transfer shunt trip with a remote initiating contact

On 600 and 1200 amp breakers, the static sensor is mounted external to the breaker frame; on 2000, 2500 and 3000 amp units it is mounted in the breaker frame.

Current Monitors

The current monitors are transformers which produce a current proportional to the current flowing in the bus. When above a predetermined level, the induced current is the signal that causes the breaker to trip.
A current monitor is provided for each phase



Current Monitor

bus. On 600 and 1200 amp frames, the monitors mount on bus external to the frame; on 2000, 2500 and 3000 amp frames, the three phase monitors are mounted in the frame. If optional ground fault protection is selected and if the system has a neutral, an additional monitor is provided.

Flux Transfer Shunt Trip

This is a special magnetic tripping device factory-installed in the frame. On signal from the sensor, it causes the breaker contacts to open. It operates on a flux-transfer principle; it therefore operates directly from the sensor signal only and requires no external source of power.

Accessories and Modifications

The following accessories and modifications are available for use with the Systems Circuit Breaker. Refer to Tech Data 29-121 for additional information.
Motor Operators
Drawout Frame
Shunt Trip
Undervoltage Release
Alarm Switch
Auxiliary Contacts
Key Interlocks
Handle Extensions
Base Mounting Hardware

Inspection and Maintenance

Good maintenance procedure calls for periodic inspection of all electrical apparatus including systems circuit breaker, especially after an unusual circuit condition. Terminal lugs must be tight to prevent overheating.

② When these short time rated breakers are supplied without adjustable instantaneous, they are equipped with a fixed instantaneous circuit that overrides the time delay when the current value reaches approximately 21 times the current monitor rating on 1200 and 2000 amp units, and 14 times the current monitor rating on 600, 2500 and 3000 amp units, causing the SCB breaker to trip instantaneously. This feature allows short-time rated SCB breakers to be applied on systems having short circuit capabilities up to the instantaneous rating of the breaker. Also short-time rated SCB breakers have a fault closing discriminator circuit that causes the breaker to trip instantaneously if closed on a fault of approximately eight times the current monitor rating.

③ Not U/L Listed.

④ Requires separate 120 volt full voltage or resistor type light.

Operation

Figure 1, page 3, is a simplified block schematic diagram of the Systems Circuit Breaker. It shows the basic operating sequences involved in the breaker's tripping functions. Major elements of the solid state tripping system are:

1 Current Monitors
2 Auxiliary Transformers
3 Rectifier Bridges
4 Power-and-Signal Circuit
5 Long-Delay Tripping Circuits
6 Short-Delay Tripping Circuits
7 Instantaneous-Tripping Circuit
8 Ground-Tripping Circuit
9 Trigger Circuit
10 Flux-Transfer Shunt-Trip Device

The current monitors are coils similar to standard through-type current transformers. At overloads, the current monitor's output rises in close proportion to the overload current through the circuit breaker. The design of the monitors is such that the close proportion is maintained up to overloads of 12 times the breaker nominal current rating to insure the accuracy of the tripping characteristics of the entire Systems Circuit Breaker.

The signal current from the monitors goes to the auxiliary transformers where it is stepped down to milliampere levels. The output of the auxiliary transformers is rectified by the rectifier bridges to direct-current power for use by the other circuits of the static sensor.

The power and signal circuit serves two purposes: First, it acts as the power supply for energizing the shunt-trip coil. It does this by charging a condenser with direct current supplied by the current monitors, auxiliary transformers, and rectifier bridges. When tripping is called for by the other static-sensor circuits, the fully-charged condenser discharges to the shunt coil which in turn opens the circuit breaker contacts. Because the condenser is charged by signal current which is taken from the bus being monitored, no outside power source is needed to operate the shunt-trip unit. The other sensor circuits also draw operating power from the capacitor and the rectifier bridge.

Second, the power-and-signal circuit supplies a signal for the sensing and triggering circuits.

Overload-Operation Sequence

When an overload current appears through the breaker, the voltage from the rectifiers increases proportionally to the overload current and acts as a signal to operate timing circuits in the trip circuits. These timing

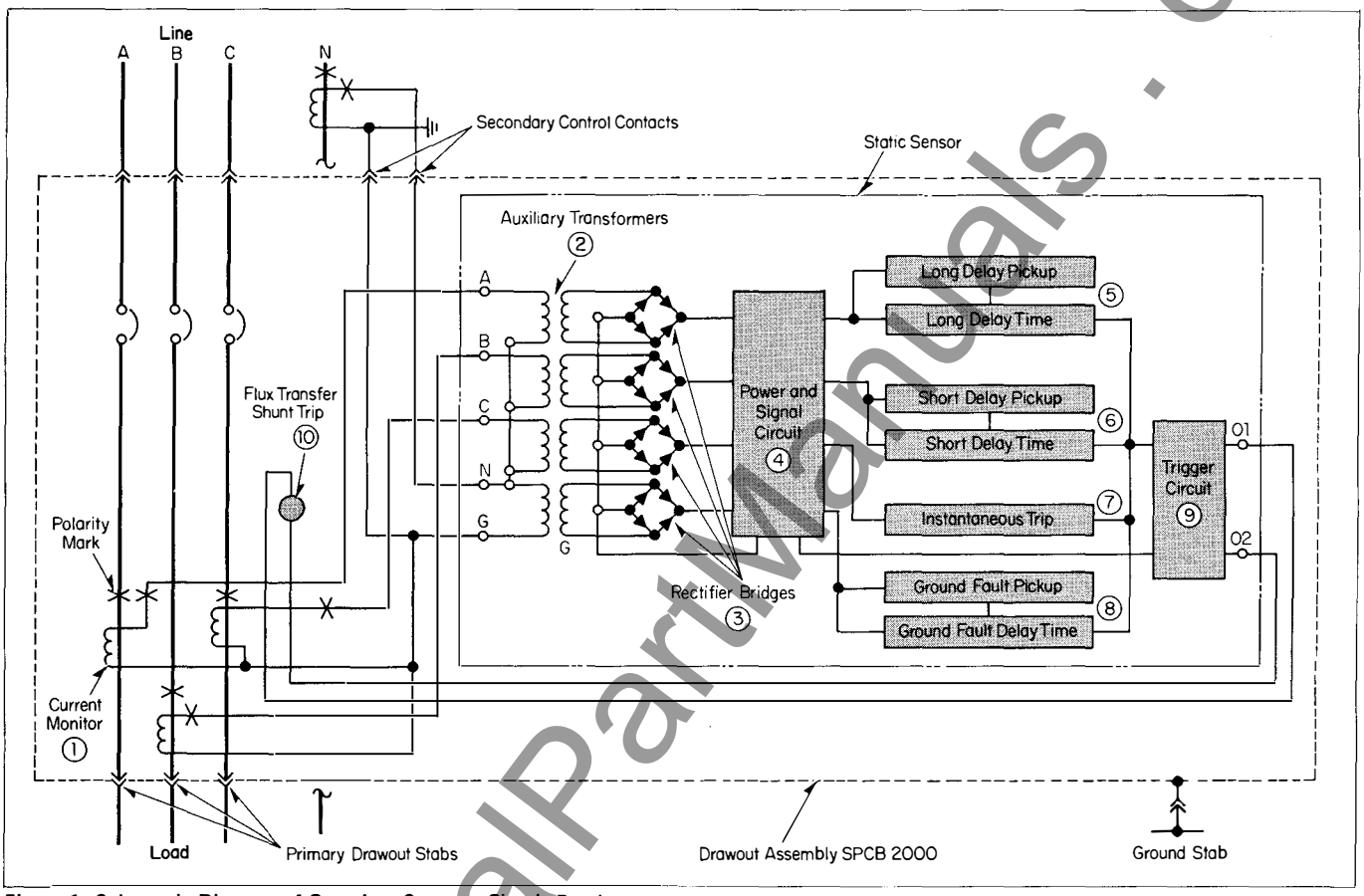


Figure 1: Schematic Diagram of Complete Systems Circuit Breaker

circuits, which signal the trigger circuit to discharge the condenser through the shunt-trip coil, cause the breaker to trip according to the trip curve established by the trip settings on the static sensor. Operations of the long-delay, short-delay, and instantaneous trip parts of the sensor are the same in 3-wire and 4-wire 3-phase distributions systems.

Ground-Fault Tripping in a 3-Phase, 3-Wire Ungrounded Delta Distribution System

Under normal conditions, i.e., with no ground fault, all current in the system flows through poles A, B, and C of the Systems Circuit Breaker. Correspondingly, these currents are reflected in the three current monitors, and must all pass through the primary of the auxiliary transformer (G). This results in no output from transformer G because the currents of a 3-phase system cancel each other out, even when the circuit load is unbalanced and the current is not equal in all three phases.

When a ground fault occurs on one phase of the 3-wire system and one of the other phases is already grounded, the ground-fault current will flow in auxiliary transformer G only. There will then be an uncancelled current in the secondary of auxiliary transformer G and this will result in a signal to the power-and-signal circuit. If the fault current is higher than the preselected percentage of the continuous-current rating of the current monitor, the ground-trip circuit will signal the trigger circuit to discharge the condenser in the power-and-signal circuit, and the breaker will trip.

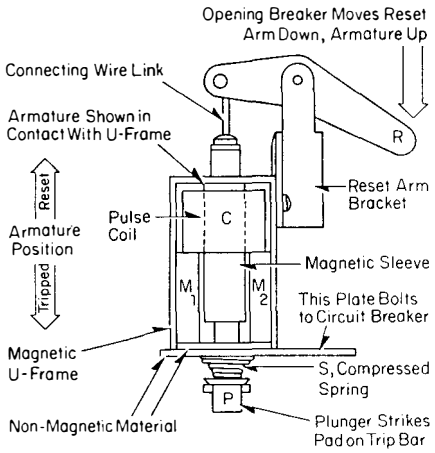
Ground-Fault Tripping in a 3-Phase, 4-Wire Grounded Distribution System

Only the addition of a fourth current monitor on the neutral bus is necessary to apply the SPCB for ground-fault tripping on a 4-wire power-distribution system. In a 4-wire power system, current will flow in the neutral bus when an unbalanced load causes the 3-phase currents to be unequal, even in the absence of a ground fault. Because this neutral-line current escapes detection by the three current monitors in the power lines, the total current in auxiliary transformer G would not be zero and the sensor would falsely report a ground fault. The purpose of the fourth current monitor is to reflect any neutral-current to auxiliary transformer G so that all current components will cancel when the load is unbalanced and there is no ground fault.

When a ground fault occurs, the operation is the same as in the 3-wire power system. Ground fault current in the neutral appears in the primary winding of auxiliary transformer G and tripping occurs in the same sequence as in the 3-wire system. Two important points should be noted about the neutral-line current monitor:

1. It should be identical to the monitors in each of the phase lines. Even if its output deviates by only a few percent from the output of the line monitors, the difference could be enough to cause ground-fault tripping of the breaker instead of time-delay overload tripping.
2. Current monitors must be connected carefully for proper polarity.

Flux-Transfer Shunt-Trip



The shunt-trip device used in the Systems Circuit Breaker permits tripping the breaker with a low-energy electrical signal. The illustration shows the trip device in the RESET position. It is held in this position by the two permanent magnets, M1 and M2. Their magnetic flux lines pass through the U-shaped frame and the magnetic sleeve of the armature, and because the UP position is the shortest magnetic path, the armature is held up against the top of the U-frame.

Compressed spring S stores the energy for tripping the breaker. It is held compressed by the permanent magnets which exert a slightly stronger force than the spring does.

When direct current from the capacitor in the static sensor passes through the pulse coil C, an electromagnetic flux is set up in a direction opposite to the flux of the permanent magnets. This opposing flux weakens the magnetic force exerted on the armature, the spring overcomes the magnetic force and forces the armature down.

Plunger P at the end of the armature strikes the trigger release rocker in the trip unit, and trips the contacts open. As the contacts open, part of the moving mechanism strikes reset arm R in a downward direction, raises the armature, compresses the spring, and resets the device. The circuit breaker is immediately ready for tripping again.

Application Considerations

In the design of power-distribution system protection, and in the selection and application of Westinghouse systems circuit breakers, the following should be considered:

Power-System Voltage and Frequency
Continuous Current Rating
Short-Circuit Current
Rated Interrupting Current
Rated Continuous Current

Ground Fault Protection

Ground-fault currents are generally initiated at a very low current level, much lower than the trip settings of standard circuit breakers. Completely coordinated electrical systems where required should be equipped with low-level ground-fault protective devices which have tripping times coordinated for ground-fault-selective tripping for maximum protection and continuity of service.

Application Tables

Tables A through E are selection guides for SCB applications in selective tripping and fully rated systems.

The tabulated values in tables B through E are based on the assumption that the SCB is mounted in a distribution switchboard located next to the supply transformer, and therefore, the impedance of the bus connecting the transformer to the switchboard main bus is negligible. For specific connections between the transformer and the distribution switchboard, where the cable impedance could be significant, refer to bulletin B-8674-B on "How to Calculate Fault Currents." For sizing breakers that are remote from the distribution switchboard, the cable and/or bus duct impedance should be considered. The complete formula method is illustrated in Bulletin B-8674-B.

Breaker type designations shown for group feeder and feeder breakers are minimum sizes for adequate interrupting current ratings. Other types may be used to meet continuous current requirements if adequate interrupting requirements and voltage are satisfied.

For more detailed application information, refer to appropriate codes and standards.

Ratings, Underwriters' Laboratories, Inc. Listed

Breaker Designation	Max. Frame Size, Cont. Amps.	Current Monitor Ratings, Amperes	Interrupting Capacity, Amperes	
			Asym.	Sym.
240 Volts Ac				
SPCB-600	600	250, 400 and 600	75,000Ⓒ	65,000Ⓒ
SPCB-1200	1200	250, 400, 600, 800, 1000 and 1200	75,000Ⓒ	65,000Ⓒ
SPCB-2000	2000	600, 800, 1000, 1200, 1600 and 2000	150,000	125,000
SPCB-2500	2500	2500	150,000	125,000
SPCB-3000	3000	3000	150,000	125,000
480 Volts Ac				
SPCB-600	600	250, 400 and 600	40,000Ⓒ	35,000Ⓒ
SPCB-1200	1200	250, 400, 600, 800, 1000 and 1200	58,000Ⓒ	50,000Ⓒ
SPCB-2000	2000	600, 800, 1000, 1200, 1600 and 2000	115,000	100,000
SPCB-2500	2500	2500	115,000	100,000
SPCB-3000	3000	3000	115,000	100,000
600 Volts Ac				
SPCB-600	600	250, 400 and 600	30,000Ⓒ	25,000Ⓒ
SPCB-1200	1200	250, 400, 600, 800, 1000 and 1200	30,000Ⓒ	25,000Ⓒ
SPCB-2000	2000	600, 800, 1000, 1200, 1600 and 2000	115,000	100,000
SPCB-2500	2500	2500	115,000	100,000
SPCB-3000	3000	3000	115,000	100,000

Ⓒ Changed since previous issue.

①Table A: Trip Current Ratings of Systems Circuit Breakers

Current Monitor Ratings.⑤	Long-time Pick-up Range, Amperes②⑥		Instantaneous Pick-up Range, Amperes		Short-time Delay Pick-up Range, Amperes③		Ground Current Pick-up Range, Amperes④	
	Min.⑦	Max.⑦	Min.⑦	Max.⑦	Min.⑦	Max.⑦	Min.⑦	Max.⑦
250	125	300	250	3000	250	1750	50	250
400	200	480	400	4800	400	2800	80	400
600	300	720	600	7200	600	4200	120	600⑧
800	400	960	800	9600	800	5600	160	800⑧
1000	500	1200	1000	12000	1000	7000	200	1000⑧
1200	600	1440	1200	14400	1200	8400	240	1200⑧
1600	800	1920	1600	19200	1600	11200	320	1200⑧
2000	1000	2400	2000	24000	2000	14000	400	1200
2500	1250	3000	2500	30000	2500	17500	500	1200
3000	1500	3600	3000	36000	3000	21000	600	1200

①Table B: Systems Circuit Breaker Application, 208 Volts⑬

Transformer Rating 3Ø Kva and % Imp.	Max. Short Circuit Kva Available	Rated Load, Continuous Amps.	Short Circuit Current RMS Symmetrical, Amperes			Selective Trip System				Fully Rated System, Non-selective			
			Transformer Only	100% Motor Load	Combined	Selective Main	Selective Group Feeder	SCB-II Feeder Instantaneous Trip	AB Feeder Brkr. (Min.)	Main	Group Feeder	SCB-II Feeder	AB Feeder Brkr. (Min.)
150⑩ 3.8%	Unlimited	416	10947	832	11779	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 LA-600	SPCB-600 EHB	SPCB-600	EHB
150⑪ 5.0%	Unlimited	416	8320	832	9152	SPCB-600	SPCB-600	SPCB-600	EB	SPCB-600 LA-600	SPCB-600 EB	SPCB-600	EB
225⑩ 3.1%	50,000 Unlimited	625	17950 20161	1250	19200 21411	SPCB-1200	SPCB-600	SPCB-600	JA/HFB	SPCB-1200 MA	SPCB-600 JA/HFB	SPCB-600	JA/HFB
225⑫ 5.75%	50,000 Unlimited	625	10148 10869	1250	11398 12119	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 MA	SPCB-600 EHB	SPCB-600	EHB
300⑩ 3.5%	50,000 150,000	834	21142 23130	1668	22810 24798	SPCB-1200	SPCB-600	SPCB-600	JA/HFB	SPCB-1200 NB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	250,000 Unlimited		23564 23828		25232 25496				LB/HFB		SPCB-600 LB/HFB		LB/HFB
300⑪ 5.0%	50,000 250,000	834	14972 16323	1668	16640 17991	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
	500,000 Unlimited		16509 16680		18177 18348				JA/HFB		SPCB-600 JA/HFB		JA/HFB
300⑨ 5.8%	50,000 Unlimited	834	13074 14379	1668	14742 16047	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
500⑫ 5.0%	50,000 Unlimited	1388	23237 27760	2776	26013 30536	SPCB-2000	SPCB-600	SPCB-600	LB/HFB	SPCB-2000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
500⑫ 5.75%	50,000 100,000	1388	21060 22679	2776	23836 25455	SPCB-2000	SPCB-600	SPCB-600	JA/HFB LB/HFB	SPCB-2000 PB	SPCB-600 JA/HFB LB/HFB	SPCB-600	JA/HFB LB/HFB
	Unlimited		24139		26915								
500⑩ 6.0%	50,000 150,000	1388	19850 21847	2776	22626 24623	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	250,000 Unlimited		22280 23133		25056 25909				LB/HFB		SPCB-600 LB/HFB		LB/HFB
500⑨ 6.5%	50,000 Unlimited	1388	18702 21353	2776	21478 24129	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
750⑫ 5.75%	50,000 Unlimited	2080	28980 36173	4160	33140 40333	SPCB-3000	SPCB-600	SPCB-600	LB/HFB	SPCB-3000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
750⑩ 6.5%	50,000 Unlimited	2080	26303 32000	4160	30463 36160	SPCB-3000	SPCB-600	SPCB-600	LB/HFB	SPCB-3000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB

② Long-time delay adjustable from 2 to 20 sec. at 600% rating.
③ Short-time delay adjustable from 2 to 10 cycles at 600% rating.
④ Ground current trip time adjustable from 0.1 (6 cycles) to 0.5 (30 cycles) sec.
⑤ Refer ratings table, page 4, to determine which monitors apply to each SCB frame rating.
⑥ Do not exceed setting which results in continuous current rating in excess of frame rating; see ratings table.
⑦ All adjustments are continuous from minimum to maximum.
⑧ When used with 2000 amp frame, these monitors have maximum ground current trip of .75 X monitor rating.
⑨ DT-3 (600-volt) transformer data from Table F.
⑩ DT-3 (5 kv) transformer data from Table F.
⑪ Liquid filled transformer data from Table F.
⑫ ASL transformer data from Table F.
⑬ All breaker selections shown are minimum possible.

①Table C: Systems Circuit Breaker Application, 240 Volts⑥

Transformer Rating 3Ø Kva and % Imp.	Max. Short Circuit Kva Available	Rated Load, Continuous Amps.	Short Circuit Current RMS Symmetrical, Amperes			Selective Trip System				Fully Rated System, Non-selective			
			Transformer Only	100% Motor Load	Combined	Selective Main	Selective Group Feeder	SCB-II Feeder Instantaneous Trip	AB Feeder Brkr. (Min.)	Main	Group Feeder	SCB-II Feeder	AB Feeder Brkr. (Min.)
150③ 3.8%	Unlimited	361	9500	1444	10944	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 LA-600	SPCB-600 EHB	SPCB-600	EHB
150④ 5.0%	Unlimited	361	7220	1444	8644	SPCB-600	SPCB-600	SPCB-600	EB	SPCB-600 LA-600	SPCB-600 EB	SPCB-600	EB
225③ 3.1%	50,000	541	15538	2164	17702	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
	100,000 Unlimited		16413 17451		18577 19615				JA/HFB		SPCB-600 JA/HFB		JA/HFB
225④ 5.0%	50,000 Unlimited	541	9970 10820	2164	12134 12984	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
225⑤ 5.75%	50,000 Unlimited	541	8784 9408	2164	10948 11572	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
300③ 3.5%	50,000 Unlimited	722	18303 20628	2888	21191 23516	SPCB-1200	SPCB-600	SPCB-600	JA/HFB	SPCB-1200 NB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
300④ 5.0%	50,000 Unlimited	722	12961 14440	2888	15849 17328	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
500④ 5.0%	50,000	1203	20140	4812	24952	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	100,000 Unlimited		21927 24060		26739 28872				LB/HFB		SPCB-600 LB/HFB		LB/HFB
500⑤ 5.75%	50,000 150,000	1203	18253 20180	4812	23065 24992	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	250,000 Unlimited		20598 20921		25410 25733				LB/HFB		SPCB-600 LB/HFB		LB/HFB
500③ 6.0%	50,000 Unlimited	1203	17205 20050	4812	22017 24862	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
500② 6.5%	50,000 Unlimited	1203	16209 18507	4812	21021 23319	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
750⑤ 5.75%	50,000 Unlimited	1804	25135 31373	7216	32351 38589	SPCB-2500	SPCB-600	SPCB-600	LB/HFB	SPCB-2500 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
750③ 6.5%	50,000 Unlimited	1804	22813 27753	7216	30029 35769	SPCB-2500	SPCB-600	SPCB-600	LB/HFB	SPCB-2500 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
1000⑤ 5.75%	50,000	2405	31413	9620	41033	SPCB-3000	SPCB-600	SPCB-600	LB/HFB	SPCB-3000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
	100,000 Unlimited		35918 41826		45538 51446		SPCB-2000	SPCB-2000	HFB/PB		SPCB-2000 HFB/PB	SPCB-2000	HFB/PB
1000③ 6.2%	50,000	2405	29370	9620	38990	SPCB-3000	SPCB-600	SPCB-600	LB/HFB	SPCB-3000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
	100,000 Unlimited		33399 38790		43019 48410		SPCB-2000	SPCB-2000	HFB/PB		SPCB-2000 HFB/PB	SPCB-2000	HFB/PB

② DT-3 (600-volt) transformer data from Table F.
③ DT-3 (5 kv) transformer data from Table F.
④ Liquid filled transformer data from Table F.
⑤ ASL transformer data from Table F.
⑥ All breaker selections shown are minimum possible.

①Table D: Systems Circuit Breaker Application, 480 Volts⑥

Transformer Rating 3ø Kva and % Imp.	Max. Short Circuit Kva Available	Rated Load, Continuous Amps.	Short Circuit Current RMS Symmetrical, Amperes			Selective Trip System				Fully Rated System, Non-selective			
			Transformer Only	100% Motor Load	Combined	Selective Main	Selective Group Feeder	SCB-II Feeder Instantaneous Trip	AB Feeder Brkr. (Min.)	Main	Group Feeder	SCB-II Feeder	AB Feeder Brkr. (Min.)
150③ 3.8%	Unlimited	180	4736	720	5456	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 JA	SPCB-600 EHB	SPCB-600	EHB
225③ 3.1%	Unlimited	271	8741	1084	9825	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 LB	SPCB-600 EHB	SPCB-600	EHB
300③ 3.6%	Unlimited	361	10314	1444	11758	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 LA-600	SPCB-600 EHB	SPCB-600	EHB
500④ 6.0%	250,000	601	11568	2404	13972	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 MA	SPCB-600 EHB	SPCB-600	EHB
	500,000 Unlimited		11787 12020		14191 14424				JA/HFB		SPCB-600 JA/HFB		JA/HFB
500⑤ 5.75%	Unlimited	601	10452	2404	12856	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 MA	SPCB-600 EHB	SPCB-600	EHB
750⑤ 5.75%	50,000 Unlimited	902	12567 15686	3608	16175 19294	SPCB-1200	SPCB-600	SPCB-600	JA/HFB	SPCB-1200 NB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
1000⑤ 5.75%	50,000	1203	15713	4812	20525	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	100,000 250,000		17966 19638		22778 24450				HFB /HKA LB		SPCB-600 HFB/HKA LB		HFB /HKA LB
	500,000 Unlimited		20262 20921		25074 25733				HKA/LB		SPCB-600 HKA/LB		HKA/LB
1000③ 6.2%	50,000 100,000	1203	14691 16706	4812	19503 21518	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	150,000 Unlimited		17521 19403		22333 24215				HFB /HKA LB		SPCB-600 HFB/HKA LB		HFB /HKA LB
1500⑤ 5.75%	50,000	1804	20891	7216	28107	SPCB-2500	SPCB-600	SPCB-600	LB HKA /FB-P	SPCB-2500 PB	SPCB-600 LB HKA/FB-P	SPCB-600	LB /HKA FB-P
	100,000 150,000		25154 26975		32370 34191		SPCB-2000	SPCB-2000	HKA /FB-P PB		SPCB-2000 HKA FB-P/PB	SPCB-2000	HKA /FB-P PB
	250,000 Unlimited		28625 31373		35841 38589				FB-P PB		SPCB-2000 FB-P-PB		FB-P /PB
1500③ 6.8%	50,000 100,000	1804	18457 21768	7216	25673 28984	SPCB-2500	SPCB-600	SPCB-600	LB/HKA FB-P	SPCB-2500 PB	SPCB-600 LB HKA/FB-P	SPCB-600	LB/HKA FB-P
	150.000 Unlimited		23149 26529		30365 33745		SPCB-2000	SPCB-2000	HKA /FB-P PB		SPCB-2000 HKA FB-P/PB	SPCB-2000	HKA /FB-P PB
2000⑤ 5.75%	50,000	2405	24921	9620	34541	SPCB-3000	SPCB-2000	SPCB-2000	HKA /FB-P PB	SPCB-3000 PB	SPCB-2000 HKA FB-P/PB	SPCB-2000	HKA /FB-P PB
	100,000 Unlimited		31286 41826		40906 51446				FB-P /PB				FB-P /PB

② DT-3 (600-volt) transformer data from Table F.
③ DT-3 (5 kv) transformer data from Table F.
④ Liquid filled transformer data from Table F.
⑤ ASL transformer data from Table F.
⑥ All breaker selections shown are minimum possible.

①Table E: Systems Circuit Breaker Application, 600 Volts⑥

Transformer Rating 3Ø Kva and % Imp.	Max. Short Circuit Kva Available	Rated Load, Continuous Amps.	Short Circuit Current RMS Symmetrical, Amperes			Selective Trip System				Fully Rated System, Non-selective			
			Transformer Only	100% Motor Load	Combined	Selective Main	Selective Group Feeder	SCB-II Feeder Instantaneous Trip	AB Feeder Brkr. (Min.)	Main	Group Feeder	SCB-II Feeder	AB Feeder Brkr. (Min.)
150③ 3.8%	Unlimited	144	3789	576	4365	SPCB-600	SPCB-600	SPCB-600	FB	SPCB-600 JA	SPCB-600 FB	SPCB-600	FB
225③ 3.1%	Unlimited	217	7000	868	7869	SPCB-600	SPCB-600	SPCB-600	FB	SPCB-600 LB	SPCB-600 FB	SPCB-600	FB
300③ 3.5%	Unlimited	289	8257	1156	9413	SPCB-600	SPCB-600	SPCB-600	FB	SPCB-600 LB	SPCB-600 FB	SPCB-600	FB
500④ 5.0%	Unlimited	481	9620	1924	11544	SPCB-600	SPCB-600	SPCB-600	FB	SPCB-600 LA-600	SPCB-600 FB	SPCB-600	FB
750② 6.5%	Unlimited	722	11107	2888	13995	SPCB-1200	SPCB-600	SPCB-600	FB	SPCB-1200 NB	SPCB-600	SPCB-600	FB
750④ 5.75%	50,000	722	10007	2888	12895	SPCB-1200	SPCB-600	SPCB-600	FB	SPCB-1200 NB	SPCB-600	SPCB-600	FB
	100,000 Unlimited		11145 12556		14033 15444				HFB /JA				HFB/JA
1000③ 6.2%	50,000 100,000	962	11748 14011	3848	15596 17859	SPCB-1200	SPCB-600	SPCB-600	HFB JA	SPCB-1200 NB	SPCB-600 HFB/JA	SPCB-600	HFB/JA
	Unlimited		15516		19364				JA FB-P		SPCB-600 JA/FB-P		JA /FB-P
1000⑤ 5.75%	50,000	962	12565	3848	16143	SPCB-1200	SPCB-600	SPCB-600	HFB JA	SPCB-1200 NB	SPCB-600 HFB/JA	SPCB-600	HFB/JA
	100,000 Unlimited		14367 16730		18215 20578				JA FB-P		SPCB-600 JA/FB-P		JA /FB-P
1500③ 6.8%	50,000	1444	14773	5776	20549	SPCB-2000	SPCB-2000	SPCB-2000	JA FB-P	SPCB-2000 PB	SPCB-600 JA/FB-P	SPCB-600	JA /FB-P
	100,000 150,000		17424 18529		23200 24305				HKA FB-P		SPCB-2000 HKA/FB-P	SPCB-2000	HKA /FB-P
	250,000 Unlimited		19518 21235		25294 27011				PB/ FB-P		SPCB-2000 PB/FB-P		PB /FB-P
1500⑤ 6.75%	50,000	1444	16722	5776	22498	SPCB-2000	SPCB-2000	SPCB-2000	HKA FB-P	SPCB-2000 PB	SPCB-2000 HKA/FB-P	SPCB-2000	HKA /FB-P
	100,000 Unlimited		20134 25113		25910 30889				PB FB-P		SPCB-2000 PB/FB-P		PB /FB-P
2000⑤ 5.76%	50,000 Unlimited	1924	19993 33460	7696	27689 41156	SPCB-2500	SPCB-2000	SPCB-2000	FB-P PB	SPCB-2500 PB	SPCB-2000 PB/FB-P	SPCB-2000	PB /FB-P
2500⑤ 5.75%	50,000 Unlimited	2405	22556 41826	9620	32176 51446	SPCB-3000	SPCB-2000	SPCB-2000	FB-P PB	SPCB-3000 PB	SPCB-2000 PB/FB-P	SPCB-2000	PB /FB-P

Table F: Approximate values of resistance, reactance, impedance and X/R ratios with secondaries of 600 volts or less, 60 Hertz, 3-phase, standard Westinghouse transformers.⑦ Primary voltage – 15 kv or less. Values shown in percent rated kva as base.

Kva	Dry-Type Ventilated ASL				DT-3 150°C Only 600 Volt Class				DT-3 150°C Only 5 Kv Class				Liquid Filled DB 47-350			
	%R	%X	%Z	X/R	%R	%X	%Z	X/R	%R	%X	%Z	X/R	%R	%X	%Z	X/R
150	2.31	5.26	5.75	2.28	2.5	5.0	5.6	2.0	2.0	3.2	3.8	1.6	1.48	4.77	5.0	3.22
225	2.45	5.20	5.75	2.12	1.9	5.0	5.3	2.6	2.0	2.4	3.1	1.2	1.48	4.77	5.0	3.22
300	2.44	5.20	5.75	2.13	1.5	5.6	5.8	3.9	2.0	2.8	3.5	1.4	1.48	4.77	5.0	3.22
500	2.15	5.23	5.75	2.43	1.8	6.2	6.5	3.5	2.0	5.7	6.0	2.8	1.30	4.83	5.0	3.71
750	1.94	5.41	5.75	2.79	1.5	6.3	6.5	4.2	1.3	6.3	6.5	4.9	1.28	5.60	5.75	4.37
1000	2.00	5.39	5.75	2.69	1.3	5.6	5.8	4.3	1.2	6.1	6.2	5.1	1.21	5.62	5.75	4.64
1500	1.73	5.46	5.75	3.15	1.0	5.6	5.7	5.6	1.2	6.7	6.8	5.6	1.06	5.64	5.75	5.32
2000	1.64	5.51	5.75	3.36	...	...	...	...	...	...	...	...	1.00	5.66	5.75	5.66
2500	1.40	5.57	5.75	3.98	...	...	...	...	...	...	...	...	0.97	5.67	5.75	5.85

② DT-3 (600 volt) transformer data from Table F.
③ DT-3 (5 kv) transformer data from Table F.
④ Liquid filled transformer data from Table F.
⑤ ASL transformer data from Table F.
⑥ All breaker selections shown are minimum possible.
⑦ Impedance values change with transformer designs. For exact impedance values of any given transformer design, consult your Westinghouse sales office.

Westinghouse Electric Corporation
Low Voltage Breaker Division
Beaver, Pa. 15009

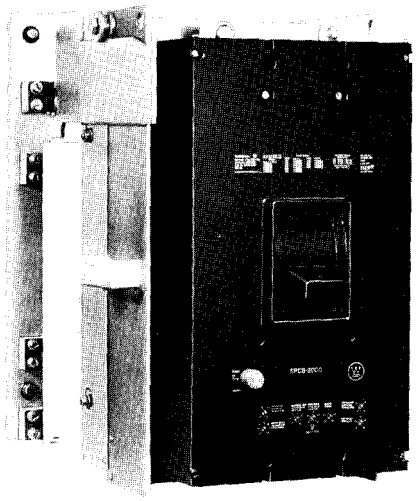
Printed in U.S.A.

Westinghouse Electric Corporation
Low Voltage Breaker Division
Beaver, Pennsylvania 15009

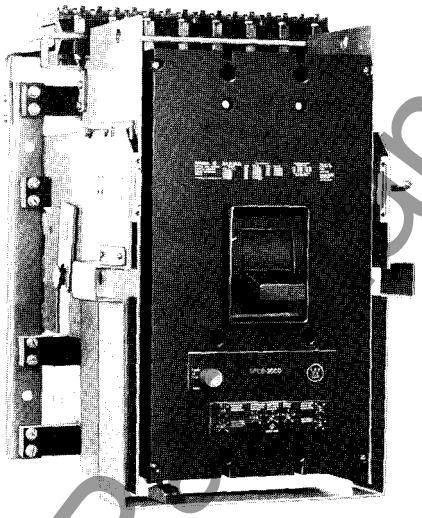
October, 1976
Supersedes Application Data 29-860
dated June, 1973
Mailed to: E, D, C/1901, 1923, 1929/DB

250-3000 Amperes, 3 Poles Only
600 Volts Ac Maximum

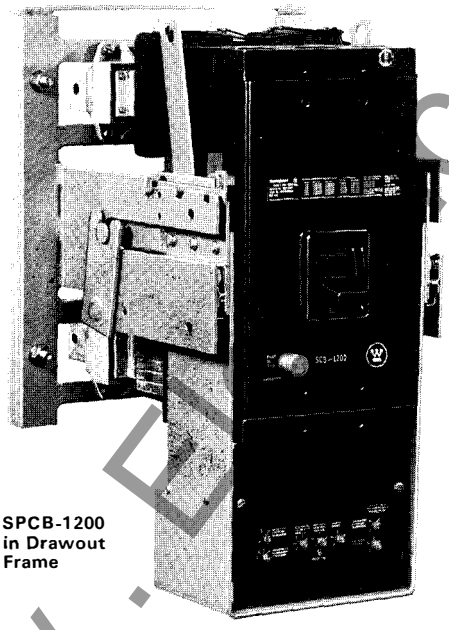
SCB-II Systems Circuit Breakers



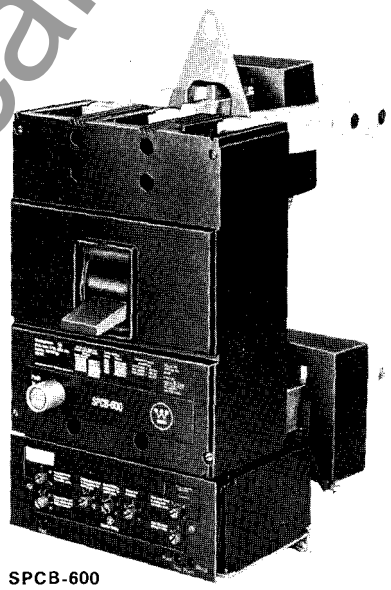
SPCB-3000
Fixed Mounting, Front Removable



SPCB-3000
Drawout Mounting



SPCB-1200
in Drawout
Frame



SPCB-600
Fixed Pre-Assembled
Rear Connected
Breaker

General Application

Systems Circuit Breakers are a simple solution to a complex problem – coordinated systems protection. They are designed for use in switchboards, motor control centers and other electrical assemblies. They provide selective tripping and ground fault protection, as well as excellent coordination between breakers and other devices in a system. The breakers have provisions for fixed or three-position drawout mounting, for manual or electrical operation and will accept many modifications and accessories.

Systems Circuit Breakers are designed for operation on Ac distribution systems of up to 600 volts.

Distribution System Protective Arrangements

There are two basic distribution-system protective arrangements: a fully rated nonselective system and a selective-tripping system. Westinghouse Systems Circuit Breakers are recommended for use on either system.

A fully rated system is one in which all breakers – main, tie and branch – have adequate interrupting current capacity for the maximum fault current available at the point of application of the breaker in the system. For such a system, the Systems Circuit Breaker's static sensor need provide only long-delay and instantaneous tripping.

A selective-tripping system is one in which circuit breakers are applied so that, of the breakers carrying the fault current, only the breaker nearest the fault opens to isolate the faulted circuit from the rest of the power system. This system results in maximum continuity of service.

Component Parts

The basic Systems Circuit Breaker has four major parts: a frame, a static sensor, current monitors, and a flux transfer shunt trip.

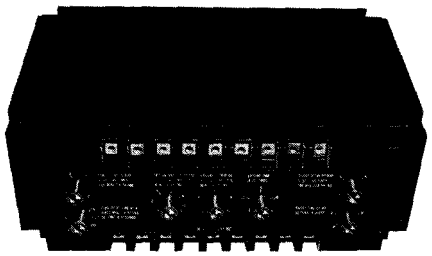
Frame

The frame includes the breaker contacts, De-ion® arc quenchers, and associated moving parts that open and close the breaker contacts, all enclosed in a glass polyester case.

Static Sensor

The static sensor contains a number of solid state circuits which act on signals received from the current monitors. As the

current monitors detect overload currents, short-circuit current, and ground fault currents, signals are passed to the sensor which act to trip the breaker at the desired time and current point. The sensor operates solely from breaker load current, is not dependent on any outside power source.



Static Sensor

The standard static sensor is provided with three adjustments: long time pick-up, long time delay, and instantaneous pick-up. Optional static sensors are available with additional adjustments: short-delay pick-up②, short-delay time②, ground fault pick-up, and ground fault time-delay. These adjustments can be varied to shape the breakers' characteristic tripping curve to provide the coordination and or selective tripping requirements of the distribution system.

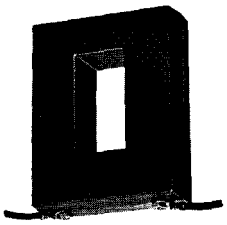
In addition to the above adjustments, static sensors are also available with the following optional circuits requiring separate 120/60 control power to the sensor:

- ground fault trip indicator circuit④
- instantaneous trip indicator circuit④
- circuit to utilize flux transfer shunt trip with a remote initiating contact

On 600 and 1200 amp breakers, the static sensor is mounted external to the breaker frame; on 2000, 2500 and 3000 amp units it is mounted in the breaker frame.

Current Monitors

The current monitors are transformers which produce a current proportional to the current flowing in the bus. When above a predetermined level, the induced current is the signal that causes the breaker to trip.
A current monitor is provided for each phase



Current Monitor

bus. On 600 and 1200 amp frames, the monitors mount on bus external to the frame; on 2000, 2500 and 3000 amp frames, the three phase monitors are mounted in the frame. If optional ground fault protection is selected and if the system has a neutral, an additional monitor is provided.

Flux Transfer Shunt Trip

This is a special magnetic tripping device factory-installed in the frame. On signal from the sensor, it causes the breaker contacts to open. It operates on a flux-transfer principle; it therefore operates directly from the sensor signal only and requires no external source of power.

Accessories and Modifications

The following accessories and modifications are available for use with the Systems Circuit Breaker. Refer to Tech Data 29-121 for additional information.
Motor Operators
Drawout Frame
Shunt Trip
Undervoltage Release
Alarm Switch
Auxiliary Contacts
Key Interlocks
Handle Extensions
Base Mounting Hardware

Inspection and Maintenance

Good maintenance procedure calls for periodic inspection of all electrical apparatus including systems circuit breaker, especially after an unusual circuit condition. Terminal lugs must be tight to prevent overheating.

Operation

Figure 1, page 3, is a simplified block schematic diagram of the Systems Circuit Breaker. It shows the basic operating sequences involved in the breaker's tripping functions. Major elements of the solid state tripping system are:

1 Current Monitors
2 Auxiliary Transformers
3 Rectifier Bridges
4 Power-and-Signal Circuit
5 Long-Delay Tripping Circuits
6 Short-Delay Tripping Circuits
7 Instantaneous-Tripping Circuit
8 Ground-Tripping Circuit
9 Trigger Circuit
10 Flux-Transfer Shunt-Trip Device

The current monitors are coils similar to standard through-type current transformers. At overloads, the current monitor's output rises in close proportion to the overload current through the circuit breaker. The design of the monitors is such that the close proportion is maintained up to overloads of 12 times the breaker nominal current rating to insure the accuracy of the tripping characteristics of the entire Systems Circuit Breaker.

The signal current from the monitors goes to the auxiliary transformers where it is stepped down to milliampere levels. The output of the auxiliary transformers is rectified by the rectifier bridges to direct-current power for use by the other circuits of the static sensor.

The power and signal circuit serves two purposes: First, it acts as the power supply for energizing the shunt-trip coil. It does this by charging a condenser with direct current supplied by the current monitors, auxiliary transformers, and rectifier bridges. When tripping is called for by the other static-sensor circuits, the fully-charged condenser discharges to the shunt coil which in turn opens the circuit breaker contacts. Because the condenser is charged by signal current which is taken from the bus being monitored, no outside power source is needed to operate the shunt-trip unit. The other sensor circuits also draw operating power from the capacitor and the rectifier bridge.

Second, the power-and-signal circuit supplies a signal for the sensing and triggering circuits.

Overload-Operation Sequence

When an overload current appears through the breaker, the voltage from the rectifiers increases proportionally to the overload current and acts as a signal to operate timing circuits in the trip circuits. These timing

② When these short time rated breakers are supplied without adjustable instantaneous, they are equipped with a fixed instantaneous circuit that overrides the time delay when the current value reaches approximately 21 times the current monitor rating on 1200 and 2000 amp units, and 14 times the current monitor rating on 600, 2500 and 3000 amp units, causing the SCB breaker to trip instantaneously. This feature allows short-time rated SCB breakers to be applied on systems having short circuit capabilities up to the instantaneous rating of the breaker. Also short-time rated SCB breakers have a fault closing discriminator circuit that causes the breaker to trip instantaneously if closed on a fault of approximately eight times the current monitor rating.

③ Not U/L Listed.

④ Requires separate 120 volt full voltage or resistor type light.

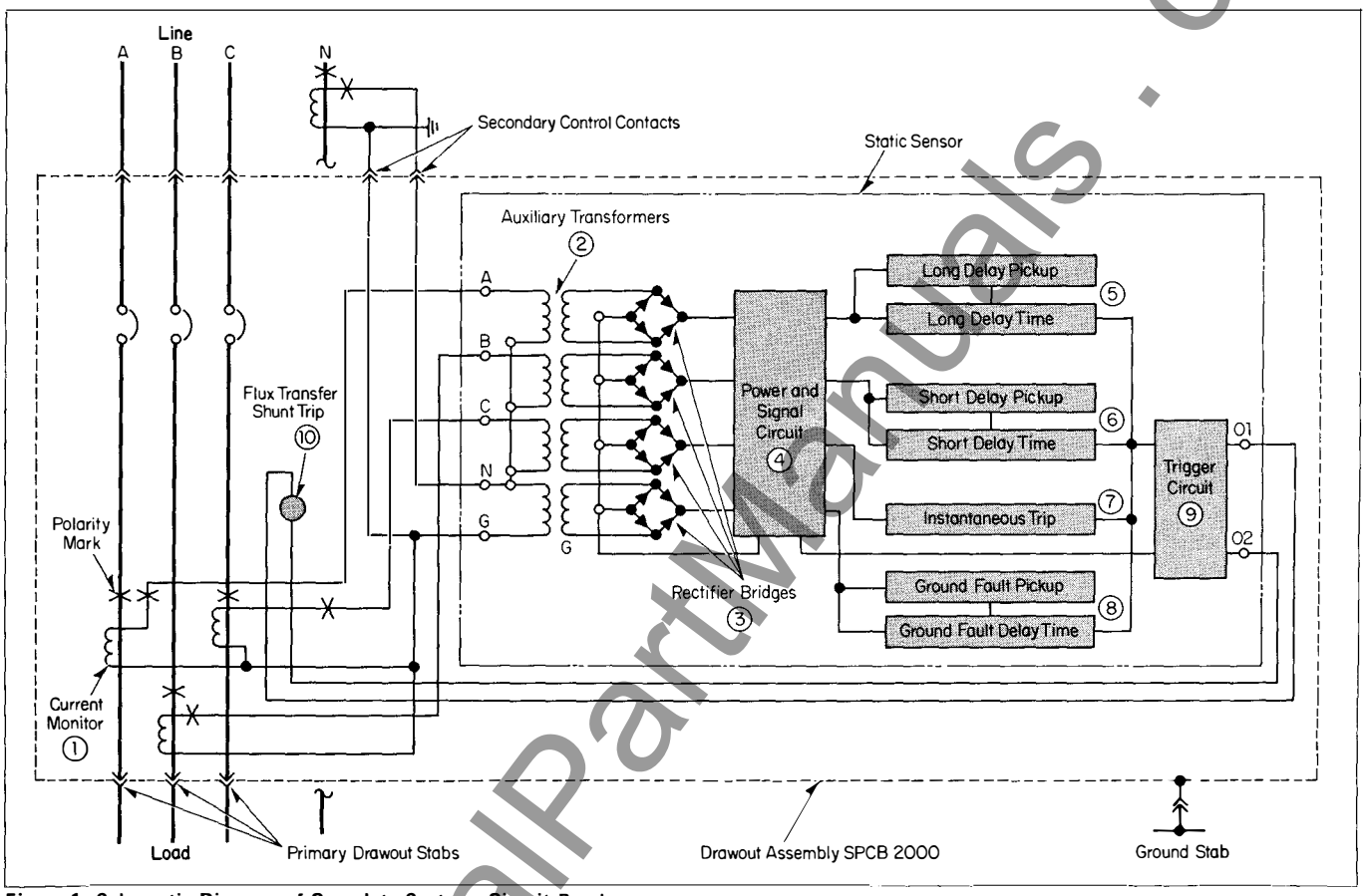


Figure 1: Schematic Diagram of Complete Systems Circuit Breaker

circuits, which signal the trigger circuit to discharge the condenser through the shunt-trip coil, cause the breaker to trip according to the trip curve established by the trip settings on the static sensor. Operations of the long-delay, short-delay, and instantaneous trip parts of the sensor are the same in 3-wire and 4-wire 3-phase distributions systems.

Ground-Fault Tripping in a 3-Phase, 3-Wire Ungrounded Delta Distribution System

Under normal conditions, i.e., with no ground fault, all current in the system flows through poles A, B, and C of the Systems Circuit Breaker. Correspondingly, these currents are reflected in the three current monitors, and must all pass through the primary of the auxiliary transformer (G). This results in no output from transformer G because the currents of a 3-phase system cancel each other out, even when the circuit load is unbalanced and the current is not equal in all three phases.

When a ground fault occurs on one phase of the 3-wire system and one of the other phases is already grounded, the ground-fault current will flow in auxiliary transformer G only. There will then be an uncancelled current in the secondary of auxiliary transformer G and this will result in a signal to the power-and-signal circuit. If the fault current is higher than the preselected percentage of the continuous-current rating of the current monitor, the ground-trip circuit will signal the trigger circuit to discharge the condenser in the power-and-signal circuit, and the breaker will trip.

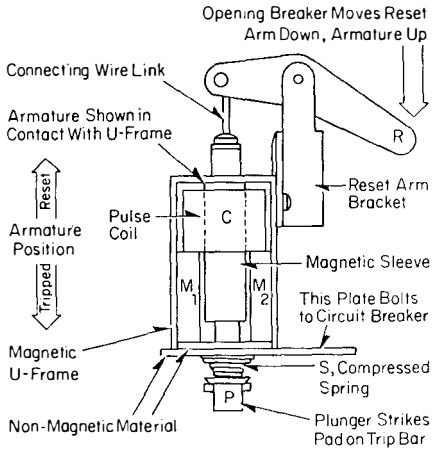
Ground-Fault Tripping in a 3-Phase, 4-Wire Grounded Distribution System

Only the addition of a fourth current monitor on the neutral bus is necessary to apply the SPCB for ground-fault tripping on a 4-wire power-distribution system. In a 4-wire power system, current will flow in the neutral bus when an unbalanced load causes the 3-phase currents to be unequal, even in the absence of a ground fault. Because this neutral-line current escapes detection by the three current monitors in the power lines, the total current in auxiliary transformer G would not be zero and the sensor would falsely report a ground fault. The purpose of the fourth current monitor is to reflect any neutral-current to auxiliary transformer G so that all current components will cancel when the load is unbalanced and there is no ground fault.

When a ground fault occurs, the operation is the same as in the 3-wire power system. Ground fault current in the neutral appears in the primary winding of auxiliary transformer G and tripping occurs in the same sequence as in the 3-wire system. Two important points should be noted about the neutral-line current monitor:

1. It should be identical to the monitors in each of the phase lines. Even if its output deviates by only a few percent from the output of the line monitors, the difference could be enough to cause ground-fault tripping of the breaker instead of time-delay overload tripping.
2. Current monitors must be connected carefully for proper polarity.

Flux-Transfer Shunt-Trip



The shunt-trip device used in the Systems Circuit Breaker permits tripping the breaker with a low-energy electrical signal. The illustration shows the trip device in the RESET position. It is held in this position by the two permanent magnets, M1 and M2. Their magnetic flux lines pass through the U-shaped frame and the magnetic sleeve of the armature, and because the UP position is the shortest magnetic path, the armature is held up against the top of the U-frame.

Compressed spring S stores the energy for tripping the breaker. It is held compressed by the permanent magnets which exert a slightly stronger force than the spring does.

When direct current from the capacitor in the static sensor passes through the pulse coil C, an electromagnetic flux is set up in a direction opposite to the flux of the permanent magnets. This opposing flux weakens the magnetic force exerted on the armature, the spring overcomes the magnetic force and forces the armature down.

Plunger P at the end of the armature strikes the trigger release rocker in the trip unit, and trips the contacts open. As the contacts open, part of the moving mechanism strikes reset arm R in a downward direction, raises the armature, compresses the spring, and resets the device. The circuit breaker is immediately ready for tripping again.

Application Considerations

In the design of power-distribution system protection, and in the selection and application of Westinghouse systems circuit breakers, the following should be considered:

Power-System Voltage and Frequency
Continuous Current Rating
Short-Circuit Current
Rated Interrupting Current
Rated Continuous Current

Ground Fault Protection

Ground-fault currents are generally initiated at a very low current level, much lower than the trip settings of standard circuit breakers. Completely coordinated electrical systems where required should be equipped with low-level ground-fault protective devices which have tripping times coordinated for ground-fault-selective tripping for maximum protection and continuity of service.

Application Tables

Tables A through E are selection guides for SCB applications in selective tripping and fully rated systems.

The tabulated values in tables B through E are based on the assumption that the SCB is mounted in a distribution switchboard located next to the supply transformer, and therefore, the impedance of the bus connecting the transformer to the switchboard main bus is negligible. For specific connections between the transformer and the distribution switchboard, where the cable impedance could be significant, refer to bulletin B-8674-B on "How to Calculate Fault Currents." For sizing breakers that are remote from the distribution switchboard, the cable and/or bus duct impedance should be considered. The complete formula method is illustrated in Bulletin B-8674-B.

Breaker type designations shown for group feeder and feeder breakers are minimum sizes for adequate interrupting current ratings. Other types may be used to meet continuous current requirements if adequate interrupting requirements and voltage are satisfied.

For more detailed application information, refer to appropriate codes and standards.

Ratings, Underwriters' Laboratories, Inc. Listed

Breaker Designation	Max. Frame Size, Cont. Amps.	Current Monitor Ratings, Amperes	Interrupting Capacity, Amperes	
			Asym.	Sym.
240 Volts Ac				
SPCB-600	600	250, 400 and 600	75,000©	65,000©
SPCB-1200	1200	250, 400, 600, 800, 1000 and 1200	75,000©	65,000©
SPCB-2000	2000	600, 800, 1000, 1200, 1600 and 2000	150,000	125,000
SPCB-2500	2500	2500	150,000	125,000
SPCB-3000	3000	3000	150,000	125,000
480 Volts Ac				
SPCB-600	600	250, 400 and 600	40,000©	35,000©
SPCB-1200	1200	250, 400, 600, 800, 1000 and 1200	58,000©	50,000©
SPCB-2000	2000	600, 800, 1000, 1200, 1600 and 2000	115,000	100,000
SPCB-2500	2500	2500	115,000	100,000
SPCB-3000	3000	3000	115,000	100,000
600 Volts Ac				
SPCB-600	600	250, 400 and 600	30,000©	25,000©
SPCB-1200	1200	250, 400, 600, 800, 1000 and 1200	30,000©	25,000©
SPCB-2000	2000	600, 800, 1000, 1200, 1600 and 2000	115,000	100,000
SPCB-2500	2500	2500	115,000	100,000
SPCB-3000	3000	3000	115,000	100,000

© Changed since previous issue.

①Table A: Trip Current Ratings of Systems Circuit Breakers

Current Monitor Ratings.⑤	Long-time Pick-up Range, Amperes②⑥		Instantaneous Pick-up Range, Amperes		Short-time Delay Pick-up Range, Amperes③		Ground Current Pick-up Range, Amperes④	
	Min.⑦	Max.⑦	Min.⑦	Max.⑦	Min.⑦	Max.⑦	Min.⑦	Max.⑦
250	125	300	250	3000	250	1750	50	250
400	200	480	400	4800	400	2800	80	400
600	300	720	600	7200	600	4200	120	600⑧
800	400	960	800	9600	800	5600	160	800⑧
1000	500	1200	1000	12000	1000	7000	200	1000⑧
1200	600	1440	1200	14400	1200	8400	240	1200⑧
1600	800	1920	1600	19200	1600	11200	320	1200⑧
2000	1000	2400	2000	24000	2000	14000	400	1200
2500	1250	3000	2500	30000	2500	17500	500	1200
3000	1500	3600	3000	36000	3000	21000	600	1200

①Table B: Systems Circuit Breaker Application, 208 Volts⑬

Transformer Rating 3Ø Kva and % Imp.	Max. Short Circuit Kva Available	Rated Load, Continuous Amps.	Short Circuit Current RMS Symmetrical, Amperes			Selective Trip System				Fully Rated System, Non-selective			
			Transformer Only	100% Motor Load	Combined	Selective Main	Selective Group Feeder	SCB-II Feeder Instantaneous Trip	AB Feeder Brkr. (Min.)	Main	Group Feeder	SCB-II Feeder	AB Feeder Brkr. (Min.)
150⑩ 3.8%	Unlimited	416	10947	832	11779	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 LA-600	SPCB-600 EHB	SPCB-600	EHB
150⑪ 5.0%	Unlimited	416	8320	832	9152	SPCB-600	SPCB-600	SPCB-600	EB	SPCB-600 LA-600	SPCB-600 EB	SPCB-600	EB
225⑩ 3.1%	50,000 Unlimited	625	17950 20161	1250	19200 21411	SPCB-1200	SPCB-600	SPCB-600	JA/HFB	SPCB-1200 MA	SPCB-600 JA/HFB	SPCB-600	JA/HFB
225⑫ 5.75%	50,000 Unlimited	625	10148 10869	1250	11398 12119	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 MA	SPCB-600 EHB	SPCB-600	EHB
300⑩ 3.5%	50,000 150,000	834	21142 23130	1668	22810 24798	SPCB-1200	SPCB-600	SPCB-600	JA/HFB	SPCB-1200 NB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	250,000 Unlimited		23564 23828		25232 25496				LB/HFB		SPCB-600 LB/HFB		LB/HFB
300⑪ 5.0%	50,000 250,000	834	14972 16323	1668	16640 17991	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
	500,000 Unlimited		16509 16680		18177 18348				JA/HFB		SPCB-600 JA/HFB		JA/HFB
300⑨ 5.8%	50,000 Unlimited	834	13074 14379	1668	14742 16047	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
500⑪ 5.0%	50,000 Unlimited	1388	23237 27760	2776	26013 30536	SPCB-2000	SPCB-600	SPCB-600	LB/HFB	SPCB-2000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
500⑫ 5.75%	50,000 100,000	1388	21060 22679	2776	23836 25455	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	Unlimited		24139		26915				LB/HFB		LB/HFB		LB/HFB
500⑩ 6.0%	50,000 150,000	1388	19850 21847	2776	22626 24623	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	250,000 Unlimited		22280 23133		25056 25909				LB/HFB		SPCB-600 LB/HFB		LB/HFB
500⑨ 6.5%	50,000 Unlimited	1388	18702 21353	2776	21478 24129	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
750⑫ 5.75%	50,000 Unlimited	2080	28980 36173	4160	33140 40333	SPCB-3000	SPCB-600	SPCB-600	LB/HFB	SPCB-3000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
750⑩ 6.5%	50,000 Unlimited	2080	26303 32000	4160	30463 36160	SPCB-3000	SPCB-600	SPCB-600	LB/HFB	SPCB-3000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB

② Long-time delay adjustable from 2 to 20 sec. at 600% rating.
③ Short-time delay adjustable from 2 to 10 cycles at 600% rating.
④ Ground current trip time adjustable from 0.1 (6 cycles) to 0.5 (30 cycles) sec.
⑤ Refer ratings table, page **4**, to determine which monitors apply to each SCB frame rating.
⑥ Do not exceed setting which results in continuous current rating in excess of frame rating; see ratings table.
⑦ All adjustments are continuous from minimum to maximum.
⑧ When used with 2000 amp frame, these monitors have maximum ground current trip of .75 X monitor rating.
⑨ DT-3 (600-volt) transformer data from Table F.
⑩ DT-3 (5 kv) transformer data from Table F.
⑪ Liquid filled transformer data from Table F.
⑫ ASL transformer data from Table F.
⑬ All breaker selections shown are minimum possible.

①Table C: Systems Circuit Breaker Application, 240 Volts⑥

Transformer Rating 3ø Kva and % Imp.	Max. Short Circuit Kva Available	Rated Load, Continuous Amps.	Short Circuit Current RMS Symmetrical, Amperes			Selective Trip System				Fully Rated System, Non-selective			
			Transformer Only	100% Motor Load	Combined	Selective Main	Selective Group Feeder	SCB-II Feeder Instantaneous Trip	AB Feeder Brkr. (Min.)	Main	Group Feeder	SCB-II Feeder	AB Feeder Brkr. (Min.)
150③ 3.8%	Unlimited	361	9500	1444	10944	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 LA-600	SPCB-600 EHB	SPCB-600	EHB
150④ 5.0%	Unlimited	361	7220	1444	8644	SPCB-600	SPCB-600	SPCB-600	EB	SPCB-600 LA-600	SPCB-600 EB	SPCB-600	EB
225③ 3.1%	50,000	541	15538	2164	17702	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
	100,000 Unlimited		16413 17451		18577 19615				JA/HFB		SPCB-600 JA/HFB		JA/HFB
225④ 5.0%	50,000 Unlimited	541	9970 10820	2164	12134 12984	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
225⑤ 5.75%	50,000 Unlimited	541	8784 9408	2164	10948 11572	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
300③ 3.5%	50,000 Unlimited	722	18303 20628	2888	21191 23516	SPCB-1200	SPCB-600	SPCB-600	JA/HFB	SPCB-1200 NB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
300④ 5.0%	50,000 Unlimited	722	12961 14440	2888	15849 17328	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 NB	SPCB-600 EHB	SPCB-600	EHB
500④ 5.0%	50,000	1203	20140	4812	24952	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	100,000 Unlimited		21927 24060		26739 28872				LB/HFB		SPCB-600 LB/HFB		LB/HFB
500⑤ 5.75%	50,000 150,000	1203	18253 20180	4812	23065 24992	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	250,000 Unlimited		20598 20921		25410 25733				LB/HFB		SPCB-600 LB/HFB		LB/HFB
500③ 6.0%	50,000 Unlimited	1203	17205 20050	4812	22017 24862	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
500② 6.5%	50,000 Unlimited	1203	16209 18507	4812	21021 23319	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
750⑤ 5.75%	50,000 Unlimited	1804	25135 31373	7216	32351 38589	SPCB-2500	SPCB-600	SPCB-600	LB/HFB	SPCB-2500 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
750③ 6.5%	50,000 Unlimited	1804	22813 27753	7216	30029 35769	SPCB-2500	SPCB-600	SPCB-600	LB/HFB	SPCB-2500 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
1000⑤ 5.75%	50,000	2405	31413	9620	41033	SPCB-3000	SPCB-600	SPCB-600	LB/HFB	SPCB-3000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
	100,000 Unlimited		35918 41826		45538 51446		SPCB-2000	SPCB-2000	HFB/PB		SPCB-2000 HFB/PB	SPCB-2000	HFB/PB
1000③ 6.2%	50,000	2405	29370	9620	38990	SPCB-3000	SPCB-600	SPCB-600	LB/HFB	SPCB-3000 PB	SPCB-600 LB/HFB	SPCB-600	LB/HFB
	100,000 Unlimited		33399 38790		43019 48410		SPCB-2000	SPCB-2000	HFB/PB		SPCB-2000 HFB/PB	SPCB-2000	HFB/PB

② DT-3 (600-volt) transformer data from Table F.
③ DT-3 (5 kv) transformer data from Table F.
④ Liquid filled transformer data from Table F.
⑤ ASL transformer data from Table F.
⑥ All breaker selections shown are minimum possible.

①Table D: Systems Circuit Breaker Application, 480 Volts⑥

Transformer Rating 3Ø Kva and % Imp.	Max. Short Circuit Kva Available	Rated Load, Continuous Amps.	Short Circuit Current RMS Symmetrical, Amperes			Selective Trip System				Fully Rated System, Non-selective			
			Transformer Only	100% Motor Load	Combined	Selective Main	Selective Group Feeder	SCB-II Feeder Instantaneous Trip	AB Feeder Brkr. (Min.)	Main	Group Feeder	SCB-II Feeder	AB Feeder Brkr. (Min.)
150③ 3.8%	Unlimited	180	4736	720	5456	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 JA	SPCB-600 EHB	SPCB-600	EHB
225③ 3.1%	Unlimited	271	8741	1084	9825	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 LB	SPCB-600 EHB	SPCB-600	EHB
300③ 3.5%	Unlimited	361	10314	1444	11758	SPCB-600	SPCB-600	SPCB-600	EHB	SPCB-600 LA-600	SPCB-600 EHB	SPCB-600	EHB
500④ 5.0%	250,000	601	11568	2404	13972	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 MA	SPCB-600 EHB	SPCB-600	EHB
	500,000 Unlimited		11787 12020		14191 14424				JA/HFB		SPCB-600 JA/HFB		JA/HFB
500⑤ 5.75%	Unlimited	601	10452	2404	12856	SPCB-1200	SPCB-600	SPCB-600	EHB	SPCB-1200 MA	SPCB-600 EHB	SPCB-600	EHB
750⑤ 6.75%	50,000 Unlimited	902	12567 15686	3608	16175 19294	SPCB-1200	SPCB-600	SPCB-600	JA/HFB	SPCB-1200 NB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
1000⑤ 6.75%	50,000	1203	15713	4812	20525	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	100,000 250,000		17966 19638		22778 24450				HFB /HKA LB		SPCB-600 HFB/HKA LB		HFB /HKA LB
	500,000 Unlimited		20262 20921		25074 25733				HKA/LB		SPCB-600 HKA/LB		HKA/LB
1000③ 6.2%	50,000 100,000	1203	14691 16706	4812	19503 21518	SPCB-2000	SPCB-600	SPCB-600	JA/HFB	SPCB-2000 PB	SPCB-600 JA/HFB	SPCB-600	JA/HFB
	150,000 Unlimited		17521 19403		22333 24215				HFB /HKA LB		SPCB-600 HFB/HKA LB		HFB /HKA LB
1500⑤ 5.75%	50,000	1804	20891	7216	28107	SPCB-2500	SPCB-600	SPCB-600	LB HKA /FB-P	SPCB-2500 PB	SPCB-600 LB HKA/FB-P	SPCB-600	LB /HKA FB-P
	100,000 150,000		25154 26975		32370 34191		SPCB-2000	SPCB-2000	HKA /FB-P PB		SPCB-2000 HKA FB-P/PB	SPCB-2000	HKA /FB-P PB
	250,000 Unlimited		28625 31373		35841 38589				FB-P PB		SPCB-2000 FB-P-PB		FB-P /PB
1500③ 6.8%	50,000 100,000	1804	18457 21768	7216	25673 28984	SPCB-2500	SPCB-600	SPCB-600	LB/HKA FB-P	SPCB-2500 PB	SPCB-600 LB HKA/FB-P	SPCB-600	LB/HKA FB-P
	150,000 Unlimited		23149 26529		30365 33745		SPCB-2000	SPCB-2000	HKA /FB-P PB		SPCB-2000 HKA FB-P/PB	SPCB-2000	HKA /FB-P PB
2000⑤ 5.75%	50,000	2405	24921	9620	34541	SPCB-3000	SPCB-2000	SPCB-2000	HKA /FB-P PB	SPCB-3000 PB	SPCB-2000 HKA FB-P/PB	SPCB-2000	HKA /FB-P PB
	100,000 Unlimited		31286 41826		40906 51446				FB-P /PB				FB-P /PB

② DT-3 (600-volt) transformer data from Table F.
③ DT-3 (5 kv) transformer data from Table F.
④ Liquid filled transformer data from Table F.
⑤ ASL transformer data from Table F.
⑥ All breaker selections shown are minimum possible.

①Table E: Systems Circuit Breaker Application, 600 Volts⑥

Transformer Rating 3ø Kva and % Imp.	Max. Short Circuit Kva Available	Rated Load, Continuous Amps.	Short Circuit Current RMS Symmetrical, Amperes			Selective Trip System				Fully Rated System, Non-selective			
			Transformer Only	100% Motor Load	Combined	Selective Main	Selective Group Feeder	SCB-II Feeder Instantaneous Trip	AB Feeder Brkr. (Min.)	Main	Group Feeder	SCB-II Feeder	AB Feeder Brkr. (Min.)
150③ 3.8%	Unlimited	144	3789	576	4365	SPCB-600	SPCB-600	SPCB-600	FB	SPCB-600 JA	SPCB-600 FB	SPCB-600	FB
225③ 3.1%	Unlimited	217	7000	868	7869	SPCB-600	SPCB-600	SPCB-600	FB	SPCB-600 LB	SPCB-600 FB	SPCB-600	FB
300③ 3.5%	Unlimited	289	8257	1156	9413	SPCB-600	SPCB-600	SPCB-600	FB	SPCB-600 LB	SPCB-600 FB	SPCB-600	FB
500④ 5.0%	Unlimited	481	9620	1924	11544	SPCB-600	SPCB-600	SPCB-600	FB	SPCB-600 LA-600	SPCB-600 FB	SPCB-600	FB
750② 5.5%	Unlimited	722	11107	2888	13995	SPCB-1200	SPCB-600	SPCB-600	FB	SPCB-1200 NB	SPCB-600	SPCB-600	FB
750④ 5.75%	50,000	722	10007	2888	12895	SPCB-1200	SPCB-600	SPCB-600	FB	SPCB-1200 NB	SPCB-600	SPCB-600	FB
	100,000		11145		14033				HFB /JA				HFB/JA
	Unlimited		12556		15444								
1000③ 6.2%	50,000	962	11748	3848	15596	SPCB-1200	SPCB-600	SPCB-600	HFB JA	SPCB-1200 NB	SPCB-600 HFB/JA	SPCB-600	HFB/JA
	100,000		14011		17859								
	Unlimited		15516		19364				JA /FB-P		SPCB-600 JA/FB-P		JA /FB-P
1000⑤ 6.75%	50,000	962	12565	3848	16143	SPCB-1200	SPCB-600	SPCB-600	HFB JA	SPCB-1200 NB	SPCB-600 HFB/JA	SPCB-600	HFB/JA
	100,000		14367		18215				JA FB-P		SPCB-600 JA/FB-P		JA /FB-P
	Unlimited		16730		20578								
1500③ 6.8%	50,000	1444	14773	5776	20549	SPCB-2000	SPCB-600	SPCB-600	JA FB-P	SPCB-2000 PB	SPCB-600 JA/FB-P	SPCB-600	JA /FB-P
	100,000		17424		23200		SPCB-2000	SPCB-2000	HKA FB-P		SPCB-2000 HKA/FB-P	SPCB-2000	HKA /FB-P
	150,000		18529		24305								
	250,000		19518		25294				PB/ FB-P		SPCB-2000 PB/FB-P		PB /FB-P
	Unlimited		21235		27011								
1500⑤ 5.75%	50,000	1444	16722	5776	22498	SPCB-2000	SPCB-2000	SPCB-2000	HKA FB-P	SPCB-2000 PB	SPCB-2000 HKA/FB-P	SPCB-2000	HKA /FB-P
	100,000		20134		25910				PB FB-P		SPCB-2000 PB/FB-P		PB /FB-P
	Unlimited		25113		30889								
2000⑤ 5.75%	50,000	1924	19993	7696	27689	SPCB-2500	SPCB-2000	SPCB-2000	FB-P PB	SPCB-2500 PB	SPCB-2000 PB/FB-P	SPCB-2000	PB /FB-P
	Unlimited		33460		41156								
2500⑤ 5.75%	50,000	2405	22556	9620	32176	SPCB-3000	SPCB-2000	SPCB-2000	FB-P PB	SPCB-3000 PB	SPCB-2000 PB/FB-P	SPCB-2000	PB /FB-P
	Unlimited		41826		51446								

Table F: Approximate values of resistance, reactance, impedance and X/R ratios with secondaries of 600 volts or less, 60 Hertz, 3-phase, standard Westinghouse transformers.⑦
Primary voltage – 15 kv or less. Values shown in percent rated kva as base.

Kva	Dry-Type Ventilated												Liquid Filled			
	ASL				DT-3 150°C Only 600 Volt Class				DT-3 150°C Only 5 Kv Class				DB 47-350			
	%R	%X	%Z	X/R	%R	%X	%Z	X/R	%R	%X	%Z	X/R	%R	%X	%Z	X/R
150	2.31	5.26	5.75	2.28	2.5	5.0	5.6	2.0	2.0	3.2	3.8	1.6	1.48	4.77	5.0	3.22
225	2.45	5.20	5.75	2.12	1.9	5.0	5.3	2.6	2.0	2.4	3.1	1.2	1.48	4.77	5.0	3.22
300	2.44	5.20	5.75	2.13	1.5	5.6	5.8	3.9	2.0	2.8	3.5	1.4	1.48	4.77	5.0	3.22
500	2.15	5.23	5.75	2.43	1.8	6.2	6.5	3.5	2.0	5.7	6.0	2.8	1.30	4.83	5.0	3.71
750	1.94	5.41	5.75	2.79	1.5	6.3	6.5	4.2	1.3	6.3	6.5	4.9	1.28	5.60	5.75	4.37
1000	2.00	5.39	5.75	2.69	1.3	5.6	5.8	4.3	1.2	6.1	6.2	5.1	1.21	5.62	5.75	4.64
1500	1.73	5.46	5.75	3.15	1.0	5.6	5.7	5.6	1.2	6.7	6.8	5.6	1.06	5.64	5.75	5.32
2000	1.64	5.51	5.75	3.36	...	...	...	...	...	...	...	...	1.00	5.66	5.75	5.66
2500	1.40	5.57	5.75	3.98	...	...	...	...	...	...	...	...	0.97	5.67	5.75	5.85

② DT-3 (600 volt) transformer data from Table F.
③ DT-3 (5 kv) transformer data from Table F.
④ Liquid filled transformer data from Table F.
⑤ ASL transformer data from Table F.
⑥ All breaker selections shown are minimum possible.
⑦ Impedance values change with transformer designs. For exact impedance values of any given transformer design, consult your Westinghouse sales office.

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