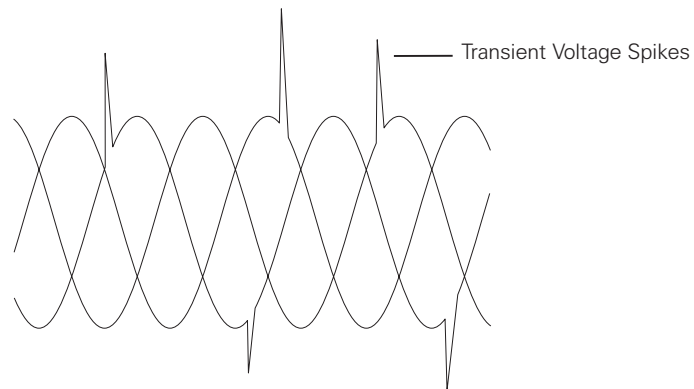


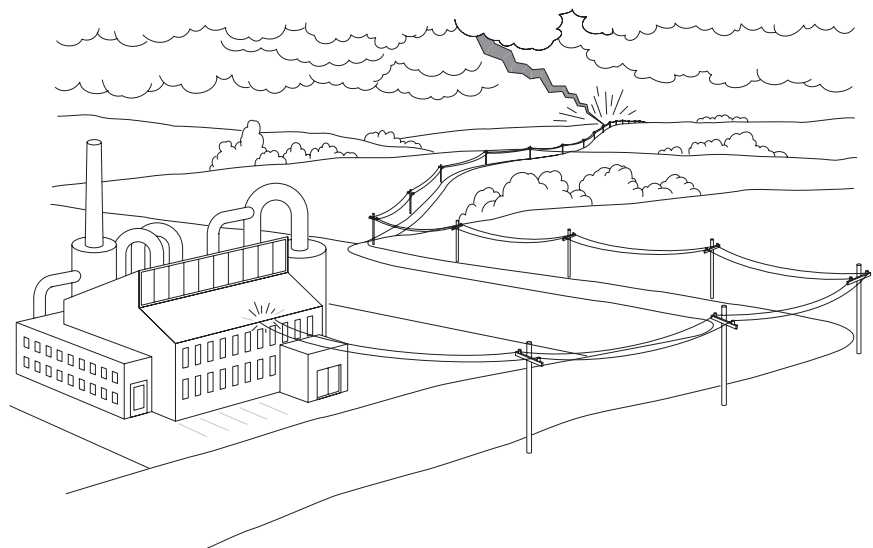
Transient Protection System (TPS)

Need for Circuit Protection

Transients voltage spikes appear on an electrical system as a result of lightning and switching transients. These transients are capable of destroying sensitive electronic equipment in commercial and industrial applications.

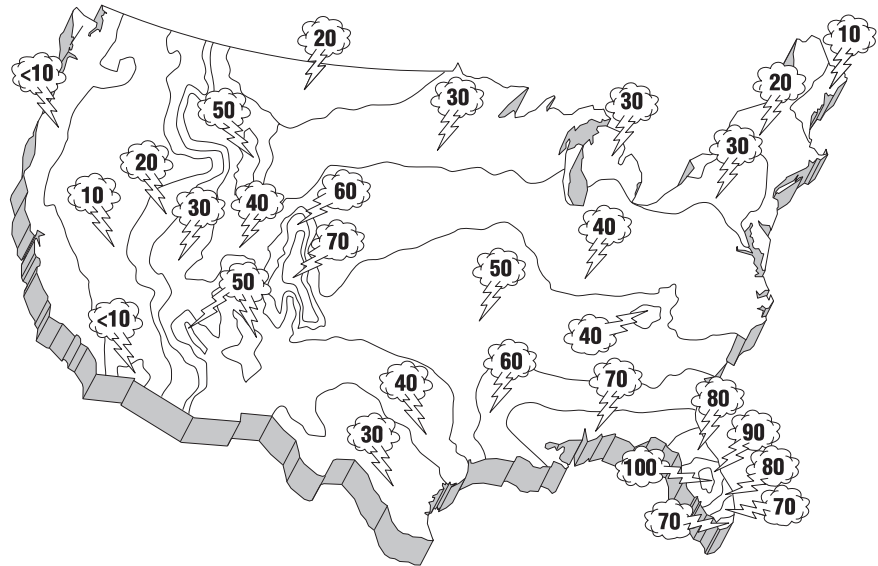


The most damaging voltage spikes are caused by lightning strikes. Although lightning strikes on high voltage lines are generally dissipated by utility transmission and arresters, a lightning strike on a power line several miles away still has the potential to cause extensive electrical damage. Damage to expensive electrical equipment can be either instantaneous or cumulative.



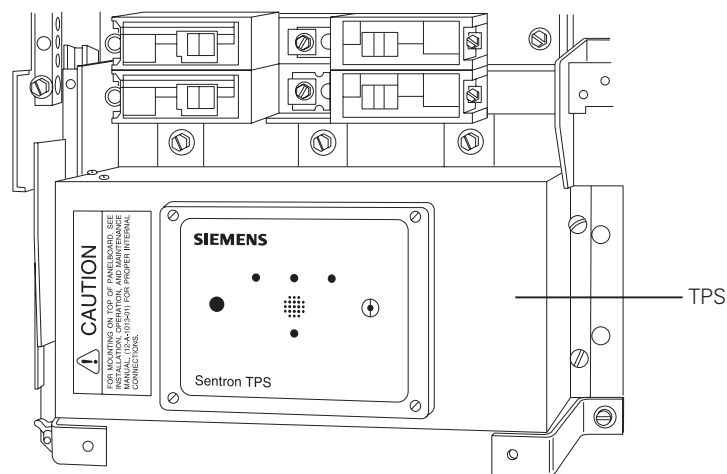
Number of Thunderstorms

A typical lightning strike consists of 25,000 amps at 30 million volts. The following map shows the approximate mean annual number of days with thunderstorms in the United States.



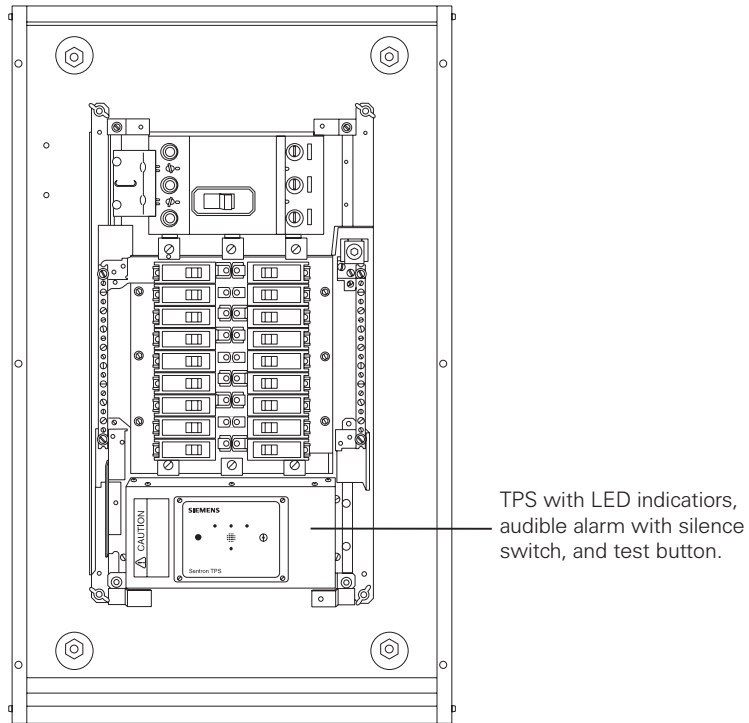
TPS

Computers and other office equipment are susceptible to the high energy levels caused by an electrical surge, whether it is caused by electrical equipment or lightning. Any component between the source of the surge and ground can be damaged. Siemens TPS transient protection system clamps these damaging voltage spikes before they damage expensive and sensitive equipment.



Installation

The TPS is bolted directly to the bus bars within the P1 panelboards. Purchased “over the counter” and utilizing a field installation kit, the TPS transient voltage protection system can easily be mounted in existing P1 lighting panelboards. LEDs indicate that the device is working and provide voltage and diagnostic monitoring. There is an audible alarm and test button. Options include a surge counter and a remote monitoring device.



Clamping Voltage

Clamping voltage is the amount of voltage allowed across a surge suppression device when it is conducting a specific current created by a surge. The following chart indicates clamping voltage for the Siemens TPS.

System Voltage	Line-to-Neutral	Neutral-to-Ground	Line-to-Ground
120/240 1Ø3W	500 V	500 V	500 V
208Y/120V 3Ø4W	500 V	500 V	500 V
480Y/277V 3Ø4W	1000 V	1000 V	1000 V

Peak Current Peak Rating

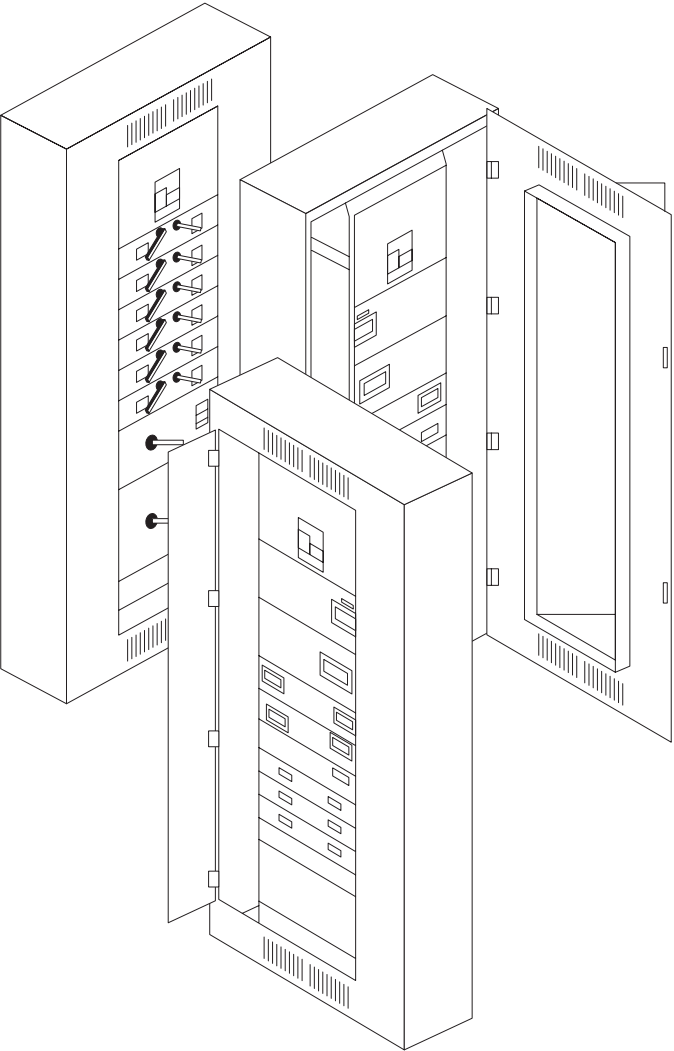
Peak current rating specifies the maximum current that a protective device can withstand from a single surge. The Siemens TPS can withstand impulse currents as high as 80,000 amps or 160,000 amps, depending on the model.

Review 6

1. The maximum number of circuits available on the P1 lighting panelboards is _____ .
2. One way to convert a P1 from top to bottom feed is to relocate the main breaker or lug module. Another way is to _____ the interior.
3. The maximum voltage of an P1 panelboard is _____ VAC.
4. The maximum integrated equipment short circuit rating of a P2 panelboard is _____ AIR.
5. The maximum voltage rating for a P1 panelboard is _____ VAC.
6. The _____ _____ _____ is used to protect sensitive electrical equipment from damaging voltage spikes.

P4 and P5 Panelboards

P4 and P5 power panelboards are similar in design and features, but vary in the ratings available. P4 and P5 panelboards will accept various circuit breakers and fusible switches. P4 will accept branch circuit breakers up to 600 amps. The P5 will accept branch circuit breakers up to 1200 amps.



Panelboard Ratings

The following information gives various P4 and P5 rating ranges. Refer to Siemens Speedfax when ordering specific panelboards. Branch circuit breakers vary depending on the panelboard rating.

	P4	P5
Voltage	600 V	600 V
System	1Ø3W, 3Ø4W, 3Ø3W,	1Ø3W, 3Ø4W, 3Ø3W,
Main Lug Only	400 A - 1200 A	800 A, 1000 A, 1200 A
Main Circuit Breaker	400 A - 600 A	800 A, 1200 A
Main Fusible Switch	100 A - 200 A	400 A - 1200 A
Branch Circuit Breakers	All 15 A - 600 A	All 15 A - 1200 A
Integrated Equipment Short Circuit Rating	200,000 AIR Maximum	200,000 AIR Maximum

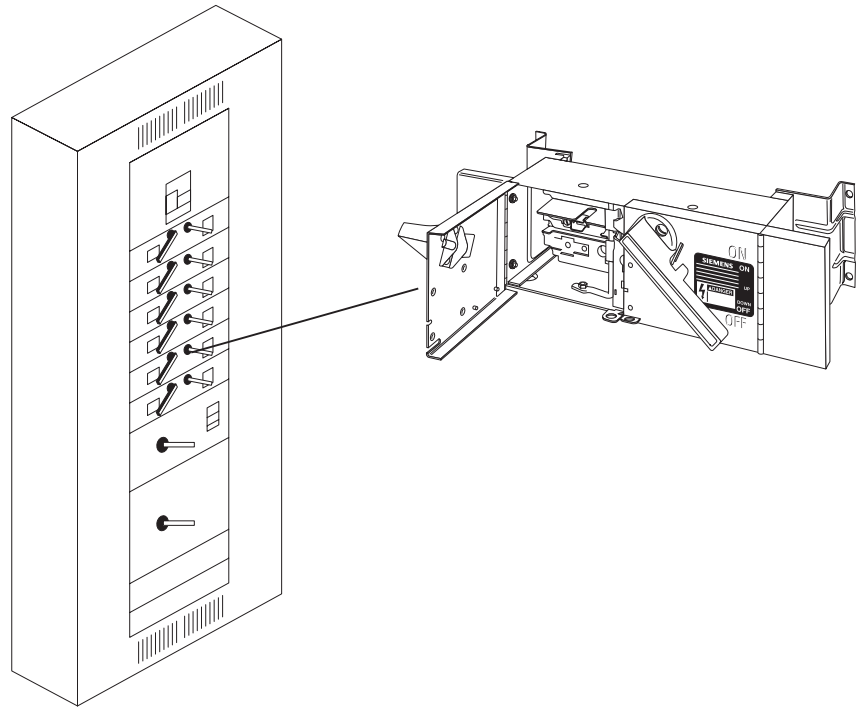
Dimensions

The P4 is 32" wide by 10" deep. This simplifies handling and installation. The enclosure height varies with the type and number of circuits required. The enclosure heights are 60,"75," and 90." A one piece door is available which allows for locking and flush mounting.

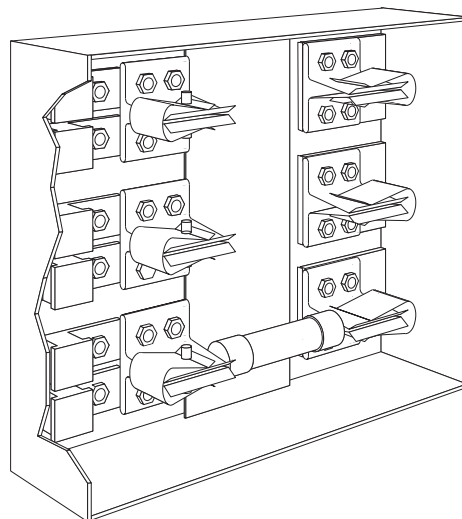
The P5 is 38" wide by 12.75" deep in a NEMA Type 1 enclosure. The P5 is 38" wide by 14.25" deep in a NEMA Type 3R or 12 enclosure. The enclosure height varies with the type and number of circuits required. The enclosure heights are 60,"75" and 90."

Fusible Switch

Although many panelboards use circuit breakers, it is important to note that some panelboards, such as the P4 and P5 also use fusible switches. Siemens branch fusible switches are available with ampere ratings from 30 to 1200 amps.

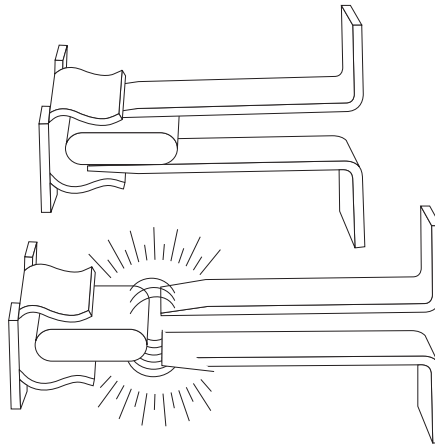


Siemens fusible switches can be fitted with Class J, L, RK1, RK5 or T fuses. The following illustration shows a Class R fuse holder.



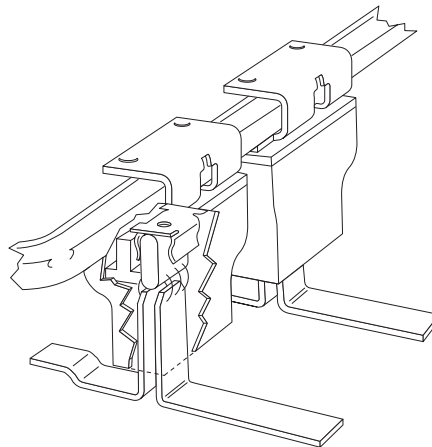
Clampmatic Action

Siemens Vacu-Break[®] fusible switches, through 600 A, feature a Clampmatic[®] action. This action holds the current carrying contact surfaces in a vise-like grip. Heat build-up due to current is minimized. When the switch is moved to the "OFF" position the movable contact snaps from between the jaws providing a quick, clean break. Twin arcs are produced which are smaller and extinguish quicker than a single arc produced by other designs.



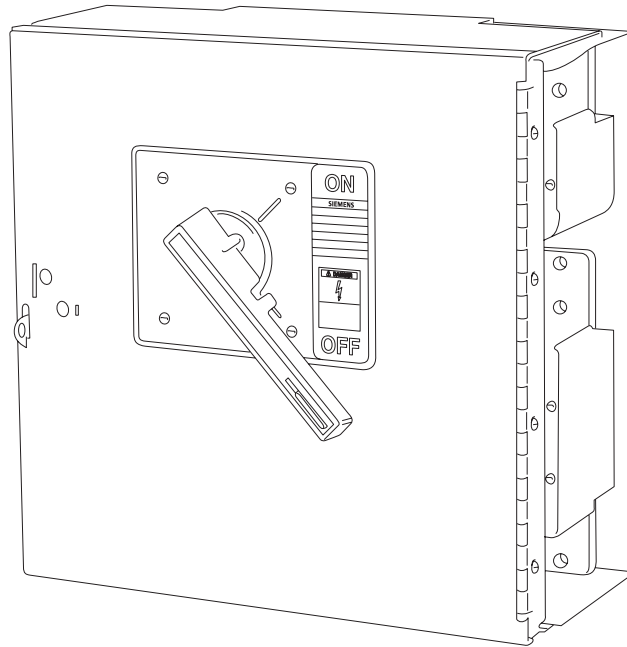
Enclosed Arc Chamber

The contacts are surrounded by an enclosed arc chamber which absorbs much of the heat from the arcing. The enclosed chamber helps limit oxygen which aids the cooling and rapid extinguishing of the arcs.



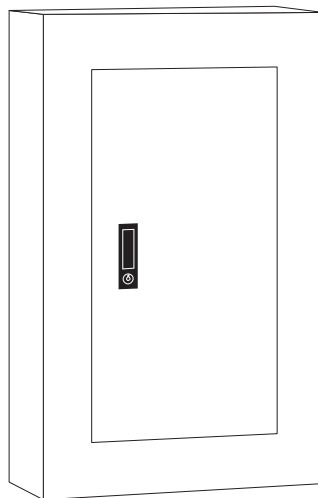
High Contact Pressure Switch

A high contact pressure (HCP) switch is used on switches rated for 800 A and 1200 A. The HCP switch does not use the Vacu-Break[®] design.



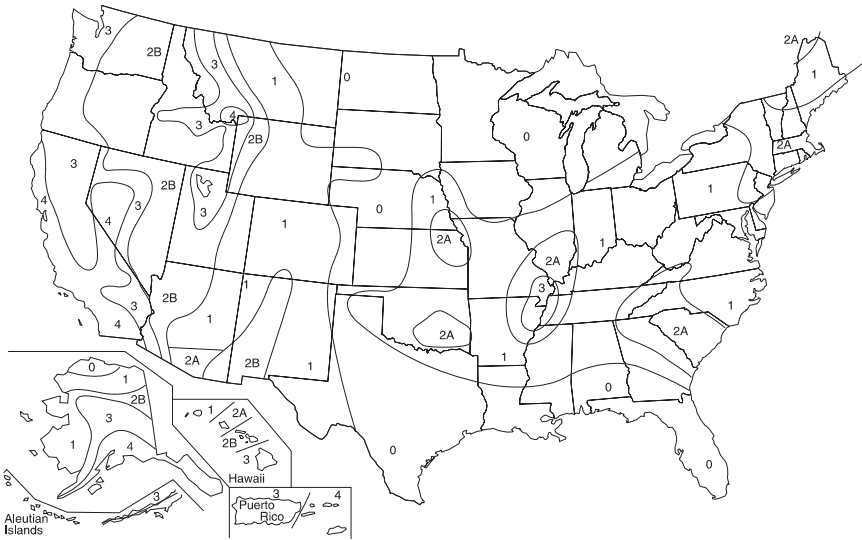
Telephone and Equipment Panelboards

Siemens also manufactures telephone and equipment cabinets which conform to requirements of Underwriters Laboratories, Inc. Cabinets are 5.75" deep, 20 or 24" wide and vary in height from 23 to 65." All telephone and equipment cabinets are preceded by the letters "TC" in the catalog number. The catalog number also reflects the cabinet height. For example, "TCS23B" is a telephone and equipment cabinet that is 23" in height.



Seismic Rated Panelboards

Seismic activity occurs throughout the United States and the world. The Uniform Building Code (UBC) specifies ratings for the United States. The following seismic zone map roughly identifies seismic activity areas in the United States. Areas in zones with higher numbers experience greater seismic activity than areas in zones with lower numbers.



Siemens panelboards have undergone extensive seismic testing in order to obtain third party certification. Siemens panelboards will operate in zones 0, 1, 2A, and 2B with no modification. Panelboards that require zone 3 and 4 ratings are available with standard lead times.

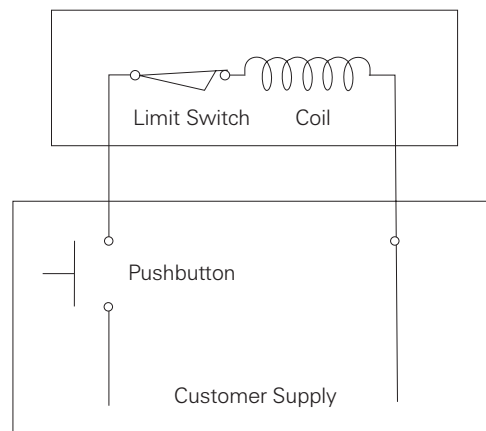
Product	UBC Seismic Zone					
	0	1	2A	2B	3	4
S1, S2, S3 P4, P5	Standard				Optional	

Accessories

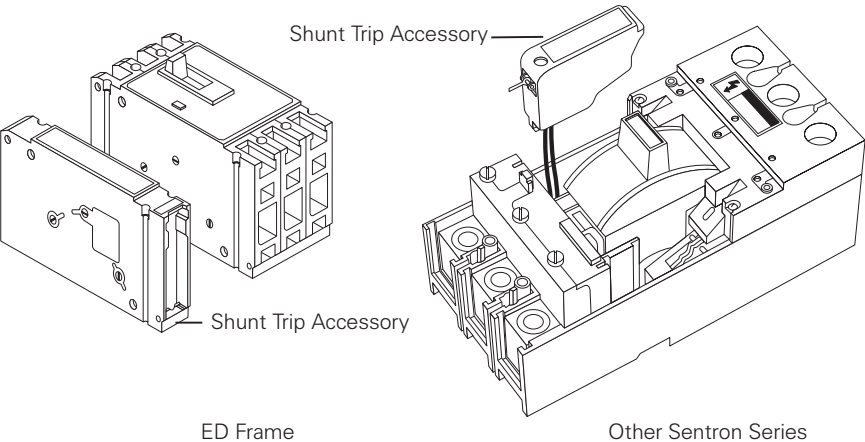
Accessories add to the performance of a panelboard or adapts the panelboard for specific application requirements. Various accessories are available for Siemens panelboards.

Shunt Trip

Some accessories modify the circuit breaker. For example, it is sometimes necessary to trip a breaker from a remote location. If someone were to get caught in a piece of machinery, anyone else can push a “panic button” tripping the breaker. One or all critical circuit breakers may be tripped at the push of a button from a distant control point by use of a shunt trip device. The shunt trip may be part of the main breaker which will shut off the entire panelboard, or part of a branch breaker. The shunt trip device consists of a coil in series with a limit switch. When the circuit breaker contacts are closed, the limit switch is closed. Depressing a customer-supplied pushbutton energizes the shunt trip coil, causing the breaker’s mechanical latch to disengage the trip mechanism and opening the circuit breaker’s contacts. When the circuit breaker’s contacts open, the limit switch also opens, removing power from the shunt trip coil. As with any trip, the breaker must be reset manually.

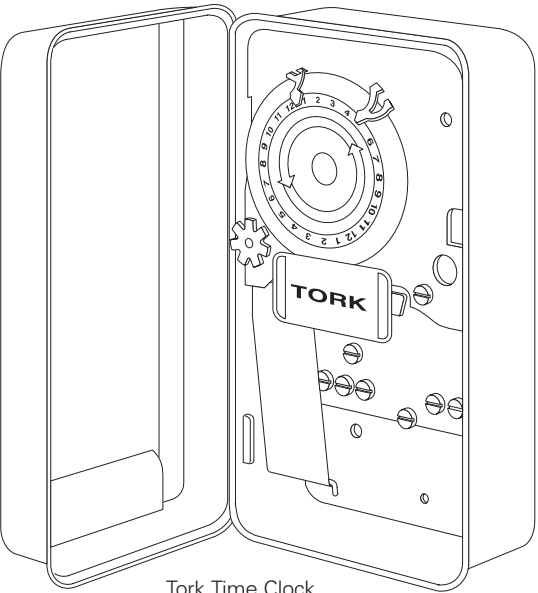


The following illustration shows how an accessory such as the shunt trip is mounted on its associated breakers.

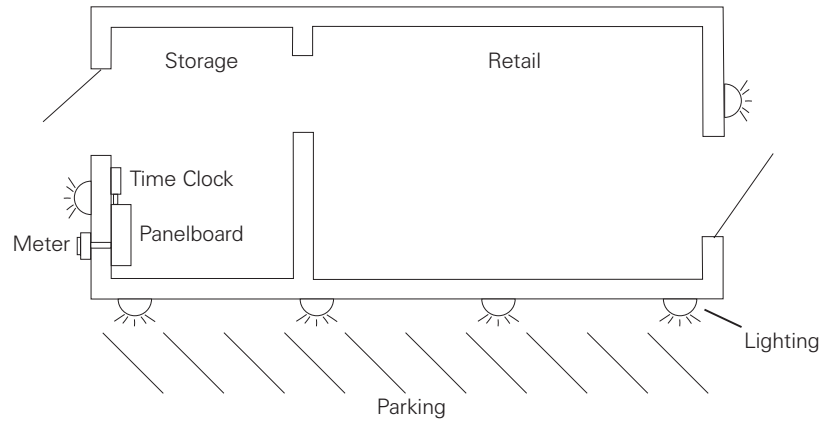


Time Clocks

Tork, Sangamo or Paragon time clocks are available as an accessory. Time clocks are available in 1 or 2-pole, single or double throw devices, or 3-pole, single throw. They are rated for a maximum of 277 volts.

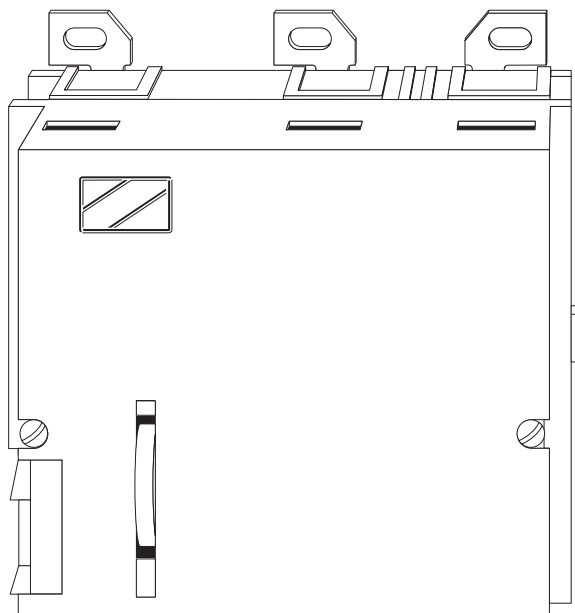


A time clock can be used to turn a branch circuit or an entire panelboard on and off at predetermined times. In the following illustration, for example, a time clock connected to a panelboard is used to turn outside lights on and off on a small commercial building.



Remote Control Switches

ASCO 920 switches are mechanically held, two- or three-pole remote control switches may be used as a main circuit disconnect device when an application calls for a switch to daily turn blocks of lighting on and off. ASCO 920 switches are available in 30, 60, 75, 100, 150, 200 and 225 amperes. Siemens also has a type CLM switch (not shown) which is a mechanically held, 20 amp, remote control unit, suitable for all types of lighting loads. It is available in 2, 3, 4, 6, 8, 10 and 12 poles.



Catalog Numbers

To help identify each type of panelboard a catalog number is assigned. The catalog number provides a description of the panelboard. There are eight parts to the standard Sentron™ Series panelboard catalog number. The following figure illustrates a typical catalog number.



Part 1

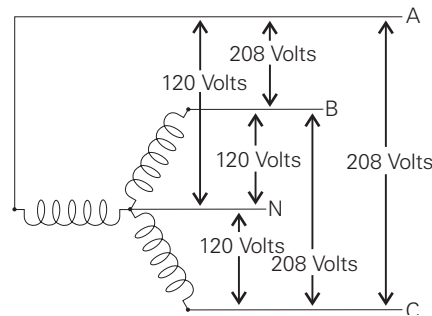
Part 1 identifies the type of panel. Panelboard are available in P1, P2, P3, P4, and P5 types. The sample panelboard catalog number shown is a P1 panelboard.

Part 2

Part 2 identifies the voltage and system. The following table shows voltage and system configurations available.

C	208Y/120 3Ø4W Wye AC - All	R	415/240 3Ø4W Wye AC - All
E	480Y/277 3Ø4W Wye AC - All	S	440Y/250 3Ø4W Wye AC - All
D	240 3Ø3W Delta AC - All	L	600/347 3Ø4W Wye AC - All
F	480 3Ø3W Delta AC - P2, P3, P4, P5	T	230 3Ø3W Delta AC - All
G	600 3Ø3W Delta AC - P2, P3, P4, P5	Z	380 3Ø3W Delta AC - P2, P3, P4, P5
I	347AC - P2, P3, P4, P5	1	24V DC 1 Pole Branches Only (3) - All
B	240/120 3Ø4W Delta BØ High Leg AC - All	2	24V DC 2 Pole Branches Only (3) - All
Q	240/120 3Ø4W Delta CØ High Leg AC - P2, P3, P4, P5	3	48 V DC 1 Pole Branches Only (3) - All
X	120/240 2Ø5W Single Neutral AC - P2, P3, P4, P5	4	48 V DC 2 Pole Branches Only (3) - All
A	120/240 1Ø3W Grounded Neutral AC (2) - All	5	125 V DC 1 Pole Branches Only (3) - All
H	120 1Ø2W Grounded Neutral AC (2) - All	N	125 V DC 2 Pole Branches Only - All
J	240 1Ø2W no Neutral AC (3) - All	O	125/250V DC 2 Pole Branches Only - All
Y	125 1Ø2W Grounded Neutral AC (2) - P2, P3, P4, P5	P	125/250V DC 2 & 3 Pole Branches - All
Z	500 2W DC - P2, P3, P4, P5	U	120V AC 3Ø3W - All
K	220/127 3Ø4W Wye AC - All	V	24V 3Ø3W Grounded BØ - All
M	380/220 3Ø4W Wye AC - All		

The panelboard identified in the example is a 208Y/120V, 3Ø4W. This indicates it is rated for a 208 volt wye-connected secondary. There are 208 volts phase-to-phase and 120 volts phase-to-neutral. It is a 3-phase (3Ø) 4-wire (4W) system.



Part 3

Part 3 indicates the number of circuits in an P1, P2 or P3 type panelboard. If the panelboard is an P4 or P5 type this number represents the enclosures height in inches. In this example the panelboard is an S1. There are 42 circuits.

Part 4

Part 4 indicates whether the panelboard is a main breaker (2-digit code varies for each different circuit breaker), main lug (ML) or main switch (MS). In this example the panelboard is an FXD6 main breaker (FX).

Part 5

Part 5 indicates the panelboard current rating. The example panelboard is rated for 250 amps.

Part 6

Part 6 indicates the bus material. The following table shows bus materials available. In this example the panelboard has standard aluminum bus bars.

- A = Tin Plated Aluminum Temp Rated (standard)
- B = 750A/in² Aluminum (optional)
- C = Copper Temp Rated (optional)
- D = 1000A/in² Copper (optional)
- E = Silver Plated Copper (optional)

Part 7

Part 7 indicates whether feed location is from the top (T) or bottom (B). In this example the panelboard is top fed.

Part 8

Part 8 indicates whether the panelboard is surface mounted (S) or flush mounted (F). In this example the panelboard is surface mounted.

Information Needed to Order Panelboards

When ordering a panelboard several questions need to be answered.

1. What is the system (voltage, phases, number of wires)?
2. What is the AIC rating (ampere interrupting capacity)?
3. What is the NEMA Type enclosure desired?
4. How many circuits are required?
5. Does the panelboard need to be suitable for service entrance?

Suitable for use on service entrance Labels (SUSE) are available provided *NEC*[®] requirements are met. A main lug only panelboard, for example, can only have a maximum of 6 breakers or it violates the 6 disconnect rule.

6. What amperage is the panelboard rated at?
7. Will the panelboard be main breaker or main lug only?
8. What special modifications are needed?
9. What is the shipping time frame?
10. Is the panelboard to be top or bottom fed?
11. Is the panelboard to be surface or flush mount?
12. Is the panelboard assembled or unassembled?

Review 7

1. The P4 panelboard will accept branch circuit breakers up to _____ amps.
2. The maximum main circuit breaker available for the P5 panelboard is _____ amps.
3. P4 and P5 panelboards use _____ switches for branch circuit protection.
4. The enclosed arc chamber limits _____ which aids in the cooling and rapid extinguishing of the arcs.
5. The maximum main circuit breaker available for P4 panelboards is rated for _____ amps.
6. A _____ accessory mounts to the circuit breaker and is used to trip a breaker from a remote location.
7. A letter _____ in part 2 of a catalog number would indicate a 120/240 volt, 1-phase, 3-wire system.
8. The number 42 in part 3 of a catalog number for a P1 panelboard indicates the panelboard
 - a. contains 42 circuits
 - b. is 42 inches tall
 - c. is 42 inches wide

Review Answers

- Review 1** 1) distribution system; 2) b; 3) 408; 4) lighting and appliance because there are less than 42 poles and more than 10% are rated 30 amps or less.
- Review 2** 1) bus; 2) current; 3) overload, short circuit, ground fault; 4) 50,000 amps; 5) R; 6) amps, voltage; 7) deadfront and trim; 8) 1.
- Review 3** 1) breaker, lug; 2) horizontally or vertically; 3) lug only; 4) feed-through; 5) 408.16; 6) two.
- Review 4** 1) 277; 2) 120 A-N, 208 B-N, 120 C-N; 3) 6; 4) Bonding; 5) neutral.
- Review 5** 1) 1000 A; 2) full; 3) UL; 4) Withstand; 5) Interrupting; 6) Integrated Equipment.
- Review 6** 1) 42; 2) invert; 3) 480; 4) 200,000; 5) 600; 6) Transient Protection System
- Review 7** 1) 600; 2) 1200; 3) fusible; 4) oxygen; 5) 600; 6) shunt trip; 7) a; 8) a.

Final Exam

The final exam is intended to be a learning tool. The book may be used during the exam. A tear-out answer sheet is provided. After grading the test, mail the answer sheet in for grading. A grade of 70% or better is passing. Upon successful completion of the test a certificate will be issued. Those receiving a score of less than 70% will be provided a second test.

1. Which of the following is not a requirement for a lighting and appliance panelboard?
 - a. A neutral connection must be provided.
 - b. A maximum of 42 overcurrent devices are allowed.
 - c. More than 10% of the overcurrent devices must be rated 30 amps or less.
 - d. Must be connected to the secondary of a 4-wire, 3-phase, wye-connected transformer.

2. Panelboards are covered by *NEC*[®] article _____ .
 - a. 110
 - b. 240
 - c. 408
 - d. 430

3. The AIC rating of a Class R fuse is _____ amps.
 - a. 10,000
 - b. 50,000
 - c. 100,000
 - d. 200,000

4. The item used to cover any unused pole spaces not filled by a circuit breaker is a _____ .
 - a. dead front
 - b. QF3 filler plate
 - c. trim
 - d. label

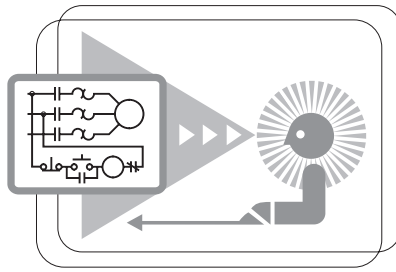
5. The type of enclosure intended for outdoor use primarily to provide a degree of protection against rain, sleet and damage from external ice formation is _____ .
- a. Type 1
 - b. Type 3R
 - c. Type 4X
 - d. Type 3R/12
6. Electrical installation, including panelboard installation is covered in *NEC*® Article _____ .
- a. 110.26
 - b. 230.71
 - c. 408.16
 - d. 240
7. Two types of panelboards are _____ .
- a. main breaker and sub-feed
 - b. main lug only and sub-feed
 - c. main breaker and main lug only
 - d. sub-feed and feed-through
8. On a three-phase, four-wire, wye-connected transformer with a secondary voltage of 480 volts phase-to-phase, the phase-to-neutral voltage is _____ volts.
- a. 277
 - b. 240
 - c. 138
 - d. 480
9. On a three-phase, four-wire, delta-connected transformer the high leg is _____ .
- a. A - N
 - b. B - N
 - c. C - N
 - d. A - B
10. The maximum number of switches or circuit breakers used to disconnect and isolate the service from all other equipment on service-entrance equipment is _____ .
- a. 1
 - b. 2
 - c. 4
 - d. 6

11. The neutral conductor is _____ grounded at the service-entrance panelboard.
- a. always
 - b. never
 - c. rarely
 - d. often
12. The neutral conductor is _____ grounded at panelboards downstream from the service-entrance panelboard.
- a. always
 - b. never
 - c. rarely
 - d. often
13. Article 230.95 of the *NEC*[®] states that *ground-fault protection of equipment shall be provided for solidly grounded wye electrical services of more than 150 volts to ground, but not exceeding 600 volts phase-to-phase for each service disconnecting means rated _____ amperes or more.*
- a. 5 milliamps
 - b. 10 amps
 - c. 1000 amps
 - d. 200,000 amps
14. The rating which refers to the interrupting rating of the lowest installed device, unless there is a series combination rating, not to exceed the withstand rating of the equipment is the _____ rating.
- a. full
 - b. withstand
 - c. interrupting
 - d. integrated equipment
15. The number "60" in part 3 of the catalog number of an P4 panelboard indicates the panelboard _____.
- a. is 60" wide
 - b. has 60 circuits
 - c. is 60" high
 - d. is rated for 60 amps
16. The height of an P1 panelboard with 42 circuits is _____ inches.
- a. 32
 - b. 38
 - c. 42
 - d. 44

Notes

Notes

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