

# SOLID STATE OVERCURRENT RELAY

C-3-215  
DECEMBER 1975

SUPERSEDES C-3-  
DATED SEPT. 1975

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## TYPE SS

### OPERATION

The Type SS Overcurrent Relay is a solid state trip system which uses current sensors and a solid state 3 phase overcurrent relay to provide overcurrent, short circuit and ground fault protection. The system is self powered and requires no external control transformer. The tripping is achieved by a low input energy shunt trip. A tripping signal of sufficient energy is generated by the relay.

### RELAY TYPES AVAILABLE

The relays are available in the following variations;

Cat. No.	RELAY CHARACTERISTICS
SS-1	Long time, instantaneous
SS-2	Long time, short time
SS-3	Long time, short time, instantaneous
SS-4	Long time, instantaneous, ground fault
SS-5	Long time, short time, ground fault
SS-6	Long time, short time, instantaneous, ground fault

Add I to Cat. No. for Local Indication.  
Add RI to Cat. No. for Local/Remote Indication.  
Add M to Cat. No. for special time current characteristics for generator protection.

The relay is completely silent in operation.

### OVERLOAD RELAYING

For full protection on long time, short time and instantaneous, current sensors are required in each phase. Current sensors are identical for each pole.

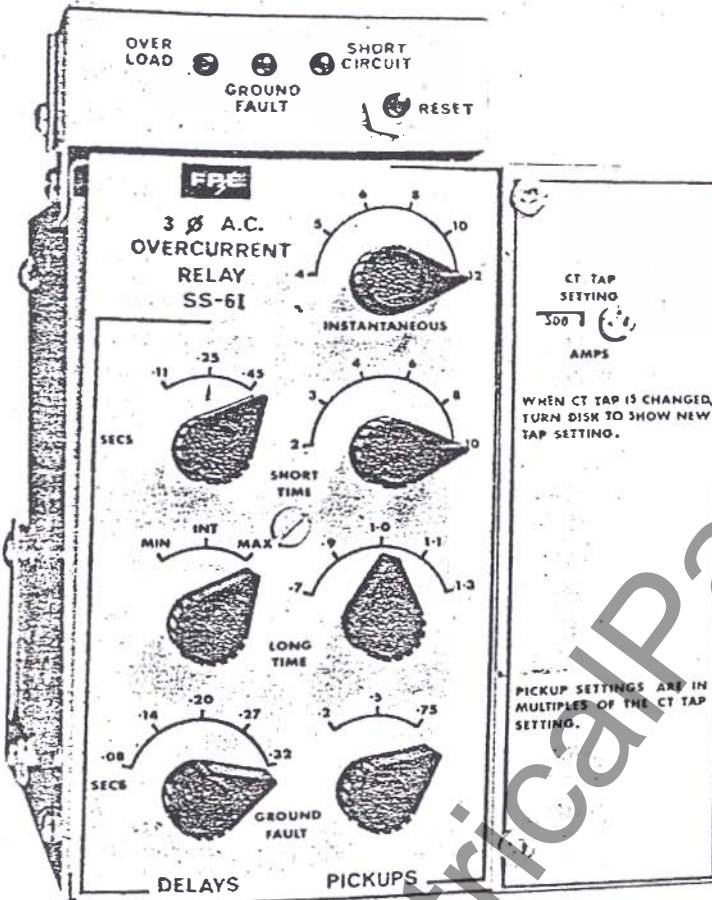
An overload in any phase will cause the relay to operate.

### GROUND FAULT RELAYING

Ground fault sensing is readily accomplished by the addition of current sensors properly placed in the circuit. In 3 phase 4 wire switchboards this can be achieved by adding a current sensor on the neutral bus external to the breaker. Two drowout secondary contacts are required on drowout breakers. The neutral sensor is identical to the sensors supplied in the phases.

On a 3 phase 3 wire grounded system no additional sensor is needed. The phase sensors are used to detect ground current.

In situations where there is a double ended switchboard, or two separate services, special consideration should be given to the position of the sensors.



### INTRODUCTION

Positive reliability of power distribution systems has become vital to modern business and industry and involves in addition to service continuity, an ability for that system to detect and isolate faults in the smallest possible area. The complexity of today's power systems demands much closer tolerances and much greater stability of protective relay characteristics than previous standards allowed.

The Federal Pioneer solid state overcurrent relay has been developed to meet these new requirements and to overcome other shortcomings of electro-mechanical relays. It is completely self powered, taking the tripping energy from the current through the breaker without any auxiliary power supply.

It is also very desirable to be able to identify the type of fault that the relay has reacted to, i.e. overload, short circuit or ground fault. The FPE type SS relay can, as an option, provide this information both locally on the relay itself or remotely by contacts supplied within the relay.

## INDICATION

Three lamps labelled OVERLOAD, SHORT CIRCUIT and GROUND FAULT can be provided to indicate the type of fault that has tripped the breaker.

When the breaker has tripped the relay will automatically reset allowing the breaker to be reclosed. The lamps are manually reset by a pushbutton mounted on the front of the relay thus indication is retained even after the relay has reset. This same pushbutton also resets the internal auxiliary relay that is required for remote indication.

The lamps are solid state light emitting diodes (L.E.D.) and are ideally suited to withstand the shock vibrations which occur when the breaker is opened and closed. A separate 120 volt ac 7.5VA auxiliary supply, derived from the line side of the circuit breaker, is required to power the lamps and the remote indication relay.

## ACCURACY

The accuracy and precision of the solid state relay are indicated by the narrow tolerance bands on the characteristic curves. A tolerance of  $\pm 10\%$  is assigned to cover the wide temperature range over which the relays can operate and maintain their characteristics. At a nominal temperature of 25°C tolerances of  $\pm 5\%$  can be expected.

## STABILITY

Related to the accuracy of the relay and of vital importance to the continuity of service, is the ability of the solid state relay to hold its characteristics over a wide temperature range and indefinite time period. While the accuracy stated above applies to the temperature range of -20°C to 55°C, the relay remains operational but with slightly wider tolerances in the temperature range of -40°C to +65°C. Experience with other solid state relays has proven the stability of the components over long periods of time.

## CO-ORDINATION

The increased precision of the time current characteristics of the standard solid state relay permits much closer and easier co-ordination between protective devices than was possible with electromagnetic relays. Where generators are being protected a relay with special time current characteristics can be provided to overcome the co-ordination problem associated with a machine with low fault current output.

## RESET CHARACTERISTICS

The FPE solid state relay completely eliminates one of the most troublesome characteristics of the electro-mechanical relay by providing near instantaneous reset. When an overload condition occurs and the relay picks up and starts to time out it will reset if the current falls to a value of 95% of pick-up ratings.

## FIELD ADJUSTMENTS

All the settings on the relay are field adjustable by knobs on the front of the relay. Time bands and pick-up settings are also as previously noted.

## Long Time

Pick-up is adjustable from .7 to 1.3 times the current sensor tap setting. Pick-up levels at 0.7, 0.9, 1.0, 1.1 & 1.3.

Available relay curves - minimum - 6.5 sec.  
medium - 19 sec.  
maximum - 35 sec.

Times shown are 6 times sensor tap setting at the middle of the band. The relay curve can be field selected by adjustments on the faceplate.

## Short Time Delay

Short time pick-up is adjustable from 2 to 10 times the sensor tap setting. Pick-up levels at 2, 3, 4, 6, 8 & 10.

Available relay curves - minimum - 7 cycles (.11 sec.)  
medium - 15 cycles (.25 sec.)  
maximum - 27 cycles (.45 sec.)

Times shown are the middle of the band. The relay curve can be field selected by adjustments on the faceplate.

## Instantaneous

Instantaneous pick-up is adjustable from 4 to 12 times the sensor tap setting. Pick-up levels at 4, 5, 6, 8, 10 & 12.

## Ground Fault

Pick-up is adjustable and can be set at 0.2, 0.5 & 0.75 times the sensor tap setting.

Time delay is adjustable from .08 to 0.32 seconds at pre-selected times.

## RATINGS

Trip ratings are established by the current sensing transformers on the breaker poles. Each sensor has a minimum of three taps which can be connected for three ratings. All relays of one type are identical and the trip rating is established simply by connecting to the appropriate sensor tap. The relay pick-up is field adjustable with the knobs on the relay and the tap setting on the sensor.

## STANDARD RATINGS

Breaker Frame	Taps Available on Current Sensor In Amperes
600A 25H-2	CS6-1 40, 70, 90 CS6-2 100, 125, 150, 175 CS6-3 200, 225, 250, 300 CS6-4 350, 400, 500, 600
Note: Coil width must be 25" minimum	
1600A 25H-2, 50H-2 50H-2	CS16-1 225, 250, 300, 350, 400 CS16-2 500, 600, 800 CS16-3 1000, 1200, 1400, 1600
3000A 50H-2	CS30-2 2000, 2500, 3000 special
2000A 65H-2 65H-2	CS20-1 225, 250, 300, 350, 400 (1) CS20-2 500, 600, 800 (2) CS20-3 1000, 1200, 1400, 1600 (3) CS20-4 1200, 1400, 1600, 2000
	(1) Interchangeable with CS16-1 (2) Interchangeable with CS16-2 (3) Interchangeable with CS16-3
3000A 75H-2 75H-2	CS30-1 1000, 1200, 1600 CS30-2 2000, 2500, 3000
4000A 75H-2	CS40-3 3000, 3500, 4000 special
4000A 100H-2 100H-2	CS40-1 1000, 1200, 1600 (1) CS40-2 2000, 2500, 3000 (2) CS40-3 3000, 3500, 4000
	(1) Interchangeable with CS30-1 (2) Interchangeable with CS30-2
5000A 100H-2 6000A 100H-2	CS50-1 3000 4000 5000 CS60-1 4000 5000 6000

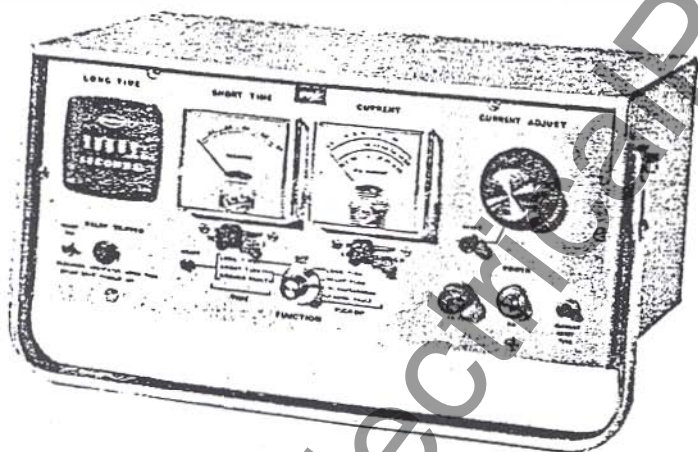
## TYPICAL SPECIFICATION

A solid state three phase overcurrent relay shall be supplied with the air circuit breaker. The solid state elements shall be mounted on plug-in printed circuit boards. The relay shall be designed to function within the published characteristic curves for single phase and three phase balanced loads and all arrangements of unbalanced loads. The trip system shall function within the rated characteristics of the breaker under normal operating conditions, short circuit interruption and electrical and mechanical endurance.

The relay shall contain long time pick-up, short time delay, instantaneous and ground fault elements. These elements shall operate independently. The long time, short time and ground fault elements shall each have field selectable time bands. All calibrated points shall be set by a selector switch on the relay faceplate.

The relay shall be supplied complete with a Trip Indicator which will describe the type of fault as an overload, short circuit or ground fault (optional).

The relay shall derive its power from current sensors which shall have a minimum of three top connections brought out on the sensor face. The relay shall operate in conjunction with the low energy shunt trip. No external power supply shall be required to trip the breaker. The relay shall be a type SS solid state device as manufactured by Federal Pioneer Limited.



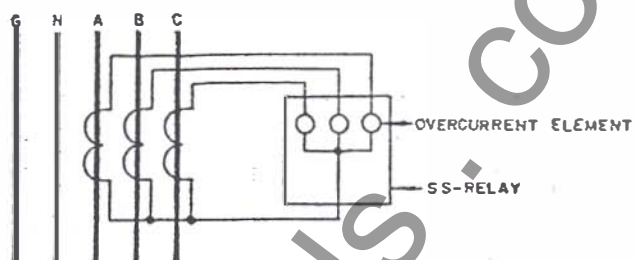
FPE TYPE DDT-SS TEST UNIT

## FIELD TESTING

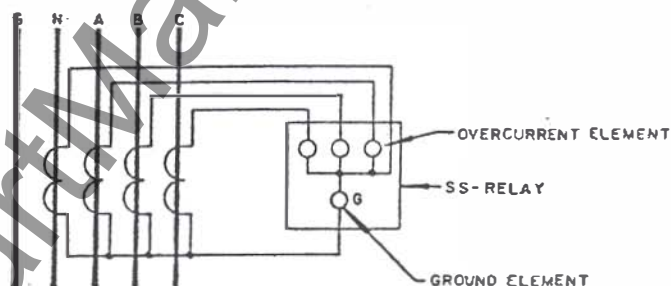
Another difficulty of electro-mechanical relays is eliminated by the use of the solid state relay. A light portable test device is available to provide accurate secondary injection testing of these relays. Any normal 115 volt ac source can supply sufficient power for this test. The test unit is plugged into the relay in a convenient location behind the faceplate. All facets of relay operation can be checked and the breaker can be tripped by the relay operation if required. The catalogue number of the FPE test unit is DDT-SS.

## CURRENT SENSOR CONNECTIONS

- (A) 3 $\phi$  3W ungrounded system  
3 $\phi$  4W system without ground fault protection



- (B) 3 $\phi$  4W system with ground fault protection

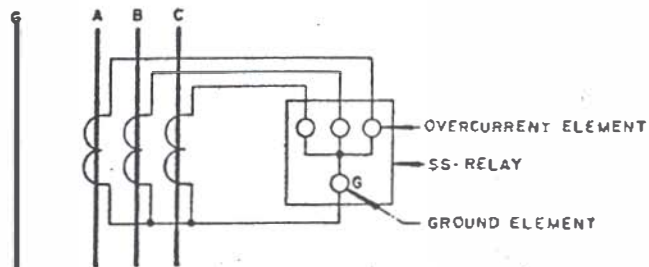


Note: System must be solidly or resistor grounded on the line side of neutral sensor. Resistor must let through more current than the ground fault pick-up setting on relay.

System must not be grounded on the load side of the neutral sensor.

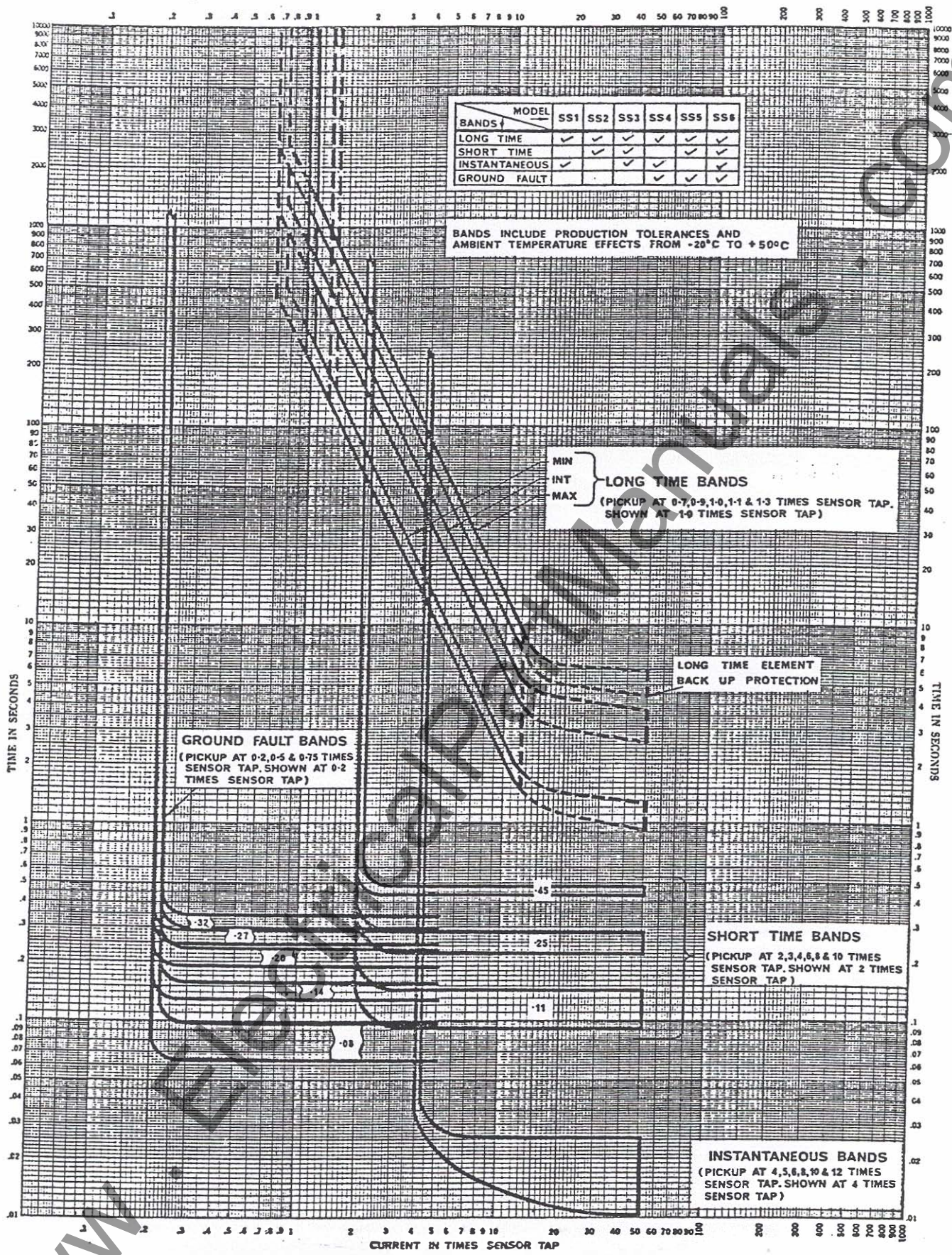
- (C) 3 $\phi$  3W system with ground fault protection  
(Neutral solidly grounded)

3 $\phi$  3W ungrounded system (see note below)



Note: Since there will not be any significant ground current in the ungrounded system, the ground fault element will not pick-up on the first phase to ground fault. It will operate on the second phase to ground fault providing this fault is on another feeder and phase from the first fault.

This G element will only pick-up on a phase to ground to phase fault.



30 AC OVERCURRENT RELAY, TYPE-SS TIME-CURRENT CHARACTERISTICS



**FEDERAL PIONEER LIMITED**

*Sales offices from coast to coast*