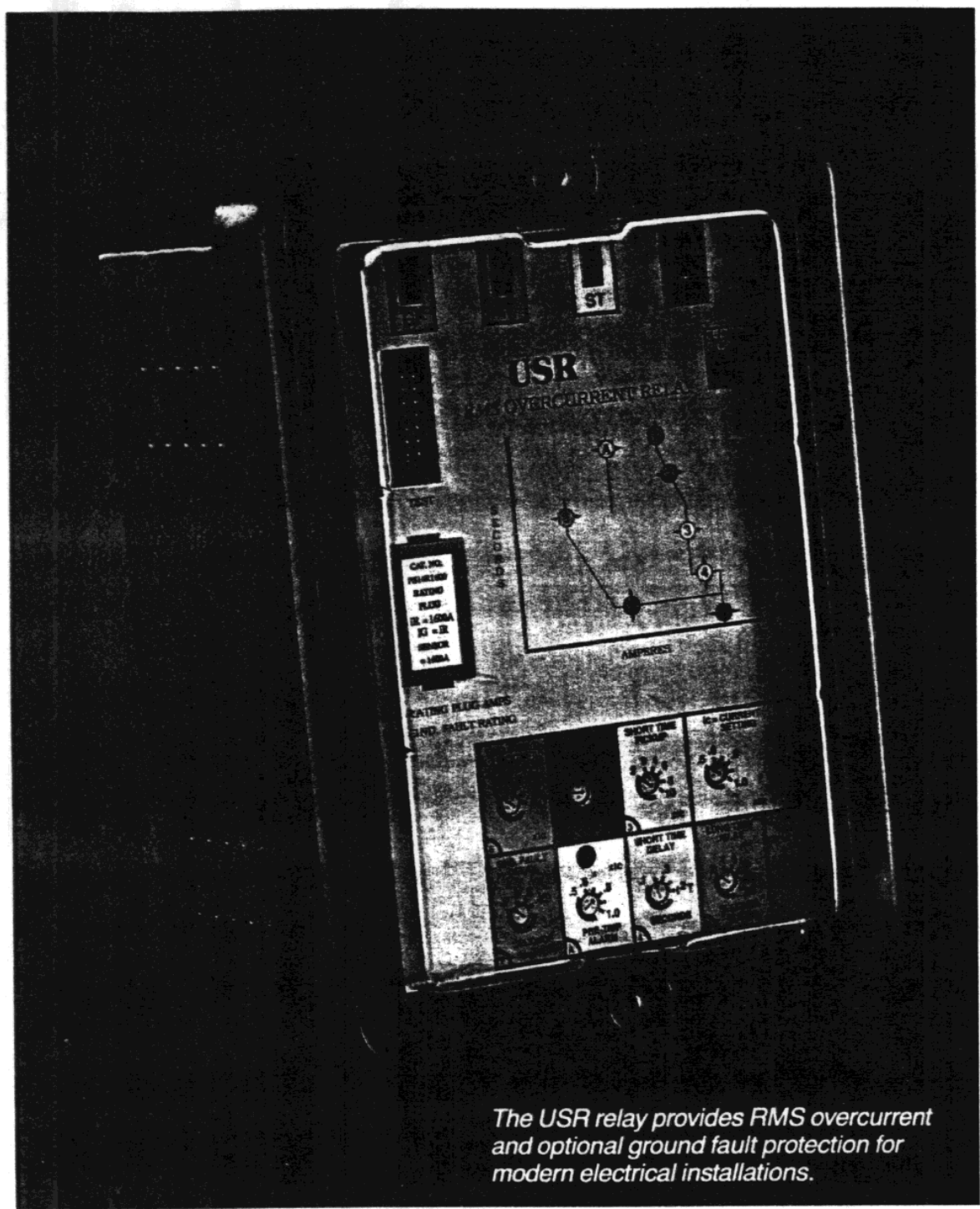


# FEDERAL PIONEER



*The USR relay provides RMS overcurrent and optional ground fault protection for modern electrical installations.*

## USR RMS Solid State Overcurrent Trip System. Wide Range of Trip Settings.

The USR is a self-powered RMS sensing solid state over current relay for 3 phase systems that offers protection for electrical power distribution circuits from overloads, short circuit and ground faults. it also offers local and remote trip indication.

This system is comprised of 3 components:

- 1) The USR Relay – which complies with ANSI standard C37.17 "Trip Devices for AC and General Purpose DC Low-Voltage Power Circuit Breakers"
- 2) Phase current sensors, 4-wire systems will be supplied with a neutral current sensor
- 3) Self-powered direct acting shunt trip device. The energy required to activate the shunt trip is generated by the phase current sensors.

### USR Relay Features

**USR RMS Trip Systems are unaffected by harmonic distortions in currents due to non linear loads in electrical distribution systems.**

The USR over current relay has field selectable set points for: Long Time (LT), Short Time (ST), Instantaneous (I) and an optional Ground Fault (GF) to meet the protective requirements of your Power System. A unique Pre-trip alarm offers you advance indication of a pending overload.

A series of rating plugs offer the widest ampere range of trip settings in the industry on each breaker frame, as shown in Table 1.

The USR responds to true RMS current value for Long Time (LT), Short Time (ST) and the Ground Fault (GF), and to Peak Value for Instantaneous (I).

The relay face plate represents these protective elements pictorially.

TABLE 1: CURRENT SENSORS AND RATING PLUGS		
BREAKER FRAME	BREAKER IC K.A. RMS SYMM @ 600 V	AMPERE RANGE OF TRIP SETTINGS
800 A	30/42	100 - 800
1600 A	50/65	200 - 1600
2000 A	50/65	250 - 2000
3000 A	65	375 - 3000
3200 A	65	400 - 3200
4000 A	85	500 - 4000
6000 A	85	750 - 6000



TABLE 2: RELAY MODEL NUMBERS & CHARACTERISTICS							
MODEL NUMBER	CHARACTERISTICS						GENERATOR PROTECTION
	LONG TIME	SHORT TIME	INSTANTANEOUS	GROUND FAULT	LOCAL REMOTE INDICATION	PRE-TRIP ALARM	
USR-3	•	•	•			•	•
USR-3IR	•	•	•		•	•	
USR-6	•	•	•	•		•	
USR-6IR	•	•	•	•	•	•	
USR-3IRG	•	•	•		•	•	
USR-LT	•					•	

**USR Features Selected Settings**

**Long Time**  
 The Long Time element has an inverse ( $I^2t$ ) time-current characteristic.

**Short Time**  
 The Short time element has a definite time and an independent inverse ( $I^2t$ ) time current characteristic. The definite time or inverse time characteristic is field selectable by means of a front panel switch.

**Instantaneous**  
 The instantaneous element has 6 different pick-up settings and an OFF position.

When the OFF position is selected, a discriminator circuit will monitor the current for 40 milliseconds and then switch the instantaneous element OFF. If the breaker closes on a fault of 13 times or greater than the plug rating, the breaker will trip instantaneously.

The benefits derived from this trip system are:

- Maximum protection for Personnel and equipment
- Minimum damage to the electrical distribution system
- Continuity of service through full co-ordination with downstream devices.

The trip system will function within the published characteristics under normal industrial and commercial operating conditions and after any circuit breaker operations within its specifications as follows:

- short circuit interruption
- electrical endurance
- mechanical endurance
- continuous operation at 110% of rated current

**Ground Fault Element**  
 The Ground Fault element time current characteristics are inverse ( $I^2t$ ) at low fault levels, becoming definite time for high fault levels. The benefit of this feature is closer co-ordination with downstream devices.

**Rating Plugs**  
 Rating plugs are available to allow selection of 25%, 30%, 40%, 50%, 60%, 75%, 80% and 100% of the sensor rating.

Each rating plug indicates in absolute primary amperes, the current rating ( $I_R$ ); the sensor rating ( $I_S$ ); and the ground current rating ( $I_g$ ). Rating plugs are field interchangeable within each sensor rating but, are not interchangeable for different sensor ratings. For current ratings below or equal to 2,000A, the ground current rating shall equal the current rating. For current ratings above 2,000A, the ground current rating shall be limited to 2,000A as shown in Table 3.

**Adjustment of Settings**  
 All field selectable points on each element of the relay can be set by individual switches with indents marking each position.

**Mounting of Trip System**  
 All system components are mounted on the circuit breaker except for the neutral current sensor. Fault current information on the solidly grounded three-wire system is provided to the relay by the phase current sensors which are residually connected.

The current sensors, solid state relay and shunt trip device can be removed in the field with conventional service tools.

Current sensors are identical for each pole. Parts in contact with the main conductors are protected with Class B (130°C) insulation. The trip system can operate effectively in an ambient temperature range of -20°C to + 55°C.

**Detailed Functions**

**Current Setting Adjustment**  
 A switch on the relay face plate allows the operator to adjust the "current setting" to 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 times the rating plug. The selected current setting establishes a base current for the pre-trip alarm, long time and short time pick-ups.

**Pre-Trip Alarm**  
 An adjustable pick-up allows the operator to adjust the pre-trip alarm to 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 times the selected current setting.

A local LED indicates pre-trip alarm pick-up.

On relay models equipped with the remote indication feature, Normally Open (NO) mechanical dry contact is provided for remote indication of the pre-trip alarm. The contact is rated for 5A resistive, 240V AC or 30V DC.

**Long Time Pick-Up**  
 The long time pick-up is fixed at 100% to 110% of the selected current setting, based on a symmetrical sinusoidal current at 60 Hz.

**Time Band for Long Time Element**  
 Six bands are provided. The band point is set at 600% of the current setting. The band points and limits are as shown in Table 4.

**Short Time Pick-Up**  
 The short time pick-up settings can be adjusted in discreet steps of 2, 3, 4, 6, 8 and 10 times the selected current setting. The short time pick-up tolerance is  $\pm 10\%$ .

TABLE 3: SENSOR RATINGS								
SENSOR RATINGS (AMPERES)	PLUG RATINGS (I <sub>R</sub> /I <sub>g</sub> ) AMPERES IN MULTIPLIERS OF SENSOR RATINGS							
	0.25	0.30	0.40	0.50	0.60	0.75	0.80	1.0
800	200/200	240/240	320/320	400/400	480/480	600/600	640/640	800/800
1600	400/400	480/480	640/640	800/800	960/960	1200/1200	1280/1280	1600/1600
2000	500/500	600/600	800/800	1000/1000	1200/1200	1500/1500	1600/1600	2000/2000
3000	750/750	900/900	1200/1200	1500/1500	1800/1800	2250/2000	2400/2000	3000/2000
3200	800/800	960/960	1280/1280	1600/1600	1920/1920	2400/2000	2560/2000	3200/2000
4000	1000/1000	1200/1200	1600/1600	2000/2000	2400/2000	3000/2000	3200/2000	4000/2000
6000	1500/1500	1800/1800	2400/2000	3000/2000	3600/2000	4500/2000	4800/2000	6000/2000

TABLE 4: BAND POINTS & LIMITS FOR LONG TIME I <sup>2</sup> t DELAY BAND						
Nominal Delay in seconds	2.0	4.0	6.0	10.0	20.0	30.0
Lower Limit	1.5	3.5	5.1	9.0	17.5	26.0
Upper Limit	2.4	4.4	6.9	11.5	23.5	35.0

TABLE 5: BAND POINTS & LIMITS FOR SHORT TIME DEFINITE DELAY BAND				
Nominal Delay in seconds	0.1	0.2	0.30	0.4
Lower Limit	0.9	0.18	0.27	0.38
Upper Limit	0.14	0.24	0.35	0.48

TABLE 6: BAND POINTS & LIMITS FOR GROUND FAULT DEFINITE DELAY BAND				
Nominal Delay in seconds	0.1	0.2	0.3	0.45
Lower Limit	0.09	0.19	0.27	0.40
Upper Limit	0.14	0.25	0.34	0.50

### Time Bands for Short Time Element

Four definite time bands and one inverse (I<sup>2</sup>t) time band are provided. The time band points and limits are as shown in Table 5.

The short time inverse band is I<sup>2</sup>t with nominal delay of 0.38 second at 6.0 times current setting. The time delay band at 600% of current setting has an upper limit of 0.42 second and a lower limit of 0.31 second. The I<sup>2</sup>t band can be selected by means of a switch on the relay face place.

### Instantaneous Pick-Up

The instantaneous pick-up range can be adjusted in discreet steps of 4, 5, 6, 8, 10 and 12 times the rating plug rating. The instantaneous pick-up tolerance is ± 10% based on a symmetrical sinusoidal current at 60 Hz. The pick-up switch is equipped with an instantaneous OFF position.

### Instantaneous Operating Time

When the circuit breaker is closed on a single phase-to-ground or a phase-to-phase fully offset fault at the operating capacity of the circuit breaker, the maximum operating time of the relay is 16 milliseconds.

The operating time represents the time taken by the relay to energize itself, sense the fault, activate the trip energy accumulation circuit and transmit this energy to the terminals of the trip solenoid.

### Ground Fault Pick-Up

Pick-up settings can be adjusted in discrete steps of 0.2, 0.3, 0.4, 0.5 and 0.6 times the plug rating. These ranges enable the operator to limit the maximum ground fault pick-up setting of the relay to 1200 amps or less for any plug rating. The ground fault pick-up tolerance is ± 10%.

### Ground Fault Element Time Delay

Four inverse definite time bands are provided. Their characteristic is inverse I<sup>2</sup>t at low fault levels.

The definite time band points provided are 0.10, 0.20, 0.30 and 0.45 seconds nominal with the band limits shown in Table 6.

In the inverse region, the lower band limit at 1.5 times pick-up settings is 0.49 second, while the upper band limit is 1.10 second. All published time delay values include intentional delay plus the capacitor charging time.

### Test Jack

A test jack, mounted on the faceplate of the relay, provides signals that can be monitored externally by a dedicated field test unit DDT-USR to test the operation of the relay.

### Indication Option (IR)

The fault indication option allows for local and remote trip indication. Local trip indication is provided by a maximum of four minibreakers with pop-out indicators mounted on the relay faceplate. Remote trip indication is provided by a set of dry contacts. The remote trip indication can be wired in the field by means of a remote indication harness receptacle mounted on the backplate of the relay. The dry contacts for remote fault indication are rated 5A resistive at 240V AC or 30V DC.

### Special Applications

To provide optimum protection for generators, Federal Pioneer Ltd. model USR-3IRG incorporates special settings for the Short Time Pick-Up and Delay characteristics.

The long time delay of 2.0, 4.0, 6.0, 10.0, 20.0 and 30.0 seconds is the same as in other models.

However the short time pick-up is adjustable in closer discrete steps of 2.0, 2.25, 2.5, 2.75, 3.0 and 4.0 times the current setting. Four inverse I<sup>2</sup>t time bands are provided with nominal delay 0.4, 0.6, 0.8 or 1.2 seconds. These inverse short time bands allow closer co-ordination with downstream devices. This feature can be of benefit on normal distribution circuits also.

The Federal Pioneer Ltd. model USR-LT was developed to provide long time characteristic only for use on fused type circuit breakers.

In this application, the overload protection is provided by the I<sup>2</sup>t thermal characteristics of six inverse time bands, the same as in other models. The short circuit protection is provided by the fuses and thereby offers the most economic option of the USR relay.

Test Set

A DDT-USR portable test set is available for checking the pick-up levels and time delays of the long time, short time, instantaneous and, ground fault elements. The test set can test the proper functioning of the trip circuit of the relay and the shunt trip.

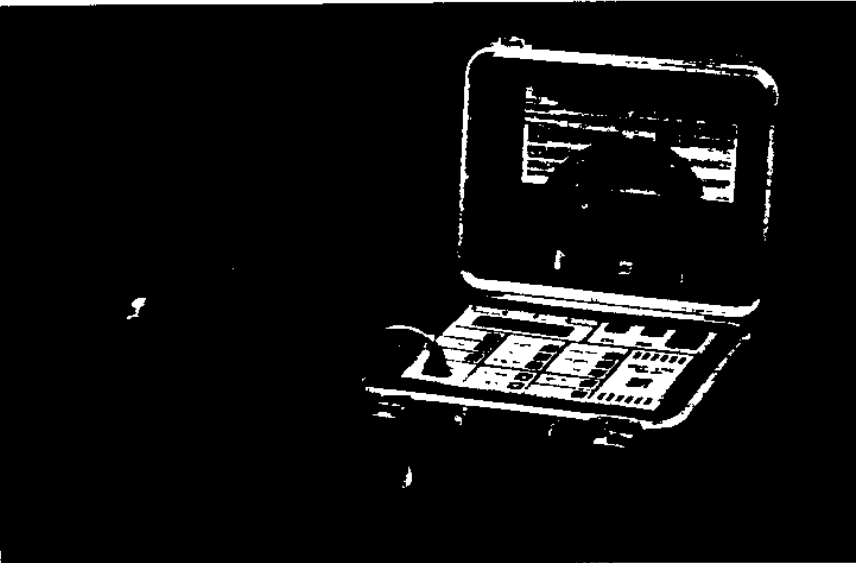
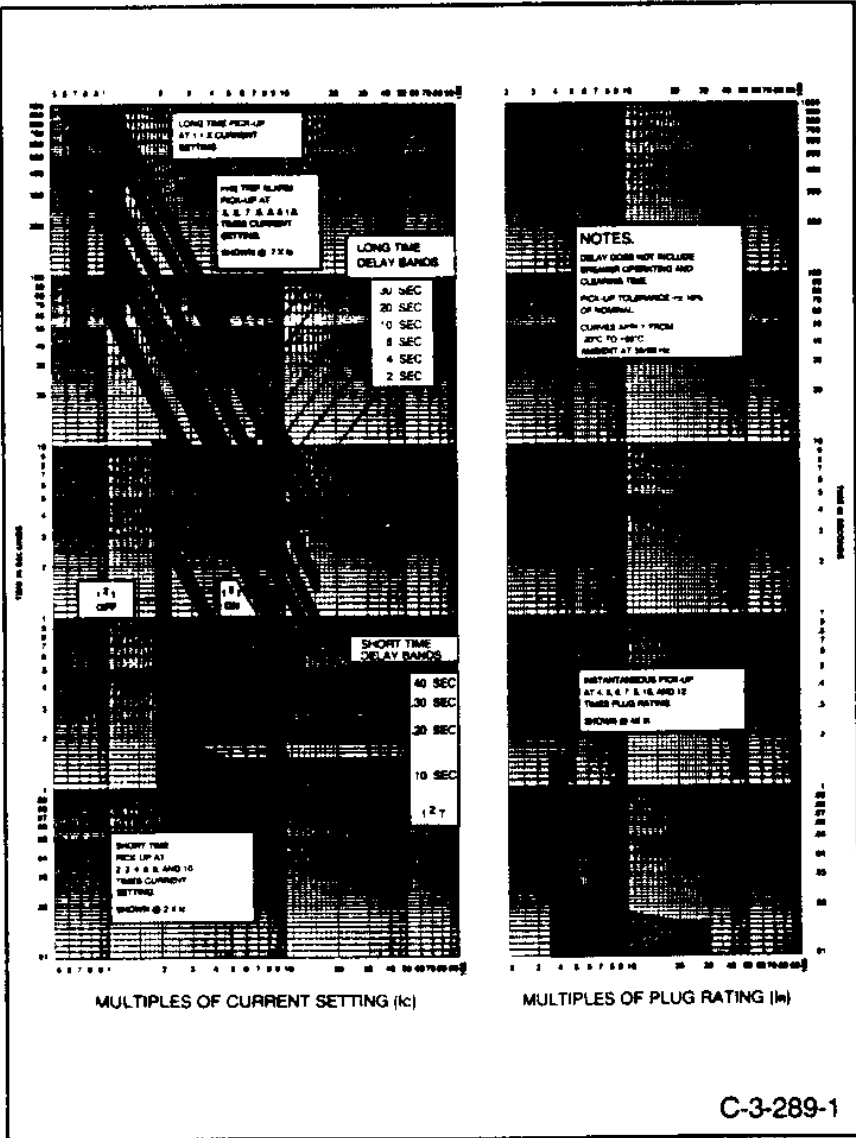


FIGURE 1:  
PRE-TRIP LONG TIME & SHORT TIME CHARACTERISTICS



USR RMS Solid State Overcurrent Trip Systems

The carefully matched components of the USR RMS Trip System include the USR relay, current sensors, self-powered direct acting shunt trip and interconnecting relay harness.



FIGURE 2:  
GROUND FAULT CHARACTERISTICS

