FEDERAL PIONEER

INSTRUCTION MANUAL

IM-3-211.1

RMS OVERCURRENT TRIP UNIT TYPE USR

August 1996

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1. INTRODUCTION

This Instruction Manual contains descriptive, operating, testing and maintenance information for Federal Pioneer Limited Solid State Overcurrent Trip Unit, Type USR for protection of low voltage power systems.

2. DESCRIPTION

2.1 GENERAL

The Solid State Overcurrent Trip System Type USR protects low voltage power systems against damage caused by overloads and fault. The types of protection offered are overload, short circuit and ground fault.

The trip unit operates to open a low voltage circuit breaker in accordance with a set of programmable time-current characteristics. Tripping energy for the operation of the circuit breaker is obtained solely from the circuit being protected. Fault indication is provided by pop-out mini breakers and does not require the use of control power.

The components used for the measurement of primary current, for the detection of fault conditions and for the provision for trip energy are semiconductors, capacitors, transformers, etc. Thus, except for the USR shunt trip, and the mechanical relay contacts for remote fault indication, the trip is completely static.

All parts of this system are designed for conservative loading of components for long life and minimum maintenance. The extensive use of semi-custom integrated circuits make this trip system more accurate, versatile, compact and reliable than electromagnetic trip devices.

The complete solid state overcurrent trip system consists of the following parts:

a) the primary current sensors
b) the overcurrent relay, and
c) the direct acting shunt trip solenoid

2.2 CURRENT SENSORS AND RATING PLUG

The current sensors interface the USR relay with the power system. The core of the current sensors is tape wound with grain oriented silicon steel. Three current sensors for monitoring the three phase currents are mounted on the primary conductors. The extra sensor required when ground fault protection is provided is mounted on the neutral conductor, or on the ground strap. The rating plug selected for a specific sensor establishes the rating of the circuit breaker.

2.3 USR RELAY

The USR Relay receives information on the primary current from the current sensors, senses overloads and short circuit faults and determines when to initiate tripping in accordance with independent programmable time current characteristics. The USR relay is true RMS sensing for Long Time, Short Time and ground fault. The power required to activate the direct acting shunt trip solenoid is obtained from the current sensors. After a fault condition has been determined, the relay diverts the output of the phase current sensors, or the output of the neutral sensor from the monitoring circuitry into an energy accumulating circuit which generates a trip pulse.

A single metal enclosure houses the current matching transformers, the power supply, the programmable logic, the programming switches and the output trip pulse generator. The optional fault indication circuits are also housed in the same enclosure.

Interconnection of the USR relay with the primary current sensors and the shunt trip solenoid is accomplished through a prewired plug mounted in the rear of the relay. Connections for remote indication are accomplished by means of a separate colour coded wiring harness. Both wiring harnesses are attached to connectors that plug and lock into the rear of the relay enclosure.

2.4 SHUNT TRIP

The shunt trip device is a cylindrical solenoid which is mounted in the circuit breaker in such a way that the plunger is held in the reset position by gravity. When the USR relay supplies the solenoid with a trip pulse, the plunger is allowed a specified distance of free travel before striking the trip lever of the circuit breaker.

2.5 TYPES OF SOLID STATE OVERCURRENT TRIP UNITS

Two basic types of Solid State Overcurrent Trip Units are available. Both types use the current sensors and the shunt trip solenoid.

The first type, USR-3, provides only overcurrent protection; being equipped with Long Time, Short Time and Instantaneous elements. The second type, USR-6, in addition to these functions, also provides Ground Fault protection.

USR-3IR and USR-6IR relays are available with fault indication packages. Marine version and that for generator protection is USR-3IRG featuring varnished p.c. boards for tropicalization and different short time pick-up settings. USR-LT is equipped with only a long time element.

USR-6-HG and USR-6-IR-HG are High Ground-Fault models which could provide a ground fault pickup setting exceeding the 1200A service entrance requirement. Please see section 4.9.5 for details.

3. OPERATION

3.1 GENERAL

The functional block diagram of Figure 1 attached, illustrates the operation of the USR relay.

There are three current sensors on the circuit breaker monitoring the primary phase current. If ground fault protection is required on 3 phase 4 wire power systems, a fourth sensor must be used. The current sensors supply currents to the relay which are proportional to the currents in the primary circuit. These currents are converted to d.c. signals by means of a rectifiers. These signals are used to provide energy for tripping, regulated logic power supply voltage and signals proportional to the ground and phase currents.

The relay may have up to four pickup elements; LONG TIME, SHORT TIME, INSTANTANEOUS and GROUND FAULT. Each pickup circuit works independently of the other and triggers its corresponding time delay circuit. The instantaneous element has no intentional time delay. All elements except INSTANTANEOUS are RMS responding. The Instantaneous element is peak sensitive for maximum speed of operation.

3.2 OVERCURRENT ELEMENTS

Overload and short circuit protection are provided jointly by the LONG TIME, SHORT TIME, and INSTANTANEOUS elements. The signal in the relay which is proportional to the highest of the three phase primary currents is compared to preset values in each of the three elements. If it does not exceed any of the preset pickup levels, the relay continues to monitor the system. If the current signals exceed a preset pickup setting, the respective time delay circuit will start timing. When the proper time delay is reached, the relay transfers itself into a fault mode. The output from the phase sensors is diverted totally into the energy accumulating circuit. When enough energy has been accumulated, a trip pulse is supplied to the shunt trip solenoid.

The LONG TIME element has six inverse (I^2t = constant) bands. The SHORT TIME element has four definite time bands which become slightly inverse at low fault levels and an inverse (I^2t = constant) band. The INSTANTANEOUS element has no intentional time delay other than that needed by the relay to initialize itself and accumulate trip energy. All I^2t functions are dynamic in behaviour and are continuously adjusting the time rate to the existing maximum phase current during the timing operation.

3.3 GROUND FAULT ELEMENT

The input signal for the GROUND FAULT element is obtained from sensing the current in the residual path of the phase sensors and neutral sensor (if needed). This allows ground current detection in both 3 phase 3 wire and 4 wire systems. If the ground current signal exceeds the preset pickup value, the ground fault time delay circuit starts timing. On reaching the preset time delay, the output trip circuit is activated.

The signal output representing the ground current is diverted into the energy accumulating circuit and ultimately discharged into the shunt trip solenoid. When indication is provided, a trip caused by a ground fault is normally registered by the G.F. indicator, locally, and by the G.F. normally open contacts. remotely. It should be noted, however, that since ground fault current is also phase current and may therefore be overcurrent, the overcurrent element indicators may also register the fault. The ground fault element has 5 time bands which are inverse (I^2t) at low ground fault levels but become definite at high ground fault levels.

3.4 SELECTING SETTINGS

The USR relay has a number of rotary switches that enable the user to program the desired time current protection profile in the field, see Figures 2(a) & 2(b) attached.

The switches are accessible on the front panel of the relay through a cutout in the faceplate. The contact surfaces of these switches are gold plated to assure long lasting and positive electrical contact. Should any switch contact of any element become open, the relay will automatically operate on the lowest setting of that element as a backup protection (with the exception of Short Time Delay, which will be reverted to the I^2t setting).

All pickup and timing functions are independent of each other. The selection of settings are therefore governed by system design considerations.

4. SPECIFICATIONS

4.1 SCOPE

The specifications cover the USR Solid State Overcurrent Trip System for use on the Federal Pioneer Ltd. low voltage power air circuit breakers.

The trip unit complies with the American National Standard for trip devices for a.c. low voltage circuit breakers (ANSI C37.17-1979).

4.2 CURRENT SENSOR RATINGS

4.2.1 The types of sensors available along with the circuit breaker frame sizes with which these current sensors can be used are given in Table 1 and Table 2 attached.

4.2.2 The excitation characteristics of the sensors and their secondary d.c. resistance are given in Figure 3 attached.

4.3 RELAY CONFIGURATIONS

The models and options available with each model are detailed in Table 3 attached.

4.4 CURRENT SETTING (Ic) ADJUSTMENT

4.4.1 A multiplier of the Plug Rating (I_R) from 0.5X to 1.0X in discrete steps of 0.5X, 0.6X, 0.7X, 0.8X, 0.9X and 1.0X I_R via a switch on the relay face plate.

4.4.2 The selected current setting establishes a base current for Pre-Trip Alarm, Long Time and Short Time pickup and delay.

4.5 PRE-TRIP ALARM ADJUSTMENT

4.5.1 A multiplier of the selected current setting (Ic) from 0.5X to 1.0X in discrete steps of 0.5X, 0.6X, 0.7X, 0.8X, 0.9X and 1.0X Ic via a switch on the relay face plate.

4.5.2 A local Light Emitting Diode (LED) shall light continuously as Pre-Trip Alarm pickup setting is exceeded.

4.5.3 A Normally Open (NO) mechanical dry contact shall close as Pre-Trip Alarm pickup is exceeded. The contact is rated for 5A at 30VDC or 240VAC resistive load.

4.6 LONG TIME ELEMENT

4.6.1 Long Time Pickup is factory set at 1.1X selected current setting (Ic); providing an effective Long Time Pickup from 0.55 xI_R to 1.10 x I_R. This aggregate tolerance is ±10% of nominal.

4.6.2 Time Delay Bands: Six calibrated I^2t bands are provided with nominal time delay of 2, 4, 6, 10, 20 and 30 seconds at 600% of current setting. Consult characteristic curves for band limits.

4.7 SHORT TIME ELEMENT

4.7.1 Pickup settings available: 2X, 3X, 4X, 6X, 8X and 10X the current settings (I_C).

4.7.2 Aggregate Pickup tolerance: ±10% of nominal

4.7.3 Time Delay Bands: Four definite time bands with nominal time delays of 0.10 second, 0.20 second, 0.30 second, 0.40 second and an inverse I^2t band with time delay of 0.38 seconds at 600% of current setting.

4.7.4 Consult characteristic curves for band limits.

4.8 INSTANTANEOUS ELEMENT

4.8.1 Pickup settings available: 4X, 5X, 6X, 8X, 10X and 12X the rating plug rating (IR).

4.8.2 Tolerance: ±10% based on symmetrical sinusoidal current at 50/60 Hz.

4.8.3 The pickup switch has an "OFF" position. When this setting is selected, the instantaneous element will not pickup unless the breaker closes on a fault that exceeds 13X the plug rating, in which case a discriminator will initiate tripping.

The discriminator circuit shall activate the trip pulse generator of the relay instantaneously provided one of the following conditions exists:

a) The breaker closes on a fault of 13X the plug rating or greater or,

b) A fault of 13X the plug rating or greater occurs while the breaker is supplying a load of less than 0.04X the plug rating.

If the breaker closes and the current is greater than 0.04X, but less than 13X the plug rating, the discriminator monitors the current for 40 milliseconds and if the fault level of 13X is not exceeded during this time, the discriminator shall switch itself off.

4.9 GROUND FAULT ELEMENT

4.9.1 **Pickup settings available:** 0.2X, 0.3X, 0.4X, 0.5X, 0.6X Plug Rating I_G. The combination of pickup setting and plug rating I_G will enable the user to program the trip unit that will meet the 1200A maximum pickup requirement of service entrance protection. The table below demonstrates the different current sensors with their respective maximum plug ratings (I_G) and pick-up setting.

Sensor Rating Amperes	Maximum Plug Rating $I_R I_G$	Maximum Ground Fault Pick-up at 0.6X Plug Rating (Amperes)
800	800/800	480
1200	1200/1200	720
1600	1600/1600	960
2000	2000/2000	1200
2500	2500/2000	1200
3000	3000/2000	1200
	2400/2000	1200
3200	3200/2000	1200
	2560/2000	1200
4000	4000/2000	1200
	3200/2000	1200
	2400/2000	1200
6000	6000/2000	1200
	4800/2000	1200
	3600/2000	1200
	2400/2000	1200

I_R - Plug Rating in Primary Amperes
I_G - Ground Fault Rating in Amperes

4.9.2 Pickup tolerance: ±10% of nominal

4.9.3 Time Delay Bands: Four calibrated bands are provided that are inverse (I^2t) at low fault levels and definite at fault levels exceeding 15 times pick-up setting. The definite time bands provided are 0.1, 0.2, 0.3 and 0.45 seconds, nominal.

4.9.4 Consult time-current characteristic curves for band limits.

4.9.5 Special High Ground (HG) Fault Models:

Certain applications may require the use of higher than 1200A ground fault pickup level to solve coordination problems in conventional time-coordinated systems. A special version of the USR relay, i.e. USR-6-HG or USR-6IR-HG, could be used to satisfy this requirement.

In these models, the I_g rating is equal to 2.5 times sensor rating. Maximum ground fault pickups could be higher than 1200A as shown in the following table:

Sensor Rating Amperes I_s	I_g Rating 2.5 x I_s	Maximum Ground Fault Pick-up at 0.6X I_g
800	2000A	1200A
1200	3000	1800
1600	4000	2400
2000	5000	3000
2500	6250	3750
3000	7500	4500
3200	8000	4800
4000	10000	6000
6000	15000	9000

Note: A special rating plug (with ground rating resistors removed) must be used in conjunction with the HG model. To order a replacement plug, please contact the factory at Bramalea location.

4.10 <u>OUTPUT TRIP PULSE</u>

The USR relay provides a trip pulse output with a minimum energy of about 1 joule. This pulse has an initial voltage of 140V and its rate of decay depends on the impedance of the shunt trip solenoid. This energy is approximately that stored in a 100 μF capacitor charged to 140V d.c.

4.11 TEST SIGNALS

A test plug is provided on the faceplate of the relay to provide access to appropriate signals so that the operation of the relay can be checked by means of a Test Set or other metering devices. The signals available on the test plug are:

TEST PLUG SIGNALS:

Pin No.	Description
1	Signal Ground
2	Not used
3	Input Reference (~ 6V w.r.t. Gnd)
4	Not used
5	B+ (Trip Capacitor Voltage)
6	GF Delay Capacitor
7	LT Pickup Signal
8	LT Delay Capacitor
9	ST Delay Capacitor
10	"GF" Input
11	"C" Input
12	"B" Input
13	"A" Input
14	"TRIP" SIG for Tester

4.12 RELAY INPUT IMPEDANCE (BURDEN)

The input impedances of the relay seen by the secondary of the current sensors at different current levels are shown in Figures 5 attached.

4.13 RESET TIME (Thermal Memory)

The Long Time and Ground Fault elements have built-in thermal memory function to allow arcing or cycling faults to accumulate even if the fault level drops below the pickup level momentarily.

The Long Time element timing circuit shall reset in an exponential decay function with a time constant of approximately 3 seconds. While for the Ground Fault element, the time constant is approximately 120 millisecond.

For Pre-Trip Alarm and Instantaneous, the reset time is less than 10 millisecond.

The reset of the timing circuits starts whenever the fault current is below the pickup levels of the corresponding elements and a minimum level of phase current is flowing in the power system to keep alive the power supply of the relay electronics. Therefore, if the circuit breaker had interrupted an overload or ground fault, reclosing of the breaker onto the same fault which had not been cleared will result in tripping of the breaker at a shorter time delay than expected. However, if the fault had been cleared, reclosing the breaker onto normal load will allow the timing circuits to be reset in due time.

4.14 PERFORMANCE IN SERVICE

The circuits in the relay are stable and show excellent repeatability over long periods of time. Service involving frequent operations will not cause the characteristics to change or drift, since there are no mechanical moving parts to wear.

The USR relay is compensated for variations in ambient temperature over the range -20 °C to +55 °C. The relay performance shall comply with the published characteristic curve over this temperature range.

5. TESTING

5.1 SECONDARY INJECTION

Testing of the overcurrent trip system is easily accomplished, in the field, with the Federal Pioneer portable Test Set Type DDT-USR. The test can be done on a complete breaker assembly located in the disconnect position in the cubicle, on the complete breaker on a work bench, or on a static trip device completely removed from the breaker. It is not necessary, however, to remove any wiring in order to do any of these tests. The type DDT USR test unit permits checking pickup and timing functions as well as the operation of the shunt trip solenoid.

The type DDT-USR cannot check the functions of the trip unit with the circuit breaker in service.

5.2 PRIMARY INJECTION

IMPORTANT:

One must bear in mind that because of the thermal memory functions of the Long Time and the Ground Fault elements, repeated testing of their delay functions without first resetting the thermal memory circuits will result in misleading or erroneous test results. To reset the thermal memory, one only needs to apply a low level of test current just below the pickup levels of the corresponding element for a sufficient period of time: 30 seconds and 3 seconds for Long Time and Ground Fault respectively.

5.2.1 If it is desired to check the current sensor operation it will be necessary to test the breaker by primary current injection methods. This involves connecting the power poles of the breaker to a controlled source of current. The advantage of this system is that the entire sensor-relay-trip coil system operation is verified. The disadvantage is that suitable equipment required for such testing is heavy, extensive and difficult to use.

5.2.2 The test equipment for single phase tests should provide 50/60 Hz. Sinusoidal current to the breaker power pole terminals. The connectors to double-stab poles (on higher current breakers) should be arranged to divide the current between the two stabs equally. If complete testing of all pickup positions of the USR is desired the test equipment should be capable of 1200% of the breaker current rating for at least .04 seconds and 600% of the current rating for 30 seconds. For minimum testing the test equipment should be capable of 600% current rating for at least 3 seconds. This will enable testing on all elements to be performed on the lowest settings for INSTANTANEOUS, SHORT TIME and LONG TIME elements.

5.2.3 The test equipment should include a timer which starts when the current is switched on and stops when the current is switched off (breaker trips). It should be capable of measuring time intervals from .01 seconds to 2000 seconds accurately.

5.2.4 The open circuit voltage of the current source must be at least 0.5 VAC when set at the required test current. This requirement must be met when checking a lower rating sensor such as 800A.

5.2.5 Test connections to the breaker should be as short as possible, otherwise, current capability will be limited and only minimum testing achieved.

5.2.6 Before attempting testing the USR relay, the element and setting to be tested must be decided. To ensure that other elements do not interfere with the test it will be necessary to set pickup and/or delay settings higher than those under test.

5.2.7 For USR types mounted in drawout breakers removed from the cubicle, it will be necessary to connect a test jumper to complete the secondary circuit between the sensors and the USR relay since the current is normally completed by a permanent jumper or external sensor, depending on the type of system being used.

5.2.8 The jumper may be connected to the contacts of the rear mounted terminal blocks as shown in Figure 7. The actual terminals used vary from one breaker to another requiring the use of the appropriate breaker wiring diagram to determine actual location.

5.2.9 For overcurrent tests (not ground fault) jumper A only must be installed. For ground fault tests jumper B only must be installed.

5.2.10 Alternatively, the connections may be made directly from the common terminal of the sensors to either the N or G terminal of the relay for overcurrent or ground fault tests respectively.

5.2.11 For USR types used with fixed breakers, a direct connection between the sensor common and either the N or G terminals of the breaker auxiliary contact block will allow testing of overcurrent or ground fault respectively.

5.2.12 After each test in which the breaker has tripped, it must again be charged and closed before proceeding with the next test.

5.2.13 After the conclusion of the tests the relay settings must be restored to their original values. The jumper, if any, should be removed from the auxiliary contacts. The main contacts of the breaker must be inspected and serviced as required by the breaker Manual C-3-222-1.

5.2.14 Care should be taken when using magnetic pickup devices for measuring current (e.g. clip-on ammeters, current sensors, etc.) to ensure that the readings are not being influenced by the strong magnetic field from high-current carrying conductors.

5.2.15 Since the published characteristics are defined for ideal testing arrangements, additional tolerance may be required to allow for field conditions (e.g. waveforms may not be sinusoidal). The trip time of the breaker should also be added to time delay measurements (max. 1¼ of a cycle) when performing primary current injection tests.

<u>CAUTION:</u>

Since much of the testing involves currents considerably higher than the continuous ratings of the breaker and the trip device, care should be exercised in not overheating it. Sufficient cooling time must be allowed between tests.

6. MAINTENANCE

6.1 GENERAL

Each Solid State Overcurrent Relay is tested and calibrated before shipment. It is ready for use after it has been interconnected with the rest of the components of the trip unit and the appropriate settings have been selected.

The only maintenance recommended is the periodic verification that the relay is functioning. This may be supplemented as desired by checking the calibration and inspection for loose or broken external wiring.

6.2 TROUBLESHOOTING

6.2.1 **Failure to Trip:** Failure of the circuit breaker to trip in response to a fault may be caused by any of the reasons listed below. Corrective action is indicated with the reason for failure to trip.

(a) **Relay set too high** - Check that the pickup settings on the relay are correct and that the correct sensor and rating plug are used.

(b) **Sensors improperly connected** - Check that all connections are tight, wiring is correct and leads not broken. Any current sensor with open-circuited secondary must be replaced.

(c) **Shunt trip solenoid open-circuited** - Check that the wiring to the trip solenoid is not broken. The d.c. resistance of the coil should be approximately 30 ohms.

6.2.2 **Failure to Close:** Failure of the circuit breaker to close and latch mechanically may be due to the reasons listed below. Corrective action as indicated.

(a) **The shunt trip solenoid** - Check to ensure that the plunger of the shunt trip solenoid is not inhibited from resetting. Refer to the circuit breaker instruction manual for mechanical mounting details.

(b) Ensure that an overload or short circuit does not exist in the load circuit.

(c) Check that there is no ground current exceeding the pickup setting.

(d) Check sensor and rating plug to ensure that the rating is properly selected for the required load. Check sensor wiring and mounting for marked polarity. A reverse connected current sensor generates a high residual current which causes the Ground Fault element of the relay to trip the breaker.

(e) Check that pickup and delay settings are such as to override certain predictable short term overloads, such as: motor starting, spotwelding, induction oven feeds, etc.

If none of the above helps, the USR relay must be tested with a DDT-USR test unit, if one is available. It may then be decided that the relay must be returned to Federal Pioneer for repairs. In such a case it will be a great help to the Service Department if the source of complaint is documented and reported as accurately as possible. The element which fails to function properly along with the setting or settings must be noted. Also, the condition under which improper operation was noted i.e. during initial testing, during maintenance, etc. and the type of testing equipment used. This will enable the quick repair and return of the unit.

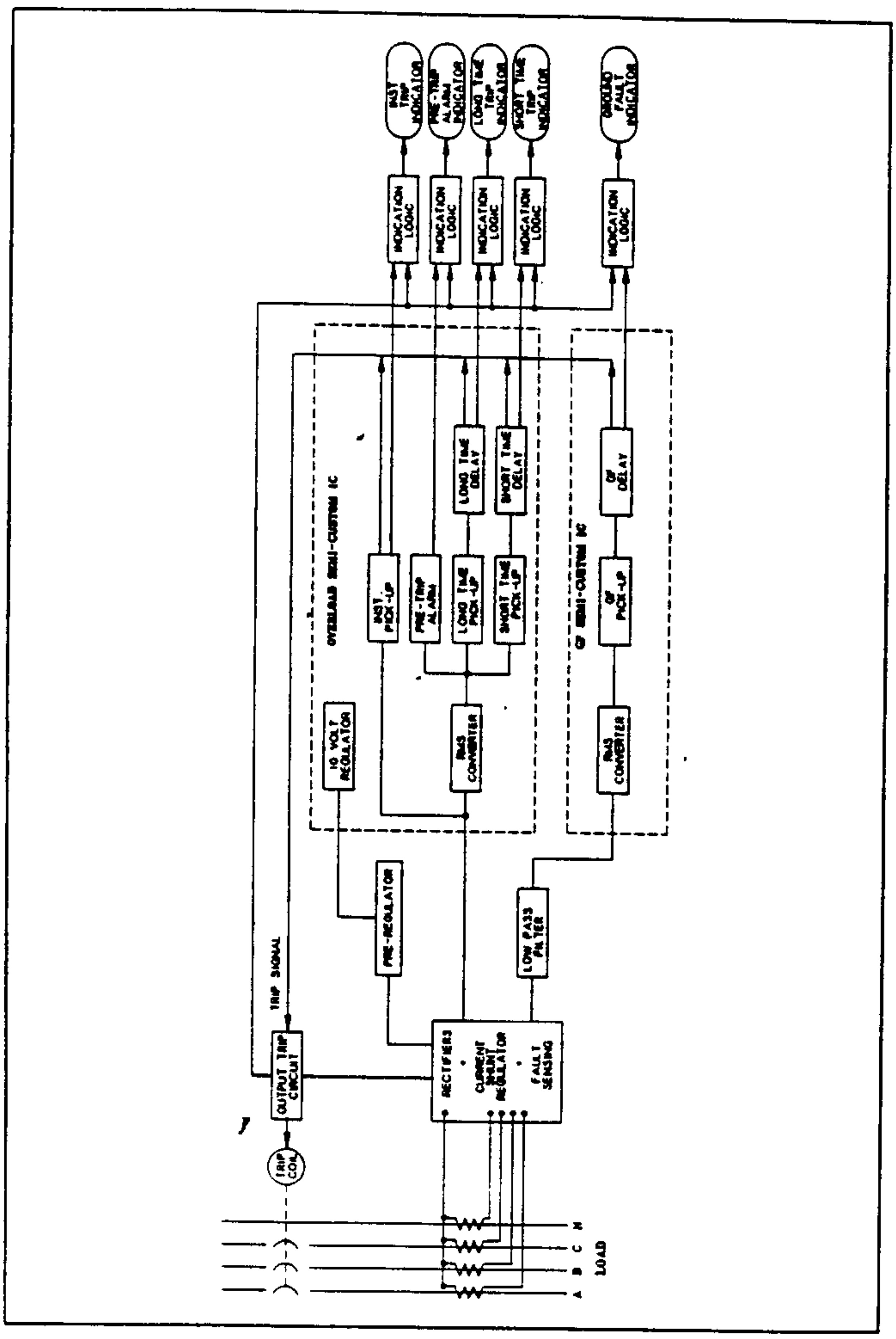


Figure 1 Functional Block Diagram

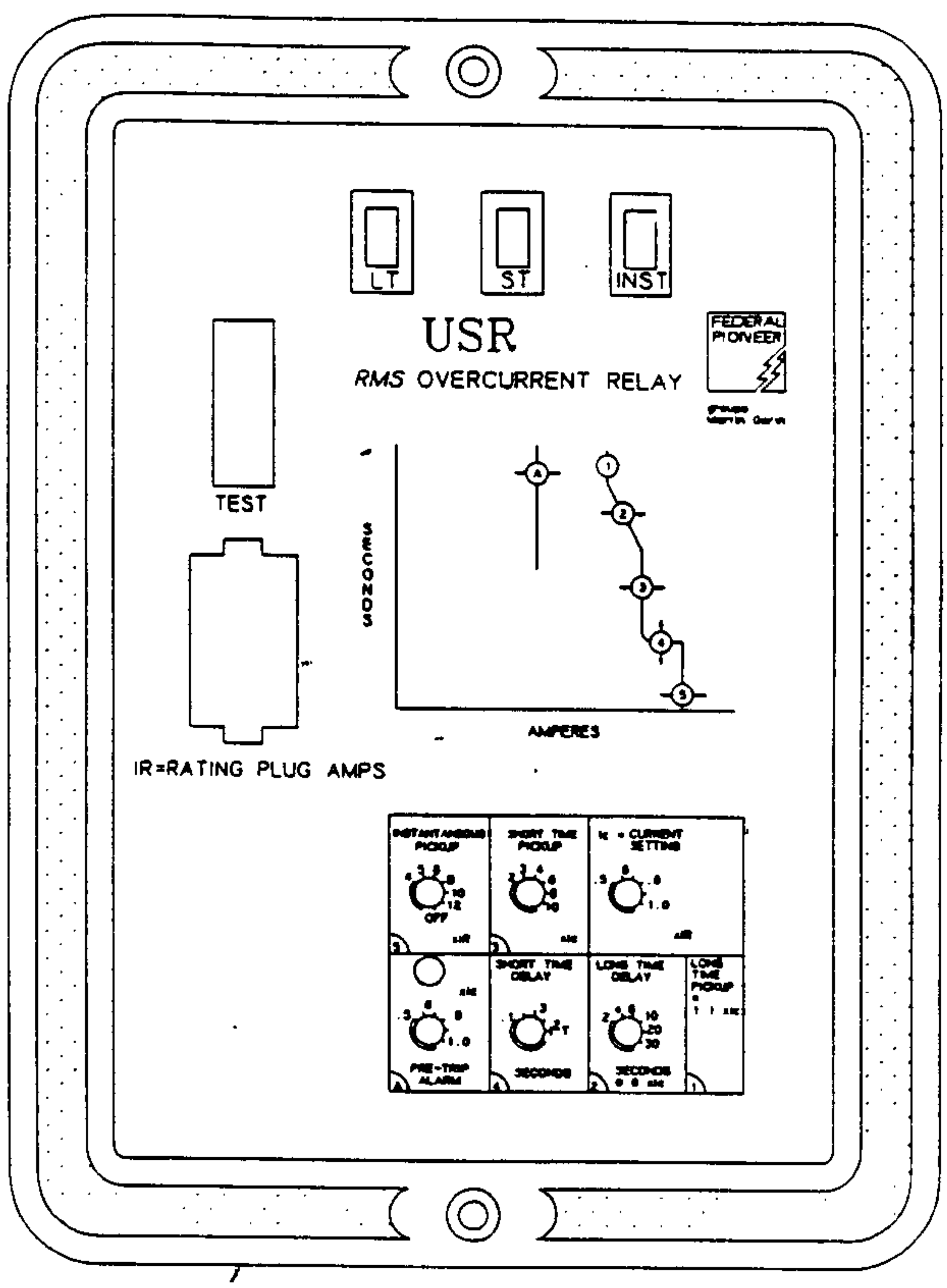


Figure 2a Faceplate Layout - Type USR-3IR Relay

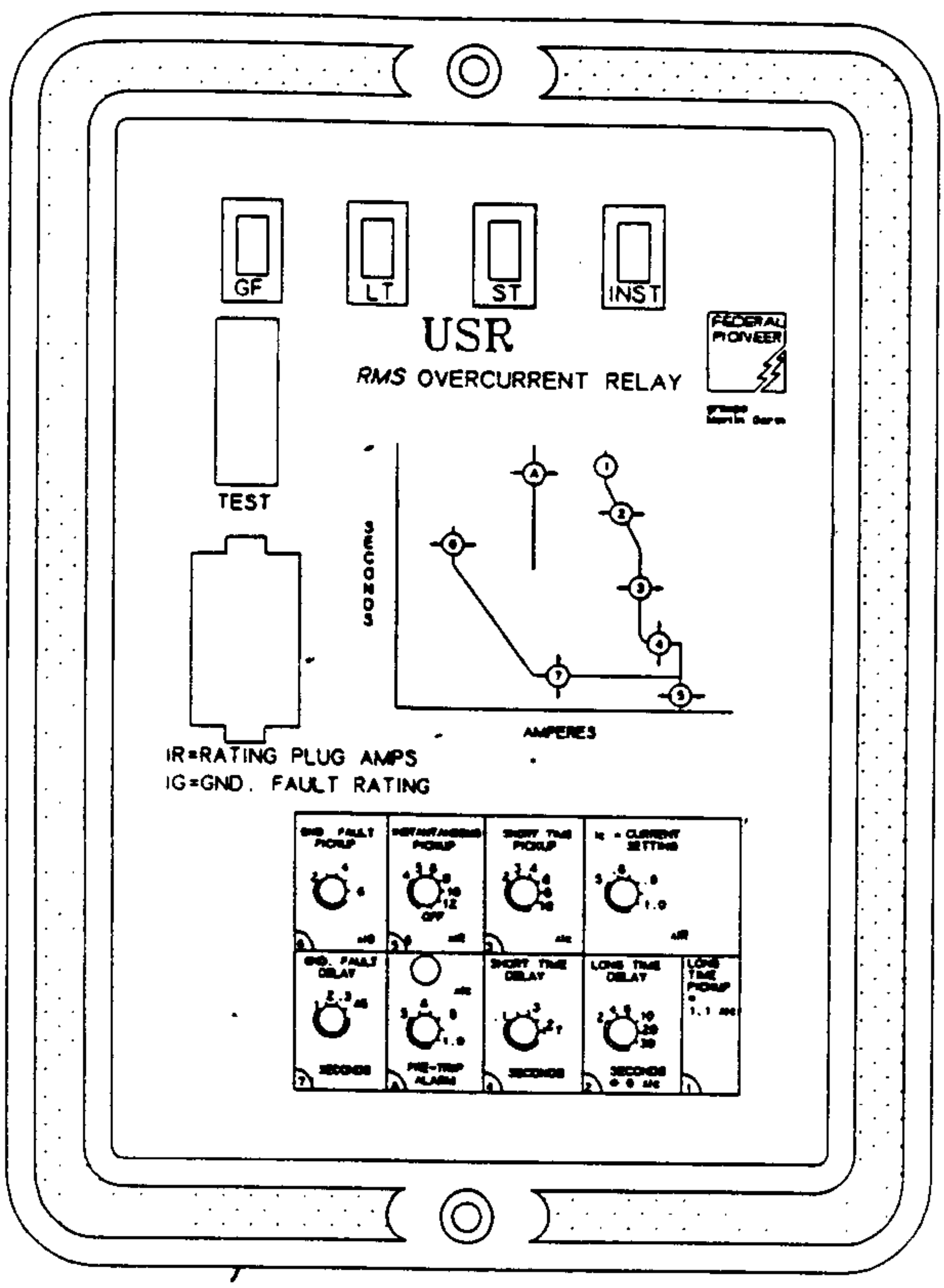
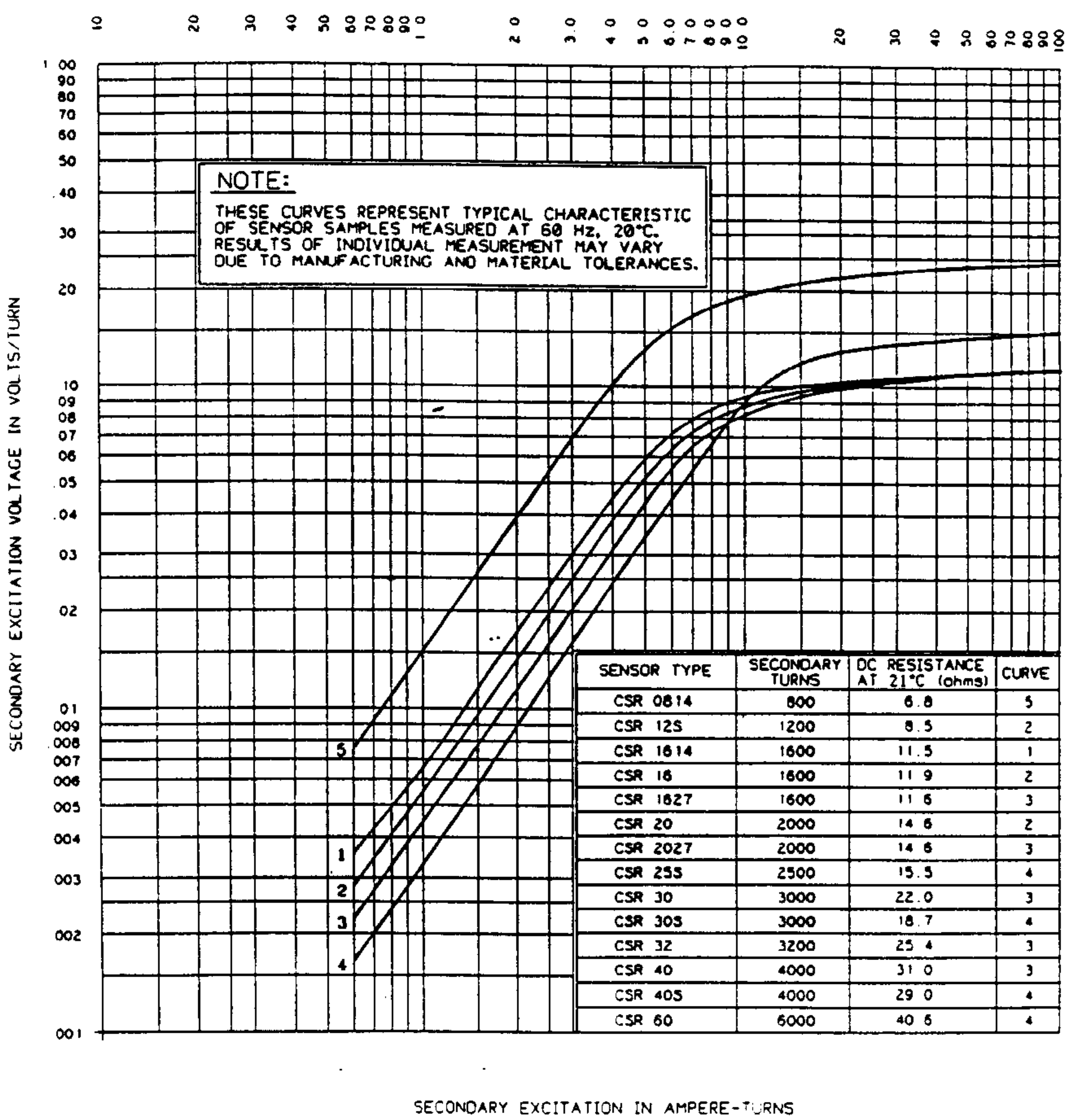


Figure 2b Faceplate Layout - Type USR-6IR Relay



SENSOR TYPE	SECONDARY TURNS	DC RESISTANCE AT 21°C (ohms)	CURVE
CSR 0814	800	6.8	5
CSR 12S	1200	8.5	2
CSR 1614	1600	11.5	1
CSR 16	1600	11.9	2
CSR 1627	1600	11.6	3
CSR 20	2000	14.6	2
CSR 2027	2000	14.6	3
CSR 25S	2500	15.5	4
CSR 30	3000	22.0	3
CSR 30S	3000	18.7	4
CSR 32	3200	25.4	3
CSR 40	4000	31.0	3
CSR 40S	4000	29.0	4
CSR 60	6000	40.6	4

Figure 3 Excitation Characteristics of Current Sensors

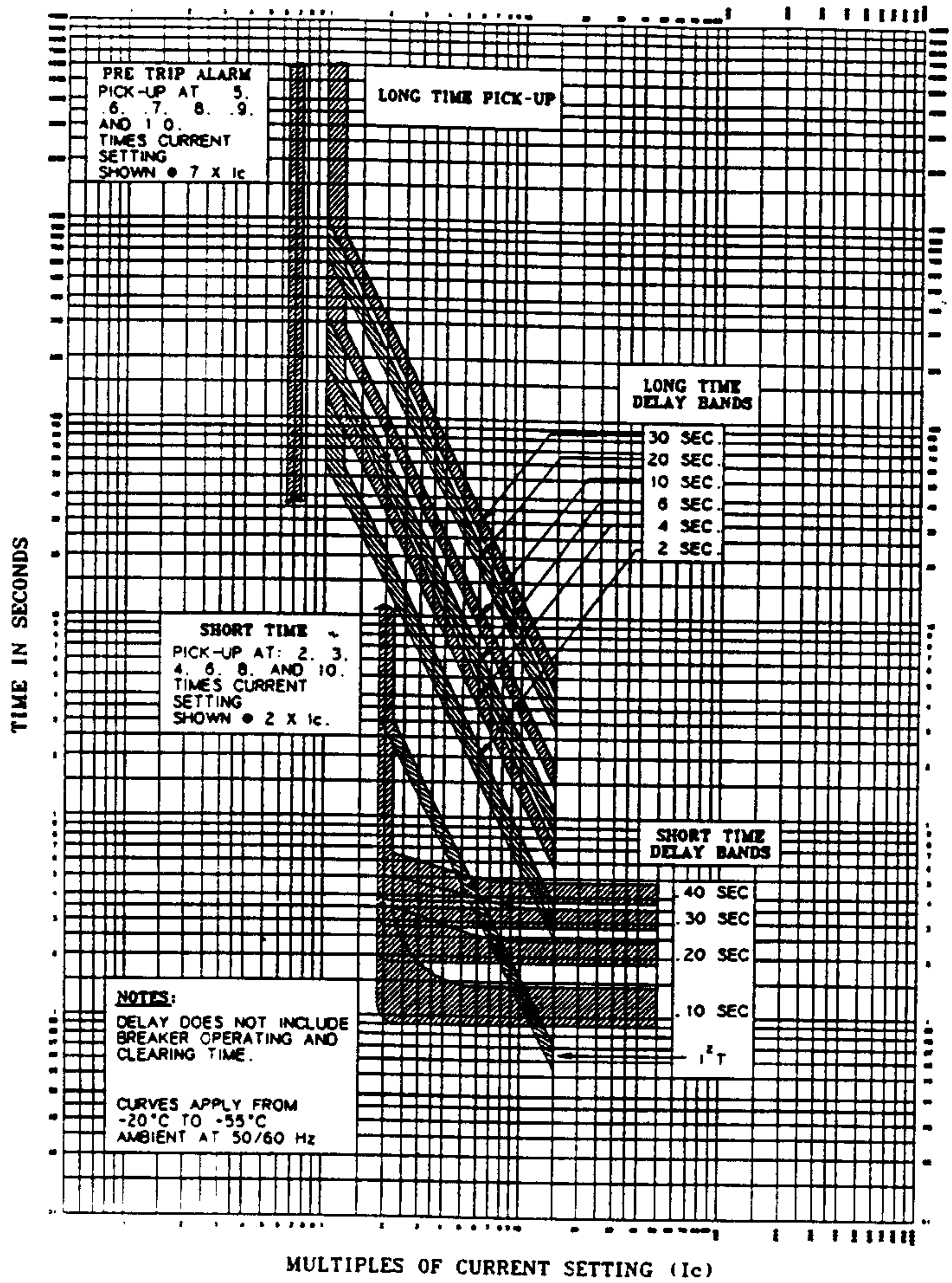


Figure 4a Time Current Characteristics of USR Relay

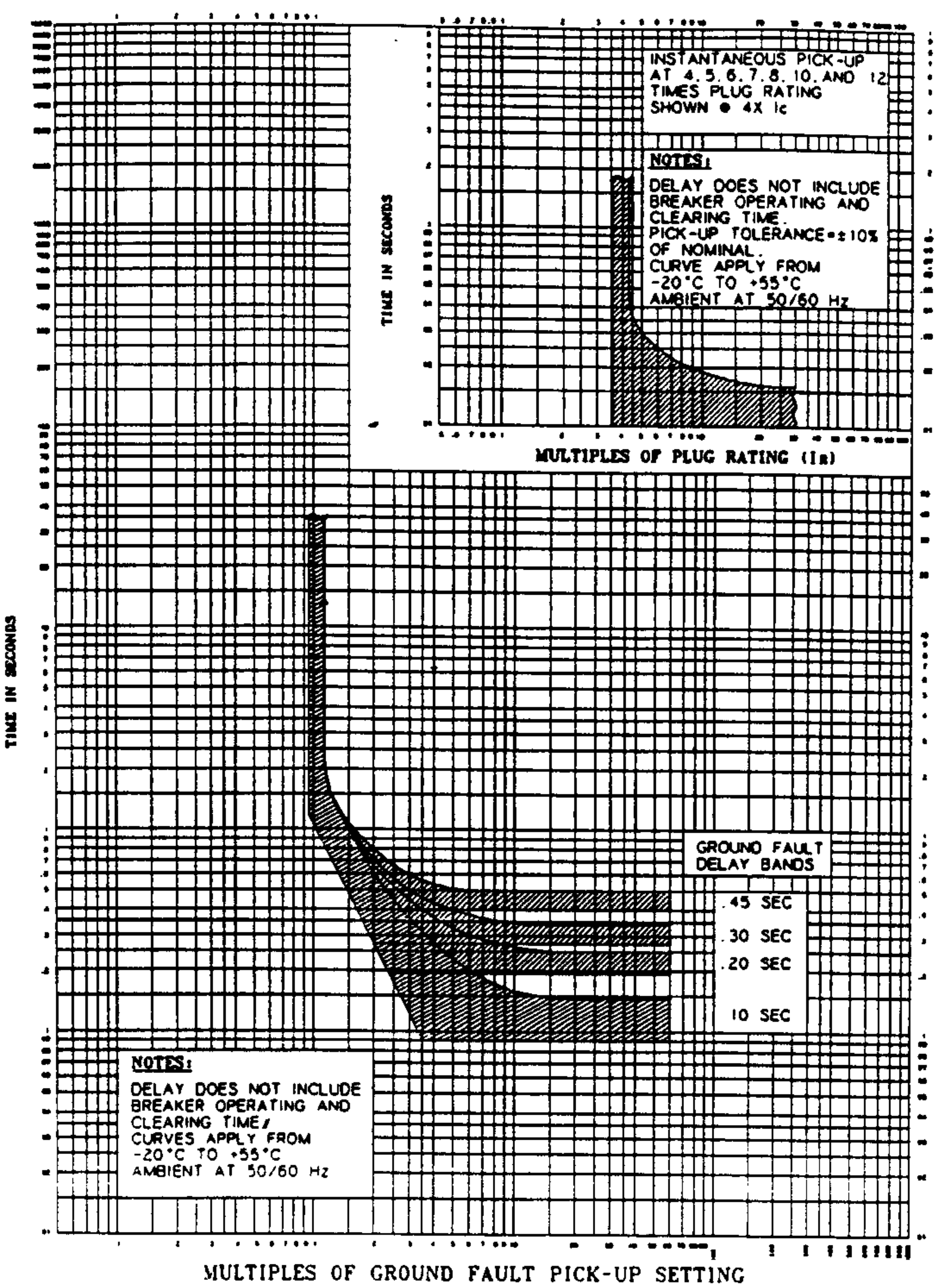


Figure 4b Time Current Characteristics of USR Relay

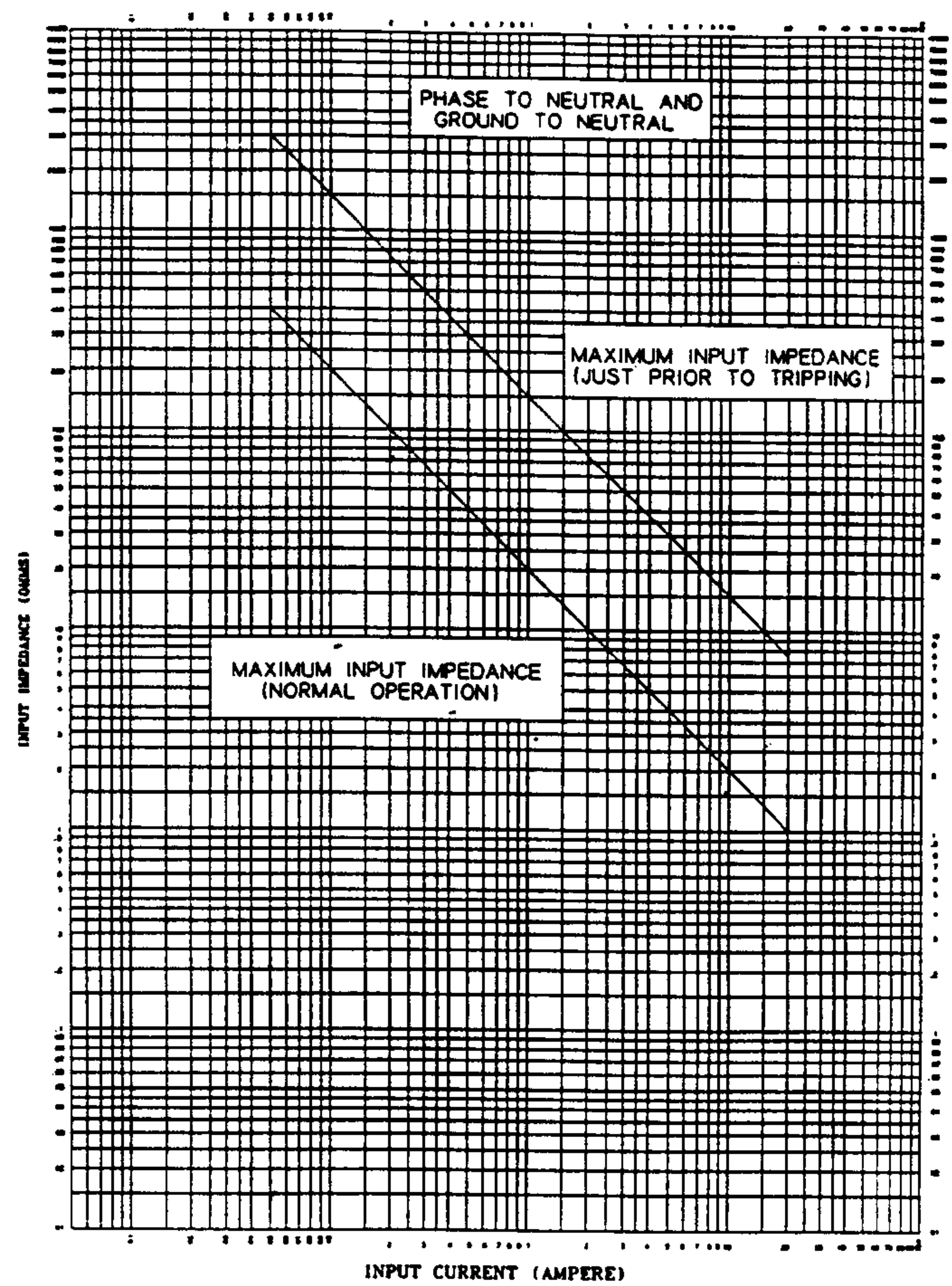
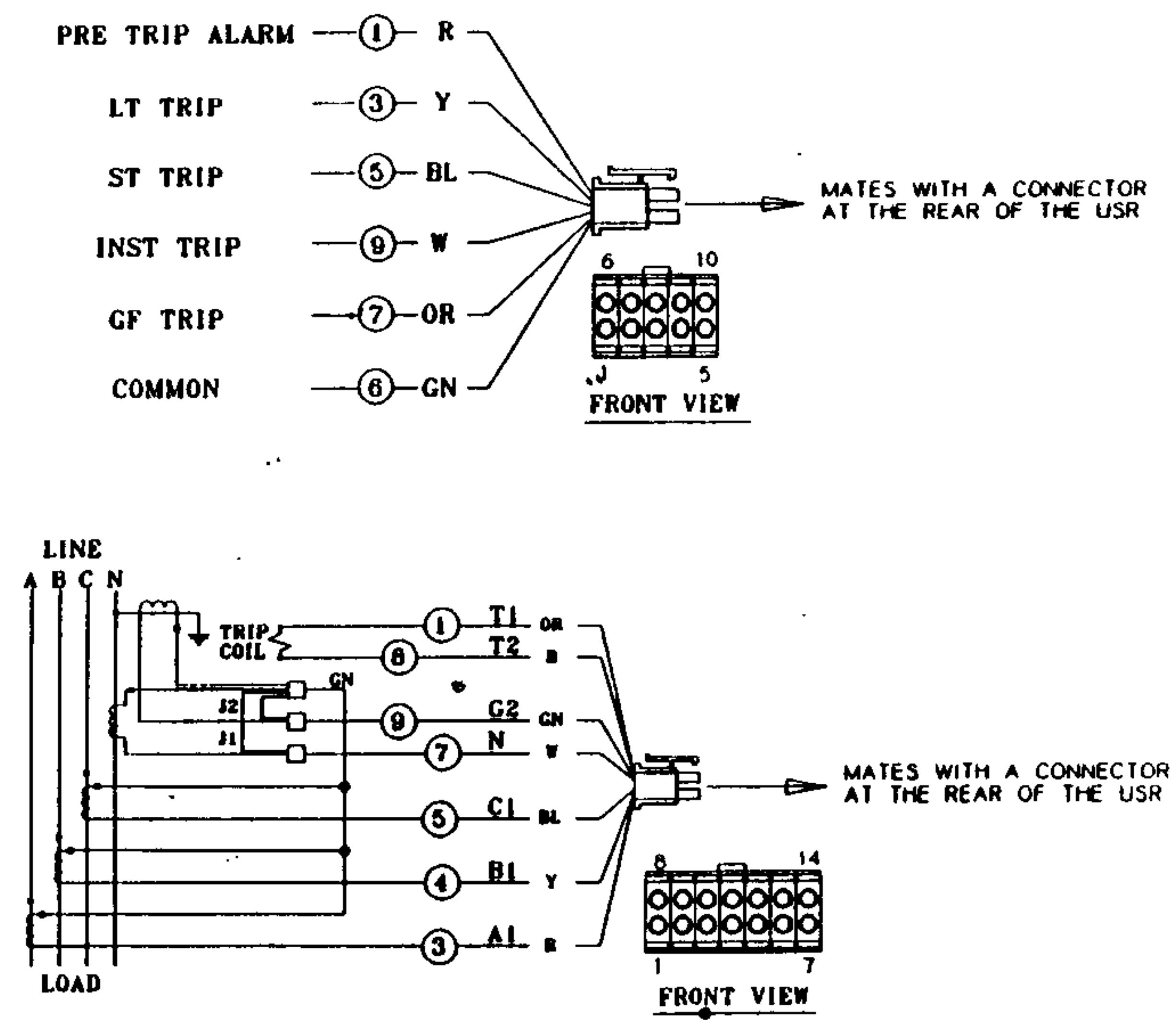


Figure 5 Input Impedance of Solid Sate Overcurrent Relay Type USR



CONNECTIONS:

CONNECTOR HARNESS:

1. PART NO. USR-RH1 AS SHOWN WITH 6 WIRES FOR USR-3IR OR USR-6IR
2. PART NO. USR-RH2 AS SHOWN WITH TWO WIRES FOR PRE TRIP ALARM ONLY FOR USR-3 OR USR-6

ALL NORMALLY OPEN CONTACT RATING

5A ● 30VDC OR 240VAC RESISTIVE
3.5A ● 120VAC INDUCTIVE
2.5A ● 240VAC INDUCTIVE

CONNECTIONS:

RELAY WITHOUT GROUND FAULT PROTECTION

WIRE PHASE CT'S AS SHOWN AND ADD JUMPER 1

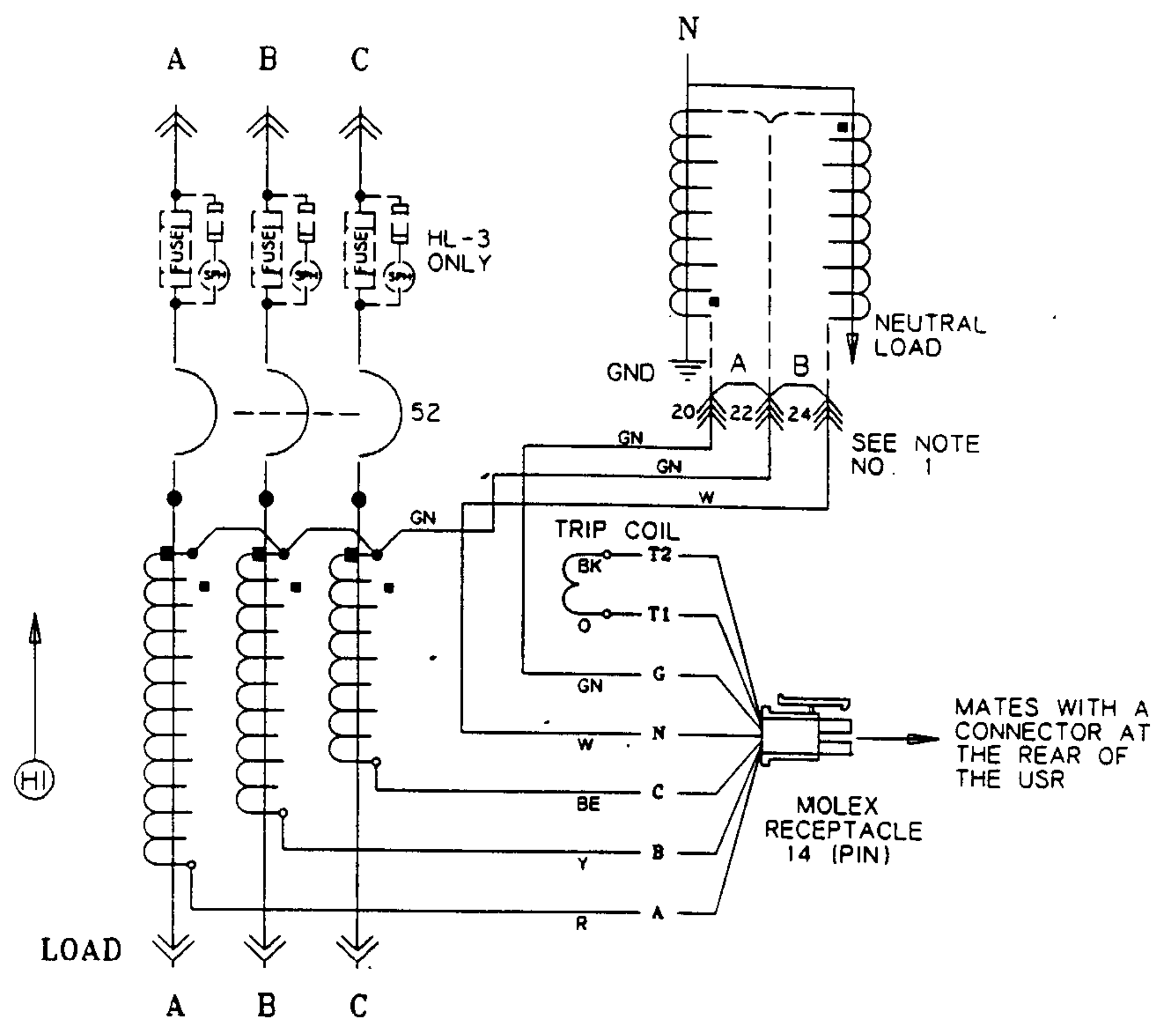
RELAY WITH GROUND FAULT PROTECTION

WIRE PHASE CT'S (AND GROUND STRAP/NEUTRAL CT AS REQUIRED) AS SHOWN AND ADD EITHER:

JUMPER 1. FOR 3Ø 4W WITH GROUND STRAP CT, OR

JUMPER 2 FOR 3Ø 4W WITH NEUTRAL CT OR FOR 3Ø 3W

Figure 6 Sensor and Remote Indication Connections



NOTES:

1) JUMPER 'A' PROVIDED ON FIXED AUXILARY CONTACT BLOCK REQUIRED WHEN NEUTRAL SENSOR CONNECTED OR NO REMOTE SENSOR INSTALLED (RESIDUAL 3PH. 3W).
IF GROUND STRAP SENSOR IS PROVIDED REMOVE JUMPER 'A' AND INSTALL JUMPER 'B'.

Figure 7 Test Connections for Primary Injection Tests

TABLE 1 CURRENT SENSOR SIZES AND RATING PLUGS TYPE H-3 & HL-3 A.C. LOW VOLTAGE POWER CIRCUIT BREAKERS

Breaker Type	Breaker Frame	Breaker Frame Width	K.A.I.C. RMS Symm. @ 600Vac	Sensor Type & Rating	Rating Plugs - Ratings Available in Primary Amperes IR/IG								Sensor Dimensions	
					100%	80%	75%	60%	50%	40%	30%	25%	I.D./Window Size	O.D.
30H-314 42H-314	800A	14"	30 42	CSR0814 800A	800 800	640 640	600 600	480 480	400 400	320 320	240 240	200 200	½" x 2⅛"	4⅛"
50H-314	1600A	14"	50	CSR1614 1600A	1600 1600	1280 1280	1200 1200	960 960	800 800	640 640	480 480	400 400	½" x 2⅛"	4⅛"
30H-3 42H-3	800A	21"	30	CSR0814 800A	800 800	640 640	600 600	480 480	400 400	320 320	240 240	200 200	½" x 2⅛"	4⅛"
50H-3	1600A	21"	50	CSR1614 1600A	1600 1600	1280 1280	1200 1200	960 960	800 800	640 640	480 480	400 400	½" x 2⅛"	4⅛"
50H-3	2000A	21"	50	CSR20 2000A	2000 2000	1600 1600	1500 1500	1200 1200	1000 1000	800 800	600 600	500 500	⅞" x 3⅛"	5½"
65H-3	1600A	27"	65	CSR1627 1600A	1600 1600	1280 1280	1200 1200	960 960	800 800	640 640	480 480	400 400	⅞" x 4⅛"	6⅛"
65H-3	2000A	27"	65	CSR2027 2000A	2000 2000	1600 1600	1500 1500	1200 1200	1000 1000	800 800	600 600	500 500	⅞" x 4⅛"	6⅛"
75H-3	3000A	27"	65	CSR30 3000A	3000 2000	2400 2000	2250 2000	1800 1800	1500 1500	1200 1200	900 900	750 750	½" x 4⅛"	6⅛"
75H-3	3200A	27"	65	CSR32 3200A	3200 2000	2560 2000	2400 2000	1920 1920	1600 1600	1280 1280	960 960	800 800	½" x 4⅛"	6⅛"
100H-3	4000A	27"	85	CSR40 4000A	4000 2000	3200 2000	3000 2000	2400 2000	2000 2000	1600 1600	1200 1200	1000 1000	1⅛" x 4⅛"	6⅛"
100H-3	6000A	33"	85	CSR60 6000A	6000 2000	4800 2000	4500 2000	3600 2000	3000 2000	2400 2000	1800 1800	1500 1500	6.75" I.D.	9¼"

IR: Plug Rating in Amperes
IG: Ground Fault Rating

TABLE 2 CURRENT SENSOR SIZES AND RATING PLUGS TYPE 12SSB3 & 12SSB2 A.C. LOW VOLTAGE SYSTEM SERVICE BREAKERS

SSB Type	SSB Frame	Frame Width	K.A.I.C. RMS Symm. @ 600Vac	Sensor Type & Rating	Rating Plugs - Ratings Available in Primary Amperes IR/IG								Sensor Dimensions	
					100%	80%	75%	60%	50%	40%	30%	25%	I.D./Window size	O.D.
12SSB3	1200A	21"	30	CSR12S 1200A	1200 1200	960 960	900 900	720 720	600 600	480 480	360 360	300 300	½" x 3⅛"	5½"
16SSB3	1600A	21"	42	CSR16 1600A	1600 1600	1280 1280	1200 1200	960 960	800 800	640 640	480 480	400 400	½" x 3⅛"	5½"
20SSB3	2000A	21"	50	CSR20 2000A	2000 2000	1600 1600	1500 1500	1200 1200	1000 1000	800 800	600 600	500 500	⅛" x 3⅛"	5½"
25SSB2	2500A	33"	50/65	CSR25S	2500 2000	2000 2000	1875 1875	1500 1500	1250 1250	1000 1000	750 750	625 625	6.75" I.D.	9¼"
30SSB2	3000A	33"	50/65	CSR30S	3000 2000	2400 2000	2250 2000	1800 1800	1500 1500	1200 1200	900 900	750 750	6.75" I.D.	9¼"
40SSB2	4000A	33"	50/65	CSR40S	4000 2000	3200 2000	3000 2000	2400 2000	2000 2000	1600 1600	1200 1200	1000 1000	6.75" I.D.	9¼"

IR: Plug Rating in Amperes
IG: Ground Fault Rating

TABLE 3 STANDARD USR OVERCURRENT RELAY MODELS

Models / Characteristics	USR 3	USR 3IR	USR 6	USR 6IR	USR 3IRG	USR LT
PRE-TRIP ALARM	X	X	X	X	X	X
LONG TIME	X	X	X	X	X	X
SHORT TIME	X	X	X	X	X	
INSTANTANEOUS	X	X	X	X	X	
GROUND FAULT			X	X		
LOCAL & REMOTE INDICATION		X		X	X	