ABB

ABB Power T&D Company Inc.
Power Automation and Protection Division
Coral Springs, FL 33065

Instruction Leaflet

41-252A

SRW
Reverse Power Relay

with Adjustable Timer

⚠ CAUTION

It is recommended that the user become acquainted with the information in this instruction leaflet before energizing the equipment. Failure to observe this precaution may result in damage to the equipment.

1.   APPLICATION

The type SRW relay is a single phase directionally controlled timing relay used to protect ac generators from motoring. When such a condition occurs and persists for a predetermined time interval, the generator may be tripped or an alarm sounded. The SRW may also be used to sense lagging power factor load flow in an abnormal direction as shown in *Figure 8*. The directional unit has 30 degree maximum sensitivity characteristics. The timer unit is adjustable from 2 to 21.5 seconds, .2 to 2 seconds or 2 to 63 seconds depending upon relay style. The range of the current pickup settings is from 1 mA to 40 mA at the maximum sensitivity angle.

2.   CONSTRUCTION

The SRW relay consists of three printed circuit modules and a front panel packaged in a FT-11 case. For detailed information on the flexitest case, refer to I.L. 41-076.

The photograph in *Figure 1* shows the SRW relay in its case.

2.1.   Interface Module

The interface module, mounted at the bottom of the relay, contains a voltage transformer, a current transformer, a reed relay and two miniature high power relays. This module also contains a dc power supply and its dropping resistors.

(1)   DC Power Supply — Three dc input voltages, 48, 125 and 250 volts, can be selected by connecting a jumper to a suitable position which is printed on the PC board's left-hand side. The relay is shipped with a setting of 125 volts.

(2)   Voltage Transformer — This transformer consists of one primary winding and one secondary winding. The continuous voltage rating at primary side is 150% of the rated line voltage but the relay's accuracy is designed between 30% and 110%. The secondary voltage is fed to the SRW module as a phase angle reference.

(3)   Current Transformer — this is a two-winding transformer with a turns ratio of 20 to 400. A load resistor of 20 ohms is connected across the secondary winding. The secondary voltage is linearly proportional to the primary current if the input current is less than 5 amps. For current higher than 5 amps, the secondary voltage is clamped to approximately peak-to-peak voltage of 20 volts in order to void ct saturation.

(4)   Trip Relays — Two miniature high power relays are connected to the trip circuit. Each relay is equipped with a normally open contact

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All possible contingencies which may arise during installation, operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local ABB Power T&D Company Inc. representative should be contacted.

for tripping or alarm purpose. These relays will be sealed in by a reed relay contact if a trip current is detected.

(5)   Reed relay and reset switch — The reed relay is for monitoring and indication of the actual trip current flow. The trip current should be between 0.5 and 30 amperes. Once the trip current is detected, the reed relay seals in the trip relays and turns on the trip indicator which is a magnetic flip-flop disc indicator on the SRW board. The indicator is reset from the outside of the case by a push rod located at the bottom of the cover. With the relay being energized, the rod touches a push-button switch and resets the target.

2.2.   SRW Module

The SRW module, located at the top of the relay, contains two LEDs, one magnetic flip-flop indicator, one thumbwheel switch, one 6PST DIP switch, several integrated circuits and associated components.

(1)   Indicators

 (a) A yellow LED is for the dc power-on condition.

 (b) A red LED indicates that the magnitude of the reverse power is above the pickup setting.

 (c) A magnetic flip target shows that the actual trip current is detected.

(2)   Pickup setting switch — A single pole 10 position (SP10T) thumbwheel switch is used. Each number (or position) represents a reverse power pickup setting between 1 mA and 40 mA.

(3)   Time delay selection — A DIP package containing six SPST switches is used. Each SPST switch indicates its own delay time. The total delay time is the summation of the selected individual times. The timer can be set in steps of .05 sec. for .2 to 2, .5 sec. for 2 to 21.5 sec and 1.0 sec for 2 to 63 sec.

(4)   All integrated circuits and electronic components are used for detecting the power direction, level, undervoltage condition and trip logic. If the input voltage is above 30% of rating and the reverse power level is above the pickup value persisting longer than the selected delay time, the logic will energize the trip relays and close their output contacts.

2.3.   Transformer In-rush Module

The In-rush module is located on top of the SRW module and electrically connected by two bottom entry connectors to the SRW module. This module contains five integrated circuits and several discrete components. A blue link L1 is used to select the power supply voltage for this module. Positions are available for 48, 125 or 250 Vdc with the 125 volt setting being the relay shipping setting. The theory upon which the SRW relay function is based assumes a sinusoidal waveform which is true for a reverse power condition. Conditions can occur however, when the waveform is not a sinusoid, such as an initial energization of a transformer with little or no load connected. When a transformer is first energized, a transient magnetizing or exciting in-rush is not a sinewave and may last for several minutes before finally damping out. The actual time depends on several factors such as size and location of the transformer, resistance of the power system from the generator to the transformer, the saturation density of the transformer, residual flux level in the bank and how the bank is energized. The SRW, due to its high sensitivity, may false trip after its timer times out under these types of conditions. The In-rush module will prevent these types of false trips.

3.   THEORY OF OPERATION

The SRW relay is a single phase directional relay used to protect ac generators from motoring. It senses the power flow into the generator. If this power flow persists for a predetermined time, the generator may be tripped. The relay must sense and perform the computation of $|I| \times \cos(\theta - 30°)$ to determine a trip, where I is a single phase current (e.g., I_a) and θ is the angle by which this current leads the voltage (e.g., Vac). The maximum sensitivity angle occurs when the angle θ equals 30 degrees. The sensitivity of the reverse current is 1 milliampere, and the continuous current capability is 10 amperes.

This relay can be easily modified and adjusted for any desired maximum sensitivity angle between 0 and 90 degrees.

A block diagram of the SRW relay is shown in *Figure*

3. The voltage circuit (Vac) contains three sections. 1. Phase shifter which shifts the input voltage by -150 degree. 2. Sine-wave to square wave inverter (180 degree shift), i.e., the waveform at point C leads the signal at point A by +30 degree. 3. Undervoltage detector to block the trip actions.

The current circuit (I_a) contains a voltage limiting circuit and a differential amplifier. The voltage limiting circuit is used to prevent the saturation of the current transformer and maintain a constant phase relationship between primary and secondary windings for input current between 1 mA and 50 amperes. The output from the amplifier is a sinewave for input I_a less than 5 amperes. For inputs between 5 and 50 amperes a clipped sine wave signal will be seen at point E but the phase relationship with the input I_a is maintained.

The multiplier section contains a solid-state switch and an amplifier. The square wave C controls the switch states, e.g. contacts close if C equals "1" and contacts open if C equals "0". The gain of the amplifier is either + 1 or -1 for the open or close contact respectively. The multiplier actually multiplies the sinewave E and the square wave C. Assume that the frequencies of the waveforms at point C (Vac) and point E (I_a) are same as the line frequency W. The square wave C can be expressed as follows:

$$C = \sum_{n=1} An \cos(n \ Wt + n\phi)$$

The wave form at point E equals $I_a \cos Wt$. The output of the multiplier can be shown as F.

$$F = C \times E = I_a \cos Wt \times \sum_{n=1} An \cos(n \ Wt + n\phi)$$

$$= I_a \cos Wt \times A_1 \cos(Wt + \phi)$$

$$+ I_a \cos Wt \times \sum_{n=2} An \cos(n \ Wt + n\phi)$$

$$= \frac{1}{2} I_a A_1 [\cos\phi + \cos(2 \ Wt + \phi)]$$

$$+ \frac{1}{2} I_a \times \sum_{n=2} An \cos[(n-1)Wt + n\phi]$$

$$+ \frac{1}{2} I_a \times \sum_{n=2} An \cos[(n+1)Wt + n\phi]$$

This means that the waveform at point F contains a dc component (0.5 x $I_a A_1$ x cosϕ), fundamental frequency W and its harmonics. A low-pass filter is used to remove the line frequency and its harmonics. A dc voltage at point G will be obtained and it is proportional to the value of $I_a \cos \phi$, where ϕ is the phase angle between signal C and E. The maximum sensitivity occurs when ϕ equals 0°. Since signal C leads Vac by +30°, the maximum sensitivity occurs when I_a leads Vac by + 30°. (Assume that I_a and signal E are in phase. It can be compensated by adjusting the phase shifter between points A and B for any phase shift caused by possible component imperfections). To produce a trip, the dc component cos ϕ must be positive, i.e., the angle ϕ is between -90° and +90°. To stay in restraint cos ϕ must be a negative value, i.e., the angle is between 90° and 270°. The waveforms in *Figure 10* show the outputs for different phase angles between two inputs C and E. The trip level I_a can be set by a level detector. After a time delay, the telephone relay will operate if Vac is greater than the undervoltage setting which is 30% of the rated line voltage.

For 90 degree maximum sensitivity (I_a and Vbc), change the phase shifter adjustment from -150° to -90°. For zero degree maximum sensitivity (I_a and Van), add a capacitor C18, (.22 MFD) in parallel with R42, and adjust the phase shifter from -150° to -180°.

The transformer In-rush module is designed to detect the zero crossing time period of the incoming waveform and block trip when an asymmetrical waveform is detected. Under normal conditions with a symmetrical waveform input, the zero crossing time period has a duty cycle of 50%. This input is applied to the In-rush module which then goes through an ac to square converter. The square wave is then converted to pulses which trigger a oneshot timer every half cycle. The oneshot has a time constant of 7.5 ms. The output of this oneshot is fed into a second oneshot with a time constant of 1.6 ms. If the input waveform zero crossing transitions occur in the time window of 7.5 to 9.1 ms, the duty cycle of the incoming waveform is between 42% and 58% and the waveform is considered symmetrical and the output transistor Q1 is held off. Under this condition, the In-

rush module will not affect the operation of the relay in any manner. If the input waveform is asymmetrical, the zero crossings will fall outside of the oneshot window and trigger Q1, which will then in turn inhibit a trip output.

4. CIRCUIT DESCRIPTION

Refer to *Figure 4* for the following discussion. IC5-A is used as a non-inverting unity gain follower. Its output feeds to the phase shifter IC5-B. The trimpot P3 controls the phase angle shifter but maintains the amplitude between the output and input waveforms. IC5-D is a zero crossing detector and inverter to control the solid-state switch IC4-A. Resistors R51 and R47 are for the undervoltage cutoff which is set at approx. 30% of the rated Vac.

IC5-C is used for ac level detector whose bias voltage at pin 5 is either +2V or -2V depending on the previous state of the input on pin 6. If the peak voltage on pin 6 exceeds +2V, the voltage on pin 7 will drop from +15V to -15V and cause the bias voltage at pin 5 to change from +2V to -2V. Conversely, if the voltage at pin 6 drops below -2V, the voltage on pin 7 will jump from -15V to +15V and change the bias voltage at pin 5 from -2V to +2V. For $|V_p| < 2V$, a constant voltage will be at pin 7, either +15V or -15V. IC2-A is a retriggerable one-shot with a dropout time of 22 ms. As soon as the input voltage exceeds the undervoltage setting, (30%), the one-shot IC2-A picks up and enables the trip NAND gate IC1-B. IC4-B and R44 are used to control the hysteresis of IC5-C. By increasing the value of R44, the dropout ratio can be increased.

The current transformer is made of Himu laminations and its turn ratio is 20 to 400. For an input of 1ma (rms) the voltage drop on R106 (20 ohms) will be 1 mV (rms).

For input I_a above 5 amperes (rms), Z103 will start to conduct current and turn on the darlington transistor Q102. Once Q102 turns on, R20 will be parallel with R106 and limit the peak-to-peak voltage across the secondary winding of T2 to avoid ct saturation. IC6 is connected as a differential amplifier whose output voltage is proportional to the input current I_a from 1 mA to 5 amps. The phase angle relationship remains constant between 1 mA and 50 amperes.

The multiplier circuit contains IC7, IC4-A, R61, R62,

R63 and R64. The gain of IC7 is +1 or -1 for the open or closed contact in switch IC4-A respectively. The output waveforms of the multiplier are shown in *Figure 10* for different phase angles between the input waveforms. A low-pass filter consisting of IC3-A, IC3-C and IC3-D with a gain of 10, blocks all ac components from the multiplier's output. The polarity of the dc voltage is determined by the phase angle ϕ. It is designed for the maximum sensitivity angle at I_a leading Vac by +30˚. A level detector IC3-B can be set to detect the magnitude of input current I_a from 1 mA to 40 mA. If a dc signal at pin 13 of IC3-B is higher than the bias voltage at pin 12, a low voltage at pin 14 will turn on the pickup LED and start the timer of IC2-B.

IC2-B is a retriggerable flip-flop and its delay time is determined by the selection of an RC time constant, where R is the total selected resistors from R1 to R6 and C is the sum of C1, C2 and C4. The NAND gate IC1-B controls the trip signal. For a normal input voltage and reverse power condition, pins 1 and 2 of IC1-B are high. After the timer IC2-B times out, pin 9 will change from 0 to 1, generate a trip signal to turn on the transistor Q101 and pick up two telephone relays SRW-1 and SRW-2. If a trip current is detected by the SRW-1 contact and reed relay RR, the RR contact seals in the trip relays and flips the magnetic indicator to the orange colored side. The indicator can be reset by push-button switch S101 only if the RR contact is open and the relay is energized by a dc supply.

5. CHARACTERISTICS

Temperature Range: -20˚ to +55˚c

Frequency: 50 Hz or 60 Hz (separate styles)

Pickup current Sensitivity: 1, 2.5, 5.0, 10, 30, 40 mA

AC Operating Voltage: 30% to 110% of the normal rating (120 or 240V)

Maximum Sensitivity Angle: Current leading voltage by + 30˚

Accuracy: ± 5% from 1 mA to 50A

AC Cutoff Voltage: 30% (approx)

Continuous ac Voltage Rating: 150%

Continuous ac Current Rating: 10 Amperes

Timer: Adjustable ranges from 2 to 21.5 seconds, 2 to 63 seconds or 0.2 to 2 seconds, with an accuracy of .± 5%.

DC Power Supply: 48/125/250 Vdc

Output Contacts: Two NO contacts

Contact Rating: Making   30A at 250 Vdc for 1 sec
                Breaking 0.25A at 250 Vdc

DC Drain: 4 Watts at 125V
             2 Watts at 48V
             7.5 Watts at 250V

AC Voltage Burden: 0.1 Watts at 120 Vac

AC Current Burden: 3VA at 5A

Indicators: Two LEDs for dc power-on and pickup
               One magnetic flip-flop for tripping

6.   SETTINGS

Three settings are required in the SRW relay, dc voltage, current level and trip time.

DC Voltage — Choose a jumper position on the left-hand-side of the printed circuit board to correspond to the available dc supply voltage, 48, 125, or 250 volts. This is required on the interface and inrush modules.

Current Level — Determine the value of reverse watts at which tripping is desired. Calculate the primary current I_P corresponding to this:

$$I_P = \frac{watts}{\sqrt{3}\ V}$$

where V is line-to-line voltage at which the reserve watts are specified

Determine the secondary current, I:

$$I = \frac{I_P}{R_C}$$

where R_C is the ct ratio:

A setting should be chosen at a level of approximately one-half this value. Set the 10-position thumbwheel switch to provide the next lowest available pickup value.

Time — Set the six position DIP switch to provide a sum equivalent to the desired time delay. All switches up (21.5 seconds, 2 sec. or 63 sec.) will

generally be adequate, but shorter times may be dictated by the application.

7.   INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration, corrosive fumes and heat. The maximum temperature outside the relay case should not exceed +55°C for normal operation (see CHARACTERISTICS for temperature range specification).

Mount the relay vertically by means of the four mounting holes on the flanges for semi-flush mounting. (For projection mounting install the special projections mounting hardware provided in mounting material kits when required.) Either the installed projection mounting stud or the mounting screws may be used for grounding the relay.

External tooth washers are provided for use in the locations shown on the outline and drilling plan to facilitate making a good electrical connection between the relay case, its mounting screws or studs, and the relay panel. Ground wires are affixed to the mounting screws or studs as required for poorly grounded or insulating panels. Other electrical connections may be made directly to the terminals by means of screws for steel panel mounting or the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench. See *Figure 12* for Outline and Drilling Plan. For detailed FT case information refer to I.L. 41-076.

7.1.   Adjustments

The proper adjustments to insure correct operation of this relay have been made at the factory. Upon receipt of the relay, no customer adjustments other than those covered under "SETTINGS" should be required.

7.2.   Acceptance Check

It is recommended that a performance check be applied to the SRW relay to verify that the circuits are functioning properly. The SRW test diagram shown in *Figure 11* aids in test of the relay. Proper energization of the relay is also shown in this figure.

Before energizing the relay, check the jumper posi-

tion on the bottom module for the rated dc power supply, and on the In-rush module on top of the relay.

A. Voltage Circuit

1. Connect the test circuit as shown in *Figure 11 (a)*.

2. Short circuit the current input terminals 8 and 9. Apply a rated dc voltage to terminals 3 (+), and 2 (com). The yellow LED (PWR) should be on.

3. Adjust the variac voltage to obtain 120 Vac to terminals 6 and 7.

4. With the connection of V (sig.) at TP2, the phase angle meter's reading should be between -145 deg. and -155 deg. Connecting V (sig.) of the phase angle meter to TP3, the reading should be between +25 deg. and +35 deg.

5. Connect a scope to pin 7 of IC5 on the SRW module. A square wave should be seen. Reduce the input ac voltage to 36 ±4 Vac. The square wave should disappear.

6. With a square wave at pin 7 of IC5, a high (+15V) should be at pin 6 of IC2 located on the SRW module. With a dc voltage at pin 7 of IC5, a low (0V) should be at pin 6 of IC2.

7. Use a dual trace storage scope to measure the dropout time delay. Connect CH-1 to pin 7 of IC5, CH-2 to pin 6 of IC2 and common to TP5. Push the single sweep button on the scope and turn off the ac voltage simultaneously. The time between two traces from high to low should be 22 ±1 ms.

B. Current Circuit

1. Disconnect the jumper between terminals 8 and 9 and connect the test circuit as shown in *Figure 11 (b)*.

2. Apply 1 ampere to terminals 9 and 8 and 120 Vac (or 70 Vac) to term. 6 & 7. Adjust the phase shifter to read I leading V by +30 deg. on the phase angle meter.

3. Connect CH-1 of the dual trace scope to TP3 and CH-2 to TP4. Two waveforms should be

in phase.

4. Connect a digital voltmeter to TP1 and its common to TP5. The reading should be higher than +13 volts.

5. Adjust the phase shifter until the meter reads zero volts at TP1. the phase angle meter should be +300 deg. or +120 deg. With a tolerance of ±2.0 deg.

6. Vary the input current between 50 mA and 10 amps. Adjust the phase shifter to obtain zero volt at TP1. The phase angle meter should be +300 deg. or +120 deg. with a tolerance of ±5 deg.

7. Repeat step #6 except vary the input voltage between 40 and 132 volts and maintain the input current at 1 ampere.

8. Connect the test circuit as shown in *Figure 11 (c)*. Repeat step #6 but for the current between 1 and 40 mA.

C. Pickup Setting

1. Set the p/u thumbwheel switch on position #7.

2. Use the test circuit of *Figure 11 (c)*. Adjust the phase shifter to read I leading V by 30 deg. and increase the input current slowly. The p/u LED should be turned on when the current is between 38 and 42 mA.

3. Repeat step #2 for the p/u positions #6, 5, 4, 3, 2 and 1. The p/u values should be 30, 20, 10, 5, 2.5 and 1.0 mA with a tolerance of ±5%, respectively.

D. Timer for 0.2 to 2 second range

1. Connect the test circuit as shown in *Figure 11(b)*.

2. Set the input voltage at 120 Vac and current at 1 amp.

3. Set the p/u thumbwheel switch on position 4 (for 10 mA).

4. Set the timer switches at .2 seconds.

5. Turn on SW-1 suddenly. The digital timer should read between 205 msec and 240 msec.

6. Set the timer switches at 1 sec.

7. Turn on SW-1 suddenly. The digital timer should read between 0.96 and 1.080 seconds.

Tripping time = (timer switch setting "5%) + curve value

Example using acceptance check values.

Set the timer switches to a value between 0.2 and 2 sec.

For timer switch setting = 1 sec. and multiple of pick-up value = 100

If input current to the relay is 1 amp and pick-up setting is at 10 mA then the "Multiple of pick-up value" is 100 (1 amp/10mA). Then from the curve (for timer switch setting of zero), the time will be between 19 msec and 29 msec for the "Multiple of pick-up value" of 100.

Tripping time = (1 sec. "5%) + (19 msec. to 29 msec.)

E. Timer

1. Connect the test circuit as shown in Figure 11 (b).

2. Set input voltage in 120 Vac and current at 1 amp.

3. Set the timer switches at 10 seconds.

4. Turn on SW-1 suddenly. The digital timer should read between 9.5 and 10.5 seconds.

5. Repeat step #4 for 2 and 20 second settings. The accuracy should be within 5%.

F. Trip Indicator

1. Short terminals 10 and 1 and adjust R to obtain 0.5 amps (dc).

2. Remove the jumper between 10 and 1. Close SW-2 and then close SW-1. The magnetic disc indicator should flip and show the orange color.

3. Turn off SW-1 and SW-2. Push the reset switch. The indicator should flip back and show the black color.

8. ROUTINE MAINTENANCE

All relays should be inspected periodically and all settings and times of operation should be checked at least once every year or at such other intervals as may be indicated by experience to be suitable to the particular application.

8.1. Calibration

The proper adjustments of the trimpots P1, P2, P3 and P4 have been calibrated by the factory and should not be disturbed by the customer unless the relay is out of calibration shown in the Acceptance Test.

Before relay calibration, check the power supply jumper's position on the bottom module for correct rated dc voltage, as well as on the In-rush filter module at the top of the relay.

1. Trimpot P4

   (a) Connect the test circuit as shown in Figure 11 (a) and connect a dc digital voltmeter across TP4 (+) and TP5 (com).

   (b) With Terminals 8 & 9 shorted and the rated ac and dc voltages applied, adjust P4 until the reading is close to 0.0 mV.

2. Trimpot P2

   Repeat steps #1(a) and #1(b) except remove the dc voltmeter from TP4 to TP1. Adjust P2 until the reading is close to 0.0 mV.

3. Trimpot P3

   (a) With the connection of V (sig.) of the phase angle meter at TP2 and the rated ac and dc voltage applied. Adjust P2 for a reading of -150 deg. (or +30 deg. at TP3).

   (b) Change the test circuit connection from Figure 11(a) to Figure 11(b).

   (c) Apply ac, dc voltages and ac current of 1 ampere. Adjust the phase shifter for current leading voltage by +120 deg.

   (d) Connect a dc digital voltmeter across TP1 (+) and TP5 (com). Adjust P3 to obtain a reading of 0.0 ±0.5 mV.

   (e) Adjust the phase shifter until the voltmeter reads zero volts again. The phase angle reading should be 300 ±2 deg.

4. Trimpot P1

(a) Connect the test circuit as shown in *Figure 11(c).*

(b) Set the p/u thumbwheel switch to #7 and apply ac, dc voltages and ac current of 40 mA.

(c) Adjust the phase shifter for current leading voltage by +30 deg.

(d) Adjust P1 until the p/u LED turns on.

(e) Check the pickup settings of 30, 20, 10, 5, 2.5 and 1.0 mA for dial numbers 6, 5, 4, 3, 2 and 1 respectively. The pickup values should be taken with the condition of current leading voltage by +30 deg. and its error should be within ±5% of settings. Resistor R17 may be removed from the PC board in order to obtain the pickup accuracy at1 mA.

5. Timer

(a) Connect the test circuit as shown in *Figure 11(b).*

(b) Set time delay for 10 seconds by either opening DIP switch #1 (10 sec.) or opening switches #2 (5 sec.), #3 (3 sec.) and #4

(2 sec.).

(c) Turn on ac and dc voltages. Set the input current at 1 ampere and adjust the phase shifter for current leading voltage by +30 deg.

(d) Turn on SW-1 suddenly. The digital timer should give a reading of 10 seconds (±5%). If the reading is too high, remove capacitor C2 and/or C4 from the PC board.

(e) Check the time delay between 2 and 21.5 seconds by turning on SW-1 suddenly. They should be within 5% of settings.

After completion of the relay's calibration, check the relay performance as shown in the section of Acceptance Check.

9.   RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts always give the complete nameplate data.

Reference Drawings

Photo

Figure 1: SRW Relay

Figure 2: Simplified Terminal Connection Drawing

* Sub 3
9645A75
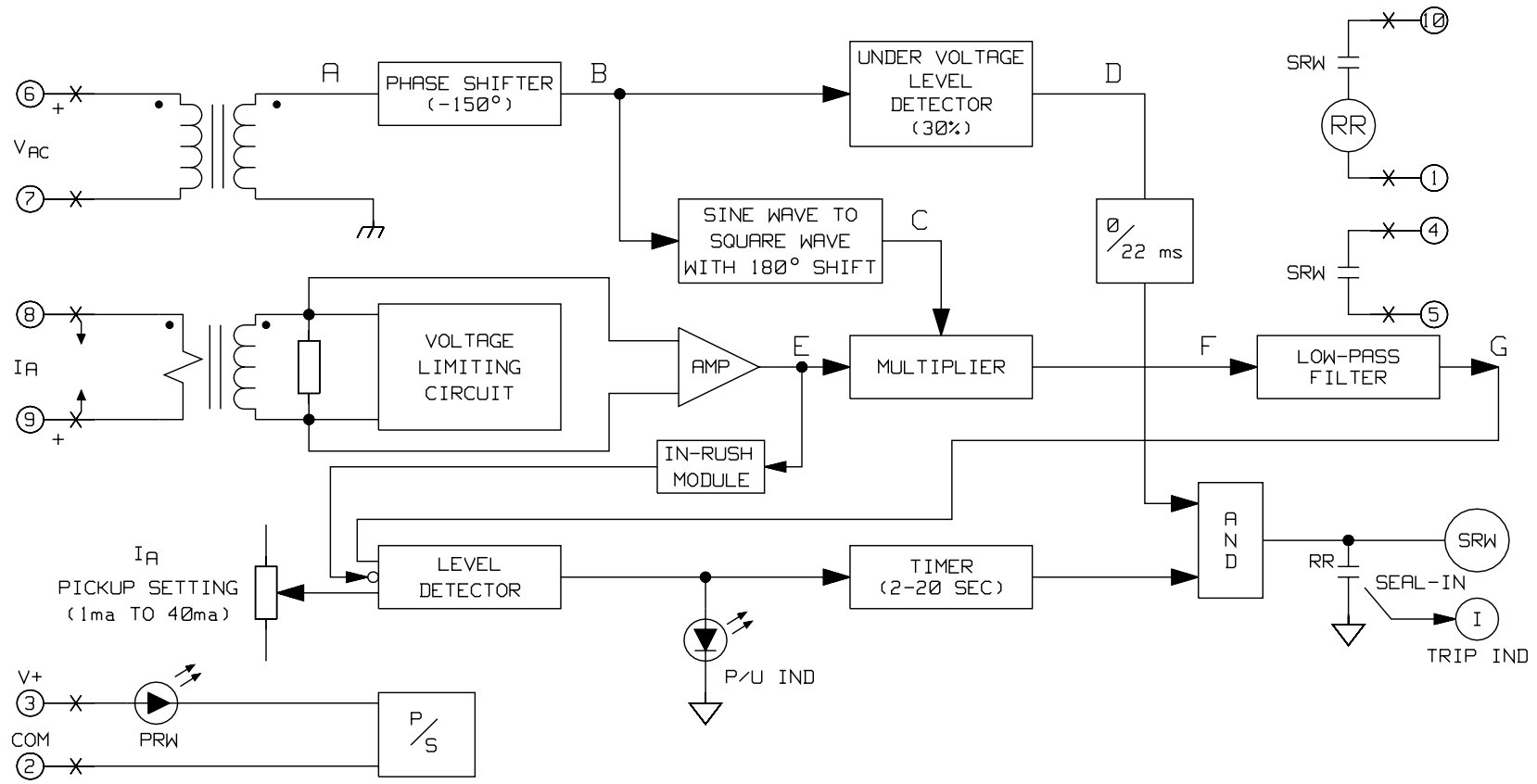
* Denotes Change
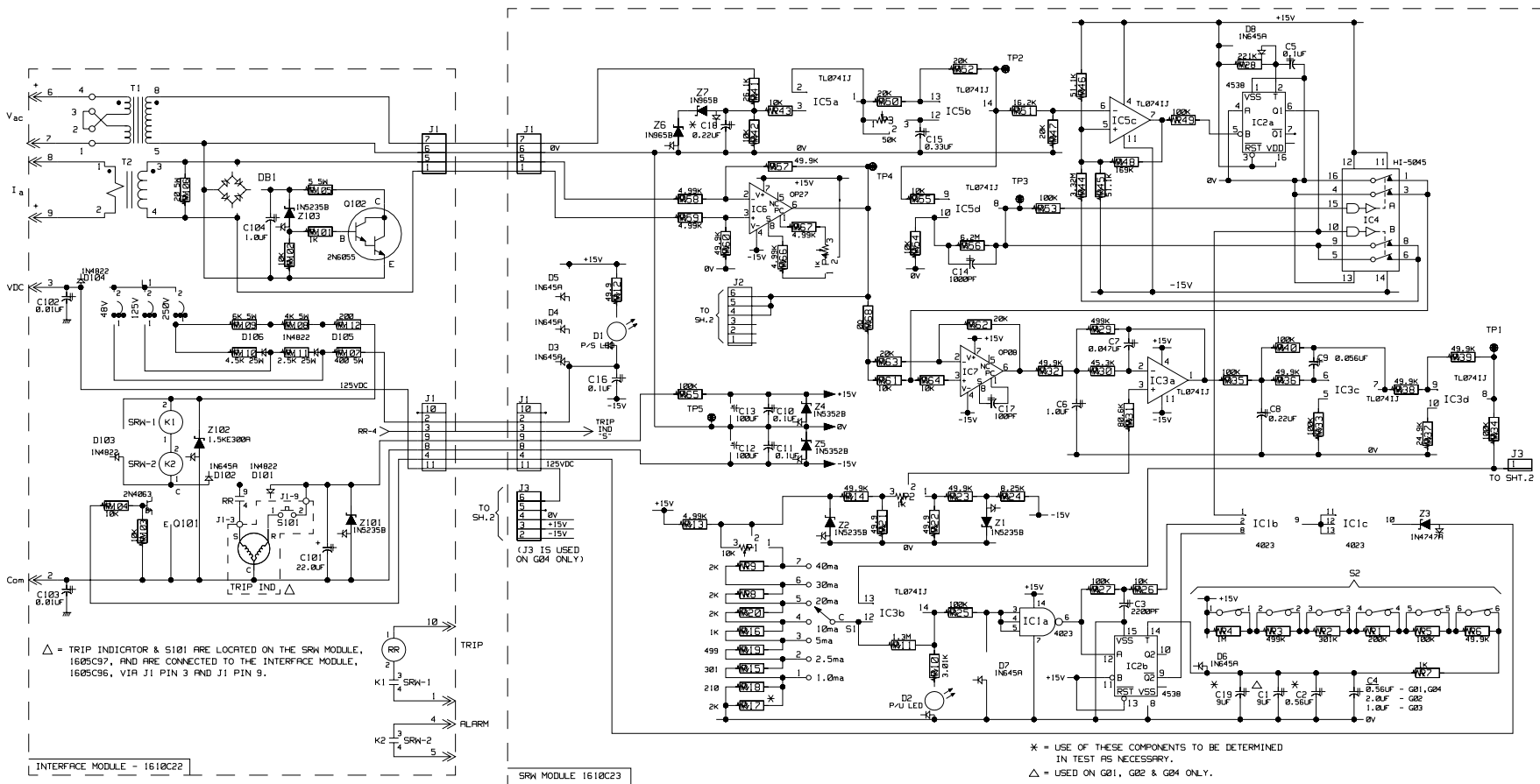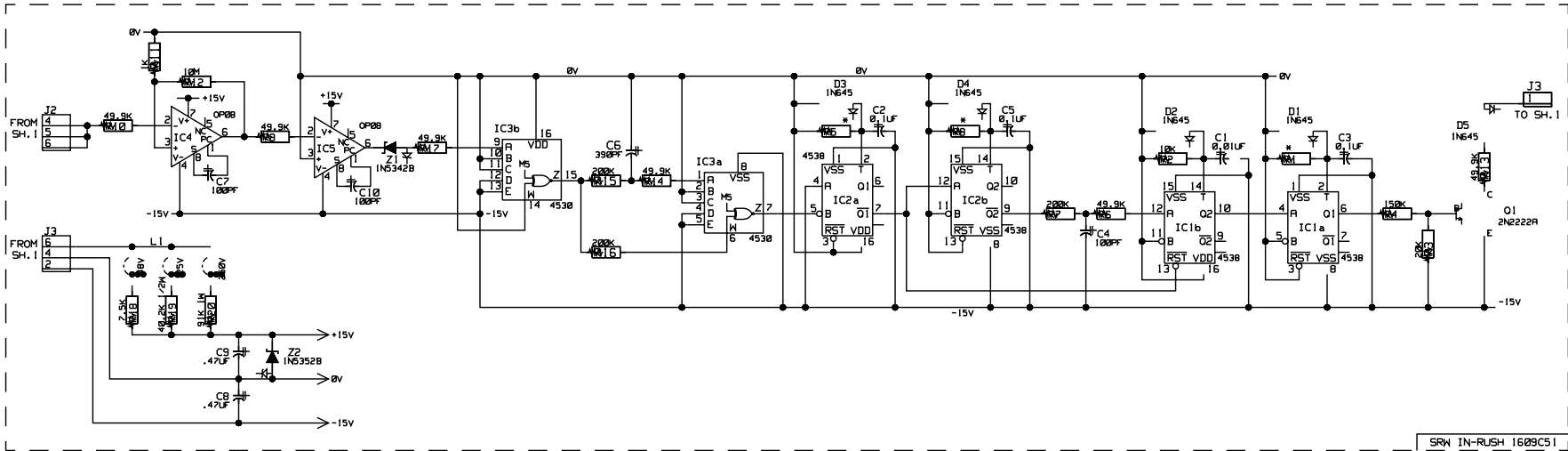
Figure 3: SRW Block Diagram

* Denotes Change

Figure 4. Internal Schematic – SRW Relay (Sheet 1 of 2)

* Sub 4
1355D79

* Denotes Change

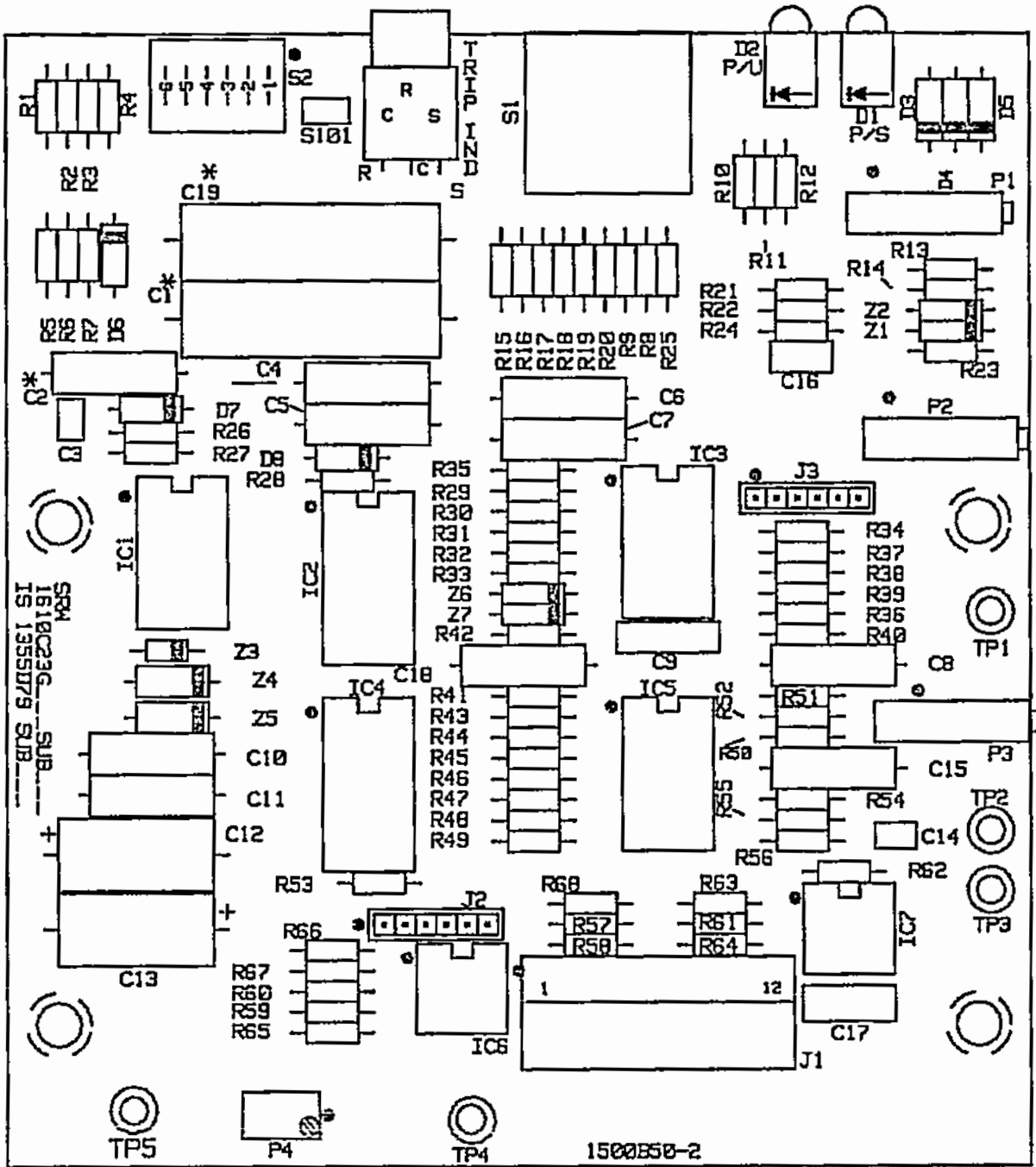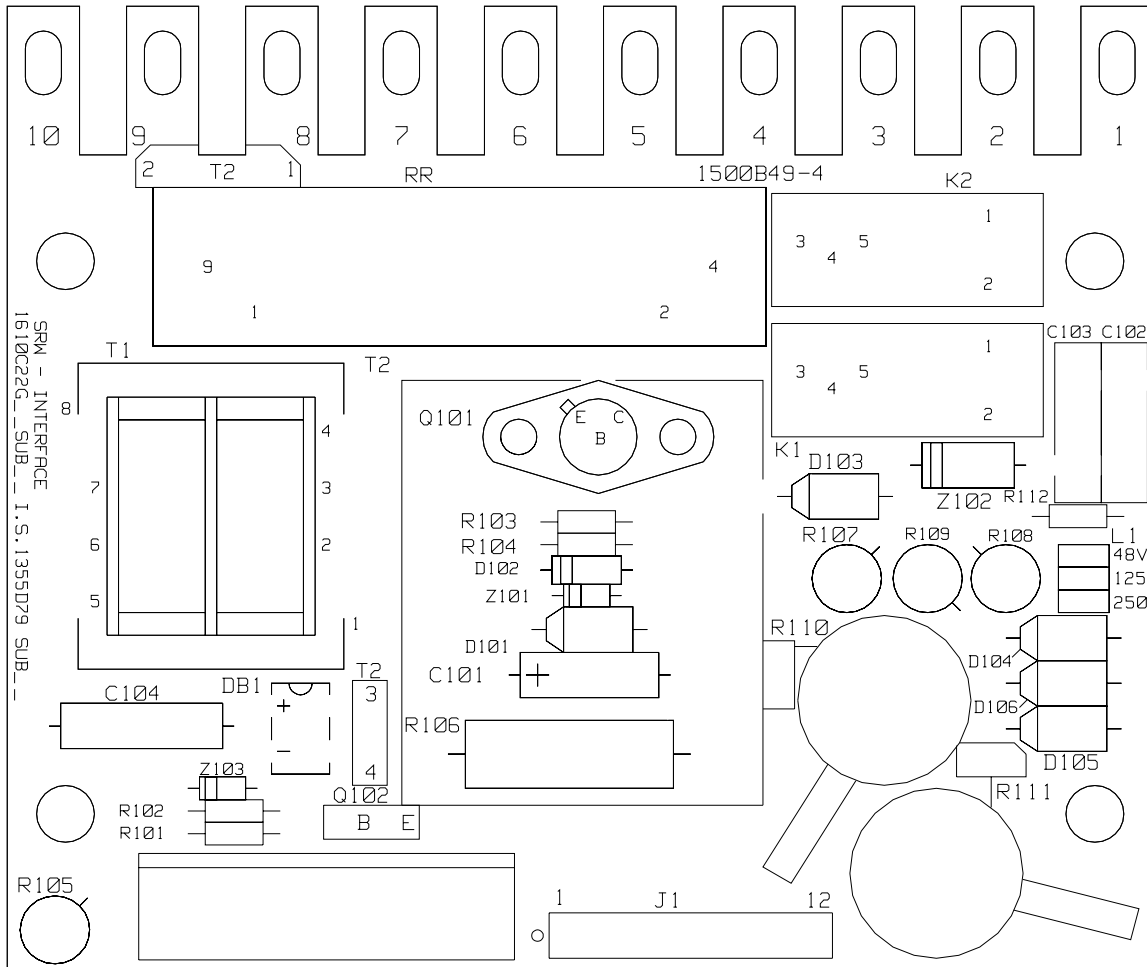Figure 4a. Internal Schematic – SRW Relay (Sheet 2 of 2)

* Sub 4
1355D79

* Denotes Change

* Sub 2
1500B50

Figure 5: Component Location - SRW Module

* Denotes Change

Figure 6: Component Location – Interface Module

* Denotes Change
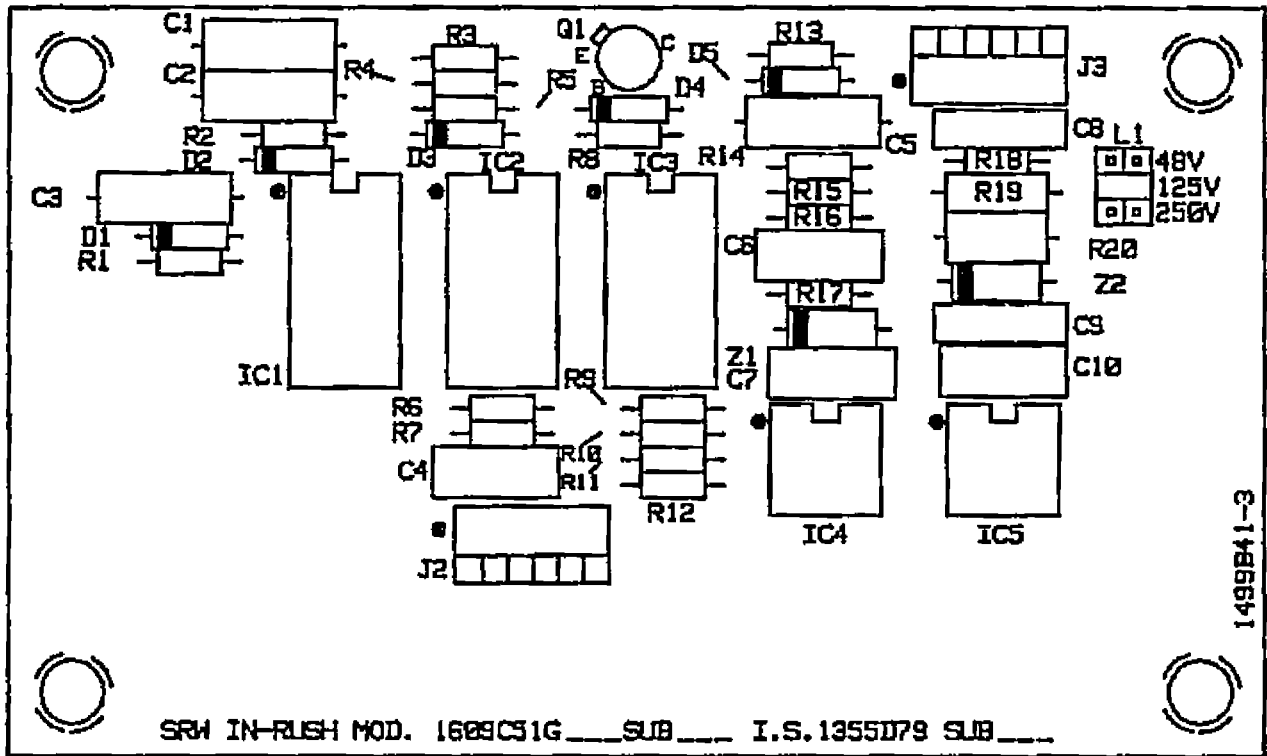
* Sub 3
1499B41

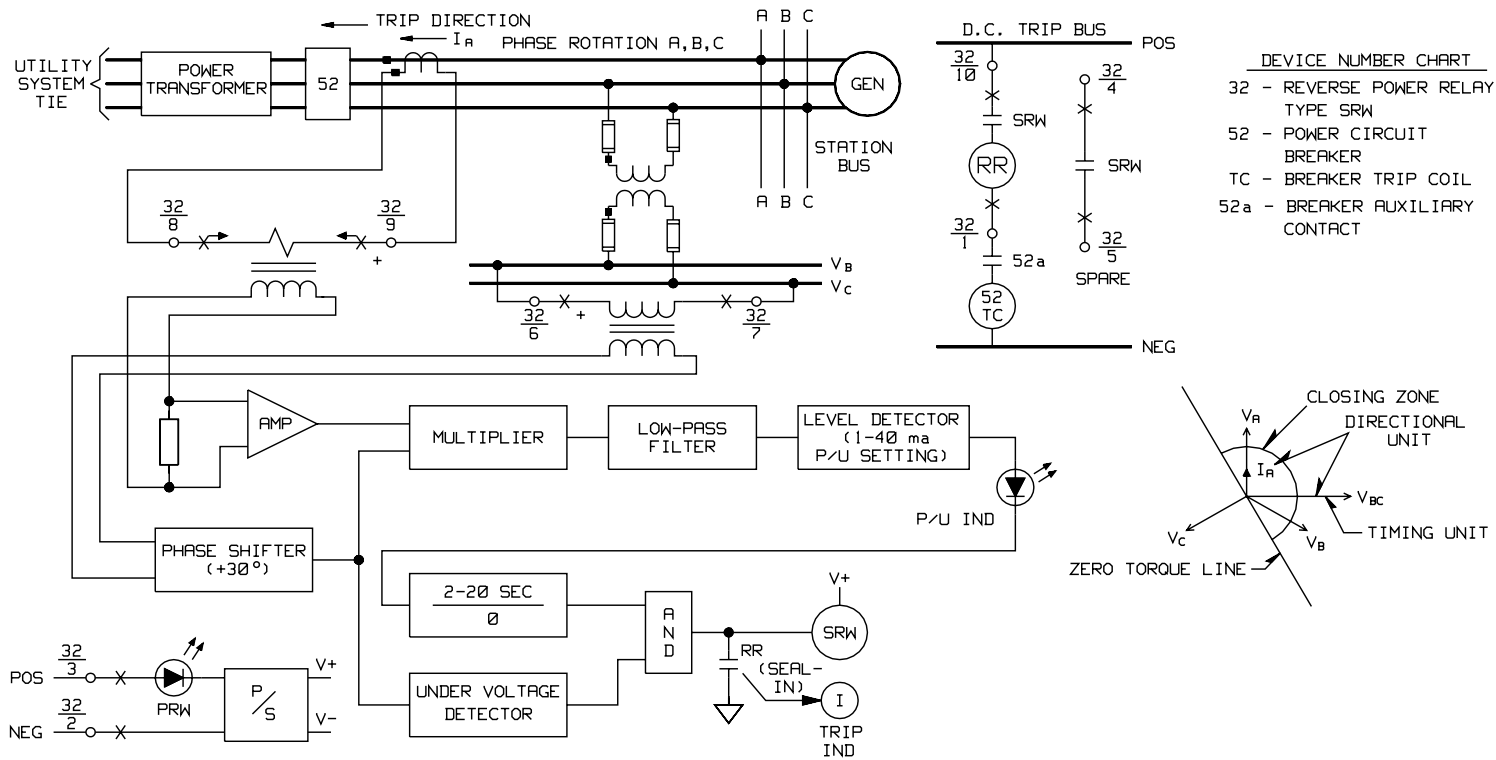*Figure 7: Component Location – In-Rush Module*

* Denotes Change
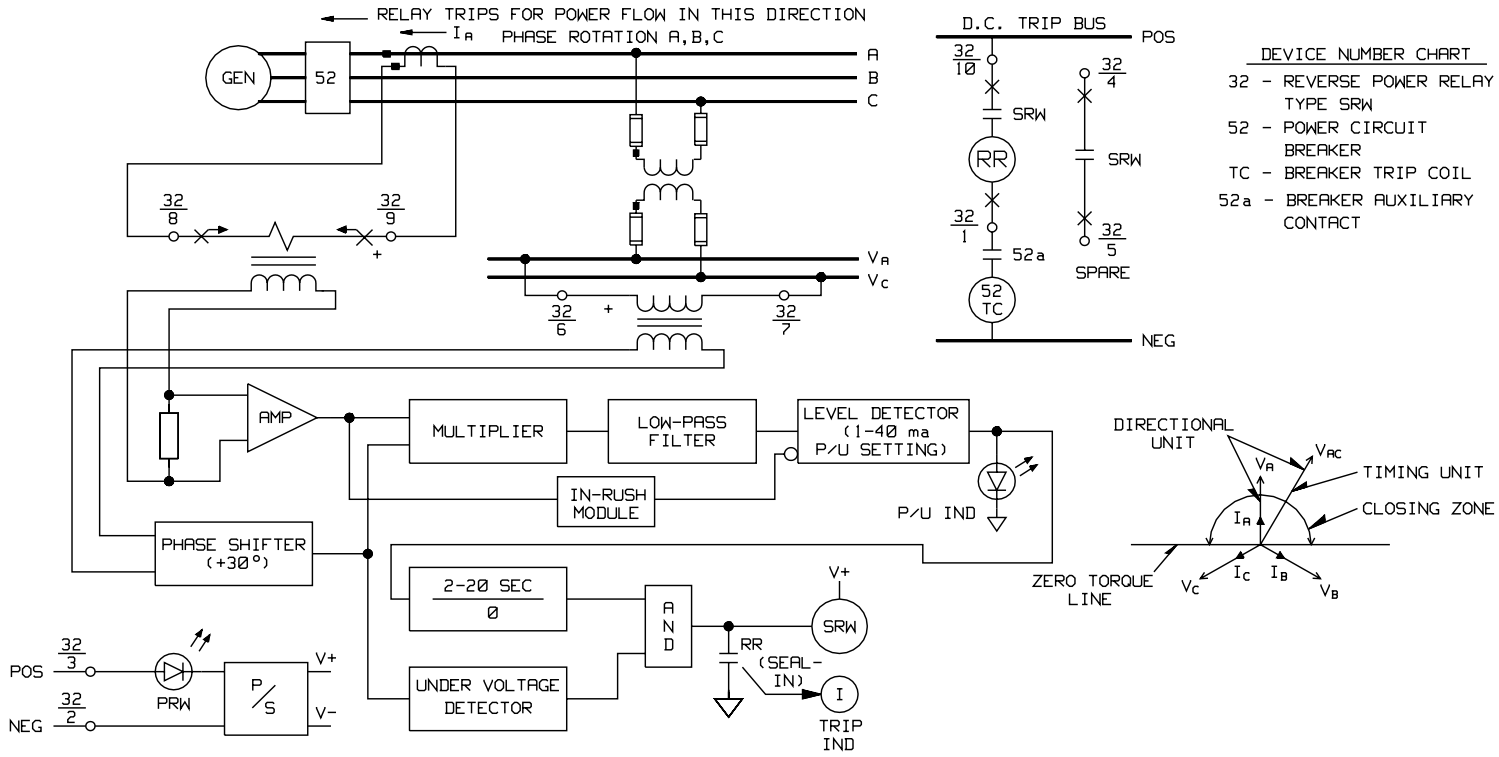
Figure 8: External Schematic of the Type SRW Relay for Reverse Power Protection

RELAY TRIPS FOR POWER FLOW IN THIS DIRECTION

I_A PHASE ROTATION A,B,C

GEN

52

A
B
C

$\dfrac{32}{8}$ $\dfrac{32}{9}$

$\dfrac{32}{6}$ + $\dfrac{32}{7}$

V_A
V_C

AMP

MULTIPLIER

LOW-PASS FILTER

LEVEL DETECTOR (1-40 ma P/U SETTING)

IN-RUSH MODULE

P/U IND

PHASE SHIFTER (+30°)

2-20 SEC 0

UNDER VOLTAGE DETECTOR

AND

RR (SEAL-IN)

SRW

I

TRIP IND

V+

POS $\dfrac{32}{3}$

NEG $\dfrac{32}{2}$

PRW

P/S

V+
V-

D.C. TRIP BUS   POS

$\dfrac{32}{10}$ SRW

RR

$\dfrac{32}{1}$ 52a

52 TC

$\dfrac{32}{4}$

SRW

$\dfrac{32}{5}$ SPARE

NEG

DEVICE NUMBER CHART

32 - REVERSE POWER RELAY TYPE SRW
52 - POWER CIRCUIT BREAKER
TC - BREAKER TRIP COIL
52a - BREAKER AUXILIARY CONTACT

DIRECTIONAL UNIT

V_A V_{AC}

TIMING UNIT

CLOSING ZONE

I_A

ZERO TORQUE LINE

V_C I_C I_B V_B

DEVICE NUMBER CHART

32 – REVERSE POWER RELAY
     TYPE SRW
52 – POWER CIRCUIT
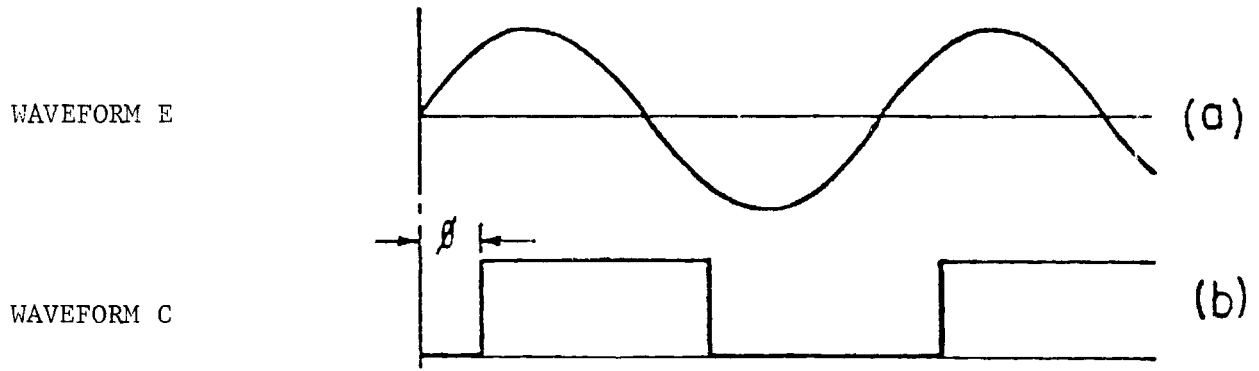   BREAKER
TC – BREAKER TRIP COIL
52a – BREAKER AUXILIARY
     CONTACT

* Sub 3
1495B46

Figure 9: *External Schematic of the SRW Relay to Prevent Reverse Magnetization When Utility Tie is Removed from the Local System.*
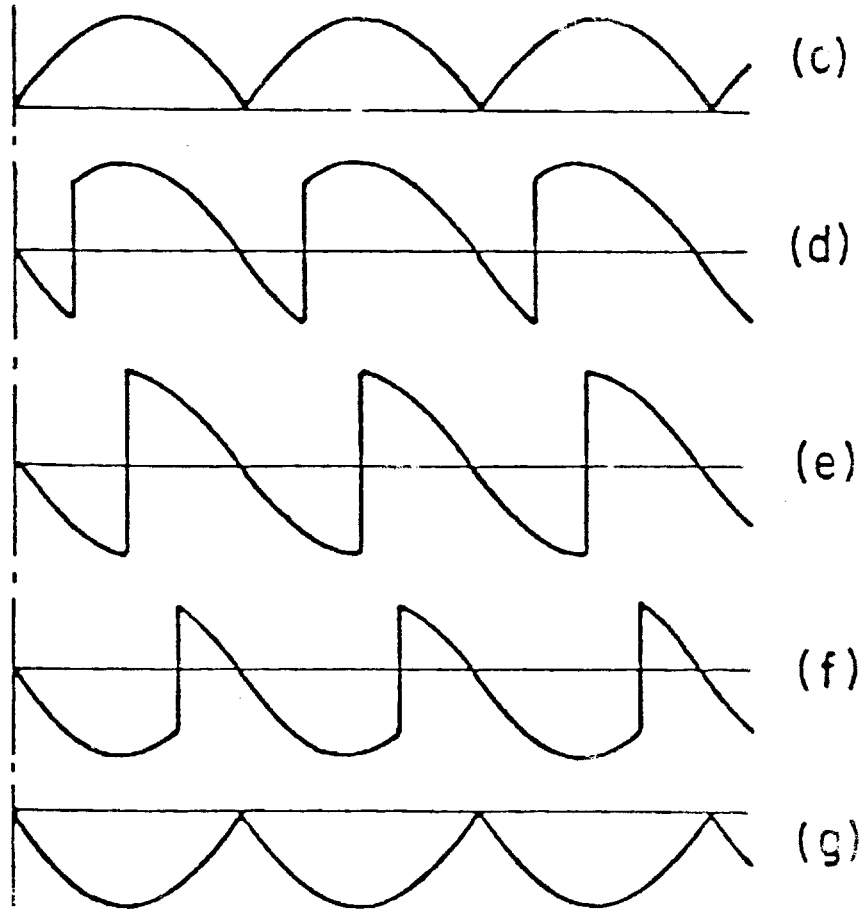
* Denotes Change

WAVEFORM E

(a)

WAVEFORM C

(b)

MULTIPLIER OUTPUT:

β = 0 DEG.

(c)

β = 45 DEG.

(d)

β = 90 DEG.

(e)

β = 135 DEG.

(f)

β = 180 DEG.

(g)

Sub 1
9645A93

Figure 10: Multiplier Waveforms
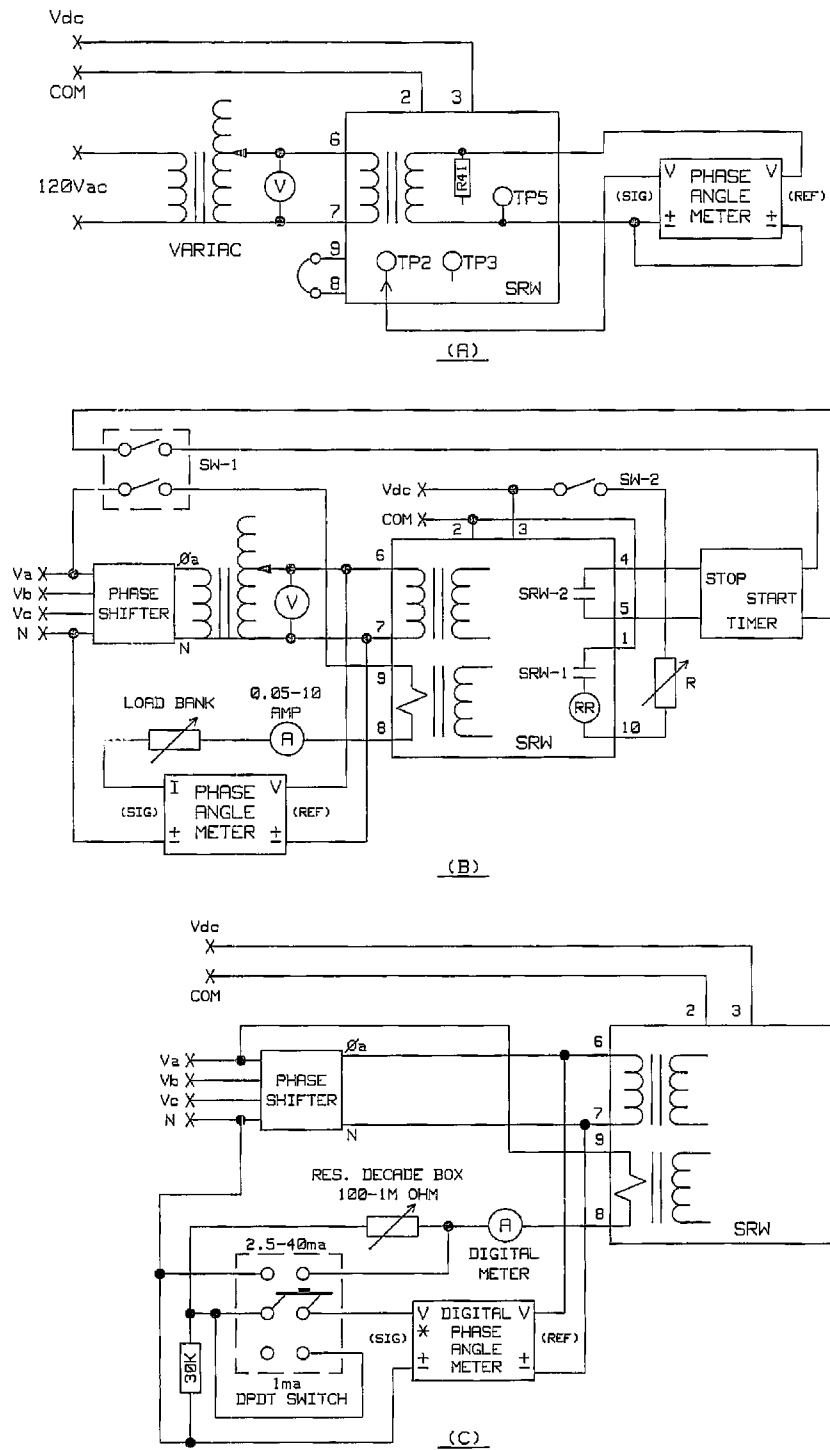
Sub 2
1495B54

Figure 11: Test Connection for the SRW Relay

CASE OUTLINE

PANEL DRILLING AND CUTOUT
FOR SEMI-FLUSH MTG.
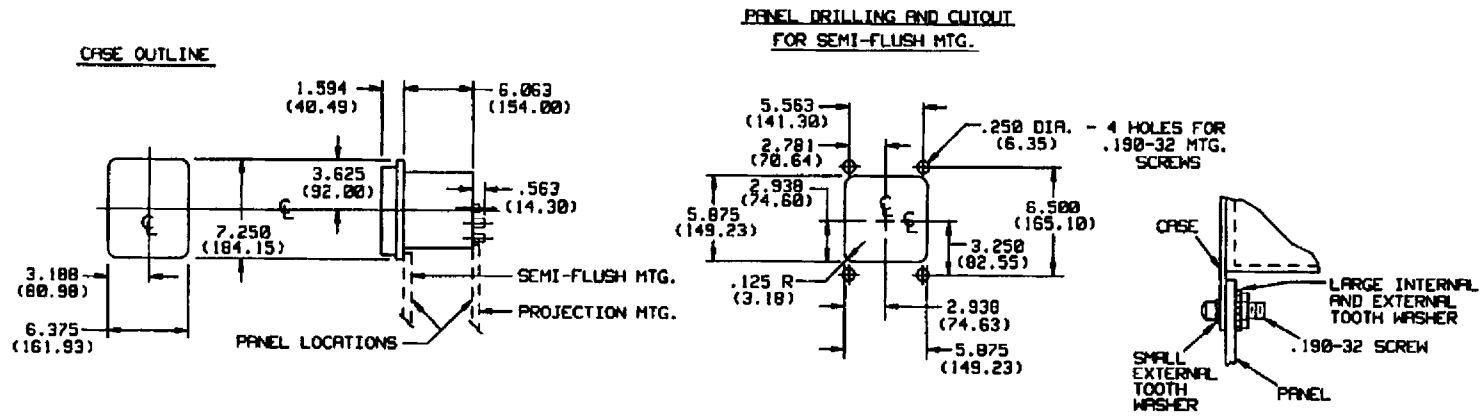
PANEL DRILLING OR CUTOUT FOR
PROJECTION MTG. (FRONT VIEW)
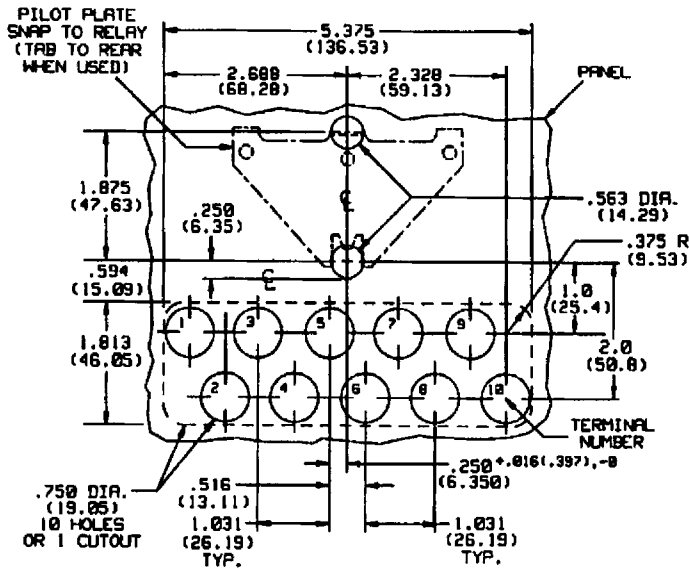
TERMINAL AND MTG. DETAILS
FOR PROJECTION MTG.

NOTE
PROJECTION HARDWARE
MUST BE ORDERED
SEPARATELY.
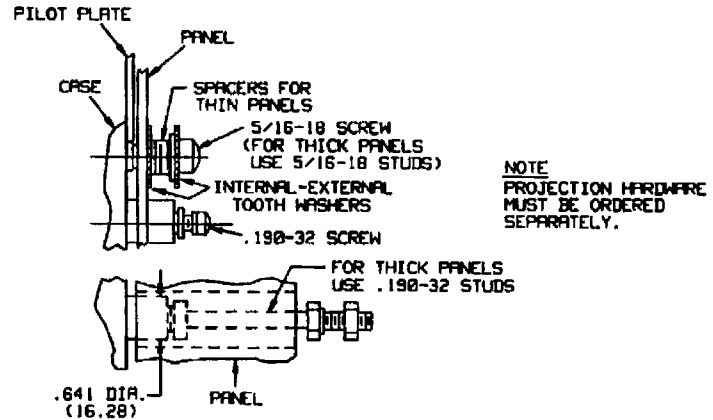
*Sub 19
57D7900

Figure 12: Outline and Drilling Plan for the SRW Relay in the FT 11 Case