ABB

Effective: November 2002
Supersedes I.L. 41-579.1N, Dated September 1980

Type TD-5 Time Delay Relay

(|) Denotes Change Since Previous Issue

CAUTION

Before putting relays into service, remove all blocking inserted for the purpose of securing the parts during shipment. Make sure that all moving parts operate freely. Inspect the contacts to see that they are clean and can close properly. Close the red handle switch last when placing the relay in service. Open the red handle first when removing relay from service.

CONTENTS

This instruction leaflet applies to TD-5 Time Delay Relays which can be described as follows:

Design 1

TD-5 Time Delay Relays with Standard Style Number
Ex: 293B301A10

Design 2

TD-5 Time Delay Relays with Smart Style Numbers
Ex: TD5T1V1ANN

1.0 APPLICATION

The type TD-5 relay is used in timing applications where accuracy, repeatability and fast reset are required. Its principal use is in time delayed distance relaying and in breaker failure timing applications.

TD-5 is a dc relay capable of direct application to station batteries. It covers 0.05 to 30 seconds in 4 different ranges. For dual independent timing refer to the TD-52 relay, I.L. 41-579.3.

2.0 CONSTRUCTION AND OPERATION

The type TD-5 relay consits of a reference voltage circuit, a rheostat (T) and scale plate, a voltage biasing potentiometer or adjustable resistor (P), a printed circuit board containing static timing components; an output relay (TR), and an indicating contactor switch (ICS). An auxiliary relay (TX) is supplied on some TD-5 relays to override bounce of the initiating contact.

TR and TX can be either telephone type relays (Design 1) or printed circuit mount miniature power relays (Design 2).

2.1 REFERENCE VOLTAGE CIRCUITS

The reference voltage circuit provides a fixed supply voltage to the R-C time delay circuit and protects the static components from high voltages. It consists of a silicon power regulator and a series resistor.

The silicon power regulator (Z or Z1) is a 10 watt Zener diode mounted on an aluminum heat sink. The series resistor (RS) is a 3-1/2 inch 40 W resistor which is tapped for 24/32 VDC and 48/125 VDC relays, and fixed for 250 VDC relays.

DESIGN 1

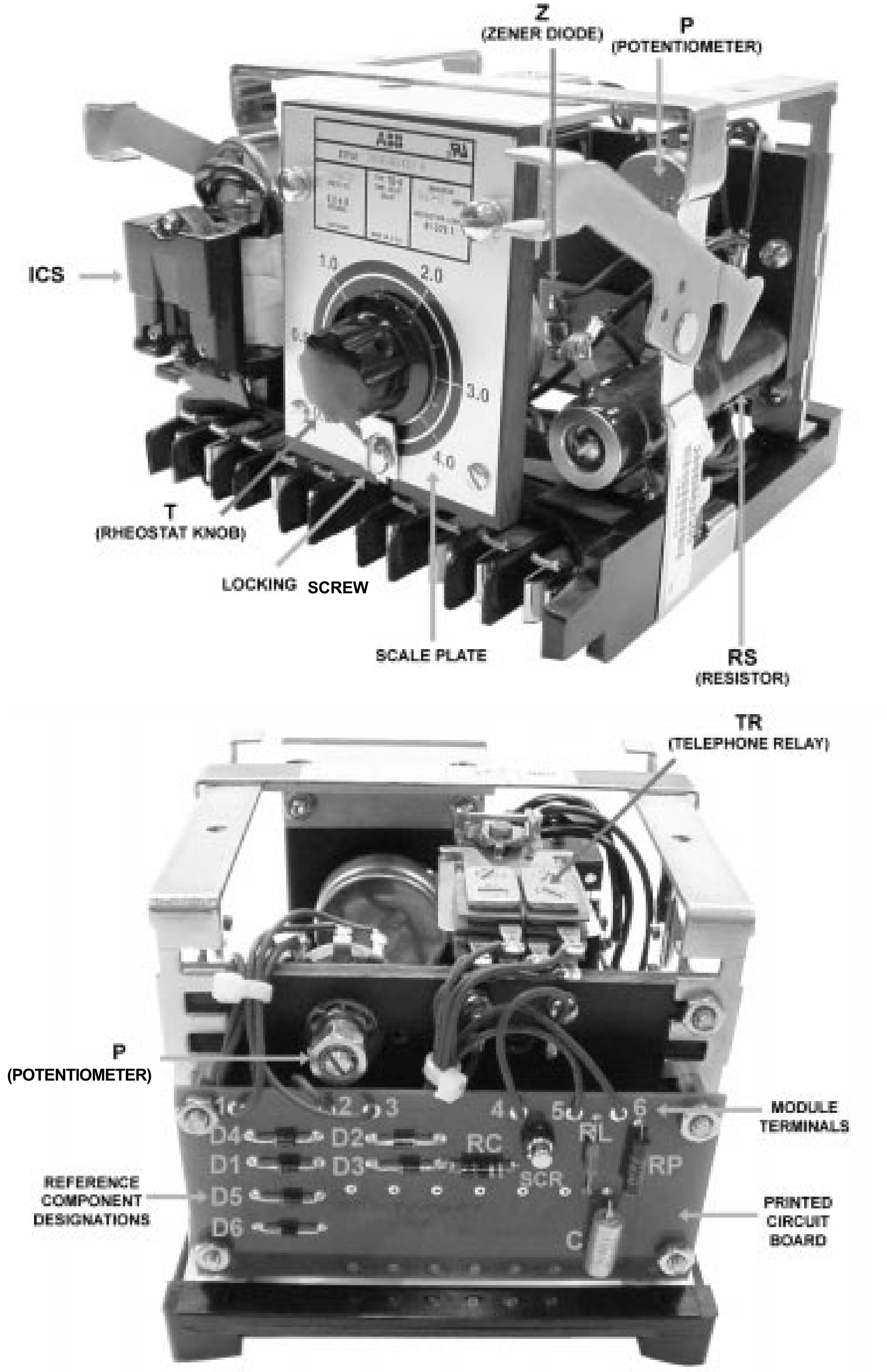


Figure 1. Design 1 TD-5 Relay Front and Rear Views, Out of Case

DESIGN 1 - TABLE OF REPLACEABLE PARTS

COMPONENT DESIGNATION	TIME DELAY (SECONDS)	VOLTAGE RATING (VOLTS DC)	PARTNAME	DESCRIPTION	STYLE NUMBER
		48/125 & 24/32	CAPACITOR	22UF 35V 10% TANTALUM	184A661H16
C	ALL	250	CAPACITOR	22UF 50V 10% TANTALUM	184A661H17
D1-D6	ALL	ALL	DIODE	1N5398	188A342H24
		48/125 & 24/32	RECTIFIER	2N885 SILICON CONTROL RECTIFIER	185A517H02
SCR	ALL	250	RECTIFIER	2N886 SILICON CONTROL RECTIFIER	185A517H03
	ALL	48/125	RESISTOR	250 OHM 4W 10%	185A067H05
	ALL	250	RESISTOR	1300 OHM 4W 10%	185A067H06
P	ALL	24/32	RESISTOR	60 OHM 4W 10%	185A067H04
		48/125	RESISTOR	270 OHM 1/2W 5%	184A763H13
		250	RESISTOR	1200 OHM 1/2W 5%	184A763H29
RC	ALL	24/32	RESISTOR	56 OHM 1/2W 5%	184A290H19
		48/125 & 24/32	RESISTOR	511 OHM 1/2W 1%	849A819H20
	0.05-1 & 0.05-0.4	250	RESISTOR	1K OHM 3W 5%	184A636H08
	0.2-4	ALL	RESISTOR	4.75K OHM 1/2W 1%	848A820H14
RL	1.5-30	ALL	RESISTOR	5.6K OHM 1/2W 1%	862A376H73
	0.05-1 & 0.05-0.4	ALL	RESISTOR	62K OHM 1/2W 1%	184A764H70
RP	1.5-30 & 0.2-4	ALL	RESISTOR	267K OHM 1/2W 1%	184A764H85
	ALL	48/125	RESISTOR	550 OHM 40W 5% (95 OHM TAP)	187A321H01
	ALL	250	RESISTOR	2.5K OHM 40W 5% FIXED	1955653
RS	ALL	24/32	RESISTOR	45 OHM 40W 5% (22.5 OHM TAP)	184A064H03
	ALL	48/125	RELAY	TELEPHONE RELAY (125 OHM COIL)	407C614H06
	ALL	24/32	RELAY	TELEPHONE RELAY (30 OHM COIL)	407C614H05
	0.05-1 & 0.05-0.4	250	RELAY	TELEPHONE RELAY (125 OHM COIL)	407C614H06
TR	1.5-30 & 0.2-4	250	RELAY	TELEPHONE RELAY (650 OHM COIL)	407C614H07
	0.05-1	ALL	RHEOSTAT	40K 2W 10%	9676A50H02
	0.05-0.4	ALL	RHEOSTAT	20K 2W 10%	9676A50H01
T	1.5-30 & 0.2-4	ALL	RHEOSTAT	100K 2W 10%	9676A50H03
		48/125	ZENER	1N2986B 10W 24V	629A798H03
		250	ZENER	1N2999B 10W 56V	629A798H04
Z	ALL	24/32	ZENER	1N2977B 10W 13V	629A798H02

ADDITIONAL COMPONENTS WHEN TX RELAY IS USED

TX	ALL	ALL	RELAY	TELEPHONE RELAY (750 OHM COIL)	19B1312H09
			ZENER	1.5KE200	878A619H01
Z2	ALL	ALL	ZENER	1N4529 AVALANCHE	837A875H03
			ZENER	1.5KE200	878A619H01
Z3	ALL	ALL	ZENER	1N4529 AVALANCHE	837A875H03
		48/125	RESISTOR	1.25K OHM 25W 5%	1202589
		250	RESISTOR	1.25K OHM 25W 5%	1202589
R1	ALL	24/32	RESISTOR	150 OHM 25W 5%	1267272
R2	ALL	250	RESISTOR	2K OHM 25W 5%	1267296
R3	ALL	ALL	RESISTOR	1.5K, 1/2W 1%	848A819H65

DESIGN 2

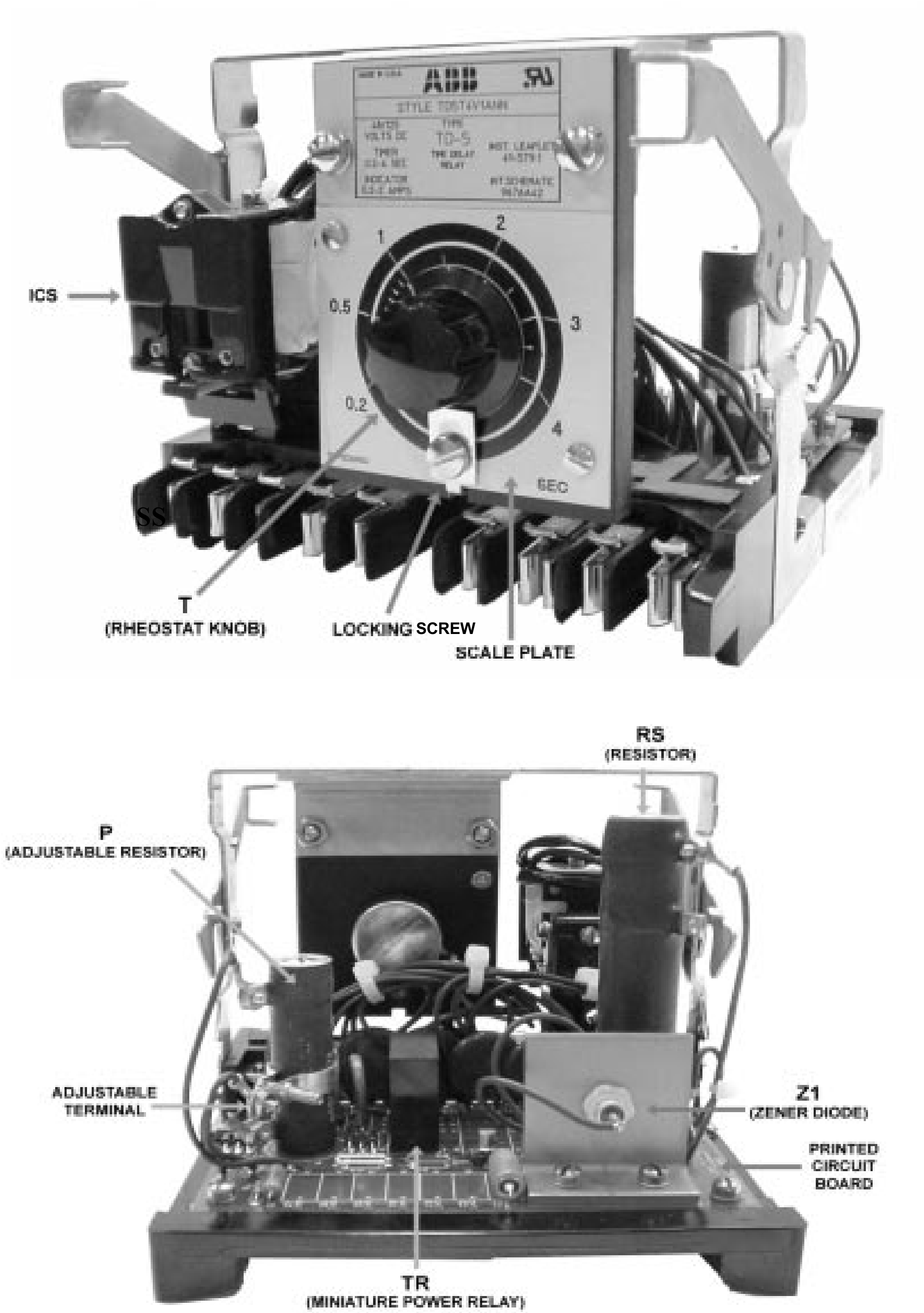


Figure 2. Design 2 TD-5 Relay Front and Rear Views, Out of Case

DESIGN 2 - TABLE OF REPLACEABLE PARTS

COMPONENT DESIGNATION	TIME DELAY (SECONDS)	VOLTAGE RATING (VOLTS DC)	PARTNAME	DESCRIPTION	STYLE NUMBER
		48/125 & 24/32	CAPACITOR	22UF 35V 10% TANTALUM	184A661H16
C1-C7	ALL	250	CAPACITOR	22UF 50V 10% TANTALUM	184A661H17
C8, C10	ALL	ALL	CAPACITOR	0.01 UF 20% 3KV CERAMIC	3536A32H02
C9	ALL	ALL	CAPACITOR	0.1 UF 20% 500V CERAMIC	184A663H14
D1-D6	ALL	ALL	DIODE	1N5398	188A342H24
		48/125 & 24/32	RECTIFIER	2N885 SILICON CONTROL RECTIFIER	185A517H02
SCR	ALL	250	RECTIFIER	2N886 SILICON CONTROL RECTIFIER	185A517H03
	ALL	48/125	RESISTOR	150 OHM 25W 5% ADJ	05D1327H74
	0.05-1 & 0.05-0.4	250	RESISTOR	1180 OHM 25W 5% ADJ	05D1328H27
	1.5-30 & 0.2-4	250	RESISTOR	750 OHM 25W 5% ADJ	05D1328H19
P	ALL	24/32	RESISTOR	50 OHM 25W 5% ADJ	05D1327H55
		48/125 & 24/32	RESISTOR	1K 1/2W 1%	862A376H01
	0.05-1 & 0.05-0.4	250	RESISTOR	1K 3W 5%	184A636H08
RL	1.5-30 & 0.2-4	ALL	RESISTOR	5.6K 1/2W 1%	862A376H73
	0.05-1 & 0.05-0.4	ALL	RESISTOR	62K 1/4W 1%	3535A41H20
RP	1.5-30 & 0.2-4	ALL	RESISTOR	267K 1/4W 1%	3532A38H42
	ALL	48/125	RESISTOR	500 OHM 40W 5% (95 OHM TAP)	187A321H08
	0.05-1 & 0.05-0.4	250	RESISTOR	2240 OHM 40W 5% FIXED	1955651
	1.5-30 & 0.2-4	250	RESISTOR	1900 OHM 40W 5% FIXED	1955649
RS	ALL	24/32	RESISTOR	45 OHM 40W 5% (22.5 OHM TAP)	184A064H03
TR	ALL	ALL	RELAY	MINIATURE POWER RELAY (6V)	9676A51H01
VR1-VR4	ALL	ALL	VARISTOR	V320LA40B	3509A31H22
	0.05-1	ALL	RHEOSTAT	40K 2W 10%	9676A50H02
	0.05-0.4	ALL	RHEOSTAT	20K 2W 10%	9676A50H01
T	1.5-30 & 0.2-4	ALL	RHEOSTAT	100K 2W 10%	9676A50H03
		48/125	ZENER	1N2986B 10W 24V	629A798H03
		250	ZENER	1N2999B 10W 56V	629A798H04
Z1	ALL	24/32	ZENER	1N2977B 10W 13V	629A798H02
ADDITIONAL COMPONENTS WHEN TX RELAY IS USED					
		48/125 & 250	RELAY	MINIATURE POWER RELAY (48VDC)	9676A51H02
TX	ALL	24/32	RELAY	MINIATURE POWER RELAY (24VDC)	9676A51H03
VR5	ALL	ALL	VARISTOR	V320LA40B	3509A31H22
			ZENER	1.5KE200	878A619H01
Z2	ALL	ALL	ZENER	1N4529 AVALANCHE	837A875H03
			ZENER	1.5KE200	878A619H01
Z3	ALL	ALL	ZENER	1N4529 AVALANCHE	837A875H03
Z4	ALL	250	ZENER	1.5KE200	878A619H01
		48/125 & 250	CAPACITOR	4.7 UF 100V 20%	9645A13H20
C11	ALL	24/32	CAPACITOR	22 UF 50V 20%	9645A13H21
		48/125	RESISTOR	5K 5W 5%	763A129H01
		250	RESISTOR	7.5K 5W 5%	763A129H47
R1	ALL	24/32	RESISTOR	360 OHM 2W 5%	185A207H16
		48/125 & 24/32	RESISTOR	JUMPER	605920-010
R2	ALL	250	RESISTOR	7.5K 5W 5%	763A129H47
R3	ALL	ALL	RESISTOR	1.5K, 1/2W 1%	848A819H65
		48/125 & 24/32	HEADER	3 POSITION SINGLE ROW	9640A47H01
JP1	ALL	250	HEADER	NOT REQUIRED	NONE
		48/125 & 24/32	JUMPER	BLUE CLIP	3532A54H01
JP1	ALL	250	JUMPER	NOT REQUIRED	NONE

2.2 RHEOSTAT (T) AND SCALE PLATE

The rheostat (T) provides a variable resistance for the R-C time delay circuit. The timing scale is non-linear, as explained in *Section 2.4, Printed Circuit Board*.

Please note, do not remove the knob from the rheostat shaft, since it is not easy to replace the knob in the calibrated position.

2.3 POTENTIOMETER (P)

P can be either a wire-wound potentiometer with a lock nut as in Design 1, or a 2 inch wire-wound adjustable resistor as in Design 2 (See Figures 1 & 2 respectively). Neither the lock nut on the potentiometer, or the adjustable terminal on the resistor should be loosened at any time, unless the relay is being re-calibrated.

The potentiometer P provides a biasing voltage, which keeps the silicon-controlled rectifier SCR turned off until the capacitor voltage reaches the potentiometer brush voltage. The same functionality is achieved when P is an adjustable resistor. For simplicity, P will be refered to as a potentiometer throughout this IL. Reference to the potentiometer's brush is equivalent to the adjustable terminal on the adjustable resistor.

2.4 PRINTED CIRCUIT BOARD

The printed circuit board (Timer Module assembly) contains the following components:

Design 1 (see Figure 3):

- Diode D1, which protects the static components in case the TD-5 relay is connected with reverse polarity.
- Limiting timing resistor RL.
- Timing capacitor(s) C.
- Resistor RP parallel to C, which makes the calibrating scale non-linear.
- Silicon-controlled rectifier SCR.
- Diode D2 to reverse bias the SCR.
- Resistor RC, and diode D3 to protect the static components from the inductive voltage kick associated with the coil of the TR telephone relay .
- Series diodes D4, D5 & D6, which compensate for the forward voltage drop through the SCR and D2, and also compensate for zener (Z) reference variations.

Design 2 (see Figure 4):

- Diode D1, which protects the static components in case the TD-5 relay is connected with reverse polarity.
- Limiting timing resistor RL.
- Timing capacitor(s) C1 to C7.
- Resistor RP parallel to C, which makes the calibrating scale non-linear.
- Silicon-controlled rectifier SCR.
- Diode D2 to reverse bias the SCR.
- Diode D3 to protect the static components from the inductive voltage kick associated with the coil of the TR relay.
- Series diodes D4, D5 & D6, which compensate for the forward voltage drop through the SCR and D2, and also compensate for zener (Z1) reference variations
- Filter capacitors C8, C9 & C10.
- Miniature power relays TR and TX, see *Sections 2.5 and 2.6* respectively.
- Varistors VR1 to VR5 across TR and TX relay contacts.
- Adjustable resistor P, see *Section 2.3*.
- Silicon power regulator Z1, and resistor RS, see *Section 2.1*.
- Resistors R1, R2 connected in series with TX coil, see *Section 2.6*
- Resistor R3, capacitor C11, and zener Z2 to protect the static components from the inductive voltage kick associated with the coil of the TX relay, see *Section 2.6*.
- Zener diodes Z3 and Z4.
- Jumper JP1 to select voltage rating.

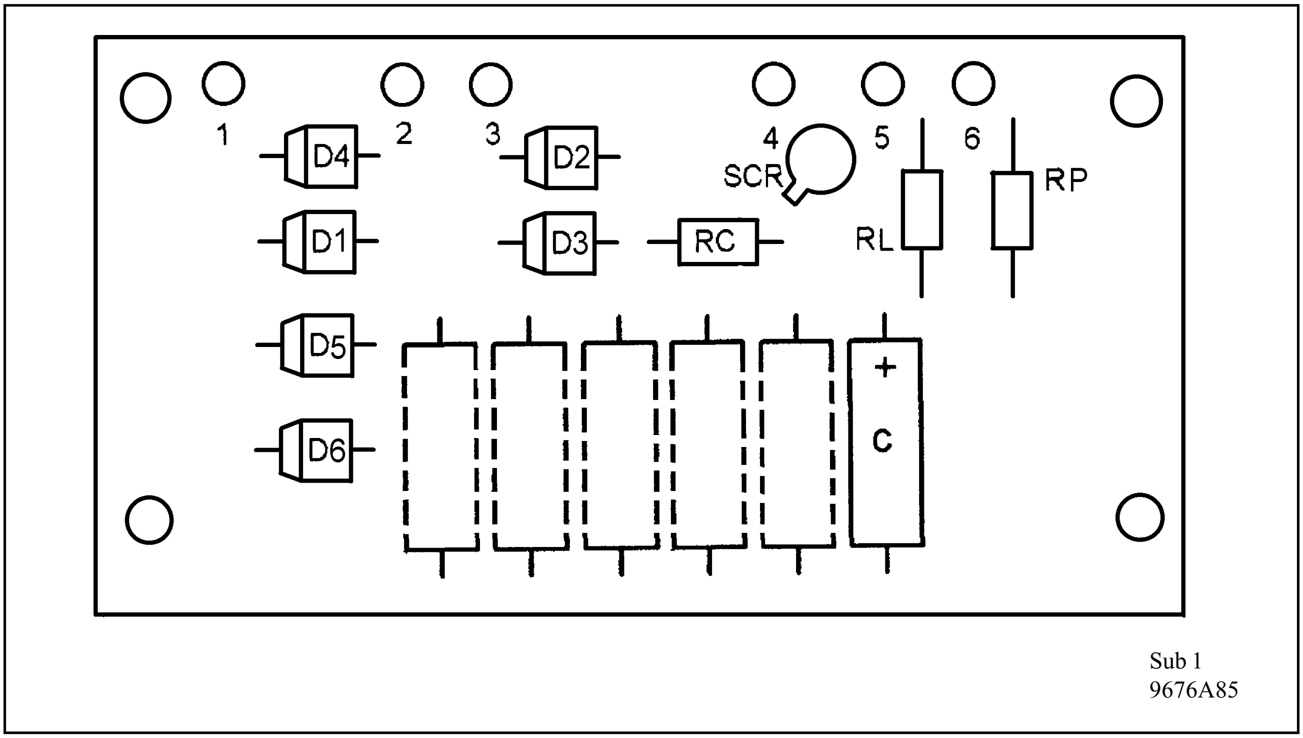


Figure 3. Design 1 Printed Circuit Board, Component Location

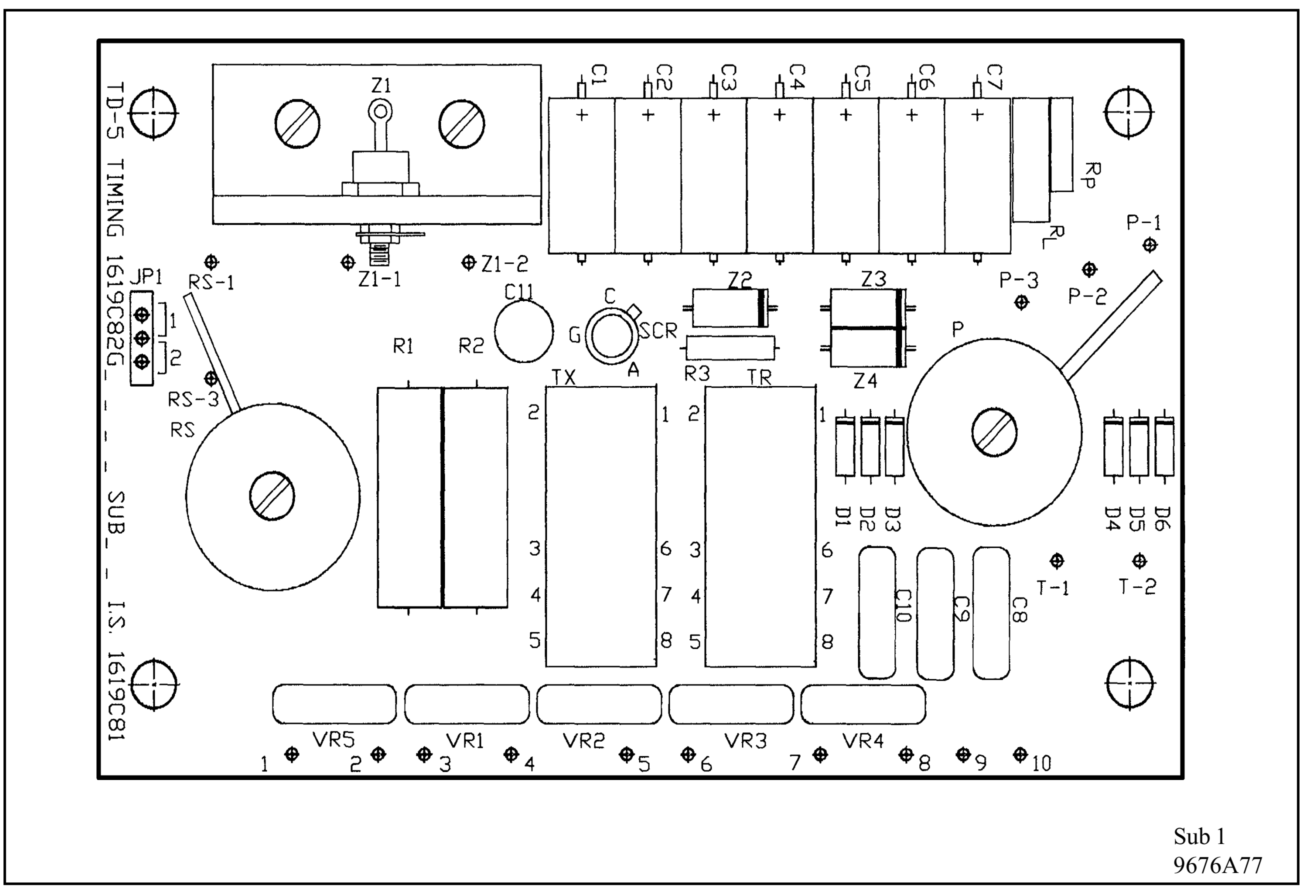


Figure 4. Design 2 Printed Circuit Board, Component Location

2.5 TR RELAY

Construction:
Design 1 - Telephone type relay.
Design 2 - Printed circuit mount miniature power relay.

Operation:
Design 1 & 2 - The TR relay is energized by the SCR at the conclusion of the time delay. Two sets of transfer contacts are provided to give a flexible trip circuit arrangement.

2.6 TX RELAY

Construction:
Design 1 - Telephone type relay.
Design 2 - Printed circuit mount miniature power relay.

Operation:
Design 1 & 2 - When used (see Figures 9 & 10), the TX relay is energized by the application of a dc voltage to the relay. Because of its slow dropout characteristic, a contact of the TX relay is connected externally around the contact of the initiating relay. This maintains voltage to the timing module of the relay if the contact of the initiating relay bounces. Discrete components (a resistor and diode in Design 1, or a resistor, diode, and capacitor in Design 2) are connected across the coil of the TX relay to protect the static components from the inductive voltage kicks associated with the coil of the TX relay. Typical operate time for the TX relay is 7 ms. Dropout time is 15 ms.

Design 1 - A 25 W resistor (R1) located on the top left of the relay (front view) is connected in series with the coil of the TX relay for use on 48/125 and 24/32 VDC relays. This resistor should be jumpered for 24 and 48 VDC operations.

Design 2 - A jumper JP1 on the printed circuit board is provided on 48/125 VDC and 24/32 VDC relays for setting the resistance that is in series with the coil of the TX relay.

This jumper is preset from the factory in Position 2 for 125 or 32 VDC operations. JP1 should should be set to Position 1 in order to change setting from 125 to 48 or from 32 to 24 VDC.
JP1 is not required on 250 VDC relays.

RELAY RATING (VDC)	JP1 POSITION	RELAY OPERATION (VDC)
48/125	1	48
48/125	2	125
24/32	1	24
24/32	2	32

2.7 INDICATING CONTACTOR SWITCH (ICS)

The indicating contactor switch is a small dc operated clapper type device. A magnetic armature, to which leaf-spring mounted contacts are attached, is attracted to the magnetic core upon energization of the switch. When the switch closes, the moving contacts bridge two stationary contacts, completing the trip circuit. Also, during this operation two fingers on the armature deflect a spring located on the front of the switch, which allows the operation indicator target to drop. The target is reset from the outside of the case by a push-rod located at the bottom of the cover.

The front spring, in addition to holding the target, provides restraint for the armature and thus controls the pickup value of the switch.

2.8 OPERATION OF TD-5 RELAY

Operation of the TD-5 relay occurs when the silicon controlled rectifier (SCR) switches from a non-conducting state to a conducting state. In the non-conducting state, the SCR acts as an opened switch to prevent energization of the TR relay, but in the conducting state it acts as a closed switch to connect the TR relay to the dc source.

To switch the SCR from a non-conducting state to a conducting state requires that a maximum of 20 micro-amperes flow in the gate of the SCR. This current is produced by the difference in voltage across the capacitor (C) and brush of the potentiometer (P).

When dc voltage is frist applied to the relay, voltage instantaneously appears across the potentiometer brush but is delayed in building up across the capacitor in accordance with the R-C time constant of the circuit. As long as the capacitor voltage is less than the pontentiometer brush voltage, a reverse voltage appears across the diode D2, and the SCR to keep the silicon controlled rectifier (SCR) biased off.

When the capacitor voltage reaches the potentiometer brush voltage plus approximately one volt (forward voltage drops across SCR and D2), gate current will flow to the silicon controlled rectifier SCR. This current switches the SCR to a conducting state to allow the TR relay to pickup.

The SCR latches on when it switches and can be reset only by removing voltage from terminals 8 and 9 of the relay. If a trip coil supervisory indicator lamp is used, when the timer is used with a fault detector to trip a breaker, a breaker “a” contact must be connected between terminal 8 of the relay and negative.

The rate at which the capacitor charges is determined by the rheostat (T) setting. The charging rate is not a linear function of the rheostat setting, since RP gives a parallel resistive path. This has the effect of expanding the scale for short times and thereby permitting more accurate settings.

3.0 CHARACTERISTICS

TIME DELAY RANGE AND VOLTAGE RATING

TIME DELAY (SECONDS)	VOLTAGE RATING (VOLTS DC)
0.05-0.4	24/32 48/125 250
0.05-1.0	24/32 48/125 250
0.2-4.0	24/32 48/125 250
1.5-30	24/32 48/125 250

3.1 VOLTAGE RATING OVER THE TEMPERATURE RANGE

The relay can stand 110% voltage continuously over a temperature range of -40 C to +70 C.

3.2 REVERSE POLARITY

Diode (D1) limits reverse voltage of the static components to less than one volt dc, so that no damage is done to the circuit by connecting the relay with reverse polarity. However, the relay will, of course, not operate under this condition, and series resistor. (RS) may overheat if reverse voltage is applied for approximately 15 minutes or more.

3.3 RESET TIME

TR dropout time = 0.1 sec. or less. TR dropout time of TD-5 Relay with TX contact is an additional 15 msec.

BATTERY DRAIN

	24 VOLTS DC	32 VOLTS DC	48 VOLTS DC	125 VOLTS DC	250 VOLTSDC
STAND-BY: (DESIGN 1 & 2)	0	0	0	0	0
OPERATING: (DESIGN 1)	500 mA	420 mA	270 mA	180 mA	80 mA
OPERATING: (DESIGN 2)	500 mA	450 mA	240 mA	200 mA	#

\# = 100 mA for time delay ranges 0.05 - 0.4 and 0.05 - 1.0 seconds,
115 mA for time delay ranges 0.2 - 4.0 and 1.5 - 30 seconds.

Note: For TD-5 with TX Relay, Design 1 has an extra operating drain of 63 mA at 48 or 125 VDC; Design 2 has an extra operating drain of 15 mA at 48, 125 or 250 VDC.

3.3.1 Discharge of timing capacitor:

The discharge of C is essentially instantaneous, the R-C time constant through P being less than 20 milliseconds, in most cases. However, the discharge path through P is limited by silicon voltage drops through SCR and D2, totaling approximately one volt. Therefore, C discharges rapidly through P down to about one volt and then more slowly through RP down to zero volts.

3.4 ACCURACY

The accuracy of the time delay depends upon the repetition rate of consecutive timings, the supply voltage, and the ambient temperature. Self-heating has a negligible effect on the time accuracy

3.4.1 Nominal Setting

The first time delay, as measured with the test circuit shown in Figure 9, taken at 25° C and rated voltage, will be within four milliseconds of its setting for settings of 0.2 seconds or less. For settings above 0.2 seconds, this accuracy will be ±2%.

3.4.2 Consecutive Timings

Incomplete capacitor discharge will cause changes in time delay. These changes are a function of discharge rate. Timing accuracy for slow repetitions will be per Table 1.

TABLE 1

RELAY RANGE TIME DELAY (SECONDS)	DELAY BETWEEN READINGS	ACCURACY AS PERCENT OF SETTING
0.05 - 1.0	AT LEAST 3 SECONDS	±2%
0.2 - 4.0	AT LEAST 5 SECONDS	±2%
1.5 - 30	AT LEAST 5 SECONDS	±2%

Timing accuracy for fast repetitions will be per Table 2.

TABLE 2

RELAY RANGE TIME DELAY (SECONDS)	DELAY BETWEEN READINGS	ACCURACY AS PERCENT OF SETTING
0.05 - 1.0	INSTANTANEOUS	±4%
0.2 - 4.0	INSTANTANEOUS	±4%
1.5 - 30	APPROX. 0.5 SEC.	±4%

3.4.3 Supply Voltage

Changes in supply voltage, between 80% and 110% of nominal, cause time delay variations of no more than ±3 milliseconds for settings of 0.3 seconds or less, and no more than ±1% for settings above 0.3 seconds.

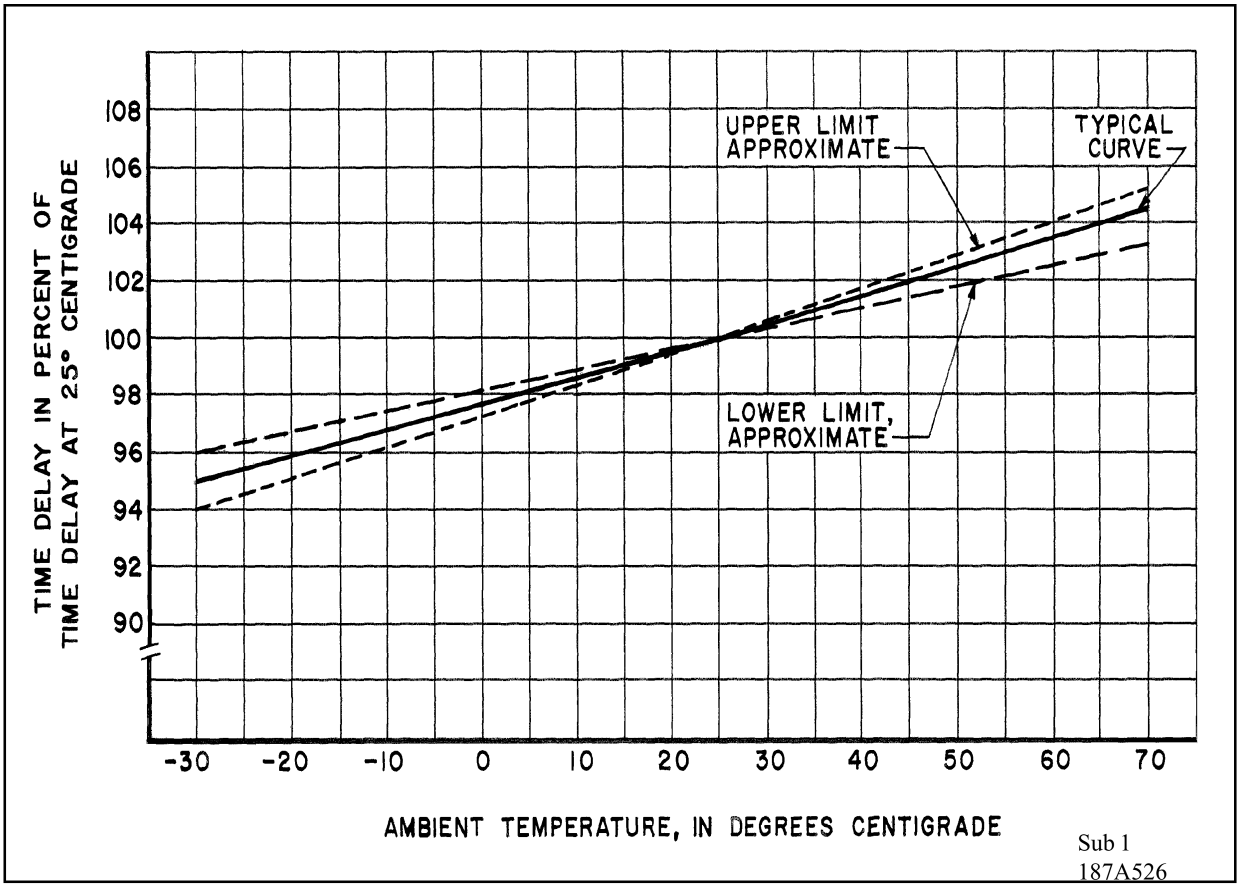


Figure 5. Timing Variations with Temperature Changes

3.4.4 Ambient Temperature

Changes in ambient temperature cause changes in time delay. This variation in time delay is a direct function of capacitance change with tempeature. Typical variation of time delay with temperature is shown in Figure 5.

4.0 RELAY SETTINGS

4.1 TIME DELAY

Time delay is selected by adjusting rheostat T.

For Zone 2 distance applications, the timer setting should be sufficient to allow relays and breakers beyond the next bus to clear the fault. The time should be set to allow successful breaker failure clearing. This usually requires a setting of apprimately 0.25 seconds.

Zone 3 timing must coordinate with remote Zone 2 timing. A typical setting is 0.5 seconds.

Breaker failure timing is set to assure normal fault clearing and fault detector reset plus 2 to 3 cycles margin. Settings of 0.1 to 0.2 second are typical.

4.2 VOLTAGE RATING (RESISTOR - RS)

The correct tap on resistor RS shoudl be selected for the supply voltage being used, per the appropriate internal schematic (see Figures 7 to 10). Note that terminal 1 of the RS resistor has a red dot for ease of identification.

- 48/125 VDC relays are preset from the factory at 125 Volts.
- 24/32 VDC relays are preset from the factory at 32 volts.

- No adjustments are necessary for 250 VDC relays.

4.3 TX RELAY

When the TX relay is used, the correct resistance in series with the coil of the TX relay has to be selected for the supply voltage being used.

Design 1: To use the relay with a supply voltage of 48 or 24 VDC, jumper R1, the 25W (2 inch) resistor that is located on the top left (front view) of the relay. (See Figure 9).

Design 2: To use the relay with a supply voltage of 48 or 24 VDC, move jumper JP1 on Printed Circuit Board to Position 1. This will jumper resistor R1, see Figures 4 and 10.

4.4 INDICATING CONTACTOR SWITCH (ICS)

No setting is required on the ICS unit except the selection of the 0.2 or 2.0 ampere tap setting. This selection is made by connecting the lead located in front of the unit's tap block to the desired setting by means of the connecting screw.

5.0 INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration, and heat. Mount the relay vertically by means of the four mounting holes on the flange of the relay case for semi-flush mounting or by means of the rear mounting stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to 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 nuts with a wrench.

For detailed FT case information refer to I.L. 41-076.

6.0 ADJUSTMENTS AND MAINTENANCE

Note:

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. In particular, do not remove knob from rheostat shaft and do not loosen the potentiometer lock nut or adjustable resistor clamp. Upon receipt of the relay, no customer adjustment, other than those covered under relay settings should be required.

6.1 ACCEPTANCE CHECK

The following check is recommended to insure that the relay is in proper working order. Perform a timing check at minimum and maximum settings. A recommended test circuit is shown in Figure 6. When testing the TD-5 with a TX relay make the dotted connection as shown in Figure 6. The neon lamp will light if the TX relay is operating properly.

6.2 ROUTINE MAINTENANCE

All relays should be inspected periodically and the time of operation should be checked at least once every two years or at such other time intervals as may be dictated by experience to be suitable to the particular application.

All contacts should be cleaned periodically. A contact burnisher S#182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

6.3 TROUBLE SHOOTING PROCEDURE

Use the following procedure to locate the source of trouble if the TD-5 is not operating correctly.

1. Inspect all wires and connections, paying particular attention to telephone relay and printed circuit board terminals.

2. Check the reference voltage circuit. This is done by measuring the dc voltage across the silicon power regulator, Z or Z1. Connect the dc volt meter positive terminal to the rear terminal (Design 1) or bottom terminal (Design 2) of RS and the negative terminal to relay terminal 8. Apply rated voltage per the test circuit diagram, Figure 6. The Zener voltage should be between 11.0 and 14.0 volts for 24/32 VDC relays, between 21.5 and 25.5 volts for 48/125 VDC relays, and between 50 and 59 volts for 250 VDC relays.

3. Check the timing capacitor voltage and the P potentiometer brush voltage with an oscilloscope or a high resistance dc voltmeter.
   Design 1: Connect between Printed Circuit Board terminal 3 and relay terminal 8.
   Design 2: Connect between adjustable terminal of P and relay terminal 8.

   The brush voltage, which is constant until the TR relay trips, should be approximately one half the reference voltage. The capacitor should gradually change to the potentiometer brush voltage, plus approximately one volt for silicon jucntion forward voltage drops through SCR and D2.

4. If reference voltage, capacitor voltage, and potentiometer voltage all appear to be correct, the SCR may be the cause of trouble. The anode to cathode voltage, as measured, should be approximately one-half the reference voltage until the capacitor voltage reaches the P brush voltage, at which time the anode to cathode voltage should drop to approximately one volt.
   Design 1: Measure between Printed Circuit board terminals 3 and 4.
   Design 2: Measure between anode of D3 and adjustable terminal of P.

7.0 CALIBRATION

Use the following procedure for calibrating the relay if the relay has been taken apart, or the adjustments have been disturbed. This procedure should not be used until it is apparent that the relay is not in proper working order. (*See Acceptance Check, Section 6.1*). Before calibrating follow the *Trouble Shooting* Procedure, Section 6.3, to locate the source of trouble.

7.1 TR, TX RELAY ADJUSTMENT

Design 1 - Adjust the armature gap on the telephone type relays (TR, TX) to be approximately .004 inch with the armature closed. This is done with the armature setscrew and locknut. Also, adjust contact leaf springs to obtain at least .015 inch gap on all contacts, at least .010 inch follow on all normally open contacts, and at least .005 inch follow on all normally closed contacts.

Design 2 - No adjustments are necessary.

7.2 RHEOSTAT KNOB ADJUSTMENT (SAME SCALE)

If it is necessary to replace the rheostat (T) or the silicon power regulator (Z or Z1), in most cases the relay may be recalibrated with the same scale plate. This is done by rotating the rheostat shaft, without knob, until a time delay equal to the minimum scale marking is obtained. Then, align the knob for this delay and tighten the knob set screw securely. Pause several seconds between readings for all delays above .05 seconds. *See section 3.4 Accuracy* for discussion of this.

7.3 SCALE PLATE CALIBRATION (NEW SCALE)

If it is necessary to replace P or the Printed Circuit Board, the relay should be recalibrated with a new scale plate. Use the following procedure:

1. With the knob of the shaft, set the rheostat (T) at maximum.

2. Adjust P so that the times are 5% to 10% longer than the maximum scale marking.

3. Set the rheostat T at minimum and check that times are less than or equal to the minimum scale marking. If not, adjust P slightly to reduce times. Tighten locknut on P.

4. Place the knob on the rheostat shaft in such a position that the times are symmetrical with respect to the scale plate marking. Tighten the knob setscrew and mark calibration lines on the scale plate. When striking calibration lines for delays above 0.5 seconds, pause at least 3 seconds be tween readings. See *Section 3.4 Accuracy* for discussion of this.

7.4 INDICATING CONTRACTOR SWITCH (ICS)

Close the main relay contacts and pass sufficient dc current through the trip circuit to close the contacts of the ICS. This value of current should not be greater than the particular ICS tap setting being used. The operation indicator target should drop freely.

The contact wipe should be 1/64" to 3/64" between the bridging moving contact and the adjustable stationary contacts. The bridging moving contact should touch both stationary contacts simultaneously.

8.0 RENEWAL PARTS

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

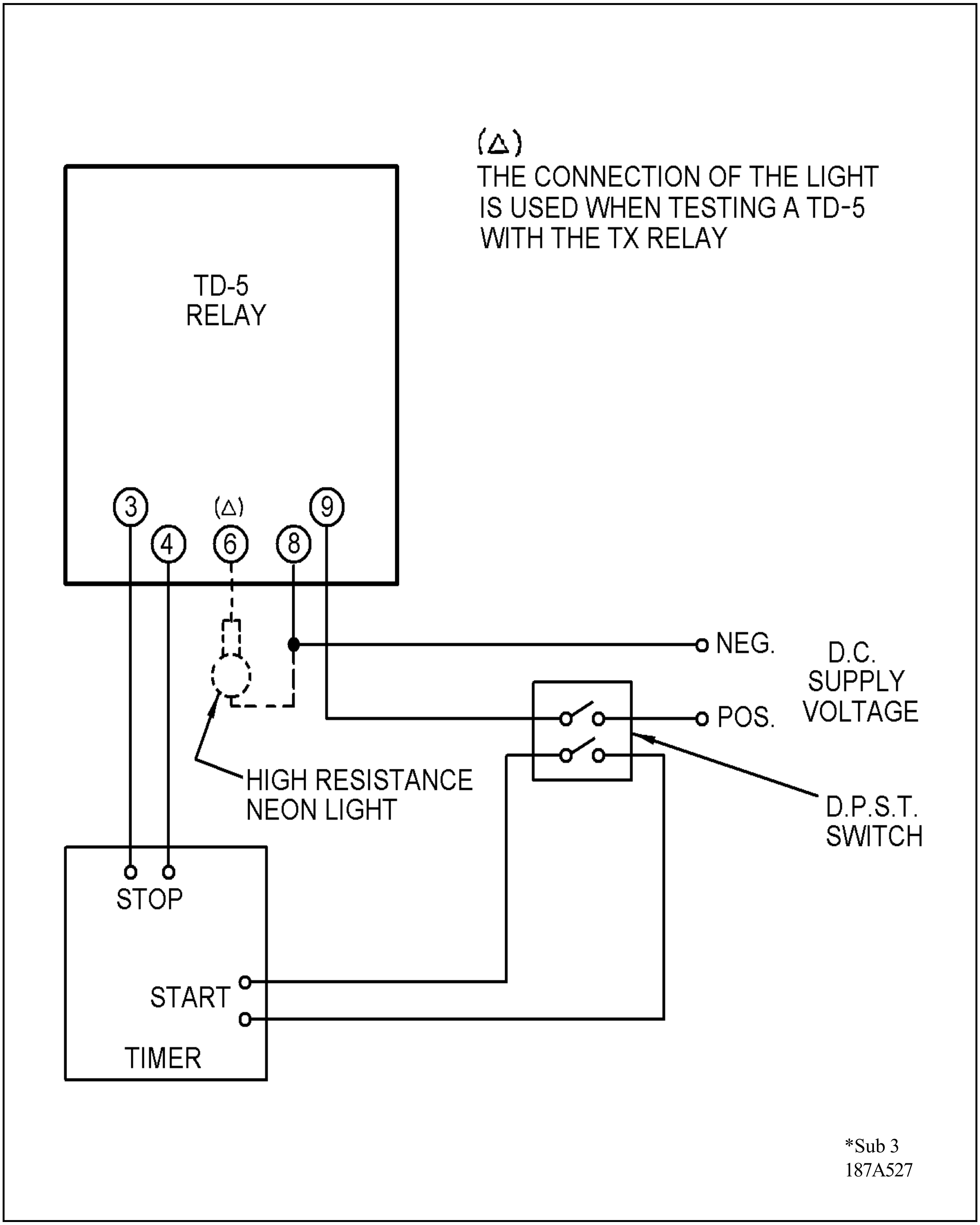
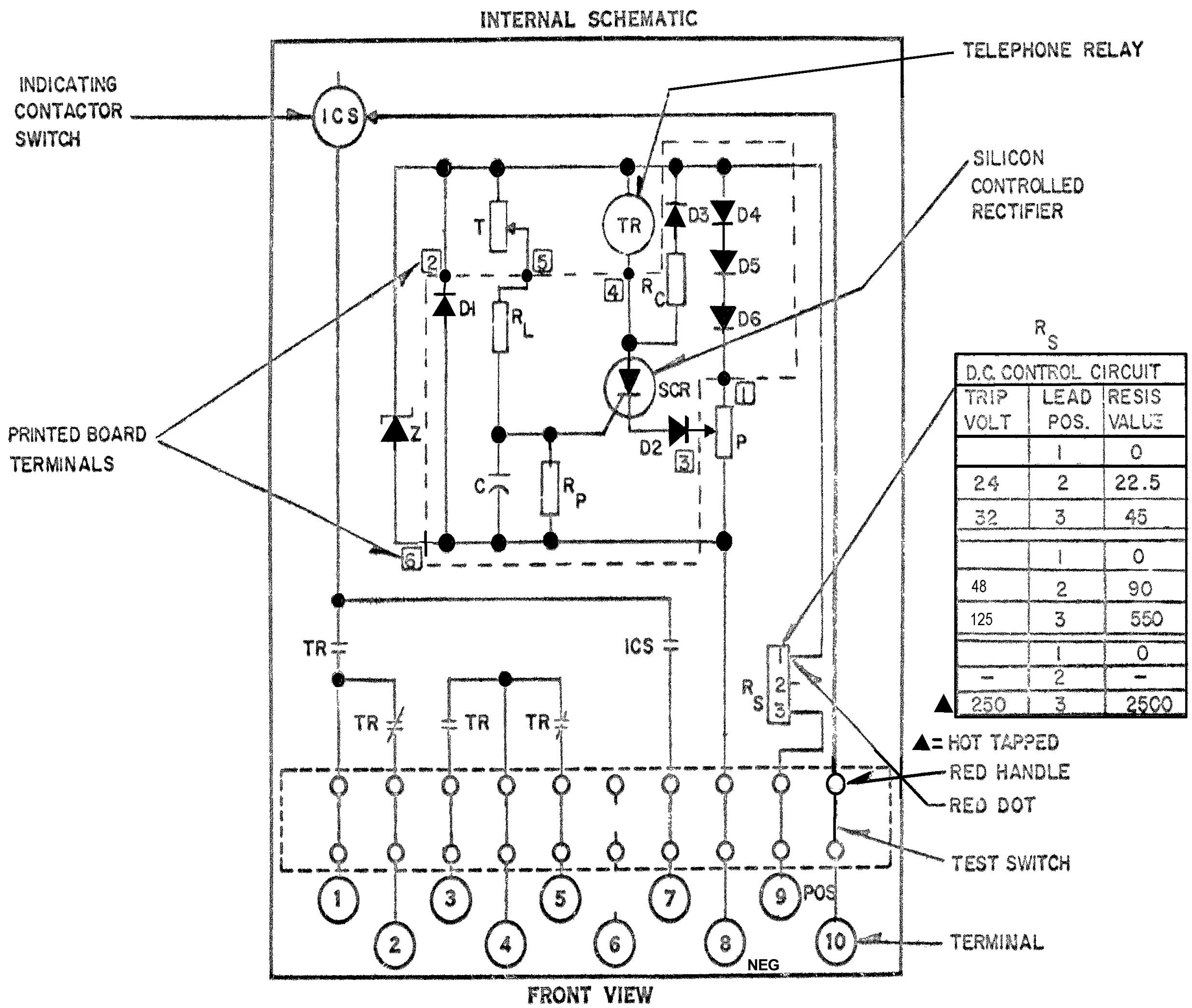
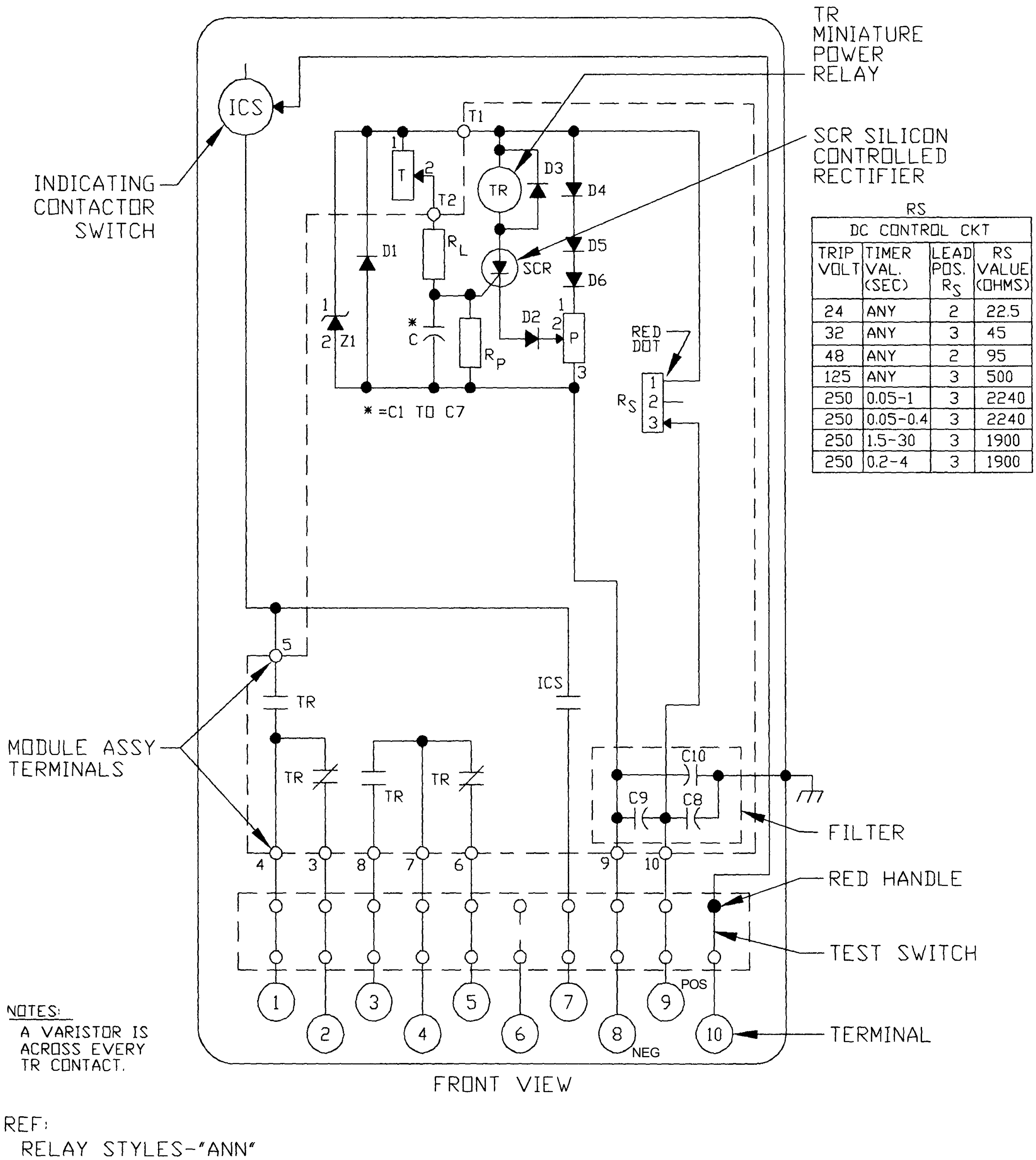


Figure 6. Test Circuits for Type TD-5 Relay



Sub 5
187A293

Figure 7. Design 1 Internal Schematic of TD-5 Relay in FT-11 Case

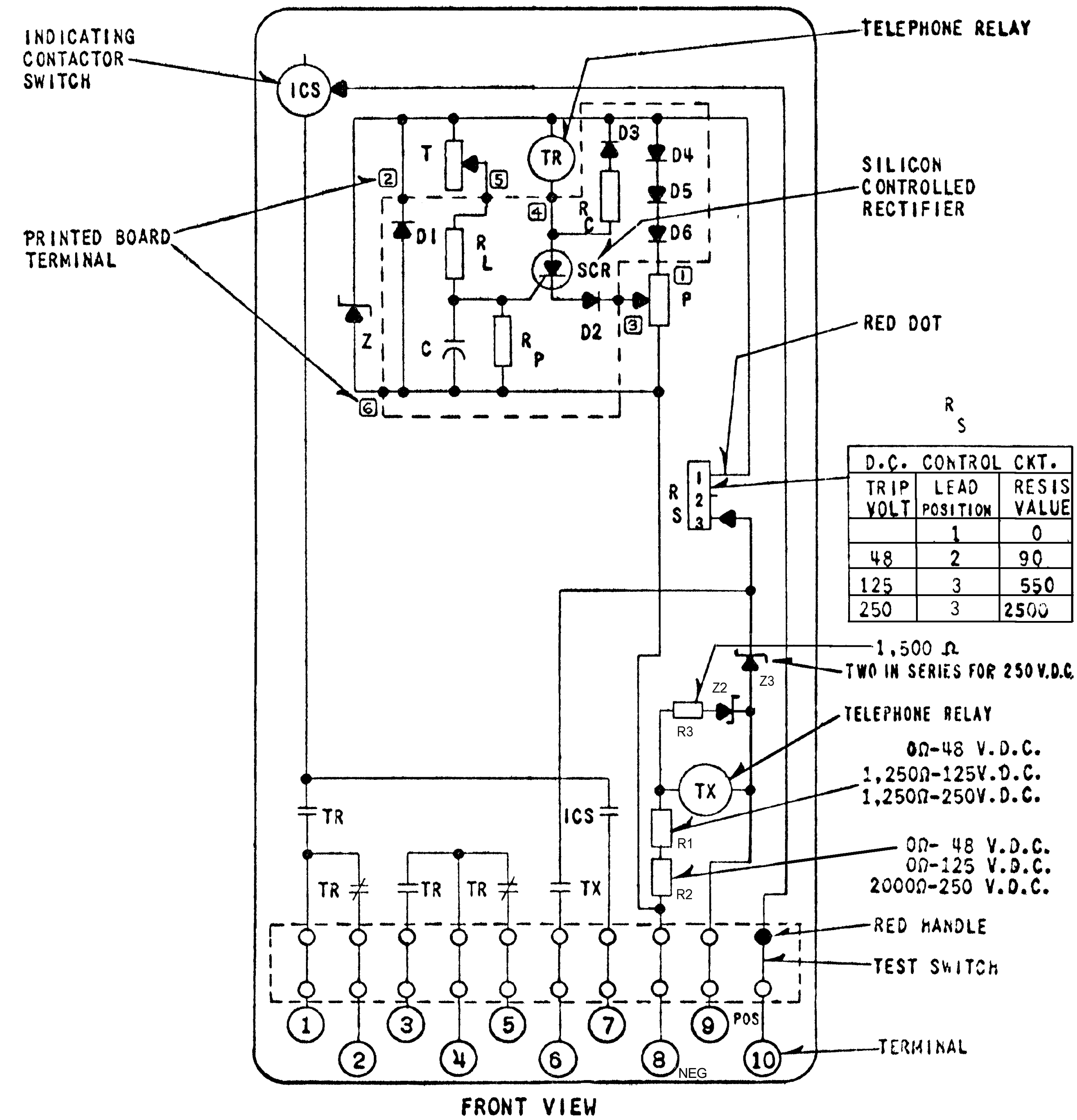


RS

DC CONTROL CKT			
TRIP VOLT	TIMER VAL. (SEC)	LEAD POS. R_S	RS VALUE (OHMS)
24	ANY	2	22.5
32	ANY	3	45
48	ANY	2	95
125	ANY	3	500
250	0.05-1	3	2240
250	0.05-0.4	3	2240
250	1.5-30	3	1900
250	0.2-4	3	1900

*Sub 2
9676A42

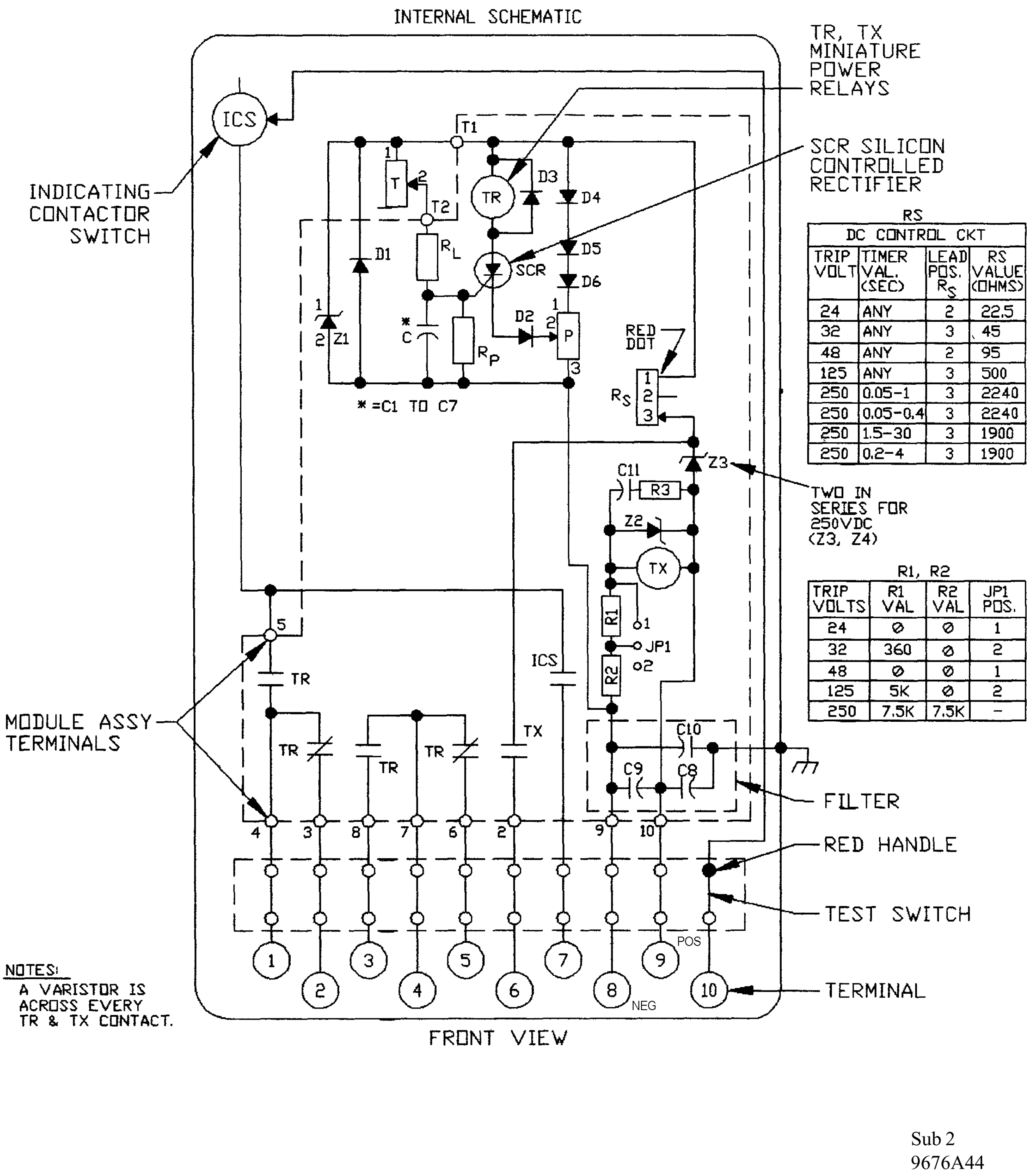
Figure 8. Design 2 Internal Schematic of TD-5 Relay in FT-11 Case



D.C. CONTROL CKT.		
TRIP VOLT	LEAD POSITION	RESIS VALUE
	1	0
48	2	90
125	3	550
250	3	2500

*Sub 6
188A016

Figure 9. Design 1 Internal Schematic of TD-5 Relay in FT-11 Case, with TX Relay



RS

DC CONTROL CKT			
TRIP VOLT	TIMER VAL. (SEC)	LEAD POS. R_S	RS VALUE (OHMS)
24	ANY	2	22.5
32	ANY	3	45
48	ANY	2	95
125	ANY	3	500
250	0.05-1	3	2240
250	0.05-0.4	3	2240
250	1.5-30	3	1900
250	0.2-4	3	1900

R1, R2

TRIP VOLTS	R1 VAL	R2 VAL	JP1 POS.
24	Ø	Ø	1
32	360	Ø	2
48	Ø	Ø	1
125	5K	Ø	2
250	7.5K	7.5K	-

Figure 10. Design 2 Internal Schematic of TD-5 Relay in FT-11 Case, with TX Relay

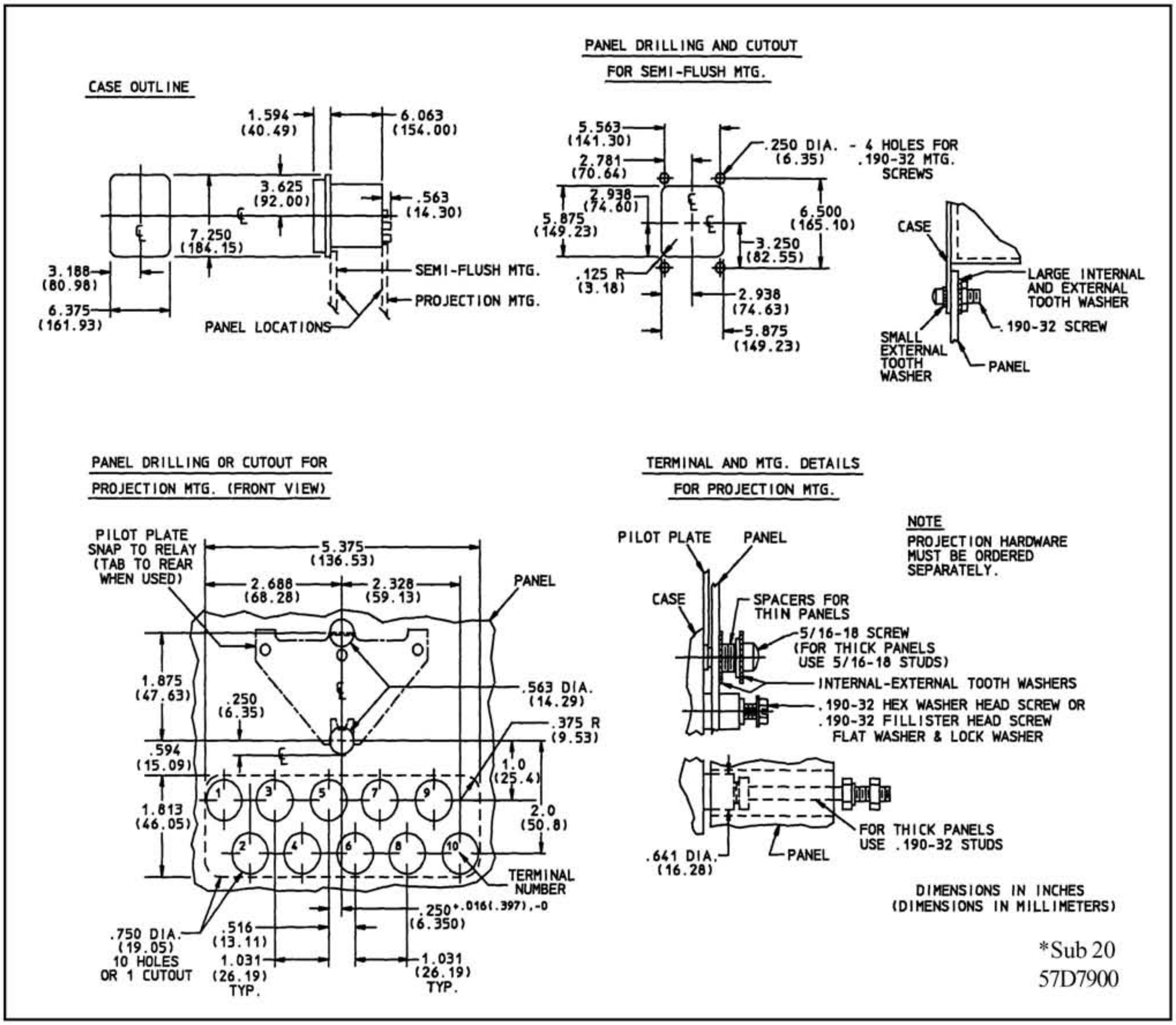


Figure 11. Outline and Drilling Plan for Type TD-5 Relays in FT-11 Case

ABB Inc.

4300 Coral Ridge Drive
Coral Springs, Florida 33065

Telephone: +1 954-752-6700
Fax: +1 954-345-5329

www.abb.com/substation automation