

# Instruction Manual

## STATION MOTOR CONTROL

MODEL 650568A

ISSUE 2



**TEMPO INSTRUMENT INCORPORATED**

Plainview, L.I., New York 11803

## STATION MOTOR CONTROL

## MODEL 650568A

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## STATION MOTOR CONTROL

MODEL 650588A

### 1.0 GENERAL

1.1 The Station Motor Control, Model 650588A, is a solid state timing device used where it is necessary to delay the termination of a controlled event for a specific period of time. A typical application of the unit, which is designed and manufactured by Tempo Instrument Incorporated, Plainville, New York, is to control the 115 VAC supply to a teleprinter motor. The CONTROLLED output of the Station Motor Control, which is connected to the teleprinter motor, will energize 25 milliseconds after the receipt of a "Mark-to-Space" transition on the Signal Loop, and will remain energized for the set time interval after the last "Mark-to-Space" transition. If no transmission is received prior to the end of this time interval, a relay located in the Station Motor Control will disconnect the 115 VAC supply from the CONTROLLED output, thereby, removing power from the teleprinter motor. Any "Mark-to-Space" transition received thereafter will cause the unit to restore ac power to the teleprinter motor almost instantly. It should be noted that if the Station Motor Control has disconnected power to the teleprinter motor, the initial one or two characters received may be garbled as the teleprinter motor requires approximately 100 milliseconds to attain full speed after application of power.

1.2 The actual time interval before power cutoff occurs is preset by the manufacturer at 20 minutes. This fixed delay may be readily changed to intervals of 5, 10, or 15 minutes by connecting a jumper wire between certain pairs of plug-in barrier strip terminals as described in the Installation section of this manual.

### 2.0 FEATURES

2.1 The components which constitute the Station Motor Control are solid state, with the exception of the latching relay and the control relay. The unit is housed in a protective Case Assembly. Operating voltage for the unit is 115 VAC  $\pm$ 10%, 60 CPS which is applied through a six foot cord provided for this purpose. In addition, two wires are provided for connecting the control line to the Station Motor Control Signal Loop. The unit is supplied with a dual power outlet, with the receptacles identified as CONTROLLED and OPTIONAL. Both receptacles are factory wired to be controlled by the control relay; however, the OPTIONAL receptacle may be converted to uncontrolled to serve as a 115 VAC, 60 CPS convenience outlet for connection of equipment not requiring control.

2.2 A Normal/Bypass switch is provided on the Station Motor Control to permit the recep-

tales to be transferred from controlled operation to convenience operation should operational procedures require this. The unit is shipped from the manufacturer with the switch in the NORMAL position. When the switch is placed in the BYPASS position, the teleprinter motor will operate continuously upon application of power.

### 3.0 SPECIFICATIONS

Time Delay . . . . . 5, 10, 15 or 20 minutes, 20 minutes set at factory

Repeat Accuracy . . . . . 5%

Operating Voltage . . . . . 115 VAC  $\pm$ 10%, 60 CPS

Output Relay Contacts . . . . . S.P.S.T.(N.O.)

Contact Current Rating at Controlled Output . . . . . 20 amperes inductive at 115 VAC

Restart Time . . . . . 25 milliseconds after receipt of "Mark-to-Space" transition

Control Signals:  
Neutral Loop . . . . . 15 to 100 milliamperes

Polar Loop . . . . . 7 to 50 milliamperes

Voltage Drop Across Input Terminals . . . . . 2.0 VDC maximum

Input Impedance:  
Neutral Loop . . . . . 100 ohms resistive

Polar Loop . . . . . 200 ohms resistive

Weight . . . . . 3 pounds, approximately

Overall Dimensions . . . . . 6 11/16 x 3 1/2 x 2 13/16 inches

### 4.0 THEORY OF OPERATION

4.1 Simplified Block Diagram Description. A simplified block diagram of the Station Motor control is shown in figure 1-1. The unit is a Delay-On-Drop-Out Timer which consists of a basic Tempo timing circuit, a latch circuit, an AND Gate and an output circuit.

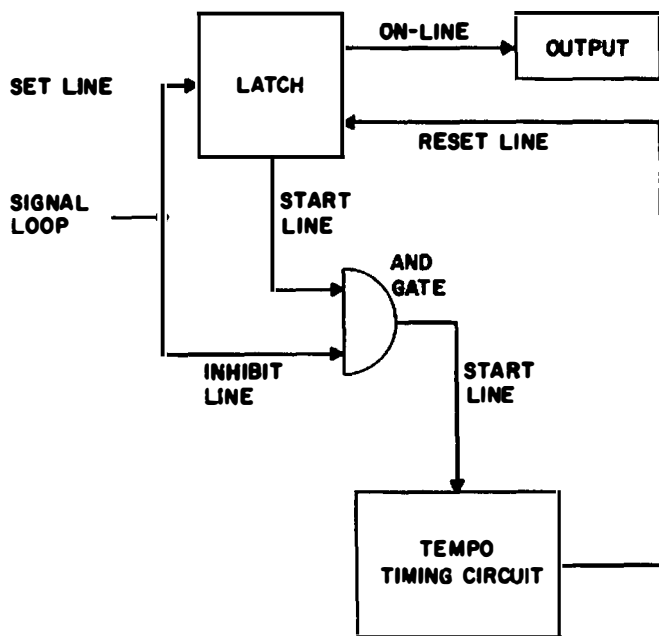


Figure 1-1. Simplified Block Diagram

4.1.1 Reference to the timer logic diagram, contained in figure 1-2, shows that power must be applied continuously to the unit. A signal appearing on the Signal Loop sets the latching circuit which energizes the control relay, turning on the teleprinter motor. "Mark-to-Space" transitions do not affect the latching circuit, which remains in its latched state. However, they do reset the timer. After the last "Mark-to-Space" transition, the timing is initiated.

4.1.2 Upon completion of the timing cycle, the latch circuit is reset and the output is de-energized. The timing circuit now reverts to its reset state.

4.2 Circuit Description. The Station Motor Control schematic diagram is shown in the Drawing section of this manual and should be referred to during the following description. Power is supplied to the circuit from a full-wave rectifier (CR1, CR2) connected to the secondary winding of transformer T1. Inductive kick-back from the loads connected to the CONTROLLED and OPTIONAL receptacle is absorbed in the transient suppressor CR12 which protects control relay K1 from excessively high induced voltages. Since the charging rate of timing capacitor C4 varies with the input voltage applied to the timing circuit, voltage variations during the timing will cause changes in the time delay interval. In order to ensure input voltage stability to the timing circuit, a Zener diode voltage regulator (Z1) is included to provide a constant voltage for the RC network, minimizing time delay errors caused by variation in the line voltage. This regulated voltage is maintained at a constant 12 volts by Z1.

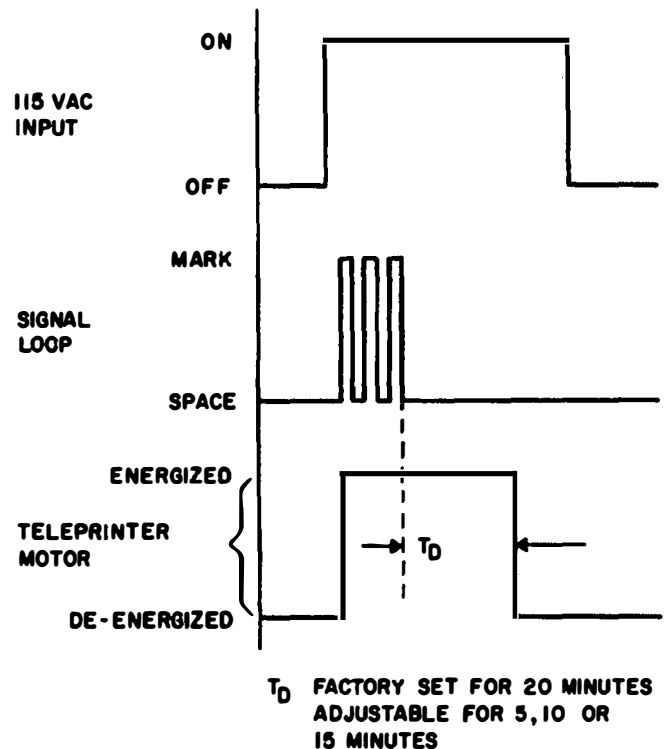


Figure 1-2. Timer Logic Diagram

4.2.1 Now consider that portion of the schematic diagram which represents the timing circuit. The essential elements which constitute this circuit may be divided into three parts: a resistor-capacitor network, consisting of timing resistors R3 through R6 and a timing capacitor C4; a resistor bias network, consisting of two fixed resistors R7 and R8, variable resistor R10, and bias diode CR3; and, lastly, a transistor gate circuit, consisting of transistors Q1, Q3 and diode CR4. Transient suppression is provided by capacitors C2, C3 and C5 to protect the circuit from spurious signals imposed on the power line. Since the output transistor of the timing circuit, Q4, has no effect on the timing, it can be considered external to the timing circuit.

4.2.2 The characteristics of the gate circuit are such that, when the regulated voltage is applied, the base of Q1 is positive with respect to the emitter, and the gate is held in an unfired state and appears as a high impedance in parallel with timing capacitor C4. Simultaneously, the gate presents an impedance of several megohms in series with the output circuit Q4 and relay K2. When the regulated voltage is applied, capacitor C4 begins to charge through the timing resistors and continues to charge until the voltage developed across the capacitor exceeds the voltage developed across the bias resistor network (R7, R8 and R10). As a result, the base of Q1 becomes a few millivolts negative with respect to the emitter. At this point the gate fires.

4.2.3 When the gate fires it locks in a fired state and applies a voltage step with a rise time of a few microseconds to the output circuit. The impedance in series with the output changes to a few

ohms, and the impedance in parallel with timing capacitor C4 changes to a few hundred ohms. The output then energizes allowing K2 to open, disconnecting the timer from the regulated supply. The timer is now in its reset state, which is the ready condition to which the timer must be returned before performing another cycle. Another timing cycle is generated upon reapplication of the regulated voltage.

4.2.4 Next consider the manner in which the input signal controls the timing circuit. A "Mark-to-Space" transition is applied to the base of transistor Q5 through the Signal Loop line. Transistor Q5 is turned off by a "Mark-to-Space" transition applying a momentary pulse to the base of Q7, through capacitor C8 and resistor R24, turning on Q7. The collector of Q7 momentarily goes to ground and as it does so it provides a path to ground for the coil of relay K2, energizing the relay. Relay K2, once energized, latches through diode CR11 and the closed relay contacts. Once relay K2 latches, a path to ground is provided for the coil of control relay K1 which energizes and applies line voltage to the outlet receptacles.

4.2.5 Additional "Mark-to-Space" transitions do not affect the latching circuit, which remains in its latched state. It does, however, allow diode CR5 to conduct, turning off transistor Q2, discharging timing capacitor C4 and resetting the timer. When the "Mark-to-Space" transitions end, the time delay commences. After the time delay, Q4 shorts out relay K2 which de-energizes control relay K1. The circuit is now in its reset state until receipt of another "Mark-to-Space" transition via the Signal Loop.

## 5.0 INSTALLATION

5.1 The Station Motor Control may be mounted in any position, on the wall, floor, side of a teleprinter, or other suitable surface; however, it should be located conveniently on or near the teleprinter or other device to be controlled. Consideration must be given to the location of the unit relative to the 115 VAC outlet, the teleprinter power cord, and the data circuit input. If the unit is to be mounted in a location not readily accessible, it may be desirable to proceed with the installation connections and operational tests before securing the unit to its final location.

5.2 The Station Motor Control outline dimensions and mounting hole locations are shown on the assembly drawing located in the Drawing section of this manual. Two of the mounting holes are on 2-1/4-inch centers to permit 19-inch relay rack installation. Mounting bolts and self-tapping metal screws are provided with the unit to facilitate installation.

**CAUTION: WHEN POWER IS CONNECTED TO THE MOTOR CONTROL UNIT DANGEROUS AC VOLTAGE IS EXPOSED ON TERMINALS, RECEPTACLE, SWITCH, RELAY, AND OTHER COMPONENTS.**

5.3 With power removed from the Station Motor Control, remove the four binding head screws, two located on each side of the unit, and remove cover.

5.4 Polar Loop Conversion. The unit is wired at the factory for neutral loop operation. If it is desired to convert the unit for polar loop operation, a jumper wire must be removed from barrier strip terminals 5 and 6.

5.5 Time Delay Conversion. The time delay of the unit is factory set for 20 minutes; however, the delay may be changed from 20 minutes to 5, 10, or 15 minutes by installing a jumper wire between the applicable barrier strip terminals as indicated in the Time Table shown below.

**CAUTION: DO NOT SHORT OR CONNECT JUMPERS TO ANY TERMINALS OR COMPONENTS OTHER THAN THOSE INDICATED IN THE TABLE.**

TIME TABLE

<u>TIME DELAY (MINUTES)</u>	<u>JUMPER CONNECTION</u>
5	1 and 4
10	1 and 3
15	1 and 2
20	No Connection

5.6 Dual Outlet. The Station Motor Control is normally wired with both outlets under the control of the cutoff relay. The OPTIONAL outlet may be wired uncontrolled to serve as a 115 VAC convenience outlet by removing the jumper from barrier terminals 8 and 9 and connecting the jumper between barrier strip terminals 7 and 8.

**NOTE: IT WILL BE NECESSARY TO OPEN THE INPUT CIRCUIT TO THE TELEPRINTER AND TO MAKE TESTS TO CHECKOUT THE INSTALLATION. IT IS RECOMMENDED, THEREFORE, THAT THE LOOP BE REMOVED FROM SERVICE AND CONNECTED TO A DUMMY CIRCUIT AT THE CENTRAL OFFICE UNTIL THE INSTALLATION IS COMPLETE.**

5.7 Interconnection. A diagram which illustrates the interconnection of the Station Motor Control and a teleprinter is shown in figure 1-3. Refer to this figure, and insert the two-conductor cable in series with the dc Signal Loop. The red wire of the cable is positive and the black wire is negative. Any convenient connecting place may be used, such as a loop switchboard or teleprinter where terminal connectors are available.

**CAUTION: WHEN POWER IS CONNECTED, BEWARE OF TOUCHING ANY TERMINALS OTHER THAN THOSE SPECIFIED. DANGEROUS AC VOLTAGE IS EXPOSED.**

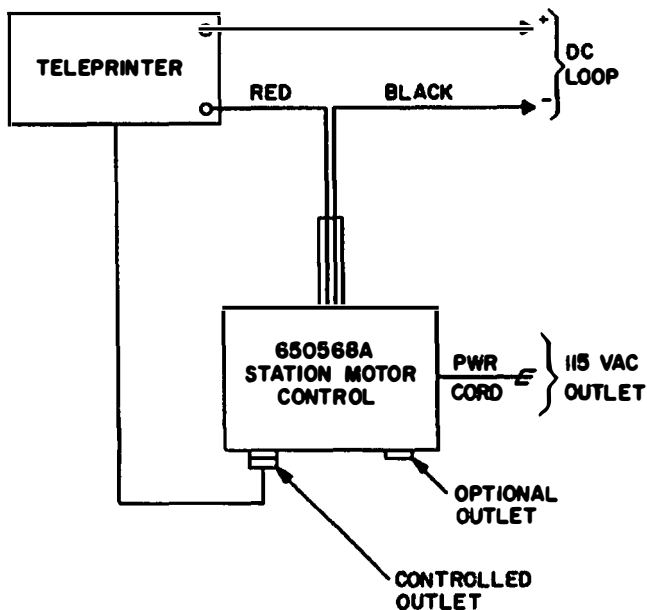


Figure 1-3. Interconnecting Diagram

5.8 Plug the teleprinter power cord into the Station Motor Control outlet designated as CONTROLLED, and plug the Station Motor Control power cord into a 115 VAC, 60 CPS outlet. The power cord plug is a three-conductor connector, therefore, if the cord is plugged into a grounded outlet and, if the teleprinter has a three-conductor plug, the teleprinter chassis and the Station Motor Control will be at ground potential. If a 3-wire to 2-wire adapter plug is used, it is recommended that a ground wire be connected separately.

5.9 Operational Checks. After connecting the Station Motor Control as specified in 5.7 and 5.8, the system should be checked as follows:

- Verify that the Station Motor Control bypass switch is positioned to NORMAL.
- With the Signal Loop idle, apply a temporary jumper across terminals 1 and 4, shorting out timing resistors R3, R4 and R5.
- Transmit several characters from the teleprinter keyboard, or otherwise open and close the circuit. The teleprinter motor should go on 25 milliseconds after receipt of a "Mark-to-Space" transition, indicating that the CONTROLLED outlet is energized.
- Again transmit a few characters from the teleprinter keyboard (or open and close the circuit a few times) to reset the timing circuit. Note that 5 minutes later the output relay de-energizes causing the teleprinter motor to stop. If the unit fails to time-out, refer to the Maintenance section for further test.
- Introduce a single character or momentary "Mark-to-Space" transition. The cutoff relay should energize and restore power to the outlets. If

the unit fails to reset, refer to the Maintenance section for further tests.

f. Remove temporary jumper from terminals 1 and 4.

g. The procedure performed in steps c through f were arranged to speed-up the check out of the unit. If desired, steps c through f may be repeated without the jumper, testing the unit for the full timing interval of 20 minutes.

h. Unless it is necessary to make further tests, or to change the time-interval as described in paragraph 5.5, unplug the power cord and replace the cover.

i. Finish mounting the unit if this has not been completed. Reconnect power to the unit, return loop to service, and check loop current.

## 6.0 MAINTENANCE

6.1 The Station Motor Control is designed for minimum maintenance. Troubleshooting is performed using standard test equipment such as an oscilloscope, Tektronics Model 504A, or equivalent and a Simpson multimeter Model 260, or equivalent. As replacement of component parts is straightforward, no detailed removal procedures are given; however, when replacing parts, it is recommended that unsoldered wiring be tagged, or otherwise identified, to facilitate reassembly. If it becomes necessary to replace components of the printed circuit board, take care not to overheat the board. Figure 1-4 is provided as a guide for Station Motor Control component locations and should be referred to when replacing or ordering parts.

**NOTE:** IN THE TEST DESCRIBED BELOW, VOLTAGE CHECKS ARE SPECIFIED AT VARIOUS TEST POINTS. THESE MEASUREMENTS ARE WITH REFERENCE TO CIRCUIT GROUND WHICH APPEARS ON THE NEGATIVE SIGNAL LOOP TERMINAL. DO NOT USE CHASSIS GROUND, AS THIS WILL CAUSE DAMAGE TO THE UNIT.

6.2 Station Motor Control Fails to Turn On. If the Station Motor Control fails to turn on, troubleshoot the unit as follows:

- Check for the presence of 115 VAC input power.
- Check fuse F1 for an open condition.
- Check for +40 volts  $\pm$  10 volts across capacitor C1. If voltage is not present, check rectifiers CR1 and CR2 or transformer T1.
- Check for approximately 25 volts across coil of relay K1. If voltage is present, check the coil of K1. The DC resistance of the coil should be approximately 300 ohms.
- Check Signal Loop by applying a steady "Mark" while checking for approximately 100 millivolts between the collector of Q5 and ground.
- Remove the "Mark." The Collector of Q5 should go to at least 6 volts, and the collector of Q7 should momentarily go to ground (approximately 100 millivolts), then relay K2 should energize and its contacts close.
- Check diodes CR10 and CR11.

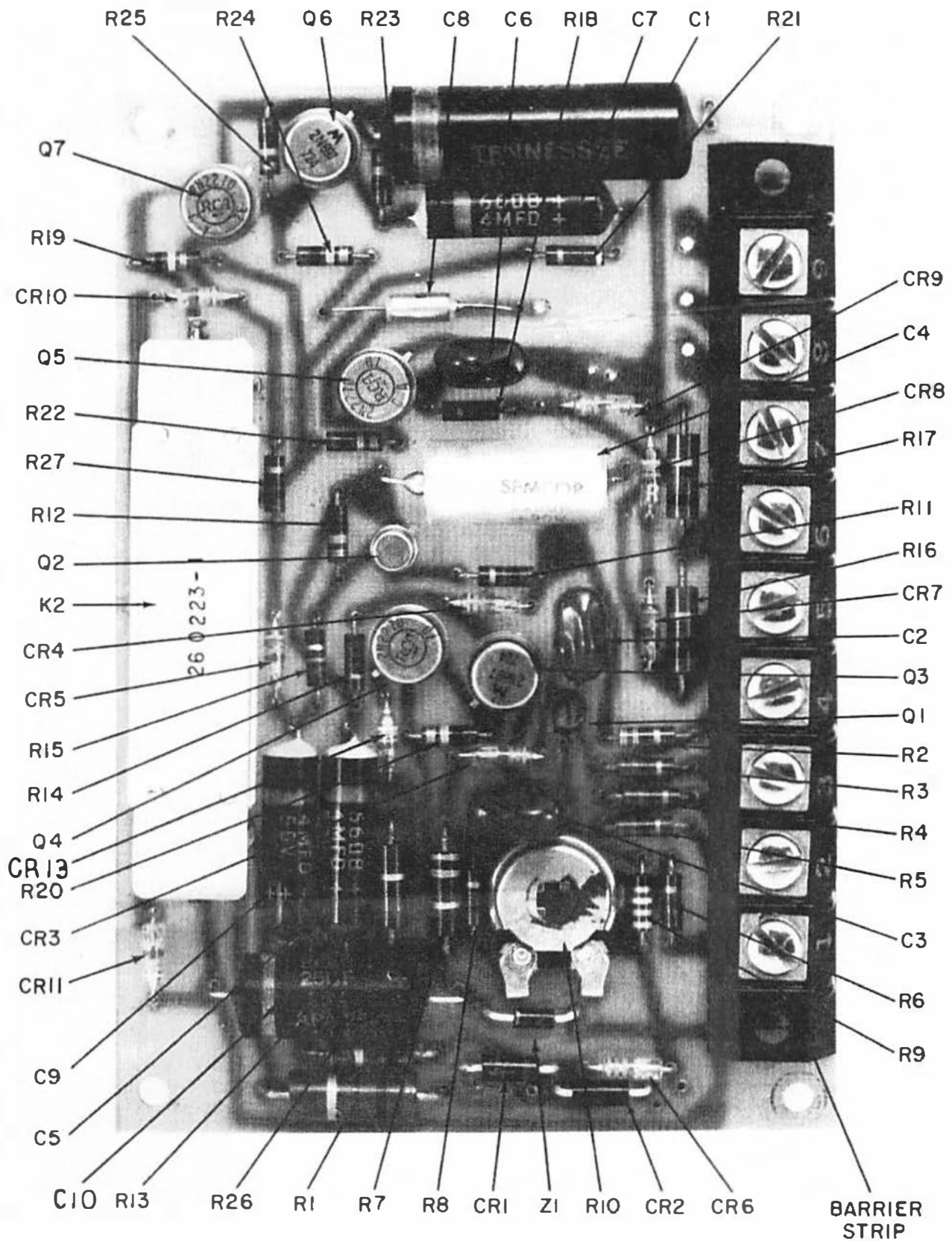


Figure 1-4. Station Motor Control Component Part Locations (Sheet 1 of 3)



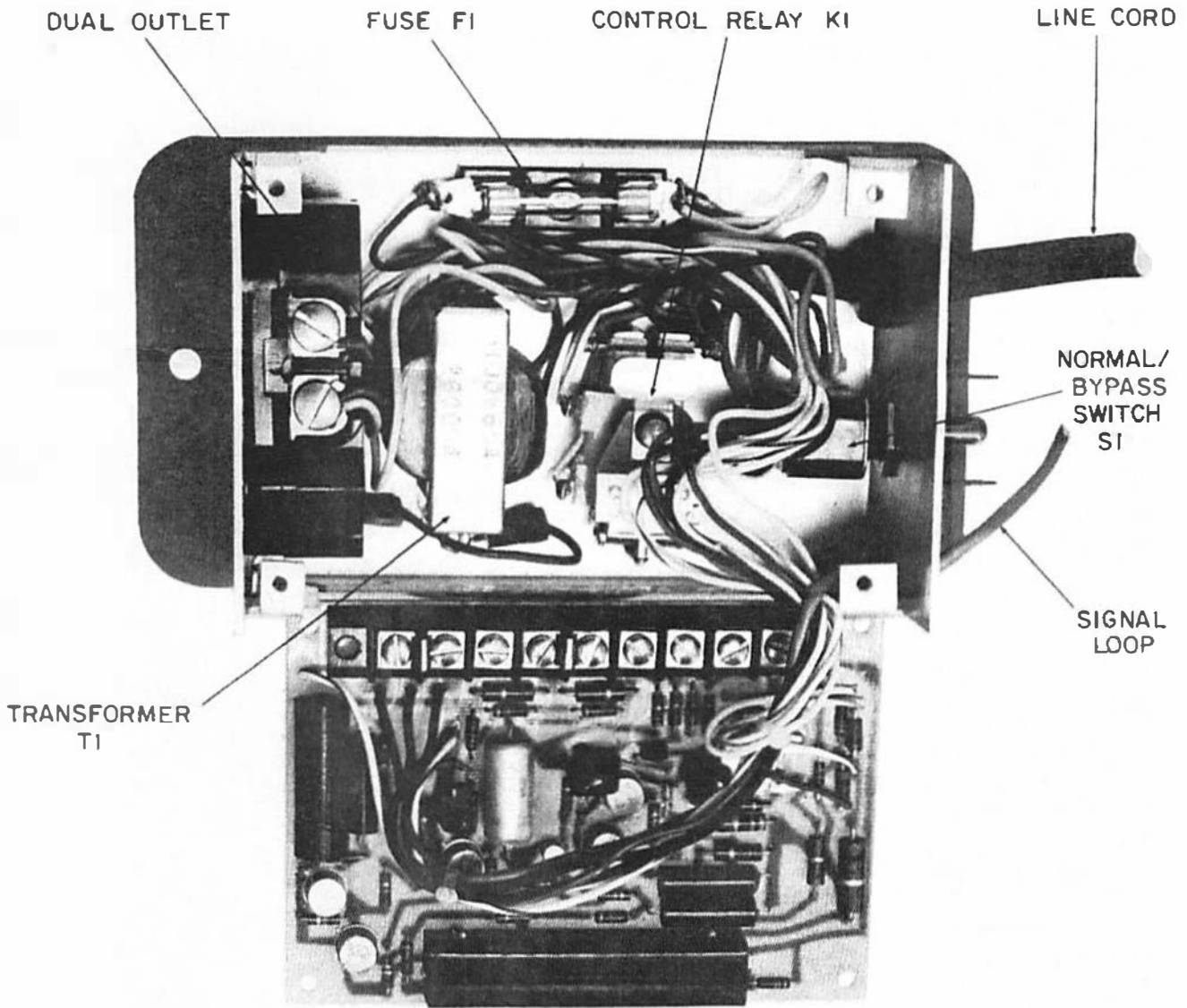


Figure 1-4. Station Motor Control Component Part Locations (Sheet 2 of 3)



Reference Designation	Item	Nomenclature	Unit Qty.	Tempo Part Number
CR1, 2		Diode	2	260196
CR3-11, 13	1N483B	Diode	10	260006
CR12		Transient Suppressor	1	260212-3
Z1		Diode, Zener	1	260231-6
Q1	2N4125	Transistor	1	260241
Q2	2N869	Transistor	1	200220
Q3, 6	2N697	Transistor	2	260105
Q4, 5, 7	2N2270	Transistor	3	260110
C1	50MFD, 50 VDC	Capacitor	1	260178-52
C2, 3, 6	0.1MFD, 100 VDC	Capacitor	3	260259
C4	200MFD, 20 VDC	Capacitor	1	260015-12
C5, 7, 9	5MFD, 50 VDC	Capacitor	3	260178-45
C8	1MFD, 35 VDC	Capacitor	1	260015-2
C10	25MFD, 25 VDC	Capacitor	1	260178-32
R1	1K, 1W	Resistor	1	260175-32
R2	33K, 0.25W	Resistor	1	260017-38
R3, 4, 5, 6	18Meg, 0.25W, 5%	Resistor	4	260238-71
R7	3.3K, 0.5W	Resistor	1	260014-38
R8	1.5K, 0.25W	Resistor	1	260017-34
R9	330K, 0.25W	Resistor	1	260017-62
R10	5K	Potentiometer	1	260265-1
R11	100K, 0.25W	Resistor	1	260017-20
R12, 20, 22, 23, 24, 25	10K, 0.25W	Resistor	6	260017-44
R13	2.7K, 0.5W	Resistor	1	260014-37
R14	270 $\Omega$ , 0.25W	Resistor	1	260017-25
R15	27K, 0.25W	Resistor	1	260017-49
R16, 17	100 $\Omega$ , 0.5W	Resistor	2	260014-20
R18, 27	1K, 0.25W	Resistor	2	260017-32
R19	100K, 0.25W	Resistor	1	260017-56
R21	4.7K, 0.25W	Resistor	1	260017-40
R26	1K, 0.5W	Resistor	1	260014-32
K1	W88 DX-45	Relay	1	260221
K2		Relay	1	260223-1
T1		Transformer	1	260004-3
F1	0.5 Amp	Fuse	1	260191
XF1		Fuse Holder	1	160335
		Terminal Block	1	160330
		Line Cord	1	160337
		Case	1	160343-1
		Cover	1	160343-2
		Switch	1	160334
		Switch Guard	1	160343-3
		Dual Outlet	1	160338
		PC Board	1	160339
		Bushing	1	160336-1
		Bushing	1	160336-3

Figure 1-4. Station Motor Control Component Part Locations (Sheet 3 of 3)

6.3 **Station Motor Control Fails to Turn Off.** If the Station Motor Control fails to turn off, troubleshoot the unit as follows:

- a. Make sure the bypass switch S1 is in NORMAL.
- b. Check transient suppressor CR12.
- c. Check relay K1 for sticky or welded contacts.
- d. Check for voltage across the coil of relay K2. If no voltage is present, make certain the relay contacts are not welded.

e. If voltage is present across K2, check the timing circuit (Q1, Q3 and Q4). Check Q2 for short.

## 7.0 DRAWINGS

Schematic - 650568A-1

Assembly Drawing - 650568A

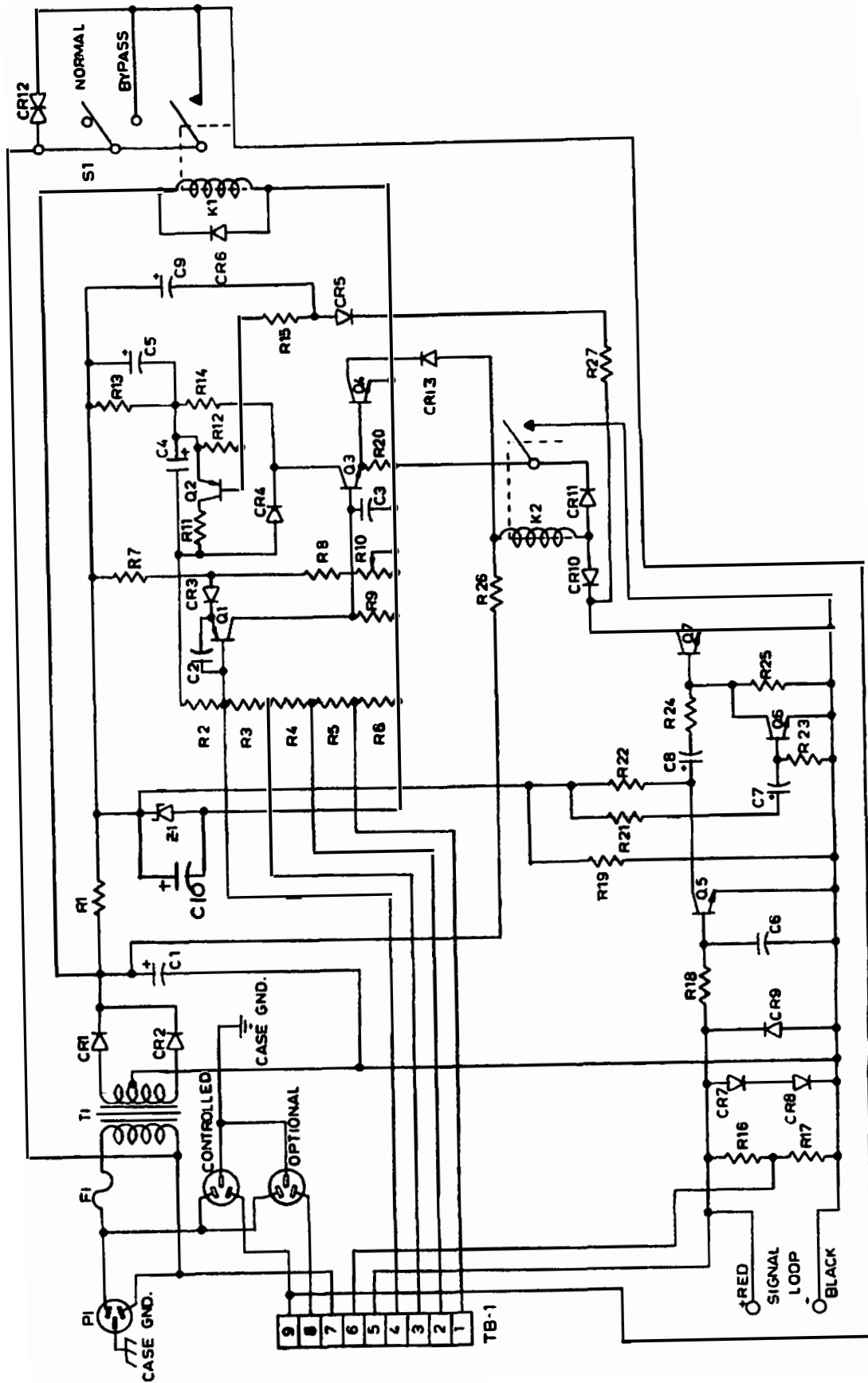
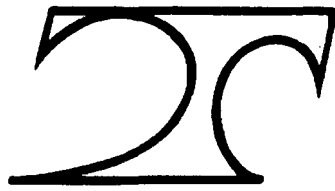


Figure 1-5. Schematic Diagram, Station Motor Control Model 650588A





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