TM 11-6625-620-45-3

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

GS, AND DEPOT MAINTENANCE MANUAL

TEST SET, RELAY TS-836/UGM-1

HEADQUARTERS, DEPARTMENT OF THE ARMY

20 NOVEMBER 1967

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the -100- or + 100- volt curcuits in the power supply, or on the 115- or 230-volt ac line connections. Serious injury or death may result from contact with these points.

DON'T TAKE CHANCES!

CHANGE No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 3 *December 1974*

General Support and Depot Maintenance Manual
TEST SET, RELAY TS-836/UGM-1

TM 11-6625-620-45-3, 20 November 1967, is changed as follows:

1. Remove and insert pages as indicated in the page list below.

Remove	*Insert*
1-1	1-1/(1-2 blank)
5-5 through 5-11	5-5 through 5-11
5-13 through 5-18	5-13 through 5-18
None	7-7/(7-8 blank) and 7-8.1/(7-8.2 blank)
7-11	7-11 and 7-12

2. New or changed material is indicated by a vertical bar.
3. Retain this transmittal sheet in front of the manual for future reference.

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Fort Huachuca (10)
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Fort Carson (5)
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Army Depot (1) except
LBAD (14)
SAAD (30)
TOAD (14)
ATAD (10)
USA Dep (2)
Sig Sec USA Dep (2)
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USAERDAW (1)
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11-97
11-98
11-117
11-127
11-500(AA-AC)

NG: None
USAR: None
For explanation of abbreviations used, see AR 310-50.

TECHNICAL MANUAL
No. 11-6625-620-45-3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 20 *November 1967*

GS and Depot Maintenance Manual
TEST SET, RELAY TS-836/UGM-1

*This manual supersedes TM 11-6625-620-45-3, 6 December 1966.

CHAPTER 1
INTRODUCTION

1-1. Scope

a. This manual contains general support and depot maintenance instructions for Test Set, Relay TS-836/UGM-1. It includes instructions appropriate to general support and depot maintenance for troubleshooting, testing, aligning, and repairing the equipment. It also lists tools, materials, and test equipment required for general support and depot maintenance. Functional analysis of the equipment is covered in this chapter.

b. The complete technical manual for this equipment includes TM 11-6625-620-12 and TM 11-6625-620-25P-3.

1-2. Indexes of Publications

a. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58/NAVSUP PUB 378/AFR 71-4/MCO P4030.29, and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33/AFM 75-.18/MCO P4610.19A, and DSAR 4500.15.

d. Report of errors, omissions, and recommendations for improving this manual by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commanding General, US Army Electronics Command, ATTN: AMSEL-MA-ML, Fort Monmouth, NJ 07703.

1-4. Destruction of Army Materiel

Demolition and destruction of this equipment will be under the direction of the commander and in accordance with TM 750-422-2.

1-5. Administrative Storage

For procedures, forms and records, and inspections required during administrative storage of this equipment, refer to TM 740-90-1.

CHAPTER 2

FUNCTIONING OF EQUIPMENT

Section I. BLOCK PROGRAM

2-1. General
(fig. 2-1)

The TS–836/UGM–1 checks the operating characteristics of electronic and mechanical relays at different signal speeds. The TS-836/UGM-1 consists of three major sections: power supply circuits, timing circuits, and output circuits. The manner in which operating and signal voltages are developed is illustrated in the block diagram and discussed. in the paragraphs below.

2-2. Power Supply
(fig. 2-1)

The output voltages of the power supply are + 100, –100, and +15 volts direct current (dc). These voltages are developed from a 115– or 220–volt alternating current (ac) power source. The input power is applied to the primary of transformer T1 which develops 120–volts ac across each of the secondary windings. The 120–volt ac is applied to a –100-volt rectifier and to a +100–volt rectifier. These rectifiers convert the 120 volts ac to –100, + 100, and + 15 volts dc. These dc voltages are maintained at a constant level by their respective regulator circuits.

2-3. Timing Circuit
(fig. 2-1)

The timing ciruit generates contant marks and spaces (reversals), to simulate messages, which are applied to the relay under test. The reversals are generated by a free-running multivibrator Q1–Q2. The multivibrator produces a sawtooth output at selectable rates and applies it to a bistable multivibrator Q3-Q4. The bistable multivibrator reshapes the sawtooth signal and changes the voltage levels to approximately +15 and +0.4 volts. These voltages are applied to emitter follower Q5. The output of the emitter follower is used to drive electronic switch Q5 in the output circuit (Pam 2–4) .

2-4. Output Circuit
(fig. 2-1)

The output circuit couples the test voltages to the relay under test and allows the output of the relay to be coupled to EXTERNAL OUTPUT jack J3 where it can be observed on a distortion meter or oscilloscope. The type of relay under test determines the current required to operate the relay coil. The current control section of the output circuit supplies the current to the relay through the relay test socket. Electronic switch Q5 simulates message transmission for the relay under test by providing reversals in the form of circuit openings and closings.

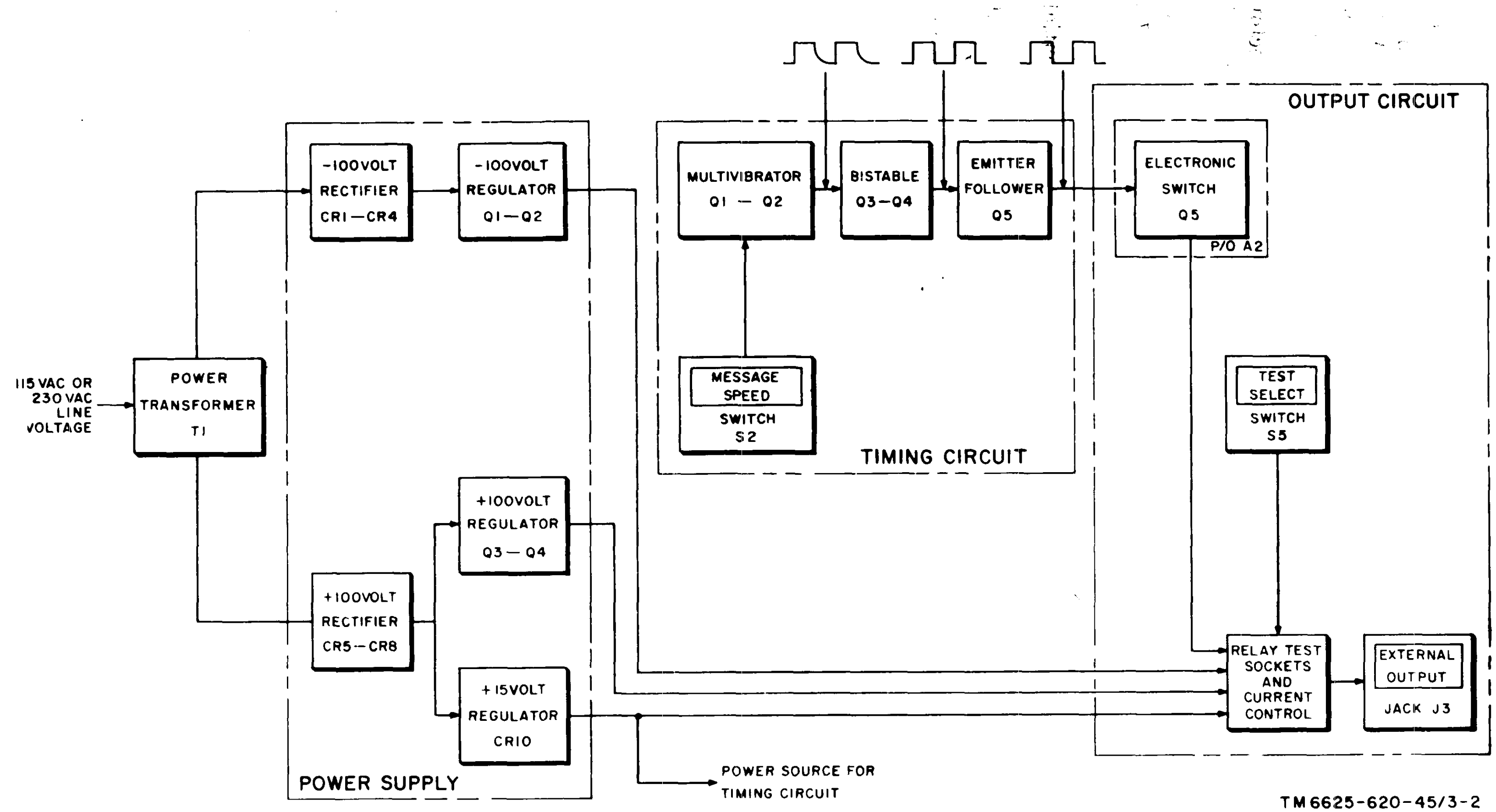

Figure 2-1. Test Set, Relay TS-836/UGM-1 block diagram.

Section II. DETAILED FUNCTIONING OF ELECTRONIC CIRCUITS

2-5. General
(fig. 2-1)

The operation of Test Set, Relay TS-836/ UGM–1 is explained in detail in paragraphs 2–6 through 2–10. The -100-volt bridge rectifier and the -100- and +100-volt regulators are discussed below.

2-6. Bridge Rectifiers (CR1-CR4 and CR5-CR8)

The rectifier consists of four diodes, connected in a full-wave bridge circuit. The output voltage developed across one of the secondary windings of transformer T1 is applied to the junction of diodes CR1 and CR3 and CR2 and CR4. When the instantaneous ‘polarity of the incoming ac voltage, developed across the secondary winding of transformer Tl, is such that a positive potential is applied to the j unction of diodes CR2 and CR4, diodes CR4 and CR1 are forward biased. Electrons flow through resistors R1, R4, and R5, and develop forward bias and collector voltage for differential amplifier Q1 (located on the printed circuit board) and current regulalor Q1 (located on the rear panel). The output voltage is developed across Zener diode CR9 and resistor R7. Diodes CR2 and CR3 are reverse biased under this condition. When the polarity of the incoming ac voltage is reversed, diodes CR2 and CR3 are forward biased and diodes CR1 and CR4 are reverse biased. Conduction through alternate pairs of diodes produces a negative pulsating dc voltage. The ripple component of the pulsating dc output is removed by filter capacitor C1 (on the rear panel). The negative output voltage is applied to the -100-volt regulator.

2-7. Voltage Regulators (-100- and +100-Volt)
(fig. 7-4)

a. The voltage regulators use Zener diodes and transistors to maintain constant output voltages. The + 100-volt regulator has a tap which provides a + 15-volt output.

b. The dc output voltage of bridge rectifier CR1-CR4 is applied to the 100-volt regulator across a voltage divider consisting of resistors R1, R4, and R5. The voltage developed across resistors R4 and R5 is applied to the base of transistor Q1 (located on assembly 3A1A2), forward biasing this transistor. This causes current flow through emitter resistors R6 and R7 ad collector resistors R2 and R3. The voltage developed at the junction of collector resistors R2 and R3 is applied to the base of transistor Q1 (on the rear panel) and forward biases this transistor. A variable voltage divider consisting of resistor R8 and BALANCE ADJUST resistor R11, provides forward bias for transistor Q2. Transistors Q1 and Q2 (located on assembly 3A1A2), form a differential amplifier circuit having common emitter resistors R6 and R7. Any change in output voltage developed at the junction of Zener diode CR9 and fuse F1 will be sensed by the differential amplifier which maintains the output voltage at a constant level. Regulation of the output voltage is described in paragraphs 2–8 and 2–9.

2-8. Regulation of Output Voltage
(fig. 7-4)

a. Assume that the load current through transistor Q1 (on the chassis) increases, the voltage chop across this transistor will also increase, decreasing the output voltage across Zener diode CR9 and resistor R7. Since Zener diode CR9 is a voltage regulator, maintaining a constant voltage drop, any decrease in voltage will be applied across emitter resistor R7 and the forward bias on transistor Q1 (located on assembly 3A1A2) will increase. Increasing the forward bias on transistor Q1 will cause more current to flow through collector resistor R3, thereby increasing the negative voltage applied to the base of transistor Q1 (on the chassis). Increasing the negative base voltage of transistor Q1 (on the chassis) will cause the forward bias on this transistor to increase and the collector-emitter resistance to decrease. Less voltage will be dropped across transistor Q1, which will cause the output voltage to increase to its previous level.

b. If the load current through transistor Q1 (on the chassis) decreases, the voltage across emitter resistor R7 will increase and the flow of current through transistor Q1 (located on assembly 3A1A2) will decrease. A decrease in conduction of transistor Q1 will cause the forward bias on transistor Q1 (on the chassis) to decrease and the collector-to-emitter resistance to increase. More voltage will be dropped across transistor Q1, which wiil cause the output voltage to decrease to a normal level.

c. The differential amplifier senses very small as well as very large load changes. Zener diode CR9 provides a fixed reference voltage for the emitter of transistor Q1 (on the chassis) This action allows maximum variation across chassis transistor Q1 to obtain the best possible regulation.

(1) *+100-volt regulutor outputs.* The +100-volt regulator provides + 100 volts in the same manner as the –l00-volt regulator provides -100 volts Also, the input voltage divider, in the +100-volt regulator circuit, consisting of resistors R9, R12, and R15 (located on terminal board TB2), develops +15 volts operating power for the timing circuit. Capacitors Cl and C2 (on the chassis) are used for filtering. Variable resistors R11 and R12 adjust the output of the –100- and +100-volt regulators, respectively.

(2) *Balancing regulator outputs.* Resistors R22 and R23 form a voltage divider across the output of both regulators. When the voltage at the junction of misters R22 and R23 is not zero a comparison is made of the difference in output voltages of the regulators. This difference can be measured with voltmeter connected to BAL TEST jacks J1 and J2 on the front panel or by connecting PERCENT meter Ml into the circuit (junction of resistors R22 and R23) by placing the TEST SELECT switch (on the front panel) in the PS BAL position.

2-9. Current Determining Circuit
(fig. 7-4)

a. The regulated outputs of the -100- and +100-volt regulators are applied through relay socket XK1 or XK2 to the coils of the relay under test to determine contact efficiency and bias distortion. Bias current is developed from the -100-volt line through resistors R5, R6, R7 (BIAS CURRENT ADJUST), R8 and R14, together with section Y of TEST CURRENT switch S3 (forming a current-limiting network). TEST CURRENT switch S3 selects one of three bias current levels (4, 10, or 30 milliamperes (ma)) for the bias coil of the relay under test by short circuiting either resistor R6 on terminal board TB2 or resistors R5 and R6. Resistor R7 (BIAS CURRENT ADJUST) adjusts the bias current applied to the bias coil of the relay under test. The bias current can be monitored at BIAS CURRENT MONITOR jack J5 on the rear panel.

b. Operating current is developed from the +100-volt line through resistors R1, R13 (on terminal board TB1), Rs (OPERATE CURRENT ADJUST), R3, and R4, together with SECTION X of TEST CURRENT switch S3 (forming a current-limiting network). TEST CURRENT switch S3 selects one of three operate current levels (8, 20 or 60 ma) for the operate coil of the relay under test by short circuiting either resistor R4 (on terminal board TB2) or resistors R3 and R4. Resistor R2 (OPERATE CURRENT ADJUST) adjust the operate current applied to the operate coil of the relay under test. The operate current can be monitored at OPERATE CURRENT MONITOR jack J4 on the rear panel.

c. When the TEST SELECT switch is in any position except PS BAL, contact current for the relay is supplied by the -100- and +100-volt lines. These voltages, connected through resistors R21 and R24, are present at terminals 4 and 7 of relay socket XK2. When the bias and operating currents are wed through the respective relay coil, a polarized signal is produced at terminal 6 of relay socket XK2. This signal is retified by a bridge rectifier consisting of diodes CR11 through CR14, and then applied through OUTPUT CURRENT SELECT switch S4 to current-limiting resistors R16 through R22 to PERCENT meter M1 where an indication of current flowing through the relay contacts can be observed. An oscilloscope or distortion meter can be connected to EXTERNAL OUTPUT jack J3 to measure distortion.

2-10. Timing Circuit
(fig. 7-4)

The timing circuit consists of a free-running multivibrator (Q1–Q2), a bistable (Q3–Q4), emitter follower (A3Q5), and an electronic switch (A2Q5). The timing circuit, by circuit openings and closings, simulates message conditions. The timing circuit, with the exception of the electronic switch, is located on assembly 3A1A3. The electronic switch is located on assembly 3A1A2.

a. Multivibrator Q1–Q2. The multivibrator circuit is a stardard free-running multivibrator, connected to MESSAGE SPEED switch S2 through frequency determining capacitors C3 through C12. These capacitors are individually switched into or out of the circuit by MESSAGE SPEED switch S2, depending on the frequency to be selected. The capacitors that are switched into the circuit operate in conjunction with base resistors R3, R4, and R5 to determine the frequency of the rnultivibratm. Resistor R1 and capacitors C1 and C2 form a decoupling network. Resistors R2 and R7 are collector load resistors. Resistor R6 is a common emitter bias resistor for the multivibrator. The output of the multivibrator, developed at the collector of transistor Q2, is coupled through capacitor C16 to a steering diode (CR1 or CR2) and applied to bistable Q3–Q4.

b. Bistable Multivibrator Q3–Q4. The bistable multivibrator circuit consists of a single, standard, bistable multivibrator with a single input. The input signal, obtained from multivibrator Q1–Q2, is applied through steering diode CR1 or CR2. With transistor Q4 conducting, the higher of the two positive base voltages appears at the anode of diode CR2. A negative transition from the multivibrator, applied to the junction of diodes CR1 and CR2, forward biases diode CR2, thereby applying the negative pulse to the base of transistor Q4, which turns off transistor Q4 and turns on transistor Q3. The next negative transition, applied to the junction of diodes CR1 and CR2, forward biases diode CR1, thereby applying the negative pulse to the base of transistor Q3 which turns off transistor Q3 and turns on transistor Q4. Capacitors C13 and C14 together with resistors R14 and R16 determine switching time for bistable Q3–Q4. Resistors R12 and R15 provide coupling between transistors Q3 and Q4. Resistors R11 and R17 are collector load resistors. Resistor R13 and capacitor C15 are emitter components common to transistors Q3 and Q4. The output of the bistable multivibrator, developed at the collector of transistor Q4, is applied to the input of emitter follower Q5.

c. Emitter Follower Q5 and Electronic Switch Q5. Emitter follower Q5 isolates electronic switch Q5. The output of bistable Q3–Q4 *(b above) is* applied to the base of transistor Q5. When transistor Q4 is conducting, the output voltage is not high enough for transistor Q5 to conduct. However, when transistor Q4 is not conducting, the positive collector voltage causes transistor Q5 to conduct. Current flows through emitter resistors R18 and R19. The voltage drop across resistor R19 turns on transistor Q5. Current flows through Q5 and diode CR15 to operate the coil of the relay under test.

CHAPTER 3

TROUBLESHOOTING

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

***Warning:* Use care in troubleshooting or making repairs in this equipment. Voltages as high as 230 volts ac are present in the power supply. Use insulated test probes when making the required voltage measurements. Always disconnect power from the equipment before touching any internal part.**

3-1. General Instructions

Troubleshooting at the general support and depot maintenance categories includes all the techniques outlined for organizational support maintenance and any special or additional techniques required to isolate a defective part. Section H describes localizing and isolating techniques to be used by general support and depot maintenance personnel. Observe the following precautions while troubleshooting the TS-836/UGM-1:

a. This equipment contains transistor circuts; therefare, never connect test equipment (other than multimeter and vtvm's) outputs directly to a transistor circuit; use a coupling capacitor.

b. Before using any ohmmeter to test transistors or transistor circuits, check the open-circuit voltage across the ohmmeter test leads. Do not use the ohmmeter if the open-circuit voltage exceeds 1.5 volts. Do not use the RX1 resistance range of the ohmmeter since the RX1 range normally connects the ohmmeter internal battery directly across the test leads and the comparatively high current (50 ma or more) may damage the transistor under test.

c. Make test equipment connections with care so the shorts will not be caused by exposed test equipment connectors. Tape or use sleeving (spaghetti) on test prods or clips to leave as little exposed metal as needed to make contact to the circuit under test.

d. The equipment internal power supply is recommened as the source of power when servicing this transistorized equipment. However, when external power sources are used, *observe polarity.* Polarity reversal may damage the transists or electro!ytic capacitor in the cir cuit. If an external source is used in place of the internal source, it must have good voltage regulation and low ac ripple. Good regulation is important because the output voltage of a power supply that. has poor regulation may exceed the maximum voltage rating of the transistors in the equipment being tested.

3-2. Organization of Troubleshooting Procedures

a. General. The first step in servicing a defective unit equipment is to sectionalize the fault. Sectionalization means tracing the fault to the major equipment component. The second step is to localize the fault. Localization means tracing the fault to the defective stage or unit responsible for the abnormal condition. The third step is isolation. Isolation means tracing the fault to the defective part; figures 3–1 through 3–6 are parts location diagrams. Some faults, such as burned-out resistors, arcing or shorted transformers, can often be isolated by sight, smell, or hearing. The majority of faults, however, must be isolated by checking voltages, resistance, and signal levels.

b. Sectionalization. Following are a group of tests arranged to reduce unnecessary work, and to aid in tracing trouble in a defective relay test set. A relay test set consists of three major sections: the power supply circuits, the timing circuits, and the output circuits. The first step is to locate the section or sections at fault by using the following methods:

(1) *Visual inspection.* The purpose of a visual inspection is to locate the faults without testing or measuring circuits. All moving parts, switch and control settings, or other visual signs should be observed and an attempt made to sectionalize the fault to a particular section.

(2) *Operational tests.* Operational tests frequently indicate the general location of trouble. In many instances, the tests will help in determining the exact nature of the fault. Operating instructions given in paragraph 3-7, TM 11–6625–620–12 provide a good operational check.

c. Localization. The tests listed in *e* below and in paragraph 3-5 will aid in localizing the trouble within that stage by voltage, resistance, or continuity measurements. Use the trouble-shooting chart to localize trouble to a particular stage or part.

d. Isolation. Procedures for isolating troubles are given in paragraph 3–6. These procedures are to be performed at general support and depot maintenance categories.

e. Techniques. In performing the sectionalization, localization, and isolation procedures, one or more of the techniques below may be used. Use these techniques only as indicated and observe all cautions.

(1) *Voltage measurements.* This equipment is transistorized; therefore observe all cautions given in paragraph 3–1 to prevent transistor damage. Make voltage and resistance measurements in this equipment only as specified. When measuring voltages, use tape or sleeving to insulate the entire test prod, except for the extreme tip. A momentary short circuit can ruin a transistor. Use resistor and capacitor color codes (fig. 7–1 and 7–2) to determine values of color-coded components. Compare voltage and resistance data obtained from readings taken on assembly 3A1A2, assembly 3A1A3, and chassis 3A1 with voltage and resistance data for normal readings (fig. 3–7, 3-8, and 7-3, respectively).

(2) *Resistance measurements.* Perform resistance measurements in this equipment only as directed on voltage and resistance charts or diagrams. Use only the ohmmeter ranges specfied (para 3-1), otherwise indications obtained will not be valid. Also, the polarity of the ohmmeter connections must be strichtly observed, where indi cated.

***Caution:* Before using any ohmmeter to test transistors or transistor circuits, refer to the precautions given in paragraph 3-1.**

(3) *Test points. This* euipment is equipped with test jacks to circuits. The test points should be *used* whenever possible to avoid needless disassembly of the equipment. These test paints are shown on the schematic diagram (fig. 7-4) and on the parts location diagrams (fig. 3-1 through 3-6).

(4) *Intermittent troubles.* In all the test, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble can often be made to appear by tapping or jarring the equipment. Make a visual inspection of the wiring and connections to the units of the set. Minute cracks in printed circuit boards can cause intermittent operation. A magnifying glass is helpful in locating defects in printed circuit boards. Continuity measurements of printed circuit conductors may be made using the same technique ordinarily used on hidden conventional wiring; observe the ohmmeter precautions ((2) above).

(5) *Resistor and capacitor color code diagrams.* Color code diagrams for resistars and capacitors (fig. 7-1 and 7–2) provide pertinent resistance ca pactance, voltage rating, and tolerance information.

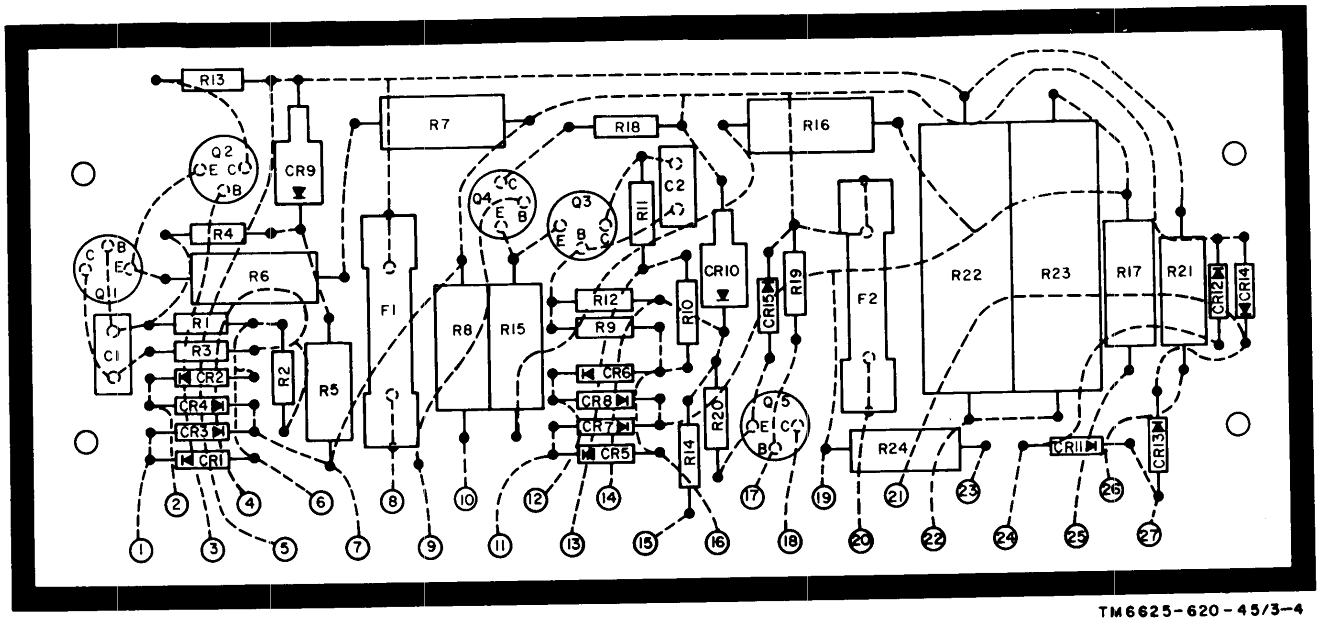

Figure 3-1. Power supply assembly 3A1A2, parts locations.

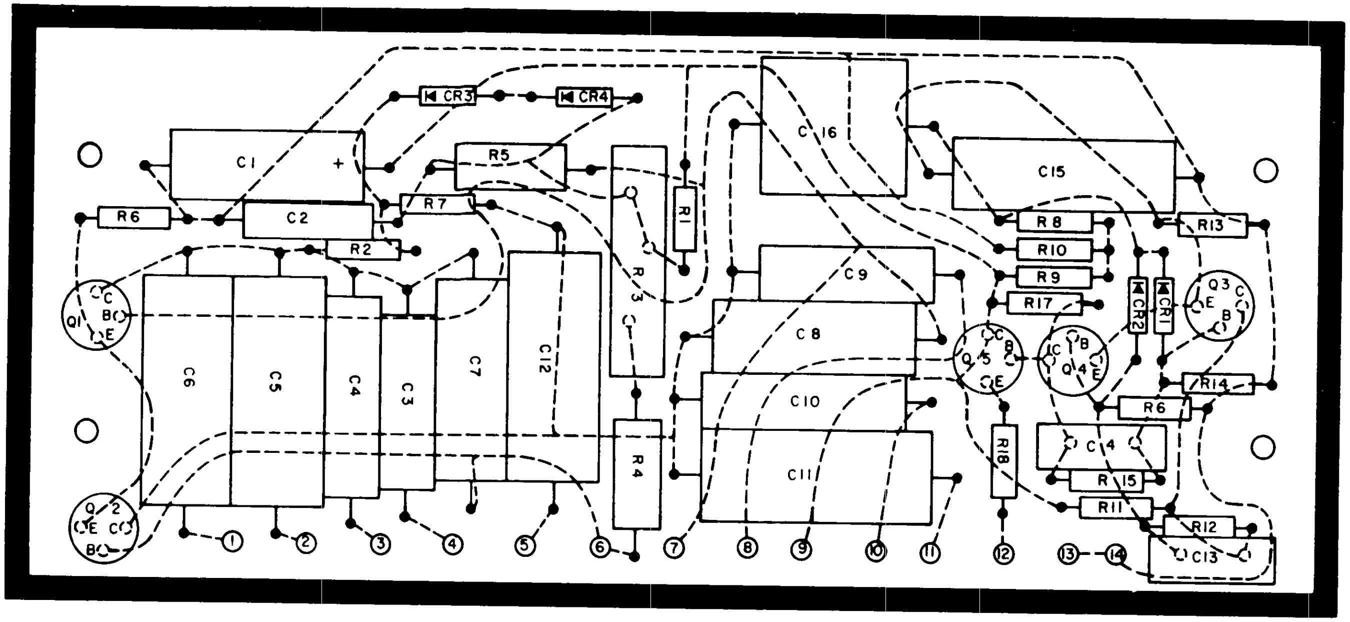

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Figure 3-2. Timing circuit assembly 3A1A3, parts locations.

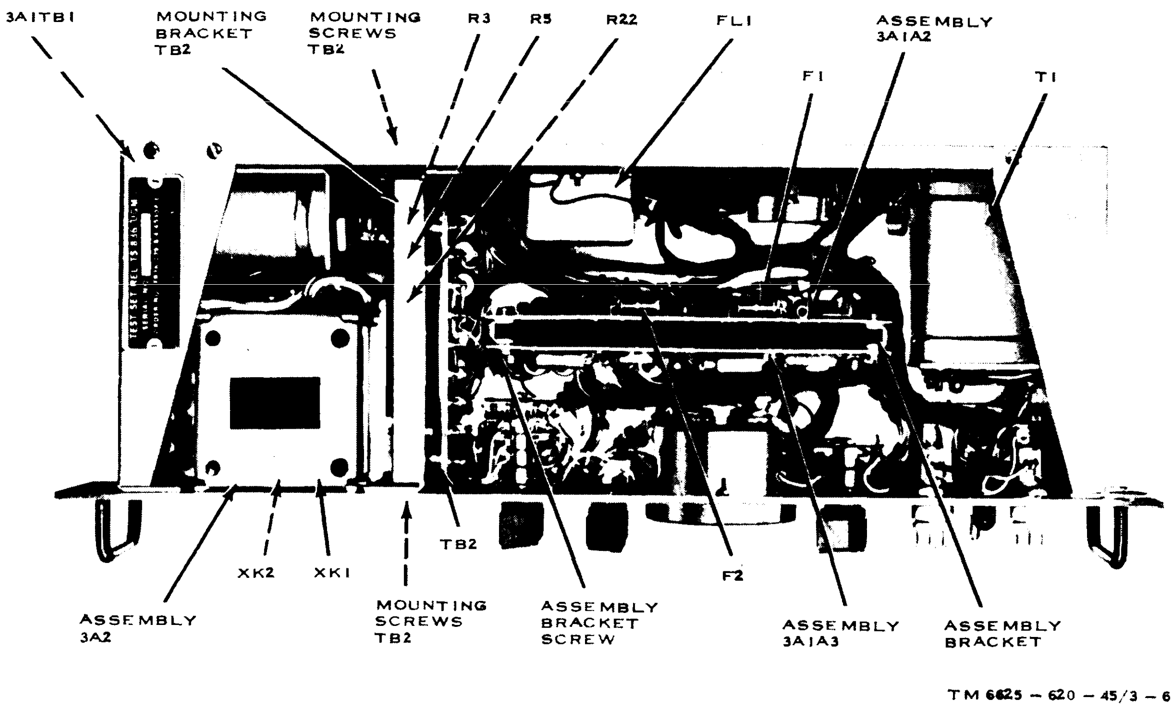


Figure 3-3. Test Set, Relay TS-836/UGM-1, top view.

3-3. Test Equipment Required

The chart below lists the test equipment required for troubleshooting the TS–836/UGM-1. Also it lists the associated technical manuals.

Test equipment	Technical manual
Frequency Meter AN/USM-26	TM 11-5057
Multimeter TS-352B/U ----------	TM 11-6625-366-15
Oscilloscope OS-8C/U------------	TM 11-1214A
Test Set, Teletypewriter TS-1060/GG.	TM 11–6625-207-10
Polar Relay, WECO Type 255A ----------	
Test Set, Teletypewriter TS-799/UGM-1.	TM 11-6625-620-12
Test Set, Teletypewriter TS-800/UGM-1.	TM 11-6625-620-12
Rectifier RA-87–A	TM 11-5815-270-15
Test Set, Transistor TSW1836/U	TM 11-6625-539-15
Solid State Relay Type 9218, Radiation Inc.	---------------

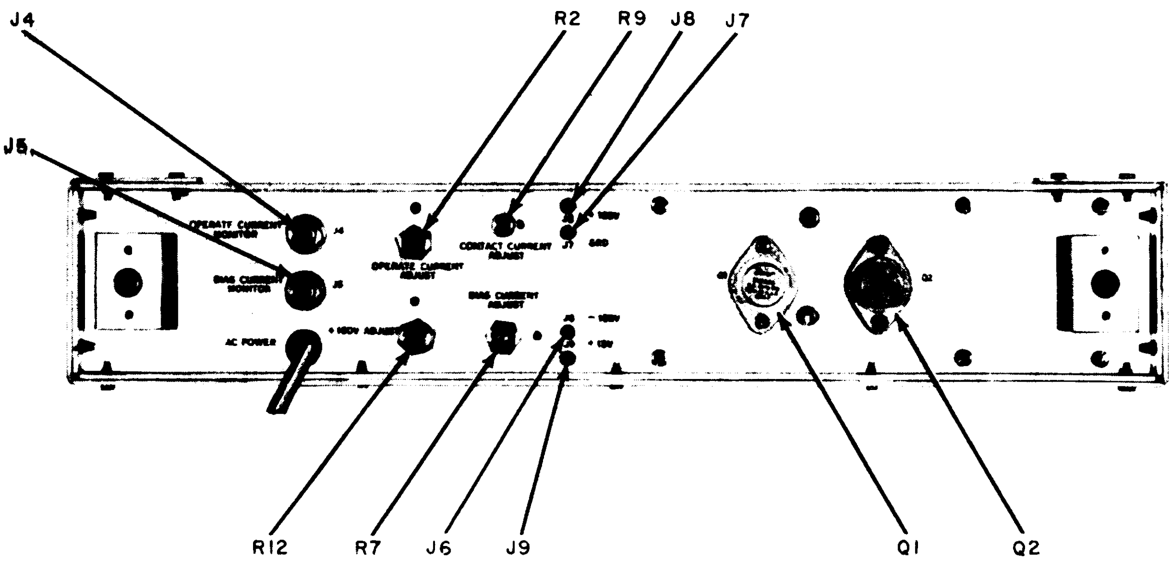
3-4. Calibration of Test Equipment

a. General. The equipment used for troubleshooting does not normally require calibration. However, the calibration of the frequency meter should be checked before the equipment is meter calibration is given in *b* below.

b. Calibration Check of Frequency Meter. To check calibration of the frequency meter, perform the following procedure:

***Caution:* POWER switch S1 must be in the OFF (down) position before installing or removing a front panel plug-in unit.**

(1) Check to that the front panel plug-in unit is in place.
(2) Operate POWER switch S1 to ON position. Allow a 30-minute warmup period. Do not make any connections to equipment during this time.
(3) Operate the MANUAL GATE switch to the closed position.
(4) Operate the FUNCTION SELECTOR switch to the 100KC CHECK position.
(5) Adjust DISPLAY TIME control for desired display. The extreme counterclockwise position is usually the best.



TM6625-620-45/3-7

Figure 3–4. Test Set, Relay TS–836/UGM–1, rear view.

(The display time cannot be adjusted to be less than the gate time.)

(6) Check to see that the indication on the display system for each position of the FREQUENCY UNIT switch agrees with the values given in the chart below.

(7) Set the FUNCTION SELECTOR switch to 10MC CHECK position.

(8) Repeat (6) above, allowing a ± 1 count in the last digit.

Counter readings for calibration check

Gate time (seconds)	100KC check	10MC check
10	0100.0000	0000.0000 ±.0001
1	00100.000	10000.000 ±.001
0.1	000100.00	010000.00 ±.01
0.001	0000100.00	0010000.0 ±.1
0.001	00000100.	00010000 ±1

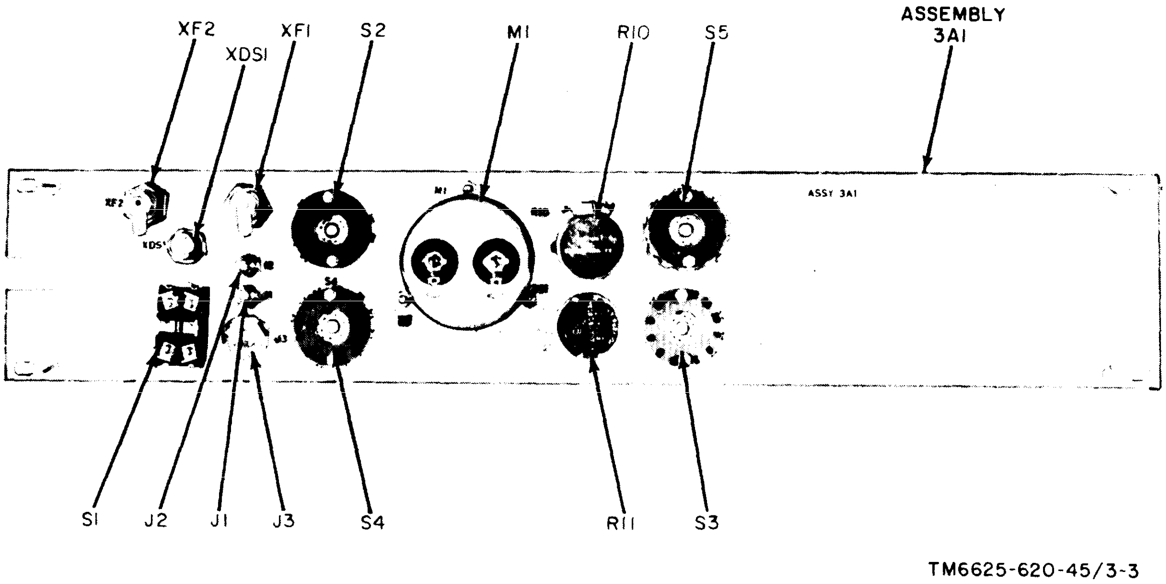


Figure 3-5. Rear view of front panel, parts locations.

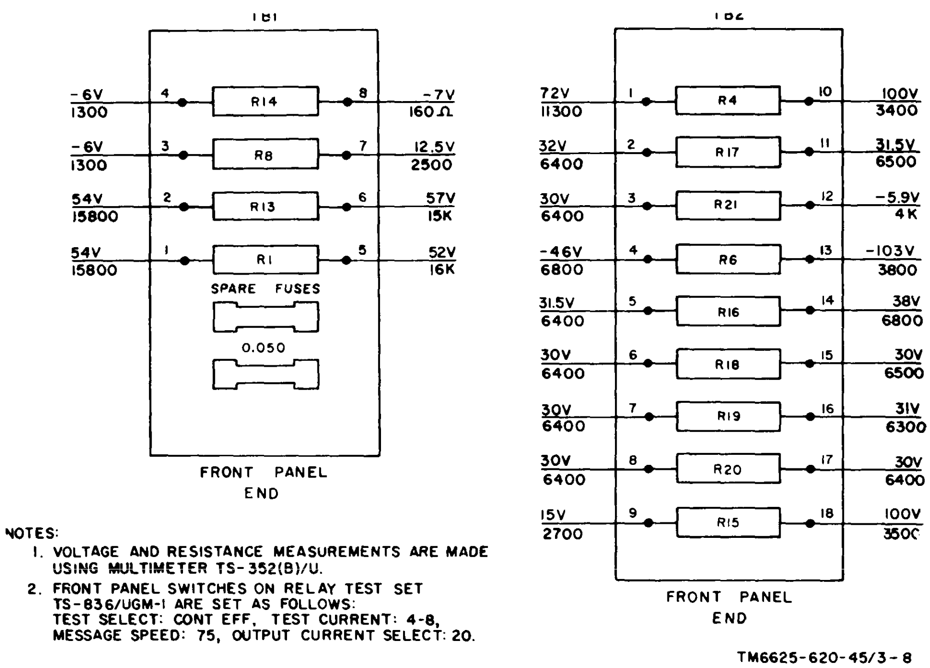


Figure 3–6. Terminal boards TB1 and TB2, parts locations and voltage and resistance diagrams.

Section II. TROUBLESHOOTING TS-836/UGM-1

3-5. Localizing Troubles

a. General. The troubleshooting chart (*c* below) outlines procedures for localizing troubles to an individual circuit or component. Follow the procedures given in the trouble-shooting chart whenever improper results are obtained after performing the maintenace checks (TM 11–6625–620–12). Depending on the nature of the operational symptoms, one or more of the localizing procedures will be necessary to locate the fault. Once the trouble is localized to a particular stage or circuit, use voltage and resistance measurements (para 3-6) to isolate the trouble to a particular defective part.

b. Use of Chart. The troubleshooting chart lists indications that the repairman observes while performing the maintenance checks and specifies the probable trouble and procedure required. Also, the *probable trouble* column in the chart localizes the trouble to am individual assembly or curcuit on the assembly. The physical location of each assembly is indicated as follows: 3A1 for components mounted on the chassis assembly, 3A2 for components mounted on the test socket assembly, 3A3 for capacitor mounting assembly, and 3A4 for transformer mounting assembly. In the chart, reference is made as required to figures 3–1 through 3-6.

c. Troubleshooting Chart.

Note. Perform the procedures in the operator's daily preventive maintenance checks and services chart (TM 11-6605-620-12) before using this chart, unless trouble has already been localized.

Indication	Probable trouble	Procedure
1. Power indicator lamp DS1 does not light.	*a.* Defective fuseholder XF1 or XF2.	*a.* Check fuseholders. Replace if defective (fig. 3-5).
	b. Filter FL1. --------------------------	*b.* Check filter for continuity. Replace if defective (fig. 3–3).
2. Fuse F1 or F2 opens, repeatedly, when POWER switch is operated to ON position.	Defective power supply circuit on assembly 3A1A2.	*a.* Check power supply circuit for shorts. Replace defective component (fig. 3-1).
3. Unable to balance power Supply.	*a.* Defective resistor R22 or R23 on assembly 3A1A2.	*a.* Check resistors. Replace defective component (fig. 3-1).
	b. Defective –100 volts regulator Q1-Q2 on assembly 3A1A2.	*b.* Check Q1-Q2 circuit by performing voltage measurements (para 3-7). Replace defective component (fig. 3-1) .
	c. Defective -100 volts rectifier CR1-CR4 on assembly 3A1A2.	*c.* Check rectifiers. Replace defective component (fig. 3-1).
	d. Defective series regulator Q1 on rear panel.	*d.* Perform voltage and resistance measurements (para 3-7). Replace if defective (fig. 3-4).
4. Unable to obtain fullscale deflection using METER ADJ control,	*a.* Defective METER ADJ variable resistor 3A1R10 on front panel.	*a.* Check resistor. Replace if defective (fig. 3-4).
	b. Defective meter 3A1Ml on front panel.	*b.* Check meter. Replace if defective (fig. 3-5).
5. No meter indication for all TEST SELECT switch positions except PS BAL.	*a.* Defective meter 3A1M1 on front panel.	*a.* Check meter. Replace if defective (fig. 3–5).
	b. Defective Test TEST SELECT switch 3A1S5 on front panel.	*b.* Check switch. Replace if defective (fig. 3-5).

Indication	Probable trouble	Procedure
	c. Defective METER ADJ variable resistor 3A1R10 on front panel.	*c.* Check resistor. Replace if defective (fig. 3-5).
	d. Defective current-limiting resistors TB2R21 and R22.	*d.* Check resistors. Replace defective component (fig. 3-6 and 343).
	e. Defective CONTACT CURRENT ADJUST resistor 3A1R9.	*e.* Check resistor. Replace if defective (fig. 3-4).
	f. Defective TEST SELECT switch 3A1S5.	*f.* Check switch. Replace if defective (fig. 3–5).
	g. Defective front panel relay socket 3A2XK1 or 3A2XKZ.	*g.* Check sockets, Replace defective components (fig. 3-3) .
6. No meter indication on MARK, SPACE, and CONT EFF positions of TEST SELECT switch.	*a.* Defective TEST SELECT switch 3A1S6.	*a.* Check switch. Replace if defeative (fig. 3-5).
	b. Defective electronic switch Q5 on assembly 3A1A2.	*b. Perform* voltage measurements *on* electronic switch. Replace if defective (fig. 3–1).
	c. Defective resistor R15 on assembly 3A1A2.	*c.* Check resistor. Replace if defective (fig. 3–1).
7. No meter indication for TEST SELECT switch 3A1S5 BIAS position only, when known bias distortion is present.	Defective TEST SELECT switch 3AIS5 at section B or C.	Check stitch; replace if necessary (fig. 3–5).
8. No output current at EXTERNAL OUTPUT jack for 20 ma and/or 30 ma position of OUTPUT CURRENT SELECT switch.	*a.* Defective OUTPUT CURRENT SELECT switch 3A1S4.	*a.* Check switch; replace if necessary (fig. 3-5).
	b. Defective current-limiting re sister 3A1R16 on terminal board TB2.	*b.* Check resistor; replace if necessary (fig. 3–6).
9. No output current at EXTERNAL OUTPUT jack for 60 ma position of OUTPUT CURRENT SELECT switch.	*a.* Defective OUTPUT CURRENT SELECT switch 3A1S4.	*a.* Check switch; replace if necessary (fig. 3-5).
	b. Defective current-limiting resistor 3A1R17 on terminal board TB2.	*b.* Check resistor; replace if necessary (fig. 3–6).
10. No output current at OPERATE CURRENT MONITOR jack J4 on rear of chassis.	*a.* Defective resistor 3A1R1 on terminal board TB1, defective variable resistor 3A1R2 (OPERATE CURRENT ADJUST), defective resistor 3A1R3, 3A1R4 on terminal board TB2 or 3A1R13 on terminal board TB1.	*a.* Check resistors; replace if defective (fig. 3-6 and 3-6).
	b. Defective TEST CURRENT switch 3A1S3 on front panel.	*b.* Check switch 3A1S3; replace if defective (fig. 3-5).
11. No output current at BIAS CURRENT MONITOR jack J5.	*a.* Defective resistors 3A1R14, 3A1R8 on terminal board TB1 or defective variable resistor 3A1R7 (BIAS CURRENT ADJUST).	*a.* Check resistors; replace if defective (fig. 3-5 and 3-6).
	b. Defective TEST CURRENT switch 3A1S3 on front panel.	*b.* Check switch 3A1S3; replace if defective (fig.3-5).
12. Improper meter indication for contact efficiency only.	Defective resistor R24 on assembly 3A1A2.	Check resistor; replace if defective (fig. 3-1).
13. Excessive distortion when known good relay checked.	Defective timing circuit on assembly 3A1A3.	Perform voltage and resistance tests (para 3–7).

3-6. Isolating Trouble Within Stage

a. General. When trouble has been localized to a stage, isolate the defective part by voltage or resistance measurements (fig. 3-6, 3-7, 3-8, and 7-3).

***Caution:* Carefully follow instructions and observe notes on voltage and resistance diagrams; carelessness may cause more troubles in the equipment and make the troubleshooting job more difficult. Do not remove or insert a transistor with voltage applied to the circuit.**

b. Transistor Testing. All transisitors are wired in the circuit, therefore, every effort should be made to troubleshoot the equipment without physically unsoldering and removing the transistors. Paragraph 3-7 contains information that may be helpful in isolating trembles to transistors.

c. Wiring Diagram. Use the wiring diagrams (fig. 7-5) to circuit trace and isolate the faulty part.

3-7. Analysis of Measurements

a. Emitter Current Measurements. Use the meter and meter ranges specified in figures 3-7 and 3–8. Note that figures 3-7 and 3-8 include the voltage and resistance measurements across the emitter resistors. By using Ohm's law (I = E/R), the emitter current can be determined without breaking the circuit.

b. In-Circuit Transistor Resistance Measurements. When measuring resistance of circuit elements connected across the junctions of any transistor (base-emitter or base-collector), consider polarity of the ohmmeter and try measurements with the ohmmeter connected one way, and then reverse the leads. Also, consider that different resistance readings will be observed in different ranges. When in doubt about any resistance reading, compare it to a measurement taken cm a known-good equipment.

c. *In-Circuit Resistance Charts.* Resistance measurements taken of emitter and collector diode with the transistor connected in the circuit are given below. The measurements are made with Multimeter TS-352B/U. These readings will be valid only if the same type of ohmmeter is used with the same polarity and range scales stated.

(1) In-curcuit resistance measurements of assembly 3A1A2 (fig. 3-7) were taken with the assembly in the TS-836/UGM-1. First, measure between the base and emitter and between the base and collector with the positive ohmmeter lead connected to the base and then measure between the base and emitter and between the base and collector with the negative ohmmeter lead connected to the base.

(2) In-circuit resistance measurement of assembly 3A1A3 (fig. 3-8) were taken with the assembly in the TS-836/UGM–1. First, measure between the base and emitter and between the base and collector with the positive ohmmeter lead connected to the base, and then measure between the base and emitter and between the base and collector with the negative ohmmeter lead connected to the base.

3-8. Dc Resistances of Transformer T1

The dc resistance data *(d* below) are provided as an aid to troubleshooting. When using these data, observe the following:

a. Before making resistance measurements of the windings, determine that faulty operation is very likely due to a bad transformer.

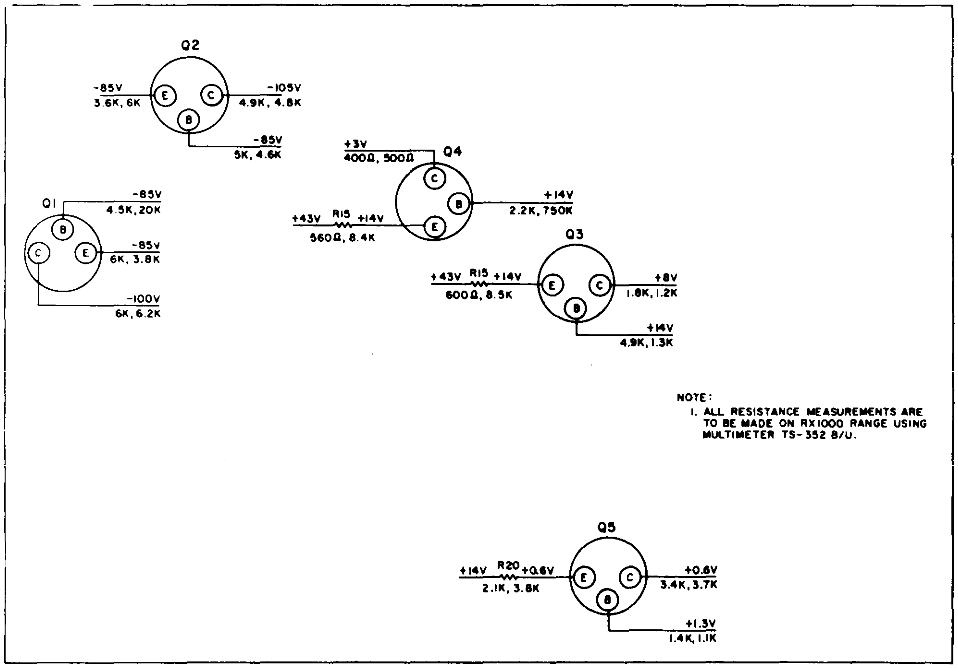
b. Do not use the resistance measurements as the sole basis for discarding a transformer as defective. Because of broad winding tolerances during manufacture, resistances may vary from one transformer to another; the chart values are typical average value.

c. The normal resistance of replacement transformers may differ greatly from the values given in the chart.

d. The resistance values given in the chart *(e* below) are directly applicable only to the type of transformer originally installed in the equipment.

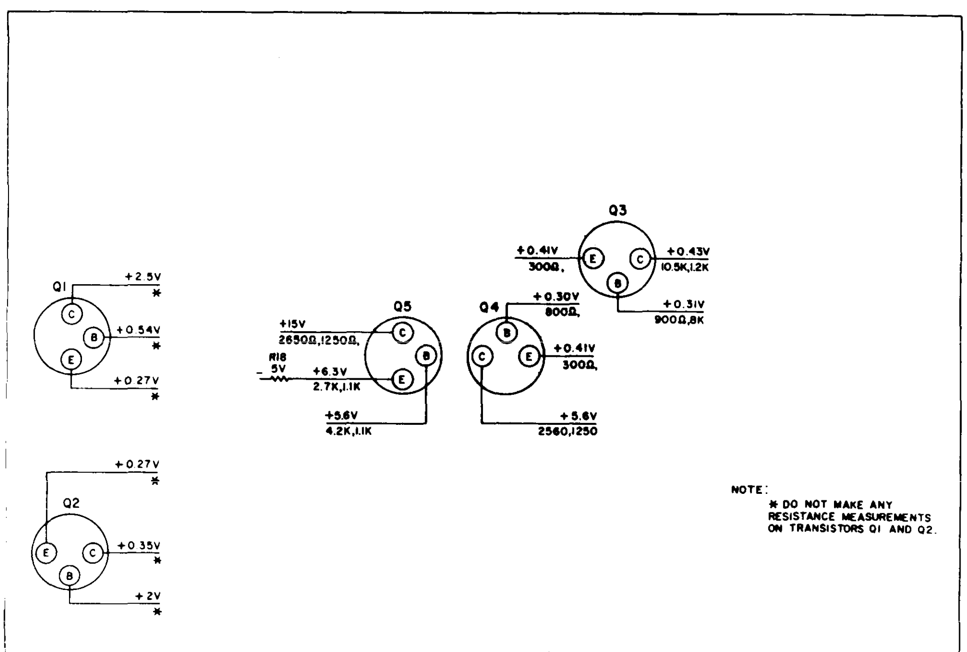
e. The resistance values of transformer T1 windings are given in the chart below.

Transformer	Terminals	Resistance (ohms)
T1	1-2	22
	3-4	22
	5-6	48
	7-8	48



TM 6625-620-45/3-9

Figure 3–7. Power supply assembly 3A1A2, voltage and resistance diagram.



TM6625-620-45/3-10

Figure 3-8. Timing circuit assembly 3A1A3, voltage and resistance diagram.

CHAPTER 4

GENERAL SUPPORT REPAIRS AND ALIGNMENT

4-1. General Parts Replacement Techniques

Most of the parts in the TS–836/UGM–1 can be reached easily and replaced without special procedures. However, the following precautions apply:

a. In the oscillator circuits, be sure that the lead length and position of the replacement part is the same as the defective part to avoid coupling and spurious oscillations.

b. Do not disturb the setting of controls when replacing parts unless the unit is to be realigned.

c. Use a pencil-type soldering iron with a 25-watt maximum capacity and an isolating transformer between the soldering iron and the ac line. Do not use a soldering gun since damaging Voltages can be induced in components.

d. When soldering transistor leads, solder quickly; wherever wiring permits, use a heat sink (such as a long-nosed pliers) between the soldered joint and the transistor. Use approximately the same length and dress of transistor leads as used originally.

4-2. Disassembly of TS-836/UGM-1

Remove the unit from its carrying case (if required) by following the procedures given in TM 11–6625–620–12.

a. Removal of Terminal Board TB1. Terminal board TB1 is mounted on the left side of the TS–836/UGM–l. Remove terminal board TB1 by performing the following procedure:

(1) Remove the two screws that secure assembly 3A2 to the front panel.

(2) Remove assembly 3A2.

(3) Remove the two screws that secure TB1.

(4) Remove TB1.

b. Removal of Terminal Board TB2. Terminal board TB2 is mounted on a bracket which must be removed to provide access to the terminal board. Remove terminal board TB2 mounting bracket from the TS–836/UGM–1 chassis by performing the following procedure:

(1) Remove the eight screws (8–32 panhead) that hold terminal board TB2 mounting bracket to the chassis; three screws are located on the front panel, two screws are located on the rear of the chassis, and the remaining three screws are located on the bottom of the chassis.

(2) Remove terminal board TB2 bracket by pulling straight out. Be careful not to break cable connections or surrounding wires.

c. Removal of Assemblies 3A1A2 and 8A1A3. Assemblies 3A1A2 and 3A1A3 are mounted on a bracket which must be removed to reach the rear of either assembly. Remove assemblies 3A1A2 and 3A1A3 as follows:

(1) Remove the assembly bracket by removing the two screws (8–32 panhead) on the bottom of the chassis and pulling the assemblies straight out.

(2) Remove assembly 3A1A2 cm 3A1A3 from the assembly bracket by removing the four (8–32 panhead) screws. (Two screws are located at each end of each assembly.)

d. Removal of Chassis-Mounted Components. When removing chassis-mounted components, first tag all connecting wires and then remove the mounting nuts.

4-3 Replacement Procedures

a. Replacement of Terminal Board TB1. Replace terminal board TB1 by reversing the procedure given in paragraph 4–2a.

b. Replacement of Terminal Board TB2. Replace terminal board TB2 by reversing the procedure given in paragraph 4–2b.

c. Replacement of Assemblies 3A1A2 and 3A1A3. Replace assemblies 3A1A2 and 3A1A3 by reversing the procedure given in paragraph 4-2c.

d. Replacement of Chassis-Mounted Components. Replace chassis-mounted components by reversing the procedure given in paragraph 4–2d.

4-4. Adjustments

The procedures for performing the +100-volt dc adjustment, the power supply balance adjustment, the bias current adjustment, and the operate current adjustment are given in chapter 5, TM 11–6625–620–12.

CHAPTER 5

GENERAL SUPPORT TESTING PROCEDURES

5-1. General

a. Testing procedures are prepared for use by Electronics Field Maintenance Shops and Electronics Service Organizations responsible for general support maintenance of electronics equipment to determine the acceptability of repaired equipment. These procedures set forth specific requirements that repaired equipment must meet before it is returned to the using organizations. A summary of the performance standards is given in paragraph 5-13.

b. Comply with the instructions preceding each chart before proceeding to the chart. Perform each step in sequence. Do not vary the sequence. For each step, perform all the actions required in the *control settings* columns; then perform each specific test procedure and verify it against its performance standard.

Warning: Voltages up to 230 volts exist on terminals in this equipment. Serious injury or death may result from contact with these terminals.

5-2. Test Equipment, Tools, and Materials

All test equipment, tools, materials, and other equipment required to perform the testing procedures given in this section are listed in the following charts and are authorized under TA 11–17, Signal Field Maintenance Shops, and TA 11–100 (11-17), Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shop, Continental United States.

a. Test Equipment.

Nomenclature	Federal stock No.	Technical manual
Frequency meter AN/USM-26.	6625-543-1356	TM 11–5057
Multimeter TS-352B/U.	6625-242-5023	TM 11-6625-366-15
Oscilloscope OS-3C/U.	6625-643-1740	TM 11-1214A
Test Set, Teletypewriter TS-1060/GG.	6625-542-6106	TM 11-6625-207-10
Polar Relay, WECO-255A.	5945-188-5631	
Test Set, Teletypewriter TS-799/UGM-1.	6625–965-0196	TM 11-6625–620-12
Test Set, Teletypewriter TS-800/UGM-1.	6625-965-0197	TM 11–6625-620-12
Solid State Relay Type 9218 Radiation Inc.		

b. Materials.

Materials	Federal stock No.
Wire, copper, insulated, No. 20, hookup, 25 ft long.	
Phone plugs, Type PJ-055B --	5935-192-4760

5-3. Test Facilities

An ac power source of 115 or 230 volts ±10 percent at 50 to 400 cycles per second (cps) with a power capability of 27.5 watts is required for the tests. There are no special procedures for connecting the TS-836/UGM-1 to the power source. Make sure that the POWER switch guard is set to the left if the equipment is to be connected to 115 volts ac and to the right if the equipment is to be connected to 230 volts ac. Be sure that the power switch is set to OFF before plugging in the power cord.

5-4. Fabrication of Test Cables

Two identical 4-foot test cables and one 3-foot test cable are required. The 4-foot test cables each consist of a phone plug type PJ-055B connected at one end, and two open leads at the other end.

a. Fabricate the 4-foot test cables as follows:

(1) Cut two 4-foot lengths of hookup wire.

(2) Remove the insulated cover from a type PJ–055B phone plug.

(3) Connect one wire to each terminal of the two-conductor phone plug.

(4) Replace the insulated cover over the phone plug.

b. Fabricate the 3-foot test cable as follows:

(1) Cut a 3-foot length of No. 18 AWG hookup wire.

(2) Strip one-half inch of insulation from each end of wire.

(3) Connect an alligator clip to each end of the wire.

5-5. Modification Work Orders

The performance standards listed in the test (pm-a 5-6 through 5–13) assume that no modification work orders have been performed. A listing of current modification work orders. will be found in DA Pam 310–7. If any modification work orders have been performed, allowances must be made in the test results.

5–6. Physical Tests and Inspection

a. Test Equipment and Materials. No test equipment is required.

b. Test Connections and Conditions.

(1) No connections necessary.

(2) Remove the TS–836/UGM–1 chassis from its transit case.

c. Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	None.	Controls may be in any position.	*a.* Inspect transit case and chassis for damage, missing parts, and condition of paint. *Note.* Touch up painting is recommended in lieu of refinishing whenever practical; screwheads, binding post, receptacles, and other plated parts will not be painted or polished with abrasives.	*a.* No damage evident or parts missing. External surfaces intended to be painted will not show bare metal. Panel lettering will be legible.
			b. Inspect all controls and mechanical assemblies for loose or missing screws, bolts, and nuts.	*b.* Screws, bolts, and nuts will be tight. None missing.
			c. Inspect all connectors, sockets, and receptacles, fuseholder, and meter for looseness, damage, or missing parts.	*c.* No loose parts or damage. No missing parts.
2	None.	Controls may be in any position.	*a.* Rotate all panel controls throughout their limits of travel.	*a.* Controls will rotate freely without binding or excessive looseness.
			b. Inspect dial stops for damage or bending, and for proper operation.	*b.* Stops will operate properly without evidence of damage.

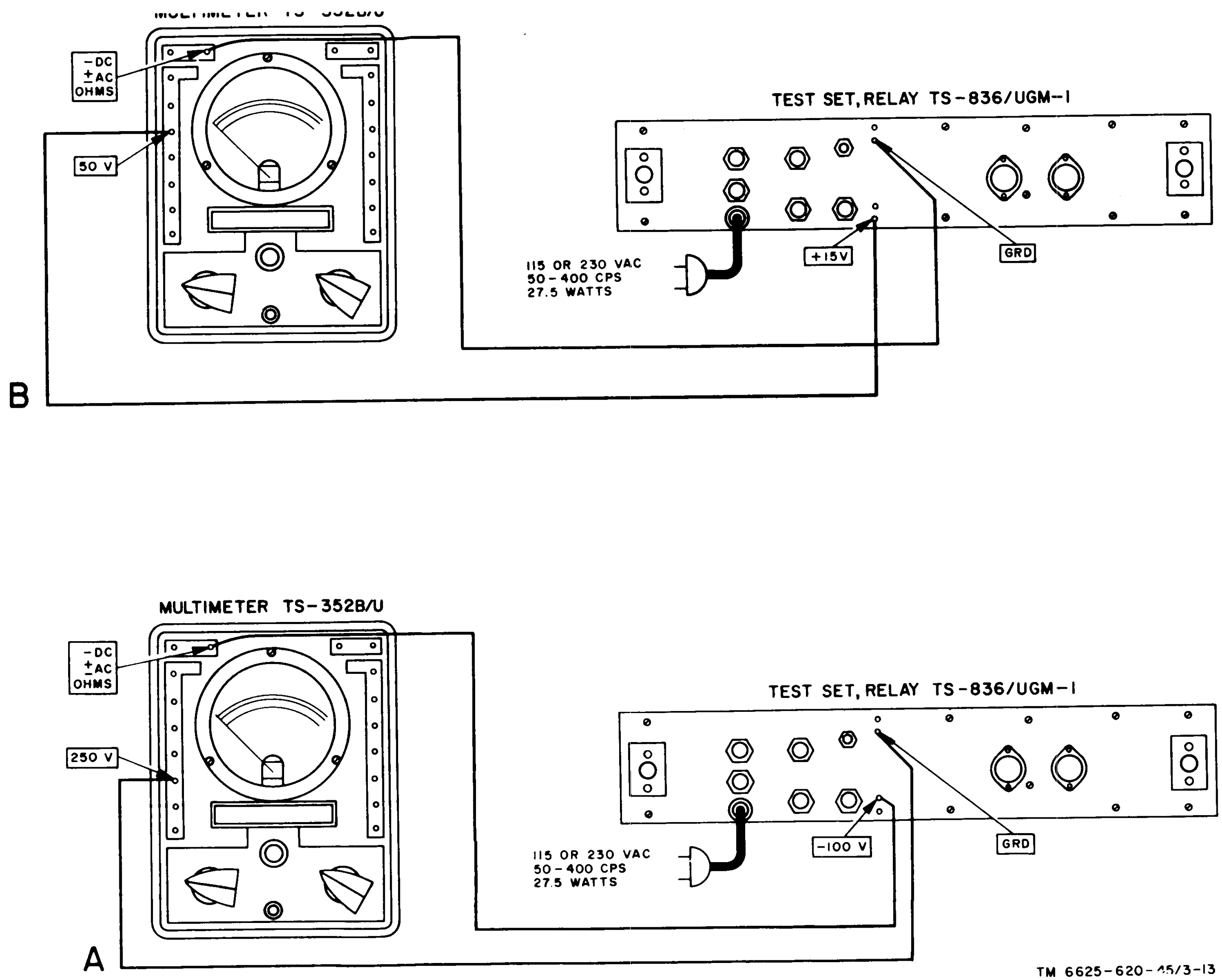


Figure 5-1. Power supply test setup.

5-7. Power Supply Test

a. Test Equipment and Materials. Multimeter TS-352B/U or FLUKE #8100A (if available).

b. Initial Equipment Calibration. None required.

c. Test Connections and Conditions. Connect the equipment as shown in A, figure 5-1 for -100 volts test (step No. 1), and B, figure 5-1 for +15 volts test (step No. 3).

d. Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	FUNCTION: REVERSE. Range switch may be in any position.	POWER: ON (115V or 230V). TEST SELECT: PS BAL Other controls may be in any position.	Set TS-386/UGM-1 panel meter for 0 indication with BALANCE ADJUST control. Observe multimeter indicator.	TS-352B/U should indicate -100 volts ±10 volts.
2	FUNCTION DIRECT. Connect 250V jack to J8 on rear panel of TS-836/UGM-1.	Same as step No. 1	Same as step No. 1.	TS-352B/U should indicate +100 volts ±10 volts.
3	FUNCTION: DIRECT. Connect 50V jack to J-9 on rear panel of TS-836/UGM-1.	Same as step No. 1.	Same as step No. 1	TS-352B/U should indicate +15 volts ±1.5 volts.

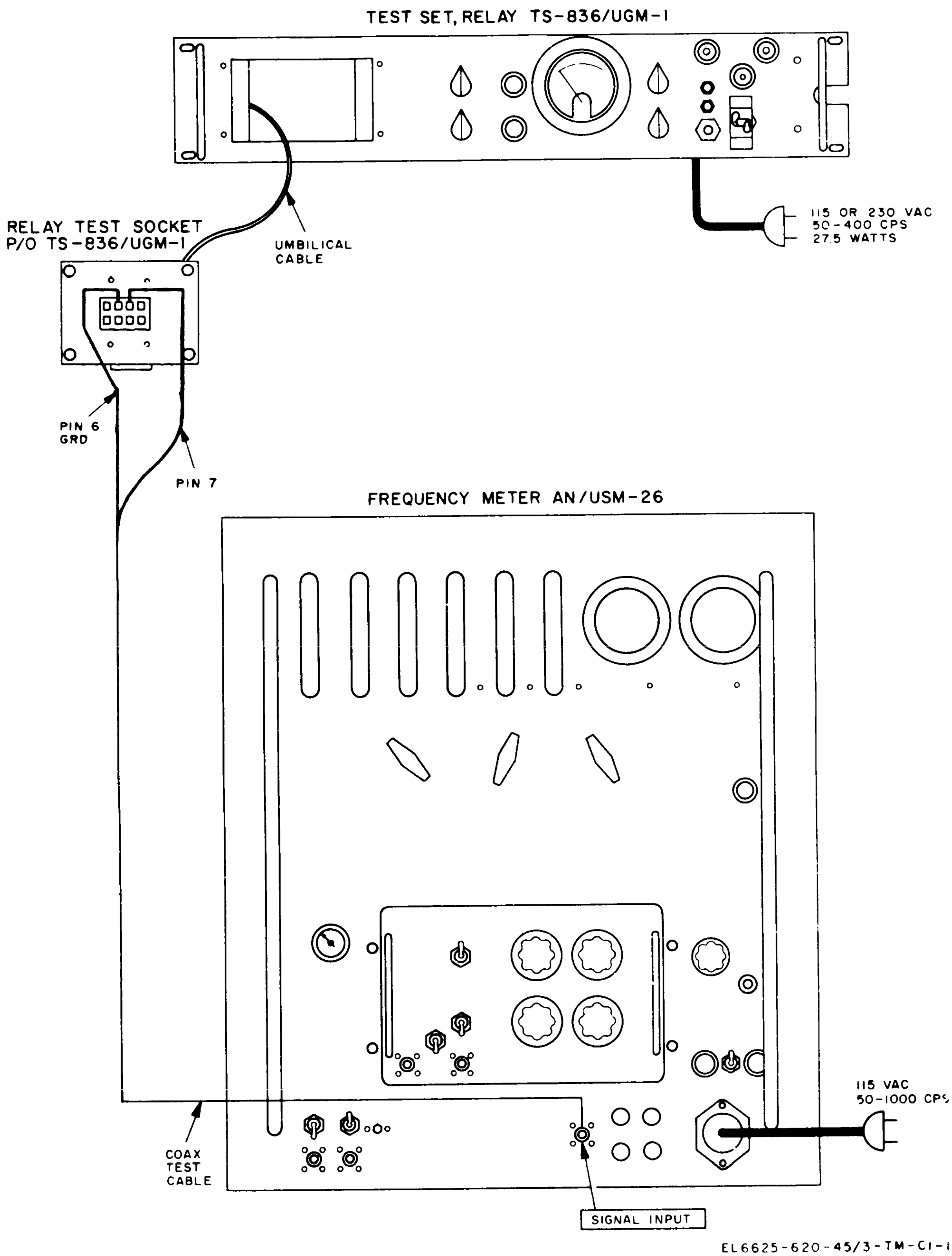


Figure 5-2. Speed test setup.

5-8. Speed Test

a. Test Equipment and Materials.
(1) Frequency Meter AN/USM-2G.
(2) Coexial test cable.
(3) Solid stab relay, Type 9218 or Stelma Type ER-17A or ER21.

b. Initial Test Equipment Calibration. There are no formal calibration procedures for the AN/USM–26. However, calibration of the AN/USM–26 should be checked by performing the following:

Caution: **POWER switch S1 must be in the OFF (down) position before installing or removing a front panel plug-in unit.**

(1) Check to see that the front-panel plug-in is in plain.
(2) Operate the POWER switch to the ON position. Allow for a 30-minute warmup period. Do not make any connections to equipment during this time.
(3) Operate the MANUAL GATE switch to the closed position.
(4) Operate the FUNCTION SELECTOR switch to the 100KC CHECK position.
(5) Adjust the DISPLAY TIME control for the desired display. The extreme counterclockwise position is usually best. (The display time cannot be adjusted to be less than gate time.)
(6) Check to see that the indication of the display system for each position of the FREQUENCY UNIT switch agrees with the values given in the chart.
(7) Set the FUNCTION SELECTOR switch to the 10MC CHECK position.
(8) Repeat (6) above, and allow a ± 1 count in the last digit.

Counter readings for calibration check

Gate Time (seconds)	100KC CHECK	10MC CHECK
10	0100.0000	0000.0000 ±.001
1	00100.000	10000.000 ±.001
0.1	000100.0	010000.00 ±.01
0.01	0000100.0	0010000.0 ±.01
0.001	00000100	00010000. ±1

c. Test Connections and Conditions. Remove relay test socket assembly 3A2 by unscrewing the two captive screws on each side of the assembly, and then connect the equipment as shown in figure 5-2.

d. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	*AN/USM-26* TIMEUNIT: MILLISEC. FUNCTION SELECTOR: PERIOD. On time internal plug-in unit, set controls as follows: TIME INTERVAL/PERIOD: PERIOD. SEP COM: COM. *AN/USM-26* DISPLAY TIME: Counterclockwise position. (Readjust for clear indication.)	TEST SELECT: BIAS. TEST CURRENT: 4-8. OUTPUT CURRENT SELECT: 30. POWER ON:	*a.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 23 and note counter indication on AN/USM-26. *b.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 37 and note counter indication on AN/USM-26. *c.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 75 and note counter indication on AN/USM-26. *d.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 100 and note indication on AN/USM-26. *e.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 125 and note counter indication on AN/USM-26. Disconnect test cable from SIGNAL INPUT jack and connect to STOP INPUT jack on plug-in unit MX-16344 of the AN/USM-26.	*a.* Counter indication should be 43.44 milliseconds ± 1% for two-bit period. *b.* Counter indication should be 26.96 ms ± 1%. *c.* Counter indication should be 13.33 ms ± 1%. *d.* Counter indication should be 10.00 ms ±1%. *e.* Counter indication should be 8.00 ms ±1%.
2	TIME UNIT: MILLISEC. FUNCTION SELECTOR: PERIOD. SEP-COM: COM. TIME INTERVAL/PERIOD: TIME INTERVAL. DISPLAY TIME: Counterclockwise position. (Readjust for clear indication.) START INPUT TRIGGER SLOPE: +. START INPUT TRIGGER LEVEL-VOLTS: 1X+4. START INPUT TRIGGER SLOPE: + STOP INPUT TRIGGER LEVEL-VOLTS: 1X-4.	Same as step No. 1.	*a.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 23 and note counter indication on AN/USM-26. *b.* Operates TS-836/UGM-1 MESSAGE SPEED switch to 37 and note counter indication on AN/USM-26. *c.* Operate TS-836/UGM-1 MESSAGE switch to 75 and note counter indication on AN/USM-26. *d.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 100 and note counter indication on AN/USM-26. *e.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 125 and note counter indication on AN/USM-26.	*a.* None required. *b.* None required. *c.* None required. *d.* None required. *e.* None required.
3	Same as step 2 except: START INPUT TRIGGER SLOPE:-. START INPUT TRIGGER LEVEL VOLTS: 1X-4. STOP INPUT TRIGGER SLOPE: +.	Same as step 1.	*a.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 23 and note counter indication on AN/USM-26. *b.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 37 and note counter indication on AN/USM-26.	*a.* Compare counter indication obtained in *a* of step 2 with that obtained here. Difference should not exceed 2%. *b.* Compare counter indication obtained in *b* of step 2 with that obtained here. Difference should exceed 2%.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
	STOP INPUT TRIGGER LEVEL VOLTS: 1X+4.		*c.* Operate TS-836/UGM-1 MESSAGE SPEED switch to 75 and note counter indication on AN/USM-26.	*c.* Compare counter indication obtained in *c* step No. 2 above with that obtained here. Difference should not exceed 2%.
			d. Operate TS-836/UGM-1 MESSAGE SPEED switch to 100 and note counter indication on AN/USM-26.	*d.* Compare counter indication obtained in *d* , step No. 2 above with that obtained here. Difference should not exceed 2%.
			e. Operate TS-836/UGM-1 MESSAGE SPEED switch to 125 and note counter indication on AN/USM-26.	*e.* Compare counter indication obtained in *e*, step No. 2 above with that obtained here. Difference should not exceed 2%.

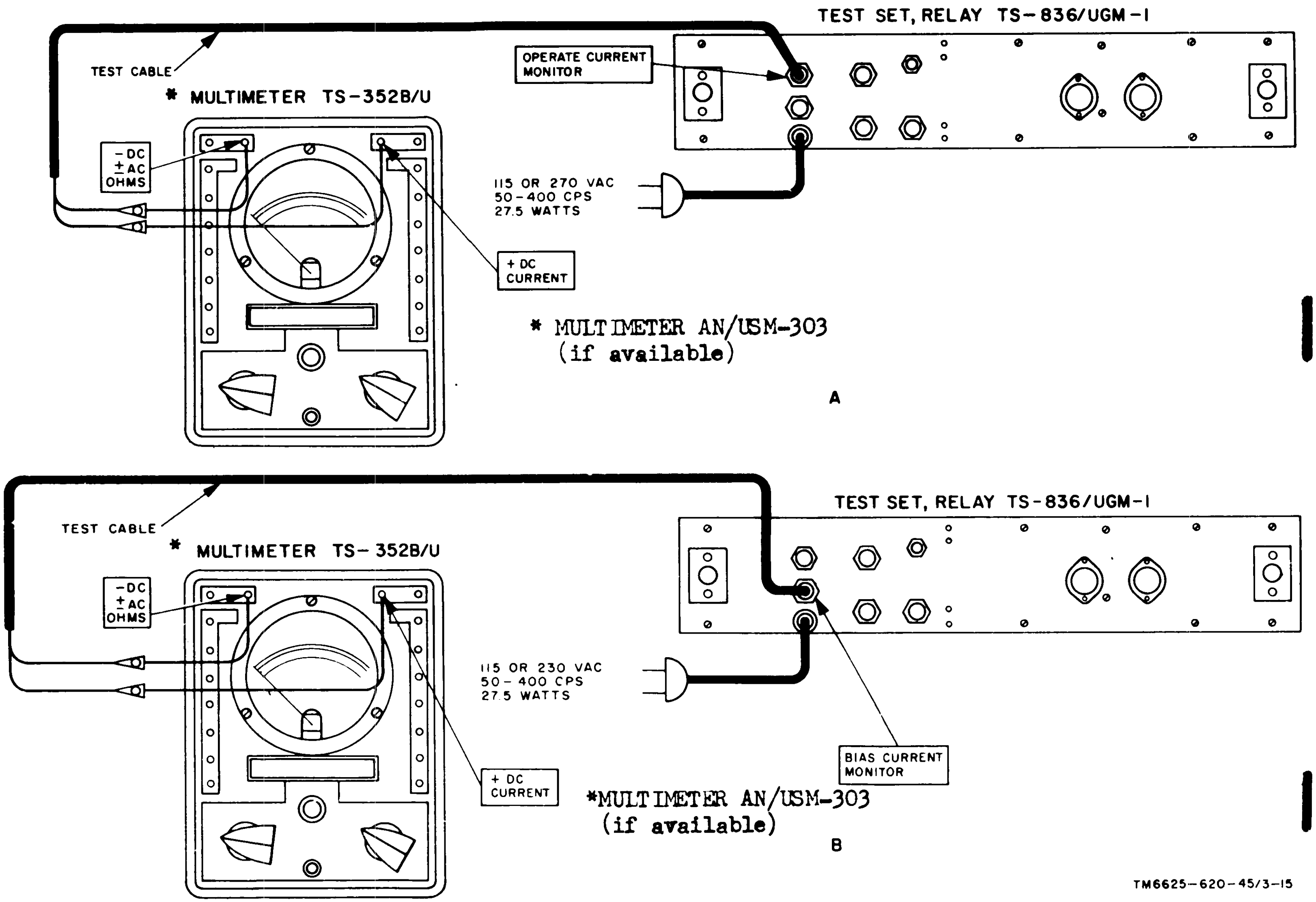


Figure 5-3. Bias test setup.

5–9. Bias Test

a. Test Equipment and Materials.

(1) Multimeter TS–352B/U or AN/USM-303(if available).

(2) Test cable.

(3) Test relay, Sigma 72.

b. Initial Test Equipment Calibration. None required.

c. Test Connections and Conditions. Connect the equipment as shown in B, figure 5–3 for steps No. 1 and 2 and as shown in A, figure 5–3 for steps No. 3, 4, and 5.

d. Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*TS–352B/U* FUNCTION: DC CURRENT Range switch: 10MA	TEST SELECT: MARK MESSAGE SPEED: 75 OUTPUT CURRENT SELECT: 20 POWER: ON	Operate TEST CURRENT switch to 4–8 position and observe multimeter indication.	TS–352B/U indication should be 4 milliamperes ±5%.
2	FUNCTION: DC CURRENT Range switch: 50 MA	TEST SELECT: MARK MESSAGE SPEED: 75 OUTPUT CURRENT SELECT: 20 POWER: ON	*a.* Operate TEST CURRENT switch to 10–20 and observe TS–352B/U indication. *b.* Operate TEST CURRENT switch to 30–60 and observe TS–352B/U indication.	*a.* TS–352B/U indication should be 10 ma ±5%. *b.* TS–352B/U indication should be 30 ma ±5%.
3	FUNCTION: DC CURRENT Range switch: 10MA	TEST SELECT: MARK MESSAGE SPEED: 75 OUTPUT CURRENT SELECT: 20 POWER: ON	Operate TEST CURRENT switch to 4–8 and observe TS–352B/U indication.	TS–352B/U indication should be 8 ma ±5%.
4	FUNCTION: DC CURRENT Range switch: 50MA	TEST SELECT: MARK MESSAGE SPEED: 75 OUTPUT CURRENT SELECT: 20	Operate TEST CURRENT switch to 10–20 and observe TS–352B/U indication.	TS–352B/U indication should be 20 ma ±5%.
5	FUNCTION: DC CURRENT Range switch: 100MA	TEST SELECT: MARK MESSAGE SPEED: 75 OUTPUT CURRENT SELECT: 20	Operate TEST CURRENT switch to 30–60 and observe TS–352B/U indication.	TS–352B/U indication should be 60 ma ±5%.

5–12. Electronic Relay Operational Test

a. Test Equipment and Materials. Electronic relay, Type 9218. or Stelma Type ER-17A or ER-21, Multimeter TS-352B/U.

b. Initial Test Equipment Calibration. None required.

c. Test Connections and Conditions. Plug Type 9218 electronic relay into test socket. Connect equipment as shown in figure 5–4.

d. Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	FUNCTION: DIRECT Range switch: 50MA	TEST SELECT: PS BAL TEST CURRENT: 4–8 MESSAGE SPEED: 23 OUTPUT CURRENT SELECT: 20 BALANCE ADJUST: Fully counterclockwise	*a.* Operate BALANCE ADJUST control clockwise until TS-836/UGM-1 indication is 0.	*a.* TS–352B/U indication: 0 ma upon completion of adjustment.
			b. Operate TEST SELECT switch to MARK position and adjust METER ADJUST control for full-scale deflection on TS–836/UGM–1 meter.	*b.* TS–836/UGM–1 meter indication: full-scale deflection upon completion of adjustment.
			c. Operate TEST SELECT switch to BIAS position and observe TS–836/UGM–1 meter indication.	*c.* TS–836/UGM–1 meter indication should be approximately zero.
			d. Operate MESSAGE SPEED switch through all settings and observe TS–836/UGM–1 meter indication for each setting.	*d.* TS–836/UGM–1 meter indication - approx. zero (all MESSAGE SPEED switch settings).
			e. Operate TEST CURRENT switch to 10–20 position and MESSAGE SPEED switch through its settings, observing TS–836/UGM–1 meter for each switch setting.	*e.* TS–836/UGM–1 meter should indicate approx. zero (each MESSAGE SPEED switch setting).
			f. Operate TEST CURRENT switch to 30–60 and MESSAGE SPEED switch through its settings, observing TS–836/UGM–1 meter for each switch setting.	*f.* TS–836/UGM–1 meter should indicate approx. zero (ea MESSAGE SPEED switch setting).

5-13. Summary of Performance Standards

Personnel may find it convenient to arrange the checklist in a manner similar to that shown below.

TEST SET, RELAY TS-836/UGM-l

	Test data	Performance standard
1. POWER SUPPLY TEST		
a. J6 output	----	-100 volts ± 10%
b. J8 output	----	+100 volts ± 10%
c. J9 output	----	+15 volts ± 10%
2. SPEED TEST		
a. Output frequency	-------	43.44 ms ± 1%
b. Output frequency	------	26.96 ms ± 1%
c. Output frequency	------	13.33 ms ± 1%
d. Output frequency	------	10.00 ms ± 1%
e. Output frequency	----	8.00 m ± 1%
3. BIAS TEST		
a. Test set output current	------	4 ma ± 5%
b. Test set output current	----	10 ma ± 5%
c. Test set output current	-------	30 ma ± 5%
d. Test Set output current	-------	8 ma ± 5%
e. Test set output current	--------	20 ma ± 5%
f. Test set output current	-------	60 ma ± 5%
4. CONTACT EFFICIENCY TEST		
Step No. 1		
a. Relay test	-------	94 or higher
b. Relay test	----	92 or higher

TEST SET, RELAY TS-836/UGM-l

	Test Data	Performance standard
c. Relay test	-----	84 or higher
d. Relay to	----	79 or higher
e. Relay test	----	75 or higher
Step No. 2		
a. Relay test	----	96 or higher
b. Relay test	----	95 or higher
c. Relay test	----	90 or higher
d. Relay test	----	88 or higher
c. Relay test	----	85 or higher
Step No. 3		
a. Relay test	----	97 or higher
b. Relay test	----	96 or higher
c. Relay test	-----	93 or higher
d. Relay test	----	91 or higher
e. Relay test	----	88 or higher
5. CONTACT BOUNCE TEST		
Reversals pattern on OS-8 C/U	-----	Verify
6. ELECTRONIC RELAY OPERATIONAL TEST		
a. TS-836/UGM-1 output	-----------	0 ma
b. TS-1836/UGM-1 output	-----	Full-scale deflection
c. TS-836/UGM-1 output	----	Approx. zero
d. TS436/UGM-1 output	----	Approx. zero
c. TS-836/UGM-1 output	----	Approx. zero
f. TS-836/UGM-1 output	----	Approx. zero

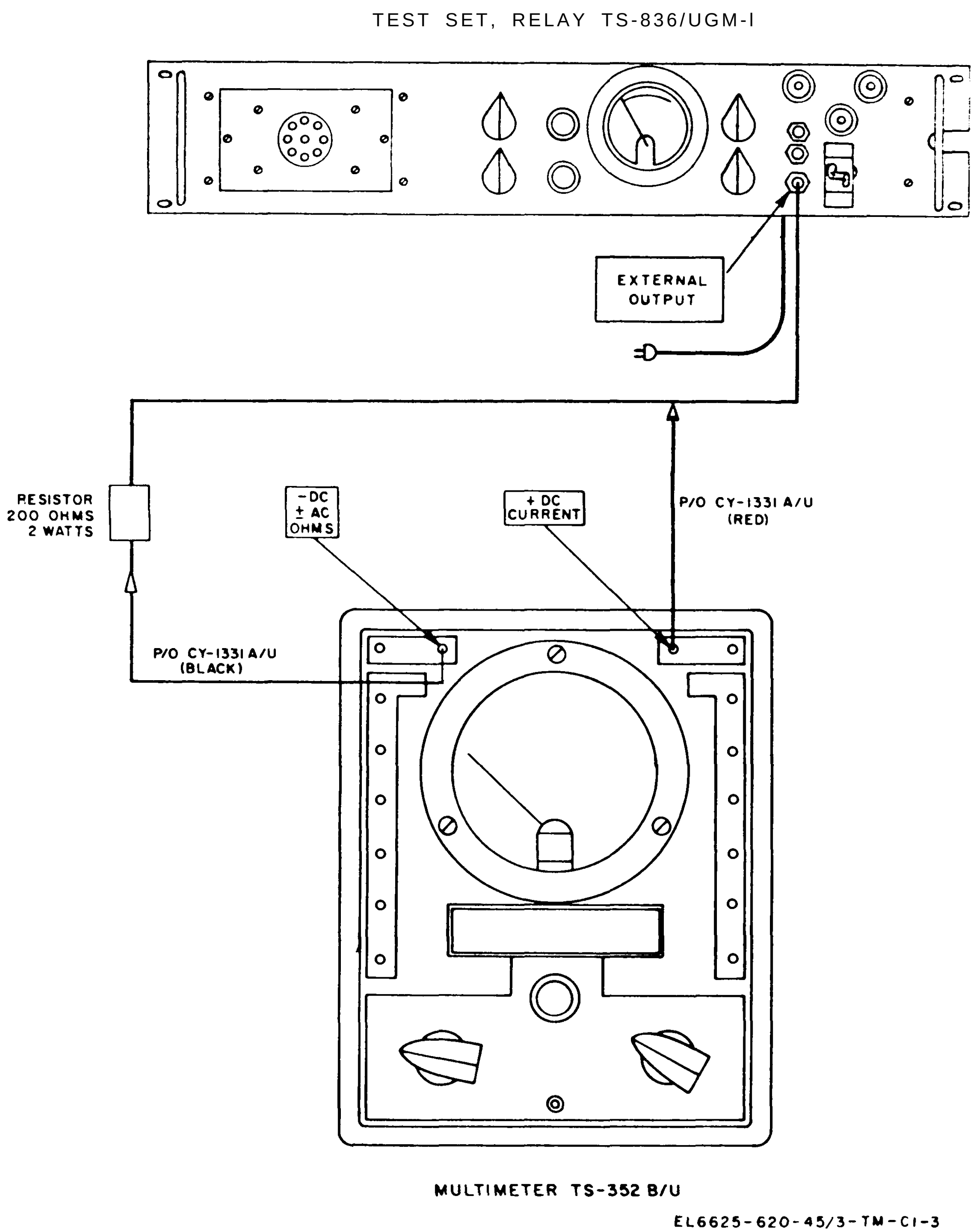


Figure 7-6. Contact Bounce, Test Setup (steps no. 1, 2, and **3)** .

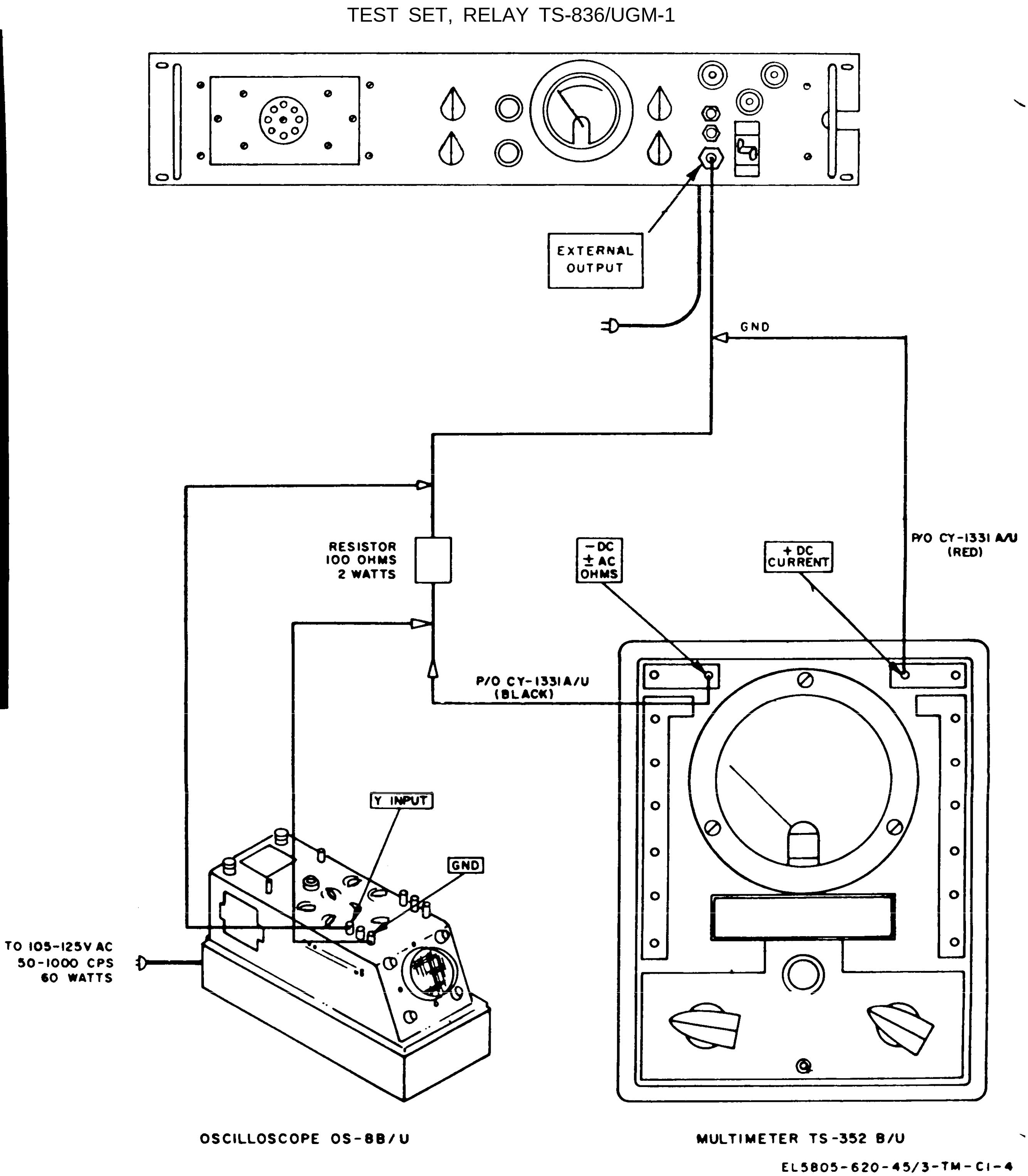


Figure 7-7. Contact Bounce, Test Setup (step No. 4).

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5–10. Contact Efficiency Test

a. Test Equipment and Materials. Test relay, Sigma 72.

b. Initial Test Equipment Calibration. None required.

c. Test Connections and Conditions. Plug-in Sigma 72 test relay into the front panel octal socket.

d. Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	None required	TEST SELECT: CONT EFF TEST CURRENT: 4–8 OUTPUT CURRENT SELECT: 20	*a.* Operate MESSAGE SPEED switch to 23 and observe TS-836/UGM-1 meter indication.	*a.* Meter should indicate 94 or higher.
			b. Operate MESSAGE SPEED switch to 37 and observe TS-836/UGM-1 meter indication.	*b.* Meter should indicate 92 or higher.
			c. Operate MESSAGE SPEED switch to 75 and observe TS-836/UGM-1 meter indication.	*c.* Meter should indicate 84 or higher.
			d. Operate MESSAGE SPEED switch to 100 and observe TS-836/UGM-1 meter indication.	*d.* Meter should indicate 79 or higher
			e. Operate MESSAGE SPEED switch to 125 and observe TS-836/UGM-1 meter indication.	*e.* Meter should indicate 75 or higher.
2	None required	Same as step 1 except: TEST CURRENT: 10–20	*a.* Operate MESSAGE SPEED switch to 23 and observe TS-836/UGM-1 meter indication.	*a.* Meter should indicate 96 or higher.
			b. Operate MESSAGE SPEED switch to 37 and observe TS-836/UGM-1 meter indication.	*b.* Meter should indicate 95 or higher.
			c. Operate MESSAGE SPEED switch to 75 and observe TS-836/UGM-1 meter indication.	*c.* Meter should indicate 90 or higher.
			d. Operate MESSAGE SPEED switch to 100 and observe TS-836/UGM-1 meter indication.	*d.* Meter should indicate 88 or higher.
			e. Operate MESSAGE SPEED switch to 125 and observe TS-836/UGM-1 meter indication.	*e.* Meter should indicate 85 or higher.
3	None required	Same as step 1 except: TEST CURRENT: 30–60	*a.* Operate MESSAGE SPEED switch to 23 and observe TS-836/UGM-1 meter indication.	*a.* Meter indication should be 97 or higher.
			b. Operate MESSAGE SPEED switch to 37 and observe TS-836/UGM-1 meter indication.	*b.* Meter indication should be 96 or higher.
			c. Operate MESSAGE SPEED switch to 75 and observe TS-836/UGM-1 meter indication.	*c.* Meter should indicate 93 or higher.
			d. Operate MESSAGE SPEED switch to 100 and observe TS-836/UGM-1 meter indication.	*d.* Meter should indicate 91 or higher.
			e. Operate MESSAGE SPEED switch to 125 and observe TS-836/UGM-1 meter indication.	*e.* Meter should indicate 88 or higher.

5-11. Contact Bounce Test

a. Test Equipment and Materials.

(1) Test cable (fabricated).

(2) Multimeter TS-352B/U.

(3) Oscilloscope OS-8C/U.

(4) Test relay, Sigma 72.

b. Initial Test Equipment Calibration. None required.

c. Test Connections and Conditions.

(1) Connect equipment as shown in figure 7-6 for steps No. 1, 2, and 3 and as shown in figure 7-7 for step No. 4.

(2) Plug Sigma 72 test relay into the octal, relay test socket on the front panel of the TS-836/UGM-1.

d. Procedure.

Step No.	Control settings: Test equipment	Control settings: Equipment under test	Test procedure	Performance standard
1	*TS-352B/U* FUNCTION: DC CURRENT Range switch: 50MA	TEST CURRENT: 10-20 MESSAGE SPEED: 125 OUTPUT CURRENT SELECT: 20 METER ADJUST: To position that provides 100% indication on meter.	*a.* Operate TEST SELECT switch to MARK position and record TS-352B/U indication.	*a.* None required.
			b. Operate TEST SELECT switch to SPACE position and record TS-352B/U indication.	*b.* None required.
			c. Compare indications observed in *a* and *b* above.	*c.* Indications obtained in *a* and *b* above should be within 1% of each other.
2	FUNCTION: DC CURRENT Range switch: 50MA	TEST CURRENT: 10-20 MESSAGE SPEED: 125 OUTPUT CURRENT SELECT: 30	*a.* Operate TEST SELECT switch to MARK position and record TS-352B/U indication.	*a.* None required.
			b. Operate TEST SELECT switch to SPACE position and record TS-352B/U indication.	*b.* None required.
			c. Compare indications observed in *a* and *b* above.	*c.* Indications obtained in *a* and *b* above should be within 1% of each other.
3	FUNCTION: DC CURRENT Range switch: 100MA	TEST CURRENT: 10-20 MESSAGE SPEED: 125 OUTPUT CURRENT SELECT: 60	*a.* Operate TEST SELECT switch to MARK position and record TS-352B/U indications.	*a.* None required.
			b. Operate TEST SELECT switch to SPACE position and record TS-352B/U indication.	*b.* None required.
			c. Compare indications observed in *a* and *b* above.	*c.* Indications obtained in *a* and *b* above should be within 1% of each other.
4	*OS-8C/U* Set controls in conformance with instructions in section 3, TM 11-1214A.	TEST CURRENT: 10-20 MESSAGE SPEED: 23 OUTPUT CURRENT SELECT: 30	*a.* Operate TEST SELECT switch to BIAS position.	*a.* None required.
			b. Observe oscilloscope pattern	*b.* Pattern should be reversals.

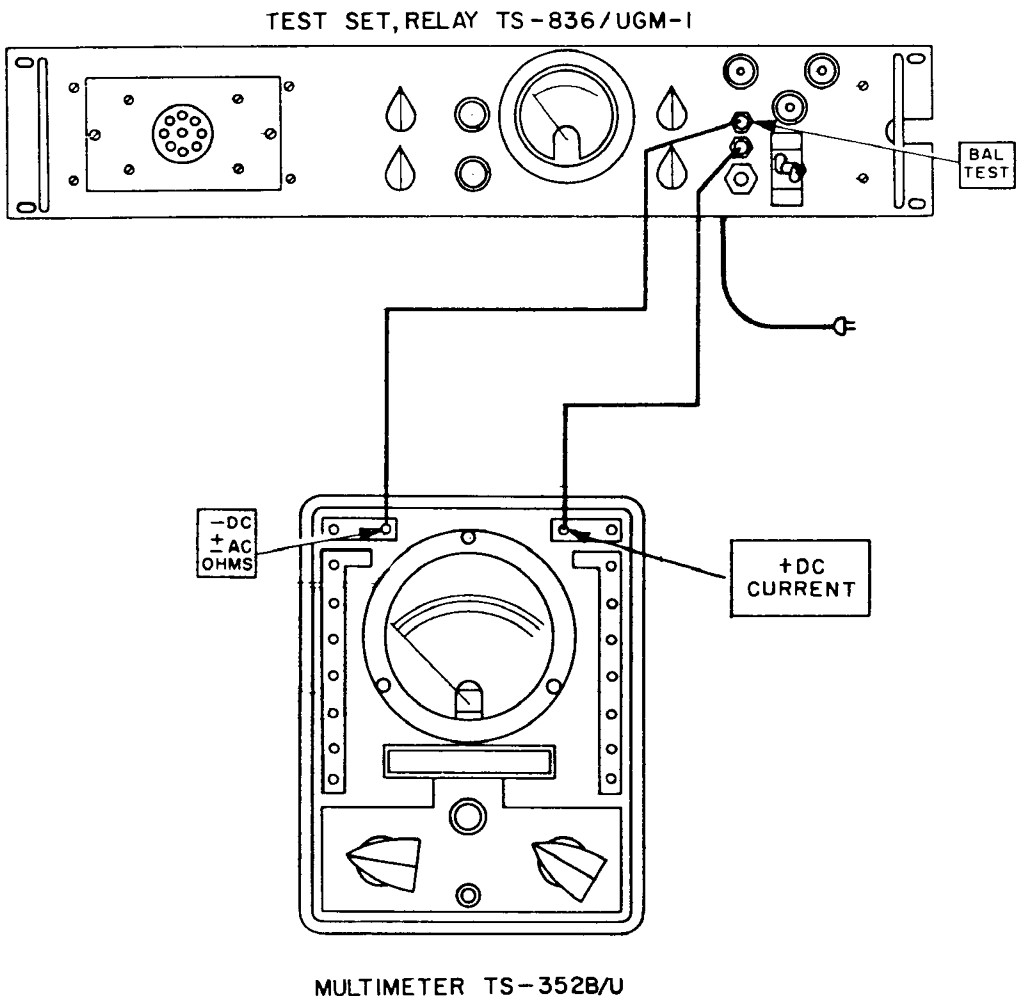
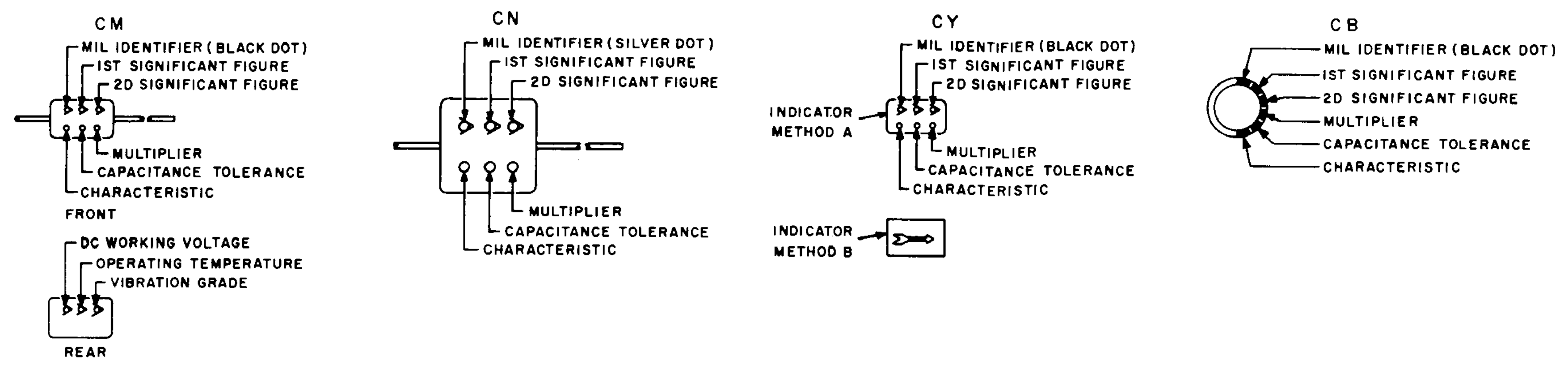


Figure 5-4. Electronic relay operational test setup.

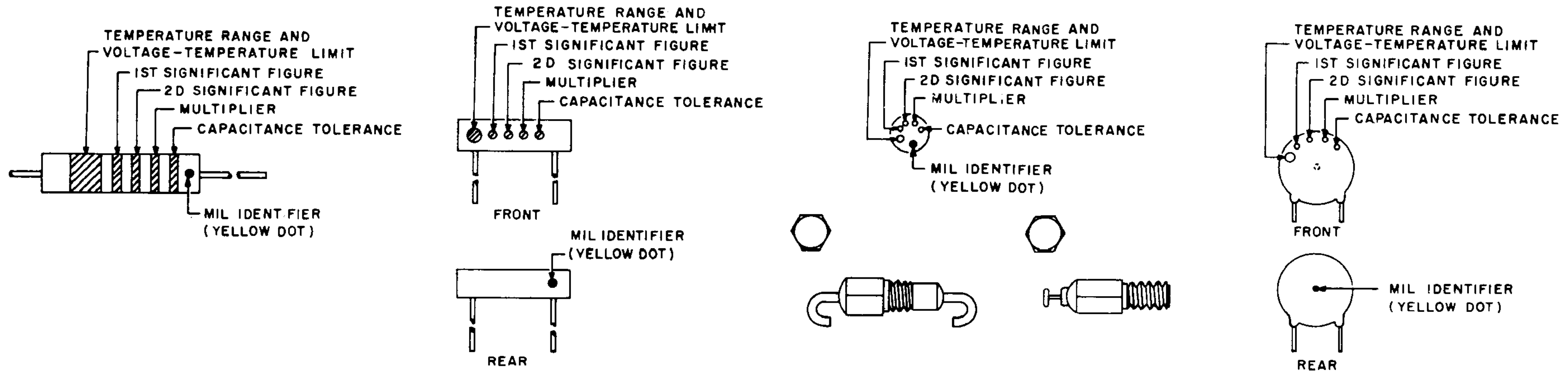
COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



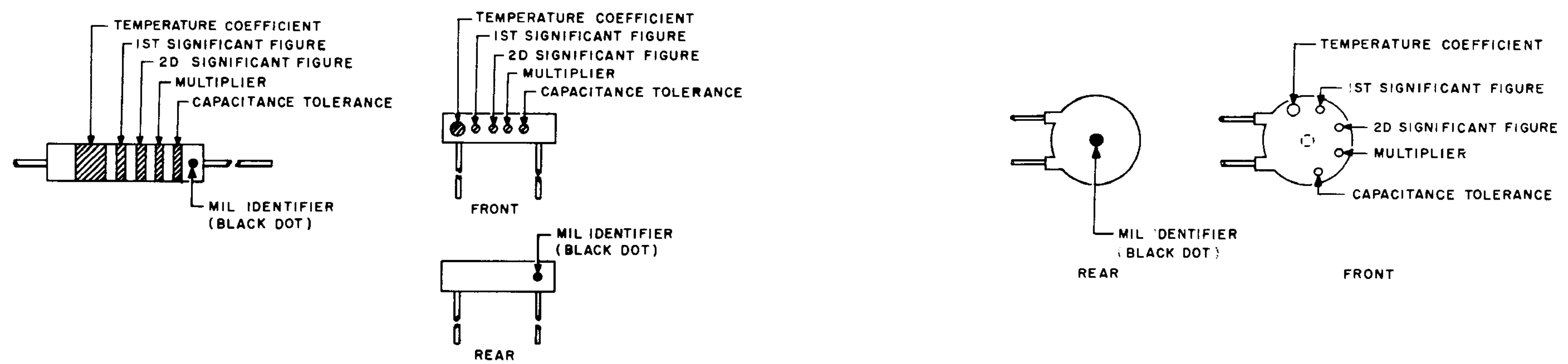
MICA-DIELECTRIC | PAPER-DIELECTRIC | GLASS-DIELECTRIC, GLASS CASE | MICA, BUTTON TYPE

GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



AXIAL LEAD | RADIAL LEAD | FEED-THROUGH | STAND-OFF | DISK-TYPE

GROUP III Capacitors, Fixed, Ceramic-Dieletric (Temperature Compensating) Style CC



AXIAL LEAD | RADIAL LEAD | DISK-TYPE

COLOR CODE TABLES

TABLE I – For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]				DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CY	CB	CM	CM	CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%		A				−55° to +70°C	10–55 cps
BROWN		1	1	10					B	E		B			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			−55° to +85°C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					−55° to +125°C	10–2,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											−55° to +150°C	
PURPLE (VIOLET)		7	7												
GREY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	± 5%							
SILVER	CN				± 10%	± 10%	± 10%	± 10%							

TABLE II – For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE – TEMP. LIMITS[3]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CZ	5	5			
BLUE	BV	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

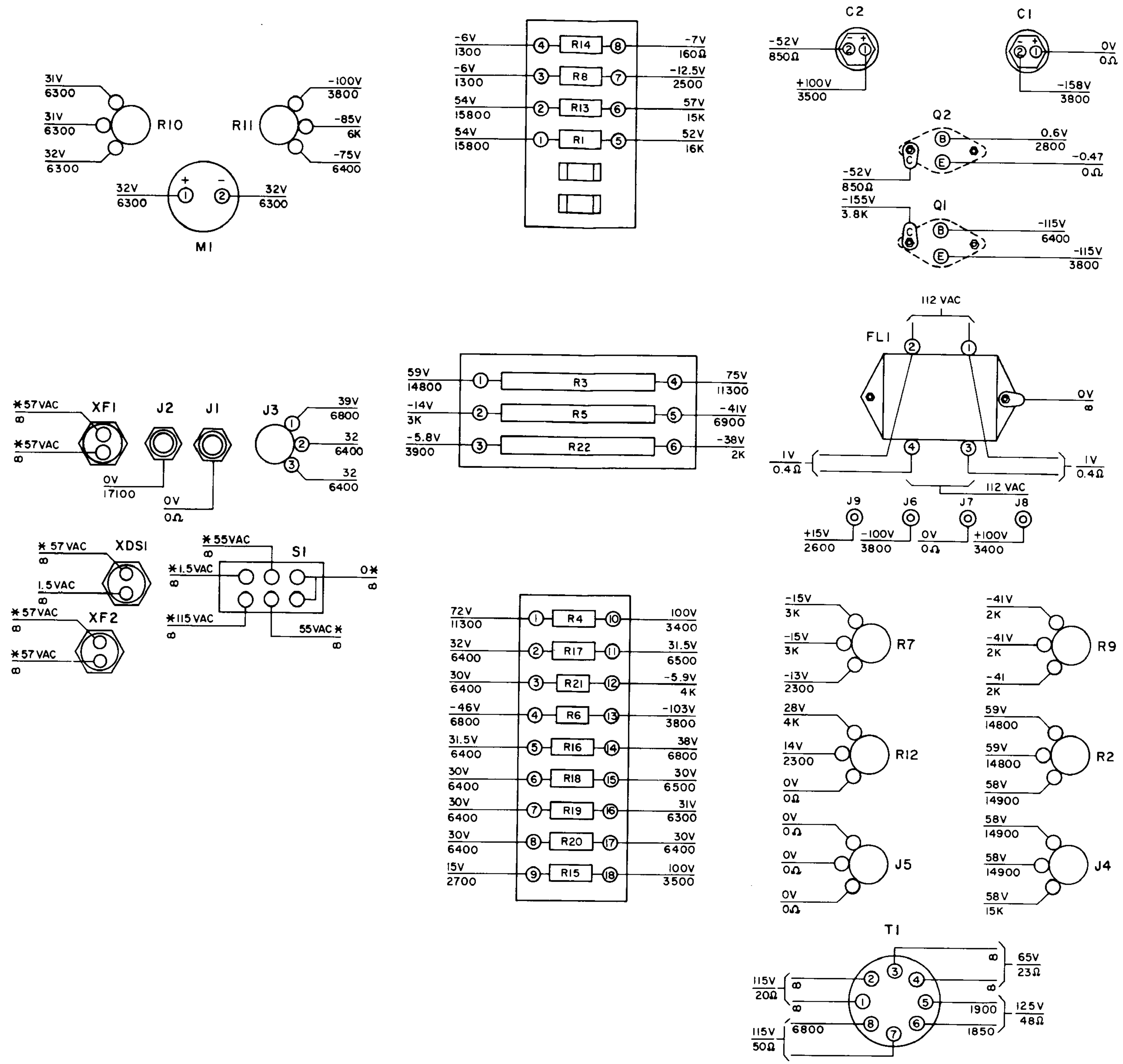
TABLE III – For use with Group III, Temperature Compensating, Style CC

COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					Capacitances over 10uuf	Capacitances 10uuf or less	
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	−30	1	1	10	± 1%		
RED	−80	2	2	100	± 2%	± 0.25uuf	
ORANGE	−150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	−330	5	5		± 5%	± 0.5uuf	
BLUE	−470	6	6				
PURPLE (VIOLET)	−750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	+100					± 1.0uuf	
SILVER							

1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: MIL–C–5, MIL–C–91, MIL–C–11272, and MIL–C–10950 respectively.
3. Letters indicate the temperature range and voltage-temperature limits designated in MIL–C–11015.
4. Temperature coefficient in parts per million per degree centigrade.

STD–C2

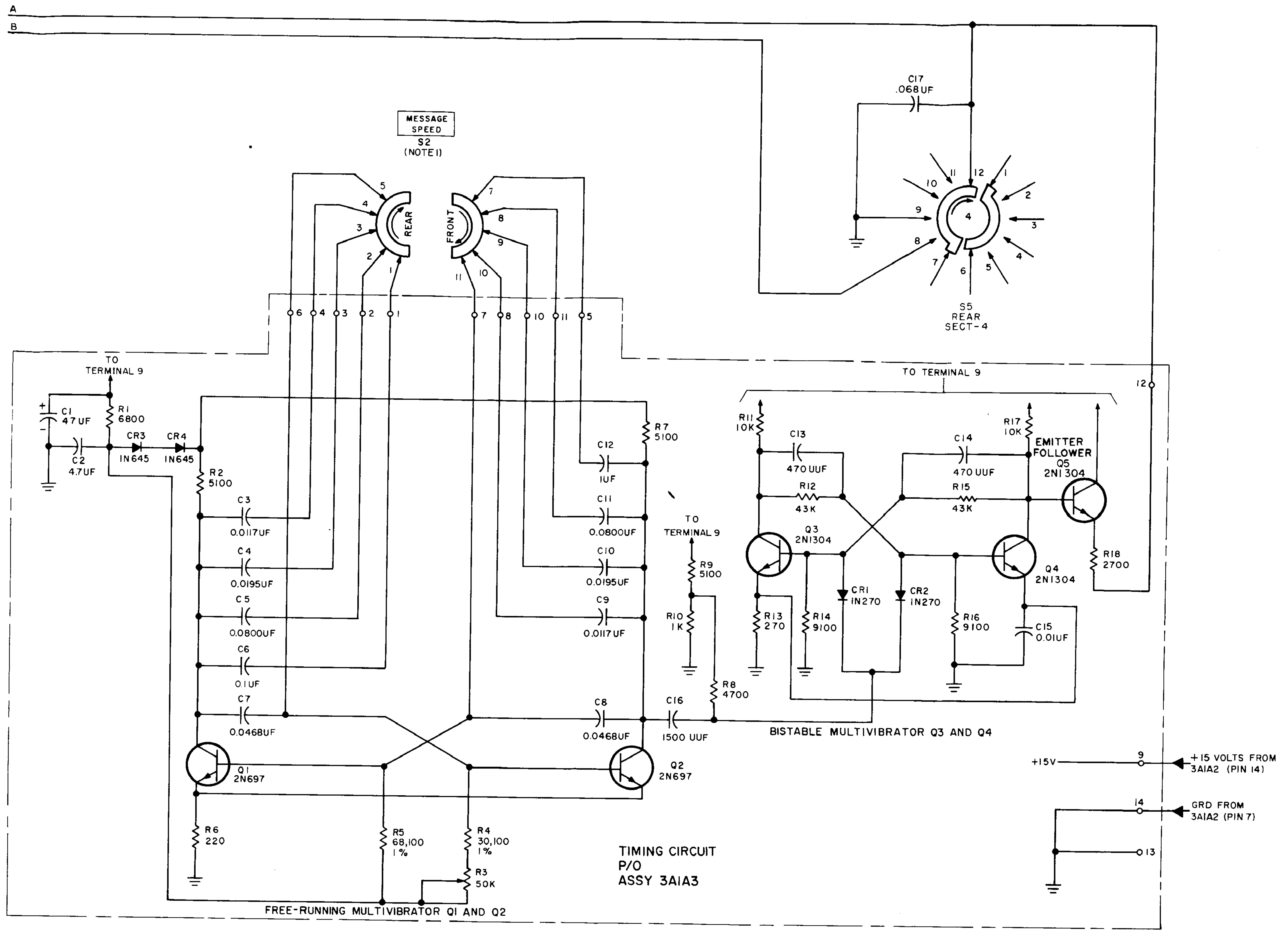
Figure 7–2. Color code markings for MIL–STD capacitors.



NOTES:
1. VOLTAGE AND RESISTANCE MEASUREMENTS ARE MADE USING MULTIMETER TS-352(B)/U.
2. FRONT PANEL SWITCHES ON RELAY TEST SET TS-836/UGM-1 ARE SET AS FOLLOWS: TEST SELECT: CONT EFF, TEST CURRENT: 4-8, MESSAGE SPEED: 75, OUTPUT CURRENT SELECT: 20.
3. RESISTANCE MEASUREMENTS ON TRANSISTORS Q1 AND Q2 MUST BE TAKEN ON RX1000 RANGE OF MULTIMETER TS-352( )/U.
4. CONNECT THE BLACK TEST LEAD, SUPPLIED WITH MULTIMETER TS-352( )/U, TO GROUND EXCEPT WHEN MEASURING NEGATIVE VOLTAGES.
5. ✱ INDICATES CONNECTION TO CHASSIS GROUND.
6. ∞ INDICATES INFINITE RESISTANCE.

Figure 7-3. Chassis assembly 3A1, voltage and resistance diagram.

Figure 7-4 (1) Test Set, Relay TS-836/UGM-1, schematic diagram.



NOTES:

1. MESSAGE SPEED SWITCH S2

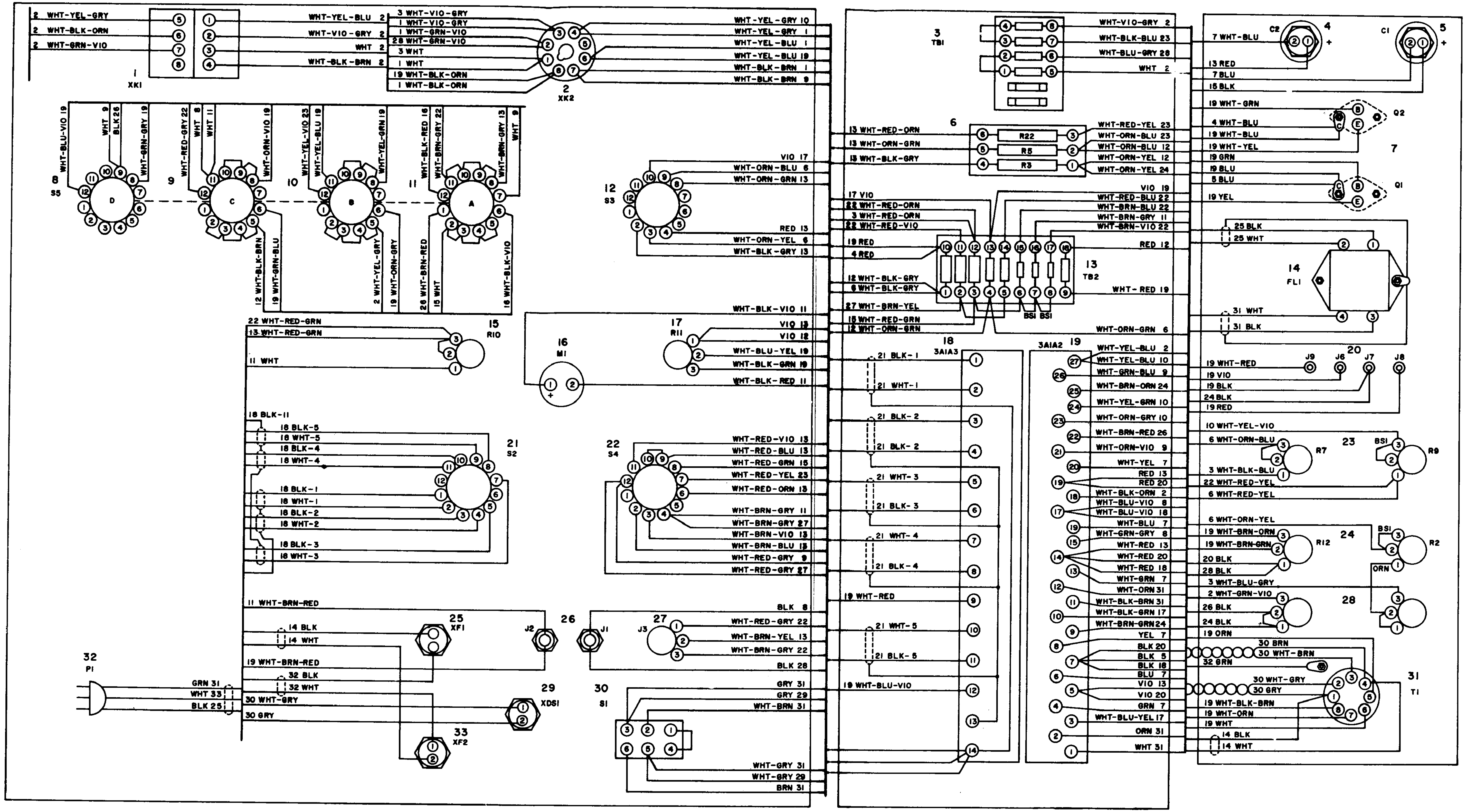
CONTACTS MADE

RATE	CONTACTS MADE	
	REAR	FRONT
23	1,2,3,4,5	7,8,9,10,11
37	2,3,4,5	8,9,10,11
75	3,4,5	9,10,11
100	4,5	10,11
125	5	11

2. UNLESS OTHERWISE SHOWN RESISTANCES ARE IN OHMS.
3. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED.
4. INDICATES FRONT AND REAR PANEL MARKINGS.
5. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
6. SWITCH POSITIONS:
   POWER S1 ---------- ON 115 V
   MESSAGE SPEED SZ ---------- 23
   TEST CURRENT S3 ---------- 4-8
   OUTPUT CURRENT SELECT S4 ---- 20
   TEST SELECT S5 ---------- PS BAL

TM6625-620-45/3-18 (2)

Figure 7-4 (2) Test Set, Relay TS-836/UGM-1, schematic diagram.



NOTES:
1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON OR BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION TO WHICH THE WIRE RUNS.
2. WIRES NOT OTHERWISE SPECIFIED ARE 22 GAUGE WITH NYLON JACKET.
3. BS DENOTES 22 GAUGE TINNED, ANNEALED COPPER WIRING.
4. BSI DENOTES 22 GAUGE TINNED, ANNEALED COPPER WIRING INSULATED WITH SILICON IMPREGNATED FIBER-GLASS SLEEVING.
5. PT DENOTES PIGTAIL LEAD.
6. PTI DENOTES PIGTAIL LEAD INSULATED WITH SILICON IMPREGNATED FIBER-GLASS SLEEVING.
7. P DENOTES PAIR.
8. DENOTES SHIELDED CONNECTION.
9. WIRING NOT OTHERWISE SPECIFIED IS DRESSED BACK TO THE PANEL AND RUN AT RIGHT ANGLES IN THE MOST CONVENIENT MANNER.

Figure 7-5. Test Set, Relay TS-836/UGM-1, wiring diagram.

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THE METRIC SYSTEM AND EQUIVALENTS

'NEAR MEASURE

. Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

'EIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

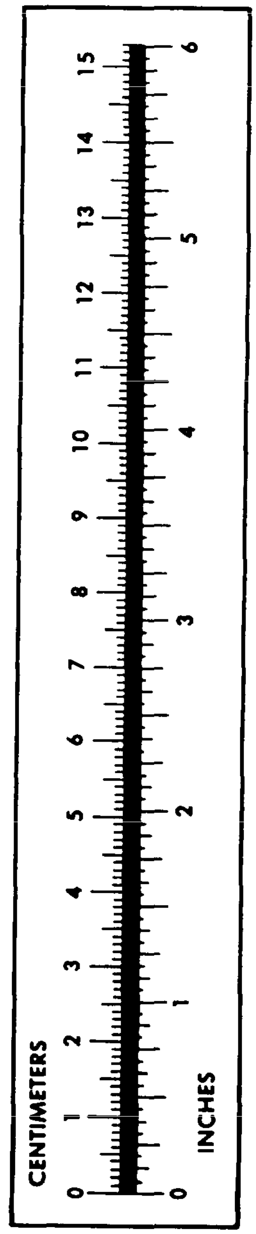
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ıts	Liters	0.473
arts	Liters	0.946
.allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
'ers	Gallons	0.264
.ms	Ounces	0.035
.ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
"lometers per Liter	Miles per Gallon	2.354
›meters per Hour	Miles per Hour	0.621



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