

ARMY TM 11-6625-255-14
AIR FORCE TO 33A1-13-170-1

OPERATOR'S, ORGANIZATIONAL, DIRECT
SUPPORT, AND GENERAL SUPPORT
MAINTENANCE MANUAL

SPECTRUM ANALYZERS TS-723A/U,
TS-723B/U, TS-723C/U, AND
TS-723D/U (NSN 6625-00-668-9418)

This copy is a reprint which includes current pages from Change 1. The title was changed to read as shown above by Change 1.

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
JANUARY 1976

WARNING

Hazardous voltages are used in the operation of this equipment. Use extreme caution not to contact high voltage, 115V or 230V, input connections when operating this equipment. Before working inside the equipment, always disconnect primary power and ground the high voltage capacitors. Failure to comply may result in serious injury or death to personnel.

TECHNICAL MANUAL }
No. 11-6625-255-14 }
TECHNICAL ORDER }
No. 33A1-13-170-1 }

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON, DC, 9 January 1976

**Operator's, Organizational,
Direct Support, and General
Support Maintenance Manual**

SPECTRUM ANALYZERS

**TS-723A/U, TS-723B/U, TS-723C/U,
AND TS-723D/U (NSN 6625-00-668-9418)**

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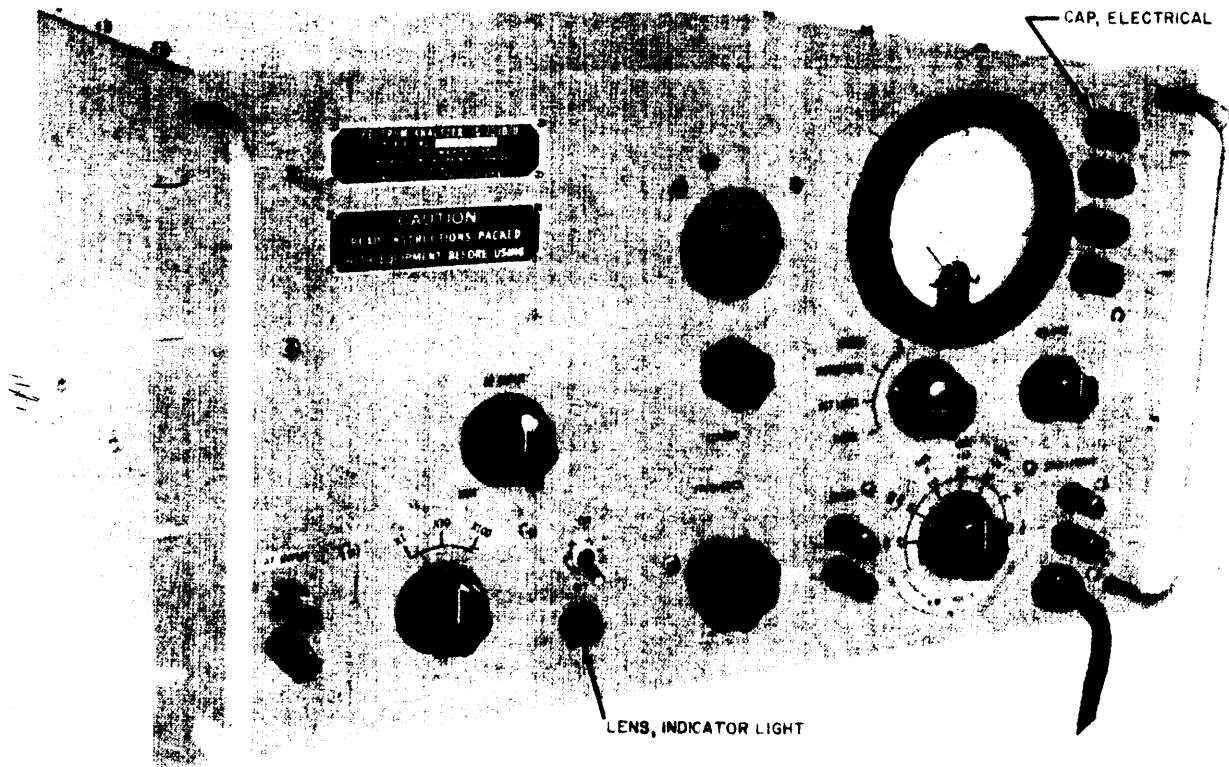
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Figure 1-1. Spectrum Analyzer TS-723D/U.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual describes Spectrum Analyzers TS-723A/U, TS-723B/U, TS-723C/U, and TS-723D/U and covers their installation, operation, functioning, and operator, organizational, and general support maintenance. No direct support maintenance is authorized for this equipment. Figure 1-1 shows TS-723D/U; all other models are similar.

b. Official nomenclature utilizing (*) is used to indicate all models of the equipment. Therefore, Spectrum Analyzer TS-723(*)/U will represent Spectrum Analyzer TS-723A/U, TS-723B/U, TS-723C/U, and TS-723D/U, except where model differences dictate.

1-2. Indexes of Publications

a. *DA Pam 110-4.* 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. *DA Pam 310-7.* 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 (Army). Air Force personnel will use AFM 66-1 for maintenance reporting and TO-00-35D54 for unsatisfactory equipment reporting.

b. *Report of Packaging and Handling Deficiencies.* Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, 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 55-3/NAVSUPINST 4610.33A/AFR 75-18/MCO

P4610.10B and DSAR 4500.15.

1-4. Destruction of Army Materiel.

Demolition and destruction of electronic equipment will be under the direction of the commander and in accordance with TM 750-244-2.

1-5. Administrative Storage

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

1-6. Reporting of Errors

a. The reporting 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) or DA Form DA Form 2028-2 (Test) located in the back of the manual, and forwarded direct to Commander, US Army Electronics Command, AT TN: DRSEL-MA-Q, Fort Monmouth, NJ 07703. To use the form in the back of the manual, fill it out as shown on the sample figure 1-2, fold it where shown, and drop it in the mail. A reply will be furnished direct to you.

b. For Air Force, use USAFLC Form 252 (Request for TO Revision or Change). Forward direct to prime ALC/MST.

1-6.1 Reporting Equipment Improvement Recommendations (EIR)

a. *Army.* EIR's will be prepared using DA Form 2407, Maintenance Request. Instructions for preparing EIR's are provided in TM 38-750, the Army Maintenance Management System. EIR's should be mailed directly to Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, NJ 07703. A reply will be furnished directly to you.

b. *Air Force.* Air Force personnel are encouraged to submit EIR's in accordance with AFM 900-4.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS



SOMETHING WRONG WITH THIS MANUAL?

THEN... JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)

Commander
Stateside Army Depot
ATTN: AMSTA-US
Stateside, N.J. 07703

DATE 10 July 1975

PUBLICATION NUMBER

TM 11-5840-340-12

DATE

23 Jan 74

TITLE

Radar Set AN/SPC-76

BE EXACT... PIN-POINT WHERE IT IS

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

| PAGE NO. | PARA-GRAPH | FIGURE NO. | TABLE NO. |
|----------|------------|------------|-----------|
| 2-25 | 2-28 | | |
| 3-10 | 3-3 | | 3-1 |
| 5-6 | 5-8 | | |
| | | FO3 | |

Recommend that the installation antenna alignment procedure be changed throughout to specify a 2° IFF antenna lag rather than 1°.

REASON: Experience has shown that with only a 1° lag, the antenna servo system is too sensitive to wind gusting in excess of 27 knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2° without degradation of operation.

Item 5, Function column. Change "2 db" to "3db."

REASON: The adjustment procedure for the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.

Add new step f.1 to read, "Replace cover plate removed in step e.1, above."

REASON: To replace the cover plate.

Zone C 3. On J1-2, change "+24 VDC to "+5 VDC."

REASON: This is the output line of the 5 VDC power supply. + 24 VDC is the input voltage.

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SSG I. M. DeSpirito 999-1776

SIGN HERE:

SSG I. M. DeSpirito

DA FORM 2028-2 (TEST) 1 AUG 74

P.S.--IF YOUR OUTPUT WANTS TO KNOW ABOUT YOUR MANUAL "FIND" MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

Figure 1-2. DA Form 2028-2(Test), sample

EL6625-255-14-TM-44

Section II. DESCRIPTION AND DATA

1-7. Purpose and Use

Spectrum Analyzer TS-723(*)/U is used to measure harmonic distortion and noise level in audio-frequency (af) amplifiers. Measurements of distortion are made in percentage or in decibels (dB), and measurements of noise are made in effective values or root mean square (rms) values or in dB values referred to one milliwatt (row) across 600 ohms (dBm). The spectrum analyzer may also be used as an alternating current (at), vacuum-tube voltmeter (vtvm) to measure ac signals as low as 0.003 volt.

1-8. Description

a. General. The spectrum analyzer consists of a panel-chassis assembly with a bottom cover and a perforated or louvered metal cover that encloses the

top and rear of the chassis. All operating controls and connecting binding posts for standard operation are on the front panel.

b. Additional Equipment Required.

(1) A shielded test cable with banana plug connectors is the only component required to operate the spectrum analyzer test unit.

(2) An oscilloscope or a linear radiofrequency (rf) detector will extend the usefulness of the equipment.

(3) When relay rack mounting is desired, a standard 19-inch wide equipment rack is required.

1-9. Differences Between Models

For information detailing differences between models, refer to table 1-1 and figures 3-1, 3-2, and 3-3.

Table 1-1. Differences Between Models

| Item | TS-723A/U | TS-723B/U | TS-723C/U | TS-723D/U |
|--|-----------------------------|--------------------------|---------------------------------|---------------------------------|
| Components, finished construction. | Commercial | Militarized | Militarized | Militarized. |
| Cover | Perforated. | 9 louvers at rear. | 9 louvers at rear. | 9 louvers at rear. |
| Potentiometer R4. | Signal INPUT control. | Signal AF INPUT control. | Signal AF INPUT control. | Signal AF INPUT control. |
| Binding posts (E5 and E6) | AF-RF INPUT. | Not used. | Not used. | Not used. |
| Selector switch (S2). | AF-RF. | Not used. | Not used. | Not used. |
| Indicator lamp. | None. | Mounted on front panel. | Mounted on front panel. | Mounted on front panel. |
| Fuses and power cord. | Mounted at rear of chassis. | Mounted on front panel. | Mounted on front panel. | Mounted on front panel. |
| Spare fuseholders. | None. | Mounted on front panel. | Mounted on front panel. | Mounted on front panel. |
| FREQUENCY tuning dials (Course and Fine) | Marked FREQUENCY | Marked FREQUENCY. | Marked FREQUENCY, COARSE, FINE. | Marked FREQUENCY, COARSE, FINE. |
| Engraved panel marking 115-230V switch. | White | White | Black | Black. |
| METER RECTIFIER circuit. | None. | None | At rear of chassis. | At rear of chassis. |
| | V14. | V14. | V14. | CR1 and CR2. |

1-10. Tabulated Data

The technical characteristics of Spectrum Analyzer TS-723(*)/U areas follows:

| | |
|----------------------------------|---|
| Distortion measurement range | Fundamental frequency from 20 Hz to 20 kHz. |
| Frequency calibration accuracy | ±2 percent from 20 Hz to 20 kHz. |
| Filter characteristics | Fundamental frequency is rejected by more than 99.99 percent, or down approximately 80 dB, |
| Second harmonic attenuation. | Less than 17 percent (-1,5 dB) in the fundamental range from 20 to 5,000 Hz, Less than 32 percent (-3 dB) in the fundamental range from 5 to 20 Hz. |
| Residual harmonic measurements | Residual frequencies (harmonics of the fundamental frequency) are measured to within ±3 percent of the full-scale value for distortion levels as low as 0.5 percent. Meter indications are proportional to the average value of the |

| | |
|--|---|
| | residual components, Distortion introduced by the instrument is less than 0.1 percent. |
| Sensitivity | Distortion levels as low as 0.3 percent may be measured full scale. Levels of 0.1 percent are accurately readable. |
| Noise amplifier gain | 40 dB gain ±1 dB from 20 Hz to 15 kHz. |
| Set-level amplifier gain | 20 dB gain ±1 dB from 20 Hz to 20 kHz ± 2,5 dB from 10 Hz to 100 kHz. |
| Amplifier input impedance . . | Approximately 200,000 ohms, 40 µF shunt. |
| Input level for distortion measurement | Rms 1 volt, minimum. |
| Meter range | Full scale 0.03, 0.10, 0.30, 1.0, 3.0, 10, 30, 100, 300, R.M.S. VOLTS. DB: -30, -20, -10, 0, +10, +20, +30, +40, and +50. |
| Vtvm section frequency range | 10 Hz to 100 kHz. |
| Vtvm section frequency response | Flat ±3 percent of 1,000 Hz from 10 Hz to 100 kHz on all ranges. |
| Meter calibration | Calibrated to read rms of a sine |

wave with two linear voltage scales: 0 to 1 volt and 0 to 3 volts. Voltage ranges are related by 10-dB steps. Zero dBm-1 mw across 600 ohms 1,000 cps. DBm scale calibrated from -12 dBm to +2 dBm.

Full-scale meter movement . . . 1 mA.

Voltmeter input impedance . . . Input shunt capacitance approximately 37 μ F. Input shunt resistance: 0.03- to 30-volt range is 1 megohm; 10-volt range is 3 megohms; 300-volt range is 2.4

megohms.

Meter overload capacity Will not be damaged by overloads of up to 100 times normal load.

Noise measurement Full-scale readings can be made of 300 microvolt. Noise measurement range is 10 Hz to 20 kHz. Satisfactory readings can be made down to -75 dBm.

Input power supply rating . . . Voltage: 115 volts (may be modified for a 230-volt operation).
Frequency: 50 to 1,000 Hz.
Wattage: 90 watts.

CHAPTER 2

SERVICE UPON RECEIPT AND INSTALLATION

Section I. SERVICE UPON RECEIPT OF MATERIEL

2-1. Unpacking

a. Refer to figure 2-1, and follow the steps below when unpacking the spectrum analyzer.

(1) Place wooden packing crate as close as possible to desired location of equipment.

(2) Cut and fold back metal straps.

(3) Remove nails with a nailpuller, and remove top and sides of packing case. Do not attempt to pry off sides or top; such action may damage equipment.

(4) Remove outer carton, and carefully cut and remove the waterproof barrier.

(5) Open outer corrugated carton and remove inner corrugated carton.

(6) Carefully cut and remove moisture-vaporproof barrier.

(7) Open inner corrugated carton and lift out small carton which contains running spare parts.

(8) Remove filler material and lift unit out of corrugated carton.

b. The spectrum analyzer may be received in domestic packing cases. The instructions given in *a* above also apply to domestic shipments. If

wrapping paper has been used in lieu of cartons, remove it carefully and check the contents as in paragraph 2-2.

2-2. Checking Unpacked Equipment

a. Inspect equipment for damage incurred during shipment. If the equipment has been damaged, report damage on DD Form 6, as in paragraph 1-3 *b.*

b. Check equipment against the component listing on the packing slip to see if shipment is complete. Report all discrepancies in accordance with paragraph 1-3. The equipment should be placed in service even though a minor assembly or part that does not affect proper functioning is missing.

c. Check to see whether the equipment has been modified. (Equipment which has been modified will have the MWO number on the front panel, near the nomenclature plate). Check also to see whether all currently applicable MWO's have been applied. (Current MWO'S applicable to the equipment are listed in DA Pam 310-7.)

Section II. INSTALLATION

2-3. Tools, Test Equipment, and Materials Required for installation

All tools required for installation are found in Tool Kit, Electronic Equipment TK-100/G

2-4. Installation Instructions

Spectrum Analyzer TS-723(*)/U may be mounted on a standard 19-inch equipment rack, or placed on a work bench. Normally it is adjusted for 115V operation. If the source voltage for TS-723A/U or TS-723B/U requires changing the strapping on transformer T1, follow the procedure in *a* or *b* below, whichever is applicable. To change the voltage operation for TS-723C/U or TS-723D/U, follow procedure *c* below.

a. Strapping T1 for 230V Operation.

(1) Remove the bottom cover.

(2) For TS-723A/U, refer to block 10, figure FO-4, and disconnect the jumpers between terminals 3 and 4, and terminals 5 and 7, on terminal board TB7 (fig. 7-2). Connect and solder a piece

of # 18 AWG bare copper wire between terminals 4 and 5 on TB7.

(3) For TS-723B/U, refer to block 42, figure FO-5, and disconnect the jumpers between terminals 1 and 3, and terminals 2 and 4, on transformer T1 (fig. 7-4). Connect and solder a piece of #18 AWG bare copper wire between terminals 2 and 3 on T1.

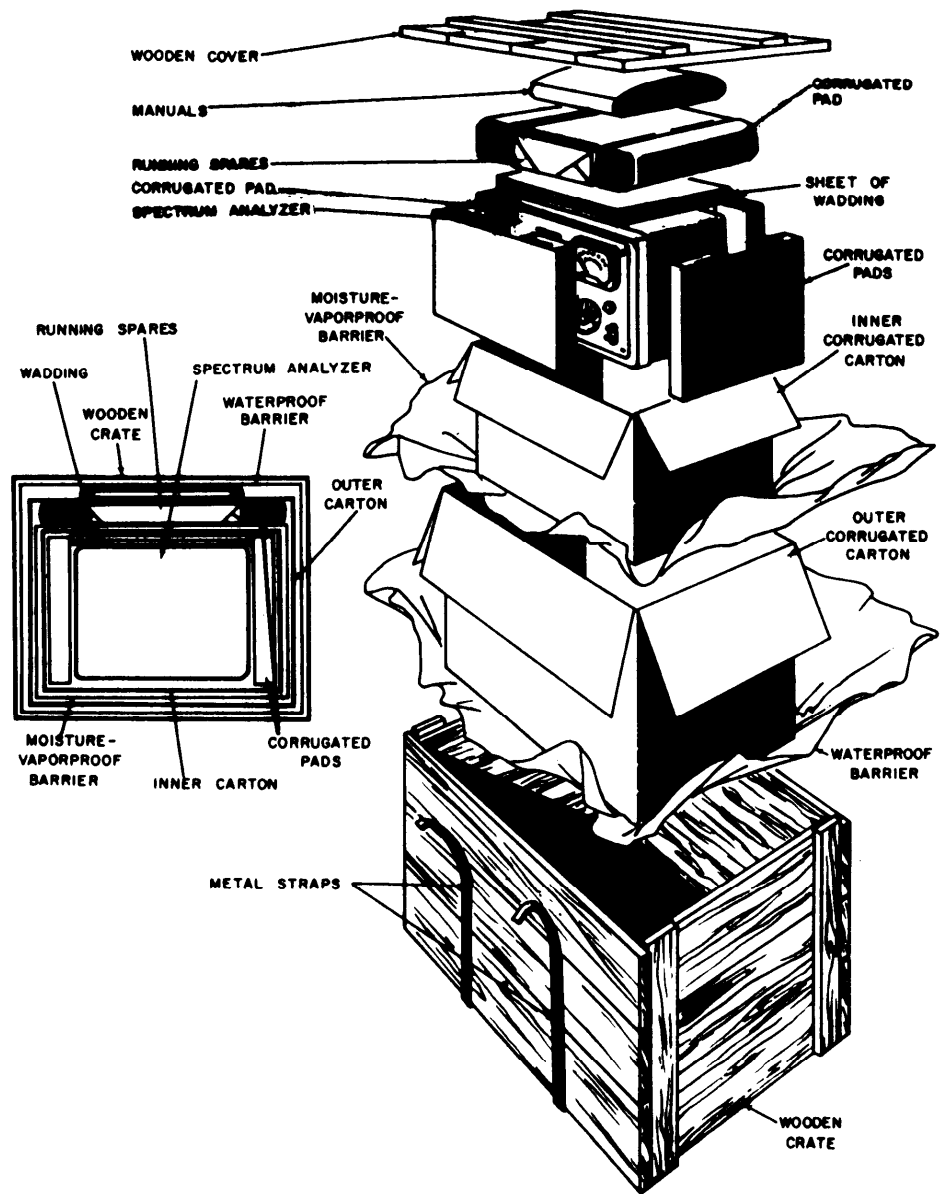
(4) Replace the bottom cover.

(5) Be sure that the fuse is rated at 0.8 ampere at 230 volts, and tag the unit to indicate it has been set for 230V operation.

b. Strapping T1 for 115V Operation.

(1) Remove the bottom cover and reverse the instructions given in *a* (2) above for the TS-723A/U, using #18 AWG insulated copper wire to replace the jumpers between terminals 3 and 4 and terminals 5 and 7.

(2) For TS-723B/U reverse the procedures in *a* (3) above, using #18 AWG insulated copper wire to replace the jumpers between terminals 1



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Figure 2-1. Packaging of Spectrum Analyzer TS-723(*)/U.

and 3 and terminals 2 and 4.

(3) Follow the procedures in *a* (4) and (5) above substituting a 1.6 ampere fuse and a tag indicating the unit has been set for 115V operation.

c. Power Transformer (TS-723C/U and TS-723D/U). A switch has been added in the primary circuit of power transformer T1 which provides for 115V or 230V operation directly without any need to change the transformer strapping or wiring. A locking plate fits over the toggle switch and is screwed to the rear of the chassis so that the switch cannot accidentally be thrown after it has been properly set. Set this switch to correspond to the voltage source being

used, taking care to use the proper fuse as specified in *a* and *b* above. When operating from a 230V source, take care never to set this switch to the 115V position.

2-5. Interconnections

a. Make the power and ground connections as follows:

(1) Connect the power cord to the available line source. Refer to paragraph 2-4 for wiring changes if necessary.

(2) If the TS-723A/U power cord plug has a round grounding terminal, and the ac outlet will not accept this plug, replace the plug with con-

necter, plug type UP-121M, or equivalent as needed. In all other models the power cord is terminated with connector plug UP- 121M.

(3) If the AC outlet is of the standard two-slot type, use a standard plug, and ground the equipment with No. 12 AWG copper wire, or equivalent.

b. Make the input and output connections as follows:

(1) For distortion measurements, connect the test leads to the AF INPUT binding posts.

(2) For noise, signal level, or gain measurements which require preamplification, connect the test leads to the AF INPUT binding posts.

(3) For noise, signal level, or gain measurements that do not require preamplification, connect the test

leads to the METER binding posts.

(4) If an oscilloscope is to be used, connect it to the OSCILLOSCOPE binding posts.

2-6. Installation of Plug-in Items

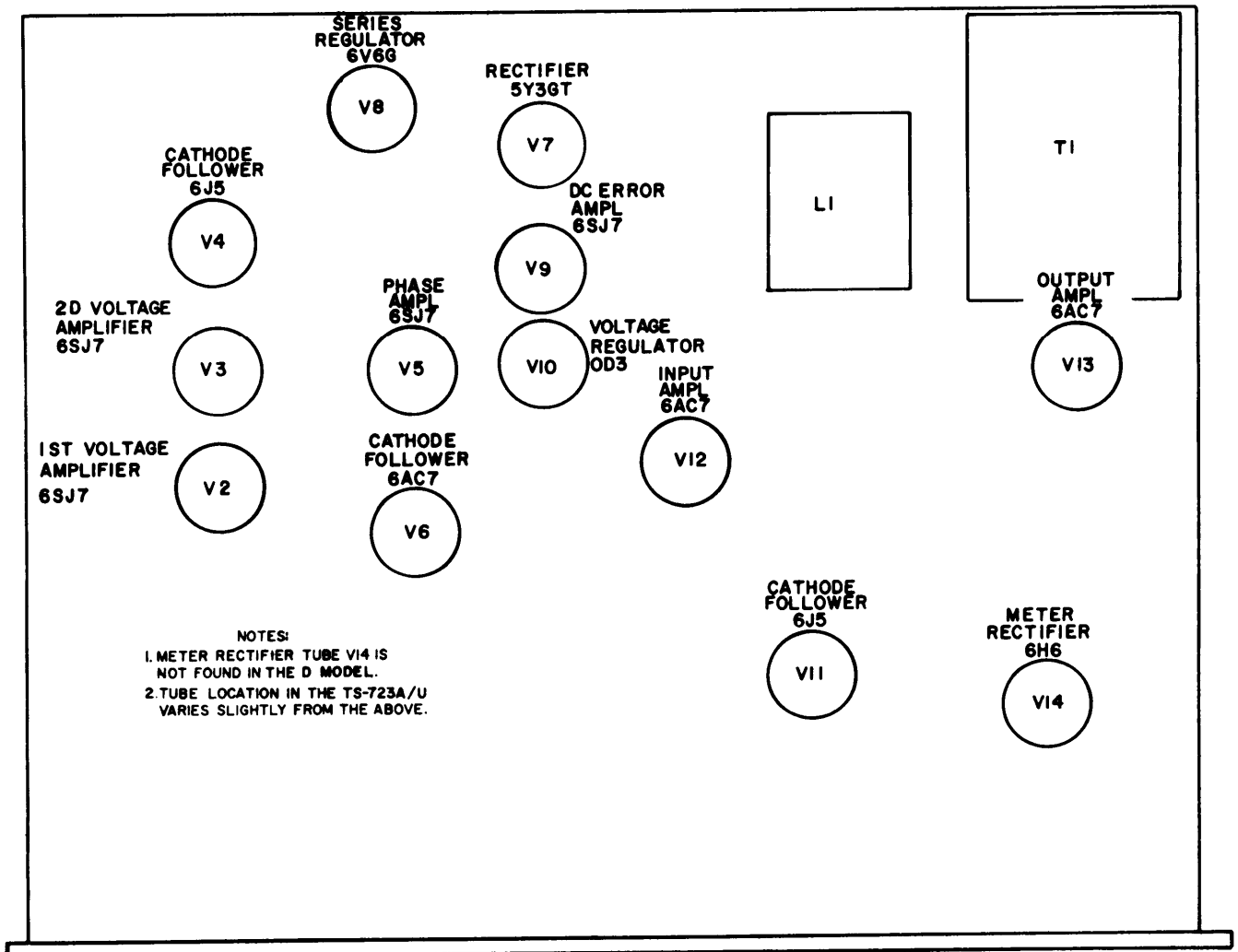
The TS-723(*)/U is shipped with the tubes and fuses installed.

a. Check for breakage and proper seating of tubes (fig. 2-2).

b. Check that proper fuses are installed in fuse holders.

(1) 1.6A, 250V fuse in 1.6 AMP fuse holder (0.8A, 250V for 230V operation).

(2) 0.15A, 250 fuse in .15 AMP fuse holder.



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Figure 2-2. Tube locations, Spectrum Analyzer TS-729(*)/U.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. CONTROLS AND INSTRUMENTS

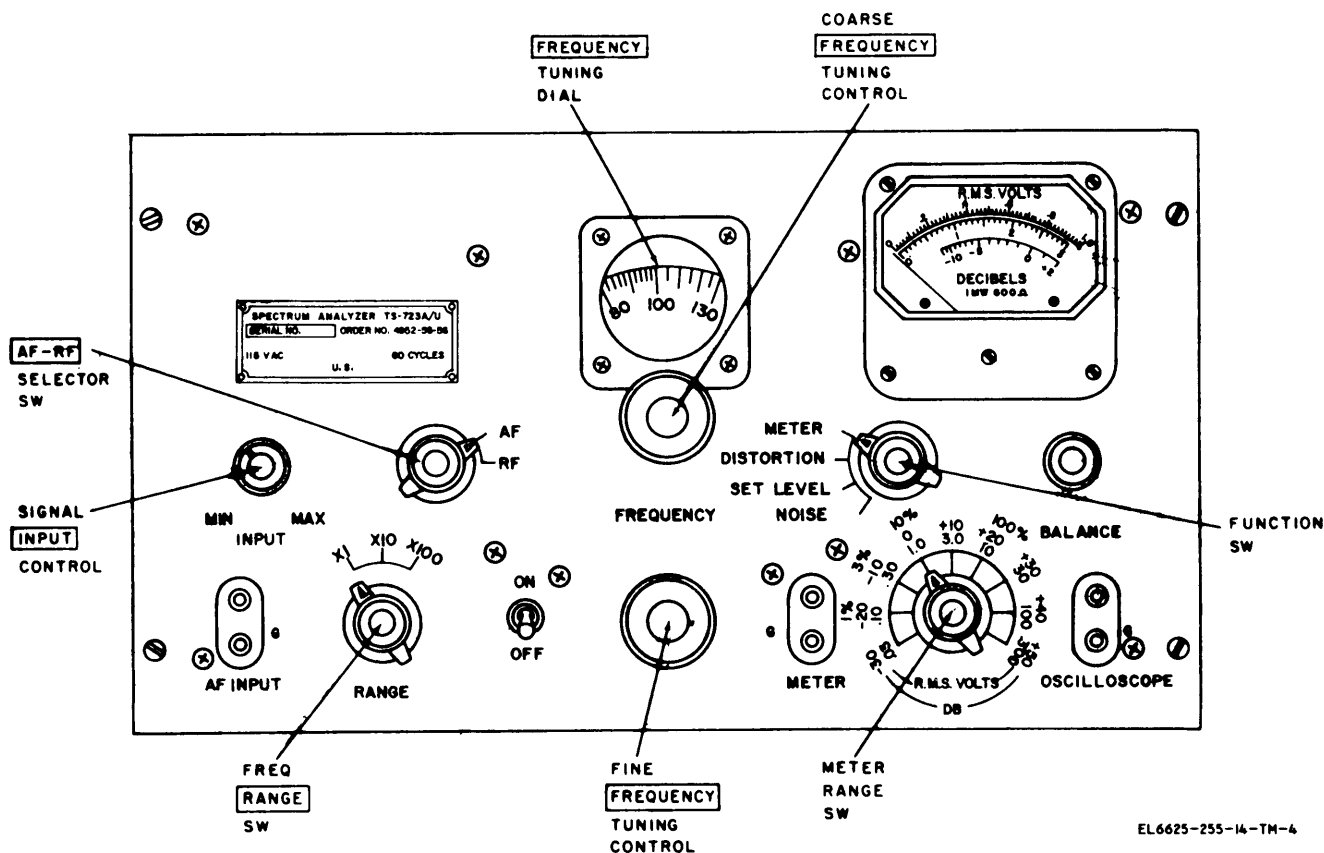
3-1. Damage from Improper Settings

To prevent the equipment from damage as a result of improper settings, observe the following precautions when setting the controls:

- a. Turn the signal AF INPUT control to MIN.
- b. Set the meter range switch to +50 DB. This protects the meter pointer from being damaged in case of violent deflection.

3-2. Operator Controls

Table 3-1 lists the controls and indicators used by the operator, together with their functions. Front panel controls are illustrated in figures 3-1 and 3-2. Rear panel views of all models are shown in figure 3-3.



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Figure 3-1. Front panel controls and indicators, Spectrum Analyzer TS-723A/U.

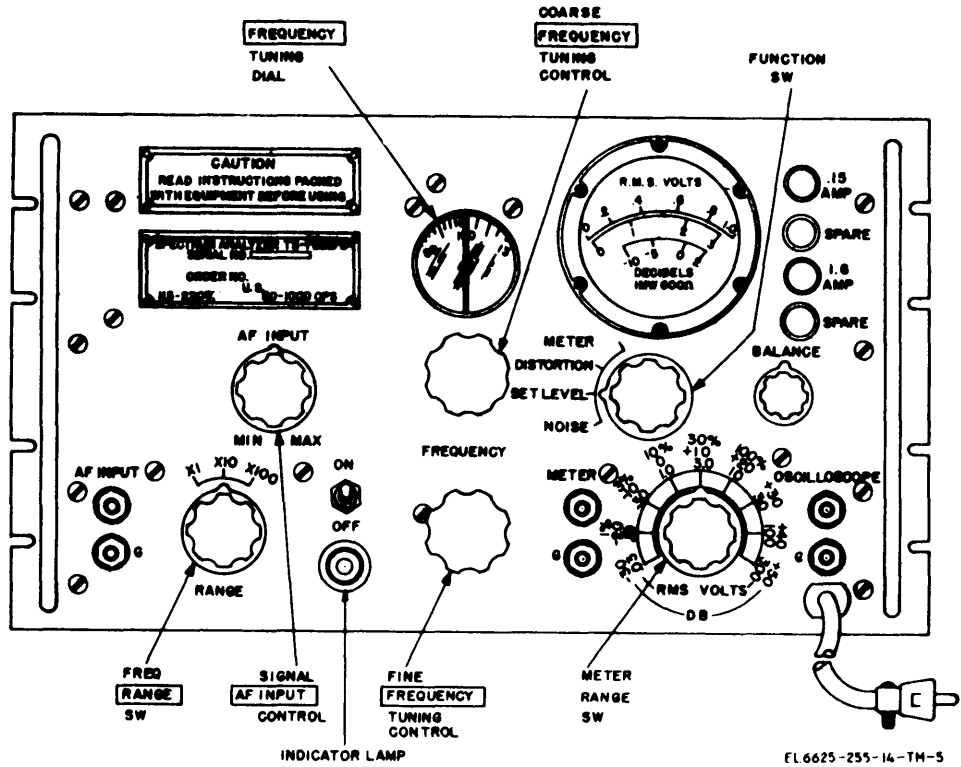


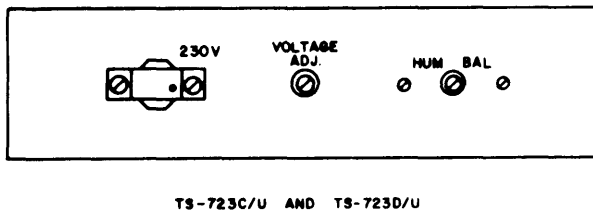
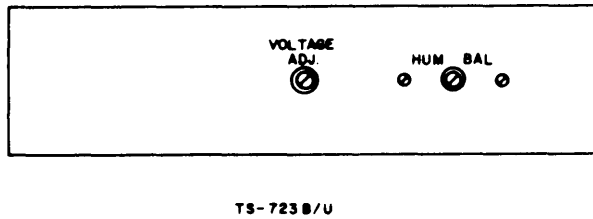
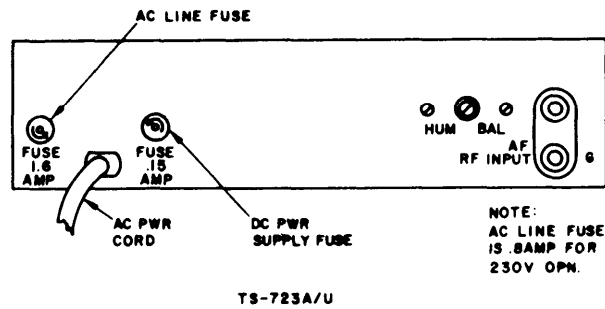
Figure 3-2. Front panel controls and indicators, Spectrum Analyzers TS-723B/U, TS-723C/U, and TS-723D/U.

Table 3-1. Operator Controls and Indicators

| Control, indicator, or fuse | Function | | | | | | | | |
|--|---|----------|----------|------------|---|-----------|---|-------|--|
| ON/OFF power switch. | Applies power to equipment. | | | | | | | | |
| ON/OFF indicator lamp (TS-723B/U, TS-723C/U, and TS-723D/U). | Glows when ON/OFF switch is ON. | | | | | | | | |
| Signal INPUT control. | Controls input level of applied signal in any position of function switch except METER position. | | | | | | | | |
| AF/RF selector switch (TS-723A/U only). | Selects input signal from either AF INPUT or AF-RF INPUT binding posts. Leave switch in AF position. | | | | | | | | |
| Frequency RANGE switch. | Selects any of three frequency bands available. The frequency range band is given below: X1 20 to 200 Hz. X10 200 to 2,000 Hz. X100 2,000 Hz to 20 kHz. | | | | | | | | |
| FREQUENCY tuning dial. | Indicates reading of input signal frequency in conjunction with frequency RANGE switch. Direct dial readings are given from 20 to 200. | | | | | | | | |
| FREQUENCY tuning controls. | Tune spectrum analyzer to input signal frequency, within limits set by frequency RANGE switch. | | | | | | | | |
| Coarse FREQUENCY control (upper knob), Fine FREQUENCY control (lower knob). | Used for coarse tuning adjustments. | | | | | | | | |
| Function switch. | Used for fine tuning adjustments. Selects desired function as follows: | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>Position</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>DISTORTION</td> <td>Adjusts equipment to measure harmonics of input signal compared to a reference level.</td> </tr> <tr> <td>SET LEVEL</td> <td>Adjusts input signal to a reference level for distortion measurements and increases range level when measuring noise signals.</td> </tr> <tr> <td>NOISE</td> <td>Used for voltage measurements of every weak signal inputs.</td> </tr> </tbody> </table> | Position | Function | DISTORTION | Adjusts equipment to measure harmonics of input signal compared to a reference level. | SET LEVEL | Adjusts input signal to a reference level for distortion measurements and increases range level when measuring noise signals. | NOISE | Used for voltage measurements of every weak signal inputs. |
| Position | Function | | | | | | | | |
| DISTORTION | Adjusts equipment to measure harmonics of input signal compared to a reference level. | | | | | | | | |
| SET LEVEL | Adjusts input signal to a reference level for distortion measurements and increases range level when measuring noise signals. | | | | | | | | |
| NOISE | Used for voltage measurements of every weak signal inputs. | | | | | | | | |

Table 3-1. Operator Controls and Indicators— Continued

| Control, indicator, or fuse | Position | Function |
|--|----------|---|
| | METER | Used to measure ac signal voltage when input signal is connected to METER binding post. |
| BALANCE control. | | Adjust equipment in conjunction with DISTORTION position of function switch. |
| HUM BAL control. | | Adjusts equipment to prevent internal interference. |
| Meter range switch. | | Selects proper range scale in dB, dBm, percentage, or rms values for meter. Each setting of switch represents full-scale deflection of meter equivalent to designation of position. |
| Meter indicator. | | Shows measurements by needle deflection on designated scale when used with meter range switch. |
| 1.6 AMP fuse. | | Protects equipment from line surges, or application or wrong voltage. |
| .15 AMP fuse. | | Protects equipment when internal short circuit occurs. |
| 115-230V switch (TS-723C/U and TC-723C/U). | | Changes transformer T1 input connections for 115V or 250V source. |



EL6625-255-14-TM-6

Figure 3-3. Rear panels, Spectrum Analyzer TS-723()/U

Section II. OPERATION UNDER USUAL CONDITIONS

3-3. Types of Operation

a. Spectrum Analyzer TS-723(*)/U acts as either a spectrum analyzer or a vtvm. It may be used to make distortion measurements in percentage or dB, to search for an unknown input signal frequency, or, when used as a vtvm, to measure signals in rfm values or dBm values.

b. For any type of operation, perform the following procedures:

- (1) Starting procedure (para 3-4).
- (2) Procedure for the desired type of operation (para 3-5 through 3-11).
- (3) Stopping procedure (para 3-12).

3-4. Starting Procedure

NOTE

Check to see that the initial controls settings (para 3-1) have been made before this procedure is started.

a. Preliminary. Set front panel controls as follows:

- (1.) Set the ON/OFF power switch to OFF.
- (2) Set the meter range switch to the approximate level to be measured. Leave at +50 DB if level is unknown.

NOTE

To obtain accurate results during operation, ground the spectrum analyzer as instructed in paragraph 2-5 *a.*

b. Starting.

- (1) Throw the ON-OFF power switch to ON; the tuning dial indicator should glow. Allow the equipment to warmup for at least five minutes.
- (2) Check to see that the meter pointer is at 0 on the R.M.S. VOLTS scale.

NOTE

If, during the starting procedure, an abnormal result is obtained, refer to table 5-2.

3-5. Distortion Measurements in Percentage

a. Connect test leads from signal source to be measured to the AF INPUT binding posts.

b. Set the AF/RF selector switch to AF (TS-723A/U).

c. Set the meter range switch to 100%.

d. Set the function switch to SET LEVEL.

e. Slowly rotate the signal INPUT control clockwise until the meter pointer reaches a full-scale deflection of 1.0.

f. Set the frequency RANGE switch to the

position which includes the fundamental frequency of the signal source.

g. Turn the function switch to DISTORTION.

h. Adjust the coarse FREQUENCY tuning control (upper) until the meter pointer drops sharply. If the dip cannot be found, or is not pronounced, refer to paragraph 3-7 for instructions.

i. Adjust the fine FREQUENCY tuning control (lower) for a maximum dip of the meter pointer. The tuning becomes sharp as the meter indication decreases.

j. Adjust the BALANCE control for a minimum meter indication. The tuning becomes sharper as the meter indication decreases.

NOTE

The source must put out a stable signal to maintain a steady balance.

k. Readjust the controls until no further reduction in meter indication can be obtained. As adjustment progresses, decrease the setting of the meter range switch to maintain midscale meter deflections.

l. Distortion measurements are read on the meter in conjunction with the meter range switch.

3-6. Distortion Measurements in Decibels

a. Follow the procedure given in paragraph 3-5 *a* through *f.*

b. Set the meter range switch to +20 DB.

c. Slowly rotate signal INPUT control clockwise until the meter pointer rests at 0 DECIBELS.

d. Follow the procedure given in paragraph 3-5 *g* through *k.*

e. Distortion measurements are obtained as follows:

(1) When the meter range switch is set to +20 DB, dB distortion measurements can be read directly on the meter.

(2) When the switch is set in any other position, dB distortion measurements are obtained by algebraically adding minus 20 dB and the DB range setting to the value indicated on the meter.

NOTE

DB measurements for the +20 DB position can also be obtained by the method given in (2) above.

(3) Examples of typical dB distortion measurements are shown in table 3-2.

(4) The dB range of each position of the meter range switch is shown in table 3-3.

Table 3-2. Typical DB Distortion Measurements

| 1 DB setting of meter range switch | 2 Meter reading | 3 Col 1 plus col 2 | 4 Distortion measured Col 3 + (-20 dB) |
|---|-----------------------|--------------------------|--|
| -20 | -1.5 | -21.5 | -41.5 |
| 0 | -1.5 | -1.5 | -21.5 |
| -30 | -1.5 | -31.5 | -51.5 |
| +10 | -1.5 | +8.5 | -11.5 |
| +20 | -1.5 | +18.5 | -1.5 |
| -20 | +1 | -19 | -39 |
| -30 | +1 | -29 | -49 |
| +10 | +1 | +11 | -9 |

NOTE

The maximum possible error in distortion readings is -11 percent of the reading obtained. Distortion readings greater than -20 dB, such as -11.5 and -9 dB readings shown in column 4 above, are not precise readings but only indicate extreme distortion.

Table 3-3. DB Range of Meter Range Switch Positions

| DB setting | Range (dB) |
|------------|------------|
| -30 | -62 to -48 |
| -20 | -52 to -38 |
| -10 | -42 to -28 |
| 0 | -32 to -18 |
| +10 | -22 to -8 |
| +20 | -12 to +2 |
| +30 | -2 to +12 |
| +40 | +8 to +22 |
| +50 | +18 to +32 |

3-7. Unknown Input Signal Frequency

When the af signal frequency to be measured is unknown, proceed as follows:

a. Follow the procedure given in paragraph 3-5 a through e, except to set the function switch to DISTORTION.

b. Set the frequency RANGE switch to XI.

c. Rotate the coarse FREQUENCY tuning control from 20 through 200 on the FREQUENCY tuning dial and, at the same time, watch the meter pointer for a dip. If there is no dip, set the frequency RANGE switch to X10. If there is still no needle dip, set the switch to X100.

d. Follow the procedure given in paragraph 3-5 i through k.

e. The approximate unknown frequency may now be read on the frequency dial multiplied by the designated number of the frequency RANGE switch.

3-8. Use as Vtvm for Measuring Signals in Rms Values

Note that the AF-RF selector switch (TS-723A/U), signal INPUT control, frequency RANGE switch, and both FREQUENCY controls have no effect when the spectrum analyzer is operated as a standard ac vtvm.

a. Connect the test leads from the signal source

to be measured to the METER binding posts.

b. Set the function switch to METER.

c. Increase or decrease the setting of the meter range switch R.M.S. VOLTS scale to obtain a readable meter indication.

d. Read the indicated voltages on the top or center scale of the meter as designated by the meter range switch.

3-9. Use as Vtvm for Measuring Signals in DBm Values

a. Follow the procedure given in paragraph 3-8 a and b.

b. Set the meter range switch to DB; this position gives an easily readable meter indication.

c. If the internal impedance of the signal source being measured is 600 ohms, the dBm level is the meter indication algebraically added to the setting of the meter range switch. Examples of meter indications are given in table 3-4.

d. If the internal impedance of the signal source being measured is not equal to 600 ohms, a correction factor must be applied to the meter reading obtained in column 3 of table 3-4.

(1) Record the value obtained from the meter.

(2) Refer to the impedance correction chart (fig. 3-4). Find the intersection of impedance of the signal source under measurement and the diagonal line. The closest horizontal line to this intersection is the dBm correction factor.

(3) This dBm correction factor must be algebraically added to the sum of the meter reading and setting of the meter range switch.

(4) Examples of dBm measurements and applied correction factors are given in table 3-5.

Table 3-4. Examples of Meter Indications

| 1 DB setting of position of meter range switch | 2 Meter indication (DECIBELS scale) | Measured signal in dBm (sum of col 1 and 2) |
|--|---|---|
| 0 | -5 | -5 |
| -10 | -5 | -15 |
| -20 | -5 | -25 |
| -30 | -5 | -35 |
| +10 | -5 | +5 |
| +20 | -5 | +15 |
| +30 | +1 | +31 |

Table 3-5. Examples of dBm Measurements and Applied Correction Factors

| Source impedance in ohms. | Algebraic sum of meter read- ing and setting of meter range switch in dB m range. | dBm correc- tion factor obtained from fig. 5-4. | Corrected dBm reading of actual sig- nal being measured (algebraic sum of col 2 and 3). |
|---------------------------------|--|---|--|
| 60 | -8 | +10 | +2 |
| 60,000 | +4 | -20 | -16 |

*See table 3-4.

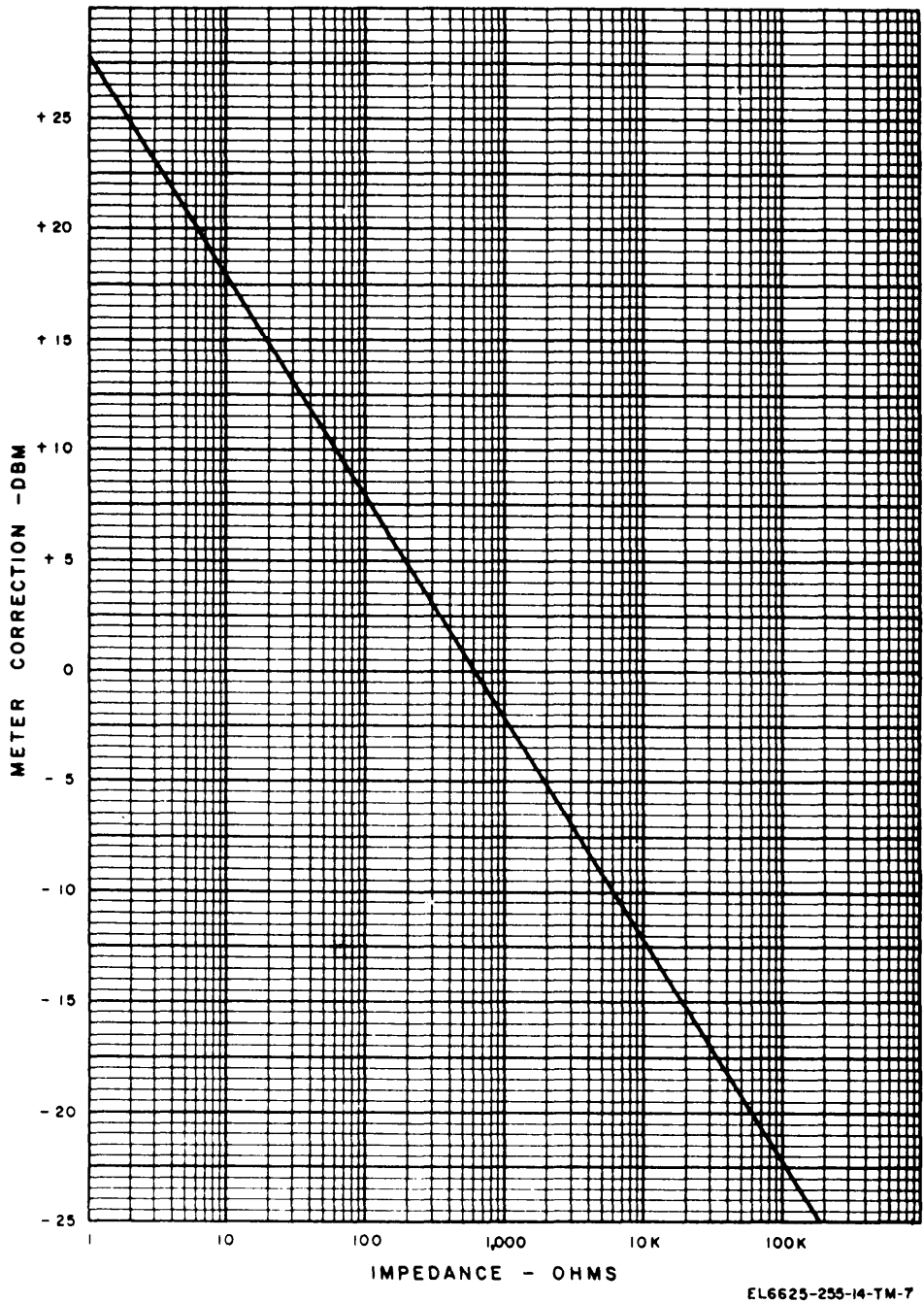


Figure 3-4. Impedance correction chart.

3-10. Use as Vtvm With Increased Sensitivity

When the function switch is set to SET LEVEL, the sensitivity of the spectrum analyzer is increased by a voltage gain of 10, or by a dB gain of +20. When this switch is set to NOISE, the sen-

sitivity of the spectrum analyzer is increased by a voltage gain of 100, or by a dB gain of 40.

a. Connect test leads from the signal source to be measured to the AF INPUT binding posts.

b. Set the AF-RF selector switch (TS-723A/U) to AF.

c. Set the function switch to SET LEVEL for a 20-dB gain (or for a voltage gain of 10) or to NOISE for a 40-dB gain (or for a voltage gain of 100).

d. Set the meter range switch to 10 R.M.S. VOLTS.

e. Slowly advance the signal INPUT control. If the meter reading exceeds 10 before the control is turned to MAX, do not use increased sensitivity to make the measurement. When this condition exists, make rms voltage readings as described in paragraph 3-8, or dBm readings as described in paragraph 3-9.

f. Set the signal INPUT control to MAX and the meter range switch to R.M.S. VOLTS (g below) or DB (h below) to obtain the most readable meter deflection.

g. Compute the voltage reading as described in paragraph 3-8 d. If the function switch is set to SET LEVEL, divide the computed reading by 10. If the switch is set to NOISE, divide the computed reading by 100.

h. Compute the dBm readings as described in paragraph 3-9 c and d. If the function switch is set to SET LEVEL, algebraically add -20 dBm to the computed reading. If the switch is set to

NOISE, algebraically add -40 dBm to the computed reading. *For example*, if the computed meter reading is -18 dBm and the function switch is set to NOISE, algebraically adding 40 dBm to -18 dBm gives a true reading of -58 dBm.

3-11. Use of Oscilloscope With Spectrum Analyzer

If an oscilloscope is available, more significant information about the signal source under test can be obtained. The oscilloscope provides the operator with information about the signal source that could give erroneous readings on the spectrum analyzer. Noise, hum, parasites, stray field pick-up, or any other form of extraneous signals will be indicated on the oscilloscope. The oscilloscope is connected to the OSCILLOSCOPE binding posts and may be used with measuring techniques described in paragraphs 3-5, 3-6, 3-8, 3-9, and 3-10.

3-12. Stopping Procedure

- a. Turn the power switch to OFF.
- b. Disconnect the test leads.
- c. Disconnect the power cord from the power outlet.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

3-13. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather may hamper the efficient operation of electronic equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Keep the equipment warm and dry. If the equipment is not kept in a heated enclosure, construct an insulated box for its protection.

b. Make certain the equipment has been warmed up sufficiently before use. This may take 15 to 30 minutes, depending on the temperature of the surrounding air.

c. When equipment which has been exposed to the cold is brought into a warm room, it will sweat until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly.

3-14. Operation in Tropical Climates

In tropical climates, electronic equipment may be installed in tents, huts or, when necessary, in underground dugouts. When equipment is installed below ground, and when it is set up in swamp areas, danger of moisture damage is more acute than normal in the tropics. Ventilation is usually very poor, and the high relative humidity causes condensation on the equipment whenever its temperature becomes lower than the ambient air. To counteract this condition, place lighted electric bulbs under the equipment.

3-15. Operation in Desert Climates

The main problem with electronic equipment in desert areas is the large amount of sand and dust that lodges in the moving parts and mechanical assemblies. Cleaning and servicing intervals shall be shortened according to local conditions.

CHAPTER 4

OPERATOR MAINTENANCE INSTRUCTIONS

Section I. OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES

4-1. General

a. To insure that the spectrum analyzer is always ready for operation, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services (PMCS) to be performed are listed and described in table 4-1. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment. Record all deficiencies, together with the corrective action taken, as prescribed in TM 38-750.

b. Lubrication is usually carried out by organizational maintenance personnel. Refer to chapter 5, section III for organizational lubrication instructions.

4-2. Operator Tools and Equipment

a. Tools and test equipment authorized for use by the operator of the spectrum analyzer are listed in appendix B of this manual.

b. There are no repair parts authorized for use by the operator.

Table 4-1. Operator Preventive Maintenance Checks and Services

| D - Daily | | W - Weekly | | Work time (M/H) |
|-----------------------------------|---|--------------------------------|--|-----------------|
| Time required: 0.1 | | Time required: 1.4 | | |
| Interval and sequence No. | | Item to be inspected procedure | | |
| D | W | | | |
| 1 | 1 | COMPLETENESS | | 0.1 |
| See that the equipment and compo- | | | | |

Table 4-1. Operator Preventive Maintenance Checks and Services- Continued

| D - Daily | | W - Weekly | | Work time (M/H) |
|---------------------------|---|--|--|-----------------|
| Time required: 0.1 | | Time required: 1.4 | | |
| Interval and sequence No. | | Item to be inspected procedure | | |
| D | W | | | |
| | | nents are complete. Refer to paragraph 1-8 of this manual. | | |
| | 2 | EXTERIOR SURFACES See that the exterior surfaces, including the panel and meter glass, are clean and free of dust. Check the meter glass for cracks. Refer to paragraph 4-5 for applicable cleaning procedures. | | 0.1 |
| | 3 | CONNECTORS Check the security and fit of all connectors. | | 0.1 |
| | 4 | CONTROLS AND indicators Observe that the action of each knob, dial, and switch is smooth and free of binding and excessive looseness. Also check the meter for sticking or bent pointer. | | 0.1 |
| | 5 | OPERATION While equipment is in use, be alert for abnormal readings or operation. | | 0.2 |
| | 6 | CABLES Inspect cord and cables for chafed, cracked, or frayed insulation. Replace cables that are broken, arced, stripped, or worn excessively. | | 0.2 |
| | 7 | HARDWARE Inspect hardware for looseness and general condition. Replace or tighten as necessary. | | 0.1 |
| | 8 | METAL SURFACES Inspect exposed metal surfaces for rust and corrosion. Touch up paint as required (para 5-2) | | 0.5 |

Section II. MAINTENANCE OF THE SPECTRUM ANALYZER

4-3. General

The maintenance duties assigned to the operator of the spectrum analyzer are listed below, together with a reference to the paragraphs or table covering the specific maintenance functions.

a. Operator's daily preventive maintenance checks and services (table 4-1).

b. Operator's weekly preventive maintenance checks and services (table 4-1).

c. Cleaning (para 4-5).

4-4 Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services are

required for the TS-723(*)/U on a daily and weekly, (operator) and a monthly and quarterly (organizational) basis. In addition, the daily and weekly preventive maintenance checks and services must be performed under the special conditions listed below:

- a. Initial installation.
- b. Return for higher category maintenance.
- c. Reinstallation after removal for any reason.
- d. At least once each week, if the equipment is maintained in a standby condition.

4-5. Cleaning

Inspect the exterior of the TS-723(*)/U. The surfaces should be clean, and free of dust, dirt, grease, and fungus.

- a. Remove dust and loose dirt with a clean soft cloth.

WARNING

The fumes of trichloroethane are toxic.

Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable but exposure of the fumes to an open flame or hot metal forms highly toxic phosgene gas.

- b. Remove grease, fungus, and ground-in dirt from the case with a cloth dampened (not wet) with trichloroethane.
- c. Remove dust or dirt from plugs and jacks with a soft brush.

CAUTION

Do not press on the METER FACE when cleaning. Damage to the equipment may result.

- d. Clean the front panel, meter face, and controls; use a soft clean cloth. If necessary, dampen the cloth with water or mild detergent for more effective cleaning.

CHAPTER 5

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. TOOLS AND TEST EQUIPMENT, REPAINTING AND REFINISHING

5-1. General

a. Tools and test equipment authorized for use by the organizational repairman servicing the spectrum analyzer are listed in appendix B of this manual.

b. Repair parts for organizational maintenance are found in TM 11-6625-255-20P.

c. All paints and procedures used shall be in accordance with TB 43-0118, Field Instructions for Painting and Preserving Electronics Command Equipment.

5-2. Rustproofing and Painting

a. *Rustproofing.* When the finish on the

spectrum analyzer has become badly scarred or damaged, rust and corrosion can be prevented by touching up the bare surface. Use No. 000 sandpaper to clean the surface down to the bare metal. Obtain a bright, smooth finish.

NOTE

Do not use steel wool. Minute particles may enter the case and cause internal shorting.

b. *Painting.* Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion.

Section II. LUBRICATION

5-3. General

The type of lubricant to be used, the interval, and specific instructions for lubricating the moving parts of the spectrum analyzer are given in figure 5-1, and paragraph 5-4.

5-4. Lubrication Instructions

a. Gasoline should not be used as a cleaning fluid at any time. When the spectrum analyzer is overhauled or repairs are made, clean the parts with an authorized cleaning compound, prior to

lubrication.

b. Do not use excessive amounts of lubricating oil, and do not allow connections to become greasy.

c. Be sure that lubricants and points to be lubricated are free from sand, grit, or dirt. This is the greatest cause of bearing damage.

d. Lubrication intervals are based on daily 8-hour periods of operation. For longer daily operation, intervals should be shortened accordingly.

Section III. ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

5-5. General

The PMCS at the organizational level are basically the same in nature as those at the operator's level. Refer to para 4-2 before proceeding to table 5-1.

5-6. Scope of Maintenance

The maintenance duties assigned to the organizational repairman are listed below together with a reference to the table or paragraph covering the specific functions.

- a. Organizational monthly PMCS (table 5-1).
- b. Organizational quarterly PMCS (table 5-1).
- c. Rustproofing and painting (para 5-3).
- d. Organizational troubleshooting (table 5-2).

Table 5-1. Organizational Preventive Maintenance Checks and Services

| M—Monthly Time required: 0.9 | Q—Quarterly Time required: 0.3 | Work time (m/h) |
|---|--|-----------------------|
| <i>Interval and sequence No. M Q</i> | <i>Item to be inspected procedure</i> | |
| 1 | LUBRICATION Check and renew lubricants as specified in paragraph 5-4. | 0.3 |
| 2 | PLUCKOUT ITEMS Inspect seating or pluckout items. Make certain that tube clamps grip tube bases firmly. | 0.1 |
| 3 | JACKS Inspect jacks for snug fit and good contact. | 0.1 |

Table 5-1. Organizational Preventive Maintenance Checks and Services — Continued

| Interval and sequence No. M Q | Item to be inspected procedure | work time (m/h) | Interval and sequence No. | | Item to be inspected procedure | Work time (m/h) |
|----------------------------------|--|-----------------|---------------------------|---|---|-----------------|
| | | | M | Q | | |
| 4 | TRANSFORMER TERMINALS Inspect the terminals on the power transformer. There should be no evidence of dirt or corrosion. | 0.1 | | 2 | plete, serviceable, and current. MODIFICATIONS Check DA Pam 310-7, and insure that all applicable MWO's have been applied. All URGENT MWO's must be applied immediately, ALL ROUTINE MWO's must be scheduled. | 0.1 |
| 5 | RESISTORS AND CAPACITORS Inspect the resistors and capacitors for cracks, blistering, or other defects. | 0.1 | | | | |
| 6 | INSULATORS Inspect insulators, bushings, and sleeves for cracks, chipping, and excessive wear. | 0.1 | | 3 | SPARE PARTS Inspect all accessories and spare parts for general condition and method of storage. There should be no evidence of overstock, and all shortages must be noted on valid requisitions. | 0.1 |
| 7 | INTERIOR Clean interior or chassis and cabinet, | 0.1 | | | | |
| 1 | PUBLICATIONS See that all publications are com- | 0.1 | | | | |

Section IV. ORGANIZATIONAL TROUBLESHOOTING

5-7. General

Troubleshooting the spectrum analyzer is based upon the operational check (para 3-5 through 3-11). Perform all functions of the spectrum analyzer as outlined in Chapter 3, until an abnormal condition or result is observed. Note the abnormality and refer to table 5-2, organizational troubleshooting. Perform the check and corrective action indicated for the particular malfunction. If the corrective measures indicated do not result in correction of the trouble, higher maintenance category repair is required.

5-8. Physical Tests and Inspection

a. Failure of the spectrum analyzer to operate properly can be caused by one or more of the following faults:

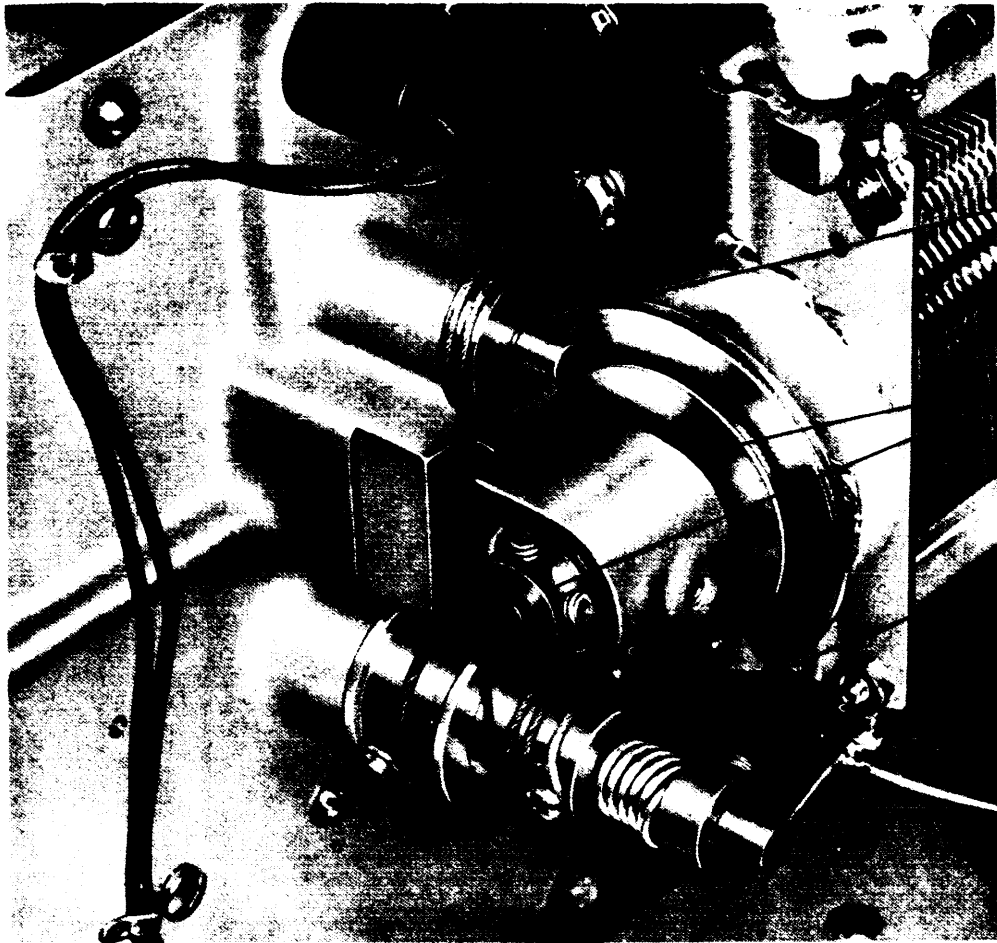
- (1) Worn, broken, or disconnected power cord or plug.
- (2) Burned-out fuses.
- (3) Power cord-not grounded properly.
- (4) Defective tubes.

b. Inspect all cabling and the general condition of the spectrum analyzer before removing the electron tubes.

c. Refer to the organizational troubleshooting procedures outlined in table 5-2, in order to localize the trouble.

Table 5-2. Organizational Troubleshooting

| Malfunction | Probable cause | Corrective action |
|--|--|--|
| 1. Meter does not indicate. | a. Defective external test leads b. Blown fuse. c. Defective meter | a. Repair or replace test leads. b. Check and replace fuses F1 and/or F2. c. Higher category maintenance required. |
| 2. Ac power switch is set to ON, and pilot lamp does not light. | Defective lamp II. | Replace lamp II. |
| 3. Pilot lamp is dim. | Strapping of power transformer T1 is wrong (TS-723A/U or TS-723B/U) or 115V/230V switch on rear panel (TS-723C/U or TS-723D/U) is in wrong position. | Check input voltage against strapping (para 2-4) or 115V/230V switch. |
| 4. With signal applied, and function switch set to METER, pointer deflects to right stop. | Defective tube | Check tubes V7 through V14, and replace if defective. |
| 6. With signal applied and function switch set to NOISE, pointer deflects to right stop, | Defective tube. | Check tubes V2 through V6, and replace if defective. |
| 6. With signal applied and function switch set to SET LEVEL, pointer deflects to right stop. | Defective function switch S4 | Check switch S4, and repair or replace as necessary. |
| 7. With signal applied and function switch set to DISTORTION, meter indicates 0. | Defective bridge circuit | Higher category maintenance required. |



INTERVAL LUBRICANT

- Q OAI IDLER SHAFT
(1 OR 2 DROPS)
- Q OAI COUPLER
DRIVE SHAFT
(1 OR 2 DROPS)
- Q OAI DRIVE SHAFT
(1 OR 2 DROPS)

KEY

| LUBRICANT | INTERVAL |
|---|---|
| OAI -- OIL, LUBRICATING, AIRCRAFT AND INSTRUMENTS. | Q -- QUARTERLY. OR WHEN DISASSEMBLED FOR REPAIR. |

Figure 5-1. Lubrication of Spectrum Analyzer TS-723(*)/U.

CHAPTER 6

FUNCTIONING OF EQUIPMENT

6-1. Circuitry

NOTE

Preference symbol followed by another reference symbol in parentheses, indicates that the latter is used in all models other than the TS-723A/U; for example C18 (C38) means that C18 is used in the TS-723A/U, and C38 is used in all other models, unless otherwise specified.

The block diagram for Spectrum Analyzer TS-723(*)/U is shown in figure 6-1. For more detailed overall circuit information, see figures FO-2 and FO-3. The spectrum analyzer consists of three major circuits: a frequency selective amplifier, a vacuum-tube voltmeter (vtvm) circuit, and a power supply.

a. Frequency Selective Amplifier Section. The frequency selective amplifier section consists of a three-stage preamplifier, a Wien bridge circuit, and a bridge amplifier. The preamplifier stage amplifies the incoming signals and passes them to the bridge. The bridge may be switched in or out of the circuit as required. When switched into the circuit, it is tuned to reject the fundamental frequency of the incoming signal and allow all of the remaining harmonics to pass through to the bridge amplifier. When it is switched out of the circuit, all frequencies in the incoming signal are passed from the preamplifier directly to the bridge amplifier. The bridge amplifier amplifies the output of the bridge when the bridge is switched into the circuit, and acts as the final two stages of amplification when the bridge is switched out of the circuit. The bridge is responsive to input signals which have fundamental frequencies from 20 to 20,000 Hz. When the spectrum analyzer is used as a vtvm, the bridge is switched out of the circuit and the frequency selective amplifier may be used as a 20 or 40 dB gain amplifier for the vtvm circuit. The gain of the amplifier is controlled by the amount of negative feedback applied to the input of the preamplifier from the output of cathode follower V6 in the bridge amplifier. The negative feedback is controlled by an adjustable feedback network. When the function switch is set to SET LEVEL, the negative feedback is attenuated enough to establish 20-dB maximum gain in the combination of the preamplifier and bridge amplifier. When the switch is set to NOISE, the maxi-

um gain of the two amplifiers is 40 dB. When the spectrum analyzer is used for making distortion readings, the bridge is first switched out of the circuit. A reference reading is obtained on the meter in the voltmeter circuit; the bridge is switched into the circuit and is tuned to reject the fundamental frequency, thus allowing the remaining harmonics to be measured. The meter reading obtained is the percent of distortion, or the dB difference, between the fundamental frequency and its harmonics.

b. Vtvm Section. The vtvm section consists of a voltage divider stage V11, a two-stage voltage amplifier V12 and V13, and a meter rectifier circuit V14 (CR1 and CR2). Voltage divider stage V11 is basically a cathode follower tube with multitapped cathode resistors R58 and R88 (fig 6-8) in the TS-723A/U. In all other models the cathode resistors are R92 through R98. This stage provides a high input impedance for the vtvm section. The two-stage voltage amplifier amplifies the output of the voltage divider stage and applies this amplified ac voltage to the meter rectifier circuit. A negative feedback path (fig. 6-10) for returning output voltage to the input of amplifier V12 is provided by the meter rectifier circuit. This negative feedback voltage controls the gain of the amplifier. Tube V14 (CR1 and CR2) functions as a Full-wave rectifier and converts the ac output voltage of the two-stage voltage amplifier to the dc voltage required for actuating the meter. The meter is a milliammeter calibrated in rms volts and decibels. The vtvm circuit may be used independently of the frequency selective amplifier. When used in this way, the input signals to be measured are connected to the METER binding posts and fed directly into the voltage divider circuit.

c. Power Supply. The power supply circuit supplies regulated and unregulated B+ voltages to the other circuits in the spectrum analyzer. Incoming ac line voltage passes through power transformer T1 (fig. 6-12). Stepped up ac voltages obtained from the high-voltage secondary windings of T1 is rectified in full-wave rectifier V7. Unregulated B+ voltage (after the filter) from V7 is supplied to the vtvm circuit and to series regulator V8. Tube V8 supplies regulated B+ to the amplifier circuits. Dc error amplifier circuit V9

and V10 controls the output of V8.

6-2. Preamplifier Circuit

a. Figure 6-2 is a simplified schematic diagram of the preamplifier circuit. Input signals to the preamplifier circuit may be connected to AF INPUT binding posts E7 and E8, or to AF-RF INPUT (TS-723A/U only) binding posts E5 and E6. AF-RF selector switch S2 (TS-723A/U only) provides selective switching between the AF INPUT binding posts and the AF-RF INPUT binding posts. When S2 is set to AF, the AF INPUT binding posts are connected to the input of the preamplifier circuit through C6. AF INPUT binding posts E7 and E8 are used to connect audiofrequency signals.

b. Tube V2 is the first voltage amplifier. Signal INPUT control R4 is a variable resistor which adjusts the level of the signal applied through C7 to the grid of V2. Operating bias for V2 is obtained from the voltage drop produced across R9. Resistor R8 is the grid return. Resistors R6 and R7, and variable resistor R5 (NOISE GAIN) determine the amount of negative feedback returned to V2 from the output of bridge amplifier tube V6. Resistors R6 and R5 are switched in or out of the circuit by section S4B of function switch S4. When these resistors are switched out of the circuit, R7 and R9 form a divider network for the negative feedback voltage. The resultant gain of the combined preamplifier and bridge amplifier circuits is 20 dB. When R5 and R6 are switched into the circuit, they form a divider network, in combination with R7 and R9, which adjusts the overall gain of the preamplifier and bridge amplifier circuits to 40 dB. Resistor R5 is used to adjust the overall gain of the preamplifier and bridge amplifier at 40 dB. This control is adjusted during calibration and alignment of the spectrum analyzer and does not normally require readjustment. Resistor R10 is the plate load for V2. The screen voltage of V2 is reduced by voltage divider R11 and R12. Resistors R13 and R90 provide a negative feedback path between the cathodes of V2 and V4. The output of the V2 is coupled to V3 through C8.

c. Tube V3 is the second voltage amplifier. Operating bias is produced by the voltage drop across R15. Resistor R14 is the grid return. Screen grid voltage is provided by voltage divider R16 and R18. Resistor R17 is the plate load for V3. The output of V3 is coupled to V4 through C10.

d. Tube V4 is the third amplifier stage and operates as a cathode follower. Resistor R 19 is the grid return for this stage. Operating bias is

produced by the voltage drop across R20, in the fixed resistive arm of the bridge (fig. 6-3). The output of V4 is obtained at the cathode. This output is applied to the input of V2 as additional negative feedback, and to the junction of the fixed resistive arm and series reactive arm in the bridge circuit.

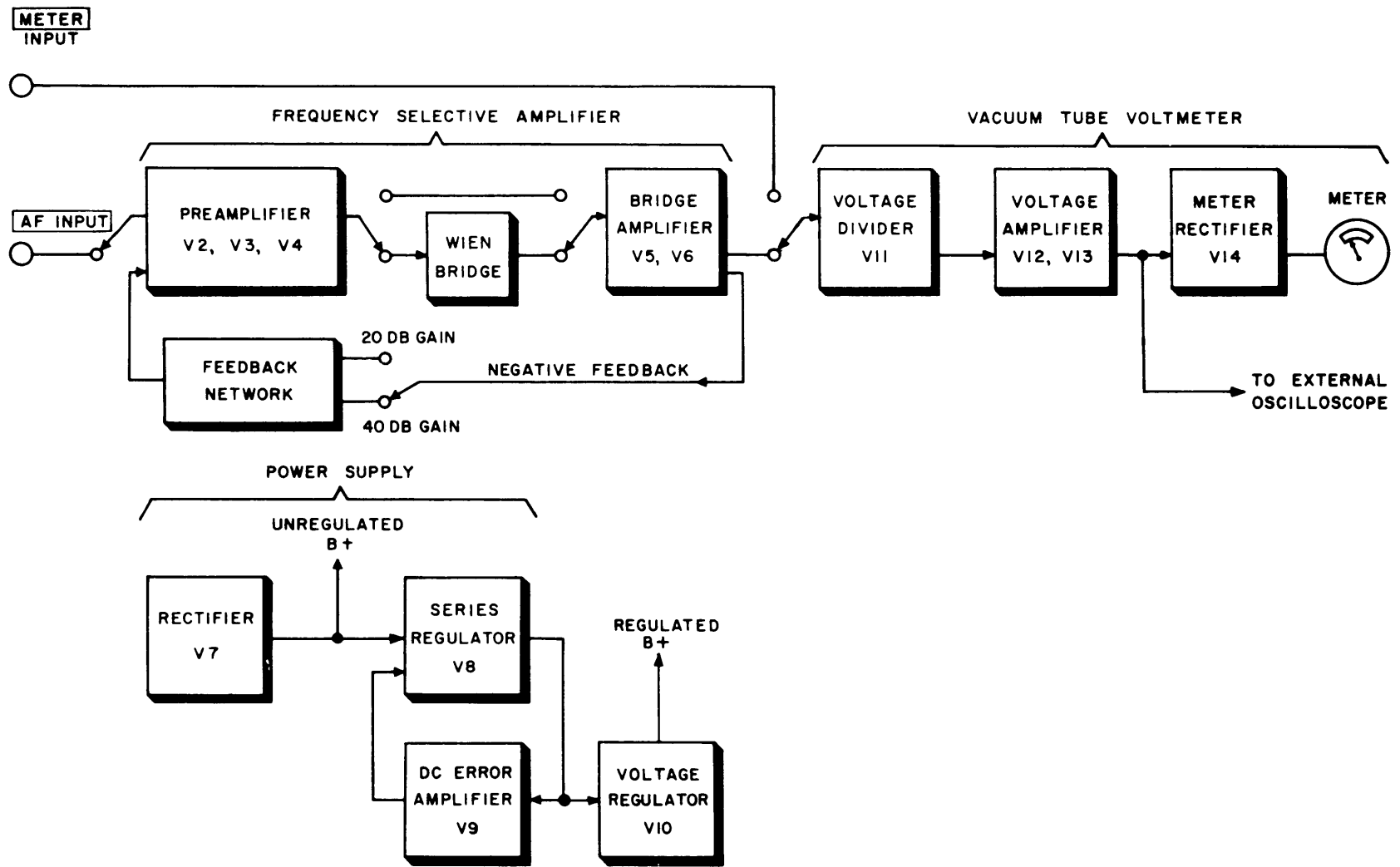
6-3. Wien Bridge Circuit

a. Figure 6-3 is a simplified schematic diagram of the bridge. The bridge circuit operates as a variable-frequency rejection filter. It has a fixed resistive arm, a variable resistive arm, a series reactive arm, and a shunt reactive arm. The fixed resistive arm consists of R20 and R21. The variable resistive arm consists of fixed resistors R24, R25, and R22, and variable resistors R89 and R23. Resistor R89 is the range setting balancing chassis control which is adjusted during alignment of the spectrum analyzer and does not normally require readjustment. Variable resistor R23 is the BALANCE control which is adjustable from the front panel.

b. Resistors R1, R26, R3, R27, R39, and R28 are connected by frequency RANGE switch S3 in pairs according to the frequency range selected. These resistors form a part of the series reactive arm. For the X1 frequency range, R1 and R26 form the series resistance for the arm. For the X10 frequency range, R3 and R27 form the series resistance for the arm. For the X100 frequency range, R39 and R28 form the series resistance for the arm. Variable FREQUENCY tuning capacitor C13 is a four-section tuning capacitor. Capacitor C13A and C13B are parallel-connected in the series reactive arm. Capacitor C13C and C13D are parallel-connected in the shunt reactive arm of the bridge. Trimmer capacitor C12 provides a vernier tuning adjustment of the series reactive arm of the bridge to calibrate the FREQUENCY tuning dial. Fixed capacitor C14 compensates for the effect of the input capacitance of V5 in the bridge amplifier circuit.

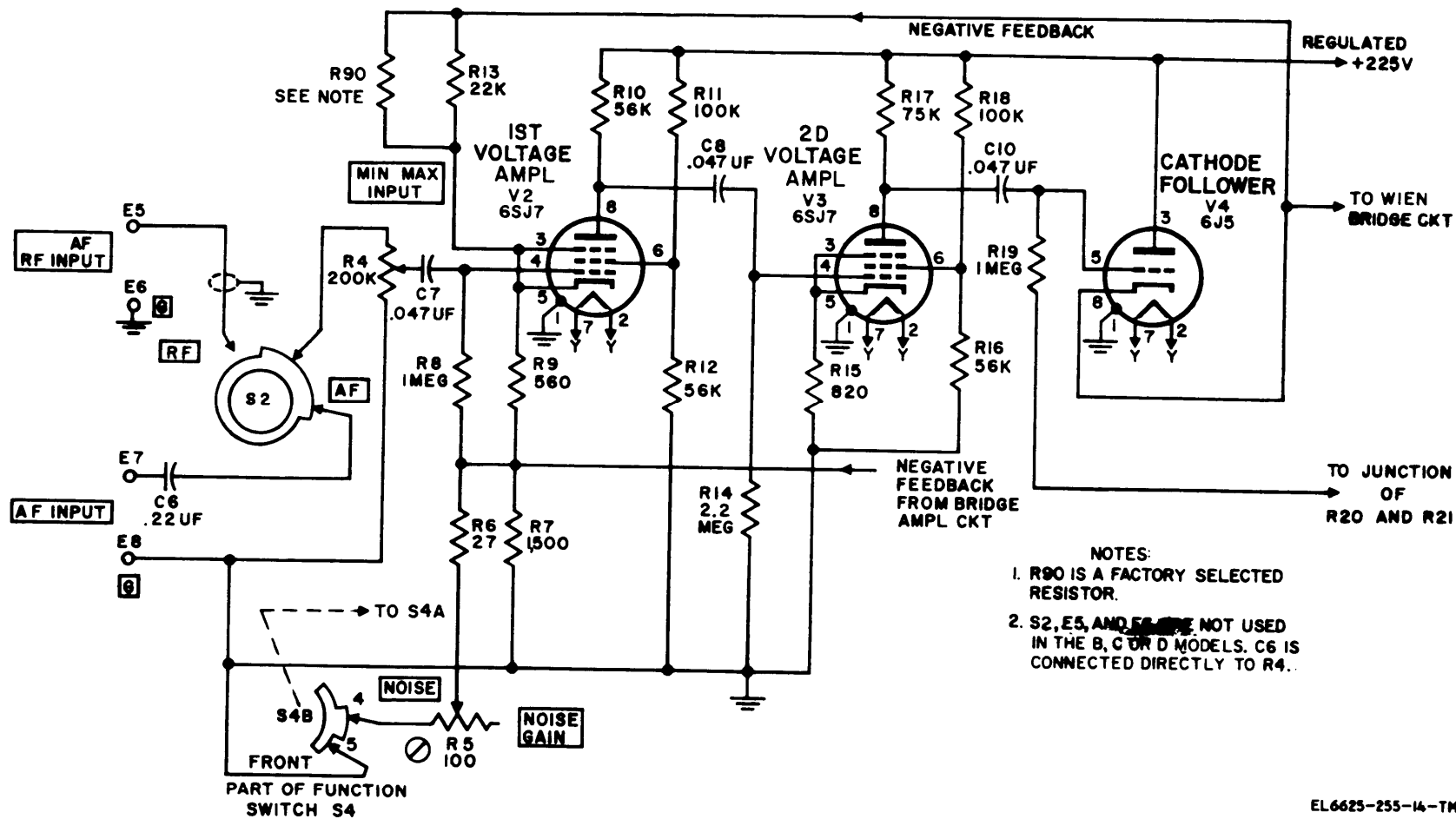
c. Resistors R47, R29, R91, R30, R2, and R31 are connected by switch S3 in pairs according to the frequency range selected. These resistors form a part of the shunt reactive arm of the bridge. For the X1 setting of switch S3, resistors R2 and R31 are connected to form a series resistance for the shunt reactive arm. For the X10 setting of S3, R30 and R91 are connected to form a series resistance for the arm. For the X100 setting of S3, R29 and R47 are connected to form a series resistance for the arm.

d. Variable FREQUENCY tuning capacitor C13 is mechanically controlled by two front panel



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Figure 6-1. Block diagram, Spectrum Analyzer TS-723 (*)/U.



EL6625-255-14-TM-10

Figure 6-2. Preamplifier circuits, simplified schematic diagram.

knobs, one for coarse FREQUENCY settings of the capacitor and one for fine FREQUENCY adjustments. Capacitor C13 is used to select the exact rejection frequency of the bridge.

e. The bridge is never physically disconnected from the circuit. Operation of function switch S4A to SET LEVEL or NOISE places a ground at the junction of the series reactive arm and shunt reactive arm (fig. 6-7). This action disables the frequency rejection characteristic of the bridge.

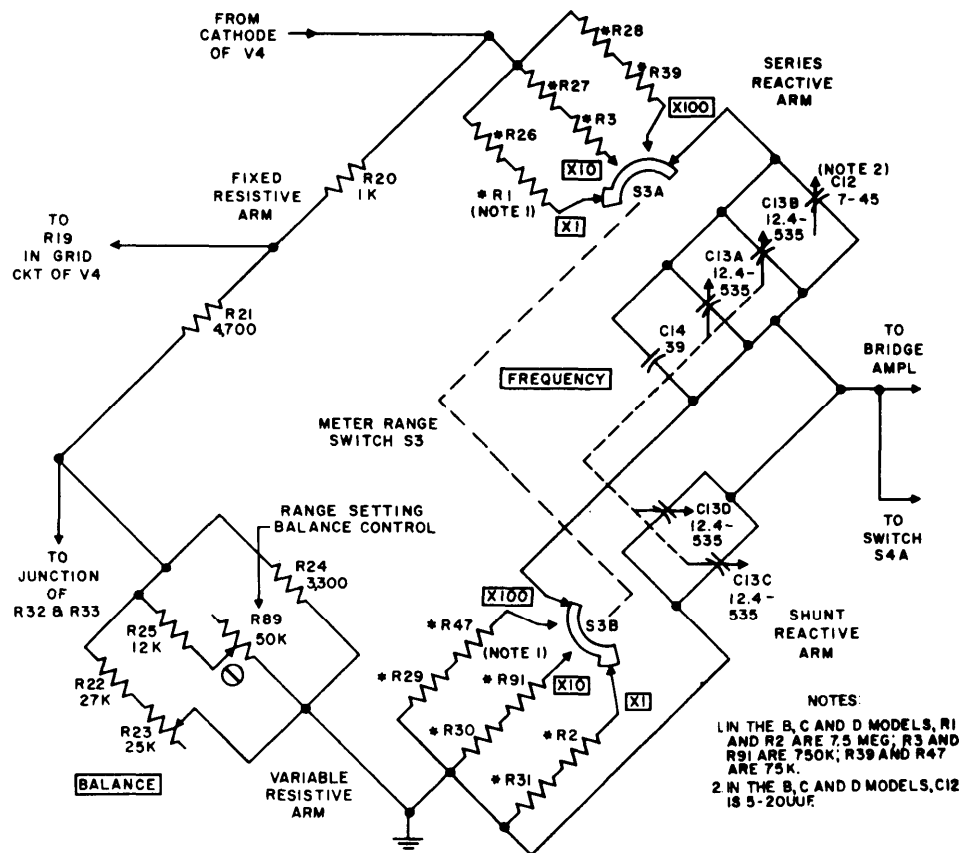
6-4. Bridge as Frequency Rejection Filter

a. The sharp frequency rejection property of the bridge is obtained from the combined characteristics of the resistance-capacitance networks in the bridge and vacuum-tube circuits contained in the preamplifier and bridge amplifier. Figure 6-4 shows the frequency rejection characteristics of the bridge. The equivalent circuit diagram of the bridge shows the conditions that exist in the bridge to give the frequency rejection characteristics shown in the graph. RC_1 represents the series reactive arm of the bridge, RC_2 represents the shunt reactive arm, R_1 represents the fixed resistive arm, and R_2 represents the variable resistive

arm. When the bridge is adjusted to reject a given fundamental frequency, RC_1 must be equal to RC_2 , and R_1 must be equal to two times R_2 . It can be seen from the graph that the skirt rejection characteristic of the bridge does not have a steep slope.

b. When the bridge is inserted as the interstage coupling element in an inverse feedback amplifier, the rejection characteristics of the bridge are greatly improved. When the bridge is used in this way, the phase, as well as the amplitude response, can be used. Figure 6-5 shows how the rejection characteristics of the bridge are improved when the bridge is inserted as the coupling component in a feedback amplifier. The feedback amplifier attains maximum negative feedback when the returned function of the output signal is impressed at the input circuit in opposite phase to the original signal. This condition exists only for the frequency being rejected (f_0) as illustrated in figure 6-6 because the bridge imparts considerable phase shift to other frequencies.

c. Only V2 and V3 produce 180° phase displacements. This action establishes proper phase orientation for the negative feedback loop. There

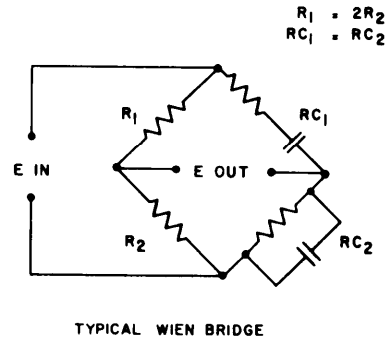
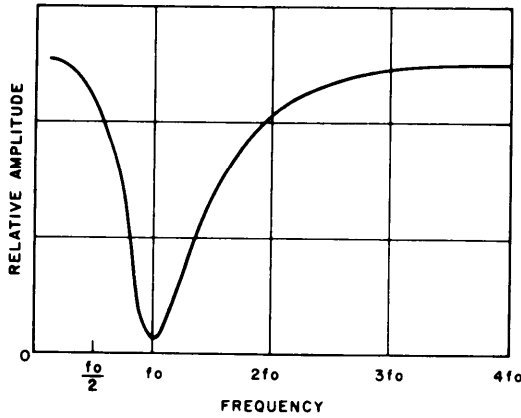


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Figure 6-3. Bridge circuit, simplified schematic diagram.

is little departure from exact phase opposition between the feedback signal and the original input signal because of the combined action of the pre-amplifier and the bridge amplifier when the bridge is excluded from the circuit; therefore, the relative

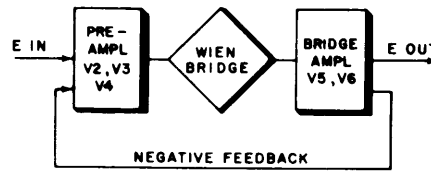
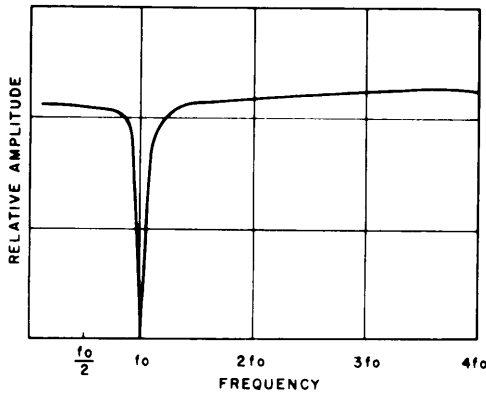
phase of the feedback voltage is governed by the bridge. More negative feedback exists in the amplifier for the frequency being rejected, and the gain of the amplifier is less for this frequency than for the remaining frequencies; therefore, through



TYPICAL WIEN BRIDGE

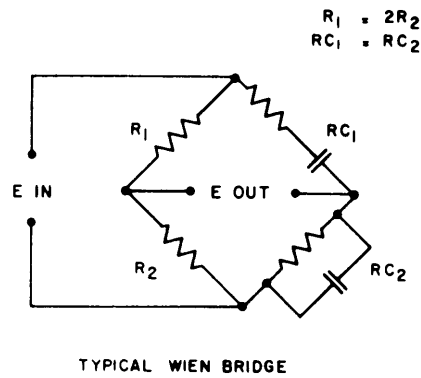
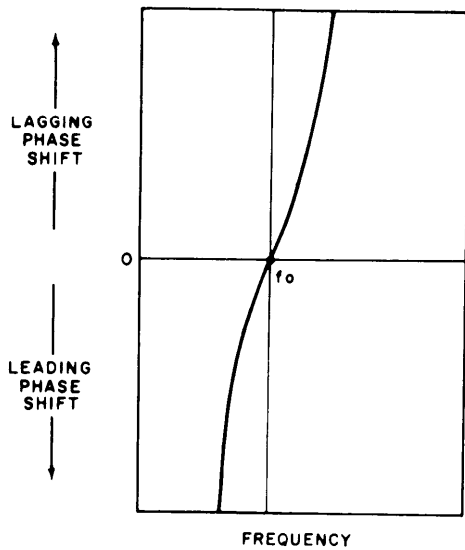
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Figure 6-4. Frequency rejection characteristics of bridge.



EL6625-255-14-TM-13

Figure 6-5. Frequency rejection of bridge when used with feedback amplifier.



TYPICAL WIEN BRIDGE

EL6625-255-14-TM-14

Figure 6-6. Phase shift characteristics of bridge.

its effect on feedback, the bridge causes the amplifier gain to be reduced for the frequency being rejected (fo). Both phase and amplitude characteristics combine to decrease the attenuation of other frequencies; therefore, the bridge, in conjunction with the amplifiers, produces a much sharper frequency rejection curve than is obtained from the bridge alone.

6-5. Bridge Amplifier Circuit

a. Figure 6-7 is a schematic diagram of the bridge amplifier circuit. Tube V5 is the phase amplifier for the bridge amplifier circuit. The input signal to tube V5 is obtained from the bridge and is applied to both the control grid and the cathode. The grid connection to the input signal is made to the junction of the series and shunt reactive arms of the bridge through C32. The cathode connection to the input signal is made to the junction of the resistive arms of the bridge. At the rejection frequency of the bridge, no net signal voltage appears at the input of V5.

b. Operating bias for V5 is produced by the voltage drop across R33. Resistor R32 is the grid return. Resistor R34 is the plate load. Resistor R35 is the screen grid voltage dropping resistor. Capacitor C15 bypasses the screen grid to ground. When switch S4A is set to SET LEVEL or NOISE, V5 is converted to a grounded grid amplifier. Under this condition, the reactive arms (fig. 6-3) of the bridge are shorted to ground and there is no rejection frequency. The output of V5 is passed through C16 to the control grid of V6.

c. Cathode follower V6 is the output stage of the bridge amplifier. The screen grid and suppressor grid of V6 are connected at the plate so

that the tube essentially functions as a triode. Operating bias is produced by the voltage drop across R37. Resistor R36 is the grid return. SET LEVEL control R38 adjusts the feedback voltage obtained at the cathode of V6 and returned to V2. This action provides gain control of the combination of the preamplifier and bridge amplifier circuits, when function switch S4 is set to SET LEVEL.

6-6. Function Switch S4 and dB Gain of Spectrum Analyzer

Rotary switch S4A (fig. 6-7) has four switching positions. The setting of this switch determines the type of operation of the spectrum analyzer as follows:

a. When S4A is at METER, the preamplifier, bridge, and bridge amplifier circuits are disconnected from the vtvm circuit. In this position, incoming signals are connected to the METER binding posts, and the spectrum analyzer is operated as a standard vtvm.

b. When S4A is set to DISTORTION, it inserts the frequency selective amplifier ahead of the vtvm circuit. In this position, the fundamental frequency of the signal being measured is rejected by the bridge and only the remaining harmonics pass through the bridge amplifier to the vtvm circuit.

c. When S4A is set to SET LEVEL it shorts the bridge circuit to ground so that the preamplifier and bridge amplifier circuits operate as a straight five-tube amplifier with 20-dB gain. In this position, all incoming frequencies are passed from the output of the bridge amplifier to the vtvm circuit.

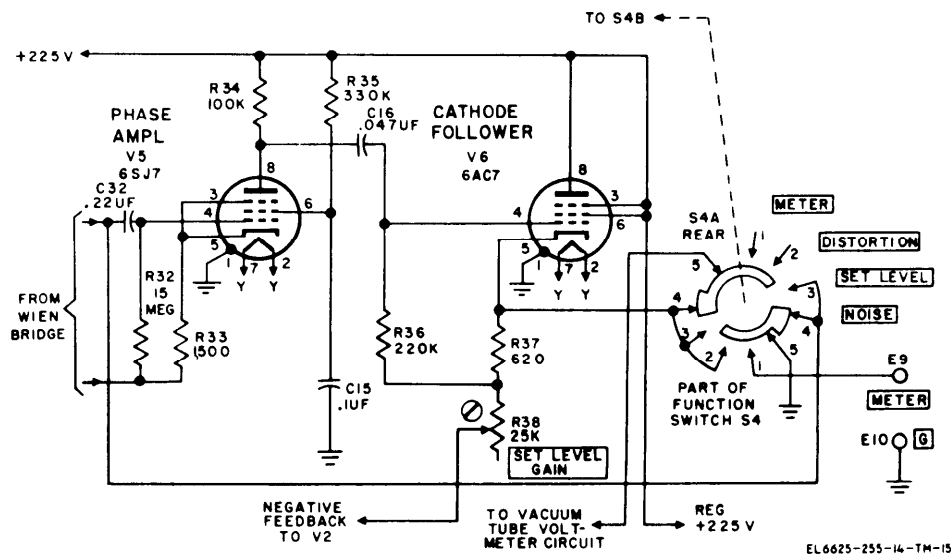


Figure 6-7. Bridge amplifier circuit, simplified schematic diagram.

d. When S4A is set to NOISE, the bridge circuit is shorted to ground so that the preamplifier and bridge amplifier circuits operate as a straight five-tube amplifier with 40-dB gain. When S4A is set to NOISE, switch S4B (fig. 6-2) is also automatically set to NOISE since both switches are on the same shaft. This action brings NOISE GAIN control R5 and R6 into the negative feedback circuit from V6, attenuating the feedback voltage which, in turn, increases the gain of the amplifier circuits. In this position, all incoming frequencies are passed from the output of the bridge amplifier through the switch contacts to the vtvm circuit.

6-7. Voltage Divider Circuit

a. Figures 6-8 and 6-9 show simplified schematic diagrams of the voltage divider circuit. Tube V11 is a cathode follower with multisection series resistance connected in its cathode circuit. Tube V11 and its accompanying circuitry provide a high input impedance for the vtvm section and make possible adjustment of the frequency response for different voltage ranges. Taps on the cathode resistance are connected to the switch contacts of switch section S6B on the TS-723A /U, or switch section S6C on all other models. Meter range switch S6 has nine positions for selecting various voltage and dB ranges.

NOTE

In the TS-723A/U, the cathode resistance is composed of multisection resistors R58 and R88. In all other models, the resistance is made up of R92 through R98.

b. When S6 is set to .30, 1.0, 3.0, 10, or 30 R.M.S. VOLTS, the incoming signals pass through C22 to the grid of V11.

c. When S6 is set to .10 R.M.S. VOLTS, switch S6B brings trimmer C25 into the cathode circuit of V11. Trimmer C25 provides control of the high-frequency response for this voltage range.

d. When S6 is set to 100 or 300 R.M.S. VOLTS, the incoming signals pass through network R52 and R77 in parallel with trimmer C20 before passing through C22 to the grid of V11. For the 300 R.M.S. VOLTS setting, switch S6A switches in network R53 and R78 in parallel with C24 and C23. Voltage divider R53, R78, R57, R52, and R77 reduces the level of the incoming signal before it is passed through C22 to the grid of V11. Trimmer C20 is used to adjust the high-frequency response for the 100 R.M.S. VOLTS setting. Trimmer C23 is used to adjust the high-frequency response for the 300 R.M.S. VOLTS setting. Capacitor C24 reduces the effect of C20 on the high-frequency response for the 300 R.M.S. VOLTS setting.

e. Resistors R88 and R58 in the TS-723A/U (R92 through R98 in all other models) form part of the cathode biasing network. The net grid bias is determined by the combination of the cathode resistance and R57 in conjunction with the series combination of R54 and R55. Resistor R54 is also used in combination with C21 to form a filter to isolate the grid circuit from the power supply. Resistor R56 is connected to the plate of V11 to improve the frequency response. At high frequencies, R56 is partially bypassed by tube and stray

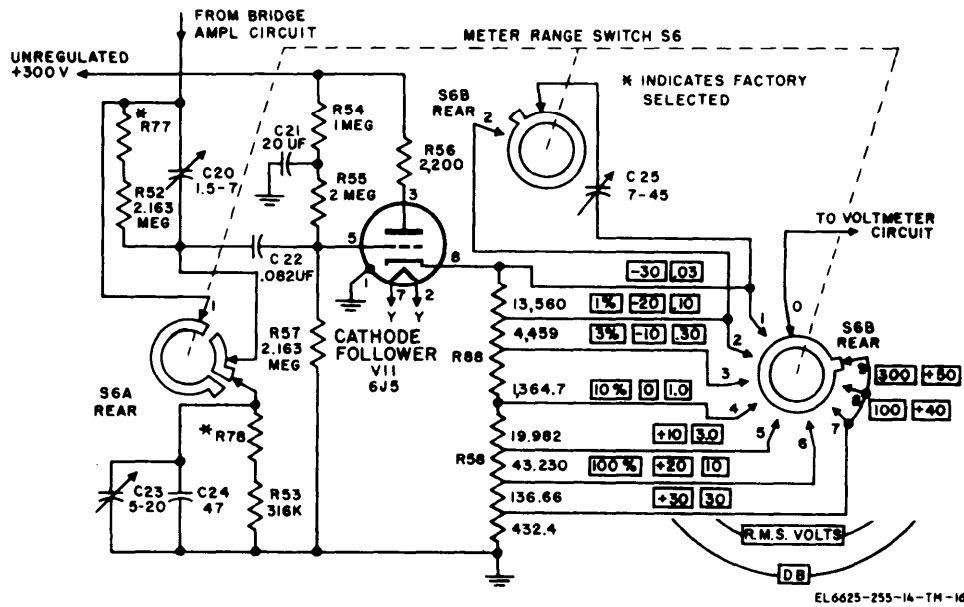


Figure 6-8. Voltage divider circuit, simplified schematic diagram, Spectrum Analyzer TS-723A/U.

capacitances, therefore, it consumes a smaller part of the available tube output voltage, and the output voltage developed across the cathode resistance rises. This rise in high-frequency response approximately offsets the drop in high-frequency response caused by shunt capacitances in the input and output circuits. The output of the voltage divider circuit is passed to the grid of V12 through C26.

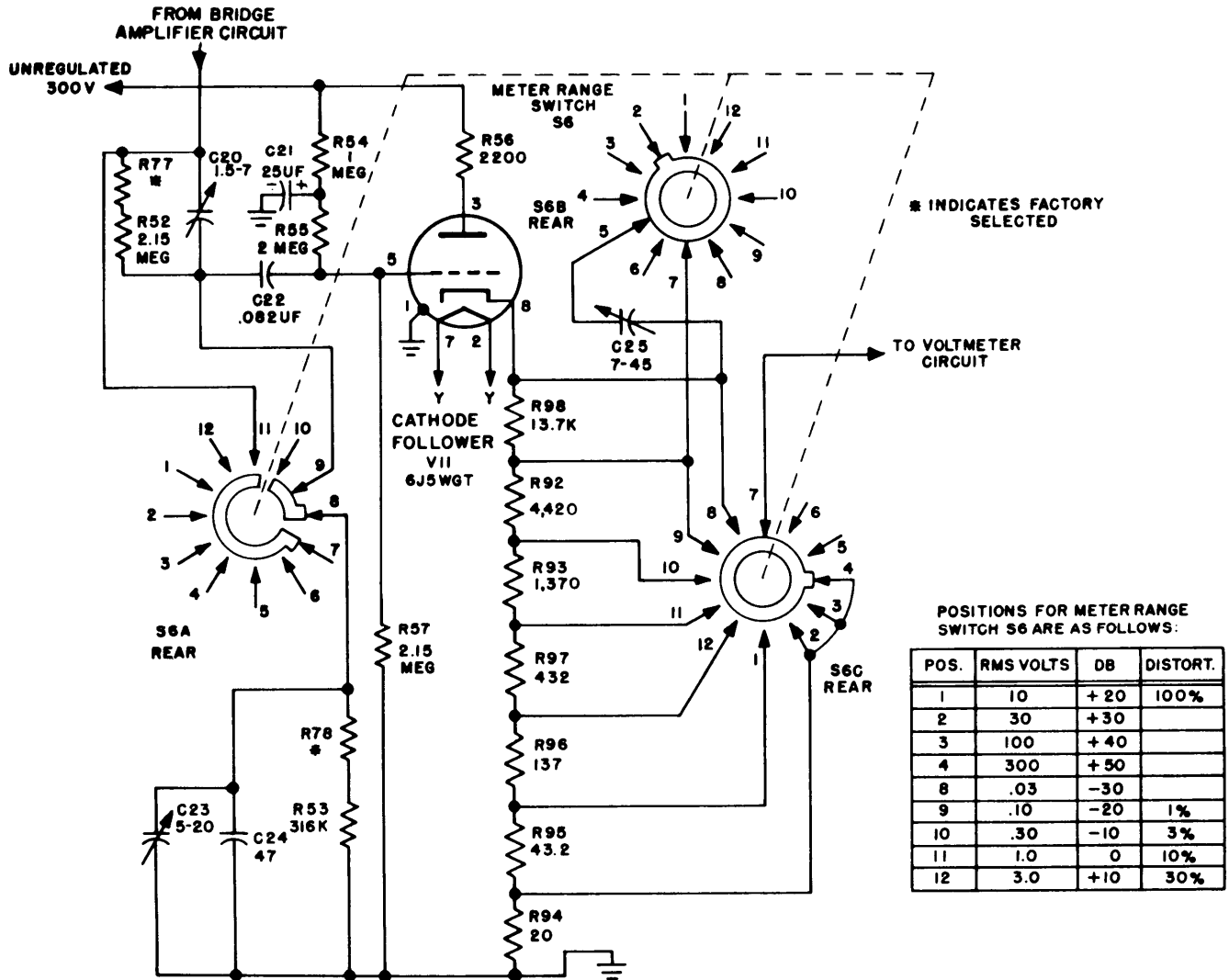
6-8. Voltage Amplifier and Meter Circuit

a. Figure 6-10 is a simplified schematic diagram of the voltage amplifier and meter circuit. Tube V12 is the first voltage amplifier of the vtm circuit. Grid bias for V12 is obtained from the negative bias supply through R59. Resistor R64 is the plate load for V12. Resistor R65 is the screen grid voltage dropping resistor. The parallel combination of C28A and C28B bypasses the screen

grid variations to ground. The output of V12 is passed to V13 through C29. Resistor R75 is a grid limiting resistor.

b. Tube V13 is the output voltage amplifier of the vtm circuit. Grid bias for V13 is obtained from the negative bias supply through R66. Resistor R68 is the plate load, and R69 is the screen grid voltage dropping resistor. The parallel combination of C28C and C28D (C38B) bypasses the screen grid to ground. The output of V13 is passed through C30 and applied to the plate of V14A (CR2, TD-723D/U only) through R73 and to the cathode of V14B (CR1, TD-723D/U only) through R74. The output of V13 is also connected to OSCILLOSCOPE binding post E11.

c. Tube V14 (CR1 and CR2 of TS-723D/U) is a full-wave rectifier which converts the ac voltage output of V 13 to direct current for operation of meter M1. Tube V14B (CR1 of TS-723D/U) pro-



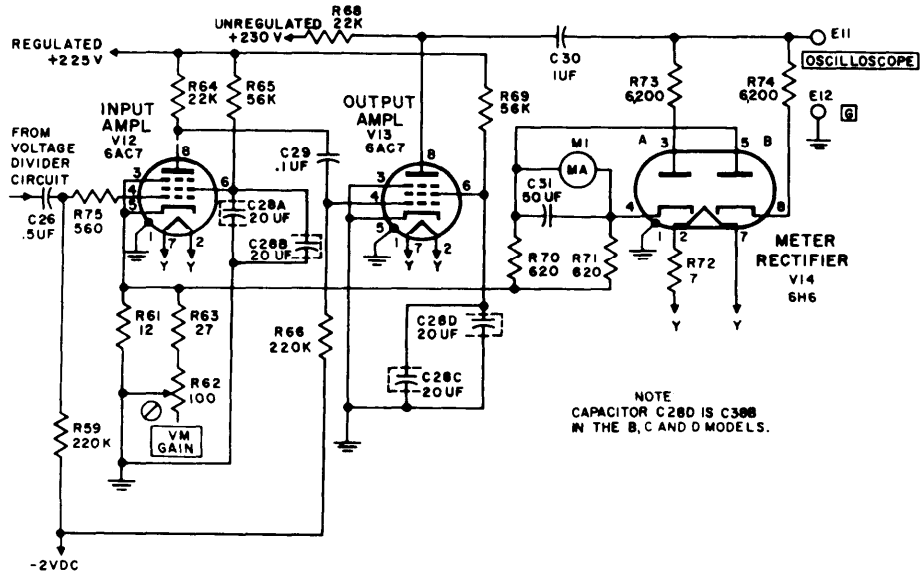
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Figure 6-9. Voltage divider circuit, simplified schematic diagram, Spectrum Analyzer TS-723B/U, TS-723/U, and TS-723D/U.

vides conduction for the negative portion of the ac cycle. Tube V14A (CR2 of TS-723D/U) provides conduction for the positive portion of the ac cycle. Meter M1 is a milliammeter calibrated in R.M.S. VOLTS and DECIBELS. The sensitivity of the meter is 1,000 ohms per volts, or 1 milliampere for full-scale reading. Capacitor C31 filters out the ac component appearing across the meter terminals.

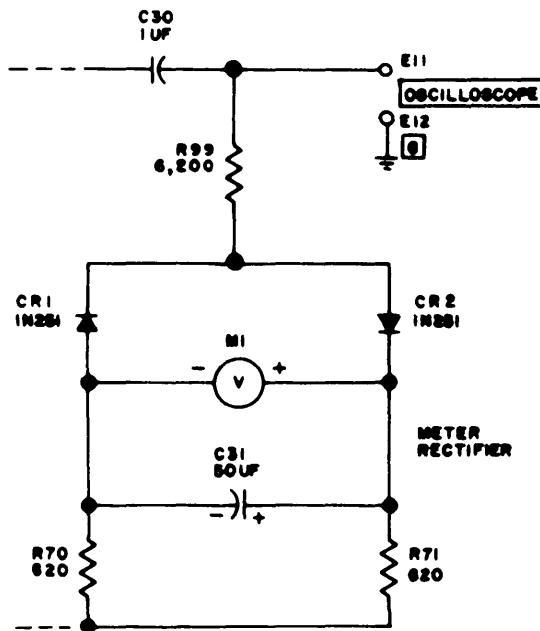
d. A negative feedback loop is obtained at the output of V14 (CR1 and CR2 of TD-723D/U). This negative feedback voltage is fed back to the

input of V 12. Its function is to improve frequency response and to stabilize the operation of the vtvm circuit. The amount of feedback voltage established by the feedback loop is completed through R71. During the negative portion of the ac cycle, the feedback loop is completed through R70. The amount of feedback voltage applied to the grid of V12 is governed by network R61, R62, and R63. The variable resistor R62 VM GAIN is used to adjust



EL6625-255-14-TM-18

Figure 6-10. Voltage amplifier and meter circuit, simplified schematic diagram.



EL6625-255-14-TM-19

Figure 6-11. Meter rectifier circuit, Spectrum Analyzer TS-723D/U.

the amount of feedback voltage.

e. For TD-723A/U, TD-723B/U, and TD-723C/U resistor R72 is inserted in the filament circuit of V14 to limit the thermal emission of the tube. R72 also stabilizes V14 with respect to line voltage variations and protects the meter from overload currents. For the TD-723D/U, resistor R99 is inserted in the rectifier circuit of CR1 and CR2 stabilizing this circuit with respect to variations of line voltage, protecting the meter from overload currents.

6-9. Power Supply Circuit

Figure 6-12 is a simplified schematic diagram of the power supply circuit which operates as follows :

a. The ac line voltage is stepped up by the high-voltage secondary winding of T1. Tube V7 provides full-wave rectification of the stepped up voltage. The pulsating dc output of V7 is passed through filter C37, C17A, and C17B, and L1. Capacitors C37, C17A, and C17B are connected in a series-parallel combination to obtain operation with a safe dc working voltage. Resistors R84 and R85 equalize the voltage distribution across these capacitors and, at the same time, act as a bleeder circuit. The filtered dc voltage is passed through an additional filtering network which consists of R49, R50, R51, C17C, C17D (C18C), C18A, and C18B. It is then supplied to the voltage divider stage of the vtvm section at +300 volts dc.

b. Filtered dc voltage from V7 is also applied to the plate of series regulator V8. The output of V8 is obtained at the cathode. This output is governed by the control voltage applied to the control grid of the tube. The control grid voltage is, in turn, controlled by the conductive state of dc error amplifier V9. Tube V8 supplies the regulated +225 volts for the plate circuits of the frequency selector circuit and V 12. The output of V8 is fed through voltage divider network R44, R42, and R43 to the grid of V9. Voltage adjust control R43 is used to vary the amount of voltage applied to the grid of V9 from this source. Voltage regulator V10 is connected in the cathode circuit of V9. The stabilized voltage drop across V10 provides V9 with a reference bias. Screen grid voltage for V9 is provided by voltage divider R86 and R87. Resistor R48 is the plate load for V9 and the grid return for V8. Resistor R46 limits the ionization current of V10.

c. When the dc output voltage from V8 increases, the grid bias voltage applied to V9 from V8 becomes more positive, causing higher plate

current for V9. The increased plate current flows through R48, resulting in a decrease in plate voltage in V9. The plate voltage of V9 determines the grid bias voltage of V8. When the plate voltage of V9 becomes less positive, the control grid of V8 receives a more negative bias. This action increases the effective dc resistance of V8 and lowers the output B+ voltage; therefore, the voltage change responsible for this sequence of events is counteracted.

d. When the output voltage of V7 decreases, the grid bias voltage applied to V9 from V8 becomes more negative to decrease the plate current of V9. The decreased plate current flows through R48 and results in an increase in plate voltage in V9. Grid voltage supplied to V8 from V9 becomes less negative, which decreases the effective dc resistance of V8 and increases the output of B+ voltage.

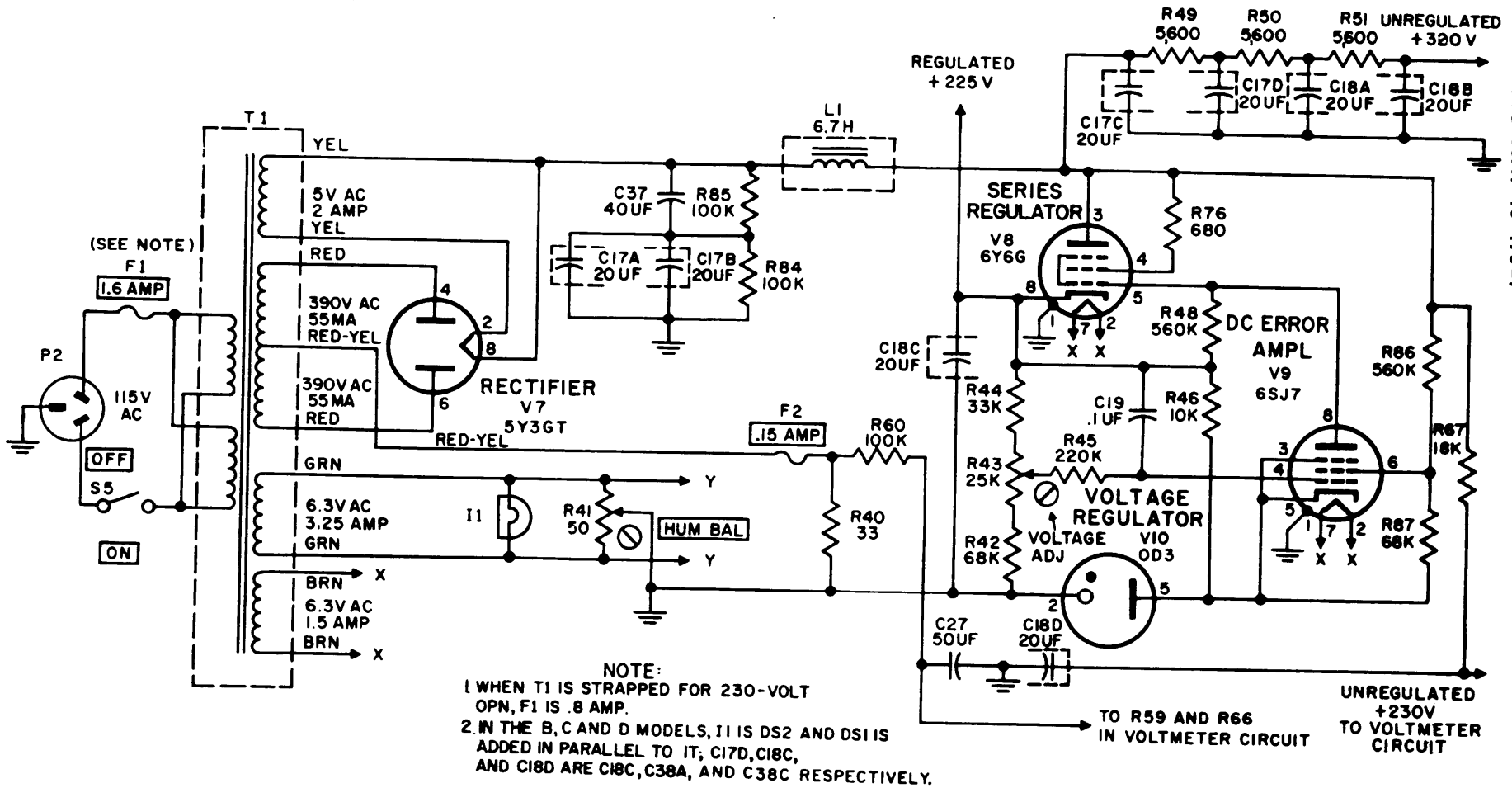
e. Network R45 and C19 applies residual ripple voltage directly to the grid of V9. As a result, the regulating characteristic of V8, V9, and V10 produces cancellation of ripple voltage and makes the regulator circuit insensitive to transients. Capacitor C18C (C38A) provides additional filtering for the regulated output of V8.

f. A negative bias supply is obtained by insertion of R40 between the center tap of the high-voltage secondary winding of T1 and ground. This action places the transformer center tap at a negative potential with respect to ground. The bias voltage is filtered by R60 in conjunction with C27. It is then applied as grid bias to V12 and V13.

g. HUM BAL variable resistor, is used to adjust the effective ac potential point of the frequency selective amplifier and vtvm filament circuit. It is used primarily to minimize hum produced in these filament circuits.

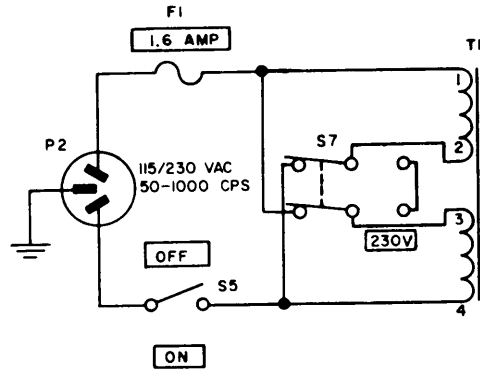
h. Resistor R67 is inserted in the output unregulated supply to reduce the unregulated voltage to +230 volts for application to the plate circuit of V13, Capacitor C18D (C38C) provides filtering for the +230-volt dc supply.

i. When the ac source is 230 volts, the primary of T1 has to be changed from two windings in parallel for 115-volt operation to one winding in series (fig. FO-2 or FO-3). As the current path through each winding is 0.8 ampere, fuse F1 must be rated for twice that value, or 1.6 amperes for 115-volt operation and 0.8 ampere for 230-volt operation. Refer to paragraph 2-4 for instructions on how to convert T1 for either type of operation.



EL6625-255-14-TM-20

Figure 6-12. Power supply circuit, simplified schematic diagram.



NOTE:
CHANGE F1 TO .8 AMP FOR
230 VAC OPERATION.

EL6625-255-14-TM-21

Figure 6-13. 115V-230V changeover switch (TS-723C/U and TS-723D/U), partial schematic diagram.

CHAPTER 7

GENERAL SUPPORT MAINTENANCE

Section I. GENERAL

7-1. Voltage and Resistance Measurements

It shall be assumed that general support maintenance personnel are capable of making most voltage and resistance measurements without detailed step-by-step instructions. Observance of the following techniques will generally prove helpful.

a. When measuring voltages, use tape or sleeving to insulate the entire test prod except for the extreme tip.

b. Use the same or equivalent multimeter specified on the voltage and resistance diagram (fig. 7-8).

c. When servicing the Wien bridge assembly, be careful not to disturb the placement of parts or to bend the tuning capacitor plates; a short circuit or change of alignment may occur.

d. Make resistance measurements only as directed on the voltage and resistance diagram (fig. 7-8).

e. The color code diagram for resistors and capacitors (fig. FO-1) provides pertinent resistance, voltage rating, and tolerance information.

7-2. Checking Filament and B+ Circuits for Shorts

a. *When to Check.* When either of the following conditions is in evidence, check for short circuits and clear the trouble before applying power.

(1) When abnormal symptoms are present whose origins are unknown.

(2) When abnormal symptoms discovered during operational tests indicate possible power supply trouble.

b. *Conditions for Tests.* Prepare for the short

circuit tests as follows:

CAUTION

Do not remove or replace parts before reading the instructions given in Section III, Maintenance of Spectrum Analyzer.

(1) Remove top and bottom dust covers.

(2) Remove all tubes and dial lamps.

c. *Measurements.* Make the resistance measurements indicated in table 7-1. If abnormal results are obtained, perform the isolating procedures described. When the faulty part is found, repair the trouble before applying power to the equipment.

d. *Additional Voltage Checks.* When making repairs in the spectrum analyzer always check, in addition to the resistance measurements, the power supply output voltages before putting the equipment back into service. Refer to table 7-2 for procedures.

NOTE

When the spectrum analyzer is being operated from a 115V ac power source, the regulated +225 volts dc obtained at pin 8 of V8 must be between 220 and 230 volts dc for a variation in line voltage of 105 to 125 volts ac. If the spectrum analyzer is being operated from a 230V ac power source, the regulated +225 volts dc obtained at pin 8 of V8 must be between 220 and 230 volts dc for a line variation of 204 to 256 volts ac.

Table 7-1. Checking Filament and B+ Circuits for Shorts

| <i>Point of measurement</i> | <i>Normal Indication</i> | <i>Isolating procedure</i> |
|--|--------------------------|---|
| Pin 3 of V11 to ground (figs. 7-2 and 7-6). | 170K | A lower reading maybe due to a short in capacitor C 17 or C 1g. An infinite reading may be due to open resistor R49, R50, R51, or R56, or open choke L1. |
| Pin 3 of V8 to ground (figs. 7-2 and 7-6). | 150K | If resistance is zero or infinite, check C17, C37, R84, RS5, and L1. |
| Junction of R68 and C18D (A model), R68, and C38C (B, C, and D models) (fig. 7-5). | 180K | If resistance is not within ±10 percent, check C18D (C38C) and R67. |

NOTE

As in chapter 6, a reference symbol followed by another symbol in paren-

theses indicates that the latter is used in all models other than the TS-723A/U.

Table 7-2. Voltage Measurements

| Point of measurement | Normal indication | Isolating procedure |
|---|-------------------|--|
| Pin 3 of V8. (fig. 7-6) | +430 volts dc. | If a close reading is not obtained, check V7C, C17 and C37, R84 and R85, and L1. |
| Junction of C18D (C38C) and R68. (fig. 7-6) | +230 volts dc. | If a close reading is not obtained, check C18D and R67, |
| Junction of R51 and C18B, (fig. 7-6) | +320 volts dc. | If a close reading is not obtained, check C17C, C17D, (C38C), C18B, R49, R50, and R51. |
| Pin 8 of V8. (fig. 7-6) | +225 volts dc. | If the indication varies by more than a few volts, adjust R43. If adjustment of R43 does not correct the reading, check V8, V9, and V10 and associated circuit components. |

7-3. Dc Resistance of Transformers and Coils

The dc resistance data (table 7-3 below) is provided as an aid to troubleshooting (sec II). When using the data, observe the following:

a. Before making resistance measurements of the windings, check to see if abnormal operation is due to a faulty transformer or coil: follow the troubleshooting procedures (table 7-4) and make voltage

and resistance checks (figs. 7-7 and 7-8).

b. Do not use the resistance measurements as the sole basis for discarding a transformer or coil as defective. Because of rather broad winding tolerances during manufacture, resistance may vary from one transformer or coil to another. The values given in the table are average values. The

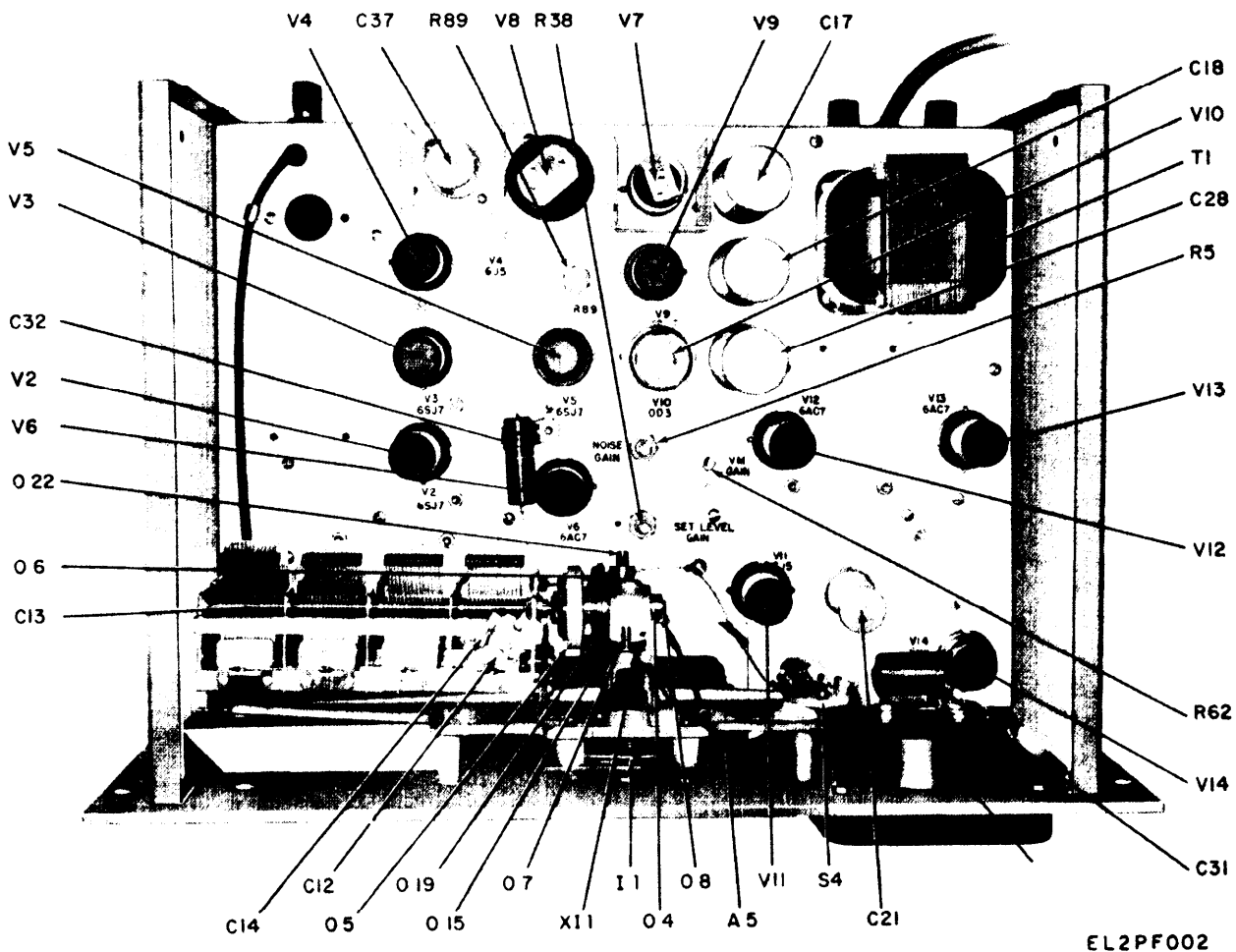
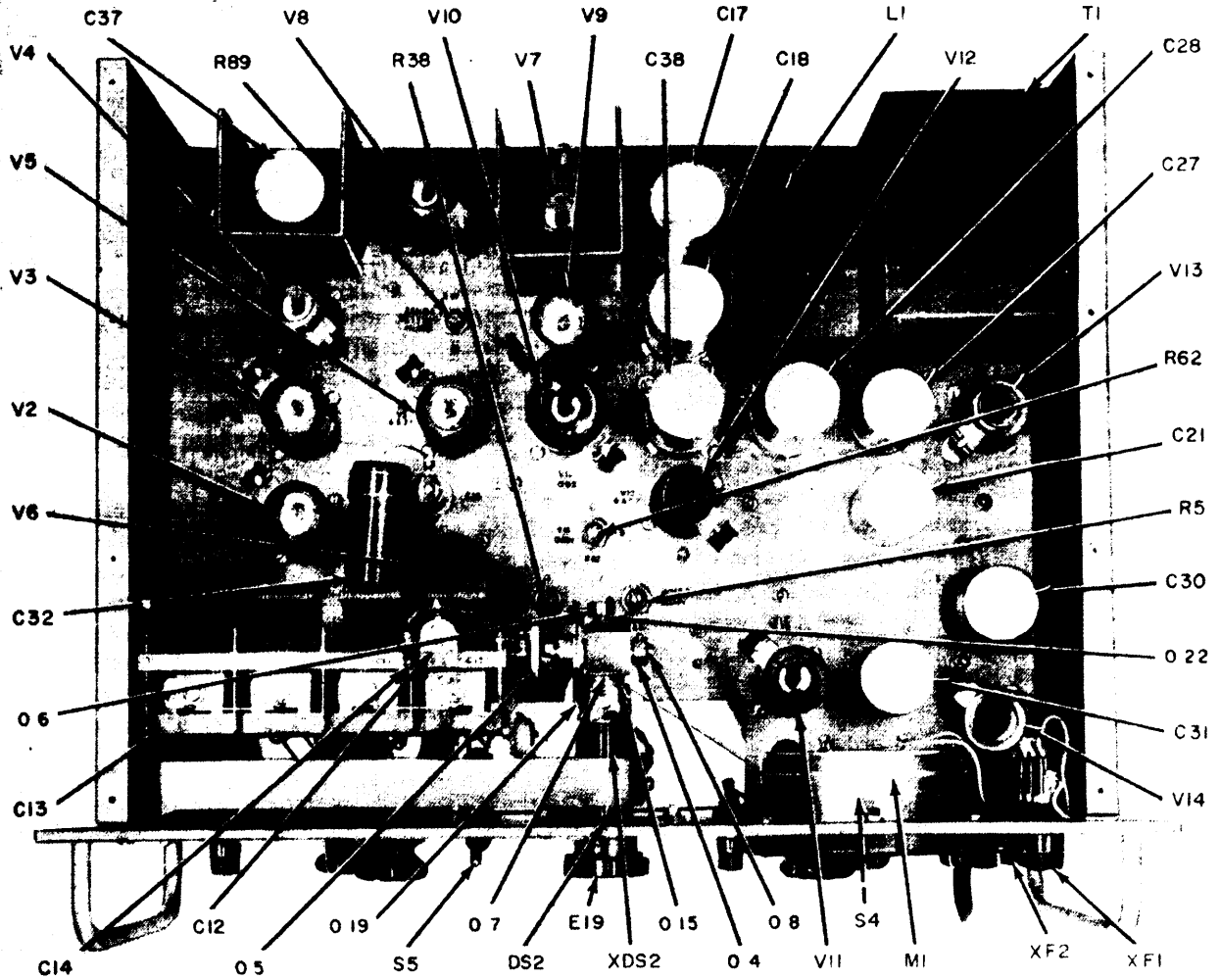


Figure 7-1. Spectrum Analyzer TS-723A/U chassis, top view, location of parts.



EL 6625-255-14-TM-23

Figure 7-2. Spectrum Analyzer TS-723B/U, TS-723C/U, and TS-723D/U chassis, top view, location of parts.

normal resistance of replacement transformers and coils may differ greatly from the values given in the table.

Table 7-3. Dc Resistance of Transformers and Coils

| Transformer or coil | Terminals | Ohms |
|---------------------|-----------|-------|
| T1 | 1-2 | 5.2 |
| | 3-4 | 5.2 |
| | 5-6 | 0.5 |
| | 7-9 | 320.0 |
| | 10-11 | 0.5 |
| | 12-13 | 0.5 |
| LI | 1-2 | 135.0 |

Section II. TROUBLESHOOTING

7-4. General Instructions

WARNING

When servicing the spectrum analyzer, use caution to avoid contacting points of high voltage.

Troubleshooting at the general support maintenance level includes all techniques outlined for or-

ganizational maintenance, and any special or additional techniques required to isolate a defective part. Localization and isolation techniques, and a troubleshooting table follow.

7-5. General Support Tools and Equipment Required

For a complete listing of tools and test equipment

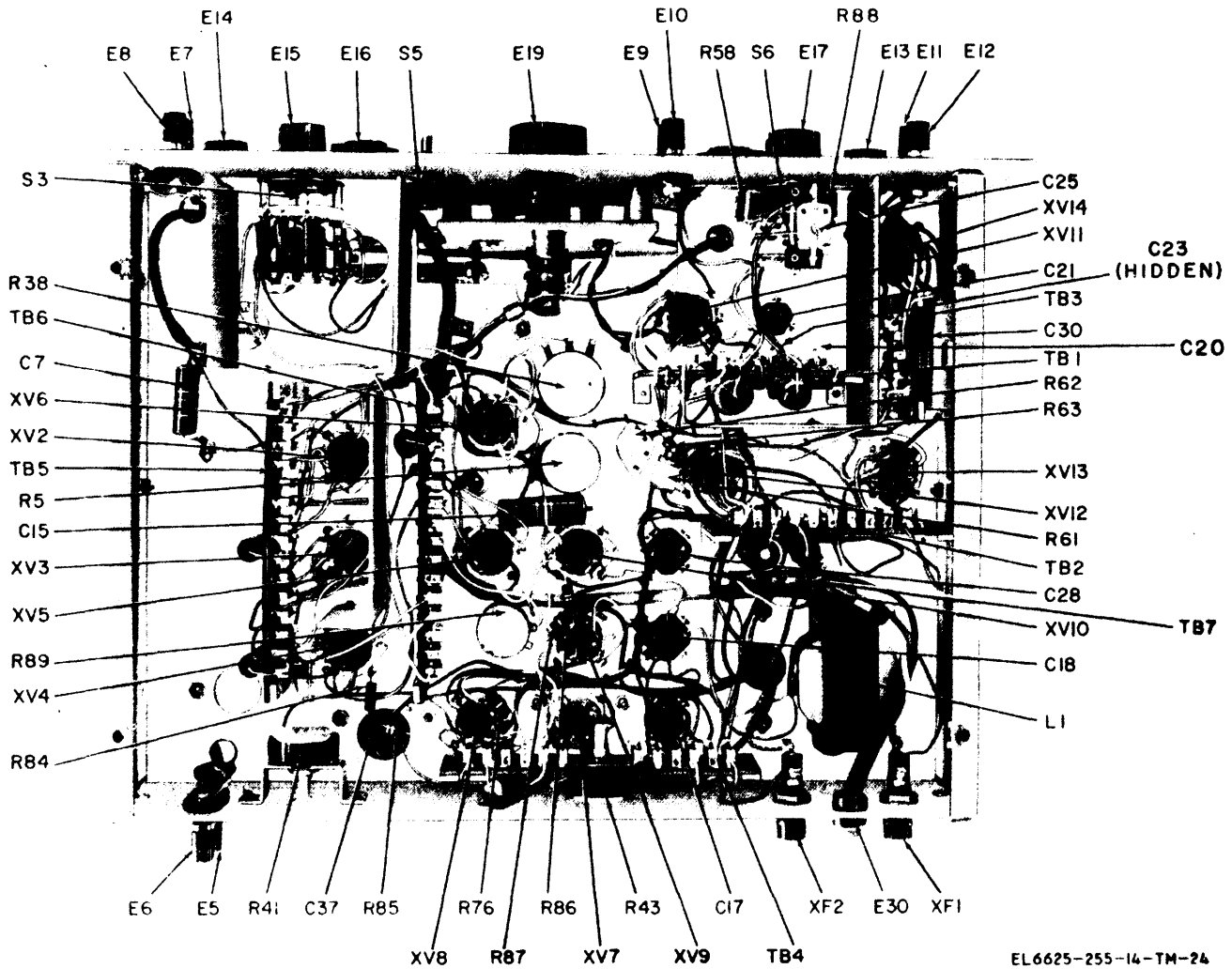


Figure 7-3. Spectrum Analyzer TS-723A/U chassis, bottom view, location of parts.

required for troubleshooting, maintenance, and repair of the spectrum analyzer, along with the appropriate maintenance category, consult the maintenance allocation chart, appendix B of this manual.

7-6. Organization of Troubleshooting Procedures

a. General. The first step in servicing a defective spectrum analyzer is to localize the fault, which means tracing the fault to a defective stage or circuit. The second step is isolation, which means locating a defective part or parts. Some defective parts, such as burned resistors and arcing or shorted rectifiers, can be located by sight, smell, or hearing; however, most defective parts must be located by checking voltage and resistance.

b. Localization and Isolation. Listed below is a group of tests organized to reduce unnecessary work and aid in tracing a trouble to a specific component. Follow the procedure in the sequence

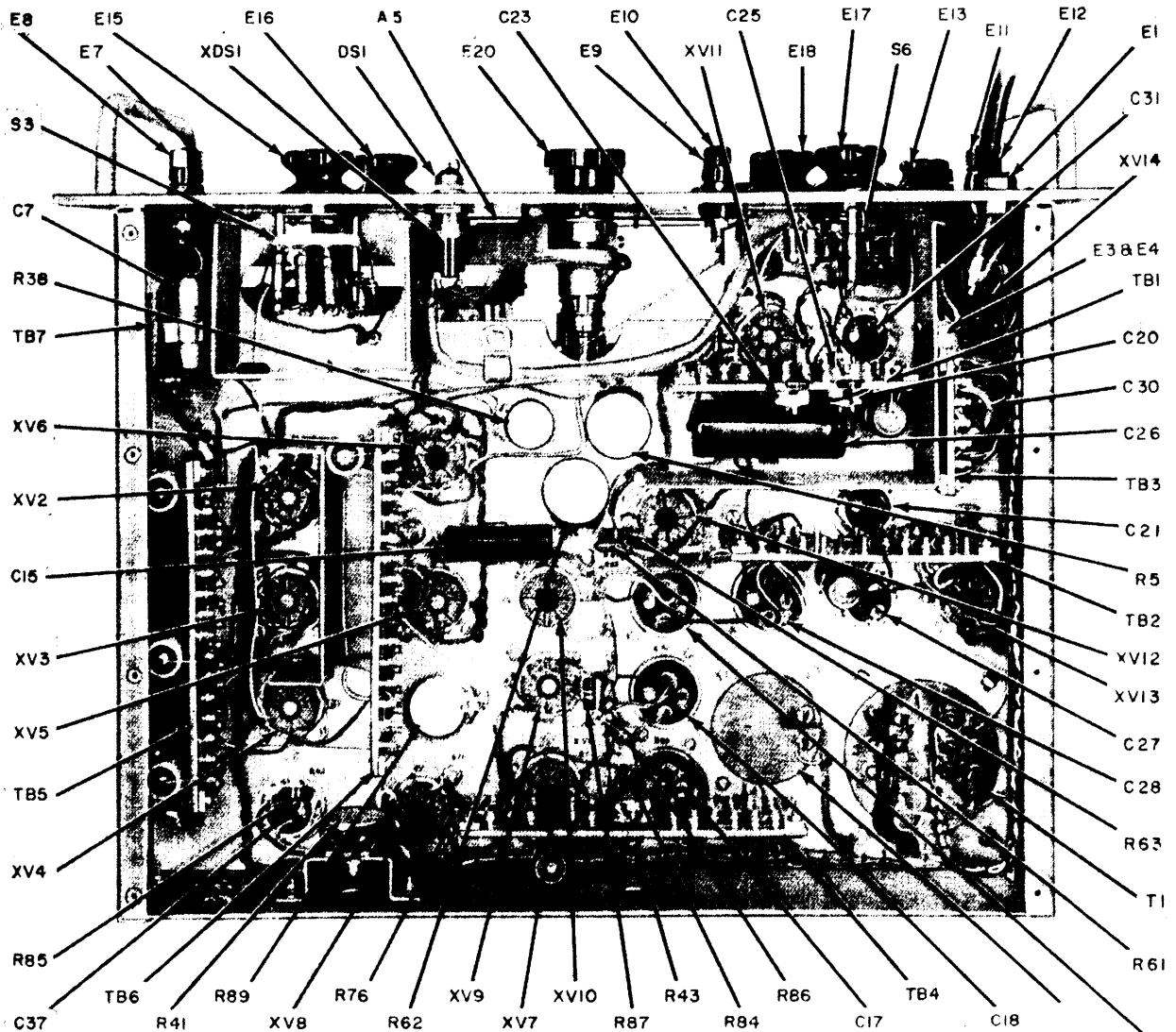
given.

(1) *Visual inspection.* The purpose of visual inspection is to locate faults without testing or measuring circuits. All meter readings or other visual signs should be observed and an attempt made to localize the fault to a particular stage.

(2) *Operational tests.* The operational tests given in chapter 3 may indicate the general location of trouble and, in many instances, will help in determining the exact nature of the fault.

(3) *Localization.* The procedures listed in the troubleshooting table are used in localizing trouble to a particular stage. The table lists symptoms of common troubles and gives (or references) corrective measures. Such a table obviously cannot include all symptoms that may occur. The repairman should use the table as a guide in analyzing symptoms that may not be listed.

(4) *Isolation.* Procedures for isolating trouble are given in table 7-4.



EL6625-255-14-TM-25

Figure 7-4. Spectrum Analyzer TS-723B/U chassis, bottom view, location of parts.

(5) *Techniques.* Applicable techniques are given in paragraph 7-1.

(6) *Intermittent troubles.* In all the tests, the possibility of intermittent trouble should not be overlooked. This type of trouble, if present, may often be made to appear by tapping or jarring the equipment.

7-7. Troubleshooting Setup

The spectrum analyzer must be connected to a 115- or 230-volt ac source and to test equipments which vary from test to test. Remove the top and bottom dust covers and connect the audiofrequency oscillator and oscilloscope as specified for the particular tests given in table 7-4.

7-8. Localizing Trouble

a. General. Procedures for localizing trouble are given in table 7-4 below. Parts locations are indicated in figures 7-1, through 7-5. A schematic diagram of B + voltage distribution is shown in figure 7-6. Voltage and resistance measurements are shown in figures 7-7 and 7-8. Depending upon the nature of the operational symptoms, one or more of the localizing procedures will be necessary. When trouble has been localized to a particular stage, use voltage and resistance measurements to isolate the trouble.

CAUTION

If operational symptoms are not known,

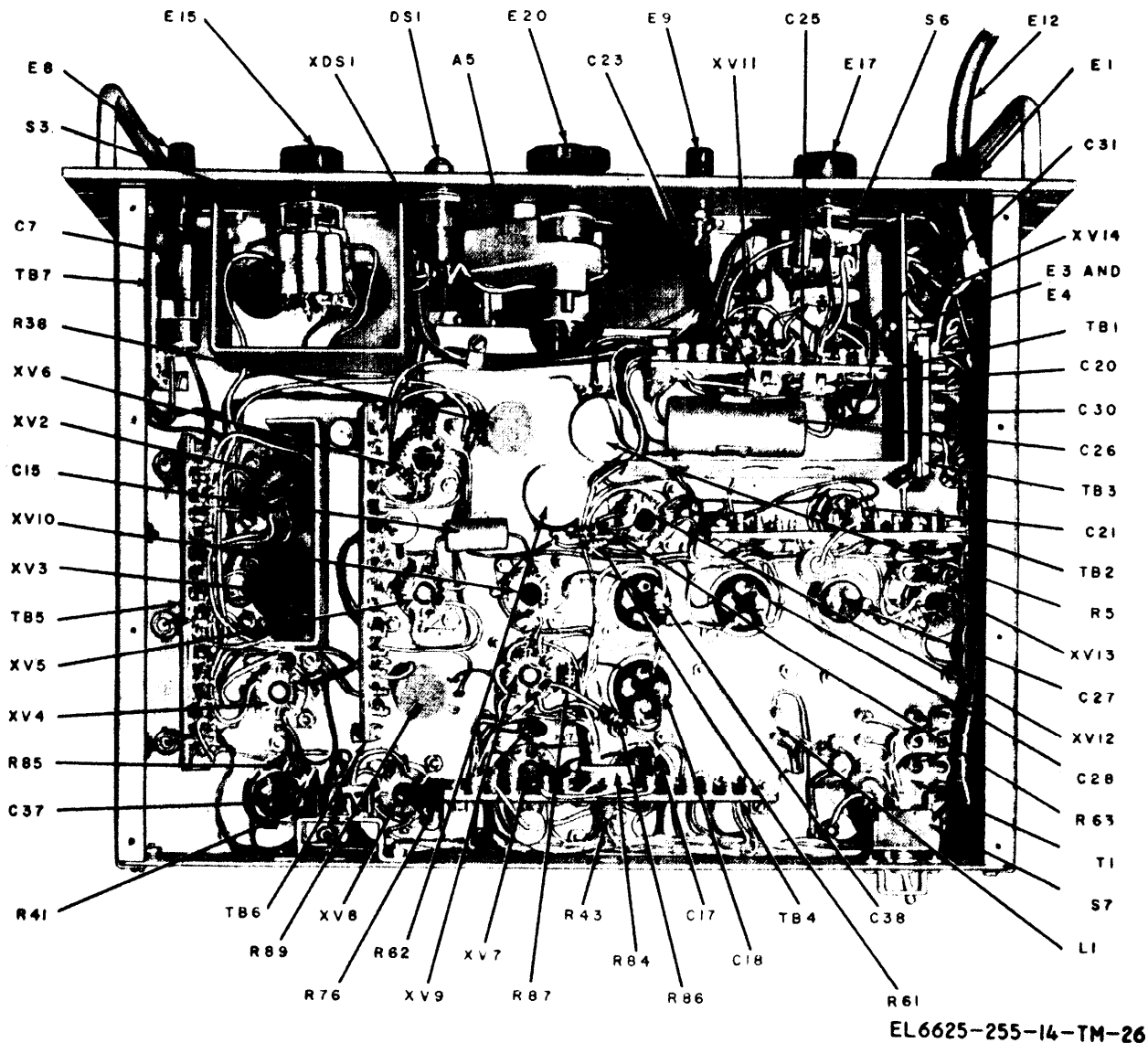


Figure 7-5. Spectrum Analyzer TS-723C/U and TS-723D/U chassis, bottom view, location of parts.

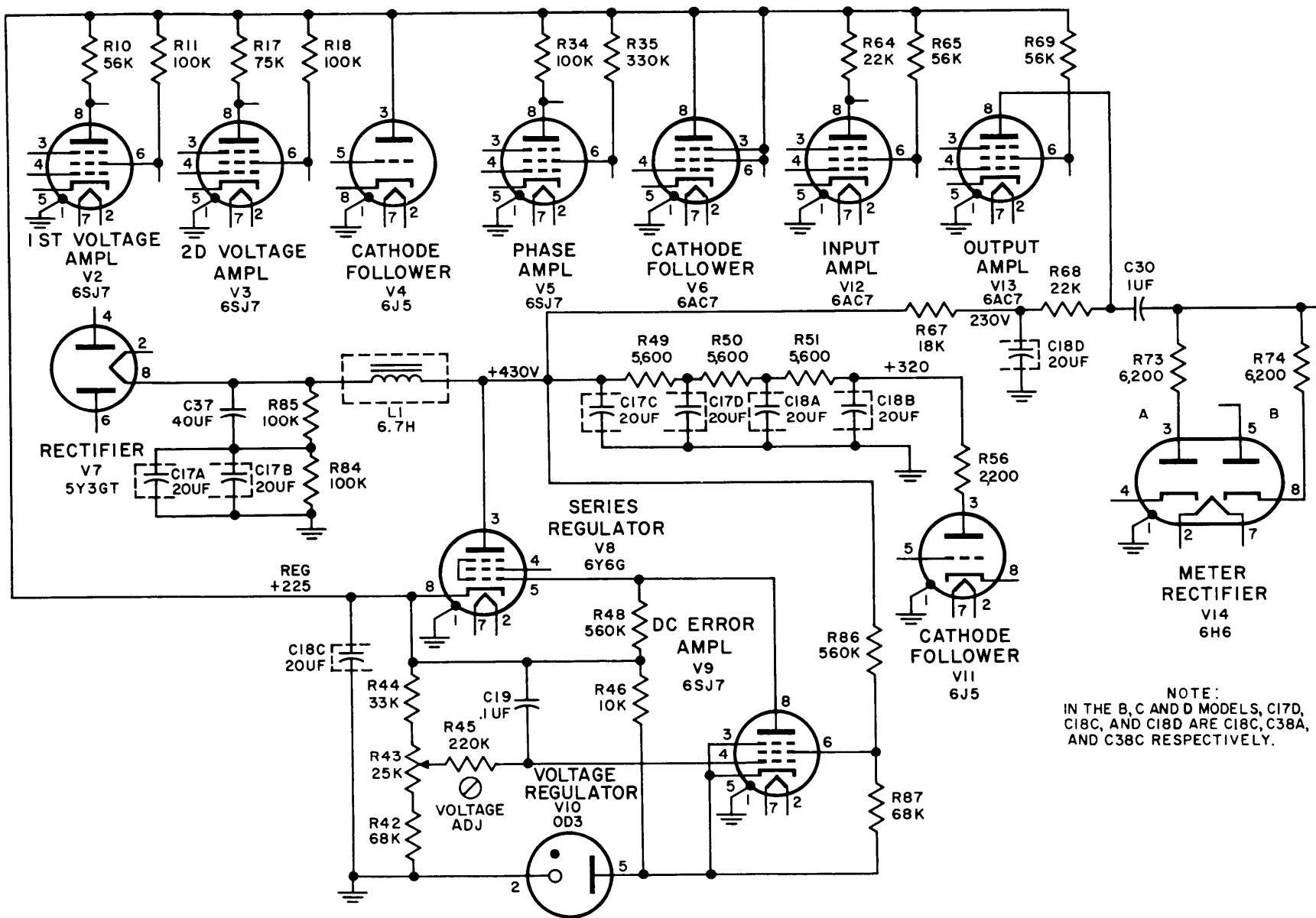
or if they indicate the possibility of short circuits within the spectrum analyzer, make the short circuit checks described in paragraph 7-2 and table 7-1 before applying power to unit.

b. *Use of Table.* When a malfunction has been observed, look for a description of the symptom in the appropriate column and perform the corresponding measure in the corrective action column. If no operational symptoms are known,

perform all functions of the spectrum analyzer as described in chapter 3 until a malfunction appears.

NOTE

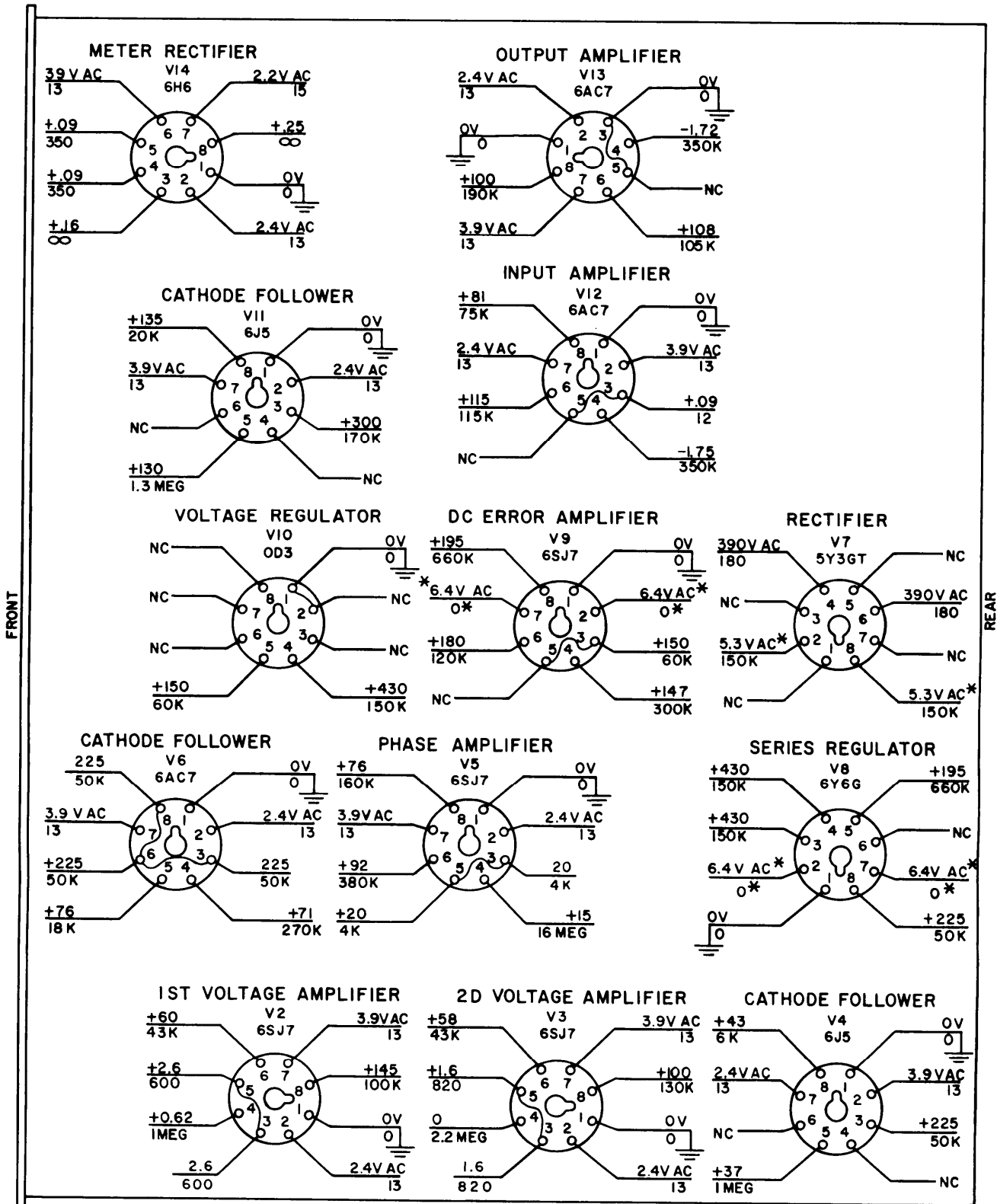
As in chapter 6, a reference symbol followed by another reference symbol in parentheses indicates that the latter is used in all models other than the A model,



NOTE:
 IN THE B, C AND D MODELS, C17D,
 C18C, AND C18D ARE C18C, C38A,
 AND C38C RESPECTIVELY.

EL2PF003

Figure 7-6. B+ voltage distribution.



NOTES:

1. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH A 20,000-OHMS-PER-VOLT METER. USE HIGHER METER RANGES TO PREVENT CIRCUIT LOADING.
2. * MEASURED ACROSS FILS.
3. VOLTAGE READINGS ARE ABOVE LINE. RESISTANCE READINGS BELOW LINE.
4. NC INDICATES NO CONNECTION.

EL2PF004

Figure 7-7. Tube socket voltage and resistance diagram.

| Malfunction | Probable Cause | Corrective action |
|---|--|---|
| <p>1. Line cord connected to power source, and ac power switch is ON. Dial lamp does not light.</p> | <p>a. Defective lamp I1 (DS2). b. Blown fuse F1.</p> | <p>a. Replace lamp. b. Replace blown fuse with spare fuse. Fuse F1 should be 1.6 ampere for 115-volt operation, and 0.8 ampere for 230-volt operation. c. Check strapping of T1 (para 2-4). d. Set switch to correct position.</p> |
| <p>2. Function switch S4 is set to METER. Af oscillator adjusted to deliver several volts at 1,000 Hz, is connected to METER binding posts. Spectrum analyzer meter does not show response:</p> | <p>c. Transformer T1 (TS-723A/U and TS-723B/U) not properly strapped for line voltage being used. d. 115V-230V ac changeover switch (TS-723C/U and TS-723D/U) set to wrong position.</p> <p>a. Fuse F2 in power supply is blown.</p> <p>b. Defective V8, V9, V10, V11, V12, V13, or V14. c. Defective switch S4. d. Defective component in power supply or vtvm circuit.</p> | <p>a. Replace blown fuse. If fuse blows again, check C17, C37, and C18, Check V7, b. Check tubes and replace defective tube. Check contacts of switch S4. c. Make voltage and resistance checks; replace defective component. d. Check V14 or solid-state rectifier; replace if defective. e. Check M1; replace if defective.</p> |
| <p>3. Function switch S4 is set to METER. Af oscillator adjusted to deliver several volts at 1,000 Hz, is connected to METER binding posts. The oscilloscope, connected to OSCILLOSCOPE binding posts, shows 1,000 Hz output but indication is 0 or very low.</p> | <p>a. Defective C31. b. Defective V14 or solid-state rectifier CR1 or CR2. c. Defective meter M1.</p> | <p>d. Check V14 or solid-state rectifier; replace if defective.</p> |
| <p>4. Function switch S4 is set to NOISE. AF-RF selector switch S2 is set to AF (TS-723A/U) Af oscillator, adjusted for 0.8 volt and 1,000 Hz, is connected to AF INPUT binding posts. Signal INPUT control R4 is set to MAX. Meter range switch S6 is set to 100 R.M.S. VOLTS. Meter M1 indicates significantly lower than 1 volt or there is no meter indication.</p> | <p>a. Defective V2, V3, V4, V5, or V6. b. Defective contacts on S2, S4, or S6 if no reading is obtained.</p> | <p>a. Check tubes and replace defective tube. b. Check switch contacts. Replace defective switch if trouble is not corrected by cleaning contacts.</p> |
| <p>NOTE In the TS-723A/U, switch S6 must be replaced as an assembly including R58, R88, and C25. In all other models, R58 and R88 and R92 through R98. Capacitor C25 is not included on the S6 switch assembly,</p> | | |
| <p>5. Function switch S4 is set to SET LEVEL. AF-RF selector switch S2 is set to AF (A model only). Af oscillator, adjusted for 0.8 volt and 1,000 Hz, is connected to AF INPUT binding posts. Signal INPUT control R4 is set to MAX. Meter range switch S6 is set to 10 R.M.S. VOLTS. Meter M1 indicates significantly lower than 1 volt, or there is no meter indication.</p> | <p>c. SET LEVEL GAIN control R38 not properly adjusted. d. NOISE GAIN control R5 not properly adjusted. e. Defective component in preamplifier or bridge amplifier circuits. Defective contacts on S4.</p> | <p>c. Refer to paragraph 7-16, d. Refer to paragraph 7-16. e. Make voltage and resistance checks. Check contacts of S4; replace if necessary.</p> |

7-9. Isolating Trouble Within Stage

After the trouble has been localized to a stage with the troubleshooting table, use the following

technique to isolate the defective part.

a. Test the tube involved using either the recommended test set or the standard tube substitu-

tion method.

b. Take voltage measurements at the tube sockets (fig. 7-7) and other related points.

c. If voltage readings are abnormal, take resistance readings (figs. 7-7 and 7-8). Refer also

to the dc resistance of transformers and coils, paragraph 7-3 and table 7-2.

d. Use the wiring diagram (fig. FO-3 or FO-4) to trace circuits and to isolate the faulty part.

SECTION III. MAINTENANCE OF SPECTRUM ANALYZER

7-10. General Parts Replacement Techniques

NOTE

Several of the spectrum analyzer parts have smaller tolerances than those used in most radio equipments. Resistors R1, R2, R26, R27, R28, R29, R30, R31, R39, R47 and R91, used in the Wien bridge, are precision-selected at the factory as part of switch assembly S3. If these parts require replacement, replace complete switch assembly S3. Resistors R58 and R88 (R92 through R98) are part of switch assembly S6 and have been designed specifically for Spectrum Analyzer TS-723(*)/U. If either of these resistors becomes defective, replace complete switch assembly S6. Resistors R77, R78, and R90 are close tolerance resistors and must be selected during replacement as described in paragraph 7-16.

a. The components of the spectrum analyzer are easy to reach and replace if found faulty. The sockets, filter capacitors, filter choke, and transformer are securely mounted to the chassis with hexagonal nuts, machine screws, or rivets.

b. In the TS-723A/U to reach capacitor C6, switch S2, and variable resistor R4, remove the four Phillips-head screws that attach the front panel. Remove the four Phillips-head screws that attach the capacitor drive assembly to the front panel. Pull the front panel away from the capacitor drive assembly.

c. If any of the switches requires replacement, carefully mark the wires connected to the switch wafers with tags to avoid disconnection when the new switch is installed. Follow this practice whenever replacement requires disconnecting several wires.

7-11. Replacement of Capacitor Drive Cables

a. Refer to figure 7-9 and proceed as follows:
(1) Remove the top cover.

(2) Cut the old cables. Remove the screw that attaches rear drive cable 0 20 to cone pulley 0 19. Remove the screw that attaches front drive cable 0 21 to cone pulley 0 19. Remove the screw

that attaches rear drive cable 0 20 to groove pulley 0 14 and the screw that attaches front drive cable 0 21 to flat pulley 0 13. Remove the old drive cables and discard them.

(3) Cut a piece of cable 11 inches long. Place clamp E60 over one end of the cable. Form a loop around the mounting screw in the end of the cable and insert it back through the clamp. Slide the clamp tightly against the screw with the end of the cable extending approximately one-eighth of an inch. Place the clamp on a bench and tap the clamp. Insert the free end of the cable through the hole in the large groove section of cone pulley 0 19. Pull the cable through far enough to form a loop and install clamp E60 as described above.

(4) Cut a piece of cable 15 inches long, Form a loop in one end as described in (3) above. Insert the free end of the cable through the hole in the side of cone pulley 0 19 associated with the small section of the pulley. Form a loop in the cable as described in (3) above.

(5) Attach drive cables 0 20 and 0 21 to cone pulley 0 19; use the attaching screws,

(6) Loosen the setscrews in drive shaft collar 0 6. Seat rear drive cable 0 20 in the groove of the large section of cone pulley 0 9.

b. All front panel knobs are held with Allen-head setscrews. When removing a knob, make a note of the position of the pointer and shaft and replace the knob under the same conditions.

7-12. Disassembly and Reassembly of Capacitor Drive Assembly

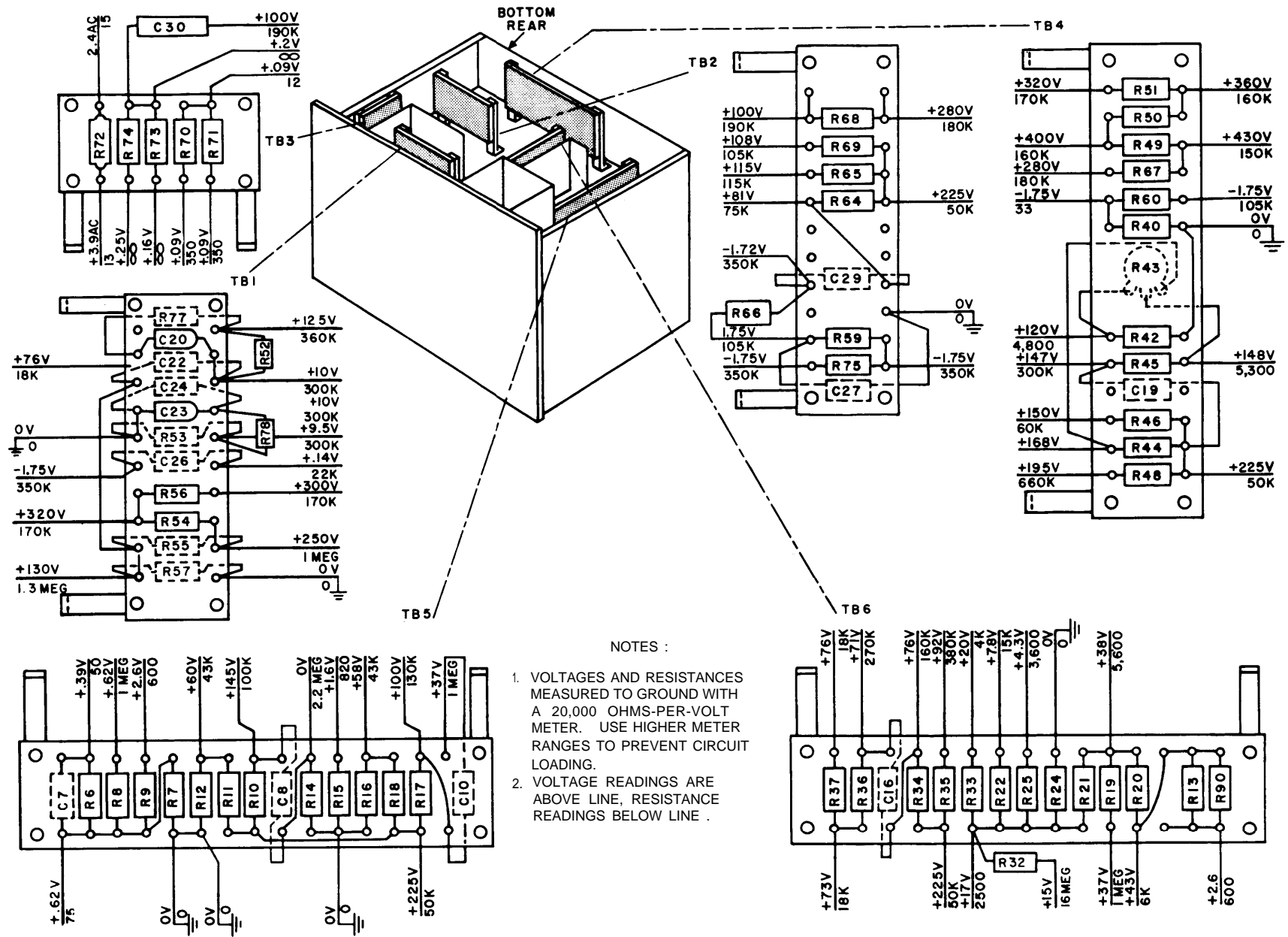
CAUTION

Do not disassemble the capacitor drive assembly unless it is absolutely necessary; it is very difficult to recalibrate. If it is necessary to repair the capacitor drive assembly, disassemble it only as far as necessary to repair the defective part.

a. *Disassembly.* Disassemble the capacitor drive assembly (fig. 7-10) as follows:

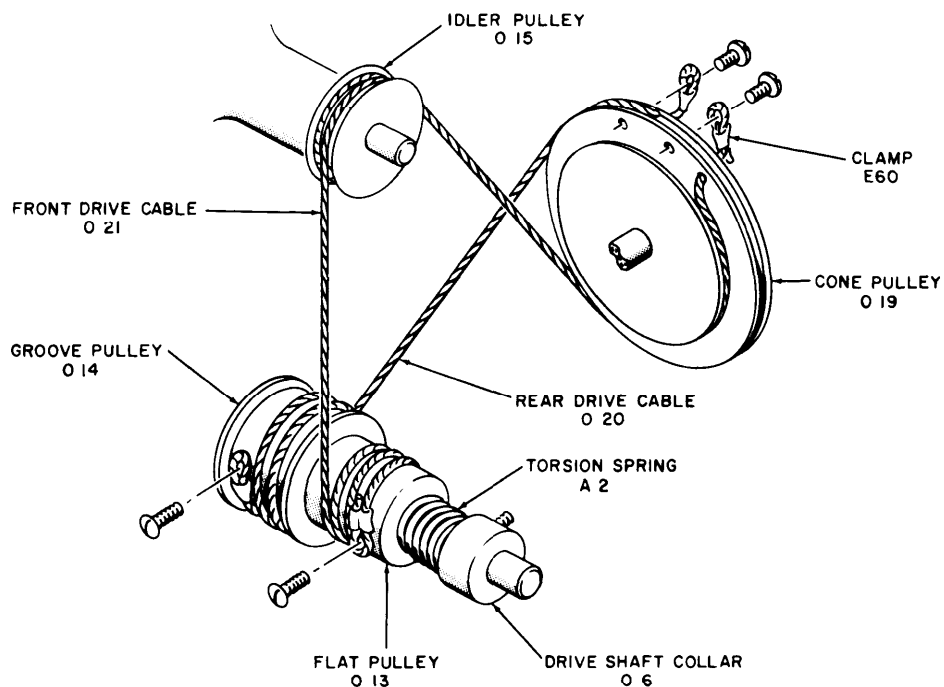
(1) Loosen the setscrew that attaches each FREQUENCY dial knob, and remove the two FREQUENCY dial knobs. Removal of the lower FREQUENCY tuning dial knob releases disk spring A3.

(2) Remove the four No. 10-32 Phillips-head



EL2PF005

Figure 7-8. Terminal board voltage and resistance diagram.



EL2PF006

Figure 7-9. Replacing capacitor drive cables

screws that attach the capacitor drive assembly to the front panel. Unsolder all wiring connections. Tag all wires for identification during reassembly. Lift out the capacitor drive assembly.

(3) Remove the two 6-32 roundhead screws, lockwashers, and nuts that attach dial window A8. Remove dial window A8.

(4) Slide shaft disk 02 off dial shaft 03. Turn frequency dial A5 fully clockwise. Carefully make a scribe line on the face of the mounting chassis directly in line with 200 on the dial scale. Remove the four screws that attach dial shaft 018, Remove dial shaft 018 and frequency dial A5. Slide out dial shaft 03.

(5) Loosen the dial stop screw that attaches dial hub 09. Remove dial hub 09 and bearing washer 060. Remove the No. 6-32 roundhead screw that attaches back drive cable 020 to groove pulley 014. Remove the No. 6-32 roundhead screw that attaches front drive cable 021 to flat pulley 013. Loosen the two setscrews that attach dial shaft collar 06 and remove torsion spring A2. Loosen the setscrew that attaches groove pulley 014, flat pulley 013, and bearing washer 063 off drive shaft 022. Pull flat pulley 013 out of groove pulley 014. Carefully remove any burrs from the shaft with No. 000 sandpaper before pulling out drive shaft 022.

(6) Rotate variable capacitor C13 so that the plates are completely meshed. Note and mark the ex-

act position of coupler 05 on the capacitor shaft. Loosen the setscrew that attaches coupler 05 to the shaft of variable capacitor C13. Remove the No. 6-32 binder head screw that attaches each mounting bracket A62. Slide variable capacitor C13 out of coupler 05 and remove it from the mounting chassis.

(7) Remove the two No. 6-32 screws, lockwashers, and nuts that attach coupler 05 to the mounting bar of cone pulley 019. Slide coupler 05 from coupler shaft 08.

(8) If cables 020 and 021 are to be replaced, cut the cables and remove the No. 4-40 screw that attaches each cable to cone pulley 019. Loosen the setscrew that attaches cone pulley 019 to coupler shaft 08. Slide cone pulley 019 and bearing washer 062 from coupler shaft 08. Loosen the two setscrews that attach coupler shaft collar 04. Slide coupler shaft collar 04 and bearing washer 061 from coupler shaft 08. Remove any burrs on coupler shaft 08 with No. 000 sandpaper before sliding the shaft out of the bearings.

(9) Lift off idler pulley 015. Loosen the setscrew that attaches idler shaft 07, and lift out the shaft.

(10) Remove the No. 6-32 screw that attaches cable clamps H60 and H61. Remove cable clamps H60 and H61. Loosen the No. 6-32 screw that attaches lampholder XI 1 (XDS2). Remove the lampholder.

(11) Loosen the setscrew that attaches disk

shaft bearing spacer E33. Press out disk shaft bearing 0 1, disk shaft bearing spacer E33, and dial shaft bearing 0 11; use a suitable press.

(12) Loosen the setscrew that attaches dial shaft bearing spacer E32. Press out dial shaft bearing 0 11, dial shaft bearing spacer E32, and dial shaft bearing 0 12, use a suitable press.

b. Reassembly. Reassemble the capacitor drive assembly (fig. 7-10) as follows:

(1) Press in dial shaft bearing 0 12; use a suitable press. Replace dial shaft bearing spacer E32. Press in dial shaft bearing 0 11; use a suitable press. Tighten the setscrew that secures dial shaft bearing spacer E32.

(2) Press in coupler shaft bearing 0 10; use a suitable press. Replace disk shaft bearing spacer E33. Press in disk shaft bearing 0 1; use a suitable press. Tighten the setscrew that secures disk shaft bearing spacer E33.

(3) Replace idler shaft 0 7 and tighten the attaching setscrew. Place idler pulley 0 15 on idler shaft 0 7.

(4) Slide bearing washer 0 62 and cone pulley 0 19 over the end of coupler shaft 0 8, and tighten the setscrew that attaches cone pulley 0 19. Position coupler 0 5 on the mounting bar of cone pulley 0 19 and attach it with the two screws, lockwashers, and nuts. Coat coupler shaft 0 8 with oil (OAI) and replace coupler shaft collar 0 4 over the end of coupler shaft 0 8. Hold cone pulley 0 19 and coupler shaft collar 0 4 firmly against the bearing washers and tighten the two setscrews that attach coupler shaft collar 0 4.

(5) Slide capacitor C13 into coupler 0 5. Rotate the plates of capacitor C13 to the fully meshed position. Align the mark on coupler 0 5 with the mark on capacitor C 13 made during disassembly, and tighten the setscrew. If a new coupler or capacitor is being installed, with the capacitor plates fully meshed, line up the heads of the screws, used to attach coupler 0 5 to coupler shaft 0 8, horizontal with the top edge of capacitor C13. Attach the three mounting brackets A62 to the mounting chassis; use a No. 6-32 binder-head screw and lockwasher for each bracket.

(6) Replace dial hub 0 9 on drive shaft 0 22 and securely tighten the dial stop screw. Place bearing washer 0 60 on drive shaft 0 22. Coat drive shaft 0 22 with oil (OAI) and insert the shaft through drive shaft bearings 0 11 and 0 12. Place bearing washer 0 63, groove pulley 0 14, and flat pulley 0 13 on drive shaft 0 22. Do not tighten the setscrews in groove pulley 0 14

(7) Set back drive cable 0 20 in the groove of the large section of cone pulley 0 19. Bring it under the pulley and wrap it clockwise around

groove pulley 0 14; attach it with the No. 4-40 screw.

NOTE

If drive cables are to be replaced when groove pulley 0 14 and flat pulley 0 13 have not been removed from drive shaft 0 22, refer to paragraph 7-11.

(8) Seat front drive cable 0 21 in the groove of the small section of cone pulley 0 19. Run the cable over the top of cone pulley 0 19 and wrap it counterclockwise one complete turn around idler pulley 0 15. Pass the cable through the groove in the front of the bearing support in the mounting chassis. Wrap the cable counterclockwise around flat pulley 0 13 and attach it with the No. 4-40 screw.

(9) Rotate capacitor C13 to the fully opened position. Turn drive shaft 0 22 clockwise until the stop screw in dial hub 0 9 butts against the screw extending through the front of the mounting chassis. Hold the shaft in this position and turn groove pulley 0 14 until the slack is removed from back drive cable 0 20. Tighten the setscrew that attaches groove pulley 0 14.

(10) Place torsion spring A2 over the end of drive shaft 0 22 and seat the spring end in the hole in flat pulley 0 13. Place drive shaft collar 0 6 over the end of drive shaft 0 22 and seat the end of the spring in the hole in the bottom of the collar.

(11) Check to see that capacitor C13 is still in the fully opened position. Hold drive shaft 0 22 fully clockwise, and rotate flat pulley 0 13 counterclockwise until the slack is removed from front drive cable 0 21. Still holding drive shaft 0 22 fully clockwise, rotate drive shaft collar 0 6 counterclockwise until all slack is removed from both drive cables. Rotate dial shaft collar 0 6 an additional one-half turn counterclockwise to tighten torsion spring A2; tighten the two setscrews.

NOTE

Drive shaft collar 0 6 may be turned by inserting an Allen wrench in one of the setscrews. Hold the wrench so that when the spring is tightened the wrench can be turned with the thumb to tighten the setscrew.

(12) Replace lampholder XI 1 (XDS2) and secure it with the No. 6-32 screw. Run the wires down the back of the mounting chassis and attach them with cable clamps H60 and H61. Coat dial shaft 0 3 with oil (OAI) and replace it in the mounting chassis.

(13) Rotate drive shaft 0 22 fully clockwise. Position frequency dial A5 on dial hub 0 9 so that

the 200 mark on the dial is exactly in line with the mark made on the face of the mounting chassis during disassembly. Position dial shaft 018 over the four mounting holes in dial hub 09 and attach in with the four Allen-head screws.

(14) Carefully clean the dial window and attach it to the front of the mounting chassis with the two No. 6-32 screws, lockwashers, and nuts.

(15) Position the capacitor drive assembly inside the panel chassis assembly and attach it to the front panel; use the four No. 8-32 Phillips-head screws.

(16) Place disk spring A3 over the end of dial shaft 03 and replace the lower FREQUENCY dial knob. Replace the upper FREQUENCY dial knob on dial shaft 018.

NOTE

After reassembly, the calibration of the dial must be checked as described in paragraph 7-20.

7-13. Adjustment of Regulated B + Voltage

The regulated B + voltage (+225 volts) provides a part of the stability of the spectrum analyzer; therefore, it is important that this voltage be set correctly before further adjustments are made.

a. Make the following connections:

(1) Connect the spectrum analyzer power cord to the variable transformer output terminals.

(2) Connect Multimeter TS-352B/U (in ac position) to measure the output of the variable transformer.

(3) Connect Multimeter ME-26(*)/U (in dc position) between pin 8 of V8 and ground.

(4) Connect the variable transformer to a 115-volt ac power source.

b. Adjust the variable transformer output to 115-Volts.

c. Turn the spectrum analyzer power on and adjust control R43 (fig. 7-3, 7-4, or 7-5) so that the ME-26(*)/U indicates +225 volts,

d. Adjust the variable transformer for an output of 105 volts; the ME-26/U should not indicate less than 220 volts, Readjust the variable transformer for an output of 125 volts; the ME-26/U should not indicate more than 230 volts.

7-14. Zero Setting Meter M1

Zero set meter M1 before proceeding with the alignment procedure given below,

a. Turn the spectrum analyzer power on.

b. Set the meter range switch to 300 R.M.S. VOLTS.

c. Set the function switch to METER.

d. Allow the equipment to warm up. If the meter

pointer rests at zero on the top scale, set the meter range switch to .03 R.M.S. VOLTS. Unscrew the top METER binding post and touch the metal part of the binding post with the finger. The meter pointer should deflect fully clockwise and pin against the right stop. Remove the finger and note that the meter pointer returns to zero, indicating that the vtvm circuit and power supply are operating properly.

e. If the meter pointer does not rest at exactly zero with the meter range switch set to 300 R.M.S. VOLTS (*d* above), record the meter indication. Turn the meter zero adjust screw until the meter pointer rests at exactly zero on the top meter scale. Turn the spectrum analyzer off. The meter pointer should drop below the 0 mark. This drop should not exceed one-half division on the top meter scale. If the drop is greater than this, turn the spectrum analyzer power on and turn the zero adjust screw to obtain the same indication recorded in *d* above,

f. With the power on, remove V13, If the meter pointer does not return to zero, the thermal emission from V14 (TS-723A/U) is too high. Replace V14, If replacing V14 does not bring the meter pointer to zero, replace V14 and check C18D (C38C).

g. If, when V13 is removed, the meter pointer drops to zero, replace V13 and place a wire jumper across the METER binding posts. If the meter pointer drops to zero, the source of the meter indication is external rf fields. If the meter pointer does not drop to zero when the METER binding posts are shorted, remove V12. If the meter pointer does not drop to zero, V13 is defective. Replace V13. If replacing V13 does not bring the meter pointer back to zero, replace original V13 and check C27.

h. If the meter pointer does drop to zero when V12 is removed, replace V12 and remove V11. If the meter pointer does not drop to zero, V12 is defective. Replace V12.

i. If the meter pointer does drop to zero when V11 is removed, replace V11. If replacing V11 does not bring the meter pointer back to zero, return original V11 and check V10.

7-15. Adjustment of HUM BAL Control

Adjust for hum balance as follows:

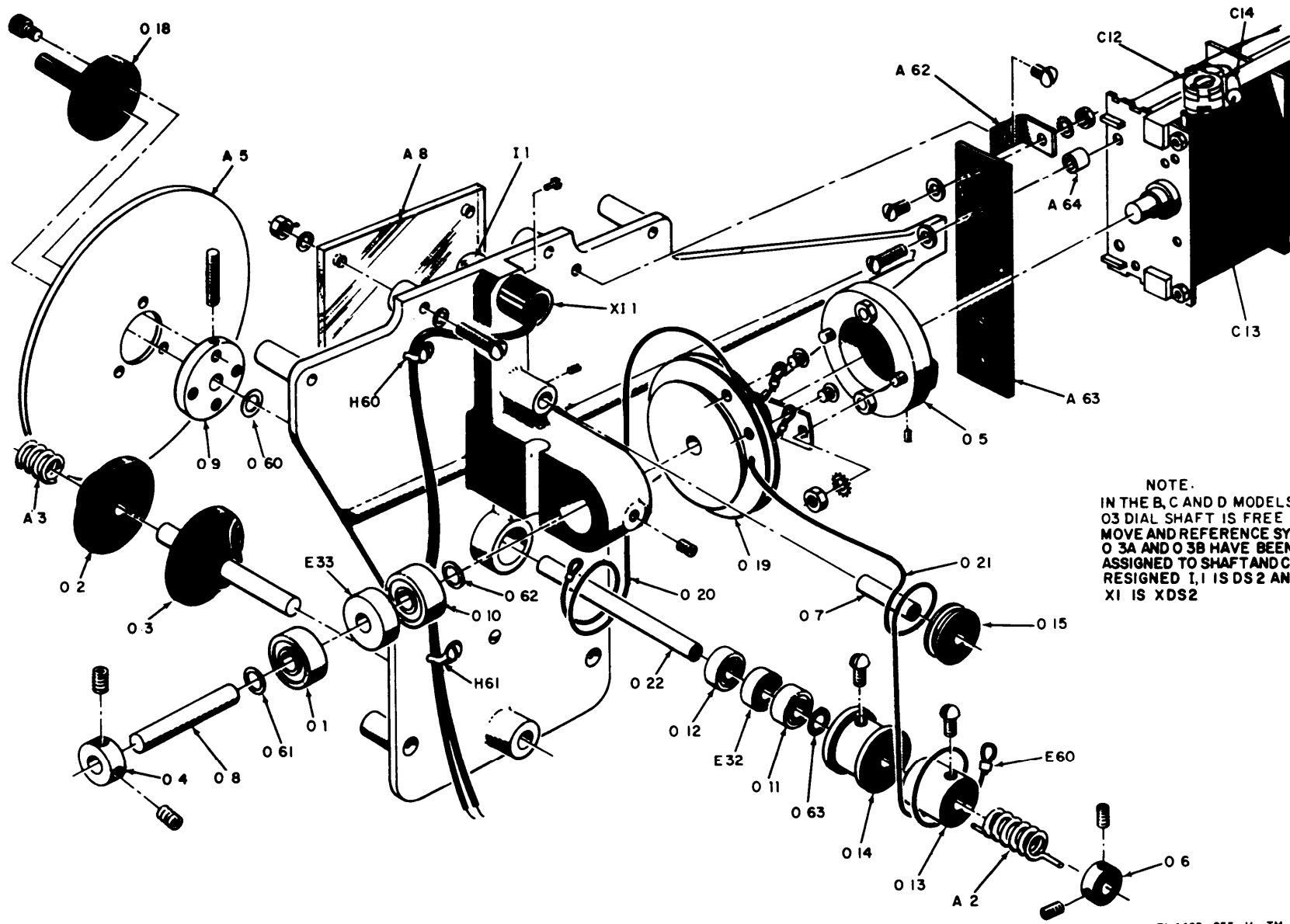
a. Zero set the meter as described in paragraph 7-14.

b. Set the function switch to DISTORTION.

c. Connect a 10-megohm resistor across the AF INPUT binding posts. Cover the resistor and AF INPUT binding posts with lead foil. The lead foil must be grounded and completely insulated from the resistor and binding posts.

d. Set the frequency RANGE switch to X1.

e. Set the signal INPUT control to MIN.



NOTE.
 IN THE B, C AND D MODELS THE
 O3 DIAL SHAFT IS FREE TO
 MOVE AND REFERENCE SYMBOLS
 O 3A AND O 3B HAVE BEEN
 ASSIGNED TO SHAFT AND COLLAR
 RESIGNED I, I IS DS 2 AND
 XI IS XDS2

EL6625-255-14-TM-31

Figure 7-10. Capacitor drive assembly, exploded view.

KEY to fig. 7-10:

A2 Torsion spring
 A3 Disk spring
 A5 Frequent dial
 A8 Dial window
 A62 Mounting bracket
 A63 Mounting board
 A64 Spacer
 C12 Variable capacitor
 C13 Variable capacitor
 C14 Fixed capacitor
 E32 Dial shaft bearing spacer
 E33 Disk shaft bearing spacer
 E60 Clamp
 H60 Cable clamp
 H61 Cable clamp
 I 1 Dial lamp
 0 1 Disk shaft bearing
 0 2 Shaft disk
 0 3 Dial shaft
 0 4 Coupler shaft collar
 0 5 Coupler

0 6 Dial shaft collar
 0 7 Idler shaft
 0 8 Coupler shaft
 0 9 Dial hub
 0 10 Coupler shaft bearing
 0 11 Dial shaft bearing
 0 12 Dial shaft bearing
 0 13 Flat pulley
 0 14 Groove pulley
 0 15 Idler pulley
 0 18 Dial shaft
 0 19 Cone pulley
 0 20 Back drive cable
 0 21 Front drive cable
 0 22 Drive shaft
 0 60 Bearing washer
 0 61 Bearing washer
 0 62 Bearing washer
 0 63 Bearing washer
 XI 1 Lampholder

f. Set the meter range switch to .03 R.M.S. VOLTS.

g. If the meter pointer rests at zero, or indicates at not more than one division, adjustment for hum balance is not necessary.

NOTE

The maximum allowable reading is 0.0007 R.M.S. VOLTS.

h. If the meter pointer does not rest at zero, turn the FREQUENCY tuning dial to 60. If the combination of adjusting the FREQUENCY tuning knobs and the BALANCE control at near 60 Hz results in a zero-meter indication, 60-cycle hum is present in the circuit. Turn the function switch to SET LEVEL and adjust HUM BAL control R41, at the rear panel, for a zero-meter indication. If turning the FREQUENCY tuning dial to 60 Hz does not result in a zero-meter indication, the meter is indicating noise. Check V2, V3, V4, V5, and V6.

i. If a zero-meter indication cannot be obtained by adjusting R41, replace V2 and readjust R41 for a zero-meter indication.

j. If the meter cannot be zero-set by replacing V2, replace the original V2 in its socket. Repeat this test for tubes V3, V4, V5, and V6.

7-16. Alignment of Vtvm Section

Calibrate the vtvm section as follows:

a. Connect the signal generator and the vtvm to the METER binding posts. Adjust the signal generator for 1,000 Hz at exactly 1 volt.

b. Turn on the spectrum analyzer and allow it to warm up for 15 minutes.

c. Set the function switch to METER.

d. Set the meter range switch to 1.0 R.M.S. VOLTS.

e. Adjust variable resistor R62 (VM GAIN) for a meter reading of 1.0 R.M.S. VOLTS on the top meter scale.

f. Set the meter range switch to 3.0 R.M.S. VOLTS. Record the reading obtained on the meter.

g. Adjust the voltage output of the signal generator to produce a reading of 0.08 volt on the spectrum analyzer meter. Record the reading on the vtvm.

h. Adjust the signal generator for 10,000 Hz at the same voltage output recorded on the vtvm (g above). Set the meter range switch to .10 R.M.S. VOLTS. The spectrum analyzer meter should indicate 0.08 ± 3 percent R.M.S. VOLTS. If this reading is not obtained, adjust trimmer C25 until the meter indicates 0.08 ± 3 percent R.M.S. VOLTS.

i. Adjust the signal generator for 100,000 Hz at the same voltage output recorded on the vtvm (g above). The reading on the spectrum analyzer meter should be 0.08 ± 3 percent R.M.S. VOLTS. If this reading is not obtained, adjust C25 until the meter indicates 0.08 ± 3 percent R.M.S. VOLTS.

j. Repeat the adjustments described in h and i above until the 0.08 ± 3 percent R.M.S. VOLTS reading is obtained for both 10,000 and 100,000 Hz without requiring further readjustment.

k. Set the meter range switch to 100 R.M.S. VOLTS.

l. Adjust the signal generator for 1,000 Hz. Adjust the signal generator voltage output to produce a reading of 80 R.M.S. VOLTS on the spectrum analyzer meter. Record the reading on the vtvm.

m. Adjust the signal generator for 10,000 Hz at the same voltage output recorded in l above. The spectrum analyzer meter should indicate 80 ± 3 percent R.M.S. VOLTS. If this reading is not obtained, adjust trimmer C20 until the meter indicates 80 ± 3 percent R.M.S. VOLTS.

n. Adjust the signal generator for 100,000 Hz at the same voltage output recorded in l above.

The spectrum analyzer meter should indicate 80 ±3 percent R.M.S. VOLTS. If this reading is not obtained, adjust C20 until the meter indicates 80 ±3 percent R.M.S. VOLTS.

o. Repeat the adjustments described in *m* and *n* above until the reading of 80±3 percent R.M.S. VOLTS is obtained for both 10,000 and 100,000 Hz without further readjustment. If the proper tolerance cannot be obtained for both frequencies, measure R77 and replace it with a lower value resistor selected from table 7-5 below. Repeat *m* and *n* above. If the proper tolerance still cannot be obtained, replace R77 with a higher value resistor than the original one and repeat *m* and *n* above until the proper tolerances are obtained.

Table 7-5. Values of Resistors

| Resistor | Values used in individual sets (K) |
|----------|------------------------------------|
| R77 | 82 |
| | 91 |
| | 100 |
| | 110 |
| | 120 |
| R78 | 10 |
| | 11 |
| | 12 |
| R90 | 82 |
| | 100 |
| | 120 |
| | 150 |
| | 180 |
| | 220 |

NOTE

An alternate procedure for finding the value of R77 when the decade resistor box is available is to disconnect and measure R77, set the decade resistor box for this value, and substitute it in place of R77; then follow the procedure given here.

p. Set the meter range switch to 300 R.M.S. VOLTS.

q. Adjust the signal generator for 1,000 Hz. Adjust the voltage output of the signal generator to produce a reading of 250 R.M.S. VOLTS on the spectrum analyzer meter. Record the reading on the vtvm.

r. Adjust the signal generator for 10,000 Hz at the same voltage output recorded in *g* above. The spectrum analyzer meter should indicate 250 ±3 percent R.M.S. VOLTS. If this reading is not obtained, adjust trimmer C23 until the meter indicates 250 ±3 percent R.M.S. VOLTS.

s. Adjust the signal generator for 100,000 Hz at the same voltage output recorded in *g* above. The spectrum analyzer meter should indicate 250 ±3 percent R.M.S. VOLTS. If this reading is not obtained, adjust C23 until the meter indicates 250

±3 percent R.M.S. VOLTS.

t. Repeat the readjustments described in *r* and *s* above until the reading of 250±3 percent R.M.S. VOLTS is obtained for both 10,000 and 100,000 Hz without further readjustment. If the proper tolerance cannot be obtained for both frequencies, follow the procedure given in *o* above to find the proper value for R78, but refer to *r* and *s* above in place of *m* and *n* above.

7-17. Adjustment of Preamplifier-Bridge Amplifier Gain

Adjust the amplifier gain as follows:

a. Adjust the signal generator for 1,000 Hz and connect it to the AF INPUT terminal. Connect a vtvm across the AF INPUT terminal and adjust the signal generator output for a 0-dB indication on the vtvm.

b. Set the function switch to SET LEVEL.

c. Remove V6 from its socket.

d. Set the signal INPUT control to MAX.

e. Remove the vtvm from the AF INPUT binding posts without disturbing the signal generator connections. Connect the vtvm to pin 8 of V4. The vtvm should indicate between -2 and -1 dB. This indicates a total gain of 18 to 19 dB for the amplifier. If the proper reading is not obtained, replace R90 to compensate for the error. The selective values of R90 are listed in paragraph 7-16o. Follow the procedure given in paragraph 7-16o for replacing R90 with resistors of different value until the proper vtvm reading is obtained. If the proper reading cannot be obtained, replace tubes V2, V3, and V4 and repeat the selective procedure for R90.

f. Set the function switch to METER.

g. Set the meter range switch to -20 DB.

h. Connect the signal generator to the METER binding posts and adjust the signal generator for 100 Hz. Adjust the signal generator output so that a reading of exactly -20 dB is obtained on the spectrum analyzer meter. *For the following tests, do not disturb the level of the 100-HZ signal.*

i. Set the function switch to SET LEVEL.

j. Set the meter range switch to 0 DB.

k. Set the AF-RF selector switch to AF (TS-723A/U).

l. Set the signal INPUT control to MAX.

m. Move the signal generator input from the METER binding posts to the AF INPUT binding posts.

n. Adjust SET LEVEL GAIN control R38, on top of the chassis, to produce a meter reading of exactly 0 dB.

o. Set the function switch to NOISE.

p. Set the meter range switch to +20 DB.

q. Adjust NOISE GAIN control R5 to produce a meter reading of exactly +20 dB.

7-18. Calibrating Wien Bridge Circuit

Adjust the bridge circuit as follows:

a. Set BALANCE control R23 to its midrange position.

b. Set the frequency RANGE switch to X10.

c. Set the AF-RF selector switch to AF (TS-723A/U).

d. Set the signal INPUT control to MAX.

e. Set the meter range switch to +20 DB.

f. Set the function switch to DISTORTION. Check to see that the FREQUENCY tuning dial is not set near 100.

g. Connect the signal generator to the AF INPUT binding posts. Adjust the signal generator for 1,000 Hz and increase its amplitude until the spectrum analyzer meter indicates exactly +20 dB.

h. Turn the FREQUENCY tuning dial at exactly 100; this is equivalent to 1,000 Hz.

i. The meter pointer should deflect to zero on the top scale. Decrease the setting of the meter range switch one step at a time. The meter should return to zero on the top scale with each setting of the switch. In the -30 DB position of the switch, the meter pointer should be to the left of -10 DECIBELS (equivalent to 60 dB down from the original reference setting of +20 DB). *If the proper meter indications are observed, do not make any adjustments to the bridge circuit.* If the proper meter indications are not observed, proceed to j below,

j. Set the meter range switch to the position where the best null indication was obtained (i above). Minutely adjust trimmer C12 and balance setting control R89 until the proper meter deflection is obtained. Work back and forth between those two controls as required. Do not change the setting of the FREQUENCY tuning dial.

k. If the proper meter deflection cannot be obtained (j above), replace switch assembly S3 and repeat j above.

NOTE

The 12 resistors attached to switch assembly S3 are factory-selected and cannot be replaced individually.

7-19. Adjustment of FREQUENCY Tuning Dial

When the capacitor drive assembly has been disassembled, or if the screws that retain the dial shaft have become loosened through vibration, the FREQUENCY tuning dial may shift out of position. Return the dial to its proper position as

follows:

a. Set the BALANCE control to its midrange position.

b. Set the frequency RANGE switch to X10.

c. Set the AF-RF selector switch to AF (TS-723A/U).

d. Set the meter range switch to +20 DB.

e. Set the function switch to DISTORTION.

f. Adjust the signal generator to 1,000 Hz. Check the signal generator output with the frequency counter.

g. Adjust the FREQUENCY tuning control knobs to obtain a meter indication of zero on the top meter scale. Decrease the meter range switch setting to -30 DB. Adjust the FREQUENCY tuning control knobs to obtain the maximum left-hand meter deflection of the meter pointer. The meter pointer must deflect to the left of -10 DECIBELS (equivalent to 60 dB down from the original +20 DB reference setting),

h. Securely hold the capacitor drive shaft in this position with a pair of pliers, gripping the drive shaft collar on the inside end of the shaft. Remove the upper FREQUENCY tuning control knobs by loosening the two setscrews. Slip the FREQUENCY tuning dial around its hub until the 100 mark lines up exactly with the line down the center of the FREQUENCY tuning dial window. Tighten the four Allen-head screws in the collar of the frequency dial shaft by inserting an Allen-head wrench through the shaft hole in the front of the front panel. Replace the upper FREQUENCY tuning control knob.

7-20. Recalibrating FREQUENCY Tuning Dial

When variable capacitor C13 is replaced, it may be necessary to recalibrate the FREQUENCY tuning dial. The old FREQUENCY tuning dial may be reused by turning it over, or a new blank dial may be requisitioned. Recalibrate the FREQUENCY tuning dial as follows:

a. Replace the old FREQUENCY tuning dial with a new blank dial or turn the old dial over. Remove the FREQUENCY tuning dial window. Using the FREQUENCY tuning dial window as a template, cut a piece of thin metal identical with that of the FREQUENCY tuning dial window. Scribe the metal with a centerline on the FREQUENCY tuning dial window. Measure three-eighths of an inch from the edge of the plate where the mounting holes are located and scribe a line at right angles to the centerline. Cut along this line to the centerline. Cut down the centerline to the right-angle line and remove the rectangular piece of metal. Attach the notched metal plate to the face of the mounting chassis in place of the FRE-

QUENCY tuning dial window. Attach the capacitor drive assembly to the front panel (para 7-12 *b*). Replace the two FREQUENCY tuning control knobs.

b. Set the BALANCE control to its midrange position.

c. Set the frequency RANGE switch to X10.

d. Set the AF-RF selector switch to AF (TS-723A/U).

e. Set the meter range switch to +20 DB.

f. Set the function switch to DISTORTION.

g. Adjust the signal generator at 1,000 Hz.

Check the signal generator output with the frequency counter. Connect the signal generator to the AF INPUT binding posts. Adjust the signal generator output for a reading of exactly +20 dB on spectrum analyzer meter.

h. Adjust the FREQUENCY tuning control knobs to obtain a meter indication of zero on the top meter scale. Decrease the meter range switch setting to -30 DB. Adjust the FREQUENCY tuning and the BALANCE control knobs to obtain the maximum left-hand meter deflection of the meter pointer. The meter pointer must deflect left of -10 DECIBELS (equivalent to 60 dB down from the original +20 DB reference setting).

i. When the best possible meter null indication has been obtained, scribe a mark on the face of the FREQUENCY tuning dial along the edge of the notched metal plate. Write 100 above this scribed line.

j. Adjust the signal generator for each of the following frequencies, each time adjusting for a meter null indication as described in *h* above and scribing the dial as described in *i* above:

190, 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275, 280, 285, 290, 295, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 520, 540, 560, 580, 600, 620, 640, 660, 680, 700, 720, 740, 760, 800, 820, 840, 860, 880, 900, 920, 940, 960, 980, 1000, 1050, 1100, 1150, 1200, 1250, 1300, 1350, 1400, 1450, 1500, 1550, 1600, 1650, 1700, 1750, 1800, 1850,

1900, 1950, 2000, 2050, and 2100.

k. Set the frequency RANGE switch to X1.

l. Repeat the procedure given in *h*, *i*, and *j* above starting with the signal generator set to 20 Hz. The mark on the dial made for 200 Hz should be in line with the edge of the notched metal plate. Set the signal generator to 100 Hz and check to see that the scribed line made at 1,000 Hz lines up with the notched metal plate. Set the signal generator for 200 Hz and see that the scribed line made at 2,000 Hz lines up with the notched metal plate.

m. Set the frequency RANGE switch to X100.

n. Repeat *j* above with the signal generator set at 2,000, 10,000, and 20,000 Hz, in turn.

NOTE

If there is more than 1/64-inch difference in the position of the scribe lines for the three settings of the frequency RANGE switch, calibrate the bridge circuit as described in paragraph 7-18 and repeat *b* through *n* above.

o. Remove the FREQUENCY tuning dial and notched metal plate from the capacitor drive mechanism and engrave the markings; use the old dial as a pattern. Engrave numbers as follows:

20 for 20,000 Hz; or 2,000 Hz; 22 for 22,220, or 2,200 Hz; 25 for 25,250, or 2,500 Hz; 30 for 30,300, or 3,000 Hz; 35 for 35,500, or 3,500 Hz; 40 for 40,400, or 4,000 Hz; 50 for 50,500 or 5,000 Hz; 60 for 60,600 or 6,000 Hz; 70 for 70,700, or 7,000 Hz; 80 for 80,800, or 8,000 Hz; 100 for 100, 1,000, or 10,000 Hz; 130 for 130, 1,300, or 13,000 Hz; 160 for 160, 1,600, or 16,000 Hz; and 200 for 200, 2,000, or 20,000 Hz.

p. After engraving, black-anodize or paint the dial with black enamel and fill the letters with white lead.

q. Reinstall the completed FREQUENCY tuning dial and adjust as described in paragraph 7-19.

Section IV. GENERAL SUPPORT TESTING PROCEDURES

7-21. General

a. These testing procedures have been prepared for use by electronics field maintenance shops and electronic service organizations, 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 organization.

b. Follow the instructions given before each

table, before preceding to the tabular procedures. Perform each step in sequence. For each step, perform all actions required in the Control settings columns; then perform each specific procedure, and verify it against its performance standard.

c. Tools and test equipment required for maintenance at the general support level are found in appendix C of this manual.

7-22. Modification Work Orders

If a modification is performed on this equipment, after modification, the spectrum analyzer must be calibrated.

7-23. Physical Tests and Inspections

a. Test Equipment and Materials. Electronic

Light Assembly MX-1292/PAQ.

b. Test Connections and Conditions.

(1) No connections necessary.

(2) Remove the top and bottom dust covers.

c. Procedure. Follow the procedures outlined in table 7-6.

Table 7-6. Physical Tests and Inspections

| Step No. | Control settings Test Equipment | Equipment under test | Test procedure | Performance Standard |
|----------|------------------------------------|----------------------------------|--|---|
| 1 | None. | Controls may be in any position. | a. Inspect case and chassis for damage, missing parts, and condition of paint. | a. No damage evident or parts missing. Painted surfaces will not show bare metal. Screw-heads, binding posts, receptacles, and other plated parts will not be painted or polished with abrasives. |
| | | | 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, fuseholders, 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 through-out 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. |
| | | | c. Operate all switches. | c. Switches will operate properly. |

7-24. 225-Volt Supply Regulation

a. Test Equipment and Materials.

(1) Power Transformer, Variable CN-16A/

U.

(2) Multimeter TS-352B/U.

(3) Multimeter ME-26(*)/U.

b. Test Connections and Conditions. Connect the equipment as shown in figure 7-11. Remove the top and bottom covers of the TS-723(*)/U.

c. Procedure. Follow the procedures outlined in table 7-7.

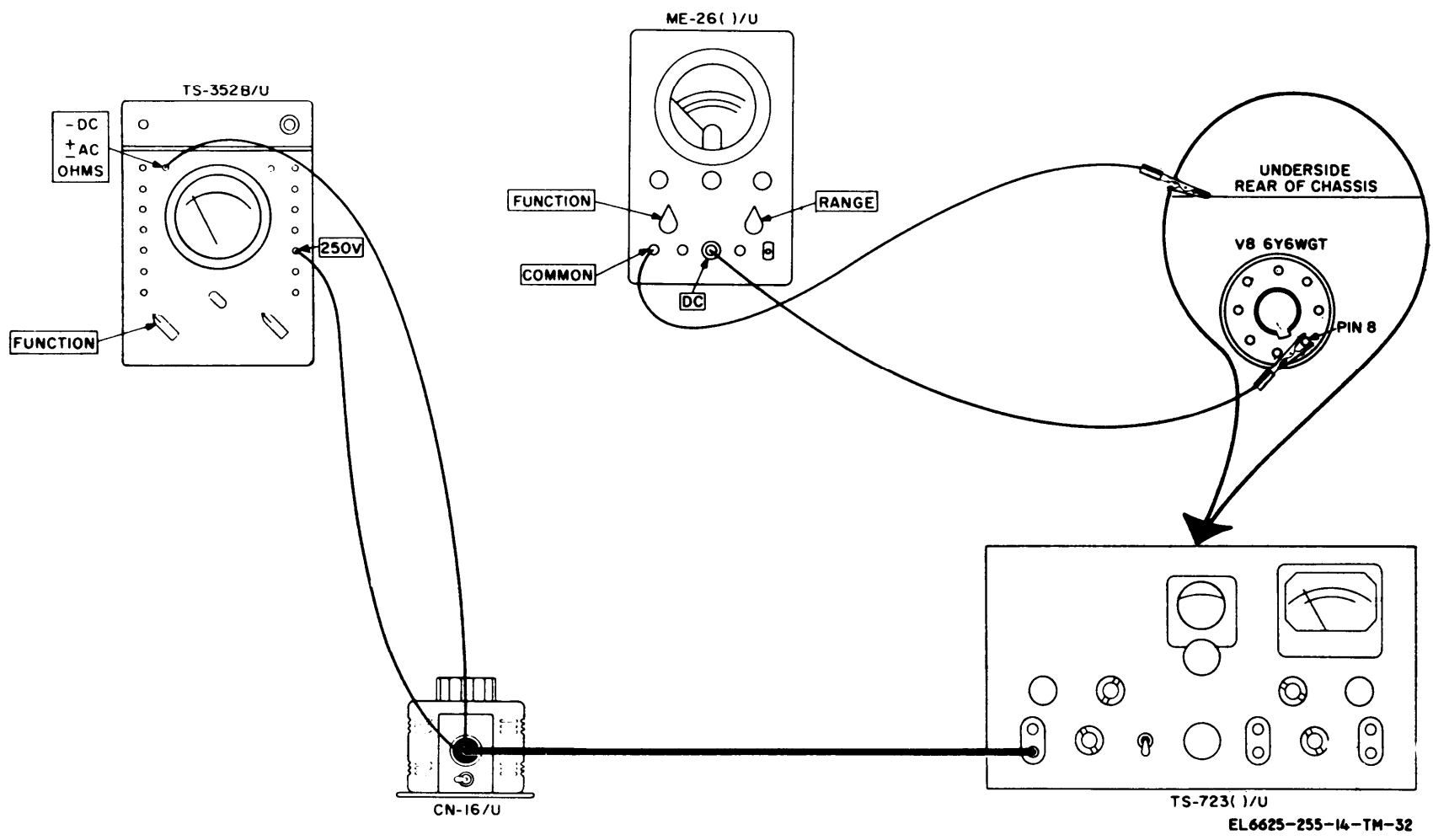


Figure 7-11. 225V supply regulation test setup.

Table 7-7. 225- Volt Supply Regulation Test

| | <i>Test Equipment</i> | <i>Control settings</i> | <i>Equipment under test</i> | <i>Test procedure</i> | <i>Performance standard</i> |
|---|---|-------------------------|-----------------------------|--|--|
| 1 | TS-352B/U: FUNCTION switch: AC VOLTS ME-26(*)/U: FUNCTION SELECTOR switch: + RANGE switch: 300V. | | ON-OFF power switch: ON. | a. Adjust CN-16A/U for reading of 115 volts on TS-352B/U. b. Observe indication on ME-26(*)/U. | a. None. b. Meter reads between 220 and 230 volts . |
| 2 | Same as step 1. | | Same as step 1. | a. Adjust CN-16A/U for indication of 105 volts on TS-352B/U. b. Observe indication on ME-26(*)/U. | a. None. b. Same as step 1 b. |
| 3 | Same as step 1. | | Same as step 1. | a. Adjust CN-16A/U for indication of 125 volts on TS-352B/U. b. Observe indication on ME-26(*)/U. | a. None. b. Same as step 1 b. |

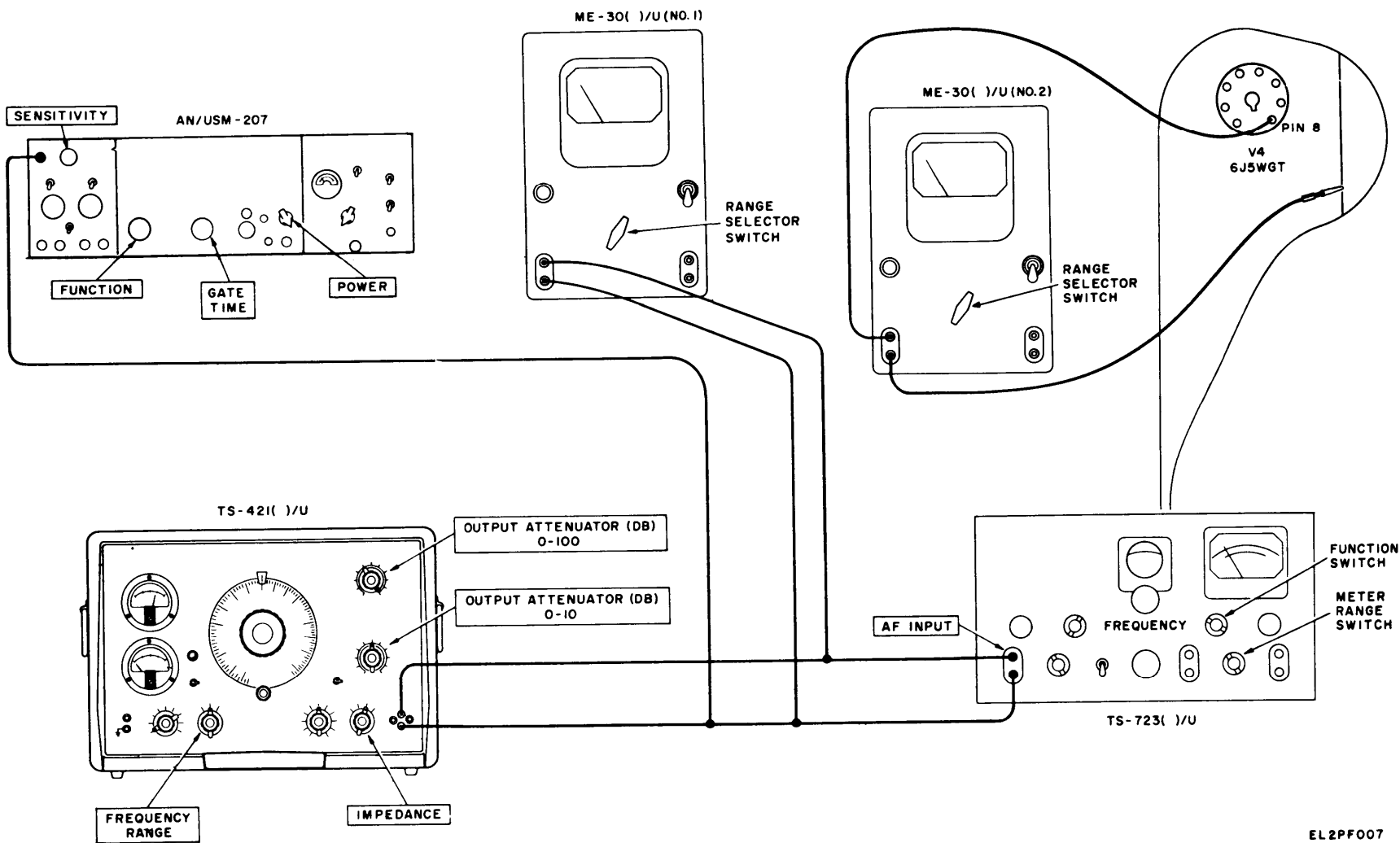


Figure 7-12. Internal amplifier gain test setup.

7-25. Internal Amplifier Gain Test

a. Test Equipment and Materials.

- (1) Audio Oscillator TS-421(*)/U.
- (2) Voltmeter, Meter ME-30/U (two re-
quired).
- (3) Digital Readout, Electronic Counter

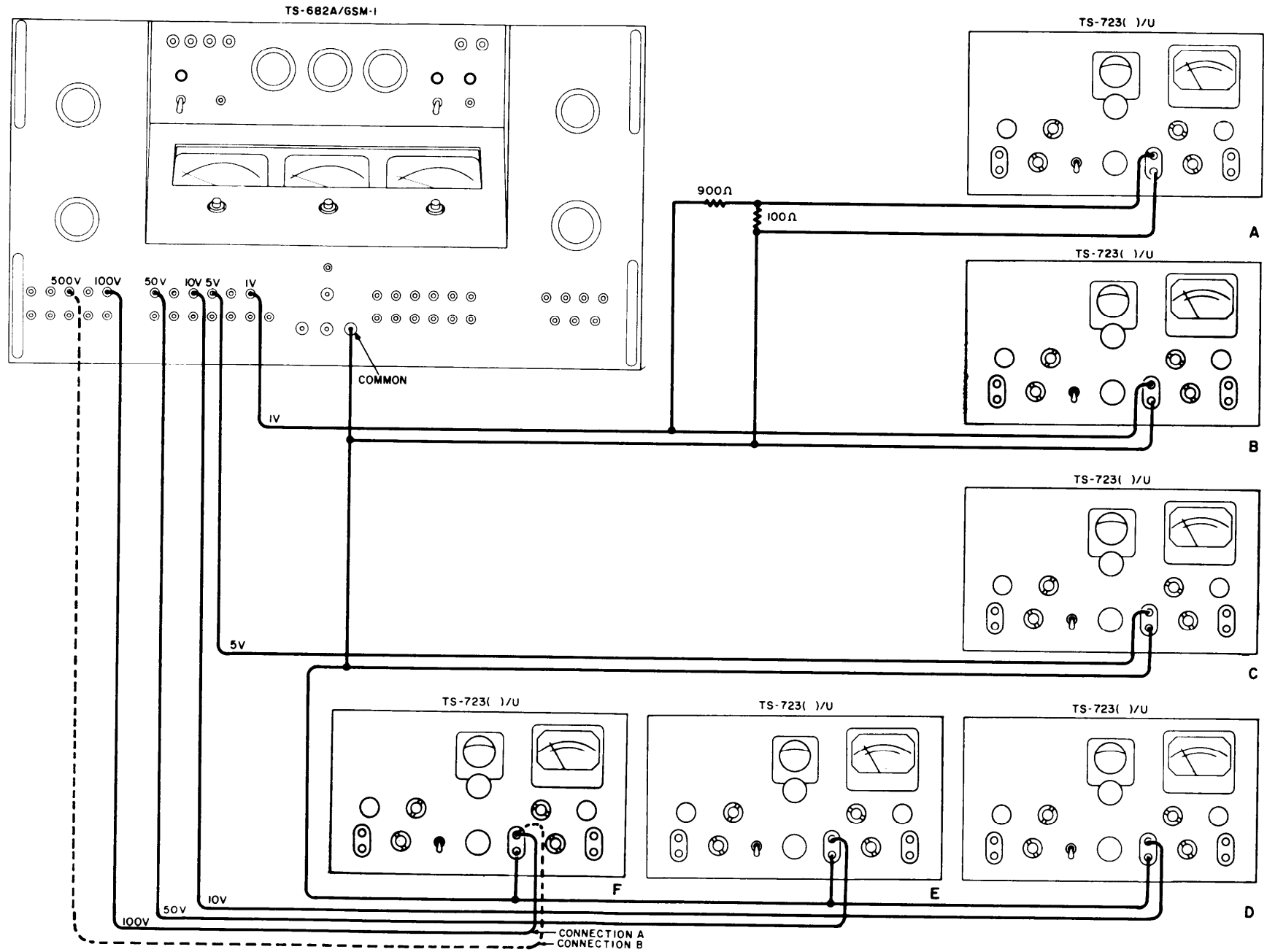
AN/USM-207.

b. Test Connections and Conditions. Connect the equipment as shown in figure 7-12 and remove tube V6 (6AC7).

c. Procedure. Follow the procedures outlined in table 7-8.

Table 7-8. Internal Amplifier Gain Test

| Test equipment | Control settings | Equipment under test | Test procedure | Performance standard |
|---|------------------|--|--|--|
| TS-421(*)/U: FREQUENCY RANGE switch: X10 IMPEDANCE switch: 600 OUTPUT ATTENUATOR (DB) (0-100): 100. OUTPUT ATTENUATOR (DB) (0-100): 10 AN/USM-207: SENSITIVITY: .1V FUNCTION: FREQ GATETIME: 1 POWER: TRACK ME-30. U, No. 1: Range selector switch: 1 ME-30/U, No. 2: Range selector switch: 10 | | Function switch: SET LEVEL. AF INPUT: MAX Meter range switch: 10 | Adjust TS-421(*)/U FREQUENCY dial for reading of 100. Adjust OUTPUT ATTENUATOR switches for reading of 0 dBm on ME-30./U No. 1. Adjust fine tuning knob on TS-421 (*)/U for reading of 1,000 Hz on AN/USM-207. Check to see that ME-30/U No. 1, is still reading 0 dBm. Observe reading on ME-30/U, No. 2. | ME-30/U No. 2, should read between 18 and 19 dB. |



EL2PF008

Figure 7-13. Voltmeter calibration test setup.

7-26. Voltmeter Calibration Test

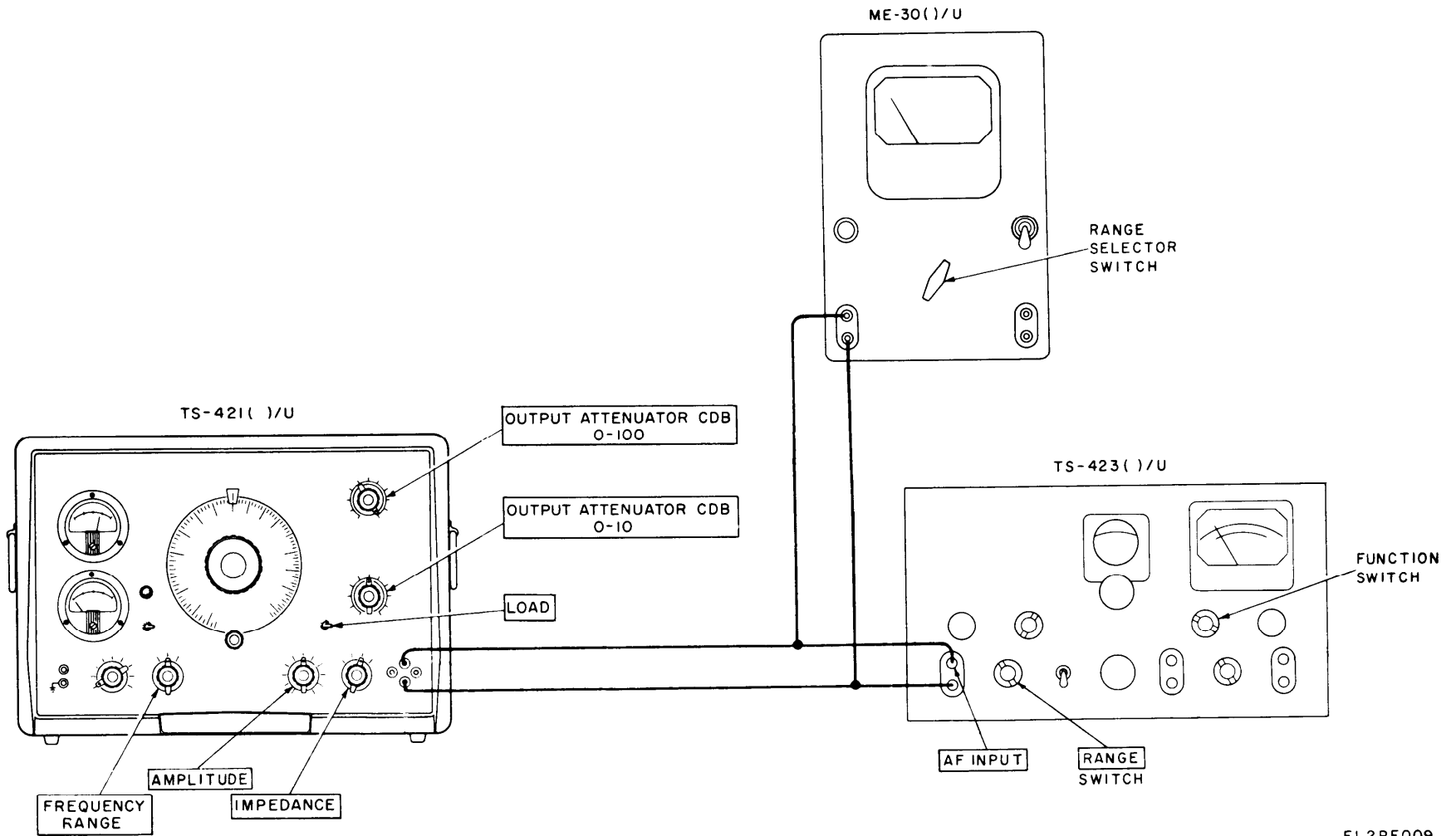
a. Test Equipment and Materials.

- (1) Meter Test Set TS-682A/GSM-1.
- (2) 900-ohm resistor.
- (3) 100-ohm resistor.

b. Test Connections and Conditions. Connect the equipment as shown in figure 7-13.

c. Procedure. Follow the procedures outlined in table 7-9.

| Step No. | Test equipment | Control settings | Test procedure | Performance standard |
|----------|--|--|--|---|
| 1 | TS-682A/GSM-1; AC LINE switch: ON. Output controls: Extreme counter-clockwise position. Right-hand selector switch: AC and DC VOLTS. Center selector switch: AC VOLTS. Left-hand selector switch: ALL OTHER AC AND DC SCALES. | Function switch: METER. Meter range switch: .03 R.M.S. VOLTS. | Connect equipment as shown in A, figure 7-13. Adjust voltage output controls on TS-682A/GSM-1 so that the meter on the TS-723(*) /U indicates 0.029 volt exactly. | Indication on TS-682A/GSM-1 meter is between 0.28 and 0.30 volt ac. |
| 2 | Same as step 1. | Same as step 1 except: Meter range switch: .10. | Adjust voltage output controls on TS-682A/GSM-1 so that meter on TS-723(*) /U indicates exactly 0.097 volt. | Indication on TS-682A/GSM-1 meter is between 0.94 and 1.00 volt ac. |
| 3 | Same as step 1. | Same as step 1 except: Meter range switch: .30. | Connect equipment as shown in B, figure 7-13. Adjust voltage output controls so that meter on TS-723(*)/U indicates exactly 0.29 volt. | Indication on TS-682A/GSM-1 meter is between 0.28 and 0.30 volt ac. |
| 4 | Same as step 1. | Same as step 1 except: Meter range switch: 1.0. | Adjust voltage output controls so that meter on TS-723(*)/U indicates exactly 0.97 volt. | Indication on TS-682A/GSM-1 meter is between 0.94 and 1.00 volt ac. |
| 5 | Same as step 1. | Same as step 1 except: Meter range switch: 3.0. | Connect equipment as shown in C, figure 7-13. Adjust voltage output controls so that meter on TS-723(*)/U indicates exactly 2.90 volts. | Indication on TS-682A/GSM-1 meter is between 2.8 and 3.0 volts ac. |
| 6 | Same as step 1. | Same as step 1 except: Meter range switch: 10. | Connect equipment as shown in D, figure 7-13. Adjust voltage output controls of TS-682A/GSM-1 so that meter on TS-723(*)/U indicates exactly 9.70 volts. | Indication on TS-682A/GSM-1 meter is between 9.4 and 10 volts. |
| 7 | Same as step 1. | Same as step 1 except: Meter range switch: 30. | Connect equipment as shown in E, figure 7-13. Adjust voltage output controls of TS-682A/GSM-1 so that meter on TS-723(1) /U indicates exactly 29 volts. | Indication on TS-682A/GSM-1 meter is between 28 and 30 volts. |
| 8 | Same as step 1. | Same as step 1 except: Meter range switch: 100. | <p>CAUTION</p> <p>Turn off all power to TS-682A/GSM-1 in steps 8 and 9. DANGEROUS VOLTAGE IS PRESENT AT OUTPUT TERMINALS.</p> <p>Connect equipment as shown in F, figure 7-13. Adjust voltage output controls of TS-682A/GSM-1 so that meter on TS-723(*)/U indicates exactly 97 volts.</p> | Indication on TS-682A/GSM-1 meter is between 94 and 100 Volts. |



EL2PF009

Figure 7-14. Noise, set level, and frequency response test setup.

**7-27. Noise, Set Level, and Frequency
Response Test**

a. *Test Equipment and Materials.*

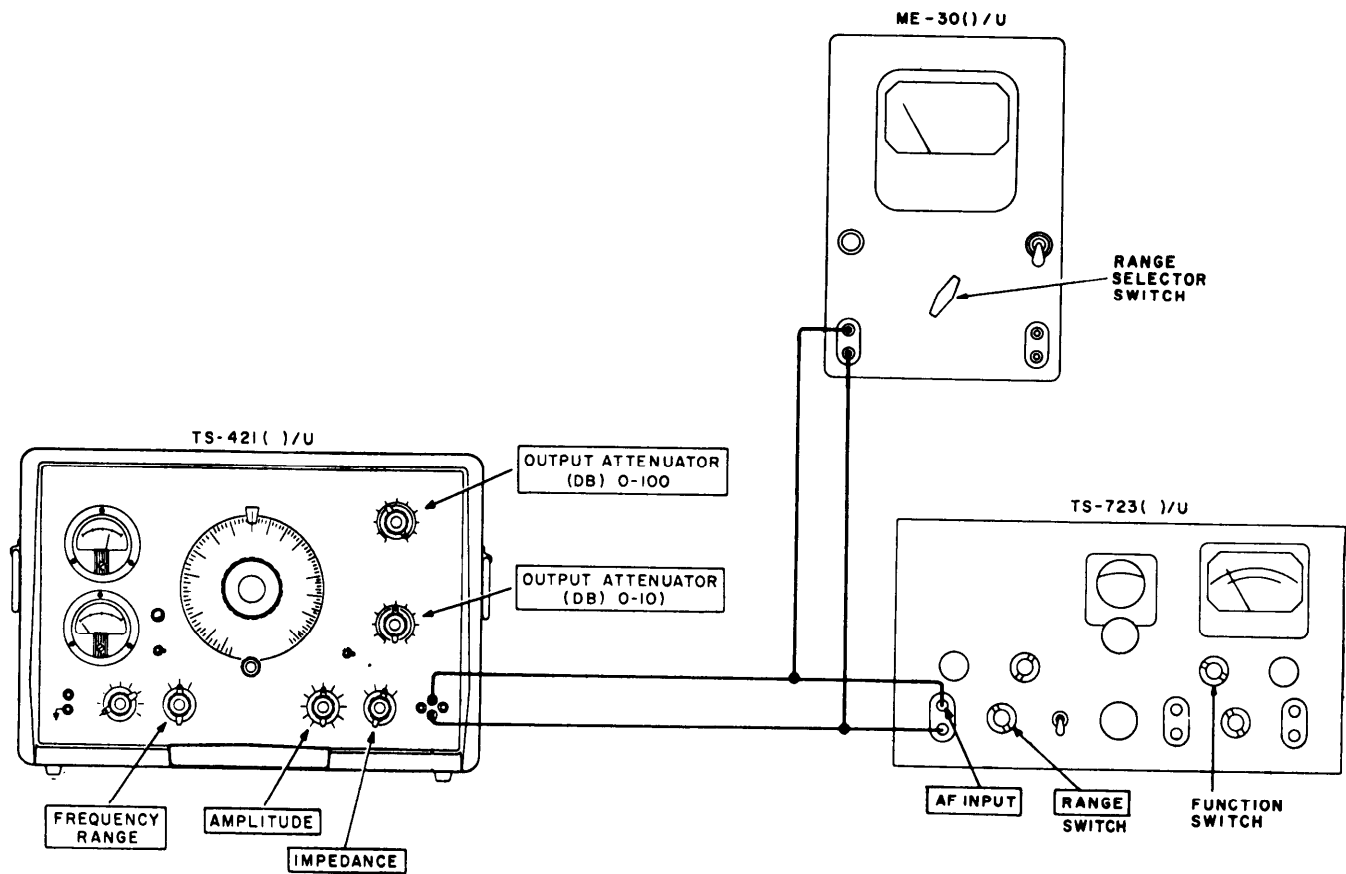
- (1) Audio Oscillator TS-421(*)/U.
- (2) Voltmeter, Meter ME-30(*)/U.

b. *Test Connections and Conditions.* Connect the equipment as shown in figure 7-14.

c. *Procedure.* Follow the operations outlined in table 7-10.

Table 7-10. Noise, Set Level, and Frequency Response Test

| Step No. | Test Equipment | Equipment under test | Test Procedure | Performance standard |
|----------|---|--|--|--|
| 1 | TS421(*)/U: FREQUENCY RANGE switch: X10. OUTPUT ATTENUATOR (DB) (0-100): 100. OUTPUT ATTENUATOR (DB) (0-10): 10. LOAD: OFF. IMPEDANCE switch: 600. ME-30(*)/U: | Function switch: NOISE. Signal input control: extreme clock-wise position. Meter range switch to +20 DB. | Adjust FREQUENCY tuning dial for frequency of 1,000 Hz. Adjust OUTPUT ATTENUATORS and AMPLITUDE controls for reading of -20 dBm on ME-30(*)/U. | TS-723(*)/U meter should indicate exactly +20 dB. |
| 2 | Range selector switch: -20 DB. Same as step 1 except: TS-421(*)/U: FREQUENCY RANGE switch: x1. | Same as step 1. | Same as step 1 except: adjust FREQUENCY tuning dial for frequency of 20 Hz. | TS-723(*)/U meter should indicate between 19 and 21 dBm. |
| 3 | Same as step 1, except: TS-421(*)/U: FREQUENCY RANGE switch: 200. | Same as step 1. | Same as step 1, except adjust FREQUENCY tuning dial for frequency of 20,000 Hz. | Same as step 2. |
| 4 | Same as step 1. | FUNCTION switch: SET LEVEL. METER range switch: 0 dB. | Same as step 1. | TS-723(*)/U meter should indicate exactly 0 dBm. |
| 5 | Same as step 1. | Same as step 4. | Vary frequency of TS-421(*)/U between 20 and 20,000 Hz while maintaining output level at -20 dBm as indicated on ME-30(*)/U. | TS-723(*)/U meter should indicate between -1 and +1 dBm. |



EL2PF010

Figure 7-15. Dial calibration test setup.

7-28. Dial Calibration Test

a. Test Equipment and Materials.

- (1) Audio Oscillator TS-421(*)/U.
- (2) Digital Readout, Electronic Counter AN/USM-207.

b. Test Connections and Conditions. Connect the equipment as shown in figure 7-15.

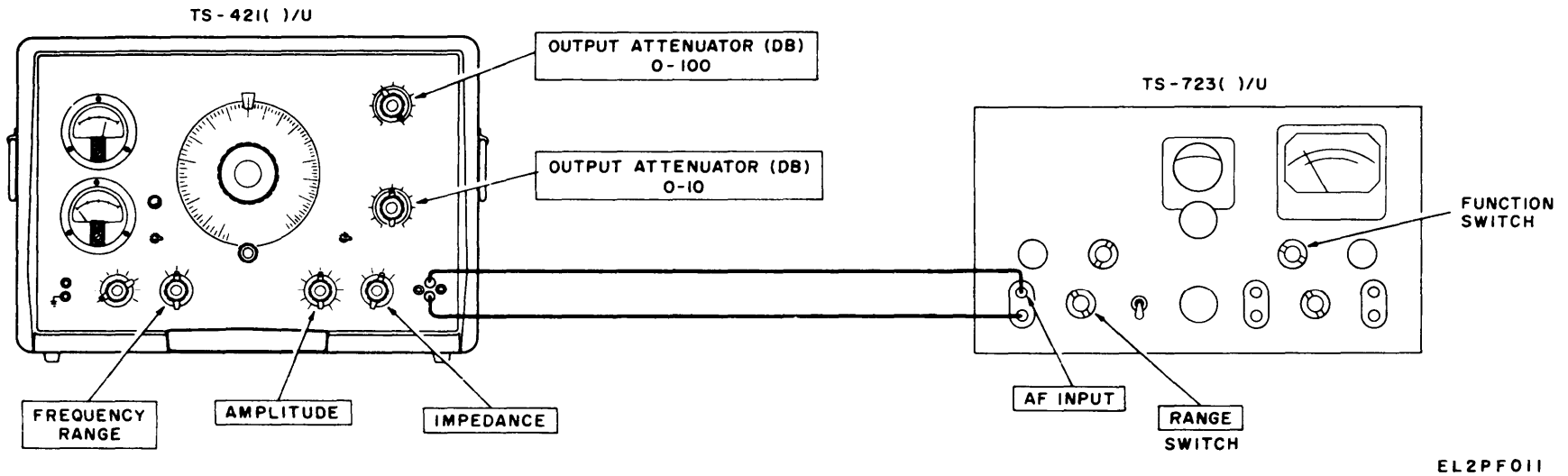
c. Procedure. Follow the procedures outlined in table 7-11.

Table 7-11. Dial Calibration Test

| Step No | Test equipment | Control settings | Equipment under test | Test procedure | Performance standard |
|---------|---|------------------|---|--|--|
| 1 | AN/USM-207 SENSITIVITY: 10V. POWER: TRACK DISPLAY: MIDRANGE. Time base switch: 1. FUNCTION: FREQ. TS-421(*)/U: FREQUENCY RANGE switch: XI. OUTPUT ATTENUATOR (DB) (o-100): 100. ATTENUATOR (DB) (010): 10. IMPEDANCE switch: 600. | | Function switch: SET LEVEL. Signal INPUT control: Maximum clockwise. Meter range switch: 10. Frequency RANGE switch: XI. | a. Adjust OUTPUT ATTENUATORS of TS-421(*)/U until a reading of 7.75 volts is obtained on TS-723(*)/U meter. Adjust FREQUENCY control of TS-421(*)/U until AN/USM-207 indicates exactly 20Hz. b. Turn function switch of TS-723(*)/U to DISTORTION, and adjust its tuning and BALANCE controls to minimum indication on meter. | a. None. b. FREQUENCY tuning dial indicates between 19.6-20.4 Hz |
| 2 | Same as step 1. | | Same as step 1. | a. Set function switch to SET LEVEL. Tune TS-421(*)/U for output of 50 Hz., as indicated on AN/USM-207. TS-723(*)/U meter should indicate 7.75 volts. If it does not, adjust TS-723(*)/U AMPLITUDE control until it does. b. Set function switch to DISTORTION. Adjust TS-723(*)/U FREQUENCY and BALANCE controls to minimum indication on meter. | a. None. b. Frequency tuning dial indicatea between 49 and 51 Hz. |
| 3 | Same as step 1. | | Same as step 1. | a. Set the function switch to SET LEVEL. Tune TS-421(*)/U for output of 100 Hz as indicated on AN/USM-207. TS-723(*)/U meter should indicate 7.75 volts. If it does not, adjust AMPLITUDE control of the TS-421(*)/U until it does. b. Set function switch to DISTORTION. Adjust TS-723(*)/U FREQUENCY tuning and BALANCE controls to minimum indications on meter. | a. None. b. Frequency tuning dial indicates between 98 and 102 Hz. |
| 4 | Same as step 1. | | Same as step 1. | a. Set function switch to SET LEVEL. Tune TS-421(*)/U for output of 200 Hz, as indicated on AN/USM-207. TS-723(*)/U meter should indicate 7.75 volts. If it does not adjust TS-723(*)/U AMPLITUDE control until it does. b. Set function switch to DISTORTION. Adjust TS-723(*)/U FREQUENCY and BALANCE controls | a. None. b. Frequency tuning dial indicates between 196 and 204 Hz. |

Table 7-11. Dial Calibration Test - Continued

| Step No. | Test equipment | Control settings | Equipment under test | Test procedure | Procedure standard |
|----------|--|---|----------------------|--|--------------------|
| 5 | Same as step 1 except TS-421(*)/U: FREQUENCY RANGE switch: X10. | Same as step 1 except: Frequency Range switch: X10. | Frequency | <p><i>t</i>o minimum indication on meter.</p> <p>a. Set function switch to SET LEVEL. a. None. Tune TS-421(*)/U for output of 1,000 Hz as indicated on AN/USM-207. TS-723(*)/U meter should indicate 7.75 volts. If it does not, adjust AMPLITUDE control of TS-421(*)/U until it does.</p> <p>b. Set function switch at DISTOR- b. The FREQUENCY tuning dial TION. Adjust TS-723(*)/U FRE- indicates between 980 and 1,020 QUENCY tuning and BALANCE Hz. controls to minimum indication on meter.</p> | |
| 6 | Same as step 1 except: TS-421(*)/U: FREQUENCY RANGE switch: X100. | Same as step 1 except: Frequency range switch: X100. | Frequency | <p>a. Set function switch to SET LEVEL. a. None. Tune TS-421(*)/U for output of 20,000 Hz as indicated on AN/USM-207. TS-723(*)/U meter should indicate 7.75 volts. If it does not, adjust TS-421(*)/U AMPLITUDE control until it does.</p> <p>b. Set function switch to DISTOR- b. FREQUENCY tuning dial indicates TION. Adjust TS-723(*)/U FRE- between 19,600 and 20,400 Hz. QUENCY and BALANCE con- trols to minimum indication on meter.</p> | |



EL2PF011

Figure 7-16. Second harmonic attenuation test setup.

7-29. Second Harmonic Attenuation Test

a. *Test Equipment and Materials.*

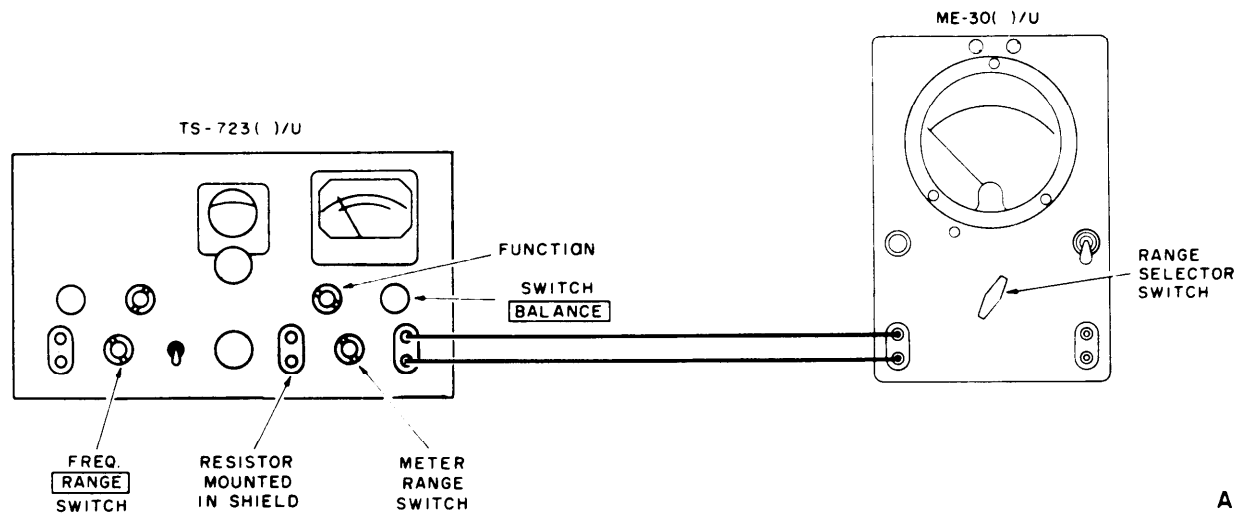
Audio Oscillator or TS-421(*)/U.

b. *Test Connections and Conditions.* Connect the equipment as shown in figure 7-16.

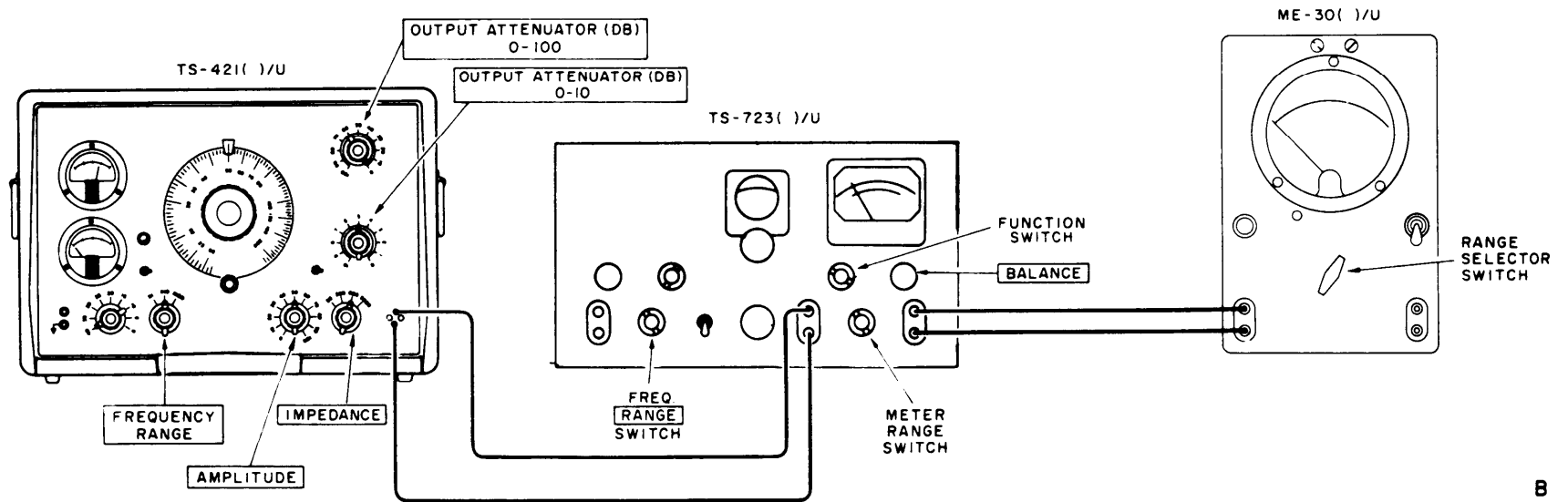
c. *Procedure.* Follow the procedures outlined in table 7-12.

Table 7-12. Second Harmonic Attenuation Test

| Step No. | Test Equipment | Control Settings | Equipment under test | Test procedure | Performance standard |
|----------|--|------------------|---|---|--|
| 1 | TS-421(*)/U: FREQUENCY RANGE switch: X10. OUTPUT ATTENUATOR (DB) (0-100): 100. OUTPUT ATTENUATOR (DB) (0-100): 10. IMPEDANCE switch: 800. | | Meter range switch: +20 dB. Function switch: SET LEVEL. Frequency RANGE switch: X1. AF INPUT switch: MAX | <p>a. Adjust TS-421(*)/U frequency to 200 Hz. Adjust OUTPUT ATTENUATOR and AMPLITUDE controls for indications of +20 dB on TS-723(*)/U meter. Adjust TS-723(*)/U for frequency of 100 Hz.</p> <p>b. Turn TS-723(*)/U function switch to DISTORTION, and observe meter indication.</p> | <p>a. None.</p> <p>b. TS-723(*)/U meter shall indicate +18.5 dB or more.</p> |
| 2 | Same as step 1 except: TS-421(*)/U: FREQUENCY RANGE switch: X100. | | Same as step 1 except: FREQUENCY RANGE switch: X10. | <p>a. Same as step 1 a except adjust TS-421(*)/U frequency to 3,000 Hz and TS-723(*)/U to 1,500 Hz.</p> <p>b. Same as step 1 b above.</p> | <p>a. None.</p> <p>b. TS-723(*)/U meter shall indicate +17 dB or more.</p> |



A



B

EL6625-255-14-TM-38

Figure 7-17. Oscilloscope output test setup.

7-30. Oscilloscope Output Test

a. Test Equipment and Materials.

- (1) Audio Oscillator TS-421(*)/U.
- (2) General Radio GR-274-OBJ shield, or equal.
- (3) 10-megohm, $\pm 5\%$, 1/4-watt resistor.

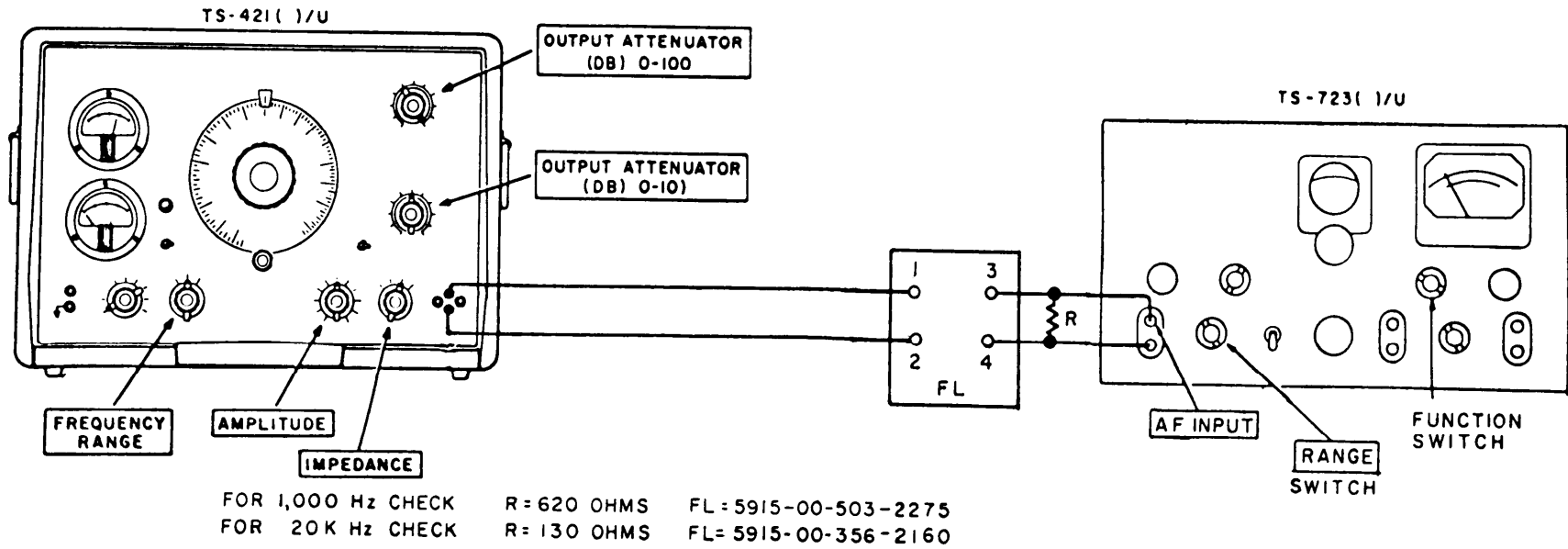
(4) Voltmeter, Meter ME-30(*)/U.

b. Test Connections and Conditions. Connect the equipment as shown in figure 7-17.

c. Procedure. Follow the procedures outlined in table 7-13.

Table 7-13. Oscilloscope Output Test

| Step No | Test equipment | Control Settings | Equipment under test | Test procedure | Performance standard |
|---------|--|------------------|--|---|---|
| 1 | ME-30(*)/U: Range selector switch: 1. | | Meter range switch: 1.0. Function switch: METER. | Connect equipment as shown in A, figure 7-17. Connect 10-megohm resistor across METER terminals. Resistor should be mounted inside shield. | ME-30(*)/U shall indicate less than 0.5 volt. |
| 2 | ME-30(*)/U: Range selector switch:30. TS-421(*)/U: FREQUENCY RANGE switch: X10. OUTPUT ATTENUATOR (DB) (0-100): 100. OUTPUT ATTENUATOR (DB) (010): 10. IMPEDANCE switch: 600. | | Same as step 1. | Connect equipment as shown in figure B, 7-17. Adjust TS-421(*)/U FREQUENCY control for output frequency of 1,000 Hz. Adjust attenuators (OUTPUT ATTENUATOR) (DB) for output of 1 volt as read on the TS-723(*)/U meter. After checking OSCILLOSCOPE output voltage on TS-723(*)/U, disconnect ME-30(*)/U, connect oscilloscope AN/USM-281(*)/U to OSCILLOSCOPE output terminals on TS-723(*)/U. | Output voltage should be 17.5 volts as read on ME-30(*)/U (TS-723D/U meter should indicate 3.5 volts). No appreciable distortion shall appear on oscilloscope screen. |



EL2PF012

Figure 7-18. Distortion test setup.

7-31. Distortion Test

a. Test Equipment and Materials.

- (1) Audio Oscillator TS-421(*)/U.
- (2) Bandpass filter (NSN 5915-00-356-2160).
- (3) Bandpass filter (NSN 5915-00-503-2275).
- (4) Resistor, fixed, 130 ohms $\pm 5\%$ 2W (FSN 5905-00-279-1965).

(5) Resistor, fixed, 620 ohms (NSN 5905-00-199-2470).

b. Test Connectums and Conditions. Connect the equipment as shown in figure 7- 18.

c. Procedure. Follow the procedures outlined in table 7-14.

Table 7-14 Distortion Test

| Step No. | Test equipment | Control Settings | Equipment under test | Test procedure | Performance standard |
|----------|--|------------------|--------------------------------------|---|--|
| 1 | TS-421(*)/U: Adjust controls to produce a 1,000-Hz signal. | | Set signal INPUT control to maximum. | Follow procedure for measuring distortion of an incoming signal (refer to paragraph 3-5). | TS-723(*)/U meter shall indicate -60 db. |
| 2 | TS-421(*)/U: Adjust controls to produce a 20,000-Hz signal. | | Same as step 1. | Same as step 1. | Same as step 1. |

APPENDIX A

REFERENCES

| | |
|--------------------|---|
| DA Pam 310-4 | Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders. |
| DA Pam 310-7 | U.S. Army Equipment Index of Modification Work Orders. |
| TM 11-5102 | Resistors, Decade ZM-16/U, ZM-16A/U, and ZM-16B/U. |
| TM 11-6625-255-20P | Organizational Maintenance Repair Parts and Special Tools Lists: Spectrum Analyzers TS-723/U, TS-723A/U, TS-723B/U, and TS-723C/U, FSN 6625-668-9418. |
| TM 11-6625-274-12 | Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U. |
| TM 11-6625-277-14 | Operator's, Organizational, Direct Support and General Support Maintenance Manual Meter Test Set TS-682/GSM-1 and TS-682A/GSM-1 (NSN 6625-00-669-0747). |
| TM 11-6625-316-12 | Operator and Organizational Maintenance Manual: Test Sets, Electron Tube TV-2/U, TV-2A/U, TV-2B/U, and TV-2C/U. |
| TM 11-6625-320-12 | Operator and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U, and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-30E/U. |
| TM 11-6625-355-12 | Operator's, Organizational Maintenance Manual: Audio Oscillators TS-421/U and TS-421A/U. |
| TM 11-6625-366-15 | Operator's, Organizational, DS, GS, and Depot Maintenance Manual: Multimeter TS-352B/U. |
| TM 11-6625-700-10 | Operator's Manual: Digital Readout, Electronic Counter AN/USM-207. |
| TM 11-6625-1703-15 | Operator, Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tool Lists: Oscilloscope AN/USM-281A. |
| TM 38-750 | The Army Maintenance Management System (TAMMS). |
| TM 740-90-1 | Administrative Storage of Equipment. |
| TM 750-244-2 | Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command). |

APPENDIX C

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations for the TS-723(*)/U. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and /or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel/lubricants/hydraulic fluids or compressed air supplies.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system.

j. Overhaul. That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

C-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate

"worktime" figures will be shown for each category. The number of man-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, sub-assembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

- C - Operator/crew
- O- Organizational
- F - Direct support
- H - General support
- D - Depot

e. *Column 5, Tools and Equipment*, Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

C-4. Tool and Test Equipment Requirements (Table 1)

a. *Tool or Test Equipment Reference Code*. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. *Maintenance Category*. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. *Nomenclature*. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. *National/NATO Stock Number*. This column lists the National/NATO stock number of the specific tool or test equipment.

e. *Tool Number*. This column lists the manufacturer's part number of the tool followed by the Federal supply code for manufacturers (5-digit) in parentheses.

SECTION II MAINTENANCE ALLOCATION CHART
 FOR
 SPECTRUM ANALYZER TS-723(*)/U

| (1) GROUP NUMBER | (2) COMPONENT/ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE CATEGORY | | | | | (5) TOOLS AND EQUIPMENT |
|------------------------|-------------------------------|--|-----------------------------|------------------------------|---|----------------------------------|---|---|
| | | | C | O | F | H | D | |
| 00 | SPECTRUM ANALYZER TS-723(*)/U | Inspect Test Test Service Service Replace Align Repair Rebuild | | 0.2 0.3 0.5 0.3 | | 1.0 0.5 1.0 0.8 | | 13 1-3,5-12 13 11 1,3,5,9,11 1 2-12 |

**TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
SPECTRUM ANALYZER TS-723(*)/U**

| TOOL OR TEST EQUIPMENT REF CODE | MAINTENANCE CATEGORY | NOMENCLATURE | NATIONAL/NATO STOCK NUMBER | TOOL NUMBER |
|---------------------------------------|-------------------------|---|-------------------------------|-------------|
| 1 | H | TEST SET , ELETRON TUBE TV-7D/U | 6625-00-820-0064 | |
| 2 | H,D | OSCILLOSCOPE AN/USM-281A | 6625-00-228-2201 | |
| 3 | H,D | AUDIO OSCILIATOR TS-421/U | 6625-00-669-0228 | |
| 4 | D | TEST SET , ELECTRON TUBE TV-2/U | 6625-00-669-0263 | |
| 5 | H,D | VOLTMETER , ELECTRONIC ME-30/U | 6625-00-643-1670 | |
| 6 | H,D | COUNTER , ELECTRONIC AN/USM-207 | 6625-00-911-6368 | |
| 7 | H,D | MULTIMETER TS-352B/U | 6625-00-553-0142 | |
| 8 | H,D | RESISTOR, DECADE ZM-16/U | 6625-00-669-0266 | |
| 9 | H,D | TRANSFORMER , VARIABLE POWER CN-16/U | 5950-00-235-2086 | |
| 10 | H,D | MULTIMETER ME-26/U | 6625-00-360-2493 | |
| 11 | H,D | TOOL KIT , ELECTRONIC EQUIPMENT TK-100/G | 5180-00-6435-0079 | |
| 12 | H,D | METER TEST SET TS-682/GSM-1 | 6625-00-669-0747 | |
| 13 | 0 | TOOLS AND TEST EQUIPMENT AVAILABLE TO THE ORGANIZATIONAL REPAIRMAN BECAUSE OF HIS ASSIGNED MISSION. | | |

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General, United States Army
Chief of Staff

Official:

PAUL T. SMITH
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The Adjutant General

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 USAERDAA (1)
 USAERDAW (1)
 MAAG (1)
 USARMIS (1)
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 7
 11-16
 11-95
 11-96
 11-97
 11-98
 11-117
 11-237
 11-500 (AA-AC)
 17
 17-51
 29-134
 29-136
 30-25
 33-500
 39-51

NG: State AG (3); Units- Same as Active Army except Allowance is (1cy) per unit
USAR: None

For explanation of abbreviation used, see AR 310-50

Published Under the Authority of the Secretary of the Air Force.

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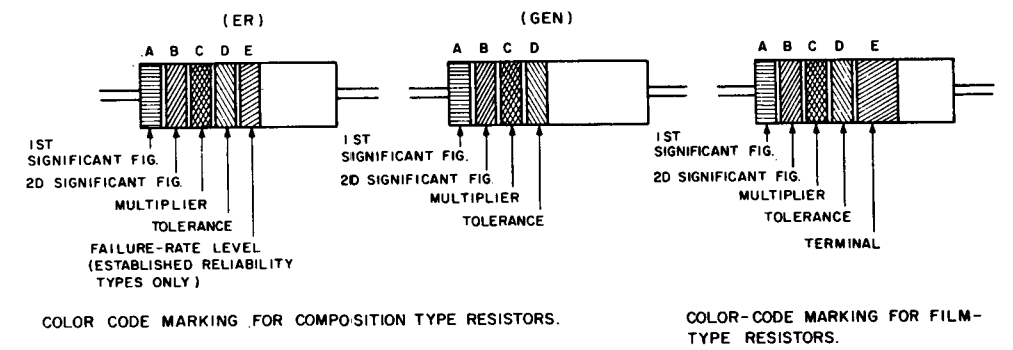
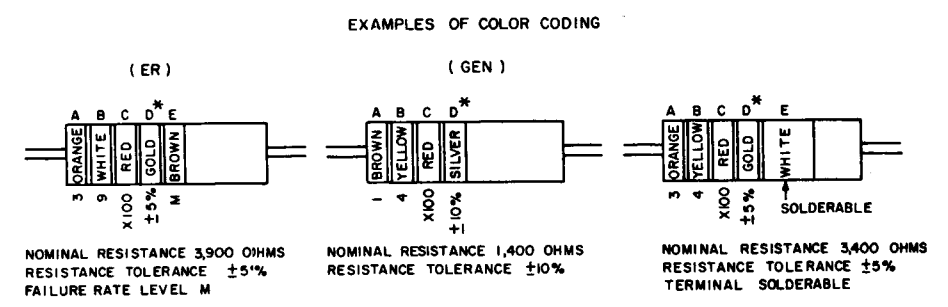


TABLE 1
COLOR CODE FOR COMPOSITION TYPE AND FILM TYPE RESISTORS.

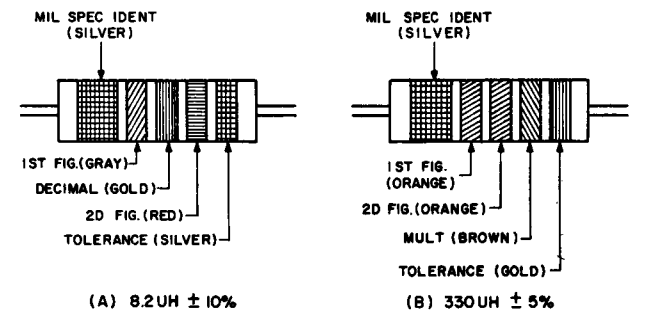
| BAND A | | BAND B | | BAND C | | BAND D | | BAND E | |
|-----------------|--------------------------|-----------------|---------------------------|--------|------------|--------|--|--------|--------------------|
| COLOR | FIRST SIGNIFICANT FIGURE | COLOR | SECOND SIGNIFICANT FIGURE | COLOR | MULTIPLIER | COLOR | RESISTANCE TOLERANCE (PERCENT) | COLOR | FAILURE RATE LEVEL |
| BLACK | 0 | BLACK | 0 | BLACK | 1 | | | BROWN | M=1.0 |
| BROWN | 1 | BROWN | 1 | BROWN | 10 | | | RED | P=0.1 |
| RED | 2 | RED | 2 | RED | 100 | | | ORANGE | R=0.01 |
| ORANGE | 3 | ORANGE | 3 | ORANGE | 1,000 | | | YELLOW | S=0.001 |
| YELLOW | 4 | YELLOW | 4 | YELLOW | 10,000 | SILVER | ±10 (COMP. TYPE ONLY) | WHITE | |
| GREEN | 5 | GREEN | 5 | GREEN | 100,000 | GOLD | ±5 | | |
| BLUE | 6 | BLUE | 6 | BLUE | 1,000,000 | RED | ±2 (NOT APPLICABLE TO ESTABLISHED RELIABILITY) | | |
| PURPLE (VIOLET) | 7 | PURPLE (VIOLET) | 7 | | | | | | |
| GRAY | 8 | GRAY | 8 | SILVER | 0.01 | | | | |
| WHITE | 9 | WHITE | 9 | GOLD | 0.1 | | | | |

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH.)
 BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE.
 BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE.)
 BAND D — THE RESISTANCE TOLERANCE.
 BAND E — WHEN USED ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE-RATE LEVEL (PERCENT FAILURE PER 1,000 HOURS) ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY 1/2 TIMES THE WIDTH OF OTHER BANDS, AND INDICATES TYPE OF TERMINAL.
 RESISTANCES IDENTIFIED BY NUMBERS AND LETTERS (THESE ARE NOT COLOR CODED)
 SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATORS. THE LETTER R IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:
 2R7 = 2.7 OHMS 10R0 = 10.0 OHMS

FOR WIRE-WOUND TYPE RESISTORS COLOR CODING IS NOT USED, IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS.



COMPOSITION-TYPE RESISTORS FILM-TYPE RESISTORS
 * IF BAND D IS OMITTED, THE RESISTOR TOLERANCE IS ±20% AND THE RESISTOR IS NOT MIL-STD.
 A: COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS.



COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES. AT A, AN EXAMPLE OF THE CODING FOR AN 8.2UH CHOKE IS GIVEN. AT B, THE COLOR BANDS FOR A 330UH INDUCTOR ARE ILLUSTRATED.

TABLE 2
COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES.

| COLOR | SIGNIFICANT FIGURE | MULTIPLIER | INDUCTANCE TOLERANCE (PERCENT) |
|--------|--------------------|------------|--------------------------------|
| BLACK | 0 | 1 | |
| BROWN | 1 | 10 | 1 |
| RED | 2 | 100 | 2 |
| ORANGE | 3 | 1,000 | 3 |
| YELLOW | 4 | | |
| GREEN | 5 | | |
| BLUE | 6 | | |
| VIOLET | 7 | | |
| GRAY | 8 | | |
| WHITE | 9 | | |
| NONE | | | 20 |
| SILVER | | | 10 |
| GOLD | | | 5 |

MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKE COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS.

CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB.

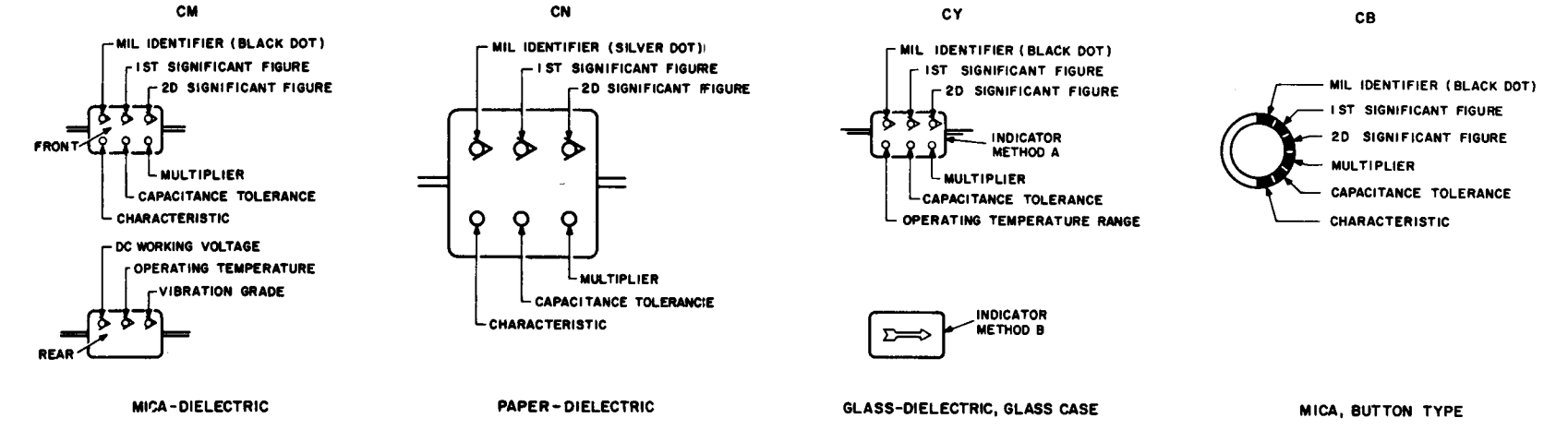


TABLE 3 — FOR USE WITH STYLES CM, CN, CY AND CB.

| COLOR | MIL ID | 1ST SIG FIG. | 2D SIG FIG. | MULTIPLIER | CAPACITANCE TOLERANCE | | | | CHARACTERISTIC | DC WORKING VOLTAGE | OPERATING TEMP RANGE | VIBRATION GRADE |
|-----------------|------------|--------------|-------------|------------|-----------------------|------|------|------|----------------|--------------------|----------------------|----------------------------|
| | | | | | CM | CN | CY | CB | | | | |
| BLACK | CM, CY, CB | 0 | 0 | 1 | | | | | A | | -55° to +70°C | 10-55 HZ |
| BROWN | | 1 | 1 | 10 | | | | | B, E, B | | | |
| RED | | 2 | 2 | 100 | ±2% | | | | 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 HZ |
| GREEN | | 5 | 5 | | | ±5% | | | F | | 500 | |
| BLUE | | 6 | 6 | | | | | | | | | -55° to +150°C |
| PURPLE (VIOLET) | | 7 | 7 | | | | | | | | | |
| GRAY | | 8 | 8 | | | | | | | | | |
| WHITE | | 9 | 9 | | | | | | | | | |
| GOLD | | | | 0.1 | | | ±5% | ±5% | | | | |
| SILVER | CN | | | 0.01 | ±10% | ±10% | ±10% | ±10% | | | | |

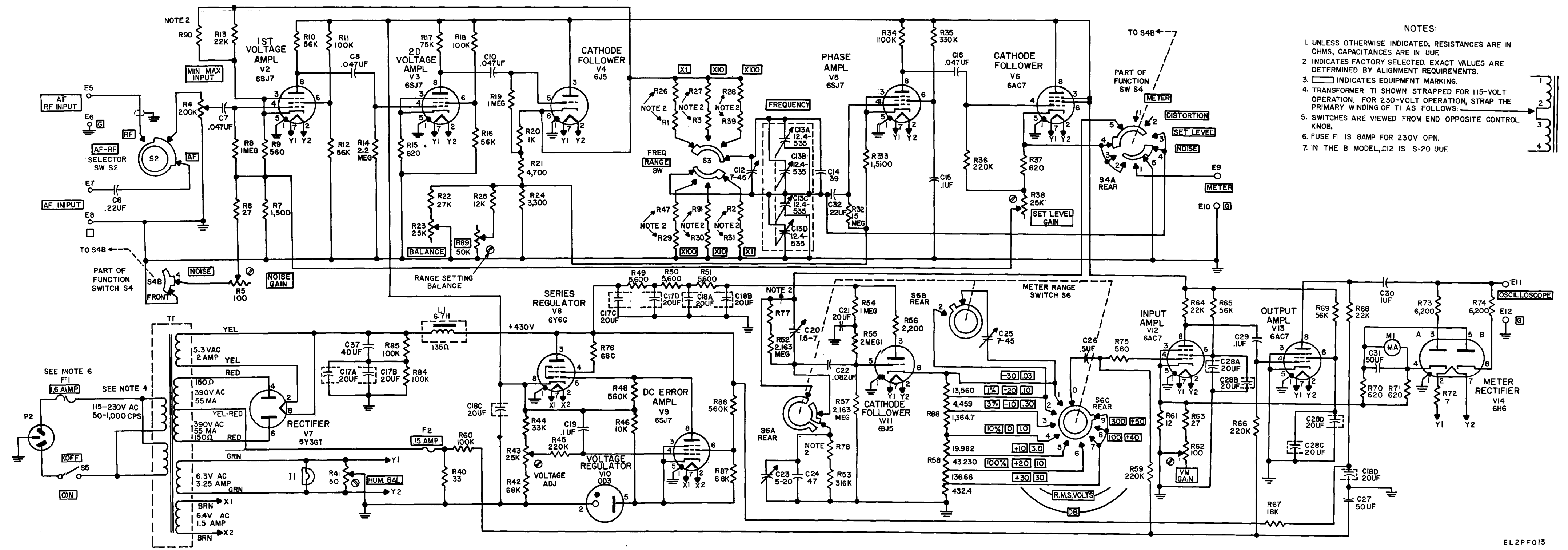
TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC.

| COLOR | TEMPERATURE COEFFICIENT | 1ST SIG FIG. | 2D SIG FIG. | MULTIPLIER | CAPACITANCE TOLERANCE | | MIL ID |
|-----------------|-------------------------|--------------|-------------|------------|--------------------------|-----------------------------|-----------|
| | | | | | CAPACITANCES OVER 10 UUF | CAPACITANCES 10 UUF OR LESS | |
| BLACK | 0 | 0 | 0 | 1 | | ±2.0 UUF | CC |
| BROWN | -30 | 1 | 1 | 10 | | ±1% | |
| RED | -80 | 2 | 2 | 100 | | ±2% | ±0.25 UUF |
| ORANGE | -150 | 3 | 3 | 1,000 | | | |
| YELLOW | -220 | 4 | 4 | | | | |
| GREEN | -330 | 5 | 5 | | | ±5% | ±0.5 UUF |
| BLUE | -470 | 6 | 6 | | | | |
| PURPLE (VIOLET) | -750 | 7 | 7 | | | | |
| GRAY | | 8 | 8 | 0.01* | | | |
| WHITE | | 9 | 9 | 0.1* | | ±10% | |
| GOLD | +100 | | | 0.1 | | | ±1.0 UUF |
| SILVER | | | | 0.01 | | | |

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-250, MIL-C-112728, AND MIL-C-109900 RESPECTIVELY.
 3. LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-110150.
 4. TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.
 * OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS.

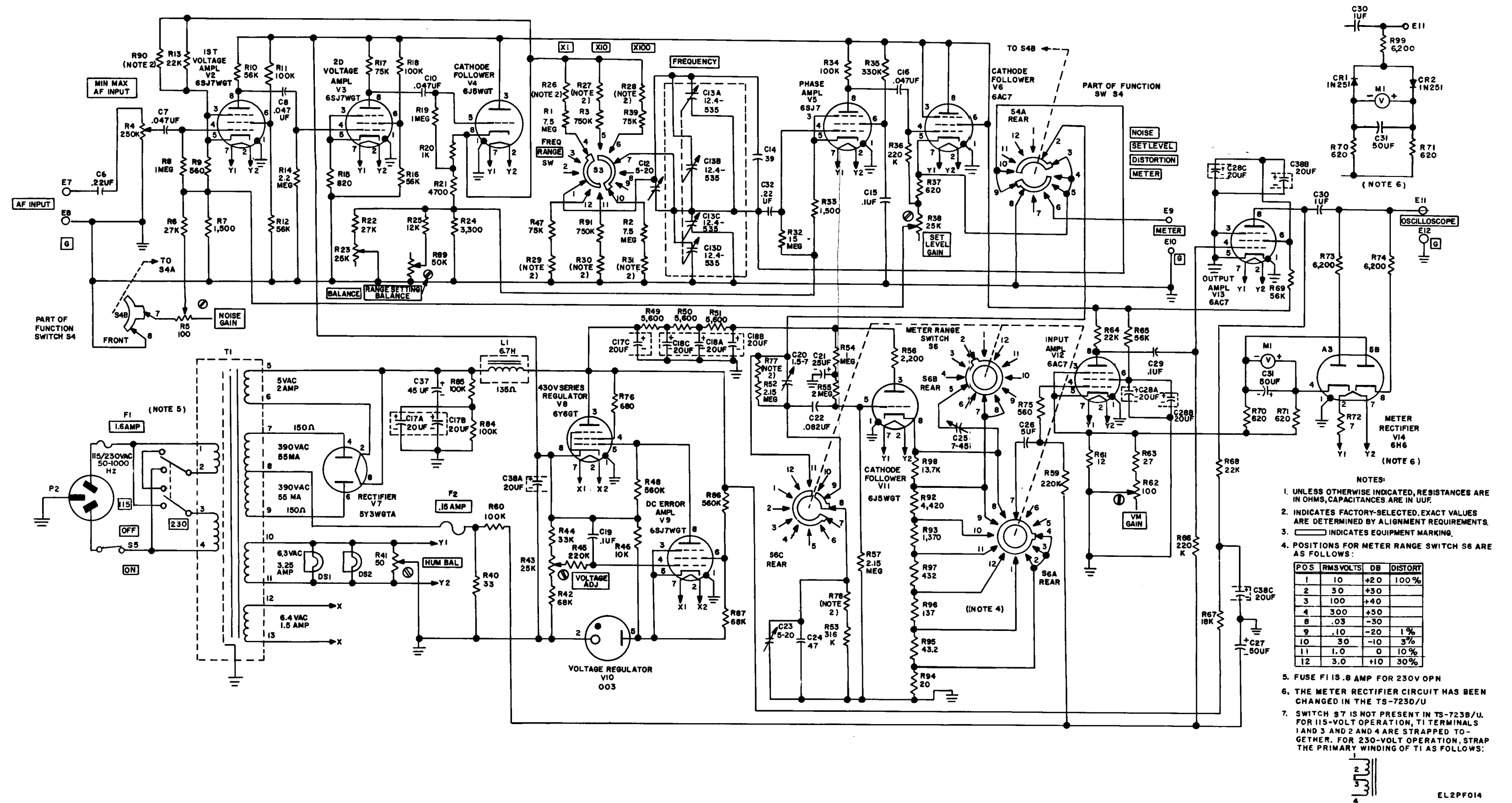
Figure FO-1. Color code markings for MIL-STD resistors, capacitors, and inductors.



- NOTES:
1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UUF.
 2. INDICATES FACTORY SELECTED. EXACT VALUES ARE DETERMINED BY ALIGNMENT REQUIREMENTS.
 3. INDICATES EQUIPMENT MARKING.
 4. TRANSFORMER T1 SHOWN STRAPPED FOR 115-VOLT OPERATION. FOR 230-VOLT OPERATION, STRAP THE PRIMARY WINDING OF T1 AS FOLLOWS:
 5. SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB.
 6. FUSE F1 IS 8 AMP FOR 230V OPN.
 7. IN THE B MODEL, C12 IS S-20 UUF.

EL2PF013

Figure FO-2. Schematic diagram, Spectrum Analyzer TS-723A/U.



- NOTES:
- UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UUF.
 - INDICATES FACTORY-SELECTED, EXACT VALUES ARE DETERMINED BY ALIGNMENT REQUIREMENTS.
 - INDICATES EQUIPMENT MARKING.
 - POSITIONS FOR METER RANGE SWITCH S6 ARE AS FOLLOWS:
- | POS | RMSVOLTS | DB | DISTORT |
|-----|----------|-----|---------|
| 1 | 10 | +20 | 100% |
| 2 | 30 | +30 | |
| 3 | 100 | +40 | |
| 4 | 300 | +50 | |
| 8 | .03 | -30 | |
| 9 | .10 | -20 | 1% |
| 10 | 30 | -10 | 3% |
| 11 | 1.0 | 0 | 10% |
| 12 | 3.0 | +10 | 30% |
- FUSE F1 IS .8 AMP FOR 230V OPN
 - THE METER RECTIFIER CIRCUIT HAS BEEN CHANGED IN THE TS-723D/U
 - SWITCH S7 IS NOT PRESENT IN TS-723B/U. FOR 115-VOLT OPERATION, T1 TERMINALS 1 AND 3 AND 2 AND 4 ARE STRAPPED TOGETHER. FOR 230-VOLT OPERATION, STRAP THE PRIMARY WINDING OF T1 AS FOLLOWS:

Figure FO-3. Schematic diagram, Spectrum Analyzers TS-723B/U, TS-723C/U, and TS-723D/U.

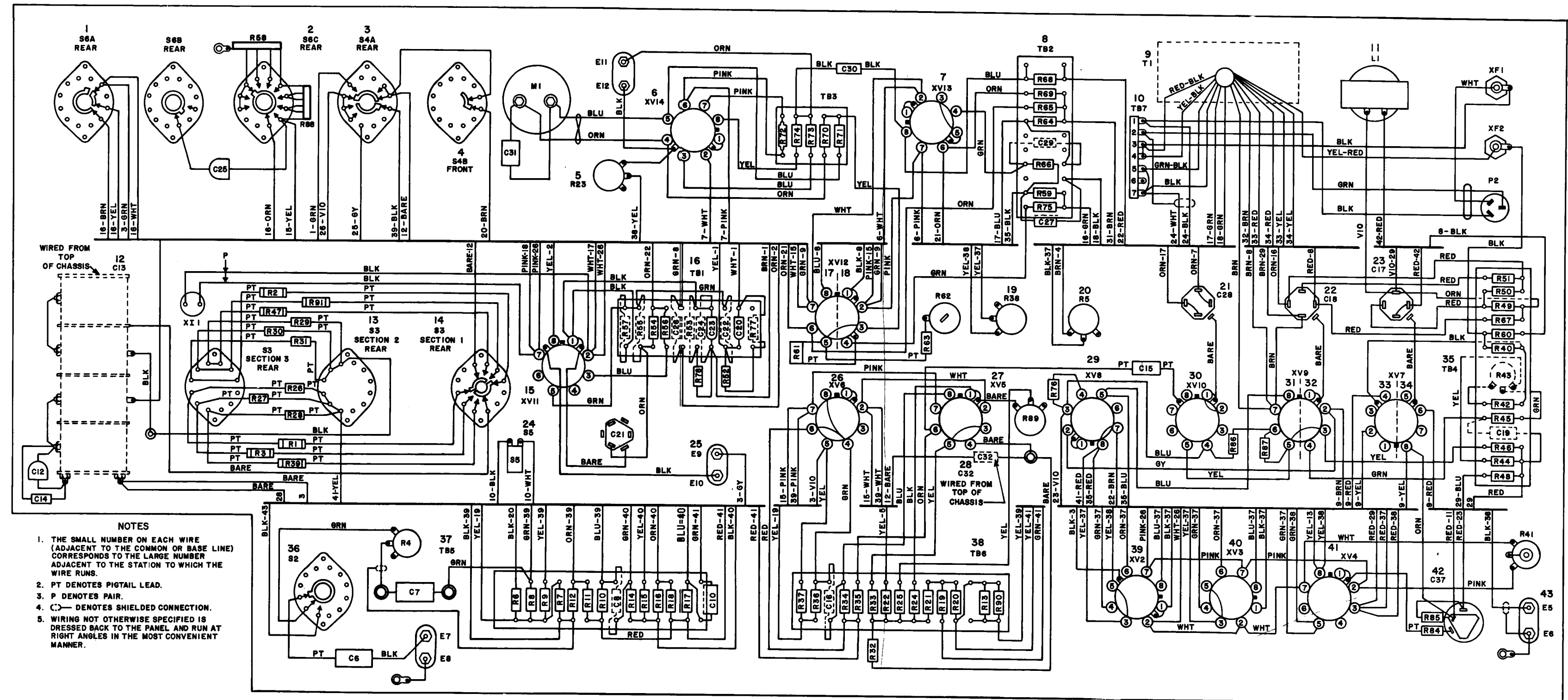
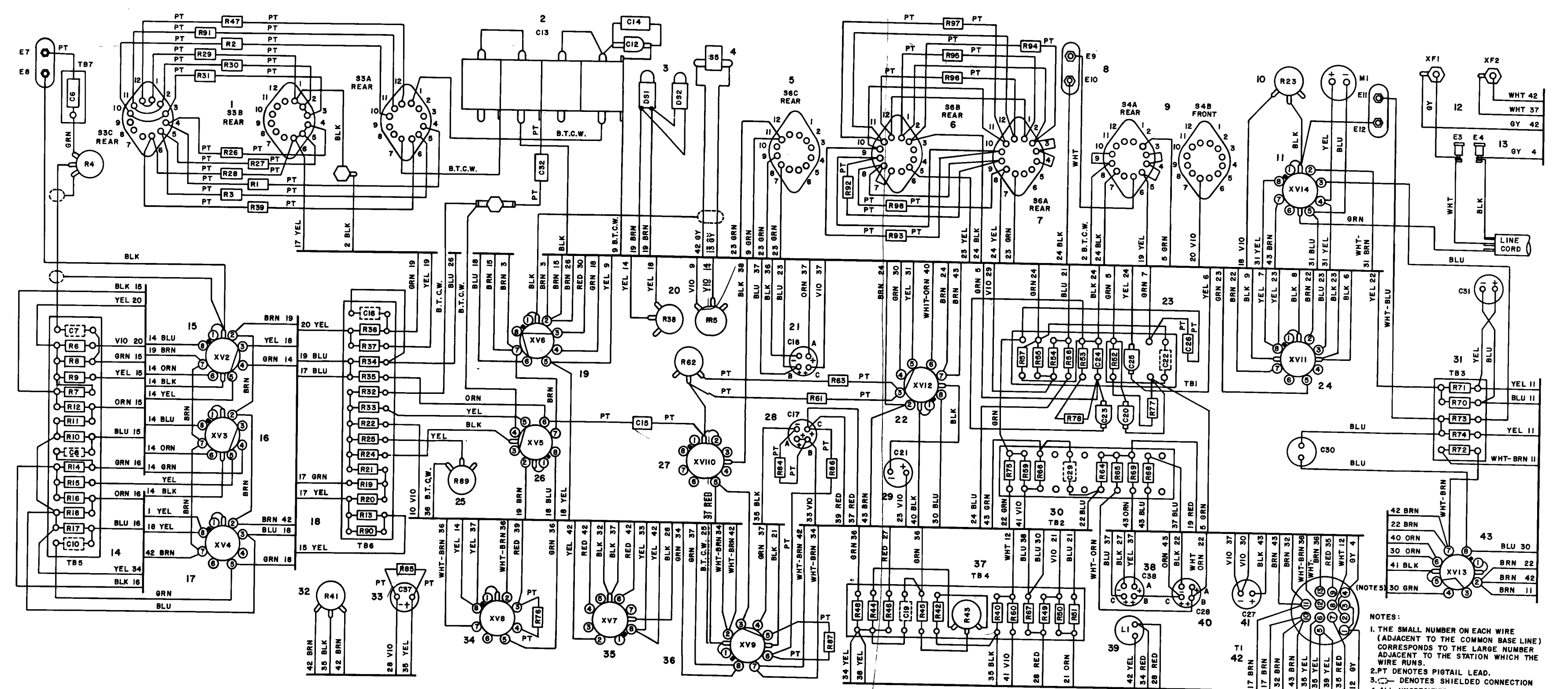


Figure FO-4. Wiring diagram, Spectrum Analyzer TS-73A/U.



- NOTES:
1. THE SMALL NUMBER ON EACH WIRE (ADJACENT TO THE COMMON BASE LINE) CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION WHICH THE WIRE RUNS.
 2. PT DENOTES PIGTAIL LEAD.
 3. ○ DENOTES SHIELDED CONNECTION.
 4. ALL UNSPECIFIED WIRES ARE B.T.C.W.
 5. TS-723C/U AND TS-723D/U USE SWITCH S7 TO CHANGE STRAPPING OF T1 FROM 115V TO 230V OPERATION.

EL2PFO16

Figure FO-5. Wiring diagram, Spectrum Analyzers TS-723B/U, TS-723C/U, and TS-723D/U.

