TM 11-6625-400-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

FIELD AND DEPOT MAINTENANCE MANUAL

METER, MODULATION ME-57/U

HEADQUARTERS, DEPARTMENT OF THE ARMY

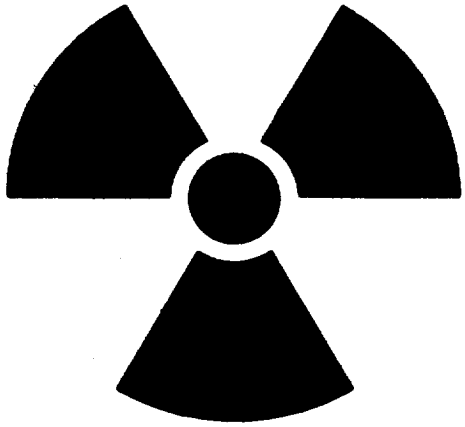
29 OCTOBER 1962

WARNING

Be careful when working on the 115- or 230-volt ac line connections and the B+ supply circuits. Serious injury or death may result from contact with these voltages.

DON'T TAKE CHANCES!

RADIATION HAZARD



Co 60

Tube type 5651WA used in this test set contains radioactive material. This tube is potentially hazardous when broken; see qualified medical personnel and the Safety Director if you are exposed to or cut by broken tubes. Be extremely careful when replacing these tubes (para 18) and follow the safety procedures in their handling, storage, and disposal.

Never place radioactive tubes in your pocket.

Use extreme care not to break radioactive tubes while handling them.

Never remove radioactive tubes from cartons until ready to use them.

TM 11-6625-400-35
C 2

CHANGE
No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 28 June 1967

DS, GS, And Depot Maintenance Manual

METER MODULATION ME-57/U

TM 11-6625-400-35, 29 October 1962, is changed as follows:

The title of the manual is changed as Shown above.

Note. The parenthetical reference to previous changes (example "page 2 of C 2") indicates that pertinent material was published in that change.

Page 2, paragraph 1. Delete subparagraphs c and d and substitute new subparagraph c:

c. DA Form 2028 (Recommended Changes to DA Publications) will be used for reporting discrepancies and recommendations for improving this equipment publication. The form will be completed by the individual using the manual and forwarded direct to Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-MR-NMP-AD, Fort Monmouth, N. J., 07703.

After paragraph 1, add:

1.1 Indexes of Publications

a. DA Pam 310-4. Refer to DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment. Department of the Army Pamphlet No. 310-4 is a current index of technical manuals, technical bulletins, supply manuals (types 7, 8, and 9), supply bulletins, and lubrication orders that are available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc.) and the latest changes and revisions of each equipment publication.

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. Department of the Army Pamphlet No. 310-7 lists all authorized Department of the Army modification work orders, identifying the type, model, series, and Federal stock number of the item to be modified; number, date, and classification of the MWO; category of maintenance authorized to perform the modification; and the man-hours required to apply the modification to each item.

Page 43. After chapter 4, add:

CHAPTER 5

DEPOT OVERHAUL STANDARDS

38. Applicability of Depot Overhaul Standards (DOS)

The tests outlined in this chapter are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

39. Applicable References

a. Repair Standards. Applicable procedures of the depots performing these tests and the general standards for repaired electronic equipment given in TB SIG 355-1, TB SIG 355-2, and TB SIG 355-3 form a part of the requirements for testing this equipment.

b. Technical Publications. The only other technical publication applicable to the equipment to be tested is TM 11-6625-400-12, Operator and Organizational Maintenance Manual: Meter, Modulation ME-57/U.

c. Modification Work Orders. Perform all modification work orders applicable to this equipment before making the tests specified. DA Pam 310-7 lists all available MWO'S.

40. Test Facilities Required

The following items are needed for depot testing:

Item	Technical manual
Analyzer, Spectrum TS-723(*)/U[a]	TM 11-5097
Generator, Signal AN/URM-127	TM 11-6625-683-15
Multimeter ME-26(*)/U[b]	TM 11-6625-200-12
Voltmeter, Electronic ME-30(*)/U[c]	TM 11-6625-320-12
Counter, Electronic, Digital Readout AN/USM-207	TM 11-6625-700-10
Generator, Signal AN/URM-70	TM 11-1258
Generator, Signal AN/USM-44	TM 11-6625-508-10
Indicator, Panoramic IP-173(*)/U[d]	TM 11-5086

aAnalyzer, Spectrum TS-723 (*)/U represents Analyzer, Spectrum TS-823A/U, TS-723B/U, TS-723C/U, or TS-723D/U.
bMultimeter ME-26(*)/U represents Multimeter ME-26/U, ME-26B/U, ME-26C/U, or ME-26D/U.
cVoltmeter, Electronic ME-30(*)/U represents Voltmeter, Meter ME-30A/U or Voltmeter, Electronic ME-30B/U, ME-30C/U, or ME-30E/U.
dIndicator, Panoramic IP-173 (*)/U represents Indicator, Panoramic IP-173/U, IP-173A/U, IP-173B/U, or IP-173C/U,

41. General Test Requirements

All tests will be conducted under the following conditions:

a. At normal room temperature.

b. Line voltage of 115 or 230 volts (±10 percent), 50 to 420 cps.

42. Frequency Range Test

a. Connect the output of Generator, Signal AN/USM-44 to the input jack of the ME-57/U.

b. Set the AN/USM-44 to a frequency of 20 mc.

c. Set the range switch on the ME-57/U to the 20- to 50-mc band, and tune the ME-57/U to 20 mc. There should be a limiting indication and a zero reading of the carrier shift meter.

d. Repeat the procedures in b and c above for frequencies at the ends of the five frequency bands on the ME-57U. Tuning of the ME-57/U shall be continuous throughout the range of 20 to 1,000 mc.

43. Input Sensitivity Test

a. Connect the equipment as shown in figure 28.1 (page 2 of C 1). (Signal Generator SG-3/U is part of the AN/URM-70.)

b. Set the FREQUENCY IN MEGACYCLES dial on the AN/URM-70 to the 50-100 position 50-mc mark by adjustment of the tuning dial.

c. Adjust the OUTPUT control on the AN/URM-70 until the output meter needle is aligned on its center scale division.

d. Set the red index line on the plexiglass vernier over the 100-K mark on the OUTPUT attenuator dial of the AN/URM-70.

e. Set the OUTPUT attenuator dial to 10K and the MODULATION switch on the AN/URM-70 to the 1,000-cycle position.

f. Set the controls on the ME-57/U as follows :

(1) Set the FREQUENCY RANGE-MC switch to 20-55.

(2) Set the DEVIATION RANGE KC switch to 1,000 TUNE.

(3) Set the TUNE-FINE TUNE switch to TUNE.

g. Adjust the TUNING control on the ME-57/U for a 0 (zero) CARRIER SHIFT meter reading and LIMITING indication on the LIMITING meter.

h. Set the TUNE-FINE TUNE switch to FINE TUNE, and repeat the procedure in g above.

i. Turn the MODULATION switch on the AN/URM-70 to OFF.

j. Reduce the RF output of the AN,TJRM-70 until the ME-30(*)/U reaches its peak voltage indication. Raise the RF output of the AN/URM-70 until a 20-db reduction in voltage is indicated by the ME-30(*)/U.

k. The OUTPUT dial of the AN/URM-70 should indicate an output of 3,500 microvolt or less.

44. Deviation Accuracy and Modulation Frequency Tests

a. Connect the output of the AN/USM-44 to one input of the IP-173 (*)/U, and tune for 45 mc.

b. Connect the output of the AN/URM-70 to the other input of the IP-173(*)/U, and tune for 50 mc.

c. Connect the output of the AN/URM-127 to the External Modulation Input of the AN/URM-70, and adjust the audiofrequency to 2.08 KC.

d. Connect the AN/USM-207 to monitor the audio output of the AN/URM-127.

e. With no modulation applied, adjust the IP-173(*)/U for a carrier indication on the CRT. Vary the frequency of the AN/USM-44 slightly around a nominal value of 45 mc (5 mc below the frequency of the AN /URM-70) to center the carrier pip on the CRT of the IP-173 (*)/U.

f. Select external modulation on the AN/URM-70, and increase the modulation level until the carrier indication is zero at the first null. The FM deviation at the output of the AN/URM-70 is now calibrated at 5 KC.

g. Disconnect the output of the AN/URM-70 from the IP-173(*)/U, and connect it to the input of the ME-57/U.

h. Turn the modulation off, and tune the ME-57/U for a carrier frequency of 50 mc. Set the DEVIATION RANGE KC switch to the 0- to 20-range, and turn on the modulation. The ME-57/U should indicate a 5-KC deviation ±0.75.

i. Repeat the test in a through h above for the carrier and modulation frequencies specified in table 1. The control settings required and the test results are listed in the table.

45. Audio Distortion Test

a. Connect the output of the AN/URM-70 to the input of the ME-57/U.

b. Connect the output of the AN/URM-127 to the external modulation inputs of the AN/URM-70.

c. Connect the input of the Analyzer, Spectrum TS-723 (*)/U to the audio output jacks of the ME-57/U.

d. Tune the AN/URM-70 to a carrier frequency of 50 mc.

e. Tune the AN/URM-l27 to a modulating frequency of 50 cycles.

g. Turn on the external modulation of the AN/URM-70, and increase the modulation level until the ME-57/U indicates a 40-KC deviation. Refer to table 2 for proper range settings on the ME-57/U.

h. Connect the ME-26/U to the audio output of the ME-57/U. The audio output should read 1 volt at the 40-KC deviation. The AUDIO ADJ control should be set at this time if the output is not 1 volt.

i. Take a reading of the audio distortion at the modulation frequency with the TS-723 (*)/U. Allowing for 0.5 percent distortion contributed by the test equipment, the audio output of the ME-57/U should show 3 percent or less distortion.

j. Repeat the test in a through i above for the carrier and modulating frequencies specified in table 2. The control setting required and the test results are listed in the table.

Table 1. Deviation Accuracy Modulation Frequency

Carrier freq mc AN/URM-70	Mod freq kc AN/URM-127	Mod index IP-173( )/U	Cal dev kc	ME-57/U freq range mc	ME-57/U tol kc	ME-57/U dev range kc
50	2.08	2.40 1st null	5	20-55	±0.75	0-20
50	6.66	2.40 1st null	10	20-55	±0.75	0-20
100	4.17	2.40 1st null	10	55-120	±0.75	0-20
100	4.17	2.40 1st null	10	55-120	±2.0	0-50
100	16.66	2.40 1st null	40	55-120	±2.0	0-50
150	8.33	2.40 1st null	20	120-250	±2.0	0-50
150	8.33	2.40 1st null	20	120-250	±5.0	0-100
150	33.3	2.40 1st null	80	120-250	±10.0	0-100
200	25.0	2.40 1st null	60	120-250	±10.0	0-100
200	25.0	2.40 1st null	60	120-250	±30.0	0-300
200	28.9	8.65 3d null	250	120-250	±30.0	0-300
400	36.2	5.52 2d null	200	250-500	±30.0	0-300
400	36.2	5.52 2d null	200	250-500	±100.0	0-1000
400	67.8	11.79 4th null	800	250-500	±100.0	0-1000

Table 2. Audio Distortion

Carrier freq AN/URM-70 mc	Modulating freq AN/URM-127 kc	Deviation reading ME-57/U	ME-57/U freq range mc	ME-57/U dev range kc
50	50 cycles	40 kc	20-55	0-50
50	1 kc	50 kc	20-55	0-50
50	5 kc	40 kc	20-55	0-50
100	10 kc	80 kc	55-120	0-100
100	15 kc	250 kc	55-120	0-300
200	20 kc	600 kc	120-250	0-1000

Page 53, appendix (page 3 of C 1). Delete the appendix and substitute:

APPENDIX

REFERENCES

Following is a list of references that should be available to the DS, GS, and depot maintenance personnel of Meter, Modulation ME-57/U.

ME-57/U.	
DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, Lubrication Orders,
DA Pam 310-7	Military Publications: Index of Modification Work Orders.
TA 11-17	Signal Maintenance Shops.
TA 11-100(11-17)	Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shop, Continental United States.
TB SIG 355-1	Deport Inspection Standard for Repaired Signal Equipment,
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TM 11-319	Sweep Generators SG-92/U and SG-92A/U.
TM 11-1258	Signal Generator AN /URM-70.
TM 11-5030	Signal Generator TS-497A/URR.
TM 11-5057	Frequency Meter AN/USM-26.
TM 11-5086	Panoramic Indicators IP-173/U, IP-173A/U, IP-173B/U, and IP-173C/U.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, TS-723C/U, and TS-723D/U.
TM 11-5129	Oscilloscopes AN/USM-50A, B, and C.
TM 11-6625-366-15	Multimeter TS-352B/U.
TM 11-5551	Instruction Book for R-F Signal Generator Set AN/URM-25.
TM 11-6625-200-12	Organizational Maintenance Manual: Multimeters ME-26A/U, ME-26B/U, ME-26C/U, and ME-26D/U.

TM 11-6625-261-12	Operator's and Organizational Maintenance Manual: Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U.
TM 11-6625-320-12	Organizational Maintenance Manual: Voltmeter, Meter ME-30A /U and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.
TM 11-6625-400-12	Operator and Organizational Maintenance Manual: Meter, Modulation ME-57/U.
TM 11-6625-508-10	Operator's Manual: Signal Generators AN/USM-44 and AN/USM-44A.
TM 11-6625-683-15	Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Signal Generator AN/URM-127.
TM 11-6625-700-10	Operator's Manual: Digital Readout, Electronic Counter AN/USM-207.

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
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Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

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11-592

NG: AG (3) ; units — same as Active Army except allowance is one copy.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

U. S. GOVERNMENT PRINTING OFFICE: 1967—302007/280

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 14 February 1966

Field and Depot

Maintenance Manual

METER, MODULATION ME-57/U

TM 11–6625-400–35, 29 October 1962, is changed as follows:

Page 41, paragraph 36a. Add subparagraph (5) after subparagraph (4).

(5) Voltmeter, Meter ME-30A/U

Subparagraph c, chart. Make the following changes:

"Test equipment control settings" column, step NO. 1, under "IP-173 (*)/U". Delete "Sweep width: Maximum counterclockwise" and substitute: Sweep width: Maximum clockwise.

"Test equipment control settings'" column, step No. 1, under "TS–382 (*) /U". De. lete "Tuning dial: 16.6"and substitute: Tuning dial: 166.

West procedure" column. step No. 2. Delete in its entirety and substitute: Adjust the SWEEP WIDTH and RESOLUTION controls of the 1P-173(*)/U to obtain a properly centered and convenient presentation on the scope. Increase the DEVIATION control of the SG–3/U to obtain the first null indication on the scope.

"Test procedure" column. step No. 11. Delete the sentence and substitute: Connect the output cable of the TS–497A/ URR to the IP–173\U and proceed as in step 2, but increasing the DEVIATION control to obtain the 3d null indication on the scope.

"Test procedure" column, step No. 14. Delete the sentence and substitute: Connect the output cable of the TS-497A / URR to the IP–173/U and proceed as in step 2, but increasing the DEVIATION control to obtain the 4th null indication on the scope.

"Performance standard column. Make the following changes: Delete the text for steps 4, 7, 10, 13, and 16 and substitute:

Step	Performance standard
4---------.	Deviation meter reads 40kc ± 2 kc.
7---------.	Deviation meter reads 16kc ±.75 kc.
10---------.	Deviation meter reads 80kc ±10 kc.
13---------.	Deviation meter reads 250kc ± 30 kc.
16---------.	Deviation meter reads 800kc±100 kc.

Page 42. Add paragraph 36.1 and figure 28.1 after paragraph 36.

36. 1. Quieting Signal Sensitivity Test

a. Set up the equipment as shown in figure 28.1.

b. Set the FREQUENCY IN MEGACYCLES dial on the SG–3/U to the 50-100 position 50 MC mark by adjustment of the tuning dial.

c. Adjust the OUTPUT control on the SG–3/U until the output meter needle is aligned on its center scale division.

d. Set the red index line on the plexiglass vernier over the 100K mark on tile OUTPUT attenuator dial of the SG–3/U.

e. Set the OUTPUT attenuator dial to 10K and the MODULATION switch on the SG3- 3/U to the 1000 cycle position.

f. Set the controls on the ME-57/U as follows:

(1) FREQUENCY RANGE MC switch to 20-55.

(2) DEVIATION RANGE KC switch to 1000-TUNE.

(3) TUNE-FINE TUNE switch to TUNE.

g. Adjust the TUNING control on MODULATION METER ME-57/U for a O CARRIER SHIFT meter reading and limiting indication on the LIMITING meter.

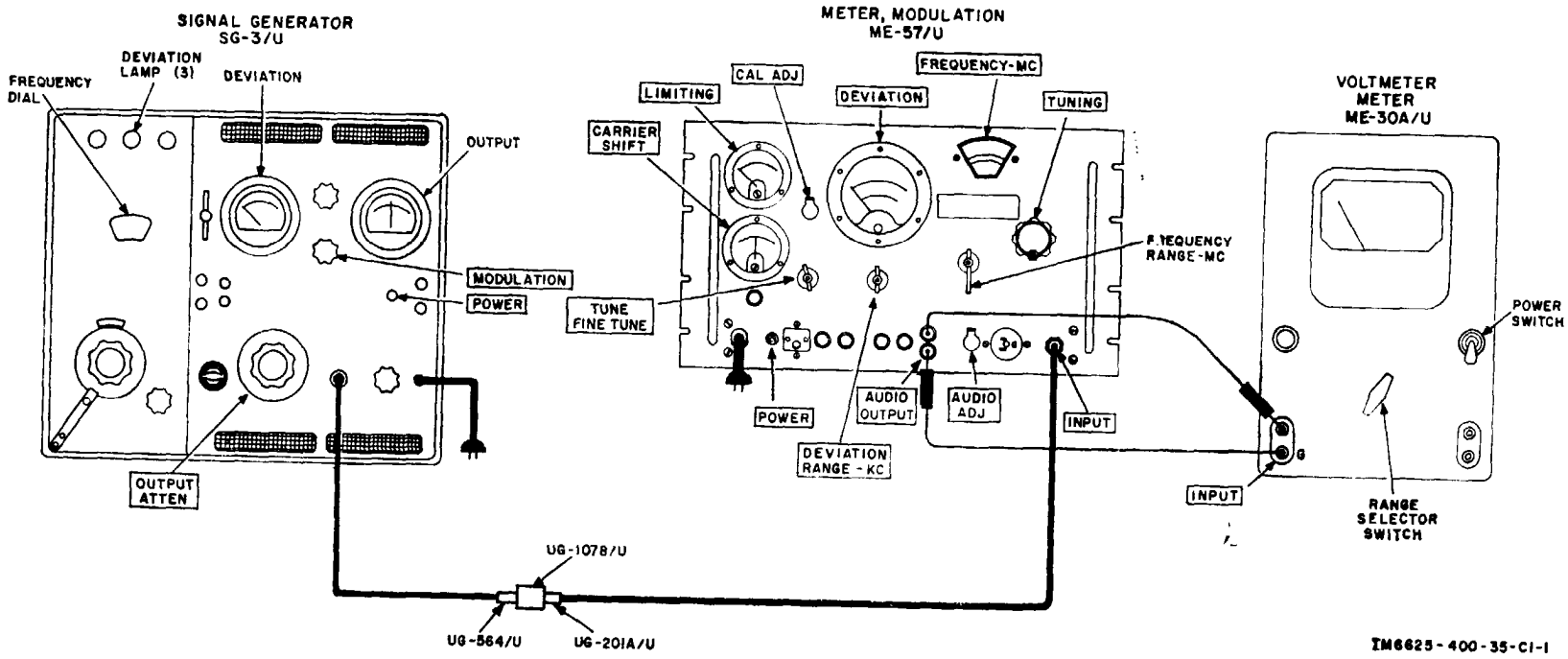

Figure 28.1. Sensitivity test.

h. Set the TUNE-FINE TUNE switch to FINE TUNE, an repeat step g.

i. Turn the MODULATION switch on the SG–3/U to OFF.

j. Reduce the rf output of the SG-3/U until the ME-30A/U reaches its peak voltage indication. Raise the rf output of the SG-3/U until a 20-db reduction in voltage is indicated by the ME-30A/U.

k. The OUTPUT dial of the SG-3/U should indicate an output of 3,500 microvolt or less.

Page 53, appendix references. Delete and substitute:

APPENDIX

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TA 11-17	Signal Maintenance Shops.
TA 11-100 (11-17)	Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shops.
TM 11–319	Signal Generators SG-92/U & SG-92A/U.
TM 11–1258	Signal Generator, AN/URM-70.
TM 11–5030	Sinai Generator TS-497A/URR.
TM 11-5057	Frequency Meter AN/USM-26.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, and TS-723C/U.
TM 11-5129	Oscilloscopes AN/USM–50A, B, & C.
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-5551	Instruction Book for Signal Generator AN/URM-25.
TM 11-6625-200-12	Operator and Organizational Maintenance Manual Multimeter ME-26A/U and ME-26B/U.
TM 11-6625-320-12	Operator and Organizational Maintenance Manual ME–30A/U, ME-30B/U and ME-30C/U.
TM 11–6625-261-12	Operators and Organizational Maintenance Manual Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U and TS-382F/U.
TM 11-6625-400-12	Operator and Organizational Maintenance Manual, Meter Modulation ME-57/U.

By Order of the Secretary of the Army:

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Chief of Staff.

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NG: State AG (3) ; units-same as Active Army except allowance is one copy to each unit.
USAR: None.
For explanation of abbreviations used, see AR 320-50.

TAGO 1295A
U.S. GOVERMENT PRINTING OFFICE: 1966

Technical Manual
No. 11-6625-400-35

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., 29 0ctober 1962

METER, MODULATION ME-57/U

CHAPTER 1

THEORY

Section I. GENERAL

1. Scope

a. This manual covers field and depot maintenance for Meter, Modulation ME-57/U. It includes instructions appropriate to fourth and fifth echelons for trouble-shooting, testing, aligning, and repairing specified maintenance parts. It also lists tools, materials, and test equipment for fourth and fifth echelon maintenance. Detailed circuit operation of the equipment is described in paragraphs 3 through 9.

Note: No maintenance functions are assigned to third echelon.

b. The complete technical manual for this equipment includes TM 11-6625-400-12.

c. Refer to DA Pamphlet 310-4 to determine what Changes to or revisions of this publication are current.

d. Forward comments concerning this manual to: Commanding Officer, U. S. Army Electronics Materiel Support Agency, ATTN: SELMS-MP, Fort Monmouth, N. J. (DA Form 1598 (Record of Comments on Publications), DA Form 2028 (Recommended Changes to DA Technical Manual Parts Lists or Supply Manual 7, 8, or 9), DD Form 96 (Disposition Form) or other suitable form or letter may be used.)

Note: For applicable forms and records, refer to paragraph 2, TM 11-6625-400-12.

2. Block diagram (fig. 1)

The modulation meter is used to measure deviation and carrier shift of frequency-modulated (fm) signal generators and transmitters. Signal paths are shown in figure 1 and discussed in a through 1 below. For complete circuit details, refer to the overall schematic diagram (fig. 32).

a. Oscillator V1. The oscillator is self-contained and is mounted on top of the chassis. It provides a signal to mix with the incoming radiofrequency (rf) signal. The modulation meter input frequency is covered in five ranges selected by the FREQUENCY RANGE-MC switch.

b. Mixer CR1. The mixer is mounted on the back of the oscillator. A crystal diode is used to mix the rf signal with the oscillator signal. The resulting intermediate frequency (if.) signal is fed to the if. amplifiers.

c. If. Amplifiers V2 Through V6. Five if. amplifiers use a combination of stagger tuning and broad bandpass to amplify the if. signal. Stages V2 through V5 have automatic volumn control (avc) applied to them. Stage V6 has no avc applied.

d. Limiters V7 and V8. Two limiter stages use high conductance-type pentodes to achieve limiting of the if. signal. These stages are stagger tuned and broad band type circuits. The limited signal is fed to the driver amplifier circuit.

e. LIMITING Meter M1. The LIMITING meter is fed from the first limiter stage. It indicates that the level of the rf input is sufficient for proper operation.

f. Driver Amplifier V9. The driver amplifier amplifies the limited if. signal to the level required for optimum discriminator operation.

g. Discriminator T9. The discriminator converts the frequency-modulated if, signal to voltages corresponding to the amount of modulation applied to the signal. The discriminator output is fed to CARRIER SHIFT meter M2 and audio circuits.

h. CARRIER SHIFT Meter M2. Meter M2 is a zero-center meter that indicates the amount of carrier shift caused by the modulation of the rf signal. Readings are in kilocycles (kc).

i. Divider Network. This precision divider is used to select the amount of signal required for full-scale readings on the

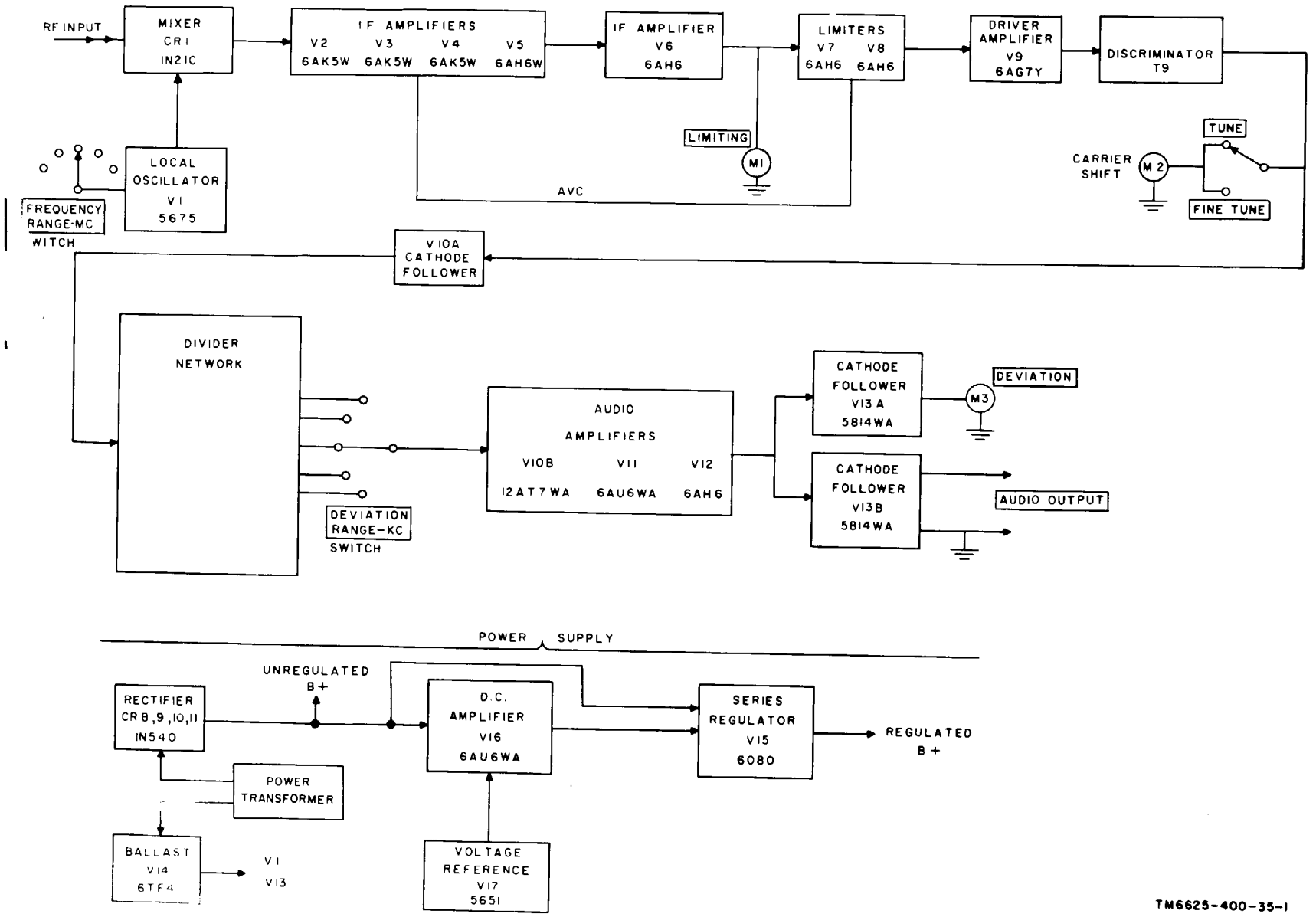


Figure 1. Meter, Modulation ME-57/U, block diagram.

DEVIATION meter, as set by the DEVIATION RANGE-KC switch. The signal is then fed to the audio amplifiers.

j. Audio Amplifiers V10 Through V13. The audio amplifiers are resistance-capacitance (rc) coupled stages with cathode follower input and outputs. The bandpass is flat up to 70,000 cycles per second (cps). The output is fed to the DEVIATION meter and the AUDIO OUTPUT binding posts.

k. DEVIATION Meter M3. This three-scale, five-range meter indicates deviation of fm signal generator or transmitter output.

1. Power Supply. Full-wave rectification is accomplished by a bridge rectifier circuit consisting of CR8 through CR11. It has an unregulated 240-volt output. A regulated 195-volt output is obtained by the use of voltage regulator stage V17, direct current (de) amplifier stage V16, and a series regulator stage V15. Ballast tube V14 provides a regulated filament voltage for use with oscillator V1 and audio output cathode follower V13

Section II. CIRCUIT THEORY

3. Oscillator (fig. 2)

The local oscillator generates a signal that is fed to the mixer to be mixed with the incoming signal from a frequency-modulated signal generator or transmitter. The oscillator is tunable over a range from 32 through 512 megacycles (me) in five bands, which are selected by the FREQUENCY RANGE-MC switch. The frequency of the oscillator signal is always 12 megacycles higher than the incoming signal, except on the 500-1000 range where the second harmonic of the oscillator is used. A 5675 pencil triode is used in the shunt-fed modified Colpitts oscillator. Regulated filament voltage is applied through filter network Z 1. Filter network Z1 keeps all rf signals shorted to ground. Plate voltage is fed through 22, which functions the same as Z1. Resistor R8 is the plate load resistor. Plate current flows only when the FREQUENCY RANGE-MC switch is in one of the five frequency bands and keeps V1 nonoperating while changing frequency ranges. This prevents unwanted oscillations which would occur if V 1 were kept operating. The frequency determining circuit is composed of C1, a two-section, air-dielectric, variable capacitor, and one of five inductances (represented by LB) selected by the FREQUENCY RANGE-MC switch. Inductances and resistances (represented by LA and RA) are used to couple the oscillator output to the mixer. They are selected by the FREQUENCY RANGE-MC switch, and are designed to give optimum crystal injection. Capacitor C107 and resistor R7 form a grid leak bias circuit.

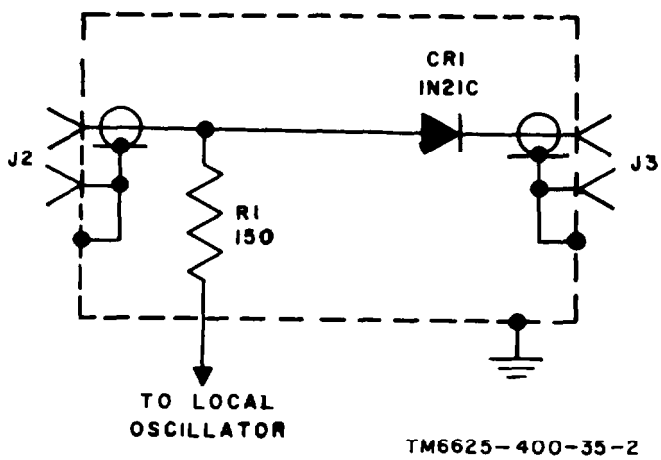


Figure 2. Oscillator, schematic diagram.

4. Mixer (fig. 3)

The crystal mixer receives the oscillator signal and the rf signal; the resultant if. signal is fed to the first stage of the if. amplifier circuits. The oscillator signal is injected through R1 to CR1. Resistor R1 provides signal separation from the local oscillator.

5. Intermediate Frequency Amplifiers

Figures 4 through 8 are simplified schematic diagrams of if. amplifier stages V2 through V6. The five stages of amplification form a high-gain, wide-band circuit

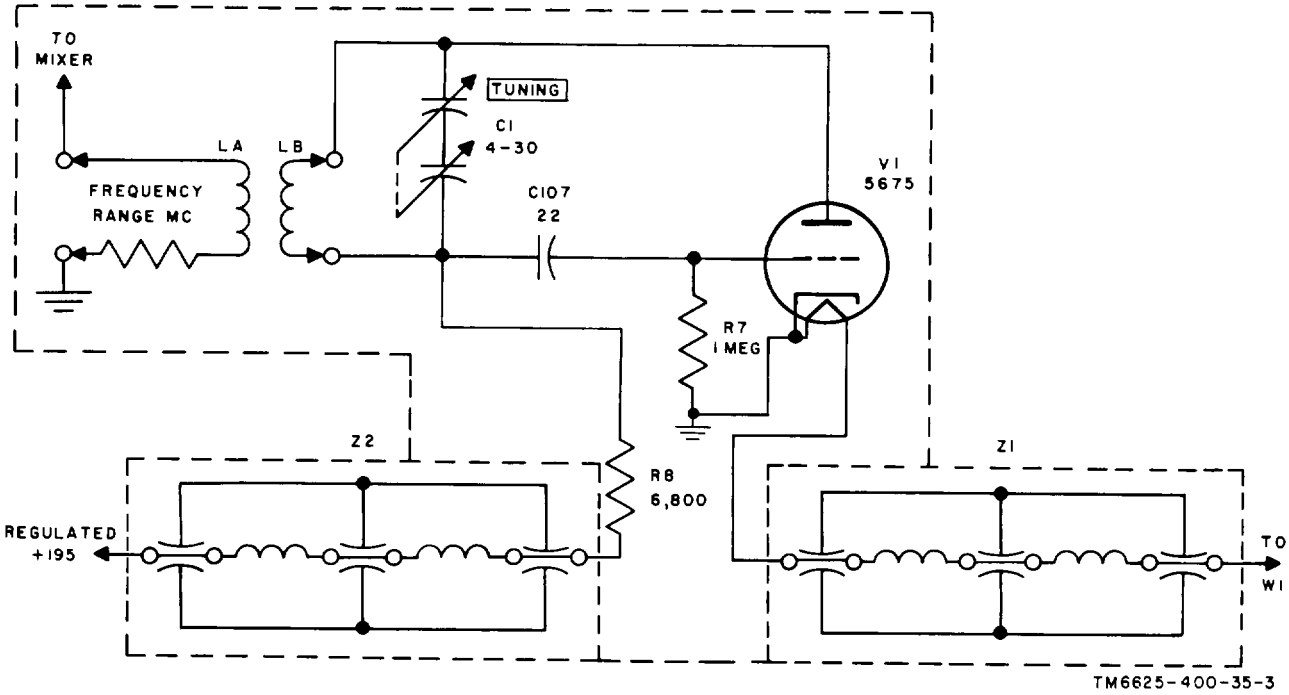


Figure 3. Mixer circuit schematic diagram.

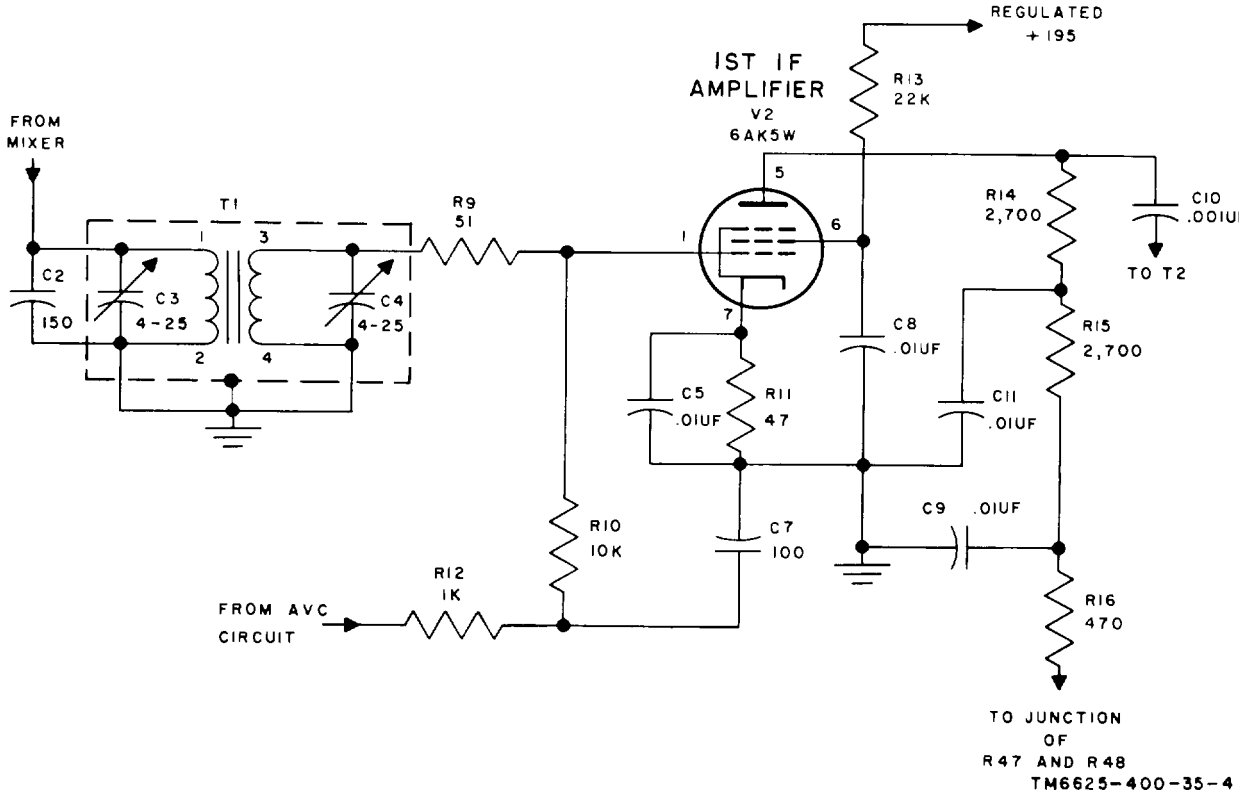


Figure 4. First if. amplifier, schematic diagram.

operating at a center frequency of 12 megacycles. The circuit has an overall bandwidth of 3 mc. A delayed automatic volume control (avc) circuit prevents saturation of the amplifiers. The output of V6 is fed to the limiter stages.

a. Tube V2 (fig. 4) is the first if. amplifier. The signal input is coupled through T1 to the grid of V2. Capacitor C2 along with trimmer capacitor C 3 tune the primary of T1; C4 is the trimmer for the secondary. Resistor R9 suppresses parasitic oscillations. Resistor R10 is the grid return to the avc supply. Avc decoupling is obtained through R12 and C7. Operating bias for V2 is obtained by the voltage drop across R11. The screen voltage-dropping resistor is R13. The plate load resistor for V2 is R14. Resistors R15 and R16 and capacitors C 9 and C 11 form a plate decoupling circuit. C a p a c i t o r C8 is the screen grid bypass capacitor and C5 is the cathode bypass capacitor. Inductor L13 and capacitor C6 (fig. 32) form the filament decoupling circuit. The output of V2 is coupled to T2 through C10.

b. Tube V3 (fig. 5) is the second if. amplifier. The signal input is coupled through T2 to the grid of V3. Capacitors C12 and C13 tune T2. Resistor R17 suppresses parasitic oscillations. Resistor R18 is the grid return to the avc supply. Avc decoupling is obtained by R24 and C15. Operating bias for V3 is produced by the drop across R19, which is bypassed by C14. Resistor R20, which is bypassed by C17, is the screen voltage-dropping resistor. The plate load resistor for V3 is R21. Capacitors C18 and C20 along with resistors R22 and R23 form the plate supply decoupling circuit. Capacitor C 16 and inductor L14 (fig. 32) are the filament bypass. The output of V3 is coupled to T3 through C19.

c. Tube V4 (fig. 6) is the third if. amplifier. The signal input is coupled through T3 to the grid of V4. Capacitors C21 and C22 tune T3. Parasitic oscillations are suppressed by R25. Resistor R26 is the

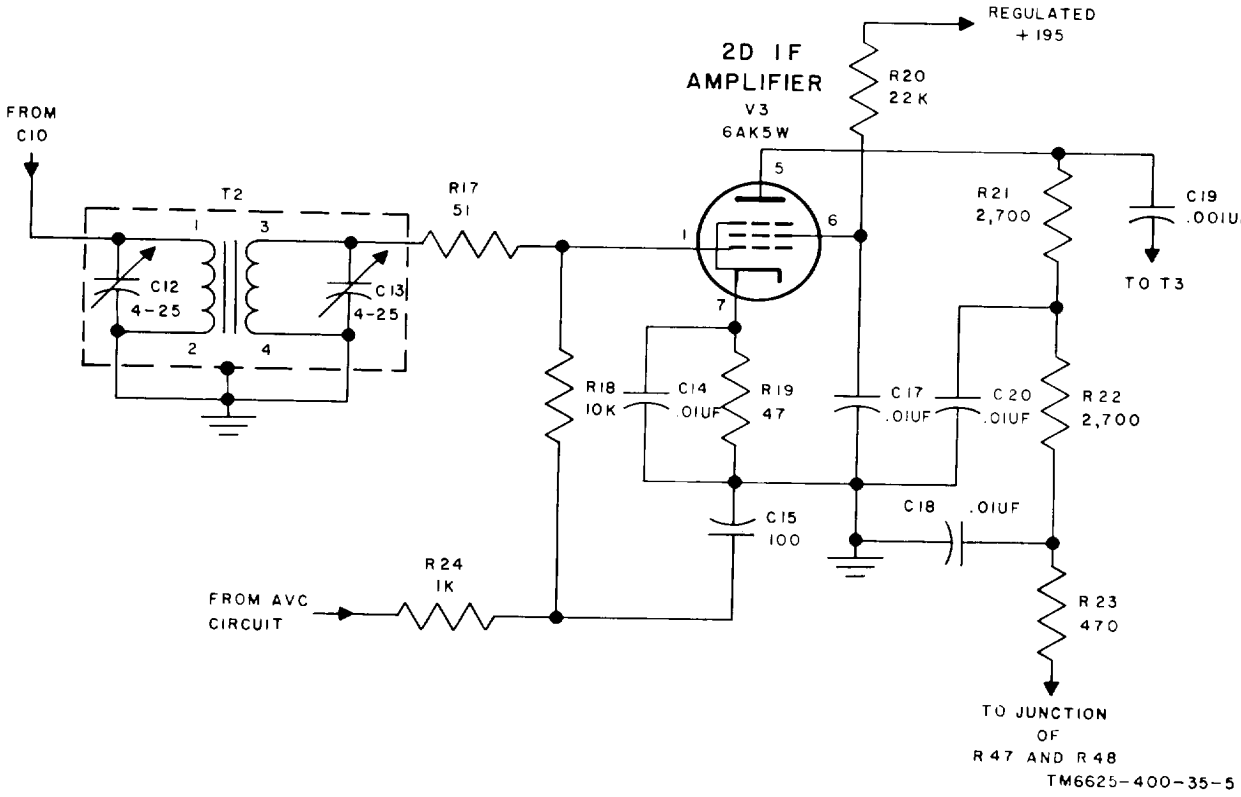


Figure 5. Second if. amplifier, schematic diagram.

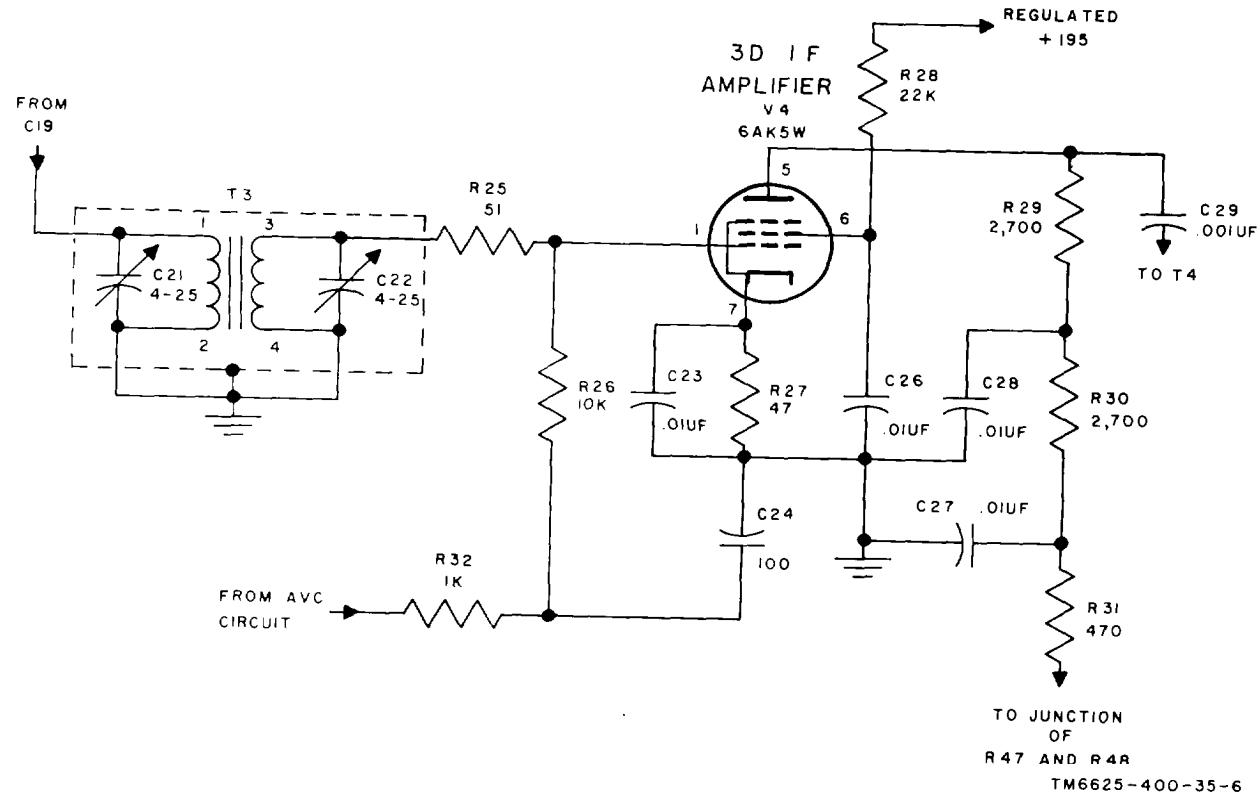


Figure 6. Third if. amplifier, schematic diagram.

grid return to the avc supply. Avc decoupling is obtained by R32 and C24. Operating bias for V4 is produced by the drop across R27, which is bypassed by C23. Resistor R28 is the screen voltage-dropping resistor; the bypass capacitor is C26. The plate load resistor for V4 is R29. Resistors R30 and R31 and capacitors C28 and C27 are used for plate supply decoupling. Capacitor C25 and inductor L15 (fig. 32) form the filament decoupling circuit.

d. Tube V5 (fig. 7) is the fourth if. amplifier. The signal input is coupled through T4 to the grid of V5. Capacitors C30 and C31 tune T4. The secondary of T4 is shunted by R33 to lower the Q of the circuit. Alternating current (at) coupling to the grid of V5 is through C32. Resistor R34 is the grid return to the avc supply. Avc decoupling is obtained by R40 and C 34. Operating bias for V5 is developed by the drop across R35, which is bypassed by C 33. The screen voltage-dropping resistor is R36, which is bypassed by C36. The plate load resistor for V5 is R37. Capacitors C37 and C39 and resistors R38 and R39 form a +240-volt supply decoupling network. Capacitor C35 (fig. 32) is the filament bypass. Capacitor C 38 couples the output of V5 to T5. Coil L16 (fig. 32) is the rf filament choke.

e. Tube V6 (fig. 8) is the fifth if. amplifier. The signal input is coupled through T5 into the grid of V6. Capacitors C41 and C42 tune T5. Resistor R42 loads the secondary of T5 for wide bandpass, and also serves as the grid return for V6. Operating bias for V6 is obtained by the voltage drop across R43, which is bypassed by C43. No avc voltage appears on the grid of V6. The screen voltage-dropping resistor is R44. Capacitor C45 bypasses R44. Resistor R45 is the plate load for V6. Resistors R46 and R47 and capacitors C46 and C48 form the plate supply decoupling circuit. Capacitor C44 (fig. 32) is the filament bypass. The output of V6 is coupled through C47 to T6. Coil L17 (fig. 32) is the rf filament choke.

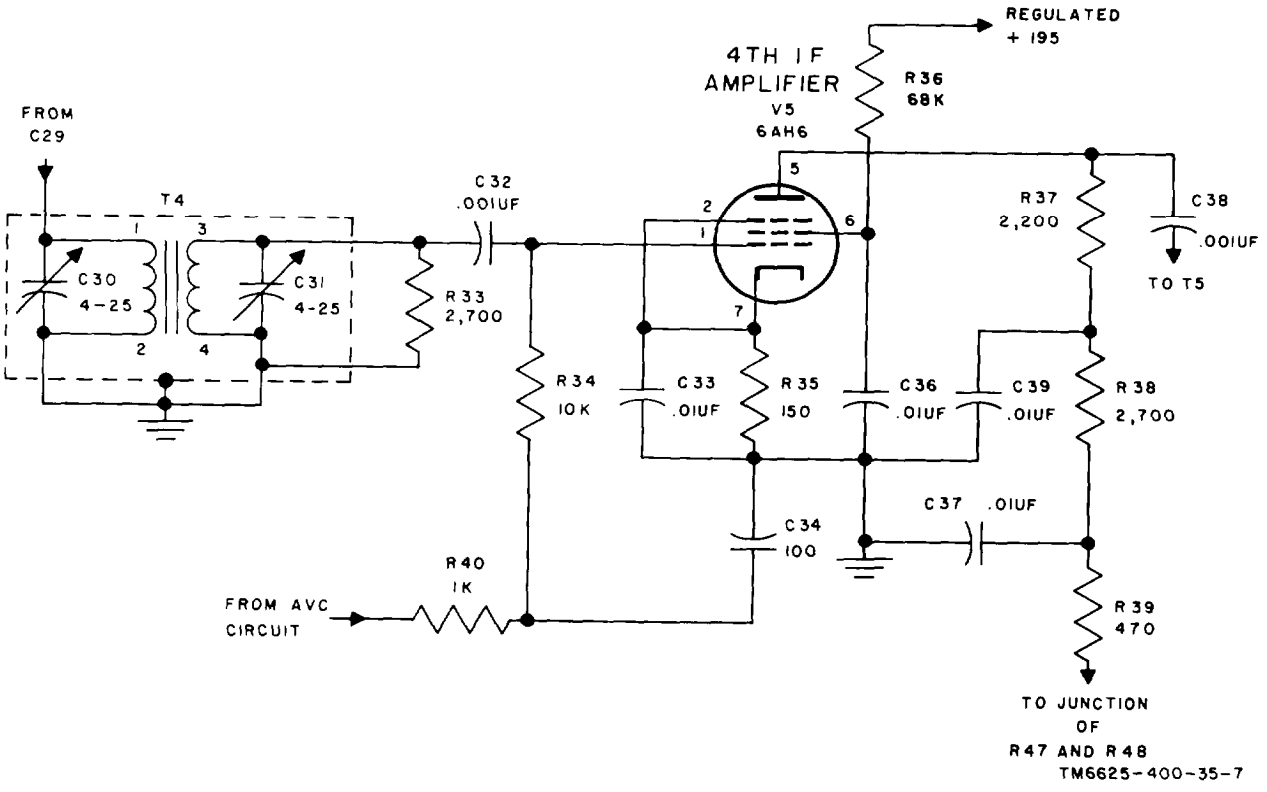


Figure 7. Fourth if. amplifier, schematic diagram.

6. Limiters

Figures 9 and 10 are simplified schematic diagrams of the limiters. Limiting is achieved by grid limiting action in stages V7 and V8. The two stages are used to obtain the required amplitude-modulated (am.) rejection characteristics. The signals from the amplifier stages are limited and fed to driver amplifier stage V9.

a. Tube V7 (fig. 9) is the first limiter stage. Signals from V6 are coupled through T6 into the grid of V7. Capacitors C51 and C52 tune T6. The signal is coupled from T6 through C53. Crystal diode CR2 improves the rectification efficiency of the grid circuit of V7, by acting as a shunt to the cathode-to-grid path of V7. The grid return for V7 is R50, which is in series with LIMITING meter Ml. LIMITING ADJ. control R51 sets the LIMITING meter to the start of the black area when the signal input level to the equipment is 5 millivolts. Capacitor C54 is the bypass for the LIMITING meter. The screen voltage of V7 is obtained from the divider comprised of R52 and R53. Capacitor C56 is the screen grid bypass. The plate load for V7 is R54. Capacitor C58 and resistor R55 provide supply voltage decoupling. Coupling between V7 output and T7 is through C57. Filament bypass is through C55 (fig. 32).

b. Tube V8 (fig. 10) is the second limiter stage. Signals from V7 are coupled through T7 to the grid of V8. Capacitors C59 and C 60 tune T7. Capacitor C61 is a dc blocking capacitor between the grid and T7. Crystal diode CR3 improves the rectification efficiency of the grid circuit of V8 by acting as a shunt for the cathode-to-grid path of V8. The grid return for V8 is through R56. Screen voltage for V8 is obtained from divider comprised of R57 and R58, which is bypassed by C63. The plate load for V8 is R59. Resistor R60 and capacitor C65 provide supply voltage decoupling. Capacitor C62 (fig. 32) is the filament bypass. Capacitor C64 provides coupling from the plate of V8 to T8.

c. Tube V9 (fig. 11) is the driver amplifier stage. Signals from V8 are coupled

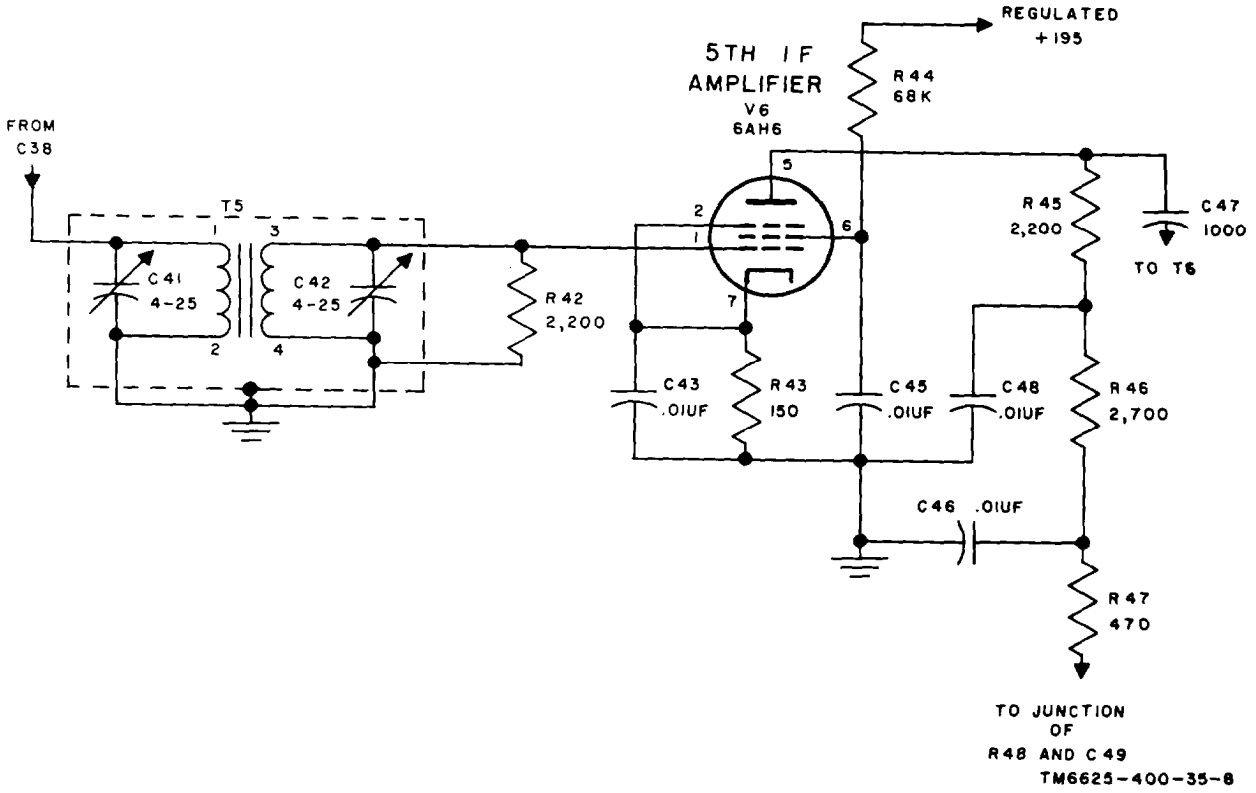


Figure 8. Fifth if. amplifier, schematic diagram.

through T8 to the grid of V9. Variable capacitors C66 and C67 tune T8. Resistor R61 lowers the Q of the secondary of T8. Resistor R62 suppresses parasitic oscillations. Operating bias for V9 is developed across R63, which is bypassed by C68. Screen voltage for V9 is obtained from screen dropping resistor R64, which is bypassed by C70. Capacitor C72 is the filament bypass. The plate load for V9 is the primary of the discriminator.

7. Discriminator
(fig. 12)

a. The discriminator is a modified Foster-Seely type and is completely enclosed in the can for T9. The discriminator receives the signals from the driver amplifier and converts the information to an audio signal with its amplitude determined by the amount of deviation from the carrier frequency. This audio signal is then fed to the audio amplifier circuits.

b. The discriminator primary is tuned to center frequency by C73. Resistor R66 loads the circuit, giving a broad response to the band of frequencies from 10.5 to 13.5 mc. Decoupling of the +240-volt unregulated supply is through R65, C71, and C72B. Coupling from the primary to the secondary of T9 is through C74. The networks consisting of R67 and C75, R68 and C76, R69 and C79, and R70 and C80, are used to obtain the desired linear wide-peak separation characteristics. Capacitor C78 is the fixed tuning capacitor for the secondary of T9. Tuning of the secondary is accomplished by the use of C77. Resistors R71 and R72 are the load resistors for CR5 and CR6. Capacitor C81 acts as stabilizer to keep the dc level constant when no deviation is present. Carrier shift indication is displayed on CARRIER SHIFT meter M2. The deflection of the meter is proportional to the voltage at pin 3 of the discriminator. Two ranges of carrier shift are available by use of the TUNE-FINE TUNE switch S4. In the TUNE position (positions shown)

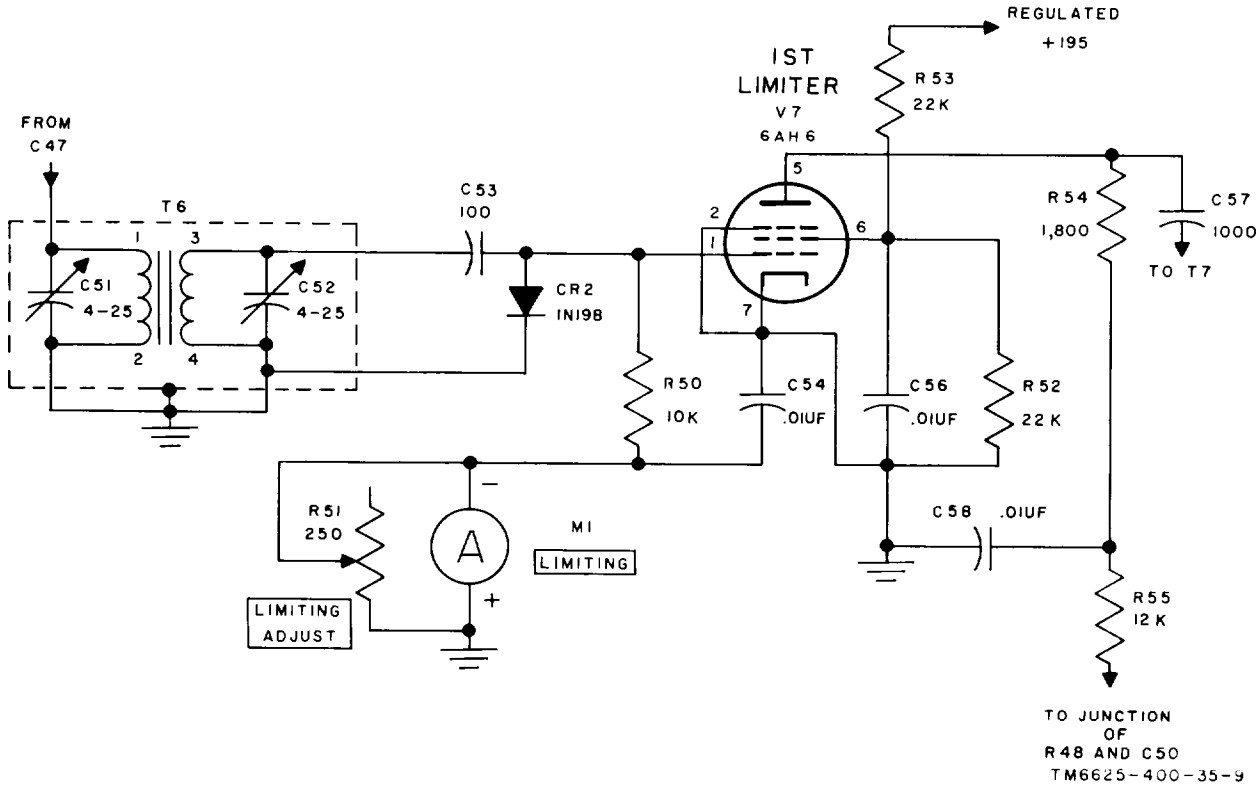


Figure 9. First limiter stage, schematic diagram.

of S4, the entire S-curve of the discriminator is displayed. In the FINE TUNE position, carrier shift up to 250 kc is displayed. Resistors R73 and R74 are in series with the CARRIER SHIFT meter to limit current through the meter. Resistor R75 is a calibration potentiometer for the FINE TUNE position of S4. Capacitors C82 and C83 are bypass capacitors. The audio signal is coupled through C84 to the grid of V10A.

8. Audio. Amplifier

The audio amplifier circuit (V10, V11, V12, and V13) is comprised of four rc-coupled stages. The low-distortion, high-stability circuit has a cathode follower input and output. The signal inputs from the discriminator are amplified and fed to DEVIATION meter M3 and the AUDIO OUTPUT terminals.

a. Tube V10 (fig. 13) is the cathode follower input and first audio stage. Resistor R76 is the grid return for V10A. The load resistor for V10A is R77. Operating bias for V10A is developed by the drop across R79. Plate decoupling is achieved by R80 and C72A. Attenuation of the audio signal is obtained by tapping off a fixed portion of the voltage applied to the voltage divider consisting of R78, R82, R83, R84, and R85. This effectively varies the range of the DEVIATION meter. Capacitor C85 provides coupling from V10A cathode to the attenuator circuit. Coupling from the attenuator to the grid of V10B is through C86. The grid return for the grid V10B is through R86. The plate load for V10B is R87. Decoupling of the supply voltage is achieved by R88 and C87. The cathode of V10B is tied to the voltage divider in the cathode of V12 (fig. 15). The cathode voltage is raised or lowered as necessary to give constant gain throughout the amplifier circuit. A bypass circuit in the plate of V10B, comprised of R89 and C88, is used to short frequencies above the audio range to ground. Signals from the plate of V10B are coupled to the grid of V11 through C106.

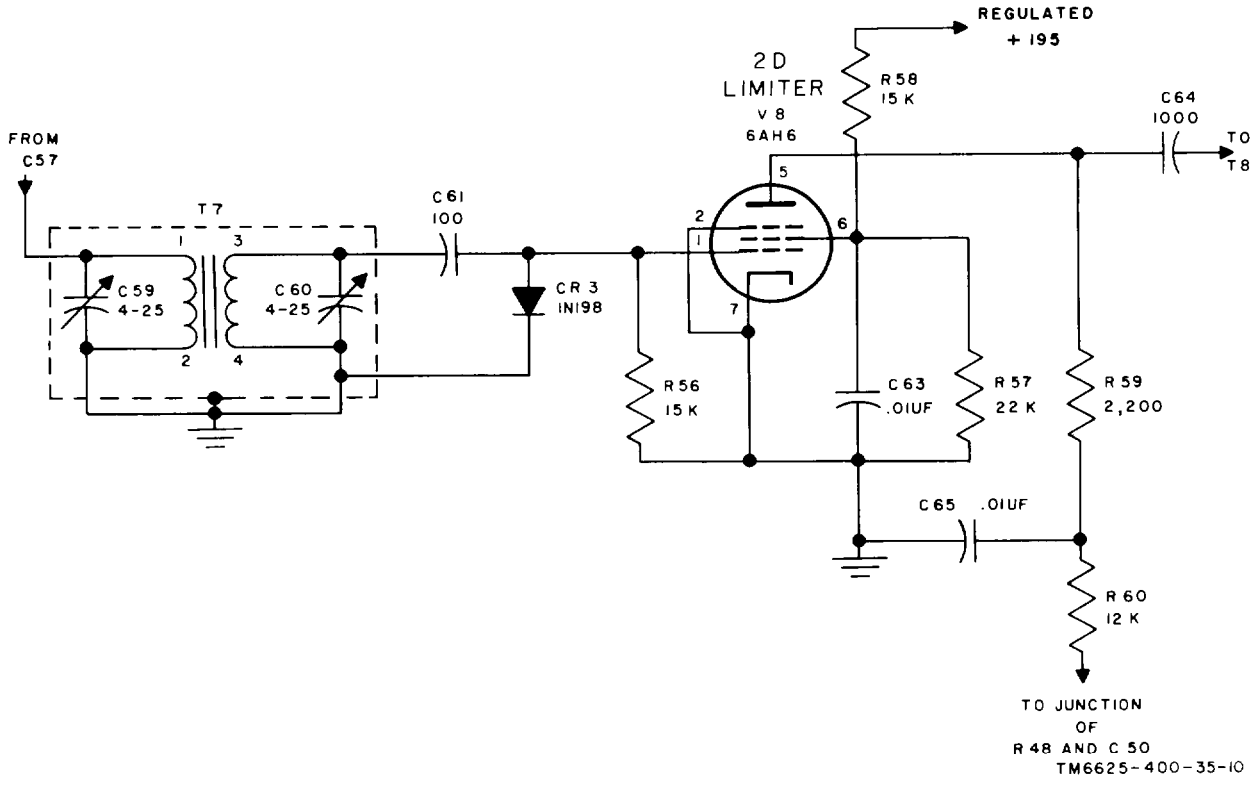


Figure 10. Second limiter. schematic diagram.

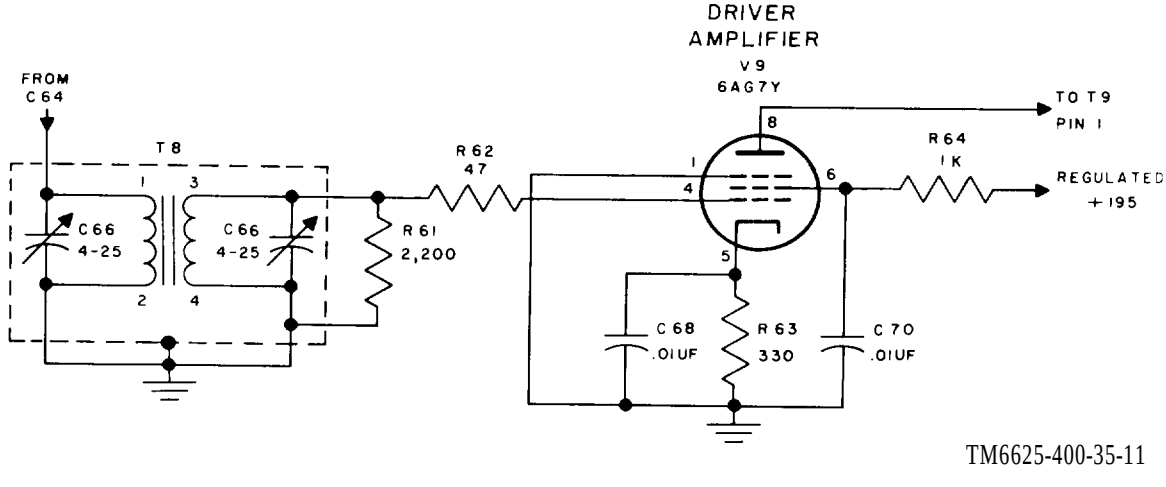


Figure 11. Driver amplifier schematic diagram.

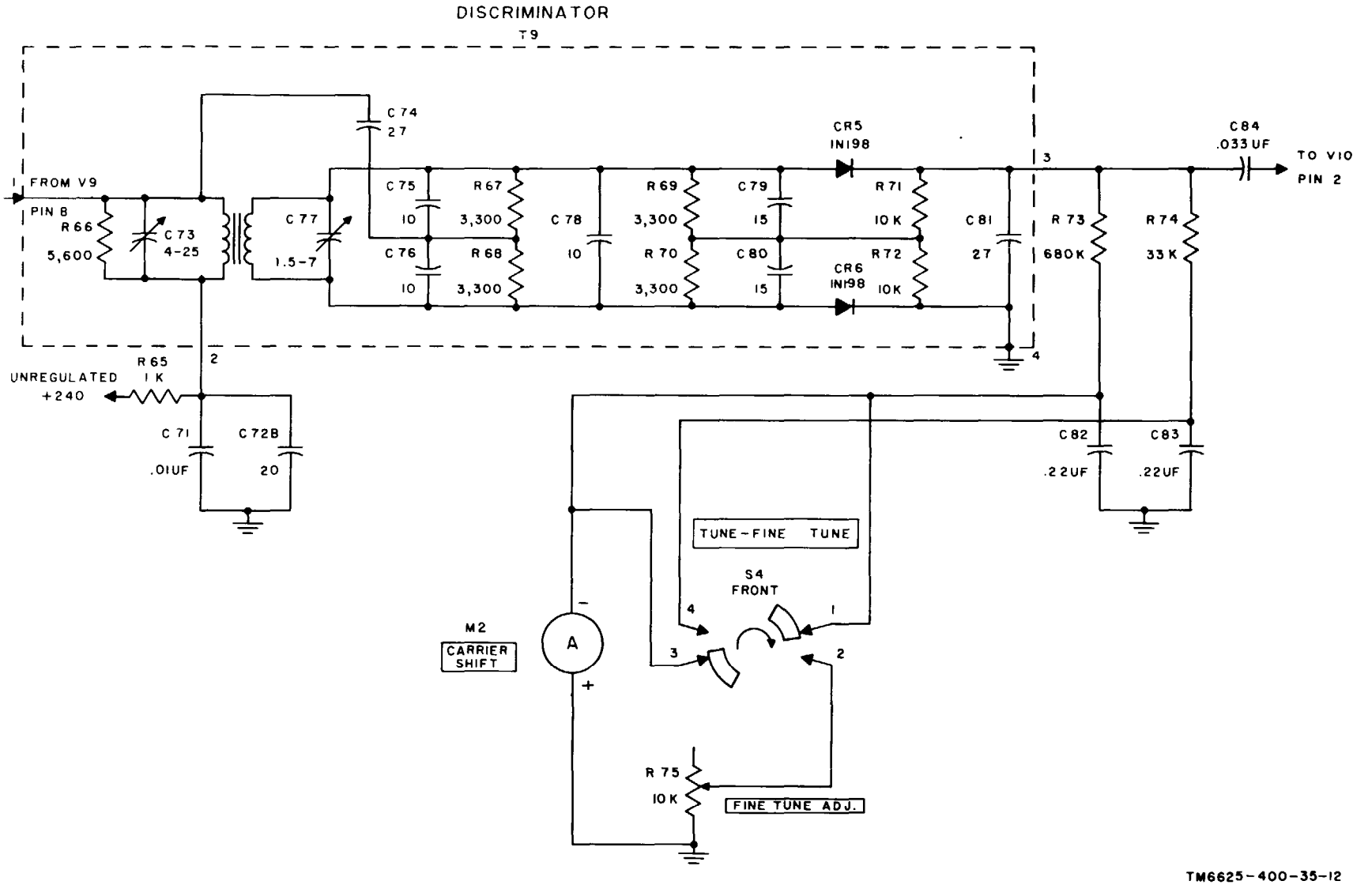


Figure 12 Discriminator, schematic diagram.

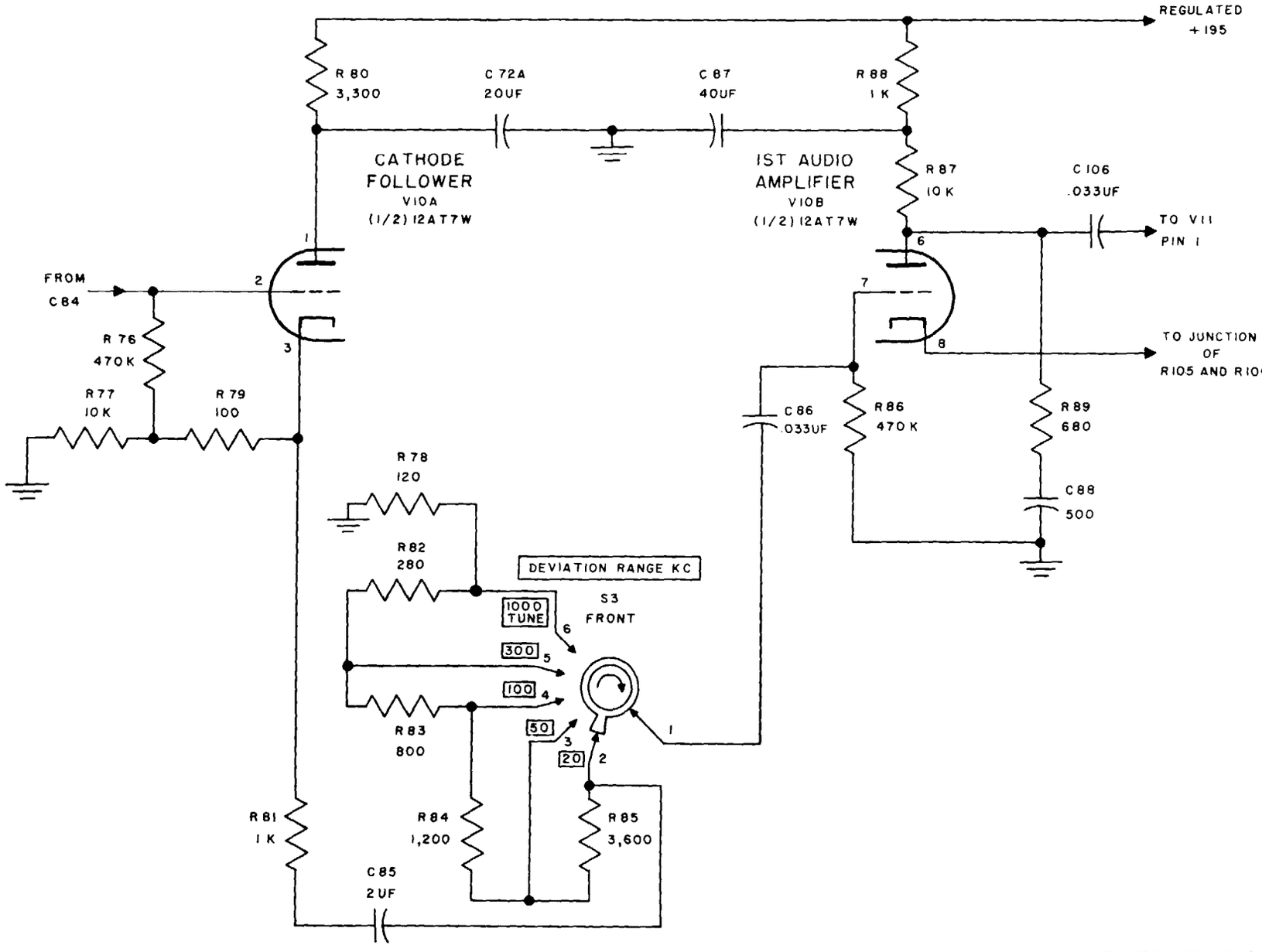


Figure 13 First audio amplifier V10, simplified schematic diagram.

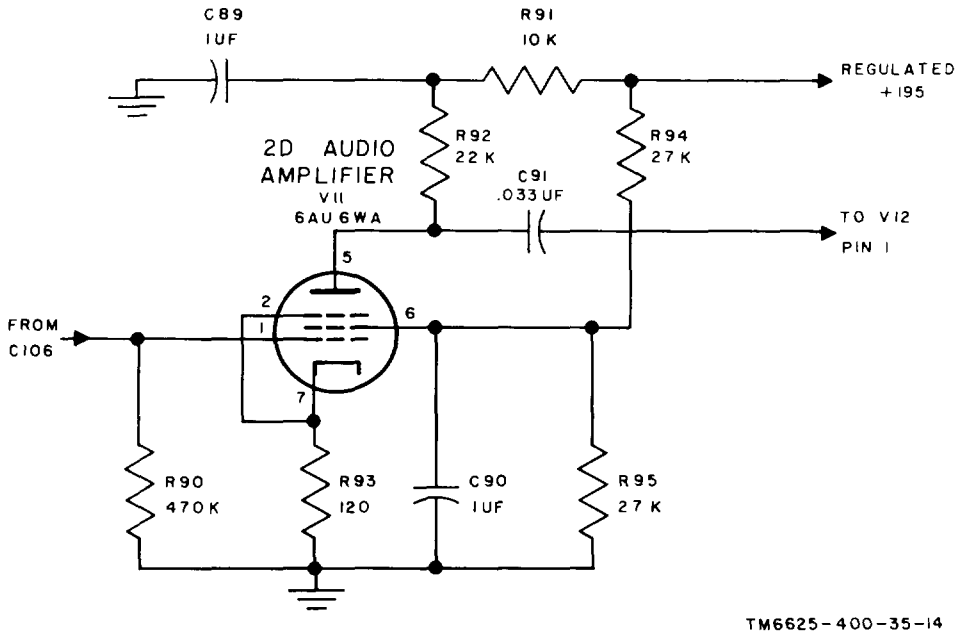


Figure 14. Second audio amplifier V11, schematic diagram.

b. Tube V11 (fig. 14) is the second audio amplifier stage. Resistor R90 is the grid return. Operating bias for V11 is derived by the drop across R93. The plate load for V11 is R92. Decoupling of the supply voltage is achieved by R91 and C89. The screen voltage is obtained from the voltage divider consisting of R94 and R95. Screen decoupling is through C90. Coupling from the plate of V11 to the grid of V12 is through C91.

c. Tube V12 (fig. 15) is the third audio amplifier stage. Resistor R100 is the grid return. Operating bias for V12 is developed by the drop across R105 and R106. The junction of R105 and R106 is the return for the cathode of V10B. The plate load for V12 consists of R104 and R103. Supply voltage decoupling is achieved by R101 and C 92 B and R102 and C92A. Screen voltage is obtained from the divider consisting of R107 and R108. Screen decoupling is through C93. Two outputs are taken from this stage. The signal from the plate is coupled through C94 to the grid of V13A. The signal from the junction of R103 and R104 is coupled through C98 to the grid of V13B.

d. Tube V13 (fig. 16) provides two cathode follower output stages. The grid return for V13A is R109. The cathode load for V13A is R112. Operating bias for V13A is developed across R111. Coupling from the cathode of V13A to the DEVIATION meter rectifier circuit is through C 96. Rectification of the audio signal is achieved by CR7 and R113. Resistor R116 limits current through the meter. Meter calibration is obtained by the setting of CAL ADJ R118. Plate decoupling for V13A is through R110 and C95. Grid bias for V13B is developed by the drop across R117. Operating bias is developed by the drop across R115. The load for the cathode of V13B is comprised of R119, R120, and R121. Resistor R120 is adjusted to give 1 volt root mean square (rms) output for 40-kc deviation on the 0-50-kc deviation range. Capacitor C99 couples the audio output to the AUDIO OUTPUT binding post. Plate decoupling for V13B is through R114 and C97.

9. Power Supply and AVC (fig. 17)

a. The 115- or 230-volt ac line voltage is stepped up by the high voltage secondary winding of T10. A full-wave bridge rectifier consisting of CR8, CR9, CR10, and CR11 provides rectification of the ac voltage. The pulsating dc is passed through

two stages of capacitor input filtering to provide an unregulated 240-volt output. Capacitors C101, C102, and C103, and inductors L11 and L12 comprise the filter network for the power supply.

b. Filtered dc voltage is applied to the plates of series regulator V15. The regulated 195-volt output is taken from the cathode of V15. Bias for the grids of V15 is obtained from the plate of dc amplifier V16. Part of the load for the cathode of V15 is comprised of R126, R127, and R128. The setting of R127 controls the fixed bias on the grid of V16. Variation in the regulated 195 volts are coupled through C 100 to the grid of V16. The screen voltage for V16 is controlled by the setting of R132. Resistors R129, R123, and R132 form a voltage divider to provide the proper screen voltage. Plate load for V16 is R124. The cathode of V16 is held constant by voltage regulator V17. Resistor R125 is a bleeder resistor for V17. The reference level for the avc circuit is controlled by R130. If the output voltage varies, the change is felt on the grid of V16. Tube V16 changes its conduction, which varies the bias on the series regulator V15. Tube V15 then changes its conduction to obtain the correct output voltage.

c. Transformer T10 has four separate filament windings. The output at terminals 7 and 8 is 6.3 volts ac. The power ON indicator lamp is DSI. The output at terminals 11 and 12 is fed to ballast tube V14. Resistor R131 in series with V14 provides a regulated 6-volt output, which is used for filaments of V1 and V13.

d. The avc circuit (fig. 32) prevents saturation of the first four if. amplifiers. The output of the fifth if. amplifier is compared to a dc reference level and, if necessary, additional bias is placed on the grids of the first four if. amplifiers. The preset level is taken from the tap on R130. This level is present on the cathode side of diode CR4. The plate of diode CR4 is connected to the junction of R41 and C40. Resistor R41 is the load for CR4, and capacitor C40 acts as a stabilizer to smooth any changes in the dc level. Whenever the positive level at the output of T6 exceeds the dc component at the cathode of CR4, current flows from plate to cathode, thereby clamping the level on the grids of V2, V3, V4, and V5.

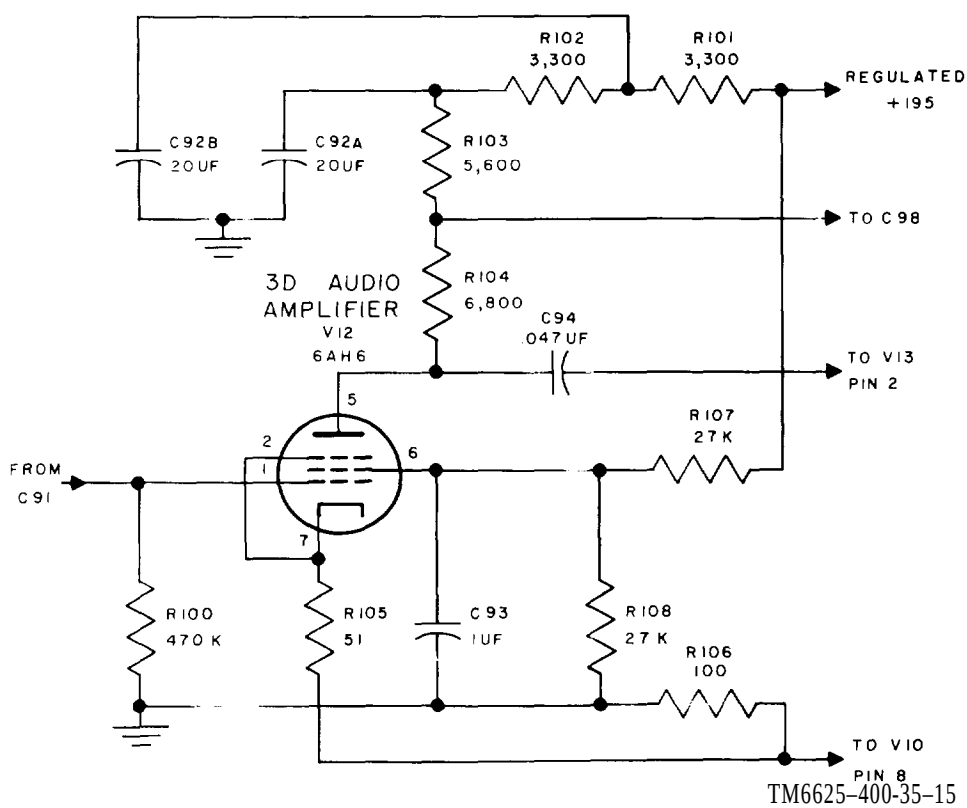


Figure 15. Third audio amplifier, schematic diagram.

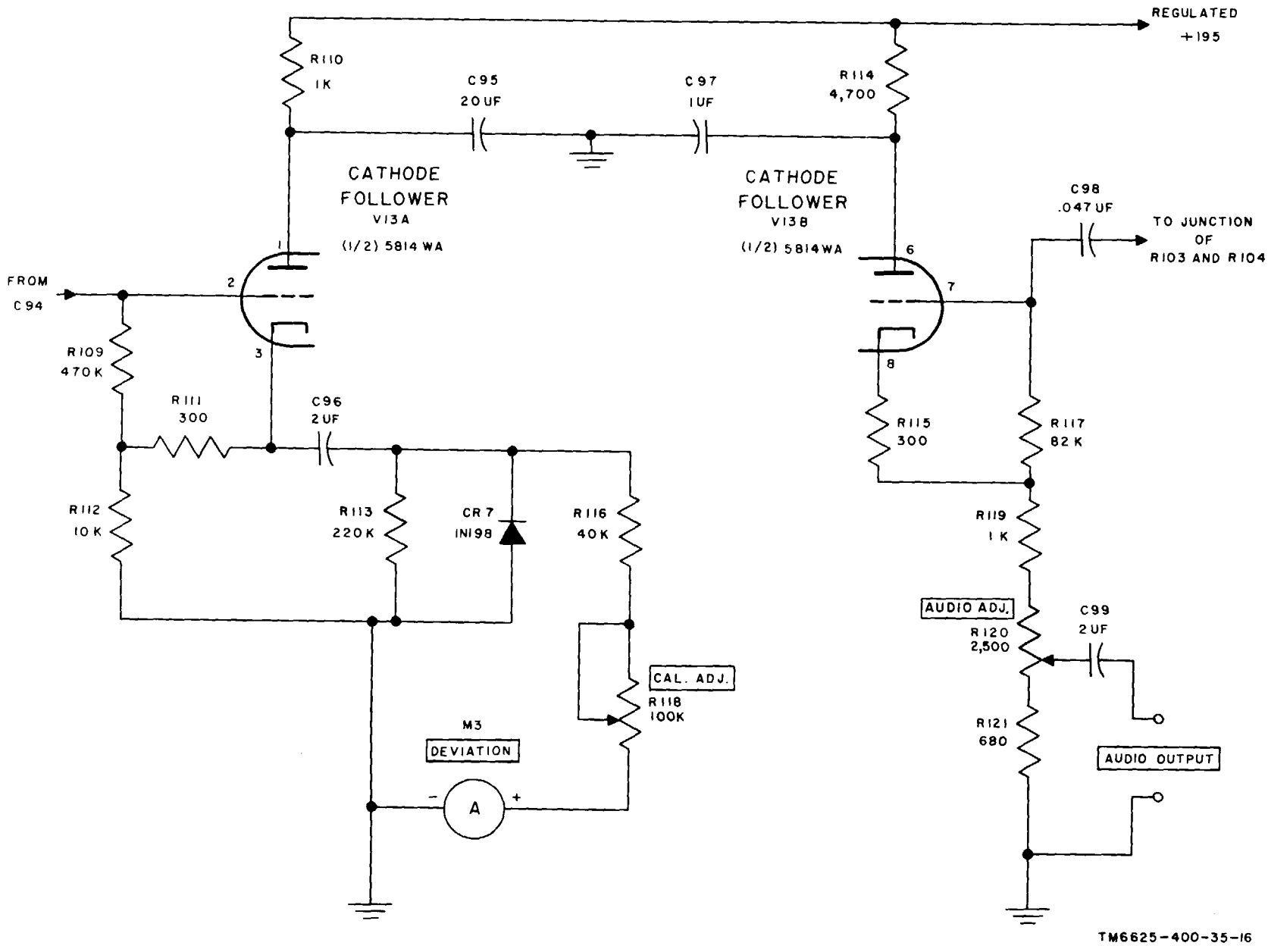


Figure 16. Fourth audio amplifier, schematic diagram.

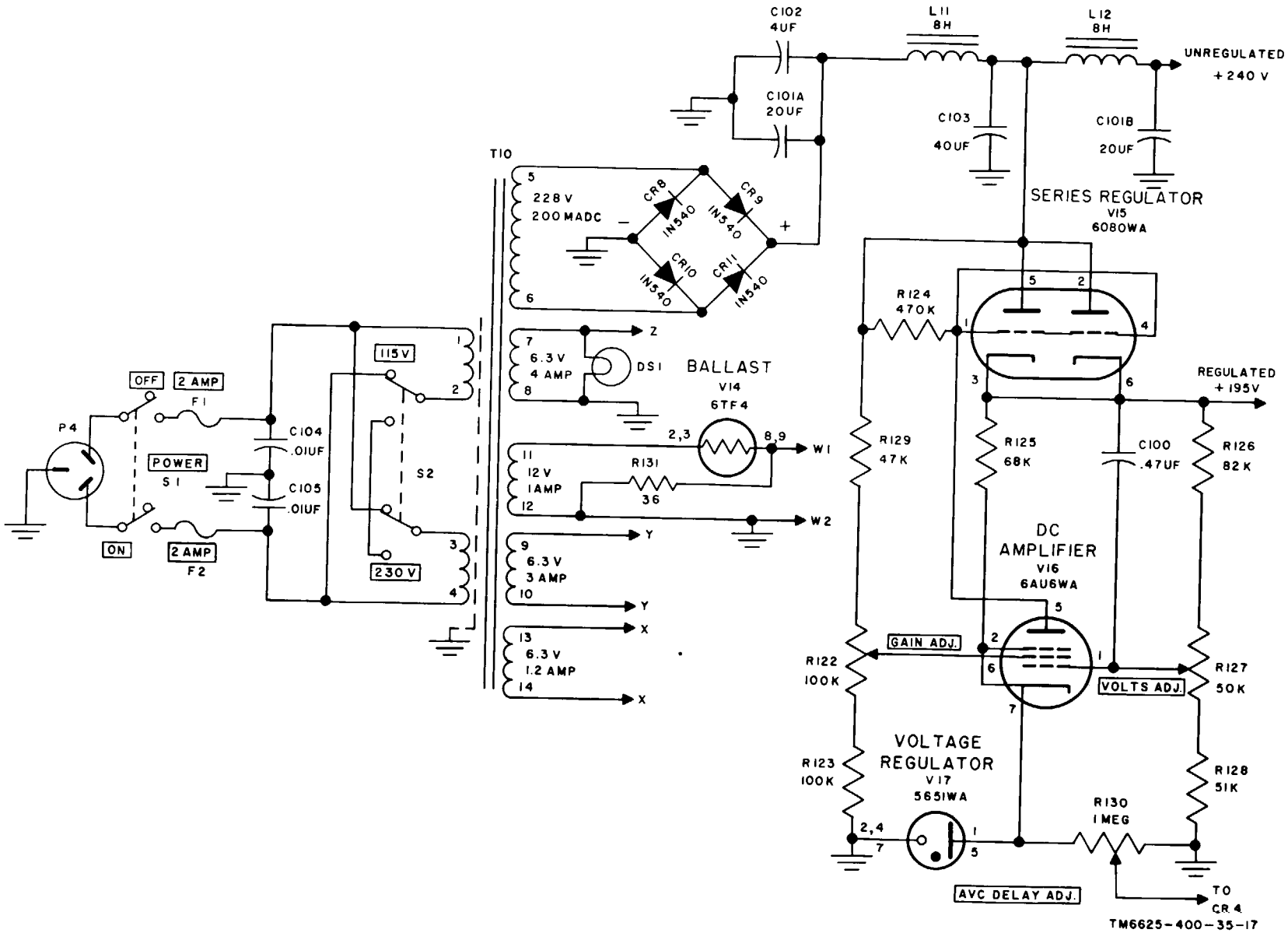


Figure 17. Power supply, simplified schematic diagram.

CHAPTER 2

TROUBLESHOOTING

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

Warning: When servicing the modulation meter, be careful when working on the ac line or dc voltages. Always disconnect the power cord from the source before changing any component.

10. General Instructions

Troubleshooting at field and depot maintenance levels includes all the techniques outlined for organizational maintenance and any special or additional techniques required to isolate a defective part. The systematic troubleshooting procedure includes sectionalizing and localizing techniques.

11. Organization of Troubleshooting Procedures

a. GeneraI. The first step in servicing a defective modulation meter is to sectionalize the fault. Sectionalization means tracing the fault to a major circuit responsible for the abnormal operation. The second step is to localize the fault. Localization means tracing the fault to a defective component which is responsible for the abnormal condition. Some faults may be located by sight; however, the majority of the trouble must be located by checking voltages and resistances.

b. Sectionalization. The modulation meter consists of five main sections: the local oscillator, the intermediate frequency amplifier, the discriminator, the audio amplifier, and the power supply. The first step in tracing trouble is to locate the circuit or circuits at fault as follows:

(1) Visual inspection. Visual inspection will help locate faults without testing or measuring circuits. All meter readings and other visual signs should be observed and an attempt made to sectionalize the fault to a particular section.

(2) Operational tests. Operational tests frequently indicate the general location of trouble. In many instances, the tests will help in determining the exact nature of the fault. The equipment performance checklist (TM 11-6625-400-12) is a good operational test.

c. Localization. The tests listed below will aid in isolating the trouble. First, localize the trouble to a single stage or circuit, and then isolate the trouble within that circuit by voltage, resistance, and continuity measurements.

(1) Signal tracing. Signal tracing (para 16) will help in isolating the fault to a specific stage.

(2) Voltage and resistance measurements. Abnormal voltage or resistance measurements may pinpoint a fault. Use resistor and capacitor color codes (fig. 29 and 30) to find the value of components. Use voltage and resistance charts (fig. 21 and 22) to find normal readings and compare them with reading taken.

(3) Troubleshooting chart. The troubleshooting chart contains symptoms which will aid in localizing trouble to a component part.

(4) Intermittent troubles. In all tests, the possibility of intermittent troubles should not be overlooked. Usually, this type of trouble can be made to occur by tapping or jarring the equipment. Check the tiring and connections to the parts of the modulation meter (fig. 33).

12. Test Equipment Required

The following chart lists test equipment required for troubleshooting Meter, Modulation ME-57/U, the associated technical manuals, and the common names.

Test equipment	Technical manual	Common name
Multimeter TS-352(*)/U[a]	TM 11-5527	Multimeter
Audio Oscillator TS-382(*)/U[b]	TM 11-6625-261-12	Audio oscillator
Multimeter ME-26(*)/U[c]	TM 11-6625-200-12	Vtvm
Generator, Signal AN/URM-70	TM 11-1258	Fm signal generator
Generator, Signal SG-92/U	TM 11-319	Sweep generator
Oscilloscope AN/USM--50(*)[d]	TM 11-5129	Oscilloscope
R. F. Signal Generator Set AN/URM-25	TM 11-5551	Low-frequency generator
Signal Generator TS-497A/URR	TM 11-5030	Am. generator
Tool Equipment TK-21/G	SB 11-260	Toolkit

[a] Represents Multimeters TS-352A/U, TS-352A/U, and TS-352B/U.
[b] Represents Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U.
[c] Represents Multimeters ME-26A/U and ME-26B/U.
[d] Represents Oscilloscopes AN/USM-50A, B, and C.

Section II. TROUBLESHOOTING METER, MODULATION ME-57/U

Caution: Do not attempt removal or replacement of parts before reading the instructions in paragraph 20.

13. Checking Filament and B+ Circuits for Shorts

a. When to Check. When any of the following conditions exist, check for short circuits and clear the troubles before applying power.

(1) When the modulation meter is being serviced and the nature of the abnormal symptoms is not known.

(2) When the abnormal symptoms reported from operational test indicate possible power supply troubles, (step 8, equipment performance checklist, TM 11-6625-400-12).

b. Conditions for Test.

(1) Remove the dust cover.

(2) Remove all tubes from their sockets.

(3) Remove the power indicator lamp.

c. Measurements. Make the resistance measurements indicated in the following chart. If abnormal results are obtained, make the additional isolating checks outlined below. When the faulty part is found, repair the trouble before applying power to the unit.

Point of measurement	Normal indication	Isolating procedure
Between ground and pin 9 of XV13.	Resistance should be approximately 36 ohms.	If resistance is zero, check for short at XV13 (fig. 19) or shorted lead from J4 (fig. 18) or at Z1 on the oscillator. If the resistance is infinite, check for open resistor R131 on TB6 (fig. 19) .
Between ground and pin 4 of XV16.	Infinite resistance.	If a short or finite resistance is read, check the wiring to and at sockets XV15 and XV16 (fig. 19).
Between ground and pin 9 of XV10.	Infinite resistance.	If a short or finite resistance is read, check the wiring to and at sockets XV10, XV11, and XV12 (fig. 19).
Between ground and the junction of C101A and C102. Be sure of meter polarity to obtain correct reading. (The higher of the two read-	Resistance should be approximately 250K.	If resistance is zero, check for shorted filter capacitor C101A or C102. If resistance is approximately 110 ohms, check for short in C103. If resistance is approximately 165 ohms, check for short in C101B or bypass capacitor C50. If any other resistance below

Point of measurement	Normal indication	Isolating procedure
ings is the correct one.) *Note:* If using the TS-352(*) /U, the lead connected to the OHMS connector should be grounded.		250K is observed, check all the bypass capacitors (fig. 20 and 32).
Between ground and pin 6 of XV15.	Resistance should be approximately 10K; reading will be determined by setting of R130.	If resistance is less than 10K, check all screen bypass capacitors (fig. 20 and 32). If resistance is higher than 10K, check R130 for open (fig. 19).

14. Test Setup

a. The modulation meter measures deviation of a frequency-modulated carrier. Some faults with the modulation meter can be determined by using an unmodulated carrier input. The use of an unmodulated carrier can help determine faults in the local oscillator, if., limiter, and discriminator circuits. A modulated carrier is required to completely check the discriminator and the audio circuits.

b. Connect the output of the fm signal generator to the input connector of the modulation meter (fig. 28). Connect a vacuum-tube voltmeter to the audio output of the modulation meter. Use a shielded lead.

15. Localizing Trouble

a. General. The procedures in the troubleshooting chart are presented in sequence so that the user can trace the fault to the particular stage. When trouble has been traced to a stage, a tube check or voltage and resistance measurements should disclose the defective component part.

b. Use of Chart. The troubleshooting chart is designed to supplement the operational checks in TM 11-6625-400-12. If no operational symptoms are known, begin with item 1 of the equipment performance checklist (TM 11-6625-400-12) and proceed until a symptom of trouble appears.

Caution: If operational symptoms are not known, or if they indicate the possibility of short circuits, check for shorts as described in paragraph 13.

c. Troubleshooting Chart.

Symptom	Probable trouble	Correction
1. Power indicator lamp DS1 does not light, no filament or B+ voltage.	No ac power is applied to the power transformer.	Check ac source.
	Defective POWER switch S1.	Check power cord.
	Open fuse F1 or F2 in power supply.	Replace switch S1.
		Replace fuse. If replaced fuse blows, check size of fuse (2 amp, 250V, type 3AG for 115-volt operation and 1 amp, 250V, type 3AG for 230-volt operation). Check capacitors C101 and C102 for short circuit.
2. Power indicator lamp DS1 does not light. Modulation meter is operative.	Defective lamp DS1 or defective lamp socket.	Replace lamp DS1. Replace socket.
3. With unmodulated carrier input, LIMITING meter M1 does not read at any position of the FREQUENCY RANGE-MC switch or TUNING control.	Defective mixer diode CR1.	Replace CR1.
	Defective local oscillator tube V1.	Replace V1 (para 22c).
	Defective if. amplifier stages V2 through V6.	Check tubes and voltages and resistances (fig. 21 and 22).
	Defective limiter stage V7.	Check tube. Check voltages and resistances.
	A defective component in the limiting indicator circuitry.	Check M1 and R51.
4. With unmodulated carrier input, LIMITING meter M1 reads at frequency other than that of incoming signal. FREQUENCY RANGE-MC switch setting is correct.	Dial slipped on tuning shaft.	Set dial to proper reading; tighten setscrews (fig. 31).

Symptom	Probable trouble	Correction
Note: Be sure that the frequency at which the LIMITING meter is indicating is not an image.		
5. With unmodulated carrier input, LIMITING meter M1 reads at frequency not within the correct FREQUENCY RANGE-MC setting.	Rotor in oscillator is not aligned with FREQUENCY RANGE-MC switch setting.	Set rotor to correct band; align shafts and knob (fig. 31).
6. With unmodulated carrier input, CARRIER SHIFT meter M2 does not respond as TUNING control is varied.	Defective limiter tube V7.	Replace V7.
	Defective stage V8 or V9.	Replace defective tube. Check voltages and resistances (fig. 21 and 22).
	Defective components within T9.	Check and replace any defective part in T9.
	Faulty contacts on switch S4.	Replace switch S4 (para 24).
	Defective meter M2 or associated circuitry.	Replace defective components.
7. With unmodulated input, DEVIATION meter M3 reads some amount of deviation.	Unstable local oscillator caused by defective component in local oscillator circuit.	Check and replace any defective component in the local oscillator circuit.
8. Frequency-modulated signal applied to input. LIMITING and CARRIER SHIFT meters read correctly. DEVIATION meter does not read. No audio output at AUDIO OUTPUT terminals.	Defective tube V10, V11, V12, or V13.	Replace defective tube.
	Defective component in audio amplifier circuitry.	Replace defective component.
	Faulty contacts in switch S4.	Replace switch S4 (para 24).
9. With modulated carrier, DEVIATION meter readings are present; no audio output.	Defective tube V13.	Replace V13.
	Defective component in V13B circuit.	Measure voltages and resistances (fig. 21 and 22). Replace defective component.
10. With modulated carrier, no DEVIATION meter readings are present; voltages are at AUDIO OUTPUT terminals.	Defective tube V13.	Replace V13.
	Defective meter M3.	Replace meter M3.
	Defective components in V13A circuit.	Measure voltage and resistance (fig. 21 and 22). Replace defective component.
	Improper adjustment of AVC DELAY ADJ. R130.	Adjust R130 (para 30).
11. CARRIER SHIFT and DEVIATION meter readings are normal. No limiting indication on LIMITING meter. Adjustment of R51 has no effect.	Defective meter M1.	Replace meter M1.
	Shorted potentiometer R51.	Replace R51.
	Shorted capacitor C54.	Replace C54.
12. CARRIER SHIFT and DEVIATION meter readings are normal. LIMITING meter needle is pegged at top of scale.	Improper adjustment of R51 (LIMITING ADJ).	Adjust R51 ADJ.
	Open potentiometer R51.	Replace R51.
	Avc circuit inoperative or improperly adjusted.	Check all components of the avc circuits and replace defective ones. Adjust AVC DELAY ADJ. R130 (para 30).
13. With modulated signal input, LIMITING and DEVIATION meter readings are correct; CARRIER SHIFT meter does not read as TUNING control is varied.	Resistor R73 or R74 open.	Replace R73 or R74.
	Capacitor C82 or C83 shorted.	Replace C83 or C84.
	Defective meter M2.	Replace meter M2.
	Defective switch S4.	Replace switch S4.
14. With modulated signal input, all meters do not read.	Defective power supply.	***Warning:* The 5651WA tube contains radioactive material. Handle carefully to avoid breaking.** Check all power supply components.
	Defective mixer diode CR1.	Replace CR1.
	Defective oscillator stage V1.	Check all components in the local oscillator.
	Defective if. amplifier stage V2 through V6.	Check tubes and voltage and resistance readings (fig. 21 and 22).

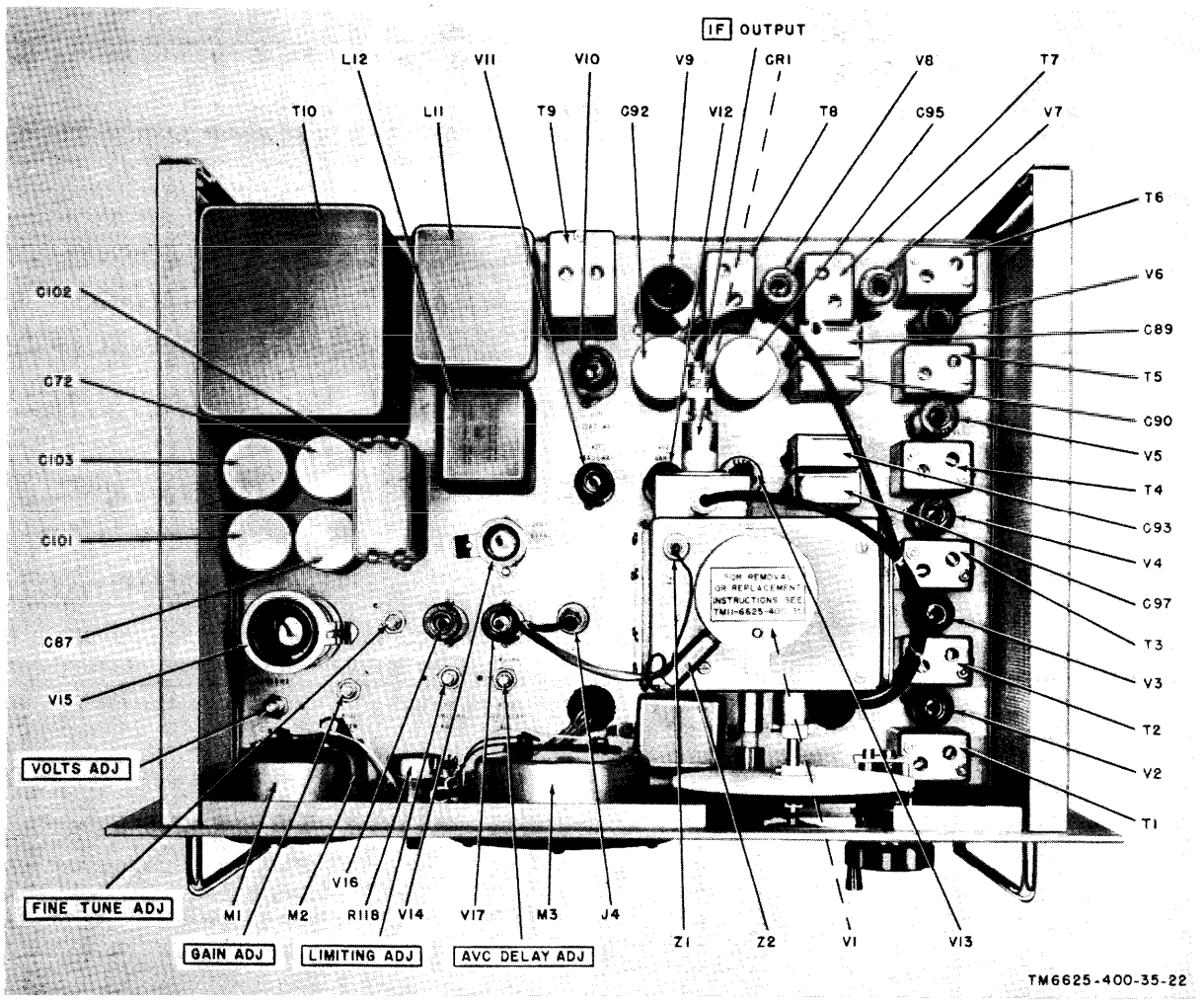


Figure 18. Modulation meter, top view.

16. Signal Substitution

a. General. Signal substitution procedures help to localize troubles to a section or stage in the modulation meter. An externally generated signal is substituted for the signal normally present in each stage. The test equipment required is listed in paragraph 12. In the following tests, ground one side of the external generator to the modulation meter chassis and the other side to the point indicated in the test procedures below.

b. Oscillator Substitution. If the oscillator is suspected of malfunctioning or nonoperation, the am. generator may be used to apply an if. signal to the if. amplifier strip. Proceed as follows:

(1) Disconnect the rf cable at the if. input mixer connection (fig. 18).
(2) Connect the am. generator output to this cable. (Be sure that the modulation selector switch is in the OFF position.)
(3) Tune the am. generator to 12 mc and increase the output until the LIMITING meter indicates in the black area.
(4) Check the indication on the CARRIER SHIFT meter. It should read nearly zero with TUNE-FINE TUNE switch in FINE TUNE position. If it does not read zero, tune the am. generator until it does.

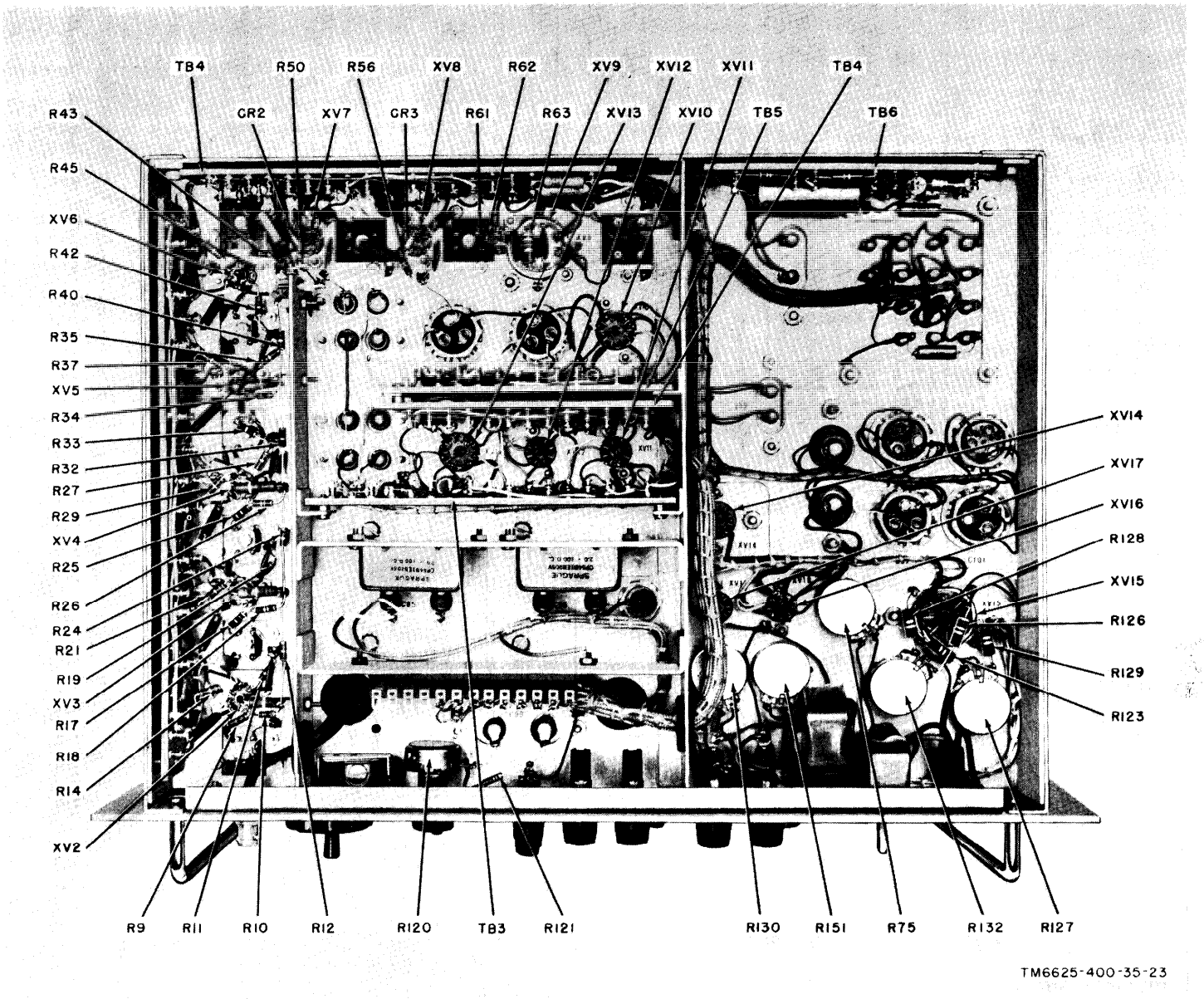


Figure 19. Modulation meter, bottom view showing resistor location.

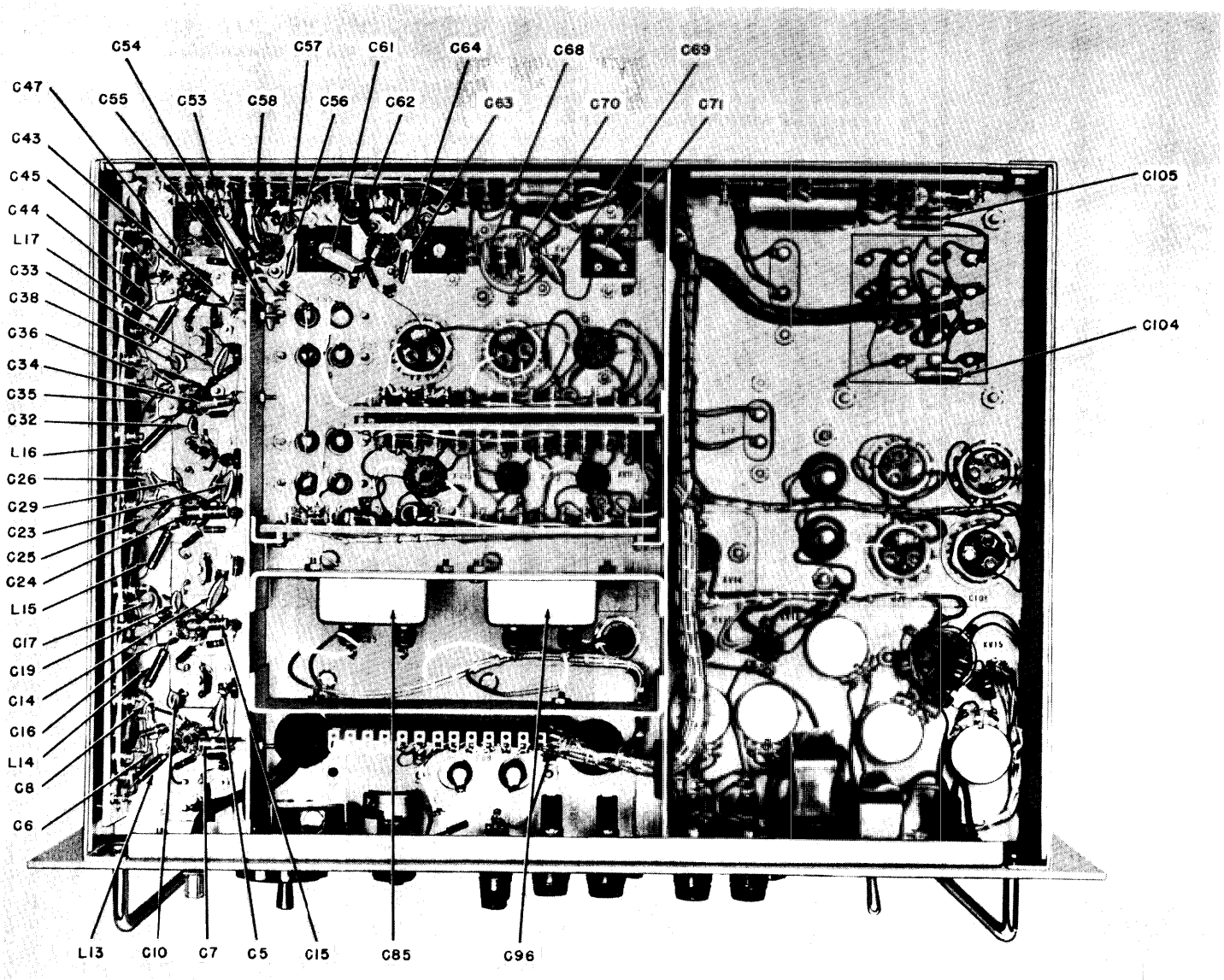
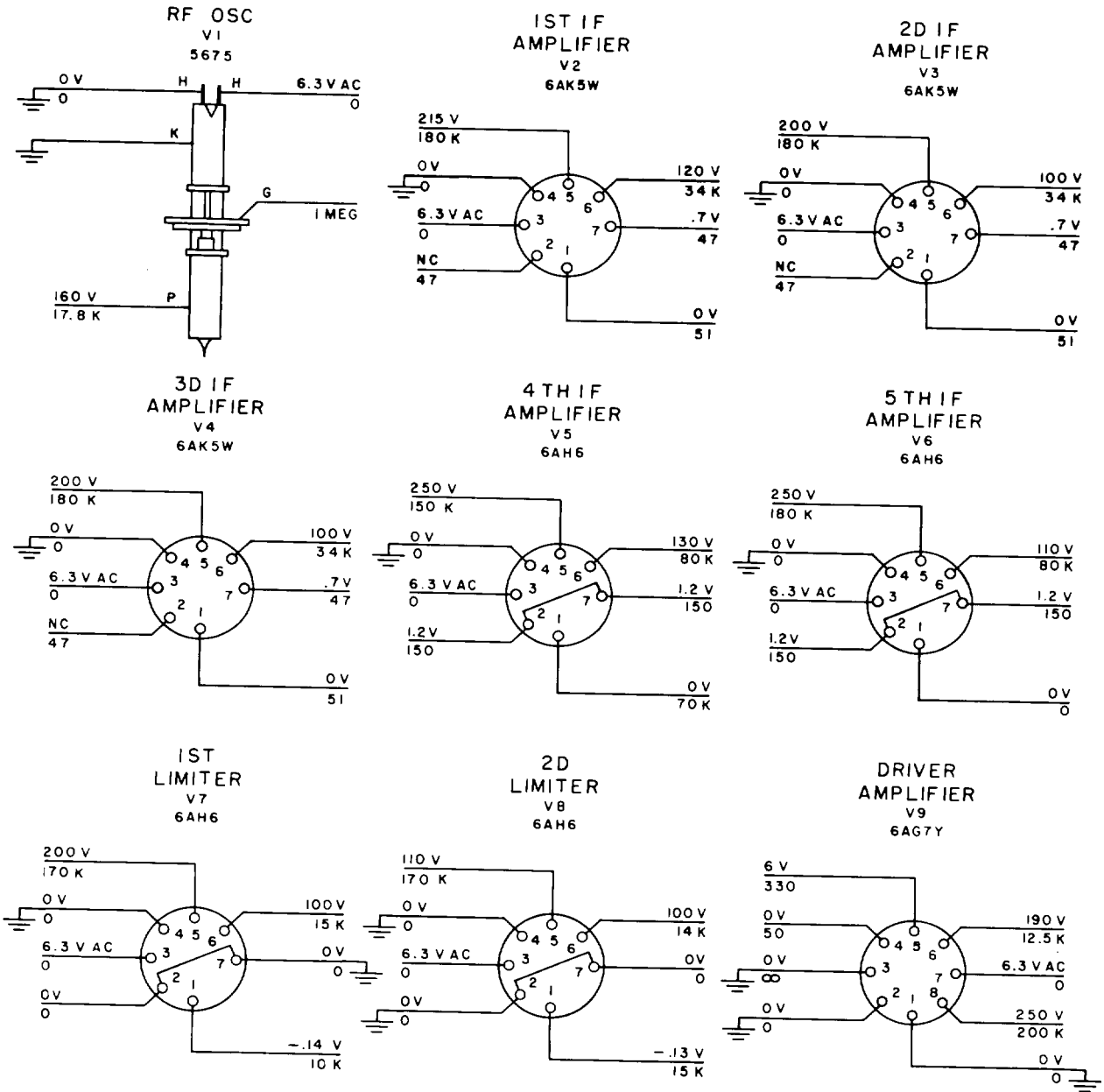


Figure 20. Modulation meter, bottom view showing inductor and capacitor location.



NOTES:

1. ALL VOLTAGE AND RESISTANCE MEASUREMENTS MADE WITH THE [TUNE-FINE TUNE] SWITCH IN THE [TUNE] POSITION AND THE [DEVIATION RANGE-KC] SWITCH IN THE [1000 TUNE] POSITION.
2. ALL VOLTAGE MEASUREMENTS MADE WITH LINE VOLTAGE SWITCH SET TO [115 V] AC POSITION.
3. ALL RESISTANCE MEASUREMENTS MADE WITH POWER SWITCH OFF.
4. ALL VOLTAGES ARE MEASURED TO GROUND AND ARE DC UNLESS OTHERWISE SPECIFIED.
5. DC VOLTAGE MEASURED WITH 20,000 OHMS/VOLT METER.
6. AC VOLTAGE MEASURED WITH 10,000 OHMS/VOLT METER.
7. RESISTANCE MEASUREMENTS ARE MEASURED TO GROUND.
8. NC INDICATES NO CONNECTION.

TM6625-400-35-18 (1)

Figure 21(1). Tube socket voltage and restitance diagram (part 1 of 2).

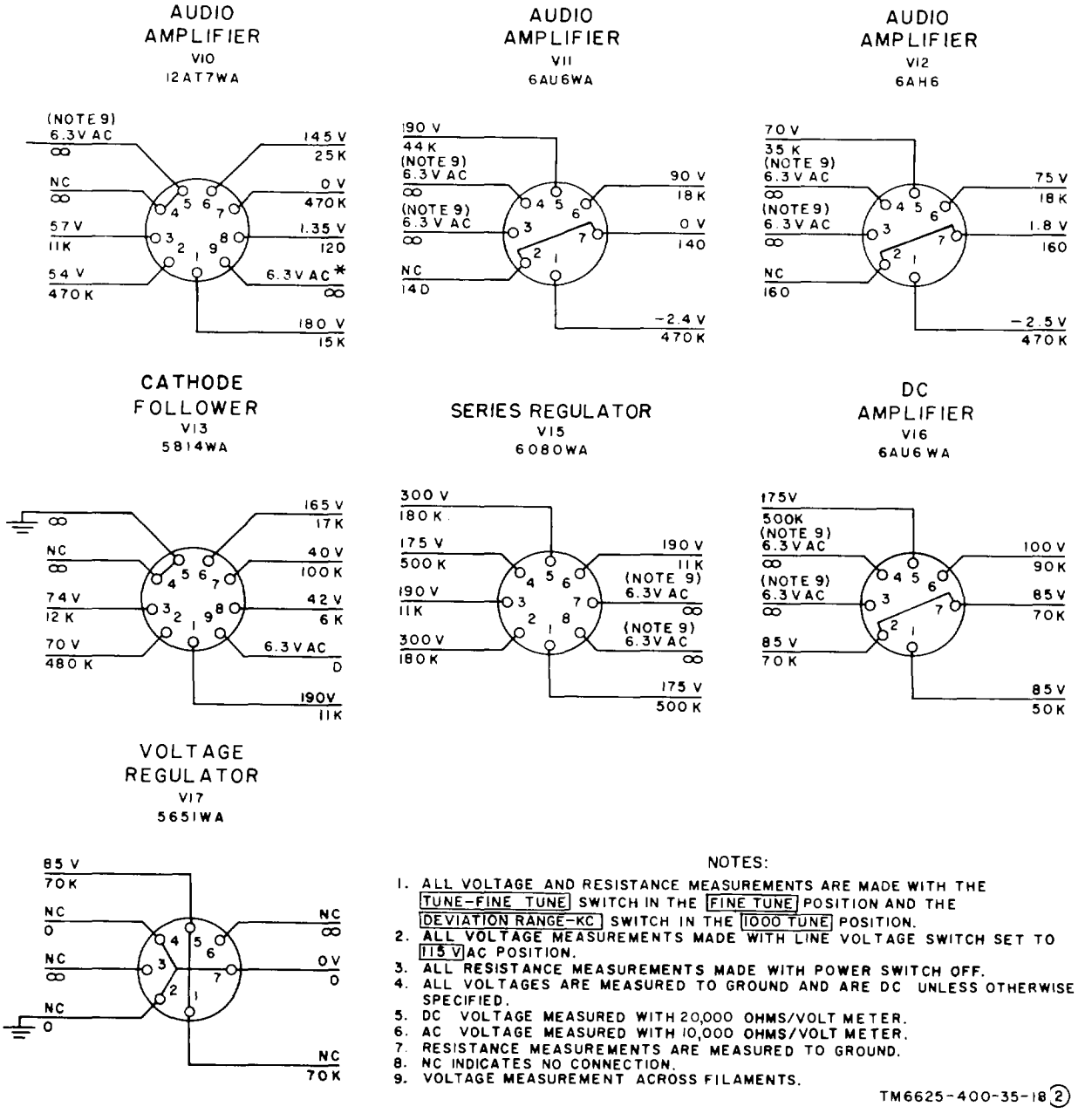


Figure 21 ② . Tube socket voltage and resistance diagram (part 2 of 2).

(5) If LIMITING and CARRIER SHIFT meter readings are indicated, the oscillator probably is faulty.

(6) If the LIMITING meter reading cannot be indicated, the trouble is probably in the if. amplifiers.Ifthe if. amplifiers are suspected of being faulty, use the test method given in c below.

c. Intermediate Frequency Amplifiers.

(1) Connect the rf output of the sweep generator to the if. input of the modulation meter.

(2) Connect the sweep output of the sweep generator to the external sweep connections on the oscilloscope.

(3) Set the sweep generator frequency

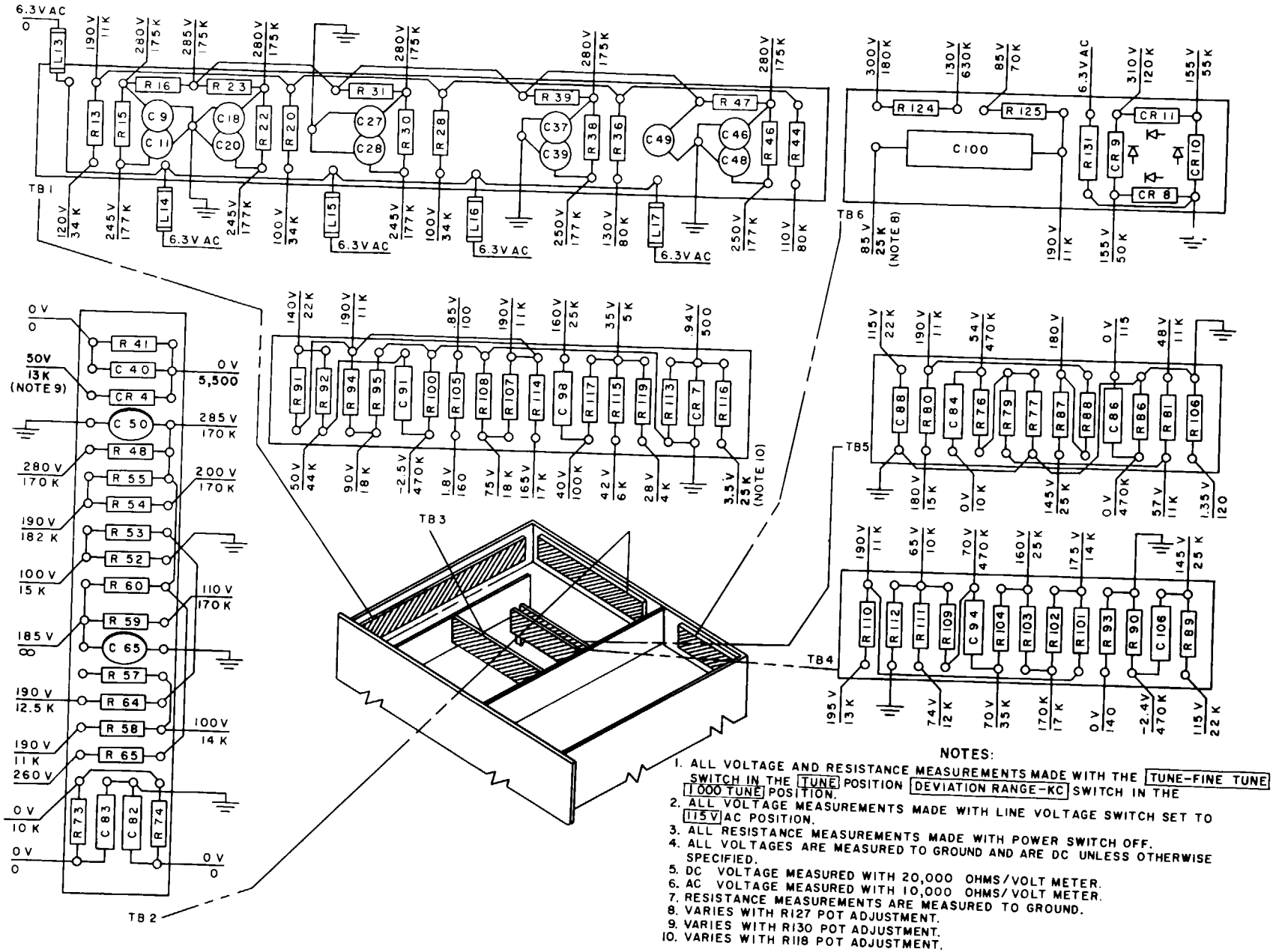


Figure 22. Terminal board voltage and resistance diagram.

to 12 mc and the sweep from 10.5 through 13.5 mc.

(4) Use the oscilloscope to observe the bandpass of the if. amplifiers. Start at the cathode of V6. If no bandpass is present at this point, check at the cathode of the preceding stage until the faulty stage is located. Check all the components of the faulty stage.

d. Discriminator Substitution, If a modulated signal input gives an indication on the CARRIER SHIFT meter, but does not indicate deviation, the audio circuit is probably faulty. Use the audio oscillator to simulate the discriminator output.

(1) Disconnect pin 3 of the discriminator can (T9) and connect the lead to the audio oscillator output.

(2) Set the audio oscillator frequency between 50 and 70,000 cycles per second (cps).

(3) Monitor the audio oscillator level with the vtvm. Set the voltage at 0.16 volt rms.

(4) Use the oscilloscope and observe the waveform in the audio circuit.

17. Audio Circuit Stage Gains

Follow the procedure in paragraph 16d to check the gain of each audio stage. The gain should be as follows:

Test connections	Input voltage	Output voltage	Gain
Pins 2 (grid) and 1 (plate) of V10A	0.16	0.11	0.7
Pins 7 (grid) and 6 (plate) of V10B	0.11	0.07	0.07
Pins 1 (grid) and 5 (plate) of V11	0.07	3.6	52
Pins 1 (grid) and 5 (plate) of V12	3.6	9.7	2.7
Pins 2 (grid) and 1 (plate) of V13A	9.7	9.2	0.94
Pins 7 (grid) and 6 (plate) of V13B	9.2	8.7	0.94

18. Isolating Trouble Within Stage

When trouble has been localized to a stage, either through operational checks, troubleshooting (para 15), or signal substitution (para 16), use the following techniques to isolate the defective part:

Warning: The 5651WA tube contains radioactive material. Handle carefully to avoid breaking.

a. Test the tube involved either in a tube tester, or by substituting a similar type tube which is known to be operating normally (TM 11-6625-400-12).

b. Take voltage measurements at the tube sockets (fig. 21 and 22) and other related points to the stage in question.

c. If voltage readings are abnormal, take resistance readings (fig. 21 and 22) to isolate open and short circuits. Refer to the dc resistances of transformers and coils (para 19a).

d. If signals are weak and all checks fail to indicate a defective part, check the alignment of the if. and limiter stages (para 27 and 28).

e. Use the wiring diagram (fig. 33) to trace circuits and isolate the faulty component.

19. Additional Troubleshooting Data

The items listed below will help the repairman troubleshoot the modulation meter.

a. Dc Resistances of Transformers and Coils. The dc resistances of the transformer windings in the modulation meter are as follows:

Transformer or coil	Terminals	Ohms
T10	1-2	1.5
	3-4	1.5
	5-6	14.0
L1	1-2	115
L2	1-2	170

b. Band Switching Difficulty.

(1) If the FREQUENCY RANGE-MC switch does not operate properly, the trouble may be with the detent mechanism (fig. 31). The detent is properly positioned when it locks into the notch on the rotor while all rotor contacts are fully engaged in the mating contacts on the tuning capacitor and output block.

(2) If the FREQUENCY RANGE-MC switch rotates freely, check the setscrews (fig. 31) that hold the rotor to the shaft or the dial or shutter to the shaft. They may have become loose.

CHAPTER 3

REPAIR SAND ALIGNMENT

Section I. REPAIRS

20. General Parts Replacement Techniques

Most of the parts of the modulation meter can be reached and replaced easily without special tools or procedures. Observe the following precautions:

a. When replacing diodes CR2 through CR11, use a pair of pliers or some other device which will act as a heat sink to protect the diode from excessive heat.

b. Remove the cover to replace parts in the discriminator circuit (contained in T9, fig. 24). It may be necessary to remove the entire assembly from the chassis. When replacing the cover, be sure that the connections on C 72 do not touch the can. These connections are at high potentials to ground.

21. Removal of Oscillator Unit

a. Removal.

(1) Loosen the setscrews on the TUNING knob and pull off the knob.
(2) Remove the cross recessed screw from the FREQUENCY RANGE-MC knob and pull off the knob.
(3) Disconnect P3 from J4 by unscrewing P3. Disconnect the if. cable from the mixer housing (fig. 18).
(4) Remove the shields and tubes V11, V12, and V13.
(5) Hold oscillator assembly and remove the four screws on the underside of the chassis that hold the oscillator unit to the chassis (fig. 20).
(6) Lift the oscillator unit carefully from the chassis.

b. Replacement.

(1) Replace the oscillator unit on the chassis in its approximate location.
(2) Replace the four screws from the underside of the chassis (fig. 20).
(3) Replace tubes V11, V12, and V13 and their shields.
(4) Connect P3 to J4. Connect the if. cable to the mixer housing (fig. 18).
(5) Place the FREQUENCY RANGE - MC knob on the rotor shaft and replace the cross recessed screw. Be sure that the pointer is in the correct position.
(6) Place the TUNING knob on the tuning shaft and tighten the setscrews.

22. Disassembly and Reassembly of Local Oscillator (fig. 31)

To replace any part of the oscillator remove the oscillator from the c h ass is (para 21).

a. Disassembly.

Note: Disassemble the oscillator assembly only as far as needed to replace a worn or broken component.

(1) Rotate the rotor (23) to a position between two bands, to disengage the contacts attached to the tubeholder assembly (17) and capacitor contact assembly (28). This will prevent damaging them.
(2) Loosen the setscrews (24) in the rotor hub.
(3) R e m o v e the retaining ring (10) from the groove in the rotor shaft (9) .
(4) Release the tension on the detent arm (5) by loosening the screw (3) that holds it to the detent bracket (4).
(5) Hold the rotor (23) and pull the rotor shaft (9) out.
(6) Remove the rotor (23).
(7) Remove tube V1 (para 23).
(8) Remove resistors R7 (60) and R8 (61) from the grid and plate contacts of V1.
(9) Loosen the two setscrews (38) that

hold the tuning capacitor (31) shaft to the coupling (39). Pull out the coupling (39) until it is flush with the inside of the housing (1).

(10) Remove the screws (3), lockwashers (6), and hexagonal nuts (7) that hold the tuning capacitor (31) to the mounting bracket (30).

(11) Remove the tuning capacitor (31) and the plateholder assembly (17), capacitor contact assembly (28), and the rotor contacts.

b. Reassembly.

(1) Mount the plateholder assembly (17) and capacitor contact assembly (28) on the tuning capacitor (31).

(2) Replace the tuning capacitor (31) on the mounting bracket (30); use the screws (3), lockwashers (6), and hexagonal nuts (7).

(3) Place the coupling (39) over the tuning capacitor shaft.

(4) Tighten the setscrews (38) on the shaft.

(5) Tighten the screws that hold the tuning capacitor (31) to the bracket (30). Be sure that the shaft rotates freely.

(6) Replace resistors R7 and R8 to the capacitor contact assembly (28) and plateholder assembly (17) contacts.

(7) Replace V1.

(8) Replace the rotor shaft (9) in its original position.

(9) Push the rotor shaft (9) into position.

(10) Tighten the detent arm (5) by tightening the screw (3) attached to the detent bracket (4).

(11) Replace the retaining ring (10) in the groove in the rotor shaft (9).

(12) With the rotor in position, tighten the setscrew (24) on the rotor hub.

c. Replacement of Electron Tube V1 (fig. 23).

(1) List up the lid that covers the tube enclosures.'

(2) Remove the two screws that hold the tube socket bracket assembly.

(3) Lift off the socket bracket assembly.

(4) Remove the two remaining screws.

(5) Lift off the upper disk, the cathode contact, and the lower disk.

(6) Pull the tube straight up to remove it from the plate contact.

(7) Insert new tube into the plate contact.

(8) Be sure that the grid makes contact with the grid contact mounting of the tuning capacitor.

(9) Replace the lower disk, cathode contact, and upper disk.

(10) Replace the two screws that do not hold the socket bracket.

(11) Place the socket bracket assembly over the tube pins.

(12) Replace the two screws that hold the socket bracket.

(13) Check the continuity of filament circuit.

(14) Close the lid.

23. Equipment Adjustments

If repairs or replacements have been made within the oscillator, it may be necessary to adjust the shutter or dial on its shaft. Make these adjustments as follows:

a. Shutter Assembly (fig. 31).

(1) Rotate the rotor (23) to the position that will put the 20- to 55-mc coil on the rotor (23) in contact with the tuning capacitor (31).

(2) Loosen the setscrews (33) on the drive sprocket (47).

(3) Rotate the drive sprocket (47) on the shaft (46) until the shutter assembly (45) is in the position for the 20-55 mc band.

(4) Tighten the setscrew (33) that holds the drive sprocket (47) to the shaft (46) .

b. Tuning Drive Mechanism (fig. 31). If the drive mechanism for the tuning capacitor has been disassembled, it maybe necessary to adjust the gears for optimum mesh. Make this adjustment as follows:

(1) Loosen the screws that hold the bracket to the front panel so that the bracket may be positioned. The holes are oversize.

(2) Move the bracket so that the intermediate gear meshes with the dial gear.

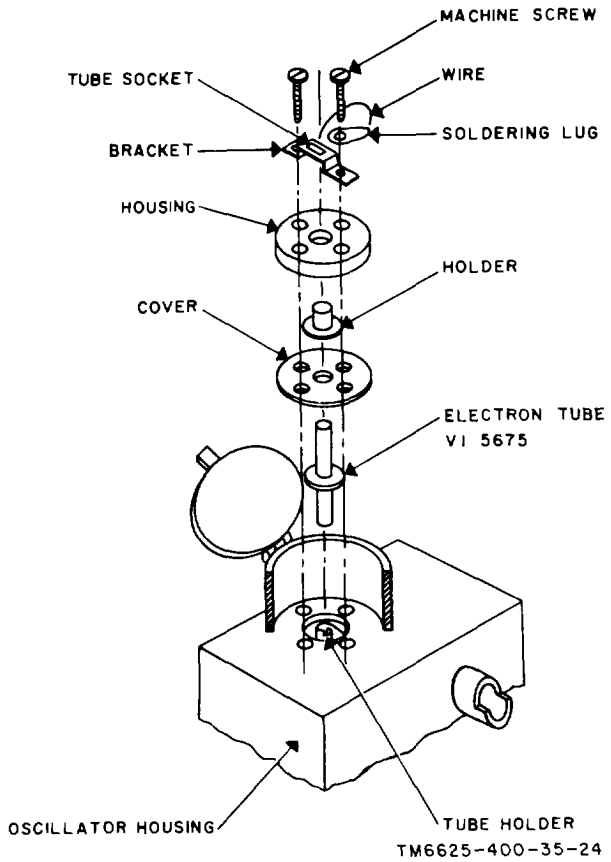


Figure 23. Replacement of V1.

(3) Hold the bracket in the desired location and tighten the screws. Use a small clamp to hold the bracket.

24. Replacement of Components on Modulation Meter Chassis

a. Switches.

(1) Remove the hexagonal nut that holds the switch to the front panel.

(2) Remove the wires from the switch contacts. Tag each wire as it is removed so that it can be rewired to the same contact on the new switch.

(3) Connect and solder the wires to the new switch.

(4) Replace the switch on the front panel and secure it with the hexagonal nut.

b. Potentiometers.

(1) Remove the hexagonal nut that holds the potentiometer to the chassis.

(2) Remove the wires from the potentiometer. Tag each wire as it is removed so that it can be rewired to the same contact on the newpotentiometer.

(3) Connect and solder the wires to the new potentiometer.

(4) Replace the potentiometer on the chassis and secure it with the hexagonal nut.

c. Transformer T10.

(1) Remove all wires from the lugs on the bottom of the transformer. Tag each wire with the lug number as it is removed.

(2) Remove the four nuts that hold the transformer to the chassis and remove the transformer.

(3) Place the new transformer on the chassis in the same position as the old transformer and secure it with the four nuts.

(4) Replace all the wires on the lugs; note their correct location. Solder all the wires to the lugs.

d. Capacitors C72, C87, C92, C95, C101, and C103.

(1) Unsolder wires from all terminal lugs of the capacitor to be replaced. Tag each wire to assure replacing the lead in the same location.

(2) Note the position of the ground lug by marking the chassis with a pencil opposite the white lug.

(3) Unscrew the nut from the bottom of the capacitor and remove it with its lockwasher. Remove the old capacitor.

(4) Place the new capacitor into its hold with the white lug opposite the mark made in (2) above. Tighten the nut with the lockwasher under it so that the capacitor is snug and will not move.

(5) Connect and solder the leads removed in (1) above.

Section II. ALIGNMENT AND CALIBRATION

25. Test Equipment Required for Alignment and Calibration

The following chart list test equipment required for aligning Meter , Modulation ME-57/U, the associated technical manuals, and the common assigned name:

Test equipment	Technical manual	Common name
Generator, Signal AN/URM-70	TM 11-1258	Fm signal generator
Indicator, Panoramic IP-173(*)/U[a]	TM 11-5086	Panoramic indicator
Oscilloscope AN/USM-50(*)[b]	TM 11-5129	Oscilloscope
Signal Generator TS-497A/URR	TM 11-5030	Am. generator
Generator, Signal SG-92/U	TM 11-319	Sweep generator
Frequency Meter AN/USM-26	TM 11-5057	Frequency meter
UG-107B/U		T-connector

[a] Represents Panoramic Indicators IP-173/U, IP-173A/U, IP-173B/U, and IP-173C/U.

[b] Represents Oscilloscope AN/USM-50A, B, and C.

26. Oscillator Calibration

Note: Perform this alignment only after the discriminator is aligned (para 29).

a. Set the FREQUENCY RANGE-MC switch to 20-50.

b. Loosen the setscrew that holds the dial (42, fig. 31) to the shaft.

c. Connect the output of the am. generator to the rf input of the modulation meter.

d. Connect the mixer if. output (fig. 27) to the frequency meter. Use the T -connector (UG-107B/U).

e. Set the controls of the am. generator as follows:

Range knob: D
EXT. PULSE: OFF
Tuning: 35
MICROVOLTS: 5,000
EXT. MOD.: OFF

f. Set the controls of the frequency meter as follows:

TIME UNIT: SECONDS
FUNCTION SELECTOR: FREQUENCY
FREQUENCY UNIT: 1
DISPLAY TIME: Midrange
GAIN: MIDRANGE
RANG E-MC: 10-20
MANUAL GATE : CLOSED
100 KC STANDARD: INT.

g. Turn on the equipment and let it warm up for a few minutes.

h. Adjust the am. generator PAD control for redline reading on the OUTPUT meter.

i. Turn the TUNING control on the modulation meter until the LIMITING meter indicates in the LIMITING portion of the scale.

j. Turn the TUNING control until the CARRIER SHIFT meter reads 0. Switch the TUNE-FINE TUNE switch to FINE TUNE and continue to tune for 0 indication on the CARRIER SHIFT meter.

k. Adjust the TUNING knob on the frequency meter until the tuning eye closes as far as possible. If the eye overlaps, turn the GAIN control towards MIN. until the two sides just touch. Note the reading on the TUNING dial and set the MIXING FREQUENCY MCS switch to that reading.

1. The frequency meter should read between 1,998,800 and 2,001,200.

m. Set the tuning dial to 35 mc and tighten the setscrew.

27. If. Amplifier Alignment

Whenever repairs are made to circuitry involving V2, V3, V4, V5, and V6, the alignment of the if. amplifiers s h o u l d be checked. The response curve should resemble that shown in figure 24. If the response curve is not the proper configuration, the if. amplifier will need alignment. Check and align the if. amplifier as follows :

a. Disconnect the if. c a b l e from the mixer housing (fig. 18).

b. Connect the sweep generator output to the if. cable.

c. Set the sweep generator to center frequency of 12 mc and sweep 6 mc.

d. Connect the sweep voltage output of the sweep generator to the horizontal input " terminal of the oscilloscope.

e. C o n n e c t a shielded cable, with a 10,000-ohm resistor in series, to the vertical input of the oscilloscope. Connect a 0.01-uf capacitor across the vertical input terminals of the oscilloscope. Connect the

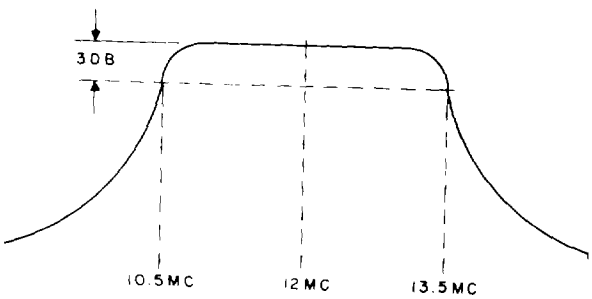
other end of the cable to pin 6 of V7 and to ground.

f. Adjust the oscilloscope controls to obtain a presentation of the response curve.

g. Loosely couple a marker of 12 mc into V6. Use the am. generator to generate the 12-mc marker. This marker should appear approximately at the center of the response curve.

h. Adjust the markers to the 3-decibel (db) points on the response curve. These points should be at approximately 10.5 and 13.5 mc.

i. If the response curve does not resemble closely that shown in figure 24, adjust the trimmers of T6, T5, T4, T3, T2, and T1 in that order.



TM6625-400-35-26

Figure 24. If. amplifier response,

28. Limiter Alignment

a. Repeat the procedure given in paragraph 27, a through d.

b. Connect the shielded cable (para 27) from pin 5 of V9 to the vertical input of the oscilloscope.

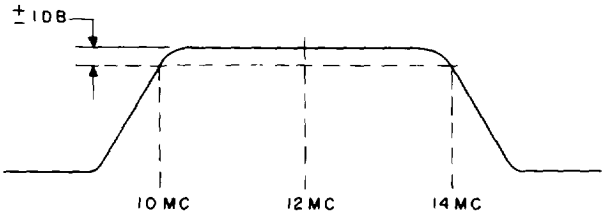
c. Adjust the oscilloscope controls to obtain a response curve presentation. Increase the output level of the sweep generator until limiting occurs as indicated by a sudden widening of the response curve.

d. Loosely couple a marker of 12 mc into V9. It should appear approximately at the center of the response curve. Check the location of the markers at 10, 12, and 14 mc. The response curve should be flat within 1 db over this band.

e. If the response does not resemble closely that shown in figure 24, adjust trimmers of T7 and T6 to obtain the proper curve. Adjust T7 first, and work toward the if. amplifiers.

f. Disconnect the sweep generator and the probe.

g. Connect P5 to J5.



TM6625-400–35–27

Figure 25. Limiter response curve.

29. Discriminator Alignment

a. Repeat the procedures given in paragraph 27a through d.

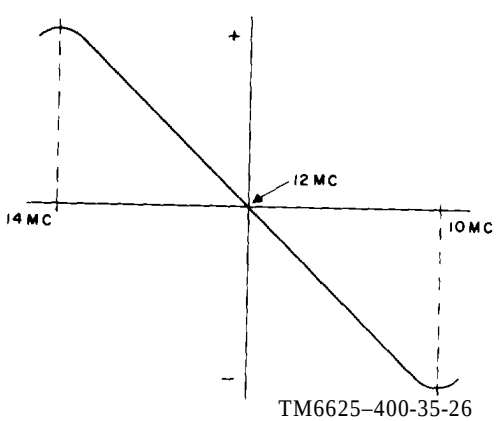
b. 'Connect a shielded cable from the junction of R73 and R74 to the vertical input terminals of the oscilloscope. Use a 10,000-ohm resistor in series; do not use the bypass capacitor to ground.

c. Adjust the signal level until limiting occurs as indicated by a rapid decrease of noise level on the oscilloscope.

d. Adjust the oscilloscope controls to obtain a response curve that covers about two-thirds of the screen.

e. Loosely couple a marker to the probe and check the location of the 10-, 12-, and 14-mc markers. These points should be as shown in figure 26.

f. If the discriminator is out of alignment, adjust C73 for proper center frequency. Adjust C77 for proper peak separation.



TM6625–400-35-26

Figure 26. Discriminator response curve.

30. Avc Delay Adjustment

a. Connect the output of the am. generator to the INPUT jack of the modulation meter. Set the am. generator frequency to 50 mc and the voltage to 5 millivolts.

b. Tune the modulation meter to the incoming signal frequency.

c. Connect the multimeter 10V range to the center tap of R130.

d. Connect the vtvm 10V ac range to pin 3 of T6 to read signal level.

e. Set R130 to give a dc voltage reading equal to the ac voltage reading obtained in d above.

f. Disconnect the am. generator, multimeter, and vtvm.

31. DEVIATION Meter Calibration

To determine the accuracy of the DEVIATION meter calibration, calibrate the output of the fm signal generator by using the panoramic indicator.

a. Connect the equipment as shown in figure 28.

b. Adjust the controls of the panoramic indicator as follows:

CENTER FREQ: On vertical marker.
SWEEP WIDTH: Maximum clockwise position.
RESOLUTION: Maximum clockwise position.
INTENSIFIER: M a xi mum counterclockwise position.
SCALE SELECTOR: LIN.
GAIN: Midrange
SWEEP SELECTOR RATE : 30
VIDEO FILTER: OUT

c. Adjust the controls of the am. signal generator as follows:

Range: E
Frequency: 95 mc
Modulation selector: OFF

d. Adjust the controls of the audio oscillator as follows:

RANGE: X100
ATTENUATOR (OUT PUT MULTIPLIER) : 1

e. Adjust the controls of the fm signal generator as follows:

FREQ. RANGE-MC: 100-200.
DEV MULT: X5
MODULATION: OFF.
Frequency: 100 mc

f. Adjust the controls of the modulation meter as follows:

deviation range-KC: 1000 TUNE.
TUNE-FINE TUNE: TUNE.
FREQUENCY RANGE-MC: 55-120.
DEVIATION RANGE-KC : 50.

g. Turn the equipment on and let it warm up for 30 minutes.

h. Adjust the FOCUS, BRILLIANCE, and HORIZONTAL POSITION controls of the panoramic indicator to obtain the proper presentation on the scope.

i. Adjust the OUTPUT LEVEL control of the audio oscillator to obtain a l-volt output .

j. Switch the MODULATION switch of the fm signal generator to EXT and increase the DEVIATION control to obtain the first null indication on the panoramic indicator. If the proper presentation cannot be obtained, adjust the output levels of the two signal generators.

k. Disconnect the output cable of the am. signal generator from the panoramic indicator.

1. Turn the MODULATION control of the fm signal generator to OFF. Adjust the TUNING control of the modulation meter to 100 mc as indicated by a 0 reading on the CARRIER SHIFT meter. If the LIMITING meter is not reading in the black area, increase the output of the fm signal generator to obtain a reading in the black area. Turn the TUNE-FINE TUNE switch to FINE TUNE and adjust the TUNING control for O indication on the CARRIER SHIFT meter.

m. Turn the MODULATION control of the fm signal generator to EXT. The DEVIATION meter should read 40 kc ±2. If it does not read correctly, adjust the CAL ADJ control until it does.

CHAPTER 4

FOURTH ECHELON TESTING PROCEDURES

32. General

a. Testing procedures are prepared for use by Signal Field Maintenance Shops and Signal Service Organizations responsible for fourth echelon maintenance of signal equipment to determine the acceptability of repaired signal equipment. These procedures set forth specific requirements that repaired signal equipment must meet before it is returned to the using organization. A summary of the performance standards is given in paragraph 37.

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

33. Test Equipment Required for Fourth Echelon Testing

All test equipment required to perform the testing procedures given in this section is listed in the following chart and is authorized under TA 11-17 and TA 11-100 (11-17).

Nomenclature	Federal stock No.	Technical manual
Analyzer, Spectrum TS-723(*)/U[a]	6625-668-9418	TM 11-5097
Audio Oscillator TS-382(*)/U[b]	6625-192-5094	TM 11-6625-261-12
Multimeter ME-26(*)/U[c]	6625-646-9409	TM 11-6625-200-12
Generator, Signal AN/URM-70	6625-519-2104	TM 11-1258
Indicator, Panoramic IP-173(*)/U[d]	6625-224-5500	TM 11-5086
Oscilloscope AN/USM-50(*)[e]	6625-668-4676	TM 11-5129
Signal Generator TS-497A/URR	6625-669-0298	TM 11-5030

[a] Represents Spectrum Analyzers TS-723A/U, TS-723B/U, and TS-723C/U.
[b] Represents Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U.
[c] Represents Multimeters ME-26A/U and ME-26B/U.
[d] Represents Panoramic Indicators IP-173/U, IP-173A/U, IP-173B/U, and IP-173C/U.
[e] Represents Oscilloscopes AN/USM-50A, B, and C.

34. Physical Tests and Inspections

a. Test Equipment. None Required.

b. Test Connections and Conditions.

(1) No connections are necessary.

(2) Remove modulation meter from its case.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test Procedure	Performance standard
1	N/A	Controls may be in any position.	*a.* Inspect case and chassis for damage, missing parts, and condition of paint. Note: Touchup painting is recommended in lieu of refinishing whenever practicable; screwheads, binding posts, receptacles, and other plated parts will not be painted or polished with abrasives.	*a.* No damage evident or parts missing. External surfaces intended to be painted do not show bare metal. Panel lettering is legible.
			b. Inspect all controls and mechanical assemblies for loose and missing screws, bolts, and nuts.	*b.* Screws, nuts, and bolts are tight and none missing.
			c. Inspect all connectors, sockets, receptacles, and fuseholders for looseness, damage, or missing parts.	*c.* No looseness or damage evident.
2	N/A	Controls may be in any position.	*a.* Rotate all panel controls throughout their limits of travel.	*a.* Controls rotate freely without binding or excessive looseness.
			b. Operate all switches.	*b.* Switches operate properly.

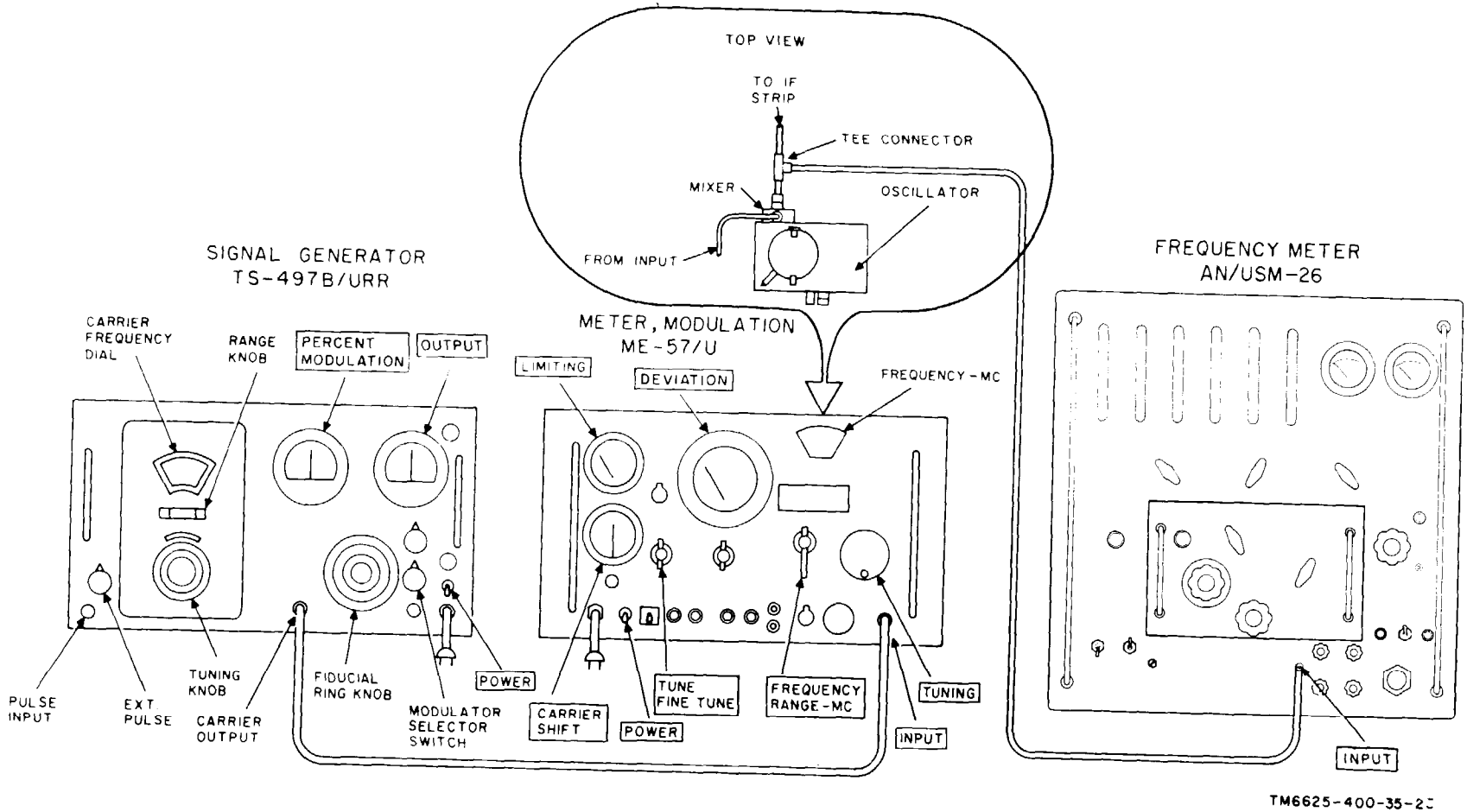


Figure 27. Frequency range checks test connections.

35. Frequency Range Checks

a. Test Equipment.

(1) Signal Generator TS-497A/URR.

(2) Frequency Meter AN/USM-26 with Frequency Meter Subassembly MX-1637/U.

b. Test Connections and Conditions. Connect the equipment as shown in figure 27.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	*TS-497A/URR* Range: C EXT. PULSE: OFF Modulation selector: OFF MICROVOLTS: 5,000 Tuning dial: 20 *AN/USM-26* TIME UNIT: SECONDS FUNCTION SELECTOR: FREQUENCY FREQUENCY UNIT: 1 DISPLAY TIME: mid-range MANUAL: CLOSED RANGE-MC: 10-20 GAIN: midrange	*ME-57/U* FREQUENCY RANGE-KC: 20-55 TUNING: 20 TUNE-FINE TUNE: TUNE DEVIATION RANGE-KC: 1000 TUNE	Allow the test equipment and modulation meter to warm up a few minutes.	None.
2	Same as step No. 1.	Same as step No. 1.	*a.* Tune the TS-497A/URR tuning dial until the CARRIER SHIFT meter on the modulation meter reads 0. Switch the TUNE-FINE TUNE switch to FINE TUNE. Adjust the TS-497A/URR tuning control until the CARRIER SHIFT meter again reads 0. *b.* Adjust the PAD control on the TS-497A/URR for redline reading on the OUTPUT meter. *c.* Adjust the TUNING knob on the AN/USM-26 until the tuning eye closes as far as possible. If the eye overlaps, reduce the GAIN until the two sides just meet. Note the reading on the TUNING dial and set the MIXING FREQUENCY MCS switch to that reading.	*a.* None. *b.* None. *c.* AN/USM-26 indicates from 1,998,800 to 2,001,200.
3	*TS-497A/URR* Same as preceding step, except: Range: D Tuning: 35 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 35	Same as step No. 2.	Same as step No. 2.
4	*TS-497A/URR* Same as step No. 1, except: Tuning: 50 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 50	Same as step No. 2.	Same as step No. 2.
5	*TS-497A/URR* Same as step No. 1, except: Tuning: 60 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: FREQUENCY RANGE-KC: 55-120 TUNING: 60	Same as step No. 2.	Same as step No. 2.
6	*TS-497A/URR* Same as step No. 1, except: RANGE: E Tuning: 87.5 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 87.5	Same as step No. 2.	Same as step No. 2.
7	*TS-497A/URR* Same as step No. 1, except: Tuning: 100 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 100	Same as step No. 2.	Same as step No. 2.
8	*TS-497A/URR* Same as step No. 1, except: Tuning: 130 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: FREQUENCY RANGE-MC: 120-250 TUNING: 130	Same as step No. 2.	Same as step No. 2.
9	*TS-497A/URR* Same as step No. 1, except: Range: F Tuning: 185 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 185	Same as step No. 2.	Same as step No. 2.
10	*TS-497A/URR* Same as step No. 1, except: Tuning: 240 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 240	Same as step No. 2.	Same as step No. 2.
11	*TS-497A/URR* Same as step No. 1, except: Tuning: 260 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: FREQUENCY RANGE-MC: 250-500 TUNING: 260	Same as step No. 2.	Same as step No. 2.
12	*TS-497A/URR* Same as step No. 1, except: Tuning: 375 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 375	Same as step No. 2.	Same as step No. 2.
13	*TS-497A/URR* Same as step No. 1, except: Tuning: 225 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 450	Same as step No. 2.	Same as step No. 2.
14	*TS-497A/URR* Same as step No. 1, except: Tuning: 275 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: FREQUENCY RANGE-MC: 500-1000 TUNING: 550	Same as step No. 2.	Same as step No. 2.
15	*TS-497A/URR* Same as step No. 1, except: Tuning: 375 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 750	Same as step No. 2.	Same as step No. 2.
16	*TS-497A/URR* Same as step No. 1, except: Tuning: 300 *AN/USM-26* Same as step No. 1.	Same as step No. 1, except: TUNING: 900	Same as step No. 2.	Same as step No. 2.

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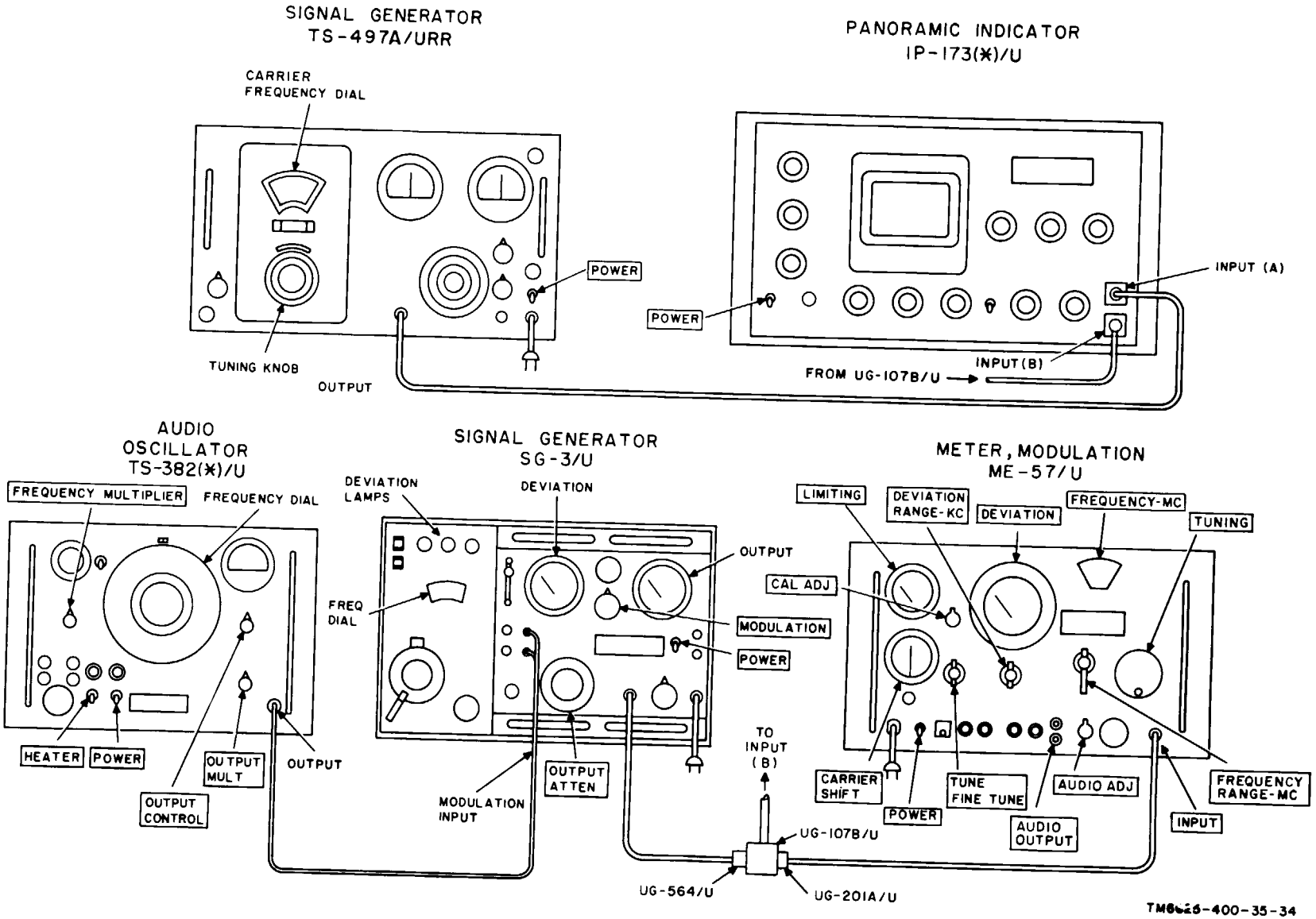


Figure 28. Deviation range accuracy check.

36. Deviation Accuracy

a. Test Equipment.
(1) Audio Oscillator TS-382(*)/U
(2) Signal Generator SG-3/U (p/o AN/URM-70)
(3) Signal Generator TS-497A/URR
(4) Panoramic Indicator IP-173(*)/U

b. Test Connections and Conditions. Connect the equipment as shown in figure 28.

c. Procedure.

Step No.	Test equipment control settings	Equipment under test control settings	Test procedure	Performance standard
1	*IP-173(*)/U* CENTER FREQ: On vertical marker SWEEP WIDTH: Maximum counterclockwise RESOLUTION: Maximum clockwise INTENSIFIER: Maximum counterclockwise SCALE SELECTOR: LIN GAIN: Midrange SWEEP SELECTOR RATE: 30 VIDEO FILTER: OUT *TS-497A/URR* Range: E Frequency: 95 mc Modulation selector: OFF EXT. PULSE: OFF *TS-382(*)/U* RANGE: X100 OUTPUT MULTIPLIER (ATTENUATOR): 1 Tuning dial: 16.6 *SG-3/U* FREQ. RANGE-MC: 100-200 DEV MULT: X5 MODULATION: OFF Frequency: 100 mc	*ME-57/U* DEVIATION RANGE-KC: 1000 TUNE TUNE-FINE TUNE switch: TUNE FREQUENCY RANGE-MC: 55-120	Turn on the equipment and let it warm up for 30 minutes.	None.
2	Same as step 1, except: *SG-3/U* MODULATION: EXT	Same as step 1.	Adjust the FOCUS, BRILLIANCE, and HORIZONTAL POSITION controls of the IP-173(*)/U to obtain a properly centered and convenient presentation on the scope. Increase the DEVIATION control of the SG-3/U to obtain a null indication on the scope.	None.
3	Same as step 1.	Same as step 1.	Disconnect the output cable of the TS-497A/URR from the IP-173(*)/U. Tune the ME-57/U to 100 mc until the CARRIER SHIFT meter indicates 0. Turn the TUNE-FINE TUNE switch to FINE TUNE and readjust the TUNING control for 0 indication on the CARRIER SHIFT meter. If the LIMITING meter does not read in the black area, increase the output of the SG-3/U until it does.	
4	Same as step 1, except: *SG-3/U* MODULATION switch: EXT	DEVIATION RANGE-KC: 50	----------	DEVIATION meter reads 40 KC ±2.
5	Same as step 1, except: *TS-382(*)/U* Tuning: 66 *TS-497A/URR* Range: D Frequency: 45 mc *SG-3/U* Frequency: 50 mc FREQ. RANGE-MC: 50-100 DEV MULT: X1	Same as step 1, except: FREQUENCY RANGE-MC: 20-55	Connect the output cable of the TS-497A/URR to the IP-173(*)/U and proceed as in step 2.	None.
6	Same as step 5.	Same as step 5.	Disconnect the output cable of the TS-497A/URR from the IP-173(*)/U. Tune the ME-57/U to 50 mc until the CARRIER SHIFT meter indicates 0. Turn the TUNE-FINE TUNE switch to FINE TUNE and readjust the TUNING control until the CARRIER SHIFT meter reads 0. If the LIMITING meter does not read in the black area, increase the output of the SG-3/U until it does.	None.
7	Same as step 5, except: *SG-3/U* MODULATION switch: EXT	Same as step 5, except: DEVIATION RANGE-KC: 20	----------	DEVIATION meter reads 16 KC ±0.75.
8	Same as step 1, except: *TS-382(*)/U* RANGE: X1000 Tuning: 33 *TS-497A/URR* Frequency: 145 mc *SG-3/U* Frequency: 150 mc	Same as step 1, except: FREQUENCY RANGE-MC: 120-250	Same as step 5.	None.
9	Same as step 8.	Same as step 8.	Disconnect the output cable of the TS-497A/URR from the IP-173(*)/U. Tune the ME-57/U to 150 mc until the CARRIER SHIFT meter reads 0. Turn the TUNE-FINE TUNE switch to FINE TUNE and readjust the TUNING control until the CARRIER SHIFT meter reads 0. If the LIMITING meter does not read in the black area, increase the output of the SG-3/U until it does.	
10	Same as step 8, except: *SG-3/U* MODULATION switch: EXT	Same as step 8, except: DEVIATION RANGE-KC: 100	----------	DEVIATION meter reads 80 KC ±10.
11	Same as step 8, except: *TS-382(*)/U* Tuning: 29 *TS-497A/URR* Range: F Frequency: 195 mc *SG-3/U* FREQ. RANGE-MC: 200-400 Frequency: 200 mc	Same as step 1, except: FREQUENCY RANGE-MC: 120-250	Connect the output cable of the TS-497A/URR to the IP-173/U and proceed as in step 2.	None.
12	Same as step 11.	Same as step 11.	Disconnect the output cable of the TS-497A/URR from the IP-173(*)/U. Tune the ME-57/U to 200 mc until the CARRIER SHIFT meter indicates 0. Turn the TUNE-FINE TUNE switch to FINE TUNE and readjust the TUNING control until the CARRIER SHIFT meter reads 0. If the LIMITING meter does not read in the black area, increase the output of the SG-3/U until it does.	
13	Same as step 11, except: *SG-3/U* MODULATION: EXT	Same as step 11, except: DEVIATION RANGE-KC: 300	----------	DEVIATION meter reads 250 KC ±30.
14	Same as step 11, except: *TS-382(*)/U* Tuning: 68 *TS-497A/URR*	Same as step 1, except: FREQUENCY RANGE-MC:	Connect the output cable of the TS-497A/URR to the IP-173(*)/U and proceed as in step 2.	None.
	Frequency: 395 mc *SG-3/U* Frequency: 400 mc	250-500		
15	Same as step 14.	Same as step 14.	Disconnect the output cable of the TS-497A/URR from the IP-173(*)/U. Tune the ME-57/U to 400 mc until the CARRIER SHIFT meter indicates 0. Turn the TUNE-FINE TUNE switch to FINE TUNE and readjust the TUNING control until the CARRIER SHIFT meter reads 0. If the LIMITING meter does not read in the black area, increase the output of the SG-3/U until it does.	None.
16	Same as step 14, except: *SG-3/U* MODULATION: EXT	Same as step 14, except: DEVIATION RANGE-KC: 1000 TUNE	----------	DEVIATION meter reads 800 KC ±100.

37. Test Data Summary

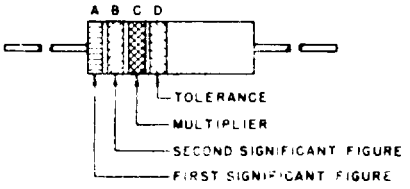
Personnel may find it convenient to arrange the checklist in a manner similar to that shown below.

1. FREQUENCY RANGE CHECK	The TUNING dial shall shall maintain an accuracy of 0. 01% over the entire frequency range of the modulation meter.
2. DEVIATION ACCURACY CHECK	The DEVIATION meter reading shall be accurate to within the limits specified below over the entire frequency range of the modulation meter.

DEVIATION RANGE-KC switch setting	Accuracy
20	±4.5%
50	±5.0%
100	±12.0%
300	±12.0%
1000	±12.0%

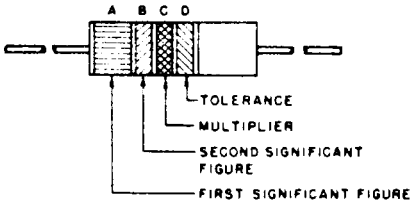
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS

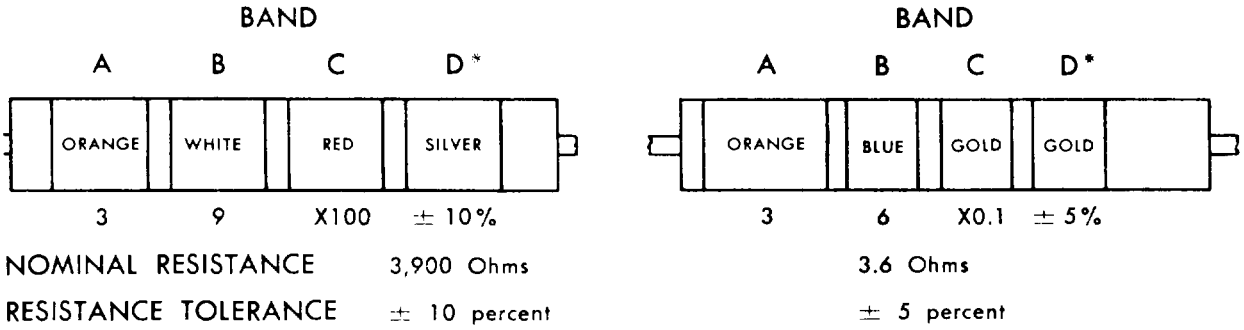


BAND A— Double Width Signifies Wire-wound Resistor

COLOR CODE TABLE

BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1		
BROWN	1	BROWN	1	BROWN	10		
RED	2	RED	2	RED	100		
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

EXAMPLES OF COLOR CODING

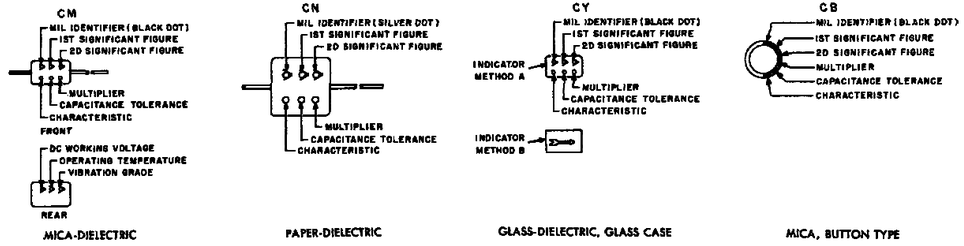


*If Band D is omitted, the resistor tolerance is ± 20%, and the resistor is not Mil-Std.

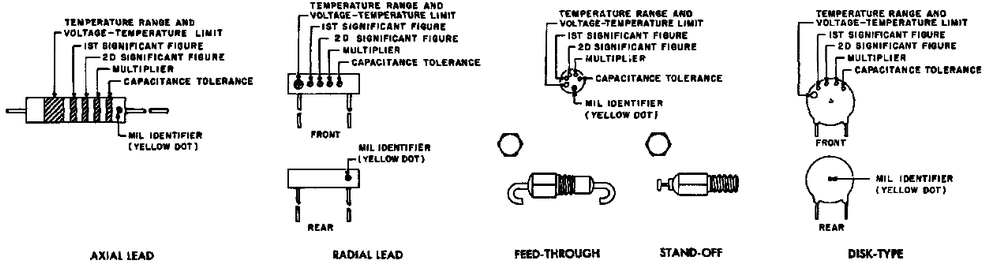
Figure 29. MIL-STD resistor color code markings.

COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

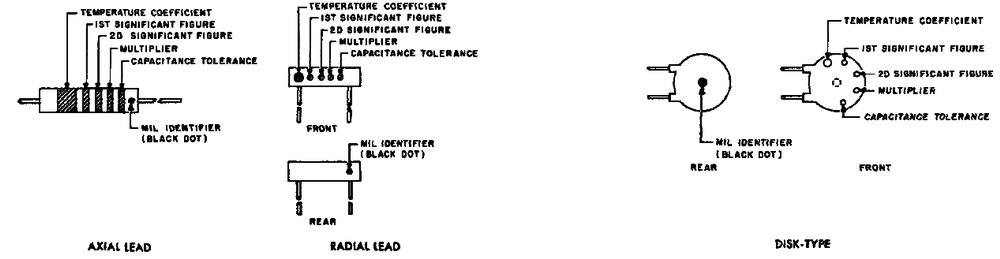
GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



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



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



COLOR CODE TABLES

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

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

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

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

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

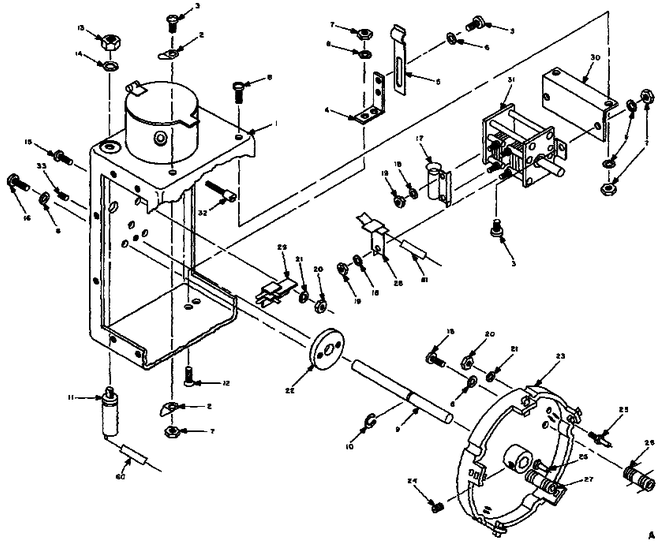
COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					Capacitances over 10uuf	Capacitances 10uuf or less	
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	−30	1	1	10	± 1%		
RED	−80	2	2	100	± 2%	± 0.25uuf	
ORANGE	−150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	−330	5	5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

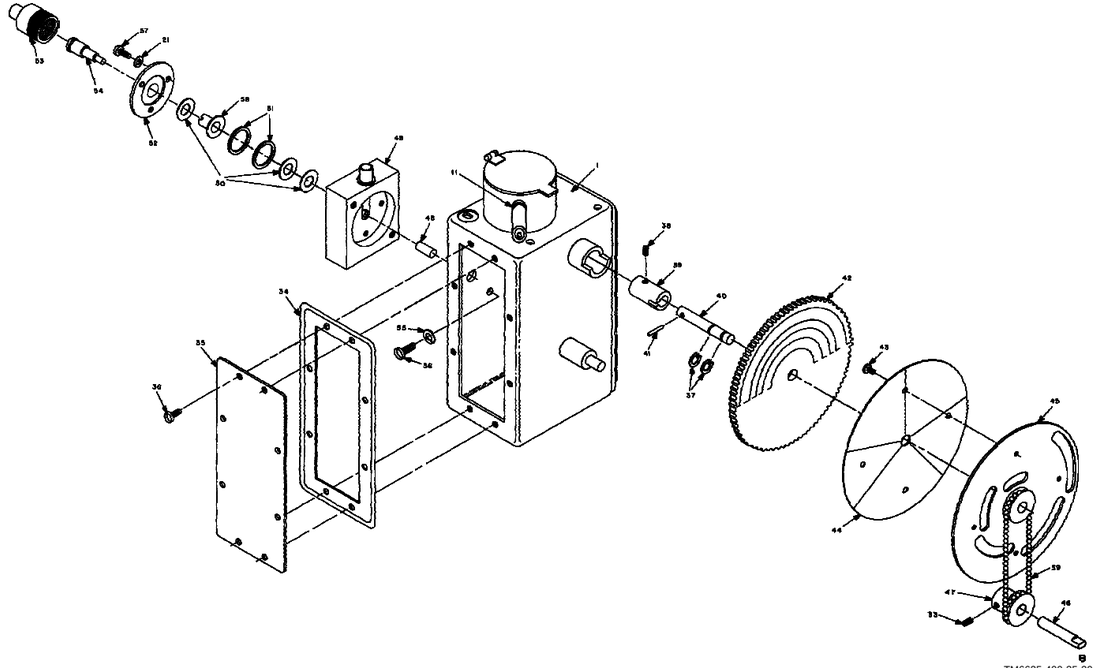
1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: Mil–C–5, Mil–C–91, Mil–C–11272, and Mil–C–10950 respectively.
3. Letters indicate the temperature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

STD–C2

Figure 30. MIL-STD capacitor color code markings.

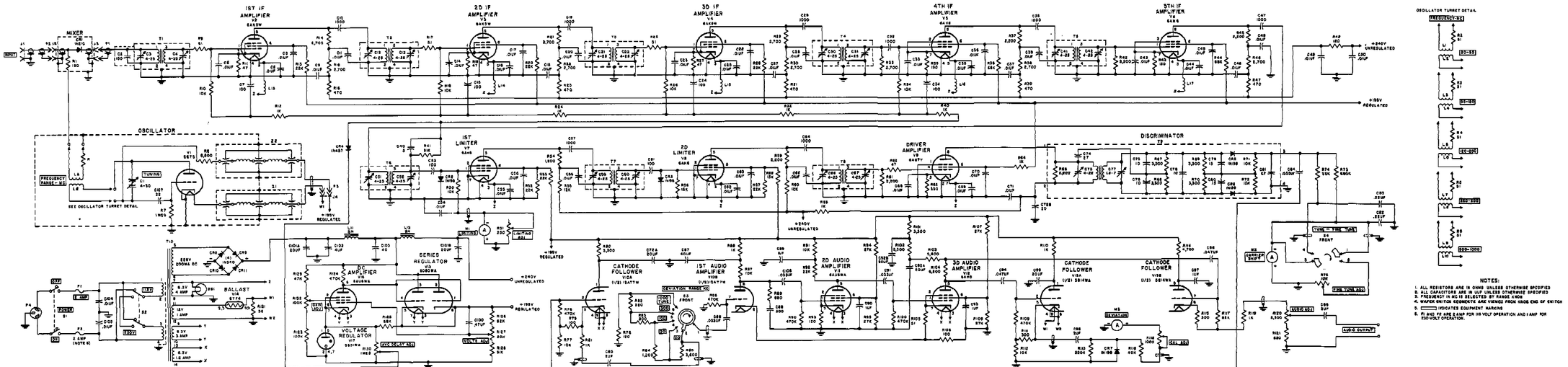
1 Housing
2 Soldering lug
3 Screw
4 Detent bracket
5 Detent arm
6 Lockwasher
7 Nut, hexagonal
8 Screw
9 Rotor shaft
10 Retaining ring
11 Filter (Z1 & Z2)
12 Screw, flathead
13 Nut, hexagonal
14 Lockwasher
15 Screw
16 Screw
17 Plateholder assembly
18 Washer
19 Nut, hexagonal
20 Nut, hexagonal
21 Lockwasher
22 Bearing
23 Rotor
24 Setscrew
25 Standoff
26 Coil
27 Coil
28 Capacitor contact assembly
29 Contact assembly
30 Mounting bracket
31 Tuning capacitor
32 Tuning slug
33 Setscrew
34 Gasket shielding
35 Cover side
36 Screw
37 Retaining ring (1/4 dia)
38 Setscrew
39 Coupling
40 Shaft (1/4 dia)
41 Spring pin
42 Dial
43 Screw
44 Hairline
45 Shutter assembly
46 Shaft
47 Drive sprocket
48 Resistor R1
49 Mixer housing
50 Insulator
51 Locator
52 Plug
53 Diode CR1
54 Contact assembly
55 Lockwasher
56 Screw
57 Screw
58 Holder
59 Bead chain
60 Resistor R7
61 Resistor R8





TM6625-400-35-20

Figure 31. Oscillator assembly, exploded view.



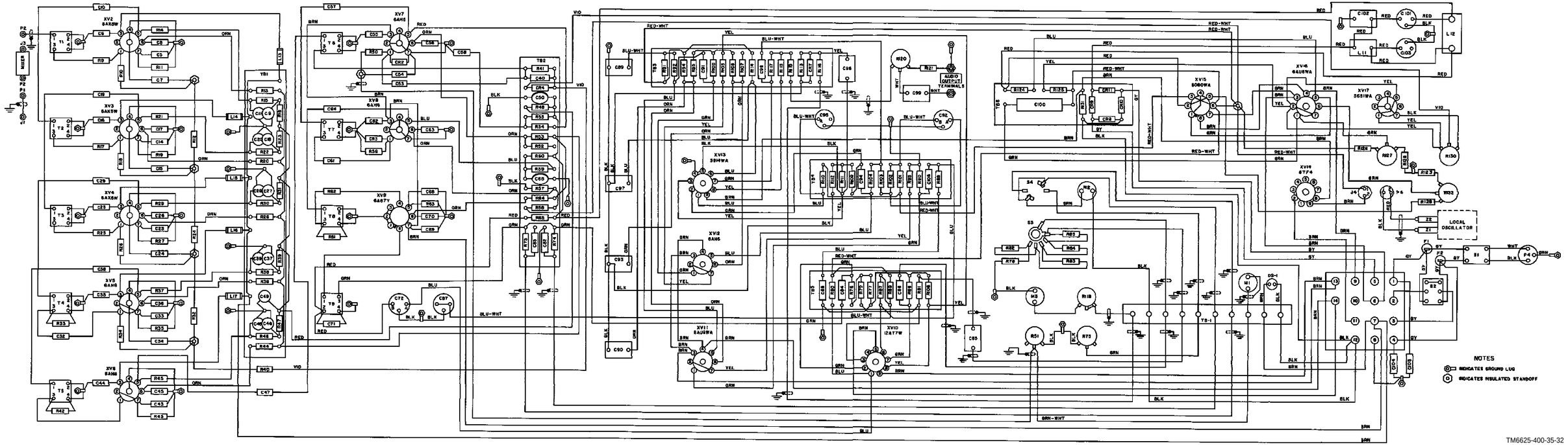
OSCILLATOR TURRET DETAIL

NOTES:

1. ALL RESISTORS ARE IN OHMS UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITORS ARE IN μμF UNLESS OTHERWISE SPECIFIED
3. FREQUENCY IN MC IS SELECTED BY RANGE KNOB
4. MARKER SWITCH REMOTE ARE VIEWED FROM KNOB END OF SWITCH
5. ▭ INDICATES EQUIPMENT MARKING
6. F1 AND F2 ARE 2 AMP FOR 115 VOLT OPERATION AND 1 AMP FOR 230 VOLT OPERATION.

TM 9-625-100-35-21

Figure 38. Meter, Modulation ME-57/U, schematic diagram.



TM6625-400-35-32

Figure 33. Meter, Modulation ME-57/U, wiring diagram.

APPENDIX

REFERENCES

Following is a list of references available to the field and depot repairman of Meter, Modulation ME-57/U:

DA Pamphlet 310-4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TA 11-17	Signal Field Maintenance Shops.
TA 11-100(11-17)	Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shops.
TM 11-319	Signal Generator SG92/U.
TM 11-1258	Signal Generator AN/URM-70.
TM 11-5030	Signal Generator TS-497A/URR.
TM 11-5057	Frequency Meter AN/USM-26.
TM 11-5086	Panoramic Indicators IP- 173/U, IP-173A/U, IP- 173B/U, and IP-173C/U.
TM 11-5097	Spectrum Analyzers TS-723A/U, TS-723B/U, and TS-723C/U.
TM 11-5129	Oscilloscopes AN/USM-50A, B, and C.
TM 11-5527	Multimeters TS-352/U,TS-352A/U, and TS-352B/U.
TM 11-5551	Instruction Book for R. F. Signal Generator Set AN/URM-25.
TM 11-6625-200-12	Operator and Organizational Maintenance Manual, Multimeters ME-26A/U and ME-26B/U.
TM 11-6625-261-12	Operator's and Organizational Maintenance Manual, Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U.
TM 11-6625-400-12	Operator and Organizational Maintenance Manual, Meter, Modulation ME-57/U.

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