MODEL 560FM
STANDARD SIGNAL GENERATOR

Operating INSTRUCTIONS

MEASUREMENTS
A McGRAW-EDISON DIVISION
BOONTON NEW JERSEY

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Additional information with regard to the applications and maintenance of this equipment will be available from time to time. Users of the Model 560-FM are urged to discuss their problems with us and to suggest such modifications as might make the instrument more adaptable to their special requirements.

Maintenance difficulties should be reported to Measurements before proceeding with actual repairs, since, through our familiarity with the instrument, we are able to suggest the appropriate repair procedure.

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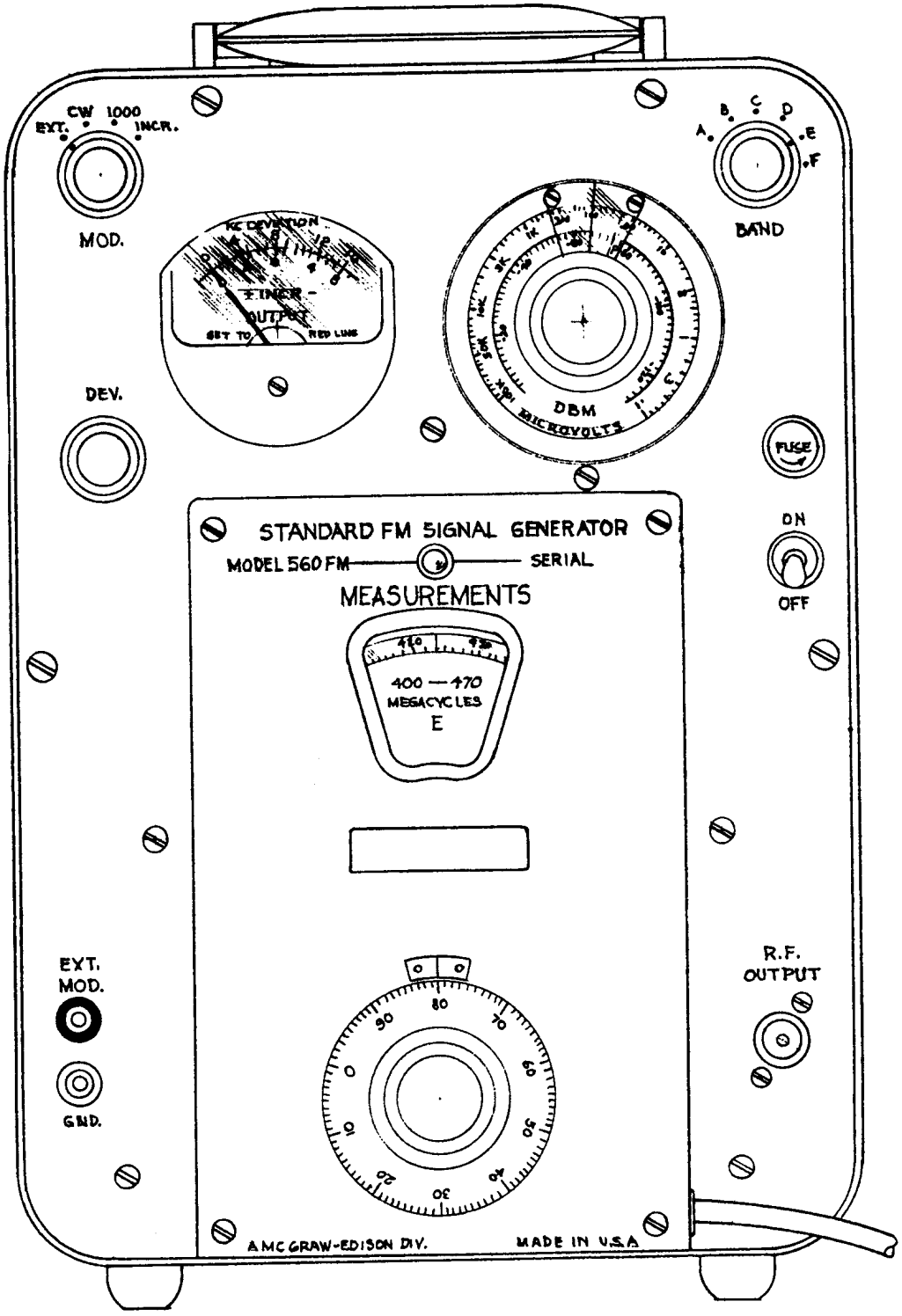


Figure 1. Front View of Model 560-FM Standard Signal Generator

CHAPTER 1

INTRODUCTION

SECTION I.

GENERAL

1. SCOPE OF MANUAL

a. This manual describes the basic operation of the Model 560 FM Standard Signal Generator. Two appendices follow the text. Appendix I describes recommended procedure for preparing the instrument for reshipment or for prolonged storage, while Appendix II is a List of Replaceable Parts.

SECTION II.

DESCRIPTION AND DATA

2. GENERAL

a. The Model 560 FM Standard Signal Generator is portable test equipment for checking the operation of mobile communication receivers. CW or frequency-modulated carrier may be selected as required.

3. TECHNICAL CHARACTERISTICS

a. Carrier frequency ranges:

(1)

Band A	25 to 32 mcs.
Band B	32 to 41 mcs.
Band C	41 to 54 mcs.
Band D	132 to 175 mcs.
Band E	400 to 470 mcs.
Band F	890 to 960 mcs.*

* Band F dial is calibrated on second harmonic of 445 to 480 mcs range.

(2) The range switch operates a mask to expose the frequency range in use.

b. Frequency accuracy:

(1) Each range individually calibrated to an accuracy of ± 0.5%.

c. Tuning:

(1) A vernier frequency dial having 100 divisions is geared to the main dial. This vernier dial may be set to place its zero division at any desired frequency.

d. Output Voltage:

(1) The output voltage is continuously variable from 100,000 microvolts to 0.1 microvolt. The output is also calibrated from -8 to -128 DBM. (0 DBM is one milliwatt into 50 ohms). An individually calibrated correction curve is supplied for band F.

(2) A pad mark, is provided on the fiducial so that the output may be read directly, when a 2 to 1 voltage-ratio pad is employed.

(3) The output is calibrated in terms of the voltage developed across a 50-ohm resistive termination.

e. Output System:

(1) The mutual inductance attenuator is of the waveguide-below-cut-off type. This attenuator has excellent incremental calibration accuracy determined by its physical dimensions which are held to close tolerances.

(2) The output voltage reference level is continuously monitored by a temperature-compensated barretter bridge. The 100,000 microvolt reference level is accurate to ± 10% from 25 mc to 175 mc, ± 20% from 400 to 470 mc; output chart provided for 890 to 960 mcs.

(3) To improve reliability, no resistor is used in series with the output pick-up loop. Inadvertently operating the press-to-talk button when servicing Mobile equipment could burn out such a resistor. An external pad, Measurements Part No. 80-ZH3, may be used to improve the VSWR of the output system.

f. Shielding:

(1) Double shielding is used on the oscillator to reduce stray radiation to a low value.

(2) Multi-section individually-shielded r-f filters are used on all circuits supplying the oscillator.

(3) Carrier leakage is negligible.

g. Modulation:

(1) The Model 560-FM is an FM signal generator utilizing variable-capacitance diodes in the frequency modulator.

(2) An internal 1000-cycle Wien bridge RC oscillator provides modulation voltage. Deviation may be varied from zero to 16 kcs.

(3) Approximately 16 volts peak is required across EXT MOD terminals to produce 16 kcs. deviation. For external modulation the frequency deviation response is within 1 db from 0 to 16 kcs.

h. Residual Modulation:

(1) Residual FM modulation is less than 100 cycles at 460 mc.

(2) Regulated d-c power supplies are used for the plate and the heater of the oscillator tube.

i. Deviation:

(1) Peak deviation is indicated directly on the panel meter for bands A, B, C and D. Deviation Correction Curves are used to set the desired deviation for bands E and F.

(2) Deviation accuracy is within ± 10% of full scale for frequency bands A, B, C and D.

(3) Means are provided for manually shifting the carrier frequency 16 kilocycles to facilitate discriminator alignment. This is accomplished by varying the d-c potential applied to the variable-capacitance diodes. The frequency shift, in kilocycles, is indicated by the panel meter.

j. Power Requirements:

(1) Potential	117 volts
(2) Frequency	50 to 60 c.p.s.
(3) Power Consumption	50 watts
(4) Fuse	0.5 ampere, slow-blow

k. Physical Data:

(1) Dimensions: 14-1/2" high x 10-1/2" wide x 9-1/2" deep.

(2) Weight: 26 pounds.

4. DESIGN FEATURES

a. The electrical and mechanical design of the Model 560 FM Standard Signal Generator is based upon many years of experience gained in manufacturing thousands of units of the Model 80 and Model 210 series of Standard Signal Generators. Like the Model 80, the Model 560-FM is a standard of radio-frequency voltage. It generates an accurately calibrated voltage at an accurately calibrated frequency. No compromise has been made in the design of the Model 560-FM

b. In accordance with Measurements' policy of maintaining high-quality features in instruments, the Model 560 FM uses a temperature-compensated barretter bridge for continuously monitoring the output voltage. The barretter bridge is the most accurate standard presently available for r-f voltage measurement and, because of its response, insures a high degree of absolute voltage accuracy. It is far superior to a crystal diode in its stability, its freedom from errors due to temperature changes, and in its excellent long-term stability.

Excellent incremental voltage accuracy is provided by the mutual-inductance, wave-guide-below-cut-off attenuator. The accuracy of this attenuator is determined by physical dimensions which are held to a close tolerance.

c. The type 6AF4A oscillator tube employed is a readily available tube of uniform characteristics. The use of this tube makes the Model 560 FM attractive from the service viewpoint.

Regulated and well-filtered direct-current power supplies are used for oscillator plate and heater to provide good frequency stability and to reduce to a minimum the residual FM due to power frequency hum. The power transformer is floated on rubber mounts to reduce power-line-frequency mechanical vibration of the oscillator components.

d. The frequency bands have been designed to give excellent band spread by using a tuning ratio of approximately 1.3 to 1. This small tuning range permits the use of a variable capacitor with heavy rotor plates and wide plate spacing to reduce microphonics to a minimum.

e. Frequency modulation is produced by two variable-capacitance diodes connected across the stator plates of the tuning capacitor through adjustable trimmer capacitors to obtain optimum Q, low distortion and maximum stability.

f. Deviation compensation is provided by a tracking potentiometer ganged to the tuning dial and individual level-setting potentiometers for each frequency band. The deviation is indicated directly on the panel meter for bands A, B, C and D. Deviation Correction Curves are used to set the desired deviation for bands E and F. The deviation accuracy is within ± 10% of full scale frequency bands A, B, C and D.

g. Means are provided for incremental change in carrier frequency to facilitate descriminator alignment. This is accomplished by varying the d-c potential applied to the variable-capacitance diodes. The frequency shift, in kilocycles, is indicated by the panel meter.

5. COMPONENTS SUPPLIED

TABLE I. TABLE OF COMPONENTS

Quan.	Description	Overall Dimensions			Unit Weight	Volume Cu. Ft.
		Height	Width	Depth		
1	Model 560 FM Standard Signal Generator complete with cover.	14-1/2	10-1/2	9-1/2	26 lbs.	1.1
1	Manual of Operating Instructions.					
1	Tube, 6AF4A, installed.					
1	Tube, 6X4, installed.					
1	Regulator Tube, 6TF4, installed.					
1	Tube, 12BH7A installed.					
1	Tube, 5651, installed.					
1	Tube, 12AT7, installed.					
1	Tube, 6AQ5A, installed.					

6. EXPORT PACKAGING

a. When export shipment is required the instrument is packed in a wooden box.

TABLE II. EXPORT PACKING DATA

No. of Packages	Case Dimensions			Weight	Cu. Ft.
	Height	Width	Depth		
1	17"	22"	17"	64#	3.7

CHAPTER 2

OPERATING INSTRUCTIONS

SECTION I.

SERVICE UPON RECEIPT OF EQUIPMENT

7. UNPACKING

a. Take precaution when unpacking the instrument to avoid damaging or marring the surface.

(1) Place packing case in a location where it can be easily handled.

(2) Cut carton seals or, if wood box is used, remove nails with nail puller.

(3) Remove instrument from case, then inspect case for signs of damage during transit.

8. PRELIMINARY INSPECTION

a. The following preliminary checks will indicate whether or not instrument is operating properly.

(1) Connect power cord to power source of 117 volts 50/60 cycles. Turn power on and allow about ten minutes for instrument to stabilize.

(2) Select range A and set BAND switch at A.

(3) Place MOD switch at CW and adjust ring fiducial (outer ring) of MICROVOLTS dial to set meter pointer at red line.

(4) Place MOD switch at 1000 and rotate DEV control from full counterclockwise to full clockwise position. Meter pointer should deflect from zero to full scale.

b. Repeat a.(2) through a.(4) for each range. Make certain that BAND switch is always set for the range in use.

SECTION II.

CONTROL FUNCTIONS

9. POWER

a. The ON-OFF switch controls the application of line voltage to the primary of the power transformer.

b. The FUSE serves to protect the instrument against overloads.

10. TUNING DIAL

a. The knob and dial at the lower edge of the front panel sets the fundamental carrier frequency. The frequency is directly indicated under the fiducial line in the panel opening directly above.

11. RANGE SELECTOR

a. The bar knob directly above the tuning dial controls frequency band switching. The frequency bands are marked A, B, C, D, E, and F. When switching bands, rock the bar knob slightly from side to side to make certain that the range change mechanism has moved properly into detent.

12. EXT. MOD.

a. The EXT. MOD. binding posts on the left side of the panel permit the application of an external signal for frequency modulation of the carrier.

b. Approximately 1 kc FM deviation is produced per 1.0 volt peak of modulating signal. A signal of 16 volts peak is sufficient to produce 16 kc deviation. The deviation is indicated on the panel meter.

13. OUTPUT CONTROL

a. The OUTPUT control is a dual control consisting of a ring fiducial and a dial calibrated in MICROVOLTS and DBM.

(1) The ring fiducial is used to set the output reference level of 100,000 microvolts. The ring is rotated clockwise or counterclockwise until the pointer of the OUTPUT meter is directly over the RED LINE on the meter.

(2) The inner dial adjusts position of the output loop in the piston attenuator and will indicate the true output in MICROVOLTS or DBM when the R.F. OUTPUT connector is terminated in a 50 ohm resistive load.

b. In order to set the output r.f. level, the MOD. switch must be in the CW position. This connects the meter to the output bridge circuit. When the MOD. switch is in the EXT. or 1000 position the meter is disconnected from the barretter bridge and is used to indicate frequency deviation.

c. When a 50-ohm, 6 DB pad is connected between output connector and 50-ohm load resistor, the output level is read directly beneath the pad line on the plastic fiducial.

14. MOD. SWITCH

a. The MOD. switch is located to the upper left of the meter. Its purpose is to supply the carrier signal with the type of modulation desired.

b. The EXT. position allows external modulation to be applied to the oscillator via the two binding posts EXT. MOD. located at the extreme lower left corner of the front panel. The deviation is indicated on the panel meter.

c. The CW position provides an unmodulated continuous-wave carrier. In this position the panel meter is connected to the bolometer bridge for r.f. voltage level setting.

d. The 1000-cycle position applies approximately 16 volts peak to the modulator input for internal modulation.

e. The INCR position permits incremental adjustment of carrier frequency.

15. BAND SWITCH

a. The BAND switch located in the upper right hand corner of panel selects the proper modulating band in use. This voltage level is pre-set by factory adjustment of potentiometers connected to the BAND switch.

b. This switch, is used when either internal or external modulation is applied or when incremental control of carrier frequency is desired. This switch must be set to the position corresponding to the frequency band in use in order that the meter will indicate frequency deviation. For example, when the A frequency band is used, the BAND switch must be set to A.

16. DEV. CONTROL

a. The DEV. control is a potentiometer which controls frequency deviation when either internal or external modulation is employed. It also adjusts incremental frequency shift.

b. The frequency deviation, or incremental frequency shift, is indicated on the panel meter.

17. KC DEVIATION, + INCR −, METER

a. This meter is used to establish reference level of output voltage and also to measure deviation.

b. When the MOD switch is in the CW position, the meter is connected to the barretter bridge to monitor the r-f output level.

c. When the MOD switch is in the EXT. or the 1000 position, the meter is disconnected from the barretter bridge and indicates frequency deviation in kilocycles. In this case the meter is connected to a crystal diode rectifier and operates as an a-c voltmeter.

d. When the MOD switch is in the INCR position, the meter indicates incremental shift in carrier frequency.

SECTION III

OPERATION

18. INSTALLATION

a. The Model 560-FM Standard Signal Generator is portable test equipment requiring no fixed installation. During operation space should be provided between the case and other equipment to allow ample ventilation.

19. OPERATION

a. Connect the power cord to a source of 117-volt, 50-60 cycle alternating current, and place ON-OFF switch in the ON position. Set MOD. switch to CW position. Allow about ten minutes for the oscillator to become stabilized.

b. Rotate the bar knob to select the desired frequency band. Rock the knob slightly from side to side to test for proper detent.

c. Set the TUNING knob to the desired carrier frequency.

d. Rotate the ring fiducial until the OUTPUT meter pointer rests on the red line on the meter scale.

e. Turn the MICROVOLTS dial to the desired output voltage as indicated under the fiducial line.

f. To frequency modulate the carrier using internal 1000-cycle modulation, set BAND switch to frequency band in use and MOD. switch to 1000. Rotate DEV. control to desired KC DEVIATION as indicated on meter.

g. To frequency modulate the carrier using external modulation, connect the modulating signal to the EXT. MOD. binding posts. (This signal should be approximately 16 volts peak to produce the full 16 kc of deviation.) Set MOD. switch to EXT. and BAND switch to frequency band in use. Rotate DEV. control to desired KC DEVIATION as indicated on meter.

h. If incremental control of carrier frequency is desired, set MOD. switch to INCR and BAND switch to frequency band in use. DEV. control adjusts the frequency shift.

i. For frequency bands A, B, C, and D the deviation in kilocycles is indicated on the panel meter to an accuracy of ± 10% of full scale. For bands E and F refer to Deviation Correction Curves in rear of Instruction Book.

CHAPTER 3

EQUIPMENT USED WITH MODEL 560 FM

SECTION I.

GENERAL

20. ACCESSORIES AND AUXILIARY EQUIPMENT

a. Accessories

(1) MEASUREMENTS Type 80-ZH4 Output Cable consisting of 4 ft. of RG-55/U Cable with 50-ohm type N plug at one end and pair of 3/4" spaced binding posts terminated in 50-ohm resistor at other end.

(2) MEASUREMENTS Type H-5710 Cable consisting of 4 ft. of RG-55/U Cable with 50-ohm type N plugs at both ends.

(3) MEASUREMENTS Type 84-Z2-2 Cable consisting of 4 ft. of RG-8/U Cable with 50-ohm type N plug at one end and type UHF plug at other end.

(4) MEASUREMENTS Type 80-ZH3 Pad, 2 to 1 voltage ratio (6 db), 50-ohm to 50-ohm for use from d.c. to 1000 Mc. Type N 50-ohm plug at input and type N 50-ohm jack at output.

(5) MEASUREMENTS Type M-342 Pad, 10 to 1 voltage ratio (20 db), 50-ohm to 50-ohm for use from d.c. to 1000 Mc. Type N 50-ohm plug at input and type N 50-ohm jack at output.

b. AUXILIARY EQUIPMENT

(1) MEASUREMENTS Model 202-C Standard Barretter Bridge.

(2) MEASUREMENTS Model 111-B Crystal Calibrator.

CHAPTER 4

TECHNICAL SERVICE - MAINTENANCE INSTRUCTIONS

SECTION I

GENERAL

21. SCOPE

a. The purpose of this chapter is to describe briefly the theory of operation of the various circuits and describe a few adjustments that can be made in the field using equipment that is usually available. Extensive repairs or adjustments other than those referenced will require return of the instrument to MEASUREMENTS.

SECTION II

CONDENSED THEORY OF OPERATION

22. R-F OSCILLATOR

a. The r-f oscillator utilizes a type 6AF4A miniature triode. A split-stator capacitor tunes a range of approximately 1.3 to 1.

b. The oscillator coil is inductively coupled to the pick-up loop in the attenuator. Varying the coupling adjusts output voltage.

c. Double shielding of the r-f oscillator circuits and thorough filtering of all leads entering the oscillator compartment reduce r-f leakage to a negligible value.

d. Carrier frequency may be varied incrementally plus or minus 8 kcs to facilitate discriminator alignment. This is accomplished by varying the d-c bias applied to the variable capacitance diodes. The shift in carrier frequency is measured by the KC DEVIATION meter.

23. A-F OSCILLATOR

a. The internal audio modulating signal of 1000 cycles is generated by a modified Wien bridge oscillator using a type 12BH7 dual triode. The resultant sine wave has very low harmonic content

b. The modulating signal is applied simultaneously to the r-f modulator circuit and the deviation meter through MOD switch S2 and BAND switch S3. The signal is also available across the EXT. MOD. binding posts. The output impedance of the circuit is 100,000 ohms which should be considered when connecting to external equipment.

24. MODULATOR

a. Frequency modulation is produced by applying the modulating signal to variable capacitance diodes which are capacitively coupled to the r-f oscillator tube. Associated circuit constants have been carefully selected to obtain optimum circuit Q and low distortion.

b. Amplitude of the modulating signal is controlled by DEV. potentiometer, R19. Compensation for the variable amount of signal required for fixed deviation over the tuning range is provided by tracking potentiometer R30, compensation potentiometer R28 and a group of level-adjustment potentiometers for the individual bands.

c. Deviation in kilocycles is directly indicated on the KC DEVIATION meter scale for range A through D. Refer to curves in this instruction book to determine true deviation for ranges E and F.

25. OUTPUT SYSTEM

a. The output system consists of a piston type, mutual inductance attenuator and a temperature-compensated bolometer bridge which continually monitors output voltage level. Drive voltages for the bolometer bridge and attenuator are obtained by magnetic coupling between the single turn coils L17 and L18 and the oscillator coil of the range in use.

b. The voltage monitoring coil, L17, is mounted flush with the open end of the movable attenuator tube, operation of which is controlled by the ring fiducial of the output dial. Voltage induced in this coil thermally varies, the resistance of bolometer RT3 thereby changing the balance of the monitoring bridge. When the bridge is in balance, output meter, M1, reads at the red line and the proper voltage reference is established. The voltage across a terminated 50-ohm cable connected to the RF OUTPUT connector may be read directly from the setting of the MICROVOLTS dial.

c. The output-voltage coil, L18, moves axially within the attenuator tube under control of the MICROVOLTS dial. As this attenuator functions as a wave guide below cut-off the magnetic field within the tube, and therefore the voltage induced in L18, will decrease logarithmically as separation between r-f oscillator coil and L18 is increased. Since attenuation accuracy is a function of attenuator tube diameter and calibrated travel of the pick-up loop, all dimensions are held to close tolerances.

d. Pick-up loop L18 consists of a single turn of wire to guard against possible damage under rugged conditions sometimes encountered in the field. The use of a series resistor to improve VSWR has been intentionally omitted to prevent possible burn-out of the output loop in the event the press-to-talk button is inadvertently operated during servicing of FM mobile equipment. When an improved VSWR is desired, an external resistive pad such as MEASUREMENTS type 80ZH3 should be used between the RF OUTPUT connector and the output cable.

26. POWER SUPPLY

a. The power supply furnishes plate and heater voltages for all tubes. Plate and heater voltages for the r-f oscillator tube V6 are electronically regulated to assure maximum stability and freedom from residual frequency modulation.

b. Two 6.3-volt windings of power transformer T1 supply 12.6 volts to bridge rectifier CR1. The rectified output current flows through ballast tube RT1 to maintain constant heater current through tube V6 with a 10% variation in line voltage.

SECTION III

MAINTENANCE

27. GENERAL

a. The purpose of this Section is to acquaint operating and maintenance personnel with the procedures for making certain adjustments that may be necessary after tubes are replaced.

WARNING

DO NOT ATTEMPT TO READJUST CONTROLS NOT SPECIFICALLY DESCRIBED IN THE FOLLOWING PARAGRAPHS.

b. Whenever replacement or readjustment of other controls is necessary the instrument should be returned to MEASUREMENTS. These are factory adjustments requiring specialized test equipment not readily available to field personnel.

28. REMOVING INSTRUMENT FROM CASE

a. To remove the front panel assembly of the Model 560 FM from its case:

(1) Turn the attenuator MICROVOLTS dial fully clockwise to the 100,000 microvolts position.

(2) Break the seals on the two screws between the two rubber feet located at the bottom front edge of the case. Remove these two screws.

(3) Unscrew the four large black filister head screws around the edges of the front panel.

(4) Carefully withdraw the panel assembly from the case.

b. To remove the power supply and audio oscillator chassis:

(1) The front panel assembly must be removed as described in the preceding paragraph.

(2) Unscrew the two black button head screwson the top of the case toward the back.

(3) Unscrew the two black button head screws on the back of the case.

(4) Carefully withdraw the chassis from the case.

29. REPLACEMENT OF R-F OSCILLATOR TUBE

a. Remove front panel assembly as described in paragraph 29a.

b. Place panel assembly face down and unlatch the three shield clamps which secure the outer shield can.

c. Remove outer and inner shield cans. This may be done by applying a twist action to each can.

CAUTION

NEVER USE TOOLS TO PRY COVERS OFF OSCILLATOR SHIELD. SLIGHT DENTS IN THESE COVERS MAY CAUSE SERIOUS LEAKAGE OF THE CARRIER FREQUENCY.

d. Remove lower nylon screw from roller spring and retract upper screw sufficiently to permit roller to be removed. Rotate spring to clear coil disc.

e. Rotate coil disc to place detent roller midway between detent positions.

f. Hold coil disc firmly and remove nut which secures disc to shaft.

g. Lift detent roller clear of disc edge and carefully lift coil disc assembly from its hub. The oscillator tube is now available for replacement. If possible, select tube which has least effect on frequency calibration (see paragraph 33).

h. Retract detent roller, making certain its spring is engaged. Lower coil disc in proper position to engage the flatted portion of its hub. Release detent roller against edge of coil disk and rock disc until it is properly seated. Replace coil disc nut and tighten firmly.

i. Replace roller, insert lower nylon screw and tighten both screws.

CAUTION

CARE MUST BE TAKEN WHEN TIGHTENING THESE NYLON SCREWS AS EXCESSIVE TWIST WILL SHEAR THE SHANK.

j. Check alignment of the three coil contacts with their respective contact posts on the condenser assembly since misalignment may seriously damage them.

k. Replace coil shield cans making certain that location lines on shields coincide with those on can.

30. A-F OSCILLATOR ADJUSTMENT

a. Replacement of audio oscillator tube V5 or ballast lamp RT2 may affect the level of modulating voltage in which case resetting of AUDIO OSC. ADJ. control (R9) will be necessary.

(1) Set range selector knob for A range and place BAND switch at A.

(2) Place MOD switch at 1000 and rotate DEV control to maximum clockwise position.

(3) Adjust R9 to produce full scale reading on deviation meter.

CAUTION

TO MINIMIZE DISTORTION DO NOT ADJUST FOR A METER READING GREATER THAN FULL SCALE.

b. Frequency of the audio oscillator may be checked by connecting a frequency counter or similar audio frequency meter to the EXT. MOD. binding post.

(1) Place MOD switch at 1000.

(2) Frequency may be reset by adjusting capacitor C32. This is mounted on the rear of the power chassis and reference should be made to paragraph 29b for instructions on removing this unit.

31. VOLTAGE ADJUSTMENTS

a. Plate supply voltage

(1) Connect an accurate d-c voltmeter (1000 ohms per volt or higher sensitivity) between terminals 6 and 8 of terminal strip.

(2) Allow instrument to operate about five minutes at normal line voltage.

(3) Set VOLTAGE ADJ. control, R46, (located on power chassis) to produce a reading of 145 volts.

b. Heater supply voltage

NOTE

READJUSTMENT OF HEATER VOLTAGE WILL BE NECESSARY ONLY IN THE EVENT EITHER THE R-F OSCILLATOR TUBE V6 OR BALLAST TUBE RT1 IS REPLACED.

(1) Connect an accurate d-c voltmeter between terminals 6 and 11 of terminal strip.

(2) Allow instrument to operate at 115-volt line voltage for about five minutes.

(3) Set HTR ADJ, R3 (located on power chassis) to produce a reading of 6.3 volts.

32. CALIBRATION OF OUTPUT VOLTAGE

a. Checking accuracy of output voltage at high frequencies requires the use of specialized test equipment in order to eliminate errors due to lead resonance, etc., that are not usually troublesome at low frequencies. MEASUREMENTS Model 202-C Standard Bolometer Bridge has been designed especially for these measurements and the following calibration instructions are based on using this instrument.

(1) Connect output of Model 560 FM to input connector of the Model 202-C through a short length of 50-ohm cable.

CAUTION

THE MODEL 202-C IS DESIGNED FOR OPERATION AT A NOMINAL INPUT OF 50000 MICROVOLTS. A 2:1 VOLTAGE LOSS PAD SHOULD THEREFORE BE CONNECTED BETWEEN THE CABLE AND THE INPUT CONNECTOR OF THE MODEL 202-C TO PREVENT DAMAGING THE BOLOMETER.

(2) Allow the instrument to operate about five minutes to become stable.

(3) Place MOD switch in CW position and adjust ring fiducial to bring meter pointer to red line.

(4) Set MICROVOLTS dial at 100 K (pad mark 50 K).

(5) The Model 202-C should indicate an output of 50 K microvolts $\pm$ 10% between 25 and 175 megacycles, and $\pm$ 20% between 400 and 470 megacycles. In the event these limits are exceeded proceed as follows:

(a) Select frequency band which produces the average indication on the Model 202-C, then adjust the ring fiducial to balance the instrument at a setting of 50 K microvolts.

(b) Adjust OUTPUT CAL., R23, (located on power chassis) to bring pointer of meter M1 to red line.

(c) Check all other ranges as described in (1) through (5) to make certain prescribed tolerances are obtained.

33. RADIO FREQUENCY CALIBRATION

a. Every effort has been made, in the design of the Model 560-FM, to attain an exceptionally stable r-f oscillator. It is unlikely, therefore, that with normal operation it will even be necessary to compensate for frequency shift. When the oscillator tube V6 is replaced, however, circuit capacity may be changed sufficiently to require compensation at the high frequency end of the dial to bring the scale calibration within tolerance. Prior to making any adjustments the instrument should be operated on E range under normal conditions for about one hour, then the frequency calibration should be checked using a frequency meter of sufficient accuracy, or a crystal calibrator such as MEASUREMENTS Model 111-B. If several tubes are available, select one which has least effect on calibration. The less calibration is affected, the less deviation will be disturbed.

b. When compensation for circuit capacitance is found necessary, proceed as follows:

(1) Remove instrument from case as described in paragraph 29a, then remove oscillator shield cans as described in paragraph 30.

(2) With range selector on E range, tune to exactly 470 megacycles as indicated by frequency meter.

(3) Capacitor C26D directly beneath the 5/8 inch diameter hole in the coil disc, can be adjusted simultaneously with rotation of the tuning dial until coincidence of scale calibration and fiducial line is obtained.

(4) Recheck calibration at low and mid-frequency portions of dial.

CAUTION

NEVER ATTEMPT TO RESTORE FREQUENCY CALIBRATION BY BENDING PLATES OF THE TUNING CAPACITOR. THIS PROCEDURE WILL DESTROY ENTIRE CALIBRATION AND NECESSITATE RETURN OF INSTRUMENT TO THE FACTORY.

(5) Replace shield cans, then recheck calibration.

34. DEVIATION COMPENSATION

a. The requirements for accurately calibrating the deviation scale of meter M1, include the use of specialized procedures and test equipment which is not readily available to field personnel. These are factory adjustments and, once set up, it is unlikely that readjustment will be found necessary. Occasionally however, replacement of oscillator tube V6 may have sufficient effect on the modulation characteristics to warrant resetting the meter reading. When this is necessary, proceed as follows.

(1) Connect the Model 560 FM to a communications type receiver operating within the frequency range of bands A, B, C or D. Do not use bands E or F when working this adjustment.

(2) Tune the receiver to the Model 560 FM and adjust signal strength to avoid overloading the receiver circuits.

(3) Set BAND switch to range being used (A, B, C or D), MOD switch at EXT, and DEV control fully counterclockwise.

(4) Connect a low-distortion audio oscillator, capable of delivering approximately 12 volts rms across 10,000 ohms to the EXT MOD binding posts.

(5) Set the audio oscillator at exactly 6,250 cycles.

(6) Adjust the beat oscillator of the receiver to produce a suitable audio beat note with the carrier frequency.

(7) While listening to the beat note rotate DEV control clockwise to the point at which the note becomes inaudible. At this point the meter should indicate 15 kcs deviation.

(8) Adjust DEV SET control, located in power chassis to bring meter pointer to 15 kcs calibration

CAUTION

NEVER DISTURB SETTINGS OF OTHER DEVIATION ADJUSTMENT CONTROLS. THESE ARE FACTORY ADJUSTMENTS, PRE-SET FOR OPTIMUM PERFORMANCE.

b. After setting meter reading as explained in foregoing paragraph, curves should be made correlating true deviation with meter reading for bands E and F.

APPENDIX I

STORAGE AND SHIPMENT

1. STORAGE

a. Remove dust from controls and outer surface of instrument with a clean rag.

b. Loop power cable into a coil and place it on the panel with plug toward lower edge.

c. Place cover on case and fasten both catches.

d. Wrap instrument in heavy wrapping paper and seal seams with gummed tape or similar adhesive.

e. Store in a dry place. If excessive humidity is unavoidable, the wrapped instrument should be placed in a moisture-proof bag with a sufficient quantity of drying agent, such as silica gel, to insure a dry atmosphere. When the use of bag and desiccant is necessary, the instrument should be checked at six-month intervals to determine the effectiveness of the seal.

2. SHIPMENT

a. Wrap the instrument with heavy wrapping paper and seal seams with gummed tape or similar adhesive.

b. Place in fibre-board carton or wooden box large enough to permit at least three inches of excelsior or similar packing material between the instrument and sides of the box. For export packing, the instrument must be wrapped in waterproof paper and the seams sealed with waterproof glue or similar sealing compound before being placed in a wooden box.

APPENDIX II

TABLE OF REPLACEABLE PARTS

Model 560 FM StandardSignal Generator

Symbol	Part No.	Description
Capacitors		
C1	H-6617	Fixed; Electro; 20-20-20 mf, 450 VDC.
C2	H-5577	Fixed; Electro; 5 mf, 6 VDC.
C3	H-6369	Fixed; Electro; 1000-1000 mf, 15 VDC.
C4	H-6626	Fixed; Sil. mica; 1000 mmf, ± 5%.
C5	H-5579	Fixed; Electro; 4 mf, 450 VDC.
C6	H-5516	Fixed; paper; .05 mf, ± 20%, 400 VDC.
C7	H-6642	Fixed; Sil. mica; 680 mmf, ± 5%.
C8	H-5944	Fixed; feed-thru; 1000 mmf, GMV.
C9	H-5944	"
C10	H-5944	"
C11	H-5944	"
C12	H-5944	"
C13	H-5944	"
C14	H-5250	Fixed; ceramic; discap; .01 mf, GMV.
C15	H-5250	"
C16	H-5944	Fixed; feed-thru; 1000 mmf, GMV.
C17	H-5944	"
C18	H-5942	Fixed; feed-thru; 100 mmf, ± 20%.
C19	H-6627	Fixed; stand-off; 100 mmf, ± 20%.
C20	H-5942	Fixed; feed-thru; 100 mmf, ± 20%.
C21	H-5944	Fixed; feed-thru; 1000 mmf, GMV.
C22	H-5944	"
C23	H-5562	Fixed; stand-off; 1000 mmf.

Symbol	Part No.	Description
C24	H-5944	Fixed; feed-thru; 1000mmf GMV.
C25	H-6643	Variable; mica; 0.8-10 mmf.
C26	H-5776	Variable; air; incl. C26A thru E.
C27	H-6600-3	Voltage-variable.
C28	H-6600-3	" "
C29	H-6162	Fixed; ceramic; .01 mf GMV.
C30	H-6162	"
C31	H-6160	Fixed; ceramic; 1000 mmf GMV.
C32	H-6331	Variable; mica; 24-200 mmf.
C33	H-5589	Fixed; paper; 0.1 mf ± 20%, 400 VDC.
C34	H-5942	Fixed; feed-thru; 100 mmf ± 20%.
C35	H-6627	Fixed; stand-off; 100 mmf ± 20%.
C36	H-5942	Fixed; feed-thru; 100 mmf ± 20%.
C37	H-6629	Fixed; ceramic; 22 mmf ± 5%, NP030.
C38	H-6629	"
C39	H-6644	Fixed; ceramic; .02 mf, + 80%, -20%.
C40	H-5321	Fixed; ceramic; discap; 1000 mmf GMV.
C41	H-6321	"
C42	H-6643	Variable, mica; 0.8-10 mmf.
C43	H-6619-6	Fixed; ceramic; 5 K mmf, GMV.
CR1	H-6372	Rectifier; selenium.
CR2		Diode; IN34A.
CR3		Diode; IN82 or IN72.
E1	HS-18-1, 2	Post; Bushing.
E2	H-5017	Holder; fuse.
F1	H-5018-6	Fuse; 0.5A.
I1	H-5582	Lamp; 6V.

Symbol	Part No.	Description
J1	H-4968	Connector; Type N.
L1	H-5744	Coil; choke; r-f, 50 uh ± 20%.
L2	H-5744	"
L3	H-1442	Coil; choke; r-f, approx. 20 uh @ 1000 cps.
L4	H-1442	"
L5	H-1442	"
L6	H-5538	Coil; choke; r-f, 15 uh ± 20%.
L7	H-5538	"
L8	H-1441	Coil; choke; r-f, approx. 14 uh.
L9	H-6166	Coil; choke; r-f.
L10	H-6563	Coil; filter; 400 uh ± 20%.
L11	H-6563	"
L12	H-6109	Coil; choke; r-f, approx. 150 uh.
L13	H-5744	Coil; choke; r-f, 50 uh ± 20%.
L14	H-1442	Coil; choke; r-f, approx. 20 uh @ 1000 cps.
L15	H-1442	"
L16	H-1442	"
L17		P/O Attenuator Assy.- Not separately replaceable.
L18		" "
L19	H-6168	Coil assembly; Range A, 25-32 mcs.
L20	H-6170	Coil assembly; Range B, 32-41 mcs.
L21	H-6172	Coil assembly; Range C, 41-54 mcs.
L22	H-6175	Coil assembly; Range D, 130-175 mcs.
L23	H-6563	Coil; filter; 400 uh ± 20%.
L24	H-6563	"
L25	H-6538	Coil assembly; Range E, 400-470 mcs.

Symbol	Part No.	Description
L26	H-6538	Coil assembly; Range F, 890-960 mcs.
M1	H-6548	Meter; Output/ KC Deviation
Resistors		
R1	H-3734-102	Fixed; comp; 1000 ohms ± 10%, 2W.
R2	H-3734-152	Fixed; comp; 1500 ohms ± 10%, 2W.
R3	H-6601	Variable; wirewound; 20 ohms.
R4	H-3728-394	Fixed; comp; 390 K ohms ± 10%, 1/2W.
R5	H-6630	Fixed; wirewound; 10000 ohms, 10W.
R6	H-3728-102	Fixed; comp; 1000 ohms ± 10%, 1/2W.
R7	H-6692D1603Q	Fixed; film; 160 K ohms, ± 5%, 1W.
R8	H-6692D1603Q	"
R9	H-6633	Variable; composition; 5000 ohms.
R10	H-3727-242	Fixed; comp; 2400 ohms, ± 5%, 1/2W
R11	H-3728-101	Fixed; comp; 100 ohms ± 10%, 1/2W.
R12	H-3728-474	Fixed; comp; 470 K ohms, ± 10%, 1/2W.
R13	H-6624-3	Variable; wirewound; 5000 ohms.
R14	H-6624-3	Variable; wirewound; 5000 ohms.
R15		
R16	H-6624-3	Variable; wirewound; 5000 ohms.
R17	H-6624-1	Variable; wirewound; 2000 ohms.
R18	H-6624-1	"
R19	H-6634	Variable; composition, 10000 ohms.
R20	H-6624-3	Variable; wirewound; 5000 ohms.
R21	H-3727-114	Fixed; comp; 110 K ohms ± 5%, 1/2W.
R22	H-6631	Fixed; wirewound; 30000 ohms, 10W.

Symbol	Part No.	Description
R23	H-5585	Variable; wirewound; 100 ohms.
R24	H-3727-510	Fixed; comp; 51 ohms ± 5%, 1/2 W.
R25	H-3728-473	Fixed; comp; 47000 ohms ± 10%, 1/2 W.
R26	H-3727-204	Fixed; comp; 200 K, ± 5%, 1/2 W.
R27	H-3727-753	Fixed; comp; 75000 ohms ± 5%, 1/2 W.
R28	H-6636	Variable; comp; 50000 ohms.
R29	H-6645	Variable; comp; 10000 ohms.
R30	H-5586	Variable; wirewound; 20000 ohms.
R31	H-3728-154	Fixed; comp; 150 K ohms ± 10%, 1/2 W.
R32		P/O Capacitor Assembly C29.
R33		P/O Capacitor Assembly C30.
R34	H-6685-23	Fixed; dep. film; 63 ohms ± 1%, 1/2 W.
R35	H-3730-303	Fixed; comp; 30000 ohms ± 5%, 1 W.
R36	H-3727-204	Fixed; comp; 200 K ohms ± 5%, 1/2 W.
R37	H-6632	Variable; comp; 250 K ohms.
R38	H-3728-104	Fixed; comp; 100 K ohms ± 10%, 1/2 W.
R39	H-3728-272	Fixed; comp; 2700 ohms ± 10%, 1/2 W.
R40	H-3727-244	Fixed; comp; 240 K ohms ± 10%, 1/2 W.
R41	H-3727-205	Fixed; comp; 2 megohms ± 5%, 1/2 W.
R42	H-3728-274	Fixed; comp; 270 K ohms ± 10%, 1/2 W.
R43	H-3728-154	Fixed; comp; 150 K ohms ± 10%, 1/2 W.
R44	H-3728-333	Fixed; comp; 33000 ohms ± 10%, 1/2 W.
R45	H-3727-433	Fixed; comp; 43000 ohms ± 5%, 1/2 W.
R46	H-6635	Variable; wirewound; 20000 ohms.
R47	H-3727-433	Fixed; comp; 43000 ohms ± 5%, 1/2 W.
R48	H-3728-332	Fixed; comp; 3300 ohms ± 10%, 1/2 W.

Symbol	Part No.	Description
R49	H-3728-102	Fixed; comp; 1000 ohms ± 10%, 1/2 W.
R50	H-3731-222	Fixed; comp; 2200 ohms ± 10%, 1 W.
R51	H-3731-222	"
R52	H-3728-105	Fixed; comp; 1 megohm ± 10%, 1/2 W.
R53	H-3728-822	Fixed; comp; 8200 ohms ± 10%, 1/2 W.
R54)		
R55)		
R56)		Factory selected - see schematic wiring diagram.
R57)		
R58)		
R59	H-3727-164	Fixed; comp; 160 K ohms ± 5%, 1/2 W.
R60)		Factory selected - see schematic wiring diagram.
R61)		
R62		
R63	H-3728-154	Fixed; comp; 150 K ohms ± 10%, 1/2 W.
R64	H-3728-154	"
R65		Factory selected - see schematic wiring diagram.
R66	H-3728-392	Fixed; comp; 3900 ohms ± 10%, 1/2 W.
R67	H-3728-102	Fixed; comp; 1000 ohms ± 10%, 1/2 W.
RT1	H-6646	Lamp; regulator.
RT2	H-5052	Lamp; regulator, 3 W, 120 V.
RT3)	H-710	Bolometer; matched pair.
RT4)	H-710	
S1	H-383-5	Switch; power.
S2	H-6542	Switch; modulation selector.
S3	H-6750	Switch; band.
T1	H-5405	Transformer; power.

⊘ = SCREWDRIVER ADJUSTMENT BEHIND PANEL.

[XXXX] = FRONT PANEL CONTROL.

(XX) = NUMBERED TERMINALS ON POWER CHASSIS.

K = 1000

M = MEG.

UNLESS OTHERWISE SPECIFIED:

ALL RESISTORS 0.5W

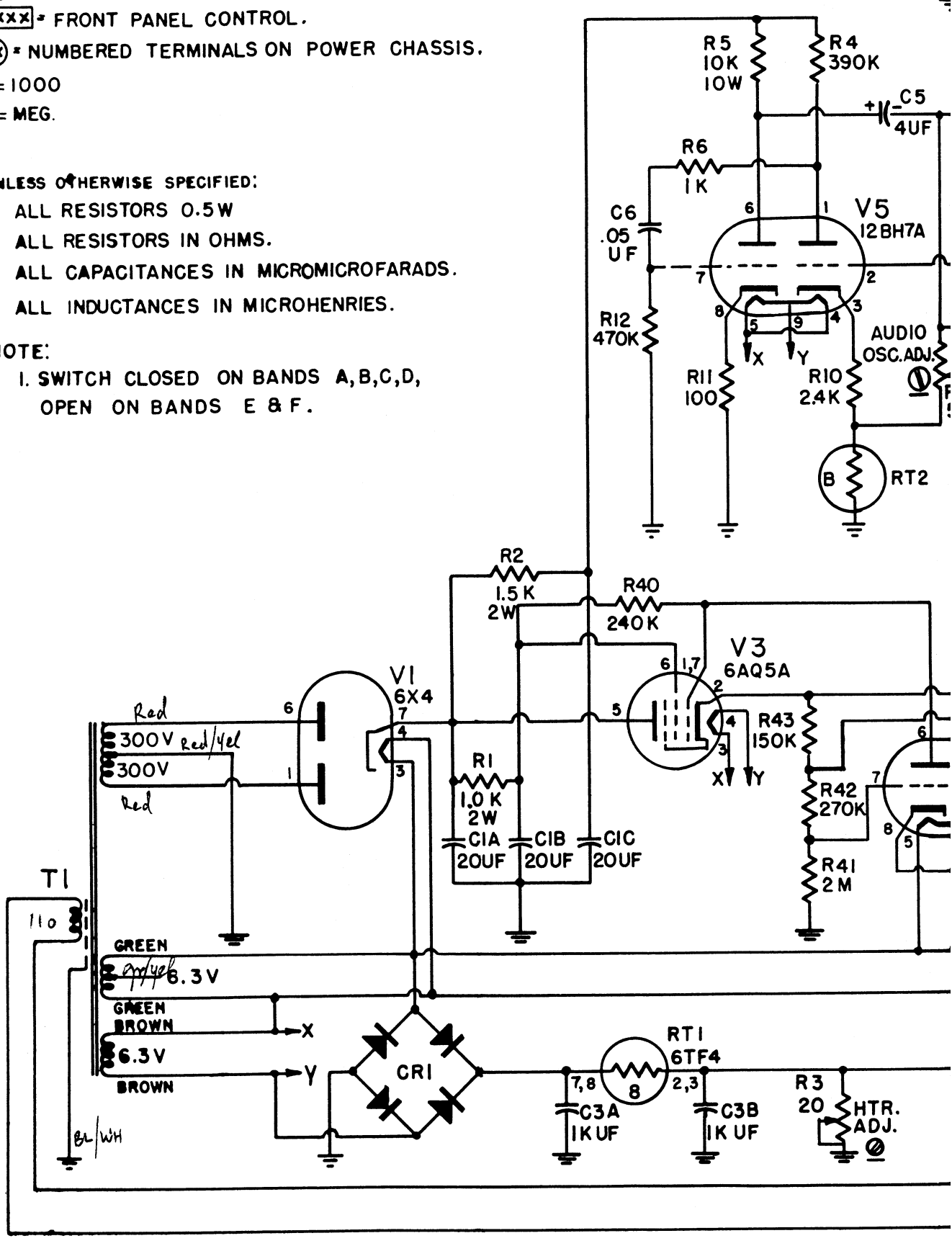
ALL RESISTORS IN OHMS.

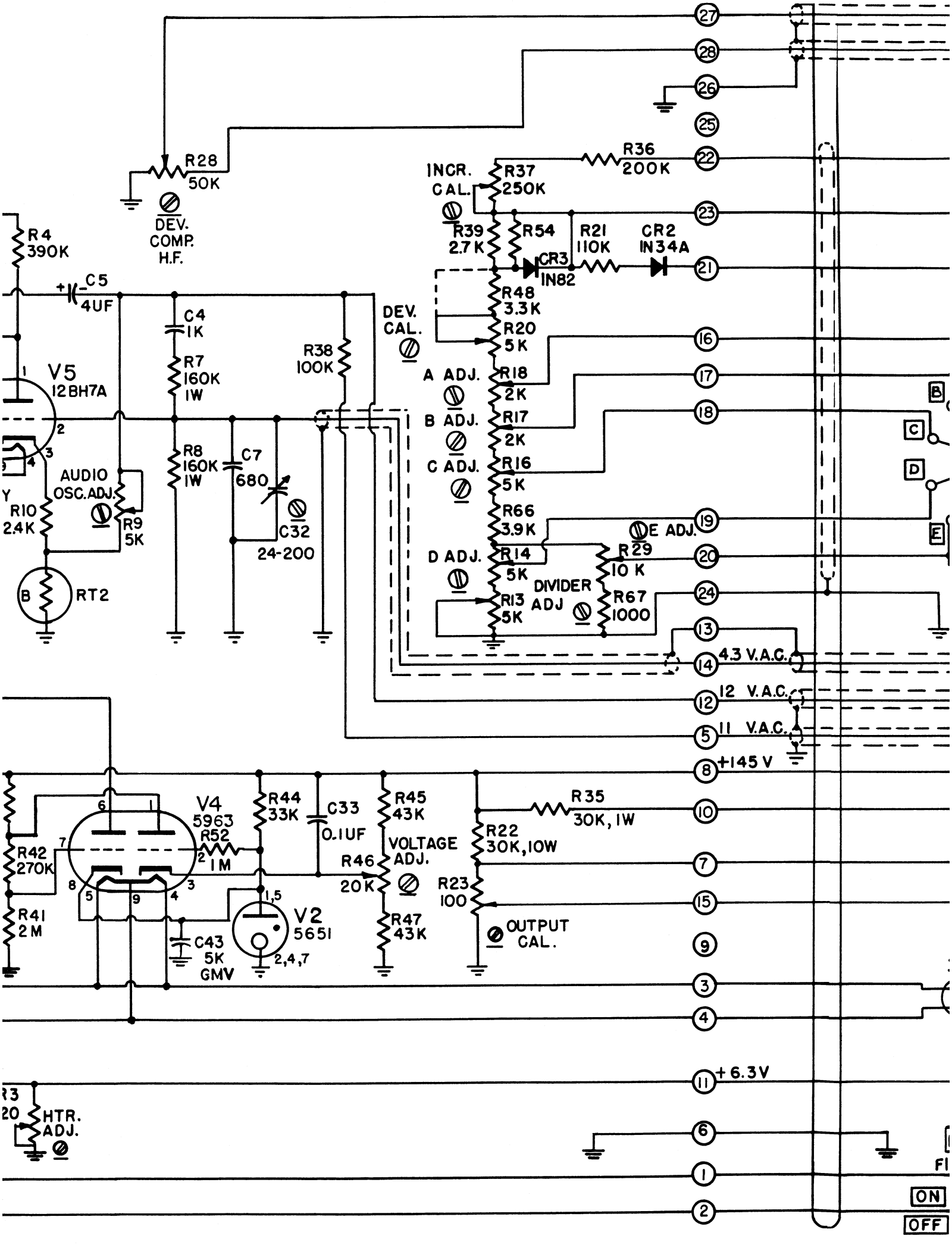
ALL CAPACITANCES IN MICROMICROFARADS.

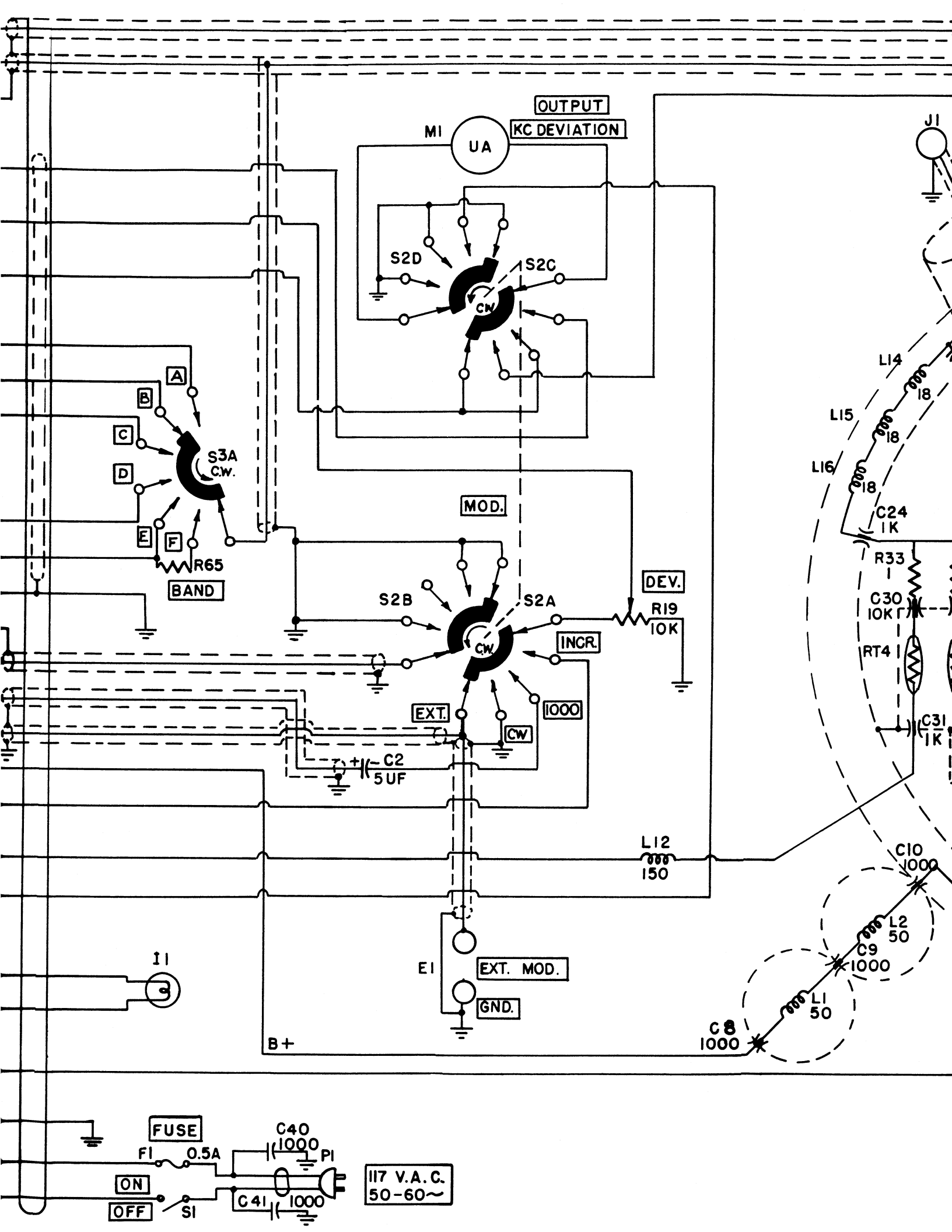
ALL INDUCTANCES IN MICROHENRIES.

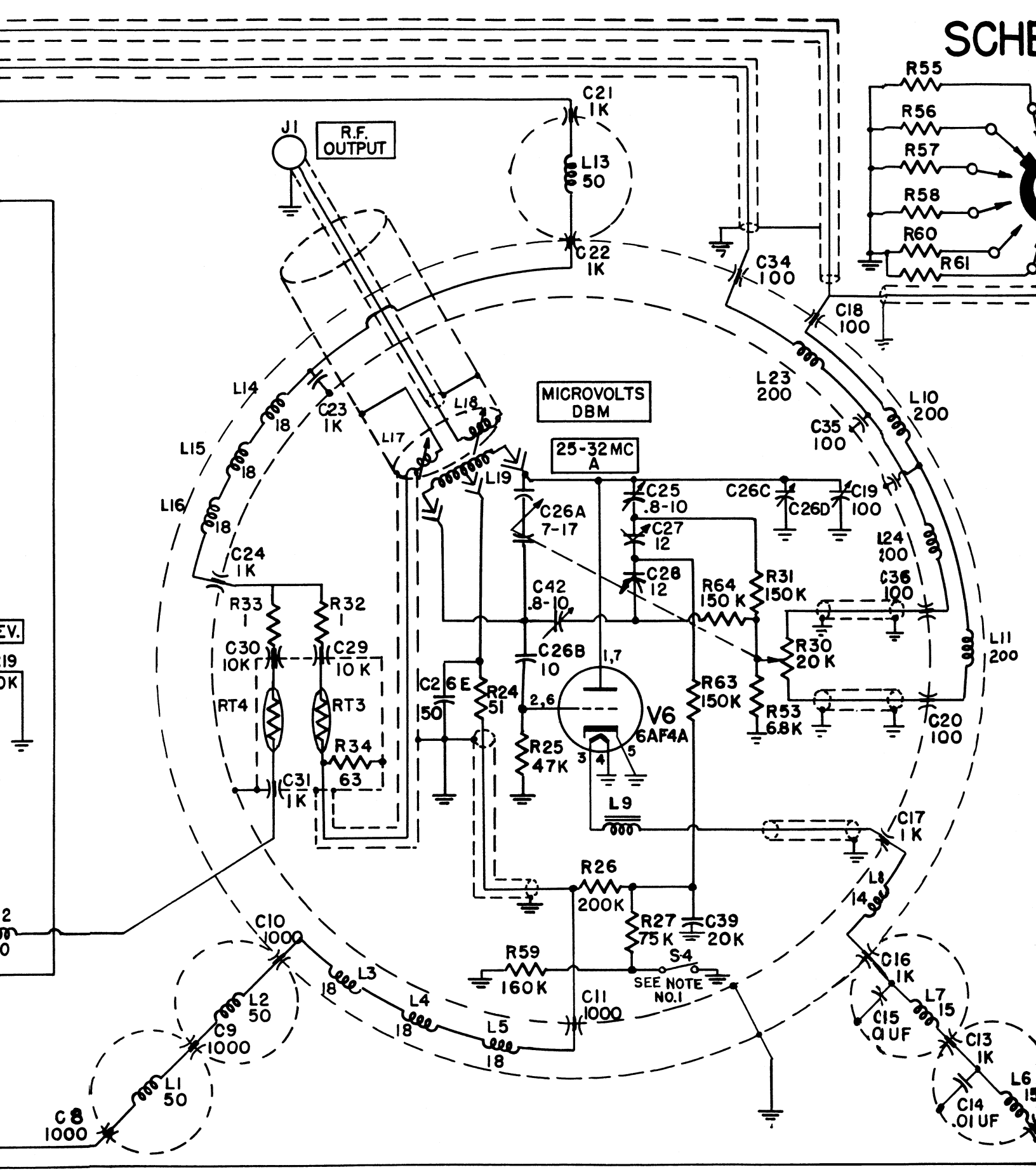
NOTE:

1. SWITCH CLOSED ON BANDS A, B, C, D,
   OPEN ON BANDS E & F.



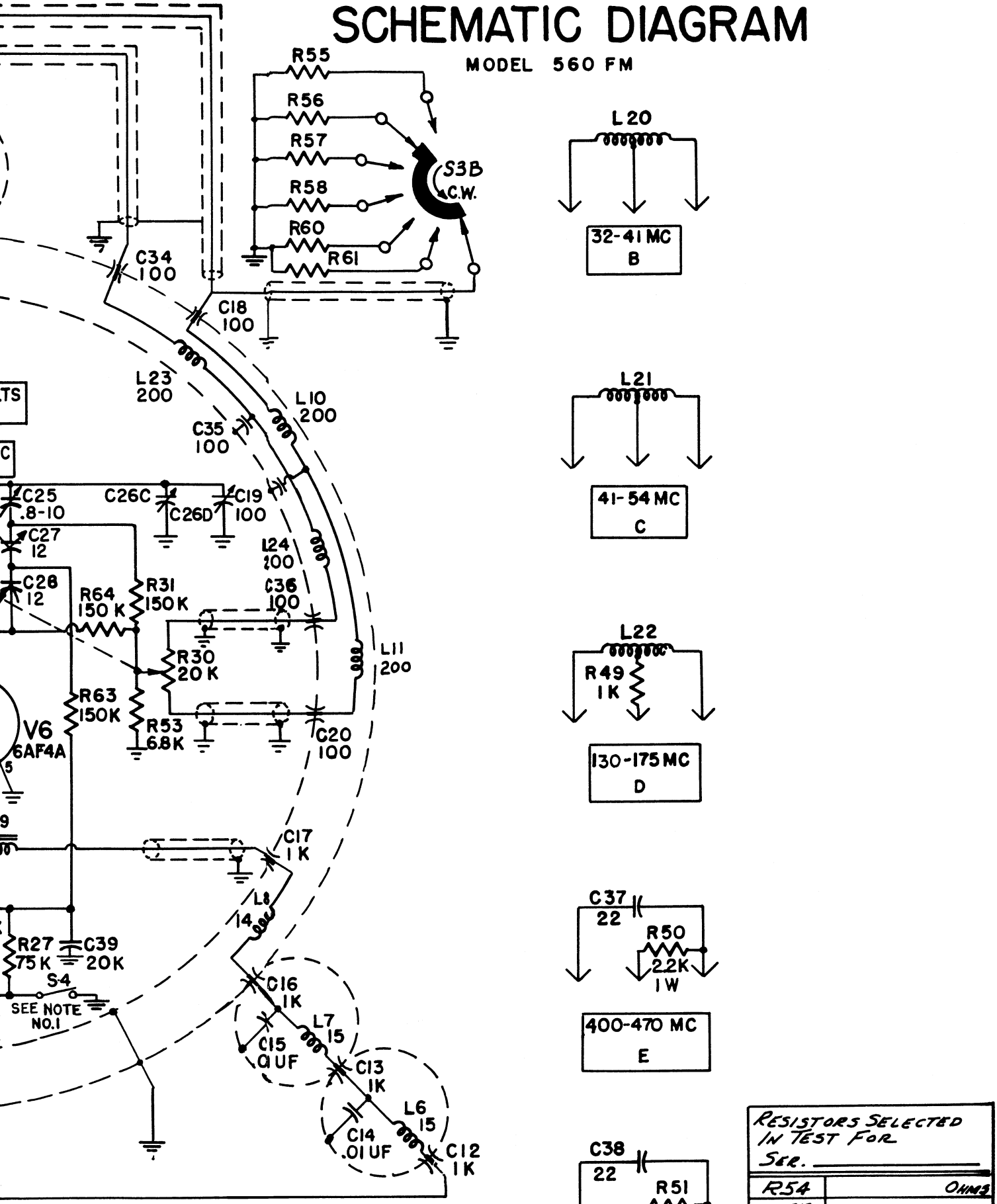

R28
50K
DEV.
COMP.
H.F.
R4
390K
C5
4UF
C4
1K
R7
160K
1W
R38
100K
V5
12BH7A
R8
160K
1W
C7
680
C32
24-200
AUDIO
OSC.ADJ.
R9
5K
R10
2.4K
RT2
DEV.
CAL.
INCR.
CAL.
R37
250K
R36
200K
R39
2.7K
R54
R21
110K
CR2
IN34A
CR3
IN82
R48
3.3K
R20
5K
A ADJ.
R18
2K
B ADJ.
R17
2K
C ADJ.
R16
5K
R66
3.9K
D ADJ.
R14
5K
E ADJ.
R29
10 K
DIVIDER
ADJ
R67
1000
R13
5K
4.3 V.A.C.
12 V.A.C.
11 V.A.C.
+145 V
V4
5963
R42
270K
R52
1M
R44
33K
C33
0.1UF
R45
43K
VOLTAGE
ADJ.
R46
20K
R47
43K
R35
30K, 1W
R22
30K, 10W
R23
100
OUTPUT
CAL.
R41
2M
C43
5K
GMV
V2
5651
2,4,7
+6.3V
HTR.
ADJ.
ON
OFF


OUTPUT
KC DEVIATION
M1
UA
J1
S2D
S2C
CW
A
B
C
D
E
F
S3A
C.W.
R65
BAND
MOD.
DEV.
R19
10K
S2B
S2A
INCR.
CW
EXT.
1000
CW
C2
5UF
L14
18
L15
18
L16
18
C24
1K
R33
C30
10K
RT4
C31
1K
L12
150
C10
1000
L2
50
C9
1000
L1
50
C8
1000
I1
E1
EXT. MOD.
GND.
B+
FUSE
F1
0.5A
C40
1000
P1
ON
OFF
S1
C41
1000
117 V.A.C.
50-60~


SCHE
J1
R.F. OUTPUT
C21 1K
L13 50
C22 1K
C34 100
C18 100
R55
R56
R57
R58
R60
R61
L14
18
C23 1K
L15
18
L16
18
L17
L18
L19
MICROVOLTS DBM
25-32 MC A
L23 200
L10 200
C35 100
C25 .8-10
C26C
C26D
C19 100
C26A 7-17
C27 12
C28 12
L24 100
C36 100
C24 1K
R33 1
R32 1
C42 .8-10
R64 150 K
R31 150K
C30 10K
C29 10 K
C26B 10
R30 20 K
L11 200
C26E 50
R24 51
1,7
2,6
V6 6AF4A
R63 150K
R53 6.8K
C20 100
RT4
RT3
R34 63
R25 47K
3
4
5
C31 1K
L9
C17 1K
R26 200K
L8 14
C10 1000
R27 75 K
C39 20K
R59 160K
S-4
SEE NOTE NO.1
C16 1K
C11 1000
L3 18
L4 18
L5 18
L2 50
C9 1000
L7 15
C15 .01 UF
C13 1K
L1 50
C8 1000
C14 .01 UF
L6 15
EV.
19
0K
2
0

SCHEMATIC DIAGRAM

MODEL 560 FM



RESISTORS SELECTED IN TEST FOR SER. _____	
R54	OHMS
R55	OHMS
R56	OHMS
R57	OHMS
R58	OHMS
R60	OHMS
R61	OHMS
R65	OHMS