42A TRANSMISSION MEASURING SYSTEM

CONTENTS

1. GENERAL

1.01 This section describes the circuits and operation of the 42A (J64042A) Transmission Measuring System which is used primarily as a means to measure pilot levels and carrier leak in the Type K Carrier Telephone Systems without disturbing working circuits. It may also be used to measure channel levels and crosstalk and to monitor noise on a high frequency basis. In addition, individual units or combination of units may be used in tests for which they are adaptable.

1.02 This issue replaces Issue 1, Prov. Std., dated July 1938. The more important revisions cover changes which have been made in the equipment and in its application as follows:

(1) Provision has been made for mobile rack mounting and for operation from 152 volt batteries.

(2) Jacks have been added to facilitate amplifier input level measurements.

(3) Provision has been made to locate an input pad near each appearance of multiple bridging cords to minimize interference into working circuits.

(4) Improved procedures have been set up for pilot and channel level measurements at both the input and output of an amplifier. New procedures for modulation and crosstalk measurements and for noise monitoring on a high frequency basis are also included.

1.03 A block diagram of the 42A transmission measuring system is shown in Fig. 1. By means of a heterodyne oscillator and a modulator, the frequency whose level is to be measured is shifted to 130 kc. This frequency is selected by a crystal band filter and transmitted to the high frequency amplifier. The amplified 130 kc is demodulated with the 129 kc output of the 50B oscillator to produce 1000 cycles. This power is amplified by, and measurements are made at the output of the 6D voice frequency amplifier.

1.04 The input impedance of the measuring system is high so that it introduces less than 0.1 db bridging loss. A four finger adapter plug (312A) is provided for insertion in the LINE and EQ jacks or REC AMP OUT and GR DEM IN jacks of the system on which measurements are to be made. One or more bridging cords are provided, when required, for connection to the measuring circuit. One end of these cords is equipped with a 308A plug for connection with the pin jacks of the 312A adapter plug. The other end, when only one bridging cord is used, is connected directly to the input of the measuring circuit; when two or more bridging cords are required, this connection is made through the MEAS TRKS switch. The modulator input impedance is 135 ohms so the 42A system can be used as a 135 ohm measuring device having about 58 db gain as discussed hereinafter.

1.05 There are two circuit arrangements of the 42A system which differ from each other primarily in the location of the 38 db input pad. Whenever a difference between the two arrangements occurs in the testing procedures outlined in this section, the jack designation for the earlier arrangement will be given first with the jack designation for the new arrangement following.

1.06 In the stationary equipment shown in Fig. 2, all units of the 42A system except the test amplifier are mounted as a group and occupy a space of approximately 19" x 68". This bay is located in the same lineup as the bays in which the sealed test terminals appear. The test amplifier is located on a bay with other high frequency amplifiers of the carrier telephone system. In the mobile arrangement shown in Fig. 3, all units of the 42A system including the test amplifier are mounted on a mobile rack.

1.07 Each unit is jack terminated for use independently or in any desired combination as shown in Figs. 11, 12 and 13.

1.08 The 17B oscillator is arranged for operation from 115 volts a-c but all other units of the 42A system that require power operate from 24 and 130 volt sources. At 152 volt offices a suitable power supply circuit is provided to derive the proper voltages without unbalancing the 152 volt battery. In the mobile arrangement the power is supplied by means of a M5F cord equipped with a 316A plug.

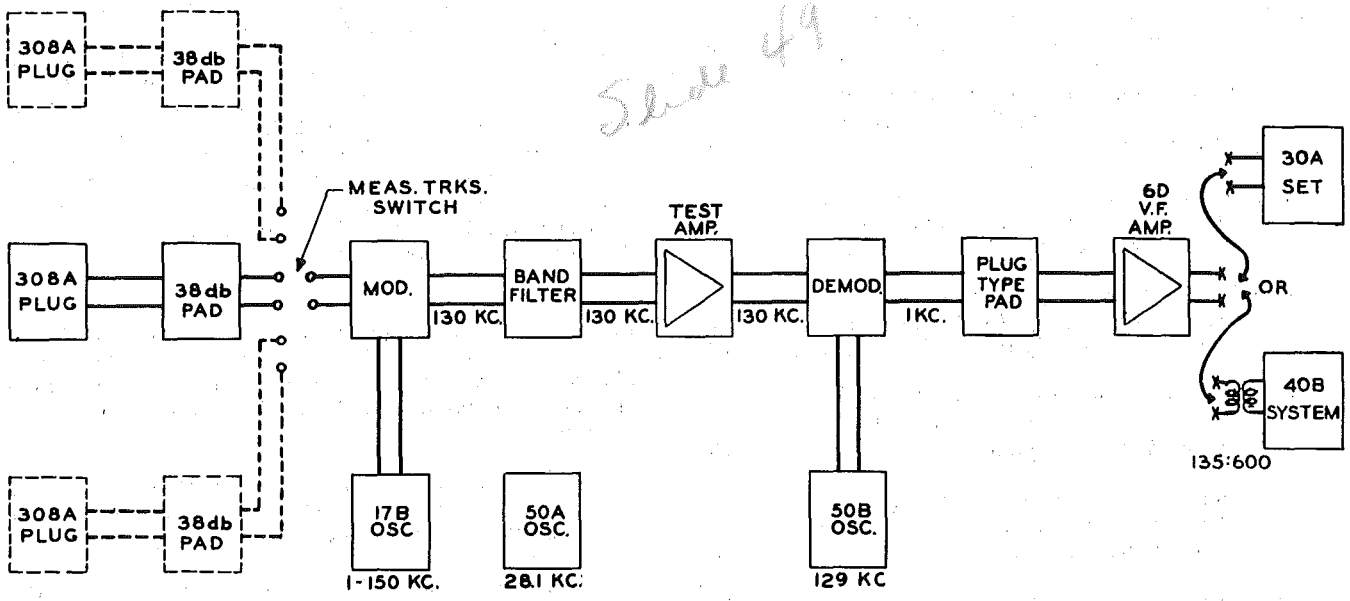


Fig. 1 - Block Diagram of 42A Transmission Measuring System

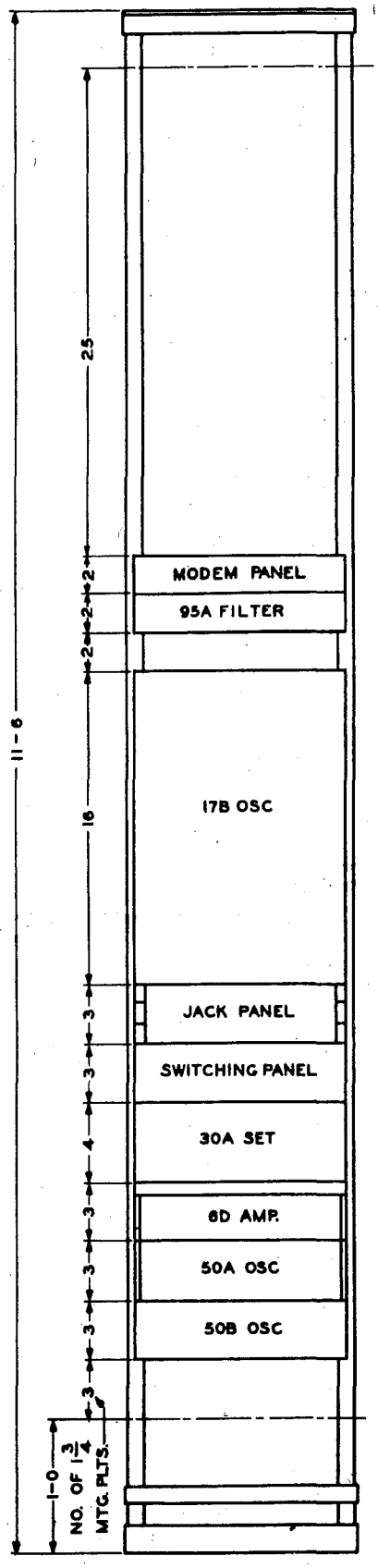


Fig. 2 - Bay Equipment - Fixed Arrangement

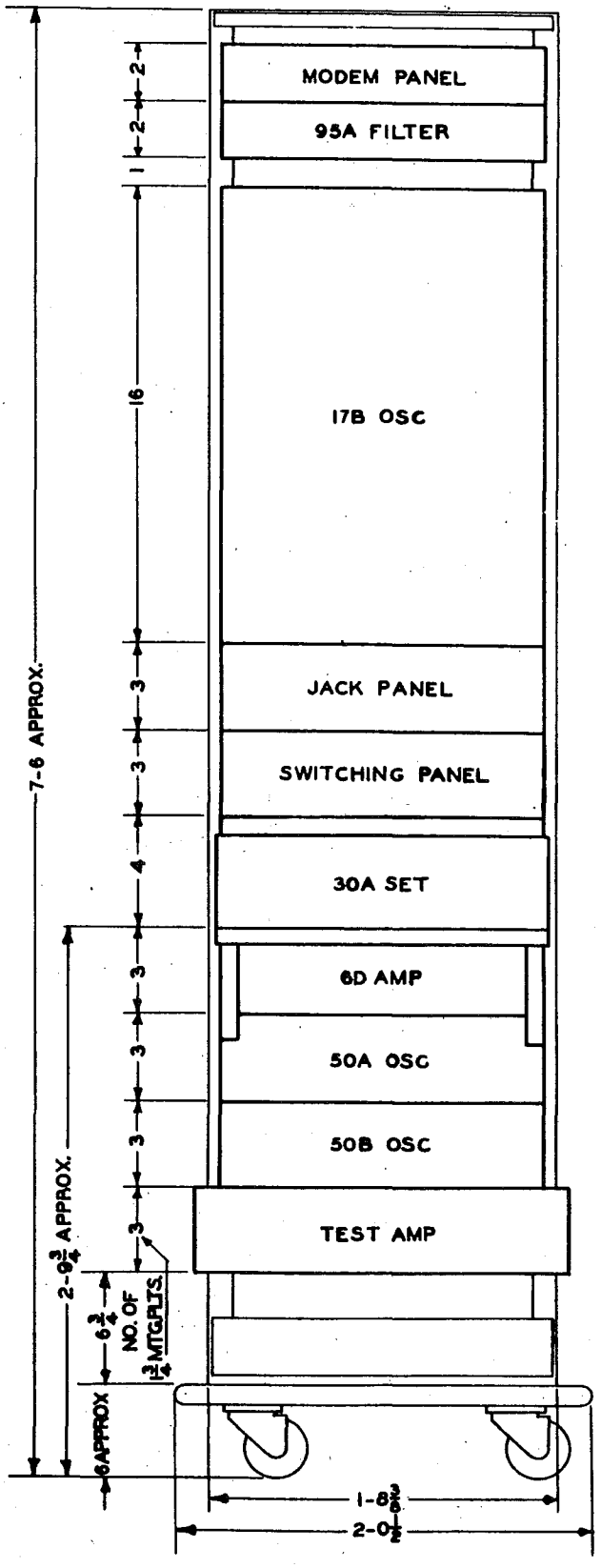
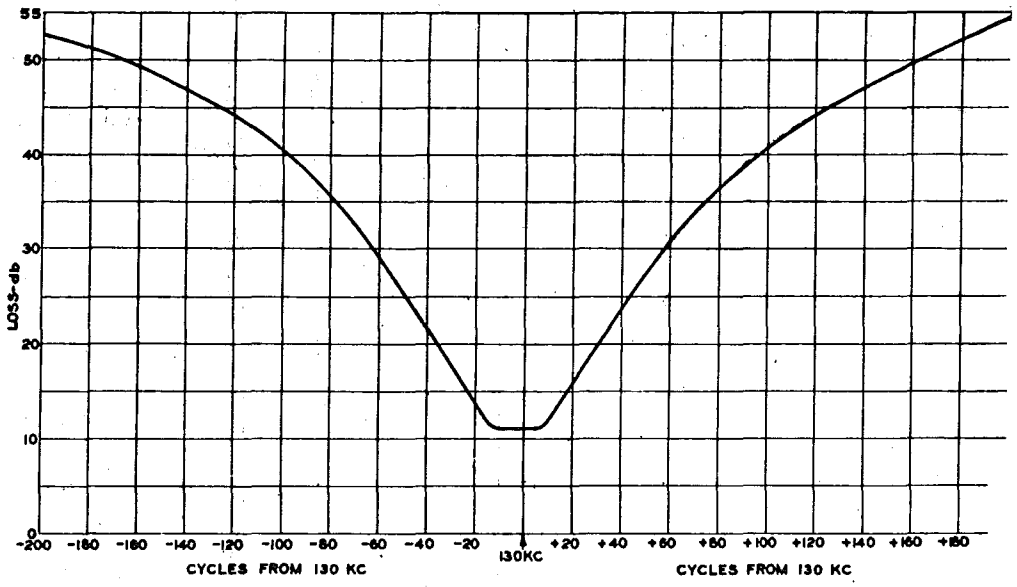


Fig. 3 - Bay Equipment Mobile Rack



Slide 50

Fig. 4 - Typical Loss-Frequency Characteristic of 95A Filter

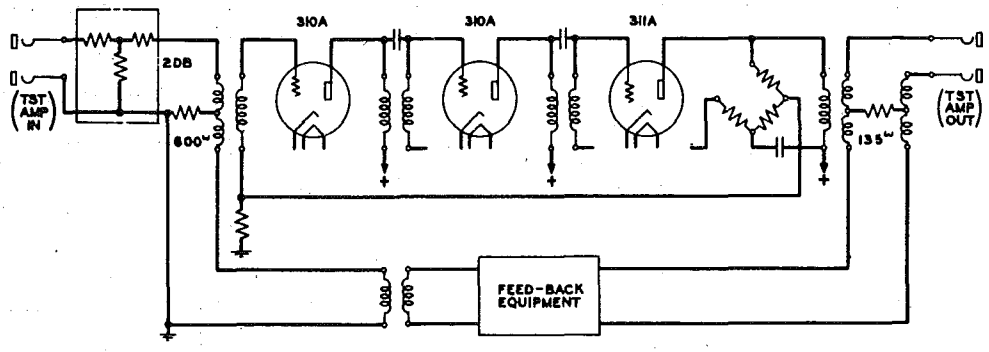


Fig. 5 - Test Amplifier - K1 Type

2. DESCRIPTION OF CIRCUITS AND EQUIPMENT

(A) 17B Oscillator

2.01 The 17B oscillator, described in other sections of these practices, is a heterodyne oscillator giving practically uniform output from 1 to 150 kc. It is used to provide the modulating frequency to shift the signal to be measured to 130 kc. The output of the oscillator is set at a frequency equal to the difference between 130 kc and the frequency of the signal. In order to facilitate this operation, the oscillator is provided with a frequency scale having a set of complementary readings in brackets for oscillator frequencies from 129 kc to 70 kc (signal frequencies from 1 to 60 kc). Thus in order to measure a given frequency the oscillator frequency is adjusted using the complementary or inverse scale to the frequency of the signal, as for example, for a signal of 28 kc the oscillator setting would be 102 (28) kc.

(B) Modulator

2.02 The modulator circuit, a schematic of which is shown in part of Fig. 11, consists of a copper-oxide bridge network between two impedance matching coils. This is followed by a 6 db pad to improve the impedance facing the filter. The total loss in the varistor and pad is constant with frequency and is approximately 11.5 db. The nominal signal input impedance is 135 ohms and the nominal output impedance is 600 ohms. The output of the 17B oscillator is supplied to the modulator at a power of about +16 dbm through a 135 to 20-ohm repeating coil in order to match the 20-ohm carrier input impedance of the modulator.

2.03 A pad having a high input impedance is provided ahead of the modulator in order that the bridging loss may be small. (See Fig. 13) This pad which has a loss of 38 db also serves to reduce the amount of possible

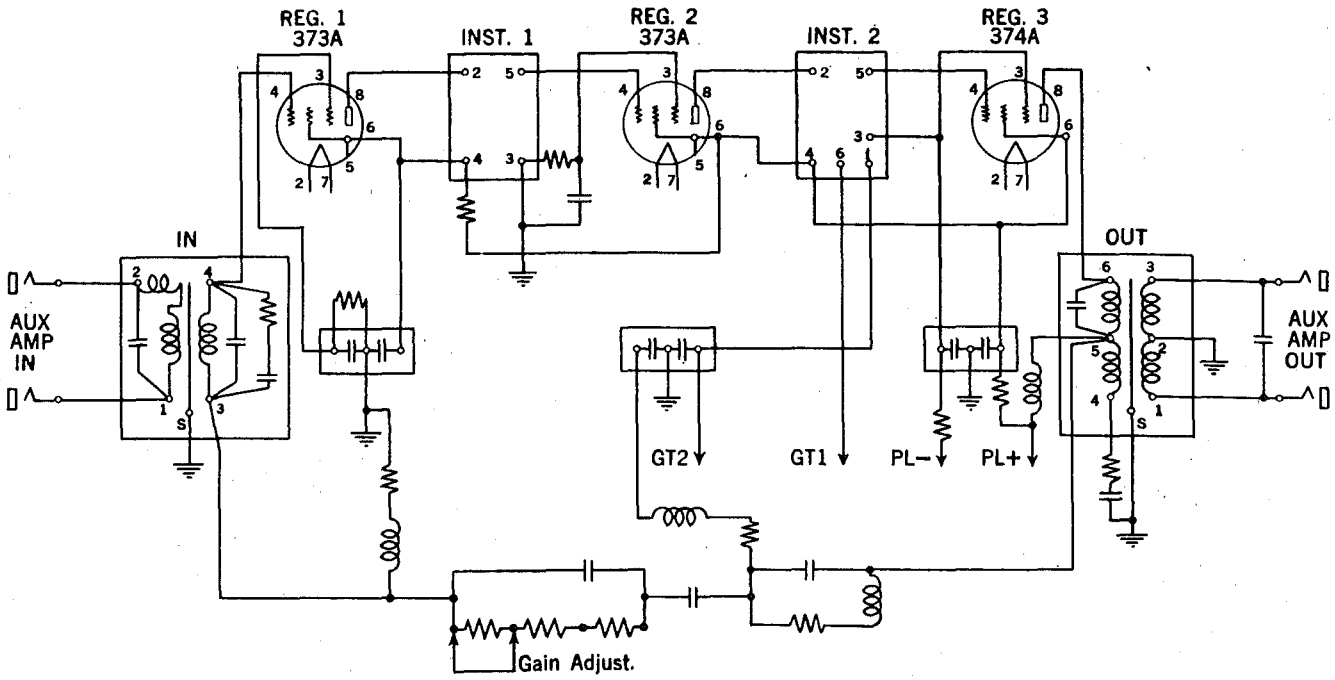


Fig. 6 - Auxiliary Test Amplifier - K2 Type

interference to the speech channels due to unbalances in the modulator. In the earlier models the 38 db pad is located between the MEAS IN and the PAD OUT jacks, and consequently the MEAS IN jacks are high impedance. In the present standard arrangement this pad is located in the measuring trunk circuit between the 308A plug and the MEAS TRK OUT jacks. Where two or more bridging cords are used, a six point selector switch is inserted ahead of the MEAS TRK OUT jacks and a 38 db pad is located near the input of each measuring trunk circuit.

(C) 95A Filter

2.04 The desired 130 kc power is selected from the other products of modulation by the 95A filter which is a quartz crystal type band filter having 11 ± 1 db loss in the center of the band. This loss is constant within 0.1 db for a 10 cycle band width, but affords about 30 db discrimination at ± 100 cycles as shown in Fig. 4. Both the input and output impedances are 600 ohms. This unit is hermetically sealed and is not accessible for repairs in the field.

Caution: In normal use, as in any of the measurements described herein, the associated equipment provides adequate protection, but this filter should be used with caution in any other arrangement as the crystal elements may be damaged should the power into the BAND FIL IN jacks be greater than about -10 dbm. (This is equivalent to a power of about +2 dbm at the MOD IN jacks.)

(D) Test Amplifier

2.05 A test amplifier is used to raise the level of the 130 kc power offsetting the losses in the input pad, modulator and filter. The test amplifier forming a part of the 42A system is of the K1 type. An additional test amplifier of the K2 type is available for use with the 42A system to make possible input measurements of type K2 amplifiers when installed in offices where K1 equipment is operating and where this type of measuring system is available.

2.06 The test amplifier of the K1 type, as shown in Fig. 5, is a stabilized feedback type using two 310A and one 311A vacuum tubes, and is similar to the type K1 transmitting amplifier. The test amplifier has an over-all gain of approximately 63 db at 130 kc, its gain frequency characteristic is reasonably flat over a frequency range of 12 to 130 kc and it has a sharp overload point at an output of +31 dbm. No provision has been made for gain adjustment. The nominal input impedance is 600 ohms and the nominal output impedance is 135 ohms.

2.07 The auxiliary test amplifier of the K2 type, as shown in Fig. 6, is a stabilized feedback type using three filamentary type pentode stages with feedback from the high side of the output transformer to the grid of the first tube. The first two stages of the amplifier employ 373A vacuum tubes and the output stage employs a 374A tube. Parallel tube sockets (not shown in Fig. 6) are provided as is the case of other K2 amplifiers and

tubes may be removed for test without interrupting the carrier frequency circuit through the amplifier. The filaments of the vacuum tubes are heated with alternating current which is provided through a filament transformer. The amplifier is used to amplify carrier frequencies in the range from 12 to 60 kc and has a gain frequency characteristic which is substantially flat over this range. By strapping resistances the gain may be varied from 68.5 to 71.5 db in steps of approximately 0.5 db. The nominal input impedance of the amplifier is 600 ohms and the nominal output impedance is 135 ohms. When this auxiliary test amplifier is patched from the MEAS TRK OUT jacks through an attenuator to the MEAS IN jacks of the 42A system, a test power as low as -85 dbm can be measured on the 42A system.

(E) 50B Oscillator

2.08 The 50B oscillator (J64050B) is a fixed frequency crystal type oscillator using a single 310A tube and is used to supply carrier frequency to the demodulator. A simplified schematic is shown in Fig. 7. The 129 kc output may be varied over a 2 db range from about +15.5 to +17.5 dbm by varying the OUTPUT potentiometer. The nominal output impedance is 20 ohms to match that of the carrier input to the demodulator.

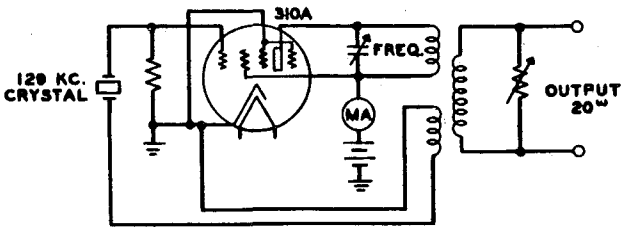


Fig. 7 - 50B Oscillator

2.09 A portion of the a-c output of the tube is fed back to the grid through a quartz crystal out to vibrate at approximately 129 kc. When the plate circuit is tuned by means of the variable FREQ condenser to a frequency equal to the natural period of the crystal, the effective impedance of the crystal is greatly reduced, producing a rise in the voltage across the grid leak resistance. This increased grid bias causes a decrease in plate current, resulting in a minimum current when the frequency of the tuned circuit equals the resonant frequency of the crystal. Under this condition the frequency of the output is controlled by the natural vibration of the crystal and is very stable. A milliammeter is provided for use in adjusting the plate circuit tuning; the FREQ condenser is adjusted until the plate current is a minimum. When tuned in this manner the frequency will be 129 kc ± 50 cycles.

(F) Demodulator

2.10 In the demodulator section of the modem unit, the 129 kc output of the 50B oscillator is used to demodulate the output of the test amplifier to obtain 1000 cycles. The demodulator, like the modulator, is a copper-oxide bridge network and is followed by a 3 db pad to improve the impedance. The nominal input impedance is 135 ohms and the nominal output impedance is 600 ohms. A simplified schematic is shown in part of Fig. 11. The total loss in varistor and pad is constant with frequency and is approximately 8.5 db.

(G) 6D Voice Frequency Amplifier

2.11 The output of the demodulator passes to the 6D amplifier (J64006D) which is a one-tube voice frequency amplifier using negative feedback. A simplified schematic is shown in Fig. 8. The input circuit includes a simple low pass filter consisting of two coils and two condensers to eliminate the products of demodulation other than the desired 1000 cycles. With an output of one milliwatt, the gain at 1000 cycles may be varied from about 23 to 30 db. The CAL potentiometer in the feedback circuit affords about 5.5 db variation, and an additional 2 db gain may be obtained by strapping out resistance G.

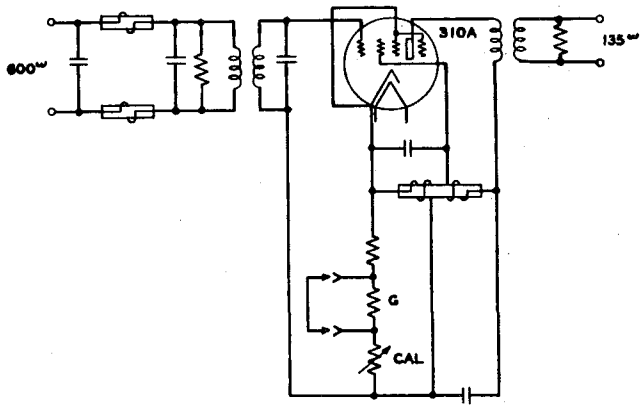


Fig. 8 - 6D Voice Frequency Amplifier

2.12 As shown by the frequency characteristic in Fig, 9, the 6D amplifier provides a flat gain for frequencies from about 700 to 1500 cycles. The maximum output power is about +11 dbm. The nominal input impedance is 600 ohms to match that of the output of the demodulator, and the nominal output impedance is 135 ohms.

2.13 When the 42A system is in the measuring position, a plug type pad (composed of 89-type resistances and a 1C pad) is in the circuit between the demodulator output and the voice frequency amplifier input. A plug type pad is selected to have a value in db equal to

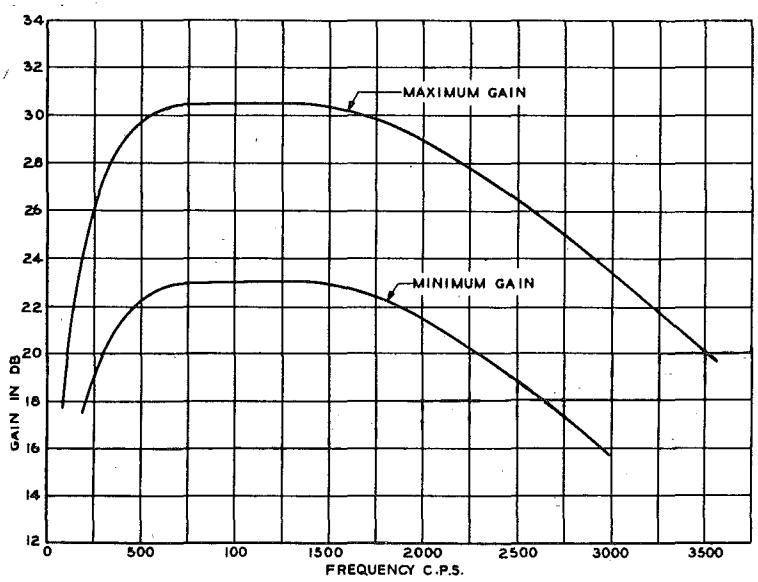


Fig. 9 - Typical Gain-Frequency Characteristics of the 6D Voice Frequency Amplifier

the operating output level at the measuring point; i.e., when measuring at the output of an amplifier operating at a +9 level, the value of the pad should be 9 db (89 AT resistance). With this pad in the circuit, the output of the 6D amplifier will be about 0 dbm when measuring pilot levels.

2.14 The amplified 1 kc power is measured on the portable 30A transmission measuring set, 40B transmission measuring system or equivalent. The circuit and operation of the 30A set and 40B system are described in other sections of these practices.

(H) 50A Oscillator

2.15 The 50A oscillator (J64050A), a simplified schematic of which is shown in Fig. 10, is a single tube oscillator used to supply 28.1 kc for calibration purposes. The calibrating frequency of 28.1 kc was selected to be near but not equal to the middle pilot frequency. The plate circuit of the oscillator tube may be tuned by means of the FREQ condenser to 28.1 kc ± 100 cycles, and a part of the a-c output of the tube is fed back to the grid to complete the oscillating circuit. The OUTPUT potentiometer affords a variation in output from -0.8 to +1 dbm.

2.16 The frequency of the 50A oscillator may be adjusted when the measuring circuit is in the calibrating position with the three-position switch in position "2" as described below. With the frequency of the 17B oscillator set to 101.9 kc, the FREQ condenser on the 50A oscillator is varied until a maximum reading is obtained at the output of the measuring circuit, indicating that the sum of the two frequencies is in the center of the pass band of the 130 kc (95A) filter.

2.17 For calibration purposes the output of the 50A oscillator is adjusted to 0 dbm and introduced into the modulator of the measuring circuit at a power of -58 dbm. (20 db in addition to the 38 db that is normally in the input circuit.) Calibration then consists of adjusting the gain of the 6D amplifier to provide an output of 0 dbm from the measuring circuit.

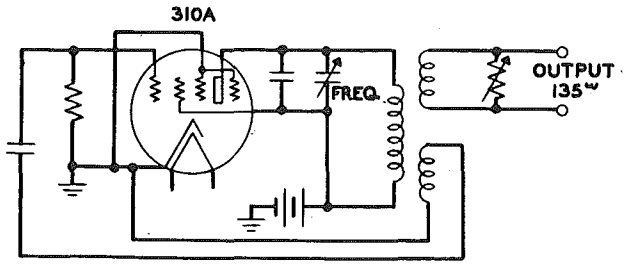


Fig. 10 - 50A Oscillator

(I) Miscellaneous Equipment

2.18 Blocking condensers are provided in the series branches of the high impedance input pad to the modulator and in the output leads of the 17B oscillator to prevent interference with the d-c pilot wire circuit for the twist regulators. A 20 db pad is provided in the earlier arrangement and a 58 db in the new arrangement to reduce the output of the 50A oscillator to a proper value for calibration purposes. These condensers and pads, the plug type pad, the MEAS TRKS switch (when provided) and a three-point ten-pole switch for changing

from calibrating to testing positions are located on the switching panel.

2.19 In addition to the repeating coil mentioned above that is used to match the 135-ohm output impedance of the 17B oscillator to the 20-ohm impedance at the carrier input to the modulator, another repeating coil of a ratio of 135 to 600 ohms is provided for general use should the need arise when using individual units or a combination of units. Both coils are mounted on the modem panel.

3. OPERATION

3.01 Before bridging on any working circuit, the 17B oscillator should be calibrated and the frequency of its output should be adjusted to some value above 60 kc. Should the frequency of the 17B oscillator be set in the range of 12 to 60 kc, noise may be introduced in the type K system through unbalances in the modulator, particularly when the output is in excess of +16 dbm. In addition, no measurement should be attempted which requires the frequency of the 17B oscillator to be set at a submultiple of 130 kc, as for this condition the 130 kc harmonic of the oscillator is of a magnitude comparable to or greater than the power to be measured.

Note: This measuring circuit employs vacuum tubes and a very narrow band pass filter and accurate results can be assured only by frequent calibration and by careful adjustment of the frequency of the 17B oscillator.

3.02 The 40B transmission measuring system or the 2A or 2B noise measuring set can be used as an indicating meter in place of the 30A transmission measuring system in any of the following procedures. Thus, wherever reference is made to a patch to the 135 ohm TC jacks of the 30A set, equivalent results can be obtained by patching through a 135:600 ohm coil to the input jacks of the 40B system or to the 2A or 2B noise measuring set.

(A) Calibration

3.03 The calibration of the 42A transmission measuring system involves an adjustment of the measuring circuit to provide 58 db gain from the MOD IN jacks to the MEAS OUT jacks. After calibration and when in the measuring position the gain from the MOD IN jack to the MEAS OUT jack is 58 db minus the loss in the plug type pad.

The detailed process consists in:

(1) Adjustment of the frequency and output of the 50B oscillator.

(2) Adjustment of the frequency and output of the 17B oscillator.

(3) Adjustment of the gain of the measuring circuit.

3.04 Procedure - Adjustment of 50B Oscillator

(1) Remove the plug from the FIL jack on the 50B oscillator and turn on the 17B oscillator.

(2) Allow 30 minutes for warming up and stabilizing.

(3) Adjust the frequency of the 50B oscillator to 129 kc by adjusting the FREQ condenser so that a minimum reading is obtained on the plate meter.

(4) Patch from 129 kc OUT to RC 20 OHM jacks.

(5) Patch from the RC 135 OHM jacks to the ATTEN IN jacks of 30A set.

(6) Set the attenuator to 16 db and operate the test key to the ADJUST position.

(7) Measure the output of the 50B oscillator. Adjust the OUTPUT potentiometer as required.

Requirement: The meter reading should be 0 ± .3 db.

(8) Remove all patch cords.

3.05 Procedure - Adjustment of 17B Oscillator:

(1) Check the calibration of the 17B oscillator.

(2) Set the 17B oscillator to 101.9 kc. This is the frequency required for modulation with a line frequency of 28.1 kc to give a frequency (101.9 + 28.1 = 130) which will pass through the 130 kc band filter.

(3) Operate the output key of the 17B oscillator to 135 ohm and patch from the TST OSC OUT to the ATTEN IN jack of the 30A set. Operate the test key to the ADJUST position.

(4) With the attenuator set at 16 db, adjust the output of the 17B oscillator by means of the OUTPUT dial to obtain the required output.

Requirement: The meter reading should be 0 ± .3 db.

Note: If a 17A oscillator is used the maximum output may be .5 db low. This will be satisfactory.

(5) Remove the patch cords.

3.06 Procedure - Adjustment of Measuring Circuit Gain:

(1) Operate the three-position CAL-MEAS key on the switching panel to position 1. See Fig. 11.

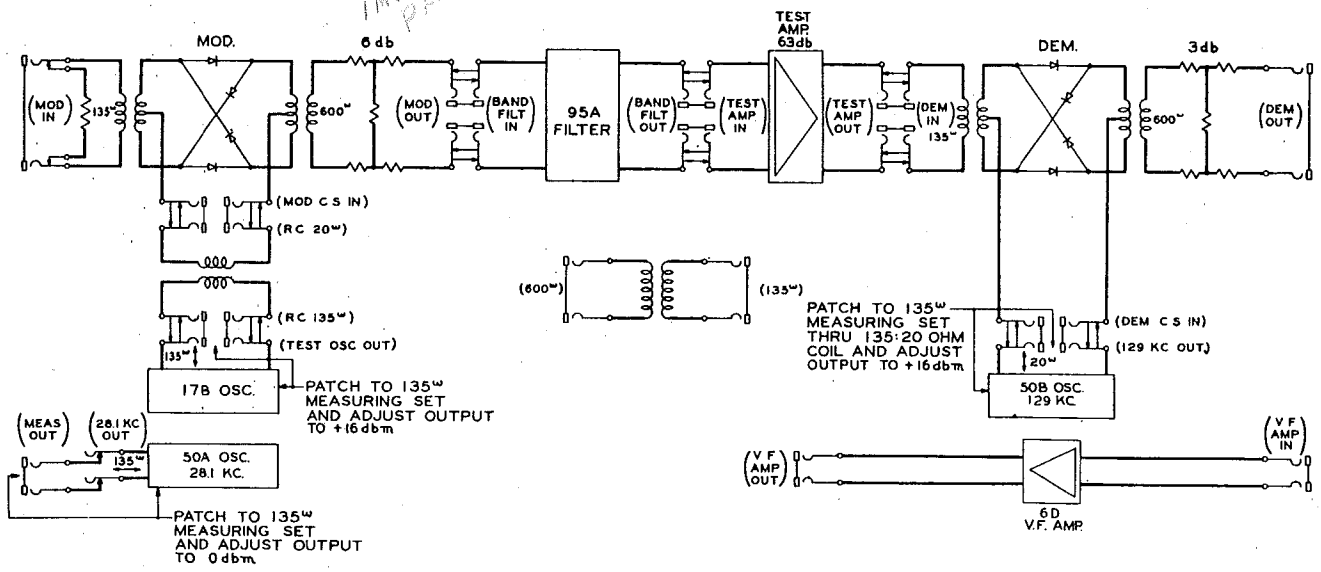


Fig. 11 - Position "1" of CAL-MEAS Key - Adjustment of Output of 17B, 50A and 50B Oscillators

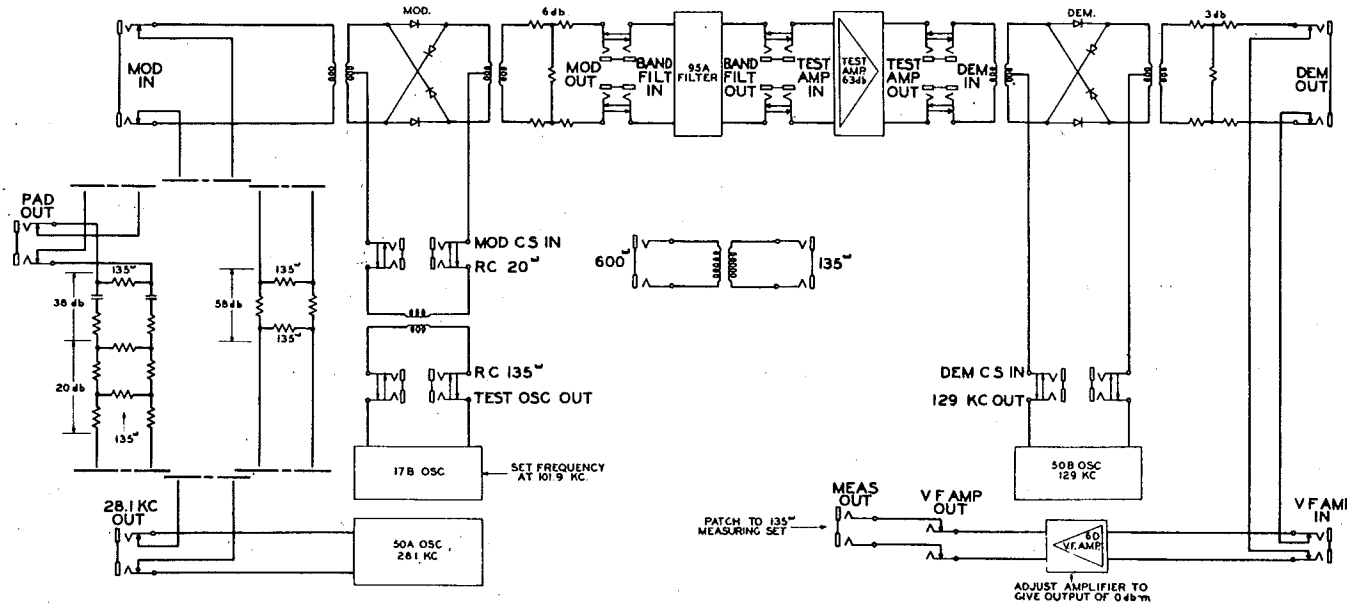


Fig. 12 - Position "2" of CAL-MEAS Key - Adjustment of Gain of Voice Frequency Amplifier

(2) Patch from the MEAS OUT jack of the measuring circuit to the 135 OHM TC jacks on the 30A transmission measuring set and read the meter.

(3) Adjust the OUTPUT potentiometer of the 50A (28.1 kc) oscillator to meet requirements with the three 10 db keys operated.

Requirement: The meter reading should be as close as possible to 0 db.

(4) Operate the CAL-MEAS key on the switching panel to position (2). See Fig. 12. This connects the output of the 28.1 kc oscillator to the input to the modulator through a 58 db loss which reduces the level of the 28.1 kc signal to that of the pilot on the line to be measured. The pilot power is ordinarily -20 dbm at the zero level point but with the 38 db loss in the bridging circuit a normal pilot referred to the MOD IN jacks of the

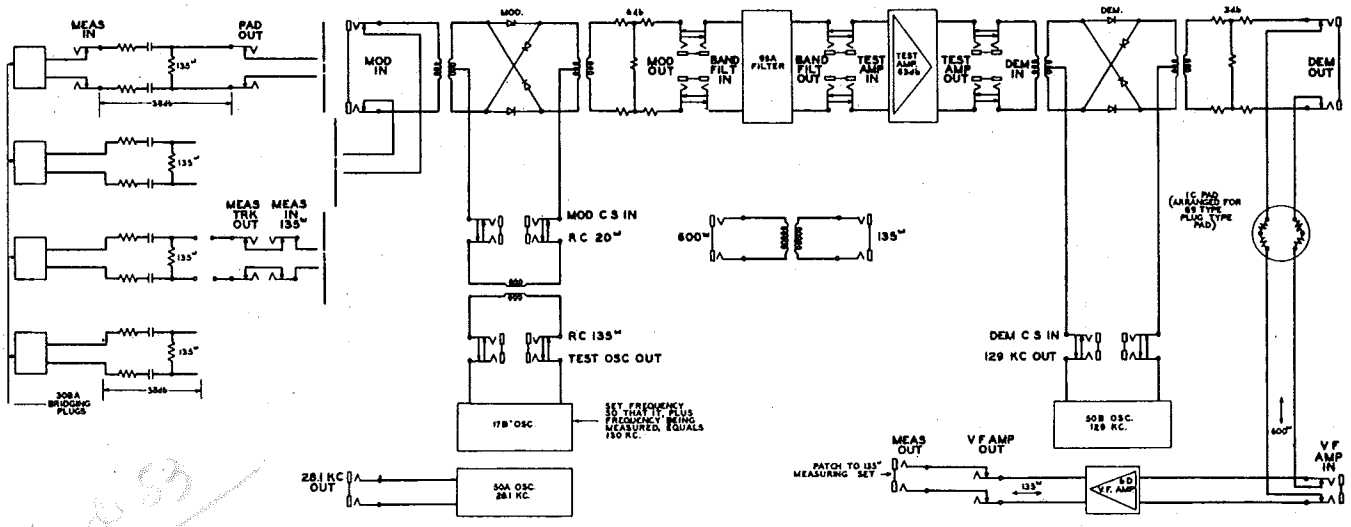


Fig. 13 - Position "3" of CAL-MEAS Key - Measuring Position

measuring circuit will be -58 dbm plus the output level of the amplifier.

(5) Set the 17B oscillator to 101.9 kc which point (28.1 kc) will also be indicated on the inverse scale. The vernier dial should be at zero.

(6) With a small deflection obtained on the thermocouple meter, adjust the frequency of the 17B oscillator by means of the small vernier CYCLES dial until a maximum deflection is obtained on the meter indicating that the modulated frequency is in the center of the 130 kc narrow bandpass filter.

Requirement: When maximum deflection is obtained, the frequency of the 17B oscillator (the film scale reading plus or minus the vernier dial reading) should be 101.9 kc ± 100 cycles.

(7) If the above requirement is not met, the frequency of the 50A oscillator should be adjusted as covered in Part 4(F).

(8) Adjust the gain of the voice frequency amplifier by means of the CAL potentiometer until the required reading is obtained on the meter with the three protection keys operated. If the requirement cannot be met within the range of the CAL potentiometer, change the adjustment of the G resistance in the feedback circuit.

Requirement: The meter reading should be as close as possible to 0 db.

(9) Operate the CAL-MEAS key on the switching panel to position 3 and the circuit is ready for use. See Fig. 13.

(B) 135 Ohm Measuring System

3.07 The 42A transmission measuring system can be used as a 135 ohm measuring system by patching directly to the MOD IN jacks. For this use the 42A system has a gain of 58 db, that is an input of -58.0 dbm at the MOD IN jacks will give a reading of 0 db at the MEAS OUT jacks.

3.08 Procedure:

(1) Calibrate the 42A transmission measuring system as covered in Part 3(A), leaving the three position CAL-MEAS key in position "2" or in position "3" with the plug type pad set for 0 db loss. Patch from the MEAS OUT jacks to the 135 OHM TC jacks of the 30A set.

(2) Set attenuator of 30A set for 58 db.

(3) Patch from 28.1 kc OUT jacks to ATTEN IN jacks of 30A set.

(4) Patch from ATTEN OUT jacks of 30A set to MOD IN jacks.

(5) Adjust the gain of the 6D voice frequency amplifier by means of the CAL potentiometer until a reading of 0 db is obtained on the meter with the three protection keys operated.

(6) If this adjustment is more than ± 0.2 db from that obtained when calibrated in accordance with Part 3(A) check for trouble in the 42A system or the 58 db pad.

(7) Remove the patch cord between 28.1 kc OUT jacks and ATTEN IN jacks.

(8) Set the inverse scale on the 17B oscillator to the frequency to be measured.

(9) Patch from the system to be measured to the ATTEN IN jacks of the 30A set.

(10) Slowly vary the CYCLES dial to obtain a maximum reading, adjusting the attenuator as required.

(11) The power to be measured in dbm is equal to the attenuator setting minus 58 db ± the meter reading.

(C) Pilot Measurement at Output of Amplifier

3.09 In the Type K system the pilot output power of all pilot frequencies except the 60 kc pilot of the K2 system, is -20 dbm at the zero level point of the circuit, or -11 dbm at the output of a repeater operating at +9 db level. The output power of the 60 kc pilot of the K2 system is +6 dbm at the zero level point or +15 dbm at the output of a repeater operating at a +9 db level. When calibrated and ready for test, the measuring circuit provides a gain of 20 db less the value in db of the plug type pad. Thus with a 9 db (89 AT resistance) pad, a meter reading of 0db for a low level pilot means a pilot frequency power of -11 dbm which corresponds to an output level for the adjacent speech channels of approximately +9 db. Where the pilot frequency is different from the adjacent carrier, care must be taken to differentiate between them.

3.10 Procedure:

(1) With the 42A system calibrated and ready for test as described in Part 3(A), insert in the socket on the switching panel the proper 89-type resistance to give a pad value equal to the specified operating output level of the amplifier. In general, this will be 9 db (89 AT resistance). Operate the CAL-MEAS key to position "3".

(2) When the 60 kc high level pilot in a K2 system is to be measured, patch from the PAD OUT or MEAS TRK OUT jacks of the 42A system to the ATTEN IN jacks of the 30A set, and from the ATTEN OUT jacks to the MOD IN jacks of the 42A system. Set the attenuator for 26 db. For measurements of low level pilots, remove attenuator or set it to zero.

(3) Patch from the MEAS OUT jacks to the 135 OHM TC jacks of the 30A set.

(4) Set the inverse scale on the 17B oscillator to the frequency to be measured, and the small CYCLES dial to 0.

(5) Insert the 312A four finger adapter plug into the output EQ and LINE jacks (or if at a receiving terminal, the REC AMP OUT and GR DEM IN jacks) of the system to be measured. Connect the 308A plug on the bridging cord to the pin jacks of the 312A plug. Should the jacks already be in use, as in switching procedure, the 308A plug may be connected to the pin jacks of the plug already in place. If the output EQ jacks are not terminated for any reason, insert a 323A (135 ohm) plug in the output EQ jacks and connect the 308A plug to the pin jacks of the 323A plug.

(6) Operate the three 10 db protection keys on the 30A set, and at the same time slowly vary the frequency of the 17B oscillator until a maximum deflection is obtained on the meter.

(7) Make a fine adjustment to obtain a maximum reading by means of the small CYCLES dial on the oscillator and read the meter.

(8) The pilot frequency output is equal to the value of the plug type pad plus the attenuator setting minus 20 db plus or minus the meter reading. See Paragraph 3.09.

(9) Change the oscillator setting to the next frequency to be measured and repeat Items (6) and (7) above.

Note: Where low level pilots on a number of circuits are to be measured, it may be convenient to measure all circuits at one pilot frequency before proceeding to the next frequency to be measured. This does not apply to the 60 kc pilot as for this case careful tuning is needed before each measurement.

(D) Channel Measurement at Output of Amplifier

3.11 The transmitting or amplifier output of an individual channel can be measured at the sealed test terminals with the 42A transmission measuring system when 1000 cycle test power (usually -13 dbm) is placed on that channel at the channel modulator input.

3.12 Procedure:

(1) The channel to be tested should be released from service.

(2) Calibrate the 42A transmission measuring system as covered in Part 3(A). Use the proper 89 type resistance to give a pad value equal to the specified operating output level of the repeater. Operate the CAL-MEAS key to position "3".

(3) Patch from the MEAS OUT jacks to the 135 OHM TC jacks of the 30A set.

(4) Patch from the PAD OUT or MEAS TRK OUT jacks to the ATTEN IN jacks of the 30A set and from the ATTEN OUT jacks to the MOD IN jacks of the 42A system.

(5) Set the attenuator to 20 db.

(6) At the 4-wire voice frequency test bay at the transmitting terminal patch from the SEND -13 to the MOD IN jacks of the channel under test thus sending 1000 cycle test power into the channel modulator at the proper level.

(7) Set the inverse scale of the 17B oscillator to the frequency to be measured, and the CYCLES dial to 0.

(8) Insert the 312A four finger adapter plug into the output EQ and LINE jacks (or if at a receiving terminal, the REC AMP OUT and GR DEM IN jacks) of the system to be measured. Connect the 308A plug on the bridging cord to the pin jacks of the 312A plug. Should the jacks already be in use, as in the switching procedure, the 308A plug may be connected to the pin jacks of the plug already in place. If the output EQ jacks are not terminated for any reason, insert a 323A (135 ohm) plug in the output EQ jacks and connect the 308A plug to the pin jacks of the 323A plug.

(9) Operate the three 10 db protection keys in 30A set, and at the same time slowly vary the frequency of the 17B oscillator until a maximum deflection is obtained on the 30A set meter. Adjust the attenuator as required.

(10) Make a fine adjustment to obtain a maximum reading by means of the CYCLES dial on the oscillator and read the 30A set meter.

(11) The output in dbm is equal to the attenuator setting plus the pad value minus 20 db plus or minus the 30A set reading.

(E) Measurement of Stabilized Pilots at System Terminal Bus-bar

3.13 At the transmitting terminal of systems equipped with stabilized pilot supply, pilot level measurements are made at the pilot supply bus-bar to check the level of the three pilot frequencies 64, 92 and 108 kc. An individual level adjustment for each pilot frequency is provided. In this test the 42A transmission measuring system is used as a 135 ohm measuring system as described in Part 3(B).

3.14 Procedure:

(1) Repeat Items (1) through (7) of Paragraph 3.08.

(2) Set the TRNS switch of the pilot supply circuit to ALT when measuring the regular supply and to REG when measuring the alternate supply.

(3) Patch the ATTEN IN jacks of 30A set to PC LEV M jacks of pilot channel supply level measuring trunk.

(4) Set 17B oscillator at exactly 66 kc with CYCLES dial at 0 to measure the 64 kc pilot frequency.

(5) Set the attenuator at 5 db, and operate the test key to ADJUST position.

(6) Operate the three 10 db protection keys on the 30A set and slowly vary the frequency of the 17B oscillator until a maximum reading is obtained on the 30A set meter.

(7) Adjust the attenuator to get this reading as close as possible to 0 db. Note the attenuator setting and the 30A set meter reading.

(8) The 64 kc pilot in dbm is then equal to -58.0 dbm (calibrated input of 42A system) plus the attenuator setting plus or minus the 30A set meter reading. For example, if the attenuator setting is 2 db and the meter reading is -0.5 db then the pilot is: -58.0 + 2.0 - 0.5 = -56.5 dbm.

(9) Repeat Items (5) to (8) inclusive to measure the 92 kc pilot current level. Set the 17B oscillator at 38 kc for this test.

(10) Remove the patch cord from the PC LEV M jack and insert it in the 108 kc FILT OUT jacks of the test trunk circuit and repeat Items (5) to (8) inclusive to measure the 108 kc pilot current level. Set the 17B oscillator at 22 kc.

Note: In offices where more than one P.C. supply level measuring trunk is provided, the 108 kc filter is connected to the first trunk only. When measuring 108 kc pilot current levels on trunks other than the first, it is necessary to add a patch between PC LEV M jacks of the trunk under test and the 108 kc FILT IN jacks.

(F) Pilot Measurement at Input of Amplifier Using K2 Auxiliary Test Amplifier

3.15 The auxiliary test amplifier K2 type (see Paragraph 2.07) provides a means whereby the 42A transmission measuring system can be used to measure the pilot input of the Type K amplifier at the input sealed test terminal. As a preliminary to this procedure, the gain of the test amplifier at the test

frequencies, including the 600:135 ohm coil at the input of the amplifier, should be available.

3.16 Procedure:

(1) Calibrate the 42A system as described in Part 3(A) and insert an 89 type resistance in the pad socket to give a 0 db pad value. Operate the CAL-MEAS key to position "3".

(2) Patch in the test amplifier as follows:

(a) Patch from the PAD OUT or MEAS TRK OUT jacks of the 42A system to 135 OHM jacks of Coil 1 of the 30A set.

(b) Patch from 600 OHM jacks of Coil 1 to AUX. AMP IN jacks of test amplifier and patch from AUX AMP OUT jacks to ATTEN IN jacks of 30A set.

(c) Patch from ATTEN OUT jacks to MOD IN or MEAS IN jacks of the 42A system.

(d) For the 60 kc pilot measurement, set the attenuator for 45 db loss and for the other pilots, set the attenuator for 20 db loss.

(3) Patch from MEAS OUT jacks of 42A system to 135 OHM TC jacks of the 30A set.

(4) Set the inverse scale on the 17B oscillator to the frequency to be measured and set the CYCLES dial to zero.

(5) Insert the 312A four finger adapter plug into the input EQ and LINE jacks of the carrier system to be measured. Connect the 308A plug on the bridging cord to the pin jacks of the 312A plug. Should the jacks already be in use as in the switching procedure, the 308A plug should be connected to the pin jacks of the plug already in place. If the input LINE jacks are not terminated for any reason insert a 323A plug (135 ohms) in the input LINE jacks and connect the 308A plug to the pin jacks of the 323A plug.

(6) Adjust the attenuator until a reading can be obtained on the 30A set meter when the three 10 db protection keys are operated. Slowly vary the frequency of the 17B oscillator until a maximum deflection is obtained on the 30A set meter. This tunes the 42A system to the line frequency.

(7) Make a fine adjustment to obtain a maximum reading by means of the CYCLES dial on the oscillator and read the meter.

(8) The measured input in dbm is equal to the attenuator setting minus the gain of test amplifier (corrected for the 135:600 ohm coil) minus 20 db plus or minus the 30A set reading.

(G) Channel Measurement at Input of Amplifier Using K2 Auxiliary Test Amplifier

3.17 The measurement of an individual channel can be made at the input sealed test terminal in a manner similar to that described for pilot input measurements using the K2 auxiliary test amplifier. However, in this case the channel should be released from service and test power should be supplied to the channel under test.

3.18 Procedure:

(1) The channel to be tested should be released from service.

(2) At the 4-wire voice frequency test bay at the transmitting terminal, patch from the SEND -13 to the MOD IN jacks of the channel under test, thus sending 1000 cycle test power into the channel modulator at the proper level.

(3) Follow the procedure of Paragraph 3.16 Items (1) to (8) inclusive.

(H) Pilot Measurement at Input of Amplifier Using K1 Amplifier from Another System

3.19 At other than deviation regulators, the pilot input to K1 amplifiers can be checked by means of the 42A system by using as a test amplifier an amplifier from another system from which service has been released. This procedure is dependent upon the amplifier in the system to be tested and the test amplifier having about the same gain. The test amplifier should, therefore, be chosen with the same direction of transmission as the system under test. While this measurement is not exact due to normal differences between the two amplifiers it should disclose large variations and should be useful in trouble investigations. If the pilot input power in dbm is to be obtained it will be necessary to measure the gain at the test frequencies of the amplifier used as a test amplifier.

3.20 Procedure:

(1) Calibrate the 42A system as described in Part 3(A) and insert an 89 type resistance in the pad socket to give a pad value equal to the specified operating output of the amplifier. Generally this will be +9 db requiring an 89 AT resistance. Operate the CAL-MEAS key to position "3".

(2) Patch from the PAD OUT or MEAS TRK OUT jacks to the input EQ jacks of a spare amplifier in the same direction of transmission as the system to be measured. Patch from the output EQ jacks of the spare amplifier to the MOD IN or MEAS IN jacks of the 42A system.

(3) Patch from the MEAS OUT jacks of the 42A system to the 135 OHM TC jacks of the 30A set.

(4) Set the inverse scale on the 17B oscillator to the frequency to be measured and set the CYCLES dial to zero.

(5) Insert the 312A four finger adapter plug into the input EQ and LINE jacks of the carrier system to be measured. Connect the 308A plug on the bridging cord to the pin jacks of the 312A plug. Should the jacks already be in use as in the switching procedure, the 308A plug should be connected to the pin jacks of the plug already in place. If the input LINE jacks are not terminated for any reason, insert a 323A plug (135 ohms) in the input LINE jacks and connect the 308A plug to the pin jacks of the 323A plug.

(6) Operate the three 10 db protection keys on the 30A set and at the same time slowly vary the frequency of the 17B oscillator until a maximum deflection is obtained on the 30A set meter. This tunes the 42A system to the line frequency.

(7) Make a fine adjustment to obtain a maximum reading by means of the CYCLES dial on the oscillator and read the meter.

(8) A reading of 0 db on the 30A set meter indicates that the incoming pilot is approximately correct. The pilot power in dbm is equal to the value of the plug type pad minus 20 db minus the gain of the spare amplifier plus or minus the 30A set meter reading.

(I) Channel Measurement at Input of Amplifier Using K1 Amplifier from Another System

3.21 The same considerations given in Paragraph 3.19 for the pilot input measurement apply to the channel measurement. However, in this case the channel to be measured should be released from service and test power should be supplied to the channel under test.

3.22 Procedure:

(1) The channel to be tested should be released from service.

(2) At the 4-wire voice frequency test bay at the transmitting terminal, patch from the SEND -13 to the MOD IN jacks of the channel under test, thus sending 1000 cycle test power into the channel modulator at the proper level.

(3) Follow the procedure of Paragraph 3.20 Items (1) to (7) except in Item (2) patch from the output EQ jacks of the spare amplifier to the ATTEN IN jacks of the 30A set and from the ATTEN OUT jacks to the MOD IN or MEAS IN jacks of the 42A system. Set the attenuator for 20 db.

(4) A reading of 0 db on the 30A set meter indicates that the input is approximately correct. The test power in dbm is equal to the attenuator setting plus the value of the plug type pad minus 20 db minus the gain of the spare amplifier plus or minus the 30A set meter reading.

(J) Channel Measurement at Input of Amplifier Using 2A or 2B Noise Measuring Set

3.23 An alternative procedure to that given in Part 3(I) for measuring the channel input at an intermediate amplifier is to use a 2A or 2B noise measuring set as the measuring set for the 42A system in place of the 30A set. This permits the use of the gain of the 2A or 2B set, but the minimum input which can be measured by this method is limited by the resistance noise in the test amplifier and is about 22 db less sensitive than the procedure given in Part 3(I).

3.24 Procedure:

(1) The channel to be tested should be released from service.

(2) At the 4-wire voice frequency test bay at the transmitting terminal, patch from the SEND -13 to the MOD IN jacks of the channel under test, thus sending 1000 cycle test power into the channel modulator at the proper level.

(3) Calibrate the 42A system as described in Part 3(A) and insert an 89 type resistance in the pad socket to give a 0 db pad value. Operate the CAL-MEAS key to position "3".

(4) Patch the 2A or 2B noise measuring set to the 42A system as follows:

(a) Patch from MEAS OUT jacks of the 42A system to the 135 ohm jack of Coil 1 of 30A set.

(b) Patch from 600 ohm jack of Coil 1 to the LINE jacks of the 2A or 2B noise measuring set.

(5) Insert a 135 ohm plug (323A) in the MOD IN jacks and note the reading on the 2A or 2B set. Normally this reading should be about 34 db above reference noise. Should the reading be greater than about 44 db check for noise trouble as discussed in Part 4. Remove the 135 ohm termination (323A plug) from the MOD IN jacks.

(6) Set the inverse scale on the 17B oscillator to the frequency to be measured, and the small CYCLES dial to zero.

(7) Insert the 312A four finger adapter plug into the input EQ and LINE jacks of the system to be measured. Connect the 308A plug on the bridging cord to the pin jacks of the 312A plug.

(8) Slowly vary the frequency by means of the CYCLES dial and note the maximum deflection of the 2A or 2B set.

(9) The meter reading obtained in Item '8) should be decreased by the correction factor indicated below:

Difference Between Readings Obtained in Items (8) and (5)	Correction Factor
3 db	3. db
5 "	1.5
7 "	1.0
9 "	.5
13 "	.2
more than 13 db	0

(10) The channel input in dbm is equal to the corrected reading minus 110 db.

(K) Carrier Leak Measurement

3.25 The carrier leak of each channel may be measured at the output of the transmitting amplifier while the system is in service by means of the 42A transmission measuring system. Where a pilot frequency is adjacent to the carrier frequency, care must be taken to differentiate between them.

3.26 Procedure:

(1) Calibrate the 42A system as described in Part 3(A) and insert on 89 type resistance in the pad socket to give a 0 db pad value. Operate the CAL-MEAS key to position "3".

(2) Patch from MEAS OUT jacks of 42A system to 135 OHM jacks of Coil 1 of 30A set and patch from 600 OHM jacks of Coil 1 to 40B system or to the 2A or 2B Noise Measuring Set.

(3) Set the inverse scale on the 17B oscillator to the frequency to be measured, and set the CYCLES dial to zero.

(4) Insert the 312A four finger adapter plug into the output EQ and LINE jacks of the terminal to be measured. Connect the 308A plug on the bridging cord to the pin jacks of 312A plug. Should the jacks already be in use, the 308A plug may be connected to the pin jacks of the plug already in place. If the output EQ jacks are not terminated for any reason, insert a 323A (135 ohm) plug in the output EQ jacks and connect the 308A plug to the pin jacks of the 323A plug.

(5) Slowly vary the frequency of the 17B oscillator until a maximum deflection is obtained on the 40B system or the 2A or 2B noise measuring set.

(6) Make a fine adjustment to obtain a maximum reading by means of the CYCLES dial on the oscillator and read the meter. This tunes the 42A system to the frequency to be measured.

(7) The carrier leak in dbm is equal to the gain or loss shown by the 40B System reading minus 20 db. If the 2B noise measuring set is used, the carrier leak in dbm is equal to the reading of the 2A or 2B noise measuring set minus 110 db.

(L) Modulation Measurement

3.27 Interchannel modulation in any given Type K system can be measured by placing test power on one channel and measuring the power generated in other channels of the same system. For example, a 1000 cycle test power on channel 1 appears as 13 kc on the high frequency line and the harmonics to be measured are 26 kc and 39 kc which fall in channels 4 and 7 respectively. These powers can be selected and measured at intermediate repeater stations or at the receiving terminal by means of the 42A system without disturbing the other channels. The testing power should always be transmitted from a terminal as the transmitting channel or group equipment is needed to filter out the harmonics in the oscillator. The testing power can be applied to the MOD IN jacks of the individual channel or when channel equipment is not available and the system is out of service, the testing power can be applied at proper level to the GR MOD IN jacks of the transmitting group equipment.

3.28 Procedure:

(1) Calibrate the 42A system as covered in Part 3(A). Adjust the plug type pad for 9 db loss (89 AT Resistance). Operate the CAL-MEAS key to position "3".

(2) Patch from the MEAS OUT jacks of the 42A system through a 135:600 ohm repeating coil to the LINE jacks of a 2A or 2B noise measuring set or to the 600 OHM TST jacks of a 43A noise measuring system. If noise measuring equipment is not available the 40B system or a 6A set may be used. In this case a 0 db pad (89A resistance) should be used in the 42A system.

(3) Insert a 135 ohm plug (323A) in the MOD IN jacks and note the reading on the 2A or 2B set. Normally this reading should be about 25 db above reference noise when a 9 db pad is used or 34 db when a 0 db pad is used. Should the reading be greater than about 35 db (or 44 db), check for

noise trouble as discussed in Part 4. Remove the 135 ohm termination (323A plug) from the MOD IN jacks.

(4) Set the inverse scale on the 17B oscillator to the frequency to be measured and the small CYCLES dial to zero.

(5) When measurements are being made on a spare line at a terminal where spare group equipment is not available, that is, the receiving amplifier is unterminated, proceed to Item (7). Otherwise insert a 312A adapter plug into the REC AMP OUT and GR DEM IN jacks (or into the output LINE and EQ jacks at a repeater station).

(6) Connect the 308A plug on the bridging cord to the pin jacks of the 312A plug and proceed to Item (9).

(7) When measurements are being made at the output of an unterminated receiving amplifier, patch from the REC AMP OUT jacks to the ATTEN IN jacks of the 30A set.

(8) Set the attenuator for 38 db and patch from the ATTEN OUT jacks to the MOD IN jacks on the 42A system.

(9) Slowly vary the frequency of the oscillator and record the maximum reading.

(10) The level of the modulation product at the output of the amplifier in db above reference noise is equal to the reading on the 2A or 2B set (or 43A system) minus 11 db, or if the 40B or 6A set were used it is equal to 70 db minus the transmission loss indicated by the measuring equipment.

(M) Crosstalk Measurement

3.29 Crosstalk between Type K systems can be measured on a high frequency basis by a method similar to that given in Paragraph 3.28 for modulation measurements. Single frequency test power is sent on one system and this same frequency is selected and measured on adjacent systems. As there are two or more systems involved, care must be taken to insure proper termination at all times. When the disturbing or disturbed systems are not terminated in channel equipment or measuring equipment, 135 ohm plugs should be inserted in the GR MOD IN (or output LINE) jacks of the disturbed systems at the transmitting terminal, and in the REC AMP OUT jacks of the disturbing system at the receiving terminal.

3.30 Procedure - Crosstalk Measurements

(1) Calibrate the 42A system as covered in Part 3(A). Adjust the plug type pad for 9 db loss (89 AT Resistance). Operate the CAL-MEAS key to position "3".

(2) Patch from the MEAS OUT jacks of the 42A system through a 135:600 ohm repeating coil to the LINE jacks of a 2A or 2B noise measuring set or to the 600 OHM TST jacks of a 43A noise measuring system.

(3) Repeat Items (3) through (9) of Paragraph 3.28.

(4) The crosstalk referred to the output of the amplifier in db above reference noise is equal to the reading on the noise set minus 11 db.

(N) Noise Monitoring

3.31 Part of the 42A transmission measuring system can be used for monitoring noise on a high frequency basis. The 17B oscillator is adjusted to the carrier frequency of the channel to be monitored, and the modulator of the 42A system is used to demodulate the high frequencies to voice frequencies. Monitoring should take place through a filter in order to reduce or eliminate frequencies above about 4 kc. For this reason the 2A or 2B noise measuring set should be used whenever possible, although the 6D (voice frequency) amplifier in the 42A system may be used when a noise set is not available.

3.32 This method of measuring noise is not entirely satisfactory as it results in the simultaneous demodulation of two adjacent channels, the lower numbered of which will be heard upside down and the high numbered, right side up. However, when the unwanted channel is idle or when the wanted one is very noisy this method will prove useful.

3.33 This method can be used without disturbing service provided the 308A plug is removed when the oscillator frequency is being changed. If a 4 kc tone is heard when monitoring a channel, particularly with the 6D amplifier, it probably is a channel carrier frequency.

3.34 Procedure:

(1) Patch from the MOD OUT jacks of the 42A system to the LINE jacks of a 2A or 2B noise measuring set and monitor through the receiver associated with the noise set, or patch from the MOD OUT jacks to the VF AMP IN jacks and from the MEAS OUT jacks to a telephone set.

(2) Set the frequency of the 17B oscillator to the carrier frequency to be monitored. The output of the oscillator should be about +16 dbm.

(3) Insert a 312A adapter plug into the output LINE and EQ jacks.

(4) Connect the 308A bridging plug to the pin jacks on the 312A plug.

(5) The channel to be monitored will be heard right side up and the next lower channel will be heard upside down.

(6) Remove the 308A bridging plug before the frequency of the oscillator is changed.

4. MAINTENANCE OF 42A TRANSMISSION MEASURING SYSTEM

(A) General

4.01 The maintenance of the 42A system consists essentially in checking for defective vacuum tubes or other features affecting performance. The particular equipment in trouble should be determined from the procedures given in the following paragraphs.

4.02 The maintenance of certain parts of the 42A system are covered in other sections as indicated below. The auxiliary test amplifier K2 type is not covered in a section at the time of issuing this section.

17B Oscillator - E40.318
30A Transmission Measuring Set - E40.225
Test Amplifier K1 Type - E34.560 and E34.561

4.03 The heater current of the vacuum tubes in each of the 50A and 50B oscillators and the 6D amplifier should be measured at the FIL jacks with the 1R or 1AC tube test set and should be between 0.29 and 0.35 ampere. If the output of the 50A or 50B oscillator is low or unstable the vacuum tube involved should be replaced. The vacuum tube in the 6D amplifier should also be replaced if the output is unstable.

(B) Gain Measurement - 6D Amplifier

4.04 Since the input impedance of the 6D amplifier is 600 ohms, it is necessary to use a 135:600 ohm coil in the following measurement and the loss of this coil is included in the requirements.

4.05 Procedure:

(1) If there is a strap across G resistance in feedback circuit of the amplifier, remove the strap.

(2) Adjust CAL potentiometer to extreme counterclockwise position.

(3) Set attenuator of 30A set for 23 db loss.

(4) Set 17B oscillator frequency at 1000 cycles and adjust for minimum output.

(5) Patch from oscillator OUT or TST OSC OUT jack to POTENTIOMETER IN jacks of the 30A set.

(6) Patch from ATTEN OUT jack to 135 OHM jacks of coil 1 of 30A set.

(7) Patch from 600 OHM jacks of coil 1 to VF AMP IN jacks of 6D amplifier.

(8) Patch from VF AMP OUT jacks of 6D amplifier to GAIN OUT jacks of 30A set.

(9) Operate test key of 30A set to COMPARE position and adjust the test power to obtain a reading of 0 db on the 30A set meter.

(10) Operate test key of 30A set to ADJUST position and adjust the attenuator to obtain a reading as close as possible to 0 db on the 30A set meter.

(11) The amplifier gain is equal to the attenuator setting plus or minus meter reading as obtained in Item (10).

Requirement: The gain should not be greater than 23.0 db.

(12) If the requirements are not met, check the tubes and investigate for trouble.

(13) Add strap across G resistance in feedback circuit of 6D amplifier.

(14) Adjust CAL potentiometer to extreme clockwise position.

(15) Set attenuator of 30A set for 32 db loss.

(16) Measure gain following procedure of Items (9) to (11) inclusive.

Requirement: The gain shall not be less than 30.5 db.

(17) If requirement is not met, check the tubes and investigate for trouble.

(18) Before removing patch cords proceed with the output measurement covered in Part 4(C) following.

(C) Output Measurement - 6D Amplifier

4.06 With the 6D amplifier adjusted to give a gain of 30 db with an output level of 0 db, increasing the input level from -30 db to -25 db should result in an increase in the output of about 5 db. Increasing the output further up to 0 db should not cause the output to exceed +12 dbm.

4.07 Procedure:

(1) Set attenuator of 30A set for 30 db loss.

(2) Repeat Items (4) to (9) of Paragraph 4.05.

(3) By means of CAL potentiometer of 6D amplifier adjust the output to as close as possible to the required value.

Requirement: The output should be 0 db.

(4) Increase the attenuator by 5 db and note the output as read on the 30A set meter.

(5) Decrease the attenuator 10 db from the last value (leaving 25 db in the attenuator) and with one thermocouple protection key non-operated note the reading on the 30A set meter.

Requirement: The meter reading should be within + 0.2 db of that obtained in Item (4).

(6) Decrease the attenuator 25 db and with one thermocouple protection key of the 30A set non-operated note the reading on the 30A set meter.

Requirement: The meter reading should be less than +2 db.

(D) Loss Measurement - 95A Filter

4.08 The loss of the 95A filter at 130 kc is determined by measuring the gain of the test amplifier at 130 kc with the 95A filter between the attenuator used for the gain measurement and the test amplifier. The gain is then remeasured with the filter removed from the circuit, the difference in measured gain being equal to the loss of the 95A filter.

4.09 Procedure:

(1) Set attenuator of the 30A set for maximum loss.

(2) Set 17B oscillator frequency at 130 kc and adjust for minimum output.

(3) Patch from oscillator OUT or TST OSC OUT jacks to POTENTIOMETER IN jacks of 30A set.

(4) Patch from ATTEN OUT jacks to 135 OHM jacks of coil 1 of 30A set.

(5) Patch from 600 OHM jacks of coil 1 to BAND FILT IN jacks of 95A filter.

(6) Patch from BAND FILT OUT jacks to 600 OHM jacks of coil 2 of 30A set.

(7) Patch from 135 OHM jacks of coil 2 to 10 db IN jacks of 30A set.

(8) Patch from 10 db OUT jacks to RC 135 OHM jacks of 42A system.

(9) Patch from RC 600 OHM jacks of same repeating coil to TST AMP IN jacks.

(10) Patch from TST AMP OUT jacks to GAIN OUT jacks of 30A set.

(11) Operate test key of 30A set to COMPARE position and adjust the test power to obtain a reading of 0 db on the 30A set meter.

(12) Operate test key of 30A set to ADJUST position and adjust the attenuator to obtain a reading as close as possible to 0 db on the 30A set meter.

(13) The measured gain is equal to the attenuator setting plus or minus the meter reading as obtained in Item (12). Note this gain.

(14) Remove the patch cord between 600 OHM jacks of coil 1 and BAND FILT IN jacks and the one between BAND FILT OUT jacks and 600 OHM jacks of coil 2.

(15) Patch from 600 OHM jacks of coil 1 to 600 OHM jacks of coil 2.

(16) Increase the attenuator setting by 11 db and remeasure the gain of the test set-up, which omits the 95A filter, following the procedure of Items (11) to (13), inclusive.

Requirement: The measured gain shall be 11.0 ± 1.0 db greater than that noted in Item (13). This difference in gain is equal to the loss of the 95A filter.

(E) Frequency Measurement - 50B Oscillator

4.10 Procedure:

(1) Calibrate 17B oscillator.

(2) Set 17B oscillator frequency at 1000 cycles and adjust for minimum output.

(3) Patch from oscillator OUT or TST OSC OUT jacks to 135 OHM TC jacks of 30A set.

(4) Adjust output of 17B oscillator to give a reading as close as possible to 0 db on 30A set meter.

(5) Remove patch cord from 135 OHM TC jack and insert it into one of the multiple jacks of 30A set.

(6) Insert 323A plug in another of the multiple jacks.

(7) Adjust the FREQ condenser of the 50B (129 kc) oscillator to the point where turning in either direction will increase the reading of the PLT meter.

(8) Patch from 129 kc OUT jacks to RC 20 OHM jacks of the 42A system.

(9) Patch from RC 135 OHM jacks of same repeating coil to ATTEN IN jacks of 30A set.

(10) Set the attenuator to 16 db and operate the test key to the ADJUST position.

(11) Measure the output of the 50B oscillator and adjust it to the required value.

Requirement: The meter reading should be 0 ± 0.3 db.

(12) Remove the patch cords inserted under Items (7) and (8).

(13) Patch from 129 kc OUT jacks to MOD CS IN jacks.

(14) Patch from TST AMP OUT jacks to ATTEN IN jacks of 30A set and set the attenuator for a loss of 5 db.

(15) Operate the test key of the 30A set to ADJUST position.

(16) Bridge the 308A plug of the 42A system measuring cord across the pin jacks of one of the 305A plugs associated with the 3P20B cord which connects the output of the 17B oscillator to the multiple jacks.

(17) With the three thermocouple protection keys operated, vary the frequency of the 17B oscillator around the 1000 cycle point to obtain a maximum reading on the thermocouple meter, adjusting the attenuator of the 30A set as required to give approximately a 0 db reading on the meter.

Requirement: The frequency of the 17B oscillator at which the maximum deflection is obtained should be 1000 ± 100 cycles.

(F) Frequency Measurement and Adjustment - 50A Oscillator

4.11 The frequency of the 50A (28.1 kc) oscillator is satisfactory if during calibration of pilot level measuring system as covered in Part 3(A) the maximum deflection is obtained on the thermocouple meter with the 17B oscillator set at a frequency of 101.9 kc ± 100 cycles. If this requirement is not met, the frequency of the 50A oscillator should be adjusted in the following manner.

4.12 Procedure:

(1) Calibrate the 17B oscillator.

(2) Follow the calibrate procedure of Part 3(A) up to and including Item (5) of Paragraph 3.06.

(3) Vary the FREQ condenser of the 50A oscillator until a maximum reading is obtained on the 30A set meter.

(4) Adjust the frequency of the 17B oscillator by means of the CYCLES dial until a maximum reading is obtained on the 30A set meter.

Requirement: The setting of the 17B oscillator should be within 101.9 kc ± 100 cycles.

(G) Over-all Tests of 42A System

4.13 After the 42A system has been calibrated in accordance with Part 3(A) the calibration may be checked by substituting external pads for the test pads used in the calibrating procedure. The following procedure which does this also checks the level measuring cords and measuring trunk circuits where they are provided.

4.14 Procedure - Where No Measuring Trunks Are Provided:

(1) With the 42A system calibrated as covered in Part 3(A) operate the CAL-MEAS key to position "3".

(2) Insert a 0 db (89 type resistance) pad in the measuring circuit.

(3) With the output of the 50A (28.1 kc) oscillator adjusted to 0 db as covered in Part 3(A) patch from 28.1 kc OUT jacks to ATTEN IN jacks of 30A set. Set the attenuator for a loss of 20 db.

(4) Insert 323A plug in ATTEN OUT jacks.

(5) Bridge the 308A plug of the LEV MEAS cord across the pin jacks of the 323A plug.

(6) Note the reading of the 30A set meter.

Requirement: The meter reading should be 0 ± 0.1 db.

(7) Turn over the 308A plug and again note the reading of the 30A set meter.

Requirement: The meter reading should be 0 ± 0.1 db.

(8) If the requirement of Item (7) is not met use "X" wiring as covered on Drawing SD-64065-01.

(9) Remove the 0 db (89 type resistance) pad from the measuring circuit and insert in its place a 9 db (89 type resistance) pad.

(10) Change the attenuator from 20 db to 11 db and note the reading on the 30A set meter.

Requirement: The meter reading should be 0 ± 0.2 db.

4.15 Procedure - Where Measuring Trunks are Provided:

(1) With the 42A system calibrated as covered in Part 3(A) operate the CAL-MEAS key to position "3".

(2) Insert a 0 db (89 type resistance) pad in the measuring circuit.

(3) With the output of the 50A (28.1 kc) oscillator adjusted to 0 db as covered in Part 3(A) patch from 28.1 kc OUT jacks to ATTEN IN jacks of 30A set. Set the attenuator for a loss of 20 db.

(4) Patch from ATTEN OUT jacks to a test trunk over to the measuring position.

(5) At the measuring position, insert 323A plug in the test trunk.

(6) Bridge the 308A plug of the measuring cord associated with one of the measuring trunks across the pin jacks of the 323A plug.

(7) Note the reading of the 30A set meter.

Requirement: The meter reading should be 0 ± 0.1 db.

(8) If this requirement is not met, measure the loss of the test trunk and correct the reading accordingly.

(9) Turn over the 308A plug and again note the reading of the 30A set meter.

Requirement: The meter reading should be 0 ± 0.1 db corrected for the test trunk as covered in Item (7).

(10) If this requirement is not met use "X" wiring as covered on Drawing SD-64065-01.

(11) Remove the 0 db (89 type resistance) pad from the measuring circuit and insert in its place a 9 db (89 type resistance) pad.

(12) Change the attenuator from 20 db to 11 db and note the reading on the 30A set meter.

Requirement: The meter reading should be 0 ± 0.2 db.

(13) Repeat Items (4) to (9) inc. for each measuring trunk provided.

(H) Check of Selectivity

4.16 Procedure:

(1) With the 42A system calibrated as covered in Part 3(A) operate the CAL-MEAS key to position "3".

(2) Insert a 0 db (89 type resistance) pad in the measuring circuit.

(3) With the output of the 50A (28.1 kc) oscillator adjusted to 0 db as covered in Part 3(A) patch from 28.1 kc OUT jack to ATTEN IN jacks and set the attenuator for a loss of 20 db.

(4) Insert 323A plug in ATTEN OUT jacks.

(5) Bridge the 308A plug of the LEV MEAS cord across the pin jacks of the 323A plug.

(6) With the CYCLES dial of the 17B oscillator on 0, adjust the film scale of the 17B oscillator until a maximum deflection is obtained on the 30A set meter.

Requirement: The meter should read 0 db.

(7) By means of the CYCLES dial slowly increase the frequency of the 17B oscillator until the reading of the 30A set meter has decreased 0.1 db. This indicates an increase of 0.1 db in the filter loss.

(8) Restore the CYCLES dial to 0 and slowly decrease the frequency of the 17B oscillator until the reading of the 30A set meter has decreased 0.1 db.

Requirement: The frequency range between the two points at which the reading has decreased 0.1 db should be between 10 and 30 cycles.

(9) Set the 17B oscillator at the frequency which is half way between the two frequencies at which the 0.1 db decrease in 30A set meter reading was obtained. This should be done by setting the film scale so that with the CYCLES dial on zero an increase or decrease of the same number of cycles will cause the reading of the meter to decrease 0.1 db.

(10) Slowly increase the frequency of the 17B oscillator by means of the film scale until the 30A set meter reading decreases 5 db.

Requirement: The reading should decrease uniformly and at no point beyond the 0.1 db loss point should the reading be greater than that within the pass band as determined in Item (8).

(11) Remove 5 db from the attenuator.

Requirement: The 30A set meter reading should be 0 db.

(12) Slowly increase the frequency until the meter reading decreases 5 db.

Requirement: The reading should increase uniformly.

(13) Remove 5 db from the attenuator.

Requirement: The 30A set reading should be 0 db.

(14) Repeat Items (12) and (13) until the 20 db has been removed from the attenuator and the 30A meter reading is -5 db.

Requirement: The reading should continue to decrease uniformly and the change in frequency necessary to obtain the final meter reading should not be greater than 110 cycles as read on the film scale.

(15) Reset the attenuator for a loss of 20 db before changing the frequency setting.

(16) Restore the 17B oscillator to the reference setting as determined in Item (9).

(17) Repeat Items (10) to (15), inclusive, but decrease the frequency instead of increasing it using the same requirements as given in these items.

(I) Measurement of Inherent Noise

4.17 Procedure:

(1) With the 42A system calibrated and ready for test as covered in Part 3(A) operate the CAL-MEAS key to position "3".

(2) Insert a 0 db (89 type resistance) pad in the measuring circuit.

(3) Insert 323A plug in MOD IN jacks.

(4) Patch from MEAS OUT jacks to 135 OHM jacks of coil 1 of the 30A set.

(5) Patch from 600 OHM jacks of coil 1 to LINE jacks of 2A or 2B noise measuring set.

(6) With the 2A or 2B set calibrated and ready for test, measure the noise using message weighting.

Requirement: The noise should not be greater than 44 db above reference noise.

(7) If these requirements are not met check for a noisy vacuum tube in the test amplifier, for unbalances in the modulator unit, for improper or insufficient ground connections or for possible adjacent source of interference.

5. DRAWINGS (Not attached)

5.01 Circuits

SD-64065-01 - Application Schematic (and Switching Panel)
SD-64066-01 - 50A Oscillator (28 kc)
SD-64079-01 - 50B Oscillator (129 kc)
SD-64080-01 - 6D Amplifier
SD-64084-01 - Modulator, Demodulator and Carrier Supply Repeating Coil Circuit
SD-64329-02 - Test Amplifier (K1 type)
SD-59145-01 - Application Schematic of Auxiliary Test Amplifier (K2 type)
SD-59127-02 - Auxiliary Test Amplifier (K2 type)

5.02 Equipment

ED-64065-01 - Bay Equipment (and Switching Panel)
ED-64066-01 - 50A Oscillator (28 kc)
ED-64079-01 - 50B Oscillator (129 kc)
ED-64080-01 - 6D Amplifier
ED-64084-01 - 1S Modem Panel
ED-64329-02 - Test Amplifier (K1 type)
ED-59127-012 - Auxiliary Test Amplifier (K2 type)