TECHNICAL MANUAL

# OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST) FOR DELAY AND LINEARITY TEST SIGNAL GENERATOR 70E1-MW (NSN 6625-00-880-1936) AND DELAY AND LINEARITY TEST SIGNAL ANALYZER 70E2-MW (NSN 6625-00-068-0729) (COLLINS RADIO GROUP)

HEADQUARTERS, DEPARTMENT OF THE ARMY

JULY 1980

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*WASHINGTON, DC, 7July 1980*

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**REPORTING OF ERRORS**

**You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in back of this manual direct to: Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. A reply will be forwarded direct to you.**

APPENDIXES

This manual is an authentication of the manufacturer's commercial literature which, through usage, has been found to cover the data required to operate and maintain this equipment. Since the manual was not prepared in accordance with military specifications and AR 310-3, the format has not been structured to consider levels of maintenance.

# SECTION 0
# INTRODUCTION

## 0-1 Scope

This manual contains the general description, installation, operation, principles of operation, and maintenance of the test instruments, which are known as the Delay and Linearity Test Signal Generator 70E1-MW and the Delay and Linearity Test Signal Analyzer 70E2-MW.

## 0-2 Indexes of Publications

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

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

## 0-3 Maintenance Forms, Records, And Reports

*a. Reports of Maintenance and Unsatisfactory Equipment*. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management System.

*b. Report of Packaging and Handling Deficiencies*. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 735-11-2/NAVSUPINST 4440.127E/AFR 400-54/MCO 4430.3E and DSAR 4140.55.

*c. Discrepancy In Shipment Report (DISREP) (SF 361).* Fill out and forward Discrepancy in Shipment Re- port (DISREP) (SF 361) as prescribed in AR 55-38/-NAVSUPINST 4610.33B/AFR 75-18/MCO P4610.19C and DLAR 4500.15.

## 0-4 Reporting Equipment Improvement Recommendations (EIR)

If your Delay and Linearity Test Set needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, New Jersey 07703. We'll send you a reply.

## 0-5 Administrative Storage

Administrative storage of equipment issued to and used by Army activities shall be in accordance with TM 740-90-1.

## 0-6 Destruction Of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

**general description**

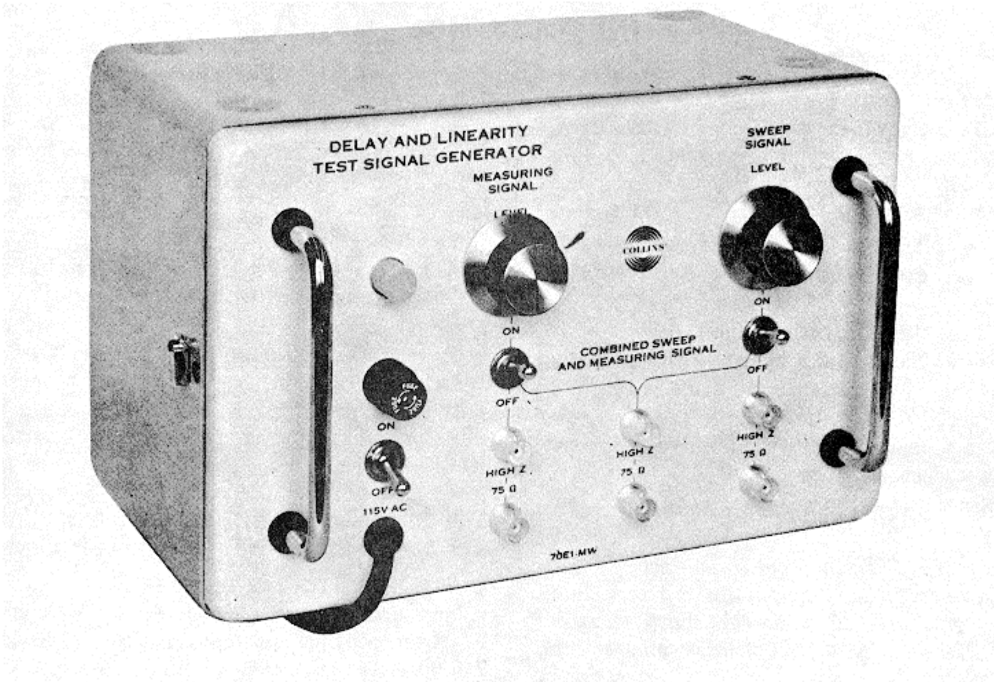



*Figure 1-1. 70E1-MW Delay and Linearity Test Signal Generator*

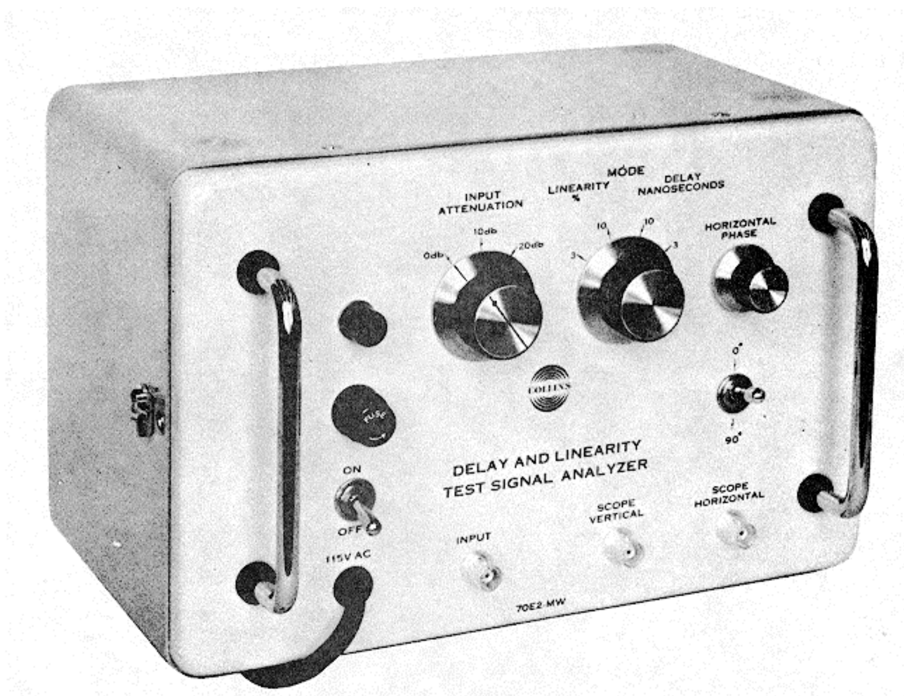



*Figure 1-2. 70E2-MW Delay and Linearity Test Signal Analyzer*

**section 1**
**general description**

1.1 GENERAL.

Delay and Linearity Test Signal Generator 70E1-MW and Delay and Linearity Test Signal Analyzer 70E2-MW are complementary test instruments used to measure time delay and linearity in a microwave system. See figures 1-1 and 1-2. This manual contains the general description, installation, operation, principles of operation, and maintenance of the test instruments. Parts lists and drawings are contained at the end of the book.

1.2 EQUIPMENT DESCRIPTION.

The 70E1-MW and 70E2-MW consist of transistorized, printed circuit, subassemblies mounted in metal cases with carrying handles and removable front covers. The instruments may be stacked vertically for bench mounting or may be operated in any convenient position when used in the field. The front panel of each unit mounts the ac power cable, operating controls, input and output jacks, and fuse holder.

1. 2.1 PHYSICAL CHARACTERISTICS.

Size:
- 11 by 7 by 8 inches

Weight:
- 70E1-MW, 11 pounds
- 70E2-MW, 12 pounds

Finish:
- Case, gray enamel
- Front panel, off-white enamel

1.2.2 OPERATING CHARACTERISTICS.

Ambient Service Conditions:
- Temperature
  - 0° to 50°C (32° to 122°F)

Relative Humidity
- Up to 95% at 50°C

Altitude
- Up to 15,000 feet above msl

Type of Service:
- Intermittent, attended

1.2.3 ELECTRICAL CHARACTERISTICS.

Power Requirements:
- 115 volts ac, 50 to 60 cps, 10 watts (3-wire power cord with ground provided)

70E1-MW, Test Generator:
- Inputs
  - None

Outputs
- 80-CPS Sweep Signal
  - Variable, 20-Db* Range
    - High-Z Output
      - 2 to 20 volts rms, nominal
    - 75-Ohm Output
      - 0.04 to 0.40 volt rms, nominal

304-Kc Measuring Signal
- Variable, 20-Db Range
  - High- Z Output
    - 0.15 to 1. 50 volts rms, nominal
  - 75-Ohm Output
    - 2 to 20 millivolts rms, nominal

Combined Outputs
- Same voltages and impedances shown for 80-cps and 304-kc outputs, except the signals are combined.

70E2-MW, Test Analyzer:
- Inputs
  - Demodulated 80-CPS Signal
    - 0.03 to 3.00 volts rms

Demodulated 304-Kc Signal
- 0.01 to 0. 50 volt rms

Outputs
- SCOPE VERT
  - High Z, 10 nanoseconds = 100 millivolts peak-to-peak

SCOPE HORIZ
- High Z, 2. 5 volts rms

+ Referenced to 0. 775 volt across any impedance

## 2.1 GENERAL.

This section of the manual outlines the procedures for unpacking, installing, and applying primary power to the 70E1-MW and 70E2-MW test instruments.

## 2.2 UNPACKING.

Unpack the instruments carefully, retaining all documents removed from the packing container. Inspect the units for signs of physical damage. Check the mechanical operation of all switches and controls. Remove the units from the metal cases by removing the four mounting screws and inspect the instruments for signs of internal damage. Check the power indicator lamp and fuse holder on the front panel to insure that the lamp and fuse are properly seated in their holders. Check the equipment against the packing list, and if there are any damaged or missing items, notify the transportation carrier and Collins Radio Company immediately.

## 2.3 INSTALLATION.

The 70E1-MW and 70E2-MW Delay and Linearity Test Signal Generator and Analyzer are portable instruments which can be operated in any convenient position on a bench or in the field, providing the required primary power is available.

## 2.4 PRIMARY POWER.

Check the available power source to insure that the test equipment power requirements are met. Connect the power cable (a three-wire, grounded power cord and plug are used) to the power outlet and turn on the ON-OFF toggle switch. The power indicator lamp should light. If the lamp does not light, check for a burned-out fuse or lamp.

3.1 GENERAL.

The following paragraphs outline the procedure for making specific measurements. Paragraph 3.2 identifies the individual controls on the units and ex- plains their functions. Paragraph 3.3 covers the actual measurement procedure.

3.2 INSTRUMENT CONTROLS.

The following paragraphs identify and describe the functions of the controls on the Delay and Linearity Test Signal Generator (70E1-MW) and the Delay and Linearity Test Signal Analyzer (70E2-MW).

3.2.1 7OE1-MW CONTROLS.

a. The ON-OFF, 115 V AC toggle switch controls the primary ac power and turns the unit on and off.

b. MEASURING SIGNAL ON-OFF switch S3, when in the ON position, applies a 304-kc signal to the measuring signal outputs and combined outputs. When S3 is in the OFF position, the measuring signal generator is disabled.

c. MEASURING SIGNAL LEVEL control R13 adjusts the level of the 304-kc measuring signal output.

d. SWEEP SIGNAL ON-OFF switch S2, when in the ON position, applies an 80-cps sweep signal to the sweep signal outputs and combined outputs. When S2 is in the OFF position, the sweep signal generator is disabled.

e. SWEEP SIGNAL LEVEL control R18 adjusts the 80-cps sweep signal output level.

3.2.2 70E2-MW CONTROLS.

a. The ON-OFF, 115 V AC switch controls the primary ac power and turns the unit on and off.

b. INPUT ATTENUATION switch S1 inserts 0, 10, or 20 db of attenuation between the INPUT jack and the age amplifier, making possible the use of input signals of up to 5 volts rms.

c. MODE switch S2 selects the linearity or delay output circuit to be applied to the SCOPE VERT jack.

d. HORIZONTAL PHASE control R29 varies the phase of the SCOPE HORIZ output relative to the 80-cps input, over a range of approximately 135°. The phase shift is accomplished by an RC phase shift network in the sweep recovery circuit of the sweep synchronizer.

e. 0°-900 HORIZONTAL PHASE switch S4,. when in the 0° position, has no effect on the phase of the SCOPE HORIZ output. When S4 is in the 90° position, the phase shift range of HORIZONTAL PHASE control R29 is extended approximately 90°.

3.3 USE OF THE DELAY AND LINEARITY TEST SET.

3.3.1 GENERAL.

This section describes the application of the 70E1-MW and 70E2-MW delay and linearity test set. Figure 3-1, details A, B, and C, shows methods of connecting the 70E1-MW generator to typical micro- wave transmitter inputs. Figure 3-2, details A and B, shows methods of connecting the 70E2-MW analyzer to typical microwave baseband outputs. Representative signal levels are given and impedances and terminations are shown where applicable.

Figures 3-3, details A, B, and C, and 3-4 illustrate several commonly used system test setups for linearization and delay equalization of microwave radio links.

3.3.1.1 DELAY DISTORTION. A certain amount of time is required for the passage of a signal through an electrical circuit. If the signal is a constant- frequency sine wave, it is convenient to measure the time of passage in terms of cycles or degrees. This time in terms of cycles is usually described as the phase shift between a given amplitude point on the sinusoid as it enters the circuit and that same point on the sinusoid as it leaves the circuit. If the positive peak of such a signal comes out of a circuit one- fourth of a cycle after it enters, it is said to have been delayed one-fourth cycle, or 900. In a linear phase network, the phase shift suffered by a signal passing through the network is directly proportional to the frequency. If the frequency is 500 kc, the phase shift would be one-eighth cycle, or 45°. The times of transit represented by 45° at 500 kc and 90° at 1 me are the same; one-fourth microsecond.

From this, it is apparent that the actual time delay or transit time of signals of different frequencies, when they are passed through a linear phase network, is the same regardless of the frequency.

In actual circuits the frequency range over which a linear phase or constant time delay characteristic exists is limited. This is acceptable because the bandwidth of information we wish to pass through the circuits is also limited. The problem is to make any variation from constant delay over the frequency range of interest small enough to introduce an acceptably small distortion.

A typical situation showing this compromise is that encountered in a microwave link. Here a composite modulating or baseband signal made up of a great many individual signals is commonly used. The effect of delay distortion on these signals can be seen by considering a sine wave at a given frequency which lies in the narrow range allowed one of these channels.

At any instant, the fm carrier and sidebands representing sine-wave modulation will have a particular amplitude and phase relation, representing a given frequency and amplitude of the modulating signal. These sidebands and carrier must pass through the radio system to the receiver discriminator, unchanged in their instantaneous relation to each other. If either sideband, for example, is delayed more than the other sideband, the demodulated signal output is no longer the same as the original modulating signal.

For this reason, it is desirable to make the entire passband occupied by the fm signal spectrum as nearly phase-linear or constant-delay as possible. The delay and linearity test set provides a means of displaying the actual variations in time delay over the signal passband. This, in turn, makes it possible to adjust and compensate a radio system to minimize or remove variations in delay or signal transit time in its passband.

Delay compensation takes the form of circuits which do not affect signal amplitude but which allow extra phase shift (or delay) to be inserted at various frequencies. This additional delay is inserted where needed to make the delay over the signal passband constant. Thus, the delay display of the test set is not a measure of absolute delay but rather of variations in delay over the frequency range being checked.

The display of delay is calibrated in nanoseconds. Variations in delay of this magnitude are sufficient to seriously affect high-density communications systems.

3.3.1.2 LINEARITY DISTORTION. Suppose a signal of varying amplitude is provided to the input of a circuit. If the circuit is linear, the output signal amplitude will be exactly proportional to the input signal amplitude. Any variation from this exact proportionality is called linearity distortion. Such distortion is particularly undesirable in a communications link where multiplex signals exist. Since a nonlinear circuit acts as a modulator, intermodulation among the multiplex channels might be expected and, needless to say, does occur, appearing as noise in the individual channels.

Linearity distortion may conveniently be measured as the percent of amplitude modulation imposed on the signal by a distorting circuit. For convenience the percent modulation is defined as a peak-to-peak value.

In an fm radio system, the frequency deviation varies according to the amplitude of the modulating signal. Usually it is difficult to achieve a truly linear mc- per-volt relation over a wide deviation. Various means of adjustment are used to compensate for nonlinearities in order to get an acceptably small nonlinearity.

The same situation occurs in detection of an fm signal. The volts-per-mc relation of the detector must be made constant over the bandwidth occupied by the received signal.

In order to adjust the transmitter and receiver for acceptable linearity, a display showing error versus frequency deviation is required. This is provided by the linearity mode of the delay and linearity test set.

For specific signal inputs and outputs of rf components under test and their recommended signal levels, refer to the maintenance publication for the individual rf system.

CAUTION

When using the 70E1-MW and 70E2-MW as with any other delay and linearity test set, use the minimum measuring signal level consistent with a non-noisy oscilloscope display. Excessive measuring signal deviation of the system under test tends to smear over and average out small variations in either linearity or delay. The resulting display then does not show a true picture of the characteristic being measured.

Do not attempt to impose the delay and linearity 80-cps sweep signal on an in-service communications link. The resulting swing of the transmitted carrier signal will cause complete disruption of service.

During linearization and delay equalization, it is ordinarily necessary to disable afc functions because of the wide frequency sweep required. An exception to this rule is the use of fast afc in the loop-back linearization technique.

Before use, one may wish to check the delay and linearity set back-to-back for operation. Connect the 70E1-MW, 75-ohm, combined output to the 70E2-MW baseband input as shown in figure 3-12. Refer to figure 3-9 for display indicating satis- factory operation.

3.3.2 INDEPENDENT LINEARIZATION OF MICROWAVE TRANSMITTERS.

Refer to figures 3-1A or 3-lB, 3-2A, and 3-3A. This method of linearization requires the use of a test receiver capable of demodulating the rf output of the transmitter under test. In figure 3-3A such a receiver has been assembled from a microwave signal generator (used as a local oscillator), an external mixer, and an if. discriminator such as those used in the radio system under test. Linearization is accomplished as follows:

a. Set up the equipment as shown in figure 3-3A.

b. After suitable warmup time has elapsed, set the transmitter on its assigned frequency. Set the local oscillator 70 me below the transmitter frequency and center the if. on the discriminator. The transmitter output level applied to the mixer should be about 6 db above the 70 mc level desired for the if. amplifier, while the local oscillator should provide' one milliwatt to the mixer crystal (most if. amplifiers have an indicator showing when the correct if. input level is present).

c. Set the 70E1-MW 304 kc MEASURING SIGNAL LEVEL to deviate the transmitter approximately 300 kc rms (or 3 db above a 200-kc CCIR test tone deviation). This can be measured at the if. discriminator baseband output by using the known volts-per- mc characteristic of the discriminator.

d. Set the 7OE1-MW 80-cps SWEEP SIGNAL LEVEL to deviate the transmitter over the range for which it is to be linearized, typically a deviation of +5 to +7 mc. Using the same calibration means as in step c., a small deviation of 2 mc may be set up. The sweep voltage required to produce this is noted; then the sweep voltage level from the 70E1-MW is increased in the proportion required to get the desired sweep deviation. This prevents bandwidth limitations or initial nonlinearity in the transmitter from giving a false reading such as would result if the entire sweep deviation were set up using the method in step c.

e. Set the INPUT ATTENUATOR on the 70E2-MW to 0. Set the 70E2-MW mode switch to LINEARITY 10%. Set the oscilloscope vertical and horizontal operation gain such that the entire trace appears on the screen. Typical displays are shown in figures 3-5 and 3-6.

f. Turn the 70E2-MW HORIZONTAL PHASE control to superimpose the trace lines as nearly as possible (use the 0° to 90° switch if the control runs against a stop). Figure 3-6 shows the correct trace after this step.

g. Calibrate the oscilloscope by setting its vertical gain to give a convenient vertical spacing between the two major display lines. (1 cm or one-half inch is a good starting place. )

h. Perform the transmitter linearization by the procedure appropriate to the linearizer used. This procedure will be found in the system maintenance practice publication. Variations in methods preclude presentation of any typical procedure.

i. As the linearization proceeds, it will be desirable to increase the oscilloscope vertical gain and to go to the LINEARITY 3% MODE on the 70E2-MW for a more detailed presentation. Since transmitter modulation sensitivity may change, occasionally repeat step d. For final linearization, set the 70E2-MW INPUT ATTENUATOR to 10 DB and reduce the 70E1-MW MEASURING SIGNAL LEVEL until a slight decrease in the 3 percent calibration line display spacing occurs. Reset the 70E1-MW INPUT ATTENUATOR to 0 DB and proceed. A typical final display is shown in figure 3-7.

Note

In this method, the nonlinearity of the receiver discriminator is added to that of the transmitter under adjustment. This imposes the requirement that the receiver have better linearity than is expected of the transmitter being linearized.

Receiver nonlinearity may be removed from the display by causing the receiver local oscillator to track the 80-cps swing of the transmitter, keeping the mixer output at 70 mc. When this is done the 304-kc modulation of the transmitter output will be demodulated over a small part of the receiver's discriminator bandwidth. Such a small part will ordinarily not exhibit appreciable nonlinearity, so the resulting display will accurately represent transmitter linearity.

Local oscillator tracking of the 80-cps sweep can be achieved by two means. The better of the two is by use of a receiver afc capable of tracking the 80-cps swing of the incoming signal, but not of responding to the 304-kc modulation.

The other method involves sweeping the receiver local oscillator with the same 80 cps used to sweep the transmitter under test. Suitable level and phase adjustments to the local oscillator sweep allow a satisfactory tracking action. However, nonlinearity of the local oscillator modulation characteristic will prevent exact cancellation of the transmitter frequency sweep.

This latter method is shown by dotted lines in figure 3-3A. A suitable 80-cps amplifier with phase and level controls is included in the Collins 70F1-MW if. adapter. This unit also has the external rf mixer shown, and provides power and mounting for an if. amplifier along with 65-, 70-, and 75-mc frequency markers for sweep calibration. Refer to figure 3-8, details A, B, and C, for typical traces showing the 70F1-MW marker signals.

3.3.3 INDEPENDENT LINEARIZATION OF MICROWAVE RECEIVER.

Refer to figures 3-1C, 3-2B, and 3-3C. This method requires the use of an rf generator capable of 304-kc frequency modulation.

Linearization is accomplished as follows:

a. With no sweep or measuring signals applied, set the rf generator to the frequency of the receiver to be linearized.

b. Apply the 304-kc measuring signal from the 70E1-MW to the rf generator. Using the known (need not be known exactly) volts-per-mc characteristic of the receiver discriminator, set the 70E1-MW MEASURING SIGNAL LEVEL to deviate the rf generator output approximately 300 kc rms (or 3 db above a 200-kc test tone deviation).

c. Apply the 80-cps sweep signal from the 70E1-MW to the local oscillator of the receiver under test. Use an external signal generator in the if. range to introduce a frequency marker signal at 70 mc into the if. portion of the receiver under test.

d. Set the 70E2-MW INPUT ATTENUATOR at 10 dband the MODE switch to LINEARITY 10%.

e. Refer to paragraph 3. 3. 2, sections e., f., and g., for operation of the 70E2-MW HORIZONTAL PHASE control and oscilloscope adjustment.

f. After getting a suitable display, insert an if. marker frequency at one limit of the desired discriminator linearity range. (Example: If the discriminator is to be linearized over +8 mc, set the marker to one extreme: 78 mc. ) Increase the 70E1-MW SWEEP SIGNAL output until the display shows a beat, or birdie, at one end. Shift the marker to the other extreme (62 mc in the example). Adjust the 70E1-MW SWEEP SIGNAL output and the rf generator output frequency to center the display and to make sure the local oscillator is being swept over the required range.

g. Perform the receiver linearization by the procedure given in the applicable system's maintenance publication. As with transmitter linearization, there are a variety of possible procedures, each unique with respect to a given receiver design. For this reason, no procedure is specified here.

h. As the linearization proceeds, it will be desirable to increase the oscilloscope vertical gain and to go to the LINEARITY 3% MODE on the 70E2-MW for a more detailed display. Since receiver discriminator characteristics may be changed by adjustment, calibrate the receiver deviation sensitivity after linearization. This is best done with either an fm transmitter signal of known deviation or a deviation calibrator.

i. For a check of the linearity presentation detail, increase the 70E2-MW INPUT ATTENUATOR setting by 10 db. If no significant change in display occurs, the received signal at the 70E2-MW is within a satisfactory range.

3.3.4 TRANSMITTER LINEARIZATION BY LOOPBACK METHOD.

Refer to figures 3-2B and 3-3C.

Where no test receiver is available, the loop-back method allows linearization of a microwave transmitter via its own normal communications path. By this method, the signal from the transmitter under test is received at the next station in its path. The high-amplitude 80-cps sweep is removed from the receiver output by using a fast afc which causes the receiver local oscillator to track the sweep of the transmitter frequency. The remaining 304-kc measuring signal output of the receiver is transmitted back to the originating station over a return micro- wave link. This return link needs only a relatively poor performance because the 304-kc signal transmitted over it has a constant frequency and a level comparable to a normal test tone signal. A small amount of am. is present on the 304-kc signal thus returned. Because of the absence of an 80-cps sweep in the returned signal, the filter-coupler shown in figure 3-2B is used to provide an 80-cps input to the 70E2-MW. The use of this setup for linearization is accomplished as follows:

a. Set up the equipment as shown in figure 3-3C.

b. After warmup, set the microwave transmitter to be linearized on its assigned frequency.

c. Set the 70E1-MW 304-kc MEASURING SIGNAL LEVEL to deviate the transmitter to approximately 300 kc rms (or 3 db above the standard 200-kc rms test tone deviation). Knowledge of the standard input levels for given deviation in the system under test is advisable for this operation.

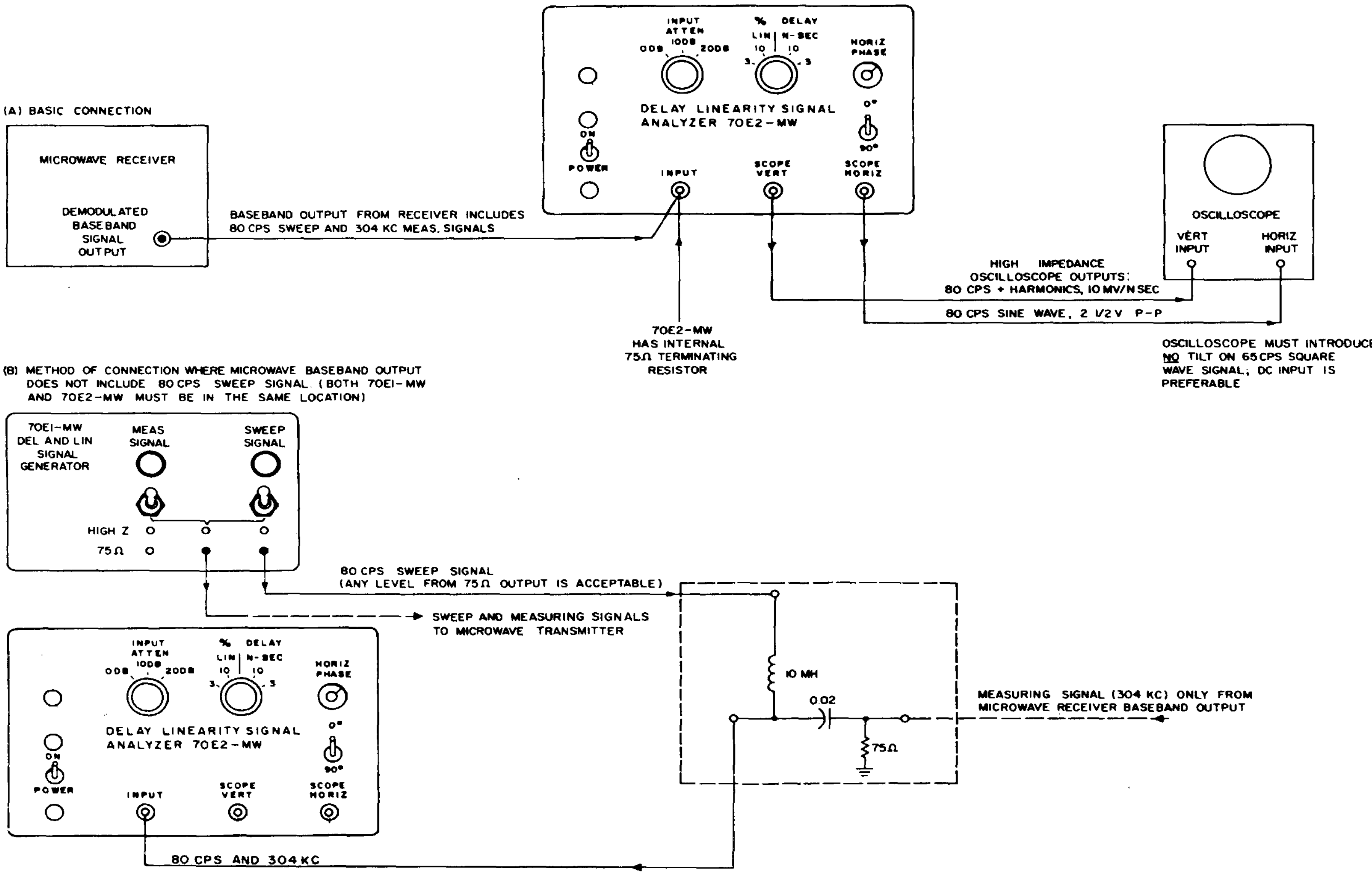



*Figure 3-2. Methods of Connecting the 70E2-MW*

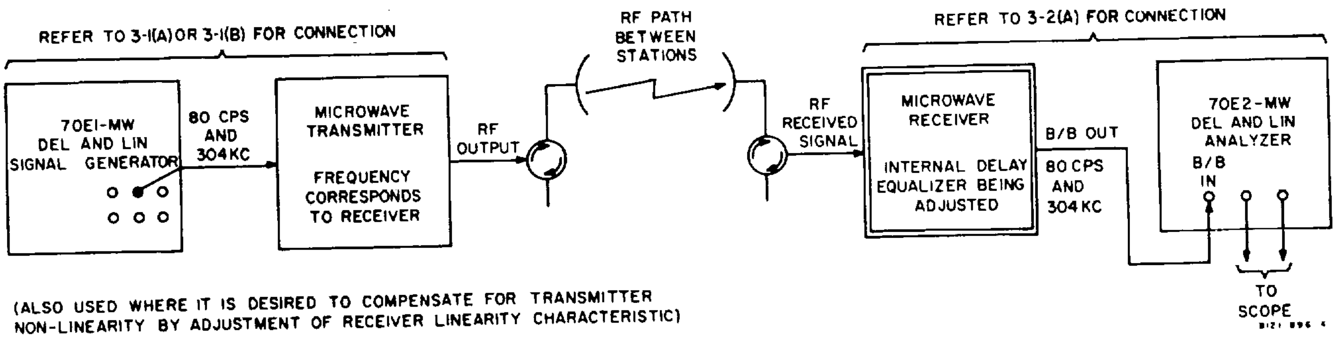



*Figure 3-4. Connections for Delay Equalization*

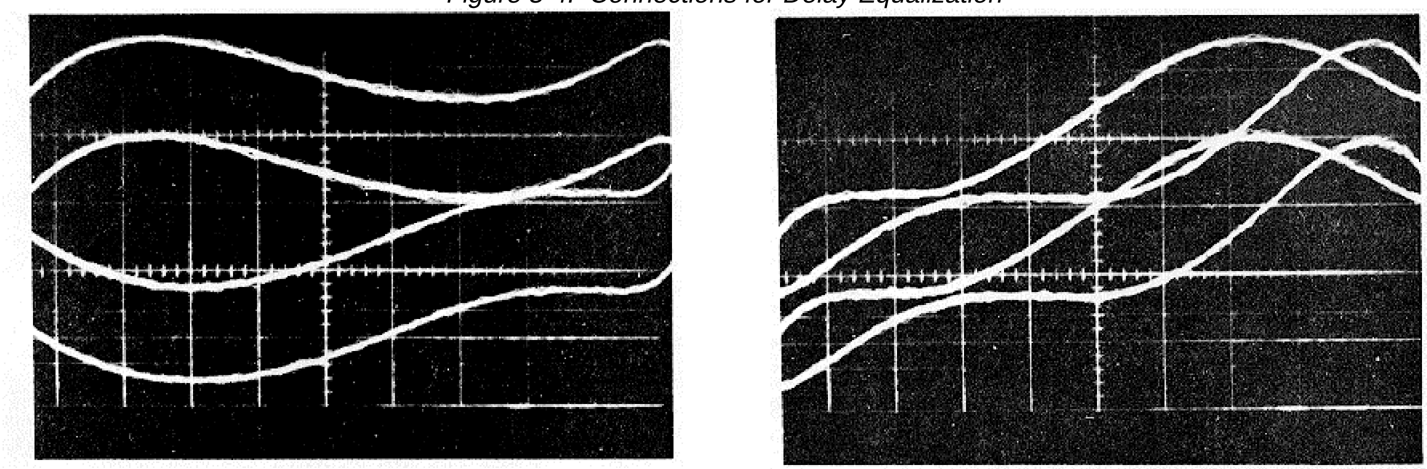


*Figure 3-5. Incorrect Horizontal Phase Control Adjustment*

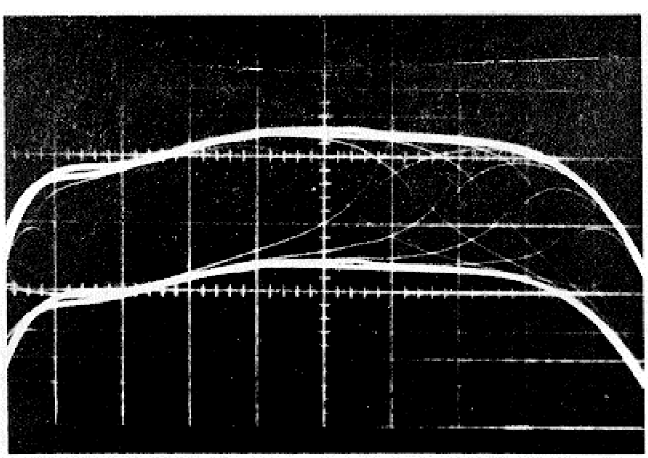


*Figure 3-6. Oscilloscope Trace Showing Correct Setting of HORIZ PHASE Control*

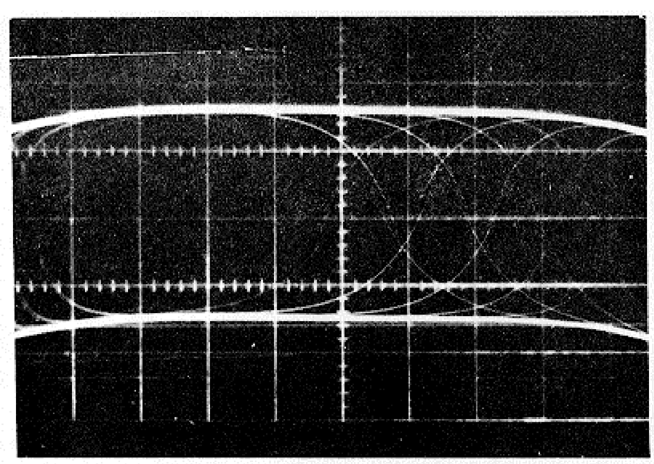
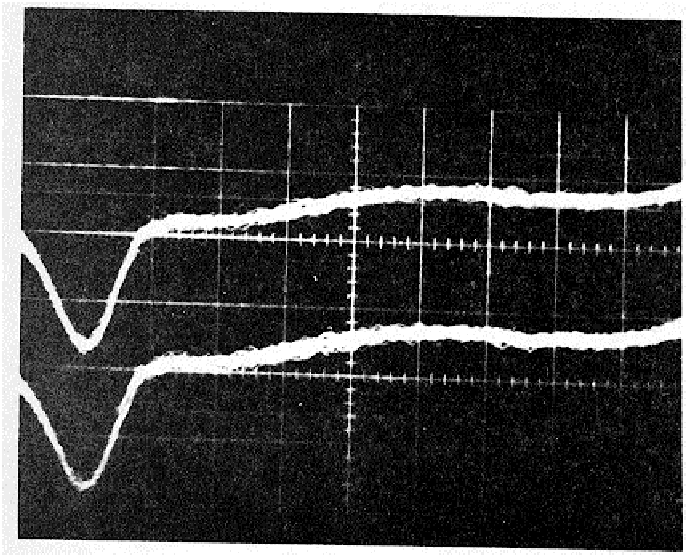
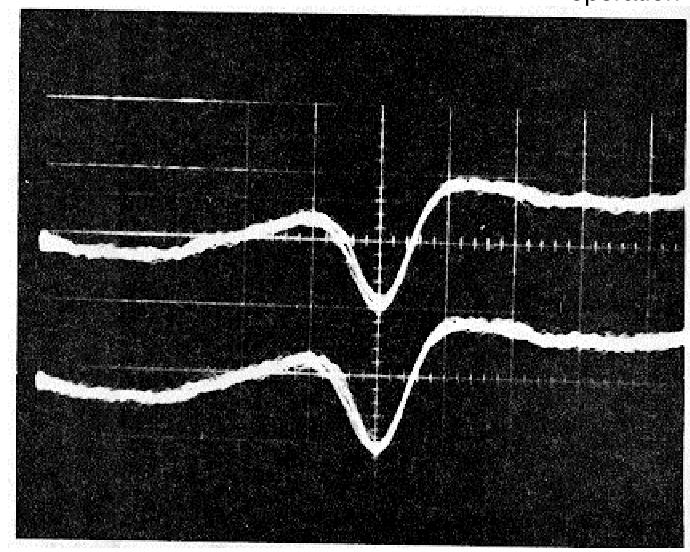


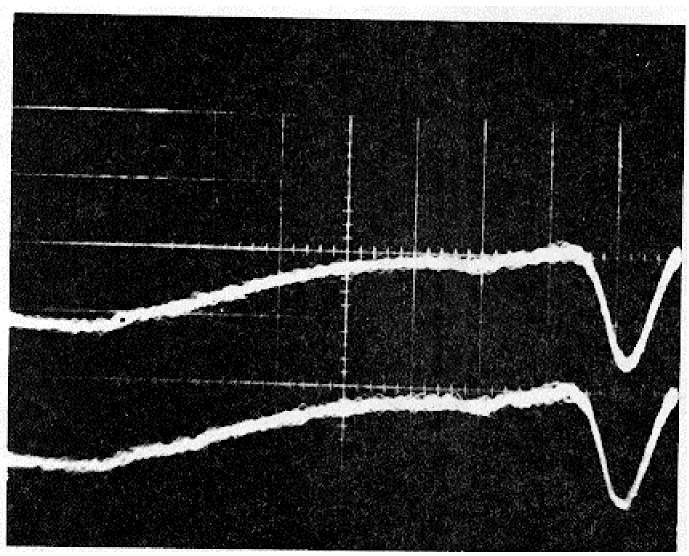
*Figure 3-7. Typical Oscilloscope Trace, Final Linearization*



A. 65-Mc Marker



B. 70-Mc Marker



C. 75-Mc Marker

*Figure 3-8. Oscilloscope Traces Showing Absorption Marker in Delay Mode*

d. Set the 70E1-MW 80-cps SWEEP SIGNAL LEVEL to deviate the transmitter over the range for which it is to be linearized, typically a deviation of +5 to +7 mc.

e. At the receiving station, check the output of the receiver corresponding to the transmitter under adjustment with an oscilloscope to ascertain that both 80-cps and 304-kc signals are present. Set the receiver for fast afc action and recheck the output. The 80-cps component should now be no greater than the 304-kc signal.

f. Patch the receiver output through a 304-kc high-pass filter to the modulation input of the return path transmitter. The 304-kc output level from the receiver will normally be satisfactory as an input level for the transmitter.

g. At the transmitting station proceed with transmitter linearization according to the maintenance method prescribed for the microwave system. Use sections 3. 3.2, e., f., g., h., and 1., in the operation of the 70EI-MW and 70E2-MW delay and linearity test set. Note that with the coupling filter connected between the 70E1-MW and 70E2-MW as shown in figure 3-2B, any sweep signal level required to sweep the transmitter under test is acceptable to the 70E2-MW.

3.3.5 DELAY EQUALIZATION OR SYSTEM LINEARIZATION.

Refer to figures 3-1A or 3-1B, -and 3-2A. This procedure is required for system delay equalization. It may also be used to adjust a receiver linearity characteristic to compensate for transmitter non- linearity, thus achieving overall system linearity.

In delay equalization the basic operation of the 70E1-MW and 70E2-MW is the same as in linearization, except for use of the 70E2-MW DELAY mode instead of the LINEARITY mode.

It is assumed that the system has been linearized before delay equalization is begun. The following steps are then necessary:

a. Make the transmitter end connections according to figure 3-1, details A or B. Disable the afc on both transmitter and receiver before measuring.

b. Make the receiver end connections according to figure 3-2A. operation

c. Check transmitter and receiver for on-frequency operation.

d. Set the 7_0QE1-MW 304-kc MEASURING SIGNAL LEVEL to deviate the transmitter approximately 300 kc rms (about 3 db above a 200-kc rms test tone deviation). It is assumed that the required measuring signal level to produce this deviation is known. A trace similar to figure 3-9 should be obtained.

e. Set the 7(E1-MW 80-cps SWEEP SIGNAL LEVEL to sweep the transmitter over the frequency range for which it is desired to delay equalize.

f. Set the 70E2-MW INPUT ATTENUATOR to 0 db and the MODE switch to DELAY 10 NS. Use the same procedure for oscilloscope calibration as was described for linearization in paragraph 3.3.2 e., f., g., and i., substituting DELAY 10 NS and 3 NS for LINEARITY 10%° and LINEARITY 3%. A trace similar to figure 3-10 should be obtained.

g. Follow the procedure for delay equalization given in maintenance publications applying to the rf equipment under adjustment. A trace similar to figure 3-11 should result.

h. System clean-up linearization with this test setup follows the same sequence of events as delay equalization, again using the 70E2-MW LINEARITY mode.

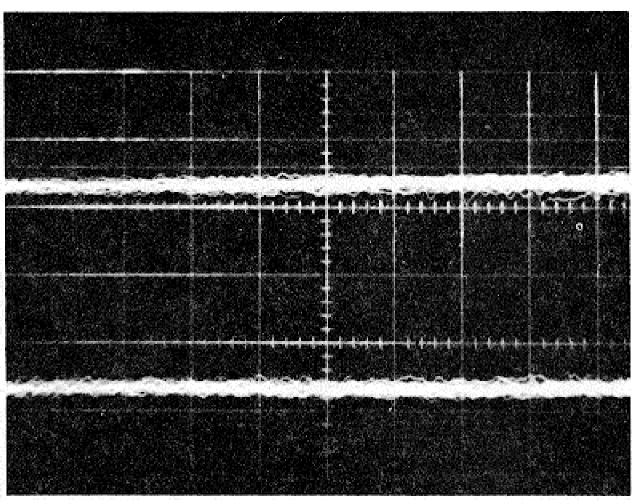


*Figure 3-9. Trace of Properly Operating Test Set Connected Back-to-Back*

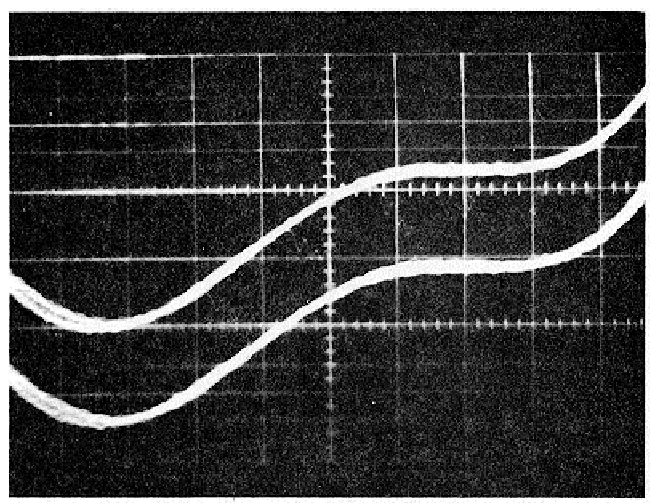


*Figure 3-10. Typical Oscilloscope Trace, Delay Equalization*

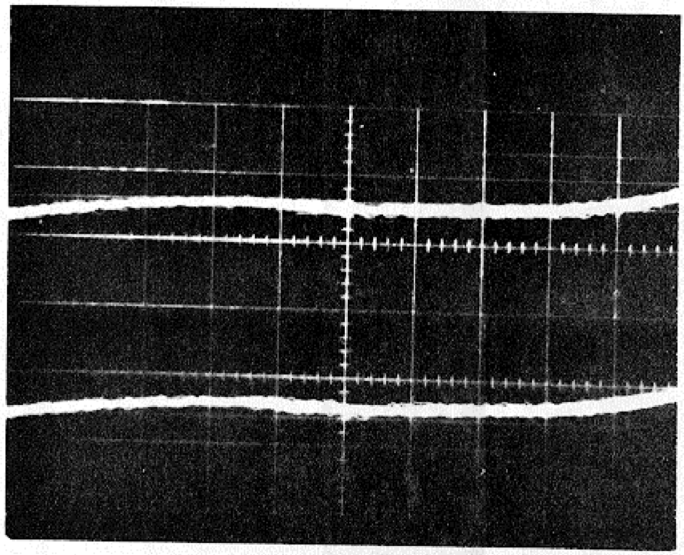


*Figure 3-11. Typical Oscilloscope Trace, Final Delay Equalization*

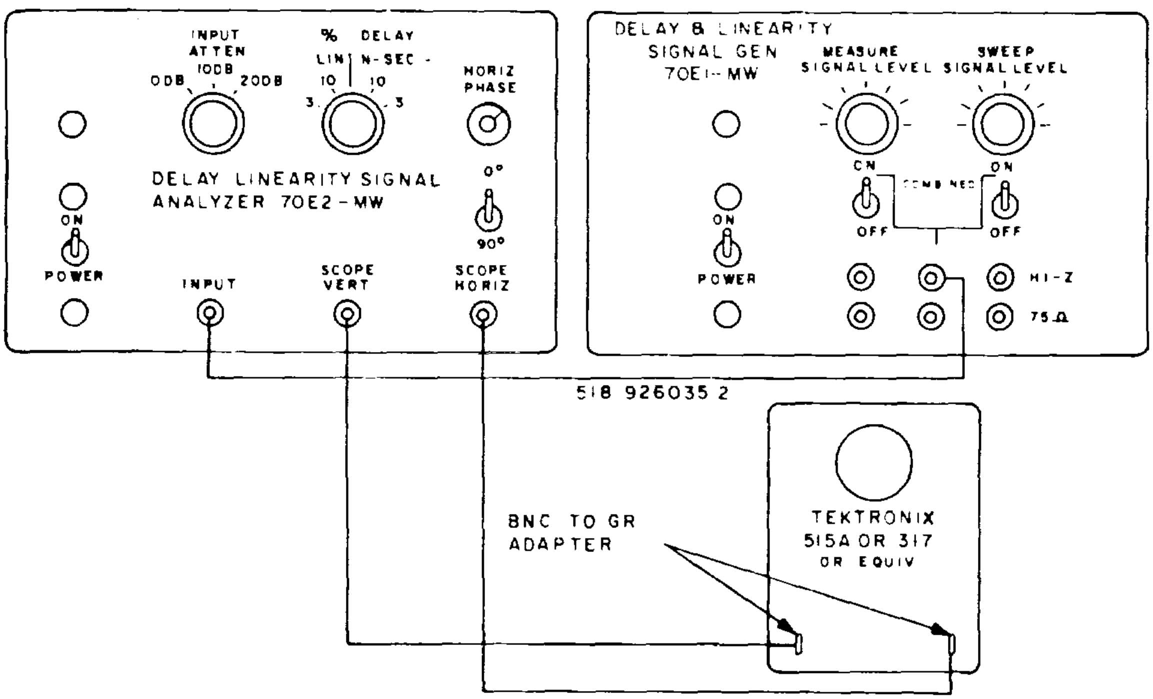



*Figure 3-12. Back-to-Back Test Setup*

## 4.1 GENERAL.

This section of the manual contains the principles of operation for the Delay and Linearity Test Signal Generator and Analyzer, 70 E1-MW and 70E2-MW, respectively. Paragraph 4.2 presents a discussion of the theory of delay and linearity testing. Paragraphs 4. 3, 4.4, and 4.5 cover the principles of operation of the circuits incorporated in the indivi- dual units.

## 4.2 THEORY OF DELAY AND LINEARITY TESTING.

The following paragraphs discuss the theory on which delay distortion and linearity distortion measurements are based. Figures 4-1 and 4-2 indicate the signal flow and basic functions of a frequency modulated system set up with a delay and linearity test set. The major areas of distortion generation are defined.

### 4.2.1 THEORY OF DELAY TESTING.

Delay distortion is created by nonlinear phase- frequency relationships in the various selective net- works and filters in an rf system. The transmitter and receiver bandpass filters contribute some delay distortion, but the highly selective bandpass filters in the if. amplifier at the receiving stations contribute the major portion of the overall distortion. In order to maintain the desired selectivity in a microwave receiver, for example, it is necessary to accept the delay distortion in the system and compensate for it with an equalizer network in the if. amplifier at the receiver.

Delay distortion in a microwave system is usually created when the signal transit time, as the signal passes through the system, varies with frequency. If the transit time delay is constant over a given frequency range, the phase shift of signals passing through the system increases linearly with increasing frequency. Figure 4-3A shows the phase-frequency characteristic of the selective networks and filters in a microwave system.

The solid line in figure 4-3B shows a typical, uncorrected, delay distortion characteristic of a micro- wave system. The phase equalizer network is a device with a constant amplitude and frequency response, but which adds delay distortion with the characteristic shown by the broken line in figure 4-3B. The third line in the figure sums the characteristics of the system delay distortion and the equalizer- network delay distortion, resulting in an almost constant delay time over the operating bandwidth of the system.

The method used to measure delay distortion is similar to the method employed to measure linearity distortion. Refer again to figures 4-1 and 4-3. A constant-frequency, constant-amplitude, measuring signal, which is moved across the operating bandwidth of the system by a sweep voltage, causes the transit time delay distortion to appear as a change in phase of the measuring signal frequency. The measuring signal and sweep signal are applied to the transmitter klystron simultaneously. The sweep signal is a high- amplitude, low-frequency (80-cps) signal which causes the klystron frequency to move across the operating range of the transmitter. The measuring signal is a low-amplitude, high-frequency (304-kc) signal which appears on the rf carrier as a modulating signal. Thus, the carrier of the klystron is modulated by the measuring signal which is swept back and forth across the frequency operating range of the transmitter. The measuring signal, appearing at the receiver discriminator output, is amplified and its phase compared to a reference signal source (a 304-kc, crystal- controlled oscillator) which is locked to the carrier of the incoming signal by a phase-lock circuit. The phase-lock circuit permits the detection of short-term phase variations between the incoming signal and the oscillator signal, but prevents long-term frequency drift between the two signals. The phase difference between the two signals is used to present an oscilloscope display which visually indicates the amount of delay distortion in the microwave hop. (Since the measuring signal frequency is fixed, any change in its phase shift as it is swept over the rf passband directly represents a change in transit time delay.)

### 4.2.2 THEORY OF LINEARITY TESTING.

Linearity distortion in an fm system results from variations in the slope of the voltage versus frequency characteristic of the modulated transmitter klystron and the receiver discriminator. See figure 4-4, details A and B. In order to measure the linearity of a system, it is necessary to measure the frequency deviation caused by a low-level measuring signal, applied to the transmitter, as the transmitter and receiver are tuned across the system tuning range.

When testing linearity, both the level and frequency (304-cps) of the measuring signal applied to the modulation input are maintained constant while the frequency of the transmitter carrier (or receiver local oscillator) is varied. The deviation caused by the 304-cps measuring signal, as it appears at the output of the transmitter, is measured by monitoring the signal as it appears at the discriminator output of a remote receiver. If the carrier frequency of a micro- wave transmitter is slowly changed (with the transmitter afc turned off) by slowly changing the repeller voltage of the klystron (with the 80-cps sweep signal), the small deviation caused by the measuring signal shifts up and down on the voltage versus frequency characteristic of the klystron. The linearity of the klystron is then represented by the variation of discriminator output as the transmitter frequency is shifted over the operating range of the equipment. The resulting signal at the receiver is used to present an oscilloscope display which indicates the amount of nonlinearity in the transmitter.

If the repeller voltage of the receiver local oscillator is slowly varied, and the transmitted carrier frequency remains constant (transmitter afc turned on and receiver afc turned off), the frequency deviation caused by the measuring signal is shifted back and forth over the frequency range of the discriminator. As the slope of the discriminator voltage-versus- frequency characteristic changes, the level of the measuring signal output changes. Thus, the resulting signal is used to present an oscilloscope display which indicates the amount of nonlinearity in the receiver discriminator.

## 4.3 70E1-MW CIRCUIT DESCRIPTION.

The Delay and Linearity Test Signal Generator, 70E1-MW, consists of a sweep signal generator, a measuring signal generator, and a filter coupler. The following paragraphs describe the circuits incorporated in the above sections of the 70OE1-MW. See functional block diagram, figure 4-5 and simplified block diagram, figure 6-1.

### 4.3.1 SWEEP SIGNAL GENERATOR.

The sweep signal generator produces an 80-cps, high-amplitude sweep signal which is typically used to vary the klystron repeller voltage of a microwave transmitter undergoing test, thus varying the frequency of the transmitter. See schematic diagram, figure 6-3.

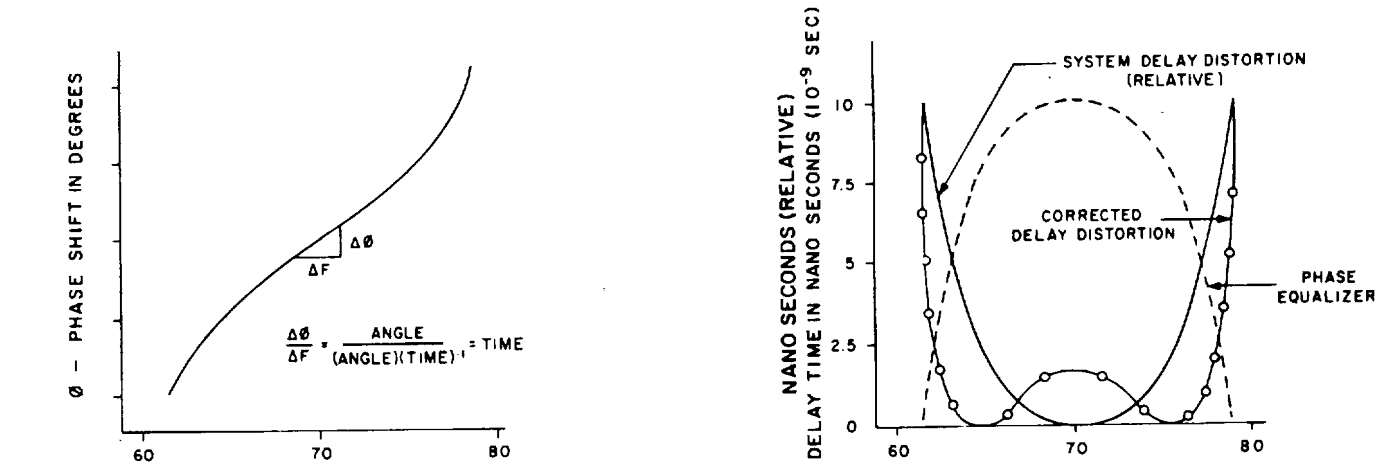
The sweep signal generator consists of unijunction pulse oscillator Q1, bi-stable multivibrator Q2 anld Q3, and push-pull amplifiers Q4, Q5, and Q6, Q7. Unijunction pulse oscillator Q1 is a free-running pulse generator with a pulse repetition rate deter- mined by the RC time constant of capacitor C1, fixed resistor R1, and variable resistor R2. Thermistor R3 compensates for variations of Ql characteristics to prevent changes in operating frequency with ambient temperature variations. The positive output pulses, which occur at twice the sweep signal frequency, are coupled through capacitors C2 and C3 to the multivibrator transistors.

Transistors Q2 and Q3 form a bistable multivibrator which is triggered by the positive pulse inputs from Q1 and divides the pulse frequency by two. The pulse inputs are applied to both multivibrator transistors simultaneously, causing the conducting transistor to turn off. This, in turn causes the non-conducting transistor to turn on. With each applied pulse, the transistors change state, alternately switching on and off. The output, taken from the collector of Q3, appears as a symmetrical square-wave signal at a prf of half that of the trigger pulses. This signal is applied through SWEEP SIGNAL LEVEL control R18 and a pi-section low-pass filter to push-pull amplifier transistors Q4, Q5, Q6, and Q7 which drive output transformer T1. T1 steps up the signal voltage to a level sufficient for sweeping typical reflex klystrons. BAL control R20 adjusts the dc operating point of Q5 and Q7 to achieve balanced operation for low distortion. The pi-section low-pass filter combined with the amplifiers causes the square-wave inpt to the amplifiers to appear as a sine-wave signal at the output of T1 by removing the harmonics and leaving only the fundamental. The output of T1 is coupled to the coupler circuit board through shielded lines.

### 4.3.2 MEASURING SIGNAL GENERATOR.

The measuring signal generator produces a 304-kc measuring signal which Is used to modulate the rf carrier of the transmitter under test. See schematic diagram, figure 6-2.

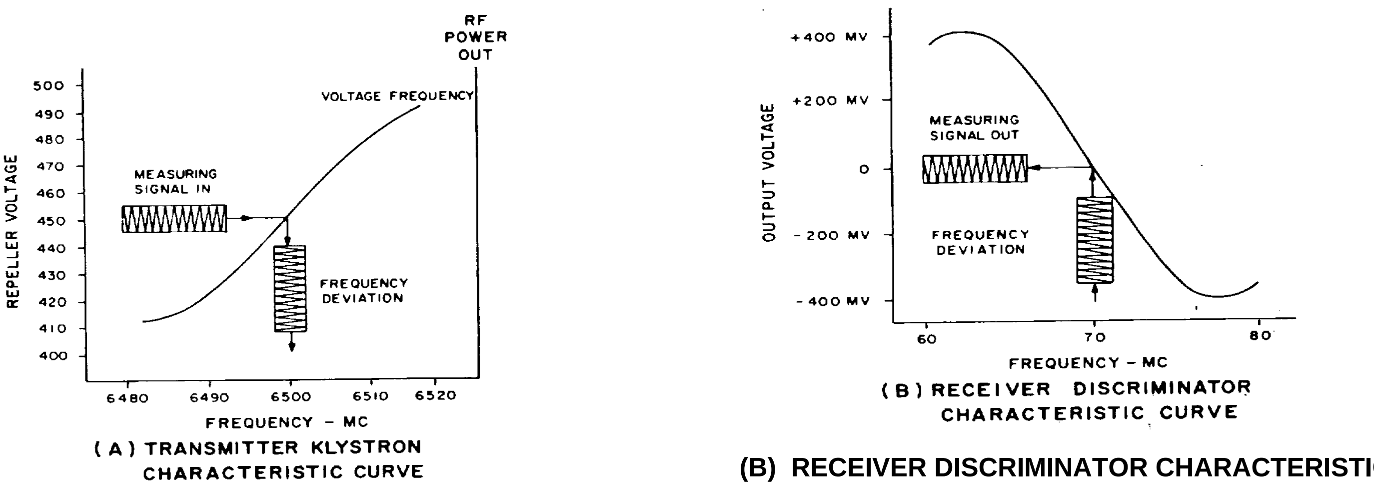
The measuring signal generator consists of a crystal controlled oscillator and a two-stage, variable gain amplifier. Transistor QI is the oscillator which is frequency controlled by crystal Y1. Capacitors C2 and C6 adjust the frequency of the collector tank cir- cuit and the crystal feedback circuit, respectively, and are used to trim the oscillator to its exact specified frequency. The output of the oscillator is coupled through an isolating filter (R5, C9, and R6) to the base of amplifier transistor Q2. Transistor Q2 is directly coupled to emitter follower Q3 which provides outputs to the high impedance front panel jacks. The output is also coupled to the 75-ohm output jacks through an impedance matching transformer T1. Feedback from the emitter of Q3 is applied through C13 and R12 to the emitter of Q2 to stabilize the gain of the amplifier. LEVEL control R13 is an adjustable voltage divider to set the measuring signal output level. Zener diode CR1 regulates the voltage applied to the oscillator to prevent any change in oscillator frequency with power supply variations.




**(A) PHASE-FREQUENCY RELATIONSHIP**

**(B) DELAY TIME-FREQUENCY RELATIONSHIP**

*Figure 4-3. System Delay Characteristics*




**(A) TRANSMITTER KLYSTRON CHARACTERISTIC CURVE**

**(B) RECEIVER DISCRIMINATOR CHARACTERISTIC CURVE**

*Figure 4-4. Klystron and Discriminator Voltage Versus Frequency Characteristics*

4.3.3 COUPLER BOARD.

The coupler board consists of two low-pass filters which allow the 75-ohm and high impedance outputs of the sweep signal generator and measuring signal generator to be combined into common outputs with- out interaction between the two generators. Refer to the simplified schematic diagram, figure 6-1, and the coupler diagram. figure 6-4.

4.4 70E2-MW CIRCUIT DESCRIPTION.

The Delay and Linearity Test Signal Analyzer, 70E2-MW, consists of an agc amplifier, limiter discriminator, reference oscillator,, calibrator amplifier, and a sweep synchronizer. The following para- graphs describe the circuits incorporated in the above sections of the 70E2-MW. See functional block diagram, figure 4-6, and simplified schematic diagram, figure 6-5.

4.4.1 AGC AMPLIFIER.

The agc amplifier selects the 304-kc measuring sig-nal from the baseband input, and is used to amplify and control the level of the signal for application to the limiter discriminator and calibrator amplifier. See schematic diagram, figure 6-6.

The agc amplifier consists of a step attenuator input, a bandpass filter, two gain-controlled amplifier stages, three conventional amplifier stages, an agc detector, an agc control transistor, and a relay driver transistor. The step attenuator presents 0 db, 10 db, or 20 db of attenuation to the 304-kc baseband input signal from connector JI. The baseband signal is applied to the filter formed by C1, C2, and L1, which rejects all but the 304-kc component of the base- band signal. The filter frequency is adjusted by variable capacitor C1, and the output of the filter is coupled to emitter follower Q2. Transistor Q2 is directly coupled to Q3 which drives the three-stage amplifier Q5, Q6, and Q7. Output from emitter follower Q7 is applied to the calibrator amplifier and the limiter discriminator circuit boards. Output from Q7 is also applied to emitter follower Q8 which drives the agc detector; a voltage doubler formed by C17, CR1, CR2, and C18. The detector output is applied through AGC RANGE control R39 to control transistor Q4. The AGC RANGE control sets the limits over which the agc functions. Transistor Q4 appears as variable shunt impedance across the output of Q3. Thus, as the output of Q7 tends to vary, the shunt impedance across Q4 varies inversely, which causes the output to remain constant. Relay driver Q9 is controlled by a bistable circuit in the calibrator amplifier. As the square-wave signal turns Q9 on and off, relay K1 is energized and de-energized. The relay contacts apply a ground to switch S2 when the relay coil is energized, causing the 3 NS CALIB and 10 NS CALIB controls, R41 and R40, in series with C16, to be shunted across the output of Q7. R40 or R41, together with C16, constitute an RC phase shift network. When the MODE switch is in the LINEARITY positions, the relay has no effect on the agc amplifier output.

4.4.2 LIMITER DISCRIMINATOR.

The limiter discriminator amplifies and limits the 304-kc signal from the agc amplifier, and compares the signal with a reference input from the 304-kc reference oscillator. The unit provides a signal out- put to the reference oscillator and calibrator amplifier which is proportional to the phase difference between the input from the agc amplifier and the input from the reference oscillator. See schematic diagram, figure 6-7.

The limiter discriminator consists of a three-stage amplifier employing back-to-back, biased diodes for limiting, a phase discriminator, and an emitter-follower output stage. The input from the agc amplifier is applied through LIM THRESHOLD control R1 to amplifier Q1. The output of Q1 is applied to a limiting diode circuit consisting of CR1, CR2, R8, R9, and R10. Under low-level signal conditions, the diodes are biased in such a manner that CRI and CR2 are in conduction. As long as the diodes conduct, the signal from Q1 flows through the diodes to amplifier transistor Q2. If an ac input voltage rises beyond a certain positive point, predetermined by the bias applied to CR2, the diode is back biased and limits the positive signal excursion. Also, if the ac input voltage falls below a certain negative point, predetermined by the bias applied to CRI, the diode is back biased and limits the negative signal excursion. The output of Q2 is applied through another diode limiting circuit, identical to the one discussed above, to amplifier transistor Q3. The output of Q3 is applied through the phase discriminator circuit consisting of TI, T2, CR5, CR6, R24, R25, C11, C12, and Zener diode CR7 to emitter-follower output transistor Q4. The input to T1 is compared to the reference oscillator input to T2, producing an output which is proportional to the phase difference between the two discriminator inputs. The discriminator output, amplified by Q4, is applied to the reference oscillator phase lock circuits and the calibrator amplifier vertical circuits.

4.4.3 REFERENCE OSCILLATOR.

The reference oscillator provides a 304-kc reference signal for application to the phase discriminator circuit in the limiter discriminator. The reference oscillator also senses any changes in the phase discriminator output and causes a crystal oscillator to vary in frequency such that the oscillator frequency is locked to the measuring signal carrier input to the phase discriminator. See schematic diagram, figure 6-8.

The reference oscillator consists of a dc amplifier, a voltage-variable, crystal controlled oscillator, and a two-stage amplifier. The input from the phase discriminator of the limiter discriminator is coupled through Zener diode CR2 to the emitter of common base amplifier Q2. The dc output level of Q2 is adjusted by OSC LOCK control R7 which sets the bias point of the transistor. The output of Q2 is applied through an 80-cps rejection twin-tee filter to voltage variable capacitor CR3 in the feedback path of crystal Oscillator Q3. As the input to the dc amplifier varies, the capacity of CR3 varies, causing the frequency of .he crystal oscillator to shift and be locked to the 304-kc measuring signal. The voltage variable capacitor operating range is set by CENTER FREQ variable capacitor C12. The collector tank circuit of Q3 .s adjusted to the proper frequency by CENTER FREQ variable capacitor C9. Reference signal output from he tank circuit is applied to amplifier Q4 which is

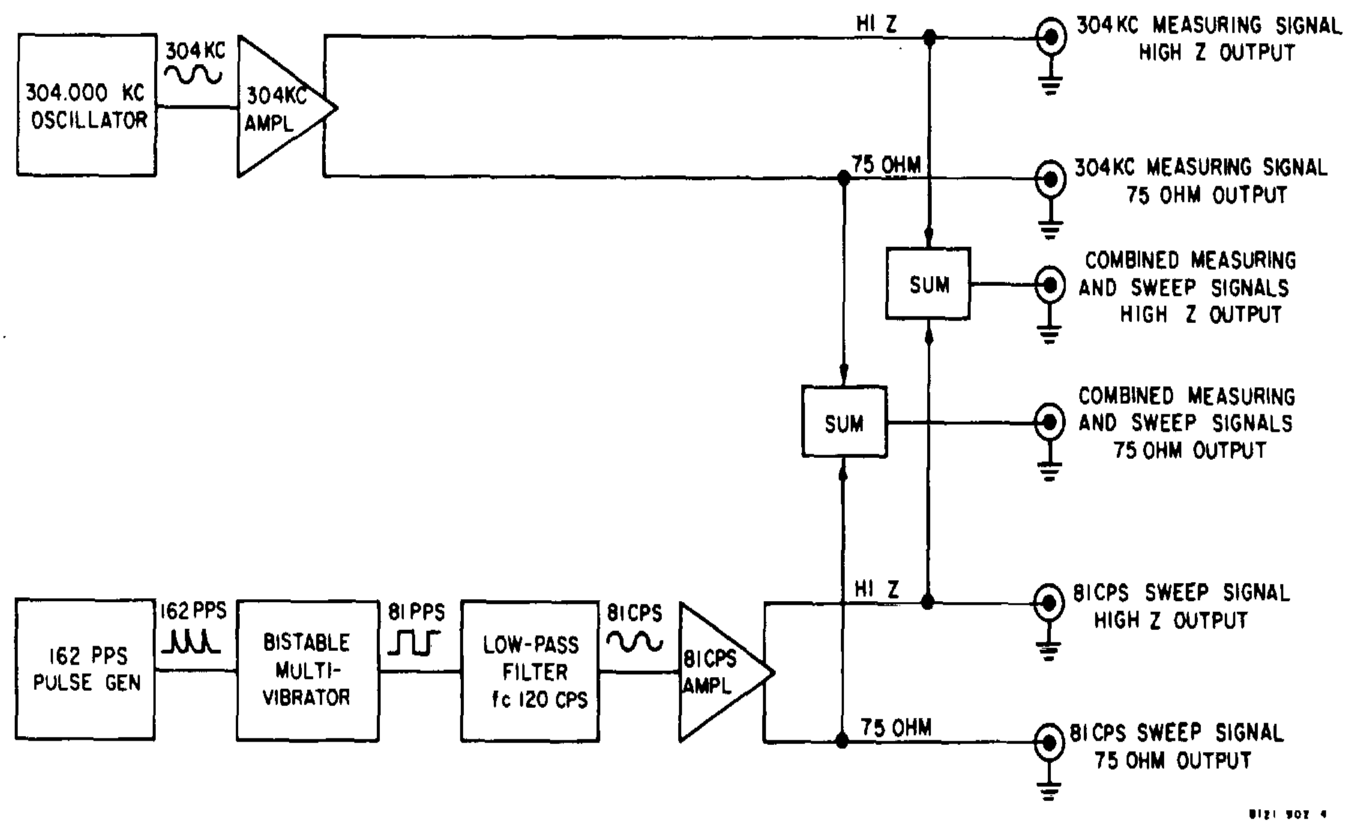



*Figure 4-5. 70E1-MW Functional Block Diagram*

directly coupled to emitter-follower output transistor Q5. The output of Q5 is fed to the discriminator circuit for comparison with the 304-kc measuring signal from the agc amplifier.

4.4.4 CALIBRATOR AMPLIFIER.

The calibrator amplifier provides linearity and delay output circuits for application to the SCOPE VERTI- CAL output jack. A switching transistor is incorporated in the linearity circuit that alternately shunts the AC signal circuit with calibrated loads, causing the linearity output to appear on the oscilloscope as two traces separated by a calibrated amount. See schematic diagram, figure 6-9.

The calibrator amplifier consists of two separate amplifier stages, a unijunction pulse oscillator, a driven multivibrator, and a switching transistor. Transistor Q1 amplifies the measuring signal input from the agc amplifier and applies an output through switch S3 and variable resistors R7 and R8 to AM detector, diodes CR5 and CR6. The detector output enters the filter, composed of inductor LI and capacitors C8 and C9, which removes the measuring signal. Connector pin F supplies the filter output to switch S3. The signal level appearing at the detector input is controlled by transistor Q6. When Q6 con- ducts resistor R7 (or R8) and capacitor C15 load the detector and reduce the detector input signal level. When Q6 is cut off, resistors R7 (or R8), R37, and R20, and capacitor C15 load the detector and reduce the detector input signal level a smaller amount. Transistor Q2 amplifies the limiter discriminator output and supplies an output to switch S3 via pin J.

Unijunction pulse oscillator Q3 is a free running oscillator which operates on a frequency determined by the RC time constant of R21 and C2. Positive output pulses are applied to multivibrator transistors Q4 and Q5. With each positive pulse, the conducting transistor cuts off and the opposite transistor con- ducts. Thus, with each pulse, the circuit changes state. The output of Q4 switches relay driver Q9 in the agc amplifier on and off, and the output of Q5 switches switching transistor Q6 on and off. Relay driver Q9 in the agc amplifier and switching transistor Q6 in the calibrator amplifier load the signal path of the agc amplifier and calibrator amplifier, respectively, with two different values of impedance. Thus, the multivibrator, relay driver Q9, and switching transistor Q6 produce a dual trace on the oscilloscope by superimposing a calibrated amplitude (linearity) or phase (delay) modulation on the measuring signal before the signal is detected or discriminated. MODE switch S3 selects the linearity or delay output that is applied to the SCOPE VERTICAL connector.

4.4.5 SWEEP SYNCHRONIZER.

The sweep synchronizer provides an output signal to the SCOPE HORIZONTAL jack that synchronizes the oscilloscope sweep with the 80-cps signal that is used to modulate the transmitter undergoing test. The synchronizer also provides controls for adjusting the phase of the output signal between 0O and 135° with respect to the input signal. See schematic diagram, figure 6-10.

The sweep synchronizer consists of a single-state amplifier, a diode clipper, a phase shift oscillator serving as an active filter, a two-stage amplifier, a variable phase shift network, another two-stage amplifier, and a 90° phase shift network. The signal applied to the INPUT jack is coupled to amplifier Q1. The low-pass filter formed by L1 and C1 prevents the 304-kc signal from feeding through to Q1, allowing only the 80-cps component of the signal to be amplified. The output of Q1 is applied to the clipping network formed by R7, CR1, and CR2. The clipping network limits the 80-cps signal applied to the feedback path of phase shift oscillator Q2. The phase shift oscillator is normally in a nonoscillating condition and is driven into sine-wave oscillation by the signal that is applied to the feedback path. The nominal frequency of the phase shift oscillator is adjusted by FREQ control R11. The synchronized oscillator output is applied to direct-coupled amplifiers Q3 and Q4. Emitter follower Q4 drives the phase shift transformer network formed by T1, C18, and HORIZONTAL PHASE control R29. HORIZONTAL PHASE control R29 varies the 80-cps phase between 0O and approximately 1350. The signal is then applied through amplifiers Q5 and Q6 to a 90° phase shift bridge formed by R42, R43, C26, and C27. A double-pole, double-throw toggle switch selects 0° or 90° phase shift by taking the output from the appropriate bridge terminals. The bridge and HORIZONTAL PHASE control provide the capability of varying the phase of the 80-cps signal from O0 through 180°. The output from the bridge is coupled through step-up transformer T2 to the SCOPE HORIZONTAL connector.

4.5 70E1-MW AND 70E2-MW POWER SUPPLIES.

The 7OE1-MW and 70E2-MW test instruments contain identical power supply chassis. The power supply is constructed on a metal subassembly and is mounted in the same location in both test instruments. See schematic diagram, figure 6-11.

The power supply consists of a transformer, bridge rectifier, filter network, and a diode regulator. The primary power is applied to power transformer T1 through power switch S4 and fuse Fl. The output of T1 is applied to lamp DS1 through resistor R1, and to the bridge rectifier formed by CR2, CR3, CR4, and CR5. The dc output of the rectifier is filtered by the network formed by C1, R2, C2, and R3. The output is then regulated to 20 volts by diode CR1 for application to the various circuit boards in the test instrument.

# section 5

## maintenance

5.1 GENERAL.

This section of the manual contains the alignment and troubleshooting procedures for maintaining the Delay and Linearity Test Signal Generator (70E1-MW) and Analyzer (70E2-MW). Since the alignment procedure requires examination of all functions of the equipment, this procedure is equally usable in isolation of faults in operation. Paragraph 5.1 lists the recommended test equipment required for alignment of the instruments.

5.2 RECOMMENDED TEST EQUIPMENT.

The following test equipment, or equivalent, is recommended for the alignment of the 70E1-MW and 70E2-MW.

a. Volt-Ohm-Milliammeter, Triplett 630A

b. Vacuum-Tube-Voltmeter, Hewlett-Packard 400D

c. Oscilloscope, Tektronix 545

d. Counter, Hewlett-Packard 523

e. Adjustable Transformer, Variac, 115 volts ac,

f. Test Calibrator, shown in figure 5-11

5.3 70E1-MW ALIGNMENT.

The following procedure should be used to properly align the 70E1-MW Delay and Linearity Test SignalGenerator.

a. Connect the 70E1-MW according to figure 5-1.

b. Adjust the Variac transformer for 115 voltsac.

c. Turn the 70E1-MW on, allowing 5 minutes for warmup.

d. Set the MEASURING SIGNAL switch to OFF, and the SWEEP SIGNAL switch to ON.

e. Connect the counter, vtvm, and oscilloscope to the SWEEP SIGNAL HIGH Z output.

f. Adjust FREQ ADJ control R2, on the sweep generator board, for an 81.0-cps reading on the counter. Adjust BAL control R20 for a clean appearing sine-wave output on the oscilloscope. See figure 5-2 for the location of R20.

g. Vary the SWEEP SIGNAL LEVEL control from fully counterclockwise to fully clockwise (minimum to maximum), verifying smooth operation and an output range from 2 to 20 volts rms, nominal, with good waveform.

h. Reconnect the measuring instruments to the SWEEP SIGNAL 75-ohm output. Connect the 75-ohm termination across the line as shown in figure 5-1.

i. Vary the SWEEP SIGNAL LEVEL control from minimum to maximum, verifying an output range from 0.05 to 0.40 volt rms, nominal.

j. Repeat step g. with the measuring instruments connected to the COMBINED HIGH Z output, with no 75-ohm termination across the line. (To measure SWEEP SIGNAL voltages, turn the MEASURING SIG-NAL switch to OFF.)

k. Repeat step i. with the measuring instruments connected to the COMBINED 75-ohm output, using the 75-ohm termination across the line. (To measure SWEEP SIGNAL voltages, turn the MEASURING SIG-NAL switch to OFF. )

l. Set the SWEEP SIGNAL switch to OFF, and the MEASURING SIGNAL switch to ON. Connect the counter, vtvm, and oscilloscope to the MEASURING SIGNAL HIGH Z output. Set the MEASURING SIGNAL LEVEL 1 volt without the 75-ohm termination across the line. (If no output, continue to step m.)

m. Tune the FREQ ADJ capacitor C2 on the measuring signal generator board for maximum output on the vtvm. See figure 5-3.

n. Adjust the FREQ ADJ capacitor C6 for a frequency of 304.000 kc ± 1 cps as noted on the counter.

o. Repeat steps m. and n. in order for maximum output.

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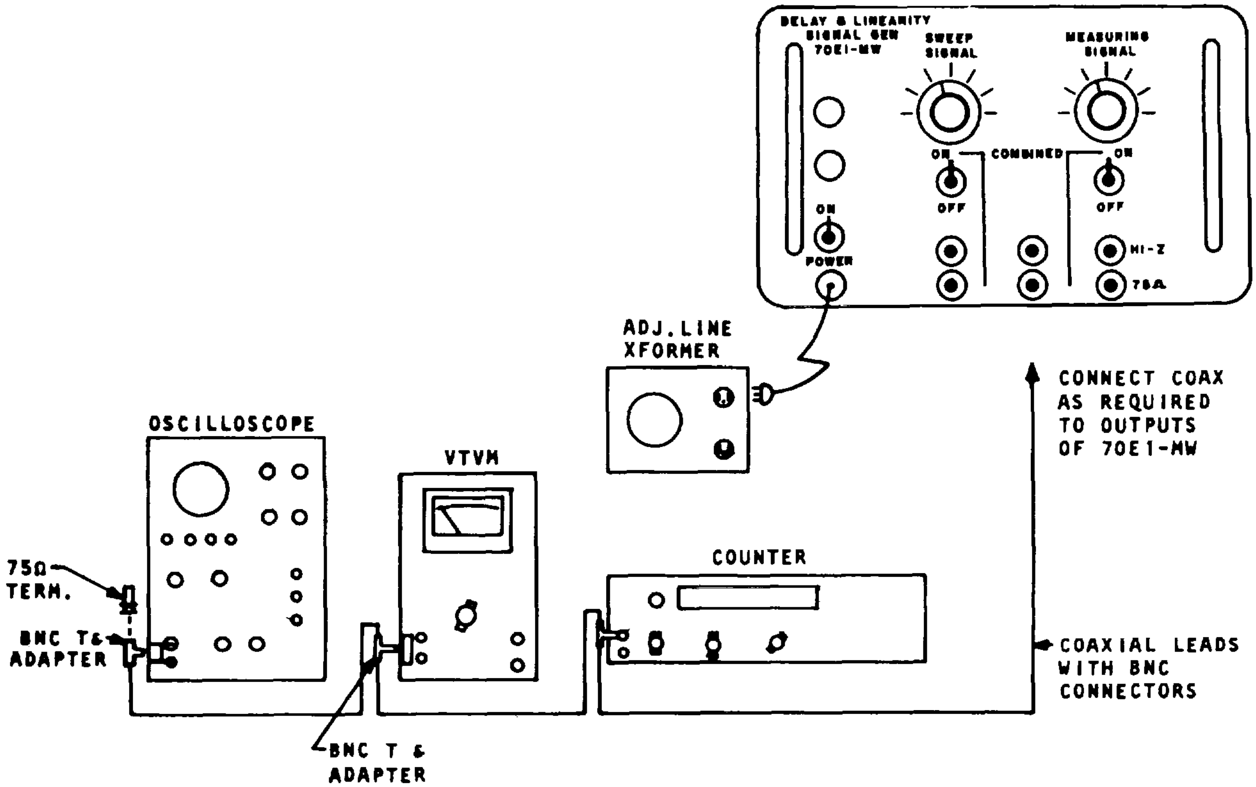


*Figure 5-1. 70E1-MW Test Setup*

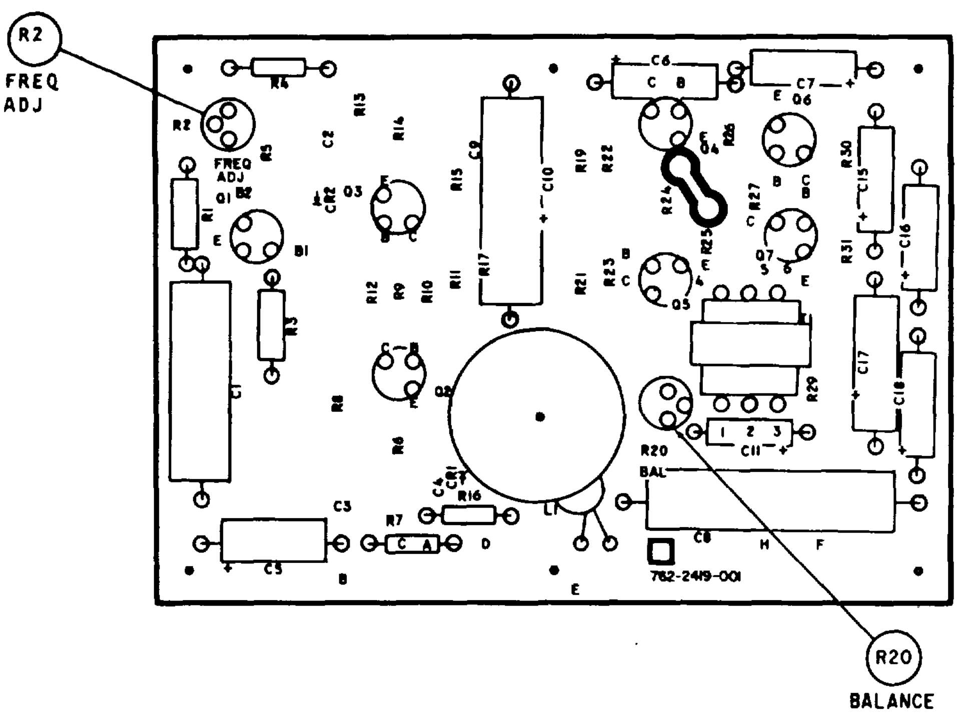


*Figure 5-2. Sweep Generator Board*

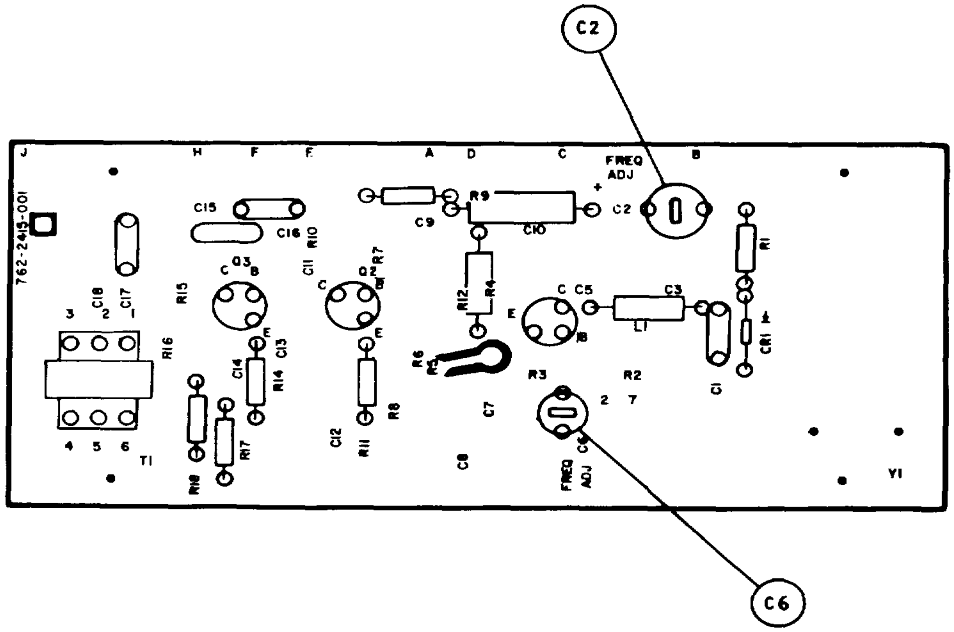


*Figure 5-3. Measuring Signal Generator Board*

p. Vary the MEASURING SIGNAL LEVEL control from minimum to maximum, verifying smooth operation and an output range from 0.15 to 1.50 volts rms, nominal values.

q. Move the measuring instruments to the MEASURING SIGNAL 75-ohm output, and terminate with 75-ohms.

r. Repeat step p., verifying an output range from 3 to 30 millivolts rms, nominal.

s. Repeat steps p. and q. with the measuring instruments connected to the COMBINED outputs, again using the 75-ohm termination when measuring the 75-ohm output level.

5.4 70E2-MW ALIGNMENT.

The following procedure is recommended for aligning the 70E2-MW Delay and Linearity Test Signal Analyzer.

5.4.1 GENERAL.

a. Connect the 70E2-MW according to figure 5-4.

b. Adjust the variable transformer for 115 volts ac.

c. Turn on both the 70E1-MW and the 70E2-MW, allowing 5 minutes for warmup.

5.4.2 AGC AMPLIFIER ALIGNMENT.

a. Set the 70E1-MW SWEEP SIGNAL switch to OFF and MEASURING SIGNAL switch to ON.

b. Rotate the 70E1-MW MEASURING SIGNAL LEVEL control fully clockwise.

c. Set the 70E2-MW INPUT ATTENUATION switch to 0 DB.

d. Connect the vtvm between resistor R14 and ground (figure 5) on the 70E2-MW agc amplifier board.

e. Using a non-metallic screwdriver, adjust FREQ ADJ capacitor C1 for a maximum indication on the vtvm.

f. Move the vtvm from resistor R14 to terminal C.

g. Adjust AGC RANGE control R39 fully counterclockwise and rotate the control three-fourths of its full clockwise rotation.

h. Observe that the vtvm indicates 0.1 to 0.2 volts rms.

i. Rotate the 70E1-MW MEASURING SIGNAL LEVEL control fully counterclockwise and observe that the vtvm indicates less than 6-db change.

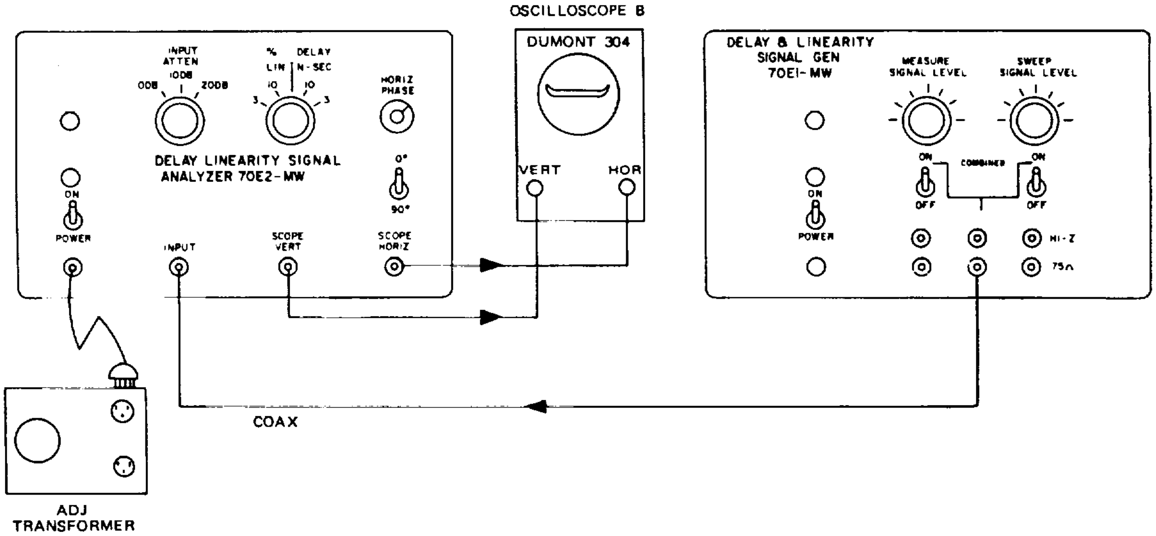


*Figure 5-4. 70E2-MW Test Setup*

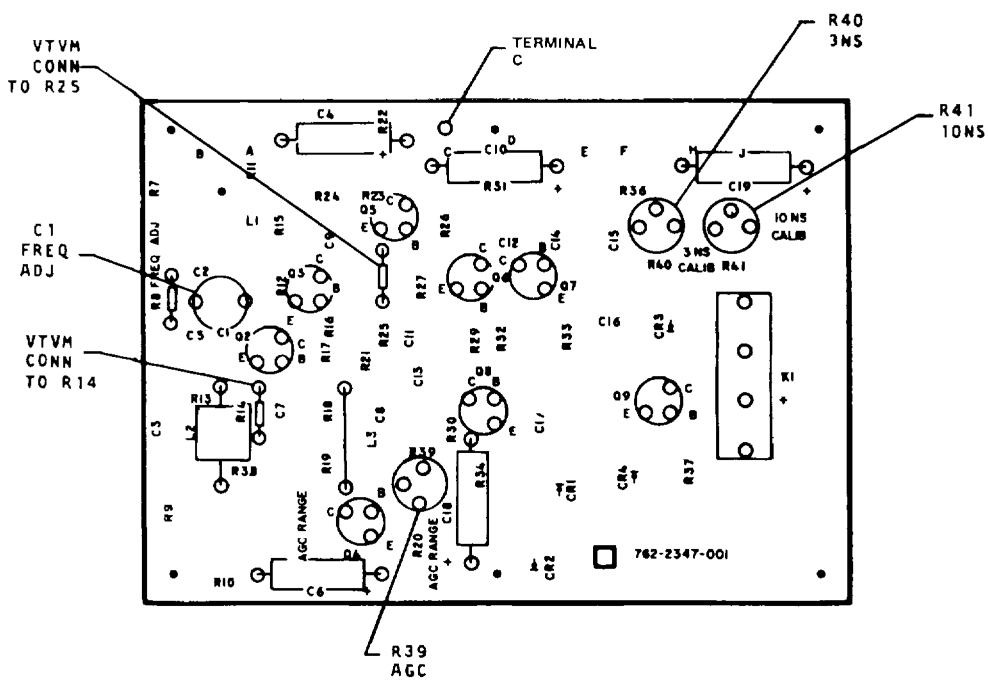


*Figure 5-5. AGC Amplifier Board*

maintenance

5.4.3 LIMITER DISCRIMINATOR ALIGNMENT.

a. Leave the SWEEP SIGNAL switch in the OFF position. Turn MEASURING SIGNAL LEVEL fully counterclockwise, leaving the MEASURING SIGNAL switch in the ON position.

b. Leave the INPUT ATTENUATOR switch in the O DB position.

c. Connect the oscilloscope to diode CR2 on the limiter discriminator board. See figure 5-6. Use 1-usec/cm sweep rate on the oscilloscope.

d. Adjust the LIM THRESHOLD control R1 to obtain the waveform shown in figure 5-7. Note that some rounded clipping of peaks is shown.

5.4.4 REFERENCE OSCILLATOR ALIGNMENT.

a. Turn the MEASURING SIGNAL LEVEL control to midrange. Leave other controls as in the previous steps, excepting the MEASURING SIGNAL switch which should be turned to the OFF position.

b. Connect the vom to C4 and the vtvm to R21. See figure 5-8. Use the 50- or 60-volt dc scale on the vom, and the 1-volt scale on the vtvm.

c. Disable the reference oscillator by keeping a finger against the case of Q3, and adjust OSC LOCK control R7 to give an 11. 00. 5-volt dc reading on the vom.

d. Remove the finger from Q3 and trim C9 for center of range over which vtvm reading is obtained. (Nominally, about 0.4 volt rms is seen. )

e. Turn the MEASURING SIGNAL switch to the ON position. Remove the vtvm.

f. Adjust C12 to return the vom reading to approximately 11 volts.

g. Repeat steps c., d., e., and f.

5. 4.5 SWEEP SYNCHRONIZER ALIGNMENT.

a. Set the SWEEP SIGNAL switch to ON and the MEASURING SIGNAL switch to OFF.

b. Using the width of the oscilloscope display as a relative indication, adjust Rll on the sweep synchronizer board for maximum width. See figure 5-9.

c. Set the MEASURING SIGNAL switch to ON.

Note

An oscilloscope indication similar to figure 5-10 should be obtained. If this pattern appears, it is an indication of satisfactory operation. If no such pattern appears, corrective action is required.

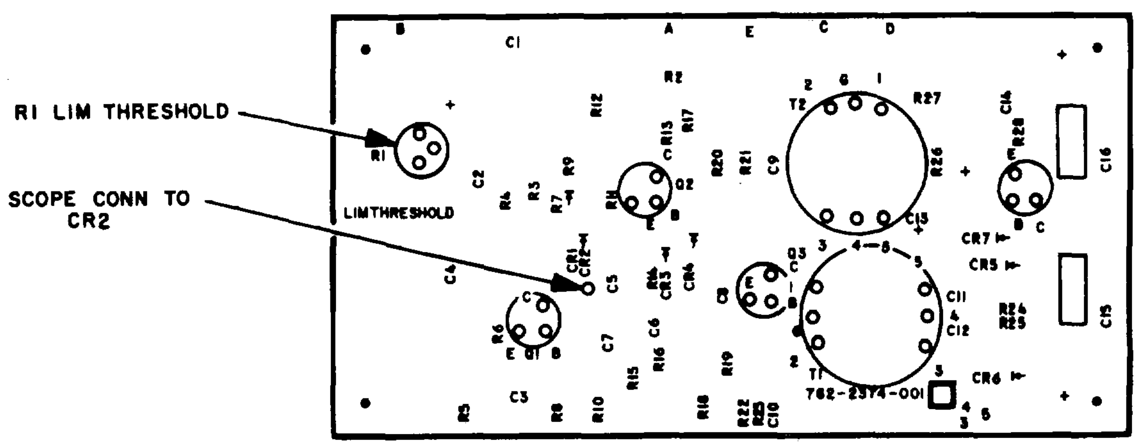


*Figure 5-6. Limited Discriminator Board*

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maintenance

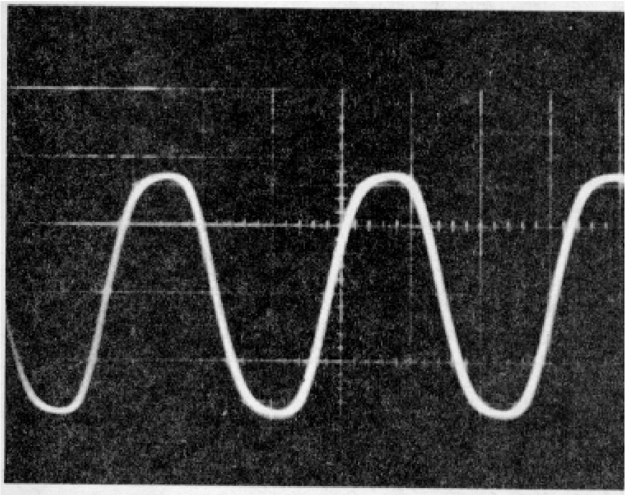

*Figure 5-7. Oscilloscope Display Showing Limiting Threshold*

5.4.6 CALIBRATION AMPLIFIER ALIGNMENT AND OPERATIONAL TEST.

The following procedures are used to align the calibration amplifier and to check the units for proper operation.

5.4.6.1 CONTROL SETTINGS. The equipment should be connected as shown in figure 5-7A and the I controls set as follows:

a. 70E1-MW

1. Power switch ON.

2. MEASURING SIGNAL LEVEL half scale.

3. MEASURING SIGNAL switch ON.

4. SWEEP SIGNAL LEVEL full clockwise.

5. SWEEP SIGNAL switch ON.

b. 70E2-MW

1. Power switch ON.

2. INPUT ATTENUATOR set to 0 DB.

3. MODE selector set to LINEARITY 10%.

4. HORIZONTAL PHASE to be set later.

c. Calibration Unit (figure 5-11) set LINEARITY 10%.

d. Oscilloscope

1. Vertical gain set to 0.1 volt/cm.

2. Horizontal gain set to give display covering approximately three-fourths the width of the screen.

5.4.6.2 PROCEDURE.

a. Adjust the 70E2-MW HORIZONTAL PHASE control to obtain the display in figure 5-12A.

b. Adjust resistor R8 (figure 13) on the 70E2-MW calibrator amplifier to obtain the display in figure 5-14.

Note

Readjust the 70E2-MW HORIZONTAL PHASE control to stabilize the oscilloscope display when performing steps b. and c.

c. Set the 70E2-MW MODE switch to LINEARITY 3% and set the calibration unit switch to LINEARITY 3%.

d. Adjust resistor R7 (figure 13) on the 70E2-MW calibrator amplifier to obtain the display in figure 5-15.

e. Repeat steps a. through d.

f. Set the 70E2-MW MODE switch to DELAY 10 NANOSECONDS and set the dalibration unit switch to DELAY 10 NS.

g. Adjust resistor R41 (figure 5-5) on the 70E2-MW agc amplifier to obtain the display in figure 5-16.

h. Set the 70E2-MW MODE switch to DELAY 3 NANOSECONDS and set the calibration unit switch to DELAY 3 NS.

i. Adjust resistor R40 (figure 5-5) on the 70E2-MW agc amplifier to obtain the display in figure 5-17.

j. Repeat steps f. through i.

k. Set the 70E2-MW INPUT ATTENUATION switch to 20 DB and observe a slight change in the waviness of the oscilloscope display.

l. Set the 70E2-MW INPUT ATTENUATION switch to 0 DB and rotate the 70E1-MW SWEEP SIGNAL LEVEL and MEASURING SIGNAL LEVEL controls fully counterclockwise.

m. Observe that the waviness of the oscilloscope display increases but does not become similiar to the display in figure 5-18.

maintenance

5.5 TROUBLESHOOTING PROCEDURE.

The following troubleshooting procedure is recommended for isolating faulty circuit components:

a. Visually inspect the units for loose connections and signs of component damage.

b. Attempt to align the unit in accordance with paragraph 5.3 or 5. 4. Since the alignment procedure is sequential, failure to obtain a specified output within +25% usually indicates component failure in the step immediately preceding.

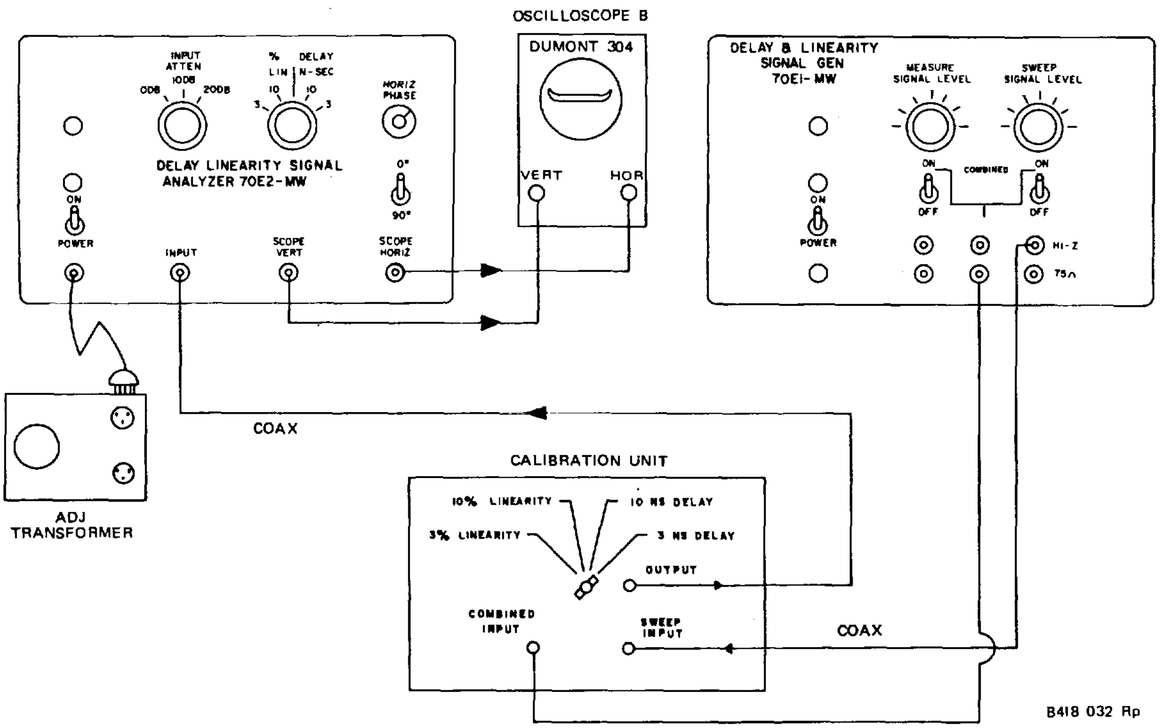


*Figure 5-7A. 70OE1-MW and 70E2-MW Operation] Test Setup*

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maintenance

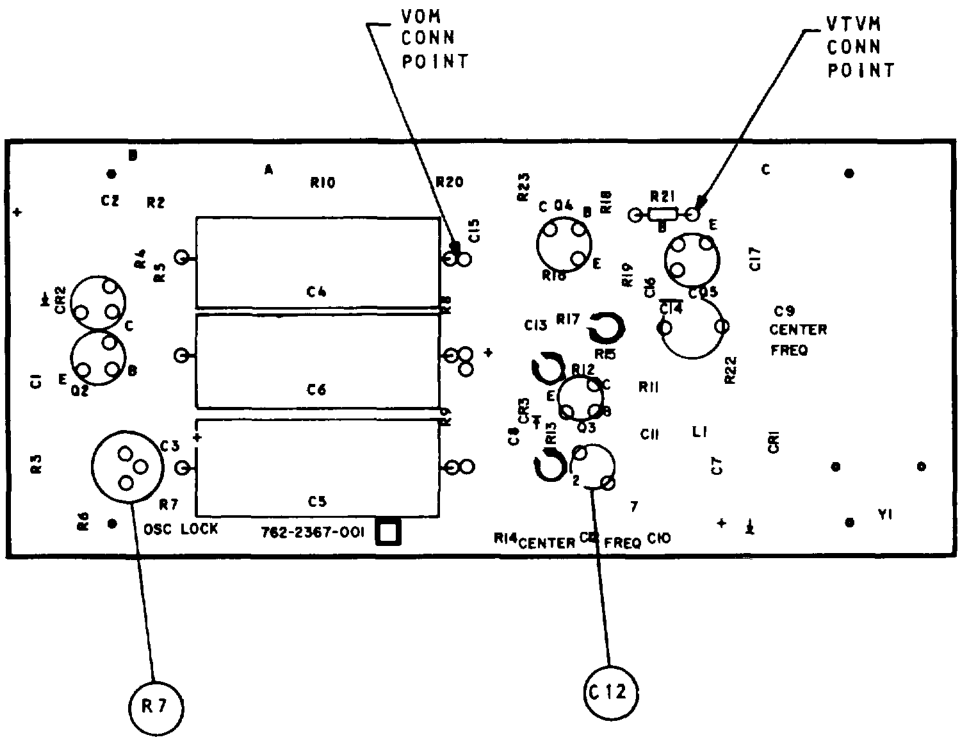



*Figure 5-8. Reference Oscillator Board*

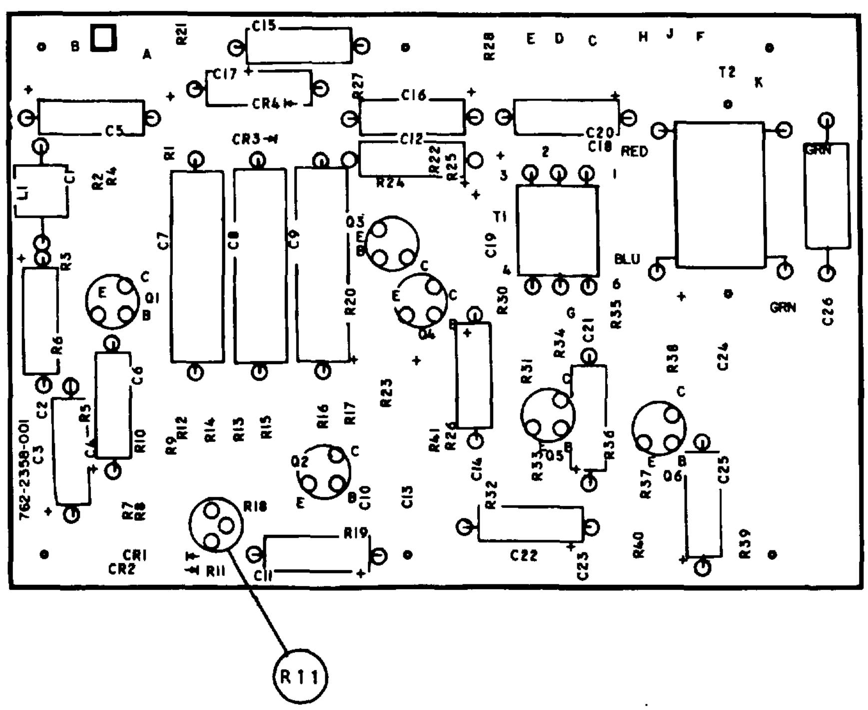



*Figure 5-9. Sweep Synchronizer Board*

maintenance

c. Check the circuit boards for the voltages shown on the schematic diagrams. Perform resistance and continuity checks on the boards.

d. Replace, rather than attempt to repair, a defective relay.

5.6 REPLACEMENTS AND SPARE PARTS.

Replacements and spare parts can be ordered from the following address:

Collins Radio Company
Service Parts
Dallas Division
Dallas, Texas

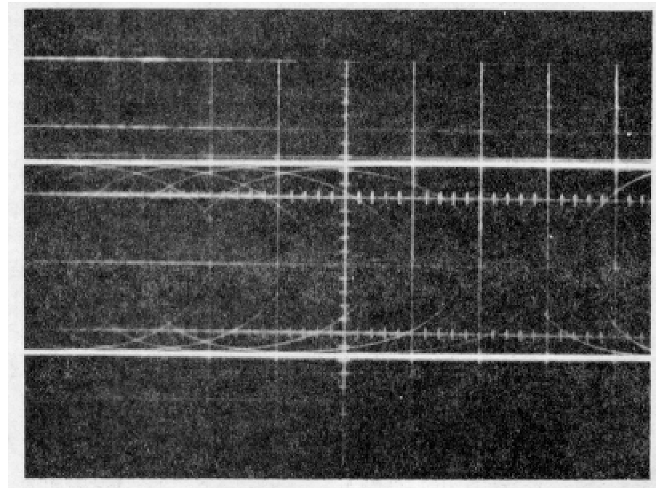
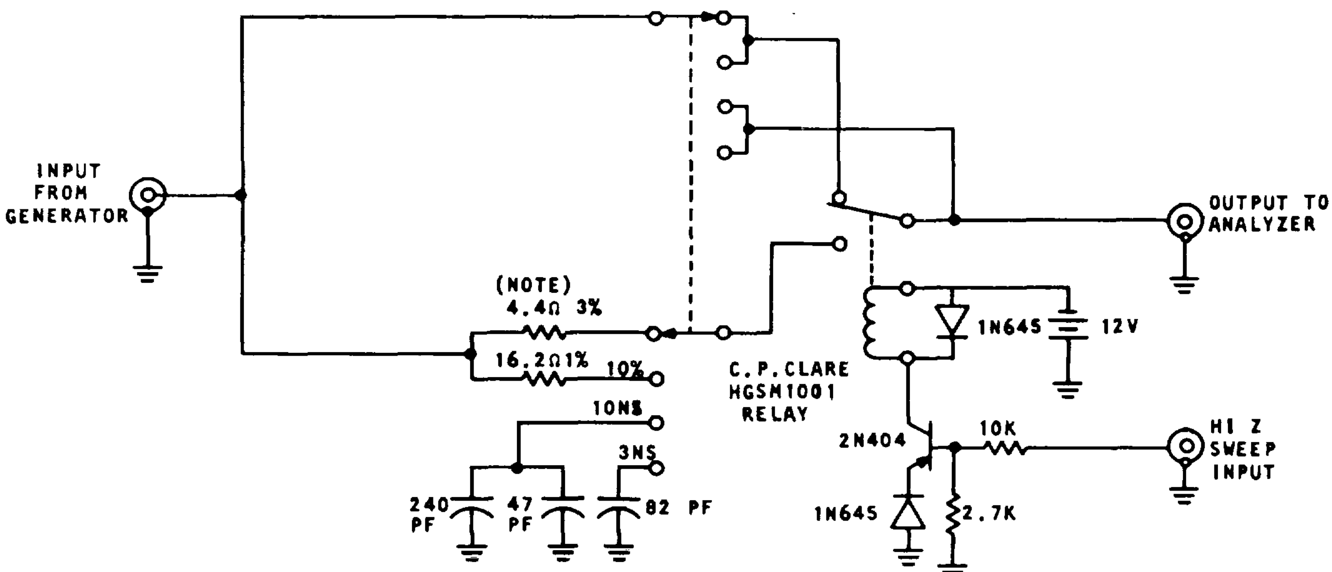


*Figure 5-10. Oscilloscope Display Showing Calibration Lines*




**NOTE: 4.40 RESISTOR MADE UP OF 4, 17.8n 1% RESISTORS IN PARALLEL**

*Figure 5-11. Calibration Unit Schematic Diagram*

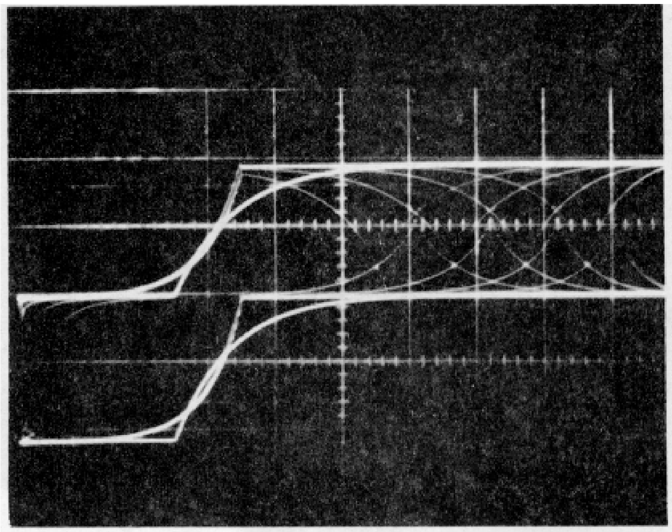


Figure 5-12A. Display Showing Correct Use of HORIZ PHASE Control

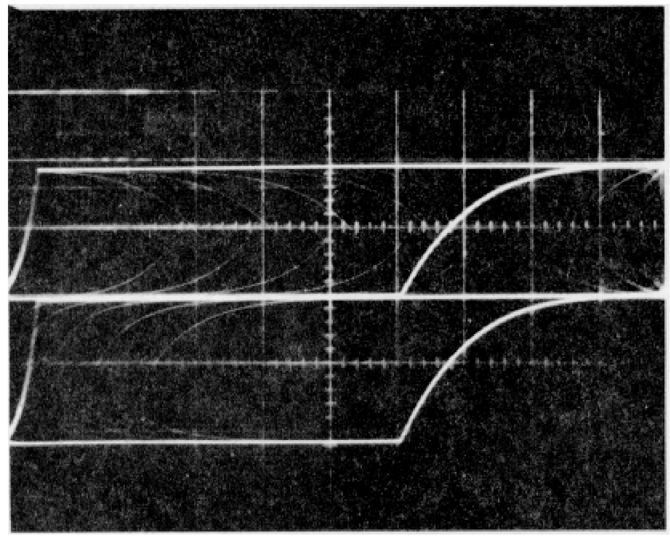


Figure 5-12B. Display Showing Incorrect Use of HORIZ PHASE Control

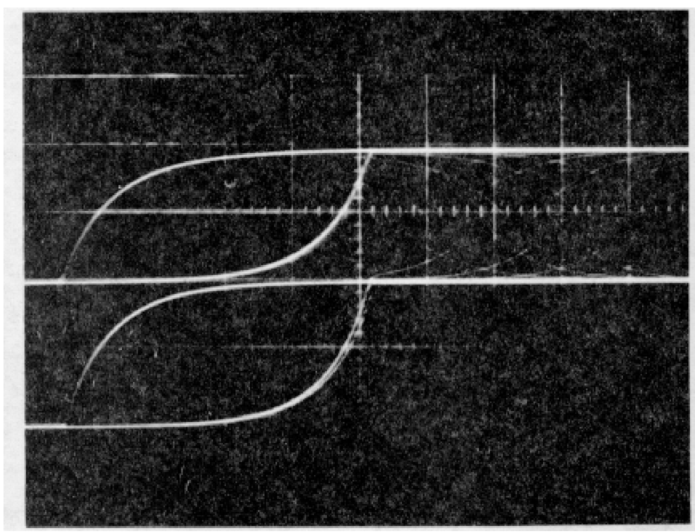


Figure 5-12C. Display Showing Incorrect Use of HORIZ PHASE Control

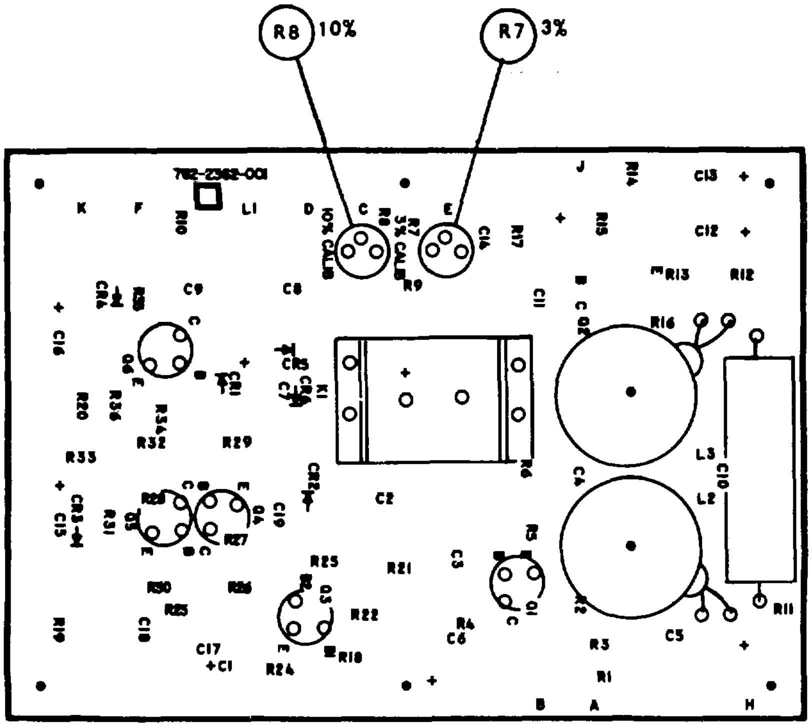



Figure 5-13. Calibration Amplifier Board

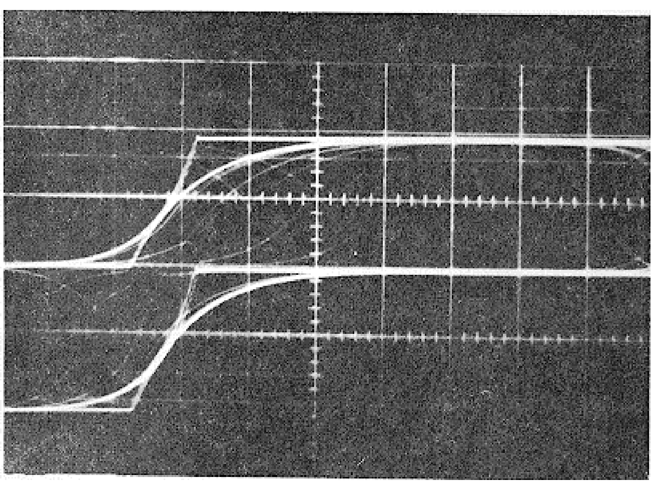


*Figure 5-14. Oscilloscope Display of 10% Linearity Calibration*

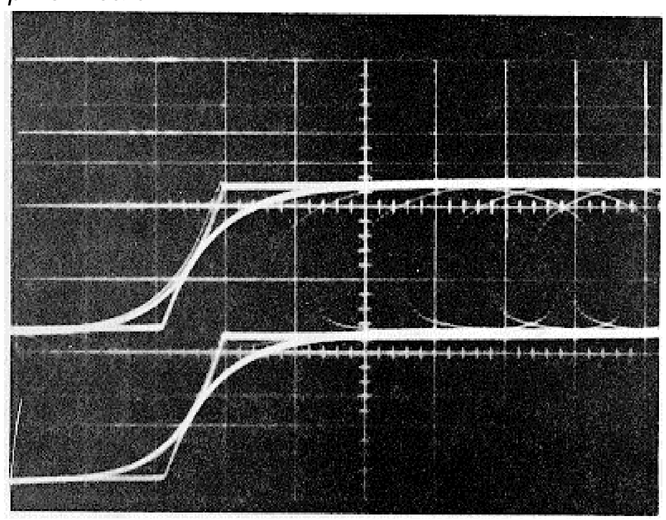


*Figure 5-15. Oscilloscope Display of 3 % Linearity Calibration*

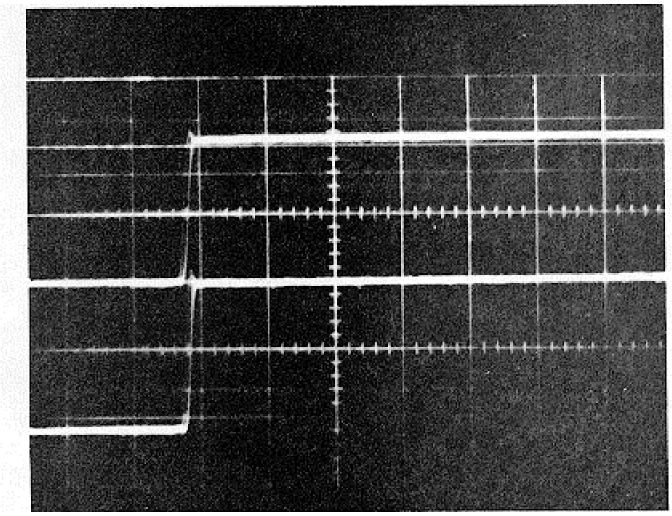


*Figure 5-16. Oscilloscope Display of 10-Nsec Delay Calibration*

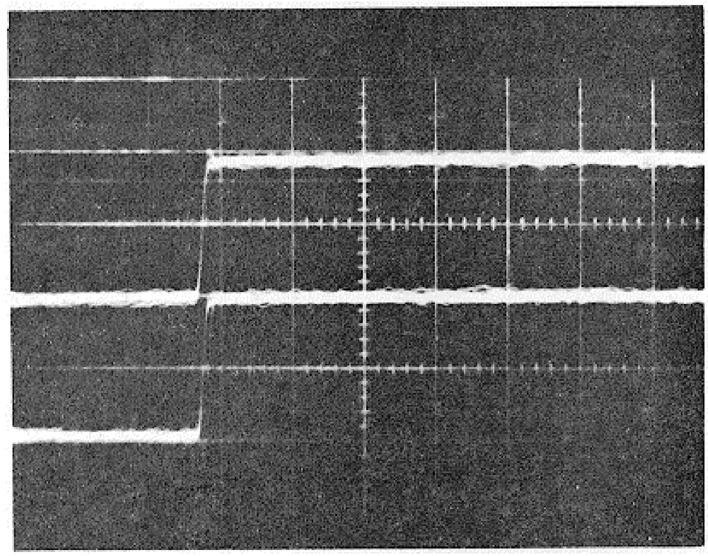


*Figure 5-17. Oscilloscope Display of 3-Nsec Delay Calibration*

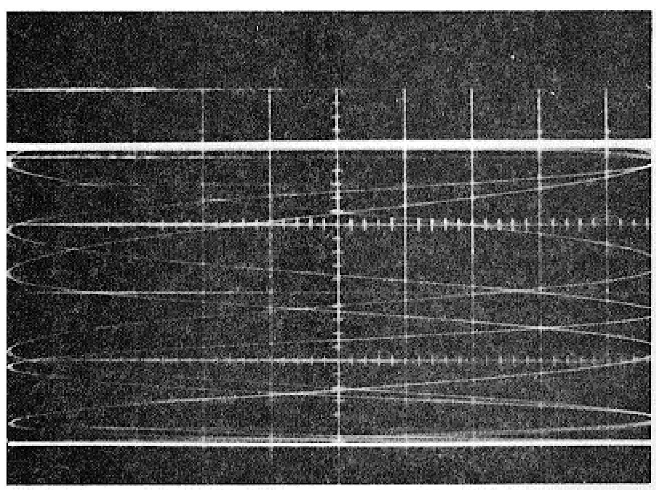


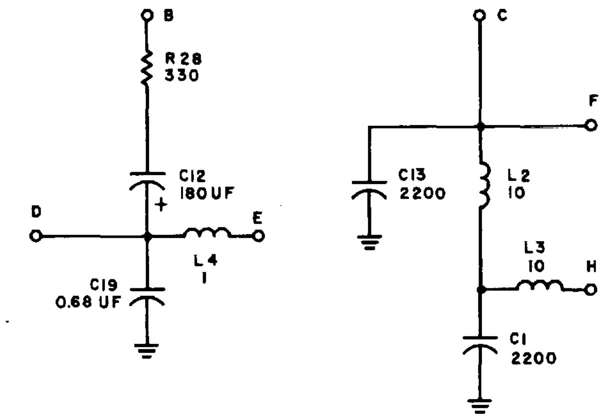
*Figure 5-18. Oscilloscope Display of Out-of-Phase-Lock Condition*

# section 6
## drawings

6.1 GENERAL.

This section of the manual contains signal flow block diagrams and circuit board diagrams for the 70E1-MW and 70E2-MW. The following is a list of the drawings contained in this section:

TABLE 6-1. DRAWING INDEX

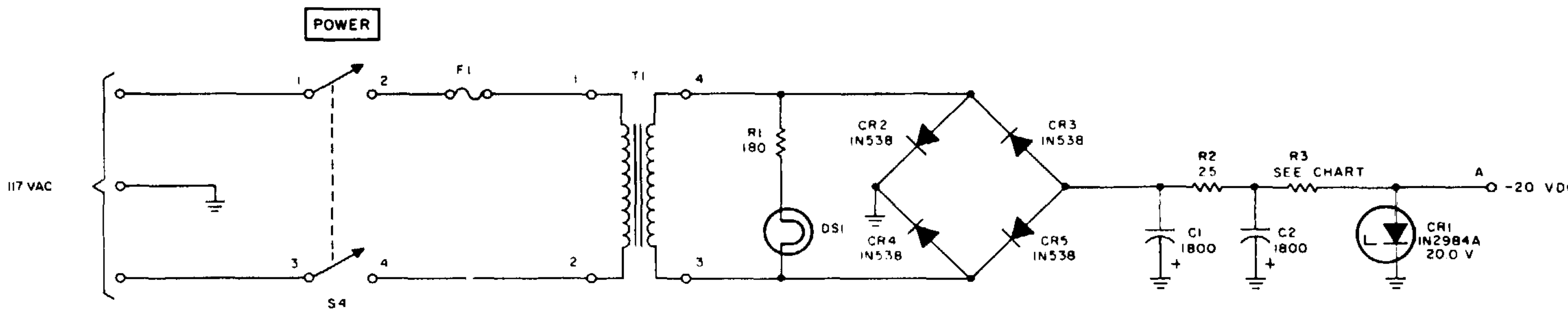



NOTES.

I. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN PICOFARADS,ALL INDUCTANCE VALUES ARE IN MILLIHENRIES.

-001

*Figure 6-4 . 70OE1-MW Coupler, Schematic Diagram*




| R3 | UNIT TYPE |
|---|---|
| 25 OHM | 70E2-MW |
| 6.3 OHM | 70F1-MW |

NOTES

1 UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS
ALL CAPACITANCE VALUES   E IN MICROFARADS

2 SOLID BOXES INDICATE LOCATIONS ON FRONT PANEL

*Figure 6-11 .    70E1-MW and 70E2-MW Power Supply, Schematic Diagram*

# SECTION 7

# PARTS LIST

## 7.1 GENERAL

This section contains the parts list for the delay and linearity test instruments. The lists are broken down for the individual units, and further divided for each printed circuit board in the units.

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| | DELAY AND LINEARITY TEST SIGNAL GENERATOR 70E1-MW | 758-5068-001 |
| | CHASSIS ASSEMBLY | 762-2494-00U |
| | INCLUDES | |
| | SWEEP GENERATOR BOARD | 762-2420-001 |
| | SEE BREAKDOWN ON PAGE 7-2 | |
| | COUPLING BOARD | 762-2424-001 |
| | SEE BREAKDOWN ON PAGE 7-4 | |
| | MEASURING SIGNAL GENERATOR BOARD | 762-2417-001 |
| | SEE BREAKDOWN ON PAGE 7-4 POWER SUPPLY | 762-2455-001 |
| | SEE BREAKDOWN ON PAGE 7-6 | |
| DS51 | LAMP, INCANDESCENT<br>0.04-AMP CURRENT RATING9 28 VAC. MS25237-327 | 262-0179-000 |
| F1 | FUSE<br>1/4-AMP CURRENT RATING. BUSSMANN PART NO. MDL1-4 | 264-0291-000 |
| J1 | CONNECTOR, ELECTRICAL<br>TYPE NO. UG1094AU | 357-9804-000 |
| J2 THROUGH J6 | SAME AS J1 | |
| MP1 | KNOB. SKIRTED | 757-0233-003 |
| R1 THROUGH R12 | NOT USED | |
| R13 | RESISTOR. VARIABLE, COMPOSITION<br>1000 OHMS, 20% TOL. 1 WATT, RV2NAXSDIO2B | 380-1338-000 |
| R14 THROUGH R17 | NOT USED | |
| R18 | RESISTOR, VARIABLE, COMPOSITION<br>50.000 OHMS. 20% TOL, 1 WATT. CTS PART NO. K022700 | 380-1308-000 |
| S1 | SWITCH. TOGGLE<br>DPST CONTACT ARRANGEMENT, ARROW-HART AND HEGEMAN ELECTRIC PART NO. B1024GB | 260-2344-000 |
| S2 | SAME AS 51 | |
| 53 | SAME AS 51 | |
| WI | CABLE ASSEMBLY | 762-2506-001 |
| W2 | CABLE ASSEMBLY | 762-2506-002 |
| XDS1 | LAMPHOLDER<br>DIALIGHT PART NO. 183-9730-1472 | 262-2558-000 |
| XF1 | FUSEHOLDER<br>15-AMP CURRENT RATING* BUSSMANN PART NO. HCMHBBZZ | 265-1138-000 |
| | SWEEP GENERATOR BOARD | 762-2420-001 |
| C1 | CAPACITOR. FIXED. FILM<br>1 UF,10% TOL9 100 VDCW. GECO PART NO* 61F51AA105 | 933-0594-000 |
| C2 | CAPACITORS FIXED# MICA<br>2700 UUF, 5% TOL, 500 VDCW. CM06F272J03 | 912-3034-000 |
| C3 | SAME AS C2 | |
| C4 | CAPACITOR, FIXED, CERAMIC<br>0.1 UF. PLUS 80% MINUS 20%. 25 VDCW, SPRAGUE ELECTRIC PART NO. 5C7A | 913-3806-000 |
| C5 | CAPACITOR, FIXED. ELECTROLYTIC<br>68 UF. 20% TOL, 30 VDCWT SPRAGUE ELECTRIC PART NO. 109D686X0030F2 | 184-7782-000 |
| C6 | SAME AS C5 | |
| C7 | SAME AS C5 | |
| CB | CAPACITOR. FIXED. FILM<br>1.8 UF. 10% TOLD 100 VDCWG GECO PART NO. 61F67AA185 | 933-0597-000 |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| C9 | CAPACITOR, FIXED, FILM<br>0.68 UF, 10% TOL. 100 VDCW, GECO PART NO.<br>61F49AA684 | 933-0593-000 |
| C10 | CAPACITOR, FIXED. ELECTROLYTIC<br>8 UF, PLUS 20% MINUS 15%, 30 VDCW. SPRAGUE<br>ELECTRIC PART NO. 109D805C2030CL | 184-7780-000 |
| C11 | SAME AS C10 | |
| C12 | NOT USED | |
| C13 | NOT USED | |
| C14 | NOT USED | |
| C15<br>THROUGH<br>C18 | SAME AS C5 | |
| CR1 | SEMICONDUCTOR DEVICE, DIODE<br>HUGHES PRODUCTS PART NO. HD2658 | 353-0166-000 |
| CR2 | SAME AS CR1 | |
| E1 | INSULATOR. DISK<br>ROSS MILTON PART NO. A10044DAP | 352-9889-000 |
| E2<br>THROUGH<br>E7 | SAME AS E1 | |
| E8 | HEAT SINK. SEMICONDUCTOR DEVICE<br>INLAND ELECTRONICS PRODUCTS PART NO.<br>TR1O1E1 | 352-9977-000 |
| E9 | SAME AS E8 | |
| L1 | CHOKET RF<br>7200 UH INDUCTANCE, 1% TOLT COLLINS RADIO<br>PART NO. MP930-42B | 240-0406-000 |
| Q1 | SEMICONDUCTOR DEVICE. TRANSISTOR<br>GECO PART NO. 2N1671A | 352-0361-000 |
| Q2 | SEMICONDUCTOR DEVICE. TRANSISTOR<br>TEXAS INSTRUMENTS PART NO* N1OOOA | 352-0336-000 |
| 03 | SAME AS 02 | |
| 04 | SEMICONDUCTOR DEVICE, TRANSISTOR<br>TEXAS INSTRUMENTS PART NO. 2N1307 | 352-0396-000 |
| 05 | SEMICONDUCTOR DEVICE* TRANSISTOR<br>TEXAS INSTRUMENTS PART NO. 2N1306 | 352-0346-000 |
| 06 | SEMICONDUCTOR DEVICE. TRANSISTOR<br>FAIRCHILD CAMERA AND INSTRUMENT<br>PART NO. 2N1131 | 352-0219-000 |
| Q7 | SEMICONDUCTOR DEVICE* TRANSISTOR<br>FAIRCHILD CAMERA AND INSTRUMENT<br>PART NO. 2N696 | 352-0206-000 |
| R1 | RESISTOR. FIXED* FILM<br>6810 OHMS, 1% TOL. 1/2 WATT. | 705-7136-000<br>RN65D6811F |
| R2 | RESISTOR. VARIABLE. WIRE WOUND<br>5000 OHMS, 5% TOL. 1 WATT. INTERNATIONAL<br>RESISTANCE PART NO. CT1OO-5K | 381-1470-000 |
| R3 | RESISTOR. THERMAL<br>100 OHMS, 10% TOL, 1/4 WATT. TEXAS<br>INSTRUMENTS PART NO. TITM1-4 100-1OPCT | 714-2347-000 |
| R4 | RESISTOR. FIXED, FILM<br>562 OH1MS. 1% TOL. 1/2 WATT. | 705-7084-000<br>RN65D5620F |
| R5 | RESISTOR, FIXED. COMPOSITION<br>2700 OHMS, 10% TOL. 1/2 WATT. | 745-1370-000<br>RC20GF272K |
| R6 | RESISTOR, FIXED. COMPOSITION<br>56,000 OHMS. 10% TOL, 1/2 WATT* RC20GF563K | 745-1426-000 |
| R7 | RESISTOR. FIXED. COMPOSITION<br>560 OHMS. 10% TOL. 1/2 WATT. RC2OGF561K | 745-1342-000 |
| R8 | RESISTOR. FIXED. COMPOSITION<br>1800 OHMS. 10% TOL. 1/2 WATT. | 745-1363-000<br>RC20GF182K |
| R9 | RESISTOR, FIXED, COMPOSITION<br>15.000 OHMS. 10% TOL, 1/2 WATT* RC20GF153K | 745-1401-000 |
| R10 | SAME AS R9 | |
| R11 | SAME AS R9 | |
| R12 | SAME AS R9 | |
| R13 | RESISTOR. FIXED. COMPOSITION<br>470 OHMS. 10% TOL. 1/2 WATT. RC20GF471K | 745-1338-000 |
| R14 | SAME AS R6 | |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| R15 | SAME AS R8 | |
| R16 | RESISTOR, FIXED, COMPOSITION<br>270 OHMS, 10% TOL. 1/2 WATT. RC20GF271K | 745-1328-000 |
| R17 | RESISTOR. FIXED. COMPOSITION<br>1 KILOHM TOL, 1/2 WATT, RC20GF102K | 745-1352-000 |
| R18 | NOT USED | |
| R19 | RESISTOR. FIXED, FILM<br>1009000 OHMS, 1% TOL, 1/2 WATT, RN65D1003F | 705-7192-000 |
| R20 | RESISTOR, VARIABLE, WIRE WOUND<br>50,000 OHMS, 5% TOL. 1 WATT, INTERNATIONAL<br>RESISTANCE PART NO. CT100-50K | 381-1473-000 |
| R21 | RESISTOR. FIXED. FILM<br>46,400 OHMS. 1% TOL, 1/2 WATT, RN65D4642F | 705-7176-000 |
| R22 | RESISTOR, FIXED, FILM<br>82,500 OHMS, 1% TOL, 1/2 WATT, RN65D8252F | 705-7188-000 |
| R23 | SAME AS R19 | |
| R24 | RESISTOR, FIXED, COMPOSITION<br>1000 OHMS, 10% TOL 1/2 WATT. RC20GF1O2K | 745-1352-000 |
| R25 | SAME AS R24 | |
| R26 | RESISTOR, FIXED, FILM<br>26.1 OHMS, 1% TOL, 1/2 WATT, RN65D26R1F | 705-7020-000 |
| R27 | RESISTOR, FIXED, FILM<br>21.5 OHMS, 1% TOL, 1/2 WATT, RN65D21R5F | 705-7016-000 |
| R28 | NOT USED | |
| R29 | RESISTOR. FIXED, COMPOSITION<br>22,000 OHMS, 10% TOL, 1/2 WATT, RC20GF333K | 745-1415-000 |
| R30 | RESISTOR, FIXED. COMPOSITION<br>2200 OHMS, 10% TOLD 1/2 WATT. RC20GF222K | 745-1366-000 |
| R31 | SAME AS R30 | |
| TB1 | BOARD# FABRICATED | 762-2419-001 |
| | COUPLING BOARD | 762-2424-001 |
| C1<br>THROUGH<br>C11 | NOT USED | |
| C12 | CAPACITOR, FIXED. ELECTROLYTIC<br>180 UF, 20% TOL. 10 VDCW, SPRAGUE ELECTRIC<br>PART NO. 109D187XO01OF2 | 184-7704-000 |
| C13 | CAPACITOR, FIXED, MICA<br>2200 UUF, 1% TOL, 500 VDCW. CM06F222J03 | 912-3025-000 |
| C14 | SAME AS C13 | |
| C15<br>THROUGH<br>C18 | NOT USED | |
| C19 | CAPACITOR. FIXED. FILM<br>0.68 UF, 10% TOL, 100 VDCW, GECO PART<br>NO, 61F49AA684 | 933-0593-000 |
| L1 | NOT USED | |
| L2 | CHOKE, RF<br>10,000 UH INDUCTANCE, 10% TOL. DELAVAN<br>PART NO. 3500-42 | 240-0844-000 |
| L3 | NOT USED | |
| L4 | COIL. RF 240-0839-000<br>1000 UH INDUCTANCE, 10% TOL, DELAVAN<br>PART NO. 3500-32 | |
| TB1 | BOARD, FABRICATED | 762-2423-001 |
| | MEASURING SIGNAL GENERATOR BOARD | 762-2417-001 |
| C1 | CAPACITOR. FIXED. ELECTROLYTIC<br>2.2 UF. 20% TOL. 20% TOL. 20 VDCW, SPRAGUE<br>ELECTRIC PART NO. 150D225X0020A2 | 184-7377-000 |
| C2 | CAPACITOR* VARIABLE. CERAMIC<br>8 UUF MAX MIN, 50 UUF MIN MAX. 350 VDCW,<br>ERIE TECHNOLOGICAL PRODUCTS PART<br>NO. 557-099U2PO-34R | 917-1186-000 |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| C3 | CAPACITOR, FIXED. MICA<br>1000 UUF. 5% TOL, 500 VDCW. CMO6F10O2J03 | 912-3001-000 |
| C4 | NOT USED | |
| C5 | CAPACITOR, FIXED, MICA<br>330 UUF, 5% TOL, 500 VDCW. CM05F331J03 | 912-2852-000 |
| C6 | CAPACITOR, VARIABLE, CERAMIC<br>5.5-18 UUF, 350 VDCW, ERIE TECHNOLOGICAL<br>PRODUCTS PART NO. 538011COPOR2R | 917-1222-000 |
| C7 | CAPACITOR, FIXED, MICA<br>27 UUF1 5% TOL, 500 VDCW1 CM05E270J03 | 912-2774-000 |
| C8 | CAPACITOR, FIXED, MICA<br>4700 UUF, 5% TOL, 500 VDCW, CM06F472J03 | 912-3052-000 |
| C9 | CAPACITOR, FIXED, MICA<br>120 UUF, 5% TOL, 500 VDCW, CM05F121J03 | 912-2822-000 |
| C10 | CAPACITOR, FIXED, ELECTROLYTIC<br>68 UF, 20% TOL, 30 VDCW. SPRAGUE ELECTRIC<br>PART NO. 109D686X0030F2 | 184-7782-000 |
| C11 | CAPACITOR, FIXED, MICA<br>47 UUF. 5% TOL. 500 VDCW. CM05E470J03 | 912-2792-000 |
| C12 | CAPACITOR, FIXED, CERAMIC<br>0.1 UF. PLUS 80% MINUS 20%, 25 VDCW,<br>SPRAGUE ELECTRIC PART NO. 5C7A | 913-3806-000 |
| C13 | SAME AS C12 | |
| C14 | SAME AS C12 | |
| C15 | CAPACITOR, FIXED, MICA<br>2200 UF, 5% TOL. 500 VDCW. CM06F222J03 | 912-3025-OU0 |
| C16 | SAME AS C15 | |
| C17 | SAME AS C12 | |
| C18 | SAME AS C12 | |
| CR1 | SEMICONDUCTOR DEVICE. DIODE<br>TYPE NO. 1N758 | 353-2723-000 |
| E1 | INSULATOR. DISK<br>ROSS MILTON PART NO. A10044DAP | 352-9889-000 |
| E2 | SAME AS E1 | |
| E3 | SAME AS E1 | |
| E4 | SHIELD | 541-6554-003 |
| L1 | COIL. RF<br>1000 UH INDUCTANCE. 10% TOL, DELAVAN<br>PART NO. 3500-32 | 240-0839-000 |
| Q1 | SEMICONDUCTOR DEVICE, TRANSISTOR<br>TEXAS INSTRUMENTS PART NO. 2N1142 | 352-0162-000 |
| Q2 | SEMICONDUCTOR DEVICE, TRANSISTOR<br>TEXAS INSTRUMENTS PART NO. 2N2189 | 352-0412-000 |
| Q3 | SAME AS 02 | |
| R1 | RESISTOR, FIXED, COMPOSITION<br>1000 OHMS, 10% TOL, 1/2 WATT, RC20GF102K | 745-1352-000 |
| R2 | RESISTOR, FIXED, COMPOSITION<br>33,000 OHMS, 10% TOL, 1/2 WATT, RC20GF333K | 745-1415-000 |
| R3 | RESISTOR, FIXED, COMPOSITION<br>10,000 OHMS, 10% TOL, 1/2 WATT, RC2OGF103K | 745-1394-000 |
| R4 | RESISTOR, FIXED, COMPOSITION<br>4700 OHMS, 10% TOL, 1/2 WATT, RC20GF472K | 745-1380-000 |
| R5 | SAME AS R3 | |
| R6 | SAME AS R3 | |
| R7 | RESISTOR, FIXED, COMPOSITION<br>15,000 OHMS, 10% TOL, 1/2 WATT, RC20GF153K | 745-1401-000 |
| R8 | RESISTOR, FIXED, COMPOSITION<br>2200 OHMS, 10% TOL, 1/2 WATT, RCZOGF222K | 745-1366-000 |
| R9 | RESISTOR, FIXED, COMPOSITION<br>470 OHMS, 10% TOL, 1/2 WATT, RC20GF471K | 745-1338-000 |
| R10 | RESISTOR, FIXED, COMPOSITION<br>3900 OHMS, 10% TOL, 1/2 WATT. RC20GF392K | 745-1377-000 |
| R11 | SAME AS R1 | |
| R12 | RESISTOR, FIXED, FILM<br>51,100 OHMS. 1% TOL. 1/2 WATT. RN65D5112F | 705-7178-000 |
| R13 | NOT USED | |
| R14 | RESISTOR, FIXED, COMPOSITION<br>68 OHMS, 10% TOL, 1/2 WATT* RC20GF680K | 745-1303-000 |
| R15 | SAME AS R9 | |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| R16 | SAME AS R9 | |
| R17 | SAME AS R4 | |
| R18 | RESISTOR, FIXED, COMPOSITION<br>330 OHMS. 10% TOL. 1/2 WATT. RC20GF331K | 745-1331-000 |
| T1 | TRANSFORMER. IF<br>ALADDIN ELECTRONICS PART NO* 71-1767 | 278-1954-000 |
| TB1 | BOARD. FABRICATED | 762-2416-001 |
| XY1 | SOCKET, ELECTRON TUBE<br>9 CONTACTS* T51O3POl | 220-1103-000 |
| Y1 | CRYSTAL. QUARTZ<br>304 KC FREQUENCY. BLILEY ELECTRIC PART<br>NO. 289-4865-000 | 289-4865-000 |
| | POWER SUPPLY | 762-2455-001 |
| C1 | CAPACITOR* FIXED* ELECTROLYTIC<br>1800 UF, PLUS 100% MINUS 10%, 60 VDCW | 183-0924-000 |
| C2 | SAME AS C1 | |
| CR1 | SEMICONDUCTOR DEVICE. DIODE<br>AUTOCALL PART NO. 1N2984A | 353-1364-000 |
| CR2 | SEMICONDUCTOR DEVICE. DIODE<br>SEMI-CONDUCTOR PRODUCTS PART NO. 1N538 | 353-1526-000 |
| CR3 | SAME AS CR2 | |
| CR4 | SAME AS CR2 | |
| CR5 | SAME AS CR2 | |
| E1 | TERMINAL POST<br>ARMEL ELECTRONICS PART NO. RTMTi2M | 306-0976-00o |
| E2<br>THROUGH<br>E9 | SAME AS El | |
| E1O | HEATSINK | 762-9404-001 |
| R1 | NOT USED | |
| R2 | RESISTOR. FIXED. WIRE WOUND<br>25 OHMS. 5% TOL. 10 WATTS. OHMITE PART<br>NO. 1 3-4D57F25PORM5PCT | 710-2894-000 |
| R3 | SAME AS R2 | |
| R4 | RESISTOR. FIXED. COMPOSITION<br>180 OHMS* 10% TOL. 2 WATTS* RC42GF181K | 745-5621-000 |
| T1 | TRANSFORMER, FILAMENT<br>CHANNEL FRAME. LEADS 1 TO 2 115 OHMS<br>IMPEDANCE* LEADS 3 TO 4 26 OHMS IMPEDANCE,<br>DRESSER ELECTRONICS PART NO. 950-0646-400 | |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| | DELAY AND LINEARITY TEST SIGNAL ANALYZER 70E2-MW | 758-5069-001 |
| | CHASSIS ASSEMBLY | 762-2446-001 |
| | INCLUDES | |
| | AGC AMPLIFIER RECEIVER BOARD SEE BREAKDOWN ON PAGE 7-7 | 762-2459-001 |
| | RECEIVER CALIBRATOR AMPLIFIER BOARD SEE BREAKDOWN ON PAGF 7-9 | 762-2363-001 |
| | REFERENCE OSCILLATOR RECEIVER BOARD SEE BREAKDOWN ON PAGE 7-11 | 762-2368-001 |
| | LIMITER DISCRIF,INATOR RECEIVER BOARD SEE BREAKDOWN ON PAGE7-13 | 762-2375-001 |
| | SWEEP SYNCcRONI7FR BOARD SEE BREAKDOWN ON PAGE 7-14 | 762-2359-001 |
| | POWER SUPPLY CHASSIS ASSEMBLY SEE BREAKDOWN ON PAGE 7-16 | 762-2455-001 |
| C1 THROUGH C25 | NOT USED | 264-0291-000 |
| C26 | CAPACITOR, FIXED, PAPER 0.22 UF, 20% TOL9 100 VDCW. SANGAMO ELECTRIC PART NO. SDB1K01224M | 931-4492-000 |
| C27 | SAME AS C26 | |
| DS1 | LAMP, INCANDESCENT 28 VOLTS, 0.04 AMP. M525237-327 | 262-0179-000 |
| F1 | FUSE, CARTRIDGE 1/4 AMP, 250 VOLTS, BUSSMANN DIVISION OF MCGRAW EDISON PART NO. MDL1-4 | 264-0291-000 |
| R1 | RESISTOR, FIXED, COMPOSITION 100 OHMS, 10% TOL, 1/2 WATT. RC20GF1O1K | 745-1310-000 |
| R2 | RESISTOR. FIXED. COMPOSITION 180 OHMS. 10% TOL. 1/2 WATT. RC20GF181K | 745-1321-000 |
| R3 | RESISTOR. FIXED. COMPOSITION 150 OHMS, 10% TOL. 1/2 WATT. RC20GF151K | 745-1317-000 |
| R4 THROUGH R41 | NOT USED | |
| R52 | RESISTOR. FIXED. COMPOSITION 220 OHMS, 10% TOL. 1/2 WATT. RC20OGF221K | 745-1324-000 |
| S1 | SWITCH. TOGGLE DPST CONTACT ARRANGEMENT, ARROW HART AND HEGEMAN ELECTRIC PART NO. 81024GB | 260-2355-000 |
| S2 | SWITCH, ROTARY, MINATURE 3 POSITIONS. 1 DECKS GRAYHILL PART NO. 24001-3 | 59-9030-000 |
| S3 | SWITCH. ROTARY, MINATURE 4 POSITIONS, 3 DECKS, GRAYHILL PART NO. 24003-4 | 259-9068-000 |
| S4 | SWITCH. TOGGLE DPDT CONTACT ARRANGEMENT* ARROW HART AND HEGEMAN ELECTRIC PART NO* 81027CE | 240-2345-000 |
| XDS1 | LAMPHOLDER 28 VOLTS. DIALIGHT PART NO* 183-9730-000 | 262-2558-000 |
| XF1 | FUSEHOLDER BUSSMANN MFG DIVISION OF MCGRAW EDISON PART NO. HKPEHLORWZ | 265-1086-000 |
| R53 | RESISTOR, FIXED FILM 75 OHMS, 1% TOL, 1/2 WATT, RH65D75ROF | |
| | AGC A4MLIFIER DECEIVER BOARD | 762-2459-00t |
| C1 | CAPACITOR. VARIABLE. CERAMIC 8-50 UUF. 350 VDCW, ERIE TECHNOLOGICAL PRODUCTS PART NO. 557-099U2PO-34R | 917-1186-000 |
| C2 | CAPACITOR. FIXED, MICA 270 UUF, 5% TOL, 500 VDCW. CM05F271JO3 | 912-2846-000 |
| C3 | CAPACITOR, FIXED. MICA 120 UUF, 5% TOL. 500 VDCW. CMOSF121J03 | 912-2822-000 |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| C4 | CAPACITOR, FIXED, ELECTROLYTIC 68 UF, 20% TOL, 30 VDCWT SPRAGUE ELECTRIC PART NO. 109D686X0030F2 | 184-7782-000 |
| C5 | CAPACITOR* FIXED, MICA 4700 UUF, 5% TOL. 500 VDCWT CM06F472J03 | 912-3052-000 |
| C6 | NOT USED | |
| C7 | CAPACITOR, FIXED. CERAMIC 0.1 UF, PLUS 80% MINUS 20%. 25 VDCW, SPRAGUE ELECTRIC PART NO. 5C7A | 913-3806-000 |
| C8 | SAME AS C7 | |
| C9 | SAME AS C5 | |
| C10 | SAME AS C4 | |
| C11 | SAME AS C5 | |
| C12 | SAME AS C5 | |
| C13 | SAME AS C7 | |
| C14 | CAPACITOR* FIXED. MICA 470 UF. 5% TOL, 500 VDCW. CM06F471J03 | 912-2974-000 |
| C15 | SAME AS C5 | |
| C16 | CAPACITOR* FIXED, MICA 1000 UUFT 5% TOL. 500 VDCW. ELECTRO MOTIVE PART NO. DM2OF1O2J | 912-3315-000 |
| C17 | SAME AS C16 | |
| C18 | CAPACITOR. FIXED, ELECTROLYTIC 180 UF. 20, TOL, 10 VDCW. SPRAGUE ELECTRIC PART NO. 109D187XOO01OF2 | 184-7784-000 |
| C19 | SAME AS C4 | |
| CR1 | SEMICONDUCTOR DEVICE, DIODE HUGHES PRODUCTS PART NO. HD2658 | 353-0166-000 |
| CR2 | SAME AS CR1 | |
| CR3 | SEMICONDUCTOR DEVICE, DIODE TEXAS INSTRUMENTS PART NO. 1N645 | 353-2607-000 |
| CR4 | SAME AS CR3 | |
| E1 | INSULATOR. TRANSISTOR ROSS MILTON PART NO. A10044DAP | 352-9889-000 |
| E2 THROUGH E8 | SAME AS EI | |
| K1 | RELAY# REED 1A CONTACT ARRANGEMENT, WHEELOCK SIGNALS PART NO. 262-1A12 | 410-0426-010 |
| L1 | COIL, RF 240-1772-000 0.6 MH INDUCTANCE, 1.5% TOL. COLLINS RADIO INFORMATION SCIENCE CENTER PART NO. MPF054-15 | |
| Q1 | NOT USED | |
| Q2 | SEMICONDUCTOR DEVICE. TRANSISTOR TYPE NO. 2N3638 | 352-0636-000 |
| Q3 | SAME AS 02 | |
| Q4 | SEMICONDUCTOR DEVICE. TRANSISTOR TEXAS INSTRUMENT PART NO. 2N1307 | 352-0396-000 |
| Q5 THROUGH Q9 | SAME AS 02 | |
| R1 THROUGH R9 | NOT USED | |
| R10 | RESISTOR. FIXED. COMPOSITION 390 OHMS, 10% TOL. 1/4 WATT. RC07GF391K | 745-0734-000 |
| R11 | RESISTOR. FIXED. FILM 1000 OHMS, 10% TOL. 1/4 WATT. RC07GF102K | 745-0749-000 |
| R12 | RESISTOR. FIXED. FILM 47.000 OHMS. 10% TOL, 1/4 WATT. RC07GF473K | 745-0809-000 |
| R13 | SAME AS R12 | |
| R14 | RESISTOR. FIXED. COMPOSITION 2200 OHMS. 10% TOL. 1/4 WATT. RC07GF222K | 745-0761-000 |
| R15 | RESISTOR. FIXED. COMPOSITION 3300 OHMS, 10% TOL. 1/4 WATT. RC07GF332K | 745-0767-000 |
| R16 | RESISTOR. FIXED. COMPOSITION 109000 OHMS, 10% TOL. 1/4 WATT. RC07GF103K | 745-0785-000 |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| R17 | RESISTOR, FIXED. COMPOSITION<br>120 OHMS. 10% TOL. 1/4 WATT, RCO7GF121K | 745-0716-000 |
| R18 | RESISTOR, FIXED, COMPOSITION<br>47,000 OHMS. 10% TOL, 1/4 WATT. RC07GF473K | 745-0773-000 |
| R19 | SAME AS R16 | |
| R2C | RESISTOR, FIXED. COMPOSITION<br>10 OHMS. 10% TOL, 1/4 WATT, RC07GFIOOK | 745-0677-000 |
| R21 | NOT USE[) | |
| R22 | RESISTOR. FIXED, COMPOSITION<br>330 OHMS 10% TOL, 1/4 WATT, RC07GF331K | 745-0731-000 |
| R23 | SAME AS R12 | |
| R24 | SAME AS R12 | |
| R25 | SAME AS R14 | |
| R26 | RESISTOR, FIXED. COMPOSITION<br>15,000 OHMS. 10% TOL, 1/4 WATT, RC07GF153K | 745-0791-000 |
| R27 | SAME AS R14 | |
| R28 | RESISTOR, FIXED, COMPOSITION<br>3900 OHMS, 10% TOL. 1/4 WATT. RC07GF392K | 745-0770-000 |
| R29 | RESISTOR. FIXED. COMPOSITION<br>56 OHMS. 10% TOL. 1/4 WATT% RC07GF560K | 745-0704-000 |
| R30 | SAME AS R11 | |
| R31 | SAME AS R12 | |
| R32 | SAME AS R12 | |
| R33 | RESISTOR, FIXED. COMPOSITION<br>1500 OHMS. 10% TOL. 1/4 WATT9 RC07GF152K | 745-0755-000 |
| R34 | SAME AS R33 | |
| R35 | NOT USED | |
| R36 | RESISTOR. FIXED. COMPOSITION<br>820 OHMS, 10% TOL. 1/4 WATT. RC07GF821K | 745-0746-000 |
| R37 | RESISTOR FIXED. COMPOSITION<br>2700 OHMS, 10% TOL, 1/4 WATT, RC07GF272K | 745-0764-000 |
| R38 | NOT USED | |
| R39 | RESISTOR, VARIABLE, WIRE WOUND<br>20,000 OHMS. 5% TOL, 1 WATT, INTERNATIONAL<br>RESISTANCE PART NO. CT100-20K | 381-1472-000 |
| R40 | RESISTOR* VARIABLE. WIRE WOUND<br>1000 OHMS, 5% TOL, 1 WATT. INTERNATIONAL<br>RESISTANCE PART NO. CT1OO-1K | 381-1468-000 |
| R41 | RESISTOR* VARIABLE. WIRE WOUND<br>5000 OHMS, 5% TOL. 1 WATT. INTERNATIONAL<br>RESISTANCE PART NO. CT100-5K | 381-1470-000 |
| TB1 | BOARD ASSEMBLY, FABRICATED | 762-2347-000 |
| | RECEIVER CALIBRATOR AMPLIFIER BOARD | 762-2363-001 |
| C1 | CAPACITOR, FIXED. ELECTROLYTIC<br>68 UF. 20% TOL, 30 VDCW. SPRAGUE ELECTRIC<br>PART NO. 109D686X0030F2 | 184-7782-000 |
| C2 | CAPACITOR. FIXED. PAPER<br>0.1 UF. 20% TOL. 100 VDCWO SANGAMO<br>ELECTRIC PART NO. SDB1KO1104M | 931-4488-000 |
| C3 | CAPACITOR. FIXED. MICA<br>3900 UUF. 5% TOL. 500 VDCW, ELECTRO<br>MOTIVE PART NO. DM19F432F03 | 912-3046-000 |
| C4 | CAPACITOR. FIXED. CERAMIC<br>0.1 UF. PLUS 80% MINUS 20%X 25 VDCW,<br>SPRAGUE ELECTRIC PART NO. 5C7A | 913-3806-000 |
| C5 | SAME AS C1 | |
| C6 | SAME AS C1 | |
| C7 | CAPACITOR. FIXED. ELECTROLYTIC<br>1 UF, 20% TOL, 35 VDCW. SPRAGUE ELECTRIC<br>PART NO. 150D105X0035A2 | 184-7398-000 |
| C8 | CAPACITOR, FIXED. MICA<br>4700 UUF, 5% TOL. 500 VDCW, CM06F472J03 | 912-3052-000 |
| C9 | CAPACITOR, FIXED, MICA<br>2200 UF. 5% TOL, 500 VDCW. CM06F222J03 | 912-3025-000 |
| C10 | CAPACITOR. FIXED. MICA<br>20,000 UUF, 5% TOL, 500 VDCW. CM07F203J03 | 912-2747-000 |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| C11 | SAME AS C1 | |
| C12 | NOT USED | |
| C13 | NOT USED | |
| C14 | SAME AS C3 | |
| C15 | CAPACITOR. FIXED. MICA<br>430 UUF, 5% TOL. 300 VDCW, ELECTRO MOTIVE<br>PART NO. DM15F431J03 | 912-2861-CCO |
| C16 | SAME AS C10 | |
| C17 | CAPACITOR. FIXED, MICA<br>2700 UUF. 5% TOL, 500 VDCW. CM06F272J03 | 912-30C34-000 |
| C18 | SAME AS C17 | |
| C19 | SAME AS C4 | |
| CR1 | NOT USED | |
| CR2 | SEMICONDUCTOR DEVICE, DIODE<br>HUGHES PRODUCTS PART NO. HD2658 | 353-0166-000 |
| CR3 | SAME AS CR2 | |
| CR4 | SEMICONDUCTOR DEVICE, DIODE<br>TEXAS INSTRUMENTS PART NO. 1N645 | 353-2607-000 |
| CR5 | SEMICONDUCTOR DEVICE, DIODE<br>TEXAS INSTRUMENTS PART NO. 1N914 | 353-290b-000 |
| CR6 | SAME AS CR5 | |
| E1 | INSULATOR. TRANSISTOR<br>ROSS MILTON PART NO. A10044DAP | 352-9889-000 |
| E2<br>THROUGH<br>E6 | SAME AS EI | |
| L1 | CHOKE. RF<br>109000 UH INDUCTANCE. 10% TOL. DELEVAN<br>ELECTRIC PART NO. 3500-42 | 240-0844-000 |
| L2 | COIL* TOROIDAL<br>20 MH INDUCTANCE, 1% TOLT COLLINS RADIO<br>PART NO. MPB48-14B | 240-0468-000 |
| L3 | SAME AS L2 | |
| Q1 | SEMICONDUCTOR DEVICE. TRANSISTOR<br>TEXAS INSTRUMENTS PART NO. 2N2189 | 352-0412-000 |
| Q2 | SEMICONDUCTOR DEVICE, TRANSISTOR<br>TEXAS INSTRUMENTS PART NO. N1000 | 352-0335-000 |
| Q3 | SEMICONDUCTOR DEVICE, TRANSISTOR<br>SEMICONDUCTOR PRODUCTS PART NO. 2N1671A | 352-0361-000 |
| Q4 | SAME AS Q2 | |
| Q5 | SAME AS Q2 | |
| R1 | RESISTOR. FIXED. COMPOSITION<br>1200 OHMS, 10% TOL, 1/4 WATT, RC07GF122K | 745-0752-000 |
| R2 | RESISTOR. FIXED. COMPOSITION<br>159000 OHMS. 10% TOL, 1/4 WATT, RC07GF153K | 745-0791-000 |
| R3 | RESISTOR, FIXED, COMPOSITION<br>2200 OHMS, 10% TOL, 1/4 WATT. RC07GF222K | 745-0761-000 |
| R4 | RESISTOR. FIXED. COMPOSITION<br>2700 OHMS. 10% TOL. 1/4 WATT, RC07GF272K | 745-0764-000 |
| R5 | RESISTOR. FIXED. COMPOSITION<br>220 OHMS. 10% TOL. 1/4 WATT, RC07GF221K | 745-0725-000 |
| R6 | RESISTOR. FIXED. COMPOSITION<br>470 OHMS. 10% TOL. 1/4 WATT. RC07GF471K | 745-0737-000 |
| R7 | RESISTOR, VARIABLE, WIRE WOUND<br>20.000 OHMS, 5% TOL. 1 WATT. INTERNATIONAL<br>RESISTANCE PART NO. CT100-20K | 381-1472-000 |
| R8 | RESISTOR. VARIABLE. WIRE WOUND<br>10.000 OHMS. 5% TOL, 1 WATT. INTERNATIONAL<br>RESISTANCE PART NO. CT100-10K | 381-1471-000 |
| R9 | RESISTOR. FIXED. FILM<br>1000 OHMS. 1% TOL. 1/2 WATT. RN65DlOO1F | 705-7096-000 |
| R10 | RESISTOR, FIXED. COMPOSITION<br>0.33 MEGOHM. 10% TOL, 1/4 WATT. RC07GF334K | 745-0839-000 |
| R11 | RESISTOR, FIXED. COMPOSITION<br>1000 OHMS, 10% TOL. 1/4 WATT. RC07GF102K | 745-0749-000 |
| R12 | RESISTOR. FIXED. COMPOSITION<br>33,000 OHMS, 10% TOL, 1/4 WATT, RC07GF333K | 745-0803-000 |
| R13 | RESISTORT FIXED, COMPOSITION<br>1200 OHMS. 10% TOL. 1/4 WATT, RC07GF122K | 745-0752-000 |
| R14 | RESISTOR, FIXED. COMPOSITION<br>180 OHMS. 10% TOL. 1/4 WATT. RC07GF181K | 745-0772-000 |

| SYMBOL | DESCRIPTION NUMBER | PART |
|---|---|---|
| R15 | RESISTOR* FIXED* COMPOSITION 27 OHMS. 10% TOL. 1/4 WATT. RC07GF270K | 745-0692-000 |
| R16 | RESISTOR. FIXED, COMPOSITION 4700 OHMS, 10% TOL. 1/4 WATTS RC07GF472K | 745-0773-000 |
| R17 | RESISTOR. FIXED, COMPOSITION 109000 OHMS. 10% TOL. 1/4 WATT. RC07GF103K | 745-0785-000 |
| R18 | RESISTOR. FIXED. COMPOSITION 560 OHMS. 10% TOL. 1/4 WATT. RC07GF561K | 745-0740-000 |
| R19 | SAME AS R16 | |
| R20 | RESISTOR. FIXED. COMPOSITION 680 OHMS, 10% TOL. 1/4 WATTS RC07GF681K | 745-0743-000 |
| R21 | RESISTOR. FIXED. FILM 1479000 OHMS. 1% TOL, 1/2 WATT, RN65D1473F | 705-7200-000 |
| R22 | RESISTOR* FIXED. COMPOSITION 100 OHMS. 10% TOL. 1/4 WATT. RC07GFlO1K | 745-0713-000 |
| R23 | RESISTOR. FIXED* COMPOSITION 390 OHMS* 10% TOL. 1/4 WATT. RC07GF391K | 745-0734-000 |
| R24 | SAME AS R4 | |
| R25 | RESISTOR. FIXED. COMPOSITION 56.000 OHMS. 10% TOL, 1/4 WATT, RC07GF563K | 745-0812-000 |
| R26 | SAME AS R3 | |
| R27 | SAME AS R2 | |
| R28 | SAME AS R2 | |
| R29 | SAME AS R2 | |
| R30 | SAME AS R2 | |
| R31 | SAME AS R18 | |
| R32 | SAME AS R3 | |
| R33 | SAME AS R25 | |
| R34 | SAME AS R17 | |
| R35 | SAME AS R4 | |
| R36 | SAME AS R17 | |
| R37 | RESISTOR, FIXED. COMPOSITION 47.000 OHMS. 10% TOL, 1/4 .ATT, RC07GF473K | 745-0809-000 |
| TB1 | BOARD ASSEMBLY, FABRICATED | 762-2362-001 |
| | REFERENCE OSCILLATOR RECEIVER BOARD | 762-2368-001 |
| C1 | CAPACITOR. FIXED. MICA 2200 UF. 5% TOL. 500 VDCW. CM06F222J03 | 912-3025-000 |
| C2 | CAPACITOR* FIXED, ELECTROLYTIC 68 UF. 20% TOL, 30 VDCW. SPRAGUE ELECTRIC PART NO. 109D686X0030F | 184-7782-000 |
| C3 | CAPACITOR, FIXED. ELECTROLYTIC 180 UF. 20% TOL. 10 VDCW. SPRAGUE ELECTRIC PART NO. 109D187XO01OF2 | 184-7784-000 |
| C4 | CAPACITOR, FIXED. PAPER 1 UF, 20% TOL. 100 VDCW. SANGAMO ELECTRIC PART NO. SDB1KO1105M | 931-4500-000 |
| C5 | SAME AS C4 | |
| C6 | SAME AS C4 | |
| C7 | CAPACITOR. FIXED. ELECTROLYTIC 2.2 UF. 20% TOL. 20 VDCW. SPRAGUE ELECTRIC PART NO. 150D225X0020A2 | 184-7377-000 |
| C8 | CAPACITOR. FIXED. MICA 1000 UUF. 5% TOL. 500 VDCW. ELECTRO MOTIVE PART NO. DM2OF1O2J | 912-3315-000 |
| C9 | CAPACITOR. VARIABLE. CERAMIC 8-50 UUF. 350 VDCW, ERIE TECHNOLOGICAL PRODUCTS PART NO. 557-099J2PO-34R | 917-1186-000 |
| C10 | CAPACITOR. FIXED. MICA 1800 UUF. 5% TOL, 500 VDCW. ELECTRO MOTIVE PART NO. DM20F182J | 912-3333-000 |
| C11 | CAPACITOR. FIXED. MICA 300 UUF. 5% TOL. 500 VDCW. CMOSF301J03 | 912-2849-000 |
| C12 | CAPACITOR. VARIABLE. CERAMIC 9-35 UUF. 200 VDCW. ERIE TECHNOLOGICAL PART NO. 538011E2P094R | 917-1225-000 |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| C3 | SAME AS C1 | |
| C14 | CAPACITOR, FIXED, MIC', 120 UUF, 5% TOL. 500 VDCW. CM05F121J03 | 912-2822-000 |
| C15 | SAME AS C2 | |
| C16 | CAPACITOR. FIXED, MICA 0.051 UF, 5% TOL. 1500 VDCW, SPRAGUE ELECTRIC PART NO. 5C7A | 913-3606-000 |
| C17 | SAME AS C16 | |
| CR1 | SEMICONDUCTOR DEVICE, DIODE TYPE NO. 1N755 | 353-2717-000 |
| CR2 | CAPACITOR. SILICON DIODE 33 UF, PACIFIC SEMICONDUCTOR PART NO* V33 | 922-6014-000 |
| CR3 | SAME AS CR2 | |
| E1 | INSULATOR. TRANSISTOR ROSS MILTON PART NO. A10044DAP | 352-9889-000 |
| E2 THROUGH E5 | SAME AS EI | |
| L1 | COIL. RF 240-0839-000 1000 UH INDUCTANCE, 10% TOL. DELEVAN ELECTRIC PART NO. | |
| Q1 | NOT USED | |
| Q2 | SEMICONDUCTOR DEVICE. TRANSISTOR TEXAS INSTRUMENTS PART NO. N1000 | 352-0335-000 |
| Q3 | SEMICONDUCTOR DEVICE. TRANSISTOR TEXAS INSTRUMENTS PART NO. 2N1142 | 352-0162-000 |
| Q4 | SEMICONDUCTOR DEVICE. TRANSISTOR TYPE NO. 2N3638 | 352-0636-000 |
| Q5 | SEMICONDUCTOR DEVICE. TRANSISTOR FAIRCHILD CAMERA AND INSTRUMENT PART NO* 2N696 | 352-0206-000 |
| R1 | NOT USED | |
| R2 | RESISTOR. FIXED, COMPOSITION 330 OHMS. 10% TOL. 1/4 WATT. RC07GF331K | 745-0731-000 |
| R3 | RESISTOR. FIXED. COMPOSITION 1800 OHMS. 10% TOL, 1/4 WATT. RC07GF182K | 745-0758-000 |
| R4 | RESISTOR. FIXED. COMPOSITION 3900 OHMS, 10% TOL. 1/4 WATT. RC07GF392K | 745-0770-000 |
| R5 | RESISTOR, FIXED. COMPOSITION 10,000 OHMS. 10% TOL. 1/4 WATT. RC07GF103K | 745-0785-000 |
| R6 | RESISTOR. FIXED. COMPOSITION 1000 OHMS. 10% TOL. 1/4 WATT. RC07GF102K | 745-0749-000 |
| R7 | RESISTOR. VARIABLE, WIRE WOUND 5000 OHMS. 5% TOL. 1 WATT. INTERNATIONAL RESISTANCE PART NO. CT100-SK | 381-1470-000 |
| R8 | RESISTOR. FIXED. FILM 2870 OHMS. 1% TOL. 1/2 WATT, RN65D2871F | 705-7118-000 |
| R9 | SAME AS R8 | |
| R10 | RESISTOR. FIXED. FILM 715 OHMS* 1% TOL. 1/2 WATT, RN65D7150F | 705-7089-000 |
| R11 | RESISTOR. FIXED. COMPOSITION 15.000 OHMS, 10% TOL, 1/4 WATT, RCO7GF153K | 745-0791-000 |
| R12 | SAME AS R5 | |
| R13 | SAME AS R4 | |
| R14 | RESISTOR. FIXED, COMPOSITION 1 MEGOHM. 10% TOL. 1/4 WATT. RC07GF105K | 745-0857-000 |
| R15 | RESISTOR. FIXED. COMPOSITION 33.000 OHMS. 10% TOL. 1/4 WATT. RC07GF333K | 745-0803-000 |
| R16 | SAME AS RlI | |
| R17 | RESISTOR. FIXED. COMPOSITION 2200 OHMS, 10% TOL. 1/4 WATT. RC07GFZ22K | 745-0761-000 |
| R18 | RESISTOR. FIXED, COMPOSITION 270 OHMS. 10% TOL, 1/4 WATT. RC07GF271K | 745-0728-000 |
| R19 THROUGH R22 | SAME AS R6 | |
| R23 | SAME AS R4 | |
| TB1 | BOARD ASSEMBLY. FABRICATED | 762-2367-001 |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| | LIMITER DISCRIMINATOR RECEIVER BOARD | 762-2375-001 |
| C1 | CAPACITOR, FIXED, ELECTROLYTIC<br>68 UF. 20% TOL, 30 VDCW. SPRAGUE ELECTRIC<br>PART NO. 109D686X0030F2 | 184-77OZ-000 |
| C2 | CAPACITOR* FIXED' MICA<br>3900 UF. 5% TOL. 500 VDCW, ELECTRO MOTIVE<br>PART NO. DM20F392J | 912-3360-000 |
| C3 | SAME AS C2 | |
| C4 | CAPACITOR, FIXED. CERAMIC<br>0.1 UFP PLUS 80% MINUS 20%. 25 VDCW,<br>SPRAGUE ELECTRIC PART NO. 5C7A | 913-3806-000 |
| C5 | SAME AS C4 | |
| C6 | SAME AS C2 | |
| C7<br>THROUGH<br>C10 | SAME AS C4 | |
| C11 | CAPACITOR, FIXED. CERAMIC<br>1500 UUF, 20% TOL. 500 VDCW, SPRAGUE<br>ELECTRIC PART NO. 19C246A1 | 913-3010-000 |
| C12 | SAME AS C11 | |
| C13 | CAPACITOR. FIXED, CERAMIC<br>2.2 UF. PLUS 80% MINUS 20%. 25 VDCW<br>SPRAGUE ELECTRIC PART NO. 5C15A | 913-3812-000 |
| C14 | SAME AS C1 | |
| C15 | SAME AS C1 | |
| C16 | SAME AS C1 | |
| CR1 | SEMICONDUCTOR DEVICE, DIODE<br>TEXAS INSTRUMENTS PART NO, lN914 | 353-2906-000 |
| CR2 | SAME AS CR1 | |
| CR3 | SAME AS CR1 | |
| CR4 | SAME AS CR1 | |
| CR5 | SEMICONDUCTOR DEVICE, DIODE<br>TRANSITRON ELECTRONIC PART NO. 1N995 | 353-0144-000 |
| CR6 | SAME AS CR5 | |
| CR7 | SEMICONDUCTOR DEVICE. DIODE<br>TYPE NO. 1N752 | 353-2711-000 |
| E1 | INSULATOR, DISK<br>ROSS MILTON PART NO. A10044DAP | 352-9889-000 |
| E2 | SAME AS El | |
| E3 | SAME AS El | |
| E4 | SAME AS El | |
| Q1 | SEMICONDUCTOR DEVICE. TRANSISTOR<br>TYPE NO. 2N3638 | 352-0636-010 |
| Q2 | SAME AS Q1 | |
| Q3 | SAME AS Q1 | |
| Q4 | SEMICONDUCTOR DEVICE, TRANSISTOR<br>RCA PART NO. 2N2270 | 352-0430-000 |
| R1 | RESISTOR. VARIABLE. WIPE WOUND<br>5000 OHMS, 5% TOL. 1 WATT, INTERNATIONAL<br>RESISTANCE PART NO. CT1OO-5K | 381-1470-000 |
| R2 | RESISTOR, FIXED. COMPOSITION<br>560 OHMS, 10% TOL, 1/4 WATT, RC07GF561K | 745-0740-000 |
| R3 | RESISTOR, FIXED, COMPOSITION<br>15,000 OHMS, 10% TOL, 1/4 WATT, RC07GF153K | 745-0791-000 |
| R4 | RESISTOR. FIXED, COMPOSITION<br>2200 OHMS, 10% TOL, 1/4 WATT, RC07GF222K | 745-0761-000 |
| R5 | RESISTOR, FIXED, COMPOSITION<br>56 OHMS, 10% TOL, 1/4 WATT, RC07GF560K | 745-0704-000 |
| R6 | SAME AS R2 | |
| R7 | SAME AS R4 | |
| R8 | RESISTOR, FIXED, COMPOSITION<br>1000 OHMS, 10% TOL, 1/4 WATT, RC07GF102K | 745-0749-000 |
| R9 | RESISTOR, FIXED, COMPOSITION<br>27,000 OHMS, 10% TOL, 1/4 WATT* RC07GF273K | 745-0800-000 |
| R10 | SAME AS R8 | |
| R11 | SAME AS R4 | |
| R12 | SAME AS R3 | |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| R13 | SAME AS R4 | |
| R14 | SAME AS R5 | |
| R15 | SAME AS R2 | |
| R16 | SAME AS R8 | |
| R17 | SAME AS R9 | |
| R18 | SAME AS R8 | |
| R19 | SAME AS R4 | |
| R20 | SAME AS R3 | |
| R21 | RESISTOR, FIXED, COMPOSITION<br>3900 OHMS, 10% TOL, 1/4 WATT, RC07GF392K | 745-0770-000 |
| R22 | SAME AS R5 | |
| R23 | SAME AS R8 | |
| R24 | RESISTOR, FIXED9 COMPOSITION<br>689000 OHMS, 10% TOL, 1/4 WATT* RC07GF683K | 745-0815-000 |
| R25 | SAME AS R24 | |
| R26 | SAME AS R4 | |
| R27 | RESISTOR, FIXED, COMPOSITION<br>1200 OHMS9 10% TOL.  1/4 WATT.  RCO7GF122K | 745-0752-000 |
| R28 | RESISTOR, FIXED.  COMPOSITION<br>2700 OHMS  10% TOL, 1/4 WATT, RC07GF272K | 745-0764-000 |
| R29 | SAME AS R2 | |
| T1 | TRANSFORMER, BROADBAND<br>MOLDED* LEADS 1 TO 2 600 OHMS IMPEDANCE,<br>10% TOL.  LEADS 3 TO 5 18.000 OHMS<br>IMPEDANCE, LEAD 4 CT, ALADDIN ELECTRONICS<br>PART NO.  01-578 | 667-9520-000 |
| T2 | SAME AS T1 | |
| TB1 | BOARD ASSEMBLY.  FABRICATED | 762-2374-001 |
| | SWEEP SYNCHRONIZER BOARD | 762-2359-001 |
| C1 | CAPACITOR, FIXED.  CERAMIC<br>0.1 UF.  PLUS 80% MINUS 20%, 25 VDCW,<br>SPRAGUE ELECTRIC PART NO.  5C7A | 913-3806-000 |
| C2 | CAPACITOR, FIXED, ELECTROLYTIC<br>180 UF, 20% TOL.  10 VDCWG SPRAGUE ELECTRIC<br>PART NO, 109DI87XOO1OF2 | 184-7784-000 |
| C3 | SAME AS C2 | |
| C4 | CAPACITOR.  FIXED.  ELECTROLYTIC<br>68 UF.  20% TOL, 30 VDCW.  SPRAGUE ELECTRIC<br>PART NO.  109D686X0030F2 | 184-7782-000 |
| C5 | SAME AS C4 | |
| C6 | SAME AS C1 | |
| C7 | CAPACITOR, FIXED.  PAPER<br>0*22 UF.  20% TOL, 100 VDCW, SANGAMO<br>ELECTRIC PART NO.  SDB1K01224M | 931-4492-000 |
| C8 | SAME AS C7 | |
| C9 | SAME AS C7 | |
| C10O | SAME AS C4 | |
| C1 | SAME AS C2 | |
| C12 | SAME AS C2 | |
| C13 | SAME AS C4 | |
| C14 | CAPACITOR* FIXED.  ELECTROLYTIC<br>15 UF, 20% TOL, 30 VDCW.  SPRAGUE ELECTRIC<br>PART NO.  109D156XO03OC2 | 184-7775-000 |
| C15 | SAME AS C4 | |
| C16 | SAME AS C4 | |
| C17 | SAME AS C4 | |
| C18 | CAPACITOR, FIXED* ELECTROLYTIC<br>1 UF.  20% TOL, 35 VDCW.  SPRAGUE ELECTRIC<br>PART NO.  15OD105XOO35A2 | 184-7398-000 |
| C19 | CAPACITOR, FIXED.  ELECTROLYTIC<br>2.2 UF.  20% TOL.  20 VDCW.  SPRAGUE ELECTRIC<br>PART NO.  150D225X0020A2 | 184-7377-000 |
| C20 | SAME AS C4 | |
| C21 | SAME AS C4 | |
| C22 | SAME AS C2 | |
| C23 | SAME AS C1 | |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| C24 | SAME AS C14 | |
| C25 | SAME AS C2 | |
| C26 | CAPACITOR, FIXED. PAPER 33,000 UUF, 20% TOL, 200 VDCW. SANGAMO ELECTRIC PART NO. SDB1K02333M | 931 -4504-000 |
| CR1 | SEMICONDUCTOR DEVICE, DIODE TEXAS INSTRUMENTS PART NO. 1N914 | 353-2906-000 |
| CR2 | SAME AS CR2 | |
| CR3 | SEMICONDUCTOR DEVICE, DIODE TYPE NO. 1N747 | 353-2701-000 |
| CR4 | SEMICONDUCTOR DEVICE. DIODE TYPE NO. 1N752 | 353-2711-000 |
| E1 | INSULATOR. DISK ROSS MILTON PART NO. A10044DAP | 352-9889-000 |
| E2 THROUGH E6 | SAME AS El | |
| L1 | CHOKE, RF240-0842-000 2500 UH INDUCTANCE, 10% TOL. DELAVAN PART NO. 3500-38 | |
| Q1 | SEMICONDUCTOR DEVICE. TRANSISTOR TEXAS INSTRUMENTS PART NO. N1000 | 352-0335-000 |
| Q2 THROUGH Q6 | SAME AS 01 | |
| R1 | RESISTOR, FIXED. COMPOSITION 2200 OHMS, 10% TOL. 1/4 WATT. RC07GF222K | 745-0761-000 |
| R2 | RESISTOR. FIXED. COMPOSITION 15.000 OHMS, 10% TOL, 1/4 WATT, RC07GFlOOK | 745-0791-000 |
| R3 | RESISTOR. FIXED. COMPOSITION 1800 OHMS, 10% TOL. 1/4 WATT. RC07GF182K | 745-0758-000 |
| R4 | RESISTOR, FIXED. COMPOSITION 3900 OHMS. 10% TOL. 1/4 WATT, RC07GF392K | 745-0770-000 |
| R5 | RESISTOR. FIXED. COMPOSITION 68 OHMS. 10% TOL. 1/4 WATT. RC07GF680K | 745-0707-000 |
| R6 | RESISTOR. FIXED. COMPOSITION 1000 OHMS. 10% TOL. 1/4 WATT. RC07GF102K | 745-0749-000 |
| R7 | SAME AS R6 | |
| R8 | RESISTOR. FIXED. COMPOSITION 8200 OHMS, 10% TOL. 1/4 WATT. RC07GF822K | 745-0782-000 |
| R9 | SAME AS R2 | |
| RI0 | RESISTOR* FIXED. COMPOSITION 3300 OHMS, 10% TOL. 1/4 WATT. RC07GF332K | 745-0767-000 |
| R11 | RESISTOR, VARIABLE. WIRE WOUND 5000 OHMS. 5% TOL. 1 WATT. INTERNATIONAL RESISTANCE PART NO. CT100-5K | 381-1470-000 |
| R12 | RESISTOR, FIXED. FILM 1000 OHMS, 1% TOL. 1/2 WATT. RN65101F | 705-7096-000 |
| R13 | RESISTOR. FIXED. FILM 2150 OHMS, 1% TOL. 1/2 WATT. RN65D2151F | 705-7112-000 |
| R14 | SAME AS R12 | |
| R15 | RESISTOR, FIXED. FILM 3160 OHMS, 1% TOL. 1/2 WATT. RN65D3161F | 705-7120-000 |
| R16 | RESISTOR. FIXED. COMPOSITION 10.000 OHMS9 10% TOL, 1/4 WATT. RC07GF103K | 745-0785-000 |
| R17 | SAME AS R16 | |
| R18 | RESISTOR. FIXED. COMPOSITION 15 OHMS. 10% TOL. 1/4 WATT. RC07GF150K | 745-0683-000 |
| R19 | RESISTOR. FIXED. COMPOSITION 4700 OHMS, 10% TOL. 1/4 WATT. RC07GF472K | 745-0773-000 |
| R20 | RESISTOR, FIXED. COMPOSITION 399000 OHMS. 10% TOL, 1/4 WATT, RC07GF393K | 745-0806-000 |
| R21 | SAME AS R6 | |
| R22 | SAME AS R8 | |
| R23 | SAME AS R6 | |
| R24 | RESISTOR. FIXED, COMPOSITION 330 OHMS. 10% TOL. 1/4 WATT. RC07GF331K | 745-0731-000 |
| R25 | SAME AS R1 | |
| R26 | RESISTOR. FIXED. COMPOSITION 1200 OHMS, 10% TOL. 1/4 WATT. RC07GF122K | 745-0752-000 |

| SYMBOL | DESCRIPTION | PART NUMBER |
|---|---|---|
| R27 | RESISTOR9 FIXED, COMPOSITION<br>560 OHMS, 10% TOL. 1/4 WATT. RC07GF561K | 745-0740-000 |
| R28 | RESISTOR* FIXED, COMPOSITION<br>1500 OHMS, 10% TOL, 1/4 WATT, RC07GF152K | 745-0755-000 |
| R29 | NOT USED | |
| R30 | RESISTOR, FIXED. COMPOSITION<br>18B000 OHMS. 10% TOL, 1/4 WATT. RC07GF183K | 745-0794-000 |
| R31 | SAME AS R30 | |
| R32 | SAME AS R4 | |
| R33 | SAME AS R10 | |
| 'R34 | SAME AS R19 | |
| R35 | SAME AS R2 | |
| R36 | SAME AS R3 | |
| R37 | RESISTOR. FIXED. COMPOSITION<br>680 OHMS, 10% TOL, 1/4 WATT. RC07GF681K | 745-0743-000 |
| R38 | SAME AS R4 | |
| R39 | RESISTOR. FIXED. COMPOSITION<br>220 OHMS. 10% TOL. 1/4 WATT. RC07GF221K | 745-0725-000 |
| R40 | RESISTOR. FIXED. COMPOSITION<br>2700 OHMS, 10% TOL. 1/4 WATT* RC07GF272K | 745-0764-000 |
| R41 | RESISTOR. FIXED. COMPOSITION<br>22.000 OHMS. 10% TOL. 1/4 WATT, RC07GF223K | 745-0797-000 |
| T1 | TRANSFORMER, AF<br>HERMETICALLY SEALED. LEADS 1 TO 3 2000<br>OHMS IMPEDANCE, 10% TOL, LEADS 4 TO 5<br>600 OHMS IMPEDANCE, LEAD 2 CT. MICROTRAN<br>PART NO, MH683 | 667-0054-000 |
| T2 | TRANSFORMER, AF<br>LEADS BLUE AND RED 159000 OHMS IMPEDANCE,<br>20% TOL. LEADS GREEN AND GREEN 95.000 OHMS<br>IMPEDANCE. BLACK LEAD CT | 667-0465-000 |
| TB1 | BOARD ASSEMBLY, FABRICATED | 762-2358-001 |
| | POWER SUPPLY CHASSIS ASSEMBLY | 762-2455-001 |
| C1 | CAPACITOR, FIXED. ELECTROLYTIC<br>1800 UF, PLUS 100% MINUS 10%' 60 VDCW | 183-0924-000 |
| C2 | SAME AS.C1 | |
| CR1 | SEMICONDUCTOR DEVICE. DIODE<br>AUTOCALL PART NO. 1N2984A | 353-1364-000 |
| CR2 | SEMICONDUCTOR DEVICE. DIODE<br>SEMI-CONDUCTOR PRODUCTS PART NO. 1N538 | 353-1526-000 |
| CR4 | SAME AS CR2 | |
| CR5 | SAME AS CR2 | |
| E1 | TERMINAL POST<br>ARMEL ELECTRONICS PART NO. RTMT12M | 306-0976-000 |
| E2<br>THROUGH<br>F9 | SAME AS E1 | |
| E10 | HEAT SINK | 762-9404-001 |
| R1 | NOT USED | |
| R2 | RESISTOR, FIXED. WIRE WOUND<br>25 OHMS. 5% TOL, 10 WATTS* OHMITE PART<br>NO. 1 3--4D57r?5PORM5PCT | 710-2894-000 |
| R3 | SAME AS R2 | |
| R4 | RESISTOR. FIXED. COMPOSITION<br>18. OHMS. 10% TOL, 2 WATTS. RC42GF181K | 745-5621-000 |
| T1 | TPANSFORMER<br>CHANNEL FRAME. LEADS I TO 2 115 OHMS<br>IMPEDANCE.'LEADS 3 TO 4 26 OHMS IMPEDANCE,<br>DRESSER ELECTRONICS PART NO. 950-0646-400 | 662-0481-000 |

7.2 This section contains the Part Number-National Stock Number Cross Reference Index for the delay and linearity test instruments.

## PART NUMBER - NATIONAL STOCK NUMBER CROSS REFERENCE INDEX

| PART NUMBER | FSCM | NATIONAL STOCK NUMBER | PART NUMBER | FSCM | NATIONAL STOCK NUMBER |
|---|---|---|---|---|---|
| AL0044DAP | 07047 | 4920-01-013-4664 | RC07GF271K | 81349 | 5905-00-686-4525 |
| CM05E270J03 | 81349 | 5910-00-079-5162 | RC07GF272K | 81349 | 5905-00-686-4527 |
| CM05E470J03 | 81349 | 5910-00-954-1772 | RC07GF273K | 81349 | 5905-00-752-3157 |
| CM05F121J03 | 81349 | 5910-00-811-5081 | RC07GF331K | 81349 | 5905-00-726-6435 |
| CM05F271J03 | 81349 | 5910-00-060-1189 | RC07GF332K | 81349 | 5905-00-686-4528 |
| CM05F331JO3 | 81349 | 5910-00-702-8057 | RC07GF333K | 81349 | 5905-00-726-6436 |
| CM06F102J03 | 81349 | 5910-00-060-1194 | RC07GF334K | 81349 | 5905-00-806-5259 |
| CM06F222J03 | 81349 | 5910-00-957-8582 | RC07GF391K | 81349 | 5905-00-811-0674 |
| CM06F272J03 | 81349 | 5910-00-782-8883 | RC07GF392K | 81349 | 5905-00-755-0719 |
| CM06F471J03 | 81349 | 5910-00-043-1994 | RC07GF393K | 81349 | 5905-00-682-4222 |
| CM06F472J03 | 81349 | 5910-00-051-4641 | RC07GF471K | 81349 | 5905-00-686-4526 |
| DM20F10O2J | 72136 | 5910-00-826-7028 | RC07GF472K | 81349 | 5905-00-752-3340 |
| DM20F392J | 72136 | 5910-00-814-5139 | RC07GF473K | 81349 | 5905-00-688-4447 |
| MDL1-4 | 71400 | 5920-00-280-9534 | RC07GF560K | 81349 | 5905-00-755-0797 |
| MS25237-327 | 96906 | 6240-00-155-7836 | RC07GF561K | 81349 | 5905-00-726-6441 |
| RC07GF1OOK | 81349 | 5905-00-465-9557 | RC07GF563K | 81349 | 5905-00-825-2357 |
| RC07GFLO1K | 81349 | 5905-00-726-5340 | RC07GF680K | 81349 | 5905-00-726-6836 |
| RC07GF102K | 81349 | 5905-00-752-3338 | RC07GF681K | 81349 | 5905-00-726-6837 |
| RC07GF103K | 81349 | 5905-00-816-8554 | RC07GF683K | 81349 | 5905-00-686-3362 |
| RC07GF105K | 81349 | 5905-00-721-0552 | RC07GF821K | 81349 | 5905-00-755-0796 |
| RC07GF121K | 81349 | 5905-00-982-5503 | RC07GF822K | 81349 | 5905-00-834-9874 |
| RC07GF122K | 81349 | 5905-00-752-3335 | RC20GF101K | 81349 | 5905-00-186-3008 |
| RC07GF150K | 81349 | 5905-00-087-7997 | RC20GF102K | 81349 | 5905-00-195-6817 |
| RC07GF152K | 81349 | 5905-00-726-5343 | RC20GF103K | 81349 | 5905-00-185-8518 |
| RC07GF153K | 81349 | 5905-00-726-5344 | RC20GF151K | 81349 | 5905-00-279-1756 |
| RC07GF181K | 81349 | 5905-00-810-8135 | RC20GF152K | 81349 | 5905-00-195-5514 |
| RC07GF182K | 81349 | 5905-00-726-5346 | RC20GF153K | 81349 | 5905-00-190-8876 |
| RC07GF183K | 81349 | 5905-00-810-8132 | RC20GF181K | 81349 | 5905-00-256-0410 |
| RC07GF221K | 81349 | 5905-00-825-2360 | RC20GF182K | 81349 | 5905-00-279-2672 |
| RC07GF222K | 81349 | 5905-00-726-6433 | RC20GF221K | 81349 | 5905-00-256-0409 |
| RC07GF223K | 81349 | 5905-00-752-3156 | RC20GF222K | 81349 | 5905-00-171-2009 |
| RC07GF270K | 81349 | 5905-00-836-2745 | RC20GF223K | 81349 | 5905-00-229-2620 |

## PART NUMBER -- NATIONAL STOCK NUMBER
## CROSS REFERENCE INDEX

| PART NUMBER | FSCM | NATIONAL STOCK NUMBER | PART NUMBER | FSCM | NATIONAL STOCK NUMBER |
|---|---|---|---|---|---|
| RC20GF271K | 81349 | 5905-00-185-6966 | RN65D5620F | 81349 | 5905-00-062-5037 |
| RC20GF272LK | 81349 | 5905-00-195-6741 | RN65D6811F | 81349 | 5905-00-060-2481 |
| RC20GF331K | 81349 | 5905-00-104-8334 | RN65D7150F | 81349 | 5905-00-985-2408 |
| RC20GF333K | 81349 | 5905-00-249-4248 | RN65D8252F | 81349 | 5905-00-892-6466 |
| RC20GF392K | 81349 | 5905-00-185-6575 | TRIOLEL | 81349 | 5999-00-792-9754 |
| RC20GF471K | 81349 | 5905-00-171-2005 | IN645 | 01295 | 5961-00-466-2868 |
| RC20GF472K | 81349 | 5905-00-195-6451 | 1N914 | 01295 | 5961-00-999-4566 |
| RC20GF561K | 81349 | 5905-00-942-9326 | 109D156X0030C2 | 56289 | 5910-00-010-8141 |
| RC20DF563K | 81349 | 5905-00-192-3988 | 109D187XOO0010F2 | 56289 | 5910-00-752-4602 |
| RC20GF680K | 81349 | 5905-00-116-8566 | 109D686X0030F2 | 56289 | 5910-01-004-3302 |
| RC42GF181K | 81349 | 5905-00-256-0411 | 109D805C2030C2 | 56289 | 5910-00-806-4338 |
| RN65D10O01F | 81349 | 5905-00-883-9198 | 150D105X0035A2 | 56289 | 5910-00-726-5003 |
| RN65D1003F | 81349 | 5905-00-814-3815 | 150D225X0020A2 | 56289 | 5910-00-779-8392 |
| RN65D1473F | 81349 | 5905-00-993-6013 | 2N1142 | 01295 | 5961-00-128-8751 |
| RN65D21R5F | 81349 | 5905-00-045-4162 | 2N1307 | 01295 | 5961-00-813-7283 |
| RN65D2151F | 81349 | 5905-00-063-8405 | 2N2189 | 01295 | 5961-00-732-7638 |
| RN65D26R1F | 81349 | 5905-00-053-0276 | 24001-3 | 81073 | 5930-00-755-3526 |
| RN65D2871F | 81349 | 5905-00-993-1365 | 3500-32 | 99800 | 5950-00-117-8566 |
| RN65D3161F | 81349 | 5905-00-993-1362 | 3500-38 | 99800 | 5950-00-828-7855 |
| RN65D4642F | 81349 | 5905-00-993-2261 | 538011E2P094R | 72982 | 5910-00-929-0155 |
| RN65D5112F | 81349 | 5905-00-993-2267 | 557-099U2PO-34R | 72982 | 5910-00-940-3195 |

# APPENDIX A
# REFERENCES

| | |
|---|---|
| DA Pam 310-4 | Index of Technical Publications: Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders. |
| DA Pam 310-7 | U.S. Army Index of Modification Work Orders. |
| SB 38-100 | Preservation, Packaging, Packing and Marking Materials, Supplies and Equipment Used by the Army. |
| SB 700-20 | Army Adopted/Other Items Selected for Authorization/List of Reportable Items. |
| TB 43-0118 | Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters. |
| TM 38-750 | The Army Maintenance Management System CrAMMS). |
| TM 740-90-1 | Administrative Storage of Equipment. |
| TM 750-244-3 | Procedures for Destruction of Equipment to Prevent Enemy Use (Mobility Equipment Command). |

# APPENDIX B
# MAINTENANCE ALLOCATION

## Section I. INTRODUCTION

**B-1. General**
This appendix provides a summary of the maintenance operations for 70E1-MW and 70E2-MW. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

**B-2. Maintenance Function**
Maintenance functions will be limited to and defined as follows:

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

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

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

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

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

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

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

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

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

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

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

**B-3. Column Entries**

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

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

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of task hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4are as follows:

C - Operator/Crew
O - Organizational

F - Direct Support
H - General Support
D - Depot

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

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV and section VII, Remarks, which is pertinent to the item opposite the particular code.

**B-4. Tool and Test Equipment Requirements (Sect. III and Sect. VI)**

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

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

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

d. NationaUN47TO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

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

**B-5. Remarks (Sect. IV and Sect. VII)**

a. Reference Code. This code refers to the appropriate item in section I or section V, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II or section V.

## SECTION II MAINTENANCE ALLOCATION CHART

**FOR**

70E1-MW DELAY AND LITEARITY TEST SIGNAL GENERATOR

| (1) GROUP NUMBER | (2) COMPONENT ASSEMBLY REMARKS | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE LEVEL C | O | F | H | D | (5) TOOLS AND EQUIPMENT | (6) |
|---|---|---|---|---|---|---|---|---|---|
| 00 A | 70E1-MW DELAY AND LINEARITY TEST SIGNAL | Inspect | | | 0.5 | | | | |
| | GENERATOR | Replace | | 0.5 | | | | | B |
| | | Inspect | | | | 0.5 | | | C |
| | | Aline | | | | 1.0 | | 1 thru 5 | |
| | | Test | | | | 1.5 | | 1 thru 5 | |
| | | Repair | | | | 2.0 | | 7,8,9 | |
| | | Calibrate | | | | 2.0 | | 1 thru 6,10 | |
| | | Replace | | | | 1.0 | | 8 | |
| | | Overhaul | | | | | 4.0 | 1 thru 10 | |
| 0001 | 70E1-MW POWER SUPPLY | Test | | | | 0.5 | | 1 | |
| | | Repair | | | | 1.0 | | 7,8 | |
| 0002 | LINE CHORD (CABLES) | Repair | | | | 1.0 | | 8 | |

## SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS FOR 70E1-MW DELAY LINEARITY TEST SIGNAL GENERATOR

| TOOL OR TEST EQUIPMENT REF CODE | MAINTENANCE CATEGORY | NOMENCLATURE | NATIONAL/NATO STOCK NUMBER | TOOL NUMBER |
|---|---|---|---|---|
| 1 | H,D | MULTIMETER, AN/USM-223 | 6625-00-999-7465 | |
| 2 | H,D | VOLTMETER, ELECTRONIC ME-459/U | 6625-00-229-0457 | |
| 3 | H,D | OSCILLOSCOPE AN/USM-281C | 6625-00-106-9622 | |
| 4 | H,D | COUNTER, ELECTRONIC AN/USM-207A | 6625-00-044-3228 | |
| 5 | H,D | ADJUSTABLE TRANSFORMER, VARIAC, 115 VOLTS AC, SINGLE PHASE CN-16/U | 5950-00-235-2086 | |
| 6 | H,D | TEST CALIBRATOR, AS SHOWN IN FIGURE 5-11 OF COMMERCIAL MANUAL | | |
| 7 | H,D | MAINTENANCE KIT MK-772/U | 5999-00-757-7042 | |
| 8 | H,D | TOOL KIT, ELECTRONIC EQUIPMENT TK-IOO/G | 5180-00-605-0079 | |
| 9 | O,H,D | TOOLS AND TEST EQUIPMENT AS AUTHORIZED TO THE REPAIR TECHNICIAN BECAUSE OF ASSIGNED TASK. | | |
| 10 | H,D | DELAY LINEARITY SIGNAL ANALYZER 70E2-MW | | |

## SECTION IV. REMARKS

70E1-MW AND LINEARITY TEST SIGNAL GENERATOR

| REFERENCE CODE | REMARKS |
|---|---|
| A | VISUALS ONLY. |
| B | 9 KNOBS, FUSES, ETC. |
| C | VISUALS, CASE REMOVED |

## SECTION V. MAINTENANCE ALLOCATION CHART

## FOR

## 70E2-MW AND LINEARITY TEST SIGNAL ANALYZER

| (1) GROUP NUMBER | (2) COMPONENT ASSEMBLY | (3) MAINTENANCE FUNCTION | (4) MAINTENANCE LEVEL C | O | F | H | D | (5) TOOLS AND EQUIPMENT | (6) REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| 00 A | 70E2-MW DELAY AND LINEARITY TEST | | Inspect | | 0.5 | | | | |
| | SIGNAL ANALYZER | Replace | | 0.5 | | | | | B |
| | | Inspect | | | | 0.5 | | | C |
| | | Aline | | | | 1.0 | | 1 thru 4 | |
| | | Test | | | | 1.5 | | 1 thru 4,9 | |
| | | Repair | | | | 2.0 | | 6,7,8 | |
| | | Replace | | | | 1.0 | | 7 | |
| | | Calibrate | | | | 2.0 | | 1 thru 5,9 | |
| | | Overhaul | | | | | 4.0 | 1 thru 9 | |
| 0001 | 70E2-MW POWER SUPPLY | Test | | | | 0.5 | | 1 | |
| | | Repair | | | | 1.0 | | 6,7 | |
| 0002 | LINE CHORD (CABLES) | Repair | | | | 1.0 | | 7 | |

## SECTION VI TOOL AND TEST EQUIPMENT REQUIREMENTS
## FOR
70E2-MW DELAY AND LINEATITY TEST SIGNAL ANALYZER

| TOOL OR TEST EQUIPMENT REF CODE | MAINTENANCE CATEGORY | NOMENCLATURE | NATIONAL/NATO STOCK NUMBER | TOOL NUMBER |
|---|---|---|---|---|
| 1 | H,D | MULTIMETER AN/USM-223 | 6625-00-999-7465 | |
| 2 | H,D | VOLTMETER, ELECTRONIC ME-459/U | 6625-00-229-0457 | |
| 3 | H,D | OSCILLOSCOPE AN/USM-281C | 6625-00-106-9622 | |
| 4 | H,D | ADJUSTABLE TRANSFORMER, VARIAC, 115 VOLTS AC, SIGNAL PHASE CN-16/U | | 5950-00-235-2086 |
| 5 | H,D | TEST CALIBRATOR, AS SHOWN IN FIGURE 5-11 OF COMMERCIAL MANUAL | | |
| 6 | H,D | MAINTENANCE KIT MK-772/U | 5999-00-757-7042 | |
| 7 | H,D | TOOL KIT, ELECTRONIC EQUIPMENT TK-IOO/G | | 5180-00-605-0079 |
| 8 | D,H,D | TOOLS AND TEST EQUIPMENT AS AUTHORIZED TO THE REPAIR TECHNICIAN BECAUSE OF ASSIGNED TASK | | |
| 9 | H,D | DELAY AND LINEARITY TEST SIGNAL GENERATOR 70E1-MW | | |

## SECTION VII. REMARKS

70E1-MW AND LINEARITY TEST SIGNAL GENERATOR

| REFERENCE CODE | REMARKS |
|---|---|
| A | VISUALS ONLY. |
| B | 8 KNOBS, FUSES, ETC. |
| C | VISUALS, CASE REMOVED. |

*U.S. GOVERNMENT PRINTING OFFICE: 1980-603128/225

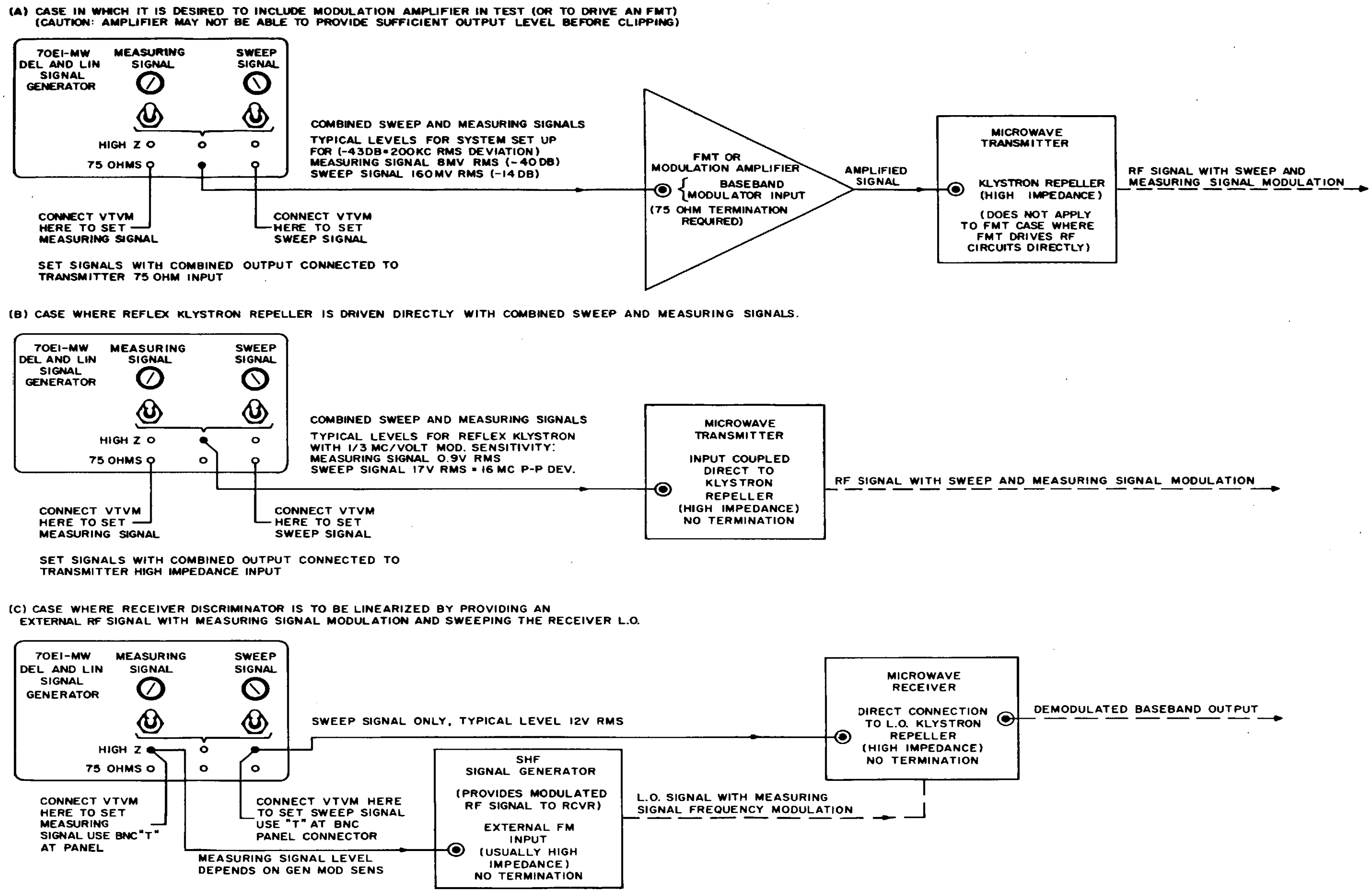



Figure 3-1. Methods of Connecting the 70E1-MW

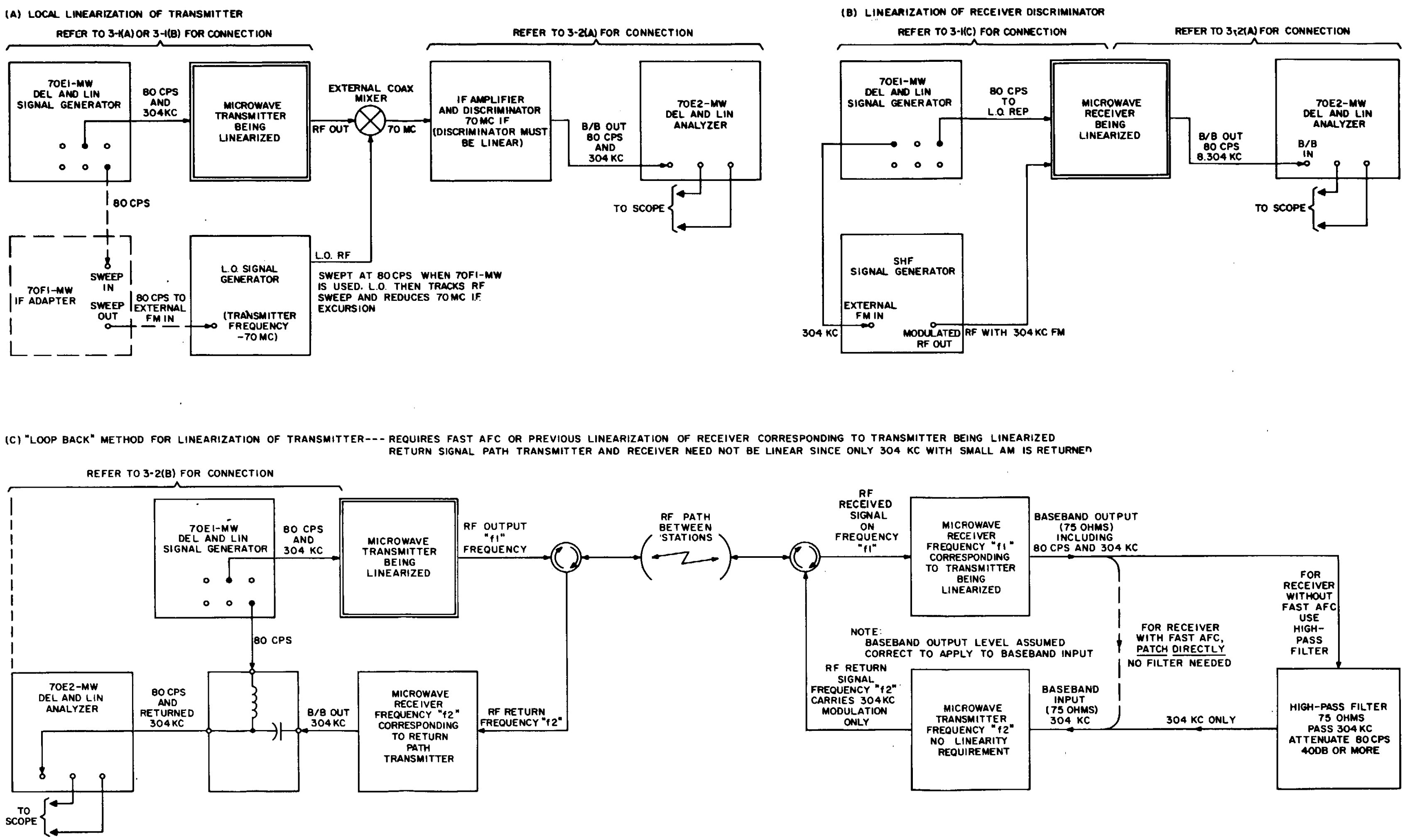



*Figure 3-3. Connections for Linearization*

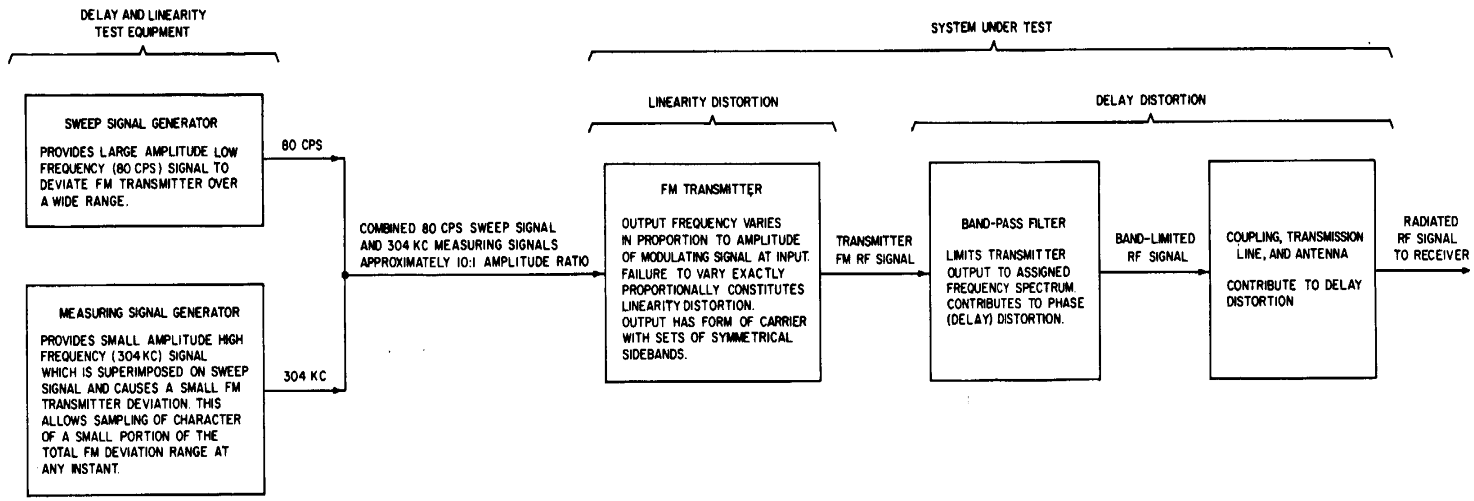



*Figure 4-1. Functional and Signal Flow Diagram at Transmitter*

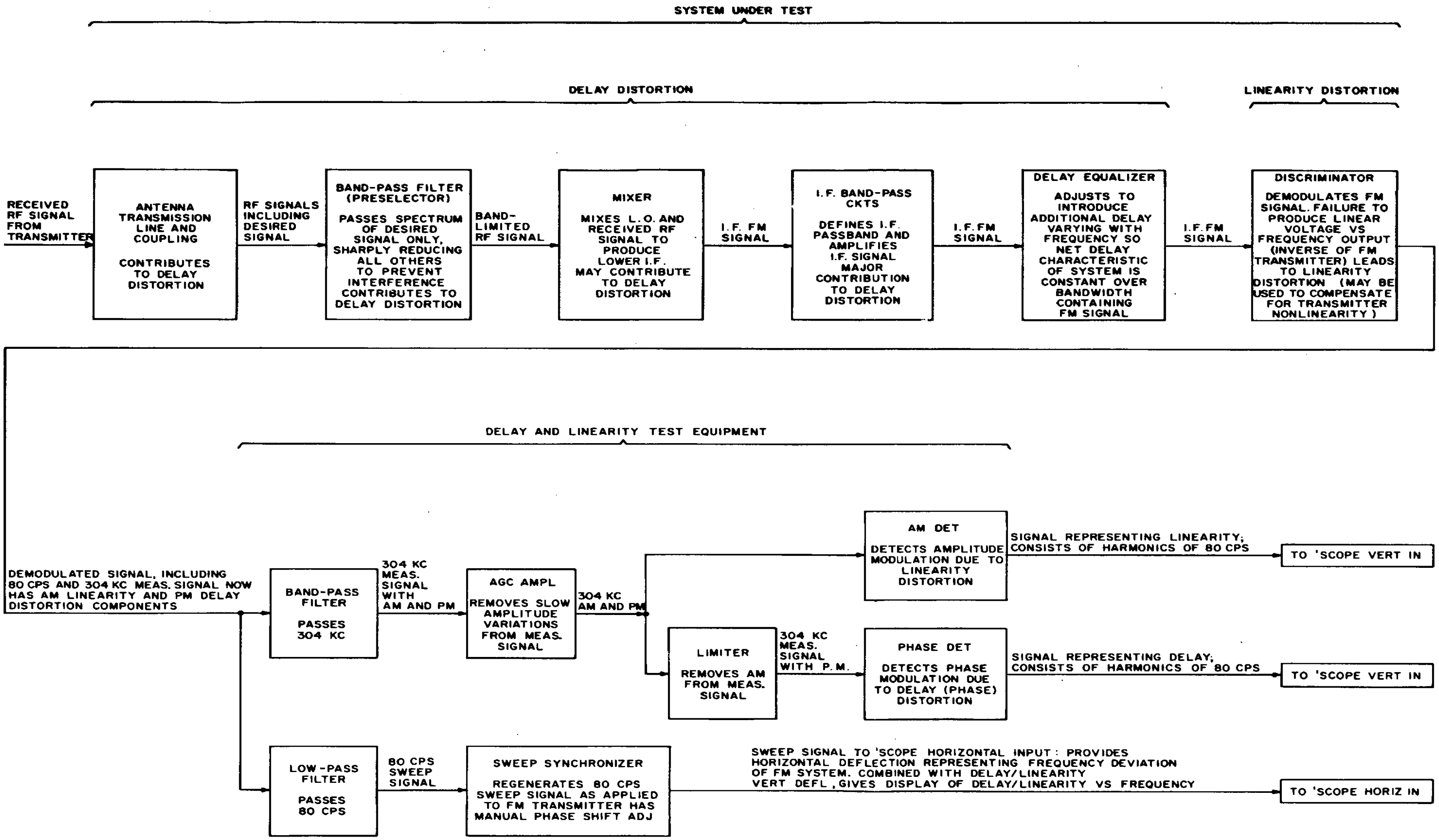



*Figure 4-2. Functional and Signal Flow Diagram at Receiver*

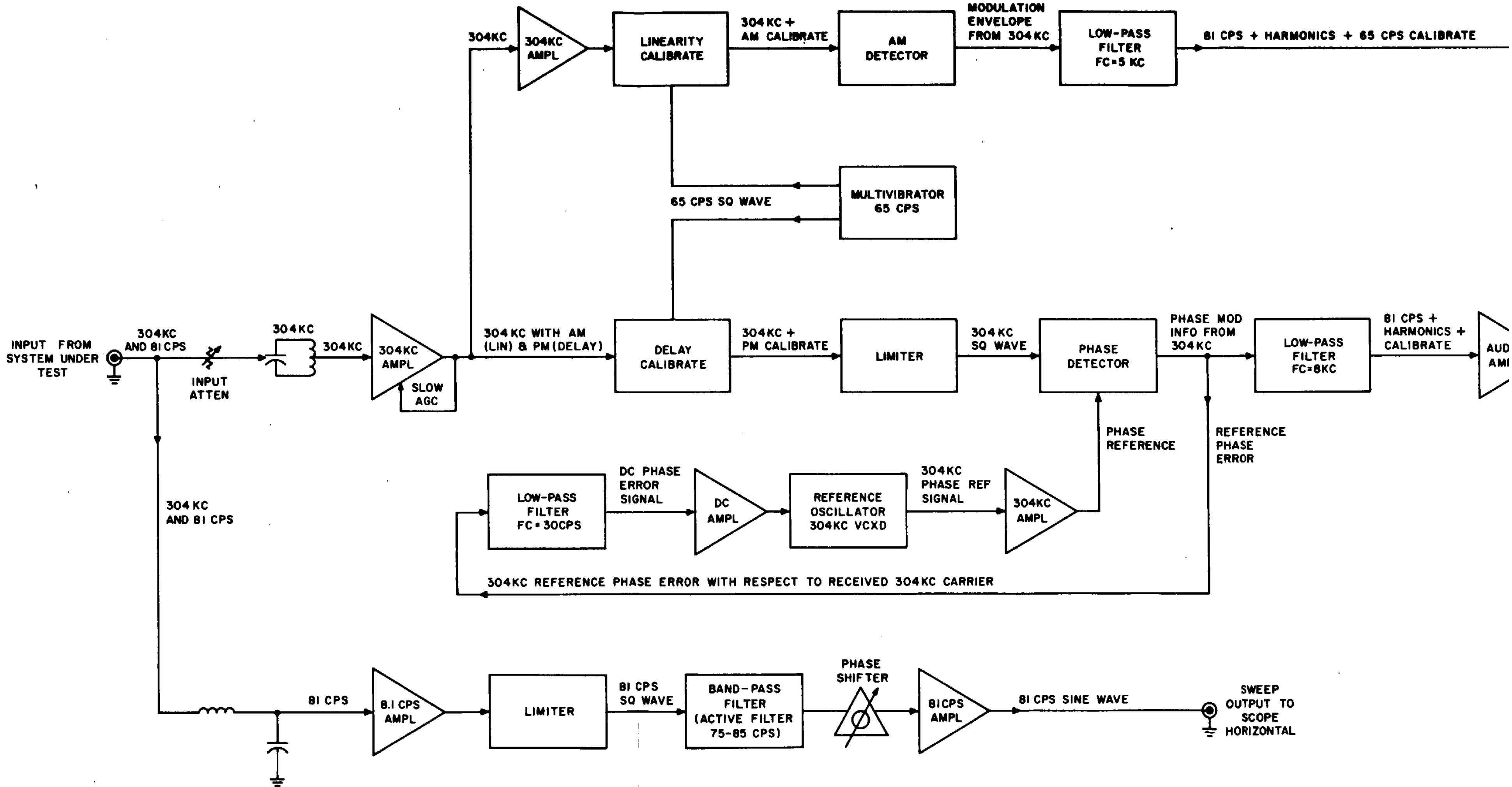



*Figure 4-6. 70E2-MW Functional Block Diagram*

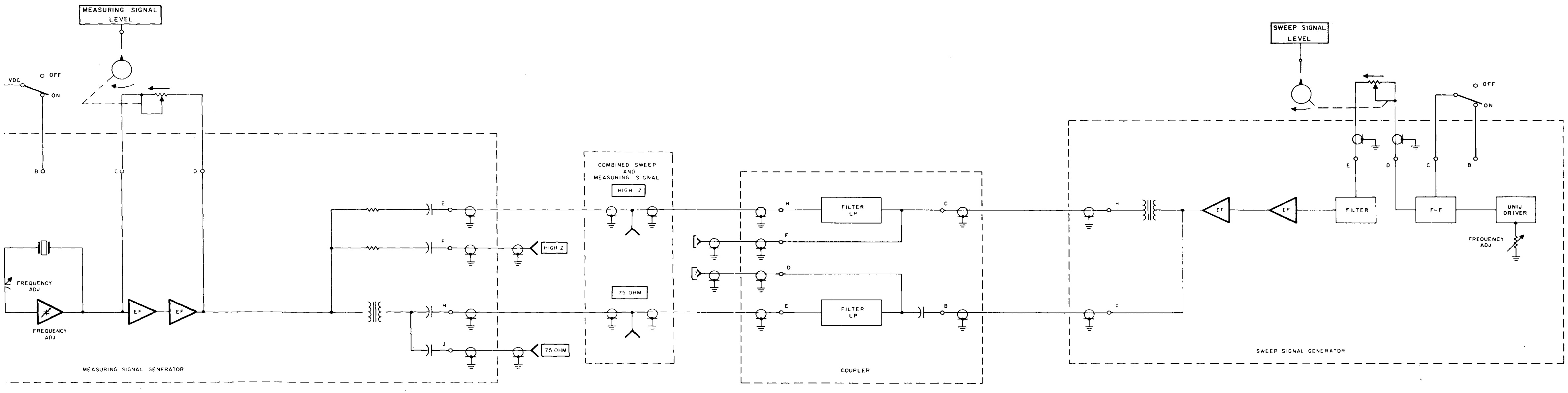
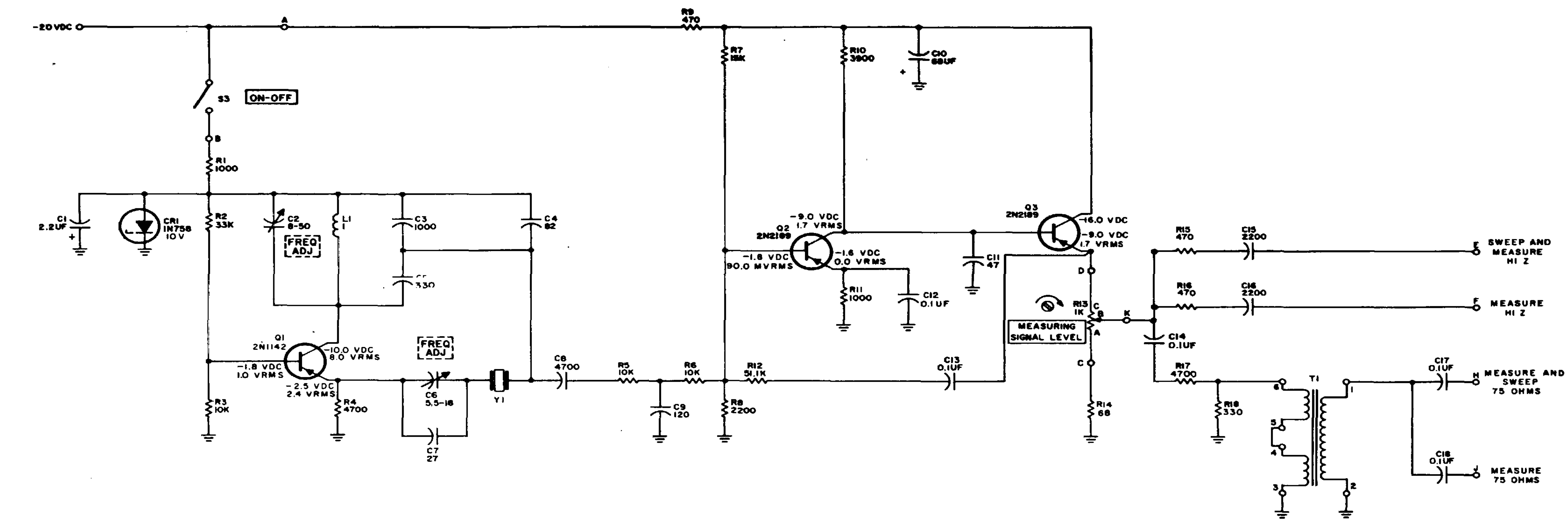



*Figure 6-1. 70E1-MW Signal Flow Block Diagram*




NOTES:

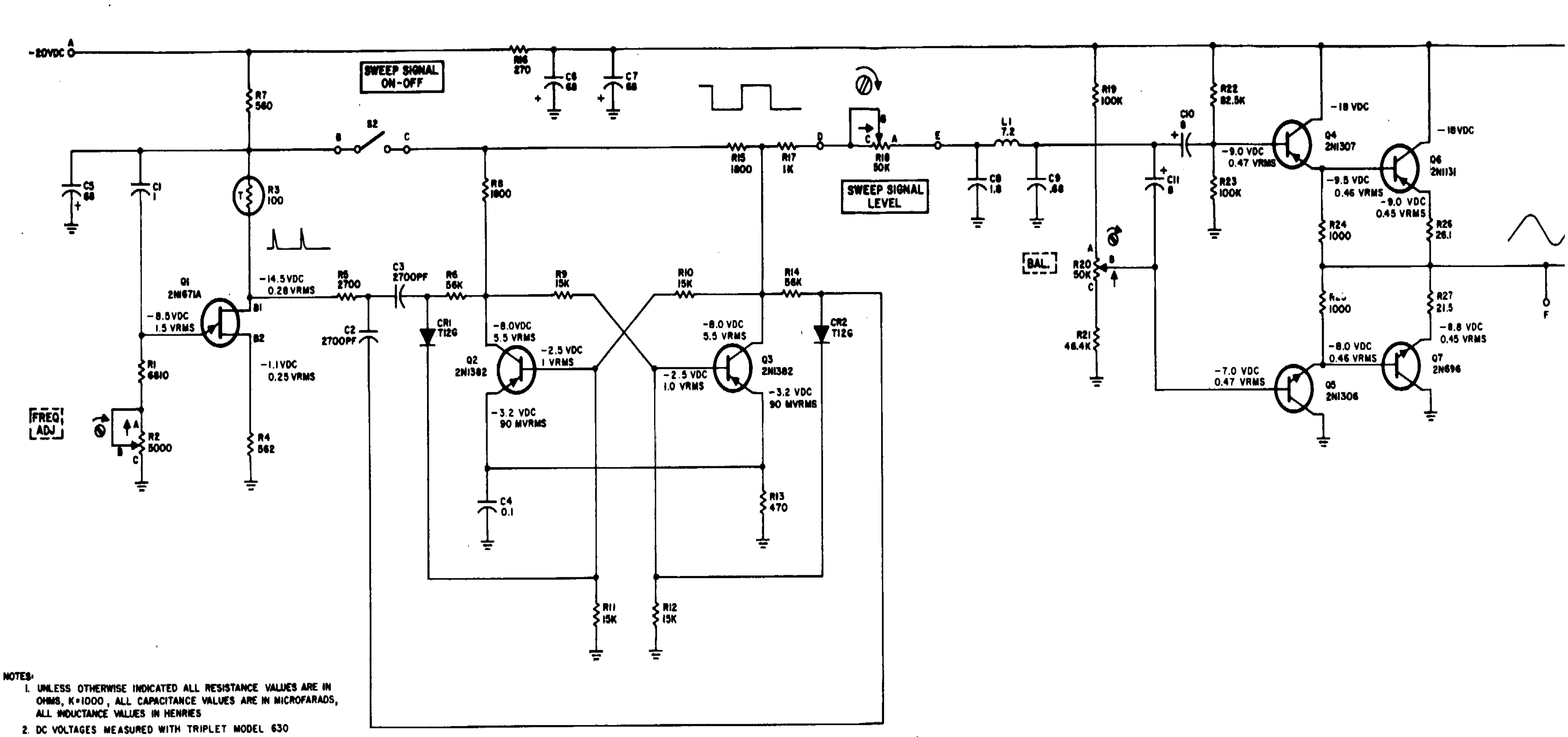
1. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS K=1000, ALL CAPACITANCE VALUES ARE IN PICOFARADS, ALL INDUCTANCE VALUES ARE IN MILLIHENRIES

2. DASHED BOXES INDICATE LOCATION ON PRINTED BOARD

3. DC VOLTAGES MEASURED WITH 20,000 OHM/VOLT TYPE METER (TRIPLETT MODEL 630 )

4. AC VOLTAGES WITH HP 4000 USING OPEN WIRE LEADS WITH I? VRMS OUTPUT AT THE HI Z JACK AND ?S OHM JACK TERMINATED

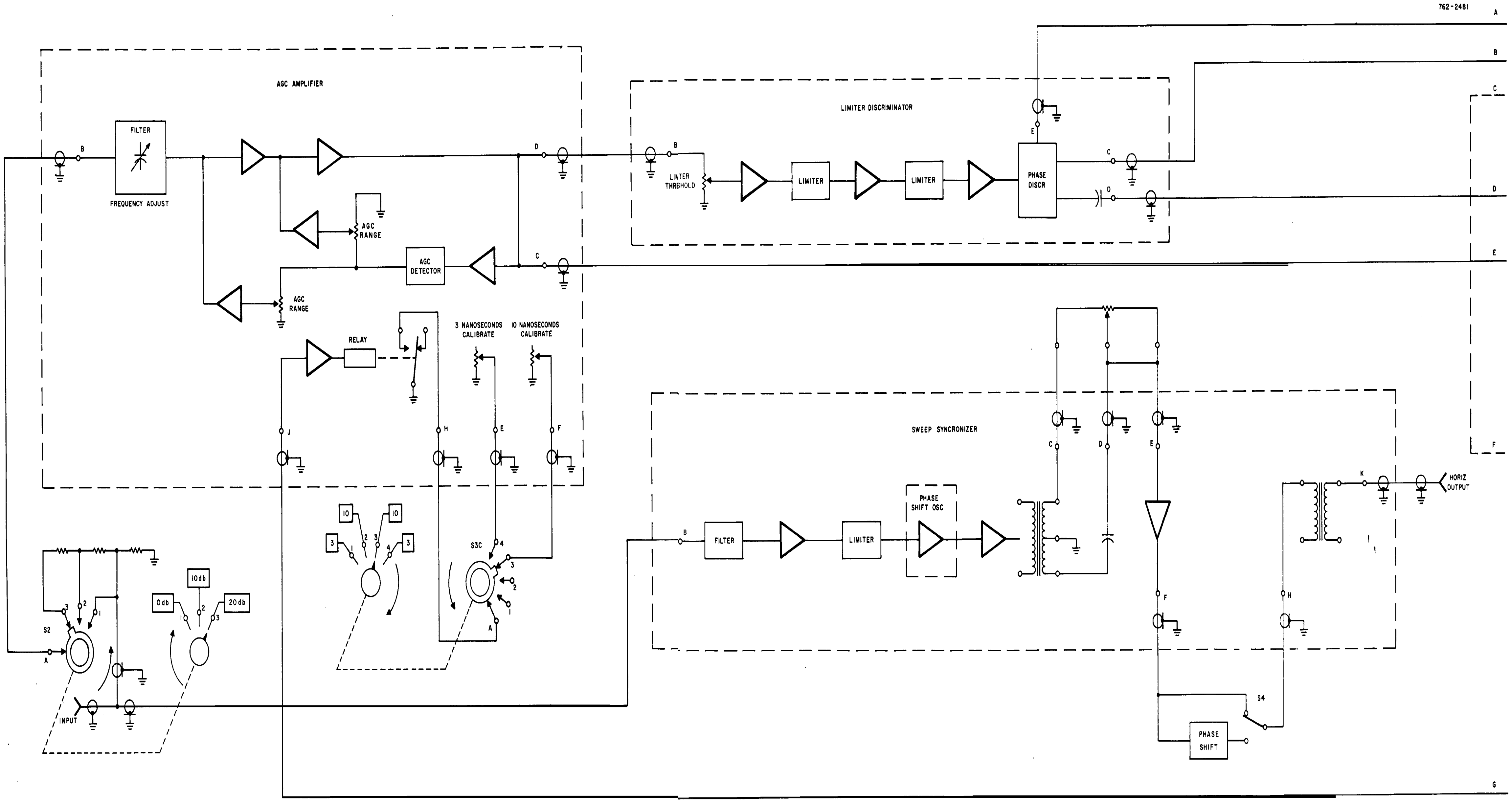
*Figure 6-2. 70E1-MW Measuring Signal Generator, Schematic Diagram*




NOTES:

1. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, K=1000, ALL CAPACITANCE VALUES ARE IN MICROFARADS, ALL INDUCTANCE VALUES IN HENRIES
2. DC VOLTAGES MEASURED WITH TRIPLET MODEL 630
3. AC VOLTAGES MEASURED WITH 400D USING OPEN LEADS AND LOW IMPEDENCE SWEEP OUTPUT JACK TERMINATED WITH 75 OHMS AND WITH 77MV OUTPUT SIGNAL AT LOW IMPEDENCE OUTPUT JACK
4. SOLID BOXES INDICATE LOCATIONS ON FRONT PANEL
5. DASHED BOXES INDICATE LOCATIONS ON PRINTED BOARD

*Figure 6-3. 70OE1-MW Sweep Signal Generator, Schematic Diagram*


762-2481
AGC AMPLIFIER
FILTER
FREQUENCY ADJUST
AGC RANGE
AGC DETECTOR
AGC RANGE
RELAY
3 NANOSECONDS CALIBRATE
10 NANOSECONDS CALIBRATE
LIMITER DISCRIMINATOR
LIMITER THRESHOLD
LIMITER
LIMITER
PHASE DISCR
SWEEP SYNCRONIZER
FILTER
LIMITER
PHASE SHIFT OSC
HORIZ OUTPUT
S4
PHASE SHIFT
S2
INPUT
0db
10db
20db
S3C

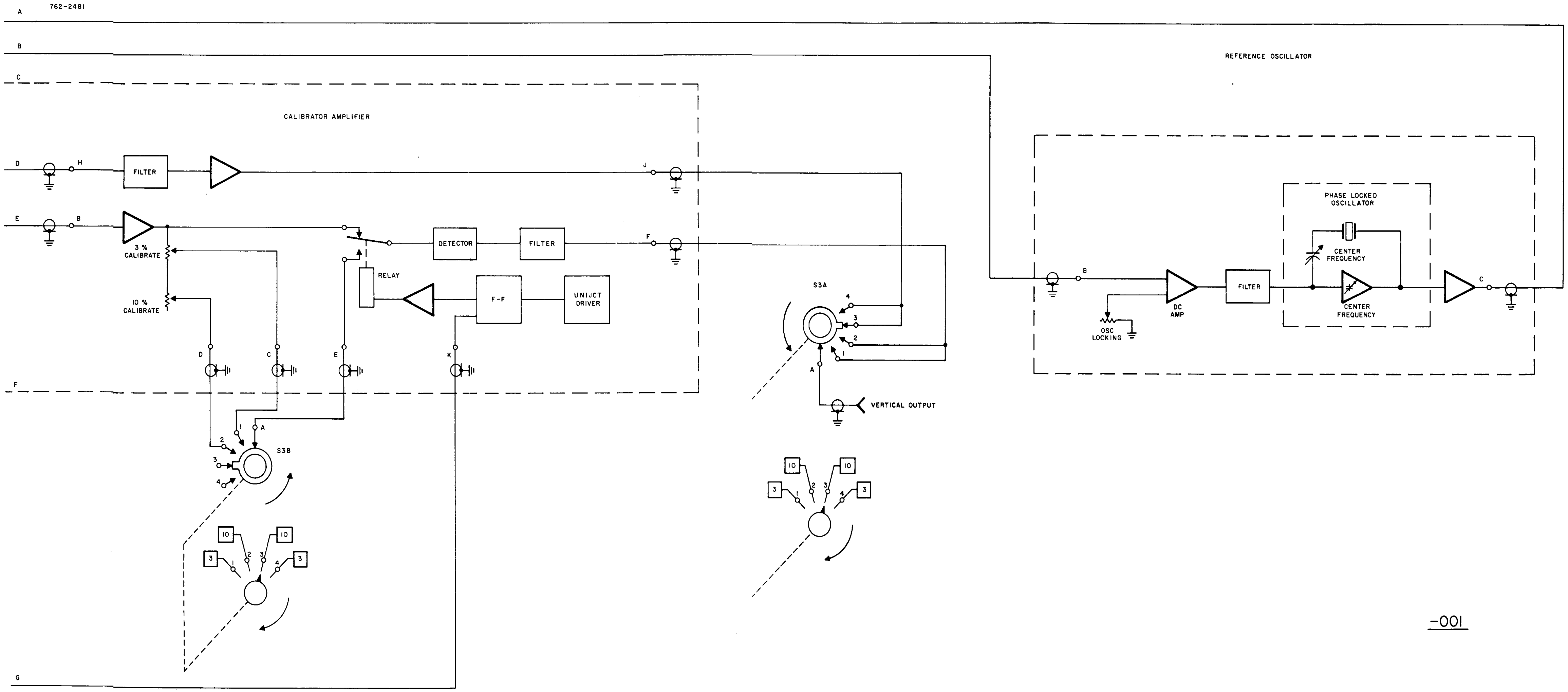



Figure 6-5. 70E2-MW Signal Flow Block Diagram

6-11/6-12

Figure 6-5. 70E-MW Signal Flow Block Diagram

drawings

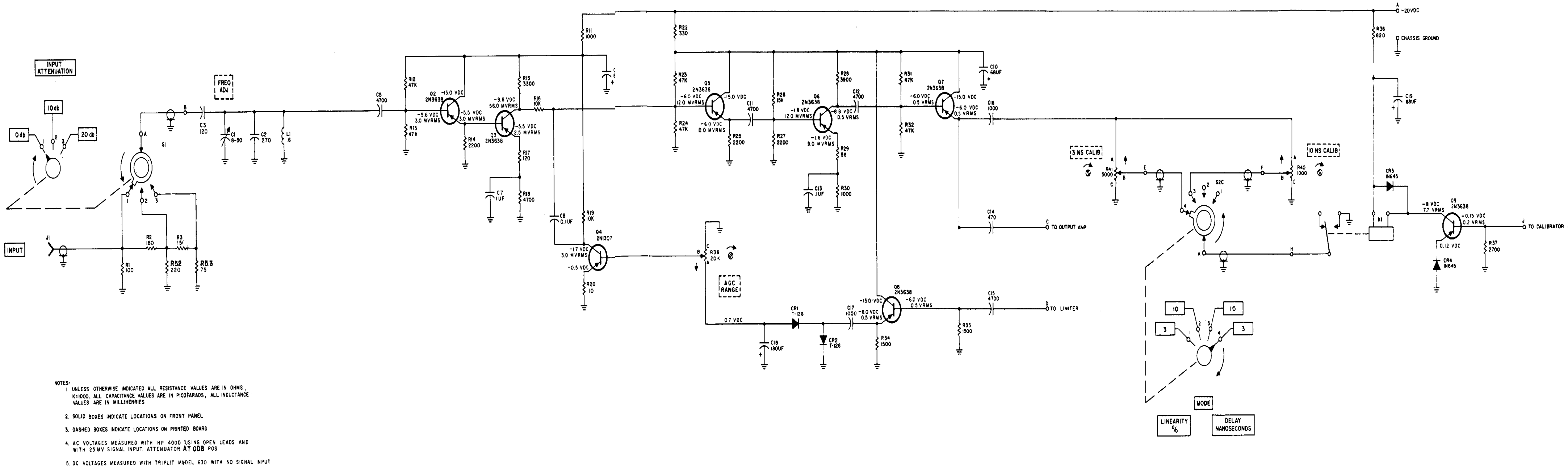
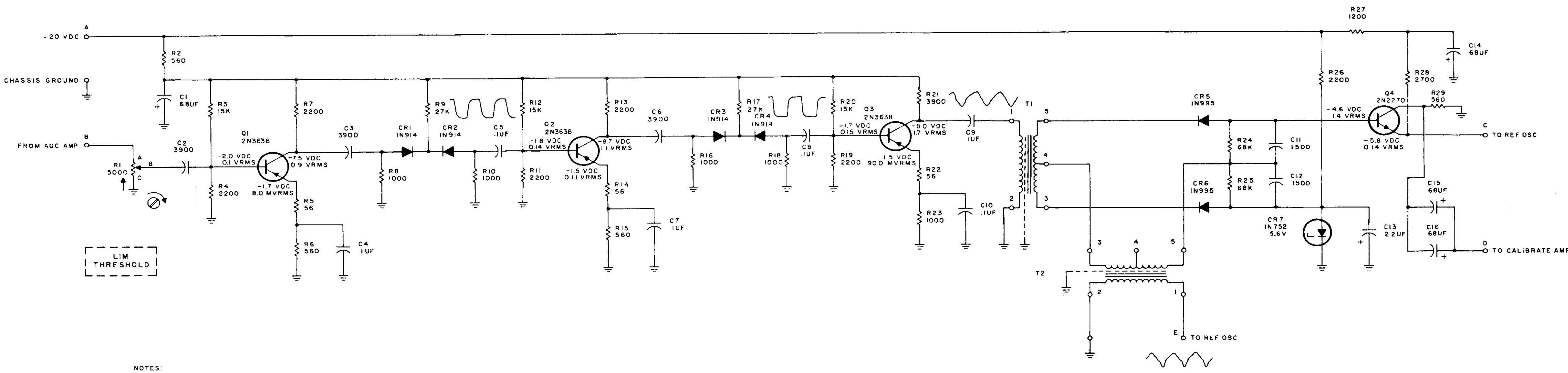



*Figure 6-6. 70E2-MW AGC Amplifier, Schematic Diagram*

drawings




NOTES:

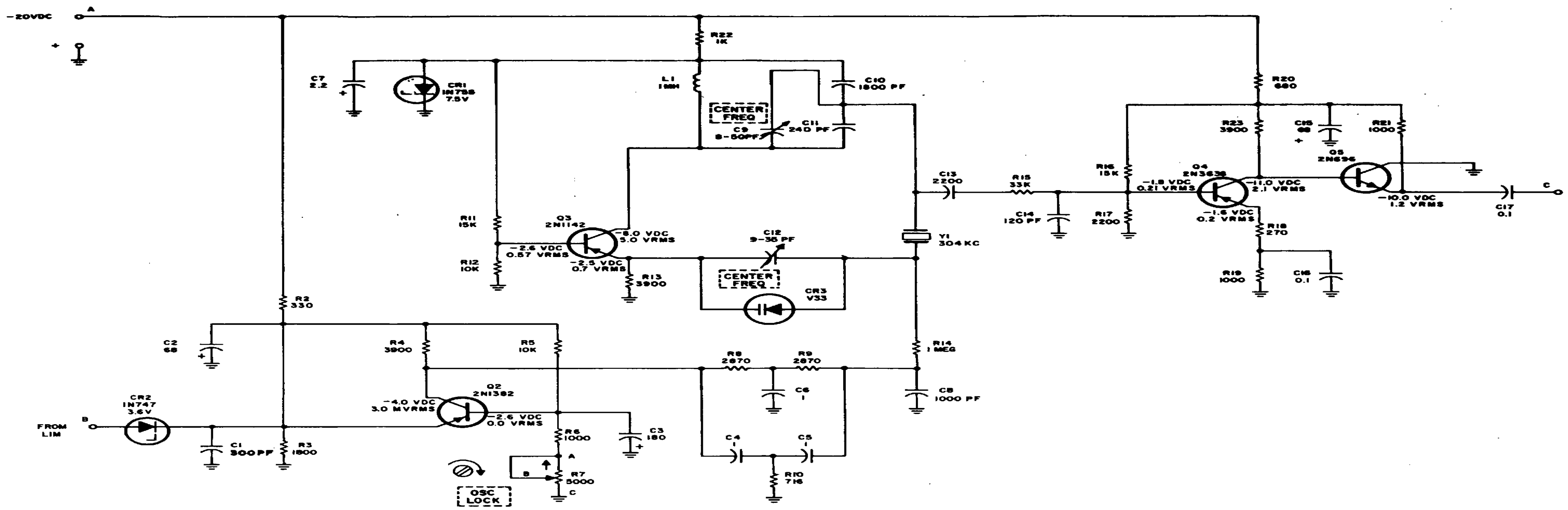
1 UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS K=1000, ALL CAPACITANCE VALUES ARE IN PICOFARADS.

2. DASHED BOXES INDICATE LOCATION ON PRINTED BOARD

3. DC VOLTAGES MEASURED WITH 20,000 OHM/VOLT TYPE METER (TRIPLETT MODEL 630) WITH NO SIGNAL INPUT, AC VOLTAGES MEASURED WITH HP 400D USING OPEN WIRE LEADS WITH INPUT LEVEL TO ANALYZER SET AT 25 MVRMS MEASURING SIGNAL AND 80 MVRMS SWEEP SIGNAL

*Figure 6-7. 70E-MW Limiter Discriminator, Schematic Diagram*

drawings




NOTES:
1. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, K=1000, MEG=1000000, ALL CAPACITANCE VALUES ARE IN MICROFARADS
2. DASHED BOXES INDICATES LOCATION ON PRINTED CIRCUIT BOARD
3. DC VOLTAGES MEASURED WITH 20,000 OHM/VOLT TYPE METER (TRIPLETT MODEL 630) WITH NO SIGNAL INPUT
4. AC VOLTAGES MEASURED WITH HP 400D USING OPEN WIRE LEADS WITH INPUT LEVEL TO ANALYZER SET AT 25 MVRMS MEASURING SIGNAL AND 80 MVRMS SWEEP SIGNAL

Figure 6-8. 70E2-MW Reference Oscillator, Schematic Diagram

6-17/6-18

*Figure 6-8. 70E2-MW Reference Oscillator Schematic Diagram*

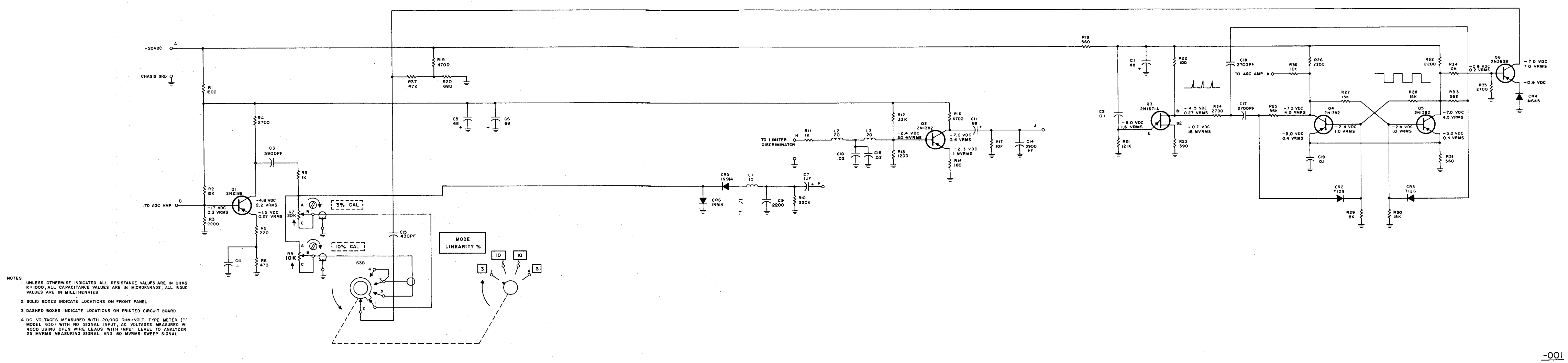



Figure 6-9. 70E2-MW Calibrator Amplifier, Schematic Diagram

6-19/6-20

*Figure 6-9. 70E2-MW Calibrator Amplifier*
*Schematic Diagram*

drawings

NOTES.
1 UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, K=1000, ALL CAPACITANCE VALUES ARE IN MICROFARADS
2 DC VOLTAGES MEASURED WITH 20,000 OHM/VOLT TYPE METER (TRIPLETT MODEL 630) WITH NO SIGNAL INPUT, AC VOLTAGES MEASURED WITH HP 400D USING OPEN WIRE LEADS WITH INPUT LEVEL TO ANALYZER SET 25 MVRMS MEASURING SIGNAL AND 80 MVRMS SWEEP SIGNAL

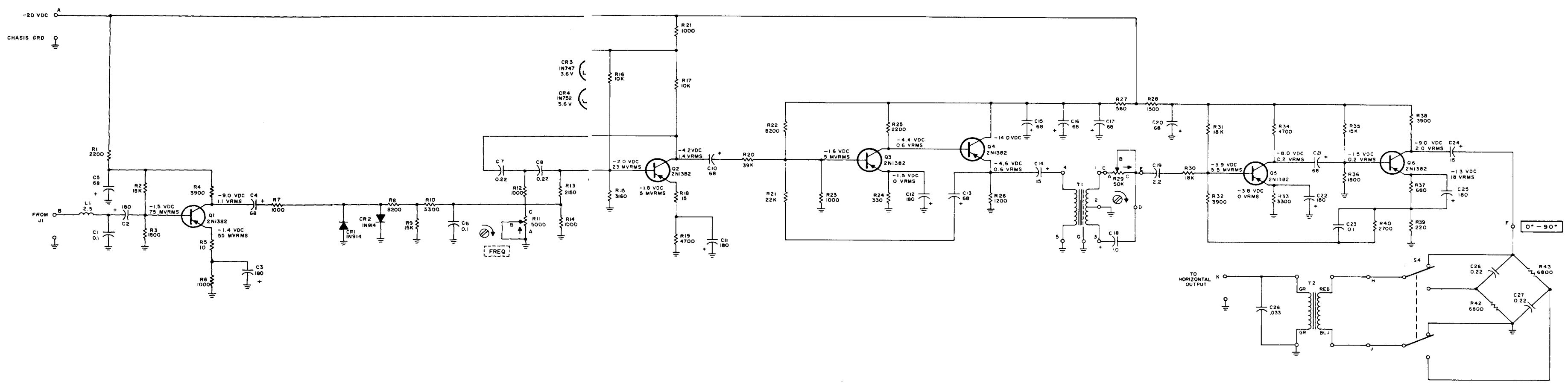


Figure 6-10. 70E2-MW Sweep Synchronizer, Schematic Diagram

6-21/6-22

*Figure 6-10. 70E2-MV Sweep Synchronizer Schematic Diagram*

By Order of the Secretary of the Army

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SHAD (2)
Ft Gillem (10)
USA Dep (1)
Sig Sec USA Dep (1)
Ft Richardson (CERCOM Ofc) (2)
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(2 copies each unit)
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29-610

*ARNG:* None
*USAR*: None
For explanation of abbreviations used, see AR 310-50

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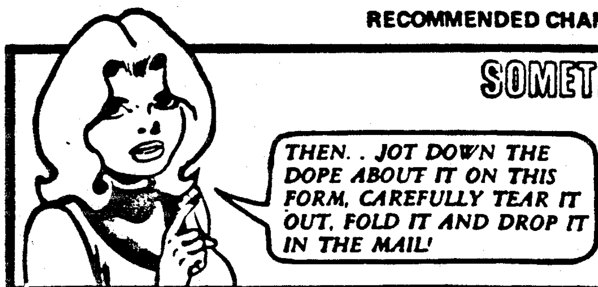


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