RADIO TEST EQUIPMENT
MICROWAVE TEST SETS
J68392A TRANSMITTER-RECEIVER TEST SET
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains descriptive information and operating procedures for the J68392A transmitter-receiver test set and the portable J68392G IF Reference Detector used with the TD-3 and TH-3 microwave radio systems. The operating procedures for the test set were previously issued in Section 104-415-300 which is replaced by this section.

2. DESCRIPTION

A. General

2.01 The J68392A transmitter-receiver test set provides the means for testing the TD-3 and TH-3 transmitter-receiver bays and their component parts. The test set is used both for routine maintenance testing, and for maintenance center (test bench) testing and troubleshooting. The test set is used to make IF and RF amplitude response measurements, IF and RF power measurements, IF and RF return-loss measurements, receiver noise figure measurements, and frequency measurements.

2.02 The equipment of the test set can be divided into four broad categories: IF equipment, RF equipment, common equipment, and miscellaneous apparatus. The IF equipment includes an IF oscillator, an IF return-loss bridge, an IF amplifier, an IF detector, and a low frequency (135 MHz) counter. The RF equipment consists of an RF oscillator, RF frequency meter, and a noise generator. (The RF frequency meter and noise generator were supplied only with early model test sets. Refer to 2.07 through 2.15, which cover differences between models.) The common equipment includes a control circuit, IF and RF power meter, counter, oscilloscope, power supply, and voltage regulator. The miscellaneous apparatus includes IF and RF cables, pads, attenuators, filters, transducers, and adapters.

2.03 The majority of the IF and RF tests are performed by applying a swept signal from the IF or RF oscillator to the input of the unit under test and displaying the detected output of the unit under test on the oscilloscope. The sweep test signals are controlled by the IF and RF control circuits.

2.04 The J68392G IF Reference Detector is designed for use with the J68392A test set to make periodic maintenance adjustments of the IF sweeper. The IF reference detector is used for maintenance of test consoles for both the TD-3 and TH-3 radio systems. The power measuring device used in the detector is a barretter connected in a wideband coaxial circuit. This test set makes it possible to verify the flatness of a sweeper to be ≤ 0.01 dB between 60 and 80 MHz. After the IF sweeper has been adjusted, it will serve as a reference for all IF-IF and IF-RF measurements.

B. Equipment Description

2.05 The components of the J68392A test set are mounted in a rolling console type cabinet (Fig. 1). All operating controls of the test set are contained on the front panels. The connections to the units under test are made from the front of the console. The left side of the cabinet consists of a door which is hinged full length along the rear of the cabinet. The door covers a shallow compartment containing a rack for storing the various cables used to connect the test set to the units under test. Panels at the rear and right side of the cabinet are fastened in place with snap latches. The panels can be easily removed for convenience in maintaining the test set. The lower of the two drawers in the front of the test set is equipped with molded plastic inserts to hold the small loose pieces of miscellaneous test equipment. The upper drawer has a hinged cover that serves as a writing and work shelf. The overall height of the test set is 69-1/4 inches; the cabinet base is 29-1/4 inches wide and 34-3/8 inches from front to rear. Power requirements are 115 volts, 60 Hz at approximately 8 amperes.

2.06 The J68392G IF Reference Detector, shown in Fig. 2. is a ruggedized precision test instrument. It is operated from 117 volts ac and is completely self-contained in a formica-clad portable carrying case with a walnut finish. It measures approximately 15 inches long by 8 inches wide by 7-1/2 inches high and weighs 14 pounds. On the front panel are the controls and a ruggedized meter for balancing the detector. Jacks are provided for connection of the IF input signal and measurement of the dc output as well as the connection of ac power. The barretter head is mounted on the input jack directly below the front panel in a shielded box.

Differences Between Models

2.07 The J68392A test set has undergone a considerable amount of change since it was first introduced. The different versions of the test set are identified by various list number suffixes to the basic J-code as explained in the following paragraphs.

2.08 The J68392A, List 1 version is the original configuration of the test set and is shown in Fig. 1, 3, and 4. The units mounted on the front are the counter, oscilloscope, power meter, RF oscillator, and RF frequency meter. In addition, there is the RF and IF sweep control unit panel containing the common controls, and the test set control panel containing the IF oscillator and IF amplifier controls, the patch field, and the IF attenuators. Figure 3 shows the cabinet with the back panel removed. At the bottom of the cabinet are located the test set power supply and the noise generator power supply. Also visible in this view are the IF oscillator, the −19 volt regulator, the IF amplifier, and the internal RF power-monitor head. This power head is connected to a monitor point on the RF oscillator and provides a continuous measurement of the oscillator output level. Figure 4 shows the interior of the test set from the right side. This view shows the noise generator. The internally mounted IF and RF power heads used for general power measurements, and other miscellaneous units.

2.09 The J68392A, List 2 change deleted the KS-19979 RF frequency meter, which is unnecessary for normal testing. A blank panel is mounted in the space formerly occupied by the meter in the front panel.

2.10 The J68392A, List 3 change deleted the RF power monitor feature of the RF oscillator. This change removed the internal RF power-monitor head used to continuously monitor the oscillator output power. This feature is not necessary for any normal test set application.

2.11 The J68392A, List 4 change deleted the noise generator and its power supply. This change was made possible by the development of an alternate method of measuring the receiver noise figure.

2.12 The List 5 modification substituted the KS-20383 RF oscillator for the KS-19974 oscillator originally supplied. This change was made to add 6-GHz capability to the test set to permit its use with the TH-3 system. The original KS-19974 oscillator covers only the 4-GHz band; the KS-20383 oscillator covers both the 4-GHz and 6-GHz bands. In addition, this change substituted an external RF power head for the internally mounted head originally supplied. This change, which permits connecting the RF power head directly to the unit under test instead of through a connecting cable, is necessary for satisfactory power measurements in the 6-GHz band. Figure 5 shows this version of the test set.

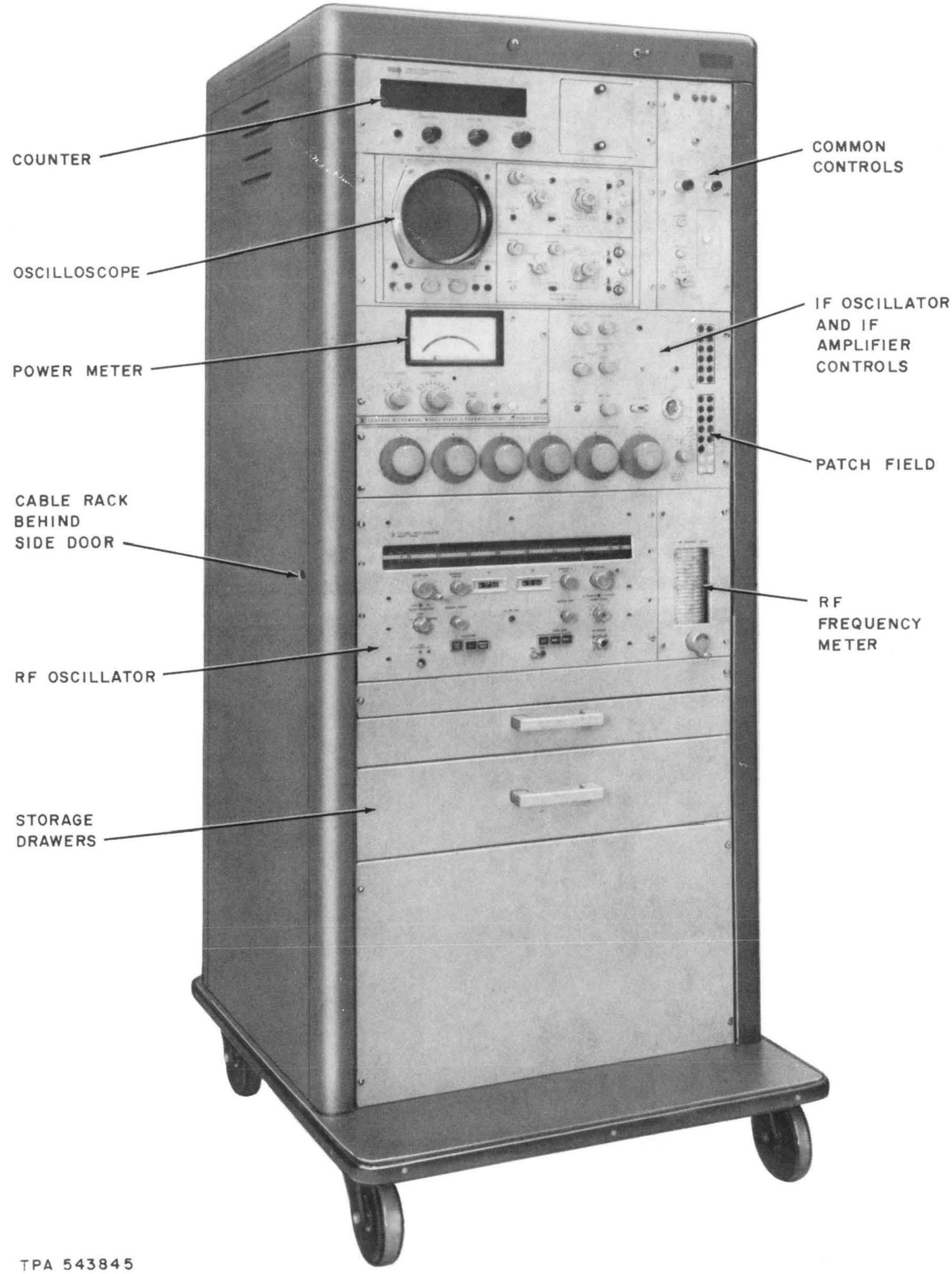

Fig. 1—J68392A, List 1 Transmitter-Receiver Test Set

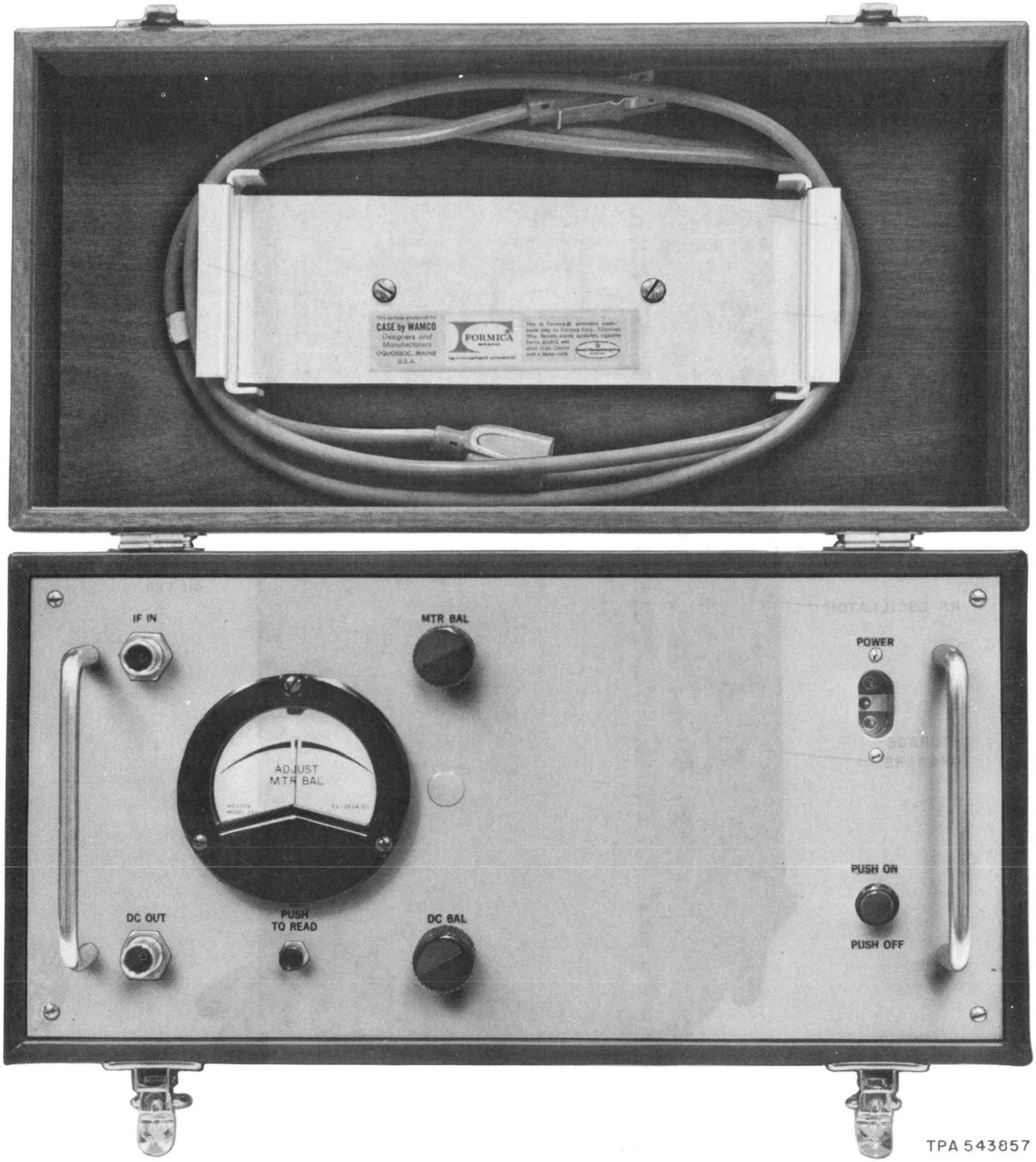

Fig. 2—J68392G—IF Reference Detector

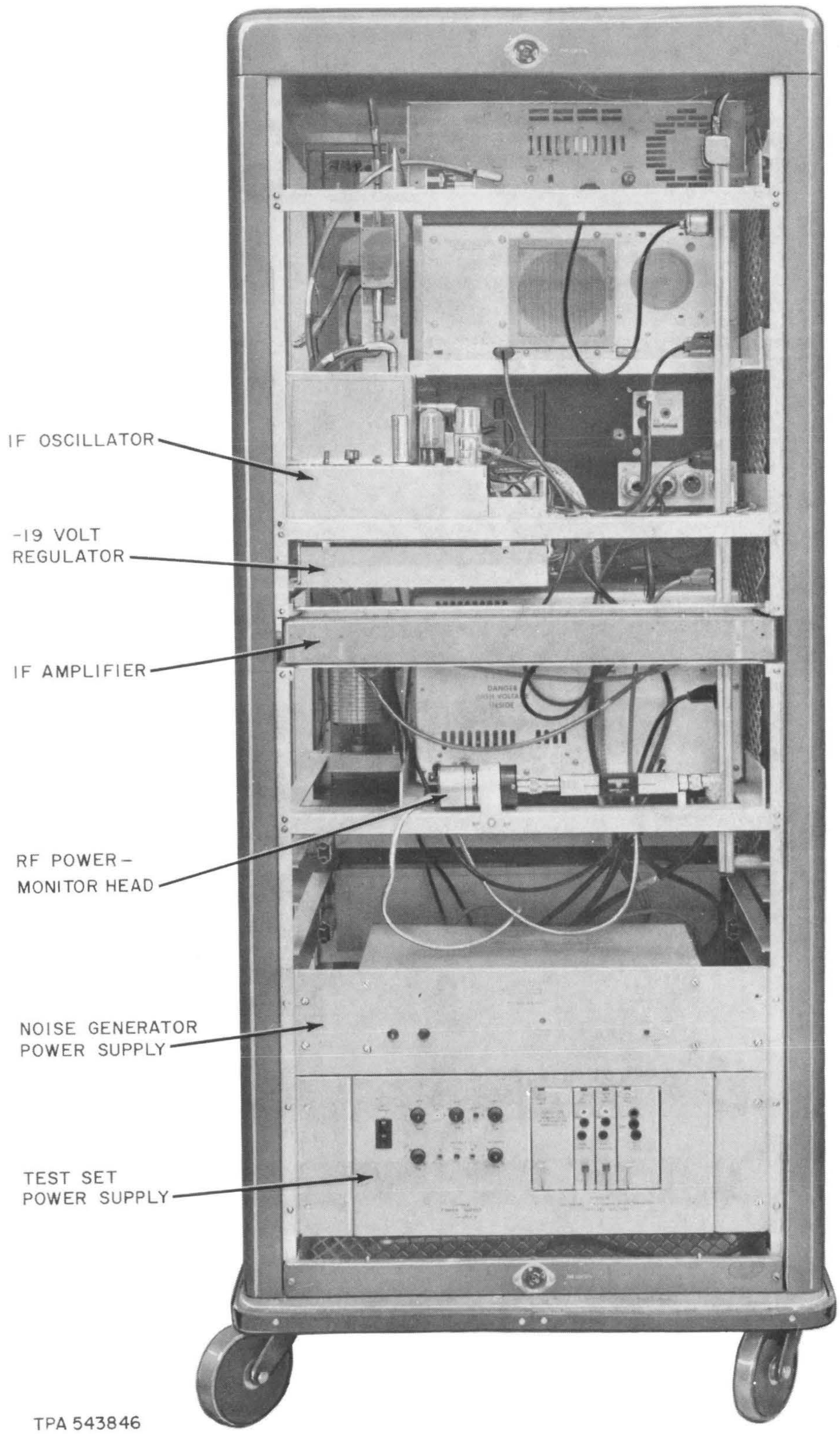

Fig. 3—J68392A, List 1 Transmitter-Receiver Test Set—Rear Panel Removed

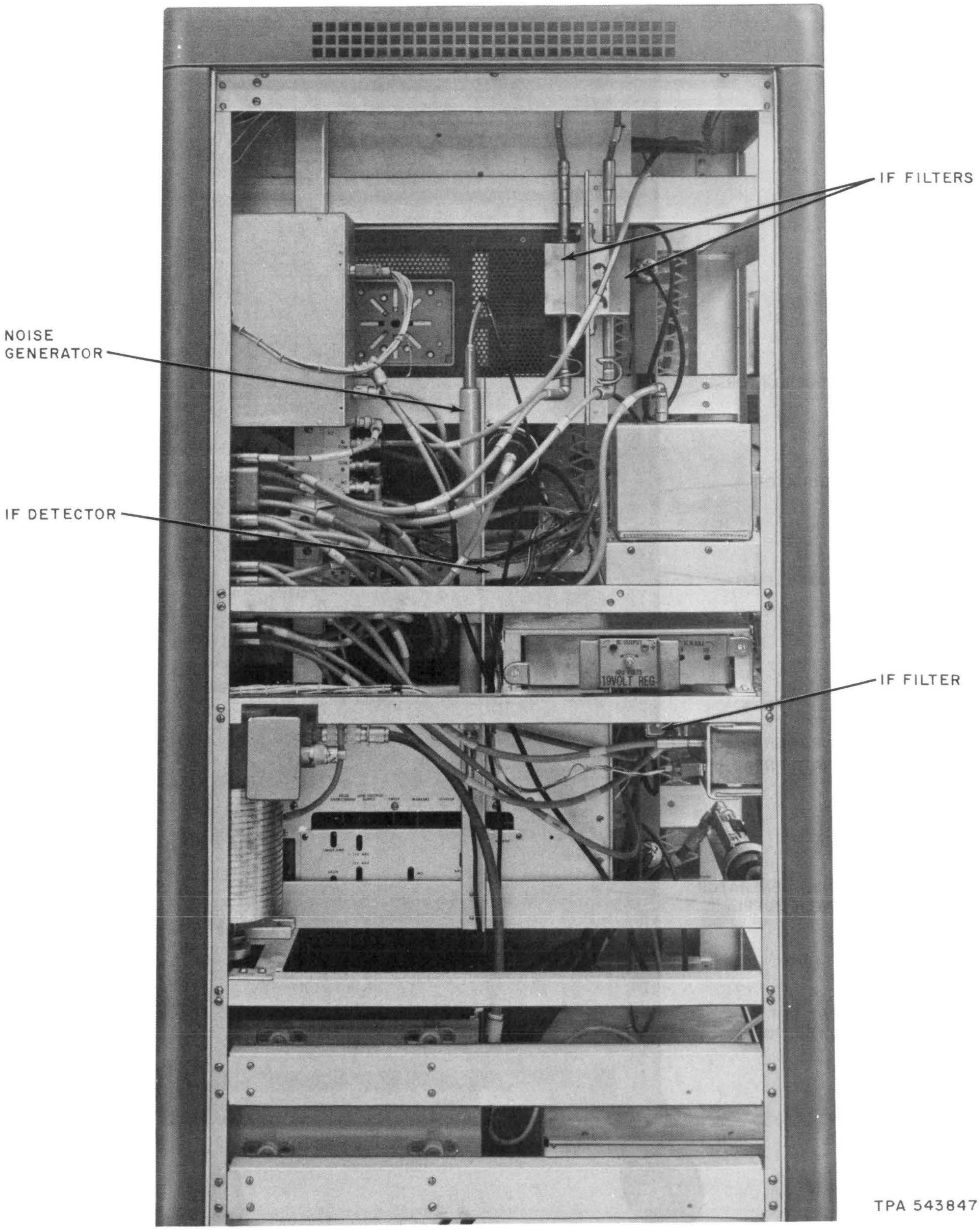

Fig. 4—J68392A, List 1 Transmitter-Receiver Test Set—Right Side Panel Removed

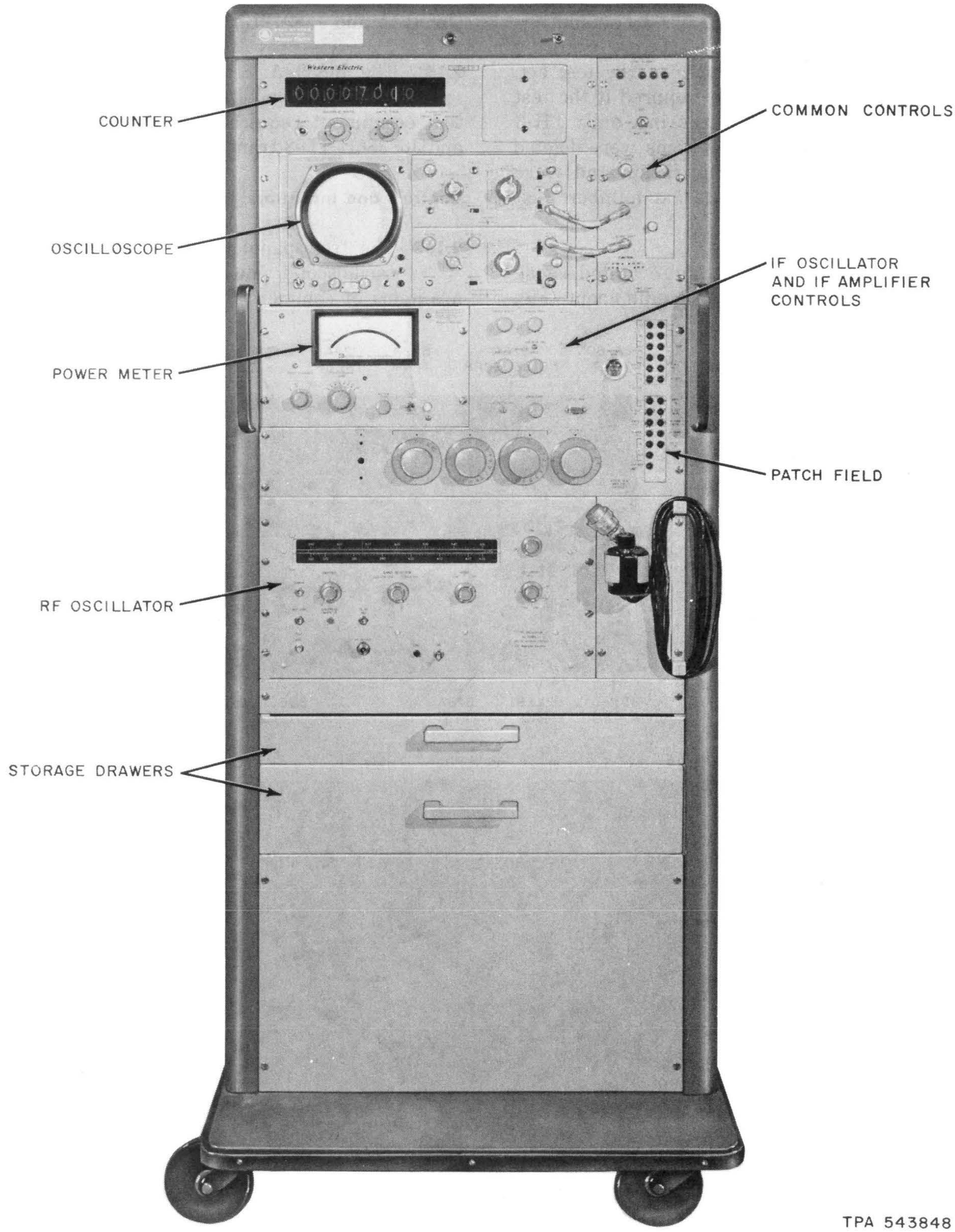

Fig. 5—J68392A, List 5 Transmitter-Receiver Test Set

2.13 All the miscellaneous items of test equipment required (Fig. 6) to test TD-3 transmitter-receiver bays (J68386A and J68386B) were originally incorporated in the List 1 version of the test set. Since these items would not be required if the test set were to be utilized for testing only TH-3 transmitter-receiver bays, these items were deleted from the basic test set configuration and were grouped together as a separate list number, List 6.

2.14 The J68392A, List 7 change added those miscellaneous items of test equipment (Fig. 7) necessary to test TH-3 transmitter-receiver bays (J68912A and J68912B).

2.15 The J68392A, List 8 change to the test set added some additional items of miscellaneous test equipment required for testing the J68386G and J68386H TD-3 transmitter-receiver bays.

Controls and Indicators

2.16 The front-panel-mounted frequency counter, oscilloscope, power meter, and RF oscillator are items of commercial test equipment. Complete

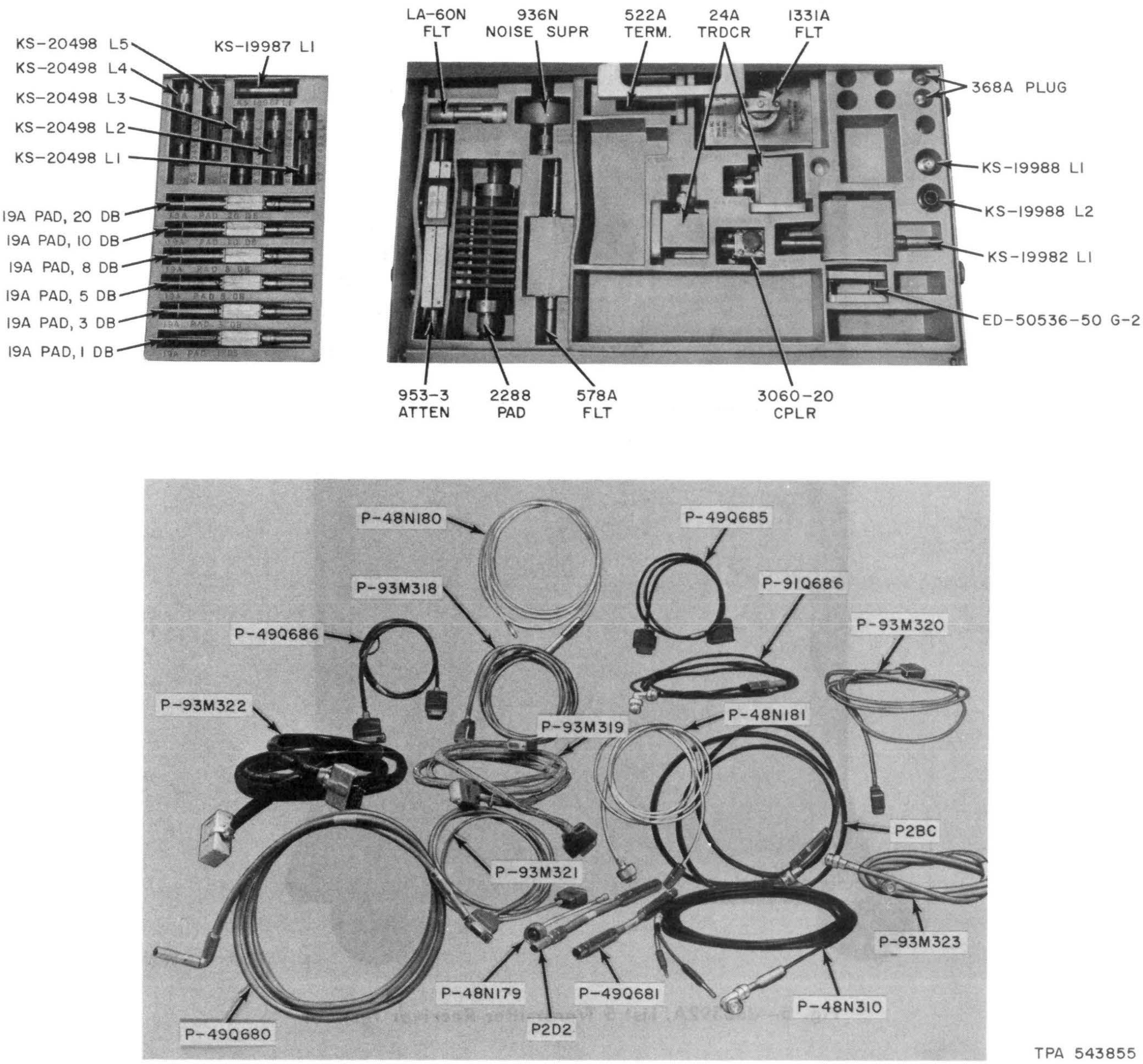

Fig. 6—J68392A, List 6 Miscellaneous Test Equipment For 4-GHz Systems

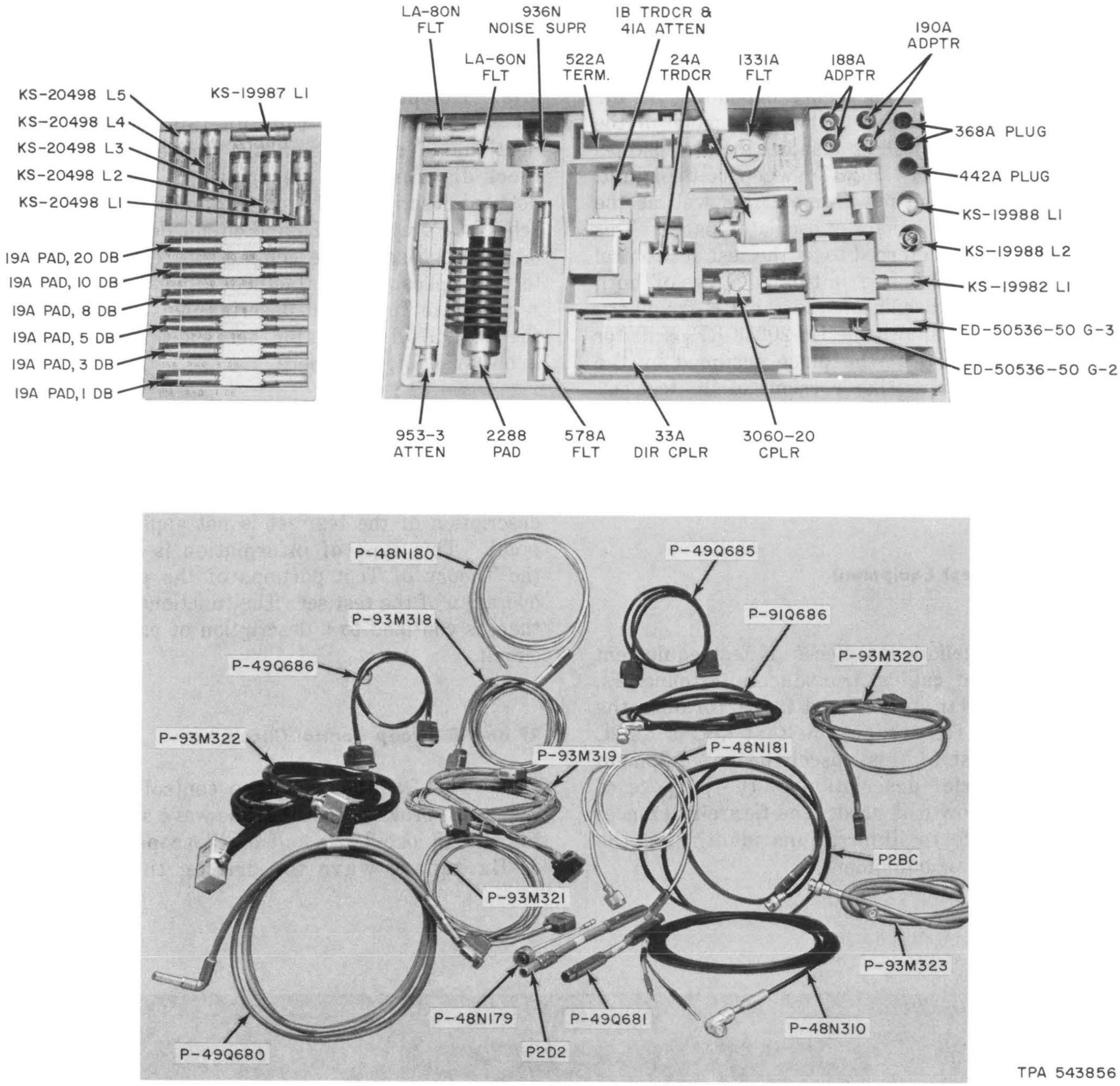

Fig. 7—J68392A, List 7 Miscellaneous Test Equipment For 6-GHz Systems

descriptive and operating information for each of these units is contained in the respective manufacturer's manual. These manuals have cover-sheet sections as follows:

(a) KS-19977 frequency counter—104-415-510

(b) KS-19976 oscilloscope—104-415-511

(c) KS-19978 power meter—104-415-513

(d) KS-19974 RF oscillator—104-415-508

(e) KS-20383 RF oscillator—104-415-514

For the convenience of the craftsman in learning and operating the test set, the front panels of these and other units showing all the controls and indicators are illustrated in this section. (Figures for the frequency counter and the RF oscillators are typical units, however there will be some variation in control location and appearance depending on the manufacturer.) Figure 8 is the front panel of the frequency counter, and Fig. 9 shows the oscilloscope. Figure 10 is the RF and IF sweep control unit. Figure 11 shows the power meter, as well as the attenuator, jack and marker oscillator panel. This panel is generally referred to as the test set control panel. Figure 12 is a front-panel view of both the KS-19974 RF oscillator and the RF frequency meter. Figure 13 shows the KS-20383 RF oscillator with a blank panel at the place occupied by the frequency meter in earlier versions of the test set. Table A lists the test set controls, switches, and indicators that are not covered by the manufacturers' manuals. The table contains a brief functional description of each item listed.

Miscellaneous Test Equipment

2.17 The miscellaneous pieces of test equipment consist of cables, transducers, attenuators, and other similar items used in performing the various tests for which the test set is used. Table B is a list of this miscellaneous equipment containing a brief description of the purpose of each item and how it is used. The figure references in the table are to illustrations identifying the individual items of equipment.

C. Functional Description

General

2.18 Except for the description of the KS-19975 IF oscillator, the functional description portions of this section are limited in scope to block-diagram type descriptions. For a more detailed description of a unit, refer to the applicable schematic drawing (SD) and circuit description (CD) or, in the case of the commercial test equipment, to the applicable manufacturer's manual (See 2.16). A complete functional description is provided for the KS-19975 IF oscillator, because this information is not available elsewhere.

2.19 The different units of the test set are connected together in slightly different configurations, depending on the type of test being performed. Therefore, an overall block diagram description of the test set is not applicable at this point. This type of information is contained in the Theory of Test portions of the part covering operation of the test set. The functional description, then, is confined to a description of each individual circuit.

RF and IF Sweep Control Circuit

2.20 The RF and IF sweep control circuit (Fig. 14) provides a 31-Hz sine-wave sweep voltage for the IF oscillator and oscilloscope, supplies a 31-Hz square wave for driving the reference

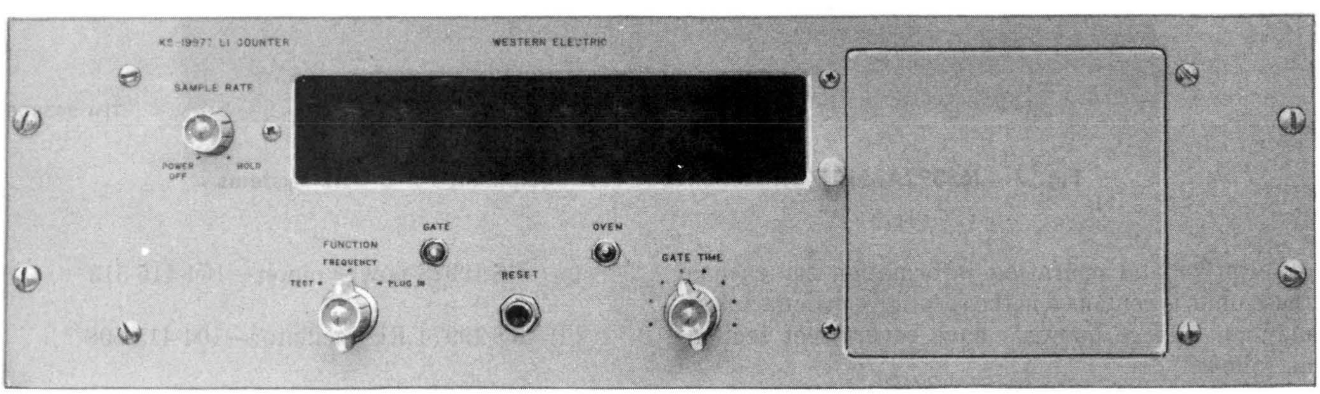

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Fig. 8—KS-19977 Frequency Counter—Controls and Indicators

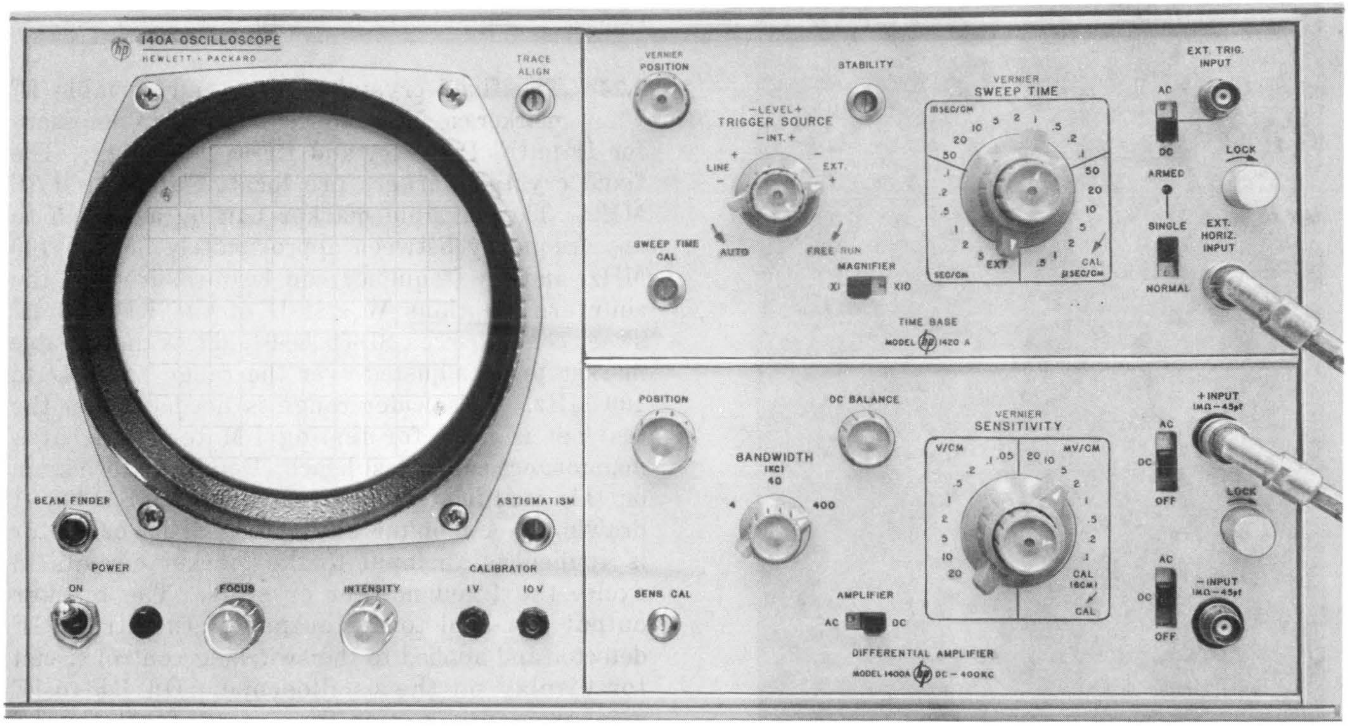


Fig. 9—KS-19976 Oscilloscope—Controls and Indicators

trace—test trace switching relay, and provides the fixed and variable IF markers.

2.21 The 31-Hz oscillator and oscilloscope drive circuits provide the overall synchronization for the test set whenever swept tests involving the IF oscillator are being performed. The circuit has three 31-Hz, sine-wave outputs. One output is used as a sweep voltage for the oscilloscope and is applied to the horizontal input of the oscilloscope through the switching control circuit. Another output is applied through the switching control circuit to the relay drive circuit. The third output is a sweep voltage for the IF oscillator. Two of the front panel controls are associated with the third output. These are the IF SWEEP WIDTH and IF CENTER FREQ controls. The control names are indicative of their functions: the IF SWEEP WIDTH control is used to adjust the amount of sweep of the IF oscillator, and the IF CENTER FREQ control is used to set the center frequency of the IF oscillator.

2.22 The switching control circuit is used to select the 31-Hz input from either the 31-Hz oscillator or the RF oscillator for application to the relay drive circuit. The square-wave output from the relay drive circuit is connected to a switching relay in the switching control circuit. The relay alternately switches the oscilloscope vertical input between a dc reference voltage and the dc output from either the IF marker and the IF detector or, in the case of IF-to-RF measurements, the IF marker and the RF detector. The control circuit also selects the required oscilloscope sweep from either the 31-Hz oscillator and oscilloscope drive circuit (IF-to-IF or IF-to-RF measurements), or the 31-Hz signal from the RF oscillator (RF-to-RF or RF-to-IF measurements) for connection to the oscilloscope horizontal input. Front panel controls associated with the switching control circuit are the FUNCTION switch, the TEST TRACE control, and the REF TRACE control.

2.23 In addition to the 31-Hz input, the relay drive circuit also receives two other inputs from the switching control circuit—the trace start and trace stop inputs. These inputs determine the length of time that the relay is energized on each half cycle. The controls associated with these inputs (See Table A) are used to adjust the vertical

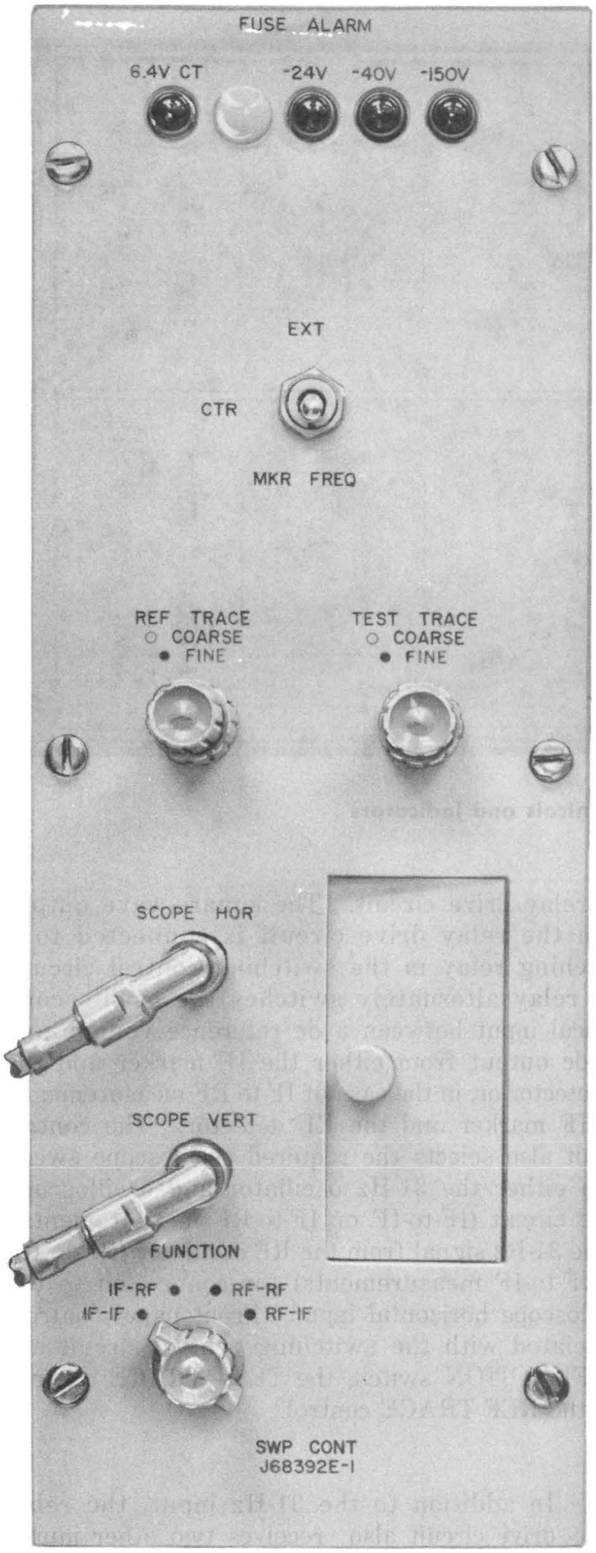


Fig. 10—RF and IF Sweep Control Unit Panel—Controls and Indicators

alignment of the end-points of the test and reference traces.

2.24 The fixed crystal marker and variable IF marker circuits produce the markers necessary for IF-to-IF, IF-to-RF, and RF-to-IF testing. The fixed crystal markers are located at 64 and 76 MHz. The variable marker can be adjusted to any frequency between approximately 55 and 100 MHz, and its frequency can be measured by the counter. (Options W and U of the RF and IF sweep control circuit SD-50566-01, allows the variable marker to be adjusted over the range from 47 to 100 MHz. This wider range is needed when the test set is used for testing FM terminals at a maintenance center test bench. Detailed information on this modification is given on the ED-51303-01 drawing.) A monitor output of the IF oscillator is applied as an input to the marker circuits to excite the fixed marker crystals. The marker output is added to the output of the RF or IF detector and applied to the switching control circuit for display on the oscilloscope. On RF-to-IF measurements, a monitor output from the IF detector is used as an input to the marker circuit instead of the monitor signal from the IF oscillator. The amplitude and frequency of the variable marker are controlled by front panel controls VAR MKR AM and IF MARKER FREQ, respectively. The amplitude of both the fixed and variable markers is controlled by the IF MARKER AMPLITUDE control.

IF Amplifier

2.25 The IF amplifier (Fig. 15) consists of eleven gain stages giving a total gain of approximately 61 dB, and seven variolosser stages with adjustable loss of from 0 to 5 dB. Thus, the overall gain of the amplifier is adjustable over a 35-dB range from approximately 26 dB to approximately 61 dB. The control current for the variolosser stages is derived from −19 volts and is controlled by the AMPL GAIN control mounted on the front panel of the test set. The input and output stages have internal controls for adjusting the return loss of the amplifier, and two of the stages have controls for adjusting the amplitude slope characteristic of the amplifier.

IF Detector

2.26 The IF detector (Fig. 16) is used to convert an incoming IF signal to a dc output voltage. The level of the output is proportional to the level pp. 13-14 missing in original. If you have these please contact sametler@gmail.com

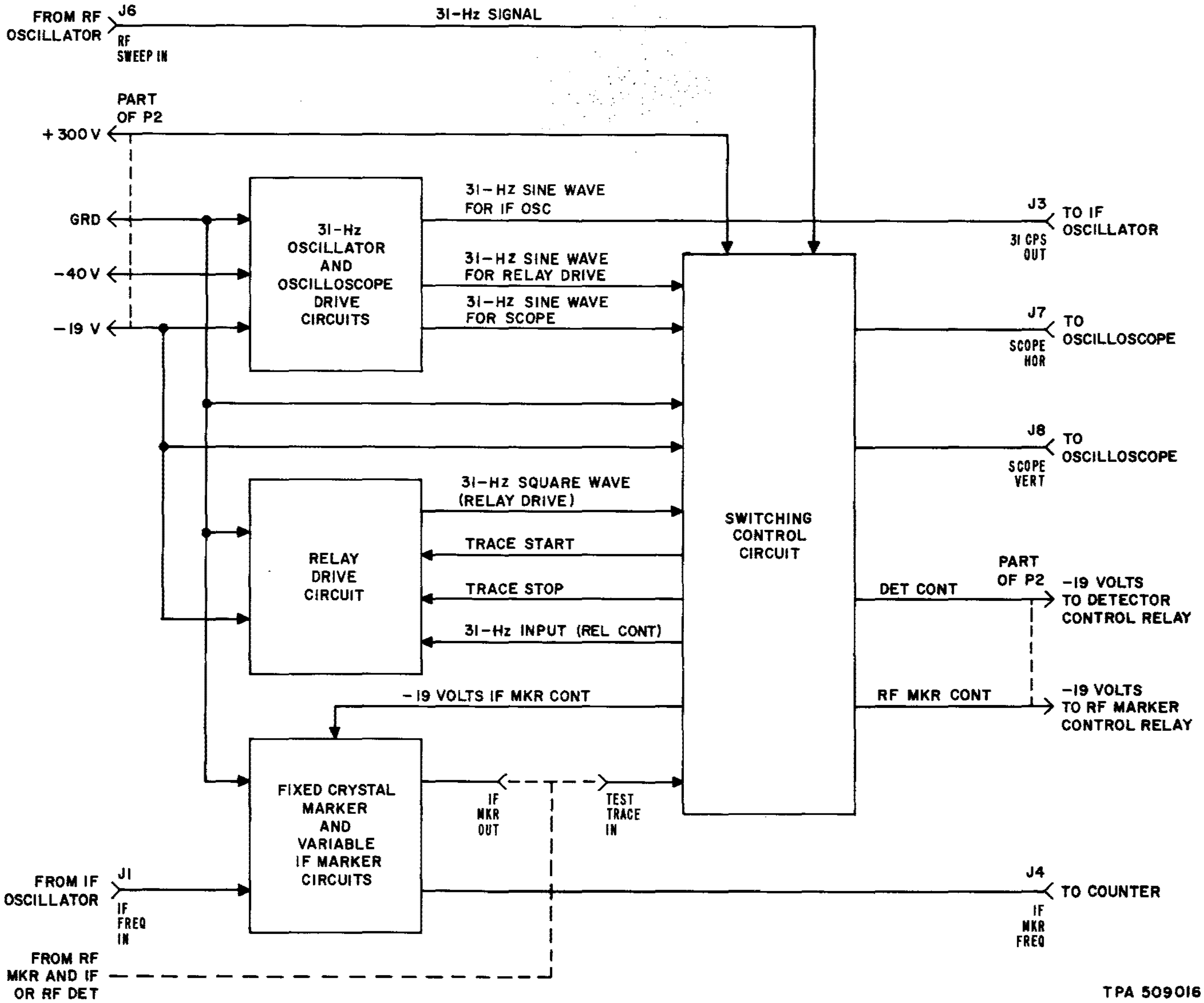


Fig. 14—RF and IF Sweep Control Circuits—Block Diagram

2.29 The input to the grid of V3 consists of a 31-Hz sine wave superimposed on a dc bias. This bias selects the midpoint of conduction of V3 and establishes the center frequency of oscillation of V1 and V2. The 31-Hz voltage causes the conduction to vary above and below this midpoint. The greater the amplitude of the 31-Hz voltage, the greater the change in conduction of V3; thus, the greater the swing in oscillator frequency. The values of bias voltage and 31-Hz voltage are set by the IF CENTER FREQ and IF SWEEP WIDTH controls, respectively, in the RF and IF sweep control circuit (See 2.21).

2.30 The output of the oscillator is taken from the output winding of T1 and applied through a filter to the IF OUT jack. The level of the output is kept constant by action of the automatic level control circuit composed of electron tubes V4, V5, and V6 and their associated circuitry. A sample of the oscillator output signal is taken from a capacitive voltage divider, rectified by diode CR1, and applied to the grid of V4A. This dc voltage is proportional to the output level. A dc bias voltage taken from OUTPUT LEVEL potentiometer R20A controls the conduction level of the stage. Since V4A and V4B have common cathodes, any

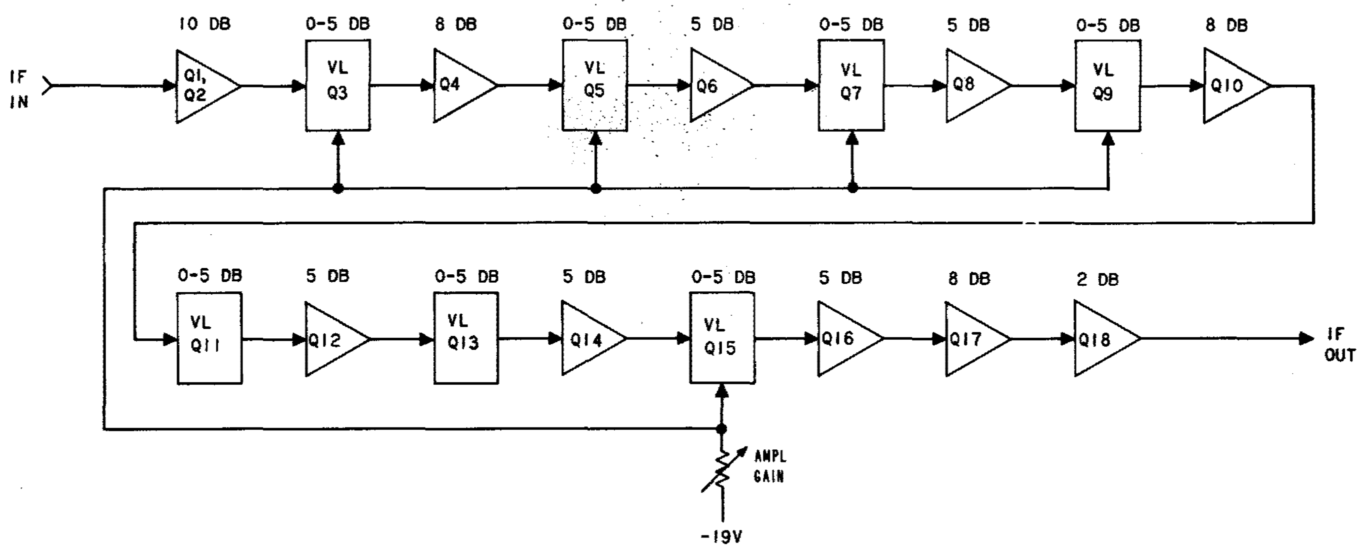


Fig. 15—IF Amplifier—Block Diagram

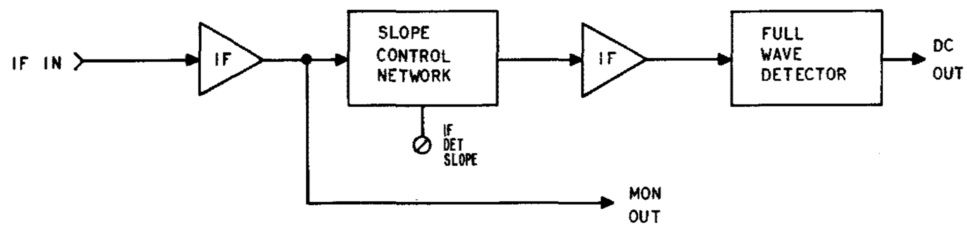


Fig. 16—IF Detector—Block Diagram

change in conduction in V4A is cathode-coupled to V4B. Tube V4B operates as a grounded grid amplifier. The output from V4B is applied to the control grid of V5. The output of V5 is dc-coupled to the control grid of V6. The two sections of V6 are operated in parallel. A bias voltage from OUTPUT LEVEL potentiometer R20B is applied to the grid of V6 to control its conduction level. Conduction of V6 controls the plate voltage applied to oscillator V1 and V2. Any change in oscillator output level produces an error voltage at the grid of V4A. This produces an amplified error voltage on the grid of V6 and, hence, on the plates of V1 and V2. This action reduces the error voltage to zero and maintains the output of the oscillator at a constant level as determined by the setting of the OUTPUT LEVEL control. Refer to Section 104-415-504 for a schematic diagram of the IF oscillator.

Return-Loss Bridge

2.31 The KS-19982 return-loss bridge (Fig. 18) is used to make return-loss measurements on IF components. The bridge operates with a 75-ohm impedance and can measure up to 50-dB return loss in the 50- to 100-MHz range. The return-loss bridge is a network which operates on the principle of the Wheatstone bridge. The input terminals (IN) of the bridge are connected to the IF sweep oscillator, the unknown terminals (UNKNOWN) are connected to the unit to be tested, and the output terminals (OUTPUT) are connected through the IF detector to the oscilloscope. The sweep of the oscilloscope is synchronized with the sweep of the IF oscillator.

2.32 With a 75-ohm swept signal applied to the IN terminals and a calibrated 75-ohm

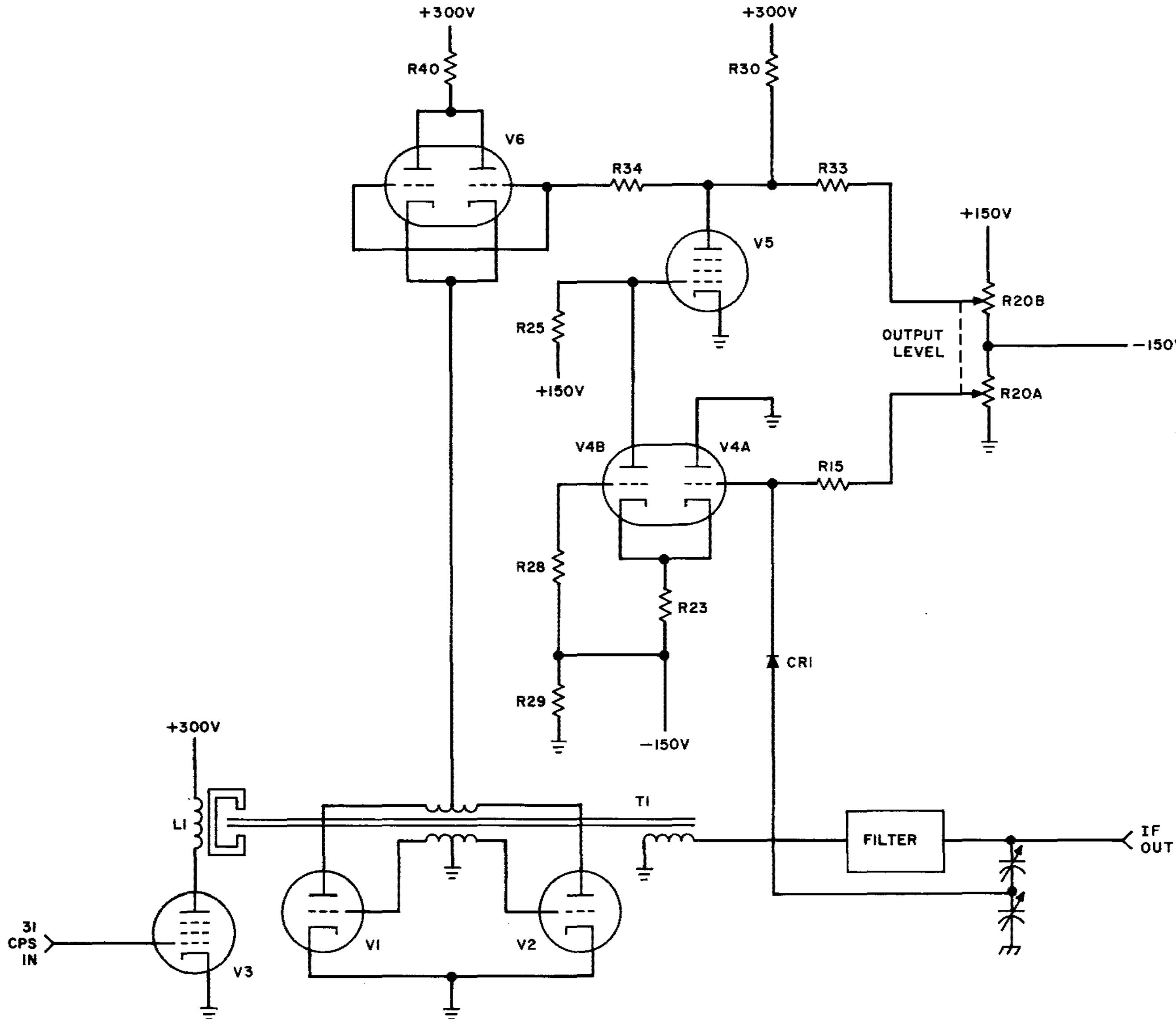


Fig. 17—IF Oscillator—Simplified Schematic Diagram

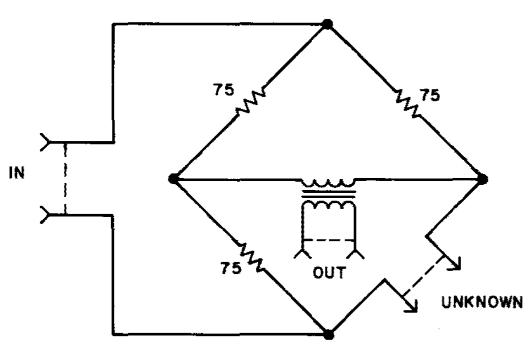


Fig. 18—Return-Loss Bridge—Simplified Schematic Diagram

termination attached to the UNKNOWN terminals, the bridge will be in balance and no current will flow through the primary of the output transformer; thus, no voltage will appear in the secondary of the output transformer. If a termination other than 75 ohms is attached to the UNKNOWN terminals, the bridge will be out of balance and current will flow through the primary of the output transformer, producing a voltage in the secondary of the transformer. This output voltage, which is directly related to the reflected voltage component due to the mismatch of impedances at the UNKNOWN terminals, is displayed on the oscilloscope. Since the oscilloscope sweep is synchronized with the IF oscillator sweep, the oscilloscope displays the return-loss characteristic of the termination as a function of frequency over the swept frequency band.

RF Frequency Meter

2.33 The KS-19979 RF frequency meter is a direct-reading, high-resolution frequency meter that operates in the range of 3600 to 4300 MHz. The unit consists of a high-Q mechanically-tuned cavity coupled to a coaxial transmission line. A built-in diode detector coupled to the cavity provides a dc output voltage when the cavity is tuned to resonate at the frequency of the RF signal present in the coaxial line. The frequency meter is accurate to ±0.5 MHz at normal room temperature. The meter is supplied only with the J68392A, List 1 version of the test set. Refer to the part covering differences between models, 2.07 through 2.09.

RF Oscillator

2.34 The KS-20383 RF oscillator is used to supply the unit under test either a single frequency or swept RF signal in the 3.6- to 4.3-GHz band or 5.9- to 6.5-GHz band. Depending on the manufacturer either a backward wave oscillator (BWO) tube or a transistor oscillator-varactor diode multiplier circuit, is used as the source of RF power. Connection between the oscillator and the unit under test is made using an 8-foot coaxial cable assembly, on the output end of which is connected a directional coupler and RF detector. This forms part of a leveling loop. The portion of the RF output signal appearing in the sidearm of the directional coupler is detected by the RF detector. The dc output of the detector is fed back to the oscillator via the cable assembly. After amplification, this feedback signal is applied to a PIN diode modulator located at the output of RF source. The modulator acts as a variable attenuator in which the amount of attenuation inserted in the transmission path is dependent on the dc voltage from the detector. By means of this leveling loop, approximately constant output power over each swept-frequency band is supplied to the unit under test. The leveled output power available can be continuously adjusted over a 5-dB range from +8 to +13 dBm. For swept RF-to-RF or RF-to-IF measurements, a 31-Hz triangular sweep voltage from an internal oscillator is applied to the RF source. A portion of this sweep voltage is delivered to the RF and IF sweep control circuit to provide synchronous operation of the reference trace—test trace relay, and to supply the horizontal sweep voltage for the oscilloscope.

2.35 In test sets before the J68392A, List 5 version, the KS-19974 RF oscillator was supplied. (Refer to 2.07 through 2.12 which cover differences between models.) The earlier model oscillator is similar to the BWO version of the KS-20383 oscillator except that it supplies only a 3.6- to 4.3-GHz output and has a leveled power output which is continuously adjustable over a 10-dB range from +10 to +20 dBm. For a complete description of the KS-19974 RF oscillator, refer to the manufacturer's manual filed with Section 104-415-508; for the KS-20383 oscillator, refer to Section 104-415-514.

Frequency Counter

2.36 The KS-19977 frequency counter is a digital counter capable of measuring frequencies up to 135 MHz. An 8-digit, in-line display of the measured frequency is presented on the front of the counter. A coaxial relay in the test set controlled by the CTR switch on the RF and IF sweep control unit panel can be switched to select as an input to the counter either an output from the variable IF marker oscillator, to permit measuring its frequency, or an output from an external source connected to the CTR jack on the test set patch field.

2.37 For a complete description of the frequency counter, refer to the manufacturer's manual filed with Section 104-415-510.

Oscilloscope

2.38 The KS-19976 oscilloscope is used for displaying the swept amplitude response and return-loss characteristics of the unit under test. The oscilloscope has plug-in units for both the horizontal and vertical deflections. These inputs to the oscilloscope are normally obtained from the RF and IF sweep control circuits of the test set, although the internal sweep circuits of the oscilloscope may be used for some measurements. For a complete description of the oscilloscope, refer to the manufacturer's manual filed with Section 104-415-511.

Noise Generator

2.39 The KS-19980 noise generator provides a reference amount of noise in the 3.6- to 4.3-GHz band for use in TD-3 receiver noise figure measurements. The generator consists of an argon gas noise tube mounted in a coaxial structure and operated from an associated power supply. The noise generator was furnished only in early versions of the test set and was removed by the J68392A, List 4 change. Refer to the part covering differences between models, 2.07 through 2.15. For a complete description of the noise generator, refer to the manufacturer's manual filed with Section 104-415-512.

Power Meter

2.40 The KS-19978 power meter is capable of measuring any power between −35 dBm and +10 dBm over the frequency range from 2 MHz to 12.4 GHz. A switch on the power meter is used to select either a 75-ohm coaxial head for IF power measurements or a 50-ohm coaxial head for RF power measurements. A thin-film thermoelectric junction is used in each head to convert the incident power to a proportional dc voltage which is then applied to the meter unit. For a complete description of the power meter, refer to the manufacturer's manual filed with Section 104-415-513.

Power Supply

2.41 The J87296A power supply (Fig. 19) provides voltages required for the IF oscillator, the RF and IF sweep control circuit, and the −19 volt regulator. The power supply requires a nominal input voltage of 117 volts ac, and supplies four dc output voltages (−24, −40, −150, and +300) and one ac voltage (6.4 center tapped). The ac input voltage is transformed and regulated by two ferroresonant regulated transformers, T1 and T2. Transformer T1 supplies regulated ac inputs for the −24 and −40 volt dc supplies and an unregulated 6.4-volt ac output. Transformer T2 supplies regulated ac inputs for the −150 and +300 volt dc supplies.

2.42 The 6.4-volt output of the power supply is taken directly from a winding on transformer T1. This winding is placed on the linear portion of the transformer, and its output is, therefore, unregulated. The 6.4-volt output has a current capacity of 3.9 amperes and furnishes heater power for the tubes in the IF oscillator.

2.43 The −24 volt, −40 volt, −150 volt, and +300 volt supplies all use conventional full-wave rectifiers (diodes CR2 through CR5 and CR9 through CR12). The −24 volt output is filtered by capacitor C2 and applied directly to the output connector. This supply has a current capacity of approximately 0.9 ampere and furnishes the input power for the −19 volt regulator. The −40 volt output is filtered by capacitor C3 and regulated by regulator CP3. This supply has a current capacity of about 10 milliamperes, and provides bias for the RF and IF sweep control circuit. The −150 volt output is filtered by capacitor C6 and regulated by regulator CP2. The −150 volt supply has a current capacity of about 10 milliamperes, and furnishes bias voltage for the IF oscillator. The +300 volt output is filtered by capacitor C5 and regulated by regulator CP4. This supply has a current capacity of about 130 milliamperes. The supply furnishes principally plate voltage for the IF oscillator. It also is used for bias voltage in the RF and IF sweep control circuit.

−19 Volt Regulator

2.44 The J87279A −19 volt regulator supplies the −19 volts required for the IF amplifier, IF detector, and RF and IF sweep control circuits. The regulator is a solid-state, active series line regulator that drops the nominal −24 volt input voltage from the power supply to −19 volts. Regulation is maintained to within ±0.2 volts between 70° and 80°F, and within ±0.4 volts between 40° and 140°F, for input voltages between −21 and −27 volts. Although the regulator has a capacity of 4 amperes, it can deliver only about 1 ampere in the test set application because of the limited capacity of the −24 volt power supply. About 400 milliamperes is available at the EXT DC PWR connector on the test set control panel for powering external circuits. The regulator chassis contains DC OUTPUT pin jacks, for connection of a voltmeter, and three controls. These are the ADJ VOLTS control for adjusting the output voltage, and HV ALM ADJ and LV ALM ADJ controls. These latter two controls are used to set the high-voltage and low-voltage alarm trip points, and are not used in the test set application of the regulator.

IF Reference Detector

2.45 The J68392G IF Reference Detector (Fig. 2) is used to adjust the sweep output power

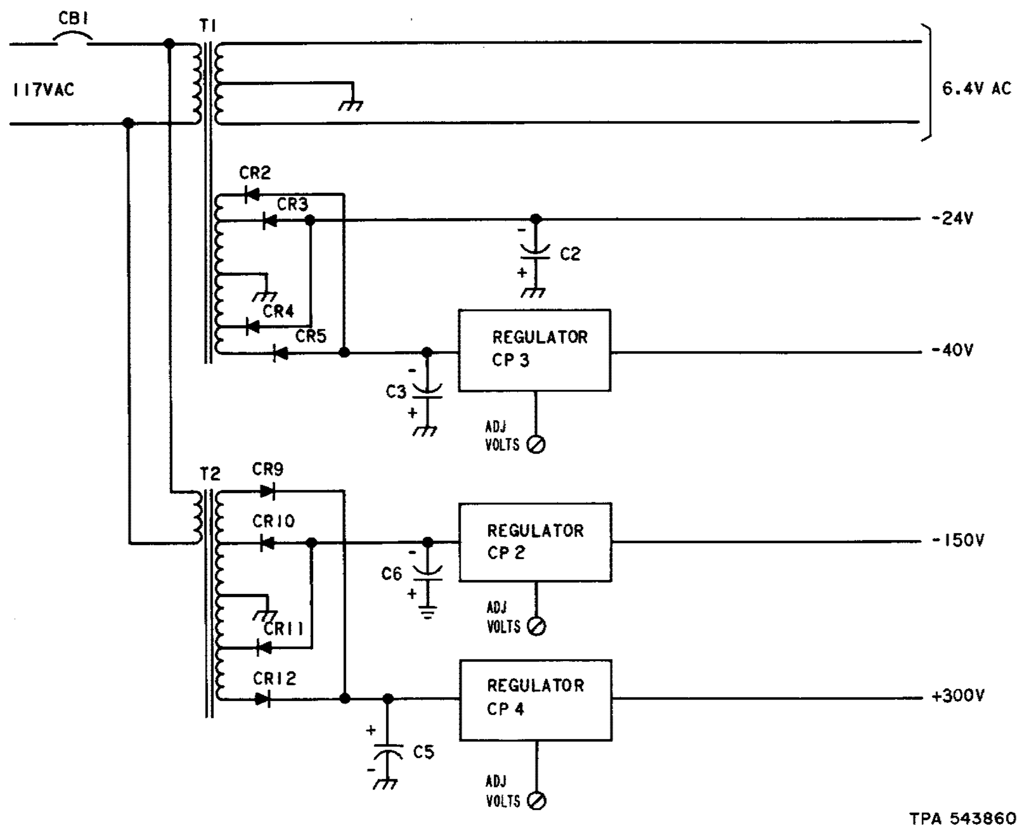


Fig. 19—J87296A Power Supply—Simplified Schematic Diagram

of the IF sweeper in the test set console to be flat with frequency. The detector uses a resistive bridge with a barretter in one arm, thus if the temperature changes, the bridge becomes unbalanced. Power dissipation in the barretter is determined by the IF input and a dc bias current. To verify a constant sweeper output over its swept range, the reference detector is used as a test load. The rectification efficiency of the detector is essentially constant over a 50- to 90-MHz range, and its response time is fast enough to follow power changes at a 31-Hz sweep rate.

3. OPERATION AND THEORY OF TESTS

A. General

3.01 This part contains the operating procedures for the transmitter-receiver test set when used for general types of tests. No attempt has been made to describe all the tests that can be performed; only the tests that are normally considered routine are covered. Each subpart contains a theory of test and a general setup and calibration procedure for each type of test covered. The specific tests are included in other applicable transmitter-receiver bay sections.

3.02 Most tests require that the unit under test have the normal dc power applied. As noted in 2.44 the EXT DC PWR jack on the test set will provide −19 volts at up to 400 milliamperes of current, and may be used to power the unit under test if required. Power cables are furnished with the test set for this purpose (See Table A).

> ***Note:*** Except for the microwave generator, the current capacity of this source is sufficient to power any one individual unit in the transmitter-receiver bay requiring −19 volts.

3.03 While working on the test equipment, observe all general safety precautions outlined in Section 010-110-001.

Warning 1: A number of the voltages employed in this test set are LETHAL.

Warning 2: DO NOT look into an energized waveguide. The RF power density within 3 inches of the open end of a waveguide carrying a power of 1 watt or more is potentially hazardous to the eyes or other body tissue.

3.04 The operating procedures covered are:

(a) Initial Setup of Test Set

(b) IF-to-IF Amplitude Response Measurements

(c) IF-to-RF Amplitude Response Measurements

(d) RF-to-RF Amplitude Response Measurements

(e) RF-to-IF Amplitude Response Measurements

(f) IF Return-Loss Measurements

(g) Antenna Waveguide System Return-Loss Measurements (Only test sets designated List 1 provide the necessary components to perform this test. To utilize test sets above List 1, a Weinschel model 1506 RF power divider must be obtained from the maintenance center.)

B. Operating Procedures

Initial Setup of Test Set

3.05 Perform the initial setup of the test set as follows:

(a) If any problems are encountered in the initial setup of the test set, refer to Section 104-415-501, Chart 1.

(b) Connect the ac power cord between either P55 or P56 at the top or bottom rear of the test set and a convenient 117-volt ac power source.

(c) Observe the pilot lamp at the top front of the test set. If the pilot lamp is not lighted, operate the adjacent toggle switch to the opposite position and the lamp should light.

(d) Check that the AC INPUT circuit breaker on the J87296A power supply (Located on the rear of the test set) is in the ON position. Observe that no fuse alarm lamps are lighted.

(e) Energize the counter, the oscilloscope, the power meter, and the RF sweep oscillator.

(f) Allow the equipment to warm up for at least 30 minutes.

(g) Set the INPUT CHANNEL switch on the power meter to the IF position. Determine that no input is connected; then zero the power meter by setting the POWER RANGE DBM switch to the −25 position and adjust the METER ZERO control for an indication of ZERO on the meter.

Note: The ZERO indication appears on the left side of the meter scale and should not be confused with the 0 indication on the right side of the meter scale.

(h) Set the FUNCTION switch on the counter to the TEST position. Press the RESET button and determine that the counter indicates 1 MHz ±1 count on the last digit; then set the FUNCTION switch to the FREQ position. The test set is now ready for operation.

Caution: Never apply more than +10 dBm to the power meter.

IF-to-IF Amplitude Response Measurements

Theory of Test

3.06 For IF-to-IF amplitude response measurements, a swept-frequency IF signal is applied to the unit under test, and an IF detector is connected to its output. The dc output of the detector is applied to the vertical deflection circuit of the oscilloscope. The horizontal deflection circuit is swept in synchronism with the input signal from the IF oscillator. The amplitude response is thus presented as an oscilloscope display of relative amplitude versus frequency. Deviations from the normal flat response are indicated directly on the oscilloscope, which is calibrated horizontally for frequency and vertically for amplitude.

3.07 An output from the 31-Hz oscillator (Fig. 20) provides the sweep voltage for the IF oscillator. The swept-frequency output of the oscillator appears at the IF OUT jack. A monitor output of the IF oscillator is used to drive the marker generating circuit. The marker generating circuit produces three markers: two fixed crystal-controlled markers and one variable marker. The fixed markers are at 64 and 76 MHz, and the variable marker can be set anywhere between 55 and 100 MHz (See 2.24). The fixed markers provide convenient reference points when calibrating the frequency (X or horizontal) axis of the oscilloscope display. The frequency of the variable marker can be read on the frequency counter. The three marker signals are added to the output of the IF detector, and appear on the test trace displayed on the oscilloscope.

3.08 The IF output from the unit under test is connected through the IF DET IN jack to the IF detector. The output of the detector is a dc voltage, the level of which is proportional to the amplitude of the IF input signal. This dc voltage is combined with the marker voltages from the marker generating circuit and applied to the 31-Hz relay. The relay, which is controlled by a voltage from the 31-Hz oscillator, alternately applies either the test signal plus markers or a dc reference voltage as the amplitude information to the Y (vertical) input of the oscilloscope. The X (horizontal) input of the oscilloscope is driven by the output of the 31-Hz oscillator. This synchronizes the sweep of the oscilloscope with the sweep of the IF oscillator and the action of the 31-Hz relay.

Preparation for Test

3.09 The preparation for test consists of calibrating the test set and connecting the test set to the unit under test. Calibration consists of checking that the output of the IF oscillator is +10 dBm, calibrating the oscilloscope, and adjusting the level of the IF signal being applied to the unit under test to the proper value. The step-by-step procedure is contained in Fig. 20.

3.10 Following is an explanation of what is being accomplished in each step that requires explanation.

Step 2: The output of the IF oscillator at the IF OUT jack is applied to the ATTEN 2 IN jack with a 372A plug. The output of the attenuator is applied through an 8-foot cord, a 6-inch adapter, and another 8-foot cord to the IF PWR METER jack [options (X) and (W)]. From there the signal is applied to the IF power head of the power meter.

Step 3: Controls on the test set are preset for the calibration procedure. The CTR switch in the MKR FREQ position connects the counter so that it measures the frequency of the variable marker output from the marker generating circuit. The FUNCTION switch is positioned to set up the test set for an IF-to-IF test. The power meter is set to measure an IF signal at a power between −5 dBm and −15 dBm. Attenuator ATTEN 2 was set for 17-dB attenuation in Step 1. The attenuated output of the IF oscillator is then measured at −7 ±1 dBm. The output of the IF oscillator is adjusted, if necessary, for the proper indication.

Step 4: The ATTEN 2 controls are adjusted so that −7 ±0.1 dBm is indicated by the power meter. This sets the proper input power for the IF detector.

Step 5: The attenuated output of the IF oscillator is changed from the IF PWR MTR jack to the IF DET IN jack [options (X) and (Y)].

Steps 6 through 10: The IF signal with markers superimposed appears on the oscilloscope display. The test set controls are adjusted to give 2-MHz per centimeter horizontal deflection with both the test trace and reference trace centered on the oscilloscope display and with the variable-frequency marker (set at 70 MHz) showing at the center of the display.

Step 11: Increasing the attenuation of the input signal will cause the test trace to be below the reference trace. The oscilloscope controls are adjusted such that 0.1 dB of additional attenuation causes the test trace to be 2 centimeters below the reference trace. (Each division of the oscilloscope graticule is one centimeter.) This calibrates the oscilloscope vertical deflection circuits for 0.05 dB per centimeter. Varying the setting of the IF DET SLOPE control adjusts the flatness of the IF detector such that the test trace is flat within 0.01 dB between 60 and 80 MHz.

Step 12: The 6-inch adapter is removed, and the unit under test and a 19A pad are connected in series between the two 8-foot cords [option (Z)]. Since the normal IF input power to the IF detector is −7 dBm, the output from the unit under test may require attenuating. Therefore, a 19A pad giving an amount of attenuation necessary to bring the output of the unit under test down to −7 dBm is used. For instance, the IF main amplifier used in the TD-3 receiver has an output of +1 dBm. An 8-dB pad would be selected to reduce the signal level to −7 dBm at the IF DET IN jack.

Step 13: Attenuator ATTEN 2 is set to supply the correct input power to the unit under test. The power at the ATTEN 2 OUT jack is equal to +10 dBm minus the setting of the ATTEN 2 controls.

3.11 In performing the IF-to-IF amplitude response measurement, the input to the IF detector is the swept IF signal which has been amplitude-modulated by the response of the unit under test.

IF-to-RF Amplitude Response Measurements

Theory of Test

3.12 For IF-to-RF amplitude response measurements, a swept-frequency IF signal is applied to the unit under test, and an RF detector is connected to its output. The dc output of the detector is applied to the vertical deflection circuit of the oscilloscope. The horizontal deflection circuit is swept in synchronism with the input signal from the IF oscillator. The amplitude response is thus presented as an oscilloscope display of relative amplitude versus frequency. Deviations from the normal flat response are indicated directly on the oscilloscope, which is calibrated horizontally for frequency and vertically for amplitude.

3.13 The test set operation for an IF-to-RF amplitude response measurement is very similar to the IF-to-IF operation as explained in 3.07 and 3.08. The main difference is that the output of the unit under test is an RF signal and is applied to the RF detector instead of the IF detector. This is shown in the test setup diagram, Fig. 21.

Preparation for Test

3.14 The preparation for test consists of calibrating the test set and connecting the test set to the unit under test. Calibration consists of checking that the output of the IF oscillator is +10 dBm, adjusting the level of the IF signal being applied to the unit under test to the proper value, and calibrating the oscilloscope. The step-by-step procedure is contained in Fig. 21.

3.15 Following is an explanation of what is being accomplished in each step that requires explanation.

Step 1: The output of the IF oscillator is adjusted for a level of +10 dBm and checked for flatness as explained in 3.10, Steps 2 through 11.

Step 2: Attenuator ATTEN 2 is set to supply the correct input power to the unit under test. The power at the ATTEN 2 OUT jack is equal to +10 dBm minus the setting of the ATTEN 2 controls.

Step 3: The input to the unit under test is connected to the ATTEN 2 OUT jack by an 8-foot cord. A variable pad and, if required, a fixed pad are connected in series between the output of the unit under test and the RF power meter. Since the normal input power to the RF detector is in the range 0 to −5 dBm, the output from the unit under test may require attenuating. Therefore, a fixed pad having the attenuation necessary to bring the output down to this range may have to be used.

Step 4: The actual power at the output of the calibrated RF cable option (V), or variable pad, option (W), is measured. The power range specified for option (V) takes into account the nominal insertion loss (1.5 dB) of the KS-19986 L4 calibrated cable. If the test set is equipped with an internal RF power head and the RF power cannot be connected directly to the RF PWR MTR, use the KS-19986, L4 calibrated cable to make the RF power measurement.

Step 5: The output of the variable pad is connected through a low-pass filter to the RF detector. The output of the RF detector is connected by an 8-foot cord to the RF DET IN jack.

Step 6: The FUNCTION switch is positioned to set up the test set for an IF-to-RF test.

Steps 7 through 9: With the test trace and reference trace coincident, increasing the attenuation of the input signal to the test set will cause the test trace to be below the reference trace. The oscilloscope controls are adjusted such that 0.5 dB of additional attenuation causes the test trace to be 10 centimeters below the reference trace. This calibrates the oscilloscope vertical deflection circuits for 0.05 dB per centimeter.

Step 10: The test setup is returned to normal and the test can now be performed.

3.16 In performing the IF-to-RF amplitude response measurement, the input to the RF detector is the swept IF signal converted to RF and amplitude-modulated by the response of the unit under test.

RF-to-RF Amplitude Response Measurements

Theory of Test

3.17 For RF-to-RF amplitude response measurements, a swept-frequency RF signal is applied to the unit under test, and an RF detector is connected to its output. The dc output of the detector is applied to the vertical deflection circuit of the oscilloscope. The horizontal deflection circuit is swept in synchronism with the input signal from the RF oscillator. The amplitude response is thus presented as an oscilloscope display of relative amplitude versus frequency. Deviations from the normal flat response are indicated directly on the oscilloscope, which is calibrated horizontally for frequency and vertically for amplitude.

3.18 The 31-Hz sweep voltage for the RF oscillator (Fig. 22) is developed by a circuit internal to the RF oscillator. The swept-frequency output of the oscillator is applied through the RF OUT jack, a leveling coupler and detector, and a fixed pad to the unit under test. The RF output of the unit under test is applied to the RF detector. The output of the detector is a dc voltage, the level of which is proportional to the amplitude of the RF input signal. This dc voltage is applied to the 31-Hz relay. The relay, which is controlled by the 31-Hz voltage from the RF oscillator, alternately applies either the RF detector voltage or a dc reference voltage as the amplitude information to the Y (vertical) input of the oscilloscope. The X (horizontal) input of the oscilloscope is driven by the 31-Hz output of the oscillator. This synchronizes the sweep of the oscilloscope with the sweep of the RF oscillator and the action of the 31-Hz relay. The KS-19974 RF oscillator furnished with early models of the test set (see 2.12) covers only the 3.6- to 4.3-GHz band and provides a pair of frequency markers adjustable over this range. The List 1 version of this oscillator provides a monitor output to drive an external RF frequency meter. The frequency meter, supplied in List 1 test sets only (See 2.09), produces a highly accurate marker which is adjustable between 3.6 GHz and 4.3 GHz. The marker output of the frequency meter is added to the output of the RF detector. The KS-20383 RF oscillator, which covers the 3.6- to 4.3-GHz and 5.9- to 6.4-GHz bands, does not provide RF markers. Instead, frequency accuracy sufficient for normal testing is provided by the calibrated frequency scale and sweep width control on the oscillator.

Preparation for Test

3.19 The preparation for test consists of setting the power level out of the RF oscillator, calibrating the oscilloscope, checking the flatness of the RF detector, and establishing the proper level of the input to the unit under test. The step-by-step procedure is contained in Fig. 22.

3.20 Following is an explanation of what is being accomplished in each procedural step that requires explanation.

Step 1: The connections needed for the initial power and calibration measurements of the test setup are made. Padding is provided at the output of the leveling coupler to drop the RF power to the range of 0 to −10 dBm (approximately).

Step 2: Controls on the test set are preset for the calibration procedure. The FUNCTION switch is positioned to set up the test set for an RF-to-RF test. The power meter is set to measure an RF signal at a power level between 0 and −10 dBm. The RF oscillator is set to produce a sweep width of 20 MHz about the center frequency of the particular unit under test.

Step 3: The RF oscillator/leveling coupler combination is connected through the RF pad to the input of the power meter.

Step 4: Since the normal input power to the RF detector is in the range of 0 to −5 dBm, the output power level of the RF oscillator is adjusted for midrange (−2.5 dBm) at the output of the fixed pad.

Step 5: The output of the fixed pad is then connected through a 2-inch adapter, a 6-inch calibrated RF cable, a variable pad, and a low-pass filter to the RF detector. The output of the RF detector is connected through a 10-foot cord to the RF DET IN jack. This is shown as option (X). The low-pass filter is necessary to prevent harmonics of the RF signal (generated by the RF detector) from causing distortion in the swept measurement.

Steps 6 through 9: The RF signal with markers superimposed if provided appears on the oscilloscope display. The test set controls are adjusted to give 2 MHz per centimeter (20 MHz in 10 centimeters) horizontal calibration with the test trace and reference trace coincident and centered on the oscilloscope display.

Step 10: By increasing the attenuation of the input signal to the test set, the test trace is caused to show up below the reference trace. The oscilloscope controls are adjusted such that 0.5 dB of additional attenuation causes the test trace to be 10 centimeters below the reference trace. This calibrates the vertical deflection circuit of the oscilloscope for 0.05 dB per centimeter.

Steps 12 and 13: A fixed pad having the correct attenuation is chosen, and the output of the RF oscillator is adjusted to give the proper input power to the unit under test.

Step 14: The unit under test together with suitable transducers, as required are connected between the fixed pad at the input and the variable pad, low-pass filter, and RF detector combination at the output [option (Z)]. Again, the output of the unit under test might require attenuating to ensure approximately −2.5 dBm into the variable pad. The equipment is now ready for the test to be performed.

3.21 In performing the RF-to-RF amplitude response measurement, the input to the RF detector is the swept RF signal which has been amplitude-modulated by the response of the unit under test.

RF-to-IF Amplitude Response Measurements

Theory of Test

3.22 For RF-to-IF amplitude response measurements, a swept-frequency RF signal is applied to the unit under test, and an IF detector is connected to its output. The dc output of the detector is applied to the vertical deflection circuit of the oscilloscope. The horizontal deflection circuit is swept in synchronism with the input signal from the RF oscillator. The amplitude response is thus presented as an oscilloscope display of relative amplitude versus frequency. Deviations from the normal flat response are indicated directly on the oscilloscope, which is calibrated horizontally for frequency and vertically for amplitude.

3.23 Operation of the test equipment is very similar to the RF-to-RF and IF-to-IF procedures previously described. The main difference is that a monitor output of the IF detector is applied through the IF amplifier to the marker oscillator, which produces the same three markers used for IF-to-IF measurements. The markers are added to the output of the IF detector for display on the oscilloscope.

Preparation for Test

3.24 The preparation for test consists of checking the operation of the RF oscillator, checking the operation of the IF detector, setting the proper power into the unit under test, and calibrating the oscilloscope. The step-by-step procedure is contained in Fig. 23.

3.25 Following is an explanation of what is being accomplished in each step that requires explanation.

Step 1: Proper operation of the RF oscillator is established. Refer to 3.20, Steps 1 through 10 for details.

Step 2: Proper operation of the IF detector is established. Refer to 3.10, Steps 2 through 11 for details.

Step 3: Attenuator ATTEN 2 is set with high enough attenuation to protect the power meter when the output of the unit under test is applied.

Step 4: Controls on the test set are preset for the calibration procedure. The FUNCTION switch is positioned to set up the test set for an RF-to-IF test. The power meter is set to measure an RF signal in the range of the input to the particular unit under test.

Steps 5 and 6: The output of the RF oscillator is adjusted to provide the proper input power to the unit under test.

Steps 7 through 9: The IF output from the unit under test is applied through attenuator ATTEN 2 to the power meter, which is set up to measure an IF signal in the −5 to −15 dBm power range. Attenuator ATTEN 2 is adjusted for a power of −7 dBm out of the attenuator. This is the normal input power to the IF detector.

Steps 10 through 15: The output from attenuator ATTEN 2 is now applied to the IF detector. The IF signal with markers superimposed appears on the oscilloscope display. The markers are obtained by taking the swept IF signal appearing at the monitor output of the IF detector and applying this signal, after IF amplifier amplification, to the marker oscillator circuit. The test set controls are adjusted to give 2-MHz per centimeter (12 MHz in 6 centimeters) horizontal calibration with the test trace and reference trace coincident and centered on the oscilloscope display.

Step 16: By increasing the attenuation of the input signal to the test set, the test trace is caused to show up below the reference trace. The oscilloscope controls are adjusted such that 0.1 dB of additional attenuation causes the test trace to be 2 centimeters below the reference trace. This calibrates the vertical deflection circuit of the oscilloscope for 0.05 dB per centimeter.

3.26 In performing the RF-to-IF amplitude response measurement, the input to the IF detector is the swept RF signal converted to IF and amplitude-modulated by the response of the unit under test.

IF Return-Loss Measurements

Theory of Test

3.27 For IF return-loss measurements, a swept-frequency IF signal is applied to a return-loss bridge, and the unit under test is connected to the UNKNOWN port of the bridge (2.31 and 2.32). The output of the bridge is connected to the IF detector, and the dc output of the detector is applied to the vertical deflection circuits of the oscilloscope. The horizontal deflection circuit is swept in synchronism with the input signal from the IF oscillator. The IF return-loss characteristic of the unit under test is thus presented as an oscilloscope display of return loss versus frequency. The units under test normally have controls for adjusting the impedance such that the return loss will be optimum across the IF frequency band.

3.28 Operation of the test set IF oscillator, marker oscillator, counter, IF detector, 31-Hz relay, and oscilloscope are as described in 3.07 and 3.08.

Preparation for Test

3.29 The preparation for test consists of calibrating the test set and connecting the test set to the unit under test. Calibration consists of adjusting the power into the return-loss bridge to the proper value, adjusting the power into the IF detector to the proper value, calibrating the oscilloscope, and checking for proper operation of the return-loss bridge. The step-by-step procedure is contained in Fig. 24.

3.30 Following is an explanation of what is being accomplished in each step that requires explanation.

Step 1: Attenuator ATTEN 1 is set to provide approximately −4 dBm to the return-loss bridge. Attenuator ATTEN 2 is set to a reference value (50 dB) for the return-loss measurement.

Steps 2 through 4: Controls on the test set are preset for the calibration procedure. The +10-dBm output from the IF oscillator is supplied through attenuator ATTEN 1 to the power meter. The attenuator is adjusted so that the proper signal level will be applied to the bridge.

Step 5: The unterminated return-loss bridge is connected between the output of ATTEN 1 (−4 dBm) and the input to ATTEN 2. The output of ATTEN 2 is passed through the IF amplifier and connected to the IF power meter. The power meter is set to measure an IF signal at a power level between −5 and −15 dBm.

Step 6: The loss through the unterminated return-loss bridge is 12 dB (6 dB to the unknown port where total reflection occurs and plus 6 dB between the unknown and output ports). Thus, neglecting cable losses, the input to ATTEN 2 is −4 −12 = −16 dBm. The gain of the test set IF amplifier is adjusted to 59 dB to increase the −16 −50 = −66 dBm output of ATTEN 2 to −7 dBm, the proper input power for the IF detector.

Step 7: The −7 dBm output from the test set IF amplifier is applied to the IF detector.

Steps 8 through 12: The IF signal with markers superimposed appears on the oscilloscope display. The test set controls are adjusted to give 2-MHz per centimeter horizontal deflection with both the test trace and reference trace centered on the oscilloscope display, and with the variable-frequency marker (set at 70 MHz) showing at the center of the display.

Step 13: Increasing the attenuation of the input signal will cause the test trace to be below the reference trace. The oscilloscope controls are adjusted such that 1.0 dB of additional attenuation causes the test trace to be 2 centimeters below the reference trace. This calibrates the oscilloscope vertical deflection circuits for 0.5 dB per centimeter.

Steps 14 and 15: The UNKNOWN port of the return-loss bridge is terminated with a precision termination (greater than 60-dB return loss), which drastically attenuates the signal at the output of the bridge. If the bridge is functioning properly, the test trace will be considerably below the reference trace even with the ATTEN 2 controls set to 0.

Step 16: The termination is removed and the unit under test is connected to the UNKNOWN port of the bridge [option (Z)].

3.31 In performing the IF return-loss measurement, the loss supplied by attenuator ATTEN 2 is removed until the reference trace and the test trace coincide at the frequency of interest. The return loss is the difference between the setting of the ATTEN 2 controls and the reference setting of 50 dB. This can be illustrated by the following example. The calibration of the test set-up is made with the unknown port of the return-loss bridge unterminated. This is equivalent to having total reflection, or 0-dB return loss at the unknown port. For example, if a unit under test having 30-dB return loss is connected to the unknown port, the input to the IF detector will be reduced 30 dB below that delivered under the calibrate (0-dB return loss) condition. To make the test and reference traces coincident, the amount equal to the return loss of the unknown (in this case 30 dB) must be removed from ATTEN 2. By this procedure the return loss of the unknown, at the point where the traces are coincident is always equal to the reference setting of ATTEN 2 (50 dB) minus the setting necessary to obtain trace coincidence.

Antenna Waveguide System Return-Loss Measurements

Theory of Test

3.32 For waveguide run return-loss measurements, a swept-frequency RF signal is applied through the leveling coupler to one leg of a power divider (supplied only with early models of the test set). The waveguide run under test is connected to one leg of the power divider, and the RF detector is connected to the third leg. If a reflection is present in the waveguide run, a portion of the reflected signal will appear at the detector input where it adds to that portion of the incident signal delivered directly to the detector. As the RF frequency is swept, the addition of the reflected and incident signals varies smoothly between in-phase to out-of-phase addition. As a result, the detector output, which is displayed on the oscilloscope as in amplitude response measurements, will contain a ripple component. The amount of return loss of the reflection can be determined from the amplitude of the ripple, and the distance to the irregularity in the waveguide run causing the reflection can be obtained from the period of the ripple. For detailed theory on microwave antenna and waveguide return-loss measurements, refer to Section 402-400-100.

3.33 The 31-Hz sweep voltage for the RF oscillator (Fig. 25) is developed by a circuit internal to the RF oscillator. The swept-frequency output of the oscillator is applied through the RF OUT jack, a leveling coupler and detector, and a fixed pad to the RF power divider. One output leg of the divider is applied through a variable pad to the RF detector. The operation of the test set circuitry is as described in 3.18.

Preparation for Test

3.34 The preparation for test consists of setting the power out of the RF oscillator to the proper value and calibrating the oscilloscope. The step-by-step procedure is contained in Fig. 25.

3.35 Following is an explanation of what is being accomplished in each procedural step that requires explanation.

Step 1: Controls on the test set are preset for the calibration procedure. The FUNCTION switch is positioned to set up the test set for an RF-to-RF test. The power meter is set to measure an RF signal at a power level between −5 and +5 dBm. The RF oscillator is set to produce a sweep width of 20 MHz about the center frequency of the particular radio channel.

Step 2: The RF oscillator/leveling coupler combination is connected through an RF pad to the input of the power meter. A 10-dB pad is used with the KS-19974 oscillator; a 5-dB pad is used with the KS-20383 oscillator.

Step 3: The power level of the RF oscillator output is adjusted for an output of +5 dBm out of the fixed pad. The output from the pad is then applied to the power divider. One output from the divider is applied to a 20-dB pad, and the other output is applied through a variable pad (set at 1 dB) and a low-pass filter to the RF detector. The output of the RF detector is fed to the test set at the RF DET IN jack.

Steps 4 through 7: The RF signal, with markers superimposed if provided, appears on the oscilloscope display. The test set controls are adjusted to give 2-MHz per centimeter (20 MHz in 10 centimeters) horizontal calibration with the test trace and reference trace coincident and centered on the oscilloscope display.

Step 8: By increasing the attenuation of the input signal to the test set, the test trace is caused to show up below the reference trace. The oscilloscope controls are adjusted such that 1 dB of additional attenuation causes the test trace to be 10 centimeters below the reference trace. This calibrates the vertical deflection circuit of the oscilloscope for 0.1 dB per centimeter.

3.36 In performing the antenna waveguide system return-loss test, the input to the RF detector is a portion of the reflected signal which is added to the signal delivered directly to the detector. The oscilloscope display will be similar to that shown in B, Fig. 25. The magnitude of the return loss in dB is obtained by measuring the peak-to-peak amplitude of the ripple (in dB) and using the table in C, Fig. 25, to convert to return loss. The distance to the waveguide irregularity from the point of measurement is determined using the graph in D, Fig. 25.

4. REFERENCE DRAWING LIST

4.01 The following drawings are related to this section.

SD-50564-01	Application Schematic-Transmitter-Receiver Test Set
SD-50565-01	Transmitter-receiver Test Set—IF Amplifier Circuit
SD-50566-01	Transmitter-Receiver Test Set—RF and IF Sweep Control Circuits
SD-50568-01	IF Detector Circuit
SD-81783-01	−19 Volt Regulator
SD-81836-01	Power Supply
ED-51303-01	Transmitter-Receiver Test Set—Information for IF Frequency Range Extension

TABLE A

CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION
RF and IF Sweep Control Unit	
FUSE ALARM lamps 6.4V CT, –24V, –40V, and –150V	Indicate loss of the applicable voltage from the power supply when lighted.
CTR — EXT/MKR FREQ	Toggle switch selects the input to the frequency counter. In the MKR FREQ position, the input to the counter is the output from the variable marker oscillator. In the EXT position, the input to the counter appears at the CTR jack in the patch field to permit connecting the counter to other circuits.
REF TRACE — COARSE REF TRACE — FINE	These are concentric controls; the knob closer to the panel being the COARSE control, and the other knob being the FINE control. The controls are used to position the reference trace vertically on the oscilloscope.
TEST TRACE — COARSE TEST TRACE — FINE	These are concentric controls; the knob closer to the panel being the COARSE control, and the other knob being the FINE control. The controls are used to position the test trace vertically on the oscilloscope.
FUNCTION	This switch is used to select the test condition of the test set; IF-to-IF, IF-to-RF, RF-to-RF, or RF-to-IF.
The following are adjustments located behind the swing-out door in the RF and IF sweep control unit. They are not normally used in the operation of the test set, but are used during routine maintenance of the test set.	
31 CPS FREQ	Used to adjust the frequency of the 31-Hz oscillator to 31 ±0.5 Hz.
31 CPS SHAPE*	Used to adjust the output of the 31-Hz oscillator for maximum amplitude and undistorted shape of the sine wave.
31 CPS LEVEL†	Used to adjust the level of the 31-Hz oscillator output.
IF TRACE — START	Used to align the left end of the IF test trace with the reference trace.
IF TRACE — STOP	Used to align the right end of the IF test trace with the reference trace.

TABLE A (Cont)

CONTROL OR INDICATOR	FUNCTION
RF and IF Sweep Control Unit (Cont)	
IF TRACE — LIN	Used to adjust the linearity of the IF test trace such that the 64-MHz marker and 76-MHz marker are equidistant from the variable marker when the latter is adjusted to 70 $\pm$0.1 MHz.
RF TRACE — START	Used to align the left end of the RF test trace with the reference trace.
RF TRACE — STOP	Used to align the right end of the RF test trace with the reference trace.
RF TRACE — WIDTH	Used to adjust the width of the RF test trace.
	*This control is on the RF and IF Sweep Control Unit containing wiring boards as shown in ED-50557-30 (SD-50566-01, Fig. 2).
	†This control is on the RF and IF Sweep Control Unit containing wiring boards as shown in ED-50557-30, G2 (SD-50566-01, Fig. 3).
Test Set Control Panel	
IF — SWEEP WIDTH	Used to adjust the sweep width of the IF oscillator.
IF — CENTER FREQ	Used to adjust the center frequency of the IF oscillator.
VAR MKR AM	Used to adjust the height of the variable marker on the IF test trace.
IF MARKER — AMPLITUDE	Used to adjust the height of both the variable marker and the fixed markers on the IF test trace.
IF MARKER — FREQ	Used to adjust the frequency of the variable IF marker.
AMPL GAIN	Used to adjust the gain of the internal IF amplifier.
RF MKR AM	Used to adjust the height of the RF marker on the RF test trace. (Furnished only in test sets having an RF frequency meter — See Par. 2.08 and 2.09).

TABLE A (Cont)

CONTROL OR INDICATOR	FUNCTION
Test Set Control Panel (Cont)	
IF DET SLOPE	Used to adjust the output flatness of the IF detector.
ATTEN 1	A variable attenuator adjustable from 1 to 15 dB in 1-dB steps with a single knob.
ATTEN 2	A variable attenuator adjustable from 0 to 91 dB in 0.1-dB steps with four knobs (test sets equipped in accordance with Lists 1, 2, and 3) or from 0 to 51 dB in 0.1 dB steps with three knobs (test sets equipped in accordance with Lists 4 and higher).
ATTEN 3	A variable attenuator continuously adjustable from 4.2 to 16 dB with one knob calibrated from MIN to MAX.
NOISE LAMP	Pushbutton switch which actuates the noise lamp power supply in those test sets equipped with a noise generator. (See Par. 2.11)

TABLE B

MISCELLANEOUS TEST EQUIPMENT

EQUIPMENT	FIG.	DESCRIPTION AND PRINCIPAL USE
Cable Assemblies		
P2BJ (3 supplied)		2-foot IF cable having a 358A plug at each end. Used for interconnection of jacks in patch field.
P2DE		6-inch IF cable having a 358A plug on one end and a 503A jack on the other end. Used to connect the IF return-loss bridge to the transmitter-receiver bay components.
P49Q680 (3 supplied)		8-foot IF cable with a 358A plug at one end and a 374B (right angle) plug at the other end. For general use in IF tests.
P49Q681		6-inch IF cable with a 477B jack at each end. Used as back-to-back adapter for general IF tests.
P91Q686		8-foot "lossy" (at RF) cable with a 358B plug at one end and a right angle male BNC connector at the other end. Used to connect the RF detector to jacks in the patch field.
P49Q684		4-foot cable with multiple pin connectors at each end. Used as power extender cable for J68387B microwave generator.
P48N179 (2 supplied)		6-inch cable with an N-type connector on one end and a Conhex connector on the other end. Used in testing the J68387B microwave generator.
P48N181		6-foot cable with a 358B plug on one end and an N-type connector on the other end. Used in testing the J68387B microwave generator.
P48N180		6-foot cable with a 358B plug on one end and a Conhex connector on the other end. Used when testing the J68387B microwave generator, J68387R microwave generator, or the J68387W 40-MHz oscillator and shift modulator.
P49Q685		3-foot cable with a 9-pin male connector on one end and a 9-pin female connector on other end. Used to connect the unit under test to the EXT DC PWR connector.
P49Q686		3-foot cable with a 9-pin male connector on one end and a 15-pin female connector on the other end. Used to connect unit under test to the EXT DC PWR connector.
P93M318		6-foot cable with multiple pin connectors on each end. Used as RF and IF sweep control unit power extender during maintenance of test set.

TABLE B (Cont)

EQUIPMENT	FIG.	DESCRIPTION AND PRINCIPAL USE
Cable Assemblies (Cont)		
P93M319		6-foot cable with multiple pin connectors on each end. Used as RF and IF sweep control unit power extender during maintenance of test set.
P93M320		6-foot cable with multiple pin connectors on each end. Used as IF amplifier power extender during maintenance of test set.
P93M321		6-foot cable with multiple pin connectors on each end. Used as IF detector power extender during maintenance of test set.
P93M322		6-foot cable with multiple pin connectors on each end. Used as IF sweep oscillator power extender during maintenance of test set.
P93M323		6-foot cable with male BNC connectors at each end. Used for testing IF marker oscillator during maintenance of test set.
P48N310		10-foot cable with a right angle male BNC connector on one end and a two-plug prod on the other end. Used during maintenance of test set for power supply noise testing and testing the J87279A —19 volt regulator.
P2BC		6-foot cable with a 358A plug on one end and a right angle male BNC connector on the other end. Used for general testing.
KS-19986, L1		6-inch calibrated RF cable (0.1 dB nominal loss) with male N-type connector on one end and female N-type connector on the other end. Used for general RF testing.
KS-19986, L4		8-foot calibrated RF cable (1.5 dB nominal loss) with male N-type connectors at each end. Used for general RF power measurements at 4 GHz with test sets equipped with an internal RF power head.
KS-14510, L10		Probe assembly used with KS-14510, L1 Volt-Ohm-Milliammeter. Used during maintenance of the test set for power supply testing.
P48N309		1-foot cable assembly consisting of a 470 ohm, 1 watt resistor connected between miniature tip plugs. Used for testing the J68387T IF limiter-carrier resupply.
Other Loose Items of Test Equipment		
IF Return-Loss Bridge		KS-19982, L1 and L2. See Paragraphs 2.31 and 2.32.

TABLE B (Cont)

EQUIPMENT	FIG.	DESCRIPTION AND PRINCIPAL USE
Other Loose Items of Test Equipment (Cont)		
RF Power Divider		Weinschel Model 1509. Used when making antenna system return-loss measurements. (Supplied only with List 1 test set.)
RF Detector		KS-19981, L1. Converts RF input signal to positive dc output for display on oscilloscope.
Noise Suppressor		Weinschel Model 936N. Used to break ground path of RF test connections to eliminate ac ripple on test trace.
19A Pads		Six pads having different values of attenuation: 1 dB, 3 dB, 5 dB, 8 dB, 10 dB, and 20 dB. Used as IF attenuators. Mates with large-series plug on one end and a large-series jack on the other end.
4-GHz RF Pads KS-19983, L1 KS-19983, L2 KS-19983, L3 KS-19983, L4		10 dB 20 dB 30 dB 40 dB } Used as RF attenuators at 4 GHz only. Supplied only in List 1, 2, and/or 3 versions of test set.
4 and 6-GHz RF Pads KS-20498, L1 KS-20498, L2 KS-20498, L3 KS-20498, L4 KS-20498, L5		5 dB 10 dB 20 dB 30 dB 40 dB } Used as RF attenuators at both 4 and 6 GHz. Supplied in List 4 and higher test sets.
372A Patch Plug (8 supplied)		For interconnection of adjacent jacks in test set patch field. Mates with large-series jacks.
Variable Attenuator		Weinchel Model 953-3. 0.7 to 3 dB, continuously adjustable, 50-ohm, with type-N connectors. Used for calibrating the vertical sensitivity of the oscilloscope when making RF measurements at 4 GHz.
44A Waveguide Bend		45-degree WR229 waveguide bend. Supplied only with List 1 test set. Not required for normal tests.
41A Attenuator		0 to 0.5 dB step attenuator in WR159 waveguide. Used for calibrating the vertical sensitivity of the oscilloscope when making RF measurements at 6 GHz.
Low-pass Filter		Microlab LA-50N or LA-60N (4 GHz) and LA-80N (6 GHz). Used ahead of the RF detector to prevent harmonics, either from the RF source or generated in the detector, from causing distortion of the test trace.

TABLE B (Cont)

EQUIPMENT	FIG.	DESCRIPTION AND PRINCIPAL USE
Other Loose Items of Test Equipment (Cont)		
1331A Filter		WR229 tunable cavity filter. Used when adjusting the BO suppression of the J68387E IF driver amplifier and transmitter modulator (TD-3).
578A Filter		75-ohm band elimination filter having at least 50-dB loss at 50±2 MHz. Used for maintenance of the IF oscillator.
442A Plug		75-ohm coaxial (Small connector series) terminating plug. Used in IF tests.
522A Termination		WR229 high power termination. Used for terminating the output of the TD-3 (J68386A and J68386B) and TD-3A (J68386G and J68386H) transmitters during tests.
1B Transducer (2 supplied)		WR159 waveguide-to-type-N COAX transducer. Used for 6-GHz RF test.
24A Transducer (2 supplied)		WR229 waveguide-to-type-N COAX transducer. Used for 4-GHz RF test.
Isolating Transducer (2 supplied)		WR229 waveguide-to-type-N COAX transducer with built-in coaxial isolator. Used originally for 4-GHz RF test but no longer required. (Supplied only with List 1 test set.)
KS-19987, L1 Adapter		Type-N female-to-female adapter. Used in 4- and 6-GHz tests.
OSM Adapter		OSM Model 21030. Type-N female-to-OSM male adapter. Used when making tests on the J68387R microwave generator.
188A Adapter (2 supplied)		IF connector having 477-type jack on one end and a 558-type jack on other end. Used in IF tests for adapting small series plugs to large and vice versa.
190A Adapter (2 supplied)		IF connector having 440-type plug on one end and a 477-type jack on other end. Used to adapt small series jacks to large series plugs and vice versa in IF tests.
Directional Coupler		Narda model 3060-20, 20-dB directional coupler having Type-N connectors on all ports. Used when adjusting the input return loss of the 125-MHz amplifier in the J68387B microwave generator.
33A Directional Coupler and Termination		36-dB loss directional coupler. WR159 waveguide input and side-arm output. Built-in high power termination on output of main arm. Used when making tests on the TH-3 (J68912A and J68912B) transmitter.

TABLE B (Cont)

EQUIPMENT	FIG.	DESCRIPTION AND PRINCIPAL USE
Other Loose Items of Test Equipment (Cont)		
Shorting Plate (2 supplied)		ED-50536-50, G2. Used for covering open waveguide ports when making tests on the TD-3 (J68386A and J68386B) and TD-3A (J68386G and J68386H) transmitter receiver bays.
High Power RF Pad		Weinschel Eng. Model 2288. 40-dB RF pad, rated at 16 watts. Used in measuring the 125-MHz output power from the J68387B microwave generator.
368A Plug		75-ohm (large connector series) terminating plug. Used in IF tests.
63A Pad		6.5 dB. Supplied in List 8 test sets for use in IF tests on TH-3 (J68912A and J68912B) transmitter receiver bays. Mates with small series plug on one end and a small series jack on the other end.
P-46Y029 Coaxial Adapter		Special adapter supplied with List 8 test sets for making IF-to-IF tests on the J68913C IF limiter-amplifier and transmitter modulator (TH-3).
KS-13734, L1 Adapter		Type-N male-to-female right angle adapter. Supplied with List 8 test sets for 6 GHz tests on TH-3 (J68912A and J68912B) transmitter receiver bays.
24D Directional Coupler		28 $\pm$ 1.0 dB loss directional coupler. WR229 waveguide input and main arm output; type-N female connector on sidearm output. Used when making tests on the TD-3A (J68386G and J68386H) transmitters.
Shorting Plate (2 supplied)		ED-50536-50, G3. Used for covering open waveguide ports when making tests on the TH-3 (J68912A and J68912B) transmitter-receiver bays.

PREPARATION FOR TEST

1. On the test set control panel, set the ATTEN 2 controls to 17 dB.

2. Make the test connections using options (W) and (X).

3. Set the test set controls as follows:

UNIT	CONTROL	POSITION
RF and IF Sweep Control Unit	CTR switch	MKR FREQ
	FUNCTION switch	IF — IF
Test Set Control Panel	IF — SWEEP WIDTH	Midrange
	IF — CENTER FREQ	Midrange
	IF MARKER — AMPLITUDE	Midrange
	IF MARKER — FREQ	Midrange
Oscilloscope Time Base Unit	POSITION and POSITION — VERNIER	Midrange
	MAGNIFIER switch	X10
	SWEEP TIME switch	EXT
	SWEEP TIME — VERNIER	Midrange
	SINGLE — NORMAL switch	NORMAL
Oscilloscope Differential Amplifier	POSITION	Midrange
	BANDWIDTH (KC) switch	4
	AMPLIFIER switch	DC
	SENSITIVITY switch	2 MV/CM
	SENSITIVITY — VERNIER	Midrange
	+INPUT — AC-DC-OFF switch	DC
	—INPUT — AC-DC-OFF switch	OFF
Power Meter	INPUT CHANNEL switch	IF
	POWER RANGE DBM switch	—5

Requirement: The power meter shall indicate —2 ±1 (+10 ±1 dBm at the IF OUT jack; —7 ±1 dBm at the ATTEN 2 OUT jack).

If the requirement is not met, remove the back cover panel from the test set and adjust the OUTPUT control on the IF sweep oscillator. If the requirement still cannot be met, refer to Sections 104-415-501 and 104-415-504.

4. Adjust ATTEN 2 for a —2 ±0.1 indication on the power meter.

5. Change option (W) to option (Y).

6. On the RF and IF sweep control unit, adjust the TEST TRACE controls to center the trace on the oscilloscope.

7. On the oscilloscope time base unit, adjust the SWEEP TIME — VERNIER and POSITION controls for approximately 10 centimeters horizontal deflection on the oscilloscope display.

8. On the test set control panel, adjust the IF MARKER — FREQ control for a 70 ±0.1 MHz indication on the counter.

9. On the test set control panel, adjust the IF — SWEEP WIDTH and IF — CENTER FREQ controls to obtain the oscilloscope display shown. Use the IF MARKER — AMPLITUDE control to adjust the markers to the desired size.

Note 1: An extraneous marker appears at 89 MHz.

Note 2: The IF MARKER — AMPLITUDE control provides a common adjustment for both the fixed and variable markers. The VAR MKR AM control can be used to independently adjust the size of the variable marker.

10. On the RF and IF sweep control unit, adjust the REF TRACE control to bring the reference trace into coincidence with the test trace at 70 MHz.

11. On the test set control panel, increase the ATTEN 2 setting by 0.1 dB. On the oscilloscope differential amplifier, adjust the SENSITIVITY — VERNIER control and the POSITION control for 2 centimeters vertical separation between the reference trace and test trace. Return ATTEN 2 to its original setting. This calibrates the oscilloscope for 0.05 dB per centimeter.

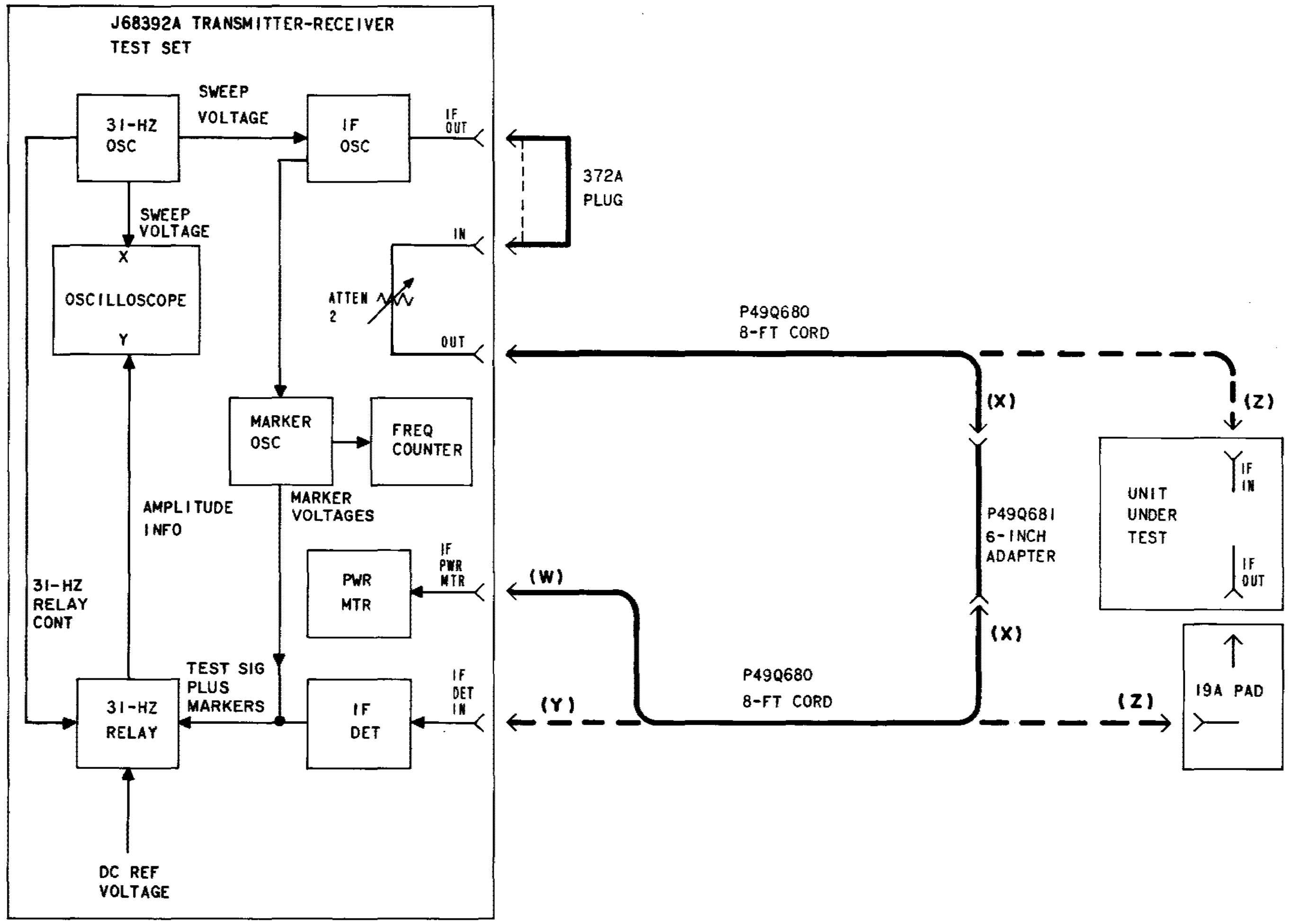
Requirement: The test trace shall be flat to within 0.01 dB between 60 and 80 MHz.

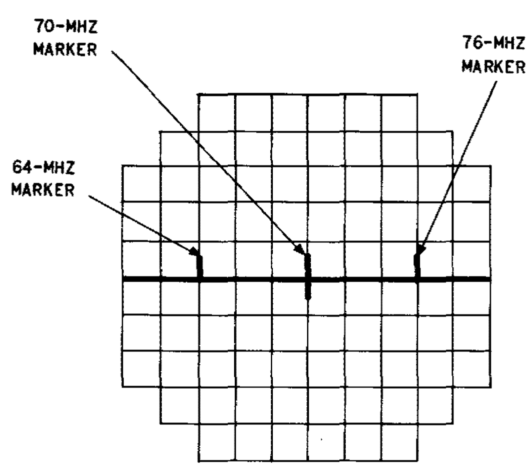
If this requirement is not met, adjust the IF DET SLOPE control on the test set control panel for a flat trace. If the requirement still cannot be met, refer to Section 104-415-504.

12. Change option (X) to option (Z). Select the 19A pad to give —7.0 dBm at the IF DET IN jack.

13. Adjust the ATTEN 2 controls such that the input signal to the unit under test is at the proper level.

Fig. 20—IF-TO-IF Amplitude Response Test—Functional Block Diagram





OSCILLOSCOPE DISPLAY
(STEP 9)

TPA 543861

PREPARATION FOR TEST

1. On the test set control panel, set the ATTEN 2 controls to 17 dB.

2. Make the test connections using options (W) and (X).

3. Set the test set controls as follows:

UNIT	CONTROL	POSITION
RF and IF Sweep Control Unit	CTR switch FUNCTION switch	MKR FREQ IF — IF
Test Set Control Panel	IF — SWEEP WIDTH IF — CENTER FREQ IF MARKER — AMPLITUDE IF MARKER — FREQ	Midrange Midrange Midrange Midrange
Oscilloscope Time Base Unit	POSITION and POSITION — VERNIER MAGNIFIER switch SWEEP TIME switch SWEEP TIME — VERNIER SINGLE — NORMAL switch	Midrange X10 EXT Midrange NORMAL
Oscilloscope Differential Amplifier	POSITION BANDWIDTH (KC) switch AMPLIFIER switch SENSITIVITY switch SENSITIVITY — VERNIER +INPUT — AC-DC-OFF switch –INPUT — AC-DC-OFF switch	Midrange 4 DC 2 MV/CM Midrange DC OFF
Power Meter	INPUT CHANNEL switch POWER RANGE DBM switch	IF –5

Requirement: The power meter shall indicate –2 ±1 (+10 ±1 dBm at the IF OUT jack dBm at the ATTEN 2 OUT jack).

If the requirement is not met, remove the back cover panel from the test set and adjust the control on the IF sweep oscillator. If the requirement still cannot be met, refer to Sections 10 and 104-415-504.

4. Adjust ATTEN 2 for a –2 ±0.1 indication on the power meter.

5. Change option (W) to option (Y).

6. On the RF and IF sweep control unit, adjust the TEST TRACE controls to center the the oscilloscope.

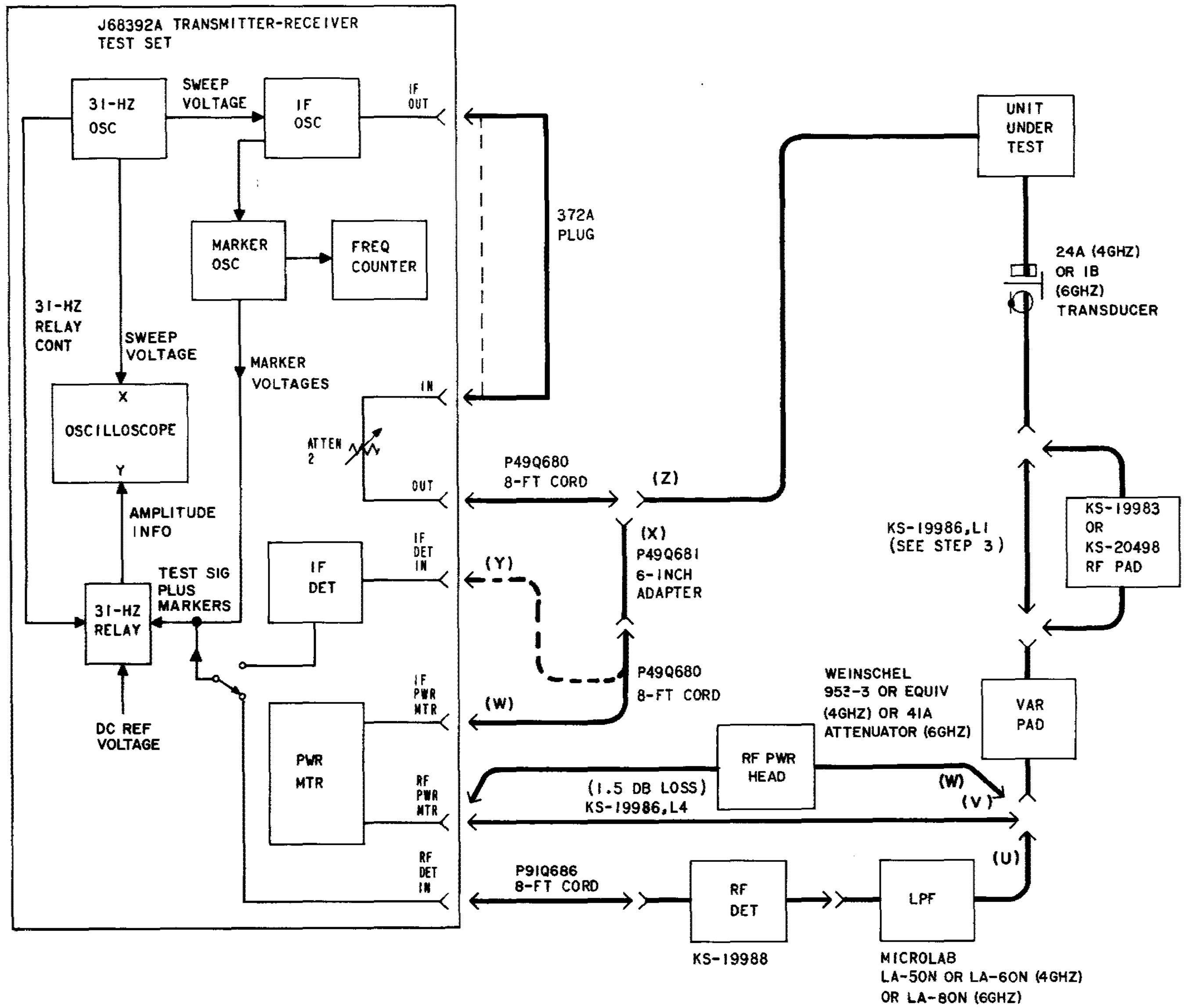


Fig. 21—IF-TO-RF Amplitude Response Test—Functional Block Diagram

Notes:

1. The frequency scale on the oscilloscope may be reversed for some units under test, causing the 64- and 76-MHz markers to become reversed.

2. Use NJ8505 9-1/4 inch AN connector pliers to tighten all N-type connectors.

3. Use option (V) for test sets equipped with an internal RF power head, and use option (W) for test sets equipped with an external RF power head.

PREPARATION FOR TEST

1. Check the output of the IF oscillator for proper power and flatness by performing Steps 1 through 11 of the Preparation for Test shown in Fig. 20.

2. Adjust the ATTEN 2 controls to provide the correct power into the unit under test.

Note: The following procedure requires a knowledge of the output power from the unit under test.

3. Change the test connections to options (Z) and (V) or (W). If necessary, select a KS-19983 (4-GHz systems only) or a KS-20498 (4- or 6-GHz systems) fixed pad which, when placed in series with the variable pad set at 1 dB, (Weinschel-Type, 4 GHz) or 0 dB (41A attenuator, 6 GHz) reduces the power at the ouput of the variable pad to the range of 0 to —5 dBm.

4. On the power meter, set the POWER RANGE DBM switch to the 0 position and the INPUT CHANNEL switch to the RF position. Check that the power meter indicates between —1.5 and —6.5 dBm for option (V) or between 0 and —5 dBm for option (W).

5. Change the test connections to options (Z) and (U).

6. On the RF and IF sweep control unit, set the FUNCTION switch to the IF — RF position.

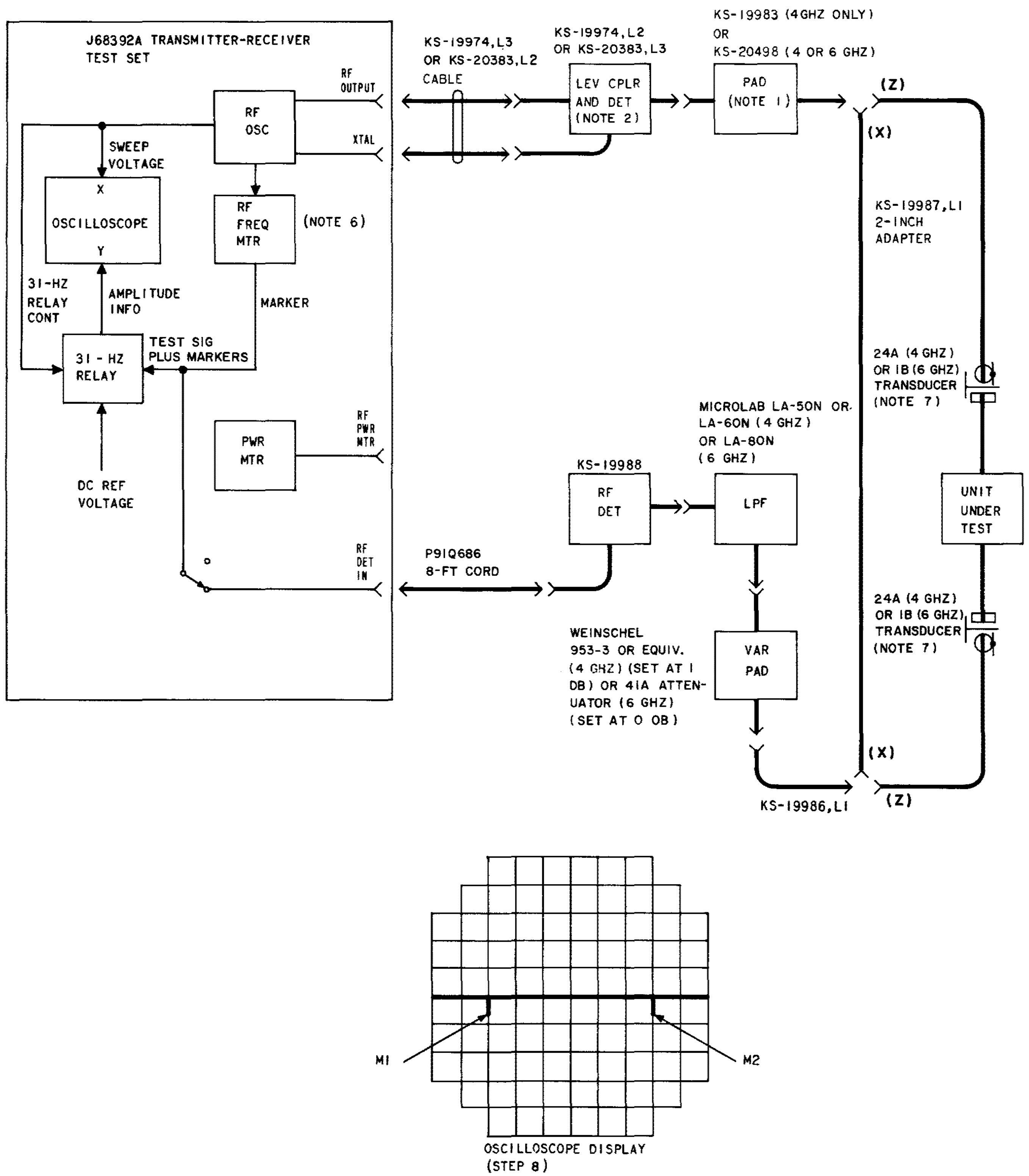
Note: If ripple is observed moving in the test trace, a 936A noise suppressor should be inserted between the low-pass filter and the RF detector, may be effective in reducing the ripple.

7. Adjust the TEST TRACE and REF TRACE controls so that the traces are coincident at 70 MHz.

8. Increase the attenuation of the variable pad by 0.5 dB.

9. On the oscilloscope differential amplifier, adjust the POSITION and SENSITIVITY — VERNIER controls for 10 centimeters vertical separation between the reference trace and the test trace. This calibrates the oscilloscope to 0.05 dB per centimeter.

10. Return the setting of the variable pad to its original position.



TPA 543863

Notes:

1.

PAD REQUIRED WITH KS-19974 OSC	
When Option (X) is used	20 dB
When this level is required into the unit under test	Use this pad
−30 to −20 dBm	40 dB
−20 to −10 dBm	30 dB
−10 to 0 dBm	20 dB
0 to +10 dBm	10 dB
+10 to +20 dBm	0 dB

PAD REQUIRED WITH KS-20383 OSC	
When Option (X) is used	10 dB & 5 dB
When this level is required into the unit under test	Use this pad(s)
−32 to −27 dBm	40 dB
−27 to −22 dBm	30 +5 dB
−22 to −17 dBm	30 dB
−17 to −12 dBm	20 +5 dB
−12 to −7 dBm	20 dB
−7 to −2 dBm	10 +5 dB
−2 to +3 dBm	10 dB
+3 to +8 dBm	5 dB
+8 to +13 dBm	0 dB

2. If a Hewlett-Packard E02-692D RF oscillator and leveling coupler are used, insert a Microlab LA60N low-pass filter in front of the detector on the leveling coupler.

3. Some earlier units are designated CW ±ΔF.

4. Use NJ8505 9-1/4 inch AN connector pliers (Boker & Co) to tighten all N-type connectors.

5. For test sets equipped with an external RF power head, the KS-19987, L1 2-inch adapter is required after fixed pad(s) to connect the power head.

6. The RF frequency meter is supplied only in test sets equipped in accordance with J68392A, List 1.

7. Use transducers as required to make proper connections to the unit under test.

Fig. 22 — RF-TO-RF Amplitude Response Test — Functional Block Diagram

4. On the RF oscillator, adjust the POWER LEVEL control for an indication of —2.5 on the power meter (—2.5 dBm).

5. Make the test connections using option (X).

6. On the RF and IF sweep control unit, adjust the TEST TRACE control to center the test trace vertically on the oscilloscope.

7. If the test set is equipped with a KS-20383 RF oscillator, proceed to Step 9. IF the test set is equipped with a KS-19974 RF oscillator, adjust the M1 (MARKER 1) control to 10 MHz less than the center frequency; adjust the M2 (MARKER 2) control to 10 MHz above the center frequency.

8. Adjust the RF oscillator controls to place the markers as shown. Use the MARKER AMPLITUDE control on the RF oscillator to adjust the markers to the desired size.

9. On the RF and IF sweep control unit, adjust the REF TRACE control to bring the reference trace into coincidence with the test trace at the center frequency.

10. Increase the attenuation of the variable pad by 0.5 dB. On the oscilloscope differential amplifier, adjust the POSITION control and SENSITIVITY — VERNIER control for 10 centimeters vertical separation between the reference trace and the test trace. Return the variable pad to its original setting. This calibrates the oscilloscope for 0.05 dB per centimeter.

Requirement: The test trace shall be flat to within 0.03 dB over the 20-MHz band.

11. Disconnect the option (X) test setup.

12. Determine the proper power to the unit under test. Using the table, Note 1, select the proper pad(s).

13. Connect the pad(s) to the output of the leveling coupler and measure the power at the output of the pad(s). Adjust the POWER LEVEL control on the RF oscillator to achieve the proper input to the unit under test.

Note: Power meter drift sometimes causes difficulty in making power measurements on the lowest ranges of the power meter. This problem can be avoided by using the procedures listed below:

STEP	EXAMPLE
(a) Determine the proper power to the unit under test.	—28 dBm
(b) Select the proper pad value from Note 1.	40 dB
(c) Add the pad value, Step (b), to the input power, Step (a).	—28 +40 = +12 dBm
(d) Note the value of pad(s) used in Step 1.	15 dB
(e) Subtract the value of pad(s), Step (d) from the power computed in Step (c).	+12 —15 = —3 dBm
(f) Set the power at the output of the pad(s) used in Step 1 to the power computed in Step (e).	Measured power = —3 dBm
(g) Remove the original pad(s) and insert the proper pad value, Step (b). The power at the output of this pad will be equal to that required, Step (a).	Input to unit under test = —3 + 15 —40 = —28 dBm

This is the actual procedure prescribed in certain transmitter-receiver bay sections (for example Section 411-404-501)

14. Make the test connections using option (Z). It may be necessary to pad the output of the unit under test to obtain a power of approximately —2.5 dBm into the variable pad. If possible, set the power to —2.5 ±0.25 dBm into the variable pad. Under this condition, the test trace will appear on the oscilloscope (without changing any control setting) and the vertical sensitivity established in Step 10 will be retained. If the condition cannot be met, set the power as close to —2.5 dBm as possible and recalibrate the vertical sensitivity of the oscilloscope using Steps 6, 9, and 10.

Fig. 22—RF-TO-RF Amplitude Response Test—Functional Block Diagram (Cont'd)

PREPARATION FOR TEST

1. Make test connections corresponding to option (X), but do not connect option (X).

   If the test set is equipped with a KS-19974 RF oscillator, use a 20-dB pad after the leveling coupler. If the test set is equipped with a KS-20383 RF oscillator, use a 10-dB pad plus a 5-dB pad (15-dB total) after the leveling coupler.

2. Set the test set controls as follows:

UNIT	CONTROL	POSITION
RF and IF Sweep Control Unit	FUNCTION switch	RF — RF
Oscilloscope Time Base Unit	POSITION and POSITION VERNIER	Midrange
	MAGNIFIER switch	X10
	SWEEP TIME switch	EXT
	SWEEP TIME — VERNIER	Midrange
	SINGLE — NORMAL switch	NORMAL
Oscilloscope Differential Amplifier	POSITION	Midrange
	BANDWIDTH (KC) switch	4
	AMPLIFIER switch	DC
	SENSITIVITY switch	2 MV/CM
	SENSITIVITY — VERNIER	Midrange
	+INPUT — AC-DC-OFF switch	DC
	—INPUT — AC-DC-OFF switch	OFF
Power Meter	INPUT CHANNEL switch	RF
	POWER RANGE DBM switch	0
KS-19974 (Alfred) RF Oscillator	LINE switch	RF
	FUNCTION — SWEEP SELECTOR switch	ΔF (Note 3)
	MARKER AMPLITUDE	Midrange
	CW	Channel Center FREQ
	ΔF	20 MHz
Hewlett-Packard E02-692D RF Oscillator (Similar to KS-19974)	LINE switch	RF
	SWEEP SELECTOR switch	AUTO
	FUNCTION pushbuttons	ΔF depressed
	AMPL MOD pushbuttons	MARK 1 depressed
		MARK 2 depressed
	START/CW	Channel Center FREQ
	STOP/ΔF	20
KS-20383 RF Oscillator	LINE switch	ON
	BAND SELECTOR switch	3.65-4.25 GHz or 5.9 to 6.5 GHz, as required
	CW	Channel Center FREQ
	MODE switch	ΔF
	ΔF	20

3. Connect the output of the KS-19983 or KS-20498 pad(s) to the RF PWR MTR connector (on test sets equipped with an internal RF power head) or to the external RF power head if provided. (Note 5)

4. On the RF oscillator, adjust the POWER LEVEL control for an indication of —2.5 on meter (—2.5 dBm).

5. Make the test connections using option (X).

6. On the RF and IF sweep control unit, adjust the TEST TRACE control to center the vertically on the oscilloscope.

7. If the test set is equipped with a KS-20383 RF oscillator, proceed to Step 9. IF the equipped with a KS-19974 RF oscillator, adjust the M1 (MARKER 1) control to 10 MH the center frequency; adjust the M2 (MARKER 2) control to 10 MHz above the center

8. Adjust the RF oscillator controls to place the markers as shown. Use the MARKER AM control on the RF oscillator to adjust the markers to the desired size.

9. On the RF and IF sweep control unit, adjust the REF TRACE control to bring the refe into coincidence with the test trace at the center frequency.

10. Increase the attenuation of the variable pad by 0.5 dB. On the oscilloscope differential adjust the POSITION control and SENSITIVITY — VERNIER control for 10 centime cal separation between the reference trace and the test trace. Return the variable pad t nal setting. This calibrates the oscilloscope for 0.05 dB per centimeter.

Requirement: The test trace shall be flat to within 0.03 dB over the 20-MHz band.

11. Disconnect the option (X) test setup.

12. Determine the proper power to the unit under test. Using the table, Note 1, select the prop

13. Connect the pad(s) to the output of the leveling coupler and measure the power at the ou pad(s). Adjust the POWER LEVEL control on the RF oscillator to achieve the prop the unit under test.

Note: Power meter drift sometimes causes difficulty in making power measurements on ranges of the power meter. This problem can be avoided by using the procedures listed be

STEP	EXAMPLE
(a) Determine the proper power to the unit under test.	—28 dBm
(b) Select the proper pad value from Note 1.	40 dB
(c) Add the pad value, Step (b), to the input power, Step (a).	—28 +40 = +12 dBm
(d) Note the value of pad(s) used in Step 1.	15 dB
(e) Subtract the value of pad(s), Step (d) from the power computed in Step (c).	+12 —15 = —3 dBm
(f) Set the power at the output of the pad(s) used in Step 1 to the power computed in Step (e).	Measured power = —3 dBm
(g) Remove the original pad(s) and insert the proper pad value, Step (b). The power at the output of this pad will be equal to that required, Step (a).	Input to unit under test = —3 + 15 —40 = —28 dBm

PREPARATION FOR TEST

1. Determine that the RF oscillator is functioning properly; perform Preparation for Test on Fig. 22, Steps 1 through 10.

2. Determine that the IF detector is functioning properly; perform Preparation for Test on Fig. 20, Steps 1 through 11 with the following exceptions:

   In Step 2, omit option (X); connect the ATTEN 2 OUT jack directly through one P49Q680 8-foot cord to the IF PWR MTR jack.

   In Step 5, continue to omit option (X), connect the ATTEN 2 OUT jack directly through one P49Q680 8-foot cord to the IF DET IN jack.

3. Set the ATTEN 2 controls to 20 dB.

4. Set the test set controls as follows:

UNIT	CONTROL	POSITION
RF and IF Sweep Control Unit	FUNCTION switch	RF — IF
Test Set Control Panel	IF MARKER — AMPLITUDE AMPL GAIN RF MKR AM (If provided)	Midrange Midrange Fully CCW
Power Meter	INPUT CHANNEL switch POWER RANGE DBM switch	RF As required (see Steps 5 and 6)

5. Determine the proper RF input power for the unit under test, and select the appropriate pad in accordance with Note 1. Connect the pad to the output of the leveling coupler, and connect the output of the pad to the RF PWR MTR connector (on test sets equipped with an internal RF power head) or to the external RF power head if provided (Note 3). (See the note associated with Step 13 of Fig. 22.)

6. Adjust the POWER LEVEL control on the RF oscillator for the proper indication on the power meter.

7. Make the test connections using option (Y).

8. On the power meter, set the INPUT CHANNEL switch to the IF position and the POWER RANGE DBM switch to the —5 position.

9. Adjust the ATTEN 2 controls for an indication of —2 on the power meter (—7 dBm).

10. Change the test connections to option (Z).

11. On the RF and IF sweep control unit, adjust the TEST TRACE control to vertically center the test trace on the oscilloscope.

12. On the oscilloscope time base unit, adjust the SWEEP TIME — VERNIER and POSITION controls for a horizontal test trace display of approximately 10 centimeters.

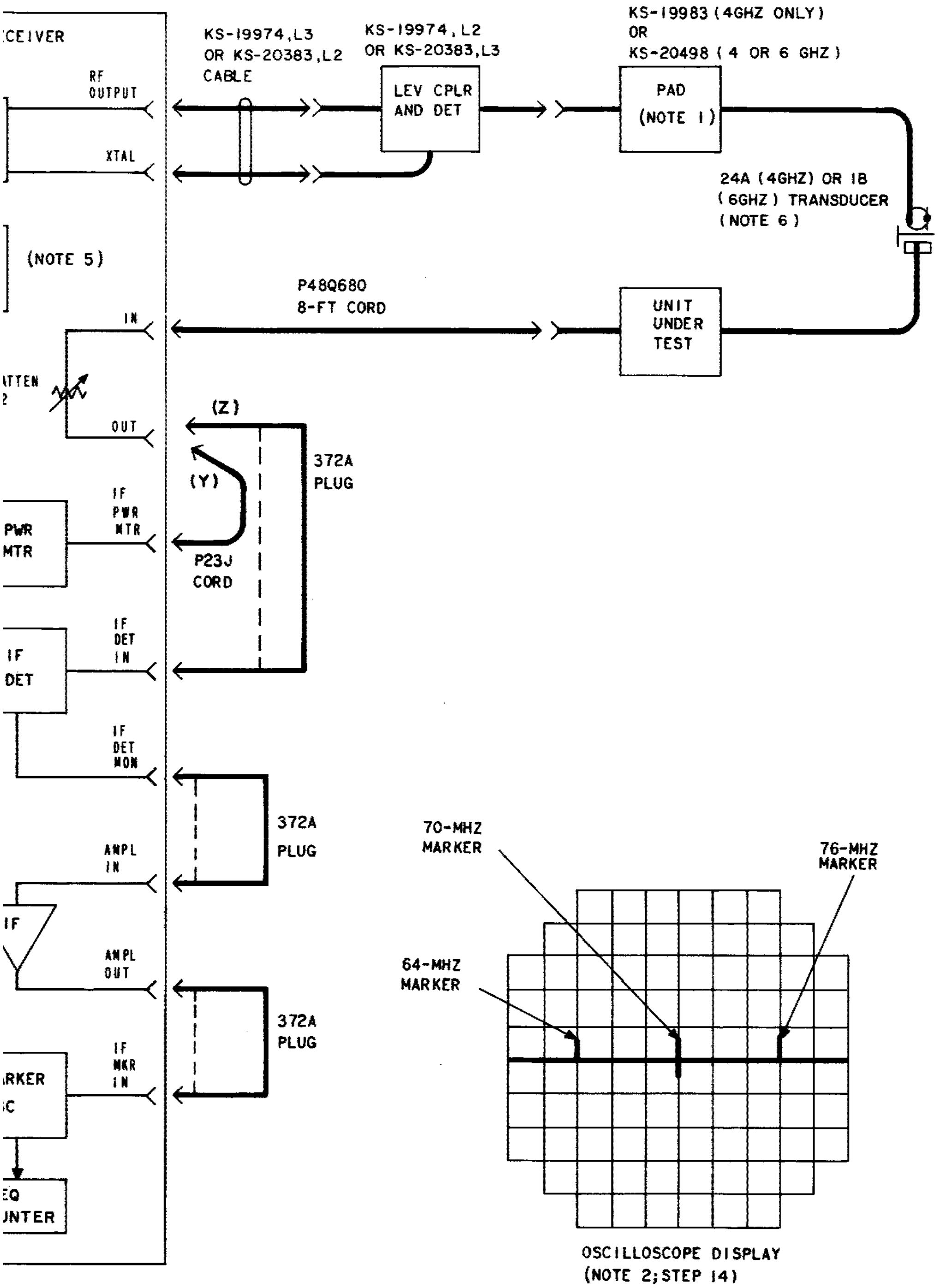
13. On the test set control panel, adjust the IF MARKER — FREQ control for an indication of 70 ±0.1 MHz on the counter.

14. On the RF oscillator, adjust the CW (START/CW) control to center the 70-MHz marker as shown. Adjust the ΔF (STOP/ΔF) control to place the 64- and 76-MHz markers as shown.

15. On the RF and IF sweep control panel, adjust the REF TRACE control to bring the reference trace into coincidence with the test trace at 70 MHz.

16. Increase the attenuation of ATTEN 2 by 0.1 dB. On the oscilloscope differential amplifier, adjust the SENSITIVITY — VERNIER and POSITION controls for 2 centimeters vertical separation between the reference trace and the test trace. Return the ATTEN 2 controls to their original settings. This calibrates the oscilloscope for 0.05 dB per centimeter.

Fig. 23—RF-TO-IF Amplitude Response Test—Functional Block Diagram



TPA 543864

Notes:

1.

PAD REQUIRED WITH KS-19974 OSC	
For this level into unit under test	Use this pad
−30 to −20 dB	40 dB
−20 to −10 dB	30 dB
−10 to 0 dB	20 dB
0 to +10 dB	10 dB
+10 to +20 dB	0 dB

PAD REQUIRED WITH KS-20383 OSC	
For this level into unit under test	Use this pad (s)
−32 to −27 dBm	40 dB
−27 to −22 dBm	30 & 5 dB
−22 to −17 dBm	30 dB
−17 to −12 dBm	20 & 5 dB
−12 to −7 dBm	20 dB
−7 to −2 dBm	10 & 5 dB
−2 to +3 dBm	10 dB
+3 to +8 dBm	5 dB
+8 to +13 dBm	0 dB

2. The frequency scale on the oscilloscope will be reversed if the local oscillator frequency for the unit under test is above the channel center frequency. In this case the 64- and 76-MHz markers would be reversed on the oscilloscope display.

3. For test sets equipped with an external RF power head, the KS-19987, L1 2-inch adapter is required after the fixed pad(s) to connect the power head.

4. Use NJ8505 9-1/4 inch connector pliers to tighten all N-type connectors.

5. The RF frequency meter is supplied in only test sets equipped in accordance with J68392A, List 1.

6. Use transducers as required to make power connections to the unit under test.

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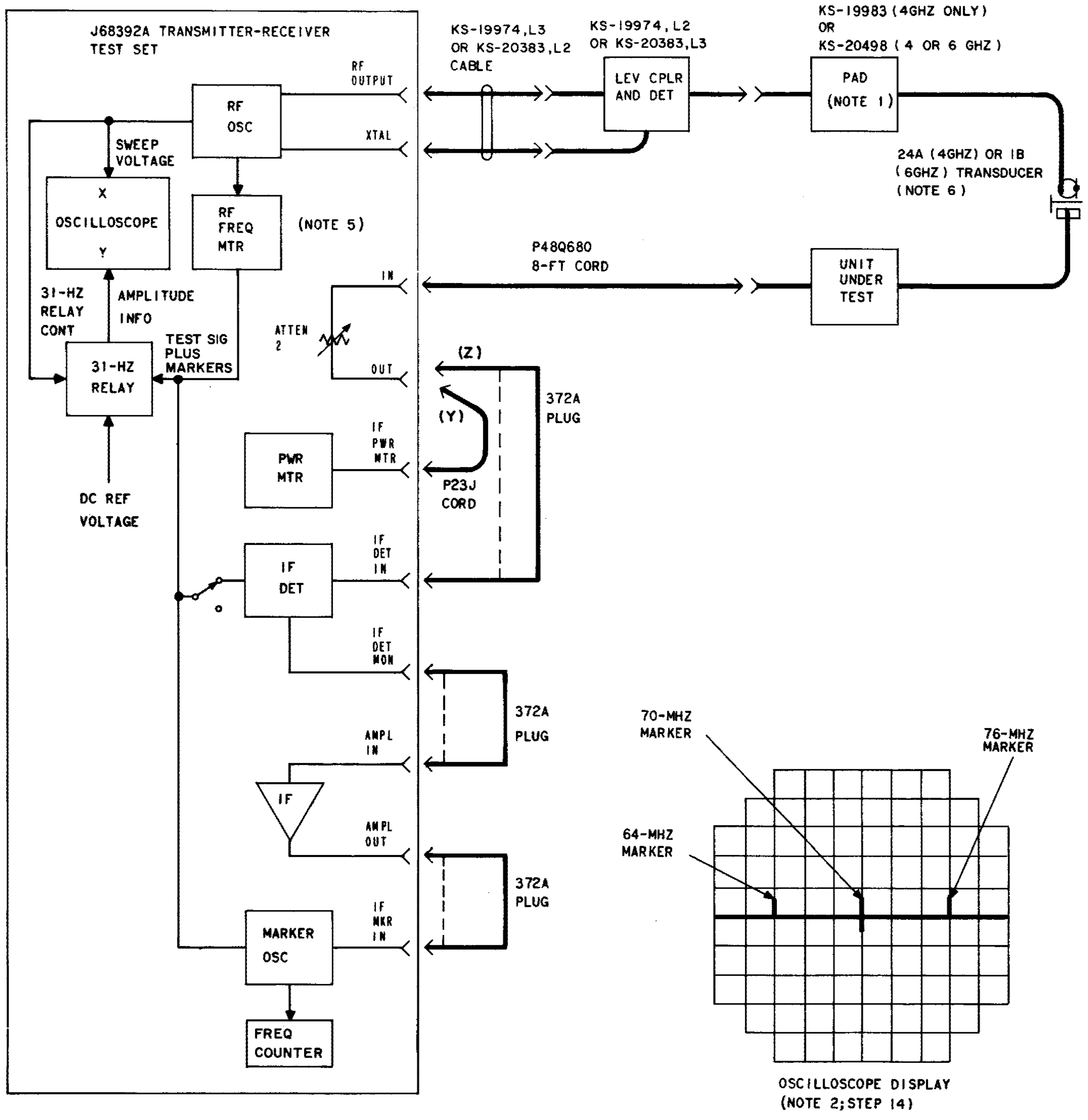


TPA 543864

Notes:

1.

PAD REQUIRED WITH KS-19974 OSC	
For this level into unit under test	Use this pad
−30 to −20 dB	40 dB
−20 to −10 dB	30 dB
−10 to 0 dB	20 dB
0 to +10 dB	10 dB
+10 to +20 dB	0 dB

PAD REQUIRED WITH KS-20383 OSC	
For this level into unit under test	Use this pad (s)
−32 to −27 dBm	40 dB
−27 to −22 dBm	30 & 5 dB
−22 to −17 dBm	30 dB
−17 to −12 dBm	20 & 5 dB
−12 to −7 dBm	20 dB
−7 to −2 dBm	10 & 5 dB
−2 to +3 dBm	10 dB
+3 to +8 dBm	5 dB
+8 to +13 dBm	0 dB

2. The frequency scale on the oscilloscope will be reversed if the local oscillator frequency for the unit under test is above the channel center frequency. In this case the 64- and 76-MHz markers would be reversed on the oscilloscope display.

3. For test sets equipped with an external RF power head, the KS-19987, L1 2-inch adapter is required after the fixed pad(s) to connect the power head.

4. Use NJ8505 9-1/4 inch connector pliers to tighten all N-type connectors.

5. The RF frequency meter is supplied in only test sets equipped in accordance with J68392A, List 1.

6. Use transducers as required to make power connections to the unit under test.

PREPARATION FOR TEST

1. On the test set control panel, set attenuator ATTEN 1 to 14 dB and attenuator ATTEN 2 to 50 dB.
2. Make the test connections using option (U).
3. Set the test set controls as follows:

UNIT	CONTROL	POSITION
RF and IF Sweep Control Unit	FUNCTION switch	IF — IF
	CTR switch	MKR FREQ
Test Set Control Panel	IF — SWEEP WIDTH	Midrange
	IF — CENTER FREQ	Midrange
	IF MARKER — AMPLITUDE	Midrange
	IF MARKER — FREQ	Midrange
	AMPL GAIN	Midrange
Oscilloscope Time Base Unit	POSITION and POSITION — VERNIER	Midrange
	MAGNIFIER switch	X10
	SWEEP TIME switch	EXT
	SWEEP TIME — VERNIER	Midrange
	SINGLE — NORMAL switch	NORMAL
Oscilloscope Differential Amplifier	POSITION	Midrange
	BANDWIDTH (KC) switch	4
	AMPLIFIER switch	DC
	SENSITIVITY switch	10 MV/CM
	SENSITIVITY — VERNIER	Midrange
	+INPUT — AC-DC-OFF switch	DC
	–INPUT — AC-DC-OFF switch	OFF
Power Meter	INPUT CHANNEL switch	IF
	POWER RANGE DBM switch	0

4. Adjust ATTEN 1 for a –4 ±0.5 indication on the power meter (–4 ±0.5 dBm).
5. Change the test connections to option (V) and (W). On the power meter, set the POWER RANGE DBM switch to the –5 position.
6. On the test set control panel, adjust the AMPL GAIN control for an indication of –2 on the power meter (–7 dBm).
7. Change test connection option (W) to option (X).
8. On the RF and IF sweep control unit, adjust the TEST TRACE controls to center the test trace vertically on the oscilloscope display.
9. On the oscilloscope time base unit, adjust the SWEEP TIME — VERNIER and POSITION controls for approximately 10 centimeters horizontal deflection on the oscilloscope display.
10. On the test set control panel, adjust the IF MARKER — FREQ control for an indication of 70 ±0.1 MHz on the counter.
11. Adjust the IF — SWEEP WIDTH and IF — CENTER FREQ controls to obtain the oscilloscope display shown. Use the IF MARKER — AMPLITUDE control to adjust the markers to the desired size.

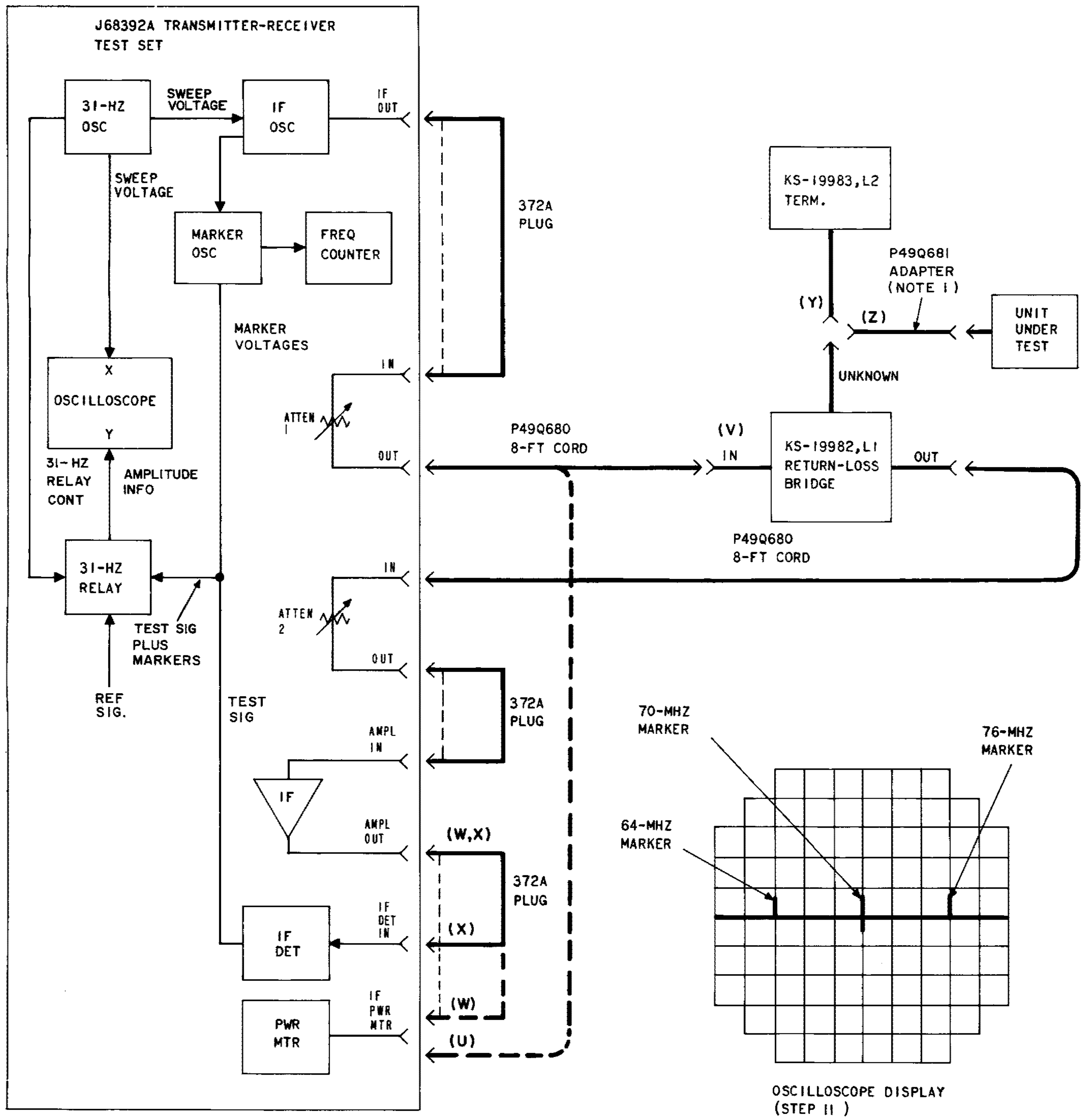
Note: An extraneous marker will appear at 89 MHz.

12. On the RF and IF sweep control unit, adjust the REF TRACE control to bring the reference trace into coincidence with the test trace at 70 MHz.
13. On the test set control panel, increase the ATTEN 2 setting by 1 dB. On the oscilloscope differential amplifier, adjust the SENSITIVITY — VERNIER control and POSITION control for 2 centimeters vertical separation between the reference trace and test trace. Return ATTEN 2 to its original setting. This calibrates the oscilloscope for 0.5 dB per centimeter.
14. Add test connection option (Y).
15. Set attenuator ATTEN 2 to 0.

Requirement: The test trace shall be below the reference trace. If the test trace is not visible, adjust the POSITION control on the oscilloscope differential amplifier until the test trace is visible to ensure that the test trace is below the reference trace. Operate the POSITION control to return the reference trace to the center of the oscilloscope display.

16. Set the attenuation ATTEN 2 to 50 dB, and change test connection option (Y) to option (Z).

Fig. 24—IF Return-Loss Test—Functional Block Diagram



Note 1: Required only when the return-loss measurement is made through a connecting cable.

PREPARATION FOR TEST

1. On the test set control panel, set attenuator ATTEN 1 to 14 dB and attenuator ATTEN 2 to 50 dB.
2. Make the test connections using option (U).
3. Set the test set controls as follows:

UNIT	CONTROL	POSITION
RF and IF Sweep Control Unit	FUNCTION switch CTR switch	IF — IF MKR FREQ
Test Set Control Panel	IF — SWEEP WIDTH IF — CENTER FREQ IF MARKER — AMPLITUDE IF MARKER — FREQ AMPL GAIN	Midrange Midrange Midrange Midrange Midrange
Oscilloscope Time Base Unit	POSITION and POSITION — VERNIER MAGNIFIER switch SWEEP TIME switch SWEEP TIME — VERNIER SINGLE — NORMAL switch	Midrange X10 EXT Midrange NORMAL
Oscilloscope Differential Amplifier	POSITION BANDWIDTH (KC) switch AMPLIFIER switch SENSITIVITY switch SENSITIVITY — VERNIER +INPUT — AC-DC-OFF switch —INPUT — AC-DC-OFF switch	Midrange 4 DC 10 MV/CM Midrange DC OFF
Power Meter	INPUT CHANNEL switch POWER RANGE DBM switch	IF 0

4. Adjust ATTEN 1 for a —4 ±0.5 indication on the power meter (—4 ±0.5 dBm).
5. Change the test connections to option (V) and (W). On the power meter, set the POWER RANGE DBM switch to the —5 position.
6. On the test set control panel, adjust the AMPL GAIN control for an indication of —2 on the power meter (—7 dBm).
7. Change test connection option (W) to option (X).
8. On the RF and IF sweep control unit, adjust the TEST TRACE controls to center the test trace vertically on the oscilloscope display.
9. On the oscilloscope time base unit, adjust the SWEEP TIME — VERNIER and POSITION controls for approximately 10 centimeters horizontal deflection on the oscilloscope display.

PREPARATION FOR TEST

1. Set the test set controls as follows:

UNIT	CONTROL	POSITION
RF and IF Sweep Control Unit	FUNCTION switch	RF — RF
Oscilloscope Time Base Unit	POSITION and POSITION — VERNIER	Midrange
	MAGNIFIER switch	X10
	SWEEP TIME switch	EXT
	SWEEP TIME — VERNIER	Midrange
	SINGLE — NORMAL switch	NORMAL
Oscilloscope Differential Amplifier	POSITION	Midrange
	BANDWIDTH (KC) switch	4
	AMPLIFIER switch	DC
	SENSITIVITY switch	EXT
	SENSITIVITY — VERNIER	Midrange
	+INPUT — AC-DC-OFF switch	DC
	−INPUT — AC-DC-OFF switch	OFF
Power Meter	INPUT CHANNEL switch	RF
	POWER RANGE DBM switch	+5
KS-19974 (Alfred) RF Oscillator	LINE switch	RF
	FUNCTION — SWEEP SELECTOR switch	ΔF (Note 2)
	MARKER AMPLITUDE switch	Midrange
	CW	Channel Center FREQ
	ΔF	20 MHz
	POWER LEVEL	Fully CCW
Hewlett-Packard E02-692D RF Oscillator (Similar to KS-19974)	LINE switch	RF
	SWEEP SELECTOR switch	AUTO
	FUNCTION pushbuttons	ΔF depressed
	AMPL MOD pushbuttons	MARK 1 depressed MARK 2 depressed
	ALC pushbutton	Depressed
	START/CW	Channel Center FREQ
	STOP/ΔF	20
	POWER LEVEL	Fully CCW
KS-20383 RF Oscillator	LINE switch	ON
	BAND SELECTOR switch	3.65-4.25 GHz or 5.9 to 6.5 GHz, as required
	CW	Channel Center FREQ
	MODE switch	ΔF
	ΔF	20
	POWER LEVEL	Fully CCW

2. Make the test connections using option (W).

3. On the RF oscillator, adjust the POWER LEVEL control for an indication of 0 on the power meter (+5 dBm at output of RF pad). Change the test connections from option (W) to option (X).

4. On the RF and IF sweep control unit, adjust the TEST TRACE controls to center the test trace vertically on the oscilloscope and adjust the REF TRACE controls to bring the reference trace into coincidence with the test trace at center frequency.

5. On the oscilloscope time base unit, adjust the POSITION controls and SWEEP TIME — VERNIER control for a horizontal test trace display of approximately 10 centimeters.

Note: It is important to limit the oscillator sweep width to ±10 MHz to prevent interference to adjacent radio channels when measuring the antenna system return loss. Make sure the ΔF (or STOP/ΔF) control is set at 20 MHz.

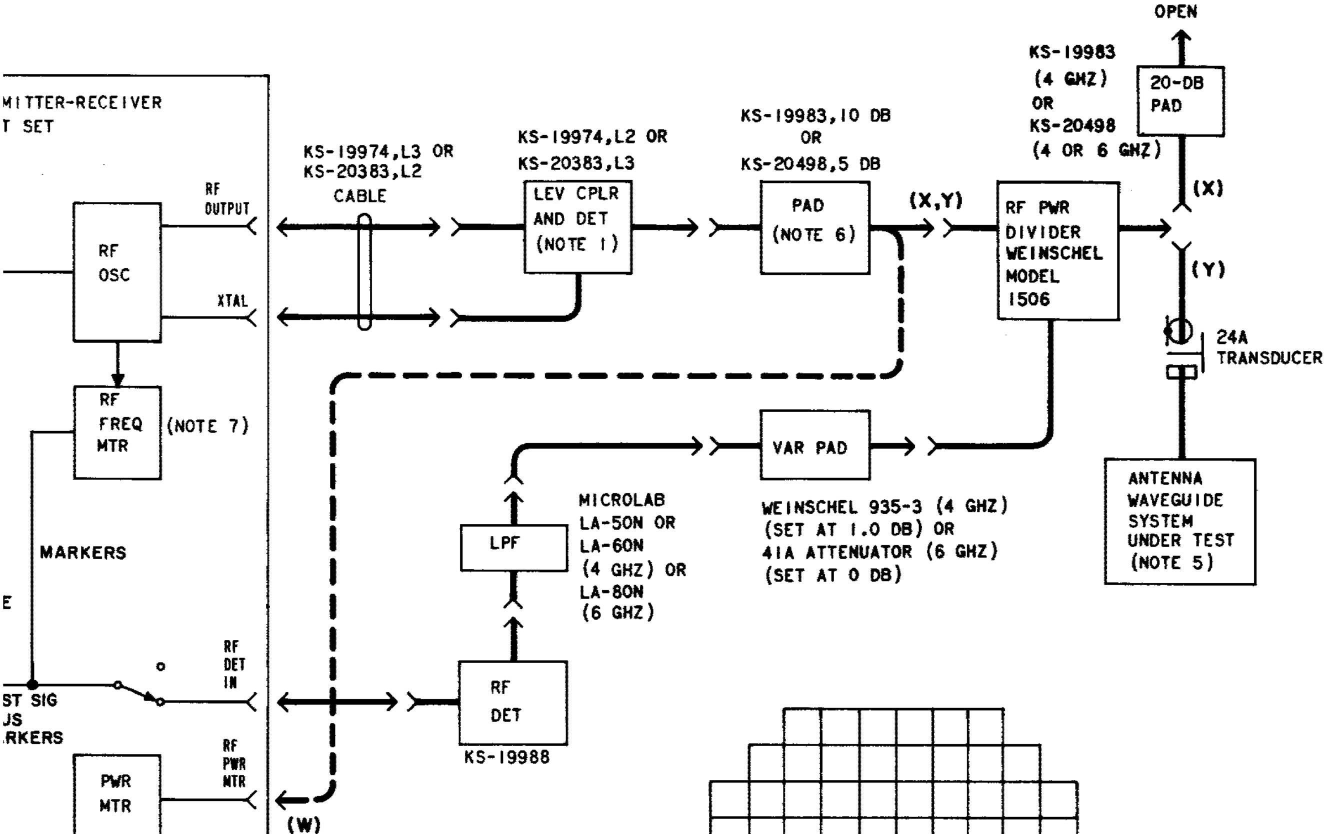
6. If the test set is equipped with a KS-20383 RF oscillator, proceed to Step 8. If the test set is equipped with a KS-19974 RF oscillator, adjust the M1 (MARKER 1) control to 10 MHz less than center frequency; adjust the M2 (MARKER 2) control to 10 MHz above the center frequency.

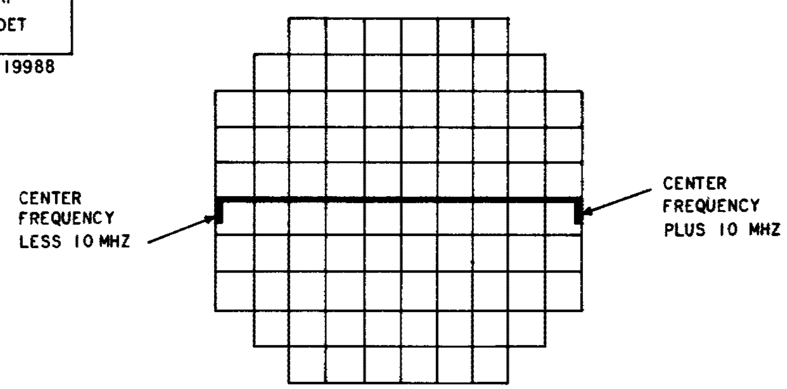
7. On the RF oscillator, adjust the ΔF (STOP/ΔF) and CW (START/CW) controls to place the markers as shown in A. Use the MARKER AMPLITUDE control on the RF oscillator to adjust the markers to the desired size.

8. Increase the attenuation of the variable pad by 1 dB. On the oscilloscope differential amplifier, adjust the POSITION control and SENSITIVITY — VERNIER control for 10 centimeters vertical separation between the reference trace and the test trace. Return the variable pad to its original setting. This calibrates the oscilloscope for a 0.1 dB per centimeter.

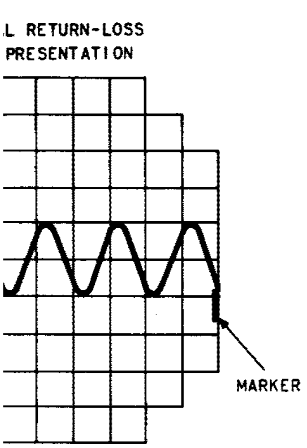
9. Change the test connections from option (X) to option (Y).

Fig. 25—Antenna Waveguide System Return-Loss Test—Functional Block Diagram





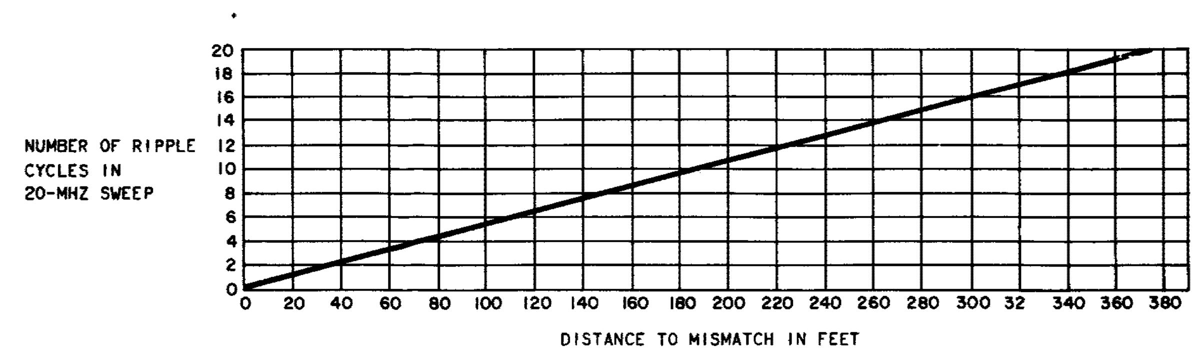
A



B

RIPPLE AMPLITUDE TO RETURN-LOSS CONVERSION			
MAX RIPPLE (DB)	RETURN LOSS (DB)	MAX RIPPLE (DB)	RETURN LOSS (DB)
0.06	42.5	0.5	24.0
0.08	40.0	0.6	22.5
0.1	38.0	0.7	21.5
0.15	34.5	0.8	20.0
0.2	32.0	0.9	19.0
0.3	28.5	1.0	18.0
0.4	26.0	1.2	17.0

C



D

Notes:

1. If a Hewlett-Packard E02-692D RF oscillator and leveling coupler are used, insert a Microlab LA50N or LA60N low-pass filter ahead of the RF detector on the leveling counter.
2. Some earlier units are designated CW $\pm\Delta F$.
3. Only test sets designated list 1 provide the necessary components to perform this test. To utilize other list numbered sets, a Weinschel Model 1506 power divider must be obtained.
4. Use NJ8505 9-1/4 inch connector pliers to tighten all N-type connectors.
5. If the return-loss measurement is to be made through a channel network of a transmitter-receiver bay, refer to the appropriate transmitter-receiver section to determine the proper apparatus to be removed to gain access to the channel network.
6. If the test set is equipped with the KS-19974 RF oscillator, use a KS-19983, 10-dB pad. With the KS-20383 oscillator, use a KS-20498, 5-dB pad.
7. The RF frequency meter is supplied only in test sets designated list 1.

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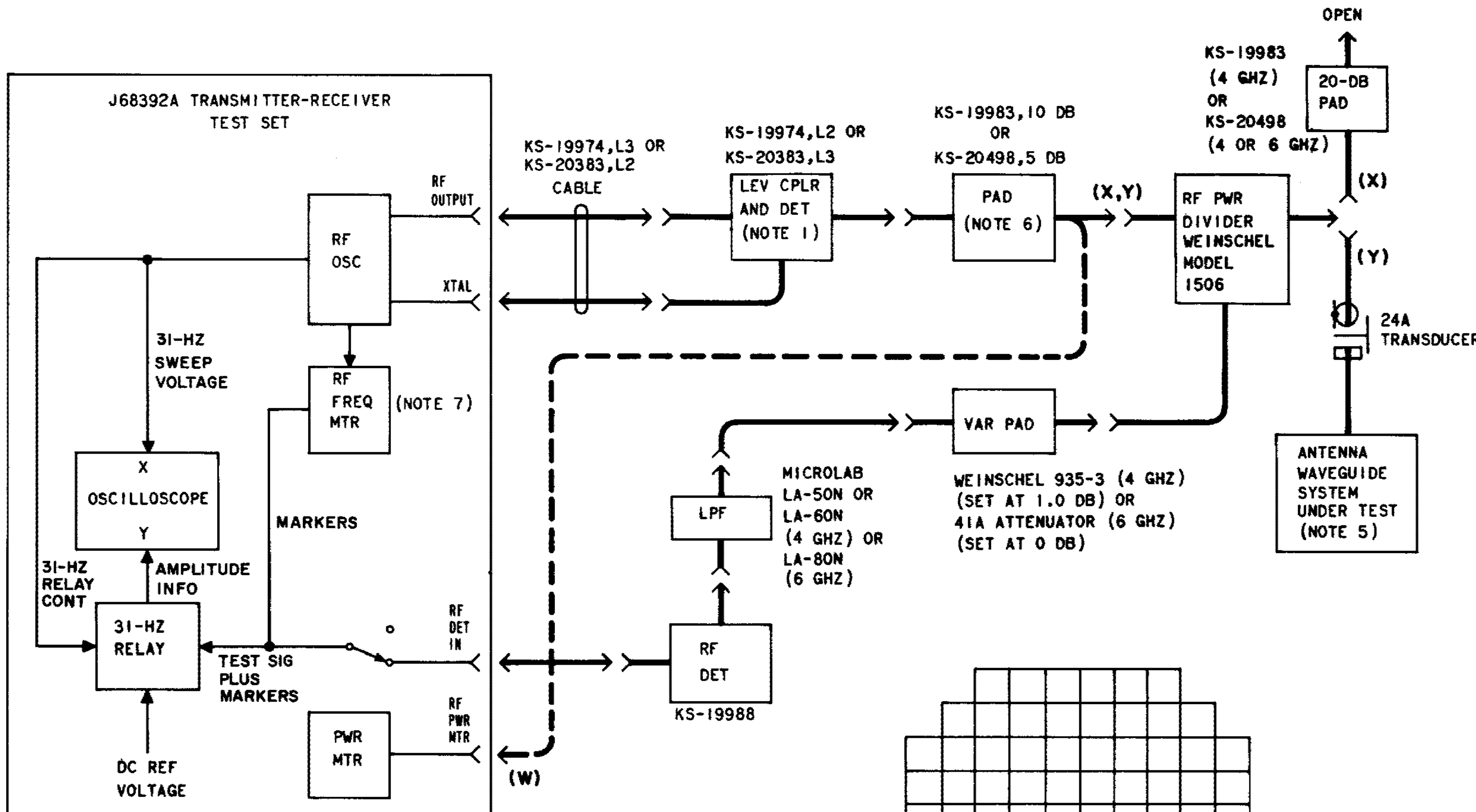
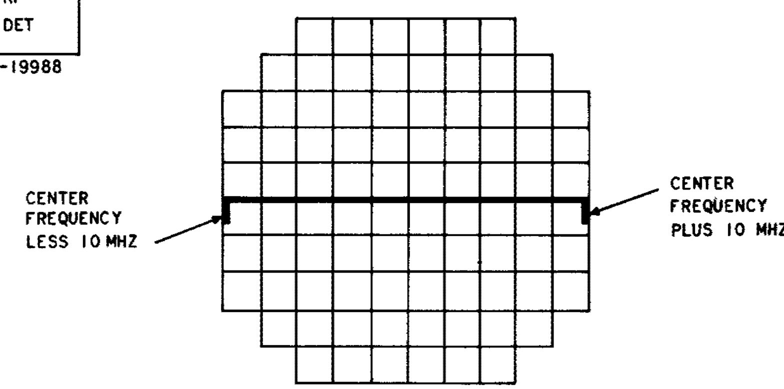
KS- RF





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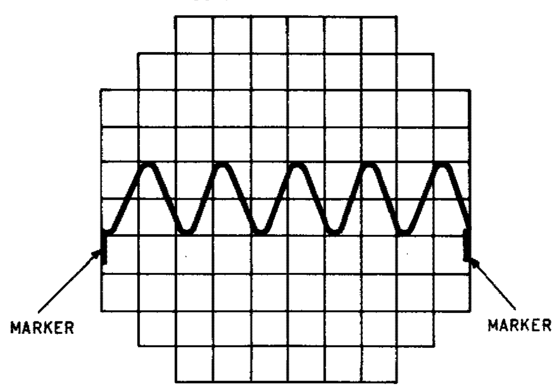
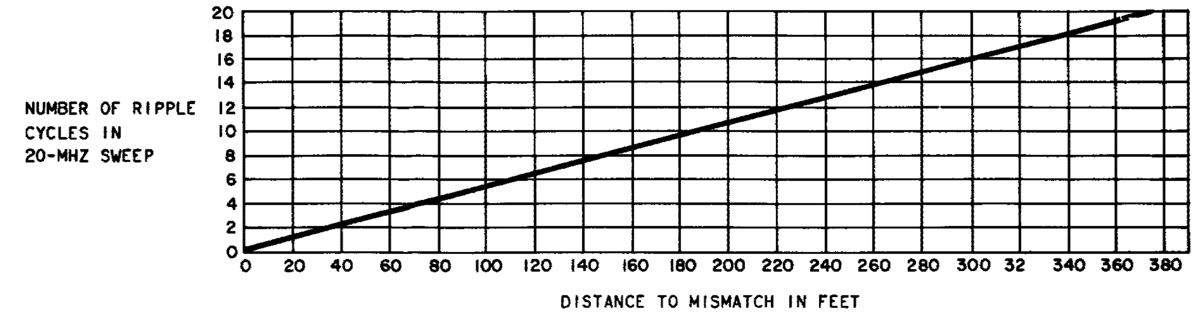


B

RIPPLE AMPLITUDE TO RETURN-LOSS CONVERSION

MAX RIPPLE (DB)	RETURN LOSS (DB)	MAX RIPPLE (DB)	RETURN LOSS (DB)
0.06	42.5	0.5	24.0
0.08	40.0	0.6	22.5
0.1	38.0	0.7	21.5
0.15	34.5	0.8	20.0
0.2	32.0	0.9	19.0
0.3	28.5	1.0	18.0
0.4	26.0	1.2	17.0

C



D

Notes:

1. If a Hewlett-Packard E02-692D RF oscillator and leveling coupler are used, insert a Microlab LA50N or LA60N low-pass filter ahead of the RF detector on the leveling counter.

2. Some earlier units are designated CW $\pm\Delta F$.

3. Only test sets designated list 1 provide the necessary components to perform this test. To utilize other list numbered sets, a Weinschel Model 1506 power divider must be obtained.

4. Use NJ8505 9-1/4 inch connector pliers to tighten all N-type connectors.

5. If the return-loss measurement is to be made through a channel network of a transmitter-receiver bay, refer to the appropriate transmitter-receiver section to determine the proper apparatus to be removed to gain access to the channel network.

6. If the test set is equipped with the KS-19974 RF oscillator, use a KS-19983, 10-dB pad. With the KS-20383 oscillator, use a KS-20498, 5-dB pad.

7. The RF frequency meter is supplied only in test sets designated list 1.