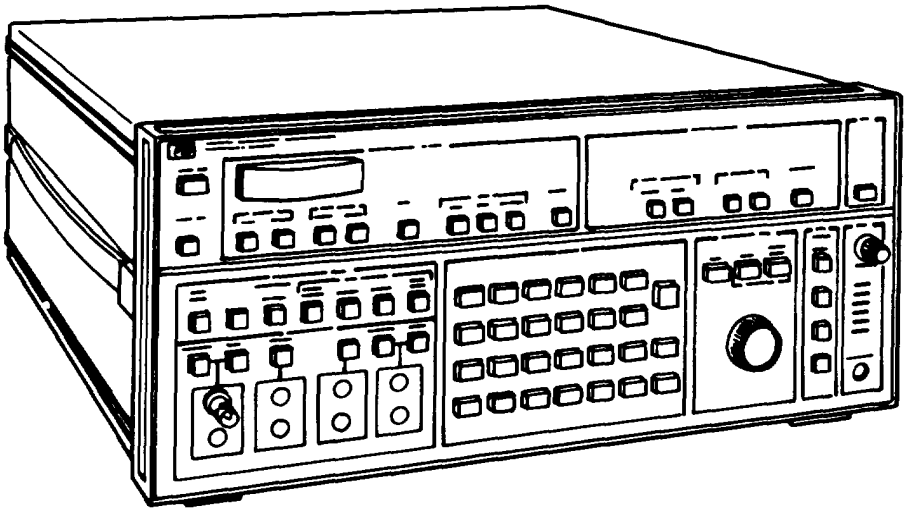
TM 11-6625-3087-40

TECHNICAL MANUAL

GENERAL SUPPORT MAINTENANCE MANUAL



EQUIPMENT DESCRIPTION PAGE 1-2

SERVICE UPON RECEIPT PAGE 2-1

SYMPTOM INDEX PAGE 2-2

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SUBJECT INDEX PAGE INDEX-1

FREQUENCY SELECTIVE LEVEL METER

AN/USM-490

(NSN6625-01-138-3351)

HEADQUARTERS, DEPARTMENT OF THE ARMY

1 JANUARY 1987

5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

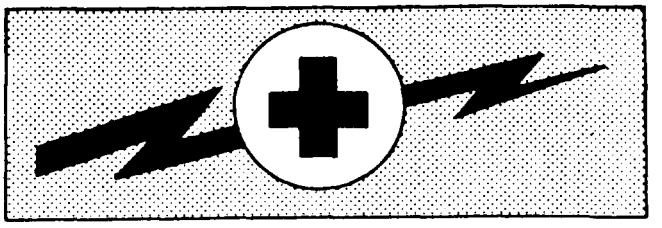
1. DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER

3. IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A WOODEN POLE OR A ROPE OR SOME OTHER INSULATING MATERIAL

4. SEND FOR HELP AS SOON AS POSSIBLE

5. AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION



W A R N I N G

HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if personnel fail to observe safety precautions.

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When the technician is aided by operators, they must be warned about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment, after power has been turned off, always ground every part before touching it.

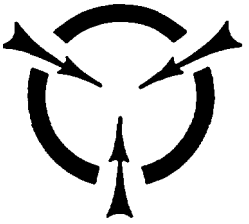
Be careful not to contact high-voltage connections of 115-volt ac input when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

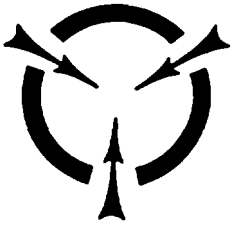
WARNING

Do not be misled by the term “LOW VOLTAGE”. Potentials as low as 50 volts may cause death under adverse conditions.

For Artificial Respiration, refer to FM 21-11.



CAUTION



THIS EQUIPMENT CONTAINS PARTS AND ASSEMBLIES SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). USE ESD PRECAUTIONARY PROCEDURES WHEN TOUCHING, REMOVING OR INSERTING PRINTED CIRCUIT BOARDS.

ESD CLASS 1

NOTE

The symbol for static sensitive devices in military inventory is as depicted in the caution block above. ‘

GENERAL HANDLING PROCEDURES FOR ESDS ITEMS

- USE WRIST GROUND STRAPS OR MANUAL GROUNDING PROCEDURES
- KEEP ESDS ITEMS IN PROTECTIVE COVERING WHEN NOT IN USE
- GROUND ALL ELECTRICAL TOOLS AND TEST EQUIPMENT
- PERIODICALLY CHECK CONTINUITY AND RESISTANCE OF GROUNDING SYSTEM
- USE ONLY METALIZED SOLDER SUCKERS
- HANDLING ESDS ITEMS ONLY IN PROTECTED AREAS

MANUAL GROUNDING PROCEDURES

- MAKE CERTAIN EQUIPMENT IS POWERED DOWN
- TOUCH GROUND PRIOR TO REMOVING ESDS ITEMS
- TOUCH PACKAGE OF REPLACEMENT ESDS ITEM TO GROUND BEFORE OPENING
- TOUCH GROUND PRIOR TO INSERTING REPLACEMENT ESDS ITEMS

ESD PROTECTIVE PACKAGING AND LABELING

- INTIMATE COVERING OF ANTISTATIC MATERIAL WITH AN OUTER WRAP OF EITHER TYPE 1 ALUMINIZED MATERIAL OR CONDUCTIVE PLASTIC FILM OR HYBRID LAMINATED BAGS HAVING AN INTERIOR OF ANTISTATIC MATERIAL WITH AN OUTER METALIZED LAYER
- LABEL WITH SENSITIVE ELECTRONIC SYMBOL AND CAUTION NOTE

CAUTION

Devices such as CMOS, NMOS, MNOS, VMOS, HMOS, thin-film resistors PMOS, and MOSFET used in many equipments can be damaged by static voltages present in most repair facilities. Most of the components contain internal gate protection circuits that are partially effective, but sound maintenance practice and the cost of equipment failure in time and money dictate careful handling of all electrostatic sensitive components.

The following precautions should be observed when handling all electrostatic sensitive components and units containing such components.

CAUTION

Failure to observe all of these precautions can cause permanent damage to the electrostatic sensitive device. This damage can cause the device to fail immediately or at a later date when exposed to an adverse environment.

STEP 1 Turn off and/or disconnect all power and signal source and loads used with the unit.

STEP 2 Place the unit on grounded conductive work surfaces.

STEP 3 Ground the repair operator using a conductive wrist strap or other device using a 1-M series resistor to protect the operator.

STEP 4 Ground any tools (including soldering equipment) that will contact the unit. Contact with the operator's hand provides a sufficient ground for tools that are otherwise electrically isolated.

STEP 5 All electrostatic sensitive replacement components are shipped in conductive foam or tubes and must be stored in the original shipping container until installed.

STEP 6 When these devices and assemblies are removed from the unit, they should be placed in the conductive work surface or in conductive containers.

STEP 7 When not being worked on, wrap disconnected circuit boards in aluminum foil or in plastic bags that have been coated or impregnated with a conductive material.

STEP 8 Do not handle these device unnecessarily or remove from their packages until actually used or tested.

Technical Manual

No. 11-6625-3087-40

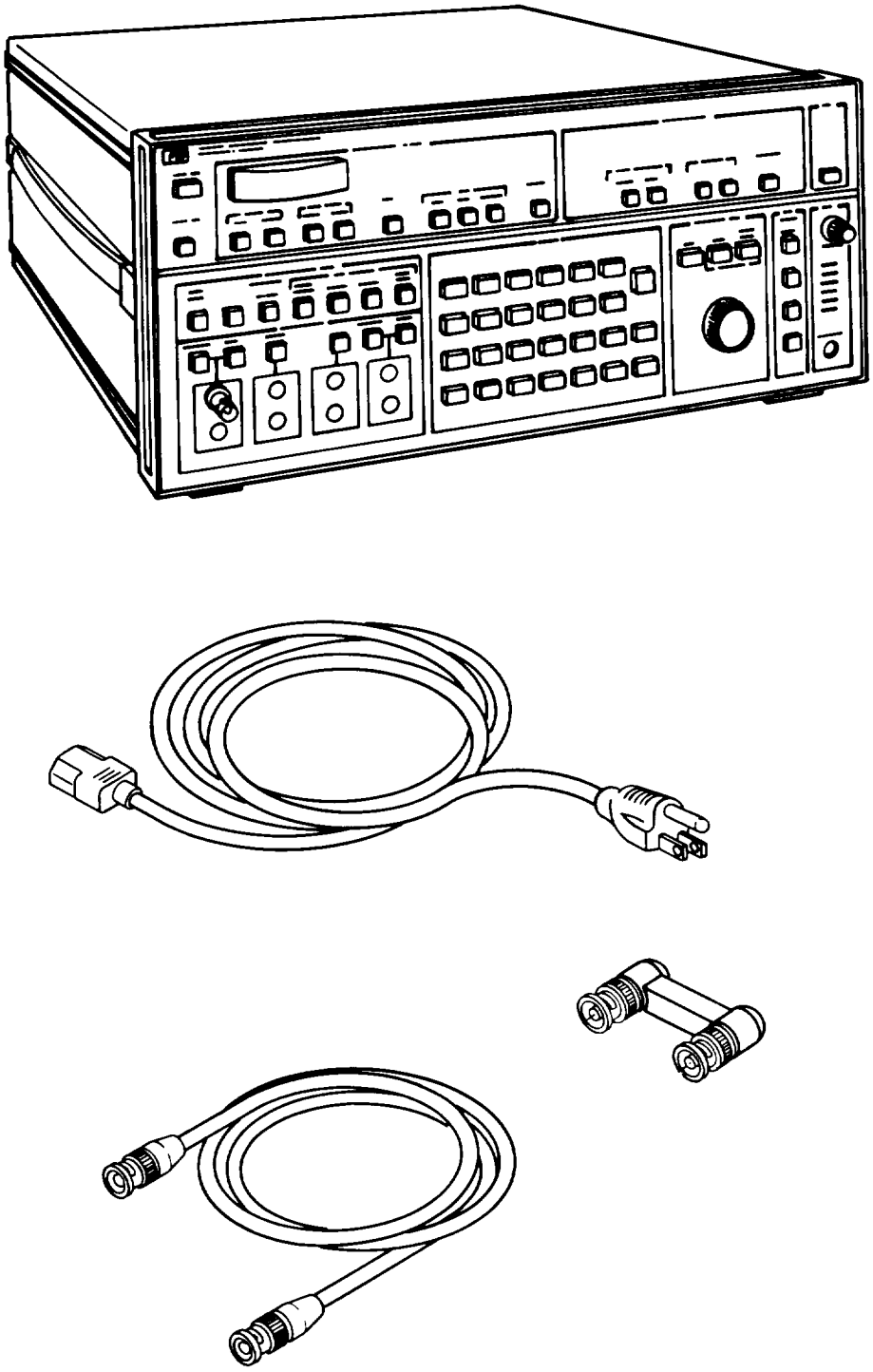
HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 1 January 1987

GENERAL SUPPORT MAINTENANCE MANUAL

FREQUENCY SELECTIVE LEVEL METER AN/USM-490
(NSN6625-01-138-3351)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028, (Recommended Changes to Publications and Blank Forms) or 2028-2 located in back of this manual direct to: Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-ME-MP, Fort Monmouth, New Jersey 07703-5000. In either case, a reply will be furnished to you.



EL9NT001

Figure 1-1. Frequency Selective Level Meter AN/USM-490.

CHAPTER 1
INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE.

This manual contains general support maintenance instructions for all configurations of Frequency Selective Level Meter AN/USM-490. This manual includes procedures for removal, replacement disassembly, cleaning, inspection, repair, test, and adjustment as authorized by the Maintenance Allocation Chart (MAC). Differences between configurations are indicated where necessary throughout the manual. Information is provided for maintenance to the Level Meter that is beyond the scope of tools, equipment, personnel, or supplies normally available to the operator or organizational maintenance.

1-2. CONSOLIDATED INDEX OF ARMY PUBLICATIONS AND BLANK FORMS.

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. MAINTENANCE FORMS, RECORDS, AND REPORTS.

a. Reports 01 Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750 as contained in the Maintenance Management Update.

b. Report of Packaging and Handling Deficiencies. Fill out foward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73B/AFR4M-54/MCO 4430.3H,

c. Discrepancy in Shipment Report (DISREP)(SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP)(SF 361) as prescribed in AR 55-38 NAVSUPINST4610.33C/AFR 75-18/MCO P4610.19D DLAR4500.15.

1-4. DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE.

Destruction of Army material to prevent enemy use is described in TM 750-244-2.

1-5. PREPARATION FOR STORAGE OR SHIPMENT.

Preparation instructions for storage and shipment are found in Chapter 2, Section V.

1-6. SAFETY, CARE, AND HANDLING.

Observe all WARNINGS, CAUTION'S, and NOTES in this manual. This equipment can be extremely dangerous if these instructions are not followed,

1-7. NOMENCLATURE CROSS-REFERENCE LIST.

Common names will be used when major components of the Level Meter are mentioned in this manual.

NOTE

Official nomenclature must be used when filling out report forms or looking up technical manuals.

Common Name	Offical Nomenclature
Level Meter	Frequency Selective Level Meter AN/USM-490
AN/USM-490	Frequency Selective Level Meter AN/USM-490

1-8. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

If your Level Meter needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at: Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: AMSEL-PA-MA-D, Fort Monmouth, New Jersey 07703-5000. We'll send you a reply.

1-9. WARRANTY INFORMATION.

The Level Meter is warranted by Hewlett-Packard Company for 12 months. Warranty starts on the date of shipment to the original buyer. Report all defects in material or workmanship to your supervisor who will take appropriate action.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-10. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.

Refer to TM 11-6625-3087-12, Chapter 1, Section II for this information.

1-11. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.

Refer to TM 11-6625-3087-12, Chapter 1, Section II for this information.

1-12. EQUIPMENT DATA.

Refer to TM 11-6625-3087-12, Chapter 1, Section II for this information.

Section III. PRINCIPLES OF OPERATION

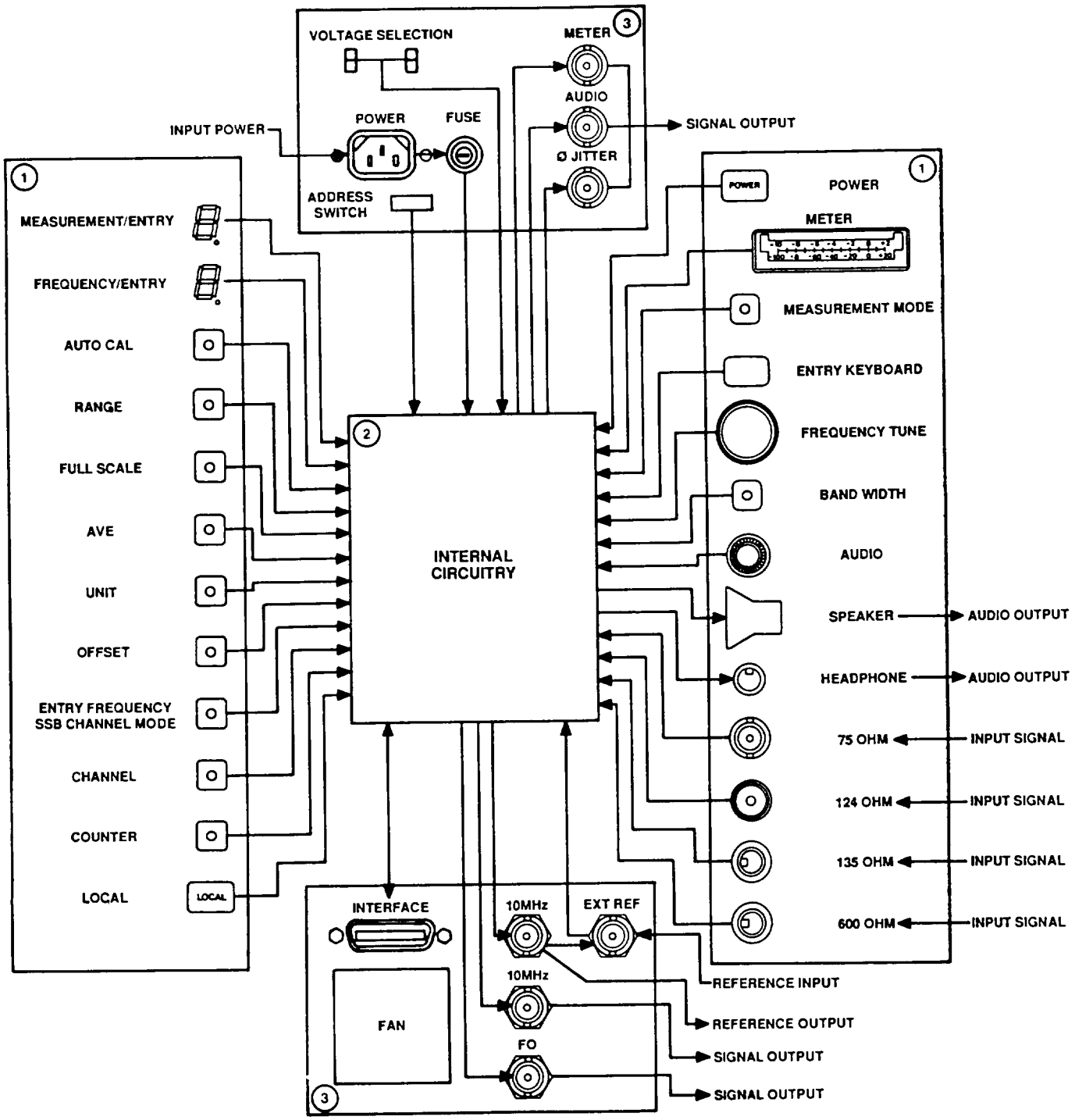
1-13. GENERAL FUNCTIONAL DESCRIPTION.

Frequency Selecting Level Meter AN/USM-490 primarily measures telecommunications analog signals for correct frequency and signal level. (Fig. 1-2.)

(1) The front panel contains all of the controls and indicators necessary for selecting input signal measurements. Seven input connectors are provided, two for 75 ohms or 10K ohms shunted by 50pf input, two for 124 ohms balanced input, two 135 ohms balanced input, and one for 600 ohms balanced or bridged input. One output connector is provided for the use of headphones. Two displays provide measurement or entry data. Twenty-one annunciators light appropriate labels for the displays or show the status of the Level Meter. A speaker with volume control is provided for audio output. Signal strength is measured on M 1 Analog Tuning Meter. Various data can be entered using the entry keyboard.

(2) The internal circuitry analyzes the input signal from one of the front panel input connectors. The settings of the front panel controls determine which of the ten measurement modes are used, along with input connector selection, bandwidth selection, and other parameters used to control the analysis and synthesis of input signals. Measurements of idle message channel noise, message channel signal translation, incidental phase modulation, I004HZ signal measurement, simulating voice traffic, carrier leak signal measurement, noise spike measurement, 2600Hz signal measurement, and insertion loss of cables are possible using one of the measurement modes. An internal power supply provides all voltages necessary to run the internal circuits.

(3) The rear panel contains the power input connector, fuse, voltage selection switch for 115-230Vac input power selection, and an interface control switch for tracking generator operation, interface troubleshooting, and address selection. Eight connectors are provided for interface connection, 10 MHz reference output, 10MHz reference input, O to 32MHz tracking signal output, meter output, detected audio output, and phase jitter output. A fan is provided for internal circuitry cooling,



EL9NT002

Figure 1-2. Level Meter Block Diagram.

1-14. DETAILED FUNCTIONAL DESCRIPTION. (Fig. FO-1.)

(1) (2) One of the balanced or unbalanced inputs within the Level Meter frequency range is selected thru the Al Input Multiplexer Assembly and passed m the A2 Input Amplifier Assembly. The A2 Input Amplifier Assembly either amplifies or attenuates the input signal and passes it to the A5 First Mixer Assembly.

(3) The amplified or attenuated input signal from A2 Input Amplifier Assembly and the first local oscillator signal of 50 to 82.5 MHz from the summation loop are mixed to obtain the first intermediate frequency (IF) of 50MHz.

(4) The A4 Broadband Power/C AL/Overload Assembly performs three main functions: First, the broadband power (BBP) level measuring circuit measures the average total broadband power of the input signal. Second, an underload/overload detector senses the input signal and tests the need for adjustment, either automatically or manually. Third. the tracking calibration signal generator is used in automatic calibration operation.

(5) The A15 Tracking Output Assembly accepts a 50 to 82.5 MHz first local oscillator signal from the summation loop and beats it against a 50 MHz signal from the A40 Frequency Reference Assembly. This produces a O to 32.5 MHz output signal which tracks the front panel tuned frequency. This output signal is available at the rear panel BNC connector labeled FO (0 to 32 MHz). This signal is also used in the A4 Broadband Power/CAIJOverload Assembly as the tracking calibration signal. The rear panel BNC output is maintained at approximately OdBm by the summation loop voltage-controlled oscillator which controls the amplitude of the 50 MHz input signal to the first mixer.

(6) The A16 10MHZ Frequency Reference Assembly produces a very stable 10 MHz output that can be coupled to the A40 Frequency Reference Assembly by use of the adapter on the rear panel.

(7) The A40 Frequency Reference Assembly provides most of the frequencies used throughout the Level Meter as references. A 50 MHz oscillator is used as the base frequency and all other frequencies are obtained by dividing 50 MHz by 5 or 10 in stages until each desired frequency is reached. Available frequencies are: 50MHz, 10MHz, 2MHz, 1MHz, and 100KHz.

(8) The first local oscillator consists of the A30 Fractional N+N, A31 Fractional N Voltage-Controller Oscillator, A32 Fractional N Phase Detector, A50 Step Loop, A51 Summation Loop Voltage-Controller Oscillator, A52 Summation Loop Mixer, and A53 Summation Loop Phase Detector Assemblies. The output of the first local oscillator is a 50 to 82.5 MHz signal.

(9) (10) (11) The step loop is contained on the A50 Step Loop Assembly. The summation loop is contained on the A51 Summation Loop Voltage-Controller Oscillator Assembly, A51 Summation Loop Mixer, and A53 Summation Phase Detector Assemblies. The A50 Step Loop Assembly contains the four basic elements of a phase-locked loop which are:

(12) (13)
- A voltage-controlled oscillator.
- A divide-by-N circuit.
- A phase detector.
- A low pass filter.

The A50 Step Loop Assembly locks up under direction of the A60 Controller Assembly from 54 to 86 MHz in exactly 2MHz steps. The exact frequency is dependent on the desired local oscillator frequency. The step frequency is mixed with the preset local oscillator frequency of 50 to 82.5 MHz in the A52 Summation Loop Mixer Assembly. This produces a difference frequency between 2 and 4MHz. This signal is used as one input to the A53 Summation Loop Phase Detector Assembly. The other input is a 2 to 4MHz reference signal from the fractional N loop. The phase difference between the two 2 to 4MHz inputs produces a DC tuning voltage. This controls the frequency of

the A51 Summation Loop Voltage-Controller Oscillator Assembly to the exact desired local oscillator frequency, from 50 to 82.5MHz. This step tuning voltage is also sent to a voltage comparator in the summing circuits as a reference for the summation tuning voltage. This provides the coarse frequency stepping of the summation loop voltage-controlled oscillator while the fractional N loop provides the fine frequency control. The A51 Summation Loop \'oltage-Controller Oscillator Assembly output of 50 to 82.5 MHz has the same frequency resolution and stability as the 2 to 4 MHz output from the A31 Fractional N Voltage-Controller Oscillator Assembly.

(14) (15) (16) (17) The fractional N loop consists of the A30 Fractional N+N, A31 Fractional N Voltage-Controller Oscillator, and A32 Fractional Phase Detector Assemblies. These assemblies form a phase-locked loop that operates at a selected frequency between 20 and 40MHz under the direction of the A60 Controller Assembly. The A31 Fractional N Voltage-Controller oscillator Assembly frequency is passed through a divide-by-ten circuit resulting in a 2 to 4MHz signal, with 0.1Hz resolution, This signal becomes the variable reference input to the A53 Summation Loop Phase Detector Assembly. The fractional N logic circuits provide precise control of the A31 Fractional N Voltage-Controller Oscillator Assembly to obtain the exact desired frequency with 1Hz resolution. The divide-by-10 circuit then provides the 0.1 HZ resolution.

(18) (19) The first intermediate frequency signal from the A5 Input Mixer Assembly is passed to the A 10 Second Mixer Assembly. Here it is mixed with the second local oscillator frequency of 49.984375 MHz from the Al 1 Second Local Oscillator Assembly to obtain the second intermediate frequency signal of 15.625KHz.

(20) (21) The A20 IF Filter Assembly determines the final bandwidth of the second intermediate frequency signal that is passed to the A21 IF Gain/Detector Assembly. Additional amplification of the second intermediate frequency signal is provided by the A20 IF Filter and A21 IF Gain/Detector Assemblies. The final signal level is then measured by a true RMS detector/logger stage on the A21 IF Gain/Detector Assembly.

(22) The A70 Impairments B Assembly has three separate, functional circuits used for communications channel impairment measurements. Demodulated sideband audio from the A21 IF Gain/Detector Assembly is supplied to the A70 impairments B Assembly and is supplied to the phase jitter and weighted filter/notch filter circuits. At the output of the notch filter circuit, the audio is passed to the impulse measurement circuit. The A70 Impairments B Assembly also includes a true RMS detector/logger circuit for level measurements of the processed audio, a crystal calibration oscillator for the weighted filter, and some control circuits for use by the Level Meter.

(23) The DC voltage level from the A21 IF Gain/Detector Assembly is converted to a digital number by the A22 Analog-Digital Converter Assembly. This is then passed to the microprocessor on the A60 Controller Assembly as the amplitude of the input signal. If the Level Meter COUNTER is on, the second intermediate frequency signal bypasses the detector circuits on A21 IF Gain/Detector Assembly and the frequency is counted by the A22 Analog-Digital Converter Assembly. This is then passed to the A60 Controller Assembly.

(24) All digital operations of the internal circuitry are directed by the microprocessor on the A60 Controller Assembly. The A60 Controller Assembly has software stored in six ROM'S. Two NMOS and two CMOS RAM's provide memory and data storage. The microprocessor handles all front panel switch selections, changes in Level Meter measurement modes, processes data, commands display changes, monitors circuit card assembly status, performs automatic calibration, and performs internal self-test procedures when selected.

(25) The A60 Controller Assembly sends digital values for amplitude and frequency to the A98 Keyboard Assembly for display to the operator. The A98 Keyboard Assembly also accepts data from the operator and sends it to the A60 Controller Assembly for processing.

(26) The A61/A62 HP interface Bus Assembly accepts instructions or data from the rear panel connector and sends this information to the microprocessor on the A60 Controller Assembly. It also accepts data from the microprocessor on the A60 Controller Assembly and sends this information to the rear panel connector. This information can then used by other instruments. The A61 HP Interface Bus Assembly has its own microprocessor to allow for rapid handling of input and output data to and from the rear panel connector and the A60 Controller Assembly.

(27) The A80 Power Supply Assembly is primarily a voltage regulator for the three main supply voltages of +12Vdc, -12Vdc, and +5Vdc. The source to the A80 Power Supply Assembly for these voltages is the power supply circuitry on the A99 Motherboard Assembly and some chassis-mounted components. The A99 Motherboard Assembly also provides a common point of contact for all of the plug-in circuit card card assemblies and eliminates unnecessary wiring and cabling between these assemblies. The A99 Motherboard Assembly also provides connection points for chassis-mounted components such as the power transformer T1.

1-15. DETAILED CIRCUIT THEORY. (Fig. FO-2 thru FO-25.)

(1) A1 INPUT MULTIPLEXER ASSEMBLY . (Fig. FO-2.) The purpose of the Al Input Multiplexer Assembly is to convert input signal impedance and voltage levels to usable values. Input signals from the front panel connectors are analyzed and, if balanced, are converted to unbalanced signals. Frequency compensation is provided for balanced inputs.

The correct termination impedance is supplied for all input selections by switching relays K1 thru K5. Relay switching logic is supplied from the A60 Controller Assembly through photoisolator A99U1 to serial to parallel shift register U31. The data pulses are gated into U31 by the termination clock signal (T CLK) from the A60 Controller Assembly through pulse transformer A99T4. The relay configuration for each input termination selection is shown below.

Input	*Activated Relays*
75 ohms unbalanced	K2 K3
10K ohms shunted by 50pf	K2
124 ohms balanced	K1 K2
135 ohms balanced	K1 K2
600 ohms balanced	K1 K2K4
600 ohms balanced-bridged	K1 K2K4 K5

Probe power comes from the -12Vdc isolated ground bus and from a +15Vdc isolated ground supply on the A99 Motherboard Assembly. Isolated ground is used as common.

(2) A2 INPUT AMPLIFIER ASSEMBLY. (Fig. FO-3.) Input signal from the Al Input Multiplexer Assembly is passed through the de-energized contacts of K 1 to the 0/20/40dB attenuator. K2 and K3 select the proper attenuation and pass the input signal to the amplifier. K4 controls the selection of a constant +5.25 or +15.25dB voltage gain for the amplifier. FET Q] provides high impedance buffering because U 1 a biases Q1 and keeps the point between the emitters of Q3 and Q4 at virtual ground. Q2 ensures that Q1 inserts no additional losses by maintaining the Q1 source/drain loop at unity gain, and reduces distortion. Driving the same signal at the same time, in phase, through transistor pairs Q3/Q5 and Q4/Q6 also reduces distortion.

When U4 pin 19 is HIGH, U1 pin 7 turns on Q7 and 5dB of attenuation is applied to the amplifier output. When Q7 is turned off, the signal is not attenuated and is passed directly to buffer amplifiers Q10 thru Q14 for output. The buffers provide a 50 ohms impedance output to the A5 Input Mixer Assembly and 50 ohms output to the A4 Broadband Power/CAL/Overload Assembly for broadband power measurements. The +10.5 volt regulators U2, QI0, and Q21 increase stability in the input amplifier. Current limiting protection is provided by R100, R110, CR5, CR6, CR8, and CR9.

When a calibration cycle occurs, K1 is energized bringing the calibration signal from the A4 Broadband Power/CAL/Overload Assembly to the A2 Input Amplifier Assembly. This calibration signal is normally equal in frequency to the displayed frequency on the front panel. For frequencies below 20KHz, the calibration signal remains at 20KHz.

Relay switching logic is supplied from the A60 Controller Assembly through photoisolator A99U1 to serial to parallel shift register U5. The data pulses are gated into U5 by the amplifier clock signal (AMP CLK) from the A60 Controller Assembly through pulse transformer A99T5.

The parallel eight bits from US are latched into U4 by the clock signal (ISO LATCH) from A60 Controller Assembly through pulse transformer A99T3. Four of the outputs from U4 control relays K1 thru K4 through the open collector drivers of U3. LJ3 pin 11 goes logic LOW when calibration is selected. This energizes K 1 to bring in the calibraition signal from the A4 Broadband Power/CAL/Overload Assembly and, at the same time, sends a (L) CAL signal to turn on calibration. Any time a full scale setting of +5dBm or higher is selected, 40dB of attenuation is required from the 0/20/40dB circuits. U3 pin 13 goes logic LOW causing K3 energize, K2 to de-energize, and 40dB is selected. This same LOW signal is applied to A4 Broadband Power/CAL/Overload Assembly to select the high level calibraition signal of –20dBm. U4 pin 19 turns Q7 on or off to select O or 5dB attenuation to the input or calibration signal as required.

The three remaining outputs of U4 pins 2, 5, and 6 select broadband averaging or set the proper threshold of the underload/overload trip points on the A4 Broadband Power/CAL/Overload Assembly.

(3) A5 INPUT MIXER ASSEMBLY. (Fig, FO-5.) The A5 Input Mixer Assembly accepts 50Hz to 32.5 MHz from the A2 Input Amplifier Assembly and combines it with the first local oscillator frequency of 50 to 82.5 MHz from the A51 Summation Loop Voltage Controlled Oscillator Assembly to produce the first intermediate frequency of 50MHZ.

The 32.5 MHz low pass filter keeps frequencies greater than 32.5 MHz from mixing with the first local oscillator. This would produce a 50MHz image intermediate frequency. As an example:

With 10MHz selected, the first local oscillator frequency would be 60 MHz and the different frequency out of balanced mixer CR 1 would be the desired 50MHz.

Limiter U1 provides a strong drive signal for the first local oscillator into double balanced mixer CR 1. This reduces both harmonic and intermodulation distortion.

The balanced mixer output signal is applied to 50MHz crystal filter Y1 and Y2 with a 10KHz bandpass. C23 is used to adjust a notch on the low side of the 50 MHz bandpass at 49.968750MHz. This notch provides image rejection for the second intermediate frequency in the A10 Second Mixer Assembly.

The + 14dB amplifier Q21 and Q22 compensates for any signal loss in the mixer.

(4) A4 BROADBAND POWER/CAL/OVERLOAD ASSEMBLY. (Fig. FO-4.) The three main functions of the A4 Broadband Power/CAL/Overload are:

Broadband Power Level Measuring.The function of the broadband power detector is to measure the average total broadband or wideband power present in the input signal. The sampling circuits take a sample of the incoming waveform and the detector measures the power in the sampled signal. The RF signal is amplified +3dB by Q4 and Q5 then sampled through diode bridge circuit CR 10 thru CR13 which is normally biased off.

The sampling voltage-controller oscillator circuit is frequency modulated by an 80Hz oscillator to sweep the range from 20 to 50KHz, This prevents the sampling circuits from performing sampling against any signal in the wideband input. A delay network between U2a and U2b causes the output voltage-controller oscillator pulses at T1 to be 25ns. The pulses from T1 are then used to turn on diode bridge CR10 thru CR13 for a small amount of time to pass a sample of the input signal waveform through +23d B amplifier/driver U3. This sample is then sent to the detector/ logger for amplitude measurement.

Tile true RMS detector/logger circuit determines the overall power level of the sample and converts it to a logarithmic DC voltage for use by the A22 Analog-Digital Converter Assembly. The broadband averaging line (H) BBA from the A2 Input Amplifier Assembly, goes HIGH any time averaging is selected with the WIDEBAND mode. A HIGH on broadband averaging turns on Q8 which shorts out C40 and allows C41 to average the logger sample measurements. If average is ON when calibration occurs, Q8 is turned off during the calibration cycle.

Scaling amplifier U5b adjusts the logger output to a scale factor of 100mv/dB in preparation for driving the underload/overload detector. R34 and R35 divide the signal level by 10 before the signal is passed to the Analog-Digital Converter Assembly. Since the broadband power LOG RMS signal must pass over the isolation barrier separating the input circuits from the rest of the Level Meter, the return and the signal lines are resistor isolated into a balanced input to a buffer amplifier on the A22 Antilog-Digital Converter Assembly. This provides common mode rejection for the DC signal level between the grounds.

Underload/Overload Detection. Scaling amplifier U5b output is passed through U5a to the underload/overload detector. Precision voltage referance inputs U6a and U6b set the trip points for the input signal, If either underload or overload occurs the yellow of red LED's will light, and the UNDERLOAD or OVERLOAD line will go HIGH. This condition notifies the A60 Controller Assembly that an auto range condition exists. If auto full scale is selected, the microprocessor will increase the overall gain for underload or attenuate the setting.

For different front panel modes of operation, the reference voltage input signal power level in dB that will cause underload or overload to occur can be shifted by 5, 10, or 15dB as needed. This is accomplished by the A60 Controller Assembly through control of the THRESH 1 and THRESH 2 input lines to the underload/overload trip point reference circuits. When either of these lines go LOW, current is supplied to US pin 2. This controls input signal power level and shifts the trip points. THRESH 1 going LOW causes a 5dB change; THRESH 2 going LOW causes a 10dB change, and both going LOW causes a 15dB change,

Calibrated Siqnal Generator. The calibration balanced input to the A4 Broadband Power/CAL/Overload Assembly is the 0 to 32.5MHz tracking oscillator signal from the A15 Tracking Output Assembly. It may also be a fixed 1MHz signal from the A40 Frequency Reference Assembly gated through the A15 Tracking Output Assembly. This input to the A-1 Broadband Power/CAL/Overload Assembly is only present in calibration, when the (L) CAL line goes LOW, turning off Q101 and allowing the bias voltage to be applied to U101a. The limiter output is sent to a precision square wave generator which is fed by a constant current source. The current source controls the current flow through the emitters of differential amplifier pair Q102/Q103 by controlling the base voltage of Q104. The (H) LOW' LEVEL CAL line controls whether the CAL OUT signal to the Input Amplifier Assembly is the –40 (low level) or –20 (high level) square wave. Tf 40 out is desired, a full scale setting of OdBm or below, Q106 is turned on and U104a provides no current gain. When –20 *out is* desired, a full scale setting of +5dBm or above, Q106 is off and U104a provides additional gain to increase the power of the CAL OUT signal to the A2 Input Amplifier Assembly. The filter components in the generator circuit are needed because the calibration signal is a square wave and the input signal is normally a sine wave.

(5) A15 TRACKING OUTPUT ASSEMBLY. (Fig. FO-8.) The 50 to 82.5 MHz first local oscillator input to the double-balanced mixer is amplified and limited inside U1. This is done so that any amplitude changes that occur with the frequency are not noticed in the output of the mixer. The 50MHz input of U1 is such that a 2dB change in input signal amplitude will cause a 2dB change in the mixer output. A variable voltage applied through R8 to the 50 MHz input provides level control feedback. The O to 32.5 MHz output from U 1 is amplified by 40dB amplifier U2. This amplified output feeds power amplifier stage Q1 thru Q3 that drives the rear panel tracking output connector J5. in the event this output is mistakenly connected to a source, overload protection circuitry CR9 thru CR12 is provided. At the power amplifier output, a signal tap is provided to a peak-to-peak level detector that, together with intergrator U3, maintains OdB (+0.5dB) at the rear panel output connector J5 using voltage control feedback to U 1.

The amplified output from U2 also goes into buffer circuit U4 which squares the signal at ECL levels for input to ECL gate U5. The (L) CAL line turns Q4 off when in cailibration and allows U4 to pass the CAL SIGNAL to U5d. A second input to U5d is a buffered 1MHz signal from the A40 Freqtiency Reference Assembly.

(6) A16 10MHz FREQUENCY REFERENCE ASSEMBLY. (Fig. FO-9.) The precision frequency reference 10MHZ oscillator uses +23Vdc from the A80 Power Supply Assembly, This voltage is regulated at +15Vdc by U1 for use by U3. When the Level Meter has had power removed for any period of time, the oven will draw a larger amount of current from regulator U 1 until the crystal oscillator reaches operating temperature. R7 determines the sensing current level. U2, pin 1 will go HIGH, turning LED CR 1 on and turning on Q3. When Q3 is on, the (H) cold line

to the A60 Controller Assembly will be LOW indicating a cold oven and will turn on the OVEN light on the front panel. Q2 shorts our the 10MHz output from the oscillator. When the oven reaches operating temperature, U2 pin 1 will LOW, the LED on the board will go out,and the front panel OVEN light will go out.

(7) A40 FREQUENCY REFERENCE ASSEMBLY. (Fig. FO-16.) The 50 MHz reference is obtained from a voltage-controlled crystal oscillator made up of Q90 and Q91. Y90 (50MHz) and voltage variable capacitance diode CR91 provide a positive feedback path. A DC controlled voltage from U55 is used to change the capacitance of CR91 to maintain the 50MHz reference accuracy. CR90 provides amplitude limiting for the oscillator output.

The voltage-controlled crystal oscillator feeds buffer/level shifter circuit U92 that raises the sinewave to an ECL level signal. ECL level buffers U90 and U93 drive three 50 MHz outputs to the Al 5 Tracking output Assembly, A11 Second Local Oscillator Assembly, and test connector J6.

The 10MHz output also goes to U53 where the signal is divided by 5 into 10hl Hz signals. The 10 MHz signals are used as follows:

10MHz from U53 pin 4 is buffered by U52b and passed through a low path filter. The signal is then squared by buffers U3a and U3b and drives +10B amplifier Q1 and Q2 to obtain the desired amplitude level. The output of T1 is sent through a low pass filter to reduce harmonic distortion and then passed 10 rear panel BNC connector J3.

10MHz from U53 pin 2 is buffered U4 and sent to C15 to remove the DC component and shift the signal to a O volt reference. This signal is then passed to the step loop assembly.

10MHz signal from U53 pin 3 goes to U31 where the 10MHZ signal is divided by 10, Two outputs of 1MHz and one output of 2MHz are obtained.

The 2MHz signal goes to a test jack secondary J2. The two 1MHz out-of-phase outputs drive Q30 and Q31. The result is a TTL signal at 1MHz. This 1MHz signal goes to U30 where it is divided by 10 to a 100KHz signal. This 100KHz signal is passed through a pulse shaper circuit to get a 30ns narrow pulse and used by the A32 Fractional-N Phase Detector Assembly as a reference input.

The 1MHz output from U31 pin 14 is buffered by U32 and shifted in level from ECL to CMOS by U33b. The two buffered outputs go to the A15 Tracking Output Assembly and the A22 Analog-Digital Converter Assembly. The third buffered output goes through a 20dB attenuator circuit and supplied to the A11 Second Local Oscillator Assembly.

The 10MHz at U53 pin -4 is also passed through buffers U51 and U52 to a phase detector stage. The other input to the phase detector may come from the A16 10MHZ Frequency Reference Assembly if the rear panel adapter is installed, Any other stable external 10MHZ, 5MHZ, 3.333333MHz, 2.5MHz, 2MHz, or 1MHz signal may be used as the second input to the phase detector.

The external source is connected through the rear panel BNC connector EXT REF INPUT 10 MHz J1 to signal amplifier U1 with input protection provided by diodes CR1 and CR2. The signal level is shifted from a 0 volt reference at the DNC input to a +-3.5 volt (VBB) reference at the input to U1a. It is then amplified by U1b, and out-of-phase signals at (Jib pins 6 and 7 are passed m pulse shaper U2a. U1b pin 6 output is delayed slightly behind U1b pin 7 output so that U2a is turned on for only a short period. The pulses from U2a which are out-of-phase outputs, are applied to differential simplified Q50 and Q51 and then used to switch a bridge made up of diodes CR50 thru CR53.

If an external source is being used, the phase detector bridge switches the 10MHZ signal from U53 to U54. CS6 and R59 filter the signal so that only a DC level is seen as the input and output of U54. This analog signal is then buffered by U55 and used to control the frequency of the voltage-controlled crystal oscillator, locking it in phase with the external source. U54 has a voltage gain of 11 to pull up the low Ievel of the 10MHZ signal from U53 to an amplitude that will control the voltage-controlled crystal oscillator.

If an external source is not used, the diode bridge is never turned on and U54 pin 3 is essentially at ground potential. R78 is now used to set the voltage-controlled crystal oscillator frequency to exactly 50MHz while shorting TP4 to TP5 to speed up the normally very slow loop response time. Q55 is normally on, providing a very narrow bandwidth to the loop. If an external source is used that is outside this bandwidth. the output of U54 will swing positive and negtitive trying to lock on, The negative peaks will turn on CR55, charging C75, and turning off Q55. Q88 now controls the input impedance to ground instead of R83, widening the bandwidth. This isdoneso the loop can speed up the lock on the external source. When lock-on is achieved; the output of U54 will stop swinging, Q55 will again turn on, and the desired narrow bandwidth is achieved.

Whenever the Ioop is not locked on and searching, the charge on C75 will bias off Q56. This will allow Q54 to turn on and the loop unlock indicator DS1 will light. ALOW signal on the (L)REF UNLOCKED line to the A60 Controller Assembly will cause an error code of Err 8 to be displayed on the front panel.

(8) FIRST LOCAL OSCILLATOR. Detailed circuit theory of the First LOcal Oscillator is described in detailed circuit theory for items 9 thru 17.

(9) A50 STEP LOOP ASSEMBLY. (Fig. FO-17.) The A50.) Step Loop Assembly consists of the following elements:

Step Loop Voltage-Controlled Oscillator. The step loop voltage-controlled oscillator operates in the range of 54 to 86 MHz in 2MHz steps. The actual frequency is controlled by the step tune voltage across the voltage variable capacitance diodes CR1 find CR2. The step tune voltage varies from +9 to –9 Vdc. This voltage varies the capacitance of the voltage variable capacitance diodes and changes the frequency of the oscillator. The voltage-controlled oscillator output is buffered by Q7 and Q8. One output goes to two isolation amplifiers Q5 and Q6 to provide a capability for monitoring the step voltage-controlled oscillator frequency at J2 and an output to the A52 Summation Loop Mixer Assembly. The other output is through isolation amplifier Q5 and Q6 to ECL waveshaper U70 which converts the sine wave to a square wave output at ECL levels. This drives the divide-by-N circuit.

Step Loop Divide-By-N. A programmable divide-by-N counter is used to divide the present voltage-controlled oscillator frequency down to 2MHz. This is used as a variable input to the phase detector. The A60 Controller Assembly sends a divide-by-N code (where N is an integer from 27 to 43) over lines F1, F2, F4, F8, F10, and F20 to counters U71 and U72. The counters accept the voltage-controlled oscillator input, count the pulses, divide the count by the selected integer, and output the result to the phase detector. When the step loop is locked, the divider output frequency is 2MHz.

Step Loop Phase *Detector.* The step loop phase detector has two inputs, The first input is a 10 MHz reference from the A40 Frequency Reference Assembly. Divider/waveshaper U76 converts the 10MHZ pulse to a 2MHz pulse as the precision reference input to the step loop phase detector. The second input is from the divide-by-N circuit which varies about 2MHz. This signal varies as the present voltage-controlled oscillator frequency and the A60 Controller Assembly selected value of N change.

The step loop phase detector compares the 2MHz variable input from the divide-by-N circuit to the fixed 2MHz precision reference. If the rising edges of the pulses are at the proper phase, the voltage-controlled oscillator has the correct frequency. The loop will be phase-locked and the step tune dc voltage across main loop charging capacitor C48 will be constant. This holds the v{>lt:lge-controlled oscillator frequency constant, The positive and negative current sources are now exactly in phase, and no current flows through S1 and R50 into C48.

If the voltage-controlled oscillator frequency is too low:

The variable input pulse lags the reference input pulse, The negative current source Q71 will now be turned on longer than the positive current source Q72. The voltage across C48 will decrease as current flows through R50 and S1 into Q71. As the voltage across C48 sees more negative, the voltage-controlled oscillator will increase in frequency until the variable input is in phase with the reference frequency. The negative and positive current sources will again turn on and off together at the 2MHz rate set by the reference input. When this occurs, no more current flows and the loop is locked.

If the voltage-controlled oscillator frequency is too high:

The circuit action is reversed. The positive source is on longer than the negative, current flows out of Q72 into C48, and the voltage-controlled oscillator frequency decreases until the loop is again locked,

The switching amplifiers have differential. simultaneous out-of-phase inputs to ensure quick turn-on and turn-off of the two current sources. The TEST position of S1 taps a fixed reference voltage for the voltage-controlled oscillator frequency adjustment and test.

Step Loop Low Pass Filter. The step loop low pass filter keeps the 2MHz pulse so current flow adding 2MHz sidebands to the voltage-controlled oscillator output. The output of the step loop low pass filter also goes to a unity gain buffer stage U1 and then on to the step/sum voltage comparattor on the A53 Summation Phase Detector Assembly. U1 feeds an unlock detector circuit U73 which compares the step tune voltage to +9V. If the loop is not locked or is locked at too high or too low a frequency, the step tune voltage will exceed the unlock thresholds. DS70 will turn on and the A60 Controller Assembly will be notified through a LOW on (L) step unlock to present error code E3.8 on the front panel.

(10) SUMMATION LOOP. The summation loop is a phase-locked loop in which a mixer circuit replaces the standard divide-by-N circuit. The reference input to the phase detector is programmable by the A60 Controller Assembly. The comparator circuits and switching logic allow [he loop to handle large frequency changes by the operator, Detailed circuit theory for the summation loop is described in detailed circuit theory for items 11, 12, and 13.

(11) A51 SUMMATION LOOP VOLTAGE-CONTROLLER OSCILLATOR ASSEMBLY. (Fig. FO-18.) The voltage-controlled oscillator Q13 and Q14 operates in the frequency range of 50 to 82.5 MHz in O.1HZ steps. The actual frequency is controlled by the summation tuning voltage which is felt across voltage variable capacitance diodes CR1 and CR2. It is important that both the STEP and SUMMATION loops track together very closely, therefore A50CR1, A50CR2, A52CR1, and A51CR2 are a matched set of four. If me diode must be replaced, all tour must be replaced. S1 provides a fixed voltage tap in the TEST position for voltage-controlled oscillator frequency adjustment and test.

The voltage-controlled oscillator output is buffered by Q11 and then uses two emitter followers Q9 and Q10 to drive the four outputs through isolation amplifiers Q1 and Q8. The 100MHz low pass filters provide rejection of harmonics.

(12) A52 SUMMATION LOOP MIXER ASSEMBLY. (Fig. FO-19.) Mixer stage U1 has two inputs, the 54 to 86MHz output from the step loop voltage-controlled oscillator and the 50 to 82.5MHz output of the A51 Summation Loop Voltage-Controlled Oscillator. These two signals are mixed together to provide a difference frequency between 2 and 4MHz. The mixer output is amplified by Q1 and filtered to remove high frequency components and then drives wave shaper circuit U2. The output of Q2 is a sine wave which U2 converts to a square wave at an ECL output level to drive the A53 Summation Loop Phase Detector Assembly.

(13) A53 SUMMATION LOOP PHASE DETECTOR ASSEMBLY. (Fig. FO-20.) The 2 to 4MHz variable input from the A52 Summation Mixer Assembly is limited by U7 at an ECL input level to U6b. The 2 to 4MHz reference input from the Fractional N loop is phase-compared to the variable input. Positive/negative current sources Q4 and Q5 are then turned on and off as necessary to change the summation tuning voltage to the A51 Summation Loop Voltage-Controlled Oscillator.

When the summation loop is phase-locked to the Fractional N reference, the outputs of the current sources Q4 and Q5 are in sync. No current flows through the low pass filter to or from the A51 Summation Loop Voltage-Controlled Oscillator and the summation voltage-controlled oscillator frequency is stable. If the operator makes a from panel frequency change so that only the Fractional N reference is changed, the loop will unlock. The phase detector will then adjust the on/off time duration of the correct current source to raise or lower the summation tuning voltage. The summation tuning voltage is sent to the summation loop. The summation voltage-controlled osillator frequency will change accordingly, and the A52 Summation Loop Mixer Assembly output will follow the voltage-controlled oscillator change, When it equals the Fractional N reference, the loop will again stabilize.

The step tuning voltage changes with the step loop and this voltage is input [o differential amplifier U1. U1 drives the loop synchronization comparator circuit U3 to handle any loop out-of-limit conditions. The output of either U3a or U3b will change state, as required, to override the phase detector and drive the summation loop voltage-controlled

oscillator up or down in frequency until the loop is back within Iimits. Then the Fractional N reference will assume control of the loop until phase lock occurs.

In normal locked loop operation, the output of U1 is appmximately 0 volts; the output of U3a is HIGH. and the output of U3b is LOW. If the loop unlocks with the summation voltage-controlled oscillator too low and nut of limits, the step tuning voltage will be more negative than the summation tuning voltage, U1 output will go positive causing the output of U3a to go LOW. This state change of U3a turns negative current source Q5 on. it also freezes the phase detector flip-flops by putting a LOW on the D inputs of U6a and U6b. This turns positive current source Q4 off to pull the summation voltage-controlled oscillator frequency up to within 2MHz of the step voltage-controlled oscillator. When the summation tuning voltage lowers at the input of U1 enough to return U1 output to 0 volts, U3a reverses state and the loop is within operating limits, The phase detector assumes control and locks up the loop. During this sequence, the output of U3b would remain constant.

If the loop unlocks with the summation voltage-controlled oscillator too high and out of limits, negative current source Q5 turns off; U3b changes state, and positive current source Q4 turns on until the summation voltage-controlled oscillator comes down to within 2MHz of the step voltage-controlled oscillator. When the phase detector assumes control, it again locks up the summation loop to agree with the frictional N loop.

Any time the summation loop goes to an out-of-limit condition, one of the two inputs to U4a will go HIGH turning Q1 cm to light the UNLOCK LED DS1. At the same time, this LOW at pin 2 of U4a is sent to the A60 Controller Assembly by the sum unlock (L) line. This causes an E3.2 error code to be displayed on the front panel.

(14) FRACTIONAL N LOOP. Detailed circuit theory of the fractional N loop is described in detailed circuit theory for items 15 thru 17,

(15) A30 FRACTIONAL N+N ASSEMBLY. (Fig. FO-13.) This assembly provides the divide-by-N function for' the fractional N phase-locked loop. The fractional N logic chip U16 receives instructions and data from the A60 Controller Assembly. U16 then controls the fractional N voltage-controlled oscillator at a frequency which will give the desired tuned frequency while using a whole integer as the fractional N loop divide-by-number. For example:

> The desired front panel frequency is 3,603MHz. This is added to 54MHz by the A60 Controller Assembly to get 57.603 MHz. This number is divided by two to get the divide-by-N number for the step loop or 28. The remainder is subtracted from 4MHz or 4MHz – 1.603 to obtain the desired frequency that must be input to the A53 Summation Loop Phase Detector Assembly from the A31 Fractional N Voltage-Controller Oscillator Assembly or 2.397MHz.

To get the correct fractional N voltage-controller oscillator frequency output. the fractional N voltage-controlled oscillator must run at a frequency ten times higher than the required output, This is because of the divide-by-10 circuit in the A31 Fractional N Voltage-Controller Oscillator Assembly, The A60 Controller Assembly sends the frequency command to U16 which determines the divide-by-N number from 200 to 400 for NNN to 993 counter U1 to U3. Also determined is the fractional portion of the frequency for pulse swallow determination and for the API current calculation, U16 sends the 9's complement of the divide-by-N number to preset the NNN to 993 counter to the correct number. For example:

> If 2.397MHz is the desired input to the summation loop from the Fractional N loop, the fractional N voltage-controlled oscillator has a frequency of 23.97MHz or 10 times higher. The divide-by-N number is 239 and the frictional number is 0.7 obtained from the 23.97MHz.
>
> The 9's complement of the divide-by-N number would be 999-239 or 760. This number would then preset the NNN to 993 counter to 760.

The counter increments from the preset number to 993 at a rate controlled by the fractional N voltage-controlled oscillator frequency. When the count reaches 993, it is shifted to 993 to 999 counter U5 and U6. This is done to set the NNN to 993 counter for the next reference period, After the counter has reached 999, the next clock pulse causes

the counter to roll over and generate a cycle start pulse. This begins a new reference period. The cycle start occurs at a 100 KHz rate. The divide-by-N number times the 100 KHz rate equals the input frequency from the voltage-controlled oscillator to the counter, or the rate the counter must count. For example:

In the previous example, the fractional N voltage-controlled oscillator is running at a rate of 23.97MHz. The counter must count 760 to 999 or 239 counts at a rate of 100KHz. 239 times 100KHz equals 23.9MHz.

The difference between voltage-controlled oscillator frequency and the counter input frequency, or counting rate, is the fractional number saved by U16. This number is used to determine when to swallow one of the fractional N voltage-controlled oscillator pulses entering pulse delete gate U4c, This is done so that the average frequency of the signal going into the counter is an exact 100KHZ multiple of the divide-by-N number. The fractional number is also used to calculate the amount of API current needed. For example:

in the previous example, the difference between the voltage-controlled oscillator and the required counter frequency is 23,97 MHz minus 23.9 MHz or 70KHz. The fractional number saved by U16 was 0.7. The pulse delete gate, using the voltage-controlled oscillator input of 23.97MHz, provides a 23.9 MHz output to the counter.

The fractional number saved by U16 is also used to calculate the amount of API current needed by the A32 Fractional N Phase Detector Assembly. The fractional number tells the five API lines how long they must turn on, with the maximum amount being 10 API-clock pulses. For example:

In the previous example, the fractional number was 7. This will tell API-1 to run for 7 of the 10 pulses, and API-2 thru API-4 to run for 0 of the ten pulses.

For a further explanation of API current, see item 17.

When the bias current is switched off, U16 pin 10 goes LOW, reversing the inputs to U11b and to U12a. Before the counter rolls over, the clock pulse VCO-2 triggers U12a. Q1 turns on at the next fractional N voltage-controlled oscillator clock pulse to U12b, TP3 goes HIGH and a new 100 KHz variable frequency input pulse is sent to the phase detector to begin ramp-on. After a time period, which is dependent upon the fractional N voltage-controlled oscillator frequency, the counter rolls over. A new cycle start pulse is generated and a new reference period begins. After the cycle start pulse is received, U 16 sets the S + H line pin 11 to HIGH. This samples the integrator output from the A32 Fractional N Phase Detector Assembly. U16 then sets the S + H line LOW to hold the FN TUNE voltage for the fractional N voltage-colltrolled oscillator.

After the sample/hold operation takes place, U16 determines if 360 degrees or more of phase error has accumulated since the last pulse swallow. If it has, the PS line, U16 pin 12 to U14 pin 2 is set HIGH and this signal is gated through to pulse delete gate U4C. Here it shows up as a one-shot LOW pulse that inhibits one pulse of the voltage-controlled oscillator input to the counter. After the PS line again goes LOW, the BIAS Line is set HIGH. After several pulses of the chip clock U 16 pin 7, a precisely controlled amount of API current is turned on at the A32 Fractional N Phase Detector Assembly. This is done by U16 control of lines API-1 thru API-5. If the desired frequency is not an exact multiple of .1 MHz, API current will be flowing during each reference period. When a change in frequency is ordered by the A60 Controller Assembly, U 16 calculates the amount of API current required.

After ten API clock pluses, all API control lines are turned off. This is followed a few clock pulses later by the BIAS line going LOW.

U16 now controls the following fractional N operations:

The integrator circuit output from A32 Fractional N Phase Detector Assembly is sampled and passed to the A31 Fractional N Voltage-Controlled Oscillator Assembly.

If 360 degrees or more of phase accumulation has occurred within U 16 during the previous reference period, a pulse swallow occurs at the fractional N voltage-controlled oscillator input to the NNN to 999 counter.

The following operations are on the A32 Fractional N Phase Detector Assembly:

The positive bias current is switched into the integrator circuit.

The negative APl current sources are switched into the integrator circuit, taking out a calculated amount of bias current

The API current sources are switched off, followed by the bias current source.

output data is sent to the counter in 9's complement to preset the divide-by-N number in the NNN to 993 counter for the next reference period. This is done during the last six counts 993 to 999 of the counter.

(16) A31 FRACTIONAL N VOLTAGE-CONTROLLED OSCILLATOR ASSEMBLY. (Fig. FO-14.) The A31 Fractional N Voltag-Controlled Oscillator Assembly receives a DC voltage (FN TUNE) from the A32 Fractional N Phase Detector Assembly. The tuning voltage is from 0 to +6 volts and is passed through variable gain amplifier U1a. This output is applied to CR4, CR5, and CR6 to set the voltage-controlled oscillator to a frequency of between 20 MHz (+6 volts) and 40MHz (0 volts). A stable cathode bias for the voltage variable capacitance diodes is provided by U1b through tank coil L4. The voltage-controlled oscillator output is buffered by Q3 and Q4 and takes three paths as follows.

The first path goes through Q5 and Q6 to the A30 Fractional N+N Assembly

The second path provides a test point (TP1) for monitoring the 20 to 40MHz voltage-controlled oscillator frequency.

The third path goes through Q7 and Q8 to wave shaper circuit CR7 and CR8 which converts the voltage-controlled oscillator sine wave to an ECL square wave. This drives the divide-by - 10 circuit U3.

U3 provides two separate 2 to 4 MHz outputs. one to TP2 and the other through buffered variable reference U4b and U4c, to input to the A53 Summation Loop Phase Detector Assembly.

The FN TUNE voltage is also applied to dual comparator U2a and U2b to detect whether an out-of-lock condition exists. If the tuning voltage is greater than +8.6 volts or less than --8.6 volts, U2a or U2b respectively will turn Q9 on. When Q9 turns on. LED CR11 will illuminate and the (L) FN UNLOCK line will go LOW, telling the A60 Controller Assembly to display error code E3.4 on the A98 Keyboard Assembly.

(17) A32 FRACTlONAL N PHASE DEETECTOR ASSEMBLY. (Fig. FO-15.) The fractional N phase detector U 1 compares the phase relationship of a frequency variable 100KHz signal from the A30 Fractional N+N Assembly to a stable 100KHz reference Signal from the A40 Reference Frequency Assembly, A negative going pulse is then generated. The width of the pulse is based on the time between the leading edges of the two input signal pulses to U1, This pulse controls the ramp-up time of the integrator circuit Q24 thru Q31 to generate the control voltage for the fractional N voltage-controlled oscillator. The ramp-down time of the integrator circuit in between reference pulses, is started by the turn-on of a fixed bias Current. This bias is current modified by five control currents. These currents perform a function called Analog Phase Interpolation (API). The current sources and associated switches are called API's. The on/off signals for the control currents are from the Fractional N-N Assembly and are labeled API-1 thru API-5. Control of these five currents enables the precision tuning of the fractional N voltage-controlled oscillator in 1Hz increments. A sample/hold circuit Q32 through Q34 and U7 keep the changing integrator circuit output from modulating the FN TUNE voltage. When the ramp-up is complete, the voltage on the integrator is sampled and then passed to the fractional N voltage-controlled oscillator. See fig. 1-3 for a representation of the output voltage from the integrator circuit.

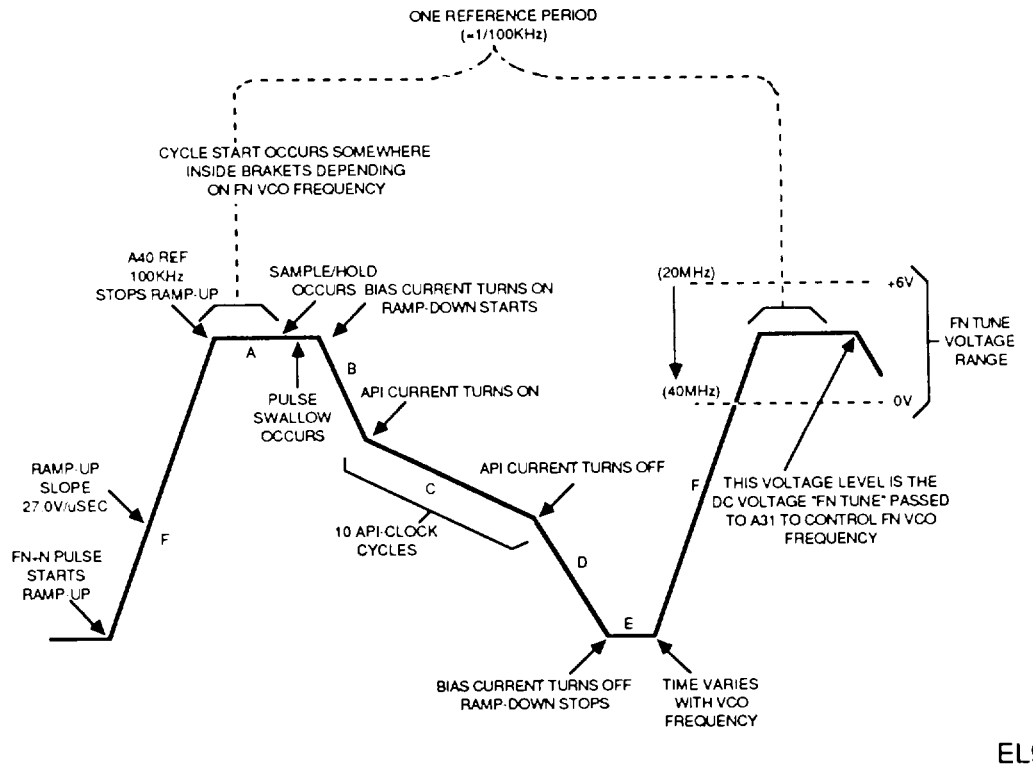


Figure 1-3. Fractional Integrator Circuit Output.

The 100KHz input pulse normally arrives at U1 before the reference input pulse. The outputs of U la are switched by this pulse through Q1 find Q2 to turn Q3 off and Q4 on. TP8 now goes LOW, turning CR3 off and starting the ramp-up time of the integrator circuit. When the 100 KHz reference pulse arrives at U1b, U1a is reset. Q1 and Q2 are switched to turn Q3 on and Q4 off. TP8 now goes on HIGH, CR3 turns on, and ramp-up stops. The integrator circuit now has a constant output as shown by the flat portion (A) in fig. 1-3. This level is sampled and passed to the fractional N voltage-controlled oscillator. U1b will be reset by the time the next pulse from the A30 Fractional N+N Assembly arrives.

When the bias line goes HIGH at U3 pin 14 and the latch clock triggers U3, the ramp-down time begins. The first part of the ramp-down current shown at (B) in fig. 1-3 is bias current only applied to the integrator circuit. All ramp-down current flows into U5. The lacth clock is now triggering U3 at the rate called the API Clock,

At all times other than during ramp-down, the latch clock is held HIGH by the LOW present on the bias line. After several API clock pulses, a combination of API lines 1 thru 5 are switched to modify the bias current with API current as shown at (C) in fig. 1-3. The selected API current sinks absorb a precise amount of the bias current so that the slope of the integrator ramp-down is decreased. Each API current sink absorbs 10 times more current than the one next to it with API-1 absorbing the most and API-5 the least. These current sinks are turned on and off by the outputs of U3 and Q18 thru Q20. This API current cycle lasts for 10 pulses of the API Clock. Each current sink may be on for 0 to 9 of the 10 pulses so that any numerical combination from 0 to 99,999 is possible.

Next the API current sinks are switched out of the integrator loop and again only the bias current ramps the Integrator downward shown at (D) in fig. 1-3. When the Bias current is turned off after a specific number of API clock pulses, the integrator is in a quiet state shown at (E) in fig. 1-3. This rest state varies in time depending on voltage-controlled oscillator frequency, but it ends upon receipt of the next fractional N+N 100 KHz pulse at the phase detector, This pulse again begins the ramp-up shown at (F) in fig. 1-3, and at the input of the 100 KHz reference pulse which stops ramp-up, the reference period is complete. The duration of the ramp-down time is controlled by microcircuit A30U16.

Sample and Hold occurs during the (A) portion of the waveform. Soon after the 100 KHz reference pulse shuts off the ramp-up, microcircuit A30U16 sets the S + H line HIGH. Q80 provides buffering, Q81 shifts the level, and open collector switches U8a thru U8d bias and turn on Q32 and Q33. C11 charges to a DC level equal to the integrator circuit top of the ramp output voltage, The S + H line now goes LOW and C11 holds the FN TUNE voltage for the fractional N voltage-controlled oscillator,

Bias current source Q21 feeds into the +5 volt point at the input to the bias/APl current summation amplifier. Q8, Q10, and Q11 hold this point at a constant +5 volts, permitting precise current division in the five API lines. The API current sinks then drain off current from that point to control the slope of the integrator circuit ramp-down.

The integrator input at the gate of Q22a is held at O volts DC by grounding the gate of Q22b. Q22 provides a high impedance input stage with unity gain. Q24, Q25, Q26, and Q27 form a high gain, high speed operational amplifier to satisfy the ramp-up and ramp-down speed requirements of the integrator circuit. Q28, Q29, Q30, and Q31 provide a very low impedance output with low distortion for ramp-up current output.

(18) A10 SECOND MIXER ASSEMBLY, (Fig. FO-6.) The A10 Second Mixer Assembly accepts the 50MHZ first intermediate frequency from the A5 Input Mixer Assembly and mixes it with the 49.984375 MHz from the Al 1 Second Local Oscillator Assembly. This produces the second intermediate frequency signal of 15.625KHz.

The 50 MHz crystal bandpass filter T20, Y1, and Y2 is used in conjunction with the same filter on the A5 Input Mixer Assembly to produce a very steep 10KHZ wide bandpass signal into the second mixer. Crystals A10Y1 and A 10Y2 are a matched pair. Notch adjust C22 provides image rejection at twice the second intermediate frequency signal,

Limiter U1 provides a strong drive signal for the second Iocal oscillator into double balanced mixer CR1. This reduces intermodulation distortion and extraneous spurs. 25dB amplifier U40 provides isolation and drive between the mixer T2, T3, and CR1 and the two intermediate frequency outputs, Both outputs to the A20 IF Filter Assembly are a 15.625KHz signal. One has a 10KHz wide bandpass. The other output goes through 400Hz bandwidth filter U 101 and has a 400Hz wide bandpass.

(19) A11 SECOND LOCAL OSCILLATOR ASSEMBLY. (Fig. FO-7,) The second local oscillator has a frequency which is exactly 49.984375MHz. This very stable frequency is obtained by fine tuning voltage-controlled crystal oscillator Q21, Q22, and CR20 and using 49.9843MHz crystal Y20 in the feedback circuit. The voltage-controlled crystal oscillator is one component of a phase-locked loop that uses the same A40 Frequency Reference Assembly output as the first local oscillator for phase stability and frequency accuracy.

The voltage-controlled crystal oscillator output of 49.984375MHz takes two paths. One goes to the A 10 Second Mixer Assembly through buffer U44. The other to mixer U50 through buffer U33. The second input to U50 is the 50MHz frequency reference from the A40 Frequency Reference Assembly, These two signals mixed together furnish the 15.625KHz variable input to phase detector U70b through waveshaper U60.

The reference input to U70 comes from the A40 Frequency Reference Assembly as a 1MHz low level signal. This signal is shaped by Q10 and Q11 to a TTL square wave and input to U70a. U70a is a selectable divide by circuit which is set up to divide by 64. The 1MHz square wave from Q10 and Q11 divided by 64 in U70a gives the stable 15.625KHZ reference input internally to U70b. The variable 15.625KHz input from mixer U50 is compared in U70b to the reference input, A DC tuning voltage is then generated and passed to integrator U80. integrator' U80 filters the tuning voltage so that TP2 is a DC level to be passed to the voltage-controlled crystal oscillator.

U90 is a dual comparator used to detect an unlocked loop condition. If the loop starts to drift, U80 will drive U90 to the positive or negative limit, As soon as the voltage at U90 pins 3 and 6 exceeds +10.5Vdc, one of the open collector outputs of U90 will go LOW. CR91 will then turn on and the (L) 2nd L.O. UNLOCK line will notify the A60 Controller Assembly to display error code E3.1 on the front panel.

(20) A20 IF FILTER ASSEMBLY, (Fig. FO-10.) The inputs to the A20 IF Filter Assembly are two 15.625KHz signals from the A10 Second Mixer Assembly. One has a bandwidth of 10 KHz and the other a bandwidth of' 400KHz. These two inputs pass through an isolation barrier separating the receiver input section from the rest of the Level Meter. To keep unwanted spurious signals (spurs) from crossing this isolation barrier, each of the inputs is passed through ground isolation amplifier CR1, CR2, U2, and U1 a which has good common mode rejection characteristics.

The Level Meter has three selectable bandwidths of 20Hz, 400Hz, or 3100Hz. U3 and U4 are used to switch the correct input signal to the proper filter circuit.

When the 20Hz bandwidth is selected, the signal path uses the 10KHz wide signal input from the A10 Second Mixer Assembly and switches it through a 20Hz crystal lattice filter. The signal then goes through a wideband filter to the A21 IF Gain/Detector Assembly, When the 400Hz bandwidth is selected, the signal path uses the 400Hz wideband signal input from the A10 Second Mixer Assembly which bypasses the 20Hz lattice filter. This signal is then fed through the wideband filter.

When the 3100Hz bandwidth is selected, the 10KHz wide signal input from the A10 Second Mixer Assembly is used by passing the 20HZ Iattice filter. When this signal is passed through the 3100Hz wideband fiiter, it receives the 3100Hz banwidth. The output wideband filter stage provides an equalizing capability to square up the bandpass.

In order to achieve the steep sides desired (high Q) in the 20Hz filter, two gyrator circuits consisting of U6b, U6c, U7a, and U7b are used to simulate the high inductance required, Two control lines, (H) 400 and (H) 3100 are used to select the second intermediate frequency signal path. (L) 35/(H) 10 is used to select the gain of the 10/35 dB output amplifier. These three control lines are under the direction of the A21 IF Gain/Detector Assembly.

(21) A21 IF GAIN/DETECTOR ASSEMBLY, (Fig. FO-11.) The second intermediate frequency signal of 15.625KHz is input to the A21 IF Gain/Detector Assembly from the IF Filter Assembly. This signal has a bandwidth of 20Hz, 400Hz, or 3100Hz.

The 15.625KHz signal is applied to OdB or 35dB selectable amplifier U7 and U18. The amplifier output then goes to 0dB to 35dB amplifier U3, L4, and U8 that is selectable in 5 dB steps. The dynamic range possible for IF gain is 70dB on the A21 IF Gain, Detector Assembly plus an additional 25dB through the output amplifier of the A20 IF Filter Assembly, for a total of 95dB.

In the 0 to 35dB amplifier U8, a three-digit code from the A60 Controller Assembly is applied to the input lines of U4 A0, A1, and A2 to select a pair of precision, thin-film resistors from U3. This selected resistor ratio sets up the gain for U8. R3 and R8 form a fixed–5dB pad that always applies 5dB attenuation to the signal.

The output of U8 at TP1 is split three ways as follows:

The first signal path goes through R32 directly to the A22 Analog-Digital Converter Assembly for use in determining the input signal frequency.

Another signal path is through the logger stages to the A22 Analog-Digittil Converter Assembly for' use in amplitude measurements.

The third signal path is to the product detector stage U13 for demodulating the single sideband audio or, in CAL, for beating with the calibration oscillator signal from the A70 Impairments B Assembly. The CAL output is used to check the weighted filter in the A70 Impairments B Assembly.

The logger range expander and true RMS detector/logger circuits are dependent on each other for operation. The true RMS detector/logger can only accept a dynamic range on its input of approximately 50dB. The expander circuit expands the logger range by compressing the 100dB dynamic range output from U8 to a 50dB range input for the detector/logger. This provides a constant current feedback path to help the expander circuit operate.

Whenever the 10dB RANGE is selected on the front panel, the A60 Controller Assembly opens switch U6d. This turns on Q2 and switches in an additional 10dB attenuator using R60, R61, and R62 at U9 pin 2. The purpose of this additional attenuation is to cause the detector logger to operate over the most linear portion for increased accuracy on the 10dB RANGE.

Detector logger U5 takes the 15.625KHz intermediate frequency signal in at pin 1 and computes the true RMS voltage level of the signal. It then provides a logarithmic DC output voltage at pin 6 that accurately represents the dBm level of the input signal to the Level Meter. In addition. when averaging is selected, the processor sets (H) SMOOTH high to turn on Q4. This shorts out filter capacitor C30 and allows greater signal averaging to take place using the larger capacitance of C29.

10/100dB DC amplifier U6, U10, and U2O amplifies the logger DC output and provides proper output levels for the A22 Analog-Digital Converter Assembly. The output of U5 is temperature sensitive so compensation for temperature variations is provided by precision wire-wound resistor R20 and a network consisting of R9. R10, R11, and CR9. The same processor signal that attenuates the logger input by 10dB in the 10dB RANGE increases the gain of U10 to compensate for the attenuation by opening U6c. Because of the two different gain and offset cent'igurations of U10. two sets of gain offset adjustments are provided. One set. R19/R23 is for the 100dB Range.

Because the A22 Analog-Digital Convrerter Assembly can only operate on negative input voltages, U20 clamps the output of U10. A maximum positive voltage of 40 millivolts is allowed while letting the negative voltage swing to –5 volts.

Digital control of the IF circuits on the A20 IF Filter Assembly and A21 IF Gain/Detector Assembly is provided by the A60 Controller Assembly. A 16-bit serial data stream is clocked into serial-to-parallel shift register U 1 and shifted into U21 until all 16-bits are in position. When eight bits are in U1 and eight bits are in U21, the data is latched into U2 and U22, and a new IF configuration is selected.

The output data from U22 feeds digital-analog converter U23 to provide the correct offset reference for the meter amplifier. This reference changes any time a calibration cycle computes new error constants, thus making the front panel analog meter indication and the rear panel METER output closer to the front panel MEASUREMENT/ENTRY display.

In addition to the control signals already discussed. U2 also performs the following operations:

Switch the gain of U7 between 0dB and 35dB.

Control the gain of amplifier A20U10 on the A20 IF Filter Assembly.

Control the selection of 20 Hz. 400Hz, or 3100HZ bandwidth on the A20 IF Filter Assembly.

Product detector U13 is a double balanced mixer that accepts the 15,625KHz bandwidth limited IF signal from U8. This signal is mixed with the single sideband local oscillator signal from the A22 Analog-Digital Converter Assembly to demodulate either the upper or Iower sideband audio. The single sideband local oscillator signal may also be from the A70 Impairments B Assembly when calibration is active. This calibration signal will cause 1000Hz of audio tone to be output from U13 to test and calibrate some A70 Impairments B Assembly circuits during calibration.

The output of U13 is fed through low pass active filter U17a, U17b, and U6a to filter out the carrier and sideband. With S1 in the OPT position, the audio is sent to the A70 impairments B Assembly and processed. Audio from the A70 Impairments B Assembly is then returned and passes through the OPT contacts of S1 to the VOLUME control and AUDIO output connector on the rear panel.

Analog switch U6a is closed except when in CAL, When the calibration cycle is active, the (L) CAL line from A22 Analog-Digital Converter Assembly goes LOW. This opens U6a and mutes the speaker.

When the calibration cycle is not active, the single sideband demodulated audio is picked off the wiper of the VOLUME control and fed back to A21 IF Gain/Detector Assembly. It then passes through audio amplifier U16 to drive the speaker.

The meter amplifier is fed by the A22 Analog-Digital Converter Assembly. The meter input signal passes through the closed contacts of U6b into the amplifier unless the calibration cycle is active. When the (L) CAL signal is LOW (CAL active), U6b opens, disconnecting the calibration cycle signal fluctuations from the meter. C49 maintains the last meter position that existed before the calibration cycle.

Digital-analog converter U23 sets the reference for the meter amplifier through U20b. This reference corrects the meter indication with the calibration constants obtained during the prior calibration cycle. U20A is a buffer amplifier for the rear panel METER output connector with diodes CR6 and CR7 providing circuit protection. U20c keeps the meter from being over wrtten by limiting current flow through the meter.

(22) A70 IMPAIRMENTS B ASSEMBLY. (Fig. FO-23.) The A70 Impairments B Assembly has three separate, functional circuits used for communications channel impairment measurements.

Phase Jitter. A measurement for phase jitter is performed on a specific test tone of 1004 Hz. This tone is usually applied to one end of a channel being tested and then measured at the other end for phase modulation or jitter placed on the tone by the channel. This is done by demodulating the phase jitter component or sidebands from the test tone and measuring their peak-to-peak amplitude. A DC voltage, directly related to the number of degrees peak-to-peak of the phase jitter present, is then passed to the A22 Analog-Digital Converter Assembly.

The incoming single sideband demodulated audio is bandwidth limited for normal channel sideband audio, but is a 1004Hz tone for phase jitter tests. This tone is applied to band pass filter U23 and U24. This filter is centered on 1000Hz and is 1000Hz wide so that it passes 500 to 1500Hz. Overall filter gain is +15dB provided by input amplifier U23a. The sine wave output of the filter is applied to limiter U26c which converts it to a square wave from 0 to + 12V peak.

The 1004Hz square wave, with phase jitter, becomes one input to the phase detector half of U31. The voltage-controlled oscillator output is also I004Hz but without phase jitter. The phase-locked loop has a divide-by-N equal to one. This locks to the test tone frequency and will track it even if drift occurs. The exact frequency of the tone is not critical to phase jitter measurements. The phase jitter sidebands are demodulated from their carrier and the test tone, and only jitter is measured. The frequency ranges for phase jitter sidebands are from 4 to 300Hz and from 20 to 300Hz, The 4 and 20Hz lower limits of the jitter ranges are adjusted in the loop filter. The high end of the ranges are obtained by passing the output of U31 pin 2 through a 300Hz low pass filter. U25 is used to switch between the 4 to 300Hz measurement band and 20 to 300Hz measurement band. A HIGH on U25 pin 2 selects the 4 to 300HZ measurement band. The voltage-controlled oscillator in U31 is enabled only when Q4 is turned on under direction of the A60 Controller Assembly.

The last stage of the low pass filter is an adjustable gain amplifier. It is used to obtain the proper scale factor of 6 DEG per 1 volt for the phase jitter DC output to a voltage divider circuit on the A22 Analog-Digital Converter Assembly. The only signal remaining at the output of the low pass filter is the phase jitter sidebands. This signal has two paths:

One path is through a buffer U30b to a rear panel BNC connector. By observing this signal on a spectrum analyzer, an oscilloscope, or a frequency counter, analysis can be made of the frequency source of the phase jitter present in the channel.

The second path is through peak-to-peak detector U29a, U29b, and U30a which converts the AC signal to a DC signal. The amplitude of the DC signal represents the number of degrees of phase jitter present on the test tone.

U42 and U43 provide a means of speeding the discharge time of holding capacitors C150 and C151 before a new measurement is made.

U31 pin 10 is a DC voltage related to the voltage-controlled oscillator error voltage. This voltage is fed to dual comparator circuit U26a, U26b, and U26d used as a valid frequency detector. For normal operation, U26 pin 1 is HIGH, U26 pin 13 is LOW, and U26 pin 2 is HIGH. This indicates a valid frequency. If the voltage-controlled oscillator is running outside a 100Hz window of 960 to 1060HZ:

U26 pin 1 will go LOW indicating the frequency greater than 1060HZ.

U26 pin 13 will go HIGH indicating the frequency is less than 960 Hz.

In either case, U26 pin 2 will go low indictiting the frequency is invalid

This signal (L) JITTER INVALID is passed to the A60 Controller Assembly which displays (he error code E2.3 on the front panel display for as long as the tone is invalid and the PHASE JITTER measurement mode is selected, An adjustment, R181, is provided to move the center frequency of the 100Hz window.

Weighted *Filter/Notch Filler.* The single sideband demodulated audio is also applied to the input of a weighted filter with an overall gain of +6dB. Whenever the WTD 3100HZ bandwidth is selected, a C message filter is switched in by U37. When no weighting is desired, an alternate path through +6dB amplifier U 1 a is provided. The audio is then applied to buffer U4a where two paths are possible:

When the NOISE/TONE measurement mode is selected, a notch filter is switched in to notch out the tone. The notch filter has unity gain and is centered on 1010HZ. The bandwidth is 30Hz at the –60dB points to eliminate the 1004Hz tone.

In all other measurement modes, except IMPULSE, the audio bypasses the notch filter.

Switching is performed by U38.

The audio is now applied to +7.7dB gain buffer U8a from which parallel paths take it to the true RMS detector/logger, impulse circuits, and speaker amplifier.

The logger range expander circuit conditions and shifts the dynamic range of the audio so that it is within the input limitations of detector/logger chip U22. The output of U22 is a logarithmic DC voltage representing the true RMS amplitude of the audio signal present at the output of U8a.

This signal is amplified by U10a and the voltage is clamped by U10b to prevent it from exceeding about +40 millivolts. Q3 provides a larger time constant selection for U22'S RMS detector when average is selected on the front panel.

The second output of U8a is applied through R52 to the A21 IF Gain/Detector Assembly which sends it to the speaker through the volume control and speaker amplifier. The third path is to the impulse circuits.

Impulse Noise Circuits. Impulse noise measurements are made for communications channels that carry data. For impulse measurements, the single sideband demodulated audio may include the I004HZ tone. It is passed through the notch filter, and if selected, is passed through the weighted filter. The resulting channel noise is then compared to a threshold voltage that is selected by the operator in dBm from the front panel. The entered level by the operator is digitized by [he A60 Controller Assembly and then changed to an analog voltage by a digital-analog converter. This is inputed to a voltage comparator as a fixed reference level. Any impulse noise spikes in the channel noise that exceed the threshold reference level are counted and passed to the A60 Controller Assembly. When a time period set by the operator has passed, the processor freezes the total count and displays it to the operator. A dead timer circuit controls the maximum number of impulse spikes that can be counted per second to 7.

The impulse circuits have a total dynamic range of 60dB. 45dB, in 15dB steps, is in the path of the channel signal and 15dB in 0.25dB steps, is the digital-analog converter range. The AC channel signal from the notch filter is applied first to 0 or +15dB amplifier U39a with gain determined by U35b. The output signal then goes to 0 or +30dB amplifier U39b with gain determined by U36. The signal is then applied to unity gain full wave rectifier stage U9a, U9b, CR4, and CR5 which folds the negative half of the channel noise signal over on top of the positive half. This signal is then inputed to the comparator U 19. All positive and negative impulses in the channel will now appear as positive spikes at the comparator.

The other input to the comparator starts as a digital input to digital-analog converter U18 from the A60 Controller Assembly. This is the reference Ievel, or threshold value, to which the operator has selected to compare the channel noise. U41 converts the DC current out of U18 pin 4 to a DC voltage at U19 pin 3. The static condition of U19 pin 7 is normally LOW or channel noise below threshold setting. Any impulse noise spike of long enough duration and high enough amplitude to trip U19 pin 7 HIGH will trigger the one-shot circuit U20 in the dead timer. The Q output of U20 then holds the input to the one-shot LOW until the time constant set up by C83, R98, and R97 allow the one-shot to reset. This time delay is 143ms or 7 per second maximum. At the same time, the Q output of U20 has incremented the counter in U21. U21 is a 4-bit counter with a maximum count of 16. The counter is sampled once every second by the A60 Controller Assembly to prevent overflow. U35a allows a faster time constant to be implemented for impulse calibration during the calibration cycle.

Calibration Oscillator. The upper sideband and lower sideband oscillators used as the single sideband local oscillator during normal operations produce a 1850Hz tone when beating against the second intermediate frequency. This tone can not be used for calibration of the weighted filter because some of its level is clipped by the filter. A separate calibration oscillator is used to generate the single sideband local oscillator frequency in calibration that is 1000Hz after mixing with the second intermediate frequency. This provides accurate calibration of the weighted filter.

U40 pin 10 is normally held LOW keeping the CAL OSC from reaching the A22 Analog-Digital Converter Assembly. When U40 pin 10 goes HIGH, the CAL OSC signal is then passed through U40 and on to the A22 Analog-Digital Converter Assembly. The frequency of the CAL OSC signal, 1.6625MHz, is divided by 10 on the A22 Analog-Digital Converter Assembly. This produces a 16.625 KHz or 16.425 KHz signal which will become the single sideband local oscillator frequency. When beat against the second intermediate frequency of 15.625KHz, a 1000Hz audio tone is produced. This tone becomes the single sideband demodulated signal input to the A70 impairments B Assembly in calibration.

Digital Control. All of the control lines which set up the various analog switches, together with the digital threshold Ievel selected for impulse measurements, are input in a serial data stream from the A60 Controller Assembly. The serial data comes in to U15 and is shifted through U15, into U14, and through U14 by the option clock line OPTCK. Once the entire data stream is present, the LATCH line latches the data into U16 and U17. U16 sets up all the analog switches and U17 provides the impulse reference level for the digital-analog converter.

(23) A22 ANALOG-DIGITAL CONVERTER ASSEMBLY. (Fig. FO-12.) The A22 Analog-Digital Converter Assembly has three main functions:

- Frequency Counter.
- Dual slope analog-digital converter.
- Sideband oscillators.

Frequency Counter. The IF input from the A21 IF Gain/Detector Assembly is a signal that has been bandwidth limited at 3100Hz. 400 Hz. or 20Hz at about 15.625KHz. This signal is limited by U4 to get a square wave input to the phase-lock loop circuit. The function of the loop is to multiply the input signal frequencies by 20 to enable faster counting. If there are multiple signals in the channel, the loop locks on to the strongest signal. U4d provides loop stability.

The output from the phase-locked loop centered at 312.500Hz. By measuring the second intermediate frequency and knowing the first local oscillator frequency, the A60 Controller Assembly calculates the frequency of the input signal and displays it,

The logic state machine U8 clears counter U6 then gates the output of the phase-lock loop" into the counter for one-half second. The A60 Controller Assembly then pulses (H) SCAN high and reads the value in the counter. It reads one digit at a time through output lines AD1, AD2, AD4, and AD8. The number in counter U6 should be exactly one-half of the phase-locked loop output frequency, or about 156,250 counts.

The divide-by-10 circuits U14, U15, and U16 accept 1MHz from the A40 Reference Frequency Assembly and produce a 1Hz reference signal and a 500 KHz counting signal. Both signals are square waves. The 1Hz output sets a one second reference for time sharing the frequency/level counter U6 between the frequency counter mode and the analog-digital level measuring mode. It is also used for the impulse noise clock. When the front panel COUNTER is on, each one second cycle is divided as follows:

One-half second for frequency counting and analog-digital time

Wait period.

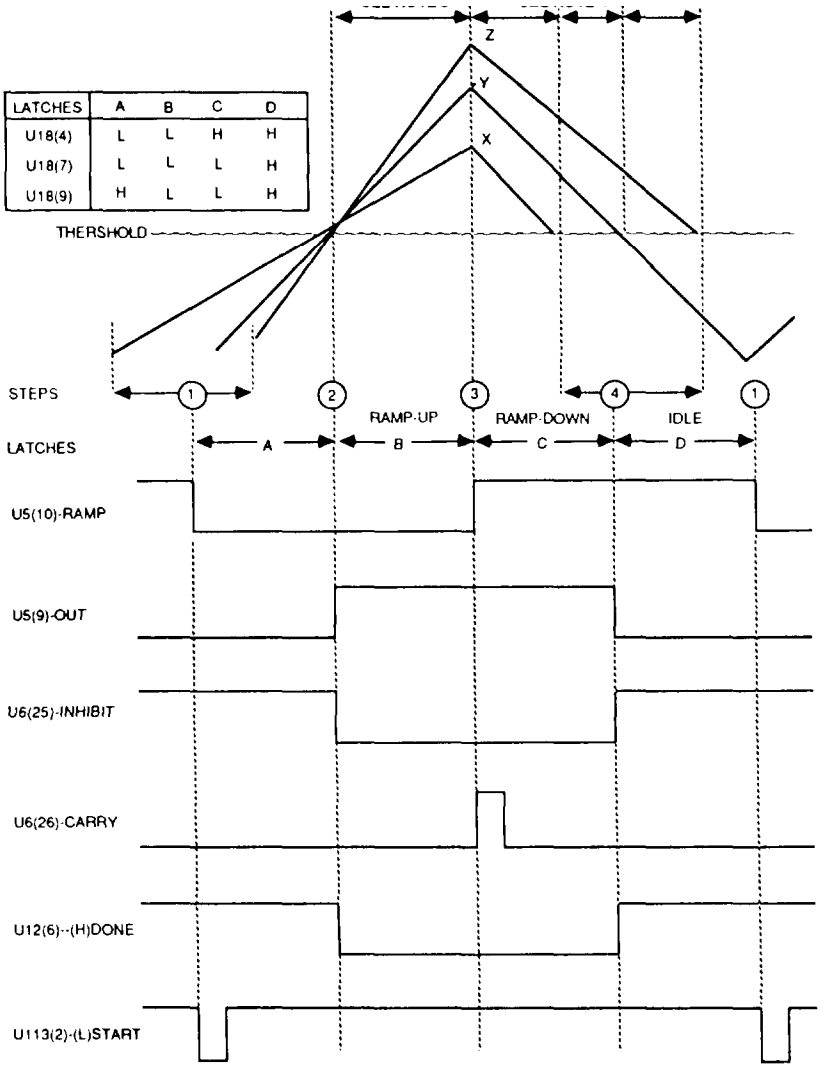
The wait period varies with the demand for analog-digital time, When the front panel COUNTER is off, U6 is used only for analog-digital level measurements. The frequency counter mode is active when U2 pin 19 goes HIGH for one-half second by direction of the A60 Controller Assembly. This occurs during the negative half-cycle of the 1Hz CLK signal to the A60 Controller Assembly. During this one-half second, U 11 pin 9 and U11 pin 4 are HIGH, gating the phase-locked loop output from U 17 pin 13 into U6. The (L) START line is pulsed LOW immediately after U2 pin 19 goes HIGH. This sets up latch U18c for the HIGH to LOW edge of the 1Hz clock to start counter U6. For the frequency counting mode, the count must start from zero. So the same logic that starts the counter, immediately resets it to zero. This is done through U12 pin 8 now going HIGH which sets the CLEAR line HIGH at U6 pin 14. At the same time, to ensure a full one-half second time period to count the phase-locked loop pulses, the CLEAR lines on all the divide-by-10 circuits are also set HIGH. A fresh starting negative half cycle of the 1Hz output can now begin. The counter now counts phase-locked loop pulses until the 1 Hz again goes positive, one-half second later, This resets the INHIBIT line HIGH and stops the counter. In this same sequence, (H) DONE goes LOW when U6 is counting and HIGH again when the counter stops. This tells the A60 Controller Assembly to set U2 pin 19 back to LOW and to read the counter. The counter will contain exactly 10 times the intermediate frequency in Hertz. 0.1HZ resolution is now possible in determining the frequency of the input signal to the Level Meter. When the count is read out of U6, it is also preset to 990.000. The logic-state machine is now in the idle state and ready for the analog-digital level measuring conversion mode to begin.

Analog-Digital Conversion. When U2 pin 19 goes LOW during the positive half-cycle of the 1Hz CLK signal, U11c turns off. U11 pin *5 goes* steady HIGH and U11 pin 4 has the 500 KHz output of the divide-by-10 circuits present as the input for U6. When the front panel COUNTER is OFF, U2 pin 19 will always be LOW placing the counter U6 continuously in the analog-digital level measuring mode,

Analog-digital level measuring (fig. 1-4) takes place as follows:

In the idle state the outputs of latches U18a, U18b, and U18c are all HIGH. The idle state occurs during the time period between successive analog-digital conversions. A single analog-digital conversion takes place in four steps. During each step, the logic state of the output lines of the three U18 latches shows the step in which the analog-digital conversion process is on,

Step 1. The A60 Controller Assembly pulses the (L) START line from HIGH to LOW. The RAMP input US pin 10 goes LOW, and the analog-digital converter begins ramping upwards at a rate determined by the level of the selected input voltage at pins 1 and 2. C7 is charged in one direction as the ramp increases,



NOTES:
1. The ramp-up slope depends on the input voltage to U5 (pins 1 and 2). Z represents a high input and X represents a low input.
2. The ramp height represents the voltage across charging capacitor A22C7.
3. The time between steps (2) and (3) is a fixed time period, determined by the counter going from 990,000 to 1,000,000.
4. The time between steps (3) and (4) varies as a function of how large the input voltage was to U5 and therefore how high the charge on A22C7 became.
5. The ramp-down slope is a constant value for all inputs (set by A22R21).
6. Steps:

   (1) Processor pulses (L) START from HIGH to LOW, forcing "RAMP" from HIGH to LOW. Ramp starts up as A22C7 charges.
   (2) Ramp crosses threshold. U5 sets "OUT" from LOW to HIGH. Counter starts counting from 990,000. "(H) DONE" goes LOW.
   (3) Counter overflows at 1,000,000 from 500kHz pulses and begins counting upwards from zero. U6 pulses "CARRY" from LOW to HIGH, forcing "RAMP" back to HIGH, Ramp starts down as A22C7 discharges at a constant rate.
   (4) Ramp again crosses threshold after time period determined by height of ramp. U5 now sets "OUT'" back to "LOW". Counter stops. LSM sets "(H) DONE" back to HIGH. Processor now scans U6 for digital number representing value of analog voltage, presetting counter, LSM is idle.

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Figure 1-4. Analog-Digital Conversion.

Step 2. When the ramp or voltage on C7 passes an internal threshold of approximately 1 volt, U5 sets the OUTline pin 9 from LOW to HIGH. The logic-state machine then removes the HIGH at the INHIBIT U6 pin 25 and counter U6 begins counting upwards from a preset value of 990,000. The input pulses to the counter come from the 500KHz output of the divide-by -10 circuits through U11a and U11b. The logic-state machine now sets the(H) DONE line to the A60 Controller Assembly to LOW.

Step 3. After 10,000 counts, the counter will contain 1,000,000 and overflow back to zero. U6 will set the CARRY line pin 26 HIGH. The logic-state machine then sets the U5 RAMP back to HIGH and the ramp reverses direction. The ramp now decreases as C7 discharges at a fixed rate determined by the setting of R21.

Step 4. The analog-digital converter ramps downward until the charge on C7 passes the internal threshold again. U5 sets the OUT line back to LOW. The logic-state machine now resets the INHIBIT line on U6 to HIGH and the counter stops counting. The logic-state machine also sets the (H) DONE line to HIGH. The A60 Controller Assembly sees the (H) DONE line go HIGH and the sequence of analog-digital conversion is complete.

The count now contained in U6 shows the amplitude of the voltage at the input to U5. The A60 Controller Assembly now pulses the (H) SCAN line HIGH and after each pulse and samples the output lines of U6, one digit at a time, in binary coded decimal. The internal circuitry of U6 thru U17b, presets the counter to 990,000 as part of the process of reading out the count in U6. After the analog-digital count is read out and displayed, and if the frequency COUNTER is cm, the A60 Controller Assembly sets U2 pin 19 output (o HIGH followed by (L) START to LOW. The logic-state machine is now idle and waiting for the negative half-cycle of the 1Hz signal to begin frequency counting,

USB/LSB Oscillator This function is unrelated to the frequency counter and analog-digital conversion functions. The lower sideband or upper sideband oscillator output is sent to the A21 IF Gain/Detector Assembly. Here it mixes with the 15.625 KHz second intermediate frequency signal to demodulate the sideband audio. In calibration, a third oscillator signal CAL OSC is switched to the A21 IF Gain/Detector Assembly that comes from the A70 Impairments B Assembly. The CAL OSC signal is mixed with the second intermediate frequency and provides an audio tone back to the A70 impairments B Assembly for weighted filter checks. U101b switches the correct one of the three signals to the A21 IF Gain/Detector Assembly by raising two lines HIGH and letting the desired signal pulse through the gate. (L) CAL shuts off both upper sideband and lower sideband oscillators when LOW to let the CAL OSC signal pass. When calibration is not active, CAL OSC is always HIGH; (L) CAL is HIGH, and U2 pin 6 going either HIGH or LOW selects the upper sideband Y102/Q103 network or lower sideband Y101/Q102 network oscillator as required.

The other outputs of U2 control the 8:1 input data selector and pass control lines (H) SMOOTH, (L) 1MHz ENABLE, and (L) CAL to other assemblies. U1 accepts the serial control data from the A60 Controller Assembly and shifts it into a parallel output to U2 which is then latched. U3 selects the output signal to the meter drive amplifier on the A21 IF Gain/Detector Assembly. U7 selects the input signal to the analog-digital converter. Both U3 and U7 are under direction of the A60 Controller Assembly.

(24) A60 CONTROLLER ASSEMBLY. (Fig. FO-21.) All digital operations internal to the Level Meter are managed by the A60 Controller Assembly.

Microprocessor U6 has three types of input/output devices as follows:

16 address lines, A0 thru A15, for selecting a particular ROM or RAM memory address

8 data lines (D0 thru D7) for reading data or instructions into the microprocessor from ROM or RAM memory or for writing data into a RAM memory address.

9 control lines for directing read/write operations, timing signals, and enable, interrupt, and reset operations.

Seven of the address lines, A0 thru A2 and A12 thru A15, are also used to select one of eight different combinations of input data from various circuits in the Level Meter. Each combination can then be passed to the microprocessor and can also send output data to different circuits via the 8 data lines to U18, the parallel interface adapter. The parallel interface adapter directs the output data to the correct circuit over one of its two data buses, port A or port B.

All mnemonics on control lines use positive logic. For example, R/W means that, when this line is HIGH, the microprocessor is performing a read operation. When LOW, a write operation is in process.

Microprocessor operation. Timing for the microprocessor is furnished by clock generator U5. A3.8MHz oscillator circuit U4e and U4f provides the basic timing frequency to U5. U5 then provides outputs at that frequency, half that frequency, and one-fourth that frequency to control all microprocessor operations. A start-up circuit keeps the microprocessor from running until the +5V supply voltage is stabilized. It does this by holding the $\overline{\text{RESET}}$ line to U6 in a LOW state until Cl charges up enough to let the $\overline{\text{RESET}}$ line go HIGH. Comparator U23 also monitors the +5 V supply for ripple or noise spikes. One side of the comparator input is heavily filtered and the other side is not. Spikes in the +5V supply voltage will not cause a system reset because C21 and C29 will filter it out. C21 is not large enough to handle wider spikes or AC ripple, but C29 can. The comparator will trip on either of these conditions. C30 gives positive feedback to speed the comparator output in going LOW and Cl will discharge through CR7 into U23, When the transient is gone or C30 is completely charged, the comparator will flip back. Cl will again charge and the HIGH on the $\overline{\text{SYSTEM RESET}}$ of U5 and will force the $\overline{\text{RESET}}$ line HIGH to U6 to restart the microprocessor. S 1 pin 1 provides a manual means of resetting the microprocessor by shorting out C 1. U23 will not detect excessively high or low steady-state conditions in the +5V supply voltage.

U2a, U3, U4b, and U4d provide gating for the write enable line (WE) to ensure data is properly written into NMOS RAM's U14 and U16.

Memory Operation (ROM/RAM). As clocked by the 01 and 02 inputs from U5, processor U6 performs fetch and execute operations from ROM memory. During the fetch phase, U6 places a word on bits A0 through Al 1 of the address bus which is sent in parallel to ROM's U7 thru U12. At the same time, a three-bit select code is placed on bits A12 thru A14 to ROM select chip U24. The select code determines which one of the ROM's is the desired one and it allows only that ROM to output data on the data lines. The selected ROM places its data on lines DO thru D7 which are buffered by U 13. It is then input to U6 over the data bus and stored in U6. U13 is gated by U2b when bit A15 is set HIGH, and the read/write line (R/W), read from ROM condition, and 02 are also HIGH. During the execute phase, U6 examines the word from ROM and carries out the instruction.

RAM memory shares the same address bus with ROM memory. When A15 is set LOW, a read from RAM condition exists. U26 is used to decode bits A12 thru A14 and select the proper RAM pair for a read operation. For read from RAM, U2a is off because the read/write line (R/W) is HIGH and the write enable line (WE) to U14 and U16 is HIGH. The the read/write line (R/W) to U28 and U29 is also HIGH. Bits A0 and A9 now select the desired address for NMOS RAM, bits A0 thru A7 for CMOS RAM, and a single 8-bit data word is assembled from the selected RAM pair U14 and U16 or U28 and U29. This is passed through shorting network J1 to the microprocessor data bus.

NMOS RAM pair U14 and U16 is used for normal operations of the Level Meter. CMOS RAM pair U28 NMOS RAM pair U14 and U16 is used for normal operations of the Level Meter. CMOS RAM pair U28 and U29 is used only to perform the STORE/RECALL operations from the front panel. A nickel cadmium battery, which is located on the A80 Prover Supply Assembly, provides a keep alive voltage (V-BAT) to the CMOS RAM's. This means that these stored conditions are kept even with the Level Meter turned off for extended periods. The select line from U26 pin 14 to CMOS RAM has a filter network composed of R26, R27, and C37. This protects the CMOS chips from spikes at turn on, Additional protection for the CMOS data is provided by Q1 and other components which keep spikes from disturbing the stored data on U28 and U29. Writing into RAM memory occurs when the respective RAM write enable lines, U28 and U29 pin 16 and U14 and U16 pin 10, are set LOW. The microprocessor puts the address to be written into on the address bus and then puts the data for that address on the data bus.

U26 also controls the selection of' input/output (1/0) data to or from other circuits in the Level Meter. When the read/write line (R/W) is HIGH and U26 selects Y6 pin 9 LOW, U25 pin 6 output goes LOW and S will strobe input data onto the data bus from the input multiplexers. When the read/write line (R/~) is LOW and U26 selects Y4 pin 11 LOW, CS2 selects U18 to accept data from the microprocessor and output it from port A or port B, as determined by address lines A0 and A1 into U18. U18 turns on when address line Al 1 is HIGH and CS2 is LOW. Line E clocks the data transfer.

Input/Output (I/0). All inputs that enter the A60 Controller Assembly pass through the input multiplier with two exceptions:

V-BAT which is the keep alive voltage to the CMOS RAM's,

INT which is the interrupt line from the HP-lB Assembly (A61) to U18.

The rest of the inputs are passed into four 8:1 input data selector chips U39 thru U42 for data lines D0 thru D3, or into two dual 4:1 selector chips U36 and U38 for data lines D4 thru D7. The microprocessor will select one combination of eight inputs. This is done by setting a specific code on address lines A0, A1, and A2 and then searching the data selectors.The selected inputs are put on their respective output lines D0 thru D7 for transfer to the microprocessor. Eight-position DIP switch S2 provides special test inputs to the microprocessor as well as identification of the Level Meter configuration. Five-position DIP switch S1 provides a manual microprocessor reset and additional test capabilities. Comparators U37a thru U37d are level shifters for inputs which are not at TTL levels.

All outputs from the A60 Controller Assembly are controlled through ports A and B of U 18. The microprocessor sets up an output operation by placing the output gating code on the data bus and then the destination port A or B on address lines A0 and A1. U18 is then turned on by setting A11 HIGH and CS2 LOW. The read/write line (R/W) is now set LOW, indicating a write command, and the next ∅2 pulse on line E clocks the gating code into U18 and directs it to the correct port. As an example:

If Port B were the destination, the gating code would be placed on U18 output lines PBO thru PB7. The next negative-going pulse on line E is now passed to U18 pin 19, CB2, and gated to one of two output decoders U30 or U31. The selection is determined by U18 pin 13 (PB3). If PB3 is HIGH, the pulse is gated through U30 and one of its output lines Y0 thru Y7. If PB3 is LOW, the pulse is gated through U31.

When selected, pulses Y1 or Y7 from U31 are sent to latches U21 or U22 where they gate data from U18 port A, PA0 thru PA7, to other circuits in the Level Meter. U31 outputs Y2 and Y6 are used to convert parallel data, PA0 thru PA7 arriving at U19 into serial data. A typical serial output to the A70 Impairments B Assembly would occur as follows:

The microprocessor would place a clock steering command on PA0 thru PA7 and latch it into U21. U21 pin 6 would then turn on the OPTION CLOCK gate U33C as soon as an output code from Y7 of U31 latched the port A data into U21. The microprocessor would then change PA0 thru PA7 to the data to be sent to the A70 Impairments B Assembly. Y6 of U31 now causes the data to be latched into the shift register. Eight successive pulses on the Y2 line clock the data over the serial output line of U19 pin 9. In between each pulse of Y2, the microprocessor must also generate the OPTCK signal by selecting output Y3 of U31. This signal shifts in the serial data stream, one bit at a time, into a serial to parallel shift register on the A70 Impairment B Assembly.

The Y3 output is a general purpose clock that is steered by U21, Y4 and Y5 go to A30U16 as instruction valid (FIV) and external clock (FDC) lines, respectively. The Y0 output is used both as a display clock on the A98 Keyboard Assembly and also as a reset to display refresh timer U20. Lines Y0 thru Y6 of U30 go directly off the A60 Controller Assembly as control lines or latches for other circuits.

Port B of U18 usually provides the control function for output operations while port A usually provides the actual data to be sent to other circuits. During normal operations, the microprocessor will determine that some data must be output to a specific circuit. The microprocessor would first direct new data over the data bus to U 18 for port A, PA0 thru PA7, and then direct an output gating code m port B that would select the Y1 output of U31. The Y1 output of U31 would then latch PA0 thru PA7 data into U22 for transmission to the correct circuit.

Some parallel output data, like the serial data, is latched in at the circuit it is directed to. For example:

Change to various display annunciators on the front panel are handled by sending PA0 thru PA7 data directly from buffer U1 to the A98 Keyboard Assembly. Y3, Y4, Y5, or Y6 of U30 are selected to latch the data to the A98 Keyboard Assembly into the correct annunciator group, ANNUN 0 thru ANNUN 3.

Whenever data must be transmitted across the ground isolation barrier, some signal isolation is necessary. Photoisolator A99U1 and pulse transformers A99T3, A99T4, and A99T5 provide this isolation feature for selected signals.

Interrupts. When the A61 HP Interface Assembly has input data for the microprocessor, it will set the INT line HIGH and U18 will then set $\overline{\text{IRQ B}}$ LOW to interrupt the microprocessor for the interface operations. The basic timing signals for all other microprocessor operations come from U20 which generates a timing pulse at about 1900Hz. This pulse, occurring on the INT CA1 line causes U18 to set the $\overline{\text{IRQ A}}$ line LOW, interrupting the microprocessor. Each time U18 sets the IRQ A or IRQ B line LOW, it places a status word on the data bus lines D0 thru D7. This identifies to the microprocessor the source of the interrupt request. The microprocessor sets the read/wire line (R/W) HIGH, samples the status word and, if it is interface data, requests a data word from the input multiplexers on the A61 HP Interface Bus Assembly. If the display timer is the source, the microprocessor then checks various program counters for subroutine executions.

(25) A98 DISPLAYS/KEYBOARD ASSEMBLY. (Fig. FO-24.)

Displays. The front panel displays are selected and updated in one of two ways, either one short or pulsed display refresh, The panel indicators such as dBm, OVLD, etc, are one-shot. They are selected on or off, and not disturbed again unless they must be changed from their present condition. To reduce steady-state power consumption, however. the measurement and frequency digital LED display areas and the switch LED's are refreshed at a scan rate of about 100Hz. Prior to each refresh clock pulse, the numerical value segments for each digit are relatched into the segment drivers. The next pulse then illuminates the correct number, 0 thru 9 plus the decimal point, for the selected digit DS1 thru DS14. Since every digit is pulsed once during a single display scan, or 100 times per second, it takes less than 10 milliseconds to update the entire display if a change occurs. The switch LED's, or key annunciators, are pulsed on in five groups of seven or eight as part of the scan. The scan is fast enough that no flickering is visible and the displays and switch LED's appear to be on at all times.

Digit display data enters the A98 Keyboard Assembly as follows:

The A60 Controller Assembly puts the proper segment pattern of the first digit DS1 on data line PA0 thru PA7 of J1 and the display clock line (DSP CLK) latches the data into U7. The A60 Controller Assembly now places a single bit (HIGH) on the display serial input line (DSPS1). The next clock pulse on DSP CLK sets U1 pin 3 HIGH and U4 pin 1 LOW, which selects DS 1. The pattern latched into U7 determines the segments that light on DS 1. The correct drivers Q1 through Q8 are turned on and the correct number is displayed on DS1. DSP CLK is about 1900Hz.

The A60 Controller Assembly changes the segment pattern on PA0 thru PA7 to that for DS2 and sets DSP S1 to LOW prior to the next clock pulse. The next clock pulse on DSP CLK shifts the HIGH on U1 pin 3 to U1 pin 4 and also latches the new segment pattern into U7. This lets U4 pin 1 go HIGH, turning OFF DS1, and U4 pin 4 go LOW, turning on DS2. This process continues as DSP CLK shifts the single pulse down and out of U1 into U2, through U2 until the last digit DS14 has been scanned. It then scans through the switch LED groups in the last part of U2 and the three outputs of U3. The clock pulses are about 0.5ms apart and the entire

scan takes 19 pulses or about 10 milliseconds to complete. Only one display digit DS1 thru DS14 or one group of switch LED's is actually on and drawing current at any one time.

The one-shot displays are much simpler to update. The A60 Controller Assembly sets the correct on/off pattern for a group of front panel annunciators on lines PA0 thru PA7. It then sets the correct latch line LOW, ANNUN 0 thru ANNUN 3. The annunciators now remain in this state until a change to one of them occurs. At that time only the respective group driven by U8, U9, U10 or U11 will be updated.

Keyboard. At the same time as the display refresh of digits DS1 thru DS8, the bit being shifted down the output line QA thru QH of U1 is also applied to eight keyboard switch groups A thru H. There are eight switches in each group (seven in group B) for a total of 63 front panel switches. In their static condition with no keys depressed and scan refresh not in process, key lines KEY 0 thru KEY 7 are all LOW. This is due to pull up resistors R17 holding +5V on the inverting buffers of U14. When scan refresh begins and switch group A inverting buffer U12 pin 12 goes LOW, the A60 Controller Assembly samples key lines KEY 0 thru KEY 7. If one of the switches in group A is pressed during the 0.5ms clock pulse, the LOW at U12 pin 12 will be seen through the switch and at the output of inverting buffer U 14 as a HIGH on that key line.

For example, if switch group E were being scanned during the refresh cycle and the number 8 key was pressed:

U14 pin 5 would go HIGH on key line KEY 2, The A60 Controller Assembly is scanning group E and only the KEY 2 line is HIGH. So switch SW 26 must be depressed (number 8) since it is the only switch in this 8 x 8 matrix common to both group E and key line KEY 2. The scanning process is fast enough that the A60 Controller Assembly actually looks at all the switches several times before the operator can remove his finger from the key.

Multiple switch depressions are handled by A60 Controller Assembly software so that each switch depression appears as only a single input from that key.

Rotary Pulse Generator (RPG). The RPG utilizes key lines KEY 6 and KEY 7 to provide an input to the A60 Controller Assembly. When the scan refresh pulse has been shifted completely through U1, U2, and is in the last position (QC) of U3, it causes U15 pin 5 to go HIGH which disables all of the U14 buffers. The A60 Controller Assembly again samples the key lines, but looks only at KEY 6 and KEY 7. If the RPG was turned CW or CCW, one or both of the U16 flip-flops will be set and either U15 pin 13 KEY 7 or both U15 pin 13 KEY 7 and U15 pin 11 KEY 6 will be HIGH. The microprocessor will then increase or decrease the displayed frequency one step accordingly. When the refresh cycle starts over again and DSP S1 goes momentarily HIGH, a pulse is applied to the CLR inputs of U16 to reset the flip-flops. This in done in case the RPG was used during the last refresh cycle and to make it available again for the up coming cycle.

(26) A61 HP INTERFACE BUS ASSEMBLY. (Fig, FO-22.) The timing for the A61 HP Interface Bus Assembly is done by the internal clock circuit of microprocessor U1. It utilizes external coil L3 to achieve a reference clock frequency of approximately 4 to 5MHz. U1 internally divides this clock by 15 to obtain the Address Latch Enable (ALE) address strobe frequency at U1 pin 11 of approximately 300KHz.

U1 uses the same eight parallel lines called BUS 0 thru BUS 7 for transmitting both address and data words and for accepting both instructions and data. During an instruction fetch, U1 places address bits A0 thru A7 of the next instruction to be executed on the BUS 0 thru 7 lines. It also addresses bits A8 thru A10 on port two (P2) lines 0 thru 2. On the next Address Latch Enable (ALE) clock pulse, U21 latches in the address to ROM U29. When the program store enable line ($\overline{\text{PSEN}}$) goes LOW, the chip select line (CS) on U29 enables the ROM output. U29 now places the instruction word found in the selected address on the bus where it is read by U 1 and then executed.

When U1 has data for the A60 Controller Assembly microprocessor, it first places a status or control word on the bus and latches it into U21 with the next ALE clock pulse. It then places the data word on the bus and strobes the bus write line (WR) with a narrow negative pulse. On the trailing edge of this pulse, U23 latches the data word into the A60 Controller Assembly microprocessor input lines and U22 latches the status or control word. The control word will set U22 pin 9 HIGH which is the interrupt request line, (H) INTERRUPT, to the A60 Controller Assembly microprocessor. The A60 Controller Assembly microprocessor will then input the data word when it completes its present instruction cycle. U1 will now wait for the A60 Controller Assembly microprocessor to return one byte.

When the A60 Controller Assembly microprocessor has data to return to U1, it places the data word on lines PA0 thru PA7. It then sets the (H) LOAD BUS line HIGH to latch the data word into U24 and to notify U1 thru U25b that a word is available for transfer. For U24 to place the data word on the bus, both inputs to U19b must be HIGH. This w ill trigger the control enable line (CNTRL) on U24. U22 pin 2 will already be HIGH as part of the handshake that occurred when U1 passed data to the A60 Controller Assembly. U1 now gates U19b on, output LOW, by strobing the read line (RD) with a narrow negative pulse. U24 now places the data word on the bus and U1 reads the data.

When the Level Meter is turned on, U1 reads its own interface address code from address switch A62S1. U1 outputs a control word to U22 which places a LOW at U22 pin 2. This removes the enable from U19b but provides an enable to U19a thru U16b. When the read line (RD) is pulsed, U26 passes the setting of the address switches over the bus to (U1, U1 then passes this address word to the A60 Controller Assembly microprocessor. If the front panel LOCAL key is pressed, the A60 Controller Assembly microprocessor displays the address code in the FREQUENCY/ENTRY display area.

At turn-on, if A62S1 pin 1 is in TEST, U1 performs an automated test procedure determined by the other switch positions of A62S1.

When a Level Meter is designated as a controller on the interface bus, it makes a change to the system configuration, and it will set the attention (ATN) line true (LOW').

NOTE

All HP interface bus control lines and data lines use LOW = TRUE logic. LOW = 1 and HIGH = O.

When the ATN line goes LOW at the A61 HP Interface Bus Assembly input, it is passed through U5 to the CLK 1 input of U30. Normally 1130 has both of its flip-flops in a clear state. Q1 now flips LOW which trips the enable lines U18c pin 10 and U18d pin 12 LOW and the (L) NRFD and (L) NDAC lines become LOW. This prevents data transfer until U1 is ready. The U30 Q1 output is applied through U9 as a LOW to T1 input of U1 where it interrupts the microprocessor. U1 now outputs a control word to U22 which places a LOW at U22 pin 5. This LOW is passed through U31a to the CLK 2 input at U3 pin 13. The CLK 2 input flips@ LOW which trips CLR 1 and flops Q1 back to HIGH, This enables U18C and U18d. Q1 flops LOW tripping CLR 2 and Q2 flops HIGH. Both U30 flip-flops are now again in the clear state. At this time, all 1/0 bus transceivers U2 thru U5 must be set up to the input or listen state. This is accomplished by ATN LOW, producing a HIGH at U20 pin 5. U20 is enabled with A62S1 pin 2 in REMOTE. U20 pin 6 is HIGH and this HIGH is passed through U17a as an enable LOW at all the D101 thru D108 gates U14 and U15. Bus pull up resistors R3 now cause all the U1 port one data lines P10 thru P17 to be HIGH. These lines being HIGH make the outputs of U6, U10, and U11 HIGH. Bus transceivers U2, U3, and U4 for interface bus data lines D101 thru D108 are all HIGH at the point between the OR gates and the buffer amps. This HIGH acts as a bus pull up at these points and, since the interface bus uses LOW = TRUE logic, an incoming LOW on any of the interface bus data lines is enabled as an input to the A61 HP Interface Bus Assembly.

The handshake control lines for the listen state are set up individually by U1. NDAC is LOW through a LOW at U17 pin 5, with U17 pin 6 already LOW, causing a LOW at U18 pins 9 and 8. NRDFD is HIGH through a HIGH at U17 pin 8 causing U18 pins 13 and 11 to be HIGH. U18 pin 12 is already HIGH. DAV is enabled by U1 in the listen state. This is accomplished by a HIGH at U10 pin 5.

The (H) TALK, (H) LISTEN, (H) REMOTE, and (H) SRQ lines to the A60 Controller Assembly notify the microprocessor to light the correct status annunciator on the front panel. The (H) TALK and (H) LISTEN lines also control the direction of the interface bus data and handshake lines on the A61 HP Interface Bus Assembly when the microprocessor commands the Level Meter into either of these modes. In addition to notifying the A60 Controller Assembly microprocessor that U 1 has data for it, the (H) INTERRUPT line also resets U25b in preparation for the A60 Controller Assembly to return data.

When the Level Meter is not in REMOTE and U1 wants the Level Meter in REMOTE, it sets the ATN line LOW, puts the Level Meter listener address on D101 thru D108 and sets the remote enable line (REN) LOW. Then it sets the data valid line (DAV) LOW. When the data valid line (DAV) goes LOW, U1 samples the word from D101 thru D108 and checks U1 pin 22 to see it' the remote enable line (REN) is LOW. It also checks to see if the Level Meter is being addressed by comparing the sample word to the present address switch settings on A62S1. If the sample address and the Level Meter address are not the same, the command is ignored and the Level Meter stays in LOCAL. If they are the same, U1 places the Level Meter in LISTEN. If the remote enable line (R EN) is LOW, U 1 also places the Level Meter in REMOTE.

If the Level Meter is already in REMOTE, U22 pin 6 will be HIGH enabling U20a. If the remote enable line (REN) now goes HIGH, U20a will trip U17 pin 13 LOW which generates an interrupt to U1 on the interrupt line (lNT) pin 6. If the A60 Controller Assembly microprocessor sets the interface clear line (IFC) true, it will also trip U17 pin 13 LOW to generate an interrupt. The A60 Controller Assembly microprocessor examines U1 pin 21 and U 1 pin 22 to see which line (REN or lFC) caused the interrupt. It' the remote enable line (REN) is HIGH, U1 takes the Level Meter out of REMOTE. If the interface clear line (IFC) is LOW, TALK or LISTEN are cleared.

The Level Meter can act as a partial controller if A62S1 pin 2 switch is put in the TRACK position. This will change the state of several gates and transceivers and allow the Level Meter to control the attention line (ATN) and the remote enable line (REN) lines. In this mode, the Level Meter puts out continuous frequency information only, as a talker on the bus. U1 samples the position of A62S1 pin 2 any time the interface bus is idle and not in REMOTE, to see if this switch has changed position.

For normal operation in REMOTE as a talker, U1 reconfigures the gates through a HIGH at U22 pin 18 and U19 pin 12. This passes data, rather than accepting data onto the interface bus, All normal data transfers on the interface bus, whether in or out, take place with a handshake of control line states between the talker and the listener(s). This sequence occurs as follows:

1. All listeners set (L) NDAC LOW and (L) NRFD HIGH.

2. Talker places data word on D101 thru D108

3. Talker sets (L) DAV LOW,

4, All listeners set (L) NRFD LOW and sample D1O1 thru D108.

5. All listeners set (L) NDAC HIGH.

6. Talker sets (L) DAV HIGH and clears D101 thru D108.

7. All listeners set (L) NDAC LOW and (L) NRFD HIGH and the cycle repeats with a new data word,

(27) A80 POWER SUPPLY/ A99 MOTHERBOARD ASSEMBLY. (Fig. FO-25.) Level meter AC power is selectable, with a choice of 110/120/2201240Vac input power. Two switches, S1 and S2, mounted on the rear panel allow the operator to choose one of the four above voltages for fused F1 input to T1. S3 provides thermal shutdown protection if the ambient temperature exceeds 105° C. Fan B1 is on any time power switch A98S300 is in the ON position which energizes K1. Secondary windings of T1 drive three diode bridge, full wave rectifiers. CR 1 thru CR4 on the A99 Motherboard Assembly provide +16.5V and -16.5V to the +12V and -12V regulators. CR5 thru

CR8 furnish +8V to the +5V regulator and CR9 thru CR 12 provide fused, F1 and F2, +23V and –23V to the power supply as supply voltages for all the regulator circuits. Spare fuses, F3 and F4, are provided and located on the A99 Motherboard Assembly. The +23V feeds a +15V regulator A99U2 which provides front panel probe power and feeds another +15V regulator on the 10 MHz A40 Frequency Reference Assembly. The +15V regulator is also the current source for charging nickel-cadmium battery BT1 on the A80 Power Supply Assembly. Q1, Q2, and Q3 are Darlington transistors which provide power regulation for the three main power supplies.

In the +12V regulator, A8OCR8 if the reference zener for the circuit, Zener A80CR9 provides overload protection for amplifiers U1a and U1b. Zener A80CR3 provides –5. 11 V power for U 1. When the power switch is in standby (STBY), pin A22 of XA80 is open and Q1 is biased on through R17 and R18. This brings U1 pin 5 down to approximately 0 volts and U1 pin 6 follows, cutting off the +12V supply completely. Since the +12V is used as the reference input for the –12V and +5V regulators, all three supplies are turned off. The voltage present at the junction of R17 and R18 is applied through pin A22 to the A98 Keyboard Assembly to light the STBY annunciator light A98DS40 on the front panel.

When the power switch is chanced from STBY to ON, the junction of R17 and R18 is grounded to chassis through the power switch, turning out the STBY light, This turns Q1 off and allows the inputs to U1b to come up to the reference voltage across CR8. The voltage at TP1 now drives to + 12V as set by R 15 and all three main supplies are now turned on.

U1b is the voltage regulator while U1a provides current-limiting for the +12V supply. If the +12V supply were to become shorted, U1 pin 1 would go LOW, turning on the red LED CR2 and biasing Darlington transistor Q1 off. This limits the current into the regulutor, During normal supply operation, green LED CR5 is turned on and CR6 provides reverse bias protection for U1. This is in case the plus and minus supplies were to short to each other. The -12V regulator operates in the same way as the + 12V regulator, except that the reference for the voltage regulator U2b is the +12V supply through R38. The +5V regulator operates in the same way as the +12V regulator, except that the reference for the voltage regulator U3b is the +12V supply through R58. Zener CR20 provides overvoltage protection at +6.2V for the +5V supply.

The +23V input to the power supply is also used to charge BT1, a 100 milliampere capacity nickel-cadmium battery, When all input AC power is removed from the Level Meter, the RAM's draw approximately 100 microamperes of current from BT1. With AC power connected to the Level Meter, even in STBY, a charging current of approximately 7 milliamperes maintains BT1 at full charge. This provides about 30 days of battery life when power is removed,

A transformer on the A99 Motherboard Assembly A99T1 provides isolated power to the input section from the standard power supply buses of +12V, –1 2V, +5V, +15V, and chassis or mainframe ground. The isolated power supply buses of +12VI, –12VI, +5VI, +l5VI, and isolated ground are all used in the input section.

A99T1 also provides isolated ground to circuit card assemblies Al, A2, A4, A5, A10, and Al1. To preserve the ground isolation. all lines going to and from these assemblies have isolated coupling. Isolation of signal data and power supply lines is done as follows:

A99T1 provides separation between PC ground and isolation ground.

A99U1 provides separation for the Controller Assembly data line.

A99T4 provides separation for the Controller Assembly clock line (TCLK).

A99T5 provides separation for the Controller Assembly clock line (AMP CLK).

A99T3 provides separation for the Controller Assembly IS0 LATCH.

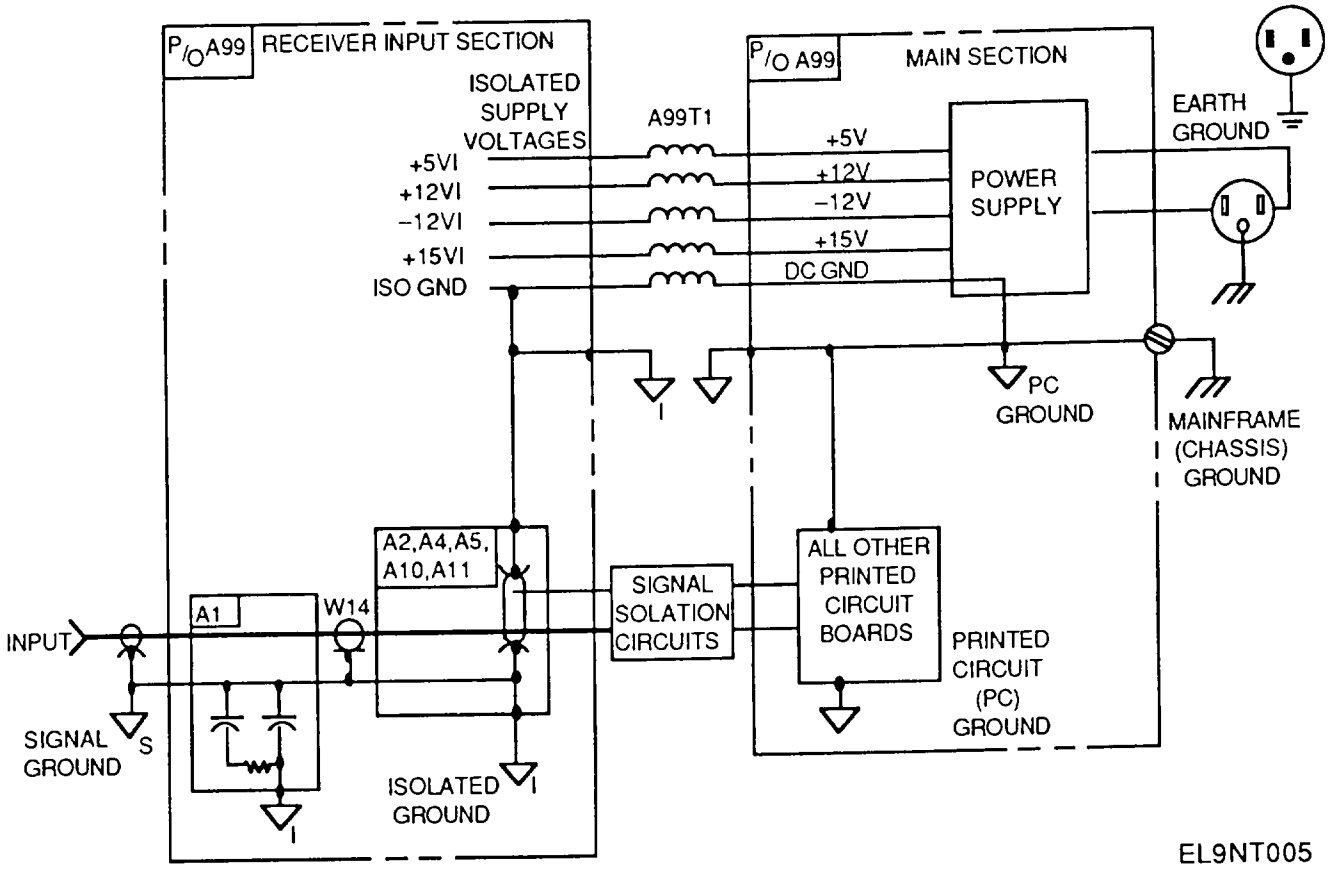


Figure 1-5. Grounding and Signal Isolation.

CHAPTER 2
MAINTENANCE INSTRUCTIONS

Section 1. REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

2-1. COMMON TOOLS AND EQUIPMENT.

Common tools and equipment required for general support maintenance of Frequency Selective Level Meter AN/USM-490 are listed in the Maintenance Allocation Chart (MAC), TM 11-6625-3087-12, Appendix B.

2-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

There are no special tools, TMDE, and support equipment required.

2-3. REPAIR PARTS.

Repair parts are listed and illustrated in the repair parts and special tools list, TM 11-6625-3087-24P.

Section II. SERVICE UPON RECEIPT

2-4. SERVICE UPON RECEIPT OF MATERIAL.

a. Unpacking. The Level Meter is packed in its own shipping carton. Unpack the equipment as follows:

- Open shipping carton and remove equipment.
- Place equipment on a suitable clean and dry surface for inspection.
- Keep all shipping materials for use in repacking and reshipping,

b. Checking Unpacked Equipment.

- Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 364, Report of Discrepancy (ROD).
- Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA Pam 738-750.
- Check to see whether the equipment has been modified.

2-5. PRELIMINARY SERVICING AND ADJUSTMENT OF EQUIPMENT.

a. Perform the turn-on procedures given in TM 11-6625-3087-12.

b. Complete performance test (para 2-42).

Section III. TROUBLESHOOTING

SYMPTOM INDEX

2-6. GENERAL.

Troubleshooting at the general support maintenance level requires you to locate any malfunction as quickly as possible. The amount of troubleshooting you can do is based on what the Maintenance Allocation Chart says you can fix. Because of this, the only trouble symptoms you will find here are those that could be caused by faulty items you can fix.

NOTE

- Before using the troubleshooting table, check your work order and talk to organizational maintenance, if possible, for a description of the symptoms and the steps that have been taken to correct them.
- Check all forms and tags attached to, or accompanying, the equipment to determine the reason for removal from service.

2-7. TROUBLESHOOTING GUIDELINES.

The following is a list of aids that you can use when troubleshooting the Level Meter:

a. The Level Meter has built-in tests or self-diagnostics that are used in troubleshooting. These tests are referenced from the individual troubleshooting procedures when required.

b. During normal operation of the Level Meter, an automatic calibration cycle takes place from time to time. This internal calibration cycle is also used during troubleshooting to check operational status of the Level Meter.

NOTE

This calibration does not replace calibration in accordance with the bulletin listed in TB43-180 for this equipment.

c. Refer to the principles of operation, Chapter 1, Section III as required. This provides circuit theory of the assembly or section you are troubleshooting with references to the schematic diagrams. Schematic diagrams are located in figures FO-2 thru FO-25.

d. Circuit cooler spray (Appendix B, item 1) can be used in isolating problems. This method is especially helpful on intermittent problem.. that get worse with a rise in temperature.

e. Use signature analysis. The digital circuit tester is a good troubleshooting tool when testing digital circuits to give a go/no-go test.

f, Many problems on level meters that have been in service for awhile are caused by corrosion. Sometimes removing and reseating the affected plug-in assemblies will correct a malfunction. Cleaning connector pins and/or switch contacts with alcohol (Appendix B, item 2), and cotton swab (Appendix B, item 3) will repair many types of digital and analog circuit malfunctions.

2-8. EQUIPMENT INSPECTION.

The following inspection procedures shall be used to locate obvious malfunctions with the Level Meter.

a. Inspect all external surfaces of Level Meter for physical damage, breakage, loose or dirty contacts and missing components.

b. Remove top and bottom covers (para 2-66) as required to access components.

WARNING

Level meter contains high voltages. After power is removed, discharge capacitors to ground before working inside Level Meter to prevent electrical shock.

c. Inspect printed circuit board surfaces for discoloration, cracks, breaks, and warping.

d Inspect printed circuit board conductors for breaks, cracks, cuts, erosion, or looseness.

e. Inspect all assemblies for burnt or loose components.

f. Inspect all chassis-mounted components for looseness, breakage, loose contacts or conductors.

g. Inspect Level Meter for disconnected, broken, cut loose, or frayed cables or wires.

2-9. TROUBLESHOOTING TABLE.

The troubleshooting table (table 2-1) lists common malfunctions which may be found during normal operation or maintenance of the Level Meter or its components. You should perform the tests or inspections and corrective actions in the order listed.

NOTE

- Troubleshooting presented in table 2-1 uses internal operational circuits and front panel indications at the beginning steps of each procedure to isolate the malfunctioning area.
- When connecting Synthesizer/Level Generator to Level Meter, always connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator 10 MHz REF input (rear panel).

Table 2-1. Troubleshooting

Malfunction Test or inspection Corrective action

1. Calibration Test Failure.

Step 1. Check for front panel error codes.

If CE-0 thru 9, A, or B is displayed, perform Diagnostic Test 13 (para 2- 10).

- Replace faulty component.

If CE-C is displayed, perform A10 Second Mixer Test (para 2-20) and A20 IF Filter TEST (para 2-24).

- Replace faulty component.

If CE-D is displayed perform A20 IF Filter Test (para 2-24) around 20Hz filter circuit.

- Replace faulty component.

If CE-E is displayed and Level Meter is not in wideband mode, perform A21 IF Gain/Detector Test (para 2-26) around U5, U9, and U10.

- Replace faulty component,

If CE-E is displayed and Level Meter is in wideband mode, perform A4 Broadband Power/CAL/Overload Test (para 2-17) around broadband power circuit.

- Replace faulty component.

If CE-F is displayed, verify A10TP1 jumper is connected (fig. FO-6). If connected, perform A21 IF Gain/Detector Test (para 2-26), A22 Analog-Digital Converter Test (para 2-27), and A70 Impairments B Test (para 2-36).

- Replace faulty component.

If CAL fails every step in calibration cycle, check cabling (fig. 2-2), then go to malfunction number 17.

Step 2. Perform Diagnostic Test 13 (para 2-10).

- Replace faulty component.

Table 2-1. Troubleshooting--Continued

Malfunction Test or inspection Corrective action

1. Calibration Test Failure-Continued.

Step 3. Disconnect black cable from connector A15J2 and connect it to connector A2J2 (fig. FO-3). Connect Synthesizer/Level Generator 75C2 output to Level Meter FO output (rear panel) using 75 Ω cable.

Set Synthesizer/Level Generator to 1MHz at -40dBm.

Press RECALL then number 0 push button.

Press RECALL, "." (decimal), CNTR->FREQ, then number 1 push button.

Verify front panel display indicates about –34dBm.

- If indication is incorrect, proceed with step 4.
- If indication is correct, proceed with step 8.

Step 4. Press RECALL then number 0 push button. Select ENTRY 100 and turn CAL off.

Press RECALL, "." (decimal), CNTR->FREQ, then number 0 push button.

Press RECALL, "." (decimal), CNTR->FREQ, then number 1 push button.

Change full scale settings from -45 to -40dBm in 5 dB steps. Verify Level Meter indicates 40 dBm.

Change full scale settings from +5 to +25dBm in 5dB steps. Verify Level Meter indicates -20 dBm.

- If indications are correct, proceed with step 6.
- If indications are incorrect, proceed with step 5.

Step 5. Perform A4 Broadband Power/CAL/Overload Test (para 2- 17).

- Replace faulty component,

Step 6. Perform Frequency Test (para 2-28).

- Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action

1. Calibration Test Failure-Continued.

Step 7. Press RECALL then number 0 push butt0n. Select ENTRY 100 and turn CAL 0ff.

Press RECALL, "." (decimal), CNTR—>FREQ, then number 0 push button.

Press RECALL, "." (decimal), CNTR->FREQ, then number 1 push button.

Press AUT0 CAL push button.

Change full scale settings from -45 to 40 dBm in 5 dB steps. Verify Level Meter indicates -40 dBm.

Change full scale settings from +5 to +25dBm in 5 dB steps. Verify Level Meter indicates -20 dBm.

- If indications are correct proceed with step 8.
- If indications are incorrect proceed with step 10.

Step 8. Press RECALL, " ." (decimal), RDNG—>OFFSET, then number 6 push butt0n.

Verify displayed value of 90 to 110Hz.

- If value displayed is incorrect proceed with step 9.
- If value displayed is correct proceed with step 10.

Step 9. Perform A60 Controller Test (para 2-34).

- Replace faulty component,

Step 10. Perform A2 Input Amplifier and A21 IF Gain/Detect0r RF/IF Test. (para 2-12).

- Replace faulty component.

2. Front Panel Displays Errors.

Step 1. Check front panel for error code.

If E2.2 is displayed, perform Diagnostic Test 13 (para 2-10).

- Replace faulty component.

Table 2-1. Troubleshooting--Continued

Malfunction	Test or inspection	Corrective action
2. Front Panel Displays Errors-Continued.		
	If E2.3 is displayed, perform Diagnostic Test 13 (para 2-10).	
		● If test passes, perform A70 Impairments B Test (para 2-36).
		● If test fails, replace faulty component.
	If E2.9 is displayed, perform Diagnostic Test 13 (para 2-10).	
		● If test passes, perform A70 Impairments B Test (para 2-36).
		● If test fails, replace faulty component.
	If E3.1 is displayed, perform A11 Second Local Oscillator Test (para 2-21) around U70, U80, and U90.	
		● Replace faulty component,
	If E3.2 is displayed, verify A51S1 in normal position (fig. FO-18). If correct, perform Summation Loop Test (para 2-33).	
		● Replace faulty component.
	If E3.4 is displayed, perform Fractional N Loop Test (para 2-30).	
		● Replace faulty assembly.
	If E3.8 is displayed, perform A50 Step Loop Test (para 2-32).	
		● Replace faulty component.
	If E4.1 or E4.2 is displayed, perform A70 Impairments B Test (para 2-36).	
		● Replace faulty component.
	If Err 7 is displayed, perform A22 Analog-Digital Converter Test (para 2-27).	
		● Replace faulty component,
	If Err 8 is displayed, wait 30 seconds. If error remains, perform A40 Frequency Reference Test (para 2-31).	
		● Replace faulty component.
	If error displayed is not listed it is an operator error. See TM 11-6625-3087-12, chapter 2, section III for explanation.	

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action

2. Front Panel Displays Errors---Continued.

Step 2. Perform A98 Keyboard Test (para 2-38).

- Replace faulty component.

Step 3. Perform A60 Controller Test (para 2-34).

- Replace faulty component.

3. Level Meter Turn-On Incorrect.

Step 1. Check to see if rear panel fan is operating.

- If not, proceed with step 3.
- If operating, check cable W 17 (fig. 2-2) from A60 Controller Assembly to A98 Keyboard Assembly and verify that A60 Controller Assembly is properly seated.

Step 2. Check front panel indications.

- If front panel is frozen, cycle power switch. Check A60 Controller Assembly to A98 Keyboard Assembly cable W17 (fig. 2-2), If still frozen, proceed with step 5.
- If Err 7 is displayed, proceed with step 4.
- If all LED's are lit, proceed with step 5.
- If none of the LED's are lit, proceed with step 4.
- If display filled with r's or one letter, proceed with step 5.
- If CE- number error is displayed, go to Malfunction No. 1.

Step 3. Troubleshoot fan (B1), relay (K1), and power switch (A98S300) (fig. FO-25).

- Replace faulty component.

Step 4. Perform A80 Power Supply Test (para 2-37).

- Replace assembly.

Step 5. Perform A60 Controller Test (para 2-34).

- Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action

3. Level Meter Turn-On Incorrect--Continued.

Step 6. Perform A98 Keyboard Test (para 2-38).

- Replace faulty component.

Step 7. Check for excessive floor noise -(>–116dBm power level indication at 1MHz).

- Go to Malfunction No. 12.

Step 8. Check overall operational status.

- Perform Diagnostic Test 14 (para 2-11).
- After Diagnostic Test 14 is complete, Perform Diagnostic Test 13 (para 2-10).

4. Amplitude Measurements Incorrect.

Step 1. Press AUTO CAL push button.

- If calibration error is displayed, go to Malfunction No. 1.

Step 2. Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter 75 Ωinput using 75 Ωcable.

Set Level Meter full scale to 0dBm, select entry 100, and select 75 Ωinput.

Set Synthesizer/Level Generator output to 0dBm at 20KHz.

Verify Level Meter amplitude is from –3dBm to +3dBm. Verify Level Meter amplitude for input frequencies of 1MHz, 10.333333MHz, and 32.5MHz.

Record frequencies where error occurs.

Step 3. Tune Synthesizer/Level Generator to frequency where amplitude error was present. Press AUTO CAL on Level Meter.

- If calibration error is displayed, go to Malfunction No. 1.
- If amplitude measurement is now correct, proceed with normal operation.

Step 4. Perform Frequency Test (para 2-28).

- Replace faulty assembly or component,

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action

4. Amplitude Measurements Incorrect-Continued.

Step 5. Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter FO output (rear panel) using 75 Ωcable.

Connect Synthesizer/Level Generator EXT REF (rear panel) to Level Meter 10MHz output.

Remove black cable (fig. 2-2) from connector A15J2 and connect it to connector A2J1 (fig. FO-3).

Set Synthesizer/Level Generator to 1MHz at 0dBm.

Verify Level Meter indicates from +5.5 to +6.5 dBm.

- If correct indication is obtained, proceed with step 6.
- If incorrect indication is obtained, proceed with step 7.

Step 6. Perform A1 Input Multiplexer Test (para 2- 14).

- Replace faulty component.

Step 7. Perform A4 Broadband Power/CAL/Overload Test (para 2-17).

- Replace faulty component.

Step 8. Press RECALL, "." (decimal), RDNG->OFFSET, then number 4 push button,

- If-125.50 and –130.30 are displayed, proceed with step 10.
- If incorrect readings are displayer proceed with step 9.

Step 9. Perform A22 Analog-Digital Converter Test (para 2-27).

- Replace faulty component.

Step 10. Perform A2 Input Amplitude and A21 IF Gain/Detector IF/RF Test (para 2- 12).

- Replace faulty component.

Step 11. Perform Amplitude Trace Test (para 2-40).

- Replace faulty component.

Table 2-1. Troubleshooting--Continued

Malfunction / Test or inspection / Corrective action
5. Audio Missing or Incorrect.
Step 1. Turn up VOLUME.
Step 2. Perform Diagnostic Test 13 (para 2-10). Verify that amplitude indication for pass 4 1 to pass 4 32 is -40dBm +3dB. If incorrect go to Malfunction No. 4. In group 5: verify audio. ● If audio is weak, distorted, or missing, proceed with step 3. ● If audio is correct, Level Meter is operating normally.
Step 3. Select opposite sideband from one used above. Repeat step 2. ● If audio is now correct proceed with step 4. ● If audio is incorrect proceed with step 5.
Step 4. Perform A22 Analog-Digital Converter Test (para 2-27). ● Replace faulty component.
Step 5. Remove A21 IF Gain/Detector Assembly (para 2-80). Move STD/OPT switch A21S1 to STD (fig. FO- 11). Install A21 IF Gain/Detector Assembly (para 2-80).
Step 6. Remove A70 Impairments B Assembly (para 2-93).
Step 7. Repeat step 2. ● If audio is correct, proceed with step 8. ● If audio is incorrect, proceed with step 9.
Step 8. Move STD/OPT switch A21S1 to OPT (fig. FO-11). Perform A70 Impairments B Test (para 2-36). ● Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction / Test or inspection / Corrective action
5. Audio Missing or Incorrect-Continued.
Step 9. Install A70 Impairments B Assembly (para 2-93). Perform A21 IF Gain/Detector Test (para 2-26). ● Replace faulty compment.
6. Auto Range Incorrect.
Step 1. Press AUTO CAL push button. ● If calibration error is displayed, go to Malfunction No. 1.
Step 2. Select following modes with and without input signal applied and record where problem occurs. Press AUTO 10 push button. Press AUTO 100 push button. Press LO DIST push button. Press SHIFT push button (LO NOISE). Press WIDEBAND push button. Press 3100Hz push button. Press 20Hz push button. Press AVE push button with AUTO 10 and AUTO 100. ● If problem exists only in AUTO 10 or AVE LO DIST AUTO 10, proceed with step 3. ● If problem exists in AUTO 10 and AUTO 100, AUTO 100, AVE LO DIST AUTO 100, or AVE WIDEBAND, proceed with step 4.
Step 3. Perform A2 Input Amplifier Test and A21 IF Gain/Detector RF/IF Test (para 2- 12). ● Replace faulty component.
Step 4 Perform A4 Broadband Power/CAL/Overload Test (para 2-17). ● Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action

6. Auto Range Incorrect-Continued.

Step 5. Verify that input source is not amplitude modulating or have second harmonics or spurs that are amplitude modulating.

- Correct input source.

Step 6. Press RECALL, " ." (decimal), RDNG—>OFFSET then number 6 push button.

- If 90 to 110Hz is displayed proceed with step 8.
- If displayed value is incorrect, proceed with step 7.

Step 7. Perform A60 Controller Test around U20, U5, and U37 (para 2-34).

- Replace faulty component.

Step 8. Go to Malfunction No. 15.

- Perform test as instructed.

7. Excessive Harmonic-Intermodulation Distortion.

Step 1. Verify that measurement equipment and test connections and cables are not introducing harmonic distortion.

- If using a Spectrum Analyzer for measuring distortion, insure input range is set 10dB higher than input signal.
- Use lowpass or bandpass filters as required to remove source harmonics from the Level Meter input.

Step 2. Perform Distortion Test (para 2-13).

- Replace faulty component.

8. Frequency Fine Tune Malfunction.

Step 1. Remove A60 Controller Assembly (para 2-90) and reinstall on an extender board.

Step 2. Using an Oscilloscope, verify that A60U36 pin 3 pulses high when rotary pulse generator is turned CCW (fig. FO-21).

- If incorrect, proceed with step 5.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action

8. Frequency Fine Tune Malfunction-Continued.

Step 3. Using an Oscilloscope, verify that A60U36 pin 3 and A60U36 pin 13 pulse high when rotary pulse generator is turned CW.

- If incorrect, proceed with step 5.

Step 4. Perform A60 Controller Test (para 2-34).

- Replace faulty component.

Step 5. Trace key lines 6 and 7 from A60 Controller Assembly to rotary pulse generator (fig. FO-21 and fig. FO-24).

- Replace faulty component.

9. Frequency Measurement Incorrect.

Step 1. Verify that source frequency is accurate.

- Replace source frequency.
- Phase lock frequency source to Level Meter. Use 10MHz output on rear panel of Level Meter,

Step 2. Press AUTO CAL push button.

- If calibration error is displayed, go to Malfunction No. 1.

Step 3. Perform Frequency Test (para 2-28).

l Replace faulty assembly or component,

Step 4. Check to see if Level Meter has amplitude measurement errors at any specific frequency. If so, tune Level Meter to affected frequency and press AUTO CAL push button.

- If calibration error is displayed, go to Malfunction No. 1.

Step 5. Perform A22 Analog-Digital Converter Test (para 2-27).

- Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction Test or inspection Corrective action
10. Front Panel Dark.
Step 1. Check to see if rear panel fan is operating. ● If not operating, proceed with step 2. ● If operating, check cable W 17 (fig. 2-2) from A60 Controller Assembly to A98 Keyboard Assembly and verify that Controller Assembly is properly seated. Proceed with step 3.
Step 2. Troubleshoot fan (B 1), relay (K1), and power switch (A98S300) (fig. FO-25). ● Replace faulty component.
Step 3. Perform A80 Power Supply Test (para 2-37). ● Replace faulty assembly.
Step 4. Perform A60 Controller Test (para 2-34). ● Replace faulty assembly.
11. Front Panel Flickering,
Step 1. Press RECALL, "." (decimal), RDNG—>OFFSET, then number 6 push button. Verify that displayed value is from 90 to 110HZ. ● If displayed value is correct, proceed with step 3. ● If displayed value is incorrect, proceed with step 2.
Step 2. Perform A60 Controller Test (para 2-34). ● Replace faulty component.
Step 3. Perform A80 Power Supply Test (para 2-37). ● Replace faulty assembly.
Step 4. Perform A98 Keyboard Test (para 2-38). ● Replace faulty component.
Step 5. Perform A60 Controller Test (para 2-34). ● Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action
12. High Noise Floor.		
	Step 1. Check display area for above -116dBm level at 1MHz without a signal applied.	
		● If above–116dBm, proceed with step 4.
		● If below–116dBm, proceed with step 2.
	Step 2. Check display area for above –116dBm level at all other frequencies.	
		● If above -116dBm, proceed with step 3.
		● If below –116dBm, Level Meter is operational.
	Step 3. Perform A60 Controller Test (para 2-34).	
		● Replace faulty component.
	Step 4. Cycle through all input impedance ranges. Check to see if above -116dBm level drops on any termination selected.	
		● If below -116dBm on any termination, proceed with step 5.
		● If all terminations above–116dBm, proceed with step 6.
	Step 5. Perform A 1 Input Multiplexer Test (para 2- 14).	
		● Replace faulty component.
	Step 6. Select 75 Ω termination, ENTRY 100, and set full scale to -35dBm. Select 20Hz and 400Hz bandwidths and check noise level for below –120dBm.	
		● If below –120dBm, proceed with step 7.
		● If above -120dBm, proceed with step 8.
	Step 7. Perform Noise Floor Test (para 2-41).	
		● Replace faulty component.
	Step 8 Remove A20 IF Filter Assembly (para 2-79). Select 3 100HZ bandwidth.	
		● If noise floor above–125dBm, proceed with step 9.
		● If noise floor below -125dBm, proceed with step 13.

Table 2-1. Troubleshooting--Continued

Malfunction Test or inspection Corrective action
12. High Noise Floor-Continued.
Step 9. Press RECALL, " ." (decimal), RDNG—>OFFSET, then number 4 push button. Verify –125.50 and –1 30.30 are displayed. ● If displayed values are correct, proceed with step 10. ● If displayed values are incorrect proceed with step 11.
Step 10. Perform A21 IF Gain/Detector Test (para 2-26). ● Replace faulty component.
Step 11. Recycle power switch. Select ENTRY 100, set full scale to –35dBm, and repeat step 9 again. ● If displayed values are correct, proceed with step 10. ● If there are other indications, proceed with step 12.
Step 12. Perform A22 Analog-Digital Converter Test (para 2-27). ● Replace faulty component.
Step 13. Install A20 IF Filter Assembly (para 2-79).
Step 14. Remove A10 Second Mixer Assembly (para 2-75). ● If noise floor is above -116dBm, proceed with step 15. ● If noise floor is below –116dBm, proceed with step 16.
Step 15. Perform A20 IF Filter Test (para 2-24). ● Replace faulty component.
Step 16. Install A10 Second Mixer Assembly (para 2-75).
Step 17. Connect Spectrum Analyzer to IF test point (fig. FO-6) on A10 Second Mixer Assembly. Set Spectrum Analyzer full scale to +7dBm and verify a spur is present at> -83dBm. ● If present, perform Spurious Signals Test (para 2-39). ● If not present, proceed with step 18.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action
12. High Noise Floor-Continued.		
	Step 18. Remove A5 Input Mixer Assembly (para 2-74).	
		● If noise floor is above -116dBm, proceed with step 19.
		● If noise floor is below –116dBm, proceed with step 23.
	Step 19. Remove A11 Second Local Oscillator Assembly (para 2-76).	
		● If noise floor is below -116dBm, proceed with step 20,
		● If noise floor is above –116dBm, proceed with step 21.
	Step 20. Perform Al 1 Second Local Oscillator Test (para 2-21).	
		● Replace faulty component.
	Step 21. Install A11 Second Local Oscillator Assembly (para 2-76).	
	Step 22. Perform A 10 Second Mixer Test (para 2-20).	
		● Replace faulty component.
	Step 23, Install A5 Input Mixer Assembly (para 2-74).	
	Step 24. Disconnect cable from connector A2J3 (fig. FO-3).	
		● If noise floor is above –116dBm, proceed with step 25.
		● If noise floor is below -116dBm, proceed with step 26.
	Step 25. Perform Frequency Test (para 2-28).	
		● Replace faulty assembly or component.
	Step 26. Perform A5 Input Mixer Test (para 2-19).	
		● Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action

12. High Noise Floor-Continued.

Step 27. Reconnect cable to connector A2J3. Disconnect black cable from connector A15J2 and connect it to connector A2J1.

Connect 75 Ωload to Level Meter FO output (rear panel).

- If noise floor is above -116dBm, proceed with step 28.
- If noise floor is below -116dBm, proceed with step 29.

Step 28. Perform A2 Input Amplifier Test (para 2-16).

- Replace faulty component.

Step 29. Perform A1 Input Multiplexer Test (para 2-14).

- Replace faulty component,

13. Interface Operations Malfunction.

Step 1. Verify correct cabling.

- Correct as required.

Step 2. Verify A62S1 switch positions (para 2-35).

- Correct as required.

Step 3. Put Level Meter into local operation by pressing REMOTE push button. Verify that REMOTE light goes out.

- If incorrect perform noted malfunction troubleshooting procedure, See symptom index.

Step 4. Perform A61 HP Interface Test (para 2-35).

- Replace faulty Assembly.

Step 5. Perform A60 Controller Test (para 2-34).

- Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action
14. Incorrect Analog Meter Reading.		
	Step 1. Verify front panel MEASUREMENT/ENTRY display is functioning properly.	
		● If incorrect, proceed with step 3.
	Step 2. Press AUTO CAL push button.	
		● If calibration error is displayed, go to Malfunction No. 1.
	Step 3. Connect Digital Multimeter to Level Meter METER output (rear panel).	
	Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter 75 Ωinput using 75 Ωcable.	
	Set Synthesizer/Level Generator output to 1MHz at 0dBm. Set Level Meter to ENTRY 10, full scale to 0dBm, and select 75 Ωinput.	
	Verify that Digital Multimeter indicates 0 volts.	
	Set Synthesizer/Level Generator input amplitude to -10dBm.	
	Verify that Digital Multimeter indicates –1Vdc.	
		● If indications are correct, proceed with step 4.
		● If indications are incorrect, replace analog meter (M1) (para 2-99).
	Step 4. Press RECALL, " ." (decimal), RDNG—>OFFSET, then number 4 push buttons. Verify –1 25.50 and –1 30.30 are displayed.	
		● If incorrect values are displayed, proceed with step 5.
		● If correct values are displayed proceed with step 6.
	Step 5. Perform A22 Analog-Digital Converter Test (para 2-27).	
		● Replace faulty component.
	Step 6. Perform A21 IF Gain/Detector Meter Test (para 2-25).	
		● Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action

15. Overload/Underload Indications.

Step 1. Verify proper operation. See TM 11-6625-3087-12, chapter 2, section III.

- Correct as required.

Step 2. Press AUTO CAL push button.

- If calibration error is displayed, go to Malfunction No. 1.

Step 3. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable.

Set Level Meter full scale to 0dBm, select entry 100, and select 75 Ω input.

Set Synthesizer/Level Generator output to 0dBm at 1MHz.

Verify OVLD indicator and red LED A4DS2 (fig. FO-4) are off.

- If incorrect, proceed with step 5.
- If correct proceed with step 4.

Step 4. Increase input amplitude to + 1.5dBm.

- If OVLD indicator is on, proceed with step 6.
- If OVLD indicator is off, proceed with step 5.

Step 5. Perform A4 Broadband Power/CAL/Overload Test (para 2-17) around broadband power detector circuit.

- Replace faulty component.

Step 6. Decrease input amplitude to < –8dBm. Verify yellow LED A4DS1 is on.

- If it is on, proceed with step 8.
- If it is off, proceed with step 7.

Step 7. Perform A4 Broadband Power/CAL/Overload Test (para 2- 17) around underload and broadband power detector circuits.

- Replace faulty component.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action

15. Overload/Underload Indications--Continued.

Step 8. Press AUTO 10 push button. Check for OL or UL displayed on front panel.

- If OL and UL are displayed and both LEDs A4DS1 and A4DS2 are not on, proceed with step 9.
- If one or both LED's A4DS1 and A4DS2 are on, proceed with step 10.

Step 9. Perform A2 Input Amplifier and A21 IF Gain/Detector RF/IF Test (para 2-12).

- Replace faulty component.

Step 10. Perform A2 Input Amplifier Test (para 2-16).

- Replace faulty component.

Step 11. Press RECALL, " ." (decimal), RDNG—>OFFSET, then number 4 push button. Verify –125.50 and 130.30 are displayed.

- If displayed values are incorrect prcceed with step 12.
- If displayed values are correct, proceed with step 13.

Step 12. Perform A22 Analog-Digital Converter Test (para 2-27).

- Replace faulty component.

Step 13. Go to Malfunction No. 6.

- Perform test as instructed.

16. Return Loss Test Failure.

Step 1. Verify Input Return Loss Test results (para 2-42).

- If malfunction occurs for all input impedances, proceed with step 2.
- If malfunction occurs for only one input impedance, proceed with step 4.

Step 2. Press RECALL, ".", CNTR—>FREQ, then number 1 push button.

- If malfunction disappears, proceed with step 3.
- If malfunction remains, proceed with step 4.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action
16. Return Loss Test Failure-Continued		
	Step 3. Perform Al Input Multiplexer Test (para 2- 14) and A2 Input Amplifier Test (para 2- 16) between A1R2 and A2C10.	● Replace faulty components.
	Step 4. Perform A1 Input Multiplexer Test (para 2-14).	● Replace faulty components.
17. Analog Signal Path Failure.		
	Step 1. Verify all Level Meter internal cable connections (fig. 2-2).	● Connect as required.
	Step 2. Select LO DIST mode. Press AUTO CAL and record results. Select WIDEBAND MODE. Press AUTO CAL and record results.	● If calibration error occur in both modes, proceed with step 3. ● If calibration errors occur in only WIDEBAND mode, proceed with step 8. ● If calibration errors occur in only LO DIST mode, proceed with step 9.
	Step 3. Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter 75 Ωinput using 75 Ωcable. Set Level Meter full scale to 0dBm, select LO DIST mode, and select 75 Ωinput. Set Synthesizer/Level Generator output to 0dBm at 1MHz.	● If signal is measured properly, proceed with step 4. ● If signal is not measured properly, proceed with step 5.
	Step 4. Perform A4 Broadband Power/CAL/Overload Test (para 2-17).	● Replace faulty component.
	Step 5. Press RECALL, " ." (decimal), RDNG—>OFFSET, then number 4 push button, Verify -125.50 and -130.30 are displayed.	● If displayed values are correct proceed with step 7. ● If displayed values are incorrect proceed with step 6.

Table 2-1. Troubleshooting-Continued

Malfunction / Test or inspection / Corrective action
17. Analog Signal Path Failure-Continued,
Step 6. Perform A22 Analog-Digital Converter Test (para 2-27).
● Replace faulty component.
Step 7. Perform A2 input Amplifier Test (para 2-16).
● Replace faulty component.
Step 8. Perform A4 Broadband Power/CAL/Overload Test (para 2-17).
● Replace faulty component.
Step 9. Press RECALL, " ." (decimal), CNTR->FREQ, then number 1 push button. Using an Oscilloscope, check pin A2 of A5 (fig. FO-5).
● If good, proceed with step 11,
● If bad, proceed with step 10.
Step 10. Perform A5 Input Mixer Test (para 2-19).
● Replace faulty component.
Step 11, Perform A10 Second Mixer Test (para 2-20), A11 Second Local Oscillator Test (para 2-21), A20 IF Filter Test (para 2-24), and A21 IF Gain/Detector Test (para 2-26).
● Replace faulty component.
18. Store/Recall Inoperative.
Step 1. Move Level Meter power switch to STBY and disconnect power cable.
Step 2. Remove A60 Controller Assembly (para 2-90).
Step 3. Verify that VBAT is from +2.2 to +2,8V at connector XA60L contact A10 (fig. FO-21).
● If good, proceed with step 4.
● If bad proceed with step 5.
Step 4. Perform A60 Controller Test (para 2-34) around CR4, CR5, CR6, CR8, C34, C36, and Q1.
● If A60 Controller components check good, replace A60U28 and A60U29.

Table 2-1. Troubleshooting-Continued

Malfunction	Test or inspection	Corrective action
18. Store/Recall Inoperative<-Continued.		
	Step 5. Troubleshoot battery charger/regulator circuit (fig. FO-25).	● Replace faulty component.

2-10. DIAGNOSTIC TEST 13.

DESCRIPTION

This test is used to check the main signal path of the receiver section.

1. Verify that A60S2 switch 7 is closed (fig. FO-21).
2. Perform Diagnostic Test 14 (para 2-11).
3. Press RECALL, "." (decimal point), CNTR-> FREQ, then number 8 push button.
4. If one of five separate groups of tests fails, a number will identify part of test that failed. f all diagnostic test 3 groups fail, go to Malfunction No. 17, table 2-1. Individual failure directions are as follows:
   - If any step in group 1.0 thru 1.11 fails, perform A2 Input Amplifier Test (para 2-16) using table 2-2.
   - If any step in group 2.0 thru 2.13 fails, perform A20 IF Filter Test (para 2-24) and A21 IF Gain/Detector Test (para 2-26) using table 2-3.
   - If group 3.1 fails, perform A21 IF Gain/Detector Test (para 2-26) around U5, U9, and U 10 circuits.
   - If group 3.2 fails, perform A22 Analog-Digital Converter Test (para 2-27, logic state machine circuit troubleshooting).
   - If any step in group 4.1 thru 4.32 fails, go to table 2-1, Malfunction No. 9.
   - Group 5 test plays music until MEAS CONT push button is pressed. If group 5 fails, perform A21 IF Gain/Detector Test (para 2-26) around audio circuit.
5. To exit Diagnostic Test 13, press MEAS CONT push button while in group 5.

Table 2-2. RF Gain Configurations

	TF13 step	Full Scale	Attenuation value	K2	K3	Amplification value	K4	07	Told Gain (Amplification)
rFOO	l.0	+ 20dBm	-40dB	0	1	+6dB	0	1	- 34dB (.020)
rF01	1.1	+15	-40	0	1	+11	0	0	-29 (.036)
rF02	1.2	+10	-40	0	1	+16	1	1	-24 (.063)
rF03	1.3	+ 5	-40	0	1	+21	1	0	–19 (.11)
rF04	1.4	0	-20	0	0	+ 6	0	1	-14 (.20)
rF05	1.5	- 5	–20	0	0	+11	0	0	- 9 (.36)
rF06	1.6	-10	-20	0	0	+16	1	1	– 4 (.63)
rF07	1.7	-15	–20	0	0	+21	1	0	+ 1 (1.1)
rF08	1.8	-20	0	1	0	+6	0	1	+ 6 (2.0)
rF09	1.9	-25	0	1	0	+11	0	0	+11 (3.6)
rF10	1.10	-30	0	1	0	+16	1	1	+16 (6.3)
rF11	1.11	-35	0	1	0	+21	1	0	+21 (11)

NOTES:
1. 1 = ON or energized.
   0 = OFF or de-energized.

2. Use LOW DISTortion mode and 100dB range.

3. Number in ( ) is the voltage amplification factor. For example: with a total gain on A2 of +6dB, an input signal at A2J1 of 275mVRMS (OdBm into 75 ohms) would be 550mVRMS at A2J3 (275x2.0).

Table 2-3. IF Gain Configurations.

	TF13 Step	Full Scale Note 3	Full Scale Note 4	U2 A20U10 121	U2 A211J7 Gain (5)	Gain	U4 (15)(18)(19)	A21U8 Gain	Tota l If Gain	Amplification
lFOO	2.0	+ 25dBm	+ 25dBm	1	10dB 1	OdB	1 1 1	OdB	10dB	3.2
01	2.1	+ 20d8m	+ 20dBm	1	10dB 1	OdB	1 1 0	5dB	15dB	5.6
02	2.2	+ 15dBm	- 40dBm	1	10dB 1	OdB	1 0 1	10dB	20dB	10
03	2.3	+ 10dBm	–45dBm	1	10dB 1	OdB	1 0 0	15dB	25dB	18
04	2.4	+ 5dBm	- 50dBm	1	10dB 1	OdB	0 1 1	20dB	30dB	32
05	2.5	OdBm	- 55dBm	1	10dB 1	OdB	0 1 0	25dB	35dB	56
06	2.6	- 5dBm	- 60dBm	1	10dB 1	OdB	0 0 1	30dB	40dB	100
07	2.7	- 10dBm	–65dBm	1	10dB 1	OdB	0 0 0	35dB	45dB	180
08	2.8	-15dBm	- 70dBm	1	10dB 0	35dB	1 1 0	5dB	50dB	320
09		- 20dBm	-75dBm	1	10dB 0	35dB	1 0 1	10dB	55dB	560
10		- 25dBm	- 80dBm	1	10dB 0	35dB	1 0 0	15dB	60dB	1000
11		- 30dBm	- 85dBm	1	10dB 0	35dB	0 1 1	20dB	65dB	1800
12		- 35dBm	– 90dBm	1	10dB 0	35dB	0 1 0	25dB	70dB	3200
13		- 40dBm	-95dBm	1	10dB 0	35dB	0 0 1	30dB	75dB	5600
14		- 45dBm	- 100dBm	1	10dB 0	35dB	0 0 0	35dB	80dB	10000
15		105dBm	- 105dBm	0	35dB 0	35dB	1 0 0	15dB	85dB	18000
16		110dBm	-110dBm	0	35dB 0	35dB	0 1 1	20dB	90dB	32000
17		115dBm	-115dBm	0	35dB 0	35dB	0 1 0	25dB	95dB	56000
18		120dBm	-120dBm	0	35dB 0	35dB	0 0 1	30dB	100dB	100000
19				0	35dB 0	35dB	0 0 0	35dB	105dB	180000
20				1	10dB 0	35dB	1 1 1	OdB	45dB	180
21	2.13			0	35dB 1	0dB	1 1 1	OdB	35dB	56

NOTES:
1. 1 = TTL HIGH (> + 3.7VDC).
   0 = TTL LOW (<+ 0.3 VDC).
2. USE LOW Distortion and ENTRY 10.
3. USE LOW DISTortion and AUTO 10, AUTO 100, or ENTRY 100.
   Full Scale less than - 45dBm not selectable in 100dB Range,
4. IF Gain is measured from A20TP910 A21 TP1.

2-11. DIAGNOSTIC TEST 14.

DESCRIPTION

This test is used to check the digital sections of the Level Meter.

1. Press RECALL, " ." (decimal point), CNTR-> FREQ, then number 9 push button.
2. If test fails, a lighted push button indicates failed ROM (fig. FO-21).
   - If 10dB push button is on, replace ROM A60U12.
   - If 100dB push button is on, replace ROM A60U11.
   - If AUTO push button is on, replace ROM A60U10.
   - If ENTRY push button is on, replace ROM A60U9.
   - If AVE push button is on, replace ROM A60U8.
   - If dBm push button is on, replace ROM A60U7.
   - If any push button other than MEAS CONT is on, perform A60 Controller Test (para 2-34).
3. To exit test, press MEAS CONT push button.

2-12. A2 INPUT AMPLIFIER AND A21 IF GAIN/DETECTOR RF/IF TEST.

DESCRIPTION

This test is used to check the switchable gain/attenuation stages on the A2 Input Amplifier Assembly and A21 IF Gain/Detector Assembly.

1. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).
2. Set Synthesizer/Level Generator output to 1 MHz at -45dBm.
3. On Level Meter,
   - Press RECALL and number O push button.
   - Select 75 Ω input.
   - Select LO DIST.
   - Select ENTRY 100.

2-12. A2 INPUT AMPLIFIER AND A21 IF GAIN/DETECTOR RF/IF TEST—Continued.

4. On Level Meter,
   - Set full scale to -45dBm,
   - Press RECALL, "." (decimal), CNTR->FREQ, then number 4 push button.
   - Verify that amplitude steps from –60dBm to OdBm in 11 steps of 5dB as shown on analog meter (RF00 thru RF11, table 2-2).
5. Set Synthesizer/Level Generator output to 40dBm.
6. On Level Meter, press MEAS CONT push button. Repeat step 4 using full scale of -40dBm.
7. Set Synthesizer/Level Generator output to –35dBm.
8. On Level Meter, press MEAS CONT push button. Repeat step 4 using full scale of –35dBm.
   - If twelve steps are visible but are not in 5dB increments, or if twelve steps are not uniform, perform A2 Input Amplifier Test (para 2-16) using table 2-2.
   - If steps are 5dB but start higher than -60dBm and end higher than 0dBm, perform A21 IF Gain/Detector Test (para 2-26).
   - If range of steps is from below –60dBm to below full scale, press RECALL then number 0 push button.
9. Set Synthesizer/Level Generator output to 1 MHz at -55dBm.
10. On Level Meter, select LO DIST and entry 100. Set full scale to -20dBm. Press RECALL, "," (decimal), CNTR—>FREQ, then number 5 push button.
11. Verify that Level Meter analog meter steps from –85dBm to +15dBm in 19 steps of 5dB each (IFOO thru IF 19, table 2-3). Analog meter should briefly jump to about -45dBm for IF 20 and to -55dBm for IF 21, and then the cycle should repeat.
    - If correct. perform Al Input Multiplexer Test (para 2-14), A2 Input Amplifier Test (para 2-16), and A5 Input Mixer Test (para 2-19).
    - If incorrect, perform A20 IF Filter Test (para 2-24) and A21 IF Gain/Detector Test (para 2-26) using table 2-3.
12. To exit test, press MEAS CONT push button.

2-13, DISTORTION TEST.

DESCRIPTION

This test is used to isolate distortion to a single assembly.

1. Remove A5 Input Mixer Assembly (para 2-74) and reinstall on an extender board.

2-13. DISTORTION TEST—Continued.

2. Remove A10 Second Mixer Assembly (para 2-75) and reinstall on an extender board.

3. Remove A20 IF Filter Assembly (para 2-79) and reinstall on an extender board.

4. Connect Spectrum Analyzer to connector A1J1 (fig. FO-2).

   - If distortion appears at this point, verify that input source is not causing distortion.

5. If input source is not causing distortion, Perform A 1 Input Multiplexer Test (para 2-14).

6. Connect Spectrum Analyzer to connector A2J3 (fig. FO-3).

   - If distortion appears at this point and not in step 4, perform A2 Input Amplifier Distortion Test (para 2- 15).

7. Connect Spectrum Analyzer to circuit card assembly A5 pin A2 (fig. FO-5).

   - If distortion appears at this point and not in steps 4 and 6, perform A5 Input Mixer Distortion Test (para 2-18).

8. Connect Spectrum Analyzer to test point A10TP3 (fig. FO-6).

   - If distortion appears at this point and not in steps 4,6, or 7, perform A10 Second Mixer Test (para 2-20).

9. Connect Spectrum Analyzer to test point A20TP11 (fig. FO-10).

   - If distortion appears at this point and not in steps 4,6, 7, or 8, perform A20 IF Filter Test (para 2-24).

10. Install A5 Input Mixer Assembly (para 2-74).

11. Install A10 Second Mixer Assembly (para 2-75).

12. Install A20 IF Filter Assembly (para 2-79).

2-14. Al INPUT MULTIPLEXER TEST.

DESCRIPTION

This test is used to isolate a malfunction in the Al Input Multiplexer Assembly.

1. Troubleshoot A1 Input Multiplexer Assembly using fig. FO-2.

2. Remove Al Input Multiplexer Assembly cover (para 2-7 1).

3. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10 MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel). On Level Meter, select ENTRY 100, set full scale to 0dBm, and select 75 Ω input.

4. Install Al Input Multiplexer Assembly (para 2-71).

2-14. A1 INPUT MULTIPLEXER TEST—Continued.

5. Verify malfunction is corrected, If not,

- Adjust A1/A2 Input Amplifier and Input Multiplexer (para 2-59).
- Adjust Al Balanced Input Frequency Response (para 2-60).

2-15. A2 INPUT AMPLIFIER DISTORTION TEST.

DESCRIPTION

This test is used to isolate distortion in the A2 Input Amplifier Assembly.

1. Remove A2 Input Amplifier Assembly (para 2-72) and reinstall on an extender board.
2. On Level Meter, tune to frequency of distortion signal. Record amplitude of distortion.
3. Short to A2Q7 pin E to ground (fig. FO-3). Record new display measurement reading.
   - If distortion level drops by 5dB, perform A2 Input Amplifier Test (para 2- 16) prior to or in 11/21dB amplifier.
   - If distortion level remains same, perform A2 Input Amplifier Test (para 2-1 6) around buffer amplifiers.
4. Remove short installed in step 3.
5. Install A2 Input Amplifier Assembly (para 2-72).

2-16. A2 INPUT AMPLIFIER TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A2 Input Amplifier Assembly.

1. Troubleshoot A2 Input Amplifier Assembly using fig. FO-3.
2. Remove A2 Input Amplifier Assembly (para 2-72) and reinstall on an extender board.
3. Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter 75 Ωinput using 75 Ωcable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel). On Level Meter, select ENTRY 100, set full scale to OdBm, and select 75 Ωinput.
4. Install A2 Input Amplifier Assembly (para 2-72).

2-16. A2 INPUT AMPLIFIER TEST—Continued.

5. Verify malfunction is corrected. If not,

- Adjust A1/A2 Input Amplifier and Input Multiplexer (para 2-59).
- Adjust A2 Intermodulation Distortion (para 2-6 1).

2-17. A4 BROADBAND POWER/CAL/OVERLOAD TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A4 Broadband Power/CAL/Overload Assembly.

1. Troubleshoot A4 Broadband Power/CAL/Overload Assembly using fig. FO-4.
2. Remove A4 Broadband Power/CAL/Overload Assembly (para 2-73) and reinstall on an extender board.
3. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel). On Level Meter, select ENTRY 100, set full scale to 0dBm, select LO DIST mode, select 3100Hz bandwidth, and select 75 Ω input.
4. Install A4 Broadband Power/CAL/Overload Assembly (para 2-73).
5. Verify malfunction is corrected. If not,

- Adjust A4 Power, Overload, and Calibration (para 2-62),

2-18. A5 INPUT MIXER DISTORTION TEST.

DESCRIPTION

This test is used to isolate a distortion malfunction in the A5 Input Mixer Assembly.

1. Remove A5 Input Mixer Assembly (para 2-74) and reinstall on an extender board.
2. For harmonic distortion, perform A5 Input Mixer Test (para 2- 19) prior to A5T20..
3. For intermodulation distortion, measure intermodulation distortion level at 200Hz and 1MHz separation.

- If both 200Hz arid 1MHz separation signals fail, perform A5 Input Mixer Test (para 2- 19) prior to 50MHz IF filter.
- If only 200Hz separation signal fails, perform A5 Input Mixer Test (para 2-19) around 50MHz IF filter and/or 14dB amplifier.
- If only 1MHz separation signal fails, perform A10 Second Mixer Test (para 2-20).

2-18. A5 INPUT MIXER DISTORTION TEST—Continued.

4. If distortion is still present, connect Oscilloscope with 10:1 probe to A5T20 inputs (fig FO-5). Verify that signal is pure, balanced, and correct amplitude.
   - If not, *perform* Frequency Test (para 2-28).
5. Install A5 Input Mixer Assembly (para 2-74).

2-19. A5 INPUT MIXER TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A5 Input Mixer Assembly.

1. Troubleshoot A5 Input Mixer Assembly using fig. FO-5.
2. Remove A5 Input Mixer Assembly (para 2-74) and reinstall on an extender board.
3. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10 MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel). On Level Meter, select ENTRY 100, set full scale to 0dBm, and select 75 Ω input.
4. Install A5 Input Mixer Assembly (para 2-74),
5. Verify malfunction is corrected. If not,
   - Adjust A5 Low Pass Filter Flatness (para 2-54).
   - Adjust A5 50 MHz Rejection (para 2-55).
   - Adjust A5/A10 50 MHz Crystal Filter (para 2-56).
   - Adjust AS Local Oscillator (para 2-58).

2-20. A10 SECOND MIXER TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A10 Second Mixer Assembly.

1. Troubleshoot A10 Second Mixer Assembly using fig. FO-6.
2. Remove A10 Second Mixer Assembly (para 2-75) and reinstall on an extender board.

2-20. A10 SECOND MIXER TEST—Continued.

3. Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter 75 Ωinput using 75 Ωcable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10MHZ output (rear panel) to Synthesizer/Level Generator REF input (rear panel). on Level Meter, select ENTRY 100, set full scale to 0dBm, select LO DIST mode, and select 75 Ωinput.

4. Install A1O Second Mixer Assembly (para 2-75).

5. Verify malfunction is corrected. If not,

- Adjust mixer balance (A21R44) as specified in Adjust A21 Logger and IF Gain (para 2-51, steps 1-5).
- Adjust A 10/A20 Bandwidth Filters (para 2-52).
- Adjust A10/A20 Bandwidth Gain (para 2-53).
- Adjust A5/A10 50MHz Crystal Filter (para 2-56).
- Adjust A1O Mixer Gain (para 2-57).

2-21. All SECOND LOCAL OSCILLATOR TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A11 Second Local Oscillator Assembly.

1. Troubleshoot A11 Second Local Oscillator Assembly using fig, FO-7.

2. Remove A 11 Second Local Oscillator Assembly (para 2-76) and reinstall on an extender board.

3. Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter 75 Ωinput using 75 Ωcable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel). On Level Meter, select ENTRY 100, set full scale to 0dBm, select LO DIST mode, and select 75 Ωinput.

4. Install A11 Second Local Oscillator Assembly (para 2-76).

5. Verify malfunction is corrected. If not,

- Adjust A40 50MHz Reference Frequency (Pam 2-46).
- Adjust A11 Second Local Oscillator (para 2-49).

2-22. A15 TRACKING OUTPUT TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A15 Tracking Output Assembly.

1. Troubleshoot A15 Tracking Output Assembly using fig. FO-8.
2. Remove A15 Tracking Output Assembly (para 2-77) and reinstall on an extender board.
3. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel). on Level Meter, select ENTRY 100, set full scale to 0dBm, select LO DIST mode, select 3100HZ bandwidth, and select 75 Ω input.
4. Install A15 Tracking Output Assembly (para 2-77).
5. Verify malfunction is corrected. If not,
   - Adjust A4050MHz Reference Frequency (para 2-46).
   - Adjust A31/A32 Fractional N Loop (para 2-47).
   - Adjust A50/A51/A53 Step and Summation Loop (para 2-48).
   - Adjust A15 Tracking Output (para 2-63).

2-23. A16 10MHz FREQUENCY REFERENCE TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A16 10MHz Frequency Reference Assembly,

1. Troubleshoot A16 10MHz Frequency Reference Assembly using fig. FO-9.
2. Remove A16 10MHz Frequency Reference Assembly (para 2-78) and reinstall on an extender board.
3. Turn on Level Meter and allow 15 minutes warmup time.
4. Install A16 10MHz Frequency Reference Assembly (para 2-78).
5. Verify malfunction is corrected. If not,
   - Adjust A16 10MHZ Reference Frequency (para 2-65).

2-24. A20 IF FILTER TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A20 IF Filter Assembly.

1. Troubleshoot A20 IF Filter Assembly using fig. FO-10.
2. Remove A20 IF Filter Assembly (para 2-79) and reinstall on an extender board.
3. Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter 75 Ωinput using 75 Ωcable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10 MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel). On Level Meter, select ENTRY 100, set full scale to 0dBm, select LO DIST mode, and select 75 Ωinput.
4. Install A20 IF Filter Assembly (para 2-79).
5. Verify malfunction is corrected. If not,

- Adjust mixer balance (A21R44) as specified in Adjust A21 Logger and IF Gain (para 2-51, steps 1-5).
- Adjust A 10/A20 Bandwidth Filters (para 2-52).
- Adjust A10/A20 Bandwidth Gain (para 2-53).

2-25. A21 IF GAIN/DETECTOR METER TEST.

DESCRIPTION

This test is used to troubleshoot the meter circuits in the A21 IF Gain/Detector and A22 Analog-Digital Converter Assemblies.

1. Remove A21 IF Gain/Detector Assembly (para 2-80) and reinstall on an extender board.
2. Connect Digital Voltmeter to test point A21TP4 (fig. FO-11). Verify test point TP4 voltage is -0.3Vdc for a full scale (0dB) analog meter reading.

NOTE

For every scale division drop, test point TP4 voltage will decrease 0.1 Vdc.

- If relationship between test point TP4 and analog meter is correct, but analog meter reading is incorrect, perform A22 Analog-Digital Converter Test (para 2-27) around U3 circuit.
- If relationship between test point TP4 and analog meter is incorrect, perform A21 IF Gain/Detector Test (para 2-26) around U19 and U20 circuits,

2-25. A21 IF GAIN/DETECTOR METER TEST—Continued.

3. Measure voltage drop across analog meter (M1). If it exceeds 25mV, replace analog meter (M1) (para 2-99).

CAUTION

Do not measure analog meter M1 with an ohmmeter.

4. Install A21 IF Gain/Detector Assembly (para 2-80).

2-26. A21 IF GAIN/DETECTOR TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A21 IF Gain/Detector Assembly.

1. Remove A21 IF Gain/Detector Assembly (para 2-80) and reinstall on an extender board,
2. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel). On Level Meter, select ENTRY 100, set full scale to 0dBm, and select LO DIST mode.
3. Troubleshoot A21 IF Gain/Detector Assembly using fig. FO-11.
4. Install A21 IF Gain/Detector Assembly (para 2-80).
5. Verify malfunction is corrected. If not,
   - Adjust A21 Logger and IF Gain (para 2-51).

2-27. A22 ANALOG-DIGITAL CONVERTER TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A22 Analog-Digital Converter Assembly.

1. Troubleshoot A22 Analog-Digital Converter Assembly using fig. FO-12 and additional test information provided below.
2. Remove A22 Analog-Digital Converter Assembly (para 2-81) and reinstall on an extender board,
3. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel). On Level Meter, select ENTRY 100, set full scale to 0dBm, and select 75 Ω input.
4. Install A22 Analog-Digital Converter Assembly (para 2-81).

2-27. A22 ANALOG-DIGITAL CONVERTER TEST—Continued.

5. Verify malfunction is corrected. If not,

- Adjust A22 Analog-Digital converter (para 2-50).

6. Use additional troubleshooting tests shown below as needed for repair of A22 Analog-Digital Converter Assembly.

ERROR CODE Err 7 TROUBLESHOOTING

1. Recycle power switch. If Err 7 is not displayed, Level Meter can be used for normal operation.

2. If Err 7 is still displayed, troubleshoot logic state machine (below).

DATA SELECTOR U7 TROUBLESHOOTING

1. Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter 75 Ωoutput using 75 Ωcable. Connect Level Meter 10 MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

2. Connect Digital Multi meter to test points A22TP1 and A22TP2.

3. Set Synthesizer/Level Generator output to 1MHz at 0dBm.

4. On Level Meter, select 75 Ωinput, select entry 100, LO DIST mode, and 31OOHZ bandwidth. Set full scale to 0dBm and tune to 1MHz.

5. Verify that Digital Multimeter indicates a full scale equivalent voltage of -0.3Vdc. Select WIDEBAND and verify -0.3Vdc indication. Press RECALL, "." (decimal), RDNG—>OFFSET, then number 4 push button. Verify Digital Multimeter indicates -1.1V&.

- If Digital Multimeter indication is incorrect, troubleshoot input multiplexer circuits on A22 Analog-Digital Converter Assembly.

LOGIC STATE MACHINE CIRCUIT TROUBLESHOOTING

NOTE

Troubleshooting logic state machine circuits is accomplished by checking various inputs and outputs, which should be toggling, until a bad component is found. Use the following checks to help locate bad a component.

1. Connect an Oscilloscope to U5 pin 7. If U5 is cycling correctly, dual slope ramp should be clearly visible at a 3-4Hz rate (about 1.5V peak-to-peak full scale) with COUNTER off and at a 2Hz rate with COUNTER on.

- If signal is incorrect, check to see if RAMP command signal at U5 pin 10 is present. If it is, and a full scale signal (-0.3V) is present at U5 pin 2, replace U5.

- If dual slope ramp is present, check gates and latches, Replace bad component.

- If frequency COUNTER and amplitude indications are not correct, troubleshoot U6, U8, and U 11.

2. With COUNTER off, verify 500 KHz at U6 pin 24.

2-27. A22 ANALOG-DIGITAL CONVERTER TEST—Continued.

3. If signal is present, check for an input of 6 pulses grouped together at U6 pin 15 line every half-second with COUNTER on.

- If correct and U6 pins 5 thru 8 are not toggling, replace U6.
- If signal is missing, trace backwards through U8 pin 3, U11 pin 4, and U11 pin 1 to U16 pin 12 where it originates. Replace bad component.

4. If signal is missing at U 16 pin 12, check 1MHz input to divide-by-10 circuits. Line into U16 pin 14 and other decade counters U14 and U15 is a CLEAR signal which should be cycling at 2Hz only when COUNTER is on. 1Hz clock at U14 pin 13 is only visible when COUNTER is off.

5. Verify U2 pin 19 is LOW with counter off. With COUNTER on, U2 pin 19 should be HIGH with narrow pulses to LOW and back to HIGH every half-second. This is command signal which switches logic state machine between analog-digital mode (U2 pin 19 LOW) and COUNTER mode (U2 pin 19 HIGH).

6. If Err 7 is displayed because (H) DONE is stuck LOW, this pulse will be missing and analog-digital process cannot begin without START pulse. Check microprocessor operation by momentarily grounding connector XA22 contact B20. If error code Err 7 was not displayed before, it should be with (H) DONE line shorted to ground after 2 seconds.

7. Verify that normal range of input voltage to U5, -0.3V to –1 .lV, analog-digital time between ramps is about ten (10) times width of dual slope ramp time with COUNTER on. With COUNTER off, idle time should be about 3 to 4 times ramp time.

- If these conditions are not true, adjust R21 (para 2-50). Replace U5 if problem not corrected.

8. Verify that U18 latch outputs pins 4, 7, and 9 are all HIGH with COUNTER off, and pulsing LOW very briefly at a 3 to 4Hz rate. Verify pins 4 and 7 remain HIGH in idle state, pulsing LOW very briefly every half-second, but U 18 pin 9 is LOW in idle state, pulsing HIGH very briefly every half-second with COUNTER on.

COUNTER OR GROUP 3.2 ERROR TROUBLESHOOTING

1. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω output using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

2. Connect Oscilloscope to circuit card assembly A22 pin A8.

3. Set Synthesizer/Level Generator output to 1MHz at 0dBm.

4. On Level Meter, select 75 Ω input, select entry 100, LO DIST, and 3100Hz bandwidth. Set full scale to 0dBm and tune to 1MHz.

5. Verify signal at connector XA22 contact A8 for a 15.625 KHz sine wave at about 4V peak-to-pak.

- If this signal is missing, perform A21 IF Gain/Detector Test (para 2-26).

6. Check U4 pin 3 for a 15.625KHz square wave at 12V peak-to-peak referenced to 0Vdc. Check U20 pin 14 for 12V peak-to-peak from +12V to 0V. Check U20 pin 4 for 312.5 KHz at 12V peak-to-peak (+12V to 0V).

2-27. A22 ANALOG-DIGITAL CONVERTER TEST—Continued.

7. If signal is missing at U20 pin 4, lift either end of R11. Voltage at junction of R12 and R13, about +7.2V, should drive voltage-controlled oscillator to about 350KHz. If it does, check U19 pin 3 for 15.625 KHz and U19 pin 9 for 312.5KHz.

- If U 19 signals are correct, replace U4.

- If voltage-controlled oscillator is not ruining with R 11 lifted, replace U20.

8. If U20 pin 4 has 312.5KHz present, check U6 pin 24 to see that it is alternating between 312.5KHz and 500KHz every half-second with COUNTER on. If not, check U2 pin 19 to see if counter is switching on. If counter is on, replace U11 or buffer U8 or U17.

UPPER/LOWER SIDEBAND TROUBLESHOOTING

1. Using an Oscilloscope, verify that signal present at test point A22TP101 is,

   CAL off, upper sideband selected 1.7474MHz.
   CAL off, lower sideband selected 1.3775MHz.
   CAL active, any sideband selected 1.66246MHz.

- If signal is not present at test point A22TP101, check U 101 pins 3, 4, and 5. If these pins are low, troubleshoot a short in oscillator.

2-28. FREQUENCY TEST.

DESCRIPTION

This test is used to check the operation of the first local oscillator (circuit card assemblies A30, A31, A32, A50, A51, A52, and A53), A15 Tracking Output Assembly, and A22 Analog-Digital Converter Assembly.

1. Connect Frequency Counter input to Level Meter Fo (0-32MHz) connector (rear panel). Connect Frequency Counter EXT REF input (rear panel) to Level Meter 10MHz output (rear panel).

2. On Level Meter, press RECALL and number O push buttons. Verify that Frequency Counter and Level Meter frequencies are 1MHz.

3. Step Level Meter tuned frequency, in 1MHz steps, from 1 to 32MHz. Verify that Frequency Counter tracks frequency, +0.1Hz.

2-28. FREQUENCY TEST—Continued.

4. Tune Level Meter to following frequencies, one at a time, while verifying that Frequency Counter tracks frequency, ±0.1Hz at a level of from -0.5 to + 50dBm,

1,000,000.1 Hz	1,555,555.6Hz
1,111,111.2Hz	1,666,666.7Hz
1,222,222.3Hz	1,777,777.8Hz
1,333,333.4Hz	1,888,888.9Hz
1,444,444.5Hz	2,000,000.0Hz

- If any Frequency Counter indications above are incorrect perform First Local Oscillator Test (Para 2-29).
- If Frequency Counter indications are correct, but output level is incorrect, perform A 15 Tracking Output Test (para 2-22).

5. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Connect Level Meter EXT 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

6. Tune Level Meter and Synthesizer/Level Generator to 1MHz.

7. On Level Meter, press COUNTER push button. Verify that displayed frequency on Level Meter is 1MHz ±0.1Hz.
   - If Frequency Counter indication is incorrect, perform A22 Analog-Digital Converter Test (para 2-27),

2-29. FIRST LOCAL OSCILLATOR TROUBLESHOOTING TEST.

DESCRIPTION

This test is used to isolate a malfunction in the First Local Oscillator (A30, A31, A32, A50, A51, A52, and A53).

1. Disconnect red cable from connector A40J1 (fig. FO-16) and connect it to connector A51J2 (fig. FO-18).

2. Connect Frequency Counter input to Level Meter EXT REF input (rear panel).

3. On Level Meter, press RECALL and number 0 push button, Verify Frequency Counter indicates 51MHz.

- If reading correct, connect Frequency Counter to Level Meter FO output (rear panel). If Frequency Counter does not indicate 1MHz, perform A 15 Tracking Output Test (para 2-22).
- If reading incorrect, proceed with step 4.

4. Move red cable to connector A50J2 (fig. FO- 17). Verify Frequency Counter now indicates 54MHz.

- If reading incorrect perform A50 Step Loop Test (para 2-32).
- If reading correct, proceed with step 5.

2-29. FIRST LOCAL OSCILLATOR TROUBLESHOOTING TEST—Continued.

5. Move red cable to connector A31J1 (fig. FO-14). Verify Frequency Counter indicates 30MHz.

- If reading incorrect, perform Fractional N Loop Test (para 2-30).
- If reading correct, perform Summation Loop Test (para 2-33).

NOTE

If First Local Oscillator frequency problem occurs at some tuned frequency other than 1MHz, use table shown below to substitute correct loop frequencies in procedure listed

Front Panel Tuned Frequency	Step Loop VCO Frequency - A50J2	Fractional-N Loop VCO Frequency - A31J1	Sum Loop VCO Frequency (First L.O. Frequency) - A51J2
0 Hz- 1,999,999.9Hz	54MHz	4.0MHz-2,000,000.1Hz	50.0MHz-51,999,999.9Hz
2.0MHz- 3,999,999.9Hz	56MHz	4.0MHz-2,000,000.1Hz	52.0MHz-53,999,999.9Hz
4.0MHz- 5,999,999.9Hz	58MHz	4.0MHz-2,000,000.1Hz	54.0MHz-55,999,999.9Hz
6.0MHz- 7,999,999.9Hz	60MHz	4.0MHz-2,000,000.1Hz	56.0MHz-57,999,999.9Hz
8.0MHz- 9,999,999.9Hz	62MHz	4.0MHz-2,000,000.1Hz	58.0MHz-59,999,999.9Hz
10.0MHz-11,999,999.9Hz	64MHz	4.0MHz-2,000,000.1Hz	60.0MHz-61,999,999.9Hz
12.0MHz-13,999,999.9Hz	66MHz	4.0MHz-2,000,000.1Hz	62.0MHz-63,999,999.9Hz
14.0MHz-15,999,999.9Hz	68MHz	4.0MHz-2,000,000.1Hz	64.0MHz-65,999,999.9Hz
16.0MHz-17,999,999.9Hz	70MHz	4.0MHz-2,000,000.1Hz	66.0MHz-67,999,999.9Hz
18.0MHz-19,999,999.9Hz	72MHz	4.0MHz-2,000,000.1Hz	68.0MHz-69,999,999.9Hz
20.0MHz-21,999,999.9Hz	74MHz	4.0MHz-2,000,000.1Hz	70.0MHz-71,999,999.9Hz
22.0MHz-23,999,999.9Hz	76MHz	4.0MHz-2,000,000.1Hz	72.0MHz-73,999,999.9Hz
24.0MHz-25,999,999.9Hz	78MHz	4.0MHz-2,000,000.1Hz	74.0MHz-75,999,999.9Hz
26.0MHz-27,999,999.9Hz	80MHz	4.0MHz-2,000,000.1Hz	76.0MHz-77,999,999.9Hz
28.0MHz-29,999,999.9Hz	82MHz	4.0MHz-2,000,000.1Hz	78.0MHz-79,999,999.9Hz
30.0MHz-31,999,999.9Hz	84MHz	4.0MHz-2,000,000.1Hz	80.0MHz-81,999,999.9Hz
32.0MHz-32,500,000.0Hz	86MHz	4.0MHz-3,500,000.0Hz	82.0MHz-82,500,000.0Hz

NOTES: 1. These frequencies are valid for LO DIST and LO NOISE modes only.

NOTE

In measurement modes other than LO DIST and LO NOISE, some frequency shift may normally occur between what the front panel tuned frequency indicates and what the First Local Oscillator frequency should be. See table shown below for measurement mode frequencies.

Measurement Mode Selection	Entry Frequency	Channel	Tracking Output Frequency #
LO DIST, LO NOISE, WIDEBAND	•	•	1,000,000Hz
NOISE/DEMOD, NOISE/TONE, PHASE JITTER, IMPULSE	CARRIER	∧	1,001,850Hz
	CARRIER	∨	998,150Hz
	TONE	∨	999,154Hz
	TONE	∧	1,000,846Hz
TONE 1004Hz (TONE 800Hz) #	TONE	•	1,000,000Hz
	CARRIER	∨	998,996Hz
	CARRIER	∧	1,001,004Hz
CARRIER	CARRIER	•	1,000,000Hz
	TONE	∨	1,001,004Hz
	TONE	∧	998,996Hz
SIGNAL 2600Hz (1010Hz) #	TONE	∧	1,001,596Hz
	TONE	∨	998,404Hz
	CARRIER	∨	997,400Hz
	CARRIER	∧	1,002,600Hz

NOTES: 1 All readings taken with front panel tuned frequency = 1,000,000Hz.
2. • Selection has no effect on T. O. frequency.

2-30. FRACTIONAL N LOOP TEST.

DESCRIPTION

This test is used to isolate a malfunction in the fractional N loop to defective circuit card assembly A30, A31, or A32.

1. Remove A30 Fractional N+N Assembly (para 2-82) and reinstall on an extender board.
2. Remove A31 Fractional N Voltage-Controller Oscillator Assembly (para 2-83) and reinstall on an extender board.
3. Short test point A31TP3 to ground (fig. FO-14). Connect Frequency Counter to test point A31TP1.
4. Verify a Frequency Counter indication of about 40MHz. If it does not exist
   - Replace A31 Fractional N Voltage-Controller Oscillator Assembly (para 2-83).
   - Verify malfunction is corrected. If not, Adjust A40 50MHz Reference Frequency (para 2-46) and A31/A32 Fractional N Loop (para 2-47).

2-30. FRACTIONAL N LOOP TEST—Continued.

5. Connect Frequency Counter to connector A30TP1 (fig. FO-13).

6. Verify Frequency Counter indicates about 40MHz. If it does, tune Level Meter to 2MHz and use an Oscilloscope to check test point A30TP3 for a 100kHz, very narrow pulse signal at about 2V peak-to-peak.

- If 100kHz pulse is missing at test point A30TP3, replace A30 Fractional N+N Assembly (para 2-82).

7. Install A30 Fractional N+N Assembly (para 2-82).

8. Install A31 Fractional N Voltage Controlled Oscillator Assembly (para 2-83).

9. Remove A32 Fractional N Phase Detector Assembly (para 2-84) and reinstall on an extender board.

10. Verify two 100kHz input signals at test points A32TP3 and A32TP4 (fig. FO-15),

- If signal at test point A32TP3 is missing, perform A40 Frequency Reference Test (para 2-31) for 100kHz output.

11. Use an Oscilloscope to check signal at test point A31TP3. DC level should be from 0V If incorrect,

- Replace A32 Fractional N Phase Detector Assembly (para 2-84).
- Verify malfunction is corrected. If not, Adjust A40 50MHz Reference Frequency (para 2-46) and A31/A32 Fractional N Loop (para 2-47).

12. Remove short from test point A31TP3.

13. Install A32 Fractional N Phase Detector Assembly (para 2-84).

2-31. A40 FREQUENCY REFERENCE TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A40 Frequency Reference Assembly.

1. Remove A40 Frequency Reference Assembly (para 2-85) and reinstall on an extender board.

2. Verify that BNC to BNC adapter is in place on rear panel of Level Meter.

3. Short test point A40TP6 to ground (fig. FO-16). Connect an Oscilloscope to U92 pin 13 and verify 50MHz.

- If frequency incorrect, troubleshoot Q90 and Q91 circuits. If Q90 and Q91 are functioning correctly, troubleshoot CR91, CR90, Y90, and U92 circuits.
- If frequency correct, proceed with step 4.

4. Remove short from test point A40TP6. If 50MHz is now incorrect or missing, verify external reference signal is 10MHZ.

- If external reference signal is incorrect, perform A16 10MHz Frequency Reference Test (para 2-23).
- If external reference frequency is correct, troubleshoot Q50, Q51, CR50, CR51, CR52, CR53, U1, and U2 circuits.

2-31. A40 FREQUENCY REFERENCE TEST—Continued.

5. Verify 10MHz external reference signal is present at CR50 thru CR53 If correct, check collector of Q52 for 10MHz signal.

   - If signal incorrect or missing at Q52, ground test point A40TP6 and troubleshoot U53, U52, U51, and Q52 circuits.
   - If 10MHz is correct at Q52, troubleshoot Q55 and Q56, then U54 and U55, and then CR54 and CR55.

6. Troubleshoot all other malfunctions using fig. FO-16.

7. Install A40 Frequency Reference Assembly (para 2-85).

8. Verify malfunction is corrected, If not,

   - Adjust A40 50MHz Reference Frequency (para 2-46).

2-32. A50 STEP LOOP TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A50 Step Loop Assembly.

1. Remove A50 Step Loop Assembly (para 2-86) and reinstall on an extender board.

2. Move switch A50S1 (fig. FO-17) to TEST.

3. Connect red cable from A40J1 (fig, FO-16) to A50J2.

4. Connect Frequency Counter input to Level Meter EXT REF input (rear panel).

5. Apply power to Level Meter. Verify Frequency Counter indicates from 53.9 to 54. 1MHz.

   - If incorrect, proceed with step 6.
   - If correct proceed with step 8.

6. Connect Frequency Counter to connector A50J1. Verify Frequency Counter indicates from 53.9 to 54.1MHz.

   - If correct, troubleshoot Q3 and Q4 circuit.
   - If incorrect, troubleshoot voltage-controlled oscillator and buffer Q7 and Q8 circuit.

7. If loop locks up at some tuned frequencies but not others, connect DC power source to test point A50TP1. Connect frequency counter to A50J1. Vary DC voltage from +8V to –8V and verify a Frequency Counter reading from 52 to 86MHZ.

   - If frequency is incorrect troubleshoot voltage-controlled oscillator circuit.
   - If frequency is correct, proceed with step 8.

2-32. A50 STEP LOOP TEST—Continued.

CAUTION

Do not let the current from the DC power source get too high while driving the voltage-controlled oscillator or other components. Equipment damage may occur.

8. Connect an Oscilloscope to U70 pin 14 and verify that 54MHz is getting to counters. Connect Frequency Counter to U74 pin 6.

9. Use tuned frequency values from table shown below to select a specific divide-by-N number for counters. If code from A60 Controller Assembly for that number (N) is correct and counters are working, verify frequency at U74 pin 6 is within corresponding range shown in table.

10. If frequency at U74 pin 6 is incorrect for any divide-by-N number, use table shown below to verify A60 Controller Assembly input codes for that N number.

- If code is correct, troubleshoot U71 and U72 circuits.
- If code is incorrect, proceed with step 11.

Front Panel Tuned Frequency	÷ N Number	Frequency Range Allowable at U74(6)*
1MHz	27	1.996 - 2.004MHz
3MHz	28	1.925 - 1.933MHz
5MHz	29	1.858 - 1.866MHz
7MHz	30	1.796 - 1.804MHz
9MHz	31	1.738 - 1.746MHz
11MHz	32	1.684 - 1.691MHz
13MHz	33	1.633 - 1.640MHz
15MHz	34	1.585 - 1.592MHz
17MHz	35	1.540 - 1.546MHz
19MHz	36	1.497 - 1.503MHz
21MHz	37	1.456 - 1.463MHz
23MHz	38	1.418 - 1.424MHz
25MHz	39	1.382 - 1.388MHz
27MHz	40	1.347 - 1.353MHz
29MHz	41	1.314 - 1.320MHz
31MHz	42	1.283 - 1.289MHz
32MHz	43	1.253 - 1.259MHz

Notes: 1. *Assumes Step VCO is within its allowable adjustment range of 53.9MHz - 54.1MHz

2-32. A50 STEP LOOP TEST—Continued.

11. Remove A60 Controller Assembly (para 2-90). Ground connector XA50 contact B 14 and reapply power.

Front Panel Tuned Frequency	A50 Stop Loop Assy F20 (11)	F10 (12)	F8 (16)	F4 (15)	F2 (14)	F1 (13)*	Step VCO Frequency #	+ N Number
0 Hz - 1,999,999.9Hz	1	0	0	1	0	1	54MHz	27
2.0MHz - 3,999,999.9Hz	1	0	0	1	0	0	56MHz	28
4.0MHz - 5,999,999.9Hz	1	0	0	0	1	1	58MHz	29
6.0MHz - 7,999,999.9Hz	1	0	0	0	1	0	60MHz	30
8.0MHz - 9,999,999.9Hz	1	0	0	0	0	1	62MHz	31
10.0MHz - 11,999,999.9Hz	0	1	0	0	0	0	64MHz	32
12.0MHz - 13,999,999.9Hz	0	1	1	1	1	1	66MHz	33
14.0MHz - 15,999,999.9Hz	0	1	1	1	1	0	68MHz	34
16.0MHz - 17,999,999.9Hz	0	1	1	1	0	1	70MHz	35
18.0MHz - 19,999,999.9Hz	0	1	1	1	0	0	72MHz	36
20.0MHz - 21,999,999.9Hz	0	1	1	0	1	1	74MHz	37
22.0MHz - 23,999,999.9Hz	0	1	1	0	1	0	76MHz	38
24.0MHz - 25,999,999.9Hz	0	1	1	0	0	1	78MHz	39
26.0MHz - 27,999,999.9Hz	0	1	1	0	0	0	80MHz	40
28.0MHz - 29,999,999.9Hz	0	1	0	1	1	1	82MHz	41
30.0MHz - 31,999,999.9Hz	0	1	0	1	1	0	84MHz	42
32.0MHz - 32.5MHz	0	1	0	1	0	1	86MHz	43

Notes: 1. *Pin numbers (11) - (16) are on resistor pack RP74.
2. 0 = +2.6 VDC, 1 = +5.0 VDC.
3. # Under certain conditions, the Step VCO can be 52MHz (100110).

12. Verify divide-by-N code appears to be 011111 (N=33).

- If U74 pin 6 is now 1.623 to 1.640MHz (from table above), perform A60 Controller Test (para 2-34).
- If counter is still not dividing correctly with A60 Controller Assembly removed and a synthetic code provided, replace U71 and U72.

13. Install A60 Controller Assembly (para 2-90).

14. Troubleshoot phase detector, switching amplifiers, and current sources using fig. FO-17.

15. Move switch A50S1 to NORMAL.

16. Install A50 Step Loop Assembly (para 2-86).

17. Return red cable to normal position (fig. 2-2).

18. Verify malfunction is corrected. If not,

- Adjust A40 50MHz Reference Frequency (para 2-46).
- Adjust A31/A32 Fractional N Loop (para 2-47).
- Adjust A50/A51/A53 Step and Summation Loop (para 2-48).

2-33. SUMMATION LOOP TEST.

DESCRIPTION

This test is used to isolate a malfunction in the summation loop to defective circuit card assembly A51, A52, and/or A53.

1. Remove A51 Summation Loop Voltage-Controlled Oscillator Assembly (para 2-87) and reinstall on an extender board.
2. Remove A52 Summation Loop Mixer Assembly (para 2-88) and reinstall on an extender board.
3. Remove A53 Summation Loop Phase Detector Assembly (para 2-89) and reinstall on an extender board.
4. Move switch A51S1 to TEST (fig. FO-18). When A51S1 in test position, Level Meter will display E3.2.
5. Connect a Frequency Counter to connectors A51J1, A51J2, and A51J3. Verify a frequency of 51.9 to 52. 1MHz.
   - If incorrect, proceed with step 6.
   - If correct, proceed with step 7.
6. Measure voltage at test point A51TP1. Verify voltage is about +7.5V. If correct,
   - Replace A51 Summation Loop Voltage-Controlled Oscillator Assembly (para 2-87).
   - Verify malfunction is corrected. If not, Adjust A40 50MHz Reference Frequency (para 2-46), A31/A32 Fractional N Loop (para 2-47), and A50/A51/A53 Step and Summation Loop (para 2-48).
7. With tuned frequency at 1MHz, verify input at connector A52J1 (fig. FO-19) is 54 MHz and input at connector A52J2 is about 52MHz. If these signals are correct, verify output at connector XA52 contact A12 is about 2MHz.
   - If output is incorrect, replace A52 Summation Loop Mixer Assembly (para 2-88).
   - If output is correct, change Level Meter tuned frequency to 1,999,999Hz.
8. Verify that frequency at connector A.53J1 (fig. FO-20) is 2,000,001” Hz and output at connector XA53 contact B12 is about 2MHz. If correct,
   - Replace A53 Summation Loop Phase Detector Assembly (para 2-89).
   - Verify malfunction is corrected. If not, Adjust A40 50MHz Reference Frequency (para 2-46), A31/A32 Fractional N Loop (para 2-47), and A50/A51/A53 Step and Summation Loop (para 2-48).
9. Move switch A51S1 to NORMAL.
10. Install A51 Summation Loop Voltage-Controlled Oscillator Assembly (para 2-87).
11. Install A52 Summation Loop Mixer Assembly (para 2-88).
12. Install A53 Summation Loop Phase Detector Assembly (para 2-89).

2-34. A60 CONTROLLER TEST.

DESCRIPTION

This test is used to isolate a malfunction in A60 Controller Assembly.

1. Remove A60 Controller Assembly (para 2-90) and reinstall on an extender board.

CAUTION

The A60 Controller Assembly contains CMOS devices (U28 and U29) which are extremely susceptible to static electricity damage. Refer to page d.

2. Verify switches A60S1 and A60S2 (fig. FO-21) are set as follows:

A60S1 Normal Operating Positions

Contact	CLOSED (UP)	OPEN (DOWN)
1		XXXX
2	NOT USED	NOT USED
3	NOT USED	NOT USED
4		XXXX
5		XXXX

A60S2 Normal Operating Positions

Contact	CLOSED	OPEN
1		XXXX
2		XXXX
3	XXXX	
4		XXXX
5	XXXX	
6	XXXX	
7	XXXX	
8		XXXX

3. If possible, perform Diagnostic Test 14 (para 2-11). Replace microcircuits as directed. If Diagnostic Test 14 cannot be performed, proceed with microprocessor kernel test below.

4. Troubleshoot A60 Controller Assembly using troubleshooting tests shown below and fig. FO-21.

5. Install A60 Controller Assembly (para 2-90).

MICROPROCESSOR KERNEL TEST.

1. Remove A60J1 (DIP short) and A60U13 from their sockets.

2. Place A60S1 (5) in up (closed) position and A60S1 (1-4) in down (open) position.

2-34. A60 CONTROLLER TEST—Continued.

3. Connect Digital Circuit Tester control leads as follows:

Clock	U5(7)	Falling edge
start	U2(9)	Rising edge
stop	U2(12)	Falling edge

4. Verify that +5V signature is 0001 and ground signature is 0000.

- If not, recheck connections, then use an Oscilloscope to check for clock signals at U2 pins 9 and 12 and U5 pin 7.
- If correct, proceed with step 6.

5. If signal at U5 pin 7 is missing, check U5 pin 3 for 3.8MHz basic hardware clock. If missing, replace U4. If present, replace U5. If signal at U2 pins 9 and 12 is missing but clocks at U6 pins 3, 36, and 37 are present, replace U6.

6. Check signatures on pins of U6 and U24 according to table shown below.

- If any of signatures are bad, check +5V supply and clock U5 first, then replace suspected microcircuit. If replacing microcircuit doesn't correct problem, check for opens or shorts on affected lines. Check also for two lines shorted together.
- If microprocessor (U6) signatures and ROM Select (U24) signatures are good, microprocessor kernel testis complete and microprocessor is probably good.

0000	1	40	0001	
0001	2	39	0000	
•0000	3	38	0000	
0001	4	37	0000•	
0001	5	36	0001•	
0001	6	35	0000	
0000	7	34	0001	
0001	8	33	0001	
5555	9	32	0001	
CCCC	10 U6	31	0001	
7F7F	11	30	0001	
5H21	12	29	0001	
OAFA	13	28	0000	
UPFH	14	27	0001	
52F8	15	26	0000	
HC89	16	25	0001•	
2H70	17	24	755U	
HPPO	18	23	3827	
1293	19	22	3C96	
HAP7	20	21	0000	

3C96	1	16	0001	
3827	2	15	4POA	
755U	3	14	12U3	
0000	4 U24	13	PC01	
0000	5	12	F2A6	
0001	6	11	6H49	
P255	7	10	0996	
0000	8	9	U3H5	

0000 = Ground
0001 = +5V

Notes:
• = Probe is pulsing on +5V or ground signature.

2-34. A60 CONTROLLER TEST—Continued.

ROM (U7-U12) TEST.

1. Connect Digital Circuit Tester control leads as shown below, then check ROM signatures. Note change in edge trigger for START and STOP.

Clock	U5(7)	Falling edge
start	(table below)	Falling edge
stop	(table below)	Rising edge

Note: The START/STOP connections are always together but at a different location for each ROM, as indicated.

ROM U7

Start/Stop - U24(7)

+5V = P254

GND = 0000

9241	1		24	P254
8AUC	2		23	1U5P
65CA	3		22	AAHU
46HC	4		21	P254
C7A5	5		20	0000*
12UO	6	U7	19	U665
3HUA	7		18	826P
FA11	8		17	0580
6495	9		16	7495
7920	10		15	A6CP
3H4A	11		14	P29U
0000	12		13	5938

ROM U10

Start/Stop - U24(11)

9241	1		24	P254
8AUC	2		23	1U5P
65CA	3		22	AAHU
46HC	4		21	P254
C7A5	5		20	0000*
12UO	6	U10	19	U665
3HUA	7		18	826P
FA11	8		17	066C
8U69	9		16	8C18
9UFA	10		15	2713
7C3H	11		14	451F
0000	12		13	7U19

ROM U8

Start/Stop - U24(9)

9241	1		24	P254
8AUC	2		23	1U5P
65CA	3		22	AAHU
46HC	4		21	P254
C7A5	5		20	0000*
12UO	6	U8	19	U665
3HUA	7		18	826P
FA11	8		17	3H7H
CA53	9		16	F6UO
55AH	10		15	96F1
51F7	11		14	PH33
0000	12		13	736U

ROM U11

Start/Stop - U24(12)

9241	1		24	P254
8AUC	2		23	1U5P
65CA	3		22	AAHU
46HC	4		21	P254
C7A5	5		20	0000*
12UO	6	U11	19	U665
3HUA	7		18	826P
FA11	8		17	C878
F447	9		16	6U12
C397	10		15	F592
7875	11		14	9CFO
0000	12		13	F7AP

ROM U9

Start/Stop - U24(10)

9241	1		24	P254
8AUC	2		23	1U5P
65CA	3		22	AAHU
46HC	4		21	P254
C7A5	5		20	0000*
12UO	6	U9	19	U665
3HUA	7		18	826P
FA11	8		17	F114
AAOH	9		16	A15F
3U12	10		15	3PC6
7910	11		14	0213
0000	12		13	2511

ROM U12

Start/Stop - U24(13)

9241	1		24	P254
8AUC	2		23	1U5P
65CA	3		22	AAHU
46HC	4		21	P254
C7A5	5		20	0000*
12UO	6	U12	19	U665
3HUA	7		18	826P
FA11	8		17	AC87
FH6A	9		16	AC7C
71AO	10		15	1F6H
8885	11		14	7C57
0000	12		13	AAH5

Notes: 1.* = probe is pulsing on ground signature.

2-34. A60 CONTROLLER TEST—Continued.

2. Check ROM's until at least one is found with correct signatures.

- If none of ROM's are good, problem is likely data bus. Check each bus line for a stuck O or 1, or two lines shorted together.

- If ROM's themselves are good, reinstall A60U13 and place A60S1(5) in down (open) position.

3. Connect Digital Circuit Tester control leads as shown below. Note edge change.

Clock	U5(7)	Falling edge
start	TP4	Rising edge
stop	TP4	Falling edge

4. Cycle Level Meter POWER switch. Close A60S1(1); then open it. Close A60S1(4); then open it.

5. Check +5V signature. It should be 494P.

- If correct, proceed with step 7.

- If incorrect, proceed with step 6.

6. Check signatures on U2, U3, U4 and U13 using table shown below,

- If good, replace U25 first and U26 next.

- If bad, replace indicated microcircuit. If still bad, check associated line for shorts, opens, or two pins shorted together.

7. Check signatures on U13 pins 3, 5, 7, 9, 11, 13, 15, and 17 using table below.

- If bad, replace U13.

- If good, proceed with step 8.

*494P	1	14	494P	
*0000	2	13	494P	
------	3	12	494P*	
0000	4	11	------	U2
A710	5	10	494P*	
494P	6	9	494P*	
0000	7	8	0000*	

494P	1	14	494P	
0000	2	13	494P	
*0000	3	12	------	U3
*0000	4	11	494P	
*494P	5	10	494P	
*0000	6	9	0000	
0000	7	8	494P	

494P	1	14	494P	
0000	2	13	0000*	
494P	3	12	494P*	
0000	4	11	494P*	U4
*0000	5	10	0000*	
*494P	6	9	494P*	
0000	7	8	0000*	

*0000	1	20	494P	
6FFO	2	19	0000*	
6FFO	3	18	A5HH	
76F6	4	17	A5HH	
76F6	5	16	28C4	U13
942F	6	15	28C4	
942F	7	14	4F1P	
4986	8	13	4F1P	
4986	9	12	C2F8	
0000	10	11	C2F8	

Notes:
+ 5V = 494P.
* = Probe is pulsing on + 5V or ground signature.

2-34. A60 CONTROLLER TEST—Continued.

8. Check signatures at U6 pins 26 thru 33 and J1 pins 9 thru 16 to verify traces on printed wiring board are good. If data bus signatures are good with ROM's reconnected through U 13, connect remainder of data bus microcircuits back to bus by reinstalling DIP short in A60J1. Record present settings and open all contacts of A60S2.

9. Cycle Level Meter POWER switch. Close A60S1(1); then open it. Close A60S1(4); then open it.

10. Recheck signatures on U13 pins 3, 5, 7, 9, 11, 13, 15, and 17.

- If any of signatures are now bad, problem is on other side of J1. Pull U18 out of its socket. If line is still bad, find line designator in table shown below and replace indicated microcircuits one at a time, in order listed, until bad microcircuit is found.
- If good, proceed with step 11.

Pin No.	Data Line	Suspect IC's
U13(9)	D0	U39, U29, U16
U13(7)	D1	U40, U29, U16
U13(5)	D2	U41, U29, U16
U13(3)	D3	U42, U29, U16
U13(11)	D4	U38, U28, U14
U13(13)	D5	U38, U28, U14
U13(15)	D6	U36, U28, U14
U13(17)	D7	U36, U28, U14

Notes: 1. Use caution in handling replacement IC's for U28 and U29 as these chips are especially sensitive to static electricity damage.

11. Close contacts 5 thru 8 on A60S2. Check +5V signature. It should be IC4C.

- If not first replace U27, then U36, and then U38.

2-34. A60 CONTROLLER TEST—Continued.

NMOS RAM (U14 and U16) TEST.

1. Connect Digital Circuit Tester control leads as follows.

Clock	U5(7)	Falling edge
start	TP4	Rising edge
stop	TP4	Falling edge

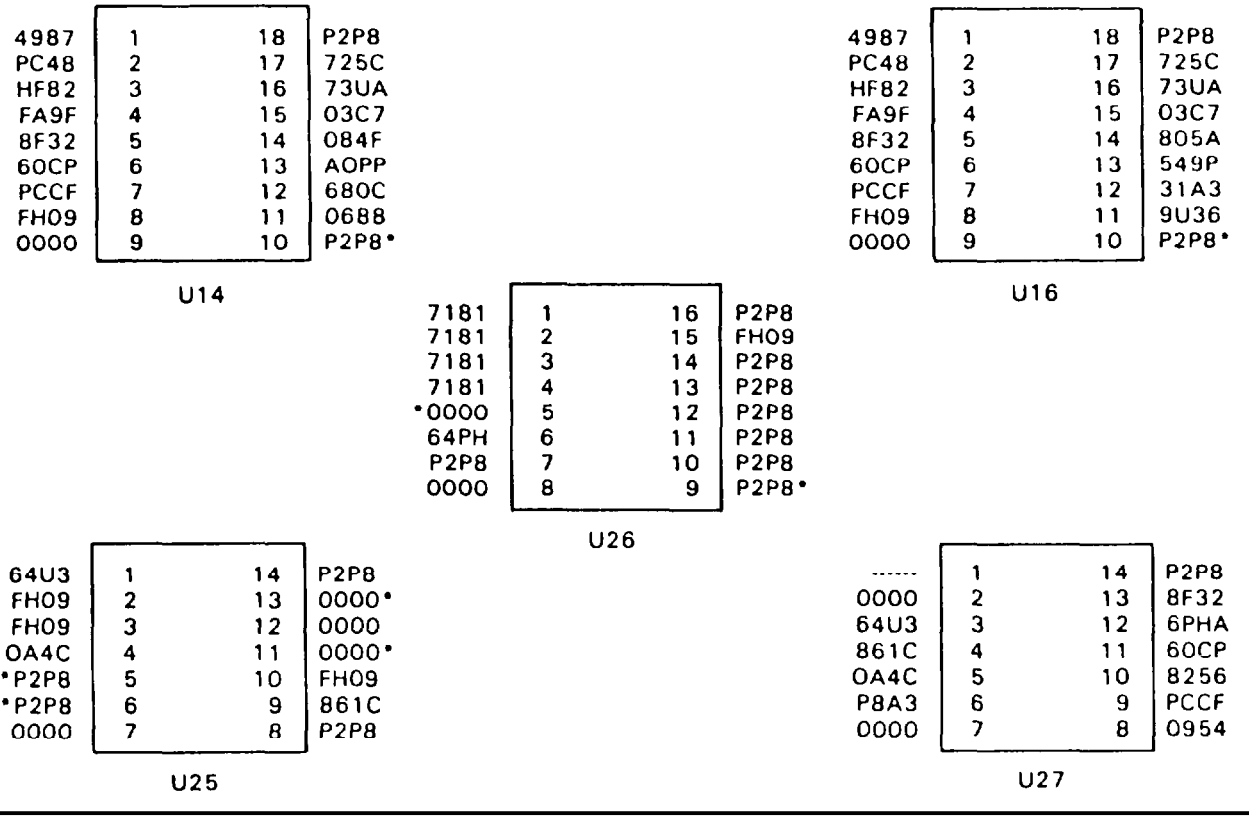
2. Set all contacts on A60S1 to down (open) position. Set A60S2 contacts 5 thru 8 as shown below.

CONTACT	CLOSED	OPEN
5		XXXX
6	XXXX	
7	XXXX	
8	XXXX	

3. Cycle Level Meter POWER switch. Close A60S1(1); then open it. Close A60S1(4) and then open it.

4. Check +5V signature. It should be P2P8.

- If not, check signatures on U14, U16, U25, U26, and U27 using table below. If any signatures are bad, replace associated microcircuit. If still bad, check for shorts or opens on affected line(s).



Notes: 1.* = Probe is pulsing on + 5V or ground signature.

2-34. A60 CONTROLLER TEST—Continued.

CMOS RAM (U28 and U29) TEST.

CAUTION

The CMOS RAM's (A60U28 and LJ29) are extremely susceptible to static eletricity damage. Use grounded tools and wrist straps when handling loose components or working in vicinity of in circuit components.

1. Connect Digital Circuit Tester control leads as show below.

Clock	U5(7)	Falling edge
start	TP4	Rising edge
stop	TP4	Falling edge

2. Set all contacts on A60S1 to down (open) position. Set A60S2 contacts 5 thru 8 as shown below.

CONTACT	CLOSED	OPEN
5	XXXX	
6		XXXX
7	XXXX	
8	XXXX	

3. Cycle Level Meter POWER switch. Close A60S1(1); then open it. Close A60S1(14); then open it.

4. Check +5V signature. It should be 61U0.

- If not, check signatures on U28 and U29 using table below. If any signatures are bad, replace associated microcircuit. If still bad, check for shorts or opens on affected lines.

5UCA	1	18	61UO
40AP	2	17	589P
778U	3	16	55A5
794U	4	15	0000
C46C	5	14	77CF
UH57	6	13	31FF
AP9P	7	12	OF46
0000	8	11	1441
32C8	9	10	32C8

5UCA	1	18	61UO
40AP	2	17	589P
778U	3	16	55A5
794U	4	15	0000
C46C	5	14	9728
UH57	6	13	6549
AP9P	7	12	754H
0000	8	11	7U90
32C8	9	10	32C8

2-34, A60 CONTROLLER TEST—Continued.

P1A (UH8) TEST.

1. Connect Digital Circuit Tester control leads as shown below.

Clock	U5(7)	Falling edge
start	TP4	Rising edge
stop	TP4	Falling edge

2. Set all contacts on A60S1 to down (open) position. Set A60S2 contacts 5 thru 8 as shown below.

CONTACT	CLOSED	OPEN
5		X X X X
6		X X X X
7	X X X X	
8	X X X X	

3. Cycle Level Meter POWER switch. Close A60S1(1); then open it. Close A60S1(4) and then open it.

4. Check +5V signature. It should be 484F.

- If not, check signatures on U1, U18, U21, U22, U30, U31, U32, and U35 using table below. If any signatures are bad, replace associated microcircuit. If still bad, check for shorts or opens on affected line(s).

0000	1		20	484F	0000	1		40	(unstable)	484F	1		20	484F
74U4	2		19	0000	1UFC	2		39	484F	CU55	2		19	1426
74U4	3		18	403P	7505	3		38	0000	4P2C	3		18	851U
4P2C	4		17	403P	1A94	4		37	0000	3486	4		17	1A94
4P2C	5	U1	16	3486	851U	5		36	2U3F	3808	5	U21	16	3CUU
1A94	6		15	3486	4P2C	6		35	2906	7HF7	6		15	2PC9
1A94	7		14	851U	3486	7		34	484F	74U4	7		14	7505
1UFC	8		13	851U	74U4	8		33	4373	403P	8		13	1UFC
1UFC	9		12	7505	403P	9	U18	32	2P61	H4U3	9		12	29P4
0000	10		11	7505	F814	10		31	P2U5	0000	10		11	PAC5
					692P	11	PIA	30	635P					
					2H39	12		29	9A2P					
484F	1		20	484F	50C2	13		28	U2F4	F814	1		16	484F
FP70	2		19	C795	H710	14		27	541U	692P	2		15	PH8A
4P2C	3		18	851U	HH2F	15		26	A9C6	2H39	3		14	3F67
3486	4		17	1A94	F730	16		25	484F•	0000	4	U30	13	6UF3
3338	5	U22	16	PFA7	51CO	17		24	484F•	P3AP	5		12	31U7
CC8F	6		15	9959	(unstable)	18		23	P700	50C2	6		11	5CH3
74U4	7		14	7505	P3AP	19		22	484F•	7P03	7		10	P373
403P	8		13	1UFC	484F	20		21	P700	0000	8		9	6001
8AH7	9		12	UCAC										
0000	10		11	9F64										
F814	1		16	484F	6UF3	1		14	484F	1UFC	1		14	484F
692P	2		15	UC73	278U	2		13	1429	29P4	2		13	29P4
2H39	3		14	9F64	278U	3	U32	12	5F65	FUFU	3	U35	12	851U
50C2	4	U31	13	C3A8	6UF3	4		11	1F3H	7505	4		11	6U36
P3AP	5		12	1429	.....	5		10	5471	29P4	5		10	29P4
484F	6		11	1F3H	0000	6		9	98HA	09H4	6		9	1A94
PAC5	7		10	98HA	0000	7		8	HO96	0000	7		8	CH62
0000	8		9	2F5H										

Notes: Allow time for signatures to stabilize (at least 3 seconds).

● = probe is pulsing on + 5V or ground signature.

2-34. A60 CONTROLLER TEST—Continued.

SHIFT REGISTER (U19) TEST.

1. Remove A1 Input Multiplexer Assembly (para 2-71) and A2 Input Amplifier Assembly (para 2-72).

2. Connect Digital Circuit Tester control leads as shown below.

Clock	U5(7)	Falling edge
start	TP4	Rising edge
stop	TP4	Falling edge

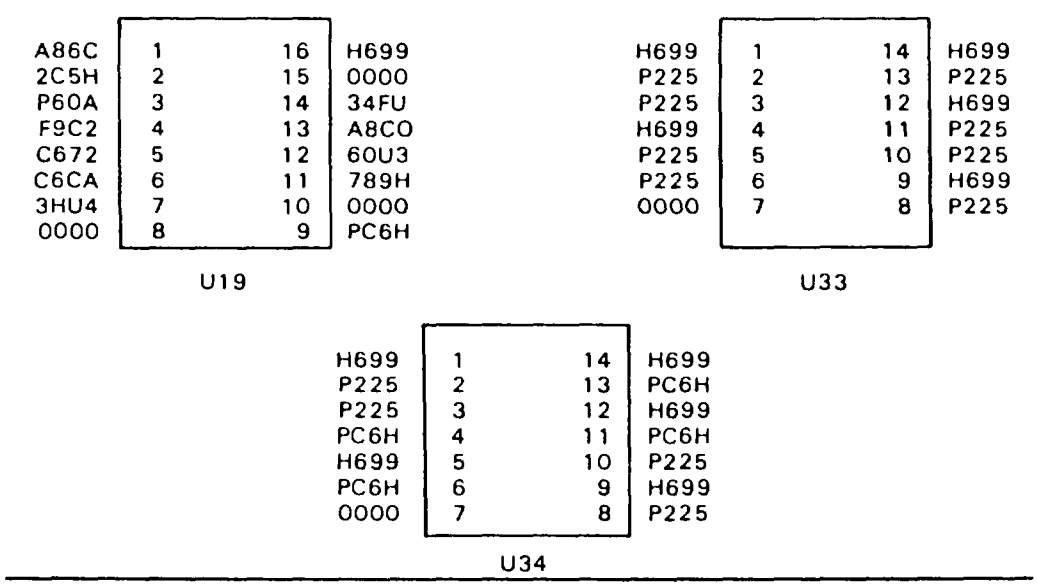
3. Set all contacts on A60S1 to down (open) position. Set A60S2 contacts 5 thru 8 as shown below.

CONTACT	CLOSED	OPEN
5	XXXX	
6	XXXX	X X X X
7		
8	XXXX	

4. Cycle Level Meter POWER switch. Close A60S1(1) then open it. Close A60SI(14) then open it.

5. Check +5V signature. It should be H699.

- If not, check signatures on U19, U33 and U34 using table below. If any signatures are bad, replace associated microcircuit. If still bad, check for shorts or opens on affected lines.



Notes:

+ 5V signature is H699.

6. Install Al Input Multiplexer Assembly (para 2-71) and A2 Input Amplifier Assembly (para 2-72).

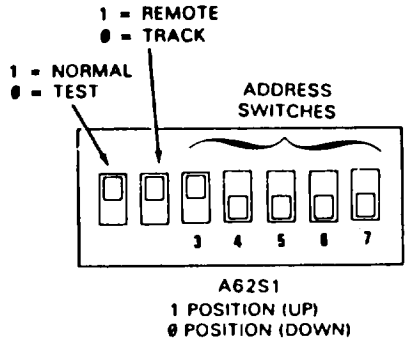
7. Reset A60S1 and A60S2 switch positions to normal.

2-35. A61/A62 HP INTERFACE TEST.

DESCRIPTION

This test is used to verify correct settings on the A61 and A62 HP Interface Assemblies.

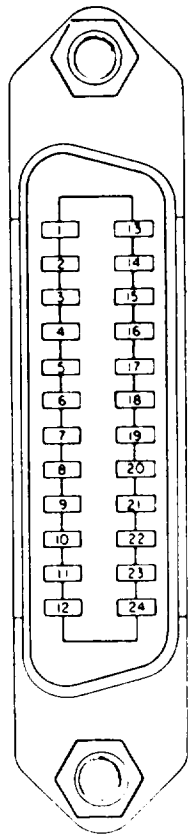
1. Verify proper switch A62S1 (fig. FO-22) settings as shown below.



Switch Contact	Address Value	Contact Position	Circuit Application
3	16	1 (up)	open = +5v = HIGH
4	8	0 (down)	closed =GRD = LOW
5	4	0 (down)	closed =GRD = LOW
6	2	0 (down)	closed = GRD = LOW
7	1	0 (down)	closed = GRD = LOW

2. Verify proper cabling as shown below.

PIN	LINE	
1	DI01	
2	DI02	
3	DI03	
4	DI04	
13	DI05	
14	DI06	
15	DI07	
16	DI08	
5	EOI	
17	REN	
6	DAV	
7	NRFD	
8	NDAC	
9	IFC	
10	SRQ	
11	ATN	
12	SHIELD-CHASSIS GROUND	
18	P/O TWISTED PAIR WITH PIN 6	THESE PINS ARE INTERNALLY GROUNDED
19	P/O TWISTED PAIR WITH PIN 7	
20	P/O TWISTED PAIR WITH PIN 8	
21	P/O TWISTED PAIR WITH PIN 9	
22	P/O TWISTED PAIR WITH PIN 10	
23	P/O TWISTED PAIR WITH PIN 11	
24	ISOLATED DIGITAL GROUND	



3. Verify total system cable length does not exceed 65 feet (20 meters).

4. Troubleshoot A61 and A62 HP Interface Assemblies using fig. FO-22.

5. Replace A61 HP Interface Bus Assembly (para 2-91) or A62 HP Interface Bus Assembly (para 2-92).

2-36. A70 IMPAIRMENTS B TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A70 Impairments B Assembly.

1. Troubleshoot A70 Impairments B Assembly using fig, FO-23 and additional test information provided below.
2. Remove A70 Impairments B Assembly (para 2-93) and reinstall on an extender board.
3, Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Set Synthesizer/Level Generator output to 1MHz at 0dBm. Connect Level Meter 10MHZ output (rear panel) to Synthesizer/Level Generator REF input (rear panel). On Level Meter, select ENTRY 100, set full scale to 0dBm, and select 75 Ω input.
4. Install A70 Impairments B Assembly (para 2-93).
5. Verify malfunction is corrected. If not,
   - Adjust A70 Impairments (para 2-64).
6. Use additional troubleshooting tests shown below as needed for repair of A70 Impairments B Assembly.

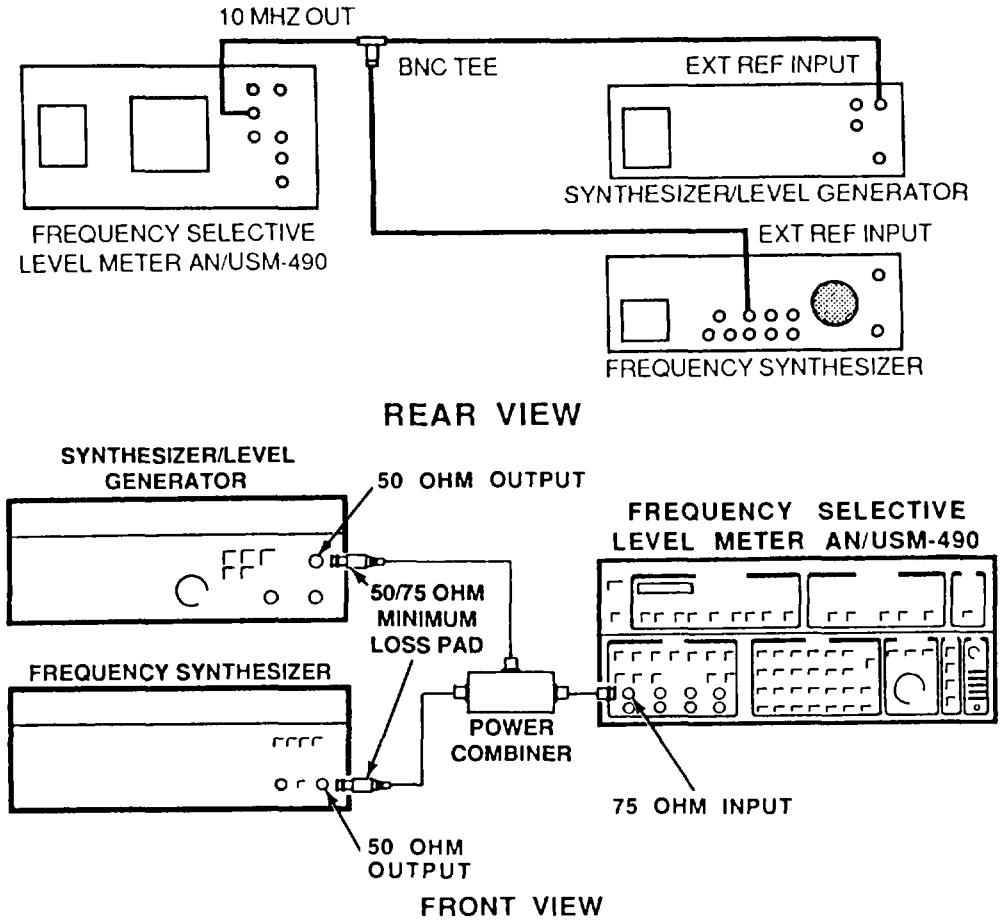
RESIDUAL PHASE JITTER TROUBLESHOOTING

1. On Level Meter press RECALL then number 0 push button. Select ENTRY 100 and set full scale to 0dBm. Select 0 jitter mode and 75 Ω input.
2. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Connect Level Meter 10 MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).
3. Set Synthesizer/Level Generator to 1.001MHz at 0dBm.
4. Using an Oscilloscope, verify test point A70TP8 has a 1000Hz signal at 2.2V peak-to-peak. Verify residual phase jitter displayed on front panel is less than 0.5" peak-to-peak.
   - If it is greater than 0.5° peak-to-peak, use an Oscilloscope to check waveforms at test points TP8, TP9, TP10, and TP11. If waveforms are correct, use a Digital Multimeter to check U29 pin 3 for 0Vrms. If U29 pin 3 is good, check U30 pin 1 for 0Vdc. If U30 pin 1 is good, perform A22 Analog-Digital Converter Test (para 2-27).

2-36. A70 IMPAIRMENTS B TEST—Continued,

PHASE JITTER TROUBLESHOOTING.

1. Connect test equipment as shown below.



2. Set Synthesizer/Level Generator to 1.001MHz at 0dBm. Set Frequency Synthesizer to 1.001150MHz at -20dBm.

3. On Level Meter, press RECALL then number O push button. Select 75 Ω input. Turn on counter. Verify display indicates 1.001MHz at approximately –6dBm.

4. Select 0 jitter mode. Verify display indicates +11.5 ° (±0.1 °) peak-to-peak.

5. If it does not, check waveforms at test points TP8, TP9, and TP11. They should be as shown on FO-23 except for some jitter (150Hz) on rising and falling edges. There should be no jitter on waveform at TP10 and should track TP9 exactly in frequency and shape.

6. If these points are good, check U29 pin 3 for a 150Hz sine wave at 3.8V (peak-to-peak). The same signal should be at the ∅ jitter AC out BNC on the rear panel. If these are good, check U30 pin 1 for –1.9Vdc (front panel indication of +11 .5° peak-to-peak).

- If correct perform A22 Analog-Digital Converter Test (para 2-27).
- If incorrect, troubleshoot the A70 peak-to-peak detector circuit.

2-36. A70 IMPAIRMENTS B TEST—Continued.

WEIGHTED FILTER TROUBLESHOOTING.

1. On Level Meter press RECALL then number 0 push button. Select ENTRY 100 and set full scale to 0dBm. Select 3100Hz bandwidth and 75 Ω input,

2. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Connect Level Meter 10 MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

3. Set Synthesizer/Level Generator to 1MHz at 0dBm,

4. Using an Oscilloscope, verify test point A70TP8 has a 1850Hz signal at 2.2V peak-to-peak. Connect Oscilloscope to test point A70TP1.

5. On Level Meter, select WTD 3100Hz bandwidth. Verify signal level at test point A70TP1 drops about 15% as weighted filter is switched in. Example: 4.5V peak-to-peak to 3.7V peak-to-peak.

· If above indications are not obtained, troubleshoot weighted filter circuits using FO-23 and table below. (Use table for comparison purposes only.)

Input Frequency (A70TP8)	Weighted Signal Amplitude (A70TP1)	Signal Reduction In dB Relative to 1KHz
400Hz	1.2V (p-p)	– 12.2dB
500Hz	1.8V (p-p)	– 7.7dB
600Hz	2.5V (p-p)	– 4.6dB
700Hz	3.2V (p-p)	– 2.5dB
800Hz	3.8V (p-p)	– 1.1dB
900Hz	4.2V (p-p)	– 0.3dB
1000Hz	4.3V (p-p)	0
1200Hz	4.2V (p-p)	– 0.2dB
1400Hz	4.0V (p-p)	– 0.7dB
1600Hz	3.8V (p-p)	– 1.1dB
1850Hz	3.7V (p-p)	– 1.3dB
2000Hz	3.7V (p-p)	– 1.3dB
2500Hz	3.6V (p-p)	– 1.6dB
3000Hz	3.2V (p-p)	– 2.8dB
3100Hz	2.9V (p-p)	– 3.4dB
3200Hz	2.7V (p-p)	– 4.3dB
3300Hz	2.5V (p-p)	– 5.3dB

NOTCH FILTER TROUBLESHOOTING.

1. On Level Meter press RECALL then number 0 push button. Select ENTRY 100 and set full scale to 0dBm. Select NOISE/TONE mode and 75 Ω input.

2. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cab1 Connect Level Meter 10MHZ output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

3. Set Synthesizer/Level Generator to 1001500HZ at 0dBm.

4. Using an Oscilloscope, verify test point A70TP8 has a 1500Hz signal at 2.2V peak-to-peak. Verify test point A70TP1 has same 1500Hz at about 4.4V peak-to-peak. Verify test point A70TP2 has same 1500Hz at about 10.8V peak-to-peak, Leave Oscilloscope connected to test point A70TP2.

2-36. A70 IMPAIRMENTS B TEST—Continued.

5. Step Synthesizer/Level Generator from 1001500Hz down to 1000500Hz in 10HZ increments while observing signal at test point A70TP2. Verify signal decreases in amplitude as frequency approaches center of notch until, at notch center (1010HZ), there is only noise present (<20mV peak-to-peak). As input signal leaves 1001010HZ and approaches 1000500HZ, signal should again increase in amplitude until it is about 10V peak-to-peak at 1000500HZ.

● If correct are not obtained troubleshoot notch filter circuit using FO-23 and table below. (Use table for comparison purposes only.)

Input Frequency (A70TP8)	Signal Amplitude (A701P2)	Signal Reduction In dB Relative to 2KHz
1200Hz	9.2V (p-p)	- 1dB
1150HZ	5.3V (p-p)	- 6dB
1100Hz	1.4V (p-p)	-17dB
1090HZ	1.0V (p-p)	- 20dB
1080Hz	0.65V (p-p)	-24dB
1070HZ	0.42V (p-p)	- 28dB
1060HZ	0.24V (p-p)	- 32dB
1050HZ	0.12V (p-p)	- 39dB
1040Hz	50mV (p-p)	- 46dB
1030HZ	20mV (p-p)	- 59dB
1020HZ	10mV (p-p)	- 78dB
1010HZ (NOTCH)	10mV (NOISE)	- 81dB (NOTCH)
1000Hz	10mV (p-p)	- 78dB
990Hz	20mV (p-p)	-61dB
980Hz	50mV (p-p)	- 48dB
970HZ	0.12V (p-p)	- 40dB
960Hz	0.27V (p-p)	- 34dB
950Hz	0.43V (pp)	-27dB
940Hz	0.72V (p-p)	- 23dB
930Hz	1.lV (p-p)	- 19dB
920Hz	1.7V (p-p)	-16dB
910HZ	2.5V (pp)	-12dB
900Hz	3.5V (p-p)	- 9dB
850Hz	9.0V (p-p)	- 1dB
800Hz	10.1V (p-p)	ØdB

AUDIO DETECTOR/LOGGER TROUBLESHOOTING.

1. Swap microcircuit A70U22 with microcircuit A4U4 (fig. FO-4).

● If no changes in symptoms occur after swap, place microcircuit back to original position. If wideband amplitude errors, UL/OL conditions, or auto ranging problems now exist, microcircuit U22 was bad and needs to be replaced.

2. On Level Meter, press RECALL then number 0 push button. Select 75 Ω input, ENTRY 100 and set Full Scale to 0dBrn.

3. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

4. Set Synthesizer/Level Generator to 1MHz at 0dBm.

2-36. A70 IMPAIRMENTS B TEST—Continued.

5. Using an Oscilloscope, verify test point A70TP8 has a 1850Hz signal at 2.2V peak-to-peak. Verify signal at test point A70TP1 has a 1850Hz signal at 4.4V peak-to-peak. Verify signal at test point A70TP2 has a 1850Hz signal at 10.4V peak-to-peak. Using Digital Multimeter, verify voltage at test point TP6 is about +0.052 Vdc and U 10 pin 1 is about -0.3Vdc.

- If above conditions are not obtained, troubleshoot audio detector/logger circuit using FO-23 and table below. (Use table for comparison purposes only.)

Input Relative To Full scale	TP8	TP1	TP2	TP7	TP6	U10(1)
ØdB	2.2V (p-p)	4.4V (p-p)	10.8V (p-p)	7.8V (p-p)	+0.052 VDC	-0.30 VDC
- 5	1.2V	2.5V	6.0V	5.8V	+0,060	-0.35
-10	0.68V	1.4V	3.4V	4.4V	+ 0,068	-0.40
-15	0.38V	0.8V	1.9V	3.4V	+0.076	-0.45
-20	0.22V	0.45V	1.1 V	2.5V	+ 0.084	-0.50
-25	0.12V	0.25V	0.6V	1.9V	+0.092	-0.55
-30	70Mv	0.14V	0.34V	1.4V	+0.100	-0.60
-35	40mV	80mV	0.19V	1.0v	+0.108	-0.65
-40	25mV	45mV	0.11v	0.8V	+0,116	-0.70
-45	15mV	26mV	60mV	0.6V	+0,124	-075
-50	10mv	16mV	40mV	0.45V	+0.132	-0.80
-55	7mV	11mV	20mV	0.35V	+0.140	-0.85
-60	5mV	6mV	15mV	0.25V	+0.148	-090
-65	5mV	5mV	10mV	0.20V	+0.156	-0.95
-70	5mV	5mV	8mV	0.15V	+0.164	-100
-75	5mV	5mV	5mV	0.13V	+0.172	-1.05
- 80dB	5mV (p-p)	5mV (p-p)	5mV (p-p)	0.10v (p-p)	+0.180 VDC	-1.10VDC

Notes:

1. Signal frequency used for above measurements was 1850Hz at A70TP8.
2, Voltages are for comparison purposes only.
3. Typical voltage gain of U10A as set by R72 is approximately -6.
4. Note that U10(1) changes .05 VDC for each 5dB change in input signal

IMPULSE NOISE TROUBLESHOOTING.

1. On Level Meter, press RECALL then number 0 push button. Select 75 Ω input, ENTRY 100 and set full scale to 0dBm.

2. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

3. Set Synthesizer/Level Generator to 1MHz at 0dBm.

4. Using an Oscilloscope, verify test point A70TP8 has a 1850Hz signal at 2.2V peak-to-peak. Verify test point TP2 has a 1850Hz signal at about 10.8V peak-to-peak. Verify test point TP4 has same signal rectified or about 5.4V (peak) and double number of positive peaks (3700Hz). Using Digital Multimeter, verify test point TP5 has +5.9V.

5. On Level Meter, select IMPULSE mode and press START. Verify test point A70TP5 reads about +3 .65Vdc (THRESHOLD should still be 0dBm and full scale should be 0dBm from above).

2-36. A70 IMPAIRMENTS B TEST—Continued.

6. Select other values of THRESHOLD settings from table below and check test point A70TP5 for approximate voltage indicated.

● If above readings are not obtained troubleshoot the impulse noise circuit up to U19 using FO-23.

THRESHOLD (T) Settings	A70TP5
0/ – 15/ – 30/ – 45dBm	+ 3.651 VDC
– 1/ – 16/ – 31/ – 46dBm	+ 3.259 VDC
– 2/ – 17/ – 32/ – 47dBm	+ 2.906 VDC
– 3/ – 18/ – 33/ – 48dBm	+ 2.591 VDC
– 4/ – 19/ – 34/ – 49dBm	+ 2.296 VDC
– 5/ – 20/ – 35/ – 50dBm	+ 2.042 VDC
– 6/ – 21/ – 36/ – 51dBm	+ 1.825 VDC
– 7/ – 22/ – 37/ – 52dBm	+ 1.625 VDC
– 8/ – 23/ – 38/ – 53dBm	+ 1.450 VDC
– 9/ – 24/ – 39/ – 54dBm	+ 1.292 VDC
– 10/ – 25/ – 40/ – 55dBm	+ 1.159 VDC
– 11/ – 26/ – 41/ – 56dBm	+ 1.024 VDC
– 12/ – 27/ – 42dBm	+ 0.924 VDC
– 13/ – 28/ – 43/ + 2dBm	+ 4.590 VDC
– 14/ – 29/ – 44/ + 1dBm	+ 4.079 VDC
+ 3dBm	+ 5.000 VDC
T > + 3dBm	E6.2**
T < – 56dBm	E6.1***

NOTES:

1. All readings were taken with Full Scale setting of ØdBm, ENTRY 100, and Level Meter frequency of 1MHz. For other frequencies and/or other full scale settings, equivalent readings (±25%) will occur anytime the threshold setting is the same number of dB below the Full Scale setting. Readings are for comparison only.

2. START must be pressed to see the new value at TP5 after the Threshold setting is changed.

3. When T = +3dBm to -12dBm, U16 (12,15,19) = 110, for U39A gain = ØdBm and U39B = ØdBm.

When T = -13dBm to -27dBm, U16 (12,15,19) = 010, for U39A gain = 15dBm and U39B = ØdBm.

When T = -28dBm to -42dBm, U16 (12,15,19) = 101, for U39A gain = ØdBm and U39B = 30dBm.

When T = -42dBm to -56dBm, U16 (12,15,19) = 011, for U39A gain = 15dBm and U39B = 30dBm.

4. * All codes are TTL, where 0 = +0.2Vdc and 1 = +4.5Vdc.

** A70TP5 has last valid reading still present.

*** A70TP5 has valid reading still present.

COMPARATOR (U19) TROUBLESHOOTING.

1. On the Level Meter, press RECALL; then 0 push buttons. Select 75 Ω input, ENTRY 100 and set Full Scale to 0dBm, and select IMPULSE mode.

2. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

3. Set Synthesizer/Level Generator to 1.0005MHz at 0dBm.

4. Using an Oscilloscope, verify test point A70TP4 has a rectified 500Hz signal with peak values of about +5V. Verify U19 pin 7 has a constant DC output of about +0.1V.

5. On Level Meter, press START push button. Verify U19 pin 7 now has a 1KHz square wave output at +5V peak to 0V base. Verify test point A70TP5 has +3.65Vdc rectified peaks at 1000Hz.

● If above readings we not obtained, troubleshoot the U 19 circuit using FO-23.

DEAD TIMER AND IMPULSE COUNTER TROUBLESHOOTING.

1. On the Level Meter press RECALL; then number O push buttons. Select 75 Ω input, ENTRY 100 and set Full Scale to 0dBm.

2-36. A70 IMPAIRMENTS B TEST—Continued.

2. Connect Synthesizer/Level Generator 75 Ω output to Level Meter 75 Ω input using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

3. Set Synthesizer/Level Generator to 1MHz at 0dBm.

4. Using an Oscilloscope, verify test point A70TP8 has a 1850Hz signal at 2.2V peak-to-peak. Verify U20 pin 3 has a 1000Hz TTL square wave.

5. Connect an Oscilloscope to A70TP3 and select a sweep time/division that will trigger sweep start at a 1Hz rate. Use DC coupling. Verify trace sweep is at about a 4.4Vdc level with 6 or 7 negative pulses visible to 0Vdc per sweep.

6. Decrease Oscilloscope sweep speed to about 0.5 SEC/DIV. Selectively look at U21 pins 3, 2, 6, and 7. In a 5-second period, number of pulses present at each pin should agree with table below.

U21 Pin #	Pulses (5 Seconds)
3	10-20
2	9-10
6	5
7	3

7. Disconnect Synthesizer/Level Generator.

8. On Level Meter, press RECALL then number 0 push button. Verify noise floor in LO DIST mode is less than –116dBm.

9. Connect an Oscilloscope to test point A70TP3 (AC coupled). Set sweep rate to 0.2 SEC/DIV.

10 Select a THRESHOLD of -111dBm. Verify waveform at test point A70TP3 should resemble that shown in FO-23 for 2-second sweep duration.

- If above readings are not obtained, troubleshoot dead timer and impulse counter circuits using FO-23.

2-37. A80 POWER SUPPLY TEST.

DESCRIPTION

This test is used to isolate a malfunctioning A80 Power Supply Assembly.

1. Remove A80 Power Supply Assembly (para 2-94) and reinstall on an extender board.

2. Using Digital Multimeter, verify DC power supply voltages on A80 Power Supply Assembly (fig. FO-25) are as follows:

A80TP1	+11.99 to +12.01 Vdc
A80TP2	–11.97 to –12.03 Vdc
A80TP3	+5.150 to +5.350 Vdc

- If not, proceed with step 4.

2-37. A80 POWER SUPPLY TEST—Continued.

3. Verify that AC ripple voltage at test point TP1, TP2, and TP3 is less than 25mVrms.

- If more than 25mVrms, ripple is present; proceed with step 6.

4. Using an Oscilloscope, check test point TP1, TP2, and TP3 for presence of any high frequency line spurs riding DC levels with an amplitude greater than 100mV peak-to-peak.

- If more than 100mV peak-to-peak, proceed with step 6.

5. Check for bus shorts as follows:

- If only CR2 is on and all voltages are less than 100mV, check +12V bus for shorts using table below.
- If only CR31 is on, (CR5 and CR54 could also be on), check –12V bus for shorts using table below,
- If only CR31 is on, (CR5 and CR34 could also be on), check +5V bus for shorts using table below.
- If no shorts are found, proceed with step 6.

+ 12VDC (Regulated) Origin: XA80 (A4-5, B4-5)	XA1 (A6.B6)* XA2 (A7,B7)* XA4 (A7,B7)* XA5 (A7,B7)* XA10 (A7,B7)* XA11 (A7,B7)* XA15 (A7,B7) XA20 (A10.B10) XA21 (A10,B10) XA22(A10,B10) XA30 (A7, 07) XA31 (A7,B7)	XA32 (A10,B10) XA40R (A7,B7) XA50L (A7,B7) XA50R (A7,B7) XA51 (A7,B7) XA52 (A7,B7) XA53 (A7,B7) XA70L (A10,B10) XA70R (A5,B5,A10,B10) A98J2 (7) A99T1 (3)
-12VDC (Regulated) Origin: XA80 (A9-10, B9-10)	XA1 (A7,B7) XA2 (A6,06) XA4 (A6,B6) XA5 (A6,B36) XA10 (A6,B6) XA11 (A6, B6) XA15 (A6,B6) XA20 (A9,B91 XA21 (A9,B9) XA22 (A9,B9) XA30 (A6,B6)	XA31 (A6,B6) XA32 (A9,B9) XA40R(A6,B6) XA50L (A6, 06) XA50R (A6,B6) XA51 (A6,B6) XA53 (A6,B06) XA70L (A9,B9) XA70R (A9,B9) A99T1 (4)
+5VDC (Regulated) Origin: XA80 (A20-21, B20-21)	XA1 (A9, 09)* XA2 (A8,B8)* XA4 (A8,B8)* XA11 (A8, B8)* XA15 (A8,B8) XA21 (A11-12,B11-12) XA221(A11-12,B11-12) XA30 (A8,B8) XA31 (A8,B8) XA32(A11-12, B11-12) XA40L (A8,B8)	XA40R (A8,B8) XA50R (A8,B8) XA52 (A8,B8) XA53 (A8,B8) XA60L (A12,B12) XA60R (A12,B12) XA61 (A11-12, B11-12) XA70L (A11-12,B11-12) XA70R (A11-12.B11.12) A98J2 (6) A99T1 (2)

2-37. A80 POWER SUPPLY TEST—Continued.

+ 15VDC {Regulated) Origin: A99U2	A99T1 (5) A1J2 (PROBE power)*	XA1 (A8)"
+23VDC {Unregulated) Origin: A99CR10/CR11	XA16 (A7, B7) XA80 (B11)	A99U2
-23VDC (Unregulated) Origin: A99CR9/CR12	XAB0(B16)	
+2.5VDC (Unregulated) Origin: XA80 (A11) Battery A80BT1 (V-BAT)	XA60L (A10)	

Note:

All pins marked (*) are “isolated voltages” having passed through Motherboard isolation transformer A99T1

6. Replace A80 Power Supply Assembly (para2-94).
7. Verify malfunction is corrected. If not,
   - Adjust A80 Power Supply Voltage (para 2-45).

2-38. A98 KEYBOARD (SWITCH/DISPLAY) TEST.

DESCRIPTION

This test is used to isolate a malfunction in the A98 Keyboard Assembly.

1. Troubleshoot A98 Keyboard Assembly using fig. FO-24 and additional test information provided below.
2. Remove A60 Controller Assembly (para 2-90) and reinstall on an extender board.

2-38. A98 KEYBOARD (SWITCH/DISPLAY) TEST—Continued.

DISPLAY CHECK.

NOTE

This test is only functional after a successful completion of the turn-on and calibration cycle.

1. Move Level Meter POWER switch to STBY. Record switch positions of A60S1 and A60S2 (fig. FO-21) for resetting at end of test.

2. Change following contacts of A60S2 to the indicated positions:

CONTACT	CLOSED	OPEN
5		XXXX
6	XXXX	
7		XXXX
8	XXXX	

3. Move Level Meter POWER switch to ON.

4. After turn on cycle, close contact 4 of A60S1 (up) and then open it (down).

5. Verify following events occur in listed order.

- All LED's will come on for approximately two seconds.
- 7 segment LEDs come on, one at a time, moving from right to left across display.
- LED's in push buttons of FREQUENCY TUNE and BANDWIDTH blocks and MEAS CONT key come on and then go off.
- LED's in push buttons of FREQUENCY/ENTRY block and OFFSET ON/OFF key come on and then go off.
- LED's in following push button groups will come on and then go off, one group at a time.
- RANGE, FULL SCALE, AVE, and UNIT.
- AUTO CAL, WIDEBAND, SHIFT, SELECTIVE, and SSB CHANNEL.
- TERMINATION (Al 1 impedance keys).
- Groups of annunciators in MEASUREMENT/ENTRY, FREQUENCY/ENTRY, and STATUS blocks come on and then go off in eight steps.
- All LED's are turned on and cycle starts over.

6. Troubleshoot A98 Keyboard Assembly using FO-24 if above conditions are not met.

7. To exit this procedure, move POWER switch to STBY, Reset A60S2 to positions recorded above.

2-38. A98 KEYBOARD (SWITCH/DISPLAY) TEST—Continued.

KEYBOARD CHECK.

NOTE

This test is only functional after a successful completion of the turn-on and calibration cycle.

1. Move Level Meter POWER switch to STBY. Record switch positions of A60S1 and A60S2 for resetting at end of test.

2. Change following contacts of A60S2 to indicated positions:

CONTACT	CLOSED	OPEN
5	XXXX	
6		XXXX
7		XXXX
8	XXXX	

3. Move Level Meter POWER switch to ON.

4. After turn-on cycle, close contact 4 of A60S1 (up) and then open it (down).

5. Each push button on front panel can now be pressed, causing a different key code number to be displayed in far right-hand portion of FREQUENCY/ENTRY block. Use table below to verify the correct key code for the pressed key.

- If errors are common to one key line (0 to 7), troubleshoot U14 circuit.
- If errors are common to one vertical column of switches, troubleshoot U 12 and U 13 circuit.
- Troubleshoot all other malfunctions using FO-24.

Switch Group	Key Label	Key Code
MEASUREMENT/ENTRY	AUTO CAL OFF-ON	25
	10dB	26
	100dB	56
	AUTO	66
	ENTRY	76
	AVE	36
	dBm	46
	dBpW	16
	dB .775V	06
	OFFSET OFF-ON	07
FREQUENCY/ENTRY	CARRIER	47
	TONE	37
	◺ (LSB)	77
	◿ (USB)	67
	COUNTER OFF-ON	57
STATUS	LOCAL	27
MEASUREMENT MODE	WIDEBAND	55
	FUNCTION (BLUE)	65
	LO NOISE	75
	Ø JITTER	35
	NOISE/TONE	45
	IMPULSE	15
	START	05

2-38. A98 KEYBOARD (SWITCH/DISPLAY) TEST—Continued.

Switch Group	Key Label	Key Code
TERMINATION	10KΩ||50pF	23
	75Ω	53
	124Ω	63
	135Ω	73
	BRIDGED	33
	600Ω	43
ENTRY	FREQ	03
	FULL SCALE	13
	STORE	20
	THSHLD	21
	FREQ STEP	02
	OFFSET	22
	RECALL	50
	TIME	51
	0	61
	1	60
	2	70
	3	30
	4	52
	5	62
	6	72
	7	12
	8	42
	9	32
	• (decimal)	71
	UP (arrow)	31
	DOWN (arrow)	41
	MHz/ – dB	00
	kHz/ + dB	10
	Hz/MIN	40
	MEAS CONT	04
	RDNG → OFFSET	01
	CNTR → FREQ	11
FREQUENCY TUNE	OFF	14
	AUTO	44
	FREQ STEP	34
	RPG (CW)	90
	RPG (CCW)	91
BANDWIDTH	20Hz	74
	400Hz	64
	3100/2000/1740Hz	54
	WTD 3100Hz	24

6. To exit this procedure, move POWER switch to STBY. Reset A60S2 to positions recorded above.

2-39. SPURIOUS SIGNALS TEST.

DESCRIPTION

This test is used to isolate spurious signals in the Level Meter.

Use fig. FO-1, table shown below, and a Spectrum Analyzer to troubleshoot spurious signal sources.

Frequencies*	Origin(s) And Figure Numbers	Using P.C. Boards And Figure Numbers
1Hz	A22 (FO-12)	A22 (FO-12) A60 (FO-21)
48.66Hz	Line Frequency	A99 (Rectifier Circuits) (FO-25)
80Hz	A4 (FO-4)	A4 (FO-4)
100(± 10)Hz	A98 (FO-24)	A98 (FO-24)
1010(± 50)Hz	A70 (FO-23)	A70 (FO-23)
1900(± 200)Hz	A60 (FO-21)	A60 (FO-21) A98 (FO-24)
0-3400Hz	A22 (Audio) (FO-12)	A21 (FO-11) A70 (FO-23) A98 (FO-24)
13.775KHz	A22 (3100Hz) LSB (FO-12)	A21 (FO-11)
15.625KHz	A11 (FO-7)	A11 (FO-7)
15.625KHz	A10 (FO-6)	A10 (FO-6) A20 (FO-10) A21 (FO-11) A22 (FO-12)
15.625KHz	A22 (CAL) (FO-12)	A21 (FO-11)
17.475KHz	A22 (3100Hz) USB (FO-12)	A21 (FO-11)
20-50KHz	A4 (FO-4)	A4 (FO-4)
41(± 1)KHz	A61 (FO-22)	A61 (FO-22)
100KHz	A30 (FO-13) A40 (FO-16)	A32 (FO-15)
200-333KHz	A61 (FO-22)	A61 (FO-22)
500KHz	A22 (FO-12)	A22 (FO-12)
1MHz	A40 (FO-16)	A11 (FO-7) A15 (FO-8) A22 (FO-12)
1.3775MHz	A22(3100Hz) (FO-12)	A22 (FO-12)
1.6625MHz	A70 (CAL) (FO-23)	A22 (FO-12)
1.7475MHz	A22 (3100Hz) (FO-12)	A22 (FO-12)
2MHz	A40 (FO-16)	A40 (Test) (FO-16)
2MHz	A50 (FO-17)	A50 (FO-17)
2-4MHz	A31 (FO-14) A52 (FO-19)	A53 (FO-20)
2-4MHz	A30 (FO-13)	A30 (FO-13) A32 (FO-15)
3-5MHz	A61 (FO-22)	A61 (FO-22)
3.5(± .3)MHz	A60 (FO-21)	A60 (FO-21)
10MHz	A16 (FO-9)	A40 (FO-16)
10MHz	A40 (FO-16)	A50 (FO-17)
10-20MHz	A30 (FO-13)	A30 (FO-13)
20-40MHz	A31 (FO-14)	A30 (FO-13)
0-32.5MHz	A15 (FO-8)	A4 (FO-4) A2 (FO-3) A5 (FO-5)
49.984375MHz	A11 (FO-7)	A10 (FO-6)
50MHz	A5 (FO-5)	A10 (FO-6)
50MHz	A40 (FO-16)	A11 (FO-7) A15 (FO-8)
50-82.5MHz	A51 (FO-18)	A5 (FO-5) A15 (FO-8) A52 (FO-19)
54-86MHz	A50 (FO-17)	A50 (FO-17) A52 (FO-19)

*No external source frequencies applied to the level meter input

2-40. AMPLITUDE TRACE TEST.

DESCRIPTION

This test is used to trace amplitude measurement malfunctions.

1. Remove power from Level Meter.
2. Remove cable from connector A213 (fig. FO-3). Disconnect purple cable from connector A40J3 (fig, FO- 16) and connect it to connector A2J3.
3. Connect Synthesizer/Level Generator 75 Ωoutput to Level Meter 75 Ωinput using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) through 50 Ωload to Digital Multimeter input.
4. Apply power to Level Meter. Select 75 Ωinput, entry 100 and set full scale to 0dBm.
5. Set Synthesizer/Level Generator to 0dBm at 20KHz. Verify that digital multimeter indicates 29mVac.
6. Reconnect cable to connector A2J3 and connect purple cable (fig. 2-2) to A10 IF TP (fig. FO-6). Remove 50 Ωload from Level Meter. Verify that Digital Multimeter indicates 500mVac.

- If indication in step 5 is incorrect, perform A1 Input Multiplexer Test (para 2-14), A2 Input Amplifier Test (para 2-16), and A5 Input Mixer Test (para 2-19).
- If indication in step 5 is correct and indication in step 6 is incorrect, perform A5 Input Mixer Test (para 2-19), and A10 Second Mixer Test (para 2-20).
- If indication in both step 5 and step 6 are incorrect, perform A20 IF Filter Test (para 2-24) and A21 IF Gain/Detector Test (para 2-26).

2-41. NOISE FLOOR TEST.

DESCRIPTION

This test is used to isolate noise floor malfunctions.

1. Connect Spectrum Analyzer to test point A21TP1 (fig. FO-11).

- If no noise is visible, perform A22 Analog-Digital Converter Test (para 2-27).

2. On Level Meter, select 20Hz bandwidth.

- If noise goes away, perform A 10 Second Mixer Test (para 2-20) around 400Hz filter. If good, perform A20 IF Filter Test (para 2-24) around U2 circuit.

3. Select 400Hz bandwidth.

- If noise goes away, perform A20 IF Filter Test (para 2-24) around U1 circuit.

2-41. NOISE FLOOR TEST—Continued.

4. Press AVE push button.

- If noise is affected, perform A21 IF Gain/Detector Test (para 2-26) before U5 circuit.

5. Connect Spectrum Analyzer to test point A10TP2 (fig. FO-6).

- If excessive amplitude modulation on frequency jitter is displayed, perform A11 Second Local Oscillator Test (para 2-21).

Section IV. MAINTENANCE PROCEDURES

2-42. PERFORMANCE TEST.

DESCRIPTION

This procedure covers:

- 10MHZ Reference Output Frequency Test.
- Input Return Loss Test.
- Amplitude Accuracy Test.
- Pros-Band Flatness Test.
- Pilot (20Hz) Filter Bandwidths Test.
- Adjacent Channel Rejection Test.
- Residual Spurious Responses Test.
- Harmonic Distortion Test.
- IF Rejection Test.
- Tracking Output Test.
- Residual Phase Jitter Test.
- Notch Filter Test.
- Counter Accuracy and Sensitivity Test.
- Balance Input Test.
- Half-Power Bandwidths (–3dB) Test.
- 400Hz Filter Shape Test.
- Carrier Frequency Rejection Test.
- Residual Noise Test.
- Input Spurious Responses Test.
- Intermodulation Distortion Test.
- Wideband Power Flatness Test.
- Phase Jitter Accuracy Test.
- WTD Filter Calibration Test.
- Impulse Noise Test.

NOTE

- Performance test procedure steps should be done in the order given.
- Keep test equipment interconnecting cables as short as possible. All cables shown are 50 Ω unless otherwise specified.
- A performance test checklist is provided at the end of the performance test procedures. Use the checklist while doing the test procedures.
- Allow an initial 20 minute warm-up period when performing the first performance test to allow the Level Meter to stabilize.
- Allow Level Meter 5 minutes to stabilize if turned off during the performance tests.
- The initialized setup of Level Meter controls and indicators is to be performed prior to each performance test.
- Rear views of test setups are shown once at beginning of each test. Do not remove rear view connections unless instructed to disconnect test equipment.

INITIALIZED SETUP.

1. Press RECALL and number 0 push button. Select 75&2 input.
2. Verify Level Meter is as follows:

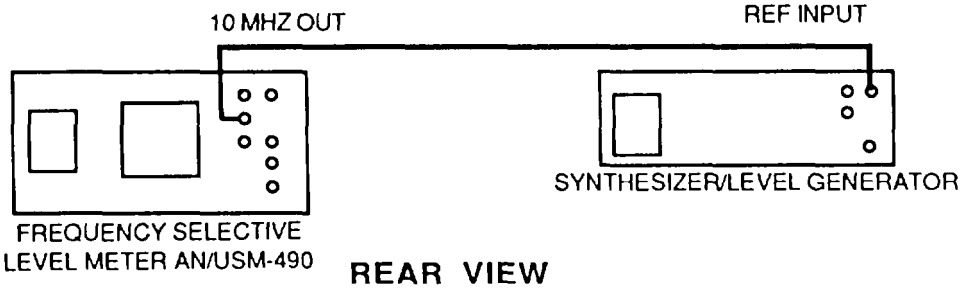
AUTO-CAL	ON
RANGE	10dB
FULL SCALE	AUTO
UNIT	dBm
ENTRY FREQUENCY SSB	CARRIER
CHANNEL	⟋
COUNTER	OFF
MEASUREMENT	LO DIST
TERMINATION	75 Ω
BANDWIDTH	3100HZ
ENTERED FREQUENCY	1 MHz

10MHZ REFERENCE OUTPUT FREQUENCY TEST.

1. Connect 10MHz output on rear panel of Level Meter to 50 Ω input on Electronic Counter using 50 Ω cable..
2. Verify frequency is from 9,999,900Hz to 10,000,100Hz.
3. Disconnect test setup.

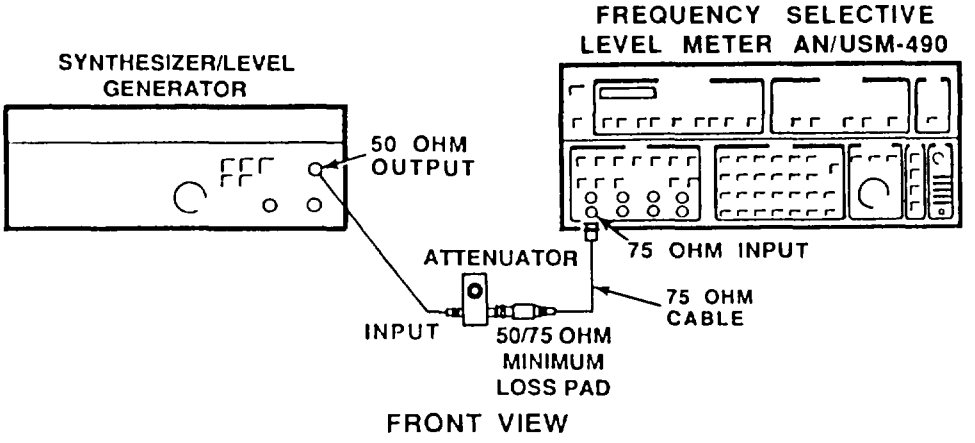
COUNTER ACCURACY AND SENSITIVITY TEST.

1. Initialize Level Meter.
2. Connect test equipment as shown below.



REAR VIEW

COUNTER ACCURACY AND SENSITIVITY TEST-Continued.



3. On Level Meter, press 75 Ω push button.

4. Set attenuator to –20dB.

5. Set Synthesizer/Level Generator output to 1MHz at -72dBm.

6. Decrease Synthesizer/Level Generator output by 0.1dB steps until Level Meter indicates as close as possible to -100dBm in Measurement/Entry display,

7. On Level Meter

- Press COUNTER push button.
- Frequency/Entry display should indicate from 1,000,001HZ to 999,999Hz.

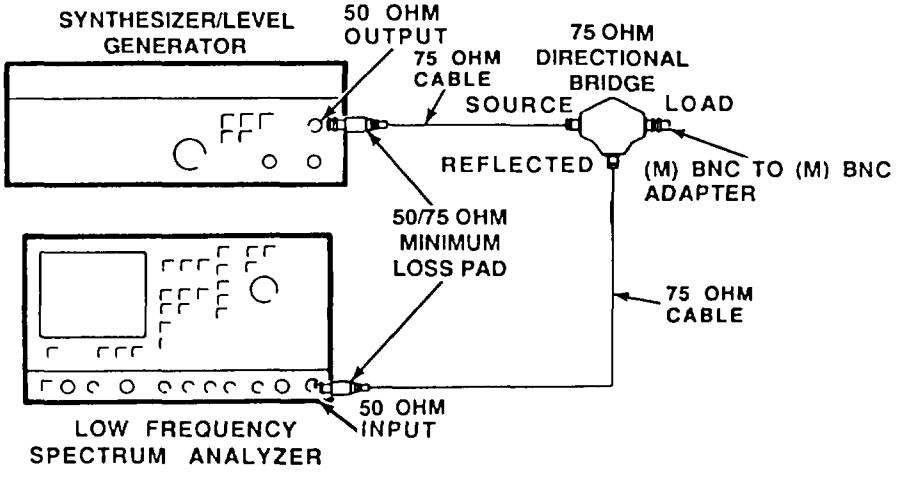
8. Disconnect test setup.

INPUT RETURN LOSS TEST.

---

1. Initialize Level Meter.

2. Connect test equipment as shown below.



INPUT RETURN LOSS TEST—Continued.

3. On Low Frequency Spectrum Analyzer, press INSTR PRESET push button.

4. Set Synthesizer/Level Generator output to 1MHz at 0dB.

5. On Low Frequency Spectrum Analyzer:

- Set center frequency to 1MHz.
- Set frequency span to 1MHz.
- Press MKR—>REF LVL push button.
- Press OFFSET push button.
- Press ENTER OFFSET push button.

6.. On Level Meter, select 75 Ωinput. Connect (m) BNC to (m) BNC adapter to load of 75 ΩDirectional Bridge and 75 Ω input of Level Meter.

7. On Low Frequency Spectrum Analyzer, verify signal amplitude is less than -30dB.

8. Disconnect (m) BNC to (m) BNC adapter from 75 Ωinput of Level Meter.

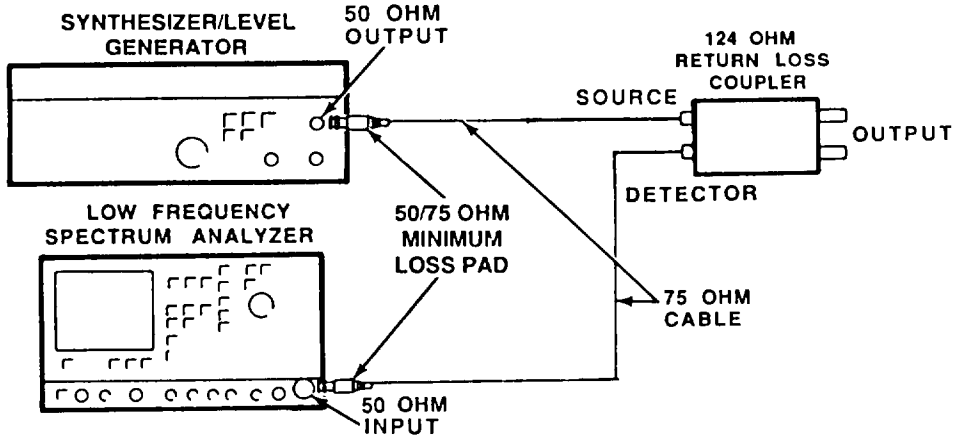
9. Set Synthesizer/Level Generator output and Low Frequency Spectrum Analyzer center frequency to 32.5MHz.

10. On Low Frequency Spectrum Analyzer:

- Set marker to 32.5MHz.
- Press MKR—>REF LVL push button.
- Press OFFSET push button,
- Press ENTER OFFSET push button.

11. Repeat steps 6 and 7.

12. Connect test equipment as shown below.



INPUT RETURN LOSS TEST—Continued.

13. Set Synthesizer/Level Generator output and Low Frequency Spectrum Analyzer center frequency to 5MHz.

14. On Low Frequency Spectrum Analyzer:

- Press MKR—>REF LVL push button.
- Press OFFSET push button.
- Press ENTER OFFSET push button.

15. On Level Meter, select 124 Ω input.

16. Connect output of 124 Ω Return Loss Coupler to 124 Ω input of Level Meter.

17. On Low Frequent y Spectrum Analyzer, verify signal amplitude is less than –30dB,

18. Disconnect 124 Ω Return Loss Coupler from Level Meter.

19. Set Synthesizer/Level Generator output to 10KHz.

20. On Low Frequency Spectrum Analyzer:

- Set START FREQ to 0KHZ.
- Set STOP FREQ to 50KHz.
- Set marker frequency to 10 KHz.
- Press MKR—>REF LVL push button.
- Press OFFSET push button.
- Press ENTER OFFSET push button.

21. Connect 124 Ω Return Loss Coupler to 124 Ωinput on Level Meter,

22. Verify signal amplitude is less than -30dB.

23. Disconnect test equipment.

24. Connect large WECO to BNC female adapter to top 124 Ω input of Level Meter.

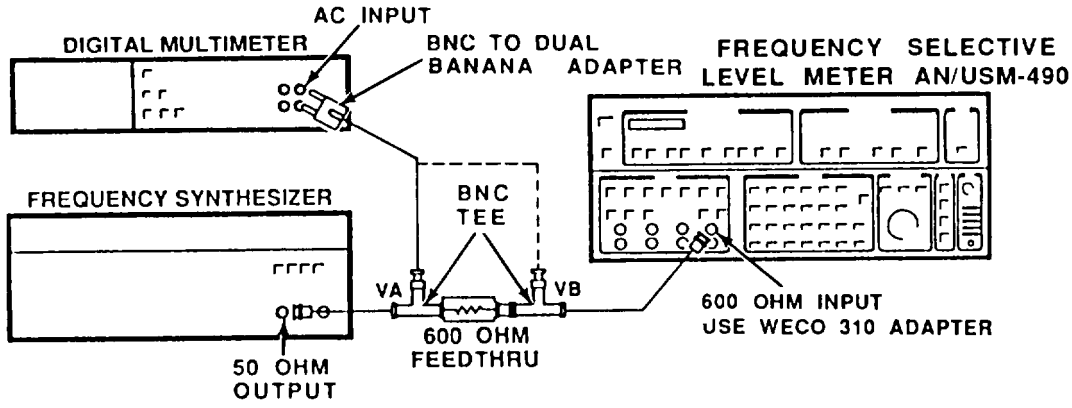
25. Connect 1/4 inch phone jack to BNC female adapter to top 135 Ω input of Level Meter.

26. Measure resistance between 124 Ωand 135 Ω connectors. Resistance should be from 19.9 to 21.31 Ω including Digital Multimeter tolerances.

27. Move adapters to lower 124 Ω and 135 Ω inputs of Level Meter and repeat step 26.

INPUT RETURN LOSS TEST—Continued.

28. Connect test equipment as shown below.



29. Switch Level Meter to STBY.

30. Set Frequency Synthesizer output to 50Hz at +7dBm.

31. Measure and record AC voltage at points A (Va) and B(Vb).

32. Calculate return loss using following formula:

$$\text{Return Loss} = -20 \log \left| \frac{2\,Vb - Va}{Va} \right|$$

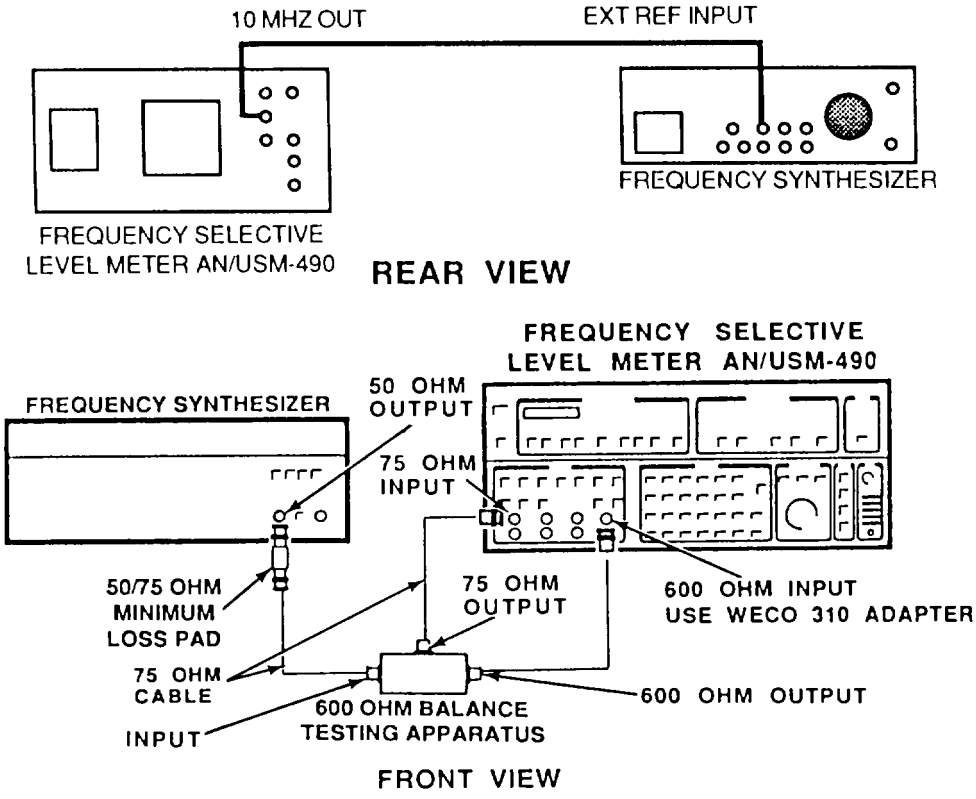
33. Verify return loss is greater than +25dB.

34. Repeat steps 31 thru 33 using Frequency Synthesizer frequency of 108 KHz at +7dBm.

35. Disconnect test setup.

BALANCE INPUT TEST.

1. Initialize Level Meter.
2. Connect test equipment as shown below.



3. Set Frequency Synthesizer output to 50Hz at 10dBm.
4. On Level Meter
   - Select 20Hz bandwidth and tune to 50Hz.
5. On Level Meter
   - Turn AVERAGE on.
   - Press RDNG—>OFFSET push button.
   - Turn OFFSET on.
   - Disconnect cable from 75 Ω input and select 600Ωinput. Level indication should be less than or equal to -40dBm.
6. Set Frequency Synthesizer output to 100 KHz at 10dBm.

BALANCE INPUT TEST—Continued.

7. On Level Meter

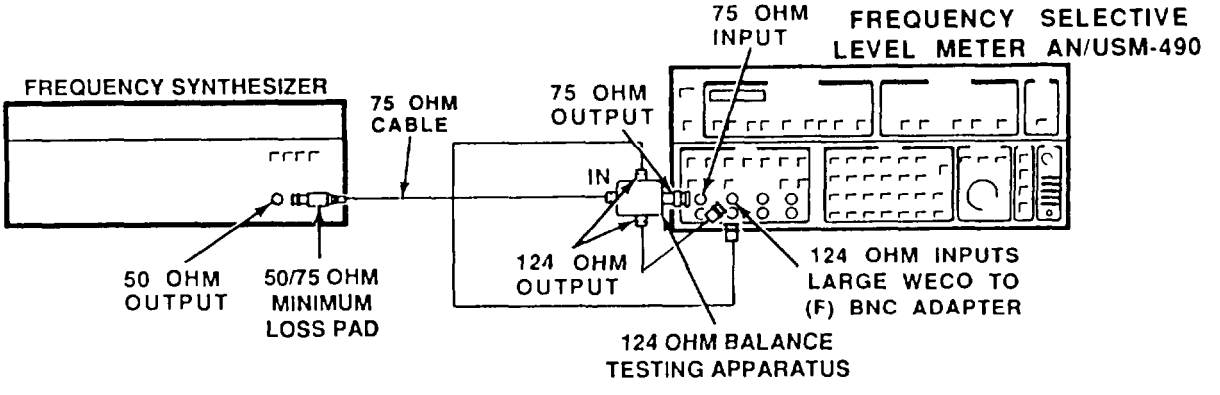
- Reconnect 75Ω input cable to Level Meter.
- Select 10KΩ || 50pF input.
- Tune to 100KHz.

8. Repeat step 5.

9. Connect test equipment as shown below.

NOTE

Select the two with the closest length for use with the output of the 124ΩBalanced Testing Apparatus.



10. Set Frequency Synthesizer output to 10KHz at 10dBm.

11. On Level Meter.

- Tune to 10KHz.

BALANCE INPUT TEST—Continued.

12. On Level Meter

- Select 10KΩ 50PF input.
- Press RDNG—>OFFSET push button,
- Turn OFFSET on.
- Select 124Ωinput.
- Remove 124ΩBalance Testing Apparatus from 75Ωinput. Level indication should be less than or equal to –36dBm.
- Reverse cables to 124Ωinputs. Level indication should be less than or equal to –36dBm.

NOTE

If reversing cables causes the indication to differ by more than 2dB, change one or both of the 75Ωcables between the Balance Testing Apparatus and the 124Ωinputs and repeat steps 10 and 12. If indication remains out of specification, replace 124ΩBalance Testing Apparatus and repeat steps 10 and 12.

13. Set Frequency Synthesizer output to 10MHz at 10dBm.

14. On Level Meter

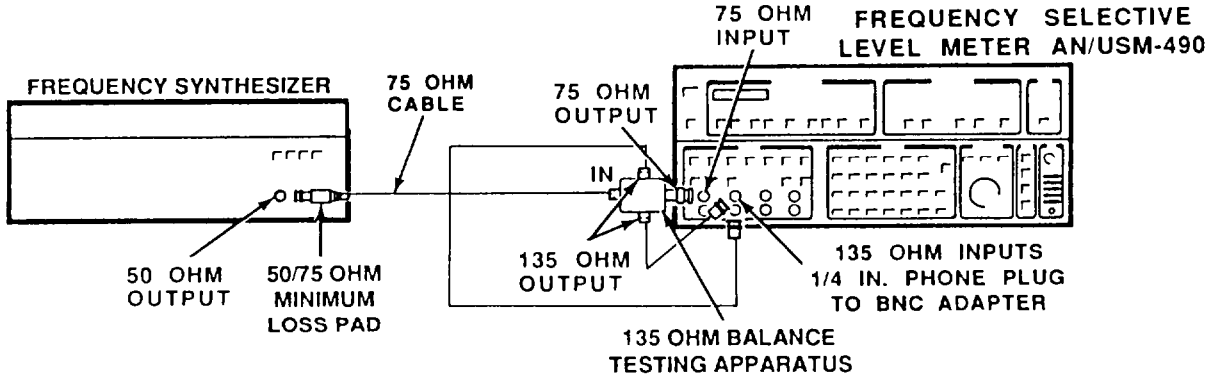
- Reconnect 75Ωinput cable to Level Meter.
- Tune to 10MHz.

15. Repeat step 12.

16. Connect test equipment as shown.

NOTE

Select the two with the closest length for use with the output of the 135ΩBalanced Testing Apparatus.



BALANCE INPUT TEST—Continued.

17. Set Frequency Synthesizer output to 10KHZ at 10dBm.

18. On Level Meter

- Tune to 10kHz.

19. On Level Meter

- Select 10KΩ|| 50pF input.
- Press RDNG—>OFFSET push button.
- Turn OFFSET on,
- Select 135Ω input.
- Remove 135Ω Balance Testing Apparatus from 75Ω INPUT on Level Meter. Level indication should be less than or equal to -36dBm.

20. Set Frequency Synthesizer output to 1MHz at 10dBm.

21. Reconnect 135Ω Balance Testing Apparatus to 75Ω input on Level Meter.

22. On Level Meter

- Tune to 1MHz.

23. Repeat step 19.

24. Disconnect test setup,

AMPLITUDE ACCURACY TEST.

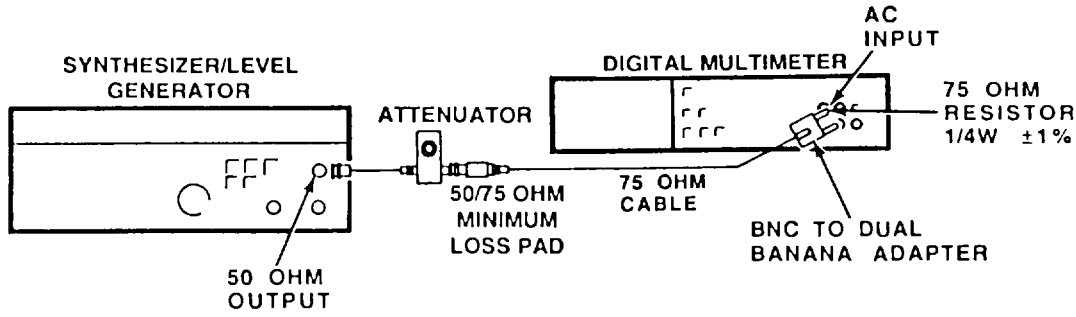
NOTE

If the Level Meter is meeting its return loss specification, only those procedures for testing the amplitude accuracy at the 75Ω input need to be performed. If the Level Meter is meeting its amplitude accuracy specification for the 75Ω input, it is reasonably certain that the other inputs are meeting their specifications as well.

1. Initialize Level Meter.

AMPLITUDE ACCURACY TEST—Continued.

2. Connect test equipment as shown below.



3. Set Attenuator to 0dB.

4. Set Synthesizer/Level Generator output to 1KHz at 10dBm. Verify voltage reading is approximately 0.45 Vrms.

5. Calculate power swing to 3 decimals using following formula:

$$p = 10\log\frac{V^2}{0.075}$$

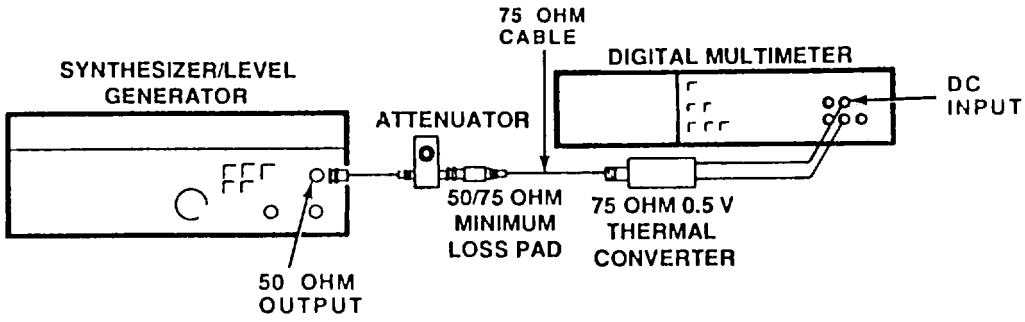
P is power in dBm and V is measured AC rms voltage across 75Ω(step 4).

6. Record calculated power Pin table 2-4 and 2-6.

CAUTION

Connect Thermal Converter to Digital Multimeter before connecting to Synthesizer/Level Generator.

7. Connect test equipment as shown below.



8. Record Digital Multimeter reading (Vth) to 6 decimals in table 2-4.

AMPLITUDE ACCURACY TEST—Continued.

9. On Synthesizer/Level Generator:

- Set frequency to 1MHz.
- Increment or decrement amplitude by 0.01dB until DC output of thermal converter is as close as possible to Vth.

l Record indication in table 2-4, column 2 for 1MHz.

10. Repeat step 9 using frequencies of 3MHz, 10MHz, and 30MHz.

11. Using the following following calculate dB error (from input error % on Thermal Converter calibration report) at 1 MHz, 3MHz, 10MHz, and 30MHz.

$$\text{dB Error} = 20\log\left(\frac{\%\ \text{Error}}{100} + 1\right)$$

Record dB errors in table 2-4, column 3.

12. Subtract numbers in column 3 from numbers in column 2 and record results in column 4.

Table 2-4. Power Calculations for Amplitude Accuracy

Calculated P _____
Measured Vth _____

(1) Frequency	(2) Frequency synthesizer setting for Vth	(3) THC error	(4) Synthesizer/level generator setting for flat signal
1KHz	10.00 dBm	0 dB	10.00 dBm
1MHz	_____dBm	_____dB	_____dBm
3MHz	_____dBm	_____dB	_____dBm
10MHz	_____dBm	_____dB	_____dBm
30MHz	_____dBm	_____dB	_____dBm

NOTE

Due to the tight tolerance required in the amplitude accuracy test, specified limits must be calculated for each test setup.

AMPLITUDE ACCURACY TEST—Continued.

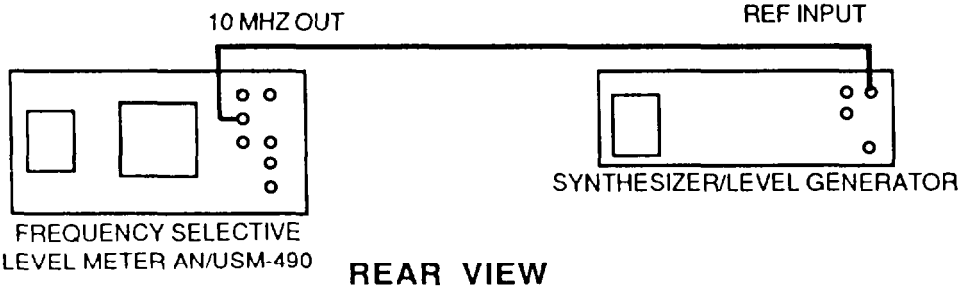
13. Calculate power for each frequency using the following formula:

- P1KHz = P + 2dB + (2dB step error for 1KHz) = _____
- P1MHz = P + 2dB + (2dB step error for 1MHz)= _____
- P3MHz = P + 2dB + (2dB step error for 3MHz) = _____
- P10MHz = P + 2dB + (2dB step error for 10MHz)= _____
- P30MHz = P + 2dB + (2dB step error for 30MHz)= _____

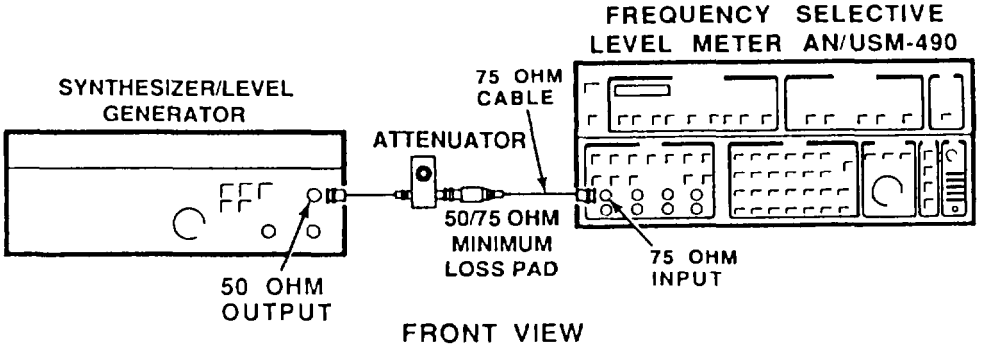
Where P is power from table 2-4, and 2dB step error is from Synthesizer/Level Generator calibration sheet.

14. Calculate minimum and maximum desired values in table 2-6, from page 2-119 to 2-123 using power values calculated in step 13.

15. Connect test equipment as shown below.



REAR VIEW



FRONT VIEW

AMPLITUDE ACCURACY TEST—Continued.

16. On Synthesizer/Level Generator:

- Set output to 1KHz at 10dBm.
- Set amplitude increment to 2dB.

17. On Level Meter

Initialize instrument.

Select 20Hz bandwidth.

Select 75Ωinput.

Tune to 1KHz, measure level of test signal, and record as measurement for 75Ω,1KHz at 2dB in table 2-6.

NOTE

The level of Synthesizer/Level Generator attenuation does not correspond to front panel displayed amplitude.
Example:
10.xx dB Synthesizer/Level Generator displayed amplitude equals 2dB of attenuation,
8.xx dB Synthesizer/Level Generator displayed amplitude equals 4dB of attenuation,
6.xx dB Synthesizer/Level Generator displayed amplitude equals 6dB of attenuation,
4.xx dB Synthesizer/Level Generator displayed amplitude equals 8dB of attenuation, ETC.

18. Perform measurements for 4dB, 6dB, 8dB, 10dB, 20dB, 30dB, 40dB, 50dB, 60dB and 70dB of Synthesizer/Level Generator attenuation using decrement function. Record Level Meter amplitude for 75Ω1KHz at dB level selected in table 2-6.

19. Set Synthesizer/Level Generator attenuation to 66dB.

20. Set Attenuator to 40dB.

21. Subtract calibration error (supplied on calibration report) of Attenuator from measured level and record measurement for 75Ω,1KHz at 106dB in table 2-6.

22. Verify that all measured values are within specified limits.

23. On Synthesizer/Level Generator:

- Set output to 1MHz at level listed in table 2-4, column 4 for 1MHz.

24. On Level Meter,

- Tune to 1 MHz,

Repeat steps 18 thru 22 and record measurements for 75Ω1MHz at dB level listed in table 2-6.

26. On Synthesizer/Level Generator:

- Set output to 3MHz at level listed in table 2-4, column 4 for 3MHz.

AMPLITUDE ACCURACY TEST—Continued.

27. On Level Meter,

- Tune to 3MHz.

28. Repeat steps 18 thru 22 and record as measurements for 75Ω3MHz at dB level listed in table 2-6.

29. On Synthesizer/Level Generator:

- Set output to 10MHz at level listed in table 2-4, column 4 for 10MHz.

30. On Level Meter,

- Tune to 10MHz.

31. Repeat steps 18 thru 22 and record as measurements for 75Ω,10MHz at dB level listed in table 2-6.

32. On Synthesizer/Level Generator:

- Set output to 30MHz at level listed in table 2-4, column 4 for 30MHz.

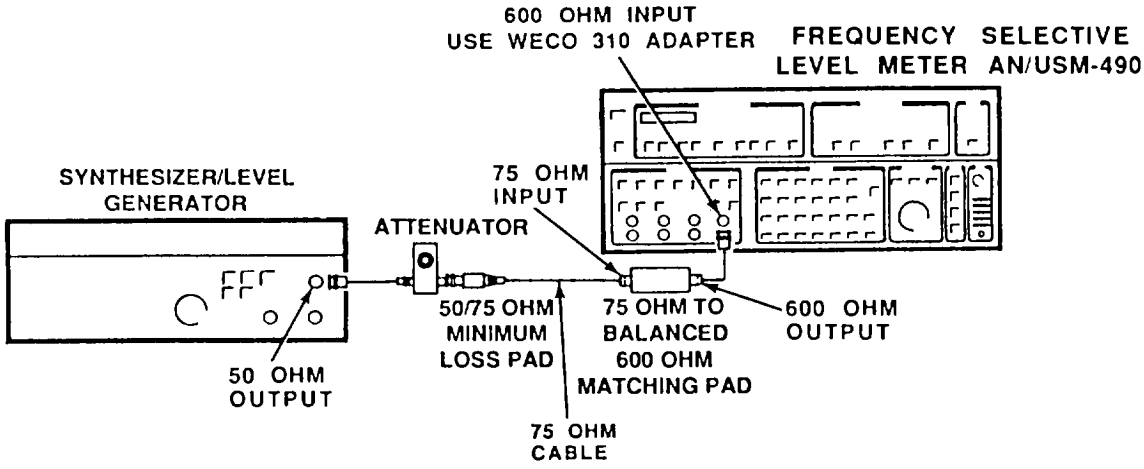
33. On Level Meter,

- Tune to 30MHz.

34. Repeat steps 18 thru 22 and record as measurements for 75Ω,30MHz at dB level listed in table 2-6.

35. On Level Meter, select 600Ωinput.

36. Connect test equipment as shown below.



37. Set Synthesizer/Level Generator output to 1KHz at 10dBm.

AMPLITUDE ACCURACY TEST—Continued.

38. On Level Meter,

- Tune to 1 KHz.

39. Repeat step 18 and record as measurements for 600Ω,1KHz at dB level listed in table 2-6.

40. Set Synthesizer/Level Generator attenuation to 50dB.

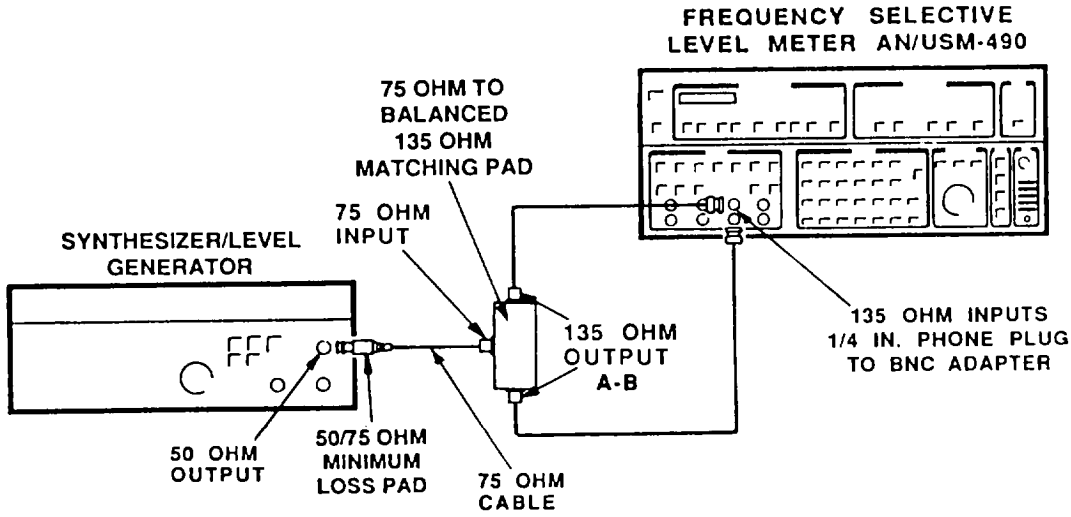
41. Set Attenuator to 40dB.

42. Subtract calibration error (supplied on calibration report) of Attenuator from measured level and record measurement for 600Ω,1KHz at 90dB in table 2-6.

43. Verify that all measured values are within specified limits,

44. On Level Meter, select 135Ωinput.

45. Connect test equipment as shown below.



46. On Synthesizer/Level Generator:

- Set output to 1MHz at level listed in table 2-4, column 4 for 1MHz.

47. On Level Meter,

- Tune to 1MHz.

48. Repeat step 18 and record as measurements for 135Ωat 1MHz at dB level listed in table 2-6.

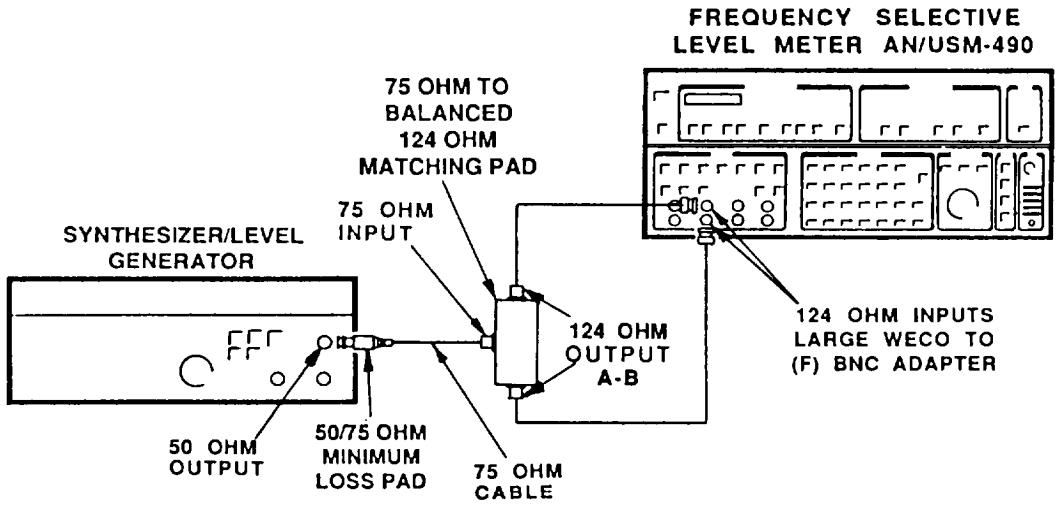
49. Set Synthesizer/Level Generator attenuation to 98dB. Record measurement for 135Ω,1MHz at 98dB in table 2-6.

AMPLITUDE ACCURACY TEST—Continued.

50. Verify that all measured values are within specified limits.

51. On Level Meter, select 124Ω input,

52. Connect test equipment as shown below.



53. On Synthesizer/Level Generator:

- Set output to 1MHz at level listed in table 2-4, column 4 for 1MHz.

54. On Level Meter,

- Tune to 1MHz.

55. Repeat step 18 and record as measurements for 124Ωat 1MHz at dB level listed in table 2-6.

56. Repeat step 49 and record as measurements for 124Ωat 1MHz at 98dB in table 2-6.

57. Verify that all measured values are within specified limits.

58. On Synthesizer/Level Generator:

- Set output to 3MHz at level listed in table 2-4, column 4 for 3MHz.

AMPLITUDE ACCURACY TEST—Continued.

59. On Level Meter.

- Tune to 3MHz.

60. Repeat steps 55 thru 57 and record as measurements for 124Ω at 3MHz at dB level listed in table 2-6.

61. On Synthesizer/Level Generator:

- Set output to 10MHz at level listed in table 2-4, column 4 for 10MHz.

62. On Level Meter,

- Tune to 10MHz.

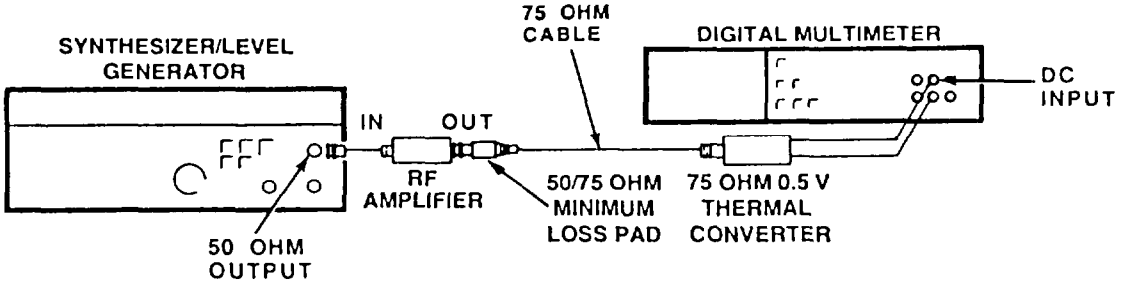
63. Repeat steps 55 thru 57 and record as measurements for 124Ω at 10MHz at dB level listed in table 2-6.

62. Set Synthesizer/Level Generator output to -6dBm.

CAUTION

Connect Thermal Converter to Digital Multimeter before connecting to Synthesizer/Level Generator.

66. Connect test equipment as shown below.



66. On Synthesizer/Level Generator:

- Set frequency to 1MHz at -6dBm.
- Increment or decrement amplitude by 0.01dB until DC output of thermal converter is as close as possible to Vth.
- Record indication in table 2-5, column 6 for 1MHz.

67. Repeat step 66 using frequencies of 3MHz, 10MHZ, and 30MHz.

AMPLITUDE ACCURACY TEST—Continued.

68. Using the following, calculate dB error (from % on calibration report) at 1MHz, 3MHz, 10MHz, and 30MHz.

$$\text{dB Error} = 20\log\left(\frac{\%\ \text{Error}}{100} + 1\right)$$

Record dB errors in table 2-5, column 7.

69. Subtract numbers in column 7 from numbers in column 6 and record results in column 8.

Table 2-5. Power Calculations for Amplitude Accuracy.

Calculated P _____
Measured Vth _____

(5) Frequency	(6) Frequency synthesizer setting for Vth	(7) THC error	(8) Synthesizer/level generator setting for flat signal
1KHz	10.00 dBm	0 dB	10.00 dBm
1MHz	_____dBm	_____dB	_____dBm
3MHZ	_____dBm	_____dB	_____dBm
10MHz	_____dBm	_____dB	_____dBm
30MHZ	_____dBm	_____dB	_____dBm

NOTE

Due to the tight tolerance required in the amplitude accuracy test, specified limits must be calculated for each test setup.

NOTE

If the Synthesizer/Level Generator output exceeds 4.99dBm during this adjustment; subtract 2dB from the attenuator steps in table 2-6 for 1MHz, 4dBm to 20dBm and change the equation for P1MHz to read as follows:

P1MHz = P+18dB+(16dB step error for 1MHz).

AMPLITUDE ACCURACY TEST—Continued.

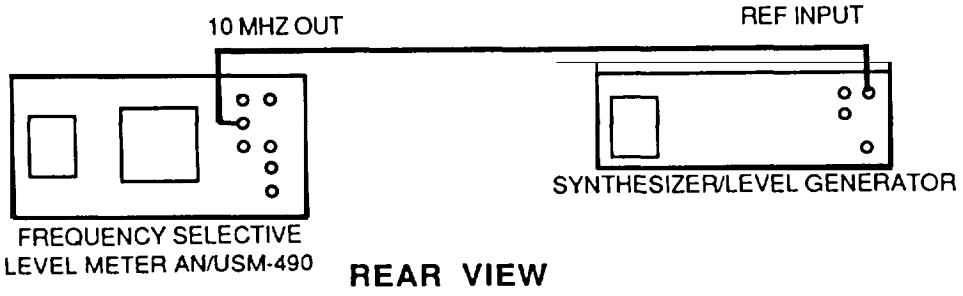
70. Calculate power for each frequency using the following formula:

- P1MHz = P + 18dB + (18dB step error for 1MHz) = _____
- P3MHZ = P + 18dB + (18dB step error for 3MHz) = _____
- P10MHz = P + 18dB + (18dB step error for 10MHz) = _____
- P30MHz = P + 18dB + (18dB step error for 30MHz) = _____

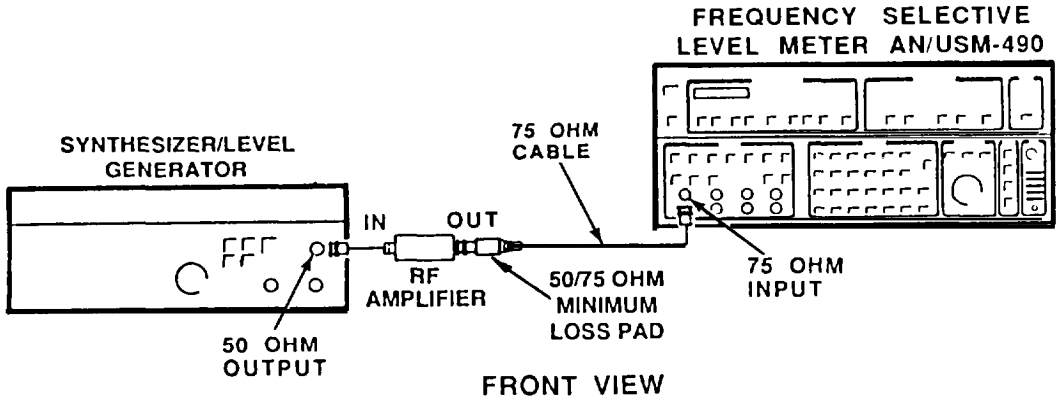
Where P is power from table 2-5, and 18dB step error is from Synthesizer/Level Generator calibration sheet.

71. Calculate minimum and maximum desired values in table 2-6, from page 2-124 to 2-125 using power values calculated in step 70.

72. Connect test equipment as shown below.



REAR VIEW



FRONT VIEW

73. On Synthesizer/Level Generator:

- Set output to 1MHz at level listed in table 2-5, column 8 for 1MHz.

AMPLITUDE ACCURACY TEST—Continued.

74. On Level Meter,

- Select 75Ω input.
- Tune to 1MHz.
- Measure level of test signal, and record as measurement for 75Ω, 1MHz at 18dB in table 2-6.

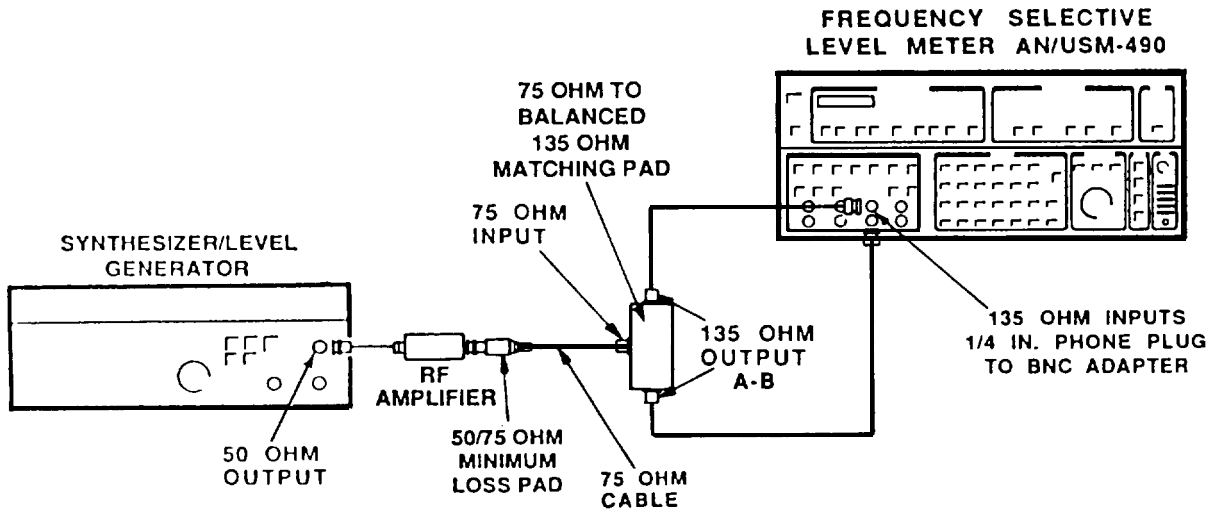
75. Perform measurements for 10dB and 6dB of Synthesizer/Level Generator attenuation. Record Level Meter amplitude for 75Ω, 1MHz at dB level selected in table 2-6.

76. Repeat steps 73 thru 75 for frequencies of 3MHz, 10MHz, and 30MHz and record measurement in table 2-6.

77. Verify that all measured values are within specified limits.

78. On Level Meter, select 135Ω input.

79. Connect test equipment as shown below.



80. On Synthesizer/Level Generator:

- Set output to 1MHz at level listed in table 2-5, column 8 for 1MHz.

81. On Level Meter,

- Tune to 1MHz.
- Measure level of test signal, and record as measurement for 135Ω, 1MHz at 18dB in table 2-6.

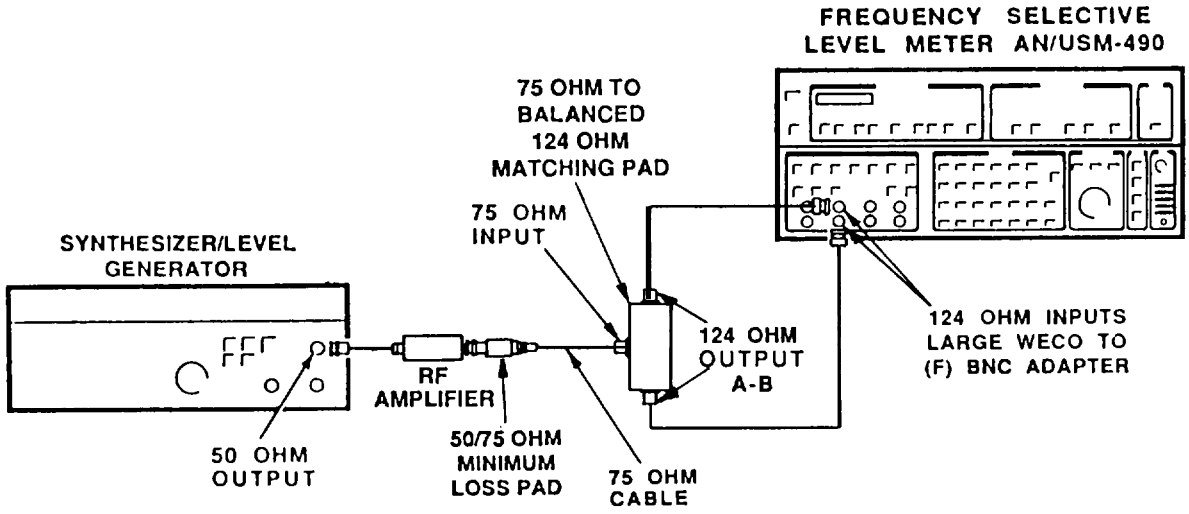
82. Perform measurements for 10dB and 6dB of Synthesizer/Level Generator attenuation. Record Level Meter amplitude for 135Ω, 1MHz at dB level selected in table 2-6.

83. Verify that all measured values are within specified limits.

AMPLITUDE ACCURACY TEST—Continued.

84. On Level Meter, select 124Ωinput.

85. Connect test equipment as shown below.



86. On Synthesizer/Level Generator:

- Set output to 1MHz at level listed in table 2-5, column 8 for 1MHz.

87. On Level Meter,

- Tune to 1MHz.
- Measure level of test signal, and record as measurement for 124Ω1MHz at 18dB in table 2-6.

88. Perform measurements for 10dB and 6dB of Synthesizer/Level Generator attenuation. Record Level Meter amplitude for 124Ω,1MHz at dB level selected in table 2-6.

89. Repeat steps 86 thru 88 for frequencies of 3MHz and 10MHz and record measurement in table 2-6.

90. Verify that all measured values are within specified limits.

91. Disconnect test setup.

HALF-POWER BAND WIDTH (–3dB) TEST.

1. Initialize Level Meter.

2. On Level Meter

- Turn AUTO CAL off.
- Press RECALL, "." (decimal), CNTR—>FREQ, and then number 7 push button.
- Press RDNG—>OFFSET and turn OFFSET on.
- Press Frequency Tune FREQ STEP push button.
- Tune frequency above and below 1MHz until Level Meter indicates –3dBmO. Record both frequencies.

3. Subtract lower frequency from higher frequency. Verify frequency is from 2790Hz to 3410HZ.

4. Repeat steps 1 thru 3 using 20 Hz. Verify frequency is from 18Hz to 22Hz.

5. Repeat steps 1 thru 3 using 400Hz. Verify frequency is from 360Hz to 440Hz.

PASS-BAND FLATNESS TEST.

1. Initialize Level Meter.

2. On Level Meter.

- Turn AUTO CAL off.
- Press RECALL, "." (decimal), CNTR—>FREQ, and then number 7 push button.
- Press RDNG—>OFFSET and turn OFFSET on.
- Set FREQ to 999,000Hz.
- Slowly tune frequency to 1,001,000Hz and verify Level Meter reads 0 ± 0.3dBmO.

3. On Level Meter:

- Select 20Hz.
- Press RECALL, " ." (decimal), CNTR—>FREQ, and then number 7 push button.
- Press RDNG—>OFFSET and turn OFFSET on,
- Set FREQ to 999,997 Hz.
- Slowly tune frequency to 1,000,003Hz and verify Level Meter reads 0 ± 03dBmO.

PASS-BAND FLATNESS TEST—Continued.

4. On Level Meter.
   - Select 400Hz.
   - Press RECALL, "." (decimal), CNTR->FREQ, and then number 7 push button.
   - Press RDNG—>OFFSET and turn OFFSET on.
   - Set FREQ to 9,999,950Hz.
   - Slowly tune frequency to 10,000,050HZ and verify Level Meter reads 0 ± 0.3dBmO.

400Hz FILTER SHAPE TEST.

1. Initialize Level Meter.
2. On Level Meter:
   - Turn AUTO CAL off.
   - Press RECALL, " ." (decimal), CNTR—>FREQ, and then number 7 push button.
   - Press RDNG—>OFFSET and turn OFFSET on.
   - Press FREQ STEP push button.
   - Select 400Hz bandwidth.
   - Slowly tune frequency above and below 1MHz until Level Meter reads –60dBmO. Record both frequencies.
3. Subtract 1MHz from each frequency. Verify that each indication is from–1100Hz minimum to + 1100Hz maximum.

PILOT (20Hz) FILTER BANDWIDTH TEST.

1. Initialize Level Meter.

2. On Level Meter

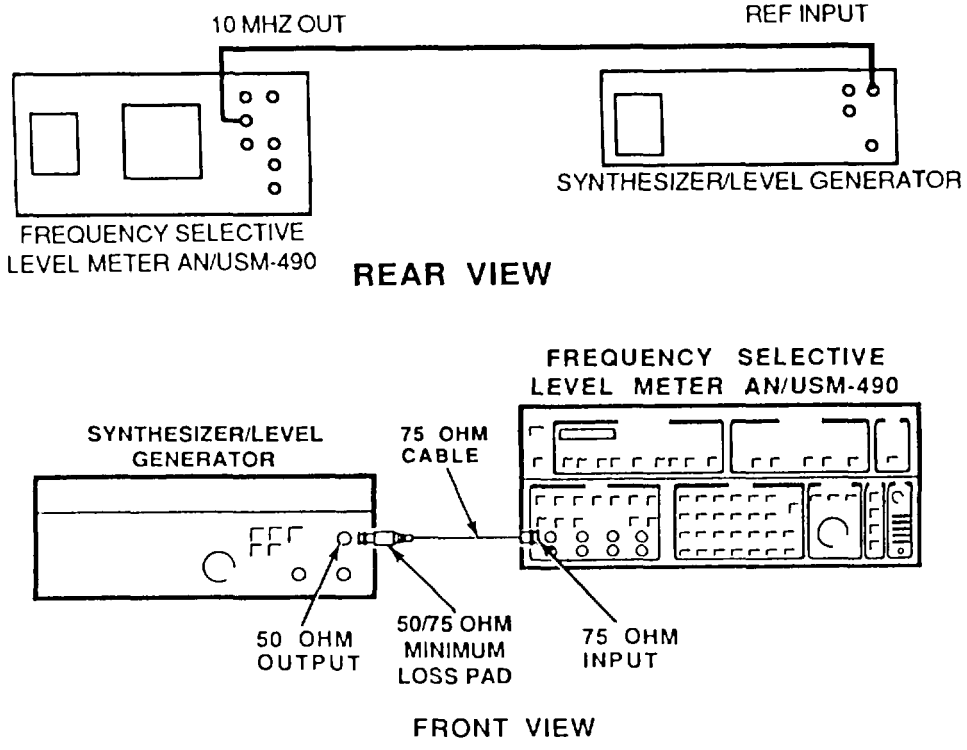
- Turn AUTO CAL off.
- Press RECALL, "." (decimal), CNTR—>FREQ, and then number 7 push button.
- Press RDNG—>OFFSET and turn OFFSET on.
- Select 20Hz bandwidth.
- Press FREQ STEP push button
- Slowly tune frequency above and below 1MHz until Level Meter reads -30dBmO.

3. Subtract 1MHz from each frequency. Verify that each indication is from -45Hz minimum to +45Hz maximum.

4. Repeat steps 2 and 3 for –60dBmO reading. Verify that each indication is from –90Hz minimum to +90Hz maximum.

CARRIER FREQUENCY REJECTION TEST.

1. Connect test equipment as shown below.



CARRIER FREQUENCY REJECTION TEST—Continued.

2. Initialize Level Meter.
3. Set Synthesizer/Level Generator output to 1MHz at 0dBm.
4. On Level Meter
   - Press RDNG—>OFFSET and turn OFFSET on.
   - Select 3100Hz bandwidth.
   - Enter step frequency of 1850Hz.
   - Step frequency one step above and one step below 1MHz. Level indication should be –60dBm or lower.
5. Leave test setup for next test.

ADJACENT CHANNEL REJECTION TEST.

1. Verify test setup identical to Carrier Frequency Rejection Test.
2. Initialize Level Meter.
3. Set Synthesizer/Level Generator output to 1MHz at 0dBm.
4. On Level Meter
   - Press RDNG—>OFFSET and turn OFFSET on.
   - Select 3100Hz bandwidth.
   - Enter step frequency of 2850Hz.
   - Step frequency one step above and one step below 1MHz, Level indication should be –75dBm or lower.
5. Disconnect test setup.

RESIDUAL NOISE TEST.

1. Initialize Level Meter.
2. On Level Meter
   - Select 75Ω input.
   - Enter a frequency of 32.495 MHz.

RESIDUAL NOISE TEST—Continued.

3. Verify a level indication of not more than –116dBm.

4. Change Level Meter input, bandwidth, and frequency as indicated in table shown below and verify that indications are within specification.

Input	Bandwidth	Frequency	Indication
75 ohm	400Hz	32.495 MHz	<–120dBm
75 ohm	20Hz	32.495 MHz	<–120dBm
124 ohm	3,100HZ	9.995MHZ	<–116dBm
124 ohm	400Hz	9.995MHZ	<–120dBm
124 ohm	20Hz	9.995MHZ	<–120dBm
135 ohm	3,100HZ	0.995MHZ	<–116dBm
135 ohm	400Hz	0.995MHZ	<–120dBm
135 ohm	20Hz	0.995MHZ	<–120dBm
75 ohm	3,100HZ	8.01KHZ	<–105dBm
75 ohm	400Hz	8.01KHZ	<-105dBm
75 ohm	20Hz	8.01KHZ	<–105dBm
124 ohm	3,100HZ	8.01KHZ	<–105dBm
124 ohm	400Hz	8.01KHZ	<–105dBm
124 ohm	20Hz	8.01KHZ	<–105dBm
135 ohm	3,100Hz	8.01KHZ	<–105dBm
135 ohm	400Hz	8.01KHZ	<–105dBm
135 ohm	20Hz	8.01KHZ	<–105dBm
600 ohm	3,100HZ	8.01KHZ	<–105dBm
600 ohm	400Hz	8.01KHZ	<–105dBm
600 ohm	20Hz	8.01 KHz	<–105dBm

RESIDUAL SPURIOUS RESPONSES TEST.

1. Initialize Level Meter.

2. On Level Meter

   l Select 75Ω input.

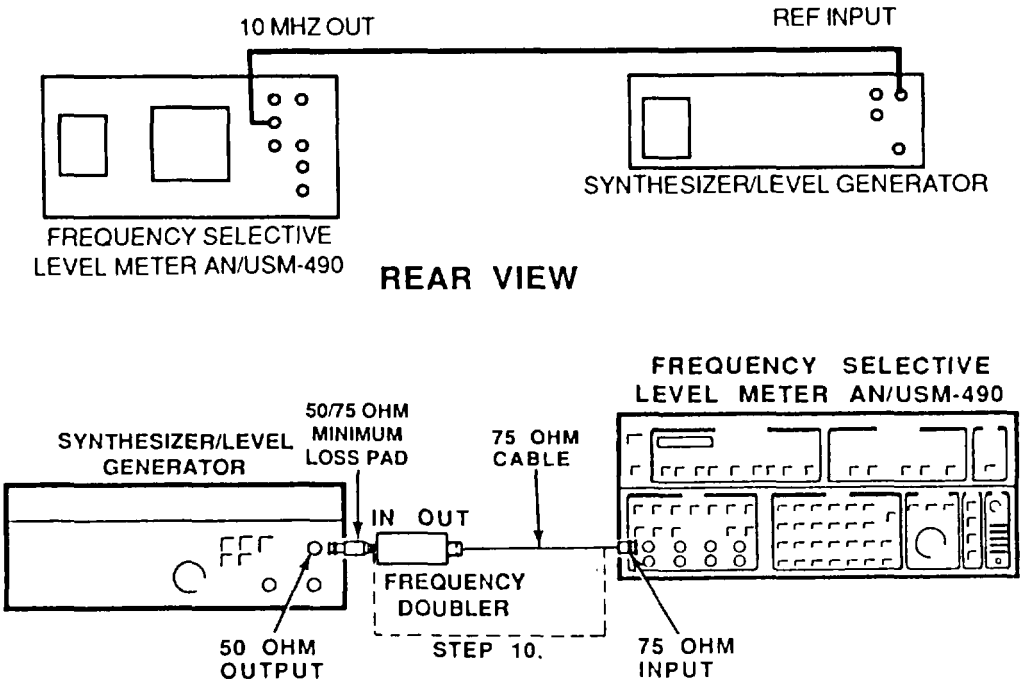
   l Select 20Hz bandwidth.

3. Tune Level Meter to 360Hz, 420Hz, 100KHz, 200KHz, 300KHz, 400KHz, 10MHz, 20MHz, and 30MHz. Verify that level does not exceed –115dBm at each frequency.

4. Tune Level Meter to 60Hz, 120Hz, 180Hz, 240 Hz, and 300Hz. Verify that level does not exceed –100dBm at each frequency.

INPUT SPURIOUS RESPONSE TEST.

1. Connect test equipment as shown below.



2. Initialize Level Meter.
3. On Level Meter, select 75Ω input.
4. Set Synthesizer/Level Generator output to 15MHz at 10dBm,
5. On Level Meter
   - Tune to 30MHz.
   - Select 20Hz bandwidth.
   - Press RDNG—>OFFSET and turn OFFSET on.
6. Set Synthesizer/Level Generator output to 50.5 MHz at 10dBm.
7. On Level Meter, tune to 1MHz. Level indication should be less than or equal to –80dBm.

NOTE

If UL flashes, press RANGE 100dB.

INPUT SPURIOUS RESPONSE TEST—Continued.

8. Set Synthesizer/Level Generator output to 65MHz at 10dBm.

9. On Level Meter, tune to 30MHz. Level indication should be less than or equal to -80dBm.

10. Remove Frequency Doubler.

11. Set Synthesizer/Level Generator output to 1.03125MHz at 5.7dBm.

12. On Level Meter

- Turn OFFSET off.
- Tune to 1MHz. Level indication should be less than or equal to –80dBm.

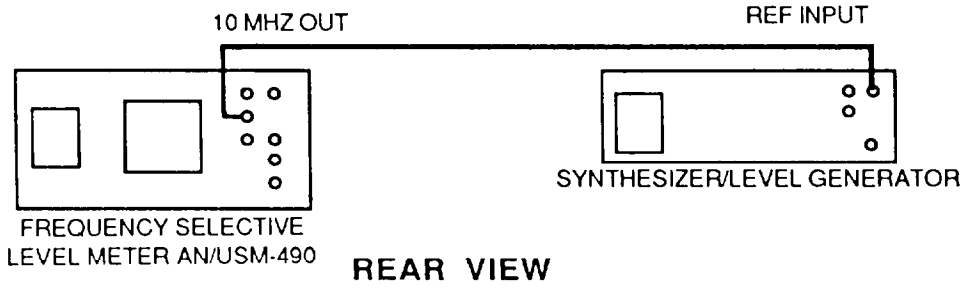
13. Set Synthesizer/Level Generator and Level Meter controls as indicated in table shown below and verify that indications are within specification.

Synthesizer/level generator		Level meter	
Frequency	Output level	Frequency	Indication
30.03125 MHz	+5.7dBm	30MHZ	<-80dBm
32.00130MHz	+5.7dBm	31.99985 MHz	<–75dBm
32,090,000.1Hz	+5.7dBm	31,990,000.1Hz	<–80dBm

14. Disconnect test setup.

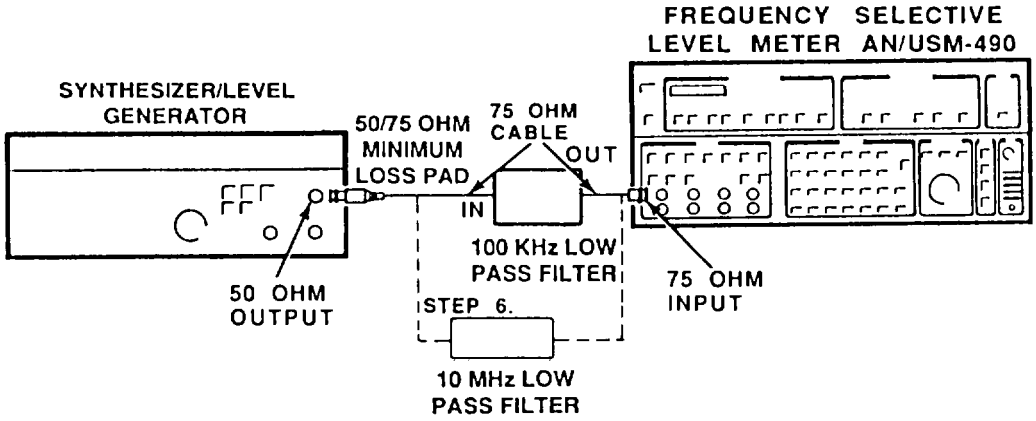
HARMONIC DISTORTION TEST.

1. Connect test equipment as shown below.



REAR VIEW

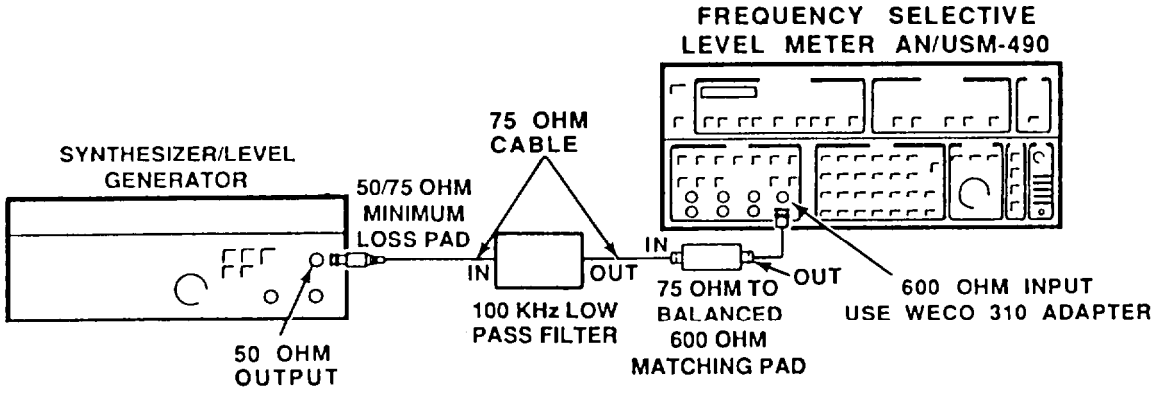
HARMONIC DISTORTION TEST - Continued.



2. Initialize Level Meter.
3. On Level Meter.
   - Press 75Ω input.
   - Tune to 100KHz.
   - Select 100dB Range.
   - Select 20Hz bandwidth.
   - Select ENTRY mode.
   - Enter 0dBm full scale.
   - Press MEAS CONT push button.
4. Set Synthesizer/Level Generator output to 100 KHz and at a level such that Level Meter indicates 0dBm.
5. On Level Meter
   - Tune to 200KHz. Level indication should be less than or equal to -70dBm.
   - Tune to 300KHz. Level indication should be less than or equal to -70dBm.
6. Replace 100KHz low pass filter with a 10MHz low pass filter.
7. On Level Meter, tune to 10MHz.
8. Set Synthesizer/Level Generator output to 10MHZ at a level such that Level Meter indicates 0dBm.
9. On Level Meter
   - Tune to 20MHz. Level indication should be less than or equal to –70dBm.
   - Tune to 30MHz. Level indication should be less than or equal to –70dBm.

HARMONIC DISTORTION TEST—Continued.

10. Connect test equipment as shown below.



11. On Level Meter,

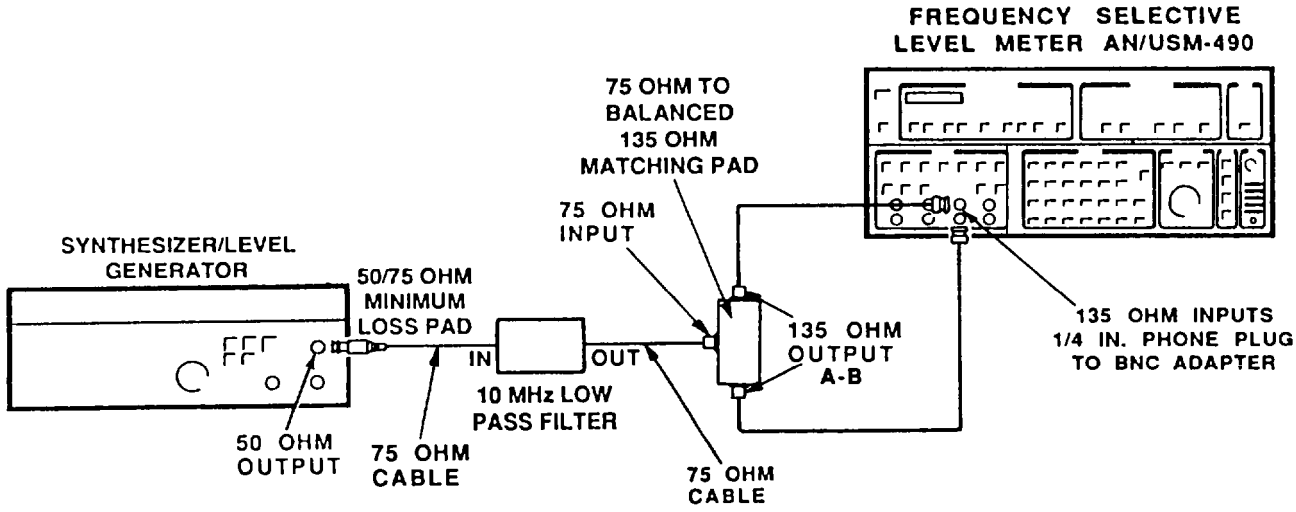
- Select 600Ω input.
- Tune to 100KHz.
- Enter –10dBm full scale.
- Press MEAS CONT push button.

12. Set Synthesizer/Level Generator output to 100KHz at a level such that Level Meter indicates –10dBm.

13. On Level Meter

- Press RDNG—>OFFSET and OFFSET push button.
- Tune to 200KHz. Level indication should be less than or equal to –70dBm.
- Tune to 300KHz. Level indication should be less than or equal to -70dBm.

14. Connect test equipment as shown below.



HARMONIC DISTORTION TEST—Continued.

15. On Level Meter:

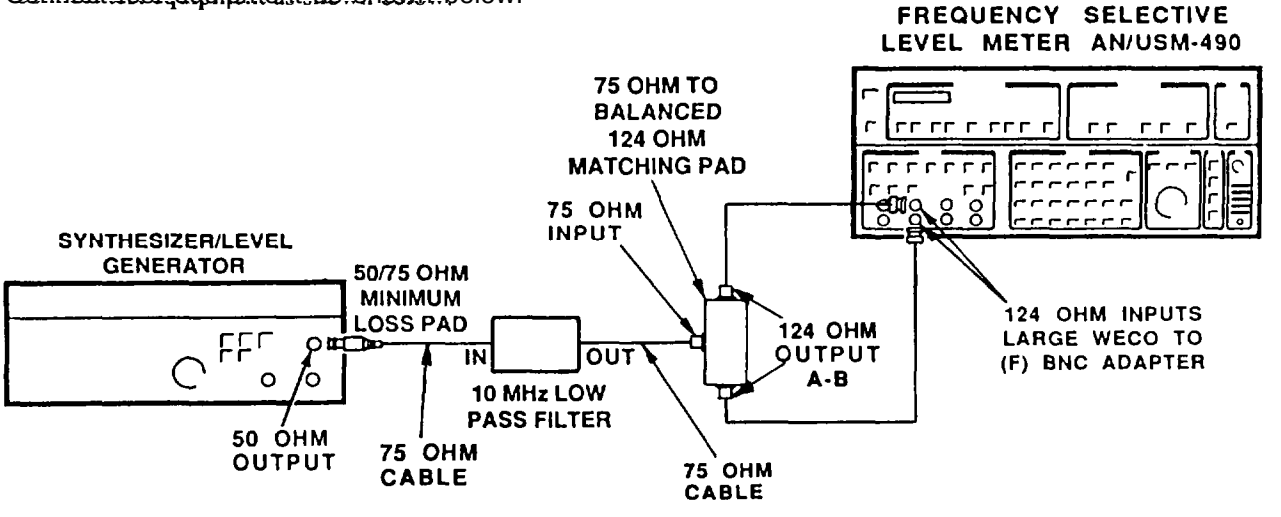
- Select 135Ω input.
- Tune to 100KHz.
- Turn OFFSET off.

16. Set Synthesizer/Level Generator output to 100KHz at a level such that Level Meter indicates –10dBm.

17. On Level Meter

- Press RDNG—>OFFSET and turn OFFSET on.
- Tune to 200KHz. Level indication should be less than or equal to -70dBm.
- Tune to 300KHz. Level indication should be less than or equal to –70dBm.

18. Connect test equipment as shown below.



19. On Level Meter:

- Tune to 10MHz.
- Turn OFFSET off.

20. Set Synthesizer/Level Generator output to 10MHz at a level such that Level Meter indicates -10dBm.

21. On Level Meter

- Press RDNG—>OFFSET and OFFSET push button.
- Tune to 20MHz. Level indication should be less than or equal to –70dBm.
- Tune to 30MHz. Level indication should be less than or equal to -70dBm.

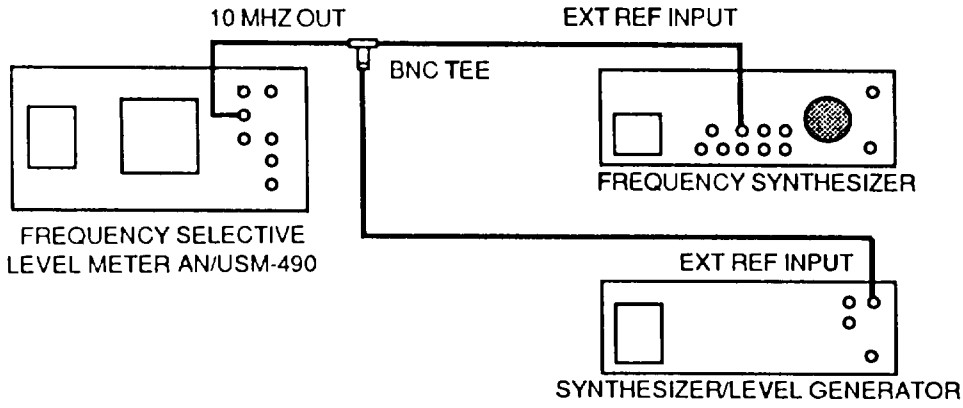
22. Disconnect test setup.

INTERMODULATION DISTORTION TEST.

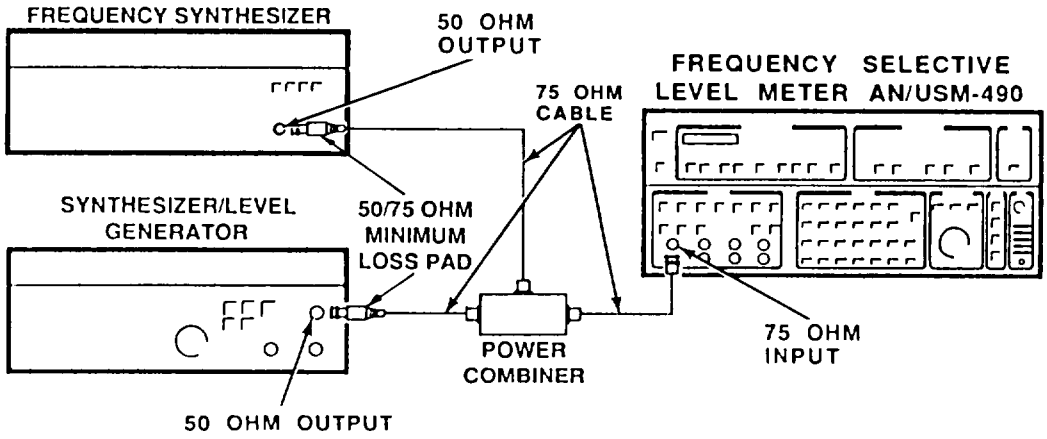
1 . Connect test equipment as shown below.

NOTE

Verify cables are same length when connecting front view.



REAR VIEW



FRONT VIEW

2 . Initialize Level Meter.

3 . On Level Meter,

- Select 75Ω input.
- Select 20Hz bandwidth.
- Sets ENTRY FULL SCALE to 0dBm.
- Select 100dB range.

4 . Set Frequency Synthesizer output to 8MHz at 8.7dBm.

INTERMODULATION DISTORTION TEST—Continued.

5. Set Synthesizer/Level Generator output 9MHz at 8.7dBm.

6. On Level Meter,

- Press MEAS CONT push button.
- Verify, range level indication is be less than or equal to –75dBm.

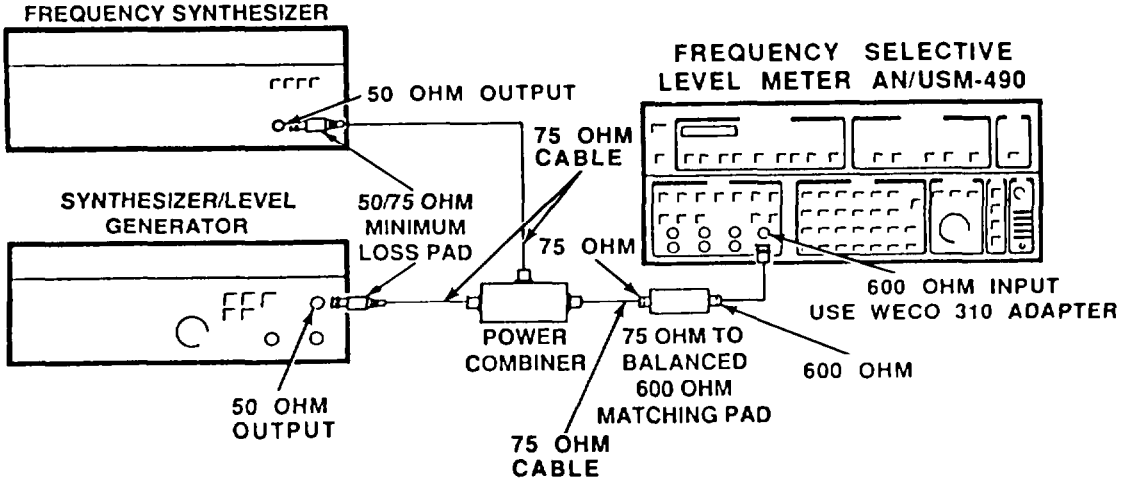
NOTE

If 0VLD indicator flashes, disregard.

7. Set Synthesizer/Level Generator, Frequency Synthesizer, and Level Meter outputs as indicated in table shown below and verify that indications are within specified limits.

Synthesizer/level generator		Frequency synthesizer		Level meter	
Frequency	output level	Frequency	Level	Frequency	Indication
9MHZ	8.7dBm	8MHz	8.7dBm	17 MHZ	<-75dBm
9MHZ	8.7dBm	8MHz	8.7dBm	10MHz	<-75dBm
9MHZ	8.7dBm	8MHz	8.7dBm	7MHZ	<–75dBm
21 MHZ	8.7dBm	20.993MHz	8.7dBm	7KHZ	<–7 mm
21 MHZ	8.7dBm	20.993 MHz	8.7dBm	21 .007 MHZ	<-70dBm
21 MHZ	8.7dBm	20.993 MHz	8.7dBm	20.986MHz	<-70dBm

8. Connect test equipment as shown below:



INTERMODULATION DISTORTION TEST—Continued.

9. On Level Meter

- Select 600W input.
- Select 3100Hz bandwidth.

10. Set Frequency Synthesizer output to 100 KHz at 8.7dB.

11. Set Synthesizer/Level Generator output to 99.8 KHz at 8.7dB.

12. On Level Meter:

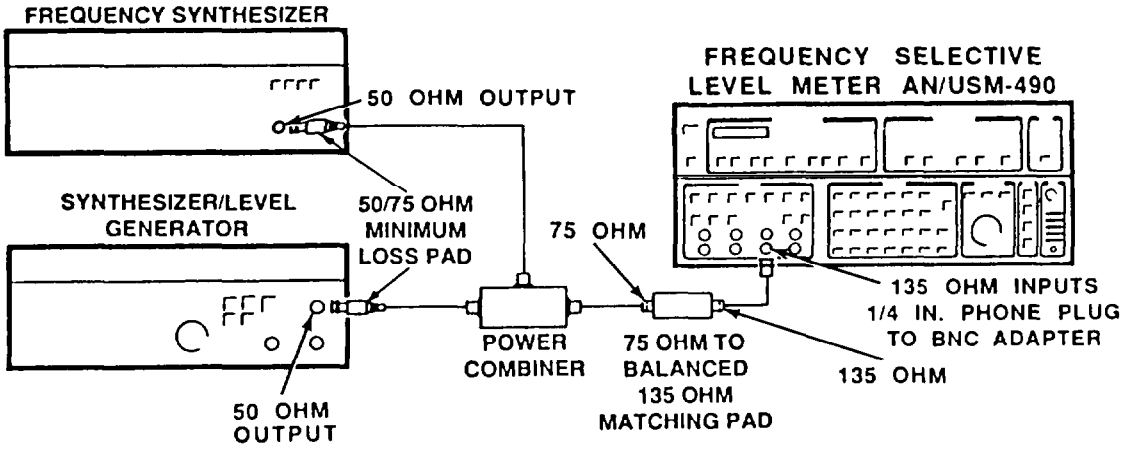
- Tune to 99.90KHz.
- Set full scale to -15dBm.
- Press RDNG—>OFFSET and press OFFSET push button.

13. Set Synthesizer/Level Generator, Frequency Synthesizer, and Level Meter frequencies and bandwidths as indicated in table shown below and verify that indications are within specified limits.

Synthesizer/level generator		Frequency synthesizer		Level meter		
Frequency	Level	Frequency	Level	Frequency	Bandwidth	Indication
200Hz	8.7dB	100KHz	8.7dB	99.8KHz	20Hz	≤–75dBm
200Hz	8.7dB	100KHz	8.7dB	100.2KHz	20Hz	≤–75dBm
200Hz	8.7dB	100KHz	8.7dB	199.8KHz	20Hz	≤–75dBm
93KHz	8.7dB	100KHz	8.7dB	7KHz	20Hz	≤–70dBm
93KHz	8.7dB	100KHz	8.7dB	107KHz	20Hz	≤–70dBm
93KHz	8.7dB	100KHz	8.7dB	193KHz	20Hz	≤–70dBm
93KHz	8.7dB	100KHz	8.7dB	86KHz	20Hz	≤–70dBm

INTERMODULATION DISTORTION TEST—Continued.

14. Connect test equipment as shown below:



15. On Level Meter

- Select 135Ω input.
- Select 3100HZ bandwidth.

16. Set Frequency Synthesizer output to 1MHz at 5.7dB.

17. Set Synthesizer/Level Generator output to 0.9998 MHz at 5.7dB.

18. On Level Meter

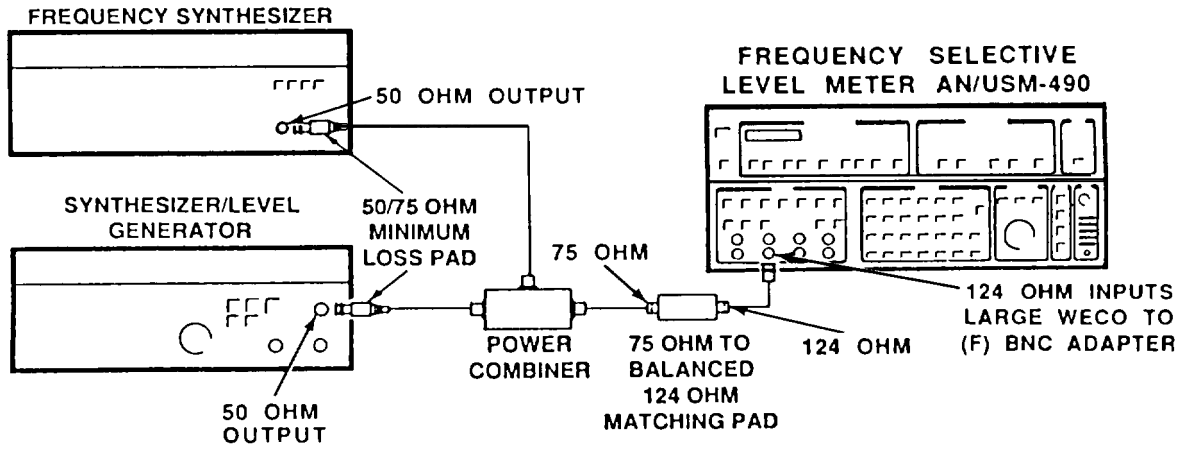
- Tune to 0.9999MHz.
- Set full scale to –10dBm.
- Press RDNG—>OFFSET and turn OFFSET on.

INTERMODULATION DISTORTION TEST—Continued.

19. Set Synthesizer/Level Generator, Frequency Synthesizer, and Level Meter frequencies and bandwidths as indicated in table shown below and verify that indications are within specified limits.

Synthesizer/level generator		Frequency synthesizer		Level meter		
Frequency	Level	Frequency	Level	Frequency	Bandwidth	Indication
10KHz	5.7dB	1MHz	5.7dB	990KHz	20Hz	≤–75dBm
10KHz	5.7dB	1MHz	5.7dB	1.01MHz	20Hz	≤–75dBm
10KHz	5.7dB	1MHz	5.7dB	1.99MHz	20Hz	≤–75dBm
993KHz	5.7dB	1MHz	5.7dB	7KHz	20Hz	≤–70dBm
993KHz	5.7dB	1MHz	5.7dB	1.993MHz	20Hz	≤–70dBm
993KHz	5.7dB	1MHz	5.7dB	1.007MHz	20Hz	≤–70dBm
993KHz	5.7dB	1MHz	5.7dB	986KHz	20Hz	≤–70dBm

20. Connect test equipment as shown below.



21. On Level Meter:

- Select 124Ωinput.
- Select 3 100HZ bandwidth.

INTERMODULATION DISTORTION TEST—Continued.

22. Set Frequency Synthesizer output to 9MHz at 5.7dB.

23. Set Synthesizer/Level Generator output to 9.002MHz at 5,7dB.

24. On Level Meter

- Tune to 9.000 1MHz.
- Set full scale to –10dBm.
- Press RDNG—>OFFSET and turn OFFSET on.

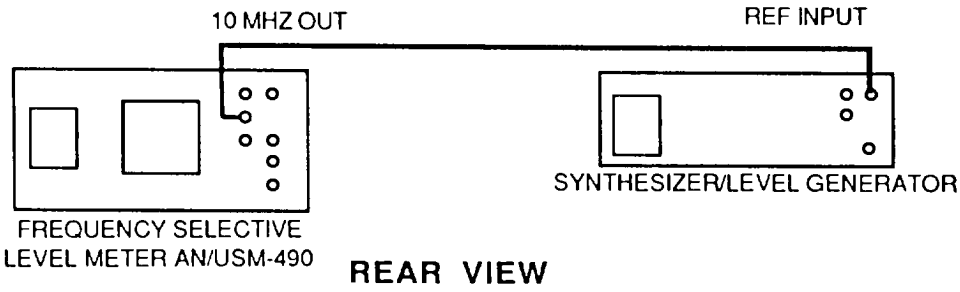
25. Set Synthesizer/Level Generator, Frequency Synthesizer, and Level Meter frequencies and bandwidths as indicated in table shown below and verify that indications are within specified limits.

Synthesizer/level generator		Frequency synthesizer		Level meter		
Frequency	Level	Frequency	Level	Frequency	Bandwidth	Indication
8MHz	5.7dB	9MHz	5.7dB	1MHz	20Hz	≤–75dBm
8MHz	5.7dB	9MHz	5.7dB	17MHz	20Hz	≤–75dBm
8MHz	5.7dB	9MHz	5.7dB	10MHz	20Hz	≤–75dBm
8MHz	5.7dB	9MHz	5.7dB	7MHz	20Hz	≤–75dBm
8.993MHz	5.7dB	9MHz	5.7dB	7KHz	20Hz	≤–70dBm
8.993MHz	5.7dB	9MHz	5.7dB	17.993MHz	20Hz	≤–70dBm
8.993MHz	5.7dB	9MHz	5.7dB	9.007MHz	20Hz	≤–70dBm
8.993MHz	5.7dB	9MHz	5.7dB	8.986MHz	20Hz	≤–70dBm

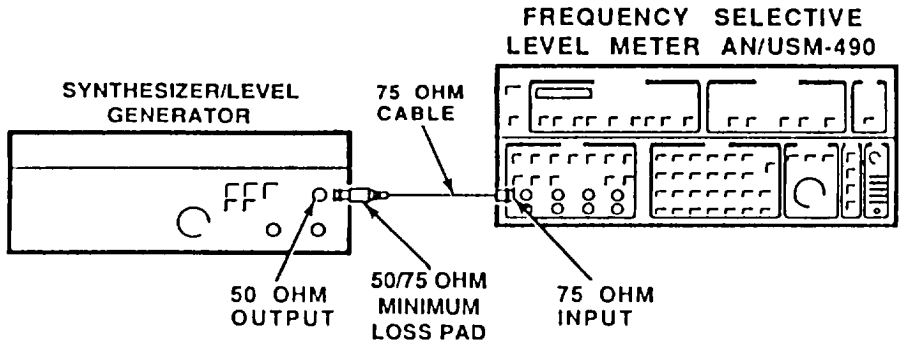
26. Disconnect test equipment setup.

IF REJECTION TEST.

1. Connect test equipment as shown below.



REAR VIEW



FRONT VIEW

2. Initialize Level Meter.
3. Set Synthesizer/Level Generator output to 50MHz at 5.7dBm.
4. On Level Meter
   - Press ENTRY.
   - Enter a full scale of 0dBm.
   - Select 10dB range.
   - Verify level indication is less than or equal to –60dBm.

NOTE

If 0VLD indicator flashes, disregard.

IF REJECTION TEST-Continued.

- Press MEAS CONT push button.

5. Set Synthesizer/Level Generator output to 15625Hz at 5.7dB. Verify level indication on Level Meter is less than or equal to -80dBm.

6. Disconnect test setup.

WIDEBAND POWER FLATNESS TEST.

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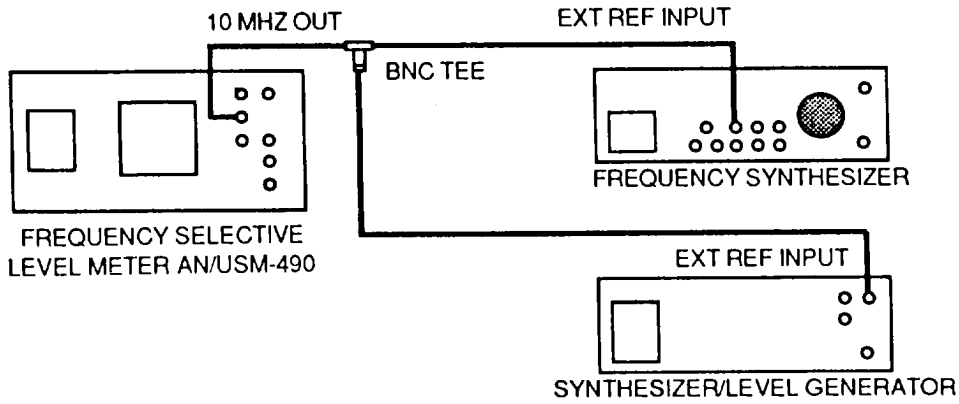
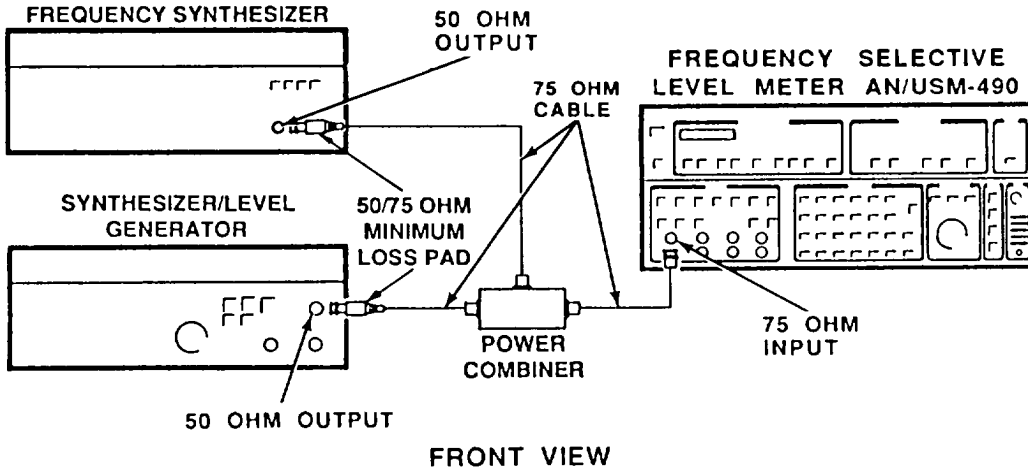
1. Connect test equipment as shown below.



REAR VIEW



FRONT VIEW

2. Initialize Level Meter.

3. On Level Meter, press WIDE BAND and AVE push button.

WIDEBAND POWER FLATNESS TEST—Continued.

4. Set Frequency Synthesizer output to 20KHz at 8.7dBm.
5. Set Synthesizer/Level Generator output to 30KHz at 8.7dBm.
6. On Level Meter, press RDNG—>OFFSET and OFFSET push button.
7. Set Synthesizer/Level Generator output to 10MHZ at 8.7dBm. Level indication should be 0M.8dBmO.
8. Set Frequency Synthesizer output to 200Hz at 8.7dB.
9. Set Synthesizer/Level Generator output to 1KHz at 8.7dB.
10. Press RDNG—>OFFSET and turn OFFSET on.
11. Set Synthesizer/Level Generator output to 32MHz at 8.7dB. Level indication should be 0 ± 1.8dBmO.
12. Repeat steps 4 thru 11 setting amplitude of Synthesizer/Level Generator and Frequency Synthesizer to –36.3dBm.
13. Disconnect test setup.

TRACKING OUTPUT TEST.

1. Connect Level Meter tracking output (rear panel Fo 0-32MHZ) to 75Ωinput (front panel) using 75Ωcable.
2. Initialize Level Meter.
3. On Level Meter
   - Select 75Ω input,
   - Select 20Hz bandwidth.
   - Turn AVERAGE to on.
   - Enter frequency of 10KHz.
4. Verify that level indicates 0 ± 0.5dBm.
5. On Level Meter
   - Press RDNG—>OFFSET push button.
   - Turn OFFSET to on.
   - Enter frequency of 200Hz.
6. Verify that level indicates 0 ± 0.5dBm.

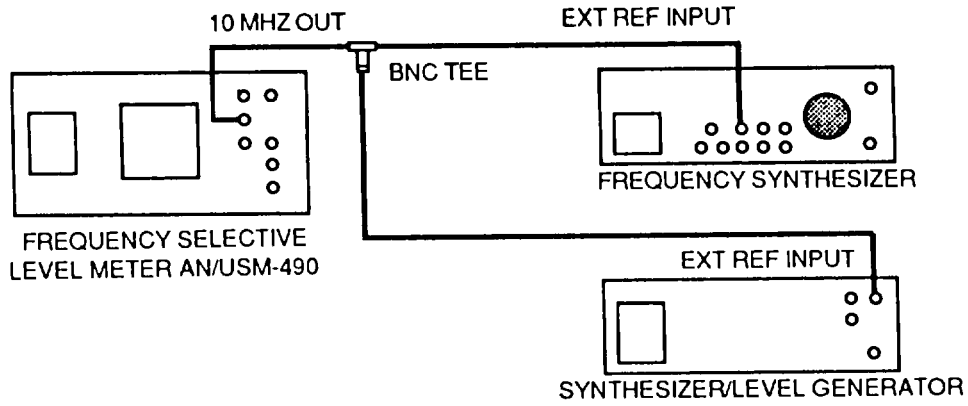
TRACKING OUTPUT TEST—Continued.

7. Repeat step 6 for frequencies of 500KHz and 32.5MHz.

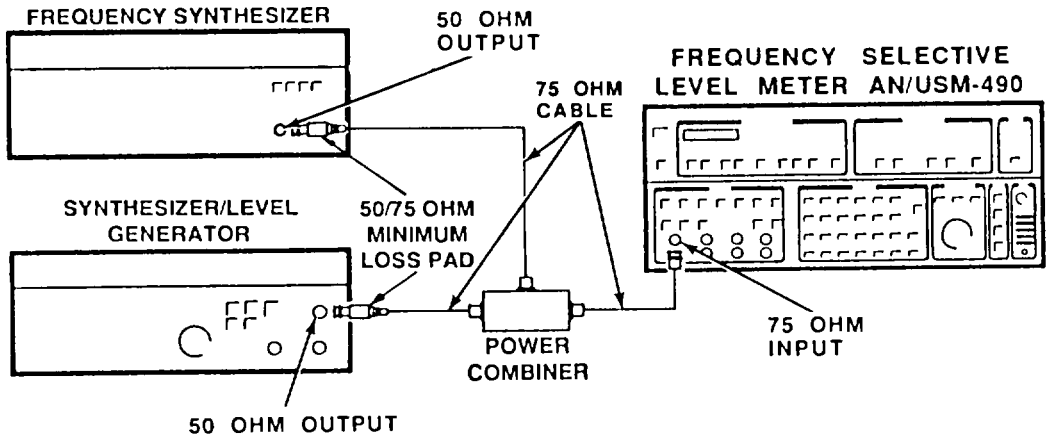
8. Disconnect test setup.

PHASE JITTER ACCURACY TEST.

1. Connect test equipment as shown below.



REAR VIEW



FRONT VIEW

2. Initialize Level Meter.

3. Set Frequency Synthesizer output to 11004HZ at -56dBm.

4. Set Synthesizer/Level Generator output to 11104Hz at -76dBm.

PHASE JITTER ACCURACY TEST—Continued.

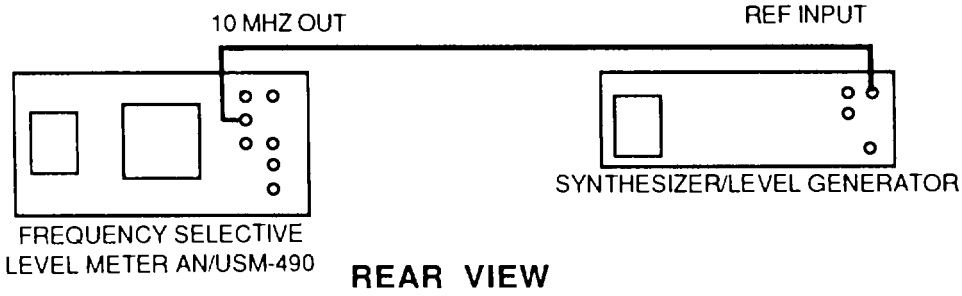
5. On Level Meter

- Select 100dB range.
- Tune to 10KHz.
- Press SHIFT and ∅±JITTER push button. Level indication should be from 10 to 13" peak-to-peak.
- Press WTD 3100HZ push button. Level indication should be from 10 to 13" peak-to-peak.

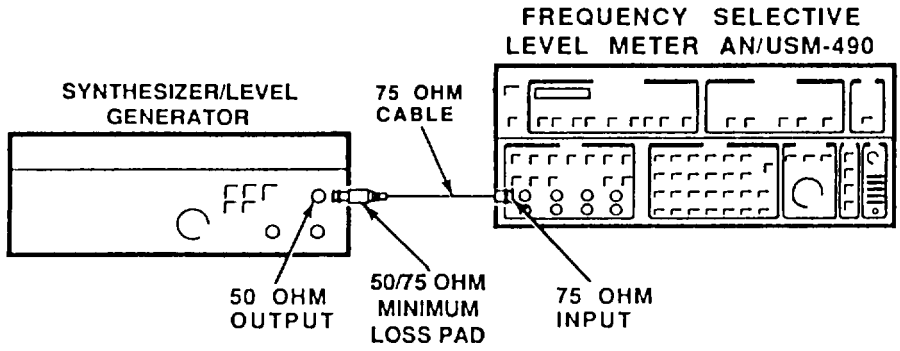
6. Disconnect test setup.

RESIDUAL PHASE JITTER TEST.

1. Connect test equipment as shown below.



REAR VIEW



FRONT VIEW

RESIDUAL PHASE JITTER TEST—Continued.

2. Initialize Level Meter.
3. On Level Meter, select 75Ωinput.
4. Set Synthesizer/Level Generator output to 50KHz at -59.8dBm.
5. On Level Meter
   - Press ENTRY.
   - Enter a full scale of –30dBm.
   - Select 100dB range.
   - Enter frequency of 48,996Hz.
   - Press SHIFT then ∅JITTER push button.
   - Verify level indication is less than or equal to 0.5 " peak-to-peak.
6. Set Synthesizer/Level Generator output to 2MHz at -59.8dBm.
7. On Level Meter, enter a frequency of 1998996Hz. Level indication should be less than or equal to 0.5" peak-to-peak.
8. Leave test setup for next test.

WTD FILTER CALIBRATION TEST.

1. Verify test equipment setup is identical to that required for Residual Phase Jitter Test.
2. Initialize Level Meter.
3. On Level Meter, select 75Ωinput.
4. Set Synthesizer/Level Generator output to 999154Hz at 5.8dBm.
5. On Level Meter, press RDNG—>OFFSET, OFFSET, and WTD 3100Hz push button. Verify level indication is 0±0.5dBmO.
6. Leave test setup for next test.

NOTCH FILTER TEST.

1. Verify test equipment setup is identical to that required for Residual Phase Jitter Test.
2. Initialize Level Meter.

NOTCH FILTER TEST—Continued.

3. On Level Meter, select 75Ωinput.

4. Set Synthesizer/Level Generator output to 1001010HZ at 5.8dBm.

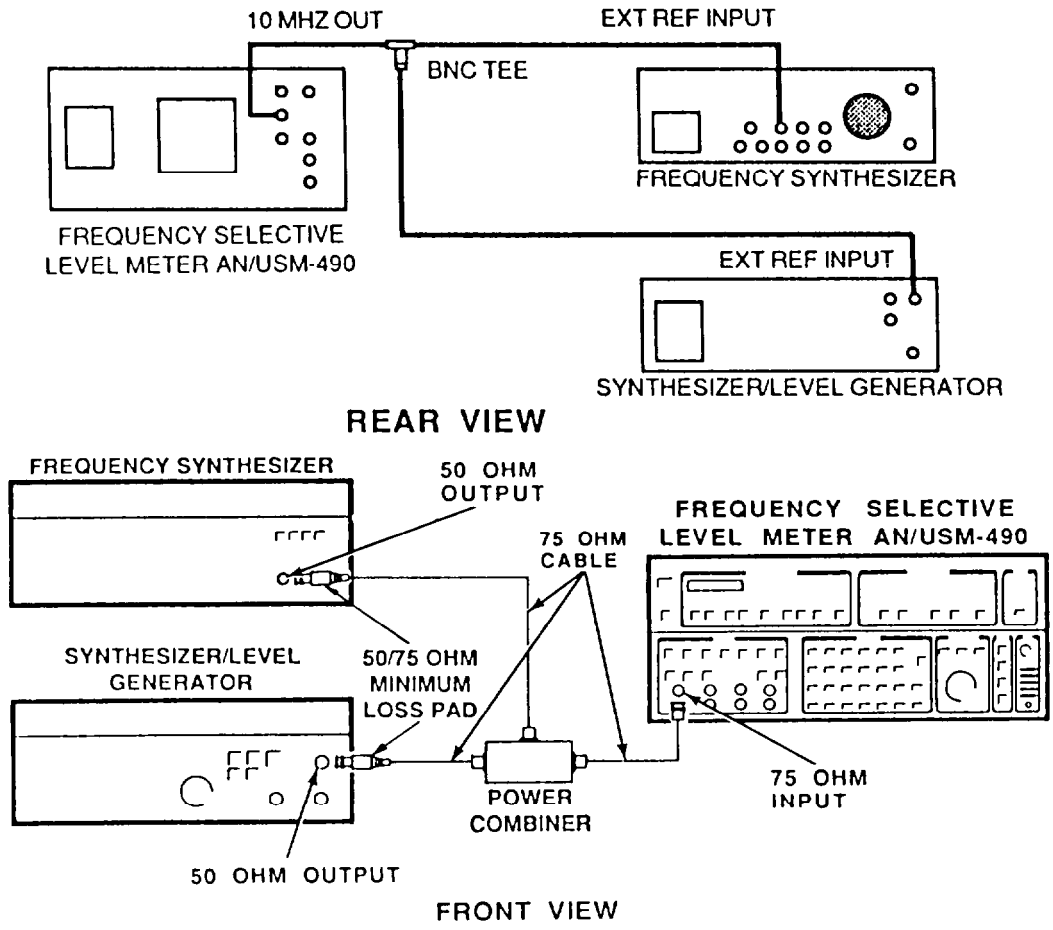
5. On Level Meter:

- Press ENTRY.
- Enter a full scale of 0dBm.
- Press RANGE 100dB, TONE 1004Hz, WTD 3100Hz, RDNG—>OFFSET, OFFSET, SHIFT, and NOISE/TONE push button. Verify level indication is less than –50dBmO.
- Step entry frequency 21Hz above and 9Hz below 1MHz. Verify level indication is less than -50dBmO.

6. Disconnect test setup.

IMPULSE NOISE TEST.

1. Connect test equipment as shown below,



IMPULSE NOISE TEST—Continued.

2. Initialize Level Meter.
3. Set Synthesizer/Level Generator output to 1001700Hz at -72.3dBm.
4. Set Frequency Synthesizer output to 2MHz at -21.3dBm.
5. On Level Meter
   - Set threshold level to –80dBm.
   - Select 75Ωinput.
   - Press TIME push button.
   - Enter number 1.
   - Press Hz/MIN push button.
   - Press SHIFT push button.
   - Press IMPULSE push button.
   - Press START push button.
   - Verify count is 1.00 or 0.
6. Set Synthesizer/Level Generator output to -70.3dBm.
7. On Level Meter
   - Press START push button. Counting should be continuous.
   - Counter should show from 400 to 442 counts at end of measurement interval.
8. Remove power and disconnect test setup.

Table 2-6. Performance Test Checklist

Test and step		Measured value		Given Desired value	Calculated
10 MHz REFERENCE OUTPUT FREQUENCY TEST					
	Step 2	_____	Hz	9,999,900 to 10,000,100HZ	
COUNTER ACCURACY AND SENSITIVITY TEST					
	Step 7	_____	Hz	1,000,000 ± 1.0HZ	
INPUT RETURN LOSS TEST					
(75Ω,1MHz)	Step 7	_____	dB	30dB MIN	
(75Ω,32.5MHz)	Step 11	_____	dB	30dB MIN	
(124Ω,5MHz)	Step 17	_____	dB	30dB MIN	
(124Ω10KHz)	Step 22	_____	dB	30dB MIN	
	Step 26	_____	Ω	19.9 to 21.31Ω	
	Step 27	_____	Ω	19.9 to 21.31Ω	
(600Ω,50Hz)	Step 33	_____	dB	25dB MIN	
(600Ω,108KHz)	Step 34	_____	dB	25dB MIN	
BALANCE INPUT TEST					
(600Ω,50Hz)	Step 5	_____	dBmO	-40dBm0 MAX.	
(600Ω,108KHz)	Step 8	_____	dBmO	-40dBm0 MAX.	
(124Ω,10KHZ)	Step 12	_____	dBmO	-36dBm0 MAX.	
(124Ω,10MHZ)	Step 15	_____	dBmO	-36dBm0 MAX.	
(135Ω,10KHZ)	Step 19	_____	dBmO	-36dBm0 MAX.	
(135Ω,1MHz)	Step 23	_____	dBmO	-36dBm0 MAX.	
AMPLITUDE ACCURACY TEST					
75 Ω,1KHz, +4 to –100dBm					
2dB	Step 17	_____	dBm	* 2.36 to 1.64 dB	____to____
4dB	Step 18	_____	dBm	* 4.36 to 3.64 dB	____to____
6dB	Step 18	_____	dBm	* 6.36 to 5.64 dB	____to____
8dB	Step 18	_____	dBm	* 8.36 to 7.64 dB	____to____
10dB	Step 18	_____	dBm	* 10.36 to 9,64 dB	____to____
20dB	Step 18	_____	dBm	* 20.36 to 19.64 dB	____to____
30dB	Step 18	_____	dBm	* 30.36 to 29.64 dB	____to____

* Calculation for minimum and maximum measured value is as follows:

Power$_{xxx}$Hz – desired value – step error= minimum or maximum value,

where: power$_{xxx}$Hz is calculated using formula in Step 13,
given value is supplied in desired value column on this table,
step error is error from Synthesizer/Level Generator attenuator error from calibration sheet.

Table 2-6. Performance Test Checklist-Continued

Test and step		Measured value		Given Desired value	Calculated
AMPLITUDE ACCURACY TEST—Continued					
40dB	Step 18	_____	dBm	* 40.36 to 39.64dB	_____ to _____
50dB	Step 18	_____	dBm	* 50.36 to 49.64dB	_____ to _____
60dB	Step 18	_____	dBm	* 60.36 to 59.64dB	_____ to _____
70dB	Step 18	_____	dBm	* 70.36 to 69.64dB	_____ to _____
106dB	Step 21	_____	dBm	* 106.91 to 105.09dB	_____ to _____
75Ω, 1MHZ, +4 to - 100dBm					
2dB	Step 25	_____	dBm	* 2.16 to 1.84dB	_____ to _____
4dB	Step 25	_____	dBm	* 4.16 to 3.84dB	_____ to _____
6dB	Step 25	_____	dBm	* 6.16 to 5.84dB	_____ to _____
8dB	Step 25	_____	dBm	* 8.16 to 7.84dB	_____ to _____
10dB	Step 25	_____	dBm	* 10.16 to 9.84dB	_____ to _____
20dB	Step 25	_____	dBm	* 20.16 to 19.84dB	_____ to _____
30dB	Step 25	_____	dBm	* 30.16 to 29.84dB	_____ to _____
40dB	Step 25	_____	dBm	* 40.16 to 39.84dB	_____ to _____
50dB	Step 25	_____	dBm	* 50.16 to 49.84dB	_____ to _____
60dB	Step 25	_____	dBm	* 60.16 to 59.84dB	_____ to _____
70dB	Step 25	_____	dBm	* 70.16 to 69.84dB	_____ to _____
106dB	Step 25	_____	dBm	* 106.71 to 105.29dB	_____ to _____
75Ω,3MHZ, +4 to - 100dBm					
2dB	Step 28	_____	dBm	* 2.16 to 1.84dB	_____ to _____
4dB	Step 28	_____	dBm	* 4.16 to 3.84dB	_____ to _____
6dB	Step 28	_____	dBm	* 6.16 to 5.84dB	_____ to _____
8dB	Step 28	_____	dBm	* 8.16 to 7.84dB	_____ to _____
10dB	Step 28	_____	dBm	* 10.16 to 9.84dB	_____ to _____
20dB	Step 28	_____	dBm	* 20.16 to 19.84dB	_____ to _____
30dB	Step 28	_____	dBm	* 30.16 to 29.84dB	_____ to _____
40dB	Step 28	_____	dBm	* 40.16 to 39.84dB	_____ to _____
50dB	Step 28	_____	dBm	* 50.16 to 49.84dB	_____ to _____
60dB	Step 28	_____	dBm	* 60.16 to 59.84dB	_____ to _____
70dB	Step 28	_____	dBm	* 70.16 to 69.84dB	_____ to _____
106dB	Step 28	_____	dBm	* 106.71 to 105.29dB	_____ to _____

* Calculation for minimum and maximum measured value is as follows:

$power_{xxx}Hz$ ⁻ desired value – step error= minimum or maximum value,

where: $power_{xxx}Hz$ is calculated using formula in step 13,
given value is supplied in desired value column on this table,
step error is error from Synthesizer/Level Generator attenuator error from calibration sheet.

Table 2-6. Performance Test Checklist< Continued

Test and step		Measured value		Given Desired value	Calculated
AMPLITUDE ACCURACY TEST—Continued					
75Ω,10MHz, +4 to -100dBm					
2dB	Step 31	_____	dBm	*2.16 to 1.84dB	_____ to _____
4dB	Step 31	_____	dBm	* 4.16 to 3.84dB	_____ to _____
6dB	Step 31	_____	dBm	* 6.16 to 5.84dB	_____ to _____
8dB	Step 31	_____	dBm	* 8.16 to 7.84dB	_____ to _____
10dB	Step 31	_____	dBm	* 10.16 to 9.84dB	_____ to _____
20dB	Step 31	_____	dBm	* 20.16 to 19.84dB	_____ to _____
30dB	Step 31	_____	dBm	* 30.16 to 29.84dB	_____ to _____
40dB	Step 31	_____	dBm	* 40.16 to 39.84dB	_____ to _____
50dB	Step 31	_____	dBm	* 50.16 to 49.84dB	_____ to _____
60dB	Step 31	_____	dBm	* 60.16 to 59.84dB	_____ to _____
70dB	Step 31	_____	dBm	* 70.16 to 69.84dB	_____ to _____
106dB	Step 31	_____	dBm	* 106.71 to 105.29dB	_____ to _____
75Ω,30MHz, +4 to -100dBm					
2dB	Step 34	_____	dBm	* 2.21 to 1.79dB	_____ to _____
4dB	Step 34	_____	dBm	* 4.21 to 3.79dB	_____ to _____
6dB	Step 34	_____	dBm	* 6.21 to 5.79dB	_____ to _____
8dB	Step 34	_____	dBm	* 8.21 to 7.79dB	_____ to _____
10dB	Step 34	_____	dBm	* 10.21 to 9.79dB	_____ to _____
20dB	Step 34	_____	dBm	* 20,21 to 19.79dB	_____ to _____
30dB	Step 34	_____	dBm	* 30.21 to 29.79dB	_____ to _____
40dB	Step 34	_____	dBm	* 40.21 to 39.79dB	_____ to _____
50dB	Step 34	_____	dBm	* 50.21 to 49.79dB	_____ to _____
60dB	Step 34	_____	dBm	* 60.21 to 59.79dB	_____ to _____
70dB	Step 34	_____	dBm	* 70.21 to 69.79dB	_____ to _____
106dB	Step 34	_____	dBm	* 106.71 to 105.29dB	_____ to _____
600Ω,1KHz, -11 to -100dBm					
2dB	Step 39	_____	dBm	* 17.31 to 16.69dB	_____ to _____
4dB	Step 39	_____	dBm	* 19.31 to 18.69dB	_____ to _____
6dB	Step 39	_____	dBm	* 21.31 to 20.69dB	_____ to _____
8dB	Step 39	_____	dBm	* 23.31 to 22.69dB	_____ to _____
10dB	Step 39	_____	dBm	* 25.31 to 24.69dB	_____ to _____

* Calculation for minimum and maximum measured value is as follows:

$power_{xxx}Hz$ ¯ desired value – step error = minimum or maximum value,

where: $power_{xxx}Hz$ is calculated using formula in step 13,
given value is supplied in desired value column on this table,
step error is error from Synthesizer/Level Generator attenuator error from calibration sheet.

Table 2-6. Performance Test Checklist-Continued

Test and step		Measured value		Given Desired value	Calculated
AMPLITUDE ACCURACY TEST—Continued					
20dB	Step 39	_____	dBm	* 35.31 to 34.69dB	_____ to _____
30dB	Step 39	_____	dBm	* 45.31 to 44.69dB	_____ to _____
40dB	Step 39	_____	dBm	* 55.31 to 54.69dB	_____ to _____
50dB	Step 39	_____	dBm	* 65.31 to 64.69dB	_____ to _____
60dB	Step 39	_____	dBm	* 75.31 to 74.69dB	_____ to _____
70dB	Step 39	_____	dBm	* 85.31 to 84.69dB	_____ to _____
90dB	Step 42	_____	dBm	* 105.71 to 104.29dB	_____ to _____
135Ω, 1MHZ, - 3 to - 99dBm					
2dB	Step 48	_____	dBm	* 9.31 to 8.69dB	_____ to _____
4dB	Step 48	_____	dBm	* 11.31 to 10.69dB	_____ to _____
6dB	Step 48	_____	dBm	* 13.31 to 12.69dB	_____ to _____
8dB	Step 48	_____	dBm	* 15.31 to 14.69dB	_____ to _____
10dB	Step 48	_____	dBm	* 17.31 to 16.69dB	_____ to _____
20dB	Step 48	_____	dBm	* 27.31 to 26.69dB	_____ to _____
30dB	Step 48	_____	dBm	* 37.31 to 36.69dB	_____ to _____
40dB	Step 48	_____	dBm	* 47.31 to 46.69dB	_____ to _____
50dB	Step 48	_____	dBm	* 57.31 to 56.69dB	_____ to _____
60dB	Step 48	_____	dBm	* 67,31 to 66.69dB	_____ to _____
70dB	Step 48	_____	dBm	* 77.31 to 76.69dB	_____ to _____
98dB	Step 49	_____	dBm	* 105.71 to 104.39dB	_____ to _____
124Ω, 1MHz, - 3 to - 99dBm					
2dB	Step 55	_____	dBm	* 9.31 to 8.69dB	_____ to _____
4dB	Step 55	_____	dBm	* 11.31 to 10.69dB	_____ to _____
6dB	Step 55	_____	dBm	* 13.31 to 12.69dB	_____ to _____
8dB	Step 55	_____	dBm	* 15.31 to 14.69dB	_____ to _____
10dB	Step 55	_____	dBm	* 17.31 to 16.69dB	_____ to _____
20dB	Step 55	_____	dBm	* 27.31 to 26.69dB	_____ to _____
30dB	Step 55	_____	dBm	* 37.31 to 36.69dB	_____ to _____
40dB	Step 55	_____	dBm	* 47.31 to 46.69dB	_____ to _____
50dB	Step 55	_____	dBm	* 57.31 to 56.69dB	_____ to _____
60dB	Step 55	_____	dBm	* 67.31 to 66.69dB	_____ to _____

* Calculation for minimum and maximum measured value is as follows:

power$_{xxx}$Hz - desired value – step error = minimum or maximum value,

where: power$_{xxx}$Hz is calculated using formula in step 13,
given value is supplied in desired value column on this table,
step error is error from Synthesizer/Level Generator attenuator error from calibration sheet.

Table 2-6. Performance Test Checklist-Continued

Test and step		Measured value		Given Desired value	Calculated
AMPLITUDE ACCURACY TEST-Continued					
124Ω,1lMHz, -3 to –99dBm					
70dB	Step 55	_____	dBm	* 77.31 to 76.69dB	_____ to _____
98dB	Step 56	_____	dBm	* 105.71 to 104.29dB	_____ to _____
124Ω,3MHz, –3 to –99dBm					
2dB	Step 60	_____	dBm	* 9.31 to 8.69dB	_____ to _____
4dB	Step 60	_____	dBm	* 11.31 to 10.69dB	_____ to _____
6dB	Step 60	_____	dBm	* 13.31 to 12.69dB	_____ to _____
8dB	Step 60	_____	dBm	* 15.31 to 14.69dB	_____ to _____
10dB	Step 60	_____	dBm	* 17.31 to 16.69dB	_____ to _____
20dB	Step 60	_____	dBm	* 27.31 to 26.69dB	_____ to _____
30dB	Step 60	_____	dBm	* 37.31 to 36.69dB	_____ to _____
40dB	Step 60	_____	dBm	* 47.31 to 46.69dB	_____ to _____
50dB	Step 60	_____	dBm	* 57.31 to 56.69dB	_____ to _____
60dB	Step 60	_____	dBm	* 67.31 to 66.69dB	_____ to _____
70dB	Step 60	_____	dBm	* 77.31 to 76.69dB	_____ to _____
98dB	Step 60	_____	dBm	* 105.71 to 104.29dB	_____ to _____
124Ω,10MHz, -3 to -99dBm					
2dB	Step 63	_____	dBm	* 9.46 to 8.54dB	_____ to _____
4dB	Step 63	_____	dBm	* 11.46 to 10.54dB	_____ to _____
6dB	Step 63	_____	dBm	* 13.46 to 12.54dB	_____ to _____
8dB	Step 63	_____	dBm	* 15.46 to 14.54dB	_____ to _____
10dB	Step 63	_____	dBm	* 17.46 to 16.54dB	_____ to _____
20dB	Step 63	_____	dBm	* 27.46 to 26.54dB	_____ to _____
30dB	Step 63	_____	dBm	* 37.46 to 36.54dB	_____ to _____
40dB	Step 63	_____	dBm	* 47.46 to 46.54dB	_____ to _____
50dB	Step 63	_____	dBm	* 57.46 to 56.54dB	_____ to _____
60dB	Step 63	_____	dBm	* 67.46 to 66.54dB	_____ to _____
70dB	Step 63	_____	dBm	* 77.46 to 76.54dB	_____ to _____
98dB	Step 63	_____	dBm	* 105.96 to 104.04dB	_____ to _____

* Calculation for minimum and maximum measured value is as follows:

Power$_{xxx}$Hz – desired value – step error = minimum or maximum value,

where: power$_{xxx}$Hz is calculated using formula in step 13,
given value is supplied in desired value column on this table,
step error is error from Synthesizer/Level Generator attenuator error from calibration sheet.

Table 2-6. Performance Test Checklist-Continued

Test and step		Measured value		Given Desired value	Calculated
AMPLITUDE ACCURACY TEST—Continued					
75Ω,1MHz, -4 to +16dBm					
18dB	Step 74	_____	dBm	* 18.16 to 17.84dB	_____ to _____
10dB	step 75	_____	dBm	* 10.16 to 9.84dB	_____ to _____
6dB	Step 75	_____	dBm	* 6.16 to 5.84dB	_____ to _____
75Ω,3MHz, -4 to +16dBm					
18dB	Step 76	_____	dBm	* 18.16 to 17.84dB	_____ to _____
10dB	Step 76	_____	dBm	* 10.16 to 9.84dB	_____ to _____
6dB	Step 76	_____	dBm	* 6.16 to 5.84dB	_____ to _____
75Ω,10MHz, +4 to +16dBm					
18dB	Step 76	_____	dBm	* 18.16 to 17.84dB	_____ to _____
10dB	Step 76	_____	dBm	* 10.16 to 9.84dB	_____ to _____
6dB	Step 76	_____	dBm	* 6.16 to 5.84dB	_____ to _____
75Ω,30MHz, +4 to +16dBm					
18dB	Step 76	_____	dBm	* 18.21 to 17.79dB	_____ to _____
10dB	Step 76	_____	dBm	* 10.21 to 9.79dB	_____ to _____
6dB	Step 76	_____	dBm	* 6.21 to 5.79dB	_____ to _____
135Ω,1MHz, –3 to +9dBm					
18dB	Step 81	_____	dBm	* 25.31 to 24.69dB	_____ to _____
10dB	Step 82	_____	dBm	* 17.31 to 16.69dB	_____ to _____
6dB	Step 82	_____	dBm	* 13.31 to 12.69dB	_____ to _____

* Calculation for minimum and maximum measured value is as follows:

$power_{xxx}H_z$ - desired value - step error = minimum or maximum value,

where: $power_{xxx}Hz$ is calculated using formula in step 70,
given value is supplied in desired value column on this table,
step error is error from Synthesizer/level Generator attenuator error from calibration sheet.

Table 2-6. Performance Test Checklist-Continued

Test and step		Measured value	Given Desired value	Calculated
AMPLITUDE ACCURACY TEST—Continued				
124Ω, 1MHz, -3 to +9dBm				
18dB	Step 87	_____	dBm * 25.31 to 24.69dB	_____ to _____
10dB	Step 88	_____	dBm * 17.31 to 16.69dB	_____ to _____
6dB	Step 88	_____	dBm * 13.31 to 12.69dB	_____ to _____
124Ω,3MHz, –3 to +9dBm				
18dB	Step 89	_____	dBm * 25.31 to 24.69dB	_____ to _____
10dB	Step 89	_____	dBm * 17.31 to 16.69dB	_____ to _____
6dB	Step 89	_____	dBm * 3.31 to 12.69dB	_____ to _____
124Ω,10MHZ, –3 to +9dBm				
18dB	Step 89	_____	dBm * 25.46 to 24.54dB	_____ to _____
10dB	Step 89	_____	dBm * 17.46 to 16.54dB	_____ to _____
6dB	Step 89	_____	dBm * 13.46 to 12.54dB	_____ to _____
HALF-POWER BANDWIDTHS (-3dB) TEST				
3100HZ	Step 3	_____	Hz	2790 to 3410HZ
20Hz	Step 4	_____	Hz	18 to 22Hz
400Hz	Step 5	_____	Hz	360 to 50Hz
PASS-BAND FLATNESS TEST				
3100Hz	Step 2	_____	dBmO 0 ± 0.3dBm0	
20Hz	Step 3	_____	dBmO 0 ± 0.3dBm0	
400Hz	Step 4	_____	dBmO 0 ± 0.3dBm0	

* Calculation for minimum and maximum measured value is as follows:

Power $_{xxx}$Hz - desired value – step error = minimum or maximum value,

where: power$_{xxx}$Hz is calculated using formula in step 70,
given value is supplied in desired value column on this table,
step error is error from Synthesizer/Level Generator attenuator error from calibration sheet.

Table 2-6. Performance Test Checklist-Continued

Test and step		Measured value	Given / Calculated Desired value
400Hz FILTER SHAPE TEST			
		Below / Above	
	Step 3	_____ Hz / _____ Hz	-1100 to 1100Hz
PILOT (20 Hz) FILTER BANDWIDTHS TEST			
		Below / Above	
30dB	Step 3	_____ Hz / _____ Hz	-45 to 45Hz
60dB	Step 4	_____ Hz / _____ Hz	-90 to 90Hz
CARRIER FREQUENCY REJECTION TEST			
		Below / Above	
	Step 4	_____ dBmO / _____ dBmO	-60dBmO MAX.
ADJACENT CHANNEL REJECTION TEST			
		Below / Above	
	Step 4	_____ dBmO / _____ dBmO	-75dBmO MAX.
RESIDUAL NOISE TEST			
	Step 3	_____ dBm	-116dBm MAX.
	Step 4	_____ dBm	–120dBm MAX.
	Step 4	_____ dBm	-120dBm MAX.
	Step 4	_____ dBm	–116dBm MAX.
400Hz	Step 4	_____ dBm	–120dBm MAX.
20HZ	Step 4	_____ dBm	–120dBm MAX.
	Step 4	_____ dBm	–116Bm MAX.
400Hz	Step 4	_____ dBm	–120dBm MAX.
20Hz	Step 4	_____ dBm	-120dBm MAX.
	Step 4	_____ dBm	-105dBm MAX.
400Hz	Step 4	_____ dBm	-105dBm MAX.
20Hz	Step 4	_____ dBm	–105dBm MAX.
124Ω,3100Hz	Step 4	_____ dBm	-105dBm MAX.
400Hz	Step 4	_____ dBm	-105dBm MAX.
20Hz	Step 4	_____ dBm	–105dBm MAX.
135Ω,3100HZ	Step 4	_____ dBm	–105dBm MAX.
400Hz	Step 4	_____ dBm	–105dBm MAX.
20Hz	Step 4	_____ dBm	-105dBm MAX.
600Ω,3100HZ	Step 4	_____ dBm	-105dBm MAX.
400Hz	Step 4	_____ dBm	-105dBm MAX.
20Hz	Step 4	_____ dBm	-105dBm MAX.

Table 2-6. Performance Test Checklist--Continued

Test and step		Measured value		Given Desired value	Calculated
RESIDUAL SPURIOUS RESPONSES TEST					
360Hz	Step 3	_____	dBm	-115dBm MAX,	
420Hz	Step 3	_____	dBm	-115dBm MAX.	
100 KHz	Step 3	_____	dBm	-115dBm MAX.	
200KHZ	Step 3	_____	dBm	-115dBm MAX.	
300KHZ	Step 3	_____	dBm	-115dBm MAX.	
400KHZ	Step 3	_____	dBm	–115dBm MAX.	
10MHz	Step 3	_____	dBm	–115dBm MAX.	
20MHZ	Step 3	_____	dBm	–115dBm MAX.	
30MHZ	Step 3	_____	dBm	-115dBm MAX.	
60Hz	Step 4	_____	dBm	-100dBm MAX.	
120Hz	Step 4	_____	dBm	-100dBm MAX.	
180HZ	Step 4	_____	dBm	-100dBm MAX,	
240Hz	Step 4	_____	dBm	-100dBm MAX.	
300Hz	Step 4	_____	dBm	-100dBm MAX.	
INPUT SPURIOUS RESPONSES TEST					
	Step 7	_____	dBm	-80dBm MAX.	
	Step 9	_____	dBm	-80dBm MAX.	
	Step 12	_____	dBm	-80dBm MAX.	
	Step 13	_____	dBm	-80dBm MAX.	
	Step 13	_____	dBm	–75dBm MAX.	
	Step 13	_____	dBm	-80dBm MAX.	
HARMONIC DISTORTION TEST					
200KHZ	Step 5	_____	dBm	-70dBm MAX.	
300KHZ	Step 5	_____	dBm	–70dBm MAX.	
20MHZ	Step 9	_____	dBm	-70dBm MAX.	
30MHZ	Step 9	_____	dBm	-70dBm MAX.	
600Ω,200 KHZ	Step 13	_____	dBm	-70dBm MAX.	
600Ω,300 KHZ	Step 13	_____	dBm	-70dBm MAX.	
135Ω,200KHZ	Step 17	_____	dBm	-70dBm MAX.	
135Ω,300KHZ	Step 17	_____	dBm	-70dBm MAX.	
124Ω,20MHz	Step 21	_____	dBm	-70dBm MAX.	
124Ω,30MHz	Step 21	_____	dBm	-70dBm MAX.	

Table 2-6. Performance Test Checklist-Continued

Test and step		Measured value	Given Desired value	Calculated
INTERMODULATION DISTORTION TEST				
	Step 6	_____ dBm	–75dBm MAX.	
17 MHZ	Step 7	_____ dBm	-75dBm MAX.	
10MHz	Step 7	_____ dBm	-75dBm MAX.	
7MHZ	Step 7	_____ dBm	-75dBm MAX.	
7KHZ	Step 7	_____ dBm	-70dBm MAX.	
21.007 MHz	Step 7	_____ dBm	-70dBm MAX.	
20.986MHz	Step 7	_____ dBm	-70dBm MAX.	
600(2,99.8 KHz	Step 13	_____ dBm	-75dBm MAX.	
600(2,100.2KHz	Step 13	_____ dBm	-75dBm MAX.	
600Ω,199.8 KHz	Step 13	_____ dBm	-75dBm MAX.	
600Ω,7KHZ	Step 13	_____ dBm	-70dBm MAX.	
600Ω,107 KHZ	Step 13	_____ dBm	-70dBm MAX.	
600Ω,193 KHZ	Step 13	_____ dBm	-70dBm MAX.	
600Ω,86 KHZ	Step 13	_____ dBm	-70dBm MAX.	
135Ω,990KHZ	Step 19	_____ dBm	-75dBm MAX.	
135Ω1.01MHZ	Step 19	_____ dBm	-75dBm MAX.	
135Ω,7KHZ	Step 19	_____ dBm	-70dBm MAX.	
135Ω,1.993 MHZ	Step 19	_____ dBm	-70dBm MAX.	
135Ω,1.007 MHZ	Step 19	_____ dBm	-70dBm MAX.	
135Ω,986KHz	Step 19	_____ dBm	–70dBm MAX.	
124Ω,1MHz	Step 25	_____ dBm	-75dBm MAX.	
124Ω,17MHz	Step 25	_____ dBm	–75dBm MAX.	
124Ω10MHz	Step 25	_____ dBm	-75dBm MAX.	
124Ω,7MHz	Step 25	_____ dBm	-75dBm MAX.	
124Ω,7KHz	Step 25	_____ dBm	-75dBm MAX.	
124Ω,17.993MHz	Step 25	_____ dBm	-75dBm MAX.	
124Ω,9.007 MHz	Step 25	_____ dBm	-75dBm MAX.	
124Ω,8,986MHz	Step 25	_____ dBm	-75dBm MAX.	
IF REJECTION FLATNESS TEST				
	Step 4	_____ dBm	-60dBm MAX.	
	Step 5	_____ dBm	-80dBm MAX.	
WIDEBAND POWER FLATNESS TEST				
	Step 7	_____ dBmO	-0.8 to +0.8dBmO	
	Step 11	_____ dBmO	-1.8 to +1.8dBmO	
10MHz	Step 12	_____ dBmO	-0.8 to +0.8dBmO	
32MHz	Step 12	_____ dBmO	-1.8 to +1.8dBmO	

Table 2-6. Performance Test Checklist--Continued

Test and step		Measured value		Given Desired value	Calculated
TRACKING OUTPUT TEST					
	Step 4	_____	dBmO	-0.5 to +0.5dBmO	
	Step 6	_____	dBmO	--0.5 to +0.5dBmO	
500KHZ	Step 7	_____	dBmO	-0.5 to +0.5dBmO	
32.5 MHz	Step 7	_____	dBmO	-0.5 to +0.5dBmO	
PHASE JITTER ACCURACY TEST					
	Step 5	_____	" P-P	10 to 13° P-P	
	Step 5	_____	" P-P	10 to 13° P-P	
RESIDUAL PHASE JITTER TEST					
	Step 5	_____	°P-P	0.5" P-P MAX.	
	Step 7	_____	°P-P	0.5" P-P MAX.	
WTD FILTER CALIBRATION TEST					
	Step 5	_____	dBmO	-0.5 to +0.5dBmO	
NOTCH FILTER TEST					
1010HZ	Step 5	_____	dBmO	-50dBmO MAX.	
995Hz	Step 5	_____	dBmO	-50dBmO MAX.	
1025Hz	Step 5	_____	dBmO	-50dBmO MAX,	
IMPULSE NOISE TEST					
	Step 5	_____	counts/Min	0 or 1	
	Step 7	_____	counts	400 to 442	

2-43. ADJUSTMENTS.

DESCRIPTION

The adjustment pocedures cover.

Adjust A80 Power Supply Voltage (para 2-45).
Adjust A4050 MHz Reference Frequency (para 2-46).
Adjust A31/A32 Fractional N Loop (para 2-47).
Adjust A501A511A53 Step and Summation Loop (para 2-48).
Adjust A11 Second Local Oscillator (para 2-49).
Adjust A22 Analog-Digital Converter (para 2-50).
Adjust A21 Logger and IF Gain (para 2-51).
Adjust A10/A20 Bandwidth Filters (para 2-52).
Adjust A10/A20 Bandwidth Gain (para 2-53).
Adjust A5 Low-Pass Filter Flatness (para 2-54).
Adjust A550 MHz Rejection (para 2-55).
Adjust A5/A10 50 MHz Crystal Filter (para 2-56).
Adjust A 10 Mixer Gain (para 2-57).
Adjust A5 Local Oscillator (para 2-58).
Adjust A1/A2 Input Amplifier and Input Multiplexer (para 2-59).
Adjust A1 Balanced Input Frequency Response (para 2-60).
Adjust A2 Intermodulation Distortion (para 2-61).
Adjust A4 Power, Overload, and Calibration (para 2-62).
Adjust A15 Tracking Output (para 2-63).
Adjust A70 Impairments (para 2-64).
Adjust A1610 MHz Reference Frequency (para 2-65).

NOTE

- Specific adjustments may be necessary after repair/replacement of specific assemblies in the Level Meter or failure of a performance test. Adjustment is not required if malfunction has been cleared after repair.
- Never perform all adjustments from para 2-45 thru 2-65 atone time.
- All indications and waveforms are referenced to chassis ground unless otherwise Specified.
- Assembly location diagram is fig. 2-1. Cable location diagram is fig 2-2.
- Individual circuit card component locator diagrams are fig FO-2 thru FO-25.
- All cables shown in test connection diagrams are 50Ωunless otherwise specified.
- Rear views of test setups are shown once at beginning of each adjustment. Do not remove rear view connections unless instructed to disconnect test equipment.

2-44. INITIAL SETUP

1. Remove power from the Level Meter.
2. Remove top cover (para 2-66).

WARNING

Dangerous voltages are present with the covers removed.

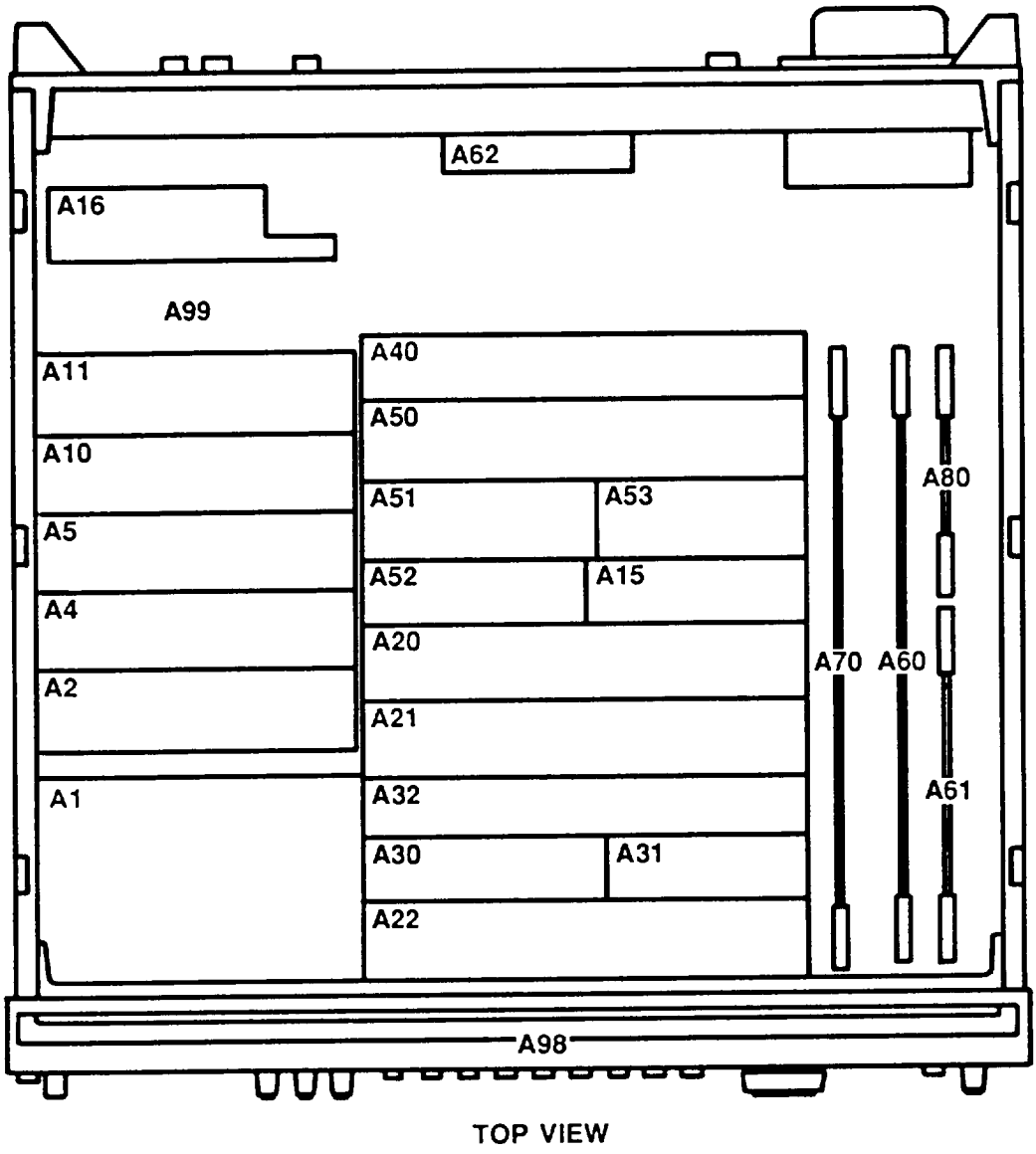
3. Connect power and turn Level Meter power switch to STBY.

2-45. ADJUST A80 POWER SUPPLY VOLTAGE.

1. Turn on Level Meter and allow 20 minutes for warm-up.
   - Verify +12VdC (CR5), -12Vdc (CR34), and +5Vdc (CR54) green LEDs are on (fig. FO-25).
2. Connect Digital Multimeter to A80TP1.
   - Adjust A80R15 (+12 ADJ) until Digital Multimeter indicates from +11.99 to +12.01Vdc.
3. Connect Digital Multimeter to A80TP2.
   - Digital Multimeter should indicate from -11.97 to –12.03Vdc.
4. Connect Digital Multimeter to A80TP3.
   - Digital Multimeter should indicate from +5.15 to +5.35Vdc.
5. If step 3 or 4 is not within specification, repeat steps 2 thru 4.
6. Install top cover (para 2-66).

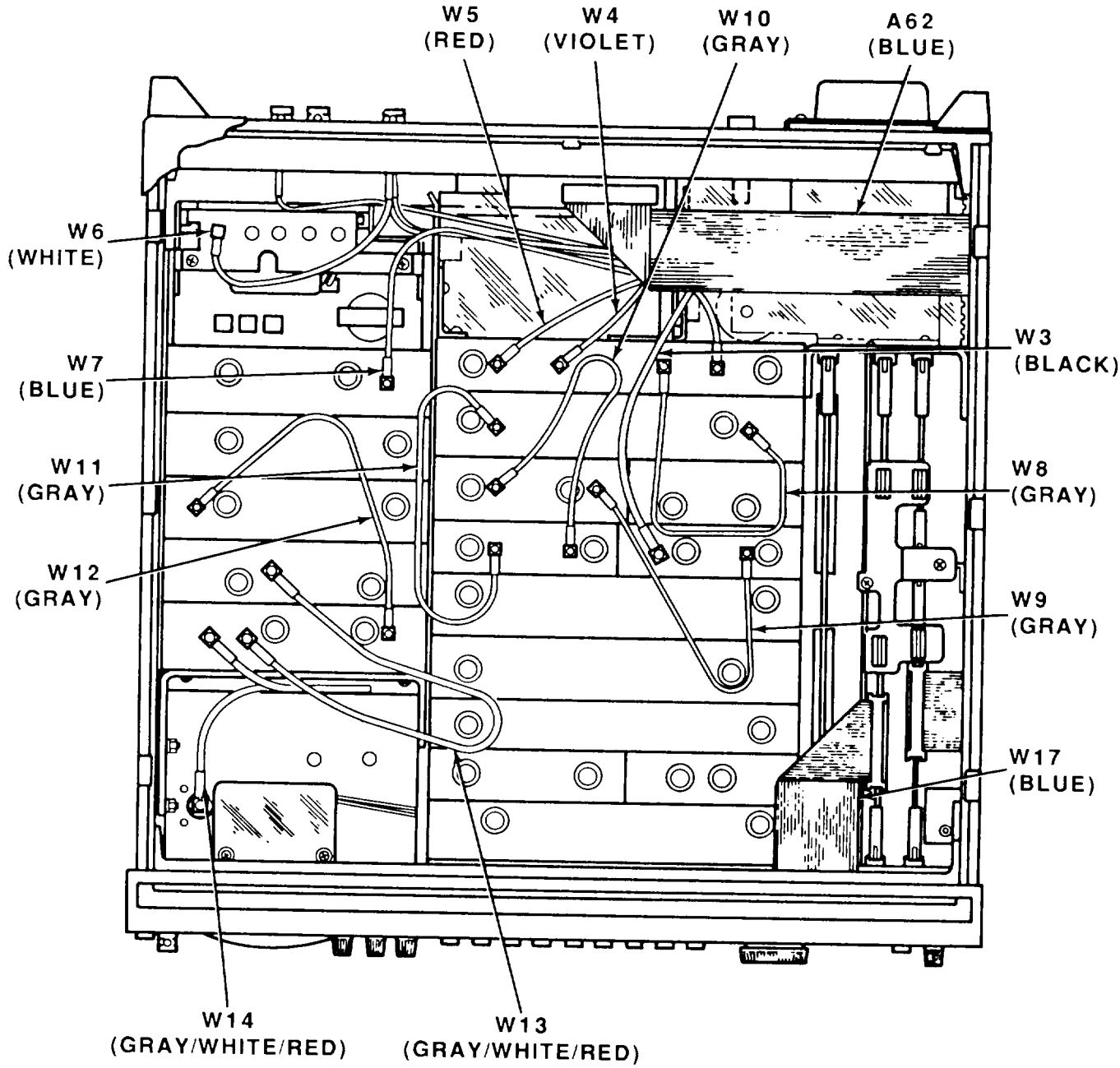
2-46. ADJUST A40 50 MHz REFERENCE FREQUENCY.

1. Remove A40 Frequency Reference Assembly (para 2-85) and reinstall on an extender board.
2. Disconnect red cable (fig. 2-2) from A40J1 (fig. FO-16).
3. Turn on Level Meter and allow 20 minutes for warm-up.
4. Connect Frequency Counter to A40J6.



EL9NT006

Figure 2-1. Assembly Locator Diagram.



EL9NT007

Figure 2-2. Cable Locator Diagram.

2-46. ADJUST A40 50MHz REFERENCE FREQUENCY—Continued.

5. Short A40TP4 to A40TP5.
   - Adjust A40R78 until Frequency Counter indicates from 49,999,990Hz to 50,000,010HZ.
6. Turn off Level Meter.
7. Remove short from A40TP4 and A40TP5.
8. Disconnect Frequency Counter.
9. Install A40 Frequency Reference Assembly (para 2-85).
10. Install top cover (para 2-66).

2-47. ADJUST A31/A32 FRACTIONAL N LOOP.

A31 FRACTIONAL N VOLTAGE CONTROLLED OSCILLATOR CHECK AND ADJUSTMENT.

1. Remove A31 Fractional N Voltage Controlled Oscillator Assembly (para 2-83) and reinstall on an extender board
2. Turn on Level Meter and allow 20 minutes for warm-up.
3. Set Oscilloscope controls as follows:

   Vertically center display on screen with no input

Input	DC Coupling
Vertical	0.2V/DIV
sweep	5µsec

4. Connect 10:1 Probe to A32TP2 (fig. FO-15).
5. On Level Meter,
   - Tune to 1.999999MHz.
   - Enter a frequency step of 0.2Hz.
   - Turn AUTO CAL off.
   - Measure and record DC voltage at junction of A31CR2 and A31R2 (fig. FO-14).
6. Connect Digital Multimeter to A31TP3.
   - Adjust A31L4 until Digital Multimeter indication is within +0.02V of indication recorded in step 5.

2-47. ADJUST A31/A32 FRACTIONAL N LOOP—Continued.

7. Step tuned frequency of Level Meter up to 2.0000001MHZ.
   - Adjust A31R4 until Digital Multi meter indicates 0 ± 0.02V.
   - Verify most negative point on waveform shown on Oscilloscopes display is more positive than –6V.

A32 FRACTIONAL N PHASE DETECTOR CHECK AND ADJUSTMENT.

1. Turn off Level Meter.
2. Install A31 Fractional N Voltage Controlled Oscillator Assembly (para 2-83).
3. Remove A32 Fractional N Phase Detector Assembly (para 2-84) and reinstall on an extender board.
4. Turn on Level Meter and wait 5 minutes for warm-up.
5. On Level Meter,
   - Tune to 9.97KHz.
   - Turn AUTO CAL off.
6. Set Low Frequency Spectrum Analyzer as follows:

Center frequency	39.8994MHz
Frequency span	2KHZ
Resolution bandwidth	30Hz
Video bandwidth	100Hz

7. Connect 50Ωinput of Low Frequency Spectrum Analyzer to A31J1.
8. Adjust Low Frequency Spectrum Analyzer until largest signal component (carrier) is at full scale.
9. After Low Frequency Spectrum Analyzer has made 2 complete sweeps, reduce video bandwidth to 3Hz. Wait one complete sweep.
   - Adjust A32R51 (AP11) to null first sideband below carrier. This sideband is 300Hz below carrier and should be at least 72dB below carrier.
10. Set Low Frequency Spectrum Analyzer as specified in step 6.
11. Tune Level Meter to 9.997KHz.
12. After Low Frequency Spectrum Analyzer has made two complete sweeps, reduce video bandwidth to 3Hz. Wait one complete sweep.
    - Adjust A32R54 (AP12) to null first sideband below carrier. This sideband is 300Hz below carrier and should be at least 72dB below carrier.
13. Set Low Frequency Spectrum Analyzer as specified in step 6.

2-47. ADJUST A31/A32 FRACTIONAL N LOOP—Continued.

14. Tune Level Meter to 9999.9Hz.

15. After Low Frequency Spectrum Analyzer has made two complete sweeps, reduce video bandwidth to 3Hz. Wait one complete sweep.

- Adjust A32R61 (API 4) to null first sideband below carrier. This sideband is 1 KHz below carrier and should be at least 72dB below carrier.

16, Turn off Level Meter.

17. Install A32 Fractional N Phase Detector Assembly (para 2-84).

18. Turn on Level Meter and allow 5 minutes for warm-up.

19. Tune Level Meter to 1.999970MHz.

20, Set Low Frequency Spectrum Analyzer as follows:

Center frequency	19.9994 MHZ
Frequency span	2KHZ
Video bandwidth	100HZ
Resolution bandwidth	30Hz

21. After Low Frequency Spectrum Analyzer has made two complete sweeps, reduce video bandwidth to 10Hz.

- Verify all spurs are 72dB below carrier level. If not, adjust A32R51 (API 1) until it is within specification.

NOTE

If this adjustment is necessary, repeat steps 5 thru 9 and readjust spur to a level at least 72dB below carrier. Recheck steps 16 thru 21 and readjust spurs to a level at least 68dB below carrier.

22. Turn off Level Meter.

23. Disconnect test equipment.

24. Replace top cover (para 2-66).

2-48. ADJUST A50/A51/A53 STEP AND SUMMATION LOOP.

A50 STEP L00P ADJUSTMENT.

1. Remove A50 Step Loop Assembly (para 2-86) and reinstall on an extender board.
2. Turn on Level Meter and allow 20 minutes for warm-up.
3. Move A50S1 (fig. FO-17) to "T" position.
4. Connect Frequency Counter to A50J2.
5. On Level Meter,
   - Center A50R45 (Flatness) and A50R46 (Gain).
   - Adjust A50L5 (Freq) for a Frequency Counter indication of from 53.9 to 54. 1MHz.
   - Move A50S1 to “N” position.
   - Move cable (W11) (fig. 2-2) from A50J1 to A50J2.
6. Connect Power Meter and Thermistor Mount to A50J1.
7. On Level Meter,
   - Tune to 3 1MHz.
   - Enter a frequency step of 30MHz.
   - Turn AUTO CAL off,
8. Adjust A50R46 (Gain) for a Power Meter indication of from –5 to –7dB.
   - Step tuned frequency of Level Meter down to 1MHz.
   - Adjust A50R45 (Flatness) for a Power Meter indication of from –5 to –7dB.
   - .Step tuned frequency of Level Meter backup to 31MHz.
9. Repeat step 8 until both measurements are within specification.
10. Repeat steps 3 thru 5 if necessary.
11. Move cable from A50J2 to A50J1.
12. Turn off Level Meter.
13. Install A50 Step Loop Assembly (para 2-86).

2-48. ADJUST A50/A51/A53 STEP AND SUMMATION LOOP—Continued.

A51 SUMMATION L00P VOLTAGE CONTROLLED OSCILLATOR CHECK AND ADJUSTMENT.

1. Remove A51 Summation Loop Voltage Controlled Oscillator Assembly (para 2-87) and reinstall on an extender board.
2. Turn on Level Meter and allow 5 minutes for warm-up.
3. On Level Meter,
   - Center A51R55 (Flatness) and A51R56 (Gain) (fig. FO-18).
   - Move A51S1 to "T" position. When A51S1 in test position, Level Meter will display E3.2.
4. Connect Frequency Counter to A51J2.
5. On Level Meter,
   - Adjust A51L8 (FREQ) for a Frequency Counter indication of from 51.9 to 52.1MHz.
   - Move A51S1 to “N” position.
   - Move cable from A51J2 to A52J2 (fig. FO-19).
6. Connect Power Meter and Thermistor Mount to A51J1.
7. On Level meter,
   - Tune Level Meter to 32MHz.
   - Enter a frequency step of 30MHz.
   - Adjust A51R56 (Gain) for a Power Meter indication of from -5 to –7dB.
   - Step tuned frequency of Level Meter down to 2MHz.
   - Adjust A51R55 (Flatness) for a Power Meter indication of from -5 to –7dB.
8. Repeat step 7 until both measurements are within specification.
9. Repeat steps 3 thru 5 if necessary.
10. Move cable from A52J2 to A51J1.
11. Turn off Level Meter,
12. Install A51 Summation Loop Voltage Controlled Oscillator Assembly (para 2-87),

A53 SUMMATION PHASE DETECTOR CHECK AND ADJUSTMENT.

1. Remove A53 Summation Phase Detector Assembly (para 2-89) and reinstall on an extender board.
2. Turn on Level Meter and allow 5 minutes for warm-up.

2-48. ADJUST A50/A51/A53 STEP AND SUMMATION LOOP—Continued.

3. Connect Digital Multimeter to A53TP2 (fig. FO-20).

4. On Level Meter,

- Enter a frequency step of 26MHz.

5. On Level Meter,

- Tune to 27.99MHz.
- Adjust A53R13 (Offset) for a Digital Multimeter indication of 0 ± 0.05V.
- Step tuned frequency of Level Meter down to 1.99MHz.
- Adjust A53R3 (Gain) for a Digital Multimeter indication of 0 ± 0.05V.

6. Repeat step 5 until both measurements are within specification.

7. On Level Meter,

- Tune to 1.99MHz.
- Enter a frequency step of 2MHz.
- Step tuned frequency, in 2MHz increments, from 1.99MHz to 27.99MHz. Adjust A53R13 until Digital Multi meter indication is 0 ± 0.2V at each step.

8. Turn off Level Meter.

9. Disconnect test equipment.

10. Install A53 Summation Phase Detector Assembly (para 2-89).

11. Install top cover (para 2-66).

2-49. ADJUST AII SECOND LOCAL OSCILLATOR.

1. Remove A11 Second Local Oscillator Assembly (para 2-76) and reinstall on an extender board.

2. Turn on Level Meter and allow 20 minutes for warm-up.

3. Connect Digital Multimeter to A11TP2 (fig. FO-7).

- Adjust Al 1122 until Digital Multimeter indicates roughly –1.4 to –2.4V.
- Verify that UNLOCK light A11CR91 is off.

2-49. ADJUST A11 SECOND LOCAL OSCILLATOR—Continued.

4. Turn off Level Meter.
5. Disconnect test equipment.
6. Install Al 1 Second Local Oscillator Assembly (para 2-76).
7. Install top cover (para 2-66).

2-50. ADJUST A22 ANALOG-DIGITAL CONVERTER.

1. Remove A21 IF Gain/Detector Assembly (para 2-80).
2. Remove A22 Analog-Digital Converter Assembly (para 2-81) and reinstall on an extender board.
3. Turn on Level Meter and allow 20 minutes for warm-up.
4. Connect Synthesizer/Level Generator OUTPUT to bottom of A22C1 (fig FO-12).
5. Set output of Synthesizer/Level Generator to 15625Hz at -30dBm.
6. Apply approximately –1Vdc to A22U7, pin 4.
7. Adjust Oscilloscope to vertically center trace on display with no input. Select input to DC coupling.
8. Connect Oscilloscope to A22TP3.
9. Adjust A22R6 (Voltage-Controlled Oscillator frequency) until square wave is centered on Oscilloscope display with respect to ground.
10. Disconnect Synthesizer/Level Generator and Oscilloscope.
11. On Level Meter press RECALL, "." (decimal), RDNG->OFFSET, and number 5 push button.
12. Connect Digital Multi meter across A22TP1 and A22TP2.
    - Adjust A22R21 (Volt Ref) so MEASUREMENT/ENTRY display on Level Meter indicates same as Digital Multimeter, ±3 counts.
13. Apply -0.5Vdc to A22, pin A2.
    - Adjust A22R21 (Volt Ref) so MEASUREMENT/ENTRY display on Level Meter indicates same as Digital Multimeter, ±3 counts.
14. Apply approximately –1Vdc to A22U7, pin 4.
15. Repeat steps 12 thru 14 until no further adjustment is required.

2-50. ADJUST A22 ANALOG-DIGITAL CONVERTER—Continued.

16. Turn off Level Meter.

17. Disconnect test equipment.

18. Install A21 IF Gain/Detector Assembly (para 2-80).

19. Install A22 Analog-Digital Converter Assembly (para 2-81).

20. Install top cover (para 2-66).

2-51. ADJUST A21 LOGGER AND IF GAIN.

1. Remove A20 IF Filter Assembly (para 2-79).

2. Remove A21 IF Gain/Detector Assembly (para 2-80) and reinstall on an extender board.

3. Turn on Level Meter and allow 20 minutes for warm-up.

4. Connect Oscilloscope to A21TP6 (fig. FO-11).

   - Adjust A21R44 (Mixer Bal) on for minimum AC on Oscilloscope display.

5. Disconnect Oscilloscope.

6. Connect 50Ω OUTPUT of Synthesizer/Level Generator to bottom lead of A21R2. Monitor 50Ω output of Synthesizer/Level Generator using Digital Multimeter.

7. Set output of Synthesizer/Level Generator to 15625Hz at 10.95dBm.

8. Step output amplitude of Synthesizer/Level Generator by 0.01dB until 1.58 1Vac is indicated on Digital Multimeter.

9. On Level Meter:

   - Select ENTRY 10 and enter a full scale of 20dBm.
   - Press MEAS CONT push button
   - Turn AUTO CAL off.
   - Press RECALL, " ." (decimal), CNTR—>FREQ, and number 0 push button.

10. Adjust A21R23 (10dB Offset) until MEASUREMENT/ENTRY display on Level Meter indicates from 19.99dBm to 20.01dBm.

11. Step amplitude of Synthesizer/Level Generator down by 10dB.

12, Adjust A21R19 (10dB Gain) until MEASUREMENT/ENTRY display on Level Meter indicates from 9.99dBm to 10.01dBm.

2-51. ADJUST A21 LOGGER AND IF GAIN—Continued.

13. Step amplitude of Synthesizer/Level Generator up by 10dB.

14. Repeat steps 10 thru 13 until no further adjustment is required.

15. Set amplitude of Synthesizer/Level Generator until 20dBm, ±0.01dB appears in MEASUREMENT/ENTRY display of Level Meter.

16. Set amplitude step of Synthesizer/Level Generator to 60dB.

17. On Level Meter

- Select ENTRY 100.
- Press RECALL, " ." (decimal), CNTR->FREQ, and number 2 push button.

18. Adjust A21R25 (100dB Offset) until from 19.99dBm to 20.01dBm appears in MEASUREMENT/ENTRY display of Level Meter.

19. Step amplitude of Synthesizer/Level Generator down by 60dB.

20. Adjust A21R28 (100dB Gain) until from -39.99dBm to -40.01dBm appears in MEASUREMENT/ENTRY display of Level Meter.

21. Step amplitude of synthesizer/level generator up by 60dB.

22. Repeat steps 18 thru 21 until no further adjustment is required.

23. Repeat steps 7 thru 22 until indications are within specification.

24. Connect Digital Multimeter to meter output on rear panel of Level Meter. Leave Synthesizer/Level Generator connected as in step 6.

25. On Level Meter, select ENTRY 10.

26. Adjust amplitude of Synthesizer/Level Generator until from 19.99dBm to 20. 01dBm appears in MEASUREMENT/ENTRY display of Level Meter.

27. Adjust A21R96 (Meter 0dB Cal) until Digital Multimeter indicates 0 ± 0.001Vdc.

28. Adjust mechanical meter zero on Level Meter, if required. See TM 11-6625-3143-12 for adjustment procedures.

29. Turn off Level Meter.

30. Disconnect test equipment.

31. Install A20 IF Filter Assembly (para 2-79).

32. Install A21 IF Gain/Detector Assembly (para 2-80).

33. Install top cover (para 2-66).

2-52. ADJUST A10/A20 BANDWIDTH FILTERS.

1. Remove A10 Second Mixer Assembly (para 2-75) and reinstall on an extender board.
2. Remove A20 IF Filter Assembly (para 2-79) and reinstall on an extender board.
3. Remove jumper wire A10J1 from A10TP1 (fig. FO-6). When A10J1 is disconnected, Level Meter will display CE-F.
4. Connect Low Frequent y Spectrum Analyzer tracking generator output to A10TP1.
5. On Level Meter, select ENTRY 100.
6. Set Low Frequency Spectrum Analyzer as follows:

Center Frequency	15.849 KHz
span	4000HZ
Resolution Bandwidth	30Hz
Video Bandwidth	100Hz

7. Connect Low Frequency Spectrum Analyzer 1MEG Ω input to A20TP12 (fig. FO-10).
   - Adjust A20L51 for a null on display.
8. Connect Low Frequency Spectrum Analyzer 1MEG Ω input to A20TP13.
   - Set center frequency to 20.593KHz. Adjust A20L52 for a null on display.
   - Set center frequency to 12.883KHz. Adjust A20153 for a null on display.
9. Connect Low Frequency Spectrum Analyzer 1MEG Ω input to A20TP14. Connect a jumper wire between A20TP12 and A20TP13.
   - Set center frequency to 18.350KHz. Adjust A20L54 for a null on display.
   - Set center frequency to 13.505KHz. Adjust A20L55 for a null on display.
10. Connect Low Frequency Spectrum Analyzer 1MEG Ω input to A20TP15. Connect a jumper wire between A20TP12 and A20TP14.
    - Set center frequency to 17.742KHz. Adjust A20L56 for a null on display.
    - Set center frequency to 13.734KHz. Adjust A20L57 for a null on display.
11. Connect Low Frequency Spectrum Analyzer 1MEG Ω input to A20TP16. Connect a jumper wire between A20TP12 and A20TP15.
    - Set center frequency to 17.516KHz. Adjust A20L58 for a null on display.
    - Set center frequency to 13.816KHz. Adjust A20L59 for a null on display.

2-52. ADJUST A10/A20 BANDWIDTH FILTERS—Continued.

12. Connect Low Frequency Spectrum Analyzer 1MEG Ω input to A20J2. Connect a jumper wire between A20TP12 and A20TP16.

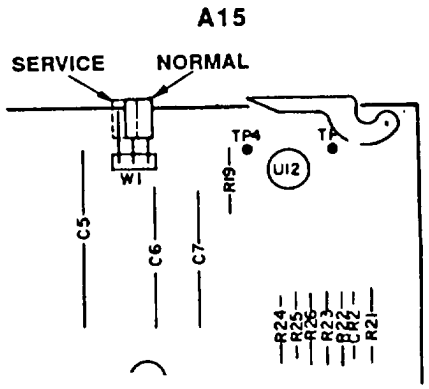
- Set center frequency to 17.434KHz. Adjust A20L60 for a null on display.
- Set center frequency to 9.968KHz. Adjust A20L61 for a null on display.

13. Disconnect jumper.

14. Connect Low Frequency Spectrum Analyzer 1MEG Ω input using 10:1 probe to A20TP11.

NOTE

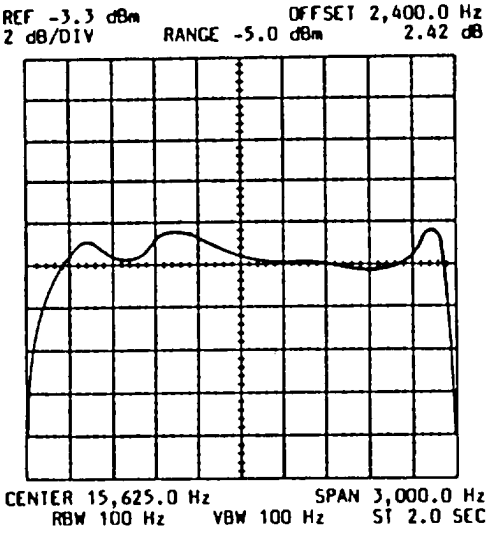
Low Frequency Spectrum Analyzer must be internally set (A15W1 to service position) for a gain 10 times greater than displayed at 2dB/DIV. See Low Frequency Spectrum Analyzer operating manual for assembly and component location. All amplitudes need to be divided by 10.



15. Set Low Frequency Spectrum Analyzer as follows:

Press	MANUAL
Range	-5dB
dB/Drv	.2dB
Center Frequency	15.625 KHz
Frequency Span	3KHZ
Resolution Bandwidth	100Hz
Video Bandwidth	100Hz
Sweep Time	2 sec
Impedance	1MEG Ω
Auto Range	OFF
REF LVL Track	ON
Press	CONT
Press	REF LVL
Adjust continuous entry knob to center display	
Press	MANUAL and enter 14.425 KHz
Press	2,400.0 Hz
Press	ENTER OFFSET
Press	MANUAL and enter 16.825KHz
Press	CONT
Press	SAVE then number 1

16. Adjust A20L91 (lower band edge flatness) and A20L92 (upper band edge flatness) until waveform displayed is as shown.



2-52. ADJUST A10/A20 BANDWIDTH FILTERS—Continued.

18. Set Low Frequency Spectrum Analyzer as follows:

Press	RECALL then number 1
dB/DIV	1dB
Frequency Span	4KHZ
Sweep Time	2.8 sec
OFFSET	OFF
Set Marker to	15.625 KHz
OFFSET	ON
Press	ENTER OFFSET

Turn continuous entry knob CCW until offset indicates approximately -3dB

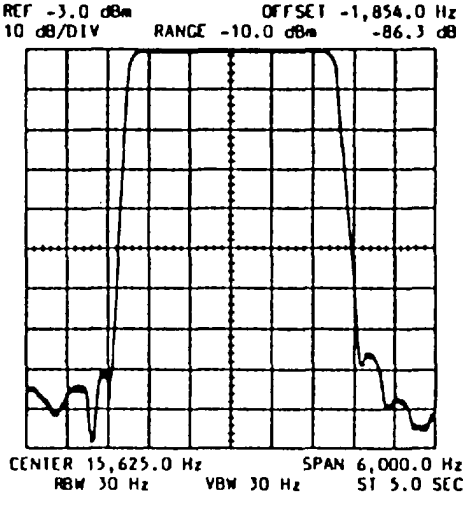
Press	ENTER OFFSET

Turn continuous entry knob to CW until offset indicates approximately 0dB

19. Verify offset frequency is from 2945 to 3255 Hz.

20. Set Low Frequency Spectrum Analyzer as follows:

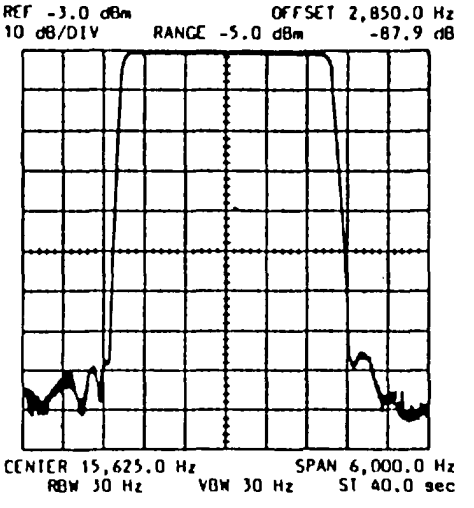
Frequency Span	6KHz
Resolution Bandwidth	30Hz
OFFSET	OFF
Marker Frequency	15.625KHz
OFFSET	ON
Press	ENTER OFFSET
dB/DIV	10dB



21. On Low Frequency Spectrum Analyzer,

- Turn continuous ENTRY adjust CCW to –1850Hz. Verify Offset Amplitude is less than -65dB as shown.
- Turn continuous ENTRY adjust CW to +1850Hz Verify Offset Amplitude is less than -65dB as shown.
- Turn continuous ENTRY adjust CCW to –2850Hz. Verify Offset Amplitude is less than -80dB as shown.
- Turn continuous ENTRY adjust CCW to +2850Hz. Verify Offset Amplitude is less than -80dB as shown.

22. Connect Low Frequency Spectrum Analyzer 1MEG Ω input using 10:1 probe to A20TP4.



2-52. ADJUST A10/A20 BANDWIDTH FILTERS—Continued.

23. Set Low Frequency Spectrum Analyzer controls as follows:

Press	INSTR PRESET
Center Frequency	15.625 KHz
Frequency Span	2.5KHz
Marker	15.625 KHz
Input	1MEG Ω
Auto Range	OFF
Range	-5dB
REF LVL	-7dBm
Sweep Time	12 sec
Press	SAVE then number 1

Set tracking generator amplitude to full CW (0dBm).

24. On Level Meter, short out A20Y1/A20Y2 top leads.

25. On Low Frequency Spectrum Analyzer, adjust continuous entry knob until marker is at 16. 1KHz, then press manual sweep push button.

26. Adjust A20C42 for a minimum level on display.

27. On Level Meter, remove short on A20Y1/A20Y2 and short out A20Y3/A20Y4 top leads.

28. On Low Frequency Spectrum Analyzer, press CONT push button. Wait one sweep and press MANUAL push button.

29. Adjust A20C32 for a minimum level on display.

30. On Low Frequency Spectrum Analyzer, press CONT push button.

31. On Level Meter, remove short.

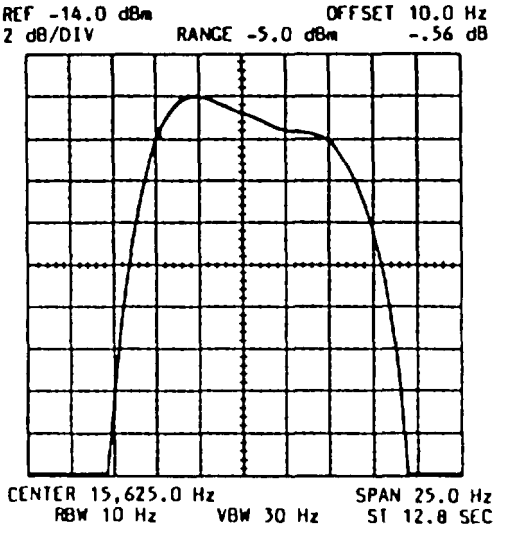
32. Set Low Frequency Spectrum Analyzer as follows:

Press	INSTR PRESET
Press	RECALL then number 1
Frequency Span	25Hz
REF LVL	-14dBm
dB/DIV	2dB
Resolution Bandwidth	10Hz
Video Bandwidth	100Hz
Sweep Time	12.8 sec
Press	MANUAL and enter 15.620KHz
Press	ENTER OFFSET
OFFSET	ON
Press	MANUAL and enter 15.630KHz
Press	CONT
Press	REF LVL

Turn continuous entry knob to center trace on display.

2-52. ADJUST A10/A20 BANDWIDTH FILTERS—Continued.

33. Adjust A20R35 (20Hz ripple) and A20R40 (20Hz tilt) until waveform displayed is as shown.



34. Set Low Frequency Spectrum Analyzer as follows:

dB/DIV	1dB
Marker	15.625 KHz
OFFSET	ON
Press	ENTER OFFSET

Turn continuous entry knob CCW until offset indicates approximately –3dB

Press	ENTER OFFSET

Turn continuous entry knob CW until offset indicates approximately 0dB

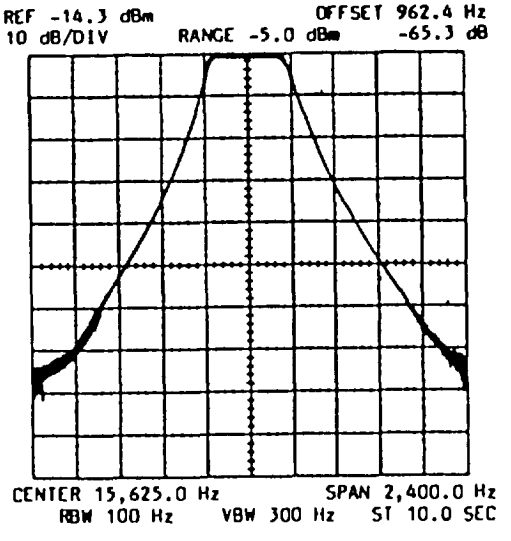
35. Verify offset frequency is from 18Hz to 22 Hz.

- If bandwidth is to wide, set marker to center frequency, press MANUAL push button and adjust A20R35 to move marker up. Press CONT then repeat step 34.
- If bandwidth is too narrow, set marker to center frequency, press MANUAL push button and adjust A20R35 to move marker down. Press CONT then repeat step 34.

36. Set Low Frequency Spectrum Analyzer as follows:

Press	RECALL then number 1
Frequency Span	200Hz
Sweep Time	20 Sec
Wait one full sweep	
Press	MKR-REF LVL push button
dB/DIV	10dB
Marker	15.625 KHz
OFFSET	ON
Press	ENTER OFFSET

37. On Low Frequency Spectrum Analyzer,



- Adjust continuous entry knob CCW for a frequency offset of –35Hz. Verify offset level more negative than -30dB as shown.
- Adjust continuous entry knob CW for a frequency offset of +35 Hz. Verify offset level more negative than -30dB as shown.
- Adjust continuous entry knob CCW for a frequency offset of –80Hz. Verify offset level more negative than -30dB as shown.
- Adjust continuous entry knob CW for a frequency offset of +80 Hz. Verify offset level more negative than -30dB as shown.

2-52. ADJUST A10/A20 BANDWIDTH FILTERS—Continued.

38. Install A20 IF Filter Assembly (para 2-79).

39. Connect Low Frequency Spectrum Analyzer 1MEG Ω input using 10:1 probe to right side of A10C101.

40. Set Low Frequency Spectrum Analyzer as follows:

Press	INSTR PRESET
Center Frequency	14.242KHz
Frequency Span	2KHZ
Input	1MEG Ω
Auto Range	OFF
Range	-25dB
REF LVL	-30dBm
sweep	Manual

41. On Level Meter, select 400Hz bandwidth.

- Adjust A 10L101 for a null on display.

42. Connect Low Frequency Spectrum Analyzer 1MEG Ω input using 10:1 probe to A10TP2. Place a shorting wire between right side of A10C101 and A10TP1.

- Set center frequency to 17.324KHz. Adjust A10L102 for a null.
- Set center frequency to 14.4KHz. Adjust A10L103 for a null.

43. Connect Low Frequency Spectrum Analyzer 1MEG Ω input using 10:1 probe to A10TP3. Place a shorting wire between right side of A10C101 and A10TP2.

- Set center frequency to 16.795KHz. Adjust A10L104 for a null.

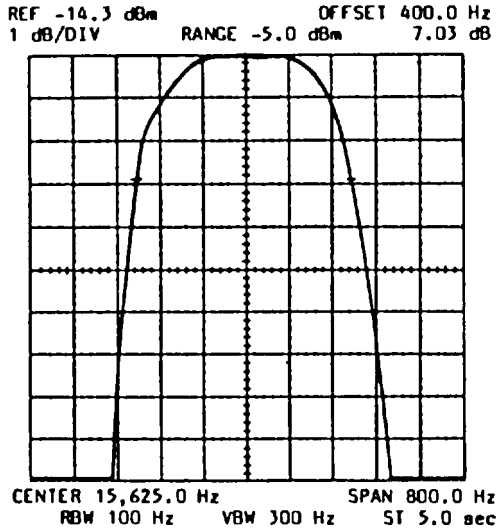
44. On Level Meter, remove short.

45. Set Low Frequency Spectrum Analyzer as follows:

Press	INSTR PRESET
Center Frequency	15.625 KHz
Frequency Span	800HZ
Input	1MEG Ω
Auto Range	OFF
Range	-5dB
dB/DIV	1dB
Resolution Bandwidth	100Hz
Video Bandwidth	300Hz
Sweep time	5 sec
Press	MKR-REF LVL
OFFSET	ON
Press	ENTER OFFSET
Turn continuous entry knob until marker is over –200Hz	
Press	ENTER OFFSET
Turn continuous entry knob until marker is over +400Hz	

2-52. ADJUST A10/A20 BANDWIDTH FILTERS—Continued.

46. Adjust as necessary A10L101, A10L102, A10L103, and A10L104 for a waveform with markers approximately -3dBm from reference, and 3dB points 400Hz ±20Hz apart as shown.



47. Set Low Frequency Spectrum Analyzer as follows:

Frequency Span	250Hz
dB/DIV	MB
OFFSET	OFF
Adjust continuous entry knob to 15.625KHz	
OFFSET	ON
Press	ENTER OFFSET

48. On Low Frequency Spectrum Analyzer,

- Adjust continuous entry knob CW for a frequency offset of –75Hz. Verify offset amplitude is not more than 0.3dB.
- Adjust continuous entry knob CW for a frequency offset of +75 Hz. Verify offset amplitude is not more than 0.3dB.

49. Set Low Frequency Spectrum Analyzer as follows:

Frequency Span	500HZ
dB/DIV	1dB
Sweep Time	10 sec
OFFSET	OFF
Press	ENTER OFFSET
Set marker to	15.625KHz.
OFFSET	ON
Press	ENTER OFFSET
Turn continuous entry knob to CCW until offset indicates approximately –3dB	
Press	ENTER OFFSET
Turn continuous entry knob to CW until offset indicates approximately 0dB	

50. Verify offset frequency is from 360Hz to 440Hz.

51. Set Low Frequency Spectrum Analyzer as follows:

Frequency Span	2.4KHz
dB/DIV	10dB
OFFSET	OFF
Set marker to	15.625 KHz
OFFSET	ON
Press	ENTER OFFSET

2-52. ADJUST A10/A20 BANDWIDTH FILTERS—Continued.

52. On Low Frequency Spectrum Analyzer,

- Adjust continuous entry knob CCW for a frequency offset of –1000HZ. Verify offset amplitude is more negative than -60dB.
- Adjust continuous entry knob CW for a frequency offset of +1000HZ. Verify offset amplitude is more negative than -60dB.

53. Turn off level Meter.

54. Replace jumper A10J1 on A10TP1.

55. Disconnect test equipment.

56. Install A10 Second Mixer Assembly (para 2-75).

57. Install top cover (para 2-66).

58. Return Low Frequency Spectrum Analyzer to normal operation.

2-53. ADJUST A10/A20 BANDWIDTH GAIN.

Remove A10 Second Mixer Assembly (para 2-75) and reinstall on an extender board.

2. Remove A20 IF Filter Assembly (para 2-79) and reinstall on an extender board.

3. Disconnect jumper A10J1 from A10TP1 (fig. FO-6). When A10J1 is disconnected, Level Meter will display CE-F.

4. Turn on Level Meter and allow 20 minutes for warm-up.

5. Connect 50Ω output of Synthesizer/Level Generator and Digital Multimeter to A10TP1.

6. On Level Meter
   - Select ENTRY 10.
   - Enter full scale of 20dBm.
   - Turn AUTO CAL off.
   - Press MEAS CONT, RECALL, "." (decimal), CNTR—>FREQ, and number 0 push button.
   - Select 3100Hz bandwidth.

7. Set output of Synthesizer/Level Generator to 15625Hz and adjust amplitude until Digital Multimeter indicates 502mVrms.

8. Adjust A20R95 (fig. FO-10) until MEASUREMENT/ENTRY display indicates from 19,99dBm to 20.01dBm.

2-53. ADJUST A10/A20 BANDWIDTH GAIN—Continued.

9. On Level Meter, select 20Hz bandwidth.
   - Adjust A20R24 until MEASUREMENT/ENTRY display indicates from 19.99dBm to 20.01dBm.
   - Select 400Hz bandwidth.
   - Adjust A10R105 until MEASUREMENT/ENTRY display indicates from 19.99dBm to 20.01dBm.
10. Turn off Level Meter.
11. Connect jumper A10J1 to A10TP1.
12. Disconnect test equipment.
13. Install A10 Second Mixer Assembly (para 2-75).
14. Install A20 IF Filter Assembly (para 2-79).
15. Install top cover (para 2-66).

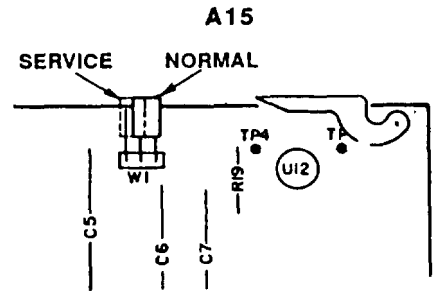
2-54. ADJUST A5 LOW-PASS FILTER FLATNESS.

NOTE

Keep test equipment interconnecting cables as short as possible.

NOTE

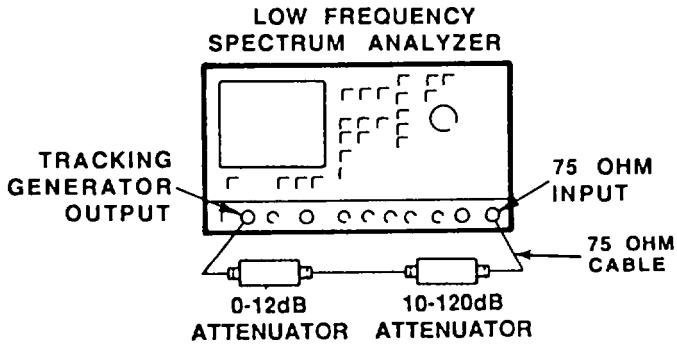
Low Frequency Spectrum Analyzer must be internally set (A15W1 to service position) for a gain 10 times greater than displayed at 2dB/DIV. See Low Frequency Spectrum Analyzer operating manual for assembly and component location. All amplitudes need to be divided by 10.



1. Remove A5 Input Mixer Assembly (para 2-74) and reinstall on an extender board.
2. Turn on Level Meter and allow 20 minutes to warm up.

2-54. ADJUST A5 LOW-PASS FILTER FLATNESS—Continued.

3. Connect test equipment as shown below.



4. Set 0-12dB Attenuator to 5dB.

5. Set 0-120dB Attenuator to 10dB.

6. Set Low Frequency Spectrum Analyzer as follows:

Press	INSTR PRESET
Input	75Ω
Auto Range	OFF
Range	–15dBm
Start frequency	100HZ
Stop frequency	35MHZ
Sweep Time	0.2sec
dB/DIV	10dB
Press	CONT
Press	REF LVL
Adjust Tracking Generator output to –18dBm	
dB/DIV	0.2dB
Press	MARKER
Set marker to	32.515MHz
Press	REF LVL
Adjust continuous entry knob to center display	
Press	STORE A—>B
Press	A-B
Press	VIEW B

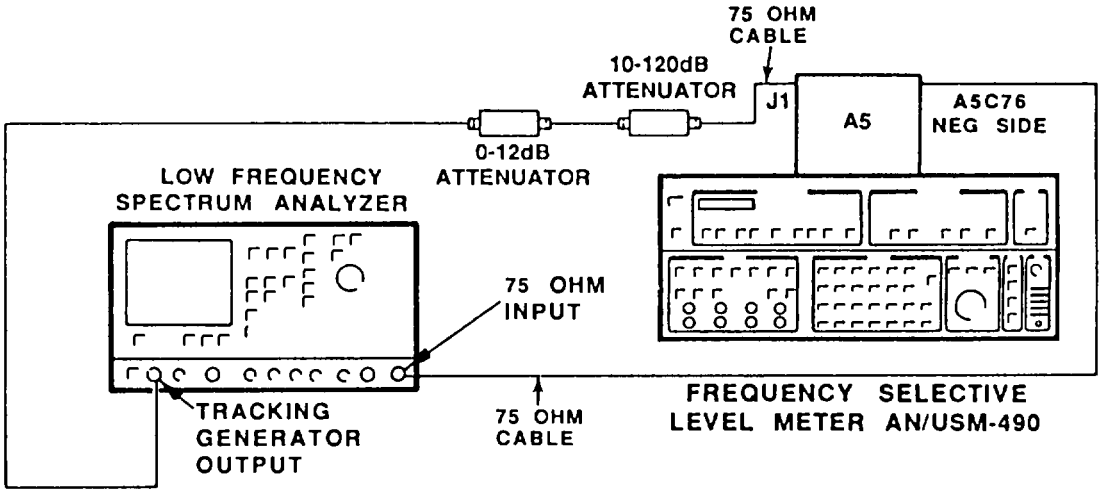
7. Set A5C76 (fig. FO-5) to TEST position.

NOTE

It maybe necessary to unsolder lead of A5C76.

2-54. ADJUST A5 LOW-PASS FILTER FLATNESS—Continued.

8. Connect test equipment as shown below.



9. On Low Frequency Spectrum Analyzer, press REF LVL push button and center display.

10. Adjust A5R50, A5C53, A5C56, A5C59, A5C61, A5C63, and A5C65 for a display as flat as possible (±0.25dBm) up to marker.

11. Turn off Level Meter.

12. Return A5C76 to normal position.

13 Disconnect test equipment.

14. Install A5 Input Mixer Assembly (para 2-74).

15. Install top cover (para 2-66).

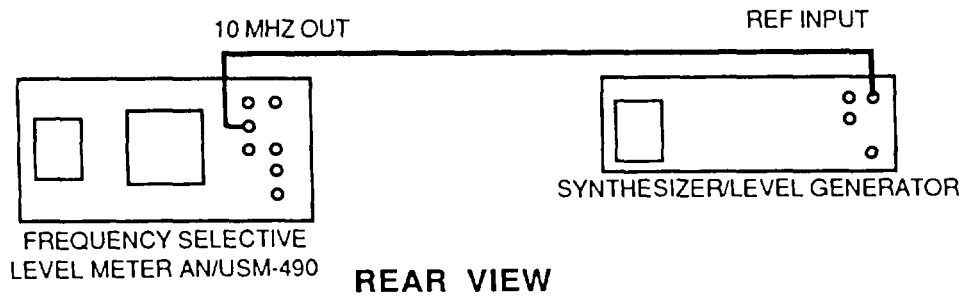
16. Return Low Frequency Spectrum Analyzer to normal operation.

2-55. ADJUST A5 50 MHz REJECTION.

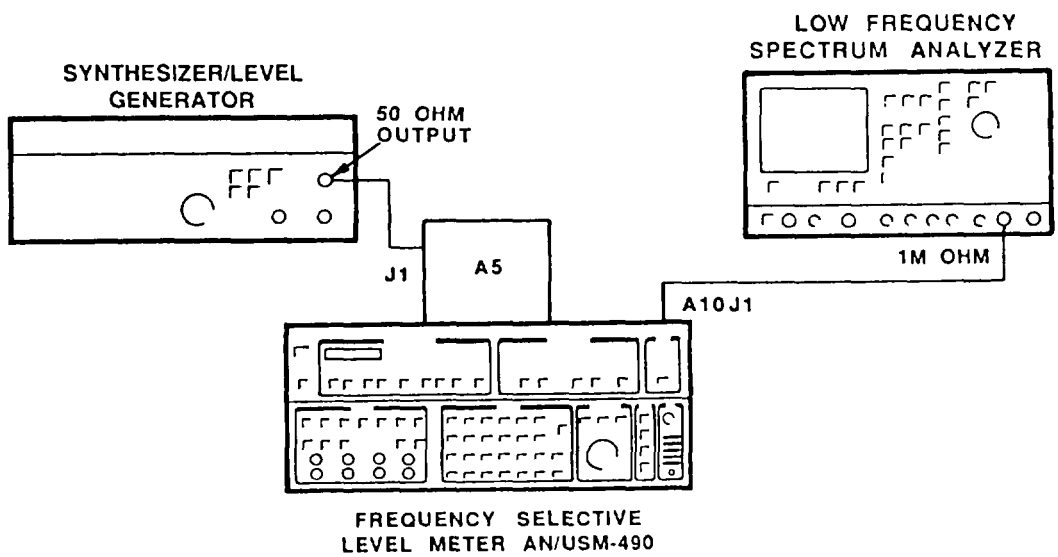
NOTE

Keep test equipment interconnecting cables as short as possible.

1. Remove A5 Input Mixer Assembly (para 2-74) and reinstall on an extender board.
2. Turn on Level Meter and allow 20 minutes for warm-up.
3. Connect test equipment as shown below.



REAR VIEW



FRONT VIEW

4. Set output of Synthesizer/Level Generator to 32MHz at -18dBm.
5. On Level Meter, tune to 32MHz.

2-55. ADJUST A5 50 MHz REJECTION—Continued.

6. Set Low Frequency Spectrum Analyzer as follows:

Press	INSTR PRESET
Input	1MEG Ω
Auto Range	OFF
Range	+10dB
Center Frequency	15.625 KHz
Frequency Span	42KHz
Sweep Time	4sec
Wait one sweep	
Press	MKR—>REF LVL
Press	OFFSET
Press	ENTER OFFSET

7. Set output of Synthesizer/Level Generator to 50MHz at –18dBm.

8. On Level Meter, tune to 1MHz.

9. Adjust A5C61 (fig. FO-5) until 50MHz is more negative than -65dB.

10. Turn off Level Meter.

11. Disconnect test equipment.

12. Install A5 Input Mixer Assembly (para 2-74).

13, Install top cover (para 2-66).

2-56. ADJUST A5/A10 50 MHz CRYSTAL FILTER.

50MHz CRYSTAL FILTER NOTCH ADJUSTMENT.

1. Remove A11 Second Local Oscillator Assembly (para 2-76). Install extender board in its place without reinstalling AII.

2. Remove A5 Input Mixer Assembly (para 2-74) and reinstall on an extender board.

3. Remove A10 Second Mixer Assembly (para 2-75) and reinstall on an extender board,

4. Disconnect jumper A10J1 on A10TP1 (fig. FO-6). When A10J1 is disconnected, Level Meter will display CE-F.

5. Turn on Level Meter and allow 20 minutes to warm up.

6. Connect A51J2 (fig. FO-18) to XA11 pin A13 and B13 (fig. FO-7).

2-56. ADJUST A5/A1050 MHz CRYSTAL FILTER—Continued.

7. Set A10R19 and A10C24 to their number 2 position.

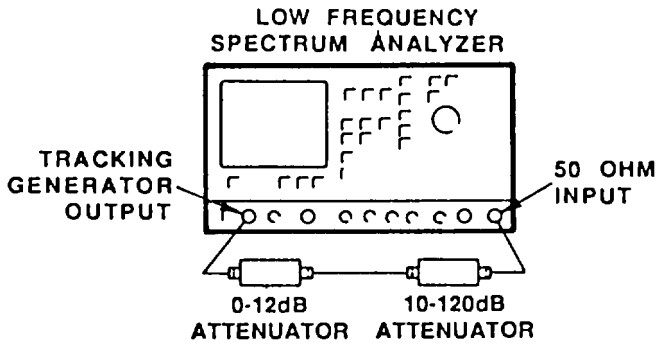
NOTE

It maybe necessary to unsolder lead of A10R19 and A10C24.

8. Set Low Frequency Spectrum Analyzer as follows:

Press	INSTR PRESET
Auto Range	OFF
Range	-5dBm
Center frequency	10MHZ
Frequency span	100KHZ
Resolution bandwidth	1KHZ
Sweep Time	1 Sec
REF level	–18dBm

9. Connect test equipment as shown below.



10. Set 0-12dB Attenuator to 5dB.

11. Set 0-120dB Attenuator to 10dB.

12. On Low Frequency Spectrum Analyzer:

- Adjust Tracking Generator output to –18dBm.

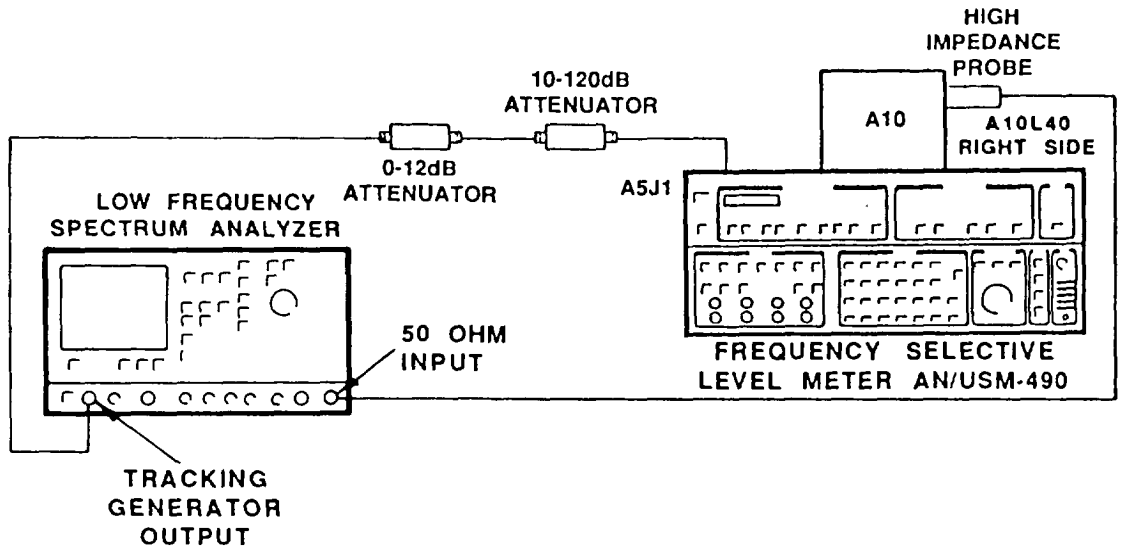
13. Turn off Level Meter.

2-56. ADJUST A5/A1050 MHz CRYSTAL FILTER—Continued.

14. Connect test equipment as shown below.

NOTE

Connect High Impedance Probe with A10 removed from Level Meter.



15. Turn on Level Meter and allow 5 minutes to warm up.

16. On Level Meter

- Press RECALL and number 0 push button.
- Select ENTRY 100.
- Set frequency to 10MHZ.
- Adjust A5L25 (fig. FO-5) for a peak on Low Frequency Spectrum Analyzer display.

17. Set Low Frequency Spectrum Analyzer as follows:

Press	MKR—>REF LVL
Wait one sweep.	
Press	OFFSET
Press	ENTER OFFSET
Set marker to +31200Hz	

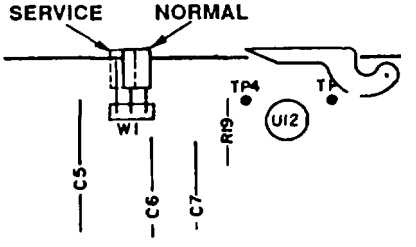
2-56. ADJUST A5/A1050 MHz CRYSTAL FILTER—Continued.

18. Adjust A5C23 to a minimum more negative than –50dB.

FIRST STAGE 50MHz FLATNESS ADJUSTMENT.

NOTE

Low Frequency Spectrum Analyzer must be internally set for a gain 10 times greater than displayed at 2dB/DIV. See operating manual for Low Frequency Spectrum Analyzer for proper procedure. All amplitudes need to be divided by 10.



1. Set Low Frequency Spectrum Analyzer as follows:

Frequency Span	11KHz
dB/DIV	0.2 dB
Sweep Time	3 Sec
Press	REF LVL
Press	SAVE and number 1

Adjust reference level as needed for an on screen display

2. Adjust A5L21 and A5R24 for ±0.05dB flatness at 2KHz from 10MHz center frequency.

NOTE

If A5R24 is not sufficiently adjusting flatness, change value of A5R23 using table shown below.

Gain	Resistance (ohms)
Decrease ↓	324
	348
	374
	402
	422
	453
	475
	499
Increase	523

3. Turn off Level Meter.

4. Return A10R19 and A10C24 to their number 1 positions, Resolder if necessary.

5. Install A5 Input Mixer Assembly (para 2-74).

2-56. ADJUST A5/A1050 MHz CRYSTAL FILTER—Continued.

SECOND STAGE 50MHz CRYSTAL FILTER ADJUSTMENT.

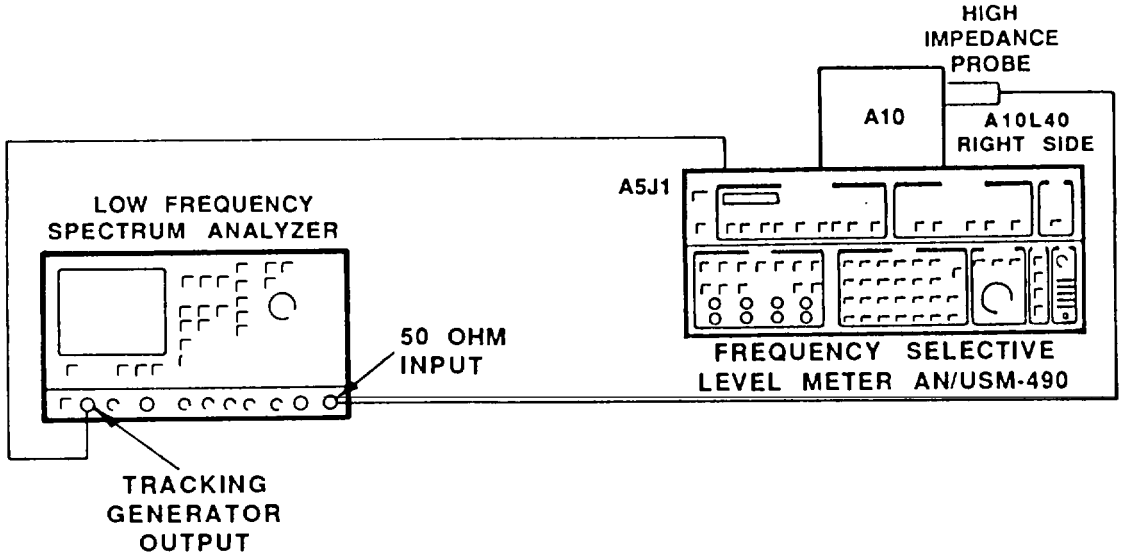
1. Turn on Level Meter and allow 5 minutes to warm up.
2. Set Low Frequency Spectrum Analyzer as follows:

Offset	OFF
dB/DIV	10dB
Frequency span	100KHZ
Marker	10MHZ
Reference level	-5dBm

3. On Level Meter,
   - Press RECALL then number 0.
   - Select ENTRY 100.
   - Set frequency to 10MHz.
4. Adjust A 10L24 for a peak on the Low Frequency Spectrum Analyzer display.
5. On Low Frequency Spectrum Analyzer, press MKR->REF LVL push button.
6. Connect test equipment as shown below.

NOTE

Connect High Impedance Probe with A10 removed from Level Meter.



2-56. ADJUST A5/A10 50 MHz CRYSTAL FILTER—Continued.

7. Set Low Frequency Spectrum Analyzer as follows:

Press	OFFSET
Press	ENTER OFFSET
Set marker to	31200Hz
Range	–20dBm

8. Adjust A1OC22 for a minimum.

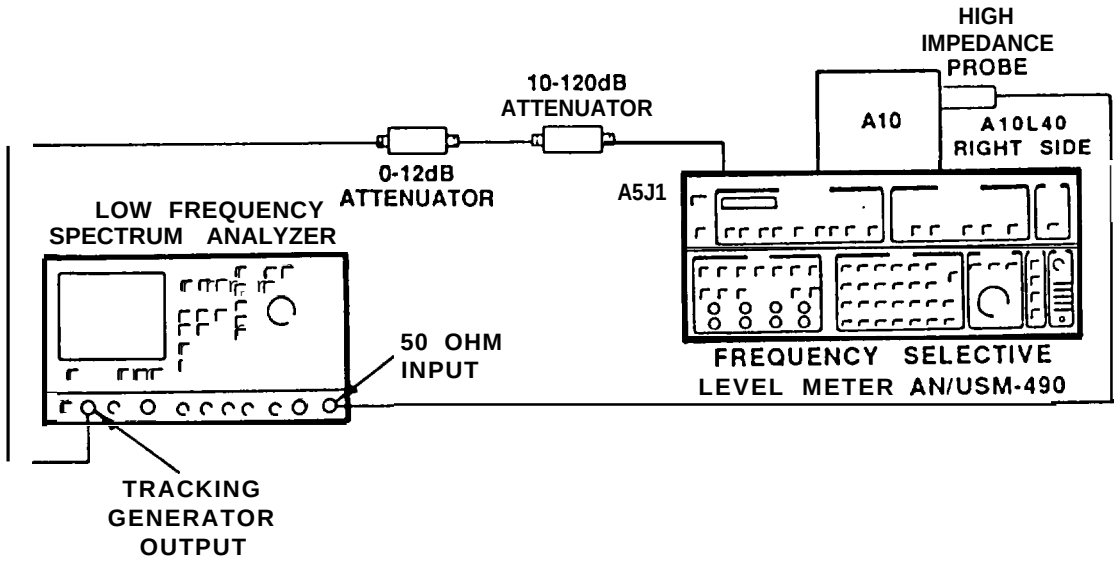
9. Turn off Level Meter.

50MHz FLATNESS ADJUSTMENT.

1. Connect test equipment as shown below.

NOTE

Connect High Impedance Probe with A lO removed from Level Meter.



2, Turn on Level Meter and allow 5 minutes to warm up.

3. Set O- 12dB Attenuator to 5dB.

4. Set 0-120dB Attenuator to 10dB.

2-56. ADJUST A5/A1050 MHz CRYSTAL FILTER—Continued.

5. Set Low Frequency Spectrum Analyzer as follows:

Press	RECALL then number 1
Press	REF LVL
Adjust for anon screen display.	

6. Adjust A10L20 and A10R24 for ±0.05dB flatness at 1.8KHz from 10MHz center frequency.

NOTE

If A10R24 is not sufficiently adjusting flatness, change value of A10R23 using table shown below.

Gain	Resistance (ohms)
Decrease ↓	374
	402
	422
	453
	475
	499
	523
	549
Increase	576

7. Turn off Level Meter.

8. Reconnect jumper A10J1 to A10TP1.

9. Disconnect test equipment.

10. Install A10 Second Mixer Assembly (para 2-75).

11. Install A11 Second Local Oscillator Assembly (para 2-76).

12. Install top cover (para 2-66).

13. Return Low Frequency Spectrum Analyzer to normal operation.

2-57. ADJUST A10 MIXER GAIN.

1. Remove A10 Second Mixer Assembly (para 2-75) and reinstall on an extender board.
2. Turn on Level Meter and allow 20 minutes for warm-up.
3. Connect 50Ωoutput of Synthesizer/Level Generator to A5J1 (fig FO-5).
4. Connect Digital Multimeter to A10TP1 (fig. FO-6).
5. Set output of Synthesizer/Level Generator to 1MHz at -18dBm.
6. On Level Meter
   - Select 1MHz.
   - Select ENTRY 100.
   - Enter full scale of 20dBm.
   - Press SSB CARRIER and ↗ push buttons.
7. Adjust A10R43 until Digital Multimeter indicates 502mVRMS.
8. Turn off Level Meter.
9. Disconnect test equipment.
10. Install A10 Second Mixer Assembly (para 2-75).
11. Install top cover (para 2-66).

2-58. ADJUST A5 LOCAL OSCILLATOR.

1. Remove A5 Input Mixer Assembly (para 2-74) and reinstall on an extender board.
2. Turn on Level Meter and allow 20 minutes for warm-up.
3. On Level Meter
   - Select ENTRY 100.
   - Tune to 0HZ.
   - Enter a full scale of 0dBm.
   - Press MEAS CONT.
4. Adjust A5R4 (fig. FO-5) for a MEASUREMENT/ENTRY display to below –25dBm from full scale.

2-58. ADJUST A5 LOCAL OSCILLATOR—Continued.

5. Turn off Level Meter.

6. Install A5 Input Mixer Assembly (para 2-74).

7. Install top cover (para 2-66).

2-59. ADJUST A1/A2 INPUT AMPLIFIER AND INPUT MULTIPLEXER.

10.5 VOLT REGULATOR ADJUSTMENT.

1. Remove A2 Input Amplifier Assembly (para 2-72) and reinstall on an extender board.

2. Turn on Level Meter and allow 20 minutes for warm-up.

3. Connect Digital Multimeter to A2TP marked -10 (fig. FO-3).

4. Adjust A2R105 until Digital Multimeter reads from –10.499 to -10.501Vdc,

5. Disconnect Digital Multimeter.

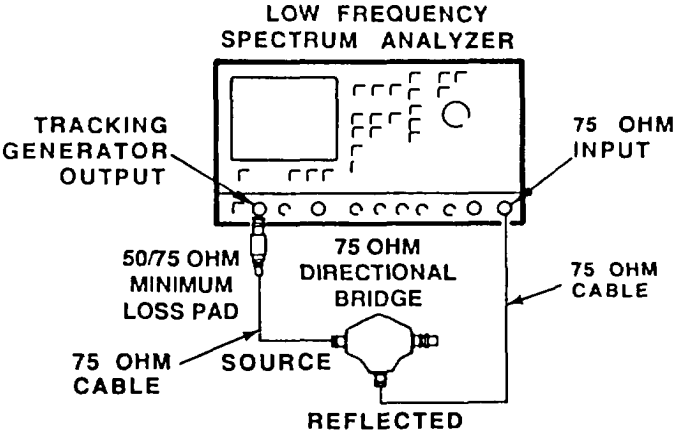
75Ω RETURN LOSS ADJUSTMENT.

1. Turn off Level Meter.

2. Install A2 Input Amplifier Assembly (para 2-72)

3. Remove Front Panel (para 2-69).

4. Connect test equipment as shown.



5. Turn on Level Meter and allow 5 minutes for warm-up.

6. Set Low Frequency Spectrum Analyzer range to –10dBm,

7. On Level Meter:

   Select ENTRY 100.

   Set full scale to -20dBm.

   Press WIDEBAND push button.

8. Set Low Frequency Spectrum Analyzer Tracking Generator output to 0dBm.

9. With load port of 75ΩDirectional Bridge open, adjust Low Frequency Spectrum Analyzer for a sweep of 0 to 32.5MHz.

10. Record level of Low Frequency Spectrum Analyzer swept display.

2-59. ADJUST A1/A2 INPUT AMPLIFIER AND INPUT MULTIPLEXER—Continued.

11. Connect load port of 75Ω Directional Bridge directly to 75Ω input of Level Meter.

12. On Level Meter, select 75Ω input. Ignore overload condition.

13. Verify display is at least 36dB below recorded level in step 10. If reading incorrect

- Remove Input Multiplexer Cover (para 2-71).
- Adjust A1L1, A1L2, and/or length of input connector jumper (fig. FO-2) until reading is correct.
- Install Input Multiplexer Cover (para 2-71).

14. On Level Meter press RECALL, "." (decimal), CNTR->FREQ, and number 1 push button.

15. Adjust A1C2 for a swept display of minimum level on Low Frequency Spectrum Analyzer that is at least 25dB below level recorded in step 10.

16. On Low Frequency Spectrum Analyzer, press STORE A—>B.

17. On Level Meter press RECALL, " ." (decimal), RDNG—>OFFSET, and number 1 push button. Set full scale to –15dBm. Ignore overload condition.

18. Adjust A2C7 (fig. FO-3) for a swept display as close as possible to stored swept display in step 16.

NOTE

Do not position signal directly over stored waveform and attempt to adjust for an exact duplicate. Adjust for likeness only.

INPUT AMPLIFIER FLATNESS ADJUSTMENT.

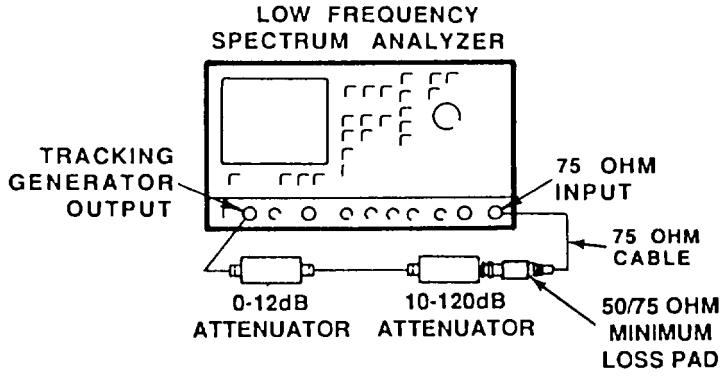
1. On Level Meter press RECALL and number O push button.

2. Set Low Frequency Spectrum Analyzer as follows:

Sweep frequency	O to 32.5 MHz
dB/DIV	1dB
Range	-25dBm

2-59. ADJUST A1/A2 INPUT AMPLIFIER AND INPUT MULTIPLEXER—Continued.

3 . Connect test equipment as shown below.



4. Set 1-12dB Attenuator to 8dB.

5 . Set 1-120dB Attenuator to 30dB.

6 . Set Low Frequency Spectrum Analyzer as follows:

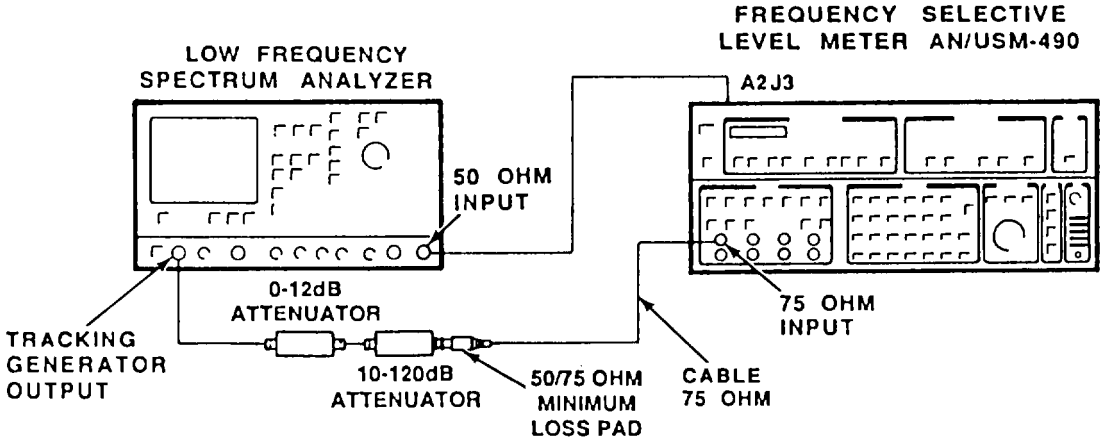
Adjust reference level for a swept level centered on display

Press STORE A—>B

7 . Set 1-12dB Attenuator to 5dB.

8 . Set 1-120dB Attenuator to 50dB.

9 . Connect test equipment as shown below.



2-59. ADJUST A1/A2 INPUT AMPLIFIER AND INPUT MULTIPLEXER—Continued.

10. On Low Frequency Spectrum Analyzer set display mode A-B.

11. On Level Meter, select ENTRY 100 and set full scale to -35dBm.

12. On Low Frequency Spectrum Analyzer, adjust reference level to move frequency center point of swept to center on display.

13. Adjust A2C32 for a swept display as flat as possible and to ±0.8dB from level at center of display.

14. Set Level Meter full scale, 1-12dB Attenuator, and 10-120dB Attenuator to levels listed in table below. Adjust component listed in table below for a swept display as flat as possible and to ±0.8dB from level at center of display

Level Meter Full Scale	1-12dB Attenuator	10-120dB Attenuator	Adjust
-30dBm	0dB	50dB	A2C33
–15dBm	5dB	30dB	A2C4
5dBm	5dB	10dB	A2C5, A2R5

15. Repeat step 14 until all adjustments are within specification.

16. Turn off Level Meter.

17. Disconnect test equipment.

18. Install Front Panel (para 2-69).

19. Install top cover (para 2-66).

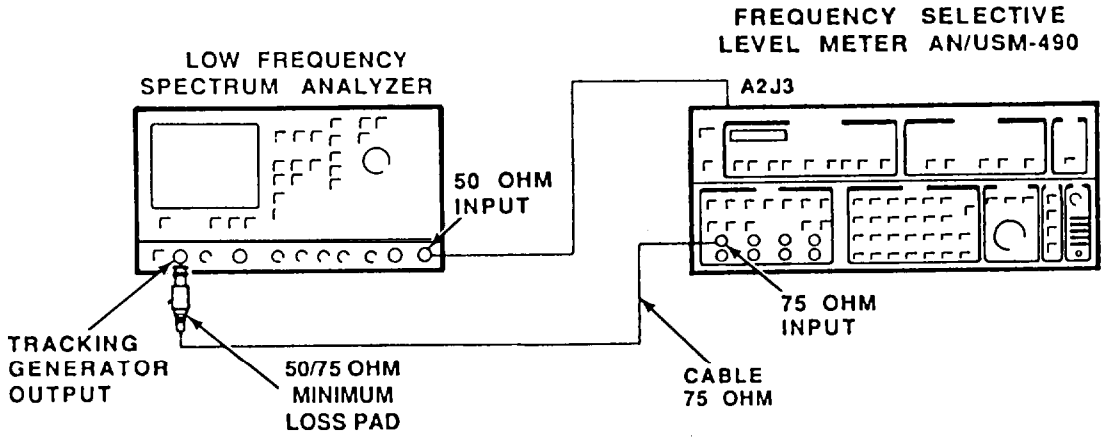
2-60. ADJUST A1 BALANCED INPUT FREQUENCY RESPONSE.

1. Remove Front Panel (para 2-69).

2. Turn on Level Meter and allow 20 minutes for warm-up.

3. Initialize Level Meter.

4. Connect test equipment as shown below.



5. On Level Meter,

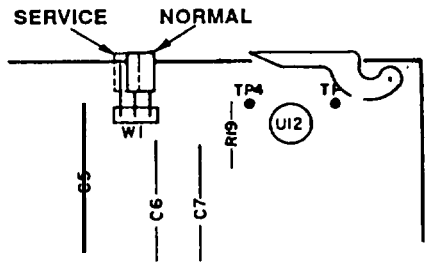
- Select 75Ω input.
- Select ENTRY 100.
- Set Full Scale to –5dBm.
- Turn AUTO CAL off.

NOTE

Low Frequency Spectrum Analyzer must be internally set (A15W1 to service position) for a gain 10 times greater than displayed at 2dB/DIV. See Low Frequency Spectrum Analyzer operating manual for assembly and component location. All amplitudes need to be divided by 10.

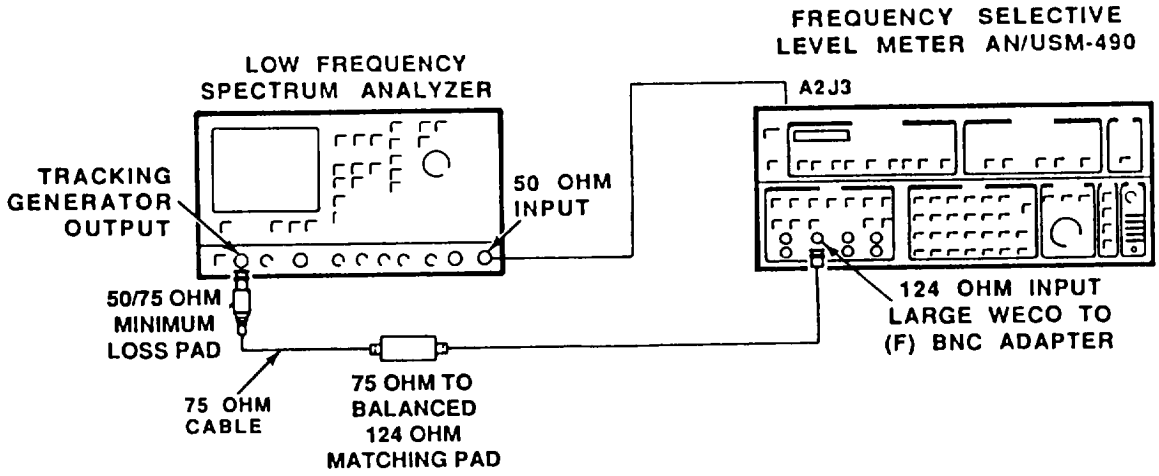
6. Set Low Frequency Spectrum Analyzer as follows:

Start frequency	10KHz
Stop frequency	10MHZ
dB/DIV	.2db
Auto range	OFF
Range	–10dBm
Set reference level	–18dBm
Press	STORE A
Press	A–B
Press	VIEW B off
Set reference level	–25dBm.



2-60. ADJUST A1 BALANCED INPUT FREQUENCY RESPONSE—Continued.

7. Connect test equipment as shown below.



8 . On Level Meter, select 124 W input.

l Adjust A1R15, A1L12, and A1L13 (fig. FO-2) for displayed center line flatness, ±0.8dB.

9 . Remove 75 to 124 W Balanced Matching Pad.

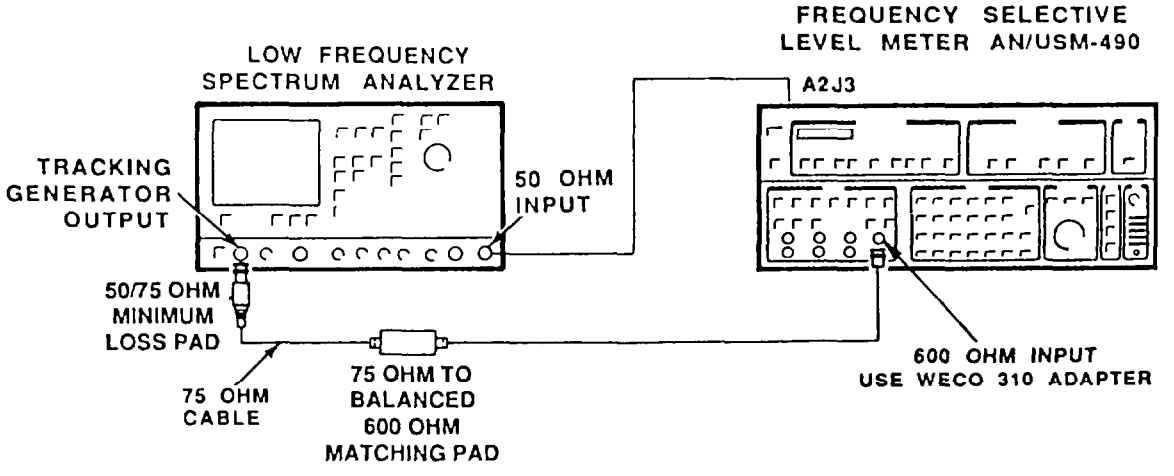
10. Repeat steps 1 thru 5.

11. Set Low Frequency Spectrum Analyzer as follows:

A-B	OFF
Start frequency	1 KHz
Stop frequency	100KHz
dB/DIV	.2db
Auto Range	OFF
Range	–l0dBm
Set reference level to	–18dBm
Press	STORE A
Press	A-B
Press	VIEW B off
Set reference level	-33dBm.

2-60. ADJUST A1 BALANCED INPUT FREQUENCY RESPONSE—Continued.

12. Connect test equipment as shown below.

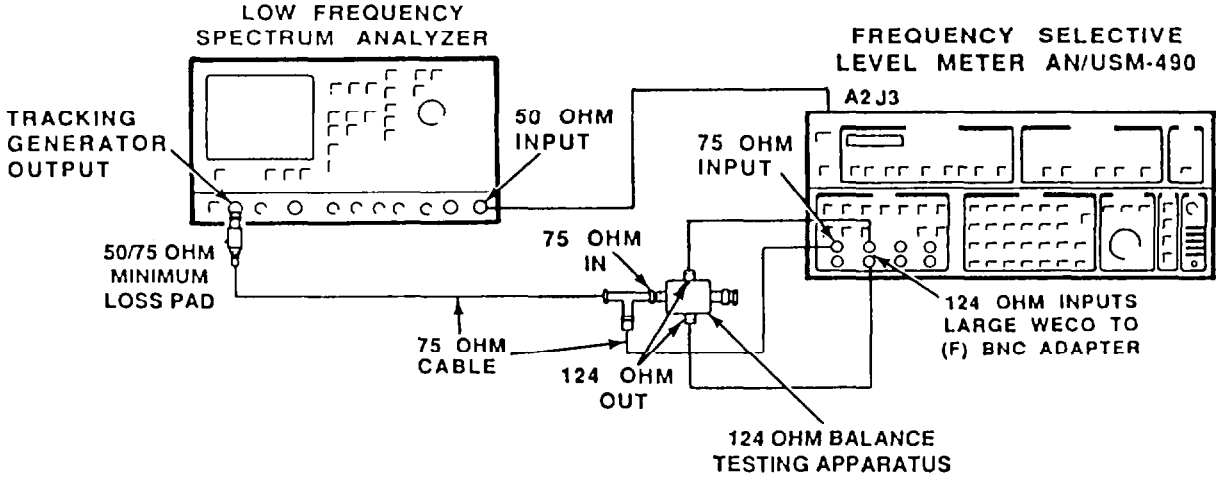


13. On Level Meter, select 600 Ω input.

- Adjust A1C22 for displayed center line flatness, ± 0.13dB.

14. Remove 75 to 600 Ω Balanced Matching Pad.

15. Connect test equipment as shown below.



2-60. ADJUST Al BALANCED INPUT FREQUENCY RESPONSE—Continued.

16. Set Low Frequency Spectrum Analyzer as follows:

Auto range	O F F
R a n g e	-l0dB
REF level	-lOdBm
Start frequency	10KHz
Stop frequency	10MHz
d B / D I V	l 0 d b
A - B	O F F

17. On Level Meter,

- Select 10K Ω II by 50pF input.
- Select ENTRY 100.
- Set Full Scale to+5dBm.
- Turn AUTO CAL off.

18. Set Low Frequency Spectrum Analyzer as follows:

Adjust sweep for a display lcm from top of screen

P r e s s	MARKER
P r e s s	OFFSET
P r e s s	ENTER OFFSET
P r e s s	STORE A—>B

19. On Level Meter, select 124 Ω input.

- Adjust A1C10 for a minimum level. Verify that measured result is less than -38dB.

20. Turn off Level Meter.

21. Disconnect test equipment.

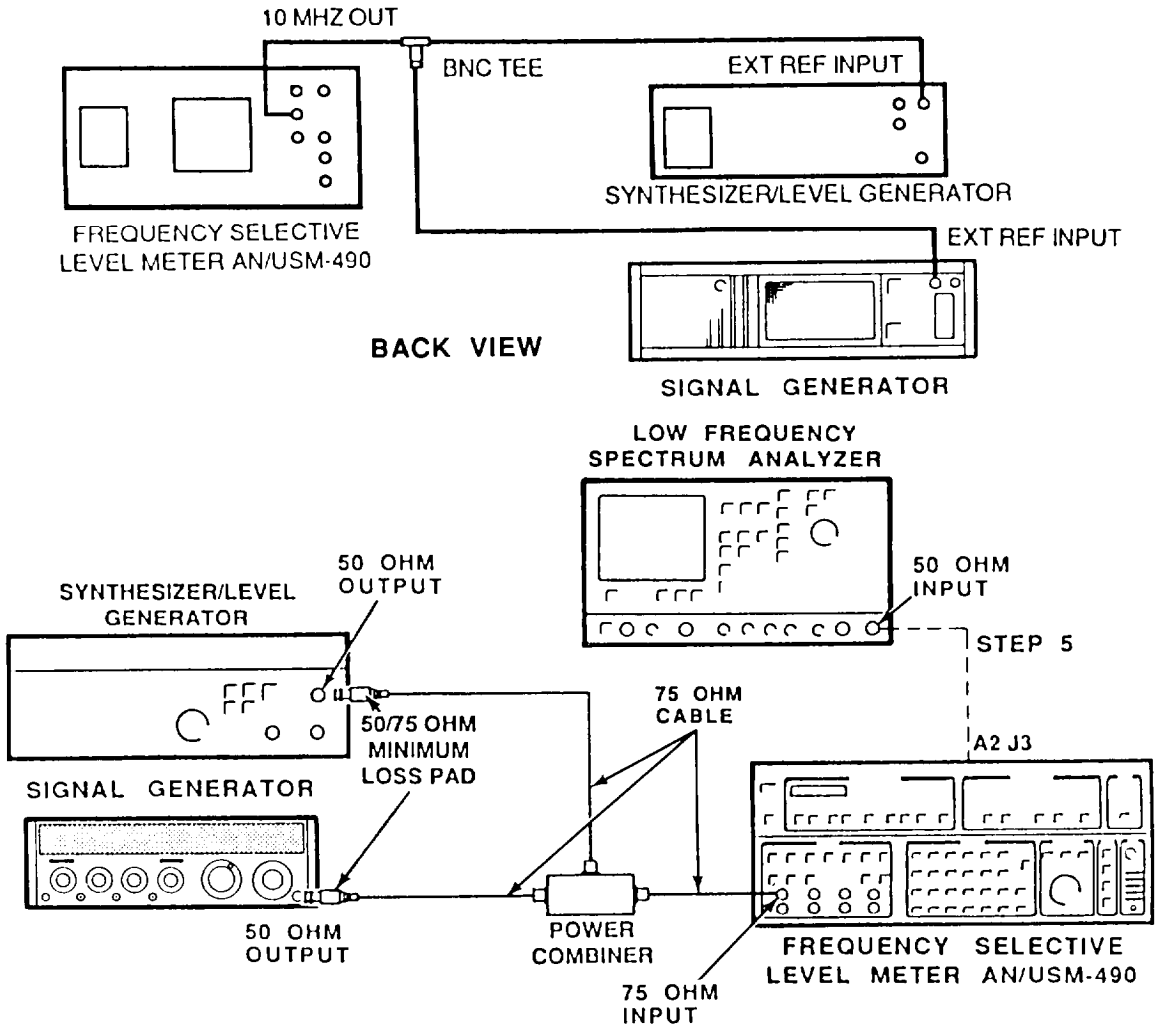
22. Install Front Panel (para 2-69).

23. Install top cover (para 2-66).

24. Return Low Frequency SPectrum Analyzer to normal operation.

2-61. ADJUST A2 INTERMODULATION DISTORTION.

1. Connect test equipment as shown be;ow



2 . Set output of Synthesizer/Level Generator to 32. 15MHz at ldBm.

3 . Set output of Signal Generator to 32MHz at ldBm.

4. On Level Meter,

l Select 75 W input.

l Select ENTRY 100.

l Set Full Scale to –l0dBm.

l Turn AUTO CAL off.

5 . Connect test equipment as shown.

2-61. ADJUST A2 INTERMODULATION DISTORTION—Continued.

6. Set Low Frequency Spectrum Analyzer as follows:

Center frequency	32.075MHz
Frequency span	500KHZ
db/DIV	10dB
Resolution bandwidth	lKHz

7. Use Spectrum Analyzer MANUAL SWEEP mode to measure 32MHz and 32.15MHz responses. Adjust output levels of Synthesizer/Level Generator and Signal Generator until both responses are –16. 0dBm. Disregard overload condition on Level Meter.

8. Set Low Frequency Spectrum Analyzer as follows:

Center frequency	150KHz
Frequency span	lKHz
Resolution bandwidth	10Hz
Video bandwidth	30Hz

9. Use Low Frequency Spectrum Analyzer MANUAL SWEEP to measure level of 150KHz response.

   · Adjust A2R12 (fig. FO-3) for a minimum level of 150KHz response.

10. Turn off Level Meter.

11. Disconnect test equipment.

12. Install top cover (para 2-66).

2-62. ADJUST A4 POWER, OVERLOAD, AND CALIBRATION.

NOTE

This calibration does not replace calibration in accordance with bulletin listed in TB43-180 for this equipment.

CALIBRATION ADJUSTMENT.

1. Turn on Level Meter and allow 20 minutes to warm-up.

2. Connect 75 W output of Synthesizer/Level Generator to 75 W input of Level Meter. Loss of cable used must be known. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

3. Set Synthesizer/Level Generator as follows:

Frequency	1.234MHz
Frequency step	31 MHZ
Level	-37dBm
Level step	45dB

2-62. ADJUST A4 POWER, OVERLOAD, AND CALIBRATION—Continued.

4. On Level Meter

- Press RECALL and number O push button.
- Select 75 W input.
- Tune to 1.234MHz and enter a FREQ STEP of 3lMHz.
- Turn AVE on.
- Select AUTO 10, automatic calibration off.
- Adjust A4R134 (fig. FO-4) (CAL -40dBm). Turn automatic calibration on; then off. Verify level indication of from –37.01 to -36.99dBm, minus any cable loss. Repeat adjustment until indication is within specification.

5. Step output of Synthesizer/Level Generator to 8dBm.

6. On Level Meter

- Adjust A4R136 (CAL –20dBm). Turn automatic calibration on; then off. Verify level indication of from +7.99 to 8.01 dBm, minus any cable loss. Repeat adjustment until indication is within specification.

7. Step output of Synthesizer/Level Generator to -37dBm.

8. Repeat steps 4 thru 6 until indications are within specification.

9. Set Synthesizer/Level Generator to 32.234 MHz at 8dBm.

10. On Level Meter.

- Tune to 32.234MHz.
- Adjust A4L106 (CAL FLATNESS –20DBm). Turn automatic calibration on; then off. Verify level indication of from +7.99 to +8.01dBm, minus any cable loss. Repeat adjustment until indication is within specification.

11. Step output of Synthesizer/Level Generator to –37dBm.

12. On Level Meter:

- Adjust A4C113 (CAL FLATNESS - 40dBm). Turn automatic calibration on; then off. Verify level indication of from –37.01 to –36.99dBm, minus any cable loss. Repeat adjustment until indication is within specification.

13. Repeat steps 9 and 12 until all indications are within specification.

2-62. ADJUST A4 POWER, OVERLOAD, AND CALIBRATION—Continued.

BROADBAND POWER ADJUSTMENT.

1. Set Synthesizer/Level Generator as follows:

Frequency	1.0023MHz
Frequency step	1MHz
Level	-35dBm
Amplitude step	

2. Verify equipment is connected as in step 2, calibration adjustments above.
3. On Level Meter
   - Press RECALL and O push button.
   - Select 75 Ω input.
   - Turn automatic calibration off.
   - Press RECALL, " ." (decimal), CNTR-> FREQ, and number O push button.
   - Select ENTRY 100.
   - Enter a FULL SCALE of -30dBm.
   - Turn WIDEBAND on.
   - Turn AVERAGE on.
   - Press RECALL, " ." (decimal), CNTR-> FREQ, and number 2 push button.
4. On Level Meter adjust A4R29 (BBP OFFSET) for a indication of from -34.9 to -35.1dBm.
5. Step output of Synthesizer/Level Generator to –55dBm.
6. On Level Meter adjust A4R30 (BBP GAIN) for a indication of from -54.9 to -55.1dBM
7. Set Synthesizer/Level Generator as follows:

Frequency	234 KHz
Frequency step	30MHZ
Level	-35dBm

8. On Level Meter
   - Turn OFFSET on.
   - Press RDNG—>OFFSET push button,
9. Step Synthesizer/Level Generator frequency to 30.234MHz.

2-62. ADJUST A4 POWER, OVERLOAD, AND CALIBRATION—Continued.

10. On Level Meter,
    - Adjust A4R24 (BBP FLATNESS) for an indication from 0.12 to 0.02dB.
11. Step Synthesizer/Level Generator frequency to 234KHz.
12. On Level Meter, verify indication of O ±.05dBm.
    - If not, press RDNG—>OFFSET then repeat steps 9 thru 12 as required until indications are within specification.
13. Repeat steps 1 thru 6.
14. Turn off Level Meter.
15. Disconnect test equipment.
16. Install top cover (para 2-66).

2-63. ADJUST A15 TRACKING OUTPUT.

1. Remove Al 5 Tracking Output Assembly (para 2-77) and reinstall on an extender board.
2. Turn on Level Meter and allow 20 minutes for warm-up.
3. On Level Meter tune frequency 10KHz.
4. Connect tracking output on rear panel (Fo O-32MHZ) to 75 Ω input on front panel of Level Meter using 75 Ω cable.
    - Adjust Al5R3 (fig. FO-8) (mixer balance) for maximum level indication on Level Meter MEASUREMENT/ENTRY display.
5. Disconnect cable,
6. Turn off Level Meter.
7. Install Al 5 Tracking Output Assembly (para 2-77).
8. Install top cover (para 2-66).

2-64. ADJUST A70 IMPAIRMENTS.

NOTE

Keep cable length as short as possible when connecting test equipment.

NOTCH FILTER ADJUSTMENT.

1 . Turn on Level Meter and allow 20 minutes to warm-up.

2 . Connect 75 Ω output of Synthesizer/Level Generator to 75 Ω input on Level Meter using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

3 . On Level Meter

- Press RECALL and 0 push button.
- Select 75 Ω input.
- Press NOISE/DEMOD push button.
- Select WTD 3100Hz.
- Select AUTO 10.
- Turn offset on.
- Enter a frequency of 1MHz.

4 . Set output of Synthesizer/Level Generator to 1001OOOHz at OdBm.

5 . On Level Meter.

- Press RDNG->OFFSET push button.
- Turn SHIFT on.
- Press NOISE/TONE push button.
- Adjust A70R33 (fig. FO-23) (Notch 2) for a minimum level indication (below -55dBm) on MEASUREMENT ENTRY display.

6 . Tune Synthesizer/Level Generator to 100101OHZ.

2-64. ADJUST A70 iMPAIRMENTS—Continued.

7 . On Level Meter

- Turn SHIFT off.
- Press NOISE/VDEMOD push button.
- Press RDNG—> OFFSET push button.
- Turn SHIFT on.
- Press NOISE/TONE push button,
- Adjust A70R40 (Notch 1) for a minimum level indication (below –55dBm) on MEASUREMENT ENTRY display.

8 . Tune Synthesizer/Level Generator to 1001017 Hz.

9 . On Level Meter.

- Turn SHIFT off.
- Press NOISE/DEMOD push button.
- Press RDNG—> OFFSET push button.
- Turn SHIFT on.
- Press NOISE/TONE push button.
- Adjust A70R45 (Notch 3) for a minimum level indication (below –55dBm) on MEASUREMENT ENTRY display.

10. Tune Synthesizer/Level Generator to 1001182Hz.

11. On Level Meter

- Turn SHIFT off.
- Press NOISE/DEMOD push button.
- Press RDNG—> OFFSET push button.
- Turn SHIFT on.
- Press NOISE/TONE push button.
- Verify that level indication is greater than –2.5dBm on MEASUREMENT ENTRY display.

12. Tune Synthesizer/Level Generator to 1000862Hz.

2-64. ADJUST A70 IMPAIRMENTS—Continued.

13. On Level Meter

- Turn SHIFT off.
- Press NOISE/DEMOD push button.
- Press RDNG—> OFFSET push button.
- Turn SHIFT on.
- Press NOISE/TONE push button.
- Verify that level indication is greater than –2.5dBm on MEASUREMENT ENTRY display.

14. Tune Synthesizer/Level Generator to 1000995 Hz.

15. On Level Meter

- Turn SHIFT off.
- Press NOISE/DEMOD push button.
- Press RDNG-> OFFSET push button.
- Turn SHIFT on.
- Press NOISE/TONE push button.
- Verify that level indication is less than –55dBm on MEASUREMENT ENTRY display.

16. Increase frequency of Synthesizer/Level Generator by 5Hz.

17. Repeat steps 15 and 16 as necessary until frequency in step 16 is 1001030HZ or greater.

LOGGER ADJUSTMENT.

1. Connect Digital Multimeter to A70TP8. Verify 75 Ω output of Synthesizer/Level Generator is connected to 75 Ω input of Level Meter using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

2. Set Synthesizer/Level Generator to 1001000HZ at 0dBm.

2-64. ADJUST A70 IMPAIRMENTS—Continued.

3 . On Level Meter:

- Select 75 Ω input and ENTRY 100.
- Turn automatic calibration off.
- Press RECALL, "." (decimal), CNTR—> FREQ, and number O push button.
- Enter a full scale of 0dBm.
- Select SSB Channel Carrier and ⟋
- Turn SHIFT off then press NOISE/DEMOD push button.
- Select WTD 3100Hz.
- Press RECALL, " ." (decimal), CNTR—> FREQ, and number 2 push button.

4 . Adjust output amplitude of Synthesizer/Level Generator until Digital Multimeter indicates 0.75Vac.

5. On Level Meter adjust A70R70 (Logger Offset) for a level indication of 0 ± 0.05dBm.

6. Decrease amplitude of Synthesizer/Level Generator by 60dB.

7. On Level Meter adjust A70R72 (Logger gain) for a level indication from –59.9 to –60. 1dBm.

8 . Increase amplitude of Synthesizer/Level Generator by 60dB.

9 . Repeat steps 5 thru 8 until indications are within specifications.

IMPULSE NOISE ADJUSTMENT.

1 . Set output of Synthesizer/Level Generator to 1002000HZ at OdBm.

2 . Disconnect Digital Multimeter. Verify that 75 Ω output of Synthesizer/Level Generator is connected to 75 Ω input of Level Meter using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

3 . On Level Meter.

- Enter a frequency of 1MHz.
- Select 100dB range and carrier ⟋ .
- Enter a full scale of 0dBm.
- Press SHIFT then IMPULSE push button,

  Enter a threshold of –20dBm and a time of 0.3 min.

4 . Connect Frequency Counter to A70TP3.

2-64. ADJUST A70 IMPAIRMENTS—Continued.

5 . Set Frequency Counter to PERIOD A with a time resolution to 100 msec.

6 . On Level Meter.

l Press START push button.

Adjust A70R97 (Dead timer) until Frequency Counter indicates from 142 to 144.

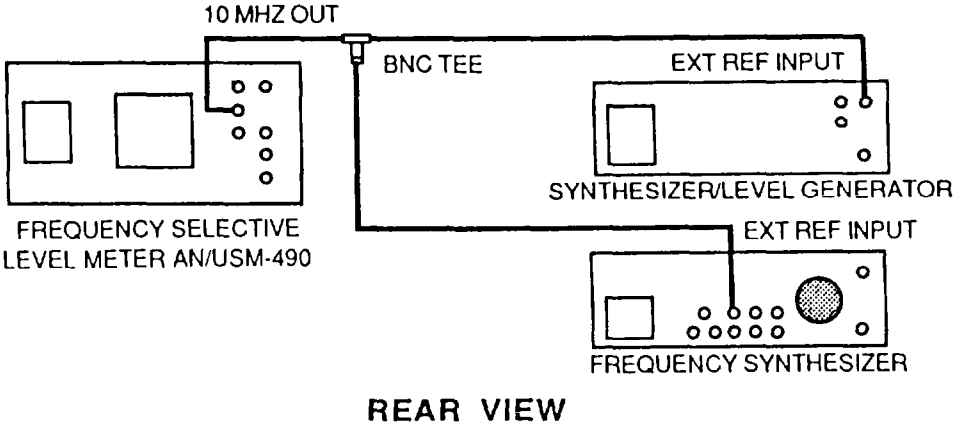
7 . Disconnect Frequency Counter.

8 . On Level Meter.

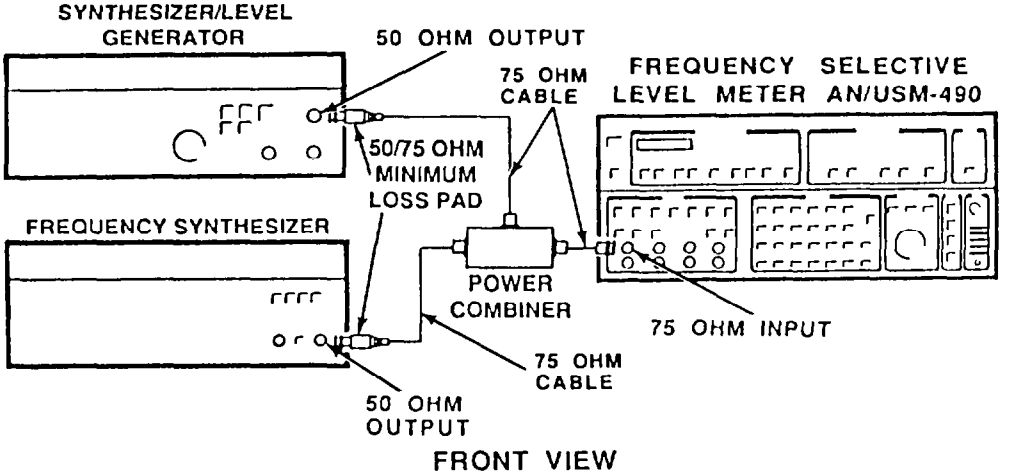
- Press START push button.
- Verify impulse noise indication from 202 to 212 counts.

PHASE JITTER ADJUSTMENT.

1 . Connect test equipment as shown below.



REAR VIEW



FRONT VIEW

2-64. ADJUST A70 IMPAIRMENTS—Continued.

2. Set output of Synthesizer/Level Generator to 1001 150Hz at –20dBm with a step frequency of 130Hz.

3. Set output of Frequency Synthesizer to 1001000Hz at 0dBm.

4. On Level Meter:

- Press RECALL then number O push button. Select 75 Ω input.
- Select ENTRY 100.
  - Enter a full scale of 0dBm and a frequency of 1MHz.
- Select carrier, SHIFT and 0 Jitter push buttons.
- Turn AVERAGE on.
- Press RECALL, " ." (decimal), CNTR-> FREQ, and number 2 push button.
  - If E2.3 is shown in Measurement/Entry display, adjust A70R181 (VFD FREQ ADJ) very slowly until an indication is obtained in Measurement/Entry display.
  - Adjust A70R14 (Ø Jitter Gain) for a phase jitter indication from 11.4 to 1 l.& P-P.

5. Step output of Synthesizer/Level Generator down 130Hz.

6. On Level Meter, adjust A70R133 (Ø Jitter 20Hz) for a phase jitter indication from 11.2 to 11.4" P-P.

7. Set output of Synthesizer/Level Generator to 1001300Hz.

- Verify that phase jitter indication on Level Meter is from 10 to 13° P-P.

8. Disconnect Power Combiner and Frequency Synthesizer from Level Meter.

9. Connect 75 Ω output of Synthesizer/Level Generator to 75 Ω input of Level Meter using 75 Ω cable. Connect Level Meter 10MHz output (rear panel) to Synthesizer/Level Generator REF input (rear panel).

10. Set output of Synthesizer/Level Generator to 100096OHZ at 0dBm.

11. On Level Meter, slowly adjustA70R181 clockwise until E2.3 appears in Measurement/Entry display.

12. Turn off Level Meter.

13. Disconnect test equipment.

14. Install top cover (para 2-66).

2-65. ADJUST A16 10 MHz REFERENCE FREQUENCY.

1. Turn on Level Meter. Insure OVEN indicator is on.
2. Initialize Level Meter.
3. Connect Digital Multimeter to A16TP1 (fig. FO-9).
4. While OVEN indicator is on, measure and record DC voltage at A16TP1.
5. While OVEN indicator is on, adjust A16R7 until DC voltage at A16TF2 is equal to DC voltage at A16TP1 ±0.3V.
6. Connect Frequency Counter to 10MHz output on rear panel of Level Meter.
7. After oven has warmed up and stabilized (red LED on circuit card assembly Al 6 has gone out), adjust frequency of oven oscillator to 10MHz, ±1Hz, using screwdriver adjustment on oven.
8. Turn off Level Meter.
9. Disconnect test equipment.
10. Install top cover (para 2-66).

2-66. REPLACE TOP/BOTTOM COVERS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

WARNING

DANGEROUS VOLTAGES ARE PRESENT WITH COVERS REMOVED.

NOTE

PRELIMINARY PROCEDURES:

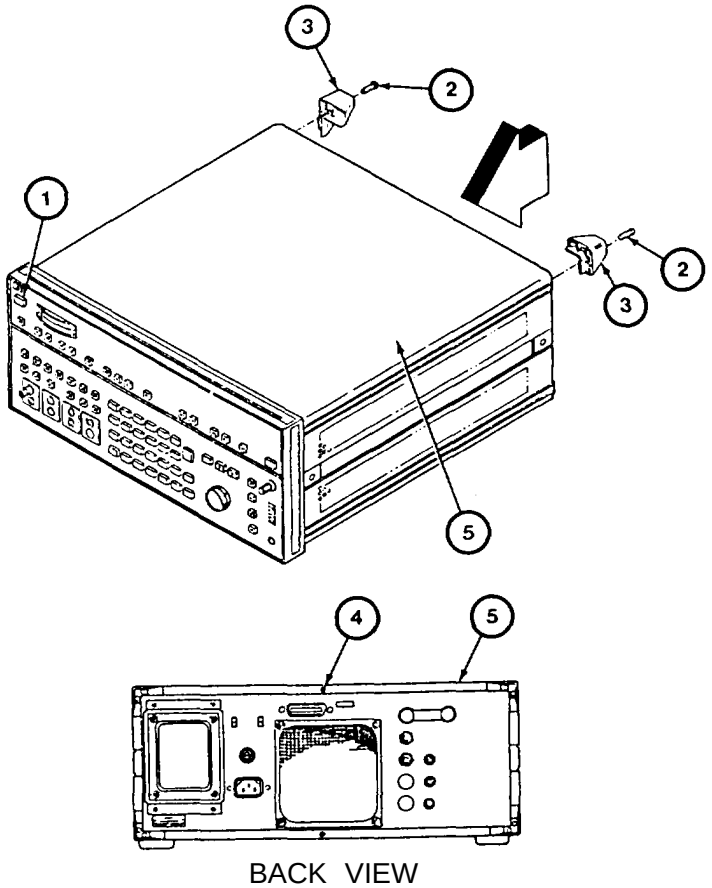
Task same for top and bottom covers. Only top cover shown.

REMOVE

1. Set power switch (1) to off and remove power cable from source.
2. Remove two screws (2) and two upper rear bumpers (3).
3. Loosen top cover retaining screw (4).
4. Slide back and remove top cover (5).

INSTALL

1. Install top cover (5) and slide forward until retaining screw (4) contacts rear frame. Take care not to bend RFI finger contacts on side cover.
2. Tighten top cover retaining screw (4).
3. Install two upper rear bumpers (3) and two screws (2).



BACK VIEW

END OF TASK

2-67. REPLACE SIDE COVERS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

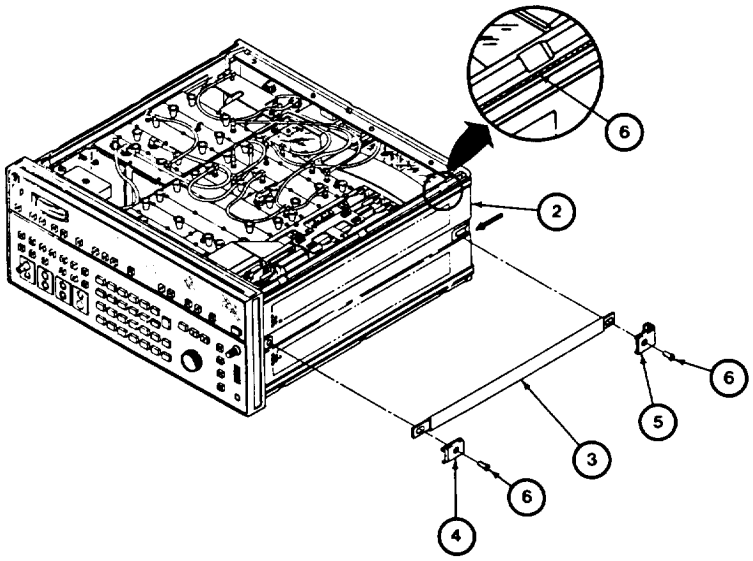
PRELIMINARY PROCEDURES:

l Task same for right and left covers. Only right side shown.

l Remove top and bottom covers (para 2-66).

REMOVE

1. Remove two screws (1) and handle retainers front (2) and rear (3).
2. Remove side handle (4),
3. Slide back and remove side cover (5).



INSTALL

1. Verify that RFI finger contacts (6) are completely on. Install side cover (5), and slide forward.
2. Install side handle (4), front handle retainer (2), rear handle retainer (3), and two screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install bottom and top covers (para 2-66).

END OF TASK

2-68. REPLACE FRONT FRAME.

DESCRIPTION

This procedure covers: Remove. Install

INITIAL SETUP

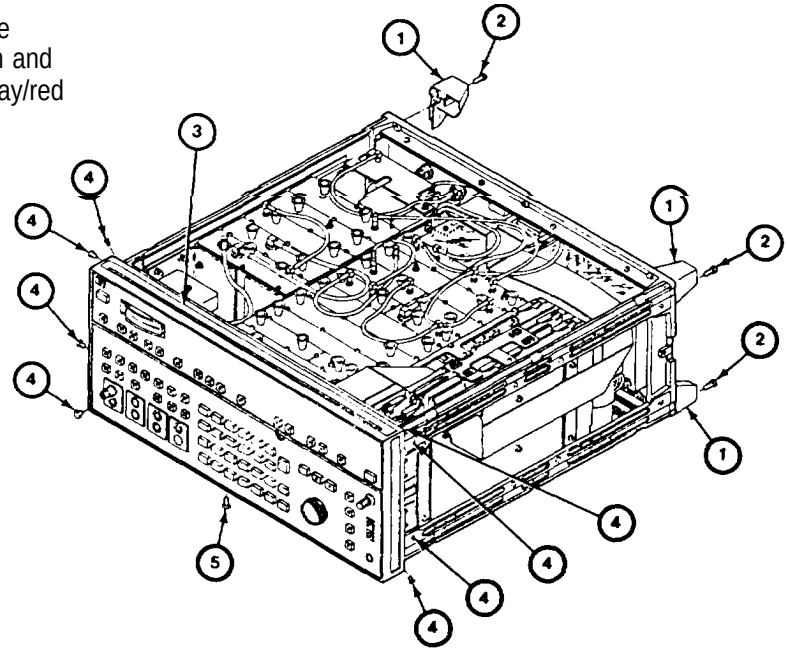
NOTE

PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).
- Remove both side covers (para 2-67).

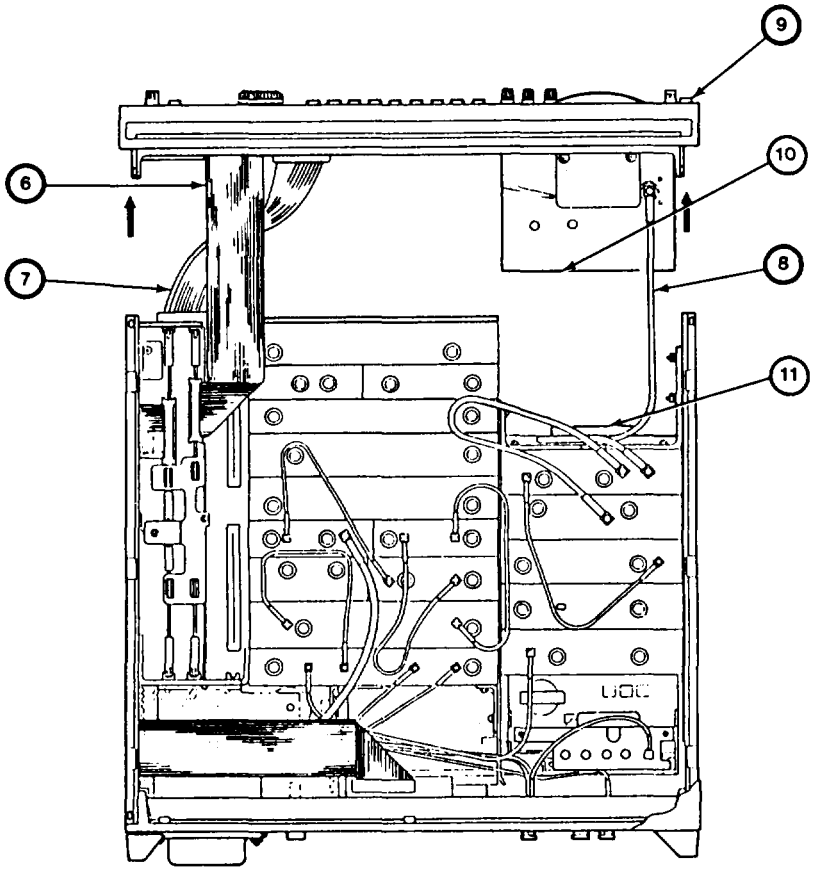
REMOVE

1. Install four rear bumpers (1) and four screws (2). Stand Level Meter on rear bumpers.
2. Remove top trim (3).
3. Remove eight screws (4) and one hex head screw (5).
4. Gently pull upon front handles and remove frame from chassis. Hold frame in position and disconnect blue cable (6), cable (7) and gray/red cable (8).
5. Remove front frame (9).



2-68. REPLACE FRONT FRAME—Continued.

REMOVE—Continued.



INSTALL

1. Position front frame (9) on chassis and connect gray/red cable (8), cable (7), and blue cable (6).
2. Folding cables in place, install front frame in chassis. Verify that connector (10) aligns properly on motherboard (11).
3. Install eight screws (4) and one hex head screw (5).
4. Install top trim (3).
5. Lay Level Meter on bottom side and remove four rear bumpers(1) and four screws (2).

NOTE

FOLLOW-ON MAINTENANCE:

- Install both side covers (para 2-67).
- Install top and bottom covers (para 2-66).

END OF TASK

2-69. REPLACE FRONT PANEL.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

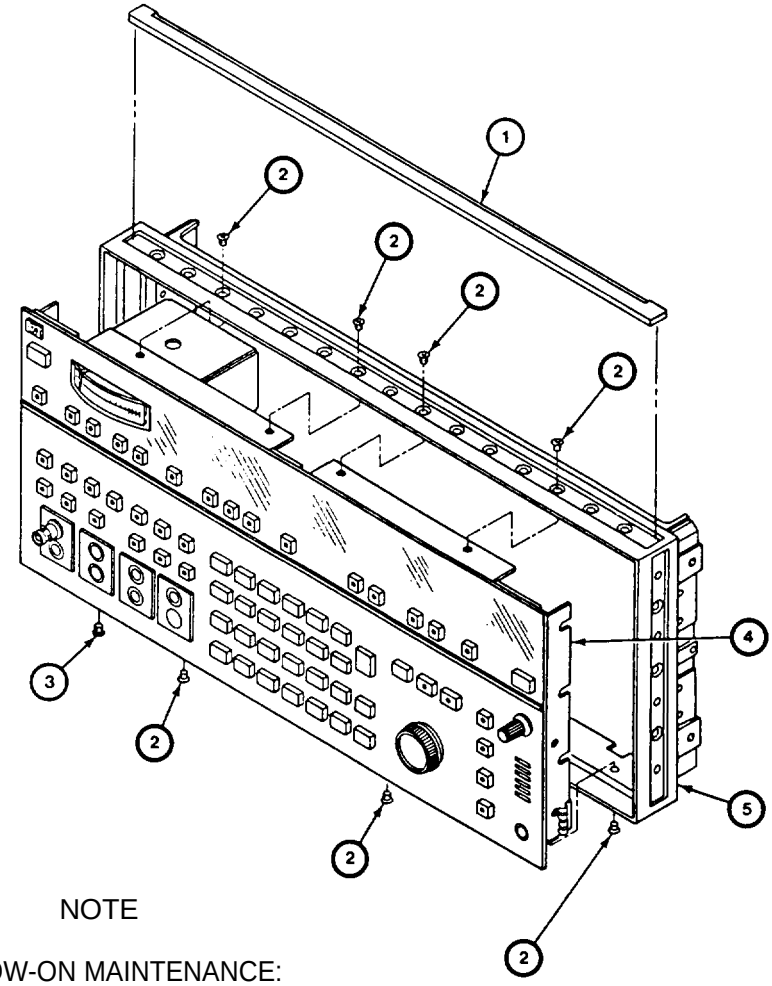
NOTE

PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).

REMOVE

1. Remove top trim (l).
2. Remove seven screws (2).
3. Remove one screw (3).
4. From rear, gently push front panel (4) out of frame (5).



INSTALL

1. From front, gently install panel (4) in frame (5) Take care not to bend RFI finger contacts.
2. Install one screw (3).
3. Install seven screws (2).
4. Install top trim (l).

NOTE

FOLLOW-ON MAINTENANCE:

- Install bottom and top covers (para 2-66).

END OF TASK

2-70. REPLACE REAR FRAME.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

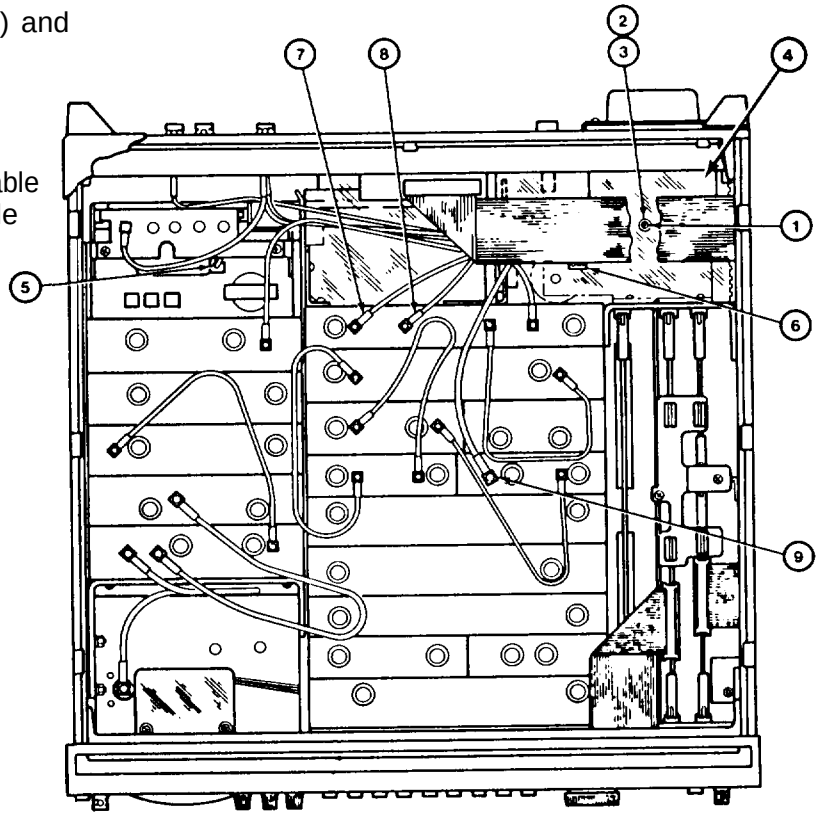
NOTE

PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).
- Remove both side covers (para 2-67).
- Remove Al 6 10MHz Frequency Reference Assembly (para 2-78).
- Remove A62HP Interface Bus Assembly (para 2-92).

REMOVE

1. Remove screw (1) lock washer (2) and flat washer (3).
2. Remove insulator plate (4).
3. Remove cable (5), cable (6), red cable (7), violet cable (8), and black cable (9).



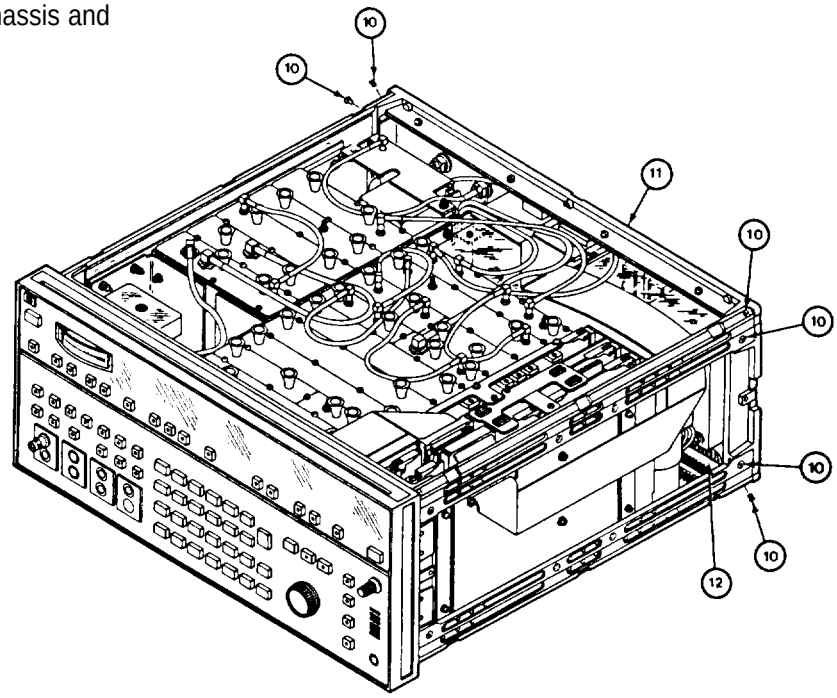
2-70. REPLACE REAR FRAME—Continued.

REMOVE—Continued

4. Remove eight screws (10).

5. Pull rear frame (11) slightly out of chassis and disconnect cable (12).

6. Remove rear frame (11).



INSTALL

1. Position rear frame (11) on chassis and connect cable (12).

2. Install rear frame in chassis. Install eight screws (10).

3. Connect cable (5), cable (6), red cable (7), violet cable (8) and black cable (9).

4. Install insulator (4).

5. Install screw (1), lock washer (2) and flat washer (3).

NOTE

FOLLOW-ON MAINTENANCE:

- Install A62 HP Interface Bus Assembly (para 2-92).
- Install A16 10MHz Frequency Reference Assembly (para 2-78).
- Install both side covers (para 2-67).
- Install bottom and top covers (para 2-66).

END OF TASK

2-71. REPLACE AI INPUT MULTIPLEXER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

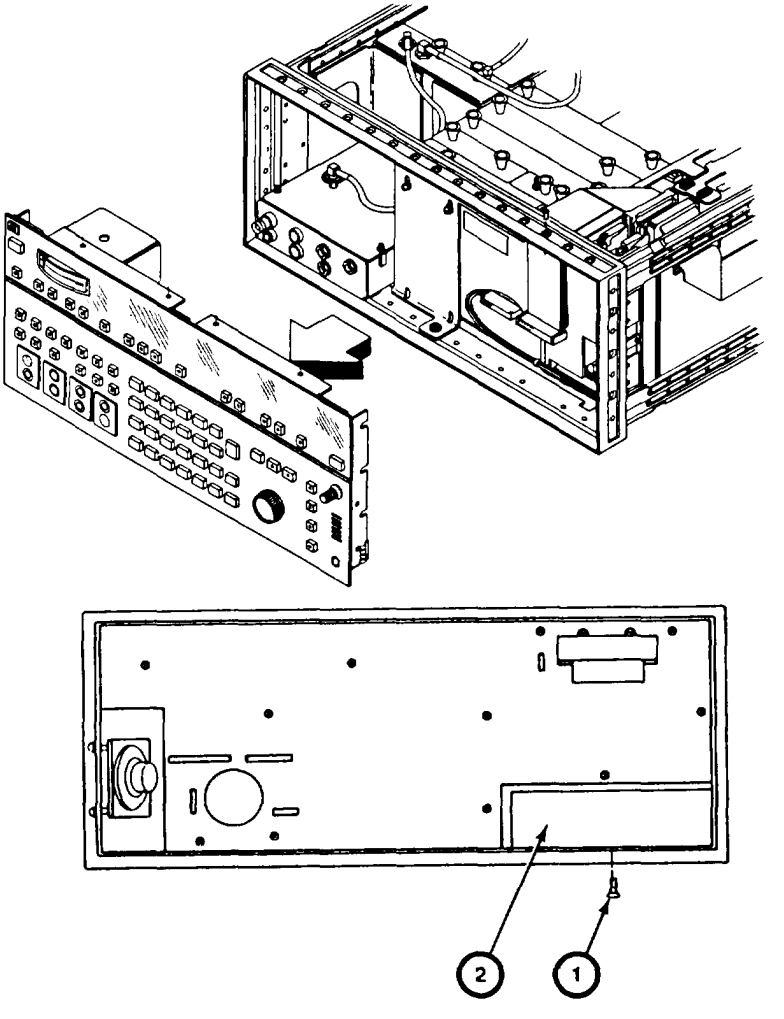
NOTE

PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).
- Remove both side covers (para 2-67).
- Remove front frame (para 2-68).

REMOVE

1. Remove screw (1).
2. Gently pull up and remove input multiplexer module (2).
3. Remove seven screws (3), lock washers (4), and flat washers (5).
4. Remove access cover (6).
5. Tag and disconnect seven wires (7).
6. Disconnect cable (8).
7. Remove three screws (9).
8. Remove six screws (10) and lock washers (11).
9. Remove AI Input Multiplexer Assembly (12).



2-71. REPLACE AI INPUT MULTIPLEXER ASSEMBLY—Continued.

INSTALL

1 . Install AI Input Multiplexer Assembly (12).

2 . Install six screws (11) and lock washers (10).

3 . Install three screws (9).

4 . Connect cable (8).

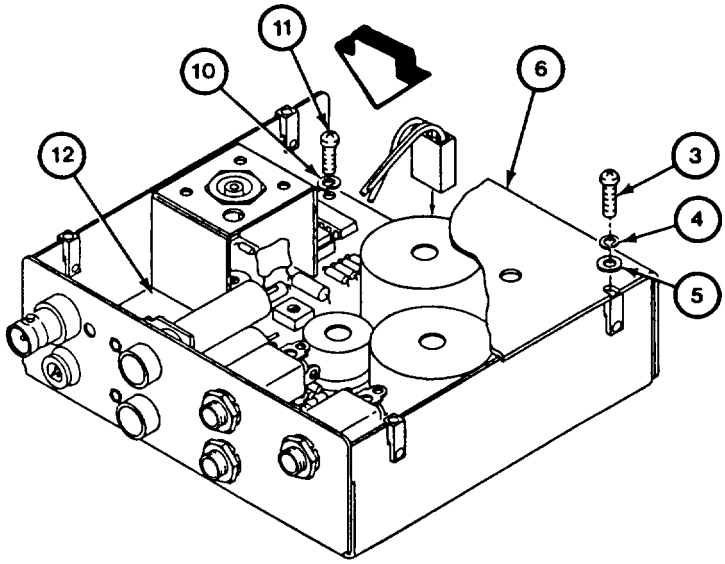
5 . Connect seven wires (7).

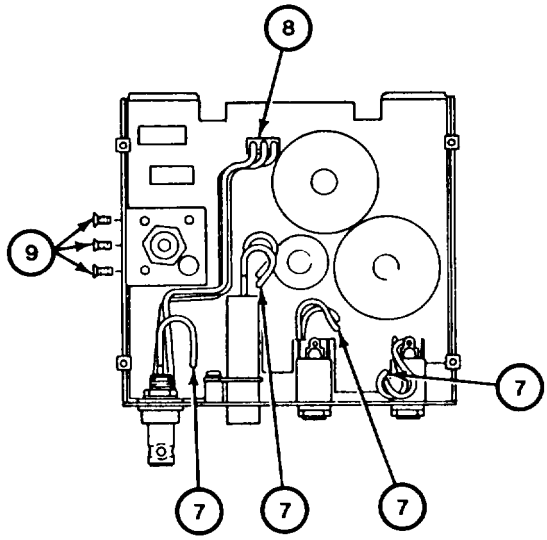
6 . Install access cover (6).

7 . Install seven screws (3), lock washers (4) and flat washers (5).

8 . Install input multiplexer module (2) in front frame.

9 . Install screw (1).





NOTE

FOLLOW-ON MAINTENANCE:

l Install front frame (para 2-68).

l Install both side covers (para 2-67).

l Install top and bottom covers (para 2-66).

END OF TASK

2-72. REPLACE A2 INPUT AMPLIFIER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

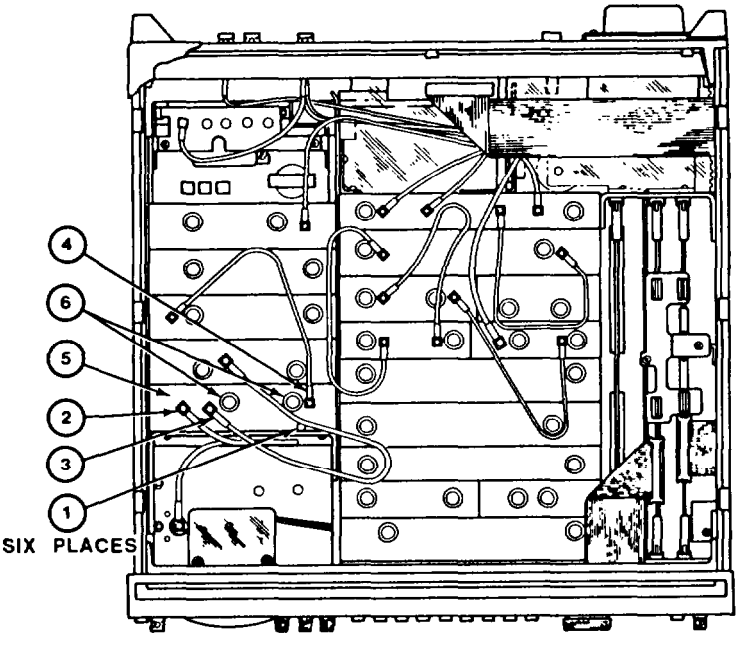
Remove top cover (para 2-66).

REMOVE

1. Remove six screws (1),
2. Disconnect gray/red cable (2), gray/red cable (3) and gray cable (4).
3. Gently remove A2 Input Amplifier Assembly (5) by pulling on two knobs (6).

INSTALL

1. Install A2 Input Amplifier Assembly (5) with components facing forward into chassis.
2. Install gray/red cable (2), gray/red cable (3) and gray cable (4).
3. Install six screws (1).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-73. REPLACE A4 BROADBAND POWER/CAL/OVERLOAD ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

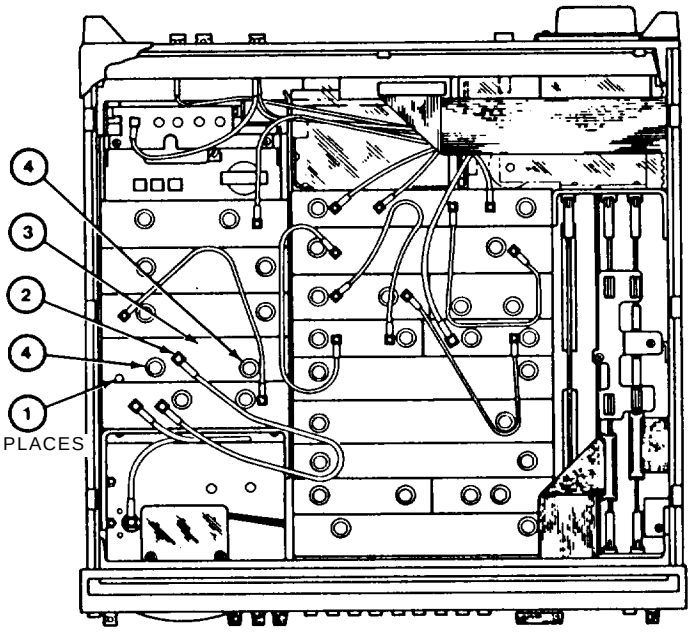
Remove top cover (para 2-66).

REMOVE

1. Remove six screws (l).
2. Disconnect gray/red cable (2).
3. Gently remove A4 Broadband Power/CAL/Overload Assembly (3) by pulling on two knobs (4).

INSTALL

1. Install A4 Broadband Power/CAL/Overload Assembly (3) with components facing forward into chassis.
2. Connect gray/red cable (2).
3. Install six screws (l).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-74. REPLACE A5 INPUT MIXER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

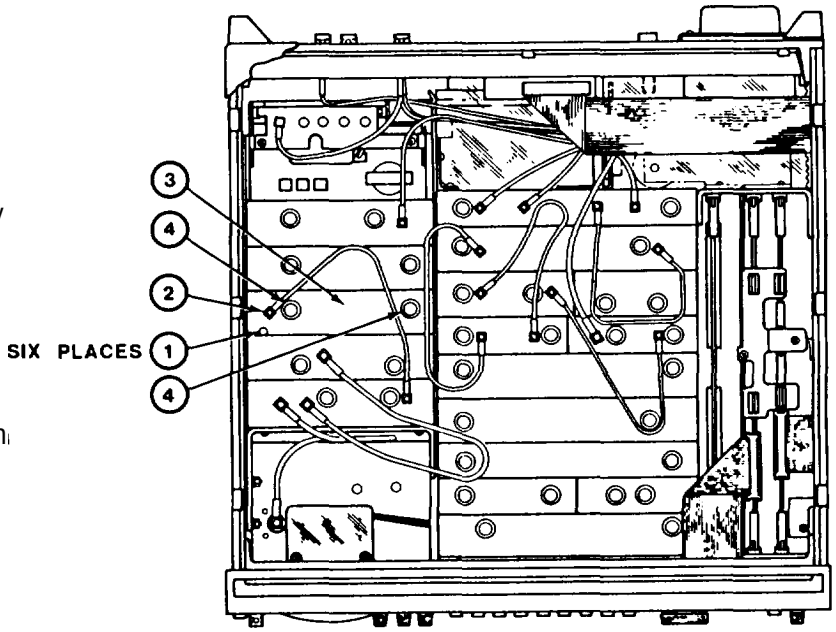
Remove top cover (para 2-66).

REMOVE

1. Remove six screws (l).
2. Disconnect gray cable (2).
3. Gently remove A5 Input Mixer Assembly (3) by pulling on two knobs (4).

INSTALL

1. Install A5 Input Mixer Assembly (3) with components facing forward into chassis.
2. Connect gray cable (2).
3. Install six screws (1).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-75. REPLACE A10 SECOND MIXER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

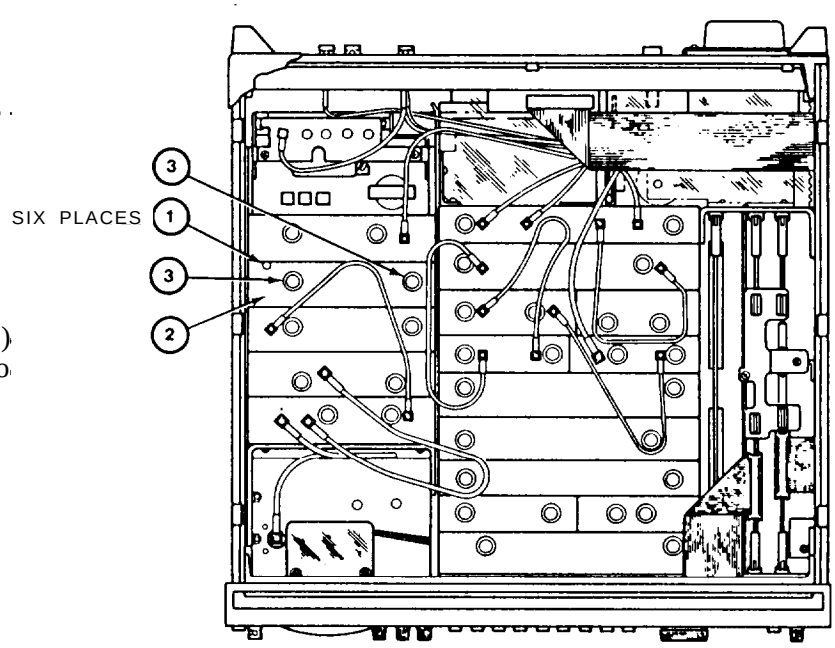
Remove top cover (para 2-66).

REMOVE

1. Remove six screws (l).
2. Gently remove A10 Second Mixer Assembly (2) by pulling on two knobs (3).

INSTALL

1. Install A10 Second Mixer Assembly (2) with components facing forward into chassis.
2. Install six screws (l).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-76. REPLACE AII SECOND LOCAL OSCILLATOR ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

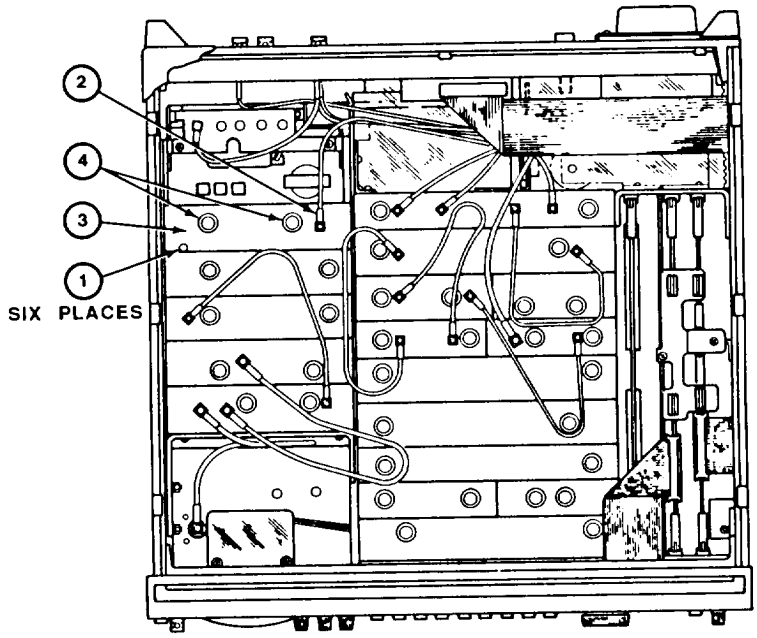
Remove top cover (para 2-66).

REMOVE

1. Remove six screws (l).
2. Disconnect blue cable (2).
3. Gently remove Al 1 Second Local Oscillator Assembly (3) by pulling on two knob (4).

INSTALL

1. Install Al 1 Second Local Oscillator Assembly (3) with components facing forward into chassis.
2. Connect blue cable (2).
3. Install six screws (1).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-77. REPLACE A15 TRACKING OUTPUT ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

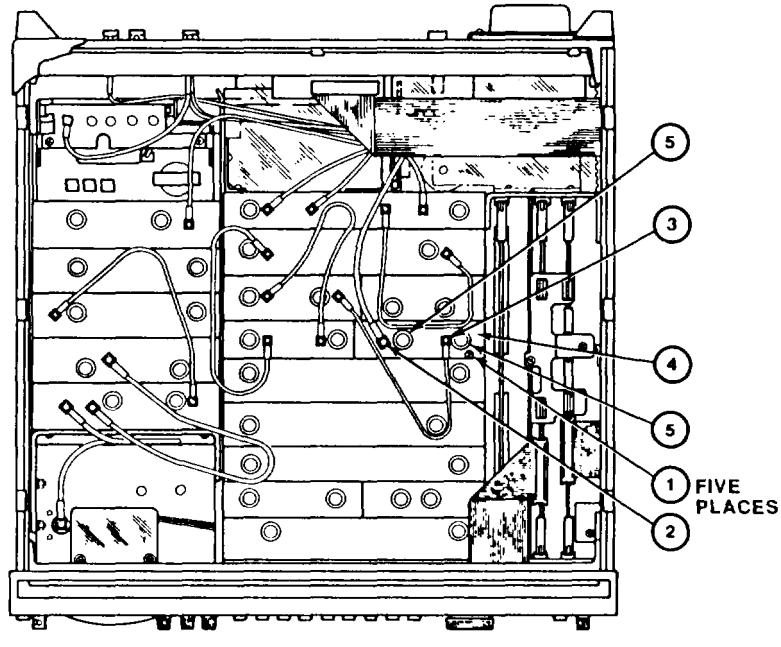
Remove top cover (para 2-66).

REMOVE

1. Remove five screws (1).
2. Disconnect black cable (2) and gray cable (3).
3. Gently remove A15 Tracking Output Assembly (4) by pulling on two knobs (5).

INSTALL

1. Install tracking output Assembly (4) with components facing forward into chassis.
2. Connect black cable (2) and gray cable (3).
3. Install five screws (1).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-78. REPLACE A16 10 MHz FREQUENCY REFERENCE ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

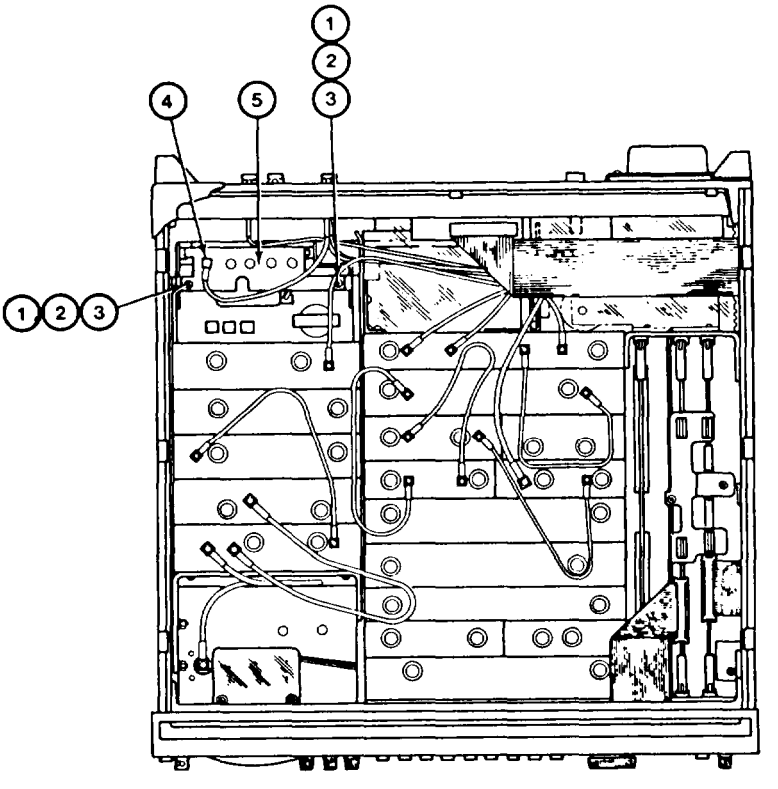
Remove top cover (para 2-66).

REMOVE

1. Remove two screws (1), lock washers (2) and flat washers (3).
2. Disconnect white cable (4).
3. Gently remove A16 10MHz Frequency Reference Assembly (5).

INSTALL

1. Install Al 6 10MHz Frequency Reference Assembly (5).
2. Connect white cable (4).
3. Install two screws (I), lock washers (2) and flat washers (3).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-79. REPLACE A20 IF FILTER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

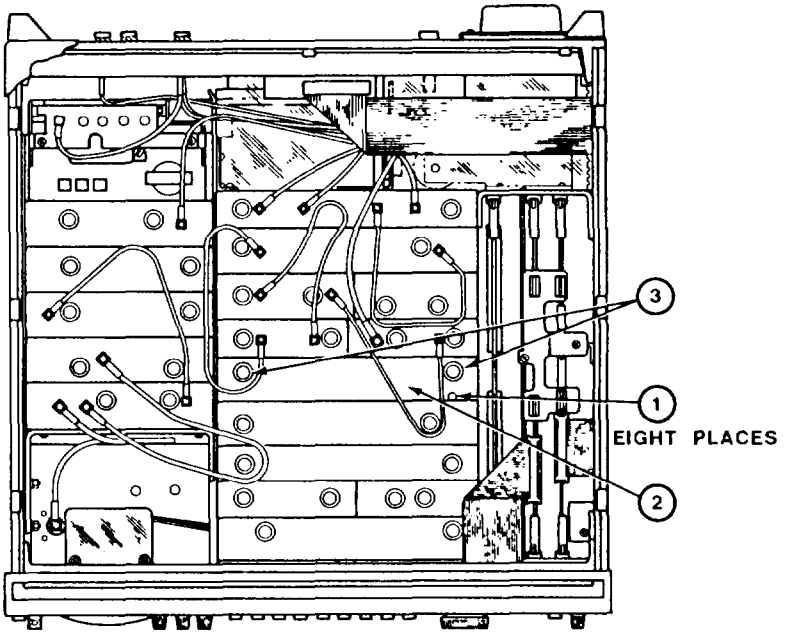
Remove top cover (para 2-66).

REMOVE

1. Remove eight screws (1).
2. Gently remove A20 IF Filter Assembly (2) by pulling on two knobs (3),

INSTALL

1. Install A20 IF Filter Assembly (2) with components facing forward into chassis.
2. Install eight screws (1).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-80. REPLACE A21 IF GAIN/DETECTOR ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

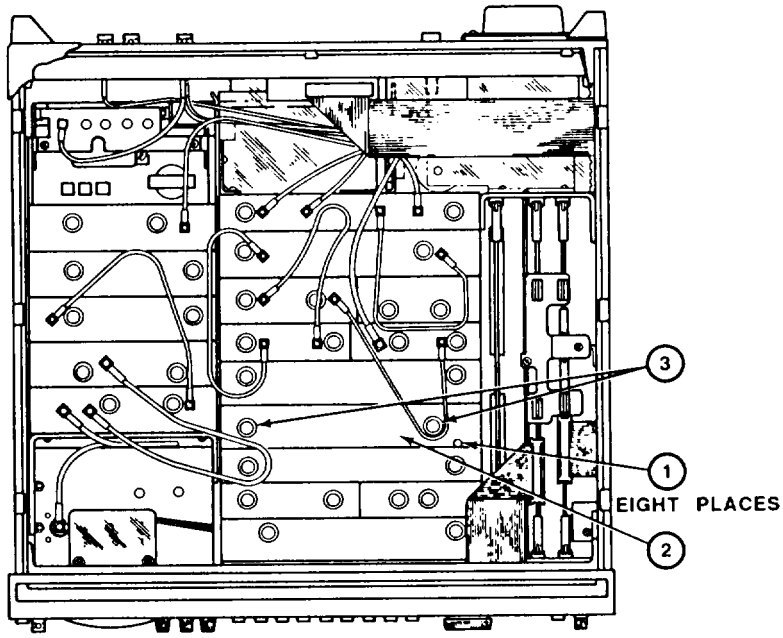
Remove top cover (para 2-66).

REMOVE

1. Remove eight screws (1).
2. Gently remove A21 IF Gain/Detector Assembly (2) by pulling on two knobs (3).

INSTALL

1. Install A2 IF Gain/Detector Assembly (2) with components facing forward 'into chassis.
2. Install eight screws (1).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-81. REPLACE A22 ANALOG-DIGITAL CONVERTER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

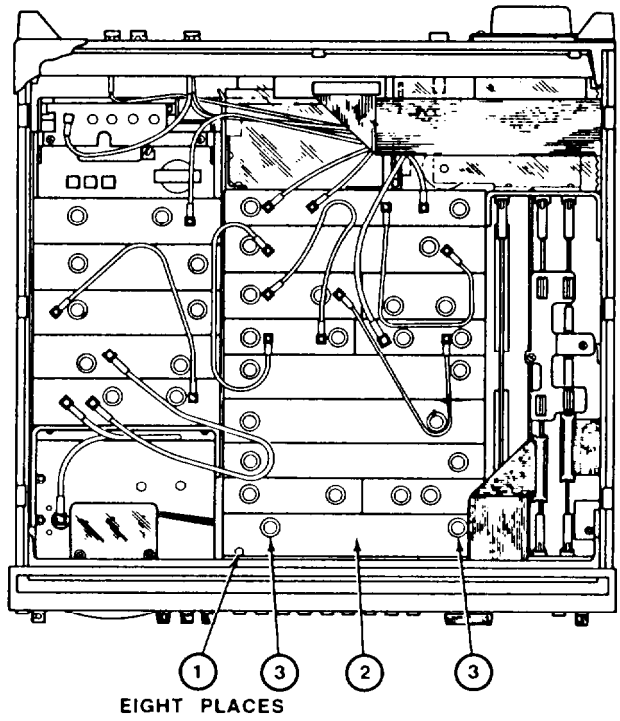
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove eight screws (1),
2. Gently remove A22 Analog-Digital Converter Assembly (2) by pulling on two knobs (3).



INSTALL

1. Install A22 Analog-Digital Converter Assembly (2) with components facing forward into chassis.
2. Install eight screws (l).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-82. REPLACE A30 FRACTIONAL N+N ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

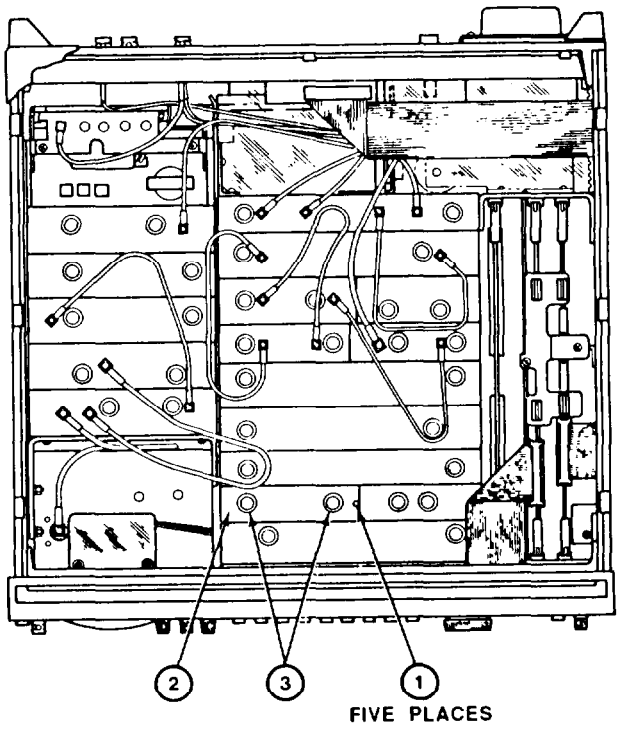
Remove top cover (para 2-66).

REMOVE

1. Remove five screws (1),
2. Gently remove A30 Fractional N+N Assembly (2) by pulling on two knobs (3).

INSTALL

1. Install A30 Fractional N+N Assembly (2) with components facing forward into chassis.
2. Install five screws (l).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-83. REPLACE A31 FRACTIONAL N VOLTAGE CONTROLLED OSCILLATOR ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

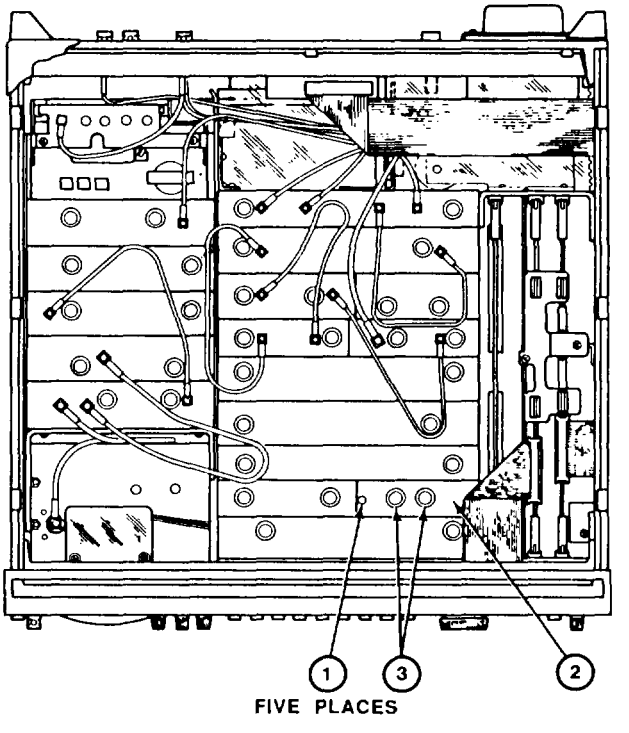
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove five screws (1).
2. Gently remove A31 Fractional N Voltage Controlled Oscillator Assembly (2) by pulling on two knobs (3).



INSTALL

1. Install A31 Fractional N Voltage Controlled Oscillator Assembly (2) with components facing forward into chassis.
2. Install five screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-84. REPLACE A32 FRACTIONAL N PHASE DETECTOR ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

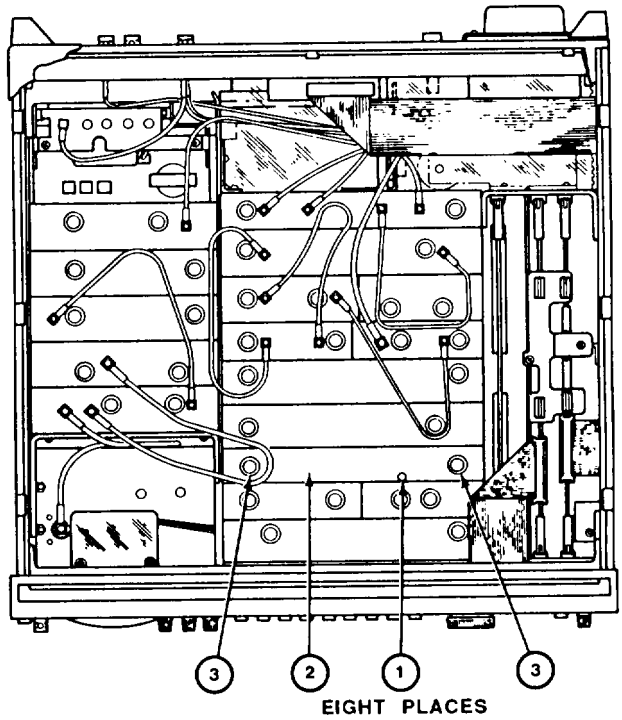
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove eight screws (1).
2. Gently remove A32 Fractional N Phase Detector Assembly (2) by pulling on two knobs (3).



INSTALL

1. Install A32 Fractional N Phase Detector Assembly (2) with components facing forward into chassis.
2. Install eight screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-85. REPLACE A40 FREQUENCY REFERENCE ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

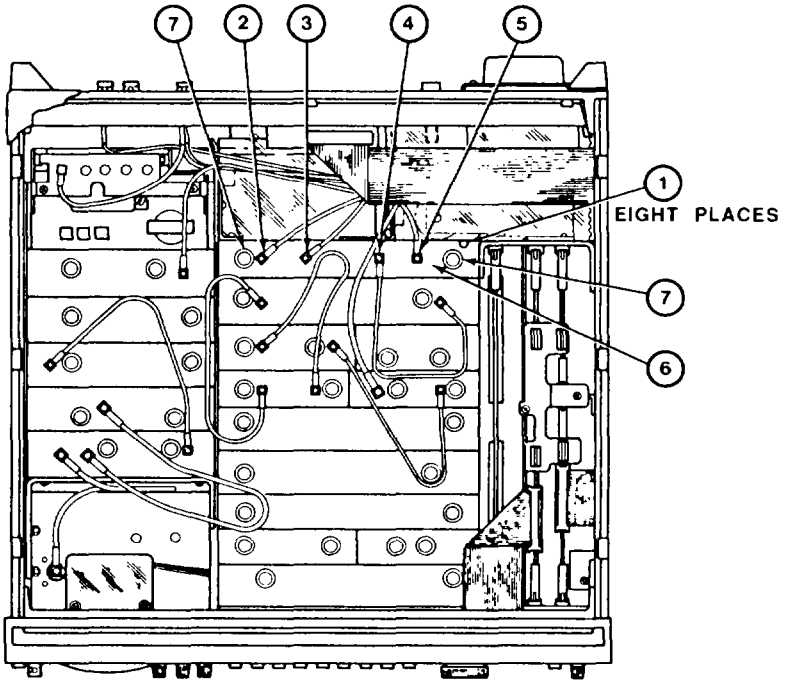
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove eight screws (1).
2. Disconnect red cable (2) and violet cable (3), gray cable (4) and blue cable (5).
3. Gently remove A40 Frequency Reference Assembly (6) by pulling on two knobs (7).



INSTALL

1. Install A40 Frequency Reference Assembly (6) with components facing forward into chassis.
2. Connect red cable (2), violet cable (3), gray cable (4) and blue cable (5).
3. Install eight screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-86. REPLACE A50 STEP LOOP ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

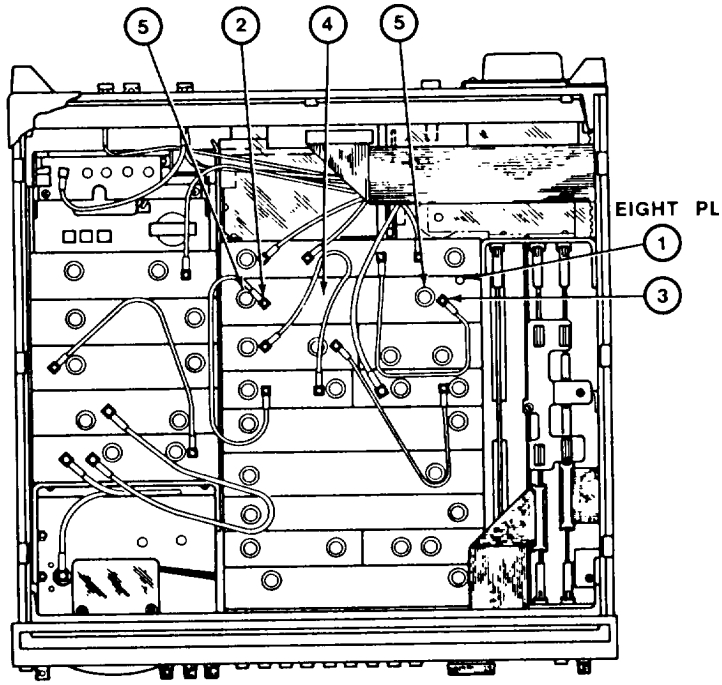
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove eight screws (l).
2. Disconnect gray cable (2) and gray cable (3).
3. Gently remove A50 Step Loop Assembly (4) by pulling on two knobs (5),



INSTALL

1. Install A50 Step Loop Assembly (4) with components facing forward into chassis.
2. Connect gray cable (2) and gray cable (3).
3. Install eight screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-87. REPLACE A51 SUMMATION LOOP VOLTAGE CONTROLLED OSCILLATOR ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

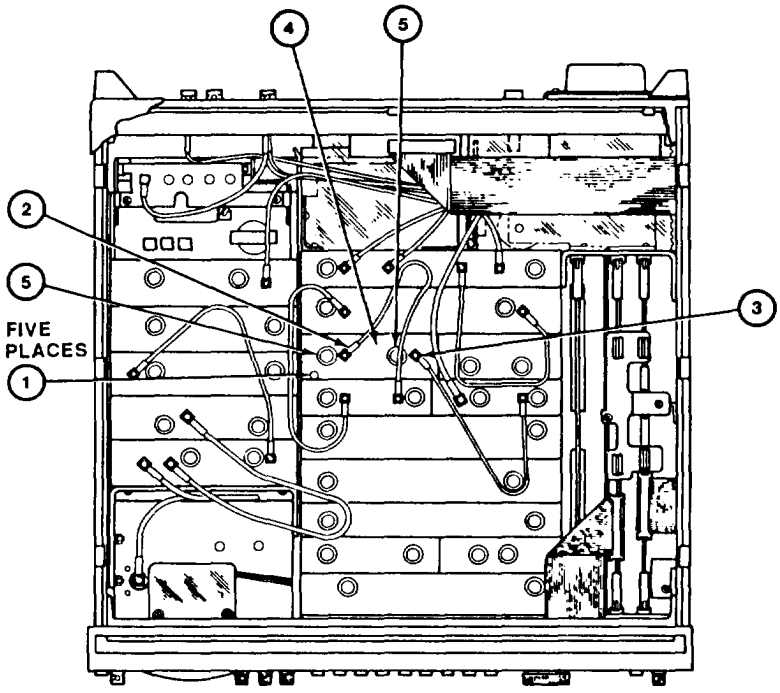
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove five screws (1).
2. Disconnect gray cable (2) and gray cable (3).
3. Gently remove A51 Summation Loop Voltage-Controlled Oscillator Assembly (4) by pulling on two knobs (5).



INSTALL

1. Install A51 Summation Loop Voltage-Controlled Oscillator Assembly (4) with components facing forward into chassis.
2. Connect gray cable (2) and gray cable (3).
3. Install five screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-88. REPLACE A52 SUMMATION LOOP MIXER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

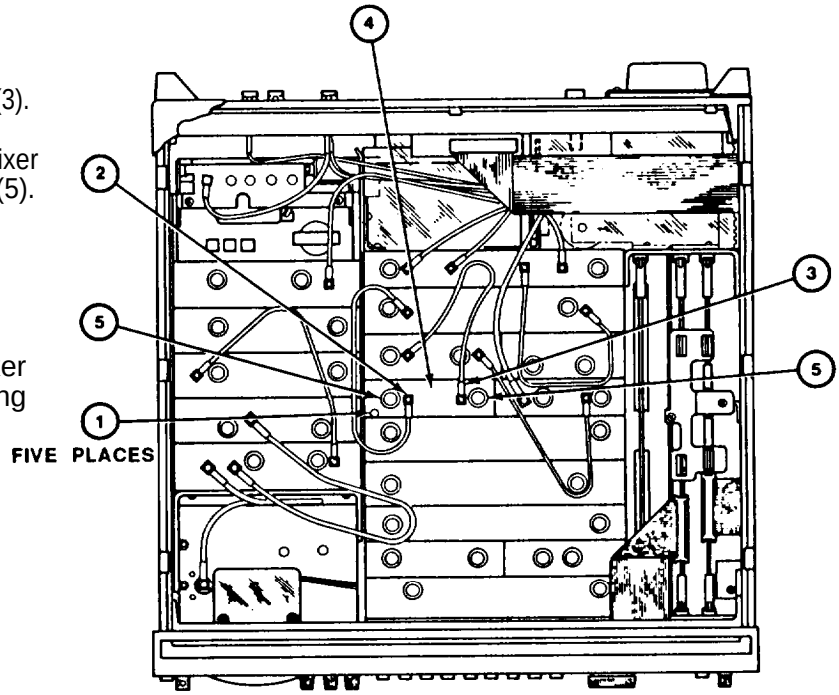
Remove top cover (para 2-66).

REMOVE

1. Remove five screws (1).
2. Disconnect gray cable (2) and gray cable (3).
3. Gently remove A52 Summation Loop Mixer Assembly (4) by pulling on two knobs (5).

INSTALL

1. Install A52 Summation Loop Mixer Assembly (4) with components facing forward into chassis.
2. Connect gray cable (2) and gray cable (3).
3. Install five screws (I).



NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-89. REPLACE A53 SUMMATION PHASE DETECTOR ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

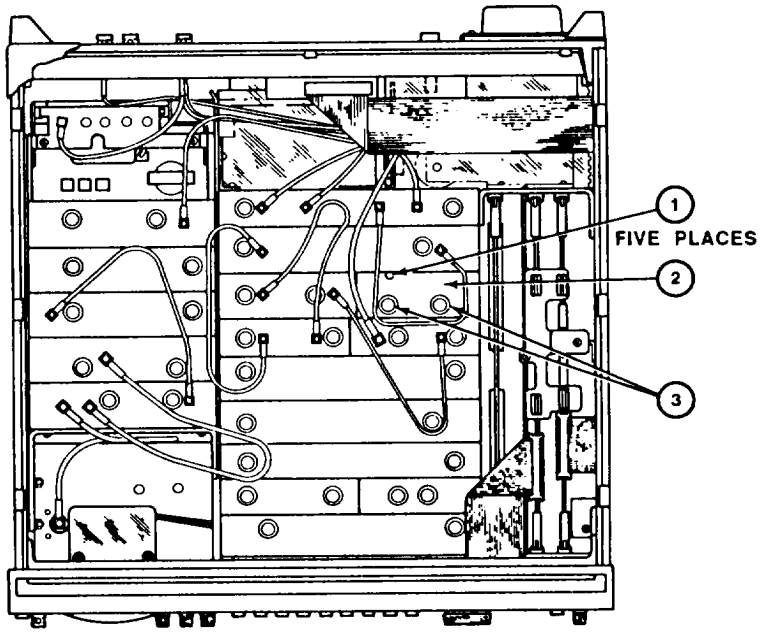
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove five screws (l).
2. Gently remove A53 Summation Phase Detector Assembly (2) by pulling on two knobs (3).



INSTALL

1. Install A53 Summation Phase Detector Assembly (2) with components facing forward into chassis.
2. Install five screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-90. REPLACE A60 CONTROLLER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

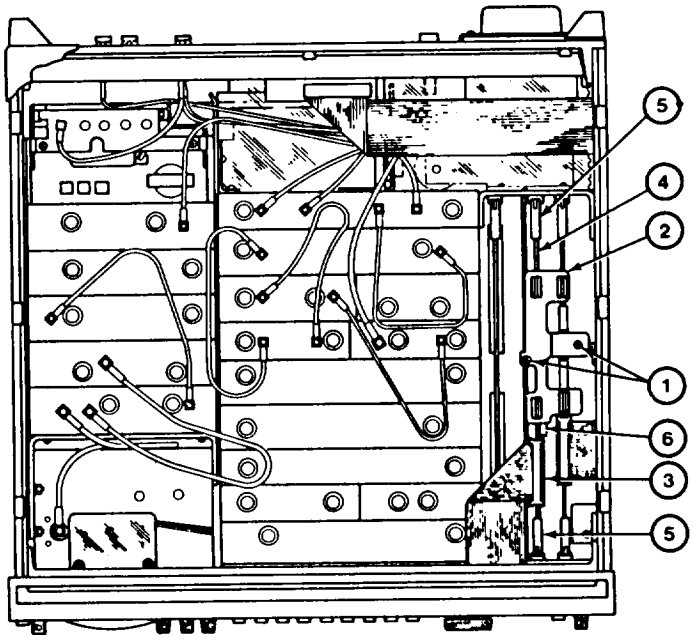
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove two screws (l).
2. Remove circuit card retainer (2).
3. Disconnect blue cable (3).
4. Gently remove A60 Controller Assembly (4) by pulling up two extractors (5).



INSTALL

1. Install A60 Controller Assembly (5) with components facing outward into proper slot.
2. Connect blue cable (3).
3. Select A60S1 (6) switch settings (para 2-34).
4. Install circuit card retainer (2).
5. Install two screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-91. REPLACE A61 HP INTERFACE BUS ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

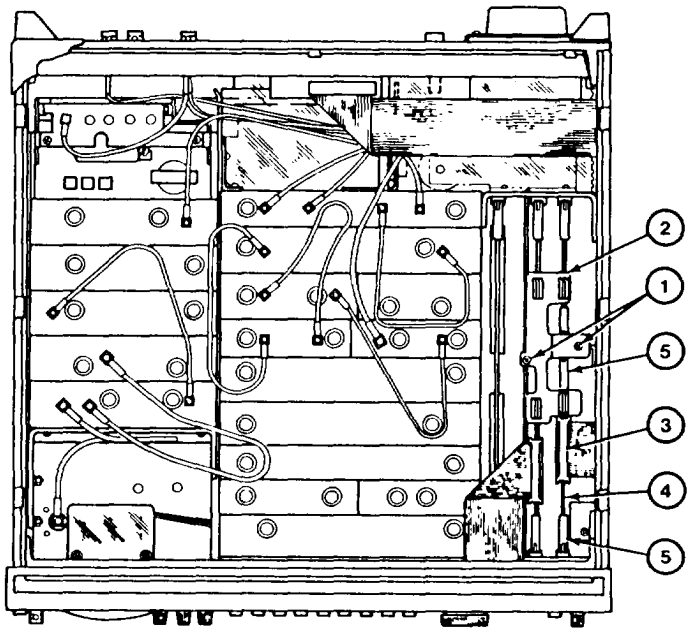
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove two screws (1).
2. Remove circuit card retainer (2).
3. Disconnect blue cable (3).
4. Gently remove A61 HP Interface Bus Assembly (4) by pulling up two extractors (s).



INSTALL

1. Install A61 HP Interface Bus Assembly (5) with components facing outward into proper slot.
2. Connect blue cable (3).
3. Install circuit card retainer (2).
4. Install two screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-92. REPLACE A62 HP INTERFACE BUS ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

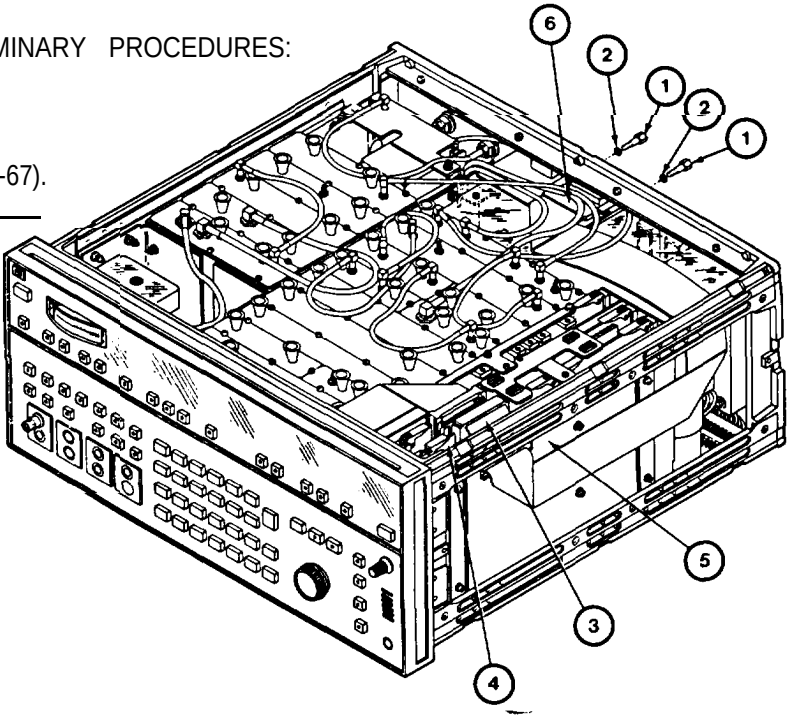
- Remove top cover (para 2-66).
- Remove right side cover (para 2-67).

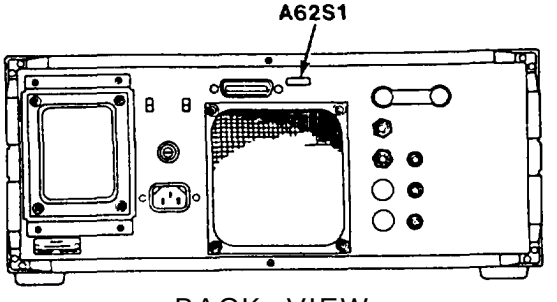
REMOVE

1. From rear, remove top standoffs (1) and lock washers (2).
2. Disconnect blue cable (3) from A61 HP Interface Bus Assembly (A61) (4) and side frame (5).
3. Remove A62 HP Interface Bus Assembly (6).

INSTALL

1. Install A62 HP Interface Bus (6).
2. Connect blue cable (3) to A61 HP Interface Bus Assembly (A61) (4) and side frame (5).
3. Install two standoffs (1) and lock washers (2).
4. Select A62S1 switch settings (para 2-35).





BACK VIEW

NOTE

FOLLOW-ON MAINTENANCE:

l Install right side cover (para 2-67).

l Install top cover (para 2-66).

END OF TASK

2-91. REPLACE A61 HP INTERFACE BUS ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

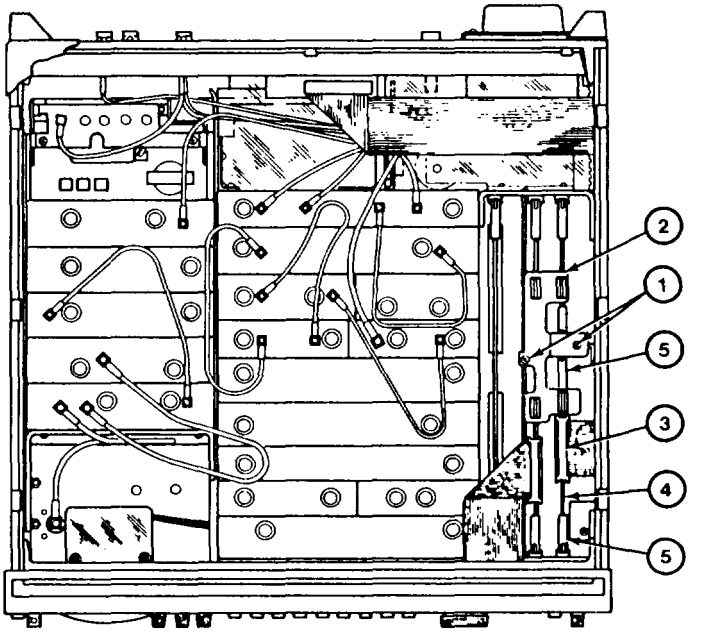
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove two screws (1).
2. Remove circuit card retainer (2).
3. Disconnect blue cable (3).
4. Gently remove A61 HP Interface Bus Assembly (4) by pulling up two extractors (5).



INSTALL

1. Install A61 HP Interface Bus Assembly (5) with components facing outward into proper slot.
2. Connect blue cable (3).
3. Install circuit card retainer (2).
4. Install two screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-92. REPLACE A62 HP INTERFACE BUS ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

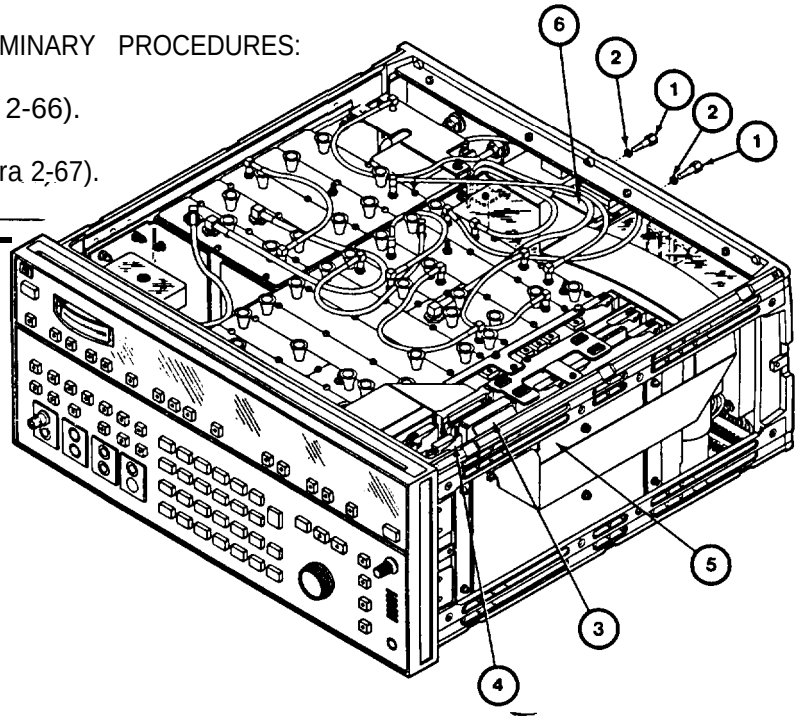
- Remove top cover (para 2-66).
- Remove right side cover (para 2-67).

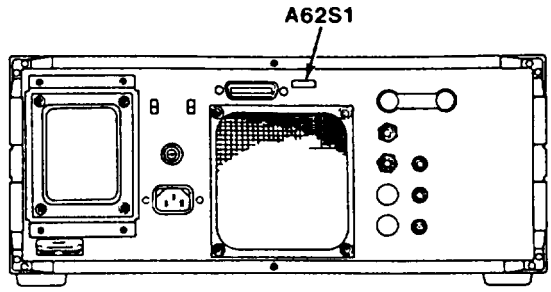
REMOVE

1. From rear, remove top standoffs (1) and lock washers (2).
2. Disconnect blue cable (3) from A61 HP Interface Bus Assembly (A61) (4) and side frame (5).
3. Remove A62 HP Interface Bus Assembly (6).

INSTALL

1. Install A62 HP Interface Bus (6).
2. Connect blue cable (3) to A61 HP Interface Bus Assembly (A61) (4) and side frame (5).
3. Install two standoffs (1) and lock washers (2).
4. Select A62S1 switch settings (para 2-35).





BACK VIEW

NOTE

FOLLOW-ON MAINTENANCE:

- Install right side cover (para 2-67).
- Install top cover (para 2-66).

END OF TASK

2-93. REPLACE A70 IMPAIRMENTS B ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

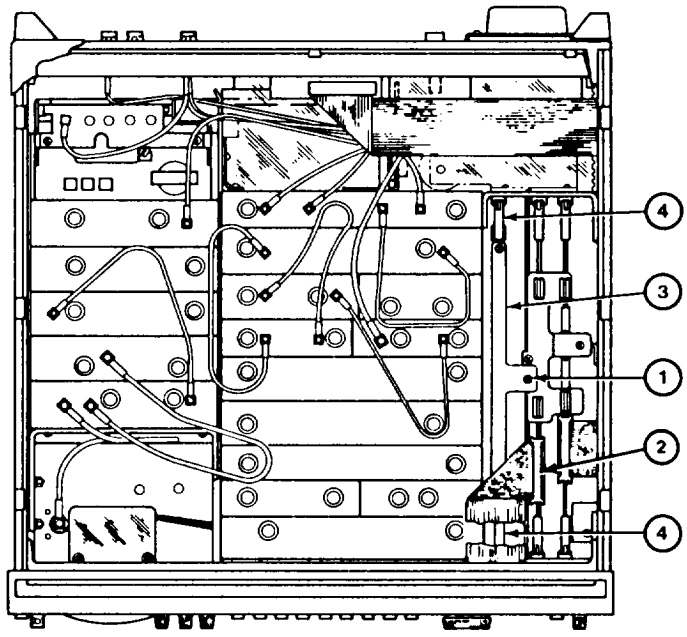
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove screw (1).
2. Disconnect blue cable (2).
3. Gently remove A70 Impairments B Assembly (3) by pulling up two extractors (4).



INSTALL

1. Install A70 Impairments B Assembly (3) with components facing outward into proper slot.
2. Connect blue cable (2).
3. Install screw (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-94. REPLACE A80 POWER SUPPLY ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

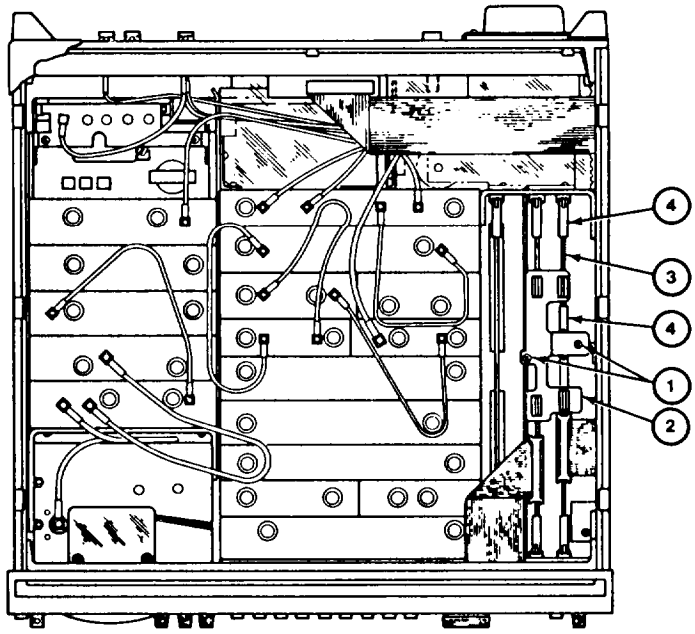
NOTE

PRELIMINARY PROCEDURES:

Remove top cover (para 2-66).

REMOVE

1. Remove two screws (1).
2. Remove circuit card retainer(2).
3. Remove A80 Power Supply Assembly (3) by pulling on two extractors (4).



INSTALL

1. Install A80 Power Supply Assembly (3) with components facing outward into proper slot.
2. Install circuit card retainer (2).
3. Install two screws (1).

NOTE

FOLLOW-ON MAINTENANCE:

Install top cover (para 2-66).

END OF TASK

2-95. REPLACE A98 KEYBOARD ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

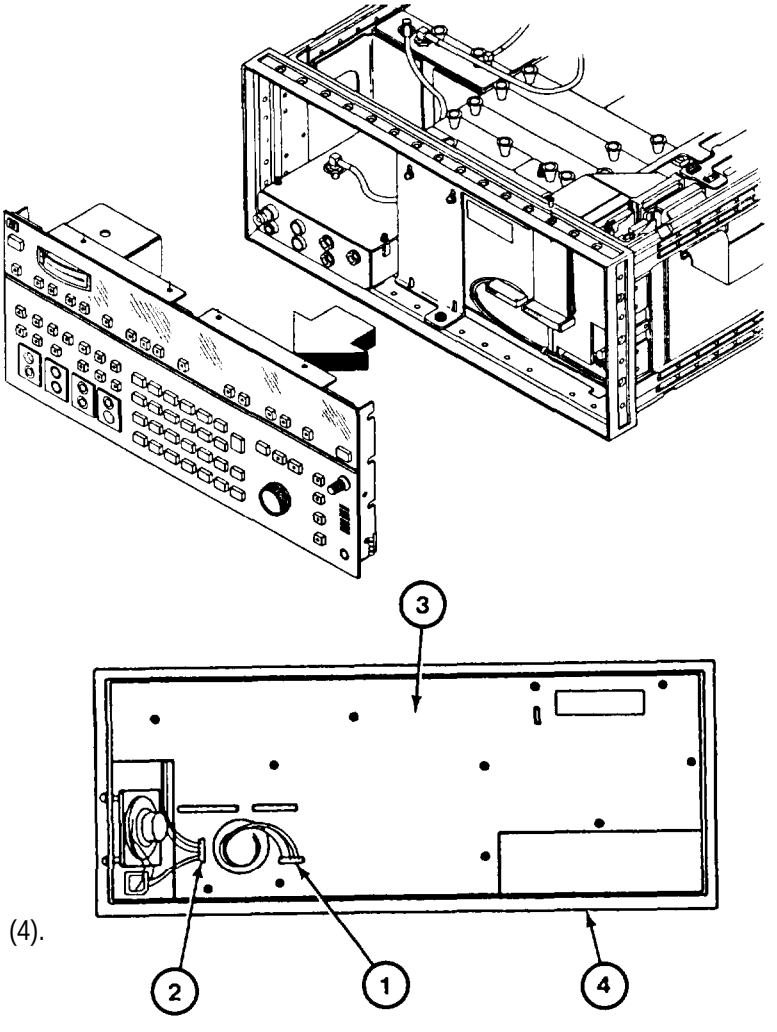
NOTE

PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).
- Remove both side covers (para 2-67).
- Remove front panel (para 2-69).
- Remove M1 Analog Meter (para 2-99).

REMOVE

1. Remove RPG cable (1) and speaker assembly (2).
2. Remove A98 Keyboard Assembly (3).



INSTALL

1. Install A98 Keyboard Assembly (3) in front panel (4).
2. Connect RPG cable (1) and speaker cable (2).

2-95. REPLACE A98 KEYBOARD ASSEMBLY—Continued.

NOTE

FOLLOW-ON MAINTENANCE:

- Install Ml Analog Meter (para 2-99).
- Install front panel (para 2-69).
- Install both side covers (para 2-67).
- Install top and bottom covers (para 2-66).

END OF TASK

2-96. REPLACE A98 SWOO THRU A98SW77 KEYBOARD SWITCH.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).
- Remove both side covers (para 2-67).
- Remove front panel (para 2-69).
- Remove A98 Keyboard Assembly (para 2-95).

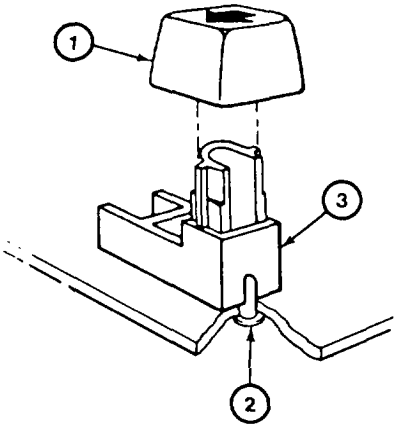
2-96. REPLACE A98 SWOO THRU A98SW77 KEYBOARD SWITCH—Continued.

REMOVE

NOTE

Do not handle or clean contact surface areas as keyboard surface acts as a contact in switch operation.

1. Remove push button (l).
2. From bottom, carefully remove plastic tabs on switch studs (2).
3. Remove switch (3).



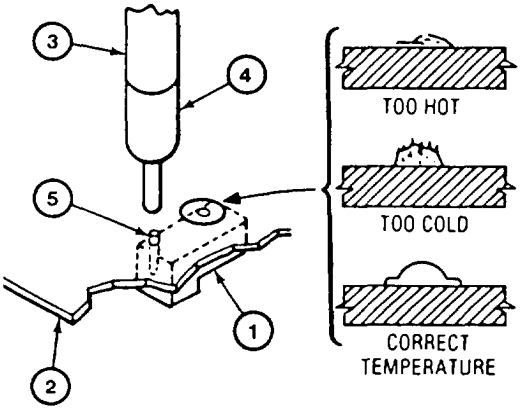
INSTALL

1. From front, insert switch (1) in keyboard assembly (2).

NOTE

- Switch must be mounted tightly against keyboard surface for proper operation.
- Proper heat for element with staking tip is 440' C (825" F).

2. USING 3 35W element (3) with staking tip (4) attached, melt plastic stud (5).
3. Verify that switch is mounted firmly against keyboard and melted post has a smooth, round surface.



NOTE

FOLLOW-ON MAINTENANCE:

- Install A98 Keyboard Assembly (para 2-95).
- Install front panel (para 2-69).
- Install both side covers (para 2-67).
- Install bottom and top covers (para 2-66).

END OF TASK

2-97. REPLACE A99 MOTHERBOARD ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

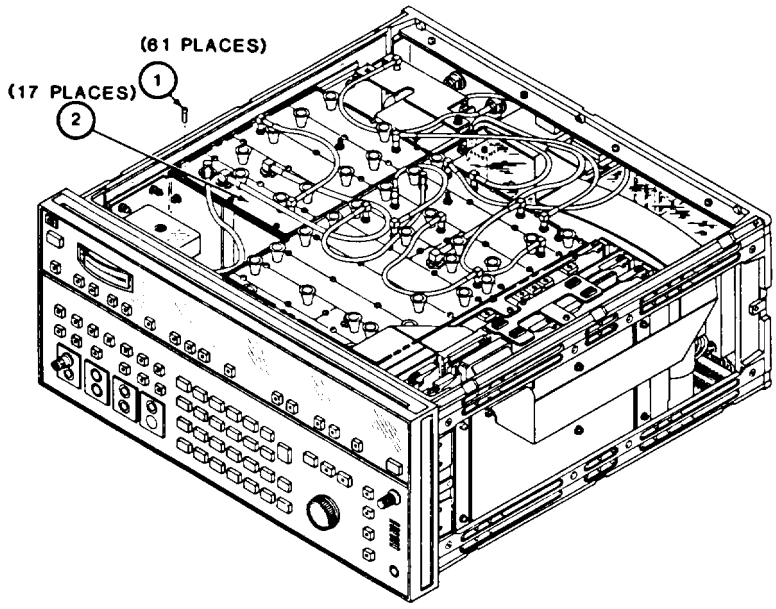
NOTE

PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).
- Remove both side covers (para 2-67).
- Remove front frame (para 2-68).
- Remove A60 Controller Assembly (para 2-90).
- Remove A61 HP Interface Bus Assembly (para 2-91).
- Remove A70 Impairments B Assembly (para 2-93).
- Remove A80 Power Supply Assembly (para 2-94).
- Remove A16 10MHz Frequency Reference Assembly (para 2-78).

REMOVE

1. Remove sixty-one screws (l).
2. Gently pull up on seventeen plug-in assemblies (2) just enough to disengage the assembly from connector mounted on motherboard assembly.
3. Remove forty-five screws (3).
4. Remove fifteen screws (4) and lockwashers (5).
5. Remove shield (6).
6. Remove two screws (7), flat washers (8) and bumpers (9).
7. Remove two screws (10), lockwashers (1 1), and flat washers (12).



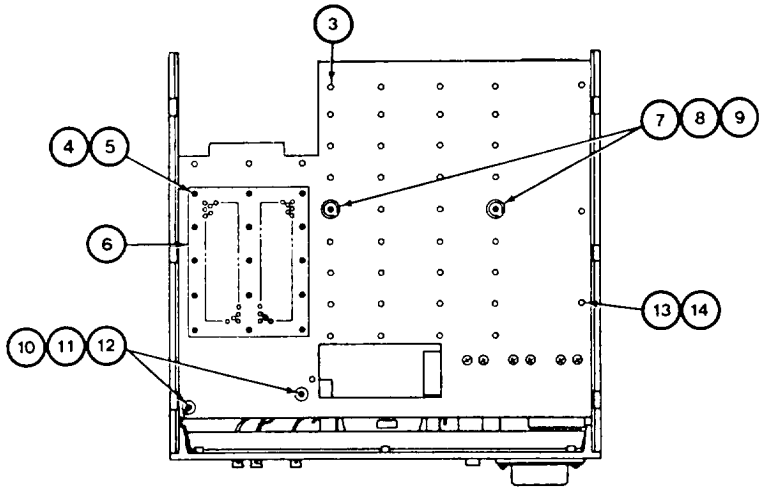
2-97. REPLACE A99 MOTHERBOARD ASSEMBLY—Continued.

REMOVE—Continued

8. Remove three screws (13) and flat washers (14).

9. Position A99 Motherboard Assembly (15) slightly out of chassis, and disconnect cable (16), cable (17) and cable (18).

10. Remove A99 Motherboard Assembly (15).



BOTTOM VIEW

INSTALL

1. Position A99 Motherboard Assembly (15) and connect cable (16), cable (17) and cable (18).

2. Install A99 Motherboard Assembly (15) into chassis.

3. Install three screws (13) and flat washers (14).

4. Install two screws (10), lockwashers (11) and flat washers (12).

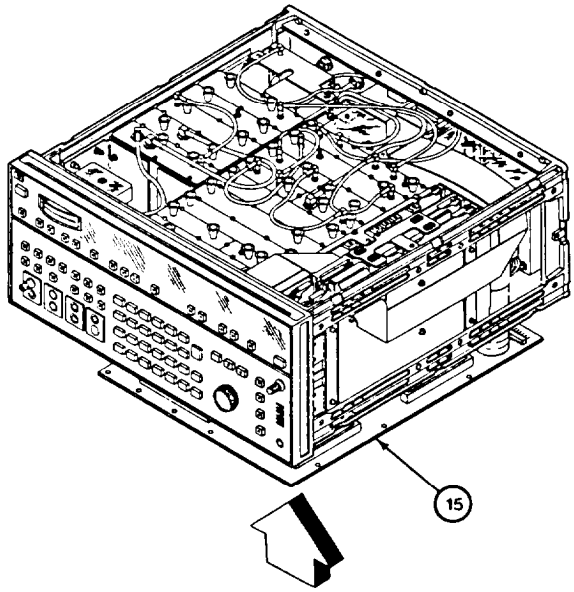
5. Install two screws (7), flat washers (8) and bumpers (9).

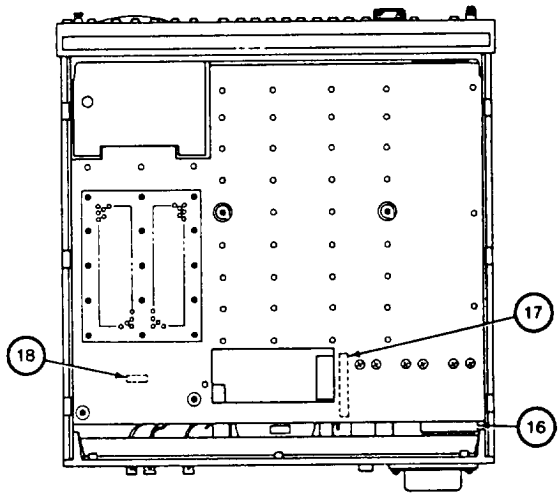
6. Install shield (6).

7. Install fifteen screws (4) and washers (5).

8. Install forty-five screws (3).

9. Reseat seventeen plug-in assemblies (2) and install sixty-one screws (l).





2-97. REPLACE A99 MOTHERBOARD ASSEMBLY—Continued.

NOTE

FOLLOW-ON MAINTENANCE:

- Install A16 10MHz Frequency Reference Assembly (para 2-78).
- Install A80 Power Supply Assembly (para 2-94).
- Install A70 Impairments B Assembly (para 2-93).
- Install A61 HP Interface Bus Assembly (para 2-9 1).
- Install A60 Controller Assembly (para 2-90).
- Install front frame (para 2-68),
- Install both side covers (para 2-67).
- Install top and bottom covers (para 2-66).

END OF TASK

2-98. REPLACE A99C1, C2, AND C3 POWER SUPPLY CAPACITORS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

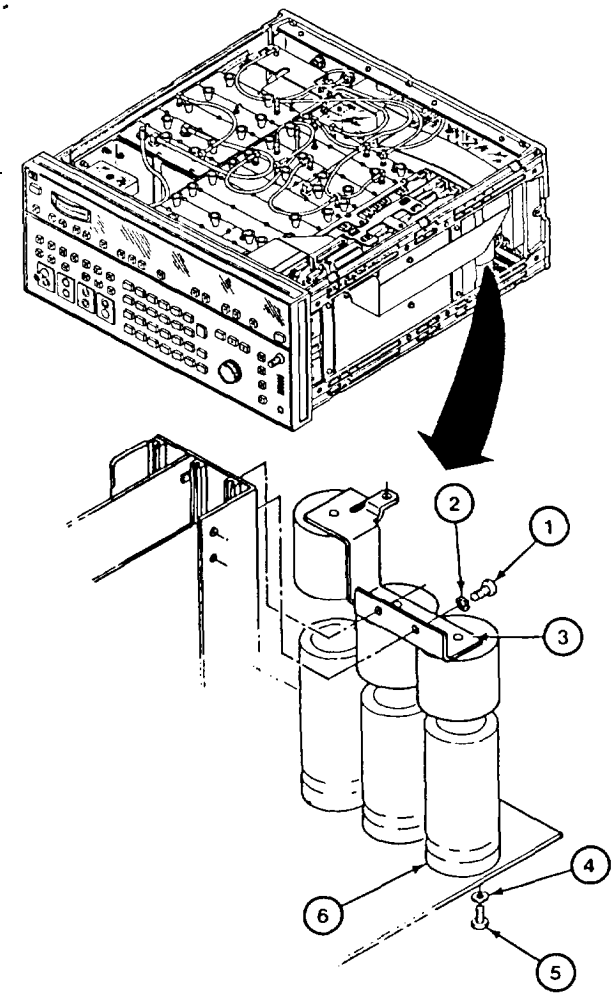
NOTE

PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).
- Remove both side covers (para 2-67).
- Remove rear frame (para 2-70).

REMOVE

1. Remove two screws (1) and lock washers (2).
2. Remove capacitor retainer (3) and position out of way taking care not to disconnect wires.
3. Remove two screws (4) and lock washers (5).
4. Remove capacitor (6).



INSTALL

1. Install capacitor (6).
2. Install two screws (5) and two lock washers (4).
3. Install capacitor retainer (3).
4. Install two screws (1) and lock washers (2).

- Install rear frame (para 2-70).
- Install both side covers (para 2-67).
- Install top and bottoms cover (para 2-66).

END OF TASK

2-99. REPLACE M1 ANALOG METER.

DESCRIPTION

This procedure covers: Remove. Install.

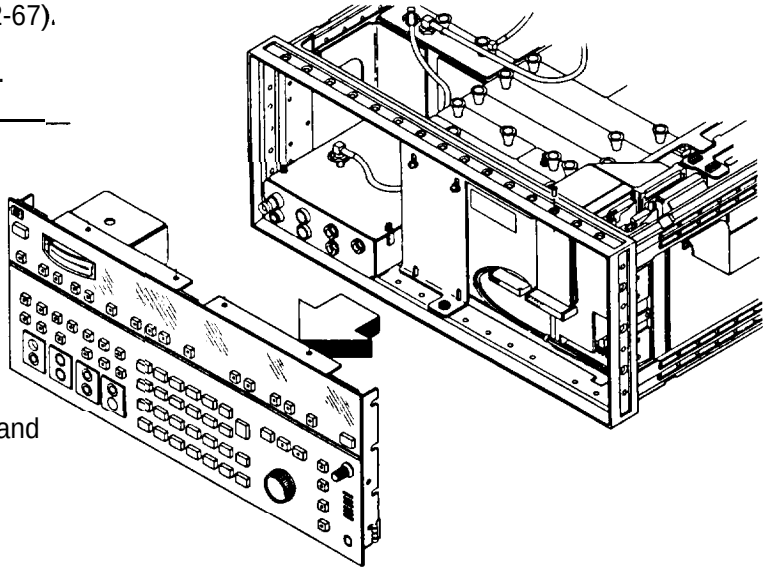
INITIAL SETUP

NOTE

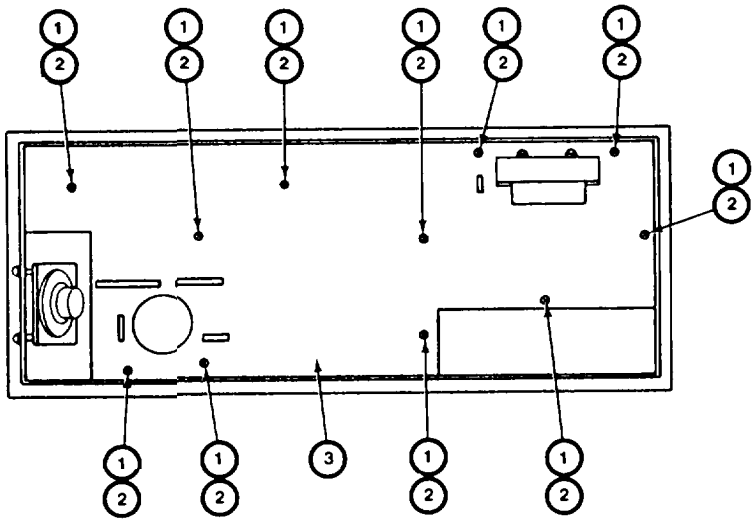
PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).
- Remove both sides covers (para 2-67).
- Remove front frame (para 2-68).

REMOVE



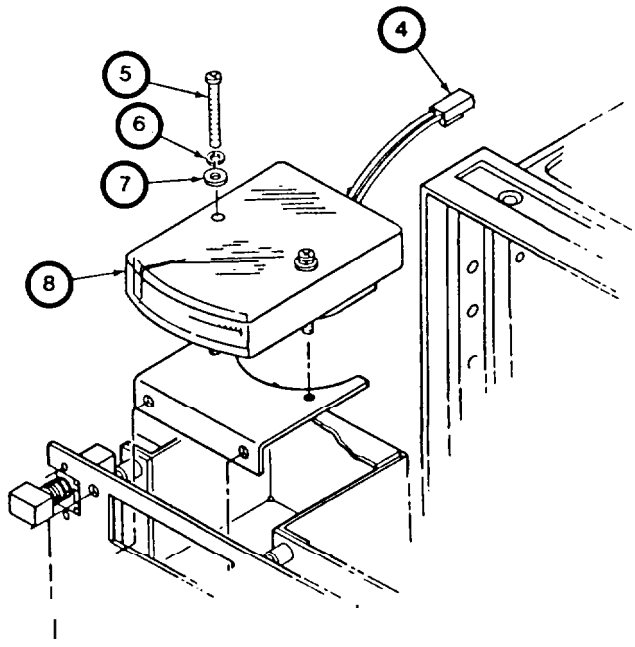
1. Remove eleven screws (1) and lock washers (2).
2. Remove circuit card shield (3).
3. Disconnect meter cable (4).
4. Remove two screws (5), lock washers (6) and flat washers (7).
5. Remove Ml Analog Meter (8).



2-99. REPLACE M1 ANALOG METER—Continued.

INSTALL

1. Install M 1 Analog Meter (8).
2. Install two screws (5), lock washers (6) and flat washers (6).
3. Connect meter cable (4).
4. Install circuit card shield (3).
5. Install eleven screws (1) and lock washers (2).



NOTE

FOLLOW-ON MAINTENANCE:

- Install front frame (para 2-68).
- Install both side covers (para 2-67).
- Install top and bottom covers (para 2-66).

END OF TASK

2-100. REPLACE T1 TRANSFORMER.

DESCRIPTION

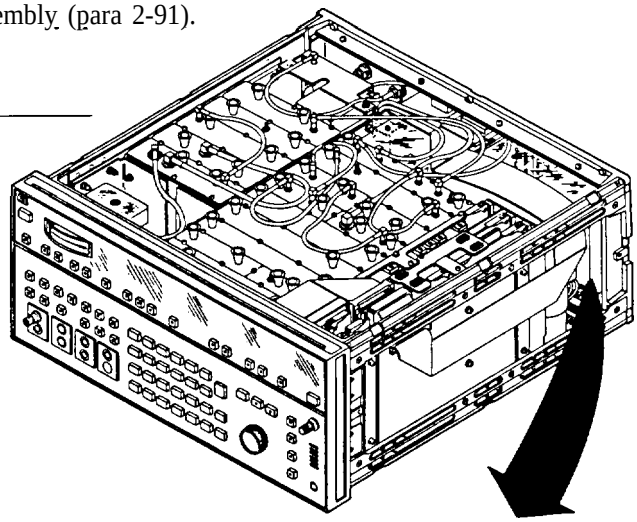
This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

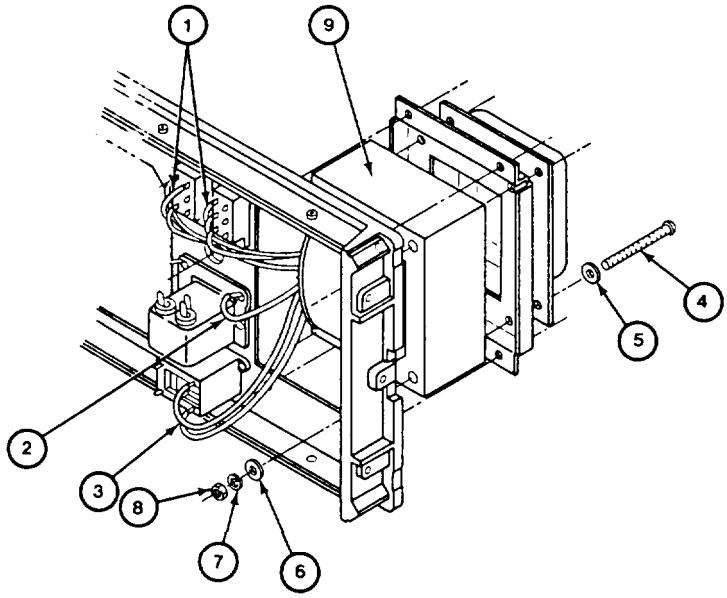
PRELIMINARY PROCEDURES:

- Remove top and bottom covers (para 2-66).
- Remove both side covers (para 2-67).
- Remove A16 10 MHz Frequency Reference Assembly (para 2-78).
- Remove A61 HP Interface Bus Assembly (para 2-91).
- Remove rear frame (para 2-70).



REMOVE

1. Working from back, tag, unsolder, and disconnect six wires (l).
2. Working from back, tag, unsolder, and disconnect one wire (2).
3. Working from back, tag, unsolder, and disconnect two wires (3).
4. Remove four screws (4), insulators (5), flat washers (6), lock washers (7) and nuts (8).
5. Remove T1 Transformer (9).



INSTALL

1. Install T1 Transformer (9).
2. Install four screws (4), insulators (5), flat washers (6), leek washers (7) and nuts (8).
3. Working from back, tag and resolder two wires (3).
4. Working from back, tag and resolder one wire (2).
5. Working from back, tag and resolder six wires (l).

2-100. REPLACE T1 TRANSFORMER—Continued.

NOTE

FOLLOW-ON MAINTENANCE:

- Install rear frame (para 2-70).
- Install A61 HP Interface Bus Assembly (para 2-91).
- Install Al 6 10MHz Frequency Reference Assembly (para 2-78).
- Install both side covers (para 2-67).
- Install top and bottom covers (para 2-66).

END OF TASK

Section V. PREPARATION FOR STORAGE OR SHIPMENT

2-101. PACKAGING.

Package Level Meter in original shipping container. Refer to SB 38-100 for preservation, packaging, packing, and marking materials.

2-102. ADMINISTRATIVE STORAGE,

Refer to TM 740-90-1 for administrative storage procedures.

2-103. ENVIRONMENT.

The Level Meter should be stored in a clean, dry environment. In high humidity environments, protect the Level Meter form temperature variations that could cause internal condensation.The following environmental conditions apply to both shipping and storage:

Temperature	-40° C to +75° C (-40° F to +158° F)
Relative Humidity	less than 95%
Altitude	less than 15,300 meters (50,000 feet)

APPENDIX A
REFERENCES

A-1. SCOPE.

This appendix lists all forms, field manuals, technical manuals, and miscellaneous publications referenced in this manual.

A-2. FORMS.

Recommended Changes to Publications and Blank Forms . . . . . DA Form 2028

Recommended Changes to Equipment Technical Manuals . . . . . DA Form 2028-2

Discrepancy in Shipment Report (DISREP) . . . . . Form SF 361

Report of Discrepancy (ROD) . . . . . Form SF 364

Quality deficiency report . . . . . Form SF 368

A-3. TECHNICAL MANUALS.

The Army Maintenance Management System (TAMMS) . . . . . DA Pam 738-750

Procedures for Destruction of Electronics Material to Prevent Enemy Use (Electronics Command) . . . . TM 750-244-2

Operator's and Organizational Maintenance Manual, Frequency Selective Level Meter AN/USM-490 . . . . . TM1l-6625-3087-12

Organizational, Direct Support and General Support Repair Parts and Special Tools List for Frequency Selective Level Meter AN/USM-490 . . . . . TM 11-6625-3087-24P

Administrative Storage Procedures. . . . . TM 740-90-1

Calibration Procedures. . . . . TM 43-180

A-4. MISCELLANEOUS.

Consolidated Index of Army Publications and Blank Forms . . . . . DA Pam 310-1

First Aid for Soldiers FM21-11

Safety Precautions for Maintenance of Electric/Electronic Equipment . . . . . TB 385-4

Abbreviations for Use on Drawings, Specifications, Standards and in Technical Documents. MIL-STD-12

Preservation, Packaging, Packing, and Marking Materials, Supplies and Equipment Used by the Army. . . . . SB 38-100

APPENDIX B
EXPENDABLE SUPPLIES AND MATERIALS LIST

Section 1. INTRODUCTION

B-1. SCOPE.

This appendix lists expendable supplies you will need for general support maintenance on frequency selective level meter AN/USM-490. These items are authorized to you by CTA 50-970, Expendable items (Except Medical, Class V, Repair Parts, and Heraldic Items).

B-2. EXPLANATION OF COLUMNS.

a. Column (1)—Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, App. D').

b. Column (2)—Level. This column identifies the lowest level of maintenance that requires the listed item.

0- Organizational Maintenance.

c. Column (3)—National Stock Number. This column indicates the national stock number assigned to the item and will be used for requisitioning purposes.

d. Column (4)—Description. This column indicates the federal item name and if required, a minimum description to identify the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

e. Column (5)—Unit of Measure (U/M). This column indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., EA, IN, PR). If the unit of measure differs from the unit of issue,-requisition the lowest unit of issue that will satisfy your-requirements. "

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	H	6850-00-405-9385	Circuit Cooler, Freon 12 Base MS240 (1 8598)	CN
2	H	6810-00-753-4993	Alcohol, Isopropyl, 80Z Can, MIL-A-10428, Grade A (81349)	CN
3	H	6515-00-303-8250	Applicator, DISP, Cotton Swab GGA616 (81348)	EA

SUBJECT INDEX

B—Continued

C

D

E

F

F—Continued

G

H

I

I—Continued

I—Continued

J

K

L

L—Continued

M

M—Continued

N

0

P

P—Continued

R

R—Continued

R—Continued

S

S—Continued

T

T—Continued

T—Continued

U

V

W

GLOSSARY

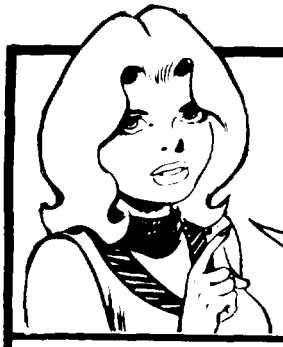
Section I. ABBREVIATIONS

AVE	Average
CAL	Calibration
CARR	Carrier
CNTR	Counter
CONT	Continue
DEMOD	Demodulation
DIST	Distortion
FDM	Frequency Domain Multiplexing
LSB	Lower side band
MEAS	Measure
MIP	Maximum input power
OVLD	Overload
STBY	Standby
SSB	Single side band
T	Time
THSHLD	Threshold
USB	Upper side band
WTD	Weighted

Section II. DEFINITION OF UNUSUAL TERMS

dBmO	Power level relative to stored OFFSET value.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



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DATE SENT
10 July 1975

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 11-5840-340-12	23 Jan 74	Radar Set AN/PRC-76

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PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO	IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
2-25	2-28			Recommend that the installation antenna alignment procedure be changed throughout to specify a 2° IFF antenna lag rather than 1°. REASON: Experience has shown that with only a 1° lag, the antenna servo system is too sensitive to wind gusting in excess of 25 knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2° without degradation of operation.
3-10	3-3		3-1	Item 5, Function column. Change "2 db" to "3db." REASON: The adjustment procedure for the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.
5-6	5-8			Add new step f.1 to read, "Replace cover plate removed in step e.1, above." REASON: To replace the cover plate.
		F03		Zone C 3. On J1-2, change "+24 VDC to "+5 VDC." REASON: This is the output line of the 5 VDC power supply. +24 VDC is the input voltage.

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SSG I. M. DeSpiritof 999-1776

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I. M. DeSpiritof

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TM 11-6625-3087-40	1 Jan 1987	FREQUENCY SELECTIVE LEVEL METER AN/USM-490

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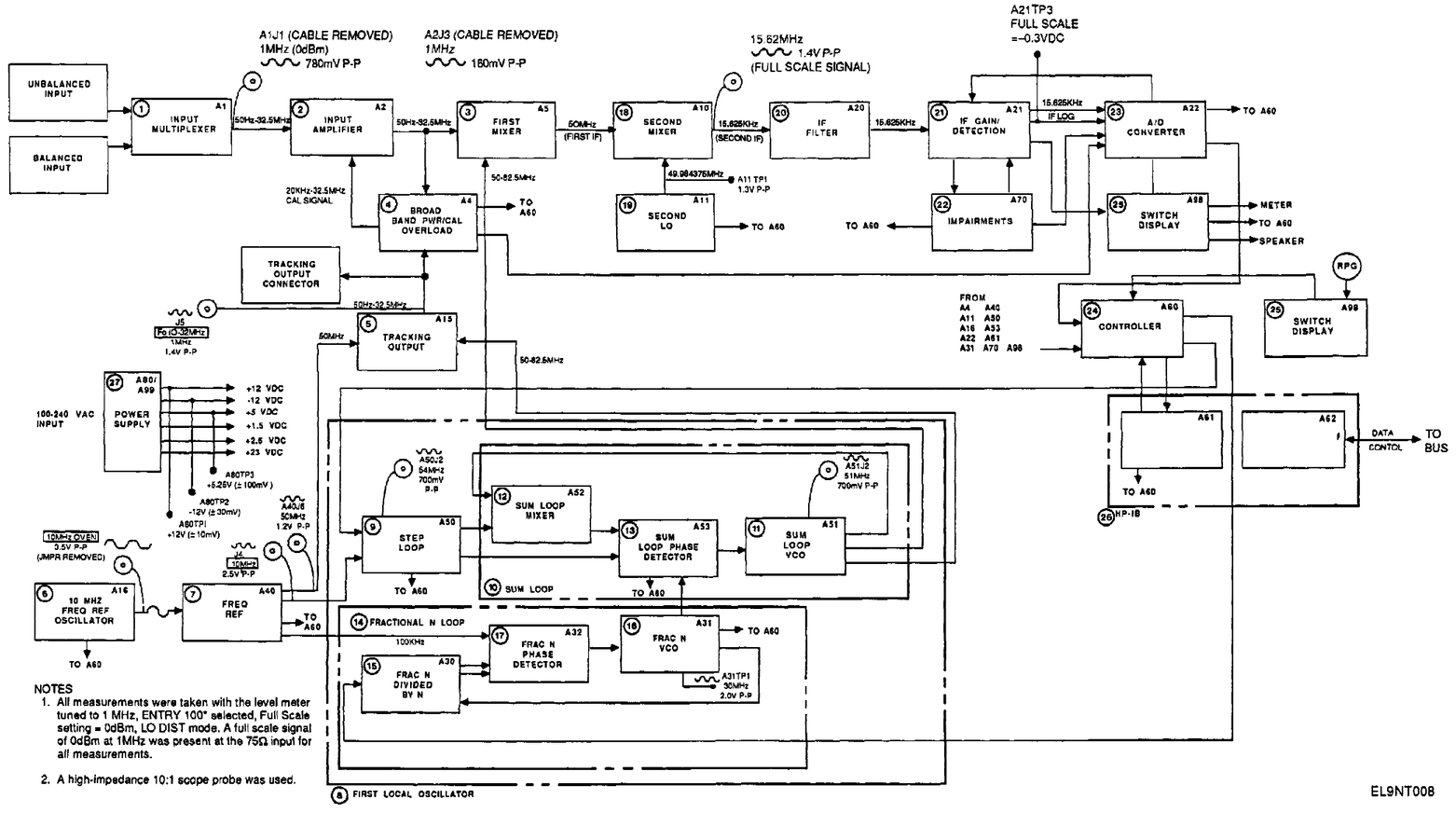
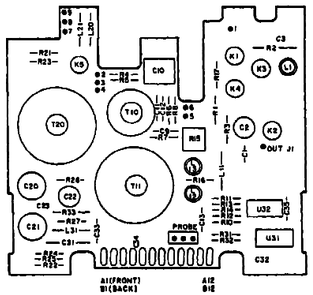


Figure FO-1. Level Meter Detailed Block Diagram.



NOTES:
1. Signal levels are measured with 1MHz at 0dBm input (75Ω). ENTRY 100 selected. Full Scale=0dBm. Unless otherwise specified, signals are 1MHz sine wave.
2. Isolated ground.
3. Signal ground.
4. Probe +15Vdc is present at probe connector in STANDBY.
6. ▽ I/S Denotes isolated (I) or signal (S) circuit ground.

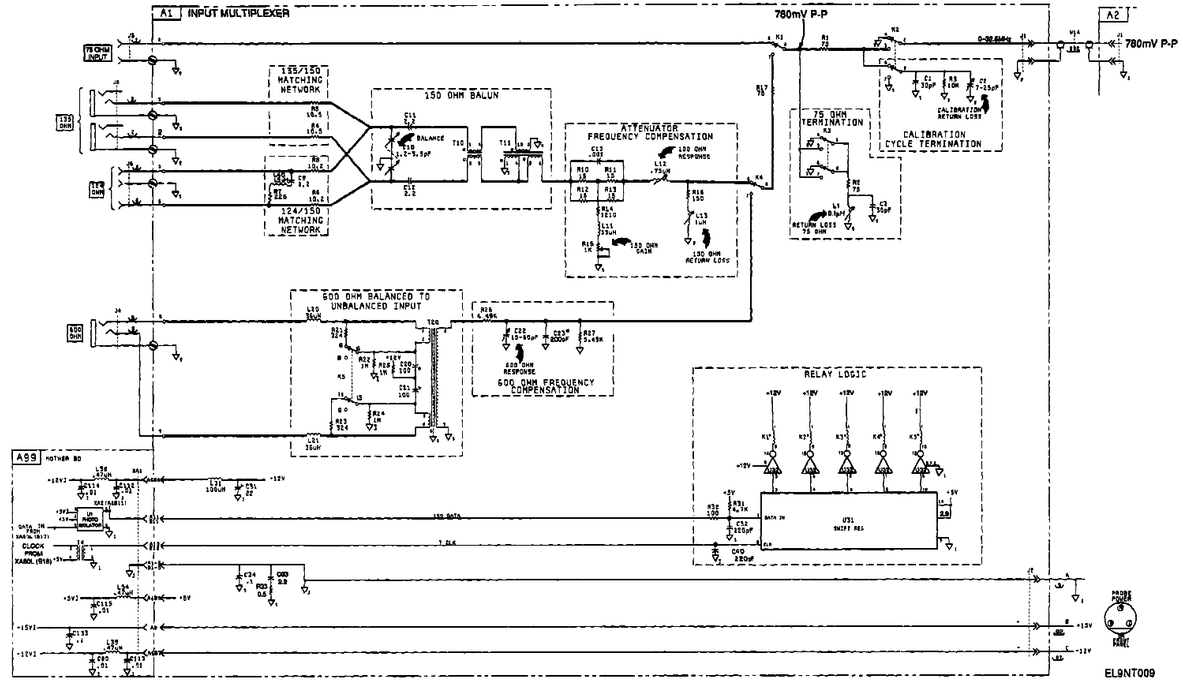
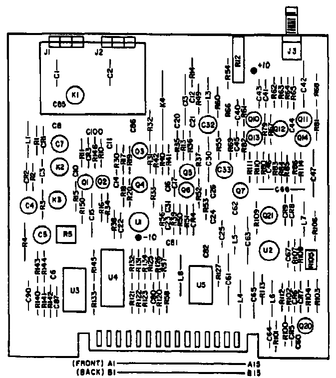


Figure FO-2. A1 Input Multiplexer Schematic Diagram.



NOTES:

1. Signal levels are measured with 1MHz at 0dBm input (75Ω), ENTRY 100 selected, Full Scale=0dBm. Unless otherwise specified, signals are 1MHz sine wave.
2. A2Q7 is operated in the inverted mode, i.e., the collector is used like an emitter and vise-versa.
3. Voltage gain of RF input amplifier (A2):

K4	Q7	Amplification	Gain
OPEN	ON	x2.0	6dB
OPEN	OFF	x3.5	11dB
CLOSED	ON	x6.3	16dB
CLOSED	OFF	x11.2	21dB

4. C53, C56, C59, C63, and C65 are interactive adjustments for flatness of the filter frequency response.
5. ▽ I/S Denotes isolated (I) or signal (S) circuit ground.
6. * Average value shown, optimum value selected at factory, the value of these components may vary from one instrument to another.

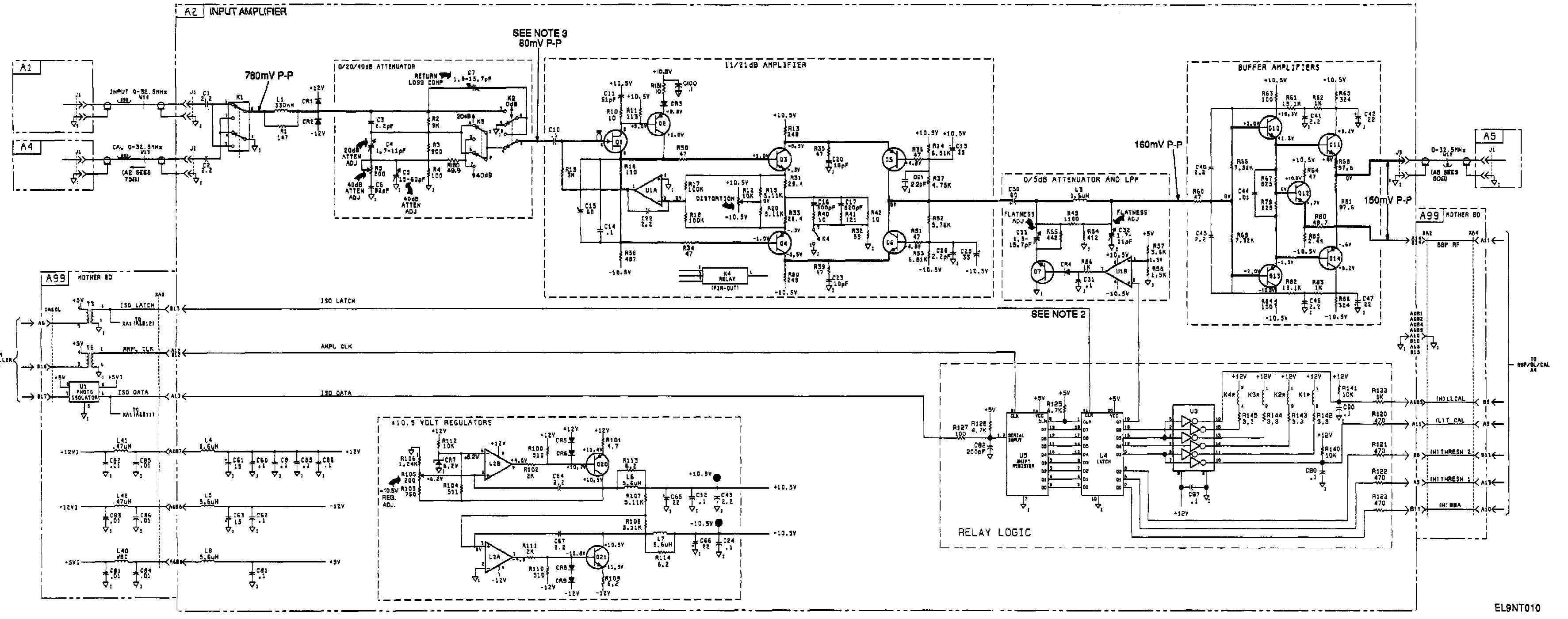
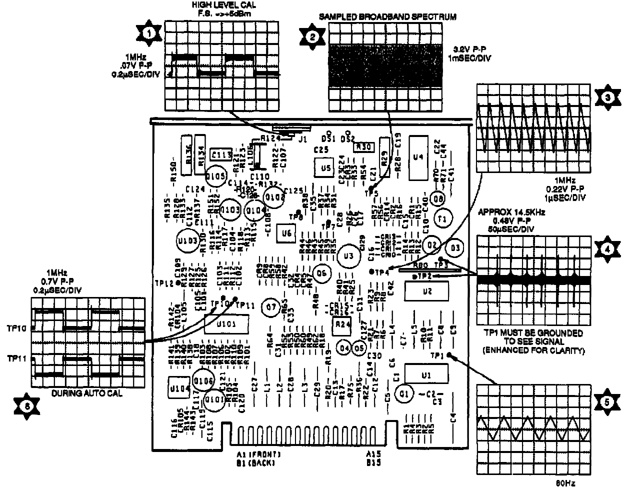
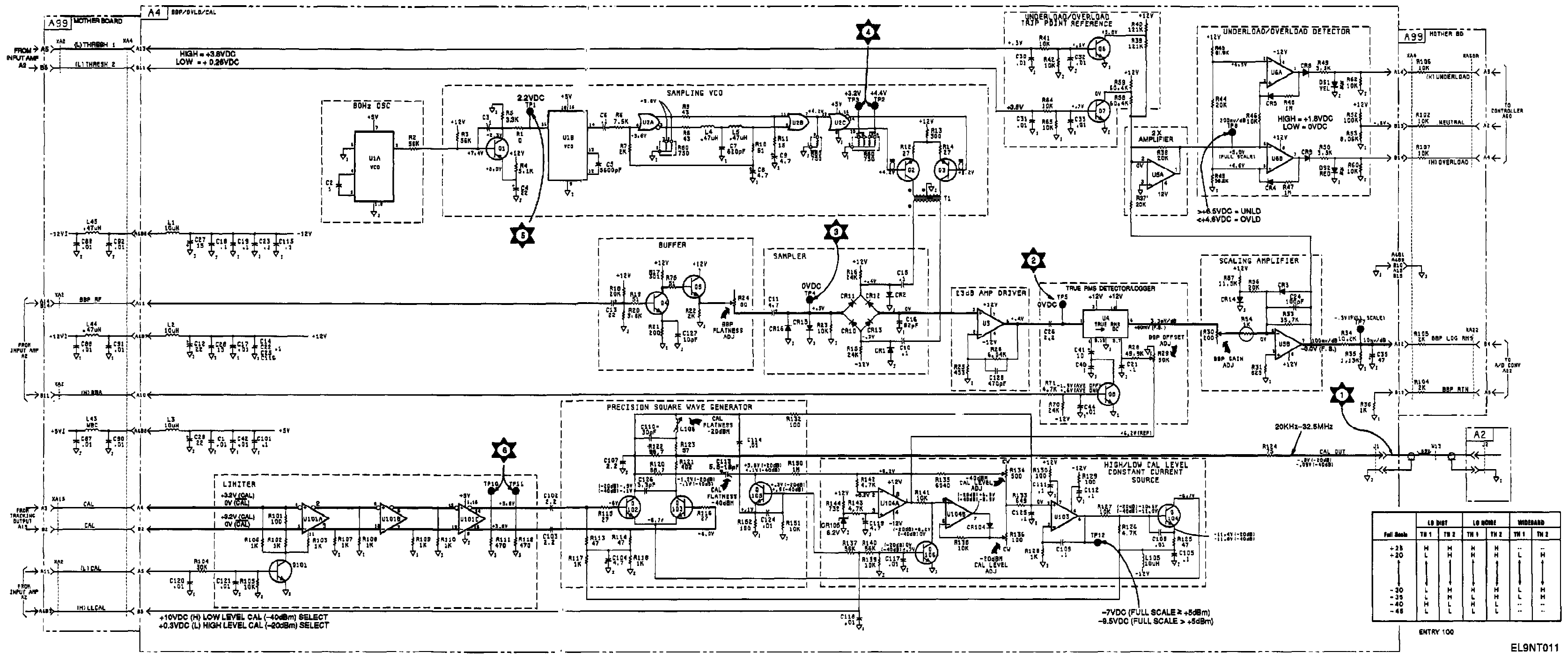


Figure FO-3. A2 Input Amplifier Schematic Diagram.



NOTES:
1. Unless otherwise noted, all voltages/waveforms were obtained with the following set-up.
   Input Signal = 1MHz @ 0dBm
   Entry 100
   LO DIST, 3100Hz
   Full Scale = 0dBm
   Freq = 1MHz
2. The tracking output and tracking CAL signals should always agree with the tuned frequency.
3. All voltages are ±10%.
4. Voltages on Q6/Q7 are for LOW DIST mode.
5. ▽ I/S Denotes isolated (I) or signal (S) circuit ground.
6. * Average value shown, optimum value selected at factory, the value of these components may vary from one instrument to another.



Full Scale	LO DIST TN 1	LO DIST TN 2	LO NOISE TN 1	LO NOISE TN 2	WIDEBAND TN 1	WIDEBAND TN 2
+25	H	H	H	H	--	--
+20	L	H	H	H	L	H
↓	↓	↓	↓	↓	↓	↓
-30	L	H	H	H	L	H
-35	L	H	L	H	L	H
-40	H	L	H	L	--	--
-45	L	L	L	L	--	--

ENTRY 100

EL9NT011

Figure FO-4. A4 Broadband Power/CAL/Overload Schematic Diagram.

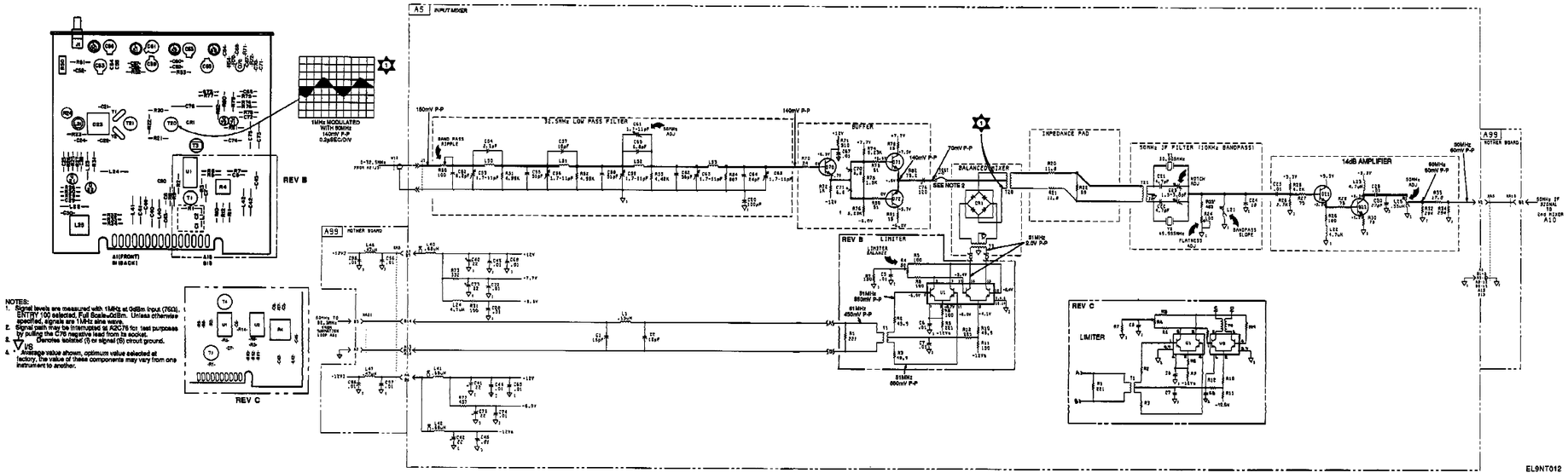


Figure FO-5. A5 Input Mixer Schematic Diagram.

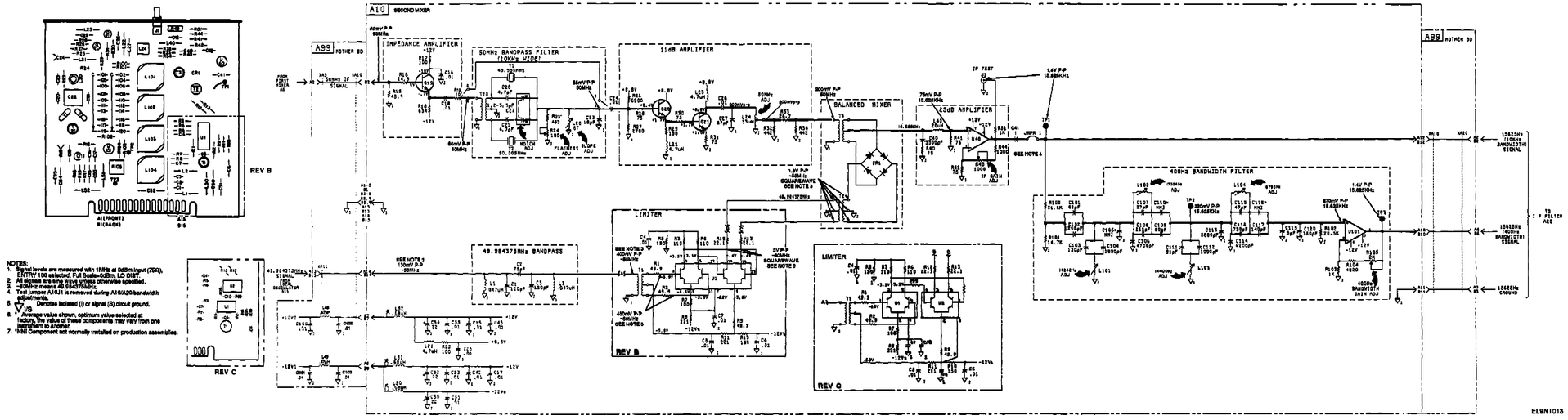
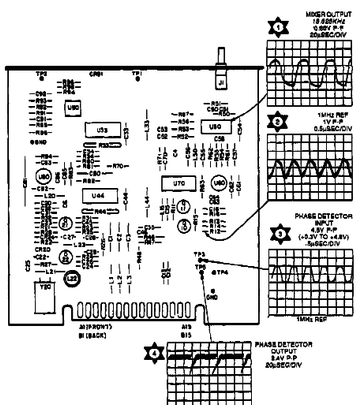


Figure FO-6. A10 Second Mixer Schematic Diagram.



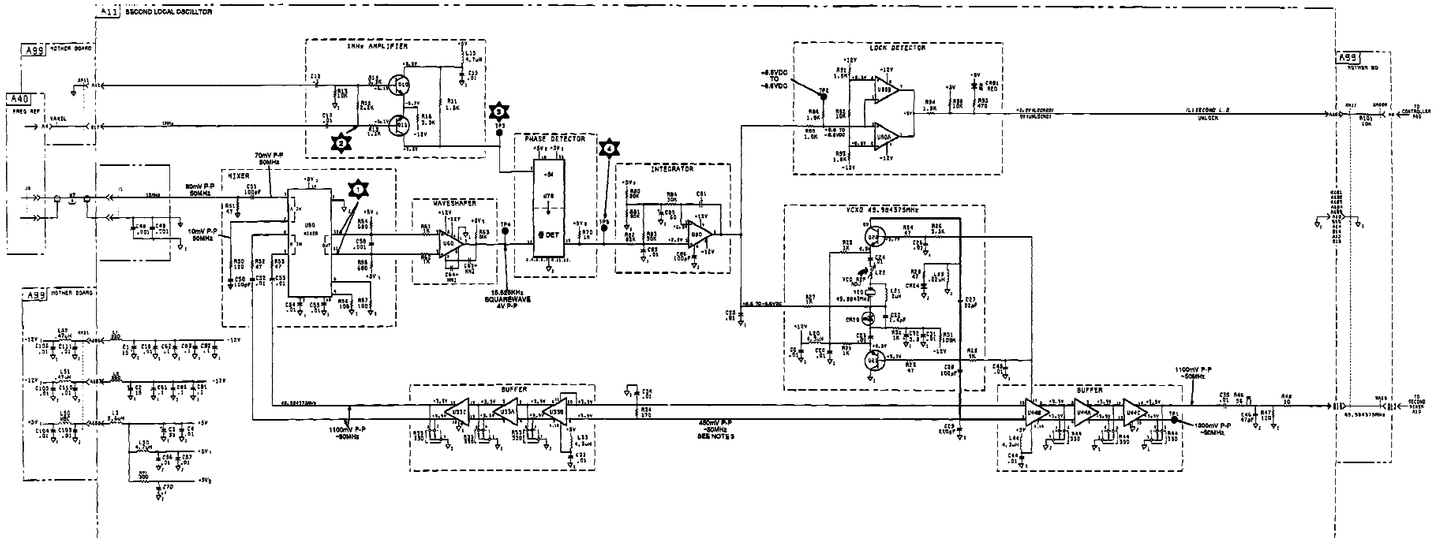
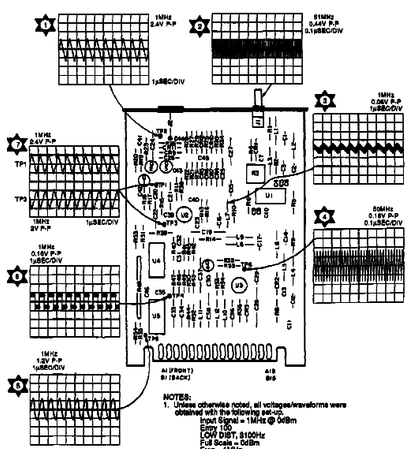


Figure FO-7. Second Local Oscillator Schematic Diagram.



NOTES:

1. Unless otherwise noted, all voltages/waveforms were obtained with the following set-up.
   Input Signal = 1MHz @ 0dBm
   Entry 100
   LOW DIST, 8100Hz
   Full Scale = 0dBm
   Freq = 1MHz
2. The tracking output and tracking CAL signals should always agree with the tuned frequency.
3. All voltages are ±10%.
4. Voltages in ( ) are for CAL.
5. ⏚ Denotes isolated (I) or signal (S) circuit ground.
6. * Average value shown, optimum value selected at factory, the value of these components may vary from one instrument to another.

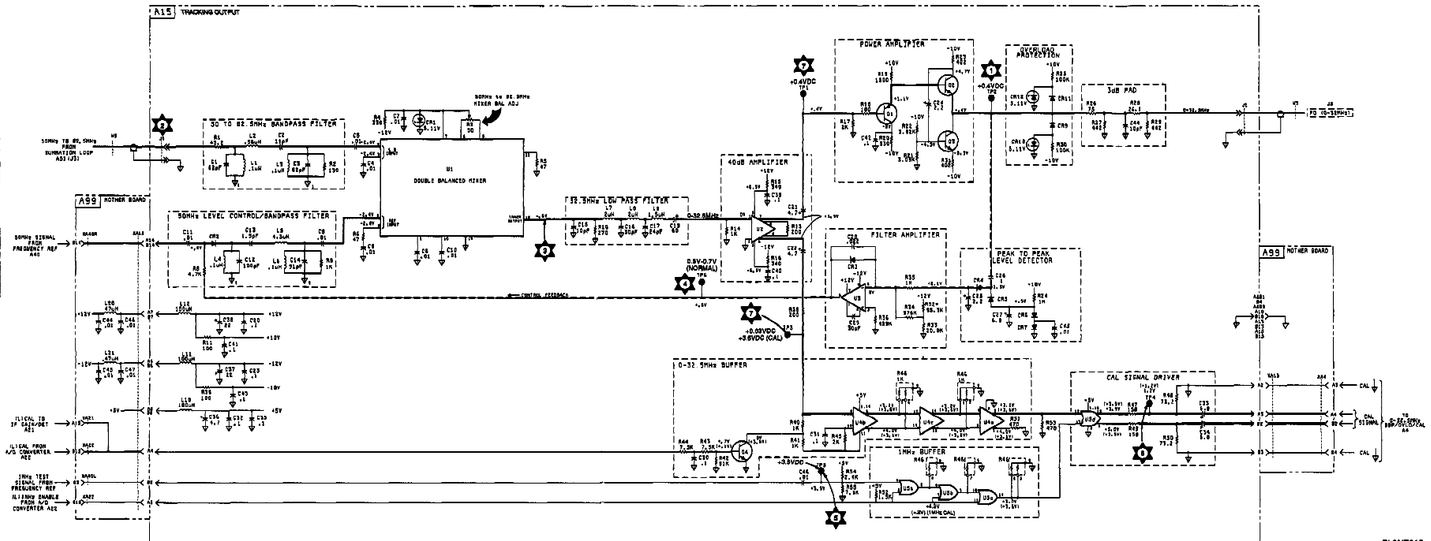


Figure FO-8. A15 Tracking Output Schematic Diagram.

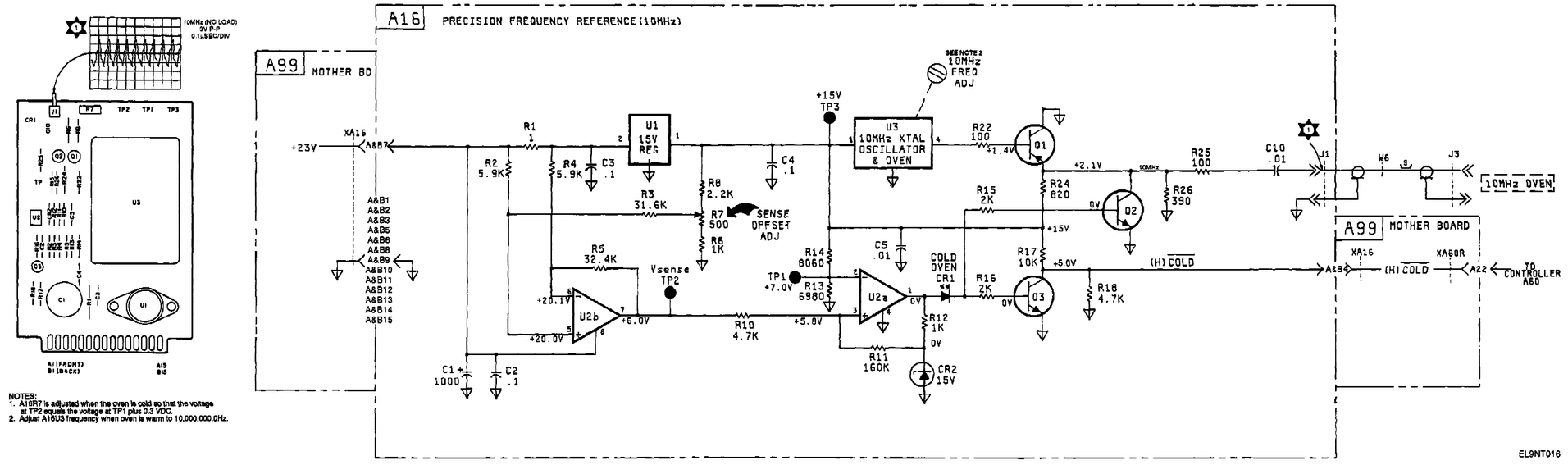
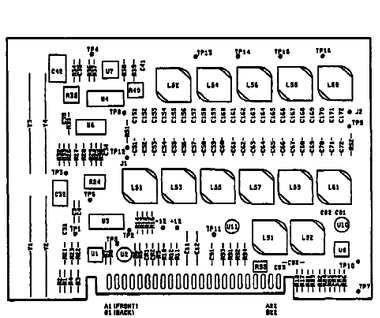


Figure FO-9. A16 10MHz Frequency Reference Schematic Diagram



NOTES:
1. Signal levels are measured with 1MHz at 0dBm input (75Ω), ENTRY 100 selected, Full Scale/dBm, LO DIST.
2. All signals are sine wave unless otherwise specified.
3. A20 IF Bandpass is 3100Hz.
4. NULL occurs only when jumper 1 is removed.
5. Denotes isolated (I) or signal (S) circuit ground.
6. VR Average value shown, optimum value selected at factory, the value of these components may vary from one instrument to another.
7. *NHI Component not normally installed on production assemblies.

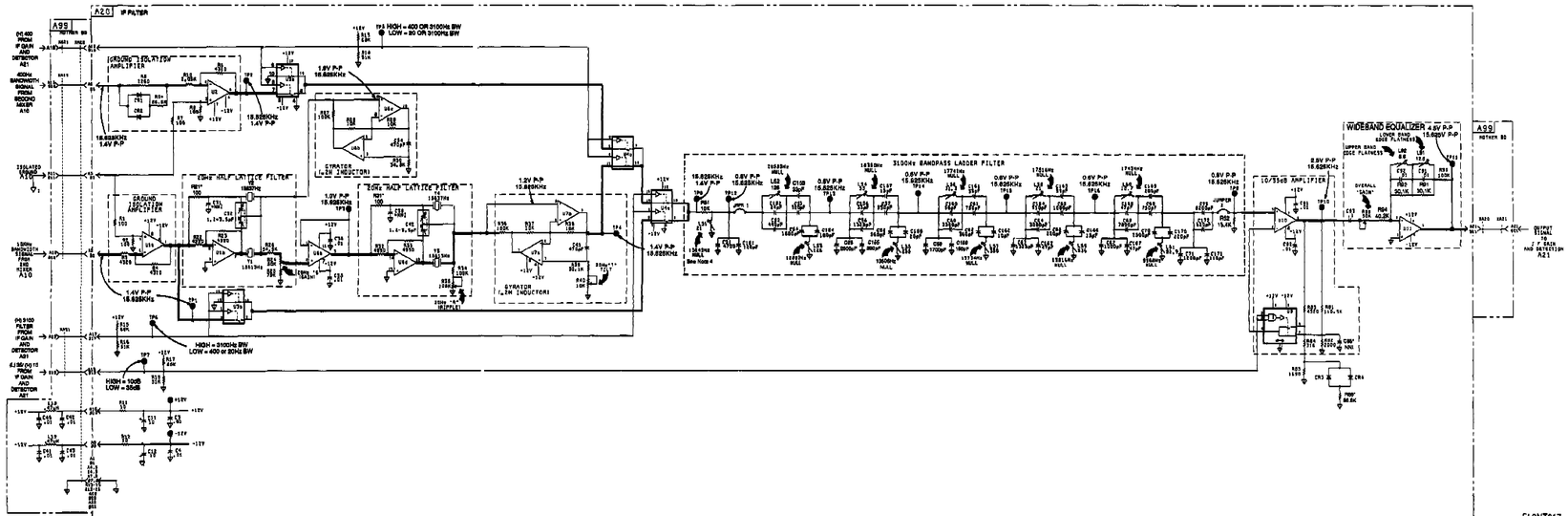
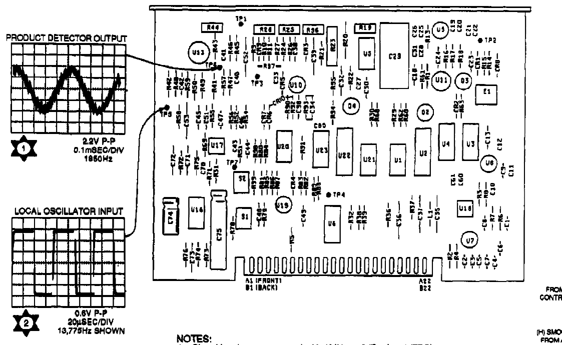


Figure FO-10. A20 IF Filter Schematic Diagram.



NOTES:

1. Signal levels are measured with 1MHz at 0dBm input (75Ω), ENTRY 100 selected, Full Scale=0dBm, LO DIST.
2. All signals are sine wave unless otherwise specified.
3. ~50MHz means 49.98437MHz.
4. Gain programming for A21U8:

U2	(16)	(10)	(10)	Gain
	A_2	A_1	A_0	
	0	0	0	0dB
	0	0	1	5dB
	0	1	0	10dB
	0	1	1	15dB
	1	0	0	20dB
	1	0	1	25dB
	1	1	0	30dB
	1	1	1	35dB

5. Signal level at A21TP2 varies according to the square root of the change in input level. For example, quadrupling the input signal (12dB increase) only doubles the signal at A21TP2 (6dB increase). This example assumes a fixed Full Scale setting.
6. ▽ I/S Denotes isolated (I) or signal (S) circuit ground.
7. * NNI Component not normally installed on production assemblies.

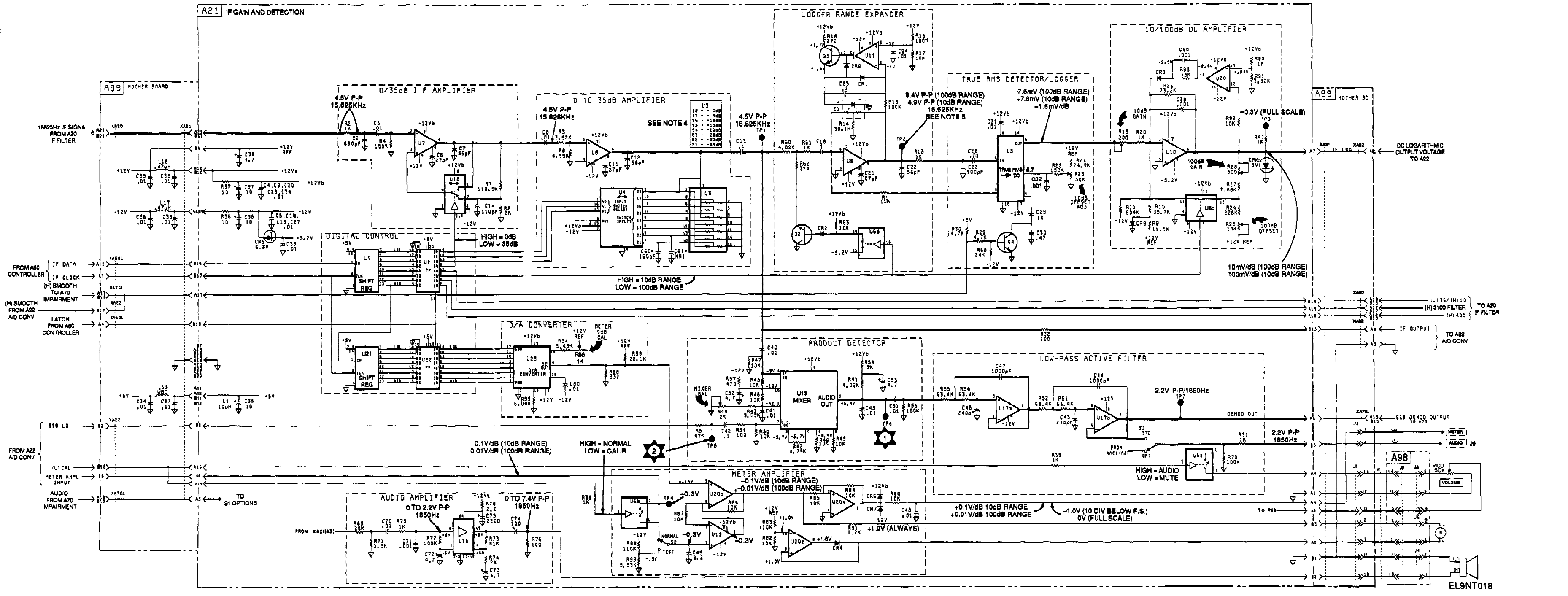
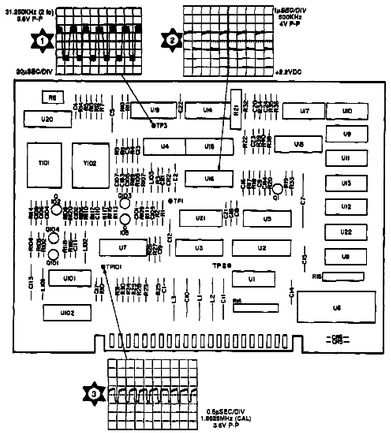


Figure FO-11. A21 IF Gain/Detector Schematic Diagram.



NOTES:
1. Signal levels are measured with 1MHz at 0dBm input (75Ω). ENTRY 100 selected, Full Scale=0dBm, LO DIST, tuned frequency to 1MHz.
2. Voltages shown for TP1 are valid for LO DIST (IF LOG), LO NOISE (IF LOG), WIDEBAND (RBP LOG RMS), and WTD S100Hz (WTD LOG). Voltages for TP1 for PHASE JITTER are the same as those shown at U7(6).
3. ENTRY on front panel means a positive voltage is presented to the A/D (U9).

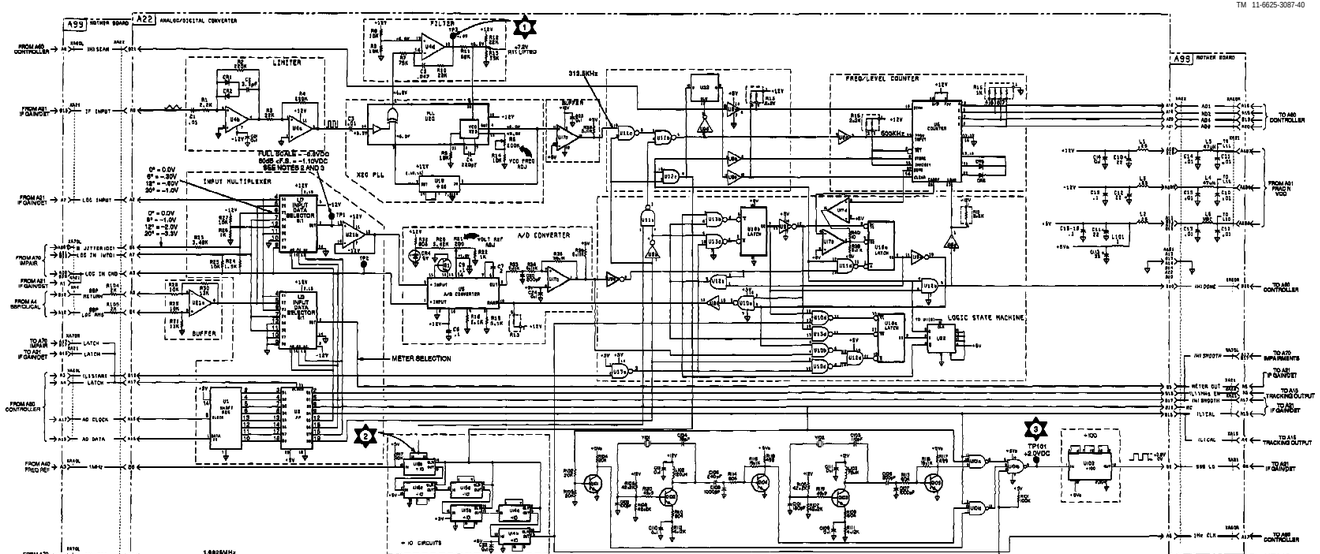
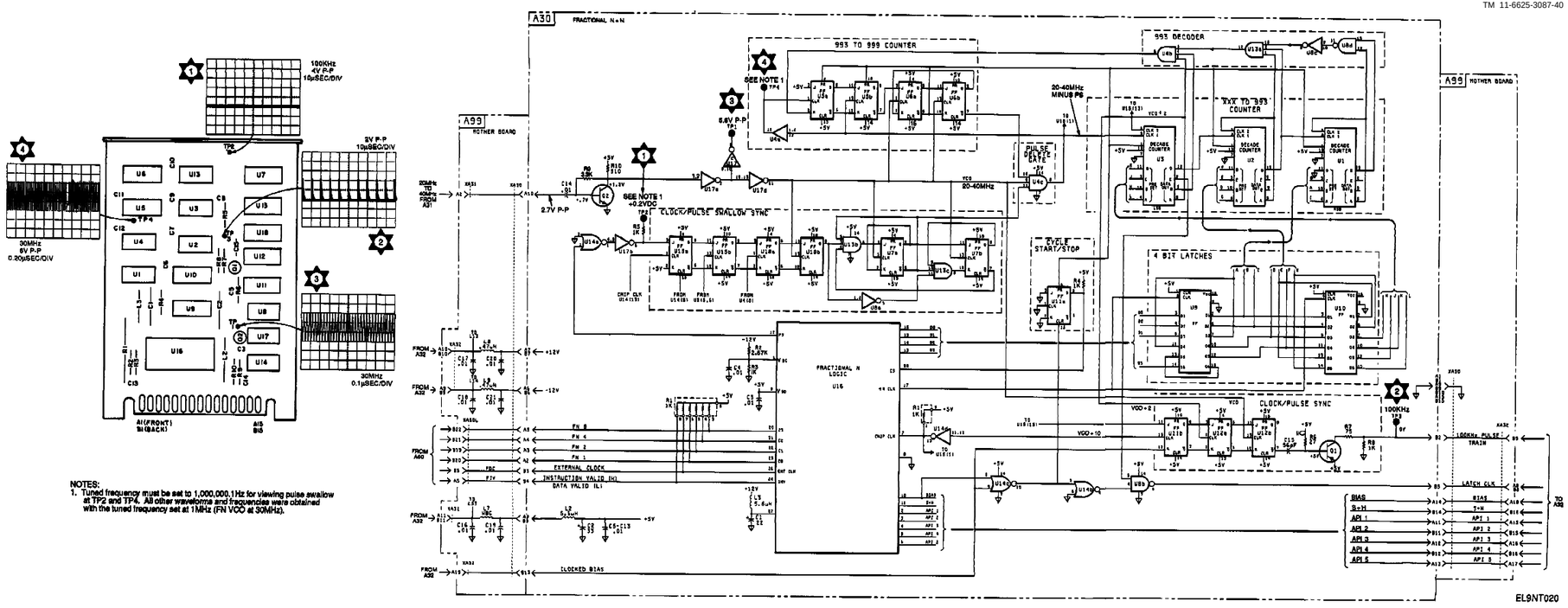
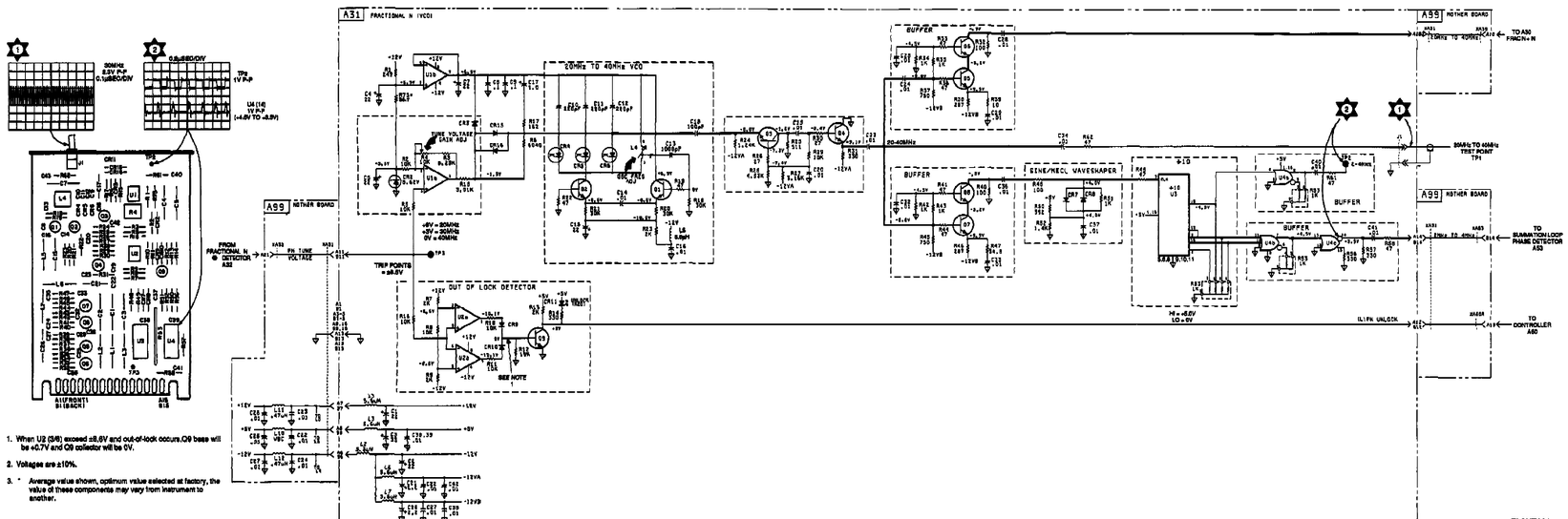


Figure FO-12. A22 Analog-Digital Converter Schematic Diagram.



NOTES:
1. Tuned frequency must be set to 1,000,000.1Hz for viewing pulse swallow at TP2 and TP4. All other waveforms and frequencies were obtained with the tuned frequency set at 1MHz (FN VCO at 30MHz).

Figure FO-13. A30 Fractional N ÷ N Schematic Diagram.



1. When U2 (3/6) exceed ±8.6V and out-of-lock occure,Q9 base will be +0.7V and Q9 collector will be 0V.
2. Voltages are ±10%.
3. * Average value shown, optimum value selected at factory, the value of these components may vary from instrument to another.

Figure FO-14. A31 Fractional N/VCO Schematic Diagram.

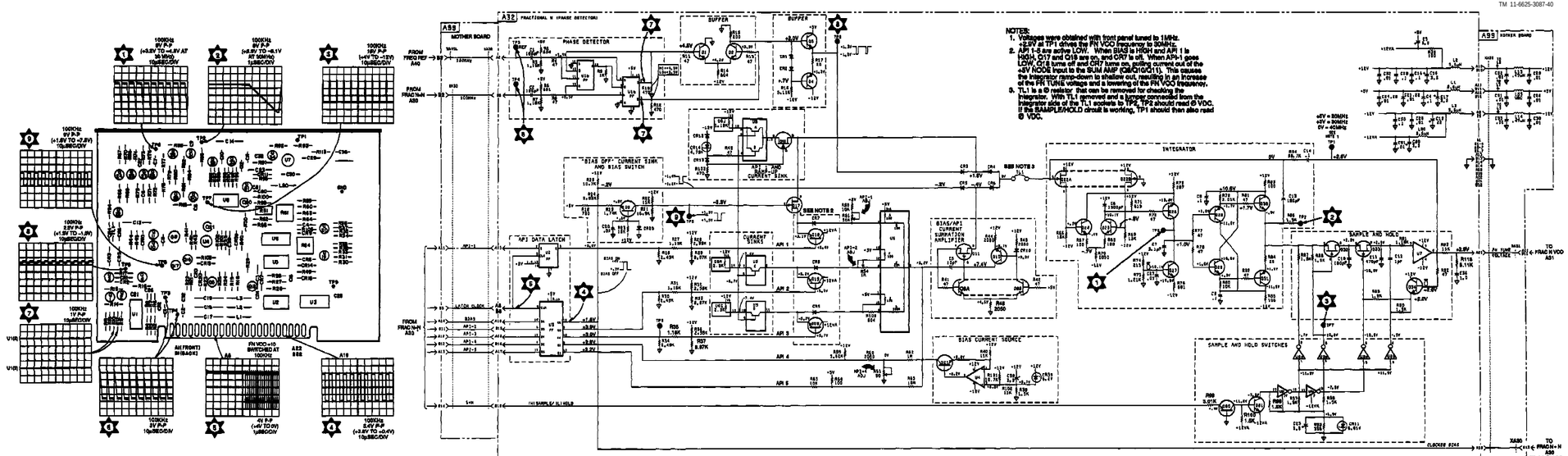


Figure FO-15. A32 Fractional N Phrase Detector Schematic Diagram

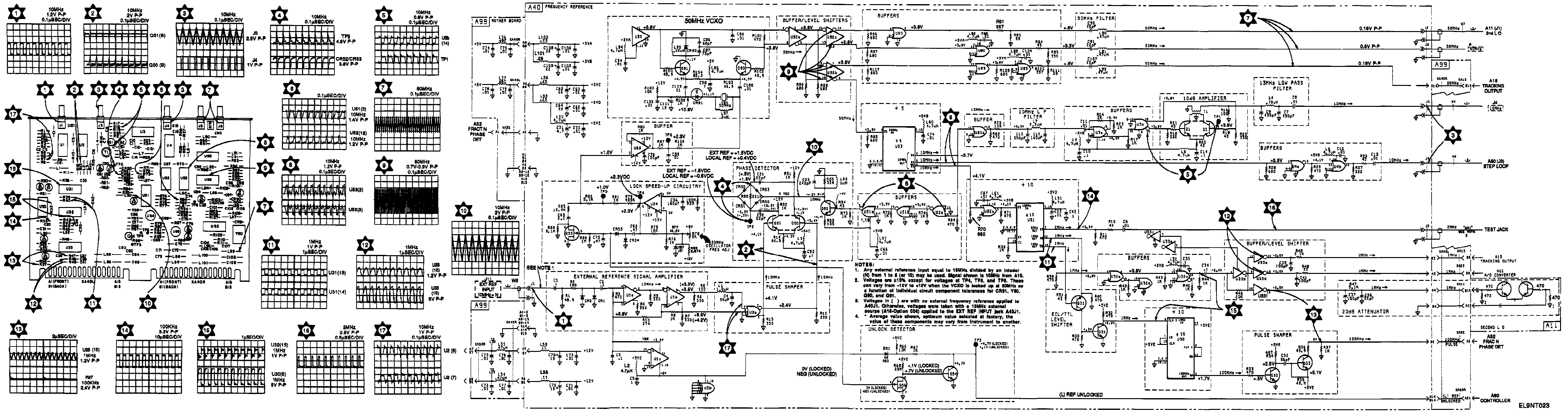
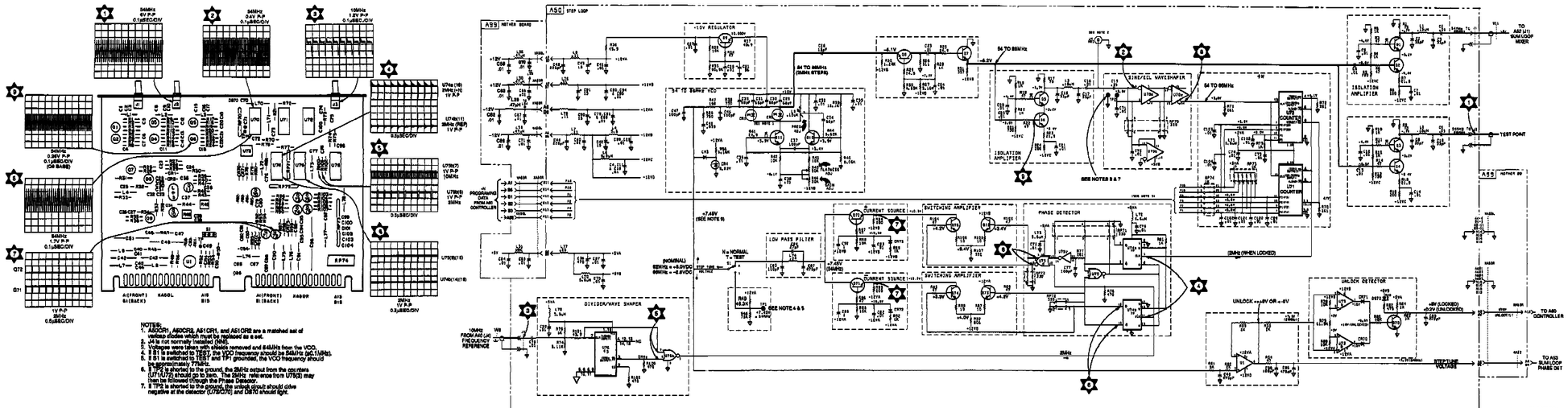
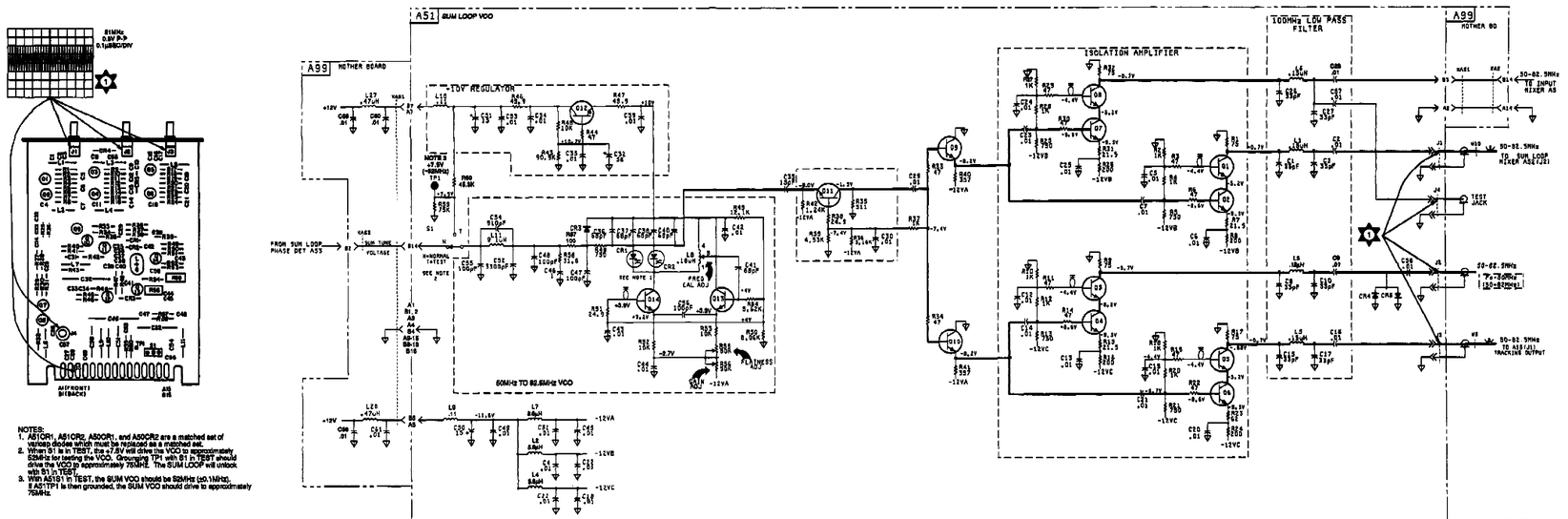


Figure FO-16. A40 Frequency Reference Schematic Diagram.



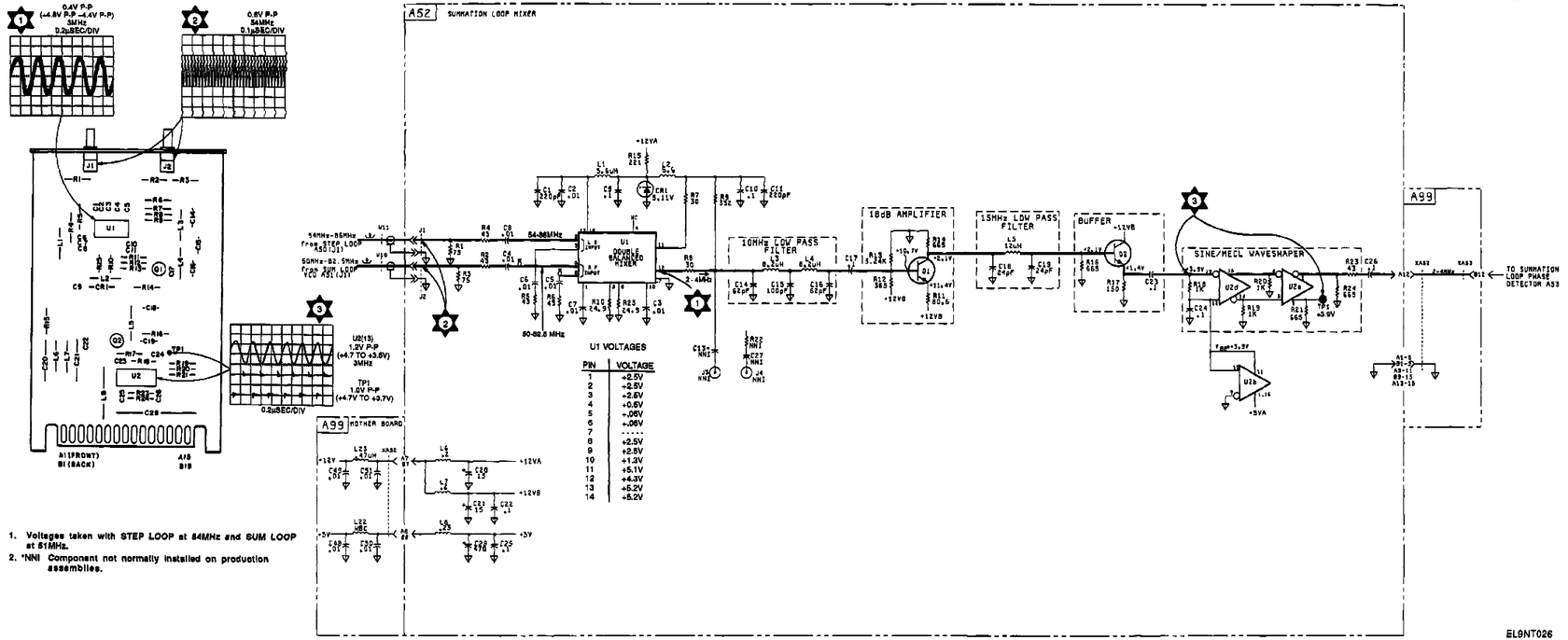
NOTES:
1. A5D(CR1, A5D(CR3, A5(1CR1, and A5(1CR2 are a matched set of varicap diodes which must be replaced as a set.
2. J4 is not normally installed (NAR).
3. Voltages were taken with shields removed and 64MHz from the VCO.
4. If S1 is switched to TEST, the VCO frequency should be 64MHz (NO.1MHz).
5. If S1 is switched to TEST and TP1 grounded, the VCO frequency should be approximately 77MHz.
6. If TP2 is shorted to the ground, the 5MHz output from the counters (U71-U73) should go to lock. The 5MHz reference from U75(8) may then be followed through the Phase Detector.
7. If TP3 is shorted to the ground, the unlock circuit should drive negative at the detector (U75(5,6)) and D870 should light.

Figure FO-17. A5D Step Loop Schematic Diagram.



NOTES:
1. A51CR1, A51CR2, A50CR1, and A50CR2 are a matched set of varicap diodes which must be replaced as a matched set.
2. When S1 is in TEST, the +7.5V will drive the VCO to approximately 82MHz for testing the VCO. Grounding TP1 with S1 in TEST should drive the VCO to approximately 75MHz. The SUM LOOP will unlock with S1 in TEST.
3. With A51S1 in TEST, the SUM VCO should be 82MHz (±0.1MHz). If A51TP1 is then grounded, the SUM VCO should drive to approximately 75MHz.

Figure FO-18. A51 Summation Loop VCO Schematic Diagram



1. Voltages taken with STEP LOOP at 84MHz and SUM LOOP at 51MHz.
2. *NNI Component not normally installed on production assemblies.

Figure FO-19. A52 Summation Loop Mixer Schematic Diagram

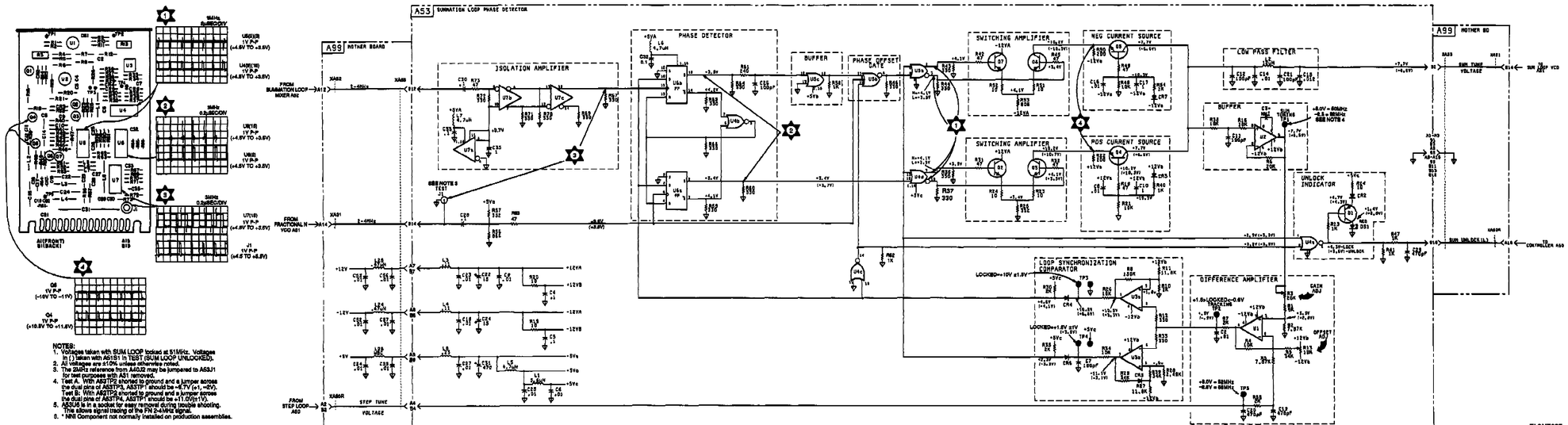


Figure FO-20. A53 Summation Loop Phase Detector Schematic Diagram.

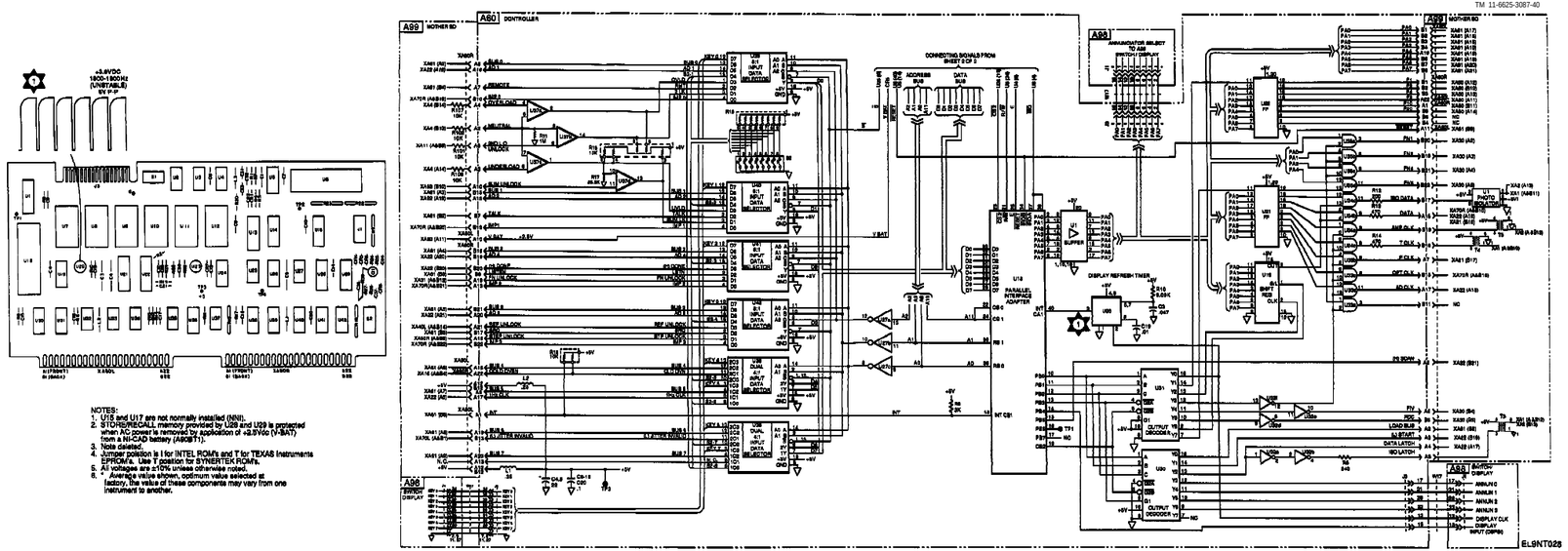


Figure FO-21. A60 Controller Schematic Diagram (Sheet 1 of 2).

NOTES:
1. U16 and U17 are not normally installed (NNI).
2. STORE/RECALL memory provided by U29 and U39 is protected when AC power is removed by application of +2.5 Vdc (Y-BAT) from a NI-CAD battery (A60BT1).
3. Note deleted.
4. Jumper position is I for INTEL ROMs and T for TEXAS Instruments EPROMs. Use T position for SYNERTEK ROMs.
5. All voltages are ±10% unless otherwise noted.
6. * Average value shown, optimum value selected at factory, the value of these components may vary from one instrument to another.

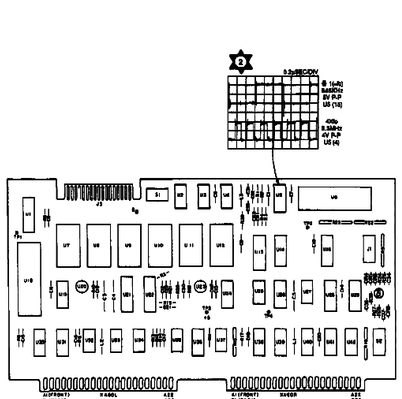


Figure FO-21. A60 Controller Schematic Diagram (Sheet 2 of 2).

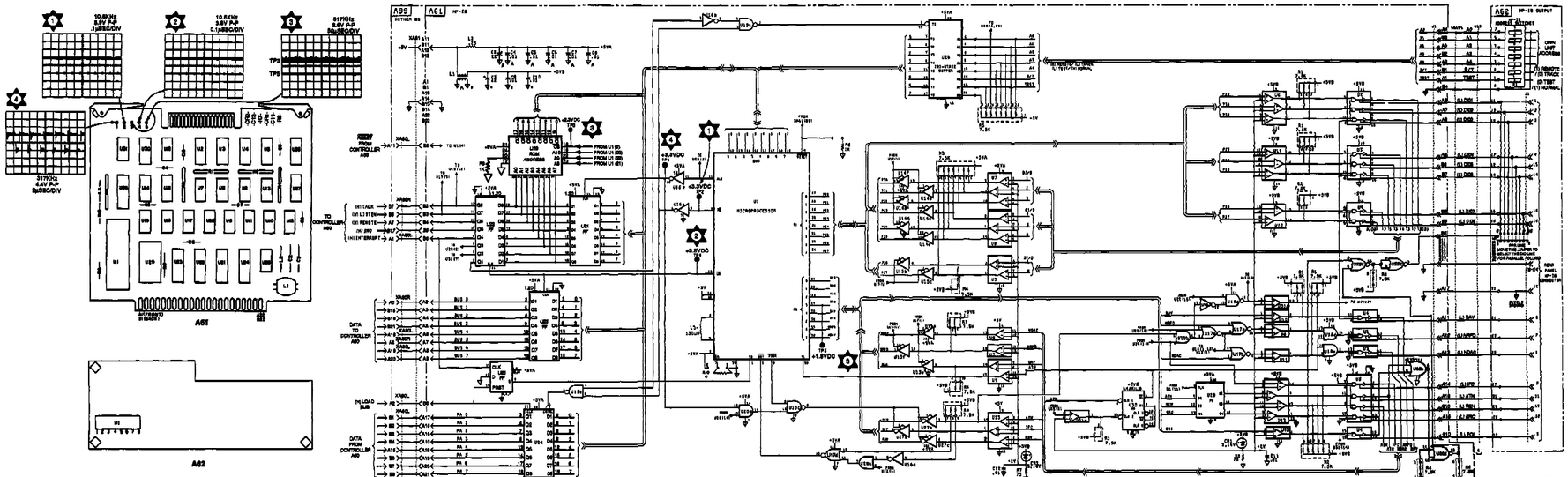


Figure FO-22. A61/A62 HP Interface Schematic Diagram.

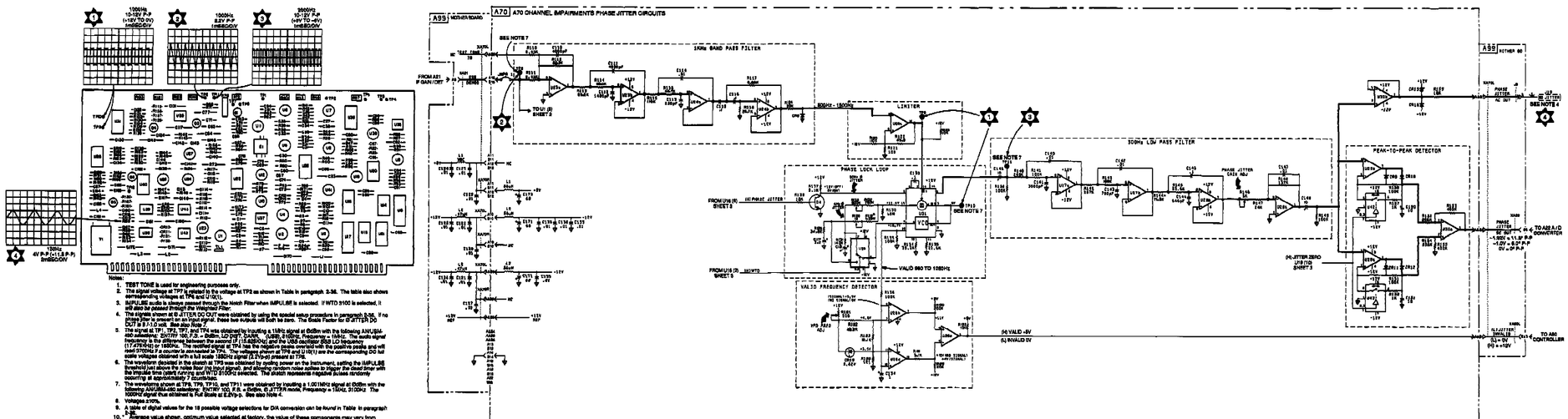


Figure FO-23. A70 Impairments B Schematic Diagram (Sheet 1 of 3).

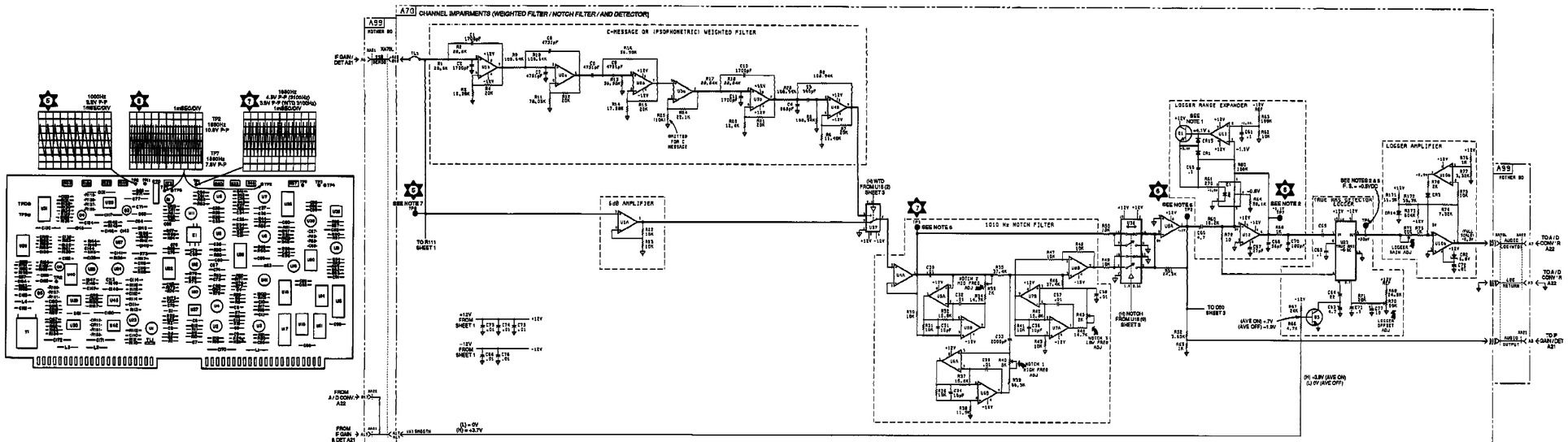
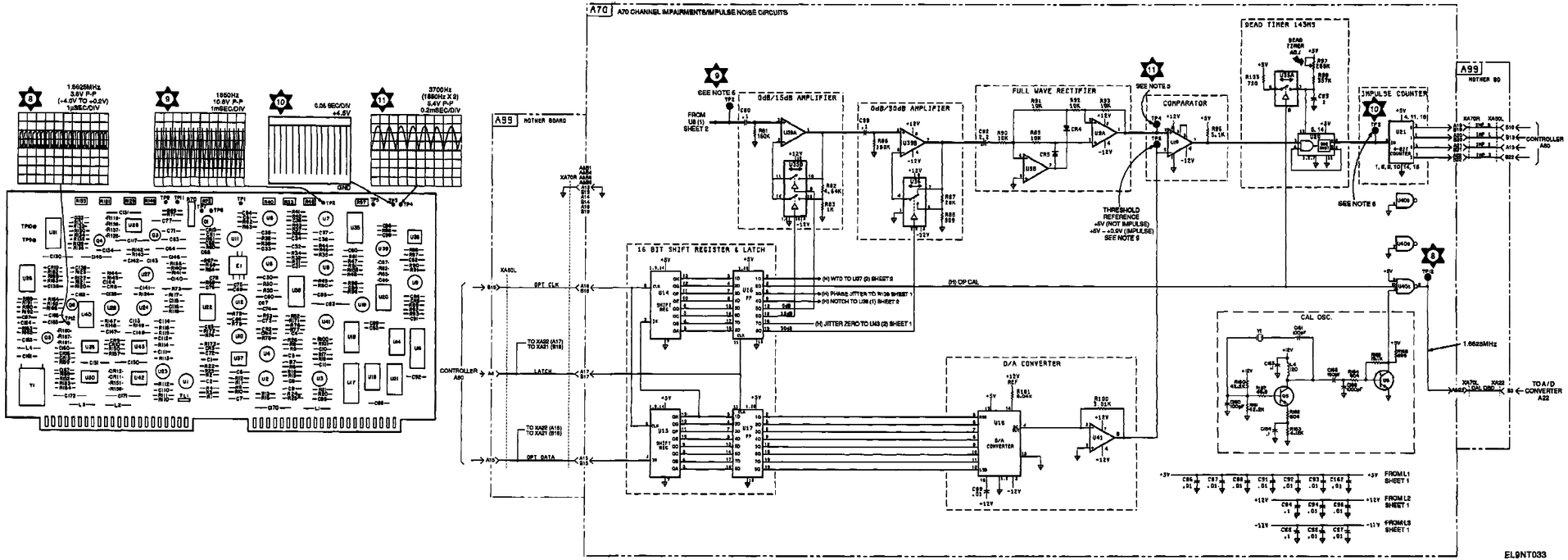


Figure FO-23. A70 Impairments B Schematic Diagram (Sheet 2 of 3).



igure FO-23. A70 Impairments B Schematic Diagram (Sheet 3 of 3).

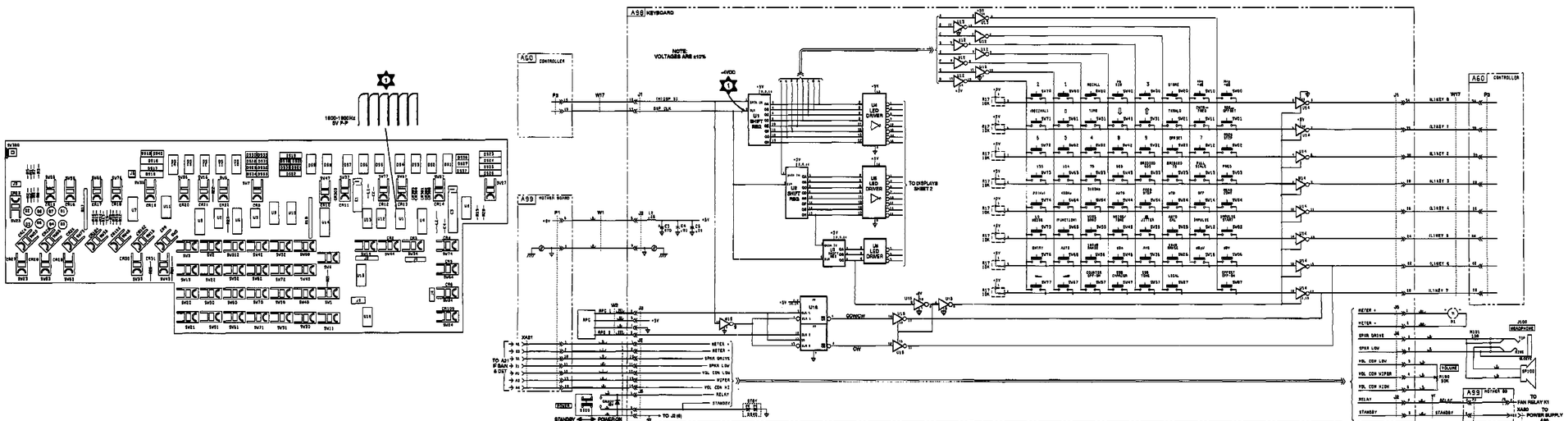


Figure FO-24. A98 Display/Keyboard Schematic Diagram (Sheet 1 of 2)

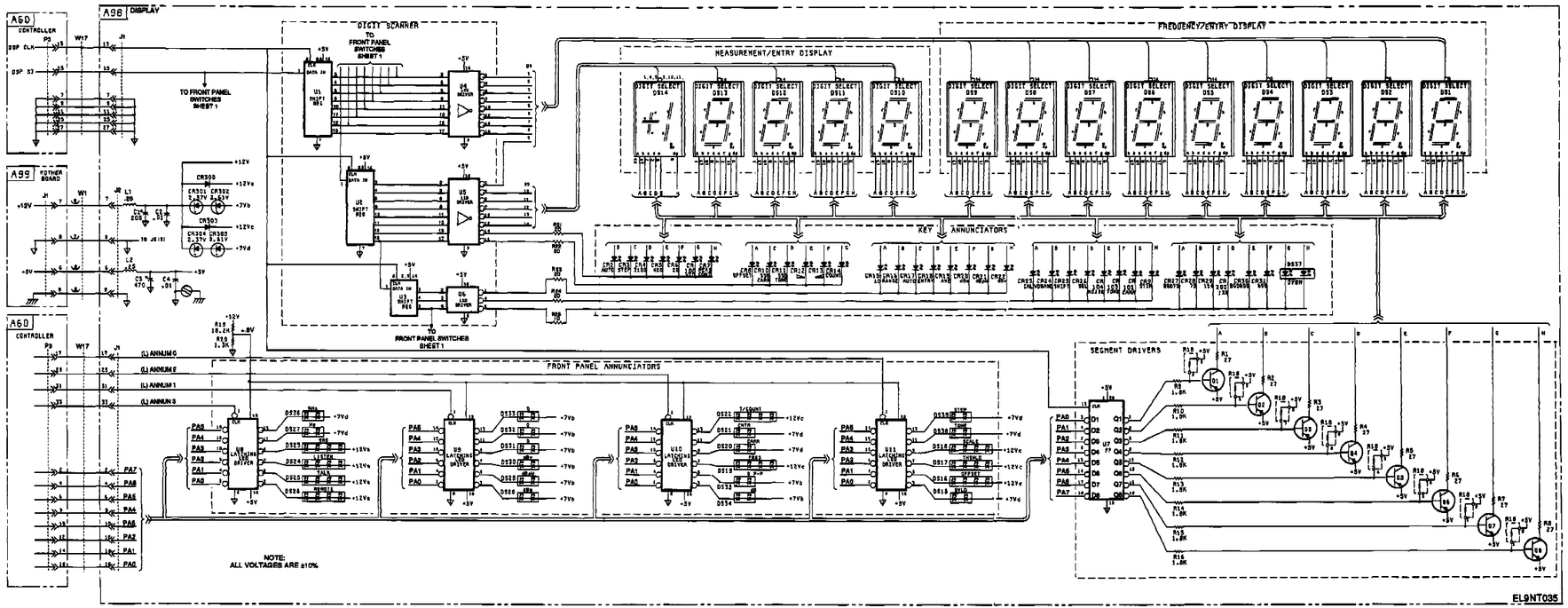
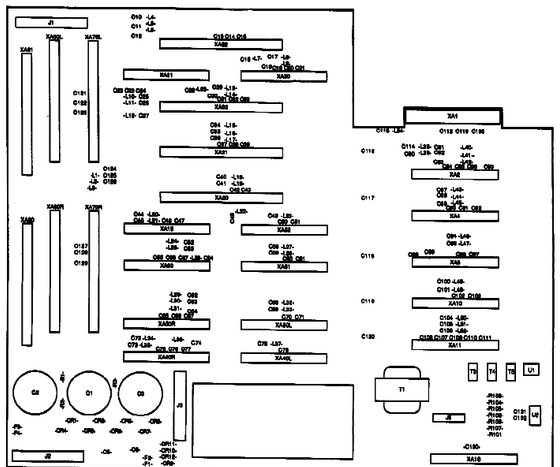


Figure FO-24. A98 Display/Keyboard Schematic Diagram (Sheet 2 of 2).



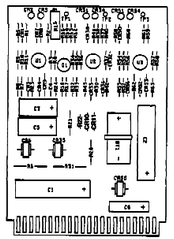


Figure FO-25. A80 Power Supply/A99 Motherboard Schematic Diagram.

PIN: 060988-00