INSTRUCTION MANUAL

nelson · ross electronics

A DIVISION OF POLARAD ELECTRONICS CORP
5 DELAWARE DRIVE LAKE SUCCESS, NEW YORK, 11040

MODEL PSA 321

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MODEL PSA 321

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MODEL PSA-321

SECTION 1

GENERAL INFORMATION

SCOPE

This manual provides Technical Characteristics, Theory of Operation, Operating Instructions, Maintenance Instructions and Re ir Procedures for the Nelson-Ross VHF/UHF Plugin Spectrum Analyzer Model PSA 321.

CHARACTERISTICS

The Nelson-Ross Spectrum Analyzer, Model PSA-321 is designed so that it may be conveniently plugged into any Tektronix 561 or 564 oscilloscope. Installation of the plugin, immediately converts the oscilloscope into a complete spectrum analyzer. All voltages and power are automatically obtained from the oscilloscope when the analyzer is inserted.

The Model PSA 321 covers the broad frequency range of 1 mc to 300 mc. A wide range of dispersions from 100 kc to 100 mc are provided as well as a Full Scan of 300 mc. If Bandwidths from 5 kc to 100 kc are readily selectable from a front panel switch. High sensitivity, flat responses, high stability and high spurious rejection are inherently characteristic of the PSA 321 which features complete solid state construction including the swept local oscillator. This model also possesses such other features as: linear, 60 db log and 13 db square law displays; 51 db IF attenuator and 40 db IF gain; video filtering; and both horizontal and vertical outputs.

TECHNICAL SPECIFICATIONS

SPECIFICATIONS	PSA 321
CENTER FREQUENCY RANGE	1 mc to 300 mc
CALIBRATED TUNING DIAL RANGE	CENTER: 0 to 300 mc VERNIER: ± 5 mc
TUNING DIAL ACCURACY	± 5%
SCAN WIDTH	Eight positions selectable with front panel switch 1. 10 kc/cm 2. 50 kc/cm 3. 100 kc/cm 4. 500 kc/cm 5. 1 mc/cm 6. 5 mc/cm 7. 10 mc/cm 8. Full Scan: 30 mc/cm
DISPERSION ACCURACY	± 10%
RESOLUTION /IF BANDWIDTH	Automatically programmed with Scan Width, in the AUTO position. Uncoupled: 5, 10, 20, and 100 KC, selectable with front panel switch
SENSITIVITY (5 kc IF Bandwidth)	-90 dbm
VERTICAL DISPLAYS	Linear: 60 db logarithmic; 13 db Square Law; Selectable with front panel switch
DISPLAY FLATNESS	± 2 db
INPUT POWER (Maximum)	-20 dbm
INPUT IMPEDANCE	50 ohms; BNC type connector on front panel
IF ATTENUATOR	51 db range in 1 db steps; ± 0.1 db/db
IF GAIN	40 db (Nominal) Continuously variable with front panel control
IF FREQUENCY	First: 500 mc; Second: 65 mc; Third: 10.7 mc
SWEEP RATES	1 cps to 30 cps

DISTORTION DYNAMIC RANGE	Harmonics and IM products at least 46 db below two equal full scale signals
DISPLAY DYNAMIC RANGE	60 db (5, 10, 20 kc resolution)
VIDEO FILTER	1 millisecond. Selectable with front panel switch
HORIZONTAL & VERTICAL OUTPUTS	0 to 1 volt from 1000 ohms maximum DC coupled at ground; connectors on front panel
COMPATIBLE OSCILLOSCOPES	Tektronix 560 series or equivalents
POWER REQUIREMENTS	All power and voltages from oscillo-scope

SECTION 2

THEORY OF OPERATION

Before operating a NELSON-ROSS Plugin Spectrum Analyzer, it is important to have a clear understanding of the nature of the spectral display and an interpretation of the data it will provide. Used conventionally, the purpose of an oscilloscope is to present a visual display of an electrical signal, presenting the amplitude with respect to time. In such a presentation, the horizontal axis of the cathode-ray represents time and the vertical axis represents instantaneous amplitude. An equally meaningful display, commonly called a spectral display, is one in which the horizontal axis represents frequency and the vertical axis represents RMS amplitude. This is the type of display provided by NELSON-ROSS Plugin Spectrum Analyzers.

SPECTRAL DISPLAYS

The nature of the spectral displays can be understood with the aid of the following illustrative examples:

Single Frequency, Idealized

An ideal spectrum analyzer, will display a signal containing energy at only one frequency as a single vertical line. This is illustrated in Figure 2-1A.

Multiple Frequencies, Idealized

Multiple signals would appear as multiple vertical lines, however close in frequency they may be. A carrier modulated by sidebands at plus and and minus a small frequency increment would thus appear as shown in Figure 2-1B.

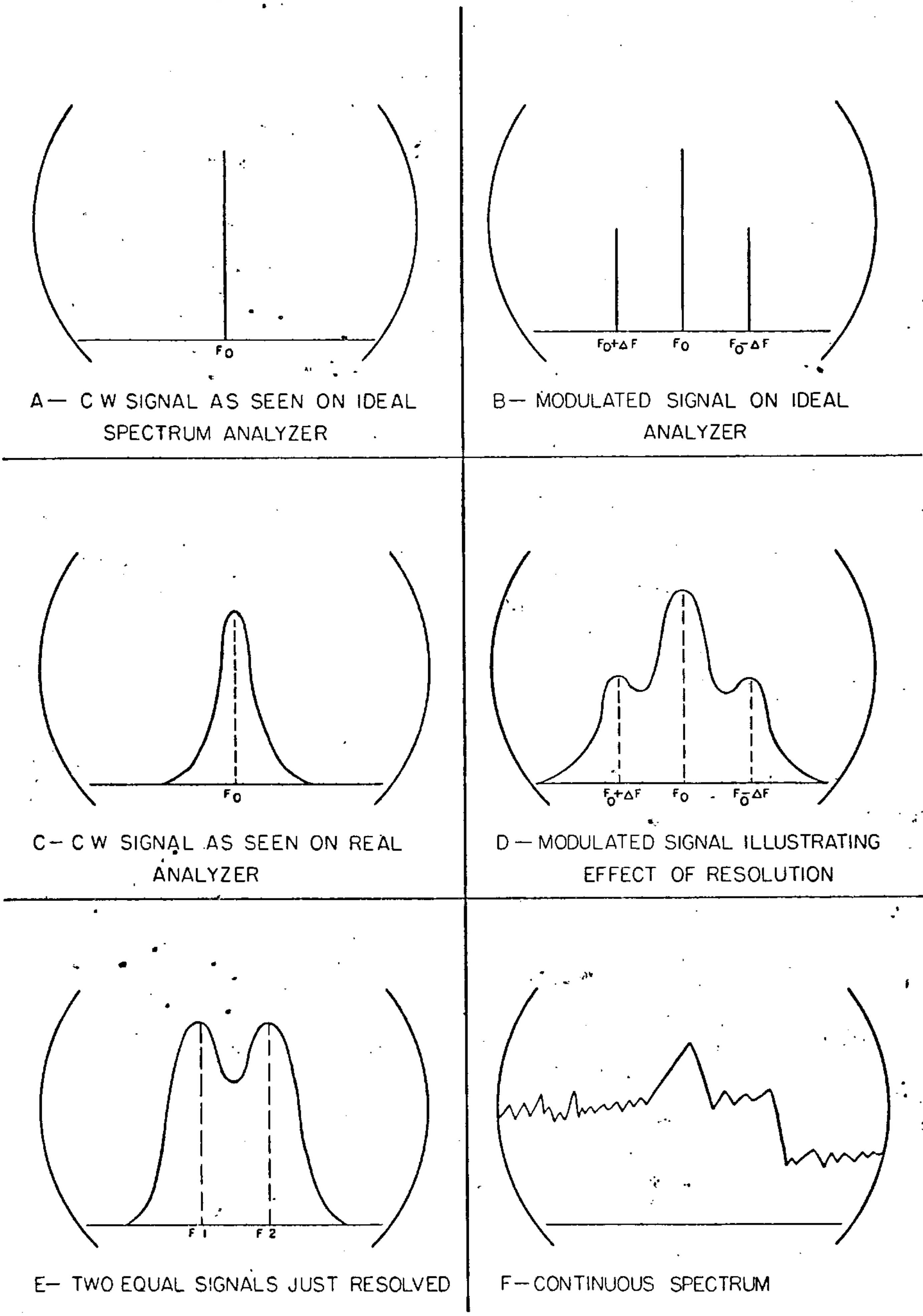


FIGURE 2-1
SPECTRAL DISPLAY CHARACTERISTICS

Single and Multiple Frequency Displays

An actual spectrum analyzer, however, cannot present an infinitely narrow vertical line. Instead the signal is broadened into a pulse as shown in Figure 2-1C. Similarly, multiple signals, closer together than the width of the pulse, will tend to blend as in Figure 2-1D. This illustrates a basic spectrum analyzer parameter which must be considered, resolution. The smallest frequency difference, between two equal amplitude signals, which can be displayed is defined as the resolution of the analyzer. Two equal amplitude signals are considered resolved when they are far enough apart to cause a 3 db dip to appear between them. This is illustrated in Figure 2-1E.

Continuous Spectrum

Signals containing frequency components spaced closer than the resolution of the analyzer generate a continous spectrum, as illustrated in Figure 2-1F.

Parameters

There are three basic parameters of a spectrum analyzer display.

Resolution - Defined in the previous paragraphs as the proximity of two adjacent frequencies which can be separated (by a 3 db dip) in the display

Scan Width - The width of the display (in kc/cm or mc/cm) on the cathode-ray tube

Scan Time - The amount of time taken to scan the Scan Width mentioned above

S ince these three parameters are interrelated it is important to understand the manner in which they effect one another. Scan Time and Scan Width may be combined to produce a factor called Sweep Rate (cycles per second per second) which may not be exceeded for any given resolution. Expressed mathamatically:

$$\frac{\text{Scan Width}}{\text{Scan Time}} \leq (K)\ \text{Resolution}$$

If this relationship is violated, either by reducing the Scan Time (increasing sweep speed) or by increasing the Scan Width, the signal will smear and lose amplitude.

This is an important point to remember - contrary to conventional oscilloscope operation with a spectrum analyzer slower sweep speeds produce better displays. Since NELSON-ROSS Plugin Spectrum Analyzers fit oscilloscopes with high sweep speed capabilities, the operator must remember to reduce the sweep speed suficiently to obtain a good display. As a rule of thumb, the upper limit for any spectrum analyzer is 10-30 sweeps/second.

AMPLITUDE MEASUREMENTS

The relationships mentioned above are of particular importance when making relative amplitude measurements. If the Scan Time, Scan Width or both are varied during a measurement - e.g. while searching for a harmonic or spurious signal - the sensitivity may vary.

It is advisable, therefore, to reduce the Scan Width (or increase Scan Time) until the signal amplitude is no longer attenuated by these effects before taking readings. As the Scan width is reduced (or the Scan Time increased) the amplitude of the component under observation will increase until a point is reached where further changes have no effect. At this point a reading of amplitude may be taken.

Utilization of Sweep Speeds recommended in the Technical Specifications section of the manual will assure optimum performance.

SECTION 3

OPERATING INSTRUCTIONS

UNPACKING AND INSPECTION

A careful inspection of the unit should be made immediately after it is unpacked. Look for obvious indications of any physical damage which may have been sustained during shipping. All crystals should be firmly seated and connectors tightly mated.

INSTALLATION OF THE PLUGIN

Insert the plugin unit into any oscilloscope listed in this manual Turn the lock knob (at the bottom center of the analyzer panel) clockwise to secure the unit. Insert a vertical amplifier plugin in the horizontal compartment of the oscilloscope. Connect a short shielded cable (BNC to BNC or BNC to UHF, as required from the H OUT of the analyzer to the vertical amplifier input. Turn the oscilloscope power on and allow both instruments to warm-up (the complete solid state plugin analyzer requires no warm-up, but the oscilloscope requires about 10 minutes).

INITIAL ADJUSTMENTS

Certain initial adjustments must be performed when installing the plugin analyzer for the first time. The initial adjustments must be made so that true representations of control functions will be possible.

Set the Plugin Spectrum Analyzer controls as follows:

CENTER FREQUENCY	0 MC
VERNIER TUNING	0 MC
SCAN WIDTH	FULL SCAN (30 MC/CM)
RESOLUTION	100 KC
DISPLAY	LIN
VIDEO FILTER	OFF
IF ATTENUATOR	IN (51 DB)
IF GAIN	CCW

It will now be possible to obtain a horizontal trace along the bottom graticule line on the oscilloscope screen by adjustment of the V POS control of the analyzer, and the POSITION control on the amplifier plugin. A vertical pip representing the internally generated zero frequency signal will appear at the left of the trace. Position the trace so that the zero signal coincides with the leftmost mark on the CRT graticule and the trace extends along the base line to the furthest mark on the right. Use the amplifier plugin gain controls to set the width of the trace.

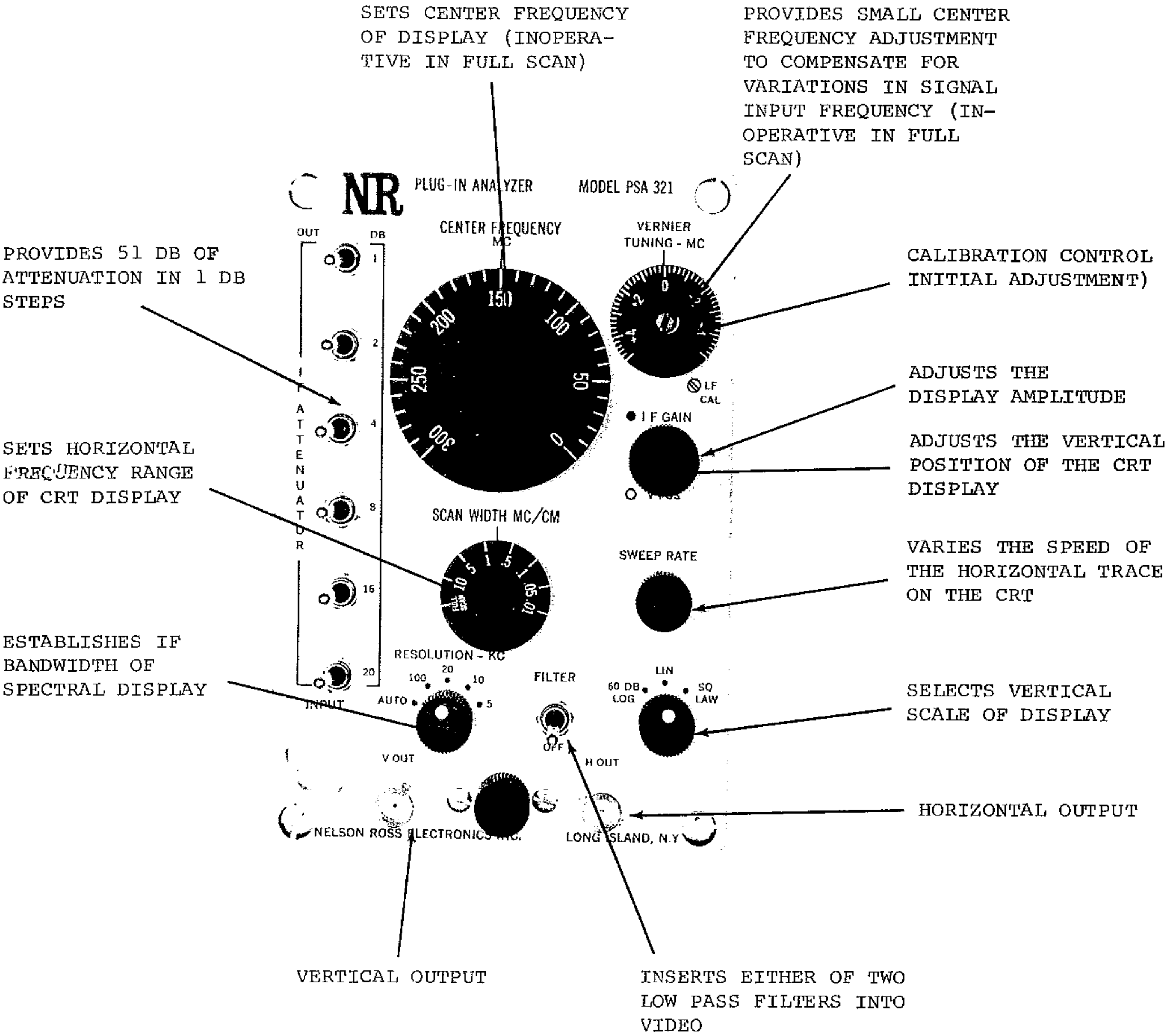
LF CAL AND DISPERSION BAL ADJUSTMENTS - Since the voltages supplied to the analyzer may vary from oscilloscope to oscilloscope, and initial adjustment is required to bring the CENTER FREQUENCY, VERNIER TUNING and SCAN WIDTH dials to the specified accuracy. Set the analyzer's controls as follows:

CENTER FREQUENCY	0 MC
VERNIER TUNING	0 MC
SCAN WIDTH	10 MC/CM
RESOLUTION	100 KC
DISPLAY	LIN
VIDEO FILTER	OFF
IF ATTENUATOR	IN (51 DB)
IF GAIN	CCW

The zero signal will appear on the screen. Using a screwdriver, adjust the LF CALIBRATE potentiometer (concentric with the VERNIER TUNING control) to position the signal directly on the graticule center line. Vary the SCAN WIDTH by switching CCW to .5 mc/cm, making note of the change in position of the zero frequency signal on the screen for each position of SCAN WIDTH. If the position has changed toward the right or left of the graticule center line, return it to the center using the LF CALIBRATE control.

FUNCTION AND OPERATION OF PANEL CONTROLS

In order to obtain the most efficient and accurate performance from any of the NELSON-ROSS Plugin Spectrum Analyzers, it is essential that the function and marking of each of the controls be fully understood. The Model PSA 321 Plugin Spectrum Analyzer may be used in any application where the necessity exists to visually observe signals whose components fall within its



MODEL PSA 321
FRONT PANEL CONTROLS AND FUNCTIONS

FIGURE 3-1

frequency range of 1 to 300 mc. With this instrument, it is possible to measure the relative amplitudes as well as the absolute values of each of the various components which make up a complex signal.

The spectrum analyzer is designed so that its basic operating characteristics may be adjusted to provide the parameters required for analysis of the desired signals. These parameters are adjusted through the use of the panel controls, which are displayed in Figure 3-1.

CENTER FREQUENCY AND VERNIER TUNING

Adjustment of these controls centers the signal being observed on the oscilloscope screen. Please note that these controls are operative for all positions of SCAN WIDTH except FULL SCAN (30 mc/cm. The CENTER FREQUENCY control is calibrated from 0 to 300 mc at 10 mc increments. The VERNIER TUNING control provides a calibrated vernier from -5 mc to + 5 mc.

SCAN WIDTH

The position of this control adjusts the scan width (bandwidth) of the screen display. This eight position switch, located to the left of the CENTER FREQUENCY control, provides SCAN WIDTHS of .01 mc/cm; .05 mc/cm; .1 mc/cm; .5 mc/cm; 1mc/cm; 5 mc/cm; 10 mc/cm; and FULL SCAN (30 mc/cm). In the FULL SCAN position, the

CENTER FREQUENCY and VERNIER TUNING controls are inoperative and the entire frequency band of the analyzer, 0 to 300 mc is displayed.

RESOLUTION

This control, centrally located on the panel, provides five selections of resolution; namely: 5, 10, 20, 100 KC and AUTO. Resolution is provided by an adjustable bandwidth RF filter in the last IF amplifier. Resolution is defined as the ability of the instrument to distinguish between two adjacent signals. Two such signals (of equal amplitude) are considered resolved if a 3 db dip appears between them. In use, the appearance of the display determines the setting of this switch. Too high a resolution will cause a great loss in sensitivity, while too low a value will result in a smeared display with beat-modulation riding on the trace. With this control set in the "AUTO" position, resolution is automatically programmed with the SCAN WIDTH control to provide an optimum display and to avoid the need for constant readjustment of the resolution control when changing scan widths.

DISPLAY

This switch, located at the lower right-hand corner of the panel, provides three vertical scale functions:

60 DB LOG - In this display mode the vertical scale of the instrument is logarithmic. Relative to a full scale signal (0 DB). Each 1/6 of the vertical scale is approximately 10 DB. Thus, a signal 30 DB down from full scale will be ½ scale. A signal 60 DB down is just visible as a small (1/6 cm) deflection on the baseline.

LIN - In this display mode the vertical deflection produced by the signal is directly proportional to the input voltage (the bottom ¼ of this scale will be non-linear due to the extremely low levels encountered).

SQUARE LAW - In this display mode the vertical deflection produced by the signal is directly proportional to the input power. Thus, two signals differing by 3 db will appear 2:1 in amplitude on the screen.

VIDEO FILTER

This switch permits the operator to insert a low-pass filter into the vertical deflection amplifier to filter out noise, etc.

IF ATTENUATOR

A six switch step attenuator providing 51 db of attenuation in 1 db steps; this attenuator is useful for making relative amplitude measurements. The use of this attenuator when the instrument is in 60 db LOG will limit the available vertical display, since the combination of 60 DB of compression and 51 db of attenuation will produce a range between noise and maximum input of

111 db. This would require a maximum input of about +10dbm, an uncreasonably high level. This attenuator is primarily for use in LIN and SQUARE LAW position.

IF GAIN

This variable control provides nominally 40 db of IF gain so that full screen signals can be set up and relative amplitude measurements carried out.

INPUT JACK

The signal input jack is a BNC type connector. Input impedance is 50 ohms.

H OUT AND V OUT

These front panel output jacks may be used for external monitoring of the spectral display by meters, X-Y recorders or similar devices. Output is 0 to 1 volt (nominal) from 1000 ohms DC coupled at ground.

SECTION 4

EQUIPMENT DESCRIPTION

GENERAL

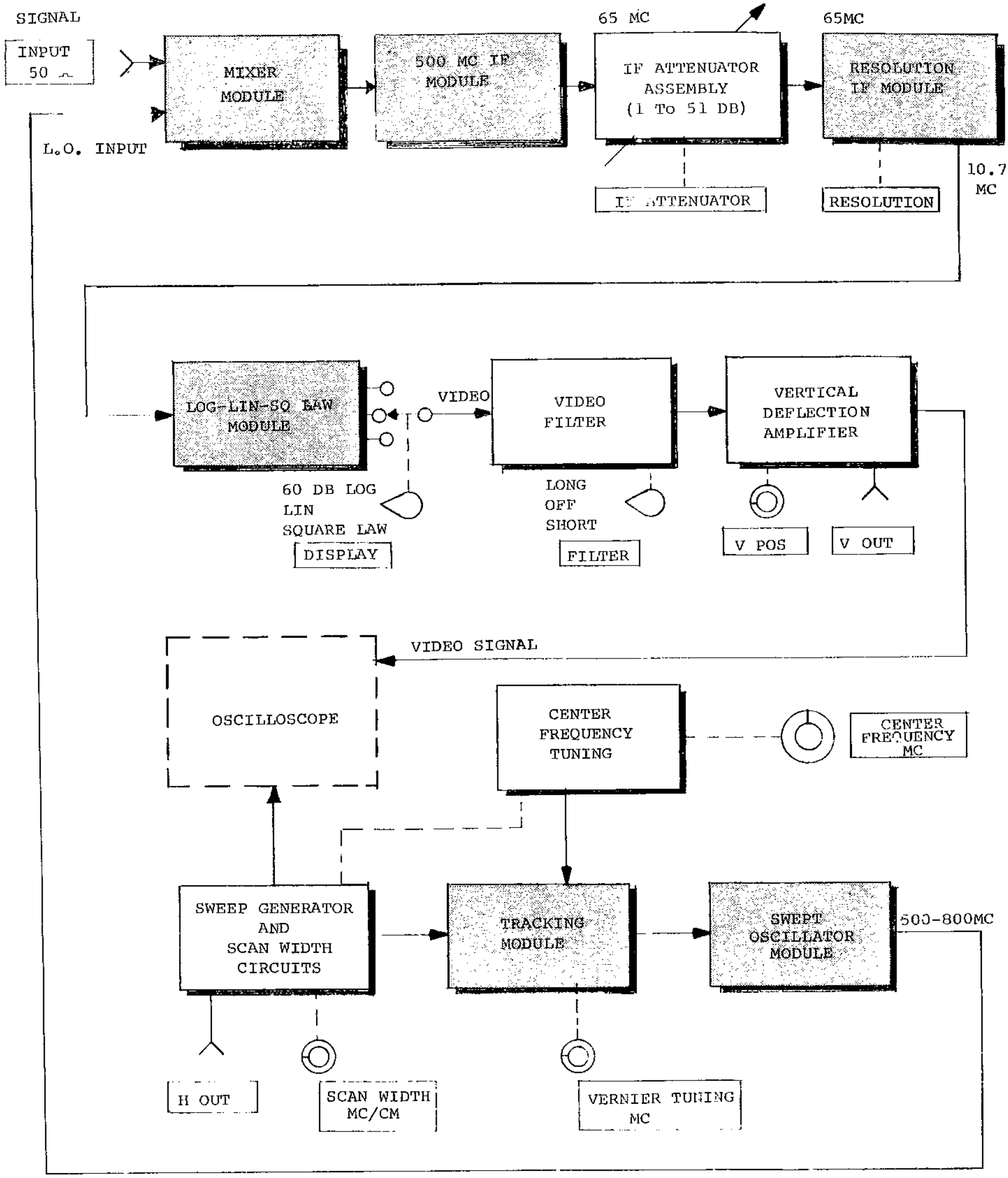
The solid state Model PSA 321 Plugin Spectrum Analyzer covers the range from 1 mc to 300 mc. The analyzer contains a broadband mixer which heterodynes the input signal with the internal local oscillator, producing an IF signal at 500 mc. A 500 mc IF system with subsequent amplifiers at 65 mc and 10.7 mc, provides gain, while a crystal filter acts as the resolution element. Linear, logarithmic, and square law amplifiers provide vertical deflection for the oscilloscope while the oscilloscope's sawtooth output to the internal local oscillator provides the horizontal sweep. As a result, the oscilloscope displays the spectrum of the input signal. The relatively high frequency of the first IF allows dispersion or scanwidths up to 300 mc.

Figure 4-1 is a block diagram of the Model PSA 321 analyzer. This unit consists of an instrument frame and six modular electronic subassemblies. Blocks representing the six modules are shaded. All other elements shown are considered part of the Instrument Frame.

The Scan Width switch is essentially a calibrated attenuator which controls the sawtooth level to provide the various specified SCAN WIDTH or dispersion. In the FULL SCAN position of the SCAN WIDTH switch the CENTER FREQUENCY control is disconnected and a fixed voltage corresponding to mid-band is applied, resulting in a full scan display.

The sawtooth is generated by a Miller sweep generator-flip-flop combination located on the frame printed circuit board.

The output of the 500 MC IF MODULE passes through the IF ATTENUATOR, a panel mounted six element toggle switch attenuator (see schematic drawing contained within Section 6 of this manual), and is fed into the RESOLUTION IF MODULE. Within this module the signal is converted down to 10.7 mc and filtered to provide the resolution characteristics of the analyzer. A complete circuit description of the RESOLUTION IF MODULE is contained within Section 6 of this manual. The 10.7 mc output is impressed upon the input of the LOG-LIN SQ LAW MODULE. A complete description of this module is contained within Section 6 of this manual. The module generates 60 db logarithmic, linear or square law video, which are available at the terminals of the DISPLAY switch S3A. The operator may select the desired video signal by positioning the DISPLAY switch in the appropriate position. The output of this swtich is then routed to the Vertical Deflection Amplifier, which is mounted on the instrument frame printed circuit board.



MODEL PSA 321

BLOCK DIAGRAM

FIGURE 4-1

INSTRUMENT FRAME

Figure 4-2 is a schematic drawing of the instrument frame. Figures 4-3 and 4-4 display the left side and right side views of the analyzer respectively.

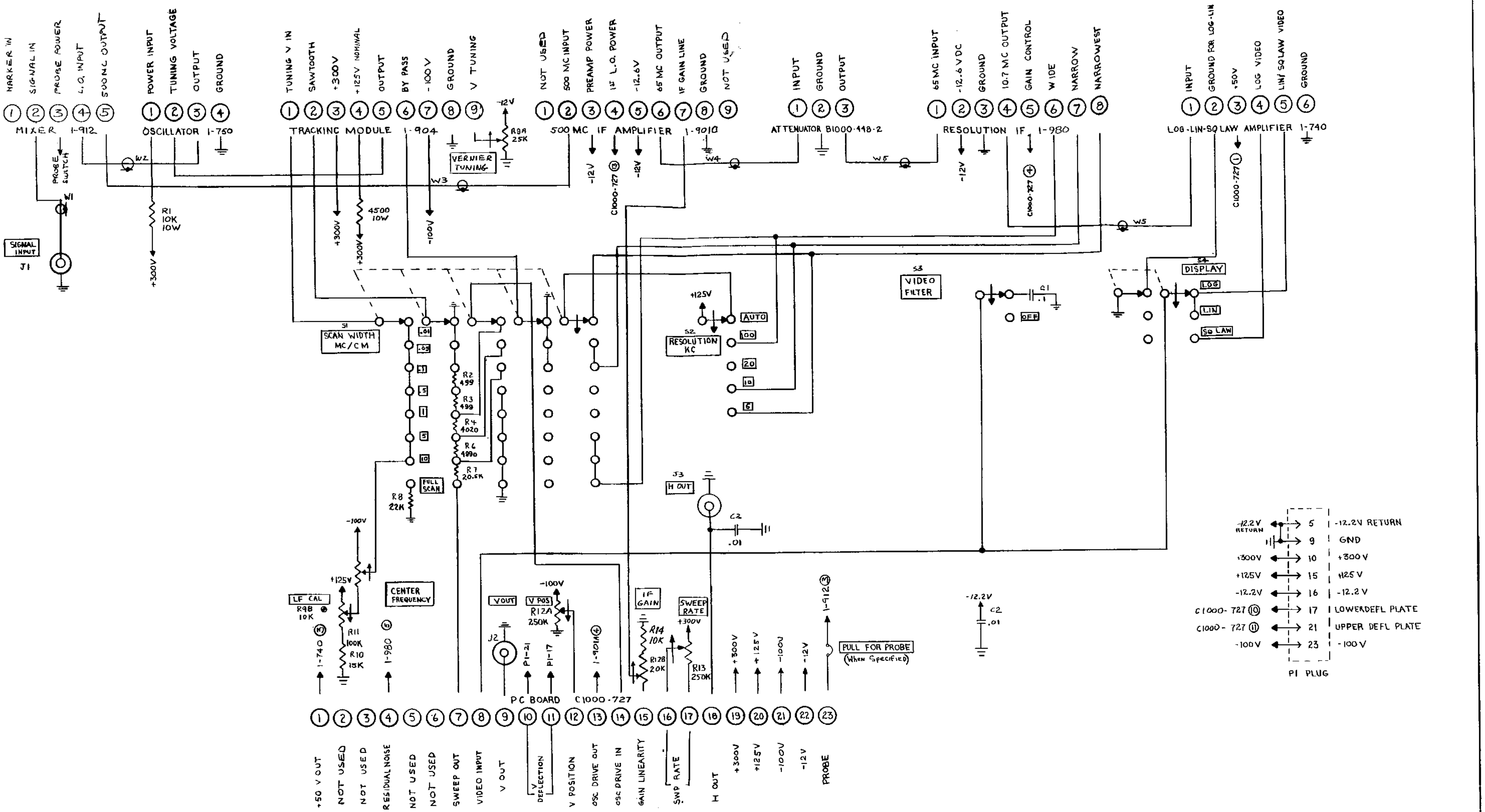
The following elements are mounted on the instrument frame:

1. PANEL CONTROLS
2. INPUT CONNECTOR
3. HORIZONTAL & VERTICAL OUTPUT CONNECTORS
4. CENTER FREQUENCY & VERNIER TUNING CIRCUITRY
5. DISPERSION CIRCUITRY
6. VIDEO FILTER CIRCUITRY
7. IF ATTENUATOR ASSEMBLY
8. VERTICAL DEFLECTION CIRCUITRY
9. POWER SUPPLY & OSCILLOSCOPE LOADS
10. SWEEP CIRCUITRY

Elements 8, 9, 10, are contained on the frame printed circuit board. Figure 4-5 is the schematic and components location drawing for this board.

The instrument frame also houses the following modules:

1. 500 MC IF MODULE
2. RESOLUTION IF MODULE
3. LOG-LIN SQ LAW MODULE
4. TRACKING MODULE
5. SWEPT OSCILLATOR MODULE



NOTES:
1. ALL RESISTORS IN OHMS K=1,000 M=1,000,000
2. ALL CAPACITORS IN MICROFARADS
3. ALL INDUCTANCE IN MICROHENRIES
4. * FACTORY SELECTED VALUE

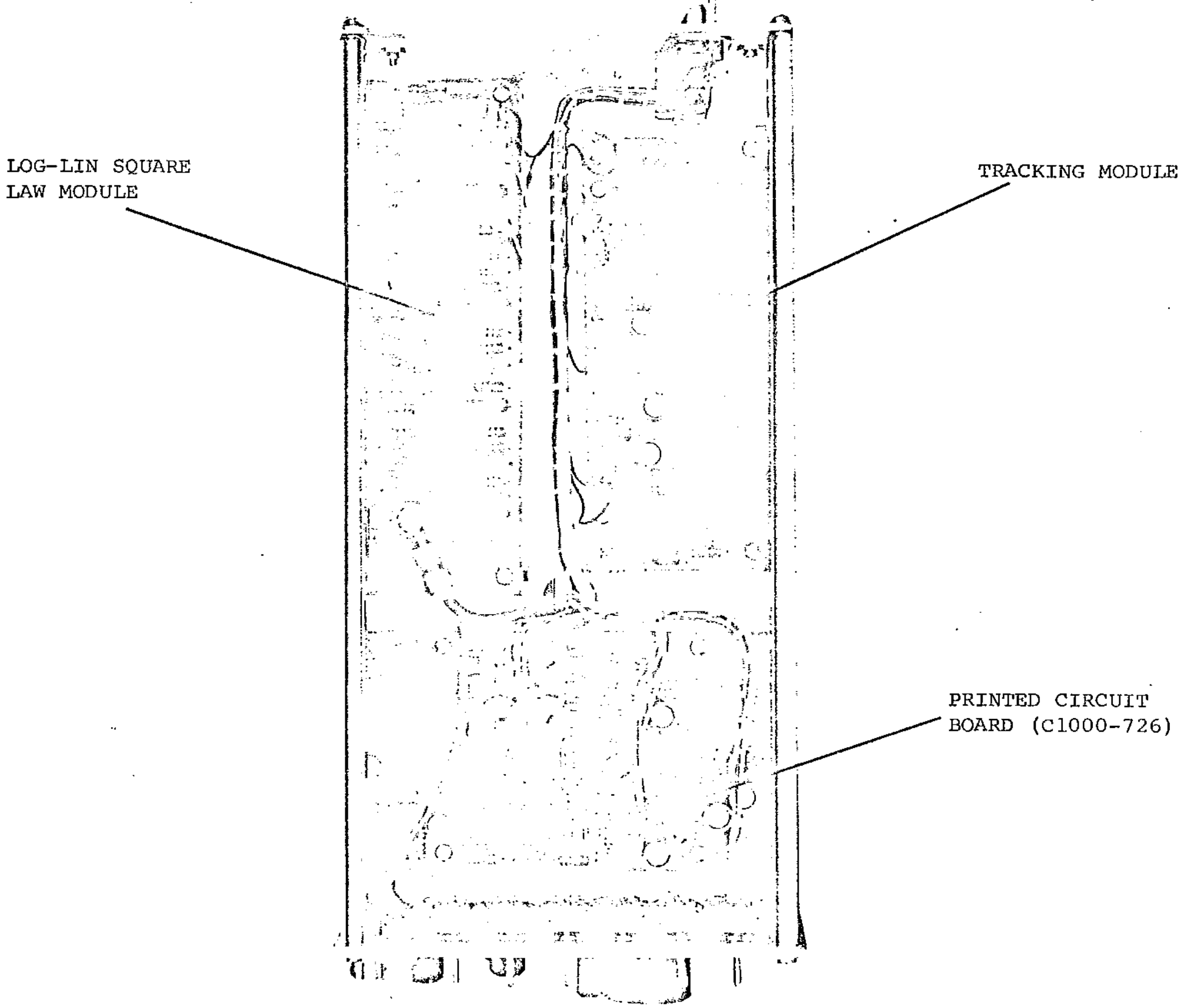
REV	DETAILS	SEQ	BY
A	ADDED 1-912		
B	REC 320	167	
C	REC 346	169	
D	REC 371	ALL	MR

NELSON-ROSS ELECTRONICS, INC. LONG ISLAND, NEW YORK

TITLE: FRAME WIRING 321

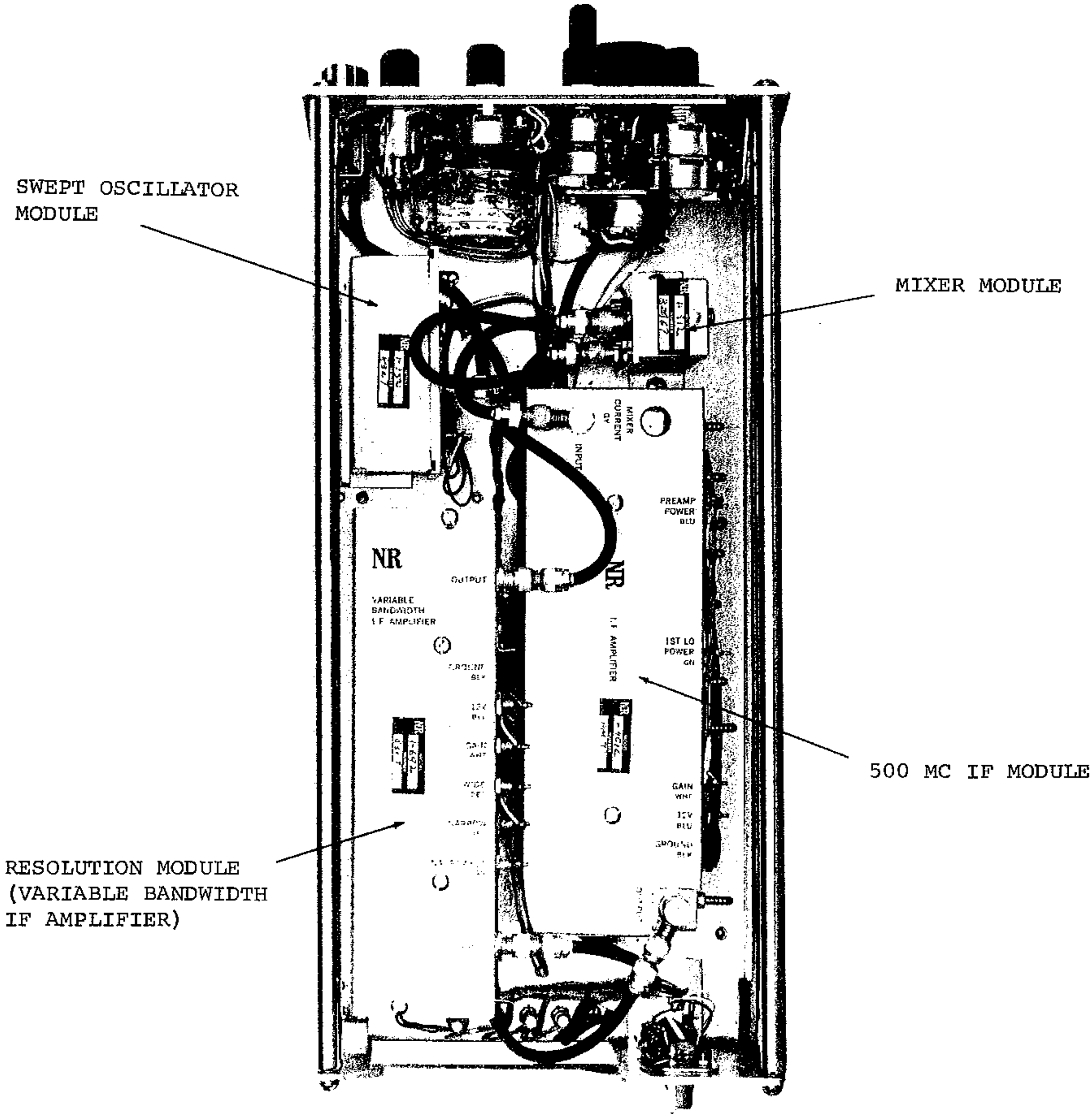
DATE: 12-1-66 DRAWING NO. D1000-726 REV D

FIGURE 4-2



MODEL PSA 321 LEFT SIDE

FIGURE 4-3



MODEL PSA 321 RIGHT SIDE

FIGURE 4-4

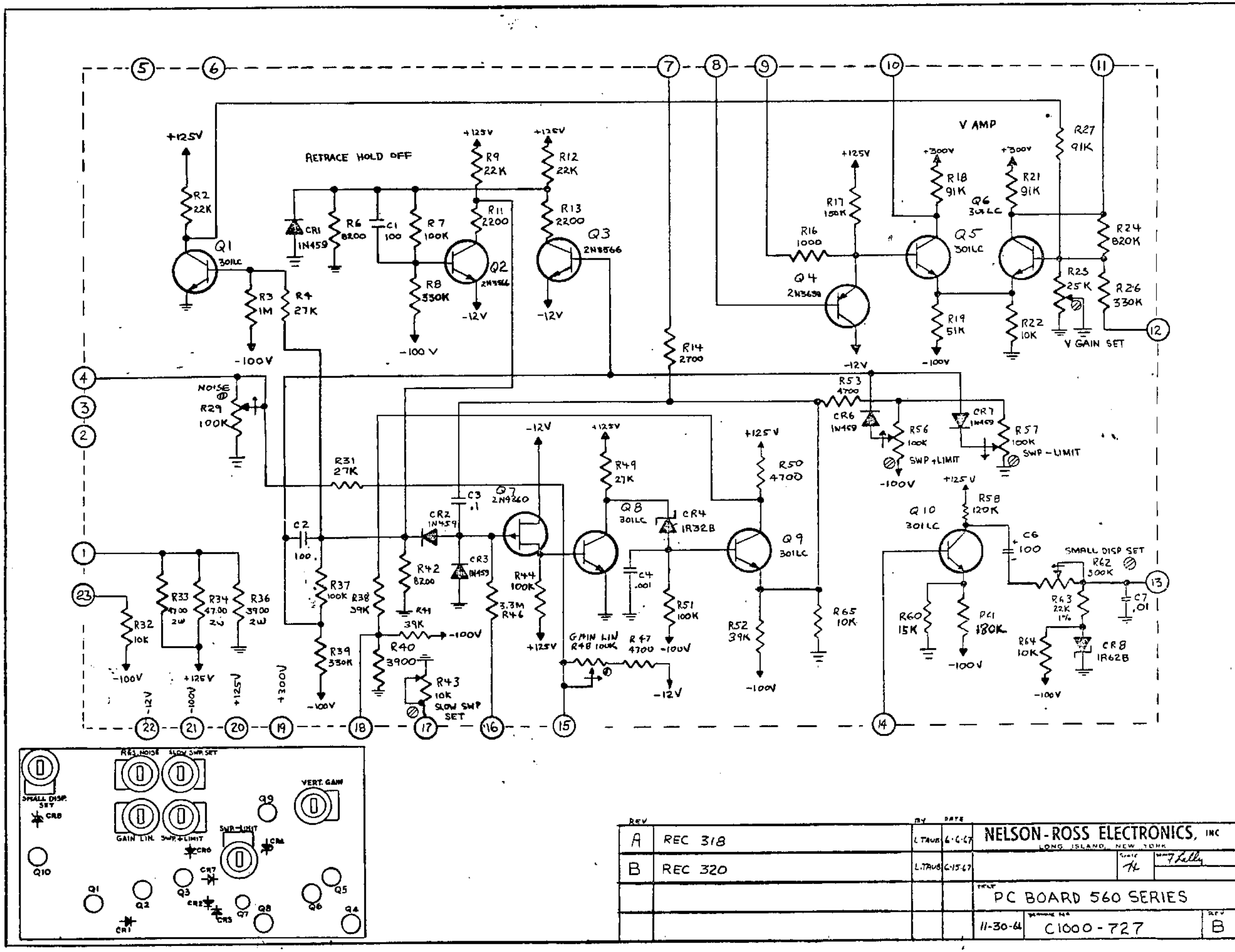

RETRACE HOLD OFF
V AMP
Q1 301LC
Q2 2N3566
Q3 2N3566
Q4 2N3638
Q5 301LC
Q6 301LC
Q7 2N3460
Q8 301LC
Q9 301LC
Q10 301LC
CR1 1N459
CR2 1N459
CR3 1N459
CR4 1R32B
CR6 1N459
CR7 1N459
CR8 1R62B
NOISE R29 100K
SWP+LIMIT
SWP-LIMIT
SLOW SWP SET
GAIN LIN
V GAIN SET
SMALL DISP SET
VERT. GAIN
REV
A REC 318 L.TAUB 6-6-67
B REC 320 L.TAUB 6-15-67
NELSON-ROSS ELECTRONICS, INC
LONG ISLAND, NEW YORK
PC BOARD 560 SERIES
11-30-64
C1000-727
B

FIGURE 4-5

CIRCUIT DESCRIPTION

The input signal is impressed at the SIGNAL INPUT jack (J1), which is a BNC connector on the front panel. This is connected, via coaxial cable, with a broadband mixer. The output of the mixer drives the 500 MC IF MODULE (the operation of all modules are described in detail in Section 6 of this manual). The local oscillator signal for this mixer is derived from the swept oscillator module, which provides a swept signal from 500 to 800 MC. Since the IF MODULE only responds to 500 MC, which must be the difference between the local oscillator and input frequencies, the result is a tuning range of 0 to 300 MC.

The SWEPT OSCILLATOR MODULE is voltage tuned, producing a signal whose frequency is proportional to the voltage impressed on the tuning control terminal. Since the voltage vs. frequency curve is non-linear, the TRACKING MODULE is provided to linearize the oscillator curve. At the inputs to the tracking module the voltage vs. frequency curve is therefore linear.

The instrument is tuned by introducing a DC voltage into the tracking module by means of the CENTER FREQUENCY potentiometer. The sawtooth output of the oscilloscope is injected into the tracking module via the SCAN WIDTH switch to provide the sweeping action.

The Scan Width switch is essentially a calibrated attenuator which controls the sawtooth level to provide the various specified SCAN WIDTH or dispersion. In the FULL SCAN position of the SCAN WIDTH switch the CENTER FREQUENCY control is disconnected and a fixed voltage corresponding to mid-band is applied, resulting in a full scan display.

The sawtooth is generated by a Miller sweep generator-flip-flop combination located on the frame printed circuit board.

The output of the 500 MC IF MODULE passes through the IF ATTENUATOR, a panel mounted six element toggle switch attenuator (see schematic drawing contained within Section 6 of this manual), and is fed into the RESOLUTION IF MODULE. Within this module the signal is converted down to 10.7 mc and filtered to provide the resolution characteristics of the analyzer. A complete circuit description of the RESOLUTION IF MODULE is contained within Section 6 of this manual. The 10.7 mc output is impressed upon the input of the LOG-LIN SQ LAW MODULE. A complete description of this module is contained within Section 6 of this manual. The module generates 60 db logarithmic, linear or square law video, which are available at the terminals of the DISPLAY switch S3A. The operator may select the desired video signal by positioning the DISPLAY switch in the appropriate position. The output of this swtich is then routed to the Vertical Deflection Amplifier, which is mounted on the instrument frame printed circuit board.

The deflection amplifier consists of a DC coupled difference amplifier. High voltage transistors are used to provide sufficient voltage to deflect the CRT.

SECTION 5

MAINTENANCE AND REPAIR

NELSON-ROSS Plugin Spectrum Analyzers are designed and manufactured to high standards of reliability and quality control. The use of fully transistorized circuitry has eliminated the need for periodic maintenance. In normal service, it is unlikely that your plugin analyzer will require repair. Should a failure occur, however, this section will provide you with a general sequential procedure for locating the fault and repairing the unit.

VISUAL INSPECTIONS

Plugin units are generally subject to considerable handling and could be accidentally damaged during storage or transfer. Accordingly, you should visually inspect the plugin unit periodically for obvious damage. Look for loose or frayed wires, damaged components, broken component boards, etc. Burn marks on a component could disclose an impending circuit failure, a short circuit or overload conditions, any of which require further investigation.

GENERAL SOLDERING CONSIDERATIONS

Many components in your plugin analyzer are mounted on printed circuit boards. The use of a 40 watt soldering iron, equipped with a chisel point is recommended for unsoldering or soldering of any components. Only high tin content solder is recommended.

Excessive pressure on a printed circuit board could cause it to crack. Diodes should be installed with the normal pigtail looped leads and any semiconductors should be protected during soldering by heat sinking their leads with a long nosed pliers or heat-sink clip.

GENERAL TROUBLE SHOOTING

Should you suspect a malfunction in your Plugin Spectrum Analyzer, the following six general steps are recommended as a sequential procedure to correct the problem:

1. Confirm that a malfunction actually does exist
2. Isolate the trouble to either the Plugin Spectrum Analyzer or the oscilloscope
3. Localize the problem to the analyzer main frame or a circuit module
4. Trouble-shoot the faulty element to determine the exact source of trouble
5. Repair the malfunction
6. Test the repaired analyzer and realign (if necessary)

CONFIRMATION

It has been found thru experience that many indications which are presumed to be caused by a malfunction in the equipment actually result from incorrect settings.

All controls should be checked for correct settings. You should also check the input cable connections and accessories. Once a determination is made that an actual equipment malfunction does exist, it must be ascertained whether it is located in the plug-in unit or the oscilloscope.

ISOLATION

Isolation of the trouble to either the oscilloscope or the plug-in unit may be accomplished by either of two psosible methods. In the first and simplest method, the plugin unit is removed and replaced with a spare plugin. The second method requires verification of input signals voltages, and analysis of the screen display.

CAUTION

Before plugging in the spare unit, it is essential that a careful inspection be made of the suspected original unit, for evidence of charred components or burned wiring. Any. indications of such damage could be the result of excessive oscilloscope supply voltages. In such cases it is absolutely necessary to make complete voltage checks prior to installing a spare. If this precaution is not taken, the spare unit may become damaged.

If, after a spare unit (known to be functioning properly) is substituted and the system does not work properly, the fault exists in the oscilloscope. Refer to the oscilloscope instruction manual for correct maintenance procedures. If a spare unit is not available for substitution further testing must be performed. A plug-in extension cable (available from the oscilloscope manufacturer) may be used to facilitate the required testing, or the top and bottom covers may be removed from the oscilloscope, and the unit stood on its side. First, check all voltages supplied by the oscilloscope to the plugin unit. The voltages supplied by the oscilloscope to the plugin analyzer are identified on the schematic drawing of the analyzer frame. This schematic may be found in Section 4 of this manual. If the voltages measure incorrectly, remove the plugin Spectrum Analyzer and check correctly with the Spectrum Analyzer removed, the trouble may be assumed to be in the plugin unit.

TROUBLE SHOOTING THE SPECTRUM ANALYZER

When it has been definitely established that the malfunction exists in the Spectrum Analyzer plugin unit, the following trouble shooting procedures are recommended.

Much time and effort will be conserved by first performing a very thorough visual inspection of the plugin unit. Carefully scrutinize the unit for evidence of, burned or broken wires, defective switches, overheated or discolored components, and loose or improperly seated crystals. In the event that a burned or discolored component is discovered, it is essential that the direct cause of the trouble be located, and corrected before replacing the component. If no defects are detected by visual inspection, then the following sequential procedure should be used to localize the fault.

Supply power to the Plugin Analyzer through an extension cable from the oscilloscope (available from the oscilloscope manufacturer).

If there is no display on the oscilloscope screen the trouble may lie within the analyzer instrument frame. The frame electronics may be checked on a D.C. basis, using any volt-ohm-meter (20,000 Ω/volt). Voltages to be found at many terminals are indicated on the frame schematic. This check should include voltages at the power resistors, the Vertical Amplifier, sawtooth and tuning voltages (where applicable).

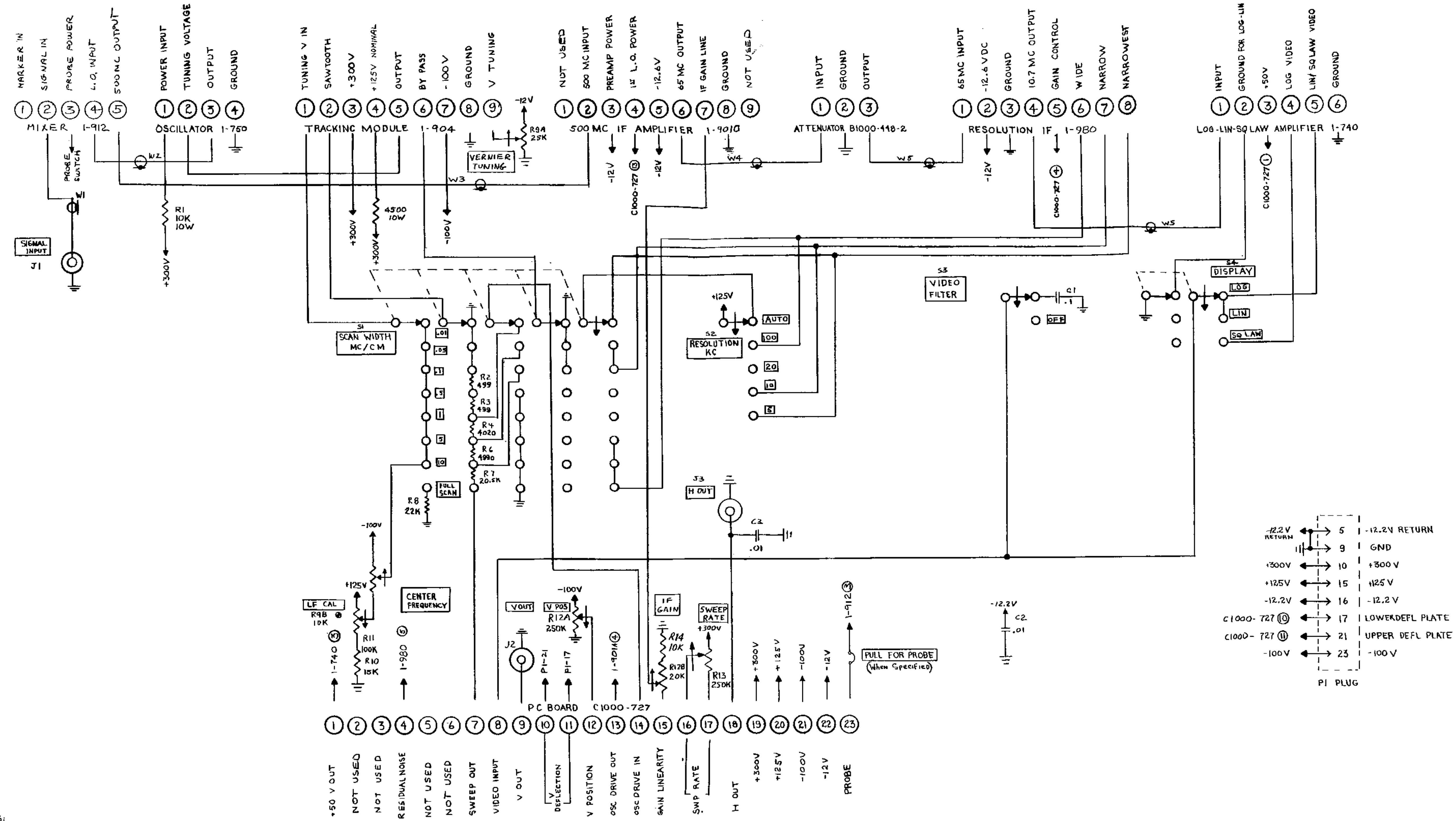
If the instrument frame is operating properly, then the malfunction must be localized to the faulty modular unit.

This may be accomplished by applying signals to the modules, one module at a time, starting with the last module (on the block diagram) and working back toward the analyzer input. Proper input frequencies for each module are indicated on the block diagram, and may be supplied by any standard signal generator. A faulty module is indicated when the test signal will not pass and there is no deflection on the oscilloscope screen. The faulty module should then be inspected and tested in accordance with the procedure specified in the individual module description, contained in Section 6 of this manual.

The instrument frame of the analyzer has been designed to permit service of the individual modules without removal from the frame. Each module is mounted to the analyzer frame on a flexible harness to permit testing and trouble shooting without the use of patch cords or jumpers.

ALIGNMENT PROCEDURE

The following procedure should be used to align the CENTER FREQUENCY and SCAN WIDTH controls:



NOTES:
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D	REC 371	ALL	

NELSON-ROSS ELECTRONICS, INC.
LONG ISLAND, NEW YORK

FRAME WIRING 321

DATE 12-1-66 DRAWING NO. D1000-726 REV D

Equipment Required

Oscilloscope: DC-100KC response (minimum 1V/CM)

Sensitivity (minimum)

Signal Generator: 5 MC to 300 MC range -30 dbm minimum output

OR

Signal Generator: 30 MC output with strong harmonics to 300 MC (alignment may be performed without this generator if necessary)

Multimeter

1) Preliminary frame alignments

A) plug in analyzer and allow to warm up. Use a test fixture or extension cord, if necessary, to allow access to all adjustments.

B) set the CENTER FREQUENCY dial to the exact center of the frequency range. Connect the multimeter between the arm of the CENTER FREQUENCY potentiometer and ground. Adjust the L.F. CAL (screwdriver adjust) for zero voltage (± ¼ volt).

C) connect the oscilloscope to the output of the Tracking Module (terminal # 5). Set the panel SCAN WIDTH control to FULL SCAN. On the Tracking Module, turn all CUT controls fully CW. Using the CENTERING and SLOPE ZERO controls, adjust for a sawtooth of between 40 and 50 volts peak-to-peak on the oscilloscope screen.

D) the extremes of the sawtooth must be adjusted so that the sawtooth output of the Tracking Module in FULL SCAN covers the same range that the D.C. output covers when the CENTER FREQUENCY is tuned from minimum to maximum at the lowest setting of the SCAN WIDTH control. This insures that the FULL SCAN display will agree with the CENTER FREQUENCY dial range. This is accomplished by adjusting the SWEEP + LIMIT and SWEEP - LIMIT adjustments on the printed circuit board in the frame so that in minimum SCAN WIDTH the DC output of the Tracking Module, at the 0 and 300 mc marks on the dial agree with the sawtooth extremes in FULL SCAN. The SWEEP + LIMIT controls the positive end of the sawtooth without effecting the negative end and vice-versa.

2) <u>CENTER FREQUENCY dial adjustment</u>

A) the curve of the tuning dial is set by means of potentiometers located on the Tracking Module. Five of the potentiometers control the spacing between points on the dial (slope potentiometers). The first SLOPE potentiometer (SLOPE 0) operates over the entire dial while each of the remaining four SLOPE potentiometers operates only over the section of the dial selected by its associated CUT potentiometer. A CENTERING control is provided to set the over-all position of the curve.

B) each SLOPE Adjustment effects the rate of change of frequency with rotation of the CENTER FREQUENCY control from the point at which its associated CUT potentiometer puts it into the circuit and upwards in frequency over the rest of the dial. The effects are additive. It is therefore necessary to start adjustment of the tuning curve from the bottom of dial and work toward the upper end. The SLOPE adjustment is permanently in the circuit, effecting the entire dial. This potentiometer is therefore the first one to be adjusted, with all CUT adjustments turned fully CW (to maximum frequency) so that the remaining SLOPE adjustments are out of the circuit. The CUT and SLOPE adjustments are then introduced progressively, to linearize the rest of the dial. The procedure is as follows:

C) set the CUT controls fully CW and turn the CENTER FREQUENCY dial to zero. Adjust the CENTERING potentiometer to place the zero signal on the center graticule line.

D) Connect a 30mc signal at -40dbm to the input of the analyzer and tune the CENTER FREQUENCY dial to 30 mc (it may be convenient to use a generator which provides harmonics to 300 mc, so that 10 marks are available for dial adjustment, instead of a clean input signal).

E) Note the position of the signal. If it is to the left of the center graticule line, turn the 0 SLOPE control CW to increase the spacing between 0 and 30 mc. If it is to the right, turn the 0 SLOPE control CCW.

F) Return the CENTER FREQUENCY control to zero and readjust CENTERING control to place the zero signal in the proper place. Repeat step "E" and note the magnitude of the correction that has been achieved. Readjust, and repeat until zero and 30 mc are correct on the dial.

G) Tune to 60 mc, insert a 60 mc signal and note the dial accuracy. If it is within 5%, tune another 30 mc interval (to 90mc) and check for accuracy. When a mark is found out of tolerance rotate the CUT 1 control CCW until the mark is seen to move, which means that the associated SLOPE 1 control is operative over that portion of the dial. Adjust the SLOPE 1 control for the best fit of the next few marks to the dial.

H) Repeat the above procedure for succeedingly higher sections of the dial until the entire dial fits within the specified accuracy.

I) Recheck and readjust the DISPERSION BAL and DISPERSION SET controls to provide the correct FULL SCAN and balance of the SCAN WIDTH control.

J) Switch the SCAN WIDTH control to .06 mc/cm. At any convenient frequency, AM modulate the signal generator with a 60 kc signal. Tune to the signal and adjust the SMALL SCAN SET control to provide 1 cm/60 kc sidebands on the display.

PARTS LIST

FRAME D1000-726

R1	WW Resistor 10W 5% 10K
R2	Film Resistor $\frac{1}{4}$W 1% 499Ω
R3	Same as R2
R4	Film Resistor $\frac{1}{4}$W 1% 4020Ω
R5	WW Resistor 10W 5% 4500
R6	Film Resistor $\frac{1}{4}$W 1% 4990Ω
R7	Film Resistor $\frac{1}{4}$W 1% 20.5K
R8	Resistor $\frac{1}{2}$W 5% 22K
R9	Potentiometer 1000-154-28
R10	Resistor $\frac{1}{2}$W 5% 15K
R11	Potentiometer 100K 1000-154-27
R12	Potentiometer 1000-154-43
R13	Potentiometer 250K 1000-154-11
C1	Capacitor .1 @ 200V Amperex C296AB/A100K
C2	Capacitor Disc .1 @ 200V CRL DD-103
C3	Same as C2
P1	Connector Amphenol 26-159-24
J1	Connector Gremar 5359
J2	Connector UG625B/U
J3	Same as J2
S1	Switch NRE 19997-5
S2	Switch Alcoswitch MRA-2-5S
S3	Switch C & K Component 7201
S4	Same as S2

PC BOARD C1000-727

R1	Not Used
R2	Resistor $\frac{1}{2}$W 5% 22K
R3	Resistor $\frac{1}{2}$W 5% 1M
R4	Resistor $\frac{1}{2}$W 5% 27K
R5	Not Used
R6	Resistor $\frac{1}{2}$W 5% 8.2K
R7	Resistor $\frac{1}{2}$W 5% 100K
R8	Resistor $\frac{1}{2}$W 5% 330K
R9	Same as R2

PARTS LIST

R10	Not Used
R11	Resistor ½W 5% 2.2K
R12	Same as R2
R13	Same as R11
R14	Resistor ½W 5% 2.7K
R15	Not Used
R16	Resistor ½W 5% 1K
R17	Resistor ½W 5% 150K
R18	Resistor ½W 5% 91K
R19	Resistor ½W 5% 51K
R20	Not Used
R21	Same as R18
R22	Resistor ½W 5% 10K
R23	Potentiometer 25K IRC U201R253B
R24	Resistor ½W 5% 820K
R25	Not Used
R26	Same as R8
R27	Same as R18
R28	Not Used
R29	Potentiometer 100K IRC U201R104B
R30	Not Used
R31	Same as R4
R32	Resistor 1W 5% 10K
R33	Resistor 2W 5% 4700Ω
R34	Same as R33
R35	Not Used
R36	Resistor 2W 5% 3900Ω
R37	Same as R7
R38	Resistor ½W 5% 39K
R39	Same as R26
R40	Resistor ½W 5% 3900Ω
R41	Same as R38
R42	Same as R6
R43	Potentiometer 25K IRC U20125B
R44	Same as R7
R45	Not Used
R46	Resistor ½W 5% 3.3M
R47	Resistor ½W 5% 4.7K
R48	Same as R29
R49	Same as R4
R50	Resistor ½W 5% 4700Ω
R51	Same as R7
R52	Resistor ½W 5% 39K
R53	Same as R47
R54	Resistor ½W 5% 39K
R55	Not Used
R56	Same as R29

PARTS LIST

R57	Same as R29
R58	Resistor ½W 5% 120K
R59	Same as R7
R60	Resistor ½W 5% 15K
R61	Resistor ½W 5% 180K
R62	Potentiometer 500K IRC U201504B
R63	Film Resistor ½W 1% 22K
R64	Same as R22
R65	Resistor ½W 5% 10K
C1	Mica Capacitor 100pf CM15E101J
C2	Same as C1
C3	Capacitor .1 @ 200V Amperex C296AB/A100K
C4	Disc Capacitor .001 CRL DD-102
C5	Not Used
C6	Electrolytic Capacitor 100uf @ 50V C D BR100-50
C7	Disc Capacitor .01 CRL DD6-103
	Heat-Sink Thermolloy 1115C

CR1	Diode 1N459
CR2	Same as CR1
CR3	Same as CR1
CR4	Diode Solitron 1R32B
CR5	Not Used
CR6	Same as CR1
CR7	Same as CR1
CR8	Diode Solitron 1R62B
Q1	Transistor Industro 301LC
Q2	Transistor 2N3566
Q3	Same as Q2
Q4	Transistor 2N3638
Q5	Same as Q1
Q6	Same as Q1
Q7	Transistor 2N4360
Q8	Same as Q1
Q9	Same as Q1
Q10	Same as Q1

SECTION 6

MODULE AND SUB-ASSEMBLY DESCRIPTIONS

This section consists of six subsections. It contains detailed descriptions of the following sub-assemblies and modules:

RESOLUTION IF MODULE (1-980)

LOG-LIN SQ LAW MODULE (1-740)

SWEPT OSCILLATOR MODULE (1-750)

500 MC IF MODULE (1-901)

TRACKING MODULE (1-904)

MIXER MODULE (1-912)

Circuit descriptions, alignment procedures, maintenance instructions, outline drawings and parts list are provided for each module.

The last sub-section contains a schematic drawing and parts list of the I.F. attenuator sub-assembly.

RESOLUTION IF MODULE 1-980

FUNCTION

The function of this module is to accept a low level signal at 65 MC input frequency and deliver an amplified signal at 10.7 MC. The IF module provides both gain and frequency conversion. A two pole crystal filter in the 10.7 MC section provides various resolution bandwidths. The overall gain of the amplifier is such that signals of the order of -80 dbm at the input will produce usable outputs. Input and output impedances are 50 ohms.

CIRCUIT DESCRIPTION

The input signal is impressed upon the base of the mixer transistor, Q1. A crystal controlled local oscillator comprised of Q2 and its associated circuitry provides a 54.3 MC signal which is applied to the emitter of Q1. The output of Q1 is a 10.7 MC signal which is initially filtered by a tuned circuit consisting of L1 and C1. The signal is then fed through the two crystal filters on the crystal filter board. Bandwidth selection is accomplished remotely by diode switching via diode pairs which are normally reversed biased. Forward biasing each pair of diodes provides a different bandwidth position. In the first switch position (widest) the filter is disconnected, providing a wide band position. In the second position the bandwidth is fixed and is a function of the crystal frequency. This position is obtained by reverse biasing all diode pairs. In the third and fourth positions, the crystal filter is inserted at progressively narrower bandwidths. The resistors and capacitors are selected at assembly to suit the crystal characteristics and bandwidths for each analyzer model. Gain and gain control is achieved by a 10.7 MC output amplifier comprised of Integrated circuit IC1 on the input-output board.

MAINTENANCE AND REPAIR

When a malfunction has been localized to this module, the module should be removed from the instrument frame, and supplied power from the frame by its harness. The following sequential procedure should then be used to trouble shoot the module.

Perform a D.C. check of voltages on the emitter, base and collector of each transistor stage. Nominal voltages are indicated on the module schematic. If voltage readings are satisfactory, the module must be checked stage by stage. With the module output connected to the next chassis in the frame, apply a signal input to each stage starting with the last stage in the module and working back to the module input. Any standard signal generator may be used to supply the stage inputs. Once a particular stage is found to be inoperative, individual components may be replaced until satisfactory operation is attained.

ALIGNMENT

Test Equipment Required: Signal Generator with output at 10.7 MC to 65 MC over the range of levels from -100 through -10 dbm.

There are three basic circuits which require alignment: the Oscillator-Mixer, the Crystal Filter and the Output Amplifier. The module must be removed to gain access to the alignment controls. During alignment, the module should be connected to the working Plugin Spectrum Analyzer so that the oscilloscope display may be used to observe the shape of the bandpass filter

1. Set the DISPLAY switch on the analyzer panel to LIN
2. For initial alignment, a -10 dbm signal at 10.7 MC should be applied to the input connector, J1 (1).
3. The resolution switch on the analyzer should be placed in the minimum resolution position, (this position removes the crystal band pass filter from the circuit).
4. Transformers Z1 and Z3 on the input-output board should then be tuned for maximum deflection on the oscilloscope screen, with R12 fully CW
5. The signal generator output level should then be reduced to the order of -50 dbm and the frequency readjusted to 65 MC
6. The oscillator tuning capacitor, C6 on the input-output board may then be adjusted to produce a local oscillator signal. When properly adjusted the mixture of the local oscillator signal with the 65 MC input will produce a 10.7 MC signal, which will cause deflection on the oscilloscope screen.
7. This capacitor, C6 must be adjusted for reliable operation of the local oscillator, a setting which may not coincide with the position for maximum deflection on the

CRT screen. It must be adjusted to permit the local oscillator to self-start.

8. This setting should be checked by applying and removing power to the spectrum analyzer a few times.

9. The crystal filter is aligned with the input connectors, J1 connected normally to the 65 MC output of the previous module. Any attenuator should, however, be switched out of the circuit by the front panel controls.

10. A signal should be provided to the input of the spectrum analyzer so that a component line is displayed on the CRT screen. The shape of this line is the shape of the band pass of the crystal filter which is to be aligned.

11. Place the RESOLUTION switch in the position in which all diode pairs are reverse biased, which is the position of maximum crystal filter bandwidth and the position in which the tuning of components is most sensitive.

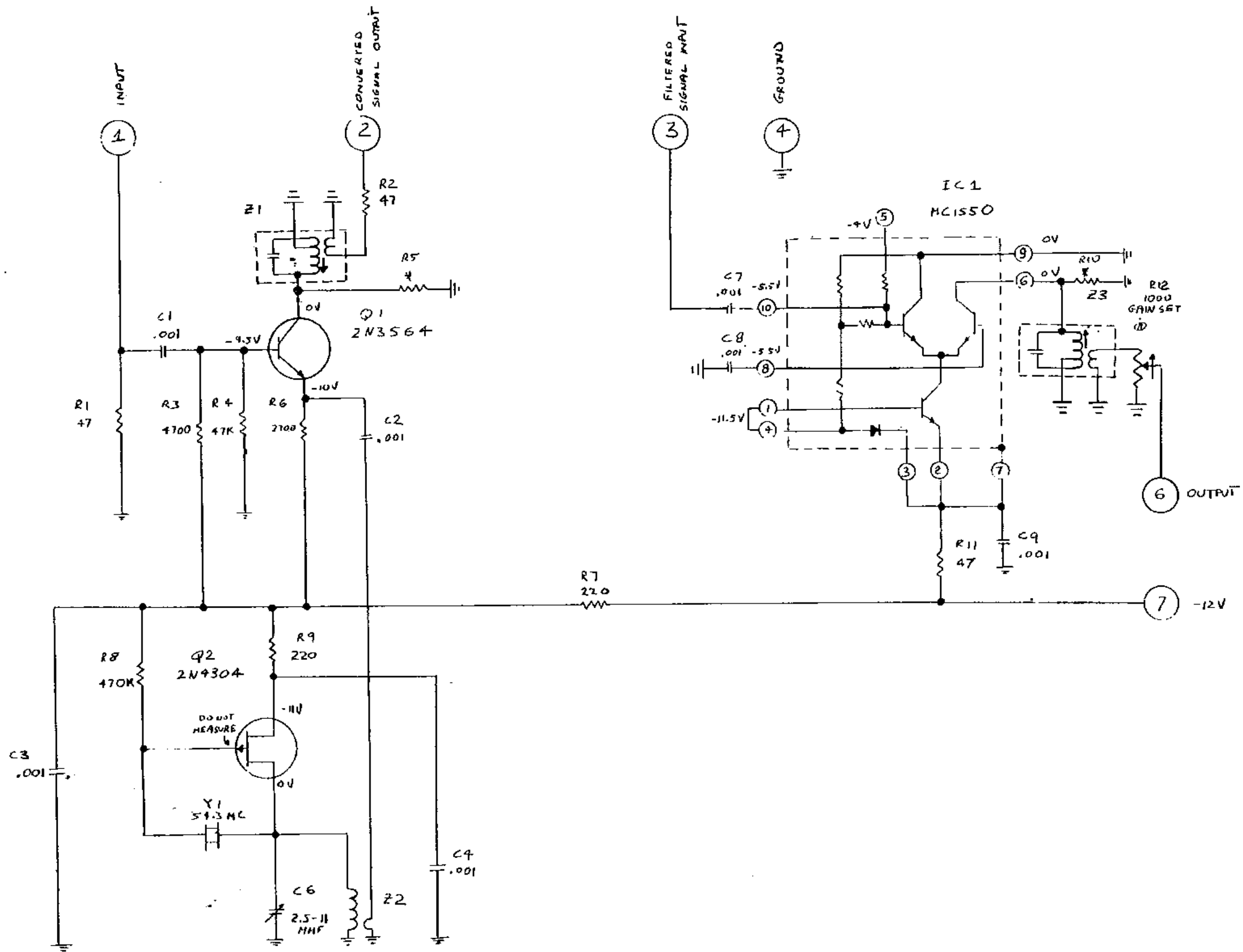
12. Trimmer capacitors C6 and C21 on the crystal filter board should be tuned alternately, for the broadest, smoothest, response obtainable. Do not tune for maximum transmission, but rather for a minimum point at which the transmission, is broad and the shape of the band pass is smooth and even.

13. Capacitors, C4 and C19 on the crystal filter board should then be alternately adjusted to minimize skirt leakage of the signal. Since these capacitors affect the tuning of C6 and C21 (of the previous step) they should be alternately readjusted until the shape of the bandpass is smooth and leakage around the skirts of the signal is minimized.

14. Switch the analyzer DISPLAY switch to LOG and increase the signal level until a full screen signal is observed. This greatly expands the skirts to facillitate adjustment of C4 and C19 for the most symmetrical bandpass characteristics.

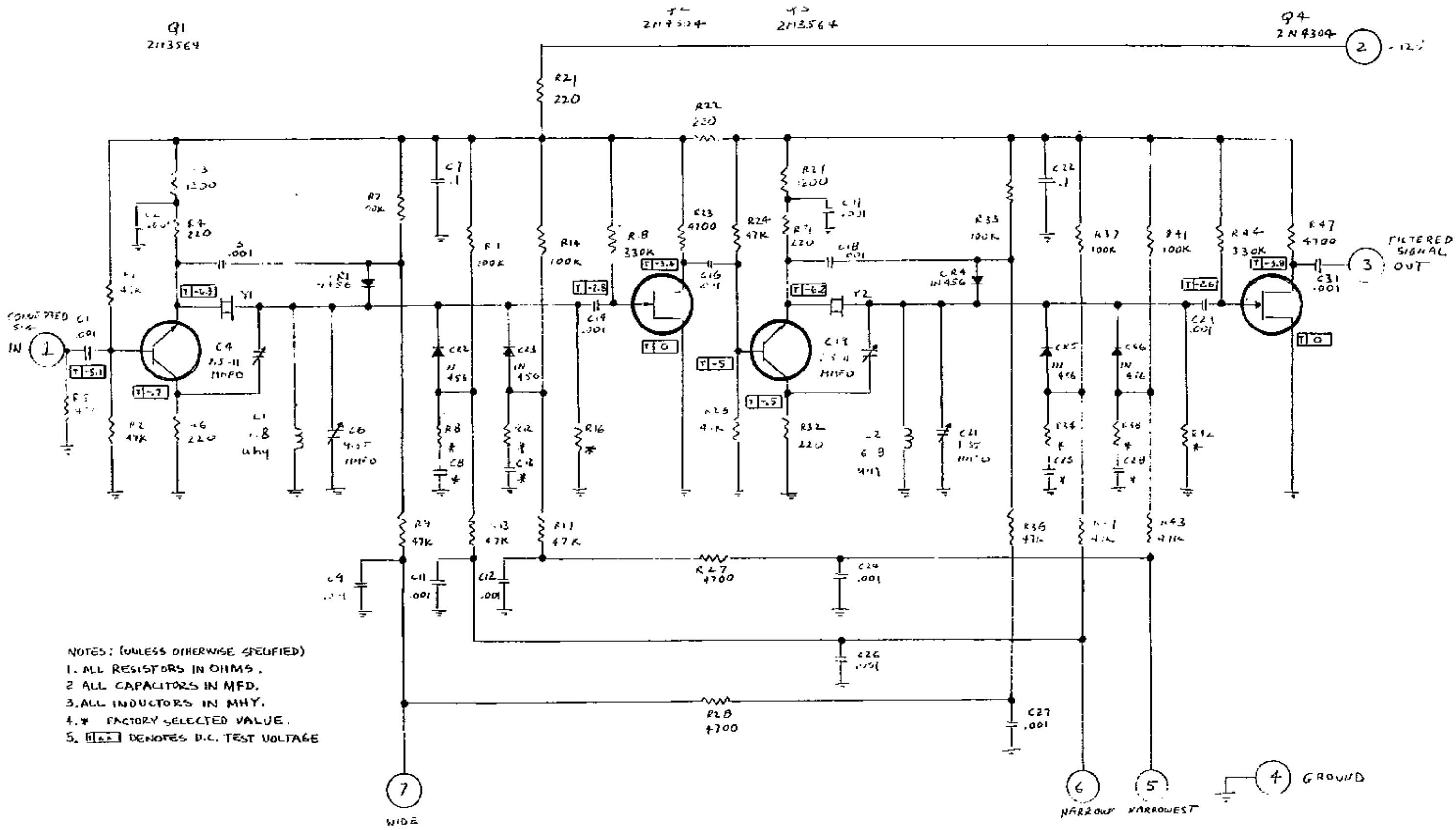
15. Return the DISPLAY switch to the LIN position.

16. Retrim Z1 and Z3 for maximum transmission. This step assures that the center frequency of the various tuned circuits is precisely the same as the center frequency of the filter, in its narrowest position.



INPUT-OUTPUT CIRCUIT PARTS LIST

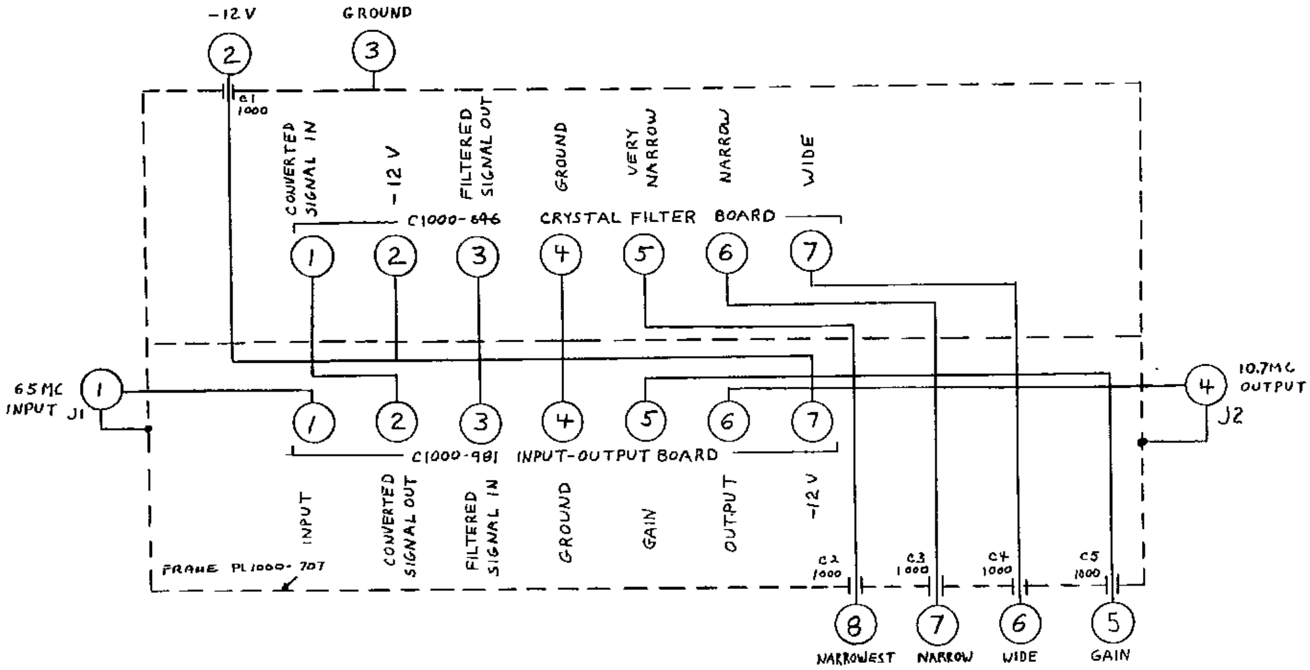
R1	Resistor ¼W 5% 47 Ω
R2	Same as R1
R3	Resistor ¼W 5% 4700 Ω
R4	Same as R3
R5	Selected At Test
R6	Resistor ¼W 5% 2700 Ω
R7	Resistor ¼W 5% 220 Ω
R8	Resistor ¼W 5% 470K
R9	Same as R7
R10	Selected At Test
R11	Same as R1
R12	Potentiometer 1000 Ω IRC U201R102B
C1	Disc. .001 Centralab DD 102
C2	Same as C1
C3	Same as C1
C4	Same as C1
C5	Not Used
C6	Trimmer 2.5-11mmf Erie 538-000-90R
C7	Same as C1
C8	Same as C1
C9	Same as C1
Q1	Transistor 2N3564
Q2	Transistor FET 2N4304
IC1	Integrated CKT Motorola MC1550
Y1	Crystal C1000-007-6
Z1	Transformer IF A1000-345-1
Z2	Transformer B1000-709-9
Z3	Same as Z1

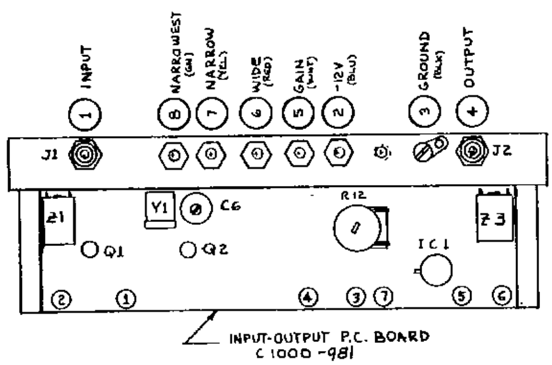


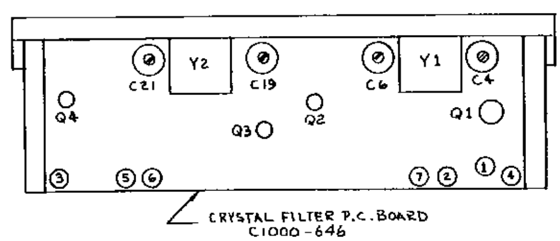
CRYSTAL FILTER PARTS LIST

R1 Resistor ¼W 5% 47K
R2 Same as R1
R3 Resistor ¼W 5% 1200 Ω
R4 Resistor ¼W 5% 220 Ω
R5 Resistor ¼W 5% 470 Ω
R6 Same as R4
R7 Resistor ¼W 5% 100K
R8 Selected At Test
R9 Same as R1
R10 Not Used
R11 Same as R7
R12 Selected At Test
R13 Same as R1
R14 Same as R7
R15 Not Used
R16 Selected At Test
R17 Same as R1
R18 Resistor ¼W 5% 330K
R19 Not Used
R20 Not Used
R21 Same as R4
R22 Same as R4
R23 Resistor ¼W 5% 4700 Ω
R24 Same as R1
R25 Not Used
R26 Same as R1
R27 Same as R23
R28 Same as R23
R29 Same as R3
R30 Not Used
R31 Same as R4
R32 Same as R4
R33 Same as R7
R34 Selected At Test
R35 Not Used
R36 Same as R1
R37 Same as R7
R38 Selected At Test
R39 Same as R1
R40 Not Used
R41 Same as R7
R42 Selected At Test
R43 Same as R1
R44 Same as R18
R45 Not Used
R46 Not Used
R47 Same as R23

C1 Disc. .001 @ 600V
C2 Same as C1
C3 Same as C1
C4 Capacitor, 2.5-11 uuf
Erie 538-000-90R
C5 Not Used
C6 Capacitor, 9-35 uuf
Erie 538-000-94R
C7 Capacitor, .1 @ 200V
C8 Selected At Test
C9 Same as C1
C10 Not Used
C11 Same as C1
C12 Same as C1
C13 Selected At Test
C14 Same as C1
C15 Not Used
C16 Same as C1
C17 Same as C1
C18 Same as C1
C19 Same as C4
C20 Not Used
C21 Same as C6
C22 Same as C7
C23 Selected At Test
C24 Same as C1
C25 Not Used
C26 Same as C1
C27 Same as C1
C28 Selected At Test
C29 Same as C1
C30 Not Used
C31 Same as C1
CR1 Diode 1N456
CR2 Same as CR1
CR3 Same asCR1
CR4 Same as CR1
CR5 Same as CR1
CR6 Same as CR1
L1 Choke 6.8 uhy
Miller R1550-23
L2 Same as L1
Y1 & Y2 Crystal Pair
A1000-007-4
Q1 Transistor, 2N3564
Q2 Transistor, FET 2N4304
Q3 Same as Q1
Q4 Same as Q2







RESOLUTION IF FRAME PARTS LIST

C1	Capacitor 1000 uuf Erie 321-000-X5V0-102M	
C2	Same as C1	
C3	Same as C1	
C4	Same as C1	
C5	Same as C1	
J1	UG697/U	
J2	Same as J1	

LOG-LIN SQUARE LAW MODULE

FUNCTION

The function of this module is to provide gain and generate a square law, logarithmic or linear detected output for vertical deflection on the oscilloscope display.

CIRCUIT DESCRIPTION

Transistors, Q1, Q2, Q3, and Q4, comprise four identical resistance coupled amplification stages. Each stage provides a fixed amount of gain and is designed to saturate at a fixed level. The output of each stage is fed into the next stage and a detector. A linear output is selected at terminal # 5, the output of the fourth detector CR6. Square law video is obtained at the same terminal by inserting diodes CR3 and CR4 into the circuit. This is accomplished by ungrounding terminal # 2, labeled "Ground for Log-Lin". Diodes CR3 and CR4 then provide a square law characteristic by virtue of their square law rectification properties and convert the linear output to a square law output. Grounding terminal # 2 biases diode CR4 on and effectively shorts out both diodes, eliminating them from the circuit to provide linear or logarithmic video.

Logarithmic video is obtained by summing the outputs of all four detectors at terminal # 4, labeled "Log Video". Each detector then provides an output over a fixed gain region of the entire amplifier. The sum of the four outputs is a 60 DB log output.

MAINTENANCE AND REPAIR

When a malfunction has been localized to this module, the module should be removed from the instrument frame without disconnecting the cable. The following sequential procedure should then be used to trouble shoot the module.

Perform a D.C. check of voltages on the emitter, base and collector of each transistor stage. Nominal voltages are indicated on the module schematic.

If voltage readings are satisfactory, the module must be checked stage by stage.

With the module output connected to the next chassis in the frame, apply a signal input to each stage, starting with the last stage in the module and working back to the module input. Any standard signal generator may be used to supply the stage inputs (indicated on the module schematic).

Once a particular stage is found to be inoperative, individual components should be checked and replaced until satisfactory operation is obtained.

ALIGNMENT AND TEST

Equipment Required: Signal Generator capable of supplying a 10.7 mc signal of at least 100 millivolts RMS.

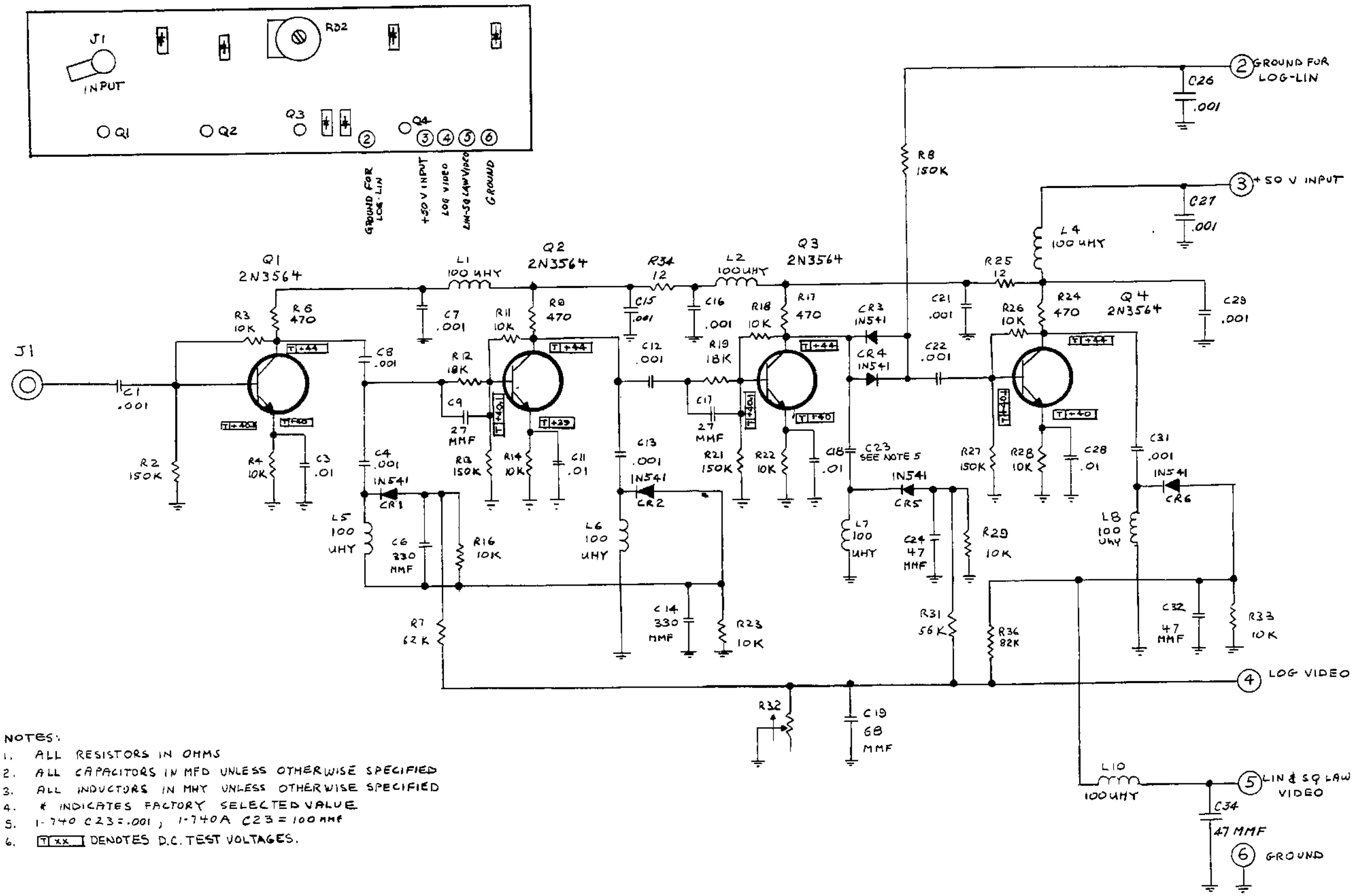
This module is highly stable and not normally subject to drift. The only adjustment required is the amplitude of the logarithmic output. This procedure will only be required when components (particularly semiconductors) have been replaced.

1. With the module mounted in the plugin spectrum analyzer and the DISPLAY switch set in the LIN mode disconnect the input connector of the module, J1, and apply an input signal of 10.7 mc from a signal generator.
2. Switch the DISPLAY control on the analyzer panel to the LOG position and adjust to provide a 60 db display dynamic range on the oscilloscope screen. This is accomplished by first adjusting the output level of the signal generator to produce a barely visible deflection on the CRT screen and then increasing the output level by 60 db. Then R32 is adjusted to provide full deflection on the CRT screen

PARTS LIST

R1	Not Used
R2	Resistor ½W 5% 150K
R3	Resistor ½W 5% 10K
R4	Same as R3
R5	Not Used
R6	Resistor ½W 5% 470 Ω
R7	Resistor ½W 5% 62K
R8	Same as R2
R9	Same as R6
R10	Not Used
R11	Same as R3
R12	Resistor ½W 5% 18K
R13	Same as R2
R14	Same as R3
R15	Not Used
R16	Same as R3
R17	Same as R6
R18	Same as R3
R19	Same as R12
R20	Not Used
R21	Same as R2
R22	Same as R3
R23	Same as R3
R24	Same as R6
R25	Resistor ½W 5% 12 Ω
R26	Same as R3
R27	Same as R2
R28	Same as R3
R29	Same as R3
R30	Not Used

R31	Resistor ½W 5% 56K
R32	Chosen At Test
R33	Same as R3
R34	Not Used
R35	Not Used
R36	Resistor ½W 5% 82K
C1	Capacitor Disc .001 @ 600V
C2	Not Used
C3	Capacitor Disc .01 @ 200V
C4	Same as C1
C5	Not Used
C6	Capacitor Mica 330 MMF 5%
C7	Same as C1
C8	Same as C1
C9	Capacitor Mica 27 MMF 5%
C10	Not Used
C11	Same as C3
C12	Same as C1
C13	Same as C1
C14	Same as C6
C15	Same as C1
C16	Same as C1
C17	Same as C9
C18	Same as C3
C19	Capacitor Mica 68 MMF 5%
C20	Not Used
C21	Same as C1
C22	Same as C1
C23	Capacitor Mica 5% Value per note 5 of schematic
C24	Capacitor Mica 47 MMF 5%
C25	Not Used
C26	Same as C1
C27	Same as C1
C28	Same as C1
C29	Same as C1
C30	Same as C1
C31	Same as C1
C32	Same as C24
C33	Not Used
C34	Same as C24
L1	Choke 100 UHY Miller 70F104A1
L2	Same as L1
L3	Same as L1
L4	Same as L1
L5	Same as L1
L6	Same as L1
L7	Same as L1
L8	Same as L1
L9	Not Used
CR1	Diode 1N541
CR2	Same as CR1
CR3	Same as CR1
CR4	Same as CR1
CR5	Same as CR1
CR6	Same as CR1
J1	Connector UG693/U
Q1	Transistor 2N3564
Q2	Same as Q1
Q3	Same as Q1
Q4	Same as Q1



NOTES:

1. ALL RESISTORS IN OHMS
2. ALL CAPACITORS IN MFD UNLESS OTHERWISE SPECIFIED
3. ALL INDUCTORS IN MHY UNLESS OTHERWISE SPECIFIED
4. * INDICATES FACTORY SELECTED VALUE
5. 1-740 C23=.001 , 1-740A C23 = 100 MMF
6. T xx DENOTES D.C. TEST VOLTAGES.

SCHEMATIC & COMPONENT LOCATION

SWEPT OSCILLATOR MODULE

FUNCTION

This Oscillator Module is housed in an RF gasketed case and consists of an electronically tunable solid state oscillator which is capable of delivering RF power over the range of 500 to 800 MHz.

CIRCUIT DESCRIPTION

The oscillator contains its own voltage regulator, and requires a supply of approximately 20 ma from a stable power source of over 20 volts, through a suitable resistor. Tuning is accomplished by supplying a tuning voltage within the limits of 0 to 100 volts at the tuning control terminal, which presents a high impedance.

MAINTENANCE AND REPAIR

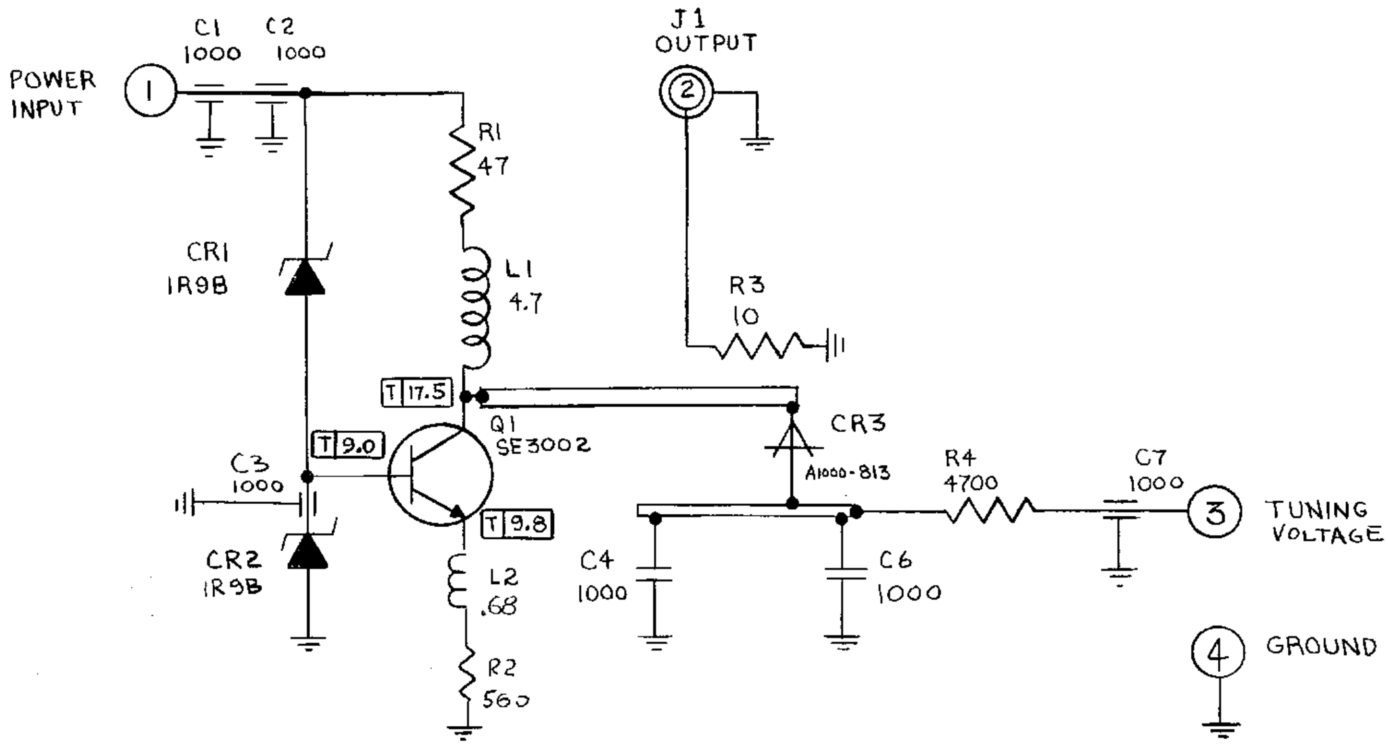
Since the techniques used in the construction, testing and adjustment of these oscillators are highly sophisticated and require extensive, special test equipment, it is not recommended that the modules, be repaired in the field. If an oscillator is faulty, it is suggested that the entire analyzer be returned to the factory for repair. A complete alignment will then be possible.

ALIGNMENT AND TEST

This unit requires no special alignment. The frequency range and output power are determined by mechanical factors and are not subject to adjustment in the field. Power output may be checked on any suitable RF power meter having a 50 ohm input, and should be between -10 and +10 dbm over the range of 500 to 800 MHz.

PARTS LIST

R1	Resistor ¼W 5% 47Ω
R2	Resistor ¼W 5% 560Ω
R3	Resistor ¼W 5% 10Ω
R4	Resistor ¼W 5% 4.7K
C1	Capacitor 1000pf Erie 321-000-X5VO-102P
C2	Capacitor 1000pf Erie 2404-000-X5V-102P
C3	Same as C2
C4	Same as C2
C5	Not used
C6	Same as C1
C7	Same as C2
L1	Choke 4.7uhy Delevan 1537-28
L2	Choke .68uhy J.W.Miller 9320-08
Q1	Transistor,Fairchild SE3002
J1	Connector UG697/U
CR1	Diode,Solitron 1R9B
CR2	Same as CR1
CR3	Diode,Varactor A1000-813



NOTES: (UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTORS IN OHMS.
2. ALL CAPACITORS IN PF
3. ALL INDUCTORS IN uhy
4. [T|XX] DENOTES D.C. TEST VOLTAGE.

500 MC IF MODULE

FUNCTION

The function of this module is to accept a signal at 500 megacycles, provide filtering to eliminate spurious responses, which might occur from local oscillator inputs, convert the signal to 65 megacycles and provide a 50 ohm output to drive the next module within the analyzer.

CIRCUIT DESCRIPTION

Since this module is used in several instruments, it is made in several configurations. The pertinent configurations are 1-715, 1-715C, 1-901 and 1-901C. 1-901 versions are identical to 1-715 versions except for right angle connectors. Configurations with no letter suffix are used when mixer current indication is required, while "C" versions have a ground return built into the input. In each case the input jack is designed to accept a 500 MC signal, which may be the output of a mixer in the instrument frame. This signal is coupled into the first resonant filter by means of a coupling loop. In configurations with no letter suffix, the coupling loop is returned to ground via capacitor C2 and returned outside the module housing through capacitor, C1. This arrangement provides for the measurement of mixer current (generated by the mixer in the instrument frame) at terminal # 1.

The Input Circuit in "C" configurations accepts the 500 MC input signal and couples to the resonant filter by means of a grounded coupling loop. In either case, the coupled input signal, passes through the resonant filters and is fed to an RF Amplifier comprised of Q1 and associated components. The output of Local Oscillator, Q2 is combined with the output of Q1 at Mixer, CR1. The output of the mixer is a 65 MC signal which is then amplified by a two stage, resistance coupled amplifier comprised of integrated circuits IC1 and IC2 and associated circuitry. Two 65 MC resonant transformers, Z1, and Z2, provide bandshaping. Gain control is achieved by varying the bias on IC2. Resistor R11 is used to set the maximum gain of the amplifier.

MAINTENANCE AND REPAIR

When a malfunction has been localized to this module, the module should be unbolted from the instrument frame and supplied power from the frame by its harness. The following sequential procedure should then be used to trouble-shoot the module.

Perform a D.C. check of voltages on the emitter, base and collector of each transistor stage. Nominal voltages are indicated on the module schematic.

If voltage readings are satisfactory, the module must be checked stage by stage.

With the module output connected to the next chassis in the frame, apply a signal input to each stage, starting with the last stage in the module and working back to the module input. Any standard signal generator may be used to supply the stage inputs (indicated on the module schematic).

Once a particular stage is found to be inoperative, individual components should be checked and replaced until satisfactory operation is obtained.

ALIGNMENT AND TEST

Test Equipment Required: Signal generator capable of producing a 65 MC signal and a 500 MC signal accurate to ± 10 MC and capable of being attenuated to levels of the order of -100 to 10 dbm.

This module should be connected to an operating plugin spectrum analyzer during alignment. Because the level of the 65 MC output signal at J2 is extremely low (of the order of -70 dbm, at normal input levels) it is necessary to utilize the remaining portions of the plugin spectrum analyzer to observe it during alignment.

1. Connect the signal generator to connector, J1 and tune it back and forth about the region of 500 MC while injecting signals into the module of the order of -10 dbm (this technique may be used when the module is only slightly misaligned).
2. Determine the frequency at which an output is observed on the CRT screen.
3. Rotate the local oscillator tuning control, C11, CCW to increase the signal frequency or CW to decrease it until the signal frequency that passes through the I.F. is brought back to 500 MC.

4. Tune trimmer capacitors C1, C2, C6, C7, C8, C17 and C18 for maximum

5. If the module is so badly misaligned that the signal cannot be passed through it, it will be necessary to first prealign the 65 MC amplifier.

6. Remove the cover on this module by removing the two retaining screws.

7. Inject a 65 MC signal into the oscillator-mixer compartment by means of a coupling loop on the end of a lead from the signal generator.

8. Tune capacitors, C17 and C18 for maximum deflection on the CRT screen.

9. Replace the cover and align the rest of the module as previously described.

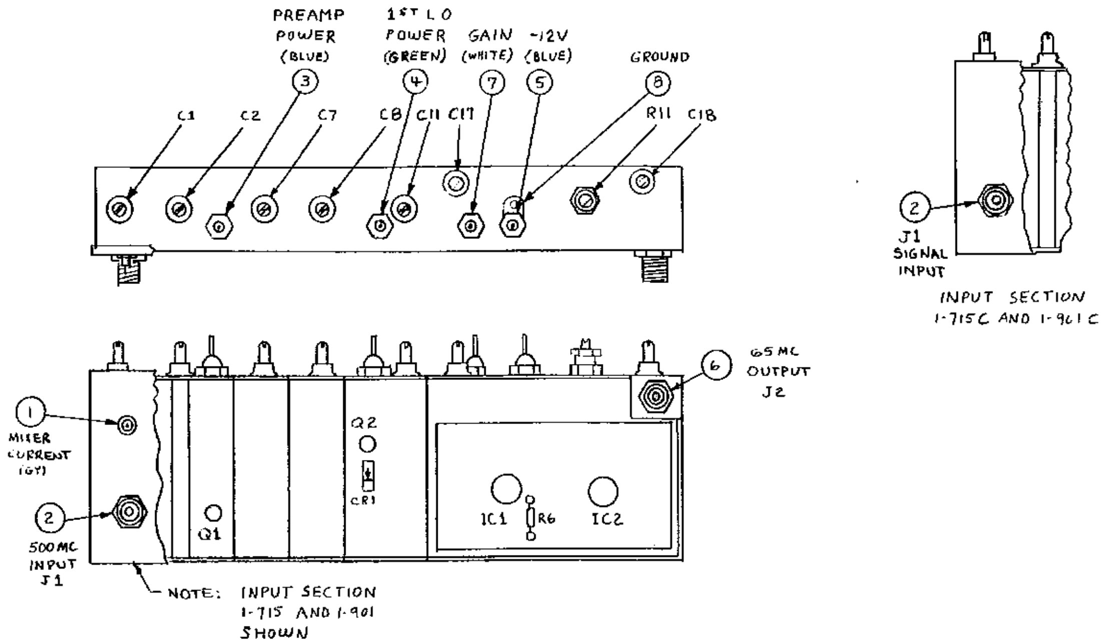
PARTS LIST-FRAME

R1	Resistor ¼W 5% 27K
R2	Resistor ¼W 5% 68K
R3	Resistor ¼W 5% 1K
R4	Same as R3
R5	Not Used
R6	Same as R3
R7	Same as R1
R8	Same as R2
R9	Resistor ¼W 5% 47 Ω
R10	Not Used
R11	Potentiometer 500 Ω C1000-154-50
C1	Capacitor, .9 to 9pf Amperex C004EA/9E
C2	Same as C1
C3	Capacitor 1000pf Erie390-000-X5VO-102P
C4	Same as C3
C5	Not Used
C6	Capacitor, 1000pf Erie321-000-X5VO-102P
C7	Same as C1
C8	Same as C1
C9	Capacitor 4.7pf Stackpole Type GA 5%
C10	Not Used
C11	Same as C1
C12	Same as C6
C13	Same as C3
C14	Same as C3
C15	Not Used
C16	Same as C6
C17	Same as C1
C18	Same as C1
C19	Same as C6
Q1	Transistor SE3002 Fairchild
Q2	Same as Q1
CR1	Diode 1N82A

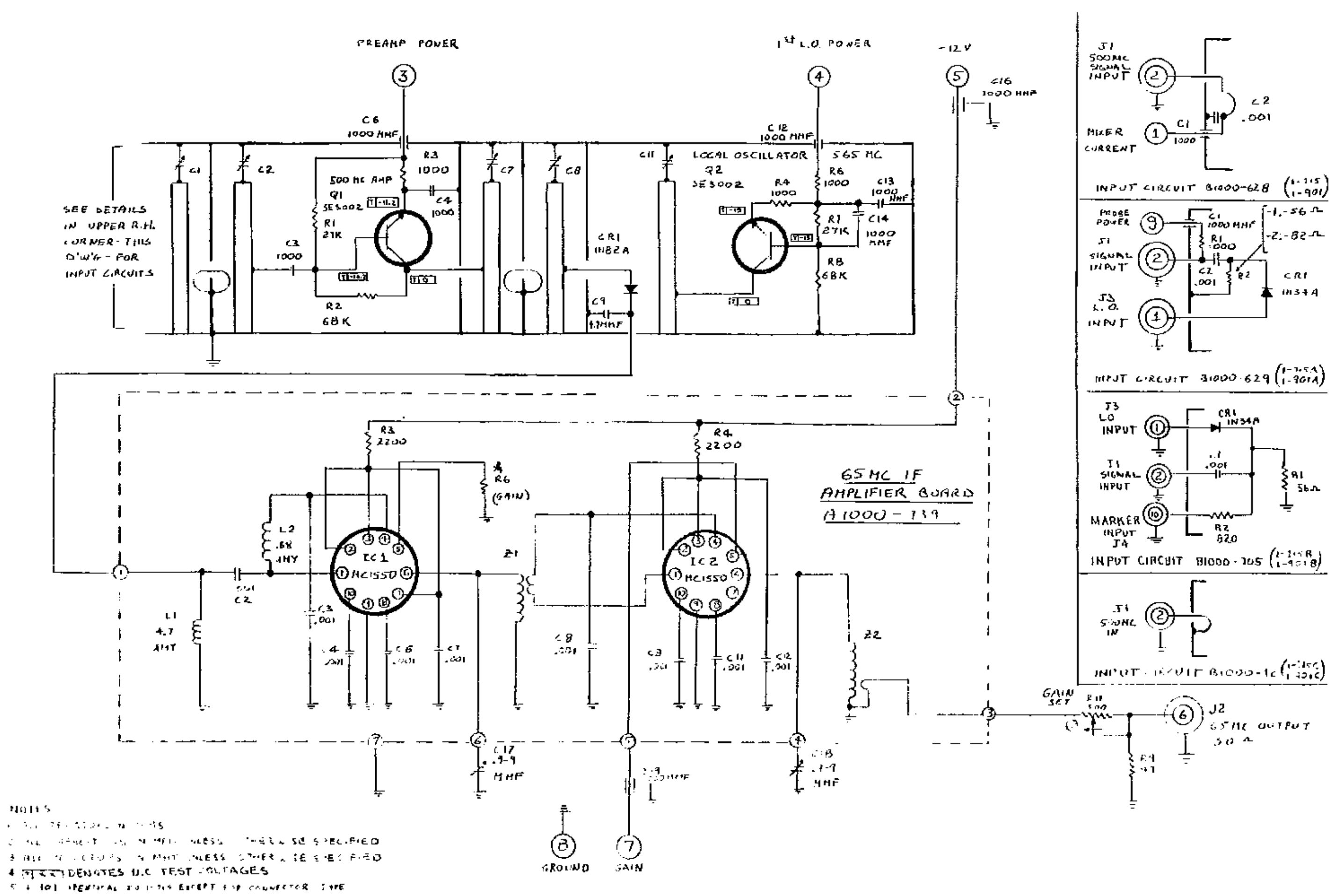
ALL COAX CONNECTORS
1-715 Module UG697/U
1-901 Module UG694/U

PARTS LIST-P.C. ASSEMBLY A1000-739

R1	Not Used
R2	Not Used
R3	Resistor ¼W 5% 2.2K
R4	Same as R3
R5	Not Used
R6	Selected at Test
IC1	Motorola MC 1550
IC2	Same as IC1
L1	Choke 4.7 uhy
L2	Choke .68 uhy
Z1	Transformer B1000-709-1
Z2	Same as Z1
C1	Not Used
C2	Capacitor .001 CRL DD102
C3	Same as C2
C4	Same as C2
C5	Not Used
C6	Same as C2
C7	Same as C2
C8	Same as C2
C9	Same as C2
C10	Not Used
C11	Same as C2
C12	Same as C2



COMPONENT LOCATION



SCHEMATIC

TRACKING MODULES

FUNCTION

The function of the TRACKING MODULE is to convert the linear tuning and sawtooth inputs to the non-linear output required to drive the OSCILLATOR module.

CIRCUIT DESCRIPTION

Since several inputs (center frequency, dispersion, and in some cases, vernier tuning) control the oscillator module they are added in a summing operational amplifier consisting of integrated circuit 1C1 and transistors Q1 and Q2. The shape of the tracking curve, which determines the dial accuracy of the instrument is determined by a diode shaping network in the feedback loop. It consists of four pairs of potentiometers, each controlling the operation of one of four diodes. In each pair, the CUT potentiometer determines the point on the tuning curve, at which the diode cuts in, while the SLOPE potentiometer controls the slope of the curve from that point to the next.

In addition, a centering adjustment is provided to permit the overall range to be set as required, and adjustments for initial gain (zero slope) and vernier tuning range are also available.

MAINTENANCE AND REPAIR

When a malfunction has been localized to this module, this module should not be removed from the instrument frame. The following procedure should then be used to trouble shoot the module:

Perform a D.C. check of voltages on the emitter, base and collector of each transistor stage. Nominal voltages are indicated on the module schematic. These voltages are obtained under the following conditions:

A. Center Frequency at Mid-Band

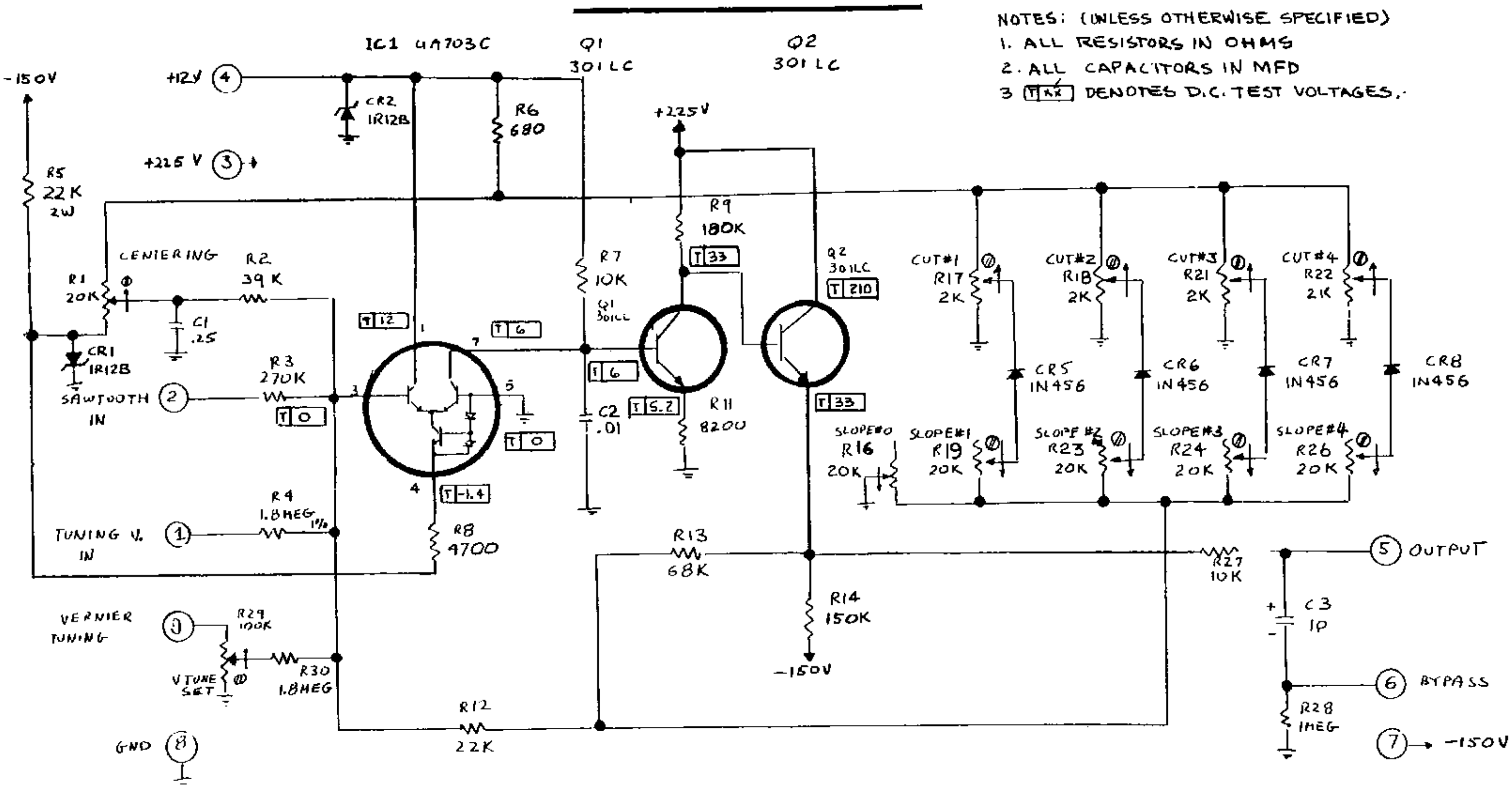
B. Dispersion dial at minimum

Once a particular section of the module is found to be inoperative, individual components may be replaced until satisfactory operation is attained.

ALIGNMENT AND TEST

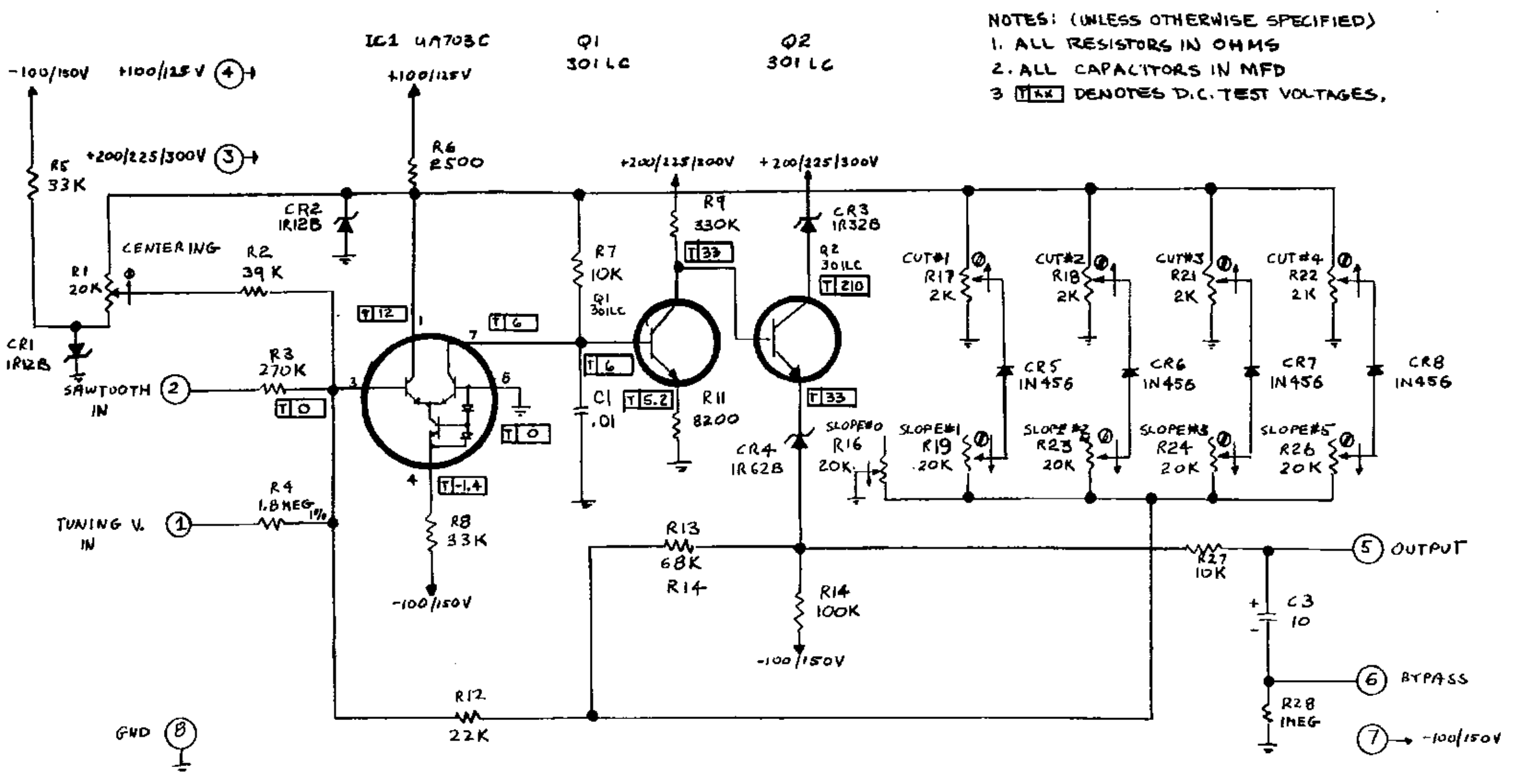
This module may be aligned only when it is installed in the analyzer frame. Alignment of the module actually constitutes alignment of the frame. Likewise, test of this module is not practical on a modular basis. The tracking module may only be tested within the analyzer frame. Instructions for alignment and test are therefore to be found in the main section of the manual of which this module is a part.

TRACKING MODULE 1-588



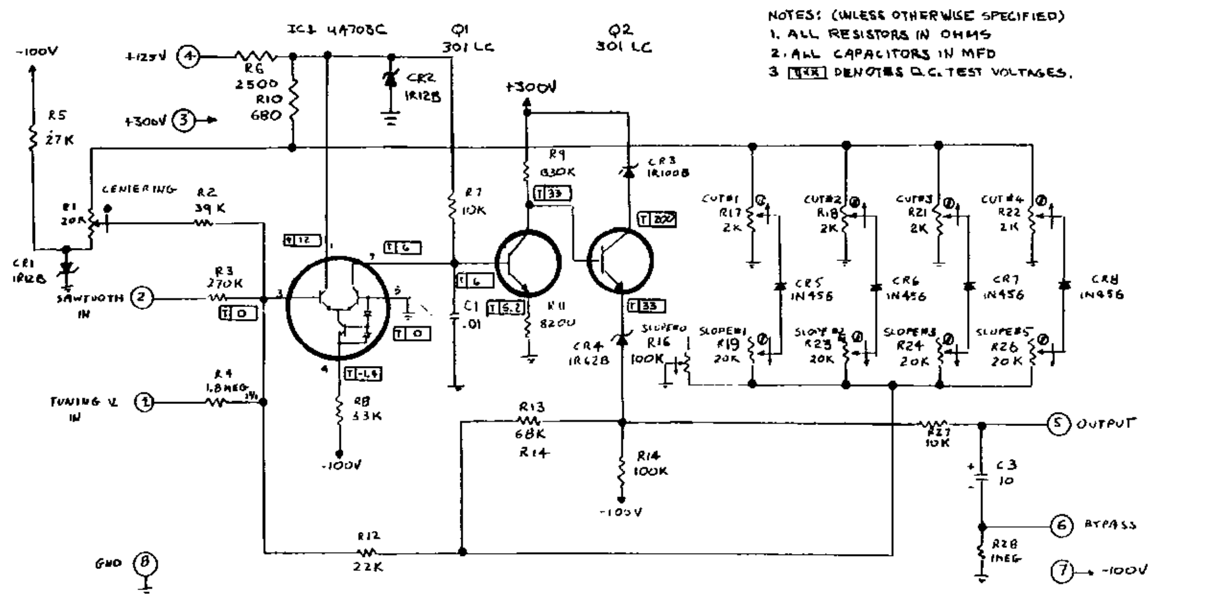
R1 Potentiometer 20K Bourns 3067
R2 Film Resistor ½W 1% 39K
R3 Film Resistor ½W 1% 270K
R4 Film Resistor ½W 1% 1.8M
R5 Resistor 2W 22K 5%
R6 Resistor ½W 1% 680
R7 Resistor ½W 5% 10K
R8 Resistor ½W 5% 4.7K
R9 Resistor ½W 5% 180K
R10 Not Used
R11 Resistor ½W 5% 8.2K
R12 Film Resistor ½W 1% 22K
R13 Film Resistor ½W 1% 68K
R14 Resistor ½W 5% 150K
R15 Not Used
R16 Same as R1
R17 Potentiometer 2K Bourns 3067
R18 Same as R17
R19 Same as R1
R20 Not Used
R21 Same as R17
R22 Same as R17
R23 Same as R1
R25 Not Used
R26 Same as R1
R27 Same as R7
R28 Resistor ½W 5% 1M
R29 Potentiometer 100K Bourns 3068
R30 Same as R4
C1 Capacitor Paper .22 Amperex C280AE/A220K
C2 Disc Capacitor .01 @ 200V Centralab DD6-103
C3 Electrolytic Capacitor 10mf 100V Sprague TE1407
Q1 Transistor 301LC Industro
Q2 Same as Q1
IC1 IC Fairchild U703C
CR1 Diode 1R12B
CR2 Same as CR1
CR3 Diode 1R32B
CR4 Diode 1R62B
CR5 Diode 1N456
CR6 Same as CR5
CR7 Same as CR5
CR8 Same as CR5

TRACKING MODULE 1-589

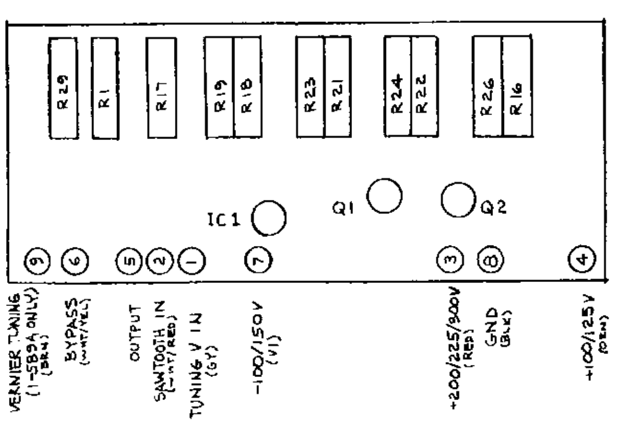


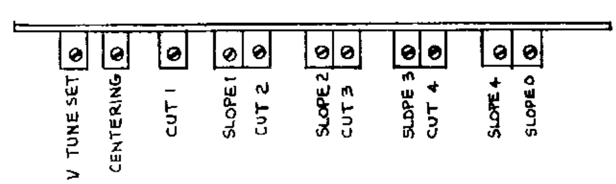
R1	Potentiometer 20K Bourns 3067
R2	Resistor, Film ½W 1% 39K
R3	Resistor, Film ½W 1% 270K
R4	Resistor, Film ½W 1% 1.8M
R5	Resistor ½W 5% 33K
R6	Resistor, WW 5W 2500 Ω
R7	Resistor ½W 5% 10K
R8	Resistor 1W 5% 33K
R9	Resistor ½W 5% 330K
R10	Not Used
R11	Resistor ½W 5% 8.2K
R12	Resistor ½W 1% 22K
R13	Resistor, Film ½W 1% 68K
R14	Resistor, ½W 5% 100K
R15	Not Used
R16	Potentiometer 20K [redacted] Bourns 3067
R17	Potentiometer 2K Bourns 3067
R18	Same as R17
R19	Same as R1
R20	Not Used
R21	Same as R17
R22	Same as R17
R23	Same as R1
R24	Same as R1
R25	Not Used
R26	Same as R1
R27	Same as R7
R28	Resistor ½W 5% 1M
C1	Capacitor, Disc [redacted]01 @ 600V
C2	[redacted]r, [redacted] NOT USED
C3	Capacitor, Electrolytic 10mfu 100WV Sprague TE1407
Q1	Transistor 301LC Industro
Q2	Same as Q1
IC1	IC Fairchild U703C
CR1	Zener Diode 1R12B
CR2	Same as CR1
CR3	Zener Diode 1R32B
CR4	Zener Diode 1R62B
CR5	Diode 1N456
CR6	Same as CR5
CR7	Same as CR5
CR8	Same as CR5

TRACKING MODULE 1-904



R1	Potentiometer 20K Bourns 3067	
R2	Resistor, Film ½W 1% 39K	
R3	Resistor, Film ½W 1% 270K	
R4	Resistor, Film ½W 1% 1.8M	
R5	Resistor ½W 5% 27K	
R6	Resistor, WW 5W 2500 Ω	
R7	Resistor ½W 5% 10K	
R8	Resistor 1W 5% 33K	
R9	Resistor ½W 5% 330K	
R10	Not Used	
R11	Resistor ½W 5% 8.2K	
R12	Resistor, Film ½W 1% 22K	
R13	Resistor, Film ½W 1% 68K	
R14	Resistor ½W 5% 100K	
R15	Not Used	
R16	Potentiometer 100K Bourns 3068	
R17	Potentiometer 2K Bourns 3067	
R18	Same as R17	
R19	Same as R1	
R20	Not Used	
R21	Same as R17	
R22	Same as R17	
R23	Same as R1	
R24	Same as R1	
R25	Not Used	
R26	Same as R1	
R27	Same as R7	
R28	Resistor ½W 5% 1M	
C1	Capacitor, Disc .01 @ 600V CRL DD6-103	
C2	Not Used	
C3	Capacitor, Electrolytic 10mfd 100WV Sprague TE1407	
Q1	Transistor Industro 301LC	
Q2	Same as Q1	
IC1	IC Fairchild U703C	
CR1	Zener Diode 1R12B	
CR2	Same as CR1	
CR3	Zener Diode 100B	
CR4	Zener Diode 1R62B	
CR5	Diode 1N456	
CR6	Same as CR5	
CR7	Same as CR5	
CR8	Same as CR5	





COMPONENT LOCATION ALL MODULES

BROADBAND BALANCED MIXER

Nelson-Ross Electronics Broadband Balanced Mixers 1-912 and 1-913 are doubly balanced diode quads arranged as ring modulators and designed for a fixed 500 MHz IF output. This construction offers both L.O. and IF rejection together with low distortion.

1-912 and 1-913 are identical except for input impedance and connector type at the SIGNAL jack. The 1-912 has a 50 ohm input and utilizes a UG697 type connector while the 1-913 has a 75 ohm input and is provided with a Jerrold CATV connector. Both are made in -1 styles (no marker input) jack and -2 styles (marker input). Probe power is injected into the SIGNAL IN connector via an internal resistor.

Since these mixers are simple and reliable, they should require very little attention. If parts should need replacement, however, it is important that exact equivalents be used. In no case should any diode except an original Nelson-Ross part be used.

There are two adjustments - TUNING and BALANCE. These adjustments should be made in a working spectrum analyzer. The TUNING adjustment is set for maximum sensitivity, while the BALANCE is adjusted for minimum zero signal. Since these adjustments interact, they should be repeated several times to find the optimum points.

PARTS LIST 1-912

R1 Resistor ¼W 5% 1000 Ω
R2 Resistor ¼W 5% 56 Ω
R3 Same as R2

C1 Paper Capacitor .1 @ 200V
Amperex C280AE/A100K
C2 Feed Thru Capacitor 1000PF
Erie 321-000-X5V0-102M
C3 Trimmer Capacitor 2.5-11PF
538-000-90R
C4 Capacitor 4.7PF
Stackpole Type GA
C5 Same as C3

Connector UG697/U

CR1-4 Diode Quad A1001-105

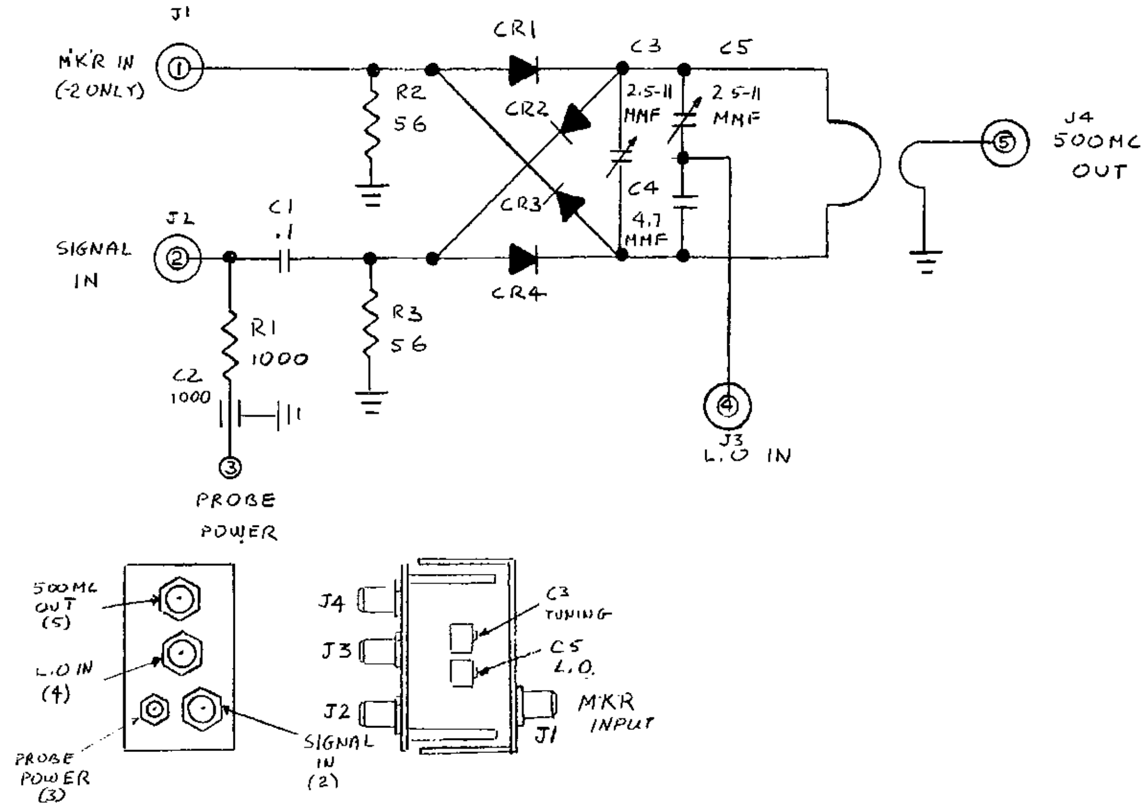
PARTS LIST 1-913

R1 Resistor
R2 Resistor ¼W 5% 82 Ω
R3 Same as R2

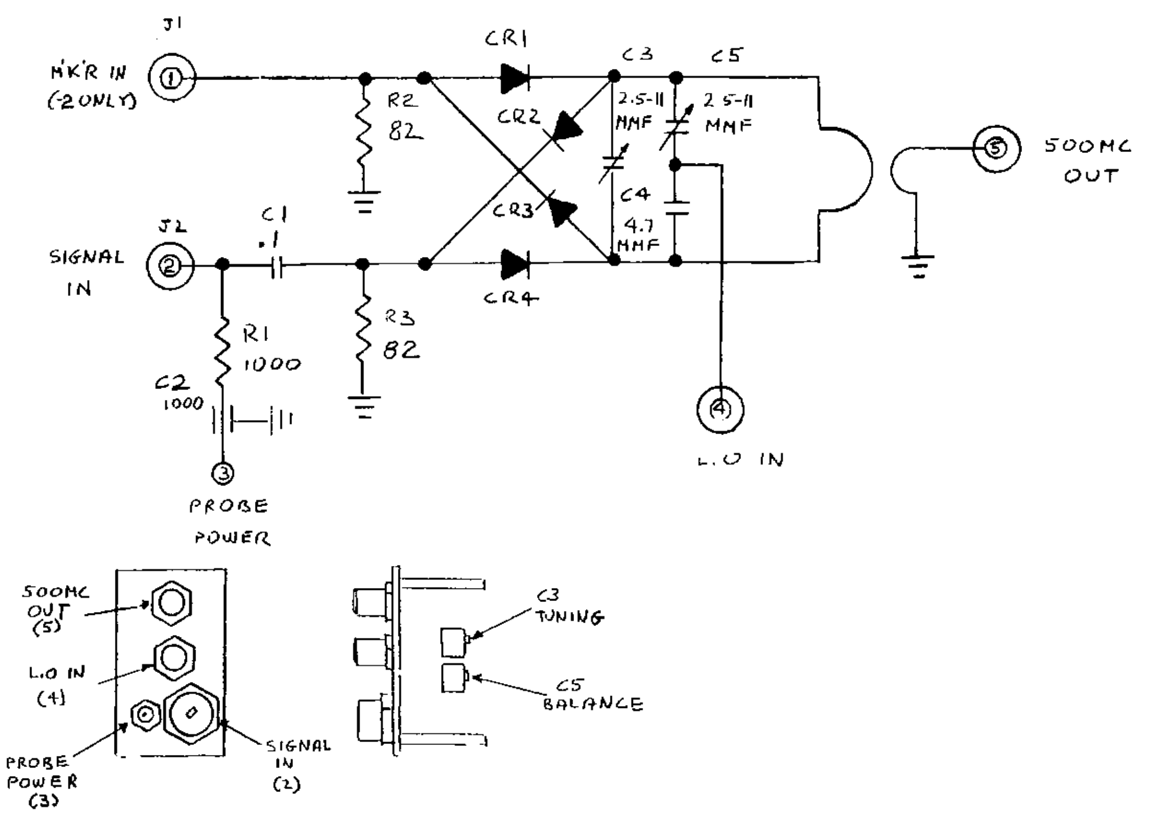
C1 Capacitor .1 Paper @ 200V
Amperex C280AE/A100K
C2 Feed Thru Capacitor 1000PF
Erie 321-000-X5V0-102M
C3 Trimmer Capacitor 2.5-11PF
Erie 538-000-90R
C4 Capacitor 4.7
Stackpole Type GA
C5 Same as C3

Connector Jerrold F61A
Connector UG697/U

CR1-4 Diode Quad A1001-108

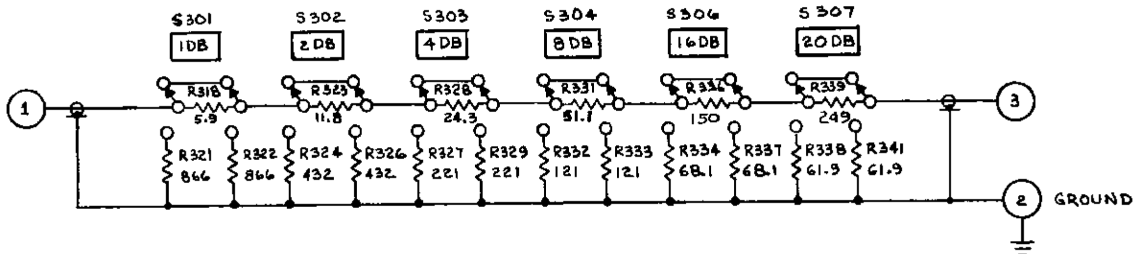


SCHEMATIC 1-912



SCHEMATIC 1-913

50Ω 51db ATTENUATOR



NOTE:
1. ALL RESISTORS IN OHMS.
2. THIS SCHEMATIC VALID FOR ALL DASH NO.

PARTS LIST

S301	Switch C & K Components 7201
S302	Same as S301
S303	Same as S301
S304	Same as S301
S305	Not Used
S306	Same as S301
S307	Same as S301
R318	Resistor ½W 1% 5.9 Ω
R319	Not Used
R320	Not Used
R321	Resistor ½W 1% 866 Ω
R322	Same as R321
R323	Resistor ½W 1% 11.8 Ω
R324	Resistor ½W 1% 432 Ω
R325	Not Used
R326	Same as R324
R327	Resistor ½W 1% 221 Ω
R328	Resistor ½W 1% 24.3 Ω
R329	Same as R327
R330	Not Used
R331	Resistor ½W 1% 51.1 Ω
R332	Resistor ½W 1% 121 Ω
R333	Same as R332
R334	Resistor ½W 1% 68.1 Ω
R335	Not Used
R336	Resistor ½W 1% 150 Ω
R337	Same as R334
R338	Resistor ½W 1% 61.9 Ω
R339	Resistor ½W 1% 249 Ω
R340	Not Used
R341	Same as R338

WARRANTY

NELSON-ROSS ELECTRONICS, INC. WARRANTS EACH INSTRUMENT MANUFACTURED BY THEM TO BE FREE FROM DEFECTS IN MATERIAL AND WORKMANSHIP. OUR LIABILITY UNDER THIS WARRANTY IS LIMITED TO SERVICING OR ADJUSTING ANY INSTRUMENT RETURNED FOR THAT PURPOSE AND TO THE REPLACEMENT OF ANY DEFECTIVE PARTS THEREOF. THIS WARRANTY DOES NOT COVER FUSES, BATTERIES AND TUBES. THIS WARRANTY IS EFFECTIVE FOR ONE YEAR AFTER DELIVERY TO THE ORIGINAL PURCHASER, WHEN THE INSTRUMENT IS RETURNED, TRANSPORTATION PREPAID, AND WHEN OUR EXAMINATION PROVES TO OUR SATISFACTION THAT THE INSTRUMENT IS DEFECTIVE. DEFECTS DUE TO ABUSE, MISUSE OR ABNORMAL CONDITIONS OF OPERATIONS WILL BE REPAIRED AT COST, ON APPROVAL OF ESTIMATE.