

MODEL

PSA 511B

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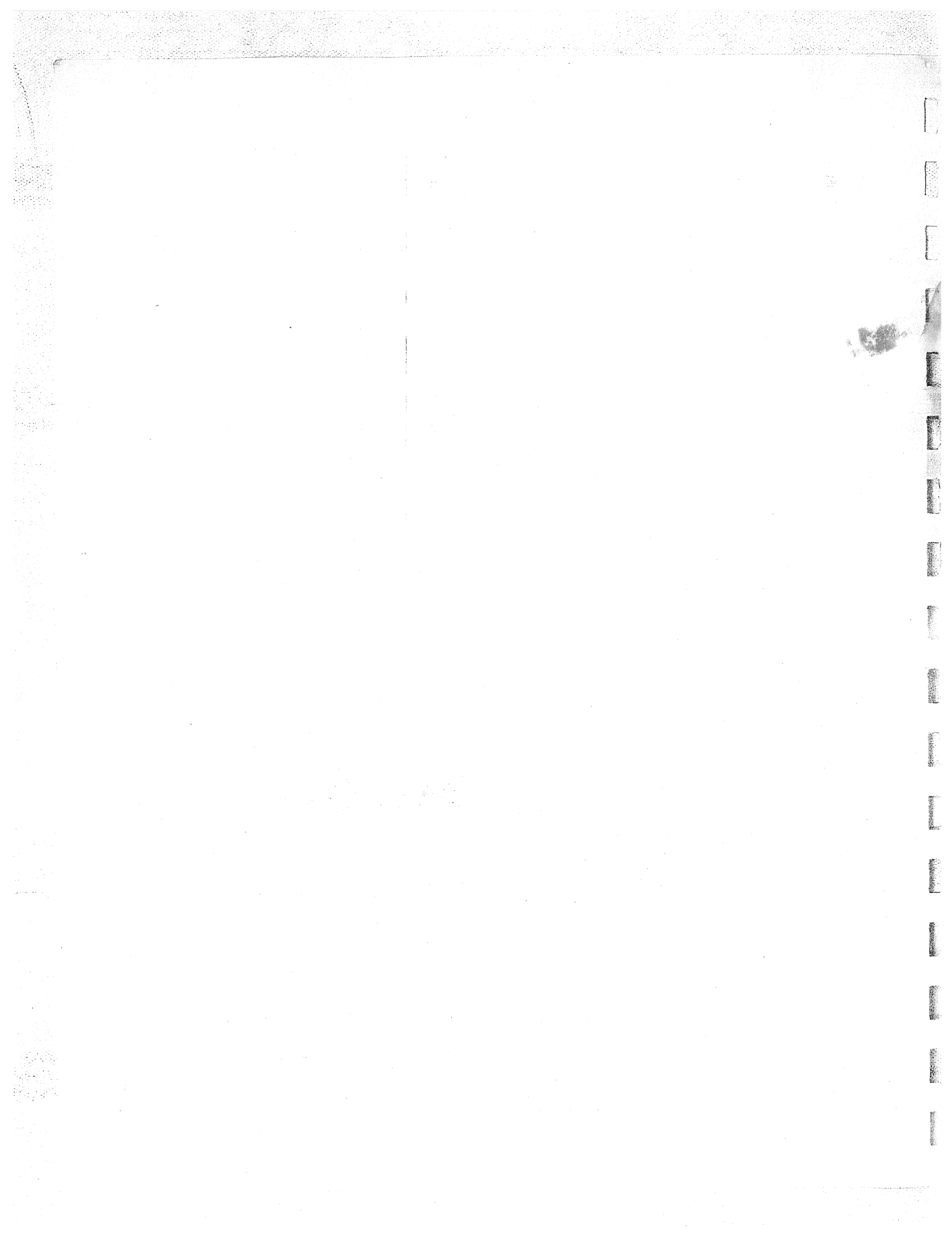


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SECTION 1

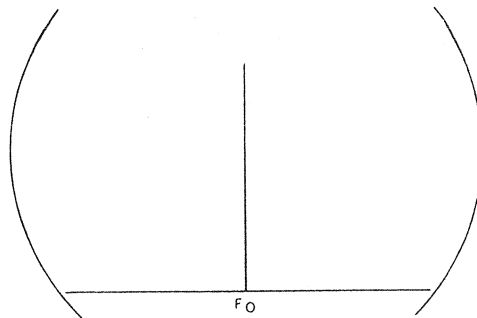
GENERAL INFORMATION

Before operating a NELSON-ROSS wideband Plugin Spectrum Analyzer it is important to have a clear understanding of the nature of spectral displays and the data they can provide. Used conventionally, the purpose of an oscilloscope is to provide a visual display of an electrical signal, presenting the amplitude with respect to time. In such a presentation, the horizontal axis of the CRT tube 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 display can be understood with the aid of the following illustrative examples: Single Frequency, Idealized

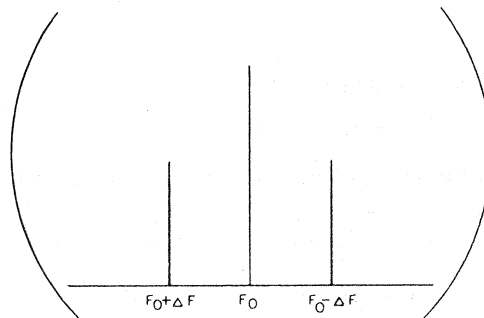
An ideal spectrum analyzer will display a signal containing energy at only one frequency as a single vertical line:



C W SIGNAL AS SEEN ON IDEAL
SPECTRUM ANALYZER

Multiple Frequencies, Idealized

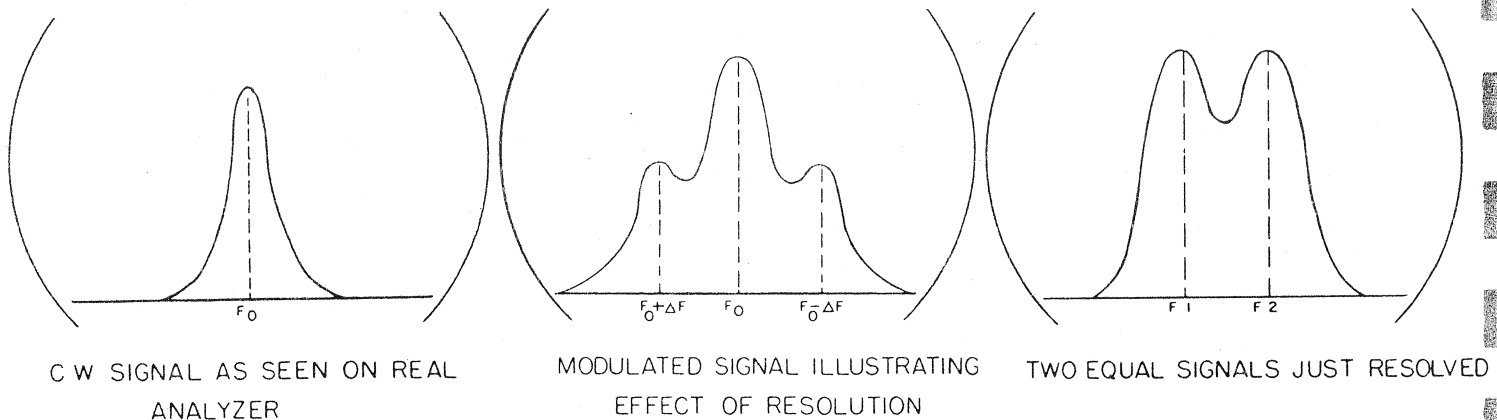
Multiple signals would appear as multiple vertical lines however close in frequency they may be. A carrier modulated by sidebands at plus and minus a small frequency increment would thus appear as shown:



MODULATED SIGNAL ON IDEAL
ANALYZER

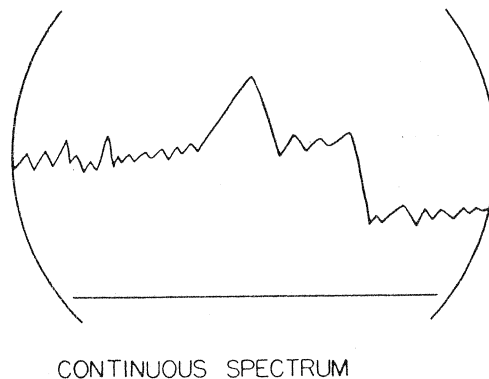
Single and Multiple Frequency Displays

An actual spectrum analyzer, however, cannot present an infinitely narrow vertical line. Instead the signal is broadened into a pulse. Similarly, multiple signals, closer together than the width of the pulse, will tend to blend. This illustrates resolution, a basic spectrum analyzer parameter which must be considered. The smaller the frequency difference which can be discerned, the better 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:



Continuous Spectrum

Signals containing frequency components spaced closer than the resolution of the analyzer generate a continuous spectrum:



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 kHz/cm or MHz/cm) on the cathode-ray tube

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

Since 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 mathematically:

$$\frac{\text{Scan Width}}{\text{Scan Time}} = (\text{Resolution})^2$$

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.

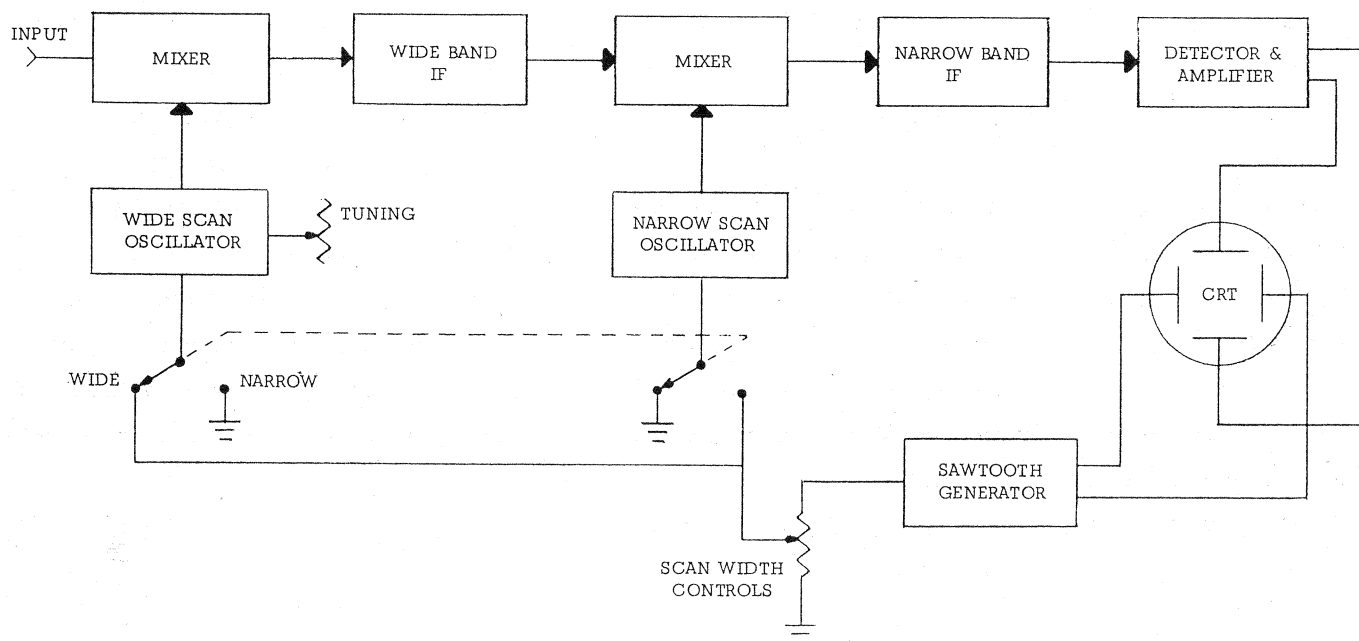
This is an important point to remember - contrary to conventional oscilloscope operation, with spectrum analyzers slower sweep speeds produce better displays. Since NELSON-ROSS Plugin Spectrum Analyzers fit oscilloscopes with high sweep speed capabilities, the operator must remember to reduce the sweep speed sufficiently to obtain a good display. For operator convenience, NELSON-ROSS Wideband Plugin Analyzers are provided with automatic resolution. In this mode of operation the resolution is programmed with the scan width so that a constant optimum scan rate may be maintained. This scan rate is automatically provided in instruments with internal scan rate generators. For instruments which utilize the oscilloscope sweep generator, the correct setting of the sweep time controls is in the technical specifications of the instrument (see section 2 of this manual).

ANALYZER OPERATION

A spectrum analyzer is basically a superheterodyne receiver which is swept across a band of frequencies in synchronization with a CRT display.

BLOCK DIAGRAM

The combination of swept receiver and display produce a plot of frequency verses amplitude (the spectrum) of an input signal. A typical block diagram is given below:



The receiver is of the double superheterodyne type (Many spectrum analyzers have additional conversions in the narrow band IF system, to obtain better resolution at lower IF frequencies). For wide scan widths the narrow scan oscillator is fixed and the wide scan oscillator is scanned. For narrow scan widths the wide scan oscillator is fixed, usually by phase locking techniques (it may be manually tuned to set the display center frequency), and the narrow scan oscillator scanned. The maximum scan width is then limited by the wide band IF bandpass.

Local Oscillators & The Display

The scanned local oscillator performs two functions: First, by virtue of its presence, it heterodynes the input into the IF for amplification by the spectrum analyzer. Second, since it is swept, it develops the spectrum of the input on the display.

The frequency of the local oscillator can be treated in one of two ways. The instantaneous frequency can be used, or the oscillator may be considered as deviating about an average (center) frequency. Since the oscilloscope's horizontal deflection is synchronized with the frequency deviation of the local oscillator, the use of the instantaneous frequency relates calculated frequency responses to specific points on the display. The use of center frequency in calculations will provide the response at the center of the display. In general, when the local oscillator is swept over a wide range of frequencies, it is better to use the instantaneous frequency, while for small local oscillator deviations (10% or less) the center frequency is more convenient. In either case, the relationships between the local oscillator and instrument response frequencies are the same. The following discussion applies in either case: When two signals are applied to a mixer, the output (of the mixer) will contain the sums and differences of the input and of all their harmonics. If the output circuit will respond to only one frequency (the IF frequency) and if one input is very small compared to the other, an output will appear only when the sum or difference of the smaller input and "n" times the larger input equals the IF frequency. The large input is the local oscillator, while the smaller input is the signal. Expressed mathematically, an output occurs when:

$$f_s = n f_o \pm IF$$

$$f_s = \text{signal frequency}$$

$$f_o = \text{L.O. Frequency}$$

From this it may be seen that there are many possible signal responses for each local oscillator frequency. The amplitude of these outputs decrease as n increases. The prime responses occur when n equals 1, and are separated by twice the IF frequency. Accordingly "n" is called the "order" of the response. Higher order responses occur when n is greater than one. They also occur in pairs separated by twice the IF and are indistinguishable from prime responses (or from other high order responses) except by their lower amplitude. Such responses are commonly used for analyzing high frequencies with a lower frequency local oscillator.

The scan width of the display (the width in frequency) is equal to scan width of the local oscillator multiplied by the order of the display (n).

Frequency Bands

The increasing frequency of the high order responses may be taken advantage of to provide wide frequency coverage with a low frequency oscillator. Each response will provide a frequency band. On NELSON-ROSS Wideband Plugin Spectrum Analyzers, the actual display center frequency is indicated on a directreading dial, along with the order and the sign (sum or difference) of the mixer response required to generate the display.

Wide Scans

In wide scan operation the same signal may possibly be seen at more than one point on the display. This is because the first local oscillator, when scanned, will pass through more than one mixer order. Since harmonics of the oscillator are used to generate the bands, the dispersion is also proportional to n . This is automatically compensated for in NELSON-ROSS Plugin Spectrum Analyzers. Each response provides the correct scan width only on its own band. It is therefore important to set the Band Switch to the proper band for the response selected.

Narrow Scans

In narrow scan the wide scan oscillator is fixed, except for manual tuning. Scanning is accomplished by the narrow scan oscillator. In this mode the display will contain no spurious responses. Each mixer response, however, may be selected with the manual tuning control. The scan width is independent of the order, so location of the proper band serves no function other than identification of the signal frequency. If the frequency is known, band selection may be omitted.

SECTION 2

CHARACTERISTICS

The NELSON-ROSS Plugin Spectrum Analyzer, Model PSA-511 is designed so that it may be conveniently plugged into any Tektronix oscilloscope that accepts letter-series plugins. 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. Sweep voltage is obtained from the oscilloscope via a banana-to-banana cable. The all solid state Model PSA-511 covers the frequency range of 10 MHz to 4.5 GHz. A wide range of internal scans from 500 Hz/cm to 100 MHz/cm are provided. Scan widths to 1 GHz are realizable. IF Bandwidths from 1 kHz may be readily selected by means of a front panel switch. High sensitivity, flat response and high stability are inherently characteristic of the PSA-511. This model also possesses such other features as linear, 60 db log and 13 square db square law displays; 59 db IF attenuator with digital readout, 40 db IF gain; video filtering; horizontal and vertical outputs.

TECHNICAL SPECIFICATIONS

SPECIFICATION: PSA-511

COMPATIBLE OSCILLOSCOPES: Tektronix letter series or equivalent

CENTER FREQUENCY RANGE: 10 MHz to 4.5 GHz

TUNING DIAL ACCURACY: $\pm 5\%$ of dial reading or 15 MHz, whichever is greater
(may be calibrated to $\pm 5\%$ at any frequency below 300 MHz by means of LF CAL panel adjustment)

FREQUENCY IDENTIFICATION: In BAND LOCATE mode, band switch is rotated until signal is centered on the display. Correct frequency scale is automatically provided so that center frequency may be read directly. Mixing mode is simultaneously indicated on the band switch.

SENSITIVITY:	Frequency Range	Band	Minimum Sensitivity *
	0-0.5 GHz	1-	-90 dbm
	1.0-1.5 GHz	1+	-90 dbm
	0.5-1.5 GHz	2-	-85 dbm
	1.5-2.5 GHz	2+	-85 dbm
	1.0-2.5 GHz	3-	-80 dbm
	2.0-3.5 GHz	3+	-80 dbm
	1.5-3.5 GHz	4-	-75 dbm
	2.5-4.5 GHz	4+	-75 dbm

* Signal + noise = 2x noise at 1 kHz Resolution

STABILIZED TUNING: Phase lock automatically activated at Dispersions of 100 kHz/cm or less. Front panel control provides lock adjustment.

DISPERSION/SCAN WIDTH:

17 calibrated positions selectable with front panel switches:

- | | | |
|---------------|----------------|----------------|
| 1. 0 kHz/cm | 7. 20 kHz/cm | 13. 5 MHz/cm |
| 2. 0.5 kHz/cm | 8. 50 kHz/cm | 14. 10 MHz/cm |
| 3. 1 kHz/cm | 9. 100 kHz/cm | 15. 20 MHz/cm |
| 4. 2 kHz/cm | 10. 0.5 MHz/cm | 16. 50 MHz/cm |
| 5. 5 kHz/cm | 11. 1 MHz/cm | 17. 100 MHz/cm |
| 6. 10 kHz/cm | 12. 2 MHz/cm | |

Dispersion continuously adjustable between calibrated fixed positions with front panel control

DIPERSION ACCURACY:

± 10%

RESOLUTION/IF BANDWIDTH:

Automatically programmed with Dispersion (5 MS/CM Scan Speed)

Uncoupled: 1, 5, 10, 20 and 200 kHz

Selectable with front panel switch

VERTICAL DISPLAYS:

Linear, 60 db Logarithmic and 13 db Square Law
Selectable with front panel switch

AMPLITUDE RESPONSE FLATNESS:

± 2 db over 500 MHz Dispersion

IMAGE SEPARATION:

1 GHz (500 MHz 1st IF)

DISPLAY DYNAMIC RANGE:

60 db

INCIDENTAL FM:

Less than 1000 Hz for fundamental mixing

INPUT IMPEDANCE:

50 ohms

TNC type connector

INPUT SIGNAL LEVEL:

20 dbm (maximum) *

IF ATTENUATOR:

59 db range in 1 db steps; digital readout

± 0.1 db/db

IF GAIN:

40 db (nominal)

Continuously variable with front panel control

SCAN RATE:

Automatic: 1/sec to 60/sec

VIDEO FILTER:

1 millisecond

Selectable with front panel switch

HORIZONTAL & VERTICAL OUTPUTS:

0 to 1 volt from 1K maximum DC coupled at ground

Two circuit phone jack on front panel

POWER REQUIREMENTS:

All power and voltages from oscilloscope

<u>*Band</u>	<u>Maximum Input Signal</u>
1-, 1+	-20 dbm
2-, 2+	-15 dbm
3-, 3+	-10 dbm
4-, 4+	-5 dbm

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 VERTICAL SCALE SELECTOR LINK

Oscilloscopes which accept letter series plugins have either 4 or 6 centimeter vertical scales. All NELSON-ROSS plugin analyzers are shipped from the factory set for 6CM vertical scales. Provision is made for soldering a link within the analyzer to accommodate the 4CM scale. The link should be installed on the POWER SUPPLY card, which is plugged into the rearmost socket of the instrument frame. The link terminals are available without equipment disassembly. They are on the upper edge of the card. Determine the vertical scale of your instrument, and add the link, if required. Should you later care to transfer the plugin from a unit with a 4CM scale to one with a 6CM scale, you may remove the link.

INSTALLATION OF THE PLUGIN

Insert the plugin into any Tektronix oscilloscope accepting letter series type plugins. Tighten the hold down screw at the bottom center of the panel and connect a banana-to-banana cable between the SWEEP IN jack on the lower right hand corner of the analyzer panel and the sawtooth out connector on the oscilloscope panel.

SETTING OF OSCILLOSCOPE CONTROLS

Turn on the oscilloscope and allow approximately 5 minutes warm up time. Set the oscilloscope sweep controls as follows:

Triggering Mode	automatic
Trigger Slope	ext -
Stability	Preset (fully counter-clockwise)
Triggering Level	zero (centered)
Sweep Time	approximately 5 milliseconds per centimeter
Horizontal Display	internal sweep

This will provide a free running sweep of approximately 20 sweeps per second on the display. Adjust the horizontal position controls on the oscilloscope to provide a sweep starting at the left-most graticule line and continuing off the screen on the right.

INITIAL SETTINGS OF ANALYZER CONTROLS

Preset the analyzer controls as follows:

Display	60 db log
Band Selector	1 -
Vernier Tuning	centered

Scan Width/centimeter	50
Resolution	automatic
IF Attenuator	Zero db
kHz/MHz Switch	MHz
IF Gain	Fully counter-clockwise
Video Filter	Off

INITIAL ADJUSTMENTS

Adjust the VERTICAL POSITION control on the analyzer to provide a trace on the lowest graticule line. Rotate the tuning dial to place the tuning cursor at zero MHz (at the left edge of the tuning dial). Adjust the LF CAL screwdriver adjust on the analyzer panel to position the zero signal at the center of the display. Rotate the SCAN WIDTH control to successively lower settings, readjusting the LF CAL each time to maintain the zero signal in the center of the display (until the .5 position is reached). Then rotate the SCAN WIDTH control clockwise to the 100 position and adjust the DISPERSION BAL screwdriver adjust (located below the vernier tuning control) to recenter the zero signal so that movement of the SCAN WIDTH control does not cause shift in the position of the zero signal on the display. The instrument is now calibrated for use.

OPERATION - WIDEBAND (MHz/cm SCAN WIDTH)

To use the instrument, connect an input signal of -20 dbm or less to the input connector. (This is a TNC type connector which may be converted with adapters, to any other convenient input connector series). Set the SCAN WIDTH Control to 50 and the BAND SELECTOR to the 1 - position. Adjust the tuning dial so that the zero signal is at the left edge of the display (This will correspond to a Center Frequency setting of about 250 MHz). In this condition, any signal connected to the analyzer will appear somewhere on the CRT display. Adjust the IF GAIN control until sufficient gain is provided to display the signal. For higher frequency signals, more than one response may be visible. These are the various mixing modes of the analyzer. Each of the responses is either the signal or a harmonic of the signal (which will probably be the result of harmonics in the input signal, not harmonics generated within the instrument). Select the largest signal since this will be the lowest mixing mode and consequently will provide the greatest sensitivity. Center this on the display by means of the Tuning dial. The signal may be observed and spectrum analysis of its characteristics performed.

BAND LOCATION

If it is desired to determine the frequency of an unknown signal, center the signal on the display and progressively rotate the SCAN WIDTH control down to the .5 position (with the variable in CAL). Center the signal carefully by means of the tuning dial, then rotate the SCAN WIDTH control fully clockwise to Band Locate. The BAND SELECTOR should then be systematically placed in each of its positions. When the correct band is reached; the signal will return approximately to the center of the display. The mixing mode generating the display is then indicated on the band selector thumbwheel and the correct frequency dial is positioned behind the cursor, so that the instrument is direct reading for signals in

this mixing mode. The desired display mode may then be selected and the IF GAIN, RESOLUTION and IF ATTENUATOR used in the conventional manner. Please note that scan width settings above 50 MHz/cm may only be used on bands 2 through 4 since lower bands are only 500 MHz wide.

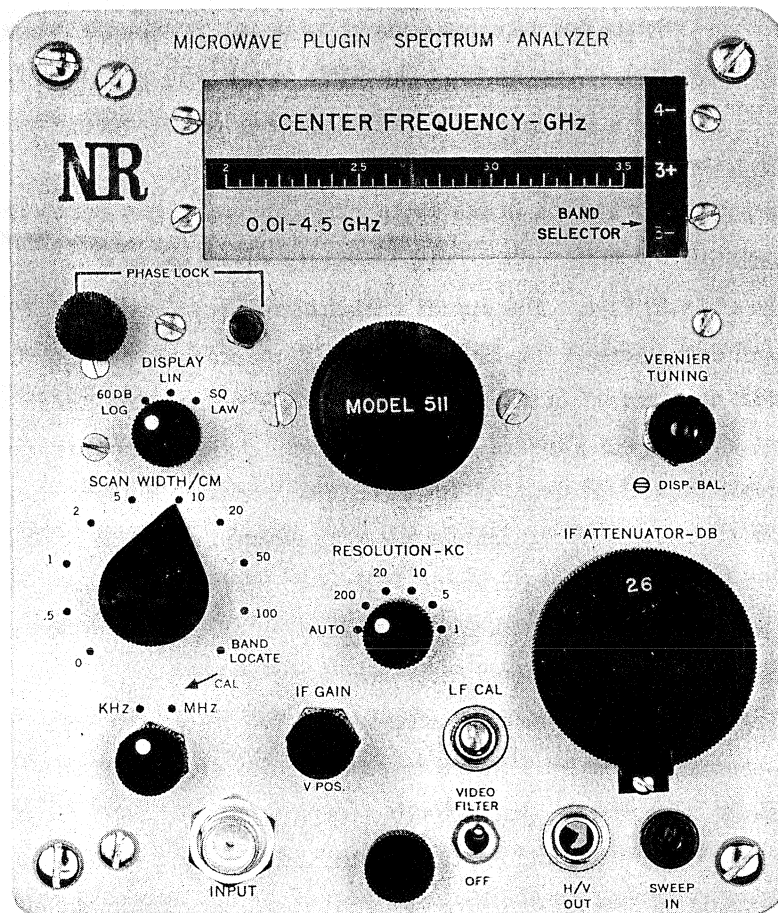
OPERATION - NARROW BAND (kHz/cm SCAN WIDTH)

If scan widths below .5 MHz are desired, the kHz/MHz switch should be rotated to the kHz position to provide scan widths from 100 kHz per centimeter down to zero. However, since phase lock is automatically actuated when the switch is turned from the MHz to the kHz position, the proper procedure must be followed in order to present a stable phase locked display on the CRT.

The procedure is as follows:

First, with the kHz/MHz switch in the MHz position, carefully center the signal in the smallest scan width available (.5 MHz/cm). Then rotate the SCAN WIDTH switch back to the 100 position and switch from MHz to kHz. The signal will disappear. Rotate the RESOLUTION switch to the 200 kHz position and depress the button which is located in the PHASE LOCK control grouping just below the left hand corner of the tuning dial. Slowly rotate the PHASE LOCK knob, in the same grouping, until the signal appears on the screen. As the knob is rotated, a series of beats will appear superimposed on the CRT display. Each beat is a point at which the phase lock will engage the first local oscillator. Locate the beat which is closest to the signal and then release the button. The instrument will be phase locked at this point and the vernier tuning control will then permit repositioning of the signal on the screen. Please note that in phase lock condition, the center frequency controls become inoperative and should not be disturbed, since rotating the center frequency control will break the phase lock and cause the signal to disappear. The VERNIER TUNING control should be utilized to position the signal on the screen. Phase lock action can be verified by determining that a small rotation of the PHASE LOCK knob does not tune the signal. The required narrow scan width may then be selected with the SCAN WIDTH switch while utilizing the vernier tuning to position the signal at the center of the display. The IF ATTENUATOR, RESOLUTION controls, IF GAIN and DISPLAY SELECTOR switch may be used in the usual manner while the instrument is phase locked.

Since phase lock is a system for stabilizing the first local oscillator in the analyzer, it provides stabilities of the order of 1 kHz on the display. However, long term drift due to thermal effects working on the first local oscillator, its power supply and drive circuits will cause the phase lock to periodically step or jump to the next possible lock point. When this occurs, do not touch the center frequency dial, since there is still a lock point available at the original setting. Merely press the button and rotate the PHASE LOCK control to reposition the signal on the center of the screen and release the button. This brings the lock point back to its original frequency and re-presents the display on the CRT screen. The PHASE LOCK knob may be trimmed slightly after the button is released to verify that the first local oscillator is not in lock, the PHASE LOCK control will permit re-positioning of the signal to the lock point. If the oscillator is in lock, small rotations of the LOCK SET control will have no effect, verifying the action of the lock.



FRONT VIEW

FIGURE 3-1

SECTION 4

EQUIPMENT DESCRIPTION

CIRCUIT DESCRIPTION

Refer to Block Diagram-Figure 4-1: The instrument is essentially a superheterodyne receiver with an extremely high first intermediate frequency and a wide open front end. The first local oscillator is manually tuned to determine the display center frequency. For wide scan widths the first local oscillator is also swept in synchronism with the CRT trace to provide a display of RF energy verses frequency. For narrow scan widths the first local oscillator frequency is fixed by phase locking and the second local oscillator is swept. This provides greater long term stability and eliminates incidental FM.

The first mixer drives an IF system consisting of a 500 MHz filter, the output of which is heterodyned down to 65 MHz by a mixer driven from the second swept local oscillator. This oscillator produces a 565 MHz signal and is tuned approximately ± 2.5 MHz by the second swept LO driver ($\pm .5$ MHz in kHz/cm scan width settings and approximately ± 2 by the FINE TUNING control).

The 65 MHz output of the mixer is amplified by a two stage integrated circuit amplifier. This amplifier also provides gain control action for the IF GAIN control. A step attenuator, driven by the output of this amplifier, provides calibrated IF attenuation.

The signal is then heterodyned down to 10.7 MHz by means of a mixer and crystal oscillator. Two stages of quartz crystal filtering provide adjustable resolution (band width). The band width of these filters is remotely programmed with DC voltages devised from the SCAN WIDTH and RESOLUTION switches. The filtered output is raised to a suitable level by an integrated circuit 10.7 MHz amplifier and fed to the last amplifier.

The last amplifier is an untuned, 4 stage RC coupled amplifier which produces linear, logarithmic and square law detected outputs. The selected output is buffered by means of a voltage follower and fed (via the plug on the rear of the analyzer) to the oscilloscope vertical deflection amplifier.

The sawtooth from the oscilloscope front panel jack is conditioned by an operational amplifier on the scan board to provide sawtooth drive for the SCAN WIDTH controls. This operational amplifier provides level shifting and gain control (via the band selector) to provide proper scan widths regardless of the oscillator harmonic selected. Depending on the position of the SCAN WIDTH RANGE switch, either the first or second oscillator is driven from the SCAN WIDTH switch. Placing the SCAN WIDTH RANGE selector in the narrow (kHz/cm) position automatically energizes the phase lock circuitry, enabling the operator to stabilize the display with the PHASE LOCK controls.

Band selection is accomplished by first centering a signal on the screen with the BAND SELECTOR in the lowest (1-) band then switching the SCAN WIDTH switch to the BAND SELECT position. This introduces offset voltages into both the first and second local oscillators. The BAND SELECTOR is then rotated until the signal is approximately back at the center of the screen. The combination of voltages

to the local oscillator in this position will be proper to cancel shifts due to harmonic and sum or difference mixing effects, so that the correct frequency scale will be visible behind the tuning pointer. The actual frequency of the signal may then be read directly, and the harmonic in use will be indicated on the BAND SELECTOR knob.

All power utilized by the analyzer circuiting is obtained from three sub-regulators which operate off the oscilloscope supplies, ensuring correct operation of the instrument regardless of the condition of the oscilloscope supplies.

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 (except for routine calibration). 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 is suggested for soldering of any components. Only high tin content solder is recommended.

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 plugin unit or the oscilloscope.

ISOLATION

Isolation of the trouble to either the oscilloscope or the plugin unit may be accomplished by either

of two possible 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 the correct maintenance procedures. If a spare unit is not available for substitution, further testing must be performed.

A plugin 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. All schematics and parts lists may be found in Section 6 of this manual. If the voltages measure incorrectly, remove the Plugin Spectrum Analyzer and recheck the voltages. At this point, if the voltages 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, loose coaxial cables, 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), or turn the oscilloscope on its side and remove the top and bottom covers.

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 DC 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 and horizontal 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 and printed circuit boards 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. Printed circuit boards may be unscrewed and swung out on their wires for service.

SECTION 6

SCHEMATICS, PARTS LISTS, & SERVICE INFORMATION

This section consists of several sub-sections, each containing the complete information for a module or similar sub-assembly of the instrument covered by this manual. Each sub-section is a complete package containing schematics, repair information, alignment procedures and replacement parts lists for the item covered.

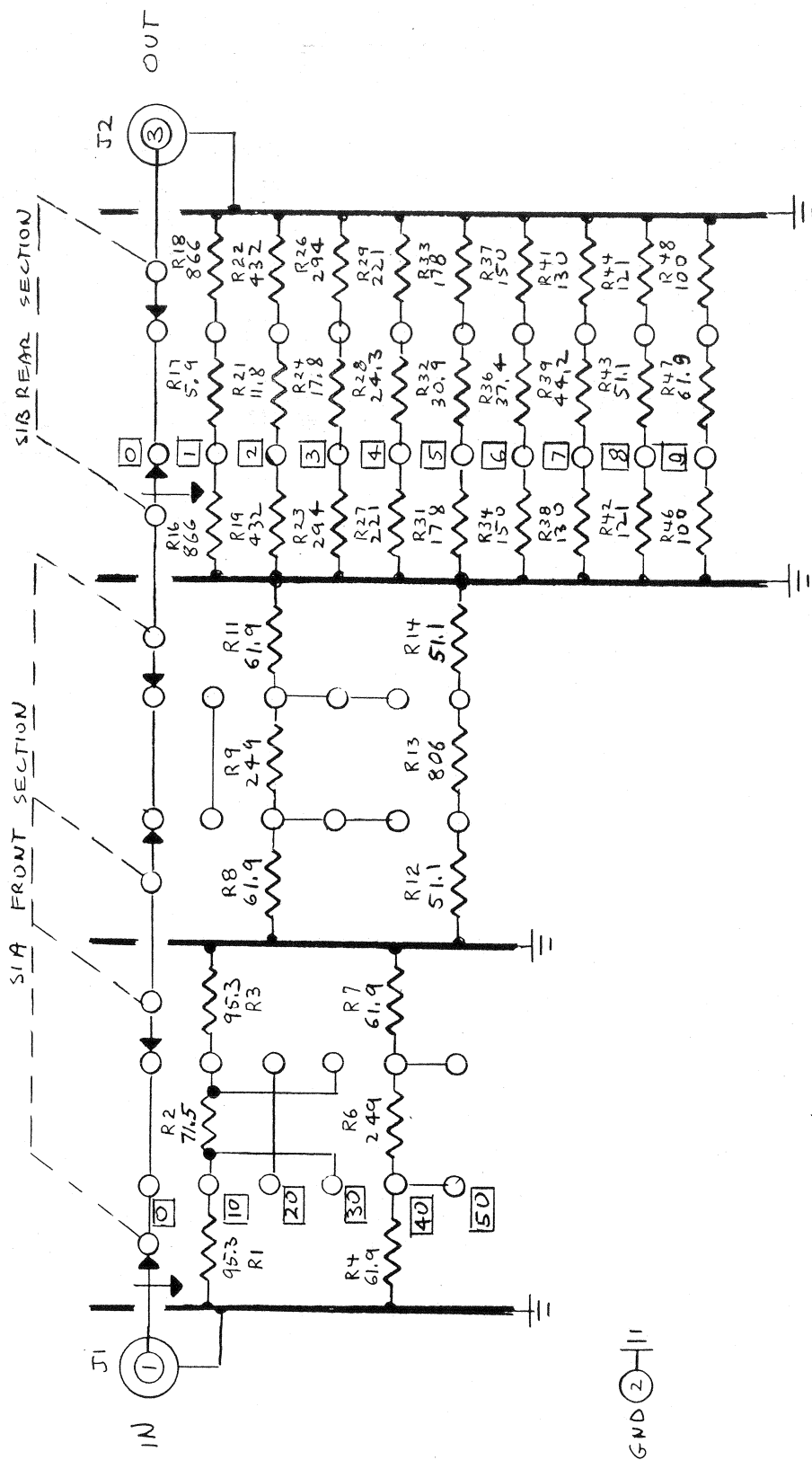
CONTENTS

2-013	Step Attenuator
2-083	Phase Lock Chassis
2-130	Log Lin Square Law Card
2-131	Input Crystal Filter Card
2-132	Output Crystal Filter Card
2-133	Scan Card
2-134	Power and Deflection Card
2-181	500 MHz Converter
2-208	65 MHz IF Amplifier Card
2-214	Mixer-Filter
2-309	Swept Oscillator
F-511	Frame PSA-511

STEP ATTENUATOR

PARTS LIST

J1	Connector UG 1619	R25	Not Used
J2	Same as J1	R26	Same as R23
R1	Resistor Film $\frac{1}{2}$ W 1% 95.3 Ω Dale MFF $\frac{1}{2}$ T1	R27	Resistor Film $\frac{1}{2}$ W 1% 221 Ω Dale MFF $\frac{1}{2}$ T1
R2	Resistor Film $\frac{1}{2}$ W 1% 71.5 Ω Dale MFF $\frac{1}{2}$ T1	R28	Resistor Film $\frac{1}{2}$ W 1% 24.3 Ω Dale MFF $\frac{1}{2}$ T1
R3	Same as R1	R29	Same as R27
R4	Resistor Film $\frac{1}{2}$ W 1% 61.9 Ω Dale MFF $\frac{1}{2}$ T1	R30	Not Used
R5	Not Used	R31	Resistor Film $\frac{1}{2}$ W 1% 178 Ω Dale MFF $\frac{1}{2}$ T1
R6	Resistor Film $\frac{1}{2}$ W 1% 249 Ω Dale MFF $\frac{1}{2}$ T1	R32	Resistor Film $\frac{1}{2}$ W 1% 30.9 Ω Dale MFF $\frac{1}{2}$ T1
R7	Same as R4	R33	Same as R31
R8	Same as R4	R34	Resistor Film $\frac{1}{2}$ W 1% 150 Ω Dale MFF $\frac{1}{2}$ T1
R9	Same as R6	R35	Not Used
R10	Not Used	R36	Resistor Film $\frac{1}{2}$ W 1% 37.4 Ω Dale MFF $\frac{1}{2}$ T1
R11	Same as R4	R37	Same as R34
R12	Resistor Film $\frac{1}{2}$ W 1% 51.1 Ω Dale MFF $\frac{1}{2}$ T1	R38	Resistor Film $\frac{1}{2}$ W 1% 130 Ω Dale MFF $\frac{1}{2}$ T1
R13	Resistor Film $\frac{1}{2}$ W 1% 806 Ω Dale MFF $\frac{1}{2}$ T1	R39	Resistor Film $\frac{1}{2}$ W 1% 44.2 Ω Dale MFF $\frac{1}{2}$ T1
R14	Same as R12	R40	Not Used
R15	Not Used	R41	Same as R38
R16	Resistor Film $\frac{1}{2}$ W 1% 866 Ω Dale MFF $\frac{1}{2}$ T1	R42	Resistor Film $\frac{1}{2}$ W 1% 121 Ω Dale MFF $\frac{1}{2}$ T1
R17	Resistor Film $\frac{1}{2}$ W 1% 5.9 Ω Dale MFF $\frac{1}{2}$ T1	R43	Same as R12
R18	Same as R16	R44	Same as R42
R19	Resistor Film $\frac{1}{2}$ W 1% 432 Ω Dale MFF $\frac{1}{2}$ T1	R45	Not Used
R20	Not Used	R46	Resistor Film $\frac{1}{2}$ W 1% 100 Ω Dale MFF $\frac{1}{2}$ T1
R21	Resistor Film $\frac{1}{2}$ W 1% 11.8 Ω Dale MFF $\frac{1}{2}$ T1	R47	Same as R4
R22	Same as R19	R48	Same as R46
R23	Resistor Film $\frac{1}{2}$ W 1% 294 Ω Dale MFF $\frac{1}{2}$ T1	S1	Switch Rotary B1001-014
R24	Resistor Film $\frac{1}{2}$ W 1% 17.8 Ω Dale MFF $\frac{1}{2}$ T1		



PHASE LOCK CHASSIS

FUNCTION

This chassis generates error signals which are used to lock the first local oscillator of the analyzer to a stable reference frequency. The reference frequency generator is also contained in this chassis.

Circuit Description

A crystal controlled 1 MHz oscillator is used as the stable reference. IC1 functions as the oscillator, with feedback provided by the crystal. The output of the oscillator is utilized to drive Q1, which is biased into the avalanche mode of operation. In this mode, every time the base goes positive the transistor breaks down, generating a fast negative pulse at the collector. This pulse drives snap-off diode CR2, generating fast balanced pulses through a pulse forming line. These pulses drive sampling diodes CR3 & CR4. The local oscillator signal appearing at J1 is sampled. If the frequency of the local oscillator is an exact harmonic of, and in phase with the sampling pulse repetition rate (1 MHz) the error signal will be zero. Phase deviations of the oscillator signal cause error output signals which ultimately find their way to the tuning input of the local oscillator, causing it to lock to the crystal clock in the phase lock chassis.

Maintenance and Repair

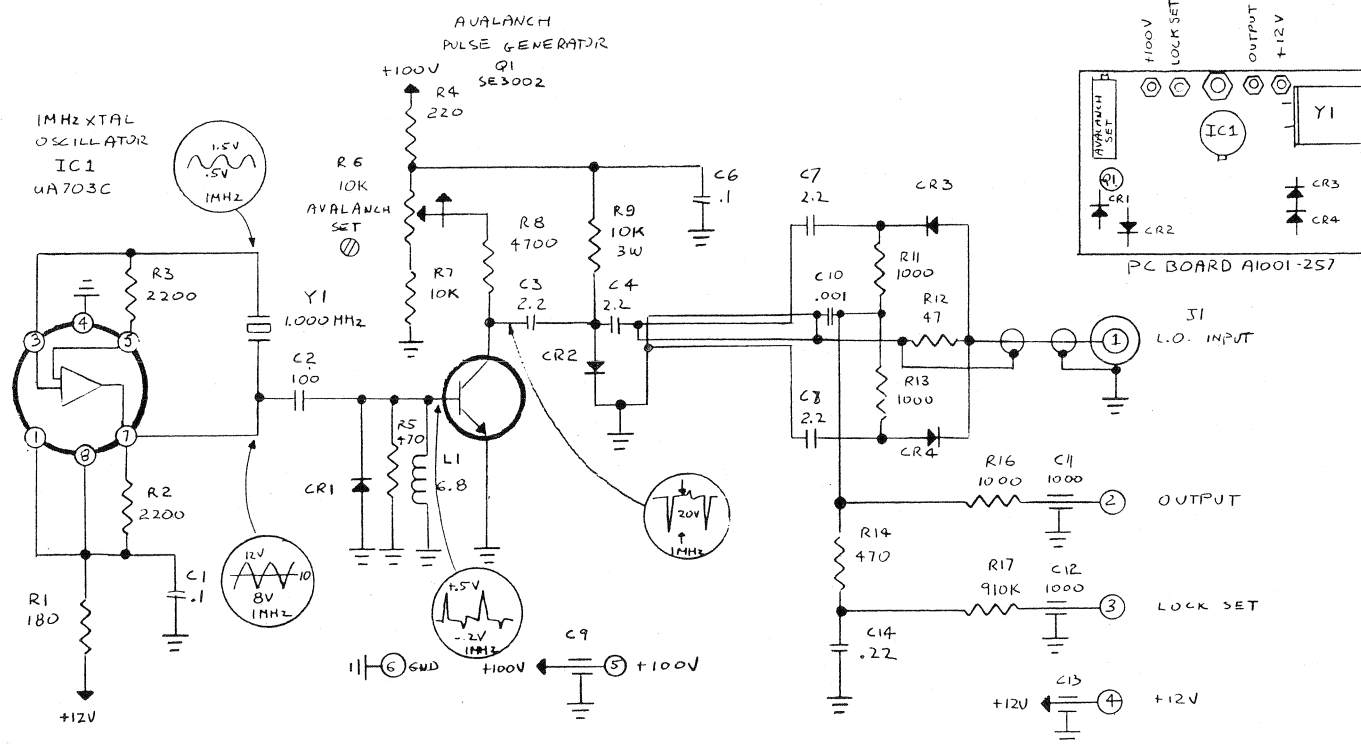
Since the pulses in the sampling circuit are extremely narrow, it is not practical to observe them on an oscilloscope. The oscillator waveforms can be checked (see schematic) and the avalanche pulse on the collector of Q1 may be observed. The sampling (phase detector) action may be checked by inserting a signal at J1 of 500 MHz, 0 dbm and observing beats on the output (terminal 3) as it is tuned from 500 MHz upward slowly towards 1000 MHz.

PARTS LIST

C1	Capacitor Paper .1mfd 200V Amperex C280AE/A100K	C12	Same as C9
C2	Capacitor Mica 100 pf CM15E101J	C13	Same as C9
C3	Capacitor Ceramic 2.2 pf 5% Stackpole Type GA	C14	Capacitor Paper .22 mfd TRW type X663F 50WVDC
C4	Same as C3	CR1	Diode Hot Carrier Hewlett Packard 2900
C5	Not Used	CR2	Varactor Snap-Off Microwave Assoc MA4755
C6	Same as C1	CR3	Same as CR1
C7	Same as C3	CR4	Same as CR1
C8	Same as C3	IC1	Integrated Circuit Fairchild UA703C
C9	Capacitor Feed Thru 1000 pf Erie 2425-003-102-AA	J1	Connector Bulkhead Micro T5003-178
C10	Capacitor Disc .001 CRL DD102	L1	Choke Molded 6.8 uhy Delevan 1557-32
C11	Same as C9		

- R8 Resistor Composition
1/4W 5% 47W

- Y1 Crystal 1.000 MHz
A1000-146-41



LOG-LIN SQUARE LAW CARD

FUNCTION

The function of this card 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 pin #3, the output of the fourth detector CR7. Square law video is obtained at the same terminal by inserting diodes CR3 and CR4 into the circuit. This is accomplished by ungrounding pin #5, 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 pin #5, biases diode CR3 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 pin #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. Potentiometer R24 "LOG SCALE SET" adjusts the output level in LOG to accommodate the sensitivity at the instrument vertical amplifier. To correct for production variations in transistor Beta, R9 and R26 may be selected to provide uniform log steps on the display. R9 effects the spacing of the upper steps (decreasing R9 spreads them out and increasing R9 compresses them) R26 effects the center steps (decreasing R26 spreads them out while increasing R26 compresses them).

MAINTENANCE AND REPAIR

When a malfunction has been localized to this module, the module should be unplugged from the instrument frame and placed on an extension. 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 MHz signal to the spectrum analyzer input.

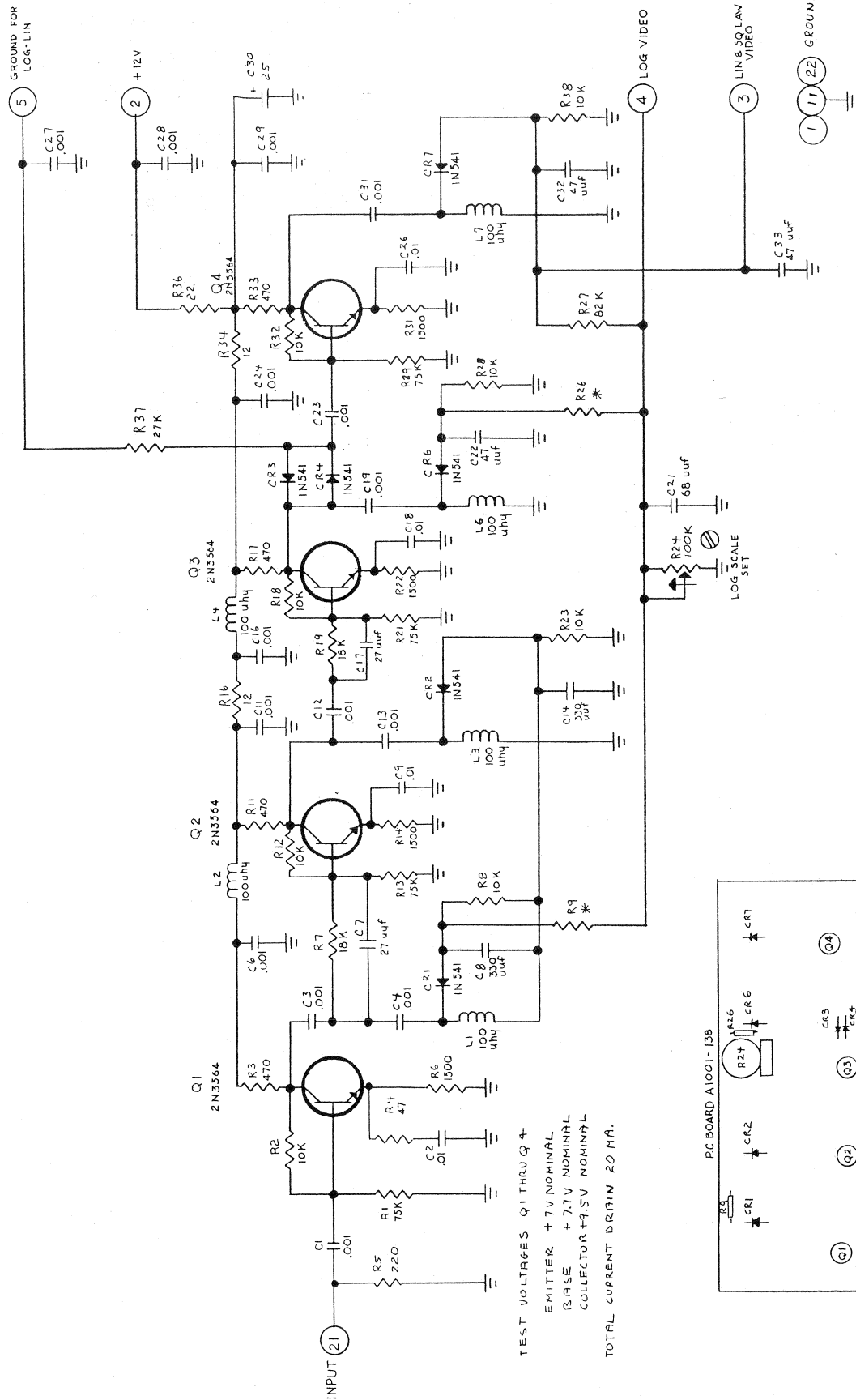
This module is highly stable and not normally subject to drift. The only adjustment required is the amplitude of the logarithmic output. This procedure will only be required when components (particularly semiconductors) have been replaced.

1. With the module mounted in the Plugin Spectrum Analyzer and the DISPLAY switch set in the LOG mode apply an input signal from a signal generator to the analyzer and adjust to display the signal on the CRT.
2. Adjust R24 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 R24 is adjusted to provide full deflection on the CRT screen, R9 and R26 may be reselected if transistors have been replaced. Note the effect of changing these resistors (See Maintenance and Repair)

PARTS LIST

C1	Capacitor Disc .001 @1000V CRL DD-102	C19	Same as C1
C2	Capacitor Disc .01 @600V CRL DD6-103	C20	Not Used
C3	Same as C1	C21	Capacitor Mica 68pf CM15E680J
C4	Same as C1	C22	Capacitor Mica 47pf CM15E470J
C5	Not Used	C23	Same as C1
C6	Same as C1	C24	Same as C1
C7	Capacitor Mica 27pf CM15E270J	C25	Not Used
C8	Capacitor Mica 330pf CM15E331J	C26	Same as C2
C9	Same as C2	C27	Same as C1
C10	Not Used	C28	Same as C1
C11	Same as C1	C29	Same as C1
C12	Same as C1	C30	Capacitor Electrolytic 25Mf @25V Amperex Type 426
C13	Same as C1	C31	Same as C1
C14	Same as C8	C32	Same as C22
C15	Not Used	C33	Same as C22
C16	Same as C1		
C17	Same as C7	CR1	Diode 1N541
C18	Same as C2	CR2	Same as CR1

CR3	Same as CR1	R9	Selected at Test
CR4	Same as CR1	R10	Not Used
CR5	Not Used	R11	Same as R3
CR6	Same as CR1	R12	Same as R2
CR7	Same as CR1	R13	Same as R1
		R14	Same as R6
L1	Choke 100 μ hy J.W. Miller 70F104A1	R15	Not Used
L2	Same as L1	R16	Resistor Composition $\frac{1}{2}$ W 5% 12 Ω IRC GBT $\frac{1}{2}$
L3	Same as L1	R17	Same as R3
L4	Same as L1	R18	Same as R2
L5	Not Used	R19	Same as R7
L6	Same as L1	R20	Not Used
L7	Same as L1	R21	Same as R1
		R22	Same as R6
Q1	Transistor 2N3564	R23	Same as R2
Q2	Same as Q1	R24	Resistor Trimmer 100K CTS U201R104B
Q3	Same as Q1	R25	Not Used
Q4	Same as Q1	R26	Selected at Test
		R27	Resistor Composition $\frac{1}{2}$ W 5% 75K IRC GBT $\frac{1}{2}$
R1	Resistor Composition $\frac{1}{2}$ W 5% 75K IRC GBT $\frac{1}{2}$	R28	Same as R2
R2	Resistor Composition $\frac{1}{4}$ W 5% 10K IRC GBT $\frac{1}{4}$	R29	Resistor Composition $\frac{1}{4}$ W 5% 75K IRC GBT $\frac{1}{4}$
R3	Resistor Composition $\frac{1}{4}$ W 5% 470 Ω IRC GBT $\frac{1}{4}$	R30	Not Used
R4	Resistor Composition $\frac{1}{4}$ W 5% 47 Ω IRC GBT $\frac{1}{4}$	R31	Same as R6
R5	Resistor Composition $\frac{1}{4}$ W 5% 220 Ω IRC GBT $\frac{1}{4}$	R32	Same as R2
R6	Resistor Composition $\frac{1}{2}$ W 5% 1.5K IRC GBT $\frac{1}{2}$	R33	Same as R3
R7	Resistor Composition $\frac{1}{2}$ W 5% 18K IRC GBT $\frac{1}{2}$	R34	Same as R16
R8	Same as R2	R35	Not Used
		R36	Resistor Composition $\frac{1}{2}$ W 5% 22 Ω IRC GBT $\frac{1}{2}$
		R37	Resistor Composition $\frac{1}{2}$ W 5% 27K IRC GBT $\frac{1}{2}$



INPUT CRYSTAL FILTER CARD

FUNCTION

The function of this card is to accept a low level signal at 65 MC input frequency and deliver a filtered signal at 10.7 MC, providing both gain and variable band pass filtering. A crystal filter in the 10.7 MC section provides various resolution bandwidths. 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 ^{10.7}~~65~~ 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 transformer Z1. The signal is then fed through the crystal filter. Transistors Q3 and Q6 provide input and output buffering. Bandwidth selection is accomplished remotely by diode switching via diodes which are normally reverse biased. Forward biasing each diode provides different bandwidth position. In the first switch position (widest) the filter is by passed, 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 diodes. In the rest of the 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. This card normally functions in conjunction with an Output Crystal Filter Card to provide two pole filtering.

MAINTENANCE AND REPAIR

When a malfunction has been localized to this module, the card should be removed from the instrument frame, and supplied power from the frame by an extension. 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 schematic. If voltage readings are satisfactory, the card must be checked stage by stage. 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 two basic circuits which require alignment: the Oscillator-Mixer and the Crystal Filter. During alignment, the card should be plugged into the working Spectrum Analyzer via an extension 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. A coupling capacitor (.001 mfd) may be used to parallel the card & signal generator inputs.
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. Transformer Z1 should then be tuned for a maximum deflection on the oscilloscope screen.
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, C12 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, C12 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 aid at the CRT display and the signal from the previous card in the spectrum analyzer. 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 diodes 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. Transformer Z2 on the crystal filter board should be tuned 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. Capacitor C16 should then be adjusted to minimize skirt leakage of the signal. Since this capacitor affects the tuning of Z2 (of the previous step) the two 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 facilitate adjustment of C16 and Z2 for the most symmetrical bandpass characteristics.
15. Return the DISPLAY switch to the LIN position.

16. Retrim Z1 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.

PARTS LIST

C1	Capacitor Disc .001 @ 1000V CRL DD-102	Q3	Same as Q2
C2	Capacitor Mylar .1 @ 250V Amperex C280AE/A100K	Q4	Same as Q1
C3	Same as C1	Q5	Not Used
C4	Same as C1	Q6	Same as Q2
C5	Same as C1	R1	Resistor Composition $\frac{1}{4}$ W 5% 47 Ω IRC GBT $\frac{1}{4}$
C6	Same as C1	R2	Resistor Composition $\frac{1}{4}$ W 5% 4.7K IRC GBT $\frac{1}{4}$
C7	Same as C2	R3	Resistor Composition $\frac{1}{4}$ W 5% 47K IRC GBT $\frac{1}{4}$
C8	Same as C1	R4	Resistor Composition $\frac{1}{4}$ W 5% 220 Ω IRC GBT $\frac{1}{4}$
C9	Same as C1	R5	Resistor Composition $\frac{1}{4}$ W 5% 10K IRC GBT $\frac{1}{4}$
C10	Same as C1	R6	Same as R2
C11	Same as C1	R7	Same as R3
C12	Capacitor Trimmer 2.5-11pf Erie 538-006-90B	R8	Resistor Composition $\frac{1}{4}$ W 5% 1.2K IRC GBT $\frac{1}{4}$
C13	Same as C1	R9	Same as R4
C14	Same as C1	R10	Not Used
C15	Not Used	R11	Resistor Composition $\frac{1}{4}$ W 5% 100K IRC GBT $\frac{1}{4}$
C16	Same as C12	R12	Same as R4
C17	Selected at Test	R13	Same as R11
C18	Selected at Test	R14	Same as R11
C19	Selected at Test	R15	Not Used
CR1	Diode 1N456	R16	Same as R11
CR2	Same as CR1	R17	Resistor Composition $\frac{1}{4}$ W 5% 330K IRC GBT $\frac{1}{4}$
CR3	Same as CR1	R18	Same as R2
CR4	Same as CR1	R19	Same as R4
L1	Choke 6.8 μ hy Delevan 1537-32	R20	Not Used
Q1	Transistor 2N3564	R21	Resistor Composition $\frac{1}{4}$ W 5% 470K IRC GBT $\frac{1}{4}$
Q2	Transistor 2N4304		

R22 Resistor Composition $\frac{1}{4}$ W 5%
2.7K IRC GBT $\frac{1}{4}$

R23 Same as R4

R24 Same as R3

R25 Not Used

R26 Same as R4

R27 Same as R3

R28 Selected at Test

R29 Same as R3

R30 Not Used

R31 Selected at Test

R32 Same as R3

R33 Selected at Test

R34 Same as R3

R35 Not Used

R36 Selected at Test

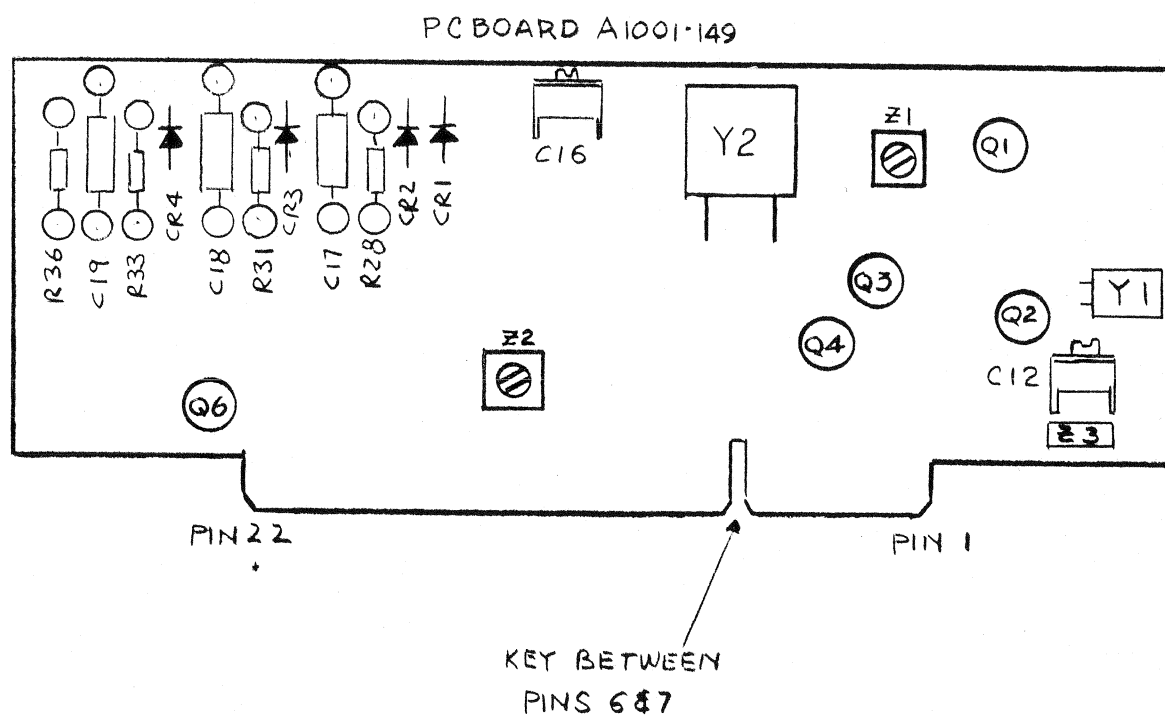
Y1 Crystal A1000-007-6

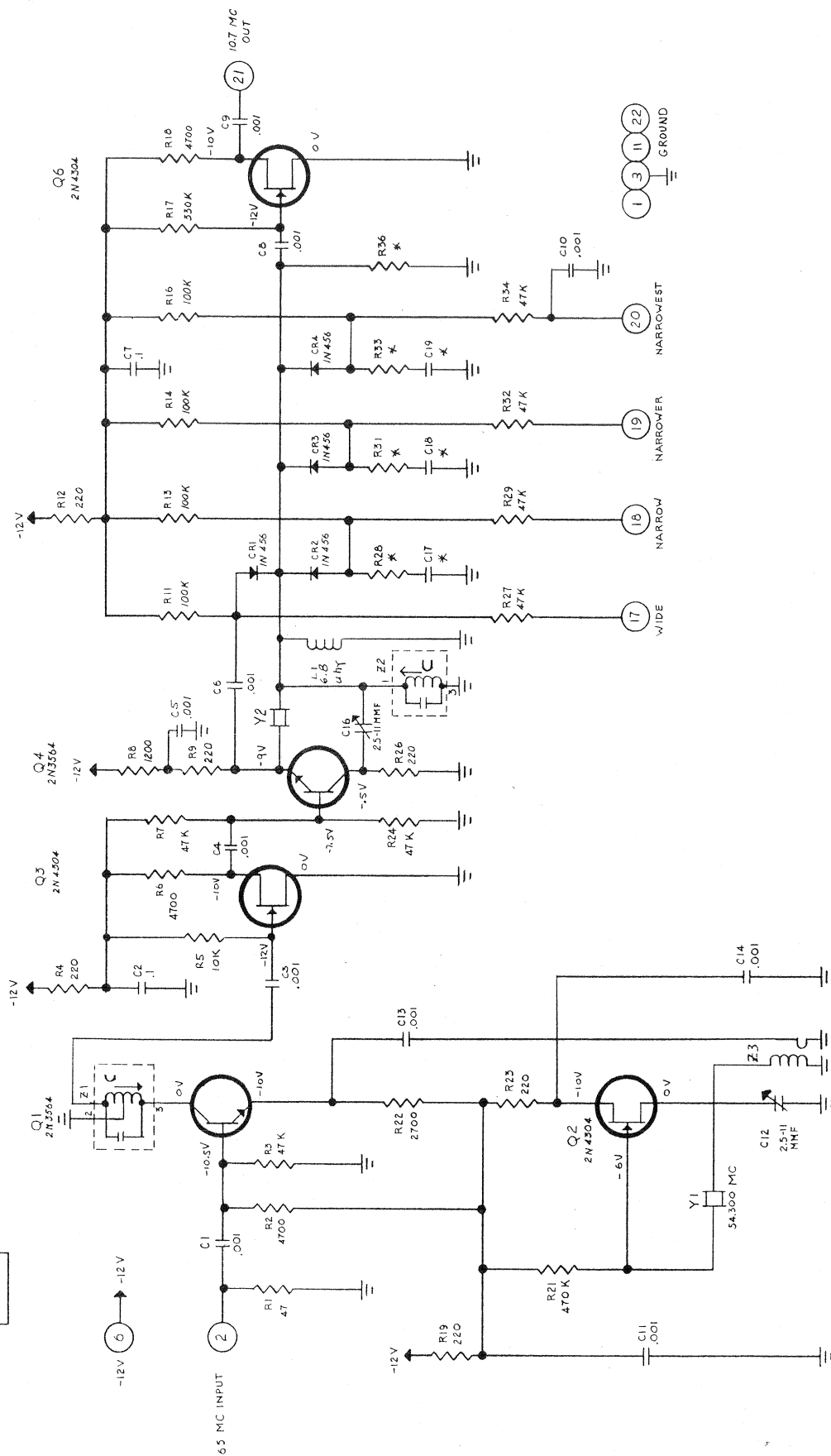
Y2 Crystal A1000-007-4

Z1 Transformer A1000-345-3

Z2 Same as Z1

Z3 Transformer B1000-709-9





OUTPUT CRYSTAL FILTER CARD

FUNCTION

The function of this card is to accept a low level signal at 10.7 MHz, provide filtering and deliver an amplified signal at 10.7 MHz. The card provides both gain and variable bandwidth filtering. A crystal filter in the 10.7 MHz 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. This card may be used alone, or in conjunction with other crystal filter cards to provide multiple pole filtering. If more than one crystal filter card is used, the filter crystals in all cards will comprise one set, and may not be replaced individually.

CIRCUIT DESCRIPTION

The input signal is impressed upon the base of the transistor, Q1 which provides buffering and drive for the filter transistor, Q2. The output of Q2 is a 10.7 MHz signal which is filtered by a crystal filter consisting of crystal Y1, Z1 and load components R21-R24 and C13-C16. Bandwidth selection is accomplished remotely by diode switching via diodes which are normally reversed biased. Forward biasing each diode provides a different bandwidth position. In the first switch position (widest) the filter is bypassed, providing a wide band position in which Z2 determines the bandwidth. In the second position the bandwidth is fixed and is a function of the crystal. This position is obtained by reverse biasing all diodes. In the rest of the 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 MHz output amplifier comprised of Integrated circuit IC1 on the input-output board, and matching output transformer Z2.

MAINTENANCE AND REPAIR

When a malfunction has been localized to this card, the card should be plugged into the instrument frame, via an extension. The following sequential procedure should then be used to trouble shoot the circuitry. 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 voltages readings are satisfactory, the card must be checked stage by stage. Apply a signal input to each stage starting with the last stage and working back to the 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 MHz to 65 MHz over the range of levels from -100 through -10 dbm.

There are two basic circuits which require alignment: the Crystal Filter and the Output Amplifier. During alignment, the module should be connected to a working Plugin Spectrum Analyzer so that the

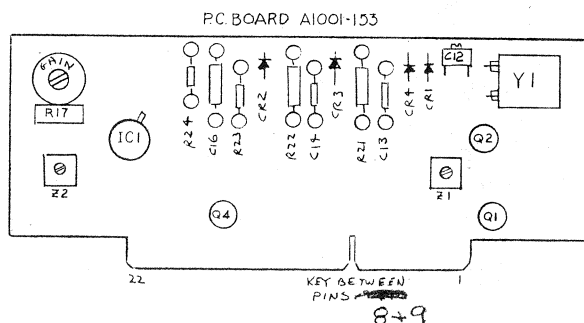
oscilloscope display may be used to observe the shape of the bandpass filter.

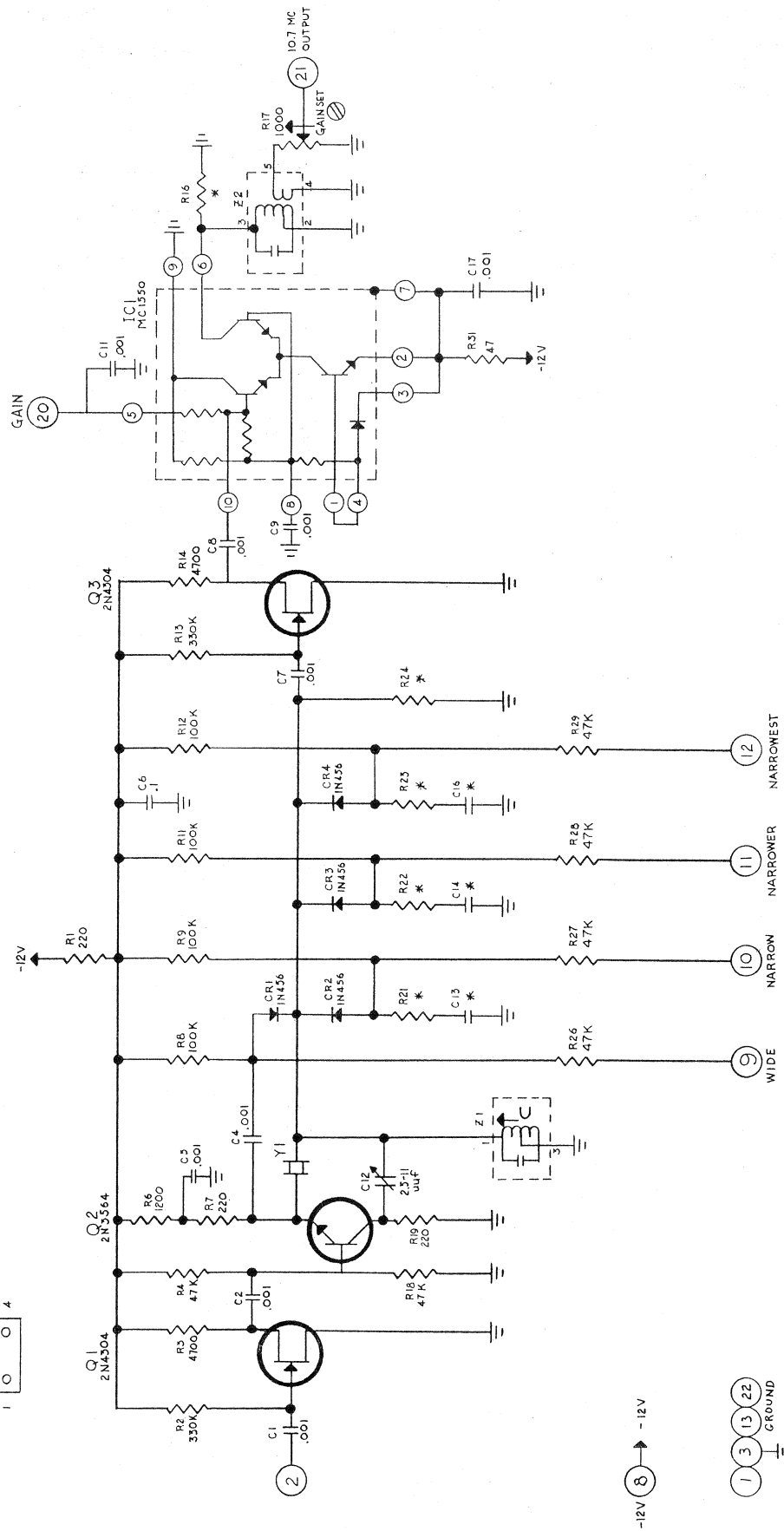
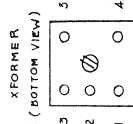
1. Set the DISPLAY switch on the analyzer panel to LIN
 2. For initial alignment, a -10 dbm signal at 10.7 MHz should be applied to the input. A .001 coupling connector may be used to parallel the input with the signal generator output.
 3. The resolution switch on the analyzer should be placed in the minimum resolution position, (this position removes the crystal band pass filter from the circuit).
 4. Transformer Z2 on the input-output board should then be tuned for maximum deflection on the oscilloscope screen, with R17 fully CW.
 5. The crystal filter is then aligned with the aid of a signal at the input of the analyzer. Any attenuator should be switched out of the circuit by the front panel controls.
 6. 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 to be aligned.
 7. Place the RESOLUTION switch in the position in which all diodes are reverse biased, which is the position of maximum crystal filter bandwidth and the position in which the tuning of components is most sensitive.
 8. Transformer Z1 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.
 9. Capacitor C12 on the crystal filter board should be alternately adjusted to minimize skirt leakage of the signal. Since this capacitor affects the tuning of Z1 (of the previous step) the two should be alternately readjusted until the shape of the bandpass is smooth and a leakage around the skirts of the signal is minimized.
 10. 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 facilitate adjustment of Z1 and C12 for the most symmetrical bandpass characteristics.
 11. Return the DISPLAY switch to the LIN position.
 12. Retrim Z2 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.
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PARTS LIST

C1	Capacitor Disc .001 @1000V CRL DD-102	C6	Capacitor Mylar .1 @250V Amperex C280AE/A100K
C2	Same as C1	C7	Same as C1
C3	Same as C1	C8	Same as C1
C4	Same as C1	C9	Same as C1
C5	Not Used	C10	Not Used

C11	Same as C1	R8	Resistor Composition $\frac{1}{4}$ W 5% 100K IRC GBT $\frac{1}{4}$
C12	Capacitor Trimmer 2.5-11pf Erie 538-006-908	R9	Same as R8
C13	Selected at Test	R10	Not Used
C14	Selected at Test	R11	Same as R8
C15	Not Used	R12	Same as R8
C16	Selected at Test	R13	Same as R2
C17	Same as C1	R14	Same as R3
CR1	Diode 1N456	R15	Not Used
CR2	Same as CR1	R16	Selected at Test
CR3	Same as CR1	R17	Potentiometer Trimmer 1K CTS U201R102B
CR4	Same as CR1	R18	Same as R4
IC1	Intergrated Circuit Motorola MC1550	R19	Same as R1
Q1	Transistor 2N4304	R20	Not Used
Q2	Transistor 2N3564	R21	Selected at Test
Q3	Same as Q1	R22	Selected at Test
R1	Resistor Composition $\frac{1}{4}$ W 5% 220 Ω IRC GBT $\frac{1}{4}$	R23	Selected at Test
R2	Resistor Composition $\frac{1}{4}$ W 5% 330K IRC GBT $\frac{1}{4}$	R24	Selected at Test
R3	Resistor Composition $\frac{1}{4}$ W 5% 4.7K IRC GBT $\frac{1}{4}$	R25	Not Used
R4	Resistor Composition $\frac{1}{4}$ W 5% 47K IRC GBT $\frac{1}{4}$	R26	Same as R4
R5	Not Used	R27	Same as R4
R6	Resistor Composition $\frac{1}{4}$ W 5% 1.2K IRC GBT $\frac{1}{4}$	R28	Same as R4
R7	Same as R1	R29	Same as R4
		R30	Not Used
		R31	Resistor Composition $\frac{1}{4}$ W 5% 47 Ω IRC GBT $\frac{1}{4}$
		Y1	Crystal A1000-007-4
		Z1	Transformer A1000-345-3
		Z2	Same as Z1





SCAN CARD

FUNCTION

The function of this plug-in card is to provide the tuning voltages for the swept (first) local oscillator and the second (565 MHz) local oscillator. The tuning voltages cause the oscillators to respond to inputs from the SCAN WIDTH, CENTER FREQUENCY, VERNIER TUNING and PHASE LOCK controls, as well as the BAND LOCATE controls. In addition, this card contains an amplifier for displaying the phase lock beats, a signal conditioner for the input sawtooth and range setting potentiometers for the IF GAIN control. Potentiometers for calibrating the tuning dial scan widths and band locate functions are also mounted on this card.

CIRCUIT DESCRIPTION

The sawtooth from the oscilloscope is conditioned by IC1 to provide a balanced, low impedance output with an amplitude at approximately ± 7 volts. This is used to drive the SCAN WIDTH switch in the instrument frame. IC1 is an integrated circuit operational amplifier connected as an adjustable gain inverter by means of feedback resistors. The gain is made inversely proportional to the harmonic number on the CENTER FREQUENCY dial. This compensates for harmonic multiplication of the dispersion. The band locate offset voltage is also passed through this amplifier, so that the offset scale is proportional to frequency band.

The output of the SCAN WIDTH switch (which consists of both sawtooth scan voltage and DC band locate voltages), is summed up with the voltage from the VERNIER TUNING control in IC2. IC2 is connected as a fixed gain DC amplifier for summing. The output at IC2 is used to drive the oscillator in the 500 MHz converter.

In MHz/CM scan widths no sawtooth or vernier tuning voltage is applied to this circuit. The 565 MHz oscillator in the converter is therefore fixed. In BAND LOCATE a fixed offset voltage is applied to the input via the BAND LOCATE CALIBRATE potentiometer. In kHz/CM scan widths the circuit sums up the sawtooth from the SCAN WIDTH control with the voltage from the VERNIER TUNING potentiometer. The changing voltage output to the 565 MHz oscillator causes it to tune, providing the required functions on the display.

A discrete component operational amplifier, consisting of Q2, Q3 and Q4, drives the tuning input of the first local oscillator. In MHz/CM scan widths this amplifier sums up the sawtooth from the SCAN WIDTH switch with the voltage from the CENTER FREQUENCY potentiometer. In kHz/CM scan widths only the tuning voltage is applied, along with the phase lock error voltage. This voltage drives the non-inverting input. Condenser C6 provides the necessary frequency compensation in this mode of operation.

The phase lock error signal (beat) is amplified by transistor Q1 for display on the CRT. This transistor is connected as an AC coupled audio amplifier.

MAINTENANCE AND REPAIR

Since the majority of the semiconductors on this card are contained in the two integrated circuits, sus-

pected faults in the card can best be diagnosed by observing the input and output wave forms with an oscilloscope. Normal waveforms will indicate proper operation. The pertinent wave forms, taken with the instrument set at maximum internal scan, are given on the schematic. Where waveforms are inappropriate, voltages are given.

ALIGNMENT

- A. Since the majority of the quantitative adjustments in the instrument are located on this card, alignment becomes a complete instrument calibration. To accomplish this, the following instrumentation is required:
 1. Signal generators: 10 MHz to 4.5 GHz. These may be broken up into as many bands as desired, providing at least each of the following frequencies:
 - a) Complete coverage 10-500 MHz
 - b) 1 GHz, 1.25 GHz, 1.75 GHz, 2 GHz, 2.5 GHz, 2.75 GHz, 3.5 GHz (these are the center of each band from 1+ to 4+)
 2. Audio Oscillator: 1000 Hz-100 kHz
- B. SET THE CONTROLS
IF GAIN - CW
RESOLUTION - AUTO
DISPLAY - LOG
ATTENUATORS - 0 db
VIDEO FILTER - OFF
BAND - 1-
CENTER FREQUENCY - 250 MHz
kHz - MHz - MHz
SCAN WIDTH/CM - 50
VERNIER TUNING - CENTERED
LF CAL - CENTERED
- C. Follow the procedure in the operating instructions (as far as possible) to set up the oscilloscope sweep and obtain a trace.
- D. Apply a 500 MHz, -30 dbm signal to the INPUT connector. Tune the 500 MHz converter (see service data - this section) to obtain a display of the input signal on the CRT. This will appear as a general rise of the baseline, since the IF frequency is not scanned.
- E. Switch to kHz/CM and retune the 500 MHz signal generator upwave slightly to display the CW signal on the CRT screen in the conventional manner. Adjust the DISPERSION BAL (front panel) so that the signal remains centered over the range of SCAN WIDTH switch settings from .5 to 100. Reset the control to 50.
- F. Modulate the signal generator with the audio oscillator to provide 100 kHz sidebands. Adjust the SMALL SCAN SET potentiometer for 2 cm/sideband spacing.
- G. Disconnect the 500 MHz signal. Switch to MHz/CM

- H. Rotate the CENTER FREQUENCY control to obtain a zero MHz dial reading. With the CENTERING potentiometer, adjust the zero signal to the center of the screen.
- I. Tune to 250 MHz. Connect a 250 MHz, -10 dbm signal to the INPUT connector. Adjust the TUNING DIAL RANGE potentiometer to display the 250 MHz signal at the center of the screen.
- J. Tune to 500 MHz and trim the TUNING DIAL RANGE potentiometer to center the 2nd harmonic of the input signal (500 MHz) on the screen.
- K. Successively tune back and forth between zero and 500 MHz to obtain the best fit, using the CENTERING and TUNING DIAL RANGE adjustments.
- L. Tune to 250 MHz. Adjust the large scan set so that the zero signal is on the left edge of the display and the 2nd harmonic (500 MHz) is on the right edge. The 250 MHz signal will be within $\pm \frac{1}{2}$ cm of the center.
- M. Check the dial on band 1- from 10 to 500 MHz. Trim the adjustments for best fit, if necessary.
- N. Tune in a signal at 250 MHz on band 1- and switch from .5 MHz/cm to BAND LOCATE. Adjust the BAND LOCATE CALIBRATE to return the signal to the center of the screen.
- O. Utilizing the other signal generators, trim the BAND LOCATE CALIBRATE in bands 1+, 2-, 2+3-, 3+ 4- and 4+.

PARTS LIST

C1	Capacitor Disc .01 @ 600V CRL DD6-103	R3	Resistor Film 1% $\frac{1}{2}$ W 100K Dale MFF $\frac{1}{2}$ T1
C2	Same as C1	R4	Same as R3
C3	Capacitor Mylar .1 @200V Amperex C280AE/A100K	R5	Not Used
C4	Same as C1	R6	Resistor Film 1% $\frac{1}{2}$ W 12.4K Dale MFF $\frac{1}{2}$ T1
C5	Not Used	R7	Resistor Composition 5% $\frac{1}{2}$ W 1500 IRC GBT $\frac{1}{2}$
C6	Capacitor Electrolytic 1 MFD @ 50V Sprague TE1300	R8	Trimpot 50 K Helipot 77PR50K
C7	Same as C1	R9	Trimpot 1 Meg Helipot 77PR 1 Meg
C8	Same as C1	R10	Not Used
1C1	Integrated Circuit 809C Amelco	R11	Resistor Film 1% $\frac{1}{4}$ W 40.2K Dale MFF $\frac{1}{4}$ T1
1C2	Same as 1C1	R12	Resistor Film 1% $\frac{1}{4}$ W 332K Dale MFF $\frac{1}{2}$ T1
Q1	Transistor 2N3566	R13	Same as R9
Q2	Same as Q1	R14	Same as R11
Q3	Same as Q1	R15	Not Used
Q4	Same as Q1	R16	Resistor Composition 5% $\frac{1}{2}$ W 10K IRC GBT $\frac{1}{2}$
R1	Resistor Composition 5% $\frac{1}{2}$ W 68K IRC GBT $\frac{1}{2}$	R17	Not Used
R2	Resistor Film 1% $\frac{1}{2}$ W 50K IRC GBT $\frac{1}{2}$	R18	Resistor Composition 5% $\frac{1}{4}$ W 22K IRC GBT $\frac{1}{4}$

R19 Resistor Composition 5%
 $\frac{1}{4}$ W 47K IRC GBT $\frac{1}{4}$

R20 Not Used

R21 Not Used

R22 Resistor Composition 5%
 $\frac{1}{4}$ W 220K IRC GBT $\frac{1}{4}$

R23 Resistor Composition 5%
 $\frac{1}{4}$ W 15K IRC GBT $\frac{1}{4}$

R24 Same as R23

R25 Not Used

R26 Resistor Composition 5%
 $\frac{1}{4}$ W 33K IRC GBT $\frac{1}{4}$

R27 Same as R23

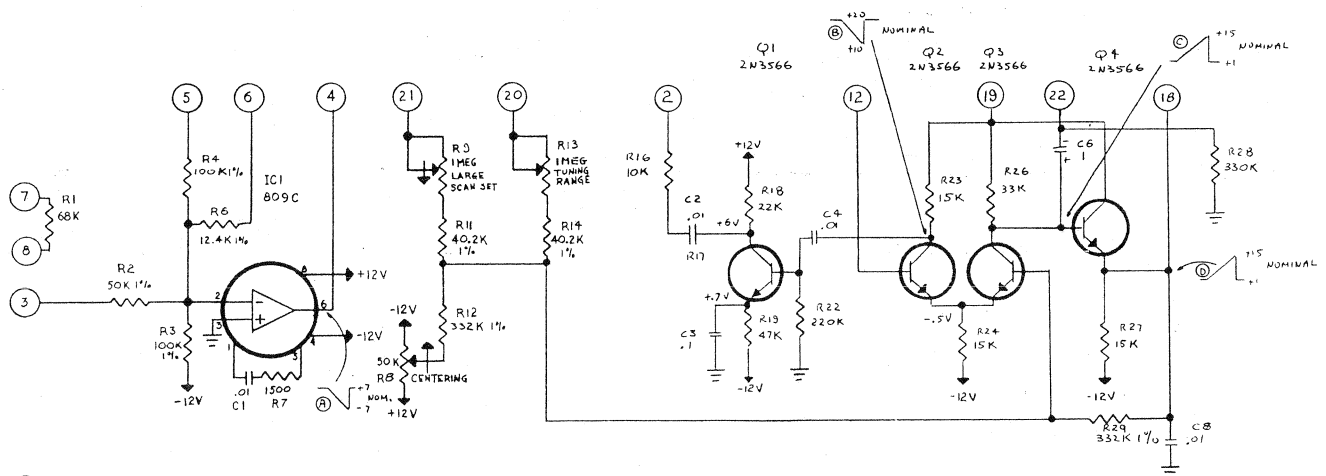
R28 Resistor Composition 5%
 $\frac{1}{4}$ W 330K IRC GBT $\frac{1}{4}$

R29 Same as R12

R30 Not Used

R31 Trimpot 20K Helipot
 77 PR20K

R32 Same as R31



10 → +12V

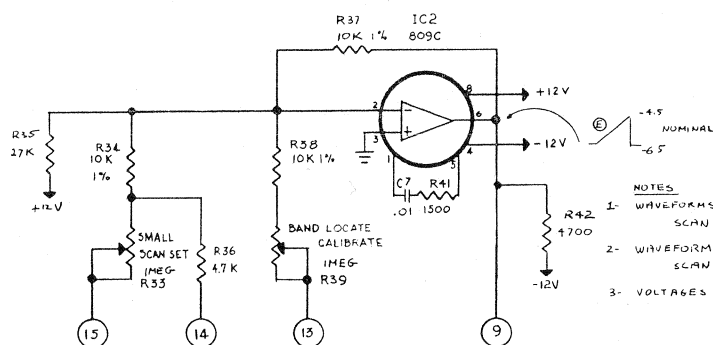
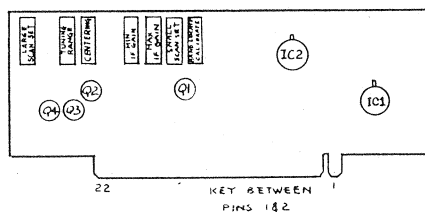
11 → -12V

1 → GND

16 → +12V

17 → -12V

PC BOARD A1001-253



NOTES
 1- WAVEFORMS (A) (B) (C) (D) TAKEN IN WIDE
 SCAN WITH FULL BAND DISPLAYED
 2- WAVEFORM (E) TAKEN IN MAXIMUM SMALL
 SCAN
 3- VOLTAGES MEASURED AS IN NOTE 1

POWER AND DEFLECTION CARD

FUNCTION

This plugin card carries the regulated power supplies which provide the voltages for the rest of the instrument, the vertical deflection circuitry and the load for the oscilloscope + 225 volt supply.

CIRCUIT DESCRIPTION

The + 12 volt supply has a self-contained voltage reference source so that all the supply outputs are independent of the actual value of the oscilloscope supplies. It is a shunt regulator. Q1 acts as the error amplifier, while Q2 is the shunt element.

The -12 volt supply uses the +12 volt supply as reference and is also a shunt regulator. Q3 is the error amplifier, while Q4 is the shunt element.

The +20 volt supply is a standard series regulator. The vertical deflection signal from the DISPLAY switch is buffered by means of operational amplifier IC1 which is connected as a voltage follower. Video filtering is accomplished by series resistor R21 and shunt capacitor C8 which is inserted to ground via the VIDEO FILTER switch. Two identical resistive dividers between the output of IC1, ground and + 225 volts provide bias (+67.5V) for the input of the oscilloscope deflection amplifier. One divider provides position deflection signals. Load resistor R16 may be inserted (by means of a jumper on the board) to reduce the output for 4 cm displays.

PARTS LIST

C1	Capacitor Electrolytic 25 MFD 25V Amperex C426AR1F25	Q1	Transistor 2N3638
C2	Capacitor Mylar .1 @ 250V Amperex C280AE/A100K	Q2	Transistor 2N3569
C3	Capacitor Disc .01 @ 600V CRL DD6-103	Q3	Same as Q1
C4	Same as C3	Q4	Same as Q2
C5	Same as C1	Q5	Not Used
C6	Same as C1	Q6	Same as Q2
C7	Capacitor Mica 33 pf CM15E330J	Q7	Transistor MST 300 MS Transistor
C8	Capacitor Mica 100 pf CM15E101J	R1	Resistor Composition 5% $\frac{1}{2}$ W 3900 Ω IRC GBT $\frac{1}{2}$
C9	Same as C1	R2	Resistor Composition 5% $\frac{1}{2}$ W 4700 Ω IRC GBT $\frac{1}{2}$
C10	Capacitor Mica 47 pf CM15E470J	R3	Resistor Composition 5% $\frac{1}{2}$ W 10K IRC GBT $\frac{1}{2}$
C11	Capacitor Mica 180 pf CM15E181J	R4	Resistor Film 1% $\frac{1}{4}$ W 10K Dale MFF $\frac{1}{4}$ T1
C12	Same as C3	R5	Potentiometer 20K Helipot 77PR20K
CR1	Diode Zener 1R12B Solitron	R6	Resistor Composition 5% $\frac{1}{2}$ W 82K IRC GBT $\frac{1}{2}$
IC1	Integrated Circuit 809C Amelco	R7	Resistor Composition 5% $\frac{1}{2}$ W 36K IRC GBT $\frac{1}{2}$
		R8	Resistor Composition 5% $\frac{1}{2}$ W 22K IRC GBT $\frac{1}{2}$

R9 Resistor Composition 5%
 $\frac{1}{2}$ W 27K

R10 Same as R2

R11 Resistor Composition 5%
2W 27K IRC GBT 2

R12 Same as R11

R13 Resistor Film 1% $\frac{1}{2}$ W 91K
Dale MFF $\frac{1}{2}$ T1

R14 Resistor Film 1% $\frac{1}{2}$ W 39K
Dale MFF $\frac{1}{2}$ T1

R15 Not Used

R16 Resistor Composition 5% $\frac{1}{2}$ W
100K IRC GBT $\frac{1}{2}$

R17 Same as R13

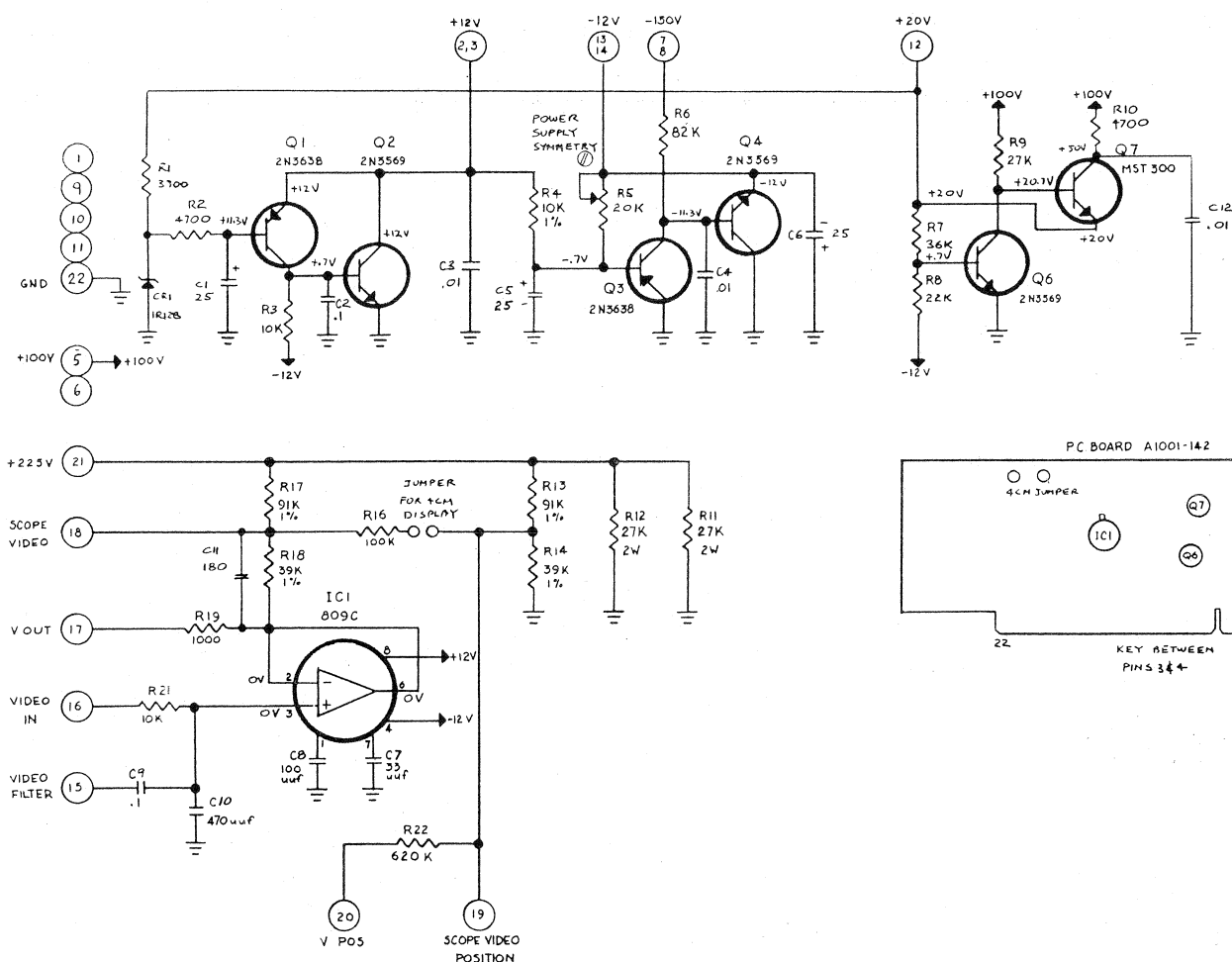
R18 Same as R14

R19 Resistor Composition 5% $\frac{1}{2}$ W
1K IRC GBT $\frac{1}{2}$

R20 Not Used

R21 Same as R2

R22 Resistor Composition 5% $\frac{1}{2}$ W
620K IRC GBT $\frac{1}{2}$



500 MHz CONVERTER MODULE

FUNCTION

This module accepts the 500 MHz IF signal from the mixer-filter and converts it down to 65 MHz for further amplification and detection. It contains a local oscillator at 565 MHz for heterodyning the signal. This oscillator may be operated CW, or swept up to ± 2 MHz to provide the Narrow Scan and Fine Tuning functions.

CIRCUIT DESCRIPTION

The module consists of 3 compartments in a silver plated, RF gasketed housing. Each compartment contains a resonant line. The lines in compartments 1 and 2 are tuned to 500 MHz and are coupled together by means of a window. The input is coupled into compartment 1 by a 50 Ω loop. Compartment 2 also contains a diode mixer which is driven from the 565 MHz local oscillator, which is housed in compartment 3. Choke L1 and capacitor C4 form a resonant filter which couples out 65 MHz while bypassing 500 MHz and 565 MHz. The diode is forward biased via R1 to provide adequate flatness.

MAINTENANCE AND REPAIR

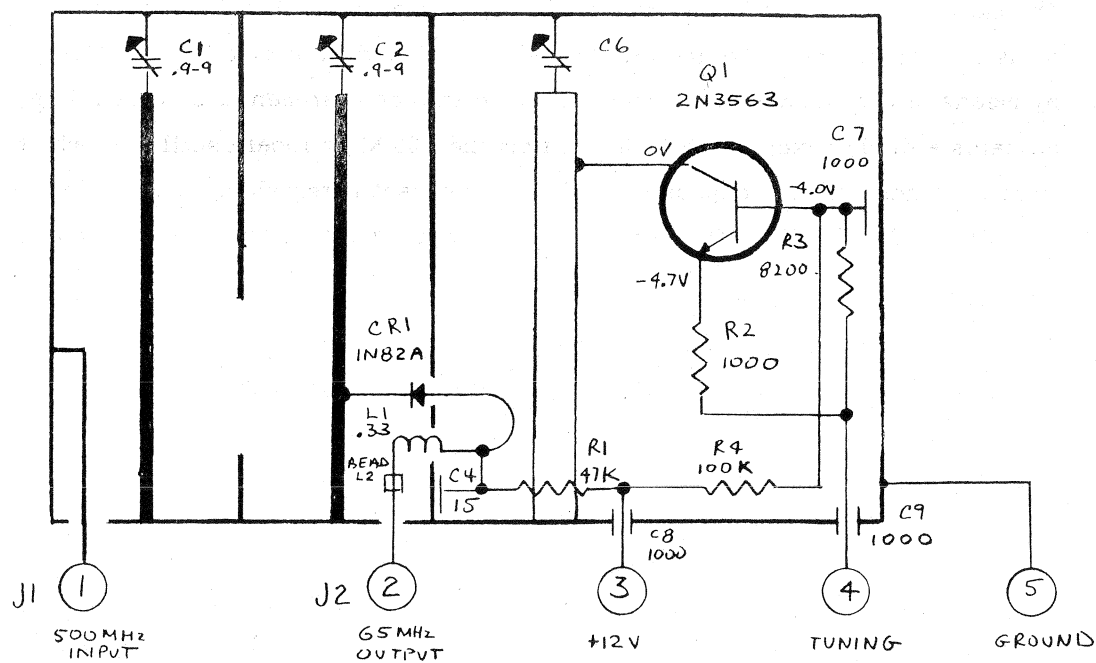
Malfunctions in this module will consist primarily of oscillator failures and/or mixer diode failures. Oscillator failure may be diagnosed by observing the diode current from J2 to ground (.1-.5 ma) with R2 disconnected. Diode condition may be checked with an ohmmeter with R2 disconnected.

ALIGNMENT AND TEST

This module should be aligned in a working instrument. Connect the output of a 500 MHz signal generator to the input (J1) and tune C6 to produce a signal on the analyzer in small scan (100 kHz/cm). Since the oscillator will tune both above and below 500 MHz, the signal will appear in two position on C6. The position with the piston furthest out is the correct one. C1 and C2 should then be tuned for maximum.

PARTS LIST

C1	Capacitor Piston .9-9 pf Amperex C004EA/9E	J1	Connector UG1619
C2	Same as C1	J2	Same as J1
C3	Not Used	L1	Choke .33 uhy 200MA National 1550-7
C4	Capacitor Solderin 15 pf RMC Type C NPO	L2	Bead Ferrite, Ferroxcube 56-590-65/3B
C5	Not Used	Q1	Transistor 2N3563
C6	Capacitor Piston JFD VC20G	R1	Resistor Composition $\frac{1}{4}$ W 5% 47K IRC GBT $\frac{1}{4}$
C7	Capacitor Solderin 1000 pf RMC Type C NPO	R2	Resistor Composition $\frac{1}{4}$ W 1K IRC GBT $\frac{1}{4}$
C8	Capacitor Feedthru 1000 pf Erie 2425-003-102-AA	R3	Resistor Composition $\frac{1}{4}$ W 5% 8.2K IRC GBT $\frac{1}{4}$
C9	Same as C8	R4	Resistor Composition $\frac{1}{4}$ W 5% 100K IRC GBT $\frac{1}{4}$
CR1	Diode 1N82A		



ALL CAPACITORS IN PF
ALL INDUCTORS IN UHY

65 MHz IF AMPLIFIER CARD

FUNCTION

This card provides gain and selectivity at 65 MHz, plus capability for gain control. This provides the IF GAIN function of the instrument.

CIRCUIT DESCRIPTION

The IF amplifier consists of two identical synchronously tuned stages coupled by means of resonant impedance matching transformers. The input stage has provision for gain setting (by means of a selected resistor). The gain control line of the output stage is brought to a pin on the connector for remote control.

MAINTENANCE AND REPAIR

With the module output connected to the frame by means of an extender, 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 should be checked and replaced until satisfactory operation is obtained.

ALIGNMENT

The only alignment this amplifier requires is the tuning of each of the trimmer capacitors C1, C7, and C14 for maximum signal gain. C1 may then be readjusted slightly for best signal to noise ratio.

PARTS LIST

C1	Capacitor Trimmer 2.5-11 Erie 538-006-90R	C13	Same as C2
C2	Capacitor Disc .001 @ 1000V CRL DD-102	C14	Same as C1
C3	Capacitor .1 @ 250V C280AE/A100K	C15	Not Used
C4	Same as C2	C16	Same as C2
C5	Not Used	C17	Capacitor Disc .01 @ 600V CRL DDG-103
C6	Same as C2	C18	Same as C17
C7	Same as 1	L1	Choke 330 uhy Delevan 2500-04
C8	Same as C2	L2	Same as L1
C9	Same as C2	R1	Resistor Composition $\frac{1}{4}$ W 5% 47 Ω IRC GBT $\frac{1}{4}$
C10	Not Used	R2	Selected at Test
C11	Same as C3	R3	Same as R1
C12	Same as C2		

MIXER -FILTER

FUNCTION

This module accepts input signals, and local oscillator power. It heterodynes the input signals against the local oscillator, providing a filtered 500 MHz IF output. In addition, it provides a decoupled local oscillator output for phase-lock purposes.

DESCRIPTION

The module housing consists of a series of chambers housing 500 MHz resonant lines. These lines form an IF filter. The IF signal is derived from the output of a mixer diode mounted in a crystal mount assembly on one side of the housing. Local oscillator energy is coupled to the mixer via a small capacitor and series resistor. Other resistors form a pad between the local oscillator input connector and the phase lock output.

MAINTENANCE AND REPAIR

Since all components in this module (except the crystal) are passive, repair, if required, can best be accomplished by systematic replacement of components.

DIODE REPLACEMENT

Should the mixer crystal diode be damaged (usually by excessive input power), it may be easily replaced. Symptoms of diode failure are:

- 1) no signal at all
- 2) very low sensitivity
- 3) highly nonlinear LOG display

To replace the diode carefully remove the signal input cable by unscrewing the co-axial connector on the crystal mount. Then unscrew the crystal holder by rotating the knurled ring on the connector end of the crystal mount. Withdraw the holder from the body of the mount. Remove the crystal by gently pulling it out of the spring clip retainer. Replace with a new crystal. Position the crystal with the arrow pointing away from the holder. Replace the holder and reconnect the signal input connector.

PARTS LIST

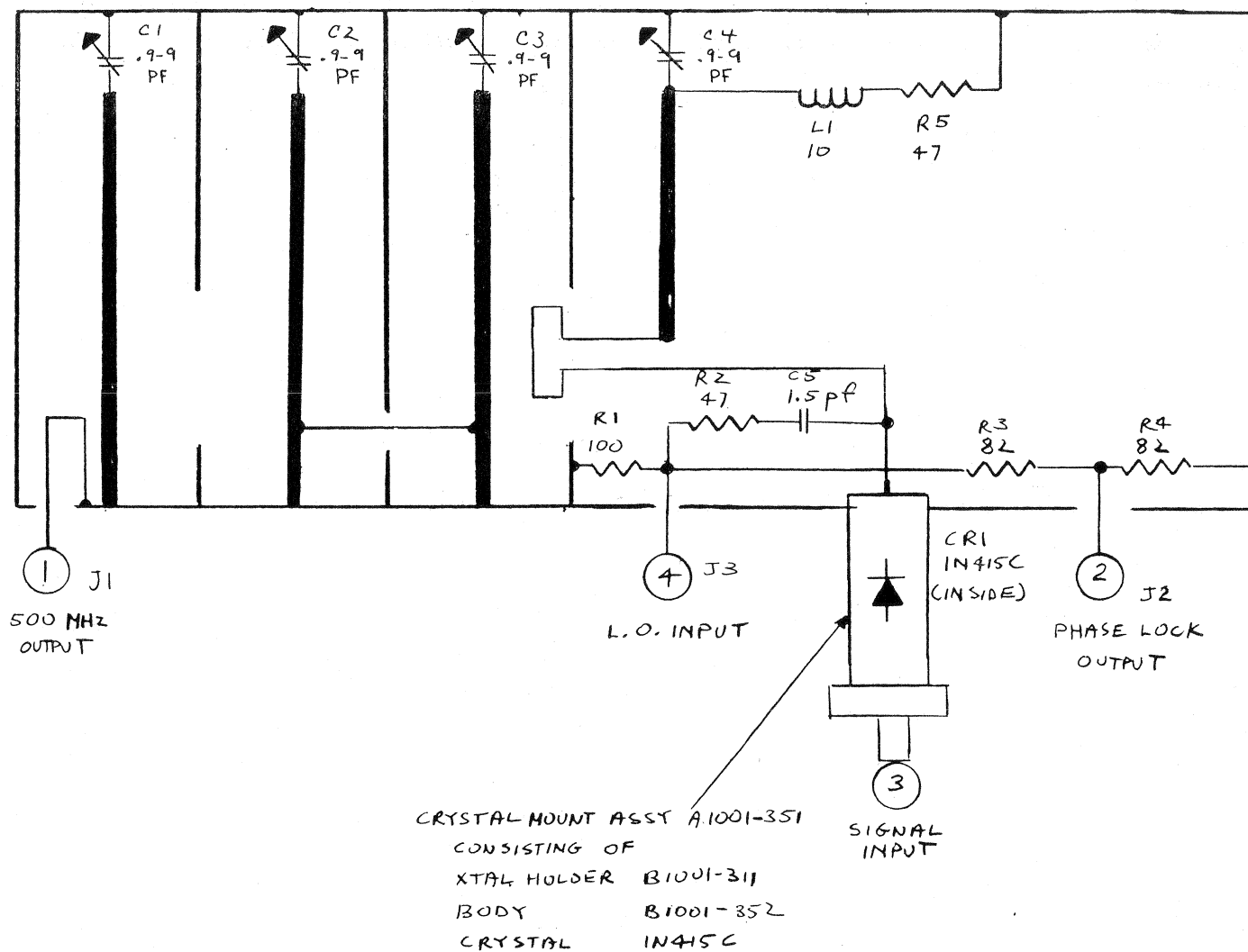
C1	Capacitor Variable .9-9 pf Amperex C004EA19E	J1	Connector UG11619
C2	Same as C1	J2	Same as J1
C3	Same as C1	J3	Connector OSM Omni Spectra 211
C4	Same as C1		
C5	Capacitor Ceramic 1.5 pf 5% Stackpole Type GA	R1	Resistor Composition 5% 1/8W 100 Ω IRC GBT 1/8
CR1	Diode Mixer 1N415C	R2	Resistor Composition 5% 1/8W 47 Ω IRC GBT 1/8
IC1	Integrated Circuit MC1550 Motorola	R3	Resistor Composition 5% $\frac{1}{4}$ W 82 Ω IRC GBT $\frac{1}{4}$
IC2	Same as IC1	R4	Resistor Composition 5% 1/8W 82 Ω IRC GBT 1/8

R5 Resistor Composition 5% $\frac{1}{4}$ W
47 Ω IRC GBT $\frac{1}{4}$

T1 Transformer
BK1000-709-19

T2 Transformer
BK1000-709-20

T3 Same as T2



SWEPT OSCILLATOR MODULE

FUNCTION

This Oscillator Module is housed in a shielded case and consists of an electronically tunable solid state oscillator which is capable of delivering RF power over the range of 500 to 1000 MHz.

CIRCUIT DESCRIPTION

The oscillator contains its own bias networks, and requires a supply of approximately 30 ma from a stable power source of 12 volts. Tuning is accomplished by supplying a tuning voltage within the limits of 0 to 15 volts at the tuning control terminal, which presents a high impedance.

MAINTENANCE AND REPAIR

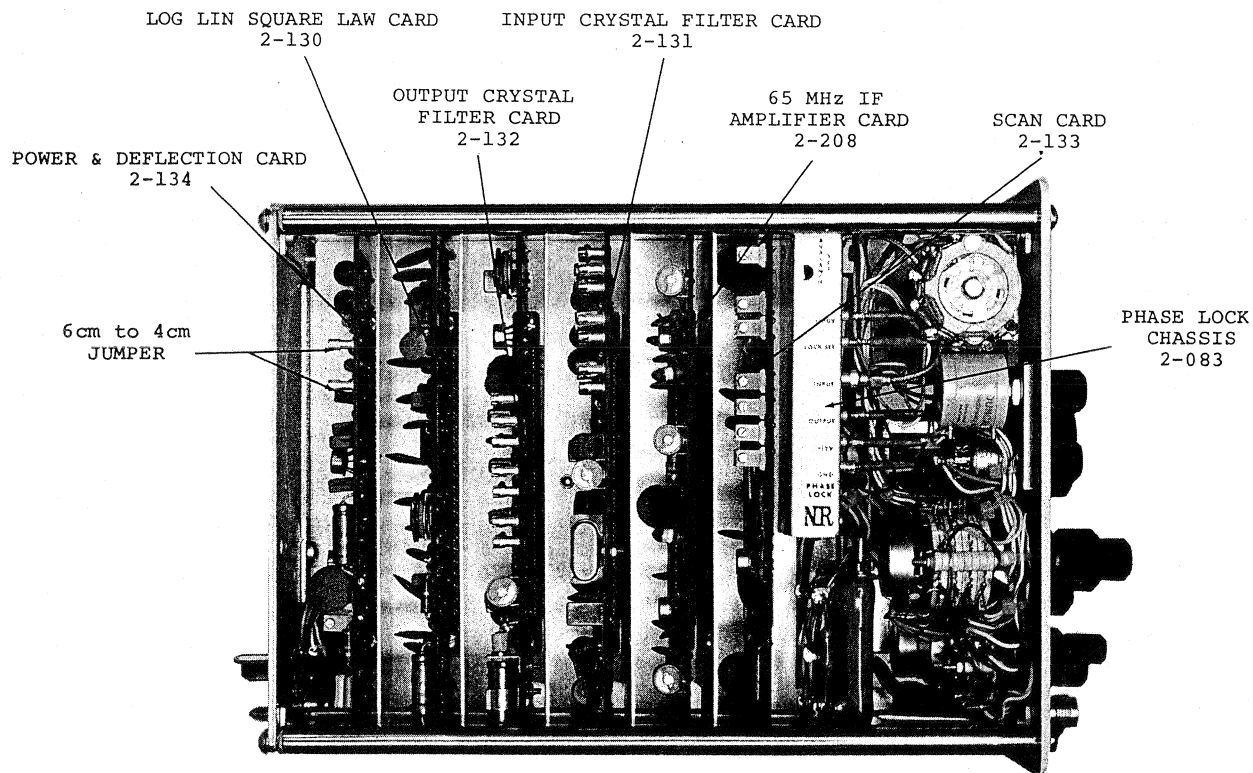
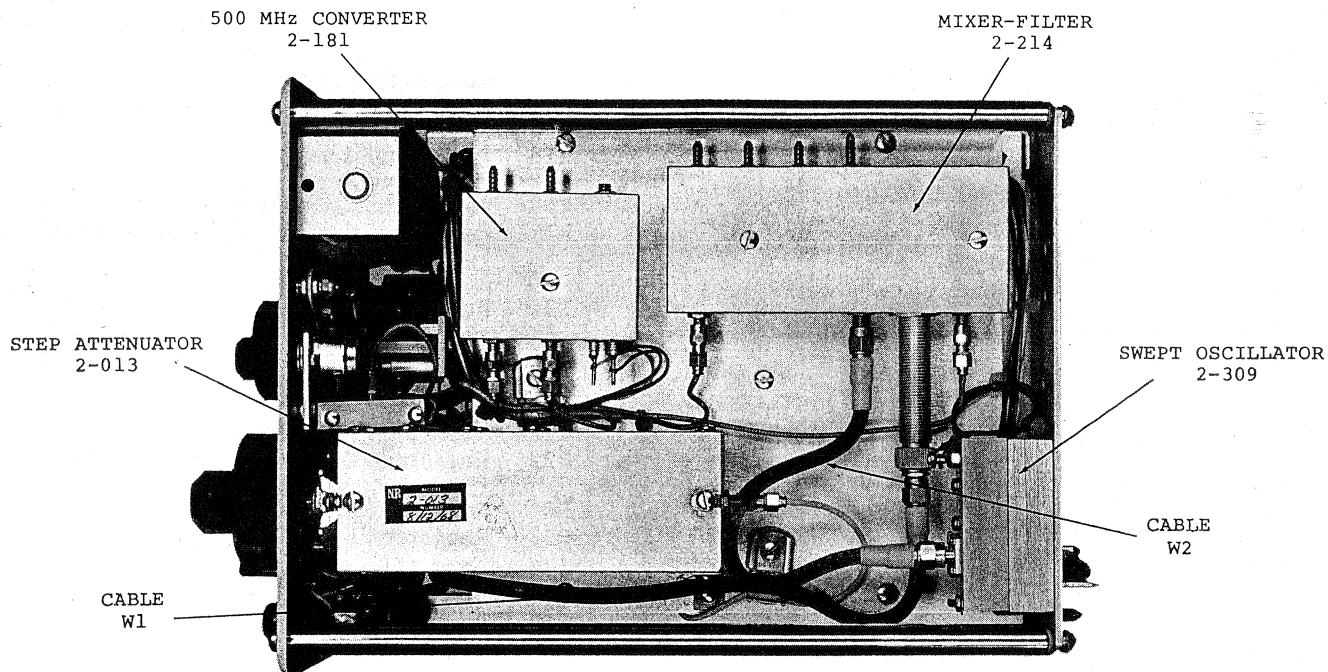
Since the techniques used in the construction, testing and adjustment of these oscillators are highly sophisticated and require extensive, special test equipment, it is not recommended that the modules, be repaired in the field. If an oscillator is faulty, it is suggested that it be returned to the factory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

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 +3 and +10 dbm over the range of 500 to 1000 MHz.

PARTS LIST

C1	Capacitor Disc. .0082 @ 1000V CRL DD822	R17	Resistor Film 1% $\frac{1}{4}$ W 100 Ω Dale MFF $\frac{1}{4}$ T1
J1	Jack TNC Part of W1	R18	Resistor Film 1% $\frac{1}{4}$ W 301 Ω Dale MFF $\frac{1}{4}$ T1
J2	Jack Banana HH Smith 1509-102	R19	Resistor Film 1% $\frac{1}{4}$ W 499 Ω Dale MFF $\frac{1}{4}$ T1
J3	Jack Phone HH Smith 277	R20	Resistor Composition 5% $\frac{1}{4}$ W 470 Ω IRC GBT $\frac{1}{4}$
R1	Potentiometer WW 10 $\frac{1}{4}$ Turn 50K Duncan 3253 50K	R21	Resistor Film 1% $\frac{1}{4}$ W 1K Dale MFF $\frac{1}{4}$ T1
R2	Potentiometer Trimmer 20K WW Bourns 271-1203M	R22	Resistor Film 1% $\frac{1}{4}$ W 3010 Ω Dale MFF $\frac{1}{4}$ T1
R3	Potentiometer Dual 20K (P) 250K (R) C1000-154-43	R23	Resistor Film 1% $\frac{1}{4}$ W 4990 Ω Dale MFF $\frac{1}{4}$ T1
R4	Resistor 3W WW 4700 Ω Ward Leonard Type 3x	R24	Potentiometer 5% 10K Cermet C1000-154-55
R5	Resistor 10W WW 2000 Ω Ward Leonard Type 10F	R25	Resistor Film 1% $\frac{1}{4}$ W 10K Dale MFF $\frac{1}{4}$ T1
R6	Resistor 5W WW 1200 Ω Ward Leonard Type 5F	R26	Resistor Composition $\frac{1}{4}$ W 5% 150 Ω IRC GBT $\frac{1}{4}$
R7	Resistor 10W WW 750 Ω Ward Leonard Type 10F	R27	Potentiometer Composition 10T 25K C-1000-154-25
R8	Resistor Composition 5% $\frac{1}{4}$ W 270 Ω IRC GBT $\frac{1}{4}$	R28	Potentiometer Composition 1000 Ω C-1000-154-32
R9	Resistor Film 1% $\frac{1}{4}$ W 25.5K Dale MFF $\frac{1}{4}$ T1	R29	Resistor Composition $\frac{1}{4}$ W 5% 18K IRC GBT $\frac{1}{4}$
R10	Resistor Film 1% $\frac{1}{4}$ W 8250 Ω Dale MFF $\frac{1}{4}$ T1	S1	Switch Rotary CTS 14809-2
R11	Resistor Film 1% $\frac{1}{4}$ W 4120 Ω Dale MFF $\frac{1}{4}$ T1	S2	Switch Rotary Mallory 12M2422G
R12	Same as R8	S3	Switch Rotary A1001-012
R13	Potentiometer Part of S3	S4	Switch Rotary Alco MRA 1-10S
R14	Resistor Film 1% $\frac{1}{4}$ W 49.9 Ω Dale MFF $\frac{1}{4}$ T1	S5	Switch Rotary Alco MRA 2-5S
R15	Same as R14	S6	Switch Toggle C & K 7201
R16	Same as R14	S7	Switch Push Button Alco MSP-205R
		W1	Cable A1001-310-1
		W2	Cable A1001-280-1

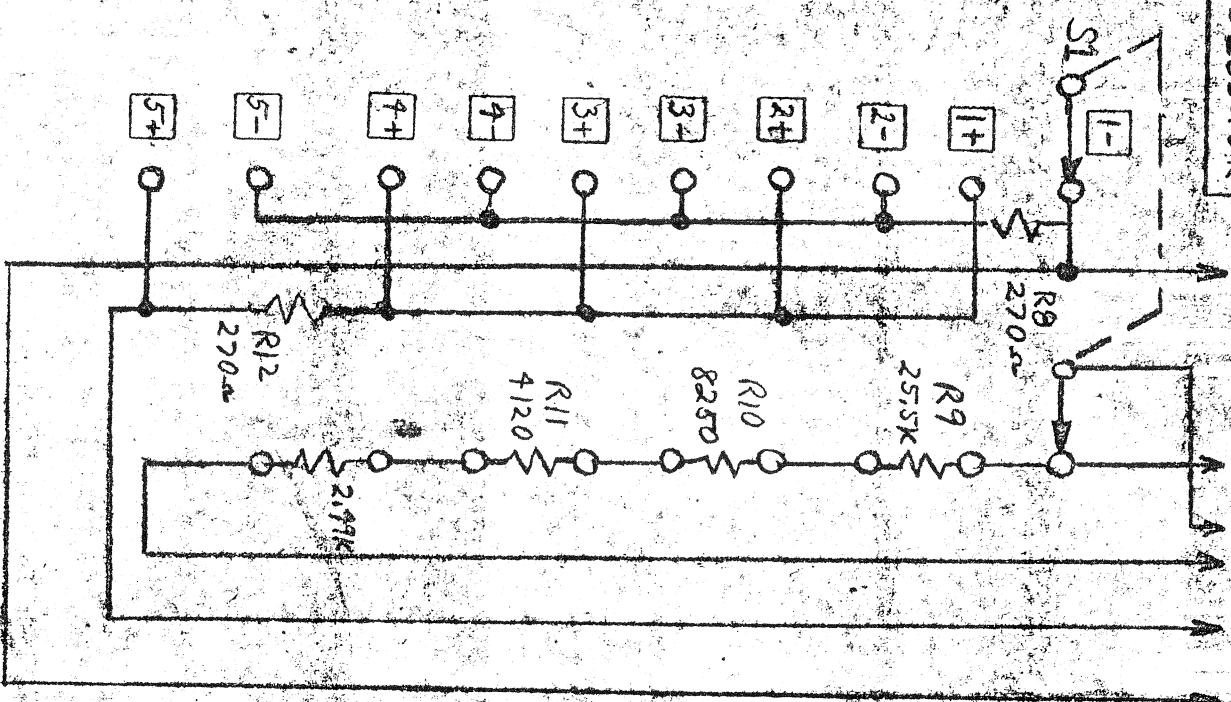


SECTION 7
ACCESSORIES AND NOTES

NOTES

BAND
SELECTOR

TO THE SAME POINTS
AS ON DWG. D1000-978



Model PSA-511B

This unit has been modified to extend its upper frequency tuning range from 4.5 GHz to 5.5 GHz. The modifications are:

1. On Scan Card module 2-133, resistor R6 is changed from 12.4K 1% to 10K 1%.
2. The detent mechanism of Band Selector switch S1 has been changed to permit travel to Band 5+ position.
3. The wiring of Band Selector Switch S1 has been modified as shown in the accompanying diagram.

The sensitivity and the flatness within the extended frequency band from 4.5 GHz to 5.5 GHz will be somewhat lower than the PSA-511 specifications.

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.

TOLERANCES (EXCEPT AS NOTED)	NELSON ROSS ELECTRONICS, INC. LONG ISLAND, NEW YORK			
DECIMAL		SCALE	DRAWN BY <i>MR</i>	
±			APPROVED BY	
FRACTIONAL	TITLE			
±	Model PSA-511B Modification			
ANGULAR	DRAWING NUMBER			
±	DATE	A1001-509		
	3-13-69			

