MODEL PSA 510

THIS MANUAL IS ISSUED WITH

MODEL PSA 510

SERIAL NUMBER 118

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MODULE DESCRIPTION

LIST OF ILLUSTRATIONS

WARRANTY

NELSON-ROSS ELCTRONICS, INC. warrants each instrument manufactured by it to be free from defects in material and workmanship for a period of one year after date of delivery to the original purchaser. 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 will be honored when the instrument is returned, transportation prepaid, and when examination proves to our satisfaction that the instrument is defective. Defects due to abuse, misuse or abnormal conditions of operation will be repaired at cost, upon approval of an estimate.

IN CASE OF FAILURE: notify us-be sure to include the serial number of the instrument.

SECTION 1

GENERAL INFORMATION

SCOPE

This manual provides Technical Characteristics, Theory of Operation, Operating Instructions, Maintenance Instructions and Repair Procedures for the Nelson-Ross Plug-In Microwave Analyzer Model PSA 510.

CHARACTERISTICS

The Nelson-Ross Microwave Spectrum Analyzer, Model PSA 510 is designed so that it may be conveniently plugged into any oscilloscope which accepts a Tektronix letter series plug-in. In a matter of minutes, the oscilloscope is converted into a complete broadband microwave spectrum analyzer. All power is automatically supplied to the plug-in by the oscilloscope.

Designed for use with an external swept local oscillator, the PSA 510 covers the frequency range from 10 megacycles to 15 kilomegacycles. Silicon solid state circuitry has been utilized to provide the utmost in reliability. A wide range of dispersions from zero to 1 Gc are available while high resolutions of from 5kc to 100 Gc are readily selectable at a front panel switch. The PSA 510 posseses high sensitivity, flat response and high stability. This instrument also features linear, 60 DB log and square law display, calibrated

IF attenuator, signal identifier and a panel meter to indicate correct local oscillator level.

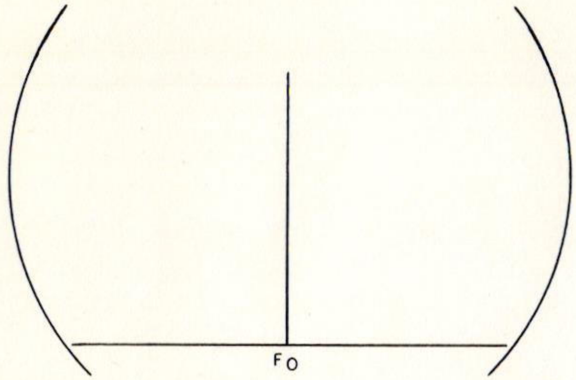
THEORY OF OPERATION

Before operating a NELSON-ROSS Plug-In 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 represent 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 Plug-In Spectrum Analyzers.

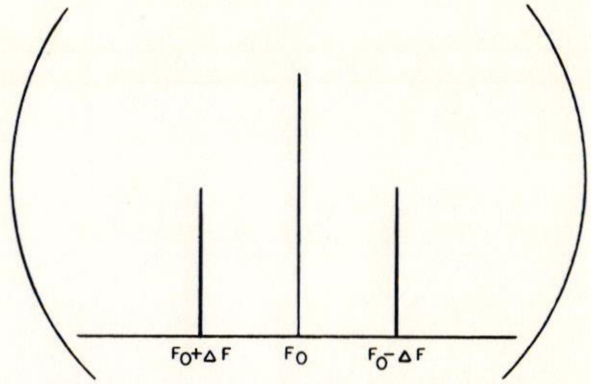
The nature of the spectral display can be understood with the aid of the following illustrative examples.

Single Frequency, Idealized

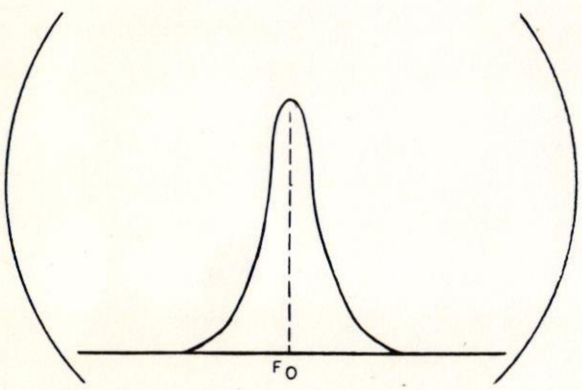
An ideal spectrum analyzer, will display a signal containing energy at only one frequency as a single vertical line. This is illustrated in Figure 1-1A.



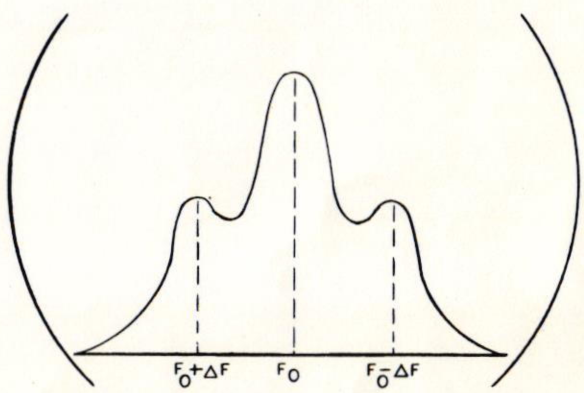
A— C W SIGNAL AS SEEN ON IDEAL SPECTRUM ANALYZER



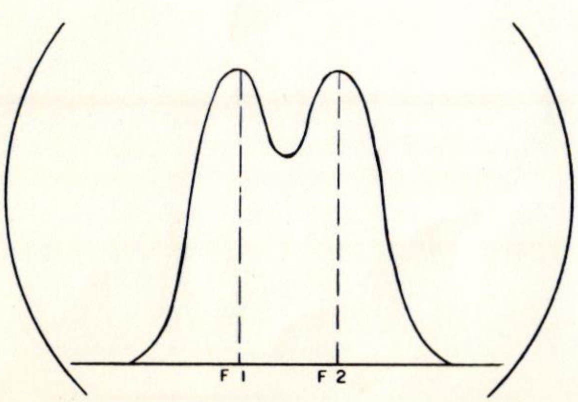
B— MODULATED SIGNAL ON IDEAL ANALYZER



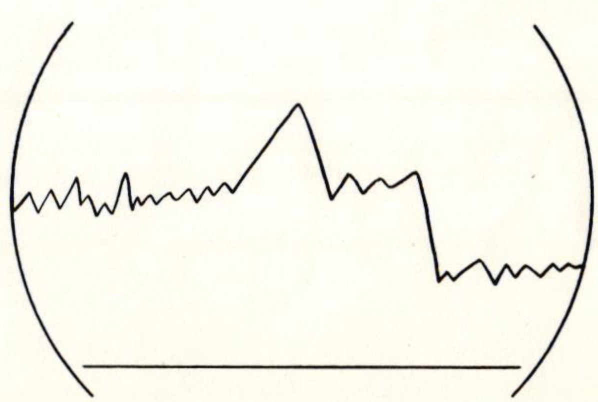
C— C W SIGNAL AS SEEN ON REAL ANALYZER



D — MODULATED SIGNAL ILLUSTRATING EFFECT OF RESOLUTION



E— TWO EQUAL SIGNALS JUST RESOLVED



F—CONTINUOUS SPECTRUM

FIGURE I-1

SPECTRAL DISPLAY CHARACTERISTICS

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 in Figure 1-1B.

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 1-1C. Similarly, multiple signals, closer together than the width of the pulse, will tend to blend as in figure 1-1D. 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 1-1E.

Continuous Spectrum

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

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 3DB dip) in the display

Dispersion - The width of the display (in frequency) on the cathode-ray tube

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

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

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

If this relationship is violated, either by reducing the scan time (increasing sweep speed) or by increasing the dispersion, 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 Plug-In Spectrum Analyzers fit oscilloscopes with high sweep speed capabilities, the operator must remember to reduce the sweep speed sufficiently 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, dispersion 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 dispersion (or increase scan time) until the signal amplitude is no longer attenuated by these effects before taking readings. As the dispersion 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.

If Sweep Speed are recommended in the Technical Specifications, section of this manual, their use will assure optimum performance.

TECHNICAL SPECIFICATIONS

PSA-510

FREQUENCY RANGE–EXTERNAL L.O.	10mc to 15Gc * Higher frequencies achieved with external mixers whose output can drive 500mc, 50Ω
FREQUENCY	First IF Frequency: 500mc Fundamental Mixing: C.F. = L.O. ±500mc Harmonic Mixing: C.F. = nL.O. ±500mc (C.F. = Center Frequency; n = any integer) Signal Identifier provided by front panel switch
MINIMUM SENSITIVITY (5kc IF Bandwidth)	Fundamental Mixing: 10mc - 4Gc: —95 dbm 4Gc - 8Gc: —90 dbm Harmonic Mixing: 10mc - 8Gc: slightly less than that for Fundamental Mixing; 8Gc - 15Gc: —75 dbm
FREQUENCY ACCURACY	L.O. accuracy ±5mc
FREQUENCY STABILITY	Total Drift = L.O. drift ±200kc; all conditions
LOCAL OSCILLATOR RANGE	500mc to 8Gc with internal mixer
LOCAL OSCILLATOR INPUT	1 milliwatt (min) to 10 milliwatts (max)
DISPERSION/SCAN WIDTH	Zero** to 1Gc (100mc/cm)
RESOLUTION/IF BANDWIDTH	5, 10, 20 and 100kc Selectable with front panel switch
DISPLAYS (6 cm vertical scale)	Linear; 60 db Logarithmic and 13 db Square Law Selectable with front panel switch
DISPLAY FLATNESS	100mc: ±1 db; 1Gc: ±4 db (Typical for Fundamental Mixing)
RESIDUAL RESPONSES	—70 dbm
INCIDENTAL FM	That of L.O.
INPUT POWER (Maximum)	0 dbm
INPUT IMPEDANCE	Signal Input: 50Ω Local Oscillator: 50Ω N type connectors on front panel
IF ATTENUATOR	51db range in 1 db steps; ±0.1 db/db
IF GAIN	40 db (nominal) Continuously variable with front panel control
SWEEP RATE	As provided by L.O. Rates up to 30cps recommended, useable to 60cps
VIDEO FILTER	Two positions: Short: 0.1 milliseconds; Long: 1 milliseconds Selectable with front panel switch
COMPATIBLE OSCILLOSCOPES	Tektronix letter series or equivalents
POWER REQUIREMENTS	All power voltages from oscilloscope

*Recommended frequency range with internal mixer is 10mc to 10.5Gc but is useable to 15Gc.
**Lower limit of Dispersion/Scan Width limited only by stability and incidental FM of the L.O.

SECTION 2

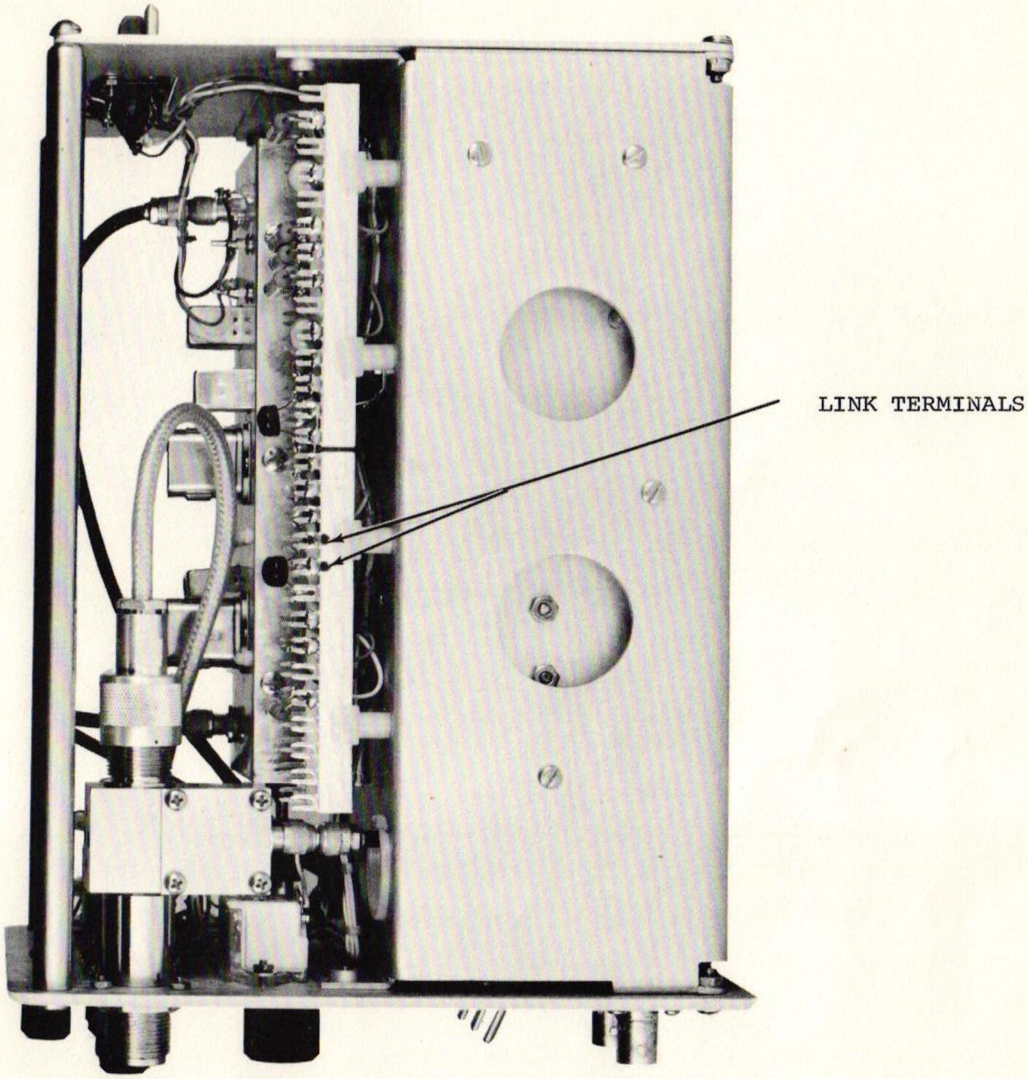
OPERATING INSTRUCTIONS

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 plug-ins have either 4 or 6 centimeter vertical scales. All Nelson-Ross Plug-In Analyzers are shipped from the factory set for 6CM vertical scales. Provision is made for soldering a link within the analyzer to accomodate the 4CM scale. The link terminals are on the lower side of the chassis shell, at the left side of the instrument. They are marked by two red dots (see Figure 2-1). Determine the vertical scale of your instrument, and add the link, if required. Should you later care to transfer the plug-in from a unit with a 4CM scale to one with a 6CM scale, you may remove the link.



INSTALLATION OF THE VERTICAL SCALE SELECTOR LINK

FIGURE 2-1

INSTALLATION OF THE PLUG-IN

Insert the plug-in unit into any oscilloscope which accepts TEKTRONIX letter series plug-ins. Turn the lock knob (at the bottom center of the analyzer panel) clockwise to secure the unit. Select the proper local oscillator - sweeper (see local Oscillator Requirements) and connect it to the oscilloscope horizontal input as directed in the sweeper instruction manual. The R.F. output of the sweeper must be connected to the LOW INPUT, (Local Oscillator Input) of the plug-in analyzer. Connect the signal input to the SIGNAL INPUT jack on the panel. The signal input lead must provide a D.C. return for the mixer. If it does not, a coaxial pad may be placed at the input to provide a return. Be sure that the maximum input power (see specifications) is not exceeded. Turn on the power and allow both instruments to warm-up. (The plug-in analyzer requires no warm-up, but the oscilloscope requires about 5 minutes).

(INSERT PADDER IF HP SWEEPER FOR DC RETURN)

EXTERNAL MICROWAVE MIXER

An external microwave mixer may be used to achieve frequencies up to 15 Gc. To substitute an external mixer, feed signal and local oscillator inputs into the external unit and connect the output of that unit to the IF INPUT jack on the analyzer front panel. The jumper between MIXER OUTPUT and IF INPUT is not used in this operating mode.

INITIAL ADJUSTMENTS

After adjusting the sweeper to approximately the proper frequency and sweep width, set the output level of the sweeper so that the MIXER CURRENT meter on the spectrum analyzer reads in the upper half of the "NORMAL" scale, (white box). This indicates an acceptable range of local oscillator levels. The higher the level the better the sensitivity.

Caution - The output level must not be set beyond the "Normal" scale on the meter. Operation in the "OVER" portion of the scale (red box) can cause damage to the analyzer. The instrument is now ready for use.

FUNCTION AND OPERATION OF PANEL CONTROLS

The panel controls of this analyzer are presented in Figure 2-2

DISPLAY

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

60DB 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 will be directly proportional to the input power. Thus, two signals differing by 3 DB will appear 2:1 in amplitude on the screen.

VIDEO FILTER

Located concentrically with the DISPLAY control, this switch permits the operator to insert either of two low-pass filters into the vertical deflection amplifier, to filter out noise, etc. The center position removes all filtering.

I.F. ATTENUATOR

A step attenuator, composed of six switches provides 51 DB of attenuation in 1 DB steps. This attenuator is useful for making relative amplitude measurements. It should be noted that 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 + 10 DBM, an unreasonably high level.

This attenuator is provided primarily for use in the LIN and SQUARE LAW operating modes.

RESOLUTION

This control, centrally located on the panel, provides for selection of resolution. Resolution is provided by an adjustable bandwidth R.F. filter in the last I.F. 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. The resolution values on the panel are approximate and are intended for guidance only. In use, the appearance of the display will determine the setting of this switch. Too high a resolution setting 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.

IF GAIN

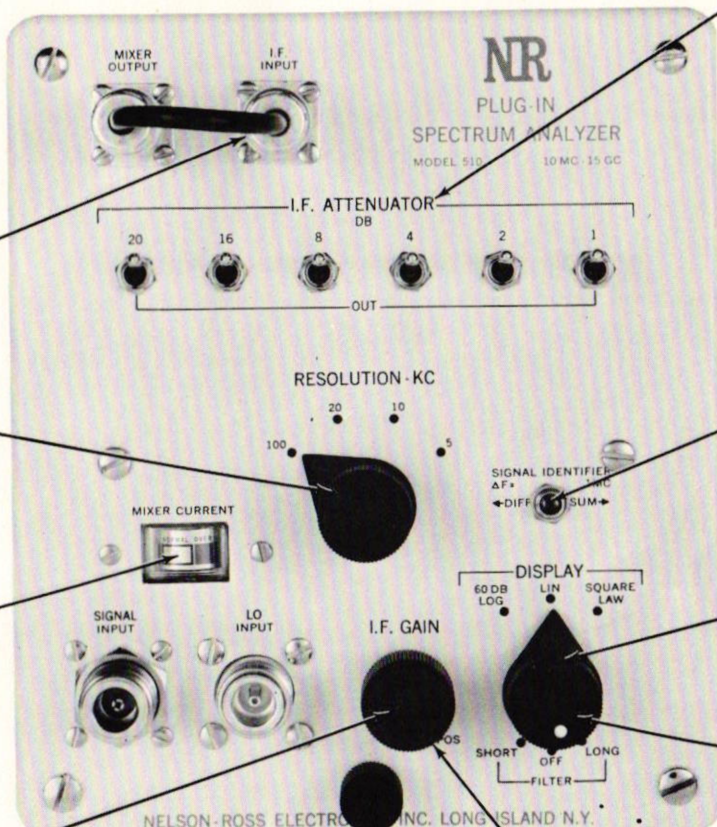
A variable gain control is provided in the IF circuit. This control is operational in all three display modes. It serves to decrease the display amplitude and may be used in conjunction with the IF ATTENUATOR switches to set the display at an exact reference level.

V POSITION

The vertical position control is located on the front panel, concentric to the IF GAIN control. The V POSITION control is used to position the trace vertically on the oscilloscope graticule. The IF GAIN control should be set in the minimum position while the vertical position is adjusted.

SIGNAL IDENTIFIER

Since any given local oscillator frequency will generate a great many possible responses, some method of identifying the particular response must be provided. In the Model PSA 510, a push button on the panel, labelled SIGNAL IDENTIFIER, performs this function. Pressing this button will cause the center frequency to shift one megacycle. This shift will cause the display to move to the right if it is the result of the summation of local oscillator and signal, and to the left if it results from the difference. This is true for higher order responses as well as for the prime responses. Because the dispersion of the display is directly proportionate to the order of the response, the apparent motion of the signal (when the button is pushed) will indicate the order. For example, if the dispersion is set for x megacycles, the apparent motion will be x/n megacycles for the nth order response. The display will automatically return to normal position when the SIGNAL IDENTIFIER button is released.



MODEL PSA 510

CONTROLS AND FUNCTIONS

FIGURE 2-2

LOCAL OSCILLATOR REQUIREMENTS

The external local oscillator performs two functions: First, by virtue of its presence, it heterodynes the input to 500 MC for amplication by the spectrum analyzer. Second, since it is swept, it developes 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 the 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 inputs and all their harmonics. If the output circuit will respond to only one frequency, 500 MC in this case, and if one input is very small compared to the other, and output will appear only when the sum or difference of the smaller input and n times the larger input equals 500 MC. The large input is the externally supplied local oscillator, while the smaller input is the signal. Expressed mathematically, an output occurs when:

$$fs = nfo \pm 500MC$$

fs = signal frequency

fo = L.O. Frequency

n = any integer

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 = 1, and are separated by 1000 MC. This is why the maximum dispersion is limited to 1000 MC. 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 1000 MC 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 dispersion of the display (the width in frequency) is equal to the sweep width of the local oscillator multiplied by the order of the display (n).

The swept source used must have the following minimum characteristics:

1. Output power sufficient to drive the mixer in the instrument or an external mixer.
2. A sweep output synchronized with the frequency deviation, suitable for driving the H input of the oscilloscope.
3. Means for level adjustment, so that the crystal current may be set to a reasonable level. Since the level is not critical, fixed pads may be used between the local oscillator and the instrument.

SECTION 3

EQUIPMENT DESCRIPTION

GENERAL

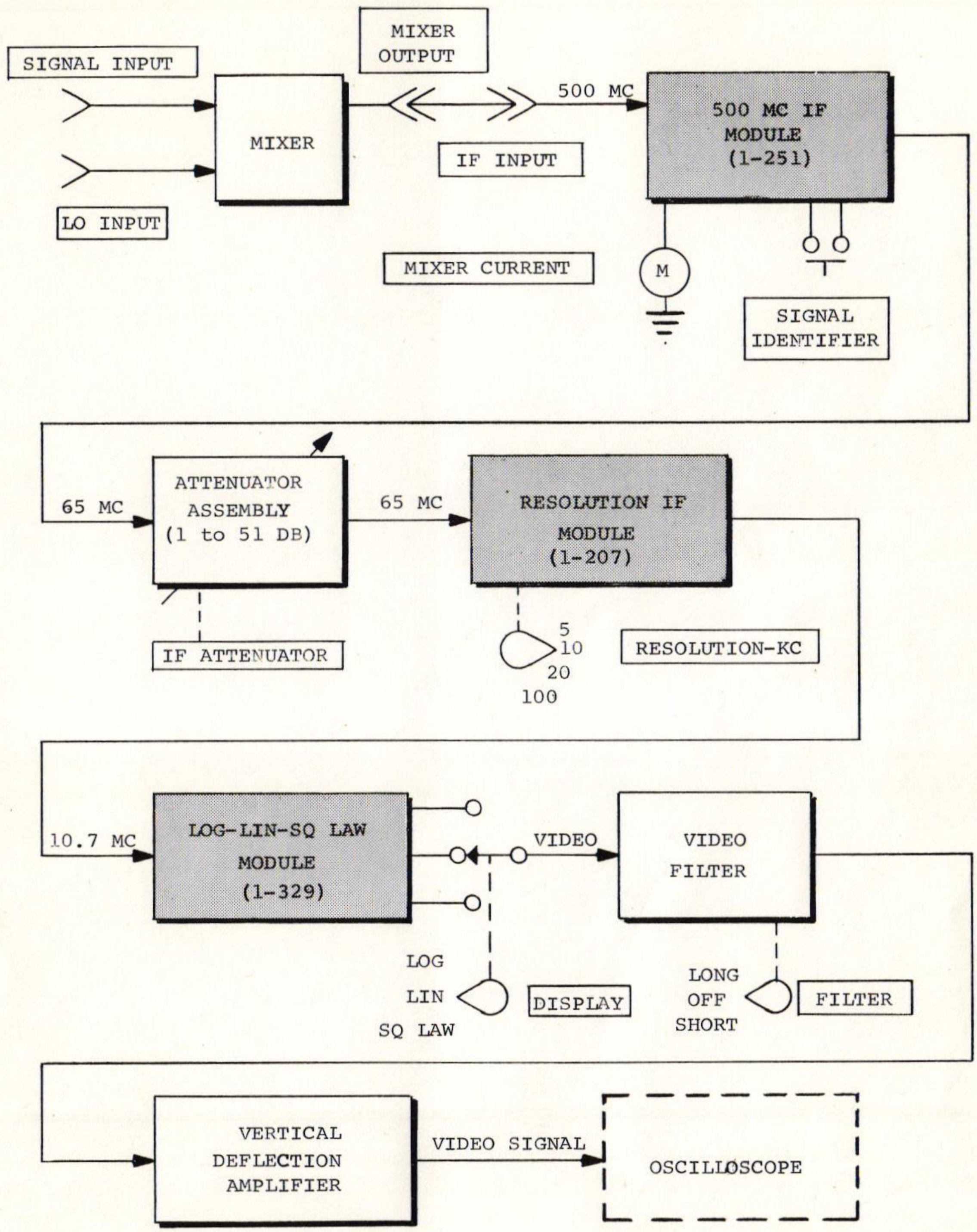
The Model PSA 510 Plug-In Microwave Spectrum Analyzer contains a broadband microwave mixer which hetrodynes the input signal with the (external) swept local oscillator, producing an I.F. signal at 500 megacycles. A 500 MC I.F. strip permits wide dispersion. Subsequent amplifiers at 65 MC and 10.7 MC provides gain while a crystal filter acts as the resolution element. Linear, Logarithmic, and Square Law amplifiers provide vertical deflection for the oscilloscope. The horizontal sweep is provided by an external local oscillator.

Figure 3-1 is a block diagram of the Model PSA 510 analyzer. This unit consists of an instrument frame and three modular electronic subassemblies. Blocks representing the three modules are shaded and the module number is shown in parantheses. All other elements shown are mounted on the Instrument Frame.

INSTRUMENT FRAME

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

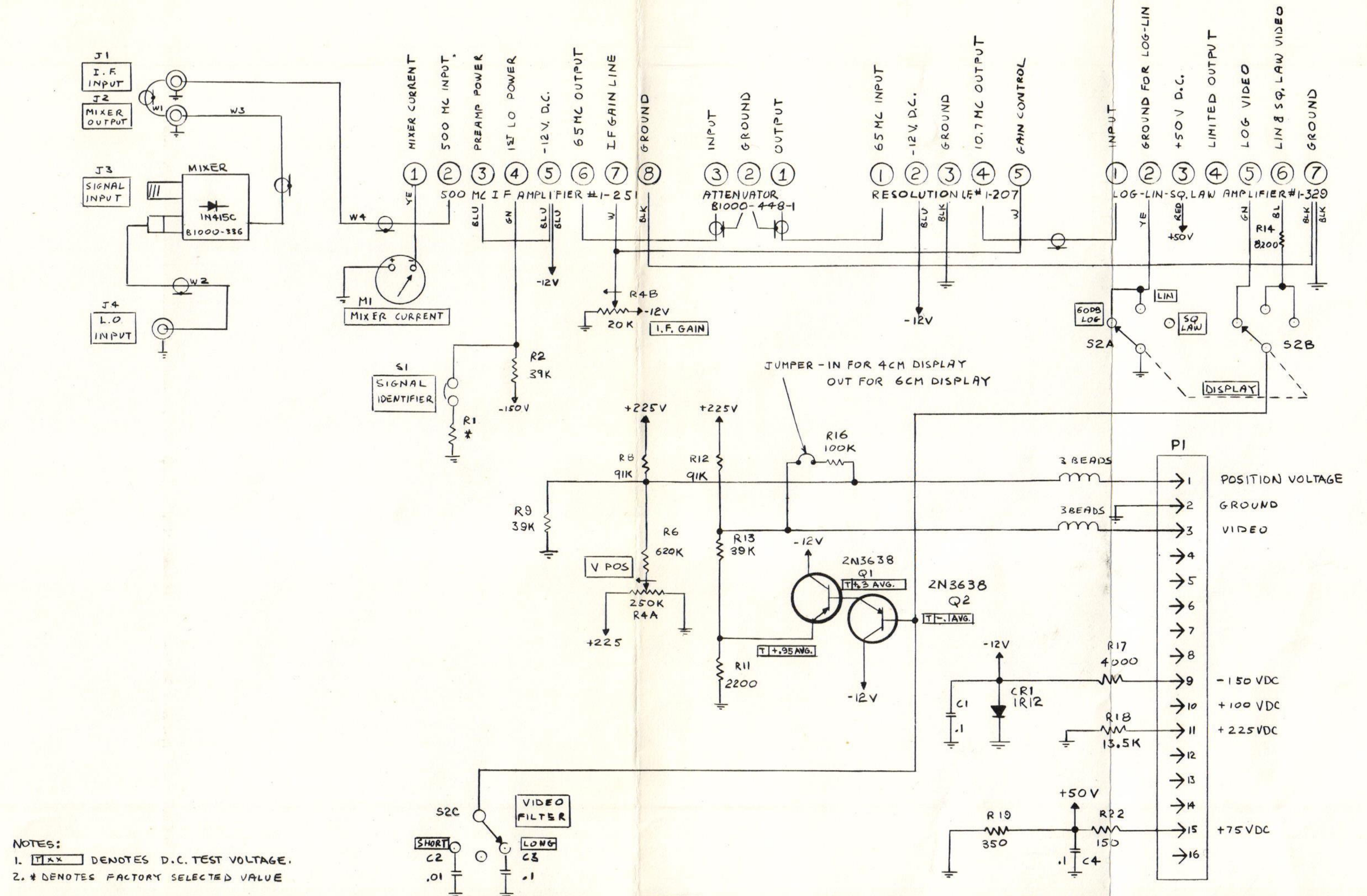
The following elements are mounted on the instrument frame:



MODEL PSA 510

BLOCK DIAGRAM

FIGURE 3-1



NOTES:
1. [T xx] DENOTES D.C. TEST VOLTAGE.
2. * DENOTES FACTORY SELECTED VALUE

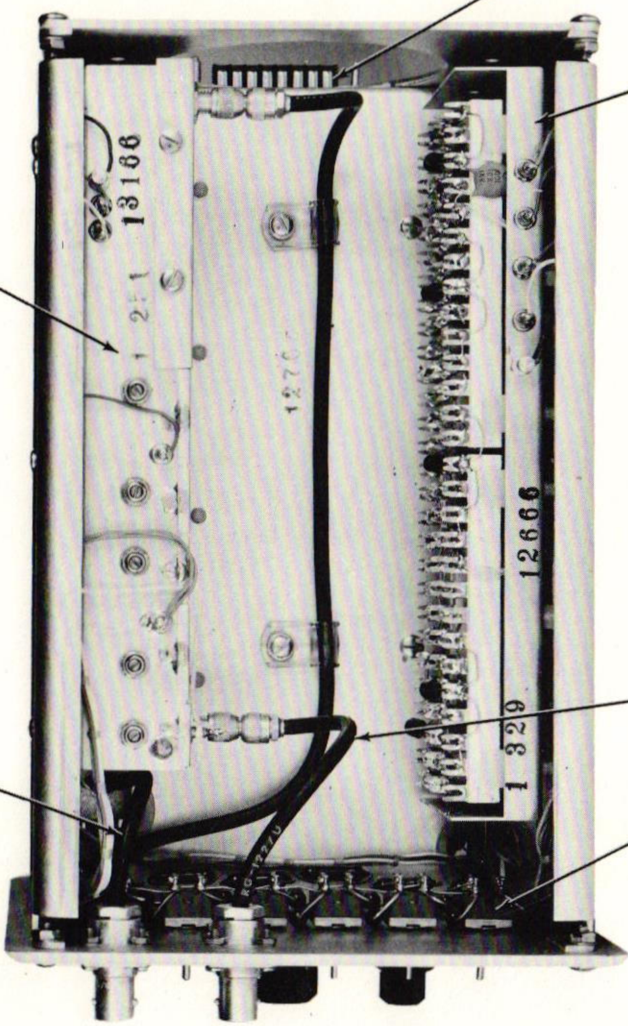
REV	DETAILS	DATE	BY
A	REC # 154	6-2-66	AR
B	REC # 186	6/6/66	S.K.

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

SCHEMATIC
FRAME MODEL PSA-510

C1000-293 REV B

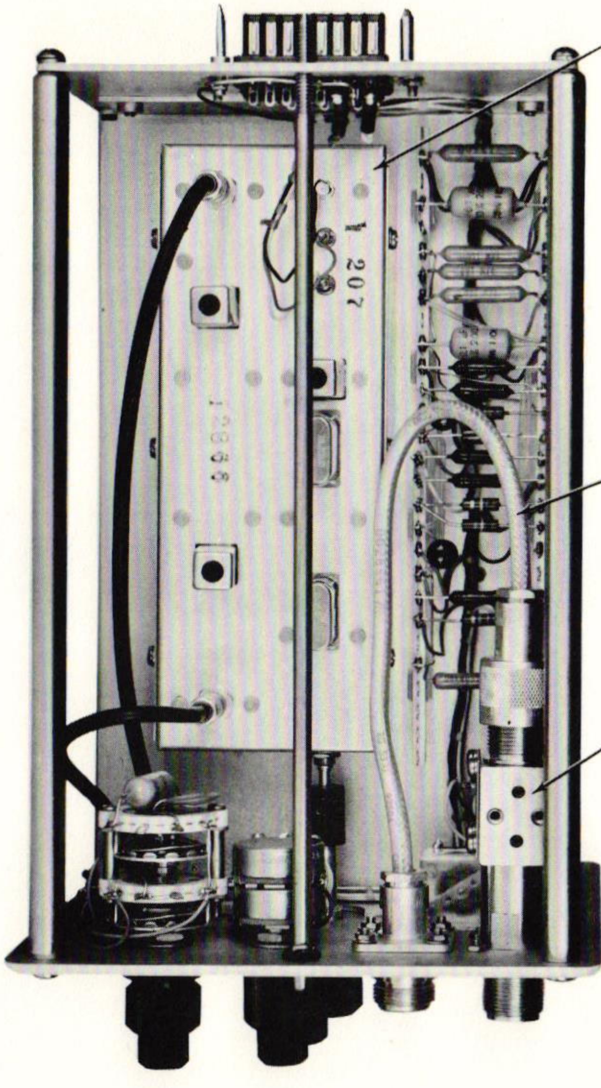
FIGURE 3-2



MODEL PSA 510

TOP VIEW

FIGURE 3-3



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BOTTOM VIEW

FIGURE 3-4

1. Panel Controls
2. Input Connectors
3. Mixer
4. Mixer Current Meter
5. Vertical Deflecter Amplifier
6. Vertical Position Circuitry
7. Video Filter Circuitry
8. Power Supply
9. Loading Resistors (for oscilloscope power supply)

The Instrument Frame also houses the following modules:

1. 500 MC IF MODULE (#1-351)
2. RESOLUTION IF MODULE (#1-207
3. LOG-IN-SQUARE LAW MODULE (#1-329)

CIRCUIT DESCRIPTION

The input signal is impressed at the SIGNAL INPUT jack (J3) which is a type N connector located on the front panel. It is mixed in the mixer with the local oscillator input, impressed at J4. The mixing is accomplished by a semiconductor diode, CR1 which is mounted within the mixer. The mixer output is a 500 MC signal which passes through a short jumper on the front panel between the IF INPUT jack, J1 and MIXER OUTPUT jack, J2. The function of J1 is to permit the use of external mixers with this instrument.

The signal then passes from J1 to the input terminal of the 500 MC IF MODULE (#251).

A complete description of 500 MC IF MODULE circuit operation is contained within Section 4 of this manual. After passing through the coupling loop (which injects the 500 megacycle energy into the IF strip) the remaining DC current passes through the MIXER CURRENT Meter, M1. This current is generated by the action of the local oscillator on the mixer diode. Since there is an optimum level of current at which the input mixer operates, the function of the MIXER CURRENT meter is to provide an indication for the operator in setting the local oscillator input level. A signal is amplified within the 500 MC IF MODULE and converted to a frequency of 65 MC.

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 4 of this manual), and is fed into the RESOLUTION IF MODULE (#1-207). 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 (#1-207) is contained within Section 4 of this manual. The 10.7 MC output is impressed upon the input of the LOG-LIN-SQ LAW MODULE (#1-329). A complete description of this module is contained within Section 4 of this manual.

The module generates logarithmic, linear or square law video, which are available at the terminals of the DISPLAY switch S2A. The operator may select the desired video signal by positioning the DISPLAY SWITCH in the appropriate position. The output of this switch is then routed to the Vertical Deflection Amplifier, which is mounted on the instrument frame and consists of cascaded emitter followers Q1 and Q2. When video filtering is desired, the operator may place capacitors C2 or C3 at the input of the Vertical Deflection Amplifier by positioning the video FILTER switch S2B to the SHORT or LONG positions respectively.

The output of emitter follower Q1 is the desired deflection signal for the oscilloscope and is coupled to the oscilloscope through a network composed of R11, R12, and R13. This network provides the proper DC level at the oscilloscope input. The other input to the oscilloscope, the DC voltage required for vertical position, is fed to the connector through a network (similar to that used for the video signal) comprised of the V POS potentiometer R4, R8, R9, and R16. Both the V Position Voltage and the Video signal are fed through inductors composed of three ferrite beads. The SIGNAL IDENTIFIER button which is located on the front panel, tunes the first local oscillator in the 500 MC IF module by a fixed 1MC increment.

This is achieved in the following manner. The local oscillator is supplied by the -150 VDC power supply (in the oscilloscope) with a constant current via resistor R2. When the SIGNAL IDENTIFIER button, S1 is pressed, it shunts the first local oscillator source with a selected value of resistor R1, reducing the amount of current through the local oscillator and reducing the voltage of the collectors. Accordingly the collector capacitance is altered turning the local oscillator by the required amount. R1 is factory selected to match the particular 500 MC IF module mounted within the frame and has to be reselected should the IF module be changed. The + 100 VDC and the 6.3 VAC power supply from the oscilloscope are not used by the analyzer. The + 225 VDC supply is loaded to its minimum requirements by means of resistor R18. The -150 VDC supply is regulated to a constant -12 VDC output by Zener diode CR2, and is used to supply power for the various transistorized modules. A + 50 VDC supply is obtained by dividing down the + 75 VDC supply from the oscilloscope, using R19, R21, and R22, which also serve to load that supply to its fixed requirement of 150 mils.

MAINTENANCE AND REPAIR

NELSON-ROSS Plug-In 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 plug-in 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

Plug-in units are generally subject to considerable handling and could be accidentally damaged during storage or transfer. Accordingly, you should visually inspect the plug-in unit periodically for obvious damage. Look for loose or frayed wires, damaged components, broken terminal strips, 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 plug-in analyzer are mounted on ceramic terminal strips. The use of a 60 watt soldering iron, equipped with a chisel point is recommended for unsoldering a soldering of any components.

Only 60-40 Rosin Core solder should be used. Excessive pressure on a ceramic terminal strip could cause it to crack. Diodes should be installed with the normal pigtail looped leads and any semiconductors should be protected uring 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 Plug-In 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 Plug-In 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 cuase by a malfunction in the equipment actually result from incorrect control settings. All controls should be checked for correct settings.

You should also check the input cable connections and accessories, Once 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 possible methods. In the first and simplest method, the plug-in unit is removed and replaced with a spare plug-in. The second method requires verification of input signals, supply 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 plug-in unit. The voltages supplied by the oscilloscope to the Plug-In analyzer are identified on the schematic drawing of the analyzer frame. This schematic may be found in Section 3 of this manual. If the voltages measure incorrectly, remove the plug-in 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 plug-in unit.

TROUBLE SHOOTING THE SPECTRUM ANALYZER

When it has been definitely established that the malfunction exists in the Spectrum Analyzer plug-in unit the following troubleshooting procedures are recommended.

Much time and effort will be conserved by first performing a very thorough visual inspection of the plug-in 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 Plug-In 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-ohmmeter (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 removed from the instrument frame and tested in accordance with the procedure specified in the individual module description, contained in Section 4 of this manual. Power should be supplied to the module from the instrument frame with jumper cords.

PARTS LIST

FRAME 510 MODEL 510

ITEM	DESCRIPTION	DRAWING NO.
R1	Chosen At Test	
R2	Comp. 1W 1% 39K	Dale MFF ½ T1
R3	Not Used	
R4	Potentiometer	C1000-154-43
R5	Not Used	
R6	Comp. ½W 5% 620 K	IRC Type GBT
R7	Not Used	
R8	Comp. ½W 1% 91K	IRC Type GBT
R9	Film ½W 1% 39K	
R10	Not Used	
R11	Comp. ½W 5% 2200 Ω	IRC Type GBT
R12	Same as R8	
R13	Same as R9	
R14	Comp. ½W 5% 8200 Ω	IRC Type GBT
R15	Not Used	
R16	comp ½W 5% 100K	
R17	Axial W.W. 4K	Ward Leonard 5 XM
R18	Axial W.W. 13.5	Ward Leonard 5 XM
R19	Axial W.W. 350 Ω	WL type 10F with brackets
R20	Not Used	
R21	Not Used	
R22	Axial WW 150Ω	Ward Leonard 5 XM

PARTS LIST

FRAME 510 MODEL 510

ITEM	DESCRIPTION	DRAWING NO.
C1	Capacitor .1	Amperex C296AB-A100K
C2	.01 Capacitor	
C3	Same as C1	
C4	Same as C1	
CR1	Diode Zener IR12B	Solitron Devices
Q1	Transistor 2N3638	Fairchild Semiconductor
Q2	Same as Q1	
M1	Meter 200 u amp.	HR-20
	Attenuator	B1000-448-1
S1	Switch P.B.	Grayhill 30-1
S2	Switch Rotary	212-2-18005-2, CTS
P1	Connector, Mating	Amphenol 26-159-16
W1	Cable Assy	A1000-403-2
W2	Cable Assy	A1000-351
W3	Cable Assy	A1000-372
W4	Same as W3	
	Mixer	B1000-336
IF 1-207	Resolution IF	C1000-207
IF 1-251	500 MC IF	C1000-251
IF 1-329	Log Lin Square Law IF	C1000-329

SECTION 4

MODULE DESCRIPTIONS

This section contains four parts. The first three parts are detailed descriptions of the following modules:

500 MC IF Module (1-251 and 1-251A)

Resolution IF Module (1-207)

Log-Lin-Sq. Law Module (1-329)

Circuit descriptions, Maintenance instructions alignment procedures and parts lists are provided for each module.

Part four of this section is a schematic drawing and parts list of the I.F. Attenuator sub-module.

500 MC IF MODULE (1-251 and 1-251A)

FUNCTION

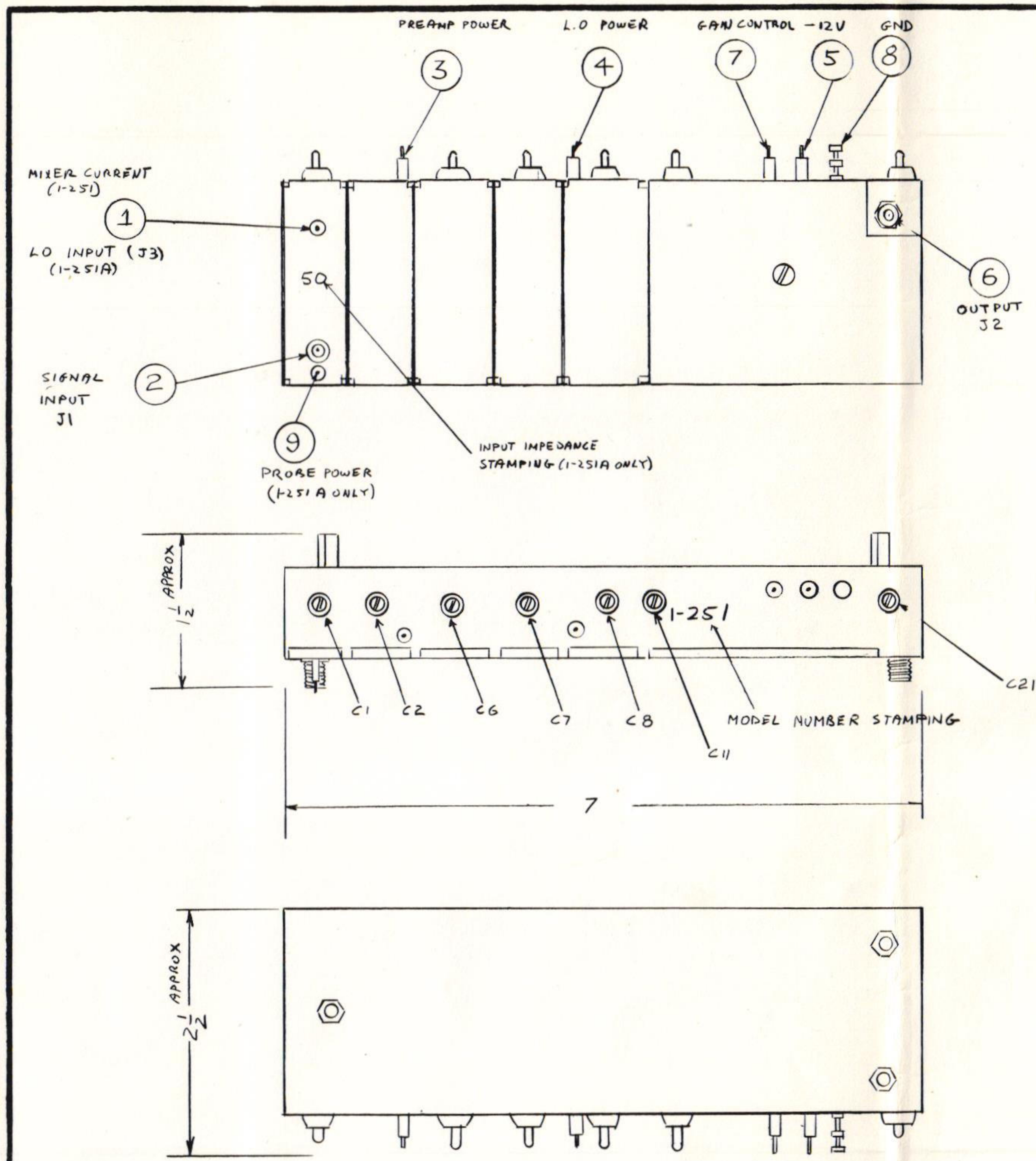
The function of this module is to accept a signal at 500 megacycles, provide considerable filtering (to eliminate spurious responses which might occur from local oscillator inputs), convert the signal to 65 megacycles and provide a 50 ohm output to drive the next module within the analyzer. Figure 251-1 is an outline drawing of this module. A schematic representation of the module is provided in Figure 251-2.

CIRCUIT DESCRIPTION

There are two configurations for the input stage of this module. They are depicted in the upper right hand corner of the schematic.

INPUT (1-251)

Modules designated 1-251 contain only one input jack and are 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 which is returned to ground via capacitor, C26 and returned outside the module housing through capacitor, C26. This arrangement provides for the measurement of mixer current (generated by the mixer in the instrument frame) at terminal 1.



NOTES

1. FUNCTIONS - 500 MC PRE-SELECTOR & AMPLIFIER, CONVERT TO 65 MC, PROVIDE GAIN [INPUT MIXER-'A' VERSION ONLY]
2. POWER - IF & PREAMP -12V DC, 4.5MA
   LO - 4 MA, CONSTANT CURRENT (20V)
3. INPUT IMPEDANCE 50Ω
4. OUTPUT IMPEDANCE 50Ω
5. TEST CHARACTERISTICS
   A: GAIN - 20 DB WITH TERMINAL 7 GROUNDED (NOMINAL)
   B: BANDWIDTH - 2 MC (NOMINAL)
   C: GAIN CONTROL RANGE - 20 DB (NOMINAL)
6. SCHEMATIC C1000-251

REV	DETAILS	DATE	BY
A	REC 183	4/3/66	S.K.

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

SPECIFICATIONS
500 MC IF MODULE #1-251 & 1-251A

C1000-353 REV A

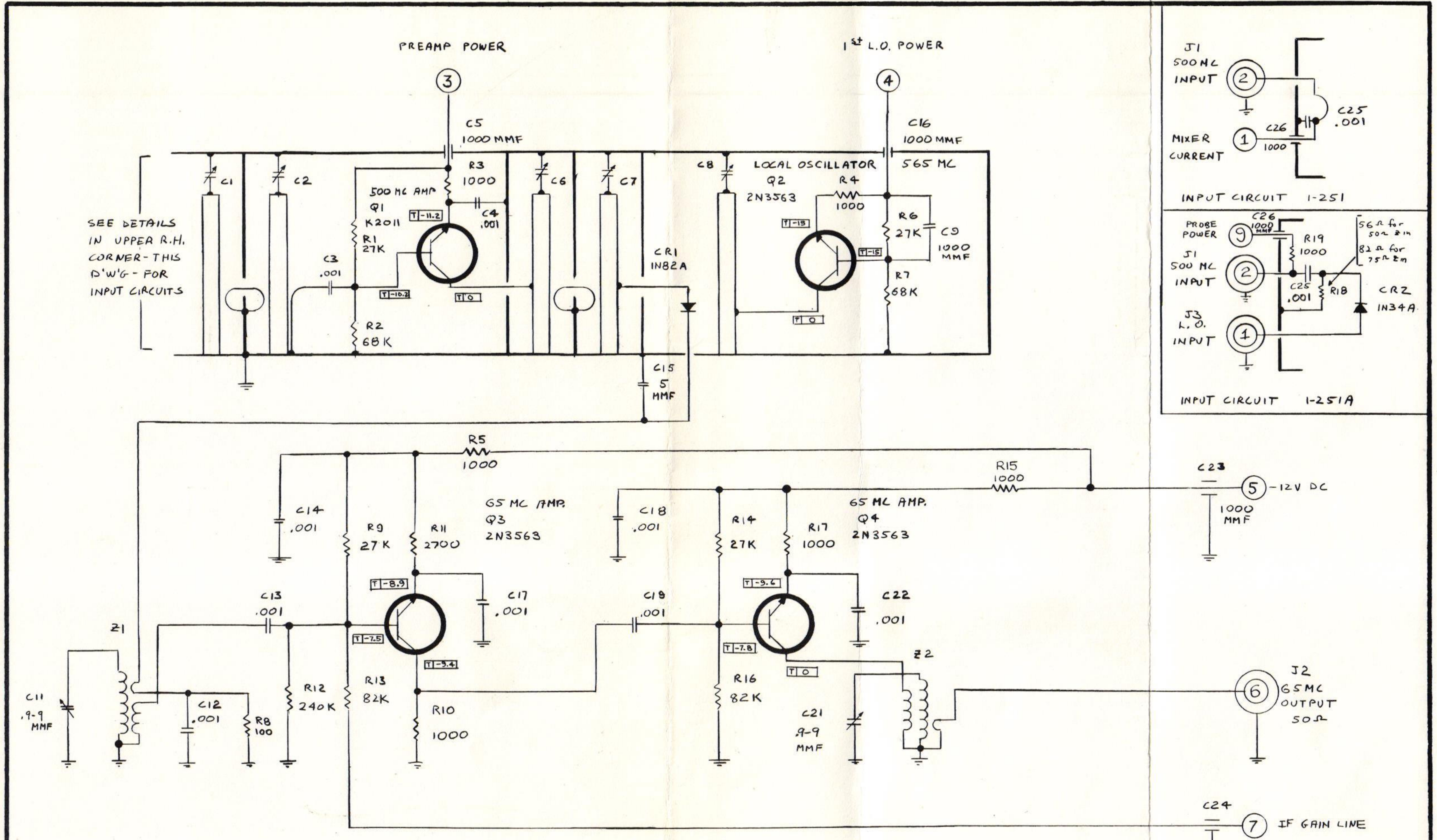
FIGURE 251-1

INPUT (1-251A)

In the module designated 1-251A, a mixer is contained in the first compartment, housing the resonant filter. This mixer consists of diode CR2 and associated components. Accordingly, jacks are provided on the cover of this compartment for both the signal input and the local oscillator. The coupling loop for the first resonant filter is contained within the mixer. The signal input is coupled to the mixer by capacitor, C25 and terminal 9 is provided to permit the introduction of a DC voltage on the input line (for use with high impedance probes).

SIGNAL PATH

The input signal is coupled to the resonant filters and 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 transistors Q3, Q4 and associated circuitry. There are 65 MC resonant transformers, Z1 and Z2 provided at the input and output of this amplification stage. Gain control is achieved by varying the bias on the base of transistor Q3.



NOTES:
1. ALL RESISTORS IN OHMS
2. ALL CAPACITORS IN MFD UNLESS OTHERWISE SPECIFIED
3. ALL INDUCTORS IN MHY UNLESS OTHERWISE SPECIFIED
4. T XX DENOTES D.C. TEST VOLTAGES

REV	DETAILS	DATE	BY
A		3/28/66	A.R.
B	REC 183		

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

SCHEMATIC
500 MC IF MODULE #1-251 & 1-251A

C1000-251 REV B

FIGURE 251-2

MAINTENANCE AND REPAIR

The covers of this module are soldered on to provide and R-F seal. It is not advisable to remove these covers for service. If this module is determined to be faulty, it should be returned to the factory for service. The unit is extremely reliable and in normal service should require no repair. Most of the components are passive and few active parts are highly derated.

ALIGNMENT

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 -10DBM.

This module should be connected to an operating plug-in spectrum analyzer during alignment. Because the level of the 65 mc output signal at J2 is extremely low (of the order of -70DBM, at normal input levels) it is necessary to utilize the remaining portions of the plug-in 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 -10DBM (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, C8, 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. Trimmer capacitors, C1, C2, C6, C7, C11, and C21 may then all be tuned 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 65mc amplifier.

6. Remove the large covers on this module by removing the single retaining screw in the center.

7. Inject a 65 mc signal by means of a coupling loop on the end of a lead from the signal generator.

8. Tune capacitors, C11 and C21, for maximum deflection on the CRT screen.

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

PARTS LIST

500 MC IF STRIP

MODEL: 1-251

ITEM	DESCRIPTION	DRAWING NO.
R1	Comp. ½W 5% 27K	IRC Type GBT
R2	Comp. ½W 5% 68K	IRC Type GBT
R3	Comp. ½W 5% 1K	IRC Type GBT
R4	Same as R3	
R5	Same as R3	
R6	Same as R1	
R7	Same as R2	
R8	Comp. ½W 5% 100 Ω	IRC Type GBT
R9	Same as R1	
R10	Same as R3	
R11	Comp. ½W 5% 2.7K	IRC Type GBT
R12	Comp. ½W 5% 240K	IRC Type GBT
R13	Comp. ½W 5% 82K	IRC Type GBT
R14	Same as R1	
R15	Same as R3	
R16	Same as R13	
R17	Same as R3	
R18	56 Ω ½W 5% (Used on 1-251A only)	IRC Type GBT
R19	Same as R3	

PARTS LIST

500 MC IF STRIP

MODEL 1-251 & 1-251A

ITEM	DESCRIPTION	DRAWING NO.
C1	Piston Capacitor	Amperex C004 AA/9E
C2	Same as C1	
C3	Disc Capacitor .001	Centralab DD-102
C4	Same as C3	
C5	Feedthru 1000 PF	Erie 2404-000-X5U-102P
C6	Same as C1	
C7	Same as C1	
C8	Same as C1	
C9	Same as C5	
C10	Not Used	
C11	Same as C1	
C12	Same as C3	
C13	Same as C3	
C14	Same as C3	
C15	Mica Capacitor 5 PF	CM15E050J
C16	Same as C5	
C17	Same as C3	
C18	Same as C3	
C19	Same as C3	
C20	Not Used	
C21	Same as C1	

PARTS LIST

500 MC IF STRIP

MODEL 1-251 & 1-251A

ITEM	DESCRIPTION	DRAWING NO.
C22	Same as C3	
C23	Same as C5	
C24	Same as C5	
C25	Same as C3	
C26	Same as C5	
J1	Connector	UG697/U
J2	Same as J1	
J3	Same as J1 (Used on 1-251A Only)	
CR1	Diode IN82A	
CR2	Diode IN34A (Used on 1-251A Only)	
Z1	Transformer	AK1000-346
Z2	Same as Z1	
Q1	Transistor	KMC 2011
Q2	Transistor	Fairchild 2N3563
Q3	Same as Q2	
Q4	Same as Q2	

RESOLUTION IF MODULE # 1-207

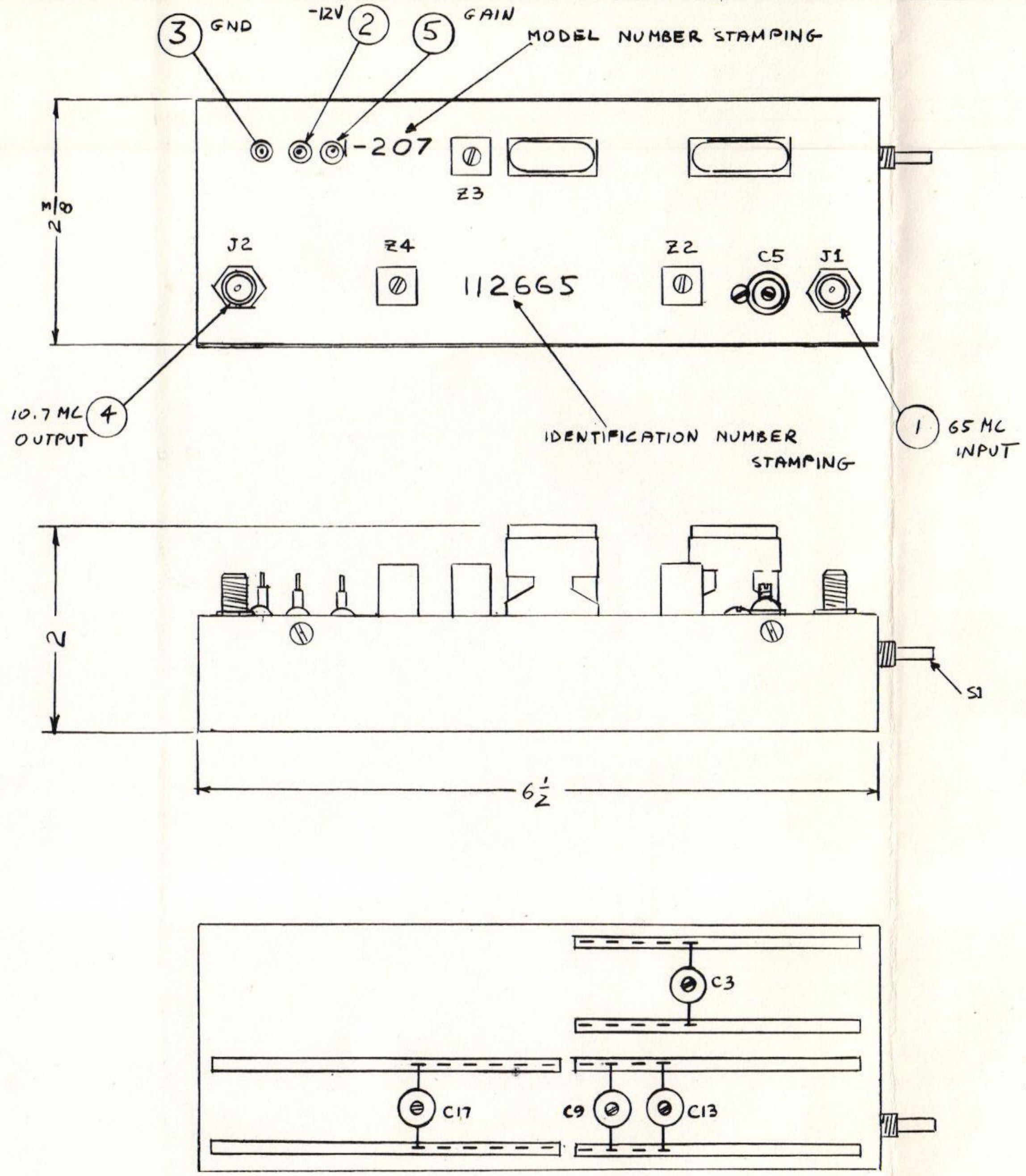
FUNCTION

The function of this module is to accept a low level signal at a 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 -90 DBM at the input will produce 500 Microvolts at the output. The input is 50 ohms while the high impedence output is specifically designed to drive the next module within the analyzer.

An outline drawing of this module is provided in Figure 207-1.

CIRCUIT DESCRIPTION

Figure 207-2 is a schematic of this module. The input signal is impressed upon the base of the mixer transistor, Q2 through a 65 MC tuned transformer, Z1. Transformer, Z1 is tuned by trimmer capacitor, C5. A crystal controlled local oscillator comprised of Q1 and its associated circuitry provides a 54.3 MC signal which is applied to the emitter of Q2. The output of Q2 is a 10.7 MC signal which is initially filtered by a coil, Z2. The signal is then fed through two crystal filters comprised of Q3, Q4 and their associated circuitry.



NOTES:

① FUNCTIONS- CONVERT 65 MC INPUT TO 10.7 MC OUTPUT, PROVIDE GAIN, ACT AS VARIABLE BANDWIDTH FILTER

② POWER -12V DC, 9 MA

③ INPUT IMPEDANCE 50Ω NOMINAL

④ OUTPUT IMPEDANCE 3K Ω NOMINAL

⑤ TEST CHARACTERISTICS

A- BANDWIDTH -3db

- 100KC (ccw)
- 20KC
- SELECTED
- SELECTED (cw)

} POSITIONS OF S1

B- GAIN - 40 DB NOMINAL AT 100 KC BW WITH PIN 5 GROUNDED

C- GAIN CONTROL RANGE - 20 DB NOMINAL

⑥ SCHEMATIC C1000-207

REV	DETAILS	DATE	BY
A	REC 186	6/6/66	SK

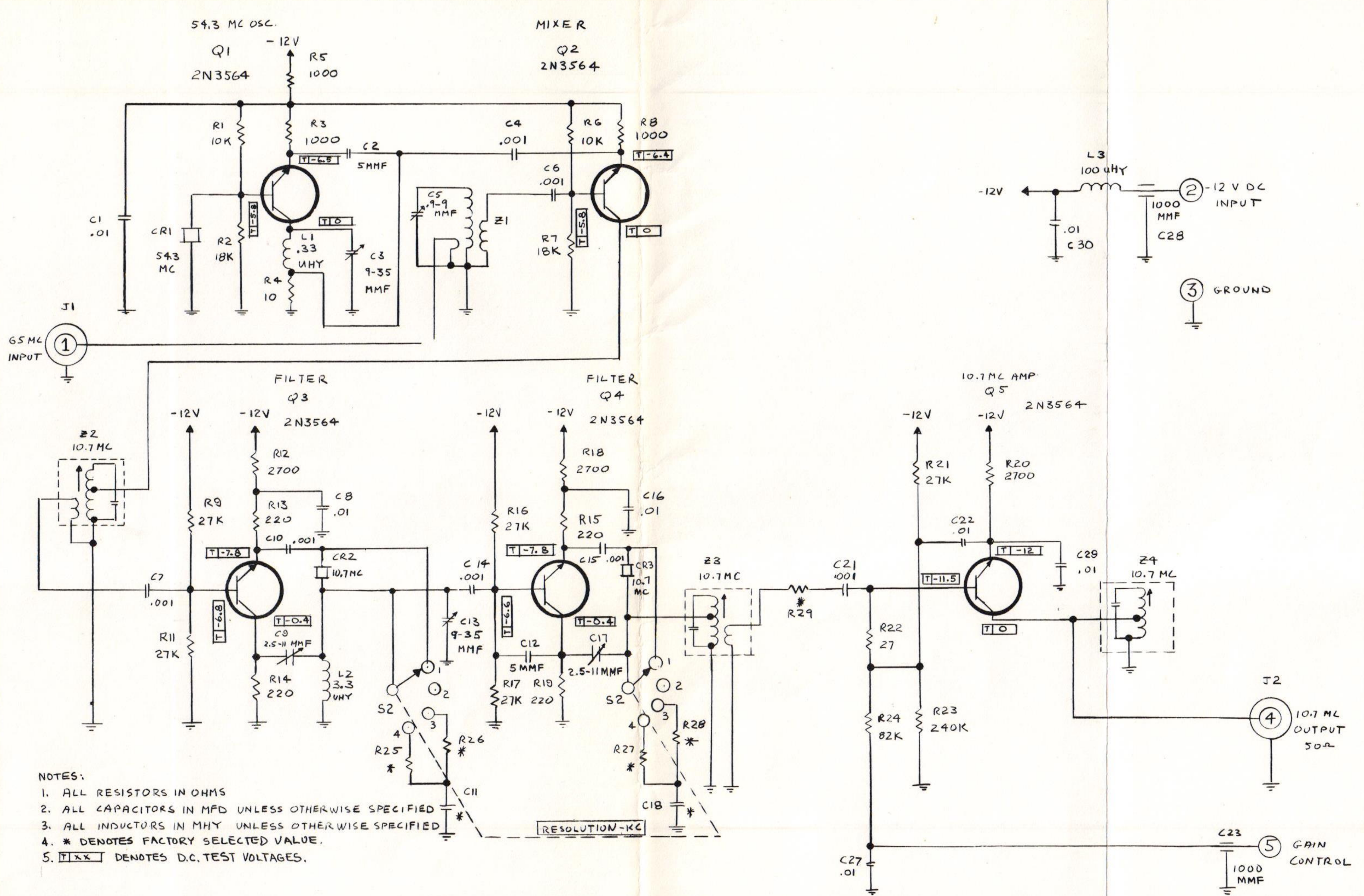
NELSON-ROSS ELECTRONICS, INC.
LONG ISLAND, NEW YORK

SPECIFICATIONS
RESOLUTION I.F. MODULE #1-207

C1000-343 REV A

FIGURE 207-1

Band width selection is accomplished with a four-position selector switch, S1, which operates in the following manner. In the first position (fully counter-clockwise) 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. In the third and fourth positions, the crystal filter is inserted at progressively narrower band-widths. Resistors R25, R26, R27, and R28 and capacitors C11 and C19 are selected at assembly to suit the crystal charac-teristics and bandwidths for each analyzer model. Gain and gain control is achieved by a 10.7 MC amplifier comprised of transistor Q5 and its associated components. This standard amplifier configuration operates with matching input trans-former, Z3 and output transformer, Z4 to provide the neces-sary gain. Gain control is achieved by varying the standing or quiescent current through the transistor by means of a voltage applied at terminal 5 (labeled "gain control"). This voltage can vary from zero volts, at maximum gain to -12 volts at the minimum gain setting. The gain control voltage is determined by the panel mounted GAIN CONTROL potentiometer.



NOTES:
1. ALL RESISTORS IN OHMS
2. ALL CAPACITORS IN MFD UNLESS OTHERWISE SPECIFIED
3. ALL INDUCTORS IN MHY UNLESS OTHERWISE SPECIFIED
4. * DENOTES FACTORY SELECTED VALUE.
5. T XX DENOTES D.C. TEST VOLTAGES.

REV	DETAILS	DATE	BY
A	REC # 145	3/66	AR
B	REC # 149	4/66	AR
C	REC # 186	6/4/66	SK

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

SCHEMATIC
RESOLUTION I.F. MODULE # 1-207

C1000-207 REV C

FIGURE 207-2

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 jumper cords. 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 so 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 may be replaced until satisfactory operation is attained.

ALIGNMENT

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

The Resolution Module contains three basic circuits which require alignment: the Oscillator-Mixer, the Crystal Filter and the Output Amplifier. The cover of this module must be removed to gain access to some of the alignment controls. All alignment controls on this module are identified on the outline drawing, Figure 207-1.

During alignment, the 10.7mc output connector, J2 should remain connected to the LOG-LIN-SQ LAW Module (#1-329). Since the output transformer, Z4 of the Resolution Module is designed to drive the input capacity of Module #1-329, it must be connected to its normal load during the alignment procedure. Module #1-329 must be installed in a working Plug-In Spectrum Analyzer so that the oscilloscope display may be used to observe the shape of the bandpass filter in the Resolution Module.

1. Set the DISPLAY switch on the analyzer panel to LIN.
2. For initial alignment, a -10DBM signal at 10.7mc should be applied to the input connector, J1 (1).
3. The Resolution switch, S1 should be placed in the full CCW position (position 1), (This position removes the crystal band pass filter from the circuit).
4. Transformers Z2, Z3, and Z4 should then be tuned for 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 65mc.

6. The oscillator tuning capacitor, C3 may then be adjusted to produce a local oscillator signal. When properly adjusted the mixture of the local oscillator signal with the 65mc input will produce a 10.7 mc signal, **switch** which will cause deflection on the oscilloscope screen.

7. This capacitor, C3 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 input transformer, Z4 may then be tuned for maximum deflection on the CRT screen by adjustment of trimmer capacitor, C5.

10. The crystal filter is aligned with the input connectors, J1 connected normally to the 65 mc output of the 500 mc module (#1-251) via the attenuator. The attenuator should, however, be switched out of the circuit by the front panel controls.

11. 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.

12. Place the RESOLUTION switch, S1 in position 2, which is the position of maximum crystal filter bandwidth and the position in which the tuning of components is most sensitive.

13. Transformer Z3, and trimmer capacitor, C13 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.

14. Capacitors, C9 and C17 should then be alternately adjusted to minimize skirt leakage of the signal. Since these capacitors affect the tuning of C13 and Z3 (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.

15. 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 C9 and C17 for the most symmetrical band pass characteristics.

16. Return the DISPLAY switch to the LIN position and place the RESOLUTION switch, S1 in position 1 (CCW).

17. Retrim Z1 (via trimmer capacitor, C5) Z2 ad Z4 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

RESOLUTION I.F.

ITEM	DESCRIPTION	DRAWING NO.
R1	Comp. ½W 5% 10K	IRC Type GBT
R2	Comp. ½W 5% 18K	IRC Type GBT
R3	Comp. ½W 5% 1K	IRC Type GBT
R4	Comp. ½W 5% 10 Ω	IRC Type GBT
R5	Same as R3	
R6	Same as R1	
R7	Same as R2	
R8	Same as R3	
R9	Comp. ½W 5% 27K	IRC Type GBT
R10	Not Used	
R11	Same as R9	
R12	Comp. ½W 5% 2.7K	IRC Type GBT
R13	Comp. ½W 5% 220 Ω	IRC type GBT
R14	Same as R13	
R15	Same as R13	
R16	Same as R9	
R17	Same as R9	
R18	Same as R12	
R19	Same as R13	
R20	Same as R12	
R21	Same as R9	
R22	Comp. ½W 5% 27 Ω	IRC Type GBT

PARTS LIST

RESOLUTION I.F.

ITEM	DESCRIPTION	DRAWING NO.
R23	Comp. ½W 5% 240K	IRC Type GBT
R24	Comp. ½W 5% 82K	IRC Type GBT
R25	Chosen At Test	
R26	Chosen At Test	
R27	Same as R25	
R28	Same as R26	
R29	Chosen At Test	
C1	Capacitor Disc .01	Centralab DD6-103
C2	5 Pf Mica 5%	CM15E050J
C3	9-35 Pf Trimmer	Erie 538-000-94R
C4	Capacitor .001 Disc	Centralab DD 102
C5	.9-9 Trimmer	Amperex C004AA/9E
C6	Same as C4	
C7	Same as C4	
C8	Same as C1	
C9	2.5-11 Trimmer	Erie 538-000-90R
C10	Same as C4	
C11	Chosen At Test	
C12	Same as C2	
C13	Same as C3	
C14	Same as C4	
C15	Same as C4	

PARTS LIST

RESOLUTION I.F.

ITEM	DESCRIPTION	DRAWING NO.
C16	Same as C1	
C17	Same as C5	
C18	Same as C11	
C19	Not Used	
C20	Not Used	
C21	Same as C4	
C22	Same as C1	
C23	1000 PF Feedthru	Erie 240-000-X5U-102P
C24	Not Used	
C25	Not Used	
C26	Not Used	
C27	Same as C1	
C28	Same as C23	
C29	Same as C1	
C30	Same as C1	
L-1	.33 mhy Choke	National R1550-7
L-2	3.3 mhy choke	National R1550-19
L-3	100 mhy choke	J.W. Miller 70F104A1

PARTS LIST

RESOLUTION I.F.

ITEM	DESCRIPTION	DRAWING NO.
Q1	Transistor 2N3564	Fairchild Semiconductor
Q2	Same as Q1	
Q3	Same as Q1	
Q4	Same as Q1	
Q5	Same as Q1	
Z1	Transformer	AK1000-346
Z2	Transformer	AK1000-345-1
Z3	Same as Z1	
Z4	Same as Z1	
CR1	Crystal	CNK1000-007-6
CR2	Crystal Pair	ANK1000-007-4
CR3	Paired to CR2	
S-1	2 Pole 4 Pos	Alco MRA 2-5S
J-1	Connector	UG697/U
J-2	Same as J-1	

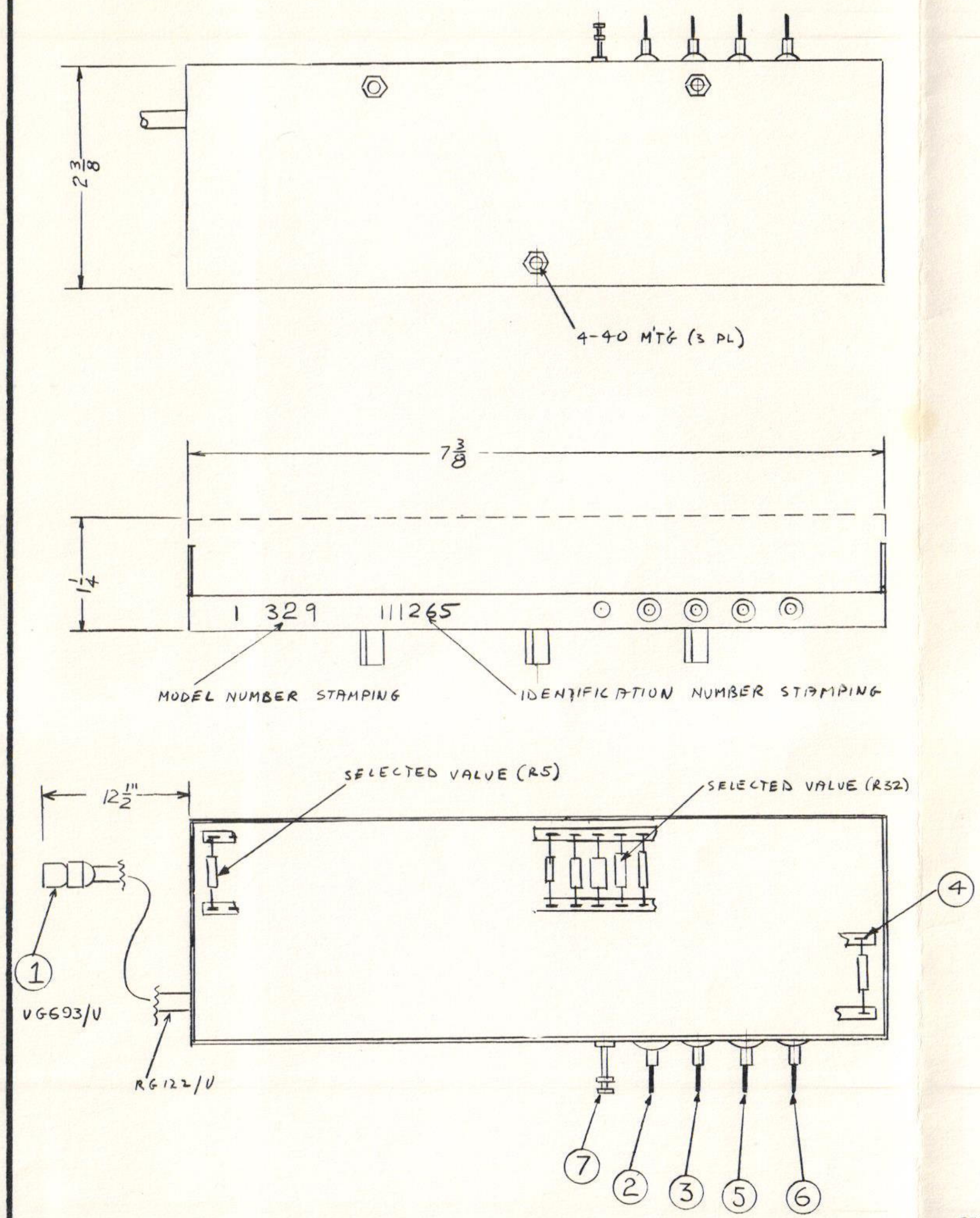
LOG-LIN-SQ LAW MODULE (1-329)

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. Figure 329-1 is an outline drawing of the module.

CIRCUIT DESCRIPTION

A schematic of this module is provided in Figure 329-2. Transistor, Q5 is a preamplifier, used to provide the proper input impedance and some voltage gain. Resistor, R5 contained in this stage is factory selected to standardize the module gain. 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. The detectors are respectively comprised of coils, L5, L6, L7, and L8 and diodes, CR1, CR2, CR5, and CR6, and the output filters associated with each detector. A linear output is selected at terminal # 6, 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".



NOTES:

① FUNCTION - GENERATE DETECTED VIDEO [LOG, LIN, SQUARE LAW] & PROVIDE LIMITED CARRIER OUTPUT

② CARRIER FREQUENCY INPUT - 10.7 MC

③ POWER - +50 V DC, 26MA

④ INPUT IMPEDANCE 500 Ω NOMINAL

⑤ TEST CHARACTERISTICS

A - LOG OUTPUT CURVE

0 DB = 6 CM [SET POINT] = 0.9V - [SELECTED BY R32]
-20 DB = 4 CM [NOMINAL] 0.6V
-40 DB = 2 CM [NOMINAL] 0.3V
-60 DB = 1/3 CM [NOMINAL] 0.05V

[SELECT R32 TO PROVIDE 0.9V OUTPUT AT 0 DB IN LOG]

B - LINEAR OUTPUT

6 CM = 0.9 V

[SELECT R5 TO PROVIDE 0.9V OUTPUT FOR 500uV RMS INPUT]

C - SQUARE

0 DB = 0.9V [SET POINT]
-3 DB = 0.45V [NOMINAL]
-6 DB = 0.225V [NOMINAL]
-10 DB = 0.09 V [NOMINAL]
-13 DB = 0.045V [NOMINAL]

D - LIMITED OUTPUT

4V P/P [NOMINAL]

⑥ SCHEMATIC - C1000-329

REV	DETAILS	DATE	BY
A	REC # 186	6/6/66	SK.

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

SPECIFICATIONS
LOG-LIN-SQUARE LAW MODULE #1-329

C1000-337 REV A

FIGURE 329-1

Diodes CR3 and CR4 then provide a square law characteristic by virtue of their square law rectification properties and thus, 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 # 5, 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 over the entire gain region of the amplifier.

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 jumper cords. 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).

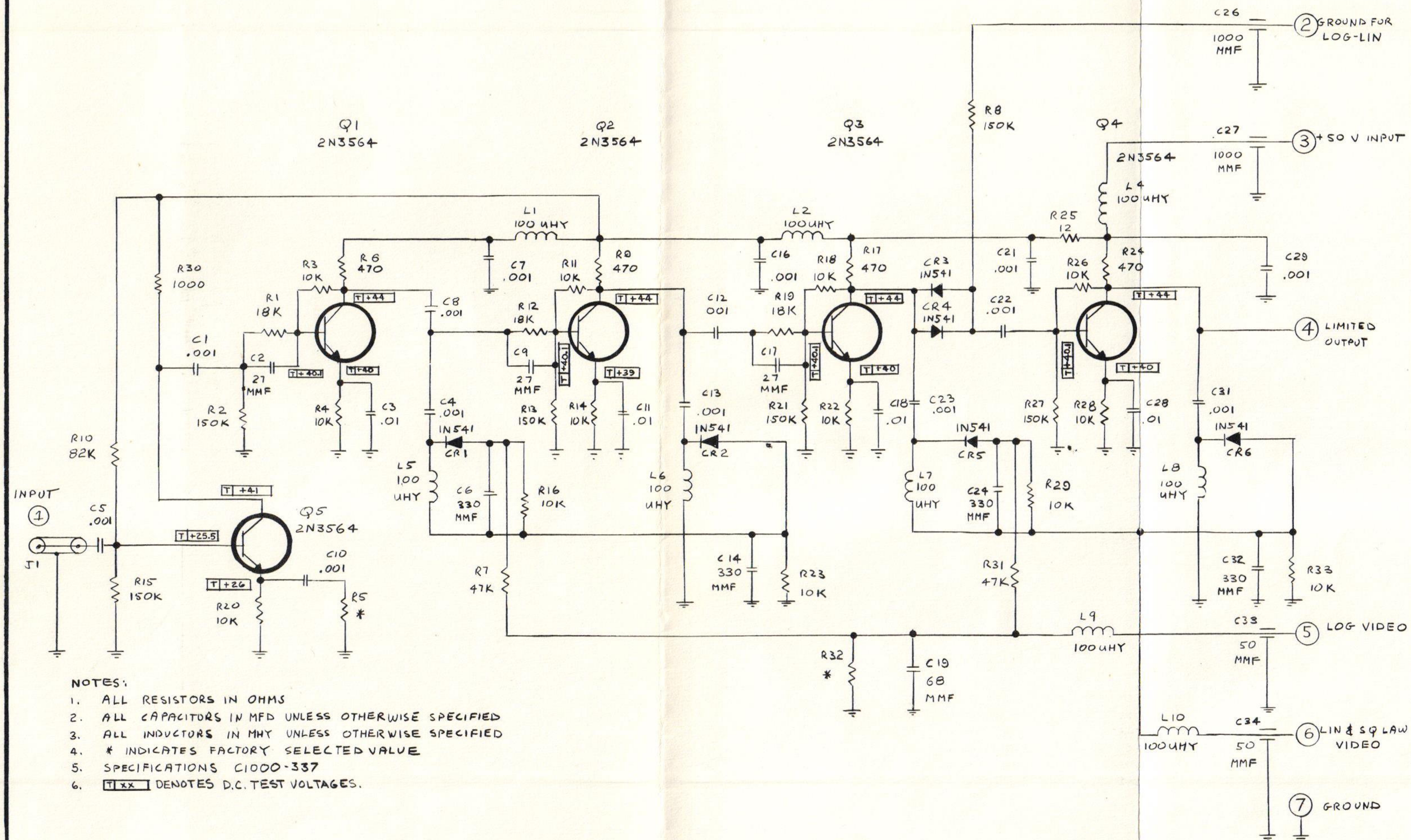
Once a particular stage is found to be inoperative, individual components should be checked and replaced until satisfactory operation is obtained.

ALIGNMENT

Equipment Required: Signal generator capable of supplying a 10.7 mc signal at 500 microvolts RMS. Decade box covering the range from 100 ohms to 20K.

This module is highly stable and not normally subject to drift. Accordingly no adjustments have been provided and alignment of this module is restricted to the reselection of "selected" resistors. This procedure will only be required when components (particularly semiconductors) have been replaced.

1. With the module mounted in the plug-in 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. Set the signal level to 500 microvolts RMS and select a value of R5 to provide full deflection on the oscilloscope screen. Full screen deflection corresponds to a D.C. voltage at terminal # 6 of 0.9 volts.



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. SPECIFICATIONS C1000-337
6. T xx DENOTES D.C. TEST VOLTAGES.

REV	DETAILS	DATE	BY
A	REC # 144	3/66	AR
B	REC # 147	4/66	AR
C	REC # 186	4/6/66	SK

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LONG ISLAND, NEW YORK

SCHEMATIC
LOG-LIN-SQUARE LAW MODULE # 1-329

C1000-329 REV C

FIGURE 329-2

3. Switch the DISPLAY control on the analyzer panel to the LOG position and select a value for resistor, R32 to provide a 60DB 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. The value of R32 is selected to provide full deflection on the CRT screen.
4. If the value selected for R32 differs greatly from the original value, the procedure should be rechecked since R32 also affects the lower level of measurement.
5. The procedure should not have to be repeated more than twice to select the proper value.

PARTS LIST

LOG LIN SQUARE LAW IF

ITEM	DESCRIPTION	DRAWING NO.
R1	Comp ½W 5% 18K	IRC Type GBT
R2	Comp. ½W 5% 150K	IRC Type GBT
R3	Comp. ½W 5% 10K	IRC Type GBT
R4	Same as R3	
R5	Chosen At Test	
R6	Comp. ½W 5% 470 Ω	IRC Type GBT
R7	Comp. ½W 5% 47K	IRC Type GBT
R8	Same as R2	
R9	Same as R6	
R10	Comp. ½W 5% 82K	IRC Type GBT
R11	Same as R3	
R12	Same as R1	
R13	Same as R2	
R14	Same as R3	
R15	Same as R2	
R16	Same as R3	IRC Type GBT
R17	Same as R6	
R18	Same as R3	
R19	Same as R1	
R20	Same as R3	IRC Type GBT
R21	Same as R2	
R22	Same as R3	

PARTS LIST

LOG LIN SQUARE LAW IF

ITEM	DESCRIPTION	DRAWING NO.
R23	Same as R3	
R24	Same as R6	
R25	Comp. ½W 5% 12 Ω	IRC Type GBT
R26	Same as R3	
R27	Same as R2	
R28	Same as R3	
R29	Same as R3	
R30	Comp. ½W 5% 1K	IRC Type GBT
R31	Same as R7	
R32	Chosen At Test	
R33	Same as R3	

PARTS LIST

LOG LIN SQUARE LAW IF

ITEM	DESCRIPTION	DRAWING NO.
C1	Disc Capacitor .001	Centralab DD-102
C2	Mica Capacitor 27 MMF 5%	CM15E270J
C3	Disc Capacitor .01	Centralab DD6-103
C4	Same as C1	
C5	Same as C1	
C6	Mica 330 MMF 5%	CM15E331J
C7	Same as C1	
C8	Same as C1	
C9	Same as C2	
C10	Same as C1	
C11	Same as C3	
C12	Same as C1	
C13	Same as C1	
C14	Same as C6	
C15	Not Used	
C16	Same as C1	
C17	Same as C2	
C18	Same as C3	
C19	Mica Capacitor 68MMF 5%	CM15E680J
C20	Not Used	
C21	Same as C1	
C22	Same as C1	

PARTS LIST

LOG LIN SQUARE LAW IF

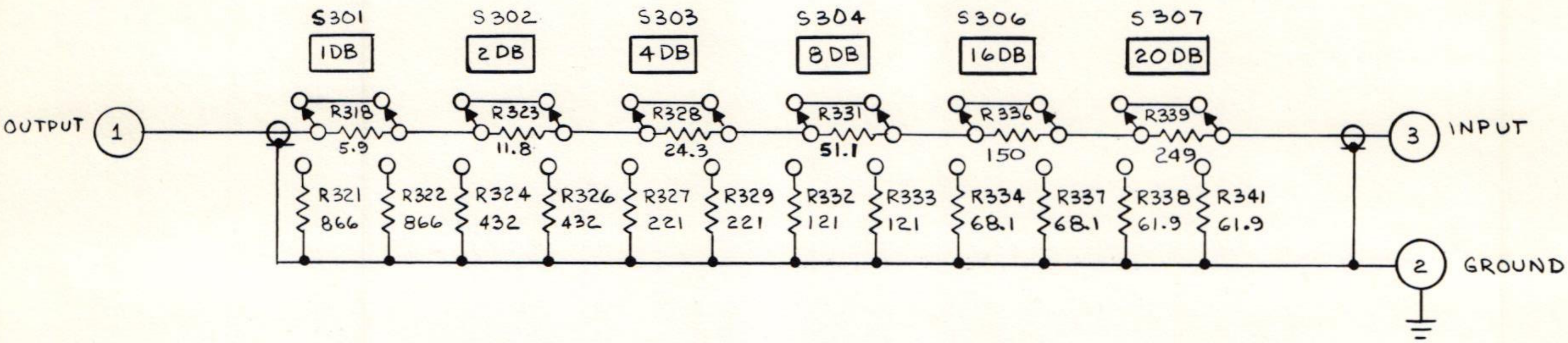
ITEM	DESCRIPTION	DRAWING NO.
C23	Same as C1	
C24	Same as C6	
C25	Not Used	
C26	Feed thru 1000 MMF	Erie 2404-000-X5U-102P
C27	Same as C26	
C28	Same as C3	
C29	Same as C1	
C30	Not Used	
C31	Same as C1	
C32	Same as C6	
C33	Feed trhu 50 MMF	Erie 2404-000-U2M-500M
C34	Same as C33	
CR1	Diode	IN541A Sylvania
CR2	Same as CR1	
CR3	Same as CR1	
CR4	Same as CR1	
CR5	Same as CR1	
CR6	Same as CR1	
J1	Connector	UG693/U

PARTS LIST

LOG-LIN SQUARE LAW IF

ITEM	DESCRIPTION	DRAWING NO.
L1	Choke 100 uhy	Miller 70F104A1
L2	Same as L1	
L3	Not Used	
L4	Same as L1	
L5	Same as L1	
L6	Same as L1	
L7	Sameas L1	
L8	Same as L1	
L9	Same as L1	
L10	Same as L1	
Q1	Transistor 2N3564	Fairchild Semiconductor
Q2	Same as Q1	
Q3	Same as Q1	
Q4	Same as Q1	
Q5	Same as Q1	

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
5/25/66	A	REC 174	S.K.		



NOTE:
1. ALL RESISTORS IN OHMS.

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

DRAWN BY
CHECKED BY

SCHEMATIC
51 DB 50Ω ATTENUATOR

DATE

B1000-448

REV A

FIGURE 448-1 SCHEMATIC - 51DB 50 Ω ATTENUATOR

PARTS LIST

ATTENUATOR 51 db, 50 Ω MODEL 510

ITEM	DESCRIPTION	DRAWING NO.
S301	Switch DPDT	CK 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	Comp. ½W 1% 5.9 Ω	Dale MFF ½ T1
R319	Not Used	
R320	Not Used	
R321	Comp. ½W 1% 866 Ω	Dale MFF ½ T1
R322	Same as R321	
R323	Comp. 11.8 Ω ½W 1%	Dale MFF ½ T1
R324	Comp. ½W 1% 432 Ω	Dale MFF ½ T1
R325	Not Used	
R326	Same as R324	
R327	Comp. ½W 1% 221 Ω	Dale MFF ½ T1
R328	Comp. ½W 1% 24.3 Ω	Dale MFF ½ T1
R329	Same as R327	
R330	Not Used	
R331	Comp. ½W 1% 51.1 Ω	Dale MFF ½ T1
R332	Comp. ½W 1% 121 Ω	Dale MFF ½ T1

PARTS LIST

ATTENUATOR MODEL 510

ITEM	DESCRIPTION	DRAWING NO.
R333	Same as R332	
R334	Comp. ½W 1% 68.1 Ω	Dale MFF ½ T1
R335	Not Used	
R336	Comp. ½W 1% 150 Ω	Dale MFF ½ T1
R337	Same as R334	
R338	Comp. ½W 1% 61.9 Ω	Dale MFF ½ T1
R339	Comp. ½W 1% 249 Ω	Dale MFF ½ T1
R340	Not Used	
R341	Same as R338	
P1	Connector	UG693/U
P2	Same as P1	

INPUT MIXER DIODE REPLACEMENT

The Input Mixer assembly contains a silicon mixer diode, type 1N415C. Although this diode will withstand signal levels in the order of 0 DBM and momentary local oscillator levels which exceed full scale, on the mixer current meter, it may fail if subjected to an excessive local oscillator signal for an extended period.

Symptoms of a mixer diode failure are: loss of sensitivity, low signal level, low mixer current or complete loss of the signal and mixer current.

A suspect diode may be replaced in the following manner:

1. Disconnect the type "N" connector from the rear, and the miniature coaxial connector from the side of the mixer assembly.

2. Remove the nut on the front panel and detach the mixer assembly.

3. <u>CAUTION</u> - DO NOT LOOSEN ANY SCREWS OR SET SCREWS ON THE MIXER ASSEMBLY.

4. Unscrew the input barrel (shown in the photo below) and remove the diode.

5. Insert a new diode (observing polarity) and reassemble input barrel. DO NOT OVERTIGHTEN INPUT BARREL.

6. Reassemble mixer to front panel and reconnect both cables to mixer assembly.