INSTRUCTION MANUAL

PLUG-IN

SPECTRUM ANALYZERS

MODEL

PSA 026

NR NELSON-ROSS ELECTRONICS INC.
5-05 BURNS AVE., HICKSVILLE, N. Y.

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MODEL PSA________________

SERIAL NUMBER______________

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SCOPE

This manual provides Operating Instructions, theory of operation, Technical Characteristics, Maintenance, and Trouble Shooting Procedures for Nelson-Ross Plug-in Low Frequency Spectrum Analyzer, Model 026.

This analyzer is designed to provide coverage of the frequency range from 0.5 CPS to 2KC. It may be conveniently plugged into any TEKTRONIX 560 Series oscilloscope. By simply installing one of these plug-in units, the oscilloscope becomes a complete Spectrum Analyzer. All voltages for Spectrum Analyzer operation are obtained automatically when the Analyzer is plugged into the oscilloscope.

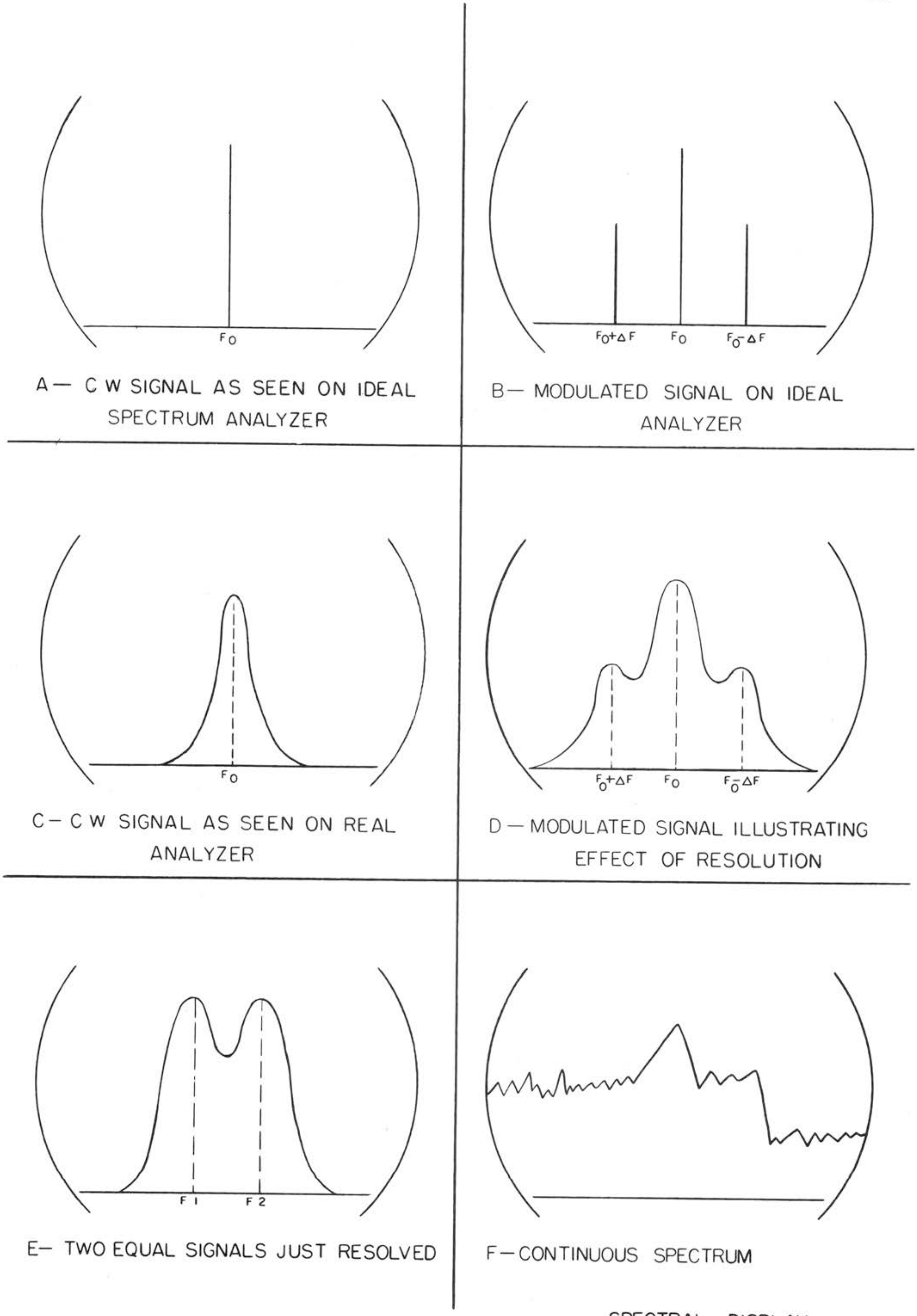
Utilizing either a storage scope or a recorder, the Sub-Audio Analyzer is an excellent tool for measurements of complex very low frequency waveforms in such areas as medical studies, vibration and noise analysis, geophysical and seismic studies, filter and crystal design, speech and music analysis, etc.

GENERAL INFORMATION

Before installing and operating a NELSON-ROSS Plug-In Spectrum Analyzer it is important to have a clear understanding of the nature and interpretation of the spectral display it will provide. The conventional use of an oscillosocpe is to present a display of the amplitude/time characteristic of an electrical signal. In such a presentation the horizontal axis of the cathode-ray tube represents time and the vertical axis represents intantaneous 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;

1- on an ideal spectrum analyzer, a signal containing energy at only one frequency will appear as a single vertical line on the display. This is illustrated in figure 1-1a
2- multiple signals would then 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 in figure 1-1b.
3- since in real life nothing is ideal, a spectrum analyzer cannot present an infinitely narrow



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 vertical line. Instead the signal is broadened into a pulse as in figure 1-d. 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 bewteen them. This is illustrated in figure 1e. When the spectrum consists of components very closely spaced, we have a continuous spectrum. This is illustrated in figure 1-1f.

There are three basic parameters to any spectrum analyzer display. They are:

Resolution- as defined in the previous paragraph

Dispersion- the width of the display (in frequency)

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

Since the 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) which may not be exceeded for any given resolution. 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 display. 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 3 sweeps/second and low frequencies will require scan times in excess of 150 seconds.

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 wise, therefor, to reduce the dispersion (or increase the 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 no longer have any effect. At this point a reading of amplitude may be taken.

CHARACTERISTICS

SPECIFICATION	PSA-016	PSA-026	PSA-036
CENTER FREQUENCY RANGE	0.5cps to 2kc		
CALIBRATED TUNING DIAL RANGE	CENTER: 0 to 2kc FINE: +50cps to —50cps		
TUNING DIAL ACCURACY	CENTER: ±5%; 100cps marks FINE: ±10%; 2cps marks		
MODES OF OPERATION	NORMAL: Tuning dials determine center frequency FULL SCAN: Entire band displayed on CRT MANUAL SWEEP: In either Normal or Full Scan Mode, set band manually swept with front panel control Mode selectable with front panel switches		
DISPERSION (SWEEPWIDTH)	10cps to 600cps		
DISPERSION ACCURACY	±10%		
RESOLUTION BANDWIDTH	0.5cps and 50cps		
DISPLAY: INPUT VOLTAGE AMPLITUDE SCALES	Linear and 40 db Logarithmic		
SENSITIVITY	4 millivolts/cm. deflection (min.)		
NOISE LEVEL	Not visible at any level		
AMPLITUDE SCALE ACCURACY	Linear ±10% Log ±1 db		
AMPLITUDE RESPONSE FLATNESS	±1 db		
SWEEP RATE	10/sec to 120 sec/scan	2/sec to 200 sec/scan (nominal)	
INPUT ATTENUATOR	80 db range in 20 db steps		
INPUT IMPEDANCE	1 megohm		
DYNAMIC RANGE	Harmonic & IM products down 40 db		
SCALE EXPANDER	20 db		
IF GAIN CONTROL	20 db; continuously variable		
VIDEO FILTER	500 milliseconds; selectable with front panel switch		
HORIZONTAL & VERTICAL OUTPUTS	0 to 1 volt from 10K maximum (nominal)		
COMPATIBLE OSCILLOSCOPES	Tektronix letter series or equiv.	Tektronix 560 series or equiv.	Hewlett-Packard 140A or equiv.
POWER REQUIREMENTS	All power and voltages from oscilloscope		

SECTION 2

OPERATING INSTRUCTIONS

INSPECTION AND INSTALLATION

It is most important that a careful inspection be made of the unit immediately after it is unpacked. Look for obvious indications of any physical damage which may have been sustained during shipping. All tubes and crystals should be firmly seated in their respective sockets.

Insert the plug-in unit into the lefthand compartment of any TEKTRONIX 560 series scope and turn the knurled knob designated lock clockwise to secure the Plug-In Unit. Insert a TEKTRONIX vertical amplifier into the right hand compartment. Connect a short BNC to BNC cable between the H OUT connector on the analyzer and the input of the vertical amplifier.

INITIAL ADJUSTMENTS

Certain initial adjustments must be performed when installing the plug-in unit for the first time. These initial adjustments must be made so that a true representation of control functions (presented in the next section) will be possible. Turn the oscilloscope power on, and allow 20 minute warm-up period. Set the controls in the following positions:

MANUAL-AUTO SCAN	AUTO SCAN
NORMAL-FULL SCAN	FULL SCAN

LOG-LIN	LIN
VIDEO FILTER	OUT
SCAN TIME	PUSH IN AND CENTER
CENTER FREQUENCY	0 CPS
FINE FREQUENCY	0 CPS
DISPERSION	MAXIMUM
INPUT ATTENUATOR	80 db
RESOLUTION	LOW
SCALE EXPANDER	OFF
VERNIER GAIN	CW

The V Pos adjustment should then be adjusted to obtain a horizontal trace along the bottom 10 cm line of the CRT graticule. A vertical pipe (representing zero frequency) will appear at the left of the trace. Utilizing the gain and position controls of the vertical amplifier plug-in, position the trace so that the zero signal coincides with the leftmost mark on the CRT graticule, and the trace extends along the baseline 10 cm to the furthese mark on the right. Make sure that the vertical amplifier plug-in input is set to D.C.

LF CAL ADJUSTMENT

Since the voltage supplied to the analyzer may vary from oscilloscope to oscilloscope, an initial adjustment is required to bring the CENTER FREQUENCY and DISPERSION dials to the specified accuracy. Set the controls as follows:

ATTENUATOR to 80 DB

DISPERSION to (30% of maximum)

RESOLUTION LOW

VIDEO FILTER OUT

MIXER BALANCE COARSE Centered

MIXER BALANCE FINE Centered

NORMAL-FULL SCAN Normal

CENTER FREQUENCY 0 CPS

MANUAL-AUTO SCAN- AUTO

NOTE

Any control not listed does not have an effect on these procedures, and should be left as indicated previously.

A signal which may be anywhere from 10% of full scale amplitude to several times full scale amplitude, will appear on the screen. Using a screwdriver, adjust the LF CAL potentiometer to position the signal directly on the graticule center line.

MIXER BALANCE ADJUSTMENT

Intitial adjustment of the MIXER BALANCE controls is necessary, in order to minimize the leakage of any portion of the local oscillator signal through the mixer. When present, this leakage will appear as a signal at zero frequency on the oscilloscope display. In order to eliminate any unwanted signal proceed as follows:

The SCALE EXPANDER and VERNIER GAIN controls should be adjusted to provide a visible signal amplitude on the oscilloscope screen. Rotate the DISPERSION control counterclockwise until a signal width covering a minimum of one quarter of the oscilloscope screen is obtained. This will provide greater adjustment accuracy.

Balancing is now accomplished by alternate adjustment of the MIXER BALANCE controls. Start by adjusting one control for a minimum signal, then adjust the other control. Alternate between the two controls until the best minimum is obtained. As the balance improves gradually increase the gain settings. All initial adjustments having been accomplished the instrument is ready for use.

NOTE

> It is not necessary to achieve a perfect zero balance in order to use the instrument. The instrument will function perfectly with zero signals as large as 20 db above full scale present. The only effect of an excessive zero signal is to obscure low frequency components near the skirts of the zero signal. If difficulty is experienced in operating near zero, increase the input signal and reduce the vernier gain and range attenuator settings, rather than trying to improve balance. This will increase the stability of the display. In any case,

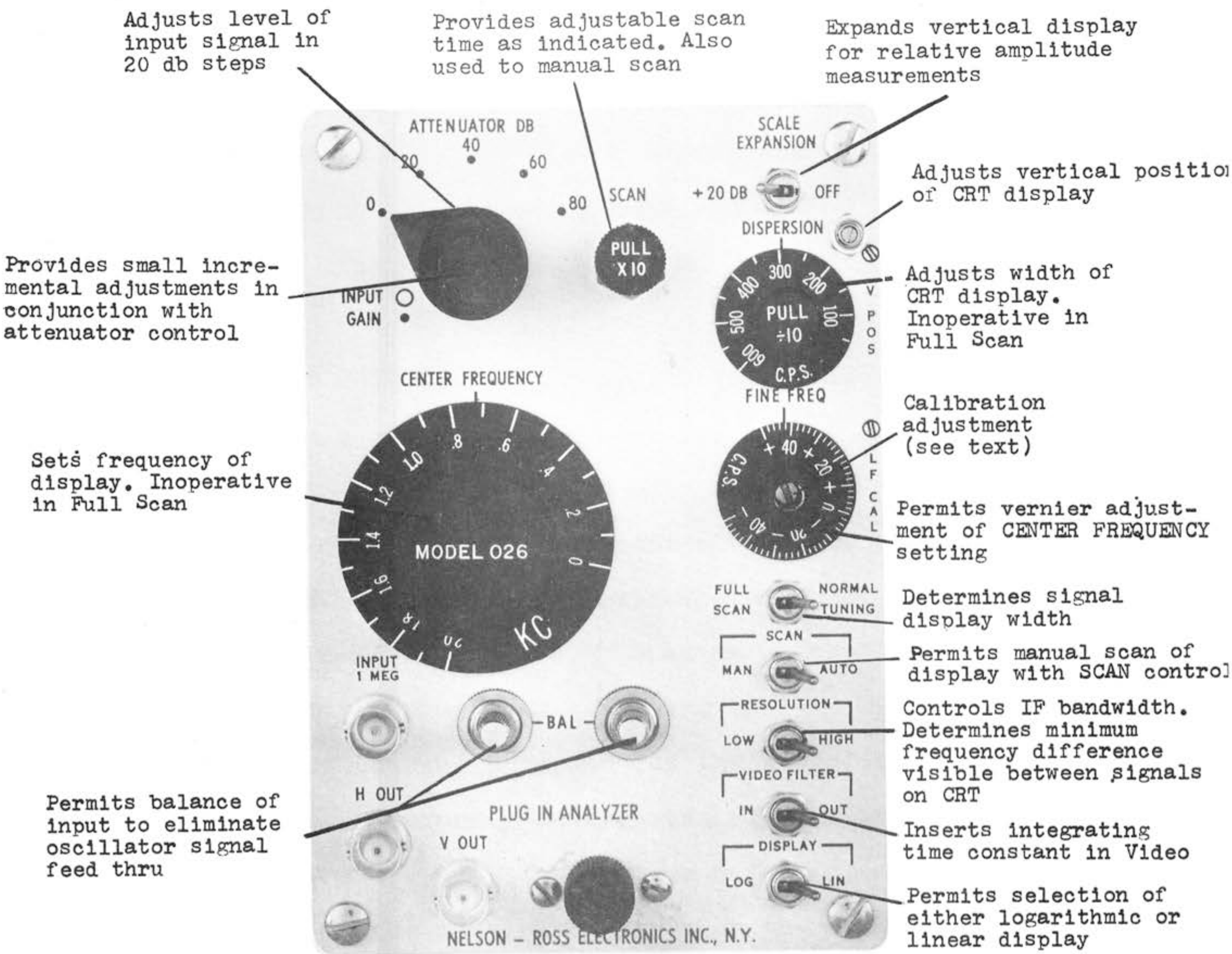
zero signals of ½ full screen amplitude are normal with the instrument set at full gain.

CONTROL FUNCTION AND OPERATION

In order to obtain the most efficient and accurate performance from any of the NELSON-ROSS Plug-In Spectrum Analyzer Units, it is essential that the function and marking of each of the controls be fully understood. Figure 2-1 contains a brief explanation of each control. The text portion of this section will present a further explanation of controls and the operational settings used during initial operation. The Spectrum Analyzer may be used in any application where the necessity exists to visually observe signals whose components fall within the frequency range of the plug-in analyzer. With the instrument, it is possible to measure the relative amplitudes as well as the absolute values of each of the various components which make up a complex signal.

The spectrum analyzer is designed so that its basic operating characteristics may be adjusted to provide the parameters required for analyzsis of the desired signal. These parameters are adjusted thru the use of the following controls:

MODE SWITCH- This switch labelled NORMAL- FULL SCAN on the panel - determines whether the instrument operates as a tunable analyzer with adjustable dispersion, or as a fixed analyzer scanning the entire band.



SPECTRUM ANALYZER CONTROLS AND FUNCTIONS

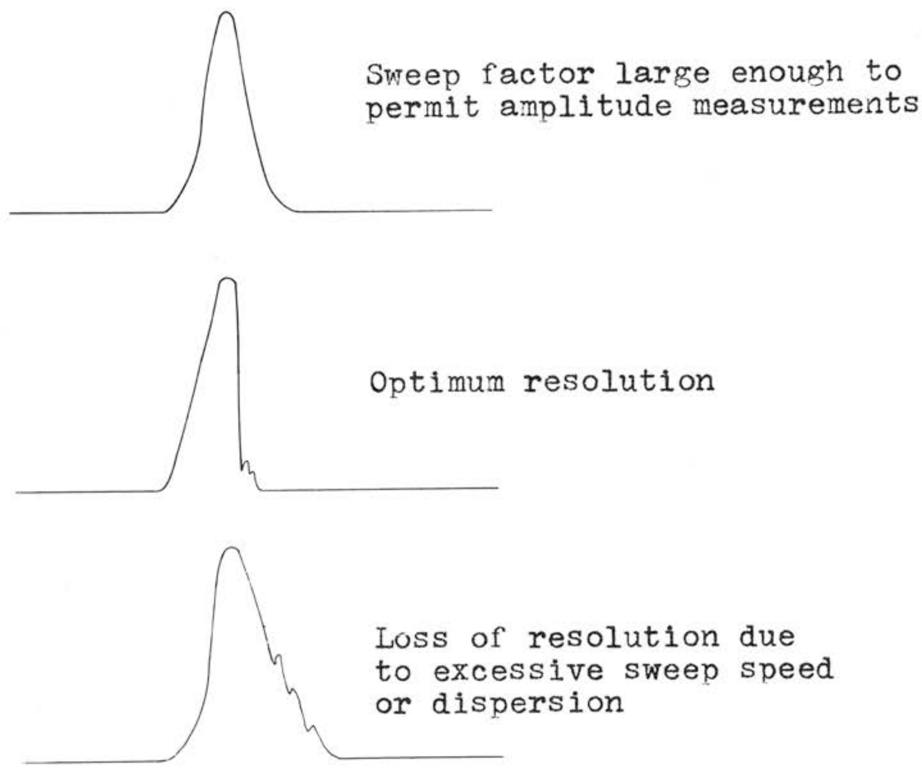
FIGURE 2-1

In FULL SCAN, the analyzer displays the entire band, with the zero frequency signal at the extreme left of the display and maximum frequency at the right. In NORMAL, the DISPERSION and CENTER FREQUENCY controls are operative. In all cases, the CRT spot travels from left to right, representing zero to maximum frequency.

CENTER FREQUENCY AND FINE FREQUENCY - Adjustment of these controls centers the signal being observed on the oscilloscope screen. The MODE SWITCH (marked NORMAL and FULL SCAN) must be in the NORMAL position to permit tuning when using the CENTER FREQUENCY control. The FINE FREQUENCY control provides a calibrated vernier for use at low resolutions.

DISPERSION - The position of this control adjusts the (frequency) width of the screen display. The MODE SELECTION switch marked NORMAL and FULL SCAN must be in the NORMAL position to permit tuning when using the DISPERSION control.

RESOLUTION - This control provides for the selection of the minimum difference frequency between two signals which may be observed on the screen. The minimum difference which is still usable on the display is known as the resolution. This difference is determined by the amplifier bandwidth of the analyzer. Adjustment of the RESOLUTION SWITCH varies the bandwidth of the tuned amplifier to provide the resolution required for the type of measurement being made. Two equal signals are considered resolved when a 3 DB (or greater) dip is visible at their intersection. When making adjustments with the DISPERSION and RESOLUTION controls, it is advisable to keep in mind the fact that a combination of narrow resolution and wide dispersion will result in deterioration of sensitivity. This loss in sensitivity is due to the fact that the amplifier connot respond to a signal which passes through it too rapidly. With proper use of the instru ment this loss in sensitivity becomes negligible. When quantitive measurements are being made, it is necessary to prevent this type of vari ation in gain. Do not make changes in resolution or dispersion when measurements are being taken. It is to be noted that there is an optimum resolution setting for a particular value of dispersion and sweep rate. Whenever a resolution setting is too narrow in relation to the dispersion setting and sweep rate, filter ringing will occur. The ringing will be visible on the right side or trailing edge of the pulse. The ringing will proportionately decrease as the resolution is decreased (widened). The various resolution conditions are illustrated in figure 2-2. It will not always be possible to obtain optimum resolution, due to the fact that the instrument has been designed with a large dispersion range. When the FULL SCAN mode is selected the sweep speed required is impractically slow. However, where very wide frequency scanning is used, optimum resolution is not required. In cases where signals are closely related (spaced at frequencies of the same order as the resolution),



RESOLUTION CONDITIONS

FIGURE 2-2

it will not always be possible to obtain optimum resolution.

GAIN CONTROLS- ATTENUATOR, SCALE EXPANDER and GAIN controls serve very important and specific purposes. Basically, they adjust incoming signals to visible levels, and provide ranging for amplitude level measurements.

The SCALE EXPANSION SWITCH may be placed on one of two positions; OFF and +20 DB. Signal ratio amplitudes of up to 20 DB may be read on the oscilloscope screen. Therefore, a total range of relative amplitudes of up to 40 DB may be measured. The amplifiers and associated circuitry following the attenuator have been designed with sufficient dynamic range to eliminate the possibility of generation of harmonics or circuit saturation providing the following precau tions are observed:

> When the SCALE EXPANDER control is set at the OFF position, ATTENUATOR and VERNIER GAIN should be set so that the <u>largest</u> component of the observed signal has <u>no greater than full screen amplitude.</u> It is then possible to set the SCALE EXPANSION switch to any position without the possibility of introducing saturation or spurious harmonic signal errors. It is then essential that only the SCALE EXPANDER switch be used to set measurement ranges.

Any attempt to set range with the GAIN control increases the possibility of amplifier overload, with resultant generation of harmonic products. These products, will appear on the oscilloscope and lead to erroneous signal analysis.

The LOG-LIN switch controls the vertical display function of the instrument. In the LIN position, deflection on the oscilloscope screen will be directly proportional to the input signal amplitude, while on the LOG position the oscilloscope deflection will be proportional to the logarithm of the input signal amplitude. The VIDEO FILTER provides suppression of beat notes which occur when signals with close components are being oberved. Use of filter requires slower sweep speeds. When sweep speeds are excessive the amplitude of the pulse decreases and the right hand side of the trace will become distorted. This distortion is caused by integration of the signal.

MANUAL SCAN - Placing the MANUAL-AUTO SCAN switch in Manual disables the sweep generator and permits the instrument to be swept manually by means of the MANUAL SCAN control knob. This mode of operation is particularly useful for point by point measurements, chart recording, etc.

SECTION 3

APPLICATIONS

The NELSON-ROSS series of Plug-In Spectrum Analyzers are capable of performing in a multiplicity of applications. The following paragraphs and illustrations are but a few examples of possible instrument applications. The applications listed below have been compiled using instruments of higher frequency. However, the examples and CRT photos will serve as a guide to the user.

DISTORTION ANALYSIS - The percentage of distortion products of both amplifiers and oscillators may be determined by using an instrument operating within the desired range. Examination of the input signal is first made. Quality and harmonic content are observed. The output of the unit under test is then observed. Performance is determined by subtracting the input harmonic content from the output harmonic content.

INTERMODULATION DISTORTION PERCENTAGE - Measurement is made by using a two-tone oscillator to drive the unit under test. In addition its possible to use two oscillators which are fed into a resistive mixer coupled to the input of the unit. The sum and difference signals in the output are then measured in relation to the fundamental outputs.

TRANSDUCER DISTORTION ANALYSIS - The distortion present in sonar transducer and loudspeakers is measured as follows: The loudspeaker or sonar transducer under test is placed in a suitable chamber. In the case of the sonar transducer, it would be located in a pond. The output signal is then detected by a microphone or other type of transducer device. Examination of the input signal is then made to determine spectral purity. The output signal is then observed. Comparison of the input and output signal for harmonic content provides distortion information.

ENVIRONMENTAL NOISE - By observing the output from a microphone connected to the input of the instrument, the frequency distribution of factory machinery or office noise may be measured.

SONAR ANALYSIS - The instrument may be used to determine frequency distribution, frequency modulation and wasted sideband energy of sonar transmitters. The driving signal may be observed directly, or the measurement may be made in a water environment thru the use of a suitable transducer pick-up. The instruments high input impedance permits use of a wide variety of detectors.

MACHINERY VIBRATION ANALYSIS - By mounting an accelerometer on the motor or machinery under investigation it is possible to determine the source of vibration. The instrument is best used in the FULL SCAN mode. Vibration source is determined by usual observation of the relationship of frequency components to equipment RPM.

VIBRATION TESTING - The mechanical resonant frequencies of components and subassemblies may be determined by using the combination of adjustable vibration drive and visual observation of the output of a transducer secured to the item under test.

Figures 3-1 through 3-8 illustrate oscilloscope presentations which are obtained in typical Spectrum Analyzer applications. A brief technical description accompanies each figure.

3-1 Illustrates 100 cycle sidebands on a 1 KC carrier. The sidebands are 30 DB below the CARRIER amplitude. The controls are set for LOG display and the MODE switch is in the normal position. This display demonstrates the LOG compression of the signal.

3-2 Demonstrates the instruments resolution capability. The signal consists of a 1 cycle CARRIER with .5 cycle sidebands. The instrument is set with the VIDEO FILTER IN AND NORMAL DISPLAY. The dispersion control is set at approximately 10 cycles.

3-3 The first, third, and fifth harmonics of a 100 cycle square wave SIGNAL are visible in this figure. The MODE switch is in the NORMAL position and the VIDEO FILTER is in "IN" position. The large position of the SIGNAL is the first (fundamental) harmonic at 100 cycles.

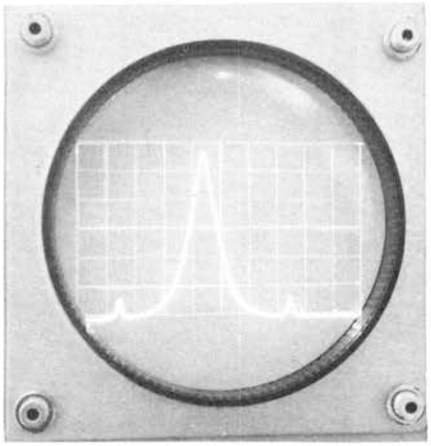
3-4 This display demonstrates the response curve of a swept stagger tuned I.F. AMP. Using the FULL SCAN MODE, and with the VIDEO FILTER in "IN" complete I.F. characteristics may be demonstrated.

3-5 Illustration of I KC signal containing 1 percent sidebands are 30 DB down from the 1 KC signal. The MODE switch is in the NORMAL position, and the DISPLAY switch is in the LIN position.

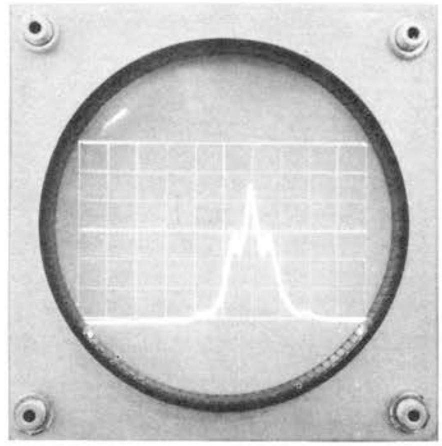
3-6 The signal input in this display is the same as that of figure 3-5. However, the DISPLAY switch is in the LOG position, illustrating compression with the sidebands 30 DB below the MAIN SIGNAL.

3-7 In this display, a 100 cycle signal is shown with the MODE switch in the FULL SCAN position. The ZERO SIGNAL and the first through the tenth harmonic are visible. All harmonics are odd.

3-8 This illustration shows the response of a transducer which has been secured to an industrial Shake Table. The MODE switch is in the NORMAL position. Use is made of 600 cycle dispersion, centered at 300 cycles. This figure demonstrates the relative amplitude of vibrations at 30 cycles above and below the center frequency.



3-1



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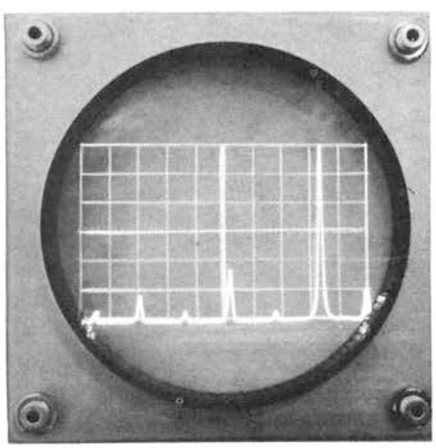

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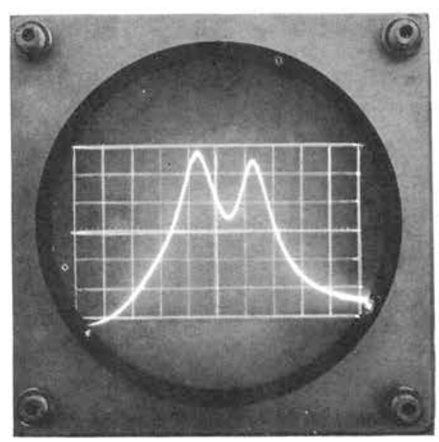
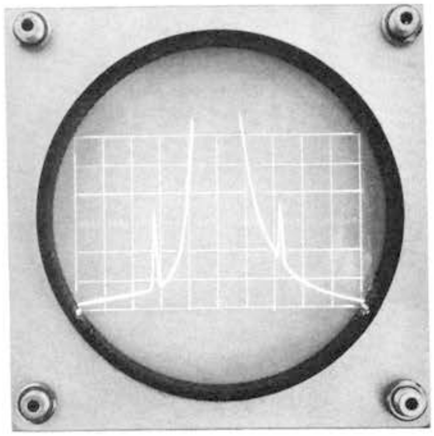


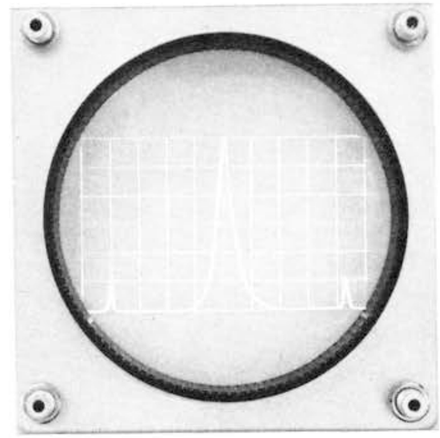
3-4

TYPICAL DISPLAYS (see text)

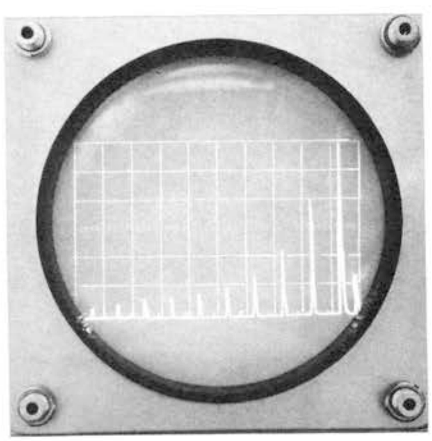
FIGURES 3-1 to 3-4



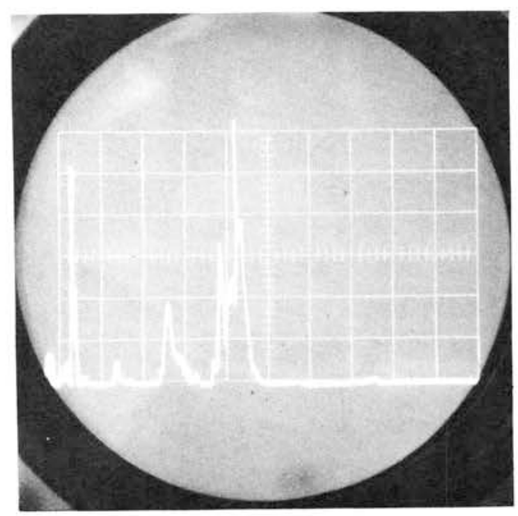
3-5



3-6



3-7



3-8

TYPICAL DISPLAYS (see text)

FIGURES 3-5 to 3-8

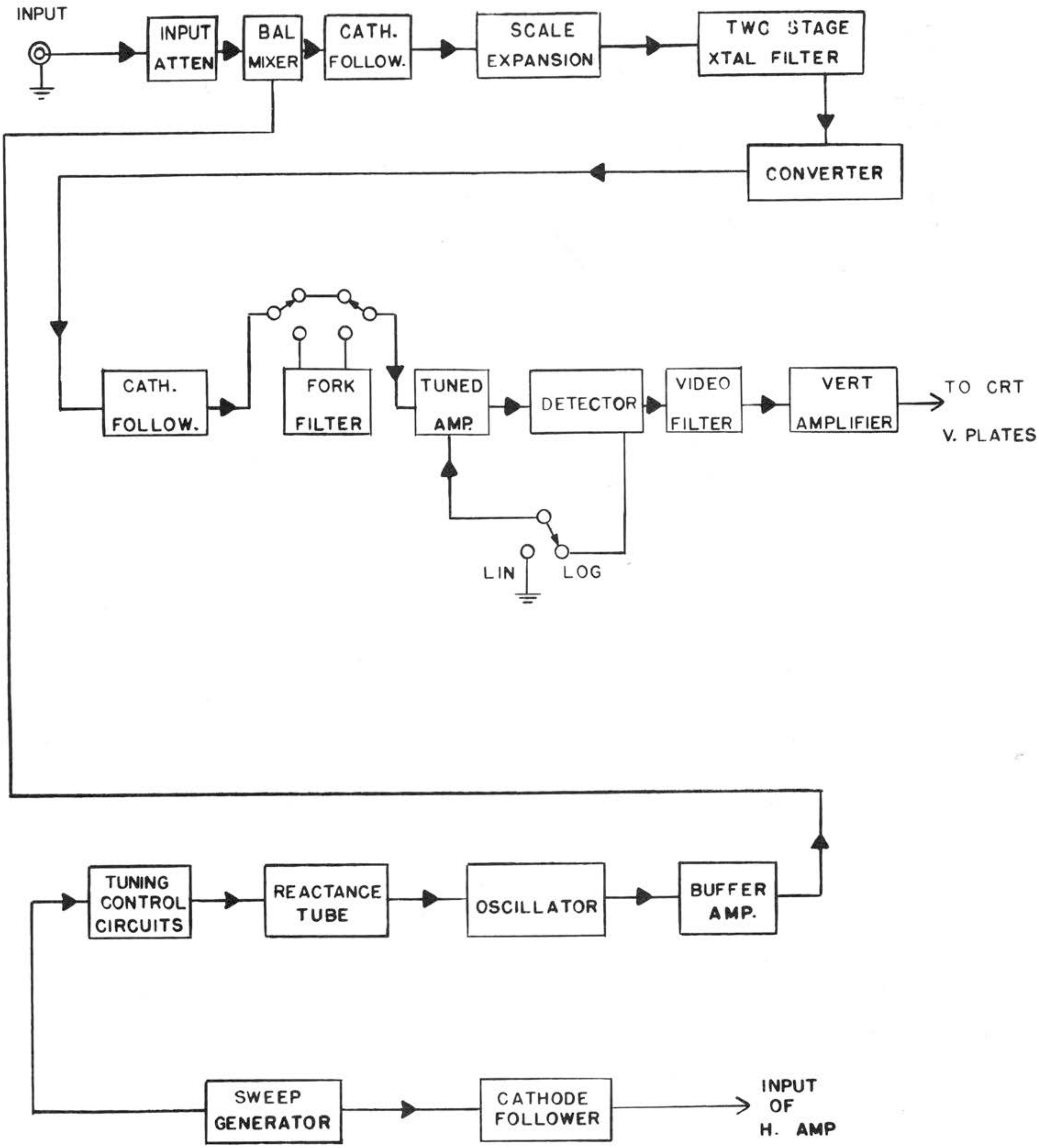
SECTION 4

CIRCUIT DESCRIPTION

BLOCK DIAGRAM DESCRIPTION

Figure 4-1 is a block diagram representation of the circuitry in the NELSON-ROSS Plug-In Spectrum Analyzer.

The input signal first passes through the input attenuator where the desired level is adjusted. The attenuated input signal is then routed through the balanced mixer. The input signal is mixed with an internally generated, swept local oscillator signal in the balanced mixer. Oscillator spurious products and modulation products are suppressed, while the sum and the difference frequency signals are enhanced. This resultant signal then passes through the cathode follower, SCALE EXPANDER and the crystal filter. The bandwidth of this filter is used to determine the resolution of the instrument when the RESOLUTION switch is in LOW. The signal output from the filter is fed to a mixer, where it is hetrodyned down to 1000CPS for final amplification. The final amplifier is tuned, and in the HIGH position of the RESOLUTION switch a tuning fork filter is inserted to provide the necessary "Q" to reduce the bandwidth to the required value for high resolution. The output of the amplifier is detected to produce the video signal. The decrease output passes through a video filter to the vertical amplifier, and provides a feedback signal which is used to generate a log function. When the LOG-LIN switch is in the LIN position this feedback signal is not utilized.



BLOCK DIAGRAM O-6
SERIES
FIGURE 4-1

The sawtooth output of the sweep generator is utilized to drive a reactance tube. The reactance tube sweeps the local oscillator in synchronism with the oscilloscope trace. Reactance tube drive is furnished through the tuning control circuits.

DETAILED CIRCUIT DESCRIPTION

INPUT ATTENUATOR

An input signal (within the frequency range of the Plug-In unit) is connected at J1. The signal passes through the input attenuator, providing attenuation of up to 80 db in 20 db steps. The gain control in the cathode follower circuit is independently concentric to the attenuator switch.

BALANCED MIXER

The selectively attenuated signal is then fed to a balanced mixer consisting of tubes V1, V2, and V3. In V1, the signal is converted into a push-pull configuration relative to the input signal. V2 & V3 are in a push-push configuration in relation to the local oscillator. The local oscillator is connected to the paralleled cathodes of V2 and V3. As a result of the outputs of V2 and V3 being connected in push-pull, the oscillator signal will cancel out in coil Z1. Since the signal frequencies are far removed from the resonant frequency of Z1, they will not appear in the output. The local oscillator is large enough to cause tubes V2 and V3 to be driven into the non-linear region of their characteristics, causing mixing action between signal and local oscillator.

The resultant difference frequency is selected by Z1 for amplification by the system.

SCALE EXPANSION

The output of Z1 is single ended with respect to ground. The SCALE EXPANDER provides two settings; - Straight thru (0 DB) and 20 DB. The SCALE EXPANDER is isolated from the secondary by ½ V4 connected as a cathode follower.

CRYSTAL FILTER

The outputs of V4 and V5 are utilized to drive the two sections of the crystal filter network. In the low position of the RESOLUTION switch, the bandwidth of the crystal filter determines the bandwidth. Capacity across each of the crystal holders is neutralized by adjustment of trimmer capacitors C12 and C16. C12 and C16 are adjusted for "Sharpest Skirts", when the "0" frequency signal is indicated on the CRT.

CONVERTER

The converter mixes the signal from the output of the crystal filter with the oscillator Z3 frequency to establish an intermediate frequency. The output of the converter drives a 1000 cycle tuned amplifier, with two variable bandwiths.

Switch S2 in LOW position connects the wide hand signal to the tuned amplifier. With S2 in the HIGH position, a fork filter having a very high Q allows only a very narrow hand signal to pass through it. With the exception of the log feedback detector, the amplifier circuitry is quite conventional. The output of V9 is a DC voltage which appears only when an I.F. signal is present. The output of V9 is detected by diode CR1. The detected signal is then fed to the oscilloscope vertical input through an integrating network consisting of resistor R79 and capacitor C47 the LOG-LIN switch circuitry.

LOG CIRCUITRY

Log scale generation is accomplished by utilization of a feedback signal to control the GAIN of V9. The signal from V9 is detected and the resultant voltage is fed back to the grid of V9 as a bias voltage. V9 has a remote cut-off characteristic especially applicable to this circuit. As the input increases, the detected bias also increases. The result is a decrease in the gain of the stage. The pentode characteristics of V9 determine the logarithmic pattern of the oscillosocpe display. The decibel range is controlled by varying the setting of the diode output divider (R81) (DB RANGE). The DB SHAPE potentiometer (R77) varies the screen voltage. Any change in this screen voltage has a direct effect on the operating point and the slope characteristics of the tube. Adjustment of this potentiometer provides the desired log shape.

LOCAL OSCILLATOR AND REACTANCE TUBE

Dual triode V6 serves as both a Hartley oscillator and a reactance tube. Coil Z2 provides resonant tank circuit inductance. The reactance circuit is conventional in design. Capacitor C21 provides only a portion of the resonant capacitance of the tank circuit. This capacitance is multiplied by the gain of the stage. The capacity seen by the oscillator tank is therefore proprotional to the GM of the tube. When the plate currect on the tube is varied (by the changes in the sawtooth drive present on the grid) the GM of the tube changes . As a result of this change in GM the local oscillator frequency changes. Adjustment of inductance Z2 or RT ADJUST Potentiometer R47 will determine the oscillator sweep frequency range with the full sawtooth input. In the NORMAL mode, the reactance tube grid voltage, and therefore the oscillator frequency is determined by CENTER FREQUENCY and, DISPERSION potentiometer settings. The dispersion setting controls the level of the sawtooth signal which is superimposed on the DC level present on the center frequency potentiometer. The oscillator sweep frequency is thereby limited by the DC sawtooth limits. The end result is "DISPERSION" or ("frequency-window") which appears across the oscilloscope screen. Potentiometer R114 acts as a tuning control. This control provides a voltage which is directly dependent upon the frequency setting of the CENTER FREQUENCY dial. This dial determines the oscillator center frequency.

The sawtooth which is provided **by** the oscilloscope circuitry is selectively attenuated by the DISPERSION control R111. The signal is now summed by the network consisting of resistors R112 and R113. The resultant signal is coupled to the grid of the reactance tube. In the FULL SCAN position, the tuning control is by-passed and the entire sawtooth signal is presented to the summing network. This results in a sweep proportional to the frequency range of the analyzer.

SWEEP GENERATOR

Tubes V11 and V12 function as a sawtooth generator. The feedback between plate and grid of V11 (via cathode follower V12) generates the negative sawtooth, while the feedback between the screen and supressor generate the retrace. The

RATE control is used as needed to give a good display with the resolution and dispersion settings in use. Too fast a sweep speed for a given resolution setting will cause ringing in the filter.

DEFLECTION AMPLIFIERS

V10 functions as vertical deflection amplifier. Single ended signals present on grid one (pin 2) are converted into push-pull signals at the plates. The D.C. voltage at the plates is varied by controls R88 and R104, to provide positioning of the trace on the CRT screen. The H OUTPUT jack is furnished to enable the sawtooth to be delivered to the INPUT of the Vertical Plug-In Amplifier. The amplitude of this sawtooth is approximately 1 volt output.

POWER AND BIAS CIRCUITRY

All operating voltages required for plug-in unit operation are secured from the oscilloscopes internal power supplies.

In order to insure a high degree of regulation over a wide range of operating conditions, all supplies (within the oscilloscope) are loaded to their minimum requirements.

SECTION 5

MAINTENANCE

INTRODUCTION

In the design and construction of the NELSON-ROSS Plug-In Spectrum Analyzers, much emphasis has been placed upon high reliability and minimum down-time. However, any piece of electronic equipment will require a certain amount of maintenance thru normal usage. With this in mind, the following maintenance information is provided in this section. In the event of the occurance of malfunction in the Spectrum-Analyzer system, it is recommended that the trouble be corrected by following four general steps:

1. Confirmation that a malfunction actually does exist.
2. Isolation of the trouble to either the Plug-In Spectrum-Analyzer unit or the oscilloscope main frame.
3. Trouble-shooting the plug-in unit to determine the exact source of trouble.
4. Repair the malfunction.

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 control settings. All controls should be checked for correct settings. As an example, if the VIDEO FILTER is in the circuit, and the

SWEEP SPEED is set at too high a level the trailing edge of the display will distort to the point of being un-usable. Excessive sweep speed will also cause the display to shift, thus resulting in erroneous frequency readings. A combination of the above errors in control settings will also result in an incorrect amplitude display. 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 main frame.

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 methods, the plug-in unit is removed and replace 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 precautions is not taken, the spare unit may become damaged.

If, after a spare unit (known to be functioning properly) is substituted the system does not work properly, the fault exists in the oscilloscope. Refer to the oscilloscope manufacturer) to facilitate the required testing. First, check all voltages supplied by the oscilloscope to the plug-in unit. If the voltages measure incorrectly, remove the plug-in Spectrum Analyzer and re-check the voltages. At this point, if the voltages check correctly with the spectrum analyzer removed, the supplies may not be regulating properly.

The voltages indicated on the schematic diagram and the tube chart are nominal, with the exception of the supply voltages they may vary considerably in each instrument.

TROUBLESHOOTING THE SPECTRUM ANALYZER

When it has been definitely established that the malfunction exists in the Spectrum Analyzer, Plug-In unit, the following trouble shooting procedures are recommended. Much time and effort will be concerned 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 imporoperly seated tubes and crystals. In the event that a burned or discolored component is discovered, (thru visual inspection) it is essential that the direct cause of the trouble be located, and corrected before replacing the component.

One very common source of trouble may be attributed to faulty vacuum tubes. If a visual check fails to reveal the cause of the trouble, it is recommended that all tubes be checked by the substitution method. Tube checks made by the tube tester method are not to be relied upon because of the wide tube operating parameters. Tubes which are found to be operating correctly should be returned to their original sockets. This will eliminate a great deal of necessary recalibration, usually resulting from variable tube characteristics.

If, after visual examination and tube substitution, the trouble still is not located, the Spectrum Analyzer circuitry should be checked by making careful voltage and resistance measurements at the points indicated on the schematic diagram and the tube voltage chart figure.

SECTION 6

ALIGNMENT PROCEDURE

GENERAL

This section provides the procedure for aligning the NELSON-ROSS PLUG-IN SPECTRUM ANALYZER 026. These instructions, when followed in the proper sequence, also furnish a method of separating any troubles which may occur. Therefore, this procedure can be used when troubleshooting the Spectrum Analyzer.

LOCAL OSCILLATOR

The three adjustments which affect the local oscillator are interacting. Therefore, the procedure must be repeated until satisfactory adjustment is obtained. Adjustments will be made as follows:

1) Connect a calibrated signal generator to the front panel INPUT connector on the Spectrum Analyzer. Set the signal generator to the upper frequency limit of the unit being aligned and adjust for a 5 millivolt output.
2) Set the Spectrum Analyzer in the FULL SCAN mode. Set both ATTENUATOR controls to 0 db and rotate the VERNIER GAIN control fully counterclockwise.
3) Position the VIDEO FILTER switch to out and the LOG-LIN switch to LIN. Set the RESOLUTION control for minimum resolution and rotate both of the MIXER BAL controls fully counterclockwise.

4) In the FULL SCAN mode the Spectrum Analyzer should display its full frequency range. The zero frequency signal (oscillator leakage) should be at the extreme left side of the oscilloscope graticule. The input from the signal generator should appear at the extreme right side of the oscilloscope graticule. Coil Z2 and RT ADJ potentiometer R47, shown in figure 6-1 are used to adjust the two limits. Z2 determines the frequency; pottentiometer R47 affects amount of scan and the frequency. Z2 and R47 should be alternately adjusted until FULL SCAN RANGE is properly set.
5) Set the Spectrum Analyzer in the NORMAL mode and rotate the CENTER FREQUENCY control (tuning dial) to the highest frequency of the Analyzer. Adjust Z2 until the high frequency signal is centered on the oscilloscope screen.
6) Set the Analyzer back to the FULL SCAN mode of operation. Adjust FULL SCAN centering control R108 until the display is centered on the oscilloscope screen.
7) Return the Analyzer to the NORMAL mode of operation. Check the divisions on the tuning dial against the settings on the signal generator to insure correct dial calibration.
8) Repeat, as necessary, steps 1 through 7 to the Spectrum Analyzer operates according to specifications.

DISPERSION

1) Rotate the DISPERSION dial to ½ maximum dispersion and set the CENTER FREQUENCY dial to mid-frequency. Using a signal generator, vary the input to measure the actual dispersion across the oscilloscope screen. Adjust DISP. SET control R109, shown in figure 6-1, until the dispersion is within the specification limits. Check and readjust, as necessary, for maximum and minimum DISPERSION dial settings.

LOG SCALE

Connect a signal generator with a calibrated attenuator to the INPUT connector of the Spectrum Analyzer. Tune the signal generator to the center of the Analyzer tuning range; tune the Analyzer to display the output. Alternately adjust DB RANGE R 81 and DB SHAPE R77, shown in figure 6-1, to obtain the correct 40 db scale curve on the display. The correct 40 db scale is ¼ display change in amplitude for each 10 db input signal level change. The DB RANGE control sets the curvature of the scale, while the DB SHAPE control varies the amplitude of the curve. If difficulty is experience in obtaining the correct curve, electron tube V9, shown in figure 6-1 should be replaced. Since the controls interact it is necessary to repeat the adjustments until satisfactory performance is obtained.

CONVERTER OSCILLATOR ADJUSTMENT

Adjust Z3 until the oscillator section of V8 oscillates, as indicated by a bias of approximately-5volts on Pin 1 (as measured by a VTVM).

Capacitor C29 is then adjusted until switching the RESOLUTION switch from HIGH to LOW causes no frequency shift in the display.

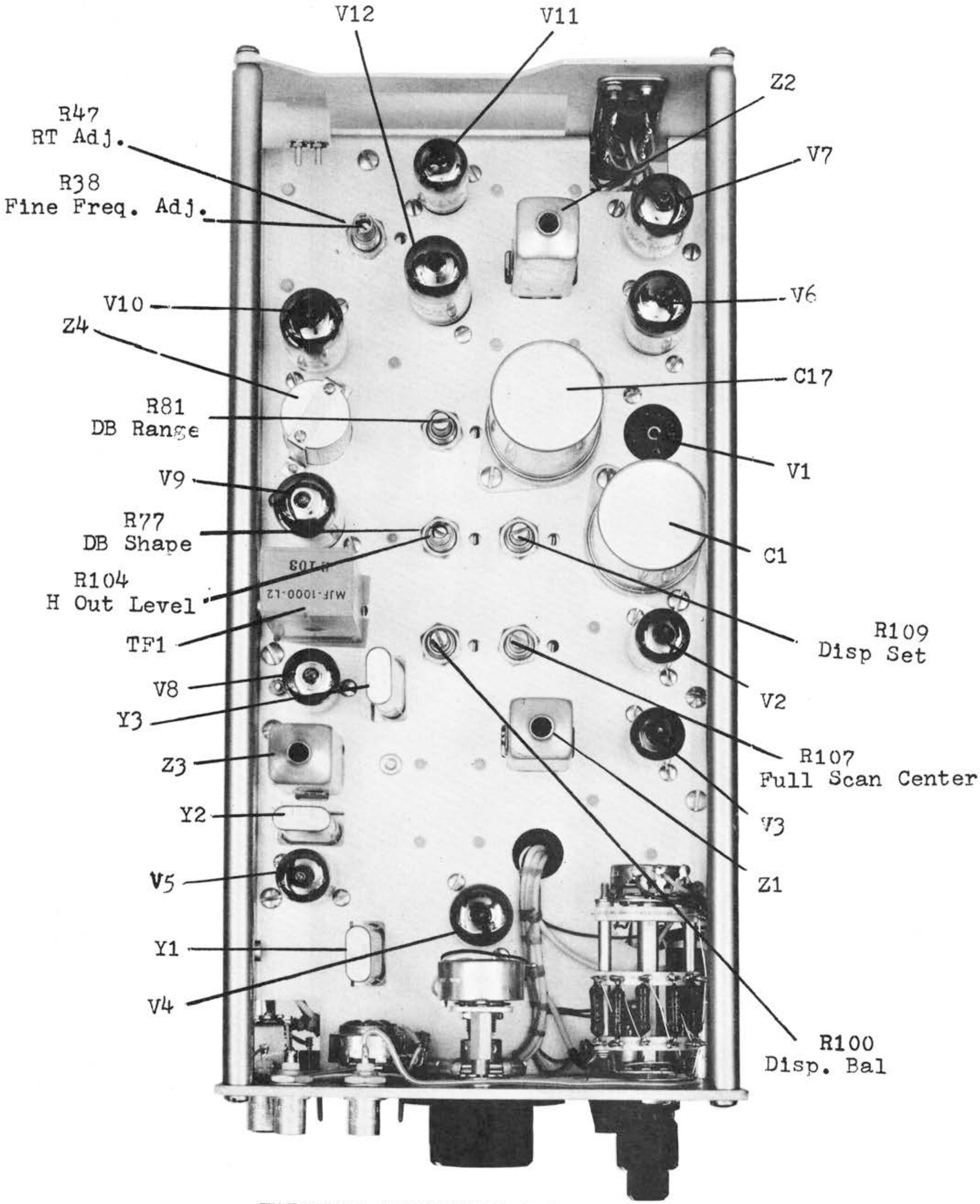
DC LEVEL ADJUSTMENTS

1) Adjust R100 DISPERSION BALANCE for a symmetrical sawtooth at pin 8 of V12B

2) Connect an oscilloscope to the H OUT jack. Adjust R104 DC LEVEL control for approx. 1 volt of sawtooth output, symmetrical about zero volts.

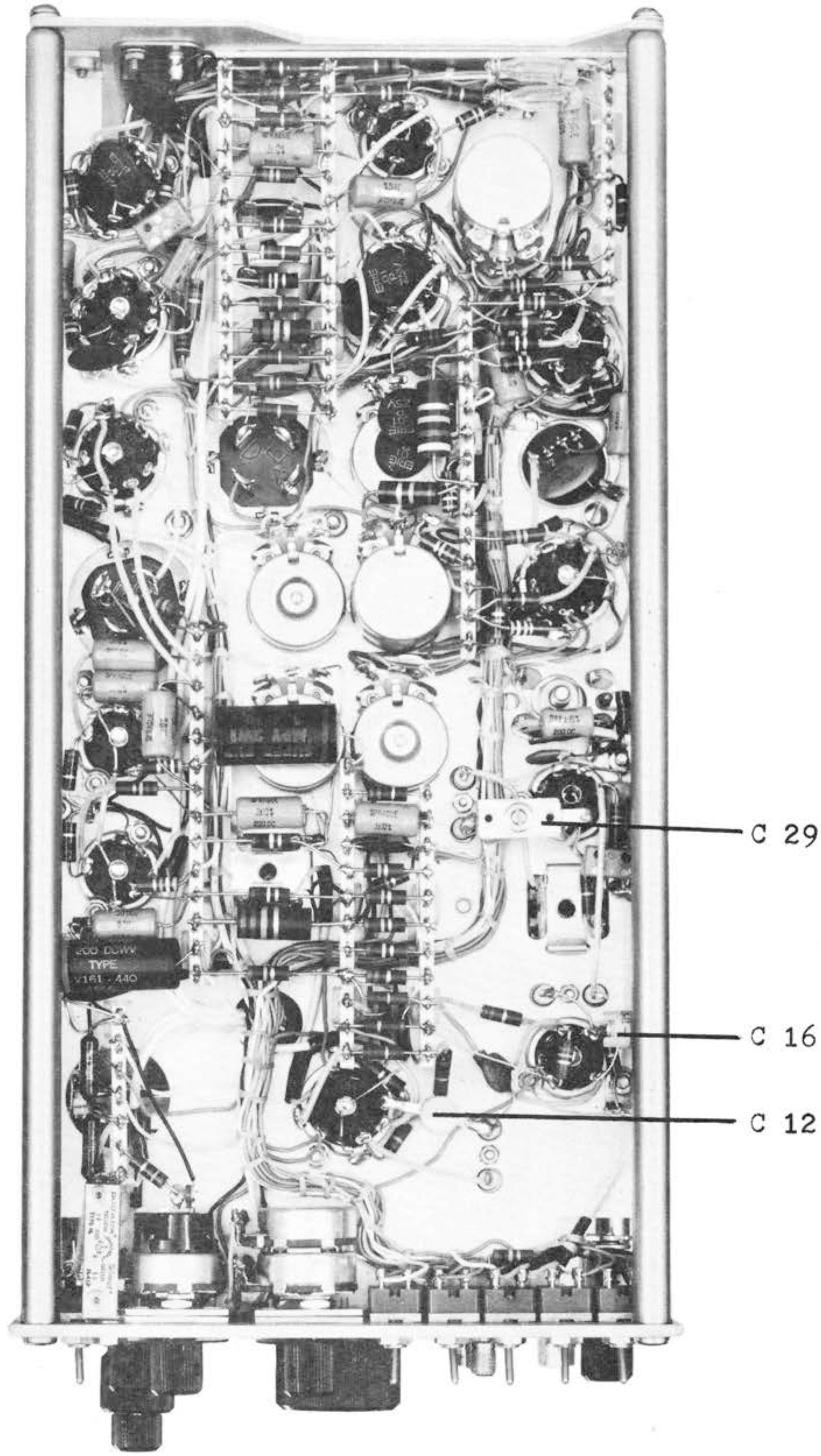
TUNING ADJUSTMENTS

All I.F. transformers should be adjusted for maximum deflection.



INTERNAL ALIGNMENT CONTROLS
TOP CHASSIS

FIGURE 6-1



BOTTOM CHASSIS ADJUSTMENTS

FIGURE 6-2

VOLTAGE CHART

MODEL 026

The voltages given in this chart are given as a guide to normal performance and may vary as much as 30%. A large difference from the value given may be taken as cause for further investigation. The voltages are valid for the following control settings:

MODE: Full Scan
SCAN: Auto
DISPLAY: Linear
MIXER BAL: Coarse and fine-centered
RESOLUTION: High
DISPERSION: Centered
VERNIER GAIN: Fully Counterclockwise
ATTENUATOR: Zero
FILTER: Out
V POS: To provide a trance on the screen or centered
LF CAL: Centered
SCAN: Fully clockwise X1
SCALE EXPANSION: Off

ALL VOLTAGES MEASURED USING 20,000 **OHMS PER** VOLT METER

TUBE	PIN #1	2	3	4	5	6	7	8	9
V1-5879	0V	NC	13V	-6V	-12V	NC	265V	270V	13V
V2-6BH6	0V	1.6V	-12V	-6V	145V	70V	1.6V		
V3-6BH6	0V	1.6V	0V	-6V	156V	87V	1.6V		
V4-12AT7	260V	5V	12V	0V	-12V	280V	0V	3V	NC
V5-6C4	210V	NC	0V	-6V	NC	1.2V	1.6V		
V6-6201	120V	-2.5V	*15V	0V	-12V	250V	*.1V	*6V	NC
V7-12AT7	30V	*.9V	.4V	0V	-12V	250V	*.5V	0V	NC
V8-6BE6	-12V	1.5V	6.3V (AC)	6.3V (AC)	150V	100V	.25V		
V9-6U8	300V	0V	90V	6.3V (AC)	6.3V (AC)	300V	.5V	9V	0V
V10-12AT7	160V	0V	2.8V	6.3V (AC)	6.3V (AC)	235V	-2.7V	2.8V	6.3V (AC)
V11-6AS6	-6V	0V	6.3V (AC)	6.3V (AC)	*120V	130V	.25V		
V12-12AT7	300V	*125V	*125V	6.3V (AC)	6.3V (AC)	*250V	*±80V	*±30V	6.3V (AC)

*AC or Sweep Riding on **DC** Level

SECTION 7

PARTS LIST

MODEL PSA 026

ITEM	DESCRIPTION	DRAWING NO.
R1	Comp. ½W 10% 27K	
R2	Comp. ½W 10% 22K	
R3	Comp. ½W 10% 2.2M	
R4	Comp. ½W 10% 22k	
R5	Comp. ½W 10% 22K	
R6	Comp. ½W 10% 100K	
R7	Comp. ½W 10% 2.2M	
R8	Comp. ½W 10% 470 Ω	
R9	Comp. ½W 10% 2.2M	
R10	Comp. ½W 10% 27K	
R11	Comp. ½W 10% 39K	
R12	Potentiometer 10¼ Turn 50K	C1000-154-26
R13	Comp. ½W 10% 39K	
R14	Comp. ½W 10% 100K	
R15	Comp. ½W 10% 2.2K	
R16	Comp. ½W 10% 100K	
R17	Potentiometer 25K	C1000-154-25
R18	Comp. ½W 10% 15K	
R19	Potentiometer 25K Part of Input Attenuator	
R20	Comp. ½W 10% 470 Ω	
R21	Comp. ½W 10% 2.2K	

SECTION 7

PARTS LIST

MODEL PSA-026

ITEM	DESCRIPTION	DRAWING NO.
R22	Film ½W 1% 47K	Dale Electronics MFF-½T1
R23	Film ½W 1% 5.23K	Dale Electronics MFF-½T1
R24	Comp. ½W 10% 6.8M	
R25	Comp. ½W 10% 2.2K	
R26	Comp. ½W 10% 220K	
R27	Comp. ½W 10% 1K	
R28	Chosen At Test	
R29	Comp. ½W 10% 2.7M	
R30	Comp. ½W 10% 180K	
R31	Comp. ½W 10% 2.2K	
R32	Comp. ½W 10% 1K	
R33	Comp. ½W 10% 1K	
R34	Comp. ½W 10% 18K	
R35	Comp. ½W 10% 15K	
R36	Comp. ½W 10% 1K	
R37	Potentiometer Dual Conc. 25K Panel	C1000-154-28
R38	Potentiometer Dual Conc. 10K Rear	C1000-154-28
R39	Comp. ½W 10% 43K	
R40	Not Used	

SECTION 7

PARTS LIST

MODEL PSA 026

ITEM	DESCRIPTION	DRAWING NO.
R41	Comp. ½W 10% 15M	
R42	Comp. ½W 10% 270K	
R43	Comp. ½W 10% 100 Ω	
R44	Comp. ½W 10% 27K	
R45	Not used	
R46	Comp. ½W 10% 8.2K	
R47	Potentiometer 25K Front Part of R38	
R48	Comp. ½W 10% 100 Ω	
R49	Comp. ½W 10% 2.2K	
R50	Not used	
R51	Not used	
R52	Comp. ½W 10% 39K	
R53	Comp. ½W 10% 27K	
R54	Comp. ½W 10% 470K	
R55	Comp. ½W 10% 2.7K	
R56	Comp. ½W 10% 1M	
R57	Comp. ½W 10% 470K	
R58	Comp. ½W 10% 220 Ω	
R59	Comp. ½W 10% 2.2K	
R60	Comp. ½W 10% 22K	
R61	Comp. ½W 10% 82K	

SECTION 7

PARTS LIST

MODEL PSA 026

ITEM	DESCRIPTION	DRAWING NO.
R62	Comp. ½W 10% 100 Ω	
R63	Comp. ½W 10% 1.8K	
R64	Comp. ½W 10% 1M	
R65	Comp. ½W 10% 2.2K	
R66	Comp. ½W 10% 390K	
R67	Comp. ½W 10% 270K	
R68	Comp. ½W 10% 10K	
R69	Chosen At Test	
R70	Not used	
R71	Comp. 2W 10% 47K	
R72	Comp. 1W 15K	
R73	Comp. ½W 10% 390K	
R74	Comp. ½W 10% 68 Ω	
R75	Not used	
R76	Comp. ½W 10% 1.1M	
R77	Potentiometer 150K	C1000-154-3
R78	Comp. ½W 10% 2.2K	
R79	Comp. ½W 10% 2.2M	
R80	Not used	
R81	Potentiometer 250K	C1000-154-11
R82	Comp. ½W 10% 100K	

SECTION 7

PARTS LIST

MODEL PSA-026

ITEM	DESCRIPTION	DRAWING NO.
R83	Comp. ½W 10% 100K	
R84	Comp. ½W 10% 2.2K	
R85	Not Used	
R86	Comp. ½W 10% 47K	
R87	Comp. ½W 10% 120K	
R88	Trimpot 10K	Bourns Type MH-41P
R89	Comp. ½W 10% 82K	
R90	Comp. ½W 10% 10 Ω	
R91	Comp. ½W 10% 15K	
R92	Comp. ½W 10% 15K	
R93	Potentiometer 250K	C1000-154-11
R94	Comp. ½W 10% 5.6M	
R95	Comp. ½W 10% 2.7M	
R96	Comp. ½W 10% 2.7M	
R97	Comp. ½W 10% 15K	
R98	Comp. ½W 10% 1M	
R99	Comp. ½W 10% 5.6M	
R100	Potentiometer 100K	C1000-154-8
R101	Comp. ½W 10% 10K	
R102	Comp. ½W 10% 22K	
R103	Comp. ½W 10% 150K	

SECTION 7

PARTS LIST

MODEL PSA-026

ITEM	DESCRIPTION	DRAWING NO.
R104	Potentiometer 10K Rear Part of R77	
R105	Not Used	
R106	Chosen At Test	
R107	Comp. ½W 10% 82K	
R108	Potentiometer 10K	C1000-154-10
R109	Potentiometer 250K	C1000-154-11
R110	Not Used	
R111	Potentiometer 25K	C1000-154-30
R112	Comp. ½W 10% 150K	
R113	Comp. ½W 4.7M	
R114	Potentiometer 100K	C1000-154-27
R115	Not Used	
R116	Comp. ½W 10% 1.8M	
R117	Potentiometer 10K Part of R37	
R118	Comp. 1W 10% 10K	
ATTENUATOR	A1000-256-1	

SECTION 7

PARTS LIST

MODEL PSA-026

ITEM	DESCRIPTION	DRAWING NO.
C1	Capacitor Electrolytic 40-20-10-10	Sprague TVL4578
C2	Capacitor .33 @ 400V	Amperex C280 CF/P330K
C3	Same as C2	
C4	Capacitor .1 @ 200V	Sprague 192 P10492
C5	Not Used	
C6	Same as C4	
C7	Capacitor Mica 470 Pf	CM15E471J
C8	Same as C7	
C9	Disc .01 @ 600V	Erie 811Z5V103P
C10	Same as C9	
C11	Same as C9	
C12	Trimmer 2.5-11	Erie 538-000-90R
C13	Disc. 001 @ 600V	Erie 801Z5V103P
C14	Same as C9	
C15	Not Used	
C16	Same as C12	
C17	Same as C1	
C18	Same as C9	
C19	Same as C9	
C20	Not Used	

SECTION 7

PARTS LIST

MODEL PSA-026

ITEM	DESCRIPTION	DRAWING NO.
C21	Capacitor Mica 270 Pf	CM15E271J
C22	Same as C7	
C23	Same as C4	
C24	Same as C9	
C25	Not Used	
C26	Same as C9	
C27	Same as C4	
C28	Same as C4	
C29	Trimmer 7-100	Arco 423
C30	Not Used	
C31	Capacitor Mica 15 Pf	CM15E150J
C32	Capacitor Mica 5 Pf	CM15E050J
C33	Same as C13	
C34	Same as C9	
C35	Not Used	
C36	Same as C4	
C37	Capacitor Mica 180 Pf	CM15E181J
C38	Same as C4	
C39	Same as C9	
C40	Not Used	

SECTION 7

PARTS LIST

MODEL PSA-026

ITEM	DESCRIPTION	DRAWING NO.
C41	Capacitor .047 @200V	Sprague 192P47392
C42	Same as C9	
C43	Same as C4	
C44	Same as C13	
C45	.02 CRL DD203	
C46	Same as C9	
C47	Same as C13	
C48	Capacitor .25 @ 200V	Averovox V161-440
C49	Same as C4	
C50	Not Used	
C51	Same as C4	
C52	Capacitor 1.0 @ 200V	Good All X663F
C53	Same as C4	
C54	Same as C9	
C55	Not Used	
C56	Same as C4	
S1	Switch DPDT Toggle	Milliswitch TT-2
S2	Same as S1	
S3	Same as S1	
S4	Same as S1	

SECTION 7

PARTS LIST

MODEL PSA 026

ITEM	DESCRIPTION	DRAWING NO.
S5	Same as S1	
S6	Part of R93	
S7	Part of R111	
S8	Same as S1	
V1	Tube Electron	5879
V2	Tube Electron	6BH6
V3	Tube Electron	6BH6
V4	Tube Electron	12AT7
V5	Tube Electron	6C4
V6	Tube Electron	6201
V7	Tube Electron	12AT7
V8	Tube Electron	6BE6
V9	Tube Electron	6U8A
V10	Tube Electron	12AT7
V11	Tube Electron	6AS6
V12	Tube Electron	12AT7
J1	Jack	UG625B/U
J2	Jack	UG625B/U
J3	Jack	UG625B/U

SECTION 7

PARTS LIST

MODEL PSA 026

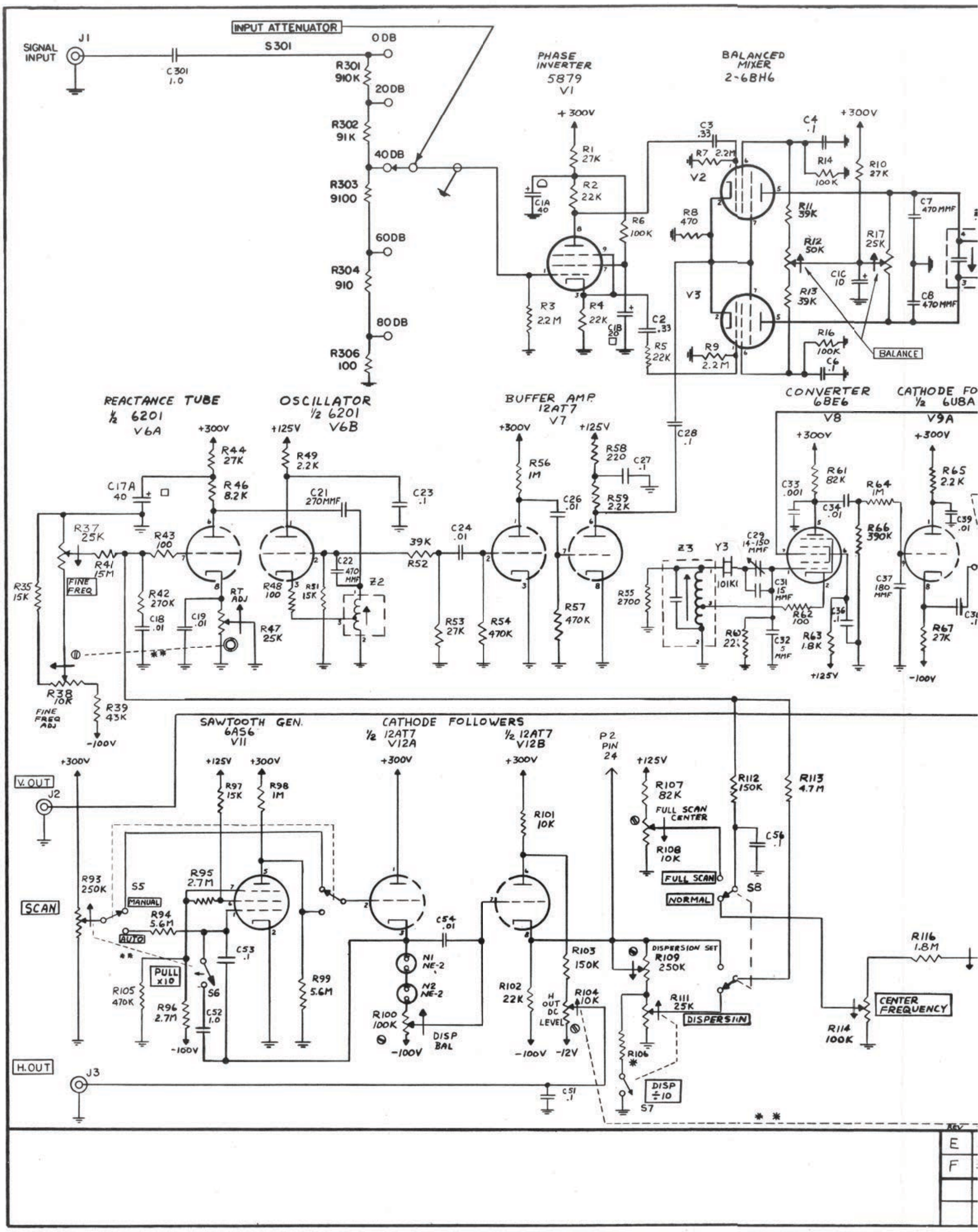
ITEM	DESCRIPTION	DRAWING NO.
Z1	Transformer	A1000-009-1
Z2	Coil	A1000-008-1
Z3	Coil	A1000-008-1
Z4	Transformer	UTC 026
TFL	Fork Filter	A1000-217-1
Y1	Crystal	A1000-007-1
Y2	Paired with Y2	
Y3	Crystal	B1000-216-2
CR1	IN34A	
N1	NE2	
N2	NE2	
P1	Not used	
P2	Connector	Amphenol 26-159-24

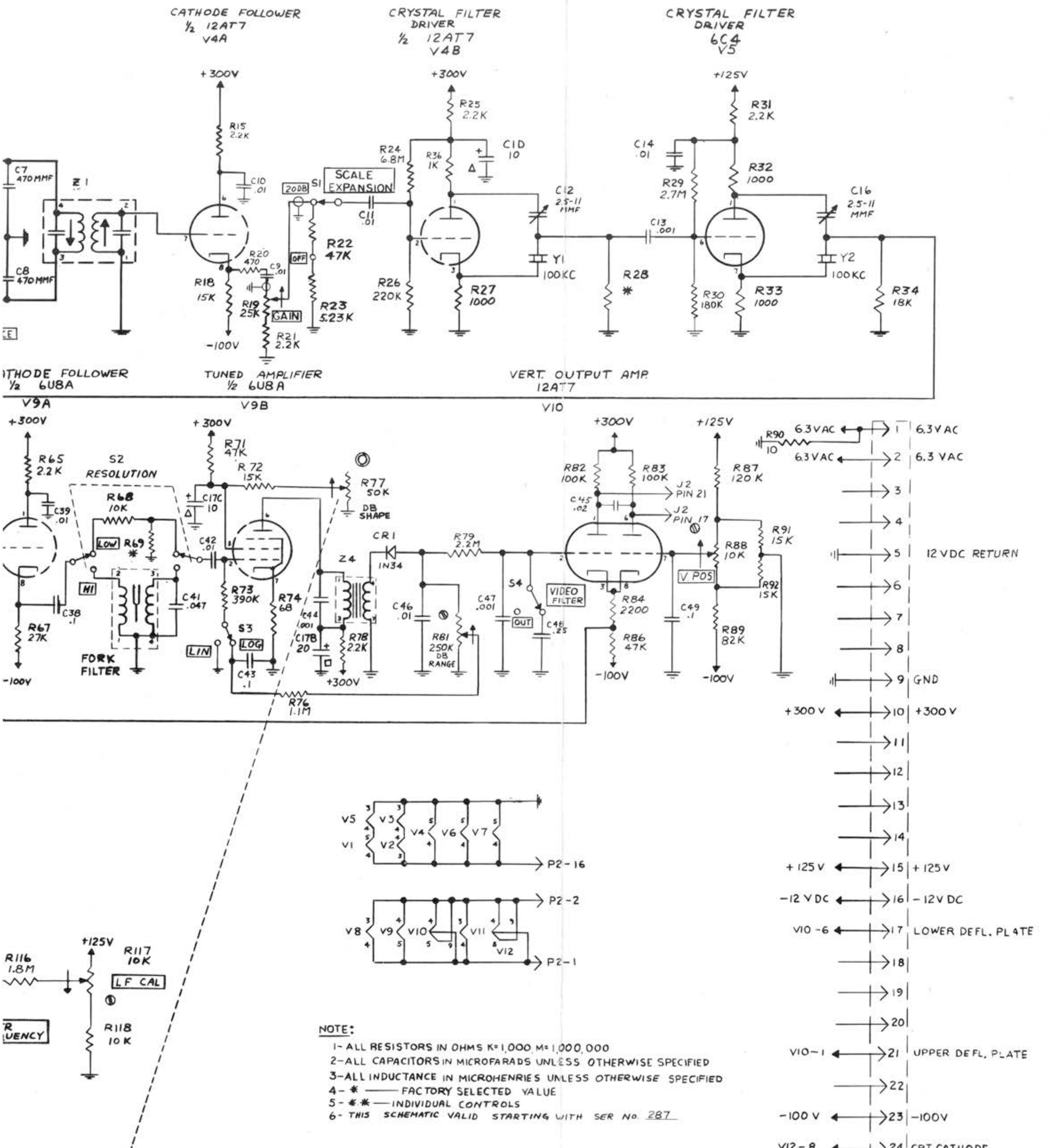
100 kc ± 50c   e.g. 100025 = LO 100000 + 25c

but also 0-50 c/s ±
will be in pass band

e.g. @ 98 kc LO

will pass from 1950 to 2050 hz


INPUT ATTENUATOR
SIGNAL INPUT
J1
S301
C301 1.0
0DB
R301 910K
20DB
R302 91K
40DB
R303 9100
60DB
R304 910
80DB
R306 100
PHASE INVERTER
5879
V1
BALANCED MIXER
2-6BH6
+300V
R1 27K
R2 22K
C1A 40
R6 100K
R3 2.2M
R4 22K
C1B 20
C2 .33
R5 22K
C3 .33
R7 2.2M
V2
V3
R8 470
R9 2.2M
C4 .1
R14 100K
R10 27K
R11 39K
R12 50K
R13 39K
R16 100K
C6 .1
R17 25K
C1C 10
C7 470MMF
C8 470MMF
BALANCE
REACTANCE TUBE
½ 6201
V6A
OSCILLATOR
½ 6201
V6B
BUFFER AMP.
12AT7
V7
CONVERTER
6BE6
V8
CATHODE FO
½ 6U8A
V9A
+125V
-100V
R44 27K
R46 8.2K
R49 2.2K
C17A 40
C21 270MMF
C23 .1
R37 25K
R43 100
R41 15M
FINE FREQ
R35 15K
R42 270K
C18 .01
C19 .01
RT ADJ
R47 25K
R48 100
R51 15K
C22 470 MMF
Z2
R38 10K
FINE FREQ ADJ
R39 43K
39K
R52
C24 .01
R53 27K
R54 470K
R56 1M
C26 .01
R57 470K
R58 220
C27 .1
R59 2.2K
C28 .1
Z3
Y3
101K1
C29 14-150 MMF
C31 15 MMF
R55 2700
R62 100
C32 5 MMF
R63 1.8K
C33 .001
R61 82K
C34 .01
C36 .1
R64 1M
R66 390K
R65 2.2K
C39 .01
C37 180 MMF
R67 27K
SAWTOOTH GEN.
6AS6
V11
CATHODE FOLLOWERS
½ 12AT7
V12A
½ 12AT7
V12B
P2 PIN 24
V. OUT
J2
R93 250K
S5
MANUAL
AUTO
SCAN
R95 2.7M
R94 5.6M
R97 15K
R98 1M
C53 .1
PULL x10
S6
R105 470K
R96 2.7M
C52 1.0
R99 5.6M
C54 .01
N1 NE-2
N2 NE-2
R100 100K
DISP BAL
R101 10K
R102 22K
R103 150K
R104 10K
H OUT DC LEVEL
-12V
R107 82K
FULL SCAN CENTER
R108 10K
FULL SCAN
NORMAL
S8
R112 150K
R113 4.7M
C56 .1
DISPERSION SET
R109 250K
R111 25K
DISPERSION
R106
DISP ÷10
S7
R116 1.8M
CENTER FREQUENCY
R114 100K
H. OUT
J3
C51 .1
REV
E
F



NOTE:

1- ALL RESISTORS IN OHMS K=1,000, M=1,000,000
2- ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED
3- ALL INDUCTANCE IN MICROHENRIES UNLESS OTHERWISE SPECIFIED
4- * —— FACTORY SELECTED VALUE
5- ** —— INDIVIDUAL CONTROLS
6- THIS SCHEMATIC VALID STARTING WITH SER No. 287

REV	SER	DETAILS	BY	REV	FROM SER #	DETAILS	BY
E	340	C301 WAS 0.1µfd C2 & 3 WERE 0.1µfd REC 348	L. TAUB 2-12-68	A		R118 WAS 18K — R116 WAS 2.2M — R55 & R20 ADDED C51 ADDED R10 & R15 WERE R15 & R20 (NO CHANGE IN VALUE)	
F	352	C47 was .01Mfd C45 Added REC 356	H. ROSS 6-10-68	B		R5 ADDED TO CORRECT SCHEMATIC ERROR	
				C		R39 WAS 56K REC 304	L. TAUB 3-67
				D		R103 WAS 180K REC 319	L. TAUB 6-67

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

SCHEMATIC PSA 026

D1000-142 F

WARRANTY

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