INSTRUCTION MANUAL

PLUG-IN

SPECTRUM ANALYZERS

MODELS

PSA 011

PSA 012

PSA 013

PSA 014

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

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WARRANTY

NELSON-ROSS ELECTRONICS, 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.

LIST OF ILLUSTRATIONS

SECTION 1

CHARACTERISTICS

SCOPE

This manual provides Operating Instructions, Theory of Operation, Technical Characteristics, Maintenance, and Trouble Shooting Procedures for Nelson-Ross Plug-In Low Frequency Spectrum Analyzers Models 011, 012, 013, and 014. These Analyzers are designed to provide coverage of four frequency ranges; 10cps to 20kc, 35cps to 100kc, 150cps to 500kc and 10kc to 2mc.

These units are designed so that they may be conveniently plugged into any oscilloscope which accepts the TEKTRONIX letter series plug-ins. By simply installing one of these plug-in units, the oscilloscope becomes a complete Spectrum Analyzer. In use, the sawtooth output of the oscilloscope is utilized to provide a signal for sweeping the Spectrum Analyzer Oscillator. All voltages for Spectrum Analyzer operation are obtained automatically when the analyzer is plugged into the oscilloscope.

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 oscilloscope 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 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:

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 vertical line. Instead the signal is broadened into a pulse as 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.

4. signals containing components closer together than the resolution of the analyzer generate a continuous spectrum, as 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) on cathode-ray tube.

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 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 3-5 sweeps/second and many low frequency analyzers will require scan times in excess of 5 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, therefore, 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.

TECHNICAL SPECIFICATIONS

SPECIFICATION	PSA 011	PSA 012	PSA 013	PSA 014
CENTER FREQUENCY RANGE	10CPS to 20KC	35CPS to 100KC	140CPS to 500KC	1KC to 2MC*
CALIBRATED TUNING DIAL RANGE	0 to 20 KC	0 to 100KC	0 to 500KC	0 to 2MC
TUNING DIAL ACCURACY	± 10 %			
MODES OF OPERATION	NORMAL: Tuning dial determines center frequency FULL SCAN: Entire band displayed on CRT Mode selectable with front panel switches			
DISPERSION (SWEEP WIDTH)	100CPS to 6KC	500CPS to 30KC	2.5KC to 150KC	10KC to 600KC
DISPERSION ACCURACY	± 10 %			
RESOLUTION BANDWIDTH	10 CPS to 100CPS	35CPS to 250CPS	150CPS to 2KC	1KC to 8KC
DISPLAY: INPUT VOLTAGE AMPLITUDE SCALES	Linear and 40 DB Logarithmic			
SENSITIVITY	85 microvolts/cm. deflection (min.)			
NOISE LEVEL	Less than 10 microvolts referred to the input			
AMPLITUDE SCALE ACCURACY	Linear ± 10 % Log ± 1 DB			
AMPLITUDE RESPONSE FLATNESS	± 1 DB			
SWEEP RATE	10/second to 50 seconds/scan Calibrated and Variable			
ATTENUATOR	80 DB range in 20 DB steps and 20 DB variable			

SPECIFICATION	PSA 011	PSA 012	PSA 013	PSA 014
INPUT IMPEDANCE	1 Megohm			
DYNAMIC RANGE	Harmonic and IM products down 60 DB			Harmonic and IM products down 46 db
INCIDENTAL FM	Less than 1% of narrowest Resolution Bandwidth			
VERTICAL SCALE EXPANSION	OFF 20DB and 40 DB			
IF FREQUENCY	100KC	262KC	1.5MC	10.7MC
OSCILLATOR OUTPUT	1 Volt peak-to-peak minimum from 4700 ohms			-20DBM (nominal) from 50 Ω
VERTICAL SIGNAL OUTPUT	6 Volts negative at ground from 1k Ω - (nominal)-(4ma maximum)			
HORIZONTAL SIGNAL OUTPUT	1 Volt positive minimum from 680 Ω			
OSCILLATOR FREQUENCY	120KC to 100KC	362KC to 262KC	2mc to 1.5mc	12.7mc to 10.7
VIDEO FILTER (LOW PASS FILTER	Four positions· 1, 3, 9, 66 milliseconds Selectable with front panel switch			
COMPATIBLE OSCILLOSCOPES	Interchangeable with Tektronix letter series Plug-In units			
POWER REQUIREMENTS	All power and voltages from oscilloscopes			

* Not recommended for signals at frequencies below 10 KC.

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.

INITIAL ADJUSTMENTS

Since oscilloscopes which accept letter series plug-ins may have either 4 or 6 cm vertical scales, provision is made for soldering a link within the analyzer to accommodate either scale. The link must be inserted for 4 cm scales and removed for 6 cm scales. All Nelson-Ross analyzers are shipped from the factory set for 6 cm vertical scales. The link terminals may be reached through the access hole in the rear plate without disassembling the analyzer. See figure 2-1 . Determine the vertical scale on your oscilloscope, and add or remove the link as required. Insert the plug-in unit into any oscilloscope which accepts the TEKTRONIX letter series plug-ins. Turn the knurled knob (at the bottom center of the analyzer) clockwise to secure the Plug-In Unit. Plug the cable emerging from the hole marked H. SWEEP into the SWEEP OUTPUT jack on the scope panel.

Turn the oscilloscope power on, and allow a 15 minute warm-up period. The sweep controls on the TEKTRONIX Oscilloscope must be set to produce a free-running display at the proper sweep speed. To obtain a free-running display, set the oscilloscope controls as follows:

TRIGGERING MODE	AUTOMATIC
TRIGGER SLOPE	INT +
STABILITY	TURN FULLY CLOCKWISE
TRIGGERING LEVEL	0 (ZERO)
SWEEP SPEED CONTROL	50 MILLISECONDS/CM

Set the NORMAL/FULL SCAN switch on the analyzer in the FULL SCAN position. The SCALE EXPANSION switch is set to the 40 db position and the ATTENUATOR to 80 db. It will then be possible to obtain a horizontal trace along the bottom graticule line on the oscilloscope screen adjustment of the V POS control. Position the trace by means of the oscilloscope HORIZONTAL position control so that the trace starts at the left hand edge of the CRT graticule.

DISPERSION BALANCE

Since the power supply and sawtooth voltages 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 (VARIABLE-CW)

DISPERSION to (30% of maximum)

RESOLUTION Minimum (Fully CCW)

VIDEO FILTER LIN-1

MIXER BALANCE FINE Centered

MIXER BALANCE COARSE Centered

NORMAL-FULL SCAN Full Scan

CENTER FREQUENCY 0 CPS

SCALE EXPANSION 40 DB

Adjust the DISPERSION BALANCE control (a screwdriver adjustment concentric with the V POS control) until the internally generated zero frequency signal-which appears at the right of the trace and may be anywhere from 10% of full scale amplitude to several times full scale amplitude-coincides with the right edge of the graticule. This adjustment sets the oscilloscope sawtooth to the required level.

LF CAL

Switch the NORMAL-FULL SCAN switch to Normal. Using a screwdriver, adjust the LF CAL potentiometer to position the zero frequency signal directly on the graticule center line.

MIXER BALANCE ADJUSTMENT

Initial adjustment of the MIXER BALANCE controls is necessary, in order to minimize the leakage of any portion of the local oscillaator 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 by setting the controls as follows:

ATTENUATOR to 80 DB

DISPERSION to (fully CW)

RESOLUTION Minimum (Fully CCW)

VIDEO FILTER LIN-1

MIXER BALANCE FINE Centered

MIXER BALANCE COARSE Centered

NORMAL-FULL SCAN Normal

CENTER FREQUENCY OCPS

The SCALE EXPANSION and VERNIER controls should then be adjusted to provide a visible signal amplitude on the oscilloscope s[illegible] 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.

The instrument is designed so that it will function properly around zero frequency only when set at maximum resolution. Decreasing resolution actually limits the minimum observable frequency. Set the resolution to maximum by rotating fully clockwise. Balancing is now accomplished by alternate adjustment of the MIXER BALANCE controls. Start by adjusting the COARSE control for a minimum signal, then adjust the FINE control.

Alternate between COARSE and FINE until the best minimum is obtained. As the balance improves gradually increase the VERNIER and SCALE EXPANDER 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 2-2 contains a brief explanation of each control. The text portion of this section will present a further explanantion 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 the frequency distribution of a signal. It is of course necessary that the signal or components of the signals being observed 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. When the spectrum analyzer is used in conjunction with a sysnchronous signal generator (NELSON-ROSS Models 101, 102, or 103) the frequency response of filters and amplifiers may be accurately determined.

The spectrum analyzer is designed so that its basic operating characteristics may be adjusted to provide the parameters required for analysis of the desired signal.

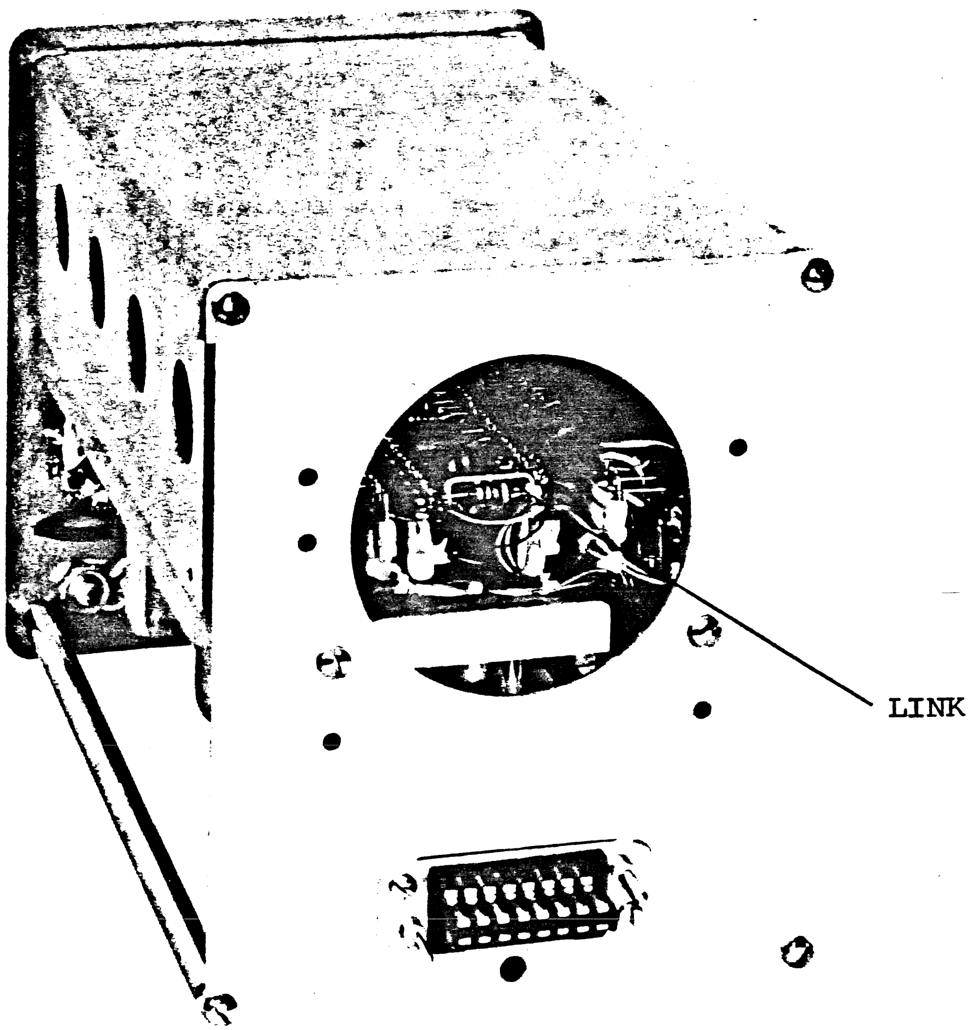


FIGURE 2-1

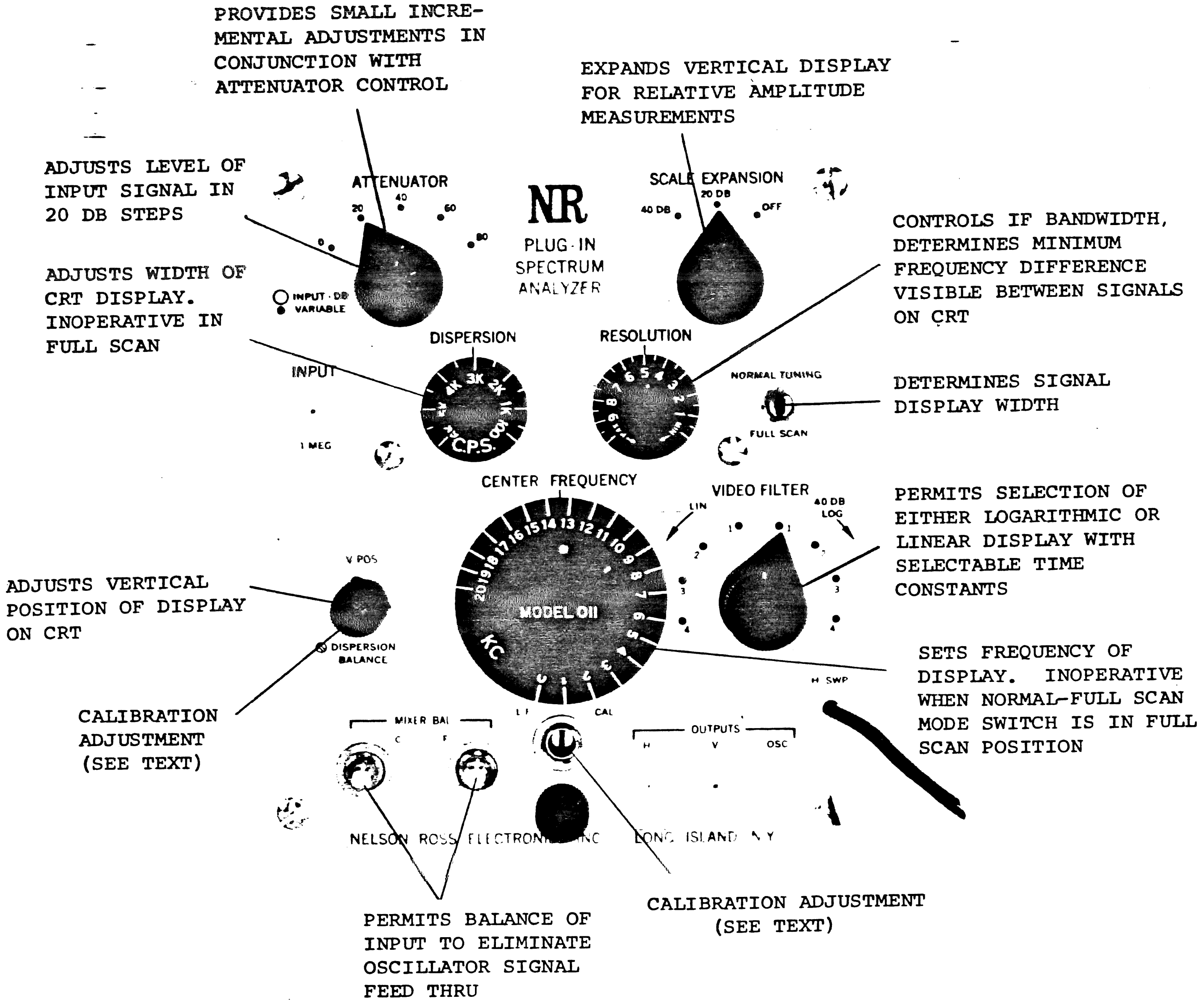

PROVIDES SMALL INCREMENTAL ADJUSTMENTS IN CONJUNCTION WITH ATTENUATOR CONTROL
EXPANDS VERTICAL DISPLAY FOR RELATIVE AMPLITUDE MEASUREMENTS
ADJUSTS LEVEL OF INPUT SIGNAL IN 20 DB STEPS
ADJUSTS WIDTH OF CRT DISPLAY. INOPERATIVE IN FULL SCAN
CONTROLS IF BANDWIDTH, DETERMINES MINIMUM FREQUENCY DIFFERENCE VISIBLE BETWEEN SIGNALS ON CRT
DETERMINES SIGNAL DISPLAY WIDTH
PERMITS SELECTION OF EITHER LOGARITHMIC OR LINEAR DISPLAY WITH SELECTABLE TIME CONSTANTS
ADJUSTS VERTICAL POSITION OF DISPLAY ON CRT
SETS FREQUENCY OF DISPLAY. INOPERATIVE WHEN NORMAL-FULL SCAN MODE SWITCH IS IN FULL SCAN POSITION
CALIBRATION ADJUSTMENT (SEE TEXT)
PERMITS BALANCE OF INPUT TO ELIMINATE OSCILLATOR SIGNAL FEED THRU
CALIBRATION ADJUSTMENT (SEE TEXT)
ATTENUATOR
NR
PLUG-IN
SPECTRUM
ANALYZER
SCALE EXPANSION
40 DB
20 DB
OFF
INPUT - DB
VARIABLE
DISPERSION
RESOLUTION
INPUT
1 MEG
NORMAL TUNING
FULL SCAN
CENTER FREQUENCY
VIDEO FILTER
LIN
40 DB
LOG
V POS
MODEL 011
KC
DISPERSION
BALANCE
MIXER BAL
CAL
OUTPUTS
H
V
OSC
H SWP

FIGURE 2-2

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

CENTER FREQUENCY - Adjustment of this control 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.

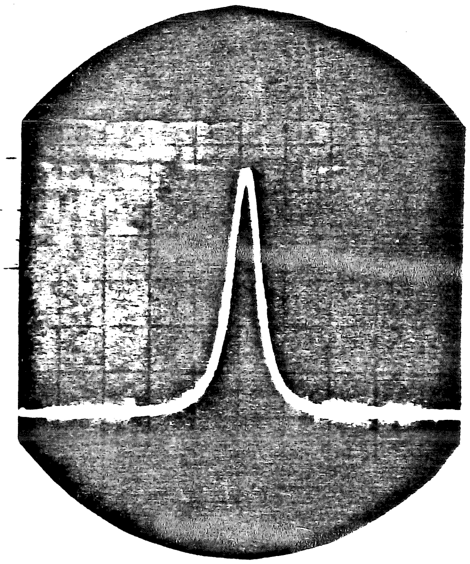
DISPERSION - The position of this control adjusts the (frequency) width of the screen display. The MODE SELECTION switch marked NORMAL and FULL SCAN must be in the NORMAL position to permit tuning when using the DISPERSION control.

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.

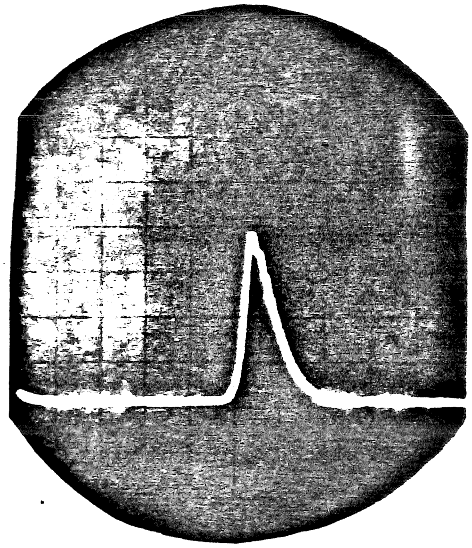
This difference is determined by the IF amplifier bandwidth of the analyzer. Adjustment of the RESOLUTION control, varies the bandwidth (of the crystal filters) to provide the resolution required for the type of measurement being made. Two equal signals are considered resolved when a 3 DB (or greater) 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 cannot respond to a signal which passes through it too rapidly. With proper use of the instrument this loss in sensitivity becomes negligible. When quantitive measurements are being made, it is necessary to prevent this type of variation 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). A point will be reached where the ringing will disappear completely. For optimum resolution, the ringing should just barely be visible.

The various resolution conditions are illustrated in figure 2-3. 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), it will not always be possible to obtain optimum resolution.

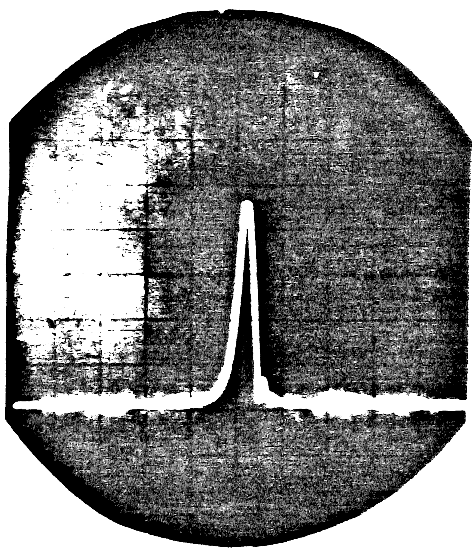
GAIN CONTROLS - SCALE EXPANSION, ATTENUATOR (and VARIABLE) controls serve very important and specific purposes. Basically, they adjust incoming signals to visible levels, and provide ranging for amplitude level measurements. The SCALE EXPANSION control may be placed in one of three positions: 0 DB, 20 DB and 40 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 60 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 precautions are observed:



SWEEP FACTOR LARGE ENOUGH
TO PERMIT AMPLITUDE
MEASUREMENTS



LOSS OF RESOLUTION AND
AMPLITUDE DUE TO EXCESSIVE
SWEEP SPEED OR DISPERSION



OPTIMUM RESOLUTION
15% LOSS IN AMPLITUDE

FIGURE 2-3

When the SCALE EXPANSION control is set at the 40 DB position, the ATTENUATOR (and VARIABLE) should be set so that the largest component of the observed signal has no greater than full screen amplitude. It is then possible to set the SCALE EXPANSION control to any position without the possibility of introducing saturation or spurious harmonic signal errors. It is then essential that only the SCALE EXPANSION control be used to set measurement ranges. Any attempt to set range with the ATTENUATOR control increases the possibility of input amplifier overload, with resultant generation of harmonics products. These products will appear on the oscilloscope and lead to erroneous signal analysis.

The VIDEO FILTER control may be set in either of 4 linear positions or 4 logarithmic positions. In any of the 4 LIN positions, deflection on the oscilloscope screen will be directly proportional to the input signal amplitude. While in any of the 4 LOG positions the oscilloscope deflection will be proportional to the logarithm of the input signal amplitude.

It should be noted that similarly numbered positions are identical in both the LOG and the LIN settings. The numbered positions represent the selection of increasing values of integration time constants in the video output of the instrument. The video filters provide suppression of beat notes which occur when signals with close components are being observed. Since increased settings of the filter control requires slower sweep speeds, it is recommended that the control be set at its lowest practical number. 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.

CALIBRATION

While a spectrum analyzer is not normally used for amplitude measurements, NELSON-ROSS PLUG-IN SPECTRUM ANALYZER Models 011, and 012 may be calibrated in order to provide accurate absolute, measurements of the components of any complex waveform. The voltage calibration circuitry of the Tektronix oscilloscope is quite adequate for such purposes. The Tektronix calibrator generates a square wave which is calibrated in a peak to peak voltage range of 200 microvolts to 100 volts. This square wave frequency is approximately 1000 CPS.

Calibration is accomplished by visually observing the amplitude of the fundamental component of the square wave while simultaneously noting the deflection produced.

The square wave is ideally suited for calibration techniques since fundamental component amplitude is independent of rise, fall, and tilt. The limiting case of a square wave is a sine wave of the fundamental amplitude resulting from increasing rise and fall times. The fundamental, being much lower in frequency than all other signal components, is quite easily identified. Fourier analysis indicates the RMS amplitude of the fundamental as:

$$E_{rms} = (1.414/pi)\ E_{p-p}\ \text{sq. wave}$$

$$E_{p-p} = (4/pi)\ E_{p-p}\ \text{sq. wave}$$

It is helpful to remember that the RMS sensitivity of the instrument is 0.45 times the peak-to peak oscilloscope calibrating voltage. In addition the peak-to-peak sensitivity is equal to 1.28 times the peak-to-peak calibrator output. Whenever performing calibration of the instrument be aware of the fact that sensitivity varies with different values of resolution and dispersion as mentioned in section 1. Therefore, calibration and measurement must be made while observing the precautions mentioned in that section. It is possible to calibrate the instrument within 10% while the conversion figures indicated in the above paragraphs are within 5%. The other 2% results from reading error.

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.

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 transd. cer secured to the item under test.

FREQUENCY RESPONSE - When used with a synchronous sweep generator (NELSON-ROSS Synchro-Sweep Generators, Model 101, 102, or 103) the spectrum analyzer may be used to provide accurate analysis of filter network or amplifier frequency response.

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 Model 011 - Illustrates 1 KC sidebands on a 10 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 Model 011 - Demonstrates the instruments resolution capability. The signal consists of a 10 KC CARRIER with 10 cycle sidebands. The instrument is set for a LIN - 4, (66 MS filter IN) NORMAL display. The dispersion control is set at approximately 100 cycles.

3-3 Model 011 - The first, third and fifth h[illegible]onics of a 1 KC square wave SIGNAL are visible in this figure.

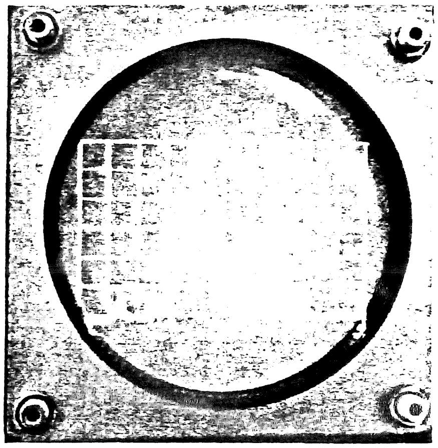
The Mode switch is in the NORMAL position and the VIDEO FILTER is in the LIN-1 position. In this display, ZERO signal is at the extreme right. The large portion of the SIGNAL is the first (fundamental) harmonic at 1 KC. The DISPERSION control is set at 6 KC.

3-4 Model 012 - This display demonstrates the response curve of a double tuned filter. The input to the filter is provided by a SYNCHRO-SWEEP generator. The generator supplies a swept zero to 100 KC SIGNAL (or ZERO to the maximum range of the spectrum analyzer), ± 1 DB in amplitude. Using the FULL SCAN MODE, and with the VIDEO FILTER in the LIN-1 position, complete filter characteristics may be demonstrated.

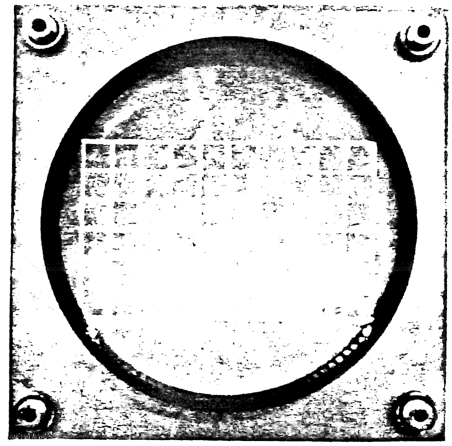
3-5 Illustration of 100 KC SIGNAL containing 1 percent sidebands (1 KC). The sidebands are 50 DB down from the 100 KC signal. The MODE switch is in the NORMAL position, and the VIDEO FILTER is in the LIN-1 position.

3-6 The signal input in this display is the same as that of figure 3-5. However, the VIDEO FILTER is in the LOG-1 position, illustrating compression with the sidebands 30 DB below the MAIN SIGNAL.

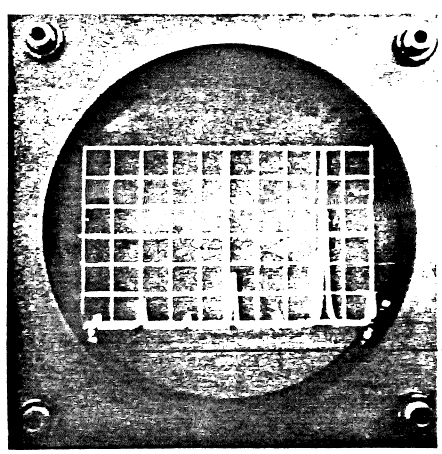
3-7 Model 011 - In this display, a 1 KC signal is shown with the MODE switch in the FULL SCAN position. The ZERO SIGNAL and the first through the tenth harmonic are visible. All harmonics are odd.



3-1



3-2



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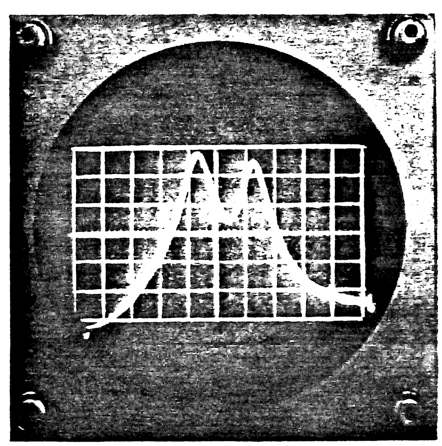
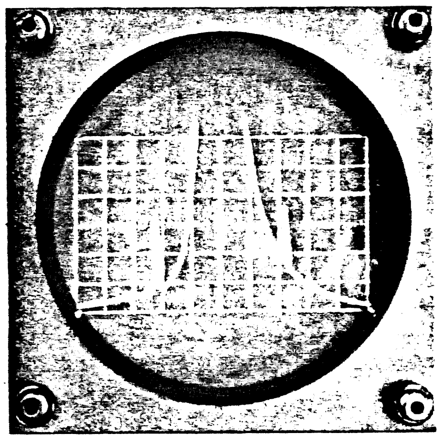


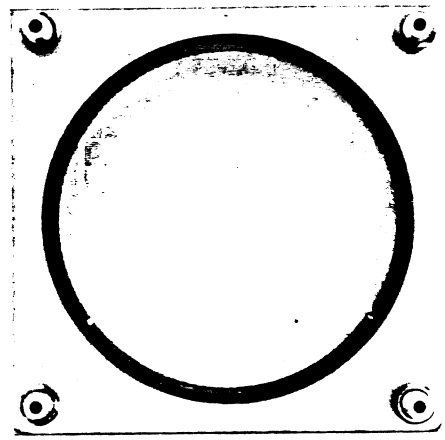
3-4

TYPICAL DISPLAYS (see text)

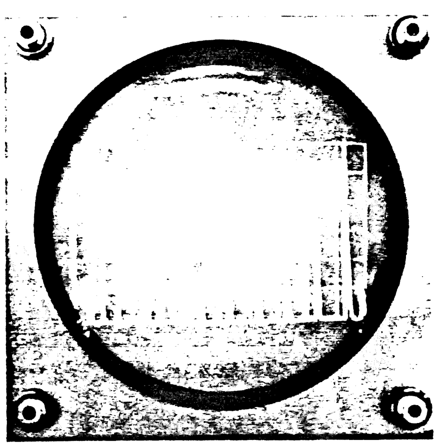
FIGURES 3-1 to 3-4



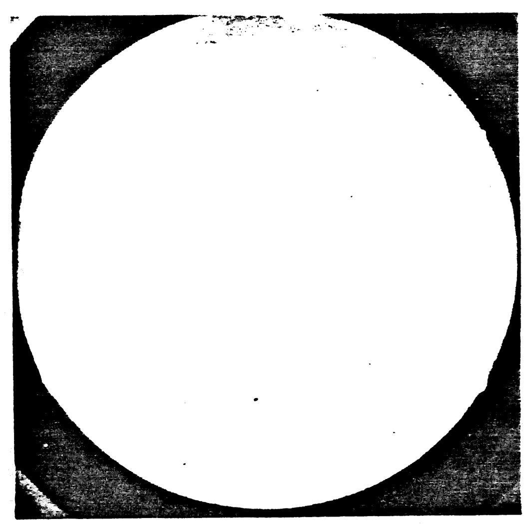
3-5



3-6



3-7



3-8

TYPICAL DISPLAYS (see text)

FIGURES 3-5 to 3-8

3-8 Model 011 - 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 6 KC dispersion, centered at 3 KC. This figure demonstrates the relative amplitude of vibrations at frequencies from ZERO to 3 KC. Equipment for this demonstration was as follows:

A Glennite Accelerometer MODEL A321TMV S/N 509 was used as the transducer. The scale factor shows approximately 2.3 G's (at the maximum) occuring at approximately 2.5 KC.

SECTION 4

CIRCUIT DESCRIPTION

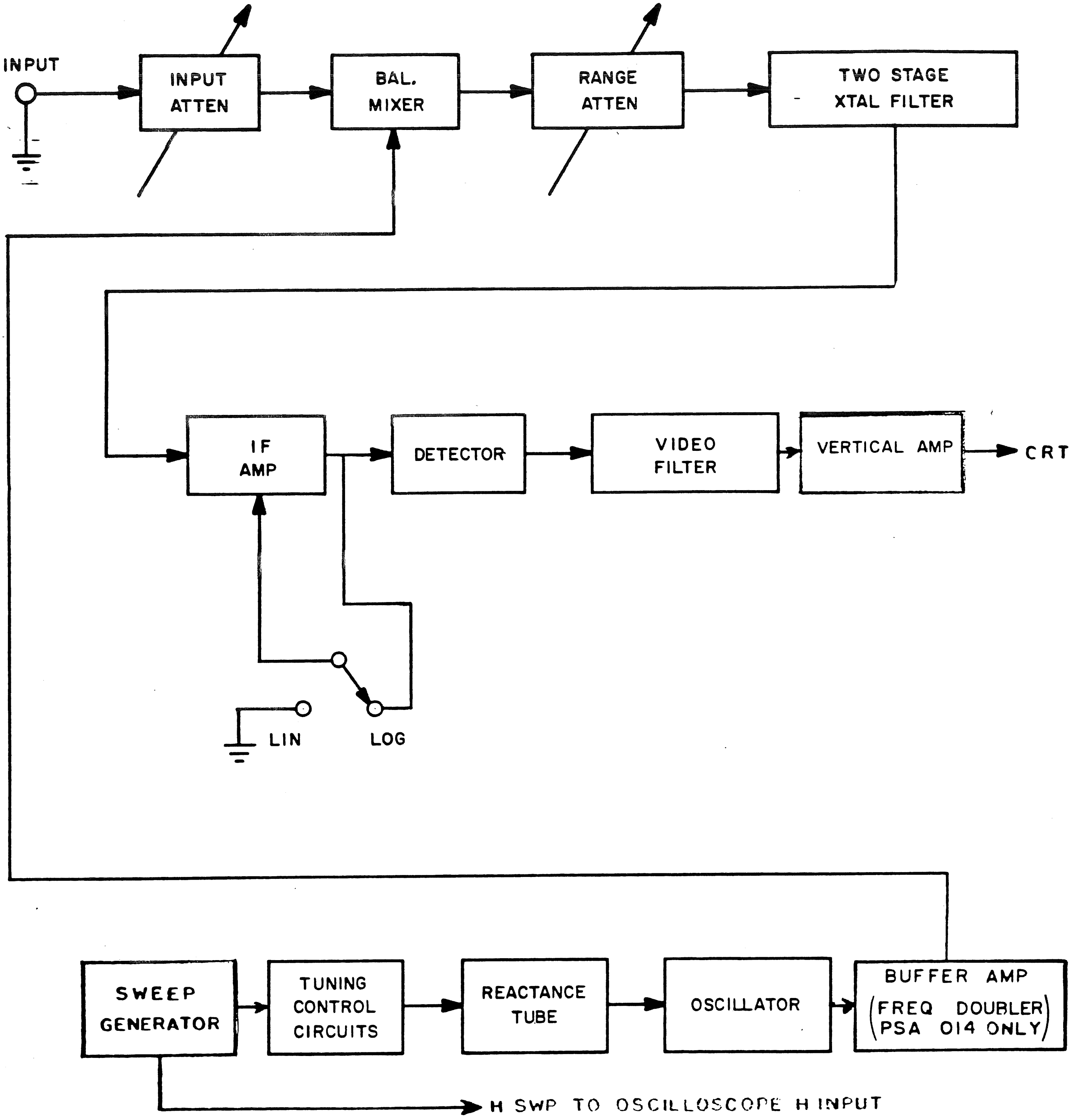
GENERAL

The circuit description presented in this section applies to NELSON-ROSS Plug-In Spectrum Analyzers Models 011, through Model 014, with certain minor component reference exceptions. These exceptions will be noted whenever they occur in the detailed 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 complemented. This resultant signal then passes through the range attenuator and the crystal filter. The frequency response of this filter may be varied in order to provide the required degree of signal resolution on the screen of the oscilloscope. The signal output from the filter drives the IF amplifier.



BLOCK DIAGRAM

FIGURE 4-1

Most of the instrument gain is provided by the amplifier. The IF amplifier is tuned to the sum frequency of the mixer output. At this point, the output of the IF amplifier is directed through two separate and independent detectors. One detector output passes through a video filter to the oscilloscope vertical amplifier. The output of the second detector provides a feedback signal which is used to generate a log function. When the video filter is in any of the LIN function positions, this feedback signal is not utilized.

The sawtooth output of the oscilloscope is utilized to drive a reactance tube. The reactance tube sweeps the local oscillator in synchronism with the oscilloscope trace. Reactance tube 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. In order to insure flat attenuation for the frequency ranges covered by Models 012, 013, and 014 compensation is provided by placing trimmer capacitors across certain resistors.

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 voltage and the derived voltage is utilized to drive the grids of V2 and V3. Tubes V2 and V3 are connected in a push-pull configuration relative to the input signal, and they 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 sum frequency is selected by Z1 for amplification by the IF amplifier system.

SCALE EXPANDER

The output of Z1 is single ended with respect to ground. The SCALE EXPANDER provides three settings: - straight thru (0 DB), 20DB and 40 DB. The scale expander is isolated from the secondary by ½ V4 connected as a cathode follower.

CRYSTAL FILTER

The output of ½ of V4 and the triode section of V5 are utilized to drive the two sections of the crystal filter network. Resolution is determined by the combined bandwidth of the two crystal filter sections. Bandwidth of each filter section is determined by shunting the output of each section with a resistance. By changing the value of resistance the effective "Q" is changed. As a result, the filter bandwidth around the I.F. frequency is also varied. This bandwidth determines the resolution of the plug-in unit. Potentiometer R32 (resolution) simultaneously varies the "Q" of both sections, except in model 014, where only the first section is varied. Capacity across each of the crystal holders is neutralized by adjustment of trimmer capacitors C12 and C16.

IF AMPLIFIER

The IF amplifier is composed of two double tuned stages consisting of V8 and V9. (in model 014, the pentode section of V5 is used as an additional IF amplifier). The majority of plug-in unit gain is provided by this circuit. VARIABLE gain adjustment is accomplished by varying the D.C. operating point of the first stage. This operating point is determined by changing the cathode bias. The cathode potentiometer (VARIABLE) controls the level cathode bias.

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 and the signal is then fed to the oscilloscope vertical input through an integrating network (and the LOG-LIN switch assembly).

LOG CIRCUITRY

Log scale generation is accomplished by utilization of a feedback signal to control the GAIN of V9. The IF signal is detected from the plate of V9 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 oscilloscope display. The decibel range is controlled by varying the setting of the diode output divider (DB RANGE). The DB SHAPE potentiometer controls the screen voltage of V9. 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 Z4 provides resonant tank circuit inductance. The reactance circuit is conventional in design. The grid-plate capacitor provides only a portion of the resonant capacitance of the tank circuit (in some units it is the stray grid-plate capacity of V6 in model 014 it is the RT ADJ). This capacitance is multiplied by the gain of the stage. The capacity seen by the oscillator tank is therefore proportional to the GM of the tube. When the plate current on the tube is varied (by 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 Z4 and the RT ADJUST 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. The CENTER FREQUENCY potentiometer 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. The signal is now summed by a resistance network and 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 over the entire band. In all models except 014, the oscillator drives V7, which acts as a limiter-buffer amplifier to provide drive to the mixer. In model 014, V7 acts as a doubler. The resonant circuit in the plate is tuned to the desired frequency (10.7-12.7mc), while the oscillator oscillates at ½ frequency (5.35-6.35mc). The second ½ of V7 is utilized as a cathode follower, driving the mixer through tuned filter C36 and L3.

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 unused supplies (within the oscilloscope) are loaded to their minimum requirements. Positive bias for the grids of the oscilloscope amplifier is provided by the divider network, which provides voltage for the V POSITION control.

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 a 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 setting 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 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 the system does not work properly, the fault exists in the oscilloscope. Refer to the oscilloscope instruction manual for correct maintenance procedures. In a case where a spare unit is not available for substitution further testing must be performed. It will be necessary to use a plug-in extension cable (available from 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 trouble may be assumed to be in the plug-in unit. Verification must be made that the sawtooth input from the oscilloscope is present, and that it meets the oscilloscope manufacturers specifications (See Manual). The horizontal trace must also appear on the oscilloscope display. If both of these conditions are met the Spectrum Analyzer may be considered to be malfunctioning.

The voltages indicated on the schematic diagram and the tube chart are nominal, with the exception of the supply voltages which are of close tolerance. The other, "Nominal" voltages may vary considerabley 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 precedures 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 improperly 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 complete procedure for aligning the NELSON-ROSS PLUG-IN SPECTRUM ANALYZERS Models 011, 012 013, and 014. 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 trouble-shooting the Spectrum Analyzers. A complete alignment of the instrument covers three basic areas: The I.F. system and crystal filters, the tuning dial, and the attenuators. The best procedure is to perform a complete rough alignment first, in this order:

1. Tuning Dial
2. I F System
3. Attenuators (not needed for Model 011)

A final alignment is then performed in the following order:

1. I F. System
2. Tuning Dial
3. Attenuators (not needed for model 011)

For each area a complete rough and final alignment is given below. Locations of the various adjustments are shown in figures 6-1 and 6-2.

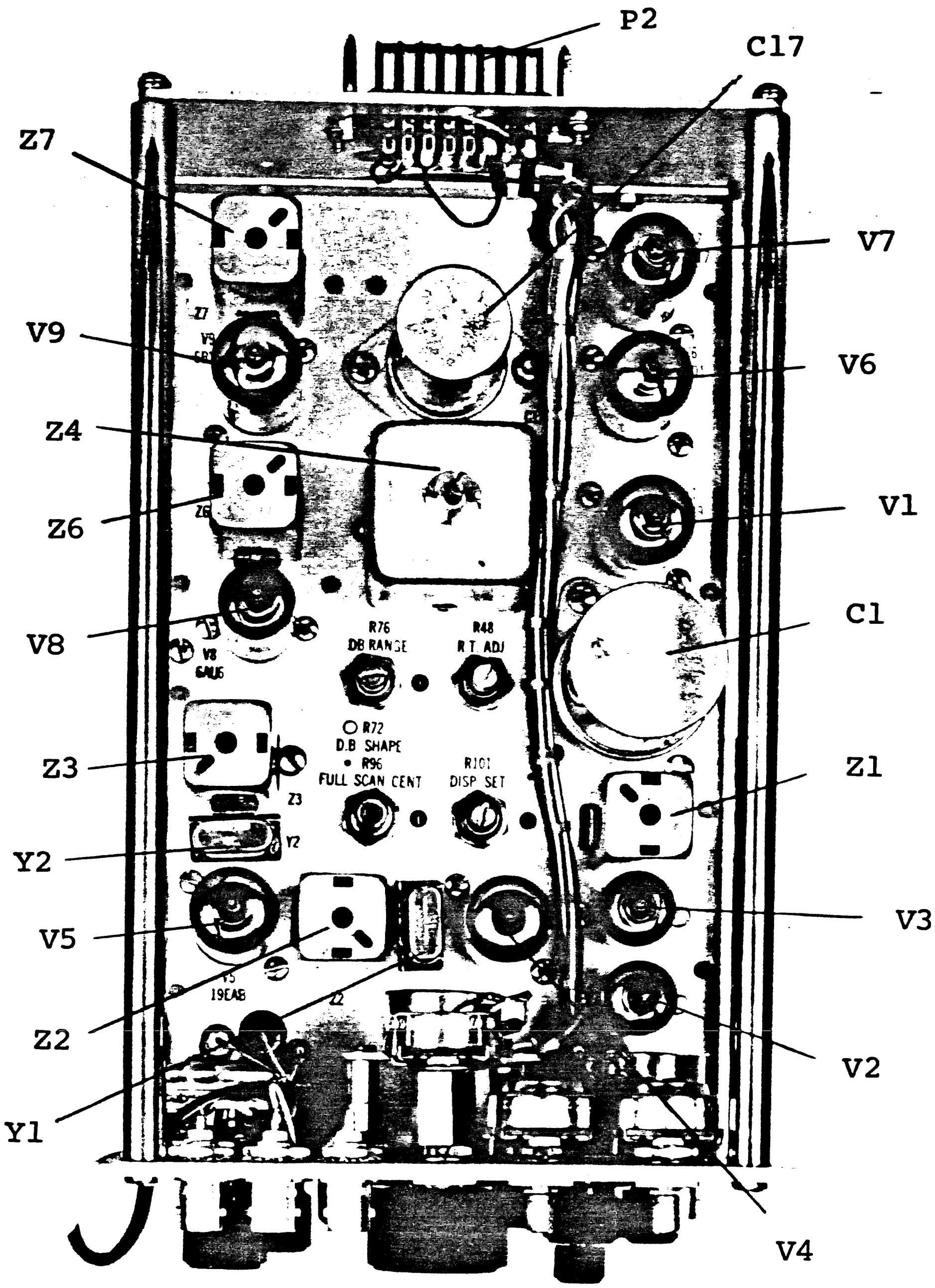

P2
C17
Z7
V7
V9
V6
Z4
V1
Z6
C1
V8
R76
DB RANGE
R48
R T ADJ
R72
D.B SHAPE
R96
FULL SCAN CENT
R101
DISP SET
Z3
Z1
Y2
V3
V5
Z2
V2
Y1
V4

FIGURE 6-1

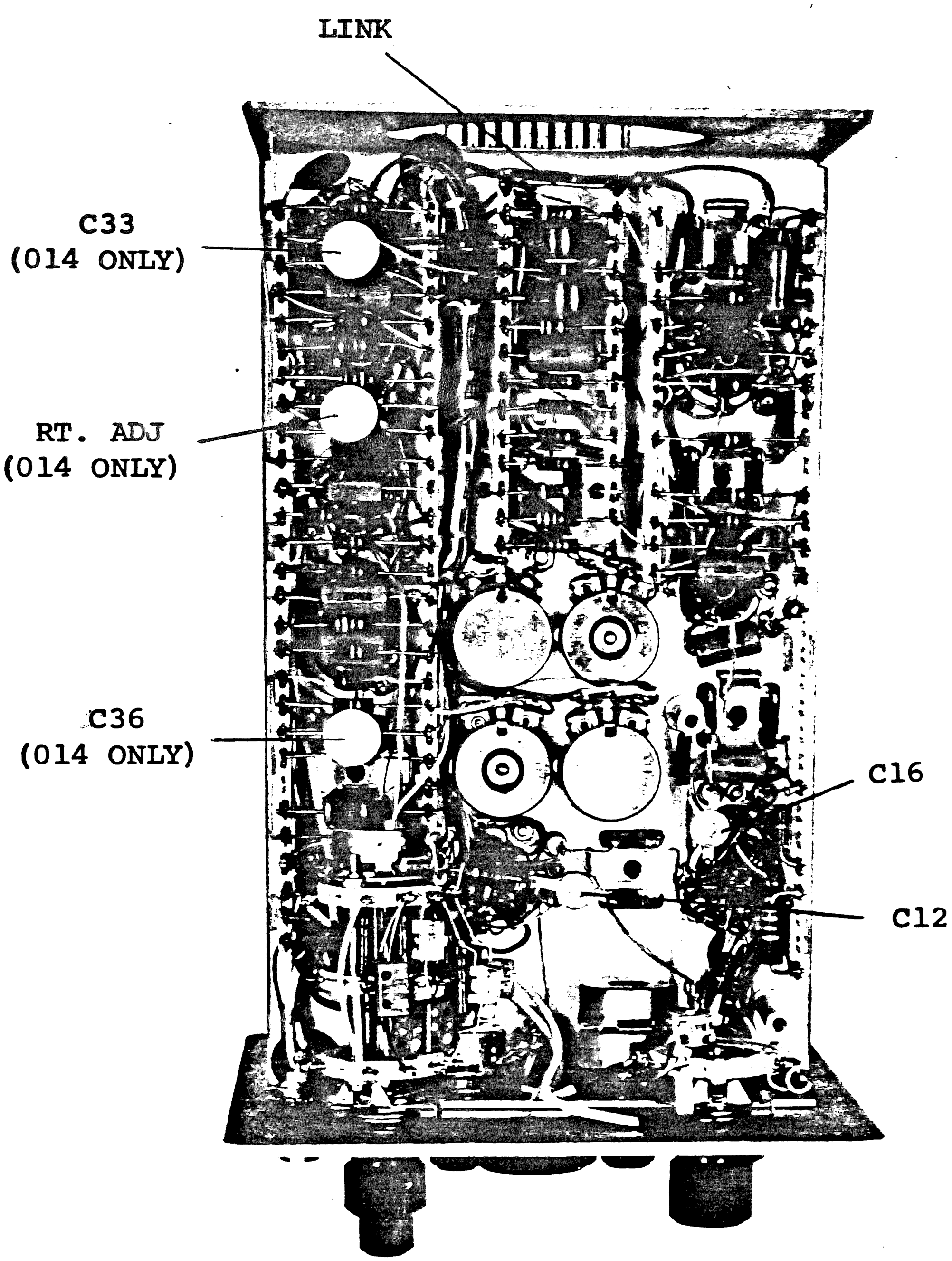


FIGURE 6-2

LIST OF TEST EQUIPMENT

The following is a list of typical test equipment required:

1. Multimeter - Simpson 260 or equivalent
2. Signal Generator - H P 650A
3. Sweep Generator - Nelson-Ross Models 101, 102, 103 as required (may be replaced by point-by-point measurements with item 2)
4. Oscilloscope, H P 140A or equivalent
5. Extension cord for letter-series plug-ins (available from Tektronix as part # 012-0138-00)

PRELIMINARY STEPS

Before attempting to align an instrument which is not operating- e.g. - no signal - make certain that there is at least 40 volts on pin 8 of V9A.

TUNING SYSTEM ALIGNMENT

ROUGH

1. Center the LF CAL and DISPERSION SET controls
2. Turn the RT ADJ fully CCW
3. Using the oscilloscope, with the instrument in FULL SCAN, first set the DISPERSION BALANCE to obtain a sawtooth- at the top of the DISPERSION SET control- which is symmetrical around ground. Then adjust the FULL SCAN CENTER control to obtain a sawtooth on pin 2 of V6 which starts positive and ends at zero volts

4. Connect the signal generator to the input, turn the instrument gain to maximum and inject enough signal to obtain a CRT deflection. Using the RT ADJ and the slug on Z4 adjust to obtain a display with the instrument maximum frequency at the left edge of the display and zero signal at the right

5. Turn the CENTER FREQUENCY dial to maximum, switch from FULL SCAN to NORMAL. Adjust the slug on Z4 to center the maximum frequency (from the Signal Generator) on the CRT display

6. Switch back to FULL SCAN and adjust the FULL SCAN CENTER control to center the full scan display - at this point full scan should occupy 10 cm on the horizontal scale

7. Turn the CENTER FREQUENCY dial to zero. Check that the zero frequency signal can be centered with the LF CAL control

8. Adjust the DISPERSION SET control to provide correct maximum dispersion at mid frequency

FINAL

1. Check the accuracy of the maximum frequency indication, and the centering of the LF CAL control at zero frequency. If these are poor, repeat steps 4 through 7 of the rough procedure.

2. Check the dial accuracy at cardinal points. If the dial is out of specification, offset the scale with Z4 slug to compensate for the point of extreme error.

3. Recheck and readjust DISPERSION SET.

IF SYSTEM ALIGNMENT

ROUGH

1. Obtain a signal display on the CRT, using a frequency in the center of the instrument range, at minimum resolution

2. Tune the top and bottom slugs of Z1, Z6, and Z7 for maximum amplitude. In model 011, some slugs will have two maximums. In each case the inmost maximum should be chosen.

3. There is only one slug each in Z2 and Z3. These slugs are adjusted for the smoothest, broadest display in minimum resolution. This display corresponds with minimum amplitude-these slugs are not to be adjusted for maximum amplitude

4. Set the DISPERSION control for maximum and increase the signal generator output to overdrive the instrument by approximately 40 db. Adjust trimmers C12 and C16 to eliminate skirt leakage adjacent to the signal

5. Place the VIDEO FILTER switch in LOG-1 and adjust for the correct log scale as follows:

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 and DB SHAPE potentiometers 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 experienced in obtaining the correct curve a slight detuning of Z6 will help. Since the controls interact it is necessary to repeat the adjustments until satisfactory performance is obtained.

FINAL

1. Repeat steps 1-5 of rough alignment
2. Measure the instrument gain at maximum gain and resolution. If the gain is insufficient or more than 3 times the specification, change the value of R69 (selected value) to provide nominally double the specified gain.

ATTENUATORS

This alignment is best performed with the aid of a Nelson-Ross Synchro-Sweep Generator, but point-by-point measurements with a signal generator may be substituted if necessary.

1. Using the CRT display to compare increments on the generator attenuator against the SCALE EXPANDER, set the compensating trimmers (models 013 and 014 only) to provide the proper steps.
2. In a similar manner, with the instrument in full scan, set the trimmers on theINPUT ATTENUATOR to provide the specified flatness (±1 db) across the entire band in every setting.

SECTION 7

DATA

VOLTAGE CHART

The voltages given in the following chart are given as a guide to normal performance. These voltages are typical for all models listed in this manual and may vary slightly for each model.

Controls should be set as shown below:

MODE SWITCH: Full Scan

MIXER BAL: (Coarse & Fine) Centered or adjusted for balance

CENTER FREQUENCY: Center of frequency range

RESOLUTION: Fully clockwise

DISPERSION: Fully counterclockwise

VERNIER GAIN: Fully clockwise

ATTENUATOR (input): Max attenuation

ATTENUATOR (Range): Max attenuation

VIDEO FILTER: Lin-1

V POS: C enter trace on CRT screen

LF CAL: Centered

ALL VOLTAGES ON FOLLOWING CHART WERE

MEASURED USING 20,000 OHMS PER VOLT METER

VOLTAGE CHART

MODEL PSA 011

PIN NUMBERS

TUBE	1	2	3	4	5	6	7	8	9
V1 5879	0	NC	11	30	24	NC	200	205	11
V2 6BH6	0	3.1	35.5	30	145	130	0		
V3 6BH6	0	3.1	41	35.5	145	120	0		
V4 12AT7	125	0	.9	41	55	122	42	6.2	NC
V5 19EA8	80	-.1	225	75	55	-.1	4.4	5.5	2.6
V6 6201	200	.025	4.1	0	12.5	130	-.55	.4	NC
V7 12AT7	26	-.35	0	24	12.5	140	-1.9	0	NC
V8 6AU6A	0	0	100	100	105	95	0		
V9 6BY8	0	0	100	100	-.55	0	1.4		

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
R1	Resistor ½W 10% 22K	
R2	Same as R1	
R3	Same as R1	
R4	Resistor ½W 10% 100K	
R5	Not used	
R6	Resistor ½W 10% 1.5K	
R7	Resistor ½W 10% 2.2M	
R8	Resistor ½W 10% 1K	
R9	Same As R7	
R10	Not used	
R11	Resistor ½W 10% 39K	
R12	Potentiometer 50K Multiturn	C1000-154-25
R13	Same as R11	
R14	Not used	
R15	Not used	
R16	Not used	
R17	Same as R1	
R18	Potentiometer 25K Multiturn	C1000-154-26
R19	Not used	
R20	Not used	
R21	Resistor ½W 10% 3.9M	

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
R22	Resistor ½W 10% 270K	
R23	Same as R8	
R24	Not used	
R25	Not used	
R26	Resistor 1W 10% 47K	
R27	Not used	
R28	Resistor 1W 10% 10K	
R29	Same as R21	
R30	Same as R22	
R31	Not used	
R32	Chosen At Test	
R33	Dual Potentiometer 100K	C1000-154-7
R34	Not used	
R35	Not used	
R36	Resistor ½W 10% 2.2K	
R37	Same as R8	
R38	Same as R8	
R39	Chosen At Test	
R40	Not used	
R41	Part of R33	
R42	Not used	

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
R43	Resistor ½W 10% 330K	
R44	Same as R7	
R45	Not used	
R46	Same as R43	
R47	Resistor ½W 10% 100Ω	
R48	Potentiometer WW 25K	C1000-154-1
R49	Same as R1	
R50	Resistor ½W 10% 4.7K	
R51	Resistor ½W 10% 8.2K	
R52	Same as R36	
R53	Same as R47	
R54	Resistor 2W 10% 27K	
R55	Resistor ½W 10% 3.3K	
R56	Same as R11	
R57	Resistor ½W 10% 27K	
R58	Resistor ½W 10% 470K	
R59	Resistor ½W 10% 1M	
R60	Resistor ½W 10% 220Ω	
R61	Resistor 2W 10% 22K	
R62	Same as R58	
R63	Same as R1	

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
R64	Resistor ½W 10% 120K	
R65	Not used	
R66	Potentiometer 25K	C1000-154-14
R67	Resistor ½W 10% 150Ω	
R68	Same as R4	
R69	Chosen At Test	
R70	Not used	
R71	Not used	
R72	Potentiometer Dual 50K	C1000-154-3
R73	Resistor ½W 10% 330 Ω	
R74	Resistor ½W 10% 68K	
R75	Not used	
R76	Potentiometer 250K	C1000-154-11
R77	Same as R36	
R78	Same as R4	
R79	Same as R60	
R80	Not used	
R81	Resistor ½W 10% 220K	
R82	Same as R1	
R83	Same as R81	
R84	Same as R50	
R85	Resistor ½W 10% 43K	

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
R86	Resistor ½W 10% 10K	
R87	Potentiometer 1K	C1000-154-31
R88	Same as R60	
R89	Potentiometer 100K	C1000-154-27
R90	Not used	
R91	Resistor ½W 5% 680K	
R92	Potentiometer WW 10K	C1000-154-2
R93	Same as R86	
R94	Resistor 1W 10% 33K	
R95	Not used	
R96	Potentiometer Dual Part of R72 10K	C1000-154-3
R97	Not used	
R98	Not used	
R99	Not used	
R100	Resistor ½W 10% 150K	
R101	Potentiometer 100K	C1000-154-8
R102	Resistor ½W 10% 680 Ω	
R103	Same as R48	
R104	Same as R86	
R105	Same as R4	
R106	Same as R48	
R107	Resistor ½W 10% 820 Ω	
R108	Same as R94	

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
C1	Electrolytic Capacitor 40-20-10-10 300V	Sprague TVL 4578
C2	Capacitor .1 mfd. 200V	Sprague 192P10492
C3	Same as C2	
C4	Capacitor 470 MMF	CM15E471J
C5	Same as C4	
C6	Same as C2	
C7	Same as C2	
C8	Not used	
C9	Not used	
C10	Not used	
C11	Capacitor .001 mfd 600V	Erie 801Z5V102P
C12	Trimmer 2.5-11 MMF	Erie 538-000-90R
C13	Chosen At Test	
C14	Same as C2	
C15	Same as C11	
C16	Same as C12	
C17	Electrolytic Capacitor 15-15 350V	Sprague TVL 2625
C18	Same as C2	
C19	Not used	
C20	Not used	
C21	Capacitor .01 MFD 600V	Erie 811Z5V103P

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
C22	Same as C21	
C23	Not used	
C24	Same as C21	
C25	Not used	
26	Same as C21	
C27	Same as C4	
C28	Same as C2	
C29	Same as C21	
C30	Not used	
C31	Same as C21	
C32	Same as C21	
C33	Same as C2	
C34	Same as C2	
C35	Not used	
C36	Same as C2	
C37	Capacitor Mica 270 MMF	CM15E271J
C38	Same as C2	
C39	Not used	
C40	Not used	
C41	Not used	
C42	Same as C11	
C43	Same as C21	

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
C44	Same as C2	
C45	Not used	
C46	Not used	
C47	Same as C21	
C48	Same as C21	
C49	Same as C11	
C50	Not used	
C51	Same as C11	
C52	Not used	
C53	Not used	
C54	Not used	
C55	Not used	
C56	Same as C11	
C61	Capacitor .1mfd 600V	Aerovox P8292ZN28

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
CR1	Diode	IN34A
~~DZ1~~	~~Diode~~	~~Zener IR32B~~
J1	Connector BNC	UG625B/U
J2	Same as J1	
J3	Same as J1	
J4	Same as J1	
L1	Not used	
L2	Choke 3 Ferrite Beads	
L3	Same as L2	
P1	Banana Plug & Cable	H.H. Smith 1510-24
P2	Connector 16 Contacts	Amphenol 26-159-16
S1	Not used	
S2	Switch toggle DPDT Min.	Milli-switch TT-2
S3	Not used	

PARTS LIST

MODEL PSA 011

ITEM	DESCRIPTION	DRAWING NO.
V1	Tube Electron	5879
V2	Tube Electron	6BH6
V3	Same as V2	
V4	Tube Electron	12AT7
V5	Tube Electron	19EA8
V6	Tube Electron	6201
V7	Same as V4	
V8	Tube Electron	6AU6
V9	Tube Electron	6BY8
Y1	Crystal Pair	A1000-007-1
Y2	Paired with Y1	
Z1	Transformer I.F.	A1000-009-1
Z2	Same as Z1	
Z3	Same as Z1	
Z4	Transformer Osc.	A1000-008-1
Z5	Not used	
Z6	Same as Z1	
Z7	Same as Z1	

PARTS LIST

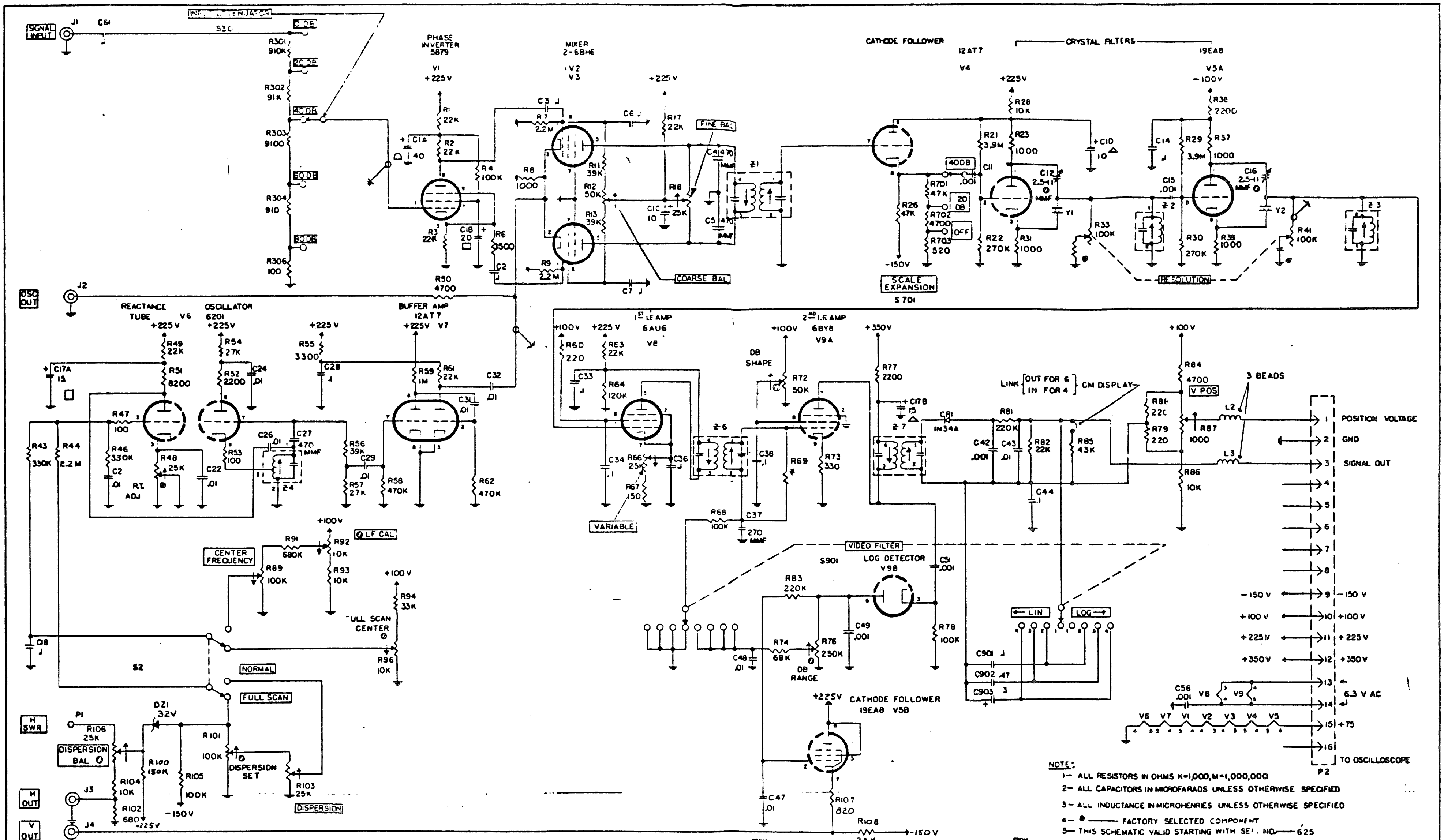
MODEL PSA 001

ITEM	DESCRIPTION	DRAWING NO.
-	Video Filter Assy	A1000-166
-	Attenuator, Input	A1000-256
-	Scale Expander	A1000-164

SECTION 8

REVISIONS

In order to provide you with the finest in electronic instruments, Nelson-Ross Electronics, Inc. maintains a continuing program inprovement. If any changes have been made in the instrument described herein after the printing of this manual, they will be detailed in the pages that follow. If this section is empty, your manual is correct as is.



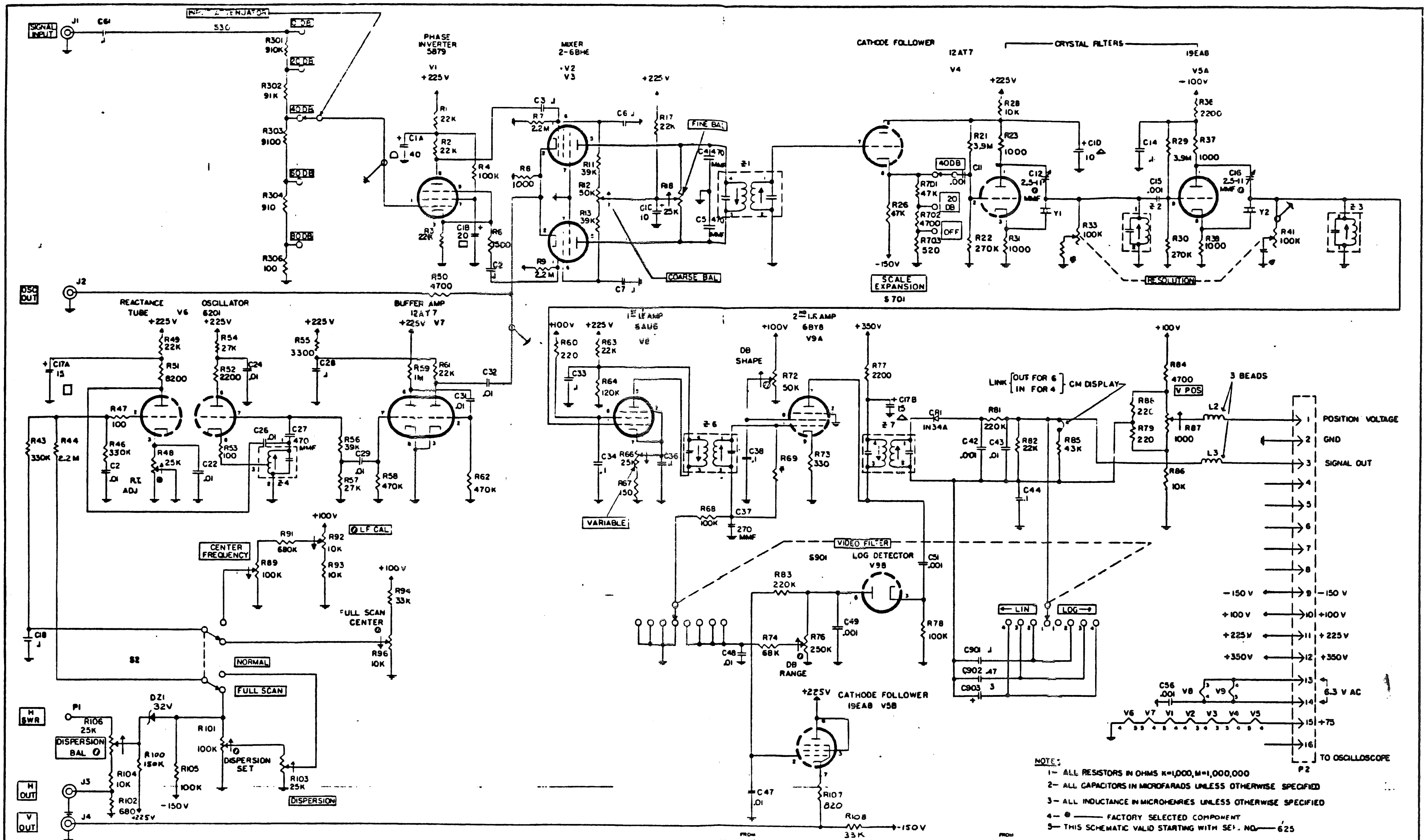
NOTE:
1— ALL RESISTORS IN OHMS K=1,000, M=1,000,000
2— ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED
3— ALL INDUCTANCE IN MICROHENRIES UNLESS OTHERWISE SPECIFIED
4— ● —— FACTORY SELECTED COMPONENT
5— THIS SCHEMATIC VALID STARTING WITH SER. NO. —— 625

REV	FROM SER#	DETAILS	REV	FROM SER#	DETAILS	BY
			B	625	REDRAWN FOR IMPROVED MODEL. SEE REV A FOR EARLIER MODELS	

NELSON-ROSS ELECTRONICS, INC.
LONG ISLAND NEW YORK

SCHEMATIC PSA 011, 001

D1000—161 REV B



NOTES:
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 COMPONENT
5— THIS SCHEMATIC VALID STARTING WITH SER. NO.— 625

REV	SER. NO.	DETAIL	BY
B	625	REDRAWN FOR IMPROVED MODEL, SEE REV A FOR EARLIER MODELS	

NELSON-ROSS ELECTRONICS, INC.
LONG ISLAND NEW YORK

SCHEMATIC PSA 011, 001

D1000—161 REV B

REVISION NOTICE:

THE FOLLOWING CHANGE HAS BEEN MADE IN ALL PSA 011 PLUG-IN SPECTRUM ANALYZERS STARTING WITH SERIAL NUMBER 645

1) ADD R42 27K ½W 1%