TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL

SIERRA SPECTRUM DISPLAY UNIT MODEL 360A

HEADQUARTERS, DEPARTMENT OF THE ARMY
OCTOBER 1971

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on
the power supplies and
their circuits, or on the
115-volt ac line connections.

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HEADQUARTERS
DEPARTMENT OF THE ARMY
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OPERATOR, ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL

FOR

SIERRA SPECTRUM DISPLAY UNIT MODEL 360A

*This technical manual is an authentication of the manufacture's commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance or of the equipment.

LIST OF ILLUSTRATIONS

SECTION A
INTRODUCTION

A-1. Scope

This manual describes the Sierra Spectrum Display Unit Model 360A end covers its operatIon, end organizational, direct end general support, end depot maintenance. It Includes troubleshooting, alignment, end replacement of parts available to organizational, DS, GS, and depot maintenance personnel.

A-2. Indexes of Publications

a: Refer to the latest issue of DA Pam 310-7 to determine whether there are new editions, changes, or additional publications pertaining to this equipment.

b. Refer to the latest Issue of DA Pam 310-7 to determine if there are current, applicable modification work orders (MWO's) pertaining to this equipment.

A-3. Forms and Records

a. Report of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38-750.

b. Reports of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiencies) es prescribed in AR 700-58 (Army), NAVSUP Publication 378 (Navy), AFR 71-4 (Air Force) and MCO P4610-5 (Marine Corps).

c. Discrepancy in Shipment (DISREP) (SF361). Fill out end forward Discrepancy in Shipment Report (DISREP) (SF361) as prescribed in AR 55-38 (Army), NAVSUP Pub 459 (Navy), AFM 75-34 (Air Force), and MCO P4610.19 (Marine Corps).

d. Reporting of Equipment Manual Improvement. Repoyt of errors, omissions, and recommendations for improving this manual by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to: Commanding General, U.S. Army Electronics Command, ATTN: AMSEL-ME-NMP-EM, Fort Monmouth, New Jersey 07703.

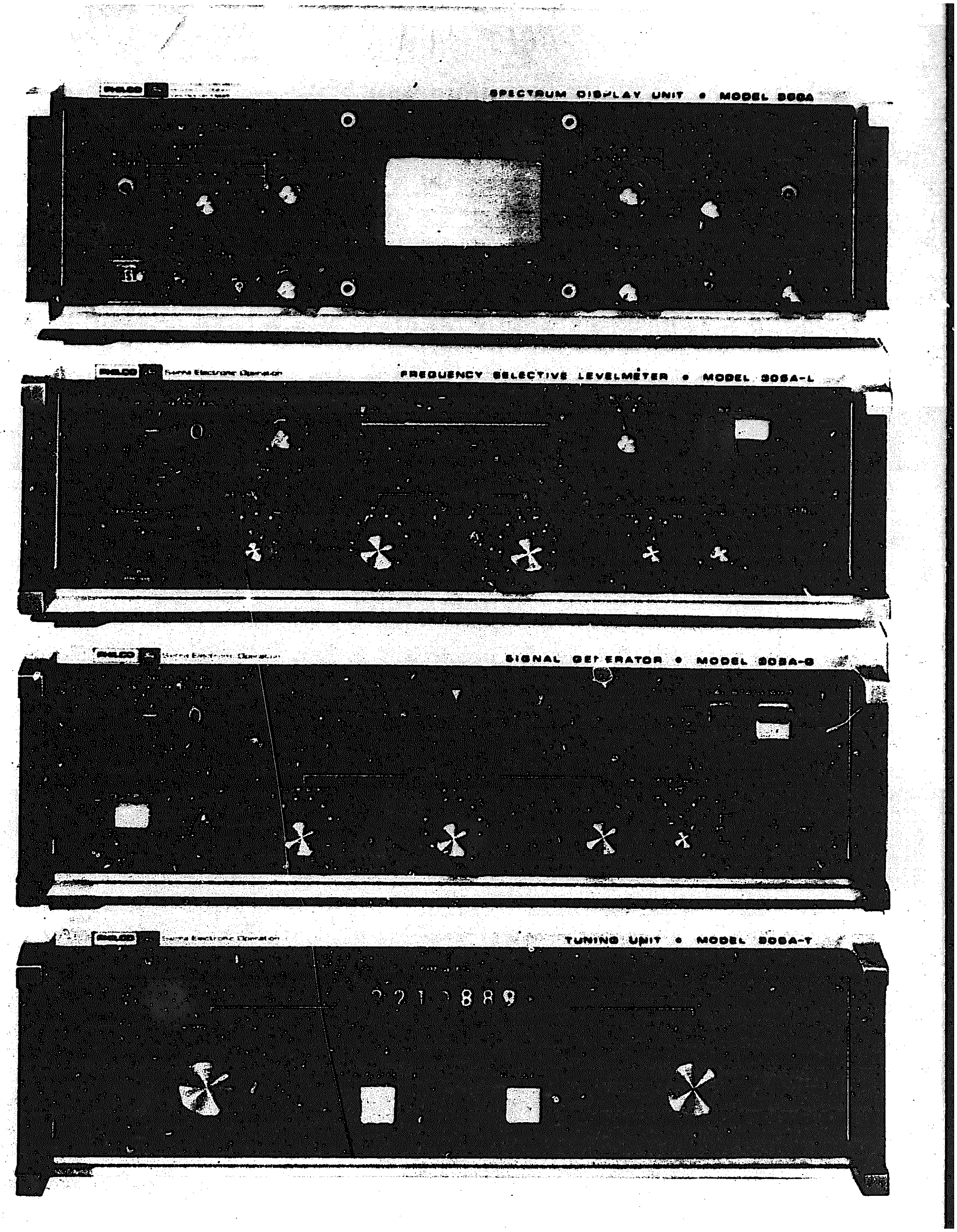


Figure 1-1 Spectrum Display Unit Model 360A with Transmission Measuring Set Model 305A

SECTION I

GENERAL

A. PURPOSE

The Sierra Model 360A Spectrum Display Unit provides a visual display of the signal present in either a 120 kHz, a 12 kHz, or a 3.6 kHz bond of the frequency spectrum. These signals are presented on a CRT Display calibrated for both signal amplitude and frequency. The Display Unit works in conjunction with a companion Sierra Model 305A or a Model 128A Frequency Selective Voltmeter. The tuning of the Voltmeter determines the frequency band that is displayed and the frequency range of the Voltmeter determines the total range of the frequency spectrum that may be covered. The design further provides a rapid sweep rate for a search mode of operation, slower rates for high resolution of signals and single sweeps for trace photography .

B. DESCRIPTION

The display of the signals in the selected band is presented on the display areas of o rectangular, long persistence P7 phosphor, Cathode Ray tube. A graticule over the face of the tube contains a linear horizontal frequency scale and a +5 dB to -20 dB logarithmic vertical scale!, An amber filter is used with the graticule to cut down reflections and the effect of ambient light. Display amplitude is adjustable with a 20 dB per step attenuator supplemented by a continuously variable 0 dB CAL control which also is used to calibrate the Display Unit to the companion Frequency Selective Voltmeter.

To generate the required display, outputs from the 21 MHz intermediate frequency (IF) amplifier and the incremental oscillator of the companion Voltmeter are connected to the Display Unit. Either a 120 kHz, a 12 kHz, or a 3.6 kHz band of the Voltmeter IF is continuously scanned by the internal sweep circuits of the Display Unit. Very narrow band-pass filters provide essentially single frequency resolution of the scanned signals.

The Fine Tuning oscillator output of the Voltmeter is used to generate a marked pulse which indicates the frequency of the signal being observed at that point. The frequency of the signal observed at the marker is the sum of the Coarse Tuning and the Fine Tuning dial recordings of the Voltmeter. The marker may be disconnected, if desired, with a front panel control. In the 10 kHz/Div Sweep mode the marker may be positioned at any point over the 120 kHz bond of frequencies being scanned. In the 1 kHz/Div and the .3 kHz/Div modes, half the bandwidth on each side of the marker is scanned and the

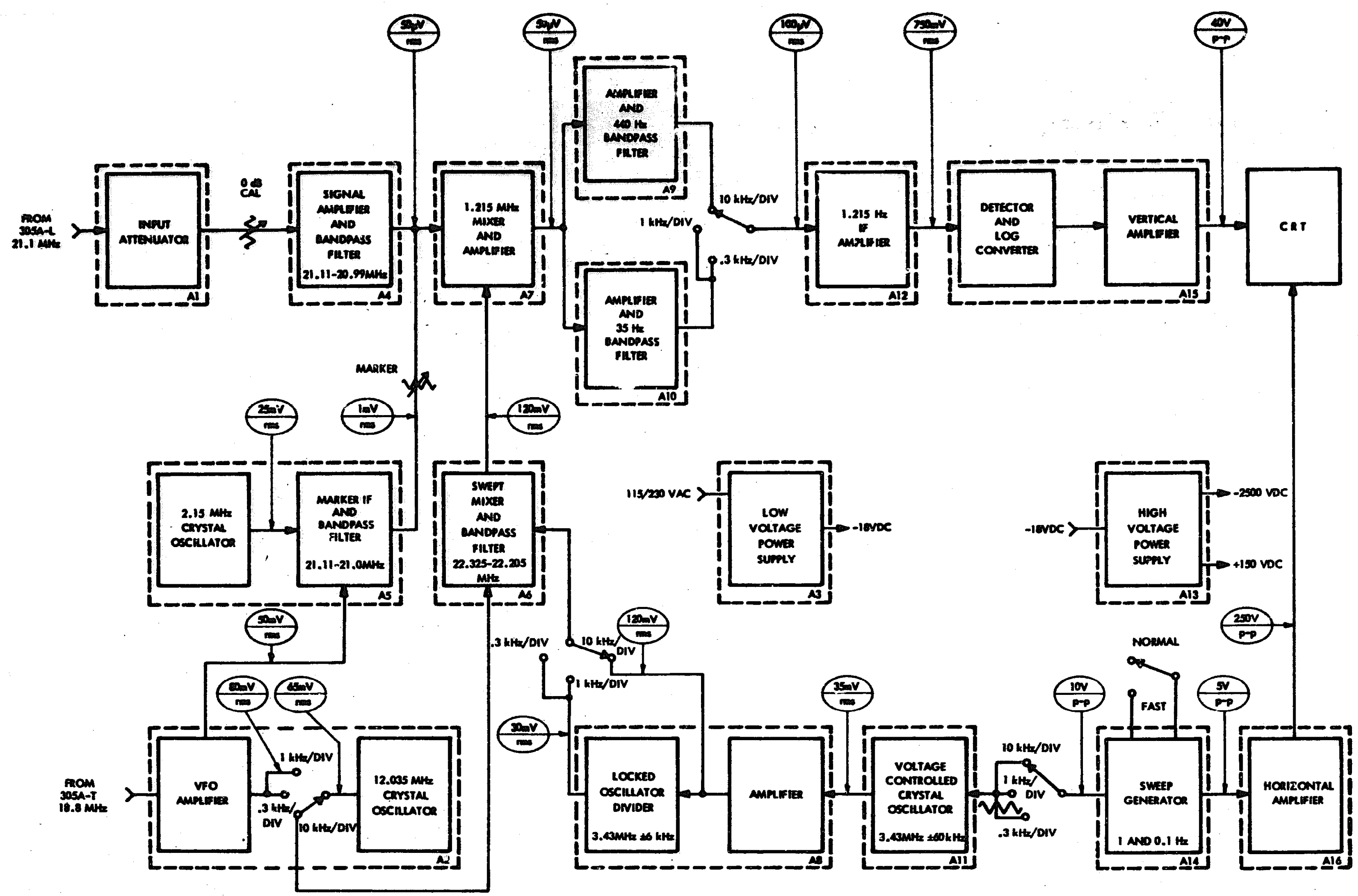


Figure1-2. Block Diagram, Spectrum Display Unit Model 360A

12 kHz or 3.6 kHz bandwidth may be positioned at any point in the 120 kHz band. This is accomplished by tuning the Fine Tuning dial of the Voltmeter. Slow sweep rates, 1 sweep per second (10 kHz/Div) for the 120 kHz bandwidth and 0.1 sweep per second (1 kHz/Div and .3 kHz/Div) for the 12 kHz and the 3.6 kHz bandwidths, are used to provide optimum display resolution with the narrow band filters employed. Refer to Block Diagram Figure 1-2.

The Spectrum Display Unit is contained in a rugged enclosure 6-1/2 inches high by 20 inches wide and 19-1/4 inches deep. The unit may be removed from the case and mounted in a standard 19 inch rack. Plug-in modular circuit boards are used for mounting most circuit elements. The modules are mounted in shielded compartments. A printed circuit card riser is provided so that a module may be elevated for testing and still be connected to the circuit.

The Display Unit is designed to work with the Sierra Model 305A or the Model 128A Frequency Selective Voltmeter (early Model 128A Voltmeters must be modified to provide the required IF and Fine Tuning oscillator output jacks. Contact Sierra for modification information).

Power for operation may be obtained from either a 115 volt or 230 volt 50-60 Hz ac source. A rear panel switch selects the proper line voltage.

C. SPECIFICATIONS

FREQUENCY COVERAGE	Same as that of the companion Frequency Selective Voltmeter
SWEEP WIDTH	120 kHz, 12 kHz, and 3.6 kHz (Fixed, switch selected)
DYNAMIC RANGE (Display Unit Only)	
Total	Same as that of the companion Frequency Selective Voltmeter
Linear	60 dB (Operates satisfactorily with signals present at the input which are 60 dB above the baseline of the cathode ray tube display)
Simultaneous Display	25 dB

FREQUENCY ACCURACY	
120 kHz Sweep Width (10 kHz/Div)	±1 kHz (Visual limitation)
12 kHz (1 kHz/Div) and 3.6 kHz (0.3 kHz/Div) Sweep Widths	±200 Hz (Dependent on accuracy of Voltmeter Fine Tuning oscillator)
FREQUENCY RESOLUTION	
120 kHz Sweep Width	Resolves signals separated by 1500 Hz to 60 dB down
12 kHz and 3.6 kHz Sweep Widths	Resolves signals separated by 60 Hz to 40 dB down
FREQUENCY STABILITY (1)	
(Display Unit only over the operating temperature range)	
120 kHz Sweep Width	±2500 Hz
12 kHz and 3.6 kHz Sweep Widths	±250 Hz
TUNING ACCURACY	
(With use of Marker)	
120 kHz Sweep Width	±1000 Hz
12 kHz and 3.6 kHz Sweep Widths	±35 Hz
AMPLITUDE RESPONSE	
(Display Unit Only)	
Flatness and Level Stability at 0 dB	±0.5 dB
Range	25 dB logarithmic (Linear dB scale) +5 dB to -20 dB referenced to voltmeter 0 dB reading
Linearity	±10% of indicated level referenced to 0 dB, 0 to -20 dB
Residual Responses (No signal input)	More than 25 dB below full amplitude display

Spurious and Intermodulation Products	More than 50 dB below largest level signal present at the input provided this signal is within the allowable dynamic range of the Display Unit	
IF BANDWIDTH (Nominal)		
120 kHz Sweep Width	440 Hz at -3 dB 2400 Hz at -60 dB	
12 kHz and 3.6 kHz Sweep Widths	35 Hz at - 3 dB 180 Hz at -60 dB	
SWEEP RATE (Nominal)(2)	Normal	Search
120 kHz Sweep Width	3.5 second/sweep	1 second/sweep
12 kHz and 3.6 kHz Sweep Widths	10 second/sweep	3.5 second/sweep
ATTENUATOR RANGE		
Input Attenuator	0 dB to 40 dB in 20 dB steps	
Vernier	+5 dB to -20 dB continuously adjustable, non-calibrated	
MARKER AMPLITUDE	+5 dB to -20 dB continuously adjustable, non-calibrated	
CATHODE RAY TUBE		
Screen	Long persistence P7 phosphor (Blue fluoresence, yellow persistence)	
Size (Nominal)	3 x 5 inches	
INPUT (Nominal)		
Impedance	50 ohms	
IF (21.11 to 20.99 MHz)	50 µV	
Incremental Oscillator (18.895 to 18.785 MHz)	75 mV	
Connectors	BNC Female	
TEMPERATURE RANGE		
Operating	+15°C to +45°C	
Storage	-20°C to +60°C	

POWER REQUIRED	**115/230V AC ±10%, 50-60 Hz, 40 watts maximum**

NOTES:

(1) Frequency accuracy stated above may be maintained by slight adjustment of Horizontal Position and Sweep Cal controls.

(2) Automatically selected by positioning of Sweep Rate switch.

(3) The standard Model 360A is designed for rack mounting, however the ruggedized case and cover is available as an accessory item and instruments so equipped are available at customer's request.

D. ITEMS COMPROMISING AN OPERABLE EQUIPMENT

FSN	Item	Quantity	Height (in)	Depth (in)	Width (in)	Weigh (in)
6625-833-3701	Sierra Spectrum Display Unit Model 360A	1	5 1/4	15	19	23 1/

SECTION II

OPERATION

A. CONNECTIONS

1. Power

Before connecting the Display Unit to the ac power line, check the slide switch under the ac connector on the rear panel to make sure it is in the position corresponding to the ac line voltage in use.

2. Signal

Two 36 inch cables with BNC male connectors on each end are furnished to connect the Spectrum Display Unit to the companion Frequency Selective Voltmeter. Connectors are on the rear panels.

Connect one cable between the connectors marked OUTPUT TO 360 or IF OUTPUT on the Frequency Selective Voltmeter and from 305A-L 21.1 MHz on the Display Unit. Connect the other cable between the connectors marked TO 360 18.8 MHz or INCREMENTAL OSC OUTPUT on the Voltmeter and from 305A-T 18.8 MHz on the Display Unit.

B. CONTROLS, INDICATORS AND CONNECTORS

1. Front Panel

Control or Indicator	Use	Schem. Ref. No.
FOCUS	Spot size adjustment	R9
INTENSITY	Trace brilliance adjustment	R10
SWEEP - kHz/Div	Sweep band width selector, single sweep or continuous	S4
SINGLE SWEEP	Single sweep trigger switch	S6
FAST-NORMAL	Sweep speedup for search function	S7

Control or Indicator	Use	Schem. Ref. No.
10 kHz/Div CAL	Horizontal trace width adjustment	R11
HORIZONTAL POSITION	Display horizontal position adjustment	R13
ATTENUATOR DB	Amplitude control, 20 dB per step	S1
0 dB CAL	Amplitude calibration control, continuous	R1
MARKER IDENT	Marker identification by removing all other signals	S3
MARKER	Marker amplitude control	R2
VERTICAL POSITION	Display vertical position adjustment	R12
SCALE ILLUM	Graticule scale illumination control	R3
POWER	AC line power On-Off switch	S1

2. Rear Panel

Connector or Control	Use	Schem. Ref. No.
FROM 305A-T 18.8 MHz	Marker and sweep control signal input, BNC connector	J 2
FROM 305A-L 21.1 MHz	Signal input from Frequency Selective Voltmeter IF, BNC connector	J I
0.5A SLOW BLOW	AC line power fuse	F I
115 VAC 230	Three prong male connector for ac power. Switch selector for 115V or 230V ac	J 3 S2

C. DISPLAY TRACE ADJUSTMENTS

1. Switch on power in both units. (It is assumed that proper input and power connections have been made to the companion Frequency Selective Voltmeter.) Attach rectangular polarized viewing hood to bezel.

2. Set the controls on the Spectrum Display Unit as follows:

a. FOCUS and INTENSITY to mid-position. After the initial adjustments have been made, as indicated below, these controls may be left in their operating positions and minor readjustments made only as necessary.

b. Set SWEEP switch to 10 kHz/DIV CONTINUOUS, MARKER to mid-position, ATTENUATOR DB switch to 0 dB CAL, 0 dB CAL control to mid-position, and the SWEEP RATE switch to FAST.

3. After the heater/cathode of the CRT has had time to come up to operating temperature, in about 10-15 seconds, adjust the INTENSITY control for a suitable trace brilliance. Adjust SCALE ILLUM for the desired graticule illumination.

4. Adjust FOCUS for sharpest trace.

5. Adjust VERTICAL POSITION control until the horizontal trace is on the -20 dB line of the vertical scale on the graticule.

D. CALIBRATION ADJUSTMENT

1. Set the controls on the companion Frequency Selective Voltmeter to the 1 MHz Calibration mode and carry out the Voltmeter calibration procedure.

2. Set the Display Unit controls according to paragraph C. above.

3. Set the Fine Tuning dial of the Voltmeter to 100 kHz. The pulse from the 1 MHz calibration Reference Oscillator of the Voltmeter will now be on the left side of the Spectrum Display Unit screen and the Marker pulse from the Voltmeter Fine Tuning Oscillator on the right. Adjust the 0 dB CAL and MARKER controls for convenient pulse heights.

4. Set the SWEEP RATE switch to NORM.

5. After about 10 minutes warmup, adjust the HORIZONTAL POSITION and the 10 kHz/DIV CAL controls until the left-hand pulse (1MHz CAL oscillator) is on the horizontal scale 0 kHz mark and the right-hand pulse (Marker) is on the 100 kHz mark

(upper, 0-100 kHz scale). These are interacting controls, adjustments on each should be repeated until the pulses are properly aligned. Finish the adjustment with the POSITION control.

6. Adjust the 0 dB CAL control until the left-hand pulse (Reference Oscillator) comes just to the 0 dB line on the vertical scale. At the same time, check that the horizontal base-line is on the -20 dB line (C.5. above).

E. SIGNAL DISPLAY ADJUSTMENTS

1. 10 kHz/DIV SWEEP Mode

a. Perform Trace and Calibration adjustments of paragraphs C. and D. above.

b. Set the Display Unit SWEEP control to 10 kHz/DIV CONTINUOUS, and the SWEEP RATE switch to NORM.

c. Tune the companion Frequency Selective Voltmeter to the desired input signal and adjust for suitable amplitude on Display Unit screen.

If the signal frequency is only approximately known, use the FAST mode on the Display Unit and the CONTINUOUS mode on the Voltmeter until the signal is located on the Display Unit screen. Signals will appear to move to the left when the Main Tuning dial of the Voltmeter is tuned higher in frequency. Set the Voltmeter to the 100 kHz lock point just below the desired frequency.

d. With the companion Voltmeter in the locked mode at the 100 kHz point just below the desired signal, the band seen on the Display Unit screen will be from 10 kHz below to 110 kHz above the Voltmeter Coarse Tuning lock point. The 0 kHz mark on the Display Unit upper scale will be at the Voltmeter Coarse Tuning lock point frequency.

e. To determine the frequency of the desired signal, when only approximately known, add the frequency indicated on the horizontal scale of the Display Unit to the frequency of the Voltmeter Coarse Tuning 100 kHz lock point.

f. The Voltmeter Fine Tuning dial may be set to the frequency of any signal on the display as follows:

(1) Note the frequency on the 0-100 kHz horizontal scale at which the desired signal appears. (The Voltmeter Coarse Tuning must be in the Locked mode and set to a 100 kHz lock point.)

(2) Turn up the MARKER control and press the MARKER IDENT button. This removes the signals and leaves the Marker pulse only showing.

(3) Set the Marker to the desired frequency on the horizontal scale by adjusting the Fine Tuning dial on the Voltmeter. The marker moves to the right when the dial is tuned higher in frequency.

(4) Release the MARKER IDENT button and turn the MARKER control to OFF.

(5) Adjust Fine Tuning for maximum output on the meter.

(6) As on alternate method: Se+ the Fine Tuning dial to the frequency of the signal os indicated by the horizontal scale of the display. Check position of marker pulse. Tune for maximum output.

2. 1 kHz/Div and .3 kHz/Div Sweep Modes

These two sweep modes provide a "window", either 12 kHz or 3.6 kHz wide, which may be shifted over the 100 kHz band above the Coarse Tuning lock point by adjusting the Fine Tuning dial of the Voltmeter. The frequency at the center of the "window" is the frequency to which the Fine Tuning dial is set plus the frequency of the Coarse Tuning lock point. The marker pulse will always be at the center of the display in these sweep modes.

b. When the Fine Tuning dial has been set so that the Marker pulse coincides with the signal of interest in the 10 kHz/DIV SWEEP mode, (Paragraph 1 .f. above) that signal will appear in the center of the display when the SWEEP switch is placed in either the 1 kHz/DIV or the .3 kHz/DIV CONTINUOUS mode positions.

c. Set marker to desired signal and select either of these sweep modes according to the magnification desired.

d. Position the signal horizontally on the display, if necessary, by adjusting the Fine Tuning dial of the Voltmeter. The display will appear to move to the left as the tuning dial is set to a higher frequency.

Note: The CRT spot may be brought to the point of interest more rapidly by momentarily switching to the FAST mode.

3. Level Measurements

After the Display Unit and the Voltmeter hove been adjusted and calibrated together according to paragraphs C. and D. above, the signal amplitude on the Display Unit screen indicates the actual peak amplitude.

a. Tune in the desired signal according to paragraphs 1. and 2. above.

b. Adjust the Voltmeter Attenuator until the peak amplitude of the desired signal is a little below, or slightly above, the 0 dB line on the Display Unit vertical scale. (Make certain the SWEEP RATE switch is in the NORM position.)

Read the Display Unit in the same manner as the Voltmeter. 0 dB on the Voltmeter corresponds to 0 dB on the Display Unit CRT scale. The signal amplitude is the algebraic sum of the Voltmeter Attenuator setting and the amplitude read on the Display Unit vertical scale. For example:

Voltmeter Attenuator	Display Unit Scale Reading	Signal Amplitude
-40 dB	-5 dB	-45 dB
+10 dB	-6 dB	+ 4 dB
-30 dB	+2 dB	-28 dB

d. To read the amplitude of an adjacent off-scale signal, adjust the Display Unit ATTENUATOR until the signal is within the range of the vertical scale on the Display Unit screen. The amplitude is then the algebraic sum of: the Display Unit vertical scale reading, the Display Unit ATTENUATOR setting, and the Voltmeter Attenuator setting. For example:

Voltmeter	Display Unit		Signal
Attenuator	Scale Reading	Attenuator	Amplitude
-50 dB	-8 dB	(+) 40 dB	-18 dB
-20 dB	+2 dB	(+) 20 dB	+ 2dB

Note: Pulses will appear to be lower in amplitude in the FAST mode due to the effect of the faster sweep and the very narrow bandwidth filters.

The peak of a complex wave signal may read higher on the Display Unit screen scale than is indicated by the meter of the Voltmeter. This due to some averaging of the amplitude of several closely spaced frequencies by the Voltmeter while the Display Unit shows the amplitude of the individual frequencies.

4. Spurious Signal Indications

Several types of spurious responses may appear in the display when strong signals of certain frequencies exist in the input of the Voltmeter.

o . Response at Voltmeter Zero Frequency Lock Point

When the Voltmeter Coarse Tuning dial is set to the zero frequency lock point, a response due to the local oscillator of the Voltmeter will appear at the left side of the display in the 10 kHz/Div sweep mode. If the Voltmeter Incremental dial is tuned to zero frequency in the 1 kHz/Div sweep mode this response will also be seen. This is normal since the Voltmeter local oscillator is tuned to the IF under these conditions.

b. IF Feedthrough

This could be caused by signals in the IF band of frequencies (21.1 11-20.99 MHz) which ore present in the input of the Voltmeter and ore strong enough to feed through the preamplifier and mixer circuits. They may be identified as those signals that do not change position on the CRT scale as the Main Tuning dial of the Voltmeter is adjusted. These signals do not heterodyne with the Local Oscilator and so are not affected by Voltmeter tuning.

C. Images (Input frequencies between 42 and 57 MHz)

The frequency of a signal causing on image is the Local Oscillator frequency plus the Voltmeter IF. Since the signal causing the image is higher than the Local Oscillator frequency while the true signal is lower, they will move in opposite directions when the Main Tuning (local oscillator) is adjusted. If the Main Tuning dial is adjusted to a higher frequency, the true signals will appear to move to the left on the CRT display while the response due to on image will move to the right, and vice versa.

d. Local Oscillatar Harmonics

While Local Oscillator harmonics ore very low in amplitude, a very strong signal may beat with one of them to produce a response in the IF band of the Voltmeter. These responses ore identified by the fact that, when the Main Tuning is odjusted they move in the same direction as the true signals, but they move two or three times as fast. This is so because the rate of change of the frequency of a Local Oscillator harmonic is in direct relation to the order of the harmonic.

SECTION III

THEORY OF OPERATION

A. FUNCTION DESCRIPTION

1. Signal Path

The input signal from the Frequency Selective Voltmeter IF is adjusted to the proper level for the desired display amplitude with the step attenuator in the Input Attenuator module, A1. Fine control is provided by the continuously variable 0 dB CAL Attenuator connected in the output of this module. A minimum input signal of 50 μ volts is required for full scale deflection of the CRT display. (Refer to the Schematic Diagram and to the Block Diagram Figure 1-2.)

The preamplifier in the Signal IF module, A4, increases the signal level by about six dB at the input of the 1.215 MHz Mixer in order to maintain a low mixer noise figure. The band-pass filter eliminates adjacent frequencies, in particular, the Frequency Selective Voltmeter Fine Tuning oscillator frequency (18.785 to 18.895) which is present at the takeoff point in the Voltmeter. Adjacent signal elimination prevents overloading and spurious generation at the 1.215 MHz Mixer so that the full dynamic range of the mixer is not restricted.

The signal input frequencies and the sweep frequency are combined in the 1.215 MHz Mixer module, A7, to produce the 1.215 MHz IF output. Signals present in the Voltmeter IF 21.11-20.99 MHz band are sequentially mixed with the sweep frequency as it scans across the 120 kHz, 12 kHz or 3.7 kHz band and are thus, one after the other, converted to 1.215 MHz. In this way simultaneously existing signals are caused to be sequentially displayed along the frequency axis of the display Cathode Ray Tube. The Marker signal is also introduced at the 1.215 MHz Mixer input along with the input signal from the Voltmeter. The Mixer and the following stage are tuned to 1.215 MHz.

The Mixer output passes through either the 440 Hz or 35 Hz band-pass crystal filter, module A9 or A10. The proper module and filter is automatically selected by the SWEEP switch, one section of which controls the B- supply to input and output matching amplifiers of these modules. The 440 Hz filter is used with the 10 kHz/Div sweep and the 35 Hz filter with the 1 kHz/Div. and .3 kHz/Div. sweeps. The narrow band-pass provides a very high resolution, essentially single signal presentation, spectrum display.

Overall gain from the input to he output of the crystal filters is about 12 dB. An additional 80 dB of gain is provided by the five stages of the 1.215 MHz 1F, module A12, and an additional 25 dB is supplied by the differential vertical deflection amplifier on module A15.

1.215 MHz IF amplifier output is applied to a detector which rectifies the signal and then to a log converter-which compresses the sigml amplitude from linear voltage to a linear dB amplitude output. Following the Log Converter is the differential vertical deflection amplifier for the CRT. All these stages are located on module A15.

2. **Sweep** and **Marker** Signals

Sweep generation starts with a bootstrap sawtooth generator on module A14 which produces a very linear sawtooth wave, the frequency of which is adjustable for either 1 or 0.1 Hz. This sawtooth wave is amplified and used for the horizontal sweep of the display CRT. The generator output is also processed to produce a sawtooth wave, the peak-to-peak variation of which is from +6 volts to -6 volts. This output, adjusted to approximately *5 volts, is applied to a Voltage Controlled Crystal Oscillator (VCXO), module A11, which has a center frequency of 34.3 MHz. +5 volts applied to the input of the VCXO shifts the frequency approximately +60 kHz and -5 volts shifts the frequency) approximately -60 kHz, Thus a 34.360-34.240 MHz output which varies at a rate determined by the frequency of the sawtooth generator is produced. This output passes through the Swept Divider, module A8, which either amplifies the 120 kHz band of frequencies, 34.360-34.240 MHz, for the 10 kHz/Div sweep, or divides down in a locked oscillator divider to produce a 3.4360-3.4240 MHz output for the 1 kHz/Div sweep, as determined by the position of the SWEEP switch. The frequencies, as actually adjusted, provide about 5% over-sweep on all bands. The oversweep is to prevent either the leading or trailing edge of a signal pulse at the extreme edge of the band from being lost from the display. For the sake of simplicity, however, whenever the figures for exact bandwidth ore quoted in the following text, oversweep is to be assumed.

To produce the .3 kHz/Div. sweep, a calibrating potentiometer, R9, is switched in series with the connection to the input of the VCXO by S5B. R9 is set so that the VCXO is shifted *18 kHz which, when the output of the VCXO is divided down in the locked oscillator, produces a sweep over a 3.6 kHz band.

The 34.36-34.24 MHz frequencies mix with the output of a 12.035 MHz crystal oscillator located on module A2, or the 3.436-3.424 MHz frequencies mix with the Receiver Second Oscillator output, 18.895-18.785 MHz, in the Mixer for the Sweep IF, moduleA6, to produce the Swept IF of 22.325-22.205 MHz. See paragraph 3 below for an outline of frequency conversions. The output of the Swept IF is the sweep frequency which is applied to the 1.215 MHz Mixer in module A7 to generate the 1.215 MHz IF when mixed with the signals from the 21.11-20.99 MHz band of the Voltmeter IF. Since this sweep frequency signal is derived from the same source as the horizontal sweep for the display CRT the two ore in exact synchronism.

The marker signal is produced by mixing the Voltmeter Second Oscillator output with the output of a 2.215 MHz crystal oscillator located on the Marker IF module, A5. This produces an output in the 21.11-21.0 MHz band for direct injection into the 1.215 MHz mixer. The marker is adjustable over the width of a 110 kHz band (total range of Voltmeter Incremental Oscillator) in the 10 kHz/Div. sweep mode as described below in paragraph 3.a. The marker remains in the center of the 1 kHz/Div sweep band as this 12 kHz band is moved over the 120 kHz band, see paragraph 3.c. below. The 1 kHz/Div. sweep mode magnifies any selected 12 kHz band out of the 120 kHz band covered by the 10 kHz/Div. sweep mode.

Since the Fine Tuning oscillator of the companion Frequency Selective Voltmeter is adjustable from -10 kHz to +100 kHz, a total range of 110 kHz, this is the range of the marker also. However, in the 1 and .3 kHz/Div. modes, a band on each side of the marker is scanned. Thus the actual bandwidth which may be scanned in the 1 kHz/Div. mode is 122 kHz and in the .3 kHz/Div. is 113.6 kHz.

The 10 kHz/Div. and the 1 kHz/Div. sweeps are derived from the same source and are related by a factor of ten, therefore switching between the two sweep bands requires no further adjustment. The 1 kHz/Div. sweep will always cover 6 kHz each side of the point at which the marker is set in the 110 kHz sweep band since the marker is derived from the same source in either band and is always located at the center of the 1 kHz sweep. The .3 kHz/Div. sweep is related to the 1 kHz/Div. sweep by the calibrating potentiometer, R9, so that what has been said is true also of this sweep mode, except that the band swept is 1.8 kHz each side of the marker.

3. Frequency Conversions

a. Marker Frequency, 10 kHz/Div. Sweep Mode

For a signal input at any 100 kHz lock point of the Coarse Tuning dial, the Voltmeter IF output is 21.1 MHz. The Voltmeter IF band scanned by the Spectrum Display Unit sweep is 21.11 to 20.99 MHz, which corresponds to the 100 kHz band above the Coarse Tuning dial setting, ±6 kHz, plus the extra 10 kHz of the -10 kHz range of the Fine Tuning Oscillator dial.

The Marker frequency introduced into the 1.215 MHz mixer when the Fine Tuning dial of the Voltmeter is set at 0 kHz, which is equivalent to a Second Oscillator frequency of 18.885 MHz, is the second Oscillator frequency plus the 2.215 MHz frequency of the marker crystal oscillator:

18.885 MHz
2.215 MHz
21.100 MHz

This shows that the marker will be at the frequency indicated by the Coarse Tuning dial when the Fine Tuning dial is set to 0 kHz.

When the Fine Tuning dial is set to 100 kHz, Second Oscillator frequency of 18.785 MHz, the marker frequency into the 1.215 MHz mixer will be:

$$\begin{array}{r} 18.785 \text{ MHz} \\ \underline{2.215 \text{ MHz}} \\ 21.000 \text{ MHz} \end{array}$$

which indicates that the marker is set 100 kHz above the Coarse Tuning dial indicated frequency when the Fine Tuning dial is set to 100 kHz. Therefore the reading of the Fine Tuning dial on the Voltmeter will indicate the frequency in the 120 kHz scanning sweep band at which the marker appears. The absolute frequency will be the sum of the readings of the Coarse Tuning and the Fine Tuning dials.

In the Coarse Tuning CONTINUOUS mode the marker indicates the frequency above the actual setting of the Coarse Tuning dial.

b. 120 kHz Scanning Sweep Band, 10 kHz/Div. Sweep Mode

The Scanning Sweep beats with the Voltmeter IF of 21.11 to 20.99 MHz in the 1.215 MHz mixer to produce the 1.215 MHz IF.

The Scanning Sweep is produced by the VCXO 34.3 MHz ±60 kHz output beating with the 12.035 MHz crystal oscillator output in the mixer of the Sweep IF to produce a Swept IF of 22.315 to 22.205 MHz:

$$34.3 \text{ MHz} \quad +60 \text{ kHz} = \begin{array}{r} 34.360 \text{ MHz} \\ \underline{-12.035 \text{ MHz}} \\ 22.325 \text{ MHz} \end{array} \qquad -60 \text{ kHz} = \begin{array}{r} 34.240 \text{ MHz} \\ \underline{-12.035 \text{ MHz}} \\ 22.205 \text{ MHz} \end{array}$$

The Swept IF beating with the frequencies of the Voltmeter IF band, 21.11-20.99 MHz, in the 1.215 MHz mixer produce the 1.215 MHz IF:

$$\begin{array}{r} 22.325 \text{ MHz} \\ \underline{-21.110 \text{ MHz}} \\ 1.215 \text{ MHz} \end{array} \qquad \begin{array}{r} 22.205 \text{ MHz} \\ \underline{-20.990 \text{ MHz}} \\ 1.215 \text{ MHz} \end{array}$$

Thus when the VCXO sweeps from 34.360 MHz to 34.240 MHz, the sweep scans the band from 10 kHz below to 110 kHz above the Coarse Tuning dial indicated frequency.

The scan along the CRT display is increasing frequency from left to right.

c. 12 kHz Scanning Sweep Band and Marker, 1 kHz/Div. Sweep Mode

In this mode the 12.035 MHz crystal oscillator is turned off and the 18.895-18.785 MHz Second Oscillator output frequency is applied to the Swept IF mixer. Also the VCXO output is divided down to produce a 3.43 MHz ±6 kHz signal which beats with the Second Oscillator frequency in the Swept IF mixer to produce the Swept IF of 22.325 MHz to 22.215 MHz:

18.895 MHz	18.785 MHz
3.430 MHz ±6 kHz	3.430 MHz ±6 kHz
22.325 MHz ±6 kHz	22.215 MHz ±6 kHz

As above, when the Swept IF beats with the Voltmeter IF band the 1.215 MHz IF is produced:

22.325 MHz ±6 kHz	22.215 MHz ±6 kHz
-21.110 MHz ±6 kHz	-21.000 MHz ±6 kHz
1.215 MHz	1.215 MHz

Since the 18.895-18.785 MHz output of the Second Oscillator is used to generate the marker, as described above, in either sweep mode, the marker will always be in the center of the 12 kHz sweep band as it is shifted over the 120 kHz band by adjusting the Incremental Tuning dial.

Thus as the Fine Tuning in the Voltmeter is changed from -10 kHz to 100 kHz, a 12 kHz band, 6 kHz on each side of the marker, moves across that 110 kHz bandwidth of the Voltmeter IF and so displays any selected 12 kHz segement of the band from 10 kHz below to 100 kHz above ±6 kHz, the Coarse Tuning dial setting.

d. 3.6 kHz Scanning Sweep Band and Marker, .3 kHz/Div Mode

This band and marker are the same as for the 12 kHz band except for the reduced bandwidth.

B. CIRCUIT DESCRIPTION

The following description takes up the separate modules in consecutive numerical order according to the module number designations. Operational relationships will not be described since they have been covered in the preceding Functional Description. Circuits may be traced and circuit location of the components referred to may be found by reference to the Schematic Diagram.

1. Input Attenuator, Module A1

The input circuit contains two 20 dB attenuation networks connected to ATTENUATION DB switch, S1. To increase attenuation the 20 dB sections are successively switched in series with each other to provide a total attenuation of 40 dB. This arrangement maintains the input impedance at a nominal 50 ohms for all attenuator positions.

Connected to this circuit, but mounted on the front panel, is the 0 dB CAL attenuator control, R1. This control has a total attenuation range of 25 dB and provides continuous, fine control between the 20 dB steps of the Input Attenuator. This control is also the calibration adjustment for calibrating the display amplitude to the Voltmeter Attenuator. The MARKER IDENT switch, S3, is also connected to this circuit and disconnects the signal input when operated.

2. VFO Amplifier, Module A2

Three functions are performed in this module, one continuous and two controlled by SWEEP switch, S4.

Input from the Fine Tuning Oscillator of the companion Frequency Selective Voltmeter is continuously amplified in common emitter stage, Q5, and emitter follower, Q6, for marker signal generation. Output level from Q6 is adjusted by front panel MARKER control, R2, and then applied to the input of the Marker IF, Module A5.

Companion Voltmeter Fine Tuning Oscillator output is also applied to common emitter amplifier, Q4, and is coupled to emitter follower, Q3, through transformer, T1. The output of Q3 is applied to the mixer stage on the Swept IF module, A6, when the unit operates in the 1 kHz/Div. or .3 kHz/Div. sweep mode. The B- supply to these amplifiers is controlled by SWEEP WIDTH switch, S4, so the amplifier operates only when the switch is in either of these sweep mode operations.

The third function of this module is the generation of a 12.035 MHz output by crystal oscillator, Q1. Output of Q1 passes through emitter follower, Q2, and is applied to the mixer stage on the Swept IF module, A6. The crystal oscillator operates only when B- supply is connected through SWEEP WIDTH switch, S4, in the 10 kHz/Div. position.

3. LV Power Supply, Module A3

The Low Voltage power supply may be operated from either a 115 volt or 230 volt ac 50-60 Hz source. A switch on the rear panel connects the power transformer, T1, primary windings either in parallel for 115 volt or in series for 230 volt ac supply operation.

The power transformer output is rectified with a full wave bridge rectifier, CR1-CR4, and filtered with C1, C2, R1. Output voltage is regulated with series regulator, Q1 (mounted on the main chassis) which is controlled by Q1, Q2 and Q3. CR5 is the voltage reference diode.

The SWEEP RATE lamps are connected across the -18 volt supply output and so are direct indications of the functioning of the power supply module. Scale illumination lights, DS2, DS3, are also connected across the B- supply through SCALE ILLUM Control, R3.

It will be noted that decoupling filters are used in the B- supply connections in many of the modules. This is to provide isolation and to prevent undesirable coupling and feedback effects.

4. Signal IF, Module A4

In this module the output level from the Attenuator module is increased by the gain of common emitter amplifier, Q1. This gain is provided in order that the input to the 1.215 MHz mixer stage in module A7 may be high enough to insure a low mixer noise figure. Q2 sets the source impedance of the 21.11-20.99 MHz band-pass filter while Q3, Q4, Q5 provide the very high terminating impedance required by the filter. These three stages also match this high impedance to the low impedance of the cable connection to the mixer input. The band-pass filter rejects all signals outside the IF 21.11-20.99 MHz band, in particular the Fine Tuning Oscillator output which is present at the point where the Companion Voltmeter IF is tapped for input to the Spectrum Display Unit.

5. Marker IF, Module A5

A Crystal Oscillator, a Mixer and a band-pass filter are mounted on this module. The Voltmeter Fine Tuning Oscillator output, 18.895-18.785 MHz, from the MARKER control, R2, is applied to the input of the mixer stage, Q3. The output of the 2.215 MHz crystal oscillator, Q1, is also applied to the mixer through isolation stage, Q2. The difference products of mixer, Q3, are removed by the 21.11-20.99 MHz band-pass filter. Filter source and matching impedances are provided by Q4 and Q5 as in the Signal IF, module A4. However, output impedance is reduced to match the cable impedance for injection into the 1.215 MHz mixer on module A7 by tapping down on the emitter resistor of Q5. The attenuator pad, R1, R2, R3 located on module A7 reduces the signal to the proper injection level. The MARKER control, R2, reduces the MARKER signal to a negligible level when it is turned to the OFF position.

6. Swept IF, Module A6

In the Swept IF, the outputs of the VFO Amplifier, Module A2, and the Voltage Controlled Crystal Oscillator (VCXO), Module A11, are mixed to produce the sweep frequency which is applied to the 1.215 MHz mixer on Module A7. (See paragraph A.3.b and c. for the freauencies used.) The frequencies are mixed in Q1 and then passed through a 22.325-22.205 MHz band-pass filter to remove either the sum or difference components as the case may be. Q2, Q3, Q4 and Q5 provide filter source and matching impedances as in the Signal IF, Module A4.

7. 1.215 MHz Mixer, Module A7

Output from the Companion Voltmeter IF, and the Marker frequency when used, are both injected into the base of the 1.215 MHz mixer, Q1 while the Sweep Frequency is applied to the emitter. Tuned circuits in the output of the Mixer and the following amplifier, Q2, discriminate against all frequencies in the mixer output except 1.215 MHz to which they are adjusted. Approximately unity gain is supplied to the signal by the mixer module.

8. Swept Divider, Module A8

The Swept Divider module contains two circuits, one for the 10 kHz/Div. mode and one for both the 1 kHz/Div. and .3 kHz/Div. modes. The output of the Voltage Controlled Crystal Oscillator is applied to each of these circuits through a tuned input amplifier, Q5, that operates continuously. Operation of the other circuits is controlled by SWEEP switch, S4, which connects the B- supply to the proper circuit. In the 10 kHz/Div. Sweep mode the 34.3 MHz output of the tuned input amplifier is applied to a direct connected pair of emitter followers, Q4, Q3, which provide circuit isolation from the 34.4 MHz signal when in the 1 kHz/Div. sweep mode. In the 1 kHz/Div. Sweep mode the 34.3 MHz output of the tuned input amplifier goes to the Locked Oscillator Divider, Q2. The frequency is divided by ten to produce 3.43 MHz which passes through the tuned amplifier Q1. This amplifier, which has approximately unity gain, has the purpose of eliminating all frequencies except 3.43 MHz to which it is tuned. The output is connected to the mixer of the Swept IF module.

9. 440 Hz and 35 Hz BW IF, Modules A9 and A10

These two modules are essentially the same except for the bandwidth and input impedance of the crystal filters. The input amplifiers, Q1, provide a match to the input of the crystal filters and supply sufficient amplification so that the overall gain of each module is about 6 dB. The two output emitter followers match the high output impedance to the following IF amplifier.

The inputs and outputs of these modules are connected in parallel, but only one filter is used at a time. The proper filter module for the sweep width in use is selected by the SWEEP switch, S4, which controls the B- supply to the input and output amplifiers on each module.

10. Voltage Controlled Crystal Oscillator (VCXO), Module A11 (Figure 3-1)

The VCXO is a sealed unit mounted on this module board. The center frequency of the crystal oscillator is 34.3 MHz. This frequency output is caused to shift when dc is applied to the input. +5 volts shifts the frequency +60 kHz and -5 volts shifts the frequency -60 kHz. When a sawtooth wave, which varies from +5 volts to -5 volts p-p, is applied to the input, the output frequency is caused to vary from 34.360 MHz to 34.240 MHz, thus forming the basis for the sweep frequency of the Spectrum Display Unit. Output is reduced to the proper level for application to the Swept Divider, module A8, with the Potentiometer, R6, and isolation and matching is provided by emitter follower stage, Q1.

11. 1.215 MHz IF, Module A12

This module is made up of four similar tuned stages, Q1-Q4, with circuit components chosen to provide essentially equal gain per stage. Overall gain of module A12 is about 80 dB. The output emitter follower stage, Q5, matches the output impedance of the IF amplifier to the following module. Decoupling filters in the B- supply are used between each stage in this module for maximum stability of operation.

12. High Voltage Power Supply, Module A13 (Figure 3-2)

High Accelerating voltage for the Cathode Ray Tube and medium voltage for the deflection amplifiers are obtained from this module. A dc converter, Q1, Q2 and T1 generates a 5.5 kHz, 18 volt squarewave output, which is transformed in the two secondaries to provide output voltages of approximately 800 volts and 150 volts.

The 800 volt output is rectified with a half-wave tripler rectifier and filter circuit, CR6-CR8, C6, C7, C9, to produce the -2600 volts dc accelerating voltage for the CRT. The output is connected to the CRT cathode, the INTENSITY and FOCUS controls in the normal manner.

The 150 volt output is rectified by a full wave bridge rectifier, CR2-CR5, and passes through the RC filter CR9, C8, C10. One output (positive) is connected to the ASTIGMATISM control, R8, while the other output is connected to the vertical and horizontal deflection amplifiers and to the Sweep module.

13. Sweep, Module A14

The linear sawtooth wave which is used for horizontal deflection of the CRT and as the basis of the scanning sweep is generated in this module.

Q1, Q2 is a mono-stable, cathode coupled multivibrator which is triggered by the output of the timing circuit R11, R23, C6. Q3 is a switch which discharges the timing capacitor, C6, when Q1 conducts. Amplifier Q4, Q5, controls

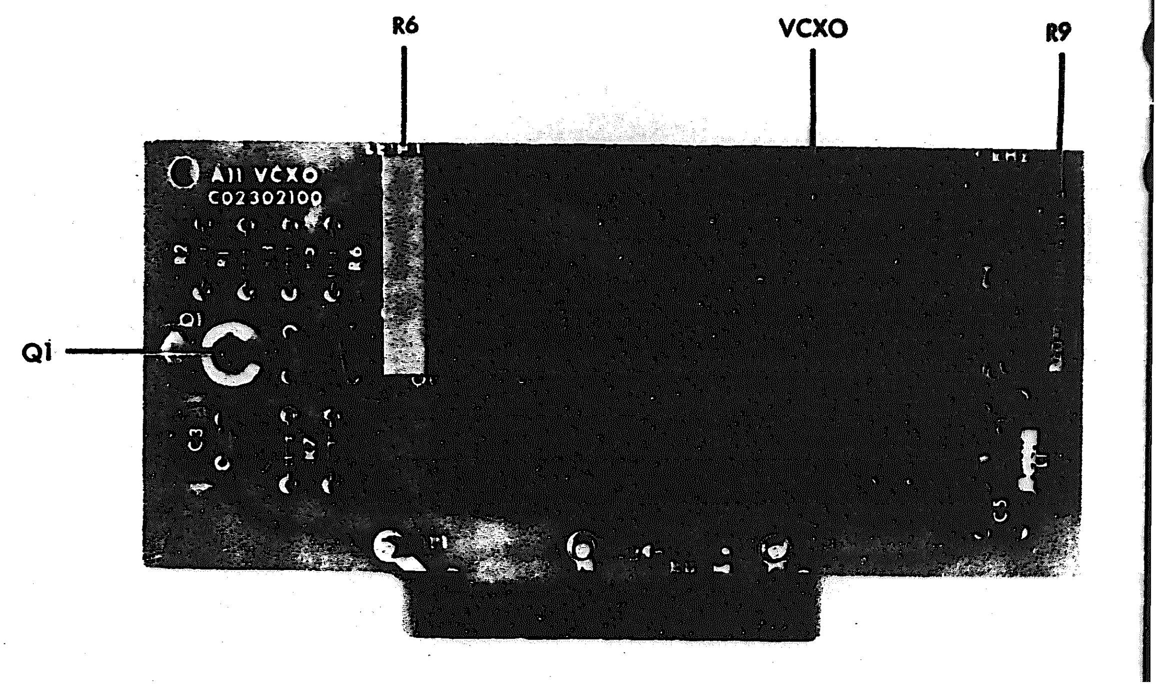


Figure 3-1. Module A11, Voltage Control led Crystal Oscillator (VCXO) C02302100

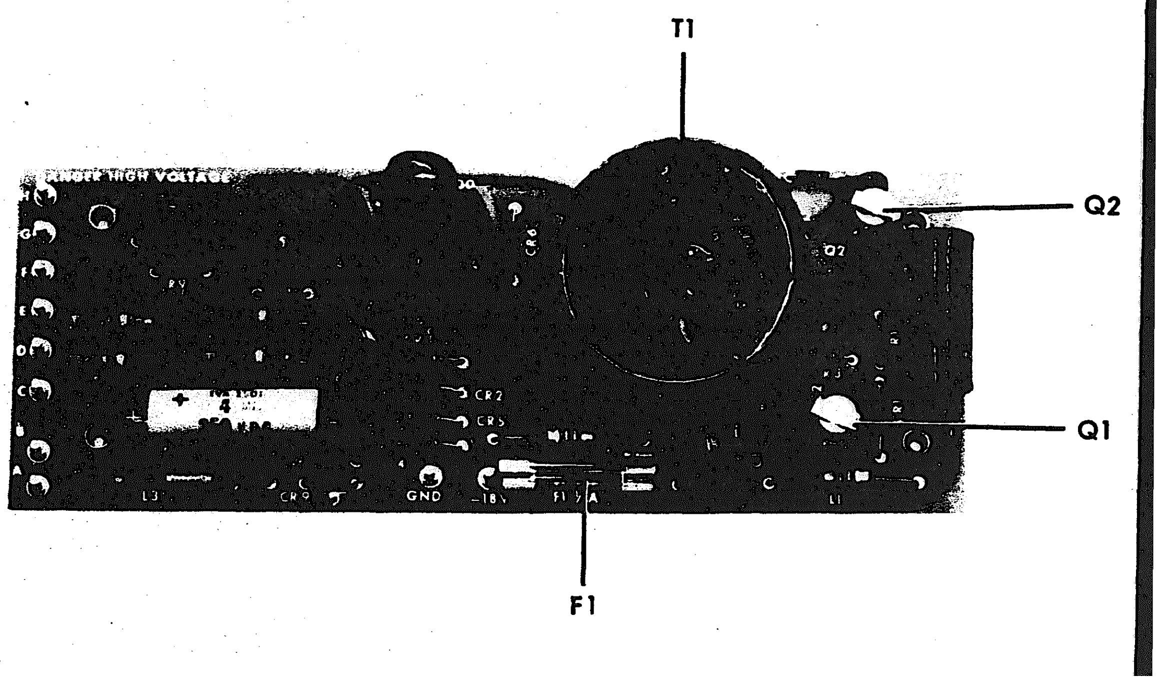


Figure 3-2. Module A13, High Voltage Power Supply CO2302300

the current flow through Q6 so that the charging current to C6 remains constant, thus producing a very linear sawtooth wave. Zener diode, CR1, sets the Q6 collector voltage of 6 volts above the emitter voltage of Q5. A 0 to -12 volt output is developed across the load resistor R13. Zener diode, CR2, adds 6 volts to this output so that the output of emitter follower, Q7, varies between +6 and -6 volts. This output, when adjusted to approximately ±5 volts with adjustable control, R17, is the sawtooth wave which is required to properly operate the Voltage Controlled Crystal Oscillator on module A11. Q8 is a voltage regulator which sets the voltage at the junction of the emitter of Q8 and collector of Q7 to +12 volts. Zener diodes CR3, CR4, provide the reference control voltage for the base of Q8.

Sawtooth output for horizontal deflection of the CRT is taken from the base of Q1 through S4, and applied to the SWEEP CAL control, R11, for adjustment of the CRT horizontal deflection sweep width. R2 in the base circuit of Q1 is a calibrating bias adjustment which adjusts the amplitude of the sawtooth wave and serves to center the VCXO output.

14. Vertical Amplifier, Module A15

This module contains the detector, log converter and the differential vertical deflection amplifier.

Signal voltage from the 1.215 MHz IF is coupled to the module through an amplifier stage Q1. The amplifier output is rectified by the push-pull pulse pair detector, CR1, CR2, and applied to the inputs of the differential amplifier, Q2, Q3. The differential amplifier furnishes a negative going output of sufficient amplitude to properly operate the log converter circuit.

The log converter circuit requires a stable reference to prevent the output logarithmic curve from changing with respect to the signal. This reference voltage is maintained by the clamping diode, CR6, which clamps the dc output of the differential amplifier to a maximum of about -9 volts. The actual voltage is determined by the voltage drop across Q4, which is set by the Threshold Adjust control, R17, connected to the base of Q4. The reference voltage is related to the log converter diode conduction voltage points since the diodes, CR3-CR5, are connected to a voltage divider in the emitter circuit of Q4. The logarithmic output curve is formed by the successive conduction of the log converter diodes at lower (more negative) voltage as the signal amplitude is increased. This output is applied to the driver stage of the differential vertical deflection amplifier through emitter follower, Q5.

The driver stage, Q6, is direct coupled to the differential vertical deflection amplifier, Q7, Q8, and the output of the differential amplifier is applied directly to the vertical deflection plates of the CRT.

All of the amplifiers in this module are connected between -18 volts and ground except the deflection amplifiers, Q7 and Q8. These amplifiers are connected between +150 volts and -18 volts in order to develop the high voltage amplitude swing required for proper deflection of the CRT beam.

Vertical positioning of the display is accomplished by adjusting the base bias of Q9 with VERTICAL POSITION control R12. Since Q9 is direct coupled to Q8 and Q7 the positioning voltage on the vertical deflection plates is controlled by R12.

15. Horizontal Amplifier, Module A16 (Figure 3-13)

deflection amplifier both operationally and circuitwise. Sweep output from the SWEEP CAL control is applied to driver stage, Q1, which is direct coupled to the differential horizontal deflection amplifier, Q2, Q4. Horizontal positioning is adjusted with the HORIZONTAL POSITION control R13 in the same manner as in the vertical amplifier. The constant current source, Q3, supplies a high effective cathode impedance which improves stability and provides a high common-mode rejection ratio.

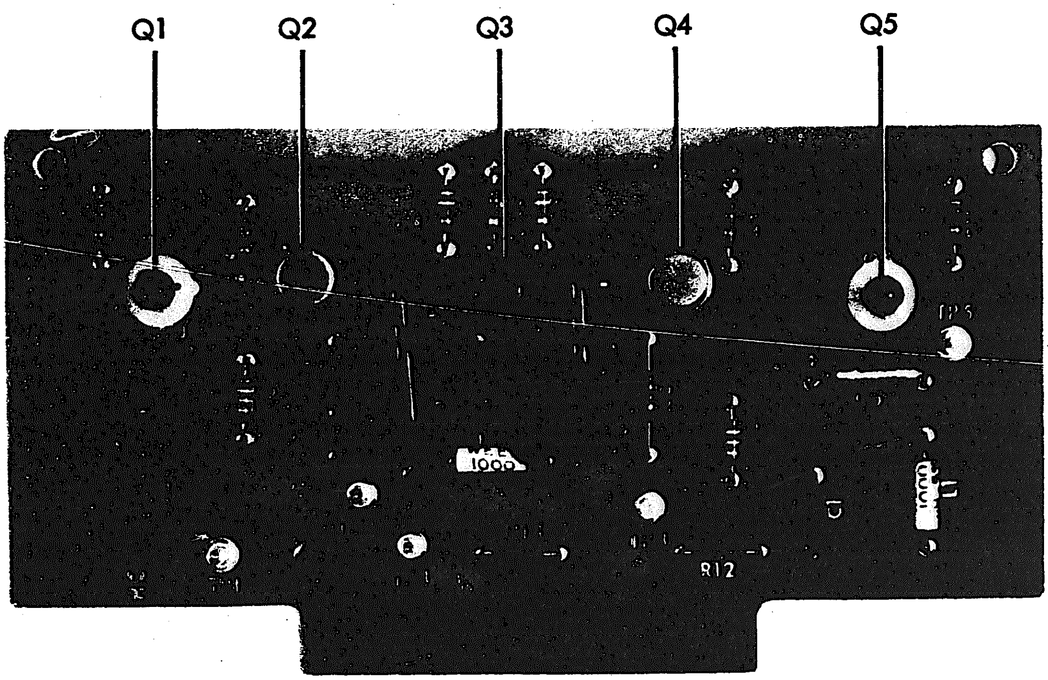


Figure 3-3. Module A16, Horizontal Amplifier. C02302600

SECTION IV

MAINTENANCE

A. General

Operator and organizational maintenance consist of keeping the equipment free of dust and dirt, and performing the operational procedures described in Section II.

In servicing the unit, reference should be made to the Theory of Operation, Section III, for module description and function, to the Block Diagram, Figure 1-2, for functional relationships and signal and voltage levels and to the Schematic Diagram for circuit connections. The Printed Circuit Card location diagram is also on the Schematic diagram.

After an analysis of the possible causes of the trouble and elimination of those circuits not concerned, appropriate signal and voltage level checks should be made to isolate the trouble to a particular module.

In making signal level checks it should be kept in mind that complex wave forms exist on connections to the mixer points. Erroneous indications may be obtained unless readings are taken with a Frequency Selective Voltmeter, or unless modules are unplugged to prevent more than one signal at a time from being present. In the latter case the module that provides the termination for the circuit should not be removed.

A module can be brought out for detailed checking by plugging in the printed circuit board riser in place of the module and then plugging the module into the riser. Some fairly general servicing tests are outlined below.

B. TROUBLESHOOTING CHECKS

Trouble Indication	Possible Cause
Power Switch On, panel lamp not on.	Check connection to ac line. Check fuse. Check for −18V output from the Low Voltage Power Supply module, A3. Check panel lamp for proper operation.

Trouble Indication	Possible Cause
Power On, but no trace appears on CRT screen after about 15 seconds.	Check for -18V input to High Voltage. Check Power Supply, module A13 and fuse. Check output voltages of A13.
Normal horizontal and vertical CRT display in 10 kHz/Div sweep width mode but not in 1 kHz/Div mode.	Trouble will most likely be in either the Locked Oscillator Divider in module A8, or in 35 Hz band-pass filter, module A10.
Normal horizontal and vertical CRT display in 1 kHz/Div Sweep Width mode but not in 10 kHz/Div mode.	Trouble most likely will be in either the 12.035 MHz crystal oscillator in module A2 or in band-pass filter module A9.
Normal horizontal and vertical CRT display but no marker pulse.	Check for input from the Voltmeter Fine Tuning Oscillator. Check VFO amplifier in module A2, check Marker IF module A5.
Vertical indication but no horizontal trace.	Check for output from sweep generator module A14. Check horizontal amplifier module A16.
Horizontal trace but no vertical indication.	Check for input from the Freauency Selective Voltmeter to Input Attenuator. If marker appears the signal channel from module A7 to the CRT is normal. Check the Vertical adjust control for proper positioning. This will eliminate the vertical amplifier. The source of the trouble may be in almost any of the remaining circuits. If so, carry out the alignment procedure given in the following paragraph to determine the source of the trouble.

C. ALIGNMENT PROCEDURE

1. **Test Equipment**

The following equipment, or equivalent, is required for alignment.

Frequency Selective Voltmeter	Sierra Model 128A or Model 305A
RF Microvoltmeter	Millivac Model MV-28B with type G High Impedance Probe
Signal Generator	HP Model 606A
Oscilloscope	Tektronix Model 543B
Oscilloscope Plug-In Unit	Tektronix Model 53/54L
AC VTVM	HP Model 400L
DC VTVM	HP Model 412A
Electronic Counter	HP Model 5245L

2. **Initial Control Settings**

a. ATTENUATOR DB to 0 dB.

b. VERNIER, maximum clockwise.

c. SWEEP 10 kHz/Div. CONTINUOUS position and FAST/NORM switch to NORM.

d. MARKER to OFF, maximum counterclockwise.

e. Remove Voltage Controlled Crystal Oscillator (VCXO) module A11 and Sweep module A14.

f. Remove all input connections except power.

g. The printed card Riser is used to elevate modules for alignment.

h. Switch POWER ON-OFF switch to OFF when elevating modules and return to ON position at the beginning of each module alignment procedure. Switch POWER ON-OFF switch to OFF at the end of each module alignment procedure and replace module.

3. **Low Voltage (LV) Power Supply, module A3 (Figure 4-1)**

a. Connect DC VTVM to TP1 and TP2 (Gnd.).

(1) Adjust R8 for a reading of -18 volts dc.

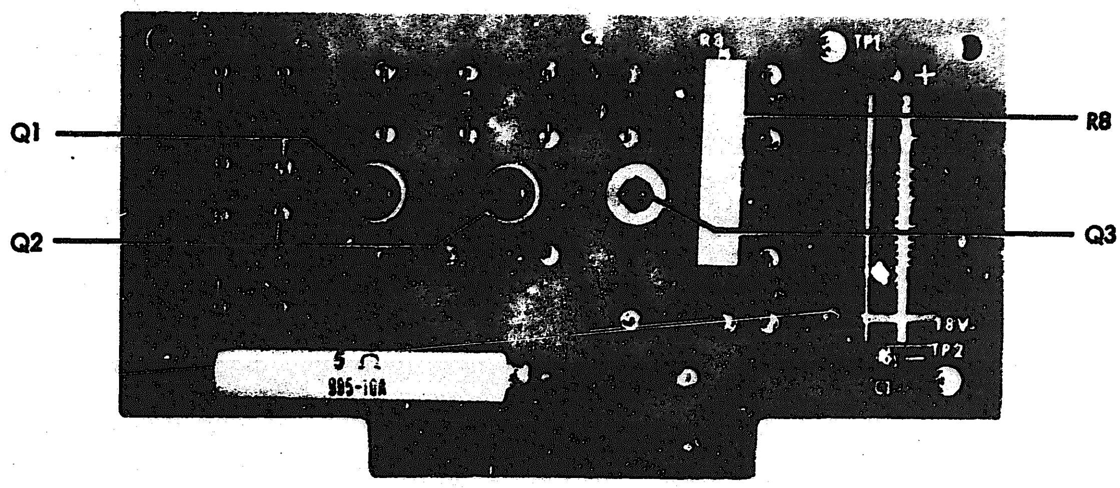


Figure 4.1 Module A3, Low Voltage (LV) Power Supply C02300500

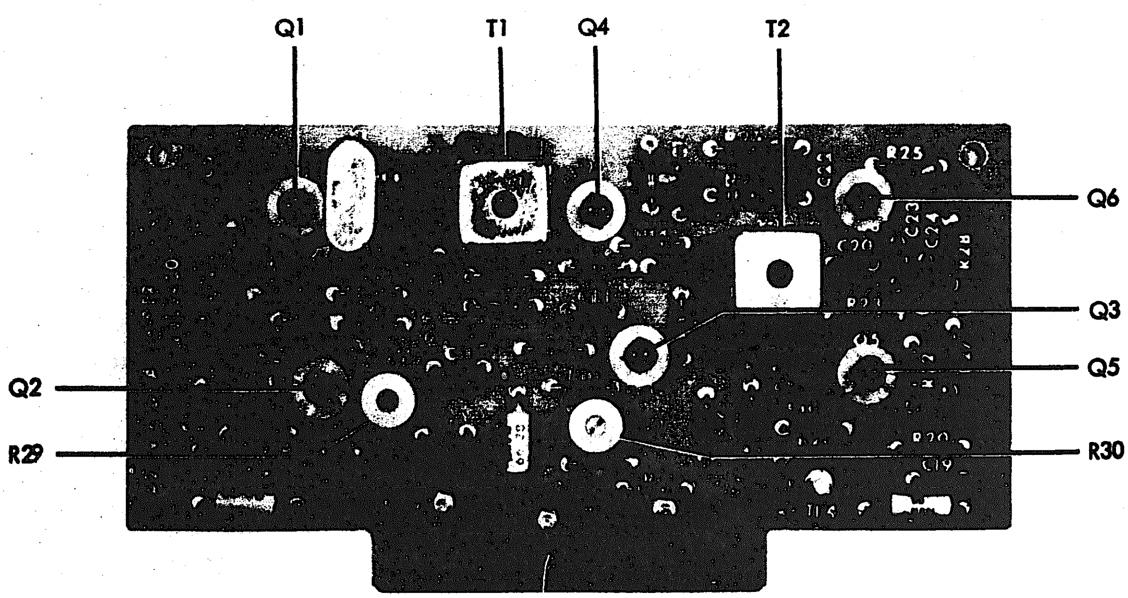


Figure 4-2 Module A2, VFO Amplifier C02300400

4. VFO Amplifier, module A2 (Figure 4-2)

a. Connect Fine Tuning Oscillator (18.8 MHz) input cable from Frequency Selective Voltmeter to J2.

b. Set the Frequency Selective Voltmeter controls to the following settings:

(1) INPUT Attenuator to CAL.

(2) INPUT Impedance to 75Ω CAL.

(3) SELECTIVITY to NARROW.

(4) MAIN TUNING (Coarse Tuning) to 1 MHz LOCKED.

(5) INCREMENTAL (Fine) Tuning to 0 kHz.

(6) Adjust INCREMENTAL (Fine) Tuning carefully for maximum reading on the meter and set the meter to 0 dB by adjusting the CAL control.

(7) Adjust INCREMENTAL Tuning CURSOR so that index line is directly on the 0 kHz mark of the dial, or adjust FINE Tuning to 0 kHz.

(8) Set the INCREMENTAL (Fine) Tuning dial to 50 kHz.

C. Connect Oscilloscope probe to TP3 and TP2 (Gnd.) on A2.

(1) Voltage level should be approximately 170-250 mV peak-to-peak.

d. Connect Oscilloscope probe to TP4 and TP2 (Gnd.).

(1) Adjust T2 for maximum reading.

e. Switch SWEEP selector to 1 kHz/Div. position.

f. Connect Oscilloscope probe to TP1 and TP2 (Gnd .).

(1) Adjust Tl for maximum reading.

Switch SWEEP selector to 10 kHz/Div. position

h. Connect RF Microvoltmeter to TP1 and TP2 (Gnd.) on A2.

(1) With the, SWEEP switch in the 10 kHz position, adjust R29 for a reading of 30 ± 2 millivolts.

(2) With the SWEEP switch in the 1 kHz position, adiust R30 for a reading of 65 ±3 millivolts.

(3) Repeat (1) and (2) above once because these adjustments interact slightly.

i. Reinstall printed circuit card A2.

5. Marker IF module A5 [Figure 4-3)

a Disconnect Fine Tuning Oscillator (18.8 MHz) input cable from J2.

b. Turn MARKER to maximum clockwise position.

e. ‘Connect Electronic Counter to output of AC VTVM (AC VTVM is used as on amplifier. If counter is sufficiently sensitive the amplifier is not needed).

d. Connect AC VTVM to TP2 and TP4 (Gnd.) .

(1) AC VTVM should read approximately 17 millivolts.

(2) Adjust C4 for a counter reading of 2.215 MHz *TO Hz.

e. Disconnect AC VTVM.

f. Connect Fine Tuning Oscillator input cable to J2. (Voltmeter tuning as in 4.b.)

9. Connect RF Microvoltmeter to TP3 and TP4 (Gnd.).

(1) Detune L4 and L5 by turning slugs clockwise so that they protrude approximately 1/4 inch from printed circuit side of module.

(2) Tune L3 for a maximum reading.

(3) Tune L4 for a minimum reading.

(4) Tune L5 for a maximum reading.

6. VCXO, module A11 (Figure 3-1), and Swept Divider, module A8 (Figure 4-4)

Plug in the VCXO module A11. Remove the VFO Amplifier Module, A2, the Swept Divider Module A8, and the Sweep Module A14.

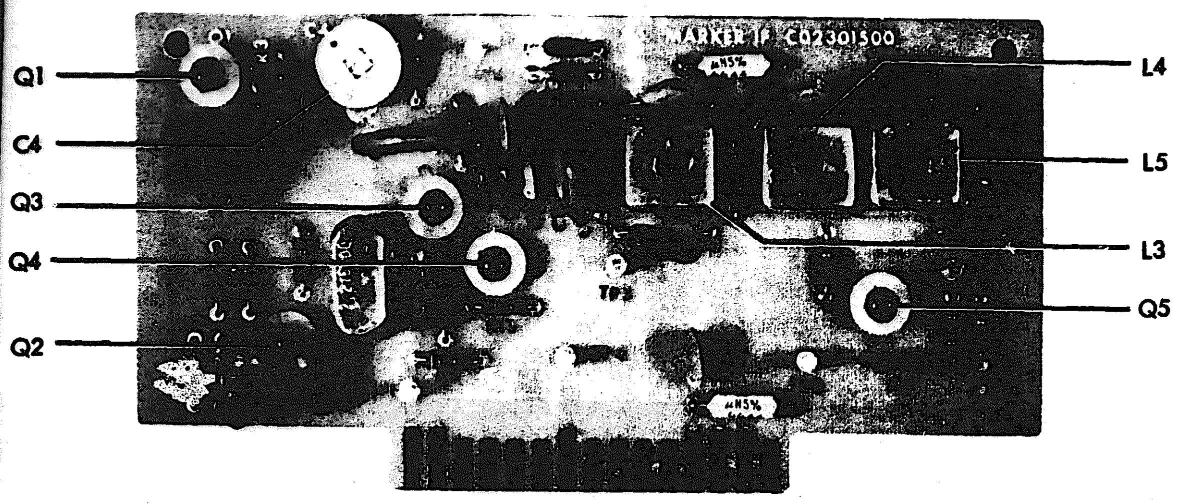


Figure 4-3. Module A5, Marker IF CO2301500

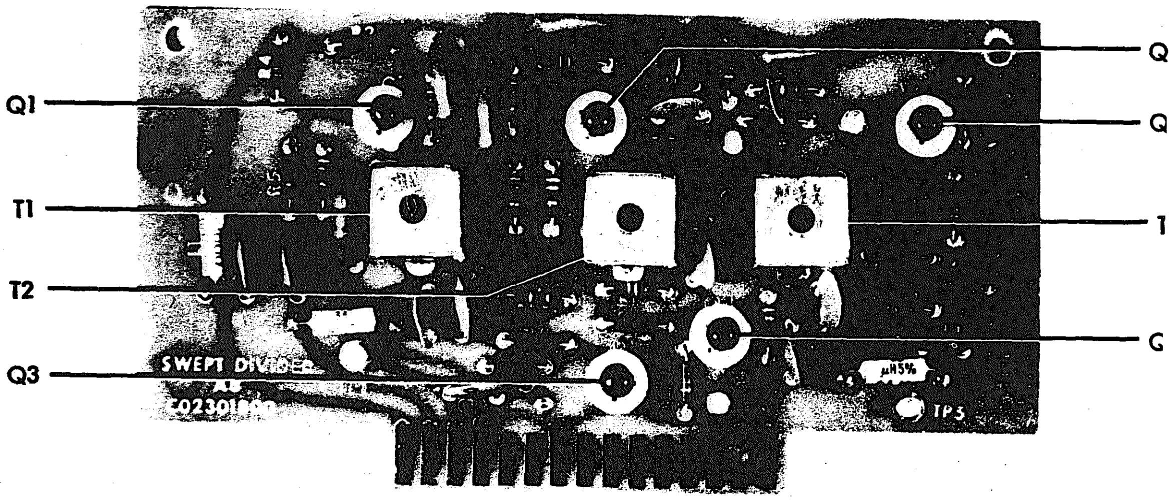


Figure 4-4. Module A8, Swept Divider CO2301800

b. Connect RF Microvoltmeter to A11 TP1 and TP2 (Gnd.).

(1) Adjust R6 on VCXO Module A11 for 70 mV.

(2) Disconnect RF Microvoltmeter.

c. Replace Board A8 and connect the Oscilloscope probe to TP1 and TP3 (Gnd.) on A8. (NOTE: Oscilloscope probe must not be connected to chassis.) Connect the Electronic counter to the Oscilloscope vertical output.

(1) Adjust T3 for maximum signal amplitude as seen on the Oscilloscope (10 kHz position).

(2) Note the frequency of the signal as read on the Electronic Counter. Frequency must be 34,300 ±0.5 kHz. If frequency is in error, remove screw from top of VCXO module and adjust oscillator trimmer as required.

d. Place the SWEEP switch in the 1 kHz/Div. CONTINUOUS position.

(1) Adjust T2 to the center of the 10 to 1 lock-in range. Lock-in is evidenced by frequency stability, that is, the counter continues to read the same frequency as T2 is adjusted over a limited range. The counter must read 0.1 of the frequency noted in c. (2) above. (If counter read 34.3 MHz then it must be stable at a reading of 3.43 MHz now. The 10:1 division must be obtained since the divider can lock at other multiples.) Adjust T2 to the center of the 10:1 lock-in range.

(2) Adjust T1 for maximum output.

e. Connect the Oscilloscope probe to TP2 and TP3 (Gnd.).

(1) Set Oscilloscope Vertical amplifier to 200 mV/cm and Horizontal to 0.1 µsec/cm.

(2) The waveform peaks at the beginning and end of each wave train should be in the same position as shown in Figure 4-5. They will move in opposite directions as T2 on A8 is adjusted.

(3) Replace VFO Amplifier A2 and Sweep Module A14.

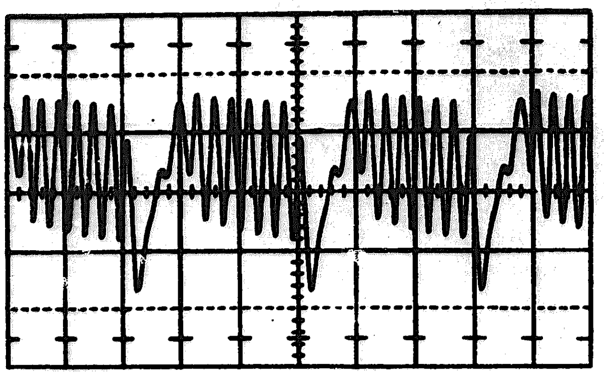


Figure 4-5. Waveform at TP2, A8

7. Swept IF, module A6 (Figure 4-6)

a. Switch SWEEP to 10 kHz/Div. CONTINUOUS.

b. Replace VFO Amplifier module, A2.

c. Fine Tuning Oscillator input cable still connected to J2. (Frequency Selective Voltmeter tuning as in 4.b.).

d. Connect RF Microvoltmeter to TP3 and TP4 (Gnd.).

(1) Follow the same alignment procedure as in paragraph 5.g. (1)-(4).

8. Signal IF, module A4 (Figure 4-7)

a. Turn MARKER to OFF, maximum counterclockwise position.

b. Connect output of Signal Generator to Spectrum Display Unit 21.1 MHz Input, J1, and to the electronic Counter in parallel.

(1) Set output level of Signal Generator to 30 millivolts rms.

(2) Set Signal Generator frequency to 21.050 MHz ±1 kHz.

c. Disconnect Fine Tuning Oscillator input cable (18.8 MHz) from J2.

d. Connect RF Microvoltmeter to TP2 and TP3 (Gnd.).

(1) Follow same alignment procedure as in paragraph 5.g.(1)-(4).

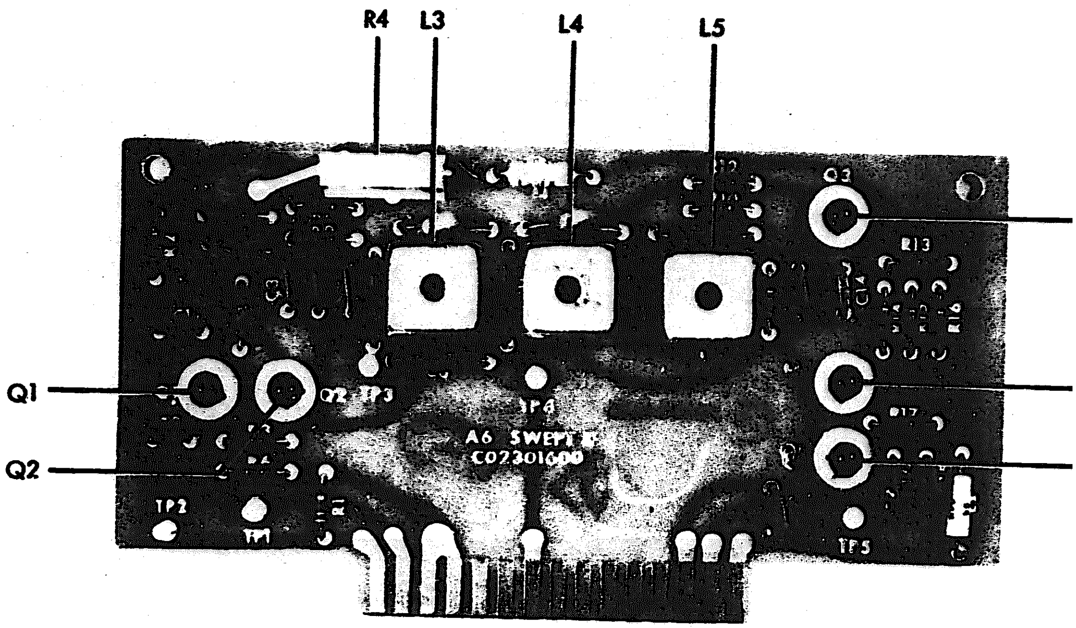


Figure 4-6. Module A6, Swept IF CO2301600

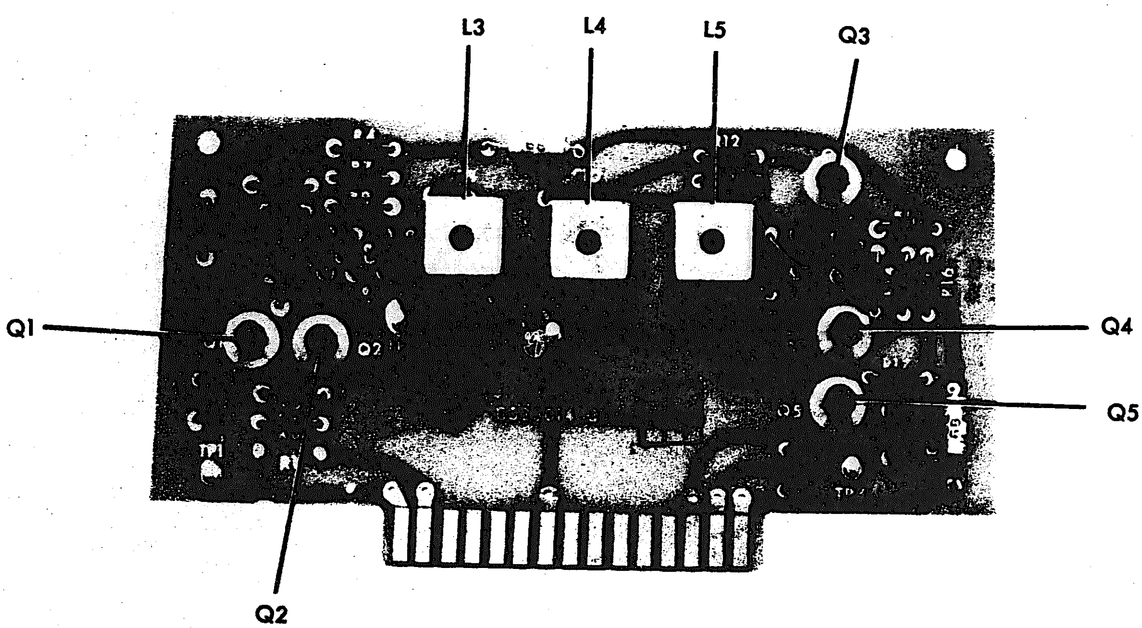


Figure 4-7 Module A4, Signal IF C02301400

9. 1.215 MHz Mixer module A7 (Figure 4-8)

a. Connect Fine Tuning Oscillator input cable to J2. Signal Generator remains connected as in 8.b. above.

b. Connect Oscilloscope probe to TP5 and TP4 (Gnd.).

(1) Adjust T1 and T2 for maximum indication.

10. 1.215 MHz IF, module A12 (Figure 4-9)

a. Connect Oscilloscope probe to TP1 and TP5 (Gnd.). Signal Generator still connected as in 8.b. above.

(1) Adjust frequency of Signal Generator for maximum indication. This assures centering in the 440 Hz band-pass crystal filter.

b. Connect Oscilloscope probe to TP2 and TP5 (Gnd.).

(1) Adjust L6 for maximum indication.

c. Reduce Signal Generator output level by 20 dB.

d. Connect Oscilloscope probe to TP3 and TP5 (Gnd.).

(1) Adjust L7 for maximum indication.

e. Reduce Signal Generator output level by an additional 20 dB.

f. Connect Oscilloscope probe to TP4 and TP5 (Gnd.).

(1) Adjust L8 for maximum indication.

g. Reduce Signal Generator output level by an additional 20 dB.

h. Connect Oscilloscope probe to TP6 and TP5 (Gnd.).

(1) Adjust L9 for maximum indication.

i. Disconnect Signal Generator from IF Input, J1.

11. Sweep, module A14 (Figure 4-10)

a. Install Sweep module, A14, on card riser.

b. Switch Oscilloscope pre-amp to dc and center for dc measurement. Set Sweep time to about 0.2 seconds.

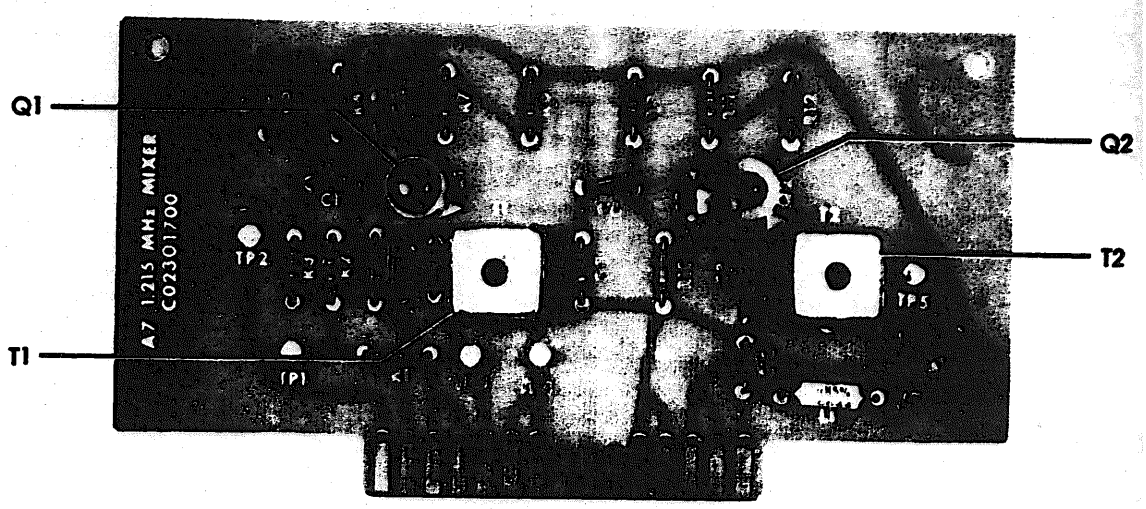


Figure 4-8. Module A7 1.215 MHz Mixer C02301700

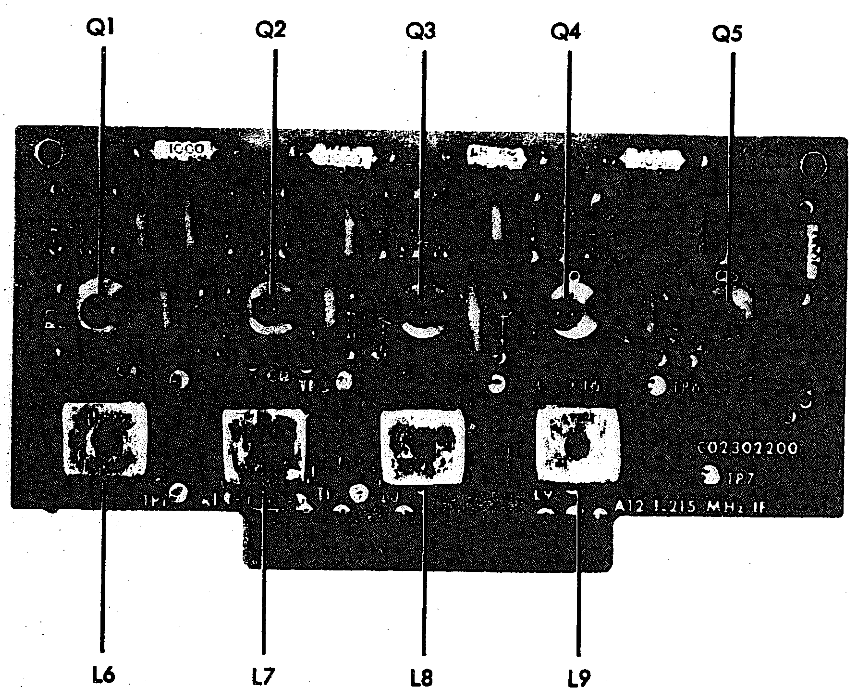


Figure 4-9. Module A12, 1.215 MHz IF CO2302200

c. Connect Oscilloscope probe to TP1 and TP2 (Gnd.).

d. Adjust R2 (VCXCO CENT) for a symmetrical waveform above and ow 0 volts dc. Adjust R17 for start of sweep at +5V and end of sweep at -5V. Note: R2 l R17 interact.

e. Reinstall Sweep module, A14.

12. Vertical Amplifier, Module A15 (Figure 4-11)

a. Connect Signal Generator to Spectrum Display Unit 21.1 MHz Input, J1, and to Electronic Counter as in 8.b. Connect voltmeter Incremental Oscillator to J2.

b. Adjust Signal Generator frequency to 21.050 MHz ±10 kHz.

c. Set Signal Generator output level to -70 dBm.

d. Set Spectrum Display Unit ATTENUATOR DB to 0 dB. Set VERNIER to maximum clockwise position. Marker in OFF position. FOCUS, INTENSITY and SCALE ILLUM set for suitable display on CRT screen. Set Sweep to 10 kHz/Div CONTINUOUS and Sweep Rate switch to NORM.

e. Adjust VERTICAL POSITION control so that the trace base line is at -20 dB on the CRT graticule scale. Connect scope to TP3 (A15) and chassis. Set 0 dB CAL control for oscilloscope pulse amplitude of -0.34 volts, peak-to-peak. Note: Use 20 milliseconds per division sweep, and look for one pulse for each Display Unit sweep.

f. Adjust R28 on A15 for top of the signal trace at 0 dB. Maintain baseline at -20 dB with VERTICAL POSITION control.

g. Decrease Signal Generator output by 15 dB.

h. Adjust R17 and VERTICAL POSITION control so that signal is at -15 dB and the baseline is at -20 dB.

i. Increase Signal Generator output by 15 dB and check that top of trace is at 0 dB. If required, adjust R28 to obtain a registor at 0 and -15 dB points.

j. Repeat steps f. through i. until signal trace amplitude is properly aligned at both 0 dB and -15 dB points.

k. Disconnect Signal Generator from IF Input, J1. Connect cable from Frequency Selective Voltmeter 21.1 MHz IF output to Display Unit 21.1 MHz IF Input J1.

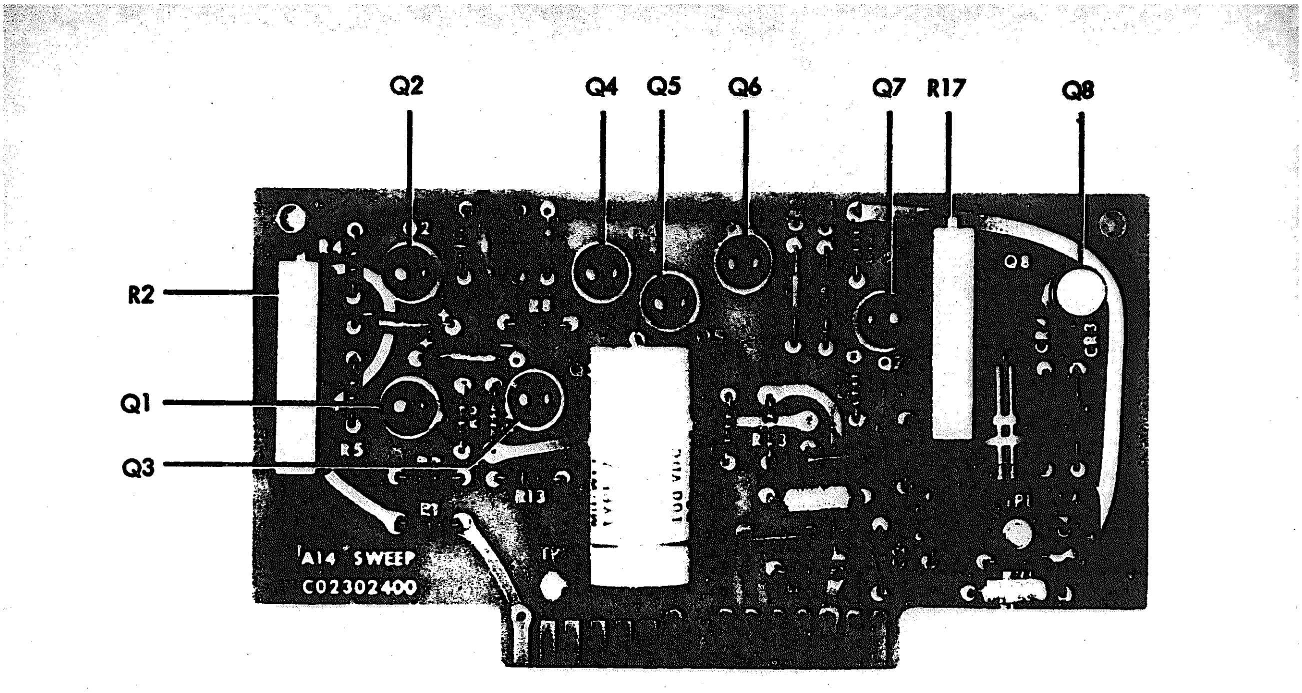


Figure 4-10. Module A14, Sweep C02302400

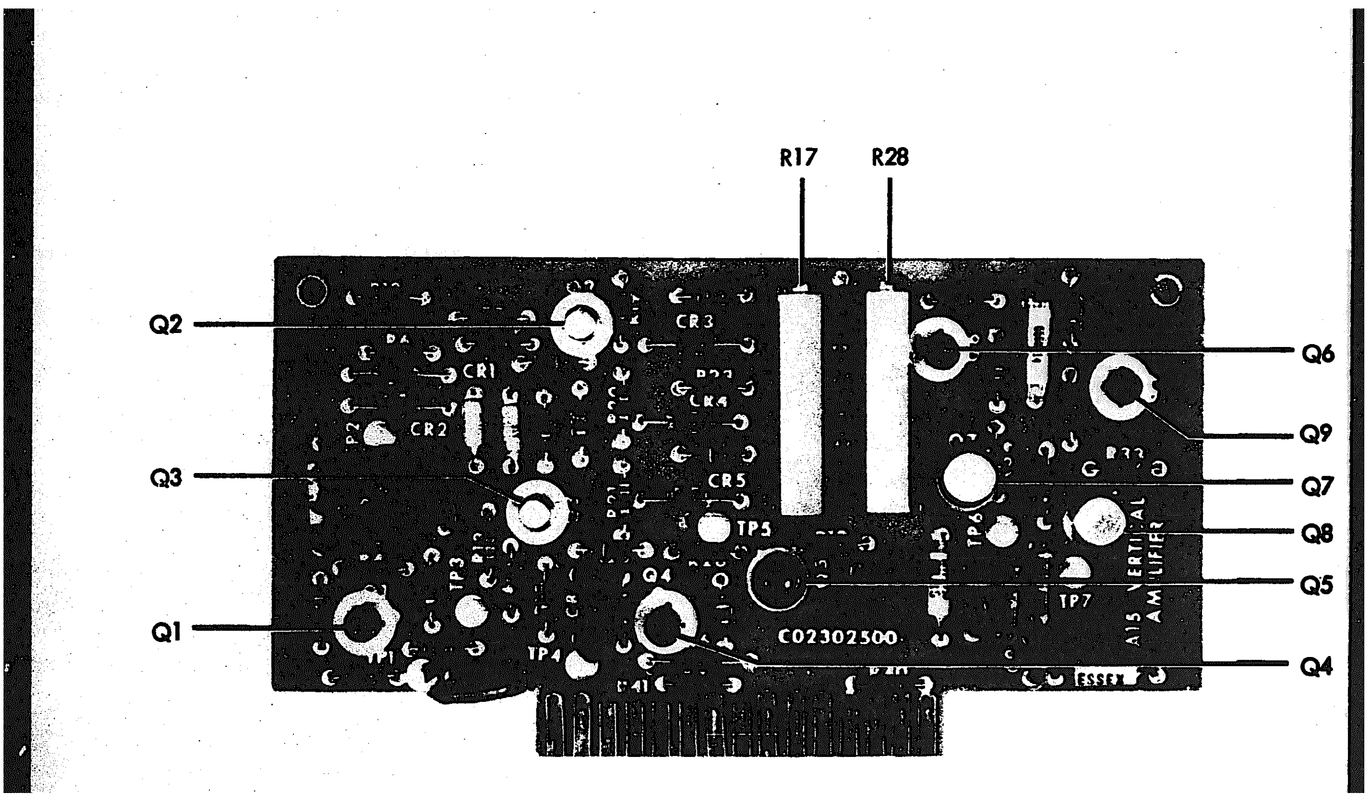


Figure 4-11 Module 4-15, Vertical Amplifier C02302500

13. 35 Hz BW IF module A10 (Figure 4-12)

a. Switch SWEEP selector to 10 kHz/Div position. Set SWEEP RATE switch to NORMAL.

b. Turn MARKER ON and adjust level for a 0 dB reading on the CRT scale.

c. Switch SWEEP selector to 1 kHz/Div.

d. Adjust R5 for a -0.5 dB marker signal level reading on the CRT scale. (Adjustment is available on top of module so it is not necessary to install module on card riser.) Using -0.5 dB, the marker pulse in the 0.3 kHz/Div range will also be close to 0 dB.

e. Switch SWEEP selector to 10 kHz/Div. position.

14. Frequency Calibration

a. Set the Frequency Selective Voltmeter controls and calibrate as in 4.b. (1) through (7) above.

(1) Now set the INCREMENTAL (Fine) Tuning to 100 kHz.

b. Set Display Unit controls as follows:

(1) SWEEP to 10 kHz/Div CONTINUOUS, NORM.

(2) ATTENUATOR to 0 dB CAL.

(3) 0 dB CAL for a Reference (CAL) Oscillator signal (left-hand pulse) of 0 dB on the vertical scale.

(4) MARKER for Marker signal (right-hand pulse) of 0 dB.

c. Make the following adjustments:

(1) Adjust the front panel controls 10 kHz/Div CAL and HORIZONTAL POSITION until the Sweep baseline is centered on the screen with about 5% oversweep beyond the end marks on both ends of the horizontal scale.

(2) Adjust A14 R17 (VCXO SENS) until the distance between the Reference Oscillator and Marker signals is equal to the distance from the 0 kHz to the 100 kHz marks on the upper horizontal scale.

(3) Adjust HORIZONTAL POSITION panel control until the Reference Oscillator signal (left-hand pulse) is on the 0 kHz mark.

(4) Readjust R17 until the Marker signal (right-hand pulse) is on the 100 kHz mark.

(5) The HORIZONTAL position and R17 are interacting controls. Repeat (3) and (4) until signals are properly centered at 0 kHz and 100 kHz.

(6) Tune INCREMENTAL (Fine) dial on the voltmeter from 100 k to -10 kHz in 10 kHz steps. Check that the marker signal displays the appropriate kHz divisions of the horizontal scale within ±2 kHz.

d. Set the SWEEP switch to .3 kHz/Div. CONTINUOUS, NORM.

(1) Set the INCREMENTAL (Fine) Tuning of the Voltmeter to 0 kHz. Tune for maximum output on the meter and check that CURSOR index is exactly on the 0 kHz mark of the dial.

(2) Set the INCREMENTAL (Fine) Tuning dial to 1.5 kHz. The Reference Oscillator signal will appear to move to the left on the display. (The Marker signal always appears in the center in the .3 kHz/Div. and 1 kHz/Div. SWEEP modes). NOTE: To correct a slight shift in the marker centering between the 1.0 and 0.3 kHz ranges, adjust the A11 VCXO FREQ. trimmer slightly in the 0.3 kHz/Div. mode.

(3) Adjust R9 on the VCXO module, A11, until the Reference Oscillator signal is on the fifth division to the left of the center of the scale. (At .3 kHz/ this is the 1.5 kHz point.)

(4) Tune the INCREMENTAL (Fine) dial to -1.5 kHz. The Reference Oscillator signal should now be on the fifth division to the right of the center of the scale. Adjust R9 slightly, if necessary, for the best adjustment at both the + and -1.5 kHz points.

15. Spurious Response Suppression

a. Connect Signal Generator to Frequency Selective Voltmeter input.

b. Adjust Signal Generator to 1.05 MHz and 0 dBm output.

c. Adjust Frequency Selective Voltmeter and Signal Generator for 0 dB reading on Voltmeter at approximately 50 kHz on the Incremental dial.

d. Set Display Unit SWEEP to 1 kHz/Div CONTINUOUS and SWEEP RATE switch to FAST.

e. Adjust Signal Generator slightly to get 0 dB pulse at the left side of display.

f. Reduce Frequency Selective Voltmeter attenuator from 0 dBm to -50 dBm.

g. Adjust R4 potentiometer to SWEEP IF module A6 for minimum spurious responses at right side of display.

Notes: Card riser should not be used for this adjustment. If the potentiometer is turned full counterclockwise, the display main signal will disappear. This is not the null desired. The null is rather broad. The two right hand spurious responses should null below -15 dB on the display (-55 dB from overdrive signal present at left side of display).

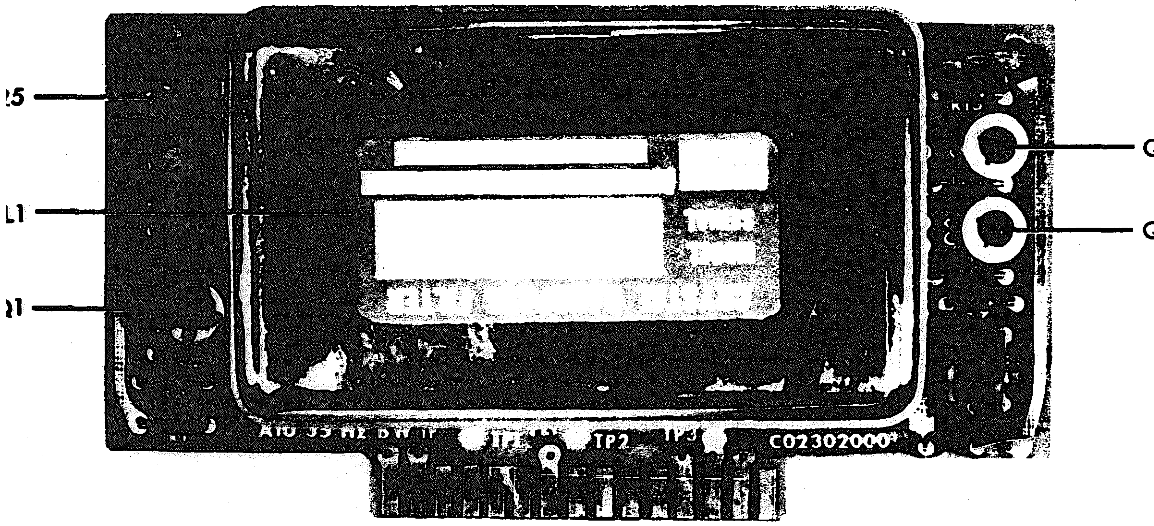
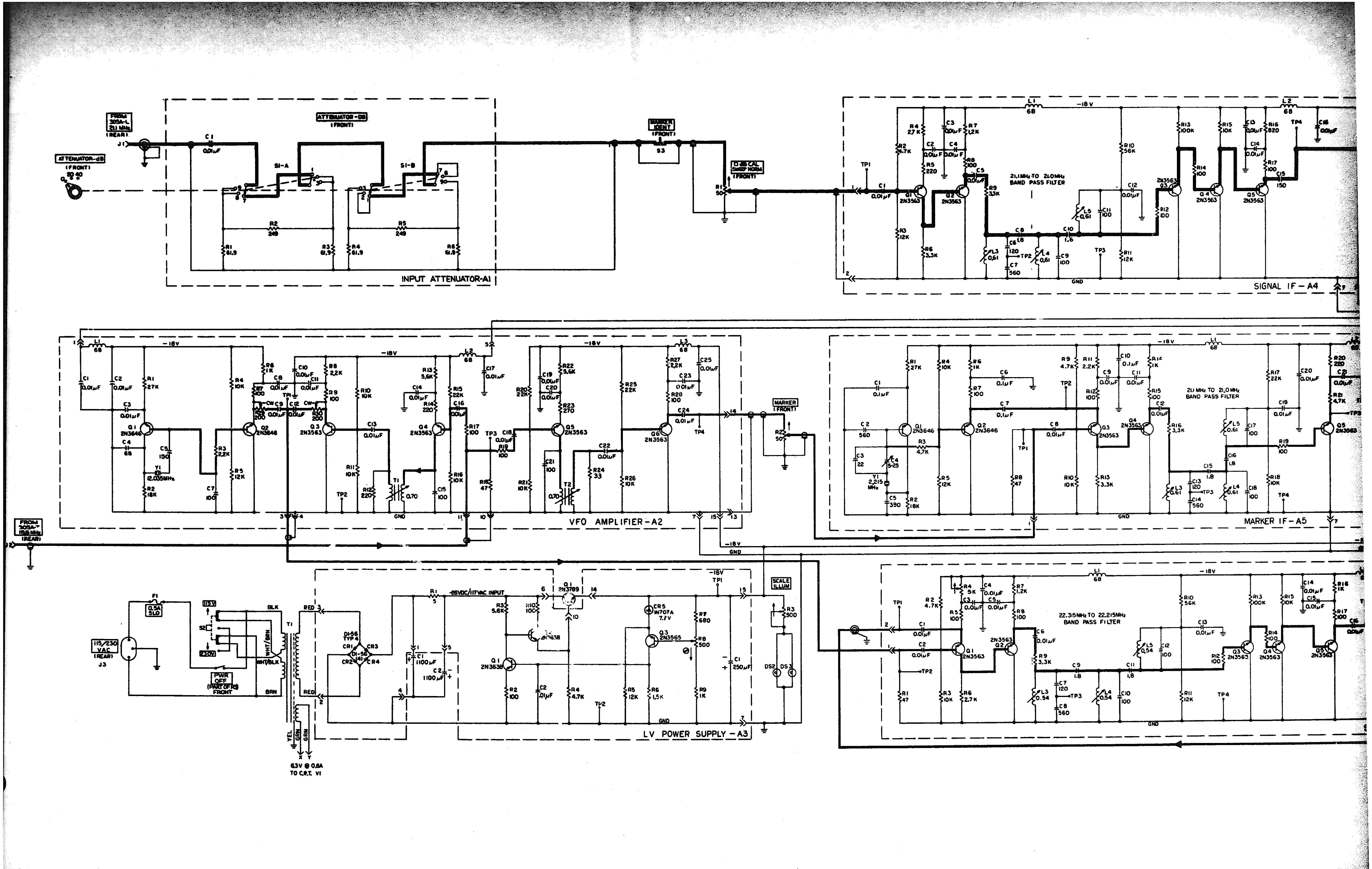
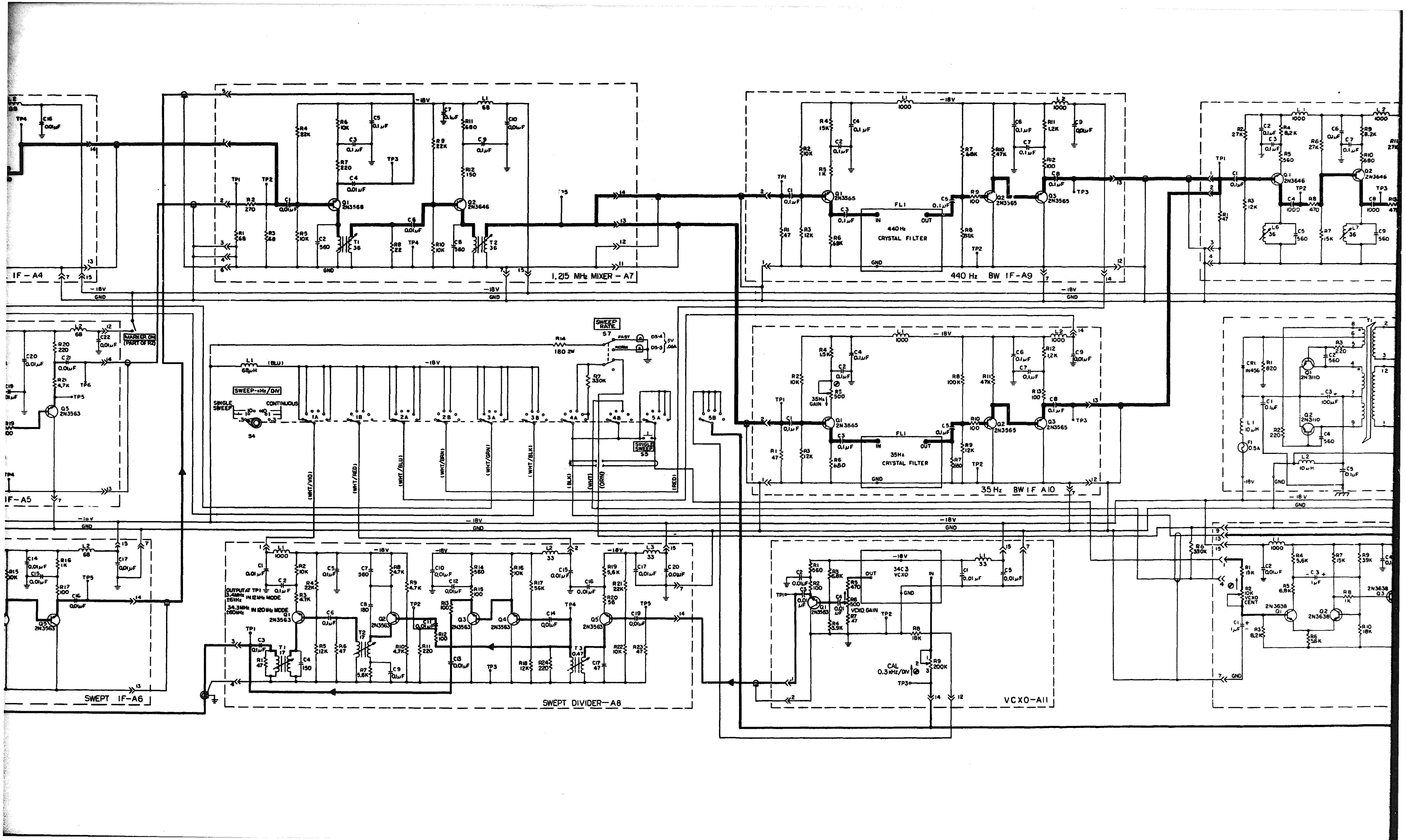


Figure 4-12 Module A10, 35 Hz BW IF C02302000


INPUT ATTENUATOR-A1
SIGNAL IF - A4
VFO AMPLIFIER - A2
MARKER IF - A5
LV POWER SUPPLY - A3
21.1 MHz TO 21.0 MHz BAND PASS FILTER
22.315 MHz TO 22.215 MHz BAND PASS FILTER
6.3V @ 0.6A TO C.R.T. V1


IF - A4
1.215 MHz MIXER - A7
440 Hz BW IF - A9
440 Hz CRYSTAL FILTER
IF - A5
MARKER ON (PART OF R2)
SWEEP RATE
SWEEP-kHz/DIV
SINGLE SWEEP
CONTINUOUS
35 Hz BW IF A10
35Hz CRYSTAL FILTER
SWEPT IF - A6
SWEPT DIVIDER - A8
VCXO - A11
34C3 VCXO
VCXO GAIN
CAL 0.3 kHz/DIV

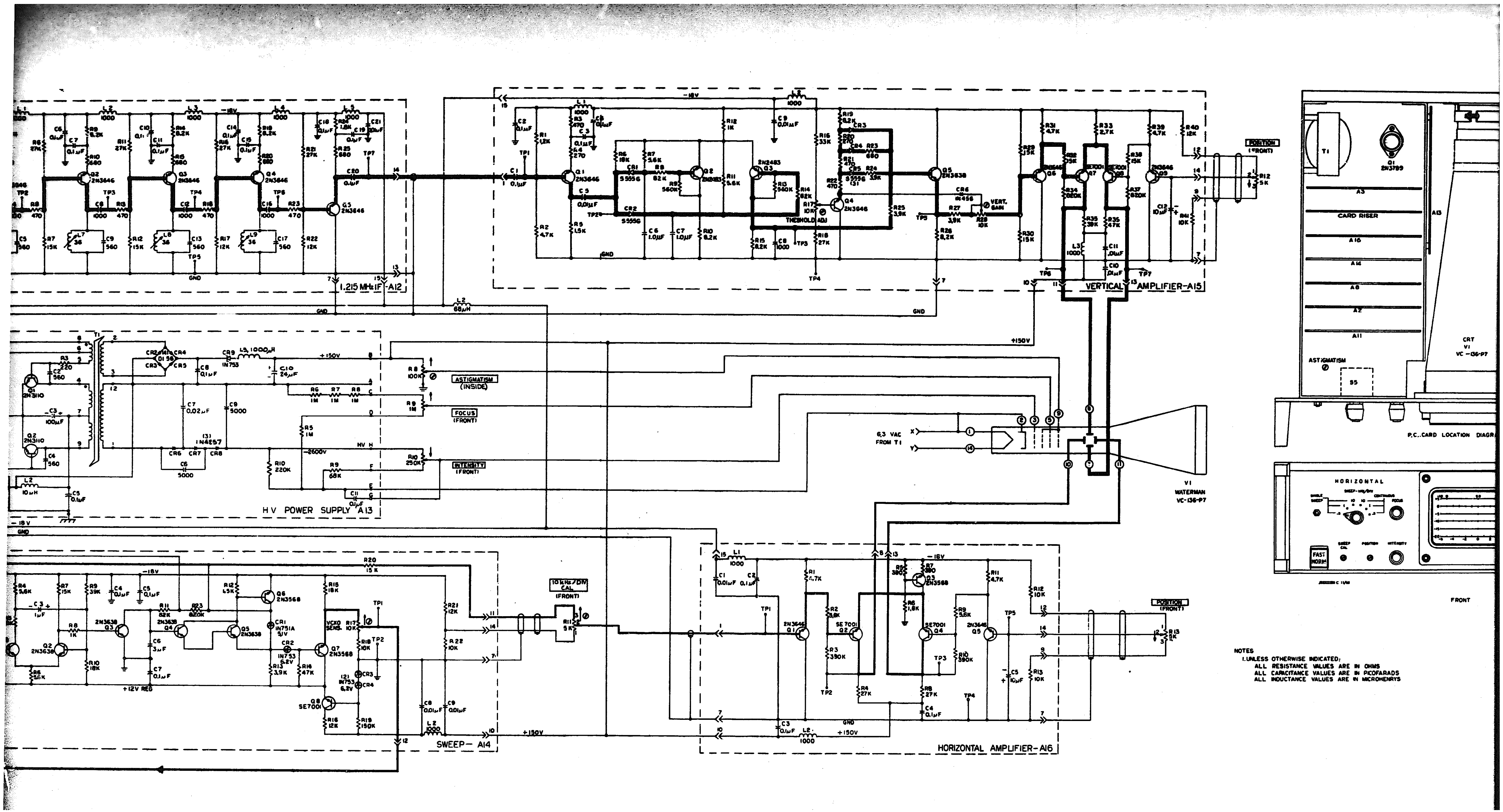


Figure 4-13. Mod

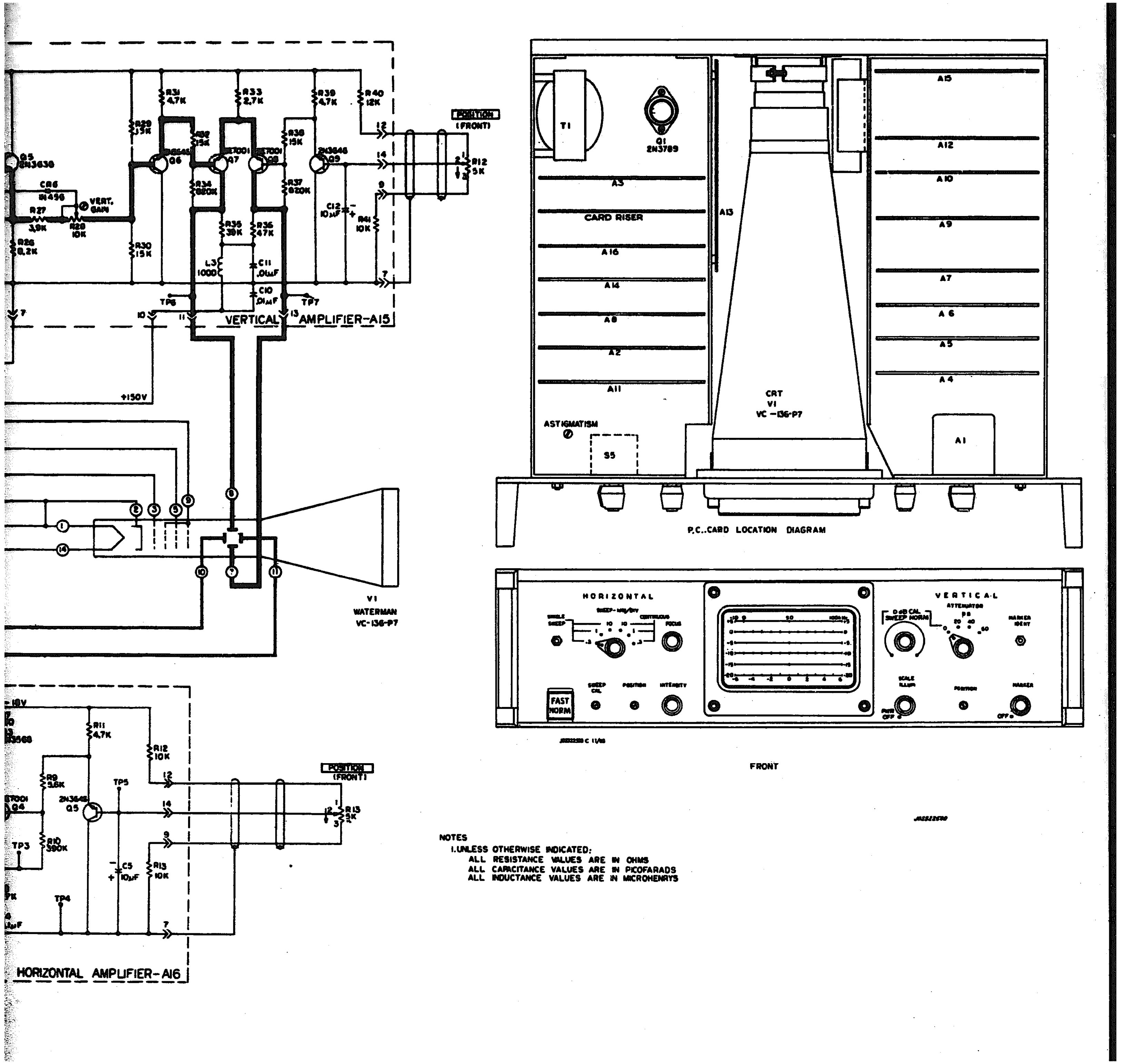


Figure 4-13. Model 36OA Schematic Diagram

APPENDIX A

REFERENCES

DA PAM 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals, (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA PAM 310-7	Index of U.S. Army Equipment Modification Work Orders.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TM 38-750	The Army Maintenance Management Systems (TAMMS).

APPENDIX B

MAINTENANCE ALLOCATION

SECTION I. INTRODUCTION

B-1. GENERAL

This appendix provides a summary of the maintenance operations covered in the equipment literature for Sierra Spectrum Display Unit Model 360A. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each fusion. This appendix may be used as an aid in planning maintenance operations.

B-2 Maintenance Functions

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

b. Test. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc. This is accomplished with external test equipment and does not include operation of the equipment and operator type tests using internal meters or indicating devices.

c. Service. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

d. Adjust. To rectify to the extent necessary to bring into proper operating range.

e. *Align.* To adjust two or more components or assemblies of an electrical or mechanical system so that their functions are properly synchronized. This does not include setting the frequency con- -1 knob of radio receivers or transmitters to the desired frequency.

f. Calibrate. To determine the corrections to be made in the readings of instruments or test equip ment used in precise measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

g. Install. To set up for use in an operational environment such as an encampment, site, or vehicle.

h. *Replace.* To replace unserviceable items with serviceable like items.

i. Repair. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes, but is not limited to welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. Overhaul. Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

k. Rebuild. The highest degree of material maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

l. *Symbols. The* uppercase letter placed in the

appropriate column indicates the lowest l which that particular maintenance functi be performed.

B-3. Explanation of Format

a. Column 1, Group Number. **Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.**

b. Column 2, ***Functional Group. Column 2 lists*** **the noun names of components, assemblies, subassemblies and modules on which maintenance is authorized.**

c. Column 3, Maintenance Functions. Column **3 lists the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The codes used represent the various maintenance categories as follows:**

Code	Maintenance Category
C	Operator/crew
O	Organizational maintenance
F	Direct support maintenance
H	General support maintenance
D	Depot maintenance

d. Column 4, Tools and Teat Equipment. **Column 4 specifies, by code, those tools and test equipment required to perform the designated function. The numbers appearing in this column refer to specific tools and test equipment which are identified in table I.**

e. Column 5, Remarks. Self-explanatory.

B-4 Explanation of Format of Table 1, Tool and Test Equipment Requirements

The columns in Table I, Tool and Test Equipment Requirements are as follows:

a Tools and Equipment. The **numbers in this column coincide with the numbers used in the tools and equipment column of the maintenance allocation chart. The numbers indicate the applicable tool for the maintenance function.**

b. Maintenance Category. The **codes in this column indicate the maintenance category normally allocated the facility.**

c. Nomenclature. **This column lists tools, test, and maintenance equipment required to perform the maintenance functions.**

d. Federal Stock Number. **This column lists the Federal stock number of the specific tool or test equipment.**

e. Tool Number. Not **used.**

SECTION II. MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS: INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	TOOLS AND EQUIPMENT	REMARKS
1	SPECTRUM DISPLAY UNIT, SIERRA, 340A	F												Visual
			H										1 thru 8	
				F									8	
					H								1 thru 8	
										F			8	Replace fuses, knobs.
										H			1 thru 8	
1A	INPUT ATTENUATOR, A1, C02223000		H										5,6,8	
										H			5,6,8	
1B	HV POWER SUPPLY A13, C02302300		H										5,8	
										H			5,8	
1C	UFO AMPLIFIER, A2 C02300400		H										1,2,4,8	
					H								1,2,4,8	
									H				8	
										H			1 thru 8	
1D	L.V. POWER SUPPLY A3, C02300500		H										6,8	
					H								6,8	
									H				8	
										H			1 thru 8	
1E	SIGNAL IF., A4 C02301400		H										2,3,7,8	
					H								2,3,7,8	
									H				8	
										H			1 thru 8	
1F	IF. MARKER, A5 C002301500		H										1,2,5,7,8	
					H								1,2,5,7,8	
									H				8	
										H			1 thru 8	
1G	SWEEP IF., A6 C02301600		H										1,2,8	
					H								1,2,8	
									H				8	
										H			1 thru 8	

SECTION II. **MAINTENANCE ALLOCATION CHART**

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	TOOLS AND EQUIPMENT	REMARKS
	SPECTRUM DISPLAY UNIT, SIERRA, 340A (Continued)													
1H	1.215 MHZ MIXER, A7 C02301700		H										1,3,4,8	
					H								1,3,4,8	
									H				8	
										H			1 thru 8	
1I	SWEEP DIVIDER, A8 C02301800		H										4,7,8	
					H								4,7,8	
									H				8	
										H			1 thru 8	
1J	440 HZ BW IF., A9 C02301900		H										1 thru 8	
									H				8	
										H			1 thru 8	
1K	35 HZ BW IF., A10 C02302000		H										1 thru 8	
					H								8	
									H				8	
										H			1 thru 8	
1L	VOLTAGE CONTROL CRYSTAL OSCILLATOR, A11 C02302100		H										2,8	
					H								2,8	
									H				8	
										H			1 thru 8	
1M	1.215 MHZ IF., A12 C02302200		H										3,4,8	
					H								3,4,8	
									H				8	
										H			1 thru 8	
1N	SWEEP, A14 C02302400		H										4,8	
					H								4,8	
										H			8	
											H		1 thru 8	

SECTION II. MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	TOOLS AND EQUIPMENT	REMARKS
	SPECTRUM DISPLAY UNIT, SIERRA, 340A (Continued)													
10	VERTICAL AMPLIFIER, A15, C02302500		H										1,3,7,8	
					H								1,3,7,8	
									H				8	
										H			1 thru 8	
1P	HORIZONTAL AMPLIFIER, A16, C02302600		H										1 thru 8	
									H				8	
										H			1 thru 8	

TABLE I. **TOOL AND TEST EQUIPMENT REQUIREMENTS**

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE Recommended in Manual	NOMENCLATURE Available on Site	FEDERAL STOCK NUMBER	TOOL NUMBER
1	H	FREQUENCY SELECTIVE V)LTMETER, SIERRA, 128A	FREQUENCY SELECTIVE VOLTMETER, SIERRA ,128A		
2	H	RF MICROVOLTMETER, MILLIVAC MODEL MV-28B W/TYPE G HIGH IMPEDANCE PROBE			
3	H	SIGNAL GENERATOR, HEWLETT PACKARD, 606A	SIGNAL GENERATOR, HEWLETT PACKARD, 606A		
4	H	OSCILLOSCOPE, TEKTRONIX, 543B W/PLUG-IN, MODEL 53/54L	OSCILLOSCOPE, TEKTRONIX, 561A, W/PLUG-IN UNITS 2B67, 3A72 AND PROBE P6028		
5	H	A.C. VTVM, HEWLETT PACKARD, 400L	A.C. VTVM, HEWLETT PACKARD, 400L		
6	H	D.C. VTVM, HEWLETT PACKARD, 412A	D.C. VTVM, HEWLETT PACKARD, 410C		
7	H	ELECTRONIC COUNTER, HEWLETT PACKARD, 5245L	ELECTRONIC COUNTER, HEWLETT PACKARD, 5245L		
8	F,H		TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-605-0079	

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USAESC (25)
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SAAD (10)
TOAD (10)
LEAD (7)
Cp Carroll Army Dep (3)
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USAAVSCOM Dep (3)

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USASUPCOM-CRB (5)
USASUPCOM-SGN (5)
USASTRATCOM Comm Op Bn, Korea (2)
Sig FLDMS (pac) (1)
Units org under fol TOE :-2 ea.
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11-45
11-97
11-98
11-168
11-802
11-303
11-347
11-357
11-367
11-368
11-377
11--500(AA-AC)
22-118
29-134
29-136
29-137

ARNG & USAR: None.

For explanation of abbreviations used, see AR 310-50.

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1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

'EIGHTS

Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

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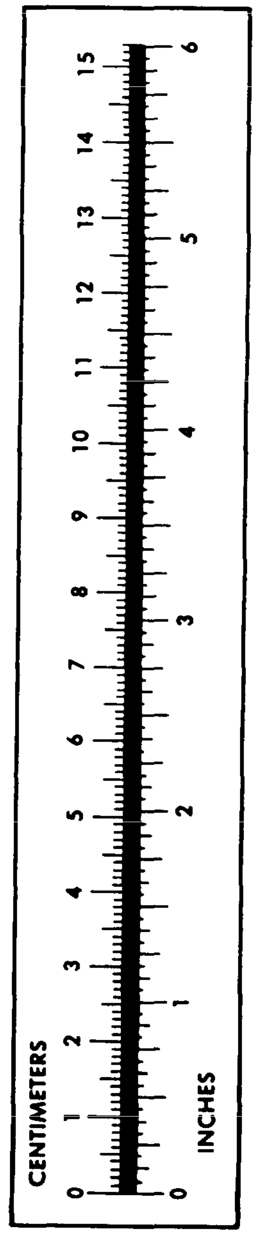
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
ıts	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

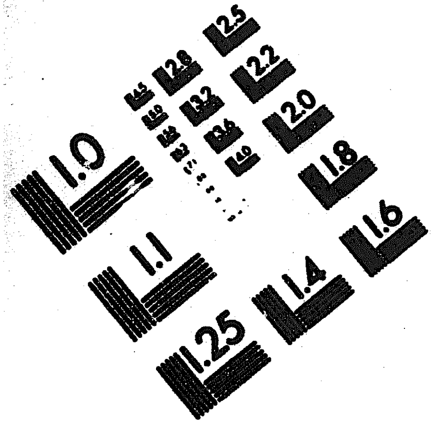
TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
'ers	Gallons	0.264
.ms	Ounces	0.035
.ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
'lometers per Liter	Miles per Gallon	2.354
›meters per Hour	Miles per Hour	0.621

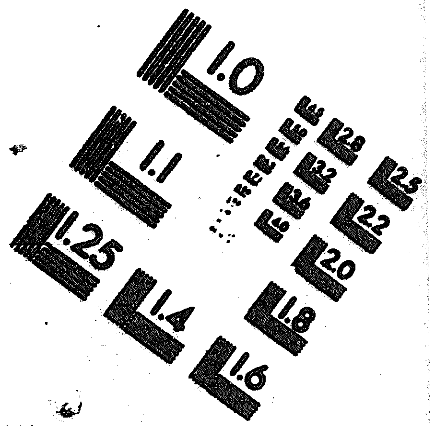


PIN: 016383-000

DEPARTMENT OF THE ARMY

MICROFORM
TEST TARGET





150 MM

1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

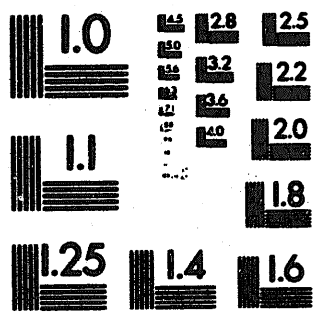
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*



1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

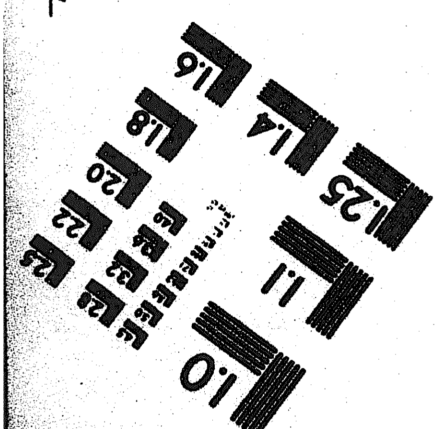
2.0 mm (e= 1.37 mm)

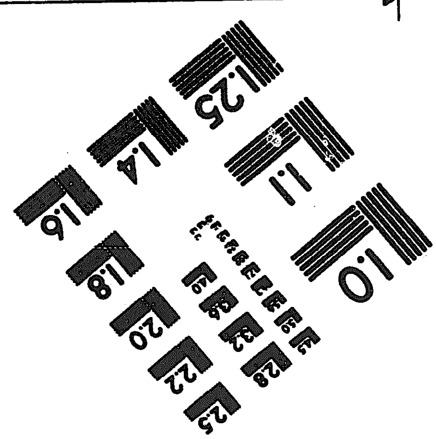
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

200 MM





250 MM