INSTRUCTION MANUAL

Serial Number ______________

PENTRIX SPECTRØPULSE

MODEL

L-20/30

and SERIES L-NARROW BAND UNITS

Tektronix, Inc.

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070-459

864

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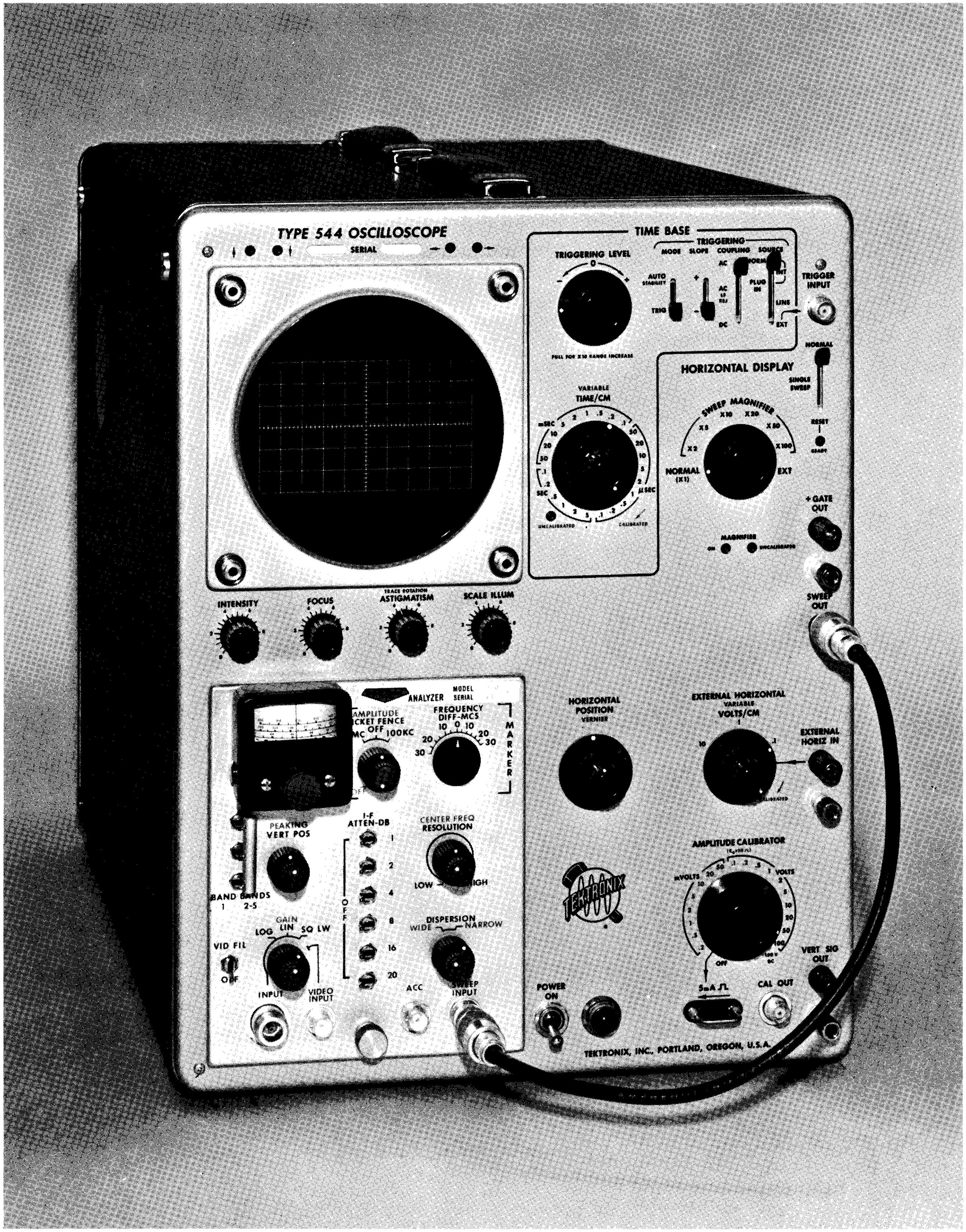
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SECTION I

INTRODUCTION

1-1. GENERAL

The spectrØpulse Narrow Band and Multi-Band Model L Spectrum Analyzers are designed for use in Tektronix Oscilloscopes for the panoramic presentation of R-F signals in the frequency range above 10 mc. The frequency distribution of the signal is displayed on the oscilloscope with signal energy on the vertical axis and the frequency along the horizontal axis. The analyzers are designed for interchangeability with the Tektronix Letter Series Plug-Ins. The analyzers plug directly into the basic oscilloscope, deriving all their power from the oscilloscope.

The spectrØpulse Narrow Band and Multi-Band Model L Spectrum Analyzers are identical with the exception of the R-F local oscillators and spurious rejection filters. The Multi-Band Model L-20 contains local oscillators operating at VHF and UHF, and the Multi-Band Model L-30 local oscillator tunes through the L-Band. The series L Narrow Band oscillators tune bandwidths of approximately 10 percent.

1-2. APPLICATIONS

spectrØpulse Spectrum Analyzers provide a rapid and accurate method for display and analysis of the frequency distribution of energy over a wide range of frequencies. Controls are provided on the plug-in unit to optimize unit performance for a wide variety of signals and modulation encountered in actual practice. Some typical applications of spectrØpulse Spectrum Analyzer units are:

a. Modulation Analysis. Qualitative and Quantitative measurements of:

   1. Sidebands associated with AM and FM signals.

   2. Spectral characteristics of pulsed signals.

b. Signal Purity Measurements of:

   1. Incidental AM and FM.

   2. Harmonic content of unmodulated and modulated signals.

c. Frequency Determination of:

   1. Signals within the range of the analyzer.

d. Sensitive Indicator. Large dynamic range-sensitive tuned indicator for measurements of:

   1. Attenuation

   2. Gain

   3. Insertion Loss

   4. VSWR

e. Alignment Tool. Visual indicator for microwave alignment and troubleshooting, such as:

   1. Tracking of the receiver and transmitter of a radar set.

f. Time Domain Characteristic Determination. Calibrated oscilloscope provides an accurate means of measuring:

   1. Pulse width and repetition rate.

   2. Rise and decay time.

   3. AM modulation.

1-3. EQUIPMENT SUPPLIED

a. spectrØpulse Spectrum Analyzer

b. Sweep Input Cable Assembly

c. Instruction Manual

1-4. ELECTRON TUBE, TRANSISTOR, AND CRYSTAL COMPLEMENT:

V301	12AU6	
V302	12AU7	
V303	12AT7	
V304	7486	L-20
V305	7486	L-20
V304	5675	L-30
V304	7486	Narrow Band
Q101	2N2996	
Q102	2N2996	
Q103	2N1743	
Q104	2N1744	
Q201	2N1745	
Q202	2N1745	
Q203	2N1745	
Q204	2N1745	
Q205	2N1745	
Q401	2N1745	
Q601	2N2996	
Q602	2N2996	
CR202	HU6C	(54MC)
CR601	HC18V	(5 MC)
CR301	1N416D	L-20
CR301	1N415D	L-30
CR301	1N415D	Narrow band
CR301*	1N78B 1N78RB	L-5058/3

*matched pair

SECTION II
SPECIFICATIONS

2-1. DETAILED SPECIFICATIONS AND MODEL NUMBERS FOR NARROW BAND ANALYZERS

FREQUENCY RANGE (MC)	MODEL NUMBER	MINIMUM SENSITIVITY (-DBM)	FREQUENCY RANGE (MC)	MODEL NUMBER	MINIMUM SENSITIVITY (-DBM)
400 - 850	L-0408	105	4200 - 4800	L-4248	105
800 - 1250	L-0812	105	4350 - 5000	L-4350	105
1200 - 1400	L-1214	105	4600 - 5200	L-4652	105
1400 - 1750	L-1417	105	4750 - 5400	L-4754	105
1550 - 1900	L-1519	105	5000 - 5650	L-5056	105
1600 - 1800	L-1618	105	5000 - 5800	L-5058	105
1800 - 2100	L-1821	105	5400 - 6200	L-5462	105
1950 - 2300	L-1923	105	5600 - 6600	L-2732/2	100
1975 - 2225	L-1922	105	6000 - 7000	L-3136/2	100
2200 - 2500	L-2225	105	6300 - 7300	L-3035/2	100
2300 - 2900	L-2329	105	6700 - 7700	L-3439/2	100
2375 - 2625	L-2326	105	7600 - 8600	L-3742/2	100
2600 - 2900	L-2629	105	7800 - 9000	L-3844/2	100
2700 - 3200	L-2732	105	8000 - 9000	L-4146/2	100
2800 - 3300	L-2833	105	8200 - 9400	L-4248/2	100
3050 - 3550	L-3035	105	8900 - 10200	L-4350/2	100
3100 - 3600	L-3136	105	9300 - 10600	L-4754/2	100
3450 - 3950	L-3439	105	9400 - 10700	L-4652/2	100
3700 - 4200	L-3742	105	9800 - 11100	L-5650/2	100
3800 - 4400	L-3844	105	10200 - 11800	L-5058/2	100
4100 - 4600	L-4146	105	10600 - 12200	L-5462/2	100
			15400 - 17800	L-5058/3	90

FREQUENCY ACCURACY ±0.1%

FREQUENCY LINEARITY ±2.0%

DISPERSION Narrow, 10 kc to 5 mc
Wide, 100 kc to 60 mc

DETAILED SPECIFICATIONS FOR NARROW BAND ANALYZERS

DISPLAY FLATNESS	±3 db
MAXIMUM INPUT POWER	-30 dbm
RESOLUTION BANDWIDTH	1 kc to 100 kc, variable
INCIDENTAL FM (including Microwave L.O.)	800 cps L-0408 to L-3439 1000 cps L-3742 to L-5462 1500 cps L-2732/2 to L-5462/2 1800 cps L-5058/3
SWEEP RATE	Determined by scope TIME/CM typically .02 cps to 1 kc calibrated
I-F ATTENUATOR	51 db ±0.1 db/db in 1 db steps
I-F GAIN CONTROL	50 db range
MARKERS	±30 mc continuously variable with 100 kc and 1 mc Picket Fences
DISPLAY	Log 40 db Linear 26 db Square Law 13 db Video 0.1 v/cm at 10 cps to 10 mc
PHYSICAL DIMENSIONS	Identical to Tektronix Letter Series Plug-in Units

2-2. DETAILED SPECIFICATIONS FOR MULTI-BAND ANALYZERS

MODEL L-20 (10 - 4,000 MC)			MODEL L-30 (1,000 - 10,000 MC)		
BAND	FREQUENCY RANGE (MC)	MINIMUM SENSITIVITY (-DBM)	BAND	FREQUENCY RANGE (MC)	MINIMUM SENSITIVITY (-DBM)
1	10 - 230	115 - 90	1	1000 - 2000	100
2	230 - 900	120 - 100	2	2000 - 4200	90
3	900 - 2000	115 - 95	3	4200 - 6400	80
4	2000 - 3100	110 - 90	4	6400 - 8600	70
5	3100 - 4000	100 - 80	5	8600 - 10400	65

FREQUENCY ACCURACY	2 mc plus 1% of dial reading
FREQUENCY LINEARITY	±3%

DETAILED SPECIFICATIONS FOR MULTI-BAND ANALYZERS

DISPERSION	Narrow, 2.5 kc to 5 mc Wide, 100 kc to 60 mc
DISPLAY FLATNESS	±3 db
MAXIMUM INPUT POWER	-30 dbm
RESOLUTION BANDWIDTH	1 kc to 100 kc, continuously variable
INCIDENTAL FM (at L.O. fundamental)	800 cps
SWEEP RATE	Determined by scope TIME/CM typically .02 cps to 1 kc calibrated
I-F ATTENUATOR	51 db ±0.1 db/db in 1 db steps
I-F GAIN CONTROL	50 db, continuously variable
MARKERS	±30 mc, continuously variable with 100 kc and 1 mc Picket Fences
DISPLAY	Log 40 db Linear 26 db Square Law 13 db Video 0.1 volt/cm, 10 cps to 10 mc
PHYSICAL DIMENSIONS	Identical to Tektronix Letter Series Plug-in Units

2-3. FUNCTIONS OF CONTROLS

a. FREQUENCY Control determines the R-F frequency of the analyzer.

b. VERT POS Control determines the vertical position of the trace on the CRT.

c. GAIN Control determines the vertical gain of the unit.

d. LOG, LIN, SQ LW, VIDEO INPUT switch determines the type of display presented.

e. I-F ATTEN toggle switches determine the value of I-F attenuation.

f. MARKER

PICKET FENCE - 1 MC - OFF - 100 KC switch determines whether the marker picket fence is off or set for 1 mc or 100 kc increments.

AMPLITUDE Control determines the amplitude of the marker oscillator.

FREQUENCY DIFF - MC Control determines the frequency of the internal marker relative to center frequency.

g. CENTER FREQ Control determines the center frequency around which the analyzer is sweeping, that is, the freq-quency to which the center of the screen corresponds.

h. RESOLUTION - HIGH - LOW - The setting of this control determines the bandwidth of the last I-F (5 mc) amplifier. HIGH corresponds to 100 kc resolution and LOW corresponds to 1 kc resolution.

i. DISPERSION Variable control - determines the frequency width of the display.

j. Dispersion: - WIDE - NARROW - The setting of this two position switch determines the range of the variable DISPERSION control.

k. PEAKING Control determines the sensitivity of the mixer.

l. BAND 1 - BAND 2-5 Switch determines the frequency band of operation.

m. VID FIL is a two position on-off switch that determines the video bandwidth. Narrow bandwidth (filter in) restricts the bandwidth to prevent occurence of "zero beats" when resolving signals close to the minimum resolution of the unit.

SECTION III
OPERATING INSTRUCTIONS

3-1. PREPARATION FOR OPERATION

The Model L Spectrum Analyzers are complete and ready for operation when unpacked from their containers. No special precautions are required other than the normal unpacking procedures associated with oscilloscope plug-in units.

a. Plug the analyzer into the oscilloscope and tighten the knurled securing knob located at the bottom of the adapter.

b. Connect the special cable supplied with the analyzer between the SWEEP INPUT of the adapter and the SAWTOOTH OUTPUT of the oscilloscope.

c. The unit is now ready for operation.

3-2. OPERATING PROCEDURE

The following procedure is to be followed prior to making specific measurements with the analyzer:

a. Turn the oscilloscope power switch to the ON position. Allow a fifteen minute warm-up period for the oscilloscope and the analyzer to stabilize.

b. With the sweep mode in the recurrent position and set for 20 milliseconds, adjust the oscilloscope HORIZONTAL GAIN, HORIZONTAL POSITION, FOCUS, INTENSITY, and ASTIGMATISM controls to obtain a sharp base line on the CRT.

c. Adjust the VERT POS control on the analyzer to locate the base line on the CRT to coincide with the lowest horizontal line on the CRT graticule.

d. Switch the DISPERSION switch to WIDE and rotate the DISPERSION control clockwise to maximum dispersion.

e. Rotate the RESOLUTION control fully clockwise to the HIGH position.

f. Set LOG, LIN, SQ LW switch to the LIN position and adjust the GAIN control to obtain approximately 1/8 inch of noise on the baseline.

g. Turn the MARKER on and set the FREQUENCY DIFF control to the "0" position.

h. Adjust the CENTER FREQ control so that the marker signal on the screen is at the center of the CRT.

i. Connect the R-F signal to be analyzed to the INPUT connector on the analyzer panel. If the signal strength is greater than -30 dbm, an external attenuator must be used.

j. Set the R-F frequency of the analyzer to the frequency of the incoming signal by means of the FREQUENCY control.

k. Adjust the GAIN control and/or the I-F ATTEN control so that the vertical deflection of the signal is at a convenient level. (See the section on determination of the frequency of an R-F signal to determine the true signal.)

NOTE

Some of the specifications (sensitivity and flatness) for these analyzers are based on the assumption that the signal source is fifty ohms and resistive. Operation from a source that is highly reactive will have an adverse effect on the flatness. It is suggested that a 6 db attenuator be used on the front end (INPUT) when good conversion flatness is desired and sufficient signal level is available.

3-3. DETERMINATION OF THE FREQUENCY OF AN R-F SIGNAL

To determine if a signal on the screen is the signal indicated by the tuning dial, it must be established whether the proper oscillator harmonic is indicated on the dial and whether the signal indicated is the image or the true frequency.

a. Local Oscillator Harmonic - To determine if the dial reading is correct, adjust the screen for greater than 50 mc dispersion and then move the signal by use of the FREQUENCY control so that it moves 50 mc on the CRT screen. If the R-F dial also indicates a 50 mc change, then the correct R-F frequency is indicated. If the dial moves less than 50 mc, then a higher frequency must be selected. If the dial moves more than 50 mc, then a lower frequency must be selected.

b. Image Frequency - Rotate the FREQUENCY dial in the direction of increasing frequency. If the signal on the CRT moves from the left side of the screen to the right, then the tuning head is tuned to the true signal. If the signal moves in the opposite direction, then an image signal has been selected. If this is the case, then the R-F head must be tuned to twice the I-F frequency (400 mc) higher than its present setting.

3-4. DISPLAYING SPECTRA OF PULSE MODULATED SIGNALS

a. Turn the MARKER on, set the FREQUENCY DIFF control to zero (mid-position), and adjust the AMPLITUDE so that the marker is clearly visible.

b. Tune the FREQUENCY control so that the peak of the main lobe coincides with the marker.

c. Adjust the DISPERSION control and the I-F ATTEN so that the desired number of side lobes are shown on the screen and the main lobe fills the screen vertically.

d. Adjust the sweep rate of the oscilloscope so that the spectrum is well defined (Sweep Rate = 1/50 prr).

e. Optimize the RESOLUTION control so that the spectrum zeros are discernible without ringing or excessive loss in sensitivity.

f. The equivalent rectangular pulse width may be determined from the spectrum presentation:

1. Measure the width of the main lobe (Δf main) or side lobe (Δf side) as described in the section on frequency difference measurement.

2. Calculate the pulse width (T)

$$T = \frac{2}{f \text{ main}}$$

$$T = \frac{1}{f \text{ SIDE}}$$

T = Pulse width (microseconds)
Δf main = Width of the main lobe (mc)
Δf side = Width of side lobe (mc)

3-5. MEASURING THE PRF OF A PULSE SIGNAL

a. Set the dispersion to zero by turning the Dispersion WIDE-NARROW control to the NARROW position and

b. Set the variable DISPERSION control fully CCW.

c. The unit is not operating as a time base oscilloscope, and each line of the screen is equivalent to one pulse. Count the number of pulses per box on the screen and use the oscilloscope calibrated sweep rate to compute the PRF of the incoming signal.

3-6. RELATIVE POWER MEASUREMENT

The choice of the correct detection law can simplify relative power measurements. The LOG position is used when signals of greatly different amplitudes (such as the relationship of main lobe to side lobe of a rectangular pulse) are to be measured. When signals of approximately equal levels are to be measured, then the square law detector will produce the most accurate results.

a. Adjust the FREQUENCY control so that the largest signal is in the center of the screen. Adjust the I-F ATTEN so that the signal occupies the full screen (graticule).

b. Rotate the FREQUENCY control so that the second signal occupies the center of the screen, and note its deflection.

c. Compute power difference

1. LIN scale ΔPower (db) = $20\log D_1/D_2$
2. LOG scale ΔPower (db) = $(D_1 - D_2)5$
3. SQ LW scale ΔPower (db) = $10 \log D_1/D_2$

where:
D_1 is the vertical deflection in divisions of the largest signal, and D_2 is the vertical deflection in divisions of the smaller signal.

3-7. PRECISION MEASUREMENT OF RELATIVE POWER

The precision measurement of relative power can be made by using the I-F ATTEN. Using the lower level as a reference point on the screen and noting the setting of the I-F ATTEN (A_1). Increase the I-F attenuation until the higher level signal is reduced to the same reference deflection. The difference between the initial I-F ATTEN reading (A_1) and the second reading (A_2) is the relative power difference in db or

$$\Delta P \text{ (db)} = A_2 - A_1$$

3-8. FREQUENCY DIFFERENCE MEASUREMENT.

The spectrum analyzer is ideally suited for the measurement of the frequency difference between two or more closely spaced signals or to determine the width of any lobe of a signal spectrum.

a. Rotate the FREQUENCY control to move the signals or spectrum to be measured to the center of the CRT display.

b. Adjust the DISPERSION control so that the frequencies of interest occupy the full screen.

c. Rotate the FREQUENCY DIFF control so that the marker pip coincides with one signal or with one edge of the spectrum lobe, and note the reading of the dial.

d. Rotate the FREQUENCY DIFF control so that the marker pip coincides with the other signal or edge of the spectrum lobe.

e. The difference between the two readings of the frequency dial (in megacycles) is the spacing between the two signals or the width of the spectrum lobe being measured.

f. The numbers on the left-side of the FREQUENCY DIFF control represent an increase in marker Frequency and should be added to the dial reading in frequency measurements, the right-hand settings of the FREQUENCY DIFF control should be subtracted from the dial reading.

3-9. PRECISION FREQUENCY MEASUREMENT

For precision frequency measurement, the PICKET FENCE is used. The PICKET FENCE, when turned on, will be superimposed on the display. The PICKET FENCE markers are spaced at equal frequency intervals. To measure the frequency difference between two points on the screen, count the number of markers between the points to be measured. The graticule division may be used to interpolate the frequency interval between markers.

For very fine frequency difference measurements, use the horizontal sweep width magnification of the oscilloscope (X5 position). This will decrease the frequency difference observed on the screen by a factor of five.

3-10. FREQUENCY STABILITY MEASUREMENT

The analyzer provides an accurate and rapid method for determining the stability of an R-F source under conditions of varying time, temperature, altitude, or load.

a. Follow the operating procedure in paragraph 3-2.

b. Adjust the marker initially so that it coincides with the signal under test. Record the marker position.

c. Repeat the marker setting at the end of the test and record the final reading of the marker.

d. The difference between marker readings at the start and the end of the test is the variation of frequency caused by the changing parameter.

3-11. OPTIMIZING RESOLUTION

The resolution of the spectrum analyzer is the measure of the capability of the instrument to separate individual signals. The resolution of the analyzer is a function of both the I-F bandwidth and the sweep frequency rate.

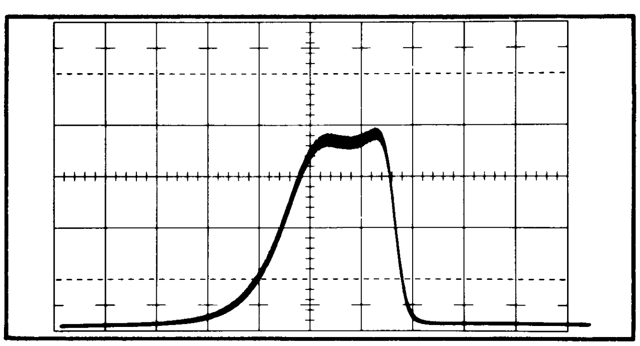


Fig. 3-1. I-F Response.

a. CW Signal
At zero or extremely low sweep rates, the effective resolution is determined by the 3 db bandwidth and will closely resemble the bandpass characteristics of the I-F (see Fig. 3-1). The factor by which the 3 db bandwidth must be reduced for infinite dispersion and sweep rates is given by

$$F = \left[1 + 0.195\left(\frac{fD}{B^2}\right)^2\right]^{1/2}$$

where

B = 3 db bandwidth of the I-F

D = Dispersion in cycles per second

f = Sweep rate in cycles per second

The resolution equals F x B

The sensitivity of the spectrum analyzer to CW signals is dependent on dispersion and resolution. The loss of sensitivity can be expressed mathematically:

$$S = S_o \left[1 + 0.195\left(\frac{fD}{B^2}\right)^2\right]^{1/4}$$

where S_o = Sensitivity at zero dispersion or zero sweep speed, and

S = Sensitivity at sweep rate f and dispersion D.

To optimize resolution for a given dispersion, set the bandwidth for the maximum at which no loss of sensitivity is evidenced. When examining two closely spaced CW signals, the RESOLUTION control is adjusted until two signals can be separated.

b. Pulse Signals
Sensitivity of the spectrum analyzer to a pulsed signal is a function of the bandwidth of the instrument. However, if the bandwidth is too large, the minima of the spectrum are no longer zero. An analyzer is optimized for operation under pulsed conditions by first adjusting the sweep speed for approximately 40 PRF lines in the principal lobe of the spectrum and then adjusting the RESOLUTION control for well-defined lobe zeros without ringing. This setting corresponds to bandwidth-pulse width products of 0.1 or less.

SECTION IV
THEORY OF OPERATION

4-1. GENERAL THEORY

The spectrØpulse Spectrum Analyzer is a superheterodyne receiver which is electronically swept over a portion of the electromagnetic spectrum. The horizontal deflection of the electron beam on the CRT is synchronized with the electronic sweep, at the same time the vertical deflection of the beam is proportional to the receiver output. The display that results is that of signal strength as a function of frequency.

4-2. CW SIGNALS

A CW signal will appear on the screen as a pip. The shape of the pip is a function of the frequency and response of the final I-F amplifier. The spectrØpulse Spectrum Analyzer has a continuously variable final bandwidth or resolution that can be adjusted, from the front panel, between 1 kc and 100 kc.

4-3. PULSE SIGNALS

A pulse signal will appear on the screen as a series of lines, the locus of which represents the energy distribution of the signal as a function of frequency. Frequency domain representations for a wide variety of waveforms are to be found in "Design Data for Radio Engineers", ITT Handbook, Chapter 35.

The appearance of the pulse depends to a great extent on the type of display: log, lin, or sq. lw. Thus, the sidelobes will be accentuated when operating log (40 db full screen) as compared to square law (13 db full screen). The relative amplitude of two portions of the signal can, however, at all times be determined by reducing the larger to the level of the smaller by means of the calibrated I-F ATTEN.

4-4. MARKER

The marker is used as a means of determining frequency differences between different signals displayed at the same time, or different portions (e.g. nulls of pulsed R-F) of the same signal. The purpose of the picket fence is to permit calibration of the screen in finer increments that can be read from the dial. The appearance of the marker, when the picket fence is on, is shown in Figure 5-4.

4-5. SIMPLIFIED SYSTEM BLOCK DIAGRAM

Figure 4-1 is a block diagram of the I-F system. The signal is converted to the I-F frequency (centered at 200 mc) by means of the R-F mixer and local oscillator. The filter network prevents spurious signals from being generated by the local oscillator and fed into the I-F amplifier. The signal is amplified in the wideband amplifier (170-230 mc) and then mixed with a sweep oscillator signal swept from 229 to 289 mc in synchronism with the time base of the oscilloscope. The signal is further amplified at 59 mc and then converted to a narrow band (1 kc to 100 kc) 5 mc amplifier which determines the system resolution. After detection and video amplification, the signal is applied to the vertical amplifier of the oscilloscope.

4-6. R-F SECTION

The R-F section (see Fig. 5-1) of the Model L analyzers consist of a crystal mixer, triode local oscillators and a switchable filter network. Thus, the L-30 employs one local oscillator with a fixed I-F filter. Alternatively, the L-20 has two local oscillators and a switchable filter.

4-7. CRYSTAL MIXER

The non-linear characteristic of the crystal is used to heterodyne the incoming R-F signal with the local oscillator to produce the I-F frequency.

4-8. LOCAL OSCILLATOR

A broadband, tunable, coaxial triode cavity

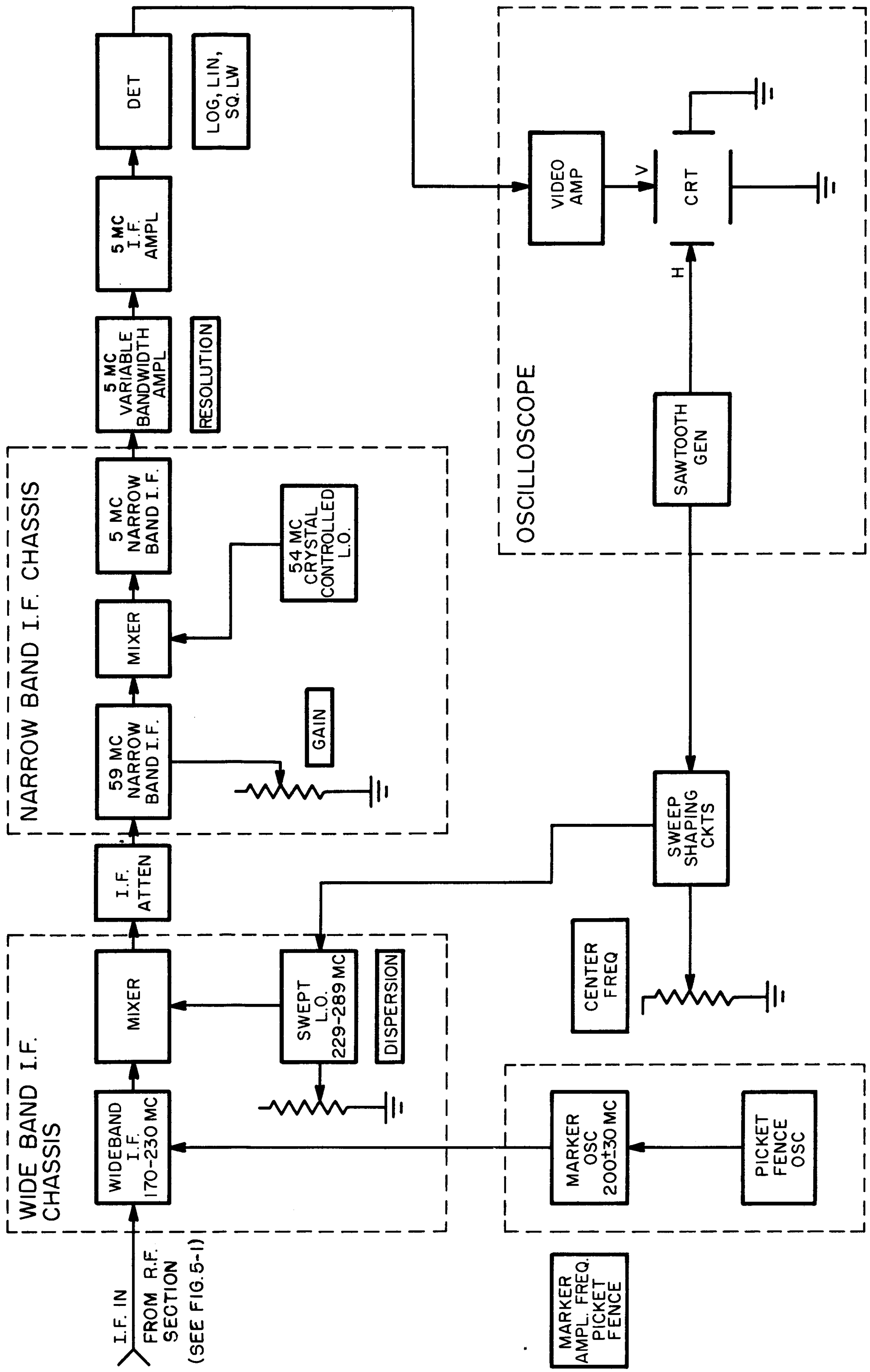


Fig. 4-1. I-F System Block Diagram.

oscillator is employed as the first local oscillator. The L-20 employs two local oscillators to cover the frequency range while the L-30 requires only a single oscillator. The narrow band units contain a simple microwave local oscillator.

4-9. FILTER

In band 1 of the L20, a filter is inserted between the crystal mixer output and the I-F input. This filter eliminates spurious responses caused by harmonic mixing of the sweeper and the first local oscillator by limiting the I-F bandwidth to 5 mc. All the narrow band units contain a single I-F filter.

4-10. WIDEBAND I-F

The wideband I-F amplifier chassis contains the 170 - 230 mc amplifier, the swept local oscillator and the first I-F mixer. Figure 4-1 shows a block diagram of the circuitry contained in the wideband I-F chassis. The frequency response of the amplifier and the mixer are adjusted by means of glass trimmer capacitors. The frequency of the swept local oscillator is controlled by a semi-conductor capacitor CR101 and a trimmer capacitor.

4-11. NARROWBAND I-F

The narrowband I-F chassis contains the 59 mc amplifier, 54 mc crystal controlled oscillator, second mixer and the 5 mc amplifier. The 59 mc and 5 mc amplifiers are both transformer coupled. The 59 mc amplifier is tuned by capacitive trimmers and the 5 mc amplifier has tunable transformers.

4-12. MARKER

The marker chassis contains two oscillators. A continuously variable (170 - 230 mc) tunnel diode oscillator and switchable (1 mc or 100 kc) transistor oscillator. The transistor oscillator modulates the tunnel diode oscillator and produces a picket fence signal. The marker amplitude is controlled by a diode attenuator.

4-13. VIDEO

The video amplifier chassis contains the external video input circuitry, the detector and the power supply converters that supply the transistors with power taken from the oscilloscope tube supplies.

4-14. VIDEO FILTER

The video filter is used to restrict the video bandwidth so as to prevent "zero beats" when observing signals separated by the minimum resolution of the unit. The filter also has the effect of suppressing the noise level and thereby improves the sensitivity in the narrow resolution position. The video filter should be set in the ON position in the following cases:

a. When attempting to observe two or more signals separated in frequency by the minimum resolution of the unit (1 kc).

b. When it is desired to observe only the envelope of a pulsed signal as opposed to observing the repetition rate lines.

c. When it is desired to obtain a clean crisp display eliminating all high frequency phenomena such as baseline noise, and beats between signals and transient responses when observing pulsed signals.

NOTES

SECTION V
MAINTENANCE

5-1. GENERAL

This section contains a guide for choosing replacement components, soldering instructions, typical test equipment required, chart of performance indications, troubleshooting procedure, and complete alignment procedures.

5-2. TYPICAL TEST EQUIPMENT

Measurement	Equipment
Voltage and Resistance	Volt-ohm-milliameter, Simpson 260 or equivalent
Voltage (High Impedance Point)	VTVM, 20,000 Ω per volt or test oscilloscope.
Waveforms	Oscilloscope, Tektronix 530-40-50 series
Alignment (I-F amplifier)	Sweep Generator, Telonic H3 or equivalent
R-F Check (I-F amplifier)	R-F Signal Generator HP 608C or equivalent
R-F Check	R-F Signal Generator HP 612A or equivalent
R-F Check	R-F Signal Generator HP 614 or equivalent
	Flexible plug-in extension cable

5-3. CHOICE OF COMPONENTS

The majority of the components used in this equipment are standard electronic and radio components, and as such can be purchased locally for fast replacement. Most of the transistors used in the analyzer as well as the variable capacitance diode, are parts of sufficiently critical nature as to require pretesting to ensure proper operation in the equipment. These components should be ordered from Tektronix.

It is the Tektronix policy to change component suppliers, from time to time, and to supply information to owners of spectrØpulse Spectrum Analyzers relating to changes in parts that materially improve the performance of the analyzers.

Certain parts in the instrument are either manufactured or specially selected by Tektronix. These parts should be ordered from Tektronix.

5-4. SOLDERING PROCEDURE

Semiconductor components, such as diodes and transistors, cannot withstand the high temperatures caused by soldering. Transistors should be removed from sockets and diodes should be heat sinked when rework is performed.

5-5. TROUBLESHOOTING PROCEDURE

NOTE

Before starting troubleshooting, determine whether the trouble is in the oscilloscope or the analyzer by checking the oscilloscope operation with another plug-in.

As will be noted from the block diagram, Figure 4-1, the spectrØpulse Spectrum Analyzer is essentially a specialized radio receiver with a microwave frequency input. All the trouble-shooting techniques which are applicable to a transistorized radio receiver operating at 200 mc are directly applicable to the I-F circuitry.

The basic troubleshooting technique is the isolation of the chassis in which the trouble is located. This can best be accomplished by an analysis of the symptoms (e.g., picket fence absent means trouble in the marker chassis), and by tracing the signal flow as shown on the block diagram. The next step is to check the transistors associated with the malfunctioning circuit. The transistors are to be checked in a transistor checker one at a time.

NOTE

Be sure to replace the transistors in the proper sockets. The transistors are specifically selected for their applications and the transistor stray capacitance forms part of the tuning of the circuit.

It should be noted that the transistors are biased in series with each other so that a voltage check will indicate in which string the faulty transistor is located. Individual transistor checks have to be performed to isolate the faulty component.

The second major cause of equipment malfunction is a faulty capacitor. A thorough visual inspection will help in the location of a broken feed-thru, by-pass, or tuning capacitor.

5-6. PERFORMANCE INDICATION CHART

Test	Procedure	Normal Indication
Oscilloscope Functions	Feed scope calibrator output to video input.	Scope controls function normally.
Marker Oscillator	Turn marker on. Rotate frequency difference control fully CCW and CW starting from the zero position.	Marker appears to move from center to left of screen and back through center to right of screen.
Picket Fence	Turn picket fence on in 100 kc position and then in 1 mc position.	Evenly spaced markers appear and then one marker appears for every ten previous ones.
Dispersion	Center Marker, then on narrow dispersion range vary dispersion control from minimum (CCW) to maximum position (CW).	Width of marker decreases.
	With dispersion control CW and range switch set to wide, check dispersion with frequency difference marker.	Dispersion greater than 60 mc.
Resolution	Center marker and adjust dispersion near minimum value, rotate resolution control from low (CCW) to high (CW).	Width of marker increases.
I-F Attenuator	Center marker and adjust I-F Attenuator.	Marker amplitude and noise level vary with value of I-F Attenuation.

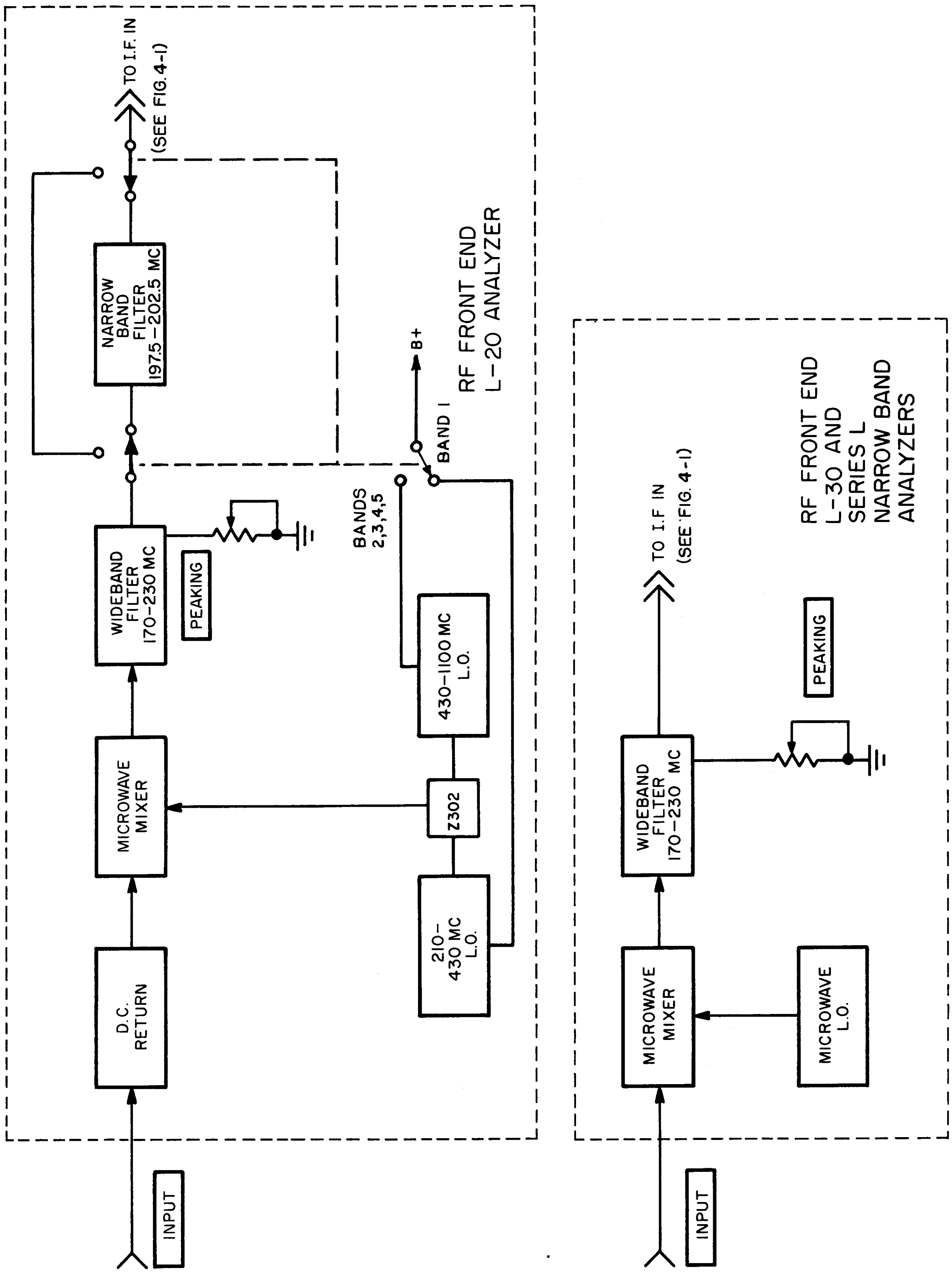


Fig. 5-1. Series L Analyzers, Block Diagram of R. F. Sections.

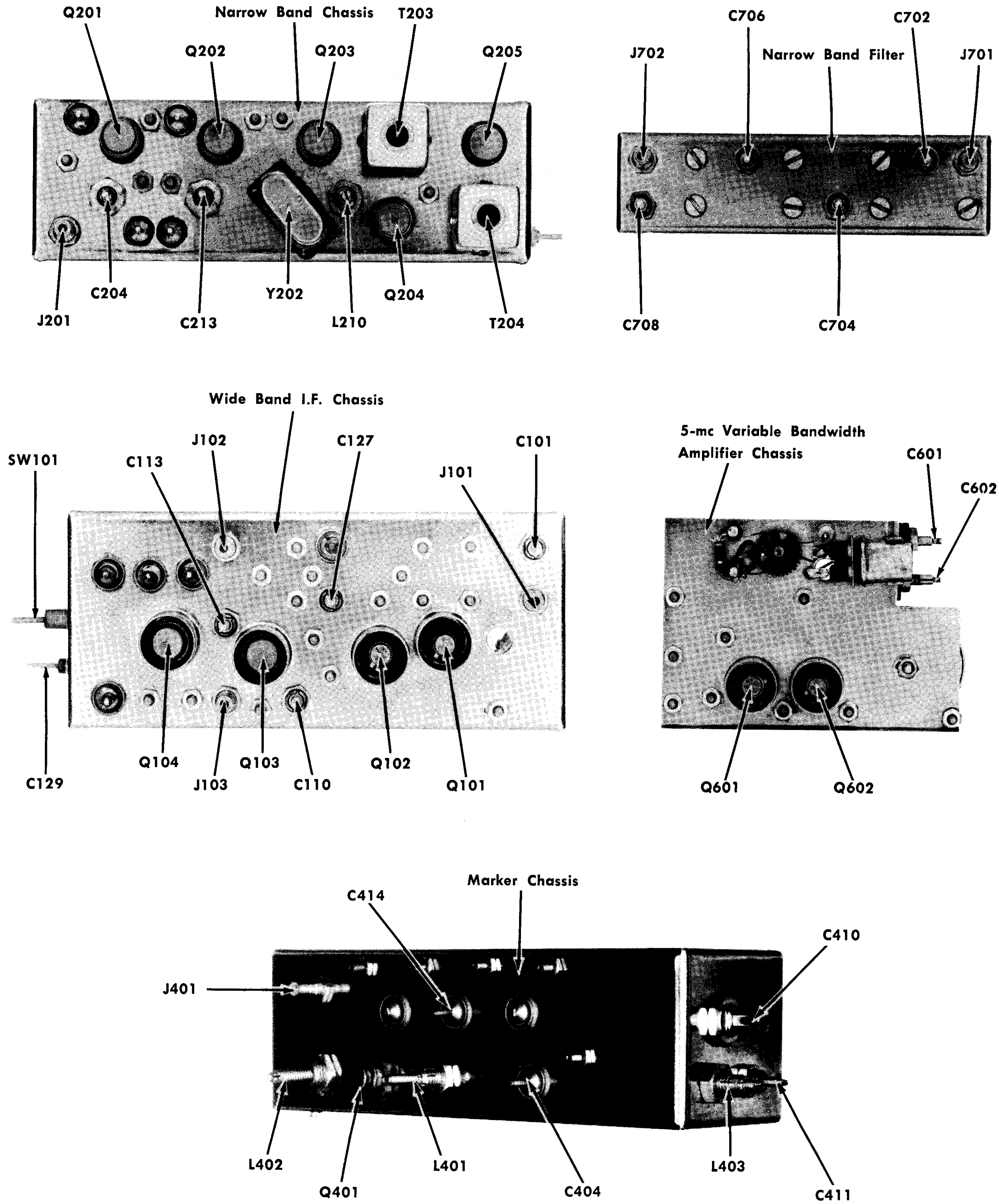


Fig. 5-2. Subassemblies and Internal Adjustments.

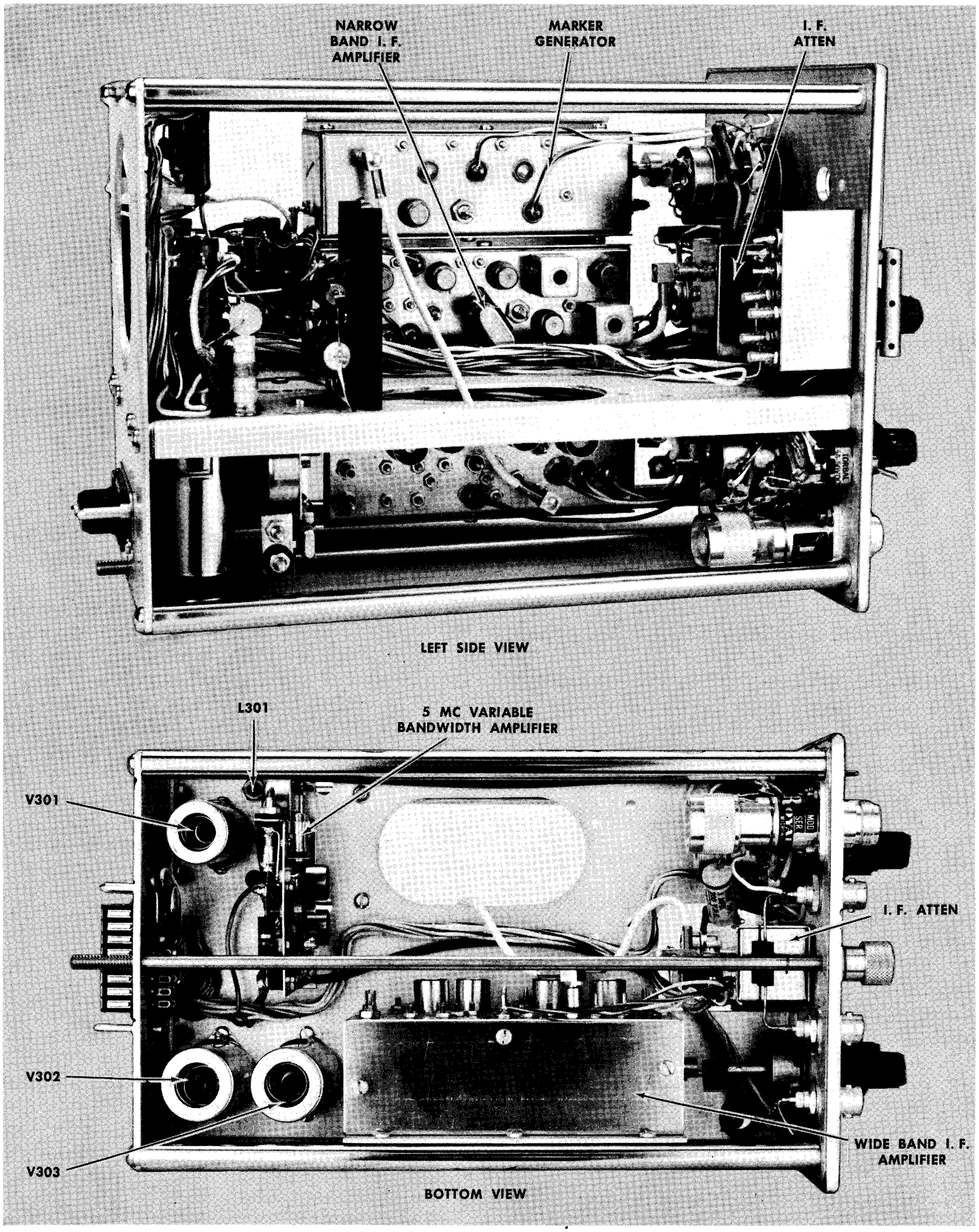


Fig. 5-3. Subassemblies and Internal Adjustments.

5-7. RESISTANCE CHART

Interconnecting plug

Pin No.	Typical resistance to ground
1	6.3 k
2	0
3	5.5 k
4	inf
5	inf
6	inf
7	inf
8	inf
9	3 k
10	3.5 k
11	5.5 k
12	20 k
13	inf
14	inf
15	200 Ω
16	inf

5-8. GENERAL ALIGNMENT INFORMATION

When it has been determined that realignment is required (as, for example, upon replacement of one or more transistors, coils, tuning capacitors, etc.), care should be exercised to limit the alignment to the minimum extent required. Realign only those I-F amplifier stages that are directly associated with the replacement parts.

The following procedure is a complete alignment procedure for the analyzer. It is broken into sections that correspond to the sub-chassis. In general, such alignment will be most simply carried out with the analyzer physically removed from the oscilloscope but electrically connected through a flexible extension cable.

NOTE

Only align the circuit that requires alignment.

Set the controls as follows:

Analyzer:

MARKER-OFF - PICKET FENCE-OFF

RESOLUTION - HIGH

CENTER FREQ - Center

DISPERSION - WIDE, maximum

I-F ATTEN - OFF

GAIN - 3/4 of maximum

Display - LIN

VERT POS - Center

Oscilloscope:

HOR POS - Center

SWEEP SPEED - 10 millisecond per centimeter or slower as required

HORIZONTAL DISPLAY - Normal

5-9. ALIGNMENT OF R-F OSCILLATORS

The frequency accuracy of the narrow band analyzers is 0.1%. This is accomplished by means of a calibration curve. This curve is no longer valid in the event of replacement or repair of the front end microwave local oscillator. In such an event, the frequency of the local oscillator must be measured very accurately in order to compile a new calibration curve. A counter-transfer oscillator or comparison by means of zero beats against a crystal controlled oscillator can be used to make the new frequency measurements.

The new R-F frequency is in all cases the measured local oscillator frequency minus 200 mc (I-F frequency).

5-10. ALIGNMENT OF WIDEBAND AMPLIFIER

Connect the SAWTOOTH OUTPUT to the analyzer by means of the cable provided. Connect a VHF sweep oscillator to J101 and adjust the oscillator to sweep from slightly below 170 mc to slightly above 230 mc. *Adjust the level control of the sweeper and the GAIN control of the analyzer to obtain a display of reasonable amplitude.

*Note: Set sweep frequency generator for 1 sweep/sec and oscilloscope for 1 msec/cm.

1. Adjust C101 to reduce the display amplitude at 170 mc to approximately 1 db less than the display amplitude at 200 mc.

2. Adjust C127 for maximum display amplitude at 230 mc.

Disconnect the sweep oscillator and apply a 59 mc signal from a signal generator to J101. Adjust the signal level to obtain a reasonable display amplitude.

3. Adjust C110 to minimize this signal level.

4. Adjust C113 to maximize this signal level.

Note that the procedures of steps 3 and 4 will cause some interaction and should be repeated until no further change of these controls is indicated.

Set the frequency of the signal generator to 200 mc and the output level to obtain a reasonable display amplitude. Center this signal on the oscilloscope screen by means of the CENTER FREQUENCY control. Switch the DISPERSION to LOW.

5. Adjust C129 to center the display.

5-11. ALIGNMENT OF NARROWBAND AMPLIFIER

With the equipment connected as in step 5 of paragraph 5-10;

6. Adjust C204 for maximum display amplitude.

7. Adjust C213 for maximum display amplitude.

8. Adjust L201 with a clockwise rotation until the display disappears. Adjust L201 one half turn counterclockwise.

9. Adjust T203 to maximize the display amplitude.

10. Adjust T204 to maximize the display amplitude.

5-12. ALIGNMENT OF DETECTOR AMPLIFIER

11. Adjust L301 to maximize the display amplitude.

5-13. ALIGNMENT OF MARKER

Set the DISPERSION switch to HIGH. Adjust the signal generator to 170, 200, and 230 mc, in turn, and mark the oscilloscope screen with a grease pencil to note the positions of these frequencies. Turn the MARKER on and adjust its center frequency to note the positions of the display at the indicated frequencies. (170 mc corresponds to -30 mc on the marker.)

12. Adjust C411 and L403 (interacting controls) to cause the marker and frequencies to correspond to 170 and 230 mc, respectively. Turn the PICKET FENCE switch to 1 MC.

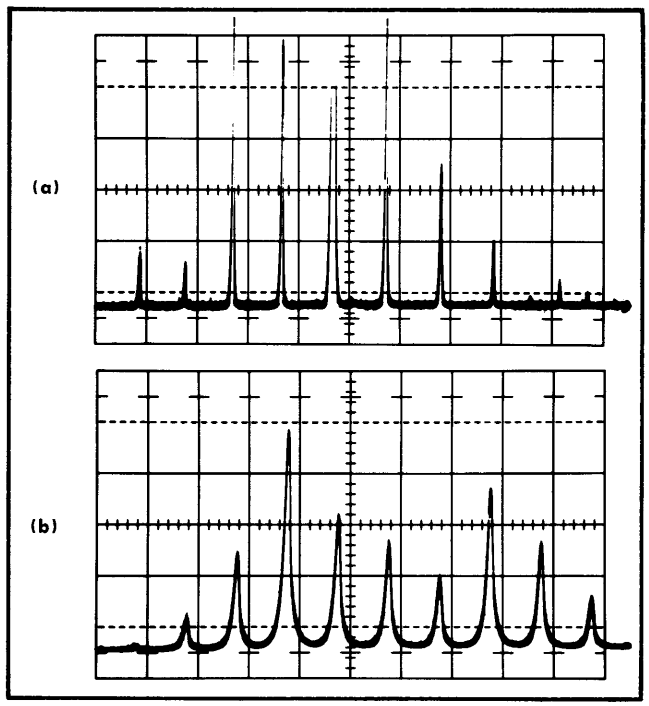


Fig. 5-4. Picket Fence Display Of 1 mc Markers (a) and 100 kc Markers (b).

13. Adjust L401 to obtain 3 markers between 199 and 201 mc. Turn the PICKET FENCE switch to 100 KC.

14. Adjust L402 to obtain 11 markers between 199 and 200 mc.

This completes the alignment of the radio frequency circuits of the analyzer. If any of the steps in the alignment cannot be carried out, it is indicative of a component failure.

5-14. ALIGNMENT OF LOW FREQUENCY CIRCUITS

The sweep drive amplifier is a differential feedback amplifier utilizing non-linear feedback to linearize the frequency sweep to the analyzer. The operation of this amplifier is largely dependent upon the values of the resistors in the feedback circuit.

If the amplifier does not operate properly, check the tubes, then the resistors in the feedback circuit, the diodes, and then the remainder of the components. Tube selection is not required for normal operation, but well-balanced tubes should be used for optimum operation.

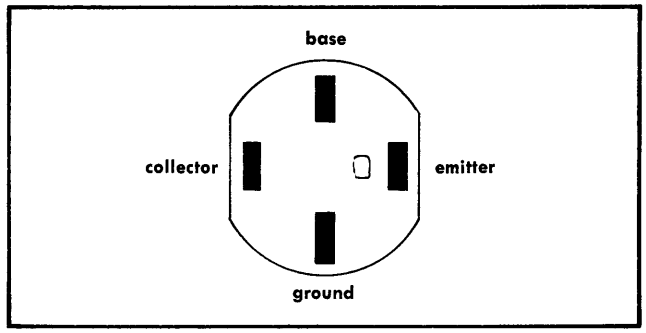


Fig. 5-5. Transistor Socket Connections.

SECTION VI

PARTS LIST AND DIAGRAMS

6-1. ORDERING INFORMATION

When ordering replacement parts, include the instrument type, model, and serial number, spectrØpulse Spectrum Analyzer part number (schematic diagram symbol), and manufacturer's part number.

6-2. CRITICAL COMPONENTS

Most components used in the analyzer are standard electronic components made by nationally distributed manufacturers. These components can be replaced with another bearing the same or equivalent manufacturer's part number. There are, however, those of critical nature that require preselection and testing in order to ensure maximum performance of the equipment. These parts should be ordered from Tektronix.

ELECTRICAL PARTS

Values are fixed unless marked Variable.

* Indicates component manufactured by or for Tektronix, reworked and/or checked.

Capacitors

Tolerance ±20% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Description				
C101	281-105	1-7 pf		Var		
C102	281-613	10 pf	Cer		200 v	10%
C103	281-628	15 pf				
C104	283-060	100 pf	Cer		200 v	5%
C105	283-067	1000 pf	Cer		200 v	10%
C106	283-060	100 pf	Cer		200 v	5%
C107	283-060	100 pf	Cer		200 v	5%
C108	283-060	100 pf	Cer		200 v	5%
C109	281-613	10 pf	Cer		200 v	10%
C110	281-105	1-7 pf		Var		
C111	283-060	100 pf	Cer		200 v	5%
C112	283-067	1000 pf	Cer		200 v	10%
C113	281-105	1-7 pf		Var		
C114	281-627	1 pf				
C115	281-627	1 pf				
C116	283-067	1000 pf	Cer		200 v	10%
C117	283-067	1000 pf	Cer		200 v	10%
C118	283-039	1000 pf	Cer		500 v	
C119	283-067	1000 pf	Cer		200 v	10%
C120	283-060	100 pf	Cer		200 v	5%

Ckt. No.	Tektronix Part No.	Description				
		Capacitors (Cont'd.)				
C121	283-039	1000 pf	Cer		500 v	
C122	283-039	1000 pf	Cer		500 v	
C123	283-039	1000 pf	Cer		500 v	
C124	283-067	100 pf	Cer		200 v	10%
C125	283-039	1000 pf	Cer		500 v	
C126	283-060	100 pf	Cer		200 v	5%
C127	281-105	1-7 pf		Var		
C128	281-628	15 pf				
C129	281-105	1-7 pf		Var		
C130	281-628	15 pf				
C132	281-628	15 pf				
C133	281-572	6.8 pf	Cer		500 v	10%
C201	283-067	1000 pf	Cer		200 v	10%
C203	283-067	1000 pf	Cer		200 v	10%
C204	281-105	1-7 pf		Var		
C206	283-067	1000 pf	Cer		200 v	10%
C207	283-039	1000 pf	Cer		500 v	
C208	283-039	1000 pf	Cer		500 v	
C209	283-067	1000 pf	Cer		200 v	10%
C210	283-067	1000 pf	Cer		200 v	10%
C212	283-067	1000 pf	Cer		200 v	10%
C213	281-105	1-7 pf		Var		
C214	283-039	1000 pf	Cer		500 v	
C215	283-067	1000 pf	Cer		200 v	10%
C216	283-110	5000 pf				
C218	283-110	5000 pf				
C219	283-609	100 pf	Mica			
C220	283-110	5000 pf				
C221	218-613	10 pf	Cer		200 v	10%
C222	283-608	68 pf	Mica			

Ckt. No.	Tektronix Part No.	Description			
		Capacitors (Cont'd.)			
C223	283-610	220 pf	Mica		
C224	283-110	5000 pf			
C225	283-110	5000 pf			
C226	283-067	1000 pf	Cer	200 v	10%
C227	283-110	5000 pf			
C228	283-609	100 pf	Mica		
C229	283-110	5000 pf			
C231	283-039	1000 pf	Cer	500 v	
C235	283-067	1000 pf	Cer	200 v	10%
C301	283-110	5000 pf			
C302	283-110	5000 pf			
C303	283-110	5000 pf			
C304	283-612	82 pf	Mica		
C305	283-609	100 pf	Mica		
C306	283-613	470 pf	Mica		
C307	285-572	0.1 µf	PTM	200 v	
C308	281-629	33 pf	Cer		
C309	283-610	220 pf	Mica		
C310	281-629	33 pf	Cer		
C311	281-629	33 pf	Cer		
C312	283-110	5000 pf			
C313	283-614	47 pf	Mica		
C315	285-572	0.1 µf	PTM	200 v	
C316	285-673	5 µf		50 v	
C401	283-110	5000 pf			
C402	285-674	0.01 µf		100 v	
C403	285-627	0.0033 µf	PTM	100 v	5%
C404	283-611	1200 pf	Mica		
C405	283-067	1000 pf	Cer	200 v	10%
C407	283-039	1000 pf	Cer	500 v	

Ckt. No.	Tektronix Part No.	Description				
		Capacitors (Cont'd.)				
C409	283-111	0.1 µf				
C410	281-106	2.7-19.6 pf	Air	Var	FREQUENCY DIFF-MC	
C411	281-105	1-7 pf		Var		
C412	281-627	1 pf				
C413	283-039	1000 pf	Cer		500 v	
C414	283-039	1000 pf	Cer		500 v	
C415	283-039	1000 pf	Cer		500 v	
C420	281-572	6.8 pf	Cer		500 v	10%
C601	281-105	1-7 pf		Var		
C602	281-105	1-7 pf		Var		
C603	283-110	5000 pf				
C604	283-110	5000 pf				
C605	283-067	1000 pf	Cer		200 v	10%
C606	283-067	1000 pf	Cer		200 v	10%
C607	283-110	5000 pf				
C608	283-110	5000 pf				
		Diodes				
D101	152-187	PC115				
D102	152-186	1N198				
D201	152-186	1N198				
D301	152-188	1N64				
D302	152-186	1N198				
D303	152-141	1N3605				
D304	152-188	1N64				
D305	152-141	1N3605				
D306	152-141	1N3605				
D307	152-141	1N3605				

Ckt. No.	Tektronix Part No.	Description
		Diodes (Cont'd.)
D401	152-189	1N2173
D402	152-188	1N64
D403	152-188	1N64
D404	152-188	1N64
D602	152-062	1N914
		Connectors
P11	131-017	Connector, 16 contact, male
J101	131-372	Connector, Coax
J201	131-372	Connector, Coax
J301	131-106	Connector, BNC, 1 contact, female
J302	131-106	Connector, BNC, 1 contact, female
J303	131-106	Connector, BNC, 1 contact, female
J401	131-372	Connector, Coax
J501	131-372	Connector, Coax
J502	131-372	Connector, Coax
		Inductors
L101	*108-319	0.18 µh
L102	*108-312	0.058 µh
L103	108-315	0.22 µh
L104	108-315	0.22 µh
L105	*108-310	0.09 µh
L106	*108-311	0.18 µh
L107	*120-353	Toroid, 8 turns
L108	*108-303	0.04 µh
L109	108-316	0.68 µh
L110	*108-314	Bare Wire

Ckt. No.	Tektronix Part No.	Description	
		Inductors (Cont'd.)	
L111	*108-313	0.05 µh	
L201	276-507	Core, Ferramic Suppressor	
L202	276-507	Core, Ferramic Suppressor	
L210	*114-165	0.12-0.17 µh	Var
L301	*114-169	25-45 µh	Var
L302	108-317	15 µh	
L303	108-318	100 µh	
L311	276-507	Core, Ferramic Suppressor	
L312	276-507	Core, Ferramic Suppressor	
L401	*114-166	8-15 µh	Var
L402	114-168	850-1200 µh	Var
L403	*114-167	0.04-0.44 µh	Var
		Transistors	
Q101	151-143	2N2996	
Q102	151-143	2N2996	
Q103	151-144	2N1743	
Q104	151-145	2N1744	
Q201	151-146	2N1745	
Q202	151-146	2N1745	
Q203	151-146	2N1745	
Q204	151-146	2N1745	
Q205	151-147	2N1747	
Q401	151-146	2N1745	
Q601	151-143	2N2996	
Q602	151-143	2N2996	

Ckt. No.	Tektronix Part No.	Description			
		Resistors			

Resistors are fixed, composition, ±10% unless otherwise indicated.

R101	316-221	220 Ω	1/4 w		
R102	316-102	1 k	1/4 w		
R103	316-222	2.2 k	1/4 w		
R104	310-147	4.7 k	1 w	Prec	5%
R105	316-222	2.2 k	1/4 w		
R106	316-102	1 k	1/4 w		
R107	316-102	1 k	1/4 w		
R108	316-221	220 Ω	1/4 w		
R109	316-102	1 k	1/4 w		
R110	316-222	2.2 k	1/4 w		
R111	316-102	1 k	1/4 w		
R112	316-153	15 k	1/4 w		
R113	316-222	2.2 k	1/4 w		
R114	316-102	1 k	1/4 w		
R115	316-102	1 k	1/4 w		
R116	316-102	1 k	1/4 w		
R117	316-221	220 Ω	1/4 w		
R118	316-470	47 Ω	1/4 w		
R119	304-183	18 k	1 w		
R121	316-470	47 Ω	1/4 w		
R122	316-332	3.3 k	1/4 w		
R123	316-682	6.8 k	1/4 w		
R124	316-471	470 Ω	1/4 w		
R125	316-471	470 Ω	1/4 w		
R201	316-331	330 Ω	1/4 w		

Ckt. No.	Tektronix Part No.	Description			
		Resistors (Cont'd.)			
R202	316-331	330 Ω	1/4 w		
R203	316-180	18 Ω	1/4 w		
R204	316-683	68 k	1/4 w		
R205	316-222	2.2 k	1/4 w		
R206	316-102	1 k	1/4 w		
R207 [1]	311-500	10 k		Var	GAIN
R208	316-102	1 k	1/4 w		
R209	316-222	2.2 k	1/4 w		
R210	316-222	2.2 k	1/4 w		
R211	316-222	2.2 k	1/4 w		
R212	316-102	1 k	1/4 w		
R213	316-102	1 k	1/4 w		
R214	316-102	1 k	1/4 w		
R215	316-102	1 k	1/4 w		
R216	316-471	470 Ω	1/4 w		
R218	316-470	47 Ω	1/4 w		
R219	316-472	4.7 k	1/4 w		
R221	316-222	2.2 k	1/4 w		
R222	310-146	8.2 k	1 w	Prec	5%
R223	302-102	1 k	1/2 w		
R301	316-471	470 Ω	1/4 w		
R302	316-102	1 k	1/4 w		
R303	316-102	1 k	1/4 w		
R304	316-470	47 Ω	1/4 w		
R305	316-680	68 Ω	1/4 w		

[1] Ganged with R311. Furnished as a unit.

Ckt. No.	Tektronix Part No.	Description				
		Resistors (Cont'd.)				
R306	316-470	47 Ω	1/4 w			
R307	316-333	33 k	1/4 w			
R308	316-332	3.3 k	1/4 w			
R309	316-223	22 k	1/4 w			
R310	316-104	100 k	1/4 w			
R311 [1]	311-500	100 Ω		Var	GAIN	
R312	304-103	10 k	1 w			
R313	316-102	1 k	1/4 w			
R314	316-102	1 k	1/4 w			
R315	304-472	4.7 k	1 w			
R316	302-103	10 k	1/2 w			
R317	316-101	100 Ω	1/4 w			
R319	305-333	33 k	2 w			5%
R320 [2]	311-503	10 k		Var	DISPERSION	
R321	316-104	100 k	1/4 w			
R322	316-104	100 k	1/4 w			
R323	316-104	100 k	1/4 w			
R324	316-682	6.8 k	1/4 w			
R325	316-105	1 meg	1/4 w			
R326	316-105	1 meg	1/4 w			
R327	316-105	1 meg	1/4 w			
R328	304-154	150 k	1 w			
R330	306-273	27 k	2 w			
R331	316-105	1 meg	1/4 w			
R332	304-333	33 k	1 w			

[1] Ganged with R207. Furnished as a unit.

[2] Concentric with SW101.

Ckt. No.	Tektronix Part No.	Description				
		Resistors (Cont'd.)				
R333	316-823	82 k	1/4 w			
R334	308-211	12 k	5 w	WW		5%
R335	316-103	10 k	1/4 w			
R336	316-333	33 k	1/4 w		(Selected)	
R337	316-823	82 k	1/4 w			
R338	316-682	6.8 k	1/4 w			
R339	323-385	100 k	1/2 w	Prec		1%
R340	316-471	470 Ω	1/4 w		(Selected)	
R341	308-334	7 k	3 w	WW		3%
R342	308-335	7 k	7 w	WW		
R343 [1]	311-504	5 k		Var	CENTER FREQ	
R344	316-104	100 k	1/4 w			
R345	304-472	4.7 k	1 w			
R346	304-153	15 k	1 w			
R347	316-472	4.7 k	1/4 w			
R348	316-682	6.8 k	1/4 w			
R349	308-333	3.5 k	3 w	WW		3%
R350 [2]	316-472	4.7 k	1/4 w		(Selected)	
R360	308-304	1.5 k	3 w	WW		1%
R372 [3]	311-501	1 k X 10 k		Var	POSITION	
R401	316-223	22 k	1/4 w			
R402	316-472	4.7 k	1/4 w			
R403	316-102	1 k	1/4 w			
R404	316-180	18 Ω	1/4 w			
R405	316-102	1 k	1/4 w			

[1] Furnished as a unit with R611.

[2] Selected component. May or may not appear in your instrument.

[3] Ganged with SW402.

Ckt. No.	Tektronix Part No.	Description				
		Resistors (Cont'd.)				
R406	308-336	7 k	5 w		WW	
R407	302-683	68 k	1/2 w			
R409	316-221	220 Ω	1/4 w			
R410	316-221	220 Ω	1/4 w			
R411	316-221	220 Ω	1/4 w			
R412	316-221	220 Ω	1/4 w			
R413	316-680	68 Ω	1/4 w			
R414 [1]	311-499	10 k		Var	AMPLITUDE	
R415	304-223	22 k	1 w			
R416	316-222	2.2 k	1/4 w			
R417	316-101	100 Ω	1/4 w			
R418	316-101	100 Ω	1/4 w			
R501	315-620	62 Ω	1/4 w			5%
R502	315-241	240 Ω	1/4 w			5%
R503	315-620	62 Ω	1/4 w			5%
R504	315-680	68 Ω	1/4 w			5%
R505	315-151	150 Ω	1/4 w			5%
R506	315-680	68 Ω	1/4 w			5%
R507	315-121	120 Ω	1/4 w			5%
R508	315-510	51 Ω	1/4 w			5%
R509	315-121	120 Ω	1/4 w			5%
R510	315-221	220 Ω	1/4 w			5%
R511	315-240	24 Ω	1/4 w			5%
R512	315-221	220 Ω	1/4 w			5%
R513	315-431	430 Ω	1/4 w			5%

[1] Furnished as a unit with R352.

Ckt No.	Tektronix Part No.		Description			
			Resistors (Cont'd.)			
R514	315-120	12 Ω	1/4 w			5%
R515	315-431	430 Ω	1/4 w			5%
R516	315-911	910 Ω	1/4 w			5%
R517	307-107	5.6 Ω	1/4 w			5%
R518	315-911	910 Ω	1/4 w			5%
R601	316-471	470 Ω	1/4 w			
R602	304-473	47 k	1 w			
R603	316-681	680 Ω	1/4 w			
R604	316-223	22 k	1/4 w			
R605	316-103	10 k	1/4 w			
R606	316-103	10 k	1/4 w			
R607	304-223	22 k	1 w			
R608	316-102	1 k	1/4 w			
R609	316-102	1 k	1/4 w			
R611 [1]	311-504	1 k		Var	RESOLUTION	

Switches

Ckt No.	Unwired	Wired	Type	Description
SW101 [2]	260-642		Toggle	DISPERSION
SW401) [3]		*262-681	Rotary	PICKET FENCE
SW402)			Toggle	OFF (Amplitude)
SW301 [4]		*262-682	Rotary	DISPLAY FUNCTION
SW305	260-643		Toggle	VID FIL

[1] Furnished as a unit with R343.

[2] Concentric with R320.

[3] Ganged with R414. Furnished as a unit.

[4] Concentric with R311. R311 ganged with R207.

Ckt. No.	Tektronix Part No.	Description	
		Switches (Cont'd.)	
SW501	260-642	Toggle	20DB
SW502	260-642	Toggle	16DB
SW503	260-642	Toggle	8DB
SW504	260-642	Toggle	4DB
SW505	260-642	Toggle	2DB
SW506	260-642	Toggle	1DB
		Transformers	
T101	*120-352	Toroid	
T201	*120-354	Toroid	3 windings
T202	*120-354	Toroid	3 windings
T203	120-356	3.45 mc	
T204	120-356	3.45 mc	
T601	*120-358	Toroid	3 windings
T602	120-357	Toroid	
		Electron Tubes	
V301	154-040	12AU6	
V302	154-041	12AU7	
V303	154-039	12AT7	
		Crystals	
Y202	158-018	54 MC	
Y601	158-019	5 MC	

ELECTRICAL PARTS

Values are fixed unless marked Variable.

* Indicates component manufactured by or for Tektronix, reworked and/or checked.

Ckt. No.	Tektronix Part No.	Description				

Capacitors

Tolerance ±20% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Description				
C360	283-039	1000 pf	Cer		500 v	
C361	283-039	1000 pf	Cer		500 v	
C362	283-039	1000 pf	Cer		500 v	
C701	281-629	33 pf	Cer			
C702	281-105	1-7 pf		Var		
C703	281-617	15 pf	Cer		200 v	
C704	281-105	1-7 pf		Var		
C705	281-504	10 pf	Cer		500 v	10%
C706	281-105	1-7 pf		Var		
C707	281-618	4.7 pf	Cer		200 v	
C708	281-105	1-7 pf		Var		

Filters

Ckt. No.	Tektronix Part No.	Description
FL301	610-137	L.P. Wide Band Filter Chassis
FL302	610-138	L.P. Narrow Band Filter Chassis

Connectors

Ckt. No.	Tektronix Part No.	Description
J701	131-372	Connector, Coax
J702	131-372	Connector, Coax

Ckt. No.	Tektronix Part No.	Description				
		Inductors				
L701	*108-305	0.032 µh				
L702	*108-304	0.045 µh				
L703	*108-304	0.045 µh				
L704	*108-304	0.045 µh				
L705	*108-303	0.04 µh				
L706	*108-302	0.12 µh				
L707	*108-301	0.025 µh				
L708	*108-300	0.2 µh				

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Description				
R318	308-338	150 Ω	5 w		WW	
R352 [1]	311-501	10 k X 1 k		Var	PEAKING	
R356	308-341	4 k	3 w		WW	3%
R357	308-340	4.2 k	25 w		WW	3%
R358	308-339	15 k	10 w		WW	3%
R361	306-123	12 k	2 w			

Switch

Ckt. No.	Unwired	Wired	Description	
SW310	(260-642 (260-643		Toggle	BAND

Crystal

Ckt. No.	Tektronix Part No.	Description
Y301	119-041	Mixer w/Crystal

[1] R352 furnished as a unit with R372. R372 description on page 6-10.

Ckt. No.	Tektronix Part No.	Description
		Oscillator
	119-039	Oscillator
	632-001	Oscillator and Dial Assembly

ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description			
		Filter			
FL301	610-137	L.P. Wide Band Filter Chassis			
		Resistors			

Resistors are fixed, composition, ±10% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Description			
R318	308-337	200 Ω	7 w		WW
R352 [1]	311-501	10 k X 1 k		Var	PEAKING
R359	316-471	470 Ω	1/4 w		
R361	Use 308-062	3 k	5 w		WW
		Crystal			
Y301	119-042	Mixer w/Crystal			
		Oscillator			
	119-040	Oscillator			
	632-002	Oscillator and Dial Assembly			

[1] R352 furnished as a unit with R372. R372 description on page 6-10.

ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description			
		Filter			
FL301	610-137	L.P. Wide Band Filter Chassis			
		Resistors			

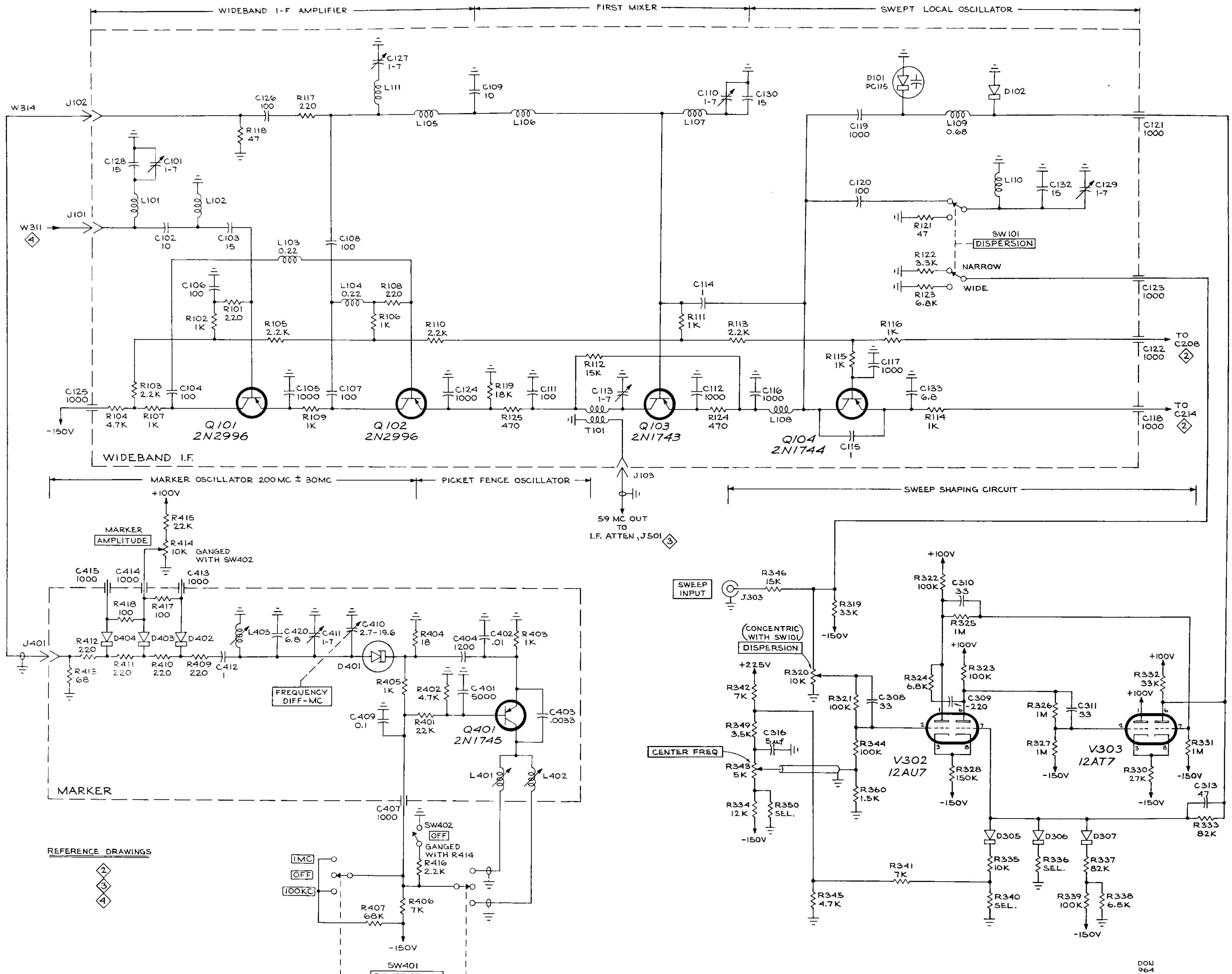
Resistors are fixed, composition, ±10% unless otherwise indicated.

R318	308-337	200 Ω	7 w		WW
R352 [1]	311-501	10 k X 1 k		Var	PEAKING
R356	308-341	4 k	3 w		WW
R357	308-340	4.2 k	25 w		WW
R358	308-339	15 k	10 w		WW
R361	308-343	3.5 k	5 w		WW

Crystal

Y301	119-042	Mixer w/Crystal

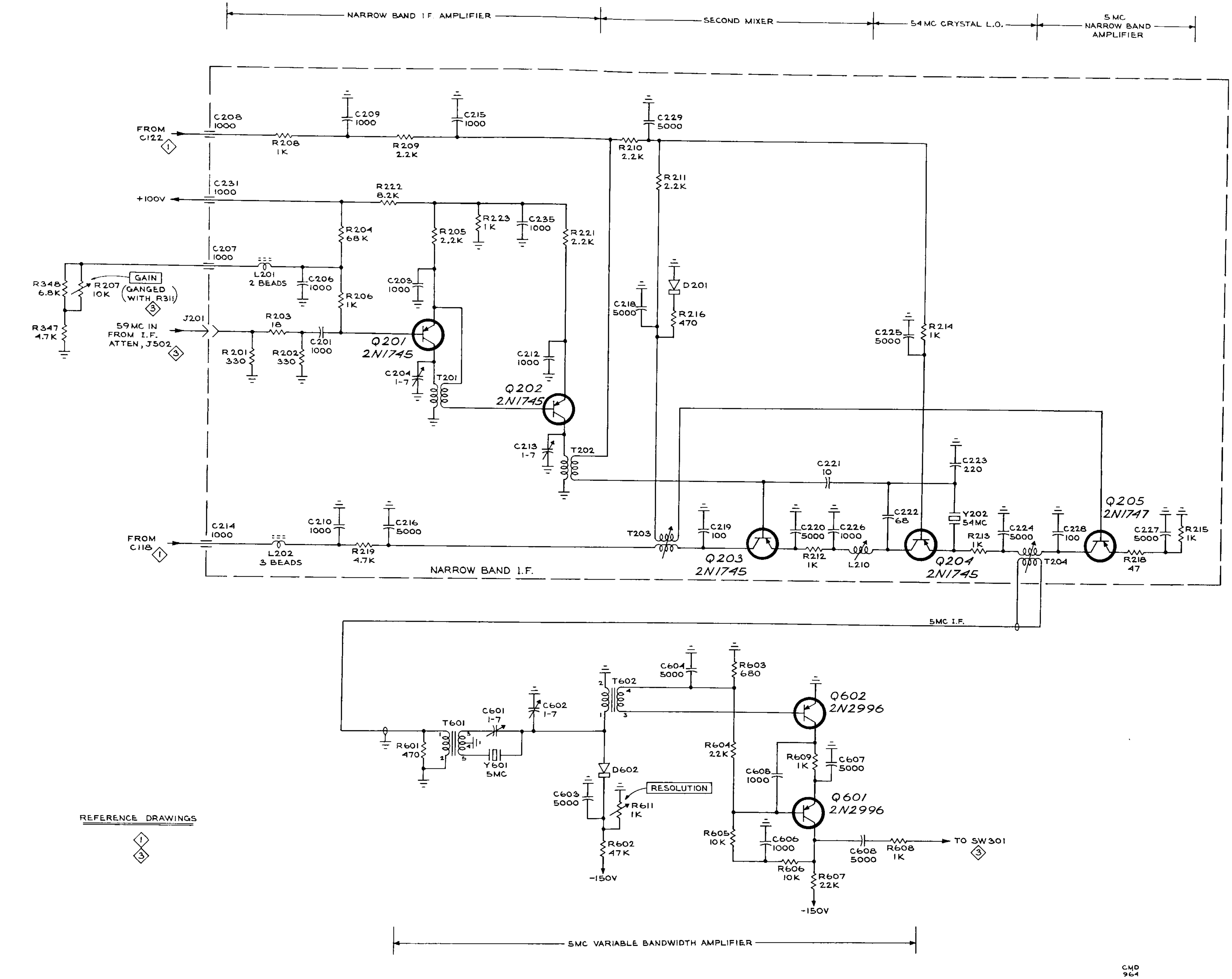
[1] R352 furnished as a unit with R372. R372 description on page 6-10.

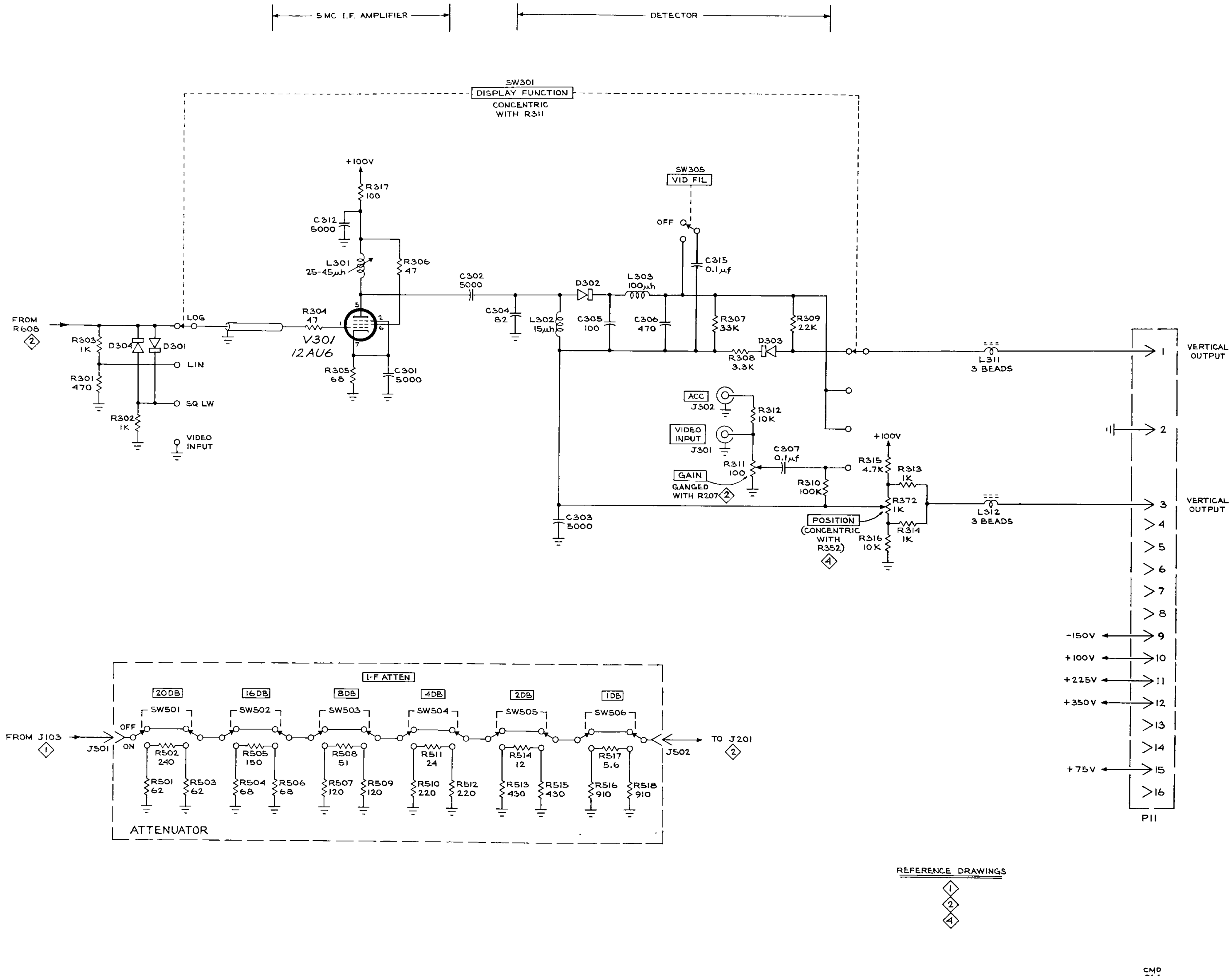


SERIES L SPECTRUM ANALYZERS

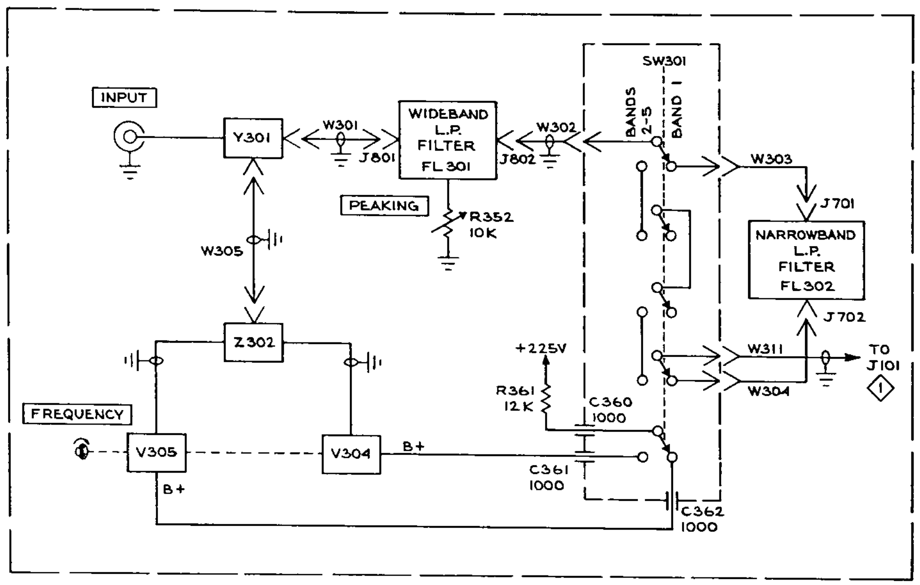
A

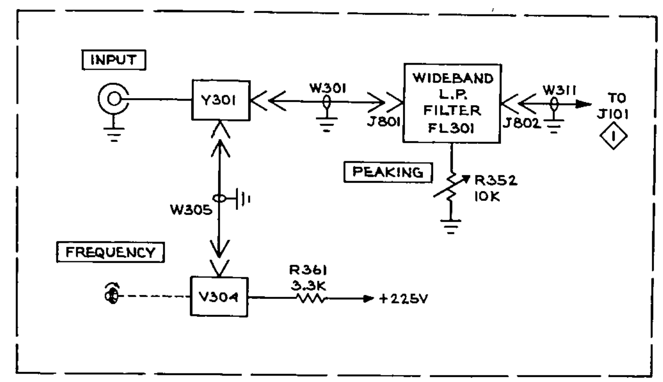
COMMON CIRCUITS ①

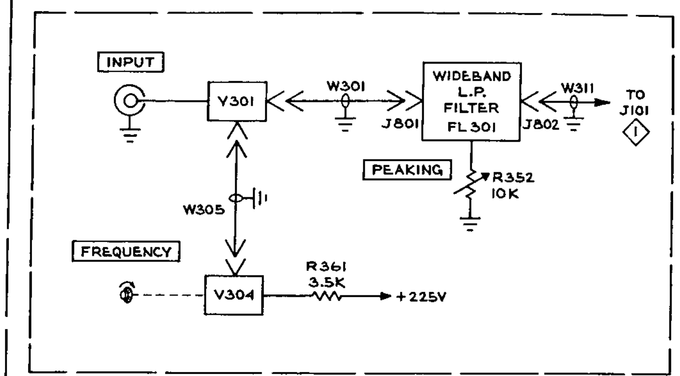

NARROW BAND I.F. AMPLIFIER
SECOND MIXER
54MC CRYSTAL L.O.
5MC NARROW BAND AMPLIFIER
FROM C122
FROM C118
+100V
59MC IN FROM I.F. ATTEN, J502
J201
GAIN
R207 10K (GANGED WITH R311)
Q201 2N1745
Q202 2N1745
Q203 2N1745
Q204 2N1745
Q205 2N1747
Y202 54MC
NARROW BAND I.F.
5MC I.F.
T601
Y601 5MC
D602
RESOLUTION
R611 1K
Q602 2N2996
Q601 2N2996
TO SW301
-150V
5MC VARIABLE BANDWIDTH AMPLIFIER
REFERENCE DRAWINGS
CMD 964

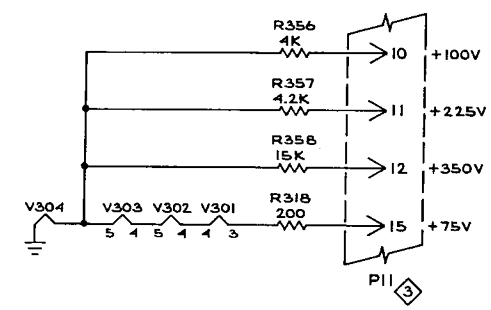

5 MC I.F. AMPLIFIER
DETECTOR
SW301
DISPLAY FUNCTION
CONCENTRIC WITH R311
+100V
R317 100
C312 5000
L301 25-45μh
R306 47
C302 5000
D302
L303 100μh
SW305
VID FIL
OFF
C315 0.1μf
FROM R608
LOG
R304 47
V301 12AU6
C304 82
L302 15μh
C305 100
C306 470
R307 33K
R309 22K
R303 1K
D304
D301
D303
R308 3.3K
VERTICAL OUTPUT
L311 3 BEADS
LIN
R301 470
R305 68
C301 5000
SQ LW
R302 1K
ACC
J302
R312 10K
VIDEO INPUT
J301
+100V
C307 0.1μf
R311 100
GAIN
GANGED WITH R207
R315 4.7K
R313 1K
R310 100K
R372 1K
L312 3 BEADS
C303 5000
POSITION
(CONCENTRIC WITH R352)
R316 10K
R314 1K
-150V
+100V
+225V
+350V
+75V
P11
I-F ATTEN
20DB
16DB
8DB
4DB
2DB
1DB
SW501
SW502
SW503
SW504
SW505
SW506
FROM J103
OFF
ON
J501
R502 240
R505 150
R508 51
R511 24
R514 12
R517 5.6
R501 62
R503 62
R504 68
R506 68
R507 120
R509 120
R510 220
R512 220
R513 430
R515 430
R516 910
R518 910
J502
TO J201
ATTENUATOR
REFERENCE DRAWINGS
CMD 964

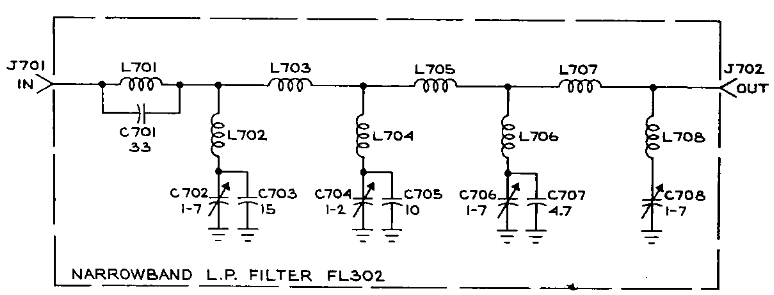
L-20 | L-30 | NARROWBAND

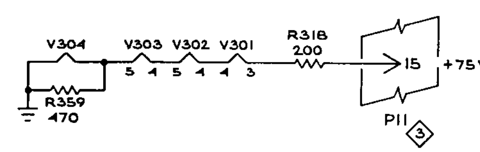


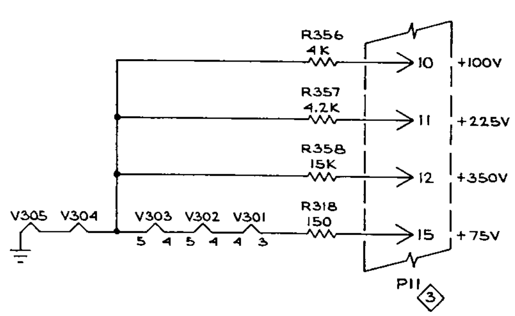












REFERENCE DRAWINGS
1
3

CMD 964

L-20, L-30, & SERIES L NARROWBAND ANALYZERS

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MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

TEXT CORRECTION

Page 5-8, top of left-hand column -- Insert The Following:

5-14. 5-MC VARIABLE BANDWIDTH AMPLIFIER ADJUSTMENT

15. Set the RESOLUTION control fully clockwise.

16. Set the Marker AMPLITUDE control fully clockwise.

17. Set the FREQUENCY DIFF-MC control to position the 200-mc marker to the approximate center of the screen. Turn the PICKET FENCE switch to OFF.

18. Set the DISPERSION control so the base of the signal is about 3-cm wide, and set the GAIN control so the signal is about 4-cm tall.

19. Adjust C601, C602, L301, T203, and T204 for a symmetrical waveform with a flat top. The dip which may appear in the middle of the waveform is not necessarily required and should not exceed 3 db below the top of the waveform.

Page 5-8 -- Change

5-14. ALIGNMENT OF LOW FREQUENCY CIRCUITS

To Read As Follows:

5-15. ALIGNMENT OF LOW FREQUENCY CIRCUITS