INSTRUCTION MANUAL

Serial Number 1331

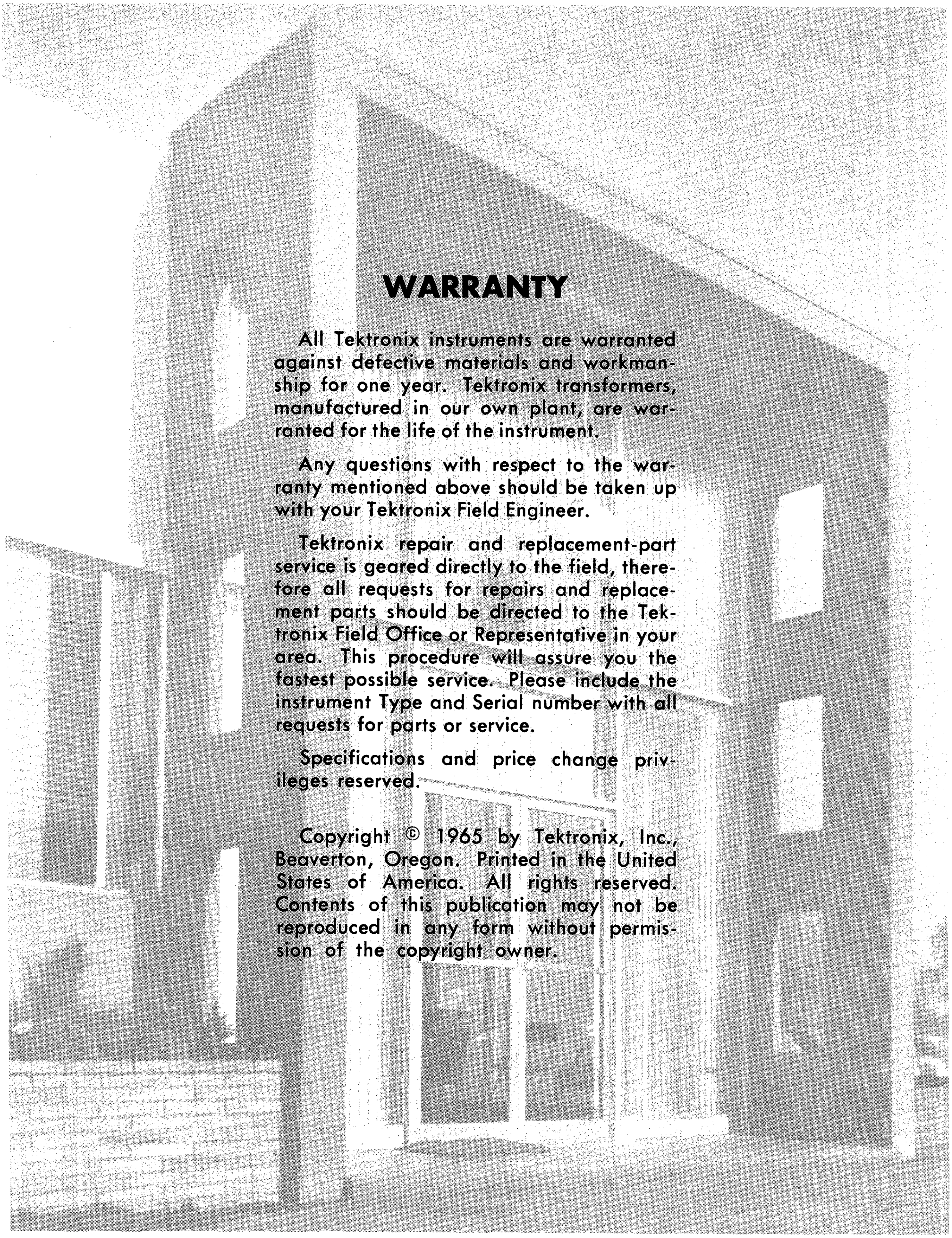
type 1L10

SPECTRUM ANALYZER

Tektronix, Inc.

S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon ● Phone MI 4-0161 ● Cables: Tektronix

070-0510-00 965



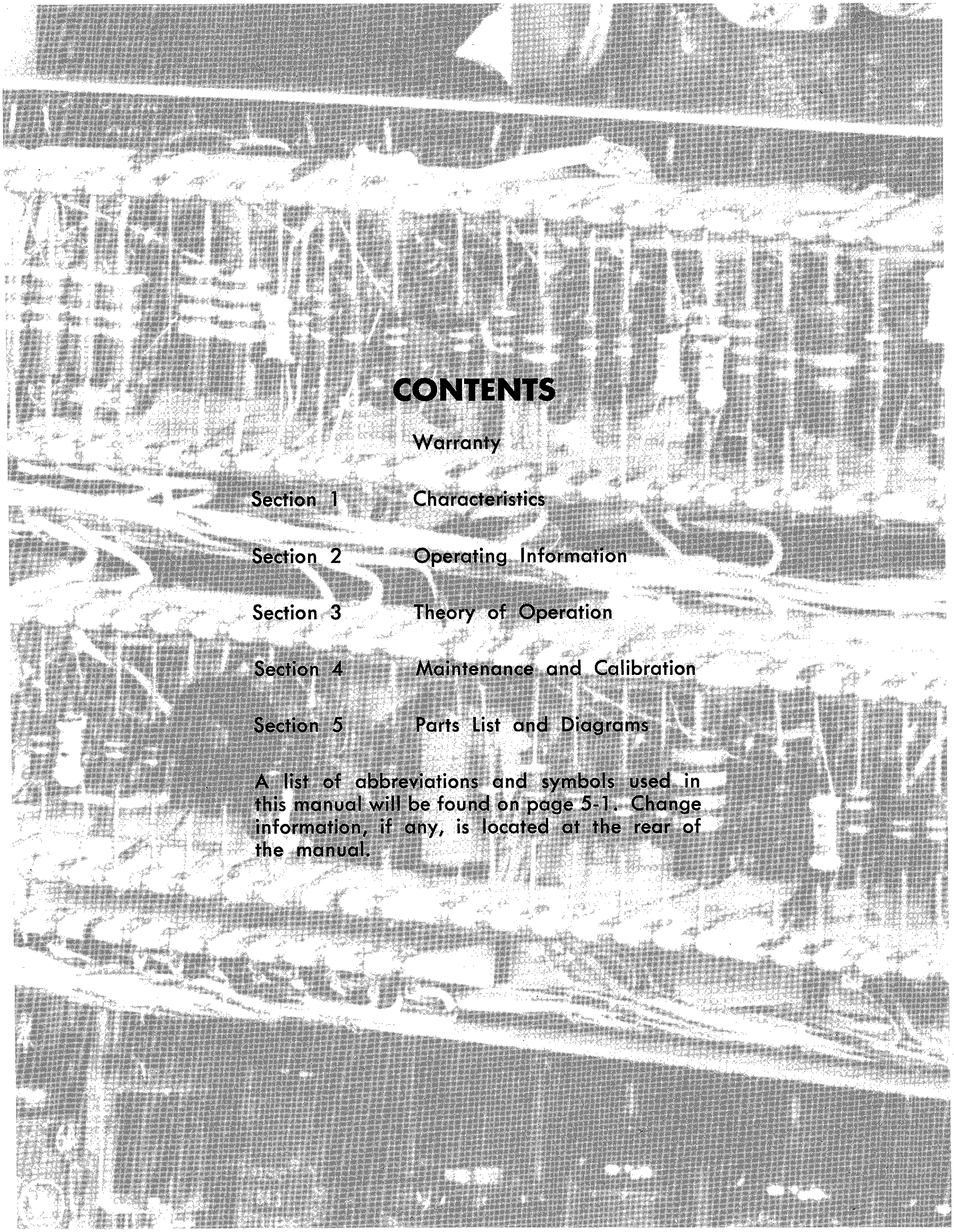
WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

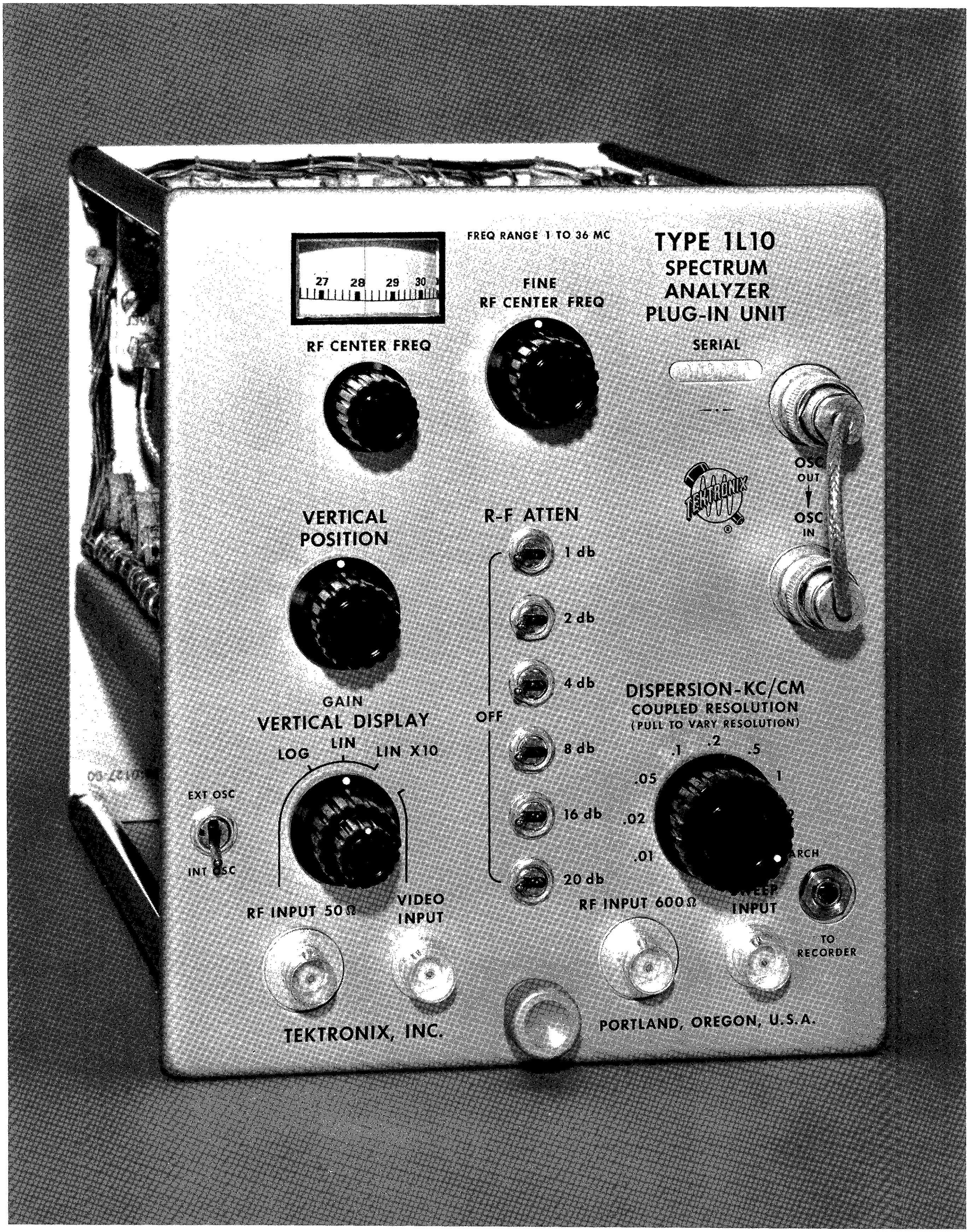
Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.



CONTENTS

A list of abbreviations and symbols used in this manual will be found on page 5-1. Change information, if any, is located at the rear of the manual.



Type 1L10 Spectrum Analyzer Plug-In Unit

SECTION 1
CHARACTERISTICS

Introduction

The Type 1L10 Spectrum Analyzer plug-in unit is designed for use with Tektronix Type 530-, 540-, 550-, and *580-Series Oscilloscopes. The Type 1L10 Spectrum Analyzer is tunable over the frequency range of 1 mc to 36 mc. The frequency "window" (dispersion) of the display is variable in eight calibrated steps of 0.01 to 2 kc/cm in a 1, 2, 5 sequence.

The Type 1L10 displays the frequency distribution of an applied signal (or signals) along the horizontal axis of the crt while the signal energy is displayed on the vertical axis.

Specifications

R-F Center Frequency Range	Continuously tunable from 1 mc to 36 mc.
Dial Accuracy	±(100 kc + 1% of dial reading)
Dispersion (width of frequency "window")	10 cps/cm to 2 kc/cm in eight calibrated steps in a 1, 2, 5 sequence.
Dispersion Accuracy	±3% when the Type 1L10 is calibrated for an individual oscilloscope. Otherwise, accuracy is +13% and —7%.
Sensitivity	—100 dbm minimum at 10 cps resolution. (0 dbm equals 1 milliwatt).
Sweep Rate	Determined by oscilloscope Time/Cm switch. Typically less than 1 Sec/Cm to more than 5 mSec/Cm.
Resolution	10 cps to 1 kc depending on setting of COUPLED RESOLUTION switch.
Maximum Input Power	—20 dbm with all R-F ATTEN switches OFF. +24 dbm with all R-F ATTEN switches ON.
Frequency Stability	Local Oscillator: 150 ppm*/°F. 10 ppm*/volt of line voltage. I-F Amplifier: 2 ppm*/°F. 1 ppm*/volt of line voltage.
Display Flatness	±1 db.
Vertical Display (with 6 cm screen)	LOG: 50 db. LIN: 26 db. LIN ×10: 26 db.
R-F ATTEN	51 db, ±0.1 db/db in 1 db steps.
GAIN Control Range	60 db.
TO RECORDER Output	Dc coupled. Output voltage at least 15 mv/cm when working into a 600 Ω load.

*A plug-in adapter must be used with 580-Series Oscilloscopes.

Accessories Included

	Tektronix Part No.
2—Instruction Manuals	070-0510-00
1—Plug, Tini-Plug, Red	134-0052-00
1—Cable Assembly, BNC to Banana Plug, 24"	012-0096-00
1—Cable Assembly, BNC to BNC, 2½"	012-0097-00

VIDEO INPUT	Deflection Factor: .1 v/cm. Bandpass: 10 cps to oscilloscope vertical amplifier bandwidth.

*Parts per million.

NOTES

SECTION 2
OPERATING INFORMATION

Function of Controls and Connectors

R-F CENTER FREQUENCY Control	Tunes the Spectrum Analyzer to the frequency to be displayed. The dial reading indicates the frequency at an accuracy of $\pm$(1% of reading +100 kc).
FINE R-F CENTER FREQUENCY	Provides a fine adjustment as a supplement to the R-F CENTER FREQUENCY control. Range of the FINE R-F CENTER FREQUENCY control is approximately 20 kc.
OSC Connectors	OSC OUT (top connector) is the output of the tunable local oscillator in the Type 1L10. Output frequency is 61 mc to 96 mc. OSC IN (bottom connector) is the oscillator input connector to the mixer. When an external oscillator is used, it should be connected to this connector.
VERTICAL POSITION	Varies the position of the trace on the crt screen. Normally set where the trace is aligned with the bottom graticule line.
R-F ATTEN	Six toggle switches that may be individually switched in or out to obtain from 1 to 51 db attenuation. The attenuators are useful for making comparative amplitude measurements.
EXT OSC-INT OSC	Turns off the internal local oscillator in the EXT OSC position. To avoid interference, the local oscillator should be turned off when an external oscillator is used. In most other applications the switch should be set to INT OSC.
VERTICAL DISPLAY	LOG: Provides about a 50 db dynamic range in a six-centimeter vertical display. LIN and LIN $\times$10: Both positions provide about a 26 db dynamic range with a six-centimeter vertical display. The LIN $\times$10 position is more sensitive than the LIN position. VIDEO INPUT: Permits a vertical input signal to be displayed on the oscilloscope for a conventional analog display of amplitude versus time. Input signal must be connected to the VIDEO INPUT connector.
GAIN	Varies the vertical amplitude of the display. Range is at least 60 db.
DISPERSION-KC/CM	Sets the frequency width of the display. For example, in the 2 position the frequency "window" of the display is 2 kc/cm or 20 kc wide over 10 cm. In the SEARCH position, the "window" is widened to permit wider uncalibrated dispersion and wider resolution bandwidth to facilitate location of signals at higher sweep rates.
COUPLED RESOLUTION (PULL TO VARY RESOLUTION)	Sets the resolving power of the instrument. (The ability to resolve between two signals that are near the same frequency.)
R-F INPUT 50 Ω	Spectrum input connector. Nominal characteristic input impedance is 50 Ω.
R-F INPUT 600 Ω	Spectrum input connector. Serves the same function as the R-F INPUT 50 Ω connector. Nominal characteristic input impedance is 600 Ω.
VIDEO INPUT	Input connector for use when the VERTICAL DISPLAY switch is set to the VIDEO INPUT position. Permits an analog display of time versus signal amplitude.
SWEEP INPUT	Jack for applying the sawtooth or sweep voltage of the oscilloscope. This coupling must be made when the Type 1L10 is used as a spectrum analyzer (i.e., in the LOG, LIN and LIN $\times$10 positions of the VERTICAL DISPLAY switch).
TO RECORDER Jack	Jack for driving a recorder. Output amplitude is at least 15 mv/cm, when working into a 600 Ω load.

First Time Operation

The following procedure provides a display on the oscilloscope and demonstrates the functions of certain controls of the Type 1L10.

1. Insert the Type 1L10 Spectrum Analyzer into the oscilloscope, turn on the power and allow 5 to 10 minutes for warm up.

2. Connect the special patch cord between the Sawtooth output connector of the oscilloscope and the SWEEP INPUT connector of the Type 1L10, and connect a coaxial cable between OSC OUT and OSC IN.

3. From a signal generator, apply a signal of between 1 and 36 mc to the R-F INPUT 50 Ω connector (or the R-F INPUT 600 Ω connector if the output impedance of the signal generator is significantly higher than 50 Ω).

4. Set the front-panel controls of the Type 1L10 as follows:

R-F CENTER FREQ	To the approximate frequency of the signal generator.
FINE R-F CENTER FREQ	Midrange (5 turns from either extreme)
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
VERTICAL DISPLAY	LIN
GAIN	Midrange

EXT OSC-INT OSC	INT OSC
DISPERSION-KC/CM COUPLED RESOLUTION	SEARCH
Sweep Rate (Oscilloscope)	.1 SEC/CM

5. Carefully adjust the R-F CENTER FREQ control to the point where the signal generator signal appears on the screen. Use the FINE R-F CENTER FREQ control to move the displayed spectra to the middle of the trace. Set the GAIN and/or R-F ATTEN switches for a vertical display of 3 to 6 divisions. The display at this point should resemble Fig. 2-1.

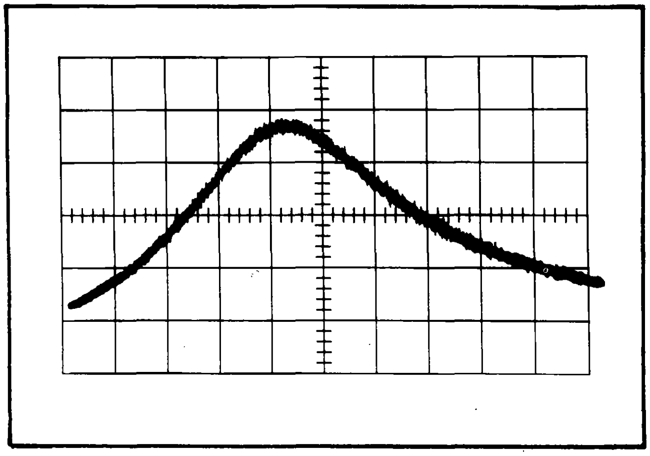


Fig. 2-1. Display of a signal with the DISPERSION-KC/CM switch in the SEARCH position.

6. Set the DISPERSION-KC/CM COUPLED RESOLUTION switch to 2.

7. Reset the FINE R-F CENTER FREQ control to position the displayed spectra to the middle of the trace. At this point the display should resemble that shown in Fig. 2-2. The frequency window is now 20 kc wide (ten divisions) and centered about the input signal frequency. If it is desired to narrow the dispersion further, move the signal to the center of the trace prior to narrowing the dispersion.

8. Set the VERTICAL DISPLAY switch to LOG. In this position of the VERTICAL DISPLAY switch the vertical deflection is logarithmic. That is, smaller signals are amplified more than larger amplitude signals. This allows a wider dynamic range of signal levels to be viewed in a given display.

Applied Signal Precautions

Signals applied to the R-F INPUT 50 Ω connector should be connected through a 50-ohm coaxial cable with a Type BNC male connector. Unshielded connections will tend to pick up stray signals and cause a confusing display. Before applying any input signals make sure the signal energy is —24 dbm (0 dbm = 1 mw) or less. If the signal energy exceeds this, use external attenuation.

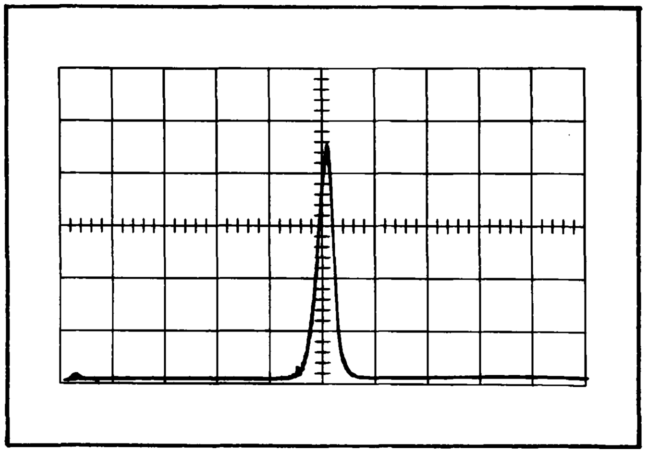


Fig. 2-2. Display of a signal with the DISPERSION-KC/CM switch at 2.

The nominal characteristic input impedance (Z_o) at the R-F INPUT 50 Ω connector is 50 Ω. Proper matching between the device under test and the Type 1L10 may be necessary to prevent adverse loading effects on the device under test. The R-F INPUT 600 Ω connector is provided for situations where the device under test has a higher output impedance.

Harmonic and Image Frequency Displays

Before making any measurements of a displayed signal (or signals), it must be determined that the signal is not a harmonic or an image frequency.

An image frequency is twice the frequency of the I-F (2 × 60 mc) above the R-F CENTER FREQ dial indication. For example, with the R-F CENTER FREQ dial set at 5 mc, an image frequency of 125 mc could be displayed on the screen (2 × I-F + 5 mc). A signal may be identified as an image frequency by turning the FINE R-F CENTER FREQ dial clockwise. If the displayed signal is an image, it will move to the left on the screen; if it moves to the right, it is not an image frequency.

Harmonic frequencies are whole-number multiples of the fundamental frequency. The amplitude and amount of harmonics associated with the fundamental frequency is proportional to the amount of sine-wave distortion. The fundamental frequency of an applied sine-wave signal will have two characteristics that differentiate it from any of the harmonics: (1) the fundamental display will be the lowest frequency and (2) the fundamental display will usually be the largest in amplitude.

Absolute Frequency Measurements

Absolute frequency measurements can be made from the R-F CENTER FREQ dial within an accuracy of ±(100 kc + 1% of the dial reading). To measure the frequency of an applied signal, proceed as follows:

1. Set the DISPERSION-KC/CM switch to SEARCH.

2. Set the R-F CENTER FREQ and FINE R-F CENTER FREQ controls to the point where the signal of interest is displayed in the center of the screen.

3. Set the DISPERSION-KC/CM switch to 2.

4. Set the R-F CENTER FREQ and FINE R-F CENTER FREQ controls to the point where the signal of interest is displayed in the center of the screen.

5. Read the frequency indicated by the R-F CENTER FREQ dial. Accuracy of the reading is ±(100 kc + 1% of the dial reading). For example, with a dial reading of 10 mc, the actual signal frequency is 10 mc ±200 kc (i.e., 1% of 10 mc + 100 kc = ±200 kc).

NOTE

Highly accurate frequency measurements may be obtained using an accurate reference frequency that is within 20 kc of the signal that is to be measured. See the following information under "Frequency Difference Measurements".

Frequency Difference Measurements

Accurate frequency separation measurements can be made between frequencies that are up to 20 kc apart. Accuracy of the measurement is within +13% and −7%. The DISPERSION-KC/CM switch sets the dispersion or "frequency window" of the display to a calibrated width. For example, with the DISPERSION-KC/CM switch set to 2, the frequency width of the display is 20 kc, (+13% or −7%) or 2 kc/cm. At a setting of 1, the width of the display is 10 kc or 1 kc/cm and so on through the remaining settings of the DISPERSION-KC/CM switch. Use the following information to measure the frequency separation between two signals.

1. With the two signals displayed on the screen, set the DISPERSION-KC/CM switch so that the signals are spaced as far apart on the screen as possible. (Center the two signals on the screen each time the DISPERSION-KC/CM switch is set to a lower position.)

2. Set the sweep rate of the oscilloscope for the best defined signal peaks.

3. Measure the distance, in graticule divisions, between the two signals (see Fig. 2-3).

4. Multiply the distance of step 3 by the setting of the DISPERSION-KC/CM switch. That is:

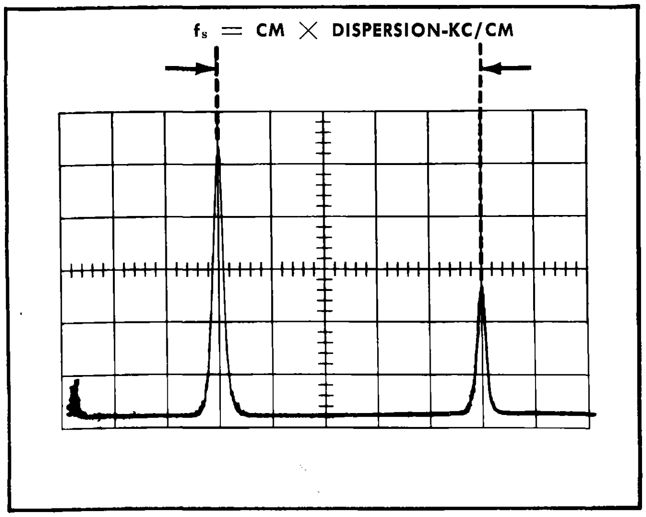


Fig. 2-3. Illustration of frequency difference measurement between two signals.

f_s = cm × DISPERSION-KC/CM setting

Where: f_s = Frequency separation in kilocycles.

cm = Distance measured in step 3 in centimeters.

Relative Amplitude Measurements

The relative amplitudes of two signals can be measured by using the R-F ATTEN switches on the Type 1L10. To measure relative amplitude, proceed as follows:

1. With the R-F CENTER FREQ and FINE R-F CENTER FREQ controls, tune the smallest amplitude signal to the center of the screen.

2. With all of the R-F ATTEN switches at OFF, adjust the GAIN control for exactly 4 cm of vertical deflection of the smallest signal.

3. With the R-F CENTER FREQ and FINE R-F CENTER FREQ controls, tune the largest amplitude signal to the center of the screen.

4. Switch as many R-F ATTEN switches to ON as required to make the largest amplitude signal exactly 4 cm high.

5. Add the settings of the R-F ATTEN switches that are switched in. The total is the relative amplitude difference, in db, between the two signals.

NOTES

SECTION 3
THEORY OF OPERATION

Introduction

A spectrum analyzer is a device that breaks down a complex electronic signal into its various frequency components. The display presented by the spectrum analyzer is a plot of frequency versus signal energy. The Type 1L10 Spectrum Analyzer is very similar to a superheterodyne radio receiver with quadruple conversion (see Fig. 3-1).

R-F Attenuator

The input signal from either the R-F INPUT 50 Ω or R-F INPUT 600 Ω connector is coupled to the R-F Attenuator section. The R-F Attenuator network is composed of 6 pi attenuator sections. Each pi attenuator may be switched in or out of the signal path with the various R-F ATTEN switches. Output of the R-F Attenuator is coupled to the balanced mixer circuit.

Front-End Local Oscillator

The Front-End Local Oscillator runs at a frequency of from 61 mc to 96 mc depending upon the setting of the R-F CENTER FREQ controls (R58 and C50). Upper frequency limit of the oscillator is set by C49 and the lower limit is set by T50. FINE R-F CENTER FREQ control is accomplished with a voltage variable capacitance diode D54. Bias on the capacitance diodes (and hence capacitance) is controlled by R58. The reactance of the D54-L54 combination is coupled by distributed capacity into the tank circuit of the collector of Q40.

The Q40 stage oscillates due to the capacitively coupled positive feedback from its collector to emitter through C48. The base of Q40 is held at R-F ground by C42.

In the SEARCH position of the DISPERSION-KC/CM switch, the sawtooth voltage of the oscilloscope is coupled to the emitter circuit of Q40. This sweeps the oscillator over a small frequency range and widens the effective dispersion. This makes it easier to locate signals on the screen and to use a faster sweep rate.

The EXT OSC-INT OSC switch SW40 removes power from the local oscillator in the EXT OSC position.

Output of the local oscillator is coupled to the Balanced Mixer circuit and is heterodyned with the input signal.

Balanced Mixer and Filter

The mixer circuit is balanced to minimize spurious signals from the local oscillator. The balance adjustments are C71 and C73. Heterodyning with the input signal takes place at the junction of D71-D73-L80-R80.

With no applied signal and with C71 and C73 set for proper balance, the local oscillator signal cancels at the junction of D71 and D73. This reduces spurious signals that might otherwise be produced by the local oscillator. When an applied signal appears at the junction of D71 and D73, it disturbs the balance of the bridge circuit by alternately biasing the diodes in different directions. When this occurs, heterodyning takes place between the applied signal and the local oscillator.

The Filter circuit is a narrowband circuit that is peaked at 60 mc. Whenever the difference frequency between the local oscillator and the applied signal equals 60 mc, signal energy is passed through the filter to the Wideband Amplifier.

Wideband Amplifier

The Wideband Amplifier chassis contains a two-stage 60-mc amplifier, a 49.3-mc oscillator, and a three-stage 10.7-mc amplifier. The 60-mc and 49.3-mc signals are mixed at the input of the 10.7-mc amplifier.

Q110 and Q120 form the two-stage 60-mc amplifier. The stages are transformer coupled through T114 and T124. C114 and C124 tune the coupling transformers for resonance at 60 mc. The emitters of Q110 and Q120 are R-F grounded through C115 and C123.

Q150 is a 49.3-mc crystal-controlled oscillator. The oscillator is peaked with the variable inductor L154. Output of the oscillator passes from the collector of Q150 to the base of Q200 through C150.

The 60-mc signal from the secondary of T124 is also coupled to the base of Q200. The Q200 stage is tuned to the difference frequency of the 60-mc and 49.3-mc signals (10.7 mc). The Q200, Q210 and Q220 stages form a three-stage 10.7-mc I-F amplifier. Between-stage coupling is accomplished with I-F transformers T204, T214 and T224. The 10.7-mc output from the secondary of T224 passes to the Swept I-F Oscillator chassis.

Swept I-F Oscillator

The Sweep Frequency Oscillator (Q360) is swept over a frequency range determined by the setting of the DISPERSION-KC/CM switch SW325A. The DISPERSION-KC/CM switch varies the amplitude of the oscilloscope sawtooth voltage that is applied to the Sweep Frequency Oscillator.

The action of the Swept I-F Oscillator circuit is as follows: The sawtooth voltage from the oscilloscope is connected to the front-panel SWEEP INPUT connector. The sweep voltage is attenuated by an amount determined by the setting of the Sawtooth Selector switch SW320. In the SEARCH position of the DISPERSION-KC/CM switch the sawtooth voltage is applied to the Front-End Local Oscillator rather than to the Sweep Frequency Oscillator. In all other positions of the DISPERSION-KC/CM switch the sawtooth voltage is applied to the sweep-frequency circuit through the attenuating resistors of the DISPERSION-KC/CM switch. The DISPERSION CAL adjustment, R321, sets the amplitude of the sawtooth voltage that appears across the voltage divider network (R322 through R329).

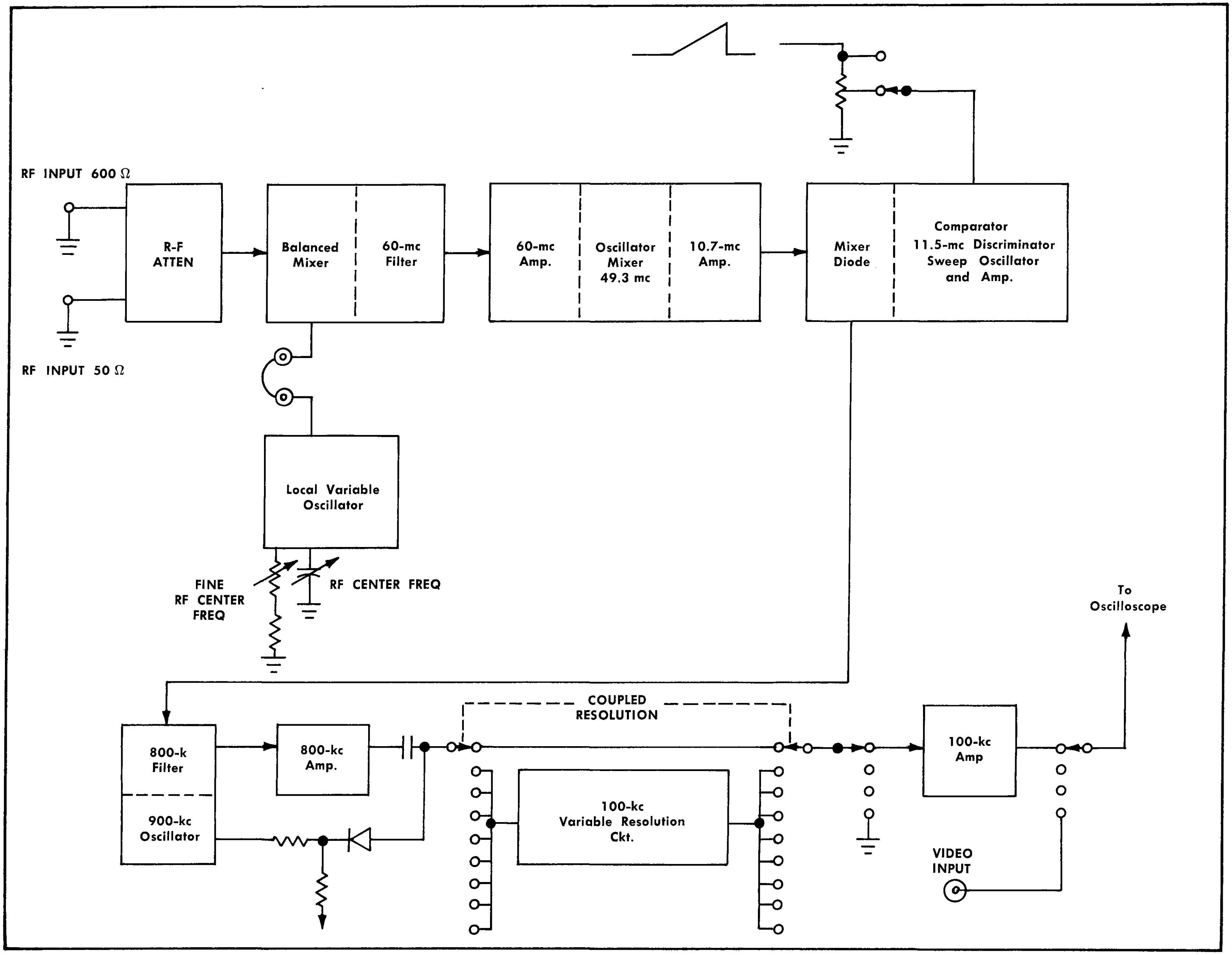


Fig. 3-1 Block diagram of the Type 1L10.

The sawtooth voltage from the voltage divider is applied to the base of emitter follower Q340. The emitter follower has a high input impedance and thus, does not significantly load the voltage divider. Output of the emitter follower is coupled to the base of Q341. Q341 forms one half of a difference amplifier. The purpose of the difference amplifier will be described a little later. For now, consider that the output of the difference amplifier is developed across R354 and applied to the voltage variable capacitance diode D362 through R355.

The sawtooth voltage appearing across D362 causes its capacitance to change in an amount proportional to the sawtooth voltage. D362 forms part of the capacitance of the tank circuit (L364) of the Sweep Frequency Oscillator Q360. The amplitude of the sawtooth voltage applied to the capacitance diode D362 determines the frequency change of the Sweep Frequency Oscillator. Output of the Sweep frequency Oscillator passes through C398 and mixes with the 10.7-mc signal from the Wideband Amplifier. Center frequency of the Sweep Frequency Oscillator is 11.5 mc. This gives a beat frequency of 800 kc.

Part of the output of the Sweep Frequency Oscillator is also coupled back through a closed loop circuit that includes an amplifier, discriminator and the other half of the difference amplifier. This closed-loop system corrects for the inherent non-linearity of the voltage variable capacitance diode D362. This is accomplished as follows: The sweep frequency is amplified by the R-F amplifier Q370 and coupled to the Discriminator circuit Y380. The Discriminator converts the sweep frequency back into a sawtooth signal. The sawtooth signal derived by the Discriminator contains any non-linearity that was introduced by the voltage variable capacitance diode D362. This sawtooth signal is coupled back to the difference amplifier through the emitter follower Q350. Assuming that the oscilloscope sawtooth voltage on the other side of the difference amplifier is linear, only the non-linear portion of the sawtooth will be amplified and coupled to the voltage variable capacitance diode. The result is that a non-linear driving voltage appears on D362. This non-linearity is such that it is equal and opposite to non-linear characteristics of the voltage variable capacitance diode. This, in turn, forces the Sweep Frequency Oscillator to produce a linear sweep frequency.

The mixed output of the Swept I-F Oscillator and the Wideband Amplifier is coupled through an 800-kc filter and then to an amplifier stage (Variable Resolution Amplifier schematic).

Variable Resolution Amplifier

The Variable Resolution Amplifier schematic contains an 800-kc filter, a feedback stabilized amplifier (Q500 and Q510), a 900-kc oscillator and a variable bandwidth circuit.

The filter circuit (L405, L410, L415, etc.) allows only the passage of the 800-kc signal. Output of the filter is coupled to a feedback stabilized amplifier consisting of Q500 and Q510. The 800-kc output of the amplifier is mixed with the output of the 900-kc oscillator giving a beat frequency of 100 kc.

The 900-kc oscillator is a stable crystal-controlled oscillator. Amplitude of the oscillator is peaked with L454.

In the SEARCH position of the COUPLED RESOLUTION switch the Variable Resolution circuit (Q520 through Q560) is bypassed. In all other positions of the switch the 100-kc signal passes through the Variable Resolution Amplifier.

The first stage (Q520) of the Variable Resolution Amplifier is a conventional amplifier with the output from the collector applied to the base of Q530 through coupling capacitor C524.

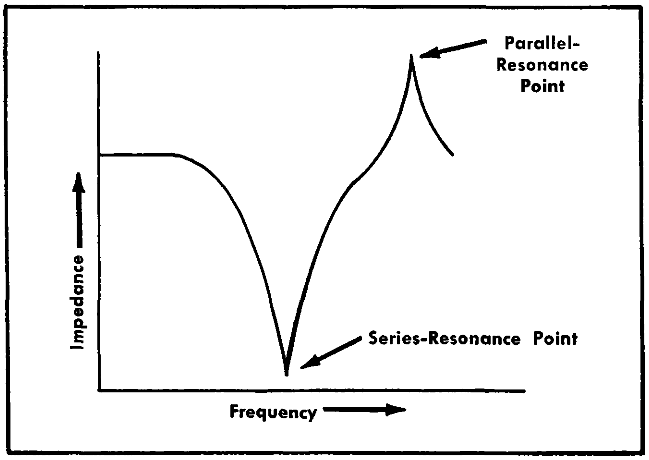


Fig. 3-2. Typical impedance versus frequency graph of a crystal. Note the series- and parallel-resonance points.

Q530 and Q540 form a bandwidth limiting circuit. Bandwidth of the circuit is set by the amount of forward bias on D548. To understand how this circuit operates, first consider the impedance characteristics of a crystal (such as Y530 in the collector circuit of Q530). Fig. 3-2 shows a typical impedance versus frequency curve of a crystal. In examining the curve, from left to right, we first encounter a very low impedance point at the series-resonant frequency point. At some higher frequency, the impedance increases—this is the parallel-resonance point. With a still higher frequency, the impedance drops fairly abruptly because of the inherent parallel capacitance of the crystal mounting.

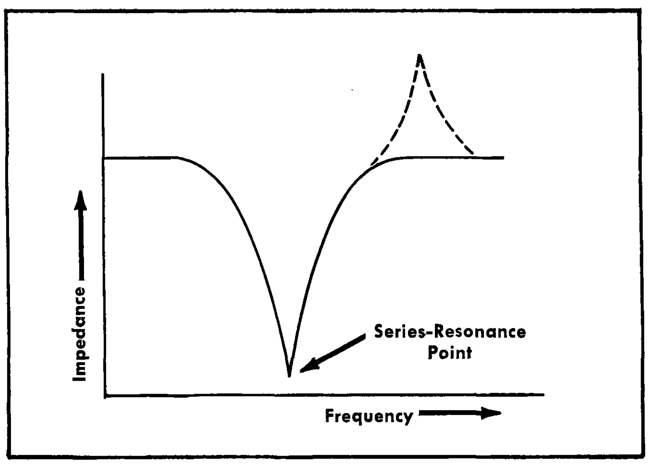


Fig. 3-3. Impedance versus frequency curve of a crystal when the parallel capacitance is effectively cancelled.

If the parallel capacitance is cancelled, the impedance of the crystal exhibits an impedance versus frequency curve that is shown in Fig. 3-3. This cancelling of the shunt capacitance of the crystal is accomplished by C534. Since the voltage on the collector is 180° out of phase with the voltage on the emitter of Q530, the capacity reactance introduced by C534 directly subtracts from the shunt X_c of the crystal. Hence, with C534 properly adjusted, Y530 exhibits no parallel resonance and assumes an impedance versus frequency curve like that shown in Fig. 3-3.

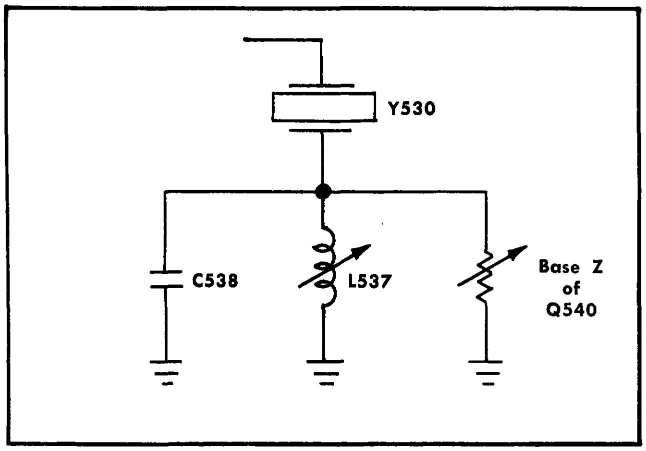


Fig. 3-4. Simplified drawing of the relationship between Y530, C538, L537 and the base impedance of Q540.

The next item to consider in the circuit is the tank circuit consisting of L537 and C538. This tank circuit and the crystal form a voltage divider when considering the voltage at the base of Q540. Also, the base impedance (which is largely resistive at 100 kc) of Q540 shunts the tank circuit of L537 and C538. Fig. 3-4 represents this circuitry in simplified form.

Since the base impedance of Q540 shunts the L537-C538 tank circuit, the 'Q' of the tank circuit can be controlled by changing the base impedance of Q540. This is accomplished by forward biasing D548. The more D548 is forward biased, the closer the emitter of Q540 comes to R-F ground. This, in turn, changes the input impedance at the base of Q540 since:

Input Z of Q540 $= h_{fe} \cdot R_{ee}$

Where: h_{fe} is the Beta of the transistor.

R_{ee} is the external emitter impedance of Q540 at 100 kc. Governed by the amount of forward bias on D548.

Fig. 3-5a shows the impedance versus frequency curve of the L537-C538 tank circuit at two settings of the COUPLED RESOLUTION switch superimposed on the impedance of Y530. Fig. 3-5b shows the resultant bandpass of the circuit at the base of Q540. Note that with a narrow bandpass the signal amplitude is less at the base of Q540. This diminishing amplitude, however, is compensated for by the increase in gain of the Q540 stage. The increased gain results from the decrease in emitter degeneration due to the increased forward bias on D548.

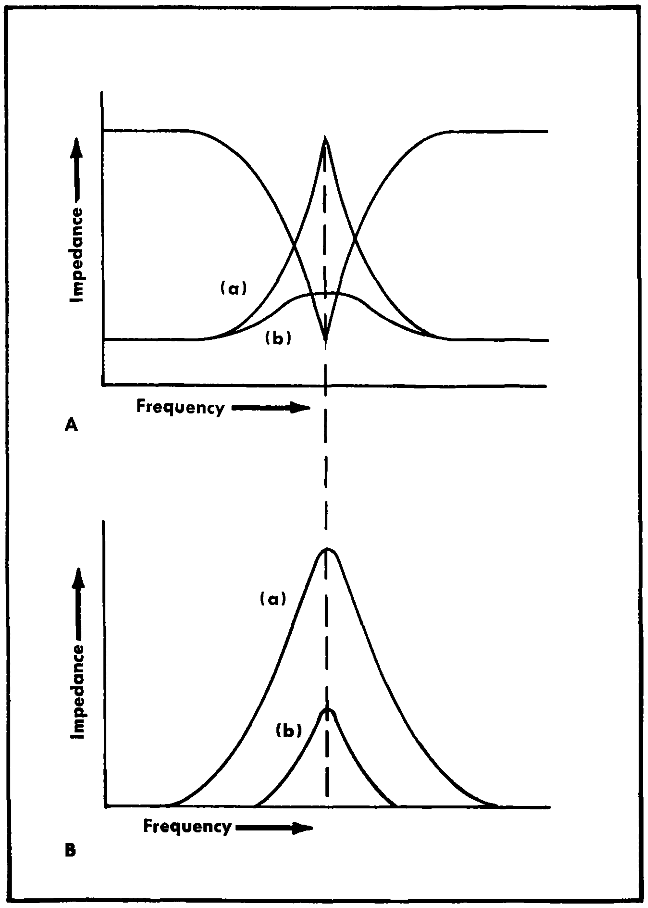


Fig. 3-5. (A) Impedance versus frequency curves of L537-C538 tank circuit at two settings (a and b) of the COUPLED RESOLUTION switch superimposed on the impedance curve of Y530. (B) Resultant voltage division curve derived from A. Notice the narrower bandwidth of curve (b).

The Q550-Q560 stage of the circuit operates the same as the Q530-Q540 stage. Output of the Variable Resolution Amplifier is coupled to the Output Amplifier and Detector Circuits.

Output Amplifier and Detector

The Output Amplifier circuitry contains an emitter follower (Q600) and two amplifier stages (Q610 and V620). The V620 amplifier stage is tuned to 100 kc with L624.

Diodes D640 and D641 detect the 100-kc output of the output amplifier. Output of the detector is coupled to the junction of R640-R641 and to the VERTICAL DISPLAY switch SW640. In the LIN ×10 position of the VERTICAL DISPLAY switch the signal passes straight through to the input of the oscilloscope with no attenuation. In the LIN position of the VERTICAL DISPLAY switch the output of the detector is attenuated approximately 10 times by the attenuation network. In the LOG position, the signal is attenuated by an amount that is proportional to the log of its amplitude. To small amplitude signals, D646 acts as a comparatively high impedance. To larger signals, D646 becomes increasingly forward biased and acts as a lower impedance. Hence, larger amplitude signals are attenuated more than smaller signals. R646 adjusts the attenuation of this network so that it is more nearly logarithmic.

In the VIDEO INPUT position of the VERTICAL DISPLAY switch the spectrum signal path is blocked and the input to the Output Amplifier is grounded. Also, any signal connected to the VIDEO INPUT connector is coupled to the vertical input of the oscilloscope. The GAIN potentiometer, R109B, sets the attenuation of the signal from the VIDEO INPUT connector. Input R of the VIDEO INPUT connector is approximately 50 Ω.

NOTES

SECTION 4
MAINTENANCE AND CALIBRATION

PREVENTIVE MAINTENANCE

Visual Inspection

The Type 1L10 Spectrum Analyzer should be inspected occasionally for such visible defects as poor connections, broken or damaged ceramic strips, improperly seated tubes or transistors, and heat-damaged parts. The remedy for most visible defects is obvious; however, particular care must be taken if heat-damaged parts are detected. Overheating can be caused by other, less apparent defects in the circuit. For this reason, it is essential to determine the actual cause of overheating before the parts are replaced; otherwise the damage may be repeated.

Recalibration

The Type 1L10 Spectrum Analyzer is a highly stable instrument and needs no recalibration except in the event the instrument fails to perform to the requirements specified in Section 1 of this manual. In the event of a failure of the instrument, first perform the Checkout Procedure described later in this section of the manual. This will serve to either localize the trouble or point out the need for recalibration.

PARTS REMOVAL AND REPLACEMENT

General Information

Removal or replacement procedures for most of the parts in the Type 1L10 are obvious. Some parts, however, require special instructions regarding their replacement. These parts are discussed in the following paragraphs.

Many components in the Type 1L10 are mounted in a particular way to control stray inductance and capacitance. When replacing this type of component, take care to duplicate lead length, lead dress, and location of the original component.

After replacing any electrical component, be sure to perform the Checkout Procedure. Components of the same type often exhibit slightly different characteristics which may affect calibration.

Tubes and Transistors

The tubes or transistors in the Type 1L10 should not be replaced unless they are actually defective. When a tube or transistor is removed and found acceptable, return the component to its original socket. This will avoid recalibration because of different tube or transistor characteristics.

The best way to check a tube or transistor is by substituting another tube or transistor of the same type that is of known good quality. Then check to see if proper operation is restored. If not, replace the original tube or transistor in its socket.

Soldering Precautions

In the production of Tektronix instruments, a silver-bearing solder is used to establish a bond to the ceramic terminal strips. This bond can be broken by repeated use of ordinary tin-lead solder or by excessive heating of the connection in the solder process. Occassional use of ordinary tin-lead solder is permissible if applied with moderate heat. The silver-bearing solder should contain about 3% silver. If this type of solder is not available locally, it may be purchased from Tektronix in one-pound rolls (order by part number 251-0514-00).

A wedge-shaped tip on the soldering iron is best for soldering and unsoldering parts on the ceramic strip. This type of tip allows the heat to be applied directly to the solder slot in the strip, reducing the overall heating effect. Use as little heat as possible to establish a good solder bond.

To properly solder and unsolder short lead components, the following procedure is recommended: (1) Use long-nose pliers for a heat sink. Attach the pliers between the component and the point being soldered. (2) Use a hot iron for a short time. (3) Carefully manipulate the leads to prevent lead or insulation damage. (4) Use only a small amount of solder; just enough to make a good bond.

Ceramic Terminal Strips

To remove a ceramic terminal strip, first unsolder all leads and components connected to it. Then pry the strip, with yokes attached, out of the chassis. The spacers may come out with the yokes. If not, the spacers can be pulled out separately. If the spacers are not damaged, they can be reused with the new strip assembly.

Another way to remove a strip from the chassis is to use diagonal cutters to cut off one side of each yoke. This frees the strip and the remainder of the yokes can be pulled from the chassis separately. Ceramic strips are supplied with the yokes attached, so it is not necessary to salvage the old yokes.

After removing a damaged strip and yokes, place the spacers into the holes in the chassis and insert the yokes into the spacers. If necessary, use a soft-faced mallet to tap the yokes into the spacers. Fig. 4-1 shows the assembled ceramic strip.

Schematics

The schematics of the Type 1L10 are at the back of this manual. The schematics contain waveforms and voltages at certain points in the circuit that will aid in troubleshooting or in analyzing the circuit operation.

If it is necessary to duplicate any of the voltages or waveforms, be sure to read the special note on the schematics regarding the proper conditions. The voltages and waveforms on the schematics are typical only, and may vary widely from instrument to instrument.

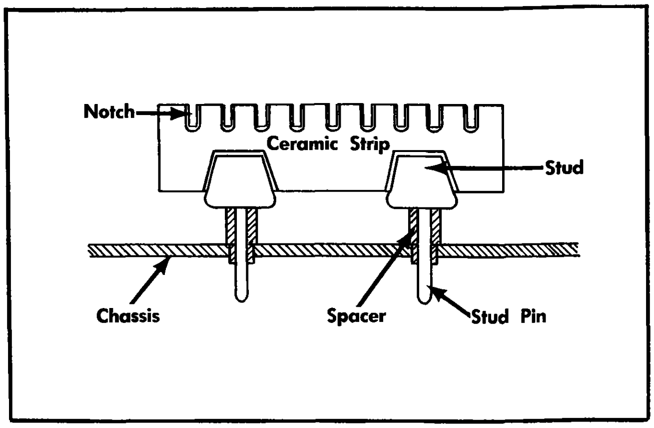


Fig. 4-1. Ceramic strip assembly.

TROUBLESHOOTING

General Information

If trouble develops in the Spectrum Analyzer, first check for proper connections and control settings. Look for simple explanations for the trouble first, before getting involved in detailed troubleshooting.

If all connections and control settings are proper, make a visual check of the instrument. Check and correct anything observed that could cause trouble.

Also, check the oscilloscope to make sure that it is operating properly. A faulty power supply in the oscilloscope can cause a variety of unusual trouble symptoms. The quickest way to check the operation of the oscilloscope is with another plug-in unit if one is available. If faulty operation is still noted with a different plug-in unit, the trouble can be assumed to be in the oscilloscope.

The Checkout and Calibration Procedures in this section are helpful in isolating trouble to a particular circuit.

Signal tracing is another important method of troubleshooting. Voltages and waveforms are shown on the schematic at points that facilitate signal tracing.

CHECKOUT PROCEDURE

Preliminary Information

This procedure offers a systematic way of checking the Type 1L10 against the requirements of Section 1 of this manual. The Checkout Procedure should be performed routinely after each 500 hours of operation or every six months if the instrument is used intermittently. Also use the Checkout Procedure after any corrective maintenance work.

Aways perform this procedure before attempting to calibrate the instrument. This will avoid making unnecessary calibration adjustments in many cases.

The test equipment required for this precedure must meet or exceed the accuracies specified under "Equipment Required". If the equipment used does not meet these requirements, the Type 1L10 cannot be checked or calibrated to the accuracies given in Section 1 of this manual.

Equipment Required

1. Tektronix oscilloscope that is normally used with the Type 1L10 Spectrum Analyzer.

2. Tektronix Type 180A Time-Mark Generator.

3. Tektronix Type 105 Square-Wave Generator.

4. Calibrated-Frequency Audio Generator capable of supplying 10-cycle to 2-kc signals with a frequency accuracy of $\pm 1\%$. The output amplitude shall be variable 0-1 volt rms.

5. Calibrated amplitude source of r-f power at frequencies between 1 mc and 60 mc. Output amplitude of the generator should be variable from 0 dbm to —100 dbm $\pm 1\%$ (0 dbm = 1 milliwatt). The frequency generator and attenuator must be well shielded to prevent stray radiation.

6. Tektronix Harmonic Modulator Unit, Tektronix part number 067-0518-00.

7. Connecting cables, 50-ohm with BNC connectors, 4 each Tektronix part number 012-0057-00.

Preliminary Setup

The following steps apply throughout the Checkout Procedure except as noted.

1. Insert the Type 1L10 Spectrum Analyzer into the oscilloscope, turn on the power and allow about 20 minutes for warm up.

2. Connect a patch cord between the SWEEP INPUT connector of the Type 1L10 and the Sawtooth output connector of the oscilloscope.

3. Set oscilloscope time-base for a free-running sweep.

Sensitivity Check

1. Set the front-panel controls of the Type 1L10 as follows:

RF CENTER FREQ	10
FINE RF CENTER FREQ	Midrange
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
EXT OSC INT OSC	INT OSC
VERTICAL DISPLAY	LIN
GAIN	Fully clockwise
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2

2. Apply the output signal of the calibrated amplitude r-f generator to the RF INPUT 50 Ω connector of the Type 1L10 (see Fig. 4-2). Set the output of the generator for about —50 dbm.

3. Vary the frequency of the r-f generator and the RF CENTER FREQ control of the Type 1L10, if necessary, to bring the signal onto the screen.

4. Decrease the output amplitude of the r-f generator to —100 dbm and note the relative amplitude between the displayed signal and the noise displayed on the trace (see Fig. 4-3). The signal must be twice or more the amplitude of

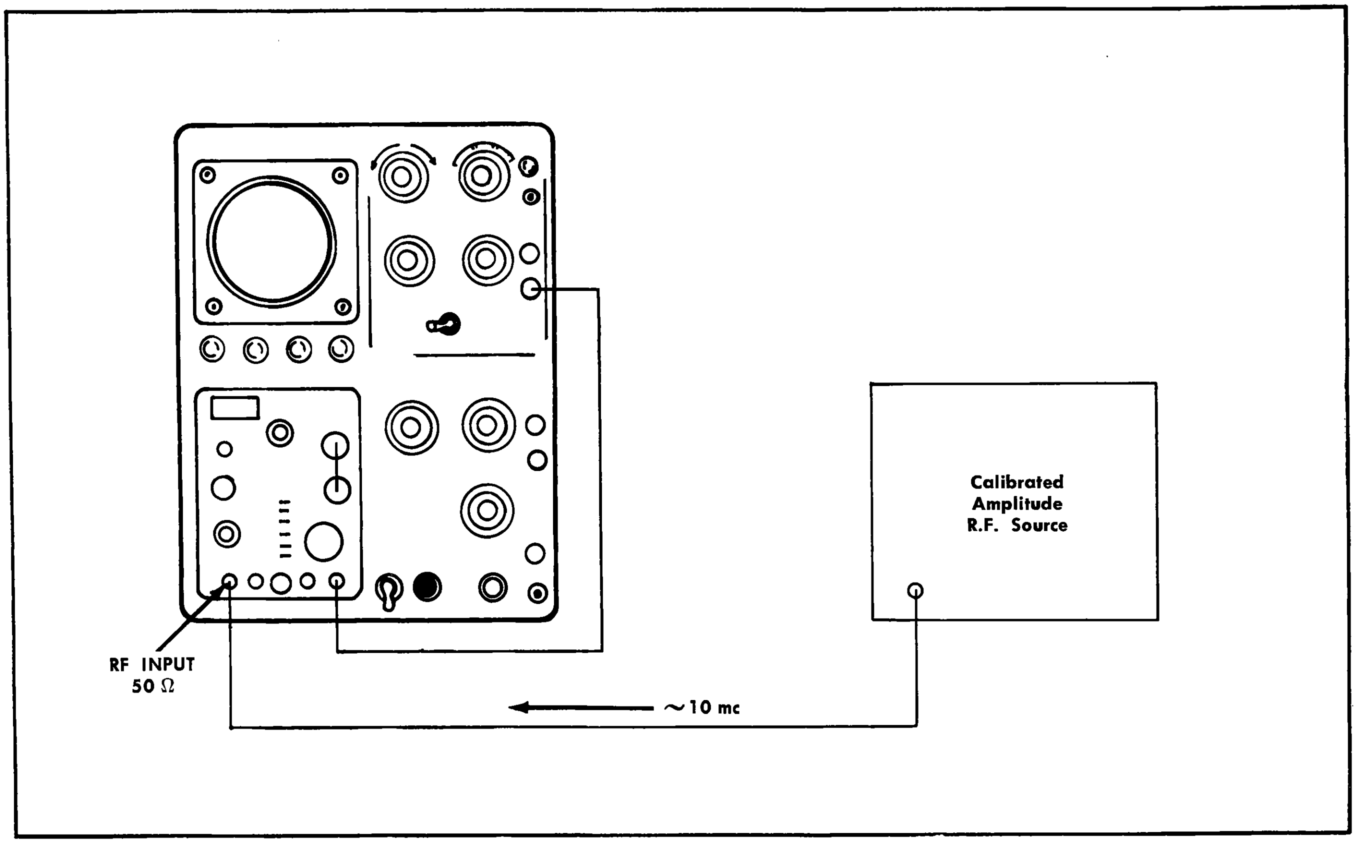


Fig. 4-2. Equipment setup for making sensitivity check.

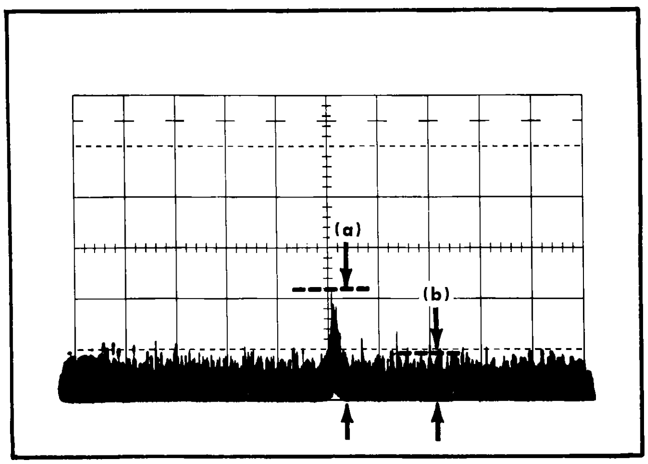


Fig. 4-3. Measurement of relative amplitude between an applied low-level signal and the noise of the system. (a) Amplitude of signal and (b) amplitude of noise.

the displayed noise. If the amplitude of the display is not at least two times noise, set the DISPERSION-KC/CM and COUPLED RESOLUTION switches to .01, and set the VERTICAL DISPLAY switch to LIN ×10. Slow the sweep rate of the oscilloscope to .5 SEC/CM. If the signal amplitude is still not two times as great as noise, the instrument needs a complete calibration.

Dispersion Check

1. Connect the equipment as shown in Fig. 4-4.

2. Set the front-panel controls on the Type 1L10 as follows:

RF CENTER FREQ	10
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
VERTICAL DISPLAY	LIN
GAIN	Midrange
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2
INT OSC EXT OSC	INT OSC

4. Set the Type 180A Time-Mark Generator for an output frequency of 5 mc.

5. Using the RF CENTER FREQ control of the Type 1L10, tune the 2nd harmonic (10 mc) of the Type 180A signal to the center of the screen.

6. Set the GAIN control and R-F ATTEN switches of the Type 1L10 for about 6 cm of the displayed signal.

7. Set the output frequency of the audio generator to 2 kc.

8. Set the output amplitude of the audio generator and the controls on the Harmonic Modulator Unit for maximum modulation (maximum number of side-frequency markers). See Fig. 4-5 for the desired display.

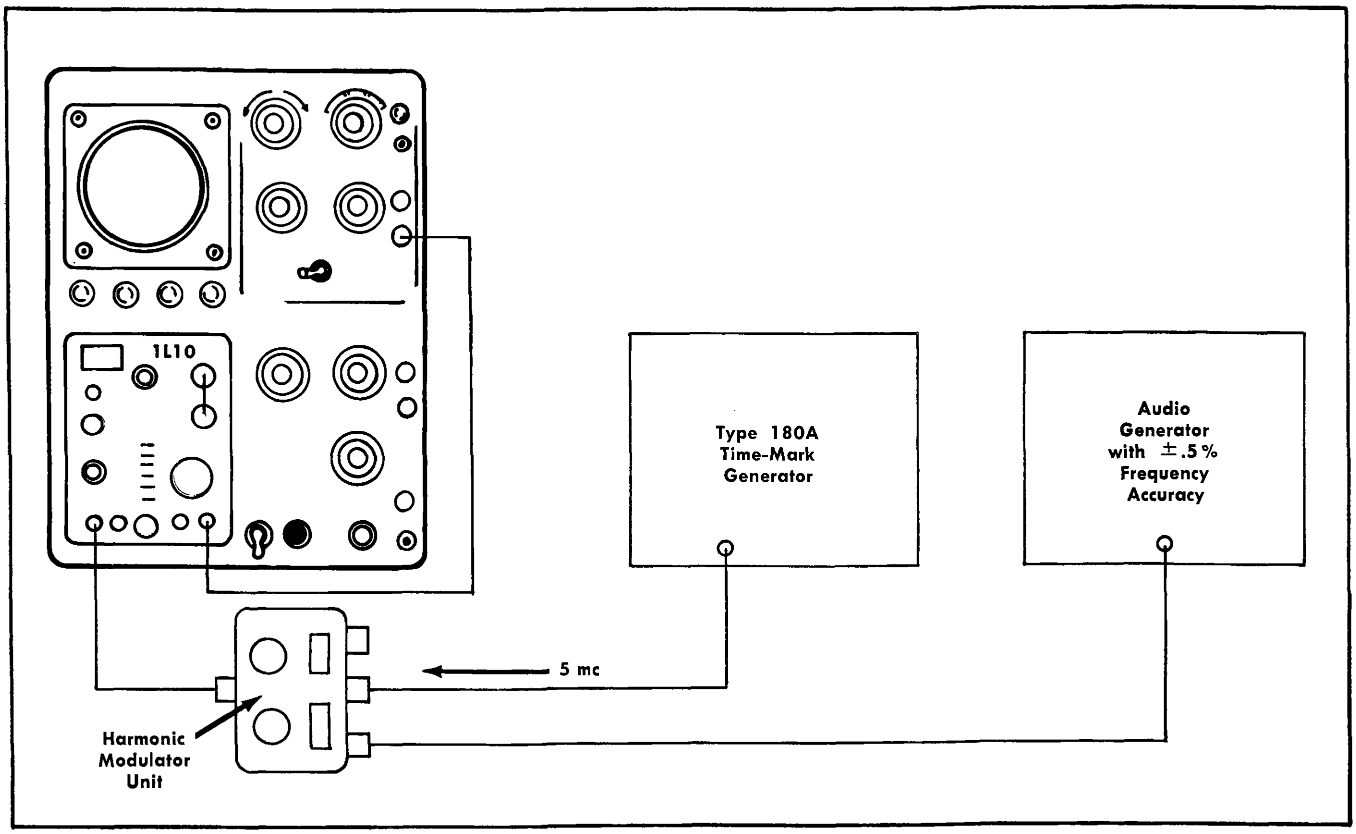


Fig. 4-4. Equipment setup for dispersion check at 2, 1, .5, .2, and .1 KC/CM settings of the DISPERSION-KC/CM switch.

9. With the FINE RF CENTER FREQ control of the Type 1L10, position the center-frequency marker to the centerline of the graticule.

10. Check the distance between markers. The markers should be 1 cm apart, +13%, −7%. If not, the dispersion of the Type 1L10 should be calibrated as per the Calibration Procedure in this section of the manual.

11. Using Table 4-1, check the 1, .5 and .2 KC/CM dispersion settings of the DISPERSION-KC/CM switch. The markers should be 1 cm apart, +13%, −7% at all settings. If not, calibrate the dispersion of the instrument as per the Calibration Procedure in this section. In each case, set the COUPLED RESOLUTION switch to the same setting as the DISPERSION-KC/CM switch.

TABLE 4-1

DISPERSION-KC/CM COUPLED RESOLUTION Setting	Audio Generator Frequency	Oscilloscope Sweep Rate
1	1 kc	50 mSEC
.5	500 cps	.2 SEC
.2	200 cps	.2 SEC
.1	100 cps	.5 SEC

12. Set the DISPERSION-KC/CM and COUPLED RESOLUTION controls to 2 and set the oscilloscope sweep rate to 20 mSEC.

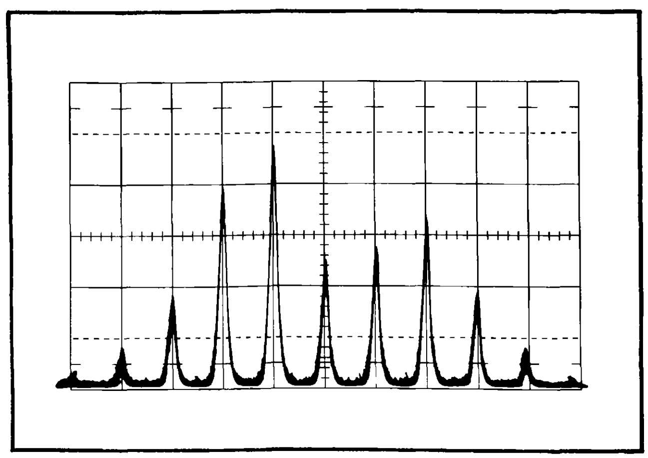


Fig. 4-5. A 5-mc signal modulated with a 2-kc audio signal. DISPERSION-KC/CM switch set at 2.

13. Set the EXT OSC INT OSC switch of the Type 1L10 to EXT OSC.

14. Set up the equipment as shown in Fig. 4-6.

15. Set the GAIN control of the Type 1L10 for about 6 cm of signal.

NOTE

The signal now observed is the 12th harmonic

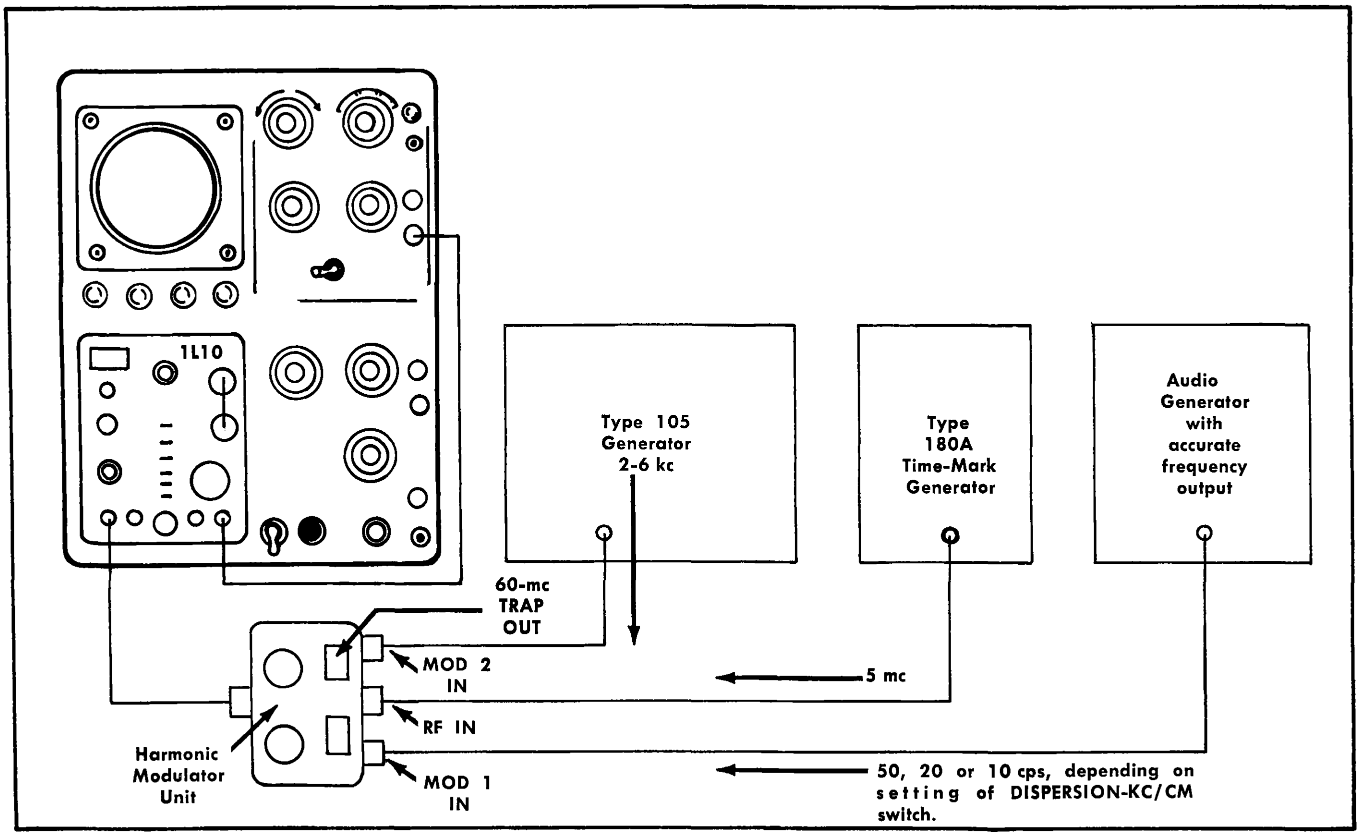


Fig. 4-6. Equipment setup for Dispersion Check/adjustment at .01, .02, .05 KC/CM settings of DISPERSION-KC/CM switch.

(60 mc) of the 5-mc signal from the Type 180A. This signal will normally appear to the right of the graticule centerline.

16. Reduce the output amplitude of the audio generator so that it is not modulating the Type 180A signal.

17. Set the output frequency of the Type 105 Square-Wave Generator to about 3 kc and adjust its output amplitude so that the modulation markers are clearly visible.

18. Set the output frequency of the Type 105 Square-Wave Generator so that the first modulation marker on the left-hand side of the center frequency is at the graticule centerline (see Fig. 4-7).

19. Set the DISPERSION-KC/CM and COUPLED RESOLUTION switches to 1, .5, .2, .1 and .05 while keeping the Type 105 Square-Wave Generator signal positioned to the graticule centerline by varying the output frequency.

20. Set the sweep rate of the oscilloscope to .2 SEC.

21. Set the output frequency of the audio generator to 50 cps and increase the output amplitude of the audio generator until the 50 cps modulation is clearly visible. Check for 1 marker/cm, +13%, −7%.

22. Using Table 4-2, check the .2 and .1 settings of the DISPERSION-KC/CM switch. The markers should be 1 cm apart +13%, −7% at all settings. If not, calibrate the dispersion of the instrument per the Calibration Procedure in this section. In each case, set the COUPLED RESOLUTION switch to the same setting as the DISPERSION-KC/CM switch. Keep the display centered by slight adjustment of the Type 105 Square-Wave Generator frequency.

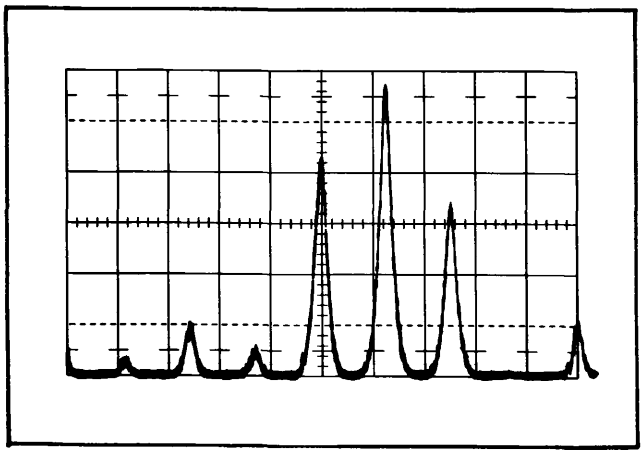


Fig. 4-7. Initial display (step 18) in checking the narrow dispersion settings of the Type 1L10.

TABLE 4-2

DISPERSION-KC/CM COUPLED RESOLUTION Setting	Audio Generator Frequency	Oscilloscope Sweep Rate
.02	20 cps	.5 SEC
.01	10 cps	1 SEC

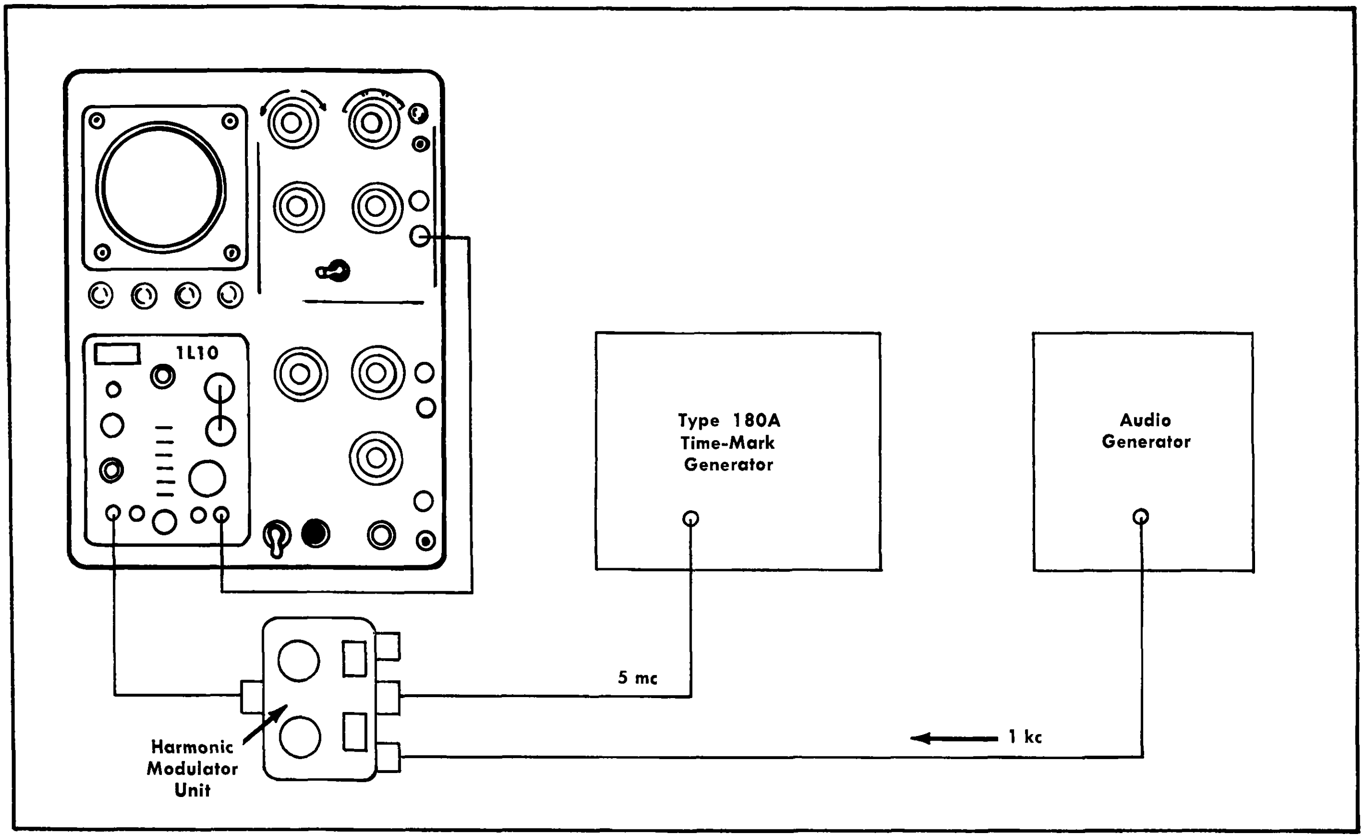


Fig. 4-8. Equipment setup for resolution check.

Resolution Check

1. Connect up the equipment as shown in Fig. 4-8.
2. Set the front-panel controls as follows:

RF CENTER FREQ	10
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
VERTICAL DISPLAY	LIN
GAIN	Midrange
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2
INT OSC EXT OSC	INT OSC
Oscilloscope Sweep Rate	20 mSEC

3. On the Harmonic Modulator Unit, set the MOD 2 switch to ON and the 60 mc TRAP switch to IN.

4. Set the Type 180A Time-Mark Generator for an output frequency of 5 mc.

5. Using the RF CENTER FREQ control of the Type 1L10, tune the 2nd harmonic (10 mc) of the Type 180A signal to the center of the screen.

6. Set the audio generator for an output frequency of 1 kc and adjust the controls on the Harmonic Modulator Unit so that at least two modulation markers (one on each side of center frequency) are visible.

7. Set the DISPERSION-KC/CM and COUPLED RESOLUTION switches to .2 and center the display on the screen with the FINE RF CENTER FREQ control.

8. With the VERTICAL POSITION control, position the bottom of the display to the bottom line on the graticule.

9. Set the GAIN control so that the center frequency marker is six centimeters in amplitude.

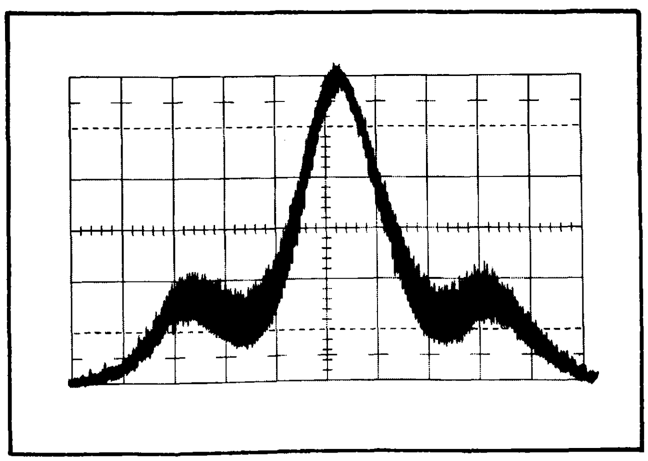


Fig. 4-9. Display of a 1-kc modulated signal with the COUPLED RESOLUTION control set at 2-KC/CM and the DISPERSION-KC/CM at .5. Notice that the valleys in the display do not come to the baseline.

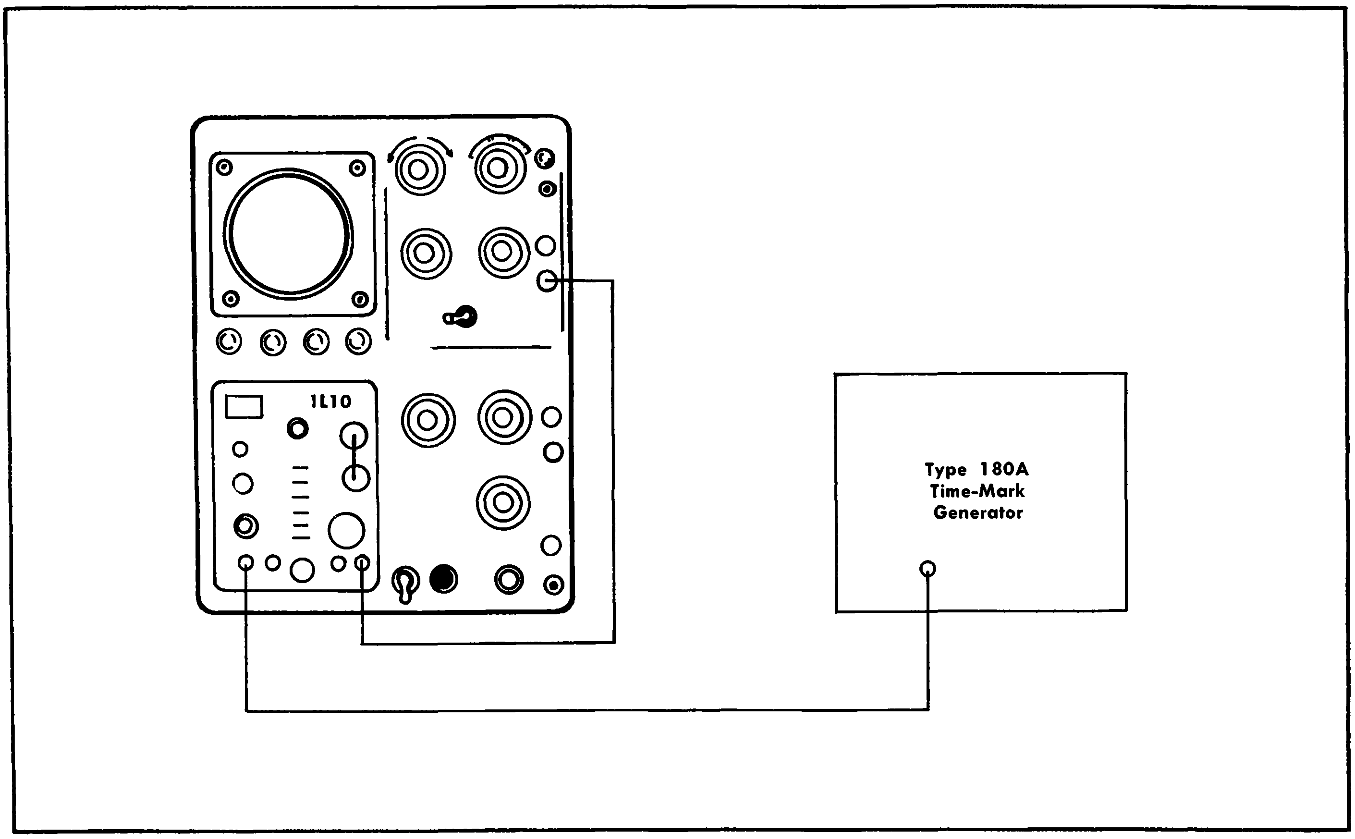


Fig. 4-10. Equipment setup for checking oscillator tracking and accuracy.

10. Pull out on the COUPLED RESOLUTION control and set it to 2. (Make sure the DISPERSION-KC/CM switch remains at the .5 position.)

11. If necessary, reset the GAIN control so that the center-frequency marker is six centimeters in amplitude.

12. If the resolution of the Type 1L10 is proper, the valleys between the center-frequency marker and the side-frequency markers will not fall to the baseline of the trace; see Fig. 4-9. If the valleys of the display fall to the baseline, the resolution of the Type 1L10 should be calibrated as per the Calibration Procedure in this section.

Oscillator Tracking Check

1. Set up the equipment as shown in Fig. 4-10.
2. Set the front-panel controls as follows:

RF CENTER FREQ	5
FINE RF CENTER FREQ	Midrange
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF except 16 db and 20 db
EXT OSC INT OSC	INT OSC
VERTICAL DISPLAY	LIN
GAIN	Midrange
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2
Oscilloscope Sweep Rate	5 mSEC

3. Set the output frequency of the Type 180A Time-Mark Generator to 5 mc.

4. Set the RF CENTER FREQ and FINE RF CENTER FREQ controls to display the Type 180A signal on the screen of the oscilloscope. Make sure the displayed signal is not a spurious signal. This can be checked by temporarily removing the input signal from the Type 180A and noting whether the signal displayed at the 5 mc dial setting disappears.

5. Change the output frequency of the Type 180A to 1 mc (1 μsec markers).

6. Slowly turn the GAIN control clockwise. A signal should appear on the trace that is in the same position as the 5 mc signal. This signal is the 5th harmonic of the 1 mc signal. Make sure this signal moves on the screen when the FINE RF CENTER FREQ control is turned.

7. Turn the RF CENTER FREQ control slowly counterclockwise until the 4th harmonic of the 1 mc signal is displayed on the screen. Check the RF CENTER FREQ dial reading. The dial reading should be 4 mc $\pm 1\%$ of dial reading ± 100 kc.

8. Continue turning the RF CENTER FREQ dial counterclockwise while checking where the 3rd, 2nd, and fundamental frequencies occur on the dial. In all cases, the tolerance is $\pm 1\%$ of dial reading ± 100 kc.

9. Set the output frequency of the Type 180A to 5 mc.

10. Set the RF CENTER FREQ control to 10 mc and tune for the 2nd harmonic of the 5 mc signal. The RF CENTER FREQ dial reading should be ±1% of dial reading ±100 kc.

Turn the RF CENTER FREQ control to 15 mc, 20 mc 25 mc, 30 mc, and 35 mc and check to see where on the dial the 3rd, 4th, 5th, 6th, and 7th harmonics of the 5 mc signal occur. In all cases, the tolerance is ±1% of dial reading ±100 kc.

Dynamic Range Check

1. Set the VERTICAL DISPLAY switch to LIN.

2. Set up the Type 1L10 to display a 6 cm signal. Leave the 2 db, 4 db, and 20 db switches at OFF.

3. Set the 2 db, 4 db, and 20 db switches to on. The displayed signal must still be discernible on the trace. Set the R-F ATTEN switches to OFF.

4. Set the VERTICAL DISPLAY switch to LOG and set up the Type 1L10 to display a 6 cm signal. In addition, the GAIN and/or COUPLED RESOLUTION should be set so as to limit the noise on the trace to 2 mm or less. Leave the R-F ATTEN switches in the OFF position.

5. Switch in all of the R-F ATTEN switches except the 1 db switch. The signal must still be discernible on the trace. Set all R-F ATTEN switches to OFF.

6. Set the VERTICAL DISPLAY switch to LIN and set the GAIN control for a 6 cm signal.

7. Set the VERTICAL DISPLAY switch to LIN ×10 and switch in the 20 db R-F ATTEN switch. The displayed signal must be 6 cm ±10%.

R-F ATTEN Check

1. Set the front-panel controls as follows:

RF CENTER FREQ	Any position
FINE RF CENTER FREQ	Midrange
R-F ATTEN	All OFF
VERTICAL DISPLAY	LIN
DISPERSION-KC/CM	2
(UN)COUPLED RESOLUTION	1
Oscilloscope Sweep Rate	5 mSEC/CM

2. Apply a —70 dbm 60-mc signal from the Calibrated Output r-f generator to the Type 1L10 RF INPUT 50 Ω connector.

3. Set the Type 1L10 GAIN control so that the 60-mc signal is exactly 5 centimeters high.

4. Switch the 1 db R-F ATTEN switch to ON and adjust the attenuator control of the r-f generator so that the 60-mc signal is exactly 5 centimeters high. The r-f generator attenuator control should read —69 dbm to ±0.1 dbm.

5. Switch the 1 db R-F ATTEN switch to OFF.

6. Check the rest of the R-F ATTEN steps in the same way, as directed in Table 4-3.

TABLE 4-3

Type 1L10 R-F ATTEN Switched to ON	r-f Generator Attenuator Setting
2 db	—68 dbm ±0.2 dbm
4 db	—66 dbm ±0.4 dbm
8 db	—62 dbm ±0.8 dbm
16 db	—54 dbm ±1.6 dbm
20 db	—50 dbm ±2.0 dbm
ALL ON	—19 dbm ±5.1 dbm

TO RECORDER Check

1. Apply a 60-mc signal from the r-f generator to the Type 1L10 RF INPUT 600 Ω connector.

2. Turn the Type 1L10 GAIN control fully clockwise.

3. Adjust the amplitude of the signal generator for 4 centimeters of display.

4. Terminate the TO RECORDER output with 600 Ω and connect the test oscilloscope across the termination. The signal amplitude should measure at least 60 millivolts.

VIDEO INPUT Check

1. Set the VERTICAL DISPLAY switch to the VIDEO input position.

2. Set the Amplitude Calibrator switch of the oscilloscope to the .1 volt into 50 Ω position. If the oscilloscope does not have this position use the .5 volt position.

3. Turn the GAIN control of the Type 1L10 fully clockwise.

4. Connect between the VIDEO INPUT connector of the Type 1L10 and the CAL OUT connector of the oscilloscope.

5. Set the sweep rate of the oscilloscope to .5 mSEC/CM and set the triggering controls for a stable display.

6. Check for approximately 1 cm of vertical deflection on the screen of the oscilloscope. This check is mainly for continuity rather than a deflection factor check. The deflection factor is controlled by the oscilloscope.

CALIBRATION PROCEDURE

Do not calibrate the Type 1L10 unless the need is indicated in the Checkout Procedure. Once the need for calibration is indicated, perform only the calibration steps that are recommended in the Checkout Procedure.

Calibration Equipment Required

1. Items 1 through 7 under "Equipment Required" in the Checkout Procedure of this section.

2. Test Oscilloscope: Tektronix Type 530 or 540-Series recommended with a Type H or K plug-in unit and a 10X Probe.

3. Alignment tools:

Description	Tektronix Part Number
Screwdriver plastic shaft	003-0000-00
Rod for 0.100" inside diameter hex slugs	003-0301-00
Handle and insert for 5/64" inside diameter hex slugs	003-0307-00 003-0310-00

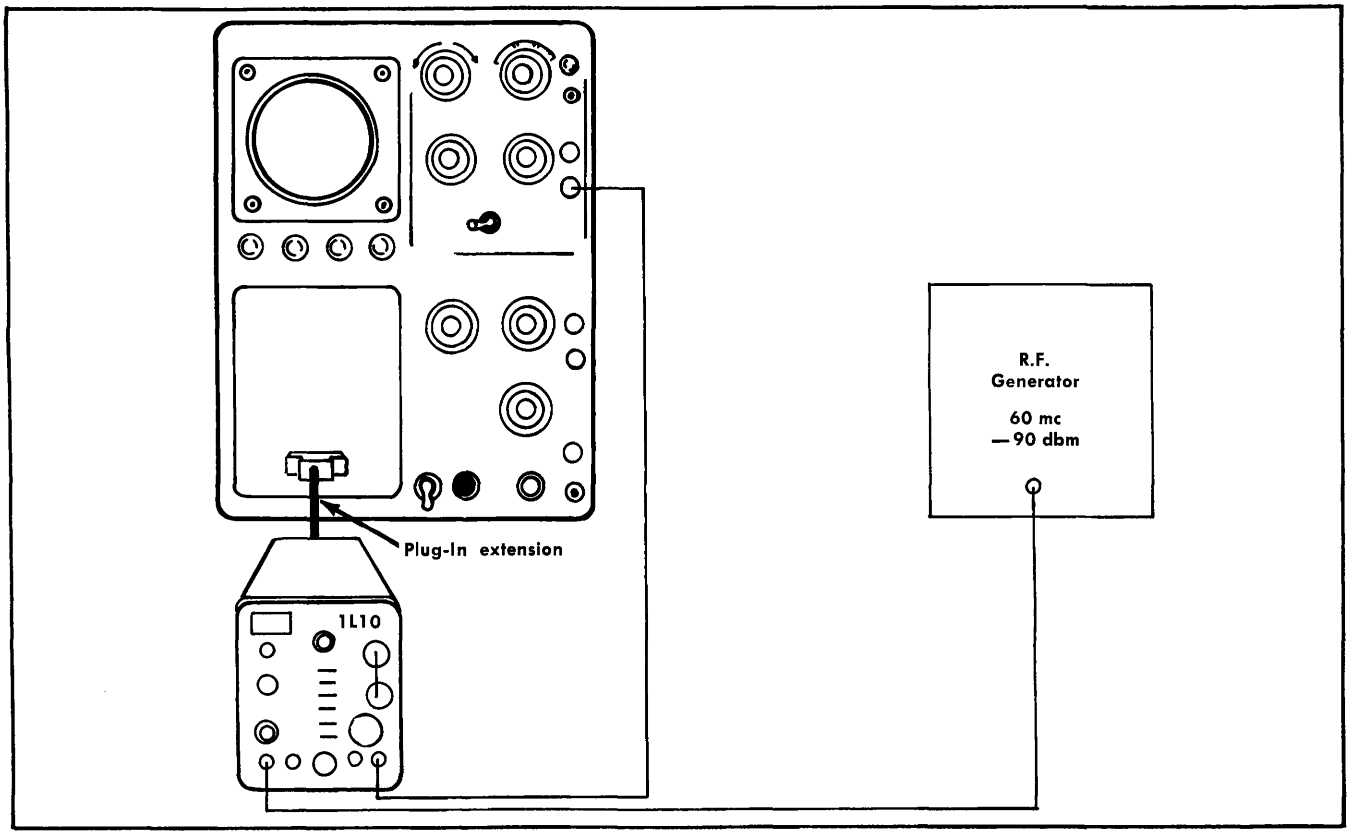


Fig. 4-11. Equipment setup for I-F stages alignment.

4. Small screwdriver with 3/32" bit width, 3/32" diameter shank 3" long: Tektronix part number 003-0192-00.

5. 1/16" allen wrench.

6. Flexible plug-in extension, Tektronix part number 012-0038-00.

1. I-F Stages Alignment

a. Connect the equipment shown in Fig. 4-11.

b. Preset the front-panel controls of the Type 1L10 as follows:

VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
EXT OSC INT OSC	EXT OSC
VERTICAL DISPLAY	LIN
GAIN	Fully clockwise
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2

Free run the oscilloscope sweep at a sweep rate of 20 mSEC/CM.

c. Set the output frequency of the r-f signal generator to 60 mc and the output amplitude for approximately —90 dbm.

d. Inside the plug-in unit, disconnect the cables at connectors J80 and J101. Connect the cable that was connected to J80 to J101. Use long-nosed pliers to reach the connectors. Connect a cable between J38 and J101.

e. Unsolder the coax at the output of the Wideband Amplifier (see Fig. 4-12) and connect the probe of the test oscilloscope to the output terminal of the Wideband Amplifier. Set the test oscilloscope to observe a 10.7 mc signal that is approximately 200 mv in amplitude.

f. While observing the test oscilloscope, adjust L154 through the range where the 10.7 mc signal appears and disappears. Set L154 to the middle of the range where the signal appears.

g. Adjust C114, C124, T204, T214 and T224 (Fig. 4-12) for maximum signal amplitude on the test oscilloscope.

h. Disconnect the cable from J101 and connect it back to J80. Reconnect the original cable to J101.

i. Adjust C89, C92, C95 and C98 (Fig. 4-12) for maximum signal amplitude on the test oscilloscope.

j. Disconnect the test oscilloscope and resolder the connection at the output terminal of the Wideband Amplifier.

k. Connect the probe of the test oscilloscope to the collector of Q370 (or to the ungrounded side of L374) and make a preliminary adjustment of L364 for a frequency of approximately 11.5 mc as displayed on the test oscilloscope.

l. Connect the probe of the test oscilloscope to the base of Q350.

m. Adjust L364 until the sawtooth voltage at the base of Q350 is approximately 1.4 volts, peak to peak. Remove the probe.

n. Connect the probe of the test oscilloscope to the end of the coax that comes from connector J458.

o. Adjust L454 for "lock" of the 900 kc oscillator. The oscillator is "locked" when its frequency no longer changes with adjustment of L454. Set L454 to the middle of its "locked in" range.

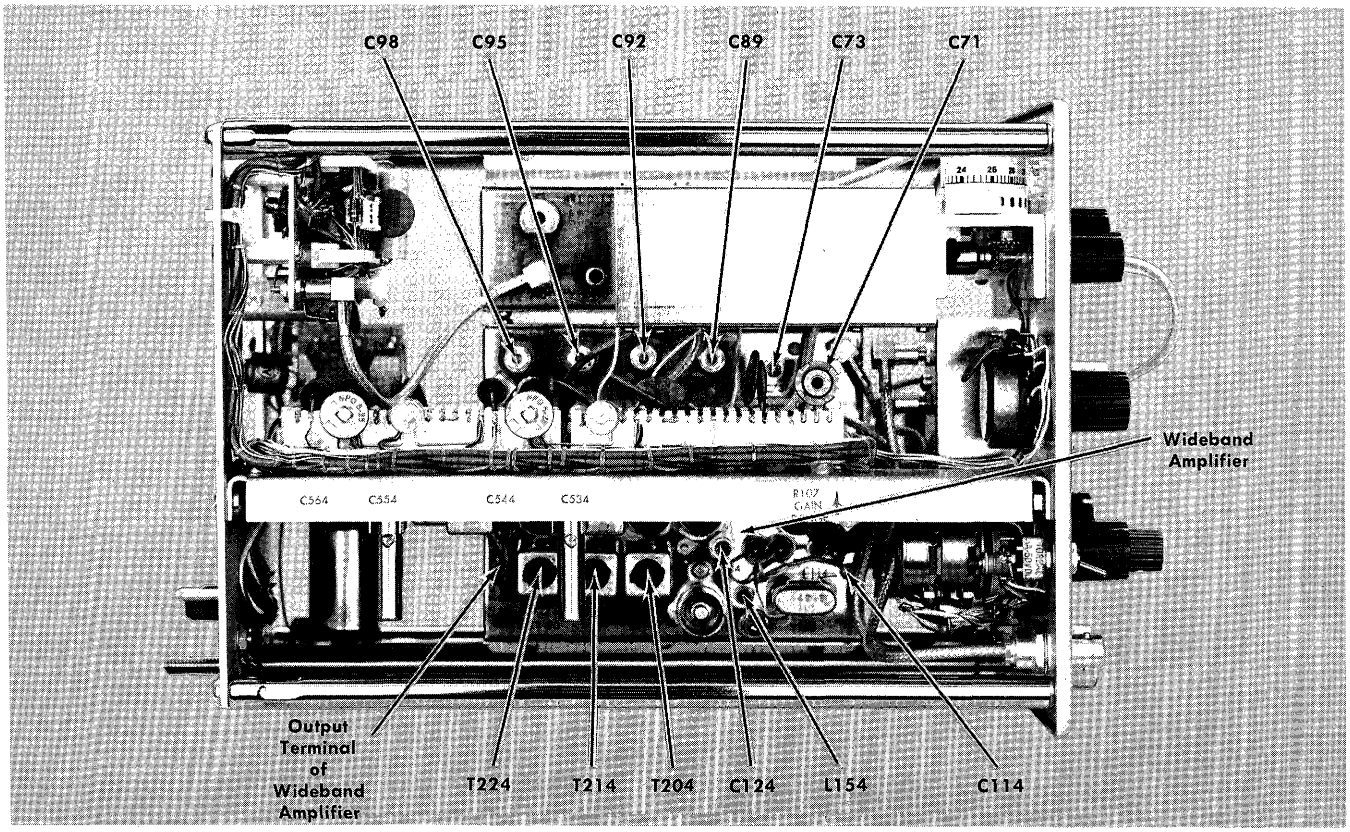


Fig. 4-12. Location of adjustments on Wideband Amplifier and 60-mc Filter chassis.

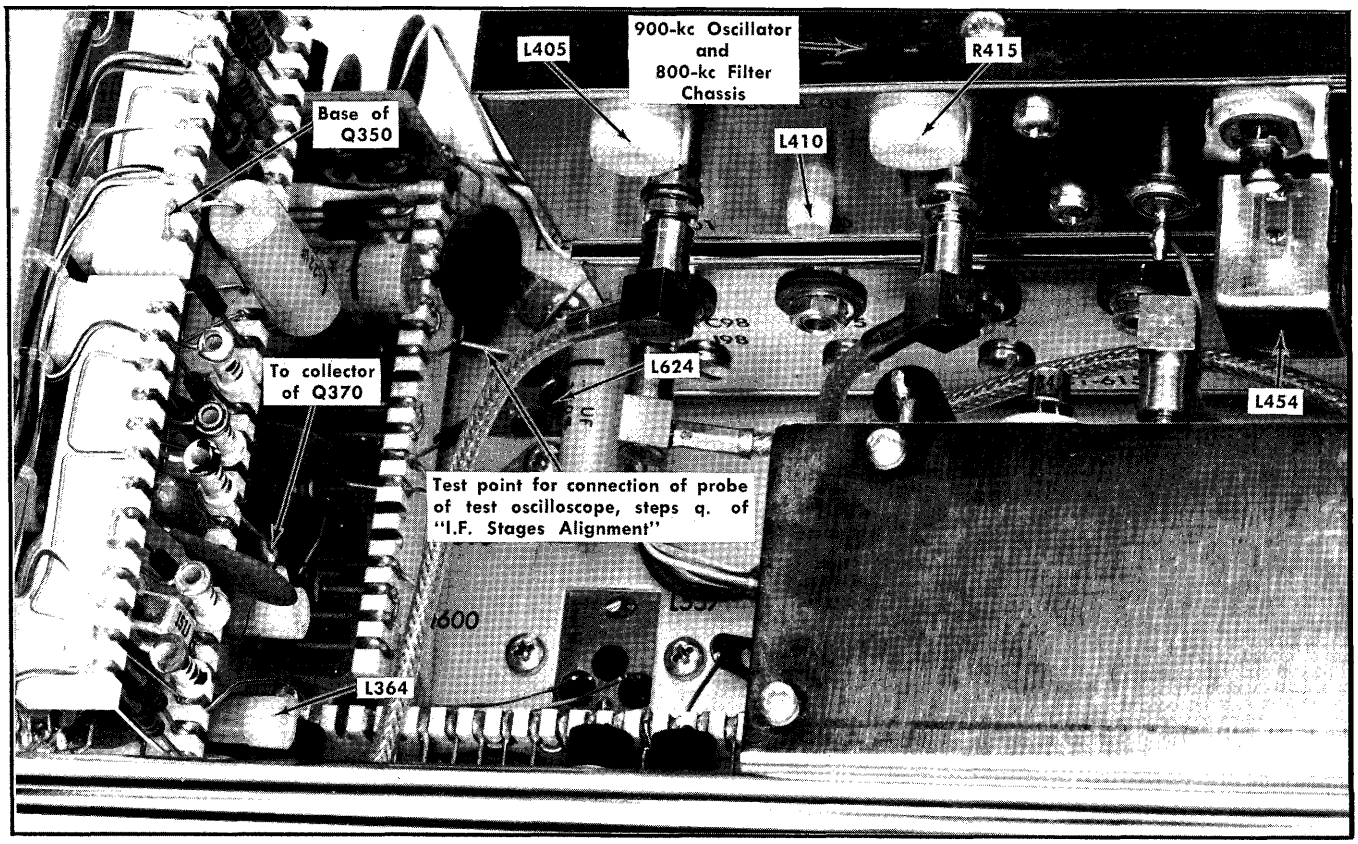


Fig. 4-13. Location of adjustments for steps k through r.

NOTE

To adjust L454 an offset adjustment tool may be needed, or the Front-End Oscillator chassis must be removed from its mounting. To remove the Front-End Oscillator from its mounting, remove the RF CENTER FREQ knob with a 1/16" allen wrench. Then remove the nut from around the shaft of the control with a 7/16" wrench. This frees the oscillator. Be careful not to short the chassis of the oscillator to any of the adjacent components.

b. Preset the front-panel controls of the Type 1L10 as follows:

RF CENTER FREQ	3 mc
FINE RF CENTER FREQ	Midrange
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
EXT OSC INT OSC	INT OSC
VERTICAL DISPLAY	LIN
GAIN	Midrange
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2

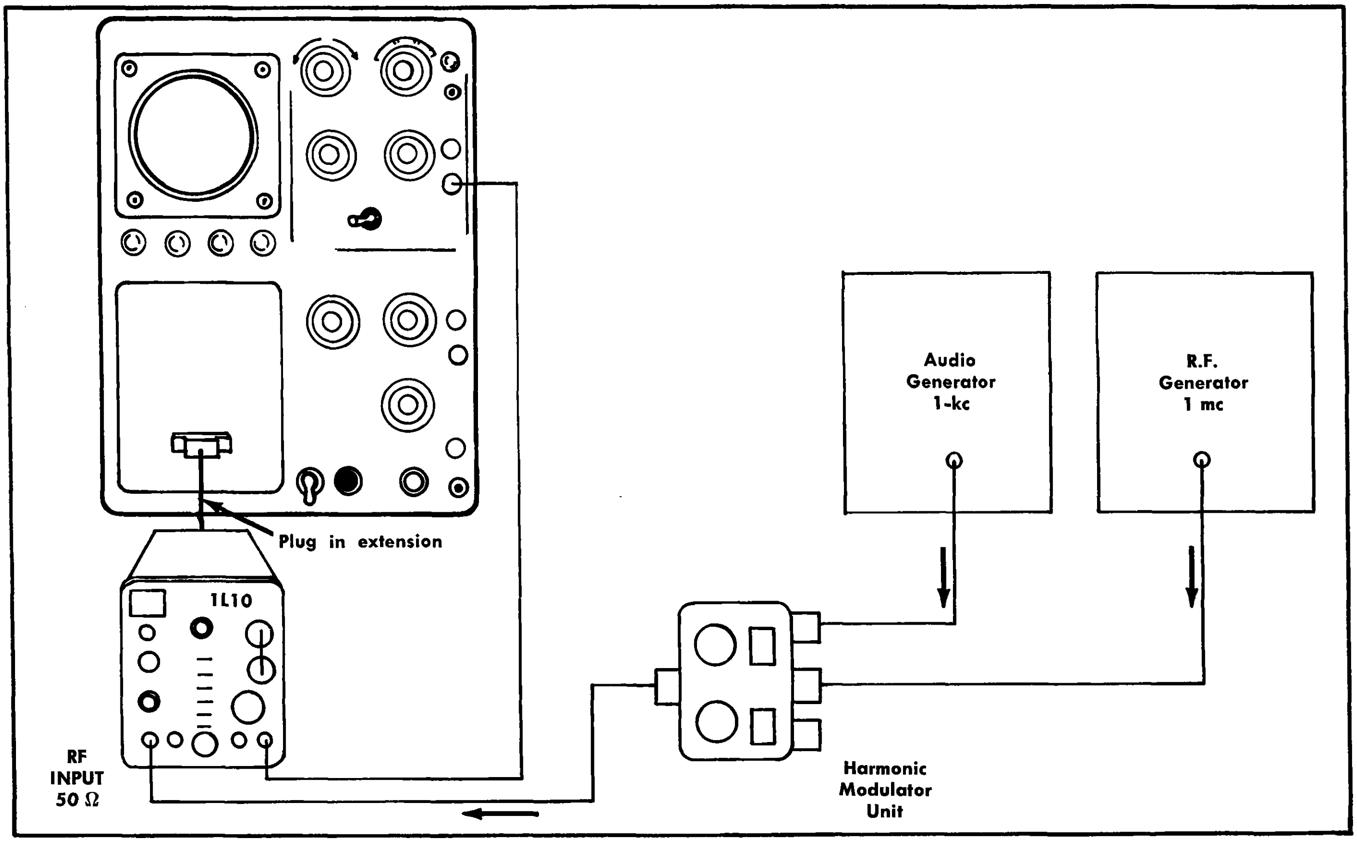


Fig. 4-14. Equipment setup for adjustment of resolution.

p. Connect the probe of the test oscilloscope to the test point shown in Fig. 4-13.

q. Adjust L405, L410 and L415 for maximum signal on the test oscilloscope. If no signal is observed on the test oscilloscope, set the COUPLED RESOLUTION switch to SEARCH. Also, it may be necessary to adjust L624 to get a display on the test oscilloscope. Remove the probe. Replace the oscillator if necesary.

r. At this point, the Type 1L10 should be producing a display of the 60 mc signal. Using this display, adjust L624 for maximum amplitude of the displayed 60 mc signal.

2. Resolution Adjustment

a. Connect the equipment shown in Fig. 4-14.

c. Set the output frequency of the r-f generator for 1 mc.

d. Set the output frequency of the audio generator for 1 kc.

e. With the RF CENTER FREQ control, tune to display the 3rd harmonic (3 mc) of the 1 mc signal from the r-f generator.

f. Set the DISPERSION-KC/CM switch to .5. (Leave the COUPLED RESOLUTION switch at 2.)

g. Set the FINE RF CENTER FREQ control so that the display is centered on the screen.

h. Adjust L557, L537, C554 and C534 for the display shown in Fig. 4-15. The valleys in the display should be adjusted for maximum distance from the base line. Also, the display must have good symmetery. While making this adjustment, keep in mind that the largest amplitude of display is not the optimum point for the proper resolution. In fact, proper resolution will occur when the display is several db lower than the maximum amplitude settings of L557, L537, C554 and C534.

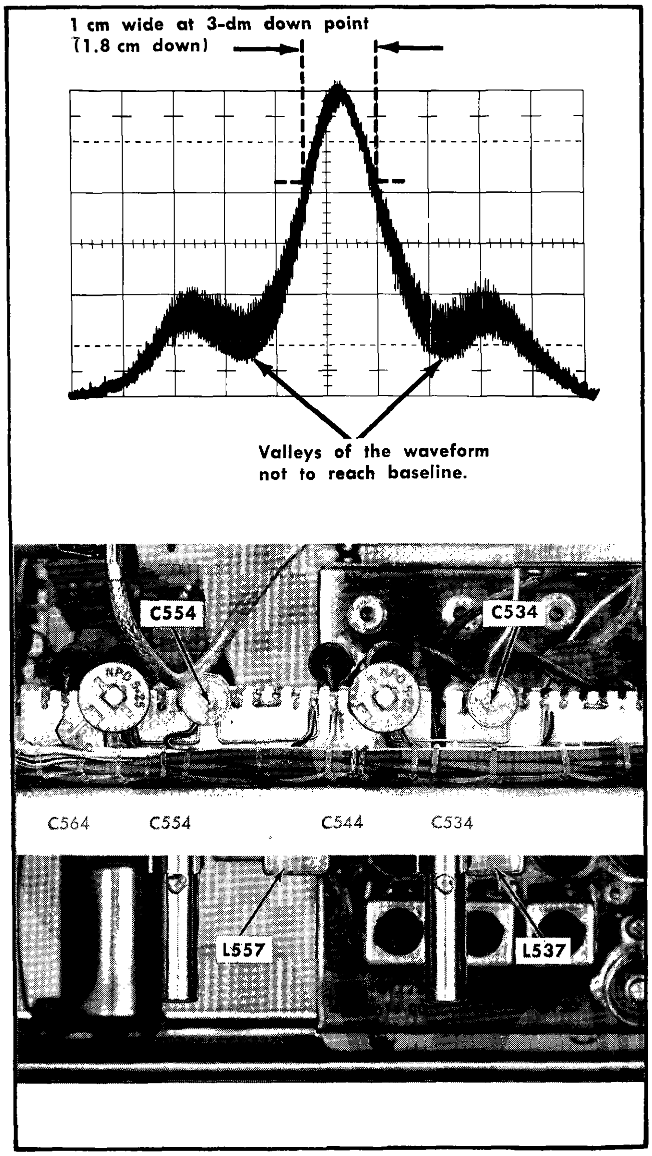


Fig. 4-15. Location of Resolution adjustments and the desired waveform with the adjustments properly set. See Text.

3. Balanced Mixer Adjustment

a. Preset the front-panel controls of the Type 1L10 as follows:

RF CENTER FREQ	1.5 mc
RF CENTER FINE FREQ	Midrange
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
GAIN	Fully Clockwise
VERTICAL DISPLAY	LIN
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2
INT OSC EXT OSC	INT OSC

b. With no signal applied to the input of the Type 1L10, slowly turn the RF CENTER FREQ control from 1.5 mc through 3 mc and look for any signal indication on the screen of the oscilloscope. Except for the possibility of any stray external signal radiation, there should be no signals observed on the display produced by the Type 1L10 (except for the inherent noise of the system).

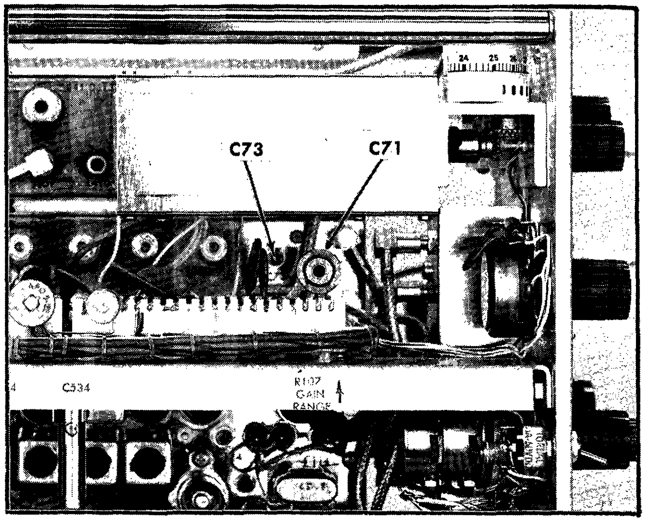


Fig. 4-16. Location of Balanced Mixer adjustments.

c. If any spurious signal is observed, position the signal to the center of the screen with the RF CENTER FREQ and FINE RF CENTER FREQ controls.

d. Adjust C71 and C73 (Fig. 4-16) for minimum displayed signal amplitude. After the adjustment is completed, maximum spurious signal amplitude is two times noise.

4. Dispersion Adjustment

a. Connect the equipment shown in Fig. 4-17.

b. Preset the front-panel controls of the Type 1L10 as follows:

RF CENTER FREQ	10 mc
FINE RF CENTER FREQ	Midrange
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
GAIN	Midrange
VERTICAL DISPLAY	LIN
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2
INT OSC EXT OSC	INT OSC

c. Set the output frequency of the r-f generator to 5 mc.

d. Set the controls of the Harmonic Modulator Unit as follows:

MOD 2 Switch	ON
MOD 2 Knob	Midrange
60-MC TRAP Switch	IN
RF Knob	Midrange

Ⓐ

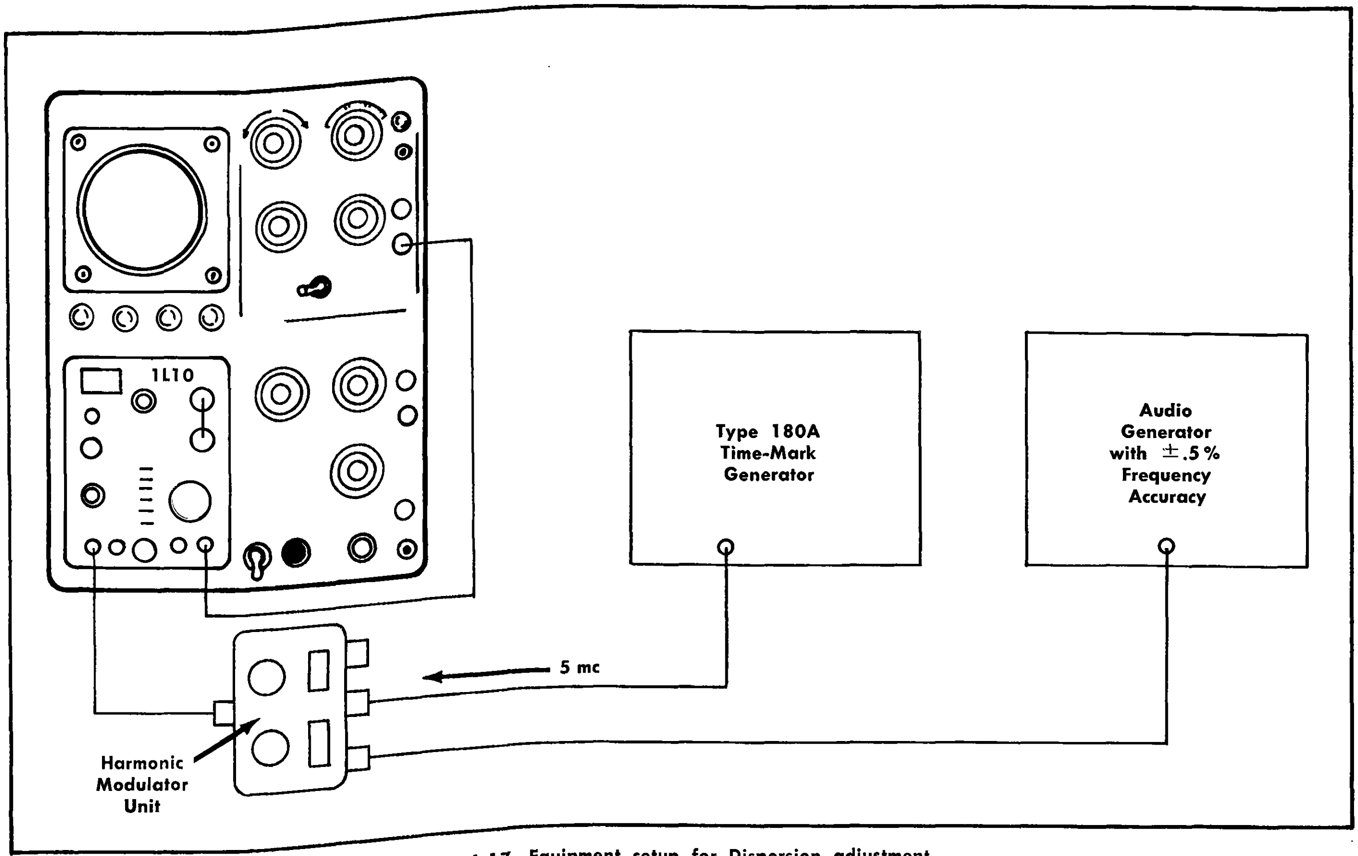


Fig. 4-17. Equipment setup for Dispersion adjustment.

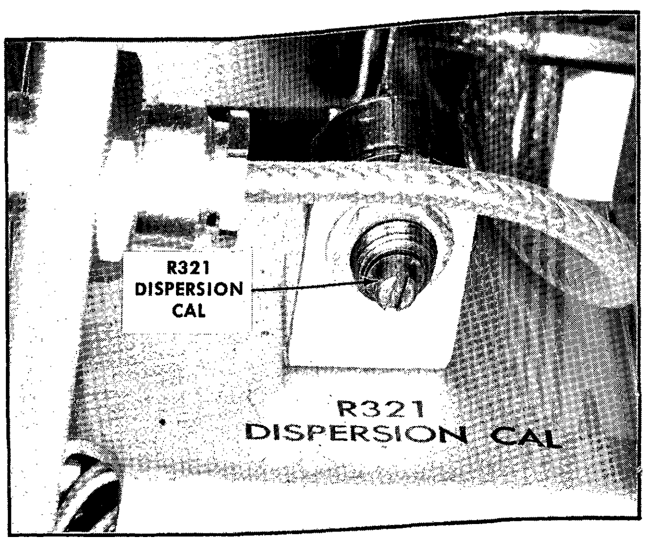


Fig. 4-18. DISPERSION CAL (R321) adjustment.

e. Set the output frequency of the audio generator to 8 kc.

f. Set the RF CENTER FREQ control of the Type 1L10 to bring the second harmonic of the 5 mc signal onto the screen. Use the FINE RF CENTER FREQ control to position the 5 mc signal to the centerline of the graticule. Momentarily turn off the MOD 2 switch on the Harmonic Modulator Unit to establish that the center-frequency marker is on the centerline of the graticule rather than one of the 8 kc sidebands.

g. Set the DISPERSION CAL R321, (Fig. 4-18) adjustment for exactly four graticule divisions between the center-frequency marker and the sideband marker on the right-hand side of the graticule.

h. Adjust L374 for exactly four graticule divisions between the center-frequency marker and the sideband marker on the left-hand side of the graticule.

i. Steps g and h interact. Repeat these steps until no further adjustment is necessary.

j. Check the dispersion at all settings of the DISPERSION-KC/CM as per the "Dispersion Check" in the Checkout Procedure.

5. Oscillator Tracking Adjustment

a. Set up the equipment as shown in Fig. 4-19.

b. Set the front-panel controls as follows:

RF CENTER FREQ	36
RF CENTER FINE FREQ	Midrange
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF except 16 db and 20 db
EXT OSC INT OSC	INT OSC
VERTICAL DISPLAY	LIN
GAIN	Midrange
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2
Oscilloscope Sweep Rate	5 mSEC/CM

Leave the Oscilloscope power OFF

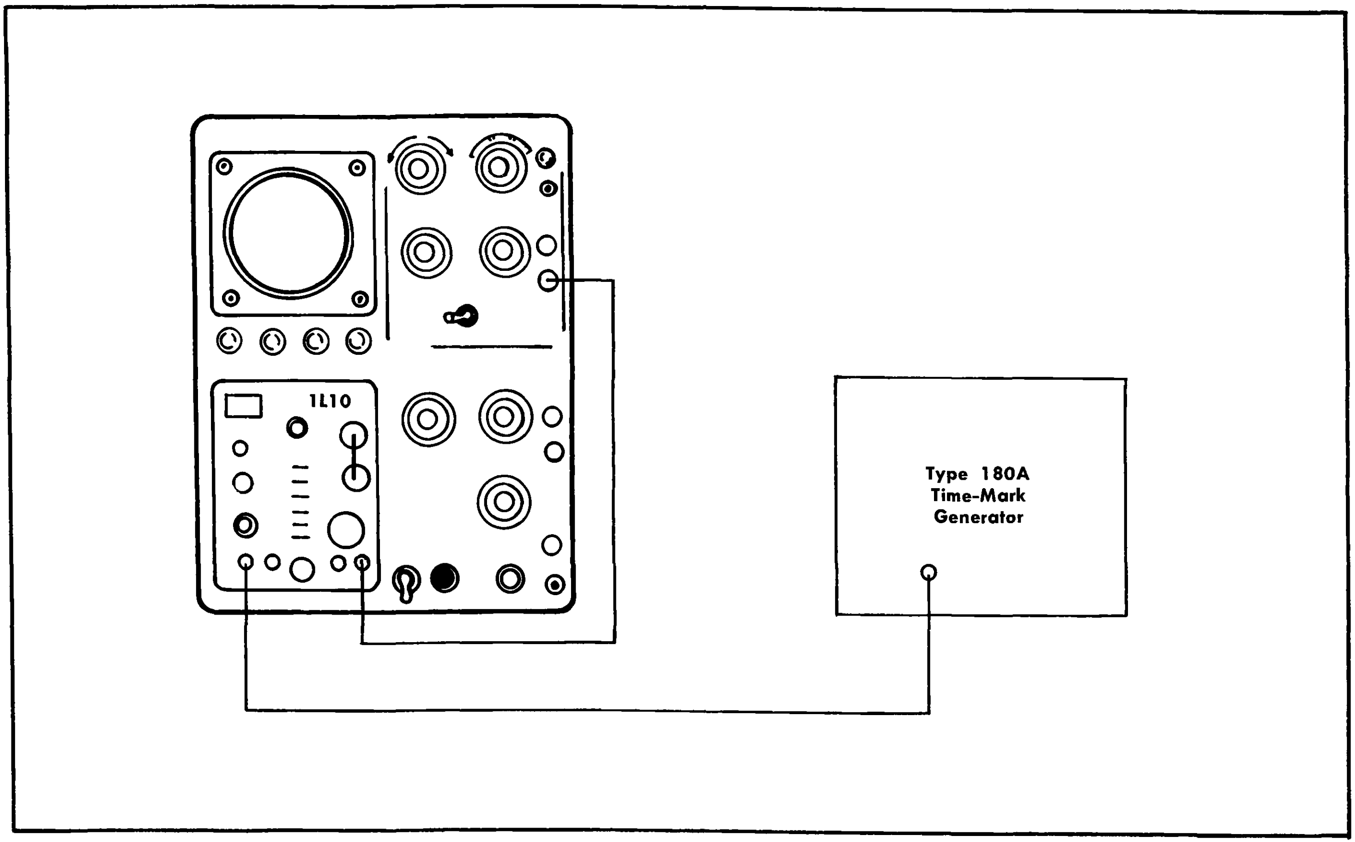


Fig. 4-19. Equipment setup for oscillator tracking adjustment.

c. Turn on the oscilloscope power and allow about 20 minutes for warm up and stablization.

d. Set the output frequency of the Type 180A Time-Mark Generator to 5 mc.

e. Set the RF CENTER FREQ control to 5 to display the Type 180A signal on the screen of the oscilloscope.

f. Change the output frequency of the Type 180A to 1 mc (1 μsec markers).

g. Turn the GAIN control clockwise slightly and note the appearance of the 5th harmonic of the 1 mc signal. Set all R-F ATTEN switches to OFF if more deflection is needed. This signal should appear at the same point on the trace as the signal of step e. Make sure that this signal can be moved by slight adjustment of the FINE RF CENTER FREQ control. If the signal is stationary when the FINE RF CENTER FREQ control is turned, you are observing the 60th harmonic of the 1 mc signal. If this is the case, repeat steps d through g.

h. Slowly turn the RF CENTER FREQ control counterclockwise and observe the 4th, 3rd, 2nd and fundamental displays of the 1 mc signal. Set the RF CENTER FREQ control to display the fundamental signal.

i. Check the RF CENTER FREQ dial reading. If it does not read 1 mc, $\pm$110 kc, carefully adjust T50 (Fig. 4-20) so that the dial reading is proper when the 1 mc signal is displayed on the screen.

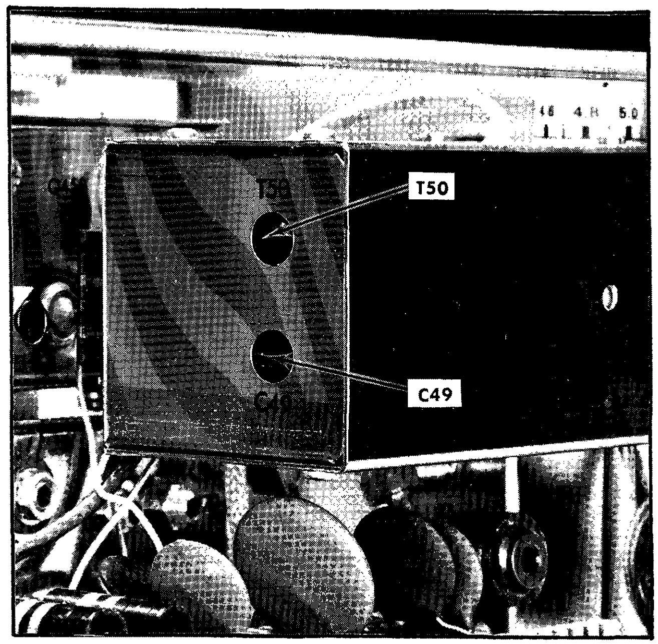


Fig. 4-20. Location of oscillator adjustments.

j. Set the output frequency of the Type 180A Time-Mark Generator to 5 mc.

k. Turn the RF CENTER FREQ control to the 35 mm region to display the seventh harmonic of the 5 mc signal. This can be verified by momentarily changing the output frequency of the signal generator to 10 mc and insuring that it produces no harmonic at this point. Return the output frequency of the signal generator to 5 mc to display the 7th harmonic of the 5 mc signal.

l. Change the output frequency of the signal generator to 1 mc and check for the presence of the 35th harmonic of the 1 mc signal. Turn off all R-F ATTEN switches. The GAIN control may have to be turned clockwise slightly in order to see this signal.

m. Slowly turn the RF CENTER FREQ control clockwise to display the 36th harmonic of the 1 mc signal.

n. Check the dial reading. If the dial does not read 36 mc, ±460 kc, carefully adjust C49 (Fig. 4-21) so that the dial reading is proper when the signal is displayed on the screen.

o. Due to interaction between adjustments, steps d through n should be repeated until no further adjustment is necessary.

NOTE

If the tracking of the oscillator cannot be calibrated to within specifications, check the setting of the slug in the oscillator housing as per steps p, q, r and s. Then repeat the preceding steps.

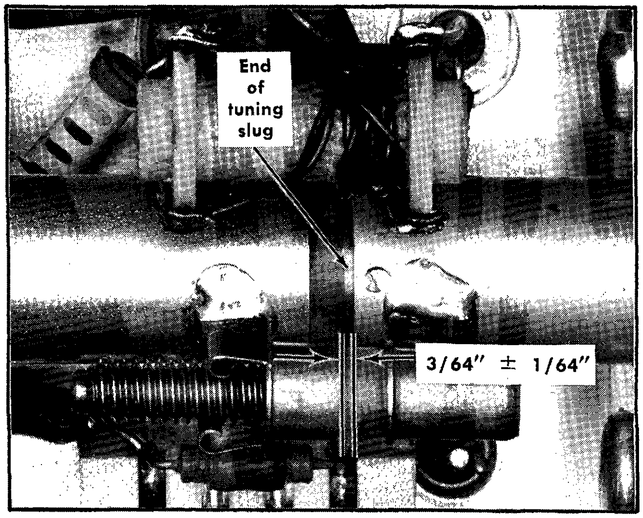


Fig. 4-21. Proper position of oscillator tuning slug when the dial reading is 36 mc.

p. Remove the Front-End Oscillator from its mounting as follows:

(a) Remove the RF CENTER FREQ knob with a $^{1}/_{16}$" allen wrench.

(b) Remove the nut from around the shaft of the RF

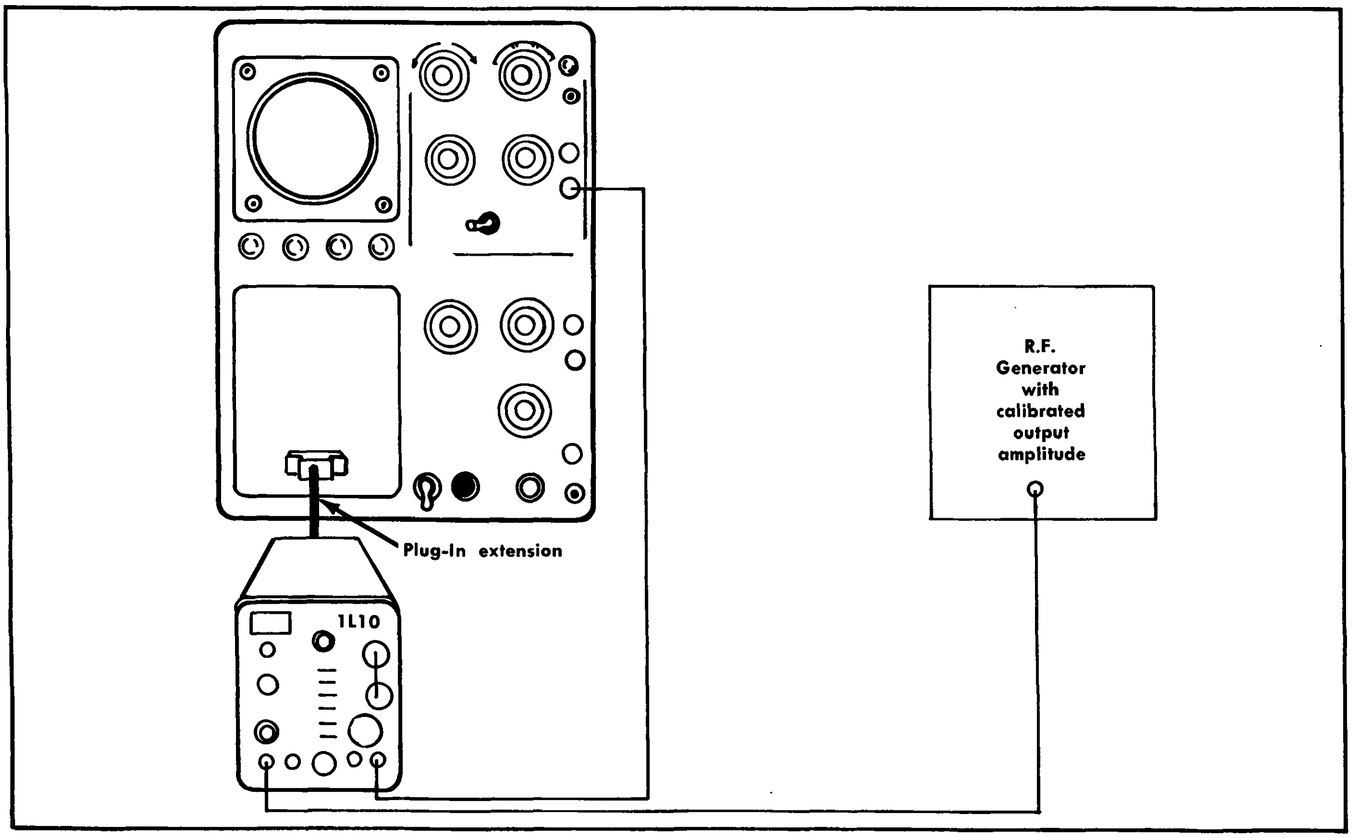


Fig. 4-22. Equipment Setup for LOG ADJ and GAIN RANGE adjustment.

CENTER FREQ control with a 7/16" wrench. This frees the oscillator from the front panel.

(c) Carefully lift the oscillator free from the front panel.

q. Remove the metal cover of the Front-End Oscillator by unscrewing all of the screws on the sides of the oscillator housing.

r. Inside the oscillator, check to insure that the end of the tuning slug of the oscillator is positioned in the transparent plastic area of the sleeve no further than 1/16" and no less than 1/32" (Fig. 4-21). If not, turn the RF CENTER FREQ control until the tuning slug is within these dimensions. Once this has been done, move the metal tape of the RF CENTER FREQ dial so that the dial reads 36. The tape can be disengaged from the sprocket by slightly unrolling the tape from one of the rollers.

s. Remount the oscillator to the front panel using the reverse of the procedures of steps d and c.

6. LOG ADJ and GAIN RANGE Adjustment

a. Connect the equipment as shown in Fig. 4-22.

b. Preset the front-panel controls of the Type 1L10 as follows:

RF CENTER FREQ	10
RF CENTER FINE FREQ	Midrange
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
GAIN	Fully Clockwise
VERTICAL DISPLAY	LIN
INT OSC EXT OSC	INT OSC
DISPERSION—KC/CM	2
COUPLED RESOLUTION	2

c. Set the output frequency of the r-f signal generator to 10 mc and the output amplitude for —90 dbm.

d. Set the RF CENTER FREQ control to display the 10 mc signal from the r-f generator.

e. Switch in the necessary R-F ATTEN switches to set the displayed amplitude of the signal to exactly 6 cm of vertical deflection. Use external attenuation if necessary, but do not change the output amplitude of the signal generator.

f. Turn the GAIN control of the Type 1L10 fully counterclockwise.

g. Increase the output amplitude of the r-f signal generator to —30 dbm.

h. Check for 6 cm of vertical deflection. If there is not 6 cm of deflection, adjust the GAIN RANGE, R107 (Fig. 4-23).

i. Set the VERTICAL DISPLAY switch to LOG.

j. Set the output amplitude of the r-f signal generator to —50 dbm.

k. Turn the GAIN control of the Type 1L10 fully clockwise.

l. Remove any external attenuation and switch all R-F ATTEN switches to OFF.

m. Check for 6 cm of vertical deflection. If there is not 6 cm of deflection, set the LOG ADJ, R646 (Fig. 4-23).

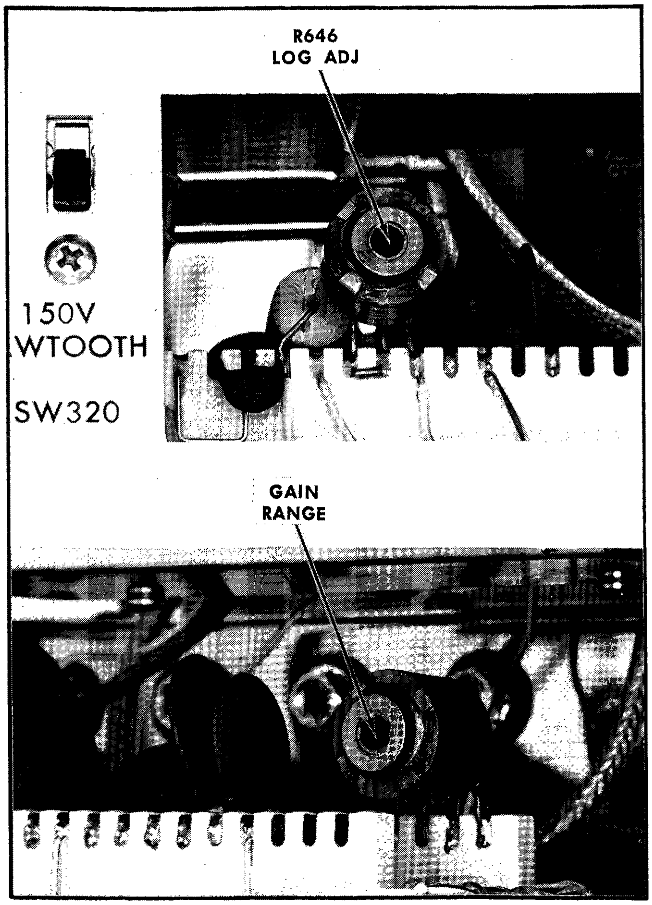


Fig. 4-23. Location of LOG ADJ and GAIN RANGE adjustments.

7. Gain Compensation Adjustment

a. Connect the equipment as shown in Fig. 4-24.

b. Preset the front panel controls of the Type 1L10 as follows:

RF CENTER FREQ	Any setting
FINE RF CENTER FREQ	Any setting
VERTICAL POSITION	Midrange
R-F ATTEN	All OFF
GAIN	Midrange
VERTICAL DISPLAY	LIN
EXT OSC INT OSC	EXT OSC
DISPERSION-KC/CM	2
COUPLED RESOLUTION	2
Oscilloscope Sweep Rate	20 mSEC/CM

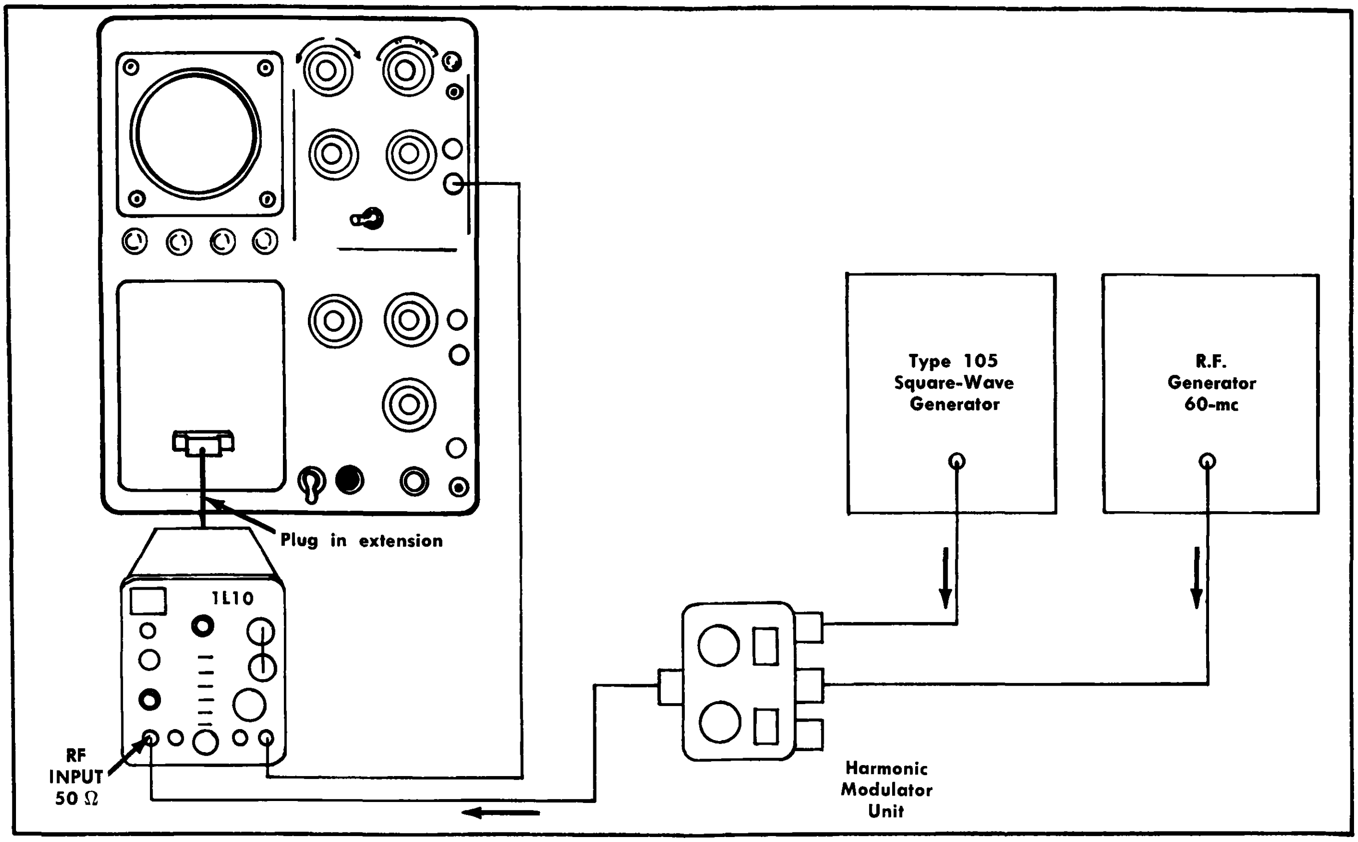


Fig. 4-24. Equipment setup for gain compensation adjustment.

c. On the Harmonic Modulator Unit, set the 60 mc TRAP switch to out.

d. Set the GAIN control of the Type 1L10 for about six centimeters of displayed signal.

e. Set the output frequency of the Type 105 Square-Wave Generator to about 2 kc and adjust its output amplitude so that the modulation markers are clearly visible.

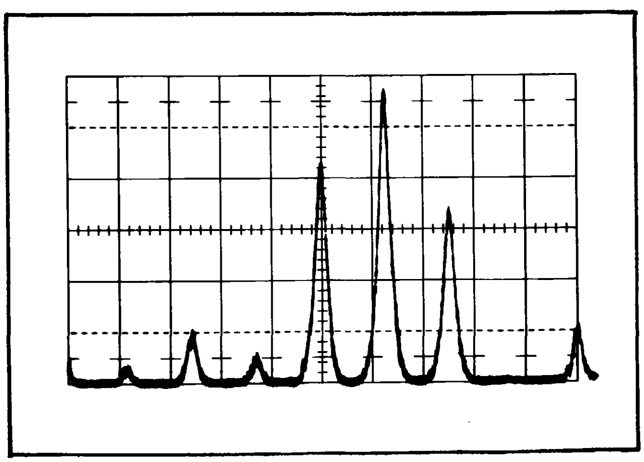


Fig. 4-25. Initial display for gain compensation.

f. Set the output frequency of the Type 105 so that the first modulation marker on the left-hand side of the center frequency is at the graticule centerline (see Fig. 4-25).

g. Set the DISPERSION-KC/CM and COUPLED RESOLUTION switches to 1, .5, .2, .1, .05, .02 and .01 while keeping the modulation marker centered on the screen by varying the output frequency of the Type 105 Square-Wave Generator.

h. Set the sweep rate of the oscilloscope to .2 SEC/CM.

i. Adjust C564 and C544 for the same displayed signal amplitude in the .1 KC/CM and 2 KC/CM settings of the DISPERSION-KC/CM switch.

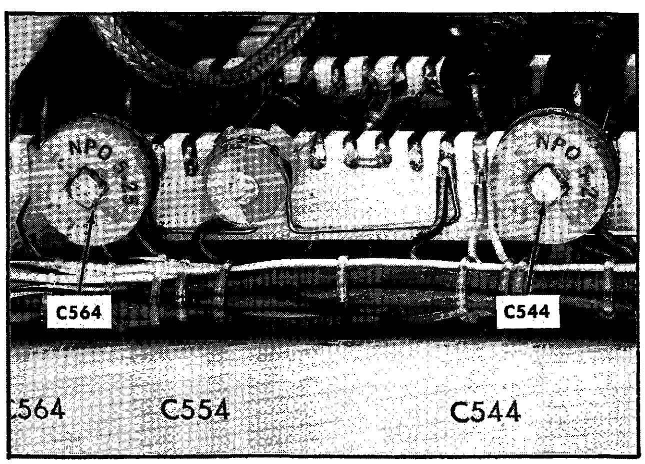


Fig. 4-26. Location of gain compensating adjustments.

NOTES

SECTION 5

PARTS LIST and DIAGRAMS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any chanae in part number.

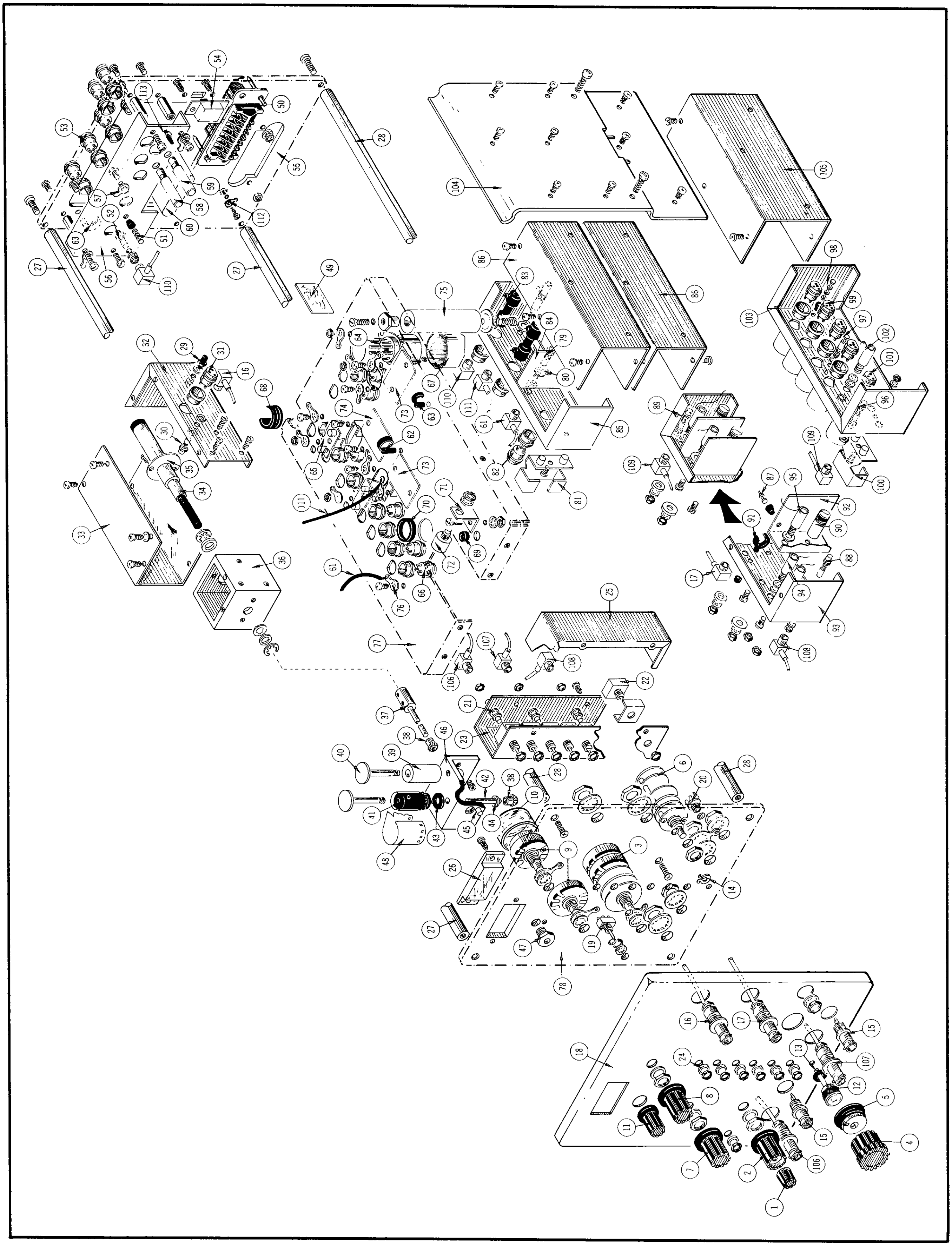
ABBREVIATIONS AND SYMBOLS

a or amp	amperes
BHS	binding head steel
C	carbon
cer	ceramic
cm	centimeter
comp	composition
cps	cycles per second
crt	cathode-ray tube
CSK	counter sunk
dia	diameter
div	division
EMC	electrolytic, metal cased
EMT	electroyltic, metal tubular
ext	external
f	farad
F & I	focus and intensity
FHS	flat head steel
Fil HS	fillister head steel
g or G	giga, or 10^9
Ge	germanium
GMV	guaranteed minimum value
h	henry
hex	hexagonal
HHS	hex head steel
HSS	hex socket steel
HV	high voltage
ID	inside diameter
incd	incandescent
int	internal
k or K	kilohms or kilo (10^3)
kc	kilocycle
m	milli, or 10^{-3}
mc	megacycle
mm	millimeter
meg or M	megohms or mega (10^6)
met.	metal
μ	micro, or 10^{-6}
n	nano, or 10^{-9}
Ω	ohm
OD	outside diameter
OHS	oval head steel
p	pico, or 10^{-12}
PHS	pan head steel
piv	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
Prec	precision
PT	paper tubular
PTM	paper or plastic, tubular, molded
RHS	round head steel
rms	root mean square
sec	second
Si	silicon
S/N	serial number
t or T	tera, or 10^{12}
TD	toroid
THS	truss head steel
tub.	tubular
v or V	volt
Var	variable
w	watt
w/	with
w/o	without
WW	wire-wound

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

EXPLODED VIEW



Ⓑ

EXPLODED VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	366-0255-00			1	KNOB, red—GAIN
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HHS
2	366-0249-00			1	KNOB, charcoal—VERTICAL DISPLAY
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
3	262-0702-00			1	SWITCH, wired—GAIN-VERTICAL DISPLAY
	- - - - - -			-	switch includes:
	210-0207-00			1	LUG, solder
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, pot, internal, 3/8 x 1/2 inch
4	366-0295-00			1	KNOB, charcoal—COUPLED RESOLUTION
	- - - - - -			-	knob includes:
	213-0048-00			1	SCREW, set, 4-40 x 1/8 inch, HSS
5	366-0296-00			1	KNOB, charcoal—DISPERSION-KC/CM
	- - - - - -			-	knob includes:
	213-0048-00			1	SCREW, set, 4-40 x 1/8 inch, HSS
6	262-0703-00			1	SWITCH, wired—COUPLED RESOLUTION-DISPERSION-KC/CM
	- - - - - -			-	switch includes:
	260-0674-00			1	SWITCH, unwired—COUPLED RESOLUTION-DESPERSION-KC CM
	- - - - - -			-	
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
7	366-0173-00			1	KNOB, charcoal—VERTICAL POSITION
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
8	366-0173-00			1	KNOB, charcoal—FINE R-F CENTER FREQUENCY
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
9	- - - - - -			2	POT
	- - - - - -			-	mounting hardware for each: (not included w/pot)
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, pot, internal, 3/8 x 1/2 inch
	210-0207-00			1	LUG, solder, pot
10	200-0263-00			1	COVER, dust, pot
11	366-0284-00			1	KNOB, charcoal—R-F CENTER FREQUENCY
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HHS
12	366-0125-00			1	KNOB, plug-in securing
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
13	210-0894-00			1	WASHER, polyethylene, .190 ID x 7/16 inch OD
	384-0510-00			1	ROD, securing, 3/16 OD x 10 1/2 inches
	- - - - - -			-	rod includes:
14	354-0025-00			1	RING, retaining
15	131-0106-00			2	CONNECTOR, female, BNC, w/hardware

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
16	175-0325-00			1	CABLE, assembly (oscillator out to oscillator chassis)
17	175-0326-00			1	CABLE, assembly (oscillator in to converter filter)
18	333-0911-00	1030	1079	1	PANEL, front, Type L-10A
	333-0911-01	1080		1	PANEL, front, Type 1L10
19	260-0643-00			1	SWITCH, toggle—EXT OSC/INT OSC
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0562-00			2	NUT, hex, 1/4-40 x 5/16 inch
	210-0940-00			1	WASHER, 1/4 ID x 3/8 inch OD
	210-0046-00			1	LOCKWASHER, internal, .400 OD x .261 inch ID
	210-0241-00			1	LUG, solder
20	136-0094-00			1	SOCKET, miniature jax, w/hardware
	610-0149-00			1	ASSEMBLY, R-F ATTENUATOR
	- - - - - -			-	assembly includes:
21	131-0372-00			3	CONNECTOR, coax., w/hardware
22	260-0642-00			6	SWITCH, toggle
	- - - - - -			-	mounting hardware for each: (not included w/switch alone)
	337-0702-00	1030	1259	1	SHIELD, switch
	210-0562-00			1	NUT, hex, 1/4-40 x 5/16 inch
	337-0799-00	1260		1	SHIELD, switch
23	441-0620-00			1	CHASSIS
24	- - - - - -			-	mounting hardware: (not included w/assembly)
	210-0940-00			6	WASHER, 1/4 ID x 3/8 inch OD
	210-0562-00			6	NUT, hex, 1/4-40 x 5/16 inch
25	337-0706-00			1	SHIELD, cover
	- - - - - -			-	mounting hardware: (not included w/shield)
	213-0138-00			4	SCREW, 4-40 x 3/16 inch, PHS phillips
26	386-0115-00			1	PLATE, dial window
	- - - - - -			-	mounting hardware: (not included w/plate)
	213-0138-00			2	SCREW, thread forming, #4 x 3/16 inch, PHS phillips
27	384-0631-00			2	ROD, spacer
	- - - - - -			-	mounting hardware for each: (not included w/rod)
	212-0043-00			1	SCREW, 8-32 x 1/2 inch, 100°, CSK, FHS phillips
	212-0044-00			1	SCREW, 8-32 x 1/2 inch, RHS phillips
28	384-0633-00			2	ROD, spacer
	- - - - - -			-	mounting hardware for each: (not included w/rod)
	212-0043-00			1	SCREW, 8-32 x 1/2 inch, 100°, CSK, FHS phillips
	212-0044-00			1	SCREW, 8-32 x 1/2 inch, RHS phillips
	610-0151-00			1	ASSEMBLY, OSCILLATOR CHASSIS (See Ref. #47)
	- - - - - -			-	assembly includes:
29	131-0372-00			1	CONNECTOR, coax.
30	131-0373-00			1	CONNECTOR, terminal standoff
	- - - - - -			-	mounting hardware: (not included w/connector alone)
	210-0259-00			2	LUG, solder, peewee
	210-0405-00			1	NUT, hex, 2-56 x 3/16 inch

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
	- - - - - -			-	ASSEMBLY, OSCILLATOR CHASSIS *(Cont'd)*
31	136-0182-00			1	SOCKET, transistor, 4 pin
	- - - - - -			-	mounting hardware: (not included w/socket alone)
	354-0234-00			1	RING, mounting
32	441-0624-00			1	CHASSIS
	- - - - - -			-	mounting hardware: (not included w/chassis)
	211-0079-00			3	SCREW, 2-56 x 3/16 inch, PHS phillips
33	200-0619-00			1	COVER
	- - - - - -			-	mounting hardware: (not included w/cover alone)
	213-0055-00			6	SCREW, 2-56 x 3/16 inch, PHS phillips
	211-0079-00			2	SCREW, 2-56 x 3/16 inch, PHS phillips
	632-0007-00			1	ASSEMBLY, OSCILLATOR & DIAL HOUSING
	- - - - - -			-	assembly includes:
34	- - - - - -			1	OSCILLATOR, w/hardware
	- - - - - -			-	mounting hardware: (not included w/oscillator alone)
	210-0839-00			1	WASHER, ripple, 1/4 x 7/16 inch
	210-0819-00			1	WASHER, bakelite, .046 x 1/4 x 1/2 inch
35	407-0139-00			1	BRACKET
	211-0503-00			2	SCREW, 6-32 x 3/16 inch, BHS
36	380-0075-00			1	HOUSING
	- - - - - -			-	mounting hardware: (not included w/housing alone)
	211-0595-00			2	SCREW, 6-32 x 1/4 inch, socket head cap
37	384-0634-00			1	ROD, shaft, drive
	- - - - - -			-	mounting hardware: (not included w/rod alone)
	213-0075-00			2	SCREW, set, 4-40 x 3/32 inch
38	214-0522-00			2	GEAR
39	214-0521-00			2	ROLLER, idler standoff
	- - - - - -			-	mounting hardware for each: (not included w/roller alone)
40	384-0636-00			1	ROD, idler standoff
41	214-0520-00			1	SPROCKET, dial
	- - - - - -			-	mounting hardware: (not included w/sprocket alone)
	213-0075-00			1	SCREW, set, 4-40 x 3/32 inch, socket, HHS
42	384-0635-00			1	ROD, sprocket dial
43	210-0992-00			1	WASHER, spacer, teflon
44	210-0991-00	1030	1259	1	WASHER, spring
	210-1011-00	1260		1	WASHER, flat, plastic
45	214-0564-00			1	PIN, roll, steel
46	380-0076-00			1	HOUSING, dial
47	- - - - - -			-	mounting hardware: (not included w/assembly)
	358-0258-00			1	BUSHING
48	331-0144-00			1	TAPE, dial
49	670-0072-00			1	ASSEMBLY, RECORD DETECTOR
	- - - - - -			-	assembly includes:
	388-0650-00			1	BOARD, etched

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
50	131-0017-00			1	CONNECTOR
	- - - - - -			-	mounting hardware: (not included w/connector)
	211-0008-00			2	SCREW, 4-40 x 1/4 inch, BHS
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
51	131-0183-00			2	CONNECTOR, feed thru
	- - - - - -			-	mounting hardware for each: (not included w/connector)
	358-0136-00			1	BUSHING, teflon
52	131-0372-00			1	CONNECTOR, coax., w/hardware
53	136-0181-00			6	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	354-0234-00			1	RING, mounting
54	260-0583-00			1	SWITCH, slide—SAWTOOTH SELECTOR
	- - - - - -			-	mounting hardware: (not included w/switch)
	213-0088-00			2	SCREW, #4 x 1/4 inch, PHS phillips
55	386-0127-00			1	PLATE, frame, back
56	441-0612-00			1	CHASSIS
	- - - - - -			-	mounting hardware: (not included w/chassis)
	385-0146-00			4	ROD, hex, 11/16 inch
	211-0504-00			8	SCREW, 6-32 x 1/4 inch BHS
	210-0202-00			2	LUG, solder, SE #6
57	210-0201-00			2	LUG, solder
	- - - - - -			-	mounting hardware: (not included w/lug)
	213-0044-00			1	SCREW, thread cutting, 5-32 x 3/16 inch, PHS phillips
58	- - - - - -			1	COIL
	- - - - - -			-	mounting hardware: (not included w/coil)
	210-0010-00			1	LOCKWASHER, internal, #10
	210-0410-00			1	NUT, hex, 10-32 x 5/16 inch
59	- - - - - -			1	COIL
	- - - - - -			-	mounting hardware: (not included w/coil)
	210-0206-00			1	LUG, solder, SE #10, long
	210-0410-00			1	NUT, hex, 10-32 x 5/16 inch
60	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
	210-0849-00			4	WASHER, fiber
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
61	175-0328-00			1	CABLE, assembly (strip to oscillator filter)
62	343-0089-00			1	CLAMP, cable, delrin
63	343-0088-00			2	CLAMP, cable, delrin

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
64	136-0010-00			1	SOCKET, 7 pin, w/shield
	- - - - - -			-	mounting hardware: (not included w/socket)
	211-0033-00			2	SCREW, 4-40 x $^5/_{16}$ inch, PHS w/lockwasher
	210-0201-00			2	LUG, solder, SE #4
	210-0406-00			2	NUT, hex, 4-40 x $^3/_{16}$ inch
65	136-0153-00			2	SOCKET, crystal
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	211-0001-00			1	SCREW, 2-56 x $^1/_4$ inch, RHS
	210-0201-00			1	LUG, solder, SE #4
	210-0405-00			1	NUT, hex, 2-56 x $^3/_{16}$ inch
66	136-0181-00			9	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	354-0234-00			1	RING, mounting
67	337-0007-00			1	SHIELD, tube, $^7/_8$ ID x 1$^3/_4$ inches high, w/spring
68	358-0215-00			1	BUSHING, plastic
69	348-0055-00			1	GROMMET, plastic, $^1/_4$ inch
70	348-0064-00			1	GROMMET, plastic, $^5/_8$ inch
71	407-0042-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/bracket)
	211-0504-00			1	SCREW, 6-32 x $^1/_2$ inch, BHS
	210-0006-00			1	LOCKWASHER, internal, #6
	210-0407-00			1	NUT, hex, 6-32 x $^1/_4$ inch
72	- - - - - -			1	POT
	- - - - - -			-	mounting hardware: (not included w/pot)
	210-0583-00			1	NUT, hex, $^1/_4$-32 x $^5/_{16}$ inch
	210-0940-00			1	WASHER, $^1/_4$ ID x $^3/_8$ inch OD
73	407-0138-00			2	BRACKET
	- - - - - -			-	mounting hardware for each: (not included w/bracket)
	213-0044-00			2	SCREW, thread cutting, 5-32 x $^3/_{16}$ inch, PHS phillips
	210-0201-00			2	LUG, solder, SE #4
74	407-0138-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/bracket)
	213-0044-00			2	SCREW, thread cutting, 5-32 x $^3/_{16}$ inch, PHS phillips
75	- - - - - -			1	RESISTOR, 25-watt
	- - - - - -			-	mounting hardware: (not included w/resistor)
	212-0037-00			1	SCREW, 8-32 x 1$^3/_4$ inches, Fil HS
	210-0008-00			1	LOCKWASHER, internal, #8
	210-0809-00			1	WASHER, centering
	210-0462-00			1	NUT, hex, 8-32 x $^1/_2$ x $^{23}/_{64}$ inch
	212-0004-00			1	SCREW, 8-32 x $^5/_{16}$ inch, BHS

EXPLODED VIEW (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
76	210-0201-00			4	LUG, solder, SE #4
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread cutting, 5-32 x $^3/_{16}$ inch, PHS phillips
77	441-0605-00			1	CHASSIS
	- - - - - -			-	mounting hardware: (not included w/chassis)
	211-0504-00			3	SCREW, 6-32 x $^1/_4$ inch, BHS
	211-0538-00			4	SCREW, 6-32 x $^5/_{16}$ inch, FHS phillips
	210-0457-00			3	NUT, keps, 6-32 x $^5/_{16}$ inch
78	386-0206-00			1	PLATE, sub-panel, front
	610-0148-00			1	ASSEMBLY, OSCILLATOR FILTER
	- - - - - -			-	assembly includes:
79	131-0372-00			3	CONNECTOR, coax., w/hardware
	131-0373-00	X1260		1	CONNECTOR, terminal stand-off (not shown)
	- - - - - -			-	mounting hardware: (not included w/connector)
	210-0001-00			1	LOCKWASHER, internal, #2
	210-0405-00			1	NUT, hex, 2-56 x $^3/_{16}$ inch
80	210-0206-00			2	LUG, solder, SE #6, long
81	136-0153-00			1	SOCKET, crystal
	- - - - - -			-	mounting hardware: (not included w/socket alone)
	211-0001-00			1	SCREW, 2-56 x $^3/_{16}$ inch, RHS
	210-0259-00			1	LUG, solder, peewee
	210-0405-00			1	NUT, hex, 2-56 x $^3/_{16}$ inch
82	136-0181-00			1	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware: (not included w/socket alone)
	354-0234-00			1	RING, mounting
83	- - - - - -			2	COIL
	- - - - - -			-	mounting hardware for each: (not included w/coil alone)
	354-0234-00			1	RING, mounting
84	337-0741-00			1	SHIELD
	- - - - - -			-	mounting hardware: (not included w/shield alone)
	213-0138-00			2	SCREW, #4 x $^3/_{16}$ inch, PHS
85	441-0613-00			1	CHASSIS
86	337-0704-00			2	SHIELD, cover (converter & oscillator filter)
	- - - - - -			-	mounting hardware for each: (not included w/shield)
	213-0088-00			3	SCREW, thread forming, #4 x $^1/_4$ inch, PHS phillips
	213-0133-00			6	SCREW, thread forming, #4 x $^3/_{16}$ inch, PHS phillips
	610-0147-00			1	ASSEMBLY, CONVERTER FILTER
	- - - - - -			-	assembly includes:
87	131-0182-00			4	CONNECTOR, feed thru
	- - - - - -			-	mounting hardware for each: (not included w/connector alone)
	358-0135-00			1	BUSHING, teflon
88	131-0372-00			3	CONNECTOR, coax., w/hardware

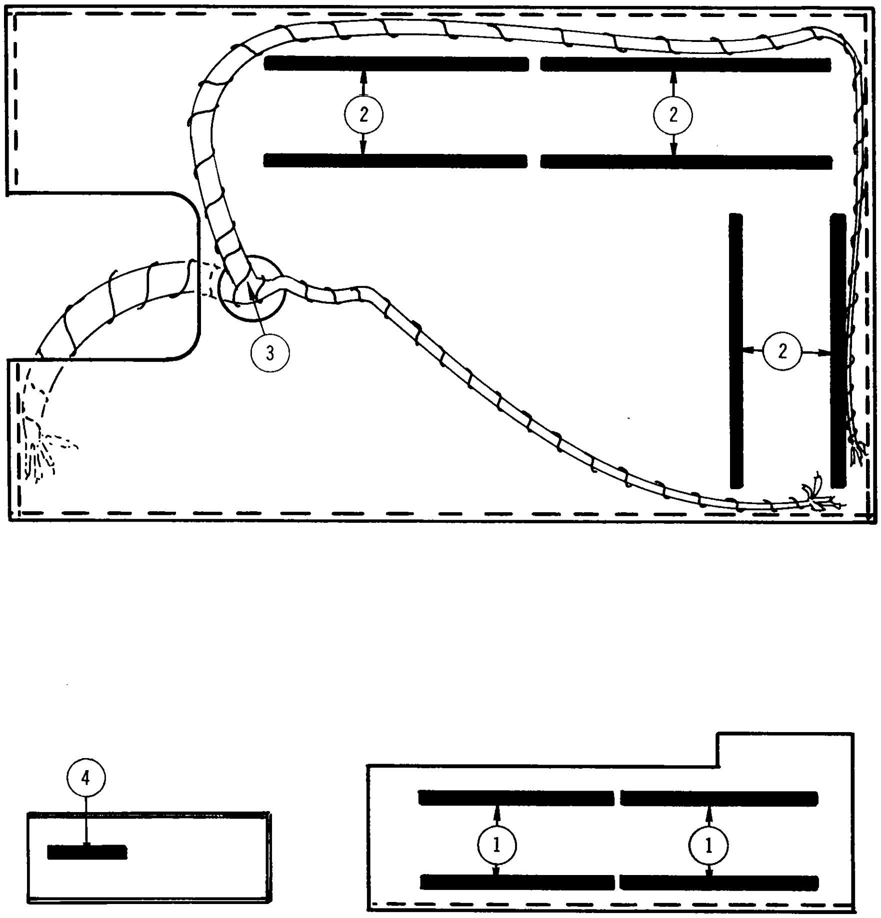
EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
89	131-0373-00			1	CONNECTOR, standoff
	- - - - - -			-	mounting hardware: (not included w/connector alone)
	210-0405-00			1	NUT, hex, 2-56 x $^3/_{16}$ inch
	210-0001-00			1	LOCKWASHER, internal, #2
90	- - - - - -			4	COIL
	- - - - - -			-	mounting hardware for each: (not included w/coil alone)
	211-0504-00			1	SCREW, 6-32 x $^1/_4$ inch, BHS
91	426-0121-00			1	HOLDER
	- - - - - -			-	mounting hardware: (not included w/holder alone)
	361-0007-00			1	SPACER, nylon
92	337-0742-00			2	SHIELD
93	441-0615-00			1	CHASSIS
94	- - - - - -			2	COIL w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/coil alone)
	210-0821-00			1	WASHER, #10 aluminum, $^1/_4$ ID x $^1/_2$ inch OD
	210-0813-00			2	WASHER, fiber, #10 shouldered
95	- - - - - -			2	COIL, w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/coil alone)
	210-0813-00			2	WASHER, fiber, #10 shouldered
	610-0146-00			1	ASSEMBLY, WIDEBAND I-F
	- - - - - -			-	assembly includes:
96	131-0372-00			1	CONNECTOR, coax.
97	131-0373-00			2	CONNECTOR, standoff
	- - - - - -			-	mounting hardware for each: (not included w/connector alone)
	210-0001-00			1	LOCKWASHER, internal, #2
	210-0405-00			1	NUT, hex, 2-56 x $^3/_{16}$ inch
98	131-0182-00			1	CONNECTOR, feed thru
	- - - - - -			-	mounting hardware: (not included w/connector alone)
	358-0135-00			1	BUSHING, teflon
99	136-0182-00			4	SOCKET, transistor, 4 pin
	- - - - - -			-	mounting hardware for each: (not included w/socket alone)
	354-0234-00			1	RING, mounting
100	136-0153-00			1	SOCKET, crystal
	- - - - - -			-	mounting hardware: (not included w/socket alone)
	211-0001-00			1	SCREW, 2-56 x $^3/_{16}$ inch, RHS
	210-0001-00			1	LOCKWASHER, internal, #2
	210-0405-00			1	NUT, hex, 2-56 x $^3/_{16}$ inch
101	136-0181-00			2	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware for each: (not included w/socket alone)
	354-0234-00			1	RING, mounting

EXPLODED VIEW *(Cont'd)*

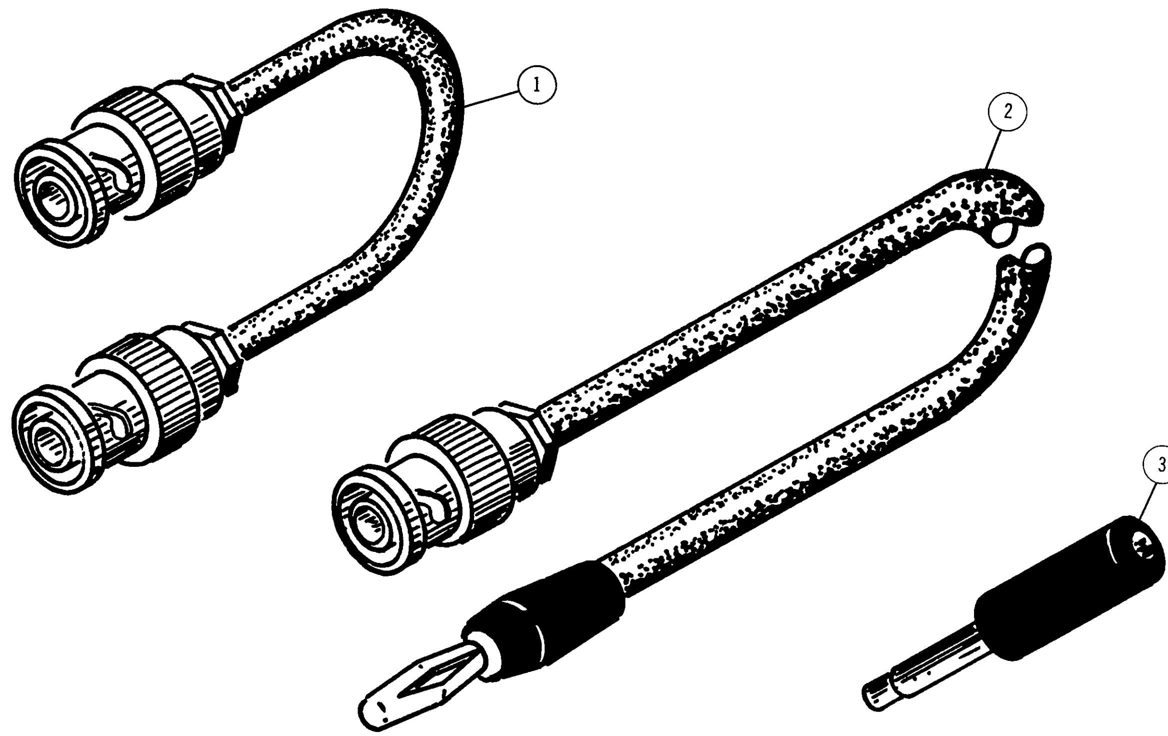
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
102	- - - - - -			2	COIL, w/hardware
103	441-0614-00			1	CHASSIS
104	407-0075-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/bracket)
	211-0504-00			2	SCREW, 6-32 x $^1/_4$ inch, BHS
	213-0088-00			4	SCREW, thread forming, #4 x $^1/_4$ inch, PHS phillips
105	337-0701-00			1	SHIELD
	- - - - - -			-	mounting hardware: (not included w/shield)
	213-0088-00			3	SCREW, thread forming, #4 x $^1/_4$ inch, PHS phillips
	213-0138-00			6	SCREW, thread forming, #4 x $^3/_{16}$ inch, PHS phillips
106	175-0325-00			1	CABLE, assembly (input 50 Ω to R-F attenuator)
107	175-0326-00			1	CABLE, assembly (input 60 Ω to R-F attenuator)
108	175-0308-00			1	CABLE, assembly (I-F attenuator to converter filter)
109	175-0309-00			1	CABLE, assembly (converter filter to wideband R-F)
110	175-0314-00			1	CABLE, assembly (oscillator filter to sweep chassis)
111	175-0328-00			1	CABLE, assembly (strip to oscillator filter)
112	210-0202-00			1	LUG, solder
	- - - - - -			-	mounting hardware: (not included w/lug)
	211-0504-00			1	SCREW, 6-32 x $^1/_4$ inch, BHS
	210-0407-00			1	NUT, hex, 6-32 x $^1/_4$ inch
113	131-0373-00	X1080		1	CONNECTOR, stand-off
	- - - - - -			-	mounting hardware: (not included w/connector)
	210-0001-00			1	LOCKWASHER, internal, #2
	210-0405-00			1	NUT, hex., 2-56 x $^3/_{16}$ inch

CABLE HARNESS & CERAMIC STRIPS



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	Q T Y.	DESCRIPTION
1	124-0147-00			4	STRIP, ceramic, 7/16 inch x 13 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0008-00			2	SPACER, nylon
2	124-0145-00			6	STRIP, ceramic, 7/16 inch x 20 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0008-00			2	SPACER, nylon
3	179-0980-00			1	CABLE HARNESS
4	124-0162-00			1	STRIP, ceramic, 7/16 inch x 4 notches
	- - - - - -			-	strip includes:
	355-0046-00			1	STUD, nylon
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0007-00			1	SPACER, nylon

ACCESSORIES



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	Q T Y.	DESCRIPTION
1	012-0097-00			1	CABLE, assembly (OSC OUT to OSC IN)
2	012-0096-00			1	CABLE, assembly, 24 inch, BNC to banana plug
3	134-0052-00			1	PLUG, red
	070-0510-00			2	MANUAL, instruction (not shown)

Ⓑ

ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt No.	Tektronix Part No.	Description					S/N Range

Capacitors

Tolerance ±20% unless otherwise indicated.

Ckt No.	Tektronix Part No.	Value	Type	Var	Voltage	Tolerance	S/N Range
C40	283-0039-00	0.001 μf	Cer		500 v		
C42	283-0067-00	0.001 μf	Cer		200 v	10%	
C46	283-0059-00	1 μf	Cer		25 v		
C47	281-0518-00	47 pf	Cer		500 v		
C48	281-0592-00	4.7 pf	Cer			±0.5 pf	
C49	281-0027-00	0.7-3 pf	Tub.	Var			
C50†	281-0109-00	1-16.5 pf		Var		FREQUENCY	
C54	283-0039-00	0.001 μf	Cer		500 v		
C55	283-0039-00	0.001 μf	Cer		500 v		
C71	281-0105-00	0.8-8.5 pf	Cer	Var			
C72	281-0592-00	4.7 pf	Cer			±0.5 pf	
C73	281-0105-00	0.8-8.5 pf	Cer	Var			
C74	281-0592-00	4.7 pf	Cer			±0.5 pf	
C80	283-0534-00	82 pf	Mica		500 v	5%	
C81	283-0534-00	82 pf	Mica		500 v	5%	
C89	281-0105-00	0.8-8.5 pf	Cer	Var			
C90	283-0534-00	82 pf	Mica		500 v	5%	
C92	281-0105-00	0.8-8.5 pf	Cer	Var			
C93	283-0534-00	82 pf	Mica		500 v	5%	
C95	281-0105-00	0.8-8.5 pf	Cer	Var			
C96	283-0534-00	82 pf	Mica		500 v	5%	
C98	281-0105-00	0.8-8.5 pf	Cer	Var			
C101	283-0067-00	0.001 μf	Cer		200 v	10%	
C107	283-0039-00	0.001 μf	Cer		500 v		
C110	283-0039-00	0.001 μf	Cer		500 v		
C114	281-0105-00	0.8-8.5 pf	Cer	Var			
C115	283-0067-00	0.001 μf	Cer		200 v	10%	
C123	283-0067-00	0.001 μf	Cer		200 v	10%	
C124	281-0105-00	0.8-8.5 pf	Cer	Var			
C125	283-0067-00	0.001 μf	Cer		200 v	10%	
C140	283-0039-00	0.001 μf	Cer		500 v		
C146	283-0067-00	0.001 μf	Cer		200 v	10%	
C147	283-0067-00	0.001 μf	Cer		200 v	10%	
C150	281-0504-00	10 pf	Cer		500 v	10%	
C155	283-0039-00	0.001 μf	Cer		500 v		
C156	281-0602-00	68 pf	Cer		500 v	5%	
C157	283-0610-00	220 pf	Mica		500 v		
C203	Use 283-0079-00	0.01 μf	Cer		250 v		
C204	283-0067-00	0.001 μf	Cer		200 v	10%	
C205	283-0067-00	0.001 μf	Cer		200 v	10%	

† Piston Assembly.

Capacitors *(Cont'd)*

Ckt No.	Tektronix Part No.		Description				S/N Range
C213	283-0079-00	0.01 μf	Cer		250 v		
C214	283-0067-00	0.001 μf	Cer		200 v	10%	
C215	283-0067-00	0.001 μf	Cer		200 v	10%	
C223	283-0079-00	0.01 μf	Cer		250 v		
C224	283-0067-00	0.001 μf	Cer		200 v	10%	
C226	283-0609-00	100 pf	Mica		500 v		
C227	283-0609-00	100 pf	Mica		500 v		
C228	283-0039-00	0.001 μf	Cer		500 v		
C351	285-0633-00	0.22 μf	PTM		100 v	10%	
C361	283-0079-00	0.01 μf	Cer		250 v		
C362	281-0523-00	100 pf	Cer		350 v		
C364	285-0008-00	150 pf	Cer		500 v	5%	
C365	Use 283-0077-00	330 pf	Cer		500 v	5%	
C370	281-0576-00	11 pf	Cer		500 v	5%	
C371	281-0518-00	47 pf	Cer		500 v		
C373	283-0079-00	0.01 μf	Cer		250 v		
C374	281-0504-00	10 pf	Cer		500 v	10%	
C375	281-0594-00	150 pf	Cer		100 v	5%	
C387	283-0079-00	0.01 μf	Cer		250 v		
C389	283-0067-00	0.001 μf	Cer		200 v	10%	
C398	281-0504-00	10 pf	Cer		500 v	10%	
C405	281-0617-00	15 pf	Cer		200 v		
C410	285-0598-00	0.01 μf	PTM		100 v	5%	
C411	285-0627-00	0.0033 μf	PTM		100 v	5%	
C415	281-0617-00	15 pf	Cer		200 v		
C450	283-0608-00	68 pf	Mica		500 v		X1260-up
C451	283-0079-00	0.01 μf	Cer		250 v		X1260-up
C453	283-0079-00	0.01 μf	Cer		250 v		1030-1259X
C454	285-0003-00	100 pf	Glass		500 v	5%	X1260-up
C455	283-0079-00	0.01 μf	Cer		250 v		1000-1259X
C456	283-0039-00	0.001 μf	Cer		500 v		
C457	283-0510-00	180 pf	Mica		500 v	5%	1030-1259
C457	285-0004-00	220 pf	Glass		500 v	5%	1260-up
C458	283-0605-00	678 pf	Mica		300 v	1%	1030-1259
C458	283-0079-00	0.01 μf	Cer		250 v		1260-up
C501	283-0079-00	0.01 μf	Cer		250 v		
C512	283-0081-00	0.1 μf	Cer		25 v		
C514	283-0104-00	0.002 μf	Cer		500 v	5%	
C520	283-0085-00	0.0027 μf	Cer		1000 v	5%	
C522	283-0079-00	0.01 μf	Cer		250 v		
C524	283-0079-00	0.01 μf	Cer		250 v		
C526	283-0081-00	0.1 μf	Cer		25 v		
C534	281-0063-00	9-35 pf	Cer	Var			
C537	283-0079-00	0.01 μf	Cer		250 v		
C538	281-0603-00	39 pf	Cer		500 v	5%	
C543	290-0267-00	1 μf	EMT		35 v		
C544	281-0075-00	5-25 pf	Cer	Var			
C550	283-0079-00	0.01 μf	Cer		250 v		
C554	281-0063-00	9-35 pf	Cer	Var			
C555	290-0267-00	1 μf	EMT		35 v		

Capacitors *(Cont'd.)*

Ckt No.	Tektronix Part No.	Description					S/N Range
C557	283-0079-00	0.01 μf	Cer		250 v		
C558	281-0603-00	39 pf	Cer		500 v	5%	
C563	290-0267-00	1 μf	EMT		35 v		
C564	281-0075-00	5-25 pf	Cer	Var			
C602	283-0079-00	0.01 μf	Cer		250 v		
C616	283-0079-00	0.01 μf	Cer		250 v		
C621	283-0079-00	0.01 μf	Cer		250 v		
C623	285-0572-00	0.1 μf	PTM		200 v		
C624	283-0035-00	0.0015 μf	Cer		500 v		
C626	283-0081-00	0.1 μf	Cer		25 v		
C629	283-0067-00	0.001 μf	Cer		200 v	10%	
C631	283-0079-00	0.01 μf	Cer		250 v		
C640	283-0067-00	0.001 μf	Cer		200 v	10%	
C642	285-0633-00	0.22 μf	PTM		100 v	10%	
C645	283-0079-00	0.01 μf	Cer		250 v		
C649	285-0572-00	0.1 μf	PTM		200 v		
C651	283-0001-00	0.005 μf	Cer		500 v		
C656	283-0001-00	0.005 μf	Cer		500 v		
C658	283-0081-00	0.1 μf	Cer		25 v		
C667	290-0267-00	1 μf	EMT		35 v		

Diodes

D46	152-0031-00	Zener	1N718A	¼ w, 15 v, 5%
D54	281-0107-00	Voltage Variable Capacitance Diode		
D71	152-0202-00	Germanium	1N82A	
D73	152-0202-00	Germanium	1N82A	
D362	281-0107-00	Voltage Variable Capacitance Diode		
D387	152-0064-00	Zener	1N961A	0.4 w, 10 v, 10%
D396	152-0188-00	Germanium	1N64	
D518	152-0188-00	Germanium	1N64	
D543	*152-0185-00	Silicon	Replaceable by 1N3605	
D548	*152-0185-00	Silicon	Replaceable by 1N3605	
D563	*152-0185-00	Silicon	Replaceable by 1N3605	
D568	*152-0185-00	Silicon	Replaceable by 1N3605	
D640	*152-0107-00	Silicon	Replaceable by 1N647	
D641	*152-0107-00	Silicon	Replaceable by 1N647	
D646	*152-0107-00	Silicon	Replaceable by 1N647	
D657	*152-0185-00	Silicon	Replaceable by 1N3605	
D667	152-0055-00	Zener	1N962A	0.4 w, 11 v, 5%

Connectors

J1	131-0372-00	Connector, Coax
J2	131-0372-00	Connector, Coax
J3	131-0372-00	Connector, Coax
P11	131-0017-00	Chassis mtd., 16 contact, male
J50	131-0372-00	Connector, Coax
J70	131-0372-00	Connector, Coax

Connectors *(Cont'd)*

Ckt No.	Tektronix Part No.	Description			S/N Range
J80	131-0372-00	Connector, Coax			
J98	131-0372-00	Connector, Coax			
J101	131-0372-00	Connector, Coax			
J300	131-0106-00	Chassis mtd., Coax, 1 contact, female			
J398	131-0372-00	Connector, Coax			
J401	131-0372-00	Connector, Coax			
J418	131-0372-00	Connector, Coax			
J458	131-0372-00	Connector, Coax			
J649	131-0106-00	Chassis mtd., Coax, 1 contact, female			
J658	136-0094-00	Socket, w/hardware			

Inductors

Ckt No.	Tektronix Part No.	Description			S/N Range
L54	108-0245-00	3.9 μh			
L80	*108-0112-00	0.3 μh			
L89	*108-0334-00	1.65 μh			
L92	*108-0335-00	2.27 μh			
L95	*108-0335-00	2.27 μh			
L98	*108-0334-00	1.65 μh			
L154	*114-0187-00	0.15-0.2 μh	Var	Core 276-0506-00	
L200	276-0507-00	Core, Ferramic Suppressor			X1200-up
L364	*114-0184-00	1.2-1.7 μh	Var	Core not available separately	
L374	*114-0183-00	4.25-6.6 μh	Var	Core not available separately	
L405	*114-0185-00	2.1-2.9 mh	Var	Core 276-0511-00	
L410	*114-0186-00	1.9-4 μh	Var	Core 276-0506-00	
L415	*114-0185-00	2.1-2.9 mh	Var	Core 276-0511-00	
L454	114-0174-00	120-280 μh	Var	Core not available separately	
L537	114-0176-00	10-40 mh	Var	Core not available separately	
L550	108-0324-00	10 mh	Var	Core not available separately	
L557	114-0176-00	10-40 mh	Var	Core not available separately	
L624	114-0178-00	1300-3000 μh	Var	Core not available separately	
L660	276-0507-00	Core, Ferramic Suppressor			
L661	276-0507-00	Core, Ferramic Suppressor			

Transistors

Ckt No.	Tektronix Part No.	Description			S/N Range
Q40	151-0161-00	2N3284			
Q110	151-0161-00	2N3284			
Q120	151-0161-00	2N3284			
Q150	151-0161-00	2N3284			
Q200	151-0161-00	2N3284			
Q210	151-0162-00	2N3324			
Q220	151-0162-00	2N3324			
Q340	151-0164-00	2N3702			
Q341	151-0164-00	2N3702			
Q350	151-0164-00	2N3702			
Q351	151-0164-00	2N3702			
Q360	151-0162-00	2N3324			

Transistors *(Cont'd)*

Ckt No.	Tektronix Part No.	Description				S/N Range
Q370	151-0162-00	2N3324				
Q450	151-0162-00	2N3324				1030-1259
Q450	151-0164-00	2N3702				1260-up
Q500	151-0162-00	2N3324				
Q510	151-0162-00	2N3324				
Q520	*151-0153-00	Replaceable by 2N2923				
Q530	151-0162-00	2N3324				
Q540	*151-0153-00	Replaceable by 2N2923				
Q550	151-0162-00	2N3324				
Q560	*151-0155-00	Replaceable by 2N2925				
Q600	*151-0153-00	Replaceable by 2N2923				
Q610	*151-0153-00	Replaceable by 2N2923				
Q650	*151-0155-00	Replaceable by 2N2925				

Resistors

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

R1	316-0561-00	560 Ω	1/4 w			
R2	316-0331-00	330 Ω	1/4 w			
R4	316-0180-00	18 Ω	1/4 w			
R5	316-0331-00	330 Ω	1/4 w			
R8	315-0911-00	910 Ω	1/4 w		5%	
R9	307-0107-00	5.6 Ω	1/4 w		5%	
R10	315-0911-00	910 Ω	1/4 w		5%	
R13	315-0431-00	430 Ω	1/4 w		5%	
R14	315-0120-00	12 Ω	1/4 w		5%	
R15	315-0431-00	430 Ω	1/4 w		5%	
R18	315-0221-00	220 Ω	1/4 w		5%	
R19	315-0240-00	24 Ω	1/4 w		5%	
R20	315-0221-00	220 Ω	1/4 w		5%	
R23	315-0121-00	120 Ω	1/4 w		5%	
R24	315-0510-00	51 Ω	1/4 w		5%	
R25	315-0121-00	120 Ω	1/4 w		5%	
R28	315-0680-00	68 Ω	1/4 w		5%	
R29	315-0151-00	150 Ω	1/4 w		5%	
R30	315-0680-00	68 Ω	1/4 w		5%	
R33	315-0620-00	62 Ω	1/4 w		5%	
R34	315-0241-00	240 Ω	1/4 w		5%	
R35	315-0620-00	62 Ω	1/4 w		5%	
R37	316-0331-00	330 Ω	1/4 w			
R38	316-0180-00	18 Ω	1/4 w			
R39	316-0331-00	330 Ω	1/4 w			
R40	305-0562-00	5.6 k	2 w		5%	
R41	322-0227-00	2.26 k	1/4 w	Prec	1%	
R42	322-0227-00	2.26 k	1/4 w	Prec	1%	
R45	321-0185-00	825 Ω	1/8 w	Prec	1%	
R46	321-0177-00	681 Ω	1/8 w	Prec	1%	

Resistors *(Cont'd)*

Ckt No.	Tektronix Part No.	Description					S/N Range
R50	316-0101-00	100 Ω	¼ w				
R57	323-0410-00	182 k	½ w		Prec	1%	
R58	311-0243-00	50 k		Var		FINE FREQUENCY	
R59	315-0103-00	10 k	¼ w			5%	
R80	316-0331-00	330 Ω	¼ w				
R101	316-0101-00	100 Ω	¼ w				
R104	316-0683-00	68 k	¼ w				
R105	316-0102-00	1 k	¼ w				
R107	311-0508-00	50 k		Var		GAIN RANGE	
R108	316-0331-00	330 Ω	¼ w				
R109A†	311-0526-00	10 k		Var		GAIN	
R109B†		1 k					
R111	306-0822-00	8.2 k	2 w				
R112	316-0102-00	1 k	¼ w				
R113	316-0222-00	2.2 k	¼ w				
R114	316-0102-00	1 k	¼ w				
R123	316-0222-00	2.2 k	¼ w				
R124	316-0102-00	1 k	¼ w				
R140	301-0752-00	7.5 k	½ w			5%	
R142	316-0102-00	1 k	¼ w				
R144	316-0222-00	2.2 k	¼ w				
R145	316-0222-00	2.2 k	¼ w				
R146	316-0222-00	2.2 k	¼ w				
R147	316-0222-00	2.2 k	¼ w				
R153	316-0471-00	470 Ω	¼ w				
R155	Use 316-0221-00	220 Ω	¼ w				
R156	304-0562-00	5.6 k	1 w				X1080-up
R203	316-0471-00	470 Ω	¼ w				
R213	316-0471-00	470 Ω	¼ w				
R223	316-0471-00	470 Ω	¼ w				
R226	316-0680-00	68 Ω	¼ w				
R227	316-0221-00	220 Ω	¼ w				
R303	323-0309-00	16.2 k	½ w		Prec	1%	
R304	323-0393-00	121 k	½ w		Prec	1%	
R305	323-0393-00	121 k	½ w		Prec	1%	
R306	321-0419-00	226 k	⅛ w		Prec	1%	
R307	321-0441-00	383 k	⅛ w		Prec	1%	
R309	322-0464-00	665 k	¼ w		Prec	1%	
R310	321-0387-00	105 k	⅛ w		Prec	1%	
R321	311-0387-00	5 k		Var		DISPERSION CAL	
R322	321-0289-00	10 k	⅛ w		Prec	1%	
R323	321-0261-00	5.11 k	⅛ w		Prec	1%	
R324	321-0239-00	3.01 k	⅛ w		Prec	1%	
R325	321-0193-00	1 k	⅛ w		Prec	1%	
R326	321-0165-00	511 Ω	⅛ w		Prec	1%	

†Furnished as a unit with SW640.

Resistors *(Cont'd)*

Ckt No.	Tektronix Part No.		Description			S/N Range
R327	321-0143-00	301 Ω	1/8 w	Prec	1%	
R328	321-0097-00	100 Ω	1/8 w	Prec	1%	
R329	321-0097-00	100 Ω	1/8 w	Prec	1%	
R340	316-0102-00	1 k	1/4 w			X1080-up
R343	316-0154-00	150 k	1/4 w			
R344	316-0472-00	4.7 k	1/4 w			
R345	302-0473-00	47 k	1/2 w			
R351	316-0103-00	10 k	1/4 w			
R353	316-0154-00	150 k	1/4 w			
R354	316-0472-00	4.7 k	1/4 w			
R355	Use 316-0334-00	330 k	1/4 w			
R360	316-0823-00	82 k	1/4 w			
R361	316-0103-00	10 k	1/4 w			
R363	Use 302-0393-00	39 k	1/2 w			
R370	316-0823-00	82 k	1/4 w			
R371	316-0103-00	10 k	1/4 w			
R373	316-0104-00	100 k	1/4 w			
R387	308-0212-00	100 k	3 w	WW	5%	
R396	316-0471-00	470 Ω	1/4 w			
R398	316-0561-00	560 Ω	1/4 w			
R450	316-0222-00	2.2 k	1/4 w			1030-1259
R450	315-0272-00	2.7 k	1/4 w		5%	1260-up
R451	316-0103-00	10 k	1/4 w			1030-1259
R451	315-0563-00	56 k	1/4 w		5%	1260-up
R452	316-0333-00	33 k	1/4 w			1030-1259
R452	316-0153-00	15 k	1/4 w			1260-up
R453	316-0102-00	1 k	1/4 w			
R455	316-0153-00	15 k	1/4 w			1030-1259
R455	315-0243-00	24 k	1/4 w		5%	1260-up
R501	316-0561-00	560 Ω	1/4 w			
R504	316-0472-00	4.7 k	1/4 w			
R510	316-0103-00	10 k	1/4 w			
R512	316-0221-00	220 Ω	1/4 w			
R513	316-0470-00	47 Ω	1/4 w			
R514	316-0102-00	1 k	1/4 w			
R515	316-0221-00	220 Ω	1/4 w			
R516	316-0221-00	220 Ω	1/4 w			
R517	316-0221-00	220 Ω	1/4 w			
R518	316-0102-00	1 k	1/4 w			
R520	316-0102-00	1 k	1/4 w			
R521	316-0682-00	6.8 k	1/4 w			
R522	316-0222-00	2.2 k	1/4 w			
R524	316-0471-00	470 Ω	1/4 w			
R525	316-0220-00	22 Ω	1/4 w			
R526	316-0471-00	470 Ω	1/4 w			
R530	316-0102-00	1 k	1/4 w			
R531	316-0103-00	10 k	1/4 w			
R533	316-0471-00	470 Ω	1/4 w			
R534	316-0471-00	470 Ω	1/4 w			
R537	316-0472-00	4.7 k	1/4 w			
R538	302-0104-00	100 k	1/2 w			

Resistors *(Cont'd)*

Ckt No.	Tektronix Part No.	Description					S/N Range
R543	306-0223-00	22 k	2 w				
R544	316-0471-00	470 Ω	1/4 w				
R574	316-0103-00	10 k	1/4 w				
R548	306-0223-00	22 k	2 w				
R550	316-0012-00	1 k	1/4 w				
R551	316-0103-00	10 k	1/4 w				
R553	316-0471-00	470 Ω	1/4 w				
R554	316-0471-00	470 Ω	1/4 w				
R555	316-0102-00	1 k	1/4 w				
R557	316-0472-00	4.7 k	1/4 w				
R558	302-0104-00	100 k	1/2 w				
R563	306-0223-00	22 k	2 w				
R564	316-0471-00	470 Ω	1/4 w				
R567	316-0103-00	10 k	1/4 w				
R568	306-0223-00	22 k	2 w				
R570	315-0472-00	4.7 k	1/4 w			5%	
R571	315-0103-00	10 k	1/4 w			5%	
R572	315-0223-00	22 k	1/4 w			5%	
R573	315-0473-00	47 k	1/4 w			5%	
R574	315-0104-00	100 k	1/4 w			5%	
R575	315-0473-00	47 k	1/4 w			5%	
R576	301-0223-00	22 k	1/2 w			5%	
R601	316-0684-00	680 k	1/4 w				
R602	316-0474-00	470 k	1/4 w				
R603	302-0472-00	4.7 k	1/2 w				1030-1259
R603	305-0223-00	22 k	2 w			5%	1260-up
R604	316-0102-00	1 k	1/4 w				
R605	316-0102-00	1 k	1/4 w				
R606	316-0104-00	100 k	1/4 w				
R614	316-0474-00	470 k	1/4 w				
R615	316-0101-00	100 Ω	1/4 w				
R616	316-0394-00	390 k	1/4 w				
R621	316-0153-00	15 k	1/4 w				
R623	316-0102-00	1 k	1/4 w				
R626	316-0221-00	220 Ω	1/4 w				
R628	316-0470-00	47 Ω	1/4 w				
R630	311-0006-00	1 k		Var		VERTICAL POSITION	
R631	304-0103-00	10 k	1 w				
R640	316-0105-00	1 meg	1/4 w				
R641	316-0105-00	1 meg	1/4 w				
R645	316-0105-00	1 meg	1/4 w				
R646	Use 311-0541-00	20 k		Var		LOG ADJ	
R647	315-0823-00	82 k	1/4 w			5%	
R648	316-0105-00	1 meg	1/4 w				
R649	323-0071-00	53.6 Ω	1/2 w		Prec	1%	

Resistors *(Cont'd)*

Ckt No.	Tektronix Part No.	Description				S/N Range
R651	316-0104-00	100 k	1/4 w			
R652	316-0105-00	1 meg	1/4 w			
R653	Use 308-0313-00	20 k	3 w	WW	1%	
R654	316-0471-00	470 Ω	1/4 w			
R656	316-0332-00	3.3 k	1/4 w			
R657	316-0332-00	3.3 k	1/4 w			
R658	316-0681-00	680 Ω	1/4 w			
R662	308-0352-00	425 Ω	25 w	WW	1%	
R667	308-0212-00	10 k	3 w	WW	5%	

Switches

	Unwired	Wired		
SW9	260-0642-00		Toggle	1 db
SW14	260-0642-00		Toggle	2 db
SW19	260-0642-00		Toggle	4 db
SW24	260-0642-00		Toggle	8 db
SW29	260-0642-00		Toggle	16 db
SW34	260-0642-00		Toggle	20 db
SW40	260-0643-00		Toggle	EXT OSC-INT OSC
SW320	260-0583-00		Slide	SAWTOOTH SELECTOR
SW325A } SW325B	260-0674-00	*262-0703-00	Rotary	DISPERSION-KC/CM COUPLED RESOLUTION
SW640†		*262-0702-00	Rotary	VERTICAL DISPLAY

Transformers

T50	*114-0188-00	0.22-0.38 μh	Var	Core 276-0555-00
T70	*120-0389-00	Toroid, 3 windings		
T114	*120-0390-00	Toriod, 2 windings		
T124	*120-0391-00	Toriod, 2 windings		
T204	120-0367-00	10.7 MC		
T214	120-0367-00	10.7 MC		
T224	120-0367-00	10.7 MC		

Electron Tube

V620	154-0040-00	12AU6

† Furnished as a unit with R109A,B.

Crystals

Ckt No.	Tektronix Part No.	Description	S/N Range
Y150	158-0020-00	49.3 MC	
Y380	*120-0368-00	Discriminator 11.5 MC	
Y450	158-0021-00	900 KC	
Y530	158-0022-00	100 KC	
Y550	158-0022-00	100 KC	

IMPORTANT

VOLTAGE AND WAVEFORM CONDITIONS

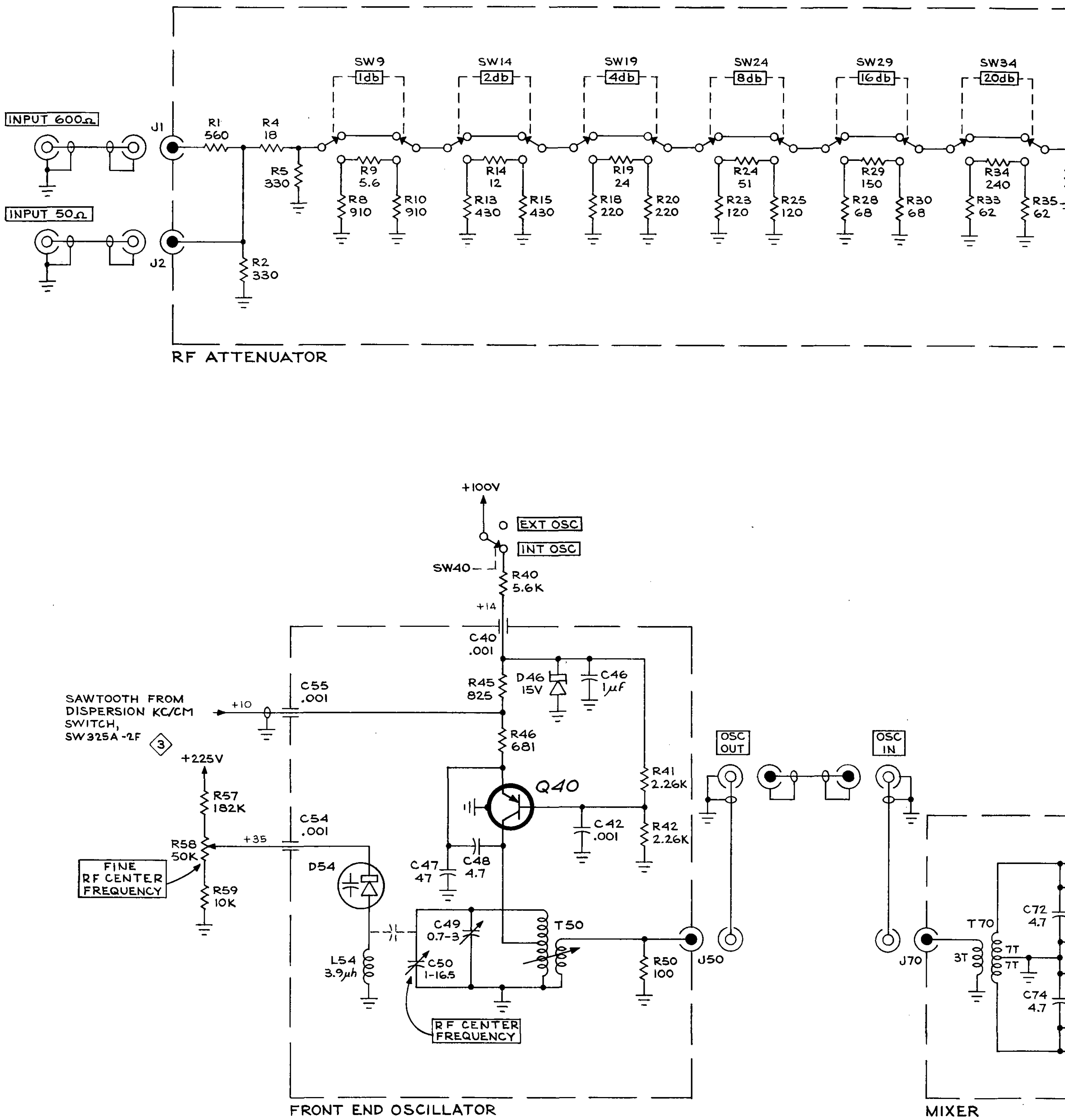
Circuit voltages measured with 20,000 Ω/volt VOM. All readings in VOLTS.

Voltage and waveform measurements are not absolute and may vary from unit to unit. For these measurements, a 30" flexible plug-in extension cable (Tektronix Part No. 012-0038-00) was used to operate the Type 1L10 outside of the oscilloscope plug-in compartment.

The oscilloscope time base was set for a free-running sweep at a 5 millisecond/centimeter rate.

Voltage readings were obtained under the following conditions:

RF CENTER FREQ	5 mc
FINE RF CENTER FREQ	Midrange
VERTICAL POSITION	Midrange
R-F ATTEN	All or
VERTICAL DISPLAY	LIN
GAIN	ccw
EXT OSC INT OSC	INT OSC
DISPERSION - KC/CM	2
COUPLED RESOLUTION	2

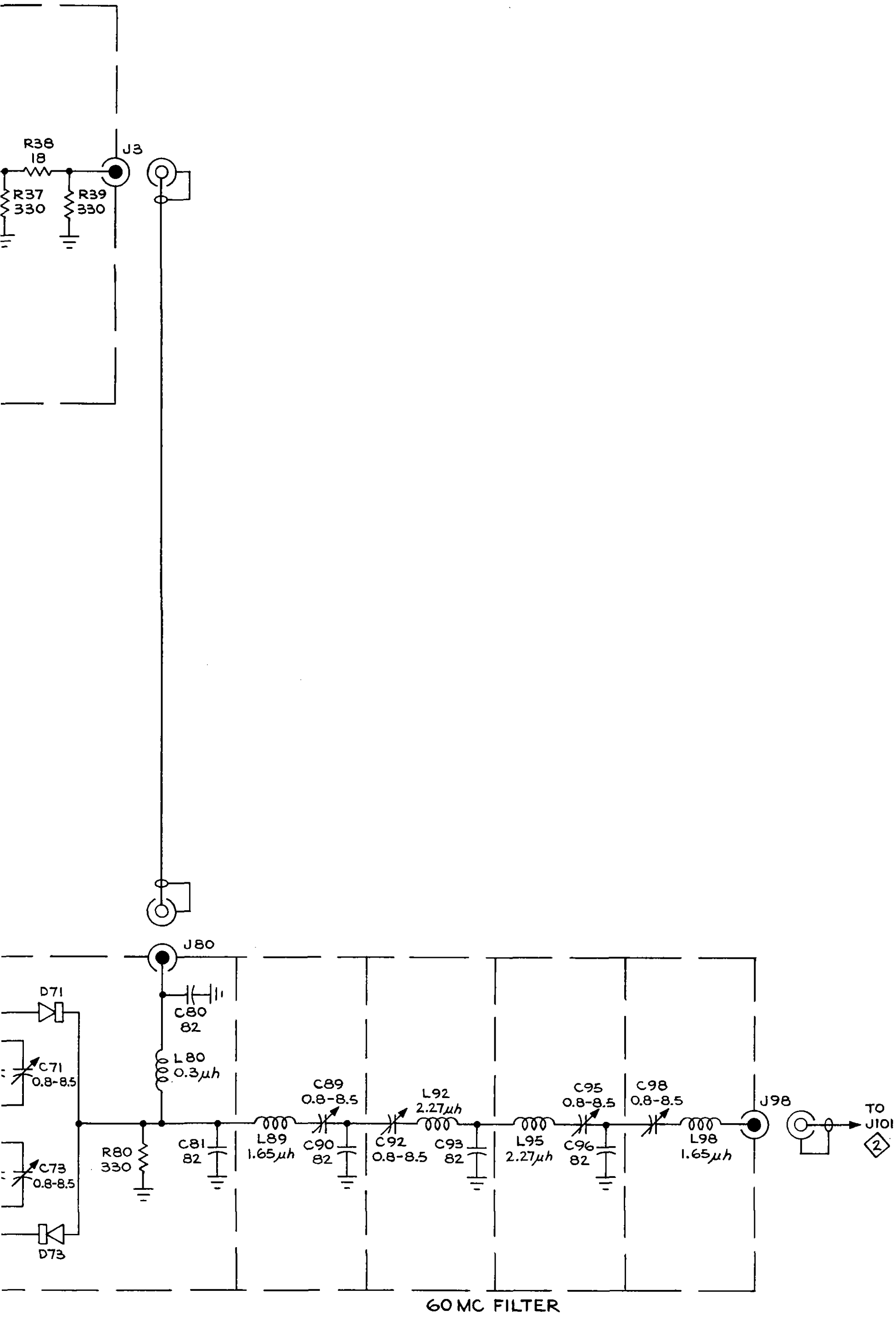


SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS

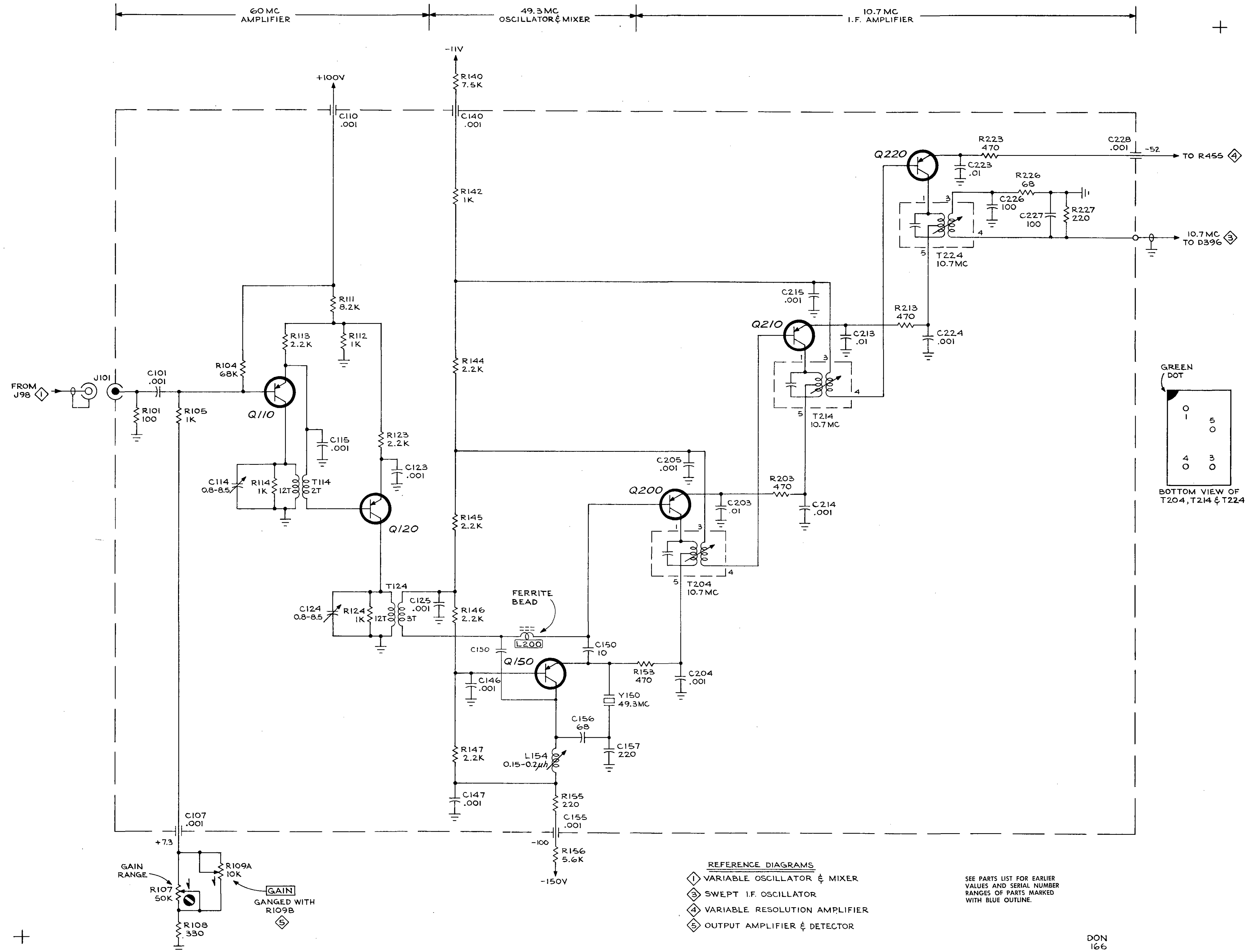
2 WIDE BAND AMPLIFIER

3 SWEPT I.F. OSCILLATOR



DON
565

VARIABLE OSCILLATOR & MIXER 1



REFERENCE DIAGRAMS

1. VARIABLE OSCILLATOR & MIXER
3. SWEPT I.F. OSCILLATOR
4. VARIABLE RESOLUTION AMPLIFIER
5. OUTPUT AMPLIFIER & DETECTOR

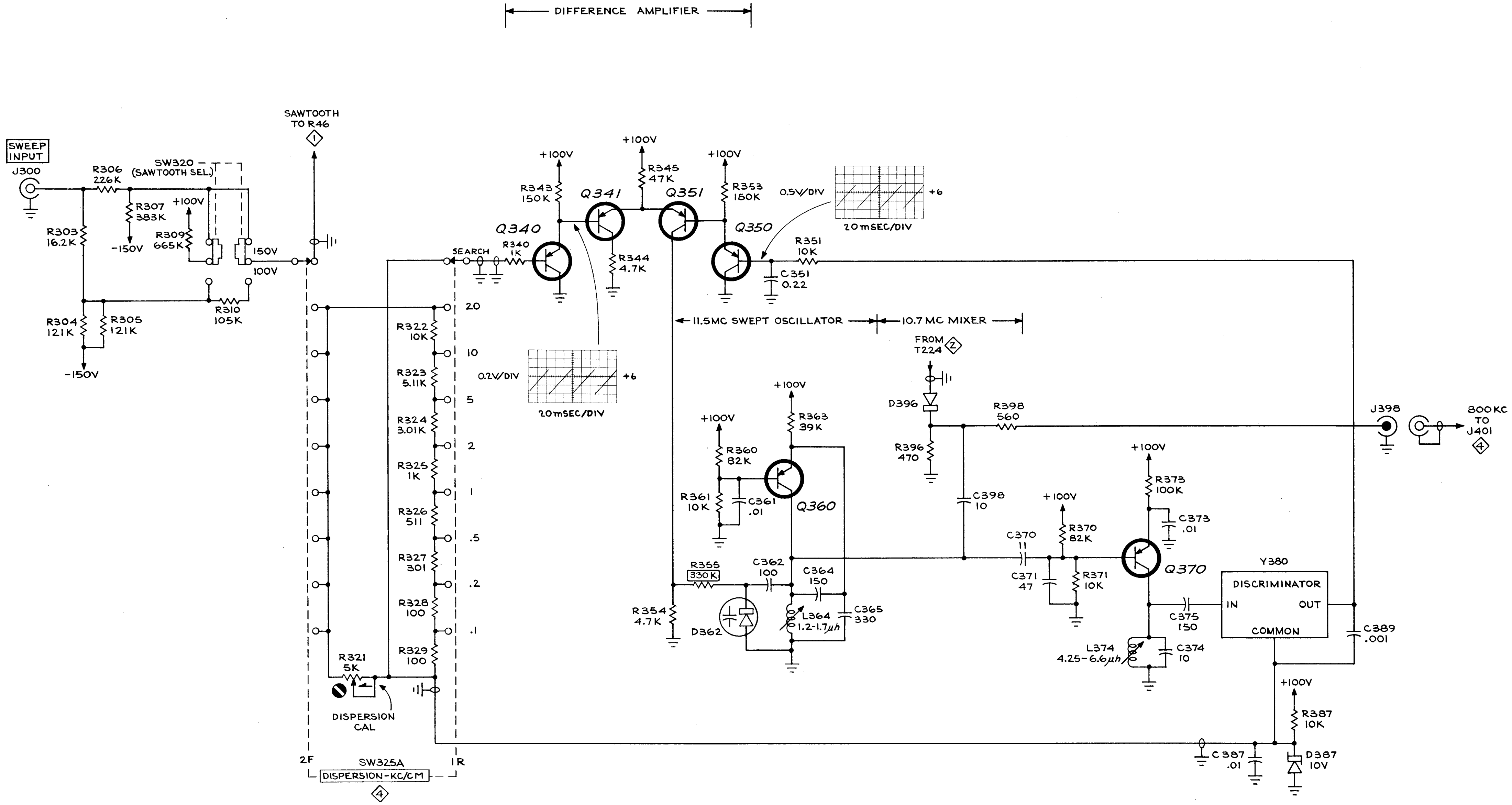
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

DON 166

TYPE 1L10 SPECTRUM ANALYZER

C

WIDE BAND AMPLIFIER 2



REFERENCE DIAGRAMS

① VARIABLE OSCILLATOR & MIXER
② WIDE BAND AMPLIFIER
④ VARIABLE RESOLUTION AMPLIFIER

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

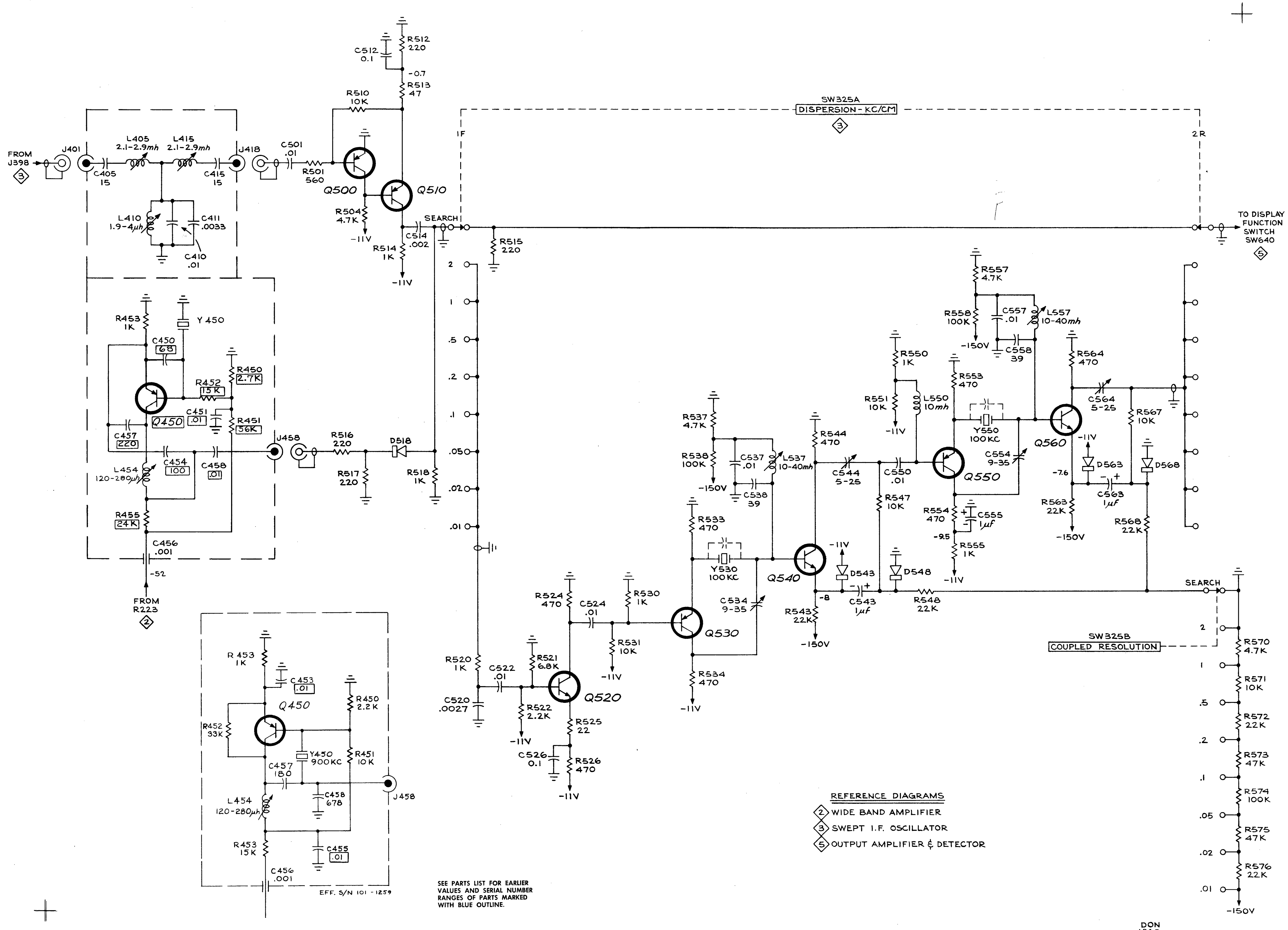
DON
166

TYPE 1L10 SPECTRUM ANALYZER

B

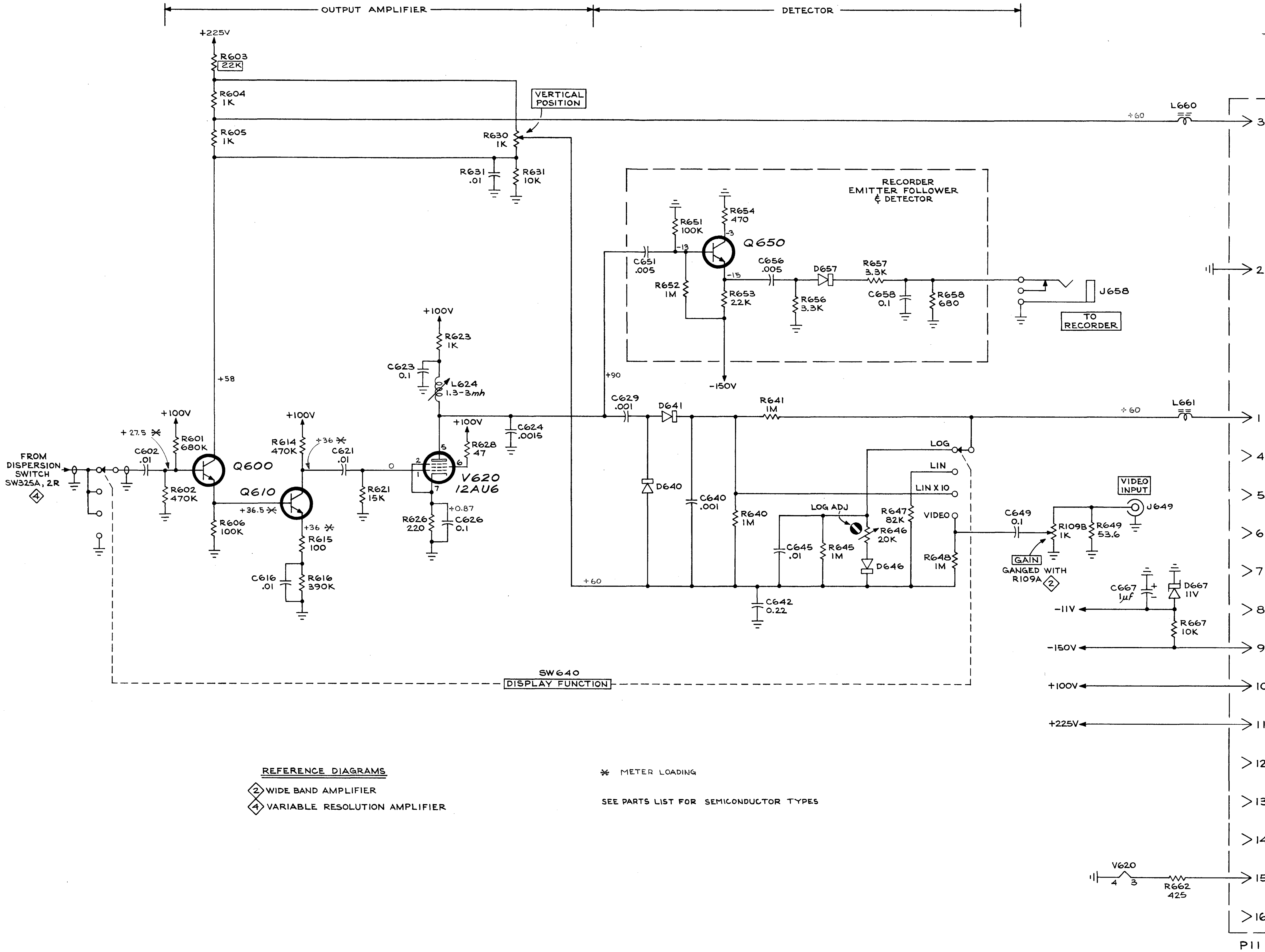
SWEPT I.F. OSCILLATOR ③

SWEEP I.F. OSCILLATOR ③



VARIABLE RESOLUTION AMPLIFIER

4



REFERENCE DIAGRAMS
② WIDE BAND AMPLIFIER
④ VARIABLE RESOLUTION AMPLIFIER

✱ METER LOADING

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

DON 366

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.

TYPE 1L10 TENT SN 1300

PARTS LIST CORRECTION

CHANGE TO:

D54	152-0271-00	Vari-cap	2.2-26 pF
D362	152-0271-00	Vari-cap	2.2-26 pF

TYPE 1L10 TENT S/N 1260

PARTS LIST CORRECTION

CHANGE TO:

R603	305-0223-00	22 k	2 W	5%

R603 will now connect to +225 V instead of +100 V supply.

TYPE 1L10/3L10

PARTS LIST CORRECTION

CHANGE TO:

C365	283-0077-00	330 pF	5%	500 V

M10520/1265

Type 1L10

Type 3L10

Parts List Correction

Part Added:

Ferrite Bead[1]	276-0507-00

[1] Add to secondary base lead of T124.

Type 1L10

Type 3L10

Parts List Correction

Change To:

R355	316-0334-00	330 K	1/4 W	10%

Parts List Correction

Remove:

C453	283-0079-00	.01 µf	250 V	Cer.
C455	283-0079-00	.01 µf	250 V	Cer.

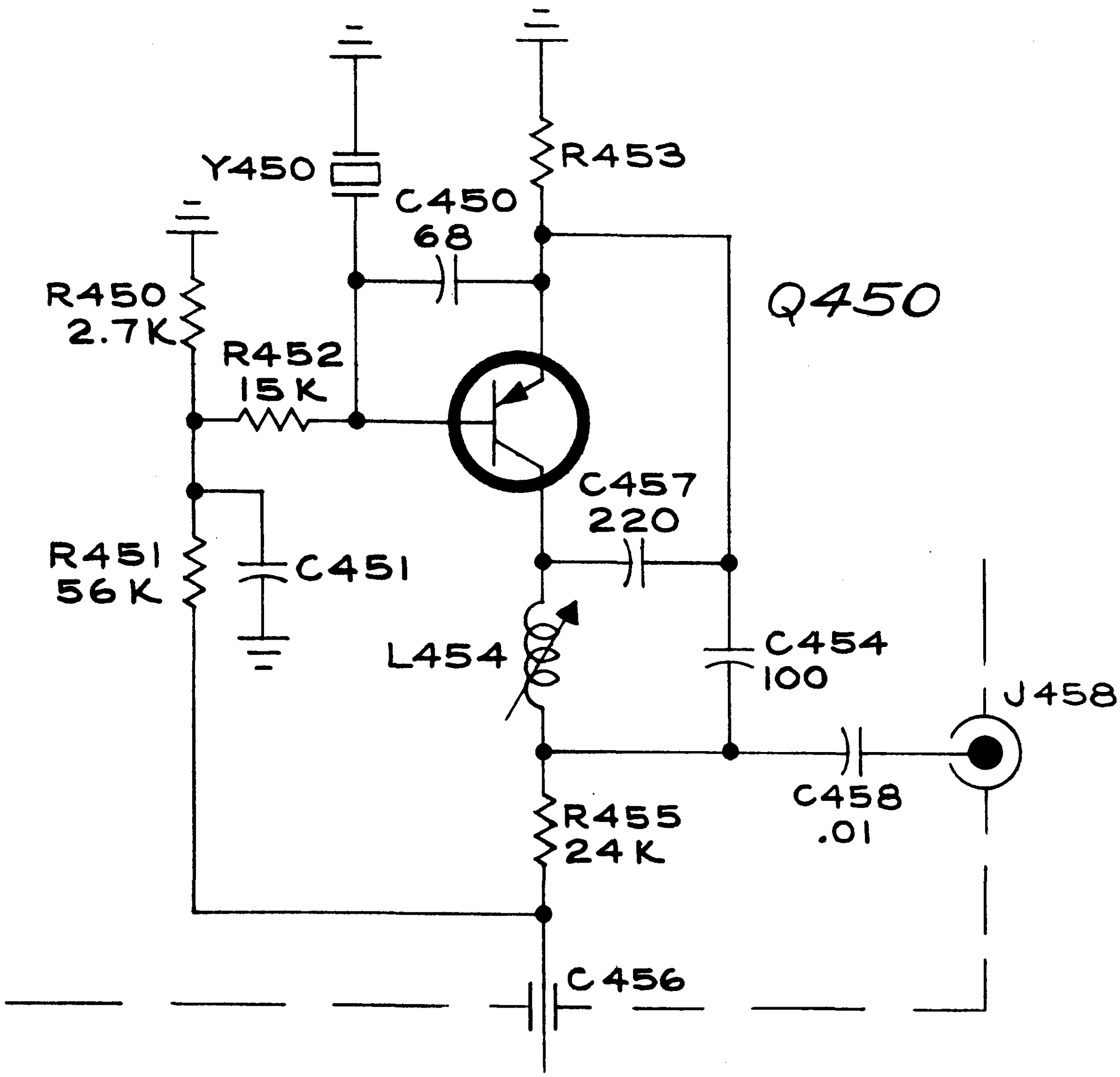
Add:

C450	283-0608-00	68 pf	500 V	Mica
C451	283-0079-00	.01 µf	250 V	Cer
C454	285-0003-00	100 pf		

Change To:

C457	285-0004-00	220 pf		
C458	283-0079-00	.01 µf	250 V	Cer
Q450	151-0164-00	2N3702		
R450	315-0272-00	2.7 K	1/4 W	5%
R451	315-0563-00	56 K	1/4 W	5%
R452	316-0153-00	15 K	1/4 W	10%
R455	315-0243-00	24 K	1/4 W	5%

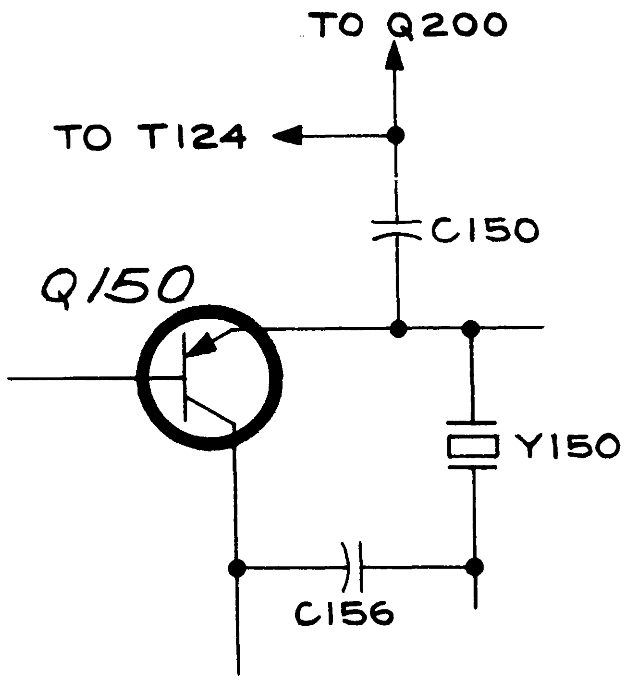
Schematic Correction



PARTIAL VAR. RESOLUTION AMP.

Type: 1L10 Tent S/N 1208
Type: 3L10 Tent S/N 165

Schematic Correction



PARTIAL WIDE-BAND AMP.

M10,399/1265