FACTORY CALIBRATION PROCEDURE

CONTENTS:

INTRODUCTION:

3L5

This is the guide for calibrating brand-new instruments, it therefore, calls out many procedures and adjustments that are rarely required for subsequent recalibration. *This procedure is company confidential.* In this procedure, all front panel control labels or Tektronix equipment names are in capital letters (VOLTS/DIV, etc.) internal adjustment labels are capitalized only (Gain Adj, etc.).

Tek form number:
0-412
August 1967

For all serial numbers.

FACTORY TEST LIMITS:

We initially calibrate the instrument to Factory Test Limits. These limits are often more stringent than advertised performance requirements. This helps insure that the instrument will meet advertised requirements after shipment, allows for inaccuracies of test equipment used, and may allow for changes in environmental conditions.

QUALIFICATION:

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers and letters to the left of the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or check-out methods and test equipment differ substantially from those in this procedure.

ABBREVIATIONS:

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100.

CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes that have been made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 47-261.

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

1	TYPE 564 OSCILLOSCOPE (plug-in scope)
1	TYPE 540B SERIES OSCILLOSCOPE (test scope)
1	TYPE 1A1 PLUG-IN UNIT (test scope plug-in)
* 1	TYPE 184 TIME MARK GENERATOR
1	TYPE 191 SIGNAL GENERATOR
1	TYPE 3B4 TIME BASE
1	TYPE P6006 10X PASSIVE PROBE
1	TYPE P6011 1X PASSIVE PROBE

b. Test Fixtures and Accessories

3	50Ω cables, BNC (012-0057-00)
1	50Ω Termination (011-0049-00)
3	50Ω 5:1 Attenuators (011-0060-00)
4	50Ω 10:1 Attenuators (011-0059-00)
1	30pF Input RC Normalizer (067-0552-00)
1	Flexible Extension (012-0064-00)
1	BNC T (103-0030-00)
1	50Ω 2.5:1 Attenuator (011-0076-00)
* 1	LF Sine Wave Generator (067-0542-99, frequency adjusted to 1%)
* 1	STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)

c. Other Equipment

1	600Ω load cable for TO RECORDER output (PMPE Dwg #1439A)
1	Multimeter 20,000Ω/volt, calibrated to ±1% at 10 volts
1	Ohms Picker (PMPE Dwg #1649A, 1670B, 1669B)

* This equipment must be traceable to NBS for instrument certification.

Substitute test equipment may be used. The Plant Staff Engineer must approve any substitutions. All equipment listed must perform within its manufacturer's specifications, unless otherwise stated.

It is assumed that all equipment is provided with BNC connectors; if equipment used has other than BNC connectors, adapters, not listed, may be needed.

QUALIFICATION

Factory test limits are qualified by the conditions specified in the main body of the calibration procedure. The numbers and letters to the left of the limits correspond to the factory calibration procedure steps where the check or adjustment is made. Instruments may not meet factory test limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

1. PRELIMINARY INSPECTION

2. PRESETS

3. RESISTANCE

4. AC-GND-AC FAST SWITCH

b. Check AC-GND-AC FAST SWITCH

5. POWER SUPPLY +10V: within 5%
ripple + hash: ≤30mV P-P

6. OUTPUT AMPLIFIER Q410 collector voltage: 167 to 203V

7. REDUCE DISPERSION LIGHT

8. VIDEO GAIN

b. Determine CRT sensitivity
c. Check min and max gain
d. Adjust VIDEO CAL

9. VOLTS/CM ACCURACY

b. Check ÷1 and ÷100 VOLTS/DIV accuracy: within 2%
c. Check VOLTS/DIV VARIABLE range: ≥3:1

10. VERTICAL TRACE SHIFT

b. Adjust R428
c. Check VIDEO to LIN to LOG trace shift: ≤4div

11. POSITION CONTROL RANGE: at least + and - 8cm

12. INPUT COMPENSATION

b. Adjust VOLTS/DIV compensation

13. SWEPT OSCILLATOR PRELIMINARY SETUP

b. Preset L164, L191, L192, L194

14. CONVERTED SIGNAL

b. Adjust T290
c. Adjust C323, C343
d. Adjust 3MHz filter
e. Adjust L280

15. SWEPT OSCILLATOR

a. Preset R214, R191
b. Adjust L164
c. Adjust 2-3MHz Filter (L192, L194, L214)
d. Check 0 and 00 decade sweeps

16. CENTER FREQUENCY CAL

b. Adjust R156
c. Select R108
d. Adjust 500 kHz CAL
3. Adjust R150
f. Adjust 10 kHz CAL
g. Compare O k and k decade dispersion:
≤.5 div difference

17. K AND OK DISPERSION

Adjust 30 kHz CF

* 18. OK AND K CENTER FREQUENCY TRACKING

b. Check center frequency tracking
O k: within 10 kHz +4%
k: within 3 kHz +4%

* 19. K AND OK DISPERSION ACCURACY AND LINEARITY

b. Check dispersion, k and Ok decade;
accuracy: within ±14%
linearity, within ±2%
c. Check functioning of Units switching

20. O and OO DECADE OSCILLATOR TRACKING

b. Adjust R128 and 0000 Hz CAL

21. O AND OO DECADE DISPERSION ADJ

b. Adjust 5000 Hz CF

22. VARIABLE RESOLUTION AMPLIFIER

b. Adjust skirt response (C323, C343)
c. Adjust bandwidth (L327, L347):
≥500 Hz at 50% amplitude point
d. Readjust L280 for max amplitude
e. Adjust 10 Hz resolution amplitude
(C332, C352)
f. Check Resolution Flatness, ±1dB
10Hz - 500Hz
g. Check max resolution - bandwidth:
≥500Hz at 50% amplitude point
h. Check min resolution - bandwidth:
≤10Hz at 50% amplitude point

23. INCIDENTAL FM

b. Check incidental FM, 50Hz to
9900Hz: ≤3Hz
c. Check incidental FM, 9900Hz to
990kHz: ≤10Hz

* 24. O AND OO DECADE OSCILLATOR TRACKING ACCURACY

OO: within 100Hz +4%;
O: within 50 Hz +4%

* 25. O AND OO DECADES DISPERSION ACCURACY

b. Check O and OO decade dispersion:
accuracy, within 10%
linearity, within 3%

26. 300KHz SPURIOUS RESPONSE

b. Adjust L270 for minimum response
to 300 kHz spurious response
c. Adjust 3MHz filter for maximum response
to 500 kHz signal

27. LOG GAIN

b. Adjust Log Range R422: 50dB above
1.3cm

* 28. LIN CAL, TO RECORDER OUTPUT

b. Adjust Lin Cal R316
c. Pick R432
d. Check LIN accuracy: within ±2%

29. BALANCED MIXER zero frequency feedthru: ≥1cm to ≤4cm

Adjust R85, C86

30. INTERMODULATION DISTORTION

c. Check intermodulation distortion: ≥50dB

31. RANDOM SPURIOUS RESPONSES

b. Check random spurious responses: ≥50dB down

32. HIGH FREQUENCY COMPENSATION

b. Adjust high frequency compensation (C491, C481)
c. Check bandwidth: ≤3dB down at 1MHz

33. DISPLAY FLATNESS, 10Hz to 1MHz

b. Select C44
c. Adjust input compensation C13, C15
d. Check .005V/DIV flatness, ÷100 in: ±0.5dB
e. Check .01 to 2V/DIV flatness, ÷100 in and out: ±0.5dB
f. Check .001 and .002 V/DIV flatness, ÷100 in and out: +0.5dB, -3dB
g. Check low frequency (10Hz) response - .005 V/DIV, ÷100 in and out: ±0.5dB

* 34. INPUT AMPLIFIER

b. Check input amplifier frequency response at .1 VOLTS/DIV and .2 VOLTS/DIV: +0.5dB, -3dB from 10Hz to 700 kHz
c. Check input amplifier frequency response at .5 VOLTS/DIV: ±0.5dB from 10Hz to 1MHz

* 35. CALIBRATOR

a. Adjust calibrator frequency: 5 kHz ±0.5%
b. Set calibrator amplitude: 4 div

36. VARIABLE CENTER FREQUENCY-Hz

b. Check VARIABLE CENTER FREQUENCY range: ≥10 kHz, extending center frequency to ≥1MHz.

37. OSC OUT freq sweep: ≥1MHz
Amplitude: ≥1.2V

38. VARIABLE DISPERSION

39. MANUAL SWEEP MODE

b. Check MANUAL SWEEP range: 0 to 70 volts approx

40. NOISE LEVEL

b. Check noise level: ≤5μvolts

41. TRIGGER TAKEOFF

b. Check trigger takeoff
Amplitude: ≥1:74
Risetime: ≤.8 s

THE END

* Indicates measurement characteristic; test equipment used must be traceable to the NBS for instrument certification.

1. PRELIMINARY INSPECTION

Check for unsoldered joints, rosin joints, proper lead dress and long wire ends. Check for loose hardware, protruding parts and foreign material. Check controls for smooth mechanical operation, proper indexing and sufficient spacing between knobs and front panel. Correct all defects.

2. PRESETS

TYPE 1A1 (Test Scope plug-in)

VOLTS/CM	.1
MODE	CH 1
INPUT SELECTOR	DC

TYPE 3L5

VERTICAL DISPLAY	VIDEO
CENTER FREQUENCY-Hz	500k
VARIABLE	CAL
AC-GND-AC FAST	GND
POSITION	midr
SWEEP INT-MANUAL	SWEEP INT
DISPERSION Hz/DIV	100 k
VARIABLE	CAL
COUPLED RESOLUTION	Coupled to DISPERSION Hz/DIV
VOLTS/DIV	.5 (outer scale)
VARIABLE	CAL

all screw driver adjustments midr

The RESOLUTION switch should be cross coupled to the DISPERSION-Hz/DIV switch unless the procedure calls out different settings for the two controls.

TYPE 2B67

TIME/DIV	1mSEC
TRIGGERING LEVEL	FREE RUN
SLOPE	+
COUPLING	AC SLOW
SOURCE	INT

3. RESISTANCE

Use multimeter to make resistance measurements from the amphenol connector to ground as in the following table:

Pin Number	Approx Resistance neg lead to ground	pos lead to ground	Ω Scale
1-5	inf	inf	1k
6	10k	8.3k	1k
7 & 8	inf	inf	1k
9	0	0	1k
10	10k	8.3k	1k
11	9k	5.2k	1k
12-14	inf	inf	1k
15	2.2k	2.2k	1k
16	10Ω	10Ω	10Ω
17	18k	18k	1k
18	1.1k	1.1k	1k
19	inf	inf	1k
20	2.2k	2.2k	1k
21	18k	18k	1k
22	3k	3k	1k
23	15k	6k	1k
24	inf	inf	1k

4. AC-GND-AC FAST SWITCH

a. Setup

Connect BNC cable from test scope AMPLITUDE CALIBRATOR to TYPE 3L5 INPUT. Connect 10X probe from TYPE 1A1 CHANNEL 1 to the TYPE 3L5 input capacitor junction on first wafer (VOLTS/DIV switch) where 560Ω resistor and the first wafer meet.

b. Check AC-GND-AC FAST SWITCH

Position TYPE 1A1 CHANNEL 1 trace to graticule electrical center. Switch TYPE 3L5 AC-GND-AC FAST to AC FAST. Check for a square-wave display on test scope with bottom of display at graticule center. Change the TYPE 3L5 AC-GND-AC FAST to AC. Check for a square-wave display on test scope with top and bottom approx equal distance above and below graticule center. Remove BNC cable and 10X probe from TYPE 3L5.

5. POWER SUPPLY

+10V: within ±5%
Ripple and hash: ≤30mV P-P

The +10V supply is accessible on the 3MHz IF chassis.

Connect TYPE 3L5 -- flexible extension -- plug-in scope Amphenol connector. Turn the plug-in scope POWER ON. Measure the power supply voltage with the multimeter. Check ripple and hash with a 10X probe from INPUT 1 of the test scope plug-in.

6. OUTPUT AMPLIFIER

Q410 collector voltage:
115V ±10V

Measure the DC voltage at Q410 collector (transistor case).

7. REDUCE DISPERSION LIGHT

Check that the REDUCE DISPERSION light is lit in the following positions:

TYPE 3L5 DISPERSION Hz/CM	TYPE 3L5 CENTER FREQUENCY-Hz		
100k	All except 500k	All except 500k	All except 500k
10k	000k, 00k thru 49k	0000 thru 9900	000 thru 990
1k	000k, 00k thru 09k	0000 thru 4900	000 thru 990
500	000k, 00k thru 09k	0000 thru 2900	000 thru 990
200	000k, 00k	0000	000 thru 990
100	000k, 00k	0000 thru 0900	000 thru 490
50	000k, 00k	0000 thru 0900	000 thru 290
20	000k, 00k	0000	000 thru 090
10	000k, 00k	0000	000 thru 040

8. VIDEO GAIN

a. Setup

Connect the SAC to the TYPE 3L5 INPUT. Switch the TYPE 3L5 to VIDEO and the VOLTS/DIV to .5 (outer scale), ÷100 out. Set the AC-GND-AC FAST switch to GND. Set the SAC to 20mVOLTS. Position the trace to 2 div below graticule center with the TYPE 3L5 POSITION control. Connect the VOM to the two vertical leads to the CRT.

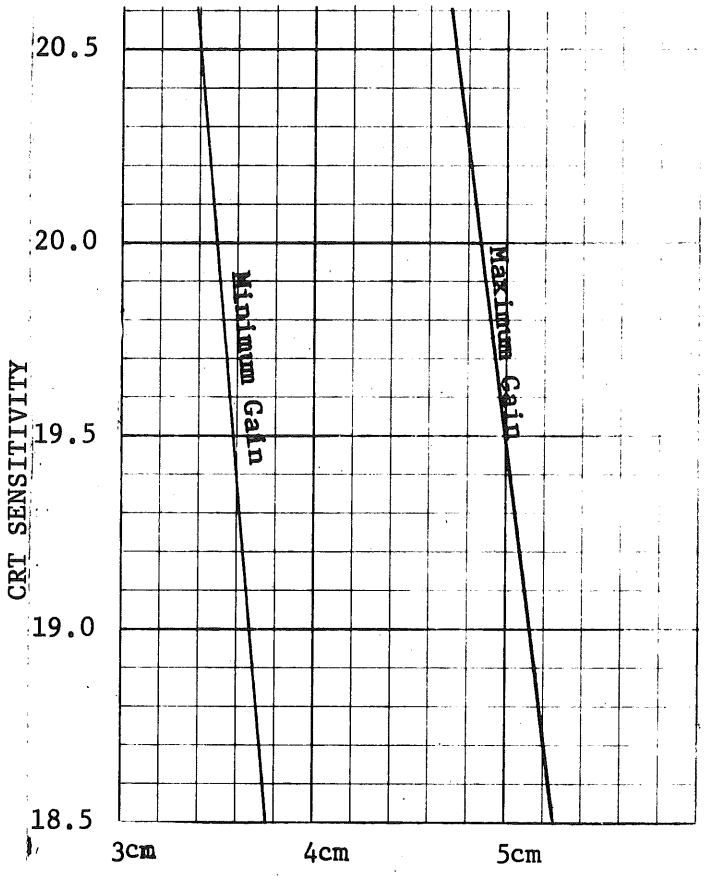
8. (cont'd)

b. Determine CRT sensitivity

Position trace 2cm above CRT graticule, center with TYPE 3L5 POSITION control, and note reading on VOM. Add the two readings together and divide by 4. This will tell you the CRT sensitivity.

c. Check minimum and maximum gain

Set the TYPE 3L5 AC-GND-AC FAST to AC FAST. Set the TYPE 3B4 for a usable display. Using the chart to the right, check min and max gain with the VIDEO CAL at its two extremes.



d. Adjust Video Gain

Adjust VIDEO CAL for 4cm exactly of deflection.

9. VOLTS/CM ACCURACY

a. Setup

Set the SAC AMPLITUDE to 5mVOLTS and the TYPE 3L5 VOLTS/DIV to .1, ÷100 pulled out.

b. Check VOLTS/DIV accuracy: within ±2%

VOLTS/DIV	SAC	Deflection	Max Error
.1	5mVOLTS	5 Div	1mm
.2	10mVOLTS	5 Div	1mm
.5	20mVOLTS	4 Div	0mm -- adjust to zero error
1	50mVOLTS	5 Div	1mm
2	.1 VOLTS	5 Div	1mm
5	.2 VOLTS	4 Div	.8mm
10	.5 VOLTS	5 Div	1mm
20	1 VOLTS	5 Div	1mm
50	2 VOLTS	4 Div	.8mm
100	5 VOLTS	5 Div	1mm
2 (inner scale)	10 VOLTS	5 Div	1mm

Change SAC amplitude to .5 Volts and push the ÷100 switch in. Set the TYPE 3L5 VOLTS/DIV to .1. Check for 5cm of deflection ±2%, ± error with ÷100 pulled out.

9. (cont'd)

c. Check VOLTS/CM VARIABLE Range:
≥3:1

Rotate the TYPE 3L5 VOLTS/DIV VARIABLE to its fully ccw position and check for 1.67cm or less of deflection. Return the VARIABLE to fully cw (CAL).

Disconnect SAC from TYPE 3L5 INPUT.

10. VERTICAL TRACE SHIFT

a. Setup

Set TYPE 3L5 VERTICAL DISPLAY to LIN. Set TYPE 3B4 TIME/DIV to 20mSEC.

b. Adjust R428

Adjust R428 for minimum vertical trace shift as the TYPE 3L5 VERTICAL DISPLAY is switched from LIN to LOG.

c. Check VIDEO to LIN to LOG trace shift
4cm max

Switch TYPE 3L5 VERTICAL DISPLAY from VIDEO to LIN to LOG and check for ≤4cm trace shift.

11. POSITION CONTROL RANGE at least + & -8cm

Set TYPE 3B4 TIME/DIV to 1mSEC. Connect 50Ω BNC cable from CAL OUT on TYPE 564 to TYPE 3L5 INPUT. Set TYPE 3L5 VERTICAL DISPLAY to VIDEO, VOLTS/DIV to .2 (outer scale). Set AMPLITUDE CALIBRATOR to 2V and adjust TYPE 3L5 VARIABLE VOLTS/DIV for 8cm of displayed signal. Change TYPE 3L5 VOLTS/DIV to .1. Check that rotating TYPE 3L5 POSITION control can position top of waveform below center of graticule and bottom of waveform above center of graticule.

Disconnect the cable.

If necessary, R428 may be re-adjusted slightly to make POSITION control range. If R428 is re-adjusted, be sure to recheck trace shift, Step 10.

12. INPUT ATTENUATOR COMPENSATION

a. Setup

Connect 10X probe from TYPE 1A1 INPUT to pin R of input board. Connect TYPE 106 as follows:

TYPE 106 -- BNC cable -- 10:1 Atten -- 10:1 Atten -- 50Ω Term -- 30pF Normalizer -- TYPE 3L5.

Make sure 10X probe is compensated.

b. Adjust VOLTS/DIV Compensation

Set TYPE 3L5 VOLTS/DIV to .5 ÷ 100 out. Adjust TYPE 106 for 5 div of 1 kHz displayed signal. In the following table, readjust TYPE 106 AMPLITUDE control to maintain 5 Div of deflection. The X10 attenuators will have to be removed on the higher VOLTS/DIV steps.

The attenuators will have to be tuned for a flat, square corner or the TYPE 3L5 will not make flatness test limits in Step 28.

TYPE 3L5		ADJUST For Best	
VOLTS/CM	÷100	Front Corner	For Level
.5	out		C10
.5	in		C13

Repeat until there is no interaction.

Adjust 1 VOLTS/CM through 50 VOLTS/CM to match the .5 VOLTS/CM (straight through) position.

.5	in	C15	
1	out	C8C	C8A
2	out	C9C	C9A
5	out	C4C	C4A
10	out	Check	Check
20	out	Check	Check
50	out	C5C	C5A
100	out	Check	Check

Push ÷100 in and check all positions of the VOLTS/CM switch.

Disconnect the 30pF Normalizer from TYPE 3L5 INPUT.

13. SWEPT OSCILLATOR PRELIMINARY SETUP

a. Setup

Change VERTICAL DISPLAY to LIN. Change the TYPE 3B4 TIME/DIV to 10mSEC. Change the test scope TIME/CM to .1 SEC. Connect the 10X probe from the TYPE 1A1 to the junction of R153 and R158. Set the TYPE 1A1 VOLTS/CM to .2.

R153 and R158 are located by Pin P of Discriminator Board.

13. (cont'd)

b. Preset coils L164, L191, L192 and L194 and L194

L164, 5 turns down from top. L191, 3 turns down from top. L192, 1 to 2 turns above coil form. L194, 4 turns down from top of coil form. R214 approx 5° cw from midrange.

c. Adjust L164, L191, and L194

Remove Q120 and adjust L164 for a sine wave of slightly greater than 3MHz on test scope. Short the cathode of D164 to ground and observe that the signal on test scope changes to 2MHz or less. Adjust L191 for least distortion of 2MHz sine wave.

Remove short from D164 cathode and replace Q120. Observe a swept frequency on the test scope. Change to MANUAL SWEEP, adjust for 2.5MHz (2.5 cycles on test scope) and adjust L194 for best sine wave at point of maximum amplitude.

14. CONVERTED SIGNAL

a. Setup

Connect the 10X probe from the TYPE 1A1 to collector of Q280. Set the test scope TIME/CM to .1μSEC. Turn MANUAL fully cw.

b. Adjust T290

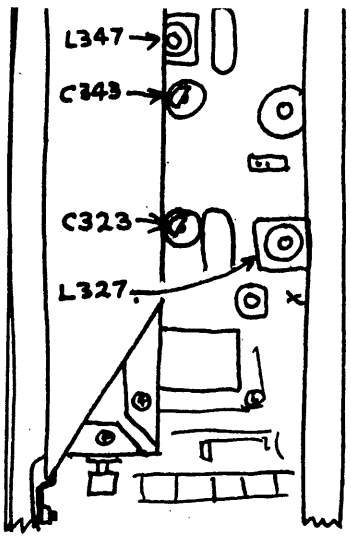
Adjust T290 for maximum amplitude of the 3.1MHz signal displayed on test scope CRT.

c. Adjust C323, C343

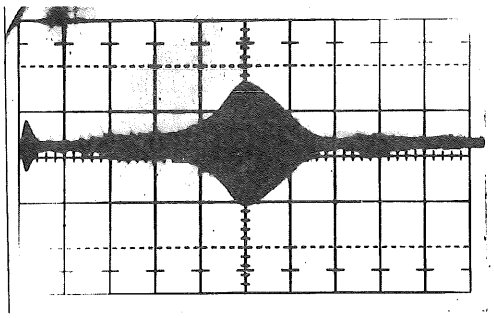
Apply 500 kHz signal from the LFSWG to the TYPE 3L5 INPUT. Connect the probe from the TYPE 1A1 to emitter of Q330 (15kΩ 2W Resistor) and trigger TYPE 3B4 from test scope +A GATE. Set the test scope TIME/CM to match the 3B4 sweep speed. Set TYPE 3L5 DISPERSION Hz/DIV to kK. Adjust C323 for minimum amplitude of signal displayed on test scope.

Disconnect the probe from emitter of Q330 and connect it to the emitter of Q350 (15kΩ 2W Resistor) and tune C343 for a display on test scope as shown in the following figure.

On the Resolution board preset C323, C343 to approximately 11 o'clock as shown, preset L327, L347 3 turns down from flush with top.



14c. (cont'd)



When tuning a TYPE 3L5 having a pre-caled filter, apply a 500kHz signal from the LFSWG to the TYPE 3L5 input. Change the DISPERSION Hz/CM to 10k.

Tune T290 for maximum amplitude of 500kHz signal on TYPE 564. (There can be two or more points in the tuning of T290 where the signal will appear; pick the one with the maximum amplitude.)

d. Adjust 3MHz Filter

Adjust C262, C257, C252 and C267 for maximum amplitude of displayed signal.

e. Adjust L280

Adjust L280 for maximum amplitude of signal displayed on TYPE 564 CRT.

Disconnect the LF Sine Wave Generator.

15. SWEPT OSCILLATOR

a. Preset R214, L191

Connect 10μS markers from the TYPE 184 to the TYPE 3L5 input. Set CENTER FREQUENCY -Hz to 500k, DISPERSION Hz/DIV to 100k. Adjust TYPE 3B4 HORIZ POSITION so that the 500kHz harmonic response of the markers is at graticule center of TYPE 564. Midrange 30kHz CF and adjust R214 for best dispersion linearity from 100kHz to 500kHz (ignore linearity of harmonics above 500kHz). Adjust L191 to point just prior to the breakup of the markers on the left of the graticule.

b. Adjust L164

Change CENTER FREQUENCY -Hz to 00k, VOLTS/CM to CAL 4CM, DISPERSION Hz/DIV to 10k. Rough set L164 so that one of the 5kHz calibrator marks is to the left of the start spurious. With the 10kHz CF CAL, move the start spurious to horizontal graticule center.

15b. (cont'd)

Change the TYPE 3L5 VOLTS/CM to .005 and the TYPE 184 to 1mS markers. Change the TYPE 3L5 DISPERSION Hz/DIV to 1k and uncouple RESOLUTION to 100. Adjust L164 for 8 harmonic responses of the 1mS markers to the left of the start spurious.

Cement the slug of L164 to the coil form after completion of 15c while observing TYPE 564 display to maintain 8kHz to left of start spurious.

c. Adjust L191

Move the start spurious to the left side of the graticule and adjust L191 for 1 marker/cm. Repeat the adjustments of L164 and L191 several times to eliminate interaction.

d. Adjust 2-3MHz Filter

Change CENTER FREQUENCY -Hz to 500k, DISPERSION Hz/DIV-COUPLED RESOLUTION to 100k. Change TYPE 184 to 10μSec markers.

Adjust R214 for best accuracy of harmonics displayed on TYPE 564. (A slight readjustment of L191 may be necessary.)

Adjust L194 for best linearity at graticule center.

If unable to make linearity, check setting of R156 (Step 16).

Repeat the adjustments of Steps b, c and d to eliminate interaction.

e. Check 0 and 00 decade sweeps

Change DISPERSION Hz/DIV to 1kHz, RESOLUTION uncoupled to 100. Change TYPE 184 to 1mS markers. Change CENTER FREQUENCY -Hz multiplier to 0 and 00 while checking to see if oscillator sweeps on lower decades.

If oscillator stops at lower decades, check that 0000Hz CAL, 5000Hz CF and R128 are at midrange.

Disconnect the TYPE 184.

16. CENTER FREQUENCY CAL

a. Setup

Connect a 500kHz signal from the LFSWG to TYPE 3L5 input. Set TYPE 3L5 DISPERSION Hz/DIV-COUPLED RESOLUTION to 200, set CENTER FREQUENCY -Hz to 500k. Connect a ground lead to Pin K of the Sweeper board.

16. (cont'd)

b. Adjust R156

Adjust R156 so that the signal is centered on the TYPE 564 CRT.

c. Select R108

With the TYPE 3B4 POSITION control set the trace for equal length to each side of graticule. Remove R108 and insert Ohms Picker in its place. Adjust Ohms Picker to place 500kHz signal over center graticule line with TYPE 3L5 CENTER FREQUENCY -Hz set to 500k and DISPERSION Hz/DIV set to 100k. Replace R108 with the value indicated by Ohms Picker.

d. Adjust 500 kHz CAL

Switch the TYPE 3L5 DISPERSION Hz/DIV to 1k and adjust the 500kHz CAL so the 500kHz signal remains in one place on TYPE 564 CRT as the TYPE 3L5 DISPERSION Hz/DIV is switched between 100k and 1k.

Disconnect LFSWG Generator.

e. Adjust R150

Connect 10μS markers from the TYPE 184 to TYPE 3L5 INPUT. Switch the TYPE 3L5 DISPERSION Hz/DIV to 100k and adjust R150 so the 10μS marks line up as near as possible with the graticule center line as the TYPE 3L5 CENTER FREQUENCY -Hz is switched between 100k and 900k.

f. Adjust 10 kHz CAL

Switch the TYPE 3L5 CENTER FREQUENCY -Hz to 50k and the DISPERSION Hz/DIV to 10k. Press the .1mS marker button on the TYPE 184 and adjust the 10kHz CAL so the 50kHz marker remains in one place on the CRT as the TYPE 3L5 DISPERSION Hz/DIV is switched between 10k and 500. Change the TYPE 184 to 10μS marks and repeat Steps 16d and 16f (do not change R150) until there is no interaction between the 500kHz and the 10kHz harmonics and the markers remain stationary on the CRT as the TYPE 3L5 DISPERSION Hz/DIV is switched between 100k and 500.

If there is insufficient range on the 10kHz CAL, recheck linearity as in Step 14c. If linearity is acceptable, R150 may need to be readjusted for greater range on 10kHz CAL control.

16g. (cont'd)

g. Compare 0k and k decade dispersion: ≤0.5 div difference

Set TYPE 3L5 CENTER FREQUENCY-Hz to 500k and DISPERSION Hz/DIV to 100k. Set the TYPE 184 for 10μS marks. Note the dispersion of the display.

Set TYPE 3L5 CENTER FREQUENCY-Hz to 30k, DISPERSION Hz/DIV to 1k with RESOLUTION UNCOUPLED to 100 and apply 1mS markers from the TYPE 184. If there is more than 0.5 division difference in dispersion between the 30k and 500k CENTER FREQUENCY-Hz settings, repeat Step 14 and Step 15.

17. K AND 0K DISPERSION

Set TYPE 3L5 CENTER FREQUENCY-Hz to 30k. Adjust 30kHz CF for one mark/div.

Disconnect TYPE 184 from TYPE 3L5.

18. 0K AND K CENTER FREQUENCY TRACKING

a. Setup

Connect LF Sine Wave Generator to TYPE 3L5 INPUT. Set LF Sine Wave Generator frequency to 500kHz. Set the TYPE 3L5 CENTER FREQUENCY-Hz to 500k and the DISPERSION Hz/DIV-COUPLED RESOLUTION to 100k. Readjust the LFSWG to center the signal on the graticule.

b. Check center frequency tracking
0k: within 10kHz +4%
k: within 3kHz +4%

Using the chart below, check TYPE 3L5 oscillator tracking from 950 kHz to 10 kHz as directed above.

18b. (cont'd)

TYPE 3L5 CENTER FREQUENCY-Hz	DISPERSION Hz/DIV	LF Sine Wave Generator	Max deviation between LF Sine Wave Generator and TYPE 3L5	
500k	10k	500 kHz	10 kHz +4%	(±30 kHz)
600k	10k	600 kHz	10 kHz +4%	(±34 kHz)
700k	10k	700 kHz	10 kHz +4%	(±38 kHz)
800k	10k	800 kHz	10 kHz +4%	(±42 kHz)
900k	10k	900 kHz	10 kHz +4%	(±46 kHz)
950k	10k	950 kHz	10 kHz +4%	(±48 kHz)
400k	10k	400 kHz	10 kHz +4%	(±26 kHz)
300k	10k	300 kHz	10 kHz +4%	(±22 kHz)
200k	10k	200 kHz	10 kHz +4%	(±18 kHz)
100k	10k	100 kHz	10 kHz +4%	(±14 kHz)
10k	1k	10 kHz	3 kHz +4%	(±3.4 kHz)
20k	1k	20 kHz	3 kHz +4%	(±3.8 kHz)
30k	1k	30 kHz	3 kHz +4%	(±4.2 kHz)
40k	1k	40 kHz	3 kHz +4%	(±4.6 kHz)
50k	1k	50 kHz	3 kHz +4%	(±5.0 kHz)
60k	1k	60 kHz	3 kHz +4%	(±5.4 kHz)
70k	1k	70 kHz	3 kHz +4%	(±5.8 kHz)
80k	1k	80 kHz	3 kHz +4%	(±6.2 kHz)
90k	1k	90 kHz	3 kHz +4%	(±6.6 kHz)
99k	1k	99 kHz	3 kHz +4%	(±6.96 kHz)

Disconnect the LF Sine Wave Generator.

19. K AND 0K DISPERSION ACCURACY AND LINEARITY

a. Setup

Reconnect the TYPE 184 and set for 10μS marks.

Set the TYPE 3L5 CENTER FREQUENCY-Hz to 500k. Set the DISPERSION Hz/DIV to 100k.

b. Check dispersion, k and 0k decades: accuracy, within ±14%, linearity, within ±2%

Use the following chart to check dispersion accuracy and linearity. Maximum dispersion error for the center 8cm is 1.1cm; maximum non-linearity within the center 8cm is 1.6mm.

19b. (cont'd)

TYPE 3L5 CENTER FREQUENCY	DISPERSION Hz/DIV	TYPE 184
500k	100k	10μS
100k thru 900k	10k	.1mS
100k thru 990k	1k	1mS
10k thru 99k	1k	1mS
50k	10k	.1mS
10k thru 99k	500	1mS

c. Check functioning of Units switching

Set TYPE 184 for 10μS markers and set TYPE 3L5 DISPERSION Hz/DIV to 10k. Check that the 10μS marker is within 1cm of the indicated position:

TYPE 3L5 CENTER FREQUENCY-Hz	position of 10μS mark from center graticule line
500k	center graticule line
510k	1cm left
520k	2cm left
530k	3cm left
540k	4cm left
550k	5cm left & 5cm right
560k	4cm right
570k	3cm right
580k	2cm right
590k	1cm right

Note: The marker should step approximately 1cm with each change in CENTER FREQUENCY-Hz.

Set TYPE 184 for .1mS markers and set the TYPE 1L5 DISPERSION Hz/DIV to 1k. Check that the .1mS marker is within 1cm of the indicated position:

TYPE 3L5 CENTER FREQUENCY-Hz	position of .1mSEC mark from graticule center
50k	center graticule line
51k	1cm left
52k	2cm left
53k	3cm left
54k	4cm left
55k	5cm left & 5cm right
56k	4cm right
57k	3cm right
58k	2cm right
59k	1cm right

Disconnect the TYPE 184 from the TYPE 3L5.

20. 0 AND 00 DECADE OSCILLATOR TRACKING

a. Setup

Connect LF Sine Wave Generator to TYPE 3L5 INPUT and set frequency to 5kHz. Set the TYPE 3L5 CENTER FREQUENCY-Hz to 0000 and the DISPERSION-Hz/DIV to 100. Change the input selector to GND and adjust the 0000Hz CAL for no shift of the start spurious while switching DISPERSION Hz/DIV between 1k and 100.

b. Adjust R128

Change the input selector switch to AC FAST and the CENTER FREQUENCY-Hz to 5000. Set the DISPERSION Hz/DIV to 100. Adjust R128 to position the 5kHz signal to the horizontal center graticule line.

Remove the LFSWG.

21. 0 AND 00 DECADE DISPERSION ADJ

a. Setup

Connect the TYPE 184 to the TYPE 1L5 INPUT. Set the TYPE 184 for 1mS marks. Set the TYPE 1L5 CENTER FREQUENCY-Hz to 5000 and the DISPERSION Hz/DIV to 1k.

b. ADJUST 5000 Hz CF

Adjust the 5000 Hz CF for one mark/cm. Disconnect the TYPE 184 from the TYPE 1L5 INPUT.

The adjustments of R128 and 5000 Hz CF interact. Repeat Steps 20 and 21 until this interaction is eliminated.

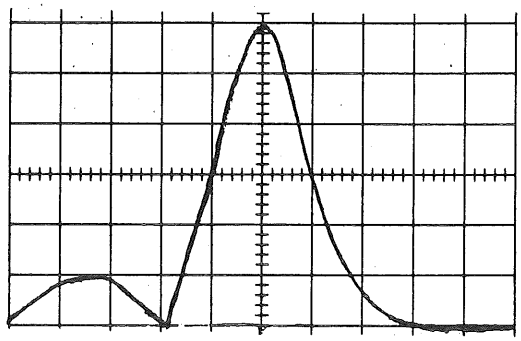
22. VARIABLE RESOLUTION AMPLIFIER

a. Setup

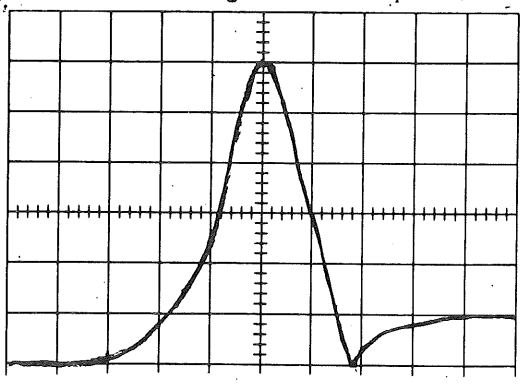
Connect the LF Sine Wave Generator to the TYPE 3L5 INPUT. Set the LF Sine Wave Generator to 5kHz. Set the TYPE 3L5 DISPERSION Hz/DIV switch to 500 and the RESOLUTION (uncoupled) to 100k.

b. Adjust skirt response (C323, C343)

Adjust C323 and C343 for minimum and equal skirt response (See adjoining waveforms).



Incorrect adjustment of C343



Incorrect adjustment of C323

22. (cont'd)

c. Adjust bandwidth (L327, L347): ≥500 Hz at 50% amplitude point

Adjust L327 and L347 for maximun bandwidth.

d. Readjust L280

Readjust L280 (previously adjusted in Step 14) for maximum amplitude. Recheck a, b, and c for interaction.

e. Adjust 10 Hz resolution bandwidth amplitude (C332, C352)

Set TYPE 3L5 DISPERSION Hz/DIV to 1k. Set TYPE 3B4 TIME/DIV to 20mSEC. Adjust the LF Sine Wave Generator frequency to 5kHz and amplitude for a 6cm display. Change the TYPE 3L5 DISPERSION Hz/DIV to 10. Change the LFSWG frequency as necessary to keep the signal at CRT center. Change the TYPE 3B4 TIME/DIV to 2 SEC. Adjust C332 and C352 for a 6cm display.

f. Check RESOLUTION Flatness: ±1dB

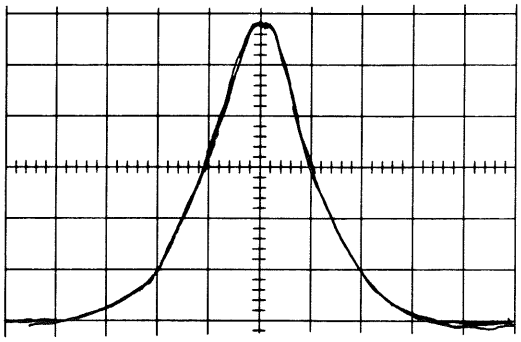
Change DISPERSION Hz/DIV to 1k. Adjust the LFSWG for 5cm display amplitude. Check each position of the DISPERSION Hz/DIV COUPLED RESOLUTION switch for a display amplitude of 4.5 to 5.6cm.

g. Check Maximum Resolution-Bandwidth: ≥500 Hz at 50% amplitude point

Set TYPE 3L5 DISPERSION to 500, RESOLUTION uncoupled to 100k. Set LF Sine Wave Generator amplitude for 6cm, TYPE 3B4 TIME/DIV to 20ms. Check displayed signal for ≥500 Hz width at 50% amplitude point.

h. Check Minimum Resolution-Bandwidth: ≤10 Hz at 50% amplitude point

Set TYPE 3L5 DISPERSION Hz/DIV-COUPLED RESOLUTION to 10, test scope TIME/CM to 1 SEC. Check displayed signal for ≤10 Hz width at 50% amplitude point.



Correct adjustment of C323 & C343

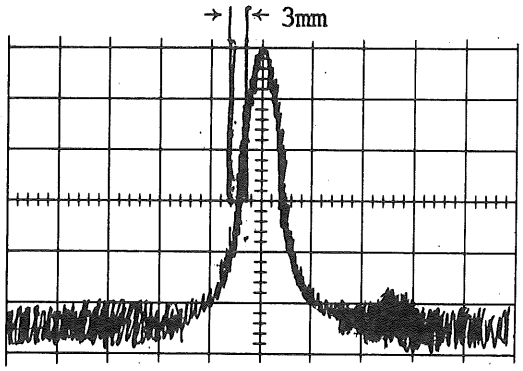
23. INCIDENTAL FM

a. Setup

Set the TYPE 3L5 as follows: CENTER FREQUENCY-Hz to 050, DISPERSION Hz/DIV to 10. Set the TYPE 3B4 TIME/DIV to 2 SEC. Connect the LF Sine Wave Generator to the TYPE 3L5 INPUT. Set the LF Sine Wave Generator to 50 Hz.

b. Check incidental FM, 50 Hz to 9900 Hz: ≤3Hz

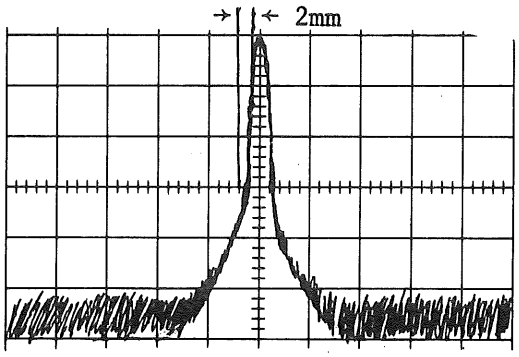
Set the amplitude of the LF Sine Wave Generator for 8cm of displayed 50 Hz signal and check for ≤3mm trace width at the center graticule line. Repeat this check at several frequencies from 50 Hz to 9900 Hz.



Disconnect the LF Sine Wave Generator from the TYPE 3L5 INPUT.

c. Check incidental FM, 10kHz to 990 kHz: ≤10 Hz

Connect the TYPE 184 to the TYPE 3L5 INPUT. Set the TYPE 3L5 CENTER FREQUENCY Hz to 10 kHz and DISPERSION Hz/DIV to 50. Set the TYPE 184 for 1mS markers. Adjust the TYPE 3L5 VOLTS/DIV and VARIABLE for 8cm of display on the CRT. Check for ≤2mm trace width at the center graticule line. Repeat at several frequencies from 9900 Hz to 1 MHz.



Disconnect the TYPE 184 from the TYPE 3L5 INPUT.

24. 0 AND 00 DECADE OSCILLATOR TRACKING ACCURACY

00 decade: within 100 Hz +4%
0 decade: within 50 Hz +4%

Set the TYPE 3L5 CENTER FREQUENCY-Hz to 9900 and the DISPERSION Hz/CM to 100. Adjust the LFSWG to center the signal on the graticule and check for ≤476 Hz (100Hz +4%) deviation from the CENTER FREQUENCY-Hz setting.

Check the oscillator tracking, using the following chart and following the above procedure:

24. (cont'd)

TYPE 3L5 CENTER FREQUENCY-Hz	DISPERSION Hz/DIV	Max deviation between LF Sine Wave Generator and TYPE 3L5
9900	100	476 Hz (100 Hz +4%)
9000	100	460 Hz (100 Hz +4%)
8000	100	420 Hz (100 Hz +4%)
7000	100	380 Hz (100 Hz +4%)
6000	100	340 Hz (100 Hz +4%)
5000	100	300 Ha (100 Hz +4%)
4000	100	260 Hzz (100 Hz +4%)
3000	100	220 Hz (100 Hz +4%)
2000	100	180 Hz (100 Hz +4%)
1000	100	140 Hz (100 Hz +4%)
990	50	89 Hz (50 Hz +4%)
900	50	86 Hz (50 Hz +4%)
800	50	82 Hz (50 Hz +4%)
700	50	78 Hz (50 Hz +4%)
600	50	74 Hz (50 Hz +4%)
500	50	70 Hz (50 Hz +4%)
400	50	66 Hz (50 Hz +4%)
300	50	62 Hz (50 Hz +4%)
200	20	58 Hz (50 Hz +4%)
100	20	54 Hz (50 Hz +4%)
50	10	50 Hz (50 Hz +4%)

Disconnect the LFSWG from the TYPE 3L5.

25. 0 AND 00 DECADES DISPERSION ACCURACY

a. Setup

Connect the TYPE 184 to the TYPE 3L5 INPUT.

b. Check 0 and 00 decade dispersion:
accuracy, within 10%
linearity, within 3%

Use the following chart to check the dispersion of the 0 and 00 decades. Maximum dispersion error for the center 8cm is 8mm; maximum non-linearity within the center 8cm is 2.4mm.

25b. (cont'd)

CENTER FREQUENCY-Hz	DISPERSION (UNCOUPLED) Hz/DIV	RESOLUTION	TYPE 184	TYPE 3B4 TIME/DIV
9000	200	50	5mS	.1 SEC
8000	100	50	10mS	.1 SEC
5000	1k	200	1mS	.1 SEC
5000	500	100	1mS	.1 SEC
5000	200	50	5mS	.1 SEC
5000	100	20	10mS	.1 SEC
5000	50	20	10mS	.1 SEC
9900	20	10	50mS	.5 SEC
7000	200	50	5mS	.1 SEC
4000	500	100	1mS	.1 SEC
2000	500	100	5mS	.1 SEC
1000	50	20	10mS	.1 SEC
1000	20	10	50mS	.5 SEC
500	100	20	10mS	.2 SEC
990	20	10	50mS	.5 SEC
990	10	10	.1 S	1 SEC
700	50	20	10mS	.2 SEC
300	50	20	10mS	.2 SEC
100	20	10	50mS	.5 SEC
50	10	10	.1 S	1 SEC
500	10	10	.1 S	1 SEC

26. 300kHz SPURIOUS RESPONSE (not necessary if using a precaled filter)

a. Setup

Connect the LFSWG to the TYPE 3L5 input. Set 3L5 CENTER FREQUENCY-Hz to 500k and DISPERSION Hz/DIV-COUPLED RESOLUTION to 100k. Remove the screws securing 3MHz Filter chassis. Turn chassis over so adjustment tool can be inserted in L270.

b. Adjust L270

Adjust LFSWG output and TYPE 3L5 VOLTS/CM so that the TYPE 3L5 is overdriven. A signal at 3cm from left edge of graticule will be present - adjust L270 for minimum display amplitude of this signal.

26. (cont'd)

c. Adjust 3MHz Filter

Reduce LFSWG amplitude and adjust C257, C252, C262, C267 and L280 for maximum amplitude of the 500kHz signal displayed on the TYPE 564.

27. LOG GAIN

a. Setup

Connect the LFSWG to the TYPE 3L5 INPUT through three 5:1 attenuators, a 2.5:1 attenuator and a 50Ω termination. Set the TYPE 3L5 as follows: VERTICAL DISPLAY to LOG, CENTER FREQUENCY-Hz to 5000, DISPERSION Hz/DIV to 10 and VOLTS/DIV to .005. Set the INPUT Selector switch to GRD and position the top edge of the trace to the bottom line of the graticule.

The setting of R428 will effect the adjustment of LOG gain.

If unable to make LOG gain, recheck vertical trace shift adjust, R428 (Step 10).

Also, selection of R418 may be necessary to increase LOG gain range.

Change the INPUT Selector back to AC, DISPERSION Hz/CM to 1k and RESOLUTION (uncoupled) to 50. Set the LFSWG to 5kHz and adjust its amplitude for a 2-3cm display on the TYPE 564.

Switch the TYPE 3B4 TIME/DIV to EXT INPUT. Switch the TYPE 3L5 SWEEP MODE to MANUAL and rotate the MANUAL knob cw from 0 toward 10. As the MANUAL knob is rotated it will cause the beam to rise and fall. Position the knob to set the beam to the peak of the second rise. Adjust the LFSWG AMPLITUDE so the beam is 1cm above the bottom graticule line.

Remove all four attenuators and reconnect the LFSWG through the 50Ω Termination to the TYPE 3L5.

b. Adjust Log Gain R422: ≥50dB above 1.3cm

Adjust R422 for a display amplitude of 7.4 to 8.0 div with the attenuators removed. Reinstall the four attenuators and readjust the LFSWG for 1.3 div of display amplitude. Remove the attenuators and readjust R422 for 7.4cm of display amplitude. Repeat until there is 7.4 to 8.0 div signal without the attenuators and 1.3 div of signal with attenuators.

28. LIN CAL, TO RECORDER OUTPUT

a. Setup

Set TYPE 3B4 TIME/DIV to 1mSEC. Set TYPE 3L5 VERTICAL DISPLAY to LIN. Connect the LF Sine Wave Generator to the TYPE 3L5 INPUT and the TYPE 1A1 as shown below:

LF Sine Wave Generator -- BNC cable -- 50Ω term -- BNC T -- BNC cable -- TYPE 3L5 INPUT
BNC T -- BNC cable -- TYPE 1A1 INPUT

Set the LF Sine Wave Generator AMPLITUDE control for 98mV P-P displayed on the test scope. Connect the 600 ohm load cable from the TYPE 3L5 TO RECORDER to the TYPE 1A1 INPUT. Remove R432 and install the Ohms Picker in its place.

b. Adjust Lin Cal R316; check TO RECORDER output

Adjust R316 for 8mV P-P displayed on the test scope.

R316 is located on a bracket near the front of the Variable Resolution board.

c. Pick R432

Adjust the Ohms Picker for a 7 div display on the TYPE 564. Read off the Ohms Picker the size of the resistor needed and install it in the place of the Ohms Picker.

d. Check LIN accuracy: within ±2%

Check for 7 div of display on TYPE 564, readjusting R316 if necessary. Recheck 10 Hz Resolution amplitude.

Disconnect LF Sine Wave Generator from TYPE 3L5 INPUT and TYPE 1A1. Disconnect 600Ω load cable from TYPE 1A1 and TYPE 3L5 TO RECORDER.

29. BALANCED MIXER

zero frequency feedthrough: ≥1 div to ≤4 div

Set the TYPE 3L5 CENTER FREQUENCY-Hz to 000. Adjust R85 and C86 for ≥1cm to ≤4cm of zero frequency feedthrough.

R85, C86 and C87 are at the rear of the Input Amplifier board. It may be necessary to reverse the leads to T80 and T90 to minimize spurious response.

Select C87 for proper amplitude if necessary.

30. INTERMODULATION DISTORTION

a. Setup

Set TYPE 3L5 CENTER FREQUENCY to 500k, VERTICAL DISPLAY to LOG, VOLTS/CM to .005 (inner scale), DISPERSION Hz/CM to 10k, uncoupled RESOLUTION to 50. Set the TYPE 3B4 TIME/DIV to .2SEC. Connect the TYPE 3L5 to two Generators (either TYPE 191 or LF Sine Wave Generator) as shown below:

LFSWG -- 10:1 atten -- 10:1 atten -- BNC cable --
TYPE 191 -- 10:1 atten -- 10:1 atten -- BNC cable --
BNC T -- 5:1 atten -- 5:1 atten -- 5:1 atten -- 2.5:1 atten -- 50Ω term -- TYPE 3L5 INPUT

b. Set reference amplitude

Set one of the Generators to 500kHz and the other to 520kHz. Adjust the Generator Amplitude controls so that each signal has a display amplitude of 1.3cm.

c. Check intermodulation distortion: ≥50dB down

Remove all three 5:1 attenuators and the 2.5:1 attenuator. Connect the BNC T to the 50Ω termination. The 500kHz and 520kHz signals now should be 7.4 div to 8 div in amplitude. Check that the amplitude of any other signal present is ≤1.3 div.

If the TYPE 3L5 does not satisfy this requirement, readjust Log Cal (Step 27) and Lin Cal (Step 28).

Disconnect the cables and signal generators from the TYPE 3L5.

31. RANDOM SPURIOUS RESPONSES

a. Setup

Change the TYPE 3L5 VERTICAL DISPLAY to LOG, DISPERSION Hz/DIV to 100k, CENTER FREQUENCY to 500k. Set the RESOLUTION to 50. Connect a 500kHz signal from the LF Sine Wave Generator through three 5:1 attenuators, a 2.5:1 attenuator, and a 50Ω termination to the TYPE 3L5 INPUT. Set the TYPE 3B4 TIME/DIV to 2 SEC.

31. (cont'd)

b. Check random spurious responses: ≥50dB down

Adjust the LF Sine Wave Generator amplitude for 1.3 div of displayed signal on plug-in scope. (Adjustment of TYPE 3L5 VOLTS/DIV may be necessary.) Remove attenuators (leave 50Ω termination connected). Disregarding start spurii and the fundamental and its harmonics, check for no more than 1.3 divisions amplitude for any spurious responses.

If any spurious response is greater than 1.3cm, readjust L270 (Step 26).

If the spurious response at approximately 960kHz is more than 2X noise, adjust T290 (Step 14b). Noise is amount of trace shift when RESOLUTION is switched from 10 to 1k.

32. HIGH FREQUENCY COMPENSATION

a. Setup

Insert the TYPE 3L5 in the right (HORIZONTAL) compartment of the TYPE 564 and the 3B4 in the left (VERTICAL) compartment of the TYPE 564. Connect the TYPE 106 HI AMPLITUDE OUTPUT to the TYPE 3L5 INPUT as shown:

TYPE 106 -- BNC cable -- 2.5:1 atten -- 50Ω termination -- TYPE 3L5

Set the TYPE 3L5 as follows:

÷100	Pulled out
VOLTS/DIV	.5 (outer scale)
VERTICAL DISPLAY	VIDEO

Set the TYPE 106 as follows:

HI AMPLITUDE FAST RISE	HI AMPLITUDE
REPETITION RATE RANGE	10kHz
MULTIPLIER	5
AMPLITUDE	for 6cm displayed signal

Set the TYPE 3B4 as follows:

TIME/DIV	5μSEC
LEVEL	adjusted for a stable display

b. Adjust High Frequency Compensation (C491, C481)

Adjust C491 and C481 for no roll off and no more than 10% overshoot on front corner. Transpose the TYPE 3L5 and TYPE 3B4

32b. (cont'd)

Plug-in Units. Remove the TYPE 106 from TYPE 3L5 INPUT. Connect the LF Sine Wave Generator to the TYPE 3L5 INPUT.

c. Check Bandwidth: ≤3dB down at 1MHz

Set LF Sine Wave Generator for 5cm of 5kHz displayed on TYPE 564. Set LF Sine Wave Generator to 1MHz and check for ≥3.5cm of vertical deflection. If TYPE 3L5 does not make bandwidth, readjust high frequency compensation.

33. DISPLAY FLATNESS 10Hz to 1MHz

.005 VOLTS/DIV through 2 VOLTS/DIV: ±0.5dB
.001 and .002 VOLTS/DIV: +0.5dB - 3dB

a. Setup

With TYPE 3L5 installed in TYPE 564 vertical plug-in box, set 3L5 controls as follows: VERTICAL DISPLAY to LIN, CENTER FREQUENCY-Hz to 5000, DISPERSION Hz/DIV-COUPLED RESOLUTION to 1k, VOLTS/DIV to .005 and ÷100 pulled out. Set TYPE 3B4 TIME/DIV to 20mSEC.

Connect the LF Sine Wave Generator to the TYPE 3L5 INPUT through three 10:1 attenuators and a 50Ω termination. Set LF Sine Wave Generator to 5kHz and adjust its amplitude for 5cm of display.

Monitor output of the LF Sine Wave Generator with test scope for constant amplitude on all frequency settings, referenced to a 5cm display on the TYPE 564 at 5kHz. Whenever frequency or amplitude of the LF Sine Wave Generator must be changed, reference back to a 5cm 5kHz display for monitoring of constant amplitude.

b. Select C44 - .005 VOLTS/DIV, ÷100 out: ±.5dB at 1MHz

Change LF Sine Wave Generator to 1MHz, and check for constant amplitude on test scope. Set TYPE 3L5 CENTER FREQUENCY-Hz to 990k, bring the signal on the screen with VARIABLE.

Select C44 for 5cm of display.

NOTE: It may be necessary to change the DISPERSION Hz/DIV to 10k in order to center the signal. Be sure to return the DISPERSION Hz/DIV to 1k.

33. (cont'd)

c. Adjust input compensation (C15, C13)

Set TYPE 3L5 CENTER FREQUENCY-Hz to 5000 and push in ÷100 switch. Change LF Sine Wave Generator to 5kHz and adjust amplitude for 5cm display on TYPE 564. Change the LF Sine Wave Generator frequency to 1MHz while monitoring constant amplitude on test scope. Change TYPE 3L5 CENTER FREQUENCY-Hz to 990k and bring signal on screen with the VARIABLE.

Adjust C15 of the ÷100 attenuator for 5cm display on TYPE 564. Pull out on the ÷100 switch, change VOLTS/CM to .01 and repeat the above procedure to adjust C13.

d. Check 50kHz-1MHz flatness - .005 VOLTS/DIV, ÷100 in: ±0.5dB

Check at 50kHz, 500kHz, and 990kHz for ±0.5dB flatness (4.7cm to 5.3cm).

e. Check 50kHz-1MHz flatness - .01 VOLTS/DIV to 2 VOLTS/DIV, ÷100 in and out: ±0.5dB

Check each setting of the TYPE 3L5 VOLTS/DIV from .01 through 2 for ±0.5dB flatness (4.7cm to 5.3cm) at 50kHz, 500kHz, and 990kHz.

Repeat this check with ÷100 pulled out.

f. Check 50kHz-1Mhz flatness - .001 and .002 VOLTS/DIV, ÷100 in and out: +0.5, -3dB

Check the .001 and .002 VOLTS/DIV settings at 50kHz, 500kHz, and 990kHz for a display flatness of +0.5dB, -3dB (3.5cm to 5.3cm).

Repeat this check with ÷100 pushed in.

g. Check low frequency (10Hz) flatness, .005 VOLTS/DIV, ÷100 in and out: ±.5dB

Set TYPE 3L5 CENTER FREQUENCY-Hz to 5000, DISPERSION Hz/DIV to 10, AC-GND-AC FAST to Ac, VOLTS/DIV to .005 and ÷100 pushed in. Set LF Sine Wave Generator to 5kHz and adjust amplitude for 5cm display on TYPE 564. Change LF Sine Wave Generator frequency to 50Hz, monitoring constant amplitude with test scope. Change TYPE 3L5 CENTER FREQUENCY-Hz to 050 and check for 5cm ±.5dB (4.7cm to 5.3cm) of 50Hz signal.

Repeat above check with ÷100 pulled out.

The following caps may be adjusted slightly to make flatness on these ranges of the VOLTS/DIV switch:

.01	C8C
.02	C9C
.05, .1, .2	C4C
.5, 1, 2	C5C

C41 on the .001 range and C40 on the .002 range may be padded with another cap, if necessary, to make flatness.

34. INPUT AMPLIFIER

a. Setup

Set TYPE 3L5 VERTICAL DISPLAY to VIDEO. Connect LF Sine Wave Generator to TYPE 3L5 and TYPE 1A1 as shown below:

LF Sine Wave Generator -- 50Ω term --
BNC T - 50Ω cable -- TYPE 3L5 INPUT
50Ω cable -- TYPE 1A1 INPUS

b. Check input amplifier frequency response at .1 and .2 VOLTS/DIV: +.5dB -3dB from 10Hz to 700kHz

Set LF Sine Wave Generator frequency to 5kHz. Set TYPE 3L5 VOLTS/DIV to .1 (outer scale). Adjust the LF Sine Wave Generator for 5cm of displayed signal. Note amplitude on test scope.

Change LF Sine Wave Generator frequency to 10Hz. Check test scope display for same amplitude as at 5kHz. Check TYPE 564 display for 3.5cm to 5.3cm of 10Hz signal.

Change LF Sine Wave Generator frequency to 700kHz, again checking display on test scope for constant amplitude. Check TYPE 564 display for 3.5cm to 5.3cm of 700kHz signal.

Set TYPE 3L5 VOLTS/DIV to .2. Set LF Sine Wave Generator frequency to 5kHz, increase the LF Sine Wave Generator amplitude control for a 5cm display and repeat above procedure.

c. Check input amplifier frequency response at .5 VOLTS/DIV: ±0.5dB from 10Hz to 1MHz

Set TYPE 3L5 VOLTS/DIV to .5. Set the LF Sine Wave Generator frequency to 5kHz. Adjust the LF Sine Wave Generator amplitude control for 5cm of displayed signal on TYPE 564. Note amplitude displayed on the test scope.

Change the LF Sine Wave Generator frequency to 10Hz. Check test scope display for a constant amplitude out of the LF Sine Wave Generator. Check TYPE 564 display for 4.7 cm to 5.3cm of 10Hz signal.

b. Change the TYPE 1A1 VOLTS/CM as necessary to get a displayed signal on test scope as the TYPE 3L5 VOLTS/DIV is changed.

If the signal displayed on the test scope changes in amplitude as the signal frequency is changed from 5kHz to 10Hz to 700Hz, readjust the LF Sine Wave Generator amplitude control for the same amplitude as at 5kHz.

34c. (cont'd)

Change the LF Sine Wave Generator frequency to 1MHz, monitoring test scope for constant amplitude. Check TYPE 564 display for 4.7cm to 5.3cm of 1MHz signal.

Disconnect the signal cable from the TYPE 3L5 INPUT.

35. CALIBRATOR

a. Adjust Calibrator frequency (R502): 5kHz ±0.5%

Set the TYPE 3B4 TIME/DIV to .2mSEC. Set the TYPE 3L5 VOLTS/DIV to CALIBRATE and VERTICAL DISPLAY to VIDEO. Adjust R502 for 1 mark/cm.

Change the TYPE 3B4 TRIGGER SOURCE to EXT and apply 1mSEC markers to its EXT INPUT. Readjust R502 for minimum drift of the Calibrator display across the graticule.

Disconnect the TYPE 184 from the TYPE 3L5.

b. Adjust Calibrator Amplitude (R522): 4cm

Set the TYPE 3L5 CENTER FREQUENCY-Hz to 5000, VERTICAL DISPLAY to LIN, and DISPERSION Hz/DIV to 1k. Set the TYPE 3B4 TIME/DIV to 50mSEC. Adjust R522 for 4cm display amplitude.

36. VARIABLE CENTER FREQUENCY-Hz

a. Setup

Set the TYPE 3L5 CENTER FREQUENCY-Hz to 990k and the DISPERSION Hz/DIV to 10k. Set the TYPE 3B4 TIME/DIV to 10mSEC. Set the TYPE 184 MARKER SELECTOR for .1ms markers.

b. Check VARIABLE CENTER FREQUENCY ≥10kHz

Rotate the VARIABLE CENTER FREQUENCY-Hz cw and check display on CRT to see that it moves to the left ≥1cm.

Disconnect the TYPE 184 from the TYPE 3L5.

37. OSC OUT

Must sweep ≥1MHz at ≥1.2V in amplitude

Set TYPE 3L5 CENTER FREQUENCY-Hz to 000k, DISPERSION Hz/DIV-COUPLED RESOLUTION to 10. Connect 10X probe from OSC OUT to TYPE 1A1 INPUT 1 and set TYPE 1A1 VOLTS/CM to .1. Check signal displayed on test scope for a ≥3MHz sine-wave, ≥1.2 volt in amplitude. Set TYPE 3L5 CENTER FREQUENCY-Hz to 990k, VARIABLE CENTER FREQUENCY cw. Check displayed signal on test scope for ≤2MHz sine-wave, ≥1.2V in amplitude.

Return CENTER FREQUENCY-Hz to 990k-CAL. Rotate TYPE 3L5 SWEEP cw and check test scope display for ≤2MHz sine wave.

38. VARIABLE DISPERSION

Set TYPE 3L5 CENTER FREQUENCY-Hz to 500k, DISPERSION Hz/DIV to 100k. Connect the 10X probe to Pin F of sweeper board. Check for a sawtooth waveform on test scope of approximately 1V in amplitude. Rotate VARIABLE DISPERSION ccw; check that sawtooth decreases in amplitude to approximately 0.

39. MANUAL SWEEP MODE

a. Setup

Connect the test scope 10X probe to TYPE 3L5 MANUAL OUT and ground. Set TYPE 3L5 SWEEP to 0.

b. Check MANUAL SWEEP MODE
Range: 0 to 70 volts approx

Turn the TYPE 3L5 SWEEP MANUAL control cw. Check for a voltage range of approximately 0 to 70 volts.

40. NOISE LEVEL

a. Setup

Set the TYPE 3L5 CENTER FREQUENCY-Hz to 500k, DISPERSION Hz/DIV to 100k, VERTICAL DISPLAY to LIN, VOLTS/DIV to .001, and V/DIV ÷100 PULL out.

b. Check noise level ≤5 volts

Check the trace width for ≤0.5cm of noise.

41. TRIGGER TAKE-OFF

a. Setup

Connect the HI AMPLITUDE OUTPUT of the TYPE 106 to the TYPE 3L5 INPUT through a 10:1 attenuator and a 50Ω termination. Set the TYPE 3L5 VERTICAL DISPLAY to VIDEO and VOLTS/DIV to .5 (outer scale), ÷100 pushed in.

Connect the test scope 10X probe to Pin BJ or BK of the Output Amplifier board. Set the test scope VOLTS/CM to .5.

b. Check trigger takeoff:
Amplitude: ≥1:7.4
Risetime: ≤0.8μs

Adjust the TYPE 106 for 3.7cm of 1kHz signal on the test scope display. Move the probe to Pin BG (trigger pickoff) Check test scope display for ≥0.5cm amplitude.

Adjust the VOLTS/CM controls of the test scope for a 5cm display and check for a risetime of ≤0.8μs.

3L5 BLOCK DIAGRAM DISCUSSION

TIME vs. FREQUENCY DOMAIN:

On the standard oscilloscope, amplitude (plotted in the vertical direction) is graphically displayed against time (plotted in the horizontal direction) thus the display represents the amplitude of the phenomenon and the changes in amplitude for all, or any part, of the time during which it occurs.

In a spectrum analyzer display, amplitude is still plotted in the vertical direction, however, it is not plotted against time. The horizontal axis of a spectrum analyzer display represents frequency rather than time. Each individual point along the horizontal axis represents one particular frequency. The window (total range of frequencies, from the lowest on the left of the display to the highest on the right for the TYPE 3L5) as well as the dispersion (amount of frequency change from one graticule line to the next) are determined by the front panel controls of the spectrum analyzer.

OPERATION IN VIDEO: (refer to TYPE 3L5 Functional Block Diagram)

Regardless of the kind of signal applied to the front panel jack or the position of the VERTICAL DISPLAY switch, the function of the INPUT ATTENUATOR and the INPUT AMPLIFIER are the same as any other vertical plug-in in general concept. The INPUT AMPLIFIER is AC coupled and has a bandwidth of approximately 10Hz to 1MHz. With the VERTICAL DISPLAY switch in the VIDEO position, the output of the INPUT AMPLIFIER is fed directly to the OUTPUT BUFFER (bypassing the rest of the analyzer) and into the vertical of the plug-in scope.

The VARIABLE (VOLTS/CM) is a variable gain control as in any vertical plug-in.

The POSITION control applies a DC offset voltage to the OUTPUT AMPLIFIER to shift the DC operating point of the amplifier.

The INPUT ATTENUATOR compensation is initially adjusted for a square wave with square corners, but may need to be readjusted when checking flatness of frequency response. Square wave response serves as a very good preset but is not the final determinant because VIDEO operation is a convenience and not a requirement of spectral analysis.

OPERATION IN LIN: (Refer to TYPE 3L5 Functional Block Diagram)

The INPUT ATTENUATOR and INPUT AMPLIFIER serve the same purpose as they did in the VIDEO mode of operation. However, the signal no longer bypasses the superhet portion of the plug-in.

The 1st IF MIXER heterodynes the incoming signal with the output of the SWEPT FREQUENCY GENERATOR to produce a 3MHz intermediate frequency.

OPERATION IN LIN: (cont'd)

Heterodyning will produce four frequencies in the output of the mixer. They are: (1) the original input frequency, (2) the original local oscillator frequency, (3) the sum frequency, and (4) the difference frequency. We are interested in the sum frequency, but only when it is 3MHz.

The adjustment of R85 (Mixer Bal) and C86, as well as the selection of C87, is for the proper amplitude of the start spurious. The start spurious is caused by feedthrough of the SWEPT FREQUENCY GENERATOR when its frequency matches that of the 1st IF. (3MHz).

NOTE: For explanation of SWEPT FREQUENCY GENERATOR, DISPERSION SWITCHING and CENTER FREQUENCY SWITCHING, refer to TYPE 3L5 Swept Frequency Generator Diagram.

The purpose of the SWEPT FREQUENCY GENERATOR is primarily that of tuning. As the SWEPT FREQUENCY GENERATOR changes in frequency, at a rate proportional to the rate of the CRT trace, it will require a different input signal frequency for each instantaneous frequency of the generator to produce the desired 3MHz IF. Keeping in mind that the only usable output of the 1st IF MIXER is 3MHz, it is apparent that only when the incoming signal frequency and the swept generator frequency will add for a 3MHz IF will the conditions be right to cause a vertical deflection on the CRT. The amount of deflection will be proportional to the amplitude of the incoming signal and its horizontal location will be proportional to the incoming signal frequency.

To maintain a constant relationship between the amplitude of the 3MHz IF signal and the amplitude of the incoming signal, the SWEPT FREQUENCY GENERATOR must maintain a constant amplitude over its entire range of frequencies. The AMPLITUDE REGULATOR in the feedback path of the SWEPT FREQUENCY AMPLIFIER controls the gain of the amplifier to hold the power output of the generator constant. R214 (Osc Amp) provides a DC reference to determine the amount of the amplitude regulated output.

To maintain a constant relationship between the horizontal location of the trace and the frequency of the SWEPT FREQUENCY GENERATOR, the generator must change in frequency at a rate consistent with the sweep rate of the plug-in scope. Therefore, in the primary mode of operation, the plug-in scope's sweep is used to control the frequency of the SWEPT FREQUENCY GENERATOR. This is accomplished through the SWEEP MODE and DISPERSION SWITCHING.

In the INT position of the SWEEP MODE switch, the sweep sawtooth of the plug-in scope is picked off at Pin 18 of J11 (the 24 pin connector at the rear of the plug-in compartment).

In the MANUAL mode, the sweep sawtooth voltage is replaced by a "pot" (R103, MANUAL) which will deliver DC voltages corresponding to any instantaneous level of the sawtooth. When operating in MANUAL it is advisable to connect the MANUAL OUTPUT to the EXT HORIZ input of the plug-in scope and place the scope's HORIZONTAL DISPLAY switch to EXT HORIZ. This drives the trace horizontally with the MANUAL OUTPUT so that the frequency of the displayed signal and the horizontal location of the display will maintain the fixed relationship necessary to make meaningful measurements.

OPERATION IN LIN: (cont'd)

The DISPERSION circuit determines how much of the control voltage applied through the SWEEP MODE will be used. This in turn determines how large a portion of the total frequency range of the oscillator will be used.

The following chart gives examples of how the dispersion determines the amount of frequency change of the SWEPT FREQUENCY GENERATOR:

DISPERSION SETTING	TOTAL CHANGE OF OSCILLATOR FREQUENCY
100 kHz/cm	1 MHz
10 kHz/cm	100 kHz
1 kHz/cm	10 kHz
500 Hz/cm	5 kHz
200 Hz/cm	2 kHz
100 Hz/cm	1 kHz
50 Hz/cm	500 Hz
20 Hz/cm	200 Hz
10 Hz/cm	100 Hz

The total range of frequencies out of the SWEPT FREQUENCY GENERATOR is from 3MHz to 2MHz. In order for this to be a linear change it is necessary to modify the slope of the sawtooth applied through the DISPERSION circuit to match the requirements of the frequency determining components in the oscillator. The following is a list of the adjustments which determine the amount and type of this modification:

R110, 30 kHz CF 1 kHz/cm CAL - partially determines the total amount of attenuation.

R114, 5000 Hz CF 1 kHz/cm CAL - partially determines the total amount of attenuation. When the CENTER FREQUENCY multiplier switch is in either the K or OK position, R114 is out of the circuit.

R113, VARIABLE - when not in detent uncalibrates the dispersion, and can be used to obtain dispersions of various width.

The CENTER FREQUENCY-Hz determines the particular point in the total, 3MHz-2MHz, range of frequencies chosen as the center around which the DISPERSION will cause the frequency to change. The DISPERSION determines how large a window will be viewed while the CENTER FREQUENCY determines where this window will be located in the total frequency range of the instrument.

The CENTER FREQUENCY is nothing more than a DC reference for the modified sawtooth from the DISPERSION circuit. The modified sawtooth and the CENTER FREQUENCY reference voltage are fed to comparators which will position the ramp from the DISPERSION circuit to the DC reference determined by the CENTER FREQUENCY controls.

There are adjustments to match the switchable DC reference of the CENTER FREQUENCY control to the requirements of the oscillator. They are: (1) R239, 500 kHz (CAL); (2) R232, 10 kHz (CAL); (3) R150; and (4) R128.

OPERATION IN LIN: (cont'd)

When the CENTER FREQUENCY MULTIPLIER is in the lower decade (0 or 00 as the last digits of the dial), R120, 0000 Hz CF CAL adjusts the DC offset voltage of the feedback through the Hz DISCRIMINATOR. When the CENTER FREQUENCY MULTIPLIER is in the upper decade (K or OK as the last digits of the dial), R156, 500 kHz Center Frequency Bal is the DC offset adjust for feedback through the kHz DISCRIMINATOR.

The purpose of both discriminators is to convert the change in frequency out of the oscillator into a changing voltage used in the comparators to modify the slope of the ramp to the exact slope required to maintain a linear change in frequency of the oscillator. For example, if the ramp out of the comparators was of a slope that would cause a nonlinear frequency change in the oscillator, the output of the discriminators would be such as to change the slope of the ramp by the correct amount and in the proper direction to correct for the nonlinearity.

The adjustment of L164 in the oscillator tank circuit and the tuning of the 3MHz FILTER are made for constant power output over the entire 1MHz frequency range of the oscillator.

The 1st IF AMPLIFIER amplifies the output of the 1st IF MIXER while the 3MHz BANDPASS FILTER passes only the 3MHz sum frequency. The 3MHz BANDPASS FILTER is adjusted for best selectivity and lowest attenuation of the 3MHz IF.

The 3.1MHz 2nd IF LOCAL OSCILLATOR is heterodyned with the 3MHz 1st IF in the 2nd IF mixer to produce a 100KHz 2nd IF which will be used in the VARIABLE RESOLUTION AMPLIFIER. Adjustment of T290 peaks the power of the 3.1MHz 2nd IF LOCAL OSCILLATOR at 3.1MHz while adjustment of L280 gives maximum gain to the 100kHz 2nd IF.

Tuned circuits in the VARIABLE RESOLUTION AMPLIFIER can discern slight frequency changes in the 100kHz IF to a degree determined by the setting of the COUPLED RESOLUTION switch. As the RESOLUTION knob is set to a smaller number, the VARIABLE RESOLUTION AMPLIFIER is able to discern more accurately a small change in frequency of the 100kHz IF. These slight changes in the 100kHz IF are caused by frequency changes in the input frequency of the 100 kHz IF by an amount less than the selectivity of the VARIABLE RESOLUTION AMPLIFIER with low resolution. Increasing the degree of resolution amounts to increasing the selectivity of the amplifier.

Capacitors C323, C332, C343 and C352 compensate for the loss of gain with an increase of selectivity. R316 LIN CAL adjusts the overall gain of the VARIABLE RESOLUTION AMPLIFIER.

The DRIVER AMPLIFIER amplifies the output of the VARIABLE RESOLUTION AMPLIFIER and passes it to the RECORDER DETECTOR and DETECTOR.

The RECORDER DETECTOR removes the 100kHz IF component and delivers the envelope to the TO RECORDER front panel connector.

OPERATION IN LIN: (cont'd)

The DETECTOR removes the IF component of the DRIVER AMPLIFIER output and delivers the envelope to the BUFFER AMP which offers a high impedance load to the DETECTOR while delivering a low impedance drive to the OUTPUT AMPLIFIER.

The OUTPUT AMPLIFIER matches the entire instrument to requirements of the plug in scope, while offering a means of adjusting the overall gain with the VIDEO CAL. The VIDEO CAL effects the gain of the overall instrument, therefore the LIN CAL and the LOG GAIN should be set after the VIDEO CAL.

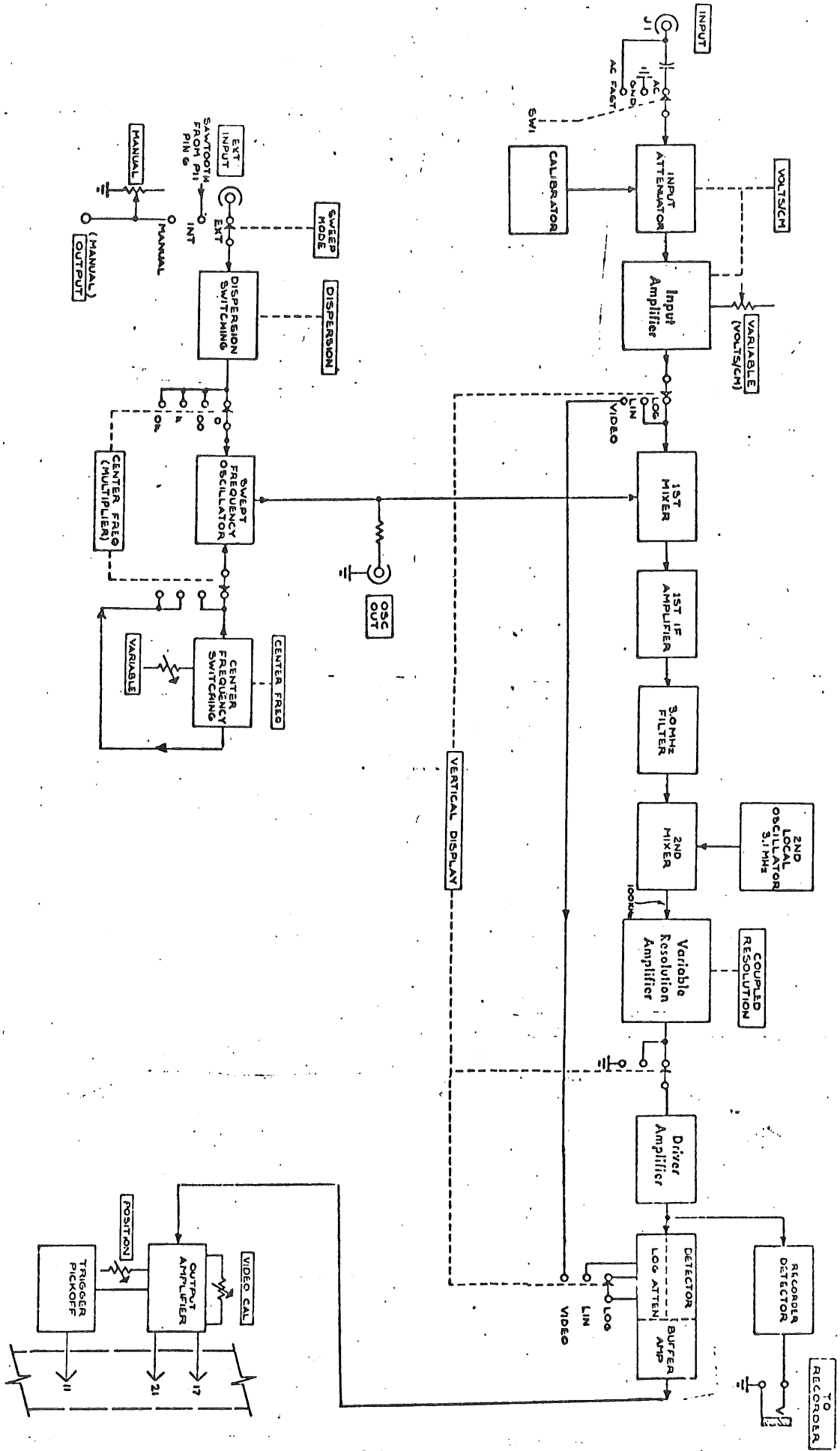
The POSITION control applies a DC offset voltage to the OUTPUT AMPLIFIER which shifts the DC operating point of the amplifier.

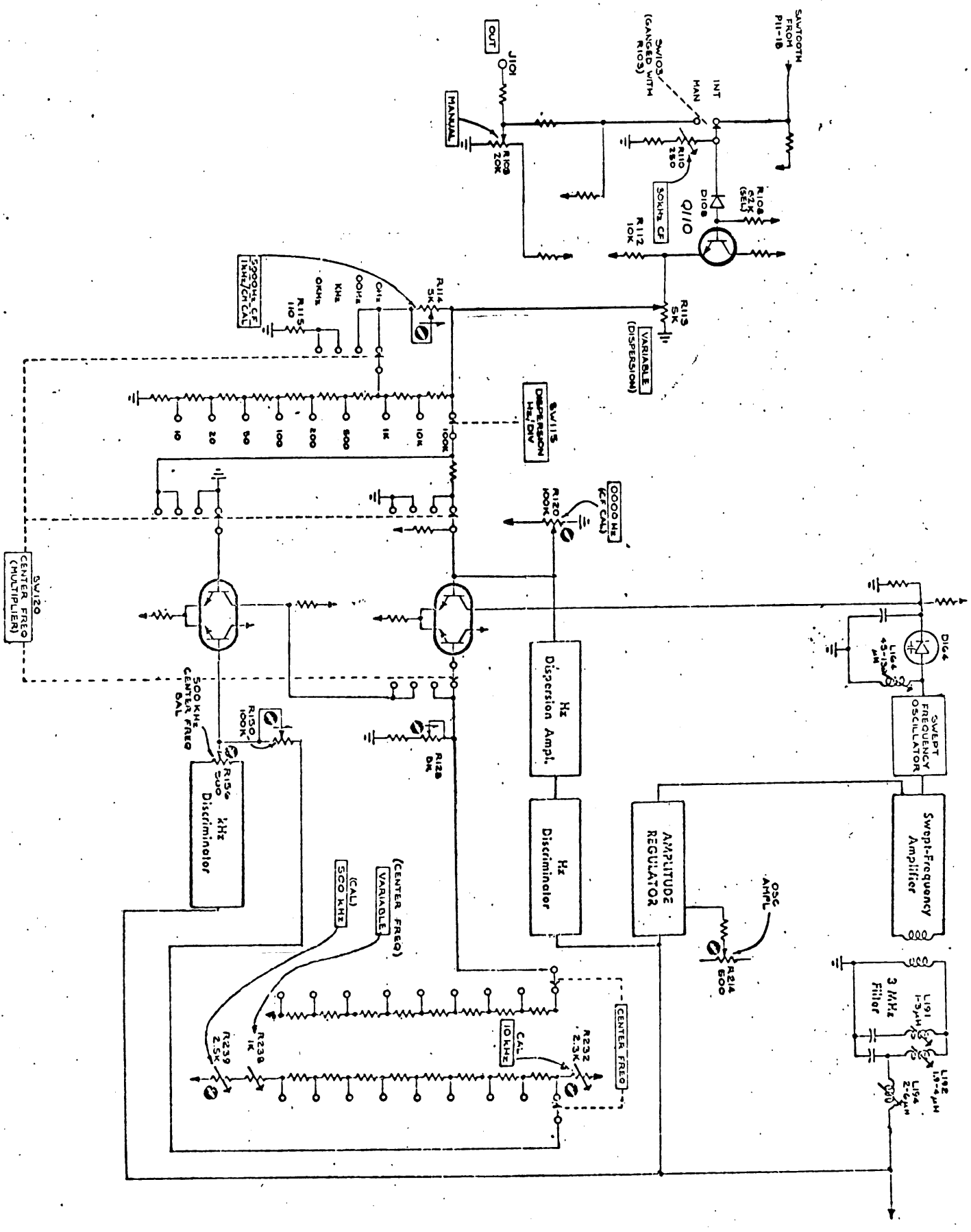
The TRIGGER PICKOFF provides a sample of the vertical signal to the horizontal plug in for internal triggering.

OPERATION IN LOG:

Operation in the LOG position of the VERTICAL DISPLAY switch is the same as in LIN with the following exceptions. The vertical display is no longer calibrated as it was in LIN. Low amplitude signals receive much more gain than do high amplitude signals. To accomplish this the signal out of the DETECTOR is fed to the OUTPUT BUFFER through a voltage variable attenuator. As the amplitude of the DETECTOR output increases, the attenuation increases, and as the DETECTOR output decreases, the attenuation decreases causing low amplitude signals to receive more gain than higher amplitude signals.

The Log Range Adj adjusts the total range of attenuation change of the LOG ATTENUATOR.


INPUT
J1
AC
GND
AC FAST
SW1
CALIBRATOR
INPUT ATTENUATOR
VOLTS/CM
Input Amplifier
VARIABLE (VOLTS/CM)
LOG
LIN
VIDEO
1ST MIXER
1ST IF AMPLIFIER
3.0MHz FILTER
2ND MIXER
2ND LOCAL OSCILLATOR 31.1MHz
100kHz
Variable Resolution Amplifier
COUPLED RESOLUTION
Driver Amplifier
DETECTOR LOG ATTEN
BUFFER AMP
LOG
LIN
VIDEO
RECORDER DETECTOR
TO RECORDER
VERTICAL DISPLAY
OSC OUT
SWEEP FREQUENCY OSCILLATOR
CENTER FREQ (MULTIPLIER)
CENTER FREQUENCY SWITCHING
VARIABLE
CENTER FREQ
DISPERSION SWITCHING
DISPERSION
SWEEP MODE
EXT INPUT
SAWTOOTH FROM P11 PIN 6
INT
EXT
MANUAL
(MANUAL) OUTPUT
POSITION
TRIGGER PICKOFF
OUTPUT AMPLIFIER
VIDEO CAL
11
21
17


SAWTOOTH FROM P11-1B
SW103 (GANGED WITH R103)
INT
MAN
OUT
J101
MANUAL
R108 20K
R110 250
R104 62K (SEL)
D108
Q110
50KHz CF
R112 10K
R113 5K
VARIABLE (DISPERSION)
5900MHz CF 1MHz/CM CAL
R114 5K
R115 110
OOHz
CMs
KHz
OKHz
SW115 DISPERSION Hz/DIV
10
20
50
100
200
500
1K
10K
100K
R120 100K
OOOOO Hz (CF CAL)
SW120 CENTER FREQ (MULTIPLIER)
D104
L104 4.5-13μH
SWEPT FREQUENCY OSCILLATOR
Hz Dispersion Ampl.
500 KHz CENTER FREQ CAL
R150 100K
R128 5K
R150a 500
1 KHz Discriminator
Hz Discriminator
AMPLITUDE REGULATOR
OSC AMPL
R214 500
Swept-Frequency Amplifier
3 MHz Filter
L191 1-3μH
L192 1.9-4μH
L194 2-6μH
(CENTER FREQ) VARIABLE
(CAL) 500 KHz
R238 1K
R239 2.5K
CAL 10 KHz
R232 2.3K
CENTER FREQ