

FACTORY CALIBRATION PROCEDURE

CONTENTS:

This is the guide for calibrating new instruments in Product Manufacturing. The procedure consists of 4 sections:

Equipment Required

Factory Test Limits - Factory Test Limits are limits an instrument must meet before leaving Manufacturing. These limits are often more stringent than advertised performance requirements. This is to insure that the instrument will meet advertised requirements after shipment, allows for individual differences in test equipment used, and (or) allows for changes in environmental conditions.

Short Form Procedure - The Short Form Procedure has the same sequence of steps and the same limits on checks or adjustments as the Main Procedure.

Main Procedure - The Main Procedure gives more detailed instructions for the calibration of the instrument. This procedure may require that some checks and adjustments be made so that performance is better than that required by the Factory Test Limits. This insures the Factory Test Limits will be met when side panels are added, permits some normal variation in test equipment and plug-in scopes, etc.

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100. Definitions of terms used in this procedure may be found in TEKTRONIX STANDARD A-101.

In this procedure, all front panel control labels and Tektronix instrument names are in capital letters (VOLT/DIV, etc). Internal adjustment labels are capitalized only (Gain Adj, etc).

CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 39-307. (HD)

*This procedure is
company confidential*

1L10

September 1968
For all serial
numbers.



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EQUIPMENT REQUIRED:

- A Needed to Calibrate Converter Filter Chassis (610-0147-00)
- B Needed to Calibrate Wide Band Amplifier Chassis (610-0146-00)
- C Needed to Calibrate Oscillator-Filter Chassis (610-0148-00)
- D Needed to Calibrate Oscillator Chassis (610-0151-00)
- E Needed to Calibrate Assembled TYPE 1L10 SPECTRUM ANALYZER

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

- DE 1 TYPE 546 OSCILLOSCOPE (Plug-in Scope)
- ABC 1 TYPE 564 OSCILLOSCOPE with
- ABC 1 TYPE 2B67 TIME BASE UNIT and
- ABC 1 TYPE 3L10 (Modified according to dwg #1780C)
- CE 1 TYPE 546 OSCILLOSCOPE with
- CE 1 TYPE 1A1 PLUG-IN UNIT and
- CE 1 TYPE P6006 X10 PROBE and
- CE 1 TYPE P6011 X1 PROBE (Test Scope)
- D 1 TYPE 191 CONSTANT AMPLITUDE GENERATOR
- DE *1 TYPE 184 TIME MARK GENERATOR
- E 1 TYPE 106 SQUARE WAVE GENERATOR
- D 1 TYPE 1L10 (Modified according to dwg #1780C)

b. Test Fixtures and Accessories

- DE 1 Harmonic Modulator (067--518-00)
- C 1 Calibration Fixture (067-0543-99)
- AC 2 Selectro to BNC female cables (175-0314-00)
- ABC 1 Plug-in extension cable for 560 series (012-0064-00)
- ABCDE 4 50 Ω BNC cables
- ABCDE 1 50 Ω BNC Terminator
- ABCDE 1 BNC "T" connector
- E 1 50 Ω BNC X10 Attenuator (011-0059-00)
- E 1 600 Ω terminated cable for the TO RECORDER jack (PMPE Dwg #1439A)
- C 1 Selectro cable (175-0423-00) terminated with a 330 Ω resistor (301-331-00)
- A 1 Converter Filter chassis cover
- DE 1 Plug-in extension cable for 540 series

c. Other Equipment

- E 1 20,000 Ω /V Multimeter (Simpson 262 or equivalent)
- ABE *1 Hewlett-Packard 608D UHF signal Generator
- E *1 Hewlett-Packard 355C UHF Attenuator
- E *1 Hewlett-Packard 355D UHF Attenuator
- E 1 Hewlett-Packard 241A Oscillator
- E 1 Kronhite 440A Oscillator

* This equipment must be traceable to NBS for certification of measurement characteristics.

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.

FACTORY TEST LIMITS

Factory Test Limits are qualified by the conditions specified in the main body of the Factory Calibration Procedure. The numbers and letters to the left of the limits correspond to the procedure steps where the check or adjustment is made. Steps without Factory Test Limits (setups, presets, etc.) are not listed. Instruments may not meet Factory Test Limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

THE FACTORY TEST LIMITS REFER TO SECTION E ONLY.

- | | |
|--|--|
| 3. POWER SUPPLIES | 12. SEARCH |
| b. -11V $\pm 5\%$
+10V $\pm 10\%$
ripple + hash <300mV | a. Dispersion at 1MHz: $\geq 20\text{kHz}$
b. Dispersion at 36MHz: $\geq 56\text{kHz}$ |
| 6. RESOLUTION | 13. BALANCED MIXER |
| c. Valleys do not reach baseline
with 1kHz sidebands | a. Spurious: $\leq 2\text{X}$ noise |
| 7. VERTICAL POSITION | * 15. DISPLAY FLATNESS |
| must position a 6cm signal off
screen at both top and bottom | b. $\pm 1\text{dB}$ |
| * 8. DISPERSION | 16. GAIN RANGE |
| c. .01 to 2kHz: $\pm 3\%$
linearity: 3% | 60dB to 65dB |
| 9. IF INCIDENTAL FM | * 17. R-F ATTEN |
| minimum resolution: resolves 10Hz | $\pm 0.1\text{dB/dB}$ |
| 10. SAWTOOTH | * 18. SENSITIVITY |
| 8kHz sidebands on 150V have some
separation as 12kHz sidebands on
100V $\pm 10\%$ | a. 50 Ω Input: -100dBm or greater
b. 600 Ω Input: -80dBm or greater |
| * 11. RF CENTER FREQUENCY | 19. INCIDENTAL FM |
| b. Scale accuracy: $\pm(100\text{kHz} + 1\%)$
c. FINE RF CENTER FREQ range: 10 to
15kHz at 20MHz | b. At 1MHz: resolves $\leq 26\text{Hz}$
c. At 36MHz: resolves $\leq 60\text{Hz}$ |
| | 20. DISPLAY FUNCTIONS |
| | b. LIN linearity: $\pm 10\%$ of 6cm
c. LIN dynamic range: $\geq 26\text{dB}$
d. LIN X10: $\pm 10\%$
e. LOG dynamic range: $\geq 50\text{dB}$ range
f. VIDEO INPUT: 100mV/cm $\pm 10\%$ |

*Indicates measurement characteristics; test equipment must be traceable to NBS for instrument certification.

21. RECORDER OUTPUT

- b. Amplitude: $\geq 15\text{mV/div}$
Linearity: $\pm 5\%$ of 6cm

THE END

SHORT FORM PROCEDURE

Factory Test Limits are limits and instrument must meet before it leaves Manufacturing; therefore, it must be possible to inspect to these limits. Because of normal variations in test equipment and plug-in scopes, addition of side panels, etc, it is necessary to set up some circuits so their performance is better than required by Factory Test Limits. Therefore, the instructions given in the Factory Calibration Procedure may call for checks or adjustments which result in less error than that allowed by the Factory Test Limits.

A. CONVERTER FILTER CHASSIS (610-0147-00)

- | | |
|--|---|
| <ul style="list-style-type: none">1. PRESET CONTROLS
608D for -49 DBM @60MHz2. SETUP<ul style="list-style-type: none">a. Calibrate TYPE 3L10 (Modified)
for 8div signal with RF ATTEN-
UATOR at 36dB.b. Connect Converter Filter Chassis | <ul style="list-style-type: none">3. 60MHz FILTER
608D DBM to -40
Remove 36dB RF ATTENUATOR
Adjust C89, C92, C95 and C98
adding 36dB with TYPE RF ATTEN-
UATOR
≈8div signal on TYPE 564 |
|--|---|

B. WIDE BAND AMPLIFIER CHASSIS (610-0146-00)

- | | |
|--|---|
| <ul style="list-style-type: none">1. PRESETS2. 800kHz FILTER<ul style="list-style-type: none">a. Setup: 800kHzb. Adjust L405, L415 max
Adjust L410 ccw until output
begins to decrease | <ul style="list-style-type: none">3. 900kHz Oscillator<ul style="list-style-type: none">a. Setupb. Adjust L454 1½ turns ccw from
maxc. Check oscillator start |
|--|---|

C. OSCILLATOR-FILTER CHASSIS (610-0148-00)

- | | | | | | | | | | | | | | | | |
|--|---|---------------|--------------------|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|
| <ul style="list-style-type: none">1. SETUP2. OSCILLATOR
Adj L154 for Oscillations | <ul style="list-style-type: none">3. AMPLIFIER<ul style="list-style-type: none">a. Setup: -90dBm on HP608Db. Adjust Amplifier<table border="0" style="margin-left: 40px;"><tr><td><u>Adjust</u></td><td><u>564 display</u></td></tr><tr><td>L154</td><td>max</td></tr><tr><td>C114</td><td>max</td></tr><tr><td>C124</td><td>max</td></tr><tr><td>T204</td><td>max</td></tr><tr><td>T214</td><td>max</td></tr><tr><td>T224</td><td>max</td></tr></table> | <u>Adjust</u> | <u>564 display</u> | L154 | max | C114 | max | C124 | max | T204 | max | T214 | max | T224 | max |
| <u>Adjust</u> | <u>564 display</u> | | | | | | | | | | | | | | |
| L154 | max | | | | | | | | | | | | | | |
| C114 | max | | | | | | | | | | | | | | |
| C124 | max | | | | | | | | | | | | | | |
| T204 | max | | | | | | | | | | | | | | |
| T214 | max | | | | | | | | | | | | | | |
| T224 | max | | | | | | | | | | | | | | |

4. GAIN

Check for control

5. SENSITIVITY

Check for at least -100dBm

D. TYPE 1L10 OSCILLATOR (610-0 -00)

1. SETUP

2. PRESETS

a. 1L10 (Modified)

EXT OSC-INT OSC	INT OSC
FINE RF CENTER FREQ	Midrange
RF ATTENUATOR	OFF
Gain	Midrange
VERTICAL DISPLAY	LIN
DISPERSION KC/DIV	2.0
IF CENTER FREQ	Midrange

b. TYPE 546

TIME/	20mSEC
TRIGGERING	AUTO

c. TYPE 191

FREQUENCY RANGE	3.6-8
AMPLITUDE RANGE	5-50mV
AMPLITUDE	10
FREQUENCY	4.0MHz

d. Oscillator

T50	3 turns cw from flush
C49	½ slug showing at index
TAPE	mark with RF CENTER FREQ fully ccw

3. SET FREQUENCY

- Adjust T50 for 4MHz
- Adjust C49 for 20MHz
- Adjust C49 for 36MHz
- Slip tape for 30MHz
Adjust T50 for 3.95MHz at 4MHz
Adjust C49 for 36MHz

4. ACCURACY

Check for max error according to the following table:

RF CENTER FREQ	TYPE 184	Max Error (dial div)
20	50nS	±1.5
10	.1µS	+1, -2
30	.1µS	±2.0
32	.1µS	±2.1
34	.1µS	±2.2
36	.1µS	±2.3
24	.1µS	±1.7
14	.1µS	±1.2
12	.1µS	±1.1
8	.1µS	±1.8
6	.1µS	±1.6
4	.1µS	±1.4
2	.1µS	±1.2
1	1µS	±1.1

5. SEARCH

- Setup
- Check SEARCH at 1MHz: 20kHz
- Check SEARCH at 36MHz: 56kHz

6. FINE RF CENTER FREQ

Check range: 10kHz to 15kHz

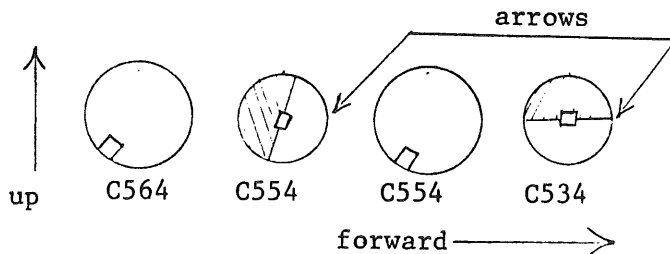
E. ASSEMBLED TYPE 1L10 SPECTRUM ANALYZER

1. PRESETS

a. TYPE 1L10

Internal Controls

Gain Range R107 midr
 L364, L374 fully cw, then 1 turn ccw
 L557, L537 flush, then 3 turns cw
 L624 flush, then 5 turns cw
 C564, C554, C544, C534



2. RESISTANCE

Check resistance from ground to:

Connector pin no.	resistance	Use of pin
1	100k	vertical output
2	0	ground
3	3.5k	vertical output
5	inf	none
6	inf	none
7	inf	none
8	inf	none
9	5k	-150V
10	3k	+100V
11	100k	+225V
12	inf	+350V
13	inf	6.3VAC elevated
14	inf	6.3VAC elevated
15	450Ω	+75
16	inf	none

3. POWER SUPPLIES

a. Setup

b. Power supply voltages

Supply	Voltage Limits	Max Hash + Ripple
-11V	10.45V to 11.55V	300mV
+10V	9V to 11V	300mV

4. 11.5MHz OSCILLATOR

Set L364 for sawtooth

5. PEAK SIGNAL

a. Setup

b. Check 900kHz Oscillator for start

c. Peak 60MHz signal

Adjust	For
L624	max
L154	max
C89	max
C92	max
C95	max
C98	max
C114	max
C124	max
T204	just cw of max
T214	max
T224	just ccw of max
L405	max
L415	max
L410	max

Detune T224 and T204 for 2cm noise, max

6. RESOLUTION

a. Setup: DISPERSION to .5 and RESOLUTION to 2

b. Adjust C554, C534, C557 and C537 for resolution

Readjust L624

c. Check resolution for discernable sidebands: valleys >.5div above baseline with 1kHz modulation.

d. Adjust C544 and C564: .01 amplitude same as at 2

7. VERTICAL POSITION

Check range: must position a 6cm signal off screen at both top and bottom

8. DISPERSION

- Setup: DISPERSION to 2
- Adjust L374 and R321 for 2kHz/div
- Check DISPERSION accuracy: 8cm $\pm 2.4\text{mm}$

<u>TIME/CM</u>	<u>DISPERSION</u>	<u>44A FREQUENCY</u>
20mSEC	1	4kHz
.1SEC	.5	2kHz
.2SEC	.2	800Hz
.2SEC	.1	400Hz
.5SEC	.05	200Hz
.5SEC	.02	80Hz
1SEC	.01	40Hz

9. IF INDIDENTAL FM

Check for discernable 10Hz sidebands

10. SAWTOOTH

Check that 12kHz sidebands with switch in 100V have the same separation $\pm 10\%$ as 8kHz sidebands with switch in 150V.

11. RF CENTER FREQUENCY

- Setup: connect INT OSC
- Check frequency scale accuracy

<u>RF CENTER FREQ</u>	<u>TYPE 184</u>	<u>Max Error (dial div)</u>
20	50nS	± 1.5
10	.1 μ S	$\pm 1, -2$
30	.1 μ S	± 2
32	.5 μ S	± 2.1
34	.5 μ S	± 2.2
36	.5 μ S	± 2.3
24	.5 μ S	± 1.7
14	.5 μ S	± 1.2
12	.5 μ S	± 1.1
8	.5 μ S	± 1.8
6	.5 μ S	± 1.6
4	.5 μ S	± 1.4
2	.5 μ S	± 1.2
1	1 μ S	± 1.0

- Check FINE RF CENTER FREQ range: moves signal 5 to 7.5cm with DISPERSION at 2.

12. SEARCH

- Check SEARCH at 1MHz: $\geq 20\text{kHz}$ dispersion
- Check SEARCH at 36MHz: $\geq 56\text{kHz}$ dispersion

13. BALANCED MIXER

- Check for spuri: ≤ 2 times noise
- Adjust C71 and C73: lowest spurious amplitude

14. LOG - LIN SHIFT

Check LOG-LIN trace shift: $\leq 0.5\text{cm}$

15. DISPLAY FLATNESS

- Setup
- Check display flatness: $\pm 1\text{dB}$

16. GAIN RANGE

Adjust Gain Range, R107: 63dB

17. R-F ATTEN

Check each switch for attenuation according to the following table for 6cm:

<u>HP 355C</u>	<u>HP 355D</u>	<u>TYPE 1L10</u>	<u>Error</u>
1	0	1	$\pm .7\text{mm}$
2	0	2	$\pm 1.4\text{mm}$
4	0	4	$\pm 1.8\text{mm}$
8	0	8	$\pm 6\text{mm}$
6	10	16	$\pm 1.2\text{cm}$
0	20	20	$\pm 1.5\text{cm}$

18. SENSITIVITY

- Check 50 Ω sensitivity, 10MHz to 36MHz: -100dBm or greater
- Check 600 Ω sensitivity at 1MHz: 80dB or more below .76 volts

19. INCIDENTAL FM

- a. Setup
- b. Check FM at 1MHz: resolves $\leq 26\text{Hz}$
- c. Check FM at 36MHz: resolves $\leq 60\text{Hz}$

20. DISPLAY FUNCTIONS

- a. Setup
- b. Check LIN linearity: $\pm 6\text{mm}$
- c. Check LIN dynamic range: $\geq 26\text{dB}$
- d. Check LIN X10: $\pm 10\%$
- e. Adjust Log Adjust, R646: 50dB range
- f. Check VIDEO INPUT: $100\text{mV/cm} \pm 1\text{mm}$

21. RECORDER OUTPUT

- a. Setup
- b. Check output into 600Ω :
amplitude $\geq 15\text{mV.div}$
linearity $\pm 5\%$ of 6cm

22. EXT OSC -INT OSC

Check that converted signal
disappears when switch is in
EXT OSC

THE END

A. CONVERTER FILTER CHASSIS
(610-0147-00)1. PRESET CONTROLS*a. Test Scope*

TYPE 564

DISPLAY NORMAL

TYPE 2B67

TIME/DIV 20mSEC

TRIGGER LEVEL FREE RUN

TYPE 3L10 (Modified)

VERTICAL DISPLAY LIN

DISPERSION kHz/DIV 2

IF CENTER FREQ 0

RF ATTENUATOR 36dB

WIDE BAND (W.B.) INT

b. HP 608D

MEGACYCLES 60

FREQUENCY RANGE C

MOD SELECTOR cw

AMP TRIMMER peak

OUTPUT LEVEL SET

DBM -49

2. SETUP*a. Calibrate TYPE 3L10 (Modified)*

Connect 608D RF SIGNAL OUT to TYPE
3L10 50 Ω RF INPUT via 50 Ω BNC cable.
Adjust TYPE 3L10 GAIN for 8div display
on Test Scope.

b. Connect Converter Filter Chassis

Connect HP608D RF SIGNAL OUT to
Converter Filter Chassis J80 via
50 Ω BNC cable and BNC to selectro
adapter. Connect J98 to TYPE 3L10
via 50 Ω BNC cable and BNC to adapter.
Set converter Filter Chassis shield
in place.

3. 60MHz FILTER

Set HP608D DBM to -40. Remove 36dB attenuation with TYPE 3L10 RF ATTENUATOR. Adjust C89, C95, and C98 for maximum indication on the Test Scope. Add 36dB with RF ATTENUATOR to keep peak on CRT. The signal indication should be $\approx 8\text{div}$ when all the capacitors are adjusted for peak.

THE END

B. WIDE BAND AMPLIFIER CHASSIS
(610-0146-00)

1. SETUP

Remove the jumper plug from right side of TYPE 3L10 (Modified). Connect the plug with cable to the TYPE 3L10 (Modified). Set W.B. to EXT.

Connect W.B. IN to J100 on the wideband amplifier. Connect the coax with clip lead to rear Selectro jack on the TYPE 3L10 (Modified) right side to the terminal next to T224.

Use the internal wideband amplifier as a guide and connect the cable wires to their proper terminals.

Connect a X1 probe from the test scope to C15 (10pf) in the wideband amplifier. Set Test Scope for .005 V/CM and free run trace. Connect the TYPE 3L10 (Modified) to the TYPE 564 with a flexible extension cable. Turn TYPE 564 POWER to ON.

2. OSCILLATOR

Adjust L154 until oscillations appear on the Test Scope. Disconnect the X1 probe. Place a cover on the wideband amplifier.

C156 may require dressing to keep oscillator running with cover in place.

3. AMPLIFIER

a. Setup

Connect an HP608D to the TYPE 3L10 (Modified) RF INPUT 50. Adjust the HP608D for -90dBm of 60MHz.

Set the TYPE 3L10 (Modified) GAIN fully cw and all RF ATTENUATORS to OUT.

3. (cont'd)

b. Adjust amplifier

Adjust the amplifier according to the following table:

<u>Adjust</u>	<u>564 display</u>
L154	max
C114	max
C124	max
T204	max
T214	max
T224	max

b. 3L10 (Modified) GAIN must be fully cw.

4. GAIN

Turn TYPE 3L10 (Modified) GAIN and check that the display amplitude can be varied.

5. SENSITIVITY

Turn TYPE 3L10 (Modified) gain fully cw, VERTICAL DISPLAY to LIN, DISPERSION and RESOLUTION to 2. Set the TYPE 2B67 TIME/DIV to .1 SEC. Turn the TYPE 3L10 (Modified) L.O. to ON. Set the HP608D for 25MHz out. Set TYPE 3L10 (Modified) Oscillator for 25MHz. Adjust HP608D DBM for a signal twice the noise amplitude.

Check that the HP608D DBM reads at least -100dBm.

THE END

C. OSCILLATOR-FILTER CHASSIS
(610-0148-00)

1. PRESETS

a. *Sine Wave Generator*
(067-0542-99)

FREQUENCY	8.0
MULTIPLIER	100kHz
FREQUENCY VARIABLE	CAL
AMPLITUDE VOLTS P-P	as convenient
AMPLITUDE MULTIPLIER	" "

b. *Bench Scope*

1A1

VOLTS/CM CH 1	
MODE	CH 1
INPUT SELECTOR CH 1	AC
VOLTS/CM CH 2	
INPUT SELECTOR CH 2	AC

546

HORIZONTAL DISPLAY	A
TIME BASE A	
TRIGGERING MODE	AUTO
" SLOPE	+
" COUPLING	AC
" SOURCE	INT
TIME/CM	

2. 800kHz FILTER

a. *Setup*

Connect the SINEWAVE GENERATOR OUTPUT to J401 via a BNC to Selectro cable and a BNC 50 Ω cable. Connect J418 to the TYPE 1A1 CH 1 INPUT via a 50 Ω BNC cable and a BNC to Selectro cable. Place cover on chassis. Change the TYPE 1A1 CH 1 VOLTS/CM for convenient display.

b. *Adjust L405, L410 and L415*

Adjust L405 and L415 for maximum display amplitude on the TYPE 546.

Adjust L410, starting fully cw, until display amplitude begins to decrease.

3. 900kHz OSCILLATOR*a. Setup*

Connect the TYPE 3L10 (Modified) W.B. in lead to J401 (for ground connection). Connect 900 OSC PLUS to C456 feed through capacitor (next to L454) via a meter lead. Connect the TYPE 3L10 (Modified) to the TYPE 564 via a plug-in extension. Turn on the TYPE 564. Connect J458 to the TYPE 1A1 CH 1 INPUT via a 1X probe and the 330 Ω load cable. Switch 900 ON-OFF to ON.

b. Adjust L454

Adjust L454 for maximum output. Then adjust L454 1½ turns ccw.

c. Check oscillator start

Turn 900 ON-OFF to OFF, then ON several times. Check that the oscillator starts each time the switch is returned to ON.

c.

If oscillator does not start: select Q450.

THE END

D. TYPE 1L10 OSCILLATOR

(610-0151-00)

1. SETUP

Connect the TYPE 1L10 (Modified) plug-in unit to the TYPE 546 vertical with a flexible extension cable.

Place a cover on the oscillator. Clamp the oscillator into the Tracking jig on the top of the TYPE 1L10 (Modified). Connect the cable from J70 to J50.

2. PRESETS

a. 1L10 (Modified)

EXT OSC-INT OSC	INT OSC
FINE RF CENTER FREQ	Midrange
RF ATTENUATOR	OFF
Gain	Midrange
VERTICAL DISPLAY	LIN
DISPERSION KC/DIV	2.0
IF CENTER FREQ	Midrange

b. TYPE 546

TIME/	20mSEC
TRIGGERING	AUTO

c. TYPE 191

FREQUENCY RANGE	3.6-8
AMPLITUDE RANGE	5-50mV
AMPLITUDE	10
FREQUENCY	4.0MHz

d. Oscillator

T50	3 turns cw from flush
C49	$\frac{1}{2}$ slug showing
TAPE	at index mark with RF CENTER FREQ fully ccw

3. SET FREQUENCY

a. Adjust T50 for 4MHz

Turn TYPE 546 on. Adjust T50 for signal on TYPE 546 with tape at 4MHz.

3. (cont'd)

b. Adjust C49 for 20MHz

Set TYPE 191 for 20MHz. Adjust C49 for signal on TYPE 546 with tape at 20MHz.

Repeat steps 3a and 3b until no further adjustment is necessary.

c. Adjust C49 for 36MHz

Set TYPE 191 for 36MHz out. Readjust C49 for signal on TYPE 546 when tape reads 36MHz. Disconnect the TYPE 191 from the RF INPUT.

d. Final adjust

Connect the TYPE 184 MARKER OUTPUT to the TYPE 1L10 (Modified) RF INPUT 50Ω. Switch in 40dB with RF ATTENUATOR. Push the TYPE 184 .1 S button. Locate the 30MHz signal on the TYPE 184. Slip tape on cogwheel to get 30MHz mark behind hairline.

Push .5μS button on TYPE 184. Count (2MHz/pip) down to 4MHz. Readjust T50 to read 3.95MHz on tape with 4MHz signal on TYPE 564. Count back to 36MHz (2MHz/pip). Adjust C49 to read 36MHz with signal display on TYPE 546.

3.95MHz is an average setting for 4MHz and is used as a guide only.

Slipping cogwheel or turning cogwheel on shaft (fine adjust) affects error between 15 and 25MHz most. L50 affects lower frequency errors. C49 affects upper frequency errors.

4. ACCURACY

Check for max error according to the following table:

RF CENTER FREQ	TYPE 184	Max Error (dial div)
20	50nS	± 1.5
10	.1 μ S	+1, -2
30	.1 μ S	± 2.0
32	.5 μ S	± 2.1
34	.5 μ S	± 2.2
36	.5 μ S	± 2.3
24	.5 μ S	± 1.7
14	.5 μ S	± 1.2
12	.5 μ S	± 1.1
8	.5 μ S	± 1.8
6	.5 μ S	± 1.6
4	.5 μ S	± 1.4
2	.5 μ S	± 1.2
1	1 μ S	± 1.0

5. SEARCH

a. Setup

Connect the TYPE 184 Marker output to the HARMONIC MODULATOR RF INPUT. CONNECT the SINE WAVE GENERATOR to the MODU FREQ 2. Connect the HARMONIC MODULATOR MODU FREQ OUT to the TYPE 1L10 (Modified) RF INPUT 50 Ω . Set the SINE WAVE GENERATOR for 2V of 20kHz output. Push the TYPE 184 1 μ S button. Switch the TYPE 3L10 (modified) DISPERSION to SEARCH.

b. Check SEARCH at 1MHz

Adjust the HARMONIC MODULATOR for best display at 1MHz (60MC TRAP to IN) and check that the fundamental and one sideband can be displayed on the TYPE 546 at the same time.

5. (cont'd)

c. Check SEARCH at 36MHz

Set Oscillator to 36MHz. Set the SINE WAVE GENERATOR for 56kHz out. Check that the fundamental and one sideband can be displayed on the TYPE 546 at the same time.

c. The 608D modulated by SINE WAVE GENERATOR may be substituted.

6. RF FINE CENTER FREQ

Set Oscillator to 20MHz. Set SINE WAVE GENERATOR to 10kHz. Turn FINE RF CENTER FREQ fully ccw. Set fundamental to left graticule edge with RF CENTER FREQ. Turn FINE RF CENTER FREQ fully cw. The first sideband on left must be visible to the right of the left graticule edge.

6. Physically dress D54 to change RF FINE CENTER FREQ range.

Set SINE WAVE GENERATOR to 15kHz. The first sideband on left must not be to the right of the left graticule edge.

THE END

E. ASSEMBLED TYPE 1L10 SPECTRUM ANALYZER

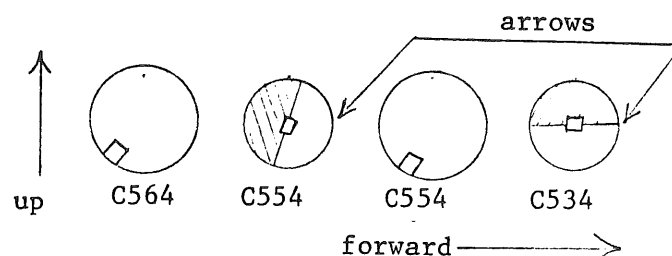
1. PRESETS*a. TYPE 1L10*

External Controls

DISPERSION kHz/cm	2
VERTICAL DISPLAY	LIN
RF - ATTEN	OFF
FINE RF CENTER FREQ	midr
GAIN	cw
EXT OSC-INT OSC	EXT OSC
100V-150V SAWTOOTH	150V

Internal Controls

Gain Range R107	midr
L364, L374	fully cw then 1 turn ccw
L557, L537	flush then 3 turns cw
L624	flush then 5 turns cw
C564, C554, C544, C534	see notes



This procedure assumes that the sub-assemblies have been preadjusted. In case of difficulty, refer to the proper subassembly section of this procedure.

b. TYPE 549

A TIME/CM	
A TRIGGERING	
MODE	AUTO
NORM-SINGLE SWEEP	NORM
MAGNIFIER	OFF

2. RESISTANCE

Ground the common (-) meter lead.
Use thelk range. Check resistance
to

Connector

<u>Pin no</u>	<u>resistance</u>	<u>Use of pin</u>
1	100k	vertical output
2	0	ground
3	3.5k	vertical output
5	inf	none
6	inf	none
7	inf	none
8	inf	none
9	5k	-150V
10	3k	+100V
11	100k	+225V
12	inf	+350V
13	inf	6.3VAC elevated
14	inf	6.3VAC elevated
15	450Ω	+75
16	inf	none

2. (cont'd)

Check -11V 13k.
Check RF INPUT 50 Ω for \approx 50 Ω .
Check RF INPUT 600 Ω for \approx 600 Ω .
Check between pin 13 and pin 14
for infinity.

3. POWER SUPPLIES*a. Setup*

Connect the TYPE 1L10 to the
TYPE 549 amphenol connector.

b. Power supply voltages.

Supply	Voltage Limits	Max Hash + Ripple
-11V	10.45V to 11.55V	300mV
+10V	9V to 11V	300mV

Check -11V and +10V power
supplies for voltage and
oscillator hash.

4. 11.5MHz OSCILLATOR

Set TYPE 1A1 CH 2 VOLTS/CM to
.05, INPUT SELECTOR to AC.
Connect a X10 probe to INPUT 2.

Connect the probe to the junction
of C351 and Q350 base. Adjust
L364 for a sawtooth display on the
TYPE 546.

L374 may need to be adjusted to
get sawtooth (see presets).

5. PEAK SIGNAL*a. Setup*

Connect MARKER OUTPUT of TYPE 184
to RF INPUT of the Harmonic Modu-
lator with a 50 Ω BNC cable. Connect
Harmonic Modulator MODU HARM OUT to
the TYPE 1L10 RF INPUT 50 Ω with a
50 Ω BNC cable. Set the Harmonic
Modulator RF VARIABLE fully cw.

5a. (cont'd)

Press the .5 μ S MARKER SELECTOR on the TYPE 184. Set the TYPE 1L10 GAIN fully cw and the RF ATTEN to provide a vertical display of about 6cm. The display will normally be seen to the right of the graticule center.

b. Check 900kHz Oscillator

Turn the TYPE 549 POWER to OFF, then to ON several times. Check that the 60MHz display returns each time.

c. Peak 60MHz signal

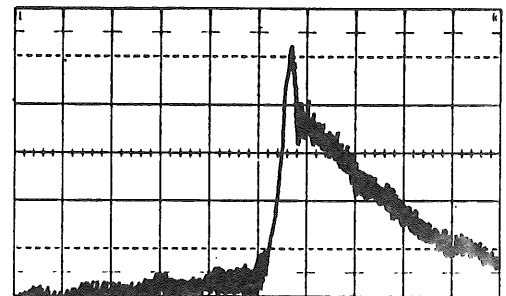
Adjust in the following order:

L624	max
C89	max
C92	max
C95	max
C98	max
L154	max
C114	max
C124	max
T204	just cw of max
T214	max
T224	just ccw of max
L405	max
L415	max
L410	max

These adjustments interact slightly. Repeat.

6. RESOLUTION*a. Setup*

Connect an HP608D to the TYPE 1L10 RF INPUT 50 Ω . Set the HP608D MEGA-CYCLES to 60, FREQ RANGE to C and MOD SELECTOR to CW. Peak AMP TRIMMER and adjust DBM for 6cm of display. Set the TYPE 1L10 DISPERSION to .5. Decouple RESOLUTION to 2.



L357 and L557 midadjusted

6. (cont'd)

b. Adjust resolution

Adjust C554 for a smooth curve into the base line on the left side of the display. Adjust C534 for the same curve on the right side. C554 and C534 interact.

Readjust L537 and L557 for minimum deflection of a rounded display. L537 and L557 interact.

Readjust C554 and C534. Adjust L624 for maximum amplitude.

c. Check resolution: valleys
>0.5cm from baseline

Switch H608D MOD SELECTOR to 1000~ and adjust MOD LEVEL to 100 PERCENT MODULATION. Set HP608D DBM for 6cm of display.

Check for two 3cm sidebands. The valleys between the sidebands and the carrier must be more than 0.5cm above the baseline.

d. Adjust C544 and C564

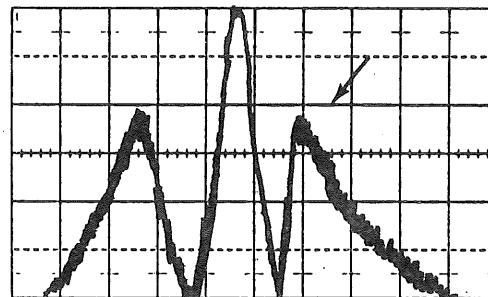
Set HP608D MOD SELECTOR to CW and readjust DBM for 6cm. Change TYPE 549 TIME/CM A to 1SEC. Change TYPE 1L10 DISPERSION and coupled RESOLUTION to .01. Adjust C544 and C564 for 6cm of display

C534 and C554 are adjusted for symmetrical curves with no reversal.

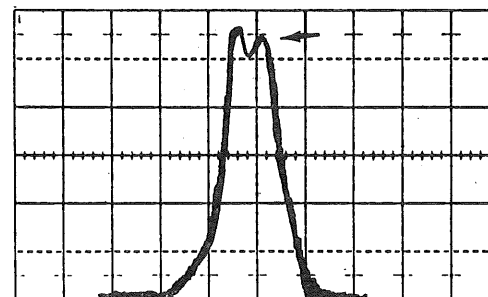
L537 and L557 are adjusted for a smooth rounded top. The display will appear to roll through minimum amplitude as L537 and L557 are adjusted.

L537, L557, C534, C554 and L624 adjustments interact.

It is sometimes helpful to preset 2kHz dispersion.



C534 and C557 misadjusted

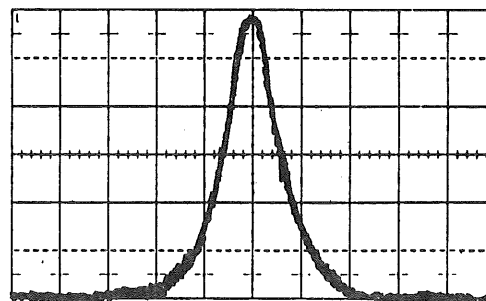


L537 and L557 misadjusted

7. VERTICAL POSITION

Must position a 6cm of signal off screen at both top and bottom

Turn VERTICAL POSITION fully cw than fully ccw. The display must position off the scan area at both the top and the bottom.



Resolution properly set

8. DISPERSION

a. Setup

Connect the Harmonic Modulator MODU HARM OUT to the TYPE 1L10 RF INPUT 50 Ω . Connect the Kronhite 440A OUTPUT to the Harmonic Modulator MODU FREQ 2. Connect the TYPE 184 MARKER OUTPUT to the Harmonic Modulator RF via a 50 Ω terminator. Connect the TYPE 106 OUTPUT to the Harmonic Modulator MODU FREQ 1 via a 50 Ω terminator. Press the TYPE 184 1 S MARKER SELECTOR. Turn the TYPE 106 AMPLITUDE full ccw. Set the 440A for 2kHz out. Set TYPE 106 REPETITION RATE RANGE to 1kHz. Set the TYPE 1L10 VERTICAL DISPLAY to LIN, DISPERSION to 2 and decouple RESOLUTION to 1. Set TYPE 549 TIME/CM to 50mSEC. Adjust the Harmonic Modulator RF VARIABLE and MODULATION 2 VARIABLE for the greatest amplitude sidebands displayed on the TYPE 549. Set the 440A for 2kHz OUT.

b. Adjust R321 and L374

Set R321 and L374 for 1 2kHz sideband per cm. Adjust L364 for linearity if necessary.

c. Check DISPERSION accuracy: $\pm 3\%$ linearity: $\pm 3\%$

Set the 440A for 1kHz. Set DISPERSION and RESOLUTION to 1. Check for 1 sideband at each graticule line $\pm .24$ cm.

Set the 440A for 4kHz. Set the TYPE 549 TIME/CM to .1. Adjust the TYPE 106 AMPLITUDE cw. Adjust the TYPE 106 MULTIPLIER to position a pair of sidebands at the 1 and 9cm graticule lines. Check for 8cm between this pair of sidebands $\pm .24$ cm.

8c. (cont'd)

Continue to check according to the following table:

<u>TIME</u>	<u>DISPERSION</u>	<u>440A FREQ</u>
.2SEC	.2	800Hz
.2SEC	.1	400Hz
.5SEC	.05	200Hz
.5SEC	.02	80Hz
1SEC	.01	40Hz

9. IF INCIDENTAL FM

Change the 440A frequency to 10Hz and check that the sidebands are discernable.

Vary the TYPE 106 repetition rate as necessary.

10. SAWTOOTH

>10% change from 8kHz to 12kHz sidebands when switched.

Change the 440A frequency to 8kHz. Set 1L10 DISPERSION to 2. Check separation of sidebands.

Switch 100V -150V Sawtooth, sw320, to 100V. Change 440A frequency to 12kHz. Check for same separation as with 150V sawtooth $\pm 10\%$.

11. RF CENTER FREQUENCY*a. Setup*

Remove the TYPE 106 from the Harmonic Modulator MODU FREQ 1. Switch the MODU FREQ 2 to OFF. Switch the 60MC TRAP to OUT. Connect TYPE 1L10 OSC OUT to OSC IN. Plug TYPE 1L10 into TYPE 549.

Push the TYPE 184 50ns MARKER SELECTOR. Set the TYPE 549 TIME/CM to 20mSEC. Set the TYPE 1L10 DISPERSION to 2kHz and the FINE RF CENTER FREQ to midr. Switch EXT OSC-INT OSC to INT OSC. Switch 100V -150V sawtooth, sw320, to 150V.

11. (cont'd)

- b. Check frequency scale accuracy:
 $\pm(100\text{kHz} + 1\%)$

Check RF CENTER FREQ dial accuracy
 according to the following table:

RF CENTER FREQ	TYPE 184	Max Error (dial div)
20	50nS	± 1.5
10	.1 μ S	$\pm 1, -2$
30	.1 μ S	± 2.0
32	.5 μ S	± 2.1
34	.5 μ S	± 2.2
36	.5 μ S	± 2.3
24	.5 μ S	± 1.7
14	.5 μ S	± 1.2
12	.5 μ S	± 1.1
8	.5 μ S	± 1.8
6	.5 μ S	± 1.6
4	.5 μ S	± 1.4
2	.5 μ S	± 1.2
1	1 μ S	± 1.0

- c. Check FINE RF CENTER FREQ
 range: 10 to 15kHz at 20mHz

Set TYPE 1L10 DISPERSION to 2kHz.
 Push the TYPE 184 .5 μ S MARKER SELECTOR. Tune RF CENTER FREQ for a display at 20MHz. Turn the FINE RF CENTER FREQ fully ccw. Set display to left graticule edge with RF CENTER FREQ. Turn FINE CENTER FREQ fully cw. Check that display moved 5 to 5.5 cm to the right.

12. SEARCH

- a. Check SEARCH at 1MHz: $\geq 20\text{kHz}$

Push the TYPE 184 1 S MARKER SELECTOR. Set Harmonic Modulator MODU FREQ 2 to ON. Set the 440A for 10kHz. Set TYPE 1L10 CENTER FREQ to 1 and DISPERSION to SEARCH. Check that the first sidebands displayed are 5div or less from the carrier.

12. (cont'd)

b. Check SEARCH at 36MHz: $>56\text{kHz}$

Push the TYPE 184 .5 μ S MARKER SELECTOR. Set the 440A for 23kHz. Set the TYPE 1L10 RF CENTER FREQ to 36MHz. Check that the first sidebands displayed are 5div or less from the carrier.

13. BALANCED MIXER

a. Check spuri: ≤ 2 times noise

Remove the cable from the TYPE 1L10 RF INPUT 50 Ω . Turn GAIN fully cw. Turn RF CENTER FREQ slow from 36MHz to 1MHz and note the frequency of any spurius. The largest apparrent signal (spurius) will normally appear at 1.6MHz.

b. Adjust C71 and C73

Display the largest spurius. Adjust C71 and C73 for the lowest amplitude of that spurius. Slight readjustment of C89 may be necessary.

Check that no spuri exceeds 2 times noise.

14. LOG-LIN SHIFT

Switch VERTICAL DISPLAY between LOG and LIN. If the trace shift is greater than 0.5cm, replace V494 in the TYPE 549.

V494 should be selected for low grid current. Recalibrate TYPE 549 vertical if V494 is changed.

15. DISPLAY FLATNESS*a. Setup .*

Connect the HP608D OUTPUT to the TYPE 1L10 RF INPUT 50Ω. Set the HP608D MEGACYCLES to 10, FREQUENCY RANGE to A, and MOD SELECTOR to CW. Peak AMP TRIMMER and set DBM to -90.

Set the TYPE 1L10 RF CENTER FREQ to 10MHz. Set VERTICAL DISPLAY to LIN. Set DISPERSION and RESOLUTION to 2. Move signal on display with RF CENTER FREQ for max amplitude. Adjust GAIN for a 6cm display.

b. Check display flatness: $\pm 1\text{dB}$

Find the -2dB level with the 2dB R-F ATTEN. Move the signal across the graticule with the RF CENTER FREQ. Check for 6cm ± 0 -2dB across graticule.

Correct flatness error with T204, T214 and T224 readjustment.

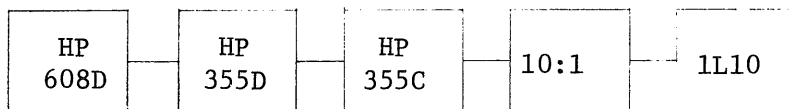
16. GAIN RANGE $>60\text{dB}$

Turn TYPE 1L10 GAIN fully cw. Center display. Set the HP608D DBM to -93. Adjust TYPE 1L10 R-F ATTEN for exactly 6cm of display.

Turn GAIN fully ccw. Set HP608D DBM to -30. Adjust GAIN Range, R107, for exactly 6cm of display.

17. R-F ATTEN $\pm 0.1\text{dB/dB}$

Connect as follows:



17. (cont'd)

Switch all R-F ATTEN switches to OFF. Set the HP608D DBM to -20. Set the HP355C to 1. Set 3L10 GAIN for exactly 6cm of display. Switch HP355C to 0 and switch TYPE 1L10 R-F ATTEN 1dB in. Check for 6cm ± 0.7 mm.

Check each switch in the same manner using the following table:

HP355C	HP355D	TYPE 1L10	Error
2	0	2	± 1.4 mm
4	0	4	± 1.8 mm
8	0	8	± 6.0 mm
6	10	16	± 1.2 mm
0	20	20	± 1.5 mm

Remove the HP355C, HP355D, and the X10 attenuator.

18. SENSITIVITY

a. Check sensitivity from 10MHz to 36MHz: -100dBm or greater

Set HP608D DBM to -90. Connect the HP608D OUTPUT to the TYPE 1L10 RF INPUT 50 Ω . Switch OFF all R-F ATTEN. Turn TYPE 1L10 GAIN fully cw. Set TYPE 549 TIME/CM A to .1 SEC. Set the HP608D DBM for a signal twice the noise amplitude. Check that the HP 608D DBM reads at least -100dBm.

Repeat sensitivity check for 20MHz, 30MHz and 36MHz.

b. Check 600 Ω sensitivity at 1MHz: -80dBm or greater

Remove the HP608D from the TYPE 1L10 RF INPUT 50 Ω .

a. T224 and T204 should be detuned an equal amount for about 2div noise max. Recheck step 15.

18b. (cont'd)

Place a "T" connector on the HP241A. Connect an HP241A to the HP350D. Connect the HP350D. Connect the HP350D output to the TYPE 1L10 RF INPUT 600 Ω . Connect the Test Scope TYPE 1A1 CH 1 to the "T" connector. Set the TYPE 546 TRIGGERING MODE to AUTO. Set the TYPE 1A1 MODE to CH 1, VOLTS/CM to .1 and INPUT SELECTOR to DC. Set the HP350D to 50. Set the HP241A for 99.9kHz out. Adjust the HP241A AMPLITUDE for 3.8cm on the TYPE 546. Adjust the TYPE 1L10 RF CENTER FREQ to 1MHz.

Increase the HP350D attenuation to -80dBm. Check for a 1MHz signal of at least twice the noise amplitude on the TYPE 549.

19. INCIDENTAL FM

a. Setup

Connect the Harmonic Modulator to the TYPE 184, 440A and 1L10 RF INPUT 50 Ω as in step 8. Set the Harmonic Modulator 60MC TRAP to IN and MODU FREQ 2 to ON.

b. Check FM at 1MHz: resolves <26Hz

Set the TYPE 184 for 1 μ S and the 440A for 26Hz. Set the TYPE 549 TIME/CM to .5SEC. Locate the signal and adjust the TYPE 1L10 GAIN for a convenient display.

With DISPERSION at .02 and RESOLUTION at .01. Check for discernable sidebands.

19. (cont'd)

- c. *Check FM at 36MHz: resolves*
 $\leq 60\text{Hz}$

Push the TYPE 184 .5 μ S MARKER SELECTOR and set the 440A for 60Hz. Turn the TYPE 1L10 RF CENTER FREQ to 36MHz and locate signal. Adjust GAIN for a convenient display. With DISPERSION at .05 and RESOLUTION at .02 check for discernable sidebands.

Remove the Harmonic Modulator from the TYPE 1L10 input.

20. DISPLAY FUNCTIONS

- a. *Setup*

Connect the HP608D OUTPUT to the TYPE 1L10 RF INPUT 50 Ω . Adjust DBM to -50 and MEGACYCLES to 10. Set FREQUENCY RANGE to A. Set TYPE 1L10 DISPERSION and RESOLUTION to 2. Obtain a 10MHz display of exactly 6cm with the RF CENTER FREQ and GAIN.

- b. *Check LIN linearity: $\pm 6\text{mm}$*

Set the HP608D DBM to -53. Check for 3.6 to 4.8cm of display.

Set the HP608D DBM to -56. Check for 2.4 to 3.6cm of display.

Set the HP608D DBM to -62. Check for 0.9 to 2.1cm of display.

- c. *Check LIN dynamic range: $\geq 26\text{dB}$*

Set HP608D DBM to -76. Check for a discernable display.

- d. *Check LIN X10: $\pm 10\%$*

Set HP608D to -70. Set DISPLAY FUNCTION to LIN X10. Check for 6cm display $\pm 6\text{mm}$.

20. (cont'd)

e. *Adjust Log Adjust, R646:*
50dB range

Set HP608D DBM to -100. Set TYPE 1L10 VERTICAL DISPLAY to LOG, UNCOUPLE RESOLUTION to .5 and adjust Gain for a 0.2div signal. Turn HP608D DBM to -48 and adjust Log Adjust for a 6cm signal.

f. *Check VIDEO INPUT: 100mV/cm*
±10%

Turn GAIN full cw. Set VERTICAL DISPLAY to VIDEO INPUT. Apply .2V from the TYPE 549 CAL OUT to the TYPE 1L10. Check for 1cm ±1mm.

21. RECORDER OUTPUT

a. *Setup*

Connect a 1X probe to the Test Scope TYPE 1A1 CH 1 input. Connect the TYPE 546 + GATE A to the TYPE 549 A TRIG INPUT. Set the TYPE 546 TIME BASE A TIME/CM to 50mSEC and TRIGGERING MODE to AUTO. Set the TYPE 549 TIME/CM A to 50mSEC, TRIGGERING MODE to TRIG, SLOPE to + and SOURCE to EXT. Adjust STABILITY to PRESET and LEVEL for a display on the 549. Set the TYPE 1L10 VERTICAL DISPLAY to LIN. Adjust GAIN for 6cm of signal. Set the TYPE 1A1 CH 1 VOLTS/CM to .02. Connect the X1 probe to the read and white lead on the TYPE 3L10 TO RECORDER jack. Insert the 600Ω special Plug into the TO RECORDER jack.

21. (cont'd)

- b. Check RECORDER output and linearity:
amplitude: $>15\text{mV}$
linearity: $\pm 5\%$ of 6cm

Check Test Scope for at least 6cm of display.

Adjust TYPE 1A1 CH 1 VARIABLE VOLTS/CM for exactly 6cm of display on the Test Scope. Adjust TYPE 1L10 for 4cm of display on the TYPE 549. Check for 3.7cm to 4.3cm display on the Test Scope.

Repeat for 2cm and 1cm and check for 2cm $\pm .3\text{cm}$ and 1cm $\pm .3\text{cm}$ on the Test Scope.

Disconnect X1 probe and Special Plug.

22. EXT OSC - INT OSC

Switch EXT OSC - INT OSC to EXT OSC.
Check that signal disappears. Switch
EXT OSC - INT OSC back to INT OSC.
Check for a signal display.

22. Recheck gain range and LOG
dynamic range prior to shipping.

THE END