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).

This procedure is company confidential

1L40

March 1969
For all serial numbers.

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.

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

A Needed to Calibrate HONEYCOMB
B Needed to Calibrate PHASE LOCK SUB-ASSEMBLY
C Needed to Calibrate COMPLETED INSTRUMENT

a. TEKTRONIX Instruments

ABC	1	TYPE 547 OSCILLOSCOPE with
ABC	1	TYPE 1A1 PLUG-IN UNIT with
BC	1	TYPE P6006 10X PROBE and
C	1	TYPE P6011 1X PROBE (Test Scope)
ABC	1	TYPE 547 OSCILLOSCOPE (Plug-in scope)
ABC	1	TYPE 1L40 PLUG-IN UNIT (Calibrated Test Plug-in)
* ABC	1	TYPE 184 TIME MARK GENERATOR
BC	1	TYPE 191 CONSTANT AMPLITUDE GENERATOR

b. Test fixtures and accessories

ABC	3	50Ω BNC cables (010-0133-00)
ABC	1	N male to BNC female adapter (103-0045-00)
A	2	GR to BNC male adapters (017-0064-00)
A	1	11 in. lossy cable (175-0364-00)
A	1	2 in. lossy cable (175-0308-00)
AB	1	1L20-1L30 square pin connector cable (Dwg #1438A)
ABC	1	Flexible extension cable (012-0038-00)
C	1	50Ω Termination (011-0049-00)
C	2	BNC X10 Attenuators (011-0059-00)
C	1	600Ω load cable for TO RECORDER (dwg #1439-A)
C	1	Waveguide mixer adapter (119-0104-00)
C	1	Waveguide mixer, 12.4-18GHz (119-0097-00)
C	1	Waveguide mixer, 18.0-26.5GHz (119-0098-00)
C	1	Waveguide mixer, 26.5-40GHz (119-0099-00)
C	1	Cable assembly (012-0115-00)
C	1	Low Frequency Sine Wave Generator (067-0542-99)
C	1	200MHz Filter (067-0595-00)
C	1	Harmonic Generator (067-0594-00)
A	2	BNC to Selectro cables (175-0362-00)
C	1	10dB Attenuator (011-0085-00)

c. Other equipment

* AC	1	20,000Ω/V Multimeter (Simpson 262 or equivalent)
AC	1	Hewlett-Packard 608D UHF signal generator
A	1	Kay Model 121B VHF-UHF Sweeping Oscillator
* C	1	Hewlett-Packard 355C UHF attenuator
* C	1	Hewlett-Packard 355D UHF attenuator
* AC	1	Hewlett-Packard 8614A UHF signal generator
* AC	1	Hewlett-Packard 8616A UHF signal generator
* C	1	Hewlett-Packard 626A SHF signal generator
C	1	Hewlett-Packard 628A SHF signal generator

(c. Cont'd)

*C	1	Hewlett-Packard 938 Frequency doubler set
*C	1	Hewlett-Packard 940 Frequency doubler set
*C	1	Polarad 1107 SHF signal generator
*C	1	Polarad 1108 SHF signal generator
C	1	Hewlett-Packard X281 Waveguide to coax adapter
C	2	Hewlett-Packard NP292A Waveguide to Waveguide
C	1	Hewlett-Packard MX292B Waveguide to Waveguide
C	2	Hewlett-Packard MP292B Waveguide to Waveguide
C	1	Hewlett-Packard NK292A Waveguide to Waveguide
C	1	Hewlett-Packard 11503A Flexible waveguide
C	1	FXP Type U-634AF waveguide section
C	1	FXP Type K-634AF waveguide section

*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 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.

FACTORY TEST LIMITS ARE REFERENCED TO SECTION C ONLY.

3. POSITION

b. range: positions trace out of graticule area

4. POWER SUPPLIES

+10V ±5% 20mA
-10V ±5% 20mA

*6. MHz/CM DISPERSION

d. Linearity: ≤2%
Accuracy:

DISPERSION	Hz/CM	error
10		2%
5		2.5%
2		4%
1		5%
.5		8%
.2		10%

*9. kHz DISPERSION

c. Accuracy and Linearity: ≤2.5%
d. Latchup: no latchup from +2.00 IF CENTER FREQ to -2.00 IF CF in any combination of DISPERSION RANGE and DISPERSION is switched

10. IF CENTER FREQ RANGE

DISPERSION	Range at least	FINE IF CF Range
10MHz	±10MHz	±1MHz
.2 to 5MHz	±25MHz	±1MHz
1 to 500kHz	±2.5M	±50kHz

11. RESOLUTION

f. Max Resolution bandwidth: ≥100kHz
h. Min resolution: ≤1kHz bandwidth

12. PHASE LOCK

c. INT REF FREQ range: ≥1kHz ≤1.3kHz
*d. INT REF FREQ accuracy: ±0.1%
e. Gate Bal: trace at electrical center ±1cm with FINE RF CENTER FREQUENCY fully ccw (Press LOCK CHECK)
f. LOCK CHECK: beat frequencies over entire RF CENTER FREQ RANGE
g. EXTERNAL REF FREQ IN: Phase lock with 1MHz to 5MHz @1V to 5V P-P
h. FINE RF CENTER FREQ range: ≥1MHz @4GHz RF CENTER FREQ

13. INCIDENTIAL FM

IF: ≤200Hz
LO + IF: ≤2kHz
LO + IF when phase locked: ≤300Hz

*14. RF CENTER FREQ

Dial accuracy: ±(2MHz +1%)

15. SPURII

≤2X noise

*16. IF ATTENUATOR

Accuracy: ±.1dB/dB

17. GAIN RANGE: ≥50dB

18. DISPLAY FUNCTIONS

with 6cm reference

LOG	
@-20dB	3cm ±0.8cm
@-40dB	discernable
LIN	
@-6dB	3cm ±0.5cm
@-26dB	discernable
SQ LAW	
@-13dB	discernable to ≤1cm
VIDEO	
Bandwidth:	lower limit ≤16Hz
	upper limit ≥10MHz

*19. DISPLAY FLATNESS

Bands 1,2&3: within 3dB
Bands 4&5: within 6dB

*20. SENSITIVITY

	Frequency	Sensitivity with RESOLUTION fully ccw	Sensitivity with RESOLUTION fully cw	Signal Generator
Band 1				
	1.5 GHz	-110dBm, min	-90dBm, min	HP8614A
	2.5 GHz		-90dBm, min	HP8616A
	4 GHz		-90dBm, min	HP8616A
Band 2				
	3.8 GHz		-80dBm, min	Polorad 1107
	5 GHz		-80dBm, min	Polorad 1107
	8.2 GHz		-80dBm, min	Polorad 1107
Band 3				
	8 GHz		-75dBm, min	Polorad 1108
	10 GHz		-75dBm, min	Polorad 1108
	12.4 GHz		-75dBm, min	Polorad 1108
Band 4				
	12.4 GHz		-70dBm, min	HP626A
	15 GHz		-70dBm, min	HP626A
	18 GHz		-70dBm, min	HP628A
Band 5				
	18 GHz		-60dBm, min	HP628A
	26.5 GHz		-60dBm, min	HP628A/HP938
	40 GHz		-50dBm, min	HP628A/HP940

THE END

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

A. HONEYCOMB

Factory Test Limits are limits an 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.

1. PRESET CONTROLS

SW 201	100V SAWTOOTH
GAIN	ccw
VIDEO FILTER	OFF
VERTICAL DISPLAY	LIN
DISPERSION RANGE	MHz/CM
DISPERSION	10
IF CENTER FREQ	0-0-0
FINE	midrange
VERTICAL POSITION	midrange

2. RESISTANCE CHECK

Terminal	Approximate Reading	Approximate Reading (Reverse Meter Polarity)
A	0Ω	0Ω
B	inf	inf
C	inf	inf
D	inf	inf
E	4k	4k
F	2.7k	3.5k
G	inf	inf
H	inf	5k
U	inf	3k
J	30k	30k
K	20k	20k
L	inf	4k
M	12k	12k
N	inf	3k
O	inf	3k
P	100k	100k

3. SWEEPER

a. Setup
   attach power
b. Check and adjust sweeper
   adjust R290 -0.7VDC at pin P
   check for sawtooth pin M

4. 70MHz OSCILLATOR

a. Setup
   Inter-connect
   bandpass filter
   IF amplifiers
   IF attenuators
   Apply 200MHz to J120
b. Adjust L444
   most positive voltage, Q450 emitter
   back ¼ turn

5. IF RESPONSE

a. Setup
   10X probe to coax, C534
b. Adjust IF amplifier

Adjust	Located	Conditions	For
L144	Wide band	20dB Atten ON GAIN fully cw	max signal
C425, 435	Narrow band	20dB Atten OFF GAIN fully cw	max noise
T454, 464	Narrow band	GAIN fully cw	max signal
C137	Wide band	20dB Atten ON GAIN fully cw	max signal

6. SWEEPER LINEARITY

a. Setup .1μS markers from TYPE 184
b. Adjust C358 for 1 mark/cm:
   non linearity ±1% max

7. IF CENTER FREQ RANGE: ±25MHz min

Adjust R290

8. MHz/CM ACCURACY linearity ±2%

TYPE 184 Marker	DISPERSION MHz/CM	CM/ MARK	Max error
.1μS	10	1	0.16cm
.1μS	5	2	0.2cm
.5μS	2	1	0.32cm
1μS	1	1	0.4cm
1μS	.5	2	0.64cm
5μS	.2	1	0.8cm

9. DISPERSION RANGE kHz/cm

a. Setup 500kHz/cm
b. Adjust C384, C385 to center 200MHz
c. Adjust C384, C385 for 500kHz/cm
R238 preset at full cw then back ≈30°

10. VARIABLE RESOLUTION AMPLIFIER

a. Setup, monitor pin B
b. Adjust C504, C508 for symmetrical display at minimum amplitude

11. 75MHz AND 65MHz TRAPS

a. Setup 75MHz to J120
b. Adjust L124 for min display
c. Set 60MHz to J120
Adjust L147 for min display

12. IF ATTENUATOR

a. Setup 200MHz to J100 6 divisions
b. Check accuracy: 0.1dB/dB

HP355C	HP355D	IF ATTEN	Error +	Error -
1	0	1	0.7mm	0.7mm
2	0	2	1.4mm	1.4mm
4	0	4	2.8mm	2.7mm
8	0	8	5.8mm	5.3mm
6	10	16	1.2cm	1.0cm
0	20	20	1.5cm	1.2cm

13. 150-250MHz BANDPASS FILTER

a. Setup KAY 121B
b. Adjust C101, 102, 104, 106, 107, 108 to min
Adjust L105 length for 185 to 190MHz
Adjust C101, 102, 104, 106, 107 and 108 for (1) within 0.5dB, 160 to 240 MHz
(2) -1.5dB @150 and 250MHz
(3) -6 to -10dB @140 and 270MHz

14. LOW PASS FILTER

Check low pass filter response
(1) rolloff starts @280MHz
(2) -1dB @300MHz
(3) -3dB @320MHz

15. COMBINED FILTERS

a. Setup
Connect all leads, pads, and filters
b. Check response
±0.75dB with ≤1.5dB down at 150 and 250MHz

16. SYSTEM FLATNESS

a. Setup add power
b. Check IF flatness ±1dB
Adjust C137 and L134
c. Check converted flatness ±1.5dB

17. IF SENSITIVITY -110 to -115dBm
@100kHz RESOLUTION

SECTION B PHASE LOCK ASSEMBLY

1. PRESETS

TYPE 547 (Plug-in Scope)
HORIZONTAL DISPLAY A
TRIGGERING (TIME BASE A)
MODE AUTO
SLOPE +
COUPLING AC
SOURCE NORM INT
TIME/CM 1mSEC

1. PRESETS (CONT)

TYPE 547 (Test Scope) with
TYPE 1A1

HORIZONTAL DISPLAY	A
TRIGGERING (TIME BASE B)	
MODE	AUTO
SLOPE	+
SOURCE	NORM INT
COUPLING	AC
TIME/CM	1μSEC
VOLTS/CM	.05

2. RESISTANCE

to ground:

PIN	Approx Resistance	Approx Resistance Reverse Meter Polarity
A	Gnd	Gnd
B	Inf	Inf
C	Inf	Inf
D	3k	9k
E	Inf	Inf
F	20k	20k
G	2k	1.8k
H	Inf	Inf
I	2.5	2.8
J	Inf	Inf

3. 1MHz OSCILLATOR

a. Setup: connect power
b. Adjust 1MHz Oscillator start, L804: least delay
c. Adjust Ref Freq Range, L800: >1kHz to <1.3kHz

4. GATE BALANCE

a. Setup
b. Adjust Gate Balance, R850, to Electrical center with FINE RF CENTER FREQ ccw (Press PHASE LOCK)

5. AVALANCHE VOLTS

a. Adjust Avalanche Volts, R831: just cw of free running
b. Check EXT REF FREQ IN: no countdown 1 to 5MHz

6. INT REF FREQ

a. Setup: hetrodyned display
b. Check accuracy: 1MHz ±1000Hz

SECTION C COMPLETED TYPE 1L40

1. PRESET CONTROLS

2. RESISTANCE

Check resistance from ground to:

Pin No.	Approximate Resistance	Reverse leads
1	60kΩ	90kΩ
2	0Ω	0Ω
3	5.5kΩ	5.5kΩ
4	inf	inf
5	inf	inf
6	inf	inf
7	inf	inf
8	inf	inf
9	3.6kΩ	4kΩ
10	3.6kΩ	3.5kΩ
11	50kΩ	100kΩ
12	inf	inf
13	inf	inf
14	inf	inf
15	1.2kΩ	1.2kΩ
16	inf	inf

3. POSITION

b. Check range: positions trace out of graticule area

4. POWER SUPPLIES

Supply	Honeycomb Square pin	Voltage	Ripple
+10V	F	+9.5V to 10.5V	20mA
-10V	E	-9.5V to -10.5V	20mA

5. SWEEPER

b. Adjust IF CF Range, R290 -0.65V to -0.9V at pin P of Honeycomb connector
c. Adjust DTR Freq Cal, R253
d. Adjust Swp Ctr, R204
e. Adjust DISP BAL

6. MHz/CM DISPERSION

b. Adjust DISP CAL: 10MHz/CM
c. Adjust MHz/CM Linearity, C358: ≤1% linearity
d. Check MHz/CM DISPERSION: linearity ≤2%

TYPE 184 MARKERS 10nS and	DISPERSION MHz/CM	cm/mark	max error in 8cm
.1μS	10	1	0.16cm
.1μS	5	2	0.2cm
.5μS	2	1	0.32cm
1μS	1	1	0.4cm
1μS	.5	2	0.64cm
5μS	.2	1	0.8cm

7. IF AMPLIFIER

b. Make adjustments as in the following table:

symbol	location	conditions	adjust for
L144	wide band amplifier	20dB ATTEN ON GAIN full cw	max signal
C425 C435	narrow band amplifier	20dB ATTEN OFF GAIN full cw	max noise ampl
T454 T464	narrow band amplifier	GAIN full cw	max signal

Repeat the above adjustments as they interact.

8. PRESET RESOLUTION

a. Replace coax mixer with MIXER ADAPTOR
b. Adjust C504 and C508
c. Adjust C610
d. Adjust C620
e. Adjust L624

9. kHz/CM DISPERSION

a. Set VERTICAL DISPLAY to LOG
b. Adjust C384, C385 and kHz/CM Cal, R368: 500kHz/CM
c. Check kHz/CM dispersion: accuracy ±0.2cm in center 8cm linearity 2.5%
Use 10nS marker and marker from chart:

DISPERSION kHz/CM	TYPE 184 MARKERS	Div/mark Display
500	1μS	2
200	5μS	1
100	10μS	1
50	10μS	2
20	50μS	1
10	.1mS	1
5	.1mS	2
2	.5mS	1
1	1mS	1

d. Check for latchup

10. IF CENTER FREQ RANGE

	DISPERSION	Range at least	FINE IF CF Range
b.	10MHz	±10MHz	
c.	5MHz	±25MHz	
d.	500kHz	±2.5MHz	
e.	20kHz		±50kHz
	.5MHz		±1MHz

11. RESOLUTION

a. Set VERTICAL DISPLAY to LIN
b. Adjust C504 and C508
c. Adjust C610
d. Adjust C620
e. Adjust L624
f. Adjust 100kHz Resolution Cal, R543: Bandwidth 55kHz to 65kHz, check for ≥105kHz, dip <3dB
h. Check ccw bandwidth ≤1kHz

12. PHASE LOCK

a. Replace MIXER ADAPTOR with coax mixer
b. Adjust L804: min start delay
c. Check INT REF FREQ range: >1.001MHz to <1.003MHz
f. Check INT REF FREQ accuracy: ±1kHz
e. Adjust Gate Bal, R850: trace at electrical center when FINE RF CENTER FREQ full ccw (Press LOCK CHECK)
f. Check LOCK CHECK: beat frequencies

g. Check EXT REF FREQ in: Phase lock with 1V @1MHz to 5MHz
h. Check FINE RF CENTER FREQ range: ≥1MHz @4.0GHz

13. INCIDENTAL FM

b. Check IF incidental FM: ≤200Hz
c. Check LO + IF incidental FM: <2kHz
d. Check LO + IF incidental FM when phase locked: ≤300Hz

14. RF CENTER FREQ

b. Check dial accuracy: ±(2MHz ±1%)

15. SPURII

b. Check spurious signals: ≤2X noise

16. IF ATTENUATOR

a. Setup : 6cm
b. Check IF ATTENUATOR accuracy: ±.1dB/dB

HP355C	HP355D	IF ATTEN	Error +	Error −
1	0	1	0.7mm	0.7mm
2	0	2	1.4mm	1.4mm
4	0	4	2.8mm	2.7mm
8	0	8	5.8mm	5.3mm
6	10	16	1.2cm	1.0cm
0	20	20	1.5cm	1.2cm

17. GAIN RANGE: ≥50dB

18. DISPLAY FUNCTIONS

Referenced to 6cm
a. Check LOG: 3cm ±0.8cm @-20dB discernable @-40dB
b. Check LIN: 3cm ±0.5cm @-6dB discernable @-26dB
c. Check SQ LAW: discernable to ≤1cm @-13dB
e. Check VIDEO: -3dB @≤16Hz

19. DISPLAY FLATNESS

a. Adjust C137 and L134: best flatness
b. Check display flatness:
within 3dB on bands 1, 2 and 3
within 6dB on bands 4 and 5

20. SENSITIVITY

	Frequency	Sensitivity with RESOLUTION fully ccw	Sensitivity with RESOLUTION fully cw	Signal Generator
Band 1				
	1.5 GHz	-110dBm, min	-90dBm, min	HP86I4A
	2.5 GHz		-90dBm, min	HP8616A
	4 GHz		-90dBm, min	HP8616A
Band 2				
	3.8 GHz		-80dBm, min	Polorad 1107
	5 GHz		-80dBm, min	Polorad 1107
	8.2 GHz		-80dBm, min	Polorad 1107
Band 3				
	8 GHz		-75dBm, min	Polorad 1108
	10 GHz		-75dBm, min	Polorad 1108
	12.4 GHz		-75dBm, min	Polorad 1108
Band 4				
	12.4 GHz		-70dBm, min	HP626A
	15 GHz		-70dBm, min	HP626A
	18 GHz		-70dBm, min	HP628A
Band 5				
	18 GHz		-60dBm, min	HP628A
	26.5 GHz		-60dBm, min	HP626A/HP938
	40 GHz		-50dBm, min	HP628A/HP940

THE END

A. HONEYCOMB

1. PRESET CONTROLS

TYPE 1L40

SW 201 (rear panel)	100V SAWTOOTH
GAIN	ccw
VIDEO FILTER	OFF
VERTICAL DISPLAY	LIN
DISPERSION RANGE	MHz/CM
DISPERSION	10
RESOLUTION	COUPLED
IF CENTER FREQ	0-0-0
FINE	midr
VERTICAL POSITION	midr

2. RESISTANCE CHECK

Set multimeter to X1k and check resistance between honeycomb connector strip pins and chassis as in the following table:

Terminal	Approximate Reading	Approximate Reading (Reverse Meter Polarity)
A	0Ω	0Ω
B	inf	inf
C	inf	inf
D	inf	inf
E	4k	11k
F	2.7k	3.5k
G	inf	3k
H	inf	2.7k
I	inf	3k
J	inf	2.7k
K	inf	10k
L	inf	4k
M	12k	12k
N	inf	inf
O	inf	inf
P	100k	100k

3. SWEEPER

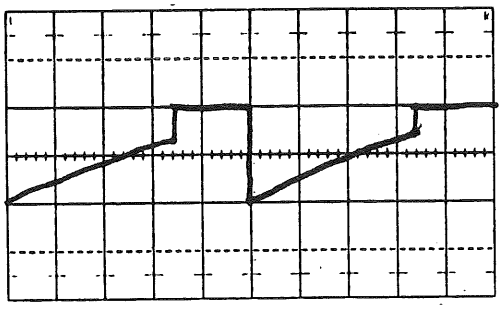
a. Setup

Plug the TYPE 1A1 into the test scope. Set the test scope TIME/CM to 10mSEC and TRIGGERING to EXT AC. Connect the plug-in scope + GATE to test scope TRIGGER INPUT.

3a. (CONT)

Connect the Honeycomb chassis to test plug-in with a square-pin extension cable. Connect the test plug-in scope with flexible extension. Turn test scope and plug-in scope POWER ON. Set plug-in scope TIME/CM to 5mSEC.

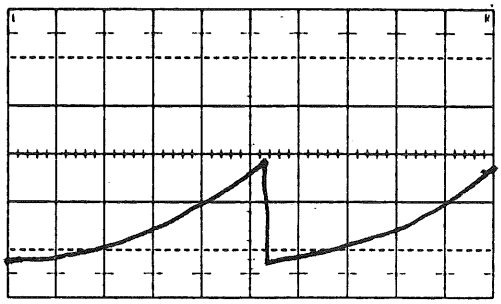
Connect an orange lossy cable (175-0384-03) between J373 and J370. Connect another cable (175-0384-03) between J376 and J379. Set SW365 (toggle switch on honeycomb) toward J376.



Test Scope Display

b. Check and adjust sweeper

Adjust the IF CF RANGE, R290, for approximately -0.7VDC at pin P of the square-pin connector strip with a meter. Connect a 10X probe from pin M of the square pin connector strip to TYPE 1A1 PLUG-IN INPUT. Check for a waveform similar to Notes with TYPE 1A1 VOLTS/CM at 1. Remove meter from pin P.



4. 70MHz OSCILLATOR

a. Setup

Connect J147 to J151 and J148 to J363. Connect J188 to J401.

Attach an N to BNC adapter to the HP608D RF OUTPUT connect the adapter to a 50Ω BNC cable and a BNC to Selectro cable to J120.

Connect Q450 emitter to the TYPE 1A1 CH 1 INPUT via a X10 probe.

Set the HP608D for 200MHz at -50dBm.

b. Adjust L444

Set the TYPE 1A1 CH 1 to .02 VOLTS/CM and INPUT SELECTOR to DC.

Adjust L444 by turning slug into coil for most positive voltage after oscillator starts. Then turn slug back ¼ turn.

5. IF RESPONSE

a. Setup

Set TYPE 1A1 VOLTS/CM to .005, AC coupled. Connect a 10X probe from pin B of square pin connector to TYPE 1A1 INPUT. Set the test scope TIME/CM to 5mSEC. Set the plug-in scope TIME/CM to 2mSEC. Set test plug-in DISPERSION RANGE to MHz/CM, DISPERSION to .2 and RESOLUTION full cw. Adjust HP608D DBM for convenient display amplitude.

b. Adjust IF amplifier response

Make adjustments as in the following table:

ckt symbol	location	conditions	adjust for
L144	wide band amplifier	20dB ATTEN ON GAIN full cw	max signal
C425 C435	narrow band amplifier	20dB ATTEN OFF GAIN full cw	max noise ampl
T454 T464	narrow band amplifier	GAIN full cw	max signal
C137	wide band amplifier	20dB ATTEN ON GAIN full cw	max signal

Repeat the above adjustments as they interact.

6. SWEEPER LINEARITY

a. Setup

Remove the 50Ω cable from the HP608D output and connect to the TYPE 184 MARKER OUTPUT. Set the TYPE 184 for 10ns (100MHz) markers.

W370 and W375 should be selected for best linearity.

b. Adjust sweeper linearity: Non-linearity 1% max

Adjust CRT FREQ CAL R253 for no shift of the 200MHz harmonic as DISPERSION switch is rotated between 10MHz and .2MHz. Set DISPERSION to 10MHz. Adjust Sweep Center R204, to set 200MHz display at the graticule center line.

6b. (CONT)

Press 10nS and .1μS on the TYPE 184. Set test plug-in DISPERSION CAL for 1 mark/cm. Adjust C358 (sweeper circuit) for best linearity over the center 8cm of the display area. Monitor pin M and recheck sawtooth.

7. IF CENTER FREQ CONTROL RANGE

±25MHz, min

Set test plug-in DISPERSION control to 5MHz/cm, COUPLED RESOLUTION. Turn IF CENTER FREQ fully ccw. Turn IF CENTER FREQ slowly cw while counting the time marks that pass under the center graticule line of the plug-in scope.

Adjust IF CF RANGE (R290) for at least 5 time marks from full ccw to full cw on the IF CENTER FREQ dial.

7. If R290 is adjusted it will be necessary to repeat steps 3 to 6. Be sure that voltage at pin P is between -0.7V and -1.0V. If not, replace D361 and readjust R290 for -0.7V at pin P.

8. MHz/CM DISPERSION ACCURACY

Check MHz/CM according to the following table, with IF CENTER FREQ at 000 and to 25MHz each side of center. Keep the 10nS MARKER SELECTOR depressed. Linearity: 2%.

TYPE 184 Marker	DISPERSION MHz/CM	CM/ MARK	Max error
.1μS	10	1	0.16cm
.1μS	5	2	0.2cm
.5μS	2	1	0.32cm
1μS	1	1	0.4cm
1μS	.5	2	0.64cm
5μS	.2	1	0.8cm

d. Dispersion error is measured over the center 8cm of display. Linearity is the displacement from its proper position of any marker compared to an exact 8cm dispersion.

Dispersion error is measured to only 10MHz each side of 000 on IF CENTER FREQ at 10MHz/CM.

9. DISPERSION RANGE kHz/cm

a. Setup

Disconnect the 50Ω BNC cable from the TYPE 184 MARKER OUTPUT and connect to the HP608D OUTPUT.

Set the test plug-in DISPERSION to 500. Set HP608D for 200MHz.

Preset C384 three turns from completely in and C385 four and one-half turns from completely in. (Sweeper Circuit).

b. Adjust center frequency to 200MHz

Locate the center frequency by changing the HP608D FREQUENCY. Adjust C384 and C385 to center 200MHz on the plug-in scope graticule.

Disconnect the 50Ω cable from the BNC adapter at HP608D RF Output.

c. Adjust kHz/cm

Connect the 50Ω cable to the TYPE 184 MARKER OUTPUT. Set the TYPE 184 MARKER SELECTOR to 1μs. Adjust C384 and C385 for 500kHz/cm (1 mark/2cm). Check linearity over the center 8cm of the plug-in scope graticule to + and - 2.5MHz each side of center frequency. Connect the 50Ω cable to the TYPE 184 HF OUTPUT and set IF OUTPUT to 5ns. Check center frequency adjustment as in the previous step.

R368 should be set full cw than back (ccw) 30°.

10. VARIABLE RESOLUTION AMPLIFIER

a. Setup

Connect the plug-in scope SWEEP A to the test plug-in SWEEP INPUT and the test TRIGGER INPUT via a BNC "T" connector and 2 50Ω BNC cables. Connect the X10 probe from PIN B of the square pin connector strip to the TYPE 1A1 INPUT.

Connect the TYPE 184 MARKER OUTPUT to J120 on the honeycomb.

Set the TYPE 1A1 for .01 VOLTS/CM AC. Set the test scope TIME/CM to 20mSEC, SOURCE to EXT and MODE to TRIG.

10a. (CONT)

Set the plug-in scope TIME/CM to 20mSEC and STABILITY fully cw.

Set the test plug-in DISPERSION to 50 and RESOLUTION fully cw.

b. Adjust C504 and C508

Set the test Plug-in 100kHz Resolution to mid-range. Position the display to center with IF CENTER FREQ.

Adjust T464 and T465 for max signal. Adjust C504 and C508 for most symmetrical display on the test scope when display on plug-in is at minimum amplitude. Plug-in scope display must have >100kHz bandwidth at -6dB (half-amplitude) on display.

Turn Resolution 1 step ccw and check for 50 to 65kHz bandwidth at -6dB on display.

b. 100kHz Resolution if already set from previously adjusted honeycomb should not be readjusted.

If the bandwidth is too wide replace D506.

Readjust R543 for 50 to 65kHz bandwidth if necessary and repeat step 10b.

11. 75MHz and 65MHz TRAPS

a. Setup

Disconnect the 50Ω BNC cable from the TYPE 184 MARKER OUTPUT and connect to HP608D OUTPUT. Adjust the HP608D for a rise in baseline at 75MHz.

b. Adjust 75MHz trap

Spread wires of L124 (wide band amplifier) for minimum deflection on test scope CRT's.

11. (cont'd)

c. Adjust 65MHz trap

Adjust HP608D for a rise in the baseline at 65MHz. Adjust L147 for minimum deflection on test scope and plug-in scope CRT's.

12. IF ATTENUATOR

a. Setup

Remove the P6040 probe from J120. Reconnect J109 to J120. Connect the HP608D output through the HP 355C and HP355D. Connect the HP355D through a 50Ω BNC cable and a X10 attenuator. Using the BNC to GR adapter and P6040 probe connect to J100. Remove the X10 probe from the square-pin connector. Switch the HP355C to 1 and HP355D to 0.

Set the HP608D for -30dBm at 200MHz. Set the test plug-in GAIN for exactly 6cm of display on the plug-in scope.

b. Check IF ATTENUATOR accuracy: ±.1dB/dB

Switch HP355C to 0 and switch the IF ATTEN 1dB on. Check for 6cm ±.7mm.

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

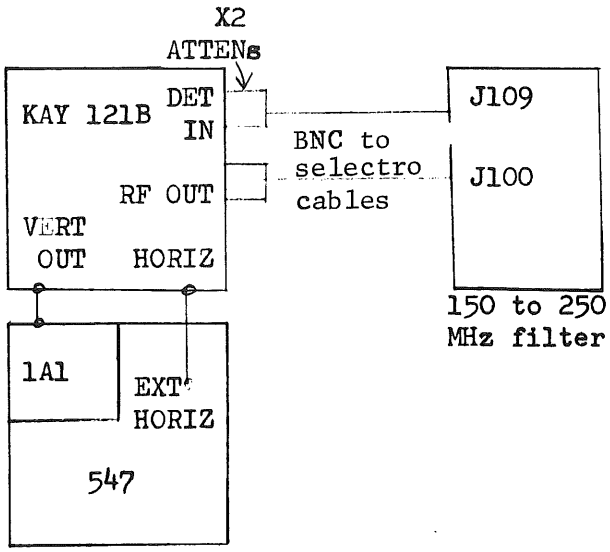
HP355C	HP355D	IF ATTEN	Error +	Error -
1	0	1	0.7mm	0.7mm
2	0	2	1.4mm	1.4mm
4	0	4	2.8mm	2.7mm
8	0	8	5.8mm	5.3mm
6	10	16	1.2cm	1.0cm
0	20	20	1.5cm	1.2cm

150-250MHz BANDPASS FILTER

a. Setup

Set the KAY 121B UHF CENTER FREQ to VHF SET. Set UHF-VHF to VHF. Set SWEEP WIDTH to WIDE and RF ATTENUATOR to Zero.

Make connections as shown below:



Connect TYPE 1A1 CH 1 OUT to CH 2 INPUT. Set CH 1 VOLTS/CM to .005 and CH 2 VOLTS/CM to .01. Set MODE to CH 2.

Set test scope for EXT HORIZ input.

Set KAY 121B VHF CENTER FREQ to ≈200. Set HARMONIC MARKERS to 100MC. Adjust second Harmonic of the 100MC markers to the test scope graticule center.

Connect BNC to GR adapter together, connecting RF OUT 50Ω to DET IN. Set KAY 121B VAR RF LEVEL ADJ for 6cm of vertical deflection on the test scope.

Reconnect BNC to GR adapters to the proper P6040 probes.

13. (cont'd)

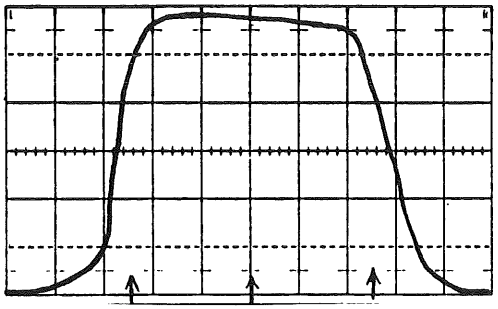
b. Adjust 150MHz to 250MHz filter

Set C101, 102, 104, 106, 107 and 108 to minimum. Adjust L105 for a center frequency of 180 to 190MHz.

Adjust C101, C102, C104, C106, C107 and C108 to obtain the following conditions:

(1) within 0.5dB (≃5.3 to 5.9div) peak to peak flatness, 160MHz to 240MHz
(2) -1.5dB (≃4.3div) at 150MHz and 250MHz
(3) 6 to 10dB down at 140MHz and 270MHz (≃1.5div to 0.5div)

b. Final check on level should be made using KAY121C attenuator.



183MHz is usually the best center frequency for L105.

14. LOW PASS FILTER

a. Check Lowpass filter response

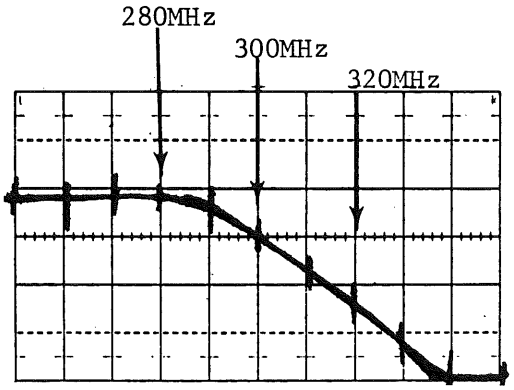
Connect the Kay 121B RF OUT to J80 and DET IN to J94.

Check for approximately 2dB insertion loss.

Switch Kay 121B UHF-VHF to UHF. Set UHF CENTER FREQ for 300MHz (use 100 MHz marker). Switch HARMONIC MARKERS to 10MHz.

Check for rolloff starting at approximately 280MHz, -1dB at 300MHz and -3dB at 320MHz.

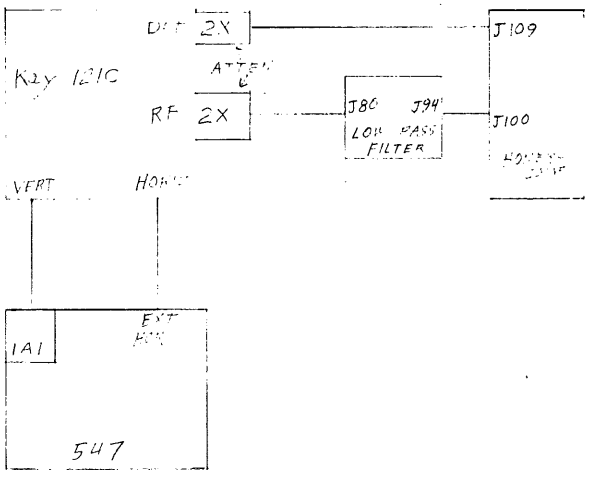
Adjustment of filter can be done by changing coil spacing and parts dress (cover not on).



15. COMBINED FILTERS

a. Setup

Connect as in the following diagram:



b. Check overall filter response within 1.5dB

Set KAY121C to VHF, CENTER FREQ to 200. Set UHF CENTER FREQ to VHF SET. Readjust the filters as necessary to obtain smoothest overall response. Allow no more than -1.5dB at 150MHz and 250MHz.

b. The flatness of the TYPE 1L40 is best with flat overall filter response.

16. SYSTEM FLATNESS

a. Setup

Connect the honeycomb chassis to the test plug-in with the 1L20-1L30 square pin connector. Connect the test plug-in to the plug-in scope. Switch POWER to ON.

Set test plug-in IF CENTER FREQ to 000, DISPERSION RANGE to MHz/CM and the DISPERSION to 10.

Connect the HP608D OUTPUT to the RF INPUT. Set the HP608D for 200MHz out.

16. (cont'd)

Adjust R253, center Freq Cal, for no display shift as DISPERSION is switched between 10 and .2. Return DISPERSION to 10.

Adjust R204, Swp Center, to center display.

Remove the HP608D from the RF INPUT. Connect the TYPE 184 MARKER OUTPUT to the test plug-in RF INPUT. Push the TYPE 184 .1μS MARKER SELECTOR.

Adjust DISP CAL for 1 mark/cm.

Remove the TYPE 184 MARKER OUT from the test plug-in RF INPUT.

b. Check IF flatness: within 2dB

b. R137 is selected to allow C137 to adjust the slope flatness response.

Set KAY 121B Attenuator to -50dB. Connect the KAY 121B RF OUT to the test plug-in RF INPUT. Set HARMONIC MARKERS to OFF, VHF-UHF to VHF, UHF CENTER FREQ to VHF SET. Set the VHF CENTER FREQ to 200 and SWEEP WIDTH to WIDE. Place honeycomb bottom down on metal plate.

Adjust C137 and L134 for best flatness. If these adjustments do not change the "tilt" of the response, select R137. The Display amplitude must not vary more than 2dB across graticule area. Remove the Kay 121B RF OUT from test plug-in RF INPUT.

If flatness is not within limits listed, repeat step 15.

c. Check converted flatness: within 3dB

Connect an HP8614A to the RF INPUT via a TYPE N cable.

Set test plug-in DISPERSION to 10MHz. Set RF CENTER FREQ to 1.5GHz. Set the HP8614A for 1550GHz out.

Move the signal from the left graticule edge to the right graticule edge by turning the RF CENTER FREQ. The display amplitude must not vary more than 3dB across graticule area.

Continue to check every 100MHz from 1.5GHz to 4.2GHz using the HP8614A and HP8616A.

17. IF SENSITIVITY -110 to -115dBm

Set RESOLUTION fully cw. Adjust the test plug-in GAIN for a display of 1cm of noise. Connect the HP608D to the RF INPUT. Set HP608D ATTEN dial to -90dBm, and frequency for 200MHz.

Turn the HP608D ATTEN dial ccw until the signal amplitude is 2cm. Read IF sensitivity from the HP608D ATTEN dial.

B. PHASE LOCK ASSEMBLY

1. PRESETS

TYPE 547 (Plug-in Scope)

HORIZONTAL DISPLAY	A
TRIGGERING (TIME BASE A)	
MODE	AUTO
SLOPE	+
COUPLING	AC
SOURCE	NORM EXT
TIME/CM	1mSEC

TYPE 547 (Test Scope) with TYPE 1A1

HORIZONTAL DISPLAY	A
TRIGGERING (TIME BASE A)	
MODE	AUTO
SLOPE	+
SOURCE	NORM INT
COUPLING	AC
TIME/CM	1μSEC
VOLTS/CM	.05

Phase Lock Chassis

Gate Balance R850	midr
Avalanche Volts R831	midr

2. RESISTANCE

Measure resistance between ground and the connector pins according to the following table:

PIN	Approx Resistance	Approx Resistance Reverse Meter Polarity
A	Gnd	Gnd
B	inf	inf
C	inf	inf
D	3k	9k
E	inf	inf
F	20k	20k
G	2k	1.8k
H	inf	inf
I	2.5k	2.8k
J	inf	inf
J850	50Ω	50Ω

3. 1MHz OSCILLATOR

a. Setup

Connect the phase lock assembly to the 1L40 with the square pin connector cable.

Connect the BNC connector on the phase lock assembly to the 1L40 RF INPUT via a BNC 50Ω cable and a BNC to N adaptor.

Connect the TYPE 1L40 to the plug-in scope and turn POWER to ON.

3. (cont'd)

b. Adjust 1MHz Oscillator, L804

Connect a 10X probe from end of C821 that connects to R821 to TYPE 1A1 INPUT.

Adjust L804 for center of range where oscillator will turn on with least delay when INT REF FREQ (R809) is turned from its full ccw position.

b. If avalanche is working 1MHz Oscillator can be monitored at BNC out if desired.

c. Adjust Ref Freq Range, L800: >1kHz to <1.3kHz

Set Test plug-in DISPERSION RANGE to kHz/CM and DISPERSION to 50. Adjust L800 for a 4.6cm movement of the IF display as INT REF FREQ is rotated from ccw to cw. Check that oscillator starts each time INT REF FREQ is turned on.

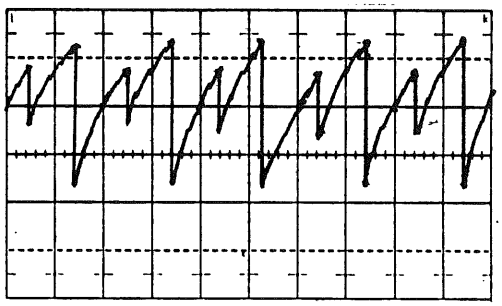
c. If markers do not appear on Plug-in Scope adjust Avalanche Volts, R831 for markers.

4. AVALANCHE VOLTS

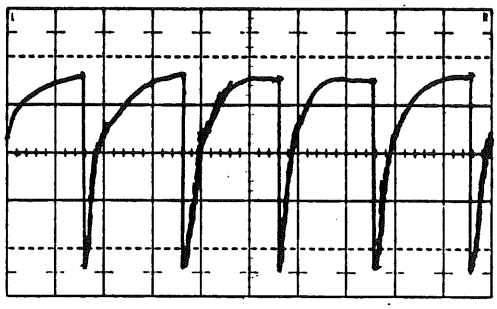
Adjust Avalanche Volts, R831

Connect the 10X probe from the collector of Q840 to the TYPE 1A1 input. Adjust Avalanche Volts, R831, fully ccw. Note bursts approximately every .5μs on test scope. Turn Avalanche Volts, R831, cw until display appears as shown in notes. Remove 10X probe.

4. If bursts do not appear every .5μs adjust R831 just cw of stop.



R831 fully cw



R831 correctly adjusted

5. GATE BALANCE

a. Adjust Gate Balance, R850

Set the trace at the bottom graticule line on the plug-in scope. Set the FINE RF CENTER FREQ fully ccw. Adjust Gate Balance, R850 until the trace noise just disappears while LOCK CHECK is pushed. Check for less than 1cm of base line shift.

b. Check beat notes: entire RF CENTER FREQ range

Connect the RF oscillator to J850. Connect the TYPE 191 OUTPUT to the BNC connector. Set for 1 V out at 5MHz. Vary test plug-in RF CENTER FREQ and check for beat frequency displays throughout its range.

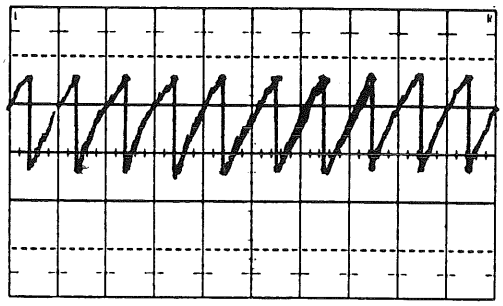
5. (CONT)

c. Check EXT REF FREQ IN

Set the TYPE 191 for 1V out at 1MHz. Check the test scope for a 1MHz display.

Vary the TYPE 191 OUTPUT between 1MHz and 5MHz. The test scope must display the same frequency as the 191 with no countdown.

Remove the 10X probe from Q840 collector.



5MHz display

6. INT REF FREQ

a. Setup

Connect the TYPE 184 MARKER OUTPUT to the TYPE 1A1 CH 1. Connect the BNC connector on the phase lock assembly to the TYPE 1A1 CH 2. Set the TYPE 1A1 CH 1 to 1V/CM and CH 2 to .2V/CM and MODE to ADD. Set TIME/CM to 1mSEC. Adjust the TYPE 547 triggering to trigger on blurred square wave display (difference display).

b. Check accuracy: 1MHz ±1000Hz

Check for no more than 1 blurred square wave per CM.

C. COMPLETED TYPE 1L40

1. PRESET CONTROLS

a. TYPE 547 (plug-in scope)

HORIZONTAL DISPLAY	A
TRIGGERING	
MODE	AUTO
SLOPE	+
SOURCE	EXT
TIME/CM	10mSEC

b. TYPE 1L40

IF ATTEN	off
IF CENTER FREQ	000
FINE	midrange
DISPERSION RANGE	MHz/CM
DISPERSION/RESOLUTION	10MHz
VIDEO FILTER	down
VERTICAL DISPLAY	LIN
FINE RF CENTER FREQ	midrange
DISP CAL	midrange
IF CENTER FREQ CAL	midrange
DISP BAL	midrange
GAIN	midrange
MIXER PEAKING	ccw
Internal Adjustments	
R368	10° from cw
R290	midrange
R543	"
R666	"
R253	"
R204	"
C610	"
C620	midrange
L624	flush

2. RESISTANCE

Measure resistance to ground at amphenol connector to the following:

Pin No.	Approximate Resistance	Reverse leads
1	60kΩ	90kΩ
2	0Ω	0Ω
3	5.5kΩ	5.5kΩ
4	inf	inf
5	inf	inf
6	inf	inf
7	inf	inf
8	inf	inf
9	3.6kΩ	4kΩ
10	3.6kΩ	3.5kΩ
11	50kΩ	100kΩ
12	inf	inf
13	inf	inf
14	inf	inf

2. (CONT)

Pin No.	Approximate Resistance	Reverse leads
15	1.2kΩ	1.2kΩ
16	inf	inf

3. POSITION

a. Setup

Connect the TYPE 1L40 via the flexible extension cable to the plug-in scope. Turn plug-in scope POWER to ON.

b. Check range: positions trace out of graticule area

Turn position control cw. Trace must position above graticule area.

Turn position control cw. Trace must position below graticule area.

Return the trace to the bottom of graticule and horizontally center trace.

4. POWER SUPPLIES

Check +10V and -10V at the honeycomb square-pin connector according to the following table:

	Pin	Voltage	Ripple
+10V	F	+9.5V to +10.5V	20mV
-10V	E	-9.5V to -10.5V	20mV

5. SWEEPER

a. Setup

TYPE 547 (test scope)
- HORIZONTAL DISPLAY: A
- TIME/CM: 20mSEC
- TRIGGERING
  - MODE: AUTO
  - SLOPE: +
  - SOURCE: EXT

TYPE 1A1
- CH 1 VOLTS/CM: 1
- MODE: CH 1
- INPUT: DC

5a. (CONT)

Connect plug-in scope SAWTOOTH OUT to the TYPE 1L40 SWEEP INPUT. Set the SAWTOOTH SELECTOR to 100V.

Connect a 10X probe from the TYPE 1A1 CH 1 to pin M on the honeycomb connector strip. Connect a voltmeter between pin P and ground.

b. Adjust IF CF Range, R290

Adjust IF CF Range, R290, for approximately -0.7V at pin P of the honeycomb connector strip.

Check test scope for a display of sawtooth waveform with no waveform discontinuity.

b. R253 and R204 may require slight readjustment.

c. Adjust CTR Freq Cal, R253

Connect the TYPE 184 H.F. OUTPUT to the TYPE 1L40 RF INPUT via BNC cable, HP355C, HP355D, and BNC to N Adapter. Set the TYPE 184 HF SELECTOR to 5nS. Set the HP355D to 20. Adjust the TYPE 1L40 GAIN for ≃4cm of display. Set DISP BAL to midrange.

Adjust Freq Cal, R253 for no display shift as DISPERSION is switched through its range.

d. Adjust Sweep Ctr, R204

Turn plug-in scope sweep off. Measure the DC resting voltage of the scope. Turn sweep on again. Adjust Sweep Control, R204 to place the signal at the graticule center if DC resting voltage was ±0.5V. Adjust to right of graticule center 1mm for each volt DC resting voltage was negative. Adjust to left of graticule center 1mm for each volt DC resting voltage is positive.

d. If scope has a 150V sawtooth correction is 1mm each 1.5 volts.

Repeat steps c through d. Remove meter leads.

6. MHz/CM DISPERSION

a. Setup

Press the 10nS and .1μS MARKER SELECTOR on the TYPE 184. Set H.F. SELECTOR to OFF. Move the BNC 50Ω cable from the TYPE 184 H.F. OUTPUT to MARKER OUTPUT. Switch the TYPE 1L40 DISPERSION RANGE to MHz/CM and DISPERSION/RESOLUTION to 10MHz. Adjust the TYPE 1L40 GAIN for approximately 4cm of display.

b. Adjust DISP CAL

Adjust DISP CAL to set the 2nd and 9th 10MHz markers under the 1cm and 9cm graticule lines.

c. Adjust MHz/CM linearity, C358

Adjust MHz/CM linearity, C358, for best linearity of the 10MHz markers. W370 and W375 may be selected for linearity. If good linearity cannot be obtained, readjust IF CF Range, R290, for between -0.7 and -1.0V at pin P.

Remove meter leads and 10X probe.

c. W370 connects J370 to J373. W375 connects J376 to J379. CTR Freq Cal, R253, must be readjusted if cables are changed.

If R290 is readjusted repeat steps 5 and 6. R290 affects the IF CENTER FREQ range.

d. Check MHz/CM DISPERSION

Check MHz/CM according to the following table, with IF CENTER FREQ at 000 and to 25MHz each side of center. Keep the 10nS MARKER SELECTOR depressed. Linearity: 2%.

TYPE 184 Marker	DISPERSION MHz/CM	CM/ MARK	Max error
.1μS	10	1	0.16cm
.1μS	5	2	0.2cm
.5μS	2	1	0.32cm
1μS	1	1	0.4cm
1μS	.5	2	0.64cm
5μS	.2	1	0.8cm

d. Dispersion error is measured over the center 8cm of display. Linearity is the displacement from its proper position of any marker compared to an exact 8cm dispersion.

Dispersion error is measured to only 10MHz each side of 000 on IF CENTER FREQ at 10MHz/CM DISPERSION.

R247 can be selected to provide sufficient sweep (5.1k to 100k).

7. IF AMPLIFIER

a. Setup

Change the 50Ω BNC cable from the TYPE 184 MARKER OUTPUT to the HF OUTPUT. Switch HF SELECTOR to 5ns. Set the TYPE 1L40 DISPERSION to .2 and RESOLUTION fully cw. Adjust GAIN fully cw. Adjust the HP355C and HP355D for convenient level.

b. Adjust IF amplifier response

Make adjustments as in the following table:

symbol	location	conditions	adjust for
L144	wide band amplifier	20dB ATTEN ON GAIN full cw	max signal
C425 C435	narrow band amplifier	20dB ATTEN OFF GAIN full cw	max noise ampl
T454 T464	narrow band amplifier	GAIN full cw	max signal

Repeat the above adjustments as they interact.

8. PRESET RESOLUTION

a. Setup

Set the DISPERSION to .2MHz/CM and RESOLUTION fully cw. Replace the coax mixer with the MIXER ADAPTOR (RF INPUT).

Connect the plug-in scope SWEEP A to the test plug-in SWEEP INPUT and the test TRIGGER INPUT via a BNC "T" connector and 2 50Ω BNC cables. Connect the X10 probe from PIN B of the honeycomb connector strip to the TYPE 1A1 INPUT.

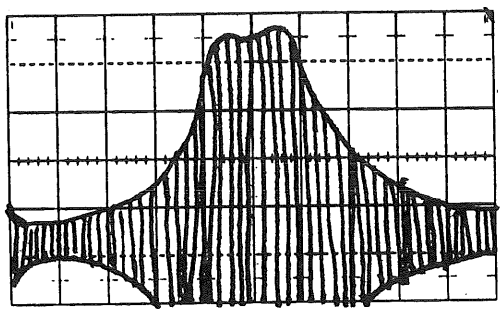
Set the TYPE 1A1 INPUT for .01 VOLTS/CM AC. Set the test scope TIME/CM to 10mSEC, SOURCE to EXT and MODE to TRIG.

Adjust TYPE 1L40 GAIN for 6cm of display. Center the display with the IF CENTER FREQ.

8. (CONT)

b. Adjust C504 and C508

Adjust C504 and C508 for most symmetrical display on test scope. Set the TYPE 1L40 100kHz Resolution Cal, R543, for a change in plug-in scope resolution bandwidth when RESOLUTION is switched 1 step ccw. Adjust T454 and T464 for best symmetry and maximum amplitude.



Test Scope display

c. Adjust C610

Set RESOLUTION to 5MHz position. Adjust C610 for the best symmetry of the waveform near the baseline on the plug-in scope. It may be helpful to increase the TYPE 1L40 GAIN for this adjustment.

d. Adjust C620

Set RESOLUTION fully cw. Adjust C620 for best symmetry of the upper slope of the waveform.

e. Adjust L624

Adjust L624 to round off the shoulders near the mid-point of the waveform.

9. kHz/CM DISPERSION

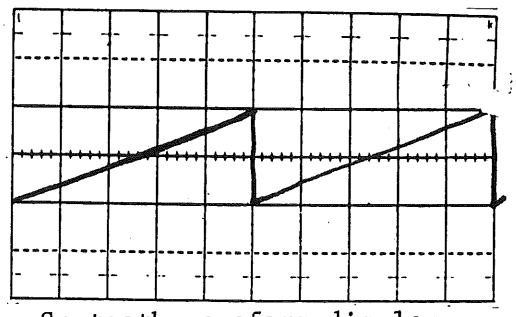
a. Setup

Set the plug-in scope TIME/CM to 5mSEC. Set the TYPE 1L40 DISPERSION RANGE to kHz/CM. Set VERTICAL DISPLAY to LOG.

Move the 50Ω BNC cable from the TYPE 184 HF OUTPUT to the TYPE 184 MARKER OUTPUT. Push the 10nS MARKER SELECTOR. Set HF SELECTOR to OFF.

b. Adjust C384, C385, and kHz/cm Cal, R368

Set the TYPE 1L40 DISPERSION to 500kHz/cm. Adjust C384 and C385 in opposite directions to keep the 200MHz mark at the graticule center line. PRESS the 10nS and 1μS MARKER SELECTORS. Adjust C384 and C385 for best linearity. Adjust kHz/cm Cal, R368, for 1 mark every 2cm. Check for linearity 2.5MHz each side of IF CENTER FREQ 000.



Sawtooth waveform display

b. If 200MHz mark is not at center adjust C384 and C385 together to place mark at CRT centerline.

Select R244 for sufficient sweep.

9. (CONT)

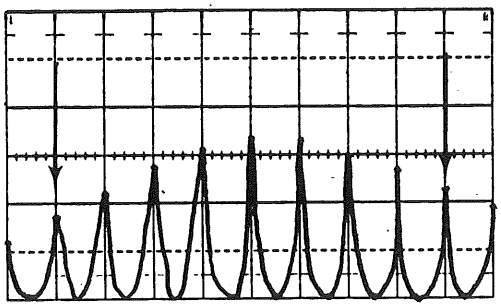
c. Check kHz/cm dispersion

Keep the TYPE 184 10nS MARKER SELECTOR depressed for each measurement. Check linearity and dispersion accuracy ±0.2cm coupled resolution.

Dispersion error is measured to 2.5MHz each side of 000 on the IF CENTER FREQ dial.

DISPERSION kHz/cm	TYPE 184 MARKERS	Div/mark Display
500	1μS	2
200	5μS	1
100	10μS	1
50	10μS	2
20	50μS	1
10	.1mS	1
5	.1mS	2
2	.5mS	1
1	.5mS	2

c. Use VIDEO FILTER on lower ranges for better resolution.



100kHz Dispersion

d. Check for latchup

Switch the TYPE 1L40 DISPERSION RANGE back and forth between MHz/CM and kHz/CM. Check that there is a display each time the DISPERSION RANGE is operated with IF CENTER FREQ between +200 and -200 and DISPERSION at 2MHz.

d. Probable cause for latchup
1) Mechanical misalignment of DISPERSION RANGE switch
2) C358

10. IF CENTER FREQ RANGE

a. Setup

Push the TYPE 184 10nS and .1μS MARKER SELECTORS.

Set the TYPE 1L40 DISPERSION RANGE to MHz/CM and DISPERSION/RESOLUTION to 10MHz.

b. Check IF CENTER FREQ range at 10MHz DISPERSION: ≥10MHz

Turn the IF CENTER FREQ control fully ccw. The first 10MHz righthand sideband must move to the left of the graticule center.

Turn the IF CENTER FREQ control fully cw. The first left hand 10MHz sideband must move to the right of the graticule center.

b. If IF CENTER FREQ control range is insufficient readjust R290 and repeat steps 5, 6, 7, 8, 9 and 10.

Steps 10b, c and d are typically checked as a part of steps 6 and 9.

10. (CONT)

c. Check IF CENTER FREQ range at 5MHz DISPERSION: >25MHz

Push the TYPE 184 10nS MARKER SELECTOR. Set DISPERSION to 5MHz. Check that the display can be positioned beyond each end of the graticule area with the IF CENTER FREQ control.

d. Check kHz/cm IF CENTER FREQ range: >2.5MHz

Change DISPERSION RANGE to kHz/CM. Check that the display can be positioned beyond each end of the graticule area with the IF CENTER FREQ control.

e. Check FINE IF CENTER FREQ range: in MHz/CM ±1MHz
in kHz/CM ±50kHz

Set FINE IF CENTER FREQ full ccw. Set DISPERSION to 20kHz/CM. Position the display to the left graticule edge with the IF CENTER FREQ. Turn the FINE IF CENTER FREQ fully cw. The display must move at least 2.5cm to the right.

Set DISPERSION RANGE to MHz/CM. Position the display to the right graticule edge with the IF CENTER FREQ. Turn the FINE IF CENTER FREQ fully ccw. The display must move at least 5cm to the left.

11. RESOLUTION

a. Setup

Set DISPERSION RANGE to kHz/CM, DISPERSION to 50kHz/cm and RESOLUTION fully cw. Set VERTICAL DISPLAY to LIN.

Connect the plug-in scope SWEEP A to the test plug-in SWEEP INPUT and the test TRIGGER INPUT via a BNC "T" connector and 2 50Ω BNC cables. Connect the X10 probe from PIN B of the honeycomb connector strip to the TYPE 1A1 INPUT.

11a. (CONT)

Set the TYPE 1A1 INPUT for .01 VOLTS/CM AC. Set the test scope TIME/CM to 10mSEC, SOURCE to EXT and MODE to TRIG. Adjust TYPE 1L40 GAIN for 6cm of display. Center the display with the IF CENTER FREQ.

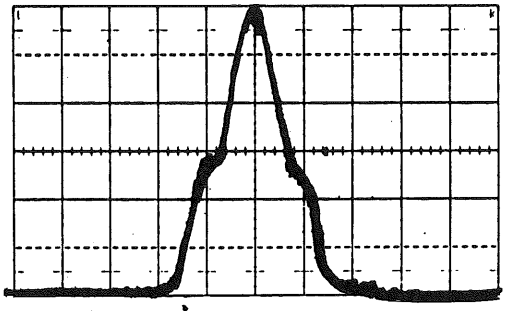
b. Adjust C504 and C508

Set the TYPE 1L40 100kHz Resolution Cal, R543, for a slight dip of approximately 0.5dB (6%) in the center of the test scope display. Adjust C504 and C508 for most symmetrical display on test scope when display on plug-in scope has 105kHz bandwidth.

b. T454 and T464 should be readjusted to give best resolution.

c. Adjust C610

Set RESOLUTION to 500kHz position and leave DISPERSION at 50. Adjust C610 for the best symmetry of the waveform near the baseline on the plug-in scope. It may be helpful to increase the TYPE 1L40 GAIN for this adjustment.



1 step ccw resolution L624, C610 slightly misadjusted

d. Adjust C620

Adjust C620 for best symmetry of the upper slope of the waveform.

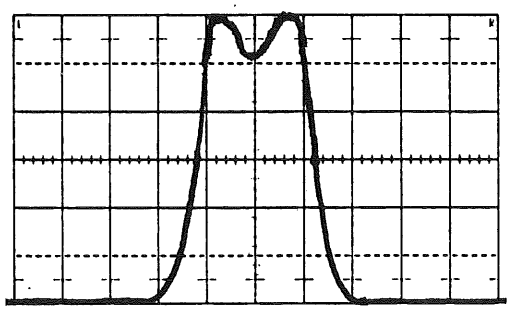
e. Adjust L624

Adjust L624 to round off the shoulders near the mid=point of the waveform.

f. Adjust 100kHz Resolution Cal, R543: bandwidth 55 to 65kHz fully cw: dip <3dB, bandwidth ≥105kHz

f. C504 and C508 may require readjustment after setting R543.

Set RESOLUTION 1 position ccw of full cw. Adjust the 100kHz Resolution Cal, R543, for midpoint (-6dB) bandwidth of 60kHz. Set Resolution fully cw. Check bandwidth for ≥105kHz. Dip at top of waveform must not exceed -3dB.



RESOLUTION fully cw adjusted

Check min bandwidth: <1kHz

Set DISPERSION to 1 and RESOLUTION fully ccw. Bandwidth should be less than 1kHz at the half-amplitude point (-6dB). Check that the bandwidth increases with each step of the RESOLUTION as it is rotated cw.

12. PHASE LOCK

a. Setup

Connect the TYPE 184 MARKER OUTPUT to the test scope TYPE 1A1 CH 1 INPUT. Press the TYPE 184 1μS MARKER SELECTOR. Set the TYPE 1A1 MODE to ADD. Connect a 50Ω BNC cable from the TYPE 1L40 1MHz CAL MARKERS OUT to the TYPE 1A1 CH 2 INPUT. Set the TYPE 1A1 CH 1 VOLTS/CM to 1 and CH 2 VOLTS/CM to .1. Set TEST SCOPE TIME/CM to 1mSEC. Adjust the test scope TRIGGERING to trigger on the blurred square wave display when INT REF FREQ VARIABLE is set cw. Replace the MIXER ADAPTOR with the coax mixer.

b. Check oscillator start: adjust L804: min starting delay

Turn INT REF FREQ VARIABLE to OFF, then turn cw. Set L804 for the center of range where oscillator starts each time VARIABLE is turned on.

c. Check INT REF FREQ range: >1kHz to <1.3kHz

Set the TYPE 1L40 DISPERSION RANGE to kHz/cm DISPERSION to 50, and IF CENTER FREQ to 000. Connect the TYPE 1L40 1MHz CAL MARKERS OUT to the RF INPUT. The display on the Plug-in scope must move 4 to 5.2cm as the INT REF FREQ VARIABLE is rotated from ccw to cw.

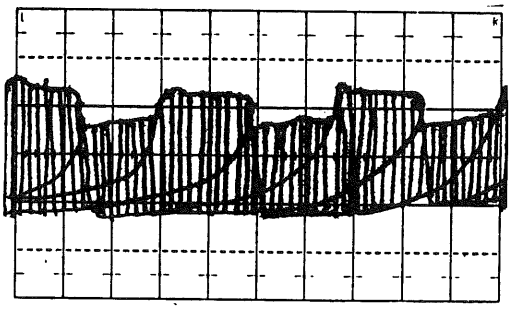
Adjust L800 if necessary for 4.6cm movement.

d. Check Frequency accuracy: ±1kHz

Reconnect the TYPE 1L40 CAL MARKERS OUT to the TYPE 1A1 CH 2 INPUT. Turn the INT REF FREQ VARIABLE on but leave fully ccw. Check for less than 10 complete fuzzy square waves on the test scope.

c. Harmonics at the RF CENTER FREQ will also show in this step.

They will move across the graticule at a greater rate than the IF harmonic. The 4 to 5.2cm of movement refers to the IF Harmonic.



Step 12d display

12. (CONT)

e. Adjust Gate Balance, R850: FINE RF CENTER FREQ full ccw

Turn INT REF FREQ VARIABLE ON. Set FINE RF CENTER FREQ fully ccw. Adjust Gate Balance, R850, so that the noise on trace just disappears while LOCK CHECK is pushed. Check that noise disappears at fully cw end. Balance the adjustment for equal range of no noise at either end.

Set FINE RF CENTER FREQ fully ccw. Check for less than 1cm of baseline shift when LOCK CHECK is pushed

f. Check LOCK CHECK: beat frequencies over the entire RF CENTER FREQ range

Press LOCK CHECK and look for wide trace at intervals as the RF CENTER FREQ is varied through its entire range.

g. Check EXT REF FREQ IN: phase lock with 1V @1MHz to 5MHz

Set INT REF FREQ to OFF. Connect the TYPE 191 OUTPUT to the TYPE 1L40 EXT REF FREQ IN via a BNC "T" connector and 50Ω BNC cable. Connect a 50Ω BNC cable from the test scope input to the "T" connector. Set the TYPE 191 AMPLITUDE for 1V out at 50kHz as measured on the test scope.

Connect the TYPE 184 HF OUTPUT to the TYPE 1L40 RF INPUT via the 200MHz trap and the ring box. Set the TYPE 184 HF SELECTOR to 2nS. Set the TYPE 191 for 1MHz out.

Check that the signal display on the plug-in scope pauses every 1MHz as the RF CENTER FREQ is tuned across the entire band.

Set the TYPE 191 for 5MHz out. Check that the display pauses every 5MHz across the entire band.

Remove the TYPE 191 connections.

12. (CONT)

h. FINE RF CENTER FREQ range ≥1MHz @4GHz

Apply TYPE 184 via Harmonic generator and 200MHz Filter to RF INPUT. Tune the RF CENTER FREQ for the 4.0GHz signal. Set DISPERSION to 100kHz.

Check that the FINE RF CENTER FREQ will move the 4.0GHz signal ≥10cm.

13. INCIDENTAL FM

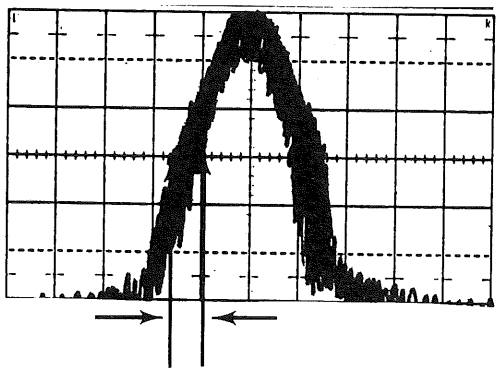
a. Setup

Remove the 200MHz filter. Detune RF CENTER FREQ so that the 200MHz IF feed-through is displayed. Set DISPERSION to 1kHz keeping the 200MHz display centered with the IF CENTER FREQ.

b. Check IF incidental FM: ≤200Hz

Set the plug-in scope TIME/CM to .2SEC. Check that trace width of the rising portion of the display does not exceed .2cm.

b. Excessive IF FM: replace Q260 in discriminator comparator.



Incidental FM

c. Check LO + IF incidental FM: ≤2kHz

Set the INT REF FREQ VARIABLE to OFF. Tune RF CENTER FREQ so the 4.0GHz signal is displayed. Check that the horizontal trace shift of the rising portion of the waveform is not greater than 2cm.

d. Check LO + IF incidental FM with phase lock: <300Hz

Set the INT REF FREQ VARIABLE to VARIABLE. Change DISPERSION to 500kHz. Press LOCK CHECK and tune FINE RF CENTER FREQ for widened trace. Center the 4.0GHz signal with the IF CENTER FREQ.

Set DISPERSION to 1kHz keeping the 4.0GHz signal centered with the IF CENTER FREQ. Check for no more than .3cm of trace width on the rising portion of the display.

14. RF CENTER FREQ

a. Setup

Set the TYPE 1L40 INT REF FREQ to OFF, DISPERSION RANGE to MHz, DISPERSION to 10MHz and the IF CENTER FREQ to 000. Set FINE RF CENTER FREQ and FINE IF CENTER FREQ to midrange. Set plug-in scope TIME/CM to 5mSEC. Apply TYPE 184 via Harmonic generator, 200MHz filter and a 10dB Atten (011-0085-00) to the TYPE 1L40 RF INPUT.

b. Check dial accuracy: ±(2MHz +1%)

Set the RF CENTER FREQ according to the following table. Check that with the signal indicated at graticule center that tape reads within indicated error on Band 1.

RF CENTER FREQ	cw display direction	signal displayed	max error
1.5	→	1.5GHz	17MHz
1.6	←	2.0GHz image	18MHz
1.7	←	4.0GHz image	19MHz
1.8	←→	weak	.02GHz
1.9	→	4.0GHz	21MHz
2.0	→	2.0GHz	22MHz
2.1	←	2.5GHz image	23MHz
2.2	←	5.0GHz image	24MHz
2.3	←→	weak	25MHz
2.4	→	5.0GHz	26MHz
2.5	→	2.5GHz	27MHz
2.6	←	3.0GHz image	28MHz
2.7	←	6.0GHz image	29MHz
2.8	→←	weak	.03GHz
2.9	→	6.0GHz	31MHz
3.0	→	3.0GHz	32MHz
3.1	←	3.5GHz image	33MHz
3.2	←	7.0GHz image	34MHz
3.3	←→	weak	35MHz
3.4	→	7.0GHz	36MHz
3.5	→	3.5GHz	37MHz
3.6	←	4.0GHz image	38MHz
3.7	←	8.0GHz image	39MHz
3.8	→←	weak	.04GHz
3.9	→	8.0GHz	41MHz
4.0	→	4.0GHz	42MHz

Disconnect the TYPE 184 from the TYPE 1L40.

15. SPURII

a. Setup

Set DISPERSION RANGE to MHz and DISPERSION to 10. Connect a 50Ω terminator to the TYPE 1L40 RF INPUT. Rotate the INT REF FREQ to the VARIABLE position. Adjust GAIN for 1cm of noise.

b. Check spurious signals: ≤2X noise

Tune RF CENTER FREQ across its entire range. Check that no display of signal is greater than 2cm in amplitude.

16. IF ATTENUATOR

a. Setup

Connect the HP608D OUTPUT via an HP355C, HP355D, and 50Ω 10X attenuator to the TYPE 1L40 RF INPUT. Set the TYPE 1L40 DISPERSION RANGE to kHz/CM.

Set the HP608D for -10dBm at 200MHz. Set the HP355D to 0 and the HP355C to 1. Adjust the 1L40 GAIN for exactly 6cm of display.

b. Check IF ATTENUATOR accuracy: ±.1dB/dB

Switch the HP355C to 0. Switch the 1dB IF ATTENUATOR on. Check for 6cm ±.7mm of display.

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

HP355C	HP355D	IF ATTEN	Error +	Error -
1	0	1	0.7mm	0.7mm
2	0	2	1.4mm	1.4mm
4	0	4	2.8mm	2.7mm
8	0	8	5.8mm	5.3mm
6	10	16	1.2cm	1.0cm
0	20	20	1.5cm	1.2cm

17. GAIN RANGE >50dB

Select R410 to obtain 0.5cm of noise with the TYPE 1L40 GAIN fully cw and the VIDEO FILTER on. Switch the VIDEO FILTER off and note an increase in noise. The minimum value of R410 is 33k.

Set the HP355D and HP355C to 0. Turn the TYPE 1L40 GAIN fully ccw. Remove the X10 Attenuator. Adjust the HP608D ATTEN for a 6cm display.

Switch HP355D to 50 and turn the TYPE 1L40 GAIN fully cw. Check for at least 6cm of display.

18. DISPLAY FUNCTIONS

a. Check LOG: dynamic range, 40dB min

Set the TYPE 1L40 VERTICAL DISPLAY switch to LOG. Apply a 200MHz signal at -40dBm from HP608D to RF INPUT. Tune the TYPE 1L40 RF CENTER FREQUENCY and adjust GAIN for a 6cm display of the -200MHz signal. Add 20dB attenuation with IF ATTENUATOR dB and check for a 3cm display ±0.8cm. Remove the IF ATTENUATOR dB attenuation. Set HP608D to -80dBm. Check that the signal is still discernable.

b. Check LIN: dynamic range, 26dB min

Set the TYPE 1L40 VERTICAL DISPLAY to LIN. Set HP608D to -30dBm. Adjust TYPE 1L40 GAIN for 6cm display. Add 6dB attenuation with IF ATTENUATOR dB. Check for 3cm ±0.5cm display. Remove IF attenuation. Set HP608D for -56dBm. Check that signal is still discernable.

c. Check SQ LAW: dynamic range, 13dB min 1.0div max, at -13dB

Set the TYPE 1L40 VERTICAL DISPLAY switch to SQ LAW. Set the HP608D ATTEN to -50dBm. Set TYPE 1L40 GAIN for 6cm display. Adjust HP608D ATTEN for -63dBm. Check for a discernable signal of 1.0cm or less amplitude.

18. (CONT)

d. Check TO RECORDER: 12mV to 20mV with 600Ω load and 6cm display

Set the TYPE 1L40 VERTICAL DISPLAY to LIN and adjust GAIN for 6cm of 200MHz display. Connect the 600Ω load cable between the TO RECORDER jack and the TYPE 1A1 CH 1 INPUT.

Check for 12 to 20mV of display on the test scope.

Connect TYPE 1A1 CH 1 out to CH 2 INPUT. Set MODE to CH 2.

Set the TYPE 1A1 VOLTS/CM and VARIABLE for 6cm of DISPLAY on the test scope. Add 6dB attenuation with the IF ATTEN dB and check for 3cm ±0.5cm of display.

e. Check VIDEO: -3dB @ ≤16Hz

Set the TYPE 1L40 VERTICAL DISPLAY to VIDEO. Turn the GAIN control fully cw. Connect the LFSWG OUTPUT to the TYPE 1L40 VIDEO INPUT. Set the LFSWG for 4cm of 50kHz on the plug-in scope.

Set the LFSWG for 16Hz out. Check for at least 2.8cm of display on the plug-in scope.

19. DISPLAY FLATNESS

a. Adjust C137 and L134

Set the TYPE 1L40 DISPERSION RANGE to MHz and DISPERSION to 10. Set RF CENTER FREQ to 1550MHz and VERTICAL DISPLAY to LIN.

Connect the HP8614A to the TYPE 1L40 RF INPUT. Set the HP8614A for -50dBm out at 1550MHz. Adjust the TYPE 1L40 GAIN and IF ATTEN for 6cm at the point of maximum display amplitude. (Rotate RF CENTER FREQ.)

Tune the 1550MHz signal across the graticule area and adjust C137 and L134 for the least total variation in amplitude. Variation must not exceed 3dB , maximum to minimum.

19. (CONT)

b. Check display flatness: within 3dB on bands 1, 2 and 3 within 6dB on bands 4 and 6

Set the HP8614 for 1650MHz. Set the signal generator for a 6div display when signal is maximum across graticule area. Then use the 1dB and 2dB IF ATTENUATORS to establish the -3dB point.

Move the display from the left edge of graticule to the right edge of the graticule with the RF CENTER FREQUENCY control. Check for no more than a 3dB range of display amplitude.

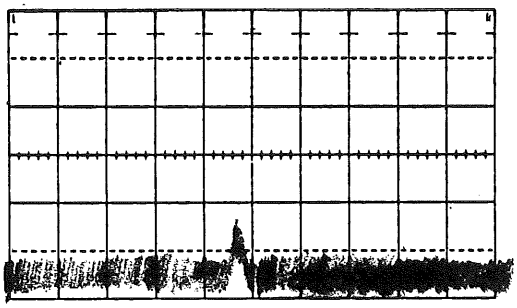
Continue to check every 100MHz. Change signal generators as necessary. Check that no amplitude variation in any display window exceeds 3dB on bands 1, 2 and 3. Check that no display variation exceeds 6dB of range on bands 4 and 5.

Use the following chart for obtaining necessary frequency outputs for display flatness check:

Frequency range	Signal Generator	Connections
1.5 to 2.4GHz	HP8614A	"N" cable to coax mixer
1.8 to 4.5GHz	HP8616A	
3.8 to 8.2GHz	Polorad 1107	
7 to 11.0GHz	Polorad 1108	
11.0 to 12.4GHz	HP626A	HP MX-292B to HP X281A to "N" cable to coax mixer
12.4 to 15.5GHz	HP626A	HP MP-292B to 119-0097-00 mixer to TNC cable to MIXER ADAPTOR
15.5 to 18.0GHz	HP628A	HP NP-292A to 119-0097-00 mixer to TNC cable to MIXER ADAPTOR
18 to 21GHz	HP628A	HP NK-292A to 119-0097-00 mixer to TNC cable to MIXER ADAPTOR
20 to 26.6GHz	HP626A	HP MP-292B to HP11503A flexible waveguide to HP MP-292B to HP938A doubler to FXR K-634AF waveguide to 119-0098-00 mixer to TNC cable to MIXER ADAPTOR
26.5 to 31GHz	HP626A	HP MP-292B to HP11503A flexible waveguide to HP NP-292A to HP940A doubler to FXR U-634AF waveguide to 119-0099-00 mixer to TNC cable to MIXER ADAPTOR.
31 to 40GHz	HP628A	HP NP-292A to HP11503A flexible waveguide to HP NP-292A to HP240A doubler to FXR U634AF waveguide to 119-0099-00 mixer to TNC cable to MIXER ADAPTOR

20. SENSITIVITY

Set the TYPE 1L40 DISPERSION RANGE to kHz/cm. Set RESOLUTION fully cw and DISPERSION to 500kHz. Connect the HP8614A to the TYPE 1L40 RF INPUT with a TYPE N cable. Set the HP 8614A for 1500MHz and locate signal using RF CENTER FREQ control. Adjust MIXER PEAKING for maximum signal indication. Check that signal is at least twice noise amplitude with -90dBm out of generator.



Signal twice noise

Set RESOLUTION fully ccw and DISPERSION to 1kHz. Check for signal at least twice the noise amplitude at -110dBm.

Set DISPERSION to 500kHz and RESOLUTION fully cw. Check sensitivity according to the following table. Consider the "N" cable as a 3dB attenuator at 10GHz and a 5dB attenuator at 12.4GHz.

Frequency	Minimum Sensitivity	Signal Generator	Connections
BAND 1			
1.5GHz	-90dBm	HP8614A	"N" cable to coax mixer
2.5GHz	-90dBm	HP8616A	
4.0GHz	-90dBm	HP8616A	
BAND 2			
3.8GHz	-80dBm	Polorad 1107	
5.0GHz	-80dBm	Polorad 1107	
8.2GHz	-80dBm	Polorad 1107	
BAND 3			
8.0GHz	-75dBm	Polorad 1108	
10.0GHz	-75dBm	Polorad 1108	
12.4GHz	-75dBm	HP626A	HP MX292B to HP X281A to "N" cable
BAND 4			
12.4GHz	-70dBm	HP626A	HP MP292B to 119-0097-00 mixer to TNC cable to MIXER ADAPTOR
15GHz	-70dBm	HP626A	
18GHz	-70dBm	HP628A	HP NP292A to 119-0097-00 mixer to TNC cable to MIXER ADAPTOR
BAND 5			
18GHz	-60dBm	HP628A	HP NK292A to 119-0098-00 to TNC cable to MIXER ADAPTOR
26GHz	-60dBm	HP626A	HP MP292B to HP11503A flexible waveguide to HP MP-292B to HP938A doubler to FXR K634AF waveguide to 119-0098-00 mixer to TNC cable to MIXER ADAPTOR
40GHz	-50dBm	HP628A	HP NP292A to HP11503A flexible waveguide to HP NP292A to HP940A doubler to FXR U634AF waveguide to 119-0099-00 mixer to TNC cable to MIXER ADAPTOR

THE END