FACTORY CALIBRATION PROCEDURE

CONTENTS:

INTRODUCTION:

10A2A

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

Tek form number:
0-409
January 1967

For all serial numbers.

FACTORY TEST LIMITS:

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

QUALIFICATION:

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

ABBREVIATIONS:

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

CHANGE INFORMATION:

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

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

1	TYPE 543B OSCILLOSCOPE
*1	TYPE 661 OSCILLOSCOPE
*1	TYPE 647A OSCILLOSCOPE
1	TYPE 1A1 PLUG-IN UNIT
*1	TYPE 4S2A DUAL-TRACE SAMPLING UNIT
*1	TYPE 5T3 TIMING UNIT
1	TYPE 11B2 TIME BASE
1	TYPE 106 SQUARE-WAVE GENERATOR
*1	TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR
1	TYPE 109 PULSE GENERATOR
1	TYPE CT-2 Current Transformer
1	TYPE P6041 Probe
1	TYPE P6006 10X Passive Probe

b. Test Fixtures and Accessories

*1	HF Sine-Wave Generator (067-0532-00)
1	GR RG8/213 cable (017-0502-00)
*1	Standard Amplitude Calibrator (SAC) (067-0502-00)
1	Plug-in Extension 93 /50 (067-0510-00)
1	TU-5 Pulser (015-0038-00)
1	TU-5/105 Adapter (013-0075-00)
1	20pF Input RC Normalizer (067-0538-00)
1	50Ω 5:1 Attenuator, BNC (011-0060-00)
1	50Ω 10: Attenuator, BNC (011-0059-00)
1	50Ω Termination GR to BNC (017-0083-00)
2	50Ω Terminations, BNC (011-0049-00)
1	Dual Input Cable, BNC (067-0525-00)
2	50Ω Coaxial Cables (012-0057-00)
1	50Ω 8" coaxial cable (012-0057-01 8")
1	600V Variable DC Supply (PMPE Dwg. #1421A, 1543B, 1544B, 1545B)
1	Multimeter (Simpson Model 261 or equivalent)

c. Equipment for Sample Checks

1	Capacitance compensated switch (PMPE Dwg. #1584B)
1	20pF Input Capacitance Standard (ICS)
1	Type 130 LC Meter
1	Resistance Bridge (0.25% or better accuracy at 1MΩ)
1	Linear Dynamic Range Test Fixture (PMPE Dwg #1620B)

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

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

QUALIFICATION

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

1. PRELIMINARY

a. General Inspection
b. Resistance Checks
c. Preset Controls

2. MAXIMUM INPUT VOLTAGE

b. Check Maximum Input Voltage (CH 1 & 2): 600V

3. MICROPHONICS

b. Check Microphonics (CH 1 & 2): ≤0.5cm

4. INITIAL DC ADJUSTMENTS

a. Adjust VAR ATTEN BAL (CH 1 & 2): 1.2 volts @ V133, V233 cathode
b. Adjust Inv Bal (CH 1 & 2): 1.2 volts @ Q164, Q264 base
c. Adjust Main Amp Diff Bal: Adjust for mid-screen trace
d. Adjust CH 1 Common Mode Current: 8.3V @ TP345
e. Adjust CH 2 Common Mode Current: 8.3V @ TP355
f. Adjust Main Amp Current: 0V @ TP453
g. Adjust Base Current (CH 1 & 2)
h. Adjust Inv Bal (CH 1 & 2)

5. FINAL DC ADJUSTMENTS

a. Adjust Var Atten Bal and Base Current (CH 1 & 2): ≤0.1cm shift
5b. Adjust Inv Bal (CH 1 & 2): ≤0.5cm shift
c. Adjust Grid Current Zero (CH 1 & 2): ≤1nA
d. Adjust Com Mode and Main Amp Current (CH 1 & 2): ≤25mV @ TP453
e. Adjust Main Amp Diff Bal: ≤0.2cm shift
f. Check Vertical Output DC Level (sample check): 9V ±0.3V
g. Adjust CH 2 Output DC Level: 0V ±60mV, NORM; 0V ±100mV, CH 2 ONLY
h. Adjust Norm Trig DC Bal: 0V ±0.2V

6. GAIN

*b. Adjust CH 1 Gain
*c. Adjust CH 2 Gain
d. Check Added Operation: ±2.5% inaccuracy
e. Check VARIABLE VOLTS/CM (CH 1 & 2): ≥2.5:1 variable ratio
f. Check Input Switch (CH 1 & 2): input coupling must correspond to setting of INPUT switch
*g. Check Attenuator Accuracy (CH 1 & 2): ≤1% error
h. Check POSITION Range (CH 1 & 2): + & - 8-12cm

7. INPUT TIME CONSTANT

b. Adjust X1 Input C: ≤1% aberration
c. Adjust Atten Compensation: ≤1% aberration
d. Adjust Input Time Constant: ≤1% aberration

8. TRIGGER AND CH 2 OUT GAIN

a. Check CH 2 Out Gain: ≥100mv/ displayed cm
b. Check Norm Trigger Gain: 0.2v/ displayed cm +20% -10%

9. MULTI-TRACE

a. Check Alternate Operation: display must alternate between CH 1 and CH 2 at all settings of TIME/CM

9. (cont'd)

b. Check Chopped Operation: ≤0.2cm aberrations, rate = 15 MHz ±15%

10. TRANSIENT RESPONSE (Preliminary)

11. TRANSIENT RESPONSE

*b. Adjust Transient Response (CH 1 & 2) 2.5ns t_r ≤3% aberrations
c. Check Normal Trigger Response: ≤4.5ns t_r ≤15% aberrations
d. Check CH 2 Only Trigger Response: ≤7.5ns t_r ≤15% aberrations
e. Check Overall Transient Response: ≤4% aberration
f. Check Added Mode Overshoot: ≤6%
g. Check CH 2 OUTPUT Response: ≤10% aberration

12. BANDPASS

*a. Check CH 1 and CH 2 Bandpass: ≥108 MHz @ - 3dB
*b. Check CH 2 OUTPUT Bandpass: ≥30 MHz @ - 3dB

13. COMMON MODE REJECTION

*b. Check Common Mode Rejection: ≥20:1 up to 50 MHz

14. INTER-CHANNEL ISOLATION

a. Check Amplifier Isolation (CH 1 & 2): ≥200:1 @ 25 MHz
b. Check Attenuator Isolation (CH 1 & 2): ≥10,000:1 @ 25 MHz

15. ATTENUATOR ABERRATIONS

b. Check Attenuator Aberrations (CH 1 & 2): ≤6% .02 to 5V; ≤10% 10 & 20V

16. SAMPLE CHECKS

a. Check Added Mode Linear Dynamic Range (CH 1 & 2): ≤5% distortion at ≥12 times VOLT/CM setting
b. Check Input Capacitance: 20pF ±3%
c. Check Input DC Resistance: 1MΩ ±1%

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

1. PRELIMINARY

a. Make General Inspection

Make a careful inspection for unsoldered connections, rosin joints, and long wire ends. Check for loose hardware and protruding parts. Check controls for smooth mechanical operation, proper indexing and knob spacing. Correct all defects found.

b. Check Resistance

Check for the specified resistance to gnd on each pin of the amphenol plug (-meter lead connected to gnd).

pin no.	meter scale	approx. resistance
1		∞ (NC)
2	X100K	1.2MΩ
3	X1	25Ω
4		∞ (NC)
5	X100	200Ω
6		∞ (NC)
7	X100	200Ω
8-11		∞ (NC)
12	X1	0Ω
13	X100	750Ω
14	X1	0Ω
15	X100	750Ω
16	X1	0Ω
17	X100K	∞
18	X10	120Ω
19		∞ (NC)
20	X1k	7.5kΩ
21-31		∞ (NC)
32	X1	0Ω

Check all diodes for opens or shorts with the ohmeter on the X1k scale.

c. Preset Controls

Preset the front panel controls as follows:

TYPE 647A

CALIBRATOR	OFF
HORIZ POSITION	midr
INTENSITY	4
FOCUS	midr
ASTIGMATISM	midr
SCALE ILLUM	midr

1c. (cont'd)

TYPE 10A2A

CH 1 and CH 2

VOLTS/CM	10mV
VARIABLE	CALIB
POSITION	midr
input selector	GND
INVERT PULL	in
GAIN	180° from cull cw
VAR ATTEN BAL	midr
TRIGGER	NORM
MODE	CH 1

Preset all internal adjustments to midr.

TYPE 11B2

HORIZ DISPLAY	A
TIME/CM	1mSEC
TRIG MODE	AUTO

Install the TYPE 10A2A and TYPE 11B2 in the VERTICAL and HORIZONTAL plug-in compartments of the TYPE 647A. Apply power to the TYPE 647A. Allow 20 minutes operating time before making adjustments or checks.

2. MAXIMUM INPUT VOLTAGE

a. Setup

Adjust the CH 1 POSITION, Inv Bal, and VAR ATTEN BAL to position the trace to graticule center. Connect the output of the 600 Volt Variable DC Supply to the CH 1 INPUT. Set the input selector to AC and the 600 Volt Variable DC Supply to +600V.

b. Check Maximum Input Voltage (CH 1 and 2) 600V

Depress the PUSH TO TEST button and hold down for about 5 seconds. The trace must return to the graticule area after the button is released. Repeat the check with -600V. Repeat the check with the input selector in DC. Check both channels.

3. MICROPHONICS

a. Setup (CH 1 and 2)

Set the input selector to DC. Apply a 50mV calibrator signal to the INPUT and adjust the Gain Range for 5cm of vertical deflection. Remove the calibrator signal and center the trace.

b. Check Microphonics (CH 1 and 2) ≤0.5cm

Change the input selector to GND. Place the microphonics shock hammer on the top, front center of the TYPE 647A. Raise the weight to the top of the shaft and release it. The microphonics produced must not exceed 0.5cm. Check both channels.

4. INITIAL DC ADJUSTMENTS

a. Adjust VAR ATTEN BAL (CH 1 and 2)
+1.2V @ nuvistor cathode

Set the MODE to CH 1 and connect a voltmeter between the cathode of V133 and gnd. Adjust the CH 1 VAR ATTEN BAL for +1.2 volts.

Change the MODE to CH 2 and connect the voltmeter between the cathode of V233 and gnd. Adjust the CH 2 VAR ATTEN BAL for +1.2 volts.

b. Adjust Inv Bal (CH 1 and 2)
+1.2V @ Q164, 264 base

With the MODE in CH 2 connect the voltmeter between gnd and the base of Q264. Adjust Inv Bal (R260) for 1.2 Volts.

Change the MODE to CH 1 and adjust Inv Bal (R160) for 1.2 volts at the base of Q164.

c. Adjust Main Amp Diff Bal

Set the POSITION controls to midr. Adjust the Main Amp Diff Bal to position the trace to graticule center.

4. (cont'd)

d. Adjust CH 1 Common Mode Current 8.3V @ TP345

Set the MODE to CH 2 and connect a voltmeter between gnd and TP345. Adjust the CH 1 Common Mode Current for (R150) for +8.3V.

e. Adjust CH 2 Common Mode Current 8.3V @ TP355

Set the MODE to CH 1 and connect a voltmeter between gnd and TP355. Adjust the CH 2 Common Mode Current (R250) for +8.3V.

f. Adjust Main Amp Current OV @ TP453

Connect the voltmeter between gnd and TP453. Adjust the Main Amp Current (R336) for OV.

g. Adjust Base Current (CH 1 and 2)

Position the trace to a convenient reference on the graticule. Slowly rotate the VARIABLE control until the trace reaches a point of maximum displacement and starts to return to the reference. (see notes)

Adjust the Base Current (R140 or R240) to bring the trace to the opposite side of the reference point by 4 times the maximum displacement. Adjust the Inv Bal as necessary to keep the trace on screen.

h. Adjust Inv Bal (CH 1 and 2)

Pull out the INVERT PULL switch. Note the amount of trace shift and adjust the Inv Bal (R160 or R260) to bring the trace halfway back to original position. Push in the INVERT PULL switch.

g. Adjustment of the Base Current is necessary only if the trace moves from the reference to a point of maximum displacement and then starts to return to the reference.

5. FINAL DC ADJUSTMENTS

a. Adjust Var Atten Bal and Base Current (CH 1 and 2) $\leq$0.1cm shift.

Adjust the VAR ATTEN BAL and the Base Current (R140 or R240) for min trace shift while rotating the VARIABLE control through its range. The trace shift after adjustment must not exceed 1mm. Return the VARIABLE to the CALIB detent.

5. (cont'd)

b. Adjust Inv Bal (CH 1 and 2) ≤ 0.5cm shift

Adjust the Inv Bal (R160 or R260) for min trace shift as the INVERT PULL switch is pulled in and out. The trace shift after adjustment must not exceed 0.5cm. Push in the INVERT PULL switch.

b. Steps 5a and 5b interact, repeat as necessary.

c. Adjust Grid Current Zero (CH 1 and 2) ≤ 1nA

Set the input selector sw to GND and position the trace to graticule center. Adjust the Grid Current Zero (R117 or R217) so there is no trace shift as the input selector is changed from GND to DC.

d. Adjust Com Mode and Main Amp Current (CH 1 and 2) ≤ 25mV @ TP453

Set the MODE to CH 2 and position the trace to graticule center. Connect a voltmeter between TP453 and gnd. Adjust CH 2 Com Mode Current R250 for 0V.

Change the MODE to ADDED and position the trace to graticule center with CH 1 POSITION control. Adjust CH 1 Com Mode Current (R150) for 0V at TP453.

Change the MODE to CH 1 and adjust Main Amp Current for 0V at TP453.

Change the MODE to CH 2 and readjust CH 2 Com Mode Current for 0V.

The voltage at TP453 must stay within 25mV of 0V with the MODE sw in CH 1, CH 2 and ADDED.

e. Adjust Main Amp Diff Bal ≤ 0.2cm shift

Set the MODE to CH 2 and position the trace to graticule center. Change the MODE to ADDED and position the trace to graticule center with the CH 1 POSITION control. Change the MODE to CH 1 and adjust the Main Amp Diff Bal (R335) to position the trace to graticule center. Change the MODE to CH 2 and position the trace to graticule center with CH 2 POSITION control.

f. Check Vertical Output DC Level (sample check) 9V±0.3 average

Set the MODE to CH 1 and position the trace to graticule center. Connect the DC Voltage Bridge between gnd and pin 5 on the amphenol plug. Note the voltage reading (V_1). Connect the Voltage Bridge between gnd and pin 7 on the amphenol plug. Note the voltage reading V2. The average voltage $\left(\frac{V1 + V2}{2}\right)$ must be 9V ± 0.3V.

5e. (cont'd)

The trace must remain within 0.2cm of graticule center as MODE is switched to each setting.

g. Adjust CH 2 Output DC Level
0V ±60mV NORM, 0V ±100mV CH 2 ONLY

Set the front panel controls as follows:

CH 1 VOLTS/CM	.01
CH 1 input selector	DC
CH 2 input selector	GND
TRIGGER	NORM
MODE	CH 1

Position the trace to graticule center. Connect a 50Ω coaxial cable from the CH 2 OUTPUT jack to CH 1 INPUT. Adjust the CH 2 Out DC Level (R530) to bring the trace back to graticule center. Change the TRIGGER to CH 2 ONLY. The trace shift must not exceed 100mV.

Remove the cable from the CH 2 OUTPUT.

h. Adjust Norm Trig DC Bal
0V ± 0.2V

Set the TRIGGER to NORM and position the trace to graticule center. Connect a volt meter between the collectors of Q574 and Q584. Remove the TYPE 11B2 plug-in. Adjust Norm Trig DC Bal for 0V. Re-install the TYPE 11B2. The DC level must not change by more than 0.3V. Change the TRIGGER to CH 2 ONLY. The DC level must not change by more than 1V.

6. GAIN

a. Setup

Set the front panel controls as follows:

input selector (CH 1 and CH 2)	DC
VOLTS/CM (CH 1 and CH 2)	.01
VARIABLE (CH 1 and CH 2)	CALIB
MODE	CH 1

6a. (cont'd)

Connect a dual input coupler to CH 1 and CH 2 INPUTS. Connect the output of the SAC to the dual input coupler. Set the SAC amplitude to 50mV.

b. Adjust CH 1 Gain

Adjust the CH 1 Gain Range (R176) for 5cm vertical deflection. Rotate the CH 1 front panel GAIN control through its range. The control must have smooth mechanical and electrical operation. Readjust the GAIN for 5cm vertical deflection.

c. Adjust CH 2 Gain

Change the MODE to ADDED and pull out the CH 2 INVERT PULL sw. Adjust the CH 2 Gain Range (R276) for cancellation of the signal. Rotate the CH 2 front panel GAIN control through its range of adjustment. The control must have smooth mechanical and electrical operation. Reset the GAIN for signal cancellation.

d. Check Added Operation $\leq$*2.5% error*

Change the SAC amplitude to 20mV and push in the CH 2 INVERT PULL sw. The addition of the two input signals must provide 4cm $\pm$ 0.1cm of vertical deflection.

e. Check VARIABLE VOLTS/CM (CH 1 and 2) $\geq$*2.5:1*

Change the SAC amplitude to 50mV and the MODE to CH 1. Rotate the CH 1 VARIABLE to full CCW. Check for smooth electrical operation over the entire range of adjustment. The vertical deflection with the VARIABLE at full CCa must be 2cm or less. Check that the UNCAL neon is lit only when the VARIABLE is out of the CALIB detent.

Change the MODE to CH 2 and repeat the check for the CH 2 VARIABLE.

6. (cont'd)

f. Check Input Switch (CH 1 and 2)

Set the input selector to DC and position the bottom of the square-wave to graticule center. Change the input selector to AC. The center of the square-wave must shift down to graticule center.

g. Check attenuator Accuracy (CH 1 and 2) ≤ 1% error

Set the MODE to CH 1, CH 1 input selector to AC and CH 2 input selector to GND. Check for the specified vertical deflection with the control set as follows:

VOLTS/CM	SAC	Deflection
.02	.1 volts	5cm ± 0.5mm
.05	.2 volts	4cm ± 0.4mm
.1	.5 volts	5cm ± 0.5mm
.2	1 volts	5cm ± 0.5mm
.5	2 volts	4cm ± 0.4mm
1	5 volts	5cm ± 0.5mm
2	10 volts	5cm ± 0.5mm
5	20 volts	4cm ± 0.4mm
10	50 volts	5cm ± 0.5mm
20	100 volts	5cm ± 0.5mm

Change the MODE to CH 2, CH 2 input selector to AC and CH 1 input selector to GND. Repeat the check for CH 2.

h. Check POSITION Range (CH 1 and 2) + and - 8 to 12cm

Change the VOLTS/CM to 1, input selector to AC and the SAC to 20V. Turn the POSITION control full CW. The bottom of the calibrator waveform must position to within the middle 4cm of the graticule area. Turn the POSITION control full ccw. The top of the calibrator waveform must position to within the middle 4cm of the graticule area.

7. ATTEN COMP AND INPUT TIME CONSTANT

a. Setup

Remove the SAC signal and the Dual Input Coupler. Connect the TYPE 106 HI AMPLITUDE OUTPUT...50Ω Coaxial Cable...10X attenuator...50Ω termination...20pF Input RC Normalizer...TYPE 10A2A INPUT. Set the TYPE 106 frequency to 5 kHz and adjust the amplitude for 4cm vertical deflection. Set the TYPE 11B2 TIME/CM to .2mSEC and adjust the TRIG LEVEL for a triggered display.

b. Adjust X1 Input C
≤1% aberration

Set the VOLTS/CM to .01 and adjust the square-wave amplitude for a 4cm display. Adjust C103 for optimum flatness. Connect the hook-up to CH 2 INPUT, change the MODE to CH 2 and adjust C203 for optimum flatness (bottom of waveform). Overshoot, rounding or tilt must not exceed 1%.

c. Adjust Atten Compensation (CH 1 & CH 2) ≤1% aberrations

Remove the 20pF Input RC Normalizer. Adjust for optimum square-wave as follows: Overshoot, rounding or tilt, after adjustment, must not exceed 1%.

VOLTS/CM	ADJUST CH 1	ADJUST CH 2
.02	C104E	C204E
.05	C105D	C205D
.1	C106C	C206C
*.2	C107D	C207D
.5	C108C	C208C
1	C109C	C209C
**2	C110C	C210C
5	C111C	C211C
10	C112C	C212C
20	C113C	C213C

d. Adjust Input Time Constant (CH 1 & CH 2) ≤1% aberration

Re-insert the 20pF Input RC Normalizer, X10 atten and the 50Ω termination as per step 7a. Set the TYPE 106 frequency to 2.5 kHz. Adjust for optimum flatness as follows: Overshoot, rounding or tilt, after adjustment, must not exceed 1%.

7c. & d. Adjust the TYPE 106 amplitude as necessary to maintain a 4cm display.

*remove the X10 atten
**remove the 50Ω termination

7d. (cont'd)

VOLTS/CM	ADJUST CH 1	CH 2
.01	previously	adjusted-check
.02	C104B	C204B
.05	C105B	C205B
.1	C106B	C206B
*.2	C107B	C207B
.5	C108B	C208B
1	C109B	C209B
**2	C110B	C210B
5	C111B	C211B
10	C112B	C212B
20	C113B	C213B

8. TRIGGER AND CH 2 OUT GAIN

a. Check CH 2 OUT Gain ≥100mV/displayed cm

Connect the output of the TYPE 106 to the CH 2 INPUT. Adjust the TYPE 106 amplitude and CH 2 VOLTS/CM to obtain a 5cm display.

Connect the CH 2 OUTPUT to the test scope vertical input. The amplitude of the CH 2 OUT signal must be at least 500mV.

b. Check Norm Trigger Gain 0.2V/displayed cm + 20% - 10%

Set the TYPE 1A1 (test scope) as follows:

MODE	ADD
VOLTS/CM (CH 1 & 2)	.05
PULL TO INVERT (CH 2)	pull out
INPUT SELECTOR (CH 1 & 2)	AC

Connect a 10X probe from the TYPE 1A1 CH 1 and CH 2 inputs to the collectors of Q574 and Q584.

Set the TYPE 10A2A TRIGGER to NORM. The signal amplitude at Q574 and 584 collectors must be between 0.9V and 1.2V (1.8cm and 2.4).

Remove the 10X probes and the TYPE 106 signal.

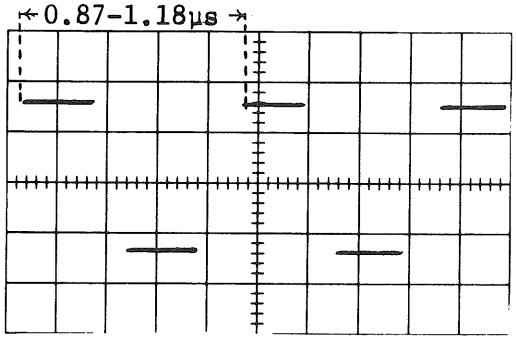
9. MULTI TRACE

a. Check Alternate Operation

Set the TYPE 11B2 TRIG MODE to FREE RUN and the TYPE 10A2A MODE to ALTER. Check for alternate traces with all settings of the TIME/CM sw.

b. Check Chopped Operation
<0.2cm aberrations, rate = 1 MHz ±15%

Change the MODE to CHOP, TIME/CM to .2μSEC and TRIG MODE to AUTO. Adjust the TRIG LEVEL for a triggered display. There must be a chopped display with no more than 0.2cm aberrations on the chopped elements. The period of the chopped waveform must be between 0.87 and 1.18μs.



10. TRANSIENT RESPONSE (Preliminary)

a. Setup

Connect the TYPE 106 H1 AMPLITUDE OUTPUT... TU5/105 adapter...50Ω coaxial cable... TU-5...GR 5X atten...GR to BNC 50Ω Termination...10A2A CH 1 INPUT. Set the front panel controls as follows:

TYPE 10A2A

VOLTS/CM (both)	.01
input selector (both)	DC
MODE	CH 1

TYPE 11B2

TIME/CM	.1μSEC
HORIZ DISPLAY	A
TRIGGER (A)	
MODE	NORM
SOURCE	INT
COUPLING	AC

TYPE 106

frequency	100 kHz
SYMMETRY	midr
H1 AMPLITUDE/FAST RISE	H1 AMPLITUDE
AMPLITUDE	set for 100V

Adjust the bias on the TYPE TU-5 PULSER to the firing potential.

Adjust C456, R462, C172, RI72 and C169 for optimum transient response.

Change the MODE to CH 2 and connect the TU-5 pulse to CH 2 INPUT. Adjust C285, R285 and C269 for 8 optimum transient response.

11. TRANSIENT RESPONSE

a. Setup

Turn the TYPE 647A POWER OFF and connect the TYPE 10A2A to the TYPE 647A VIA the plug-in adapter (067-0004-00). Apply power to the TYPE 661 sampling system VIA a two wire plug adapter. CAUTION: THE TYPE 661 AND ASSOCIATED PLUG-INS MAY BE ELEVATED ABOVE GND DURING THIS CHECK. DO NOT TOUCH THE TYPE 661 SYSTEMS CHASSIS AND GND AT THE SAME TIME.

Turn the TYPE 647A POWER ON and set the front panel controls as follows:

TYPE 661

HORIZONTAL DISPLAY	X1
POSITION	midr
AMPLITUDE/TIME CALIBRATOR	OFF

TYPE 5T3

SAMPLES/CM	100
EQUIVALENT TIME/CM	10ns
TIME POSITION	cw
TRIG LEVEL	cw
STABILITY OR UHF SYNC	preset
TRIG SOURCE	FREE RUN
SLOPE	+
SWEEP MODE	NORM
EXT TRIG MODE	50Ω, AC

TYPE 4S2A

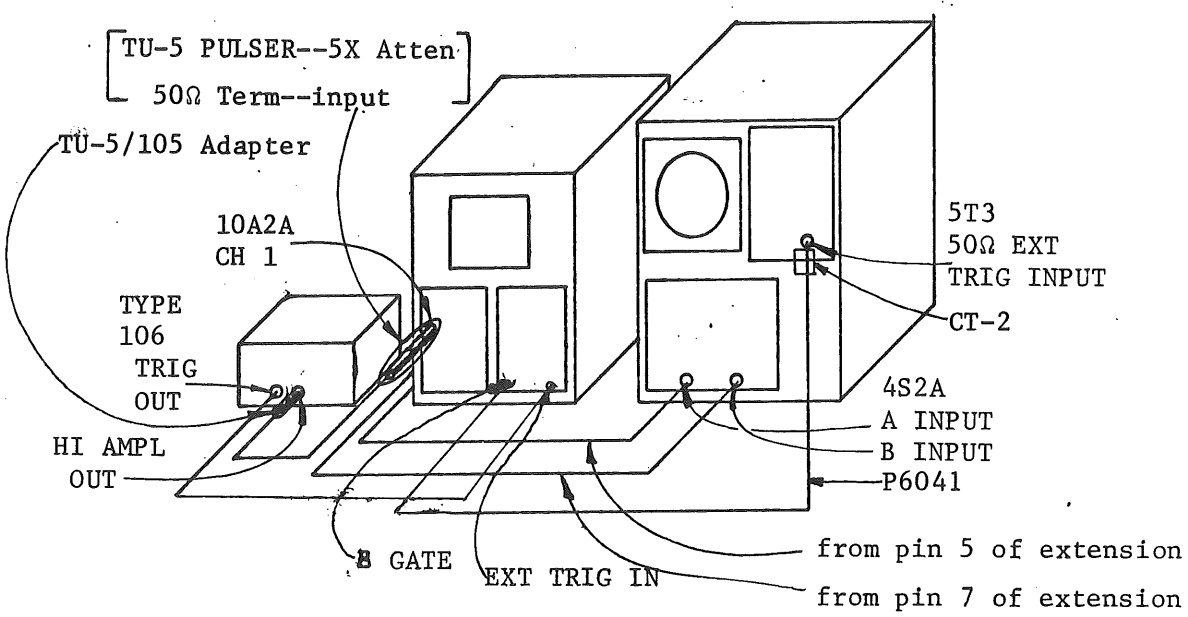
MILLIVOLTS/CM (both)	50
VERT POSITION (both)	mid screen trace
SMOOTHING (both)	NORMAL
DISPLAY (CH 1)	NORMAL
DISPLAY (CH 2)	INVERTED
MODE	ADDED ALGEB

TYPE 106

frequency	100KHz
SYMMETRY	midr
AMPLITUDE	Adjust for 100V

11a. (cont'd)

Connect the equipment as shown in the drawing.



Adjust the bias on the TYPE TU-5 pulse to the firing level. Change the TYPE 5T3 TRIG SOURCE to EXT and adjust the TRIG LEVEL for a triggered display. Use the TYPE 10A2A POSITION control to center the display on the graticule area. Adjust equally between the TYPE 4S2A CH A and CH B MILLIVOLTS/CM VARIABLE controls for a 5cm display. Adjust the TYPE 11B2 DTM and TYPE 5T3 TIME POSITION to display the leading edge of the waveform.

b. Adjust Transient Response (CH 1 & 2)
≤2.5ns t_r
≤3% aberration

Adjust for optimum CH 1 transient response as follows:

b. Adjustment of the TYPE 4S2A SMOOTHING controls may be necessary to obtain discernible display. If adjustment of SMOOTHING is necessary adjust equally between CH A and CH B and keep the SMOOTHING as close as possible to NORMAL. It may be necessary to drive the TU-5 hard to eliminate jitter. The longer time constant (R462) cannot then be properly adjusted on the sampling system but can be adjusted in the TYPE 647A.

11b. (cont'd)

ADJUST	EFFECT	APPROX REGION OF EFFECT
C456	ringing	corner to 15ns
C172 & R172	overshoot & tilt	corner to 15ns
C169	overshoot & rounding	corner to 2ns

Overshoot, rounding, ringing or tilt must not exceed 3%.

Change the EQUIVALENT TIME/CM to 1nSEC and measure the 10% to 90% risetime. The risetime must not exceed 2.5ns.

Invert the display with the TYPE 10A2A INVERT PULL switch. Recenter the display with the TYPE 10A2A POSITION control and check the risetime and aberrations on the negative going pulse. The risetime must not exceed 2.5ns; overshoot, rounding, ringing and tilt must not exceed 3%. Return the INVERT PULL switch to normal.

Return the EQUIVALENT TIME/CM to 10nSEC. Change the TYPE 10A2A MODE to CH 2 and connect the pulser to CH 2 INPUT. Center the display with the CH 2 POSITION control.

Adjust for optimum CH 2 transient response as follows:

ADJUST	EFFECT	APPROX REGION OF EFFECT
C456*	ringing	corner to 15ns
C285 & R285	rounding & overshoot	corner to 15ns
C269	rounding & overshoot	corner to 2ns

Overshoot, rounding, ringing or tilt must not exceed 3%.

Change the EQUIVALENT TIME/CM to 1nSEC and measure the 10% to 90% risetime. The risetime must not exceed 2.5ns.

b. *If readjustment of C456 is necessary recheck CH 1 transient response.

11b. (cont'd)

Invert the display with the TYPE 10A2A INVERT PULL switch. Recenter the display with the TYPE 10A2A POSITION control and check the risetime and aberrations on the negative going pulse. The risetime must not exceed 2.5ns; overshoot, rounding, ringing and tilt must not exceed 3%. Return the INVERT PULL switch to normal.

c. Check Normal Trigger Response
≤4.5ns t_r
≤15% aberrations

Connect pin 13 from the 067-0004-00 plug-in adapter to CH A of the TYPE 4S2A. Connect pin 15 from the plug-in adapter to CH B of the TYPE 452A. Set the TRIGGER to NORM. Check the pulse aberrations and risetime. The risetime must not exceed 4.5ns and aberrations must not exceed 15%.

d. Check CH 2 ONLY Trigger Response
≤7.5ns t_r
≤15% aberrations

Change the TRIGGER to CH 2 ONLY. Check the 10% to 90% risetime and the aberrations of the trigger pulse. The 10% to 90% risetime must be no more than 7.5ns. Aberrations must not exceed 15%.

e. Check Overall Transient Response (CH 1 & 2) ≤4% aberrations

Disconnect the sampling setup and install the TYPE 10A2A in the TYPE 647A. Connect the TU-5 pulse to the CH 1 INPUT and center the display. Set the TIME/CM to .2μSEC and the MAG to X10. Adjust R462 for flat transient response (corner to 45ns) at .1μSEC/CM. Be sure that the TU-5 bias is just at the firing potential for this adjustment. Do not readjust the other transient adjustments without rechecking the results with the sampling system as per step 11b. Rounding, overshoot, ringing, and tilt must not exceed 4%.

Repeat the check for CH 2.

11. (cont'd)

f. Check Added Mode Overshoot (CH 1 & 2) ≤ 6%

With the TU-5 pulse still connected to CH 2 INPUT change the MODE to ADDED. The overshoot on the fast rise pulse must not exceed 6%. Connect the TU-5 pulser to CH 1 INPUT and repeat the check.

g. Check CH 2 OUTPUT Response ≤ 10% aberrations

Connect the TU-5 pulser through two 10X attenuators and a 50Ω termination to CH 2 INPUT. Set the MODE to CH 1 and CH 1 VOLTS/CM to .01. Connect an 8" coaxial cable from CH 2 OUTPUT to CH 1 INPUT. Overshoot, rounding, ringing and tilt on the fast rise pulse must not exceed 10%.

12. BANDPASS

a. Check CH 1 and 2 Bandpass ≥ 108MHz @-3dB

Connect the output of the HF Sine Wave Generator (067-0532-00) to the Dual Output Coupler. Set the MODE to CH 1, CH 1 input selector to DC and CH 2 input selector to GND. Set the frequency to 3 MHz and adjust the amplitude for 4cm. Increase the frequency until the displayed amplitude decreases to 2.8cm. The frequency must be at least 108 MHz.

Change the MODE to CH 2, CH 2 input selector to DC and CH 1 input selector to GND. Repeat the check for CH 2.

b. Check CH 2 OUTPUT Bandpass ≥ 30MHz @-3dB

Set the front panel controls as follows:

VOLTS/CM (CH 1)	.1
VOLTS/CM (CH 2)	.01
MODE	CH 1

12b. (cont'd)

Connect an 8" 50Ω coaxial cable from the CH 2 OUTPUT jack to the CH 1 INPUT. Connect the output of the TYPE 191 through a 50Ω coaxial cable and a 50Ω termination to CH 2 INPUT. Set the TYPE 191 frequency to 50KHz and adjust the amplitude for a 4cm display.

Increase the TYPE 191 frequency until the display amplitude is reduced to 2.8cm. The frequency, as read on the TYPE 191, must be at least 30MHz.

13. COMMON MODE REJECTION

a. Setup

Set the front panel controls as follows:

VOLTS/CM (CH 1)	.02
VOLTS/CM (CH 2)	.01
MODE	CH 1
INVERT PULL (CH 1)	in
INVERT PULL (CH 2)	out

Connect a dual input coupler to the CH 1 and CH 2 INPUT'S. Connect the TYPE 191 output through a 50Ω coaxial cable and a 50Ω termination to the dual input coupler.

b. Check Commom Mode Rejection
$\geq$ 20:1 @ 50MHz

Set the TYPE 191 frequency to 50MHz and adjust the amplitude for a 5cm display. Change the MODE to ADD and the CH 1 VOLTS/CM to .01. The display amplitude must not exceed 0.5cm.

14. INTER-CHANNEL ISOLATION

a. Check Amplifier Isolation (CH 1 & 2) ≥ 200:1 @ 25 MHz

Remove the Dual Output Coupler and connect the TYPE 191 out through a 50Ω termination directly to CH 1 INPUT. Set the MODE to CH 1, CH 1 VOLTS/CM to .5, CH 2 VOLTS/CM to .01 and both input selectors to DC. Set the TYPE 191 frequency to 25MHz and adjust the amplitude for a 2cm display.

Change the MODE to CH 2 and the CH 1 VOLTS/CM to .01. The displayed amplitude must not exceed 0.5cm.

Reverse the hook up and check for cross-talk in CH 1.

b. Check Attenuator Isolation ≥10000:1 @ 25 MHz

Remove the 50Ω terminator for the TYPE 191 output. Connect the TYPE 191 output directly to CH 2 INPUT and set the CH 2 VOLTS/CM to 2. Set the TYPE 191 frequency to 25MHz and adjust the amplitude for 5cm (10V) of vertical deflection.

Change the MODE to CH 1 and CH 1 VOLTS/CM to .01. The vertical deflection must not exceed 1mm (1mV).

Reverse the hook up and check for cross-talk in CH 2.

15. ATTENUATOR ABERRATIONS

a. Setup

Connect the TYPE 109 OUTPUT through a GR RG-213/U cable and a GR 50Ω Termination to CH 1 INPUT. Connect the TYPE 113 to the TYPE 109 50Ω CHG LINE input.

VOLTS/CM (both)	.01
INPUT (both)	DC
MODE	CH 1

15. (cont'd)

b. Check Attenuator Aberrations (CH 1 & 2)
.02-5V ≤6% aberration
10 & 20V ≤10% aberration

Set the TYPE 109 PULSE POLARITY to + and adjust the AMPLITUDE for a 4cm display. Set the TYPE 11B2A TIME/CM to .1μSEC and 10X MAG to ON. Adjust the TRIG LEVEL for a triggered display.

Check the pulse aberrations at each setting of the VOLTS/CM sw. Aberrations must not exceed 6% in the .02 to 5 VOLT positions and 10% in the 10 and 20 VOLT positions.

Change the MODE to CH 2, connect the TYPE 109 OUTPUT to the CH 2 INPUT and repeat the check.

NOTE: The following checks are not made on 100% of the instruments, but are done on a sampling basis.

16. SAMPLE CHECKS

a. Check CM Linear Dynamic Range
≤5% distortion at ≥12X VOLTS/CM setting

Set the front panel controls as follows:

VOLTS/CM (CH 1)	.1
VOLTS/CM (CH 2)	.01
MODE	CH 1
INPUT selector (both)	DC

Connect the Linear Dynamic Range Test Fixture to the CH 1 and CH 2 INPUT. Connect the output of a TYPE 191 to the CM INPUT of the Lineary Dynamic Range Test Fixture and the EXT (horizontal) INPUT in the 11B2A. Set the TYPE 191 frequency to 50 kHz and adjust the amplitude for 2.4cm. Change the TYPE 11B2A HORIZ DISPLAY to EXT INPUT, B SOURCE to EXT and MAG to X10. Change the TYPE 10A2A CH 1 VOLTS/CM to .01, MODE to ADDED and CH 2 to invert.

The display should now be a flat horizontal line about 7cm long. If the line is not flat when centered on the graticule area adjust the CH 2 GAIN for optimum flatness (best CMRR).

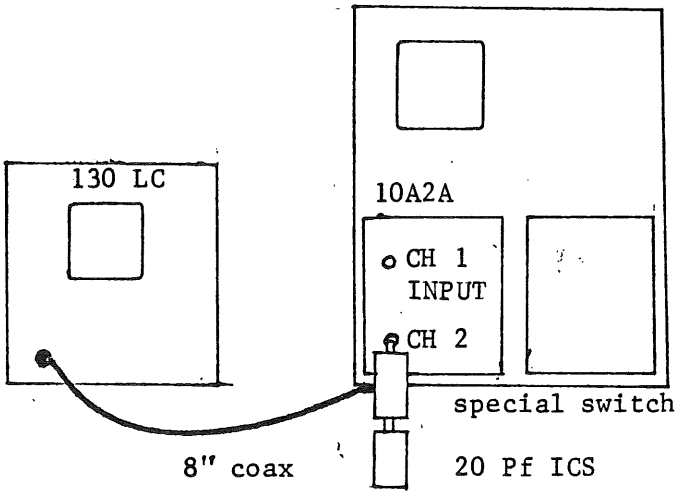
16a. (cont'd)

Connect the output of a second TYPE 191 to the DIFF INPUT on the Linear Dynamic Range Test Fixture. Set the TYPE 191 frequency to 3 MHz. Depress the CM OFF button and adjust the amplitude for 4cm of vertical deflection. Release the CM OFF button and check change in amplitude at the horizontal ends of the display. Change in amplitude must not exceed 2mm (5%).

b. Check Input Capacitance 20pF ±3%

b. Leave the TYPE 647A POWER ON for this check.

Connect the equipment as shown.



Set the switch to STD and the TYPE 130 RANGE SELECTOR to 3μμF. Adjust the TYPE 130 COARSE and FINE ZERO for a mid scale meter reading. Change the switch to UNK. The TYPE 130 meter reading must stay within 6 minor div of mid scale at each position of the TYPE 10A2A VOLTS/CM switch and with the input selector in DC and AC. Repeat the check for the other channel.

c. Check Input Resistance (CH 1 & 2) 1MΩ ±1%

Turn POWER OFF and connect a resistance bridge (0.25% or better accuracy at 1MΩ) to CH 1 INPUT set the input selector to DC. Check the input resistance on all settings of the VOLTS/CM sw. The input resistance must be between 990KΩ and 1.01MΩ.

Repeat the check for CH 2 INPUT.

THE END