FACTORY CALIBRATION PROCEDURE

TENTATIVE

CONTENTS:

INTRODUCTION:

1A5

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:

0-415
September 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 544 OSCILLOSCOPE (see Note)	NOTE: The risetime of the plug-in scope must be known in order to determine the minimum bandwidth required for the TYPE 1A5.
1	TYPE 106 SQUARE-WAVE GENERATOR	
* 1	TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR	
1	TYPE 76-TU LINE VOLTAGE CONTROL UNIT	

b. Test Fixtures and Accessories

* 1	Standard Amplitude Calibrator (SAC) (067-0502-00)
1	INPUT RC Normalizer (20pF) (067-0538-00)
* 1	DC Voltage Bridge (067-0543-99)
* 1	LF Sine-wave Generator (067-0542-99)
1	67.5 Volt Bridge (PMPE Dwg #1008-A)
1	Dual Input Coupler (067-0525-00)
1	TYPE 111 Variable Attenuator (067-0511-00)
1	8" Plug-in Extension (013-0055-00)
1	42" 50Ω coaxial cable (012-0057-00)
2	GR 50Ω 10X Attenuator (017-0078-00)
1	GR 50Ω 5X Attenuator (017-0079-00)
1	GR 50Ω 2X Attenuator (017-0080-00)
1	Microphonics shock hammer (PMPE Dwg #1283-B)
1	GR to BNC female adapter (017-0063-00)
1	5ns GR cable (017-0502-00)
1	50Ω GR to BNC in line Termination (017-0083-00)
1	Test Fixture for differential probe connector (PMPE Dwg #1669-A)
1	50Ω Termination (011-0049-00)

c. Other Equipment

1	20,000Ω/VDC multimeter

d. Equipment for Sample Checks

1	Resistance bridge with 0.04% or better accuracy at 1MΩ

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

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

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

QUALIFICATION

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

1. PRELIMINARY

a. Make General Inspection
b. Preset Controls
c. Check Amphenol Pin Resistance

2. VOLTAGES

b. Check Probe Power On Light
c. Check Zener Voltages: 20.7V ±1V; 6.2V ±0.31V

3. VERTICAL DC BALANCE

a. Adjust DC Bal (R170)
b. Adjust VAR BAL: ≥6cm range
c. Adjust Position Range (R370): ≥4cm range
d. Check STEP ATTEN BAL Range: ≥20mV
e. Adjust Output DC Level (R390): 67.5V ±1% of main frame 100V

4. GAIN

b. Adjust Gain: + & -10% range
c. Check VARIABLE Range: ≥ 2.5:1
* d. Check VOLTS/CM Accuracy (A INPUT):
1mV -20mV ±1.5%
50mV -20V ±2%
* e. Check VOLTS/CM Accuracy (B INPUT):
50mV -20V ±2%
f. Check POSITION Range: ≥12cm

5. COMMON MODE BAL

b. Adjust Common Mode Bal (R140): 25,000:1 rejection
c. Adjust Atten Bal (R105d, R106d)

6. INPUT AMPLIFIER

a. Check Microphonics: ≤100μV
b. Check Gate Current: ≤0.1nA
c. Check Signal Resolution: ≤1mm

7. INPUT CAPACITANCE

b. Adjust Input Capacitance (C108, C208): ≤1% overshoot, rounding or tilt

8. INPUT TIME CONSTANT

a. Adjust B Input Time Constant: ≤1% overshoot, rounding or tilt
b. Adjust A Input Time Constant: ≤1% overshoot, rounding or tilt

9. COMMON MODE REJECTION

* b. Adjust Common Mode Rejection:
≥12500:1 @ 1 MHz (10V)
≥1250:1 @ 10 MHz (1V)
* c. Check X1 Common Mode Rejection:
≥2500:1 @ 5 MHz (2V)
≥250:1 @ 20 MHz (0.5V)
≥25,000:1 @ 100 kHz (10V)

10. ATTEN CMR

* b. Adjust X10 CMR: ≥2500:1 @ 10 kHz
* c. Check X100 CMR: ≥2500:1 @ 10 kHz

* 11. AC COUPLED CMR ≥1250:1 @ 60 Hz

12. HF COMPENSATION

b. Adjust HF compensation: 1mV + & -2.5% aberrations in first 70ns, 2mV-20mV + & -2% aberrations in first 70ns, 1mV-20mV + & -0.5% aberrations after first 70ns

13. BANDPASS

* b. Check DC Coupled Bandwidth (upper limit):
1mV ≥40MHz
2mV ≥45MHz
5mV -20V ≥50MHz

c. Check AC Coupled Bandwidth (lower limit): ≤2 Hz

14. CROSSTALK

b. Check Amplifier Crosstalk: ≤1%
c. Check Total Crosstalk: ≤5%

15. OVERDRIVE

b. Check DC Shift: ≤10mV in first 5s or ≤1% of overdrive signal, whichever is smaller
c. Check Overdrive Recovery Time: ≤0.3μs within 10mV

16. COMPARISON VOLTAGE

b. Check V_C Zero Error: ≤2mV electrical; ≤1 line width mechanical
* c. Adjust Comparison Voltage:
5V ±3mV (1mV -2V)
0.5V ±2mV (5V -20V)
* d. Check V_C Accuracy (5V to 20V/cm): ±0.75% of indicated or ±0.75mV, whichever is greater
* e. Check V_C Accuracy (1mV -2V/cm): ±0.3% of indicated or ±3mV, whichever is greater.

17. AMPLIFIER STABILITY ≤300μV drift with line voltage change

18. DIFFERENTIAL PROBE

a. Adjust PROBE STEP ATTEN BAL
b. Check Differential Probe Input Connector

THE FOLLOWING CHECK IS NOT MADE ON 100% OF THE INSTRUMENTS BUT IS DONE ON A SAMPLING BASIS.

19. INPUT RESISTANCE: 1MΩ ±0.15%

THE END

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

1. PRELIMINARY

a. Make General Inspection

Check for unsoldered joints, rosin joints, improper lead dress and long ends. Check for loose hardware and protruding parts. Check front panel controls for smooth mechanical operation, proper indexing and knob spacing from front panel. Check all internal adjustments for smooth mechanical operation.

1a. The detent action in the 50mV, .5V and 5V positions of the VOLTS/CM will be more rigid than the other positions.

Set the VOLTS/CM to .5 volts, pull the knob out and turn cw. Check that the attenuator switch is not engaged in the .1 and .2 volt positions and the switch is mechanically stopped at .2 volts. Return the VOLTS/CM to .5 volts.

Set the VOLTS/CM to 50mV, pull the knob out and turn cw. Check that the attenuator switch is not engaged in the 20 and 10mV positions and the switch is mechanically stopped at the 10mV positions. Return the switch to 50mV.

Mechanically align the V_C dial so it reads 0.00 at full ccw.

Mechanically align the STEP ATTEN BAL knob so there is equal ↑ and ↓ rotation when the indexing mark is in the center of the window.

b. Preset Controls

TYPE 1A5

VOLTS/CM	20mV
VARIABLE	CAL
POSITION	midr
GAIN	midr
VAR BAL	midr
PROBE STEP ATTEN BAL	midr
DISPLAY	A-B
A INPUT	GND
B INPUT	GND
COMPARISON VOLTAGE	
AMPLITUDE	0.00
POLARITY	0
All internal adjustments	midr

1b. (cont'd)

TYPE 544 (plug-in scope)

HORIZONTAL DISPLAY	NORMAL (X1)
TIME/CM	.5mSEC
VARIABLE	CALIBRATED
TRIGGERING LEVEL	midr
TRIGGERING	
MODE	AUTO STABILITY
SLOPE	+
COUPLING	AC
SOURCE	INT, NORM

c. Check Amphenol Pin Resistances

Check the resistance between gnd and each pin on the amphenol plug. Connect the negative meter lead to gnd and use the X1K scale.

Pin No.	Approx Resistance
1	8kΩ
2	0Ω
3	8kΩ
4-8	∞ (NC)
9	13kΩ
10	5kΩ
11	10.5kΩ
12	∞ (NC)
13	∞
14	∞
15	3kΩ (varies with VOLTS/CM setting)
16	∞ (NC)

2. VOLTAGES

a. Setup

Install the TYPE 1A5, via the 013-0055-00 plug-in extension, in the TYPE 544 plug-in compartment. Pull out the plug-in sensing switch (SW 673, located at top right of the plug-in compartment). Apply power to the TYPE 544 via the TYPE 76TU LINE VOLTAGE CONTROL UNIT. Set the line voltage to 115 VAC. Allow 20 minutes operating time before making checks or adjustments.

2. (cont'd)

b. Check Probe Power On Light

Depress the DIFFERENTIAL PROBE ON/OFF button several times. Check that the power light for the DIFFERENTIAL PROBE lights and extinguishes alternately. With the probe power light on check that the light remains on with the VOLTS/CM at 0.2V to 1mV and extinguishes at all other settings of the VOLTS/CM.

Return the VOLTS/CM to 5V and turn the probe power off.

c. Check Zener voltages 20.7V ±1V
6.2V ±0.31V @ 5V/CM

Check for the following voltages with the 067-0543-99 DC Voltage Bridge

Location	Voltage
Emitter Q297	+20.7V ±1V
Collector Q297	+6.2V ±0.31V

Adjust Output DC Level (R390) for 60V at pin F on the Output PC board.

3. VERTICAL DC BALANCE

a. Adjust DC Bal (R170)

Change the VOLTS/CM to 20mV. Set the POSITION and STEP ATTEN BAL to midr. Adjust the DC Bal (R170) to bring the trace to graticule center. Adjust the DC Bal (R170) so there is no trace movement as the VOLTS/CM is changed from 20mV to 1mV. If necessary adjust the Position Range to keep the trace on the graticule area.

b. Adjust VAR BAL ≥6cm range

Set the VOLTS/CM to 20mV. Rotate the VAR BAL control throughout its range of adjustment. The trace must move a total of at least 6cm.

Adjust the VAR BAL so there is no trace movement as the VARIABLE VOLTS/CM is rotated from end to end.

Check that the UNCAL neon is lit when the VARIABLE is out of the CAL detent.

Return the VARIABLE to the CAL detent.

3. (cont'd)

c. Adjust Position Range (R370)
≥4cm range

Rotate the Position Range (R370) throughout its range of adjustment. The trace must move a total of at least 4cm.

Adjust the Position Range to bring the trace to the center graticule line.

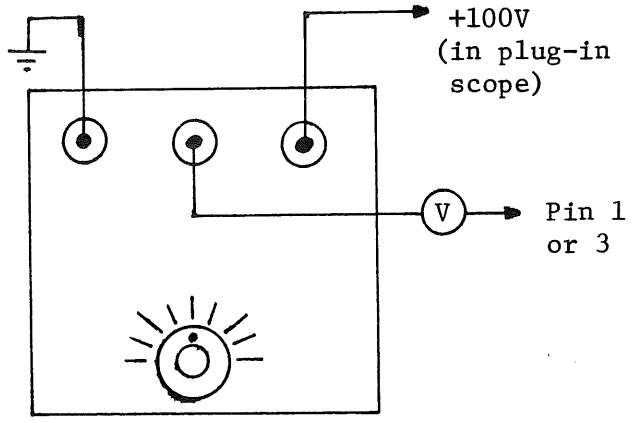
d. Check STEP ATTEN BAL Range ≥20mV

Change the VOLTS/CM to 5mV. Check that the STEP ATTEN BAL has sufficient range to position the trace at least 4cm (20mV).

Readjust the STEP ATTEN BAL so there is no trace movement as the VOLTS/CM is changed from 20mV to 1mV.

e. Adjust Output DC Level (R390)
67.5% ±1% of main frame 100V

Connect the 67.5 volt bridge as shown:



Set the dial on the 67.5 volt bridge to 67.5V and the multimeter to the most sensitive DC volts scale.

Adjust the Output DC Level (R390) for 0 volts on the multimeter.

4. GAIN

a. Setup

Connect a dual input coupler (067-0525-00) to A and B INPUT. Connect a 50Ω coaxial cable from the SAC OUTPUT to the dual input coupler. Set the SAC AMPLITUDE to .1V. Set the front panel controls as follows:

4a. (cont'd)

VOLTS/CM	20mV
DISPLAY	A-V_C
A INPUT	DC
B INPUT	GND

b. Adjust Gain + & -10% range

Check for smooth electrical operation as the GAIN control is rotated from end to end. The displayed amplitude at full cw must be at least 5.5cm. The displayed amplitude at full ccw must be 4.5cm or less.

Adjust the GAIN for exactly 5cm deflection.

c. Check VARIABLE Range

Rotate the VARIABLE ccw. Check for smooth gain change and no more than 2cm amplitude at full ccw. Return the VARIABLE to the CAL detent.

d. Check VOLTS/CM Accuracy (A INPUT)
1mV-20mV: ±1.5%
50mV-20V: ±2%

Check for the specified amplitude with the controls set as follows:

VOLTS/CM	SAC	AMPLITUDE
20mV	.1 V	5cm ±1.5%
10mV	50mV	5cm ±1.5%
5mV	20mV	4cm ±1.5%
2mV	10mV	5cm ±1.5%
1mV	5mV	5cm ±1.5%
50mV	.2 V	4cm ±2%
.1 V	.5 V	5cm ±2%
.2 V	1 V	5cm ±2%
.5 V	2 V	4cm ±2%
1 V	5 V	5cm ±2%
2 V	10 V	5cm ±2%
5 V	20 V	4cm ±2%
10 V	50 V	5cm ±2%
20 V	100 V	5cm ±2%

e. Check VOLTS/CM Accuracy (B INPUT)
50mV-20V: ±2%

Change the DISPLAY to V_C-B, A INPUT to GND and B INPUT to DC. Check for the specified amplitude with the controls set as follows:

4e. (cont'd)

VOLTS/CM	SAC	AMPLITUDE
20V	100V	5cm ±2%
10V	50V	5cm ±2%
5V	20V	4cm ±2%
2V	10V	5cm ±2%
1V	5V	5cm ±2%
.5V	2V	4cm ±2%
.2V	1V	5cm ±2%
.1V	.5V	5cm ±2%
50mV	.2V	4cm ±2%

f. Check POSITION Range *≥12cm*

Change the B INPUT to AC and the SAC amplitude to .5V. Adjust the VARIABLE for 6cm deflection. Change the SAC to 1V. Rotate the POSITION control from full cw to full ccw. The top and bottom of the display must overlap. Return the VARIABLE to the calibrated detent.

5. COMMON MODE BAL

a. Setup

Set the front panel controls as follows:

VOLTS/CM	1mV
DISPLAY	A-B
INPUT (both)	DC

b. Adjust Common Mode Bal (R140) *≥25,000:1 rejection*

Apply a 5V square-wave from the SAC to the dual input coupler. Adjust the Common Mode Bal (R140) for optimum commom mode rejection. Display amplitude must not exceed 0.2cm (exclude amplifier noise and spikes on corner of square-wave).

5b. It may be necessary to adjust R140 for something less than optimum CMR in order to bring the 100 KHz within CMR test limits (step 9c).

c. Adjust Atten Bal (R105d, R106d)

Change the VOLTS/CM to 10mV extended range (set VOLTS/CM to 50mV, pull knob out and turn to 10mV) and the SAC to 50 volts. Adjust R105d for minimum amplitude.

Change the VOLTS/CM to .1 volt extended range (set VOLTS/CM to .5V, pull knob out and turn to .1 volts) and the SAC to 100 volts. Adjust R106d for minimum amplitude.

Remove the SAC signal.

6. INPUT AMPLIFIER

a. Check Microphonics *≤100μV*

Set the VOLTS/CM to 1mV, DISPLAY to A-V_C and both INPUTS to GND. Rap on the TYPE 1A5 front panel. The microphonics produced must not exceed 1mm. Change the DISPLAY to V_C-B and repeat the check.

a. If the amount of microphonics is in doubt, check as follows:

Install the TYPE 1A5 in the plug-in compartment and tighten the securing shaft. Set the VOLTS/CM to 1mV, DISPLAY to A-V_C and both INPUTS to GND.

Place microphonics shock hammer on the top center front of the plug-in scope. Raise the weight to the top of the shaft and release it. The microphonics produced must not exceed 1mm.

b. Check Gate Current *≤0.1nA*

Connect a 50Ω termination to the B INPUT jack. Change the B INPUT from GND to AC. The trace shift must not exceed 1mm.

Change the DISPLAY to A-V_C, connect the 50Ω termination to the A INPUT jack and repeat the check.

Change the DISPLAY to V_C-B and repeat the check.

Remove the 50Ω termination.

c. Check Signal Resolution *≤1mm*

Connect the TYPE 544 CAL OUT ... 50Ω coax cable ... 111 Variable Atten ... 50Ω termination ... A INPUT. Set the VOLTS/CM to 10mV and the A INPUT to DC. Set the TYPE 544 AMPLITUDE CALIBRATOR to .1V, TIME/CM to 50μSEC and free run the sweep.

Center the display and adjust the 111 Variable Attenuator for a displayed amplitude of exactly 1cm. Install two X10 attenuators between the 111 Variable Attenuator (do not change the 111 Variable Attenuator setting) and the 50Ω termination. Change the VOLTS/CM to 1mV.

There must be a dark line between the two noise bands; that is, there must be separation between the noise bands.

c. Signal resolution is defined as: The minimum resolvable signal, from a 50Ω source, limited by periodic and random deviations originating within the TYPE 1A5.

If the minimum resolvable signal exceeds the test limit, install the TYPE 1A5 in the plug-in compartment and remeasure.

7. INPUT CAPACITANCE

a. Setup

DISPLAY	A-V_C
VOLTS/CM	20mV
A INPUT	DC
B INPUT	DC

Connect TYPE 106 HI AMPLITUDE OUTPUT -- 50Ω coaxial cable -- 10X attenuator -- 50Ω termination -- 20pF Input RC Normalizer -- TYPE 1A5 A INPUT. Set the TYPE 106 frequency to 1 kHz and adjust the amplitude for a 4cm display. Preset C122, C222, C123 and C223 for minimum capacitance.

b. Adjust Input Capacitance (C108, C208) ≤1% overshoot, rounding or tilt

Adjust C108 for optimum square corner on the top of the square-wave. Overshoot, rounding or tilt must not exceed 1%.

Change the DISPLAY to V_C-B and connect the Input RC Normalizer to the B INPUT. Adjust C208 for optimum square corner on the bottom of the square-wave.

8. INPUT TIME CONSTANT

a. Adjust B Input Time Constant ≤1% overshoot, rounding or tilt

Adjust as follows for optimum square corner and minimum tilt on the bottom of square wave. Adjust the TYPE 106 amplitude and remove the 10X attenuator when necessary to maintain a 4cm display.

VOLTS/CM	Adjust for Optimum Corner	Adjust for Minimum Tilt
20mV		C208
50mV	C205B	C205A
.5 V	C206B	C206A
5 V	C207B	C207A

Check all VOLTS/CM settings for no more than 1% overshoot, rounding or tilt.

8. (cont'd)

b. Adjust A INPUT Time Constant
≤1% overshoot, rounding or tilt

Change the B INPUT to GND, A INPUT to DC and DISPLAY to A-V_C. Connect the 20pF Input RC Normalizer to the A INPUT. Adjust as follows for optimum square corner and minimum tilt on the top of the square-wave.

VOLTS/CM	Adjust for Optimum Corner	Adjust for Minimum Tilt
20mV		C108
50mV	C105B	C105A
.5 V	C106B	C106A
5 V	C107B	C107A

Check all VOLTS/CM settings for no more than 1% overshoot, rounding or tilt.

9. COMMON MODE REJECTION

a. Setup

Connect a dual input coupler to the A and B INPUT. Connect the output of the TYPE 191 to the dual input coupler. Set the TYPE 191 frequency to 1 MHz and adjust the amplitude for 10V (same setting as 5 volts except do not terminate in 50Ω).

b. Adjust Common Mode Rejection
12500:1 @ 1 MHz; 1250:1 @ 10 MHz

Change the DISPLAY to A-B, both INPUTS to DC and the VOLTS/CM to 1mV. Adjust C122 or C222 (only one of these will affect CMR, leave the other adjustment set at minimum capacitance) for minimum deflection: 0.8cm max.

Change the TYPE 191 frequency to 10 MHz and amplitude to 1 volt. Adjust C163, C263; C123 and C223 for minimum deflection: 0.8cm max.

Recheck the 1 MHz CMR.

9a. In all common mode rejection checks, change the TIME/CM and adjust the TRIGGERING LEVEL as necessary to obtain a readable display. Do not include amplifier noise as part of the common mode signal that is being measured; i.e., if the amplifier noise is a considerable percentage of the total displayed signal, measure the peak to valley amplitude of the display as the common mode signal.

9b. Dress of C144, C244, C148 and C248 is critical at 100 KHz to 1 MHz CMR.

9. (cont'd)

It may be necessary to compromise between the adjustment of C122, C222 at 1 MHz and C163, C263; C123, C223 at 10 MHz to obtain optimum CMR.

c. Check X1 Common Mode Rejection
2500:1 @ 5 MHz (2V)
250:1 @ 20 MHz (0.5V)
25000:1 @ 100 kHz (10V)

Change the TYPE 191 frequency to 5 MHz and amplitude to 2 volts. The displayed signal amplitude must not exceed 0.8cm (0.8mV).

Change the TYPE 191 frequency to 20 MHz and amplitude to 0.5 volts. The displayed signal amplitude must not exced 2cm (2mV).

Replace the TYPE 191 with the LF Sine Wave Generator (067-0542-99). Set the frequency to 100 kHz and amplitude to 10 volts. The displayed amplitude must not exceed 0.4cm (0.4mV).

10. ATTENUATOR CMR

a. Setup

Leave the LF Sine Wave Generator connected as in the previous step. Set the VOLTS/CM to the 10mV extended range. (Set VOLTS/CM to 50mV, pull knob out and turn to 10mV.)

b. Adjust X10 CMR *≥2500:1 @ 10 kHz*

Set the LF Sine Wave Generator frequency to 10 kHz and amplitude to 100 volts. Adjust C205D for minimum deflection, 4cm max.

c. Check X100 CMR *≥2500:1 @ 10 kHz*

Change the VOLTS/CM to the .1V extended range. The displayed signal amplitude must not exceed 0.4cm.

11. AC COUPLED CMR ≥1250:1

Change the LF Sine Wave Generator frequency to 60 Hz and amplitude to 10 volts. Change the VOLTS/CM to 10mV and both INPUTS to AC.

The displayed signal amplitude must not exceed 0.8cm.

Recheck the input capacitance (step 7).

12. HF COMPENSATION

a. Setup

Install the TYPE 1A5 in the TYPE 544 and tighten the securing bolt. Connect the TYPE 106 FAST RISE + OUTPUT -- 5ns cable -- 5X atten -- 50Ω GR to BNC in line termination -- A INPUT. Change the VOLTS/CM to 20mV, DISPLAY to A-B A INPUT to DC and B INPUT to GND.

Set the TYPE 106 frequency to 100 kHz and adjust the amplitude for a 4cm display.

b. Adjust HF Compensation aberrations:
1mV, +2.5%, -2.5% in first 70ns
2mV to 20mV, +2%, -2% in first 70ns
1mV to 20mV, +0.5%, -0.5% after first 70ns

Adjust as follows for optimum transient response and minimum risetime. Overshoot, rounding, ringing and tilt must not exceed +2%, -2% (except +2.5%, -2.5% at 1mV/CM) in the first 70ns and +0.5%, -0.5% after the first 70ns. Change the attenuators in the signal path as directed.

VOLTS/CM	Adjust	*Risetime
20mV	C379, R379 C389, R389	≤7ns
Use 2X and 5X attenuation.		
10mV	R312, L312	≤7ns
Use 2X and 10X attenuation.		
5mV	R307, C309	≤7ns
Use 5X and 10X attenuation.		
2mV	R304, C305	≤8ns
Use 2X, 5X and 10X attenuation.		
1mV	R301, C302	≤9ns

12b. Disregard the amplifier noise when measuring per cent of aberrations.

* If the instrument does not make or exceed the listed risetimes, it will probably be necessary to readjust the high frequency compensations in order to make minimum bandwidth requirements (step 13).

12b. (cont'd)

Change the B INPUT to DC, A INPUT to GND and connect the -OUTPUT from the TYPE 106 to B INPUT. Center the display on the graticule area. Check aberrations on the fast rise signal at 1mV to 20mV settings of the VOLTS/CM switch. Overshoot, rounding, ringing and tilt must not exceed +2%, -2% (except +2.5%, -2.5% at 1mV) in the first 70ns and +0.5%, -0.5% after the first 70ns.

13. BANDPASS

a. Setup

DISPLAY	A-V_C
A INPUT	DC
VOLTS/CM	1mV
V_C POLARITY	0

Connect the TYPE 191 OUTPUT -- 5ns cable -- 5X GR attenuator -- 50Ω GR to BNC Termination -- A INPUT.

b. Check DC Coupled Bandwidth (upper limit)

1mV ≥41 MHz
2mV ≥46 MHz
5mV to 20V ≥51 MHz

Set the TYPE 191 frequency to 50 kHz and adjust the amplitude for a 4cm display. Increase the frequency until the displayed amplitude is reduced to 2.8cm. The TYPE 191 frequency must be at least 41 MHz. Repeat this method to check for the specified bandpass at the following VOLTS/CM settings:

VOLTS/CM	* Bandwidth
2mV	≥46 MHz
5mV	≥51 MHz
10mV	≥51 MHz
20mV	≥51 MHz

c. Check AC Coupled Bandwidth (lower limit)

≤2 Hz

Connect the LF Sine Wave Generator output -- 50Ω coax -- A INPUT. Change the A INPUT to AC. Set the LF Sine Wave Generator frequency to 50 kHz and adjust the amplitude for a 4cm display. Decrease the fequency until the display amplitude is 2.8cm. The frequency must be 2 Hz or lower.

*b. The bandwidth test limits are based on a plug-in scope risetime of 6.25ns. If the risetime is other than 6.25ns, use the table below to find test limits:

Plug-in Scope t_r	Bandwidth 1mV/CM	2mV/CM	5-20mV/CM
6.25ns	41 MHz	46 MHz	51 MHz
6.00ns	42 MHz	47.1MHz	52.5MHz
5.75ns	42.8MHz	48.2MHz	54 MHz
5.50ns	43.7MHz	49.3MHz	55.7MHz
5.25ns	44.6MHz	51 MHz	58.5MHz

14. CROSSTALK

a. Setup

VOLTS/CM	20mV
DISPLAY	V_C-B
A INPUT	DC
B INPUT	DC

Connect the TYPE 191 OUTPUT through a 50Ω coaxial cable to the A INPUT.

b. Check Amplifier Crosstalk *≤1%*

Set the TYPE 191 frequency to 50 MHz and adjust the amplitude for 10 volts out (same setting as 5 volts when terminated in 50Ω). Vary the TYPE 191 frequency from 50 MHz to 50 KHz. The displayed amplitude as seen with the DISPLAY in V_C-B must not exceed 100mV (5cm).

Change the DISPLAY to A-V_C, connect the TYPE 191 OUTPUT to the B INPUT and repeat the check.

c. Check Total Crosstalk *≤5%*

Connect the TYPE 106 HI AMPLITUDE OUTPUT through a 50Ω coax cable a 10X attenuator and a 50Ω termination to the A INPUT. Set the VOLTS/CM to 20mV, DISPLAY to A-B, A INPUT to DC and B INPUT to GND. Set the TYPE 106 frequency to 1 KHz and adjust the amplitude for a 4cm display. Check for no more than 5% (0.2cm) rounding on the square-wave as the B INPUT is changed from GND to AC or DC.

15. OVERDRIVE

a. Setup

DISPLAY	A-V_C
VOLTS/CM	1
A INPUT	DC

Connect the TYPE 106 HI AMPLITUDE OUTPUT -- 2X GR ATTEN -- 5ns cable -- 50Ω GR to BNC termination -- A INPUT. Connect a 50Ω coaxial cable from the TYPE 106 TRIGGER OUTPUT to the plug-in scope external TRIGGER INPUT. Set the test scope TRIGGER SOURCE to EXT, TIME/CM to .1mSEC and adjust the TRIGGERING LEVEL for a triggered display. Set the TYPE 106 frequency to 1 KHz and adjust the amplitude for 5 volts (5cm).

15. (cont'd)

b. Check DC Shift
≤10mV in first 5s or ≤1% of overdrive signal whichever is smaller

Change the A INPUT to GND and the VOLTS/CM to 10mV. Allow a few seconds for the amplifier to stabilize and position the trace to graticule center. Change the A INPUT to DC and observe the DC shift that occurs in the first 5 seconds. The back corner of the waveform must not shift from graticule center by more than 10mV (1cm).

c. Check Overdrive Recovery Time
≤0.3μs to within 10mV

Change the TIME/CM to .2μSEC and the VOLTS/CM to 1V. Position the leading edge of the waveform so it coincides with the left edge of the graticule. Change the VOLTS/CM to 5 mV and the TIME/CM to .1mSEC. Position the back corner of the waveform to the graticule center line. Change the TIME/CM back to .2μSEC. The waveform must return to within 10mV (2cm) of the graticule center within 0.3μs (referenced to left edge of graticule).

16. COMPARISON VOLTAGE

a. Setup

TYPE 1A5

DISPLAY	A-V_C
VOLTS/CM	1mV
V_C dial	full ccw
V_C POLARITY	0
A INPUT	DC

DC VOLTAGE BRIDGE

RANGE	11V
POLARITY	+
INPUT VOLTAGE dial	5.00

Connect the DC VOLTAGE BRIDGE between gnd and the MONITOR jack.

16. (cont'd)

b. Check V_C Zero Error
electrical: ≤2mV
mechanical: ≤1 line width

Check that the V_C dial 0 is within 1 line width of the index when the dial is full ccw.

Center the trace on the graticule. Change the V_C POLARITY to +. The trace must not shift more than 2cm (2mV).

c. Adjust Comparison Voltage
full scale { 5V ±3mV (1mV-2V
0.5V ±2mV (5V-20V)

Set the V_C dial and the DC VOLTAGE BRIDGE to read 5.00 volts. Adjust V_C Cal R113 for a null indication on the DCVB. Check for null at the 1mV through 2V settings of the VOLTS/CM switch.

Change the VOLTS/CM to 5V. Change the DCVB RANGE to 1.1 and adjust the dial to read 0.500 volts. Adjust the V_C X10 Cal (R119) for a null indication on the DCVB. Check for null at 5V through 20V settings of the VOLTS/CM switch.

d. Check V_C Accuracy (5V to 20V/CM)
±0.75% of indicated or ±0.75mV, Whichever is greater

Set the VOLTS/CM to 5V. Check for the specified voltage with V_C dial set as follows:

V_C dial	Voltage (DCVB reading)
5.00	500mV ±2mV
4.00	400mV ±3.0mV
3.00	300mV ±2.25mV
2.00	200mV ±1.50mV
1.00	100mV ±0.75mV

e. Check V_C Accuracy (1mV-2V/CM)
±0.3% of indicated or ±3mV whichever is greater.

Change the V_C and DCVB POLARITY to - and the DCVB RANGE to 11V. Change the VOLTS/CM to 2V. Check for the specified voltage with the V_C dial set as follows:

16e. (cont'd)

V_C dial	Voltage (DCVB reading)
0.05	0.5V ±3mV
1.50	1.5V ±4.5mV
2.50	2.5V ±7.5mV
3.50	3.5V ±10.5mV
4.50	4.5V ±13.5mV
5.00	5.0V ±3mV

17. AMPLIFIER STABILITY ≤300μV drift

Set the front panel controls as follows:

INPUT (A & B)	GND
DISPLAY	A-B
VOLTS/CM	1mV

Set the line voltage to 105 VAC. Allow 1 minute for the amplifier to stabilize, center the trace and increase the line voltage to 125 VAC. The trace drift over a period of 1 minute must not exceed 3mm (300μV).

The TYPE 1A5 must be in the plug-in compartment with side panels installed on the mainframe when this check is made.

18. DIFFERENTIAL PROBE

a. Adjust PROBE STEP ATTEN BAL

Set the VOLTS/CM to 20mV and position the trace to graticule center. Turn the differential probe power on and adjust the PROBE STEP ATTEN BAL to bring the trace back to graticule center. Adjust the PROBE STEP ATTEN BAL so there is no trace shift as the VOLTS/CM is changed from 20mV to 1mV.

b. Check Differential Probe Input Connector

Connect the Differential Probe Plug Checker to the DIFFERENTIAL PROBE jack. Check for the specified voltage at the following pins:

PIN	VOLTAGE
K	-50V ±5%
F	+50V ±5%
E	+20.7V ±5%
D	6.2V ±5%

18b. (cont'd)

Check that the 6.2V is applied to pin D in the 1mV through the 20mV position of the VOLTS/Cμ sw and is not applied in the 50mV through the .2V positions.

Depress the +50V load button while monitoring the +50V. The voltage must remain at +50V, ±5%.

Apply a 20mV calibrator signal to each input on the probe checker. Check for a displayed square-wave of ≈1cm (continuity check only).

THE FOLLOWING CHECK IS NOT MADE ON 100% OF THE INSTRUMENTS BUT IS DONE ON A SAMPLING BASIS.

19. INPUT RESISTANCE 1MΩ ±0.15%

Set the front panel controls as follows:

VOLTS/CM	1mV
INPUT (both)	DC
DISPLAY	A-V_C

Connect a resistance bridge (with 0.04% or better accuracy at 1MΩ) to A INPUT. NOTE: Do not turn the power off. Check for an input resistance of 998 500Ω to 1,001,500Ω.

Change the DISPLAY to V_C-B, connect the resistance bridge to the B INPUT and repeat the check.

THE END