PRODUCT REFERENCE BOOK

for the Tektronix Type

1A7A

differential amplifier unit

For all serial numbers

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SALES

file 1A7A PRB

date 3-6-68

U.S. MARKETING SALES RELEASE

1A7A HIGH GAIN DIFFERENTIAL PLUG-IN

Major Sales Features

The 1A7A is the result of a complete redesign of the 1A7. The notable differences are:

All solid state, FET inputs.

Bandwidth - Extended to 1 MHz.

CMRR - Increased to 100,000:1.

Dynamic Range - Increased to 400 mV.

Drift - Old Spec - 200 µV/h averaged over 10 h.
150 µV/°C.

New Spec - Short term - 5 µV/min after 1 hour warm up.
Long term - 10 µV/h after 1 hour warm up.
50 µV/°C.

Input Gate Current - A very important specification change.

Old Spec - ≤ nA after 20 minutes warm up, 50 pA/°C, and 20 pA/h long term drift with time.

New Spec - From 10 µV/cm to 10 mV/cm (25°C) max gate current is ±10 pA (increasing to 100 pA at 50°C).

Maximum Input Voltage - Decreased from 200 V at 10 µV/cm to ±20 V at 10 µV/cm.

Signal Output - Increased from 34 mV/cm-defl to 0.25 V/cm-defl.

Overdrive recovery is now specified.

Public Announcement: March 11, 1968.

First Public Showing: IEEE Show, March 18, 1968.

Price: $440.

First Demo Availability: April 1, 1968.

First Customer Availability: April 1, 1968.

Support Activity

Advertising: March 1968 Long-Form Catalog.
Press Release (info and photograph) sent to about 60 magazines for release after March 11, 1968.

Product Technical Information: PRB to arrive in FO around March 8, 1968.

FACTORY CALIBRATION PROCEDURE

CONTENTS:

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

Equipment Required

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

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

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

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

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

CHANGE INFORMATION:

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

This procedure is company confidential

1A7A

April 1968

For all serial numbers.

VALIDATION COPY

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

1 TYPE 540B series OSCILLOSCOPE
1 TYPE 547 OSCILLOSCOPE
1 TYPE 1A1 DUAL TRACE PLUG-IN UNIT

b. Test Fixtures and Accessories

*1 Standard Amplitude Calibrator (067-0502-00) (with EXT mod)
*1 Sine Wave Generator (067-0542-99) (with J series timing caps)
1 Normalizer, 47pF BNC (067-0541-00)
1 50 Termination, BNC (011-0049-00)
2 10:1 Attenuators, BNC (011-0059-00)
1 COAX T connector, BNC (067-0525-00)
2 50 Cables, BNC (012-0057-00)
1 600V Variable DC Supply PMPE Dwg # 1421A
1 250:1 Divider (Special)
1 Variable Attenuator (067-0511-00)
1 67.5 Volt Bridge PMPE Dwg #1008A
2 Patch Cords BNC-BNC (012-0091-00)
1 1k 1% resistor
1 .01 capacitor (MYLAR)

* This equipment must be treaceable 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.

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QUALIFICATION

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 (set-ups, 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.

3. BALANCE

b. Variable Balance .2cm, max

4. OUTPUT DC LEVEL ±2%, max of main frame +100V

5. INPUT CURRENT AND DRIFT

a. Adjust + Input 2cm ±15pa, max
b. Adjust - Input 2cm ±15pa, max
c. Check drift 5μV, max, in 1 minute after 1hr. warm up

6. NEUTRALIZATION

b. Adjust - neutralization aberration: ±1%, max
c. Adjust + neutralization aberration: ±1%, max

7. GAIN

a. Check GAIN range + & - 6%, min
b. Check VARIABLE ratio: 2.5:1, min

8. POSITION RANGE + & - 9cm, min

9. VOLTS/CM ACCURACY

a. Check 1mV to 10VOLTS/CM accuracy: ±1.5%, max
b. Check 1mV to 10 V accuracy: ±1.5%, max

10. SIGNAL OUTPUT

b. Adjust DC Level ±.5V, max
c. Adjust compensation ±3%, max
d. Check ampltiude .25V/CM, ±10% max
e. Check 1MHz amplitude .25V/CM, ±10%, max
f. Check dynamic range + & - 4.5 VOLTS, min

11. INPUT CAPACITANCE AND ATTENUATOR COMPENSATION

b. Adjust C112 (C212) aberration: ±1%, max
c. Adjust attenuator compensation aberration: ±1%, max

12. ATTENUATOR DIFFERENTIAL BALANCE 1000:1, min

*13. CMRR

b. Check CMRR 125,000:1, min
c. Check AC coupled CMRR
25,000:1, min @ 100kHz
2,500:1, min @ 60Hz
d. Check attenuator CMRR 500:1, min, @ 100kHz

*14. BANDWIDTH LIMIT

b. Check 1MHz bandwidth 1MHz, +30% -0%
c. Check HIGH FREQ -3dB POINT ±10%, max
d. Check LOW FREQ -3dB POINT ±10%, max

15. OVERDRIVE RECOVERY

b. Check overdrive recovery .5% in 10μS

16. DC OFFSET

a. Check +DC OFFSET +.4V, ±7.5%, max
b. Check -DC OFFSET -.4V, ±7.5%, max

17. DYNAMIC RANGE AND INPUT OVERLOAD

b. Check + dynamic range and INPUT OVERLOAD
range: 420mV, min
OVERLOAD light: before overload
c. Check - dynamic range and INPUT OVERLOAD
range: 420mV, min
OVERLOAD light: before overload

18. DISPLAYED NOISE

b. Check displayed noise
measured tangentially: 15μV, max

[NOTE: THE FOLLOWING CHECKS ARE NOT MADE ON 100% OF THE INSTRUMENTS BUT ARE DONE ON SAMPLING BASIS]

19. AC LF RESPONSE

b. Check AC LF response 1.6Hz, min

20. SIGNAL OUTPUT RESISTANCE

b. Check SIGNAL OUTPUT resistance:
750Ω, max

THE END

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

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. PRESETS

a. TYPE 1A7A
b. TYPE 547

2. CHECK RESISTANCE

3. BALANCE

a. Adjust AC Atten Bal
b. Adjust Variable Bal ±.2cm, max
c. Adjust Coarse Bal

4. OUTPUT DC LEVEL ±2%, max, of main frame +100V

5. INPUT CURRENT AND DRIFT

a. Adjust + Input Zero ±10pa, max
b. Adjust - Input Zero ±10pa, max
c. Check drift 5μV/min

6. NEUTRALIZATION

a. Setup
b. Adjust - neutralization aberration: ±1%, max
c. Adjust + neutralization aberration: ±1%, max

7. GAIN

a. Check GAIN range + & - 6%, min
b. Check VARIABLE ratio: 2.5:1, min

8. POSITION RANGE + & - 9cm, min

9. VOLTS/CM ACCURACY

a. Check 1mV to 10 VOLTS/CM accuracy: ±1.5%, max
b. Check 1mV to 10μV accuracy: ±1.5%, max

10. SIGNAL OUTPUT

a. Setup
b. Adjust DC Level ±.5V, max
c. Adjust compensation ±3%, max
d. Check amplitude .25V/CM, ±10%, max
e. Check 1MHz amplitude .25V/CM, ±10%, max
f. Check dynamic range + & - 4.5 VOLTS, min

11. INPUT CAPACITANCE AND ATTENUATOR COMPENSATION

a. Setup
b. Adjust C112 (C212) aberration: ± 1%, max
c. Adjust attenuator compensation aberration: ±1%, max

12. ATTENUATOR DIFFERENTIAL BALANCE 1000:1, min

13. CMRR

a. Adjust CMRR 125,000:1, min
b. Check CMRR 125,000:1, min
c. Check AC coupled CMRR
   25,000:1 @100kHz
   2,500:1 @60Hz
d. Check attenuator CMRR 500:1 @100kHz

14. CHECK BANDWIDTH LIMIT

a. Setup
b. Check 1MHz bandwidth 1MHz, +30% -0%
c. Check HIGH FREQ -3dB POINT ±10%, max
d. Check LOW FREQ -3dB POINT ±10%, max

15. OVERDRIVE RECOVERY

a. Setup
b. Check overdrive recovery .5% in 10μS

16. DC OFFSET

a. Check + DC OFFSET +.4V, ±7.5%, max
b. Check -DC OFFSET -.4V, ±7.5%, max

17. DYNAMIC RANGE AND INPUT OVERLOAD

a. Setup
b. Check + dynamic range and INPUT OVERLOAD
   range: 420mV, min
   OVERLOAD light: before overload
c. Check - dynamic range and INPUT OVERLOAD
   range: 420mV, min
   OVERLOAD light: before overload

18. DISPLAYED NOISE

a. Setup
b. Check displayed noise
   measured tangentially: 14μV, max

[NOTE: THE FOLLOWING CHECKS ARE NOT MADE ON 100% OF THE INSTRUMENTS BUT ARE DONE ON A SAMPLING BASIS]

19. AC LF RESPONSE

a. Setup
b. Check AC LF response 1.6Hz, min

20. SIGNAL OUTPUT RESISTANCE

a. Setup
b. Check SIGNAL OUTPUT resistance
   resistance: 750Ω, max

THE END

1. PRESETS

a. TYPE 1A7A

VOLTS/CM	10mVOLTS
VARIABLE	CAL
POSITION	centered
HIGH FREQ -3dB POINT	10kHz
LOW FREQ -3dB POINT	10Hz
DC OFFSET switch	off
DC OFFSET	midr
DC OFFSET FINE	midr
GAIN	midr
STEP ATTEN DC BAL	midr
INPUT switches	GND
all internal adjustments	midr

b. TYPE 547

HORIZONTAL DISPLAY TIME BASE A & B	B
TRIGGERING LEVEL	0
MODE	AUTO
SLOPE	+
COUPLING	AC
SOURCE	NORM
TIME/CM	.5mSEC
VARIABLE	CALIBRATED

Leave controls and adjustments, for any step, as they were in the step preceding unless noted otherwise.

2. CHECK RESISTANCE

Check resistance to ground on 16 pin Amphenol connector (rear). Connect negative lead of VOM to gnd. Set VOM to X1k scale.

pin number	approximate resistance	use
1	14k	output
2	0	gnd
3	14k	output
4, 5, 6, 7, 8	inf	unused
9	14k	-150v supply
10	5.6k	+100v supply
11, 12, 13, 14	inf	unused
15	500Ω	+75v filament supply
16	inf	unused

3. BALANCE

a. Adjust AC Atten Bal

Position the trace to graticule center with the TYPE 1A7A POSITION control. Set VOLT/CM to 50μV. Adjust R505 to return trace as near to graticule center as possible.

b. Adjust Variable Balance ±.2cm, max

Set TYPE 1A7A VOLTS/CM to 10mV. Adjust R425 for no trace shift while rotating the VARIABLE control ccw and cw. Set VARIABLE to CAL.

c. Adjust Coarse Bal

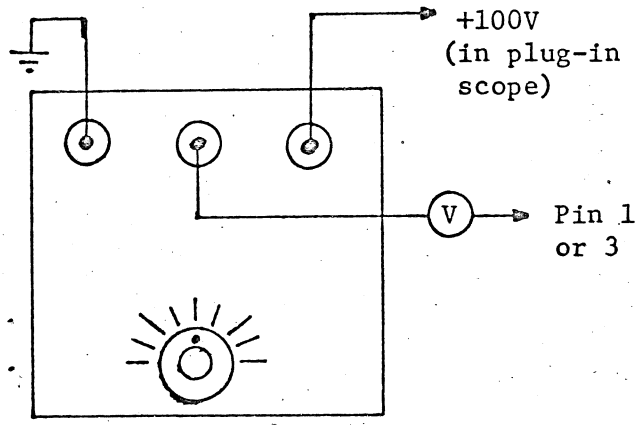
Position trace to graticule center with the TYPE 1A7A POSITION control. Set LOW FREQ -3dB POINT to DC. Set VOLTS/CM to .1mV. Adjust R345 to return trace to approximately graticule center. Adjust STEP ATTEN DC BAL for no trace shift while switching VOLTS/CM between .1mV and 10μV.

Set VOLTS/CM to 10mV and position trace to graticule center.

4. OUTPUT DC LEVEL

±2%, max, of main frame +100V

Connect the 67.5 volt bridge as shown:



Set the VOM to the most sensitive DC volts range. Check that zero volts can be obtained on the VOM with the dial on the 67.5 Volt bridge.

Disconnect 67.5 Volt bridge and VOM.

5. INPUT CURRENT AND DRIFT

a. Adjust + Input Zero ±10pa, max

Set HIGH FREQ -3dB POINT to 100Hz. Set VOLTS/CM to 10μV. Connect a .01 capacitor to the + INPUT. Position trace to graticule center with STEP ATTEN DC BAL. Adjust R115 for no trace shift while switching the + INPUT selector between GND and DC. Set + INPUT to GND.

Note: The .01 cap should be inclosed in a holder such as the 204-0209-00 with a 134-0044 connector.

b. Adjust - Input Zero ±10pa, max

Change the .01 capacitor to the - INPUT. Adjust R215 for no trace shift while switching the - INPUT selector between GND and DC. Set - INPUT selector to GND.

Note: Heating the leads of D133 and D233 to approximately solder melting temperature may cause sufficient additional leakage to compensate input current.

c. Check drift drift: 5μV, max, in 1 min
Observe trace shift for ≈ one minute: .5cm, max

Set HIGH FREQ -3dB POINT to 1MHz and VOLTS/CM to 10mV.

Remove .01 cap.

6. NEUTRALIZATION

a. Setup

Set TYPE 1A7A + INPUT to DC. Connect a .1 VOLTS from TYPE 547 AMPLITUDE CALIBRATOR to TYPE 1A7A + INPUT. Set DC OFFSET to ON and position top of display to graticule center with COARSE control. Set VOLTS/CM to 1mV.

b. Adjust - neutralization aberration: ±1%, max

Adjust C231 for least change in front corner of waveshape when switching - INPUT from GND to DC. Aberration: ±1cm, max.

c. Adjust + neutralization aberration: ±1%, max

Set TYPE 1A7A - INPUT to DC. Change signal from + INPUT to - INPUT. Position bottom of display to graticule center with DC OFFSET

6c. (cont'd)

COARSE (approx 2.4 turns CW). Adjust C131 for least change in front corner of waveshape when switching + INPUT from GND to DC. Aberration: ±1cm, max. Remove signal. Set both INPUT switches to GND, and DC OFFSET to OFF.

7. GAIN

a. Check GAIN range + & - 6%, min

Connect a 5mVOLT square wave from the SAC to the TYPE 1A7A + INPUT. Set + INPUT selector to DC and - INPUT selector to GND. Rotate GAIN full cw and not deflection: 5.3cm, min. Rotate GAIN full ccw and note deflection: 4.7cm, max. Adjust GAIN for exactly 5cm.

b. Check VARIABLE ratio: 2.5:1, min

Rotate VARIABLE full ccw and note deflection: 2cm, max. Rotate VARIABLE to CAL.

8. POSITION RANGE + & - 9cm, min

Set SAC AMPLITUDE to 10mV and MODE to +DC. Rotate TYPE 1A7A POSITION full ccw. Trace must position to within 1cm of graticule center. Set SAC MODE to -DC. Rotate TYPE 1A7A POSITION full cw. Trace must position to within 1cm of graticule center.

Set POSITION to midrange.

9. VOLTS/CM ACCURACY

a. Check 1mV to 10 VOLTS/CM accuracy ±1.5%, max

Connect 100V @ 500Hz from Sine Wave Generator to SAC EXT INPUT. Set SAC MODE to EXT.

Note: Use a SAC with EXT MOD.

9a. (cont'd)

Adjust Sine Wave Generator AMPLITUDE MULTIPLIER for 6cm display. Maintain a 6cm display with the SAC AMPLITUDE switch while checking each position of the TYPE 1A7A VOLTS/CM switch from 1mV to 10 VOLTS: ±.09div, max

b. Check 1mV to 10μV VOLTS/CM accuracy ±1.5%, max

Set TYPE 1A7A HIGH FREQ -3dB POINT to 100Hz, LOW FREQ -3dB POINT to 10kHz, and VOLTS/CM to 1mV. Set SAC AMPLITUDE to 1 VOLT. Adjust Sine Wave Generator AMPLITUDE MULTIPLIER for exactly 6cm of display. Maintain a 6cm display with the SAC AMPLITUDE switch while checking each position of the TYPE 1A7A VOLTS/CM switch from 1mV to 10μV: ±0.9div, max.

Set + INPUT selector to GND. Remove input.

10. SIGNAL OUTPUT

a. Setup

Set the TYPE 1A7A VOLTS/CM to 10mV, HIGH FREQ -3dB POINT to 1MHz, and LOW FREQ -3dB POINT to DC. Position the trace to graticule center with the position control. Set TYPE 1A1 CHANNEL 1 VOLTS/CM to .5 and position trace to graticule center. Connect TYPE 1A7A SIGNAL OUTPUT to TYPE 1A1 CHANNEL 1 input with patch cords.

Note: Patch cords are used in step 10 for minimum capacative loading on the signal output.

b. Adjust DC Level ±.5V, max

Adjust R550 for no trace shift on the test scope while switching TYPE 1A1 CHANNEL 1 INPUT SELECTOR between GND and DC.

c. Adjust compensation

Connect 50mV from the TYPE 547 AMPLITUDE CALIBRATOR to the TYPE 1A7A + INPUT. Set + INPUT selector to DC. Adjust C554 for best compensation of front corner of test scope display.

10. (cont'd)

d. Check amplitude .25V/CM, ±10%, max

Set TYPE 1A1 VOLTS/CM to .2. Adjust TYPE 1A7A VARIABLE for 4cm on Plug-in scope display. Check amplitude of test scope display: 4.5cm, min; 5.5cm, max.

Remove TYPE 1A7A input. Set VARIABLE to CAL.

e. Check 1MHz amplitude .25V/CM, ±10%, max

Connect Sine Wave Generator to TYPE 1A7A + input and adjust for 4cm at 1MHz on plug-in scope display. Check amplitude of test scope display: 4.5cm, min, 5.5cm, max.

f. Check dynamic range + & - 4.5 Volts, min

Set TYPE 1A1 VOLTS/CM to 2. Set Sine Wave Generator to 1kHz and adjust AMPLITUDE until clipping occurs on the positive and negative peaks of the test scope display. Note ampltiude of test scope display: + and - 2.25cm, min.

Remove cable and patch cord.

11. INPUT CAPACITANCE AND ATTENUATOR COMPENSATION

a. Setup

apply signal
TYPE 547 AMPLITUDE CALIBRATOR--50Ω cable--47pf INPUT TIME CONSTANT STANDARDIZER--TYPE 1A7 + INPUT

b. Adjust C112 (C212) aberration: 1%, max

Set the + (-) INPUT switch to DC and the - (+) INPUT switch to GND. Apply 5cm of signal (.1 VOLTS) from the AMPLITUDE CALIBRATOR.

Adjust C112 (C212) for best square-wave.

c. Adjust attenuator compensation aberration: 1%, max

Set the AMPLITUDE CALIBRATOR for 5cm of deflection in each of the following steps.

11c. (cont'd)

Adjust for best front corner, then for level.

TYPE 1A7 VOLTS/CM	adjust for best front corner	for level
20mVOLTS	C105C (C205C)	C105B (C205B)
50mVOLTS	check*	
.1 VOLTS	check*	
.2 VOLTS	C107C (C207C)	C107B (C207B)
.5 VOLTS	check*	
1 VOLTS	check*	
2 VOLTS	C109C (C209C)	C109B (C209B)
5 VOLTS	check*	
10 VOLTS	check*	

* The rolloff, overshoot and level must be within 1%. If necessary, detune preceding variable capacitors (within 1%) to bring all positions involved within 1%.

Repeat step 11 for - INPUT.

Remove input.

12. ATTENUATOR DIFFERENTIAL BALANCE

Connect TYPE 547 AMPLTIUDE CALIBRATOR through the coax T to TYPE 1A7A + and - INPUT. Set both input selectors to DC and adjust for minimum vertical deflection as in table below:

VOLTS/CM	CALIBRATOR	adjust	
20mV	2 VOLTS	R205E	C205C
.2 V	20 VOLTS	R207E	C207C
2 V	100 VOLTS	R209E	C209C

Remove Cable from CO-AX T.

13. CMRR

a. Adjust CMRR 125,000:1, min

Set TYPE 1A7A VOLTS/CM to 1mV. Connect 20V at 100kHz from SINE WAVE GENERATOR to Coax T connector and to the TYPE 1A7A + and - INPUT connectors. Adjust C162 for minimum deflection. Set VOLTS/CM to .1mV and fine adjust C162 for minimum deflection, 1.6cm, max.

b. Check CMRR 125,000:1, min

Set SINE WAVE GENERATOR FREQUENCY MULITPLIER to 10kHz, 1kHz, 100Hz, and 10Hz and note deflection: 1.6cm, max.

c. Check AC coupled CMRR
25,000:1, min @100kHz
2.500:1, min, @60Hz

Set TYPE 1A7A VOLTS/CM to 1mV and INPUT selectors to AC. Set Sine Wave Generator to 100kHz and note deflection: .8cm, max. Set TYPE 1A7A VOLTS/CM to 10mV. Set Sine Wave Generator to 60Hz and note deflection: .8cm, max.

d. Check attenuator CMRR 500:1, min, @100kHz

Set both INPUT selectors to DC and check as in table:

Sine Wave Generator	VOLTS/CM	Adjust if necessary	deflection
20 Volts	20mV	C205C	2cm
50 Volts	50mV		2cm
100 Volts	.1 Volts		2cm
100 Volts	.2	C207C	1cm
100 Volts	.5		.4cm
100 Volts	1		.2cm
100 Volts	2	C209C	.1cm

Remove inputs. Set the - INPUT selector to GND.

14. BANDWIDTH LIMIT

a. Setup

Set TYPE 1A7A VOLTS/CM to 10mV. Connect 5cm @1kHz from Sine Wave Generator to TYPE 1A7A + INPUT.

b. Check 1MHz bandwidth 1MHz, +30% -0%

Set Sine Wave Generator to 1MHz and note deflection: 3.5cm, min, 4.1cm, max.

c. Check HIGH FREQ -3dB POINT ±10%, max

Set the TYPE 1A7A HIGH FREQ -3dB POINT and the Sine Wave Generator to each front panel frequency and note deflection: 3.4 cm, min, 3.7cm, max. Set HIGH FREQ -3dB POINT to 1MHz.

d. Check LOW FREQ -3dB POINT ±10%, max

Set TYPE 1A7A LOW FREQ -3dB POINT and Sine Wave Generator to each front panel frequency from 10kHz to 1Hz and note deflection: 3.4 cm, min, 3.7cm, max.

Remove input. Set LOW FREQ -3dB POINT to DC.

15. OVERDRIVE RECOVERY

a. Setup

Set TYPE 1A7A VOLTS/CM to 1mV and + INPUT selector to GND. Position trace to graticule center. Set plug-in scope TRIGGERING slope to -, MODE to TRIG TIME/CM to 10µSEC, and LEVEL full ccw. Increase INTENSITY until a dot appears and position dot to left edge of graticule. Connect +100V DC from AMPLITUDE CALIBRATOR through 250:1 divider to + INPUT.

b. Check overdrive recovery .5% in 10µS

Set TYPE 1A7A + INPUT selector to DC. After a few seconds, depress button on 250:1 divider. Note: trace must return to within 2cm of graticule center within 10µS. See Fig. 1. Set + INPUT selector to GND.

Set TRIGGERING MODE to AUTO and decrease intensity to normal.

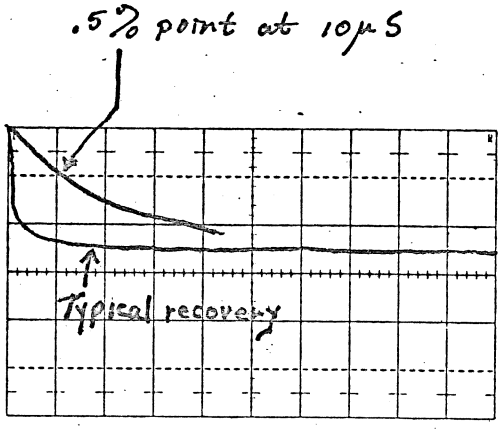


Fig #1

16. DC OFFSET

a. Check + DC OFFSET +.4V, ±7.5%, max

Set TYPE 1A7A VOLTS/CM to 10mV, + INPUT selector to DC and DC OFFSET to ON. Rotate COARSE full ccw and note trace returns to graticule.

b. Check -DC OFFSET -.4V, ±7.5%, max

Change 250:1 divider to - INPUT. Set + INPUT selector to GND and - INPUT selector to DC. Rotate COARSE full cw and note trace returns to graticule.

Rotate DC OFFSET fine and check for approximately .2cm of range.

Remove 250:1 divider. Set DC OFFSET to OFF. Set TIME/CM to .5mSEC.

17. DYNAMIC RANGE AND INPUT OVERLOAD

a. Setup

Connect Sine Wave Generator to TYPE 1A7A - INPUT. Adjust Sine Wave Generator for 4cm @1kHz. Set SAC to 5V +DC and connect through Variable Attenuator to TYPE 1A7A + INPUT. Set + INPUT selector to DC and LOW FREQ -3dB POINT to 10Hz.

b. Check + dynamic range and INPUT OVERLOAD
range: 420mV, min
OVERLOAD light: before overload

Adjust Variable Attenuator until display starts to compress. Note INPUT OVERLOAD light lights before display compresses.

Set TYPE 1A7A - INPUT Selector to GND and VOLTS/CM to .1. Set SAC MODE to square wave and note display amplitude: 4cm, min.

c. Check - dynamic range and INPUT OVERLOAD
range: 420mV, min
OVERLOAD light: before overload

Set SAC MODE to -DC. Set TYPE 1A7A VOLTS/CM to 10mV and -INPUT selector to DC. Adjust Variable Attenuator until display compresses.

17c. (cont'd)

Set SAC MODE to square wave. Set TYPE 1A7A - INPUT selector to GND and VOLTS/cm to .1. Note display amplitude: 4cm, min.

Set LOW FREQ -3dB POINT to DC.

18. DISPLAYED NOISE

a. Setup

Remove Variable Attenuator from SAC OUTPUT and connect to TYPE 547 CAL OUT. Set AMPLITUDE CALIBRATOR to .2mVOLTS, TIME/CM to 20μSEC and TRIGGERING LEVEL full cw. Set TYPE 1A7A VOLTS/CM to .1mV.

b. Check displayed noise measured tangentially: 14μV, max

Adjust Variable Attenuator until dark band vanishes. Set AMPLITUDE CALIBRATOR to 2mVOLTS and note display amptliude: 1.4cm, max.

Remove input. Set TYPE 1A7A VOLTS/CM to 10mV.

[NOTE: THE FOLLOWING CHECKS ARE NOT MADE ON 100% OF THE INSTRUMENTS BUT ARE DONE ON A SAMPLING BASIS]

19. AC LF RESPONSE

a. Setup

Set TYPE 1A7A + INPUT selector to AC. Connect Sine Wave Generator to + INPUT. Adjust Sine Wave Generator for 5cm @1kHz.

b. Check AC LF response 1.6Hz, min

Set Sine Wave Generator to 2Hz and note display ampltiude: 3.85cm, min.

Set Sine Wave Generator to 1kHz.

20. SIGNAL OUTPUT RESISTANCE

a. Setup

Connect TYPE 1A7A SIGNAL OUTPUT to TYPE 1A1 with patch cords, Set 1A1 VOLTS/CM to .2. Adjust Sine Wave Generator for 5cm on test scope display.

b. Check SIGNAL OUTPUT resistance
resistance: 750Ω, max

Connect a 1kΩ 1% resistor from TYPE 1A7A SIGNAL OUTPUT to ground. Note test scope display ampltiude: 2.9cm, min.

Remove cables from TYPE 1A7A.

THE END

MEMO

DATE: Dec. 5, 1969

TO: IP Routing DEPT:

FROM: Dave Robertson DEPT: Fin Prod QC

SUBJECT: 1A7A Change 6

Please replace the old page with the one enclosed.

OLD	NEW
6. Page 5, March 25, 1969	Dec. 5, 1969/A

Reason for change: IP Correction

ny

cc: SE (2)
Dean Nelson
Keith Summerill
PE-PEM
FPQC File
Ron Howe (3)

SIGNAL OUTPUT RESISTANCE

(Cont.)

SET - 1A7A OUTPUT CHECKER to OFF

- SINE WAVE GENERATOR FREQUENCY to 1kHz

ADJUST - SINE WAVE GENERATOR AMPLITUDE for a 5cm display on the test scope

SET - 1A7A OUTPUT CHECKER to ON

CHECK - for a display of 2.5cm minimum on test scope

SET - 1A7A OUTPUT CHECKER to OFF

DYNAMIC RANGE

+ and - 4.5 volts, min

501 SET - 1A1 VOLTS/CM to 2

- INPUT SELECTOR to GND

- trace to graticule center on test scope

- 1A1 INPUT SELECTOR to AC

ADJUST - test scope trigger for a stable display

- SINE WAVE GENERATOR AMPLITUDE until the display on the test scope starts to flatten on top and bottom

CHECK - amplitude of signal on test scope for a minimum of 2.25cm above graticule center and 2.25cm below graticule center

REMOVE - all cables from 1A7A and 1A1

INPUT CAPACITANCE AND ATTEN COMPENSATION

± 1% max aberration

502 CONNECT - 47pf NORMALIZER to 1A7A + INPUT

- 547 AMPLITUDE CALIBRATOR to 47pf NORMALIZER

USE - following table and check for rolloff, overshoot and level

1A7A VOLTS/CM	547 AMPLITUDE CALIBRATOR	AMPLITUDE	MAX ABERRATION
10mV	.1 VOLTS	5cm	± .5 mm
20mV	.2 VOLTS	5cm	± .5 mm
50mV	.5 VOLTS	5cm	± .5 mm
.1 V	1 VOLTS	5cm	± .5 mm
.2 V	2 VOLTS	5cm	+ .5 mm
.5 V	5 VOLTS	5cm	± .5 mm
1 V	10 VOLTS	5cm	± .5 mm
2 V	20 VOLTS	5cm	± .5 mm
5 V	50 VOLTS	5cm	± .5 mm
10 V	100 VOLTS	5cm	± .5 mm

REMOVE - cable and 47pf NORMALIZER from 1A7A + INPUT

ATTEN DIFF BALANCE

1000:1, min

503 CONNECT - 547 AMPLITUDE CALIBRATOR to 1A7A + and - INPUTS through a coax T

SET - both INPUT switches to DC

SET - 547 AMPLITUDE CALIBRATOR and 1A7A VOLTS/CM as in the table on the next page:

MODIFIED

ENG SPEC

9-319 D

Change No. 197-3

ENGINEERING INSTRUMENT SPECIFICATION

CHANGE NOTICE

Instrument Type: 1A7A

Publication affected: Engineering Instrument Spec. No. 197 Dated 12/28/67

Page: 1-3 & 1-7 Item Step Response, Maximum Input Gate Current

Changed from: Page 1-7

Maintenance and Operation column:

Adjustable to zero using internal adjustments.

Changed to: Page 1-3

Add to Engineering Notes column:

Test signal risetime not less than 10 ns.

Page 1-7

Delete information.

NOTE: The enclosed slit-punched pages replace the corresponding pages in the EIS.

Reason for change: Instrument may not perform as indicated by statement on page 1-7. Short risetime, high-amplitude test signals cause attenuator ringing and amplifier overload.

Approved by: Russell V Filbinger (Project Manager) Effective date 3/13/68

9-319 D

Change No. 197-4

ENGINEERING INSTRUMENT SPECIFICATION

CHANGE NOTICE

Instrument Type: 1A7A

Publication affected: Engineering Instrument Spec. No. 197 Dated 12/28/67

Page: 1-7 Item Maximum Input Gate Current

Changed from:

See page 1-7 of Spec. Book

Changed to:

Maximum Input Current		+25°C	+50°C*
10 µV/cm to 10 mV/cm	each input	±20 pA	±100 pA
	both inputs	±40 pA	±200 pA
20 mV/cm to 10 V/cm	each input	±10 pA	±10 pA
Display Shift at 10 µV/cm (AC coupled)	each input	±2 cm	±10 cm

NOTE: The enclosed slit-punched page replaces the corresponding page in the EIS.

Reason for change:

1. Instrument may not meet existing specification.
2. Re-layout of table for clarity.

Approved by: Russell V Fillmore (Project Manager) Effective date 3/13/68

9-319 D

Change No. 197-5

ENGINEERING INSTRUMENT SPECIFICATION

CHANGE NOTICE

Instrument Type: 1A7A Differential Amplifier

Publication affected: Engineering Instrument Spec. No. 197 Dated 12/28/67

Page: 1-8 Item Signal Output - Amplitude

Changed from:

0.25 V/cm within 10%, decreasing to 0.225 V/cm within 10% to 1 MHz

Changed to:

QUOTABLE	MAINTENANCE & OPERATION
.25 V/cm, within 10%	Minimum load impedance 10 kΩ (15 pF at 1 MHz)

NOTE: The enclosed slit-punched page replaces the corresponding page in the EIS.

Reason for change:

Loading circuit not specified.

Approved by: Russ Fillinger (Project Manager) Effective date 4/15/68

Specification 197

December 28, 1967

ENGINEERING INSTRUMENT SPECIFICATION

TYPE 1A7A DIFFERENTIAL AMPLIFIER PLUG-IN UNIT

FOR INTERNAL USE ONLY

TEKTRONIX, INC.

Specification 197

December 28, 1967

ENGINEERING

INSTRUMENT SPECIFICATION

TYPE 1A7A

DIFFERENTIAL AMPLIFIER

PLUG-IN UNIT

Prepared by Engineering Writing Dept

Engineering Writer Gary W. Wright Gary Wright

Approval:

Project Manager Russell V Fillinger Russell Fillinger

Project Engineer, Electrical Val Garuts Val Garuts

Evaluation Engineer, Electrical Thor Hallen Thor Hallen

Evaluation Engineer, Mechanical Leonard Brown Leonard Brown

FOR INTERNAL USE ONLY

TEKTRONIX, INC.

PREFACE

This Engineering Instrument Specification is the reference document for all company activity concerning the electrical, environmental, and physical characteristics of the subject instrument. This document is printed in two issues: a tentative copy printed on or before Prototype Release of the instrument, and a final copy printed following Engineering Release. Occasionally, if justified by the number of changes, the final copy is updated and reissued following Pilot Production.

The major function of the Engineering Instrument Specification is to provide electrical, environmental, and physical characteristics to the following departments:

- Manuals
- Product Technical Information
- Engineering Product Reliability
- Marketing Technical Training
- Product Manufacturing Staff Engineering
- Advertising
- International Manufacturing Technical Support
- International Marketing
- Manufacturing Quality Assurance
- Manufacturing Management

Electrical and environmental characteristics listed in Section 1 are *worst case*, and are to be treated as described on page 1-1. *Factory test limits are excluded from the Engineering Instrument Specification.* Factory test limits are established by Product Manufacturing Staff Engineering, and appear in documents issuing from that department.

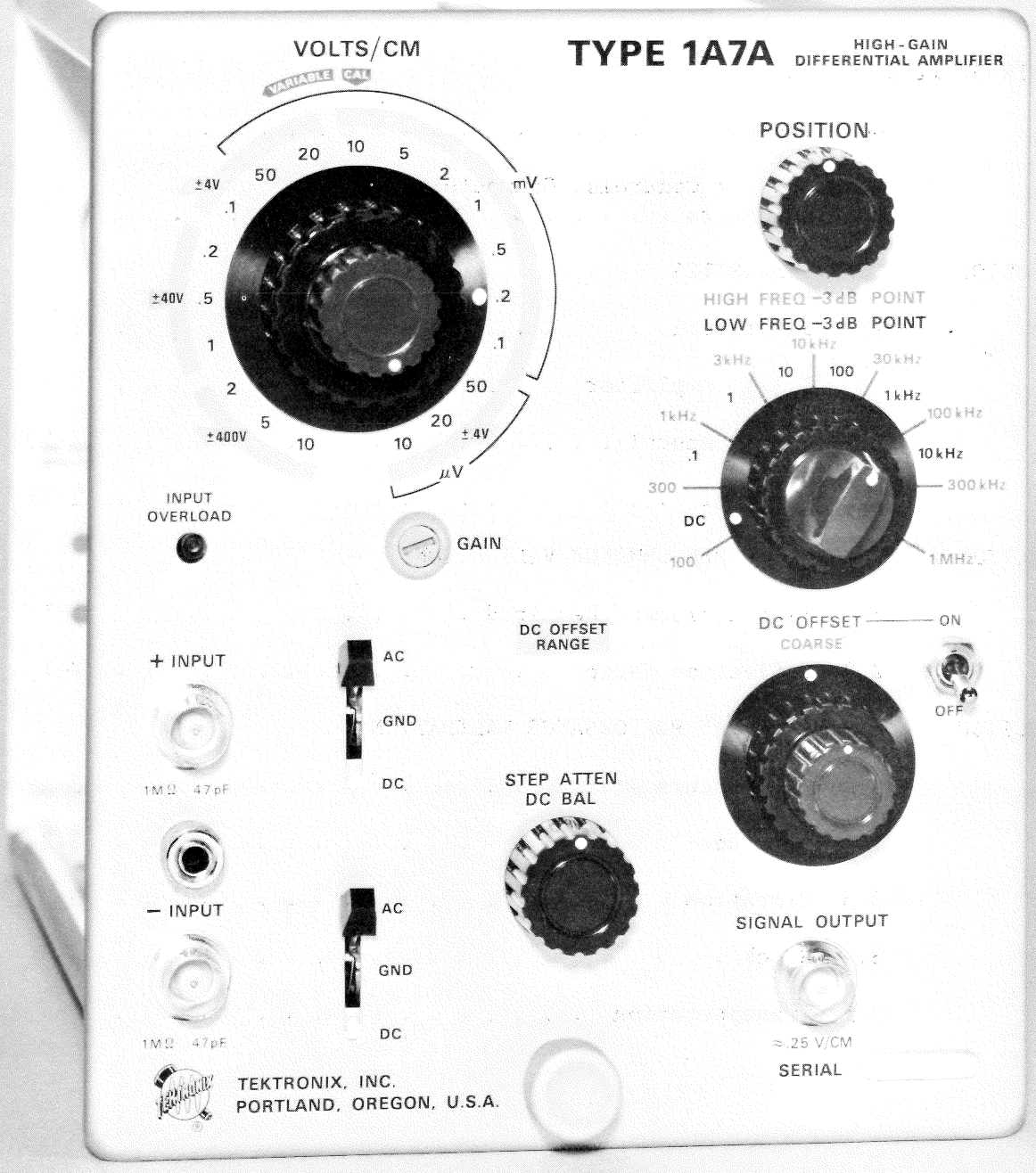
Abbreviations and symbols appearing in the Engineering Instrument Specification conform to Tektronix Standard No. A-100, *Recommended Short Forms*.

CHANGE INFORMATION LOG

This page is used as a guide to insure that all change pages have been inserted. When change pages are received, log them on this page, then insert the change pages in their appropriate place. Change numbers (located in upper right corner of Change Notice form) are assigned in sequence. Absence of a number from the sequence indicates a change which has not been inserted.

CHANGE NOTICE NUMBER	EFFECTIVE DATE OF CHANGE	PAGE NUMBER

CONTENTS


VOLTS/CM
VARIABLE CAL
TYPE 1A7A
HIGH-GAIN
DIFFERENTIAL AMPLIFIER
POSITION
mV
μV
±4V
±40V
±400V
INPUT
OVERLOAD
GAIN
HIGH FREQ −3dB POINT
LOW FREQ −3dB POINT
DC
1MHz
300kHz
100kHz
30kHz
10kHz
3kHz
1kHz
300
100
+ INPUT
− INPUT
1MΩ 47pF
AC
GND
DC
DC OFFSET
RANGE
STEP ATTEN
DC BAL
DC OFFSET
COARSE
ON
OFF
SIGNAL OUTPUT
≈.25 V/CM
SERIAL
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

INTRODUCTION

Description

The Type 1A7A is an improved version of the Type 1A7. It is a general-purpose 10 μV, DC coupled differential amplifier for Type 530-540-550 series oscilloscopes with DC offset capability with switchable high and low frequency -3 dB points. Increased bandwidth and improved drift with time in addition to better common mode rejection ratio permit measurement capabilities in the biomedical, transducer and other areas which require stable, low deflection factor, low-noise measurements. The Type 1A7A has been designed and tested to meet certain Tektronix environmental requirements for laboratory instruments.

Function of Controls, Connectors, and Indicators

VOLTS/CM Switch

Selects calibrated deflection factors from 10 μ V/CM to 10 V/CM in a 1-2-5 sequence.

VARIABLE VOLTS/DIV Control

Provides uncalibrated continuously variable deflection factor to at least 2.5 times the calibrated setting (uncalibrated deflection factor range is extended to 25 V/div).

POSITION Control

Vertically positions the display.

INPUT OVERLOAD Indicator

Indicates that differential overload is being approached. Lights when differential input + DC offset exceeds 0.75 of differential dynamic range.

GAIN Adjustment

Screwdriver adjustment allows calibration of vertical deflection factor.

+ INPUT Connector

BNC connector for applying external signals. Positive signal deflects trace up.

- INPUT Connector

BNC connector for applying external signals. Positive signal deflects trace down.

Input Selector

AC

Capacitively couples input signal to vertical amplifier.

GND

Grounds input attenuator.

DC

Signal is directly coupled to vertical amplifier.

STEP ATTEN DC BAL Control

Permits balancing of trace when switching VOLTS/CM control.

HIGH FREQ -3 dB POINT Switch

Selects upper bandwidth frequencies from 100 Hz to 1 MHz, nine steps in a 1-3-10 sequence.

LOW FREQ -3 dB POINT Switch

Seven positions select DC and lower bandwidth frequencies from 0.1 Hz to 10 kHz in decade steps.

DC OFFSET Switch

Turns DC offset ON or OFF.

DC OFFSET, COARSE and Fine Control

Permits displaying on screen, small signal variations on relatively large signals.

SIGNAL OUTPUT Connector

BNC connector for monitoring displayed signal.

SECTION 1

CHARACTERISTICS

Characteristics are attributes or capabilities of a product described in terms of acceptable qualitative or quantative limits. The characteristics in this section are categorized as electrical, environmental and physical.

The electrical and environmental characteristics together with their related validation procedures in Section 2 and 3 comprise a complete statement of the electrical and environmental performance of a calibrated instrument. Thus, the electrical and environmental characteristics are valid only: (1) if the instrument is operating under the conditions described in this section *and* in Section 2 and 3, and (2) if the instrument is calibrated and operating in a calibrated system.

Information in this section is tabulated as follows:

1. ITEM	Titles of specific attributes or capabilities of a product.
2. QUOTABLE	Characteristics describing the measurement capabilities or limitations and physical attributes of a product. These characteristics are considered necessary to qualify a product for a particular application(s). These characteristics are a commitment between Tektronix, Inc., and the customer.
3. MAINTENANCE & OPERATION	Characteristics that, when met, will insure optimum instrument operation. These characteristics may be given to a customer as maintenance or operational aids, but are *not* a commitment between Tektronix, Inc., and the customer
4. TEST RATE	Engineering's *recommendations* (not binding on Manufacturing) regarding the minimum percentage of instruments which are tested for specific characteristics; i.e. 100%, 10%, 1% or 0.1%. These recommendations are based on confidence level, and on the importance of the characteristic.
5. VAL. STEP	The step number in Section 2 or 3 where the validation procedure for the characteristic can be found.
6. ENGINEERING NOTES	Reserved for Engineering information. This information is not to be printed in any publication normally available to the customer and may not be given to a customer except under special circumstances. This information is not intended to be a commitment between the customer and Tektronix, Inc.

1.1 ELECTRICAL

1.1.1 AMPLIFIER

ITEM	QUOTABLE	MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
	NOTE Characteristics described in this section are valid over the stated environmental range for instruments calibrated at an ambient temperature of +20°C to +30°C and after a 5 minute warm up unless otherwise noted.				
Deflection Factor					
Calibrated Range	10 μ V/cm to 10 V/cm, 19 steps in a 1-2-5 sequence				
Accuracy	Within 2%		100%	2.2.1	
Uncalibrated (Variable)	Continuously variable; extends deflection factor to at least 25 V/cm	At least 2.5:1	100%	2.2.2	
GAIN Range		At least +5% to -5% from calibrated setting	100%	2.2.3	GAIN adjusted at 1 mV/CM
Differential Dynamic Range (DC OFFSET at OFF)			100%	2.2.4	
10 μ V/cm to 10 mV/cm	±400 mV				Input C changes outside differential Dynamic Range
20 mV/cm to 0.1 V/cm	±4 V				
0.2 V/cm to 1 V/cm	±40 V				
2 V/cm to 10 V/cm	±400 V				

1.1 ELECTRICAL

1.1.1 AMPLIFIER

ITEM	QUOTABLE	MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
Frequency Response (Full Graticule Reference)				2.2.5	
Overall Frequency Response DC (Direct) Coupled Input	DC to 1 MHz -0%, +30%		100%		Typically 1.1 MHz
AC (Capacitive) Coupled Input Lower Bandwidth Frequency	1.6 Hz within 5%		0.1%		
Bandwidth Limit Accuracy (-3 dB points)				2.2.6	
High					
1 MHz	-0% to +30%		100%		
300 kHz to 100 Hz	Within 12% of value indicated by HIGH FREQ -3 dB POINT switch setting. 9 steps in a 10-3-1 sequence				
Low					
0.1 Hz to 10 kHz	Within 12% of value indicated by LOW FREQ -3 dB POINT switch setting. 6 steps in a 100-10-1 sequence				AC ATTEN BAL 20 µV maximum unbalance
Step Response (Full Graticule Reference)				2.2.7	
Risetime (1 MHz Bandwidth)	350 ns to 270 ns		100%		

1.1.1 AMPLIFIER (cont)

ITEM	QUOTABLE	MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
Aberrations		+1% -1% or less 1 µs after 50% amplitude point with 25 Ω source impedance			
Overdrive Recovery	10 µs or less to recover to within 0.5% of zero level after the removal of a + or - test input applied for 1 s. Test signal not to exceed Differential Dynamic Range. Specified aberration (0.5%) based on test signal amplitude		100%	2.2.8	
Common Mode Dynamic Range		Overload occurs at approximately:	0%		
10 µV/CM to 10 mV/CM	±10 V	±15 V			
20 mV/CM to 0.1 V/CM	±100 V	±150 V			
0.2 V/CM to 10 V/CM	±500 V	- - -			
# Input Overload Light	Indicates that differential overload is being approached	Lights when differential input + DC offset is at least 75% of Differential Dynamic Range, but before overload occurs	100%	2.2.9	Lights with ≃ 0.4 V input at 10 µV/CM to 10 mV/CM depending on LF -3 dB setting
Common-Mode Rejection Ratio			100%	2.2.10	20 mV to 10 V adjustable to 5,000:1 over any 2:1 range of frequencies to 100 kHz
DC (Direct) Coupled	See graph, page 1-5				

2/8/68

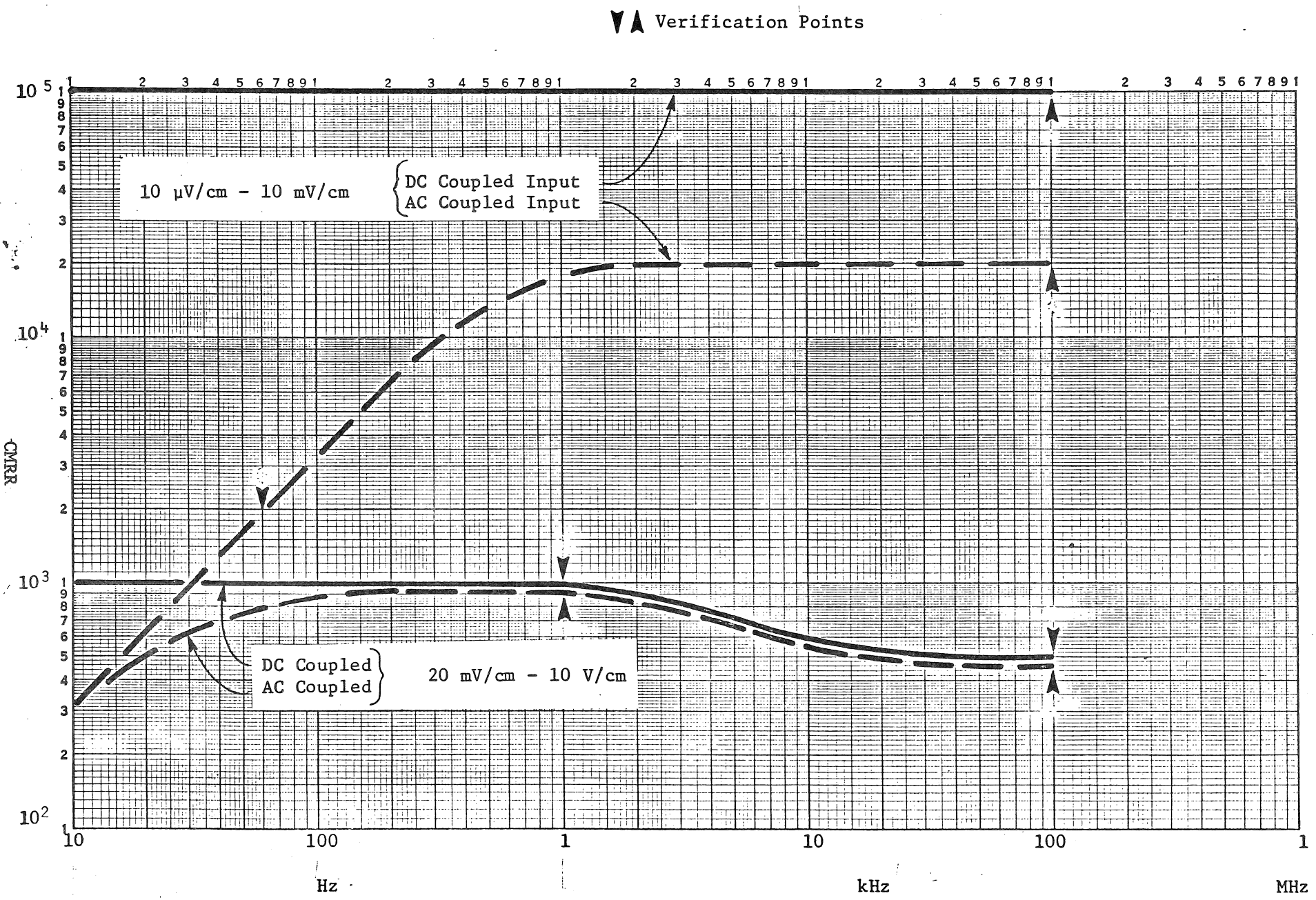


Fig. 1-1. CMRR vs Frequency For Signals Not Exceeding Common-Mode Dynamic Range

1.1 ELECTRICAL

1.1.1 AMPLIFIER (cont)

ITEM	QUOTABLE	MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
AC (Capacitive) Coupled	See graph, page 1-5				AC coupled input 10 µV/CM to 10 mV/CM. Typically 2 times better
Maximum Input Voltage			0%		
DC (Direct) Coupled, DC + Peak AC					
10 µV/CM to 10 mV/CM	±20 V	Fuse will blow if exceeded			
20 mV/CM to 10 V/CM	±500 V				
AC (Capacitive) Coupled Input DC Voltage	±500 V, each input	Precharge circuit should be used when applying voltage			
AC (Capacitive) Coupled Input DC Rejection	At least 4 X 10^5 :1				
Input R and C					
Resistance	1 MΩ within 1%		0.1%	2.2.11	
Capacitance	47 pF within 2.5 pF		0.1%		
Time Constant	47 µs within 4%		100%		

1.1.1 AMPLIFIER (cont)

ITEM	QUOTABLE			MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
Maximum Input Current		+25°C	+50°C		100% *0.1%	2.2.12	
10 µV/cm to 10 mV/cm	each input	±20 pA	±100 pA	Information deleted			
	both inputs	±40 pA	±200 pA				
20 mV/cm to 10 V/cm	each input	±10 pA	±10 pA				
Display Shift at 10 µV/cm (AC Coupled)	each input	±2 cm	±10 cm				
Variable Balance	0.2 cm or less shift with VARIABLE control turned from fully cw to fully ccw position			Adjustable to zero using internal VAR BAL control	100%	2.2.13	
STEP ATTEN DC BAL	Adjustable for no position change while switching VOLTS/CM				100%	2.2.14	
Position Range				At least +8 to -8 cm from graticule center	100%	2.2.15	
Displayed Noise (Tangentially Measured)	16 µV or 0.1 cm (whichever is greater), 1 MHz bw source resistance 25 Ω or less				100%	2.2.16	
Microphonics							Not yet determined

1.1.1 AMPLIFIER (cont)

ITEM	QUOTABLE	MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
DC Drift				2.2.17	
Drift with Time (Ambient Temperature and Line Voltage Constant)					
Short Term	5 µV/min (P-P) or 0.1 cm (whichever is greater) after 1 hour warmup		10%		
Long Term	10 µV/hr (P-P) or 0.1 cm (whichever is greater) after 1 hour warmup		0.1%		
Drift with Ambient Temperature (Line Voltage Constant)	50 µV/°C		10%		
Isolation Between + and - Inputs (+ INPUT to an Open - INPUT, - INPUT to an Open + INPUT)				2.2.18	
10 µV/cm to 10 mV/cm	At least 100:1, DC to 1 MHz	Increases if probe or cable capacitance is added to the open input	100%		
20 mV/cm to 10 V/cm	At least 200:1, DC to 1 MHz				
Signal Output				2.2.19	
Dynamic Range		At least +4 V to -4 V	100%		
# Amplitude	.25 V/cm, within 10%	Minimum load impedance 10 kΩ (15 pF at 1 MHz)			

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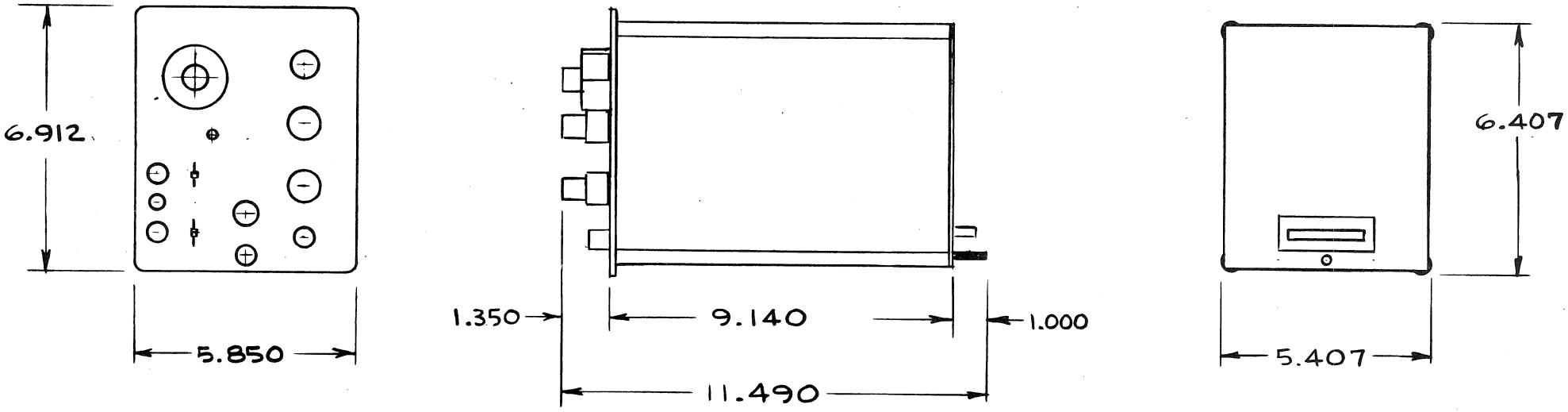
ITEM	QUOTABLE	MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
Output Resistance	750 Ω or less		1%		
Minimum Load Resistor	10 kΩ				3% aberration or less at 10 kΩ load
DC OFFSET				2.2.20	
COARSE Range from Electrical Zero		FINE Range			
10 μV/cm to 10 mV/cm	+0.4 V to -0.4 V (within 10%)	2 mV	100%		
20 mV to 0.1 V	+4 V to -4 V (within 10%)	20 mV			
0.2 V to 1 V	+40 V to -40 V (within 10%)	0.2 V			
2 V to 10 V	+400 V to -400 V (within 10%)	2 V			

1.2 ENVIRONMENTAL

ITEM	QUOTABLE	MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
Temperature					
Nonoperating	-40°C to +65°C		0.1%	3.1.1	
Operating	0°C to +50°C		0.1%	3.1.2	
Altitude					
Nonoperating	To 50,000 feet		0.1%	3.2.1	
Operating	To 15,000 feet		0.1%	3.2.2	
Vibration					
Operating		15 minutes each axis at 0.015" frequency varied from 10-50-10 c/s in 1 minute cycles with instrument secured to vibration platform. Three minutes each axis at any resonant point or at 50 c/s	0.1%	3.3.1	
Shock					
Nonoperating		30 g's, 1/2 sine, 11 11 ms duration, 2 guillotine-type shocks per axis	0.1%	3.4.1	
Transportation	Qualifies under NSTC test procedure 1A, Category II (24" drop)		0.1%	3.5.1	Tested to 30"drop height

1.3 PHYSICAL

ITEM	QUOTABLE	MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
Finish	Anodized aluminum front panel				
Weight	4.75 lbs				
Dimensions					



SECTION 2

ELECTRICAL PERFORMANCE VALIDATION

2.1 Test Equipment Required

1	Oscilloscope	:	Tektronix Type 547
1	Sinewave Generator	:	Tektronix Type 191
1	Sinewave Generator 1 Hz - 1 MHz	:	Tektronix Part No. *067-0542-99*
1	Standard Amplitude Calibrator	:	Tektronix Part No. 067-0502-00
1	Resistance Capacitance Bridge	:	ESI 250DA
1	1,000:1 Resistive Divider	:	Tektronix Part No. 067-0529-00
1	100:1 Resistive Divider	:	Tektronix Special
1	Input RC Normalizer	:	Tektronix Part No. 067-0541-00
1	*Squarewave Generator*	:	*Tektronix Type 106*

2.2 Deflection Factor

2.2.1 Accuracy

Connect Standard Amplitude Calibrator to + INPUT. Use either 4 cm or 5 cm of displayed signal depending upon combination of calibrator signal and VOLTS/CM setting. GAIN is adjusted at 1 mV/CM. Deviations from *10 mV/CM to 0.5 V/CM must be recorded.*

Check accuracy 10 µV/CM to 0.5 mV/CM as follows: Connect 1 Hz - 1 MHz Signal Generator to + INPUT. Set - INPUT selector to GND, HIGH FREQ -3 dB POINT to 100 Hz, LOW FREQ -3 dB POINT to 1 kHz and VOLTS/CM to 10 mV. Adjust Signal Generator amplitude for a 5 cm display *and FREQUENCY for 300 Hz*. Set VOLTS/CM for 10 µV/CM. Connect 1 Hz - 1 MHz Signal Generator through 1,000:1 resistive divider (067-0529-00) to + INPUT. Check display amplitude for 5 cm within 0.1 cm and that measured error at 10 µV/CM and recorded error of 10 mV/CM do not exceed 2% deviation from 1 mV/CM. Repeat to check 20 µV/CM to 0.5 mV/CM.

2.2.2 Uncalibrated (Variable)

Connect SAC to + INPUT. Set VOLTS/CM to 1 V and apply 5 V from SAC. Turn VARIABLE VOLTS/CM fully ccw. Check for 2 cm display or less.

2.2.3 GAIN Range

Connect SAC to + INPUT. Set VOLTS/CM to 1 mV. Apply 5 mV from SAC. Turn GAIN fully cw and check for 5.25 cm display. Turn GAIN fully ccw and check for 4.75 cm display. Adjust GAIN for 5 cm display.

1/25/68

2.2.4 Differential Dynamic Range

Connect 1 Hz - 1 MHz Sinewave Generator to - INPUT. Set VOLTS/CM to 1 mV, LOW FREQ -3 dB POINT to 10 Hz, and DC OFFSET to OFF. Set Sinewave Generator for 1 kHz and adjust amplitude for a 5 cm display.

Connect SAC---Variable Attenuator--- + INPUT. Set + INPUT selector to DC and SAC for 0.5 V and adjust Variable Attenuator for 0.4 V DC. Check displayed sinewave for 5 cm.

Connect 1 Hz - 1 MHz Sinewave Generator to + INPUT and SAC to - INPUT and repeat.

2.2.5 Frequency Response (Full Graticule Reference)

Overall Frequency Response DC (Direct) Coupled Input

Connect Type 191 to + INPUT. Set VOLTS/CM to 1 mV, HIGH FREQ -3 dB POINT to 1 MHz, and LOW FREQ -3 dB POINT to DC. Set Type 191 frequency to 50 kHz and adjust amplitude for a 4 div display. Increase frequency to 1 MHz and check display amplitude for 2.8 cm or greater. Set frequency to 1.3 MHz and check display amplitude for 2.8 cm or less.

AC (Capacitive) Coupled Input Lower Bandwidth Frequency

Connect 1 Hz - 1 MHz Sinewave Generator to + INPUT. Set LOW FREQ -3 dB POINT to DC. Set Sinewave Generator frequency for 10 kHz and adjust amplitude for a 4 div display. Decrease frequency until 2.8 cm are displayed and check that frequency is 1.6 Hz within 5%.

2.2.6 Bandwidth Limit Accuracy (-3 dB points)

High

1 MHz

Connect Type 191 to + INPUT. Set VOLTS/CM to 1 mV, HIGH FREQ -3 dB POINT to 1 MHz, and LOW FREQ -3 dB POINT to DC. Set Type 191 frequency to 50 kHz and adjust amplitude for a 4 div display. Increase frequency to 1 MHz and check display amplitude for 2.8 cm or greater. Set frequency to 1.3 MHz and check display amplitude for 2.8 cm or less.

300 kHz to 100 Hz

Connect 1 Hz - 1 MHz Sinewave Generator to + INPUT. Set VOLTS/CM to 1 mV and LOW FREQ -3 dB POINT to DC. Set frequency to 1/20 of switch setting and adjust amplitude for a 4 cm reference. Increase frequency until 2.8 cm are displayed. Check that frequency is within 12% of value indicated by HIGH FREQ -3 dB POINT setting.

Low

1 Hz to 10 kHz

Connect 1 Hz - 1 MHz Sinewave Generator to + INPUT. Set VOLTS/CM to 1 mV and HIGH FREQ -3 dB POINT to 1 MHz. Set frequency to 20 times LOW FREQ -3 dB POINT switch setting and adjust amplitude for a 4 cm reference. Decrease frequency until 2.8 cm are displayed. Check that frequency is within 12% of value indicated by LOW FREQ -3 dB POINT setting.

2.2.7 Step Response

Risetime (1 MHz Bandwidth)

Connect Type 106 to + INPUT. Set VOLTS/CM to 1 mV, HIGH FREQ -3 dB POINT to 1 MHz, and LOW FREQ -3 dB POINT to DC. Set TYPE 106 to + OUTPUT and adjust amplitude for a 5 cm display. Measure the time interval between the 10% and 90% amplitude points on the leading edge of the pulse.

Aberrations

Connect Type 106 to + INPUT. Set VOLTS/CM to 1 mV, HIGH FREQ -3 dB POINT to 1 MHz, LOW FREQ -3 dB POINT to DC, and + INPUT selector to DC. Set Type 106 Repetition Rate Range for 10 kHz and adjust Fast Rise amplitude for a 5 cm display. Set sweep rate for 0.5 µs/cm and position the 50% amplitude point to the 0 graticule line. Start aberration measurement 1 µs after 50% amplitude point. Check for +1% -1% or less.

2.2.8 Overdrive Recovery

Install Type 1A7A in a Type 547. Connect B Sweep + Gate through 100:1 divider to + INPUT. Set VOLTS/CM to 1 mV, HIGH FREQ -3 dB POINT to 1 MHz, LOW FREQ -3 dB POINT to DC, and + INPUT selector to DC. Set B Sweep for 0.1 s/cm, Trigger to Auto, + AC Line, and Level for free-running sweep. Set A Sweep for 10 µs/cm, Slope for -, Coupling AC, Int, and adjust Level to trigger on - slope. Set Horiz Display for A Delayed.

Check that trace recovers to within 1 cm of baseline within 10 µs.

2.2.9 Input Overload Light

Connect 1 Hz - 1 MHz Sinewave Generator to + INPUT and - INPUT. Light will light when differential input is between 0.75 and 1.0 of Differential Dynamic Range.

2.2.10 Common-Mode Rejection Ratio

Connect 1 Hz - 1 MHz Sinewave Generator to + INPUT and - INPUT. Set Sinewave Generator for the proper frequency and amplitude as # shown by verification points on page 1-5. CMRR is expressed as a ratio of input signal to displayed signal.

2.2.11 Input R and C

Resistance

Connect ESI 250 DA to + INPUT. Measure the input resistance for 1 MΩ within 1%. Repeat for - INPUT.

Capacitance

Connect ESI 250 DA to + INPUT. Measure input capacitance for 47 pF within 1.5 pF.

Time Constant

Connect Type 106---Input RC Normalizer (067-0541-00)--- + INPUT. Set VOLTS/CM for 1 mV and + INPUT selector for DC. Set Type 106 amplitude for a 5 cm display and frequency for 1 kHz. Tilt must be less than 0.2 cm. Repeat to check - INPUT.

2.2.12 Input Gate Current (+25°C)

Each Input

Set + INPUT and - INPUT to GND. Connect 50 Ω terminations to both + INPUT and - INPUT. Set HIGH FREQ -3 dB POINT for 100 Hz and set # deflection factor as stated on page 1-7. Position trace to graticule center. Switch + INPUT selector to AC and note trace deflection. Indicated voltage change is divided by 1 MΩ input resistance to determine gate current. Repeat for - INPUT.

Both Inputs

Set + INPUT and - INPUT to GND. Connect 50 Ω terminations to both + INPUT and - INPUT. Set HIGH FREQ -3 dB POINT for 100 Hz and set # deflection factor as stated on page 1-7. Position trace to graticule center. Switch + INPUT and - INPUT to AC simultaneously and note trace deflection. Indicated voltage change is divided by 1 MΩ input resistance to determine gate current.

Display Shift at 10 μV/cm (AC Coupled)

Set + INPUT to GND and VOLTS/CM for 10 μV/cm. Position trace to graticule center. Switch + INPUT to AC. Check that trace deflection is less than 1 cm.

+50°C characteristics are checked during environmental test phase.

2.2.13 Variable Balance

Set VOLTS/CM for 1 mV and position trace to graticule center. STEP ATTEN BAL must be adjusted correctly. Turn VARIABLE from fully cw to fully ccw and check for 0.2 cm or less shift.

2.2.14 STEP ATTEN DC BAL

Position trace to graticule center. Check that STEP ATTEN DC BAL can be adjusted for no position change while switching VOLTS/CM.

2.2.15 Position Range

Connect Type 106--- + INPUT. Set + INPUT selector to AC, VOLTS/CM for 50 mV, and position trace to graticule center. Adjust Type # 106 amplitude and symmetry to obtain a 3.2 *cm* display centered on screen. Set VOLTS/CM for 10 mV. Turn POSITION fully cw. Top of waveform must position to graticule center or below.

Turn POSITION fully ccw. Bottom of waveform must position to # graticule *center* or above.

2.2.16 Displayed Noise (Tangentially Measured)

Connect Type 106---100 X Attenuator---50Ω Termination--- + INPUT. Set VOLTS/CM for 10 μV and free-run time base. Adjust Type 106 amplitude until two noise bands merge. Remove 100 X Attenuator and set VOLTS/CM for 0.1 mV. Measure display amplitude. Divide # displayed voltage by *100* to determine noise.

2.2.17 DC Drift

Drift with Time (Ambient Temperature and Line Voltage Constant)

Short Term

Set VOLTS/CM for 10 μV and position trace to graticule center. Monitor total P-P trace drift after 1 hour warm-up occurring in a 1 minute interval. Trace drift must be 0.5 cm or less.

Long Term

Set VOLTS/CM for 10 μV and position trace to graticule center. Monitor total P-P trace drift after 1 hour warm-up occurring in a 1 hour interval. Trace drift must be 1 cm or less.

Drift with Ambient Temperature (Line Voltage Constant)

Check during environmental test phase.

2.2.18 Isolation Between + and - Inputs (+ INPUT to Open - INPUT, - INPUT to an Open + INPUT)

10 μV/cm to 10 mV/cm

Connect SAC to + INPUT. Set - INPUT selector to GND, VOLTS/CM to 1 mV, and DC OFFSET to ON. Set SAC for 100 mV. Adjust COARSE to position top of display to graticule center. Switch - INPUT selector to DC. Trace deflection must be 1 cm or less. Repeat for - INPUT.

20 mV/cm to 10 V/cm

Connect SAC to + INPUT. Set - INPUT selector to GND, VOLTS/CM to 100 mV, and DC OFFSET to ON. Set SAC for 2 V. Adjust COARSE to position top of display to graticule center. Switch - INPUT selector to DC. Trace deflection must be 1 cm or less. Repeat for - INPUT.

2.2.19 Signal Output

Dynamic Range

Connect SAC to + INPUT. Set VOLTS/CM to 0.2 V, HIGH FREQ -3 dB POINT to 1 MHz, LOW FREQ -3 dB POINT to DC, and + INPUT selector to DC. Set SAC for 10 V and monitor SIGNAL OUTPUT with test scope. Check # for +4 V to -4 V.

Amplitude

Connect SAC to + INPUT. Set VOLTS/CM to 10 mV, HIGH FREQ -3 dB POINT to 1 MHz, LOW FREQ -3 dB POINT to DC, and + INPUT selector to DC. # Set SAC for 50 mV and monitor SIGNAL OUTPUT through 42" RG 58/U cable to test scope. Check for 1.25 V within 10%.

Output Resistance

Connect ESI Resistance Bridge Type 250 DA to SIGNAL OUTPUT. Check that output resistance is 750 Ω or less.

2.2.20 DC OFFSET, Coarse Range From Electrical Zero

10 μV/cm to 10 mV/cm

Connect SAC---Variable Attenuator--- + INPUT. Set + INPUT selector to GND and position trace to graticule center. Set SAC amplitude # for 0.5 V, + DC. Set + INPUT selector to DC. Set DC OFFSET to ON and turn COARSE fully ccw. Adjust Variable Attenuator to position trace to graticule center. Measure input DC voltage with test scope. Voltage must be +400 mV within 10%.

Set + INPUT selector to GND and position trace to graticule center. # Set SAC amplitude for 0.5 V - DC. Set + INPUT selector to DC. Set DC OFFSET to ON and turn COARSE fully cw. Adjust Variable Attenuator to position trace to graticule center. Measure input DC voltage with test scope. Voltage must be -400 mV within 10%.

20 mV to 0.1 V

If the 10 μV/cm to 10 mV/cm DC OFFSET range is within its performance requirements then the 20 mV to .1 V range is within its performance requirements.

0.2 V to 1 V

Connect Type 106 to + INPUT. Set + INPUT selector to GND and position trace to graticule center. Adjust Type 106 amplitude for 80 V P-P output. Set + INPUT selector to DC. Set DC OFFSET to ON and turn COARSE fully ccw. Top of display must position below graticule center. Turn COARSE fully cw. Bottom of display must position above graticule center. Check that Fine has 0.2 V total range.

2 V to 10 V

When the 10 μV/cm to 1 V/cm ranges are within their performance requirements then the 2 V/cm to 10 V/cm range is within its performance requirement.

SECTION 3

ENVIRONMENTAL PERFORMANCE VALIDATION

3.1 Temperature

Perform all tests in a single chamber and, when changing chamber ambient temperature, do not exceed a change rate of 5°C per minute.

3.1.1 Nonoperating

Perform all electrical tests, described in Section 2, at 25°C. Then turn the instrument off and store at -40°C ambient for 4 hours.

Change ambient temperature to +65°C and again store for 4 hours.

Return the ambient temperature to 25°C, allow 4 hours for stabilization, and again perform all electrical tests.

Failure Criteria

Instrument and components must meet performance requirements before and after storage. If necessary, internal or external adjustments may be performed to meet required accuracies.

Cracking, warping, discoloration or any deformation which interferes with a normal mechanical function also constitutes failure.

3.1.2 Operating

Perform all electrical tests, described in Section 2, at 25°C.

With the instrument turned off, change ambient temperature to 0°C and allow the instrument to stabilize for 4 hours. At the end of this period, turn the instrument on, allow 5 minutes for warm-up, then check accuracy and operation of all front-panel functions.

With the instrument operating, change the chamber ambient temperature to +50°C and allow 4 hours for stabilization.

At the end of 4 hours, again check the accuracy and operation of all front-panel functions.

Return the instrument to 25°C, allow 4 hours for stabilization, then perform all electrical tests described in Section 2.

Failure Criteria

Instrument must meet performance requirements at each step in the test. Controls and switches must operate normally.

3.2 Altitude

Altitudes described in this section are referred to sea level. "Normal altitude", when used, refers to the natural elevation (outside the chamber) of the test facility site.

3.2.1 Nonoperating

Perform all electrical tests described in Section 2 at 25°C and normal altitude. Then store, with the instrument turned off, for 4 hours at 50,000 feet and -40°C.

Return chamber to normal altitude and 25°C and allow 4 hours for stabilization. At the end of this period, repeat the electrical tests.

This test may be performed with the nonoperating temperature test (3.1.1).

Failure Criteria

The instrument must meet performance requirements before and after the altitude test, and must experience no cracking or warping, nor any deformation which interferes with a normal mechanical function.

3.2.2 Operating

Perform all electrical tests described in Section 2 at 25°C and at normal altitude.

Operate the instrument for 4 hours at 15,000 feet. At the end of this period, maintain that altitude and measure accuracy and operation of front-panel functions.

When necessary, open the vacuum chamber and perform required switching as rapidly as possible. Then return chamber to the specified altitude and allow 1 hour for stabilization before continuing the tests.

Return the instrument to normal altitude and repeat all electrical tests described in Section 2.

Failure Criteria

Instrument will meet performance requirements before, during, and after the operating altitude tests. Any evidence of malfunction constitutes failure.

3.3 Vibration

3.3.1 Operating

Perform all electrical tests described in Section 2 before vibrating the instrument.

Fasten the instrument securely to the vibration platform.

With the instrument operating, vibrate for 15 minutes along each of the three axes at a total displacement of 0.015" (1.9 g's at 50 c/s) and with the frequency varied from 10-50-10 c/s in 1 minute cycles. Hold at any resonant point for 3 minutes.

If no resonances are present, vibrate at 50 c/s for 3 minutes in each axis for a total vibration time of about 55 minutes.

Turn off the vibration platform and repeat all electrical tests described in Section 2.

Failure Criteria

The instrument must meet performance requirements before and after the vibration tests. (Sporadic output during vibration is permissible.)

Mechanical failures are indicated by:

- Broken leads
- Broken chassis
- Broken components
- Loose parts
- Excessive wear
- Component fatigue
- Change in component value outside rated tolerance
- Deformation which interferes with a normal mechanical function

Test will be completely rerun after repairing any of these failures except vacuum tubes. Vacuum tubes may be replaced and the test continued at the point of failure.

3.4 Shock

3.4.1 Nonoperating

Perform all electrical tests described in Section 2 before proceeding with the shock tests.

Subject the instrument to guillotine-type shocks of 30 g's, 1/2 sine, 11 ms duration; 1 such shock each direction along each of the 3 major axes for a total of 6 shocks.

Failure Criteria

The instrument will meet performance requirements before and after the shock tests.

There must be no cracked or broken chassis, components, or leads; component deformation of 0.100" or more; nor any deformation which interferes with a normal mechanical function.

3.5 Transportation

Perform all tests described in Section 2 before conducting the transportation tests, then place the instrument in the carton in the manner in which it is normally shipped.

3.5.1 Package Vibration

Vibrate for 1 hour in a manner causing the package to just leave the vibration platform (slightly in excess of 1 g).

3.5.2 Package Drop

Drop the package from a height of 30" on one corner, on all edges radiating from that corner, and on all flat surfaces for a total of 10 drops.

After the transportation test, repeat all electrical tests described in Section 2.

Failure Criteria

The instrument must meet performance requirements before and after the transportation tests. There must be no broken components, leads, or chassis members, nor any deformation which interferes with a normal mechanical function.

Change Number: 197-1

Page: See Below

Effective Date: 1-25-68

Characteristic: See Below

New Spec: Change As Follows:

Page 1-7

Position Range (under Maintenance & Operation) change to:
At least +8 to -8 cm from graticule center

Page 1-8

Signal Output (Dynamic Range) (under Maintenance & Operation) change to:
At least +4 to -4 V

Page 2-1

2.1 Test Equipment Required
Add: 1 Squarewave Generator : Tektronix Type 106

2.2.1 Accuracy
Change third sentence of second paragraph to read:
Adjust Signal Generator amplitude for a 5 cm display and FREQUENCY for 300 Hz.

Page 2-3

2.2.10 Common-Mode Rejection Ratio
Change: Page number reference for verification points to 1-5.

Page 2-4

2.2.12 Input Gate Current (+25°C)
Each Input
Change page number shown on third line to: 1-7.
Both Inputs
Change page number shown on third line to: 1-7.

Page 2-5

2.2.15 Position Range
Change third line of first paragraph to: ... a 3.2 cm display ...
Change second line of second paragraph to read: graticule center or above.

2.2.16 Displayed Noise (Tangentially Measured)
Change last sentence of paragraph to read: Divide displayed voltage by 100 to determine noise.

(continued)

Change Number: 197-1 (continued)

Page 2-6

2.2.19 Signal Output (Dynamic Range)

Change last line to read: for +4 V to -4 V.

Signal Output (under Amplitude)

Change third line of paragraph under Amplitude to:

Set SAC for 50 mV ...

2.2.20 DC OFFSET, Coarse Range From Electrical Zero

Change fourth sentence (third line) of the first paragraph to read:

Set + INPUT selector to DC.

Change third sentence (second line) of the second paragraph to read:

Set + INPUT selector to DC.

Page 2-7 (Under 0.2 V to 1 V)

Change fourth sentence (third line) to read:

Set + INPUT selector to DC.

Reason: Correction

INSTRUMENT PERFORMANCE CHARACTERISTIC

CHANGE REQUEST

This form requests changes in the Engineering Instrument Specification (salmon book) or in performance characteristics quoted to the customer via publications such as the Catalog or Instruction Manual. When the instrument has an Engineering Instrument Specification, then it is the controlling document.

Return completed form to Product Evaluation and Modification Engineering Writing 50/425 for approval and distribution.

Instrument Type: _____

Publication affected: _____ No. _____ Dated _____

Requested by: _____ Dept. _____ Date _____

Page no: _____ Item _____

Now reads: _____

Change to/add: _____

Reason for change: _____

Approval: (Initial in proper space)

Proj. Mgr.	Proj. Eng.	Eval. Mgr.	Eval. Eng.			

Make change immediately

Make change at next rewrite

Reject

or

_____

Date Received _____

Date Filed _____