INSTRUMENT REFERENCE BOOK

for the Tektronix Type

3A7

high-gain
differential comparator
plug-in unit

3A7

Inter-Office Communication

To: New Product Sales Release Distribution Date: July 19, 1965

BEAVERTON

From: Ted Brandt

Subject: U. S. Marketing New Product Sales Release Type 3A7

Major Sales Features: The 3A7 is a high sensitivity differential three series plug-in with a built in comparator for slide-back measurements. Operational characteristics are similar to those of the W plug-in.

Markets: The W market primarily has been with the Defense, NASA, Computer and Nuclear industry classifications with major usage in R&D. The component industry showed large usage in production.

Price - $635.

Support Activities:

Advertising Program

Spec. Sheet - Week 28 Preliminary; Week 31 Final (in the field)

Short Form Catalog 1966

Training Program

Same material as W unit

Product Technical Information Program

PRB - Week 34

Marketing Product Administration Program

Demo availability - Start week 37

Customer instrument availability - Week 40

Major Trade Show Program

1. Wescon '65
2. NEC '65
3. NEREM '65
4. IEEE '66

Information on the 3A7 can be made public after the start of Wescon.

3A7

I. INTRODUCTION:

The 3A7 is a high sensitivity differential plug-in for the 560-Series. It features a built-in comparator for slideback measurements. It offers the features of the W Unit in the 560-Series package.

II. SPECIFICATIONS:

Conventional Amplifier:

Sensitivity:	1 mv/div to 50 mv/div in 1, 2, 5 steps. Continuously variable (uncalibrated) between steps.
Frequency response:	dc to 10 mc/s @ 50 mv/div to 10 mv/div dc to 8 mc/s @ 5 mv/div dc to 6 mc/s @ 2 mv/div dc to 4 mc/s @ 1 mv/div
Attenuators:	Decade steps from 1 to X1000
Accuracy is:	±0.05% @ X10 ±0.15% @ X100 ±3% @ X1000
Inputs:	DC or AC, AC low frequency response (30%) is $\leq$ 2 cps
Input RC:	1 meg, 20 pf, R ∞ is > 10,000 megohms

Differential Input Amplifier:

Common Mode Rejection Ratio:

DC:	$\geq$ 20,000:1 with 11 vdc from V_c out
AC:	$\geq$ 1,000:1 with a 60 cps, 15 v peak sinewave
High Frequency (dc coupled):	
20 kc sinewave:	$\geq$ 20,000:1 @ 15 v peak
500 kc sinewave:	$\geq$ 500:1 @ 15 v peak

Maximum Peak Input Voltage:

X1	=	±15 v
X10	=	±150 v
X100	=	±500 v
X1000	=	±500 v

Calibrated Differential Comparator:

Overdrive Recovery:	$\leq$ 300 nsec to within ±10 mv
Overdrive DC Shift:	$\leq$ 5 mv after 1 sec

II. SPECIFICATIONS: (continued)

Calibrated Differential Comparator: (continued)

Comparison Voltage:	0 to 1.1 v	±0.15% of the indicated value
	0 to 11 v	±0.5% of the full scale

DC Supply Resolution:

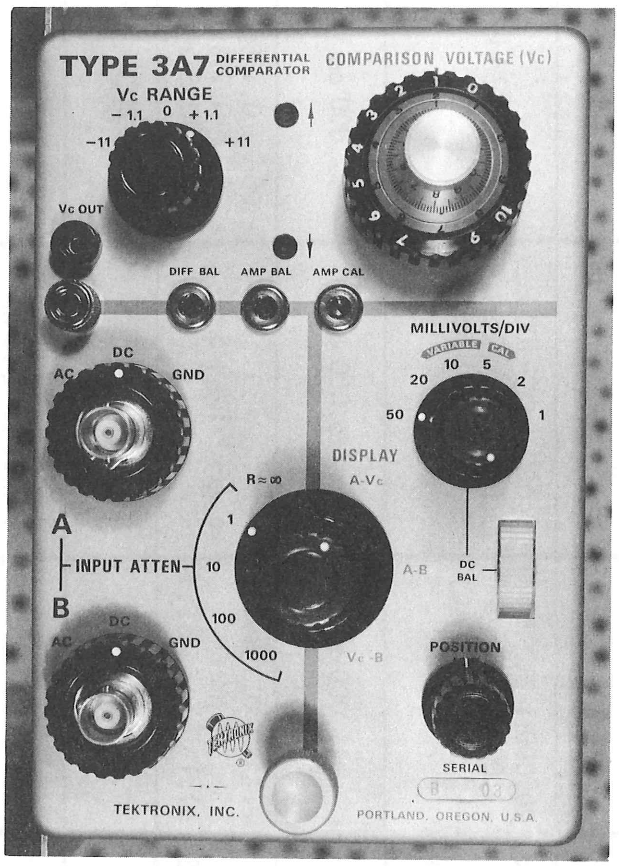
0 to 1.1 v	=	100 µv/minor dial division
0 to ±11 v	=	1 mv/minor dial division

III. GENERAL INFORMATION:

The 3A7 is in most respects simply a repackaging of the W Unit. There are a few minor differences in the circuitry; otherwise its performance will be the same as the W. A cathode follower load balance adjustment has been added in the input stage in order to obtain a little better low frequency Common Mode Rejection Ratio. The adjustment is used in conjunction with the differential balance control. There are a pair of 6153 diodes shunting the output of the differential comparator amplifier which do not appear in the W. The purpose of the diodes is to limit the swing of the signal to the driver amplifiers. The driver stage has more gain by a factor of 4 than the W driver and if the signal is not limited it can saturate the driver and introduce distortion.

The problems of the W are still with us in the 3A7 with one possible exception, we have not found the oscillations that have occurred with the W when looking at the calibrator. There does not seem to be the coupling in the 560-Series power supplies that there is in the 540-Series. The 3A7 has a definite negative input R characteristic which can create a problem when you have the right length of cable connected in at X1. The inductance of the cable along with the input capacity and the negative R characteristic make for an excellent oscillator. The solution is to incorporate a small 100 Ω resistor in series. The instrument appears to be very sensitive to shock as far as trace drift is concerned. Rotating an attenuator switch creates enough shock to cause the tract to shift ≈ 1 mv; however, in the absence of shock and in a constant thermal environment with a regulated line, the 3A7 exhibits a drift characteristic of ≈ 1 mv/hour and in one case a 3A7 trace remained on screen over a period of four days. (@1 mv/cm)

The overload recovery characteristic, as given in the specifications, is 300 nsec to return to ±10 mv. In practice we have found that most 3A7's will recover to within 2 mv in about 2 µsec and to within 1 mv in ≈ 50 msec. See the photos of recovery time.


TYPE 3A7 DIFFERENTIAL COMPARATOR
COMPARISON VOLTAGE (Vc)
Vc RANGE
−1.1
0
+1.1
−11
+11
Vc OUT
DIFF BAL
AMP BAL
AMP CAL
MILLIVOLTS/DIV
VARIABLE
CAL
20
10
5
2
50
1
DC
AC
GND
DISPLAY
A-Vc
A-B
Vc-B
R≈∞
1
10
100
1000
A
INPUT ATTEN
B
DC BAL
POSITION
SERIAL
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

IV. COMPETITION:

The 3A7 will find its stiffest competition among our own units. Listed below is a chart comparing the more outstanding features of the 3A7 with its nearest competitors.

	3A7	W	10A1	Z	Fairchild 76-07	Adage ND-1
Sensitivity (max)	1 mv@4 mc/s	1 mv@8 mc/s	1 mv@35 mc/s	50 mv@13 mc/s	5 mv@15 mc/s	10 µv 600 kc (est.)
Bandwidth (max 3 db point)	10 mc/s	23 mc/s	45 mc/s	13 mc/s	15 mv/s (3 db±1 db)	≈ 5 mc/s (1)
T_r (min)	35 nsec	15.2 nsec	7.8 nsec	27 nsec	24 nsec	≈ 70 nsec
CMRR	20,000:1 DC-20 kc 500:1@500 kc 1,000:1@60 c/s (AC)	20,000:1 DC-20 kc 1,000:1@60 c/s (AC)	20,000:1 DC-100 kc 10,000:1 100 kc - 1 mc/s	40,000:1@1 kc	40,000:1 DC to 1 kc	none slideback only
Effective Screen Height	±11,000 cm	±11,000 cm	±6,000 cm	±2,000 cm	±2,000 cm	±1,500,000 cm
Comparison Voltage	±11 v } 0.15% + ±1.1 v } 0.05% F.S.	±11 v } 0.15% + ±1.1 v } 0.05% F.S.	±6 v@0.1% + 5 mv	±100 v@0.15% ± 10 v@0.2% ± 1 v@0.5%	±10 v@0.2% ± 1 v@0.5%	I source@.01% 10 µa to 1.4 ma
Comp. Voltage Pickoff Linearity	0.05%	0.05%	0.05%	0.05%	0.05%	Info N.A.
Recovery Time	300 ns to ±10 mv	300 ns to ±10 mv	300 ns to ±2 mv 1 msec to < .5 mv	(2)	Info N.A.	1 to 8 µsec
Input Attenuator Accuracy	X10 = ±0.05% X100 = ±0.15% X1000 = ±3%	X10 = ±0.05% X100 = ±0.15% X1000 = ±2%	X10 = ±0.125% X100 = ±0.25%	2%	2% one special@0.2%	0.01%
Attenuator Matching	X10 adj to > 1000:1	X10 adj to > 1000:1	X10 - 2000:1 X100 - 200:1 X1000 - 50:1	None	None	Info N.A.

(1) Based on Adage spec of 0.1%@ 200 kc (gain unspecified)

(2) Information not available. Rate of rise limitations given as +1 v in 7 nsec and -1 v in 5 nsec.

IV. COMPETITION: (continued)

	3A7	W	10A1	Z	Fairchild 76-07	Adage ND-1
Input Impedance	1 meg 20 pf *or* 10,000 meg 19 pf	1 meg 20 pf *or* 10,000 meg 19 pf	1 meg, 20 pf	1 meg, 24 pf	1 meg 47 pf bal - 2 meg 30 pf	0 Ω to 1 meg - 10 pf
Max Input Voltage	X1 = ±15 v X10 = ±150 v X100 = ±500 v X1000 = ±500 v	X1 = ±15 v X10 = ±150 v X100 = ±500 v X1000 = ±500 v	±6 v@1 mv to 20 mv/cm ±60 v@10 mv to 200 mv/cm ±600 v@100 mv to 20 v/cm	±100 v	±100 v	±15 v to ±500 v depends on input resistance
Price	$635	$575	$900	$525	$695 $770 delay line option	Info N.A.

Fig. 1 S/N B 03

Horiz: 200 nsec/div

Vert: 5 mv/div, X1

A Input

Sig in: 105, 10 v amp,
10 kc rep-rate

Fig. 2 S/N B 03

Horiz: 200 nsec/div

Vert: 5 mv/div, X1

B Input

Sig in: 105, 10 v amp,
10 kc rep-rate

Fig. 3 S/N B 03

Horiz: .2 msec/div

Vert: 5 mv/div, X1

A Input

Sig in: 105, 10 v amp,
1.0 kc rep-rate

Fig. 4 S/N B 03

Horiz: .2 msec/div

Vert: 5 mv/div, X1

B Input

Sig in: 105, 10 v amp,
1.0 kc rep-rate

Fig. 5 S/N B 03

Horiz: 5 μsec/div

Vert: 5 mv/div, X1

A Input

Sig in: 105, 10 v amp,
10 kc rep-rate

Fig. 6 S/N B 03

Horiz: 5 μsec/div

Vert: 5 mv/div, X1

B Input

Sig in: 105, 10 v amp,
10 kc rep-rate

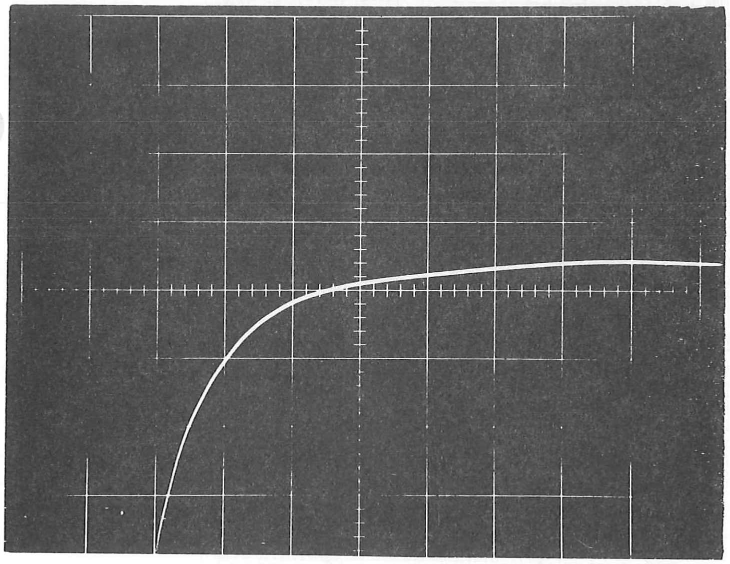


Fig. 1

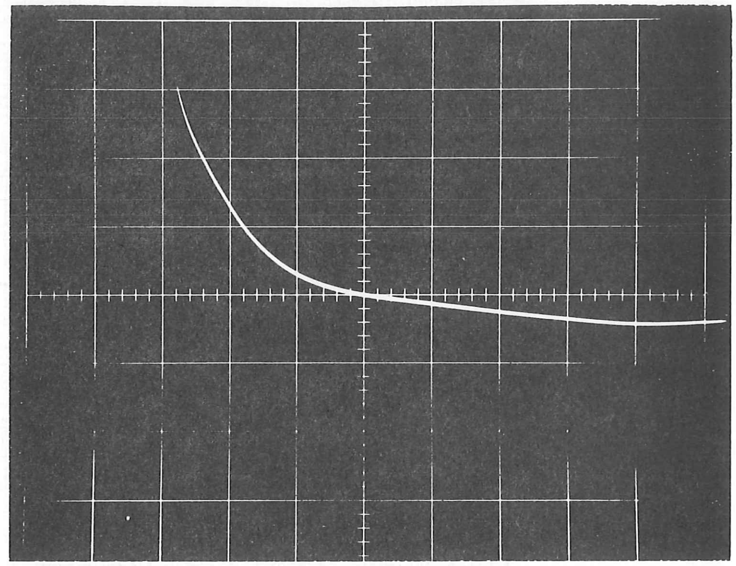


Fig. 2

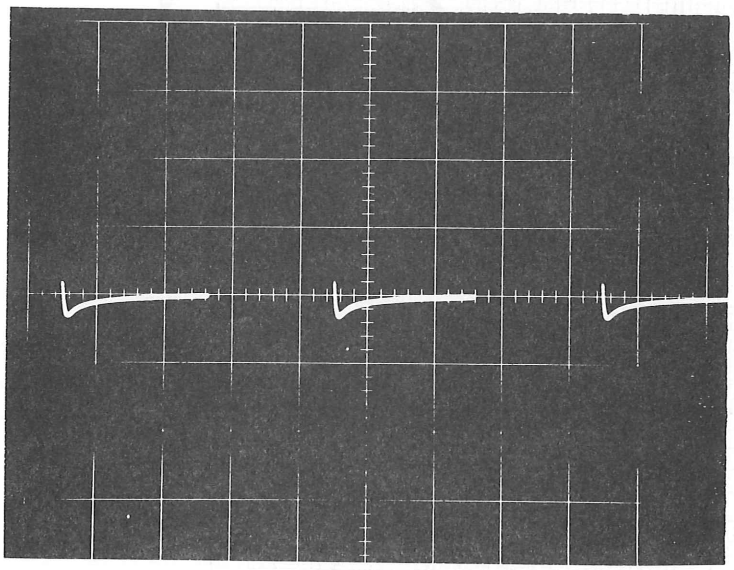


Fig. 3

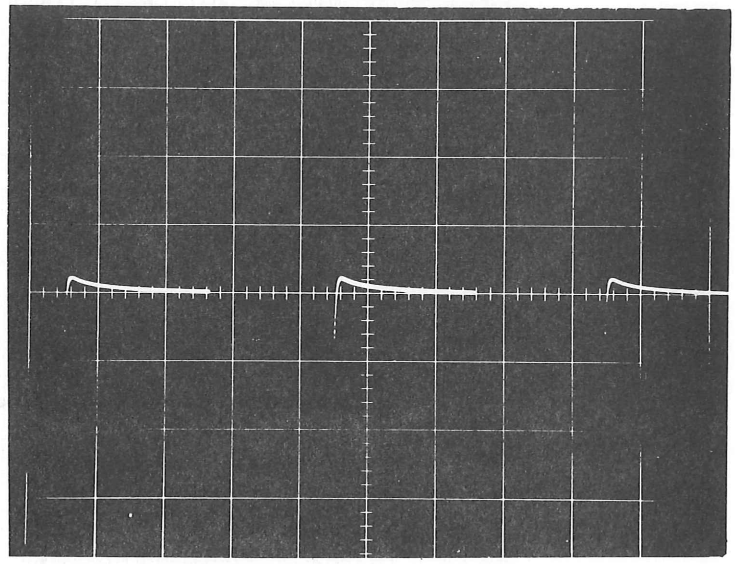


Fig. 4

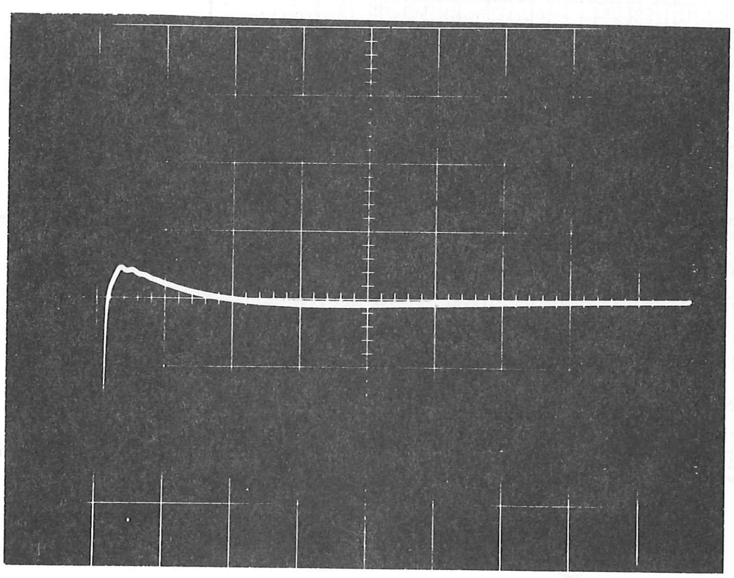


Fig. 5

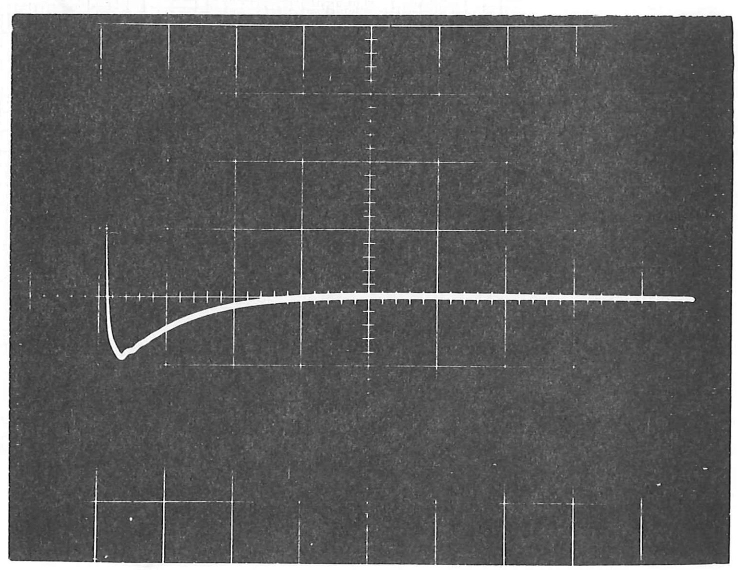
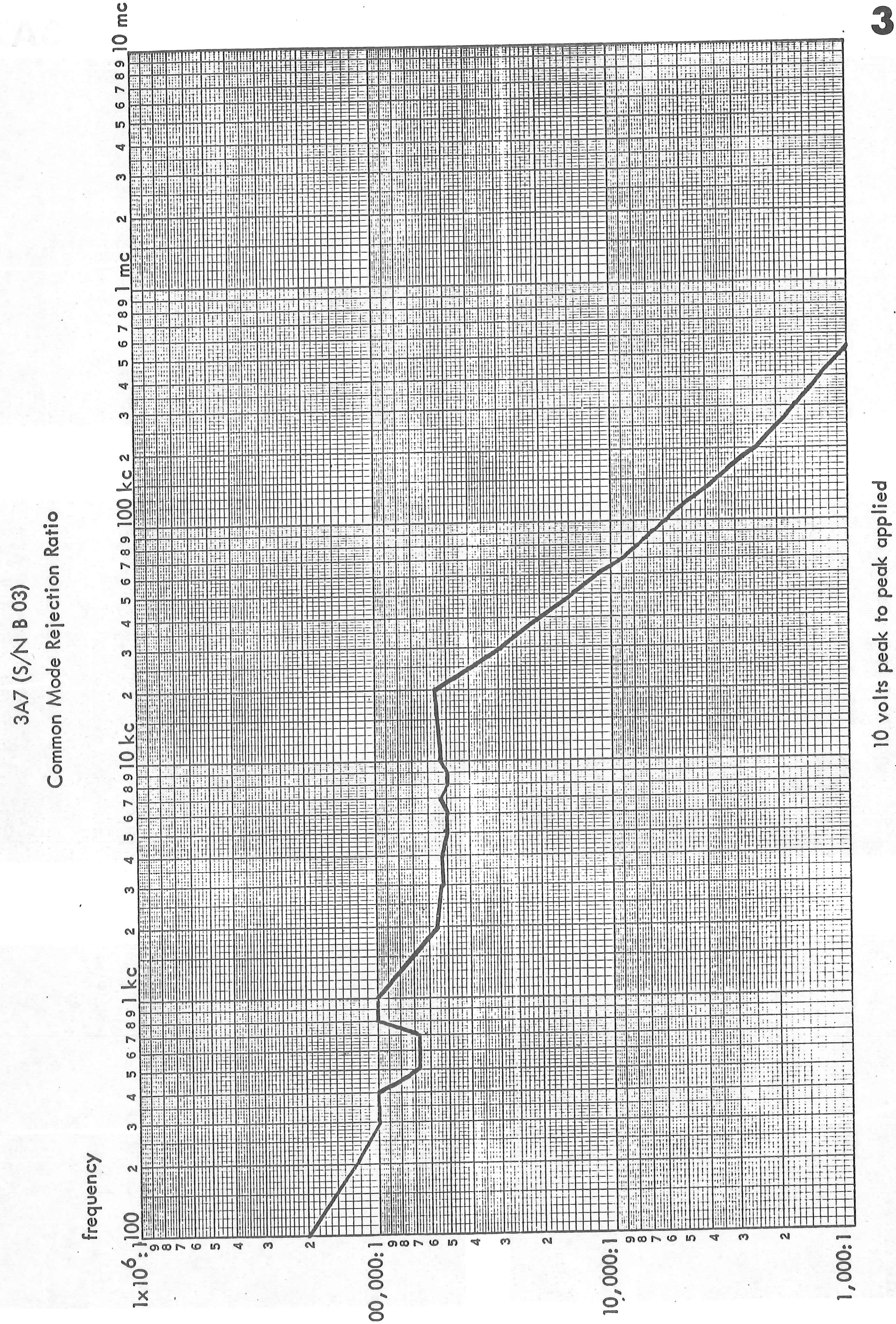
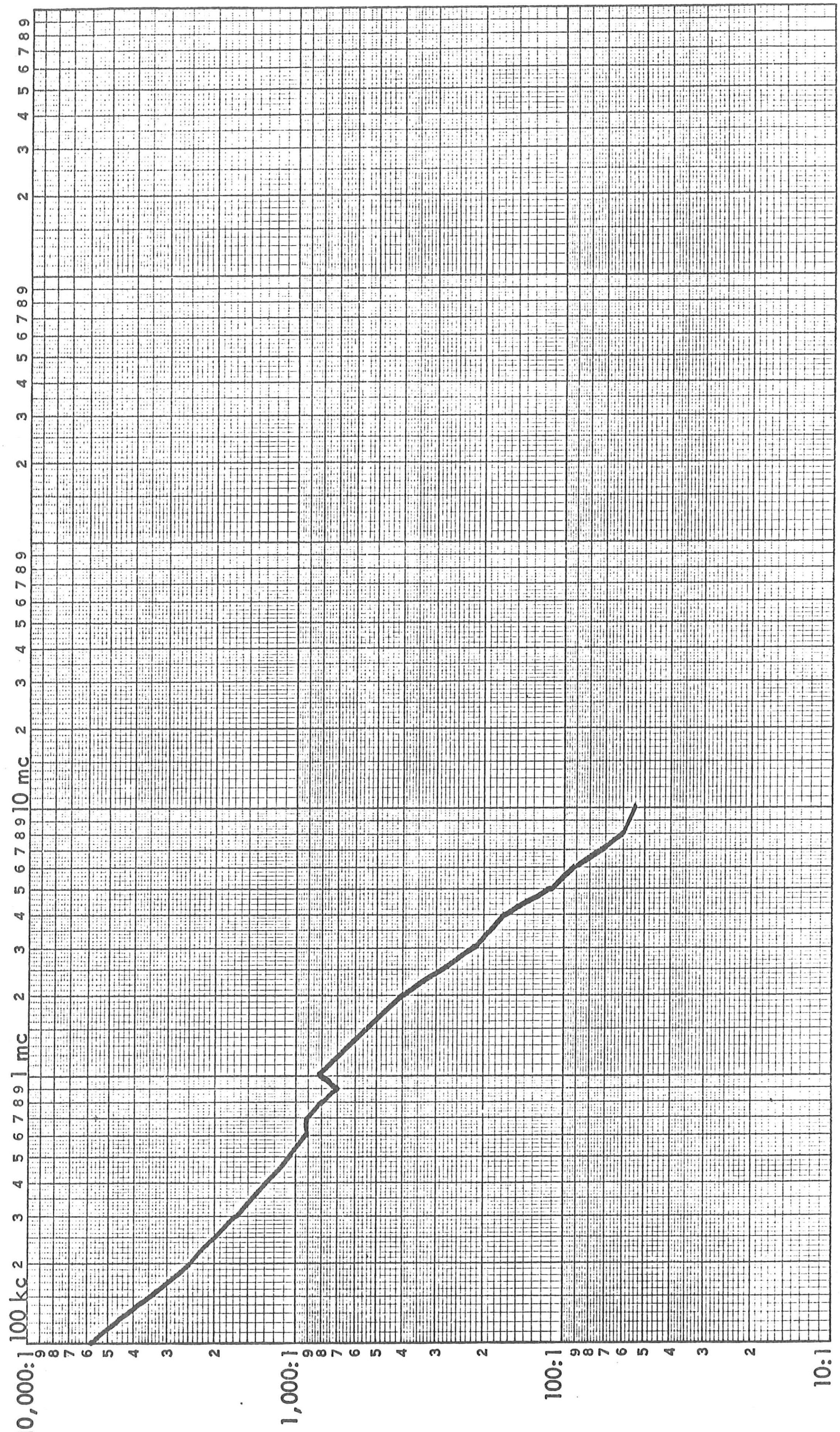


Fig. 6


3A7 (S/N B 03)
Common Mode Rejection Ratio
10 volts peak to peak applied
frequency
100
1 kc
10 kc
100 kc
1 mc
10 mc
1x10^6:1
100,000:1
10,000:1
1,000:1

3A7 (S/N B 03)

Common Mode Rejection Ratio



10 volts peak to peak applied

POWER DRAIN -- 560 SERIES PLUG-INS

Geoff Gass, 5-21-65

The power supply loading indicated below will vary somewhat with line-voltage and front-panel control settings. Where series-regulator shunts are indicated, the shunt consists of 2 k in the indicator unit in series with 0 to 6 k in the plug-in, the series combination connected between the unregulated supply and the regulated supply (in the -100 v supply, between the unregulated +supply and ground). The shunt supplies the extra current drawn by the plug-in beyond that which can be handled by the series regulator. The actual amount of shunt current varies with line-voltage, so if a positive power-supply bus in the plug-in is opened to take a current reading, the reading will be in error unless the bus is opened on the load side of the shunt connection (with the shunt still connected). The -100 v bus carries the entire load current, so a current measurement at the plug-in connector is always correct for this supply. There is no shunting for the -12.2 v supply.

CAUTION: The values below should not be used to determine if there is any "extra" power available in the compartment for other purposes or plug-in modifications. The values of the shunts, the total dissipation in the plug-in, the limitations of the indicator (transformer and series regulators) and the characteristics of the other plug-ins with which a given plug-in may be used all limit the amount of power "available" in a given plug-in compartment; in most cases, there is little or no margin allowed for extra current drain without modification of the shunts or circuitry. See 040-0245-00 instructions and power drain discussion in PRB's for indicators.

Plug-In, SN	-100 v, shunt	-12.2 v	+125 v, shunt	+300 v, shunt	6.3 v AC	117 v
3A7	37.5 1 k	690	67 FS	74 FS	1.2 A	0

MODIFIED PRODUCTS

Product	Mod	Description
3A7	505B	Medical system for Ampex. RM561A, 3A7, 2B67.
3A7	505B	Medical system. RM564, 3A7, 2B67.
3A7	803B	Two vertical inputs paralleled to rear, BNC.

Change No. 134-2

INSTRUMENT PERFORMANCE CHARACTERISTIC

CHANGE NOTICE

Instrument Type: 3A7 High Gain Differential Comparator

Publication affected: Engineering Instrument Spec. No. 134 Dated 6/14/65

Page: 3-3 Item OVERDRIVE DC SHIFT (3.1.14)

Change to/XXXX

3.1.14 Overdrive DC Shift

Set MILLIVOLTS/DIV to 10, Vc RANGE to 0, COMPARISON VOLTAGE to 500, Input Selectors to DC, and DISPLAY to A-Vc. Vertically center the trace and switch Vc RANGE to +1.1. Wait 30 seconds and then return Vc RANGE to 0. After 1 second the trace should return to within 0.5 divisions of graticule center. Switch DISPLAY to B-Vc and repeat test.

Reason for change:

To provide better test for sustained DC overdrive.

Approved by: [signature] Effective date 2/2/67
(Project Manager)

9-319

Change No. 134-1

INSTRUMENT PERFORMANCE CHARACTERISTIC

CHANGE NOTICE

Instrument Type: 3A7 HIGH GAIN DIFFERENTIAL COMPARATOR

Publication affected: Eng. Instrument Specification No. 134 Dated 6/14/65

Page: 3-2 Item HF Common-Mode Rejection Ratio

Change to/~~add:~~ XXXX

Check as in 3.1.6 and apply 20 kHz signal at 30 V P to P. Change MV/CM to 10. Apply 500 kHz signal at 30 V P to P and again check common-mode rejection ratio.

Reason for change: Correction

Approved by: Charles W. Rhodes (Project Manager) mc

Effective date 11-11-66

ENGINEERING INSTRUMENT SPECIFICATION

TYPE 3A7 HIGH GAIN DIFFERENTIAL COMPARATOR

FOR INTERNAL USE ONLY

TEKTRONIX, INC.

Specification 134

June 14, 1965

ENGINEERING

INSTRUMENT SPECIFICATION

TYPE 3A7

HIGH GAIN

DIFFERENTIAL COMPARATOR

Prepared by Technical Writing Department

Engineering Product Evaluation & Modification

Sunset Ext 279 Dan La Grange ______ Dan LaGrange

Approval:

Project Manager Charles Rhodes ______ Charles W. Rhodes

Project Engineer (E) John J. Horn ______ John Horn

Project Engineer (M) ______ for ______ Leon Prentice

Evaluation Engineer (E) Bill DeVey ______ Bill De Vey

Evaluation Engineer (M) Walt Backstrom ______ Walt Backstrom

(E) Electrical
(M) Mechanical

FOR INTERNAL USE ONLY

TEKTRONIX, INC.

CONTENTS

INTRODUCTION

This is the Instrument Specification for the Type 3A7 High-Gain Differential Comparator, and is the reference document for all company activity concerning performance requirements.

General Information

The Type 3A7 is designed for use with Tektronix 560 series Oscilloscopes. It may be used as a differential input preamplifier in addition to its use as a comparator.

Sensitivity settings from 1 mv/div to 50 v/div are selectable by two switches. The mv/div switch changes amplifier gain, in a 1-2-5 sequence, from 1 mv/div through 50 mv/div. The input attenuator provides decade attenuation from 1X to 1000X.

In the differential input mode, the dynamic range of ± 11 v allows common-mode signals up to ± 11 v to be applied to the unit without attenuation. Common-mode rejection ratio of better than 20,000:1 at dc and ac frequencies to 20 khz allows measurement of differential signals less than 1 mv in amplitude on ± 11 v common-mode signals.

As a calibrated differential comparator, the Type 3A7 has an effective screen height of ± 11,000 div at maximum sensitivity. Within the dynamic range of ± 11 volts, calibrated ± dc comparison voltages can be added differentially to the input signal to permit a maximum of about 0.001% to be resolved.

Operating Data

Amplifier

Millivolts/div Positions

1 to 50 mv/div in 1-2-5 sequence. Deflection factor is extended to 50 v/div with attenuator.

Variable Millivolts/div Range

2.5:1 (provides continuously variable uncalibrated deflection factors from 1 mv/div to 125 v/div).

Input Connectors

A and B are BNC connectors (+ signal to B deflects trace downward). Both have input coupling switches for AC, DC or Gnd.

Output Connectors

Vc output provides comparison voltage output at front panel via tip jack.

Vc Range Switch

Sets Vc ranges of 0 to 1.1 v, 0 to 11 v, either polarity. Can also be set at 0 position, providing no Vc output at any setting of other Vc controls.

Comparison Voltage Controls

Knob selects most significant digit of a voltage within the Vc range. Duodial provides continuously variable calibrated voltage selection between knob settings.

Input Atten Switch

Controls both inputs by attenuations of 1X, 10X, 100X, or 1000X. Also has R ≈ ∞ position (provides high input R at 1X attenuation).

Display Switch

A-Vc

Signal is applied to Input A, Vc applied internally to B. Main-frame crt displays differential voltage.

A-B

Signals applied to both inputs. Main-frame crt displays differential voltage.

Vc-B

Vc applied internally to A and signal applied to B. Main-frame crt displays differential voltage. Signal applied to B is inverted on the screen.

Balance Adjustments

DC Bal

Balances amplifier for no trace shift through range of Variable Millivolts/div control.

Amp Bal

Balances amplifier for no trace shift through range of Millivolts/div switch.

Diff Bal

Matches input stages for maximum common-mode rejection.

Amp Cal Adjustment

Adjusts overall amplifier gain.

SECTION 1

1.0 Performance Requirements

1.1 Electrical Characteristics

Performance requirements listed for the characteristics in this section are valid throughout the environment specified in Section 1.2 unless there is a statement to the contrary.

Performance requirements are validated by Engineering according to Sections 3 and 4. Production test methods may differ.

The following codes are used to categorize performance requirements.

G (General Use)	This performance requirement may, but not necessarily will, be quoted to a customer.
I (Internal Use Only)	This is a customer type performance requirement (not a factory test limit), but will not be quoted to a customer.
A (All)	It is recommended by Engineering that electrical testing of this performance requirement be performed on 100% of instruments. Environmental testing is performed on a sample basis.
S (Sampled)	This performance requirement carries a high confidence level and may be tested on a sample basis.

Conditions under which a performance requirement is valid may be listed under Supplemental Information or in Section 3 (Electrical Test Methods). These conditions are an essential part of the performance requirement.

NOTE: Code column also provides reference to related electrical test method.

1.1.1 AMPLIFIER

Characteristic	Performance Requirement	Code	Supplemental Information
Millivolts/cm			
Positions	1 to 50 mv/div in 1-2-5 sequence	GA	Verified in Accuracy tests
Accuracy	± 3%	3.1.1 GA	
Variable Range	≥ 2.5:1	3.1.2 GA	
Frequency Response		3.1.3	
Low Frequency			
DC Coupled	DC	GA	Verified in CMR tests
AC Coupled	≤ 2 hz @ 30% down (input RC ≥ 0.08 sec)	GS	
High Frequency			
50 mv/div	≥ 10 Mhz	GA	
20 mv/div	≥ 10 Mhz	GS	
10 mv/div	≥ 10 Mhz	GS	
5 mv/div	≥ 8 Mhz	GS	
2 mv/div	≥ 6 Mhz	GS	
1 mv/div	≥ 4 Mhz	GA	

See page 1-1 for coding legend

1.1.1 AMPLIFIER (continued)

Characteristic	Performance Requirement	Code	Supplemental Information
Risetime		3.1.4 G	Calculated from Bandwidth
50 mv/div	≤ 35 nsec		
20 mv/div	≤ 35 nsec		
10 mv/div	≤ 35 nsec		
5 mv/div	≤ 43.8 nsec		
2 mv/	≤ 58.2 nsec		
1 mv/	≤ 87.6 nsec		
Low Frequency Linearity	≤ 1 mm compression or expansion of 4-cm	3.1.5 GA	
Common-Mode Rejection Ratio			
DC Coupled	≥ 20,000:1 with 11 vdc from Vc Output	3.1.6 GA	
AC Coupled	≥ 1,000:1 with 60 hz, 15-v peak sinewave	3.1.7 GA	
HF (DC Coupled)		3.1.8 GA	
20-khz sinewave	≥ 20,000:1 @ 15-v peak		
500-khz sinewave	≥ 500:1 @ 15-v peak		

See page 1-1 for coding legend

1.1.1 AMPLIFIER (continued)

Characteristic	Performance Requirement	Code	Supplemental Information
Trace Drift with Line Voltage Change	≤ 0.5 cm with ± 10% line variation, after 1 minute stabilization at each extreme	GA 3.1.9	Checked at 1 mv/div after 20-min warm up
Input CF Grid or Gas Current	≤ 2 nanoamps	GA 3.1.10	I = trace shift in volts divided by 1 megohm
Input Crosstalk	≤ 5% (A to B or B to A) with 4-div, 50-khz sinewave at 50 mv/div. ≤ 2 div at 5 mv	GA 3.1.11	Checked with Type 190B
Microphonics	≤ 1 mv	IA 3.1.12	Switching Vc Range to produce shock
Overdrive Recovery	≤ 300 nsec to within 10 mv	GA 3.1.13	
Overdrive DC Shift	≤ 5 mv after 1 sec	GA 3.1.14	
Range of Adjustment			
Gain	≤17.5v/div to ≥24.4v/div at crt vertical neckpins	3.1.15 IA	
DC Balance	≥ 100 mv	IA 3.1.16	
Transient Response	≤ 2.5% aberration of 4-div centered square wave having ≤ 3 nsec risetime	GA 3.1.17	Checked with Type TU5
Positioning Effect on Transient Response	Change in front corner ≤ ± 2% (of signal amplitude) with entire signal displayed on screen	GA 3.1.18	Any signal amplitude

See page 1-1 for coding legend

1.1.2 ATTENUATOR

Characteristic	Performance Requirement	Code	Supplemental Information
Maximum Peak Input Voltage, Common Mode or Differential Mode		GS 3.2.1	
1X	± 15 v		
10X	± 150 v		
100X	± 500 v		
1000X	± 500 v		
Maximum Input Attenuator Error		GA 3.2.2	
10X	± 0.05%		
100X	± 0.15%		
1000X	± 3%		
Input Attenuator Compensation	≤ 1% p-p aberration of 4-div calibrator signal	GA 3.2.3	
1X Input R	Within ± 0.1% of 10X input R	GA 3.2.4	

See page 1-1 for coding legend

Characteristic	Performance Requirement	Code	Supplemental Information
	1.1.3 COMPARISON VOLTAGE		
Ranges	0 to 1.1 v and 0 to 11 v	GA	Verified in Accuracy Tests
Polarity	Positive or Negative, selectable	GA	
Accuracy	± 0.15% of indicated value ± 0.05% of full scale (Range)	GA 3.3.1	
	1.1.4 TRACE POSITION INDICATORS		
Turn-On Point	Proper light is on when trace or spot is 2 cm above or below graticule center	GA	Arrow indicates direction from center
	1.1.5 TRIGGER SIGNAL OUTPUT		
Amplitude	≥ 2 volts per displayed cm	IA	

See page 1-1 for coding legend

1.2 Environmental Characteristics

The Type 3A7 is a laboratory instrument. The following environmental limits are applicable.

1.2.1 Storage

No visible damage or electrical malfunction after storage at -40°C to +65°C and 50,000 feet, as described in Sections 4.1 and 4.2. Adjustments may be performed to meet required accuracy after storage tests.

1.2.2 Temperature

The instrument will perform to limits indicated in Sections 1.1 over a range from 0°C to 50°C when tested according to Section 4.1.

1.2.3 Altitude

The instrument will perform to limits indicated in Section 1.1 following vibration tests described in Section 4.3.

1.2.5 Transportation

The instrument will be so packed that it will meet the National Safe Transit requirements described in Section 4.4.

SECTION 2

2.0 Miscellaneous Information

2.1 Ventilation

No special ventilation required. Ventilation adequate for 560 series instruments is adequate for the Type 3A7.

2.2 Finish

Front panel has an anodized finish.

2.3 Dimensions

Fits 3-series plug-in compartments.

2.4 Connectors

A and B input connectors are BNC type. Vc output connector is a tip jack.

2.5 Warm-up Time

Twenty minutes for rated accuracies at 25°C ±5°C.

SECTION 3

3.0 Electrical Test Methods

3.1 Amplifier

3.1.1 Millivolts/div Accuracy

Checked with a Standard Square-Wave Calibrator Signal, at each mv/div setting, using an amplitude which should provide 4 or 5 div of deflection. Accuracy is deviation from correct ampltude expressed as a percentage of correct amplitude.

3.1.2 Variable Millivolts/div Range

With Variable in calib, a 5 div calibrator signal is displayed. Variable is then rotated to full ccw. Ratio is 5 divisions divided by the full ccw amplitude.

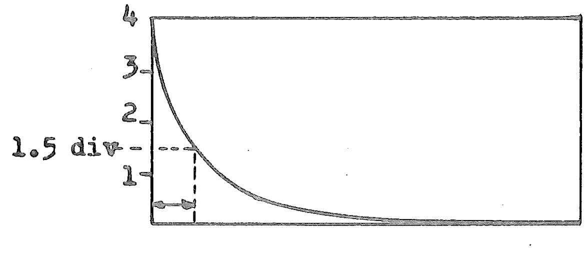
3.1.3 Frequency Response

<u>High Frequency</u>:

A 50-khz sinewave is applied from a Type 190B (to A in A-Vc, to B in Vc-B) and a 4 div reference amplitude is established. The frequency is then increased to the point where the displayed amplitude decreases to 2.8 div and the frequency noted.

<u>Low Frequency, AC Coupled</u>:

Based on input Xc being equal to, or less than, R at 2 cps. Checked at 50 mv/div with 100X attenuation. A input is checked in A-Vc and B input is checked in Vc-B. Sweep rate is set at 0.1 sec/div. The test-scope + Gate pulse is ac coupled to the input. Variable mv/div is adjusted for 4-div amplitude. The time required for the waveform to fall from the 4 div amplitude point to the 1.5 div amplitude point is then measured.



Optional Test Method

Establish 4-cm 50-hhz reference signal using an audio generator Decrease audio generator frequency, maintaining constant output level (Monitor with dc coupled test scope), to the point where the display vertical amplitude falls to 2.8 cm. Check the audio generator frequency for 2 hz or less.

3.1.4 Risetime

Calculated from bandwidth by formula $Tr = \frac{.35}{BW}$

3.1.5 Low Frequency Linearity

A test scope with a differential plug-in unit is required in addition to the plug-in scope. Pins 17 and 21 of the Type 3A7 output connector are ac coupled to the two inputs of the test-scope differential plug-in unit.

A calibrator signal is connected to either input of the Type 3A7 and the controls adjusted to display exactly 2 div deflection centered on the plug-in scope graticule. Test-scope controls are then adjusted to display exactly 4 div deflection.

Type 3A7 Vc control (not Position control) is used to move the plug-in scope display 2 div above and 2 div below the centered position. At each extreme, the effect on the amplitude of the test-scope display is noted.

3.1.6 DC Common-Mode Rejection Ratio

Measured at 1 mv/div. The trace is first centered with both inputs grounded and with the mode at A-B. Vc controls are set for 10 v and Vc output is dc coupled to both inputs. The indicated voltage (trace shift x mv/div setting) is then noted. Rejection ratio is the input voltage divided by the indicated voltage. Check with + 10 v and with - 10 v.

3.1.7 AC Common-Mode Rejection Ratio

A 60-hz, 15-v peak sinewave is ac coupled to both inputs and rejection ratio measured as in 3.1.6.

3.1.8 HF Common-Mode Rejection Ratio.

**Check as in 3.1.6 and apply 20 kHz signal at 30 V P to P. Change MV/CM to 10. Apply 500 kHz signal at 30 V P to P and again check common-mode rejection ratio.*

3.1.9 Trace Drift with Line Voltage Variation

Line voltage is changed to 10% below design-center voltage, allowed to stabilize for 1 minute and the trace centered. Line voltage is then changed to 10% above design-center voltage and, after 1 minute stabilization, trace drift is noted.

**Change notice #134-1, 11-11-66*

3.1.10 Input CF Grid or Gas Current

Checked at 1 mv/div, X1 and 0 Vc Range. A input is checked in A-Vc and B in Vc-B. Starting with the input selector at Gnd, the trace is centered. The input selector is then switched to DC and the trace shift noted. Grid current is calculated by Ohm's law using the voltage indicated by trace shift and the 1 megohm input resistance.

3.1.11 Input Crosstalk

Connect sinewave from Type 190B to A input in A-Vc mode. Signal amplitude is adjusted for 4-div at 50 mv/div. The mode is switched to Vc-B and crosstalk noted. Repeat at 5 mv/div. Move the signal to B input and repeat the check at 5 mv/div and 50 mv/div.

3.1.12 Microphonics

Checked in A-B at 1 mv/div. The Vc Range is switched from extreme to extreme at a 1 second rate. The amplitude of resulting microphonic is noted.

3.1.13 Overdrive Recovery

Connect Type 105 Output through a 50-Ω cable and 50-Ω termination to A input. Set Millivolts/div at 5 and Input Atten at 1000. Set sweep rate at 50 µsec/div.

Set the Type 105 for 10khz signal then trigger the sweep from the Type 105 Sync output.

Adjust Type 105 Output Amplitude for 2-div display. Switch Input Atten to 1 and adjust vertical position so that the top of the signal, just prior to the trailing edge, returns to the graticule center line.

Change sweep rate to .1 µsec/div. Adjust horizontal position so that the leading edge of the signal crosses the bottom line of the graticule at the junction of one of the vertical lines.

The trace must be within 2 divisions of graticule center 300 nsec later.

3.1.14 Overdrive DC Shift

**Set MILLIVOLTS/DIV to 10, Vc RANGE to 0, COMPARISON VOLTAGE to 500, Input Selectors to DC, and DISPLAY to A-Vc. Vertically center the trace and switch Vc RANGE to +1.1. Wait 30 seconds and then return Vc RANGE to 0. After 1 second the trace should return to within 0.5 divisions of graticule center. Switch DISPLAY to B-Vc and repeat test.*

**Change notice #134-2, 2-2-67*

3.1.15 Gain Adjustment Range

Connect a 100 mv calibrator signal to A input. Set Millivolts/div at 20 and Input Atten at 1. Turn Gain fully ccw. Use test scope, ac coupled at 20 v/cm, to measure the signal voltages at the two crt vertical deflection pins. The algebraic difference between these two voltages should be 87.5 volts or less.

Turn the gain fully cw and repeat the measurement. The algebraic difference between the two vertical deflection voltages should now be 122 volts or less.

3.1.16 DC Balance Range

Measured as vertical trace movement, at 50 mv/div, caused by rotation of the DC Bal adjustment from extreme to extreme.

3.1.17 Transient Response

A square wave is connected from a Type 107 through a 50-Ω cable and 50-Ω termination to the input (both are checked). The controls are adjusted to display 4 divisions of vertical deflection. The waveform is checked for excessive rounding, overshoot, ringing or tilt.

3.1.18 Position Effect on Transient Response

Measured in conjunction with 3.1.17. With the signal connected to A input, the top of the signal is moved from the top graticule line, down the graticule as far as possible with 100% of the signal displayed on the screen. Note any change in transient response. With the signal applied to B input. Move the bottom of the signal from the bottom graticule line up the graticule as far as possible with 100% of the signal on the screen. Note any change in transient response.

3.2 Attenuator

3.2.1 Maximum Peak Input Voltage
Apply (dc coupled) then remove the voltage specified in Section 1.1.2. This test should result in no destruction of tubes, transistors or other components.

3.2.2 Input Attenuator Error
<u>10X</u>
Set Vc Range to + 11 v. Connect + 11 v from TP420 to A input and to Precision DC Divider Voltage Input.

Connect a 1 megohm ± 1% resistor from Precision DC Divider Voltage Output to ground and connect Precision DC Divider ground to Type 3A7 ground.

Set Vc knob at a position between any 2 detents to internally disconnect comparison voltage from Vc Output connector and from input tube grids.

Set Mode at A-Vc. Connect Precision DC Divider Voltage Output to the Vc Output connector (connects 1.1 v to B input).

Note indicated voltage and express as a percentage of 1.1 volts.

Switch Mode to Vc-B and move the jumper from A input to B input. Again note indicated voltage and express as a percentage of 1.1 v.

100X

Switch input attenuator and Precision DC Divider to 100:1 attenuation.

Note indicated voltage and express as a percentage of 110 mv.

Change Mode to A-Vc and move the jumper from B input to A input. Express indicated voltage as a percentage of 110 mv.

1000X

Connect jumpers from Vc Out to both inputs. Disconnect all other jumpers and Precision DC Divider.

Set Vc Range at 0 and Vc knob at 10. Set Comparison Voltage duodial full cw and set Input atten at 1000.

Center the trace then switch Vc Range to + 11. Note trace shift and express as a percentage of 11 mv.

Switch Mode to Vc-B and again express trace shift as a percentage of 11 mv.

3.2.3 Input Attenuator Compensation

Measured as transient response to a 4-division calibrator signal. Check for excessive rounding, overshoot, ringing or tilt.

3.2.4 1X Input Resistance

Set Vc Range at + 11 v and set Mode at A-Vc. Connect a 1 megohm ± 1% resistor from TP420 to A input and to a precision non-loading voltmeter. Set Input Atten at 10 and note the voltmeter reading.

Change Input Atten to 1 and note the difference between the new voltage reading and the previous voltage reading. Express the difference as a percentage of the previous voltage reading.

Double the percentage to obtain actual 1X input resistance error.

Repeat the test for B input.

3.3 Comparison Voltage Supply

3.3.1 Accuracy

A non-loading voltmeter with better than ± 0.05% accuracy must be used (Vc output impedance and accuracy will decrease with loading). Set Vc knob and duodial full cw. Check + and - positions of Vc Range switch for accuracy and polarity. Switch Vc Range to 1.1 v (either polarity) and check for accuracy. Set duodial at 0.00 and check each position of Vc knob for accuracy. Set Vc knob full ccw and check duodial for tracking at each major dial division (1.00, 2.00, etc.).

NOTE: Zo ≈ 4 kΩ with Vc switch and duodial at midrange. Decreases toward 0 volts and 11 volts.

SECTION 4

4.0 Environmental Test Methods

4.1 Temperature

4.1.1 Nonoperating

Store for 4 hours at -40°C and 4 hours at +65°C, one cycle only. Temperature change rate must not exceed 5°C/min.

4.1.2 Operating

Make all electrical checks at room ambient temperature. Then turn off instrument and store at 0°C for 4 hours. After 20 minutes warm up, again make all electrical checks.

Raise ambient temperature to 50°C with instrument operating. Hold for 4 hours and again make all electrical checks. Temperature change rate must not exceed 5°C/min.
Return instrument to room temperature and after 4 hours (or temperature stabilization) make all electrical checks.

4.1.3 Failure Criteria

Nonoperating

Instrument and components must meet performance requirements before and after storage. (Adjustments may be performed if necessary to meet required accuracies).

Cracking, warping, and significant color discoloration or deformation which interferes with the normal mechanical function will not be permitted.

Operating

Instrument must be within indicated performance requirements at each step of the operating temperature check. Controls and switches shall be checked for ease of operation.

4.2 Altitude

4.2.1 Nonoperating

Store at -40°C and 50,000 feet altitude for 4 hours. This may be performed along with the storage tests.

4.2.2 Operating

The instrument while operating will be maintained at an altitude of 15,000 feet for 4 hours (with necessary thermal derating). At the end of this period and while the above conditions are maintained, the electrical checks will be performed. When necessary, the vacuum chamber may be opened and the necessary switching performed as rapidly as possible. The instrument will then be allowed to stabilize for 1 hour at the above conditions before completing the electrical checks.

4.2.3 Failure Criteria

Nonoperating

Instrument will meet performance requirements before and after the 50,000 feet storage test.

Operating

Instrument will meet performance requirement during operation at altitude. Any evidence of malfunction will constitute failure, i.e., erratic operation, noise, etc.

4.3 Vibration

4.3.1 Operating

Vibrate for 15 minutes along each of the 3 axes at a total displacement of 0.015" (1.9 g at 50 cps) with the frequency varied from 10-50-10 cps in 1-minute cycles. Hold at any resonant point for 3 minutes. If no resonances are present vibrate at 50 cps for 3 minutes in each axis. Total vibration time about 55 minutes. Sporadic output will be permitted during vobration.

4.3.2 Failure Criteria

Broken leads, chassis or other components, loose parts, excessive wear or component fatigue. Change in value of any component outside its normal rated tolerance. Deformation which interferes with the normal mechanical function.

The test will be completely re-run after repairing any of these failures.

Tube failures will be permitted during test and when replaced, the test will be continued from that point (this does not apply to transistors).

Instrument must meet performance requirements before and after the vibration test.

Tests are performed with the instrument in a fixture.

4.4 Transportation

The instrument, when packaged, must meet the National Safe Transit type of test.

4.4.1 Vibration

One hour on the vibration platform with an amplitude slightly in excess of 1 g and causing the package to just leave the vibration surface.

4.4.2 Drop Test

Drop from a height of 30 inches on one corner, all edges radiating from that corner and all flat surfaces.

4.4.3 Failure Criteria

Instrument must meet performance requirements before and after the transportation tests.

There must be no serious damage such as broken components, leads or chassis. Deformation which interferes with normal mechanical function will not be permitted.

SPECIFICATION CHANGE HISTORY

Change Number: 134-1

Page: 3-2

Effective Date: 11-11-66

Characteristic: HF Common-Mode Rejection Ratio

New Spec: Change to -

Check as in 3.1.6 and apply 20 kHz signal at 30 V P-P. Change MV/CM to 10. Apply 500 kHz signal at 30 V P-P and again check common-mode.

Reason: Correction

Change Number: 134-2

Page: 3-3

Effective Date: 2-2-67

Characteristic: OVERDRIVE DC SHIFT (3.1.14)

New Spec: Change to -

3.1.14 Overdrive DC Shift

Set MILLIVOLTS/DIV to 10, Vc RANGE to 0, COMPARISON VOLTAGE to 500, Input Selectors to DC, and DISPLAY to A-Vc. Vertically center the trace and switch Vc RANGE to +1.1. Wait 30 seconds and then return Vc RANGE to 0. After 1 second the trace should return to within 0.5 divisions of graticule center. Switch DISPLAY to B-Vc and repeat test.

Reason: To provide better test for sustained DC overdrive.

TEKTRONIX®
BEAVERTON

MAINTENANCE NOTES

3A7
Thermal
Shift

PROBLEM

When the Type 3A7 is overdriven for a relatively long time (30 seconds or so), the 0-volts baseline can shift so that one second after the removal of the overdrive signal, the instrument may not have recovered to within specifications.

This is caused when Q154 or Q254 (depending on the polarity of the overdrive) turns off with the overdrive signal. While the transistor is off, it cools, causing a change in V_{be}. After the overdrive signal is removed and the transistor is turned on again, it warms up so that the V_{be} returns to its original value. This change in V_{be} causes the shift in the 0-volts baseline.

SOLUTION

The solution is to add heat dissipators (PN 214-0498-00) to Q154 and Q254. This stabilizes the transistor junction temperature so that the change in V_{be} is minimized. This mod appears to reduce the 0-volts baseline shift by a factor of approximately two.

Ron Gantner/jm
6-19-67

FACTORY TEST LIMITS

QUALIFICATION

Factory test limits are qualified by the conditions specified in the main body of the factory calibration procedure. Instruments may not meet factory test limits if calibration or checkout methods and test equipment differ substantially from those in the factory procedure.

These limits usually are tighter than advertised performance requirements, thus helping to insure the instrument will meet or be within advertised performance requirements after shipment and during subsequent recalibrations. Instruments that have left the factory may not meet factory test limits but should meet catalog or instruction manual performance requirements.

AMPLIFIER

Fil Bal: adjusted for min trace shift
AMP BAL: adjusted for min trace shift
Driver DC Level: adjusted for 59 VDC
Position Range: adjusted for centered trace
Average Deflection Plate Voltage: 190 ±10V
Sig/Trig DC Level: adjusted for 0 VDC
Trigger Output: ≥2 volts/displayed div in a 561A main frame

COMPARISON VOLTAGE

Vc Cal: adjusted for 11 VDC ±1mV
Vc Tracking: adjusted for 1 VDC ±0.2mV
Comparison Voltage Accuracy ±0.03% ±1mV (with dial at 0.00)
Comparison Voltage 10:1 divider: ±0.04%
- Comparison Voltage: ±0.1%

GAIN

AMP CAL range; 87.5-122V, adjusted for 1mV/div
Compression/Expansion: ≤1mm
MILLIVOLTS/DIV Accuracy: ±2%
VARIABLE ratio: ≥2.5:1
1000 INPUT ATTEN: ±2%
DC BAL Range: ≥100mV
Positioning Neons: indicates direction of trace from graticule area

INPUT AMPLIFIER

Grid Current: ≤0.5 na
Microphonics: ≤1mV
Trace Drive: ≤0.5mV
Peak Input Voltage: 20VDC @ 1X

DIFFERENTIAL BALANCE

DIFF BAL & CF Load: adjusted for optimum horizontal trace

INPUT ATTEN RESISTANCE

X10 Attenuator: ±0.04%
X100 Attenuator: ±0.14%
X1 to X10 Attenuator: X1 = X10 ±0.06%

INPUT COMPENSATION

Input Compensation: ≤1% aberrations ptp with a 4 div display

OVERDRIVE RECOVERY (Rough Set)

Overdrive Recovery: rough set for slightly peaked square-wave

COMMON MODE REJECTION RATIO

20Hz CMRR: ≥30,000:1
60Hz CMRR: ≥1,000:1 ac coupled
20kHz CMRR: ≥30,000:1
500kHz CMRR: ≥500:1
10X CMRR: adjusted for minimum deflection
DC CMRR: ≥30,000:1

OVERDRIVE RECOVERY

Overdrive Recovery Time: ≤0.3μs ≤10mV
Overdrive DC Shift: ≤5mV after 1 s

HIGH FREQUENCY COMPENSATION

High Frequency Compensation: max aberration: 2.5% ptp
Transient Response: max aberration: 2.5% ptp
Positioning Effect: ≤1%
Trigger Amp Risetime: ≤.45 s
Input Crosstalk: ≤2%

Test Limits - continued

HIGH FREQUENCY COMPENSATION

High Frequency Compensation: max aberration: 2.5% ptp
Transient Response: max aberration: 2.5% ptp
Positioning Effect: ≤1%
Trigger Amp Risetime: ≤.45 s
Input Crosstalk: ≤2%

AMPLIFIER BANDPASS

Bandpass:	1mV/DIV:	≥4MHz
	2mV/DIV:	≥6MHz
	5mV/DIV:	≥8MHz
	10mV/DIV:	≥10MHz
	20mV/DIV:	≥10MHz
	50mV/DIV:	≥10MHz

FREQUENCY RESPONSE (sample check)

AC Coupled Low Frequency: ≤2Hz

PARTS REPLACEMENT KIT

VERTICAL POSITION INDICATOR NE2H NEON BULBS

For the Tektronix Type 3A7 Plug-in
Serial numbers 100-199

050-0283-00

DESCRIPTION

NE2H neon bulbs 150-0050-00, used as Vertical position indicators (B300 and B302) are no longer available and are replaced by NE2V neons, 150-0030-00. This necessitates changing the bulb biasing circuit because of the different current and firing voltage requirements.

NOTE: If the serial number of your instrument is above those listed, or if this kit has already been installed, disregard the instructions and use P/N 150-0030-00 as a direct replacement.

Publication:
Instructions for 050-0283-00
February 1966

PARTS LIST

Quantity	Description				Part Number
2 ea	Bulb, neon, NE2V				150-0030-00
1 ea	Resistor, comp,	27 k	1/2 W	10%	302-0273-00
1 ea	Resistor, comp,	82 k	1/2 W	10%	302-0823-00

INSTRUCTIONS:

IMPORTANT: When soldering to the ceramic strips, use the silver-bearing solder supplied with this kit.

CAUTION: When soldering to the neon bulb holders, use as little heat as possible to avoid melting the holders.

( ) 1. Unsolder the wires from the "up" neon holder and pry the gray section from the black panel-mounted section.

( ) 2. Likewise, unsolder the wires from the "down" neon holder and pry the gray section from the black panel-mounted section.

( ) 3. Unsolder from the Vc RANGE switch the two bare wires which went to the neon holders, and the red wire connected to the same switch terminal.

( ) 4. Remove the neon bulbs from the holders, clean out the holes and insert the new bulbs from the kit. DO NOT solder or clip off the leads yet.

( ) 5. Push the bulbs forward as far as they will go and solder the cable and 27 k resistor (from kit) as indicated in Fig 1 (viewed from rear).

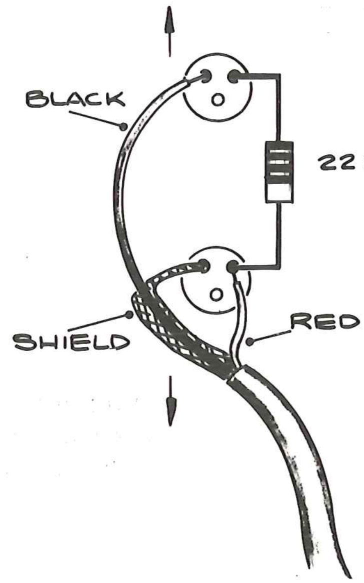


Fig 1

INSTRUCTIONS (con'd):

Refer to Fig 2 while performing steps 6 through 8.

( ) 6. Unsolder and remove the 22 k resistor (R302) between CSM-3 and CSN-3.

( ) Remove the bare wire between CSM-4 and CSN-3.

( ) 7. Relocate the red wire from CSM-3 to CSM-4.

( ) 8. Replace the 56 k resistor (R300), located between CSM-5 and CSN-5, with the 82 k resistor from the kit.

THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

( ) Moisten the back of the MODIFIED INSTRUMENT tag (from kit) and place it on the Manual Differential Amplifier Schematic.

( ) Fasten the insert page in your Instruction Manual.

TL:cet

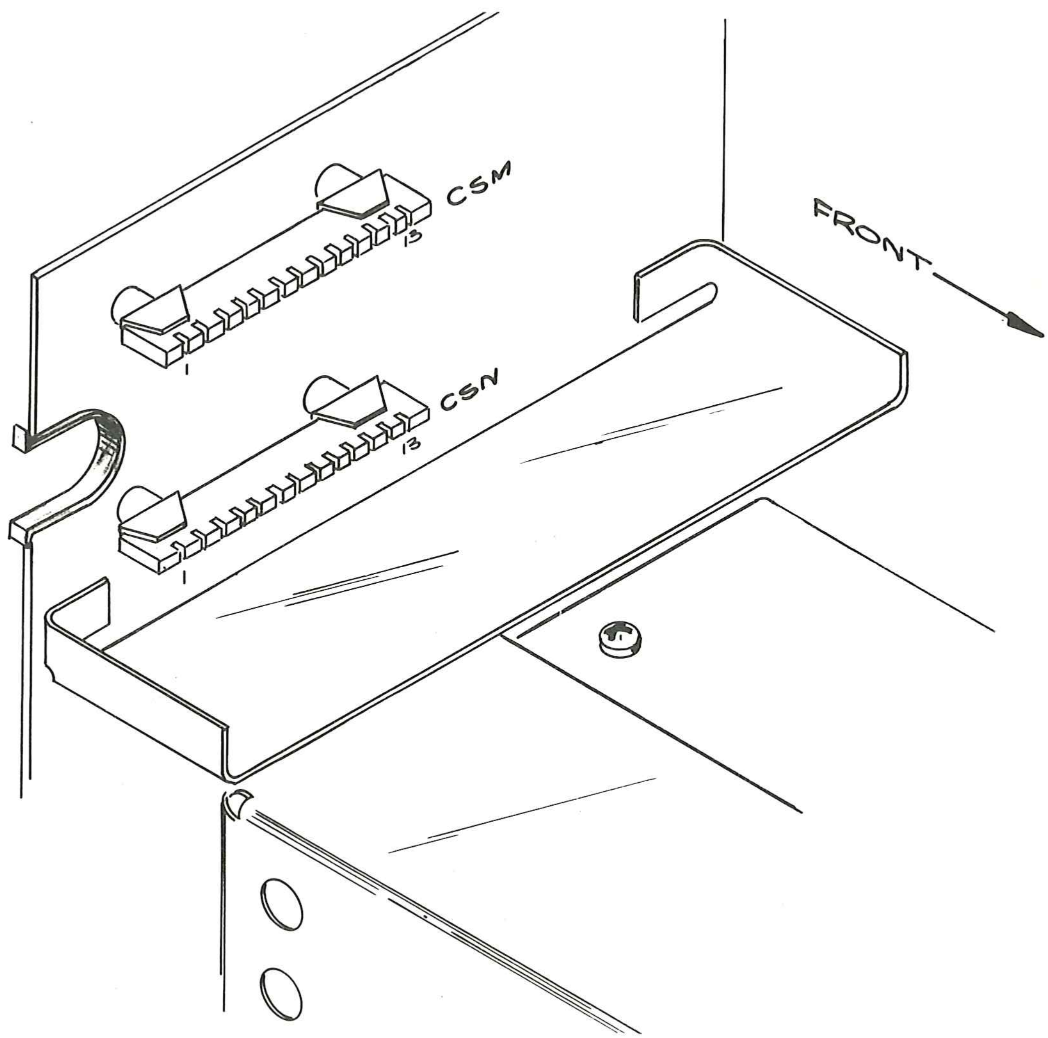


Fig 2

VERTICAL POSITION INDICATOR NE2H NEON BULBS

Type 3A7 -- s/n 100-

Installed in Type 3A7 s/n _______ Date _______

GENERAL INFORMATION

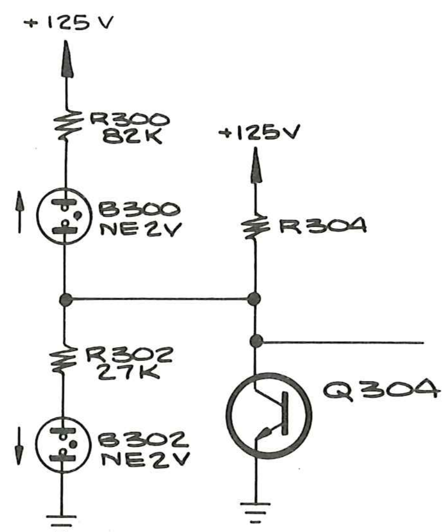
NE2H neon bulbs 150-0050-00, used as Vertical position indicators (B300 and B302) are no longer available and are replaced by NE2V neons, 150-0030-00. This necessitates changing the bulb biasing circuit because of the different current and firing voltage requirements.

The information on this page supersedes the information in your Manual.

ELECTRICAL PARTS LIST

Ckt. No.	Part Number	Description	
		BULBS	
B300	150-0030-00	NE2V	
B302	150-0030-00	NE2V	
		RESISTORS	
Resistors are fixed, comp, 10%			
R300	302-0823-00	82 k	1/2 W
R302	302-0273-00	27 k	1/2 W

SCHEMATICS



DIFFERENTIAL AMPLIFIER
(Partial Diagram)

MODIFICATION SUMMARY

3A7

COMPARISON VOLTAGE RANGE SWITCH DUMMY SOLDER LUG ADDED TO FACILITATE ASSEMBLY

INFORMATION ONLY

PILOT -4**

Effective Prod s/n 120

FRONT PANEL SYMPTOM: None.

PROBLEM: The installation of a wire by final assembly was made easier by adding a dummy lug to the Vc RANGE switch.

PRODUCTION CHANGE: A dummy solder lug was added to the Vc RANGE switch at W3-4R. The part number of the switch (260-0633-00) remained the same.

** Pilot-1, 2, etc., designate modification installed in Pilot Production that was not assigned a standard mod number.

VERTICAL INDICATOR NEON TYPE CHANGED TO IMPROVE RELIABILITY — See SQB — M10155

Effective Prod s/n 200 — Usable in field instruments SN 100-199

FRONT PANEL SYMPTOM: Vertical indicator neons do not indicate trace deflection.

PROBLEM: The trace indicator neons were sometimes failing to indicate trace deflection.

PRODUCTION CHANGE: B300 and B302 were changed from NE2H to NE2V. The NE2V contains a small amount of radioactive material to assure more reliable ignition. It was also necessary to change R300 from 56k to 82k and R302 from 22k to 27k to provide proper bias for the NE2V neons. See 'Before-After' schematic.

Parts Removed:

B300, B302	Bulb, neon NE2H	150-0050-00
R300	Res, comp, 56k 1/2W 10%	302-0563-00
R302	Res, comp, 22k 1/2W 10%	302-0223-00

Parts Added:

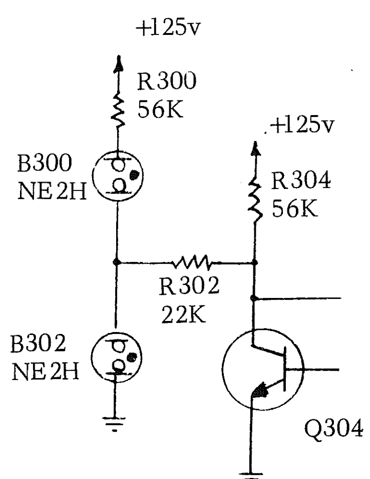
B300, B302	Bulb, neon NE2V	150-0030-00
R300	Res, comp, 82k 1/2W 10%	302-0823-00
R302	Res, comp, 27k 1/2W 10%	302-0273-00

INSTALLATION INSTRUCTIONS:

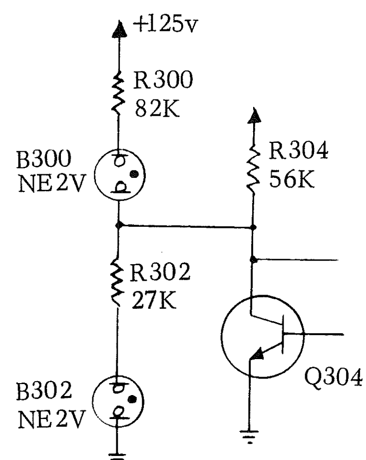
Parts Required: Parts Replacement Kit 050-0283-00

Installation Procedure:

Refer to kit instructions.



BEFORE M10155



AFTER M10155

INPUT ATTENUATOR SHIELD GROUNDING IMPROVED TO ELIMINATE POSSIBLE TRANSIENT RESPONSE VARIATION

INFORMATION ONLY

M10267

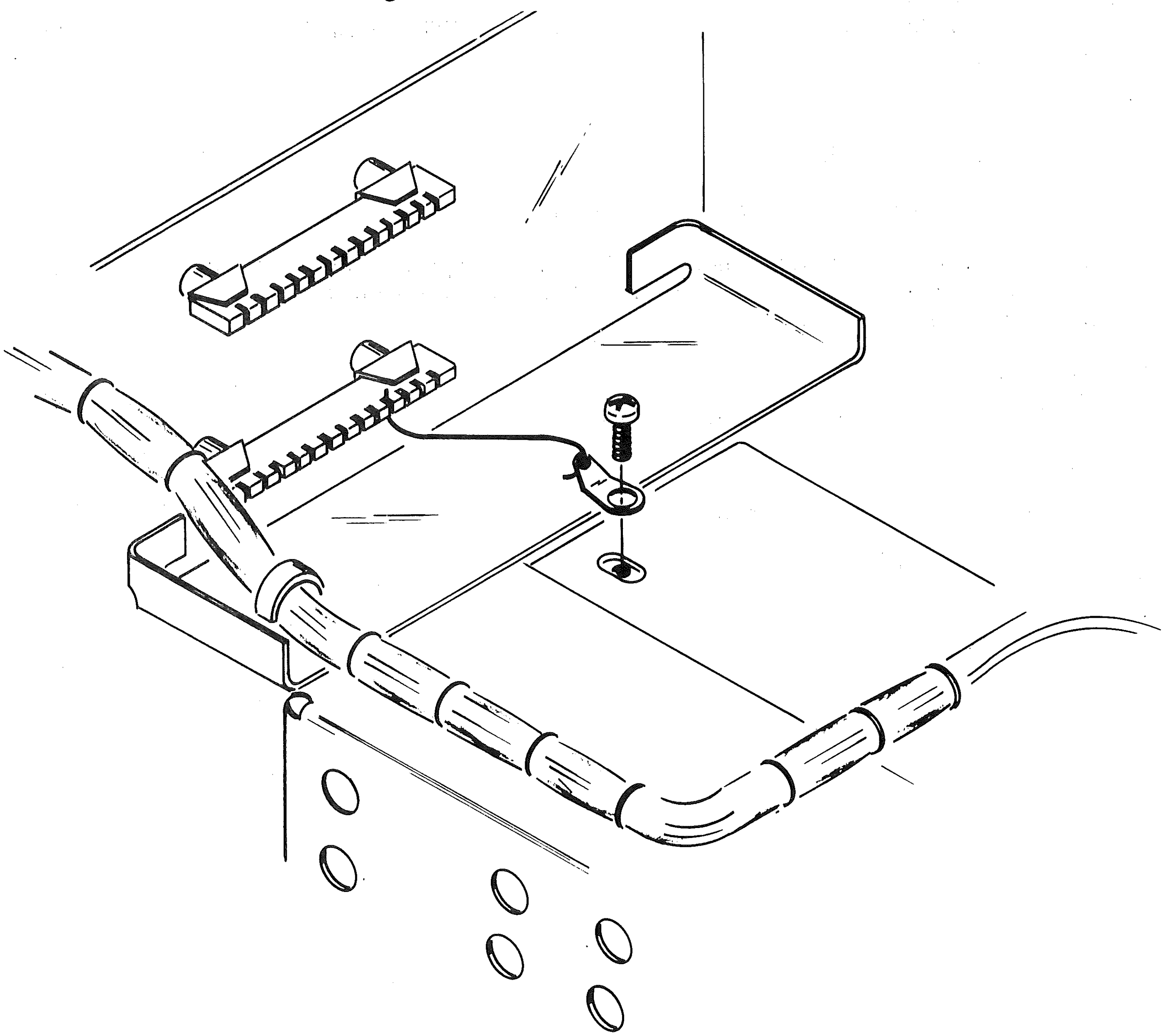
Effective Prod s/n 200

FRONT PANEL SYMPTOM: Transient response variations in low Millivolt/Division settings when input attenuator shield is shorted to ground.

PROBLEM: Transient response variations could result at low MV/DIV settings if the attenuator was grounded to the chassis with a screwdriver shaft.

PRODUCTION CHANGE: The attenuator shield grounding was improved by replacing a washer with a solder lug, and adding a bare wire from the lug to ground. See drawing for location.

Parts Removed:	Washer, steel 5S x 9/32	210-0801-00
Parts Added:	Lug, solder SE6	210-0202-00



OUTPUT AMPLIFIER CHASSIS SILKSCREENING ADDED TO IDENTIFY POTENTIOMETER FUNCTION | INFORMATION ONLY | PILOT-3**

Effective Prod s/n 201

FRONT PANEL SYMPTOM: None

PROBLEM: R280 was changed from a fixed value to a variable resistor, 311-0496-00. This required chassis labeling. All instruments were re-worked to change to a variable resistor.

PRODUCTION CHANGE: The word "DAMPING" was silkscreened on the chassis to identify R280. Prior to silkscreening, all instruments were stamped with "R280" on the chassis. The chassis part number was not changed.

ATTENUATOR CAPACITOR CHANGED TO STANDARDIZE CHANNELS 1 AND 2 | INFORMATION ONLY | M10703

Effective Prod SN 330

FRONT PANEL SYMPTOM: None

PROBLEM: C109B adjusted near the end of its range.

PRODUCTION CHANGE: C109B was changed from 1.8-13pF to 1.7-11pF to center the adjustment range and make the CH 1 and CH 2 attenuators identical and thereby facilitate assembly and test.

Parts Removed:

C109B	Cap var air 1.8-13pF	281-0103-00

Parts Added:

C109B	Cap var air 1.7-11pF	281-0102-00

JT:cet

10% AND 20% ZENER DIODES CHANGED TO STANDARD 5% UNITS

INFORMATION ONLY

M11191

Effective Prod SN not given

NOTE: All diodes in any one instrument will not necessarily change at the same time. The effective SN furnished will be when the final diode in the particular instrument is changed.

FRONT PANEL SYMPTOM: None.

PROBLEM: Zener diode values are at present widely scattered in both voltage and tolerance. The proposed modifications will standardize all 400 mW, 1 W, 1.5 W and 10 W Zeners now listed as 10 and 20%, to 5% tolerance; and change the majority of non-standard parts to standard JEDEC units. One of these changes is to minimize the number of active part numbers. There will be no increase in cost for the 5% Zeners.

PRODUCTION CHANGE: Voltage tolerance for 10% and 20% Zener diodes was changed to 5% for all uses. At the same time, all 250 mW Zener diodes were changed to 400 mW. Refer to parts removed and added list for details.

Parts Removed:

D324	Diode, 1N970A 24 V ±10%	152-0172-00
D286	Diode, 1N980A 62 V ±10%	152-0176-00

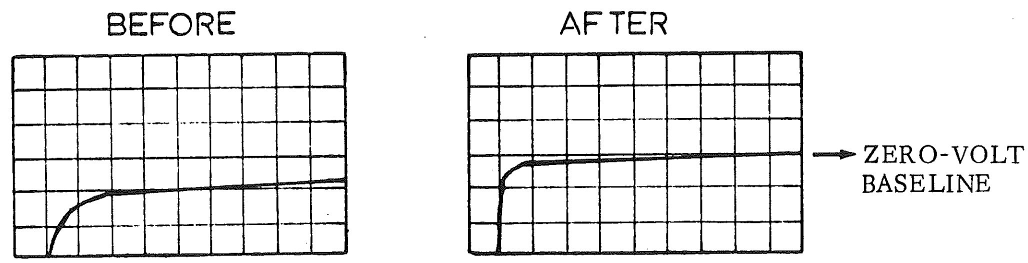
Parts Added:

D324	Diode, 1N970B 24 V ±5%	152-0265-00
D286	Diode, 1N980B 62 V ±5%	152-0285-00

DIFFERENTIAL AMPLIFIER CIRCUIT MODIFIED TO REDUCE DC SHIFT WITH OVERDRIVE | See SQB | M12021

Effective Prod SN 460 | Usable in field instruments SN 100-459

FRONT PANEL SYMPTOM: Relatively long term overdrive (in the order of 5 seconds and longer) causes the Zero-Volt base line to shift more than the specified 5 mV. This is especially noticeable on the 5, 10 and 20 mV/div positions.



OVERDRIVE -500 MV FOR 30 SEC T/Div= 1 SEC V/Div= 10 MV

PROBLEM: This problem causes extreme difficulty in making voltage measurements shortly after minor overdrive occurs. The overdrive need not be steady to cause this problem. Repetitive overdrives of one polarity can cause cumulative baseline shift. It takes several minutes of normal operation to restore the original Zero-Volt base line.

Q154 and Q254, depending on polarity of the overdrive, turn off. When one transistor is turned off, it cools, causing a shift in V_{BE}. Also minor overdrive causes the plate voltage of V174 or V274 to drop, so that tube conduction switches from the plate to the screen. Recovery from this change in operating mode adds to the difficulty in regaining the original Zero-Volt base line.

PRODUCTION CHANGE: A 10 V Zener diode was added in series with the collectors of Q154 and Q254. This lowers the operating dissipation after being turned off. A series R-C (470 Ω 180 pF) was added across R264 to eliminate CMR breakdown, which occurs in some units at 500 kHz after the 10 V Zeners are added. At the same time, two 5.1 V Zener-signal diode combinations were added in complimentary manner, to limit the overdrive amplitude applied to V174 or V274.

Parts Added:

D152, D252	Diode, Zener 1N961B 10 V	152-0149-00
D261, D263	Diode, Silicon	152-0185-00
D260, D262	Diode, Zener 5.1 V	152-0195-00
C158	Capacitor, cer disc 180 pF	283-0103-00
R158	Resistor, comp 470 Ω 1/4 W 5%	315-0471-00

Part of this mod is superseded by M12034. Also see M12514.

continued

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added' and parts listed below.

C155	Capacitor, cer 2.7 pF 500 V	281-0547-00
C150A	Capacitor, cer 3.3 pF 500 V	281-0534-00

Installation Procedure: DO NOT DISCARD ANY PARTS UNTIL MOD IS COMPLETED.

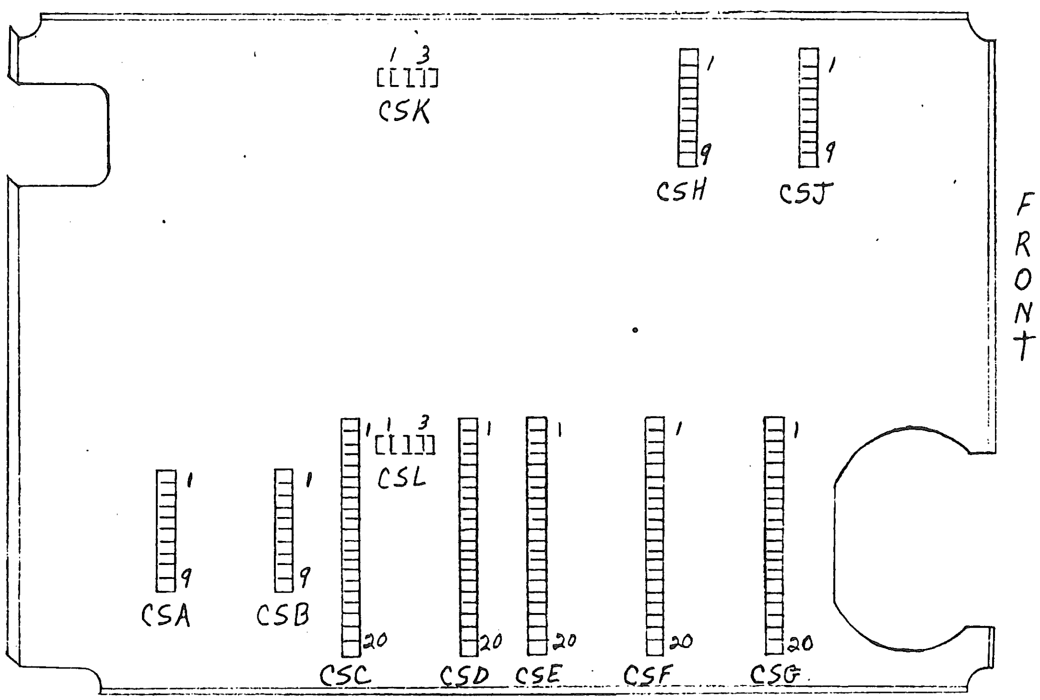
a) Remove the following wires and components:
1. R157, a 2.26k 1/2 W 1% resistor between CSC-7 and CSD-7.
2. C155, a 1.5 pF capacitor between CSC-8 and CSD-8.
3. R155, a 1.27k 1/2 W 1% resistor between CSC-8 and CSD-8.
4. R149, a 1.5k 1/2 W 1% resistor between CSC-12 and CSD-12.
5. R249, a 1.5k 1/2 W 1% resistor between CSC-13 and CSD-13.
6. bare wire from collector of Q154 to the base of Q164.
7. bare wire from collector of Q254 to base of Q264.
8. C255, a 1.5-7 pF var capacitor between CSC-17 and CSD-17.
9. R294, a 33k 1 W 5% resistor between CSA-6 and CSB-7.

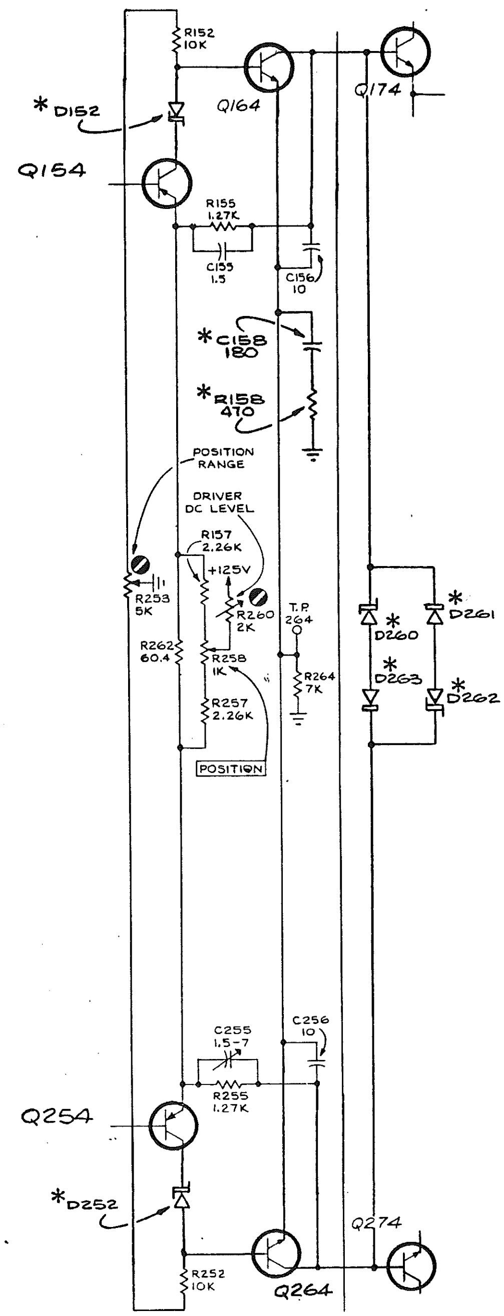
b) Install the following wires and components:
1. bare wire between CSC-19 and CSC-20.
2. bare wire between CSB-2 and CSC-9.
3. bare wire from emitter of Q274 to CSB-6 then to CSC-16.
4. R158, a 470 Ω 1/4 W 5% resistor between CSC-19 and CSD-19.
5. C158, a 180 pF ceramic capacitor between CSD-19 and CSD-20.
6. D152, a 10 V Zener diode between collector of Q154 and base of Q164. Install with the cathode (banded end) the collector of Q154.
7. D252, a 10 V Zener diode between collector of Q254 and base of Q262. Install with the cathode (banded end) to collector of Q254.
8. D261, a silicon diode between CSC-8 and CSC-11, outside of strip. Install with the cathode (banded end) to CSC-8.
9. D262, a 5.1 V Zener diode between CSC-11 and CSC-17, outside of strip. Install with the cathode (banded end) to CSC-17.
10. D260, a 5.1 V Zener diode between CSC-8 and CSC-14, outside of strip. Install with the cathode (banded end) to CSC-8.
11. D263, a 5.1 V silicon diode between CSC-14 and CSC-17, outside of strip. Install with the cathode (banded end) to CSC-17.
12. R155, a 1.27k resistor removed in step a-3, between CSC-8 and CSD-8.
13. C155, a 2.7 pF capacitor between CSC-9 and CSD-8.
14. R157, a 2.26k resistor removed in step a-1, between CSC-7 and CSD-7.

continued

Installation Procedure: (continued)

15. R149, a 1.5k resistor removed in step a-1 between CSC-12 and CSD-12.
16. R249, a 1.5k resistor removed in step a-5 between CSC-13 and CSD-13.
17. C255, a 1.5 -7pF var capacitor removed in step a-8 between CSC-16 and CSD-17.
18. R294, a 33k resistor, removed in step a-9, between CSA-6 and CSB-7.
19. C150A, a 3.3pF ceramic capacitor, on the MILLIVOLTS/DIV switch between contacts W1-11R and W2-11R (parallel with R150A, a 3.01k 1% resistor).





*COMPONENT ADDED

DIFFERENTIAL AMPLIFIER FEEDBACK CONFIGURATION CHANGED TO ELIMINATE ABERRATION AT 2 AND 5 MILLIVOLTS/DIV

INFORMATION ONLY

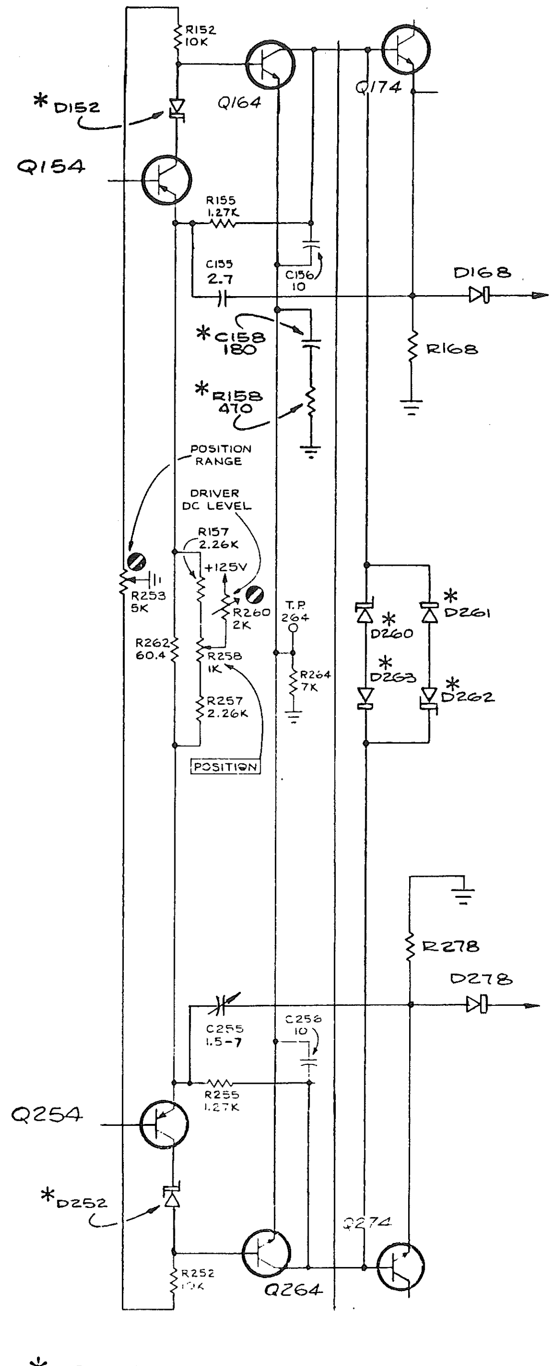
M12034

Effective Prod SN 510

FRONT PANEL SYMPTOM: Excessive transient response aberrations on front corner of square wave in the 2 and 5 mV/div ranges.

PROBLEM: Test department reports difficulty in meeting 2.5% P to P specification on aberrations in the 2 and 5 mV/div ranges due to insufficient capacity compensation in feedback loop around Q154/Q164 and Q254/Q264. Also, there is no capacity compensation across R150A.

PRODUCTION CHANGE: Capacitive feedback TO the emitters of Q154 and Q254 was reconfigured to originate FROM the emitters of Q174 and Q274 respectively. Also, a 3.3pF capacitor was added across R150A, the 2mV/div range (see schematic). This results in approximately 3 to 1 improvement in the aberrations.



*COMPONENT ADDED

OUTPUT SOCKET REPLACED BY BLACK SOCKET — INFORMATION ONLY — M12118

Effective Prod SN 570

FRONT PANEL SYMPTOM: None.

PROBLEM: Cannot obtain charcoal gray output socket in the small quantity required.

PRODUCTION CHANGE: Charcoal gray socket was replaced by a more readily available black socket.

Parts Removed:	Socket, 1-pin tip jack, charcoal	136-0163-00
Parts Added:	Socket, 1-pin tip jack, black	136-0098-00

DIFFERENTIAL AMPLIFIER COMPENSATION CAPACITOR VALUE CHANGED TO INCREASE RANGE OF ADJUSTMENT — INFORMATION ONLY — M12310

Effective Prod SN 570

FRONT PANEL SYMPTOM: None.

PROBLEM: The small range of capacity covered by C281 causes unnecessary selection of C280.

PRODUCTION CHANGE: C281 was changed froma 5-25 pF variable to an 8-50 pF variable.

Parts Removed:

C281	Capacitor, ceramic 5-25 pF Var	281-0075-00

Parts Added:

C281	Capacitor, ceramic 8-50 pF Var	281-0022-00

DIFFERENTIAL AMPLIFIER HEAT SINKS ADDED TO TRANSISTORS TO REDUCE OVERDRIVE RECOVERY DIFFICULTIES — See SQB — M12514

Effective Prod SN 570 — Usable in field instruments SN 100-569**

modified out of sequence

316	405-6	509-11	550
359	420	519	558-61
400	499	527	564
403	502	545-6	566

** Prior to SN 460, M12021 should also be installed.

FRONT PANEL SYMPTOM: The zero-baseline fails to recover to within 5 mV within one second after a relatively long-term overdrive has been removed.

PROBLEM: Q154 or Q254, depending on the polarity of the overdrive, turns off when overdrive occurs. While the transistor is off, it cools causing a shift in V_{BE}. After overdrive ceases, the transistor that had been cut off must warm up again to the point where V_{BE} returns to its normal operatting value.

PRODUCTION CHANGE: Heat dissipators were added to Q154 and Q254 to reduce the temperature difference between their base-emitter junctions and ambient air. This reduces, by a factor of 2, the amount of junction temperature restabilization required after overdrive.

Parts Removed:	None.	
Parts Added:	Heat sink for transistor case (2)	214-0498-00

INSTALLATION INSTRUCTIONS:

See MI - 12514.

COUPLERS CHANGED ON POT SHAFTS TO REDUCE MIS-ALIGNMENT AND BINDING — INFORMATION ONLY — M12572

Effective Prod SN 690

FRONT PANEL SYMPTOM: Some front panel screw driver adjustments are binding.

PROBLEM: Solid couplers used between potentiometers and extension shafts cause mis-alignment and binding.

PRODUCTION CHANGE: The solid coupler was changed to a flexible type.

Parts Removed:	Coupling, shaft 1/4 D x 1/2 Long	376-0029-00
Parts Added:	Coupling, flexible 1/8 to 1/8	376-0051-00

COMPARISON VOLTAGE POTENTIOMETER MOUNTING CHANGED TO REDUCE BINDING OF MULTI-TURN POTENTIOMETER SHAFT — See SQB — M10599

Effective Prod SN 790 — Usable in field instruments SN 100-789

FRONT PANEL SYMPTOM: COMPARISON VOLTAGE potentiometer shaft binds.

PROBLEM: Misalignment between switch SW420 and potentiometer R425.

PRODUCTION CHANGE: Switch shield bracket 337-0761-00 was modified (PN changed to -01) to allow addition of resilient pot mount 426-0289-00. See 'Before' and 'After' drawings on following page.

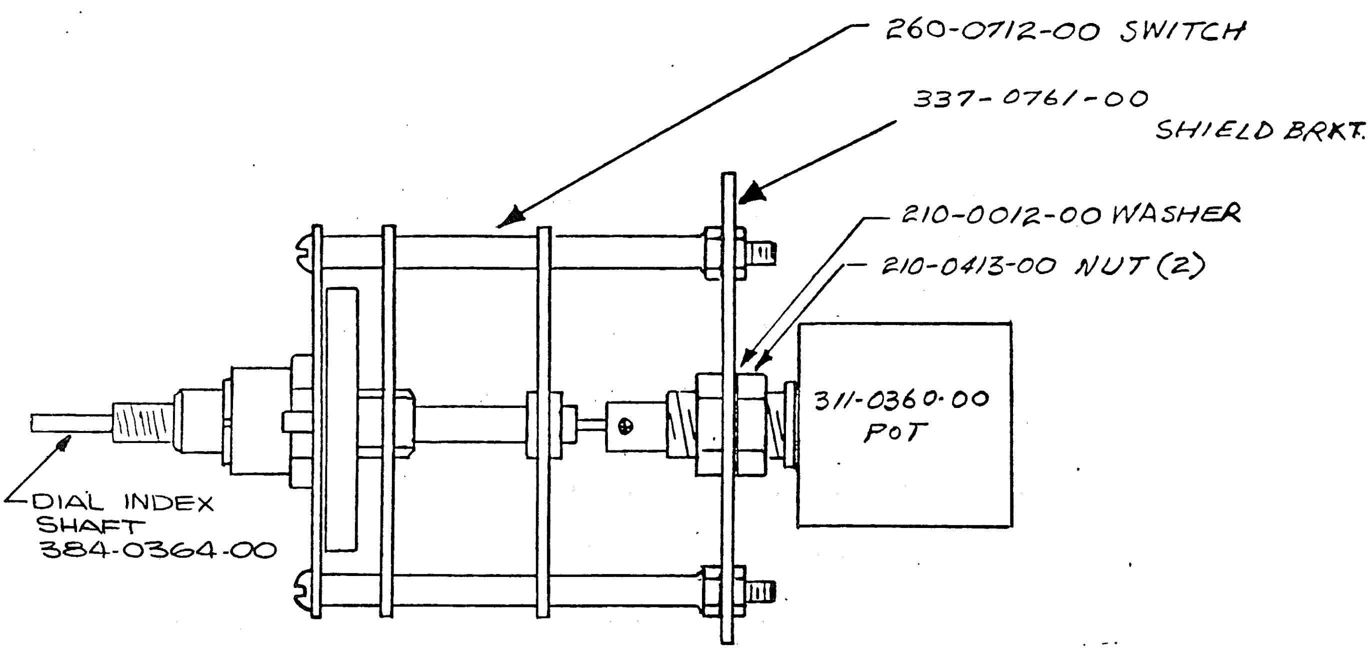
Parts Removed:	Shield, bracket	337-0761-00
Parts Added:	Mount, resilient	426-0289-00
	Shield, bracket, w/slotted hole	337-0761-01

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added.'

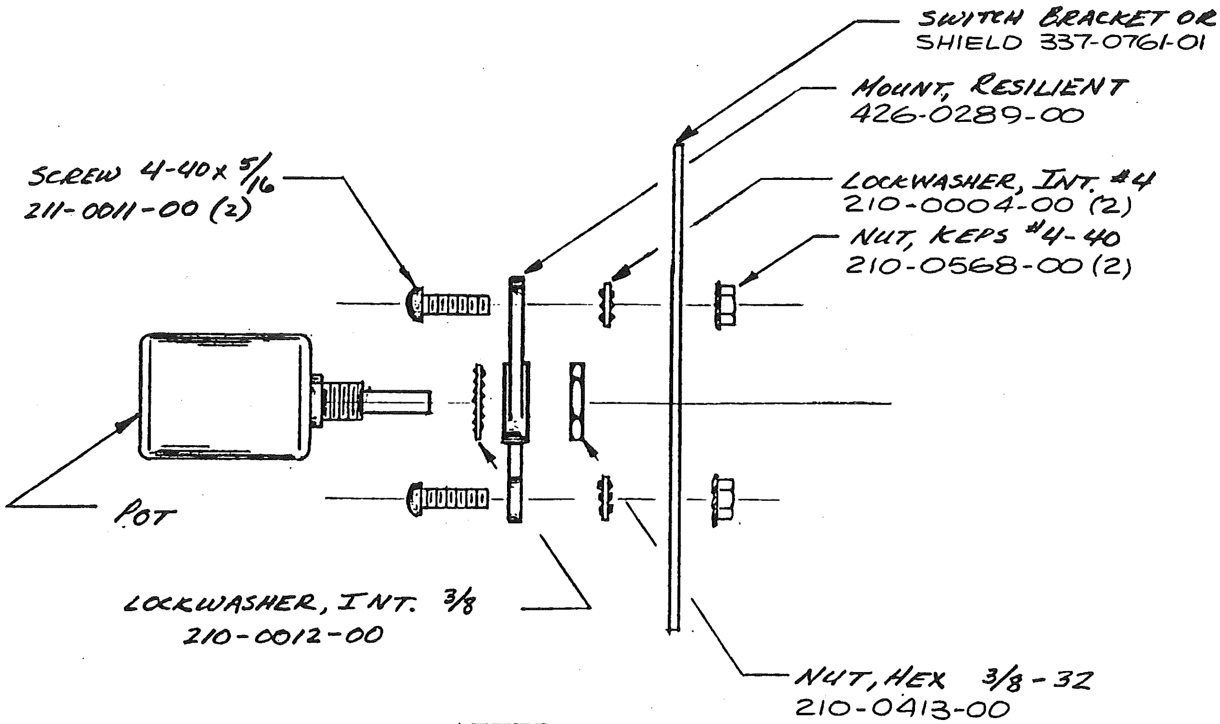
Installation Procedure:

Replace the potentiometer bracket and install the pot as shown in 'After' drawing on following page.



BEFORE

Continued.


SWITCH BRACKET OR
SHIELD 337-0761-01
MOUNT, RESILIENT
426-0289-00
SCREW 4-40 x 5/16
211-0011-00 (2)
LOCKWASHER, INT. #4
210-0004-00 (2)
NUT, KEPS #4-40
210-0568-00 (2)
POT
LOCKWASHER, INT. 3/8
210-0012-00
NUT, HEX 3/8-32
210-0413-00

AFTER

10% AND 20% ZENER DIODES CHANGED TO STANDARD 5% UNITS

INFORMATION ONLY

M11191

Effective Prod SN 890

NOTE: All diodes in any one instrument will not necessarily change at the same time. The effective SN furnished will be when the final diode in the particular instrument is changed.

FRONT PANEL SYMPTOM: None.

PROBLEM: Zener diode values are at present widely scattered in both voltage and tolerance. The proposed modifications will standardize all 400 mW, 1 W, 1.5 W and 10 W Zeners now listed as 10 and 20%, to 5% tolerance; and change the majority of non-standard parts to standard JEDEC units. One of these changes is to minimize the number of active part numbers. There will be no increase in cost for the 5% Zeners.

PRODUCTION CHANGE: Voltage tolerance for 10% and 20% Zener diodes was changed to 5% for all uses. At the same time, all 250 mW Zener diodes were changed to 400 mW. Refer to parts removed and added list for details.

Parts Removed:

D324	Diode, 1N970A 24 V ±10%	152-0172-00
D286	Diode, 1N980A 62 V ±10%	152-0176-00

Parts Added:

D324	Diode, 1N970B 24 V ±5%	152-0265-00
D286	Diode, 1N980B 62 V ±5%	152-0285-00

BE:fb

MODIFICATION INSTRUCTIONS

MI - 10599

Type 3A7 Differential Comparator

Serial Numbers 100-789

IMPROVED COMPARISON VOLTAGE POTENTIOMETER MOUNTING

This modification adds a resilient potentiometer mounting plate to the rear of the COMPARISON VOLTAGE switch for mounting the COMPARISON VOLTAGE potentiometer. The resilient mounting plate eliminates binding between the potentiometer shaft and the switch caused by misalignment of the two components.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	210-0004-00	Lockwasher, int #4
2 ea	210-0586-00	Nut, Keps, 4-40 x 1/4
2 ea	211-0011-00	Screw, 4-40 x 5/16 PHS
1 ea	337-0761-01	Shield, bracket
1 ea	426-0289-00	Mount, resilient

INSTALLATION

1) Turn the COMPARISON VOLTAGE potentiometer to the extreme ccw position.

2) Loosen the Allen head screws on the potentiometer shaft, remove the potentiometer mounting nut, and pull the potentiometer back out of the way.

3) Replace the CONVERSION VOLTAGE switch rear mounting plate with the new, PN 337-0761-01, mounting plate.

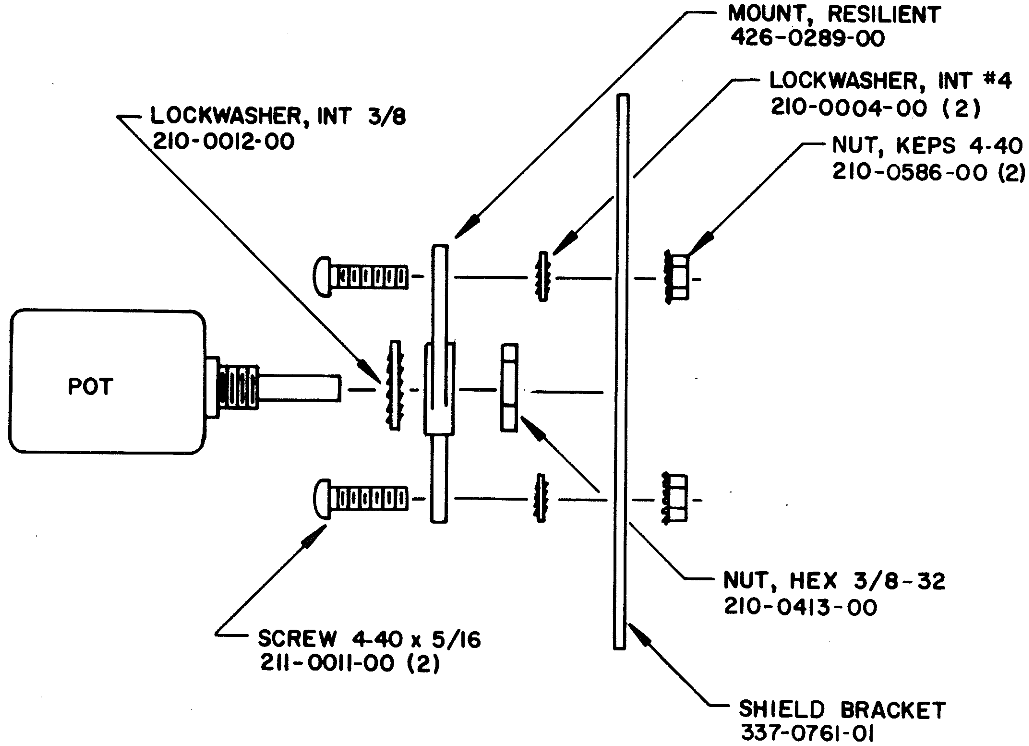
4) Mount the resilinet mount, and remount the potentiometer as shown in the drawing on page 2. Note that the potentiometer mounting nut on the potentiometer side of the bracket is no longer used.

THIS COMPLETES THE INSTALLATION.

Correct your Instruction Manual Mechanical Parts List, and check the COMPARISON VOLTAGE 10-turn dial for mechanical zero as described in the Calibration section of the Instruction Manual.

continued

DW:ls


MOUNT, RESILIENT
426-0289-00
LOCKWASHER, INT #4
210-0004-00 (2)
NUT, KEPS 4-40
210-0586-00 (2)
LOCKWASHER, INT 3/8
210-0012-00
POT
NUT, HEX 3/8-32
210-0413-00
SCREW 4-40 x 5/16
211-0011-00 (2)
SHIELD BRACKET
337-0761-01

MODIFICATION INSTRUCTIONS

MI - 12514

Type 3A7 Plug-in Unit

Serial numbers 100-570*

TRANSISTOR HEAT DISSIPATORS ADDED TO IMPROVE OVERDRIVE RECOVERY CHARACTERISTICS

Relatively long term overdrive (approximately 30 seconds) causes amplifier transistors Q154 or Q254 (depending on the polarity of overdrive) to be cut off.

The cut off transistor cools causing a shift in V_{BE} which must be restabilized after overdrive ceases.

The addition of heat dissipators reduces the temperature difference between the transistor base-emitter junctions and the ambient air, thereby reducing the amount of restabilization required after overdrive.

Below serial number 460, Tektronix Modification Instructions MI - 12021 should also be installed.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	214-0498-00	Heat sink for transistor case

INSTALLATION

Install the new heat sinks over Q154 and Q254.

* The following serial numbered instruments were modified at the factory:

316	400	405-6	499	509-11	527	550	564
359	403	420	502	519	545-6	558-61	566

6-30-67

TYPE 3A7 TENT SN 890

ELECTRICAL PARTS LIST CORRECTION

CHANGE TO:

D286	152-0285-00	1N980B	0.4 w, 62 V, ±5%
D324	152-0265-00	1N970B	0.4 w, 24 V, ±5%

This insert is placed in its appropriate position in your Product Reference Book and printed on colored paper to expedite retrieval. In a standard manual, it will be filed at the back of the manual.

INSTRUCTION MANUAL

PARTS LIST ADDENDUM

CORRECTION

ADD:

To Q154, Q254	**1 each**	**Heat Sink**	**214-0498-00**

This insert is placed in its appropriate position in your Product Reference Book and printed on colored paper to expedite retrieval. In a standard manual, it will be filed at the back of the manual.

M12,514/667

Inductors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description			S/N Range
LR208B	*108-0298-00	0.25 μH	(wound on a 36 Ω resistor)		
LR208D	*108-0271-00	0.25 μH	(wound on a 51 Ω resistor)		
L269	*108-0148-00	2.5 μH			
L270	*114-0190-00	50-75 μH	Core 276-0511-00	Var	
L280	*108-0057-00	8.8 μH			

Connector

P11	131-0149-00	Chassis mounted, 24 contact male

Transistors

Q144	*151-0139-00	Selected 2N918's (dual)
Q154	*151-0133-00	Selected from 2N3251
Q164	*151-0108-00	Replaceable by 2N2501
Q174	*151-0103-00	Replaceable by 2N2219
Q234	*151-0103-00	Replaceable by 2N2219
Q254	*151-0133-00	Selected from 2N3251
Q264	*151-0108-00	Replaceable by 2N2501
Q274	*151-0103-00	Replaceable by 2N2219
Q284	*151-0133-00	Selected from 2N3251
Q294	*151-0136-00	Replaceable by 2N3053
Q304	*151-0096-00	Selected from 2N1893

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R103	316-0470-00	47 Ω	¼ W			
R105A	323-0680-00	988 k	½ W		Prec	1%
R105B	311-0487-00	30 k		Var		
R106A†	325-0004-00	900 k	¼ W		Prec	0.1%
R106C††	325-0003-00	99.8 k	⅛ W		Prec	0.1%
R106E	311-0486-00	500 Ω		Var		
R106F	316-0101-00	100 Ω	¼ W			
R108A	323-0681-00	990 k	½ W		Prec	½%
R108F	321-0637-00	9.9 k	⅛ W		Prec	½%
R108G	311-0485-00	250 Ω		Var		
R109A	323-0623-00	999 k	½ W		Prec	1%
R109B	316-0101-00	100 Ω	¼ W			
R109D	316-0470-00	47 Ω	¼ W			
R109F	321-0193-00	1 k	⅛ W		Prec	1%
R110	315-0271-00	270 Ω	¼ W			5%

†Furnished as a unit with R206A (matched pair).

††Furnished as a unit with R206C (matched pair).

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description				S/N Range
R111	323-0373-00	75 k	½ W		Prec	1%	
R114	323-0281-00	8.25 k	½ W		Prec	1%	
R120	316-0101-00	100 Ω	¼ W				
R122	323-0481-00	1 meg	½ W		Prec	1%	
R123	323-0373-00	75 k	½ W		Prec	1%	
R126	316-0101-00	100 Ω	¼ W				
R128	323-0327-00	24.9 k	½ W		Prec	1%	
R129	321-0215-00	1.69 k	⅛ W		Prec	1%	
R130	311-0566-00	5 k		Var			
R132	321-0215-00	1.69 k	⅛ W		Prec	1%	
R134	323-0289-00	10 k	½ W		Prec	1%	
R136	323-0277-00	7.5 k	½ W		Prec	1%	
R138	321-0389-00	110 k	⅛ W		Prec	1%	
R140	323-0293-00	11 k	½ W		Prec	1%	
R142	321-0077-00	61.9 Ω	⅛ W		Prec	1%	
R143	316-0562-00	5.6 k	¼ W				
R147	316-0101-00	100 Ω	¼ W				
R149	323-0210-00	1.5 k	½ W		Prec	1%	
R150A	323-0239-00	3.01 k	½ W		Prec	1%	
R150B	323-0181-00	750 Ω	½ W		Prec	1%	
R150C	323-0147-00	332 Ω	½ W		Prec	1%	
R150D	323-0116-00	158 Ω	½ W		Prec	1%	
R150E	323-0647-00	61.4 Ω	½ W		Prec	1%	
R152	308-0301-00	10 k	3 W		WW	1%	
R155	323-0203-00	1.27 k	½ W		Prec	1%	
R157	323-0227-00	2.26 k	½ W		Prec	1%	
R158	315-0471-00	470 Ω	¼ W			5%	X460-up
R162	308-0383-00	12 k	5 W		WW	5%	
R166	316-0470-00	47 Ω	¼ W				
R168	323-0291-00	10.5 k	½ W		Prec	1%	
R170	*310-0626-00	2 k	11 W		WW	1%	
R172	302-0104-00	100 k	½ W				
R173	323-0303-00	14 k	½ W		Prec	1%	
R174	316-0470-00	47 Ω	¼ W				
R205A	323-0680-00	988 k	½ W		Prec	1%	
R205B	311-0487-00	30 k		Var			
R206A†	325-0004-00	900 k	¼ W		Prec	0.1%	
R206C††	325-0003-00	99.8 k	⅛ W		Prec	0.1%	
R206E	311-0486-00	500 Ω		Var			
R206F	316-0101-00	100 Ω	¼ W				
R208A	323-0681-00	990 k	½ W		Prec	½%	
R208F	321-0637-00	9.9 k	⅛ W		Prec	½%	
R208G	311-0485-00	250 Ω		Var			
R209A	323-0623-00	999 k	½ W		Prec	1%	
R209B	316-0101-00	100 Ω	¼ W				
R209D	316-0470-00	47 Ω	¼ W				

†Furnished as a unit with R106A (matched pair).
††Furnished as a unit with R106C (matched pair).

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description					S/N Range
R209F	321-0193-00	1 k	⅛ W		Prec	1%	
R210	315-0271-00	270 Ω	¼ W			5%	
R211	323-0373-00	75 k	½ W		Prec	1%	
R212	311-0497-00	50 k		Var			
R214	323-0281-00	8.25 k	½ W		Prec	1%	
R216	311-0329-00	50 k		Var			
R220	316-0101-00	100 Ω	¼ W				
R222	323-0481-00	1 meg	½ W		Prec	1%	
R223	323-0373-00	75 k	½ W		Prec	1%	
R226	316-0101-00	100 Ω	¼ W				
R230	316-0470-00	47 Ω	¼ W				
R232	323-0242-00	3.24 k	½ W		Prec	1%	
R233	311-0443-00	2.5 k		Var			
R236	323-0277-00	7.5 k	½ W		Prec	1%	
R238	321-0389-00	110 k	⅛ W		Prec	1%	
R240	323-0293-00	11 k	½ W		Prec	1%	
R242	321-0077-00	61.9 Ω	⅛ W		Prec	1%	
R243	316-0562-00	5.6 k	¼ W				
R244	311-0482-00	150 Ω		Var			
R245†	311-0568-00	600 Ω		Var			
R247	316-0101-00	100 Ω	¼ W				
R249	323-0210-00	1.5 k	½ W		Prec	1%	
R252	308-0301-00	10 k	3 W		WW	1%	
R253	311-0475-00	5 k		Var	WW		
R255	323-0203-00	1.27 k	½ W		Prec	1%	
R257	323-0227-00	2.26 k	½ W		Prec	1%	
R258	311-0091-00	1 k		Var			
R260	311-0474-00	2 k		Var	WW		
R262	321-0076-00	60.4 Ω	⅛ W		Prec	1%	
R264	308-0334-00	7 k	3 W		WW	3%	
R266	316-0470-00	47 Ω	¼ W				
R270	*310-0626-00	2 k	11 W		WW	1%	
R272	302-0104-00	100 k	½ W				
R273	323-0303-00	14 k	½ W		Prec	1%	
R274	316-0470-00	47 Ω	¼ W				
R276	321-0061-00	42.2 Ω	⅛ W		Prec	1%	
R277	308-0107-00	1 k	5 W		WW	5%	
R278	323-0291-00	10.5 k	½ W		Prec	1%	
R279	321-0061-00	42.2 Ω	⅛ W		Prec	1%	
R280	311-0496-00	2.5 k		Var			
R281	323-0244-00	3.4 k	½ W		Prec	1%	
R282	301-0563-00	56 k	½ W			5%	
R284	323-0320-00	21 k	½ W		Prec	1%	
R288	311-0074-00	5 k		Var			
R289	323-0315-00	18.7 k	½ W		Prec	1%	

†Furnished as a unit with SW245.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description					S/N Range
R290	323-0306-00	15 k	½ W		Prec	1%	
R292	316-0101-00	100 Ω	¼ W				
R294	303-0333-00	33 k	1 W			5%	
R300	302-0563-00	56 k	½ W				100-199
R300	302-0823-00	82 k	½ W				200-up
R302	302-0223-00	22 k	½ W				100-199
R302	302-0273-00	27 k	½ W				200-up
R304	302-0563-00	56 k	½ W				
R306	316-0153-00	15 k	¼ W				
R310	316-0223-00	22 k	¼ W				
R314	308-0271-00	667 Ω	5 W		WW	5%	
R318	316-0271-00	270 Ω	¼ W				
R320	308-0319-00	4.5 k	3 W		WW	1%	
R322	323-0347-00	40.2 k	½ W		Prec	1%	
R324	303-0223-00	22 k	1 W			5%	
R330	303-0123-00	12 k	1 W			5%	
R332	316-0220-00	22 Ω	¼ W				
R336	303-0680-00	68 Ω	1 W			5%	
R338	311-0001-00	10 Ω		Var	WW		
R342	304-0102-00	1 k	1 W				
R346	302-0104-00	100 k	½ W				
R401	308-0360-00	13.3 k	3 W		WW	1%	
R403	308-0359-00	10.35 k	3 W		WW	1%	
R406	301-0113-00	11 k	½ W			5%	
R408	Selected						
R410	311-0484-00	500 Ω		Var			
R413	308-0326-00	9.9 k	⅛ W		WW	0.01%	
R415	308-0324-00	1.222 k	⅛ W		WW	0.01%	
R422	308-0316-00	3.1 k	½ W		WW	1%	
R423	311-0484-00	500 Ω		Var			
R425	311-0360-00	5 k		Var			
R427	302-0102-00	1 k	½ W				
R430, R431, R432, R433, R434, R435, R436, R437, R438, R439, R440, R441	308-0323-00	1 k	¼ W	Matched set of 12 to ±0.02% grouping.			

Switches

Ckt. No.	Tektronix Part No. Unwired	Wired	Description		S/N Range
SW101	260-0603-00		Rotary	AC-DC-GND A	
SW105† } SW205 }	260-0634-00	*262-0680-01	Rotary	INPUT ATTEN	
SW110††	260-0635-00	*262-0679-00	Rotary	DISPLAY	
SW150	260-0713-00	*262-0734-00	Rotary	MILLIVOLTS/DIV	100-509
SW150	260-0713-00	*262-0734-01	Rotary	MILLIVOLTS/DIV	510-up
SW201	260-0603-00		Rotary	AC-DC-GND B	
SW245†††	311-0568-00				
SW410	260-0633-00	*262-0733-00	Rotary	Vc RANGE	
SW420	260-0712-00	*262-0732-00	Rotary	COMPARISON VOLTAGE (Vc)	

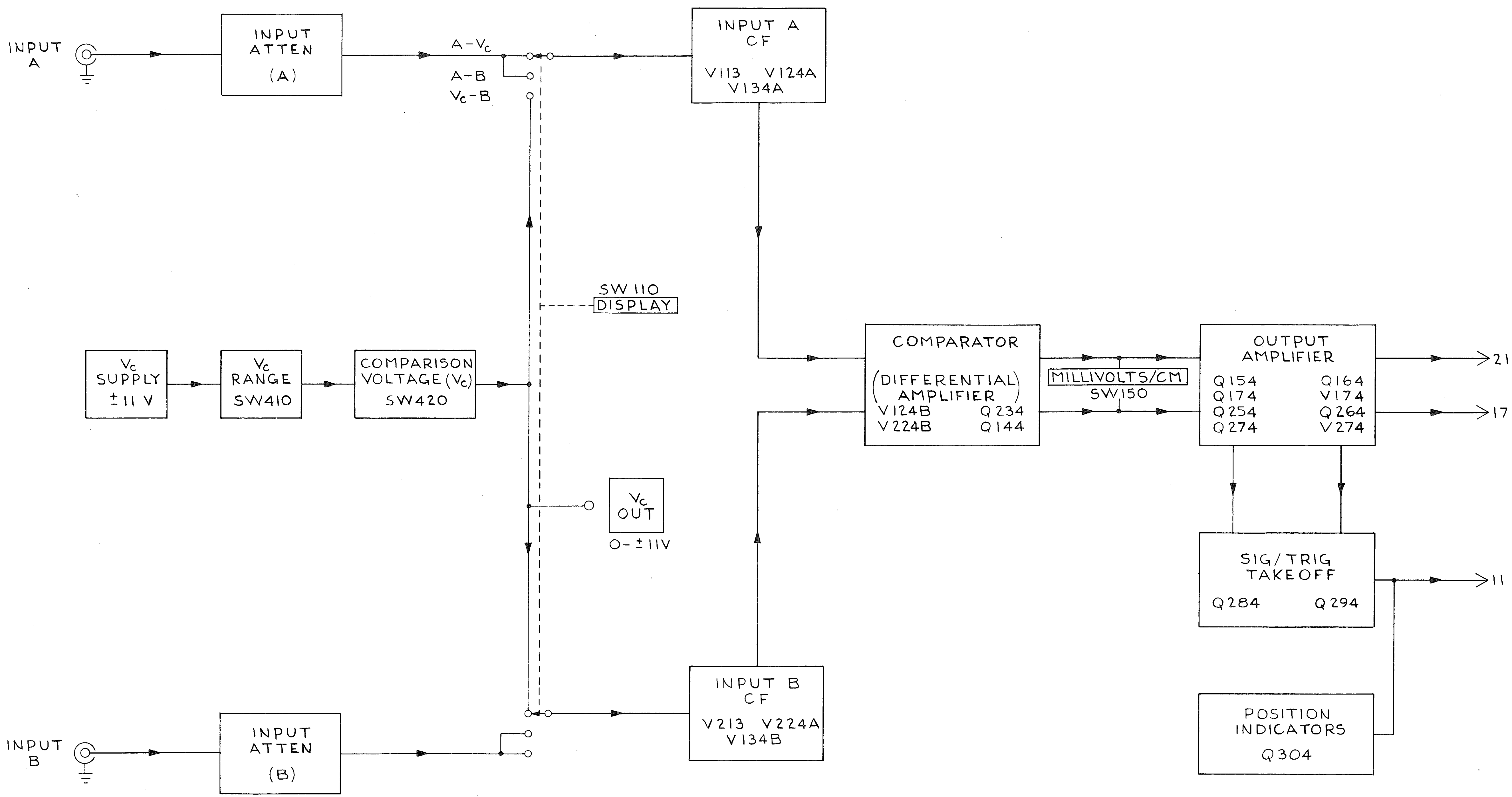
Test Points

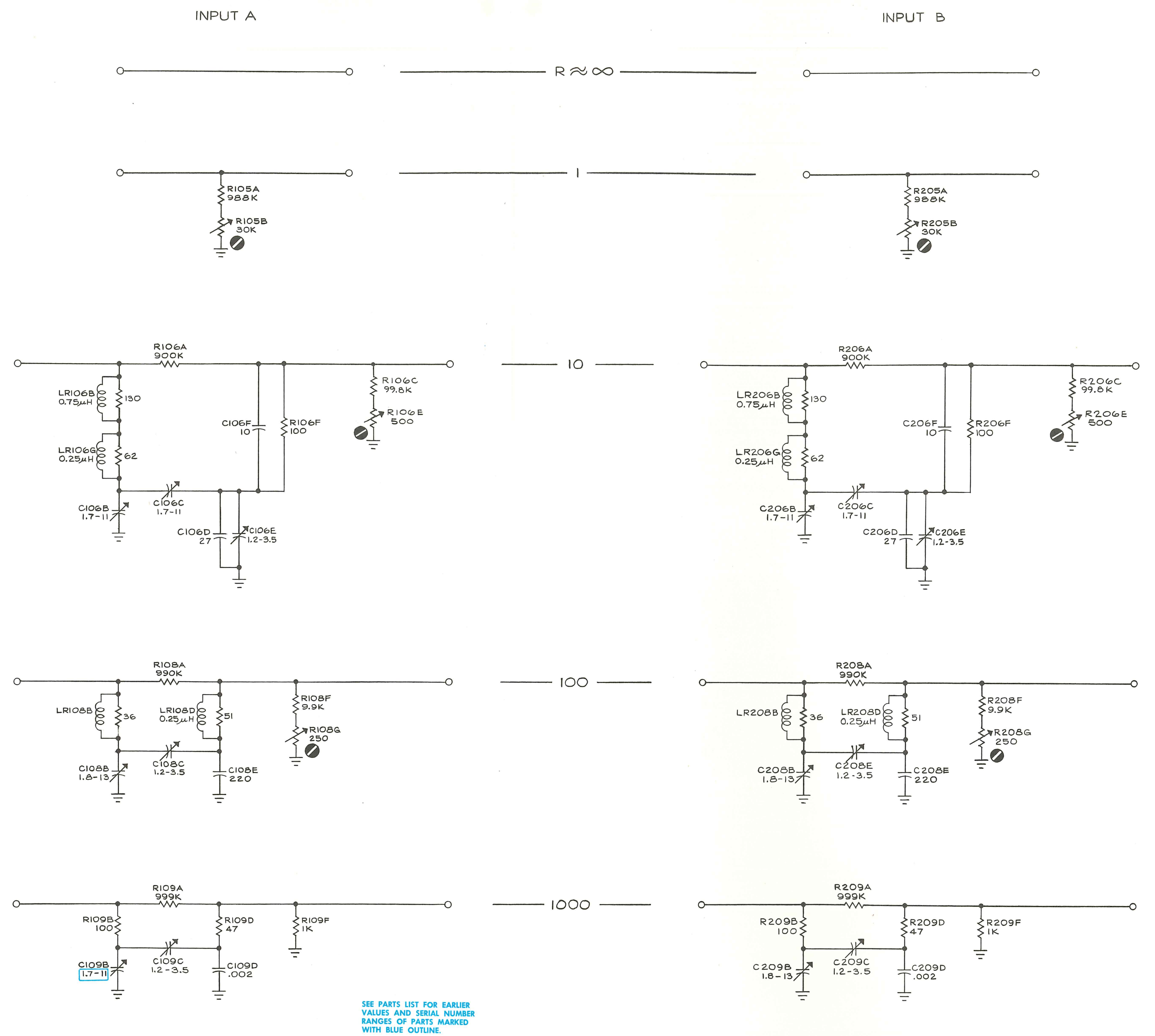
TP264	344-0105-00	Clip, test point
TP294	344-0105-00	Clip, test point
TP420	129-0006-00	Post, connecting

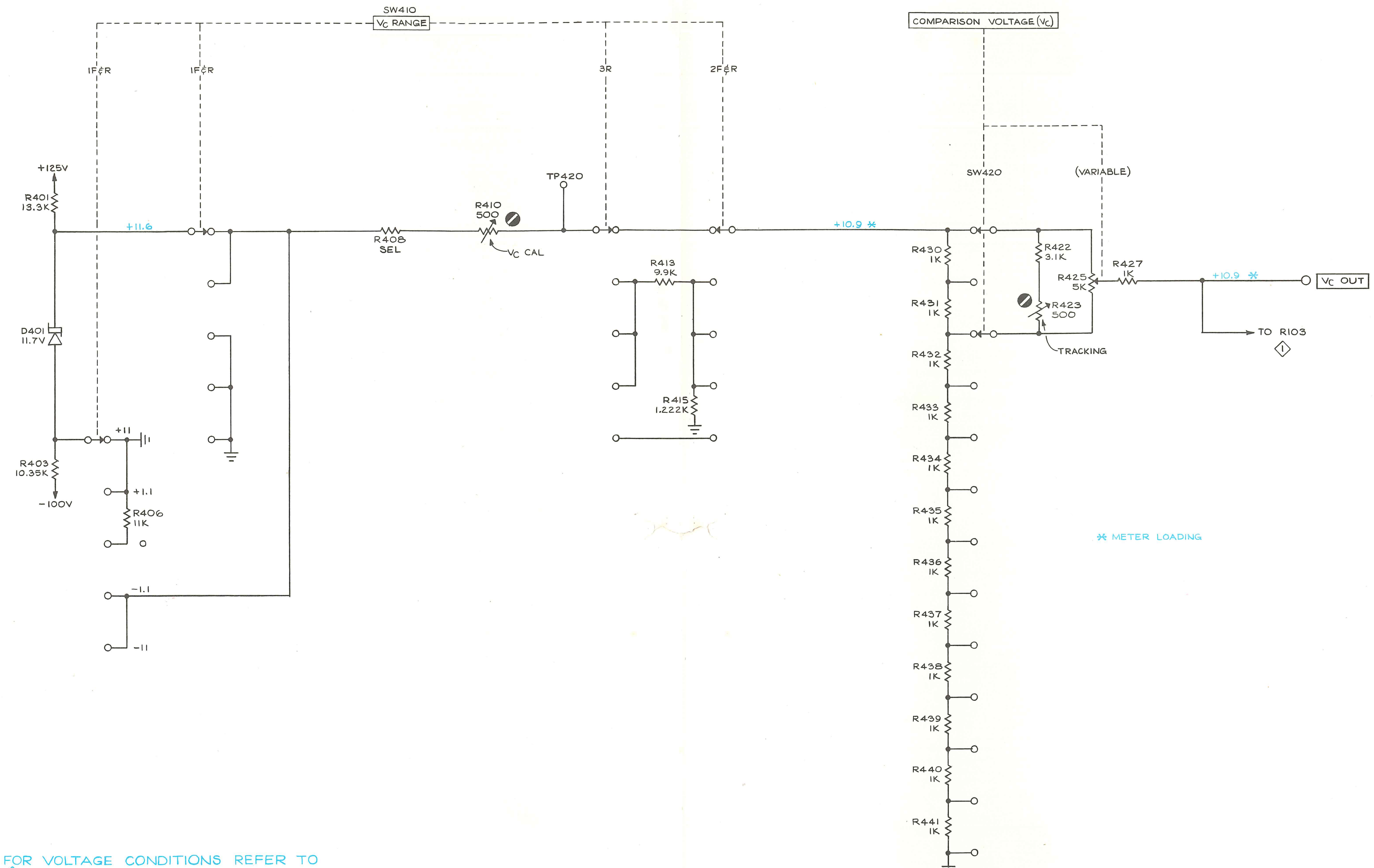
Electron Tubes

V113††††	*157-0099-00	8056, checked
V124	154-0187-00	6DJ8
V134	154-0187-00	6DJ8
V174	154-0491-00	8608
V213††††	*157-0099-00	8056, checked
V224	154-0187-00	6DJ8
V274	154-0491-00	8608

†SW105 and SW205 furnished as a unit.
††SW110 concentric with SW105 and SW205.
†††SW245 furnished as a unit with R245.
††††V113 and V213 furnished as a pair.


INPUT A
INPUT ATTEN (A)
A-Vc
A-B
Vc-B
INPUT A CF
V113 V124A
V134A
SW110
DISPLAY
Vc SUPPLY ±11 V
Vc RANGE SW410
COMPARISON VOLTAGE (Vc) SW420
COMPARATOR
(DIFFERENTIAL AMPLIFIER)
V124B Q234
V224B Q144
MILLIVOLTS/CM
SW150
OUTPUT AMPLIFIER
Q154 Q164
Q174 V174
Q254 Q264
Q274 V274
21
17
Vc OUT
0-±11V
SIG/TRIG TAKEOFF
Q284 Q294
11
POSITION INDICATORS
Q304
INPUT B
INPUT ATTEN (B)
INPUT B CF
V213 V224A
V134B


INPUT A
INPUT B
R ≈ ∞
1
R105A 988K
R105B 30K
R205A 988K
R205B 30K
10
R106A 900K
LR106B 0.75μH
130
LR106G 0.25μH
62
C106F 10
R106F 100
R106C 99.8K
R106E 500
C106B 1.7-11
C106C 1.7-11
C106D 27
C106E 1.2-3.5
R206A 900K
LR206B 0.75μH
130
LR206G 0.25μH
62
C206F 10
R206F 100
R206C 99.8K
R206E 500
C206B 1.7-11
C206C 1.7-11
C206D 27
C206E 1.2-3.5
100
R108A 990K
LR108B
36
LR108D 0.25μH
51
R108F 9.9K
R108G 250
C108B 1.8-13
C108C 1.2-3.5
C108E 220
R208A 990K
LR208B
36
LR208D 0.25μH
51
R208F 9.9K
R208G 250
C208B 1.8-13
C208E 1.2-3.5
C208E 220
1000
R109A 999K
R109B 100
R109D 47
R109F 1K
C109B 1.7-11
C109C 1.2-3.5
C109D .002
R209A 999K
R209B 100
R209D 47
R209F 1K
C209B 1.8-13
C209C 1.2-3.5
C209D .002
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.



FOR VOLTAGE CONDITIONS REFER TO
1 DIFFERENTIAL AMPLIFIER

REFERENCE DIAGRAM
1 DIFFERENTIAL AMPLIFIER

GTN
765

TYPE 3A7 PLUG-IN

A1

COMPARISON VOLTAGE GENERATOR 3

COMP. VOLTAGE GENERATOR

IMPORTANT:

Circuit voltages were obtained with a 20,000 Ω/Volt dc VOM. All readings are in volts.

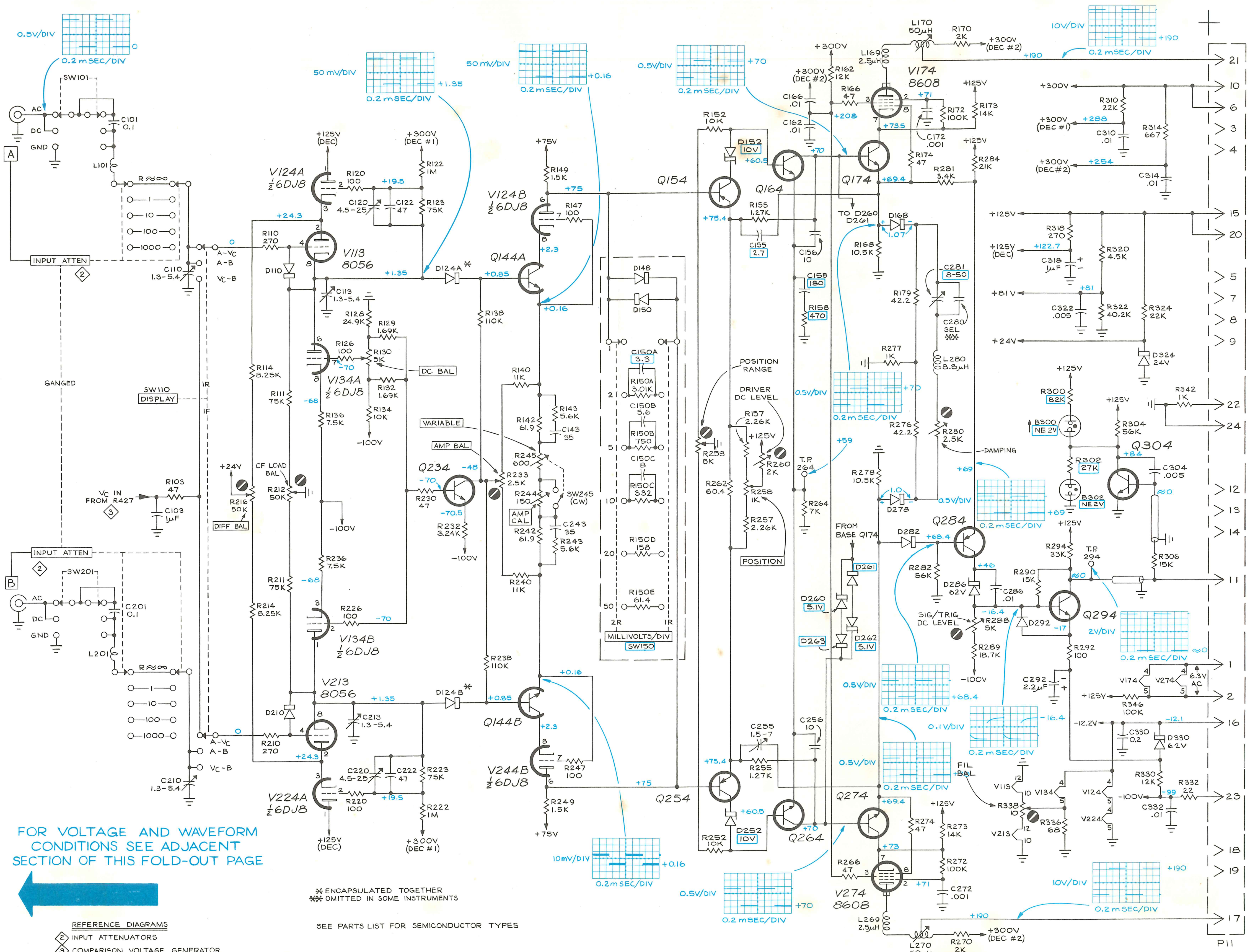
Voltage, waveform-amplitude and dc-level measurements are not absolute and may vary from unit to unit. To obtain these measurements, a 30-inch flexible-cable extension (012-0066-00) was used to operate the Type 3A7 out of the oscilloscope plug-in compartment.

Actual waveform photographs are shown on the schematic diagram. To show the waveforms in a time-related sequence, the test oscilloscope used for signal tracing was set for +Ext triggering on the 2-volt reference signal applied to Input A of the Type 3A7. Refer to the Maintenance section for full details about signal tracing.

VOLTAGES AND WAVEFORMS were obtained under these conditions:

Vc RANGE	+11
COMPARISON VOLTAGE	11 (10-10-0)
AC-DC-GND (Input A)	GND (for voltages) DC (for waveforms)
AC-DC-GND (Input B)	GND
INPUT ATTEN	10
DISPLAY	A-B
MILLIVOLTS/DIV	50
VARIABLE	CAL
POSITION	Centered

Signal — 2-volt 1-KHz calibrator signal applied to Type 3A7 input A connector and test oscilloscope +Ext connector.



FOR VOLTAGE AND WAVEFORM CONDITIONS SEE ADJACENT SECTION OF THIS FOLD-OUT PAGE

<u>REFERENCE DIAGRAMS</u>

2 INPUT ATTENUATORS

3 COMPARISON VOLTAGE GENERATOR

* ENCAPSULATED TOGETHER

** OMITTED IN SOME INSTRUMENTS

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

GTN 967

TYPE 3A7 PLUG-IN

D1

DIFFERENTIAL AMPLIFIER 1