INSTRUMENT REFERENCE BOOK

for the Tektronix Type

106

square-wave generator

For all serial numbers

U.S. MARKETING SALES RELEASE

RACK ADAPTER 016-0086-00

The rack adapter is designed to house, provide forced air cooling, and AC power for fractional rack-width instruments such as the 106, 114, 184, and 191. The rack adapter is fixed in a standard 19 inch rack. It does not mount on chassis tracks because of the ease with which the individual instruments in the rack can be extended. Any combination of two instruments can be mounted (less cabinets) side by side in only 5¼ inches of panel height. The price of the rack adapter is $125. It will be shown at IEEE.

The front panel power switch on the rack adapter controls the power to the four internal convenience outlets used to power the instruments and the two self-contained fans. A center divider provides shielding and proper ventilation with one or two of the above instruments installed. A door is provided to install over the vacant hole in single instrument installations in order to provide proper air circulation. The customer who purchases the rack adapter and two instruments would discard the door (Part Number 016-0081-00, $7.50).

Those instruments that fit in the rack adapter can be ordered without the cabinet. An 18 inch power cord is substituted for the standard cord. The customer should order 106 MOD 146B; 114 MOD 146B; 184 MOD 146B; or 191 MOD 146B. The price of MOD 146B is catalog price less $25. Availability is the same as the corresponding standard instrument on the PAL or three-week minimum.

106 MOD 146B	$565
114 MOD 146B	325
184 MOD 146B	650
191 MOD 146B	375

We would like to discourage the purchase of MOD 146B if the instrument is not to be used in the rack adapter. Cabinets are available for those customers who decide to use the instrument out of the rack adapter after having purchased a MOD 146B for use in the rack adapter. The price of each replacement cabinet is $35.

Instrument	Replacement Cabinet Part Number
106	437-0080-00
114	437-0077-00
184	437-0078-00
191	437-0078-00

TYPE 106 SQUARE WAVE GENERATOR

The Type 106 is a small, lightweight, compact, general-purpose square wave generator with a repetition rate range of 10 hertz to 1.0 megahertz, 12 volts into 50 ohms with <12 ns risetime, and 1/2 volts into 50 ohms with ≤ 1 ns risetime.

Basically the Type 106 is a combination of the 105 and 107 in an instrument about the size of the 184.

<u>Tentative characteristics</u>:

<u>Repetition Rate Range</u>: 10 hertz to 1.0 megahertz, front-panel calibrated, accuracy 10%.

<u>Outputs</u>: Three outputs are provided at front panel GR-874 connectors:

(1) Negative-going, ≥ 120 volts max amplitude, 600 ohms source Z, 240 ma max;

(2) Positive-going 1/2 volt amplitude into 50 ohms with $\leq$ 1 ns risetime;

(3) Negative-going 1/2 volt amplitude into 50 ohms with ≤ 1 ns risetime;

Symmetry: Adjustable from 45% to 55% duty factor.

<u>Triggers</u>: Output: Square wave is differentiated, producing both positive-going and negative-going triggers at the output BNC connector;

Input: Sync input.

Charles V. Sanford/ml 10-4-65

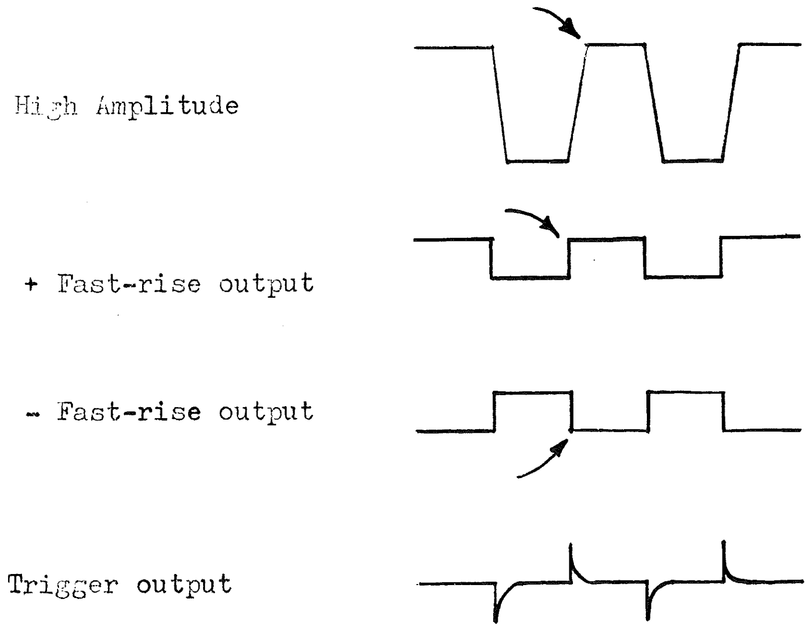


Fig. 1. Illustrates time relationship between trigger and output waveforms. Arrow indicates best corner of the generated square wave.

Front-panel controls:

Amplitude: Three amplitude controls appear on the front panel:

High Amplitude
+Fast-Rise Amplitude
-Fast-Rise Amplitude

Repetition Rate Range Switch, calibrated in steps from 10 hertz to 100 khz
Repetition Rate Multiplier, continuously variable from 1 to 10
Symmetry
Switch, toggle; Left-hand throw labelled "High Amplitude", right-hand throw labelled "Fast-Rise".

Comparison with Type 105:

Advantages of the Type 106 are:
- Smaller size: 6" x 9" x 15" vs 17" x 10" x 15"
- Less weight: 16 lbs. vs 34 lbs.
- Panel calibration of repetition rate.

Comparison with Type 107:

Advantages of the Type 106 are:
- Much shorter risetime: $\leq$1 ns vs 3 ns.
- Wide-range variable repetition rate.

Design History: Two factors contributed to the development of an instrument containing both the 105 and 107: (1) Inadequate risetime of the 107 for use with 580-Series scopes; (2) Bench space required to install both a 105 and 107. These factors led to a test fixture (067-0509-00) incorporating the 105 and 107, with improved performance characteristics.

Decision has been made to package the 067-0509-00 test fixture for sale as a catalog instrument to be known as the Type 106.

Charles V. Sanford/ml 10-4-65

RACKFRAME MOUNTING FOR THE 114, 184, 191, AND 106

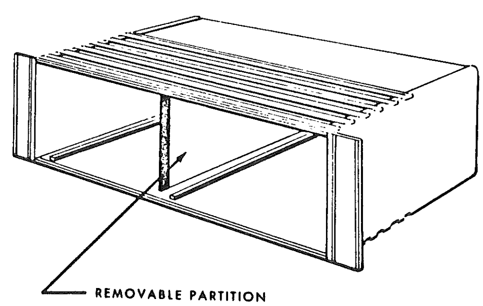
Mechanical Instrument Design is currently working on rackframe mounts for these instruments. All four instruments are in modules of a standard size and shape, with rear panel connectors in standardized locations. The rackframe mounting for this particular module will be 5-1/4" in height.

Present plans are to provide a rackframe (cradle), which will hold any combination of two instruments, side by side, in a 19" rack. These instrument modules are small enough so that no special provision will be made for mounting in backless racks.

Several optional features will be available for each rackframe.

1. A partition will be provided for shielding between instruments. The use of the optional shield is recommended whenever two instruments are used side by side.
2. Blank panels will be available to cover an unused half of the rackframe.
3. Various combinations of fans will be available, but the actual mechanical design will not be complete until further environmental information is obtained.

Stan Foss/jm
Product Technical Information
November 17, 1965



INSTRUCTION MANUAL

MODIFICATION INSERT

TYPE 106
MOD 146B

This manual insert describes the special features of the Type 106, MOD 146B which has been shipped without the standard cabinet, for mounting in a rack adapter. Also, the power cord normally shipped with this instrument has been changed to a coil cord.

PARTS LIST

The following changes have been made to the parts list of this modified instrument. When ordering replacement parts, specify instrument type, serial number, and MOD number. Include the part number and description of the desired item.

CABINET, Assembly	Delete	1	437-0080-00
POWER CORD, 3-conductor	Change	1	161-0031-00

TYPE 106

MOD 146B

Tektronix, Inc.

S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

Change No. 141A-1

ENGINEERING INSTRUMENT SPECIFICATION

CHANGE NOTICE

Instrument Type: 106 Squarewave Generator

Publication affected: EIS **No.** 141A **Dated** 3-7-67

Page: 1-2 **Item** Rep Rate Range - MULTIPLIER

Changed from:

MULTIPLIER 1X to 10X multiplication, variable

Accuracy ±10% of indicated value

Changed to:

MULTIPLIER At least 1X to 10X multiplication, variable

(Delete Accuracy statement.)

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

Reason for change:

Clarification

Approved by: J. L. Shannon (Project Manager) **Effective date** 4-30-68

Date March 7, 1967

REVISION NOTICE

This is a revised Type 106 Square-Wave Generator Engineering Instrument Specification, and supersedes the Type 106 Square-Wave Generator Engineering Instrument Specification No. 141 dated 10/18/65 .

. . . .

The following changes/additions have been incorporated into this revision. *Italicized items are new entries.* Applicable Electrical and Environmental Performance Validation procedures have been revised to reflect the following changes.

FROM	TO
Page 1-2: Risetime ≤ 12 ns into 50 Ω, ≤ 70 ns with no external load	Page 1-2: Risetime ≤ 12 ns into 50 Ω at 12 V output amplitude ≤ 20 ns into 50 Ω at 0.5 V output amplitude ≤ 120 ns with no external load
Page 1-2: AMPLITUDE Range 50 Ω load: ≤ 0.5 to 12 V ±4% unterminated: ≤ 7 to 130 V ±10%	Page 1-3: AMPLITUDE Range ≤ 0.5 V to ≥ 12 V into 50 Ω ≤ 7 V to ≥ 120 V with no external load
Page 1-2: Aberration Leading Edge -- ≤ 2% in first 100 ns	Page 1-3: Aberration (Leading Edge) ≤ + and - 2% in the first 100 ns, into 50 Ω
	Page 1-3: Low-Frequency Distortion on Negative Half-Cycle (Slope) *≤ 15% into 50 Ω at 10 Hz* *≤ 5% into 50 Ω at 100 Hz*
	Page 1-3: OUTPUT Amplitude Change with Line Voltage *≤ 20% reduction in output amplitude from 126.5 VAC to 103.5 VAC with output terminated in 50 Ω, and AMPLITUDE maximum cw*

NOTE: This revision notice is punched for easy removal and insertion in the EIS.

FROM	TO
Page 1-3: + OUTPUT and - OUTPUT Risetime ≤ 1 ns into 50 Ω	Page 1-4: Risetime (+ OUTPUT and - OUTPUT) ≤ 1 ns into 50 Ω at 500 mV output amplitude
Page 1-3: + OUTPUT - OUTPUT AMPLITUDE Range 50 mV to 500 mV into 50 Ω	Page 1-4: TRANSITION AMPLITUDE Range ≤ 50 mV to ≥ 500 mV into 50 Ω
Page 1-3: + OUTPUT - OUTPUT Aberration -- Leading Edge ≤ 2% in first 5 ns	Page 1-4: Aberration (Leading Edge) ≤ + and - 2% or + and - 6 mV whichever is greater, in the first 5 ns into 50 Ω
Page 1-3: Symmetry Change with Amplitude Less than 150 ns	Page 1-4: Duty Cycle Change with TRANSITION AMPLITUDE ≤ 150 ns, 50 mV to 500 mV output amplitude
Page 1-4: Pulse or Squarewave 2.5 to 50 V amplitude	Page 1-4: Pulse or Squarewave Amplitude Range: 2.5 V to 50 V *Frequency Range: 100 Hz to 1 MHz*
Page 1-4: Sinewave 5 to 100 pp	Page 1-4: Sinewave Amplitude Range: 5 V to 100 V P-P *Frequency Range: 100 Hz to 1 MHz*
Page 1-4: Risetime ≤ 50 ns into 50 Ω	Page 1-5: Risetime (Rate of Change) ≤ 50 ns into 50 Ω, 0 V to 0.1 V output amplitude
Page 1-4: Amplitude ≥ 0.4 V into 50 Ω	Page 1-5: Amplitude ≥ 0.1 V into 50 Ω *≥ 0.4 V with no external load*
Page 1-4: Delay Time Less than 50 ns from + trigger leading edge to leading edge of all outputs	Page 1-5: Delay Time ≤ 50 ns from + trigger leading edge to leading edge of all outputs
Page 1-4: Fuse 2.0 A, slow blow, 3 ag 115 V operation 1.0 A, slow blow, 3 ag 230 V operation	Page 1-5: Fuse Data 1.25 A slow-blowing type for 115 V operation 0.6 A slow-blowing type for 230 V operation

FROM	TO
Page 1-5: Regulation "A" Supply 12 V squarewave ±10%, into 50 Ω, over line voltage limits + 150 V ≤ ±10% - 150 V ≤ ±10% + 10.0 V ≤ ±10% - 10.0 V ≤ ±10%	Page 1-6: Tolerance (Long Term) "A" +150: ±10%; "A" -150: ±10%; "A" -20: ±10%; -10: ±15%; +10: ±15% "A" Supply Variable
Page 1-5: Ripple "A" Supply ≤ 0.5 V pp + 150 V ≤ 0.5 V pp - 150 V ≤ 0.5 V pp + 10.0 V ≤ 0.2 V pp - 10.0 V ≤ 0.2 V pp	Page 1-6: Ripple (P-P) "A" +150: 0.75 V; "A" -150: 0.75 V; "A" -20: 0.75 V; -10: 0.2 V; +10: 0.2 V "A" Supply 0.75 V
Page 1-5: "A" Supply 12 V squarewave into 50 Ω at 115 VAC line	DELETE

Specification 141A
March 7, 1967

ENGINEERING
INSTRUMENT SPECIFICATION

TYPE 106
SQUARE-WAVE
GENERATOR

FOR INTERNAL USE ONLY
TEKTRONIX, INC.

Specification 141A
March 7, 1967

ENGINEERING

INSTRUMENT SPECIFICATION

TYPE 106

SQUARE WAVE

GENERATOR

Prepared by Engineering Writing Dept.

Engineering Writer *Earl Neuman* Earl Neuman

Approval:

Project Manager *Leon Orchard* Leon Orchard

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Project Engineer, Mechanical *G. Sorum* Glenn Sorum

Evaluation Engineer, Electrical *Harry L. Ford* Harry Ford

Evaluation Engineer, Mechanical *Larry Kidder* Larry Kidder

TEKTRONIX, INC.

PREFACE

This Engineering Instrument Specification is the reference document for all company activity concerning the electrical and environmental performance 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 and environmental performance information 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

Performance Requirements listed in Section 1 are *customer* performance requirements, and are to be treated as prescribed by their respective code (see page 1-1 for code description). *Factory test limits are excluded from the Engineering Instrument Specification.* Those items coded *Internal Use Only* are not to be interpreted as factory test limits. Factory test limits are established by Product Manufacturing Staff Engineering, and appear in documents issuing from that department.

Periodically, an Engineering Instrument Specification may be revised and reprinted. The revised Engineering Instrument Specification will then have a 3-digit specification number followed by a capital letter printed in the upper right corner of the front cover, e.g. 000A for the first revision, 000B for the second revision, etc.

Changes in the Engineering Instrument Specification may be made *only* via the Instrument Performance Characteristic Change Request form of which 3 are included at the back of this copy (contact the PE&M Engineering Writing Department for additional forms).

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 changes to this book have been made. When a Change Notice is received, log it on this page, then write in the actual change information on the appropriate page. Change Notice numbers are assigned in sequence (XXX-1, XXX-2, etc.). Absence of a number from the sequence indicates a change which has not been entered.

CHANGE NOTICE NUMBER	EFFECTIVE DATE OF CHANGE	PAGE NUMBER

INTRODUCTION

This is the Engineering Instrument Specification for the Type 106 Square-Wave Generator, and is the reference document for all company activity concerning performance requirements. This specification is for *internal use only*, and supersedes the Type 106 Engineering Instrument Specification dated October 18, 1965.

Description

The Type 106 is a squarewave generator that can be used as a laboratory or general purpose instrument. It produces variable repetition rate squarewaves of high-amplitude slow rise, or low-amplitude fast rise. One unique feature of this instrument is that all squarewave outputs are from either a positive or negative potential to ground.

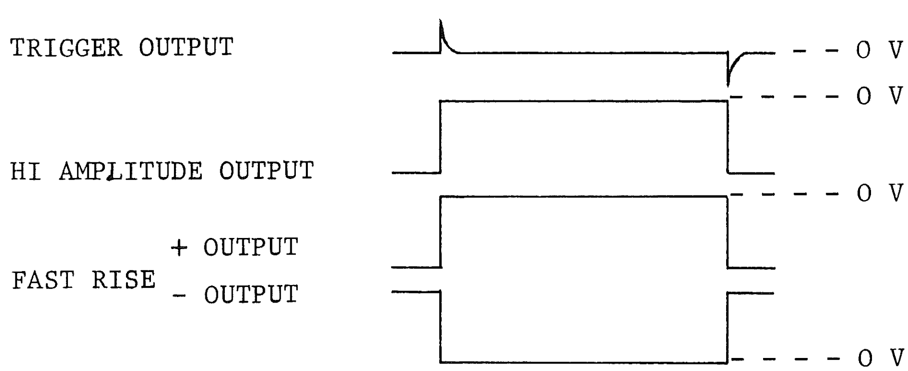
The high-amplitude function provides variable amplitude squarewaves up to 120 V in amplitude with no external termination, or 12 V (240 mA) into a 50 Ω load.

The fast-rise function provides variable amplitude, positive and negative-going squarewaves of less than 1 ns risetime into a 50 Ω load, that can be used independently or simultaneously by means of two output connectors.

Provision has been made for sync input and trigger output via front-panel BNC connectors.

Sync operation can be obtained through the use of sinewaves, squarewaves or pulses.

The trigger output waveform is a differentiated squarewave that coincides with the squarewave outputs as follows:



Functions of Controls and Connectors

REPETITION RATE RANGE

A five-position switch that selects the minimum repetition rate. Each step increases the repetition rate by a factor of 10.

MULTIPLIER

Allows continuously variable repetition rates between ranges of the REPETITION RATE RANGE switch, and extends the 100 kHz setting to 1 MHz.

SYMMETRY

Allows the duty cycle to be varied from approximately 45 to 55%.

HI AMPLITUDE - FAST RISE

A two-position switch that selects high amplitude slow-rise or fast-rise low amplitude operation.

AMPLITUDE

Controls the output amplitude of the high amplitude function.

+ TRANSITION AMPLITUDE

Controls the output amplitude of the fast-rise + OUTPUT.

- TRANSITION AMPLITUDE

Controls the output amplitude of the fast-rise + OUTPUT.

SYNC INPUT

BNC connector.

TRIGGER OUTPUT

BNC connector.

OUTPUT

GR 874 connector.

+ OUTPUT

GR 874 connector.

- OUTPUT

GR 874 connector.

Miscellaneous Information

Ventilation

The Type 106 cabinet provides for a minimum air flow of 12'^{3}/min.

Finish

Front panel is anodized aluminum. Cabinet is finished in blue vinyl paint.

Warm-up Time

Twenty minutes for rated accuracies at 25°C $\pm$5°C.

Dimensions

9" W, 6" H, 14-3/4" L.

Weight

$\simeq$ 10.5 lbs, without cabinet

SECTION 1

ELECTRICAL CHARACTERISTICS

IMPORTANT

The following performance requirements and their related validation procedures in Section 3 apply only to a *calibrated system* operating within the environmental limits specified in Section 2, Environmental Characteristics, unless stated otherwise.

Performance requirements are validated by Engineering according to Section 3. Production test methods may differ.

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

The following codes are used to categorize performance requirements:

G	(General Use)	This performance requirement may be quoted to a customer.
I	(Internal Use Only)	This performance requirement 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.
S	(Sampled)	This performance requirement carries a high confidence level and may be tested on a sample basis.
N	(Not Tested)	

NOTE: Code column also provides step number of related validation procedure.

Characteristic	Performance Requirement	Code	Supplemental Information
1.1	**REPETITION RATE**		
	NOTE This instrument may not meet these performance requirements if operated outside its cabinet for more than 30 minutes.		
Repetition Rate Range	10 Hz to 1 MHz	3.2.1 GA	Using REPETITION RATE RANGE and MULTIPLIER in combination
MULTIPLIER	At least 1X to 10X multiplication, variable		
1.2	**SYMMETRY**		
SYMMETRY Range	Varies duty cycle from $\leq$ 45% to $\geq$ 55%	3.3.1 GA	Symmetry range center is adjusted internally
1.3	**HI AMPLITUDE OUTPUT**		
Risetime	$\leq$ 12 ns into 50 Ω at 12 V output amplitude	3.4.1 GA	(Tr = 2.2RC)
	$\leq$ 20 ns into 50 Ω at 0.5 V output amplitude		R = 600 Ω source Resistance; C = external load C
	$\leq$ 120 ns with no external load		

See page 1-1 for coding legend

4-30-68

1.3 HI AMPLITUDE OUTPUT (cont'd)

Characteristic	Performance Requirement	Code	Supplemental Information
AMPLITUDE Range	$\leq$ 0.5 V to $\geq$ 12 V into 50 Ω	3.4.2 GA	At 115 VAC line voltage
	$\leq$ 7 V to $\geq$ 120 V with no external load		
Aberration (Leading Edge)	$\leq$ + and - 2% in the first 100 ns, into 50 Ω	3.4.3 GA	Measured on positive-going transition. Flat top aberration is typically less than 0.5% P-P after the first 100 ns. Exclude preshoot in the last 100 ns preceeding the negative-going transition.
Low-Frequency Distortion on Negative Half-Cycle (Slope)	$\leq$ 15% into 50 Ω at 10 Hz	3.4.4 GA	At 115 VAC line and with AMPLITUDE maximum cw.
	$\leq$ 5% into 50 Ω at 100 Hz		
Duty Cycle Change with Repetition Rate	$\leq$ 5%	3.4.5 IS	
Repetition Rate Change with SYMMETRY	$\leq$ 10%	3.4.6 IS	
OUTPUT Amplitude Change with Line Voltage	$\leq$ 20% reduction in output amplitude from 126.5 VAC to 103.5 VAC with output terminated in 50 Ω, and AMPLITUDE maximum cw	3.4.7 IA	
Output Impedance		GN	≈ 600 Ω paralleled by ≈ 85 pF

See page 1-1 for coding legend

Characteristic	Performance Requirement	Code	Supplemental Information
1.4	**FAST RISE OUTPUTS**		
Risetime (+ OUTPUT and - OUTPUT)	≤ 1 ns into 50 Ω at 500 mV output amplitude	3.5.1 GA	
TRANSITION AMPLITUDE Range	≤ 50 mV to ≥ 500 mV into 50 Ω	3.5.2 GA	
Aberration (Leading Edge)	≤ + and - 2% or + and - 6 mV whichever is greater, in the first 5 ns into 50 Ω	3.5.3 GA	Measure positive-going transition for + OUTPUT and negative-going transition for - OUTPUT. High-frequency ringing must be greater than 500 MHz. Flat top aberration is typically less than 0.5% P-P after the first 5 ns.
Duty Cycle Change with TRANSITION AMPLITUDE	≤ 150 ns, 50 mV to 500 mV output amplitude	3.5.4 GA	
1.5	**SYNC INPUT**		
Pulse or Squarewave		3.6.1 GA	To insure stable operation risetime should be less than 12.5% of the period
Amplitude Range	2.5 V to 50 V		
Frequency Range	100 Hz to 1 MHz		
Sinewave		3.6.2 GS	
Amplitude Range	5 V to 100 V P-P		
Frequency Range	100 Hz to 1 MHz		

See page 1-1 for coding legend

Characteristic	Performance Requirement	Code	Supplemental Information
1.6	**TRIGGER OUTPUT**		
+ and - Triggers			
Risetime (Rate of Change)	$\leq$ 50 ns into 50 Ω, 0 V to 0.1 V output amplitude	3.7.1 GA	The + and - triggers are coincident with the rise and fall of the HI AMPLITUDE OUTPUT
Amplitude	$\geq$ 0.1 V into 50 Ω	3.7.2 GA	
	$\geq$ 0.4 V with no external load	IN	
Time Jitter	$\leq$ 300 ps	3.7.3 GA	Check jitter one full cycle from triggering edge of pulse
Delay Time	$\leq$ 50 ns from + trigger leading edge to leading edge of all outputs	3.7.4 GA	
1.7	**POWER SOURCE**		
Line Voltage Ranges	103.5 VAC to 126.5 VAC	3.8.1 GS	
	207 VAC to 253 VAC		
Line Frequency	50 Hz to 60 Hz	3.8.2 IS	
Fuse Data	1.25 A slow-blowing type for 115 VAC operation	GN	
	0.6 A slow-blowing type for 230 VAC operation		
Power Consumption		GN	≈ 85 W at 115 VAC line

See page 1-1 for coding legend

1.8 INTERNAL POWER SUPPLIES

Characteristic	Performance Requirement						Code	Supplemental Information
Power Supply	"A" +150	"A" -150	"A" -20	-10	+10	"A" Supply		
Tolerance (Long Term)	±10%	±10%	±10%	±15%	±15%	Variable	3.9.1 IA	
Ripple (P-P)	0.75 V	0.75 V	0.75 V	0.2 V	0.2 V	0.75 V		

See page 1-1 for coding legend

SECTION 2

ENVIRONMENTAL CHARACTERISTICS

The following Environmental Characteristics apply only when the instrument is tested as described in Section 4, Environmental Performance Validation. The Type 106 is a laboratory instrument.

Characteristic	Performance Requirement	Supplemental Information
Temperature		
Nonoperating	-40°C to +65°C	
Operating	0°C to +50°C	
Altitude		
Nonoperating	To 50,000 feet	
Operating	To 15,000 feet	
Vibration		
Operating	15 minutes along each axis at 0.015". Vary the frequency from 10 to 50 to 10 c/s in 1-minute cycles. Three minutes at any resonant point or at 50 c/s.	Tested with instrument secured to vibration platform
Shock		
Nonoperating	30 g's, 1/2 sine, 11 ms duration, 1 shock per axis	Guillotine-type shocks
Transportation		
Package Vibration	1 hour, slightly in excess of 1 g	Package should just leave vibration surface
Package Drop	30" on 1 corner, all edges radiating from that corner and all flat surfaces for a total of 10 drops	

SECTION 3

ELECTRICAL PERFORMANCE VALIDATION

3.1 Test Equipment Required

1	Oscilloscope	:	Tektronix Type 540-series
1	Dual-Trace Plug-in Unit	:	Tektronix Type 1A1
1	Sampling Oscilloscope	:	Tektronix Type 661
1	Dual-Trace Sampling Unit	:	Tektronix Type 4S1
1	Timing Unit	:	Tektronix Type 5T3
1	Standard Amplitude Calibrator	:	Tektronix Part no. 067-0502-00
1	Constant Amplitude Signal Generator	:	Tektronix Type 191
1	DC Voltage Bridge	:	Tektronix Part No. 067-0543-99
1	Line Voltage Control Unit	:	Tektronix Type 76 TU
1	Line Frequency Control Unit	:	Tel-Instrument Type 4100-I-H10S
1	10X Probe, P6006	:	Tektronix Part No. 010-0127-00
1	1X Probe, P6028	:	Tektronix Part No. 010-0074-00
1	BNC T Connector	:	Tektronix Part No. 103-0030-00
1	10:1 Attenuator, 50 Ω	:	Tektronix Part No. 011-0059-00
1	50 Ω Termination	:	Tektronix Part No. 011-0049-00
1	50 Ω Termination, 2 W	:	Tektronix Part No. 017-0083-00

3.2 REPETITION RATE

3.2.1 Repetition Rate Range

Performance Requirement: Multiplier: 1 to 10X multiplication, variable

Accuracy : ±10% of indicated value

Procedure: Set REPETITION RATE RANGE at 100 kHz and MULTIPLIER at 10. Connect test scope 10X Probe to the HI AMPLITUDE OUTPUT, and set test scope Time/cm at 1 μs. Check for 1 cycle/cm.

Set REPETITION RATE RANGE at 10 kHz and MULTIPLIER at 1. Set test scope Time/cm at 100 μs and check for 1 cycle/cm.

Check all other positions of the REPETITION RATE RANGE switch, with the MULTIPLIER at X1 and X10, for less than 10% deviation from the indicated value.

3.3 SYMMETRY

3.3.1 SYMMETRY Range

Performance Requirement: Varies duty cycle from $\leq$ 45% to $\geq$ 55%

Procedure: Connect test scope as in 3.2.1 and set REPETITION RATE RANGE and MULTIPLIER for 1 cycle/10 cm. Vary SYMMETRY from limit to limit and check duty cycle.

3.4 HI AMPLITUDE OUTPUT

3.4.1 Risetime

Performance Requirement:

$\leq$ 12 ns into 50 Ω at 12 V output amplitude
$\leq$ 20 ns into 50 Ω at 0.5 V output amplitude
$\leq$ 120 ns with no external load

Procedure: Connect 10X GR attenuator to 106 HI AMPLITUDE OUTPUT---5 ns RG-8 cable---vertical input of 4S1 sampling system. Check risetime at 0.5 V and 12 V amplitude.

Remove GR cable and 10X attenuator from Type 106 and check unterminated risetime with test scope 10X probe.

3.4.2 AMPLITUDE Range

Performance Requirement:

$\leq$ 0.5 V to $\geq$ 12 V into 50 Ω
$\leq$ 7 V to $\geq$ 120 V with no external load

Procedure: Terminate HI AMPLITUDE OUTPUT in 50 Ω and connect to 1A1 vertical input. Check output amplitude over the range of the AMPLITUDE control.

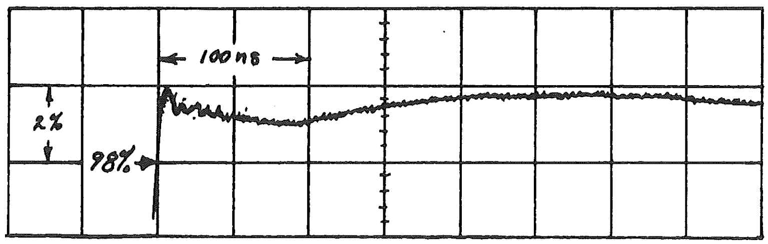
Remove the 50 Ω termination and again check output amplitude over the range of AMPLITUDE control.

3.4.3 Aberration (Leading Edge)

Performance Requirement: $\leq$ + and - 2% in the first 100 ns, into 50 Ω

Procedure: Connect 10X GR attenuator to 106 HI AMPLITUDE OUTPUT ---5 ns RG-8 cable---vertical input of 4S1 sampling system. Set

4S1 vertical sensitivity at 0.2 V/cm and adjust AMPLITUDE for 5 cm of deflection. Increase vertical sensitivity by a factor of 10. (Sensitivity now equals 2%/cm). With 4S1 DC offset, position top of the squarewave on screen and check aberrations in the first 100 ns as per illustration below.



3.4.4 Low-Frequency Distortion on Negative Half-Cycle (Slope)

Performance Requirement: $\leq$ 15% into 50 Ω at 10 Hz
$\leq$ 5% into 50 Ω at 100 Hz

Procedure: Terminate HI AMPLITUDE OUTPUT in 50 Ω, then connect to 1A1 vertical input. Set AMPLITUDE cw and REPETITION RATE RANGE at 10 Hz. Check slope at bottom of squarewave.

Set REPETITION RATE RANGE at 100 Hz, and again check slope at bottom of squarewave.

3.4.5 Duty Cycle Change with Repetition Rate

Performance Requirement: $\leq$ 5%

Procedure: Connect HI AMPLITUDE OUTPUT to 4S1 vertical input. Set 5T3 Time/cm and 106 REPETITION RATE RANGE to observe one full cycle. Turn the REPETITION RATE RANGE switch throughout its range, changing 5T3 Time/cm as necessary, and check duty cycle change.

3.4.6 Repetition Rate Change with SYMMETRY

Performance Requirement: $\leq$ 10%

Procedure: Connect HI AMPLITUDE OUTPUT to 4S1 vertical input. Set 5T3 Time/cm and 106 REPETITION RATE RANGE to observe one cycle/cm. Turn SYMMETRY control from one limit to the other and check change in repetition rate.

3.4.7 Output Amplitude Change with Line Voltage

Performance Requirement: $\leq$ 20% reduction in output amplitude from 126.5 VAC to 103.5 VAC with output terminated in 50 Ω, and AMPLITUDE maximum cw

Procedure: Terminate HI AMPLITUDE OUTPUT to 50 Ω, then connect to 1A1 vertical input. Set AMPLITUDE fully cw. With Line Voltage Control Unit, set line voltage at 126.5 VAC and note amplitude. Set line voltage to 103.5 VAC and check amplitude change.

3.5 FAST RISE OUTPUTS

3.5.1 Risetime (+ OUTPUT and - OUTPUT)

Performance Requirement: $\leq$ 1 ns into 50 Ω at 500 mV output amplitude

Procedure: Connect FAST RISE + OUTPUT to 4S1 vertical input. Set + TRANSITION AMPLITUDE for 500 mV of signal. Set 4S1 Millivolts/cm switch and Variable to observe a 4 cm display. Check risetime. Repeat for FAST RISE - OUTPUT.

3.5.2 TRANSITION AMPLITUDE Range

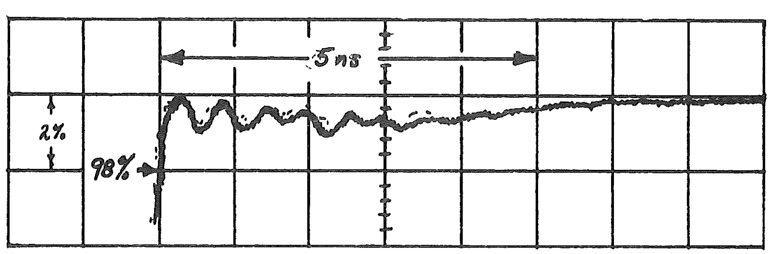
Performance Requirement: $\leq$ 50 mV to $\geq$ 500 mV into 50 Ω

Procedure: Connect FAST RISE + OUTPUT to 4S1 vertical input. Check amplitude of squarewave over the range of + TRANSITION AMPLITUDE control. Repeat for FAST RISE - OUTPUT.

3.5.3 Aberration (Leading Edge)

Performance Requirement: $\leq$ + and - 2% or + and - 6 mV whichever is greater, in the first 5 ns into 50 Ω

Procedure: Connect FAST RISE + OUTPUT to 4S1 vertical input. Set + TRANSITION AMPLITUDE fully cw. Set 4S1 Millivolts/cm at 10 (one cm of deflection now equals 2%) and check aberrations in the first 5 ns starting at the 98% amplitude point as pictured below. Repeat this check for the FAST RISE - OUTPUT.



3.5.4 Duty Cycle Change with TRANSITION AMPLITUDE

Performance Requirement: $\leq$ 150 ns, 50 mV to 500 mV output amplitude

Procedure: Set REPETITION RATE RANGE at 100 kHz and MULTIPLIER at 10. Set 4S1 Time/cm to observe one cycle in 10 cm. Externally trigger 4S1 from 106 TRIGGER OUTPUT. Turn TRANSITION AMPLITUDE from one limit to the other and check duty cycle change. Repeat for FAST RISE - OUTPUT.

3.6 SYNC INPUT

3.6.1 Pulse or Squarewave

Performance Requirement: Amplitude Range --- 2.5 V to 50 V
Frequency Range --- 100 Hz to 1 MHz

Procedure: Connect a 2 V squarewave from a Standard Amplitude Calibrator through a BNC T to Type 106 SYNC INPUT and to Channel 1 of 1A1 test scope. Connect HI AMPLITUDE OUTPUT to Channel 2 of 1A1. Set REPETITION RATE RANGE and MULTIPLIER so Type 106 is free-running at a frequency slightly below the Standard Amplitude Calibrator frequency. Set SAC at 5 V and check that Type 106 is now running at the same frequency as the SAC.

3.6.2 Sinewave

Performance Requirement: Amplitude Range --- 5 V to 100 V P-P
Frequency Range --- 100 Hz to 1 MHz

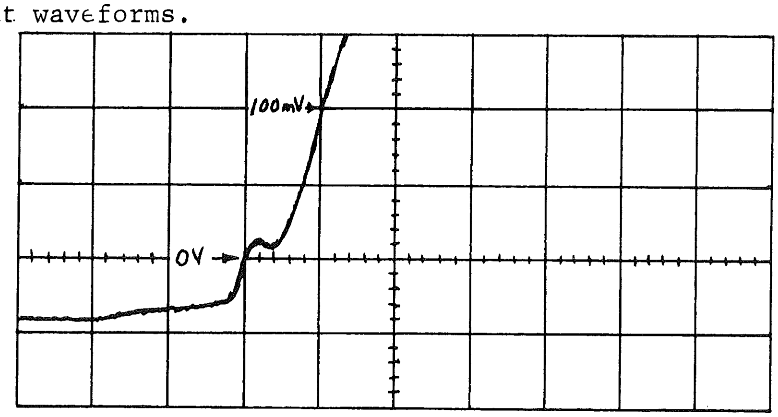
Procedure: Check for sync operation as in 3.6.1 with a sinewave generator at 100 Hz and 1 MHz, 5 V P-P signal applied.

3.7 TRIGGER OUTPUT

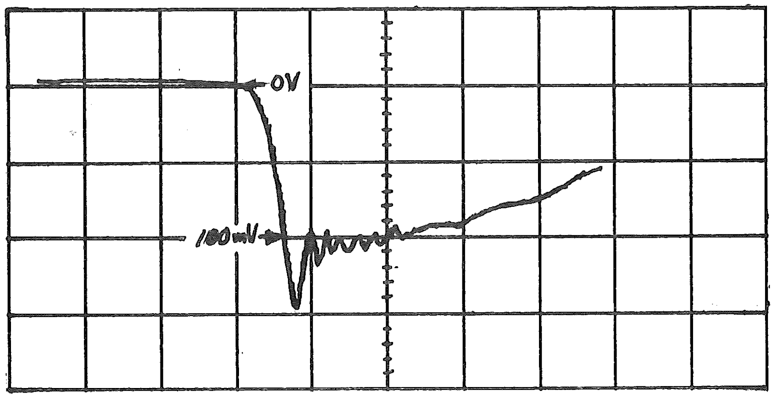
3.7.1 Risetime (Rate of Change)

Performance Requirement: $\leq$ 50 ns into 50 Ω, 0 V to 0.1 V output amplitude

Procedure: Connect a 50 Ω termination to TRIGGER OUTPUT connector. With Type 1A1 test scope, check risetime of both + and - trigger output waveforms.



3.7.1 Risetime (Rate of Change) (cont'd)



3.7.2 Amplitude

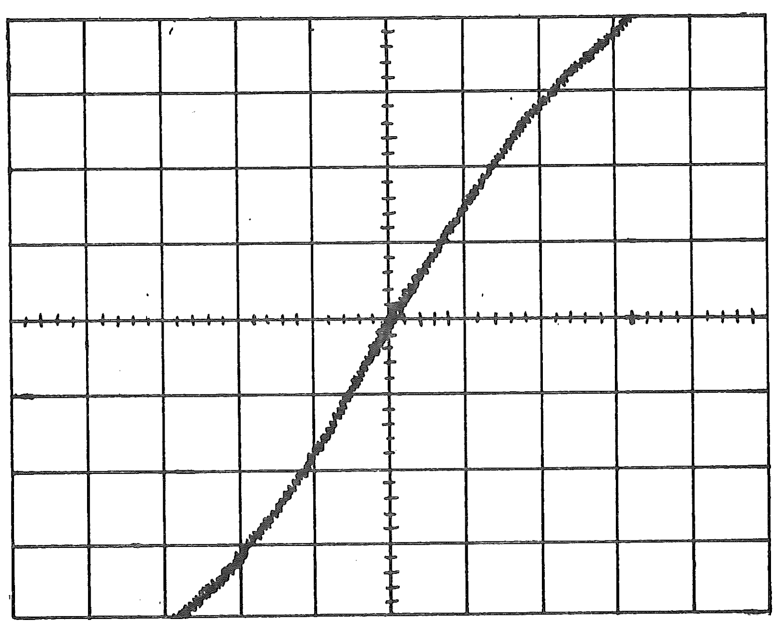
Performance Requirement: ≥ 0.1 V into 50 Ω

Procedure: Connect a 50 Ω termination to TRIGGER OUTPUT and check output amplitude of both the + and − triggers with a 1A1 test scope.

3.7.3 Time Jitter

Performance Requirement: ≤ 300 ps

Procedure: Connect FAST RISE + OUTPUT to 4S1 vertical input, and externally trigger 4S1 from Type 106 positive-going TRIGGER OUTPUT. Check width of the leading edge of the positive-going squarewave for jitter. Repeat this check for the FAST RISE − OUTPUT and HI AMPLITUDE OUTPUT as illustrated.



3.7.4 Delay Time

Performance Requirement: ≤ 50 ns from + trigger leading edge to leading edge of all outputs

Procedure: Connect TRIGGER OUTPUT through a 50 Ω termination to Channel 1 of 1A1 test scope. Connect FAST RISE + OUTPUT through a 50 Ω termination of Channel 2 of 1A1 test scope. Set V/CM switches on 1A1 for approximately equal amplitude waveforms. Set 1A1 Mode switch at Alt, then check delay from + leading edge of trigger waveform to leading edge of FAST RISE + OUTPUT. Check delay from + leading edge of trigger waveform to all other squarewave outputs.

3.8 POWER SOURCE

3.8.1 Line Voltage Ranges

Performance Requirement: 103.5 VAC to 126.5 VAC
207 VAC to 253 VAC

Procedure: Check with TU-76 Line Voltage Control Unit to vary the line voltage while monitoring the regulated DC power supplies with test scope.

3.8.2 Line Frequency

Performance Requirement: 50 Hz to 60 Hz

Procedure: Check with Tel-Instrument Type 4100-I-H10S. Monitor the regulated DC supplies with test scope and check line frequency over the above limits.

3.9 INTERNAL POWER SUPPLIES

3.9.1 Tolerance (Long Term)

Performance Requirement:

"A" +150	"A" -150	"A" -20	-10	+10	"A" Supply
±10%	±10%	±10%	±15%	±15%	Variable

Procedure: Measure the DC supplies with DC Voltage Bridge. The supplies will be within their respective tolerances at +25°C ±5°C for any 500 hour period after the first 200 hours.

3.9.2 Ripple (P-P)

Performance Requirement:

"A" +150	"A" -150	"A" -20	-10	+10	"A" Supply
0.75 V	0.75 V	0.75 V	0.2 V	0.2 V	0.75 V

Procedure: Measure ripple with test scope and 1X probe connected to the supply under test. Check each supply over line voltage limits.

SECTION 4

ENVIRONMENTAL PERFORMANCE VALIDATION

4.1 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.

4.1.1 Nonoperating

Perform all electrical tests, described in Section 3, 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 constitute failures.

4.1.2 Operating

Perform all electrical tests, described in Section 3, 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 20 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 3.

Failure Criteria

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

4.2 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.

4.2.1 Nonoperating

Perform all electrical tests described in Section 3 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 (4.1.1).

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.

4.2.2 Operating

Perform all electrical tests described in Section 3 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 the 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 3.

Failure Criteria

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

4.3 Vibration

4.3.1 Operating

Perform all electrical tests described in Section 3 before vibrating the instrument.

Fasten the instrument securely to the vibration platform.

With the instrument operating, vibrate for 15 minutes along each of the 3 axes at a total displacement of 0.015" (1.9 g's at 50 c/s), and with the frequency varied from 10 to 50 to 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 3.

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.

4.4 Shock

4.4.1 Nonoperating

Perform all electrical tests described in Section 3 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 axis for a total of 6 shocks.

Repeat all electrical tests described in Section 3.

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.

4.5 Transportation

Perform all tests described in Section 3 before conducting the transportation tests, then place the instrument in the carton in the manner in which it is normally shipped.

4.5.1 Package Vibration

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

4.5.2 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 tests, repeat all electrical tests described in Section 3.

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.

9-318

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 __________

ADVERTISING CORRECTION HISTORY NOTICE

Instrument: 106

Publication	Present Form:	Correct Form:	Date
Catalog #25, page 206 (Specification change)	Under heading HI-AMPLITUDE OUTPUT, first sentence:		
	$\leq$12-ns risetime into 50 Ω.	$\leq$12-ns risetime into 50 Ω, $\leq$120-ns unterminated.	
	Under TRIGGER OUTPUT, last sentence:		
	$\leq$50-ns risetime into 50 Ω, $\geq$0.15 V into 50 Ω, $\leq$300-ps time jitter.	$\leq$50-ns risetime into 50 Ω, from 0 V to 0.1 V. $\geq$ 0.1 V amplitude into 50 Ω, $\leq$300-ps time jitter.	

BEAVERTON

MAINTENANCE NOTES

A-150 V SUPPLY

FAILURE

PROBLEM

The A-150 V supply fails on what appears at first to be a random occurrence - the instrument operates satisfactorily for days or weeks and then experiences a rash of failures.

D224 and Q224 are destroyed when the REPETITION RANGE switch is moved slowly from one range to another. The detent spring on the switch is shorting the junction of R17, R24 to ground — a situation which is rather hard on V25 as well as the A-150 V supply.

SOLUTION

Two solutions are possible depending on the circumstances:

The production solution is to increase the length of the aluminum spacers between the detent plate and the first wafer from 0.281 inches to 0.312 inches and reduce the length of the second pair of spacers from 2.062 inches to 2.0131 inches. The switch must be unwired, removed from the instrument, disassembled and new spacers inserted.

The field solution is to slip a #4 internal lock washer between the detent plate and the spacer.

Proceed as follows:

1) Remove the screws, knobs and panel nut from the switch;

2) Unsolder the white-blue and white-yellow wires from the rear wafer;

3) Remove the switch from the front panel and loosen the switch screws;

4) With a pair of diagonal cutters, cut out a portion of the lock washer to form a "C" ring configuration;

5) Slip the lock washers into place between the detent plate and the spacer and tighten the screws; (Do not make the screws too tight or the fiber washers will be broken.)

6) Readjust the RANGE MULTIPLIER pot so the pot shaft fits snugly against the connecting spring;

7) Reinstall the switch.

Charles V. Sanford

DECORATIVE INSERT REPAIR

Nick Stadtfeld, 8-29-67

Decorative inserts or strips are used to cover certain screw and bolt heads on the outside of many of our instruments. The
strips are installed with 3M EC 847, a rubber contact cement. An equivalent adhesive, such as rubber cement, will do the job when replacement is necessary.

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.

POWER SUPPLIES

AMPLITUDE range into 50Ω: 0.5V P to P,
\# max, to 12V P to P, min
AMPLITUDE range unterminated: 7V P to P,
\# max, to 120V P to P, min
12V square-wave: ±10% max, into 50Ω
\# 100 Hz: 5% tilt, max
10 Hz: 15% tilt, max

	Supply	Tolerance	max line freq ripple
	+10	±10%	0.2V P to P
	-10	±10%	0.2V P to P
#	A -20V	±10%	0.75V P to P
#	A +150V	±10%	0.75V P to P
#	A -150V	±10%	0.75V P to P
#	A supply	----	0.75V P to P

SYMMETRY

Symmetry Range (R9): 50% duty cycle at 10 kHz
Check SYMMETRY duty cycle: adjustable from 45 to 55%
Rep rate change with SYMMETRY: 10%, max

REP RATE MULTIPLIER CAL

Rep Rate Multiplier Cal X10 (R6): 10μs/cycle
Rep Rate Multiplier Cal X1 (R30): 10μs/cycle
Bias Level (R39): 50% duty cycle
\# at 1 MHz and 10 kHz from 103.5 to 126.5V AC (line).

REPETITION RATE RANGE AND MULTIPLIER ACCURACY

±10%, max

SYNC INPUT

Square-wave sync: 2 to 50V
Sinewave sync: 5V P to P at 100 Hz and 1 MHz

TRIGGER OUTPUT

\# Amplitude: 0.1V, min, into 50Ω
\# Rate of rise into 50Ω: 50ns, max, from 0V to 0.1V
Delay time: 50ns, max

HIGH AMPLITUDE NO LOAD RISETIME

\# 120ns, max

HIGH AMPLITUDE INTO 50Ω

Risetime into 50Ω: 12ns, max
Aberrations in first 100ns: ±2%, max

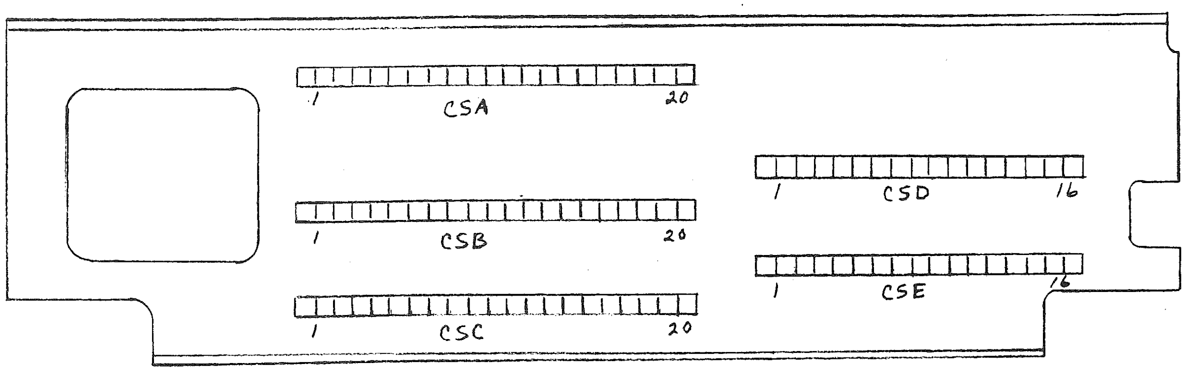
FAST RISE OUTPUT

FAST RISE + & - AMPLITUDE
ccw: 50mV, max
cw: 500mV, min
C127, C138
Risetime: 1ns, max, into 50Ω
Aberrations: 2%, max in first 5ns
C107, C118
Risetime: 1ns, max, into 50Ω
Aberrations: 2%, max, in first 5ns
Symmetry/amplitude change: 150ns, max

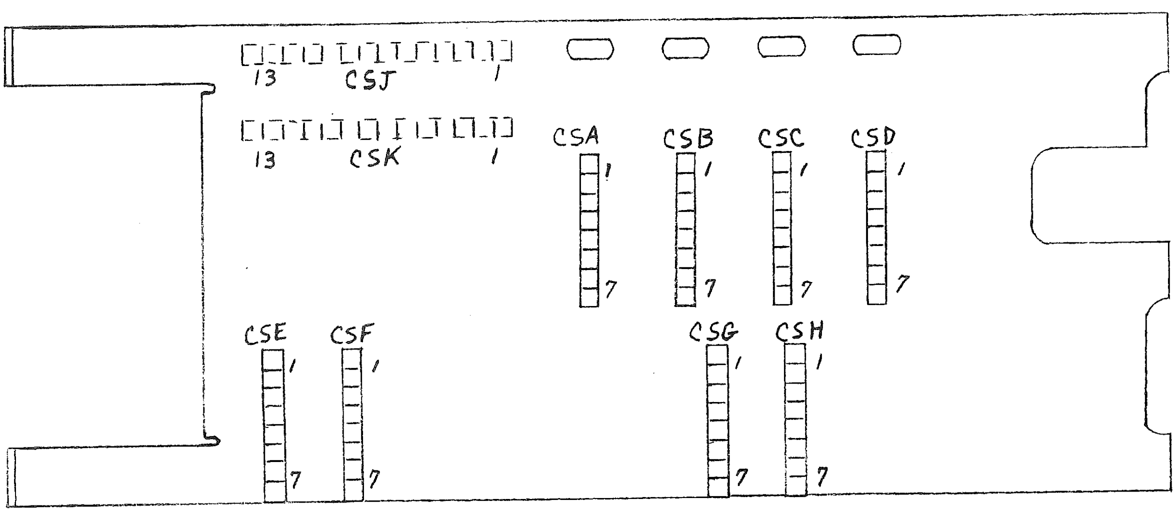
TRIGGER JITTER

300ps, max

STRIP LAYOUT~ 106



Horiz. Amp 610-0247-00



Vert. Amp 610-0248-00

Mod. #	
Date	
Kit #	

MODIFICATION KIT

'A SUPPLY' RELIABILITY IMPROVEMENT

For Tektronix Type 106
SQUARE WAVE GENERATOR
Serial numbers 200-1354

040-0476-00

DESCRIPTION

The reliability and stability of the 'A Supply' is improved by replacing the series regulator transistor Q247, a 2N3440 or a 2N3739, with a 2N4240 transistor, and making several other associated component changes.

Publication:
Instructions for 040-0476-00
November 1967

PARTS LIST

Quantity	Part Number	Description			
(1 ea)		Assembly, capacitor, consisting of:			
1 ea	290-0075-00	Capacitor, 2 x 10 µF 250 V			
1 ea	386-0252-00	Plate, capacitor mounting			
1 ea	151-0251-00	Transistor, 2N4240			
1 ea	210-0202-00	Lug, solder, SE6			
2 ea	210-0457-00	Nut, Keps, 6-32 x 1/4			
2 ea	210-0802-00	Washer, steel, 6S x 5/16			
2 ea	210-0811-00	Washer, shouldered, #6			
2 ea	211-0510-00	Screw, 6-32 x 3/8 PHS			
1 ea	214-0210-00	Spool, w/3 ft. silver-bearing solder			
2 ea	290-0159-00	Capacitor,	2 µF	150 V	
1 ea	306-0270-00	Resistor, comp,	27 Ω	2 W	10%
1 ea	316-0470-00	Resistor, comp,	47 Ω	1/4 W	10%
1 ea	316-0472-00	Resistor, comp,	4.7 k	1/4 W	10%
1 ea	386-0143-00	Plate, mica insulator			

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

INSTRUCTIONS

STEP 1 APPLIES TO INSTRUMENTS SN 779-1354 AND TO INSTRUMENTS SN 200-778 THAT HAVE REPLACED Q247 PER PARTS REPLACEMENT KIT 050-0367-00

( ) 1. Replace Q247, a 2N3739 chassis-mounted transistor, with the 2N4240 transistor from the kit.

STEPS 2 THROUGH 5 APPLY TO INSTRUMENTS SN 200-778 ONLY

( ) 2. Remove the spacer rod above Q247.

( ) 3. Remove Q247, a 2N3440 chassis-mounted transistor, and discard the #4 mounting hardware.

( ) 4. Refer to Fig. 1 and drill a new 7/32 in. hole near Q234 and, using a rattail file, enlarge the rear mounting hole as shown.

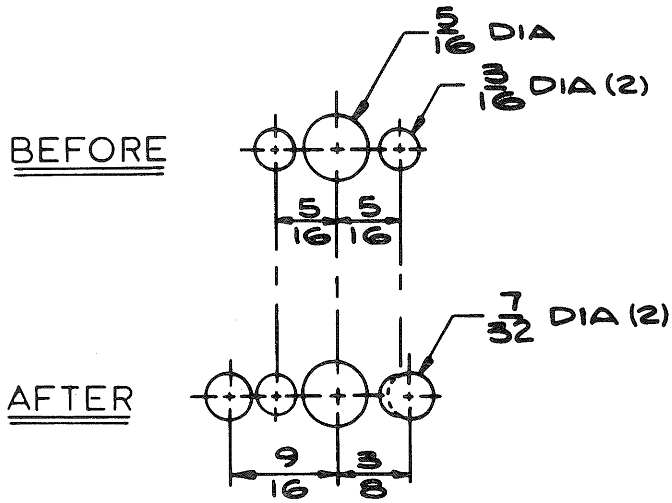


FIG. 1

INSTRUCTIONS (cont)

5. Mount the new Q247, 2N4240 transistor (from kit), using the #6 hardware (from kit) as shown in Fig. 2, and wire as follows:

( ) a) Install a bare wire from solder lug (collector of Q247) to CSC-12.

( ) b) Install a bare wire from the emitter of Q247 to the ground lug near Q233.

( ) c) Install a bare wire from the base of Q247 to CSC-10.

( ) Re-install the spacer rod removed in step 2.

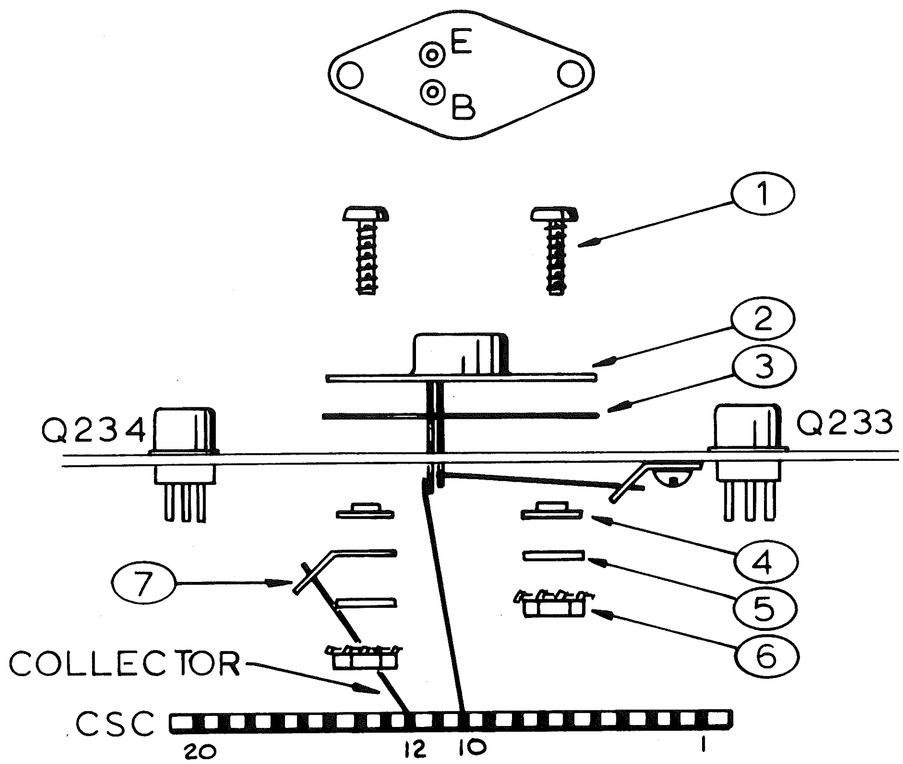


FIG. 2

Item No.	Part Number	Description
1	211-0510-00	Screw, 6-32 x 3/8
2	152-0201-00	Transistor, 2N3739
3	386-0143-00	Insulator, mica
4	210-0811-00	Washer, fiber
5	210-0802-00	Washer, steel
6	210-0457-00	Nut, hex, 6-32
7	210-0202-00	Lug, solder, SE6

INSTRUCTIONS (cont)

STEP 6 APPLIES TO INSTRUMENTS SN 200-464 ONLY

( ) 6. Replace R237, a 22k 1/4W 10% resistor located as shown in Fig. 3, with a 4.7k 1/4W 10% resistor from the kit.

THE REMAINING STEPS APPLY TO ALL INSTRUMENTS

( ) 7. Replace R241, a 100Ω 1/4W 10% resistor located as shown in Fig. 3, with a 47Ω 1/4W 10% resistor from the kit.

( ) 8. Replace R242, a 150Ω 10W wirewound resistor located as shown in Fig. 3, with a 27Ω 2W 10% resistor from the kit.

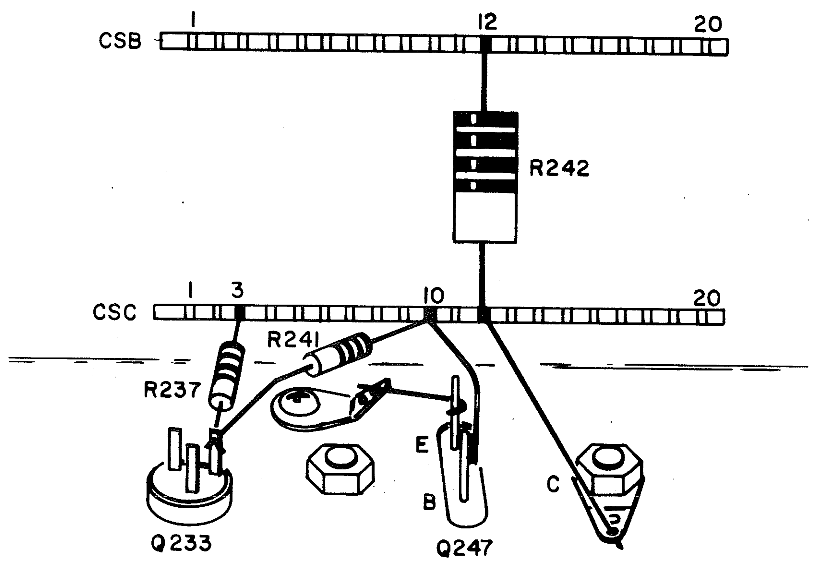


FIG. 3

INSTRUCTIONS (cont)

( ) 9. Replace C56, a 2x40µF 250V chassis-mounted capacitor near V94, with a 2x10µF 250V capacitor from the kit. See Fig. 4.

( ) 10. Install the series combination of C247-C248, two 2µF 150V capacitors, between R246, the AMPLITUDE potentiometer, and the ground lug on V94 tube socket. See Fig. 4.

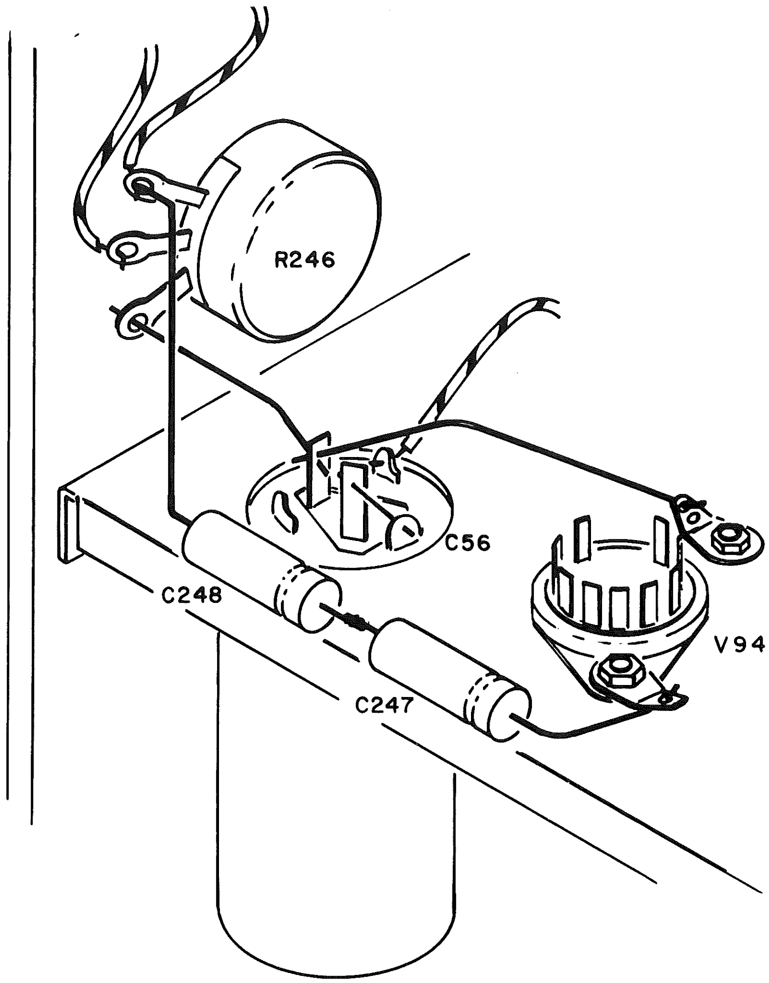


FIG. 4

THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

( ) Refer to your Instruction Manual and recalibrate as necessary.

JT:ls

INSTRUCTION MANUAL

MODIFICATION INSERT

'A SUPPLY' RELIABILITY IMPROVEMENT

TYPE 106 SQUARE WAVE GENERATOR -- SN 200-1354

Installed in Type 106 SN__________ Date____________

This insert has been written to supplement the Instruction Manual for this instrument. The information given in this insert will supersede that given in the manual.

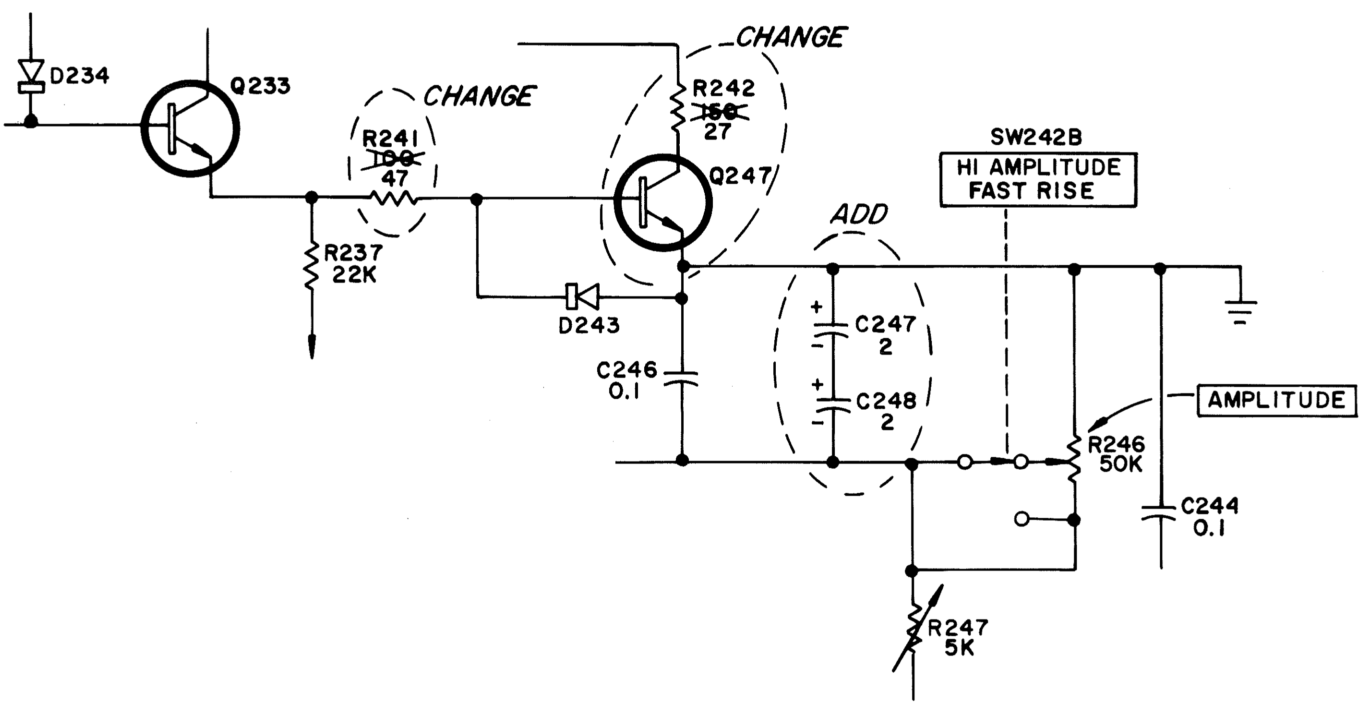
GENERAL INFORMATION

The reliability and stability of the 'A Supply' is improved by replacing the series regulator transistor Q247, a 2N3440 or a 2N3739, with a 2N4240 transistor, and making several other associated component changes.

ELECTRICAL PARTS LIST

Ckt.No.	Part Number	Description		
		CAPACITORS		
C56	290-0075-00	10 µF	250 V	
C247	290-0159-00	2 µF	150 V	
C248	290-0159-00	2 µF	150 V	
		RESISTORS		
R237	316-0472-00	4.7 k	1/4 W	10%
R241	316-0470-00	47 Ω	1/4 W	10%
R242	306-0270-00	27 Ω	2 W	10%
		TRANSISTORS		
Q247	151-0251-00	Silicon	2N4240	

SCHEMATICS



MODIFICATION KIT

OUTPUT PULSE WAVESHAPE IMPROVEMENTS

TEKTRONIX ®

For the Tektronix Type 106
SQUARE WAVE GENERATOR

Serial numbers 200-1479

040-0479-00

DESCRIPTION

This modification provides the following improvements:

1) Overshoot in the HIGH AMPLITUDE output is minimized by relocating R99 closer to the generator circuit and by changing the output to a 50Ω system.

2) Ripple in the FAST RISE output is eliminated by replacing Q217 and by making several component changes in the +10V, -10V power supply.

3) Aberrations in the HIGH AMPLITUDE output waveform are greatly reduced by the following changes:

   a) the drive to the output amplifier is improved by rewiring the grid circuit of the output amplifier and by removing an unnecessary dropping resistor, R56.

   b) the output amplifier screen resistor is removed and the screens are bussed together and by-passed to ground.

   c) the drive to the grids is delayed from one tube to the next by adding inductors in series with the grid lines.

Publication:
Instructions for 040-0479-00
March 1968

PARTS LIST

Quantity	Part Number	Description				
1 ea	151-0190-00	Transistor, 2N3904				
1 ea	151-0208-00	Transistor, 2N4036				
2 ea	152-0185-00	Diode, 6185				
3 ea	210-0201-00	Lug, solder, SE-4				
1 ea	210-0203-00	Lug, solder, SE-6				
1 ea	210-0457-00	Nut, Keps, 6-32 x 5/16				
1 ea	211-0514-00	Screw, 6-32 x 5/16				
1 ea	214-0210-00	Spool, w/3 ft. silver-bearing solder				
6 ea	276-0507-00	Ferrite bead				
1 ea	281-0525-00	Capacitor, cer,	470 pF	500 V		
2 ea	283-0008-00	Capacitor, cer,	0.1 μF	500 V		
1 ea	283-0059-00	Capacitor, cer,	1 μF	25 V		
2 ea	290-0137-00	Capacitor, EMT,	100 μF	30 V		
1 ea	301-0131-00	Resistor, comp,	130Ω	1/2 W	5%	
1 ea	301-0473-00	Resistor, comp,	47 k	1/2 W	5%	
1 ea	301-0562-00	Resistor, comp,	5.6 k	1/2 W	5%	
1 ea	304-0100-00	Resistor, comp,	10Ω	1 W	10%	
1 ea	343-0015-00	Clamp, 1/2" ID				
1 ea	385-0079-00	Rod, alum, hex, 1/4 x 3/8				
1 ea		Tubing, thermo-fit,	162-0531-00,	black,		1/2"
1 ea		Cable, coax, 50Ω,	175-0284-00,			3-3/4"
1 ea		Cable, coax, 50Ω,	175-0284-00,			4"
1 ea		Wire, #14 solid,	176-0119-00,	bare,		2"

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

INSTRUCTIONS

A. TO REWIRE HIGH AMPLITUDE OUTPUT CONNECTOR AND FAST RISE SWITCH:

SW 200-345 ONLY -- See Fig. 1 ⊕ Indicates parts from the kit

( ) 1. Unsolder the brass strip (tinned) and R99, a 600Ω 14W resistor from the HIGH AMPLITUDE OUTPUT connector. Unsolder the grounded end of R99 and remove.

( ) 2. Unsolder two brass strips from the HIGH AMPLITUDE - FAST RISE switch SW242A. (Discard the short piece.)

( ) 3. Cut off the brass strip on the forward side of R93 and discard.

( ) ⊕ 4. Replace the #4 internal lockwasher on the outboard mounting screw of V64, V84, and V94, with a #4 solder lug.

( ) 5. Drill a 5/32" hole near V64. Note: Hole location is not critical. Locate the hole to provide good lead dress of R99.

( ) ⊕ 6. Mount R99 (removed in A-1) with a 1/2" clamp on the top of the hex rod, using the 6-32 x 3/4 screw. Install the #6 solder lug between the rod and the chassis. Connect the end of R99 with short lead to the solder lug and the other end to the brass strip near R63.

( ) ⊕ 7. Solder the center conductor of the 4" coax cable (from kit) to the center terminal of SW242A.

( ) Solder the center conductor of the 3-3/4" coax cable to the outside terminal of SW242A. Solder the other end of the 3-3/4" coax, center conductor to the center terminal of the OUTPUT connector, and the shield to the shell of the OUTPUT connector.

( ) Solder the center conductor of the 4" coax to the output plate line near V94 and solder its shield to the outboard solder lug on V94 socket.

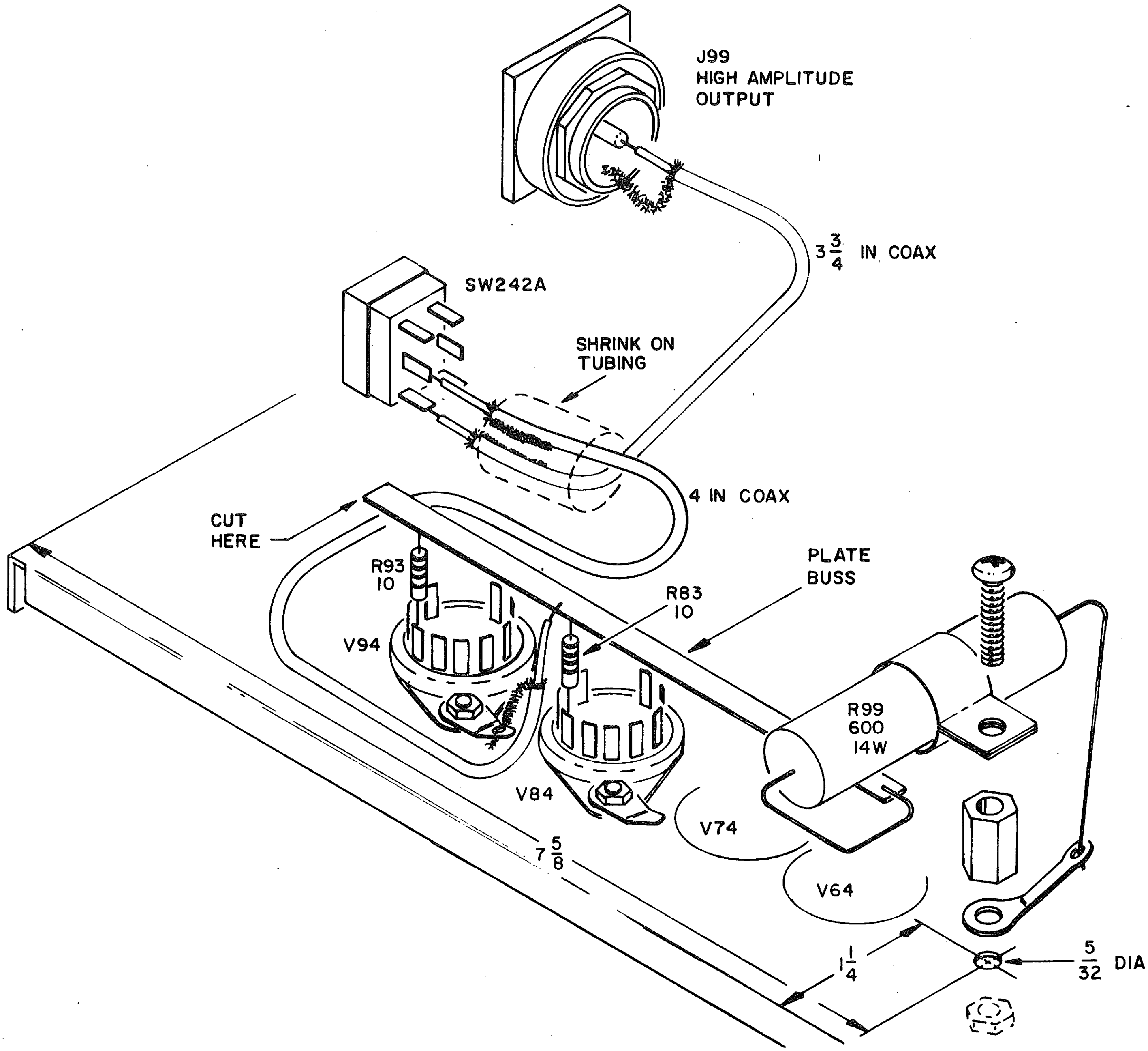

J99
HIGH AMPLITUDE
OUTPUT
3 3/4 IN COAX
SW242A
SHRINK ON
TUBING
4 IN COAX
CUT
HERE
R93
10
PLATE
BUSS
R83
10
V94
R99
600
14W
V84
V74
V64
7 5/8
1 1/4
5/32 DIA

FIG. 1

B. TO REWIRE OUTPUT AMPLIFIER: SN 200-626 -- See Fig. 2

( ) ⊕ 1. Replace R56, a 10Ω 1W 10% resistor connected between the negative terminal of C56 and pin 3 of V94, with a length of #14 bare wire from the kit.

( ) ⊕ 2. Replace C95, a 200pF capacitor located between pin 3 of V84 and solder lug, with a 0.1µF capacitor, and relocate to connect it between pin 3 of V64 and solder lug near V64.

( ) ⊕ 3. Replace C94, a 1000pF 500V capacitor located between pin 3 of V64 and CSA-6, with a 1µF 25V capacitor, and relocate to connect it between pin 3 of V64 and CSA-1.

( ) ⊕ 4. Install C43, a 0.1µF 500V capacitor, between the negative terminal of C56 and CSD-1.

( ) ⊕ 5. Connect pin 6 of V64-V74, -V84 and V94 together with a 3-1/2" length of #16 bare wire.

( ) 6. Remove R55, a 270Ω 1W resistor, located between pin 3 of V64 and CSA-2.

( ) ⊕ 7. Temporarily unsolder R91, R81 and R71 from the output tubes grid line. Install L64, L65, two ferrite beads on the grid line between R61 and R71, resolder R71 to grid line.

( ) ⊕ In a like manner install L74 and L75 between R71 and R81, and L84 and L85 between R81 and R91.

( ) 8. Install R55, a 270Ω resistor removed in step B-6, between the negative terminal of C56 and the junction of R91 and the output tubes grid line.

( ) ⊕ 9. Install C92, a 470pF 500V capacitor, between pin 6 of V84 and ground lug near V84.

( ) ⊕ 10. Replace Q34, a 151-0108-00 type transistor, with a 2N3904, PN 151-0190-00 type transistor.

C. TO MODIFY +10V AND -10V SUPPLY: SN 200-679 ONLY -- See Fig. 3

( ) ⊕ 1. Replace R217, a 27Ω 1W 10% resistor located between CSE-3 and CSF-3, with a 10Ω 1W 10% resistor.

( ) ⊕ 2. Replace Q217, a 2N2905 type transistor with a 2N4036.

( ) ⊕ 3. Install a bare wire from CSE-2 to the ground lug next to CSE.

( ) ⊕ 4. Install C213, a 100µF 30V capacitor, -end to CSE-2 and +end to CSF-1.

( ) ⊕ 5. Install a #22 white wire from terminal 15 of T201 to the ground lug near Q233, if not present.

( ) ⊕ 6. *Install C217, a 100µF 30V capacitor +end to CSE-6 and -end to CSF-5.

* SN 200-345 ONLY

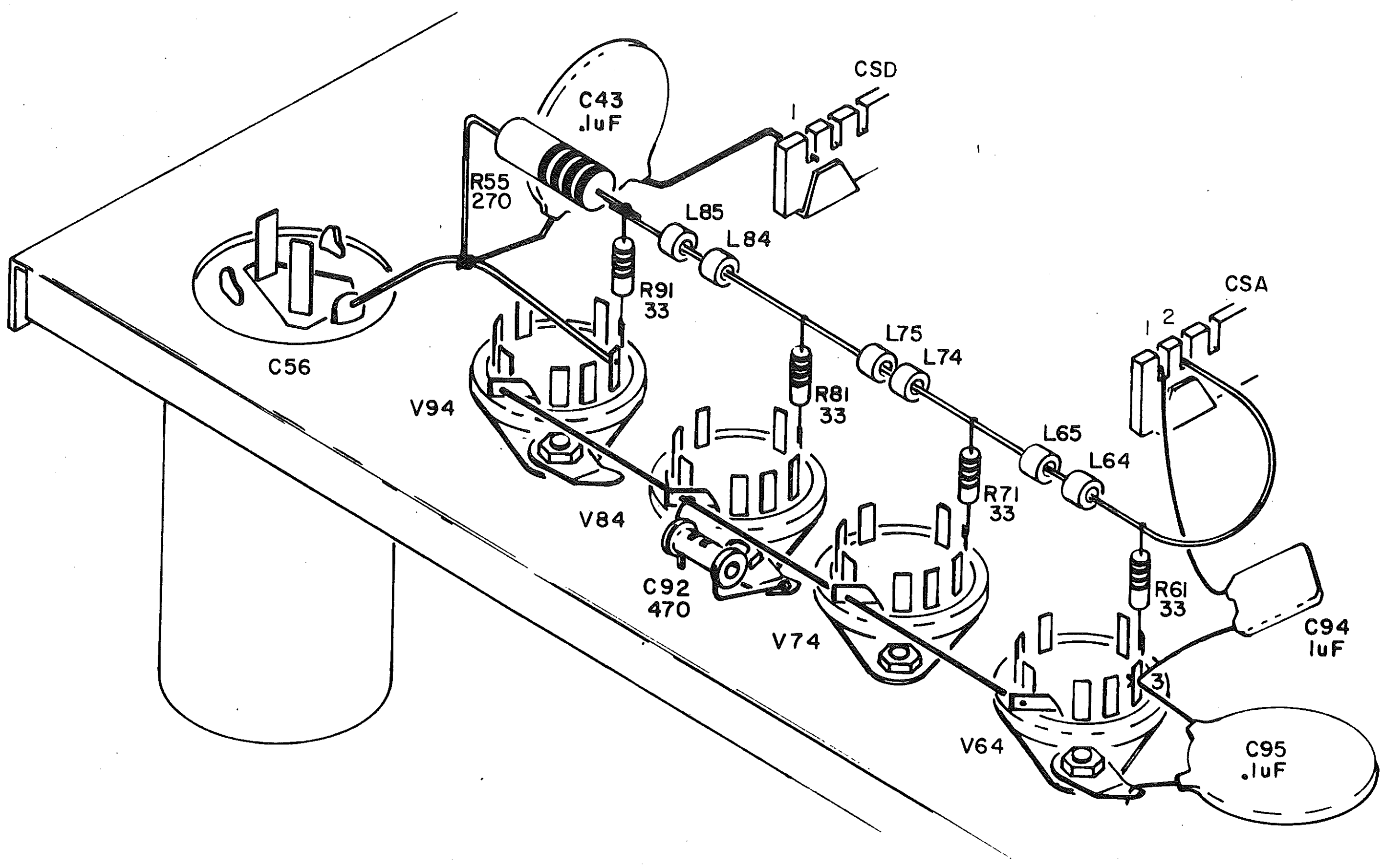

CSD
1
C43
.1uF
R55
270
L85
L84
R91
33
C56
V94
L75
L74
R81
33
CSA
1 2
L65
L64
R71
33
V84
C92
470
V74
R61
33
C94
1uF
3
V64
C95
.1uF

FIG. 2

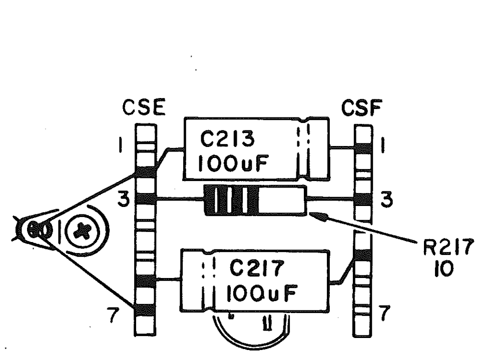

CSE
CSF
1
C213
100uF
1
3
3
R217
10
C217
100uF
7
7
Q217

FIG. 3

INSTRUCTIONS (cont)

D. TO REWIRE TRIGGER CIRCUIT: See Figs. 2 and 4

( ) Temporarily remove C262 to gain access to components on ceramic strips.

Steps 1 through 5 apply to SN 200-1479

( ) 1. Remove D33, a germanium diode, located between CSC-6 and CSD-6, above Q34.

( ) 2. Relocate a bare wire from CSD-6 to CSD-3. Other end is connected to base of Q34.

( ) ⊕ 3. Install D33, a 6185 type diode, between CSC-6 and CSD-6. Install with cathode, banded end, to CSC-6.

( ) ⊕ 4. Install R34, a 130Ω 1/2 W 5% resistor, between CSD-3 and CSC-5.

( ) ⊕ 5. Install D32, a 6185 type diode, between CSD-3 and CSD-6. Install with cathode to CSD-3.

Steps 6 and 7 apply to SN 200-626 ONLY

( ) ⊕ 6. Replace R35, a 3.9k 1/4 W 5% resistor located between CSB-5 and CSC-5, with a 5.6k 1/2 W resistor.

( ) ⊕ 7. Replace R36, an 82k 1/4 W 5% resistor located between CSB-6 and CSC-7, with a 47k 1/2 W resistor.

( ) 8. Reinstall C262.

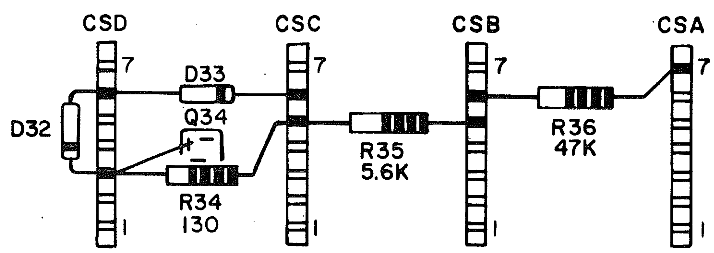


FIG. 4

THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

( ) Refer to your Instruction Manual and recalibrate as necessary.

JT:ls

INSTRUCTION MANUAL

MODIFICATION INSERT

OUTPUT PULSE WAVESHAPE IMPROVEMENTS

TYPE 106 -- SN 200 - 1479

Installed in Type 106 SN________ Date____________

This insert has been written to supplement the Instruction Manual for this instrument. The information given in this insert will supersede that given in the manual.

GENERAL INFORMATION

This modification provides the following improvements:

1) Overshoot in the HIGH AMPLITUDE output is minimized by relocating R99 coloser to the generator circuit and by changing the output to a 50 Ω system.

2) Ripple in the FAST RISE output is eliminated by replacing Q217 and by making several component changes in the +10V, -10V power supply.

3) Aberrations in the HIGH AMPLITUDE output waveform are greatly reduced by the following changes:

   a) the drive to the output amplifier is improved by rewiring the grid circuit of the output amplifier and by removing an unnecessary dropping resistor, R56.

   b) the output amplifier screen resistor is removed and the screens are bussed together and by-passed to ground.

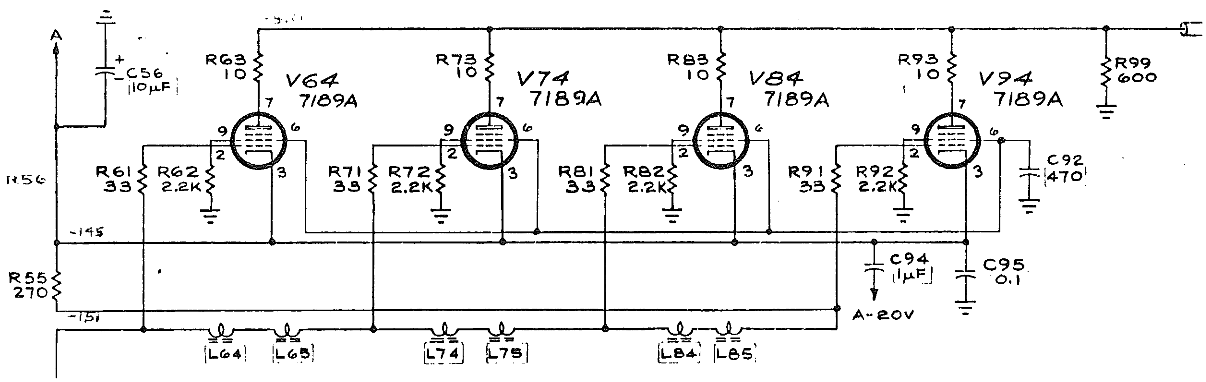
   c) the drive to the grids is delayed from one tube to the next by adding inductors in series with the grid line.

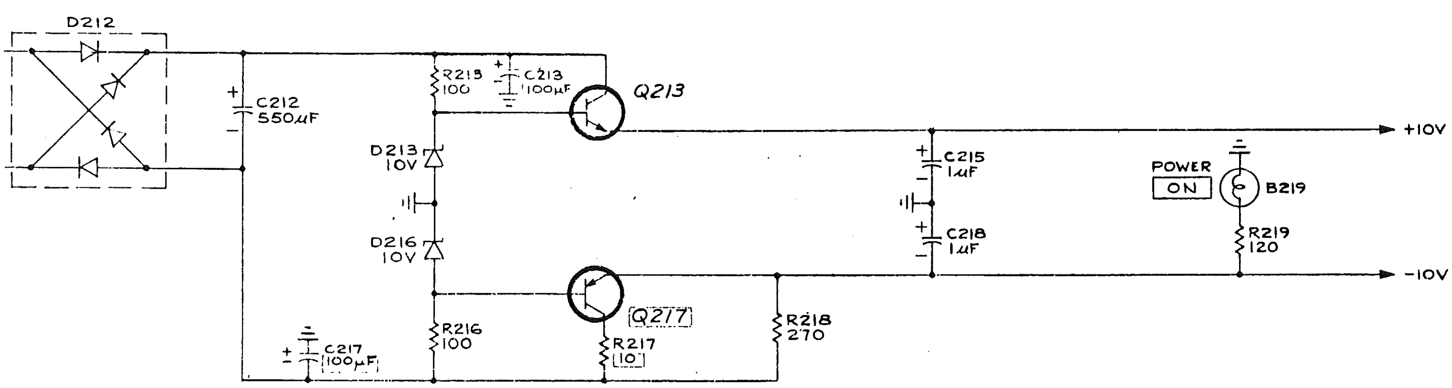
ELECTRICAL PARTS LIST

Ckt. No.	Part Number	Description		
		CAPACITORS		
C43	283-0008-00	0.1 μF	500 V	
C92	281-0525-00	470 pF	500 V	
C94	283-0059-00	1 μF	25 V	
C95	283-0008-00	0.1 μF	500 V	
C213	290-0137-00	100 μF	30 V	
C217	290-0137-00	100 μF	30 V	
		DIODES		
D32	152-0185-00	6185		
D33	152-0185-00	6185		
		INDUCTORS		
L64	276-0507-00	Ferrite bead		
L65	276-0507-00	Ferrite bead		
L74	276-0507-00	Ferrite bead		
L75	276-0507-00	Ferrite bead		
L84	276-0507-00	Ferrite bead		
L85	276-0507-00	Ferrite bead		
		TRANSISTORS		
Q34	151-0190-00	2N3904		
Q217	151-0208-00	2N4036		
		RESISTORS		
R15	Delete			
R34	301-0131-00	130 Ω	1/2 W	5%
R35	301-0562-00	5.6 k	1/2 W	5%
R36	301-0473-00	47 k	1/2 W	5%
R217	304-0100-00	10 Ω	1 W	10%

MECHANICAL PARTS LIST

	Part Number	Description
	343-0015-00	Clamp, 1/2" ID
	210-0201-00	Lug, solder, SE-4
	210-0203-00	Lug, solder, SE-6
	210-0457-00	Nut, Keps, 6-32 x 5/16
	385-0079-00	Rod, alum, hex, 1/4 x 3/8
	211-0514-00	Screw, 6-32 x 5/16


A
C56
10μF
R63
10
V64
7189A
R73
10
V74
7189A
R83
10
V84
7189A
R93
10
V94
7189A
R99
600
R56
R61
33
R62
2.2K
R71
33
R72
2.2K
R81
33
R82
2.2K
R91
33
R92
2.2K
C92
470
R55
270
C94
1μF
A-20V
C95
0.1
L64
L65
L74
L75
L84
L85


D212
C212
550μF
R215
100
C213
100μF
Q213
D213
10V
D216
10V
+10V
C215
1μF
C218
1μF
POWER
ON
B219
R219
120
-10V
Q217
R216
100
C217
100μF
R217
10
R218
270

PARTS REPLACEMENT KIT

POWER SUPPLY TRANSISTOR, Q247

DISCONTINUED

SEE NUMERICAL PARTS RECORD (NPR) FOR DISPOSITION

TEKTRONIX®

For Tektronix Type 106
Square-Wave Generator

Serial numbers 200-778

050-0367-00

DESCRIPTION

Power supply transistor 2N3739 (151-0201-00) used for Q247, replaces 2N3440 (151-0196-00), offering greater reliability.

To install the new type transistor it is necessary to drill a new hole in the chassis and enlarge an existing hole.

NOTE: If the serial number of your instrument is above those listed, or if this mod has been installed, disregard the instructions as PN 151-0201-00 is a direct replacement.

Publication:
Instructions for 050-0367-00
March 1967

PARTS LIST

Quantity	Part Number	Description
1 ea	151-0201-00	Transistor, silicon, 2N3739, NPN
1 ea	210-0202-00	Lug, solder, SE6
2 ea	210-0457-00	Nut, Keps, 6-32 x 1/4
2 ea	210-0802-00	Washer, steel, 6S x 5/16
2 ea	210-0811-00	Washer, shoulder, #6
2 ea	211-0510-00	Screw, 6-32 x 3/8 PHS
1 ea	214-0210-00	Spool, w/3 ft. silver-bearing solder
1 ea	386-0143-00	Plate, mica insulator

INSTRUCTIONS

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

( ) 1. Remove instrument from cabinet and remove spacer rod above Q247.

( ) 2. Remove Q247, a 2N3440 chassis-mounted transistor and discard the #4 mounting hardware.

( ) 3. Refer to Fig. 1 and drill a new 7/32 in. hole near Q234 and, using a rattail file, enlarge the rear mounting hole as shown.

( ) 4. Mount the new Q247, a 2N3739 type transistor (from kit), using the #6 hardware (from kit) as shown in Fig. 2, and wire as follows:

( ) a) Install a bare wire from solder lug (collector of Q247) to CSC-12.

( ) b) Install a bare wire from the emitter of Q247 to the ground lug near Q233.

( ) c) Install a bare wire from the base of Q247 to CSC-10.

( ) 5. Re-install the spacer rod removed in step 1.

THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

( ) Refer to your Instruction Manual and recalibrate as necessary.

JT:ls

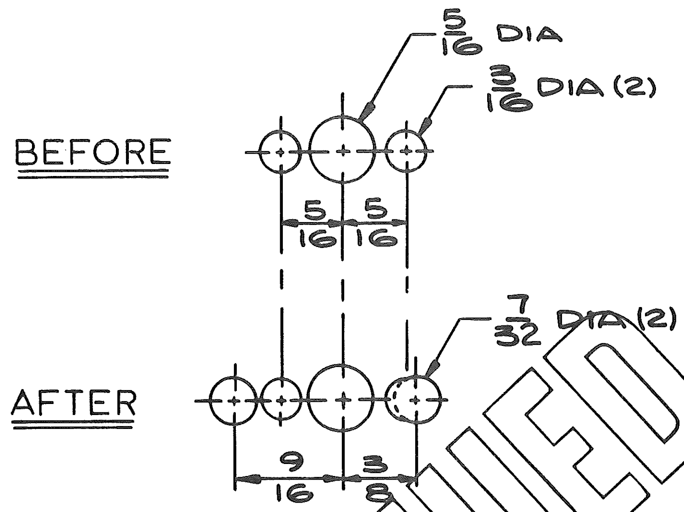


FIG. 1

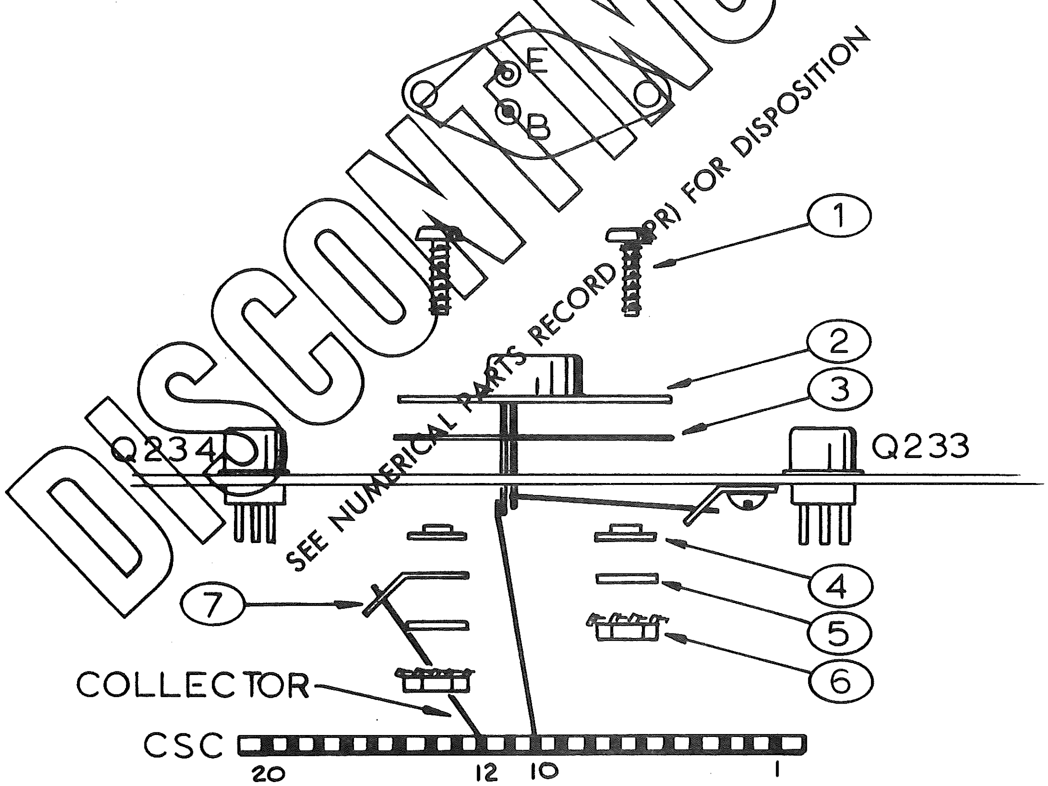


FIG. 2

Item No.	Part Number	Description
1	211-0510-00	Screw, 6-32 x 3/8
2	152-0201-00	Transistor, 2N3739
3	386-0143-00	Insulator, mica
4	210-0811-00	Washer, fiber
5	210-0802-00	Washer, steel
6	210-0457-00	Nut, hex, 6-32
7	210-0202-00	Lug, solder, SE6

MODIFICATION SUMMARY

106

INDEX

MODIFICATION SUMMARY

GENERATOR

POWER SUPPLY

INDEX

MODIFICATION SUMMARY

MISCELLANEOUS

-20V POWER SUPPLY CABLE COLOR-CODE CHANGED TO CONFORM TO POWER SUPPLY VOLTAGE — INFORMATION ONLY — M11032

Effective Prod SN 320

FRONT PANEL SYMPTOM: None.

PROBLEM: Change Notice 11012, which was a complete rework, changed the voltage of the -15V supply to -20V, to eliminate component selection. Changing the -15V supply to -20V caused the wire color-code to be incorrect.

PRODUCTION CHANGE: The wire color-code for the -20V supply was changed from tan-brown-red-black to tan-red-black-black. There was no part number changes of the reworked cables.

10% AND 20% ZENER DIODES CHANGED TO STANDARD 5% UNITS — INFORMATION ONLY — M11191

Effective Prod SN None

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:

D264	Diode, 1N3027A 20 V ±10%	152-0060-00
D124, D104	Diode, 1N4372 3 V ±10%	152-0076-00

Parts Added:

D264	Diode, 1N3027B 20 V ±5%	152-0291-00
D124, D104	Diode, 1N4372A 3 V ±5%	152-0278-00

HI AMP - FAST RISE SELECTOR SWITCH REWIRED TO REDUCE ABERRATIONS — INFORMATION ONLY — M11324-1

Effective Prod SN 346
modified out of sequence:

200-1	221	238-9	264	305	323-33
210-13	228	243	292	314	335-42
219	234-6	262	300	320-1	344

FRONT PANEL SYMPTOM: None.

PROBLEM: Inductance in the switch, connected in series with the High Amplitude output was causing excessive overshoot. The amplitude of the overshoot ranged from 2.1% to 3.8%. See M11451 and M11790.

PRODUCTION CHANGE: The wiring to the HIGH AMPLITUDE output connector from the output amplifier via the HIGH AMPLITUDE - FAST RISE switch was changed from 1/4 in. brass strap to two pieces of 50Ω coax. R99 was relocated physically closer to the generator to minimize overshoot in the output wave form. The switch still represents a discontinuity.

Parts Removed:

R99	Resistor, fixed, WW, 600Ω 14W	308-0392-00
	Strip, brass 12 x 0.250	124-0179-00

Parts Added:

R99	Resistor, fixed, WW, 600Ω 1/4W	308-0392-00
	Lug, solder, SE-6	210-0203-00
	Clamp, CL16 ss 1/2" ID	343-0015-00
	Rod, alum, hex, 1/4 x 3/8	385-0079-00
	Strip, brass, 3-3/4 x 0.250	124-0179-01
	Cable, coax, 50Ω, consisting of: 2 pcs, 3-3/4" and 5-1/2"	175-0284-00

+10V POWER SUPPLY MODIFIED TO MINIMIZE RIPPLE IN FAST RISE OUTPUT — INFORMATION ONLY — M11324-2

Effective Prod SN 346
modified out of sequence: See M11324-1

FRONT PANEL SYMPTOM: Ripple on FAST RISE OUTPUT.

PROBLEM: Ripple is present in the FAST RISE OUTPUT, especially at low line, which is a direct result of ripple out of the 10V supply.

PRODUCTION CHANGE: A wire connecting terminal 15 of T201 (center tap of the 10V Power Supply winding) to ground near Q233 was removed.

At the same time C217, a 100µF 30V capacitor, was added from the junction of R216-R217-R218 (in the 10V Power Supply) to ground.

This mod is superseded by M11451. The wire from terminal 15 of T201 should be left in place.

Parts Removed: None

Parts Added:

C217	Capacitor, EMT, 100µF 30V	290-0137-00
	Wire, #22 solid, white 10 in.	

TRIGGER OUTPUT EMITTER FOLLOWER
OSCILLATION ELIMINATED BY ADDIING
A COLLECTOR ISOLATING RESISTOR

See SQB

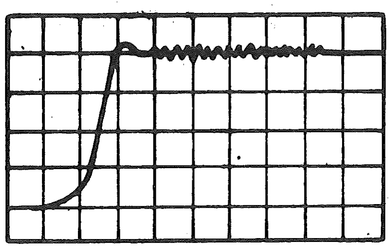
M11271

Effective Prod SN 430

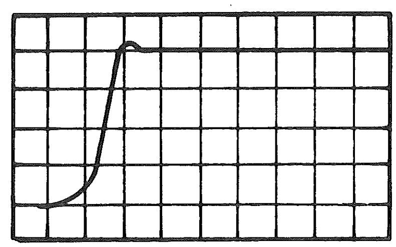
Usable in field instruments SN 200-429

FRONT PANEL SYMPTOM: An oscillation occurs at rep rates less than 500 kHz on the ground side of the square wave. The frequency of oscillation is approximately 200 kHz. See below.

BEFORE



AFTER



PROBLEM: Insufficient isolation of emitter follower Q43 from the power supply causes it to oscillate.

PRODUCTION CHANGE: A 100Ω resistor was added in series with the collector of Q43.

Parts Added:

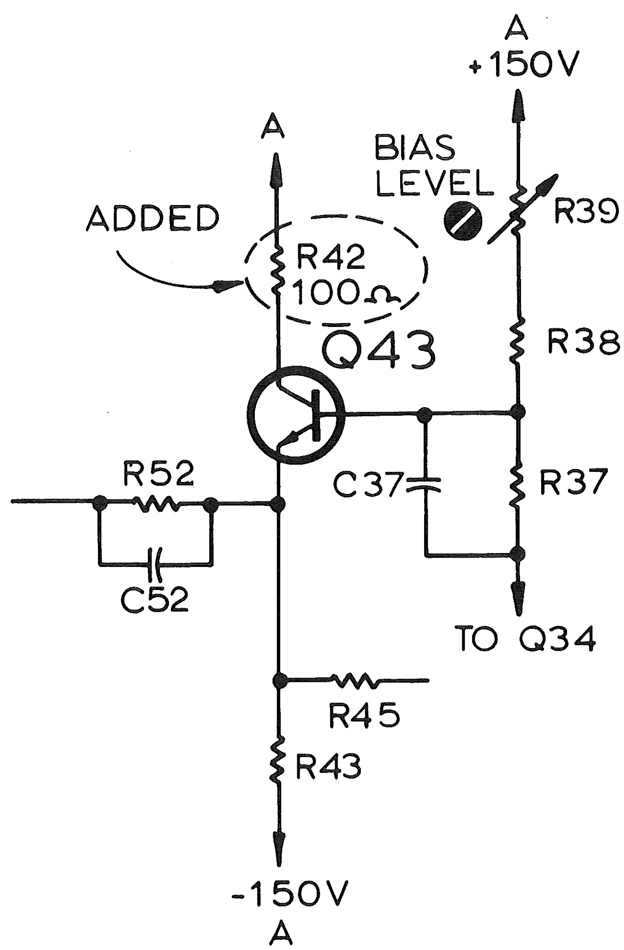
R42	Resistor, comp, 100Ω 1/4 W 10%	316-0101-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace the #22 bare wire that connects the collector of Q43 to a ceramic strip notch, with a 100Ω 1/4 W resistor.



-20 V & +150 V POWER SUPPLY LAYOUT CHANGED TO ELIMINATE SHORTING & TO FACILITATE PART REPLACEMENT — INFORMATION ONLY — M11190

Effective Prod SN 440

FRONT PANEL SYMPTOM: None.

PROBLEM: Present location of parts, in the -20 V & +150 V power supply, could cause the two supplies to become shorted to each other.

PRODUCTION CHANGE: R226, a 40 k 8 W resistor, and associated wiring were relocated. At the same time, the bare wire that connected C212 to the ceramic strips were changed to insulated stranded wire to improve access to parts on the same chassis.

'A' SUPPLY SERIES REGULATOR RESISTOR CHANGED TO PERMIT OPERATION AT HIGHER TEMPERATURES — See SQB — M11468

Effective Prod SN 465 w/exceptions

200-1	234-6
210-3	238-9
219	243
221	264
228	292

Usable in field instruments SN 200-464

300	341	408	438
305	346	413	447-8
324	357	426	453-5
329	390	428	457
339	403-5	433-5	459-60

Also 364

FRONT PANEL SYMPTOM: None.

PROBLEM: Series regulator in 'A' supply goes into Thermal runaway at high temperatures.

PRODUCTION CHANGE: R237 was reduced in value from 22k to 4.7k.

Parts Removed:

R237	22k 1/4 W 10% resistor	316-0223-00

Parts Added:

R237	4.7k 1/4 W 10% resistor	316-0472-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace R237, a 22k 1/4 W 10% resistor, connected between the emitter of Q233 and a ceramic strip notch (CSC-3), with a 4.7k 1/4 W 10% resistor.

A +150V CONSTANT VOLTAGE SOURCE
TRANSISTOR, Q257, MOUNTING HARDWARE CHANGED TO PREVENT SHORTING TO CHASSIS — See SQB — M11316

Effective Prod SN 510 — Usable in field instruments SN 200-509

FRONT PANEL SYMPTOM: None.

PROBLEM: Q257, the Constant Voltage Source transistor in the A +150V supply was shorting to the chassis via the metal anodized washers.

PRODUCTION CHANGE: Mounting hardware for Q257 was changed from two anodized washers to two shouldered fiber washers.

Parts Removed:

(2)	Washer, shouldered, anodized alum, w/#6 hole	210-0983-00

Parts Added

(2)	Washer, shouldered, fiber #6	210-0811-00

INSTALLATION INSTRUCTIONS

Parts Required: See 'Parts Added'.

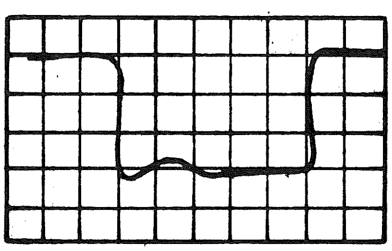
Installation Procedure: Replace the anodized aluminum washers, used to mount Q257, with #6 shouldered fiber washers.

DRIVER AMP (Q54) PROTECTIVE DIODE (D54) CHANGED TO A DIODE WITH HIGHER PIV RATING — See SQB — M11537-1

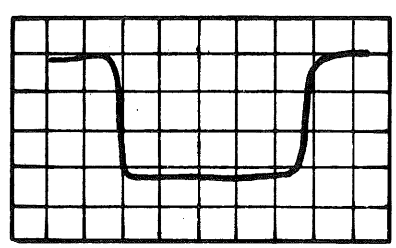
Effective Prod SN 610 (Tent) — Usable in field instruments SN 200-609 (Tent)

FRONT PANEL SYMPTOM: With REPETITION RATE set to about 500kHz and AMPLITUDE at maximum, the waveform shown below may appear.

BEFORE



AFTER



PROBLEM: Test was selecting D54 for high PIV. At maximum AMPLITUDE settings, D54 was being subjected to voltages that caused it to start breaking down in the reverse direction.

PRODUCTION CHANGE: D54 was changed from 152-0071-00 to 152-0079-00 which has a higher P I V rating.

continued

Parts Removed:

D54	Germanium diode	152-0071-00

Parts Added:

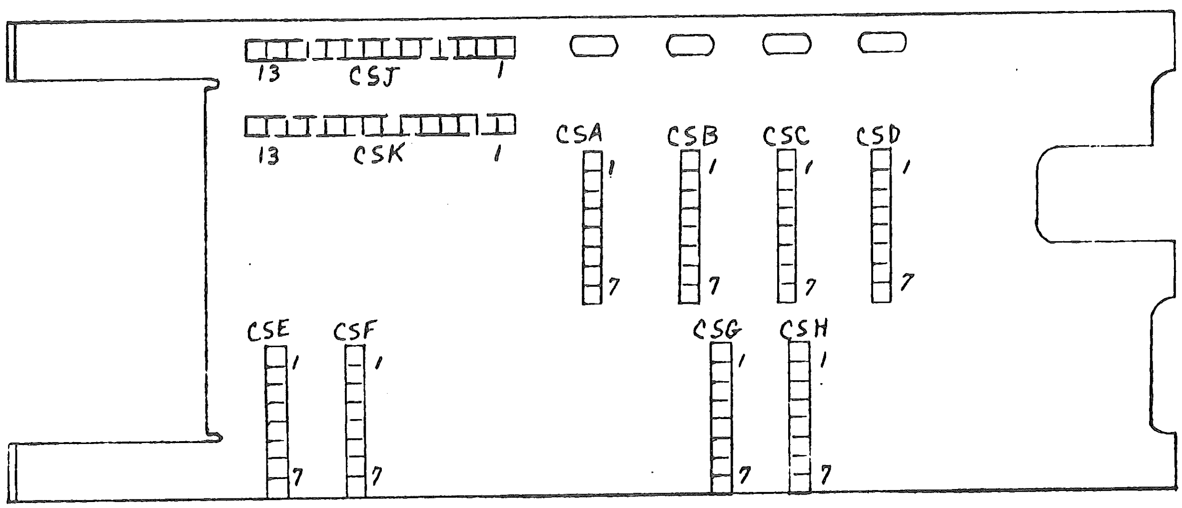
D54	Germanium diode	152-0079-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace D54, a germanium diode, located between CSA-2 and CSB-2 with an HD1841 type diode. Install with the cathode (banded end) to CSA-2.



FAST RISE + AND - OUTPUT CLAMP DIODES REPLACED WITH FASTER SWITCHING AND LOWER LEAKAGE TYPE DIODE	See SQB	M11537-2

Effective Prod SN 610 (Tent) Usable in field instruments SN 200-609 (Tent)

FRONT PANEL SYMPTOM: SYMMETRY changed more than the allowed 150 ns when switching between HI AMPLITUDE AND FAST RISE.

PROBLEM: Storage time in diodes D114 - D134 was excessive and diodes tended to have too much leakage.

PRODUCTION CHANGE: Type of diode for D114 and D134 was changed from an ED-2007 type diode to an HD1841 type diode.

Parts Removed:

D114, D134	Germanium diode	152-0071-00

Parts Added:

D114, D134	Germanium diode	152-0079-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

a) Replace D114, a germanium diode, located on the +FAST RISE OUTPUT board next to D117 and D118 with an HD1841 type diode. Install with cathode (banded end) to ground.

b) Replace D134, a germanium diode, located on the -FAST RISE OUTPUT board next to D137 and D138, with an HD1841 type diode. Install with cathode (banded end) to the junction of D137, R134 and the collector of Q134.

OUTPUT AMPLIFIER CIRCUIT
MODIFIED TO IMPROVE WAVEFORM AT LOW AMPLITUDES — See SQB — M11790

Effective Prod SN 627 — Usable in field instruments SN 202-626 **

w/exception	200-1	341	435	544-5	567-82	599-604
	212-3	346	532	547	584-5	606
	219	357	534	549	589	609-11
	234	390	537	551-2	592	615-25
	243	404-5	539	554-9	594	Also 364
	339	426	541	561-4	596-7	

FRONT PANEL SYMPTOM: None.

PROBLEM: Cathode moving, screen feed-thru, drive voltage not clean, resulting in high amplitude aberrations, in the output waveform, when the AMPLITUDE control is in fully counter-clockwise position.

PRODUCTION CHANGE: The drive voltage was cleaned up. The cathode resistor removed and the screens bussed together and by-passed to ground. Also the drive of the grids is being delayed from one tube to another.

** Mod 11451 should be installed when installing M11790.

Parts Removed:

Q34	Transistor	151-0108-00
	Cable, coax 50Ω imp (5-1/2 long) .458'	175-0248-00
C94	Capacitor 1000 pF 500 V	281-0536-00
C95	Capacitor 200 pF 500 V	281-0605-00
R56	Resistor, 10Ω 1 W 10%	304-0100-00
R35	Resistor, 3.9k 1/4 W 5%	315-0392-00
R36	Resistor, 82k 1/4 W 5%	315-0823-00
	Lockwasher, int #4 (2)	210-0004-00

Parts Added:

Q34	* Transistor, 2N3904	151-0190-00
L64, L65, L74, L75, L84, L85	* Ferrite beads	276-0507-00
C92	* Capacitor, 470 pF 500 V	281-0525-00
C43, C95	* Capacitor, 0.1 µF 500 V	283-0008-00
C94	* Capacitor, 1 µF 25 V	283-0059-00
R36	* Resistor, 47k 1/2 W 5%	301-0473-00
R35	* Resistor, 5.6k 1/2 W 5%	301-0562-00
	* Lug, solder, SE-4	210-0201-00
	Cable, coax, 50Ω imp (4 in. long) .333 ft.	175-0248-00

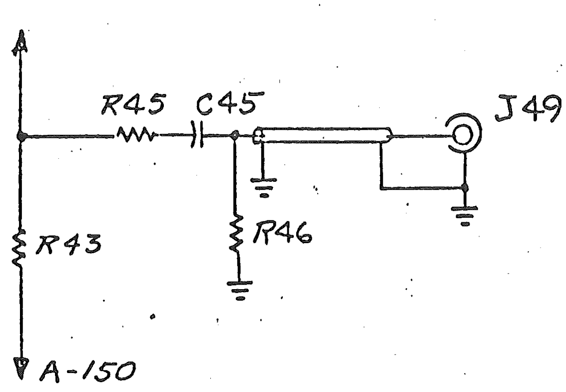
INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added' with asterisks.

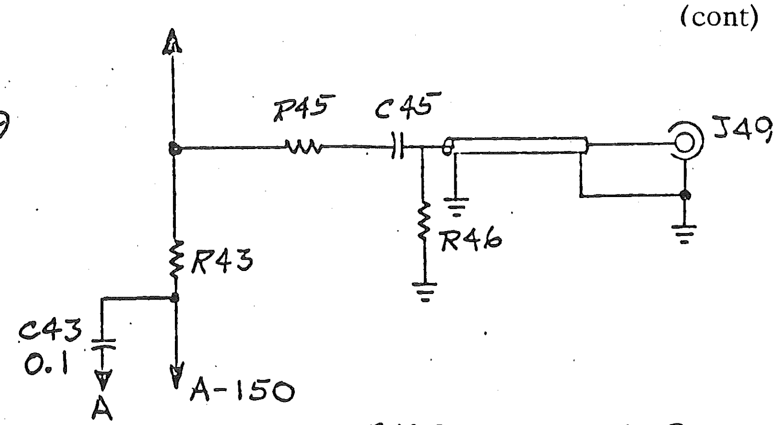
For instruments SN 202-345, see 'Parts Added' with asterisks and parts listed below:

C217	Capacitor, EMT, 100 µF 30 V	290-0137-00
	Lug, solder, SE-6	210-0203-00
	Nut, Keps, 6-32 x 5/16	210-0457-00
	Screw, 6-32 x 5/16	211-0514-00
	Rod, aluminum, hex, 1/4 x 3/8	385-0079-00
	Clamp, 1/2 in. ID	343-0015-00
	Cable, coax, 3-3/4 in.	175-0284-00
	Cable, coax, 4 in.	175-0284-00

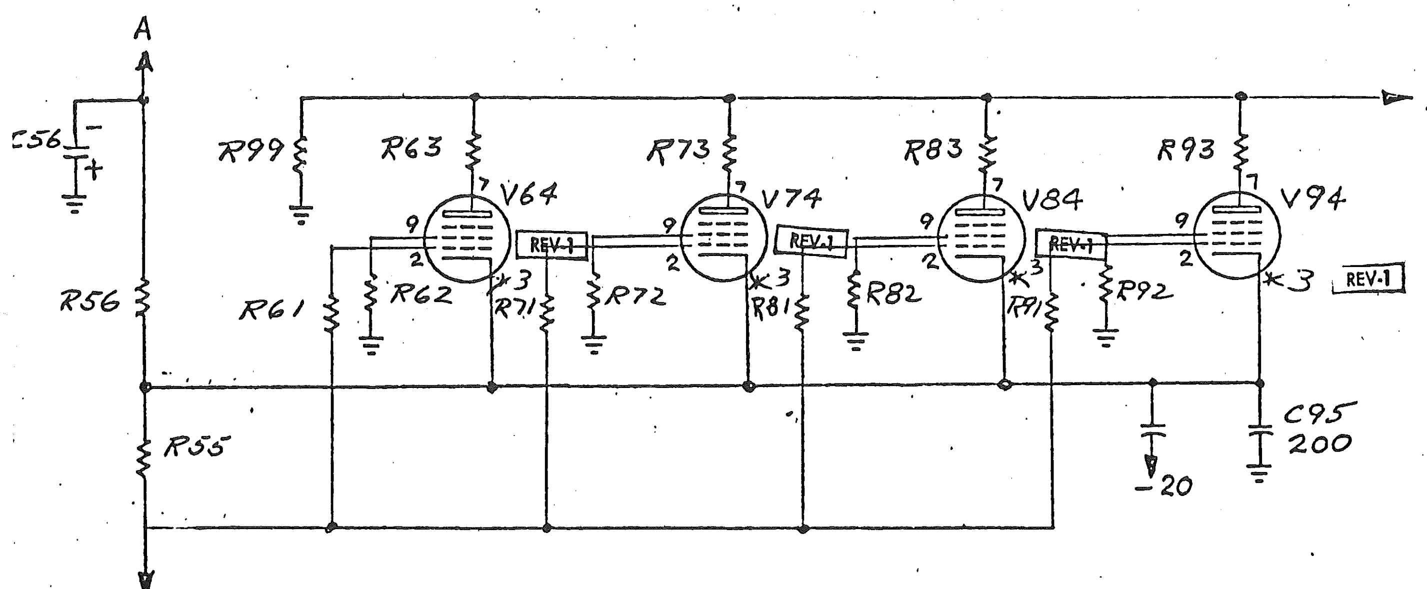
continued



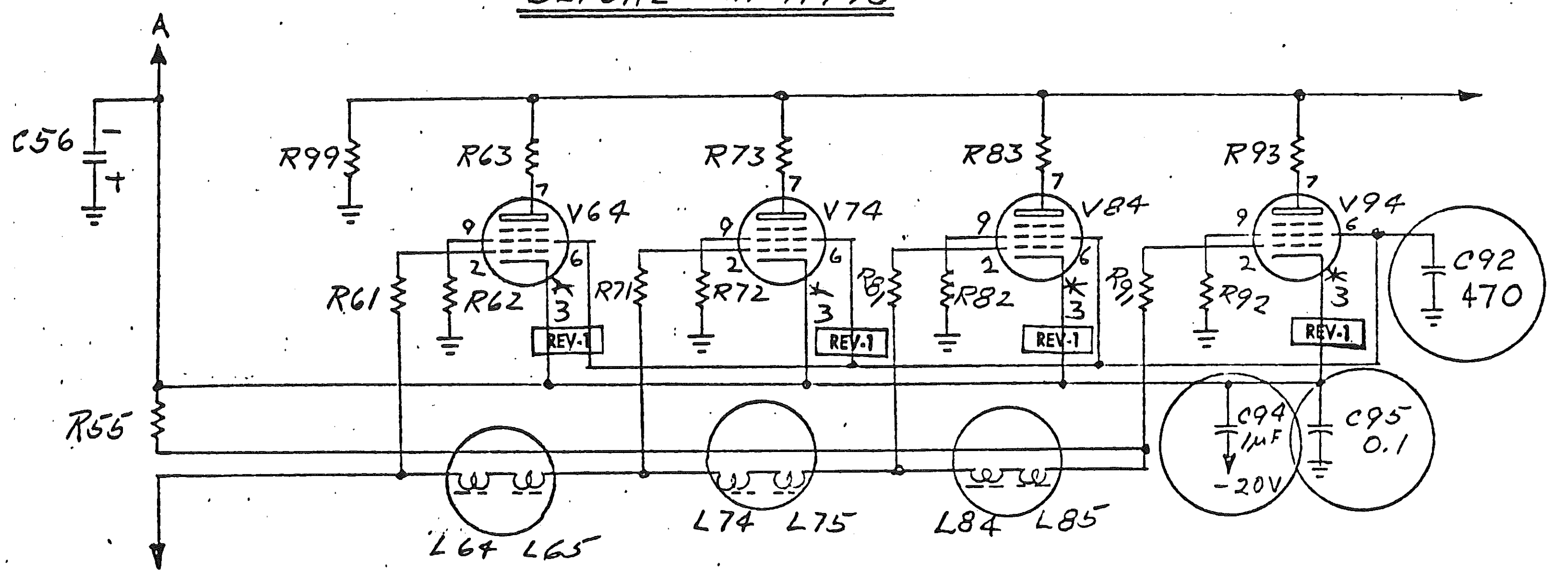
BEFORE M-11790



AFTER M-11790



BEFORE M-11790



continued

AFTER M-11790

Installation Procedure:

PART I -- FOR SN 202-345 ONLY

a) Unsolder the brass strip (tinned) and R99, a 600Ω 14W resistor from the High Amplitude output connector. Unsolder the grounded end of R99 and remove.

b) Unsolder two brass strips from the HIGH AMPLITUDE-FAST RISE switch SW242A. (Discard the short piece.)

c) Cut off the brass strip on the forward side of R93 and discard.

d) Replace the #4 int lockwasher on the outboard mounting screw of V84, with a #4 solder lug.

e) Drill a 5/32 in. hole near V64, as shown on ceramic strip layout drawing (Fig. 1). Note: Hole location is not critical. Locate the hole to provide good lead dress of R99.

f) Mount R99, with the 1/2 in. clamp on top of the hex rod, with the 6-32 x 3/4 screw. Install the #6 solder lug between the rod and chassis. Connect one end of R99 to solder lug and the other end to the brass strip near R63.

g) Make up coax leads with ground leads on each end to /58 in. See Fig. 2.

Join the shields (on one end) of the two coaxes, solder and cover with shrink-on tubing.

Solder the center conductor of the 4 in. cable to the center of SW242A. (The other end will be soldered later.)

Solder the center conductor of the 3-3/4 in. cable to the outside terminal of SW242A, other end, center conductor to output connector and ground to solder lug on trigger output connector. Note: It may be necessary to add a solder lug to the trigger output connector.

h) On Power Supply Chassis:

Install a bare wire from CSE-6 to ground lug.

Install C217, a 100µF 30V capacitor (+) end to CSE-6 and (-) end to CSF-5.

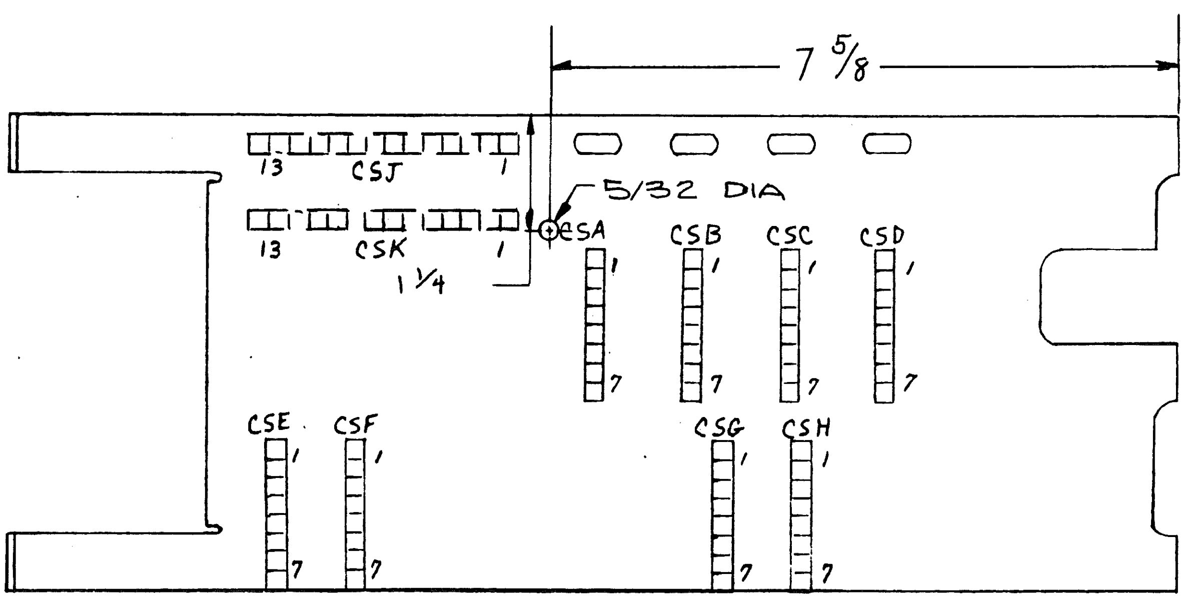


FIG. 1

continued

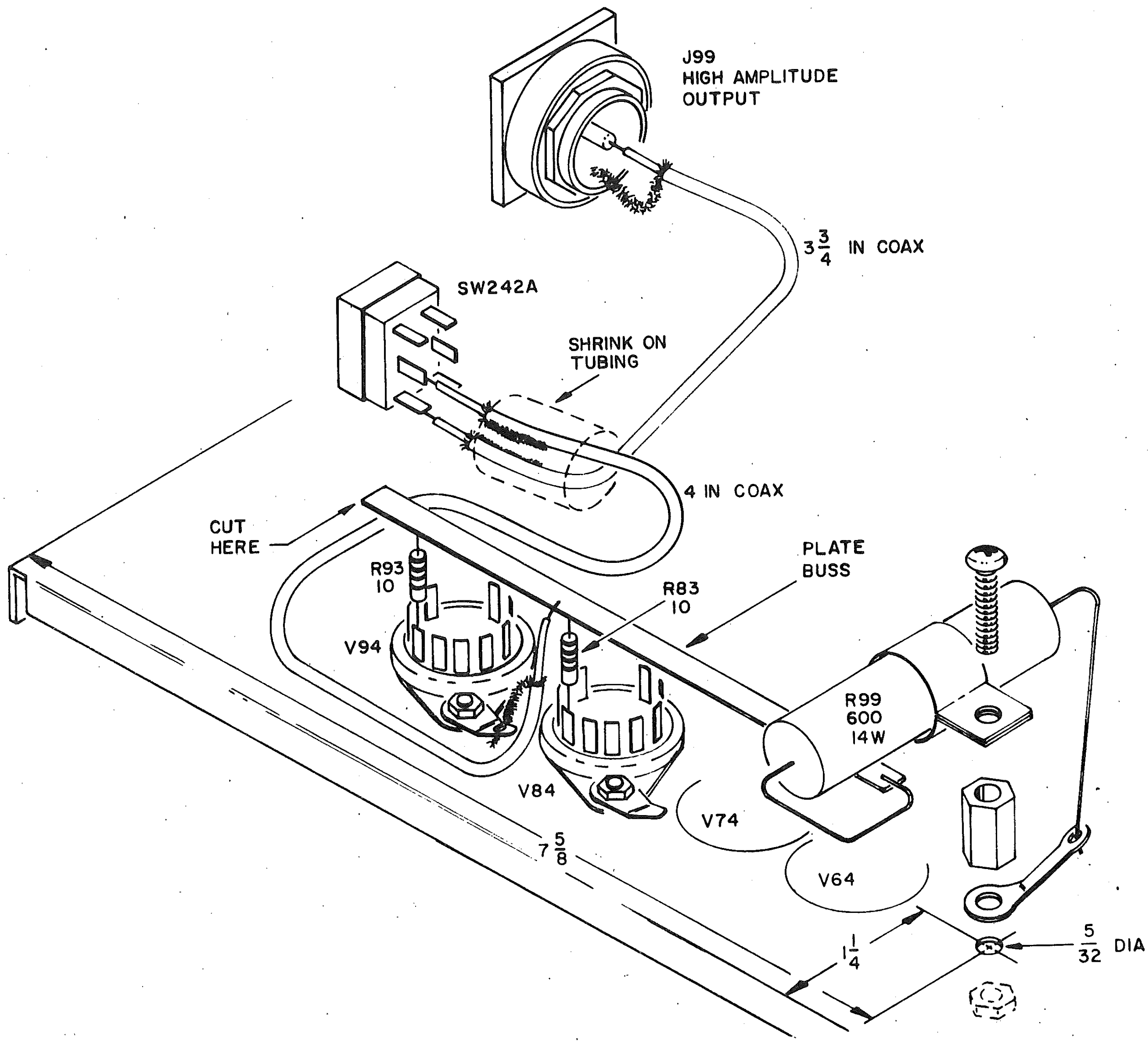
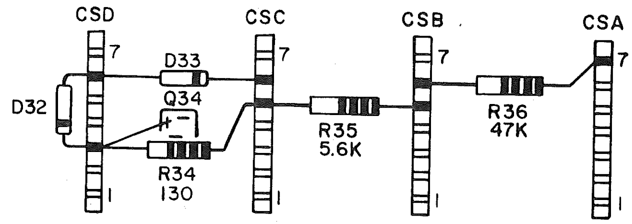


FIG. 2

continued



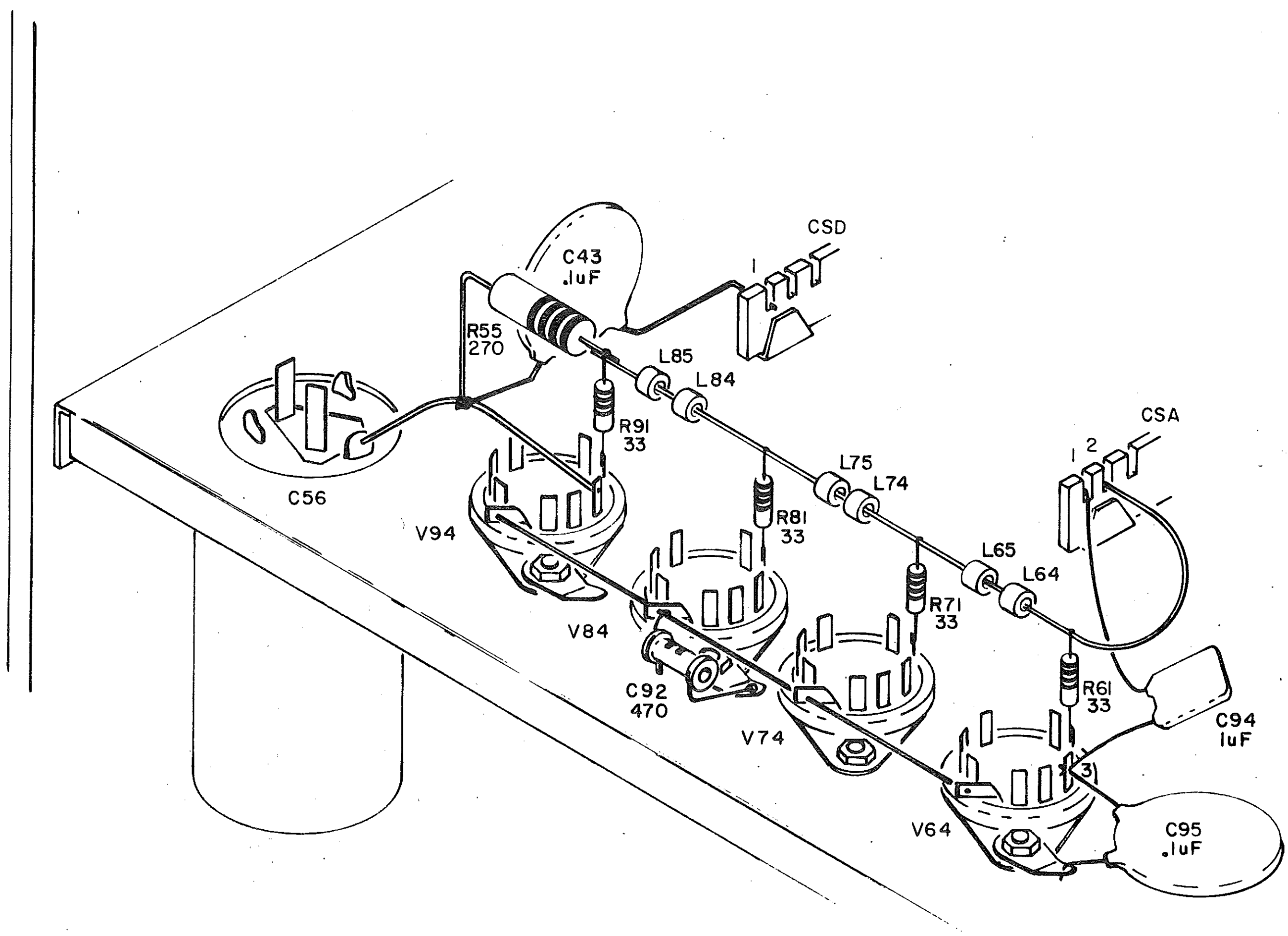


FIG. 3

continued

PART II -- ALL INSTRUMENTS (SN 202-626)

a) Replace the #4 lockwashers on the outboard tube socket mounting screws of V64 and V94, with #4 solder lugs.

b) Unsolder the coax, if present, (center conductor) from the plate buss of V64 - V94, and the shield from solder lug near V94.

c) Replace R56, a 10Ω 1W 10% resistor, connected between C56 (-term) and pin 3 of V94 with a length of #14 bare wire.

d) Replace C95, a 200pF capacitor, located between pin 3 of V84 and solder lug, with a 0.1 μF capacitor, and relocate to connect between pin 3 of V64 and solder lug near V64.

e) Replace R35, a 3.9k 1/4W 5% resistor, located between CSB-5 and CSC-5, with a 5.6k 1/2W resistor.

f) Replace R36, a 82k 1/4 W 5% resistor, located between CSB-6, and CSC-7, with a 47k 1/2W resistor.

g) Replace C94, a 1000pF 500V capacitor, located between pin 3 of V64 and CSA-6, with a 1 μF 25V capacitor, and relocate to connect between pin 3 of V64 and CSA-1.

h) Install C43, a 0.1 μF 500V capacitor, between the negative terminal of C56 and CSD-1.

j) Connect pin 6 of V64 - V74, - V84 and V94 together with a 3-1/2 in. length of #16 bare wire.

k) Remove R55, a 270Ω 1W resistor located between pin 3 of V64 and CSA-2.

m) Temporarily unsolder R91, R81, and R71 from the output tubes grid line. Install L64, L65, two ferrite beads on the grid line between R61 and R71, resolder R71 to grid line.

In a like manner, install L74 and L75 between R71 and R81, and L84 and L85 between R81 and R91.

n) Install R55, a 270Ω resistor, removed in step k, between the negative terminal of C56 and other end to the junction of R91 and the output tubes grid line.

p) Solder the center conductor of coax to output plate line near V94 and ground to outboard solder lug on V94 socket.

q) Install C93, a 470pF 500V capacitor, between pin 6 of V84 and ground lug near V84.

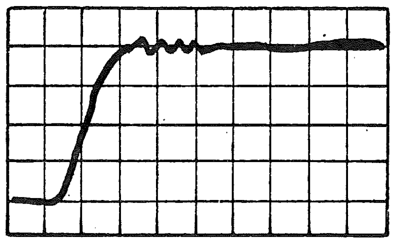
r) Replace Q34, a 151-0108-00 type transistor, with a 2N3904, PN 151-0190-00 type transistor.

+10 VOLT POWER SUPPLY REGULATION IMPROVED AT LOW LINE VOLTAGE — See SQB — M11451

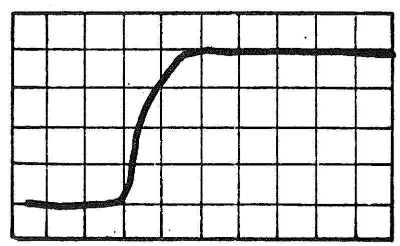
Effective Prod SN 680 — Usable in field instruments SN 200-679

FRONT PANEL SYMPTOM: Ripple on FAST RISE OUTPUT.

BEFORE



AFTER



PROBLEM: Ripple on the 10 V supply under worst case power line conditions.

When we have the following conditions there will be ripple on the FAST RISE OUTPUT:

1. Low Power Line Voltage (105).

2a. A +TRANSITION AMPLITUDE minimum (ccw) - TRANSITION AMPLITUDE maximum (cw) or

2b. The reverse of 2a.

The Ripple on the OUTPUT is a direct function of the 10 V supply.

PRODUCTION CHANGE: Q217, the -10 V constant voltage source transistor, was changed from a 2N2905 to a 2N4036. Use of the new transistor necessitated changing the collector resistor R217 from 27 Ω to 10 Ω, and connecting terminal 15 of T201 to ground. M11324 ungrounded terminal 15. At the same time, C213 a 100 µF capacitor was added to the collector of Q213 to ground. This Mod supersedes a portion of M11324.

Parts Removed:

Q217	Transistor, 2N2905	151-0134-00
R217	Resistor, 27 Ω 1 W 10%	304-0270-00

Parts Added:

Q217	Transistor, 2N4036	151-0208-00
C213	Capacitor, 100 µF 30 V	290-0137-00
R217	Resistor, 10 Ω 1 W 10%	304-0100-00
	Wire, #22 solid ins. white	175-0522-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

continued.

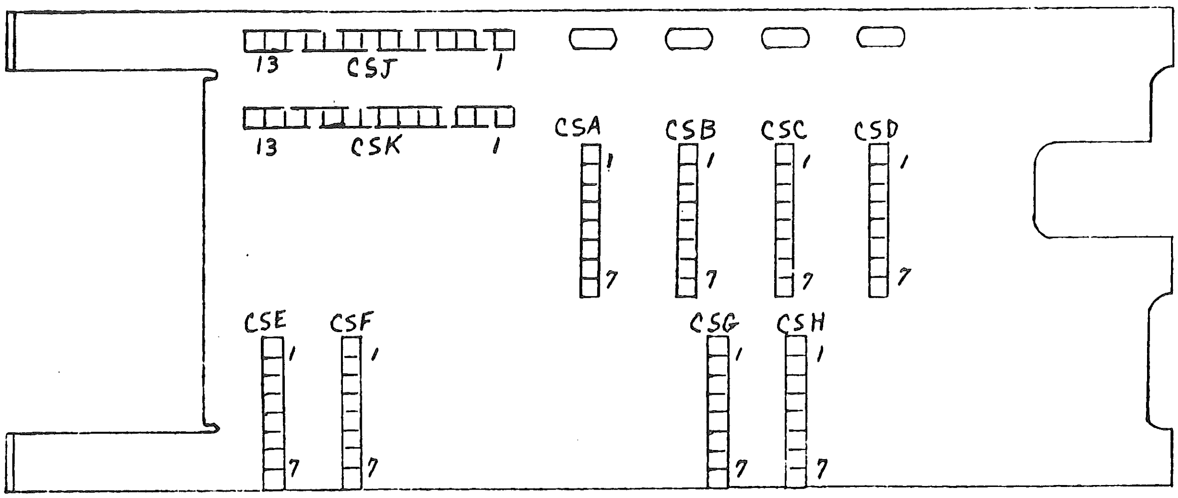
a) Replace R217, a 27Ω 1 W 10% resistor, located between CSE-3 and CSF-3, with a 10Ω 1 W 10% resistor.

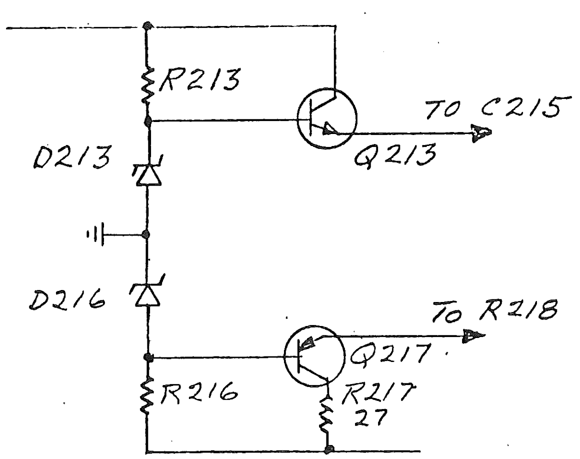
b) Replace Q217, a 2N2905 type transistor with a 2N4036.

c) Install a bare wire from CSE-2 to the ground lug next to CSE.

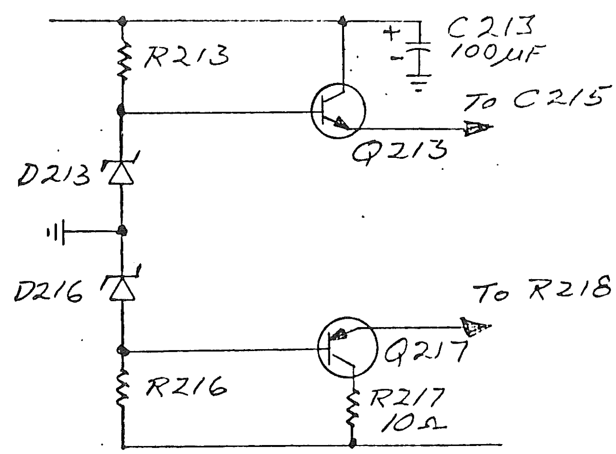
d) Install C213, a 100 μF 30 V capacitor, between CSE-2 and CS F-1.

e) Install a #22 white wire from terminal 15 of T201 to ground lug near Q233, if not present.





BEFORE



AFTER

SYNC AMP DIODE REPLACED TO IMPROVE TEMPERATURE STABILITY — See SQB — M11927

Effective Prod SN 698 — Usable in field instruments SN 200-697

w/exception 201	390	563-4	602	627	663-4	692
212	404-5	569	604	634-5	667-70	694
234	426	573-6	609	637-8	673	Also 592
243	435	582	611	643-50	676	
341	532	585	616	652-5	679	
346	534	596	621-3	657-9	684	
364	549	599-600	625	661	688	

FRONT PANEL SYMPTOM: Frequency change with temperature.

PROBLEM: D4 leakage changes with temperature, causing the bias and output impedance of Q4 to change. Approximately 5% change in frequency occurs for every 30° F change. This change was also observed when only D4 temperature was changed.

PRODUCTION CHANGE: D4 was changed from an ED2007 diode to a signal diode with a 2.7 M resistor added in parallel.

Parts Removed:

D4	Diode ED 2007	152-0071-00

Parts Added:

D4	Diode, signal 6185	152-0185-00
R5	Resistor, comp 2.7 M 5% 1/2 W	301-0275-00

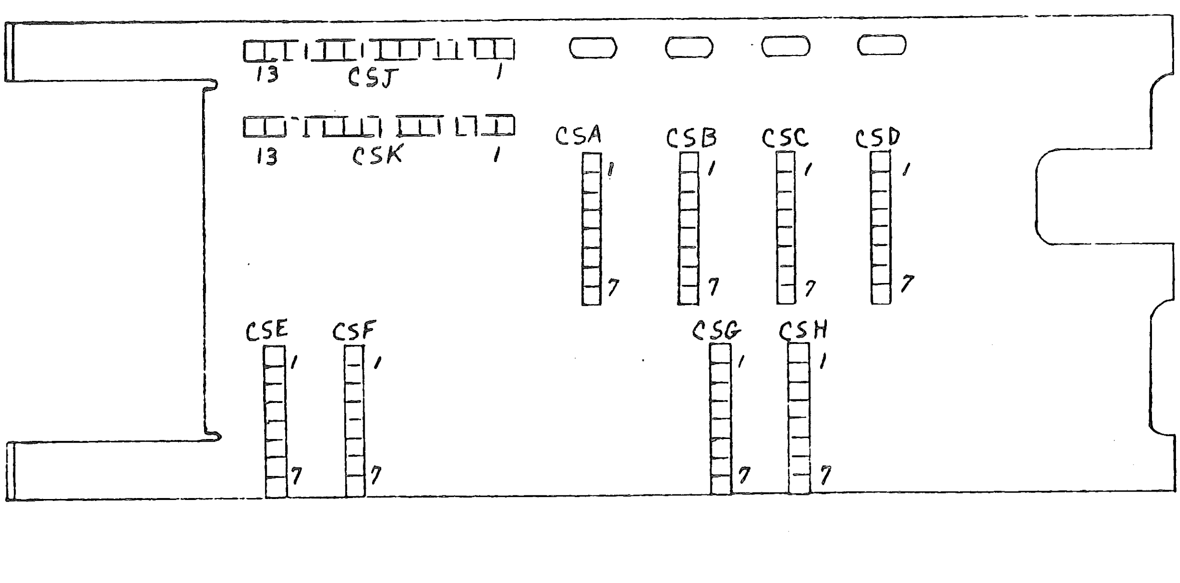
INSTALLATION INSTRUCTION:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace D4, an ED2007 type diode, located between CSG-5 and CSH-5, with a signal diode. Install with banded end to CSG-5.

Install R5, a 2.7 M 5% resistor, in parallel with D4.



POWER SUPPLY SERIES REGULATOR CHANGED TO IMPROVE RELIABILITY — See SQB — M12074

Effective Prod SN 778 — Usable in field instruments SN 200-777

modified out of sequence

201	549	609	652-5	699
212	563-4	611	657-9	701
234	573-6	616	664	719
243	582	621-3	668	721
341	585	625	670	723
346	596	627	673-8	725-6
404-5	599	634-5	680-1	753-4
426	600	637-8	685-7	764
532	602	643	689-2	775
534	604	650	696	

FRONT PANEL SYMPTOM: Output remains at maximum amplitude irrespective of amplitude control.

PROBLEM: Power dissipated by Q247 exceeds limits, and the transistor goes into secondary breakdown. Also, the supplier of Q247 (151-0196-00) changed the flange on Q247, which resulted in an increased thermal resistance between Q247 and its flange. This change was enough to make the problem show more severely. This mod is superseded by M13127.

PRODUCTION CHANGE: Q247 was changed to 2N3739 (151-0201-00) type transistor.

Parts Removed:

	Chassis	441-0664-00
Q247	Transistor, silicon NPN 2N3440	151-0196-00
	Nut, Keps steel 4-40 x 1/4 (2)	210-0586-00
	Washer, fiber #4 shoulder (2)	210-0849-00
	Screw, 4-40 x 5/16 Pan HS (2)	211-0097-00
	Insul. plate mica	386-1094-00
	Washer, flat steel .125 TD x .250 OD (2)	210-0994-00

Parts Added:

	Chassis	441-0664-01
Q247	Transistor, silicon NPN 2N3739	151-0201-00
	Lug, solder SE-6	210-0202-00
	Nut, Keps steel 6-32 x 1/4 (2)	210-0457-00
	Washer, steel 6S x 5/16 (2)	210-0802-00
	Washer, shoulder #6 (2)	210-0811-00
	Screw, 6-32 x 3/8 PHS (2)	211-0510-00
	Plate, mica insul	386-0143-00

continued

INSTALLATION INSTRUCTIONS:

Parts Required:

Modification Kit 040-0476-00

Installation Procedure:

Refer to kit instructions.

MOTOR BASE CONNECTOR CHANGED TO FACILITATE ASSEMBLY AND REDUCE COST — INFORMATION ONLY — M9271

Effective Prod SN 802

FRONT PANEL SYMPTOM: None.

PROBLEM: To reduce cost and facilitate fabrication of Tek made motor bases by adapting them for automated machinery.

This mod is superseded by M12876.

The ground connection for the three wire motor base installed by the mod proved to be inadequate.

PRODUCTION CHANGE: Tek made motor bases 131-0102-00, 131-0150-00 and 131-0430-00 were replaced with new Tek made motor bases 131-0102-01, 131-0150-01 and 131-0430-01 respectively. New and old differ in method used for their assembly and their subparts. Old motor bases use a #4 nut, lockwasher and screw on one side and a #4 nut, lockwasher and externally threaded ground post on other side.

New motor bases use a #4 self-tapping screw into new cover 200-0185-01 on one side and a #4 sems screw into new interanlly threaded ground post 129-0041-01 on other side.

Parts Removed:	Motor base	131-0102-00
Parts Added:	Motor base	131-0102-01

NEGATIVE OUTPUT RISETIME IMPROVED BY CHANGING Q134 TO A 2N4275 — See SQB — M12309

Effective Prod SN 930 — Usable in field instruments SN 200-929

FRONT PANEL SYMPTOM: The risetime at the negative output of the fastrise exceeds 1 ns.

PROBLEM: The 151-0109-00 transistors supplied by a second source, do not produce the required risetime at the output, even though they meet specifications. Shipment by the first source was delayed.

PRODUCTION CHANGE: Q134 was changed to meet the 1 ns maximum risetime requirement.

Parts Removed:

Q134	Transistor, silicon, NPN	151-0109-00

Parts Added:

Q134	Transistor, 2N4275, silicon NPN, plastic	151-0223-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace Q134, a silicon transistor located on the negative output circuit board, with a 2N4275 type transistor. The new transistor is a direct replacement.

3-WIRE POWER CORD FEMALE GROUND CONNECTION IMPROVED BY THE ADDITION OF A SPRING — See SQB (Accessories) — M11292

Effective Prod SN 970 — Usable in field instruments SN 200-969

FRONT PANEL SYMPTOM: None.

PROBLEM: Inadequate ground connection between power cord and instrument motor base.

PRODUCTION CHANGE: A ground spring was added to the non-current carrying ground receptacle on the female connector end of the power cord.

Parts Removed:	None	
Parts Added:	Spring, power cord ground (subpart of power cord (161-0024-01)	214-0698-00

INSTALLATION INSTRUCTIONS:

Parts Required:

See 'Parts Added', or part listed below.

Field Modification Kit 040-0424-01

NOTE: Field Mod Kit includes enough springs to modify 25 power cords.

Installation Procedure:

Refer to mod kit instructions.

POWER LIGHT COLOR CHANGED TO STANDARD GREEN — INFORMATION ONLY — M12031

Effective Prod SN 1170

FRONT PANEL SYMPTOM: None.

PROBLEM: More than one color was being used for the POWER ON light.

PRODUCTION CHANGE: All lights were changed to green.

Parts Removed:

B219	Lamp, cart 10 V 40 mA white	150-0052-00

Parts Added:

B219	Lamp, cart 10 V 40 mA green lens, flat	150-0065-00

+ AND - FAST RISE OUTPUT ADJ
CAPACITORS C107 - C127 CHANGED TO EASE CAL AND Q104 - Q114 REPLACED TO REALIZE COST SAVING

INFORMATION ONLY

M12606-1

Effective Prod SN 1190

modified out of sequence 942 953 1032 1044 1067 1077 1081
1089 1156-7 1159 1163-4 1168-71

FRONT PANEL SYMPTOM: None.

PROBLEM: 1) The range of adjustment of C107 and C127 was not large enough in all cases requiring the Test Department to select caps at the high end of the tolerance range.
2) Lower cost transistors are available to replace Q103 and Q114 and are direct replacements.

PRODUCTION CHANGE: 1) C107 and C127 were changed from 2-8 pF variable capacitors to 5.5 - 18 pF caps.
2) Q103 was changed from a 2N2501 to a 2N4275 type transistor and Q114 was changed from a 151-0142-00 to a 2N4258 type transistor.

Parts Removed:

C107, C127	Capacitor, var ceramic 2-8 pF	281-0091-00
Q103	Transistor, 2N2501 silicon	151-0108-00
Q114	Transistor, silicon PNP	151-0142-00

Parts Added:

C107, C127	Capacitor, var ceramic 5.5 - 18 pF	281-0093-00
Q103	Transistor, 2N4275 silicon	151-0223-00
Q114	Transistor, 2N4258 silicon	151-0221-00

+ AND - TRANSITION AMPLITUDE
CONTROL CIRCUITS MODIFIED TO ELIMINATE NOISE

See SQB

M12606-2

Effective Prod SN 1190

Usable in field instruments SN 200-1189

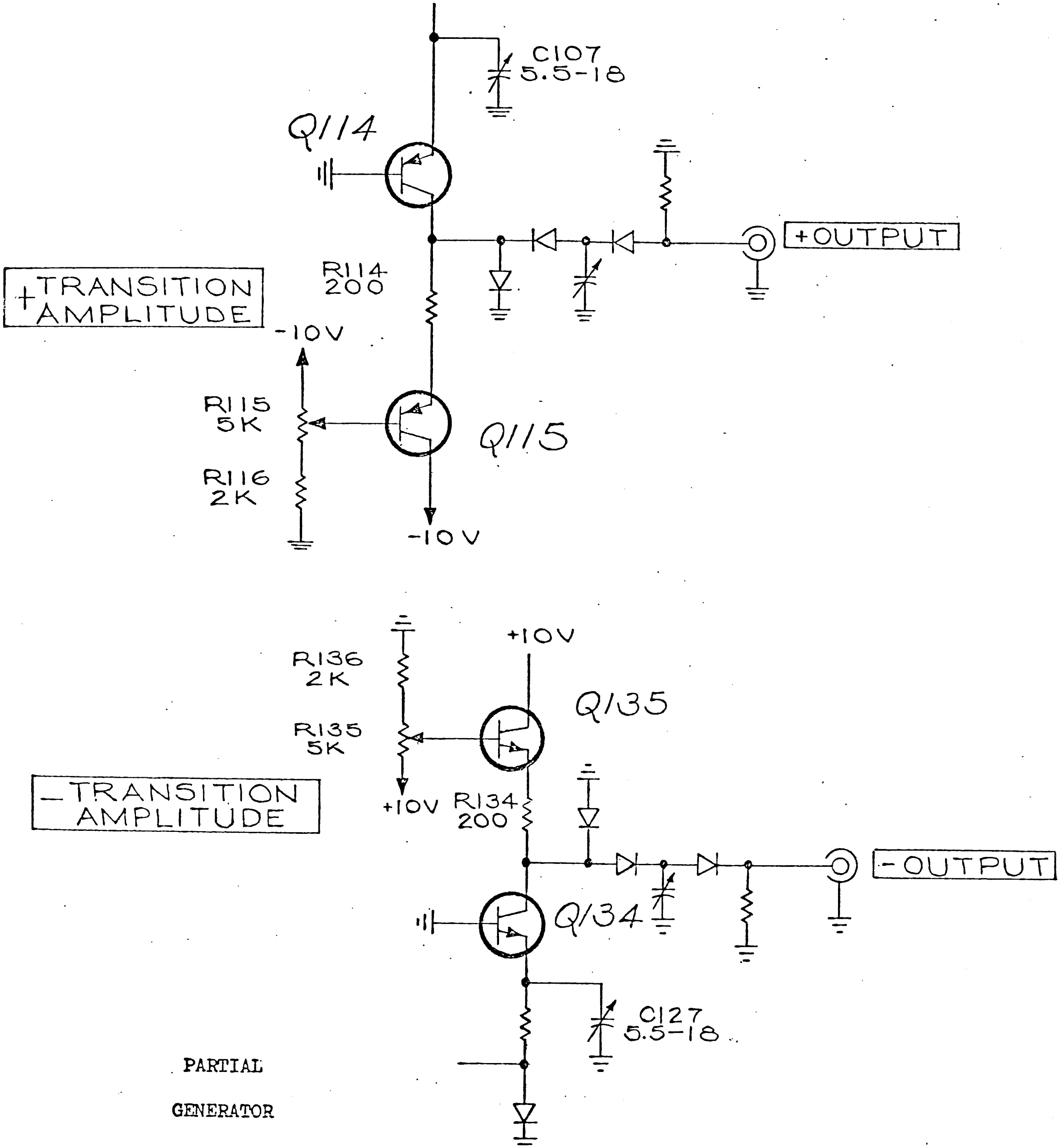
modified out of sequence 942 953 1032 1044 1067 1077 1081
1089 1156-7 1159 1163-4 1168-71

FRONT PANEL SYMPTOM: The + and - TRANSITION AMPLITUDE controls can cause jump or skip in the amplitude while rotating the control.

PROBLEM: The + and - TRANSISTION AMPLITUDE pots, R115 and R135, two 5 k 5 W wire wound log taper pots, may become noisy with age.

PRODUCTION CHANGE: Emitter followers were added between the Transition Amplitude pots and the collector resistors of the output stages to isolate the pots from the output collectors. The addition of the emitter followers, necessitated making several changes. The collector resistor of the output was reduced in value. A resistor was added between the transition pots and ground to limit the lower range. At the same time, the pots were changed from log type wire wounds to linear type carbon pots.

continued



PARTIAL

GENERATOR

continued

Parts Removed:

R115, R135	Resistor, var 5k 5+ 10% WW	311-0587-00
	Circuit Board Assy, -OUTPUT	670-0222-00
	Circuit Board Assy, +OUTPUT	670-0223-00

Parts Added:

R115, R135	Potentiometer, comp 5k ±20% lin	311-0117-00
	Circuit Board Assy, -OUTPUT	670-0222-01
	Circuit Board Assy, +OUTPUT	670-0223-01

- Output Circuit Board Assembly 670-0222-01 is the same as 670-0222-00 except for the following:

Parts Removed:

R134	Resistor, comp 240Ω 1/2W 5%	301-0241-00
	Circuit Board -OUTPUT	388-0686-00

Parts Added:

	Socket, 3-pin transistor	136-0220-00
Q135	Transistor, 2N3904	151-0190-00
R134	Resistor, comp 200Ω 1/2W 5%	301-0201-00
R136	Resistor, comp 2k 1/4W 5%	315-0202-00
	Circuit Board - OUTPUT	388-0686-01

+ Output Circuit Board Assembly 670-0223-01 is the same as 670-0223-00 except for the following:

Parts Removed:

R114	Resistor, comp 240Ω 1/2W 5%	301-0241-00
	Circuit Board +OUTPUT	388-0685-00

Parts Added:

	Socket, 3-pin transistor	136-0220-00
Q115	Transistor, 2N3906 silicon	151-0188-00
R114	Resistor, comp 200Ω 1/2W 5%	301-0201-00
R116	Resistor, comp 2k 1/4W 5%	315-0202-00
	Circuit Board +OUTPUT	388-0685-01

INSTALLATION INSTRUCTIONS:

See MI - 12606 -2

POWER INPUT MOTOR BASE MODIFIED TO MEET CANADIAN STANDARDS ASSOCIATION ACCEPTANCE SPECS | See SQB | M12174

Effective Prod SN 1290 | Usable in field instruments SN 200-1289

FRONT PANEL SYMPTOM: None.

PROBLEM: Motor base connector does not meet Canadian Standards Association acceptance standards.

PRODUCTION CHANGE: A plastic insulating shield was added to motor base connector.

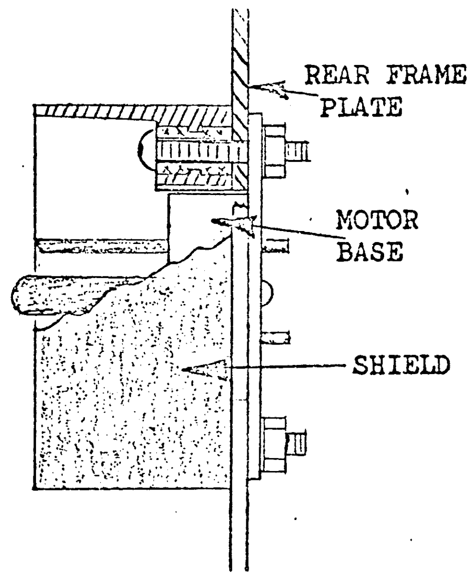
Parts Removed:	Screw, 6-32 x 5/16 THS (2)	211-0542-00
Parts Added:	Shield, motor base polycarbonate 2.035 x 1.00 w/insert (2) 358-0322-00	337-0955-00
	Screw, 6-32 x 3/4 PHS (2)	211-0514-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Install motor base connector shield, as shown in drawing using new mounting screws shown in add list.



MOTOR BASE CHANGED TO IMPROVE GROUND CONNECTION — See SQB — M12876

Effective Prod SN 1355 — Usable in field instruments SN 200-1354

modified out of sequence 928 937 1036 1191 1193 1196 1202 1213-19 1222-29 1232-59 1244 1246-52

FRONT PANEL SYMPTOM: None.

PROBLEM: The present motor base grounding is not adequate, due to cold flow of the plastic between the ground post and the mounting plate.

PRODUCTION CHANGE: The method used to attach the ground post in the motor base assemblies was changed. The new mounting eliminates plastic between the ground post and the mounting plate and provides a metal to metal ground connection. To insure a good fit between mating parts, the size of the mounting screws was changed from #4 to #6, and the clearance holes in the mounting plate and shell were increased to #6.

To prevent corrosion between new ground post and mounting plate, the plate was changed from etched aluminum to cad plated steel.

Parts Removed:	Motor base	131-0102-01
Parts Added:	Motor base	131-0102-02

INSTALLATION INSTRUCTIONS:

See MI - 12876

POWER SUPPLY SERIES REGULATOR CHANGED TO IMPROVE RELIABILITY

See SQB

M13127

Effective Prod SN 1355

Usable in field instruments SN 778-1354

928	1202	1255-57	1278	1311
937	1209	1258-59	1292-3	1313-4
1036	1213-19	1262-66	1298	1320
1191	1222-29	1268-69	1300	1328
1193	1232-44	1272	1305	1330-1
1196	1246-52	1275-76	1308-9	1334-54

FRONT PANEL SYMPTOM: None.

PROBLEM: The series regulator Q247, a 2N3739, is being operated beyond its safe operating region. If Q247 shorts monentarily, Q234 saturates and places approximately 150 V across R235, a 3k 1/4 W resistor which destroys it.

PRODUCTION CHANGE: Q247 was changed from a 2N3739 transistor to a 2N4240. To accommadate the transistor, several circuit components must also be changed. See schematic.

Parts Removed:

Q247	Transistor, silicon NPN 2N3739	151-0201-00
C56	Capacitor, 2 x 40 μF 250 V EMC	290-0012-00
R242	Resistor, 150 Ω 10 W WW	308-0315-00
R241	Resistor, 100 Ω 1/4 W 10%	316-0101-00

Parts Added:

Q247	Transistor, silicon 2N4240	151-0251-00
* C56	Capacitor, 2 x 10 μF 250 V	290-0075-00
R242	Resistor, 27 Ω 2 W 10%	306-0270-00
R241	Resistor, 47 Ω 1/4 W 10%	316-0470-00
C247, C248	Capacitor, 2 μF 150 V EMC	290-0159-00

* 290-0075-00 is a 2 x 10 μF capacitor. Only one 10 μF section will be utilized for C56.

INSTALLATION INSTRUCTIONS:

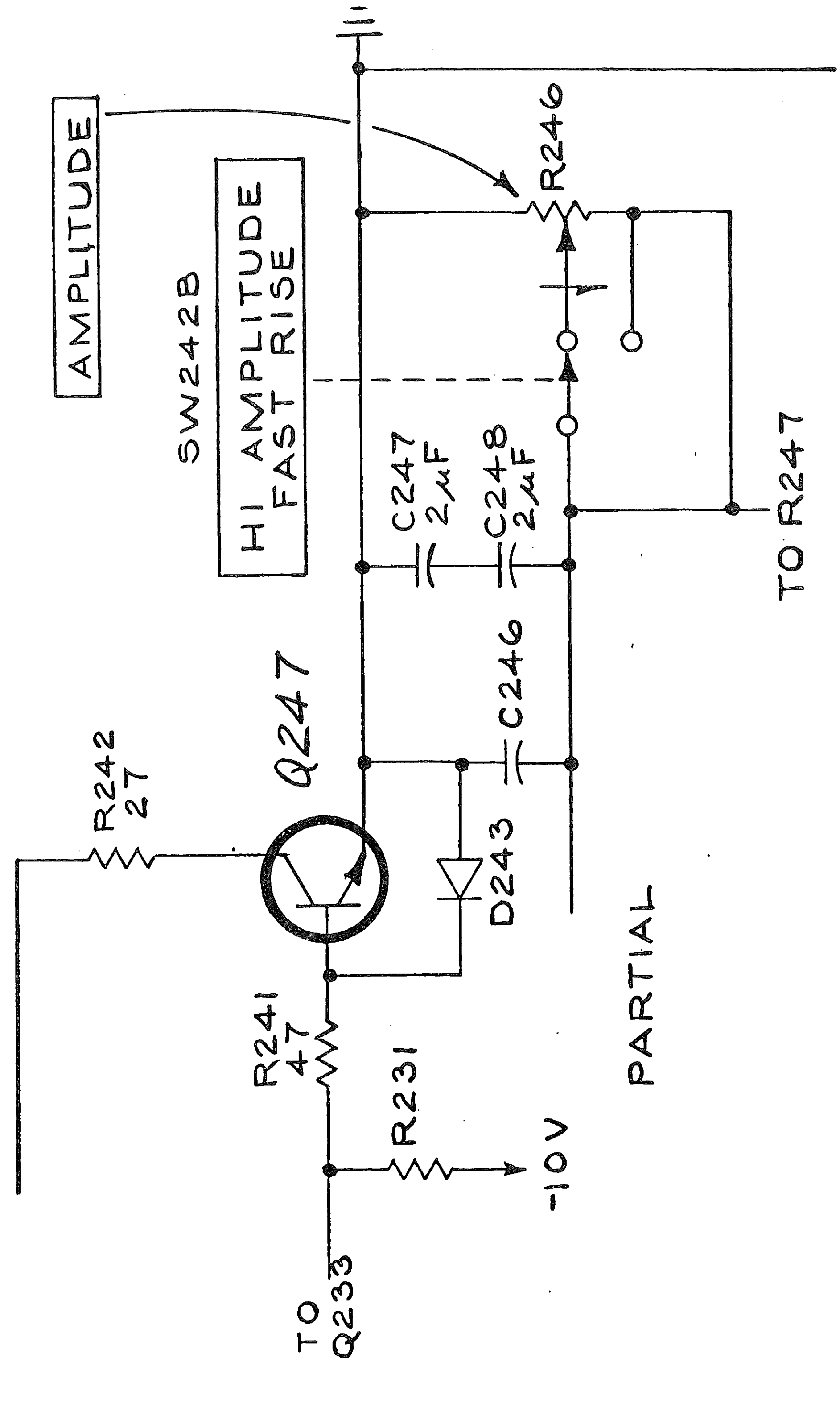
Parts Required:

Modification Kit 040-0476-00

Installation Procedure:

Use kit instructions.

continued


AMPLITUDE
SW242B
HI AMPLITUDE
FAST RISE
R246
C247
2μF
C248
2μF
TO R247
Q247
C246
R242
27
D243
PARTIAL
R241
47
R231
-10V
TO
Q233

+ AND - TRANSITION AMPLITUDE POTENTIOMETER RANGE CHANGED TO ALLOW FOR GREATER POT TOLERANCES

INFORMATION ONLY

M13083

Effective Prod SN 1450

FRONT PANEL SYMPTOM: + and - FAST RISE outputs will not reduce to less than 50 mV.

PROBLEM: The resistors, R116 and R136, in series with the TRANSITION AMPLITUDE pots installed by M12606-2 to limit the lower range of the TRANSITION AMPLITUDE controls, do not allow for pot tolerances.

PRODUCTION CHANGE: R116 and R136 were reduced in value to 1.8k.

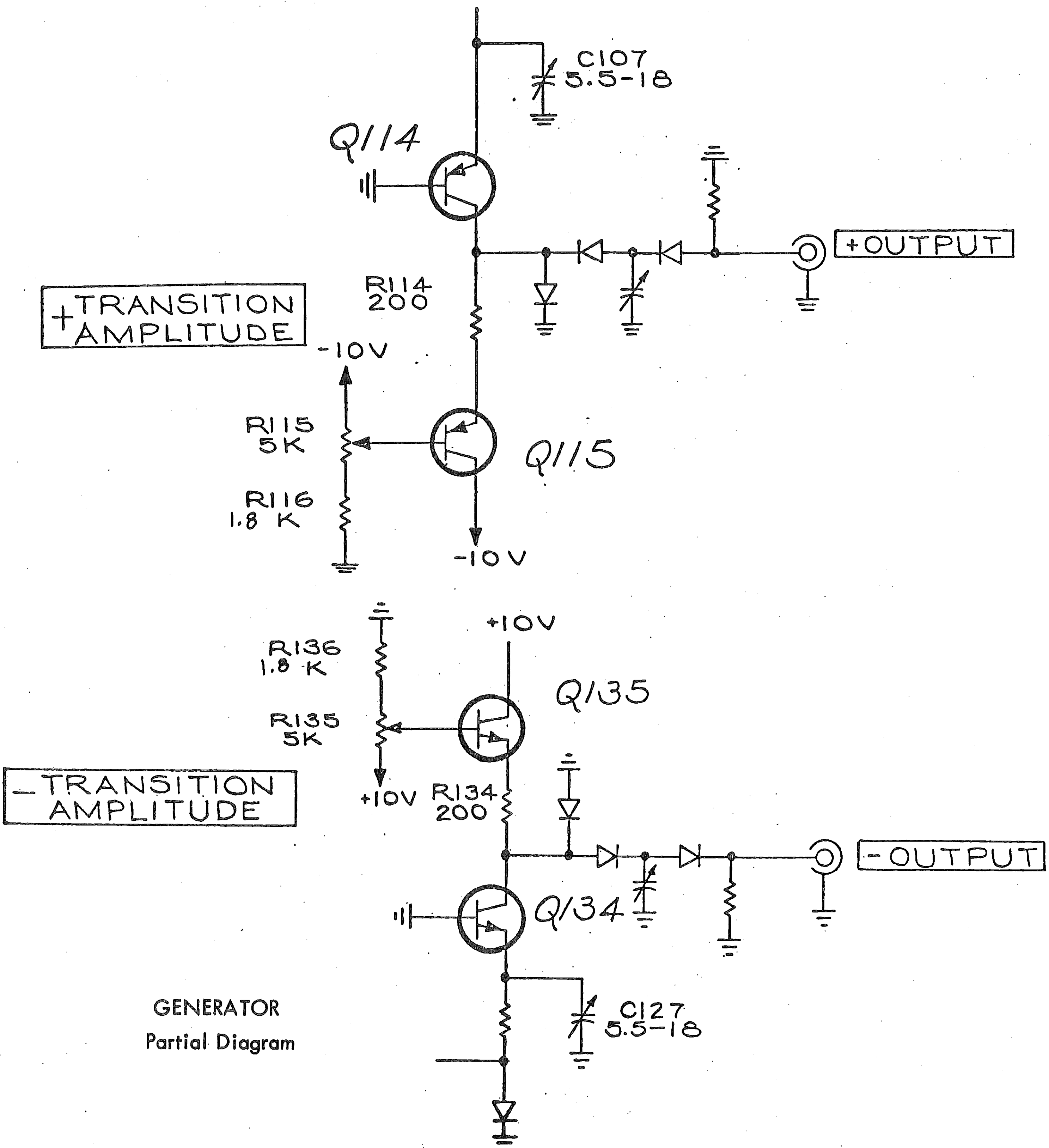
Parts Removed:

R116, R136	Resistor, comp 2k 1/4 W 5%	315-0202-00

Parts Added:

R116, R136	Resistor, comp 1.8k 1/4 W 5%	315-0182-00

continued



GENERATOR
Partial Diagram

MULTI OUTPUT AMPLIFIER CIRCUIT MODIFIED TO IMPROVE TRIGGER OUTPUT AMPLITUDE & PULSE OUT SYMMETRY	See SQB	M13187

Effective Prod SN 1480 — Usable in field instruments SN 627-1479

FRONT PANEL SYMPTOM: Trigger output amplitude not making specifications at 1 MHz or output pulse symmetry range not making specifications at 1 MHz, when it does at 10 kHz.

PROBLEM: D33 was breaking down with 15 V reverse bias causing it to act like a 15 V zener. This limited the TRIGGER OUTPUT Amplitude.

The forward current required to pass through D33 did not generate sufficient forward voltage drop to keep Q34 from saturating. This caused the symmetry to be out of specifications.

PRODUCTION CHANGE: The circuit and the diodes used to prevent Q34 from saturating were changed as shown to a circuit less sensitive to the characteristics of components.

Parts Removed:

D33	Diode, germanium	152-0071-00
R15	Resistor, 130Ω 1/2 W 5%	301-0131-00

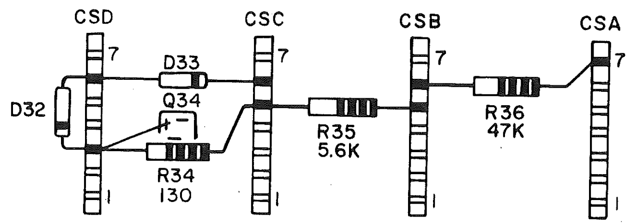
Parts Added:

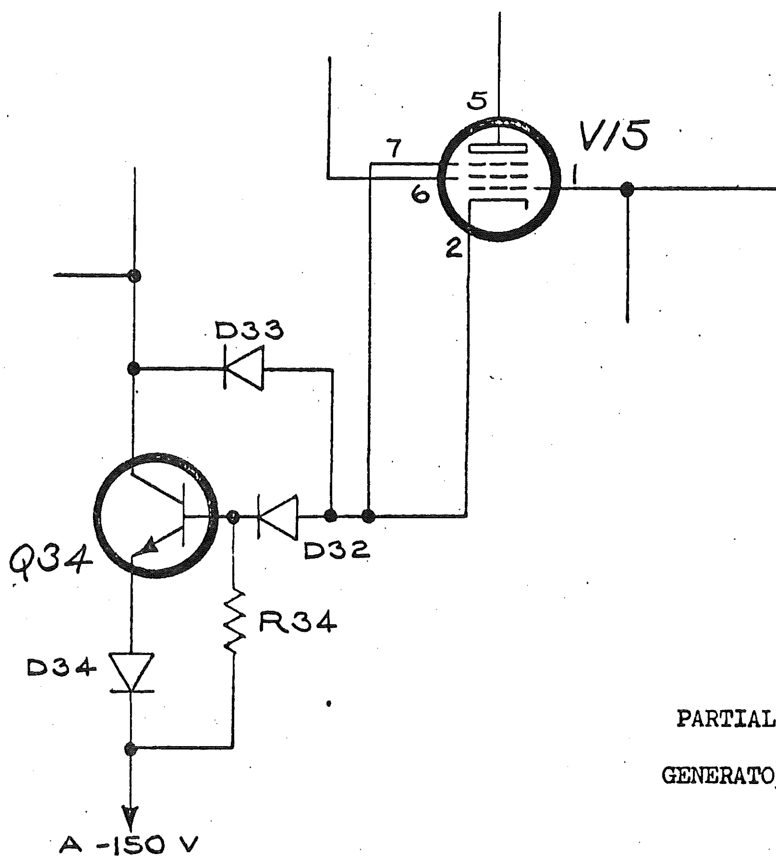
D32, D33	Diode, silicon	152-0185-00
R34	Resistor, 130Ω 1/2 W 5%	301-0131-00

INSTALLATION INSTRUCTIONS:

See MI - 13187

continued





PARTIAL

GENERATOR

MOD 146B A REGULAR INSTRUMENT WITHOUT CABINET FOR MOUNTING IN RACK ADAPTER MADE AVAILABLE AS PRODUCTION SPECIAL

INFORMATION ONLY

M11678

Effective Prod SN 1500

FRONT PANEL SYMPTOM: None.

PROBLEM: There was an increase in demand for Special Mod 146B, a mod which provides a standard instrument with a rack mounting adapter in place of a standard cabinet.

PRODUCTION CHANGE: Mod 146B, a mod which consists of a regular instrument with a rack mount adapter in place of a standard cabinet was set up as a production special. To accommodate the mod, the front panel was changed by the addition of a mod slot. Regular instruments will have a blank tag.

Parts Removed:	None.	
Parts Added:	Tag, mod insert, blank	334-0829-00
	Cable assembly, power elec.	161-0031-00

GENERATOR CIRCUIT CAPACITORS C247 AND C248 REPLACED BY C249 — INFORMATION ONLY — M13204

Effective Prod SN 1550

FRONT PANEL SYMPTOM: None

PROBLEM: M13127 added C247-C248, two 2 μF 150 V EMC capacitors connected in series. A 1 μF 450 V capacitor is now available to replace the two 2 μF capacitors.

PRODUCTION CHANGE: Two 2 μF 150 V series connected capacitors, C247-C248, were replaced by a single 1 μF 450 V capacitor, C249.

Parts Removed:

C247, C248	Capacitor, 2 μF 150 V EMC	290-0159-00

Parts Added:

C249	Capacitor, 1 μF -10% +50%, 450 V	290-0397-00

GENERATOR FREQUENCY MULTIPLIER TIMING CAPS DISCHARGED BY ADDING A BLEEDER RESISTOR — INFORMATION ONLY — M13393

Effective Prod SN 1590

FRONT PANEL SYMPTOM: None.

PROBLEM: The timing capacitors do not have a bleeder resistor and consequently do not discharge when they are switched out of the circuit.

PRODUCTION CHANGE: A bleeder resistor was added in parallel with each timing capacitor.

Parts Removed: None.

Parts Added:

R17B, R27B	Resistor comp., 20 M, 1/2 W 5%	301-0206-00
R17C, R27C R17D, R27D	Resistor comp., 22 M, 1/2 W 5%	301-0226-00
R17E, R27E	Resistor comp., 9.1 M, 1/2 W 5%	301-0915-00

JT:bl

LINE SELECTOR SWITCHES FAIL TO MEET STANDARDS OF CANADIAN STANDARDS ASSOCIATION

INFORMATION ONLY

M13660

Effective Prod SN 1620

FRONT PANEL SYMPTOM: None.

PROBLEM: The line selector switch does not meet Canadian safety standards. The spacing between the switch terminals and the case is such that solder build-up on terminals presents a possible short between the terminals and the case.

PRODUCTION CHANGE: A fiberboard solder shield is added over the terminals before soldering.

Parts Removed: None.

Parts Added:	Shield, solder, S.L. Switch	337-1036-00

JT:bl

MODIFICATION INSTRUCTIONS

MI - 12606-2

Type 106 Square-Wave Generator

Serial numbers 200-1189

ELIMINATES NOISE CAUSED BY TRANSITION AMPLITUDE POTENTIOMETERS

This modification replaces the wirewound, log taper potentiometers, R115 and R135, the + and - TRANSITION AMPLITUDE potentiometers with composition linear taper type potentiometers.

The wirewound potentiometer had a tendency to by noisy and to cause jump or skip in the output waveform when the control was rotated.

This modification adds an emitter follower in series with the transition amplitude potentiometers, and changes the value of several components.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	136-0220-00	Socket, transistor, 3-pin
1 ea	151-0188-00	Transistor, 2N3906 PNP
1 ea	151-0190-00	Transistor, 2N3904 NPN
2 ea	301-0201-00	Resistor, comp, 200Ω 1/2W 5%
2 ea	311-0117-00	Resistor, comp, 5k linear ±20% var
2 ea	315-0182-00	Resistor, comp, 1.8k 1/4W 5%

INSTALLATION

1) Remove R115 and R135, the + and - TRANSITION AMPLITUDE potentiometers, located on the front panel. Install the new type potentiometers. They will be wired in later steps.

2) Remove R114 on the + Output board and R134 on the - Output board, two 240Ω 1/2W 5% resistors.

3) Unsolder the white-green wire from the back of the + Output board. The other end was connected to R115.

4) Unsolder the white-blue wire from the back of the - Output board. The other end was connected to R135.

5) Unsolder the white-brown-red-black wire from the front of the - Output board.

6) Unsolder the tan-brown-black-brown wire from the back of the + Output board. The other end was connected to R115.

continued

INSTALLATION (continued)

7) Install a 3-pin transistor socket on the - Output board as follows: See Figs. 1 and 2.
   a. Emitter lead in hole vacated by R134 near the edge of the board.
   b. Collector lead in the hole vacated by white-brown-red-black wire.
   c. Base lead will not be soldered to the board. Solder the white-blue wire (removed in step 4) between the base pin and the center terminal of R135.

8) Install a 3-pin transistor socket on the + Output board in a similar manner to step 7. See Figs. 3 and 4.
   a. Emitter lead in hole vacated by R114.
   b. Collector lead in hole vacated by the tan-brown-black-brown wire.
   c. Base lead will not be soldered to the board. Solder the white-green wire (removed in step 3) between the base pin and the center terminal of R115.

9) Install R114, a 200Ω 1/2W 5% resistor, on the + Output board in its new location. See Fig. 3.

10) Install R134, a 200Ω 1/2W 5% resistor, on the - Ouput board in its new location. See Fig. 1.

11) Install R116, a 1.8k 1/4W 5% resistor, between the inside terminal of R115 and ground on the + Output board.

12) Install R136, a 1.8k 1/4W 5% resistor, between the inside terminal of R135 and ground on the - Output board.

13) Install the white-brown-red-black wire (unsoldered in step 5) between the outside terminal of R135 and the collector pin of the new socket on the - Output board.

14) Install the tan-brown-black-brown wire (unsoldered in step 6) between the outside terminal of R115 and the collector pin of the new socket on the + Output board.

15) Install Q115, a 2N3906 transistor, in the new socket on the + Output board.

16) Install Q135, a 2N3904 transistor, in the new socket on the - Output board.

JT:ls

INSTALLATION (continued)

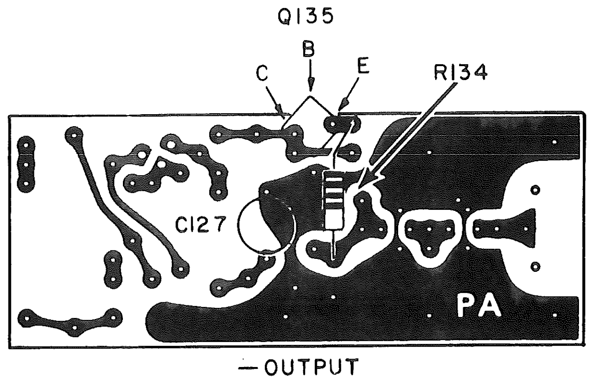


FIG. 1

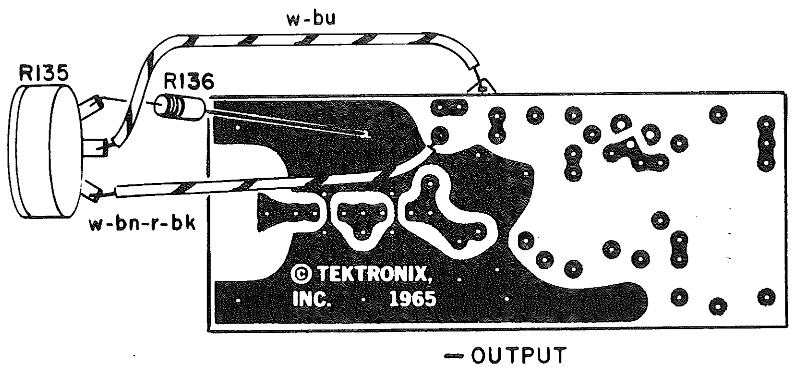


FIG. 2

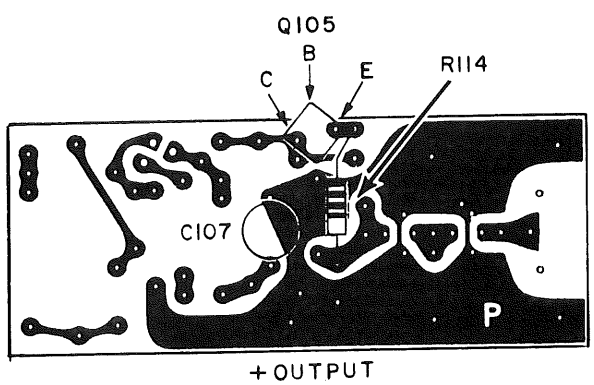


FIG. 3

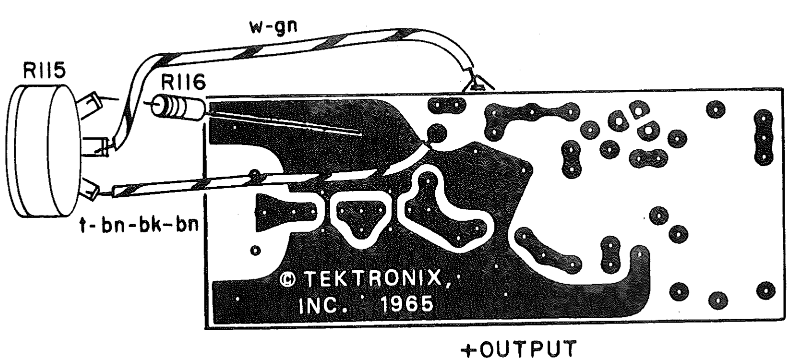
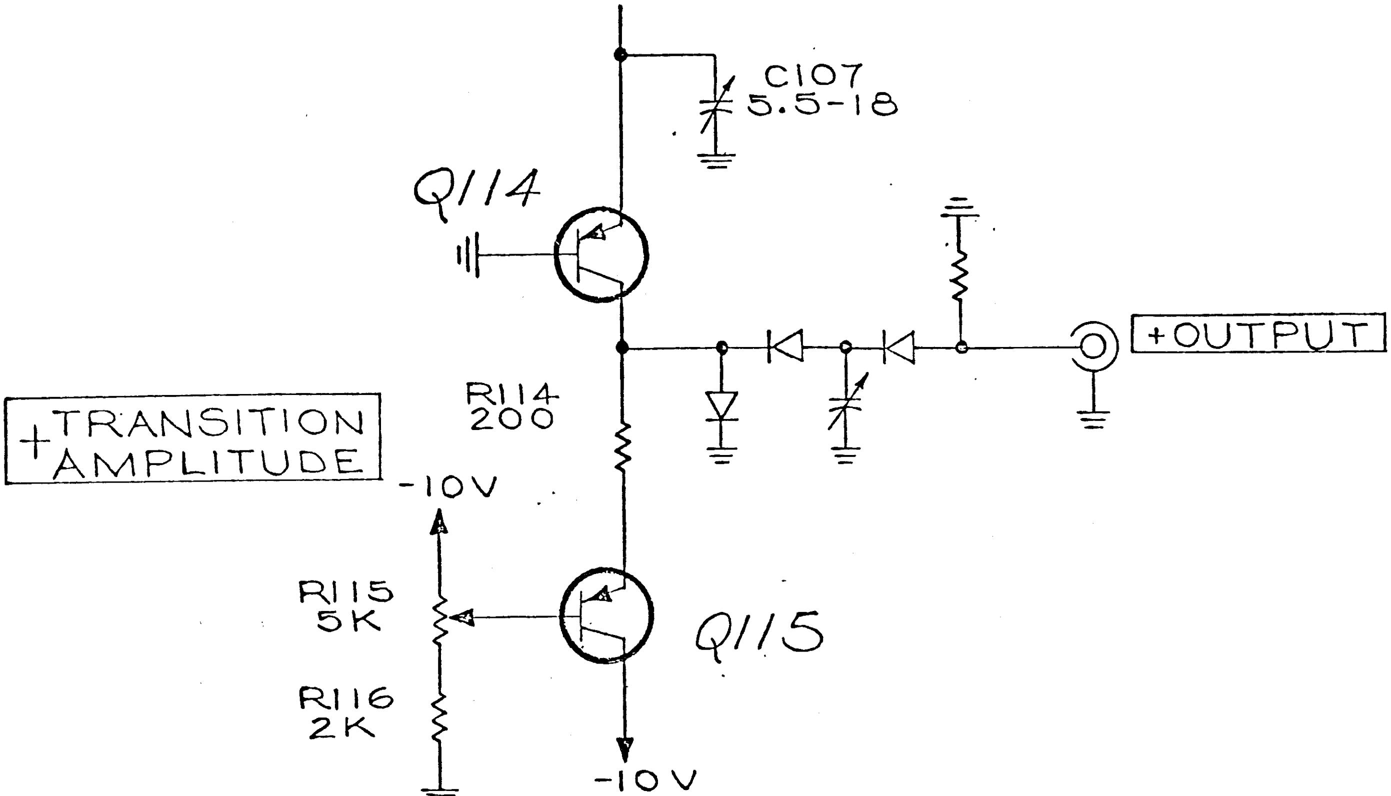
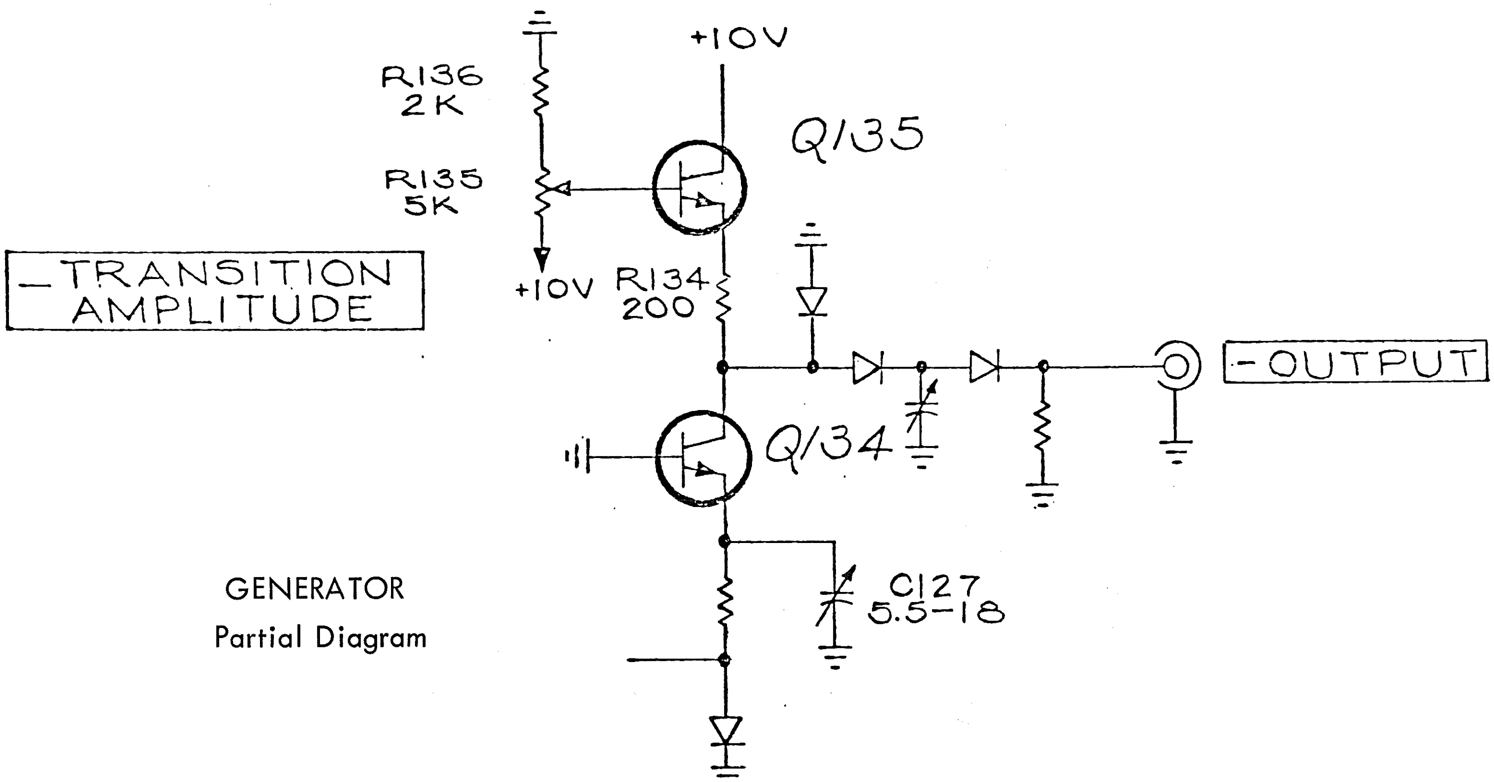


FIG. 4





GENERATOR
Partial Diagram

MODIFICATION INSTRUCTIONS

MI - 13187
Type 106 Squarewave Generator
Serial numbers 627-1479

TRIGGER OUT AMPLITUDE AND PULSE OUT SYMMETRY IMPROVED

To assure proper Output Trigger amplitude and Pulse Out symmetry, it is recommended that diode D33 be replaced, and diode D32 and resistor R34 be added.

These component changes make the Q34 amplifier stage less sensitive to component characteristics, which will help assure proper pulse and trigger output characteristics.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	152-0185-00	Diode, 6185
1 ea	301-0131-00	Resistor, comp, 130Ω 1/2W 5%

INSTALLATION

Refer to Fig. 1 for steps 1 through 5.

1) Remove D33, a germanium diode, located between CSC-6 and CSD-6, above Q34.
2) Relocate a bare wire from CSD-6 to CSD-3. Other end is connected to the base of Q34.
3) Install D33, a 6185 type diode, between CSC-6 and CSD-6. Install with cathode, banded end, to CSC-6.
4) Install R34, a 130Ω 1/2W 5% resistor, between CSD-3 and CSC-5.
5) Install D32, a 6185 type diode, between CSD-3 and CSD-6. Install with cathode to CSD-3.

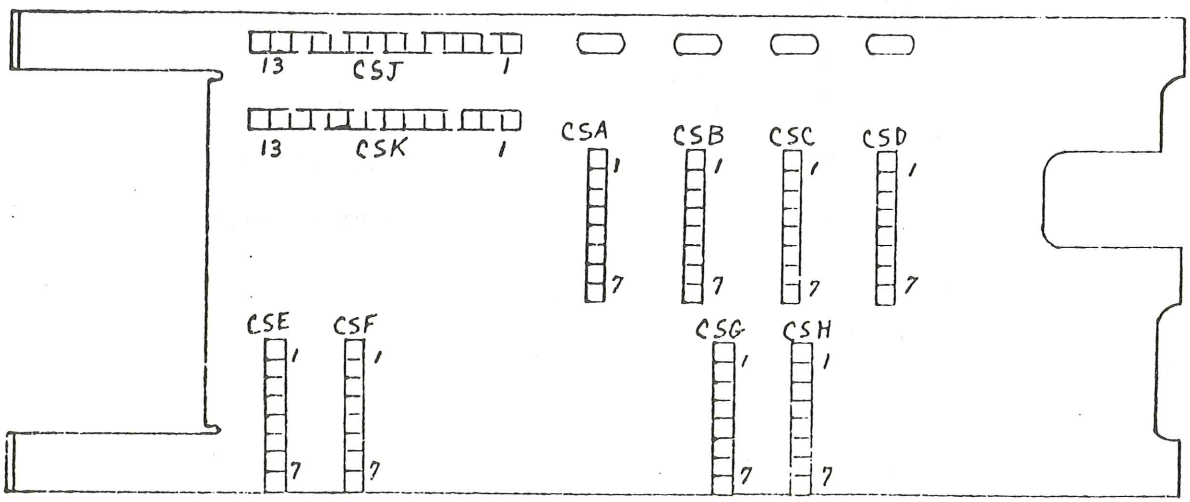


FIG. 1

continued

6) Remove R15, a 130Ω 1/2W resistor, located between pin 7 of V15 and CSE-4. See Fig. 2.

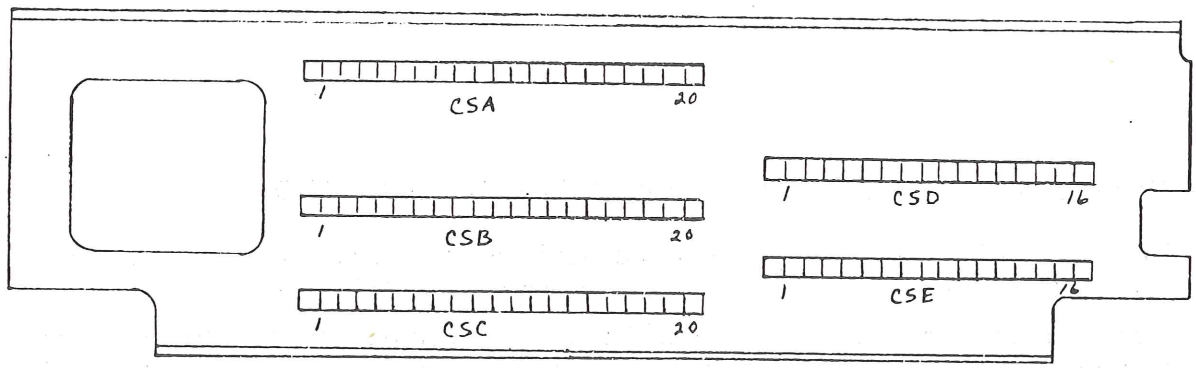
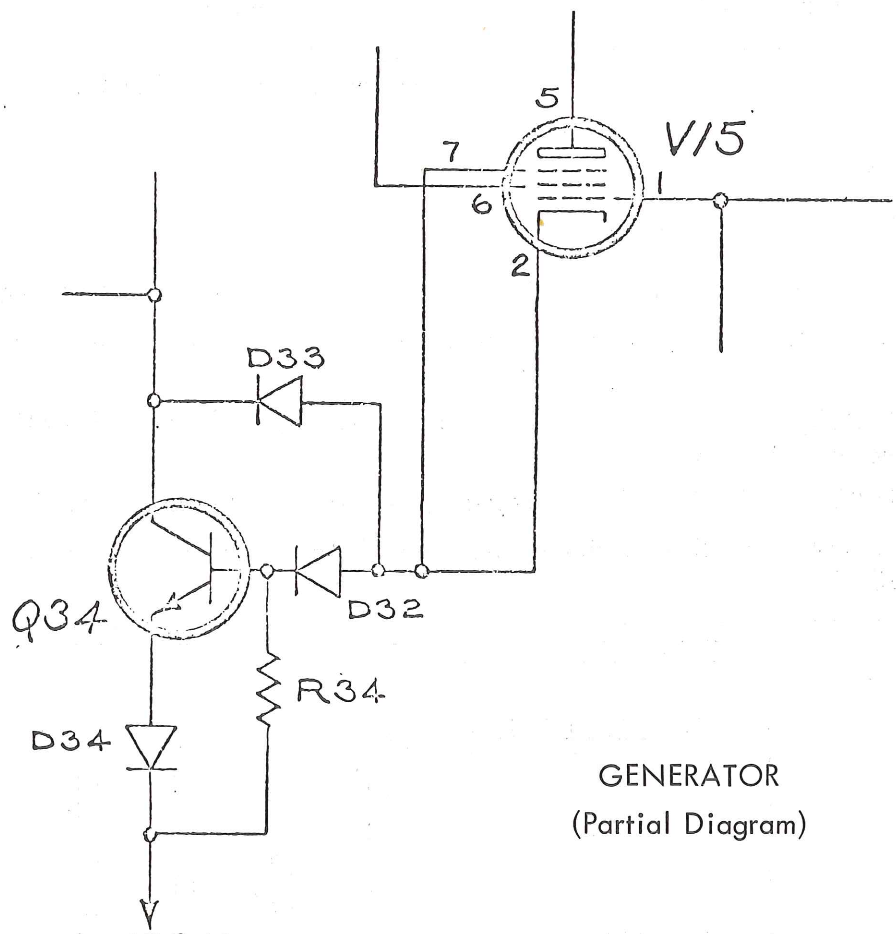


FIG. 2



GENERATOR
(Partial Diagram)

JT:ls

MODIFICATION INSTRUCTIONS

MI - 12876

GENERAL

Serial Numbers - See Below

MOTOR BASE REDESIGNED TO IMPROVE GROUNDING

The present motor base ground post mounts against the plastic motor base body. Due to cold flow in the plastic it is possible for the ground post to loosen, causing poor ground connection.

A new motor base has been designed which eliminates the plastic between the ground post and the metal mounting plate, thereby assuring a good ground connection.

Instrument	Serial No.	Instrument	Serial No.	Instrument	Serial No.
106	200-1354	317	101-5069	543B/RM	100-1588
109	101-1479	RM17	101-929	544/RM	100-979
111	101-1327	422	100-10649	545B/RM	100-8229
114	100-1699	502A	20000-27719	546	100-1099
R116	100-1199	RM503	101-6859	RM546	100-519
125	101-3129	RM504	101-2549	547/RM	100-7209
127	101-2317	507	101-822	549	
129	100-599	515A	1001-9679	551	101-7009
130	101-9879	RM15	101-3539	555	
132	101-2419	516	101-4419	556	100-2085
133	101-789	519	101-1148	R556	100-1049
160A	620-11499	524AD	101-7858	561A	5001-19207
175	101-794	526	101-2723	RM561A	5001-12409
184	100-2628	531A	20001-27419	564	101-10719
191	100-1878	RM531A	1001-27419	RM564	101-2919
262	101-549	533A	3001-5529	565/RM	101-2749
1121	101-1709	RM533A	1001-5529	567/RM	101-3039
067-0502-00	2210-869	535A	20001-34929	575	101-12389
R293		RM535A	1001-34929	581A	3975-6149
310A	10001-22319	536	101-3749	585A	5969-13429
				RM585A	100-1689
				R647	
				661	101-3459

Parts required for the following:

106	191	RM15	RM531A	RM543B	581A
109	317	516	533A	RM544	585A
111	RM17	519	RM533A	RM545B	RM585A
127	RM503	524AD	535A	RM546	661
130	RM504	526	RM535A	RM547	1121
160A	515A	531A	536	567/RM	067-0502-00

PARTS REQUIRED:

Quantity	Tektronix Part Number	Description
1 ea	131-0102-02	Connector, motor base

continued

Parts required for the following:

114	175	543B	549	561A	575
125	R293	544	551	RM561A	RM647
129	310A	545B	555	564	016-0072-00
132	502A	546	556	RM564	
133	507	547	R556	565/RM	

PARTS REQUIRED:

Quantity	Tektronix Part Number	Description
1 ea	131-0572-00	Connector, motor base

Parts required for the following: R116 184

PARTS REQUIRED:

Quantity	Tektronix Part Number	Description
1 ea	131-0430-02	Connector, motor base

INSTALLATION

Replace the motor base connector with the new type.

JT:fb

INSTRUCTION MANUAL

Serial Number ______________

TYPE 106

SQUARE-WAVE GENERATOR

Tektronix, Inc.
S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

070-0523-00 366

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial or Model Number with all requests for parts or service.

Specifications and price change privileges reserved.

CONTENTS

Abbreviations and symbols used in this manual are based on, or taken directly from, IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.

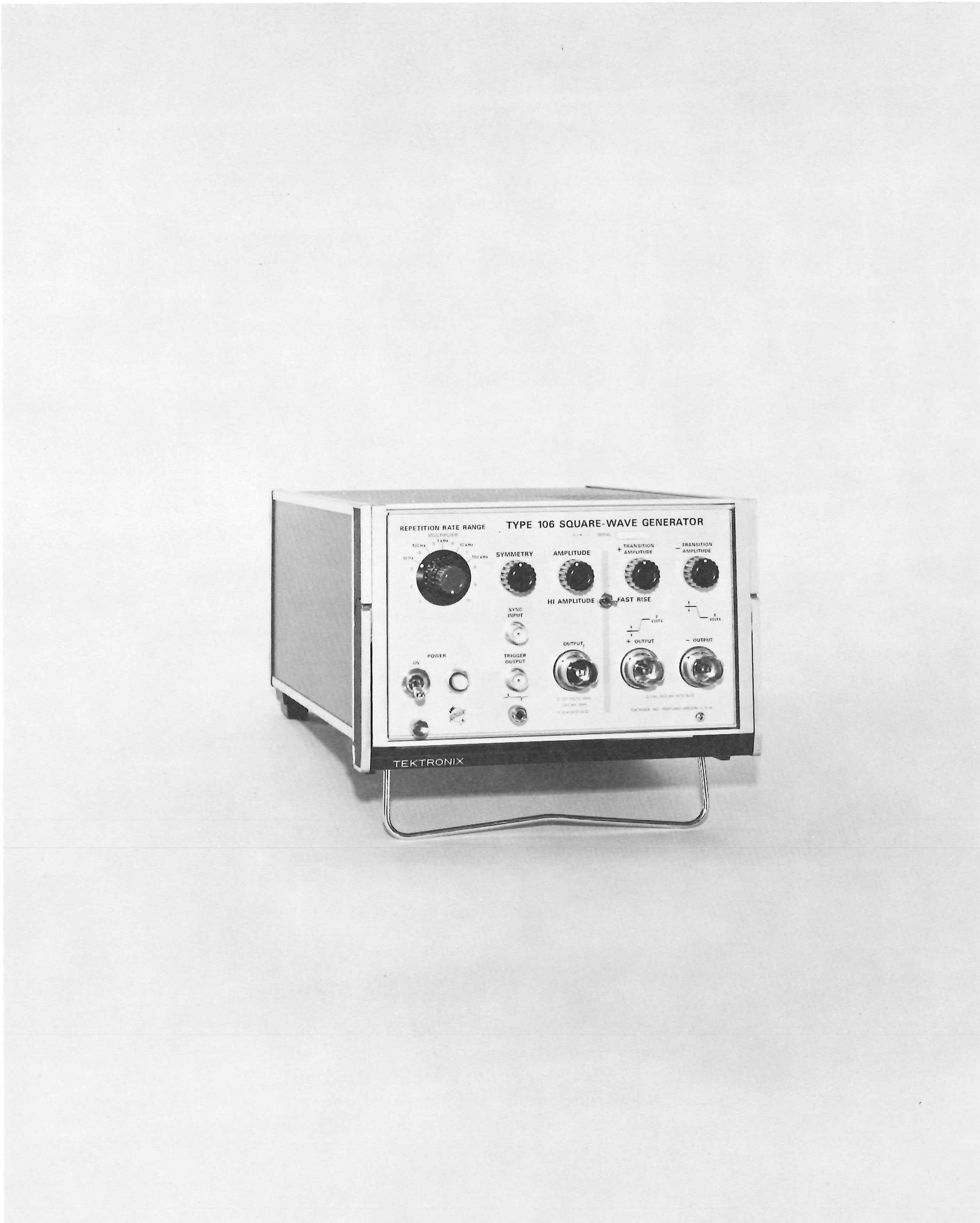


Fig. 1-1. Type 106 Square-Wave Generator.

SECTION 1
CHARACTERISTICS

Introduction

The Tektronix Type 106 Square-Wave Generator is a compact, general-purpose square-wave generator. This instrument provides three square-wave outputs; a high-amplitude output (120 volts unterminated), and positive-going and negative-going fast-rise outputs (one nanosecond or less risetime into 50 ohms). Repetition rate of the output square waves is variable from 10 Hz to 1 MHz. A sync input feature is provided to synchronize the Type 106 with an external signal source. A trigger output allows the Type 106 to trigger external devices.

The Performance Check procedure given in Section 5 of this manual provides a convenient means of checking the performance requirements. The following characteristics apply over an ambient temperature range of 0°C to +50°C. Warm-up time for given accuracy is five minutes.

ELECTRICAL CHARACTERISTICS

Square-Wave Generator

Characteristic	Performance Requirement	Supplemental Information
Repetition Rate	10 hertz to 1 megahertz	In 5 decade steps. Variable between steps with MULTIPLIER control
Repetition Rate Accuracy	Within ±10% of indicated value	Symmetry control centered
Multiplier Range	Provides continuously variable repetition rate to 10 times the rate selected by the REPETITION RATE RANGE switch	
Symmetry	Duty cycle variable from 45% or less to 55% or more	
High Amplitude Output Risetime	12 nanoseconds or less into 50-ohm load at 12 volts 20 nanoseconds or less into 50-ohm load at 0.5 volts	120 nanoseconds or less unterminated (risetime when unterminated can be calculated by: $T_r = 2.2\,RC$, where R is the 600-ohm internal resistance of the Type 106 and C is capacitance of load)
Amplitude range	Into 50-ohm load: 0.5 volts or less to 12 volts or greater Unterminated: 7 volts or less to 120 volts or greater	240 milliamps maximum
Leading edge aberrations	±2% or less in first 100 nanoseconds into 50 ohms	Measured on positive-going transition of signal
Flat top aberrations		0.5% or less, peak to peak, after first 100 nanoseconds
Trailing edge aberrations		Disregard aberrations in the last 100 nanoseconds preceding trailing edge
Polarity	Output level measured from a negative potential to ground	
Output impedance		600 ohms at OUTPUT connector
Fast Rise Output Risetime	1 nanosecond or less into 50-ohm load	Up to 500 millivolts
Amplitude range	50 millivolts or less to 500 millivolts or more into 50-ohm load	
Polarity	Simultaneous fast-rising positive-going and negative-going outputs	
Leading edge aberrations	+ and — 2%, or less, or + and — 6 millivolts, whichever is greater in the first 5 nanoseconds	Measured on positive-going transition of + OUTPUT signal and negative-going transition of — OUTPUT signal
Flat top aberrations		Less than 0.5% after first 5 nanoseconds
Symmetry change with change in amplitude		150 nanoseconds, or less, 50 millivolts to 500 millivolts
Output impedance		50 ohms at + OUTPUT and — OUTPUT connectors

Characteristic	Performance Requirement	Supplemental Information
Sync Input Requirements		
Pulse or square wave	2.5 volts to 50 volts, 100 Hertz to 1 Megahertz	For stable operation, risetime of applied pulse should be less than 12.5% of the period
Sine wave		5 volts to 100 volts peak to peak, 100 Hertz to 1 Megahertz
Input resistance		Approximately 1 megohm at DC
Trigger Output		
Output signal	Positive and negative trigger pulses coincident with the rise and fall of the OUTPUT (HI AMPLITUDE) signal	
Risetime (rate of change)	50 nanoseconds or less into 50-ohm load, between 0 and 0.1 volt	
Time jitter	300 picoseconds or less	Jitter measured one full cycle after test oscilloscope is triggered (see Section 6)
Delay time	50 nanoseconds or less from leading edge of trigger pulse to leading edge of all output signals (positive trigger pulse only for fast-rise outputs)	
Amplitude	0.10 volt or more into 50-ohm load	Approximately 0.4 volts unterminated
Output impedance		150 ohms
	Power Supply	
Line Voltage		
115-volts nominal	103.5 to 126.5 volts, RMS, AC line voltage provides regulated DC voltages	Range selected by 115 V-230 V Selector switch on rear panel
230-volts nominal	207 to 253 volts, RMS, AC line voltage provides regulated DC voltages	
Line Frequency	50 to 60 hertz	
Line Fuse		
115-volts nominal		1.25 A, slow blow
230-volts nominal		0.6 A, slow blow
Power Consumption		Approximately 85 watts at 115-volt line

ENVIRONMENTAL CHARACTERISTICS

The following environmental test limits apply when tested in accordance with the recommended test procedure. This instrument will meet the electrical performance requirements given in this section following environmental test. Complete details on environmental test procedures, including failure criteria, etc., may be obtained from Tektronix, Inc. Contact your local Tektronix Field Office or representative.

Characteristic	Performance Requirement	Supplemental Information
Temperature		
Operating	0° C to +50° C	Fan at rear circulates air throughout instrument. Automatic resetting thermal cutout protects instrument from overheating.
Non-operating	−40° C to +65° C	
Altitude		
Operating	15,000 feet maximum	
Non-operating	50,000 feet maximum	May be tested during non-operating temperature tests
Vibration		
Operating and non-operating	Vibrate for 15 minutes along each axis at a total displacement of 0.015 inch (1.9g at 50 c/s) with the frequency varied from 10-50-10 c/s in one minute cycles. Hold at any resonant point for 3 minutes. If no resonant points are found, vibrate at 50 c/s for 3 minutes on each axis.	Instrument secured to vibration platform during test. Total vibration time, about 55 minutes.

Characteristic	Performance Requirement	Supplemental Information
Shock Non-operating	One shock of 30 g, one-half sine, 11 millisecond duration along each major axis	Guillotine type shock
Transportation	Meets National Safe Transit type of test when correctly packaged	
Package vibration	Vibrate for one hour slightly in excess of 1 g	Package should just leave vibration surface
Package drop	Drop from a height of 30 inches on one corner, all edges radiating from that corner and all flat surfaces	Total of 10 drops

MECHANICAL CHARACTERISTICS

Characteristic	Information
Construction Chassis	Aluminum alloy
Cabinet	Aluminum alloy with blue-vinyl finish
Panel	Aluminum alloy with anodized finish
Circuit boards	Glass-epoxy laminate
Overall Dimensions (measured at maximum points) Height	6 inches
Width	9 inches
Depth	14¾ inches

Connectors SYNC INPUT	BNC
TRIGGER OUTPUT	BNC
OUTPUT	GR874
+ OUTPUT	GR874
— OUTPUT	GR874

Standard Accessories

Standard accessories supplied with the Type 106 are listed on the last pullout page at the rear of this manual. For optional accessories available for use with the Type 106, see the current Tektronix, Inc. catalog.

NOTES

SECTION 2
OPERATING INSTRUCTIONS

General

To use the Type 106 effectively, the operation and capabilities of the instrument must be known. This section describes the function of the front- and rear-panel controls and connectors, gives first-time and general operating information and lists some basic applications for this instrument.

Voltage Considerations

The Type 106 can be operated from either a 115- or a 230-volt nominal line. The 115 V - 230 V Selector switch on the rear panel changes the instrument from one operating range to the other. Use a small screwdriver or other pointed tool to slide this switch to the desired position.

CAUTION

The Type 106 should not be operated when the 115 V - 230 V Selector switch is in the wrong position for the nominal line voltage applied. Operation of the instrument in the wrong voltage range will either provide incorrect operation or damage the instrument.

When changing operating ranges, the line fuse must be changed. Table 2-1 lists the correct fuse for the applicable nominal line voltage.

TABLE 2-1
Line Fuses

Nominal Line Voltage	Fuse Rating
115-volts	1.25 A, slow-blow
230-volts	0.6 A, slow-blow

Cooling

To maintain a safe operating temperature, the Type 106 is cooled with air drawn in at the rear, and blown out the top and bottom of the cabinet. A thermal cutout in the instrument provides thermal protection and disconnects the power to the instrument if the internal temperature exceeds a safe operating level. Power is automatically restored when the temperature returns to a safe level. The cabinet is designed to distribute air flow throughout the instrument for the most efficient cooling. Operation of the instrument for extended periods without the cabinet may cause it to overheat and the thermal cutout to open more frequently.

Adequate clearance must be provided on all sides to allow heat to be dissipated away from the instrument. The clearance provided by the feet at the bottom and rear should be maintained. If possible, allow about one inch of clearance on the sides and top. Do not block or restrict the air flow from the air-intake holes in the cabinet.

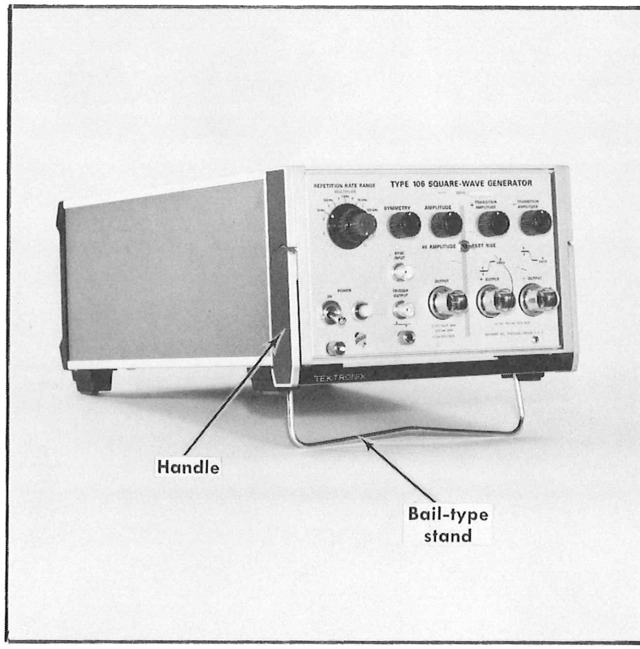


Fig. 2-1. Handle and bail-type stand.

Handle and Stand

The handle of the Type 106 can be pulled out for convenient carrying of the instrument. When not in use, the handle folds out of the way, into the trim of the instrument cabinet (see Fig. 2-1).

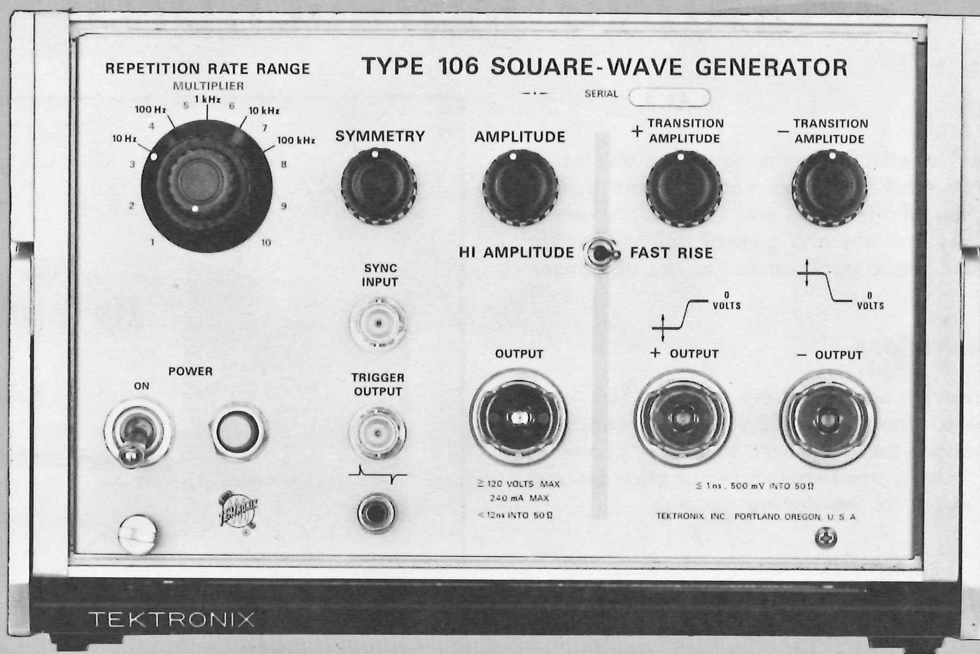
A bail-type stand is mounted beneath the cabinet. This stand permits the Type 106 to be positioned for convenient operation (see Fig. 2-1). The instrument may also be set on the rear feet either for operation or storage.

CONTROLS AND CONNECTORS

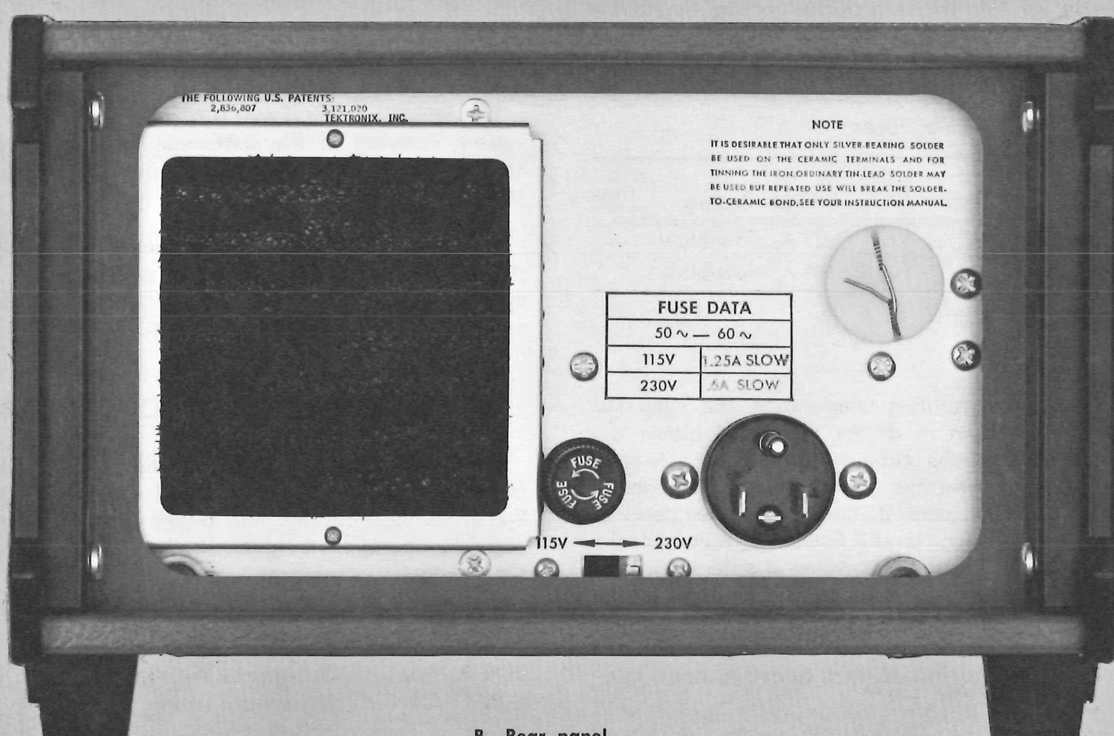
A brief description of the function or operation of the front- and rear-panel controls and connectors follows. Fig. 2-2 shows the front and rear panels of the instrument. More detailed operation is given in this section under General Operating Information.

Front Panel

REPETITION RATE RANGE	Determines the repetition rate of the output square wave.
MULTIPLIER	Provides variable repetition rate within the range selected by the REPETITION RATE RANGE switch.
SYMMETRY	Varies the duty cycle of the output square wave.



A. Front panel.



B. Rear panel.

Fig. 2-2. Front- and rear-panel controls and connectors.

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AMPLITUDE	Determines amplitude of the square wave available at the OUTPUT (HI AMPLITUDE) connector.
SYNC INPUT *	Input ~~conector~~ Connector for a synchronizing signal.
POWER	Switch: Applies power to instrument. Light: Indicates when POWER switch is on and the instrument is connected to a power source.
TRIGGER OUTPUT *	Output connector for trigger signal which is ~~coincident~~ synchronous with the rise and fall of the OUTPUT (HI AMPLITUDE) signal.
OUTPUT	Output connector for the HI AMPLITUDE square-wave signal.
HI AMPLITUDE-FAST RISE	Selects either the HI AMPLITUDE or the FAST RISE square-wave output.
+TRANSITION AMPLITUDE	Determines amplitude of the square wave available at the + OUTPUT connector.
—TRANSITION AMPLITUDE	Determines amplitude of the square wave available at the — OUTPUT connector.
+ OUTPUT *	Output ~~conector~~ connector for the positive-going FAST RISE square-wave signal.
— OUTPUT	Output connector for the negative-going FAST RISE square-wave signal.

Rear Panel

Fuse	Fuse for power input.
115 V - 230 V Selector	Selects nominal operating range of instrument.
Power	Input connector for line power.

FIRST-TIME OPERATION

The following steps will demonstrate the basic function of the controls and connectors of the Type 106. It is recommended that this procedure be followed completely for first-time familiarization with this instrument.

1. Set the front-panel controls as follows:

REPETITION RATE RANGE	1 kHz
MULTIPLIER	1
SYMMETRY	Midrange
AMPLITUDE	Midrange
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+TRANSITION AMPLITUDE	Midrange
—TRANSITION AMPLITUDE	Midrange
POWER	Off

2. Connect the Type 106 to a power source that meets the voltage and frequency requirements of this instrument.

3. Check to be sure that the 115 V - 230 V Selector switch on the rear panel is in the correct position for the applied voltage.

4. Set the POWER switch to ON. Allow about five minutes warm up before proceeding.

5. Connect the five-nanosecond GR cable from the OUTPUT (HI AMPLITUDE) connector through the in-line termination to the vertical input of a test oscilloscope (Tektronix Type 545B/1A2 or equivalent).

6. Set the test oscilloscope controls for a display three to four divisions in amplitude, DC coupled, with about one complete cycle displayed on the CRT.

7. Set the REPETITION RATE RANGE switch to 10 kHz. Note that the repetition rate is increased ten times as shown by about one cycle/division. Return the REPETITION RATE RANGE switch to 1 kHz.

8. Turn the MULTIPLIER control to 10. Note that the repetition rate of the square wave is increased about ten times as shown by about one cycle/division. Return the MULTIPLIER control to 1.

9. Rotate the SYMMETRY control throughout its range. Note that the duty cycle (symmetry) of the square wave changes from about 55% in the counterclockwise position to about 45% in the clockwise position. Return the SYMMETRY control to midrange.

10. Rotate the AMPLITUDE (HI AMPLITUDE) control throughout its range. Note the change in output amplitude between about 0.5 volt and 12 volts. Also note that the square wave starts from a negative reference potential and goes positive to zero volts. The positive-going transition of the square wave is the portion to which the risetime and aberration characteristics apply.

11. If the test oscilloscope has a dual-trace vertical system, connect a 50-ohm BNC cable between the TRIGGER OUTPUT connector and the remaining vertical input connector. Note # that the trigger output pulses are ~~coincident~~ synchronous with the rise and fall of the OUTPUT (HI AMPLITUDE) square wave. (If the test oscilloscope is single trace, compare coincidence of trigger output pulses and square-wave rise and fall on separate displays.) Disconnect the 50-ohm BNC cable.

12. Disconnect the five-nanosecond cable from the OUTPUT connector and connect it to the + OUTPUT connector. Set the HI AMPLITUDE—FAST RISE switch to FAST RISE. Adjust the vertical deflection factor to produce a display about three divisions in amplitude.

13. Rotate the + TRANSITION AMPLITUDE control throughout its range. Note the change in output amplitude between about 50 millivolts and 500 millivolts. Also note that the square wave starts from a negative potential and goes to zero volts. The fast-rise portion of the square wave is the positive-going transition.

14. Disconnect the five-nanosecond cable from the + OUTPUT connector and connect it to the — OUTPUT connector.

15. Rotate the — TRANSITION AMPLITUDE control throughout its range. Note the change in output amplitude between about 50 millivolts and 500 millivolts. Also note that the square wave starts from a positive potential and goes to zero volts. The fast-rise portion of the square wave is the negative-going transition.

16. If an external signal is available (2.5 - 50 volt square wave or 5 - 100 volt sine wave) the function of the SYNC INPUT connector can be demonstrated (suggested source, 1-kHz oscilloscope calibrator). Connect the external signal

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AMPLITUDE	Determines amplitude of the square wave available at the OUTPUT (HI AMPLITUDE) connector.
SYNC INPUT	Input conector for a synchronizing signal.
POWER	Switch: Applies power to instrument. Light: Indicates when POWER switch is on and the instrument is connected to a power source.
TRIGGER OUTPUT	Output connector for trigger signal which is coincident with the rise and fall of the OUTPUT (HI AMPLITUDE) signal.
OUTPUT	Output connector for the HI AMPLITUDE square-wave signal.
HI AMPLITUDE-FAST RISE	Selects either the HI AMPLITUDE or the FAST RISE square-wave output.
+TRANSITION AMPLITUDE	Determines amplitude of the square wave available at the + OUTPUT connector.
—TRANSITION AMPLITUDE	Determines amplitude of the square wave available at the — OUTPUT connector.
+ OUTPUT	Output conector for the positive-going FAST RISE square-wave signal.
— OUTPUT	Output connector for the negative-going FAST RISE square-wave signal.

Rear Panel

Fuse	Fuse for power input.
115 V - 230 V Selector	Selects nominal operating range of instrument.
Power	Input connector for line power.

FIRST-TIME OPERATION

The following steps will demonstrate the basic function of the controls and connectors of the Type 106. It is recommended that this procedure be followed completely for first-time familiarization with this instrument.

1. Set the front-panel controls as follows:

REPETITION RATE RANGE	1 kHz
MULTIPLIER	1
SYMMETRY	Midrange
AMPLITUDE	Midrange
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+TRANSITION AMPLITUDE	Midrange
—TRANSITION AMPLITUDE	Midrange
POWER	Off

2. Connect the Type 106 to a power source that meets the voltage and frequency requirements of this instrument.

3. Check to be sure that the 115 V - 230 V Selector switch on the rear panel is in the correct position for the applied voltage.

4. Set the POWER switch to ON. Allow about five minutes warm up before proceeding.

5. Connect the five-nanosecond GR cable from the OUTPUT (HI AMPLITUDE) connector through the in-line termination to the vertical input of a test oscilloscope (Tektronix Type 545B/1A2 or equivalent).

6. Set the test oscilloscope controls for a display three to four divisions in amplitude, DC coupled, with about one complete cycle displayed on the CRT.

7. Set the REPETITION RATE RANGE switch to 10 kHz. Note that the repetition rate is increased ten times as shown by about one cycle/division. Return the REPETITION RATE RANGE switch to 1 kHz.

8. Turn the MULTIPLIER control to 10. Note that the repetition rate of the square wave is increased about ten times as shown by about one cycle/division. Return the MULTIPLIER control to 1.

9. Rotate the SYMMETRY control throughout its range. Note that the duty cycle (symmetry) of the square wave changes from about 55% in the counterclockwise position to about 45% in the clockwise position. Return the SYMMETRY control to midrange.

10. Rotate the AMPLITUDE (HI AMPLITUDE) control throughout its range. Note the change in output amplitude between about 0.5 volt and 12 volts. Also note that the square wave starts from a negative reference potential and goes positive to zero volts. The positive-going transition of the square wave is the portion to which the risetime and aberration characteristics apply.

11. If the test oscilloscope has a dual-trace vertical system, connect a 50-ohm BNC cable between the TRIGGER OUTPUT connector and the remaining vertical input connector. Note that the trigger output pulses are coincident with the rise and fall of the OUTPUT (HI AMPLITUDE) square wave. (If the test oscilloscope is single trace, compare coincidence of trigger output pulses and square-wave rise and fall on separate displays.) Disconnect the 50-ohm BNC cable.

12. Disconnect the five-nanosecond cable from the OUTPUT connector and connect it to the + OUTPUT connector. Set the HI AMPLITUDE—FAST RISE switch to FAST RISE. Adjust the vertical deflection factor to produce a display about three divisions in amplitude.

13. Rotate the + TRANSITION AMPLITUDE control throughout its range. Note the change in output amplitude between about 50 millivolts and 500 millivolts. Also note that the square wave starts from a negative potential and goes to zero volts. The fast-rise portion of the square wave is the positive-going transition.

14. Disconnect the five-nanosecond cable from the + OUTPUT connector and connect it to the — OUTPUT connector.

15. Rotate the — TRANSITION AMPLITUDE control throughout its range. Note the change in output amplitude between about 50 millivolts and 500 millivolts. Also note that the square wave starts from a positive potential and goes to zero volts. The fast-rise portion of the square wave is the negative-going transition.

16. If an external signal is available (2.5 - 50 volt square wave or 5 - 100 volt sine wave) the function of the SYNC INPUT connector can be demonstrated (suggested source, 1-kHz oscilloscope calibrator). Connect the external signal

TYPE 106

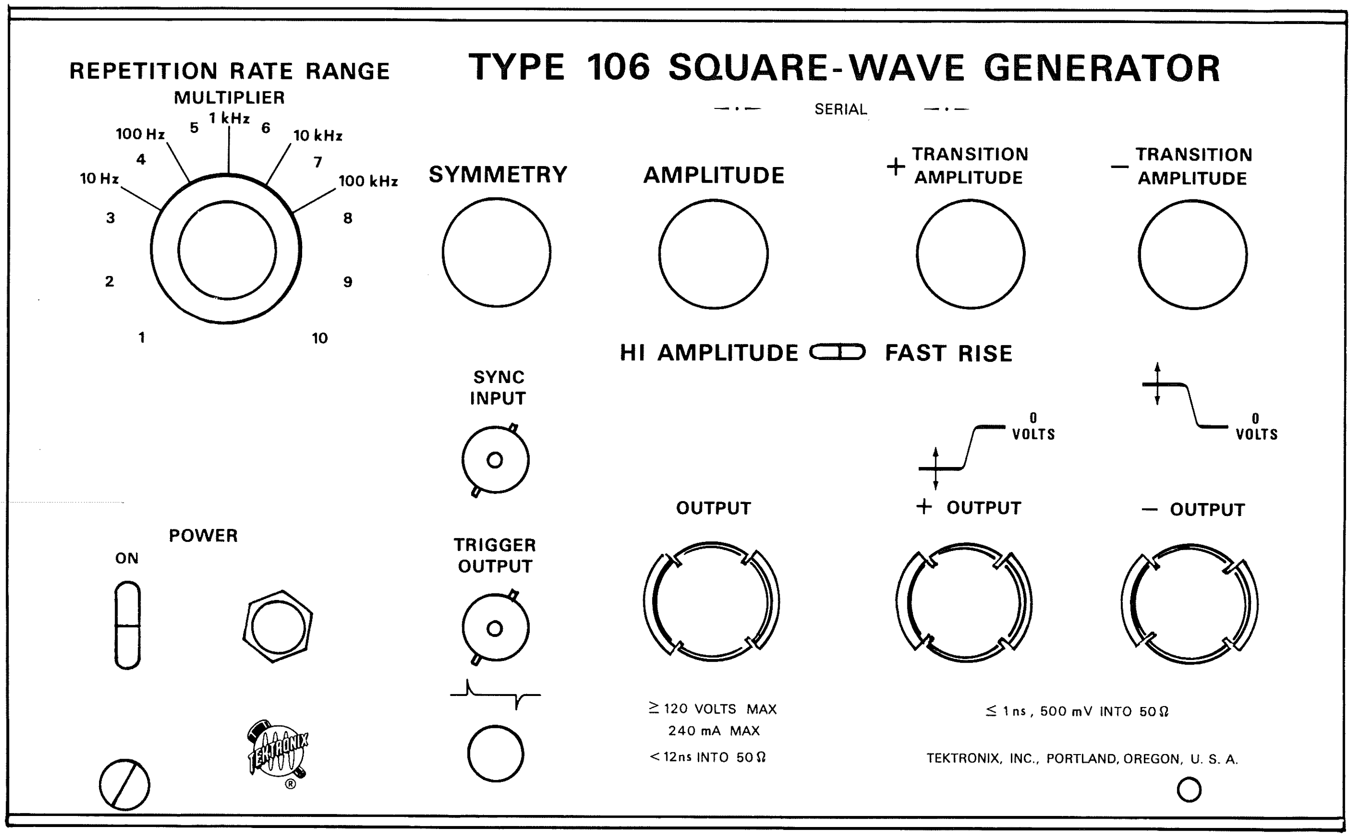


Fig. 2-3. Control set-up chart.

to the SYNC INPUT connector. Set the REPETITION RATE RANGE switch to 100 kHz and the MULTIPLIER to about 7. Note the repetition rate of the square wave and then disconnect the sync signal. Note the change in repetition rate indicating that the square wave is no longer synchronized with the external signal.

17. This completes the basic operation procedure for the Type 106. More information will be given under General Operating Information in this section.

CONTROL SETUP CHART

Fig. 2-3 shows the front panel of the Type 106. This chart can be reproduced and used as a test-setup record for special measurements, applications or procedures, or it may be used as a training aid for familiarization with this instrument.

GENERAL OPERATING INFORMATION

Output Signals

The output signals available from the Type 106 are shown in Fig. 2-4. These waveform photographs were taken on an oscilloscope which was triggered from the TRIGGER OUTPUT signal to show time relationship of the signals. Notice the zero reference level shown for the square-wave outputs, in particular, the fast-rise outputs. The signal available at the + OUTPUT connector is a positive-going signal which starts from a negative potential and goes to zero volts. The signal available at the — OUTPUT connector is a negative-going signal which starts from a positive potential and goes to zero volts. The polarity indications on the front panel refer to the portion of the square wave which possesses the desired characteristics (e.g., the + OUTPUT signal has a fast-rising, positive-going leading edge).

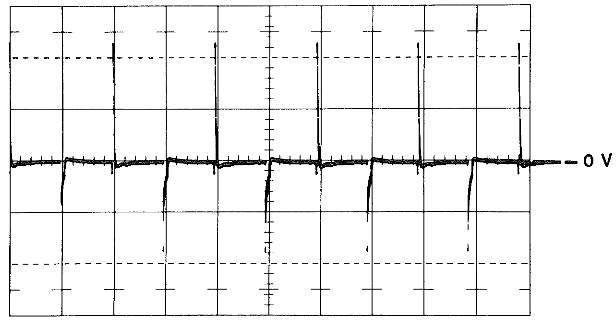
Output Termination

Minimum risetime and optimum pulse characteristics can be obtained only if the outputs are terminated in 50 ohms. A special in-line termination is supplied with the Type 106 for this purpose. This termination also serves as an adapter from the GR outputs of the Type 106 to a BNC input connector on the device under test. If terminations other than this in-line termination are used, they must be capable of dissipating the power available at the OUTPUT (HI AMPLITUDE) connector.

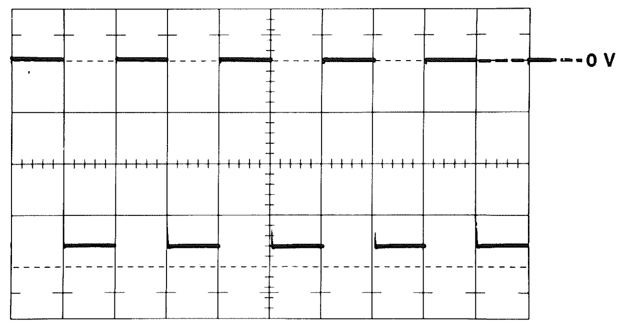
To obtain output amplitudes above about 12 volts from the OUTPUT (HI AMPLITUDE) connector, the output cable must be unterminated. This will result in slower risetime and more pulse aberrations. However, the resultant waveform is satisfactory for most applications where a high-amplitude square wave is needed such as checking the compensation of an attenuator.

Trigger Output

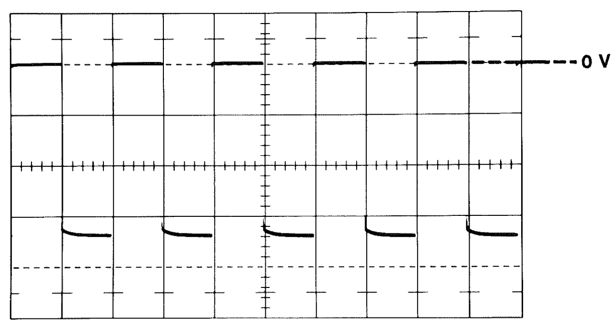
In some applications, it may be desirable to trigger the device under test from a signal which is coincident with the leading edges of the square-wave signal applied. The signal available at the TRIGGER OUTPUT connector is intended for



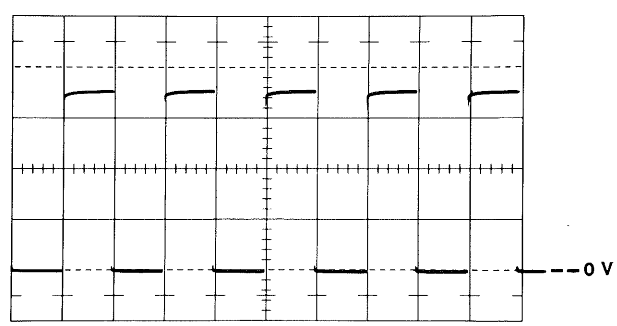
A. TRIGGER OUTPUT



B. OUTPUT (HI AMPLITUDE)



C. + OUTPUT



D. — OUTPUT

Fig. 2-4. Output signals available from the Type 106. Dotted line shows zero-volt DC level for each waveform (repetition rate, 100 kHz).

this purpose. The positive-going and negative-going trigger pulses are coincident with the rise and fall, respectively, of the square wave at the OUTPUT (HI AMPLITUDE) connector. The positive-going trigger pulses are coincident with the fast-rise outputs. However, the negative-going pulses may lead the trailing edge of the fast-rise outputs.

Symmetry

The SYMMETRY control on the front panel allows the relationship betwen the time duration of the positive and negative portions of the square wave to be adjusted with respect to each other. This control allows at least $\pm 5\%$ change in the duty cycle of the output square wave. The symmetry of the square wave may be adjusted to provide equal time duration for the positive and negative portions, or it may be adjusted to make either portion longer in duration. The SYMMETRY control may need re-adjustment when changing repetition rate, output amplitude or when using sync operation as described in the following topic.

Sync Operation

The output square waves of the Type 106 can be synchronized with an external signal source or an accurate frequency source (such as a Tektronix Type 184 Time-Mark Generator) by applying the external signal to the SYNC INPUT connector. Use the following procedure to synchronize the Type 106 output signals with an external signal.

1. Connect the external signal to the SYNC INPUT connector. If the signal is a pulse or a square wave, it must be between 2.5 and 50 volts in amplitude; if it is a sine wave, it must be between 5 and 100 volts in amplitude, peak to peak.

2. Set the REPETITION RATE RANGE switch and the MULTIPLIER control to a repetition rate setting slightly less than that of the applied synchronizing signal.

3. Adjust the symmetry control for a symmetrical output square wave.

BASIC APPLICATIONS

The following information describes the procedure and technique for using the Type 106 Square-Wave Generator to make basic measurements. These applications are not described in detail since each application must be adapted to the requirements of the indivivdual measurements. Familiarity with the Type 106 will permit these basic techniques to be applied to a wide variety of uses.

Risetime Measurements

The Type 106 can be used in conjunction with an oscilloscope to measure risetime. Risetime is normally measured between the 10% and 90% points on the leading edge of a waveform. Falltime can be measured using this same basic technique to measure the time between the 90% and 10% point on the trailing edge.

Before measuring the risetime of the device under test, the combined risetime of the Type 106 and the oscilloscope

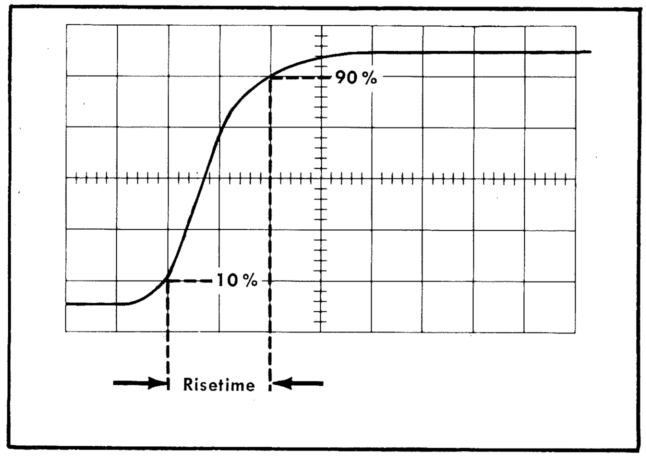


Fig. 2-5. Risetime measurement on a typical waveform.

must be known. Steps 1 through 4 of the following procedure measure this combined risetime. These steps may also be used to measure the risetime of an oscilloscope vertical system by substituting the resultant risetime in the formula given in step 8 (see Example 2) and computing the risetime.

1. Connect the + or — OUTPUT signal to the input of the oscilloscope. Terminate the output of the Type 106 correctly as described in this section.

2. Set the oscilloscope to display the leading edge of the waveform.

3. Determine the 10% and 90% points on the leading edge of the waveform.

4. Measure the time duration between these points (see Fig. 2-5). This is the combined risetime of the Type 106 and the oscilloscope (T_{re}).

5. Connect the output of the Type 106 to the input of the device under test. Terminate the Type 106 output as in step 1.

6. Connect the output of the device under test to the input of the oscilloscope. Terminate the device in its characteristic impedance for optimum performance.

7. Set the oscilloscope controls to display the leading edge of the waveform.

8. Measure the time duration between the 10% and 90% points on the leading edge of the waveform. This is the overall risetime (T_{rt}). Substitute this value in the formula:

$$T_r = (T_{rt}^2 - T_{re}^2)^{1/2}$$

Where T_r = Risetime of device under test
T_{rt} = Overall risetime
T_{re} = Risetime of measuring equipment

NOTE

When the combined risetime of the measuring equipment is 0.1 times or less that of the overall risetime, it affects the calculations very slightly and may be ignored for most computations. The risetime of the device under test then becomes the value measured in step 8.

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Example 1. To illustrate the use of this method to measure the risetime of an external device, assume that the overall risetime is 17 nanoseconds and the risetime of the measuring equipment is 7 nanoseconds.

Substituting the given values in the formula:

$$T_r = (17^2 - 7^2)^{1/2} = (289 - 49)^{1/2} = (240)^{1/2}$$

The risetime of the device under test is 15.5 nanoseconds.

Example 2. To illustrate the use of this method to measure the vertical risetime of an oscilloscope, assume that the overall risetime is 5 nanoseconds. The risetime of the applied signal (Type 106 fast-rise output) is 1 nanosecond.

Substituting the given values in the formula:

$$T_r = (5^2 - 1^2)^{1/2} = (25 - 1)^{1/2} = (24)^{1/2}$$

The risetime of the device under test is 4.9 nanoseconds.

Notice that although the risetime of the measuring equipment (generator) is 0.2 times the overall risetime it decreases the actual risetime by only 0.1 nanosecond.

Checking System Response

The square-wave output of the Type 106 can be used for checking the response of active or passive systems. Since the characteristics of the Type 106 pulse are known (see Characteristics section), distortion of the waveform beyond these limits is due to the device under test. The following procedures list several of the tests which can be made.

Compensation. The compensation of an AC-voltage divider such as is used in the input attenuator of an oscilloscope or a passive attenuator probe, can be checked by observing its response when a square-wave signal is applied. Correct response is shown by optimum square corner on the displayed waveform. If the waveform has spike, rolloff or front-corner rounding, the system is not correctly compensated. Fig. 2-6 shows typical waveforms illustrating correct and incorrect compensation adjustments.

Low-Frequency Response. Limited low-frequency response is shown by a trailing-edge droop in the flat-top portion of the square wave (see Fig. 2-7). Apply a symmetrical square-wave of a repetition rate which is not affected by the low-frequency limit. Note the amplitude and then slowly reduce the square-wave frequency until the trailing corner of the square wave falls to 63% of the amplitude at the leading edge. The low-frequency response (30% down) of

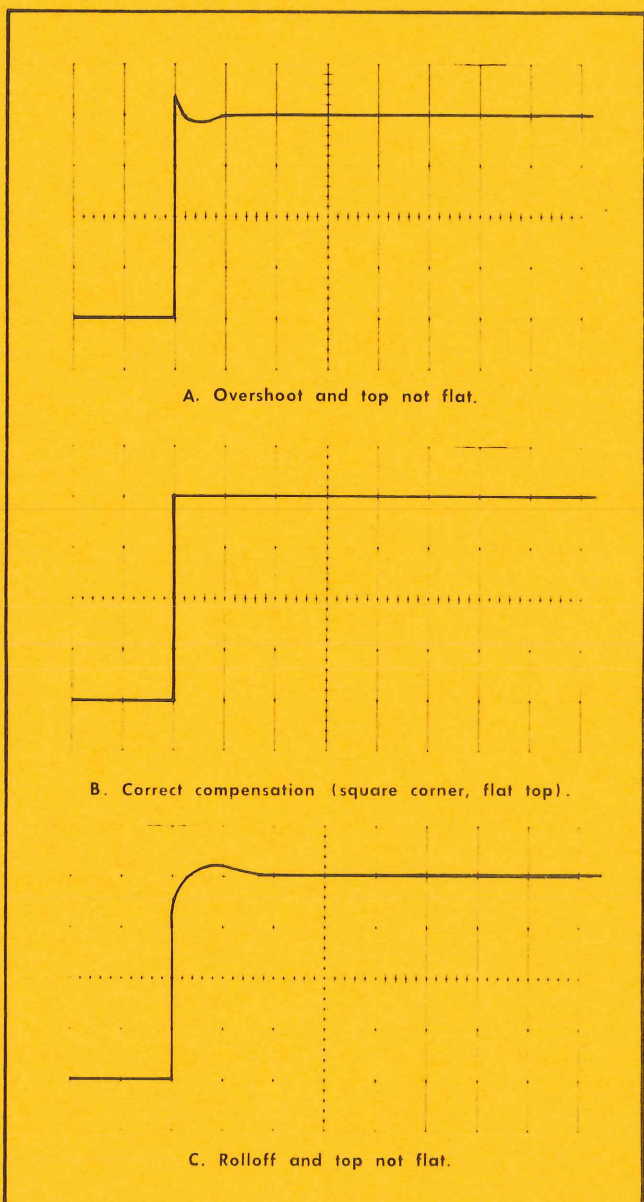

Fig. 2-6. Typical waveforms showing correct and incorrect compensation adjustments.

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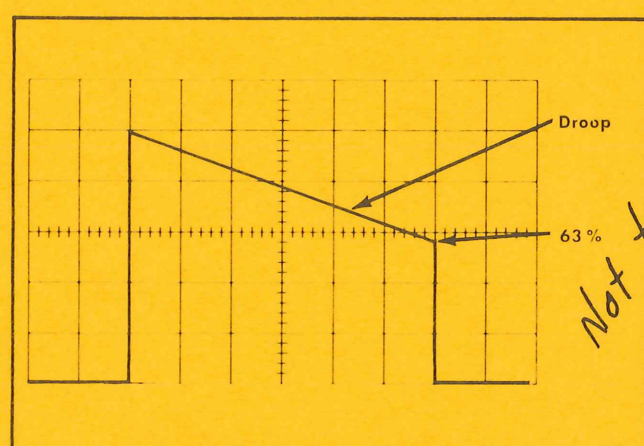

Not to scale

Fig. 2-7. Typical waveform showing limited low-frequency response.

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Example 1. To illustrate the use of this method to measure the risetime of an external device, assume that the overall risetime is 17 nanoseconds and the risetime of the measuring equipment is 7 nanoseconds.

Substituting the given values in the formula:

$$T_r = (17^2 - 7^2)^{1/2} = (289 - 49)^{1/2} = (240)^{1/2}$$

The risetime of the device under test is 15.5 nanoseconds.

Example 2. To illustrate the use of this method to measure the vertical risetime of an oscilloscope, assume that the overall risetime is 5 nanoseconds. The risetime of the applied signal (Type 106 fast-rise output) is 1 nanosecond.

Substituting the given values in the formula:

$$T_r = (5^2 - 1^2)^{1/2} = (25 - 1)^{1/2} = (24)^{1/2}$$

The risetime of the device under test is 4.9 nanoseconds.

Notice that although the risetime of the measuring equipment (generator) is 0.2 times the overall risetime it decreases the actual risetime by only 0.1 nanosecond.

Checking System Response

The square-wave output of the Type 106 can be used for checking the response of active or passive systems. Since the characteristics of the Type 106 pulse are known (see Characteristics section), distortion of the waveform beyond these limits is due to the device under test. The following procedures list several of the tests which can be made.

Compensation. The compensation of an AC-voltage divider such as is used in the input attenuator of an oscilloscope or a passive attenuator probe, can be checked by observing its response when a square-wave signal is applied. Correct response is shown by optimum square corner on the displayed waveform. If the waveform has spike, rolloff or front-corner rounding, the system is not correctly compensated. Fig. 2-6 shows typical waveforms illustrating correct and incorrect compensation adjustments.

Low-Frequency Response. Limited low-frequency response is shown by a trailing-edge droop in the flat-top portion of the square wave (see Fig. 2-7). Apply a symmetrical square-wave of a repetition rate which is not affected by the low-frequency limit. Note the amplitude and then slowly reduce the square-wave frequency until the trailing corner of the square wave falls to 63% of the amplitude at the leading edge. The low-frequency response (30% down) of

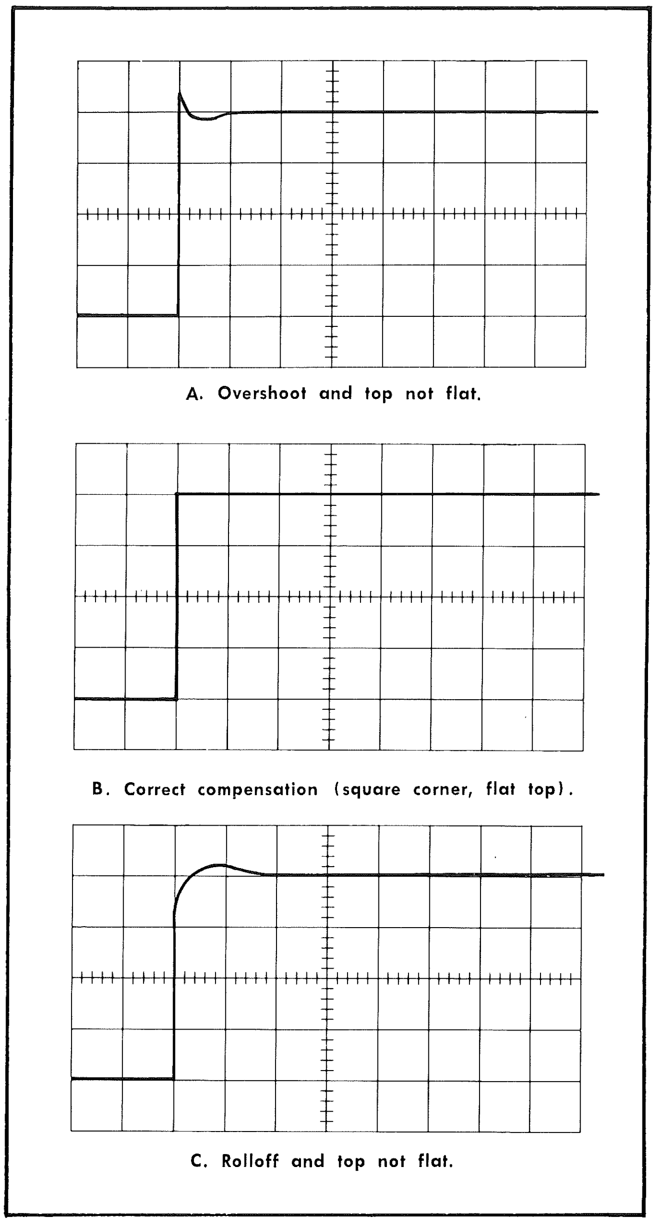

Fig. 2-6. Typical waveforms showing correct and incorrect compensation adjustments.

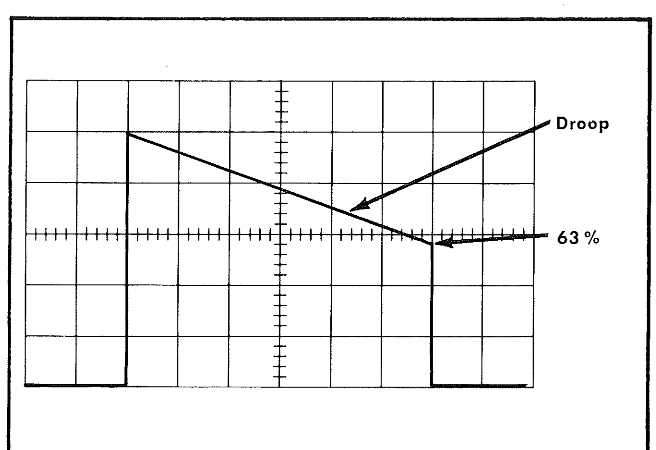

Fig. 2-7. Typical waveform showing limited low-frequency response.

the system is twice the repetition rate of the applied square-wave signal at this point.

High-Frequency Response. Incorrect high-frequency response will be shown by aberrations at the front corner of the square wave. Ringing indicates incorrect peaking adjustments. Overshoot and roll-off indicate incorrect capacitive compensation. Fig. 2-8 shows these effects on a typical waveform (see Fig. 2-6 for effect of compensation).

Limited high-frequency response is also shown by a slower risetime. Risetime of the waveform is measured as discussed under Risetime Measurements. The upper frequency response limit (at 30% down) can be calculated from the measured risetime using the formula:

$$f = \frac{0.35}{T_r}$$

Where f = upper 30% down frequency

T_r = Risetime

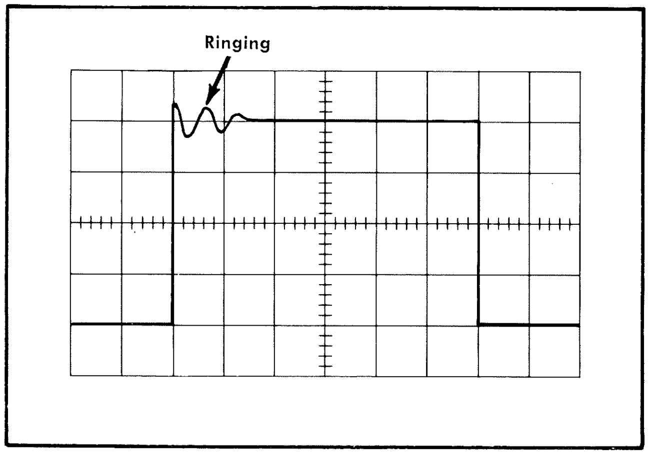

Fig. 2-8. Typical waveform showing ringing at front corner.

SECTION 3
CIRCUIT DESCRIPTION

Introduction

This section of the manual contains an electrical description of the circuits in the Type 106 Square-Wave Generator. A detailed block diagram is given in the following circuit description. Complete schematic diagrams are given in the Diagrams section. Refer to these diagrams for electrical values and relationship throughout the following circuit description.

GENERATOR CIRCUIT

Multivibrator

The frequency of the output square wave is determined by the Multivibrator, V15 and V25. These tubes are connected as an astable multivibrator with the feedback connected from the plate of each tube to the control grid of the other. The repetition rate of the output square wave is changed by selecting the feedback capacitors, C17A-E and C27A-E, with the REPETITION RATE RANGE switch, SW17. The MULTIPLIER control, R31, varies the repetition rate within the range selected by SW17, by changing the voltage level to which the feedback capacitors C17 and C27 charge. The emitter follower Q33 isolates the MULTIPLIER control, R31, from the multivibrator and allows a more linear change in repetition rate. The Rep Rate Multiplier Cal (×1) adjustment, R30, provides calibration of the repetition rate when the MULTIPLIER control is set to 1.

The Symmetry Range adjustment, R9, is adjusted to balance the plate current of V15 and V25 to produce a symmetrical square wave when the SYMMETRY control is set to midrange. The RC networks R12-C12 and R22-C22 provide correct operation of the multivibrator for low-frequency operation. L13 and L23 provide high-frequency peaking and aid in switching the multivibrator.

Symmetry of the square wave can be controlled by the front-panel SYMMETRY control. This control changes the balance between the levels on the screen grids of the multivibrator tubes to alter their cycle of operation. The symmetry of the output square wave can be changed from a duty cycle of 45% or less to 55% or more. The Rep Rate Multiplier Cal (×10) adjustment, R6, varies the level of the screen grids equally to provide correct repetition rate when the MULTIPLIER control is set to 10.

Sync Amplifier

Synchronizing signals connected to the SYNC INPUT connector are AC-coupled to the base of Q4 by C1. Transistor Q4 is normally biased off. Therefore, only the input pulses which exceed this bias are allowed to pass to the Multivibrator stage through D5. This diode disconnects the two circuits when the Multivibrator voltage goes more negative than the voltage at the collector of Q4.

The output signal is sychronized with an external signal in the following manner. The synchronizing signal from Q4 and D5 is applied to the grid of V15 through C27 and R14. This pulse will switch V15 off and force the multivibrator to operate at a different frequency than that selected by the REPETITION RATE RANGE switch and the MULTIPLIER control. However, in order for this forced switching to occur, the multivibrator must be operating at a repetition rate slightly less than the repetition rate of the applied signal. When V15 is forced off, V25 will come on and conduct in the normal manner through its half of the cycle. The output square wave produced in this manner will be unsymmetrical, since V25 conducts for the normal period and V25 is forced out of conduction sooner than normal. This can be compensated for in normal use by balancing the duty cycle of the square wave with the SYMMETRY control.

Shaper Amplifier and Trigger Output

The output square wave from the Multivibrator stage is shaped and amplified by Q34. When the signal at the cathode of V15 goes positive, it will have some overshoot at the leading edge. Q34 eliminates this overshoot and produces a square-cornered signal at its collector.

Emitter-follower Q43 provides isolation between the Drive Amplifier and Trigger Output stages and the Shaper Amplifier. The trigger signal available at the front-panel TRIGGER OUTPUT connector is obtained at the emitter of Q43. This signal is differentiated by the network C45-R46.

Driver Amplifier

The Driver Amplifier Q54 provides the final amplification for the control signal before it is applied to the Output Amplifier stage. D53 and D54 protect the transistor from being overdriven by a large signal at the base. The output signal at the collector of Q54 is coupled to the grids of the Output Amplifier tubes to control the frequency of the output square wave.

Output Amplifier

The four tubes in the Output Amplifier, V64-V74-V84-V94, are connected in parallel to provide high output current. The load resistor for this stage is R99 when operated unterminated. When the OUTPUT connector is connected to a terminated system, the load resistor is R99 paralleled by the external termination. The square corner and flat top of the output square wave is achieved by switching the plates of the Output Amplifier tubes from a negative potential to ground. The cathodes are at a negative potential. When the rising portion of the square wave begins, the plates of the Output Amplifier tubes are also at a negative potential. The signal applied from the Driver Amplifier stage turns the Output Amplifier tubes off and their plates rise positive to ground. Then, when the Multivibrator stage switches, the Output Amplifier tubes conduct and the plates go negative again to complete the cycle.

The amplitude of the output square wave is controlled by varying the cathode potential of the Output Amplifier tubes.

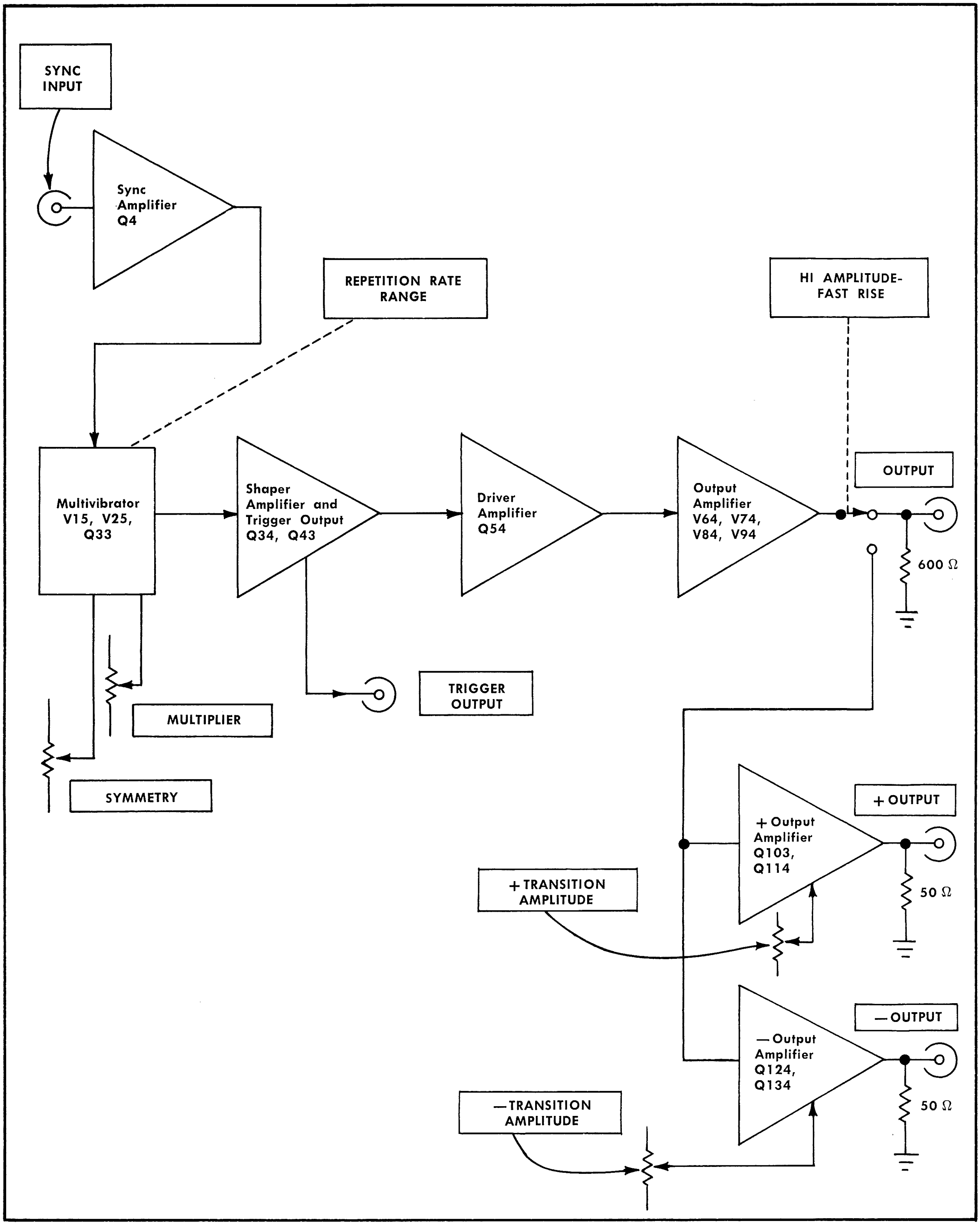

Fig. 3-1. Detailed block diagram of the Generator circuit.

The AMPLITUDE control, R246, (located in the Power Supply), varies the output of the A Supply which is connected to the cathodes. As the cathode level is raised (towards ground) the current through the tubes is limited to produce a square-wave output of less amplitude.

The output of the Output Amplifier stage is connected either to the OUTPUT connector when the HI AMPLITUDE — FAST RISE switch is set to HI AMPLITUDE or to the + and — Output Amplifiers in the FAST RISE position.

+ Output Amplifier

When the HI AMPLITUDE — FAST RISE switch is set to FAST RISE, the amplitude of the square wave produced by the Output Amplifier stage is fixed at maximum by SW242B in the Power Supply. This square-wave output signal is applied to transistors Q103 and Q124 through the compensating networks C102-C103-R103 and C122-C123-R123. Emitter follower Q103 passes the signal on to Q114. The purpose for Q103 is to match the delay that exists in the — Output stage because of the inverter transistor Q124. D103 protects the base of Q103 from going more negative than the emitter. D105 clamps the signal which is applied to Q114 so it is always positive.

Quiescently when Q114 is off, current is flowing between ground and the —10-Volt supply through R119, D118, D117, R114 and R115. As Q114 comes on, this current is interrupted and current flows between the +10-Volt supply and the —10-Volt supply through D104, Q103, R107, Q114, R114 and R115. This reverse biases D117 and D118 which interrupts current through R119. D117 and D118 are low-capacitance, fast turnoff diodes which provide a fast leading edge. When these diodes turn off, the voltage at the +OUTPUT connector rises quickly from a negative potential to ground which produces a positive-going fast-rise square-wave output. The +TRANSITION AMPLITUDE control, R115, varies the output amplitude by changing the current which flows quiescently through R119. C107 and C118 provide adjustment for optimum square corner on the leading edge of the output square wave. D114 clamps the output so it does not rise above ground potential.

— Output Amplifier

The —Output Amplifier operates in much the same manner as described for the +Output Amplifier. Q124 inverts the signal applied to Q134, D123 protects Q124, and D125 clamps the signal so it is always negative. Quiescently, current is flowing between ground and the +10-Volt supply through R139, D138, D137, R134 and R135. As Q114 comes on, this current is interrupted and current flows between the —10-Volt supply and the +10-Volt supply through D124, Q124, R127, Q134, R134 and R135. This reverse biases D137 and D138 which interrupts current through R139. When D137 and D138 turn off, the voltage at the —OUTPUT connector goes quickly from a positive potential to ground which produces a negative-going fast-rise square-wave output. The —TRANSITION AMPLITUDE control, R135, varies the output amplitude by changing the current which flows quiescently through R139. C127 and C138 provide adjustment for optimum square corner on the leading edge of the square wave. D134 clamps the output so it does not go below ground potential.

POWER SUPPLY

General

The Power Supply provides the operating power for the Type 106 from five regulated supplies. Electronic regulation is used to provide stable output voltages. A switch on the rear panel changes the instrument from 115-volt nominal line to 230-volt nominal line operation.

Power Input

Power is applied to the instrument through P201 and is applied to the primary of the transformer, T201, through the line fuse F201, POWER switch SW201, thermal cutout TK201 and the 115 V-230 V Selector switch SW202. The fan is connected across one half of the split primary winding. The 115 V-230 V Selector switch connects the split primaries of T201 in parallel for 115-volt nominal operation or in series for 230-volt nominal operation.

Thermal cutout TK201 provides thermal protection for the instrument by opening to interrupt the applied power if the internal temperature becomes too high.

A — 150-Volt Supply

The output of one secondary winding of T201 is rectified by bridge rectifier D222 to provide power for the A —150-Volt Supply. The rectified power is regulated as follows to provide a stable output voltage:

Reference for this supply with respect to the A Supply is provided by zener diode D224 which holds the emitter of Q224 approximately 75 volts more positive than the output of the A — 150 Volt Supply. Divider R228-R229 sets the base voltage of Q224 about half way between the output voltages of the A Supply and this supply, and the collector current of Q224 controls the conduction of Q227 to regulate the output. As the A Supply voltage is changed to adjust output pulse amplitude, the resulting voltage changes through Q224 and Q227 cause the output of this supply to follow the A Supply at a level approximately 150 volts more negative than the A Supply.

Ripple in the output voltage is held to a minimum by feeding a sample of the output back to the regulator transistor Q227. To understand this operation, assume that the ripple is in the negative half of its cycle. This negative voltage change at the output is connected to the emitter of the error amplifier Q224 through D224 resulting in increased current flow through Q224. The increased collector current of Q224 pulls the base of Q227 negative and reduces its collector current. The result is a reduction in output current which opposes the original output change due to ripple, and provides a stable output voltage. In a similar manner, the regulator circuit compensates for changes in input voltage or changes in load current.

A Supply

Rectified voltage for operation of the A Supply is provided by voltage divider R246-R247-R248 between the —20-Volt Supply and ground. The A Supply in reference to ground

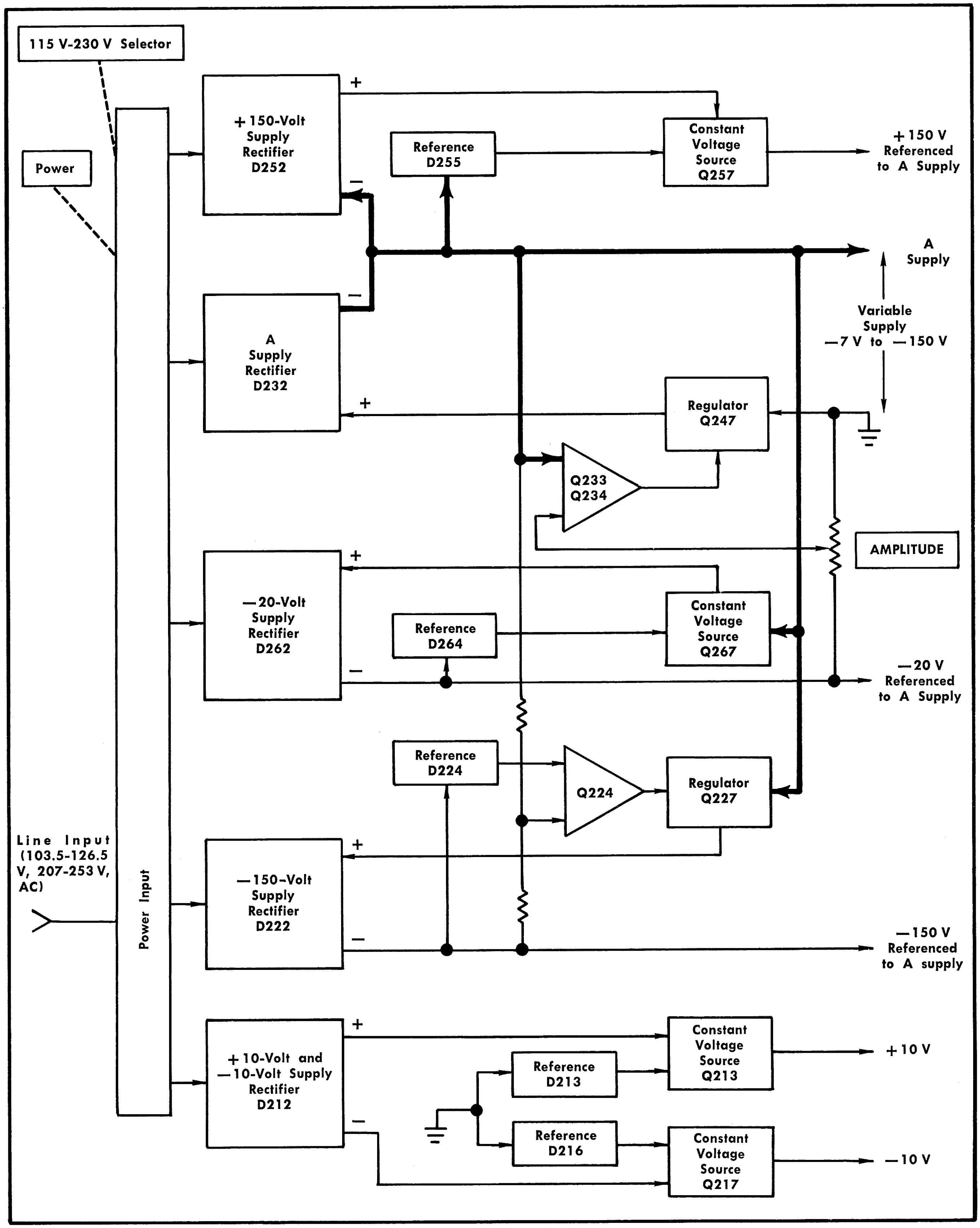

Fig. 3-2. Detailed block diagram of Power Supply circuit.

is a variable voltage output that is held constant at a selected value by the differential amplifier Q233-Q234. The differential amplifier samples the A Supply voltage and compares it against an adjustable voltage derived from the —20-Volt Supply. The AMPLITUDE conrol, R246 and the Amplitude Cal adjustment, R247 comprise the voltage divider to select the A Supply voltage. The AMPLITUDE control changes the level at the base of Q234 to vary the output of this supply (resulting in a change in the square-wave amplitude). The Amplitude Cal adjustment is adjusted to provide correct maximum amplitude of the square wave. Q223 and Q234 comprise the error amplifier and Q247 is the regulator transistor. Regulation is controlled in a manner similar to that described for the A —150-Volt Supply.

A + 150-Volt Supply

Rectifier D252 provides power for operation of the A + 150-Volt Supply. Zener diode D255 provides reference voltage for the output of the supply. Since the anode of D255 is connected to the output of the A Supply, it will maintain a voltage at the base of Q257 which follows the changes of the A Supply but is 150 volts more positive. The output voltage at the emitter of the constant voltage source transistor, Q257, will follow the voltage at its base and maintain a + 150 volt difference between this supply and the A Supply.

A — 20-Volt Supply

Rectifier D262 provides power for operation of the A — 20-Volt Supply. Zener diode D264 provides the reference for the output of this supply. D264 is connected from the base of Q267 to the A — 20-Volt output and maintains a 20 volt difference between the base-emitter of Q267 and the output. The output voltage follows the level at the emitter of Q267 (A Supply voltage) but is always 20 volts more negative.

+10-Volt and — 10-Volt Supplies

Rectifier D212 provides power for operation of the +10-Volt and —10-Volt Supplies. Transistors Q213 and Q217 are constant voltage source transistors whose emitters follow the voltage established at the base. The +10-volt output is established by Zener diode D213 at the base of Q213. The —10-volt output is established by Zener diode D216 connected to the base of Q217. The POWER ON light is connected to the output of the —10-Volt Supply to indicate when power is applied and the instrument is turned on.

NOTES

SECTION 4
MAINTENANCE

Introduction

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance, or troubleshooting of the Type 106.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis will help pervent instrument failure and will improve reliability of the instrument. The severity of the environment to which the Type 106 is subjected will determine the frequency of maintenance.

Cleaning

The Type 106 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components prevents efficient heat dissipation. It also provides an electrical conduction path.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Some chemicals to avoid are benzene, toluene, xylene, acetone or similar solvents.

Air Filter. The air filter should be visually checked every few weeks and cleaned or replaced if dirty. More frequent inspections are required under severe operating conditions. The following procedure is suggested for cleaning the filter. If the filter is to be replaced, order new air filters from your local Tektronix Field Office or representative; order by Tektronix Part No. 378-0035-01.

1. Remove the filter by pulling it out of the retaining frame on the rear panel. Be careful not to drop any of the accumulated dirt into the instrument.

2. Flush the loose dirt from the filter with a stream of hot water.

3. Place the filter in a solution of mild detergent and hot water.

4. Squeeze the filter to wash out any dirt which remains.

5. Rinse the filter in clear water and allow it to dry.

6. Coat the dry filter with an air-filter adhesive (available from air conditioner suppliers or order Tektronix Part No. 006-0680-00).

7. Let the adhesive dry thoroughly.

8. Re-install the filter in the retaining frame.

Exterior. Loose dust accumulated on the outside of the Type 106 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened with a mild solution of water and detergent. Abrasive cleaners should not be used.

Interior. Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces or for cleaning ceramic terminal strips and circuit boards.

Lubrication

The reliability of potentiometers, rotary switches, and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant (such as Tektronix Part No. 006-0218-00) on shaft bushings and switch contacts. Lubricate switch detents with a heavier grease (such as Tektronix Part No. 006-0219-00). Potentiometers should be lubricated with a lubricant which will not affect electrical characteristics (such as Tektronix Part No. 006-0220-00). Do not use excessive lubrication. A lubrication kit containing the necessary lubricants and instructions is available from Tektronix, Inc. Order Tektronix Part No. 003-0342-00.

During routine maintenance, the fan-motor bearings should be lubricated. Fig. 4-1 shows the lubrication holes in the fan. Place a few drops of light machine oil in the holes. Remember that too much lubrication is as harmful to the fan motor as too little lubrication.

Visual Inspection

The Type 106 should be inspected occasionally for such defects as broken connections, broken or damaged ceramic terminal strips, improperly seated tubes or transistors, damaged circuit boards or heat-damaged parts.

The remedy for most visible defects is obvious; however, care must be taken if heat-damaged parts are located. Overheating is usually only a symptom of trouble. For this reason, it is essential to determine the actual cause of overheating before the heat-damaged part is replaced; otherwise, the damage may be repeated.

Tube and Transistor Checks

Periodic checks of the tubes and transistors in the Type 106 are not recommended. The best check of tube or transistor performance is its actual operation in the instrument. More detail on checking tube and transistor operation is given under Troubleshooting.

Recalibration

To assure accurate measurements, check the calibration of this instrument after each 500 hours of operation or every six months if used infrequently. In addition, replacement of components may necessitate recalibration of the affected circuits. Complete instructions are given in the Calibration section.

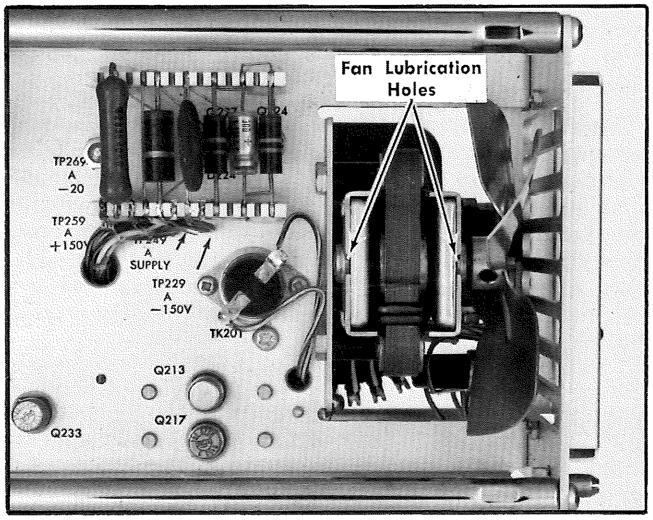

Fig. 4-1. Location of lubrication holes in fan (right side).

The calibration procedure can also be helpful in localizing certain troubles in the instrument. In some cases minor troubles not apparent during normal use may be revealed and/or corrected by recalibration.

CORRECTIVE MAINTENANCE

General

Corrective maintenance consists of component replacement and instrument repair. Special techniques or procedures required to replace components in the Type 106 are described here.

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the Type 106 can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, consult the parts lists for value, tolerance and rating.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its preformance at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special parts are used in the Type 106. These parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. These special parts are indicated in the parts list by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc.

Ordering Parts. When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument type.
2. Instrument serial number.
3. A description of the part (if electrical, include circuit number).
4. Tektronix Part Number.

Soldering Techniques

WARNING

Disconnect the instrument from the power source before soldering.

Ceramic Terminal Strips. Solder used on the ceramic terminal strips should contain about 3% silver. Ordinary tin-lead solder can be used occasionally without damage to the ceramic terminal strips. Use a 40- to 75-watt soldering iron with a ⅛-inch wide chisel-shaped tip. If ordinary solder is used repeatedly or if excessive heat is applied, the solder-to-ceramic bond may be broken.

A roll of 3% silver is mounted on the rear of the instrument. Additional silver solder should be available locally, or it can be purchased directly from Tektronix, Inc. Order by Tektronix Part No. 251-0514-00.

Observe the following precautions when soldering ceramic terminal strips.

1. Use a hot iron for a short time. Apply only enough heat to make the solder flow freely.
2. Maintain a clean, properly tinned tip.
3. Avoid putting pressure on the ceramic terminal strip.
4. Do not attempt to fill the terminal-strip notch with solder; use only enough solder to cover the wires adequately.
5. Clean the flux from the terminal strip with a flux-remover solvent.

Circuit Boards. Use ordinary 60/40 solder and a 35- to 40-watt pencil type soldering iron on the circuit boards. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the wiring from the base material.

The following technique should be used to replace a component on a circuit board. Most components can be replaced without removing the boards from the instrument.

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board, as it may damage the board.

2. When the solder begins to melt, pull the lead out gently. This should leave a clean hole in the board. If not, the hole can be cleaned by reheating the solder and placing a sharp object such as a toothpick or pointed tool into the hole to clean it out.

3. If a wire extends beyond the solder joint, clip off the in the board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the board until the component is firmly seated against the board. If it does not seat properly, heat the solder and gently press the component into place.

4. Apply the iron and a small amount of solder to the connection to make a firm solder joint. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers or other heat sink.

5. Clip the excess lead that protrudes through the board.

6. Clean the area around the soldered connection with a flux-remover solvent. Be careful not to remove information printed on the board.

Metal Terminals. When soldering metal terminals (e.g., switch terminals, potentiometers, tube or transistor socket contacts, etc.), ordinary 60/40 solder can be used. The soldering iron should have a 40- to 75-watt rating with a 1/8 inch wide chisel-shaped tip.

Observe the following precautions when soldering metal terminals:

1. Apply only enough heat to make the solder flow freely.

2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.

3. If a wire extends beyond the solder joint, clip off the excess.

4. Clean the flux from the solder joint with a flux-remover solvent.

Component Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

Removing the Cabinet. The Type 106 is held into the cabinet by the securing screw on the lower left corner of the front panel. To remove the cabinet, loosen this screw and slide the instrument out of the cabinet.

CAUTION

The cabinet of the Type 106 is designed to direct the flow of air through the instrument. Operation of the instrument for a prolonged period of time without the cabinet may cause the instrument to overheat and the thermal cutout to open more frequently.

Ceramic Terminal Strip Replacement. A complete ceramic terminal strip assembly is shown in Fig. 4-2. Replacement strips (including studs) and spacers are supplied under separate part numbers. The old spacers may be re-used if they are not damaged.

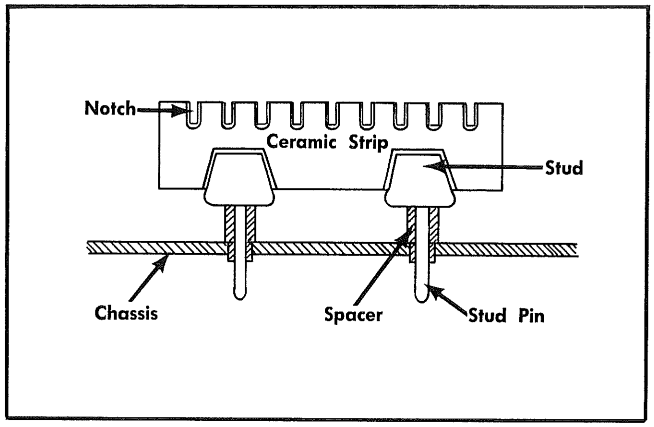

Fig. 4-2. Ceramic terminal strip assembly.

To replace a ceramic terminal strip, first unsolder all connections. Then, the damaged strip can be pried or pulled loose from the chassis. If the spacers come out with the strip, remove them from the stud pins to be used for installation of the new strip.

After the damaged strip has been removed, place the undamaged spacers in the chassis holes. Then, carefully press the studs into the spacers until completely seated. If necessary, use a soft mallet and tap lightly, directly over the stud area of the strip.

Circuit Board Replacement. If a circuit board is damaged and cannot be repaired, the entire assembly including all soldered-on components, or the board only, can be replaced. Part numbers are given in the Mechanical Parts List for either the completely-wired board or the unwired board.

All connections are soldered to the circuit boards. Most of the components mounted on the boards can be replaced without removing the board from the instrument. Observe the soldering precautions given under Soldering Techniques in this section. However, if the board itself must be replaced, use the following procedure:

1. Unsolder all leads connected to the board. Observe the soldering precautions given in this section.

2. Remove the securing nut holding the connector and circuit board assembly to the front panel (see Fig. 4-3) and remove the assembly. Use a General Radio wrench designed for this purpose.

3. Loosen the two clamp screws (see Fig. 4-3).

4. Unsolder the connection between the connector and the board and separate the units. (See Connector Repair or Termination Replacement which follows to repair these parts.)

5. To replace the board, reverse the order of removal. Correct connection of the interconnecting leads is shown in Figs. 4-6 and 4-7.

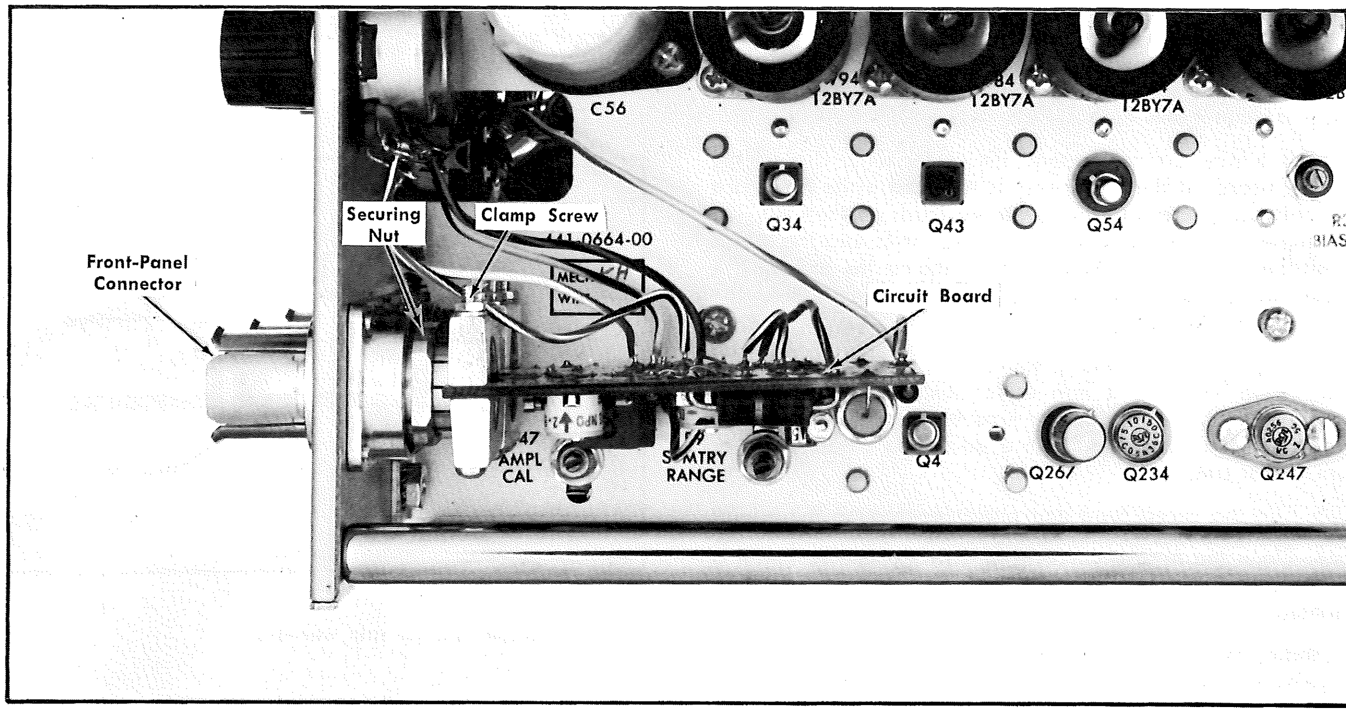

Fig. 4-3. Removing the + and — Output circuit board assemblies.

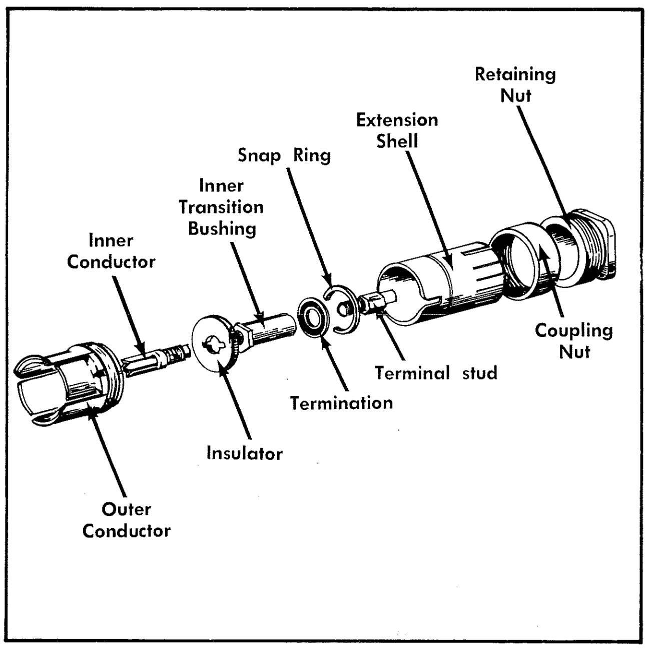

Fig. 4-4. Exploded view of + and — Output connectors.

Connector Repair or Termination Replacement. Use the following procedure to repair the connector or replace the termination. Fig. 4-4 shows the connector and its parts.

1. Follow steps 1 through 4 of the procedure under Circuit Board Replacement.

2. Use a special General Radio jig to hold the inner contact of the connector. Then, remove the hex nut on the outside of the termination. The disc termination can now be removed from the connector.

3. To completely disassemble the connector, remove the remaining hex nut.

4. The connector can be re-assembled by reversing the steps above.

Tube and Transistor Replacement. Tubes and transistors should not be replaced unless actually defective. If removed during routine maintenance, return them to their original sockets. Unnecessary replacement of tubes or transistors may affect the calibration of this instrument. Replacement tubes or transistors should be of the orginal type or a direct replacement. When tubes or transistors are replaced, check the calibration of that part of the circuit which may be affected.

Rotary Switches. Individual wafers or mechanical parts of rotary switches are normally not replaced. If a switch is defective, replace the entire assembly. Replacement switches can be ordered either wired or unwired; refer to the Electrial Parts List for the applicable part number.

When replacing a switch, it is recommended that the leads and switch terminals be tagged with corresponding identification tags as the leads are disconnected. Then, use the old switch as a guide for installing the new one. An alternative method is to draw a sketch of the switch layout and record the wire color at each terminal.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting of the Type 106, if trouble develops. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component.

Troubleshooting Aids

Diagrams. Circuit diagrams are given on foldout pages in Section 9. The circuit number and electrical value of each component in this instrument as well as important voltages and waveforms are shown on the diagrams.

Component Numbers. The circuit number of each electrical part in this instrument is shown on the circuit diagram. Each main circuit is assigned a series of circuit numbers. Table 4-1 lists the main circuits in the Type 106 and the series of circuit numbers assigned to each. For example, using Table 4-1 a resistor numbered R134 is identified as being located in the Fast Rise Output circuit.

TABLE 4-1

Circuit Numbers

Circuit Number on Diagrams	Circuit
1 - 99	Generator
100 - 199	Fast Rise Output
200 - 299	Power Supply

Switch Wafer Identification. Switch wafers shown on the diagrams are coded to indicate the position of the wafer in the complete switch assembly The numbered portion of the code refers to the wafer number counting from the front or mounting end of the switch toward the rear. The letters F and R indicate whether the front or rear of the wafer performs the particular switching function. For example, a wafer designated 2R indicates that the rear of the second wafer is used for this particular switching function.

Circuit Boards. Figs. 4-6 and 4-7 show the circuit boards used in the Type 106. Each electrical component on the boards is identified by its circuit number. Correct connection of the interconnecting leads is also shown. The boards are outlined on the diagrams with a blue line. These pictures used along with the diagrams will aid in locating the components mounted on the circuit boards.

TABLE 4-2

SUPPLY	BACK-GROUND COLOR	1st STRIPE	2nd STRIPE	3rd STRIPE
A Supply	Tan	Violet	Green	Black
A +150 V	White	Brown	Brown	Green
A —150 V	Tan	Brown	Brown	Green
A —20 V	Tan	Brown	Red	Brown
—10 Volt	Tan	Brown	Black	Brown
+10 Volt	White	Brown	Black	Black

Wiring Color-Code. All insulated wire used in the Type 106 is color-coded according to the EIA standard color-code (as used for resistors) to facilitate point-to-point circuit tracing. The widest color stripe identifies the first color of the code. Power-supply voltages can be identified by three color stripes and the following background color-code: white, positive voltage; tan, negative voltage. Table 4-2 shows the wiring color-code for the power-supply voltages used in the Type 106. The remainder of the wiring in the Type 106 is color-coded with two or less stripes or has a solid background without stripes. The color-coding helps to trace a wire from one point in the instrument to another.

Resistor Color-Code. A number of precision metal-film resistors are used in this instrument. These resistors can be identified by their grey body color. If a metal-film resistor has a value indicated by three significant figures and a multiplier, it will be color-coded according to the EIA standard resistor color-code. If it has a value indicated by four significant figures and a multiplier, the value will be printed on the body of the resistor. For example, a 333 kΩ resistor will be color-coded, but a 333.5 kΩ resistor will have its value printed on the resistor body. The color-code sequence is shown in Fig. 4-5.

Composition resistors are color-coded according to the EIA standard resistor color-code.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order which checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks assure proper connection, operation and calibration. If the trouble is not located by these checks, the remaining steps aid in locating the defective circuit and component. When the defective component is located, it should be replaced following the replacement procedures given in this section.

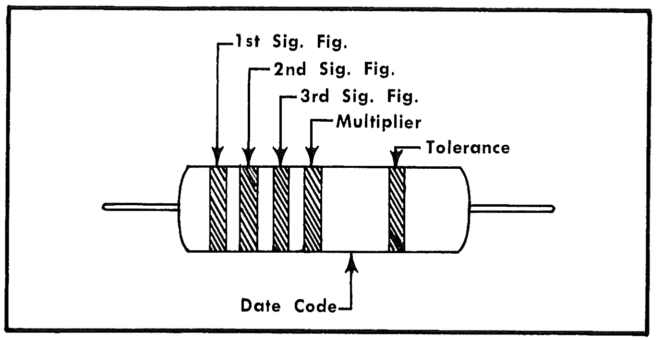

Fig. 4-5. Color-coding of metal-film resistors.

1. Check Associated Equipment. Before proceeding with troubleshooting of the Type 106, check that the equipment used with the Type 106 is operating correctly. Check that the signal is properly connected and that the interconnecting cables are not defective. Also, check the power source.

2. Check Control Settings. Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions section of this manual.

3. Check Instrument Calibration. Check the calibration of the instrument, or the affected circuit if the trouble exists in one circuit. The indicated trouble may only be a result of misadjustment, or may be corrected by calibration. Complete instructions are given in the Calibration section of this manual. Individual calibration steps can be performed out of sequence. However, if the step affects the calibration of other circuits in the instrument, a more complete calibration will be necessary.

4. Isolate Trouble to a Circuit. To isolate a trouble to a particular circuit, note the trouble symptom. The symptom often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check all affected circuits. Methods of checking the circuits are given in steps 5 through 7.

Incorrect operation of all circuits often indicates trouble in the Power Supply. Check first for correct voltage of the individual supplies. However, a defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits.

After the defective circuit has been located, proceed with steps 5 through 7 to locate the defective component(s). If the trouble has not been isolated to a circuit using the procedure described here, check voltages and waveforms as explained in step 6 to locate the defective circuit.

5. Visual Check. Visually check the circuit in which the trouble is located. Many troubles can be located by visual indications such as unsoldered connections, broken wires, damaged circuit boards or damaged components.

6. Check Voltages and Waveforms. Often the defective component can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are shown on the diagrams.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the first diagram page.

A. VOLTAGES. Voltage measurements should be taken with a 20,000 ohms/volt DC voltmeter. Accuracy of the voltmeter should be within 3% on all ranges. Be sure that the test prods are well insulated to prevent accidental shorting of components.

B. WAVEFORMS. Use a test oscilloscope which has the following minimum specifications:

Bandwidth: DC to 30 MHz

Deflection factor: 0.05 volts/division minimum

Input impedance: 1 Megohm paralleled by about 20 pF

7. Check Individual Components. The following procedures describe methods of checking individual components in the Type 106. Components which are soldered in place can be checked most easily by disconnecting one end. This eliminates incorrect measurements due to the effects of surrounding circuitry.

A. TUBES AND TRANSISTORS. The best check of tube and transistor operation is actual performance under operating conditions. If a tube or transistor is suspected of being defective, it can best be checked by substituting a new component or one which has been checked previously. However, be sure that circuit conditions are not such that a replacement tube or transistor might also be damaged. If substitute tubes or transistors are not available, a dynamic tester may be used (such as Tektronix Type 570 or Type 575). Static-type testers are not recommended since they do not check operation under simulated operating conditions.

B. DIODES. A diode can be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of about 1.5 volts, the resistance should be very high in one direction and very low when the leads are reversed.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High currents may damage the diode.

C. RESISTORS. Resistors can be checked with an ohmmeter. Check the Electrical Parts List for the tolerance of resistors used in this instrument. Resistors should be replaced if the measured value is outside the specified tolerance.

D. INDUCTORS. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response (roll-off).

E. CAPACITORS. A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter, or by checking whether the capacitor passes AC signals.

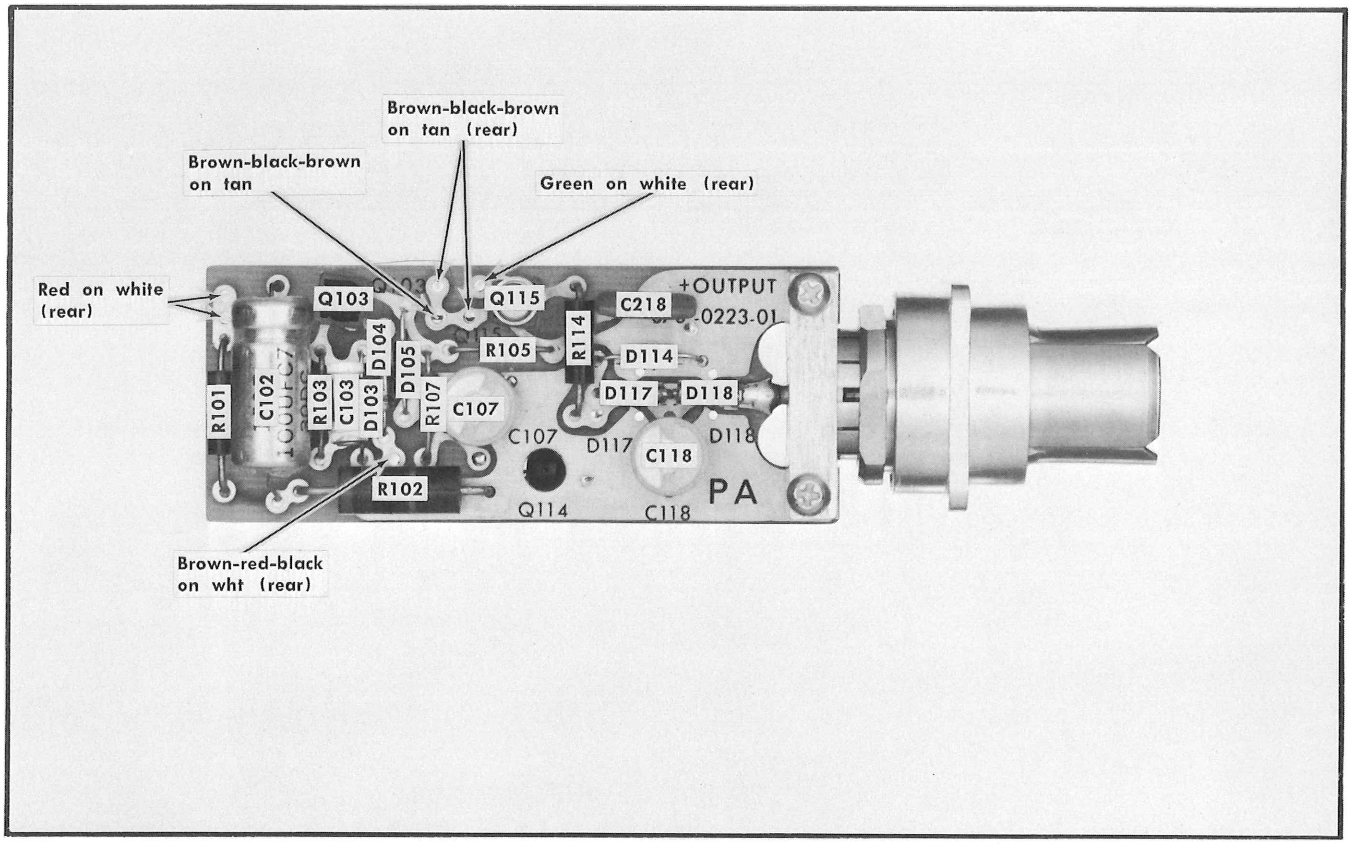

Fig. 4-6A. + Output Amplifier circuit board (above SN 1190).

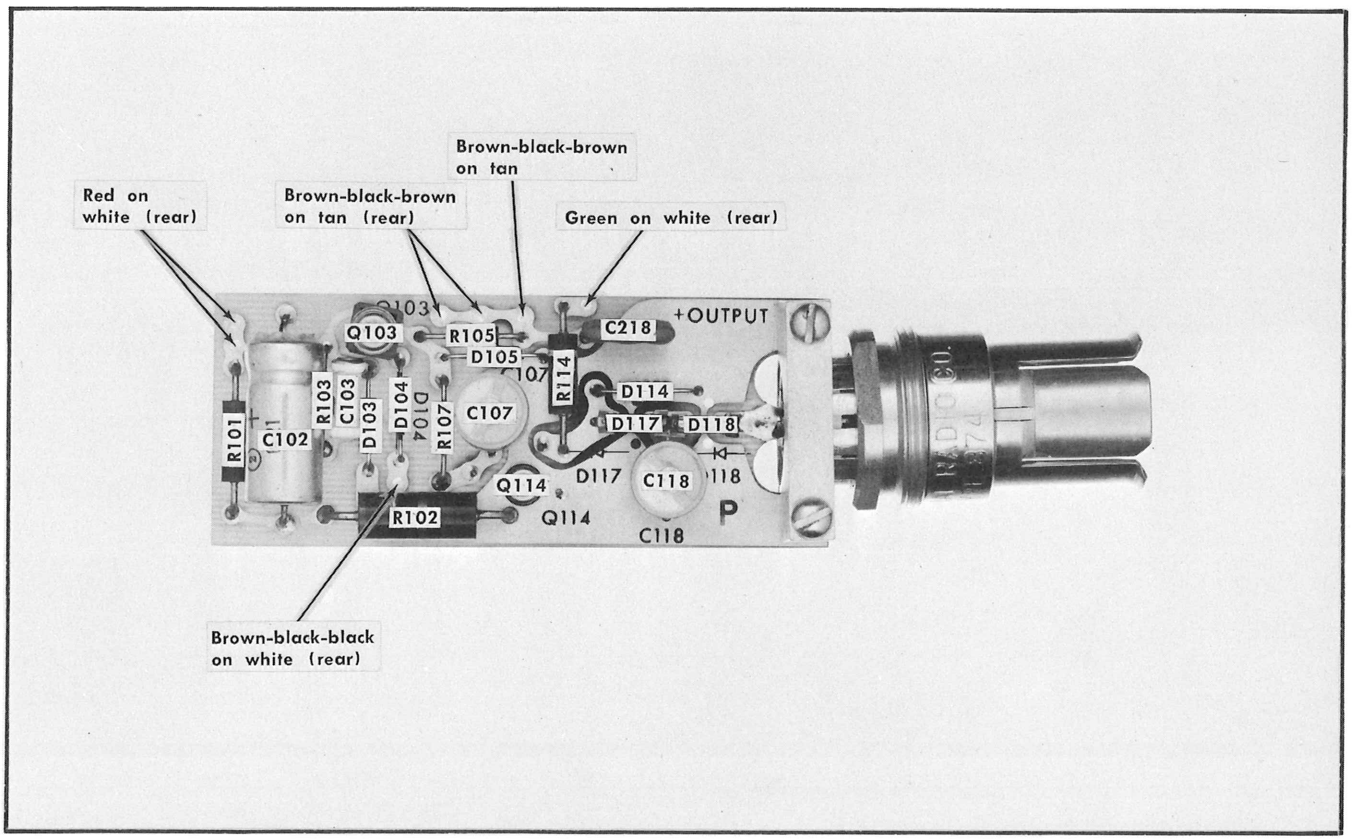

Fig. 4-6B. + Output Amplifier circuit board (SN 200 to 1189).

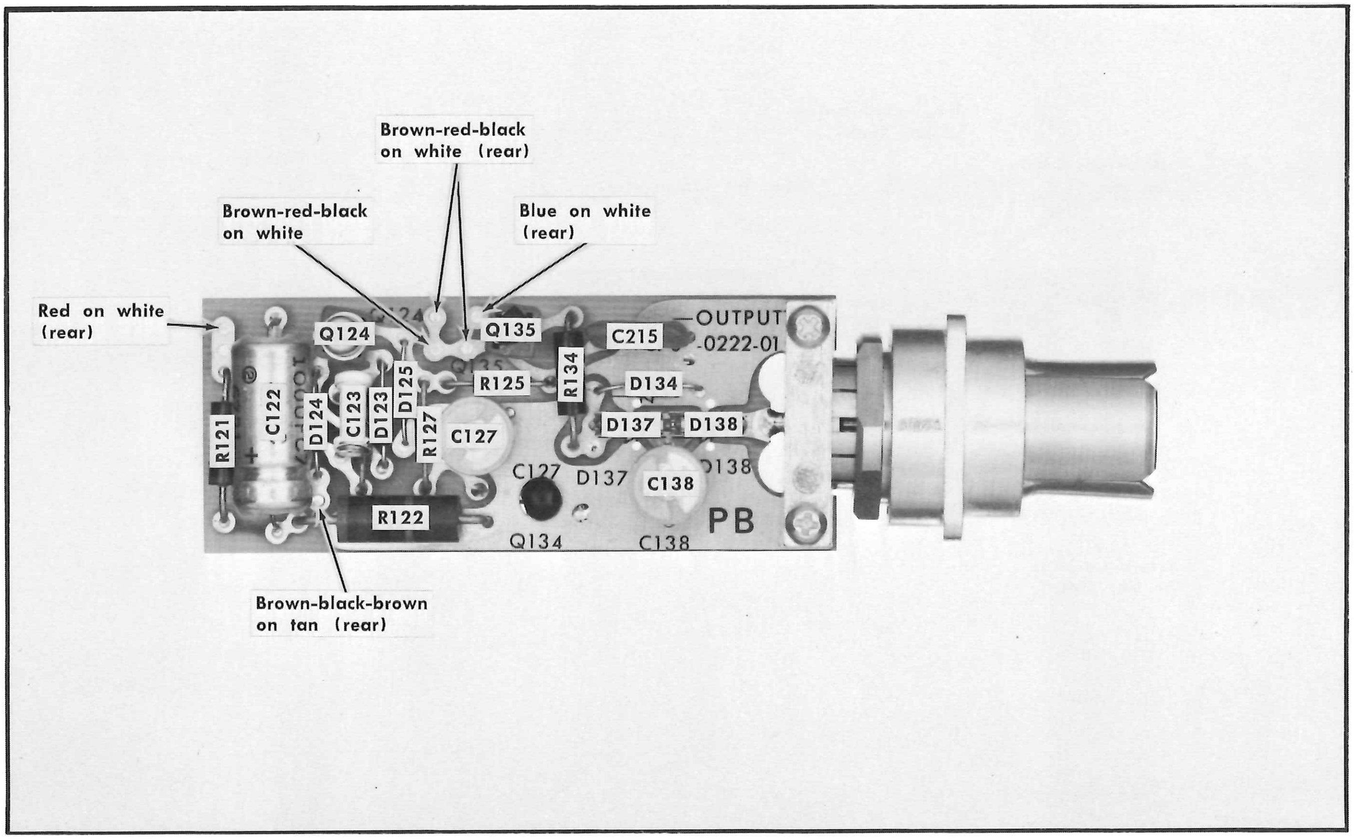

Fig. 4-7A. — Output Amplifier circuit board (above SN 1190).

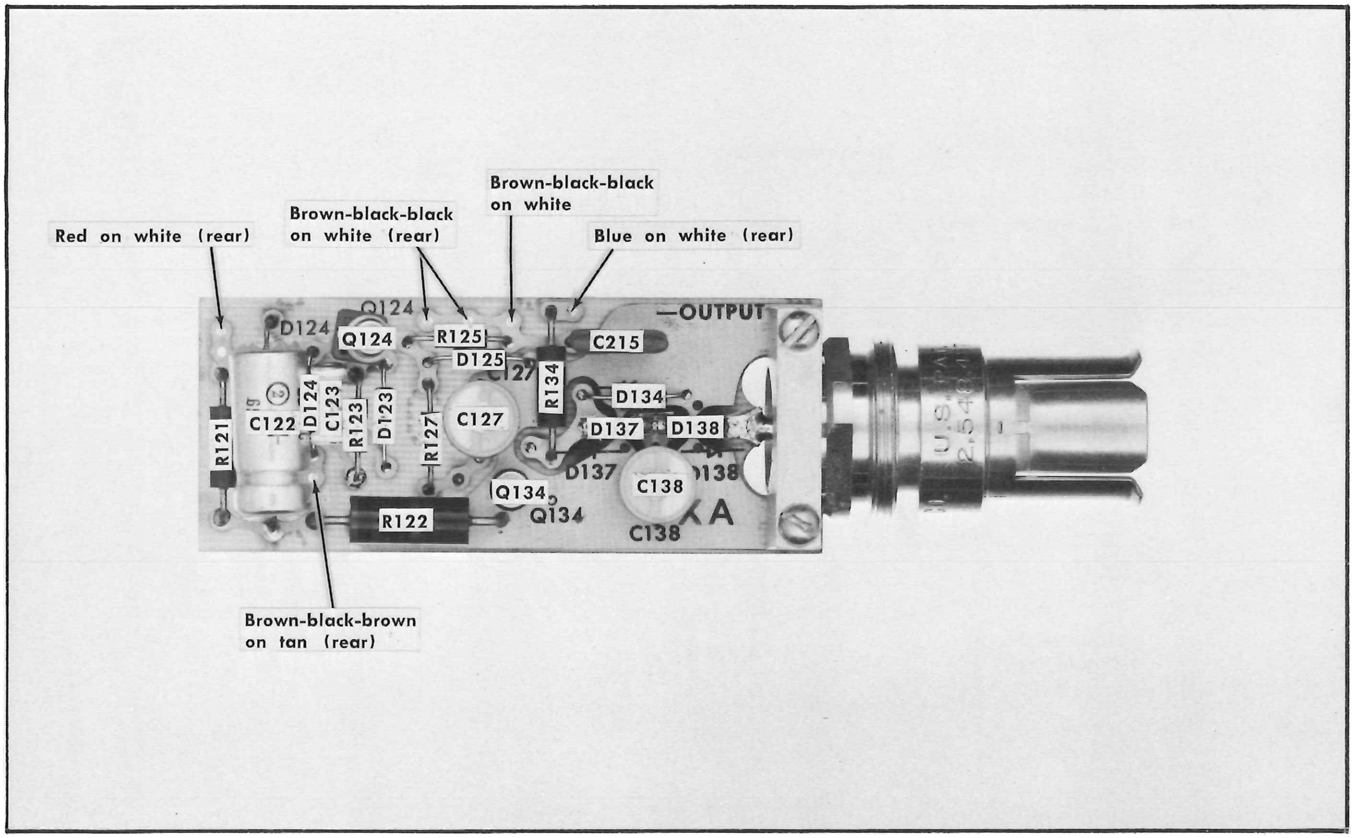

Fig. 4-7B. — Output Amplifier circuit board (SN 200 to 1189).

SECTION 5
PERFORMANCE CHECK

Introduction

This performance check procedure is provided to check the operation of the Type 106 without removing the cabinet. This precedure may be used for incoming inspection, instrument familiarization, reliability testing, calibration verification, etc.

If the instrument does not meet the performance requirements given in this procedure, internal checks and/or adjustments are required. See the Calibration section. All performance requirements given in this section correspond to those given in the Characteristics section.

Recommended Equipment

The following equipment is recommended for a complete performance check. Specifications given are the minimum necessary to perform this procedure. All equipment is assumed to be calibrated and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

1. Test oscilloscope. Frequency response, DC to 30 MHz; minimum deflection factor, 20 millivolts/division; accuracy, within ±3%; must have 1 kHz amplitude calibrator output voltages of 1, 5 and 50 volts and a dual-trace vertical system. Tektronix Type 545B Oscilloscope with Type 1A2 Dual-Trace Plug-In Unit recommended.

2. Sampling oscilloscope. Risetime, 0.35 nanoseconds; calibrated deflection factor, 10 millivolts/division minimum; calibrated sweep range, equivalent to 100 nanoseconds/division to 0.2 nanoseconds/division. Tektronix Type 661 Oscilloscope with Type 4S3 Sampling-Probe Dual-Trace Unit and Type 5T3 Timing Unit recommended.

3. Delay cable. Impedance, 50 ohms; electrical length, 60 nanoseconds; connectors, GR874. Tektronix Type 113 Delay Cable recommended.

4. Time-mark generator. Marker outputs, 1 microsecond to 1 second; marker accuracy, within 0.1%. Tektronix Type 184 Time-Mark Generator recommended.

5. Cable. Impedance, 50 ohms; type RG-213/U; electrical length, five nanoseconds; connectors, GR874. Tektronix Part No. 017-0502-00.

6. Thru-line termination. Impedance, 50 ohms; wattage ratings, 1.0 watts; accuracy, ±3%; connectors, GR874 input with BNC female output. Tektronix Part No. 017-0083-00.

7. Adapter. Connectors, GR874 and BNC female. Tektronix Part No. 017-0063-00.

8. Cable (two). Impedance, 50 ohms; type, RG-58A/U; length, 42 inches; connectors, BNC. Tektronix Part No. 012-0057-01.

9. Termination. Impedance, 50 ohms; accuracy, ±3%; connectors, BNC. Tektronix Part No. 011-0049-00.

10. BNC T connector. Tektronix Part No. 103-0030-00.

11. Attenuator. Attenuation, 10×; impedance, 50 ohms; accuracy, ±3%; connectors, GR874. Tektronix Part No. 017-0078-00.

12. VP-2 Voltage Pickoff. Tektronix Part No. 017-0077-00.

13. End-line termination. Impedance, 50 ohms; accuracy, ±3%; connectors, GR874. Tektronix Part No. 017-0081-00.

PERFORMANCE CHECK PROCEDURE

General

In the following procedure, control settings or test equipment connections should not be changed except as noted. If only a partial check is desired, refer to the preceding step(s) for setup information. Type 106 front-panel control titles referred to in this procedure are capitalized (e.g., AMPLITUDE).

The following procedure uses the equipment listed under Recommended Equipment. If equipment is substituted, control settings or setup may need to be altered to meet the requirements of the equipment used.

Preliminary Procedure

1. Connect the Type 106 to a power source which meets the voltage and frequency requirements of this instrument.

2. Set the Type 106 controls as follows:

REPETITION RATE RANGE	1 kHz
MULTIPLIER	10 (clockwise)
SYMMETRY	Midrange
AMPLITUDE	Counterclockwise
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+ TRANSITION AMPLITUDE	Counterclockwise
— TRANSITION AMPLITUDE	Counterclockwise
POWER	ON

3. Allow at least five minutes warm up at 25°C, ±5° for checking the instrument to the given accuracy.

1. Check Amplitude Control Range

a. REQUIREMENT—0.5 volt or less to 12 volts or greater into 50-ohm load. 7 volts or less to 120 volts or greater, unterminated.

b. Connect the OUTPUT (HI AMPLITUDE) connector to the input of the test oscilloscope through the five-nanosecond GR cable and the 50-ohm in-line termination.

c. Set the test oscilloscope vertical deflection to 0.1 volts/division and the sweep rate to 50 microseconds/division.

d. CHECK—Test oscilloscope display amplitude for five divisions or less (0.5 volt or less).

e. Set the test oscilloscope vertical deflection to 2 volts/division.

f. Turn the AMPLITUDE (HI AMPLITUDE) control fully clockwise.

g. CHECK—Test oscilloscope display amplitude for six divisions or greater (12 volts or greater).

h. Set the test oscilloscope vertical deflection to 20 volts/division.

i. Remove the 50-ohm in-line termination and connect the five-nanosecond cable to the test oscilloscope input using the GR-to-BNC adapter.

j. CHECK—Test oscilloscope display for 6 divisions minimum amplitude (120 volts or greater).

k. Turn the AMPLITUDE (HI AMPLITUDE) control fully counterclockwise.

l. Set the test oscilloscope vertical deflection to two volts/division.

m. CHECK—Test oscilloscope display for 3.5 divisions or less amplitude (seven volts or less).

2. Check Symmetry Range

a. REQUIREMENT—Duty cycle variable from 45% or less to 55% or greater.

b. Connect the OUTPUT (HI AMPLITUDE) connector to the input of the test oscilloscope through the five-nanosecond GR cable and the 50-ohm in-line termination.

c. Set the AMPLITUDE (HI AMPLITUDE) control to midrange.

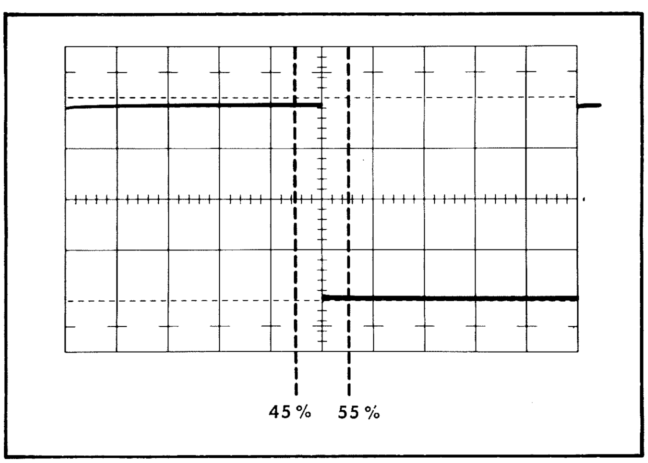

Fig. 5-1. Typical test oscilloscope display showing symmetry limits.

d. Set the SYMMETRY control fully clockwise.

e. Set the test oscilloscope sweep rate to display one complete cycle in 10 divisions (use variable control).

f. CHECK—Positive portion of square wave for duration of 5.5 divisions or more (55% duty cycle or more; see Fig. 5-1).

g. Set the SYMMETRY control fully counterclockwise.

h. If necessary, readjust the sweep rate to display one complete cycle in 10 divisions.

i. CHECK—Positive portion of square wave for duration of 4.5 divisions or less (45% duty cycle or less; see Fig. 5-1).

3. Check Repetition Rate Accuracy

a. REQUIREMENT—Within ±10% of indicated repetition rate.

b. Connect the timemark generator output to the channel 2 input connector of the test oscilloscope through a 50-ohm BNC cable and a 50-ohm termination. Set the time-mark generator for .1 millisecond markers.

c. Set the AMPLITUDE (HI AMPLITUDE) control to midrange.

d. Set the test oscilloscope vertical deflection to display about two divisions of the signal on each channel in the alternate mode.

e. Using the Type 106, time-mark generator and test oscilloscope settings given in Table 5-1, check repetition rate accuracy within ±10%.

f. Disconnect all test equipment.

4. Check Synchronized Operation

a. REQUIREMENT—Output signal synchronizes with 2.5 to 50 volt input square wave.

b. Connect the test-oscilloscope amplitude calibrator to the SYNC INPUT connector and the channel 1 input connector through a BNC T connector and two 50-ohm BNC cables.

c. Connect the OUTPUT (HI AMPLITUDE) connector to the channel 2 input connector through a five-nanosecond GR cable and a 50-ohm in-line termination.

d. Set the REPETITION RATE RANGE switch to 100 Hz and the multiplier to about 7.

e. Set the test oscilloscope amplitude calibrator for five volts output and the sweep rate to 0.5 millisecond/divsion.

f. Set the test oscilloscope to trigger from channel 1 in the chopped mode.

g. CHECK—Test oscilloscope for stable display of the channel 2 waveform (readjust the MULTIPLIER if necessary).

h. Set the test oscilloscope amplitude calibrator for 50 volts output.

i. CHECK—Test oscilloscope for stable display of the channel 2 waveform.

j. Set the test oscilloscope amplitude calibrator for one volt output.

TABLE 5-1
Repetition Rate Accuracy

REPETITION RATE RANGE Switch Setting	MULTIPLIER Control Setting	Time Markers Applied	Test Oscilloscope Sweep Rate	CRT Display (Cycles/Marker for ±10% accuracy)
100 kHz	10	10 μs	1 μs/div	9—11
100 kHz	5	10 μs	1 μs/div	4.5—5.5
10 kHz	9	0.1 ms	10 μs/div	8.1—9.9
10 kHz	4	0.1 ms	10 μs/div	3.6—4.4
1 kHz	8	1 ms	0.1 ms/div	7.2—8.8
1 kHz	3	1 ms	0.1 ms/div	2.7—3.3
100 Hz	7	10 ms	1 ms/div	6.3—7.7
100 Hz	2	10 ms	1 ms/div	1.8—2.3
10 Hz	6	0.1 s	10 ms/div	5.4—6.6
10 Hz	1	0.1 s	10 ms/div	0.9—1.1

k. CHECK—Test oscilloscope for drift of the channel 2 waveform due to inadequate sync signal.

l. Disconnect all test equipment.

5. Check Trigger Output

a. REQUIREMENT—Amplitude, 0.1 volt positive and negative into 50 ohms.

Risetime, 50 nanoseconds or less, between 0 and 0.1 volt.

Delay Time, 50 nanoseconds or less.

b. Connect the TRIGGER OUTPUT connector to the channel 2 input connector of the test oscilloscope through a 50-ohm BNC cable and a 50-ohm BNC termination.

c. Connect the OUTPUT (HI AMPLITUDE) connector to the channel 1 input of the test oscilloscope through a 50-ohm GR cable and a 50-ohm in-line termination.

d. Set the test oscilloscope to display the channel 2 signal at a vertical deflection of 0.1 volt/division and a sweep rate of 10 microseconds/division.

e. Set the REPETITION RATE RANGE switch to 100 kHz and the MULTIPLIER control to 1.

f. CHECK—Test oscilloscope display for positive and negative pulse amplitude of 1 division minimum (0.1 volt minimum; see Fig. 5-2A).

g. Set the test oscilloscope for a vertical deflection of 0.02 volts/division at a sweep rate of 50 nanoseconds/ division (use magnifier).

h. Position the display to observe the leading edge of the positive pulse.

i. CHECK—Test oscilloscope display for one division or less between the 0 and 0.1 volt levels of the trigger pulse (50 nanoseconds or less; see Fig 5-2B.

j. Set the test oscilloscope to trigger from channel 1 in the alternate mode.

k. Position the 50% points of both waveforms to the horizontal centerline.

l. CHECK—Test oscilloscope display for one division or less spacing between the 50% amplitude points of the two waveforms (50 nanoseconds or less; see Fig. 5-3C).

m. Disconnect all test equipment.

6. Check Hi Amplitude Output Into 50 ohms

a. REQUIREMENT—Risetime (terminated in 50 ohms), 12 nanoseconds or less.

Aberrations, 2% or less in first 100 nanoseconds following leading edge.

b. Connect the TRIGGER OUTPUT connector to the 1 MΩ external trigger input connector of the sampling system through a 50-ohm BNC cable and a 50-ohm BNC termination.

c. Connect the OUTPUT (HI AMPLITUDE) connector to the sampling-system vertical input through a 10× GR attenuator, five-nanosecond GR cable, 60-nanosecond delay line and the VP-2 voltage pickoff to the P6038 sampling probe. Terminate the output of the VP-2 with a 50-ohm GR termination. Set the MULTIPLIER control to 10.

d. Set the sampling-system vertical deflection to 200 millivolts/division, time position range switch to one microsecond and magnify the sweep to five nanoseconds/division.

e. Set the triggering and time-position controls for a stable display of the first leading edge.

f. Set the AMPLITUDE (HI AMPLITUDE) control for a five-division display.

g. CHECK—Sampling system display for 2.4 divisions or less between the 10% and 90% points of the leading edge (12 nanoseconds or less; see Fig. 5-3A).

h. Set the sampling system sweep rate to 50 nanoseconds/ division and the vertical deflection to 20 millivolts/division. Reposition the top of the waveform onto the viewing area with the DC offset control.

i. CHECK—Sampling system display for aberrations ± one division or less in first two divisions following the leading edge (±2% or less in first 100 nanoseconds; see Fig. 5-3B).

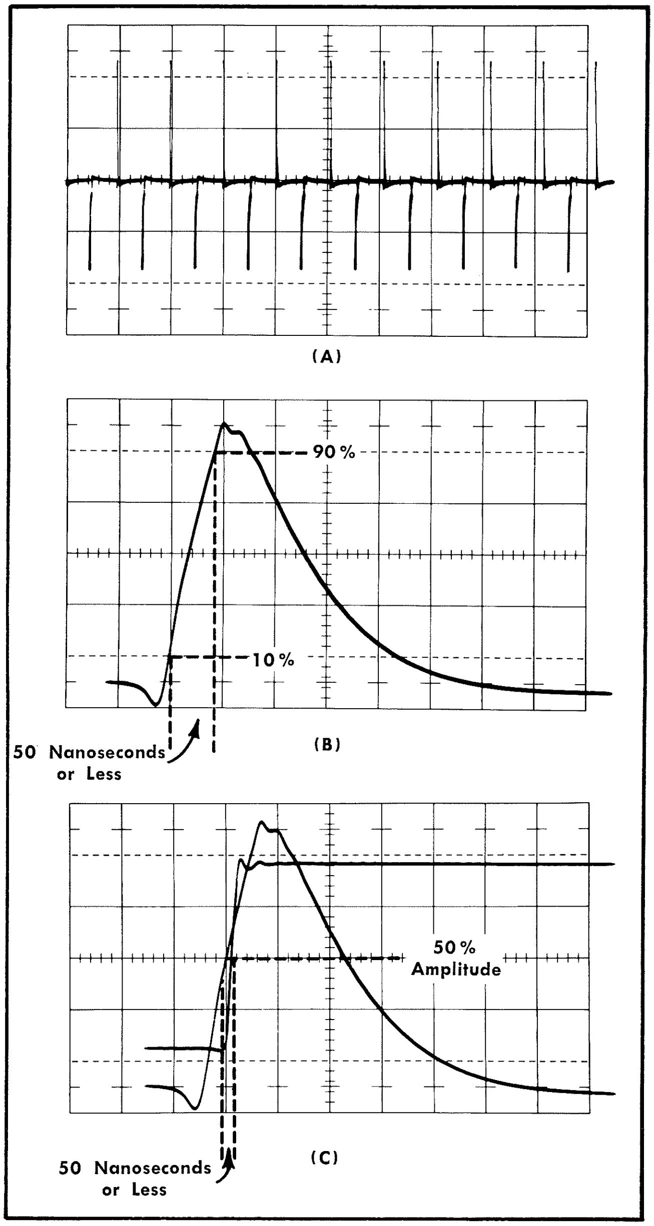

Fig. 5-2. Typical test oscilloscope display when checking TRIGGER OUTPUT; (A) amplitude, (B) risetime, (C) delay time.

7. Check + Fast Rise Output

a. REQUIREMENT—Minimum amplitude, 50 millivolts or less.

Maximum amplitude, 500 millivolts or more.

Risetime, one nanosecond or less.

Aberrations, + and — 2% or less in first five nanoseconds following leading edge.

b. Disconnect the five-nanosecond GR cable from the 10× attenuator and connect it to the + OUTPUT connector.

c. Set the HI AMPLITUDE — FAST RISE switch to FAST RISE.

d. Set the sampling system sweep rate to 10 nanoseconds/division.

e. CHECK—Sampling system display for 2.5 division or less amplitude (50 millivolts or less).

f. Set the sampling system vertical deflection to 100 millivolts/division.

g. Set the + TRANSITION AMPLITUDE control fully clockwise.

h. CHECK—Sampling system display for five division or more amplitude (500 millivolts or more).

i. Set the + TRANSITION AMPLITUDE control for five divisions of vertical deflection.

j. Set the sampling-system time position range switch to 100 nanoseconds and magnify the sweep to one nanosecond/division.

k. CHECK—Sampling system display for one division or less between the 10% and 90% points of the leading edge (one nanosecond or less; see Fig. 5-4A).

l. Set the sampling system vertical deflection to 10 millivolts/division. Reposition the top of the waveform onto the viewing area with the DC offset control.

m. CHECK—Sampling system display for aberrations ± one division or less in first five divisions following the leading edge (+ and — 2% or less in first five nanoseconds; see Fig. 5-4B).

8. Check — Fast Rise Output

a. REQUIREMENT—Minimum amplitude, 50 millivolts or less.

Maximum amplitude, 500 millivolts or more.

Risetime, one nanosecond or less.

Aberrations, + and — 2% or less in first five nanoseconds following leading edge.

b. Disconnect the five-nanosecond cable from the + OUTPUT connector and connect it to the — OUTPUT connector.

c. Set the sampling-system vertical deflection to 20 millivolts/division and the sweep rate to 10 nanoseconds/division.

d. CHECK—Sampling system display for 2.5 division or less amplitude (50 millivolts or less).

e. Set the sampling system vertical deflection to 100 millivolts/division.

f. Set the — TRANSITION AMPLITUDE control fully clockwise.

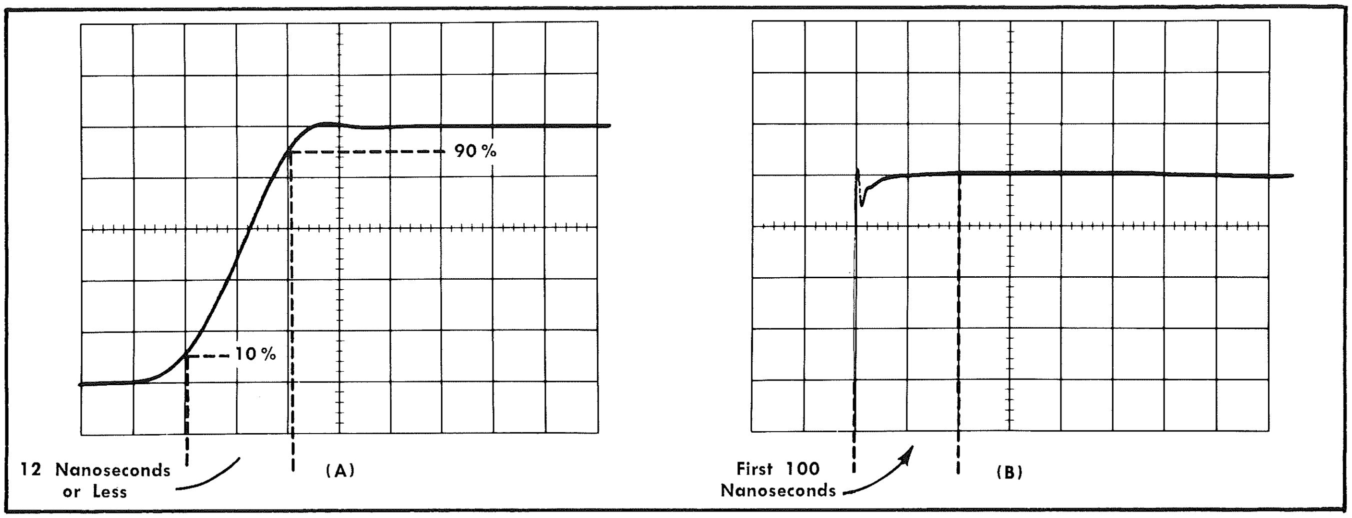

Fig. 5-3. Typical sampling system display when checking OUTPUT (HI AMPLITUDE), (A) risetime, (B) aberrations in first 100 nanoseconds.

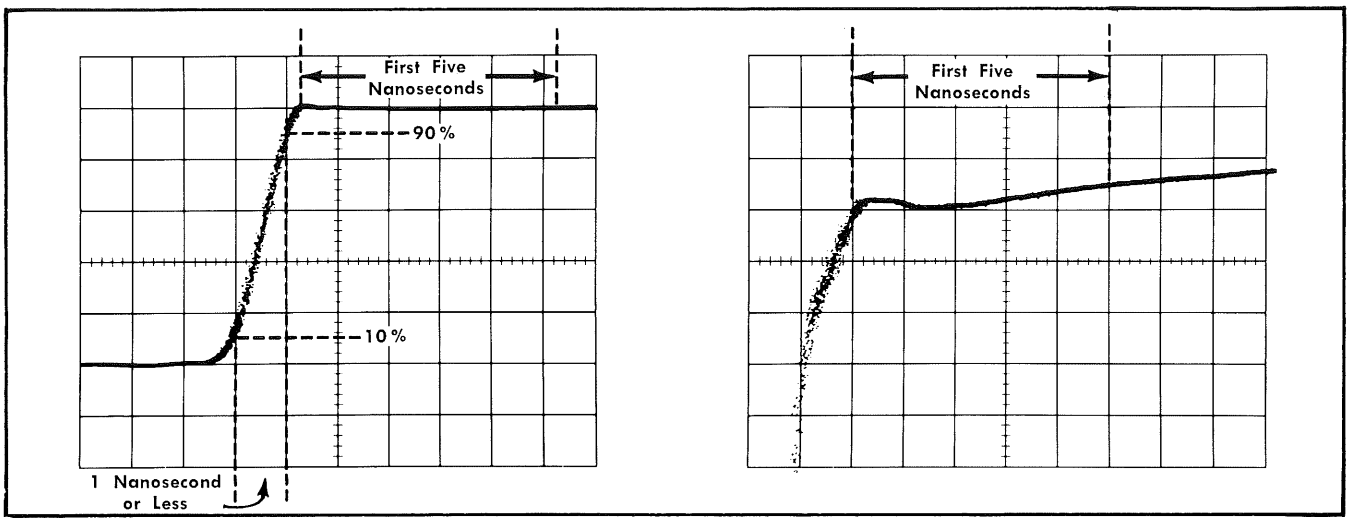

Fig. 5-4. Typical sampling system display when checking + OUTPUT; (A) risetime, (B) aberrations in first five nanoseconds.

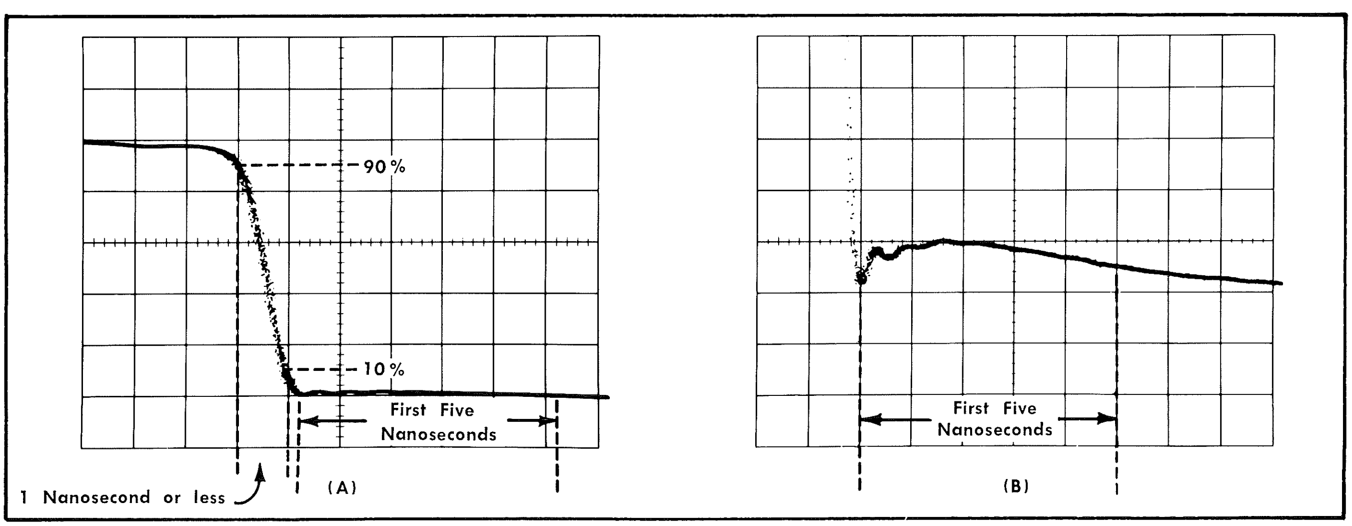

Fig. 5-5. Typical sampling system display when checking — OUTPUT; (A) risetime, (B) aberrations in first five nanoseconds.

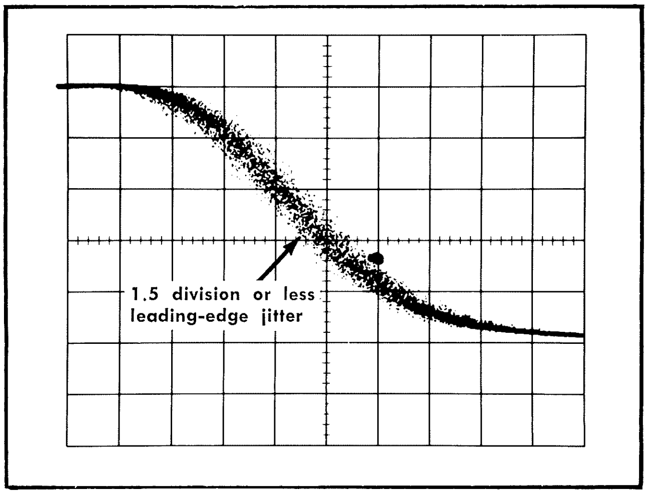

Fig. 5-6. Typical sampling system display of trigger jitter.

g. CHECK—Sampling system display for five division or more amplitude (500 millivolts or more).

h. Set the — TRANSITION AMPLITUDE control for five divisions of vertical deflection.

i. Set the sampling system time position range switch to 100 nanoseconds and magnify the sweep to one nanosecond/division.

j. CHECK—Sampling system display for one division or less between the 10% and 90% points of the leading edge (one nanosecond or less; see Fig. 5-5A).

k. Set the sampling system vertical deflection to 10 millivolts/division. Reposition the top of the waveform onto the viewing area with the DC offset control.

l. CHECK—Sampling system display for aberrations ± one division or less in first five divisions following the leading edge (+ and — 2% or less in first five nanoseconds; see Fig. 5-5B).

9. Check Trigger Jitter

a. REQUIREMENT—300 picoseconds or less.

b. Set the sampling system to magnify the sweep rate to 0.2 nanosecond/division and set the triggering controls for a stable display. Set the sampling system vertical deflection to 100 millivolts/division.

c. CHECK—Rotate the MULTIPLIER control throughout its range and check for 1.5 division or less jitter in the leading edge of the waveform (300 picoseconds or less; see Fig. 5-6).

d. Remove the five-nanosecond cable from the — OUTPUT connector and connect it to the + OUTPUT connector.

e. CHECK—Rotate the MULTIPLIER control throughout its range and check for 1.5 divisions or less jitter in the leading edge of the waveform (300 picoseconds or less).

f. Disconnect all test equipment.

This completes the performance check procedure for the Type 106. If the instrument has met all performance requirements given in this procedure, it is correctly calibrated and within the specified tolerances.

SECTION 6
CALIBRATION

Introduction

Complete calibration information for the Type 106 is given in this section. This procedure calibrates the instrument to the performance requirements listed in the Characteristics section. The Type 106 can be returned to original performance standards by completion of each step in this procedure. If it is desired to merely touch up the calibration, perform only those steps entitled Adjust . . . ◐. A short-form calibration procedure is also provided in this section for the convenience of the experienced calibrator. The short-form procedure may be used as a calibration record or an index to the steps in the complete Calibration Procedure.

The Type 106 should be checked, and recalibrated if necessary, after each 500 hours of operation, or every six months if used infrequently, to assure correct operation and accuracy. The Performance Check section of this manual provides a complete check of instrument performance without making internal adjustments. Use the performance check procedure to verify the calibration of the Type 106 and determine if recalibration is required.

EQUIPMENT REQUIRED

General

The following equipment, or its equivalent, is required for complete calibration of the Type 106 (see Figs. 6-1 and 6-2). Specifications given are the minimum necessary for accurate calibration of this instrument. All test equipment is assumed to be correctly calibrated and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

1. Variable autotransformer. Must be capable of supplying 200 volt-amperes over a range of 103.5 to 126.5 volts (207 to 253 volts for 230-volt nominal line). (If autotransformer does not have an AC voltmeter to indicate output voltage, monitor output with an AC voltmeter with range of at least 135 or 270 volts, RMS). For example, General Radio W10MT3W Metered Variac Autotransformer.

2. DC voltmeter. Minimum sensitivity, 20,000 ohms/volt; accuracy, checked to within ±1% at −150, −10, +10 and +150 volts; range, 0 to 350 volts. For example, Simpson Model 262.

3. Test oscilloscope. Frequency response, DC to 30 MHz; minimum deflection factor, 20 millivolts/division; accuracy, within ±3%; must have 1 kHz amplitude calibrator output voltages of 1, 5 and 50 volts and a dual-trace vertical system. Tektronix Type 545B Oscilloscope with Type 1A2 Dual-Trace Plug-In Unit recommended.

4. 10× probe with BNC connector. Tektronix P6008 Probe recommended.

5. Sampling oscilloscope. Risetime, 0.35 nanoseconds; calibrated deflection factor, 20 millivolts/division minimum; calibrated sweep range, equivalent to 100 nanoseconds/division to 0.2 nanosecond/division. Tektronix Type 661 Oscilloscope with Type 4S3 Sampling-Probe Dual-Trace Unit and Type 5T3 Timing Unit recommended.

6. Delay cable. Impedance, 50 ohms; electrical length, 60 nanoseconds; connectors, GR874. Tektronix Type 113 Delay Cable recommended.

7. Time-mark generator. Marker outputs, 1 microsecond to 1 second; marker accuracy, within 0.1%. Tektronix Type 184 Time-Mark Generator recommended.

8. Cable. Impedance, 50 ohms; type RG-213/U; electrical length, five nanoseconds; connectors, GR874. Tektronix Part No. 017-0502-00.

9. Thru-line termination. Impedance, 50 ohms; wattage rating, 1.0 watts; accuracy, ±3%; connectors, GR874 input with BNC female output. Tektronix Part No. 017-0083-00.

10. Adapter. Connector, GR874 and BNC female. Tektronix Part No. 017-0063-00.

11. Cable (two). Impedance, 50 ohms; type, RG-58A/U; length, 42 inches; connectors, BNC. Tektronix Part No. 012-0057-01.

12. Termination. Impedance, 50 ohms; accuracy, ±3%; connectors, BNC. Tektronix Part No. 011-0049-00.

13. BNC T connector. Tektronix Part No. 103-0030-00.

14. Attenuator. Attenuation, 10×; impedance, 50 ohms; accuracy, ±3%; connectors, GR874. Tektronix Part No. 017-0078-00.

15. VP-2 Voltage Pickoff. Tektronix Part No. 017-0077-00.

16. End-line termination. Impedance, 50 ohms; accuracy, ±3%; connectors, GR874. Tektronix Part No. 017-0081-00.

17. Insulated screwdriver. 1½-inch shaft, non-metallic. Tektronix Part No. 003-0000-00.

18. Screwdriver. 3-inch shaft. Tektronix Part No. 003-0192-00.

CALIBRATION RECORD AND INDEX

This short-form calibration procedure is provided to aid in checking the operation of the Type 106. It may be used as a calibration guide by the experienced calibrator, or it may be used as a record of calibration. Since the step numbers and titles used here correspond to those used in the complete procedure, this procedure also serves as an index to

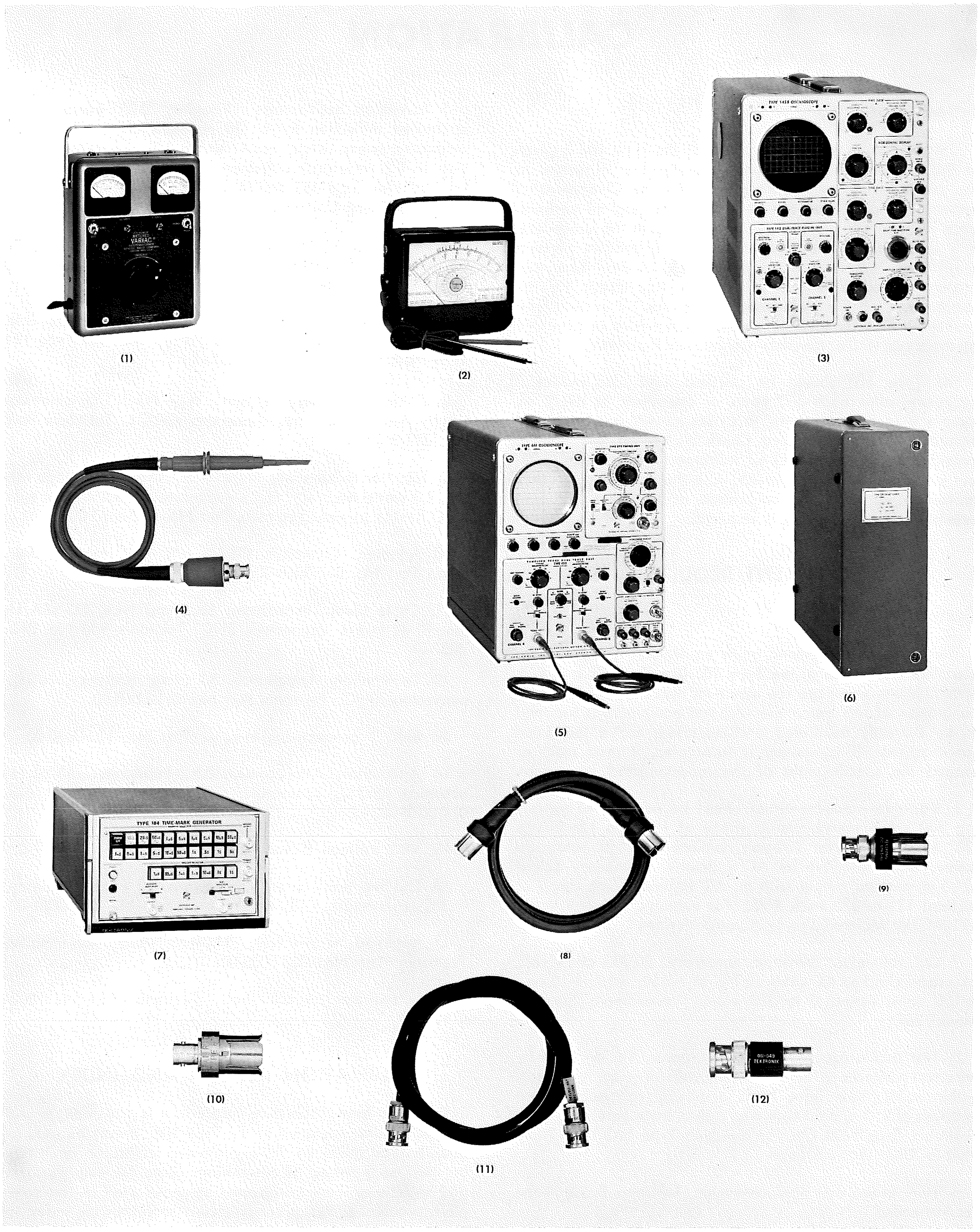

Fig. 6-1. Recommended calibration equipment. Items 1 through 12.

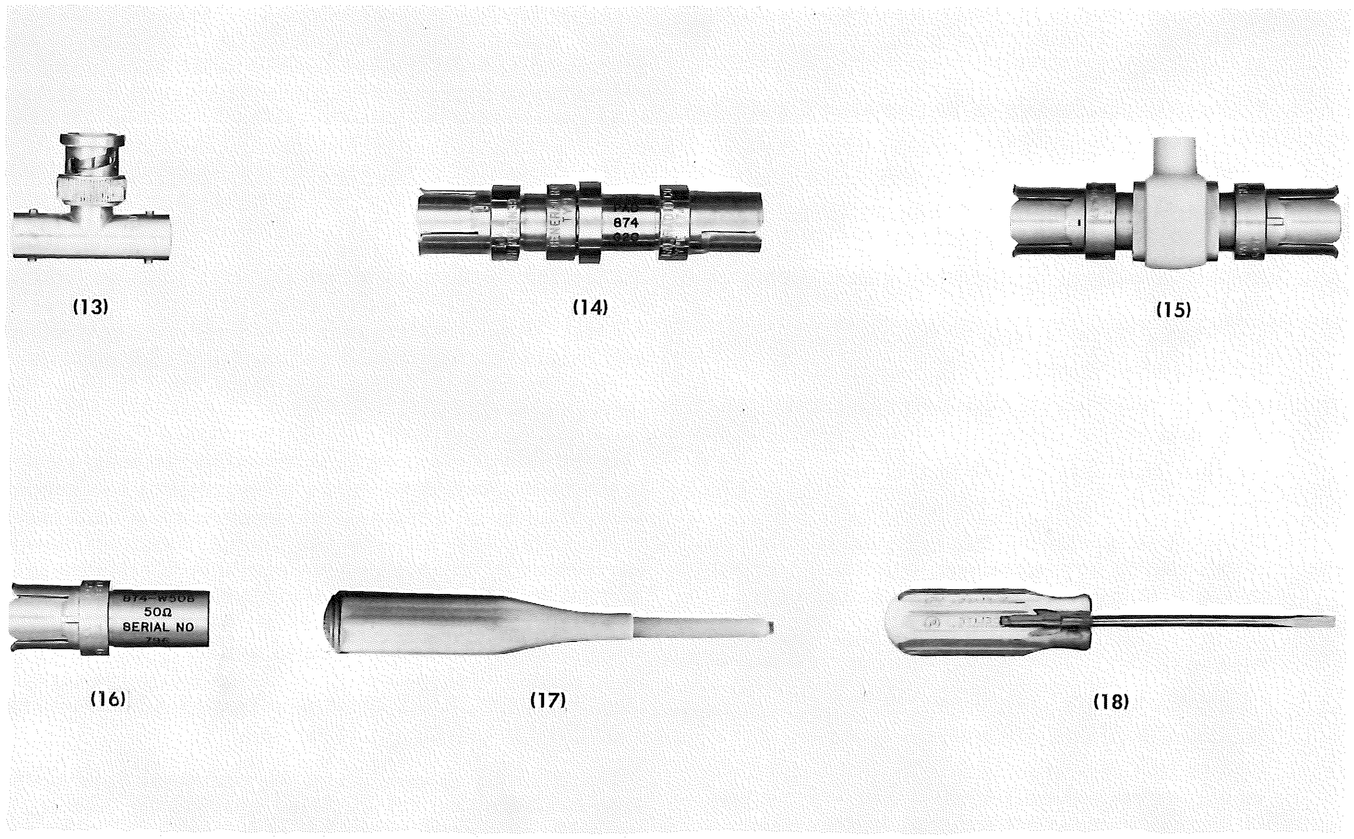

Fig. 6-2. Recommended calibration equipment. Items 13 through 18.

locate a step in the complete Calibration Procedure. Performance requirements correspond to those given in the Characteristics section.

Type 106, Serial No. ____________________

Calibration Date ____________________

Calibration Technician ____________________

☐ 1. Adjust Amplitude Cal. Page 6-5.
12-volts output amplitude or greater.

☐ 2. Check Amplitude Control Range. Page 6-5.
0.5 volt or less, minimum, termination in 50 ohms.
7 volts or less to 120 volts or greater, unterminated.

☐ 3. Check A + 150, A — 150, A —20, +10 and — 10 Volt Power Supplies. Page 6-6.

A + 150-Volt supply	+ 150 volts, ±15 volts
A — 150-Volt supply	— 150 volts, ±15 volts
A — 20-Volt supply	—20 volts, ±2 volts
+10-Volt supply	+10 volts, ±1.5 volts
—10-Volt supply	—10 volts, ±1.5 volts

☐ 4. Check A Supply Regulation. Page 6-6.
12-volt output amplitude (terminated in 50 ohms) ±1.2 divisions.

☐ 5. Check A +150, A —150, A —20, +10 and —10 Volt Supply Regulation. Page 6-7.

A + 150-Volt supply	Within ±15 volts
A — 150-Volt supply	Within ±15 volts
A — 20-Volt-supply	Within ±2 volts
+10-Volt supply	Within ±1.5 volt
—10-Volt supply	Within ±1.5 volt

☐ 6. Check Power-Supply Ripple. Page 6-8.

A supply	±0.75 volt, peak to peak
A + 150-Volt supply	±0.75 volt, peak to peak
A — 150-Volt supply	±0.75 volt, peak to peak
A — 20-Volt supply	±0.75 volt, peak to peak
+10-Volt supply	±0.2 volt, peak to peak
—10-Volt supply	±0.2 volt, peak to peak

☐ 7. Adjust Symmetry Range. Page 6-10.
45% to 55% change in duty cycle.

☐ 8. Adjust Repetition Rate Multiplier. Page 6-11.
Correct repetition rate at 1 and 10. Correct knob position at 5.

☐ 9. Adjust Bias Level. Page 6-12.
50% duty cycle at 1 MHz.

☐ 10. Check Repetition Rate Accuracy. Page 6-12.
Within ±10% of indicated repetition rate.

☐ 11. Check Synchronized Operation. Page 6-12.
Output signals synchronize with 5 and 50 volt input square wave.

☐ 12. Check Trigger Output. Page 6-13.

Amplitude, 0.1 volt.

Risetime, 50 nanoseconds or less, between 0 and 0.1 volt.

Delay time, 50 nanoseconds or less.

☐ 13. Check Hi Amplitude Output Into 50 Ohms. Page 6-14.

Risetime (terminated in 50 ohms), 12 nanoseconds or less.

Aberrations, ±2% or less in first 100 nanoseconds following leading edge.

☐ 14. Adjust + Fast Rise Output and Check Operation. Page 6-14.

Minimum amplitude, 50 millivolts or less.

Maximum amplitude, 500 millivolts or more.

Risetime and aberrations, adjust for one nanosecond or less risetime with aberrations + and — 2% or less in first five nanoseconds following leading edge.

☐ 15. Adjust — Fast Rise Output and Check Operation. Page 6-16.

Minimum amplitude, 50 millivolts or less.

Maximum amplitude, 500 millivolts or more.

Risetime and aberrations, adjust for one nanosecond or less risetime with aberrations + and — 2% or less in first five nanoseconds following leading edge.

☐ 16. Check Trigger Jitter. Page 6-17.

300 picoseconds or less jitter in leading edge of + and — output square waves.

CALIBRATION PROCEDURE

General

The following procedure is arranged in a sequence which allows the Type 106 to be calibrated with the least interaction of adjustments and reconnection of equipment. However, some adjustments affect the calibration of other circuits within the instrument. In this case, it will be necessary to check the operation of other parts of the instrument. When a step interacts with others, the steps which need to be checked will be noted.

Any needed maintenance should be performed before proceeding with calibration. Troubles which become apparent during calibration should be corrected using the techniques given in the Maintenance section.

The Adjust . . . ⏀ steps in the following procedure provide a check of instrument performance, whenever possible, before the adjustment is made. The symbol ⏀ is used to identify the steps in which an adjustment is made. To prevent recalibration of other circuits when performing a partial calibration, readjust only if the listed tolerance is not met. However, when performing a complete calibration, best overall performance will be provided if each adjustment is made to the exact setting, even if the check is within the allowable tolerance.

In the following procedure, a test equipment setup picture is shown for each major group of adjustments and checks. Beneath each setup picture is a complete list of front-panel control settings for the Type 106. To aid in locating individual controls which have been changed during complete calibration, these control names are printed in bold type. If only a partial calibration is performed, start with the nearest setup picture preceding the desired portion. Type 106 front-panel control titles referred to in this procedure are capitalized (e.g., AMPLITUDE). Internal adjustment titles are initial capitalized only (e.g., Amplitude Cal).

The following procedure uses the equipment listed under Equipment Required. If substitute equipment is used, control settings or setup may need to be altered to meet the requirements of the equipment used.

Preliminary Procedure

1. Remove the cabinet from the Type 106.

2. Connect the autotransformer to a suitable power source.

3. Connect the Type 106 to the autotransformer output.

4. Set the autotransformer output voltage to 115 (or 230 volts).

5. Set the Type 106 POWER switch to ON. Allow at least five minutes warm up at 25°C, ±5°, before checking the instrument to the given accuracy.

NOTES

TYPE 106

MAINTENANCE NOTE

CALIBRATION ADDENDUM

Section 6 Calibration

Page 6-5 Step 1

CHANGE: Steps 1(d) and 1(e) to read:

d. CHECK--Test oscilloscope display amplitude for six divisions or greater (12 volts or greater, see Fig. 6-4A).

e. ADJUST--Amplitude Cal adjustment, R247 (see Fig. 6-4B) for a compromise setting to bring the terminated and unterminated voltage ranges within limits.

Page 6-9 Fig. 6-7.

CHANGE: Figure title to read:

Fig. 6-7. Typical test oscilloscope display of power-supply ripple (60-cycle line). Sweep rate, 5 milliseconds/division; vertical deflection, 0.2 volt/division (0.02 volt/division with 10X probe).

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.

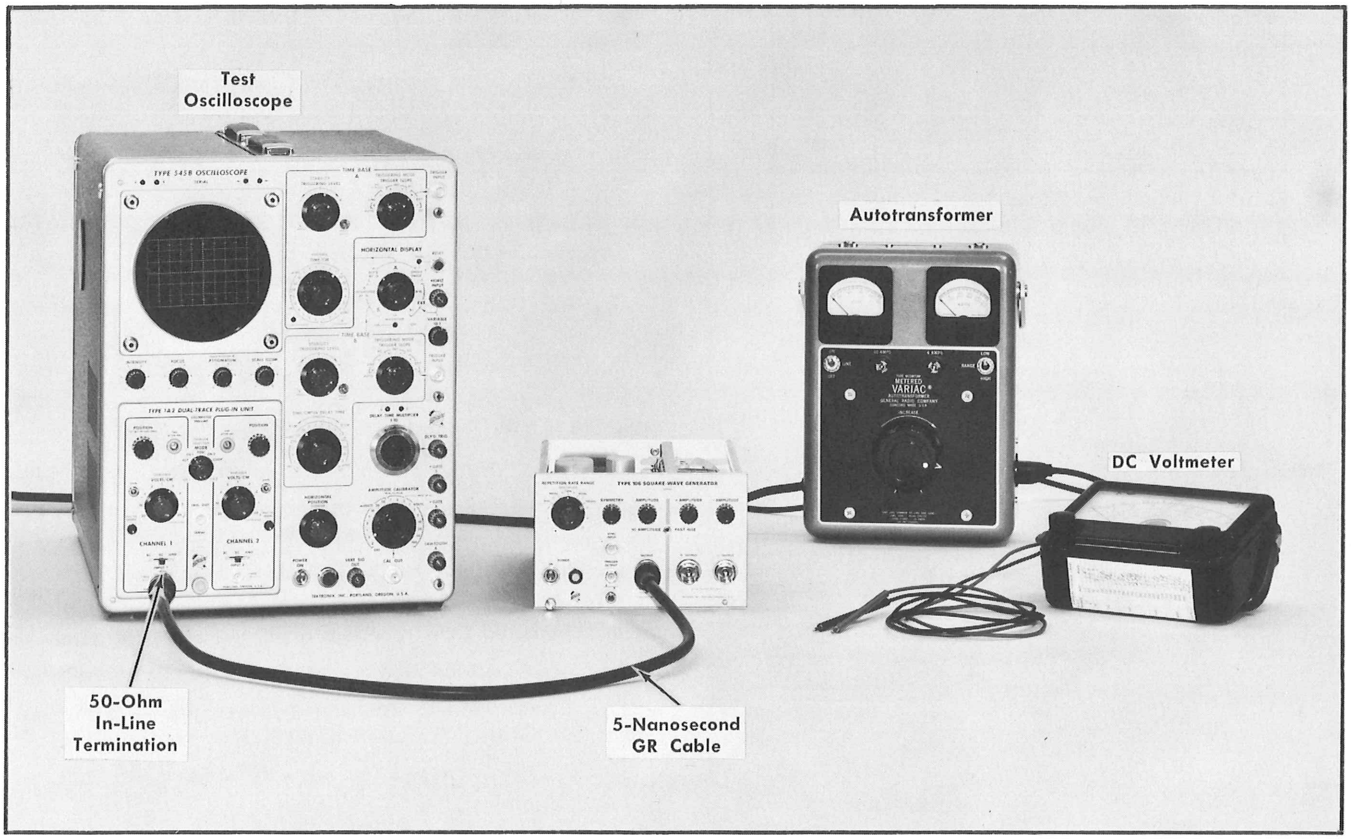

Fig. 6-3. Initial test equipment setup for steps 1 — 5.

Front-panel control settings

REPETITION RATE RANGE	1 kHz
MULTIPLIER	10 (clockwise)
SYMMETRY	Midrange
AMPLITUDE	Clockwise
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+ TRANSITION AMPLITUDE	Midrange
— TRANSITION AMPLITUDE	Midrange
POWER	ON

1. Adjust Amplitude Cal

a. Test equipment setup is shown in Fig. 6-3.

b. Connect the OUTPUT (HI AMPLITUDE) connector to the input of the test oscilloscope through the five-nanosecond GR cable and the 50-ohm in-line termination.

c. Set the test oscilloscope vertical deflection to two volts/division, input coupling to DC and the sweep rate to 50 microseconds/division.

d. CHECK—Test oscilloscope display for six divisions/amplitude, ±0.6 division, (12 volts, ±10%; see Fig. 6-4A).

e. ADJUST—Amplitude Cal adjustment, R247 (see Fig. 6-4B) for exactly six divisions of deflection.

f. INTERACTION—Check all steps.

2. Check Amplitude Control Range

a. Turn the AMPLITUDE (HI AMPLITUDE) control fully counterclockwise.

b. Set the test oscilloscope vertical deflection to 0.1 volt/division.

c. CHECK—Test oscilloscope display for five divisions or less amplitude (0.5 volt or less).

d. Remove the 50-ohm in-line termination and connect the five-nanosecond cable to the test oscilloscope input using the GR-to-BNC adapter.

e. Set the test oscilloscope vertical deflection to two volts/division.

f. CHECK—Test oscilloscope display for 3.5 divisions or less amplitude (seven volts or less).

g. Turn the AMPLITUDE (HI AMPLITUDE) control fully clockwise.

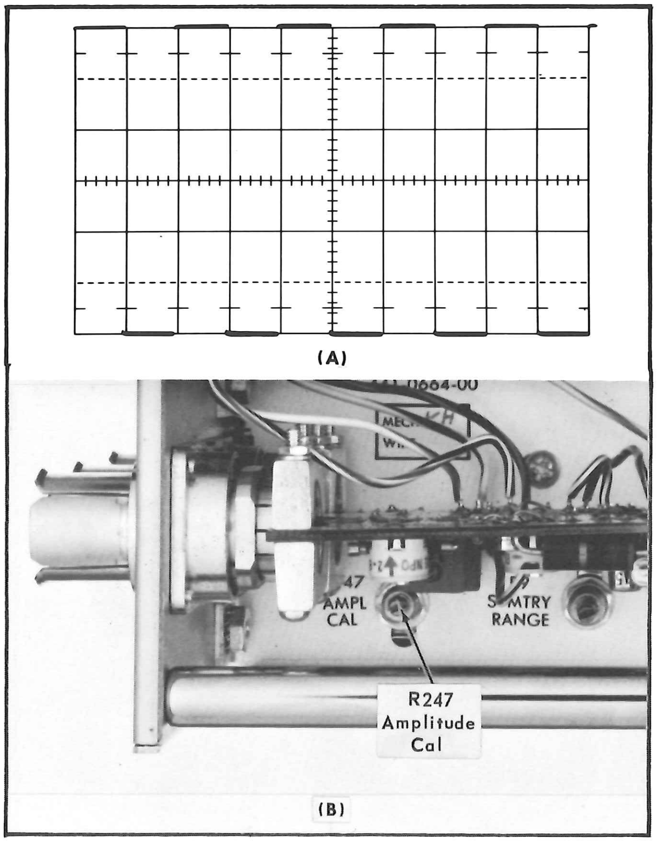

Fig. 6-4. (A) Typical test oscilloscope display when adjusting A Supply output voltage, (B) location of Amplitude Cal adjustment (right side).

h. Set the test oscilloscope vertical deflection to 20 volts/division.

i. CHECK—Test oscilloscope display for 6 divisions or greater amplitude, (120 volts or greater).

j. Remove all cable to facilitate the next step.

3. Check A +150, A —150, A —20, +10 and —10 Volt Power Supplies

a. Connect the DC voltmeter between TP259 and TP249 (see Fig. 6-5A); connect the negative lead to TP249.

b. CHECK—Meter reading for +150 volts, ±15 volts.

c. Connect the DC voltmeter between TP229 and TP249 (see Fig. 6-5A); connect the negative lead to TP249.

d. CHECK—Meter reading for —150 volts, ±15 volts.

e. Connect the DC voltmeter between TP269 and TP249 (see Fig. 6-5A); connect the negative lead to TP249.

f. CHECK—Meter reading for —20 volts, ±2 volts.

g. Connect the DC voltmeter between the +10-volt test point (emitter of Q213, see Fig. 6-5B) and chassis ground.

h. CHECK—Meter reading for +10 volts, ±1.5 volts.

i. Connect the DC voltmeter between the —10-volt test point (emitter of Q217, see Fig. 6-5B) and chassis ground.

j. CHECK—Meter reading for —10 volts, ±1.5 volts.

4. Check A Supply Regulation

a. Connect the OUTPUT (HI AMPLITUDE) connector to the input of the test oscilloscope through the five-nanosecond GR cable and the 50-ohm in-line termination.

b. Set the test oscilloscope vertical deflection to two volts/division.

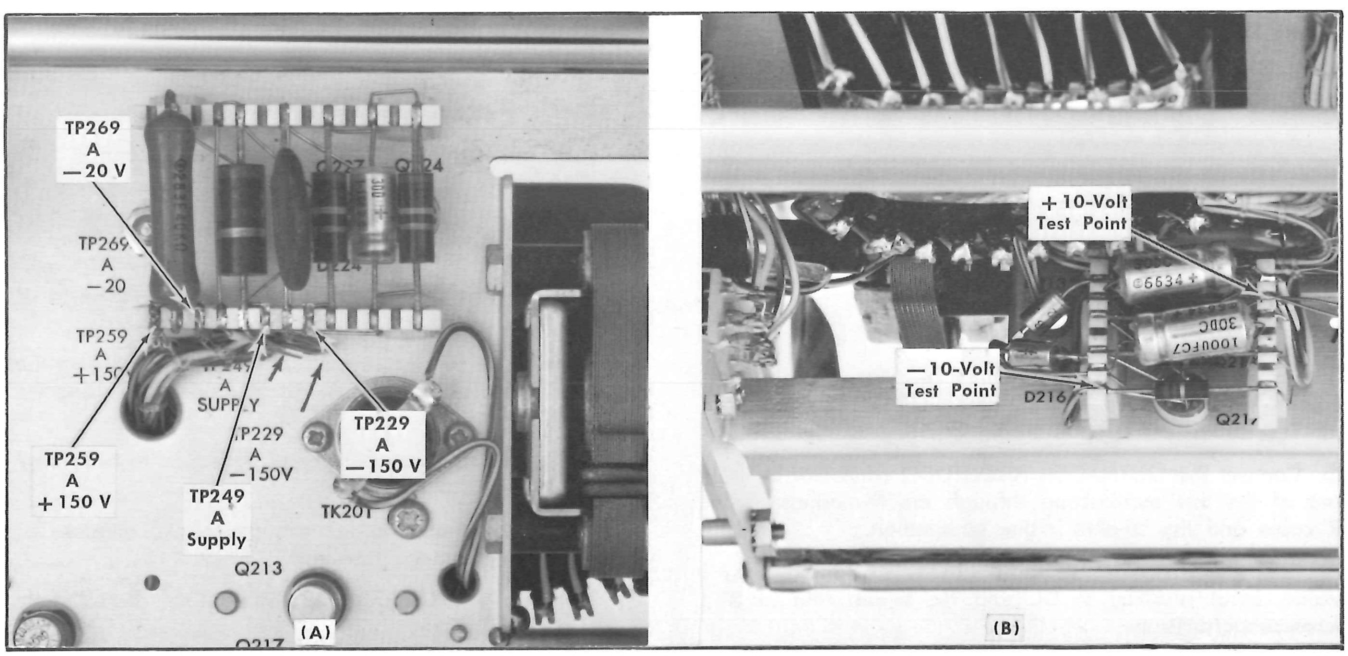

Fig. 6-5. (A) Location of A Supply, A + 150, A — 150 and A — 20 volt test points (right side), (B) location of +10 and —10 volt test points (bottom side).

c. CHECK—Test oscilloscope display for ±0.6 division maximum change while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253 volts for 230 volts nominal).

5. Check A +150, A −150, A −20, +10 and −10 Volt Supply Regulation

a. Connect the DC voltmeter between TP259 and TP249 (see Fig. 6-5A).

b. CHECK—Meter reading for ±15 volts maximum change while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253 volts for 230 volts nominal).

c. Connect the DC voltmeter between TP229 and TP249 (see Fig. 6-5A).

d. CHECK—Meter reading for ±15 volts maximum change while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

e. Connect the DC voltmeter between TP269 and TP249.

f. CHECK—Meter reading for ±2 volts maximum change while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

g. Connect the DC voltmeter between the +10 volt test point (see Fig. 6-5B) and chassis ground.

h. CHECK—Meter reading for ±1.5 volt maximum change while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

i. Connect the DC voltmeter between the —10 volt test point (see Fig. 6-5B) and chassis ground.

j. CHECK—Meter reading for ±1.5 volt maximum change while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

k. Disconnect all test equipment.

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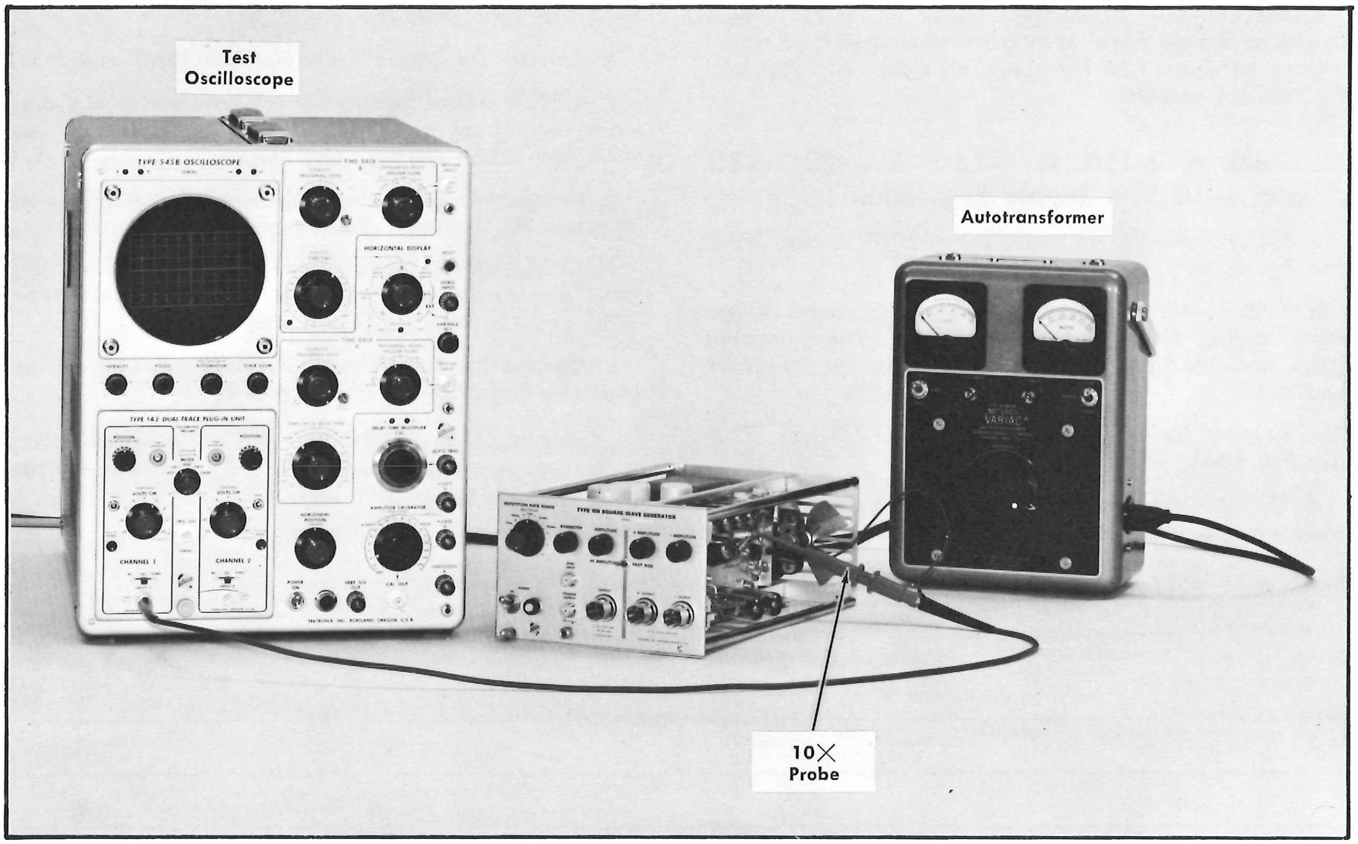

Fig. 6-6. Test equipment setup for step 6.

Front-panel control settings

REPETITION RATE RANGE	1 kHz
MULTIPLIER	10 (clockwise)
SYMMETRY	Midrange
AMPLITUDE	**Counterclockwise**
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+ TRANSITION AMPLITUDE	Midrange
— TRANSITION AMPLITUDE	Midrange
POWER	ON

6. Check Power Supply Ripple

a. Test equipment setup is shown in Fig. 6-6.

b. Connect the 10× probe to the test oscilloscope input connector.

c. Set the test oscilloscope for a vertical deflection of 0.02 volt/division, AC coupled, at a sweep rate of five milliseconds/division.

d. Connect the probe tip to TP249 (see Fig. 6-5A). Connect the probe ground lead to chassis ground.

e. CHECK—Test oscilloscope display for 3.75 divisions maximum line-frequency ripple (±0.75 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253 volts for 230 volts nominal). Fig. 6-7 shows a typical test oscilloscope display of power supply ripple.

f. Connect the probe tip to TP259 (see Fig. 6-5A). Connect the probe ground lead to chassis ground.

g. CHECK—Test oscilloscope display for 3.5 divisions maximum line-frequency ripple (±0.75 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

h. Connect the probe tip to TP229 (see Fig. 6-5A). Connect the probe ground lead to chassis ground.

i. CHECK—Test oscilloscope display for 3.5 divisions maximum line-frequency ripple (±0.75 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

j. Connect the probe tip to TP269 (see Fig. 6-5A). Connect the probe ground lead to chassis ground.

k. CHECK—Test oscilloscope display for 3.5 divisions maximum line-frequency ripple (±0.75 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

MAINTENANCE NOTE

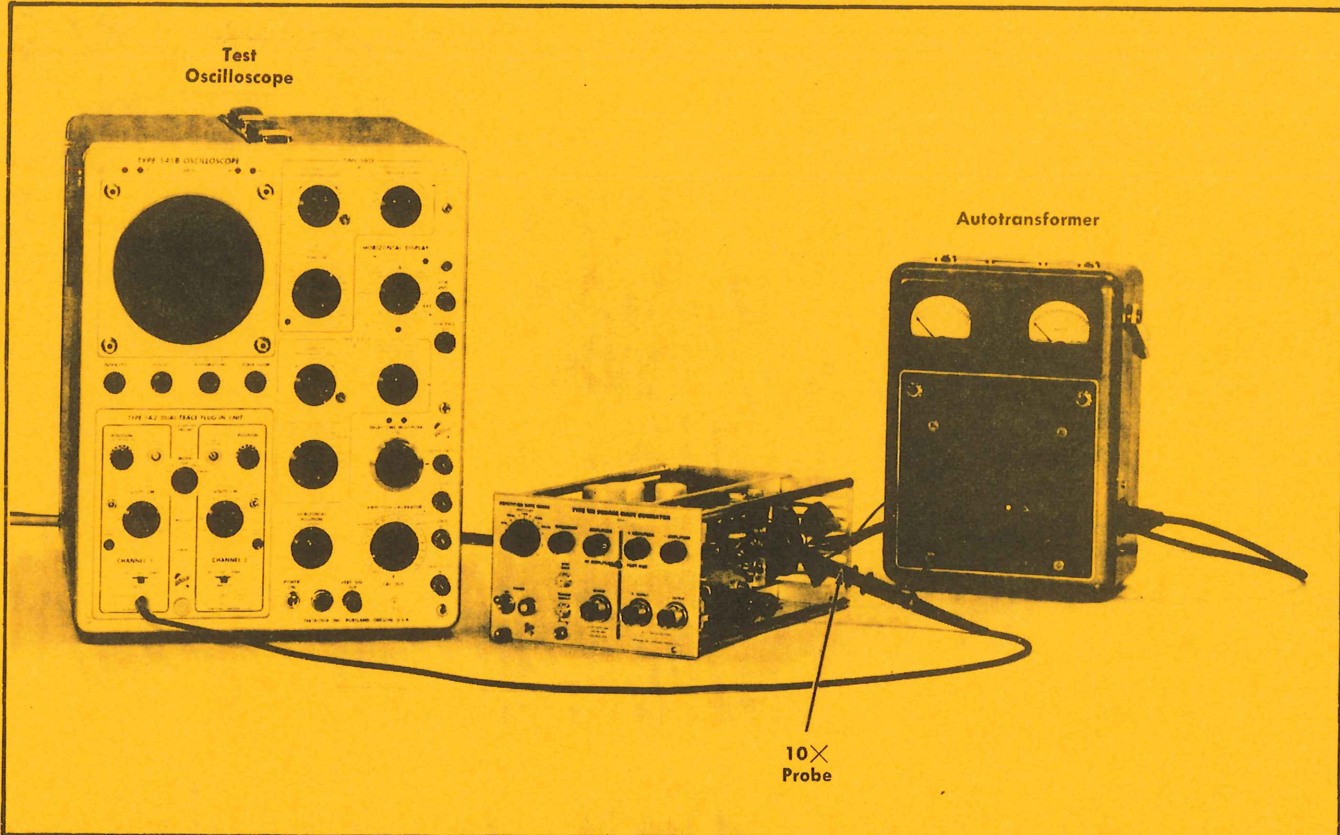

Fig. 6-6. Test equipment setup for step 6.

Front-panel control settings

REPETITION RATE RANGE	1 kHz
MULTIPLIER	10 (clockwise)
SYMMETRY	Midrange
AMPLITUDE	**Counterclockwise**
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+ TRANSITION AMPLITUDE	Midrange
— TRANSITION AMPLITUDE	Midrange
POWER	ON

6. Check Power Supply Ripple

a. Test equipment setup is shown in Fig. 6-6.

b. Connect the 10× probe to the test oscilloscope input connector.

c. Set the test oscilloscope for a vertical deflection of 0.02 volt/division, AC coupled, at a sweep rate of five milliseconds/division.

d. Connect the probe tip to TP249 (see Fig. 6-5A). Connect the probe ground lead to chassis ground.

e. CHECK—Test oscilloscope display for 3.5 divisions # maximum line-frequency ripple (±0.75 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253 volts for 230 volts nominal). Fig. 6-7 shows a typical test oscilloscope display of power supply ripple.

f. Connect the probe tip to TP259 (see Fig. 6-5A). Connect the probe ground lead to chassis ground.

g. CHECK—Test oscilloscope display for 3.5 divisions maximum line-frequency ripple (±0.75 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

h. Connect the probe tip to TP229 (see Fig. 6-5A). Connect the probe ground lead to chassis ground.

i. CHECK—Test oscilloscope display for 3.5 divisions maximum line-frequency ripple (±0.75 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

j. Connect the probe tip to TP269 (see Fig. 6-5A). Connect the probe ground lead to chassis ground.

k. CHECK—Test oscilloscope display for 3.5 divisions maximum line-frequency ripple (±0.75 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

C.V.S.
1-3-68

l. Connect the probe tip to the +10 volt point (see Fig. 6-5B). Connect the probe ground lead to chassis ground.

m. CHECK—Test oscilloscope display for one division maximum line-frequency ripple (±0.2 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

n. Connect the probe tip to the —10 volt test point (see Fig. 6-5B). Connect the probe ground lead to chassis ground.

o. CHECK—Test oscilloscope display for one division maximum line-frequency ripple (±0.2 volt) while varying the autotransformer output voltage between 103.5 and 126.5 volts (207 and 253).

p. Return the autotransformer output voltage to 115 (230) volts. (If the line voltage is about 115 (230) volts, the Type 106 can be connected directly to the line; otherwise leave the instrument connected to the autotransformer for the remainder of the procedure.)

q. Disconnect all test equipment.

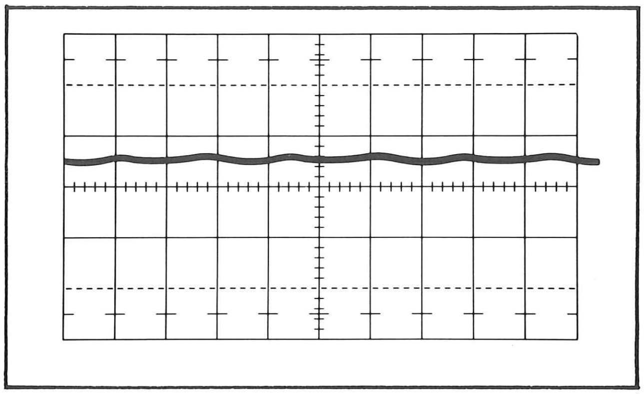

Fig. 6-7. Typical test oscilloscope display of power-supply ripple (60-cycle line). Sweep rate, 5 millisecond/division vertical deflection, 0.2 volt/division (0.002 volt/division and 10× probe).

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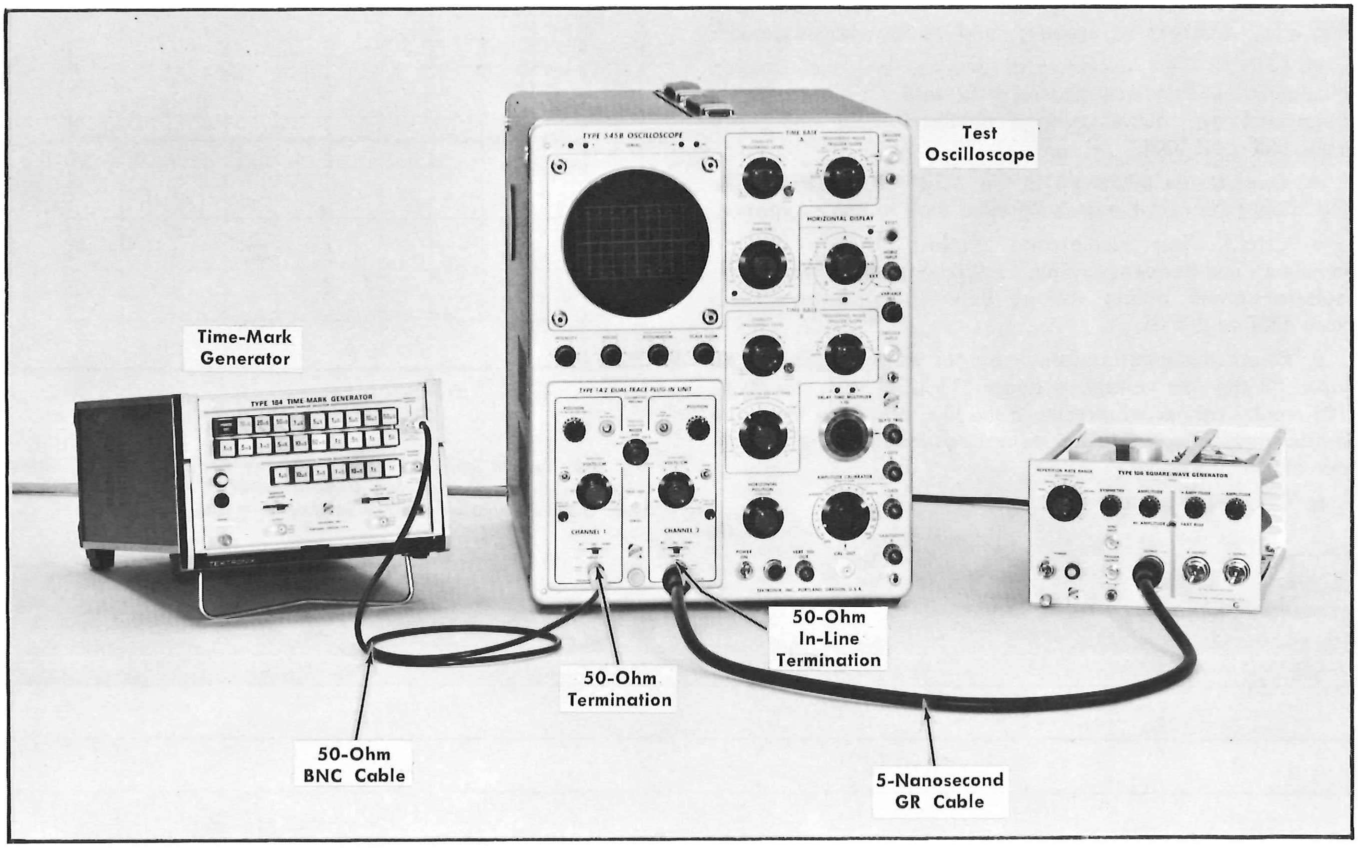


Fig. 6-8. Initial test equipment setup for steps 7 — 12.

Front-panel control settings

REPETITION RATE RANGE	1 kHz
MULTIPLIER	10 (clockwise)
SYMMETRY	Midrange
AMPLITUDE	**Midrange**
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+ TRANSITION AMPLITUDE	Midrange
— TRANSITION AMPLITUDE	Midrange
POWER	ON

7. Adjust Symmetry Range

a. Test equipment setup is shown in Fig. 6-8.

b. Connect the OUTPUT (HI AMPLITUDE) connector to the channel 2 input of the test oscilloscope through the five-nanosecond GR cable and the 50-ohm in-line termination.

c. Set the test oscilloscope vertical deflection to display about four divisions and the sweep rate to display one complete cycle in 10 divisions (use variable time/division control).

d. CHECK — Test oscilloscope display for five-division duration of the positive portion of the square wave (50% duty cycle).

e. ADJUST — Symmetry Range adjustment, R9 (see Fig. 6-9A), for five-division duration of the positive portion.

f. Set the SYMMETRY control fully clockwise; reset the time/division controls for one complete cycle in 10 divisions.

g. CHECK—Test oscilloscope display for 5.5 divisions or more duration of the positive portion of the square wave (55% or more; see Fig. 6-9B).

h. Set the SYMMETRY control fully counterclockwise; reset the time/division controls for one complete cycle in 10 divisions.

i. CHECK — Test oscilloscope display for 4.5 division or less duration of the positive portion of the square wave (45% or less; see Fig. 6-9B).

j. Return the SYMMETRY control to midrange.

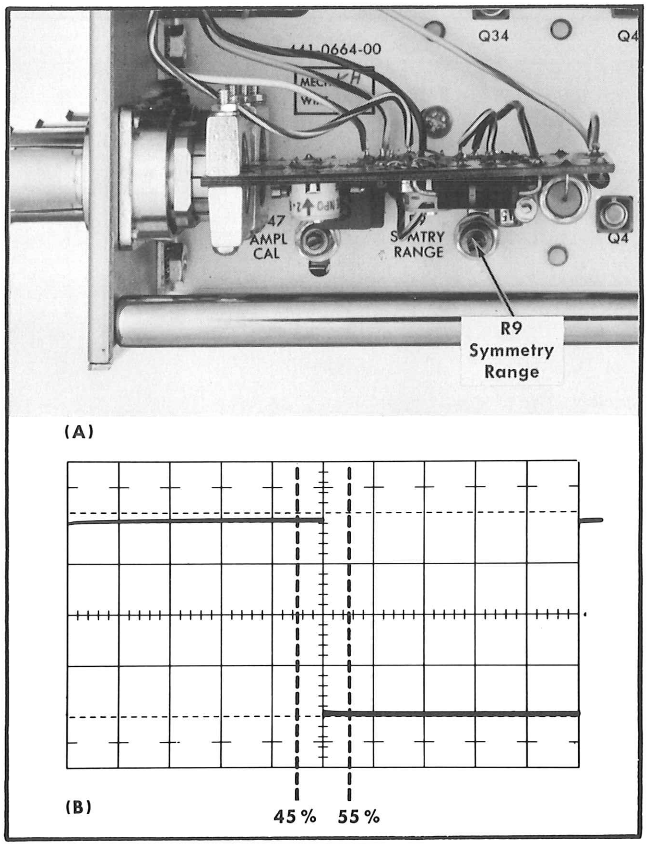


Fig. 6-9. (A) Location of Symmetry Range adjustment (right side), (B) typical test oscilloscope display showing correct SYMMETRY control range.

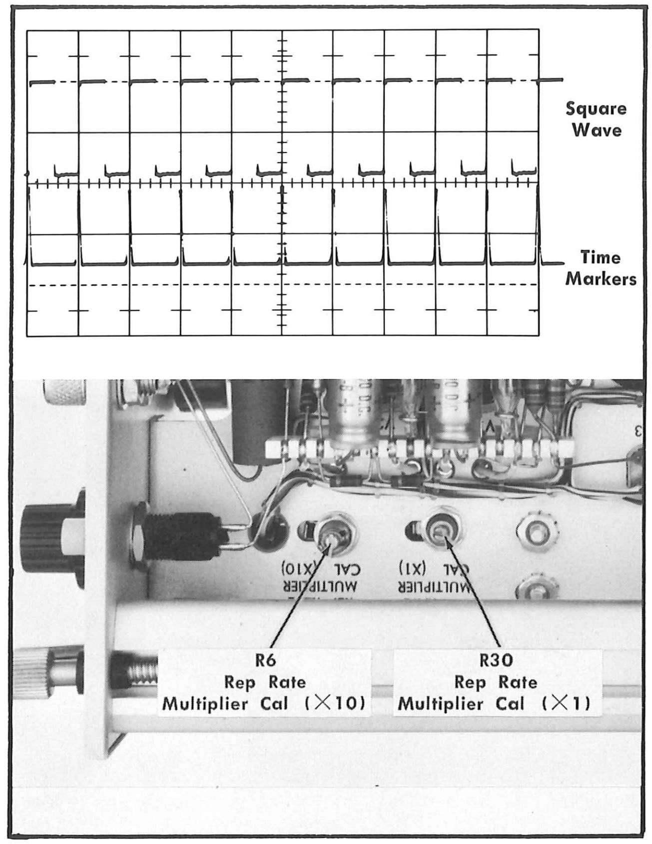


Fig. 6-10. (A) Typical test oscilloscope display when adjusting repetition rate multiplier, (B) location of repetition rate multiplier (bottom side).

8. Adjust Repetition Rate Multiplier

a. Connect the time-mark generator output to the channel 1 input connector of the test oscilloscope through a 50-ohm BNC cable and a 50-ohm BNC termination.

b. Set the time-mark generator for one-microsecond markers.

c. Set the AMPLITUDE (HI AMPLITUDE) control fully clockwise.

d. Set the REPETITION RATE RANGE switch to 100 kHz.

e. Set the test oscilloscope vertical deflection to display about two divisions of the signal on each channel in the alternate mode at a sweep rate of one microsecond/division.

f. CHECK — Test oscilloscope display for one cycle for each marker displayed (see Fig. 6-10A).

g. ADJUST — Rep Rate Multiplier Cal (×10) adjustment, R6 (see Fig. 6-10B), for one cycle for each marker displayed.

h. Set the MULTIPLIER control fully counterclockwise to 1.

i. Set the test oscilloscope sweep rate to 10 microseconds/division.

j. Set the time-mark generator for 10 microsecond markers.

k. CHECK — Test oscilloscope display for one cycle for each marker displayed (see Fig. 6-10A).

l. ADJUST — Rep Rate Multiplier Cal (×1) adjustment, R30 (see Fig. 6-10B), for one cycle for each marker displayed.

m. Recheck steps b through l as necessary for correct repetition rate.

n. Set the test oscilloscope sweep rate to 2 microseconds/division.

o. Set the time-mark generator for one microsecond markers.

p. Set the MULTIPLIER control for exactly one cycle for each two markers displayed.

q. CHECK—MULTIPLIER control should be at 5.

r. ADJUST—Loosen set screw in MULTIPLIER knob and reposition for correct indication.

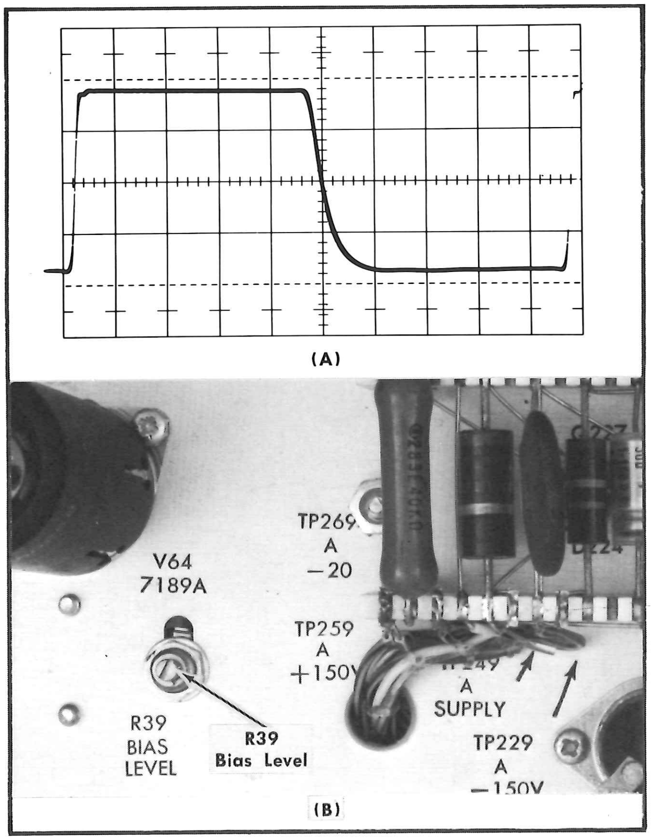


Fig. 6-11. (A) Typical test oscilloscope display when adjusting bias level, (B) location of bias level adjustment (right side).

9. Adjust Bias Level

a. Set the MULTIPLIER control fully clockwise.

b. Set the test oscilloscope sweep rate to 0.1 μs/division and the vertical mode switch to channel 2.

c. CHECK—Test oscilloscope display for 50% duty cycle (see Fig. 6-11A).

d. ADJUST—Bias Level adjustment R39 (see Fig. 6-11B) for 50% duty cycle.

e. Set the REPETITION RATE RANGE switch to 1 kHz.

TABLE 6-1
Repetition Rate Accuracy

REPETITION RATE RANGE Switch Setting	MULTIPLIER Control Setting	Time Markers Applied	Test Oscilloscope Sweep Rate	CRT Display (Cycles/Marker for ±10% accuracy)
100 kHz	10	10 μs	1 μs/div	9 - 11
100 kHz	5	10 μs	1 μs/div	4.5 - 5.5
10 kHz	9	0.1 ms	10 μs/div	8.1 - 9.9
10 kHz	4	0.1 ms	10 μs/div	3.6 - 4.4
1 kHz	8	1 ms	0.1 ms/div	7.2 - 8.8
1 kHz	3	1 ms	0.1 ms/div	2.7 - 3.3
100 Hz	7	10 ms	1 ms/div	6.3 - 7.7
100 Hz	2	10 ms	1 ms/div	1.8 - 2.3
10 Hz	6	0.1 s	10 ms/div	5.4 - 6.6
10 Hz	1	0.1 s	10 ms/div	0.9 - 1.1

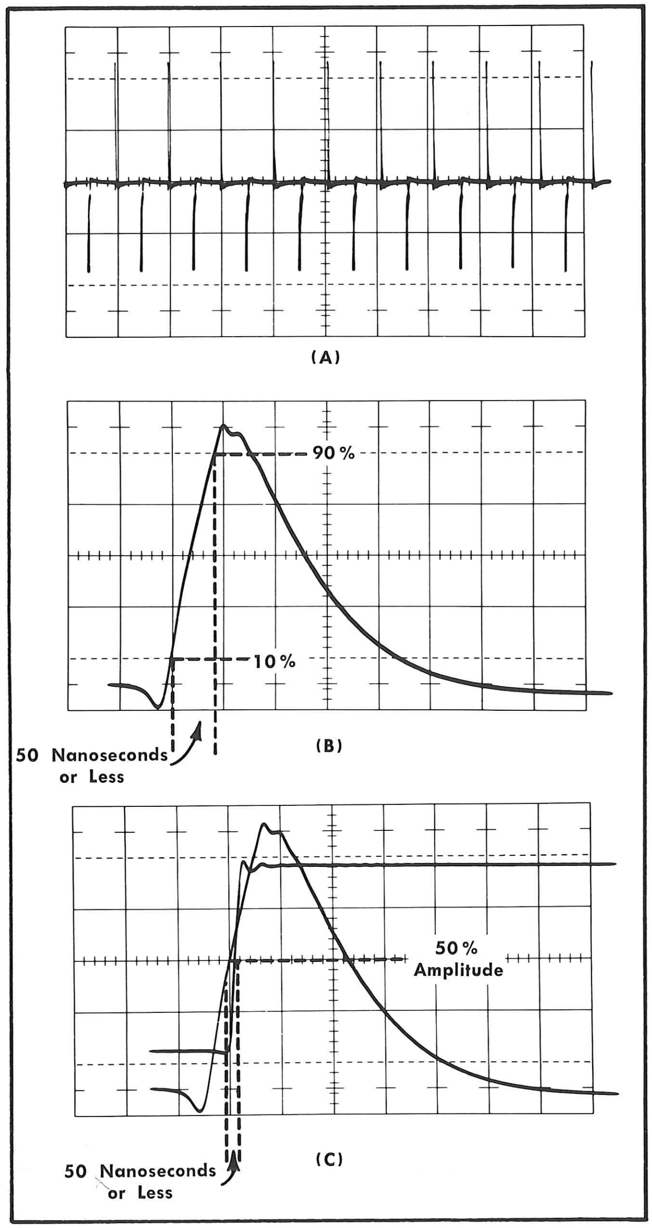


Fig. 6-12. Typical test oscilloscope display when checking TRIGGER OUTPUT. (A) Amplitude, (B) risetime, (C) delay time.

f. Set the test oscilloscope sweep rate to 10 μs/division.

g. CHECK—Test oscilloscope display for 50% duty cycle.

h. ADJUST—Bias level adjustment, R39 for 50% duty cycle.

i. Recheck steps a through h. A compromise setting may be necessary to provide best duty cycle for both checks c and g.

10. Check Repetition Rate Accuracy

a. Set the test oscilloscope vertical Mode switch to Alt.

b. CHECK—Using the Type 106, time-mark generator and test oscilloscope settings given in Table 6-1, check repetition rate accuracy within ±10%.

c. Disconnect all test equipment.

11. Check Synchronized Operation

a. Connect the test oscilloscope amplitude calibrator to both the SYNC INPUT connector and the channel 1 input connector through a BNC T connector and two 50-ohm BNC cables.

b. Connect the OUTPUT (HI AMPLITUDE) connector to the channel 2 input connector through a five nanosecond GR cable and a 50-ohm in-line termination.

c. Set the REPETITION RATE RANGE switch to 100 Hz and the MULTIPLIER control to about 7.

d. Set the test oscilloscope amplitude calibrator for five volts output and the sweep rate to 0.5 millisecond/division.

e. Set the test oscilloscope to trigger from channel 1 in the chopped mode.

f. CHECK — Test oscilloscope for stable display of the channel 2 waveform (readjust the MULTIPLIER control if necessary).

g. Set the test oscilloscope amplitude calibrator for 50 volts output.

h. CHECK — Test oscilloscope for a stable display of the channel 2 waveform.

i. Set the test oscilloscope amplitude calibrator for one volt output.

j. CHECK — Test oscilloscope display for drift of the channel 2 waveform due to inadequate sync signal.

k. Disconnect all test equipment.

12. Check Trigger Output

a. Connect the TRIGGER OUTPUT connector to the channel 2 input connector of the test oscilloscope through a 50-ohm BNC cable and a 50-ohm BNC termination.

b. Connect the OUTPUT (HI AMPLITUDE) connector to the channel 1 input connector of the test oscilloscope through a 50-ohm GR cable and a 50-ohm in-line termination.

c. Set the test oscilloscope to display the channel 2 signal at a vertical deflection of 0.1 volt/division and the channel 1 signal at a vertical deflection of 5 volts/division and a sweep rate of 10 microseconds/division.

d. Set the REPETITION RATE RANGE switch to 100 kHz and the MULTIPLIER control to 1.

e. CHECK — Test oscilloscope display for positive and negative pulse amplitude of 1 division minimum (0.1 volt peak minimum; see Fig. 6-12A).

f. Set the test oscilloscope for a vertical deflection of 0.2 volt/division at a sweep rate of 50 nanoseconds/division (use magnifier).

g. Position the display to observe the leading edge of the positive pulse.

h. CHECK — Test oscilloscope display for one division or less between the 0 and 0.1 volt level of the trigger pulse (50 nanoseconds or less; see Fig. 6-12B).

i. Set the test oscilloscope to trigger from channel 1 in the alternate mode.

j. Position the 50% points of both waveforms to the horizontal centerline.

k. CHECK — Test oscilloscope display for one division or less spacing between the 50% amplitude points of the two waveforms (50 nanoseconds or less; see Fig. 6-12C).

l. Disconnect all test equipment.

NOTES

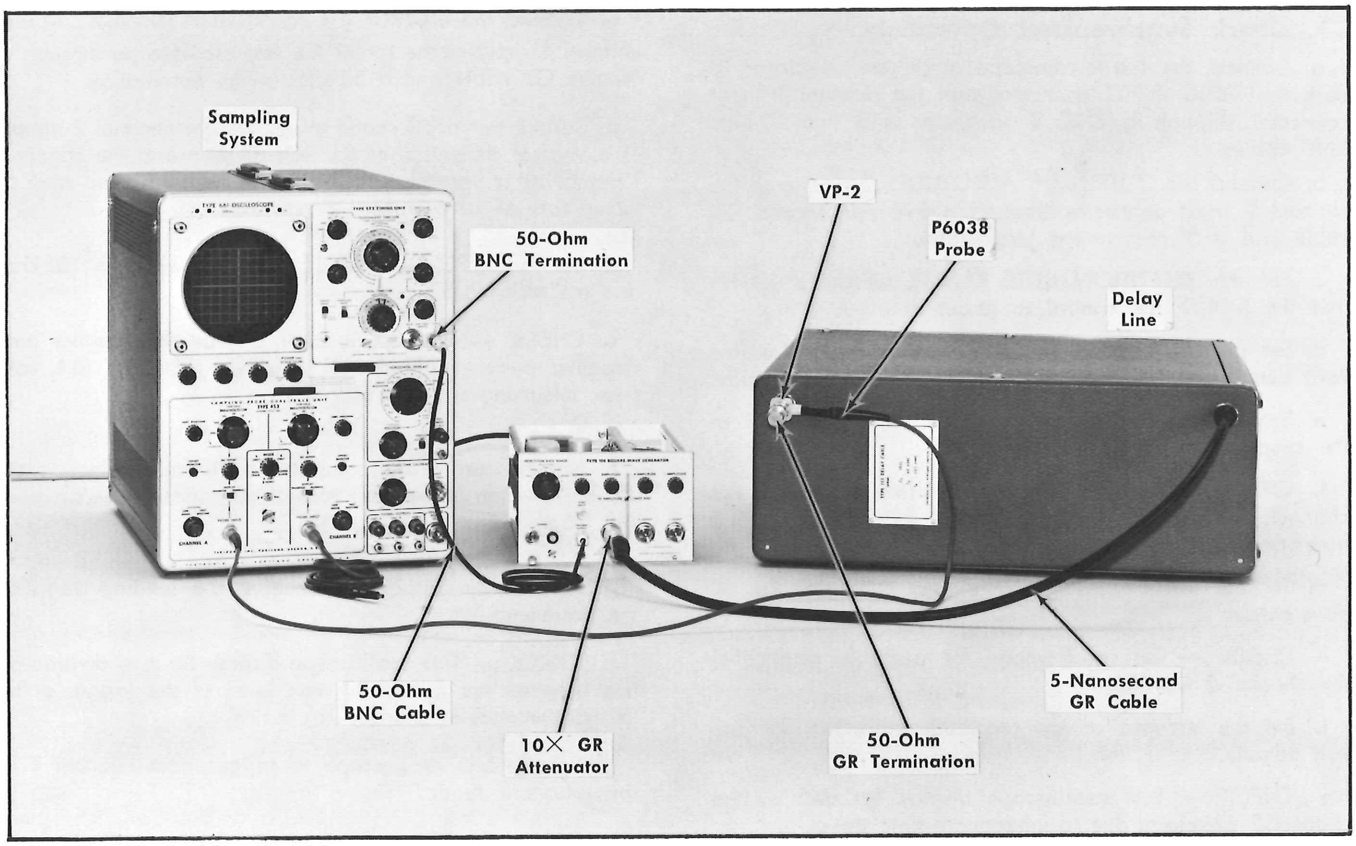


Fig. 6-13. Initial test equipment setup for steps 13 — 16.

Front-panel control settings

REPETITION RATE RANGE	100 kHz
MULTIPLIER	10 (clockwise)
SYMMETRY	Midrange
AMPLITUDE	Midrange
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+ TRANSITION AMPLITUDE	Midrange
− TRANSITION AMPLITUDE	Midrange
POWER	ON

13. Check Hi Amplitude Output Into 50 Ohms

a. Test equipment setup is shown in Fig. 6-13.

b. Connect the TRIGGER OUTPUT connector to the 1 MΩ external trigger input connector of the sampling system through a 50-ohm BNC cable and a 50-ohm BNC termination.

c. Connect the OUTPUT (HI AMPLITUDE) connector to the sampling system vertical input through a 10× GR attenuator, five-nanosecond GR cable, 60-nanosecond delay line and the VP-2 voltage pickoff to the P6038 sampling probe. Terminate the output of the VP-2 with a 50-ohm GR termination.

d. Set the sampling system vertical deflection to 200 millivolts/division, time position range switch to one microsecond and magnify the sweep to five nanosecond/division.

e. Set the triggering and time position controls for a stable display of the first leading edge.

f. Set the AMPLITUDE (HI AMPLITUDE) control for a five division display.

g. CHECK — Sampling system display for 2.4 divisions or less betwen the 10% and 90% points of the leading edge (12 nanoseconds or less; see Fig. 6-14A).

h. Set the sampling system sweep rate to 50 nanoseconds/division and the vertical deflection to 20 millivolts/division. Reposition the top of the waveform onto the viewing area with the DC offset control.

i. CHECK—Sampling system display for aberrations ± one division or less in first two divisions following the leading edge (±2% or less in first 100 nanoseconds; see Fig. 614B).

14. Adjust + Fast Rise Output and Check Operation

a. Disconnect the five-nanosecond GR cable from the 10× attenuator and connect it to the + OUTPUT connector.

b. Set the HI AMPLITUDE — FAST RISE switch to FAST RISE.

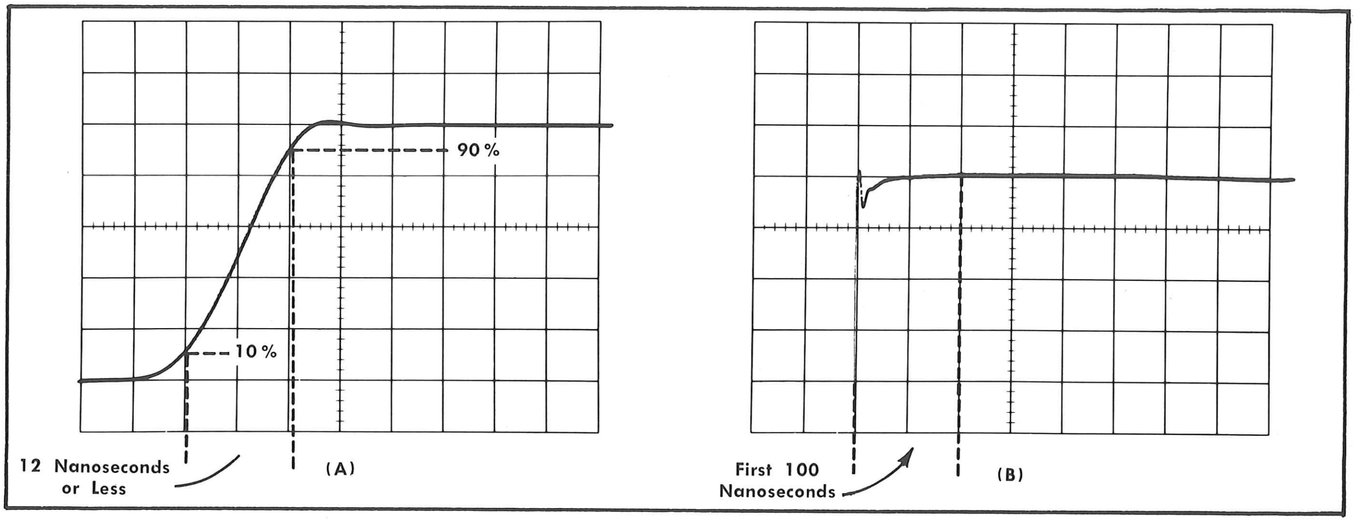


Fig. 6-14. Typical sampling system display when checking OUTPUT (HI AMPLITUDE), (A) risetime, (B) aberrations in first 100 nanoseconds.

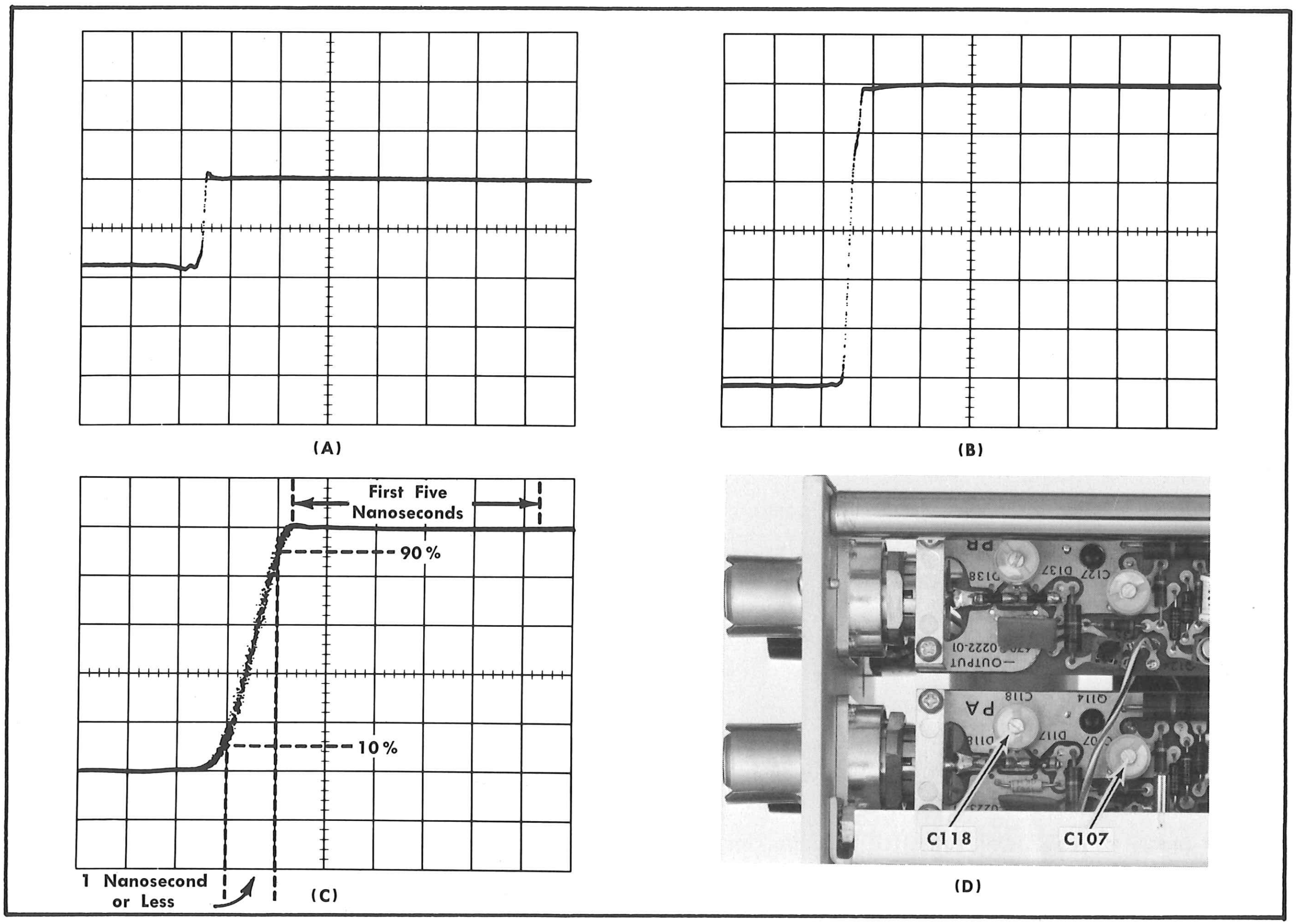


Fig. 6-15. Typical sampling system display when checking + OUTPUT; (A) minimum amplitude, (B) maximum amplitude, (C) risetime and aberrations. (D) Location of C107 and C118 (bottom side).

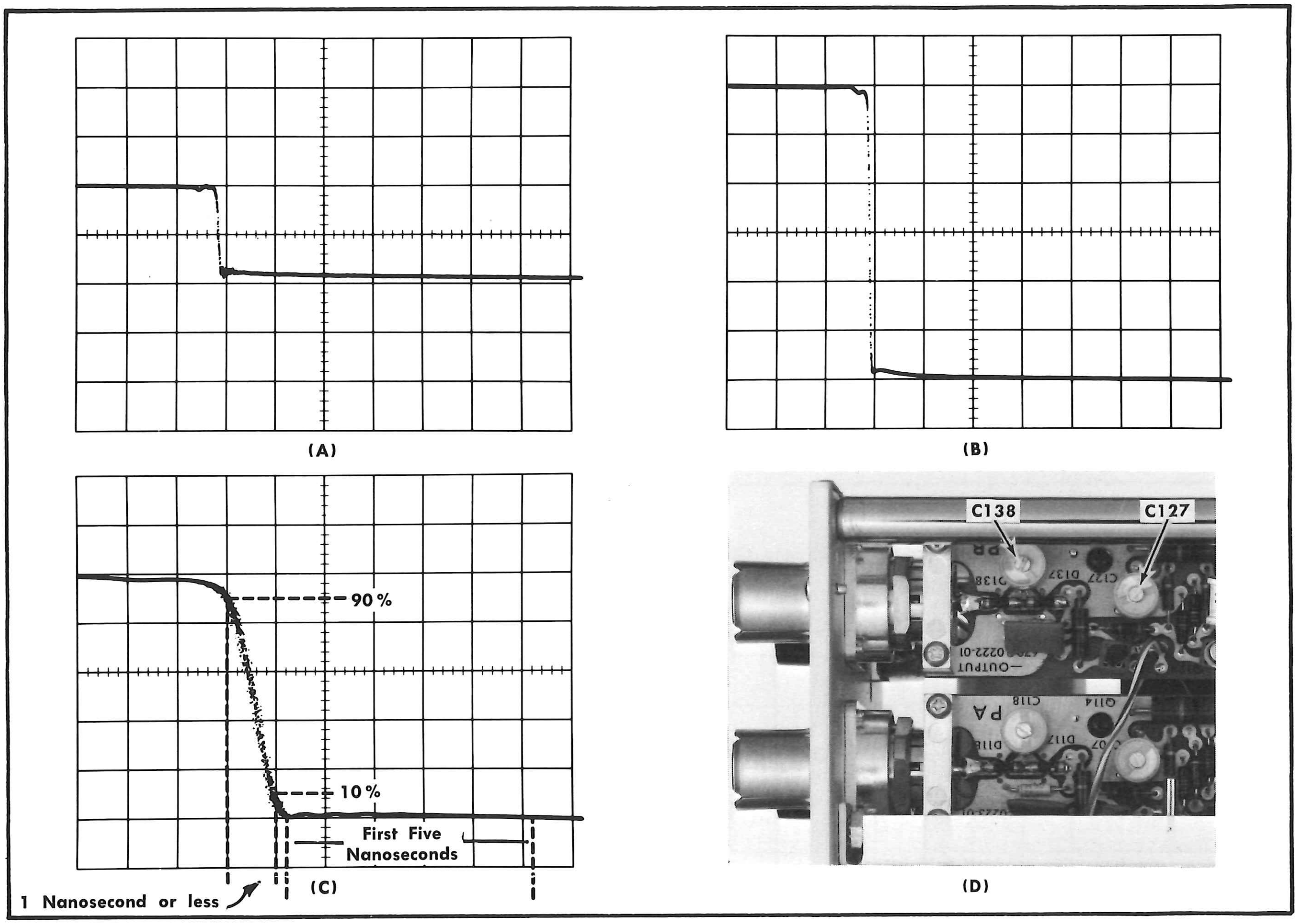


Fig. 6-16. Typical sampling system display when checking — OUTPUT; (A) minimum amplitude, (B) maximum amplitude, (C) risetime and aberrations, (D) location of C127 and C138 (bottom side).

c. Set the sampling-system sweep rate to 10 nanoseconds/division.

d. Set the + TRANSITION AMPLITUDE control fully counterclockwise.

e. CHECK—Sampling system display for 2.5 divisions or less amplitude (50 millivolts or less; see Fig. 6-15A).

f. Set the sampling system vertical deflection to 100 millivolts/division.

g. Set the + TRANSITION AMPLITUDE control fully clockwise.

h. CHECK — Sampling system display for five divisions or more amplitude (500 millivolts or more; see Fig. 6-15B).

i. Set the + TRANSITION AMPLITUDE control for five divisions of vertical deflection.

j. Set the sampling system time position range switch to 100 nanoseconds and magnify the sweep to one nanosecond/division.

k. CHECK — Sampling system display for one division or less between the 10% and 90% points of the leading edge with ±0.1 division or less aberrations in the first five divisions following the leading edge one nanosecond or less risetime with ±2% or less aberrations in first five nanoseconds; see Fig. 6-15C).

l. ADJUST—C107 and C118 (see Fig. 6-15D) for optimum risetime and square corner at the top of the leading edge of the waveform. A compromise setting may be necessary to obtain one-nanosecond risetime with + and — 2% or less aberrations.

15. Adjust — Fast Rise Output and Check Operation

a. Remove the five-nanosecond cable from the + OUTPUT connector and connect it to the — OUTPUT connector.

b. Set the sampling system vertical deflection to 20 millivolts/division and the sweep rate to 10 nanoseconds/division.

c. Set the — TRANSITION AMPLITUDE control fully counterclockwise.

d. CHECK—Sampling system display for 2.5 divisions or less amplitude (50 millivolts or less; see Fig. 6-16A).

e. Set the sampling system vertical deflection to 100 millivolts/division.

f. Set the — TRANSITION AMPLITUDE control fully clockwise.

g. CHECK—Sampling system display for five divisions or more amplitude (500 millivolts or more; see Fig. 6-16B).

h. Set the — TRANSITION AMPLITUDE control for five divisions of vertical deflection.

i. Set the sampling system time position range switch to 100 nanoseconds and magnify the sweep to one nanosecond/division.

j. CHECK — Sampling system display for one division or less between the 10% and 90% points of the leading edge with ±0.1 division or less aberrations in the first five divisions following the leading edge (one nanosecond or less risetime with ±2% or less aberrations in first five nanoseconds; see Fig. 6-16C).

k. ADJUST—C127 and C138 (see Fig. 6-16D) for optimum risetime and square corner at bottom of the leading edge of the waveform. A compromise setting may be necessary to obtain one-nanosecond risetime with + and — 2% or less aberrations.

16. Check Trigger Jitter

a. Insert the Type 106 into the cabinet.

b. Set the sampling system to magnify the sweep rate to 0.2 nanosecond/division and set the triggering controls for a stable display.

c. CHECK — Rotate the MULTIPLIER control throughout its range and check for 1.5 divisions or less jitter in the leading edge of the waveform (300 picoseconds or less; see Fig. 6-17).

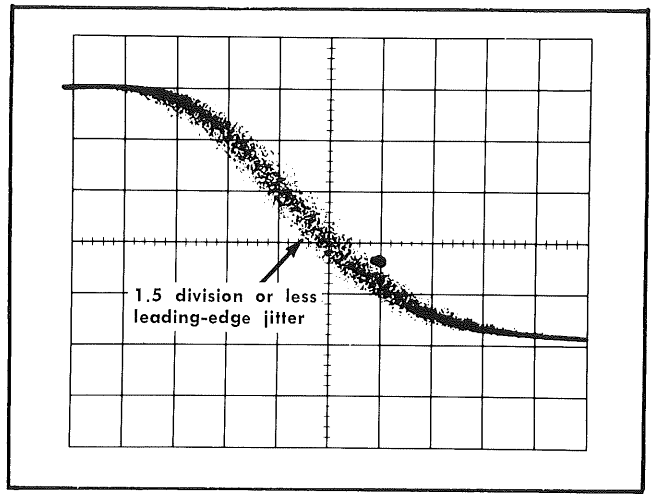


Fig. 6-17. Typical sampling system display of trigger jitter.

d. Remove the five-nanosecond cable from the — OUTPUT connector and connect it to the + OUTPUT connector.

e. CHECK — Rotate the MULTIPLIER control throughout its range and check for 1.5 divisions or less jitter in the leading edge of the waveform (300 picoseconds or less).

f. Disconnect all test equipment.

This completes the calibration procedure for the Type 106. If the instrument has been completely calibrated to the tolerances given in this procedure, it will meet the performance requirements given in the Characteristics section of this Instruction Manual.

NOTES

SECTION 7
ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description					S/N Range

Bulbs

Ckt. No.	Tektronix Part No.	Description	S/N Range
B15	150-0027-00	Neon, NE-23	
B25	150-0027-00	Neon, NE-23	
B219	150-0052-00	Incandescent, 10 V, 40 mA (white lens)	200-1169
B219	150-0065-00	Incandescent, 10 V, 40 mA (green lens)	1170-up

Capacitors

Tolerance ±20% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Description					S/N Range
C1	283-0008-00	0.1 μF	Cer		500 V		
C2	281-0534-00	3.3 pF	Cer		500 V	±0.25 pF	
C10	290-0194-00	10 μF	EMT		100 V		
C12	290-0136-00	2.2 μF	EMT		20 V		
C17A	283-0052-00	105 pF	Cer		500 V	1%	
C17B	*295-0096-00	0.001 μF	Timing Capacitor				
C17C		0.01 μF					
C17D		0.1 μF					
C17E		1 μF					
C20	290-0194-00	10 μF	EMT		100 V		
C22	290-0136-00	2.2 μF	EMT		20 V		
C27A	283-0052-00	105 pF	Cer		500 V	1%	
C27B	*295-0096-00	0.001 μF	Timing Capacitor				
C27C		0.01 μF					
C27D		0.1 μF					
C27E		1 μF					
C37	281-0518-00	47 pF	Cer		500 V		
C43	283-0008-00	0.1 μF	Cer		500 V		X635-up
C45	281-0523-00	100 pF	Cer		350 V		
C52	281-0543-00	270 pF	Cer		500 V	10%	
C56	290-0012-00	2 x 40 μF	EMC		250 V		200-1354
C56†	290-0075-00	2 x 10 μF	EMC		250 V		1355-up
C92	281-0525-00	470 pF	Cer		500 V		X635-up
C94	281-0536-00	1000 pF	Cer		500 V	10%	200-634
C94	283-0059-00	1 μF	Cer		25 V	+80%—20%	635-up
C95	281-0605-00	200 pF	Cer		500 V		200-634
C95	283-0008-00	0.1 μF	Cer		500 V		635-up
C102	290-0137-00	100 μF	EMT		30 V	+75%—15%	
C103	281-0536-00	1000 pF	Cer		500 V	10%	
C107	281-0091-00	2-8 pF	Cer	Var			200-1189
C107	281-0093-00	5.5-18 pF	Cer	Var			1190-up
C118	281-0091-00	2-8 pF	Cer	Var			
C122	290-0137-00	100 μF	EMT		30 V	+75%—15%	
C123	281-0536-00	1000 pF	Cer		500 V	10%	
C127	281-0091-00	2-8 pF	Cer	Var			200-1189
C127	281-0093-00	5.5-18 pF	Cer	Var			1190-up
C138	281-0091-00	2-8 pF	Cer	Var			

†Only one 10 μF section is utilized.

Capacitors *(Cont)*

Ckt. No.	Tektronix Part No.	Description				S/N Range
C212	290-0278-00	550 μF	EMC	50V		
C213	290-0137-00	100 μF	EMT	30 V	+75%—15%	X680-up
C215	283-0059-00	1 μF	Cer	25 V	+80%—20%	
C217	290-0137-00	100 μF	EMT	30 V	+75%—15%	X346-up
C218	283-0059-00	1 μF	Cer	25 V	+80%—20%	
C222	290-0019-00	150 μF	EMC	250 V		
C224	283-0008-00	0.1 μF	Cer	500 V		
C227	290-0285-00	4 μF	EMT	200 V	+50%—10%	
C228	290-0164-00	1 μF	EMT	150 V		
C229	283-0008-00	0.1 μF	Cer	500 V		
C232	290-0016-00	125 μF	EMC	350 V		
C234	283-0008-00	0.1 μF	Cer	500 V		
C244	283-0008-00	0.1 μF	Cer	500 V		
C246	283-0008-00	0.1 μF	Cer	500 V		
C247	290-0159-00	2 μF	EMT	150 V		X1355-1549X
C248	290-0159-00	2 μF	EMT	150 V		X1355-1549X
C249	290-0347-00	1 μF	EMT	450 V	+50%—10%	X1550-up
C252	290-0089-00	3 x 20 μF	EMC	350 V		
C255	290-0285-00	4 μF	EMT	200 V	+50%—10%	
C262	290-0278-00	550 μF	EMC	50 V		
C268	283-0059-00	1 μF	Cer	25 V	+80%—20%	

Connectors

Ckt. No.	Tektronix Part No.	Description	S/N Range
J1	131-0106-00	Coaxial, 1 contact, female, BNC	
J49	131-0106-00	Coaxial, 1 contact, female, BNC	
J99[1]			
J119[1]			
J139[1]			

Diodes

Ckt. No.	Tektronix Part No.	Description			S/N Range
D3	*152-0185-00	Silicon	Replaceable by 1N3605		
D4	152-0071-00	Germanium	ED 2007		200-697
D4	*152-0185-00	Silicon	Replaceable by 1N3605		698-up
D5	*152-0185-00	Silicon	Replaceable by 1N3605		
D32	*152-0185-00	Silicon	Replaceable by 1N3605		X1480-up
D33	152-0071-00	Germanium	ED 2007		200-1479
D33	*152-0185-00	Silicon	Replaceable by 1N3605		1480-up
D34	*152-0185-00	Silicon	Replaceable by 1N3605		
D35	*152-0185-00	Silicon	Replaceable by 1N3605		
D53	*152-0185-00	Silicon	Replaceable by 1N3605		
D54	152-0071-00	Germanium	ED 2007		200-609
D54	152-0079-00	Germanium	HD1841		610-up
D103	*152-0185-00	Germanium	Replaceable by 1N3605		
D104	152-0076-00	Zener	1N4372	0.4 W, 3 V, 10%	
D105	*152-0185-00	Silicon	Replaceable by 1N3605		
D114	152-0071-00	Germanium	ED 2007		200-609
D114	152-0079-00	Germanium	HD1841		610-up
D117	*152-0209-00	Tek GaAs			
D118	*152-0209-00	Tek GaAs			
D123	*152-0185-00	Silicon	Replaceable by IN3605		
D124	152-0076-00	Zener	1N4372	0.4 W, 3 V, 10%	

[1]See Mechanical Parts List.

Diodes *(Cont)*

Ckt. No.	Tektronix Part No.	Description			S/N Range
D212	152-0199-00	Rectifier bridge MDA 962-3 (Motorola)			
D213	152-0120-00	Zener	1N3020B	1 W, 10 V, 5%	
D216	152-0120-00	Zener	1N3020B	1 W, 10 V, 5%	
D222	152-0232-00	Rectifier bridge assembly			
D224	152-0101-00	Zener	1N3041B	1 W, 75 V, 5%	
D232	152-0232-00	Rectifier bridge assembly			
D233	*152-0185-00	Silicon	Replaceable by IN3605		
D234	*152-0185-00	Silicon	Replaceable by IN3605		
D243	*152-0185-00	Silicon	Replaceable by IN3605		
D252	152-0232-00	Rectifier bridge assembly			
D255	152-0240-00	Zener	UZ 5215	5 W, 150 V, 10%	
D262	152-0199-00	Rectifier bridge MDA 962-3 (Motorola)			
D264	152-0060-00	Zener	1N3027A	1 W, 20 V, 10%	

Fuse

F201	159-0041-00	1.25 A, 3 AG, Slo-Blo	

Inductors

L13	*108-0057-00	8.8 μH	
L23	*108-0057-00	8.8 μH	
L64	276-0507-00	Core, Ferramic Suppressor	X635-up
L65	276-0507-00	Core, Ferramic Suppressor	X635-up
L74	276-0507-00	Core, Ferramic Suppressor	X635-up
L75	276-0507-00	Core, Ferramic Suppressor	X635-up
L84	276-0507-00	Core, Ferramic Suppressor	X635-up
L85	276-0507-00	Core, Ferramic Suppressor	X635-up

Plug

P201	*131-0102-00	3 wire, male	

Transistors

Q4	*151-0195-00	Silicon	Replaceable by MPS 6515	
Q33	151-0169-00	Silicon	2N3439	
Q34	*151-0108-00	Silicon	Replaceable by 2N2501	200-634
Q34	151-0190-00	Silicon	2N3904	635-up
Q43	151-0190-00	Silicon	2N3904	
Q54	151-0190-00	Silicon	2N3904	
Q103	*151-0108-00	Silicon	Replaceable by 2N2501	200-1189
Q103	151-0223-00	Silicon	2N4275	1190-up
Q114	*151-0142-00	Silicon	Selected from 2N3546	200-1189
Q114	151-0221-00	Silicon	2N4258	1190-up

Transistors *(Cont)*

Ckt. No.	Tektronix Part No.	Description		S/N Range
Q115	151-0188-00	Silicon	2N3906	X1190-up
Q124	*151-0108-00	Silicon	Replaceable by 2N2501	
Q134	*151-0109-00	Silicon	Selected from 2N918	200-929
Q134	*151-0223-00	Silicon	2N4275	930-up
Q135	151-0190-00	Silicon	2N3904	X1190-up
Q213	*151-0136-00	Silicon	Replaceable by 2N3053	
Q217	*151-0134-00	Silicon	Replaceable by 2N2905	200-679
Q217	151-0208-00	Silicon	2N4036	680-up
Q224	151-0150-00	Silicon	2N3440	
Q227	151-0150-00	Silicon	2N3440	
Q233	*151-0136-00	Silicon	Replaceable by 2N3053	
Q234	151-0150-00	Silicon	2N3440	
Q247	*151-0196-00	Silicon	Replaceable by 40256	200-777
Q247	151-0201-00	Silicon	2N3739	778-1354
Q247	151-0251-00	Silicon	2N4240	1355-up
Q257	151-0149-00	Silicon	2N3441	
Q267	*151-0136-00	Silicon	Replaceable by 2N3053	

Resistors

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

Ckt. No.	Tektronix Part No.	Value	Wattage	Type	Prec	Tolerance	S/N Range
R1	302-0105-00	1 MΩ	½ W				
R2	315-0473-00	47 kΩ	¼ W			5%	
R3	315-0104-00	100 kΩ	¼ W			5%	
R4	315-0152-00	1.5 kΩ	¼ W			5%	
R5	301-0275-00	2.7 MΩ	½ W			5%	X698-up
R6	311-0408-00	20 kΩ		Var			
R8	311-0353-00	25 kΩ		Var			
R9	311-0256-00	300 Ω		Var			
R10	303-0203-00	20 kΩ	1 W			5%	
R11	323-0168-00	549 Ω	½ W		Prec	1%	
R12	315-0752-00	7.5 kΩ	¼ W			5%	
R14	302-0330-00	33 Ω	½ W				
R15	301-0131-00	130 Ω	½ W			5%	200-1479X
R16	302-0330-00	33 Ω	½ W				
R17	323-0406-00	165 kΩ	½ W		Prec	1%	
R20	303-0203-00	20 kΩ	1 W			5%	
R21	323-0168-00	549 Ω	½ W		Prec	1%	
R22	315-0752-00	7.5 kΩ	¼ W			5%	
R24	302-0330-00	33 Ω	½ W				
R25	301-0680-00	68 Ω	½ W			5%	
R26	302-0330-00	33 Ω	½ W				
R27	323-0406-00	165 kΩ	½ W		Prec	1%	
R30	311-0326-00	10 kΩ		Var			
R31[2]	311-0026-00	100 kΩ		Var			
R34	301-0131-00	130 Ω	½ W			5%	X1480-up
R35	315-0392-00	3.9 kΩ	¼ W			5%	200-634

[2]Furnished as a unit with SW17.

PARTS LIST ADDENDUM

TYPE 106 TENT SN 1590

ADD:

R17B	301-0206-00	20 MΩ	1/2 W	5%
R17C	301-0226-00	22 MΩ	1/2 W	5%
R17D	301-0226-00	22 MΩ	1/2 W	5%
R17E	301-0915-00	9.1 MΩ	1/2 W	5%
R27B	301-0206-00	20 MΩ	1/2 W	5%
R27C	301-0226-00	22 MΩ	1/2 W	5%
R27D	301-0226-00	22 MΩ	1/2 W	5%
R27E	301-0915-00	9.1 MΩ	1/2 W	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.

M13,393/268

Resistors *(Cont)*

Ckt. No.	Tektronix Part No.	Description				S/N Range
R35	301-0562-00	5.6 kΩ	½ W		5%	635-up
R36	315-0823-00	82 kΩ	¼ W		5%	200-634
R36	301-0473-00	47 kΩ	½ W		5%	635-up
R37	303-0273-00	27 kΩ	1 W		5%	
R38	305-0303-00	30 kΩ	2 W		5%	
R39	311-0390-00	25 kΩ		Var		
R42	316-0101-00	100 Ω	¼ W			X430-up
R43	302-0393-00	39 kΩ	½ W			
R45	315-0681-00	680 Ω	¼ W		5%	
R46	315-0151-00	150 Ω	¼ W		5%	
R52	302-0472-00	4.7 kΩ	½ W			
R55	304-0271-00	270 Ω	1 W			
R56	304-0100-00	10 Ω	1 W			200-634X
R59	302-0104-00	100 kΩ	½ W			
R61	316-0330-00	33 Ω	¼ W			
R62	301-0222-00	2.2 kΩ	½ W		5%	
R63	316-0100-00	10 Ω	¼ W			
R71	316-0330-00	33 Ω	¼ W			
R72	301-0222-00	2.2 kΩ	½ W		5%	
R73	316-0100-00	10 Ω	¼ W			
R81	316-0330-00	33 Ω	¼ W			
R82	301-0222-00	2.2 kΩ	½ W		5%	
R83	316-0100-00	10 Ω	¼ W			
R91	316-0330-00	33 Ω	¼ W			
R92	301-0222-00	2.2 kΩ	½ W		5%	
R93	316-0100-00	10 Ω	¼ W			
R99	308-0392-00	600 Ω	14 W	WW	2%	
R101	302-0100-00	10 Ω	½ W			
R102	303-0820-00	82 Ω	1 W		5%	
R103	316-0102-00	1 kΩ	¼ W			
R105	316-0472-00	4.7 kΩ	¼ W			
R107	316-0220-00	22 Ω	¼ W			
R114	301-0241-00	240 Ω	½ W		5%	200-1189
R114	301-0201-00	200 Ω	½ W		5%	1190-up
R115	311-0587-00	5 kΩ		Var		200-1189
R115	311-0117-00	5 kΩ		Var		1190-up
R116	315-0202-00	2 kΩ	¼ W		5%	X1190-1449
R116	315-0182-00	1.8 kΩ	¼ W		5%	1450-up
R119	307-0068-00	50 Ω			1%	
R121	302-0100-00	10 Ω	½ W			
R122	303-0820-00	82 Ω	1 W		5%	
R123	316-0102-00	1 kΩ	¼ W			
R125	316-0472-00	4.7 kΩ	¼ W			
R127	316-0220-00	22 Ω	¼ W			
R134	301-0241-00	240 Ω	½ W		5%	200-1189
R134	301-0201-00	200 Ω	½ W		5%	1190-up

Resistors *(Cont)*

Ckt. No.	Tektronix Part No.	Description					S/N Range
R135	311-0587-00	5 kΩ		Var			200-1189
R135	311-0117-00	5 kΩ		Va			1190-up
R136	315-0202-00	2 kΩ	¼ W			5%	X1190-1449
R136	315-0182-00	1.8 kΩ	¼ W			5%	1450-up
R139	307-0068-00	50 Ω				1%	
R206	302-0104-00	100 kΩ	½ W				
R207	302-0104-00	100 kΩ	½ W				
R213	304-0101-00	100 Ω	1 W				
R216	304-0101-00	100 Ω	1 W				
R217	304-0270-00	27 Ω	1 W				200-679
R217	304-0100-00	10 Ω	1 W				680-up
R218	302-0271-00	270 Ω	½ W				
R219	316-0121-00	120 Ω	¼ W				
R221	307-0057-00	5.1 Ω	½ W			5%	
R226	308-0168-00	40 kΩ	8 W		WW		
R227	306-0152-00	1.5 kΩ	2 W				
R228	303-0153-00	15 kΩ	1 W			5%	
R229	303-0153-00	15 kΩ	1 W			5%	
R232	306-0104-00	100 kΩ	2 W				
R233	301-0102-00	1 kΩ	½ W			5%	
R234	315-0302-00	3 kΩ	¼ W			5%	
R235	315-0302-00	3 kΩ	¼ W			5%	
R236	316-0100-00	10 Ω	¼ W				
R237	316-0223-00	22 kΩ	¼ W				200-464
R237	316-0472-00	4.7 kΩ	¼ W				465-up
R241	316-0101-00	100 Ω	¼ W				200-1354
R241	316-0470-00	47 Ω	¼ W				1355-up
R242	308-0315-00	150 Ω	10 W		WW	5%	200-1354
R242	306-0270-00	27 Ω	2 W				1355-up
R246	311-0023-00	50 kΩ		Var			
R247	311-0171-00	5 kΩ		Var			
R248	301-0302-00	3 kΩ	½ W			5%	
R251	316-0100-00	10 Ω	¼ W				
R255	301-0153-00	15 kΩ	½ W			5%	
R261	307-0113-00	5.1 Ω	¼ W			5%	
R264	302-0681-00	680 Ω	½ W				
R267	302-0820-00	82 Ω	½ W				
R268	302-0392-00	3.9 kΩ	½ W				

Switches

	Unwired	Wired		
SW17[3]	260-0771-00	*262-0742-00	Rotary	REPETITION RATE RANGE
SW201	260-0199-00		Toggle	POWER
SW202	260-0675-00		Slide	115 V-230 V
SW242	260-0398-00		Toggle	HI AMPLITUDE FAST RISE

[3]Furnished as a unit with R31.

Transformer

Ckt. No.	Tektronix Part No.	Description	S/N Range
T201	*120-0420-00	Power	

Thermal Cutout

Ckt. No.	Tektronix Part No.	Description	S/N Range
TK201	260-0677-00	Opens 158°F, ±5°; Closes 128°F, ±10°	

Test Points

Ckt. No.	Tektronix Part No.	Description	S/N Range
TP229	344-0105-00	Clip, Test Point	
TP249	344-0105-00	Clip, Test Point	
TP259	344-0105-00	Clip, Test Point	
TP269	344-0105-00	Clip, Test Point	

Electron Tubes

Ckt. No.	Tektronix Part No.	Description	S/N Range
V15	154-0212-00	6EW6	
V25	154-0212-00	6EW6	
V64	154-0503-00	7189A	
V74	154-0503-00	7189A	
V84	154-0503-00	7189A	
V94	154-0503-00	7189A	

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear on the pullout pages immediately following the Diagrams section of this instruction manual.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the Description column.

Assembly and/or Component
  Detail Part of Assembly and/or Component
  mounting hardware for Detail Part
    Parts of Detail Part
    mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF MECHANICAL PARTS LIST ILLUSTRATIONS

SECTION 9
DIAGRAMS

The following symbols are used on the diagrams:

Screwdriver adjustment

Front-panel control or connector

Clockwise control rotation in direction of arrow

IMPORTANT

Voltage and Waveform Conditions

Voltages measured with a 20,000 ohms/volt VOM. All readings in volts. Voltages are measured with respect to chassis ground unless otherwise noted.

Waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. The test oscilloscope had the following characteristics: Minimum deflection factor, 0.05 volt/division (0.5 volt/division using 10X probe); frequency response, DC to 30 MHz. DC input coupling was used except as noted otherwise. To indicate true time relationship between signals, the test oscilloscope was externally triggered from the TRIGGER OUTPUT pulse.

Voltages and waveforms on the schematics (shown in blue) are not absolute and may vary between instruments because of differing component tolerances, internal calibration or front-panel control settings. Any apparent differences between voltage levels measured with the voltmeter and those shown on the waveforms are due to circuit loading of the voltmeter.

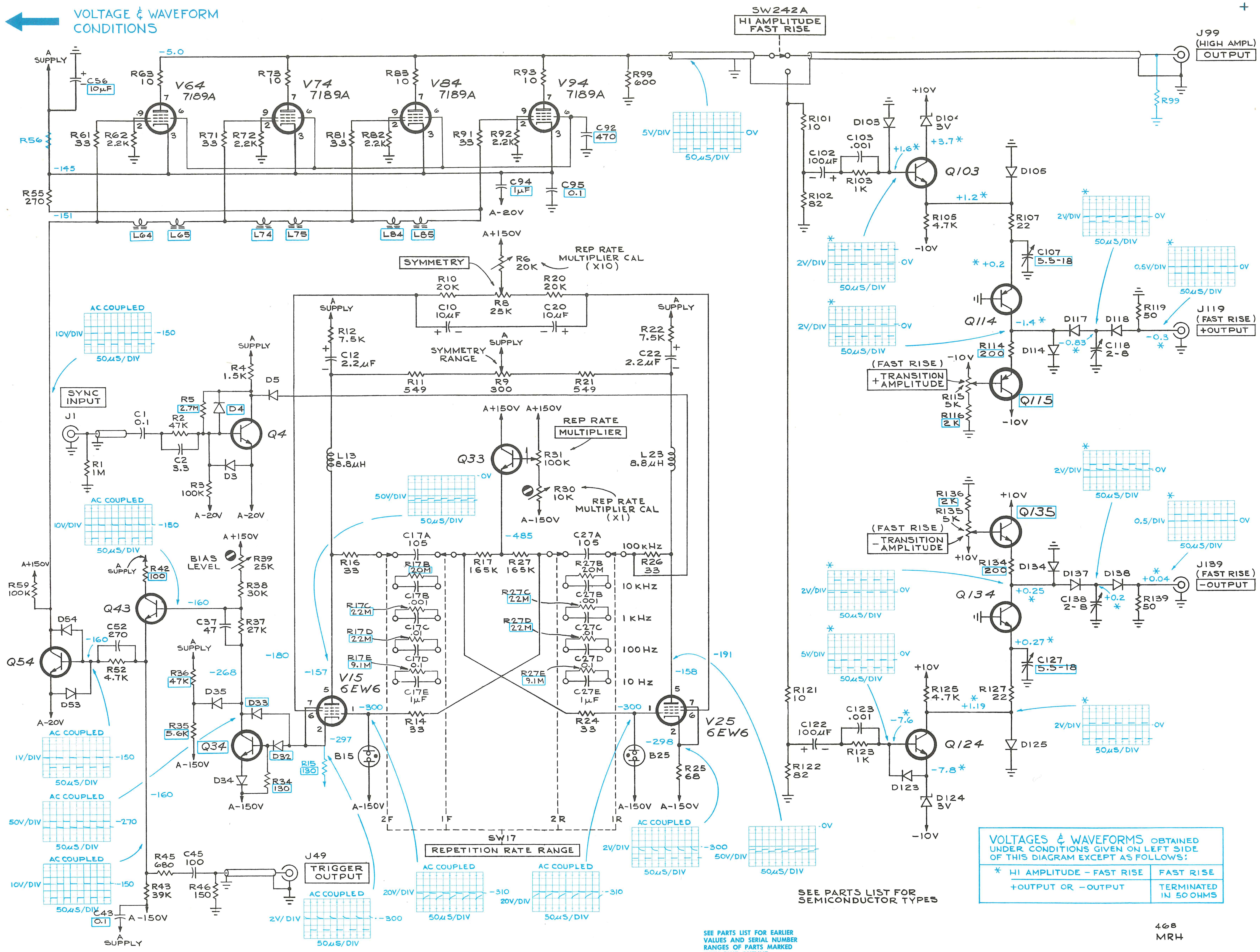
Voltages and waveforms were obtained under the following conditions unless otherwise noted on the individual diagrams:

Front-panel control settings

REPETITION RATE RANGE	1 kHz
MULTIPLIER	10
SYMMETRY	Midrange
AMPLITUDE	Clockwise
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+ TRANSITION AMPLITUDE	Clockwise
— TRANSITION AMPLITUDE	Clockwise
POWER	ON
OUTPUT (connector)	Terminated in 50 ohms
+ OUTPUT (connector)	Unterminated
— OUTPUT (connector)	Unterminated

Other conditions

Line voltage	115 volts
Output cable	Five-nanosecond GR cable RG-213 V
Output termination	50-Ohm in-line



TYPE 106 SQUARE-WAVE GENERATOR

GENERATOR

SECTION 9
DIAGRAMS

The following symbols are used on the diagrams:

Screwdriver adjustment

Front-panel control or connector

Clockwise control rotation in direction of arrow

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Voltages and waveforms were obtained under the following conditions unless otherwise noted on the individual diagrams:

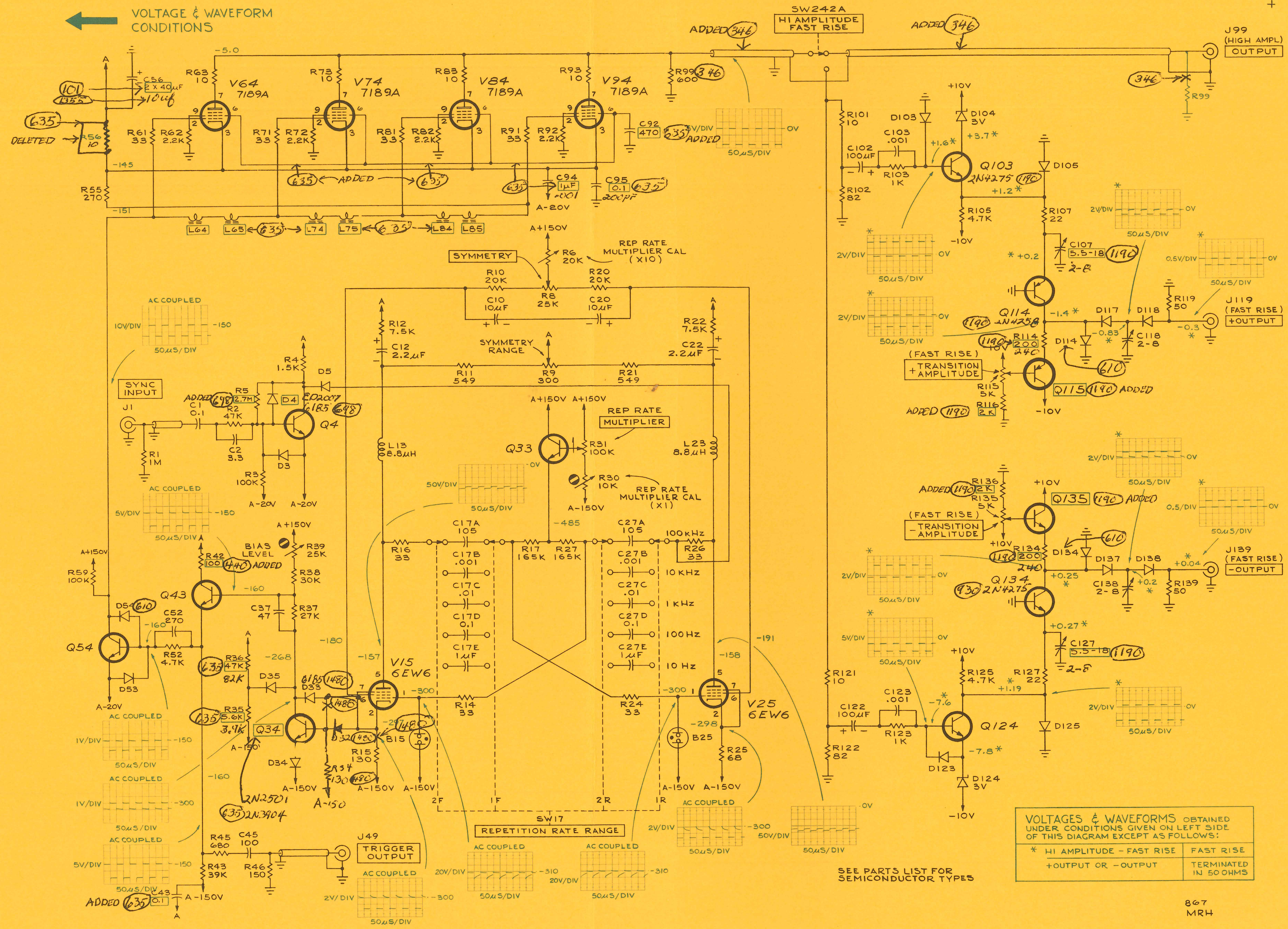
Front-panel control settings

REPETITION RATE RANGE	1 kHz
MULTIPLIER	10
SYMMETRY	Midrange
AMPLITUDE	Clockwise
HI AMPLITUDE — FAST RISE	HI AMPLITUDE
+ TRANSITION AMPLITUDE	Set for 500 millivolts output
— TRANSITION AMPLITUDE	Set for 500 millivolts output
POWER	ON
OUTPUT (connector)	Terminated in 50 ohms
+ OUTPUT (connector)	Unterminated
— OUTPUT (connector)	Unterminated

Other conditions

Line voltage	115 volts
Output cable	Five-nanosecond GR cable (RG-8A/U)
Output termination	50-Ohm in-line

The handwritten notes on this page are a complete history of electrical modifications. These notes are not on the schematics in the customer's Instruction Manual. Components whose values are changed by modification, are identified by an adjacent encircled starting serial number. When a component has been added or deleted --- rather than changed to a new value --- the encircled serial number will be accompanied by the word "added" or "deleted". Cross reference to the modification and description can be made by scanning the "EFF. SN" column of the Modification Summary Index located in another section of this Reference Book.



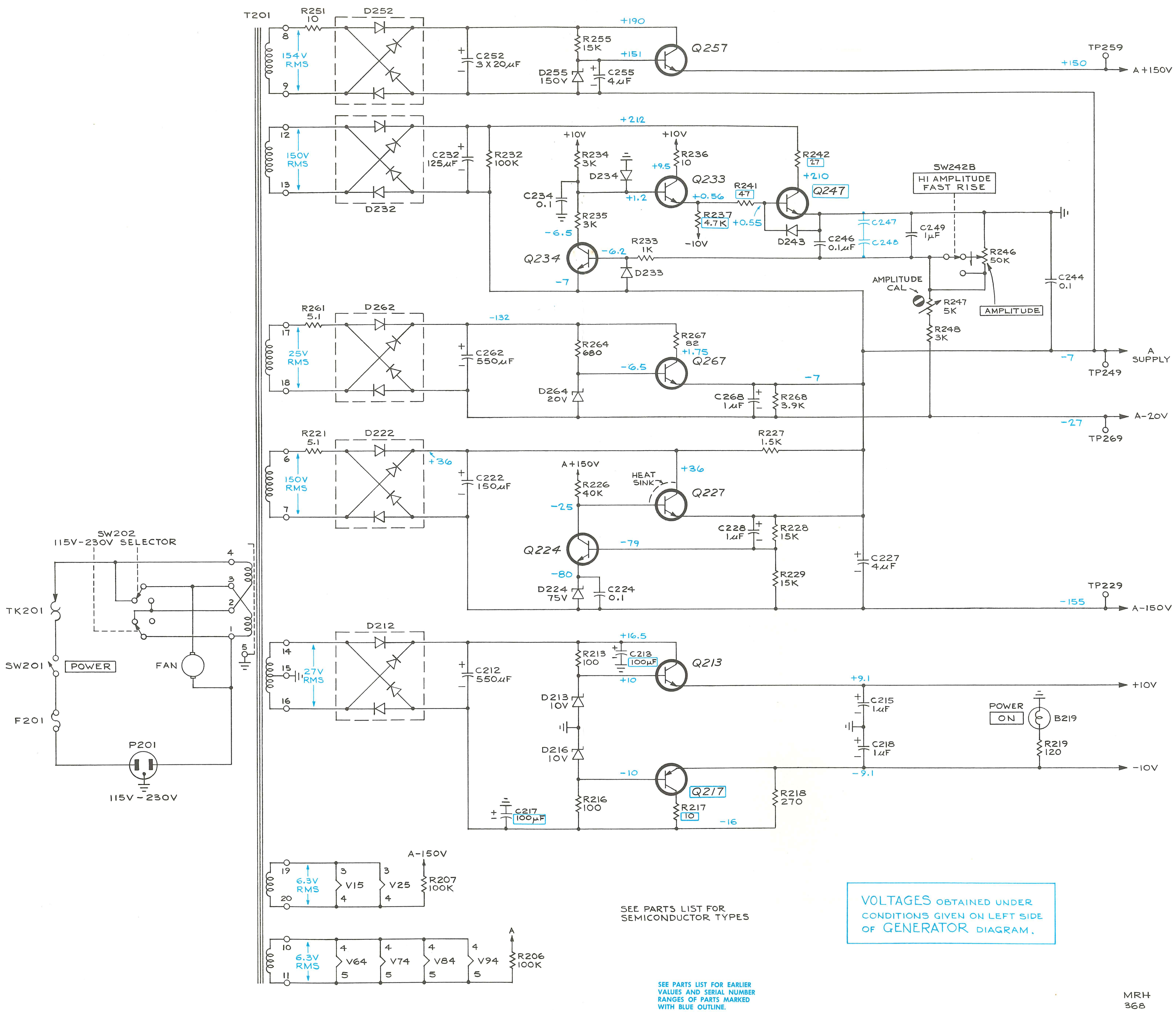
VOLTAGES & WAVEFORMS OBTAINED UNDER CONDITIONS GIVEN ON LEFT SIDE OF THIS DIAGRAM EXCEPT AS FOLLOWS:	
* HI AMPLITUDE - FAST RISE	FAST RISE
+OUTPUT OR -OUTPUT	TERMINATED IN 50 OHMS

867
MRH

TYPE 106 SQUARE-WAVE GENERATOR

E

GENERATOR

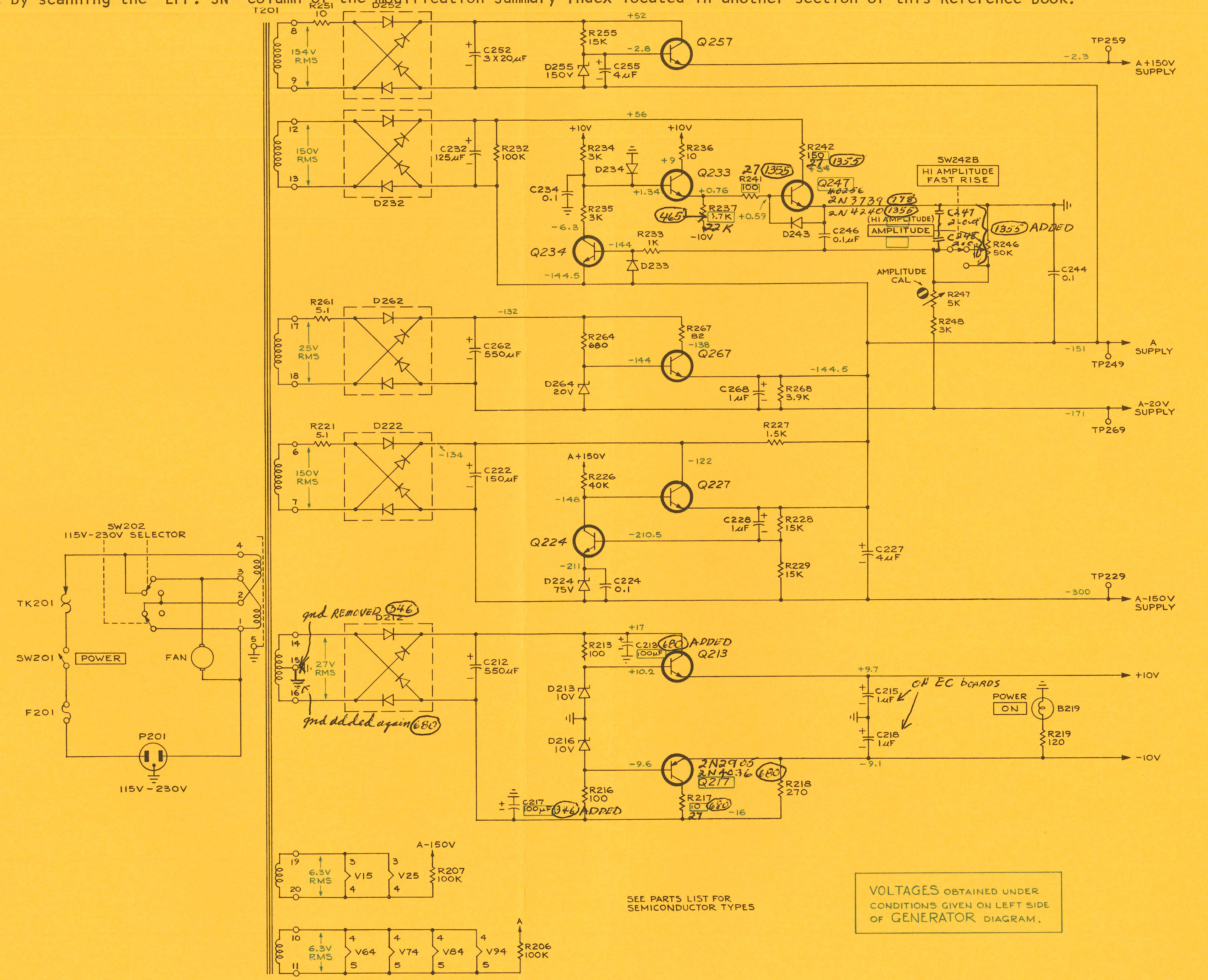


TYPE 106 SQUARE WAVE GENERATOR

F

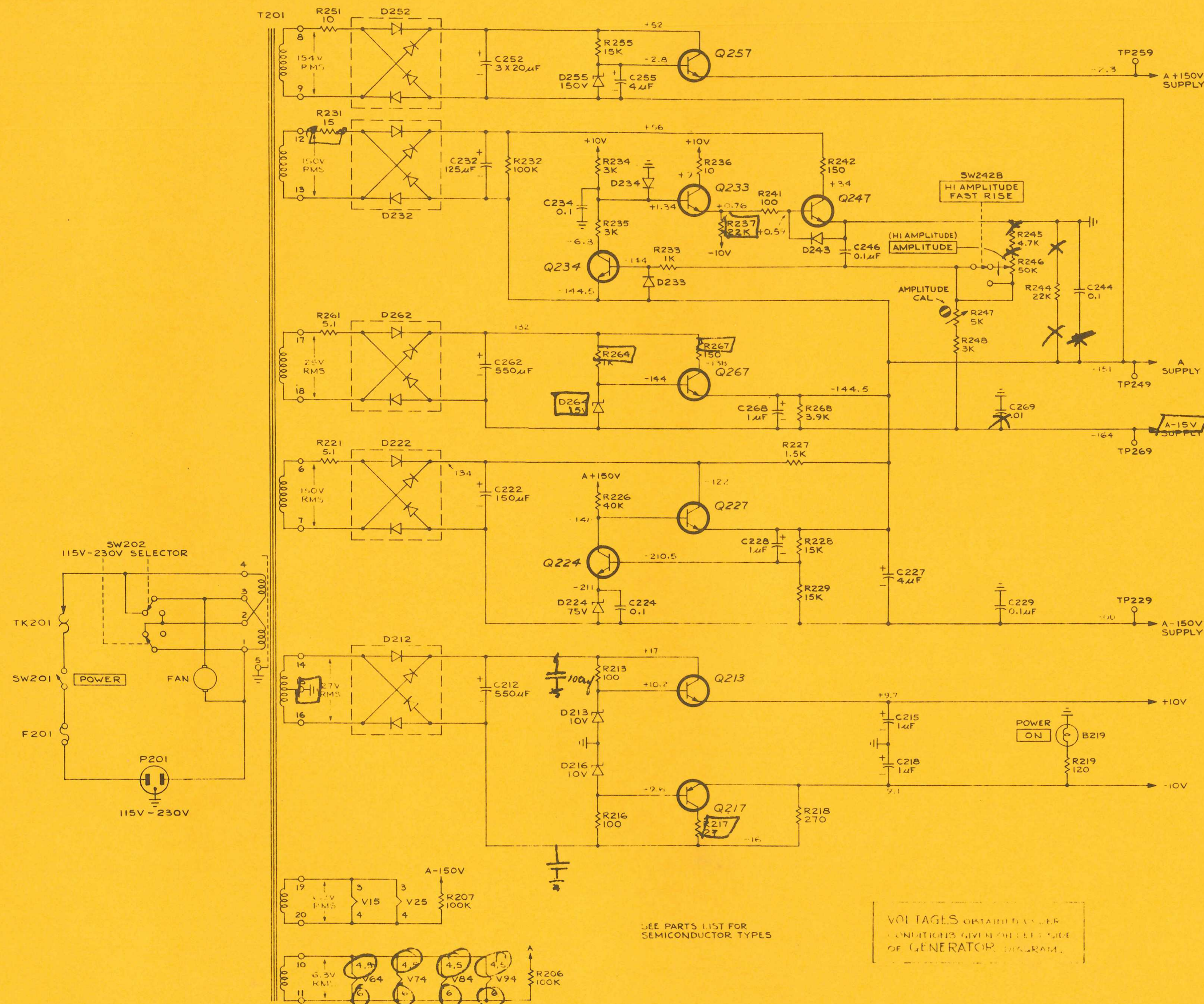
POWER SUPPLY

The handwritten notes on this page are a complete history of electrical modifications. These notes are not on the schematics in the customer's Instruction Manual. Components whose values are changed by modification, are identified by an adjacent encircled starting serial number. When a component has been added or deleted --- rather than changed to a new value --- the encircled serial number will be accompanied by the word "added" or "deleted". Cross reference to the modification and description can be made by scanning the "EFF. SN" column of the modification Summary Index located in another section of this Reference Book.



POWER SUPPLY

Instruction Manual
Schematic Addendum



TYPE 106 SQUARE WAVE GENERATOR

A

C.V.S. - 1-25-67

MRH 166

POWER SUPPLY

~~S/N 201-UP~~

BEAVERTON

MAINTENANCE NOTES

TYPE 106

"A" POWER SUPPLY BURNOUT

PROBLEM

After using the Type 106 at full output current, turning the AMPLITUDE control knob to a lower output current results (after a few minutes) in destruction of R235, a 3k 1/4W resistor in the "A" regulator circuit.

When the AMPLITUDE control is turned counter-clockwise, Q233 is supposed to let the base of Q247 move towards the −10 volt supply. I_{cbo} of Q247 (when Q247 is hot) is larger than the current through R237. If R237 is unable to pull the base of Q247 down, the comparator transistor, Q234, is turned on hard -- with eventual or immediate destruction of R235. D234 clamps the top of R235 to ground, while saturation of Q234 pulls the lower end of R235 to a negative voltage -- possibly −100 volts.

SOLUTION

Change R237 from 22k 1/4W ±10% resistor to 4.7k 1/4W ±10%. Part number of the new resistor is: 316-0472-00.

Modification 11468 will cover the change in production instruments.

Charles V. Sanford/cmh
Product Technical Information 9-1-66