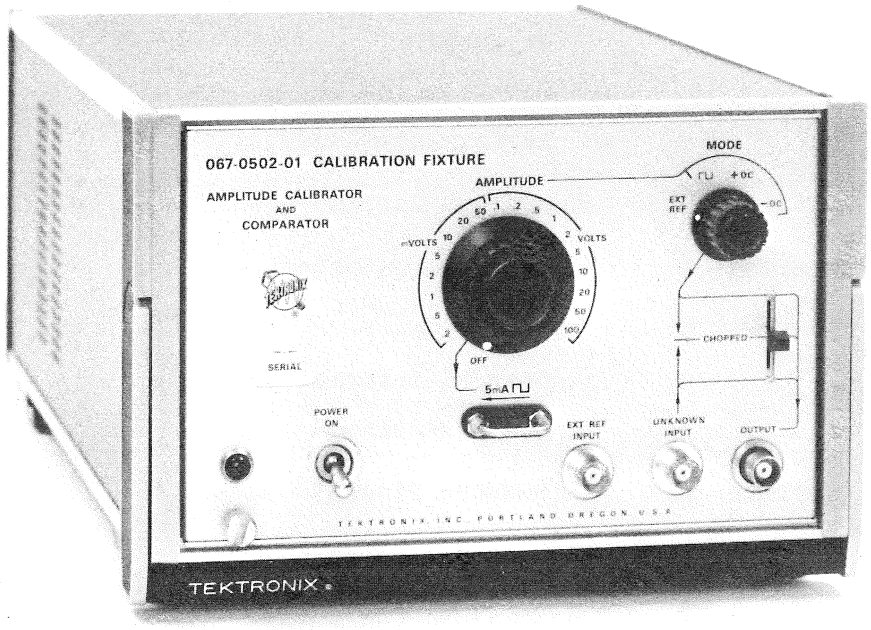
Serial Number_____

# 067-0502-01 CALIBRATION FIXTURE

Amplitude Calibrator and Comparator




The Amplitude Calibrator and Comparator provides an accurate source for positive and negative DC voltage and current as well as 60 Hz and 1 kHz squarewaves. Amplitudes are available from 0.2 mV to 100 V in a 1, 2, 5 sequence.

The comparator provides a means for making voltage measurements by alternately chopping from an accurate reference voltage (internal supply or external input) and from an unknown input, and viewing the resultant signal on an oscilloscope.

The Amplitude Calibrator and Comparator is intended to be used for verifying the accuracy of Tektronix oscilloscope amplitude calibrators.

CONTENTS

# SECTION 1

# CHARACTERISTICS

## ELECTRICAL

| Characteristics | Performance Limits |
|---|---|
| Amplitude Accuracy, 1 kHz Squarewave | Within 0.25% of amplitude setting into a 1 MΩ load |
| Squarewave Rep Rate | 1 kHz within 20% |
| Amplitude Accuracy, DC | 100 VDC within 0.25% into a 1 MΩ load |
| Maximum Input Voltage (UNKNOWN and EXT REF INPUT) | 100 V |
| Power Supply | |
| Accuracy | |
| +300 VDC (Floating) | Within 2% |
| +125 VDC (Floating) | Within 10% |
| +100 VDC (Floating) | Within 0.1% |
| -100 VDC | Within 2% |
| Maximum Ripple | |
| +300 VDC (Floating) | 15 mV P-P |
| +125 VDC (Floating) | 5 mV P-P |
| +100 VDC (Floating) | 2 mV P-P |
| -100 VDC | 2 mV P-P |
| +100 VDC | 30 mV P-P |
| Line Voltage Range | 104 to 126 volts RMS<br>208 to 252 volts RMS |
| Line Current | 0.44 A at 115 V, 60 Hz |
| Power Consumption | 43 W at 115 V |

ELECTRICAL (cont)

| Characteristics | Performance Limits |
|---|---|
| Line Frequency | 48 to 65 Hz |
| Fuse | 0.8 A slow-blowing type at 115 VAC<br>0.4 A slow-blowing type at 230 VAC |
| Warmup Time | 5 minutes |

ENVIRONMENTAL

| Characteristics | Performance Limits |
|---|---|
| Temperature | Performance requirements listed apply over a temperature range of +15°C to +35°C |

PHYSICAL

| Characteristics | Information |
|---|---|
| Finish | Anodized aluminum front panel with blue-vinyl finished cabinet |
| Overall Dimensions | |
| Length | 13-7/8 inches (35.5 cm) |
| Width | 5 inches (12.7 cm) |
| Height | 7-7/8 inches (20 cm) |
| Weight | 7-1/2 lbs. (3.4 kg) |

## CONTROLS AND CONNECTORS

### AMPLITUDE Selector

A 20-position rotary switch selecting output amplitudes from 0.2 mV to 100 V in a 1, 2, 5 sequence. A 5 mA ⊓⊔ position is also provided which supplies a 1 kHz squarewave or 5 mA DC to the 5 mA Current Loop.

### MODE Selector

A 4-position rotary switch which selects the modes applied to the output switch. An external reference input is applied in the EXT REF position, a 1 kHz squarewave in the ⊓⊔ position, and a + or - DC voltage in the +DC and -DC positions.

### Output Switch

A 3-position lever switch that: (1) connects the signal selected by the MODE selector directly to the OUTPUT connector when in the top position, (2) connects the signal at the UNKNOWN INPUT connector directly to the OUTPUT connector when in the bottom position or (3) when electromechanically switches between (1) and (2) at a 60 Hz rate providing a composite signal at the OUTPUT connector.

### EXT REF INPUT Connector

Connects an external reference signal to the MODE selector.

### UNKNOWN INPUT Connector

Connects an unknown input to the chopper or directly to the OUTPUT connector depending on the position of the output switch.

### OUTPUT Connector

Provides output signal as selected by the Output switch.

### 5 mA ⊓⊔ Current Loop

Provides either a 5 mA squarewave or 5 mA DC. The arrow above the current loop indicates the direction of conventional current flow when the MODE selector is in the squarewave (⊓⊔) or +DC position. In the -DC position, current flows in the opposite direction through the loop.

## PERFORMANCE CONDITIONS

The following conditions must be met before the specified performance characteristics are valid:

1. The instrument must be calibrated at an ambient temperature between +20°C and +30°C.

2. The instrument must be operating for at least 5 minutes within +15°C to +35°C.

# SECTION 2

# OPERATING INSTRUCTIONS

## Output Selector Switch

The 3-position switch located directly above the calibrator OUTPUT connector selects the output signal.

In the "up" position, the output signal is one of the four selected by the MODE selector. The EXT position connects the EXT REF INPUT connector directly to the OUTPUT. The ⊓⊔ position connects a positive-going 1 kHz squarewave, whose amplitude is set by the AMPLITUDE selector, directly to the OUTPUT. The +DC and -DC positions connect a DC voltage, whose amplitude is set by the AMPLITUDE selector, directly to the OUTPUT. In order to obtain the stated accuracy of the instrument, a 1 megohm load must be connected to the OUTPUT connector. In most cases, this load will be provided by the standard 1 megohm input resistance of the oscilloscope used.

In the "down" position, the UNKNOWN INPUT is connected directly to the OUTPUT.

In the CHOPPED position, a 60 Hz electromechanical chopper switches the output between the upper and lower positions of the output switch making the output signal a composite of the unknown input and the signal selected by the MODE selector. The purpose of the mixing is to allow a convenient comparison between the two signals selected. For example, an unknown DC voltage can be connected to the UNKNOWN INPUT and mixed with the accurate DC voltage generated by the Calibrator. Small differences between these voltages can be seen at the OUTPUT connector with a sensitive, AC-coupled oscilloscope.

In addition to comparisons, a positive-going or negative-going 60 Hz squarewave can be obtained from the Calibrator by setting the MODE switch to +DC or -DC, the Output Switch to CHOPPED, and the UNKNOWN INPUT left open. For low voltages, it is desirable to connect a 50 ohm termination or attenuator to the UNKNOWN INPUT connector to provide a low impedance to ground. In similar manner, an external voltage can be converted to a 60 Hz squarewave.

Access to the chopper for comparison of two external voltages is provided. The voltages are connected to the EXT REF INPUT and UNKNOWN INPUT connectors, the MODE selector is placed at EXT, and the Output Switch is placed at CHOPPED. The output signal is the composite of the two external voltages.

Amplitude Switch

This switch determines the amplitude of the squarewave and +DC or -DC voltages selected by the MODE selector. It does not affect external voltages connected to the EXT REF INPUT connector.

When the AMPLITUDE selector is placed at OFF, the MODE selector is provided with zero volts at a source resistance of 1001 ohms.

The 5 mA position provides either a 5 mA squarewave or 5 mA DC through the current loop. The arrow above the current loop indicates the direction of conventional current flow when the MODE selector is in the squarewave or +DC position. In the -DC position, the current flows in the opposite direction through the loop.

# SECTION 3

# CIRCUIT DESCRIPTION

## Clamp Circuit & Multivibrator

The 100 volt reference voltage is established without the direct participation of an active element (transistor or tube). Since some characteristics of active elements change more with time than those of passive elements, it is possible to obtain a more accurate and stable reference voltage by using passive elements.

+100 VDC is established at the top of the resistive divider string by the +100 V (FL) clamp. The designation (FL) means "floating". 10 mA flows from the +300 V (FL) supply and divides at the plate of V115B. 5 mA flows into the 20 kΩ resistive divider and 5 mA flows into the +100 V (FL) supply. The output voltage is adjusted precisely to 100 volts. The forward voltage drops across the two diodes (D112, D122) in the circuit change nearly the same amount with temperature keeping the output voltage nearly constant.

1 kHz squarewaves are generated by the multivibrator, V115. When V115B is on, its plate drops to about -50 volts, diverting the current from the +300 V (FL) supply into the tube, reverse biasing both diodes and allowing the output to fall to zero. Both sides of the multivibrator are identical to keep the current constant in the +100 V (FL) reference supply.

Negative output polarity is obtained by inverting the multivibrator output. The +300 V (FL) and +100 V (FL) supplies have a common (COM) bus not connected to the chassis allowing any point in the floating supplies to be connected to ground. Hence, the two leads to the resistive divider are reversed by the MODE selector allowing current to flow in the opposite direction in the divider providing the negative output voltage.

## Resistive Divider

The resistor values were calculated to give the proper attenuation when an external load of 1 megohm is connected. In the AMPLITUDE switch positions 100 volts through 0.2 volts, the loading on the main divider is provided by the external load (test oscilloscope). In the positions 0.1 volt through 0.2 millivolts, an internal 1 megohm resistor is placed across this divider to replace the external load which has moved to the second divider (999 kΩ to 1.001 kΩ).

## Chassis-Ground Isolation

D300 and D301 isolate the Calibrator chassis from the power line ground to allow precise comparison measurements at low output voltages. These diodes present a high resistance to the tens of millivolts found between chassis, but still provide the safety of a grounded chassis. In the event of a malfunction, the diodes (rated at 10 amperes) will not allow the chassis to become "hot" by more than their forward voltage drop (1 volt or so). The 10 ampere rating allows some component other than the diodes to fail, thereby removing the hazard.

## Internal Load Resistors

Resistors and suitable switching are part of the instrument in order to load each signal source (external, unknown, calibrator) with 1 megohm under most test conditions.

The 1 megohm input resistance of the test oscilloscope provides proper loading of the calibrator, external, and unknown inputs except when almost equal DC voltages are mixed and compared by using an AC-coupled oscilloscope. In this case, the coupling capacitor charges to the average of the DC voltages effectively removing the 1 megohm load. Hence, in the CHOPPED-DC and CHOPPED-EXT test combinations, both the calibrator and unknown voltages are provided with internal 1 megohm loads.

When the vibrating arm of the chopper connects the unknown to the output, the unknown is loaded by the the series capacitor and input resistor of the scope. However, then the chopper arm connects the output to ground, the unknown is not loaded. Since the unknown is connected to the test scope one-half of the time, the input capacitor charges to about one-half the unknown voltage. Therefore, the test scope presents an apparent input resistance of 2 megohms to the unknown and since the unknown drives this 2 megohms only half the time, the average current supplied by the unknown is the same as if it were driving a constant load of 4 megohms. Internal load resistors in the Calibrator provide a load of 4/3 megohm to the unknown which, in parallel with the effective 4 megohms, provides the required load of 1 megohm (this loading only occurs when the AMPLITUDE selector is in the OFF position).

## Floating Power Supplies

The +300 V (FL) supply is series-regulated. It supplies current for the resistive divider and 100 volt reference supply. The +125 V (FL) is shunt-regulated and provides voltage only to the reference supply.

The +100 V (FL) reference supply achieves its good stability from the temperature-compensated and aged zener diode, the high gain dual transistor, Q456, the wirewound resistors in the feedback voltage divider, and the regulated source voltage. The matched resistors in the feedback divider are necessary to permit the voltage setting pot, R451, to meet the conflicting requirements of range and resolution.

The supplies are floating to permit inversion for negative output voltages.

### Grounded Power Supplies

The -100 V and +100 V supplies provide power to the squarewave calibrator.

### 6.3 Volts AC

A virtual ground at the center of the transformer winding is established by two 100 ohm resistors in order to equalize output transients occurring in the electromechanical chopper.

# SECTION 4
# MAINTENANCE

## GENERAL INFORMATION

### Introduction

This portion of the manual contains a complete calibration procedure for the 067-0502-01 Amplitude Calibrator and Comparator. The instrument will not often require a complete, start-from-scratch calibration, but will need occasional adjustments as components age or are replaced.

Calibration is a valuable part of preventive maintenance, since many types of minor troubles may be discovered and corrected before they become serious enough to disable the instrument. Also, certain troubles can be easily isolated to a particular section of the instrument be attempting calibration.

This section includes a list of all instruments required to calibrate the Type 067-0502-01, a check out list, and a step-by-step calibration procedure. The check out list is, essentially, a short form calibration check; it has the same sequence of steps and the same limits on checks or adjustments as the calibration procedure. This list may be used to quickly check performance or locate faulty circuits.

It will be assumed in this manual that appropriate interconnections and necessary adapters are available.

It will also be assumed that a control will be left in the position indicated on the previous step unless otherwise indicated.

All front-panel control labels of the 067-0502-01 or test instrument are in capital letters (AMPLITUDE), etc. Internal adjustment labels are identified by an R or C number (R156, C112).

## Visual Inspection

The instrument should be visually inspected occasionally for such defects as poor connections, broken or damaged parts, improperly seated transistors, and heat damaged parts. The remedy for most of these defects is not obvious. A heat damaged part is usually the symptom of some defect that is not obvious. The cause of overheating should be determined and corrected before the part is replaced, otherwise the damage may be repeated.

## Transistor Checks

Periodic preventive maintenance checks on the transistors are not recommended. Satisfactory operation of the instrument in all respects is adequate assurance that the transistors are performing properly.

## Recalibration

To insure that the 067-0502-01 maintains its accuracy, check the calibration after each 500 hours of operation or every six months if used intermittently. Complete calibration instructions appear later in this section.

The calibration procedure can also be helpful in isolating troubles in the instrument. Also, minor troubles in the instrument that may not be apparent during normal operation may be revealed and corrected during calibration.

## Ordering Parts

Many of the components are standard electronic parts that may be purchased locally. However, all standard parts in the instrument can be obtained from Tektronix through your local Tektronix Field Engineer or Field Office. Before ordering, consult the parts list of this manual to determine the value, tolerance, and rating required. Some of the parts used are not standard parts and may or may not be available for replacement. Consult any particular replacement with your local Tektornix Field Engineer or Field Office.

## CALIBRATION

### Equipment Required

1 Line Voltage Control Unit, GR Type W10MT3W
1 Type 530 or 540 Oscilloscope
1 Type 1A6 High-Gain Differential Plug-In Unit
1 Volt-ohm Meter, 20,000 Ω/V
1 X1 Probe (P6028 or equivalent)
2 42-inch BNC Cables (012-0057-01)
1 50-ohm BNC Termination (011-0049-01)
1 T Connector, BNC male to 2 female (103-0030-00)
1 Adapter, BNC dual binding post (103-0035-00)
1 Adapter, clip lead BNC (013-0076-00)
1 John Fluke Meter, Model 825 A
1 Resistor, 1 MΩ, 1/2 W, 1% (323-0481-00)

### Power Supplies

1. After turning on power and allowing 5 minutes warmup, adjust DC voltages in the following order:

   +300 V (FL)
   +125 V (FL)
   +100 V (FL) - set approximately
   -100 V

2. Check the following DC voltage:

   +100 V (between 93 V and 107 V)

3. Ripple (check at nominal line, 117 V; low line, 104 V; and high line, 126 V):

| Supply | Maximum peak-to-peak millivolts |
|---|---|
| +300 V (FL) | 15 |
| +125 V (FL) | 5 |
| +100 V (FL) | 2 |
| -100 V | 2 |
| +100 V | 30 |

4. Install the case to establish normal operating temperatures.

CALIBRATION (cont)

Front Panel Output Check

1. Check for approximately correct squarewave output at all AMPLITUDE selector settings. Using current probe, check current loop for 5 mA squarewave.

2. Check for presence of +DC and -DC.

3. Check for presence of symmetrical and "clean" 60 Hz squarewaves (Output selector at CHOPPED, MODE selector at +DC and -DC). Put 50 ohm termination on UNKNOWN INPUT and examine waveform of 5 mV 60 Hz squarewaves. Waveform should be clean with only a slight tilt.

4. Apply an external signal to the EXT REF INPUT connector, place the MODE selector on EXT, place the output switch "up", and check for presence of the signal at the OUTPUT connector.

5. Apply the same signal to the UNKNOWN INPUT connector, place the Output selector "down" and check for the presence of the signal at the OUTPUT connector.

100 Volt Reference Supply

1. Install the case and allow temperature to stabilize for 10 minutes.

2. Set AMPLITUDE to 100 VOLTS, MODE to +DC.

3. Connect a 1 megohm, 1/2 watt, 1% resistor between the binding posts of the BNC to Binding Post adapter. Attach this adapter to the BNC T connector and the T connector to the calibrator OUTPUT. Connect a BNC cable from the other side of the T connector to the BNC clip lead and then to the differential voltmeter being used.

4. Using a John Fluke Differential Voltmeter (Model 825 A or other model accurate to at least 0.025%), set the output to 100 volts, within 10 millivolts. For the final adjustment, place the voltmeter on the null sensitivity showing 100 millivolts from center-scale to full-scale. Each minor division then indicates 2 millivolts. If possible, set the +100 volts within +5 millivolts and -10 millivolts.

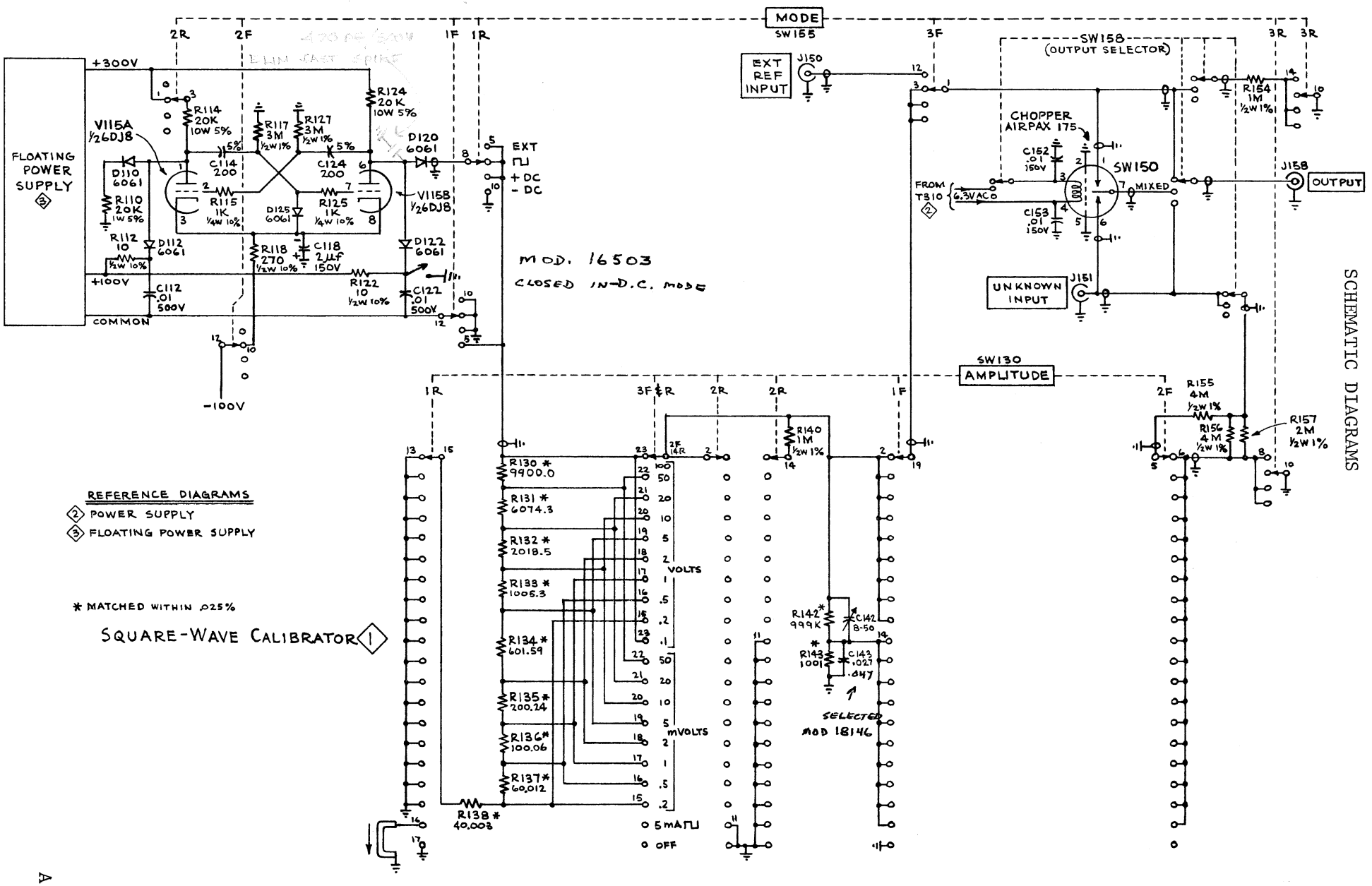
CALIBRATION (cont)

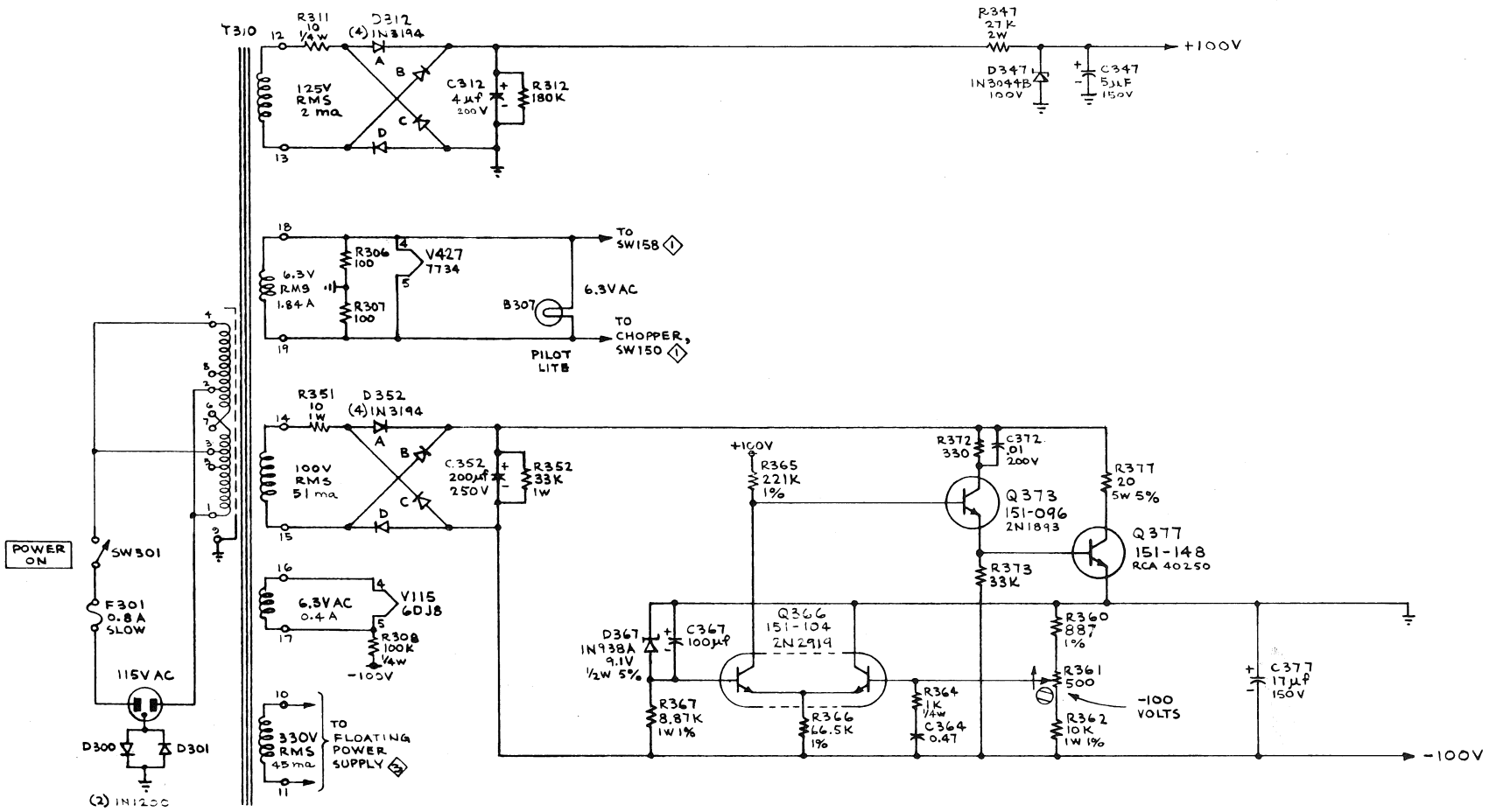
5. After the +100 volts is set, check that it changes less than ±4 millivolts from high-line to low-line.

6. Check -100 volts DC for the same tolerance.

7. Measure and record the output voltage at all settings of the AMPLITUDE selector from 100 volts through 0.1 volts. Indicated voltage must be within ±0.1% of panel markings. In addition, the algebraic sum of the error on the 0.1 volt range and the worst error on any range from 100 volts through 0.2 volts must not exceed 0.15%.

| AMPLITUDE Selector Setting | ±0.1% Tolerance | ±0.1% Tolerance Voltage Limits Low | High |
|---|---|---|---|
| 100 V | ±100 mV | Set to ±10 mV | |
| 50 V | ±50 mV | 49.950 | 50.050 (read last digit on meter) |
| 20 V | ±20 mV | 19.980 | 20.020 |
| 10 V | ±10 mV | 9.990 | 10.010 |
| 5 V | ±5 mV | 4.9950 | 5.0050 (read last digit on meter) |
| 2 V | ±2 mV | 1.9980 | 2.0020 |
| 1 V | ±1 mV | 0.9990 | 1.0010 |
| 0.5 V | ±0.5 mV | 0.49950 | 0.50050 (read last digit on meter) |
| 0.2 V | ±0.2 mV | 0.19980 | 0.20020 |
| 0.1 V | ±0.1 mV | 0.09990 | 0.10010 |

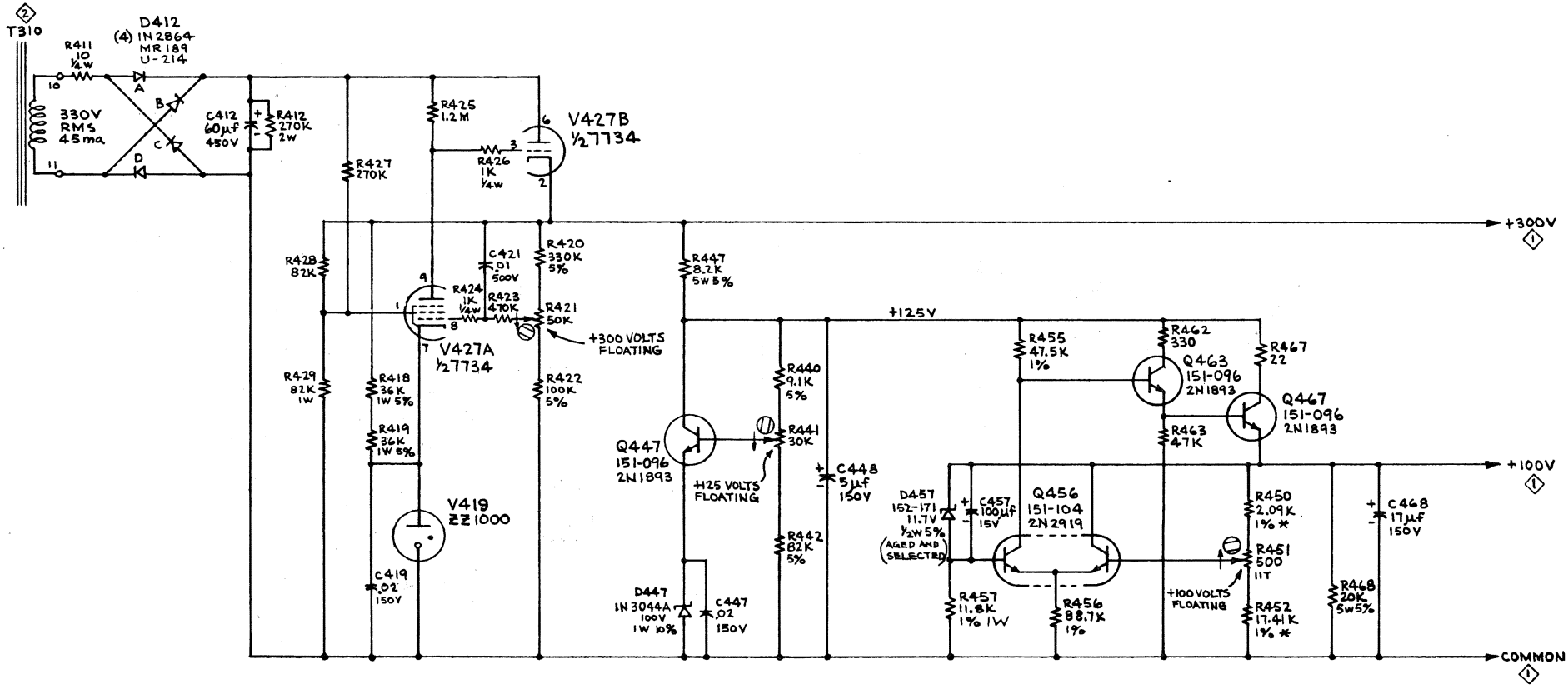

MODE
SW155
EXT REF INPUT
J150
SW158
(OUTPUT SELECTOR)
CHOPPER AIRPAX 175
SW150
FROM T310 6.3VAC
MIXED
J158
OUTPUT
UNKNOWN INPUT
J151
FLOATING POWER SUPPLY
+300V
+100V
COMMON
-100V
V115A 1/26DJ8
V115B 1/26DJ8
EXT
+DC
-DC
MOD. 16503
CLOSED IN D.C. MODE
SW130
AMPLITUDE
R130 * 9900.0
R131 * 6074.3
R132 * 2018.5
R133 * 1006.3
R134 * 601.59
R135 * 200.24
R136 * 100.06
R137 * 60.012
R138 * 40.003
VOLTS
mVOLTS
5 mATU
OFF
R140 1M 1/2W 1%
R142 * 999K
R143 * 1001
C142 8-50
C143 .027 .047
SELECTED MOD 18146
R154 1M 1/2W 1%
R155 4M 1/2W 1%
R156 4M 1/2W 1%
R157 2M 1/2W 1%
REFERENCE DIAGRAMS
(2) POWER SUPPLY
(3) FLOATING POWER SUPPLY
* MATCHED WITHIN .025%
SQUARE-WAVE CALIBRATOR (1)




POWER SUPPLY ◇2

NOTES:-

ALL RESISTORS ARE 1/2W 10% UNLESS OTHERWISE NOTED




REFERENCE DIAGRAMS

① SQUARE-WAVE CALIBRATOR

② POWER SUPPLY

NOTES:-

* MATCHED TO 0.4%

ALL RESISTORS ARE ½W 10% UNLESS OTHERWISE NOTED

4-3-69

FLOATING POWER SUPPLY ③

# SECTION 6

## ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description | | |
|---|---|---|---|---|---|---|
| | | | | **Bulb** | | |
| B307 | 150-0018-00 | | | Incandescent, miniature | 6.3 V #12 | |
| | | | | **Capacitors** | | |
| Tolerance ±20% unless otherwise indicated. | | | | | | |
| C112 | 283-0002-00 | | | 0.01 µF | Cer | 500 V |
| C114 | 283-0511-00 | | | 200 pF | Mica | 5% |
| C118 | 290-0159-00 | | | 2 µF | Elect | 150 V |
| C122 | 283-0002-00 | | | 0.01 µF | Cer | 500 V |
| C124 | 283-0511-00 | | | 200 pF | Mica | 5% |
| C142 | 281-0022-00 | | | 8-50 pF Var | Cer | |
| C143 | 285-0624-00 | | | 0.027 µF | PTM | 100 V 10% |
| C152 | 283-0003-00 | | | 0.01 µF | Cer | 150 V |
| C153 | 283-0003-00 | | | 0.01 µF | Cer | 150 V |
| C312 | 290-0285-00 | | | 4 µF | Elect | 35 V 10% |
| C347 | 290-0149-00 | | | 5 µF | Elect | 150 V |
| C352 | 290-0173-00 | | | 200 µF | Elect | 250 V |
| C364 | 285-0623-00 | | | 0.47 µF | PTM | 100 V |
| C367 | 290-0171-00 | | | 100 µF | Elect | 12 V |
| C372 | 285-0569-00 | | | 0.01 µF | PTM | 200 V |
| C377 | 290-0198-00 | | | 17 µF | Elect | 150 V +30%-15% |
| C412 | 290-0108-00 | | | 60 µF | Elect | 450 V |
| C419 | 283-0004-00 | | | 0.02 µF | Cer | 150 V |
| C421 | 283-0002-00 | | | 0.01 µF | Cer | 500 V |
| C447 | 283-0004-00 | | | 0.02 µF | Cer | 150 V |
| C448 | 290-0149-00 | | | 5 µF | Elect | 150 V |
| C457 | 290-0201-00 | | | 100 µF | Elect | 15 V |
| C468 | 290-0198-00 | | | 17 µF | Elect | 150 V +30%-15% |

Values are fixed unless marked Variable.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|---|---|---|---|---|
| | | **Semi-conductor Devices, Diodes** | | |
| D110 | *152-0061-00 | | Silicon | Tek Spec |
| D112 | *152-0061-00 | | Silicon | Tek Spec |
| D120 | *152-0061-00 | | Silicon | Tek Spec |
| D122 | *152-0061-00 | | Silicon | Tek Spec |
| D125 | *152-0061-00 | | | |
| D300 | *152-0274-00 | | Silicon | Replaceable by 1N1200 |
| D301 | *152-0274-00 | | Silicon | Replaceable by 1N1200 |
| D312 A, B C, D | 152-0066-00 | | Zener | 1N3194 |
| D347 | 152-0087-00 | | Zener | 1N3044B 1 W, 100 V, 5% |
| D352 A, B C, D | 152-0066-00 | | Silicon | 1N3194 |
| D367 | 152-0124-00 | | Zener | 1N938A 0.5 W, 9 V, 5%, TC |
| D412 A, B C, D | 152-0048-01 | | Silicon | Replaceable by 1N2864 |
| D447 | 152-0134-00 | | Zener | 1N3044A 1 W, 100 V, 10% |
| D457 | 152-0171-00 | | Zener | 1N944 0.5 W, 11.7 V, 5% (Selected, |
| | | **Fuse** | | |
| F301 | 159-0018-00 | | 0.8 A 3 AG | Slo-Blo |
| | | **Connectors †** | | |
| J150 | | | | |
| J151 | | | | |
| J158 | | | | |
| | | **Transformers** | | |
| Q366 | *151-0104-00 | | Silicon | Replaceable by 2N2913 (Dual) |
| Q373 | *151-0096-00 | | Silicon | Selected from 2N1893 |
| Q377 | *151-0148-00 | | Silicon | Selected 40250 (RCA) |
| Q447 | *151-0096-00 | | Silicon | Selected from 2N1893 |
| Q456 | *151-0104-00 | | Silicon | Replaceable by 2N2913 (Dual) |

† See Mechanical Parts List.

Values are fixed unless marked Variable.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description | | |
|---|---|---|---|---|---|---|
| | | | Transformers (cont) | | | |
| Q463 | *151-0096-00 | | Silicon | Selected from 2N1893 | | |
| Q467 | *151-0096-00 | | Silicon | Selected from 2N1893 | | |
| | | | Resistors | | | |
| Resistors are fixed, composition, ±10% unless otherwise indicated. | | | | | | |
| R110 | 303-0203-00 | | 20 kΩ | 1 W | | 5% |
| R112 | 302-0100-00 | | 10 Ω | 1/2 W | | |
| R114 | 308-0025-00 | | 20 kΩ | 10 W | WW | 5% |
| R115 | 316-0102-00 | | 1 kΩ | 1/4 W | | |
| R117 | 309-0377-00 | | 3 MΩ | 1/2 W | Prec | 1% |
| R118 | 302-0271-00 | | 270 Ω | 1/2 W | | |
| R122 | 302-0100-00 | | 10 Ω | 1/2 W | | |
| R124 | 308-0025-00 | | 20 kΩ | 10 W | WW | 5% |
| R125 | 316-0102-00 | | 1 kΩ | 1/4 W | | |
| R127 | 309-0377-00 | | 3 MΩ | 1/2 W | Prec | 1% |
| R130† | | | | | | |
| R131 | | | | | | |
| R132 | | | | | | |
| R133 | | | | | | |
| R134 | | | | | | |
| R135 | | | | | | |
| R136 | | | | | | |
| R137 | | | | | | |
| R138 | | | | | | |
| R140 | 323-0481-00 | | 1 MΩ | 1/2 W | Prec | 1% |
| R142 | | | | | | |
| R143 | | | | | | |
| R154 | 323-0481-00 | | 1 MΩ | 1/2 W | Prec | 1% |
| R155 | 309-0093-00 | | 4 MΩ | 1/2 W | Prec | 1% |
| R156 | 309-0093-00 | | 4 MΩ | 1/2 W | Prec | 1% |
| R157 | 309-0023-00 | | 2 MΩ | 1/2 W | Prec | 1% |

†R130 thru R138, R142 and R143 - resistor assembly Part No. *308-0567-00.

Values are fixed unless marked Variable.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description | | |
|---|---|---|---|---|---|---|
| | | | Resistors (cont) | | | |
| R306 | 302-0101-00 | | 100 Ω | 1/2 W | | |
| R307 | 302-0101-00 | | 100 Ω | 1/2 W | | |
| R308 | 316-0104-00 | | 100 kΩ | 1/4 W | | |
| R311 | 316-0100-00 | | 10 Ω | 1/4 W | | |
| R312 | 302-0184-00 | | 180 kΩ | 1/2 W | | |
| R347 | 306-0273-00 | | 27 kΩ | 2 W | | |
| R351 | 304-0100-00 | | 10 Ω | 1 W | | |
| R352 | 304-0333-00 | | 33 kΩ | 1 W | | |
| R360 | 323-0188-00 | | 887 Ω | 1/2 W | Prec | 1% |
| R361 | 311-0486-00 | | 500 Ω, Var | | | |
| R362 | 324-0289-00 | | 10 kΩ | 1 W | Prec | 1% |
| R364 | 316-0102-00 | | 1 kΩ | 1/4 W | | |
| R365 | 323-0418-00 | | 221 kΩ | 1/2 W | Prec | 1% |
| R366 | 323-0368-00 | | 66.5 kΩ | 1/2 W | Prec | 1% |
| R367 | 324-0284-00 | | 8.87 kΩ | 1 W | Prec | 1% |
| R372 | 302-0331-00 | | 330 Ω | 1/2 W | | |
| R373 | 302-0333-00 | | 33 kΩ | 1/2 W | | |
| R377 | 308-0123-00 | | 20 Ω | 5 W | WW | 5% |
| R411 | 316-0100-00 | | 10 Ω | 1/4 W | | |
| R412 | 306-0274-00 | | 270 kΩ | 2 W | | |
| R418 | 303-0363-00 | | 36 kΩ | 2 W | | 5% |
| R419 | 303-0363-00 | | 36 kΩ | 2 W | | 5% |
| R420 | 301-0334-00 | | 330 kΩ | 1/2 W | | 5% |
| R421 | 311-0154-00 | | 50 kΩ, Var | | | |
| R422 | 301-0104-00 | | 100 kΩ | 1/2 W | | 5% |
| R423 | 302-0474-00 | | 470 kΩ | 1/2 W | | |
| R424 | 316-0102-00 | | 1 kΩ | 1/4 W | | |
| R425 | 302-0125-00 | | 1.2 MΩ | 1/2 W | | |
| R426 | 316-0102-00 | | 1 kΩ | 1/4 W | | |
| R427 | 302-0274-00 | | 270 kΩ | 1/2 W | | |

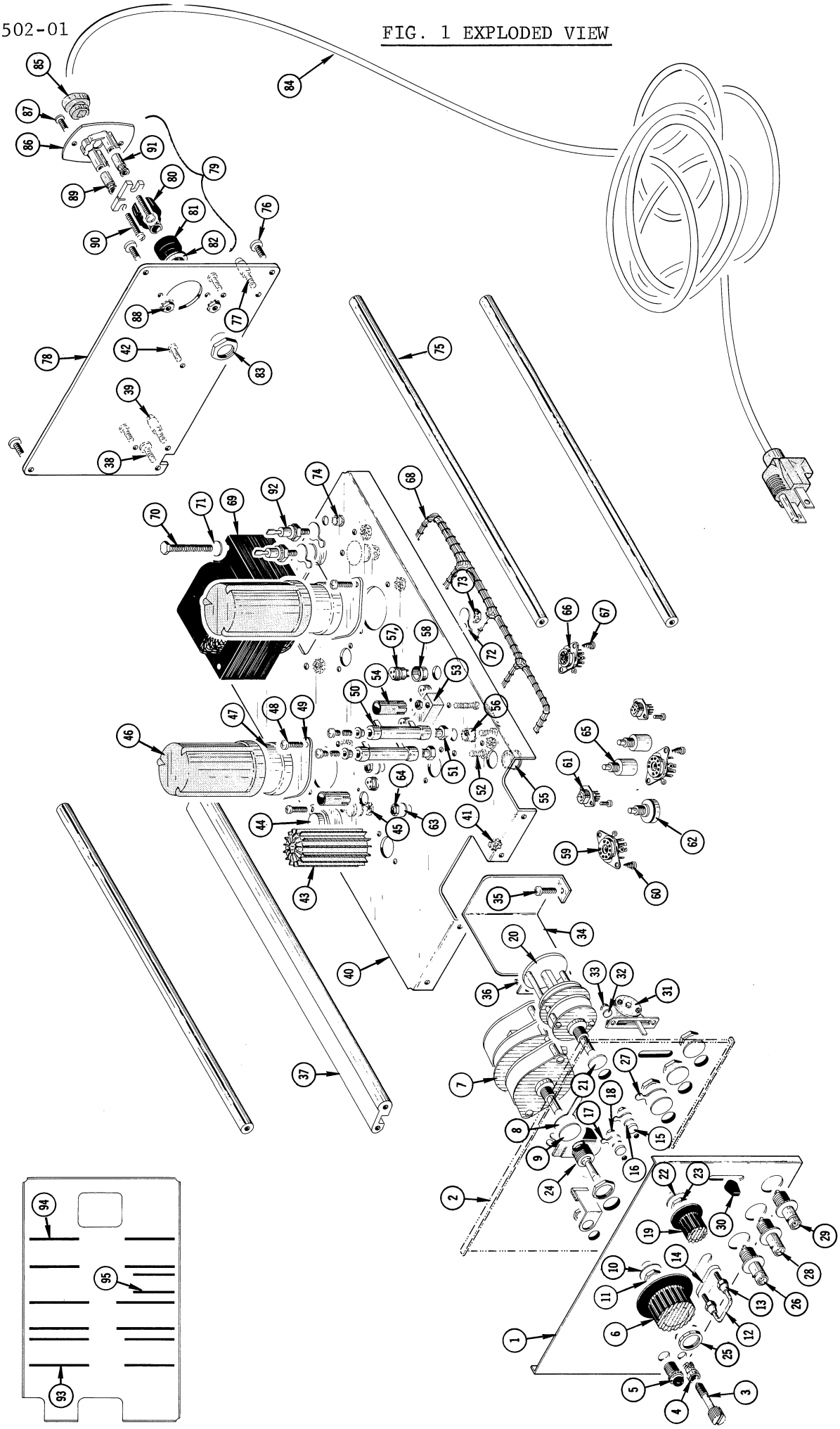
Values are fixed unless marked Variable.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description | | |
|---|---|---|---|---|---|---|
| | | | Resistors (cont) | | | |
| R428 | 302-0823-00 | | 82 kΩ | 1/2 W | | |
| R429 | 304-0823-00 | | 82 kΩ | 1 W | | |
| R440 | 301-0912-00 | | 9.1 kΩ | 1/2 W | | 5% |
| R441 | 311-0487-00 | | 30 kΩ, Var | | | |
| R442 | 301-0823-00 | | 82 kΩ | 1/2 W | | 5% |
| R447 | 308-0237-00 | | 8.2 kΩ | 5 W | WW | 5% |
| R450 | *310-0647-00 | | 2.09 kΩ | 4 W | Prec | |
| R451 | 311-0558-00 | | 500 Ω, Var | | | |
| R452 | *310-0648-00 | | 17.41 kΩ | 4 W | Prec | |
| R455 | 323-0354-00 | | 47.5 kΩ | 1/2 W | Prec | 1% |
| R456 | 323-0380-00 | | 88.7 kΩ | 1/2 W | Prec | 1% |
| R457 | 324-0296-00 | | 11.8 kΩ | 1 W | Prec | 1% |
| R462 | 302-0331-00 | | 330 Ω | 1/2 W | | |
| R463 | 302-0473-00 | | 47 kΩ | 1/2 W | | |
| R467 | 302-0220-00 | | 22 Ω | 1/2 W | | |
| R468 | 308-0272-00 | | 20 kΩ | 5 W | WW | 5% |
| | | | Switches | | | |
| | Wired or Unwired | | | | | |
| Wired | | | | | | |
| SW130 | *262-0806-01 | | Rotary | AMPLITUDE | | |
| SW130 | 260-0797-00 | | Rotary | AMPLITUDE | | |
| SW150 | 119-0016-00 | | | CHOPPER | | |
| SW155 | *260-0799-00 | | Rotary | MODE | | |
| SW158 | *260-0798-00 | | Lever | FUNCTION | | |
| SW301 | 260-0134-00 | | Toggel | POWER | | |
| | | | Transformers | | | |
| T310 | 120-0615-00 | | | | | |

Values are fixed unless marked Variable.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description |
|---|---|---|---|---|
| | | Electron Tubes | | |
| V115 | 154-0187-00 | | | 6DJ8 |
| V419 | 154-0370-00 | | | ZZ-1000 |
| V427 | ~~154-0260-00~~ 154-0660-00 | | | ~~7734~~ 6G11 |

# FIG. 1 EXPLODED VIEW



# SECTION 7

## MECHANICAL PARTS LIST

### FIG. 1 EXPLODED

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty 1 2 3 4 5 | Description |
|---|---|---|---|---|---|
| 1 | 333-1001-03 | | | 1 | PANEL, front |
| 2 | 386-1241-01 | | | 1 | PLATE, sub-panel |
| 3 | 214-0553-00 | | | 1 | LATCH SCREW, 1.388 inches long |
| 4 | 358-0255-00 | | | 1 | BUSHING, latch, plastic |
| 5 | 136-0047-00 | | | 1 | SOCKET LIGHT ASSEMBLY, w/red jewel |
| 6 | 366-0115-00 | | | 1 | KNOB, charcoal--AMPLITUDE |
| | - - - - - - | | | - | knob includes: |
| | 213-0004-00 | | | 1 | SCREW, set, 6-32 x 3/16 inch, HSS |
| 7 | 262-0806-01 | | | 1 | SWITCH, wired--AMPLITUDE |
| | - - - - - - | | | - | switch includes: |
| | 260-0797-00 | | | 1 | SWITCH, unwired |
| | - - - - - - | | | - | mounting hardware: (not included w/switch) |
| 8 | 210-0207-00 | | | 1 | LUG, solder, 3/8 ID x 5/8 inch OD, SE |
| 9 | 210-0012-00 | | | 1 | LOCKWASHER, internal, 3/8 ID x 1/2 inch OD |
| 10 | 210-0840-00 | | | 1 | WASHER, flat, 0.390 ID x 9/16 inch OD |
| 11 | 210-0413-00 | | | 1 | NUT, hex., 3/8-32 x 1/2 inch |
| 12 | 214-0335-00 | | | 1 | BOLT, current loop |
| | - - - - - - | | | - | mounting hardware: (not included w/bolt) |
| 13 | 210-0593-00 | | | 2 | NUT, current loop |
| 14 | 361-0059-00 | | | 1 | SPACER, current loop, 1 3/32 inches long |
| 15 | 210-0849-00 | | | 2 | WASHER, fiber, shouldered, #4 |
| 16 | 210-0938-00 | | | 2 | WASHER, flat, #2 |
| 17 | 210-0259-00 | | | 2 | LUG, solder, #2 |
| 18 | 210-0405-00 | | | 2 | NUT, hex., 2-56 x 3/16 inch |
| 19 | 366-0149-00 | | | 1 | KNOB, charcoal--MODE |
| | - - - - - - | | | - | knob includes: |
| | 213-0004-00 | | | 1 | SCREW, set, 6-32 x 3/16 inch, HSS |
| 20 | 260-0799-00 | | | 1 | SWITCH, unwired--MODE |
| | - - - - - - | | | - | mounting hardware: (not included w/switch) |
| 21 | 210-0012-00 | | | 1 | LOCKWASHER, internal, 3/8 ID x 1/2 inch OD |
| 22 | 210-0840-00 | | | 1 | WASHER, flat, 0.390 ID x 9/16 inch OD |
| 23 | 210-0413-00 | | | 1 | NUT, hex., 3/8-32 x 1/2 inch |
| 24 | 260-0134-00 | | | 1 | SWITCH, toggle--POWER ON |
| | - - - - - - | | | - | mounting hardware: (not included w/switch) |
| 25 | 210-0473-00 | | | 1 | NUT, 12 sided, 15/32-32 x 0.634 inch |

FIG. 1 EXPLODED (CONT)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty 1 2 3 4 5 | Description |
|---|---|---|---|---|---|
| 26 | 131-0126-00 | | | 1 | CONNECTOR, coaxial, 1 contact, BNC |
| | - - - - - - | | | - | mounting hardware: (not included w/ |
| | - - - - - - | | | - | connector) |
| 27 | 210-0255-00 | | | 1 | LUG, solder, 3/8 inch |
| 28 | 131-0126-00 | | | 1 | CONNECTOR, coaxial, 1 contact, BNC |
| | 210-0241-00 | | | 1 | LUG, terminal, 0.515 ID x 0.625 inch OD |
| 29 | 131-0274-00 | | | 1 | CONNECTOR, coaxial, 1 contact, BNC, insula ed |
| 30 | 366-0215-01 | | | 1 | KNOB, charcoal--MIXED |
| 31 | 260-0375-00 | | | 1 | SWITCH, lever--MIXED |
| | - - - - - - | | | - | mounting hardware: (not included w/switch) |
| 32 | 210-0004-00 | | | 2 | LOCKWASHER, internal, #4 |
| 33 | 210-0406-00 | | | 2 | NUT, hex., 4-40 x 3/16 inch |
| 34 | 337-0934-00 | | | 1 | SHIELD, rotary switch |
| | - - - - - - | | | - | mounting hardware: (not included w/shield) |
| 35 | 211-0507-00 | | | 1 | SCREW, 6-32 x 5/16 inch, PHS |
| 36 | 210-0457-00 | | | 2 | NUT, keps, 6-32 x 5/16 inch |
| 37 | 351-0122-00 | | | 1 | GUIDE, slide |
| | - - - - - - | | | - | mounting hardware: (not included w/guide) |
| | 211-0538-00 | | | 2 | SCREW, 6-32 x 5/16 inch, 100° csk, FHS |
| | - - - - - - | | | - | (not shown) |
| 38 | 212-0044-00 | | | 1 | SCREW, 8-32 x 1/2 inch, RHS |
| 39 | 214-0680-00 | | | 1 | PIN, locating |
| 40 | 441-0735-01 | | | 1 | CHASSIS |
| | - - - - - - | | | - | mounting hardware: (not included w/chassis) |
| | 211-0538-00 | | | 4 | SCREW, 6-32 x 5/16 inch, 100° csk, FHS |
| | - - - - - - | | | - | (not shown) |
| 41 | 210-0457-00 | | | 4 | NUT, keps, 6-32 x 5/16 inch |
| 42 | 212-0044-00 | | | 3 | SCREW, 6-32 x 5/16 inch, PHS |
| 43 | 337-0649-00 | | | 1 | SHIELD, heat dissipating |
| 44 | - - - - - - | | | 1 | TRANSISTOR |
| | - - - - - - | | | - | mounting hardware: (not included w/ |
| | - - - - - - | | | - | transistor) |
| | 211-0510-00 | | | 2 | SCREW, 6-32 x 3/8 inch, PHS |
| | 386-0143-00 | | | 1 | PLATE, mica, insulating |
| | 210-0202-00 | | | 1 | LUG, solder, SE #6 |
| | 210-0967-00 | | | 2 | WASHER, plastic, shouldered, 0.157 x 3/8 inch |
| | 210-0830-00 | | | 2 | WASHER, flat, 0.150 ID x 3/8 inch OD |
| 45 | 210-0457-00 | | | 2 | NUT, keps, 6-32 x 5/16 inch |

FIG. 1 EXPLODED (CONT)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty | 1 2 3 4 5 | Description |
|---|---|---|---|---|---|---|
| 46 | 200-0293-00 | | | 1 | | COVER, capacitor, plastic |
| | - - - - - - | | | - | | 1 ID x 3 9/16 inches |
| 47 | - - - - - - | | | 1 | | CAPACITOR |
| | - - - - - - | | | - | | mounting hardware: (not included w/ |
| | - - - - - - | | | - | | capacitor) |
| 48 | 211-0534-00 | | | 2 | | SCREW, sems, 6-32 x 5/16 inch, PHS |
| 49 | 386-0254-00 | | | 1 | | PLATE, metal, large |
| | 210-0457-00 | | | 2 | | NUT, keps, 6-32 x 5/16 inch |
| 50 | - - - - - - | | | 2 | | RESISTOR |
| | - - - - - - | | | - | | mounting hardware for each: |
| | - - - - - - | | | - | | (not included w/resistor) |
| | 211-0553-00 | | | 1 | | SCREW, 6-32 x 1 1/2 inches, RHS |
| | 210-0601-00 | | | 1 | | EYELET |
| 51 | 210-0478-00 | | | 1 | | NUT, hex., 5/16 x 21/32 inch |
| 52 | 211-0507-00 | | | 1 | | SCREW, 6-32 x 5/16 inch, PHS |
| 53 | - - - - - - | | | 1 | | RESISTOR, variable |
| | - - - - - - | | | - | | mounting hardware: (not included w/resistor) |
| | 211-0034-00 | | | 2 | | SCREW, 2-56 x 1/2 inch, RHS |
| | 210-0405-00 | | | 2 | | NUT, hex., 2-56 x 3/16 inch |
| 54 | 214-0269-00 | | | 1 | | HEAT SINK, transistor |
| 55 | 348-0063-00 | | | 1 | | GROMMET, plastic, 1/2 inch diameter |
| 56 | 348-0056-00 | | | 1 | | GROMMET, plastic, 3/8 inch diameter |
| 57 | 136-0181-00 | | | 4 | | SOCKET, transistor, 3 pin |
| | - - - - - - | | | - | | mounting hardware for each: |
| | - - - - - - | | | - | | (not included w/socket) |
| 58 | 354-0234-00 | | | 1 | | RING, socket mounting |
| 59 | 136-0015-00 | | | 2 | | SOCKET, tube, 7 pin |
| | - - - - - - | | | - | | mounting hardware for each: |
| | - - - - - - | | | - | | (not included w/socket) |
| 60 | 213-0044-00 | | | 2 | | SCREW, thread forming, 5-32 x 3/16 inch, PHS |
| 61 | 136-0078-00 | | | 2 | | SOCKET, transistor, 8 pin |
| | - - - - - - | | | - | | mounting hardware for each: |
| | - - - - - - | | | - | | (not included w/socket) |
| | 213-0055-00 | | | 2 | | SCREW, thread forming, 2-32 x 3/16 inch, PHS |

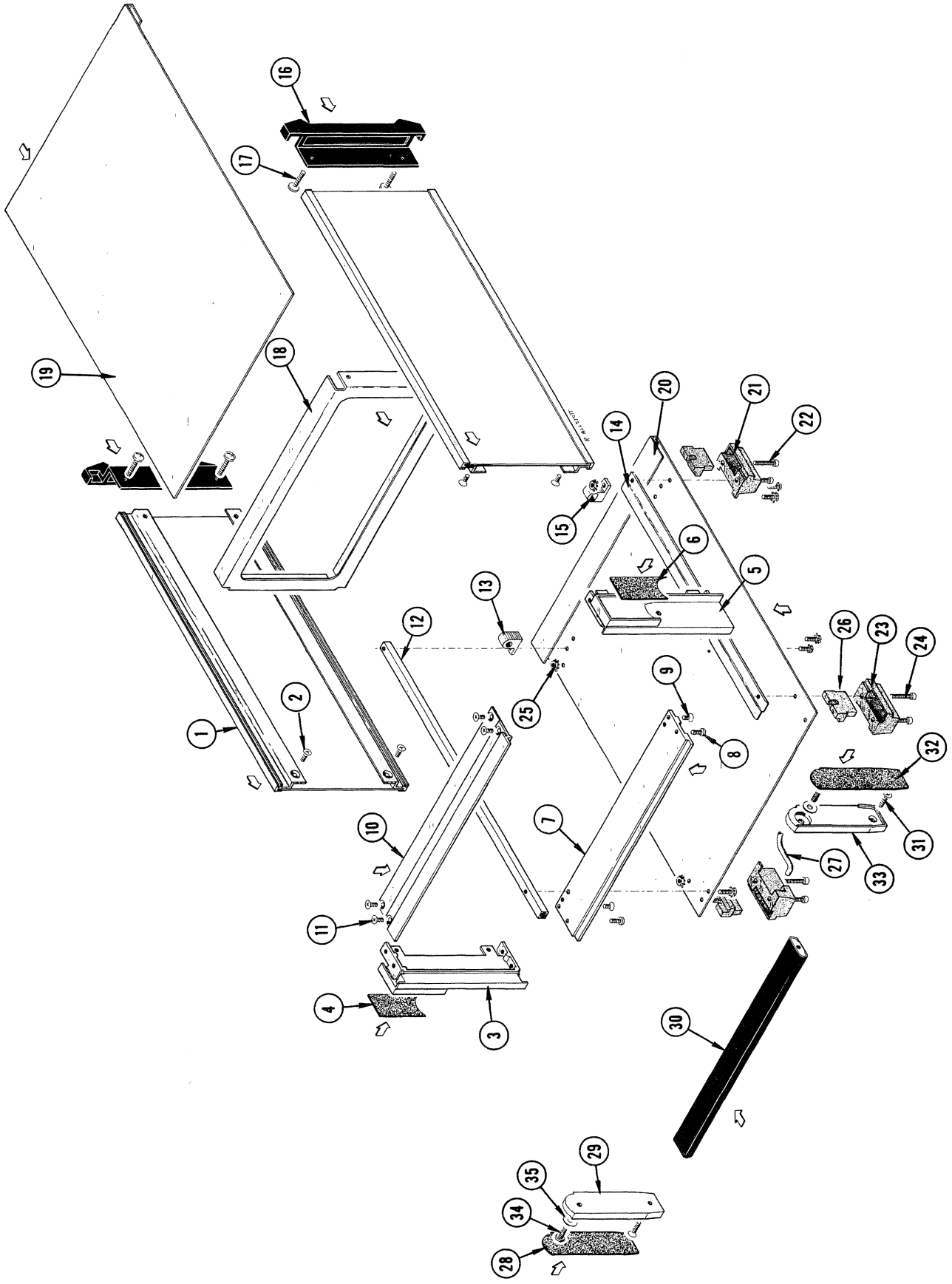
FIG. 1 EXPLODED (CONT)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty 1 2 3 4 5 | Description |
|---|---|---|---|---|---|
| 62 | - - - - - - | | | 1 | RESISTOR, variable |
| | - - - - - - | | | - | mounting hardware: (not included w/resistc |
| 63 | 210-0940-00 | | | 1 | WASHER, flat, 1/4 ID x 3/8 inch OD |
| 64 | 210-0583-00 | | | 1 | NUT, hex., 1/4-32 x 5/16 inch |
| 65 | - - - - - - | | | 2 | RESISTOR, variable |
| | - - - - - - | | | - | mounting hardware for each: (not included |
| | - - - - - - | | | - | w/resistor) |
| | 210-0012-00 | | | 1 | LOCKWASHER, internal, 3/8 ID x 1/2 inch OD |
| | 210-0583-00 | | | 1 | NUT, hex., 1/4-32 x 5/16 inch |
| 66 | 136-0008-00 | | | 1 | SOCKET, tube, 7 pin |
| | - - - - - - | | | - | mounting hardware: (not included w/socket) |
| 67 | 213-0044-00 | | | 2 | SCREW, thread forming, 5-32 x 3/16 inch, PH |
| 68 | 179-1170-01 | | | 1 | CABLE HARNESS |
| 69 | - - - - - - | | | 1 | TRANSFORMER |
| | - - - - - - | | | - | transformer includes: |
| 70 | 212-0522-00 | | | 1 | SCREW, 10-32 x 2 1/2 inches, HHS |
| 71 | 212-0812-00 | | | 1 | WASHER, fiber, shouldered, #10 |
| 72 | 210-0223-00 | | | 1 | LUG, solder, SE #10 long |
| | - - - - - - | | | - | mounting hardware: (not included |
| | - - - - - - | | | - | w/transformer) |
| 73 | 220-0410-00 | | | 4 | NUT, keps, 10-32 x 3/8 inch |
| 74 | 348-0055-00 | | | 1 | GROMMET, plastic, 1/4 inch diameter |
| 75 | 384-0615-00 | | | 3 | ROD, spacer |
| | - - - - - - | | | - | mounting hardware for each: |
| | - - - - - - | | | - | (not included w/rod) |
| 76 | 212-0044-00 | | | 3 | SCREW, 8-32 x 1/2 inch, RHS |
| 77 | 214-0680-00 | | | 1 | PIN, locating |
| | - - - - - - | | | - | mounting hardware: (not included w/pin) |
| | 210-0458-00 | | | 1 | NUT, keps, 8-32 x 11/32 inch (not shown) |

FIG. 1 EXPLODED (CONT)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty | 1 2 3 4 5 | Description |
|---|---|---|---|---|---|---|
| 78 | 386-0240-00 | | | 1 | | PANEL, rear |
| 79 | 352-0002-00 | | | 1 | | ASSEMBLY, fuse holder |
| | - - - - - - | | | - | | assembly includes: |
| 80 | 200-0582-00 | | | 1 | | CAP, fuse, black |
| 81 | 352-0010-00 | | | 1 | | HOLDER, fuse |
| 82 | 210-0873-00 | | | 1 | | WASHER, rubber, 1/2 ID x 11/16 inch OD |
| 83 | - - - - - - | | | - | | NUT |
| 84 | 161-0033-00 | | | 1 | | CABLE ASSEMBLY, power, 3 cond |
| 85 | 358-0161-00 | | | 1 | | BUSHING, strain relief |
| 86 | 103-0071-00 | | | 1 | | ADAPTER, strain relief |
| | - - - - - - | | | - | | mounting hardware: (not included w/adapter) |
| 87 | 212-0004-00 | | | 2 | | SCREW, 8-32 x 5/16 inch, PHS |
| 88 | 210-0458-00 | | | 2 | | NUT, keps, 8-32 x 11/32 inch |
| 89 | 358-0324-00 | | | 2 | | BUSHING, sleeve, plastic, 0.484 inch long |
| | - - - - - - | | | - | | mounting hardware for each: |
| | - - - - - - | | | - | | (not included w/bushing) |
| 90 | 213-0166-00 | | | 1 | | SCREW, thread forming, #6 |
| 91 | 124-0207-00 | | | 1 | | TERMINAL STRIP, ceramic, 2 double notched |
| 92 | - - - - - - | | | 2 | | DIODE, w/mounting hardware |
| 93 | 124-0145-00 | | | 6 | | STRIP, ceramic, 7/16 inch h, w/20 notches |
| | - - - - - - | | | - | | each strip includes: |
| | 355-0046-00 | | | 2 | | STUD, plastic |
| | - - - - - - | | | - | | mounting hardware for each: (not included |
| | - - - - - - | | | - | | w/strip) |
| | 361-0009-00 | | | 2 | | SPACER, plastic, 3/8 inch long |
| 94 | 124-0146-00 | | | 6 | | STRIP, ceramic, 7/16 inch h, w/16 notches |
| | - - - - - - | | | - | | each strip includes: |
| | 355-0046-00 | | | 2 | | STUD, plastic |
| | - - - - - - | | | - | | mounting hardware for each: (not included |
| | - - - - - - | | | - | | w/strip) |
| | 361-0009-00 | | | 2 | | SPACER, plastic, 3/8 inch long |
| 95 | 124-0147-00 | | | 2 | | STRIP, ceramic, 7/16 inch, w/13 notches |
| | - - - - - - | | | - | | each strip includes: |
| | 355-0046-00 | | | 2 | | STUD, plastic |
| | - - - - - - | | | - | | mounting hardware for each: (not included |
| | - - - - - - | | | - | | w/strip) |
| | 361-0009-00 | | | 2 | | SPACER, plastic, 3/8 inch long |

FIG. 2 CABINET



## FIG. 2 CABINET

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty 1 2 3 4 5 | Description |
|---|---|---|---|---|---|
| 2- | 437-0078-00 | | | 1 | CABINET |
| | - - - - - - | | | - | cabinet includes: |
| -1 | 386-0141-00 | | | 2 | PLATE, side |
| | - - - - - - | | | - | mounting hardware for each: |
| | - - - - - - | | | - | (not included w/plate) |
| -2 | 212-0002-00 | | | 2 | SCREW, 8-32 x 1/4 inch, FHS |
| -3 | 426-0253-00 | | | 1 | FRAME, front, left |
| -4 | 377-0121-00 | | | 1 | INSERT, frame, left |
| -5 | 426-0252-00 | | | 1 | FRAME, front, right |
| -6 | 377-0120-00 | | | 1 | INSERT, frame, right |
| -7 | 426-0254-00 | | | 1 | FRAME, front, bottom |
| | - - - - - - | | | - | mounting hardware: (not included w/frame) |
| -8 | 212-0004-00 | | | 2 | SCREW, 8-32 x 5/16 inch, PHS |
| -9 | 212-0002-00 | | | 2 | SCREW, 8-32 x 1/4 inch, FHS |
| -10 | 426-0255-00 | | | 1 | FRAME, front, top |
| | - - - - - - | | | - | mounting hardware: (not included w/frame) |
| -11 | 212-0002-00 | | | 4 | SCREW, 8-32 x 1/4 inch, FHS |
| -12 | 351-0093-00 | | | 1 | GUIDE, left |
| | - - - - - - | | | - | mounting hardware: (not included w/guide) |
| | 212-0023-00 | | | 1 | SCREW, 8-32 x 3/8 inch, PHS |
| -13 | 358-0293-01 | | | 1 | BUSHING, plug-in securing, left |
| | - - - - - - | | | - | mounting hardware: |
| | - - - - - - | | | - | (not included w/bushing) |
| | 211-0510-00 | | | 1 | SCREW, 6-32 x 3/8 inch, PHS |
| | 210-0005-00 | | | 1 | LOCKWASHER, external, #6 |
| | 212-0001-00 | | | 1 | SCREW, 8-32 x 1/4 inch, PHS |
| | 210-0007-00 | | | 1 | LOCKWASHER, external, #8 |
| -14 | 351-0092-00 | | | 1 | GUIDE, right |
| -15 | 358-0294-01 | | | 1 | BUSHING, plug-in securing, right |
| | - - - - - - | | | - | mounting hardware: |
| | - - - - - - | | | - | (not included w/bushing) |
| | 212-0001-00 | | | 1 | SCREW, 8-32 x 1/4 inch, PHS |
| | 210-0007-00 | | | 1 | LOCKWASHER, external, #8 |
| | 211-0510-00 | | | 1 | SCREW, 6-32 x 3/8 inch, PHS |
| | 210-0005-00 | | | 1 | LOCKWASHER, external, #6 |
| | 210-0457-00 | | | 1 | NUT, keps, 6-32 x 5/16 inch |

FIG. 2 CABINET (cont)

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty | 1 2 3 4 5 | Description |
|---|---|---|---|---|---|---|
| 2-16 | 348-0075-00 | | | 2 | | FOOT, rear guard, left and right |
| | - - - - - - | | | - | | mounting hardware for each: |
| | - - - - - - | | | - | | (not included w/foot) |
| -17 | 212-0004-00 | | | 2 | | SCREW, 8-32 x 5/16 inch, PHS |
| -18 | 386-0139-00 | | | 1 | | PLATE, rear |
| -19 | 386-0138-00 | | | 1 | | PLATE, top |
| -20 | 386-0140-00 | | | 1 | | PLATE, bottom |
| -21 | 348-0073-00 | | | 2 | | FOOT, left front and right rear |
| | - - - - - - | | | - | | mounting hardware for each: |
| | - - - - - - | | | - | | (not included w/foot) |
| -22 | 211-0532-00 | | | 2 | | SCREW, 6-32 x 3/4 inch, FIL HS |
| -23 | 348-0074-00 | | | 2 | | FOOT, right front and left rear |
| | - - - - - - | | | - | | mounting hardware for each: |
| | - - - - - - | | | - | | (not included w/foot) |
| -24 | 211-0532-00 | | | 2 | | SCREW, 6-32 x 3/4 inch, FIL HS |
| -25 | 210-0457-00 | | | 2 | | NUT, keps, 6-32 x 5/16 inch |
| -26 | 377-0119-00 | | | 4 | | INSERT, foot |
| -27 | 348-0072-00 | | | 1 | | FOOT, flip-stand bail |
| -28 | 377-0123-00 | | | 1 | | INSERT, pivot, left |
| -29 | 367-0051-00 | | | 1 | | PIVOT, handle, left |
| -30 | 367-0052-00 | | | 1 | | HANDLE |
| | - - - - - - | | | - | | mounting hardware: (not included w/handle) |
| -31 | 212-0040-00 | | | 2 | | SCREW, 8-32 x 3/8 inch, FHS |
| -32 | 377-0122-00 | | | 1 | | INSERT, pivot, right |
| -33 | 367-0050-00 | | | 1 | | PIVOT, handle, right |
| -34 | 214-0054-00 | | | 2 | | BOLT, hinge |
| -35 | 214-0558-00 | | | 2 | | WASHER, thrust, 5/16 ID x 1/2 inch OD |
| | | | | | | STANDARD ACCESSORIES |
| | 062-1105-00 | | | 2 | | MANUAL, instruction (not shown) |

# FACTORY CALIBRATION PROCEDURE

CONTENTS:

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

Equipment Required

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

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

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

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

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

*This procedure is company confidential*

TYPE 067-0502-01

For all serial numbers.

CHANGE INFORMATION:

This procedure has been prepared by Test-Final Staff Engineering. For information on changes made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact T-FSE, 39-307.

## EQUIPMENT REQUIRED

All TEKTRONIX test equipment must be calibrated to Factory Test Limits using methods specified in the applicable TEKTRONIX Factory Calibration Procedure. Other test equipment should be calibrated to its manufacturer's specifications. Exceptions to calibration procedures, which are necessary to improve the measurement capability of some test equipment, e.g. calibrated to ±0.5% accuracy at some specific setting, are noted on this Equipment Required List.

Equivalent test equipment may be used. A Test-Final Staff Engineer must approve any substitutions.

*a. TEKTRONIX Instruments*

1 TYPE 545B OSCILLOSCOPE
1 TYPE 1A6 DIFFERENTIAL AMPLIFIER
1 TYPE TU76 LINE VOLTAGE CONTROL UNIT

*b. Test Fixtures and Accessories*

1 STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-01)
1 DC VOLTAGE BRIDGE (067-0543-99)
1 50Ω Termination (011-0049-00)
1 50Ω BNC Cable 42" (012-0193-00)
1 P6011 X1 Probe BNC (010-0193-00)
1 P6021 Current Probe (015-0140-00) with Termination

*c. Other Equipment*

1 20,000Ω/VDC Multimeter
1 John Fluke Differential Voltmeter, Model 825A
(or equivalent model accurate to 0.025%)

Factory Test Limits are qualified by the conditions specified in the main body of the Factory Calibration Procedure. The numbers and letters to the left of the limits correspond to the procedure steps where the check or adjustment is made. Steps without Factory Test Limits (setups, presets, etc.) are not listed. Instruments may not meet Factory Test Limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

## 3. POWER SUPPLIES

a. Supplies:

| Supply | Tolerance |
|---|---|
| +300V (FL) | ±2% |
| +125V (FL) | ±10% |
| +100V (FL) | ±0.1% |
| -100V | ±2% |
| +100V | (93V to 107V) |

b. Ripple

| Supply | MAX RIPPLE (mV P-P) |
|---|---|
| +300V (FL) | 15 |
| +125V (FL) | 5 |
| +100V (FL) | 2 |
| -100V | 2 |
| +100V | 30 |

## 4. OUTPUT SIGNALS

a. Squarewave output:
Frequency 1kHz ±20%
Duty Cycle 45 to 55%

b. CHOPPED:
Proper operation

## 5. 5mA⊓⊔ CURRENT LOOP

Squarewave present

## 6. AMPLITUDE SUPPLY

b. +100VDC ±0.1%
c. Line Voltage Drift:
±4mV, From 106 to 126 VAC
d. -100VDC ±0.1%

## 7. VOLTAGE DIVIDER

Voltage at all settings of AMPLITUDE Selector from 100V through 0.1V must be within ±0.1% of panel markings. In addition, the algebraic sum of the error on the 0.1V range and the worst error on any other range from 100V through 0.2V must not exceed 0.15%.

## 8. LOW AMPLITUDE COMPENSATION

b. Compensation (C142): Aberrations; +0%, -5%, or less

## 9. SQUAREWAVE RISETIME ≤10μs

THE END

This instrument must meet Factory Test Limits before it leaves Manufacturing; therefore, it must be possible to inspect to these limits. Because of normal variations in test equipment and plug-in scopes, addition of side panels, etc, this procedure may require that some checks and adjustments be made so that performance is better than that required by Factory Test Limits.

## 1. PRELIMINARY INSPECTION

a. Install Current Modifications
b. Check fuse: 0.8amp slo-blo (159-0018-00)

## 2. RESISTANCE CHECKS

a. Check Chassis-ground isolating diodes
b. Check resistance of power supply output:

| Supply | Scale | Resistance |
|---|---|---|
| +300V (FL) | 1K | 14KΩ |
| +125V (FL) | 1K | 16KΩ |
| +100V (FL) | 1K | 10KΩ |
| -100V | 1K | 5KΩ |
| +100V | 10K | 110KΩ |

## 3. POWER SUPPLIES

a. Adjust Supplies

| Supply | ADJUST |
|---|---|
| +300V (FL) | R421 |
| +125V (FL) | R441 |
| +100V (FL) | R451 |
| -100V | R361 |
| +100V | check (93 to 107V) |

b. Ripple:

| Supply | Max Ripple (mV P-P) |
|---|---|
| +300V (FL) | 15 |
| +125V (FL) | 5 |
| +100V (FL) | 2 |
| -100V | 2 |
| +100V | 30 |

## 4. OUTPUT SIGNALS

a. Squarewave output:
Frequency 1kHz ±20%
Duty Cycle 45 to 55%
b. Check CHOPPED operation
c. Check EXT REF INPUT
d. Check UNKNOWN INPUT

## 5. 5mA⎍⎍ CURRENT LOOP

## 6. AMPLITUDE Supply

a. Setup
b. Adjust +100VDC (R451) within 10mV:
c. Line Voltage Drift: ±4mV
d. Check -100VDC

## 7. VOLTAGE DIVIDER

Voltage at all settings of AMPLITUDE Selector from 100V through 0.1V must be within ±0.1% of panel markings. In addition, the algebraic sum of the error on the 0.1V range and the worst error on any other range from 100V through 0.2V must not exceed 0.15%.

## 8. LOW AMPLITUDE COMPENSATION

a. Setup
b. Adjust Compensation C142:
Aberrations; +0, -5% or less

## 9. SQUAREWAVE RISETIME ≤10μs

THE END

## 1. PRELIMINARY INSPECTION

*a. Install Current Modifications*

*b. Check fuse: 0.8amp slo-blo (159-0018-00)*

## 2. RESISTANCE CHECKS

Chassis-ground isolating diodes: Connect multimeter leads between green wire (on D300 & D301) and ground. Resistance should read about 250Ω on the 100Ω scale. Reverse leads and again read about 250Ω. The following resistance checks were made with the neg lead (- of the ohms scale battery) connected to gnd.

| Supply | Scale | Resistance | Location |
|---|---|---|---|
| +300V(FL) | 1K | 14K | V427 pin 2 |
| +125V(FL) | 1K | 16K | Q447 collector |
| +100V(FL) | 1K | 10K | Q467 emitter |
| -100V | 1K | 5K | C352 (-) |
| +100V | 10K | 110K | D347 cathode |

## 3. POWER SUPPLIES

*a. Adjust Supplies:*

Apply power. Set Output Selector switch to output (up) and MODE to +DC. Connect a DCVB to the appropriate supply and adjust in the following order:

| Supply | Location | Adjust |
|---|---|---|
| +300(FL) | V427 pin 2 | R421 |
| +125(FL) | Q447 collector | R441 |
| +100(FL) | Q467 emitter | R451 (APPROX) |
| -100(FL) | C352 (-) | R261 |
| +100(FL) | D347 (cathode) | (check 93V to 107V) |

*b. Ripple:*

Set the TYPE 1A6 +INPUT to AC and the -INPUT to GND. Connect a X1 probe from the TYPE 1A6 to the appropriate supply. Set the test scope to Line Trigger and TIME/DIV to 5ms. Check ripple while varying line voltage between 104 and 126VAC.

3b. (Cont.)

| Supply | Max Ripple (P-P mV) | TYPE 1A6 VOLT/CM |
|---|---|---|
| +300V(FL) | 15 | 5mV |
| +125V(FL) | 5 | 1mV |
| +100V(FL) | 2 | 1mV |
| -100V | 2 | 1mV |
| +100V | 30 | 5mV |

Return Line Voltage to 117V.

## 4. MODE OPERATION

*a. Squarewave output:*
*Frequency 1kHz ±20%*
*Duty Cycle 45 to 55%*

Change TYPE 1A6 VOLTS/CM to 1mV and test scope to .2mS/CM. Set 067-0502-01 (SAC) AMPLITUDE switch to 0.2mV and MODE to ⎍. Connect the OUTPUT of the SAC through a 50 BNC cable to the TYPE 1A6 + INPUT. Check for (approximately) correct squarewave output at all AMPLITUDE switch settings; (change the TYPE 1A6 VOLTS/CM switch to maintain display at a convenient amplitude). Check for 1 cycle squarewave every 5cm, ±1cm (1kHz ±20%). Change test scope to 50μS/cm and adjust VARIABLE for 1 cycle in 10cm. Check that positive half cycle is 4.5 to 5.5cm long, (duty cycle 45 to 55%). Return variable to CALIBRATED and TIME/CM to 5ms.

*b. Check CHOPPED operation*

Change the Output Selector switch to CHOPPED. Check for a symmetrical and "clean" 60Hz squarewave with MODE switch at +DC and -DC. Change SAC AMPLITUDE to 5mV and TYPE 1A6 VOLTS/CM to 1mV. Place a 50Ω term on the UNKNOWN INPUT and check for a clean squarewave with very little tilt.

Remove 50Ω termination.

*c. Check EXT REF INPUT*

Return the Output Selector switch to OUTPUT (up) and apply a 5mV squarewave to the EXT REF INPUT from another SAC. Change the MODE switch to EXT REF and check for a 5mV signal on the test scope.

4. (Cont.)

*d. Check UNKNOWN INPUT*

Remove 5mV signal from EXT REF and apply to UNKNOWN INPUT. Change the output selector switch to UNKNOWN INPUT (down) and check for a 5mV signal on the test scope.

## 5. 5mA ⎍ CURRENT LOOP

Connect the P6021 Probe and Termination to the TYPE 1A6 + INPUT. Set the termination to 10mA/mV and the VOLTS/CM to 1mV. Change the SAC AMPLITUDE to 5mA ⎍. Connect the current probe to the 5mA current loop on the SAC. Check for approximately 0.5cm of signal.

## 6. AMPLITUDE Supply

*a. Setup*

Install the SAC into the case and allow temperature to stabilize for 10 minutes. Set AMPLITUDE to 100V and MODE to +DC. Connect a 1mΩ, ½w, 1% resistor across the binding posts of the John Fluke Voltmeter. Connect the OUTPUT of the SAC to the John Fluke Voltmeter.

The John Fluke Voltmeter should be allowed to warm up at least 30 minutes before use.

Set the John Fluke Voltmeter as follows:

| | |
|---|---|
| RANGE | 500 |
| + - sw | + |
| A | 1 |
| B | 0 |
| C | 0 |
| D | 0 |
| E | 0 |
| NULL | 10 |

check - CALIBRATE

*b. Adjust +100VDC (R451) within 10mV:*

Adjust R451 to "0" on the voltmeter, access hole for this adjustment is located on the right side of the case. Change NULL to 1 and adjust for "0" again. Change NULL to .1 and adjust for "0". Change NULL to .01 and adjust as close to "0" as possible.

The +100V should stay within 10mV for 5 to 10 minutes and the drift that occurs should be slow and smooth. If not; the supply may drift out of Limits after it has been run for a long period of time.

6. (Cont.)

*c. Line Voltage drift: ±4mV*

Change the line voltage from 104VAC to 126VAC and check that the +100V changes less than ±4mV. Return line voltage to 117V.

*d. Check -100V*

Change NULL to VTVM and +, - switch to -. Change the SAC MODE switch to -DC. Return the NULL to .01 and check for -100V ±0.1%.

Typically the -100V should be within 10mV of the +100V. If not; the -100V or +100V, may not stay within limits.

## 7. VOLTAGE DIVIDER

Measure and record the output voltage at all settings of the AMPLITUDE switch from 100V through 0.1V. Indicated voltage must be within ±0.1% of panel markings. In addition, the algebraic sum of the error on the 0.1V range and the worst error on any range from 100V through 0.2V must not exceed 0.15%.

Check the tolerance of each range according to the following table:

| AMPLITUDE switch setting | ±0.1% tolerance | ±0.1% tolerance voltage limits low | high |
|---|---|---|---|
| 100 V | ±100 mV | Set to ±10 mV | |
| 50 V | ±50 mV | 49.950 | 50.050 (read last digit on meter) |
| 20 V | ±20 mV | 19.980 | 20.020 |
| 10 V | ±10 mV | 9.990 | 10.010 |
| 5 V | ±5 mV | 4.9950 | 5.0050 (read last digit on meter) |
| 2 V | ±2 mV | 1.9980 | 2.0020 |
| 1 V | ±1 mV | 0.9990 | 1.0010 |
| 0.5 V | ±0.5 mV | 0.49950 | 0.50050 (read last digit on meter) |
| 0.2 V | ±0.2 mV | 0.19980 | 0.20020 |
| 0.1 V | ±0.1 mV | 0.09990 | 0.10010 |

## 8. LOW AMPLITUDE COMPENSATION

*a. Setup*

Change MODE to ⌐L⌋ and connect OUTPUT to the TYPE 1A6 + INPUT. Change the coupling to DC and VOLTS/CM to 20mVOLTS. Set sweep speed to 1mS/CM.

*b. Adjust Compensation C142; aberrations: +0%, -5% or less*

Adjust C142 for fastest risetime with no overshoot. Check aberrations: +0%, -5% or less.

## 9. SQUAREWAVE RISETIME

With AMPLITUDE set at .1V, check test scope for a risetime of ≤10μs. Change the AMPLITUDE to 100V and check for a risetime of ≤10μs. Remove BNC cable.

THE END