

# HIGH VOLTAGE AMPLIFIER

Models:

2340

2350

Single Channel High Voltage Amplifier

Dual Channel High Voltage Amplifier



## Operation Manual

rev CB



Manual Part Number: 810044-CD, Rev. CB

Published November 2022, Geneva, OH

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### This Manual

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10 TEGAM Way

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### Compliance

 **FCC Notice:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### Safety Notice Symbols and Terms

Safety Notices denote hazards. They indicate an operating procedure, instruction, or practice that, if not correctly performed or followed, could result in damage to equipment, or injury or death to personnel. Do not proceed beyond a Safety Notice until all conditions and instructions are fully understood and complied with.

### Safety Notices Symbols:



**WARNING** denotes an imminent hazard that *could* result in injury to personnel or death.



**CAUTION** denotes a hazard that *could* result in damage to the unit or other equipment.



**REMINDER** denotes important information about instrument functions, menus, and measurements.

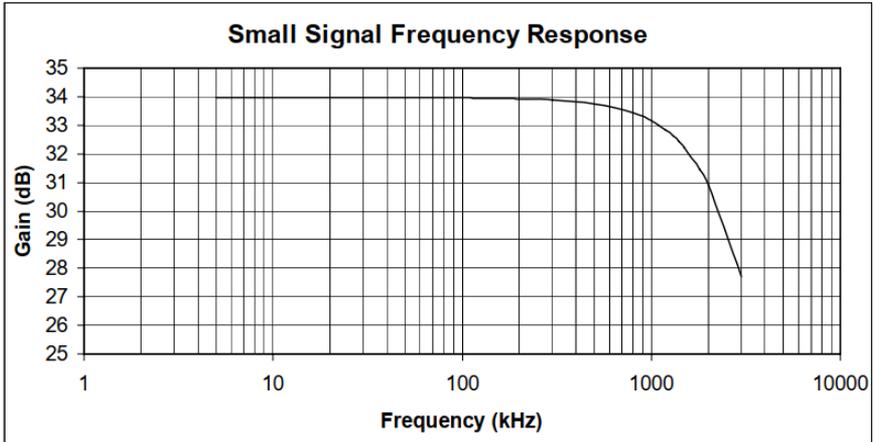
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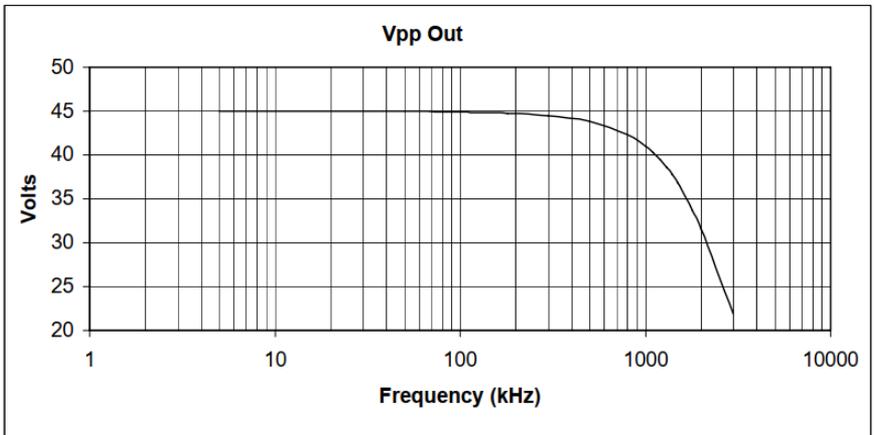
## 1. INSTRUMENT DESCRIPTION

### 1.1 Specifications

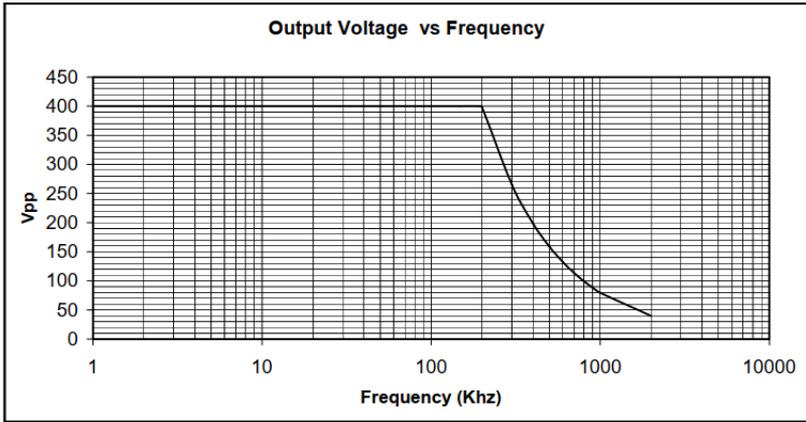
<b>GENERAL SPECIFICATIONS:</b>		
<b>Recommended Calibration Cycle</b>	1 Year	
<b>Electrical Specifications:</b>		
<b>Number of Channels</b>	1 (2340) or 2 (2350)	
<b>Input Impedance</b>	50Ω Direct Coupled	
<b>Output Voltage Range</b>	0 to ±200V Direct Coupled	
<b>Maximum Output Current</b>	40mA per Channel	
<b>Output Impedance</b>	<0.2Ω	
<b>Voltage Gain</b>	+50 Fixed (Standard Unit)	
<b>Sine Wave Distortion (THD)</b>	Refer to Figure 4	
<b>Small Signal Bandwidth</b>	DC to 2MHz -Typical (-3dB) Refer to Figure 1	
<b>Full Power</b>	200kHz/400 Vpp Sine (-0.1dB) (C <sub>L</sub> <200pF)	
<b>Slew Rate</b>	250V/uSec	
<b>Square Wave Response Aberrations</b>	<0.2 uSec foor 200 Volt Step <2%	
<b>50Ω Voltage Monitor Outputs (one per channel)</b>	50Ω Input Z (200:1 Ratio) > 1MΩ Input Z (100:1 ratio)	
<b>Safety</b>	Conforms with IEC 61010-1, CE Marked	
<b>ENVIRONMENT:</b>		
<b>Operating Temp</b>	0 to 45°C	32 to 113°F
<b>Humidity</b>	<80% RH Non-Condensing	
<b>Storage Temp</b>	-20 to 50°C	-4 to 122°F
<b>PHYSICAL CHARACTERISTICS:</b>		
<b>Dimensions</b>	193 x 84 x 28 mm	7.6 x 3.3 x 1.1 in
<b>Weight (incl. batteries)</b>	303.2 g	10.7 oz
<b>Input Supply Voltage</b>	110/220 50/60 Hz Rear Panel Selectable	
<b>Power Rating</b>	100 VA; 80W	



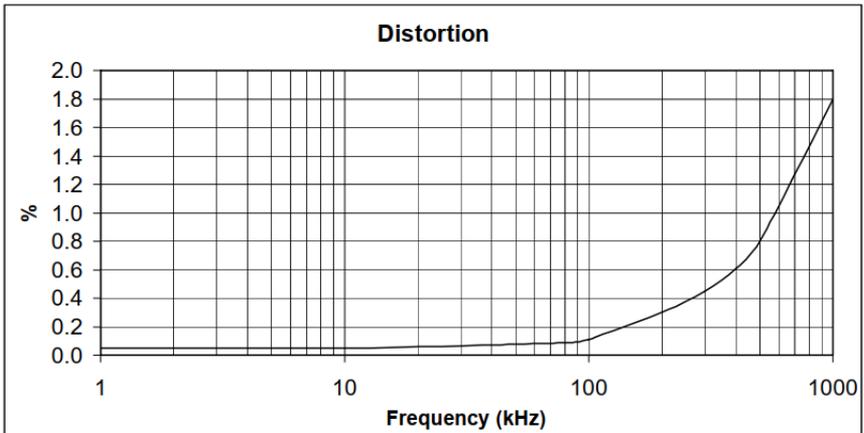
**Figure 1: Small Signal Frequency Response (Typical)**  
 Amplifier Gain measured with 900 mV peak-to-peak input.  
 Amplifier Frequency Response (-3 dB) at 2 MHz.



**Figure 2: Small Signal Frequency Response (Typical)**  
 Amplifier Gain measured with 900 mV peak-to-peak input.  
 Same as Figure 1 but Y-axis is Volts instead of dB



**Figure 3: Maximum Voltage Out vs. Frequency**  
 2340/2350 amplifier's maximum V<sub>p-p</sub> output roll off with frequency.  
 The limitation is due to the amplifier's slew rate of 250 V/μSec



**Figure 4: Distortion (Typical)**  
 Distortion measurements made with the amplifier operating at 75% of the maximum V<sub>p-p</sub> output obtained from Figure 3

## 2. PREPARATION FOR USE

### 2.1 General Information

The Model 2340-Single channel-/2350-Dual Channel- Amplifier

### 2.2 Safety Notices and Information

Read this Operation Manual thoroughly before using the instrument to become familiar with its operations and capabilities.

Visually inspect instrument before using. Do not use if unit appears damaged or with any part of the case removed.



**WARNING**

MAINTENANCE INSTRUCTIONS WITHIN THIS MANUAL ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. DO NOT ATTEMPT TO SERVICE THIS UNIT UNLESS YOU ARE QUALIFIED TO DO SO.

#### SHOCK HAZARD

**Do not use this product ungrounded.**

Insure that the power cord is plugged into a properly wired receptacle before using this instrument.

**Do not use this product without covers.**

**Do not Modify connections or configurations.**

#### EXPLOSION HAZARD

**Never use or store this product in an environment where explosive or flammable vapors or dust suspensions may exist.**

#### FIRE HAZARD

**Only power using line voltage of selected power rating.**

**Only use correct fuse for selected power rating.**

## 2.3 Unpacking and Inspection

Each 2340/2350 is put through a series of electrical and mechanical inspections before shipment to the customer. Upon receipt of your instrument unpack all of the items from the shipping carton and inspect for any damage that may have occurred during transit. Report any damaged items to the shipping agent. Retain and use the original packing material for reshipment if necessary.

If any dents, broken, or loose parts are seen, do not use the equipment. Notify TEGAM immediately.

Check that all items are present. If any items are missing, notify TEGAM immediately.

The following items are included with every new instrument:

One (1) Model 2340/2350 Voltage Amplifier

One (1) Model 2340/2350 User's Manual, P/N 810044-CD

One (1) Power Cord, P/N 600014 X 1

One (1) High Voltage BNC to BNC cables (3ft) with a 2340 or Two (2) with a 2350

### 3. OPERATING INSTRUCTIONS

#### 3.1 Intended Use

The Model 2340/2350 Amplifier is a two-channel, high voltage amplifier capable of both sourcing and sinking current for a variety of loads including resistive and reactive loads. It was specifically designed for applications that require the output voltage range of standard signal or function generators to be extended beyond their typical range to  $\pm 200\text{V}$ . The 2340/2350 amplifier is compatible with virtually all types of signal and function generators.

#### 3.2 Monitor Outputs

Each main output is accompanied by a monitor output. The monitor output is designed to provide an accurate, low-voltage representation of the amplifier output at a scale of 100:1 when feeding into a  $1\text{M}\Omega$  input and of 200:1 when feeding into a  $50\Omega$  input. The basic 2340/2350 amplifier gain is set to +50 with no inversion.

#### 3.3 Voltage & Current Limitations

It should be noted that the maximum input of the 2340/2350 amplifier should not exceed  $\pm 4\text{V}$ . This would cause the output signal to exceed  $\pm 200\text{V}$  causing the output signal to clip resulting in severe distortion. The amplifier is protected in all operating modes with current limiting in either positive or negative directions. The maximum operating current of each output is rated for 40mA.

#### 3.4 Frequency Characteristics

The 2340/2350 is capable of amplifying small signals from DC to 2MHz. The bandwidth of any amplifier decreases as the output amplitude approaches the instrument's maximum limits. There are several figures in the specification section of this manual that illustrate the frequency response, amplitude, output power and distortion characteristics of the 2340/2350. Included in these figures is a distortion versus frequency curve where the instrument's output is set to 75% of maximum amplitude (300Vp-p). Notice the steep frequency roll off when the amplifier's signal approaches its slew limitations. The 2340/2350 has a full power bandwidth that exceeds 200kHz.

#### 3.5 Protection Circuits

The 2340/2350 amplifier has a LINE POWER switch and a power indicator on the front panel. The power indicator will illuminate when the high voltage DC supply is connected to the output power amplifiers. Under normal operation, the power indicator will illuminate approximately 2 seconds after the LINE POWER switch is turned on. However, if a high voltage DC fault occurs, the power supply monitor will protect the power amplifiers by disconnecting the high voltage supply from the output amplifiers. This will cause the power indicator to shut off. The fault will latch and the power indicator will remain off until the AC power is cycled to reset the fault. The 2340/2350 also has a current limit function to protect the outputs against short circuits etc.

### 3.6 Connections

The amplifier's inputs require standard BNC connections and have an impedance of  $50\Omega$ . This makes it compatible with all TEGAM-Pragmatic or other conventional signal generators. The output is specified at less than  $.2\Omega$ . Two output cables are supplied with the 2340/2350. These are special cables, which have high-voltage BNC connectors on one end and standard BNC connectors on the other. The cables are designed for use with the high voltage output connectors on the front panel. There is a binding post available on the instrument's front panel to be used as a direct connection to the instrument's chassis. The monitor outputs may be connected using any standard type BNC to BNC cables to an oscilloscope, A/D card or other compatible monitoring device.

## 4. SERVICE INFORMATION

### 4.1 Inspection and Cleaning

The cooling fan is designed for continuous operation. Periodically check the fan to make sure that airflow is not impeded and that there is adequate ventilation to keep the instrument cool.

TEGAM recommends that the 2340/2350 be calibrated and routine functional checks be performed on a regular basis. The recommended interval is every twelve months. The actual interval is dependent upon the application and is determined by your company's Quality Assurance policy.

**CAUTION**

Servicing and calibration must be done by qualified service personnel.

**WARNING**

When disassembling the Amplifier for calibration, turn power OFF and disconnect the power cord from the AC power source.

## 4.2 Calibration

### 4.2.1 Alignment Procedure

Preparation

**Required Equipment:**

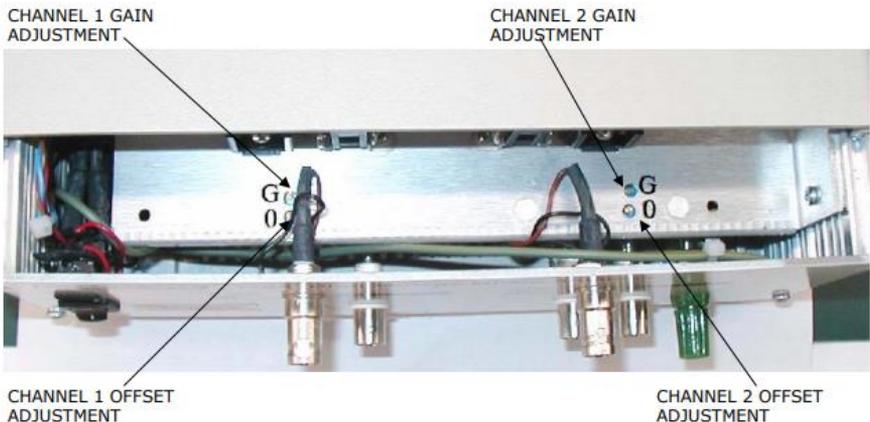
Function Generator

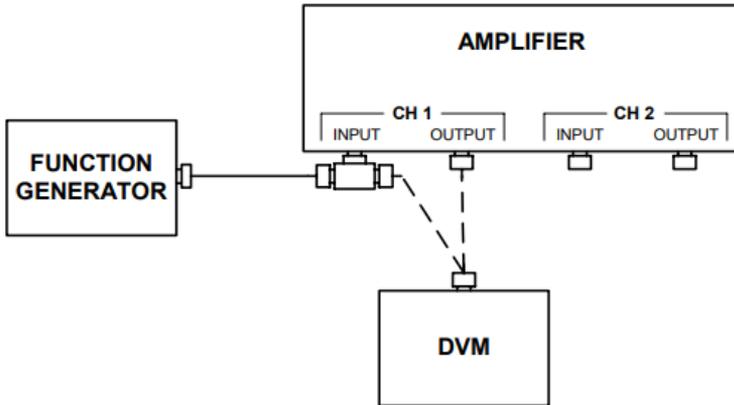
Fluke 8842A – 5 1/2 digit Digital Multimeter or equivalent

50Ω BNC Splitter

1. Remove the Amplifier's front and back bezels by pulling out on the left or right side to release the plastic from the metal sub panel. Rotate the released edge away from the panel 1 to 2 inches and move the bezel toward unreleased side and remove.
2. Remove the 2 top and 2 bottom sheet metal screws from the 4 corners of the rear panel.
3. Remove the 2 sheet metal screws from the 2 top corners of the front panel.
4. Carefully slide the rear panel out far enough so that the top cover can be grasped. Then slide the top cover back 3 to 4 inches so the offset and gain access hole adjustments at the front on the unit are visible. Refer to Figure 1.
5. Before connecting the power cord to the Amplifier verify that all wiring is routed away from metal surfaces.

**Figure 1 – Power Amplifier Gain/Offset Adjustments**



**Figure 2 – Power Amplifier Gain/Offset Setup**


6. Turn the 2340/2350 power ON and allow for the 2340/2350 to warm up for at least 15 minutes.
7. Verify that no instruments are connected to the Channel 1 or Channel 2 (2350 only) inputs.
8. Connect the DVM to Channel 1 OUTPUT and adjust the Channel 1 OFFSET potentiometer to  $0.0 \pm 5$  mVDC.
9. Apply a 4 V<sub>pp</sub> (1.414 V<sub>rms</sub>), 10 kHz, Sine wave to Channel 1 INPUT (with a BNC T-connector). Measure and [RECORD] the AC voltage with the DVM connected to the other end of the T-connector. Refer to Figure 2.
10. Multiply the recorded voltage from Step 9 by 50 and [RECORD].
11. Connect the DVM to Channel 1 OUTPUT and adjust Channel 1 GAIN potentiometer for the recorded voltage from Step 10  $\pm 0.2$  V<sub>rms</sub>.
12. If a dual channel amplifier is being calibrated, repeat Steps 7 through 11 for Channel 2.
13. Turn power OFF and disconnect the power cord from the AC power source.
14. Assemble the unit in the reverse order of disassembly.

### 4.3 Preparation for Calibration or Repair Service

Once you have verified that the cause of the malfunction cannot be solved in the field and the need for repair and calibration service arises, contact TEGAM customer service to obtain an RMA (Returned Material Authorization) number. You can contact TEGAM customer service via the TEGAM website ([www.tegam.com](http://www.tegam.com)) or by calling 440-466-6100 (*All Locations*) or 800-666-1010 (*United States Only*).

The RMA number is unique to your instrument and will help us identify your instrument and to address the particular service request by you which is assigned to that RMA number.

Of even greater importance, a detailed written description of the problem should be attached to the instrument. Many times repair turnaround is unnecessarily delayed due to a lack of repair instructions or a detailed description of the problem.

This description should include information such as measurement range and other instrument settings at the time of the malfunction, type of components being tested, frequency of the symptoms (intermittent or continuous), conditions that may cause the symptoms, changes to the test setup or operating environment that may affect the instrument, etc. Any detailed information provided to our technicians will assist them in identifying and correcting the problem in the quickest possible manner. Use a copy of the Repair and Calibration Service form provided on the next page.

Once this information is prepared and sent with the instrument to our service department, we will do our part to make sure that you receive the best possible customer service and turnaround time possible.



### 4.4 Expedite Repair & Calibration Form

Use this form to provide additional repair information and service instructions. The completion of this form and including it with your instrument will expedite the processing and repair process.

RMA#:		Instrument Model #:	
Serial Number:		Company:	
Technical Contact:		Phone Number:	
Additional Contact Info:			

#### Service Instructions:

- Evaluation                       Calibration Only       Repair Only
- Repair & Calibration       ISO 17025 Calibration with Data

#### Detailed Symptoms:

Include information such as measurement range, instrument settings, type of components being tested, is the problem intermittent? When is the problem most frequent? Has anything changed with the application since the last time the instrument was used, etc.?


## 4.5 Warranty

TEGAM, Inc. warrants this product to be free from defects in material and workmanship for a period of one (1) year from the date of shipment. During this warranty period, if a product proves to be defective, TEGAM Inc., at its option, will either repair the defective product without charge for parts and labor, or exchange any product that proves to be defective.

TEGAM, Inc. warrants the calibration of this product for a period of 6 months from date of shipment. During this period, TEGAM, Inc. will recalibrate any product which does not conform to the published accuracy specifications.

In order to exercise this warranty, TEGAM, Inc., must be notified of the defective product before the expiration of the warranty period. The customer shall be responsible for packaging and shipping the product to the designated TEGAM service center with shipping charges prepaid. TEGAM Inc. shall pay for the return of the product to the customer if the shipment is to a location within the country in which the TEGAM service center is located. The customer shall be responsible for paying all shipping, duties, taxes, and additional costs if the product is transported to any other locations. Repaired products are warranted for the remaining balance of the original warranty, or 90 days, whichever is greater.

## 4.6 Warranty Limitations

The TEGAM, Inc. warranty does not apply to defects resulting from unauthorized modification or misuse of the product or any part. This warranty does not apply to fuses, batteries, or damage to the instrument caused by battery leakage.

The foregoing warranty of TEGAM is in lieu of all other warranties, expressed or implied. TEGAM specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. In no event will TEGAM be liable for special or consequential damages. Purchaser's sole and exclusive remedy in the event any item fails to comply with the foregoing express warranty of TEGAM shall be to return the item to TEGAM; shipping charges prepaid and at the option of TEGAM obtain a replacement item or a refund of the purchase price.



#### 4.7 Statement of Calibration

This instrument has been inspected and tested in accordance with specifications published by TEGAM, Inc.

TEGAM, Inc. certifies the above listed instrument has been inspected and calibrated and meets or exceeds all published specifications and has been calibrated using standards whose accuracies are traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST) or other recognized National Metrology Institute.

**TEGAM**

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