

## *Evaluation Kit*

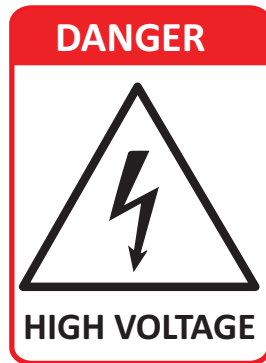
### **APPLICABLE PARTS (SOLD SEPARATELY)**

- PA99 Power Amplifier

### **INTRODUCTION**

This high-voltage Evaluation kit provides a robust PCB with ideal circuit layout and grounding in order to evaluate the Apex PA99 linear power operational amplifier. With its high-voltage, modest package size, and thermal sensing capabilities, the PA99 includes many considerations in its evaluation board. This ruggedized testing platform utilizes many design techniques that make it easy to analyze the PA99 under a wide variety of conditions. All necessary components (except DUT) are included in the kit.

This evaluation kit provides flexibility for modifying gain in both inverting and non-inverting mode, as well as for use as a differential amplifier. There are also options for stability considerations such as isolation resistors, R-C snubber networks, feedback capacitors, noise gain compensation, and compensation capacitors.



The non-insulated high Voltages that are present when operating the evaluation kit constitute a risk of electric shock, personal injury, death and/or ignition of fire.

The evaluation kit is intended for evaluation purposes only. It shall only be operated in a designated, fully protected test area by personnel qualified according to local requirements and labor laws to work with high-voltage circuits. It shall never be operated unattended.

Figure 1: EK Schematic

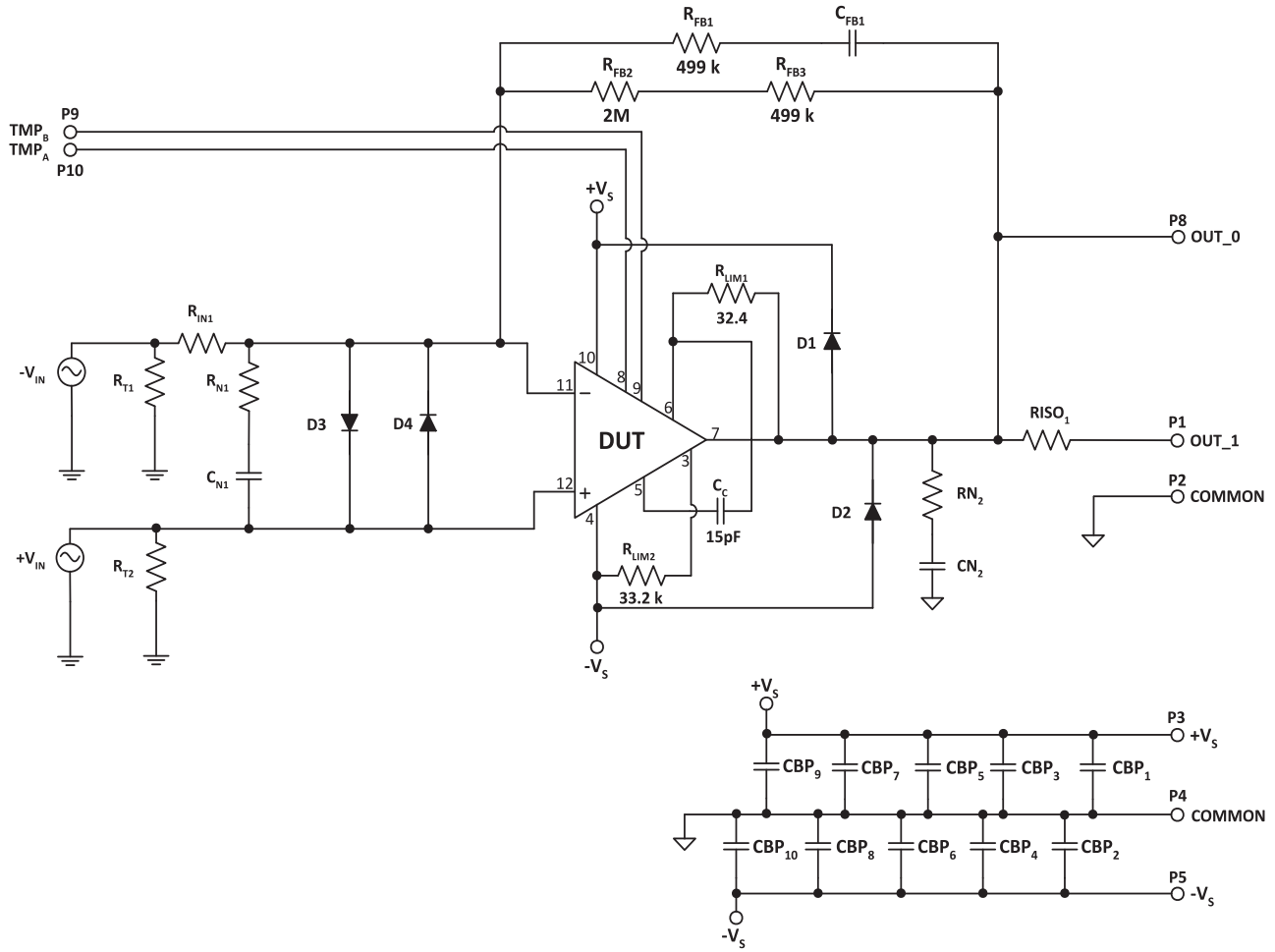
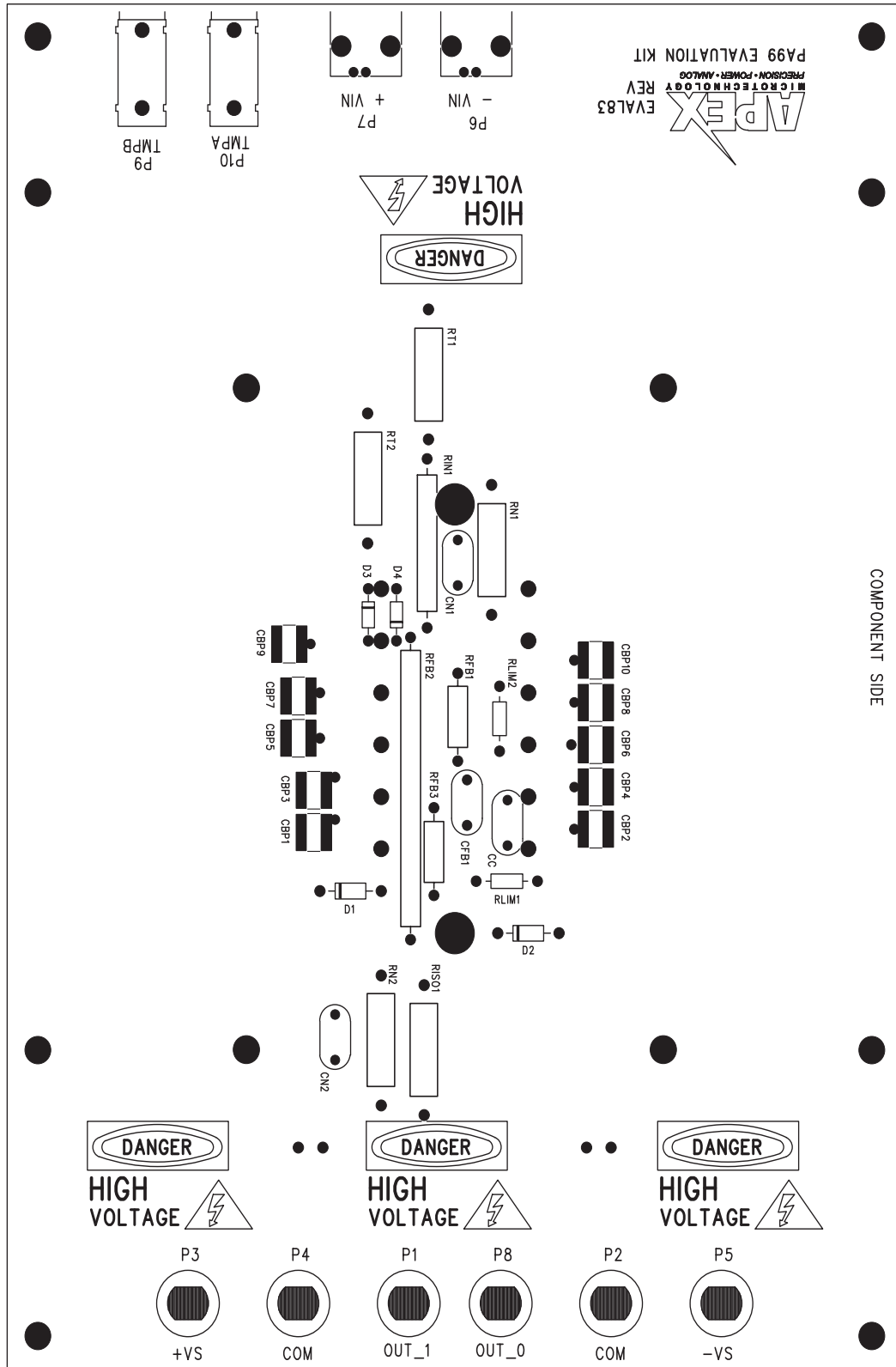


Figure 2: Board Layout



## PARTS LIST

Reference	Manufacturer Part #	Description	QTY
<b><u>Resistors</u></b>			
RT1, RT2	PR03000205109JAC00	51 Ω, 3 W, 5%	2
RLIM1	MFR-25F52-32R4	32.4 Ω, 1/4W, 1%	1
RLIM2	MFR-25F52-33K2	33.2 kΩ, 1/4W, 1%	1
RFB2	RNX2002M00FKEL	2 MΩ, 5 W, 1%	1
RIN1	CMF5510K000FKEA	10 kΩ, 2.5 W, 1%	1
<b><u>Printed Circuit Boards</u></b>			
EVAL 83	EVAL 83	Printed Circuit Board	1
<b><u>Capacitors</u></b>			
CBP-1 TO CBP-10	2225WC223KAT1A	0.022 uF, 2.5 kV	10
CC	CC45SL3FD100JY	15 pF, 6kV	1
<b><u>Diodes</u></b>			
D3, D4	1N4148	Switching Diode	2
D1, D2	GP02-30-E3/54	Rectifier, 3kV	2
<b><u>Hardware</u></b>			
	HS34	Heat Sink	1
	TW21	Thermal Washer (Pack of 5 Pcs)	1
	0284-0-15-15-16-27-10-0	Cage Jacks	12
	146510CJ	BNC Connector, Pc Mount	2
	571-0100	Horizontal Banana Jack	2
	108-0903-001	Vertical Banana Jack	6
	91735A192	Screw, Panhead, #8-32 X 0.375"	4
	2221	Standoff, 0.25" Hex, AL, #8-32 X 2"	4
	91841A009	Nut, Hex #8-32	4
	91735A151	Screw, Panhead, #6-32 X 0.75"	2
	91841A007	Nut, Hex #6-32	2
	90272A197	Screw, Panhead, #8-32 X 0.75"	4
	99492A003	Spacer, Hex, Un-Threaded, #8 X 3/16"	4
	TFT20024 NA005	Tubing, Teflon, #24 AWG, 6"	1

## BEFORE YOU GET STARTED

- Please refer to Application Note, AN01 for general operating conditions.
- All Apex Microtechnology amplifiers should be handled using proper ESD precautions.
- Always use the heat sink and thermal washer included in this kit.
- Do not change the connections while the circuit is powered.
- Initially set all power supplies to the minimum operations levels allowed in the device data sheet.
- Check for oscillations after initial power up of board.

## ASSEMBLY

During the assembly, please refer to the circuit schematics, assembly drawings, and the data sheet of the part being used on the evaluation kit.

1. Note that each side of the circuit board is identified as either the component side or the DUT side. The component side has the designators printed on that side.
2. All the components (except the cage jacks) are installed on the component side of the board and soldered on the DUT side.
3. 12 high-voltage cage jacks are included in this kit. These should be installed on the DUT side and soldered from the component side.
4. Mount capacitors CBP1 through CBP10. The capacitors provided in the kit do not have polarity, so they may be installed in either direction.
5. Install diodes D1, D2, D3, and D4, as well as resistor RFB2 on the component side of the board. RFB3 should be shorted if no resistor is being used. Ensure that the orientation of the diodes match the circuit schematic drawing.
6. Next install all the smaller components on the board, such as CC, RLIM1 and RLIM2, RT1 and RT2, and RIN1. This is done because it becomes difficult to install a smaller part on the board once all the larger components are installed. If noise gain compensation, capacitive feedback, or an output snubber network are desired, these should be installed now.
7. An isolation resistor RISO1 can be installed if desired (for reactive loads). If not, RISO1 can be shorted using an insulated piece of solid or stranded wire.
8. Mount six vertical banana jacks for P1, P2, P3, P4, P5, and P8. Drop the banana jacks into each slotted hole, secure their position with the included nut, and solder a piece of 16 gauge wire to route the end of each connector to their respective pads.
9. Mount the BNC connectors provided with the kit (146510CJ) and solder them to the board. Also solder the two horizontal banana jacks (571-0100) to TMPA and TMPB.
10. 4 #8 hex stand offs (2221) are also provided with the kit. Install with 4 #8 x 0.375" screws (91735A192) on the component side. Attach the standoffs to these screws on the corners of the board. Refer to the assembly drawings while installing the standoffs.
11. Cut the Teflon tubing into 12 pieces, each of length 0.18" or 4.5 mm approximately. These pieces go onto the pins of the power amplifier before inserting it into the board. This is done to insulate the pins from the heat sink and make sure that the amplifier is tightly fixed into the jacks. An Exacto knife works well for this.  
**Note:** The Teflon pieces should not be longer than the suggested length. If the pieces are longer, they may interfere in the seating of the part to the board and create a gap between the heat sink and the part body.
12. Five thermal washers (TW21) are provided with the kit. The thermal washer is used between the part and the heatsink (HS34). A new washer must be used for each mounting. Place the amplifier into the heatsink with a thermal washer in between. Secure this attachment with a #6 x 0.75" screw (91735A151) and matching nut on either side of the amplifier.

13. Insert the pins of the amplifier-heatsink assembly into the cage jacks. Be sure to have pin 1 (closest to the notch on the amplifier package) pointing toward the input BNC connectors. Also be sure not to bend the pins while placing them into the jacks. Perform a visual inspection to make sure all pins are inserted into the jacks without bending.
14. Place a hex spacer (99492A003) between one corner of the heatsink and the evaluation board. Place a #8 x 0.75" screw (90272A197) through the slot on the heatsink and tighten with a #8 nut on the component side. Repeat for all four corners of the heatsink. Refer to the assembly drawings for the correct way to attach the heat sink.
15. Position the board so the component side is facing up. Hook up power supply and signals as necessary. Connect the temperature jacks to a diode voltage reading multimeter. The amplifier is now ready for testing.

**Figure 3: Evaluation Kit Assembly (Top View)**

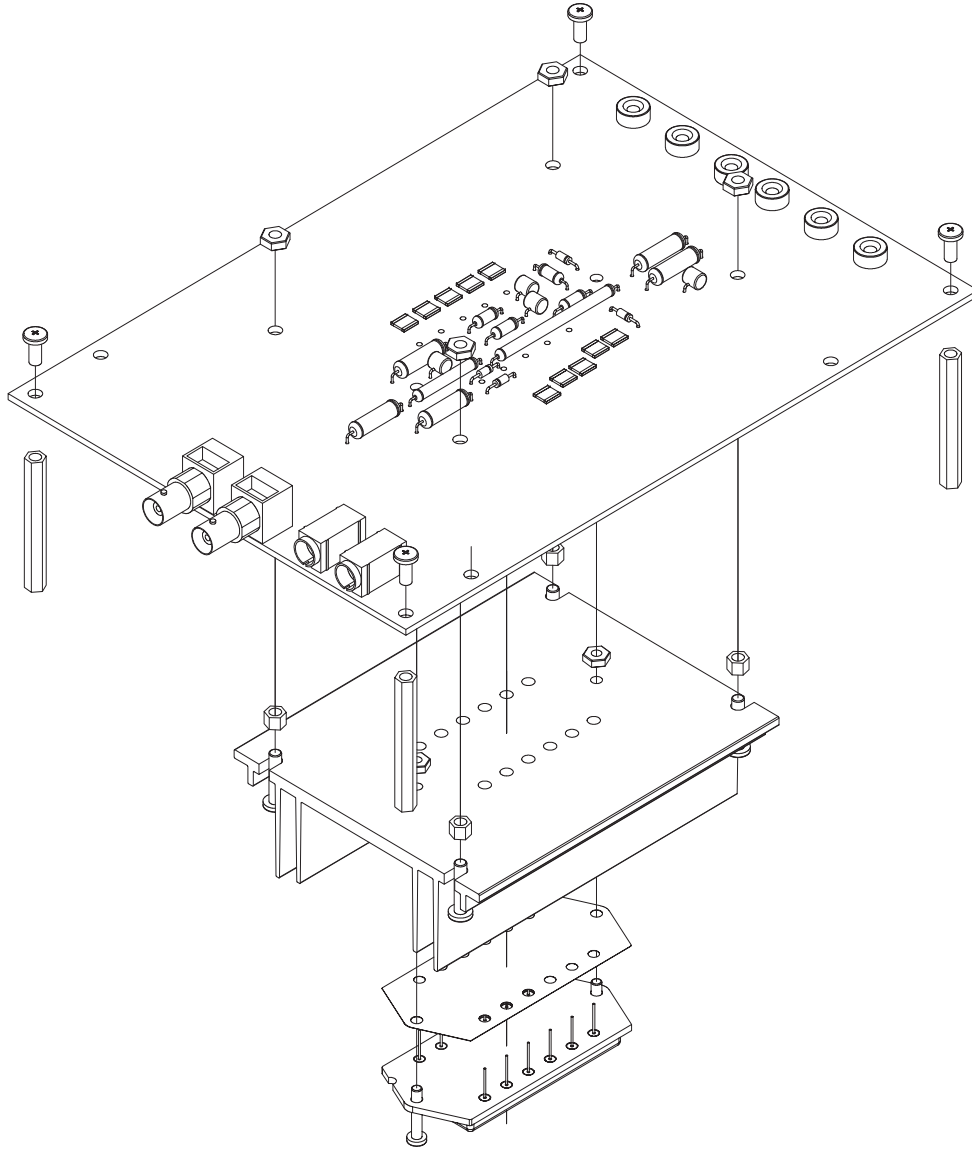
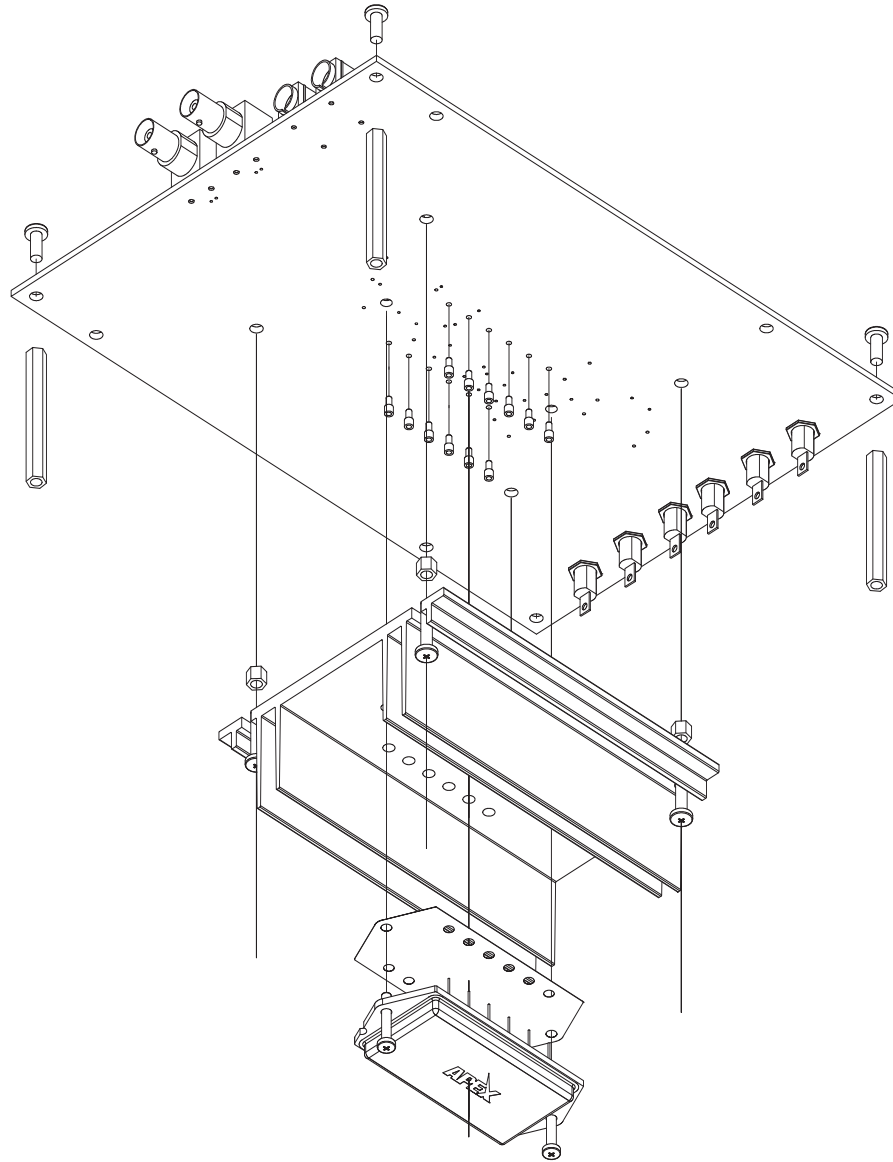


Figure 4: Evaluation Kit Assembly (Bottom View)





## TEST ASSEMBLY

### EQUIPMENT NEEDED

1. Power supply
2. Function Generator
3. Oscilloscope
4. Multi-meter

### TEST SETUP

Connect the power supply to the banana jacks. For an inverting configuration, connect the BNC cable from the function generator to the BNC connector marked - VIN, mounted on the board. For non-inverting configurations, use + VIN. Connect the load to the banana jacks marked OUT (0 for direct output, 1 for isolation resistor output) and COM. Refer to the amplifier datasheet for typical values of input voltage, frequency and supply voltage. Input and output waveforms can be checked on an oscilloscope by connecting it to the test points mounted on the board. Begin the test with minimum values of input and supply voltage. Please maintain caution while operating at high voltages.

**Note:** For added precaution, power on the circuit with the amplifier removed. Check the voltage at each cage jack without the DUT, for correct voltage / signal at each respective pin. Once this is done, switch off the supply and plug in the DUT.

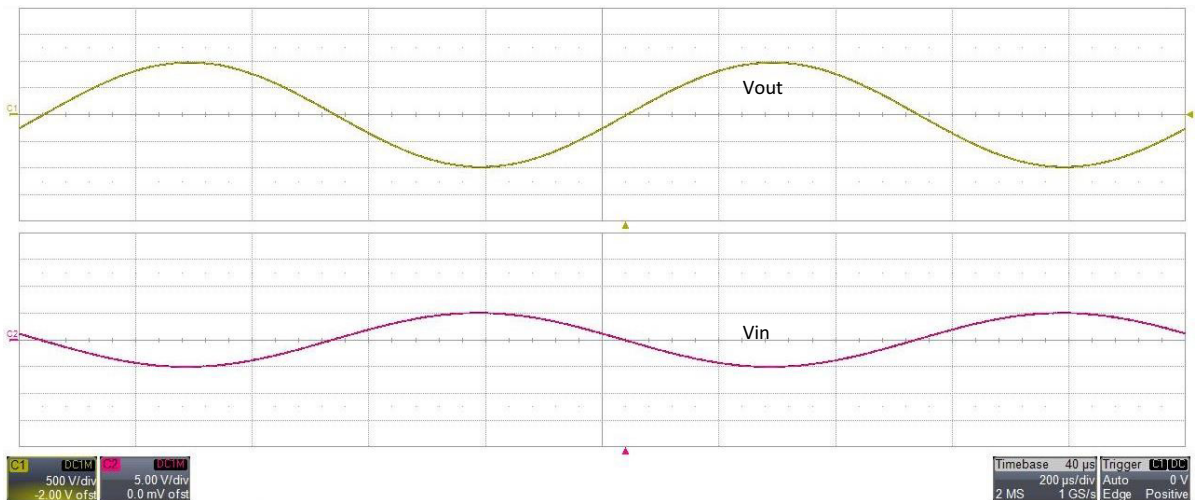
### CAUTION

This evaluation kit may be subjected to high voltages. Please maintain caution while operating the kit at high voltages.

### TEST RESULTS

Figure 5 shows input (magenta waveform) and output (yellow waveform) waveforms for a PA99 power amplifier with no load. The part was tested for an input voltage of 10V p-p, at 1 kHz frequency, and at an inverting gain of 200. The supply voltage is set at  $\pm 1250$  Volts.

Figure 5: PA99 Test Waveforms



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