

LTC6090

High Voltage CMOS Amplifier

DESCRIPTION

Demonstration circuit [1979A](#) is a high voltage CMOS amplifier featuring the [LTC®6090](#). An onboard isolated flyback converter provides $\pm 62\text{V}$ power to the LTC6090 for evaluating large signal performance. A jumper sets the gain of the ultrahigh-input impedance circuit to either unity ($1\times$) or $20\times$. In the $20\times$ mode, a signal input of just 3V can provide nearly full-swing output. In the unity-gain setting, the part operates as a precision buffer for high voltage signals.

SPECIAL FORM-FACTOR

The DC1979A includes a preassembled power converter and amplifier circuit on a small printed circuit, so the user only needs to furnish a 7V to 12V power source to operate the demo. The layout has provisions for optional BNC connectors and mounting features to install the board in a standard plastic enclosure if a permanent utility unit is desired. Refer to the Appendix for mechanical details.

Design files for this circuit board are available at <http://www.linear.com/demo>

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PERFORMANCE SUMMARY

Specifications are at $T_A = 25^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Signal, Maximum Usable	Gain = $20\times$, Onset of Output Clipping Gain = $1\times$, V_{CM} Limited		± 3.1 ± 60		V V
I_{IN}	V_{IN} Leakage Current	V_{IN} = Within Usable Range		3		pA
V_{OUT}	Output Voltage Range	Gain = $20\times$, Onset of Output Clipping		± 62		V
V_{SUPPLY}	Input to Supply Converter		7	9	12	V
I_{SUPPLY}	Quiescent Supply Current	$V_{IN} = 9\text{V}$, No Loading of Op Amp Output		62		mA
UVLO	Undervoltage Lockout			6.5		V

OPERATING PRINCIPLES

The LTC6090 op amp is set up in the standard noninverting voltage-gain configuration. GAIN jumper JP2 provides a means of controlling the gain by adding or deleting a gain resistor in the feedback path by choosing the $1\times$ or $20\times$ setting.

A small [LT®8300](#) flyback converter is used to provide about $\pm 65\text{V}$ from a convenient low voltage supply in the 7V to 12V range. A blue LED is in series with the minus supply to the LTC6090, so the op amp actually sees a resultant supply of about $65\text{V}/-62\text{V}$. The LED provides a pleasant

level of illumination at the 2.6mA quiescent current of the op amp.

To minimize signal loading, no input load resistor is included. The op amp can be connected to the instrumentation with a coaxial cable at J2, since a 50Ω output termination is included. No far-end termination should be used, as the op amp cannot deliver large signals across a 100Ω DC load. In the event of an output overload, the LTC6090, having built-in thermal shutdown, will automatically go into a low power state to protect itself from damage. After

OPERATING PRINCIPLES

cooling down some, the part will automatically resume (or attempt) normal operation, usually in a fraction of a second. This safety feature can be defeated if desired by setting the THERMAL S/D jumper JP1 to the 0 setting.

To evaluate the LTC6090 at other power supply voltages, or without any noise contribution from the onboard flyback circuit, supply potentials can be furnished directly to the

op amp without powering the LT8300. Solder tacking wires to the C4 and C6 bypass capacitors is the most convenient means of supplying external power. A ground turret is provided for any alternate powering or instrument grounding needs.

Refer to the Schematic Diagram in this document for the circuit details.

QUICK START PROCEDURE

Demonstration circuit 1979A is easy to set up to evaluate the performance of the LTC6090. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below (CAUTION: HIGH VOLTAGES!):

1. Place jumpers in the following positions:

JP1: Position 1 (enables THERMAL S/D)

JP2: Position 20× (for GAIN of 20)

2. With power off, connect the input power supply to +V and -V. A good setting is 9V, or a 9V battery can be used.

NOTE: The flyback converter input is isolated from the op amp GND, so when used for the op amp supply, the DC input will not use the GND connection.

3. Connect a signal generator at the IN+ and GND turrets. 10kHz sine wave at 1V is a good starting point.

NOTE: If the supply and instruments share a chassis ground connection, the isolation of the flyback converter is lost.

4. Connect an oscilloscope 10× probe to the OUT and GND turrets. Set the scaling to 20V/20μs per division.
5. Power up the system and a 20V sine wave should appear on the oscilloscope.
6. Increase the signal amplitude and observe the signal for clipping as signals reach the supply rails. Slew and settling behavior can be evaluated by switching the signal generator to square wave.

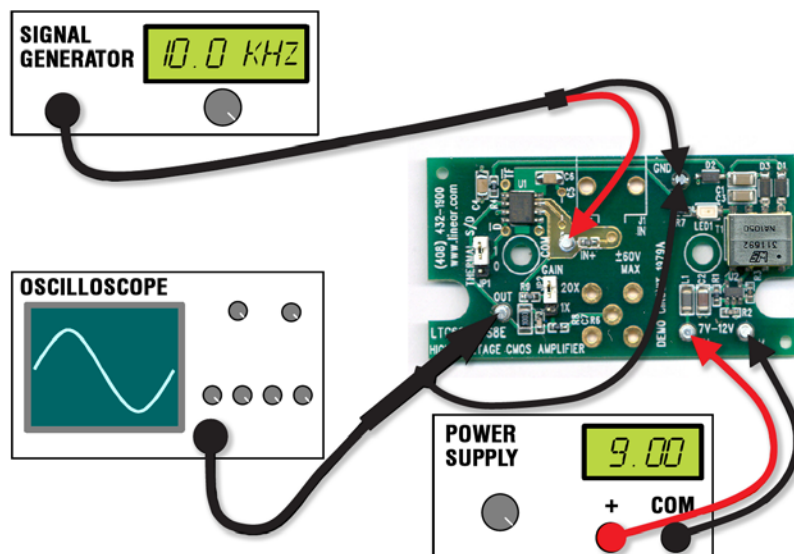


Figure 1. Proper Measurement Equipment Setup

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APPENDIX

One especially useful purpose for the DC1979A is to provide precision measurements in higher voltage circuits. The usual $10\text{M}\Omega$ presented by most instruments will often unacceptably load such circuits and give highly erroneous results. For providing a wide-range signal buffer, the GAIN jumper is set to $1\times$ so that the only errors are from the V_{OS} and input leakage current of the LTC6090. With a $\pm 50\text{V}$ reading on a $4\frac{1}{2}$ digit DMM (i.e., 200V scale), this error is generally less than one count of the display (10mV), even for a several-G Ω source resistance signal. If one desires to use the DC1979A as a permanent high voltage buffer unit, then the following information will be helpful.

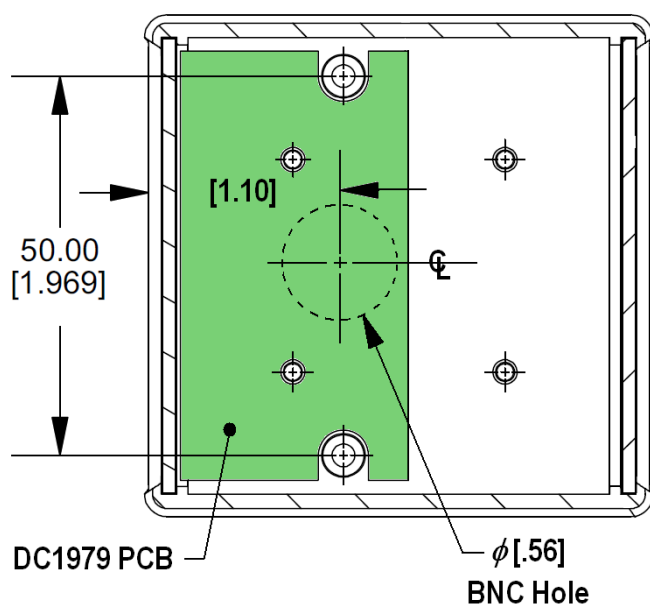


Figure 2. Base Hole and PCB Location

THE CONSTRUCTION

The following sketches show the hole placement for the BNC connectors and an optional toggle switch. The toggle switch is for use with a 9V battery that can fit inside the case, or other provisions could be made to provide power connections to the board as desired (for example, a banana jack, wall-wart DC jack, etc.).

Figure 2 provides the hole placement for the OUT signal (on J2). This is to pass the output signal through the bottom of the case using a back-mounted Connex 112404 vertical BNC connector. Two 4-40-1/4" screws are needed to mount the PCB to the case.

Figure 3 shows the hole placement for the end panel. It includes the IN signal on J1 using a Molex SD-73100-0105 right-angle BNC connector on the top side of the board, and the smaller hole is for the miniature toggle switch, such as from the manufacturer, C&K.

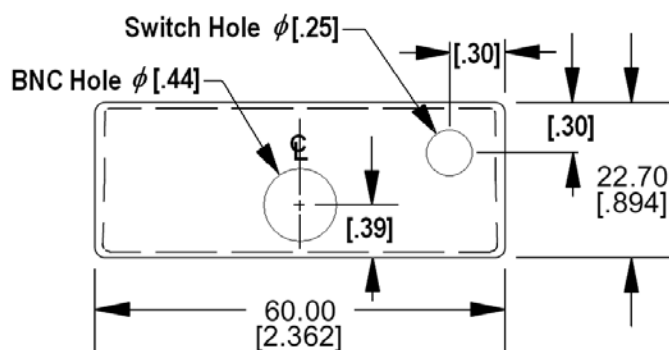


Figure 3. End Panel Hole Locations

APPENDIX

Figure 4 is an interior photo of the finished unit including the switch and 9V battery. The translucent blue Hammond 1593KTBU was selected so the LED would be visible during

operation. Standard adapters can be used to transform the output into a banana-plug pair that can directly attach the unit to a DMM, as shown in Figure 5.



Figure 4. Interior of Completed Unit



Figure 5. Completed Unit Attached to DMM

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, C3	CAP., 1206, 1 μ F, 10%, 100V, X7R	MURATA, GRM31CR72A105KA01L
2	1	C2	CAP., 1206, 4.7 μ F, 10%, 25V, X7R	MURATA, GRM31CR71E475KA88L
3	2	C4, C6	CAP., X7R, 0.1 μ F, 100V, 10%, 0805	MURATA, GCM21BR72A104KA37L
4	0	C5	CAP., COG, 15pF, 100V, 5%, TH, OPT	
5	1	C7	CAP., NPO, 5.6pF, 100V, $\pm$ 0.25pF, 0603	AVX, 06031A5R6CAT2A
6	2	D1, D3	SWITCHING DIODE, SOD-123	CENTRAL SEMICONDUCTOR, CMMR1U-02
7	1	D2	SM ZENER DIODE, SOD-123, CMHZ5266B	CENTRAL SEMICONDUCTOR, CMHZ5266B
8	5	E1-E5	TURRET	MILL-MAX, 2308-2-00-80-00-00-07-0
9	2	JP1, JP2	HEADER, 3-PIN, 2mm	SAMTEC, TMM-103-02-L-S
10	2	XJP1, XJP2	SHUNT	SAMTEC, 2SN-BK-G
11	0	J1	CON, BNC-J/RA/PCB (OPT)	MOLEX INC., SD-73100-0105
12	0	J2	CON, BNC, 5 PINS (OPT)	CONNEX, 112404
13	1	LED1	LED, 1206, BLUE	PANASONIC, LNJ951C4BRA
14	1	L1	IND., 1206	MURATA, BLM31PG330SN1L
15	1	R1	RES., CHIP, 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
16	1	R2	RES., CHIP, 23.2k, 1/10W, 1%, 0603	VISHAY, CRCW060323K2FKEA
17	1	R3	RES., CHIP, 130k, 1/10W, 1%, 0603	VISHAY, CRCW0603130KFKEA
18	2	R4, R7	RES., CHIP, 100 Ω , 1/10W, 1%, 0603	VISHAY, CRCW0603100RFKEA
19	2	R5, R9	RES., CHIP, 5.23k, 1/10W, 1%, 0603	VISHAY, CRCW06035K23FKEA
20	1	R6	RES., CHIP, 49.9 Ω , 1/10W, 1%, 0603	VISHAY, CRCW060349R9FKEA

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PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
21	1	R8	RES., CHIP, 100k, 1/16W, 1%, 1206	VISHAY, CRCW1206100KFKEA
22	1	T1	TRANSFORMER	WÜRTH ELEKTRONIK, 750311692
23	1	U1	I.C., S8E PACKAGE	LINEAR TECHNOLOGY, LTC6090CS8E
24	1	U2	I.C., 5-LEAD TSOT PACKAGE	LINEAR TECHNOLOGY, LT8300ES5#PBF-ES

SCHEMATIC DIAGRAM

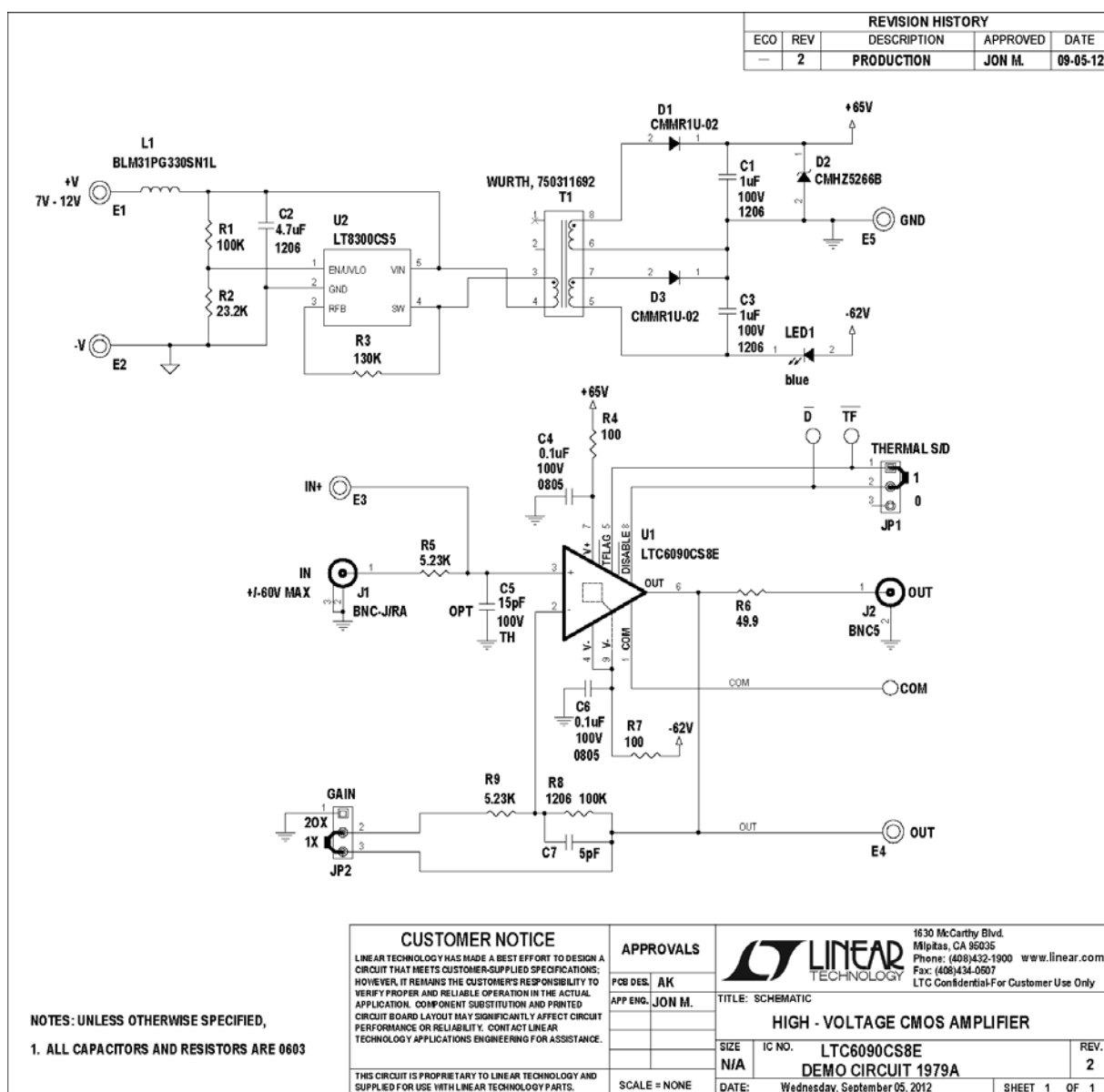


Figure 6. DC1979A High Voltage CMOS Amplifier

DEMO MANUAL DC1979A

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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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