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## DESCRIPTION

The **LTC<sup>®</sup>6363** is a low power, low noise differential op amp with rail-to-rail output swing and good DC accuracy. The amplifier may be configured to process a fully differential input signal or to convert a single-ended input signal to a differential output signal. The differential outputs of the DC2319A can be configured with a first order RC network for driving the differential inputs of an ADC. The DC2319A

can be DC-coupled or AC-coupled. Onboard jumpers configure the DC2319A for dual or single power supply. In addition, there are multiple optional surface-mount pads that can be used to change the LTC6363 configuration.

**Design files for this circuit board are available at <http://www.linear.com/demo/DC2319A>**

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**Table 1. LTC6363 Versions**

PART NUMBER	DEMO CIRCUIT NUMBER	DESCRIPTION
LTC6363	DC2319A-A	Gain Set with External Resistors
LTC6363-1	DC2319A-B	Internal Gain Resistors G = 1
LTC6363-2	DC2319A-C	Internal Gain Resistors G = 2
LTC6363-05	DC2319A-D	Internal Gain Resistors G = 0.5

## QUICK START PROCEDURE

Refer to Figure 1a. Check to ensure that both jumpers, JP1 and JP2, are set as shown. (JP1 to PWR\_ON and JP2 to SINGLE SUPPLY). Power up the DC2319A from a single power supply,  $V^+ = 5V$  and  $GND = 0V$ . Connect  $VIN^-$  to ground using E8. Connect an input voltage to  $VIN^+$  using E7. The differential output voltage can then be measured on  $VOUT^-$  and  $VOUT^+$  (E9 and E10). The outputs will be

level-shifted to be balanced symmetrical around approximately 2.5V. The difference between the outputs will be the gain multiplied by the difference between the inputs.

For a similar setup using a split supply, change the setting of JP2 to DUAL SUPPLY, and connect a negative supply to  $V^-$ . See Figure 1b.



## QUICK START PROCEDURE

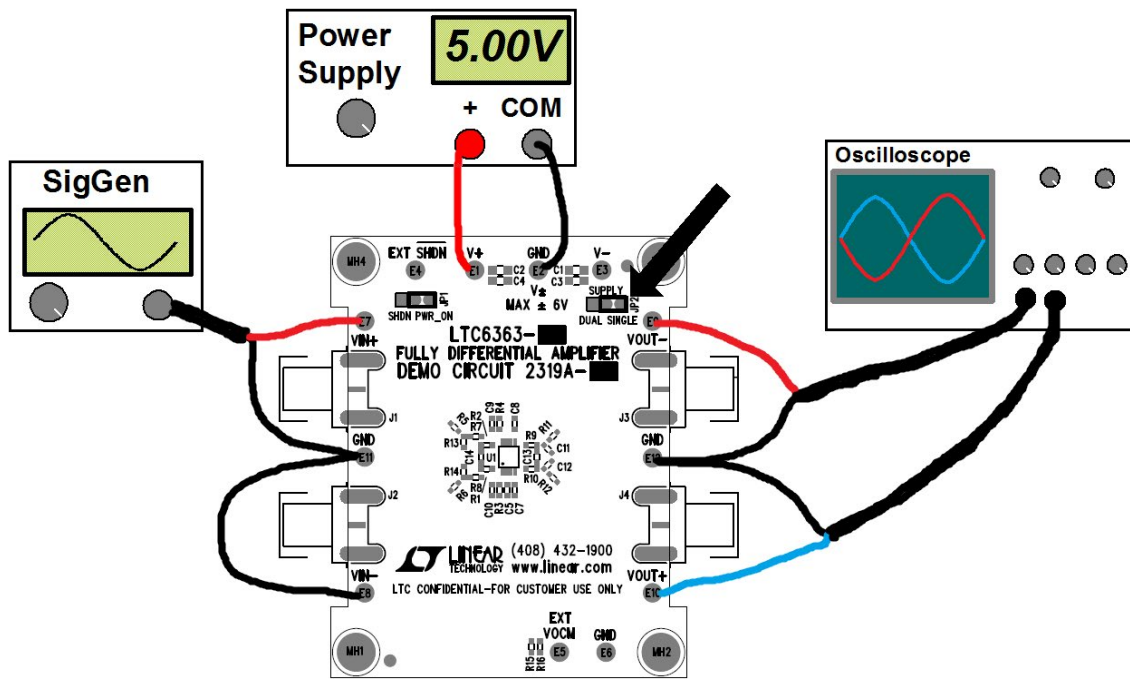


Figure 1a. DC2319A Connection Diagram (Single Supply)

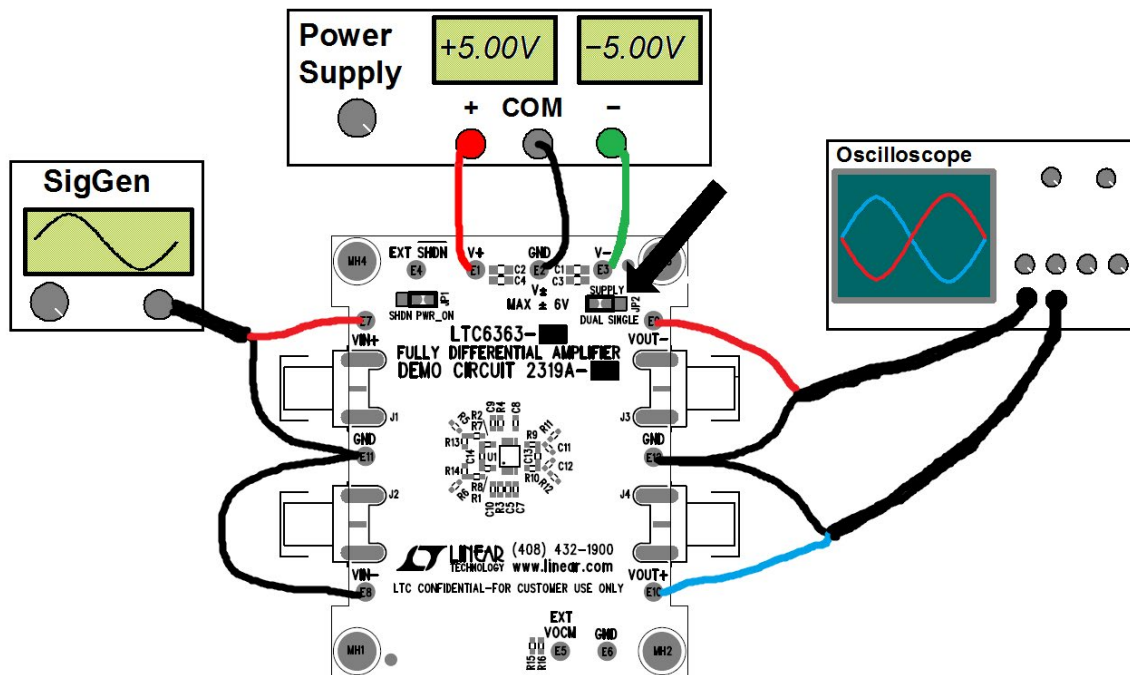


Figure 1b. DC2319A Connection Diagram (Dual Supply)

## HARDWARE CONFIGURATION

### Internal or External Gain Settings

Table 1 summarizes the gain settings for the various versions of DC2319A.

The LTC6363 (without suffix) is a non-committed op amp, which requires external feedback resistors to configure the gain. On the DC2319A-A, these resistors (R1, R2, R3, R4) are all set to 1k to configure a gain of  $G = 1$ , as shown in Figure 2. To set other gains, simply replace these resistors with other values.

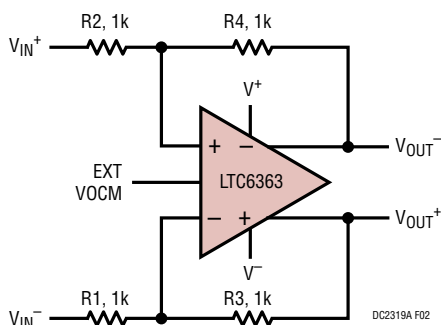


Figure 2. DC2319A-A with External Gain Setting Resistors (LTC6363)

The versions of LTC6363 with suffix (LTC6363-1, LTC6363-2, LTC6363-05) include precision gain resistors internal to the IC. The IC already sets its own gain, to  $G = 1$ ,  $G = 2$  and  $G = 0.5$  respectively, according to the suffix (see Table 1). Therefore, on DC2319A-B, DC2319A-C and DC2319A-D, the onboard feedback resistors (R3, R4) are not populated, and the input resistors (R1, R2) are shorted to  $0\Omega$ , resulting in the circuit of Figure 3.

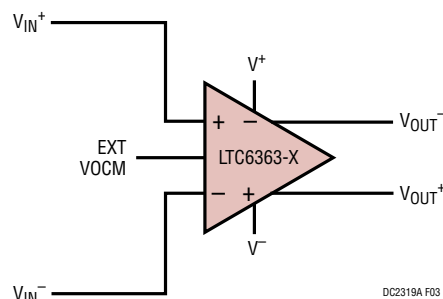


Figure 3. DC2319A-B/-C/-D with Gain Setting Resistors Internal to the IC (LTC6363-1/-2/-05)

## HARDWARE CONFIGURATION

### Single-Ended Input to Differential Output

To configure the DC2319A for single-ended input to differential output, simply connect a DC bias (such as ground) to  $VIN^-$  and connect the input signal to  $VIN^+$ . The differential output is measured on  $VOUT^+$  and  $VOUT^-$ . The unused input can also be grounded on the board by populating R13 or R14.

### Differential Input to Differential Output

To configure the DC2319A for differential input to differential output, simply connect the differential input signal to  $VIN^+$  and  $VIN^-$  respectively. The differential output is measured on  $VOUT^+$  and  $VOUT^-$ .

### AC-Coupled Applications

In the default configuration, both the inputs and outputs of the DC2319A are DC-coupled. To AC-couple the DC2319A, at either the inputs or outputs or both, simply replace the  $0\Omega$  resistors R5/R6/R11/R12 with appropriate value 0603 capacitors.

### External Output Common Mode Adjust

The DC2319A is by default configured to bias the output common mode at the voltage determined by the LTC6363 IC, which is at approximately the mid-point between the amplifier's  $V^+$  and  $V^-$  pins. (For example, if single supply is used, the output common mode will be at half the  $V^+$  voltage).

To set a different value for the output common mode voltage, populate resistors R15 and R16. This will form a resistor divider in parallel with the resistor divider internal to the LTC6363 IC.

The most accurate way to set the output common mode voltage is by applying the desired DC bias to the EXT VOCM pin at E5. This will overdrive any of the on-chip or onboard resistor dividers.

### Input or Output Filters

There are many  $0\Omega$  resistors and non-installed resistors or capacitors on the DC2319A board which can be populated by appropriate R and C values to configure lowpass filters at the inputs or outputs of the amplifier circuit.

### Active Feedback Filters

Various optional feedback components (such as R17, R18, C15, C16, C17, C18) can be populated to configure differential active feedback filters. This is most relevant for the DC2319A-A (the version of LTC6363 without internal gain suffix). The other versions (with internal gain resistors) do not provide access to the internal amplifier feedback nodes, so that it is not possible to configure external feedback filters. See Table 1.

### Layout

The DC2319A PCB layout demonstrates the known best-practices of PCB layout to get the best performance out of the LTC6363. A ground plane is used, and supply bypass capacitors are close to the supply pins. Use a symmetrical layout around the analog inputs and outputs to minimize the effects of parasitic elements. Shield analog input and output traces with ground to minimize coupling from other traces. Feedback traces are as short as possible.

Nevertheless, the DC2319A is a general purpose applications board with many placeholders for optional components. After proto-typing a specific design on the DC2319A, a final PCB layout can be further optimized by removing the placeholders for the unused components. In addition, the DC2319A is designed to accommodate both single supply and dual supply circuits. A PCB design for a single supply application would connect the amplifier's  $V^-$  pin directly to the copper ground plane and use only one supply bypass capacitor directly between  $V^+$  and ground.

## CONNECTORS AND JUMPERS

**JP1:** Jumper toggles the LTC6363 between SHDN and PWR ON.

**JP2:** Jumper toggles the SUPPLY between DUAL and SINGLE power supplies. If set to dual supply, connect a negative supply voltage to  $V^-$ .

**V<sup>+</sup>:** Connect to Positive Power Supply.

**GND:** Connect to Ground. Available at multiple turrets on the board, all shorted together internally. Only need to connect one, others can be used as ground point for measurements.

**V<sup>-</sup>:** Negative Power Supply Voltage. No need to connect if JP2 is set to single supply.

**EXT SHDN:** Externally Drives the SHDN Pin. No need to connect. To turn the amplifier ON and OFF with a logic signal, remove JP1 (or set to the PWR ON position) and then connect an external logic signal here to EXT SHDN. (See LTC6363 data sheet for logic levels)

**EXT VOCM:** Externally Drives the VOCM Pin. The voltage on this pin sets the output common mode voltage level. If left floating (default setting), then an internal resistor divider develops a voltage that is approximately mid-way between the LTC6363  $V^+$  and  $V^-$  supply rails.

**VIN<sup>+</sup>:** Connect noninverting input signal to the amplifier circuit. Available as SMA connector J1 and as turret E7.

**VIN<sup>-</sup>:** Connect inverting input signal to the amplifier circuit. Available as SMA connector J2 and as turret E8.

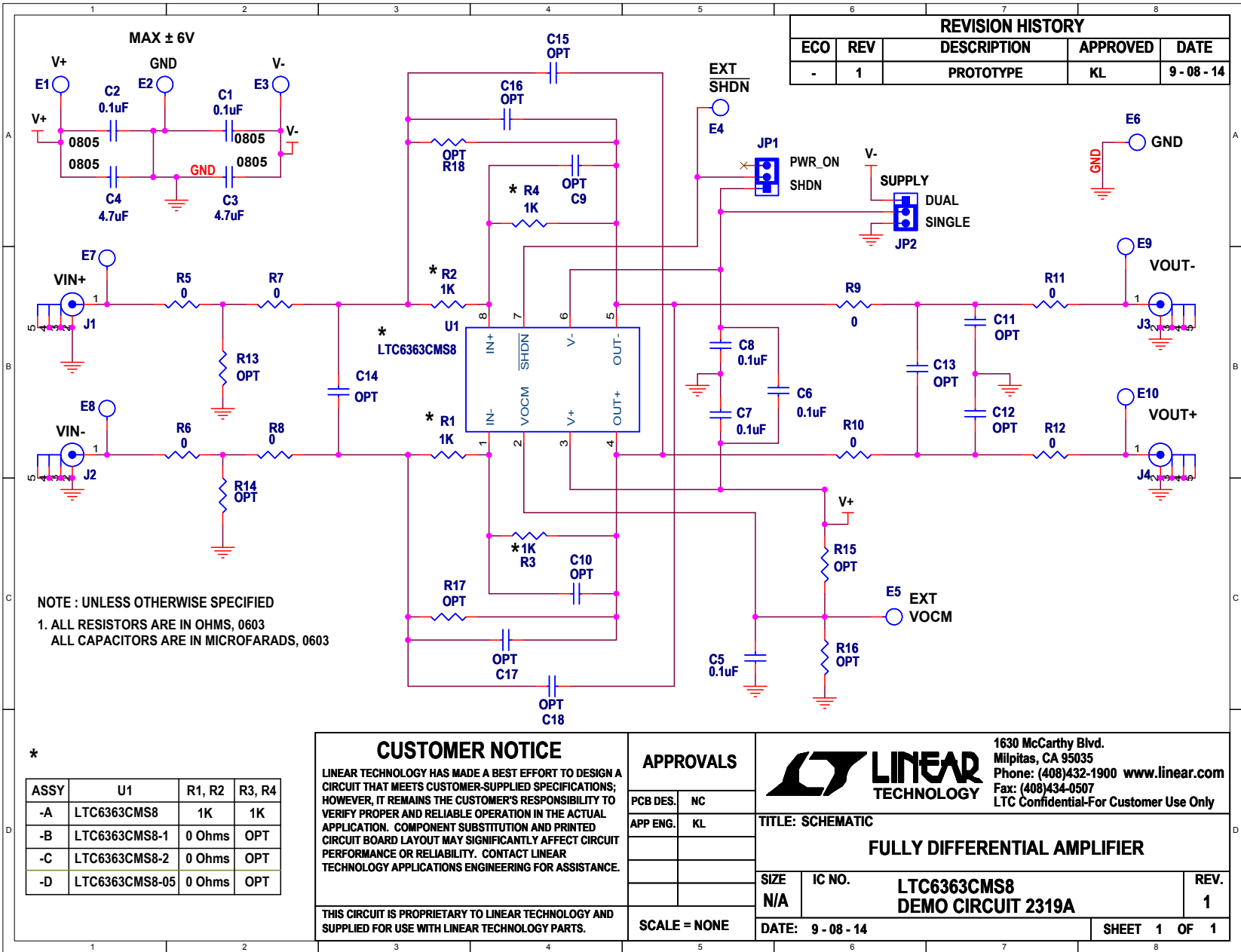
**VOUT<sup>-</sup>:** Measure inverting output signal from the amplifier circuit. Available as SMA connector J3 and as turret E9.

**VOUT<sup>+</sup>:** Measure noninverting output signal from the amplifier circuit. Available as SMA connector J4 and as turret E10.

# DEMO MANUAL DC2319A

## PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
<b>Required Circuit Components</b>				
1	2	C1, C2	CAP, 0.1 $\mu$ F, X7R, 25V, $\pm$ 10%, 0805	MURATA, GRM21BR71E104KA01L
2	2	C3, C4	CAP, 4.7 $\mu$ F, X5R, 16V, $\pm$ 20%, 0805	TAIYO YUDEN, EMK212ABJ475MG-T
3	4	C5, C6, C7, C8	CAP, 0.1 $\mu$ F, X7R, 16V, $\pm$ 10% 0603	AVX, 0603YC104KAT
4	0	C9 TO C18	CAP, 0603	OPT
5	10	E1 TO E10	TP, TURRET, 0.064" MTG HOLE	MILL-MAX, 2308-2-00-80-00-00-07-0
6	2	JP1, JP2	HEADER, 3PIN 1 ROW 0.079CC	SULLINS, NRPNO31PAEN-RC
7	2	JP1, JP2	SHUNT, 0.079" CENTER	SAMTEC, 2SN-BK-G
8	4	J1, J2, J3, J4	CONN SMA 50 $\Omega$ EDGE-LAUNCH	E.F. JOHNSON 142-0701-851
9	0	R13, TO, R18	RES, 0603	OPT
10	8	R5 TO R12	RES, 0 $\Omega$ , 1/10W, 1%, 0603	NIC, NRC06ZOTRF
<b>DC2319A-A Required Circuit Components</b>				
1	1		DC2319A-1 GENERAL BOM	
2	4	R1, R2, R3, R4	RES, 1k, 1/10W 1%, 0603	NIC, NRC06F1001TRF
3	1	U1	I.C., FULLY DIFFERENTIAL AMPLIFIER	I.C., LINEAR TECHNOLOGY LTC6363CMS8 #PBF
<b>DC2319A-B Required Circuit Components</b>				
1	1		DC2319A-1 GENERAL BOM	
2	2	R1, R2,	RES, 0 $\Omega$ , 1/10W, 1%, 0603	NIC, NRC06ZOTRF
3	0	R3, R4	RES, 0603	OPT
4	1	U1	I.C., FULLY DIFFERENTIAL AMPLIFIER	I.C., LINEAR TECHNOLOGY LTC6363CMS8-1 #PBF
<b>DC2319A-C Required Circuit Components</b>				
1	1		DC2319A-1 GENERAL BOM	
2	2	R1, R2,	RES, 0 $\Omega$ , 1/10W, 1%, 0603	NIC, NRC06ZOTRF
3	0	R3, R4	RES, 0603	OPT
4	1	U1	I.C., FULLY DIFFERENTIAL AMPLIFIER	I.C., LINEAR TECHNOLOGY LTC6363CMS8-2 #PBF
<b>DC2319A-D Required Circuit Components</b>				
1	1		DC2319A-1 GENERAL BOM	
2	2	R1, R2,	RES, 0 $\Omega$ , 1/10W, 1%, 0603	NIC, NRC06ZOTRF
3	0	R3, R4	RES, 0603	OPT
4	1	U1	I.C., FULLY DIFFERENTIAL AMPLIFIER	I.C., LINEAR TECHNOLOGY LTC6363CMS8-05 #PBF





# DEMO MANUAL DC2319A

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