LT6108-1/LT6108-2
High Side Current Sense Amplifier with Reference and a Comparator

DESCRIPTION

Demonstration circuit 1699A features the LT®6108, a high side current sense amplifier with a comparator and a 400mV reference.

The demo board circuit amplifies the voltage across an onboard current sense resistor, to provide a precision unipolar voltage output that is proportional to the sensed current. The board has one onboard comparator and an integrated 400mV reference that sets the threshold for the comparator. There are two versions of this demonstration circuit, A and B, indicating which version of the LT6108 is installed. The DC1699A-A (LT6108-1) has a latching comparator, while the DC1699A-B (LT6108-2) has a non latching comparator. Both current sense gain and current fault limits are set by onboard resistors and are the same for both boards. The gain is set at 25V/V and the comparator is set to trip at a current threshold of 500mA.

The key performance specifications are listed in the table below.

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

PERFORMANCE SUMMARY (T_A = 25°C)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Supply Range		2.7		60	V
V_{IOUT}	Measured Output Signal	I_{LOAD} = 100mA		250		mV
I_{OUT}	Output Load Current Range	Thermal Limit of R_{SENSE}			4	A
I_{QA}	V_{IN} Quiescent Current DC1699A-A	V_{IN} = 12V		800		µA
I_{QB}	V_{IN} Quiescent Current DC1699A-B	V_{IN} = 12V		650		µA
V_{THR}	Comparator Threshold	V_{IOUT} = 1.25V		500		mA

OPERATING PRINCIPLES

The LT6108 operates by amplifying the voltage drop across a sense resistor that is in series with the load. The voltage drop at the amplifier inputs is translated, via the internal variable current source, to a ground referenced signal at the amplifier output. The circuit gain is set by the ratio of the output resistor to the input resistor (see Figure 1). The comparator thresholds are set by the internal reference and the current trip points are set by dividing the output resistance into a network of three resistors. The DC1699A is shipped with a 100mΩ sense resistor, a gain of 25 and current fault threshold of 500mA.

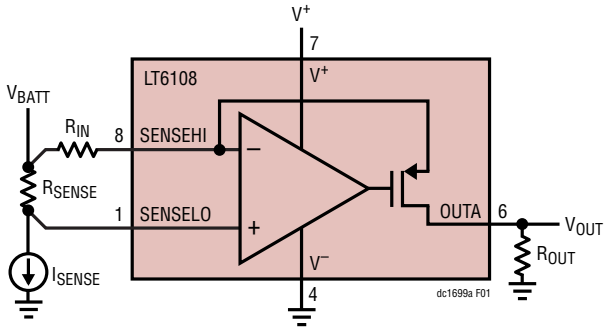
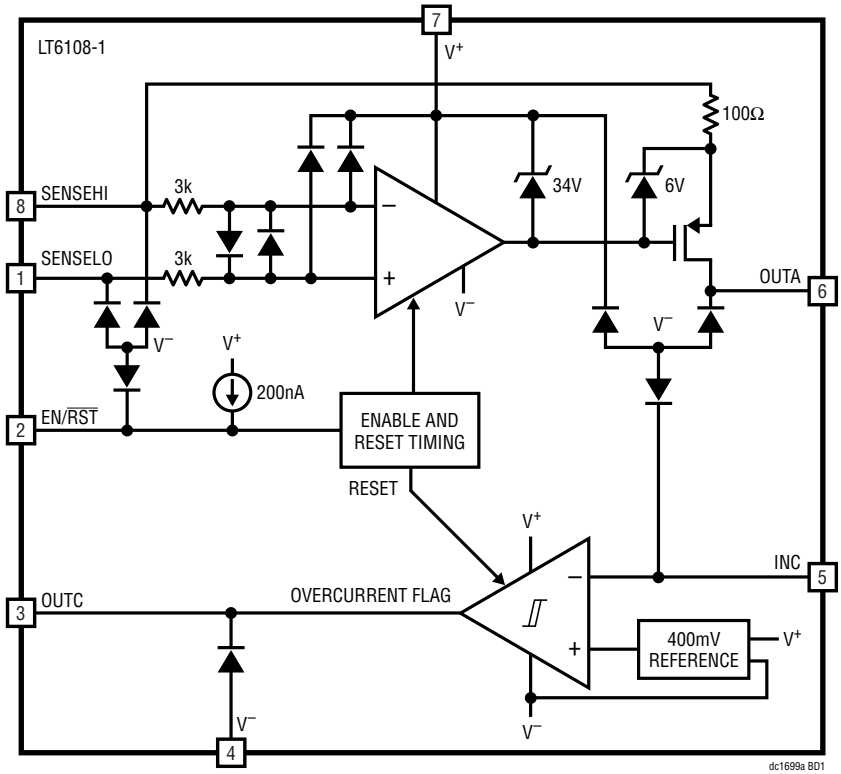
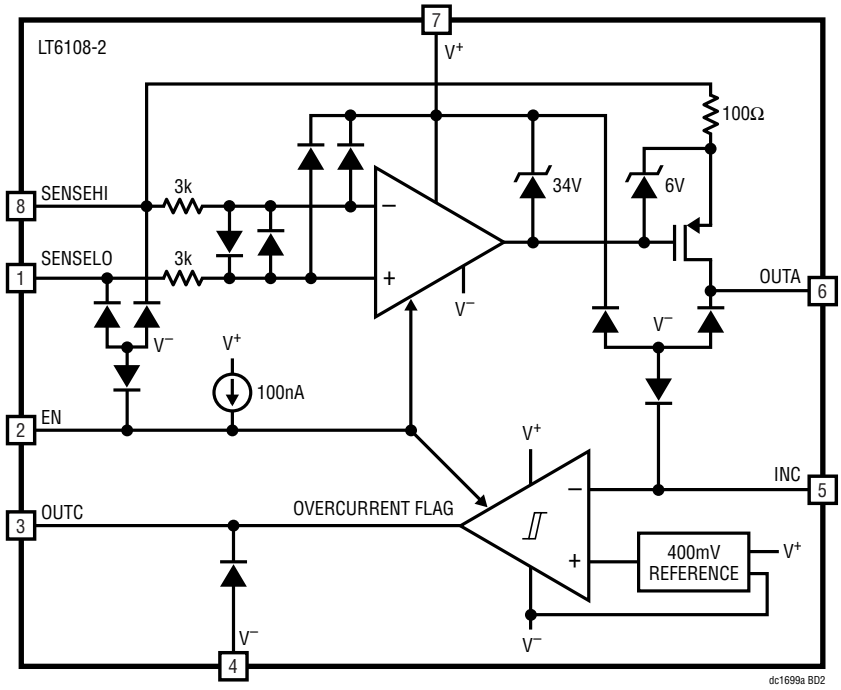


Figure 1. Amplifier Operation

BLOCK DIAGRAMS



LT6108-1



LT6108-2

QUICK START PROCEDURE

The DC1699A provides a simple way to evaluate the performance of the LT6108. Refer to Figure 2 for proper measurement equipment setup and follow the procedure below:

1. With the power off, connect the power supply positive to IN and the common to GND. With default board settings the supply can range from 3.3V to 60V. If the supply does not have an accurate current readout, a DMM may be connected in series with the supply as shown in Figure 2.
2. Connect a DMM or oscilloscope to the I_{OUT} with the common connection connected to ground.
3. Connect a load to the demo boards OUT terminal (positive) and ground. The load may be a power resistor, active load instrument or a circuit of interest.
4. Turn on the power supply. If using the DC1699A-A , the comparator starts in an unknown state and must be reset. This can be done by pressing the reset button. With the load shown in Figure 2 the comparator outputs should be high.
5. Measure the output voltage and confirm it corresponds to the load current. $V_{IOUT} = 2.5 \bullet I_{LOAD}$ for the factory installed resistors.
6. If possible, sweep the load current from 0mA to 500mA to verify the operation of the comparator. The LED will turn on when the comparator output has gone low. If using the DC1699A-A, use the reset circuitry to reset the comparator output.

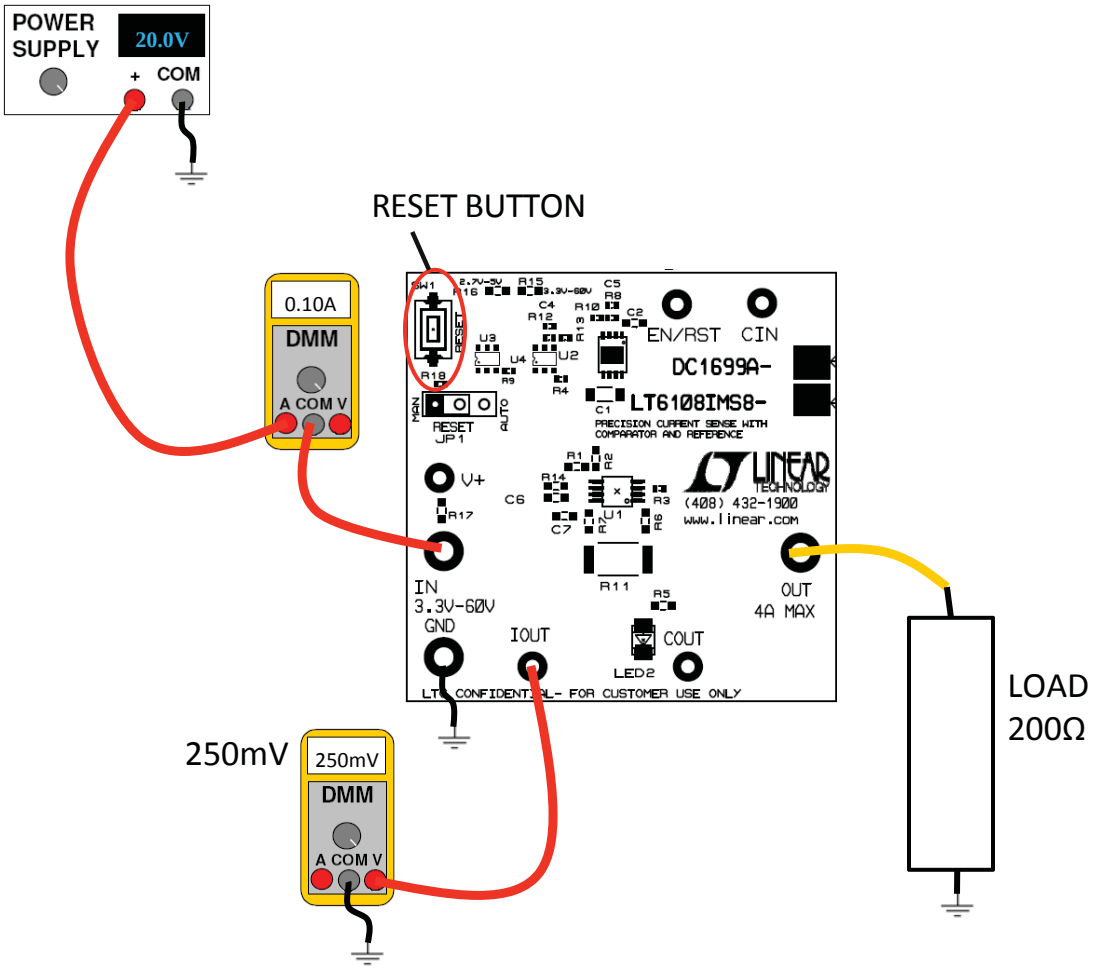


Figure 2.

OPERATION

Current Sense Gain

The gain of the LT6108 current sense amplifier is set by the ratio of R_{OUT} and R_{IN} resistors. In the demo circuit this means that the gain is set by the ratio of (R1 + R2)/R7. The gain error is primarily controlled by the precision of the resistors used. The installed resistors are 1% tolerance which will dominate the gain error. To reduce system gain error, the resistors can be replaced with 0.1% resistors.

LED Indicator

The LED indicates the state of the comparator output. When the LED is on, the comparator's output is low. When the LED is off, the comparators output is high. When the comparator output is latched low, the LT6108-1 must be reset to unlatch the comparator output and turn off the LED.

Jumper Summary

Reset (JP1): The Reset jumper has two settings for manual or auto mode. In manual mode, the user must press the reset button to trigger the LTC6993 to send the 5µs pulse that resets the latching comparators. In auto mode, the LTC6991 will continuously reset the comparators every 10 seconds. The factory default setting is manual mode.

Optional Settings

1. For supply voltages below 3.3V, remove R15 and install R16 (0Ω jumper). When R16 is installed, the supply voltage must stay between 2.7V to 6V to prevent damaging the TimerBlox® circuitry that is used to reset the comparator output.
2. To power the LT6108 from a supply separate from the load, remove R17 and connect the power supply to V^+ turret. The input cannot go more than 33V below V^+.
3. There are a number of optional components (not installed) that allow the DC1699 to be tailored to a specific application:

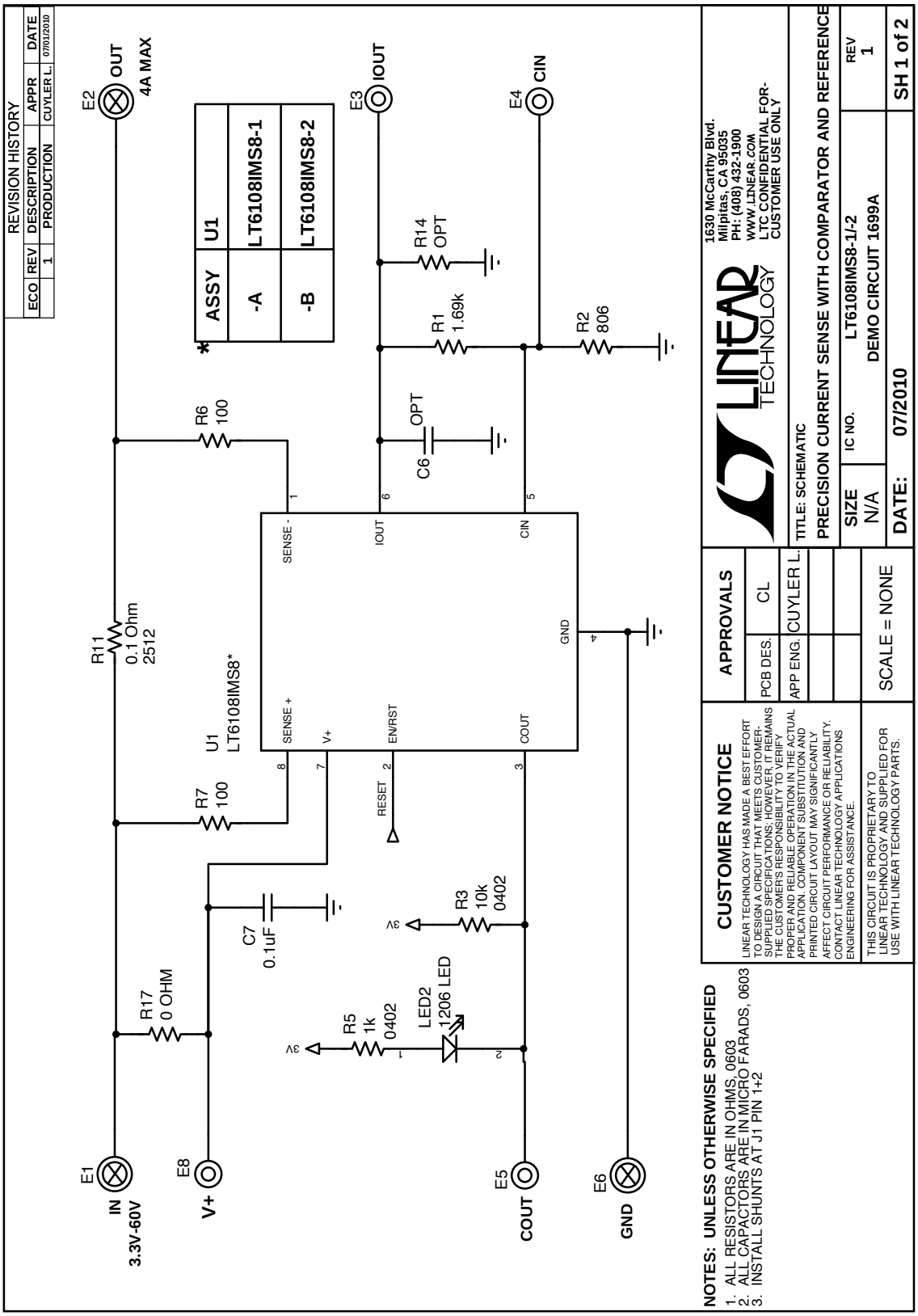
   To disconnect comparator input C_{IN} from I_{OUT}, remove R1 and R2 and install R14.

   To add filtering to the amplifier output, install C6.

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
DC1699A Genreral BOM				
1	1	C1	Capacitor, 1µF 20% 1206 100V X7R	AVX 12061C105MAT2A
2	1	C2	Capacitor, 0.47µF 20% 0603 16V X5R	AVX 0603YD474MAT2A
3	1	C5	Capacitor, 0.1µF 10% 0402 16V X5R	AVX 0402YD104KAT2A
4	1	C7	Capacitor, 0.1µF 10% 0603 100V X7R	Murata/GRM188R72A104KA35D
5	3	E1, E2, E6	TURRET TERMINAL	Mill Max 2501-2-00-80-00-00-07-0
6	5	E3-E5, E9, E10	TURRET TERMINAL	Mill Max 2308-2-00-80-00-00-07-0
7	1	LED2	RED1206 LED	Panasonic/LN1251C
8	1	R1	Resistor, 1.69k 1% 0603 1/16W	VISHAY/CRCW06031K69FKEA
9	1	R2	Resistor, 806 1% 0603 1/16W	VISHAY/CRCW0603806RFKLEA
10	2	R3, R10	Resistor, 10k 5% 0402 1/16W	VISHAY/CRCW040210K0JNED
11	1	R5	Resistor, 1k 5% 0603 1/16W	VISHAY/CRCW06031K00JNEA
12	2	R6, R7	Resistor, 100 1% 0603 1/16W	VISHAY/CRCW0603100RFKEA
13	1	R8	Resistor, 13.7k 1% 0402 1/16W	VISHAY/CRCW040213K7FKED
14	1	R11	Resistor, 0.1Ω 1% 2512 2W	IRC/LR2512LF-01-R100-F
15	0	R14	OPTIONAL	
16	2	R15, R17	Resistor, 0Ω 0603 1/16W	VISHAY/CRCW06030000Z0EA
17	1	U2	IC, LT3010EMS8E#PBF	Linear Technology Corp.LT3010EMS8E#PBF
DC1699A-A				
1	1	DC1699A	GENERAL BOM DC1699A	
2	1	C4	Capacitor, 0.1µF 20% 0402 10V X5R	TDK/C1005X5R1A104M
3	1	JP1	HEADER, 3-PIN	SAMTEC TSW-103-07-L-S
4	1	JP1	SHUNT	SAMTEC SNT-100-BK-G
5	1	R4	Resistor, 124k 1% 0402 1/16W	VISHAY/CRCW0402124KFKED
6	1	R9	Resistor, 249k 1% 0402 1/16W	VISHAY/CRCW0402249KFKED
7	2	R12, R18	Resistor, 1M 1% 0402 1/16W	VISHAY/CRCW04021M00FKED
8	1	R13	Resistor, 392k 1% 0402 1/16W	VISHAY/CRCW0402392KFKED
9	1	SW1	Switch, push button	Panasonic/EVQPPDA25
10	1	U1	IC, LT6108IMS-1	Linear Technology Corp. LT6108IMS-1
11	1	U3	IC, LTC6993CS6-1#PBF	Linear Technology Corp. LTC6993CS6-1#PBF
12	1	U4	IC, LTC6991CS6#PBF	Linear Technology Corp. LTC6991CS6#PBF
DC1699A-B				
1	1	DC1699A	GENERAL BOM DC1699A	
2	1	U1	IC, LT6108IMS-2	Linear Technology Corp. LT6108IMS-2

SCHEMATIC DIAGRAM



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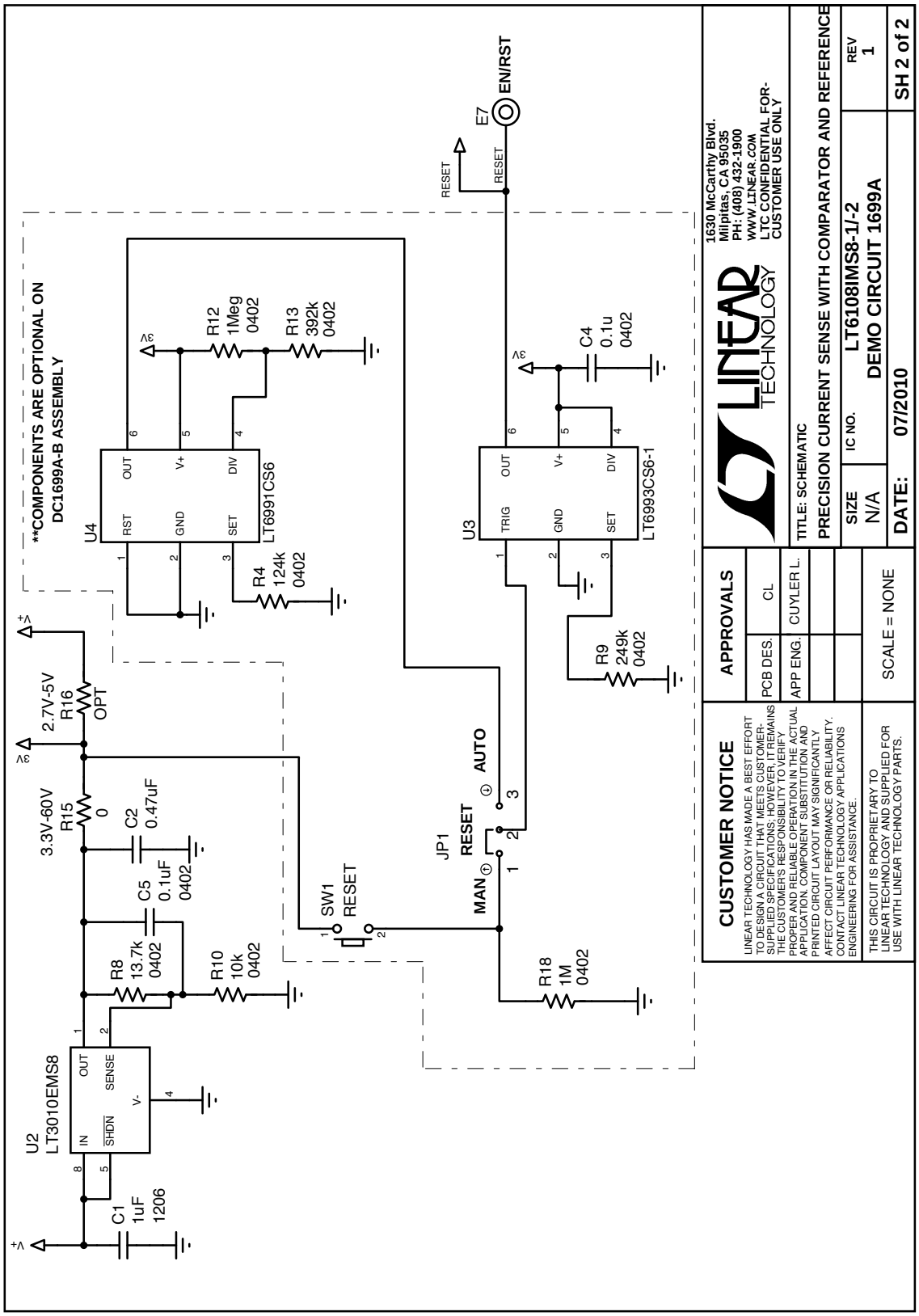

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