LTC3607EUD
Dual 600mA 15V Monolithic Synchronous Step-Down Regulator

DESCRIPTION

Demonstration circuit DC1596 is a dual output regulator consisting of two constant-frequency step-down converters, based on the LTC®3607 monolithic dual channel synchronous buck regulator. The DC1596 has an input voltage range of 4.5V to 15V, with each regulator capable of delivering up to 600mA of output current. The DC1596 can operate in either Burst Mode® operation or pulse-skipping mode. In shutdown, the DC1596 quiescent current is less than 1µA. The DC1596 is a very efficient circuit attaining up to 90%. The DC1596 uses the LTC3607's16-lead QFN package, which has an exposed pad on the bottom side of the IC for better thermal performance. These features, plus a set operating frequency range of 2.25MHz, make the DC1596 demo board an ideal circuit for industrial or distributed power applications.

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°C

PARAMETER	CONDITIONS	VALUE
Minimum Input Voltage		4.5V
Maximum Input Voltage		15V
Run	RUN Pin = GND RUN Pin = V_{IN}	Shutdown Operating
Output Voltage V_{OUT1} Regulation	V_{IN1} = 4.5V to 15V, I_{OUT1} = 0A to 600mA	1.2V ±4% (1.152V-1.148V) 1.5V ±4% (1.44V-1.56V) 1.8V ±4% (1.728V-1.872V)
Typical Output Ripple V_{OUT1}	V_{IN1} = 12V, I_{OUT1} = 600mA (20MHz BW)	<20mV_{P-P}
Output Voltage V_{OUT2} Regulation	V_{IN2} = 4.5V to 15V, I_{OUT2} = 0A to 600mA	2.5V ±4% (2.425V-2.6V) 3.3V ±4% (3.168V-3.432V) 5V ±4% (4.8V-5.2V)
Typical Output Ripple V_{OUT2}	V_{IN2} = 12V, I_{OUT2} = 600mA (20MHz BW)	<20mV_{P-P}
Mode Setting	Mode Pin Floating Mode Pin Grounded	Burst Mode Operation Pulse-Skipping
Burst Mode Operation Output Current Thresholds	Channel 1: PV_{IN1} = 12V, V_{OUT1} = 1.8V Channel 2: PV_{IN2} = 12V, V_{OUT2} = 3.3V	I_{OUT1} < 480mA I_{OUT2} < 360mA
Pulse-Skipping Operation Output Current Thresholds	Channel 1: PV_{IN1} = 12V, V_{OUT1} = 1.8V Channel 2: PV_{IN2} = 12V, V_{OUT2} = 3.3V	I_{OUT1} < 330mA I_{OUT2} < 240mA
Switching Frequency		2.25MHz ±20%

QUICK START PROCEDURE

The DC1596 is easy to set up to evaluate the performance of the LTC3607. For a proper measurement equipment configuration, set up the circuit according to the diagram in Figure 1.

Note: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the V_{IN} or V_{OUT} and GND terminals. See the proper scope probe technique in Figure 2.

Please follow the procedure outlined below for proper operation.

1. Connect the input power supply to the PVIN1/PVIN2 and GND terminals (V_{IN1} and V_{IN2} are separate nodes but are connected). Connect the loads between the VOUT and GND terminals. Refer to Figure 1 for the proper measurement equipment setup.

   Before proceeding to operation, insert jumper shunts XJP1 and XJP2 into the OFF positions of headers JP1 and JP2, shunt XJP3 into the pulse-skip position of MODE header JP3, and shunt XJP4 into the VOUT1 voltage options of choice of header JP4: 1.2V, 1.5V, or 1.8V, and shunt XJP5 into the VOUT2 voltage options of choice of header JP5: 2.5V, 3.3V, or 5V.

2. Apply 5.5V at PVINs 1, 2. Measure both VOUTs; they should read 0V. If desired, one can measure the shutdown supply current at this point. The supply current will be less than 1μA in shutdown.

3. Turn on VOUT1 and VOUT2 by shifting shunts XJP1 and XJP2 from the OFF positions to the ON positions. Both output voltages should be within a tolerance of ±2%.

4. Vary the input voltages from 5.8V (the minimum V_{IN} is dependent on V_{OUT}) to 15V, and the load currents from 0A to 600mA. Both output voltages should be within ±4% tolerance.

5. Set the load current of both outputs to 600mA and the input voltages to 12V, and then measure each output ripple voltage (refer to Figure 2 for proper measurement technique); they should each measure less than 20mVAC. Also, observe the voltage waveform at either switch node (Pin 5 for reg.1 and Pin 8 for reg.2) of each regulator. The switching frequencies should be about 2.25MHz ±20% (T = 555ns and 370ns). Both switch node waveforms should be rectangular in shape, and 180° out-of-phase with each other.

6. To operate the ckt.s in Burst Mode operation, change the shunt position of header JP3 to BURST MODE.

7. Regulators 1 (PVIN1) and 2 (PVIN2) are completely separated from each other; thus, they can be powered from different individual input supplies (if R11 is removed), as can the signal input supply, SVIN. However, SVIN must powered for either regulator to function (SVIN is connected to PVIN1 through a filter on the demo board.).

8. When finished, insert shunts XJP1 and XJP2 to the OFF position(s) and disconnect the power.

Warning: If the power for the demo board is carried in long leads, the input voltage at the part could “ring”, which could affect the operation of the circuit or even exceed the maximum voltage rating of the IC. To eliminate the ringing, a small tantalum capacitor (for instance, AVX part # TPSY226M035R0200) is inserted on the pads between the input power and return terminals on the bottom of the demo board. The (greater) ESR of the tantalum capacitor will dampen the (possible) ringing voltage caused by the long input leads. On a normal, typical PCB, with short traces, this capacitor is not needed.

QUICK START PROCEDURE

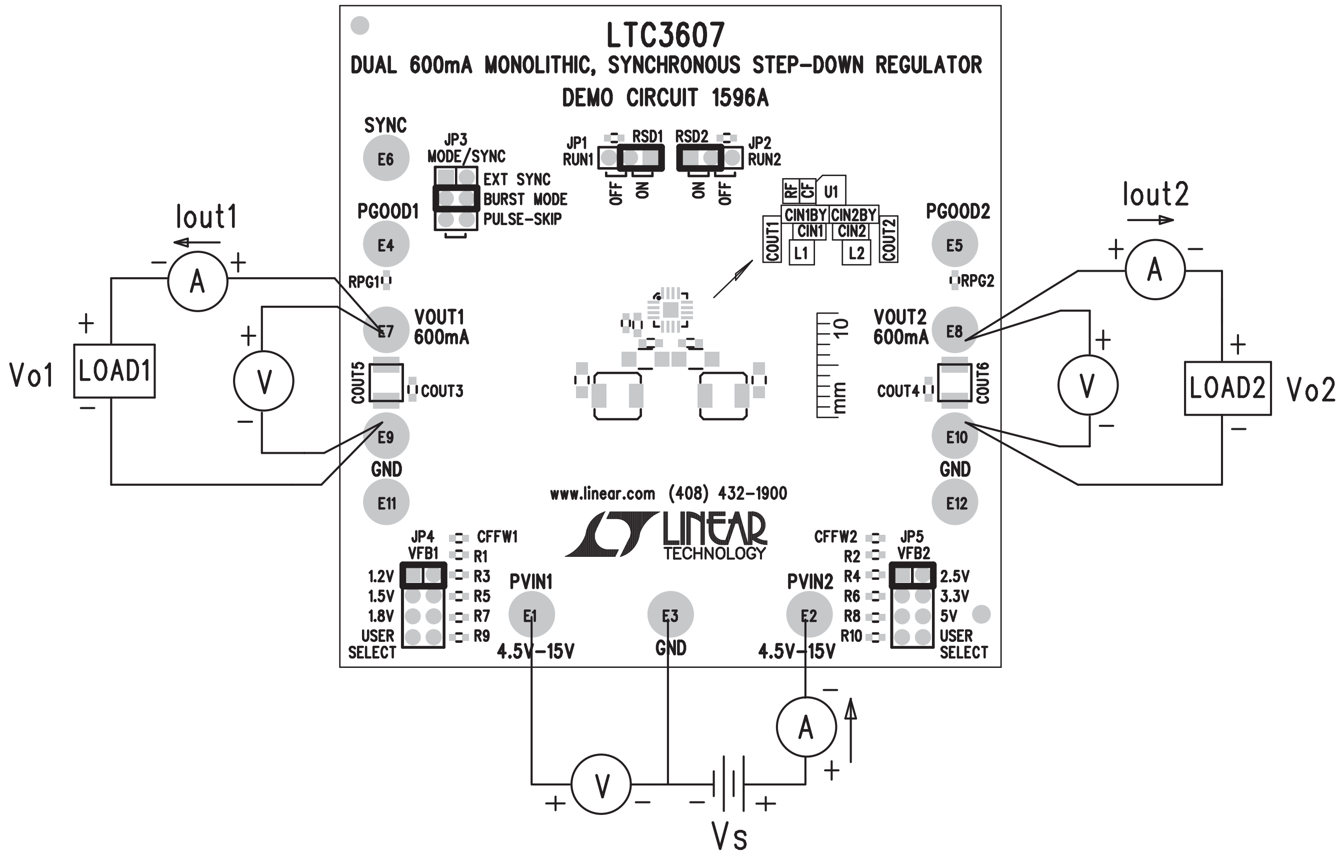


Figure 1. Proper Measurement Equipment Setup

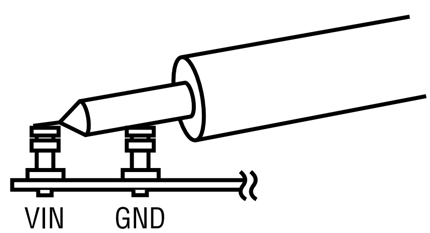
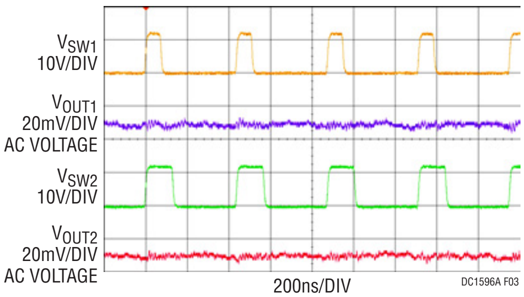


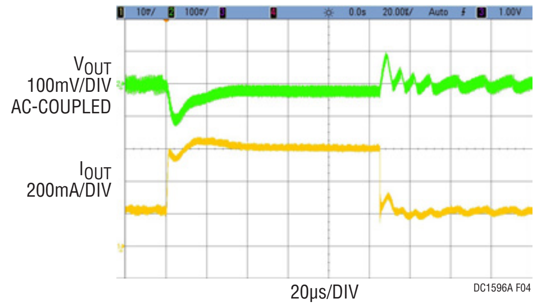
Figure 2. Measuring Input or Output Ripple

QUICK START PROCEDURE



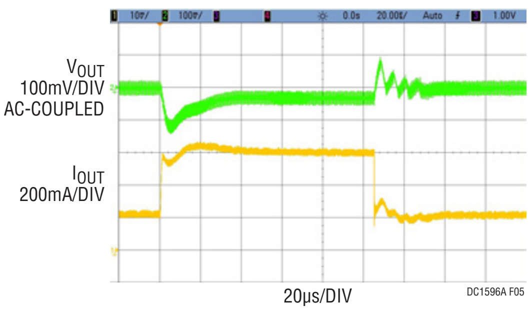
$PV_{IN1,2}$ = 12V
V_{OUT1} = 1.8V AT I_{OUT1} = 600mA
V_{OUT2} = 3.3V AT I_{OUT2} = 600mA
PULSE-SKIPPING MODE

Figure 3. Switch Operation



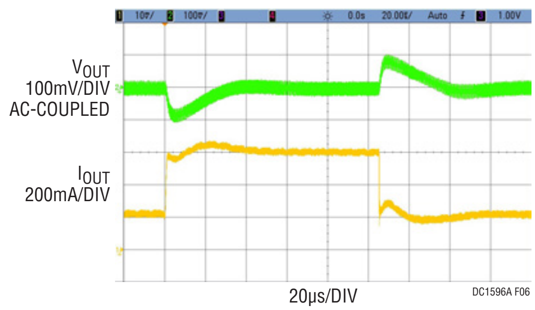
V_{IN} = 12V
V_{OUT1} = 1.2V
400mA LOAD STEP (200mA TO 600mA)
PULSE-SKIPPING MODE, f_{SW} = 2.25MHz

Figure 4. Load Step Response



V_{IN} = 12V
V_{OUT1} = 1.5V
400mA LOAD STEP (200mA TO 600mA)
PULSE-SKIPPING MODE, f_{SW} = 2.25MHz

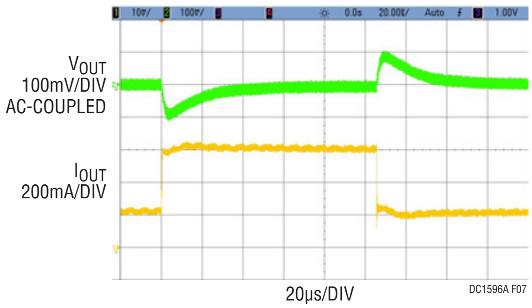
Figure 5. Load Step Response



V_{IN} = 12V
V_{OUT1} = 1.8V
400mA LOAD STEP (200mA TO 600mA)
PULSE-SKIPPING MODE, f_{SW} = 2.25MHz

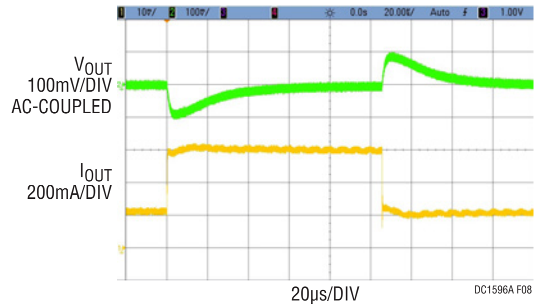
Figure 6. Load Step Response

QUICK START PROCEDURE



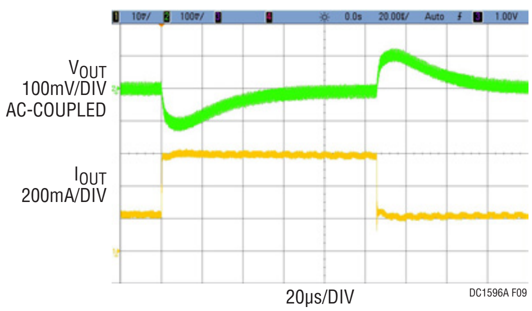
V_{IN} = 12V
V_{OUT2} = 2.5V
400mA LOAD STEP (200mA TO 600mA)
PULSE-SKIPPING MODE, f_{SW} = 2.25MHz

Figure 7. Load Step Response



V_{IN} = 12V
V_{OUT2} = 3.3V
400mA LOAD STEP (200mA TO 600mA)
PULSE-SKIPPING MODE, f_{SW} = 2.25MHz

Figure 8. Load Step Response



V_{IN} = 12V
V_{OUT2} = 5V
400mA LOAD STEP (200mA TO 600mA)
PULSE-SKIPPING MODE, f_{SW} = 2.25MHz

Figure 9. Load Step Response

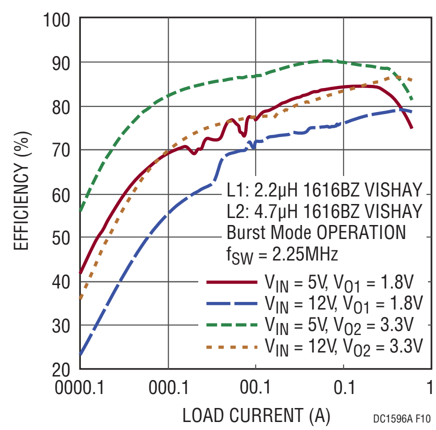
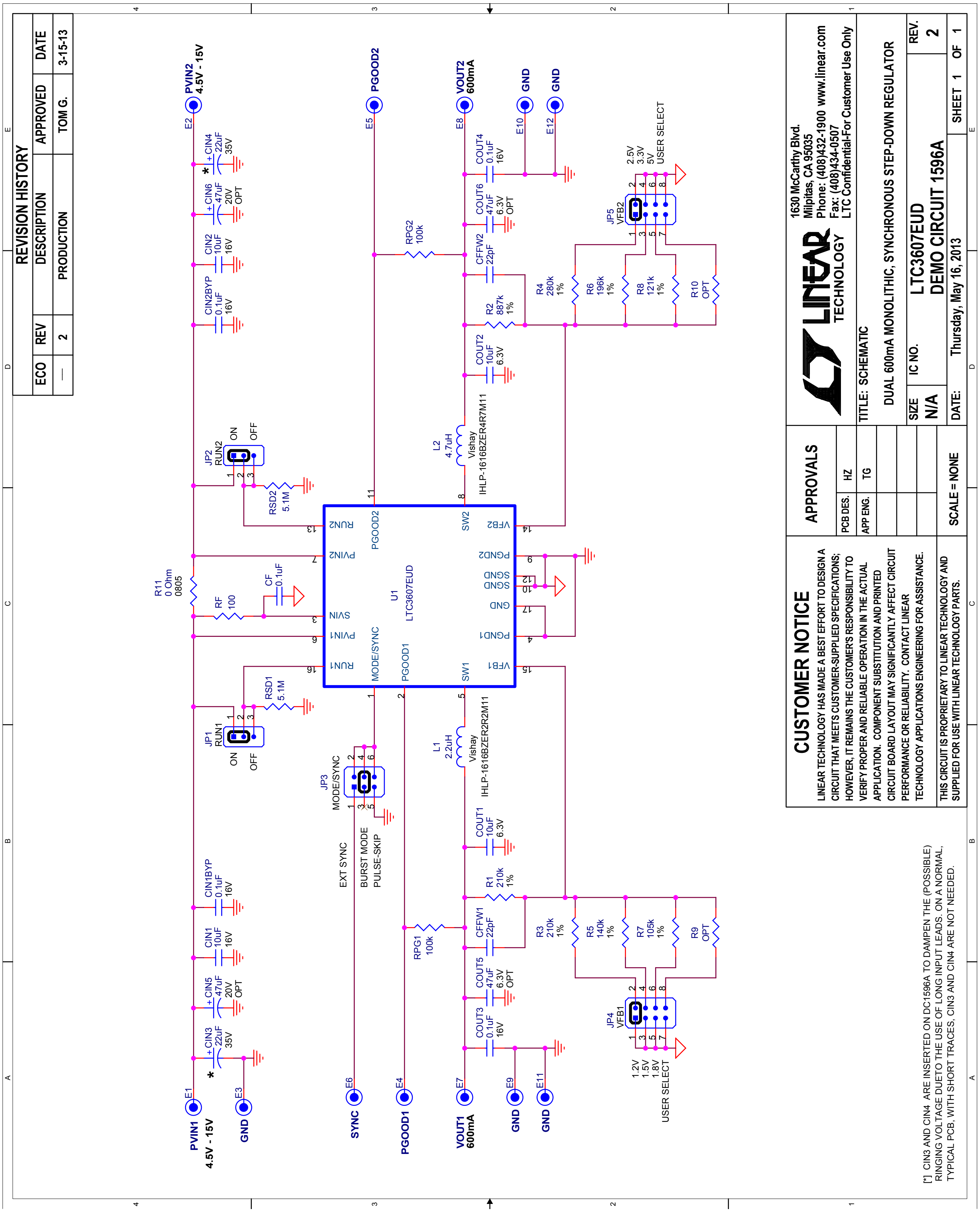


Figure 10. Efficiency

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	CFFW1, CFFW2	CAP., NPO, 22pF, 25V, 5%, 0402	AVX, 04025A220JAT2A
2	2	CIN1BYP, CIN2BYP	CAP., X7R, 0.1µF, 16V, 10%, 0603	AVX, 0603YC104KAT2A
3	2	COUT1, COUT2	CAP., X5R, 10µF, 6.3V, 10%, 0805	AVX, 08056D106KAT2A
4	2	CIN1, CIN2	CAP., X5R, 10µF, 16V, 10%, 1206	AVX, 1206YD106KAT2A
5	1	L1	Inductor, 2.2µH	VISHAY, IHLP1616BZER2R2M11
6	1	L2	Inductor, 4.7µH	VISHAY, IHLP1616BZER4R7M11
7	1	R1	RES., CHIP, 210k, 1%, 0402	VISHAY, CRCW0402210KFKED
8	1	R2	RES., CHIP, 887k, 1%, 0402	VISHAY, CRCW0402887KFKED
9	1	R6	RES., CHIP, 196k, 1%, 0402	VISHAY, CRCW0402196KFKED
10	1	R7	RES., CHIP, 105k, 1%, 0402	VISHAY, CRCW0402105KFKED
11	1	U1	IC., LTC3607EUD, 16-PIN QFN 3X3	LINEAR TECH., LTC3607EUD
Additional Demo Board Circuit Components				
1	3	COUT3, COUT4, CF	CAP., X7R, 0.1µF, 16V, 10%, 0603	AVX, 0603YC104KAT2A
2	2	CIN3, CIN4	CAP., TANT, 22µF, 35V, 20%, CASE Y	AVX, TPSY226M035R0200
3	0	COUT5, COUT6 (OPT.)	CAP., X5R, 47µF, 6.3V, 10%, 1210	AVX, 12106D476KAQ2A
4	0	CIN5, CIN6 (OPT.)	CAP., X5R, 47µF, 20V, 10%, 1812	
5	1	RF	RES., CHIP, 100Ω, 1/16W, 5%, 0402	VISHAY, CRCW0402100RJNED
6	1	R3	RES., CHIP, 210k, 1%, 0402	VISHAY, CRCW0402210KFKED
7	1	R4	RES., CHIP, 280k, 1%, 0402	VISHAY, CRCW0402280KFKED
8	1	R5	RES., CHIP, 140k, 1%, 0402	VISHAY, CRCW0402140KFKED
9	1	R8	RES., CHIP, 121k, 1%, 0402	VISHAY, CRCW0402105KFKED
10	0	R9, R10 (OPT.)	RES., 0402	
11	1	R11	RES., CHIP, 0Ω, 1%, 0805	VISHAY, CRCW08050000Z0ED
12	2	RSD1, RSD2	RES., CHIP, 5.1M, 5%, 0402	VISHAY, CRCW04025M10JNED
13	2	RPG1, RPG2	RES., CHIP, 100k, 1%, 0402	VISHAY, CRCW0402100KFKED
Hardware				
1	12	E1-E12	Testpoint, TURRET, 0.094"	MILL-MAX-2501-2-00-80-00-00-07-0
2	2	JP1,JP2	0.079 SINGLE ROW HEADER, 3-PIN	SAMTEC, TMM103-02-L-S
3	2	JP4,JP5	0.079, 2X4 HEADER	SAMTEC, TMM104-02-L-D
4	1	JP3	0.079, 2X3 HEADER	SAMTEC, TMM103-02-L-D
5	5	JP1-JP5	SHUNT, FOR JP1-JP5	SAMTEC, 2SN-BK-G

SCHEMATIC DIAGRAM



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Mailing Address:

Linear Technology

1630 McCarthy Blvd.

Milpitas, CA 95035

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Linear Technology Corporation
1630 McCarthy Blvd., Milpitas, CA 95035-7417
(408) 432-1900 • FAX: (408) 434-0507 • www.linear.com

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Тел: +7 (812) 336 43 04 (многоканальный)
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