LTC3869IGN-2
Dual, 2-Phase Synchronous Step-Down DC/DC Controllers

DESCRIPTION

Demonstration circuit 1798A is a Dual Output, Dual Phase 5A Synchronous Buck Converter featuring the LTC3869IGN-2. The entire circuit, including the bulk output capacitors, fit within a 1.04" × 0.94" area on all layers. The package style for the LTC3869IGN-2 is a 28-lead narrow plastic SSOP.

The main features of the board include rail tracking, an internal 5V linear regulator for bias, RUN pins for each output, a PGOOD signal and a mode selector that allows the converter to run in CCM, pulse-skipping or Burst Mode operation. Synchronization to an external clock is also possible through some minor component changes. Two versions of the board are available.

DC1798A-A has an on-board sense resistor for current feedback, while the DC1798A-B is configured with a DCR sense circuit that allows the converter to use the inductors DCR as the sense element instead of the on-board sense resistors to save cost and board space and improves efficiency.

The input voltage range is 4.5V to 26V. The LTC3869 datasheet gives a complete description of the part, operation and application information. The datasheet must be read in conjunction with this demo manual for DC1798A.

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

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PERFORMANCE SUMMARY (T_A = 25°C)

PARAMETER	CONDITIONS	VALUE	
Minimum Input Voltage		4.5V	
Maximum Input Voltage		26V	
Output Voltage V_{OUT1}	V_{IN} = 6.5V to 26V, I_{OUT1} = 0A to 5A	3.3V±2%	
Output Voltage V_{OUT2}	V_{IN} = 6.5V to 26V, I_{OUT2} = 0A to 5A	2.5V±2%	
Typical Output Ripple V_{OUT}	V_{IN} = 26V, I_{OUT1} = 5A (20MHz BW)	<30mV_{P-P}*	
	V_{IN} = 26V, I_{OUT2} = 5A (20MHz BW)	<30mV_{P-P}*	
Nominal Switching Frequency		400kHz	
		DC1798A-A	DC1798A-B
Efficiency	V_{OUT1} = 3.3V, I_{OUT1} = 5A; V_{IN} = 16V	90%** Typical	91.0%** Typical
See Figures 3 and 4 for efficiency curves	V_{OUT2} = 2.5V, I_{OUT2} = 5A; V_{IN} = 16V	87.5%* Typical	88.8%* Typical

*Measured at bulk output capacitor

**Optional Mosfet (Si4816BDY) will result in up to 0.4% improvement in efficiency at full load

QUICK START PROCEDURE

Demonstration circuit 1798A is easy to set up to evaluate the performance of the LTC3869IGN-2. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

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 Figure 2 for proper scope probe technique.

1. Make sure jumpers are in the following positions:

JUMPER	POSITION
JP1	ON
JP2	ON
JP3	CCM

2. With power off, connect the input power supply to V_{IN} and GND. Connect active loads to outputs.
3. Turn on the power at the input.

   NOTE. Make sure that the input voltage does not exceed 28V.
4. Check for the proper output voltages.

   V_{OUT1} = 3.234V to 3.366V,

   V_{OUT2} = 2.450V to 2.550V,

   NOTE. If there is no output, temporarily disconnect the load to make sure that the load is not set too high.
5. Once the proper output voltages are established, adjust the loads within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.
6. Different operating modes can be evaluated by changing position of jumper JP3.

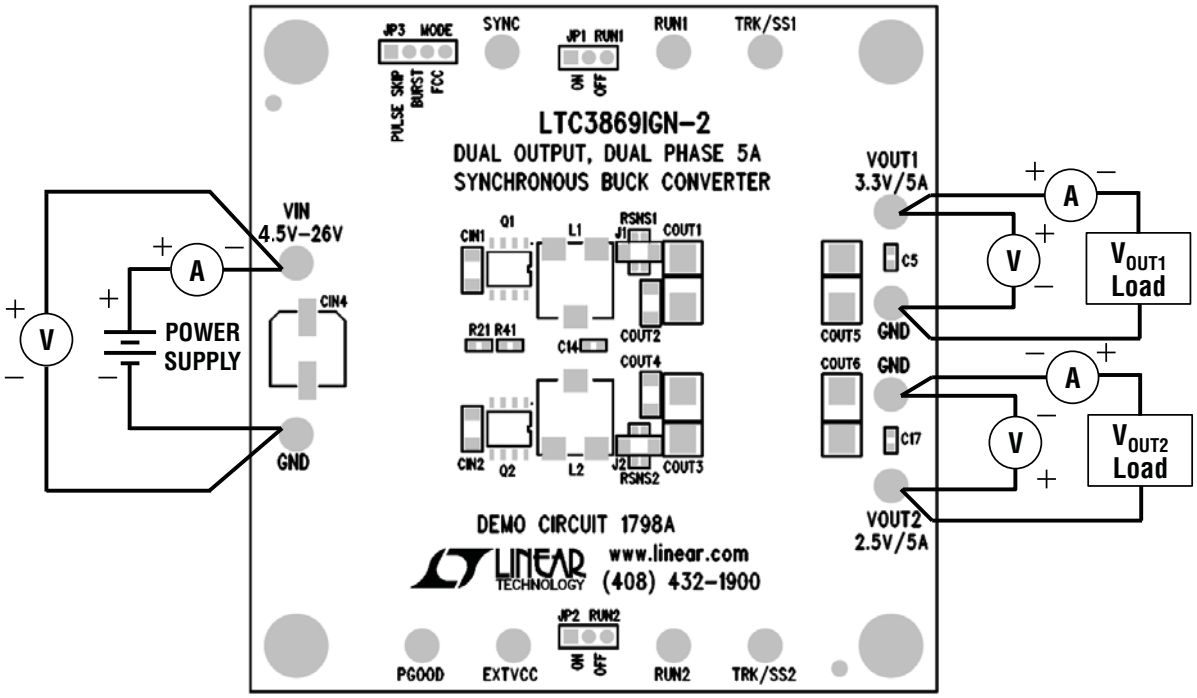


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

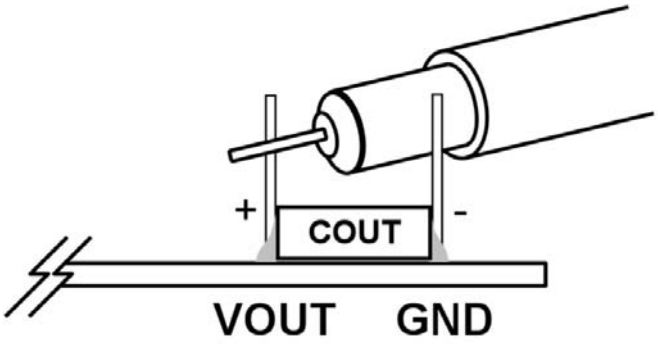


Figure 2. Measuring Output Voltage Ripple

Rail Tracking

Demonstration circuit 1798A is set up for coincident rail tracking where V_{OUT2} tracks V_{OUT1} and the ramp rate for V_{OUT1} is determined by the value of the TRK/SS1 capacitor at C6.

This board can be modified on the bench for external rail tracking or for independent turn-on of the rails. For the latter case, the ramp-rate for V_{OUT1} and V_{OUT2} will be determined by their respective TRK/SS capacitors. Refer to Table 1 for tracking options and to the data sheet for more details.

Inductor DCR Sensing and Resistor Sensing

The two different versions of the board offer either an on-board sense resistor or an inductor DCR sense circuit for current feedback. The DCR sense circuit uses the resistive voltage drop across the inductor to estimate the current. In contrast to the traditional sense resistor current feedback, the DCR sensing circuit offers lower cost and higher efficiency, but results in less accurate current limit due to the large variation in the inductor resistance.

Furthermore, this indirect current sensing method cannot detect inductor saturation and requires the use of 'soft' saturating inductors (such as powder iron) resulting in increased core losses or 'hard' saturating inductors (such as ferrite) with sufficiency high current ratings resulting in increased inductor size. The demonstration circuit 1798A is intended to demonstrate the feasibility of a high performance, high efficiency synchronous buck converter using a 'hard' saturating ferrite inductor with DCR sensing. The typical efficiency versus load current for each of the outputs is given in Figure 3 and Figure 4 respectively. An efficiency improvement of up to 1% is possible for the DCR sensing version. If further improvement in efficiency is required, the switching devices can be replaced by the optional MOSFET Q3 and Q4.

Table 1. Output Tracking Options

	TRACK 1 DIVIDER		TRK/SS1 CAPACITOR	TRACK 1 DIVIDER		TRK/SS1 CAPACITOR
CONFIGURATION	**R10**	**R12**	**C**	**R1**	**R4**	**C**
Soft Start Without Tracking V_{OUT1} V_{OUT2}	0Ω	OPEN	10nF	OPEN	OPEN	10nF
Coincident Tracking: V_{OUT1} tracking External Ramp V_{OUT2} tracking V_{OUT1}	63.4kΩ	20.0kΩ	OPEN	43.2kΩ	20.0kΩ	OPEN
Ratiometric Tracking: V_{OUT2} tracking V_{OUT1}	OPEN	OPEN	OPEN	63.4kΩ	20.0kΩ	OPEN

QUICK START PROCEDURE

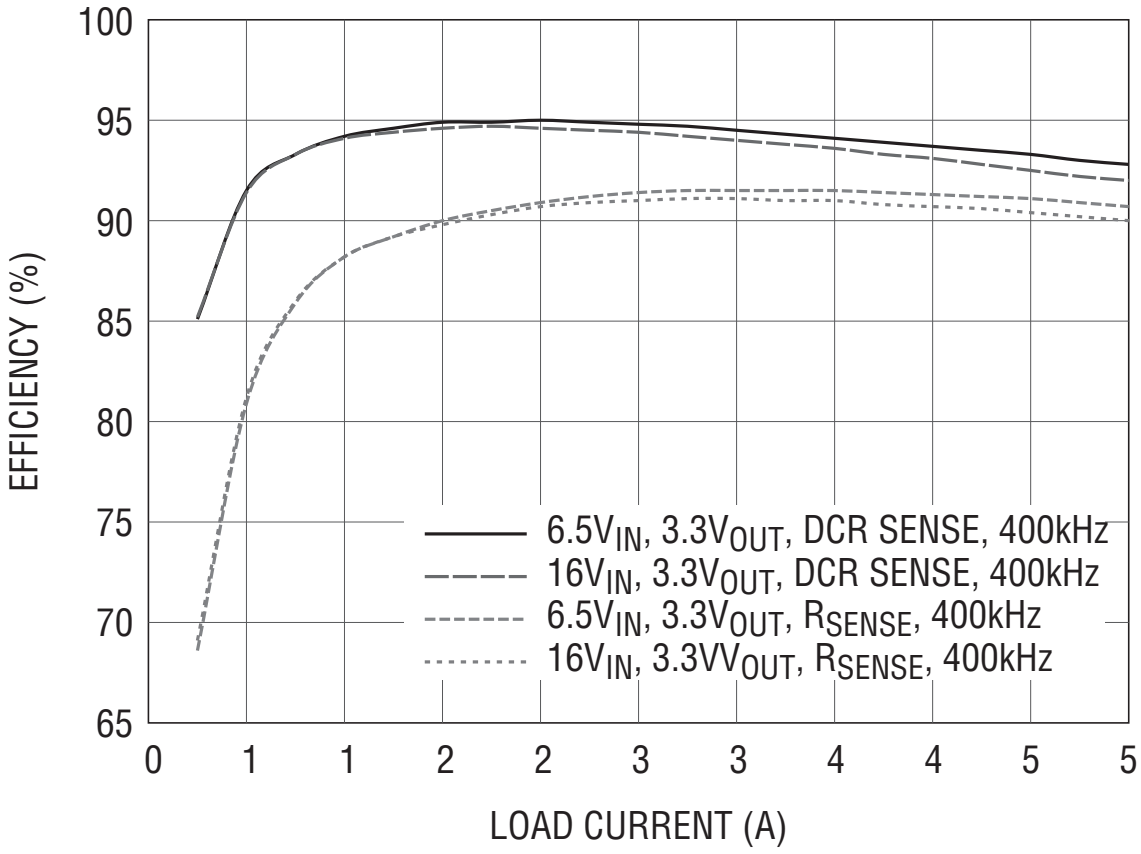


Figure 3. Typical Efficiency vs Load Current for A-A(R_{SENSE}) and A-B(DCR SENSE) Boards, 3.3V_{OUT}, 400kHz

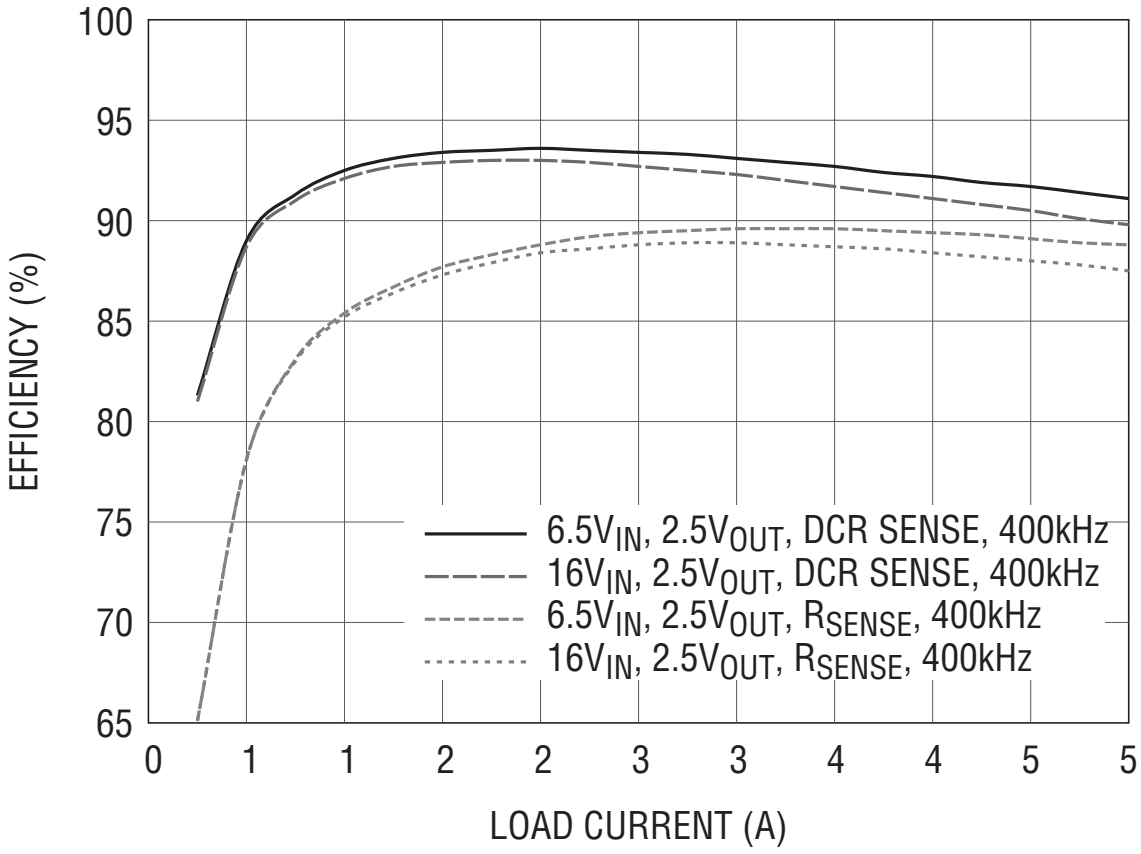
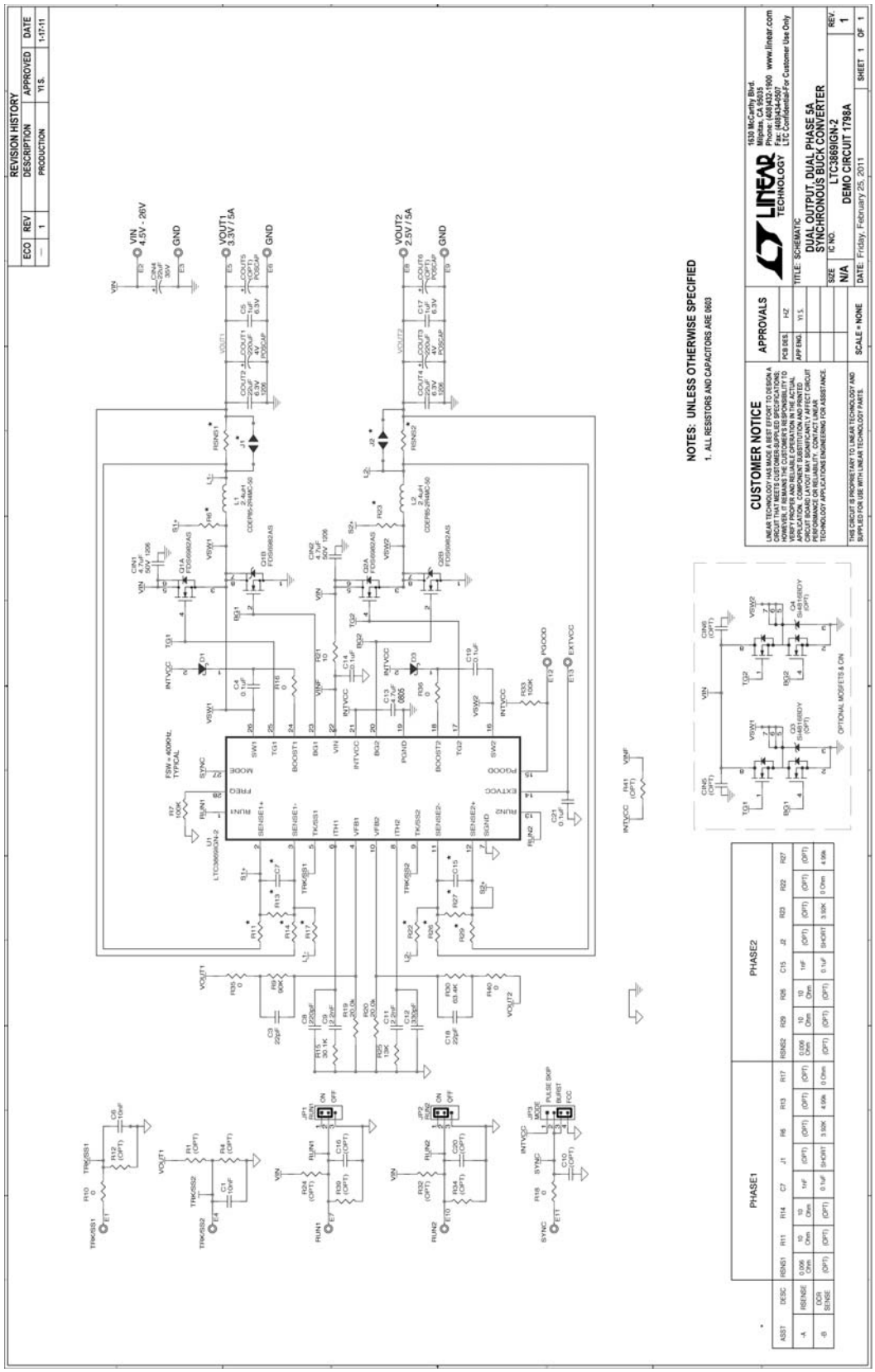


Figure 4. Typical Efficiency vs Load Current for A-A(R_{SENSE}) and A-B(DCR SENSE) Boards, 3.3V_{OUT}, 400kHz

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C_{IN1}, C_{IN2}	Cap., X5R, 4.7µF, 50V, 20%, 1206	Taiyo Yuden, UMK316BJ475ML-T
2	1	C13	Cap., X5R, 4.7µF, 16V, 20%, 0805	Taiyo Yuden, EMK212BJ475MG-T
3	1	C_{IN4}	Cap., OS-CON, 22µF, 35V, SMT	SANYO, 35SVPD22M
4	2	C_{OUT2}, C_{OUT4}	Cap., X5R, 22µF, 6.3V, 20%, 1206	AVX, 12066D226MAT2A
5	2	C_{OUT1}, C_{OUT3}	Cap., POSCAP 220µF 4V 20%, D2E Size	SANYO, 4TPE220MF
6	2	C3, C18	Cap., NPO, 22pF, 50V, 10%, 0603	AVX, 06035A220KAT2A
7	2	C7, C15	Cap., NPO, 1000pF, 25V, 10%, 0603	AVX, 06033A102KAT2A
8	4	C4, C14, C19, C21	Cap., X7R, 0.1µF, 50V, 10%, 0603	AVX, 06035C104KAT
9	2	C5, C17	Cap., X5R, 1µF, 16V, 10%, 0603	AVX, 0603YD105KAT
10	2	C1, C6	Cap., X7R, 0.01µF, 50V, 10%, 0603	TDK, C1608X7R1H103K
11	1	C12	Cap., NPO, 330pF, 25V, 10%, 0603	AVX, 06033A331KAT
12	2	C11, C9	Cap., X7R, 2200pF, 50V, 10%, 0603	AVX, 06035C222KAT
13	1	C8,	Cap., NPO, 220pF, 25V, 10%, 0603	AVX, 06033A221KAT
14	2	D1, D3	Schottky Diode 30V, SOD323	Central Semi., CMDSH-3TR
15	2	L2, L1	Inductor, 2.4µH	Sumida, CDEP85NP-2R4MC-50
16	2	Q1, Q2	Mosfet N-Ch.,Dual	Fairchild Semi., FDS6982AS
17	2	RSNS1, RSNS2	Res., Chip, 0.006, 0.5W, 5%, 1206	IRC, LRC-LRF1206LF-01-R006-J
18	1	R30	Res., Chip, 63.4k, 1/16W, 1%, 0603	VISHAY, CRCW060363K4FKEA
19	6	R10, R16, R18, R35, R36, R40	Res., Chip 0Ω 1/16W, 0603	VISHAY, CRCW06030000Z0EA (2rls)
20	4	R11, R14, R26, R29	Res., Chip, 10, 1/16W, 1%, 0603	VISHAY, CRCW060310R0FKEA
21	2	R19, R20	Res., Chip, 20k, 1/16W, 1%, 0603	VISHAY, CRCW060320K0FKEA
22	1	R7	Res., Chip, 100k, 1/16W, 1%, 0603	VISHAY, CRCW0603100KFKEA
23	1	R9	Res., Chip, 90k, 1/16W, 1%, 0603	VISHAY, CRCW060390K0FKEA
24	1	R15	Res., Chip, 30.1k, 1/16W, 5%, 0603	VISHAY, CRCW060330K0JNEA
25	1	R21	Res., Chip, 10, 1/16W, 5%, 0603	VISHAY, CRCW060310R0JNEA
26	1	R33	Res., Chip, 100K,1/16W, 5%, 0603	VISHAY, CRCW0603100KJNEA
27	1	R25	Res., Chip, 13K, 1/16W, 5%, 0603	VISHAY, CRCW060313K0FKEA
28	1	U1	I.C.LTC3869IGN-2, SSOP, 28 PIN	LINEAR TECH., LTC3869IGN-2
Additional Circuit Components				
1	0	C_{IN5}, C_{IN6} (OPT)	Cap., 1206	
2	0	C10, C16, C20 (OPT)	Cap., 0603	
3	0	C_{OUT5}, C_{OUT6} (OPT)	Cap., POSCAP, D2E size	
4	0	R1, R4, R12, R24, R32, R34, R39, R41, R6, R13, R17, R22, R23, R27	Res., Chip, 0603 (OPT)	
5	0	J1, J2 (OPT)	Res., Chip, 1206	
6	0	Q3, Q4 (OPT)	Mosfet N-Ch.,Dual with Shottky Diode	
Hardware				
1	13	E1-E13	Turret, Testpoint	Mill Max, 2501-2-00-80-00-00-07-0
2	2	JP1, JP2	0.079 SINGLE ROW HEADER, 3 PIN	SAMTEC, TMM-103-02-L-S
3	1	JP3	0.079 SINGLE ROW HEADER, 4 PIN	SAMTEC, TMM-104-02-L-S
4	3	JP1, JP2, JP3	SHUNT,	SAMTEC, 2SN-BK-G
5	4	STAND-OFF	STAND-OFF, NYLON 0.25" tall	KEYSTONE, 8831(SNAP ON)

SCHEMATIC DIAGRAM



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Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

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