LTC3890-2

60V, Low I_Q Multiphase Synchronous Step-Down Converter

DESCRIPTION

Demonstration circuit 2236A-A is a high output voltage, high efficiency synchronous PolyPhase® buck converter featuring the LTC®3890EUH-2. The DC2236A-A has a wide input voltage range of 16V up to 60V, and is capable of delivering up to 25A of output current. The output voltage is set to 12V, however, the output voltage can go as high as 24V, with certain modifications. The DC2236A-A supports three operation modes: Fixed frequency modulation, pulse-skipping and Burst Mode® operation. Fixed frequency mode of operation maximizes the output current, reduces output voltage ripple, and yields a low noise switching spectrum. Burst Mode employs a variable frequency switching algorithm that minimizes the no-load input quiescent current and improves efficiency at light loads.

The DC2236A-A consumes less than 50µA of quiescent current during shutdown and less than 1mA under a no load condition with the output in regulation in Burst Mode operation. The DC2236A-A has a standard operating frequency of 150kHz, but can be adjusted to frequencies as high as 900kHz. The DC2236A is a dual phase single output step-down converter; however it is designed to be easily transformed to a 4- or 6- phase system by combining two or three DC2236A-A boards. The LTC3890EUH-2 data sheet gives a complete description of these parts, operation and application information and must be read in conjunction with this quick start guide for demonstration circuit 2236A-A. Table 1 summarizes the differences between the parts in the LTC3890 family.

Design files for this circuit board are available at http://www.linear.com/demo/DC2236A-A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	VALUE
Minimum Input Voltage		16V
Maximum Input Voltage		60V
Output Voltage V_{OUT} Regulation	V_{IN} = 16V to 55V	12V ± 2%
Maximum Continuous Output Current		25A
Preset Operating Frequency	R7 = 30.1kΩ	150kHz
External Clock Sync. Frequency Range		75kHz to 850kHz
Efficiency	V_{IN} = 36V, V_{OUT} = 12V, I_{OUT} = 12A, See Figure 3 Efficiency Curves for Complete Operating Range	97%
Typical Output Ripple V_{OUT}	V_{IN} = 36V, I_{OUT} = 12A (20MHz BW)	<35mV$_{P-P}$
Quiescent Current at Shutdown	V_{IN} = 16V to 55V	<50µA
Input Current at No Load	V_{IN} = 16V to 55V	<1mA

QUICK START PROCEDURE

Demonstration circuit 2236A-A is easy to set up to evaluate the performance of the LTC3890-2. For proper measurement equipment configuration, set up the circuit according to the diagram in Figure 1. Before proceeding to test, insert shunt into JP1 (RUN) OFF position, which connects the RUN pin to ground (GND), and thus, shuts down the circuit.

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. With the DC2236A-A set up according to the proper measurement and equipment in Figure 1, apply 20V at V_{IN}. Measure V_{OUT}; it should read 0V. If desired, one can measure the shutdown supply current at this point. The supply current will be approximately 50µA, or less, in shutdown.
2. Turn on the circuit by inserting the shunt in header JP1 (RUN) into the ON position. The output voltage should be regulating. Measure V_{OUT} – it should measure 12V ± 2% **(Do not apply more than the rated maximum voltage of 60V to the board or the part may be damaged).**
3. Vary the converter load, which should not exceed 25A. Note: all four input and output terminals VIN, VOUT and two GND equipped with two banana connectors, two-wires can be used for each terminal to reduce copper looses and heat dissipation in the interconnection lines.
4. Vary the input voltage from 16V to 55V, the V_{OUT} – it should measure 12V ± 2%
5. Set output current to zero and move jumper JP2 (MODE) into BURST MODE position and measure V_{OUT} – it should register 12V ± 2%.
6. Set output current to zero and move jumper JP2 (MODE) into PLS SKIP position and measure V_{OUT} – it should register 12V ± 2%

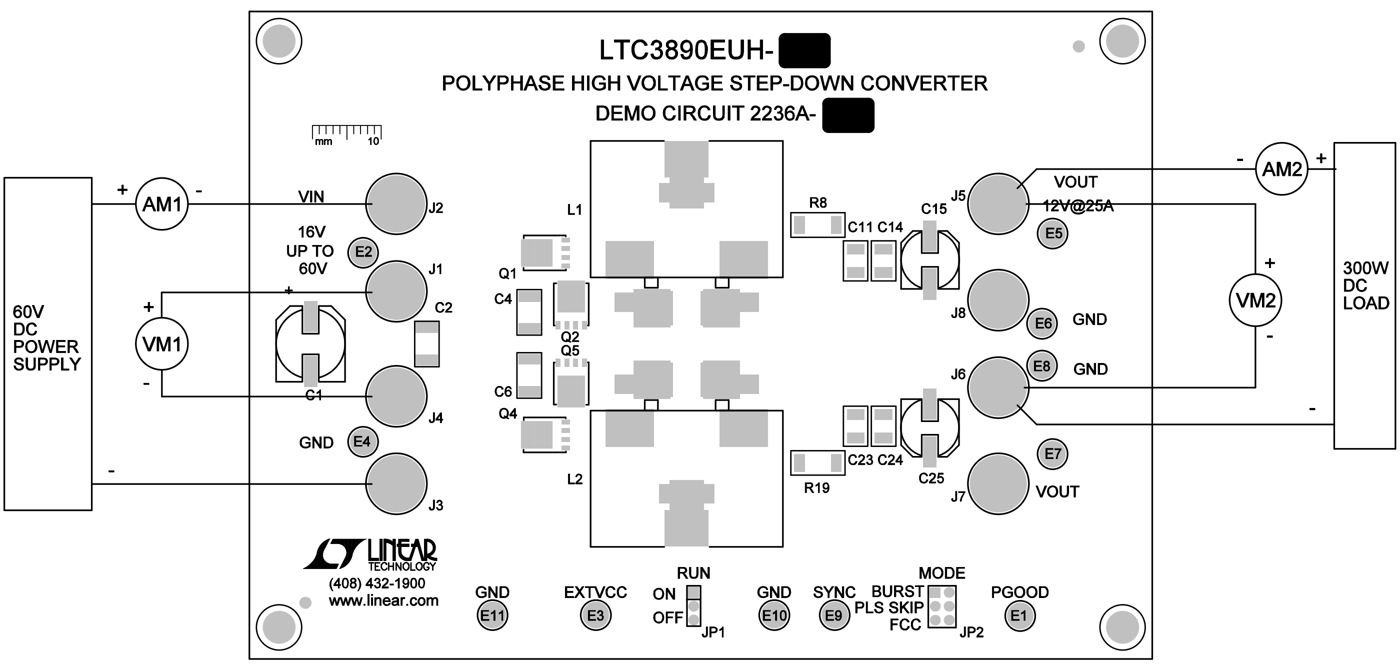


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

Table 1. Summary of the Differences Between the Parts in the LTC3890 Family

	LTC3890	LTC3890-1	LTC3890-2	LTC3890-3
I_{LIM} Pin for Adjustable Current Sense Voltage?	Yes	No	Yes	No
CLKOUT and PHASMD Pins for PolyPhase® Operation?	Yes	No	Yes	No
Independent PGOOD Pins for Each Channel	Yes; PGOOD1 and PGOOD2	No; PGOOD1 Only	Yes; PGOOD1 and PGOOD2	No; PGOOD1 Only
Overvoltage Protection Bottom Gate "Crowbar?"	Yes	Yes	No; BG Not Forced On	No; BG Not Forced On
Current Foldback During Overcurrent Events	Yes	Yes	No	No
Light Load Operation When Synchronized to External Clock Using PLLIN/MODE Pin	Forced Continuous	Forced Continuous	Pulse-Skipping	Pulse-Skipping
SENSE Pins Common Mode Range	Operation with SENSE Common Mode < 0.5V Requires V_{FB} < 0.65V	Operation with SENSE Common Mode < 0.5V Requires V_{FB} < 0.65V	Not Dependent on V_{FB} Voltage. Makes It Easy to Make a Non-synchronous Boost or SEPIC Converter with Ground-Referenced Current Sensing	Not Dependent on V_{FB} Voltage. Makes It Easy to Make a Non-synchronous Boost or SEPIC Converter with Ground-Referenced Current Sensing

QUICK START PROCEDURE

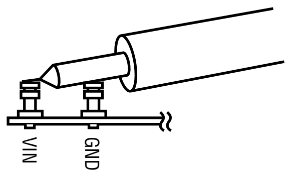


Figure 2. Measuring Input or Output Ripple

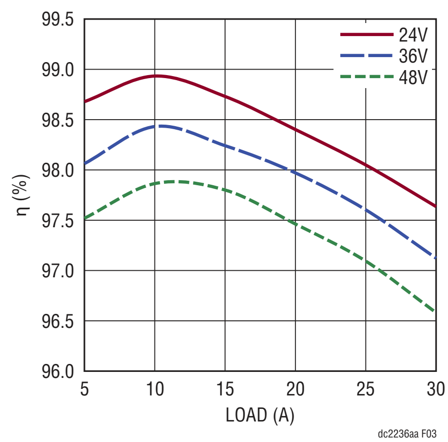


Figure 3. Efficiency vs Load

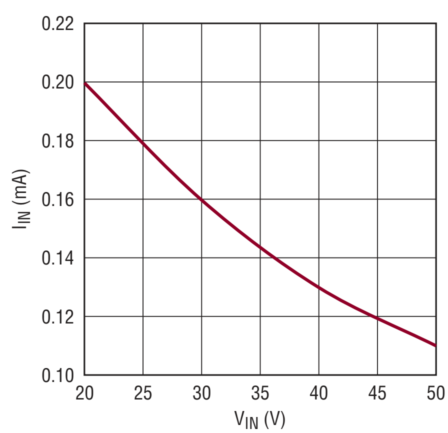


Figure 4. Input Current at No Load vs Input Voltage (Burst Mode)

QUICK START PROCEDURE

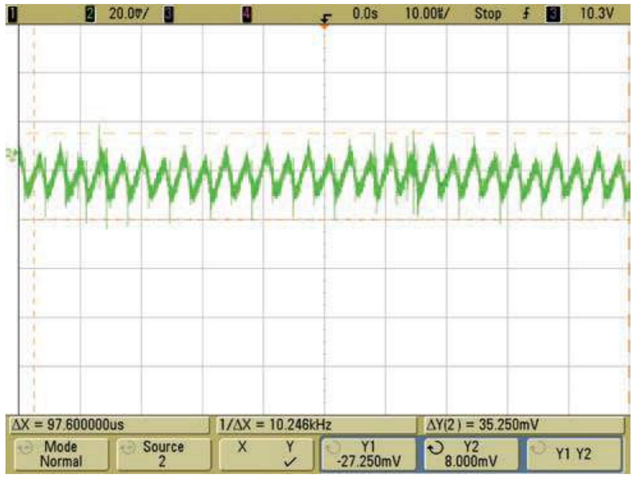


Figure 5. Output Noise, V_{IN} 36V, I_O 12A

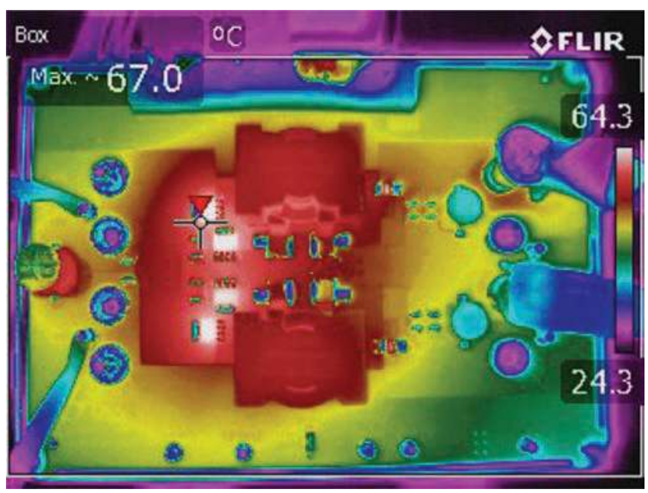
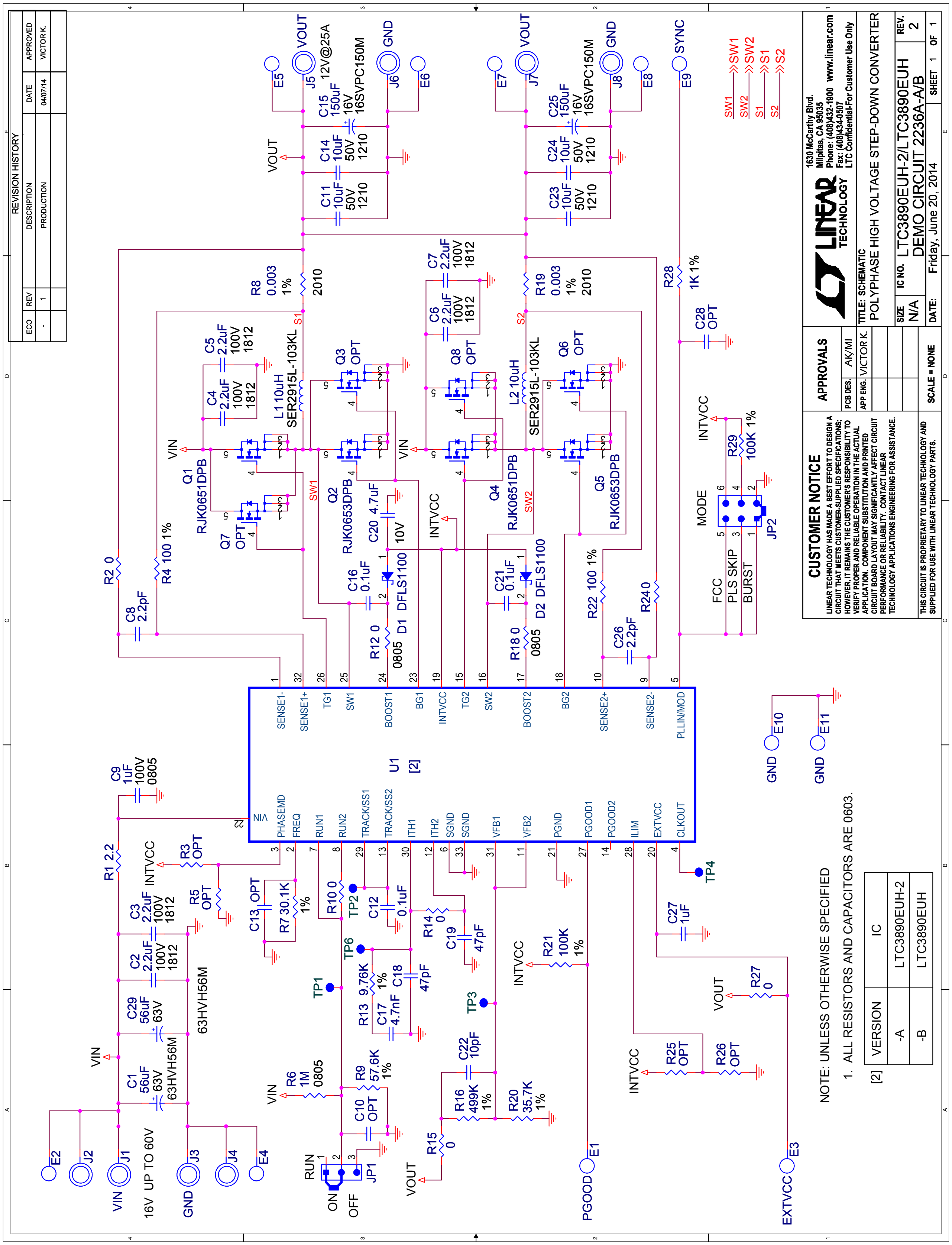


Figure 6. Thermal Map, V_{IN} 48V, V_O 12V, I_O 25A, No Air Flow

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	C1, C29	CAP., ALUM., 56µF, 63V, 20%	SUN ELECT., 63HVH56M
2	6	C2, C3, C4, C5, C6, C7	CAP., X7R, 2.2µF, 100V, 10%, 1812	TDK, C4532X7R2A225K
3	2	C8, C26	CAP., NPO, 2.2pF, 50V, ±0.25pF, 0603	AVX, 06035A2R2CAT
4	1	C9	CAP., X7S, 1µF, 100V, 10%, 0805	TDK, C2012X7S2A105K330
5	4	C11, C14, C23, C24	CAP., X5R, 10µF, 50V, 1210, 20%	TAIYO YUDEN, UMK325BJ106MM-T
6	3	C12, C16, C21	CAP., X7R, 0.1µF, 50V, 10%, 0603	TDK, C1608X7R1H104K
7	2	C15, C25	CAP., SANYO, 150µF, 16V, 20%	SANYO, 16TSVPC150
8	1	C17	CAP., X7R, 4.7nF, 100V, 10%, 0603	AVX, 06031C472KAT
9	2	C18, C19	CAP., NPO, 47pF, 25V, 10%, 0603	AVX, 06033A470KAT2A
10	2	C20	CAP., X7R, 4.7µF, 10V, 10%, 0603	TAIYO YUDEN, LMK107BJ475KA-T
11	1	C22	CAP., NPO, 10pF, 25V, 10%, 0603	AVX, 06033A100KAT2A
12	1	C27	CAP., X5R, 1µF, 25V, 10%, 0603	AVX, 06033D105KAT2A
13	2	D1, D2	DIODE, SCHOTTKY, DFLS1100, PDI-123	DIODES, INC., DFLS1100
14	2	L1, L2	IND., 10µH, SMD	COILCRAFT SER2915L-103KL
15	2	Q1, Q4	RENESAS, N CH POWER MOS FET	RENESAS, RJK0651DPB
16	2	Q2, Q5	RENESAS, N CH POWER MOS FET	RENESAS, RJK0653DPB
17	1	R1	RES., 2.2Ω, 1%, 1/10W, 0603	VISHAY, CRCW06032R20FNEA
18	2	R4, R22	RES., 100Ω, 1%, 1/10W, 0603	VISHAY, CRCW0603100RFKEA
19	6	R2, R10, R14, R15, R24, R27	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
20	1	R6	RES., 1M, 5%, 0805	VISHAY, CRCW08051M00JNED
21	1	R7	RES., 30.1k, 1%, 1/10W, 0603	VISHAY, CRCW060330K1FKEA
22	2	R8, R19	RES., 0.003Ω, 1%, 1/2W, 2010	VISHAY, WSL20103L000FEA
23	1	R9	RES., 57.6k, 1%, 1/10W, 0603	VISHAY, CRCW060357K6FKEA
24	2	R12, R18	RES., 0Ω, 1/10W, 0805	VISHAY, CRCW08050000Z0EA
25	1	R13	RES., 9.76k, 1%, 1/10W, 0603	VISHAY, CRCW060315K0FKEA
26	1	R16	RES., 499k, 1%, 1/10W, 0603	VISHAY, CRCW0603499KFKEA
27	1	R20	RES., 35.7k, 1%, 1/10W, 0603	VISHAY, CRCW060335K7FKEA
28	2	R21, R29	RES., 100k, 1%, 1/10W, 0603	VISHAY, CRCW0603100KFKEA
29	1	R28	RES., 1k, 1%, 1/10W, 0603	VISHAY, CRCW06031K00FKEA
30	1	U1	I.C., LTC3890EUH-2, QFN-32-UH	LINEAR TECH. LTC3890EUH-2
Additional Demo Board Circuit Components				
1	0	R3, R5, C10, C13, R25, R26, C28	OPT	0603 PACKAGE
2	0	Q3, Q6, Q7, Q8	OPT	LFPAK PACKAGE
Hardware: For Demo Board Only				
1	11	E1-E11	TESTPOINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
2	2	JP1, JP2	JMP, 3PIN 1 ROW, 0.079"	SAMTEC, TMM-103-02-L-S
3	2	XJP1, XJP2	SHUNT, 0.079" CENTER	SAMTEC, 2SN-BK-G
4	7	J1-J8	CONNECTOR, BANANA JACK	KEYSTONE, 575-4
5	4	MTGS AT 4 CORNERS	STANDOFF, NYLON 0.5 1/2"	KEYSTONE, 8833(SNAP-ON)

SCHEMATIC DIAGRAM



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