LTC3649
60V, Low IQ Monolithic High Efficiency Step-Down Regulator

DESCRIPTION

Demonstration circuit 2112A is a high input voltage, high efficiency synchronous monolithic buck converter featuring the LTC3649 in a 28-lead UFD package. The DC2112A has wide input voltage range from 3.1V up to 60V. The output voltage of the DC2112A can be set as to 3.3V or 5V. However, the “USER SELECT” option of DC2112A allows output voltage to be as high as input voltage minus 0.5V, with certain modifications. DC2112A is capable of delivering up to 4A of output current. DC2112A supports three operation modes: Fixed-Frequency modulation and Burst Mode, user can synchronize it with an external clock also. 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 DC2112A consumes less than 15μA of quiescent current during shutdown and it consumes less than 440μA at no load conditions in Burst Mode of operation. The DC2112A has a standard operating frequency of 500kHz, but can be adjusted in a range between 300kHz and as high as 3MHz. DC2112A is a monolithic step-down converter, LTC3649 integrates top and bottom N-channel MOSFETs, significantly reducing circuit footprint. DC2112A was designed to support multiple footprints of input/output capacitors and inductor to accommodate variety of applications. The data sheet of LTC3649 gives a complete description functionality of this regulator; also contains operation and application information and must be read in conjunction with this demo board manual for DC2112A.

Design files for this circuit board are available at http://www.linear.com/demo/DC2112A

PERFORMANCE SUMMARY Specifications are at $T_A = 25°C$

PARAMETER	CONDITIONS	VALUE
Minimum Input Voltage		4V
Maximum Input Voltage		60V
Output Voltage V_{OUT} Regulation	V_{IN} = 4V – 60V	5V ± 2% or 3.3V ± 2%
Maximum Continuous Output Current	V_{OUT}	4A
Preset Operating Frequency	R10 = 200kΩ	500kHz
External Clock Sync. Frequency Range		300kHz – 3MHz
Efficiency	V_{IN} = 12V, V_{OUT} = 5V V_{IN} = 12V, V_{OUT} = 3.3V	Up to 95% Up to 95%
Typical Output Ripple V_{OUT}	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 4A (2MHz BW)	<15mV_{P-P}
Quiescent Current at Shutdown	V_{IN} = 4V – 60V	<14μA
Input Current at No Load	V_{IN} = 4V – 60V, Burst Mode	<430μA

QUICK START PROCEDURE

Demonstration circuit 2112A is easy to set up to evaluate the performance of the LTC3649. For proper measurement equipment configuration, set up the circuit according to the diagram in Figure 1. Before proceeding to test, insert shunt into JP2 (RUN) into OFF position, which connects the RUN pin to ground (GND), and thus, shutdown the output. Set jumper JP1 (MODE) into FCC (Forced Counties Conduction Mode) position. Set jumper JP3 (V_{OUT}) into 5.0V position.

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 DC2112A set up according to the proper measurement and equipment in Figure 1, apply 12V 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 14µA, or less, in shutdown.
2. Turn on V_{OUT} of the circuit by inserting the shunt in header JP2 (RUN) into the ON position. The output voltage should be regulating. Measure V_{OUT}^- it should measure 5.0V ±2% (Do not apply more than the rated maximum voltage of 60V to the board or the part may be damaged). Vary the V_{OUT} load, which should not exceed 4A. Vary the input voltage from 6V to 55V, the V_{OUT}^- it should measure 5.0V ±2%.
3. Set JP2 (RUN) into OFF and then jumper JP3 (V_{OUT}) into 3.3V position.
4. Turn on V_{OUT2} of the circuit by inserting the shunt in header JP2 (RUN) into the ON position. The output voltage should be regulating. Measure V_{OUT}^- it should measure 3.3V ±2% (Do not apply more than the rated maximum voltage of 60V to the board or the part may be damaged). Vary the V_{OUT} load, which should not exceed 4A. Vary the input voltage from 16- 55V, the V_{OUT}^- it should measure 3.3V ±2%
5. Set output current to zero and move jumper JP1 (MODE) into BURST position and measure V_{OUT} for 3.3V.
6. Set output current to zero and move jumper JP1 (MODE) into BURST position and measure V_{OUT} for 5.0V.

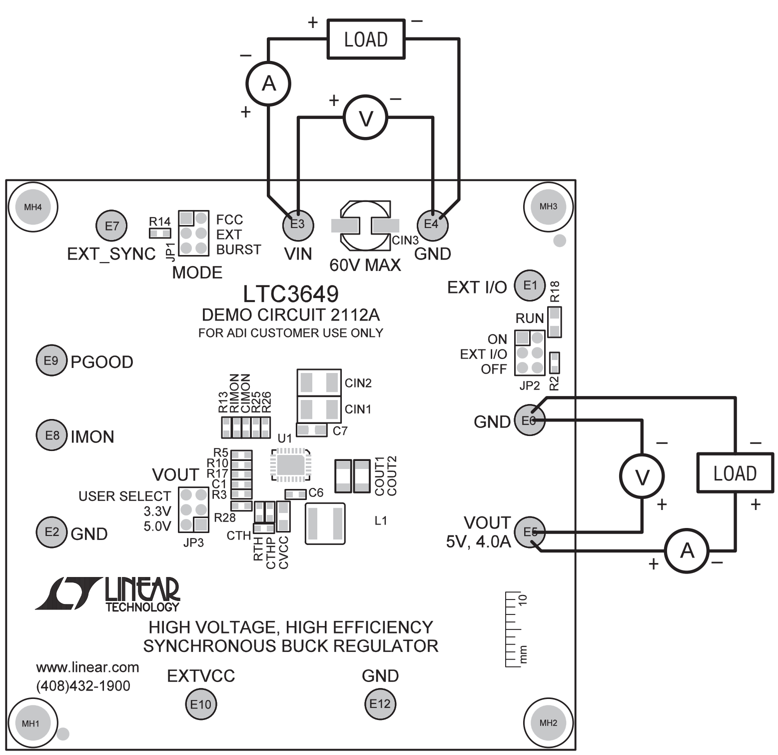


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

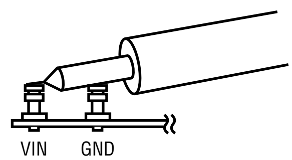


Figure 2. Measuring Input or Output Ripple

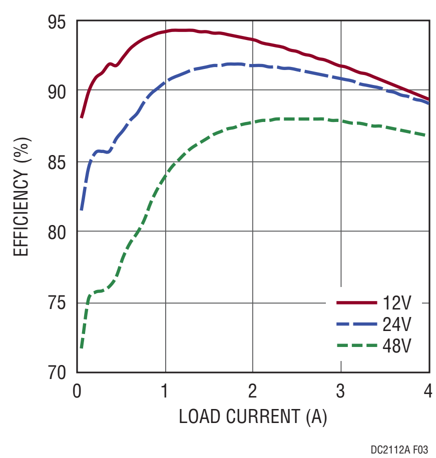


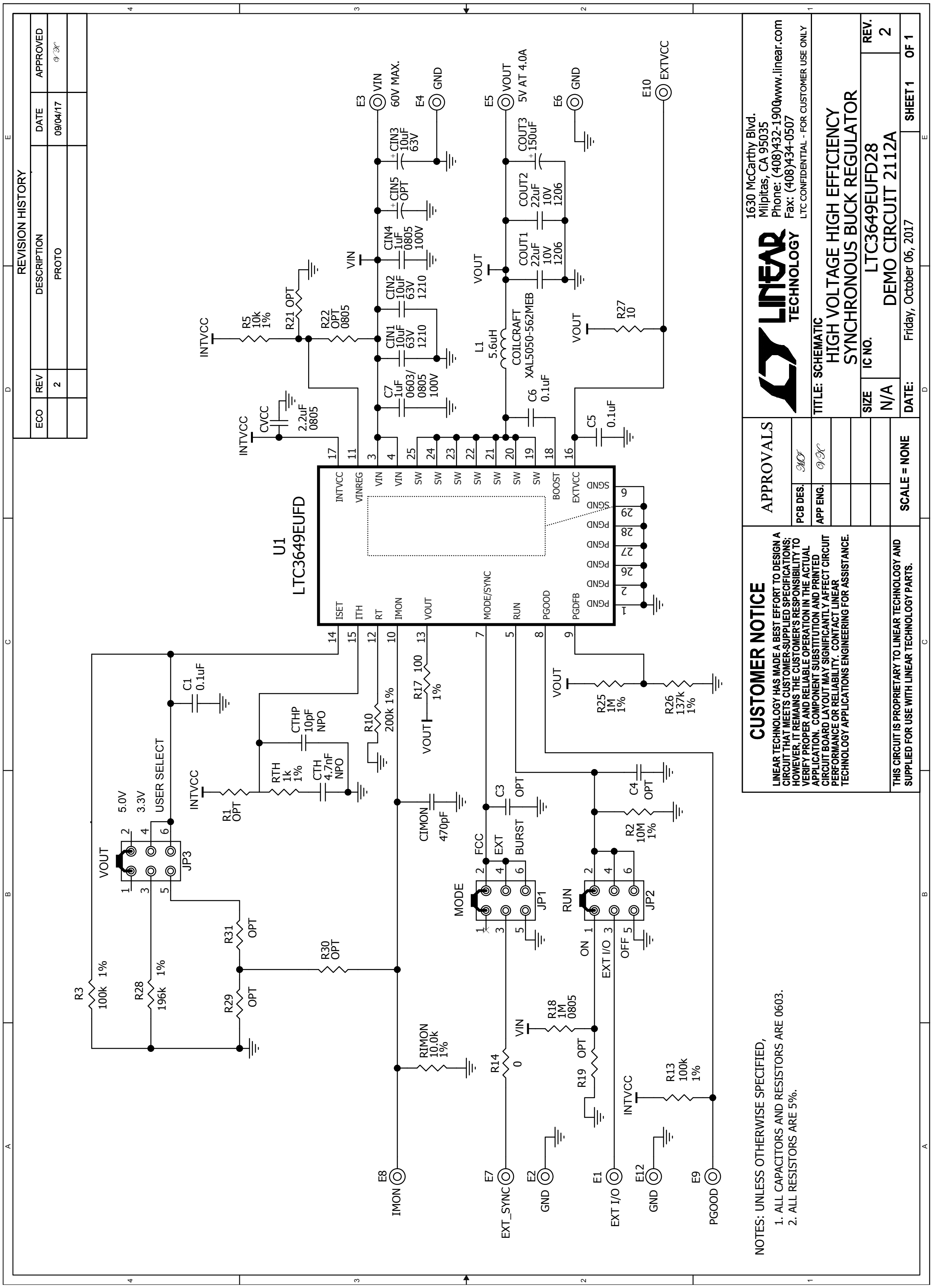
Figure 3. Efficiency vs Input Voltage and Load Current, V_{OUT} 5V, Burst Mode Operation

Figure 4. Thermal Map, V_{IN} 14V, $I_{OUT}1$ 5V at 4A, No Air Flow

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	2	CIN1, CIN2	CAP, 1210 10µF 10% 63V X7R	MURATA GRM32ER71J106KA12L
2	1	CIN3	CAP, 10µF 20% 63V ELEC	SUN ELECT. 63CE10KX
3	2	CIN4, C7	CAP, 0805 1µF 10% 100V X7S	TDK C2012X7S2A105K
4	2	COUT1, COUT2	CAP, 1210 22µF 10% 25V X7R	MURATA GRM32ER71E226KE15L
5	1	COUT3	CAP, 3528 150µF 20% 6.3V POSCAP	PANASONIC 6TPE150MAZB
6	1	CTH	CAP, 0603 4700pF 10% 25V X7R	AVX 06033C472KAT2A
7	1	CTHP	CAP, 0603 10pF 5% 25V C0G	AVX 06033A100JAT2A
8	1	CVCC	CAP, 0805 2.2µF 10% 16V X7R	AVX 0805YC225KAT2A
9	1	C1	CAP, 0603 0.01µF 10% 50V X7R	AVX 06035C103KAT4A
10	1	C5	CAP, 0603 1µF 10% 16V X5R	AVX 0603YD105KAT2A
11	1	C6	CAP, 0603 0.1µF 10% 50V X7R	AVX 06035C104KAT2A
12	1	L1	IND, 5.6µH	COILCRAFT XAL5050-562MEB
13	1	RIMON	RES, 0603 10kΩ 1% 1/10W	VISHAY CRCW060310K0FKEA
14	1	RTH	RES, 0603 1.0kΩ 1% 1/10W	VISHAY CRCW06031K00FKEA
15	1	R2	RES, 0603 10MΩ 1% 1/10W	VISHAY CRCW060310M0FKEA
16	1	R3	RES, 0603 100kΩ 1% 1/10W	VISHAY CRCW0603100KFKEA
17	1	R5	RES, 0603 10kΩ 5% 1/10W	VISHAY CRCW060310K0JNEA
18	1	R10	RES, 0603 340kΩ 1% 1/10W	VISHAY CRCW0603340KFKEA
19	1	R13	RES, 0603 100kΩ 5% 1/10W	VISHAY CRCW0603100KJNEA
20	1	R14	RES, 0603 0Ω JUMPER	VISHAY CRCW06030000Z0EA
	1	R17	RES, 0603 100Ω 1% 1/10W	VISHAY CRCW0603100RFKEA
21	1	R18	RES, 0805 1MΩ 1% 1/8W	VISHAY CRCW08051M00FKEA
22	1	R25	RES, 0603 1MΩ 1% 1/10W	VISHAY CRCW06031M00FKEA
	1	R27	RES, 0603 10Ω 1% 0.1W	VISHAY CRCW060310R0FKEA
23	1	R26	RES, 0603 137kΩ 1% 0.063W	VISHAY CRCW0603137KFKEA
24	1	R28	RES, 0603 196kΩ 1% 1/10W	VISHAY CRCW0603196KFKEA
25	1	U1	IC, SYNCHRONOUS BUCK REGULATOR	LINEAR TECH. LTC3649EUFD#PBF
Additional Demo Board Circuit Components				
		R1, R19, R21, R29, R30, R31	RES, 0603 OPTION	OPTION
		R22	RES, 0805 OPTION	VISHAY CRCW08051M00FKEA
		C3, C4	CAP, 0603 OPTION	OPTION
		CIN5	CAP, OPTION	OPTION
Hardware: For Demo Board Only				
	11	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E12	TURRET	MILL MAX 2501-2-00-80-00-00-07-0
	3	JP1, JP2, JP3	HEADER, 3-PIN, DBL ROW 2mm	SULLINS, NRPN032PAEN
	4	MH1, MH2, MH3, MH4	STANDOFF, SNAP ON	KEYSTONE 8833
	3	XJP1, XJP2, XJP3	SHUNT	SAMTEC 2SN-BK-G

SCHEMATIC DIAGRAM



dc2112af

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Legal Terms and Conditions

LT 0118 • PRINTED IN USA

ANALOG DEVICES