LT8714 Synchronous Four-Quadrant Converter

DESCRIPTION

Demonstration circuit 2240A is a synchronous four-quadrant converter featuring the LT®8714 switching controller. The LT8714 can regulate to positive, negative, or zero volts when configured as a four-quadrant topology. The DC2240A regulates from a 10V to 14V input source to an adjustable output voltage from positive 5V to negative 5V with a 5A maximum current rating, and operates at 200kHz switching frequency.

The LT8714 incorporates a power good feature to let the user know if the output voltage is within its target regulation voltage.

The LT8714 has an output voltage control (CTRL) pin which sets the output voltage. The DC2240A has a jumper to select the CTRL pin voltage source from either externally (EXT) or internally (INT). If selected internally, the output voltage can be set to +5V or –5V. If selected externally, the output voltage can vary between positive 5V and negative 5V, following a 0.1V – 1V CTRL signal with high bandwidth.

The LT8714 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this quick start guide for demo circuit 2240A.

Design files for this circuit board are available at http://www.linear.com/8714

PERFORMANCE SUMMARY

Specifications are at $T_A = 25°C$

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage		10	12	14	V
Positive Output Voltage (Max)	V_{IN} = 10V – 14V	4.85	5	5.15	V
Negative Output Voltage (Max)	V_{IN} = 10V – 14V	–4.85	–5	–5.15	V
Maximum Output Current		5			A
Positive Output Voltage Ripple	V_{IN} = 10V – 14V, V_{OUT} = 5V, I_{OUT} = 5A (20MHz BW)		25		mV_{P-P}
Negative Output Voltage Ripple	V_{IN} = 10V – 14V, V_{OUT} = –5V, I_{OUT} = –5A (20MHz BW)		25		mV_{P-P}
Typical Switching Frequency			200		kHz
Efficiency	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 5A		89		%
	V_{IN} = 12V, V_{OUT} = –5V, I_{OUT} = –5A		80		%

Figure 1. DC2240A Connection Diagram

QUICK START PROCEDURE

Demonstration circuit 2240A is easy to set up to evaluate the performance of the LT8714. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. With the power off, connect the input power supply to the board through V_{IN} and PGND terminals. Connect the load to the terminals V_{OUT} and PGND on the board. Make sure that the input power supply has sufficient current rating at minimum input voltage for the required output load.
2. Turn on the power at the input.

   NOTE: Make sure that the input voltage does not exceed 14V.
3. Check for the proper output voltages. The output should be regulated at +5.0V (±3%).

   If there is no output, temporarily disconnect the load to make sure that the load is not set too high.
4. Once the proper output voltage is established, adjust the input voltage and load current within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

   NOTE: When measuring the input or output voltage ripples, 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} and PGND, or V_{OUT} and PGND terminals. See Figure 2 for proper scope probe technique.

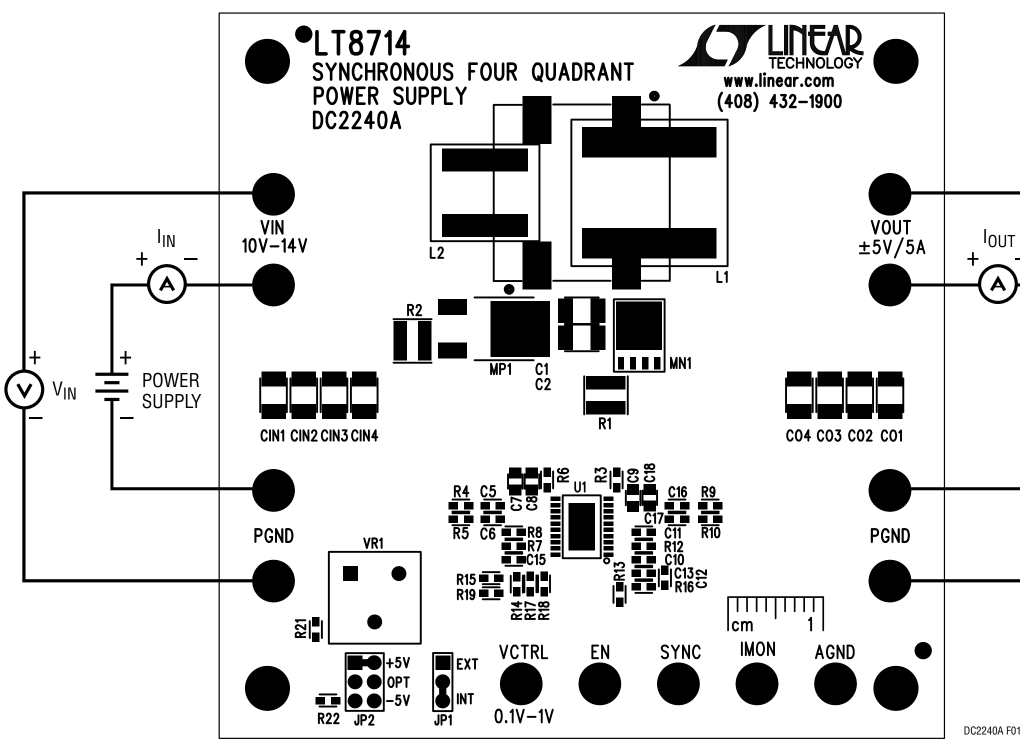


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

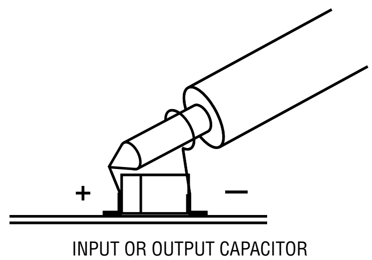


Figure 2. Proper Scope Probe Placement for Measuring Input or Output Ripple

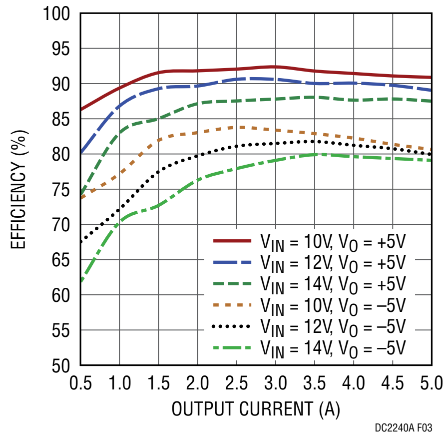


Figure 3. Typical Efficiency Curve

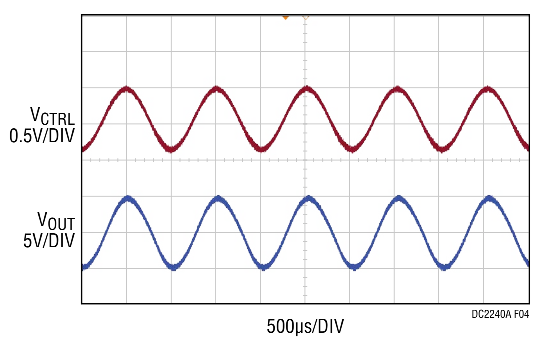
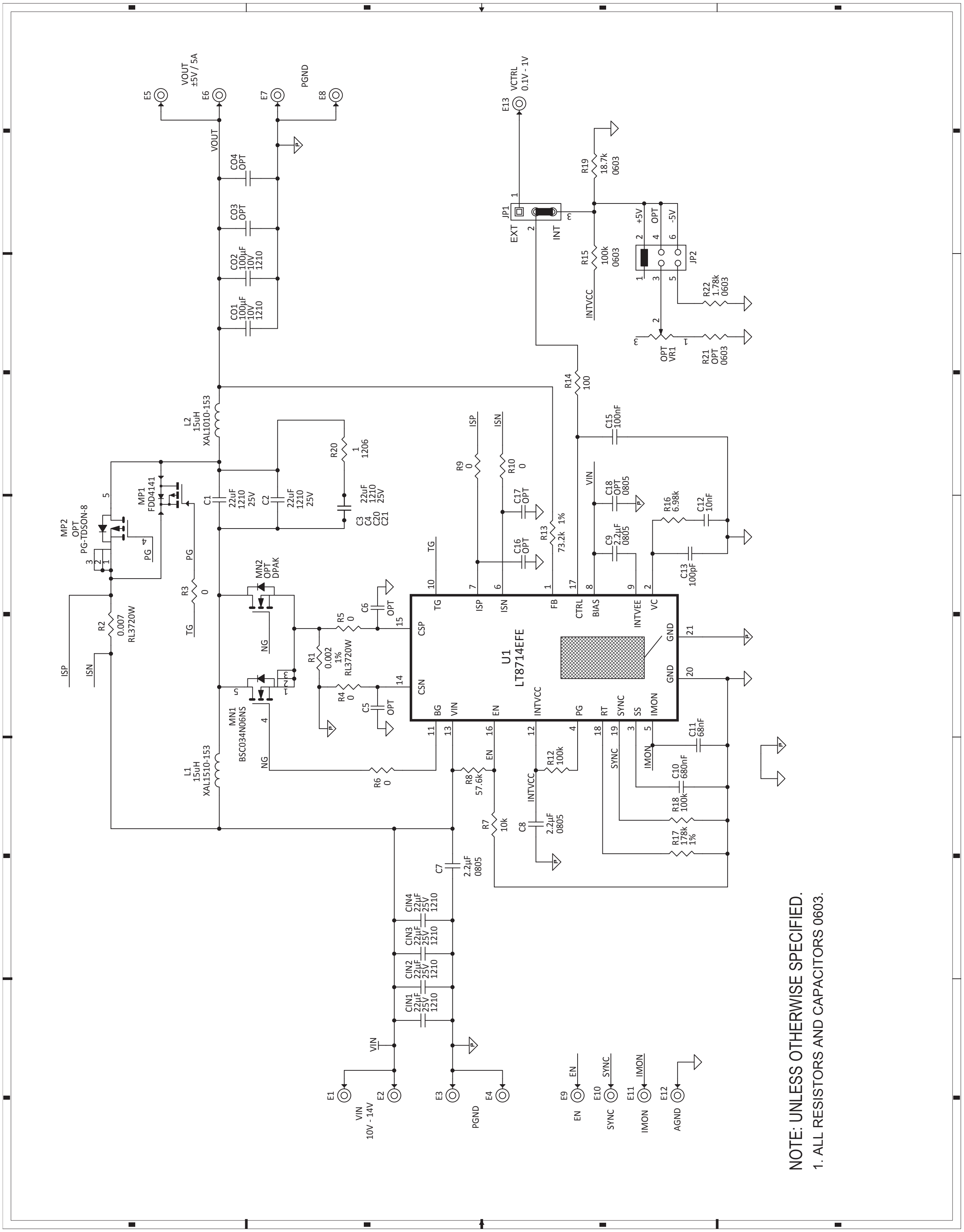


Figure 4. Output Voltage Varies Between –5V and +5V, Following an Externally Controlled 0.1V to 1V, 1kHz Sinusoidal Voltage Source

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	4	CIN1, CIN2, CIN3, CIN4	CAP., X5R, 22µF, 25V, 10%, 1210	MURATA, GRM32ER61E226KE15L
2	6	C1, C2, C3, C4, C20, C21	CAP., X5R, 22µF, 25V, 10%, 1210	MURATA, GRM32ER61E226KE15L
3	2	CO1, CO2	CAP., X5R, 100µF, 10V, 20%, 1210	MURATA, GRM32ER61A107ME20K
4	3	C7, C8, C9	CAP., X7R, 2.2µF, 25V, 10%, 0805	MURATA, GRM21BR71E225KA73L
5	1	C10	CAP., X7R, 0.68µF, 25V, 10%, 0603	TDK, C1608X7R1E684K080AB
6	1	C11	CAP., X7R, 0.068µF, 25V, 10%, 0603	MURATA, GRM188R71E683KA01D
7	1	C12	CAP., X7R, 0.01µF, 25V, 10%, 0603	MURATA, GRM188R71E103KA01D
8	1	C13	CAP., X7R, 100pF, 25V, 10%, 0603	AVX, 06033C101KAT2A
9	1	C15	CAP., X7R, 0.1µF, 16V, 10%, 0603	MURATA, GRM188R71C104KA01D
10	1	L1	INDUCTOR, 15µH	Coilcraft, XAL1510-153
11	1	L2	INDUCTOR, 15µH	Coilcraft, XAL1010-153
12	1	MN1	N-CH FET, PG-TDSON-8	INFINEON, BSC034N06NS
13	1	MP1	P-CH FET, DPAK	FAIRCHILD, FDD4141
14	1	R1	RES., SENSE, 7 mΩ, 1%, RL3720W	SUSUMU, RL3720WT-R007-F
15	1	R2	RES., SENSE, 2 mΩ, 1%, RL3720W	SUSUMU, RL3720WT-R002-F
16	6	R3, R4, R5, R6, R9, R10	RES., 0Ω, 0.1W, 1%, 0603	VISHAY, CRCW06030000Z0EA
17	1	R7	RES., 10k, 1/10W, 1%, 0603	VISHAY, CRCW060310K0FKEA
18	1	R8	RES., 57.6k, 1/10W, 1%, 0603	VISHAY, CRCW060357K6FKEA
19	1	R16	RES., 6.98k, 1/10W, 1%, 0603	VISHAY, CRCW06036K98FKEA
20	1	R19	RES., 18.7k, 1/10W, 1%, 0603	VISHAY, CRCW060318K7FKEA
21	3	R12, R15, R18	RES., 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
22	1	R13	RES., 73.2k, 1/10W, 1%, 0603	VISHAY, CRCW060373K2FKEA
23	1	R14	RES., 100, 1/10W, 1%, 0603	VISHAY, CRCW0603100RFKEA
24	1	R17	RES., 178k, 1/10W, 1%, 0603	VISHAY, CRCW0603178KFKEA
25	1	R19	RES., 18.7k, 1/10W, 1%, 0603	VISHAY, CRCW060318K7FKEA
26	1	R20	RES., 1Ω, 1/4W, 1%, 1206	VISHAY, CRCW12061R00FKEA
27	1	R22	RES., 1.78k, 1/10W, 1%, 0603	VISHAY, CRCW06031K78FKEA
28	1	U1	I.C., VOLTAGE REGULATOR, 20TSSOP	LINEAR TECHNOLOGY, LT8714EFE#PBF
29	1		FAB, PRINTED CIRCUIT BOARD	DEMO CIRCUIT 2240A
Additional Demo Board Circuit Components				
1	0	CO3, CO4 (OPT)	CAP., OPTION, 1210	
2	0	C5, C6, C16, C17 (OPT)	CAP., OPTION, 0603	
3	0	C18 (OPT)	CAP., OPTION, 0805	
4	0	VR1 (OPT)	TRIMMER, OPT	
5	0	R21 (OPT)	RES., OPT, 0603	
6	0	MN2 (OPT)	N-CH FET, OPTION, DPAK	
7	0	MP2 (OPT)	P-CH FET, OPTION, PG-TDSON-8	
Hardware: For Demo Board Only				
1	13	E1-E13	TESTPOINT, TURRET, .094" PbF	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	JP1	HEADER 3 PIN 0.079 SINGLE ROW	WURTH ELEKTRONIK, 620 003 111 21
3	1	JP2	HEADER 3 PIN 0.079 DOUBLE ROW	WURTH ELEKTRONIK, 620 006 211 21
4	2	XJP1, XJP2	SHUNT, 0.079" CENTER	WURTH ELEKTRONIK, 608 002 134 21
5	4	MH1-MH4	STAND-OFF, NYLON 0.50"	KEYSTONE, 8833 (SNAP ON)

SCHEMATIC DIAGRAM



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