LTC7149
60V, Low IQ High Voltage, Negative Output Monolithic Synchronous Regulator

DESCRIPTION

Demonstration circuit 2354A is a high input voltage, high efficiency synchronous monolithic step-down converter with negative output featuring the LTC7149. The DC2354A has wide input voltage range from 3.5V up to 55V. The output voltage of the DC2354A can be set as to –3.3V or –5V and "User Select" option of DC2354A allows output voltage to be in a rage from 0V to –60V. However voltage difference between user-selected negative output voltage ($-V_{OUT}$) and maximum input voltage (V_{IN}), should not exceed 60V. $|-V_{OUT}| + V_{IN} < 60V$. DC2354A is capable of delivering up to 4A of output current, nevertheless at lower input voltage load current should be reduced in accordance to enclosed derating curves. DC2354A supports three operation modes: Fixed-frequency modulation, Burst Mode™ operation and user can synchronize it with 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 operation employs a variable frequency switching algorithm that minimizes the no-load input quiescent current and improves efficiency at light loads.

The DC2354A consumes less than 15µA of quiescent current during shutdown and it consumes less than 600µA at no-load conditions in Burst Mode of operation. The DC2354A has a standard operating frequency of 500kHz, but can be adjusted in a range between 300kHz and as high as 3MHz. LTC7149, which is used in DC2354A, integrates top and bottom N-Channel MOSFETs, significantly reducing overall circuit footprint. DC2354A was designed to support multiple footprints of input/output capacitors and inductors to accommodate variety of applications. The data sheet of LTC7149 gives a complete description functionality of this regulator; also contains operation and application information and must be read in conjunction with this manual for Demonstration circuit 2354A.

Design files for this circuit board are available at http://www.linear.com/demo/DC2354A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS/NOTES	VALUE
Minimum Input Voltage		3.5V
Maximum Input Voltage		55V
Output Voltage V_{OUT}^- Regulation	V_{IN} = 3.5V – 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, I_{OUT} = 1A V_{IN} = 12V, V_{OUT}^- = –3.3V, I_{OUT} = 1A	90% 90%
Typical Output Ripple V_{OUT}^-	V_{IN} = 12V, V_{OUT}^- = –5V, I_{OUT} = 1A (20MHz BW)	<15mV_{P-P}
Quiescent Current at Shutdown	V_{IN} = 3.5V – 55V	<14µA
Input Current at No-Load	V_{IN} = 3.5V – 55V, Burst Mode Operation	<600µA

QUICK START PROCEDURE

Demonstration circuit 2354A is easy to set up to evaluate the performance of the LTC7149. 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 DC2354A set up according to the proper measurement and equipment in Figure 1, apply 16V 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}^- and it should measure –5.0V ±2%. Vary the current load, which should not exceed 4A. Vary the input voltage from 3.5V to 55V, the V_{OUT}^-, it should measure –5.0V ±2%. Maximum load current is function of input voltage and should be changed accordance to derating graphs on Figure 3.
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 maximum voltage of 55V to the board or the part may be damaged). Vary the current load, which should not exceed 4A. Vary the input voltage from 3.5V to 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}^-, which should be –3.3V ±2%.
6. Set output current to zero and move jumper JP1 (MODE) into BURST position and measure V_{OUT}^-, which should be –5V ±2%..

DC2354A supports synchronization to external clock referenced to input GND; use EXT_SYNC terminal for synchronization. PGOOD signal also referenced to input GND, to activate PGOOD functionality connect external voltage source to terminals VLOGIC and GND. DC2354A supports also $EXTV_{CC}$ function, however, $EXTV_{CC}$ is referenced to V_{OUT}^-. Remove R5 and install optional R33 10Ω resistor if external $EXTV_{CC}$ voltage source is used.

Note: Do not apply more than the maximum voltage of 55V to the board or the part may be damaged.

QUICK START PROCEDURE

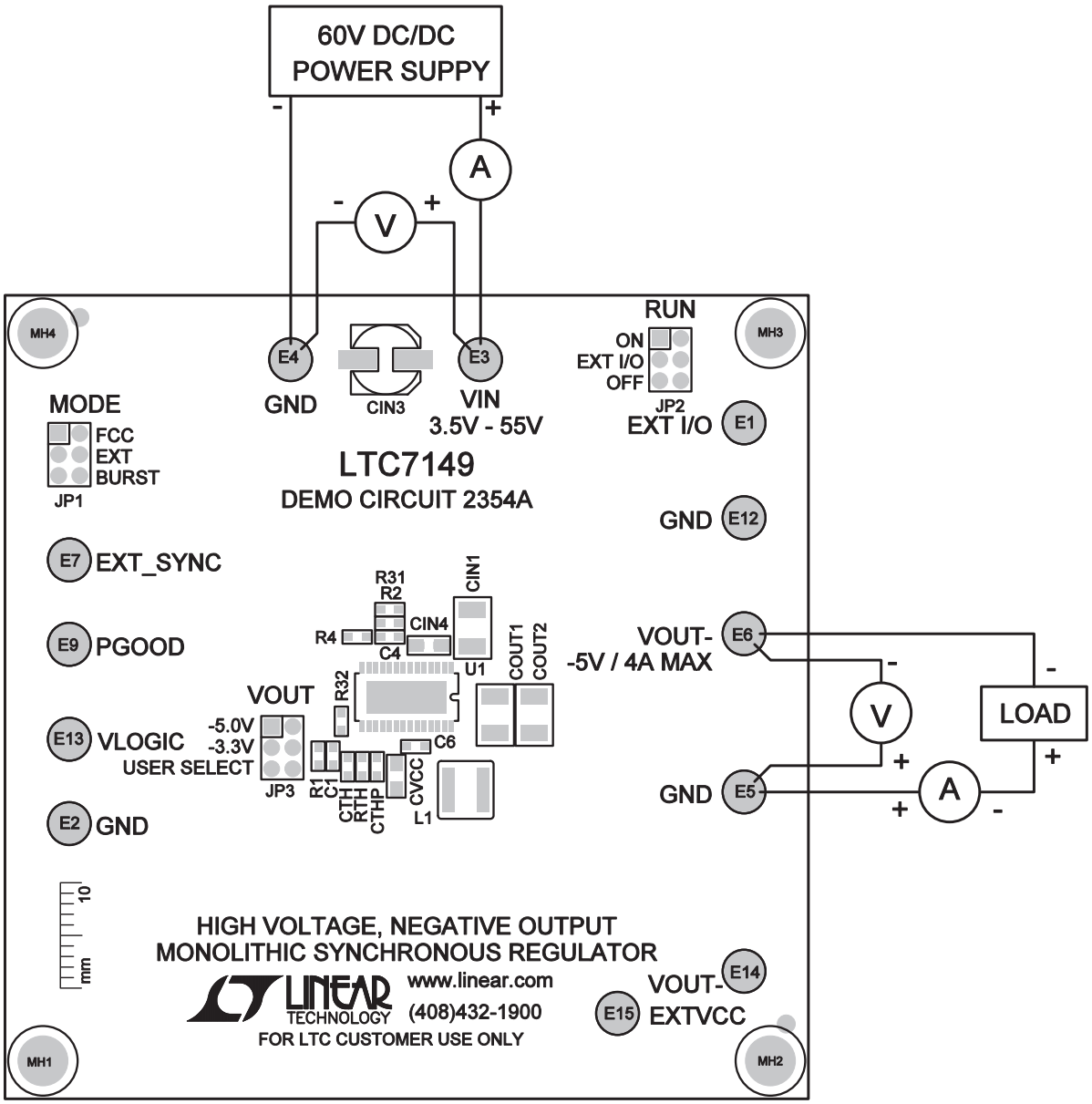


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

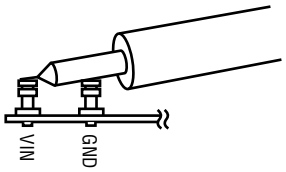


Figure 2. Measuring Input or Output Ripple

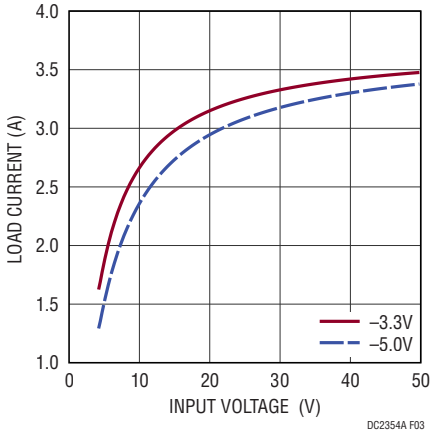


Figure 3. Output Current vs. Input Voltage Derating Charts

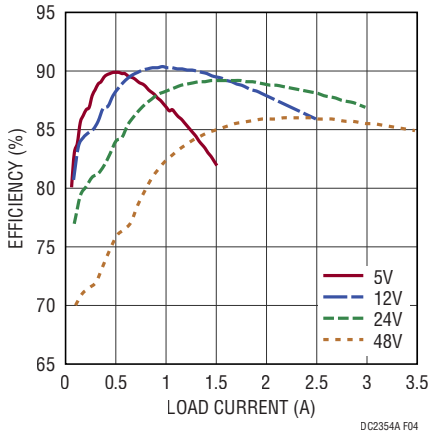


Figure 4. Efficiency vs. Load Current for Different Input Voltages

QUICK START PROCEDURE

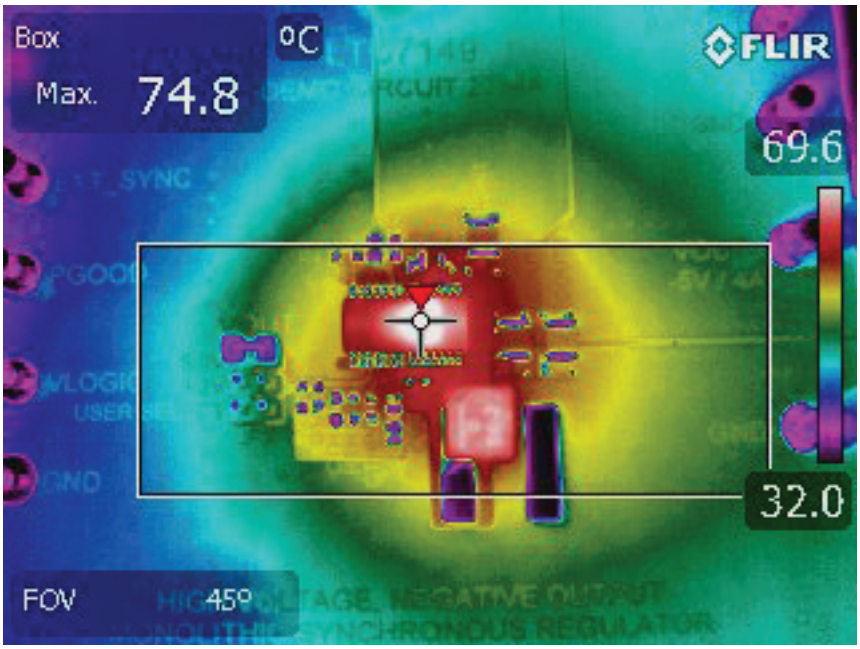
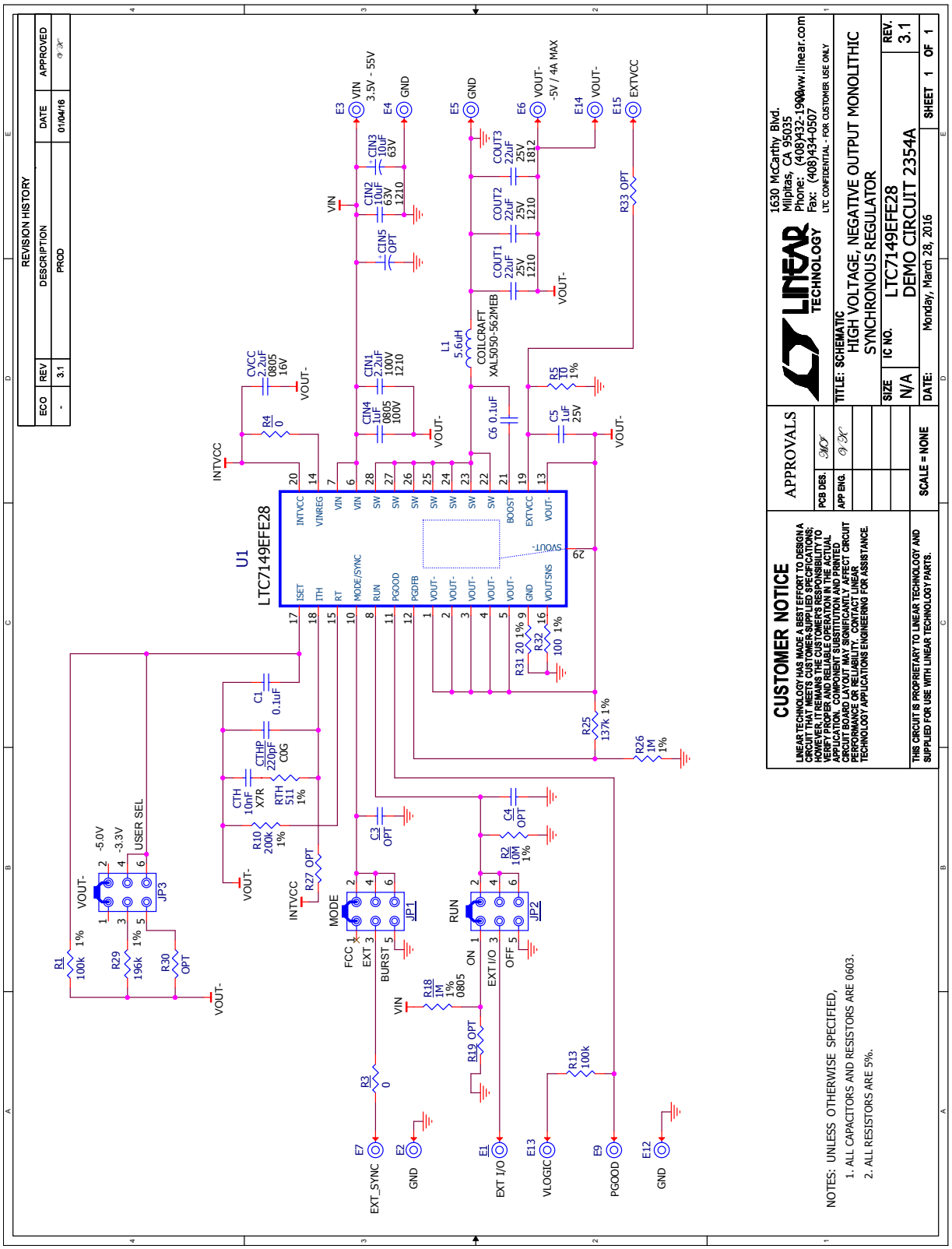


Figure 5. Thermal Map, V_{IN} 48V, V_{OUT}^{-} is –5V at 3.5A, No Air Flow

PARTS LIST

QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components			
1	CIN1	CAP, 1210 2.2µF 10% 100V X7R	TDK C3225C7R1H225K
1	CIN2	CAP, 1210 10µF 10% 63V X7R	MURATA GRM32ER71J106KA12K
1	CIN3	CAP, 10uF 20% 63V ELEC	PANASONIC EEH-ZA1J100P
1	CIN4	CAP, 0805 1µF 10% 100V X7S	TDK C2012X7S2A105K125AB
2	COUT1, COUT2	CAP, 1210 22µF 10% 25V X7R	MURATA GRM32ER71E226KE15L
1	COUT3	CAP, X7R, 22µF, 25V, 1812	TDK, C4532X7R1E226M250KC
1	CTH	CAP, 0603 10nF 10% 50V X7R	AVX 06035A221KAT
1	CTHP	CAP, 0603, 220pF, 10%, 50V, NPO	AVX 06031A101KAT2A
1	CVCC	CAP, 0805 2.2µF 10% 16V X7R	AVX 0805YC225KAT2A
2	C1, C6	CAP, 0603 0.1µF 10% 50V X7R	TDK C1608X7R1H104K080AA
1	C5	CAP, 0603 1µF 20% 25V X7R	TDK C1608X7R1E105M080AB
1	L1	IND, 5.6µH	COILCRAFT XAL5050-562MEB
1	RTH	RES, 0603 511Ω 1% 1/10W	VISHAY CRCW0603511RFKEA
2	R1, R13	RES, 0603 100kΩ 1% 1/10W	VISHAY CRCW0603100KFKEA
1	R2	RES, 0603 10MΩ 1% 1/10W	VISHAY CRCW060310M0FKEA
1	R5	RES, 0603 10Ω 1% 0.1W	VISHAY CRCW060310RFKEA
2	R3, R4	RES, 0603 0Ω JUMPER	VISHAY CRCW06030000Z0EA
1	R10	RES, 0603 200kΩ 1% 1/10W	VISHAY CRCW0603200KFKEA
1	R18	RES, 0805 1MΩ 1% 1/8W	VISHAY CRCW08051M00FKEA
1	R25	RES, 0603 137kΩ 1% 0.063W	VISHAY CRCW0603137KFKEA
1	R26	RES, 0603 1MΩ 1% 1/10W	VISHAY CRCW06031M00FKEA
1	R29	RES, 0603 196kΩ 1% 1/10W	VISHAY CRCW0603196KFKEA
1	R31	RES, 0603 20Ω 1% 0.1W	VISHAY CRCW060320R0FKEA
1	R32	RES, 0603 100Ω 1% 0.1W	VISHAY CRCW0603100RFKEA
1	U1	IC, NEGATIVE OUTPUT REGULATOR	LINEAR TECH. LTC7149EFE28#PBF
Additional Demo Board Circuit Components			
	R19, R27, R30, R33	RES, 0603 OPTION	OPTION
	C3, C4	CAP, 0603 OPTION	OPTION
	CIN5	CAP, OPTION	OPTION
Hardware			
12	E1, E2, E3, E4, E5, E6, E7, E9, E12, E13, E14, E15	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



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