LTM4656
6V to 36V Input, 24V Output, Short-Circuit Protected Synchronous Boost µModule Regulator

DESCRIPTION

Demonstration circuit 2634A is a boost µModule regulator featuring the LTM4656. The DC2634A operates from 6V to 36V input and generates 24V, 4A output from 12V input. When V_{IN} ≥24V, V_{OUT} follows V_{IN}. Also, the LTM®4656 has precision voltage reference, which can generate output voltage with 2% tolerance over the full operating conditions. The 400kHz switching frequency operation results in small and efficient circuit. The converter achieves over 95% efficiency with 4A load. The LTM4656 protects the load with the integrated soft-start and output short-circuit protection functions. The demonstration circuit can be easily modified to regulate different output voltages.

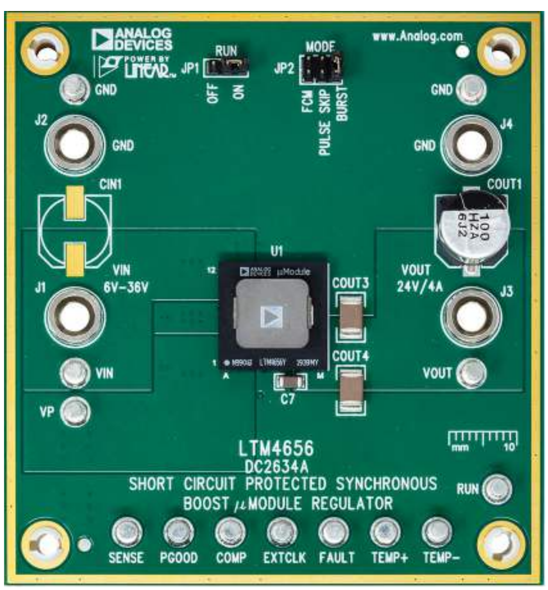
The DC2634A has small circuit footprint. It is a high performance and cost-effective solution for generating output voltages up to 36V from inputs as low as 5V.

Design files for this circuit board are available.

PERFORMANCE SUMMARY Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Minimum Input Voltage	I_{OUT} = 0A to 1.3A		6		V
Minimum Input Voltage to Support Full Load	I_{OUT} = 4A		12		V
Maximum Input Voltage (Output Follows V_{IN} above 24V Input)	I_{OUT} = 0A to 4A		36		V
V_{OUT}	V_{IN} = 6V to 23V, I_{OUT} = 0A		24 ±2%		V
Output Voltage Ripple	V_{IN} = 6V, I_{OUT} = 1A		300		mV_{P-P}
Nominal Switching Frequency			400		kHz

BOARD PHOTO



QUICK START PROCEDURE

Demonstration circuit 2634A is easy to set up to evaluate the performance of the LTM4656. For proper measurement equipment setup refer to Figure 1 and follow the procedure below:

NOTE: When measuring the input or output voltage ripple, care must be taken to minimize the length of oscilloscope probe ground lead. Measure the input or output voltage ripple by connecting the probe tip directly across the VIN or VOUT and GND terminals as shown in Figure 2.

1. With power off, connect the input power supply to V_{IN} and GND.
2. Keep the load set to 0A or disconnected.
3. Turn the input power source on and slowly increase the input voltage. Be careful not to exceed 36V.

   NOTE: Make sure that the input voltage V_{IN} does not exceed 36V.
4. Set the input voltage to 12V and check for the proper output voltage of 24V. 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 voltage is established, adjust the load and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

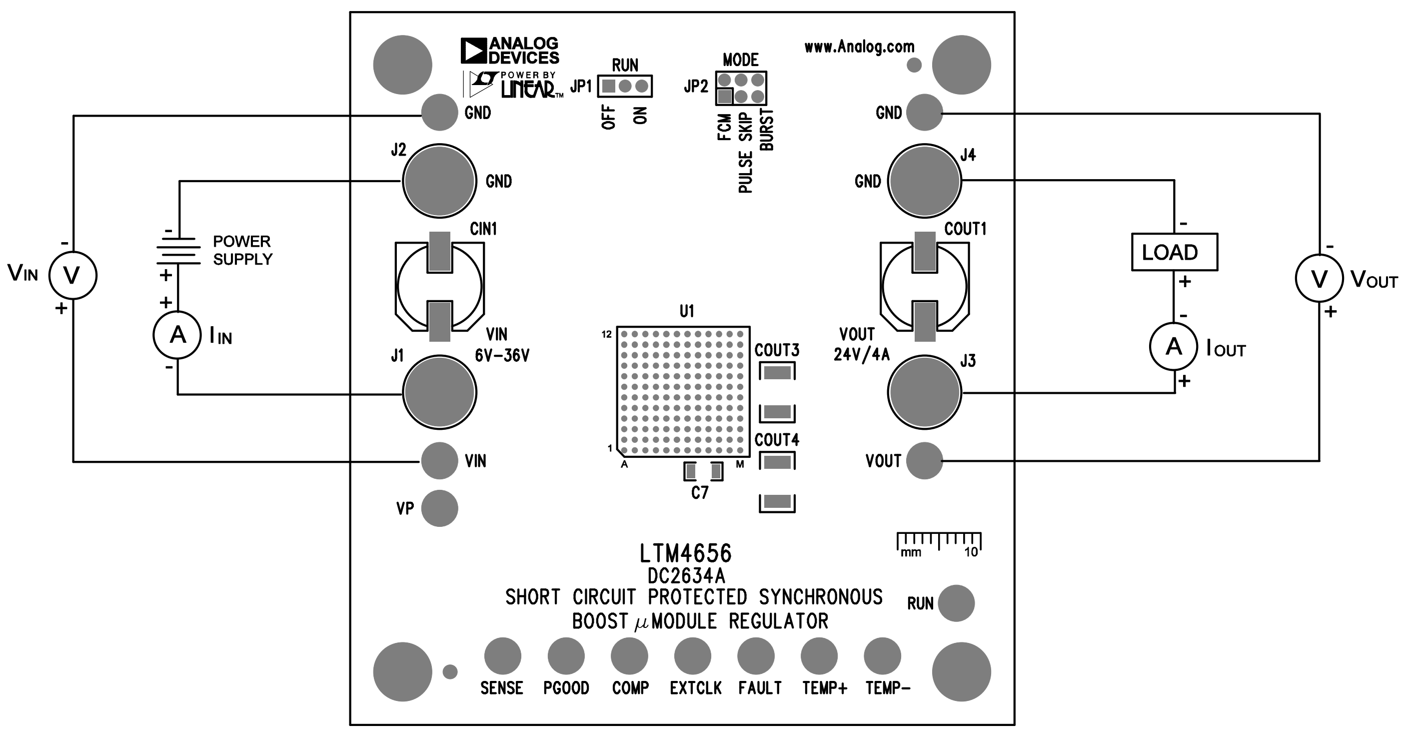


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

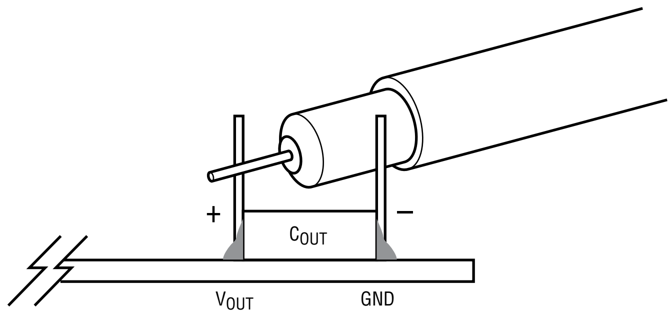


Figure 2. Measuring Input or Output Ripple

Changing the Output Voltage

To change the output voltage from the programmed 24V, change the voltage setting resistors connected to LTM4656 FB pin (see Schematic Diagram section).

Converter Output Current

The DC2634A output current depends on the input voltage and programmed input current limit. Typical performance of DC2634A is shown in Figure 3. From Figure 3, the maximum output current is 4A with 12V input. Switching the mode of operation to BURST mode can increase the efficiency at light loads.

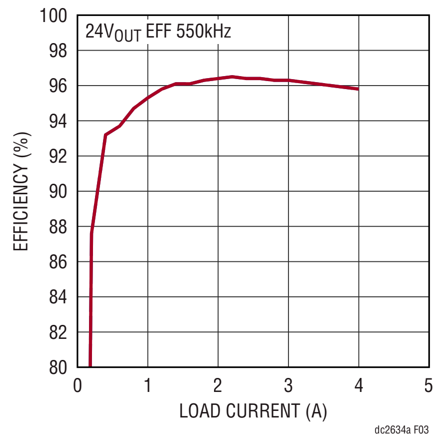
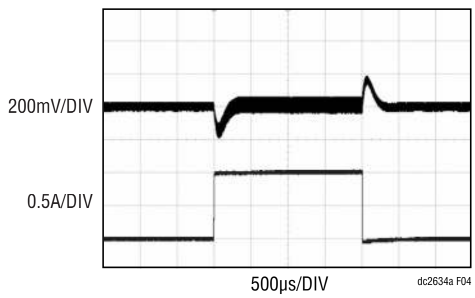


Figure 3. The 12V Input Efficiency Is Over 96% at 3A Load

QUICK START PROCEDURE

Output Load Step Response

The load step response of DC2634A is dependent on the amount and type of output caps used. For higher load steps more output capacitance can be added to keep the voltage transients at the desired level. The 1A load step transients with 12V input are shown in Figure 4. Other types of low ESR and high value capacitors can be used if space is available to reduce load transients to desired level.



C_{OUT} = 100μF ×2, 6.8μF ×2 CERAMIC
28mΩ ESR

Figure 4. The LTM4656 Has Good Load Step Response with Small Output Capacitors

Startup and Soft-Start Function

The DC2634A features internal soft start circuit that ramps the output voltage up in monotonic fashion. The soft start circuit also prevents output voltage overshoot when output voltage ramp reaches regulation.

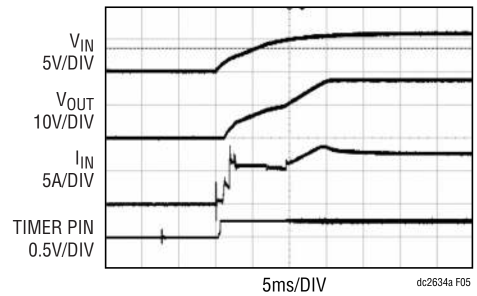


Figure 5. The DC2634A Ramps the Output Slowly at Startup without Output Voltage Overshoot

Short-Circuit Protection

The LTM4656 features safe short-circuit protection. The part will limit the input current to around 5A when output is shorted as shown in Figure 6. Also, the internal timer

QUICK START PROCEDURE

circuit will turn internal protection MOSFET off for programmed time in order to reduce the power dissipation during short-circuit. Following over current event the part will enter cooldown period of 33ms with the internal 10nF timer capacitor. The part will try to startup again after the cooldown period.

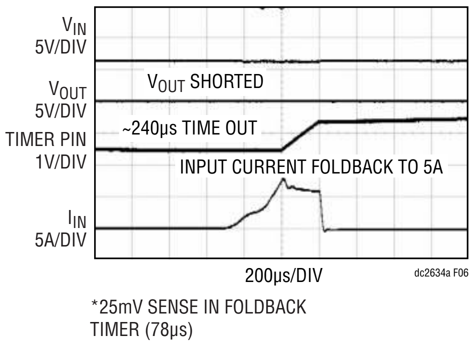


Figure 6. The DC2634A Overcurrent Protection Limits Input Current to 5A During Short-Circuit Condition

Thermal Performance

The LTM4656 features excellent thermal performance due to high efficiency of internal synchronous boost circuit. The temperature rises of LTM4656 with 12V input and 4A load is shown in Figure 7.

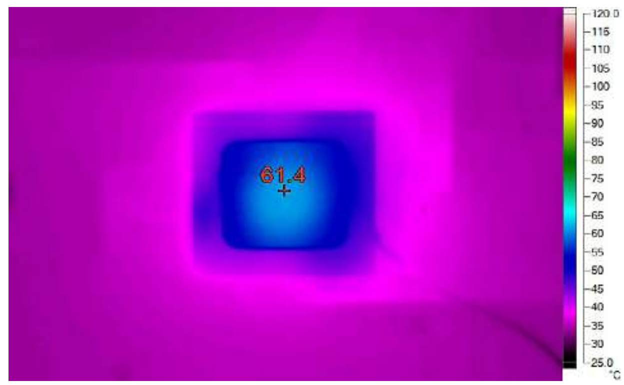
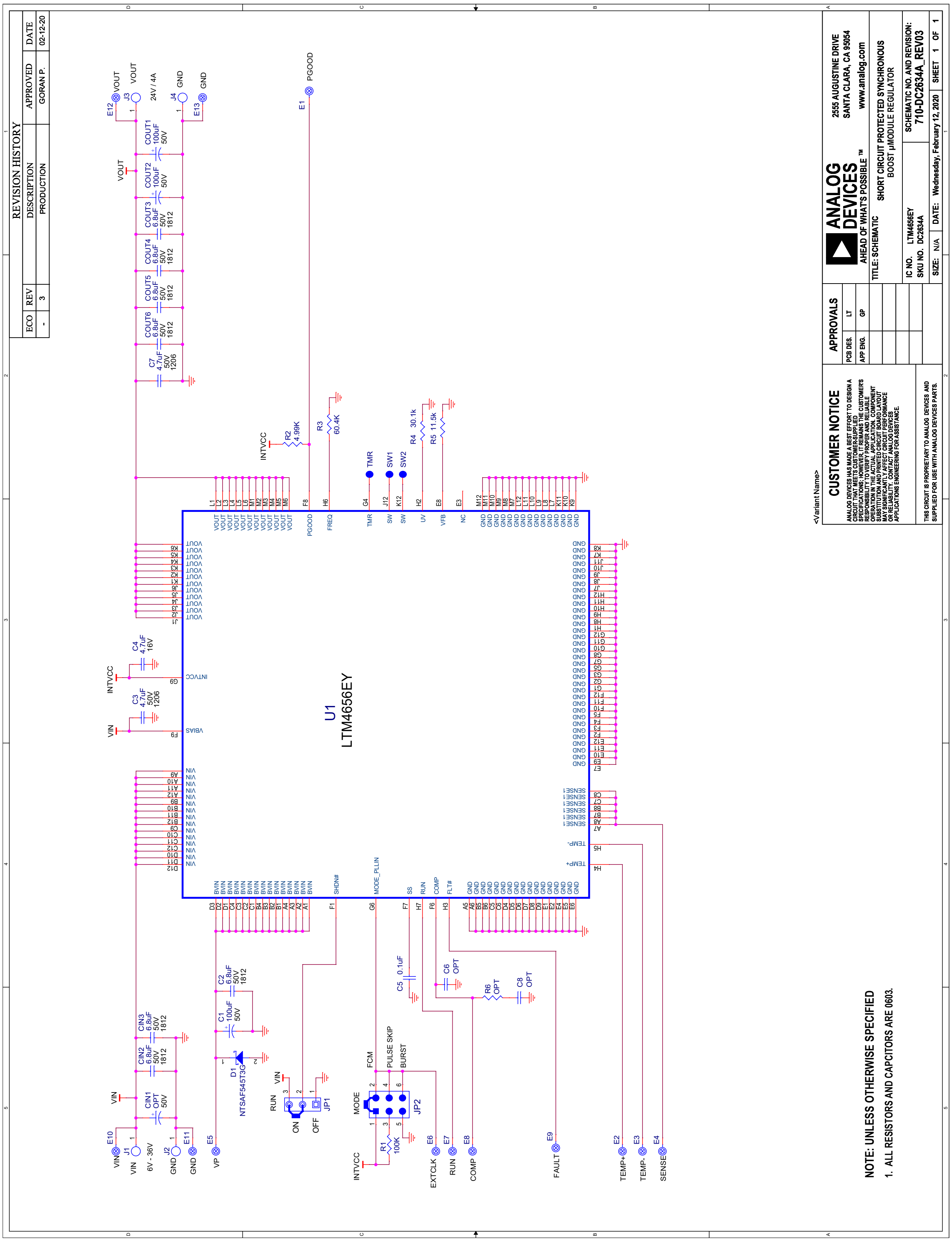


Figure 7. The LTM4656 Has Only 41.4°C Temperature Rise with 12V Input, 24V Output with 4A Load. (T_A = 25°C, No Cooling Fan)

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	3	C1, COUT1, COUT2	CAP., 100µF, ALUM POLY HYB, 50V, 20%, 10mm × 10.2mm, G, SMD, RADIAL, AEC-Q200	PANASONIC, EEHZA1H101P
2	7	C2, CIN2, CIN3, COUT3, COUT4, COUT5, COUT6	CAP., 6.8µF, X7R, 50V, 10%, 1812	TDK, C4532X7R1H685K250KB
3	2	C3, C7	CAP., 4.7µF, X7R, 50V, 10%, 1206	AVX, 12065C475KAT2A MURATA, GRM31CR71H475KA12L NIC, NMC1206X7R475K50TRPLPF TDK, C3216X7R1H475K160AC
4	1	C4	CAP., 4.7µF, X5R, 16V, 10%, 0603	AVX, 0603YD475KAT2A MURATA, GRM188R61C475KAAJD MURATA, GRM188R61C475KE11D TDK, C1608X5R1C475K080AC
5	1	C5	CAP., 0.1µF, X5R, 25V, 10%, 0603, NO SUBS. ALLOWED	AVX, 06033D104KAT2A
6	1	D1	DIODE, SCHOTTKY RECTIFIER, 45V, 5A, SMA-FL	ON SEMICONDUCTOR, NTSAF545T3G
7	1	R1	RES., 100k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1003TRF PANASONIC, ERJ3EKF1003V VISHAY, CRCW0603100KFKEA
8	1	R2	RES., 4.99k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F4991TRF PANASONIC, ERJ3EKF4991V VISHAY, CRCW06034K99FKEA
9	1	R3	RES., 60.4k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF6042V VISHAY, CRCW060360K4FKEA
10	1	R4	RES., 30.1k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF3012V VISHAY, CRCW060330K1FKEA
11	1	R5	RES., 11.5k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060311K5FKEA
12				
13	1	U1	IC, µModule REG WITH INPUT PROTECTION, BGA-144	ANALOG DEVICES INC., LTM4656EY#PBF
Additional Demo Board Circuit Components				
1	0	CIN1	CAP., OPTION, 10mm × 10.2mm	
2	0	C6, C8	CAP., OPTION, 0603	
3	0	R6	RES., OPTION, 0603	

SCHEMATIC DIAGRAM



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.

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