LTC7806
6V to 36V Input, 24V, 10A Output, Synchronous Boost Regulator with Input Current Monitor

DESCRIPTION

Demonstration circuit 2951A is a boost regulator featuring the LTC®7806. The DC2951A operates from a 6V to 36V input voltage range and generates 24V, 10A output from a 12V input. When $V_{IN} \geq 24V$, V_{OUT} follows V_{IN}. Also, the LTC7806 has precision voltage reference, which can generate an output voltage with 2% tolerance over the full operating conditions. The 350kHz switching frequency operation results in small and efficient circuit. The converter achieves over 95% efficiency with 10A load. The demonstration circuit can be easily modified to regulate different output voltages.

The DC2951A provides a high performance cost-effective solution for generating output voltages up to 36V from inputs as low as 5V.

The LTC7806 data sheet gives a complete description of this part, its operation and application information and must be read in conjunction with this demo manual.

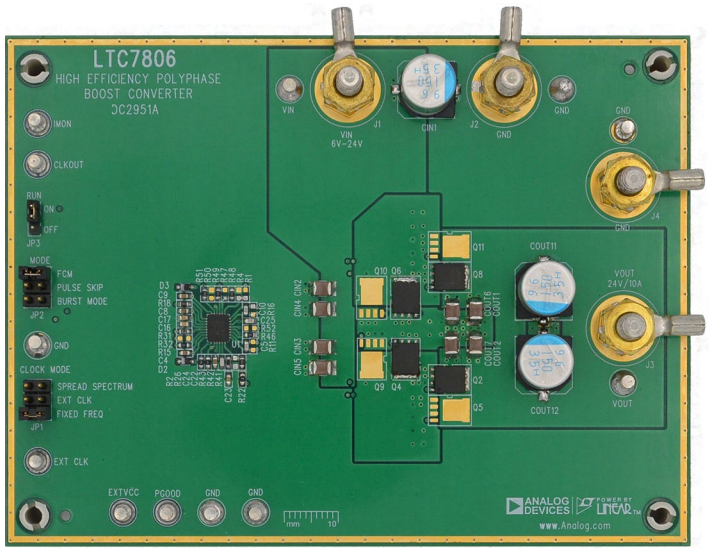
Design files for this circuit board are available.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Minimum Input Voltage	I_{OUT} = 0A to 10A		6		V
Maximum Input Voltage (Output Follows V_{IN} above 24V Input)	I_{OUT} = 0A to 10A		36		V
Output Voltage	V_{IN} = 6V to 23V, I_{OUT} = 0A		24 ±2%		V
Output Voltage Ripple	V_{IN} = 12V, I_{OUT} = 10A		300		mV_{P-P}
Nominal Switching Frequency			350		kHz

BOARD PHOTO



QUICK START PROCEDURE

Demonstration circuit 2951A is easy to set up to evaluate the performance of the LTC7806. 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 V_{IN} or V_{OUT} 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.

   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.

QUICK START PROCEDURE

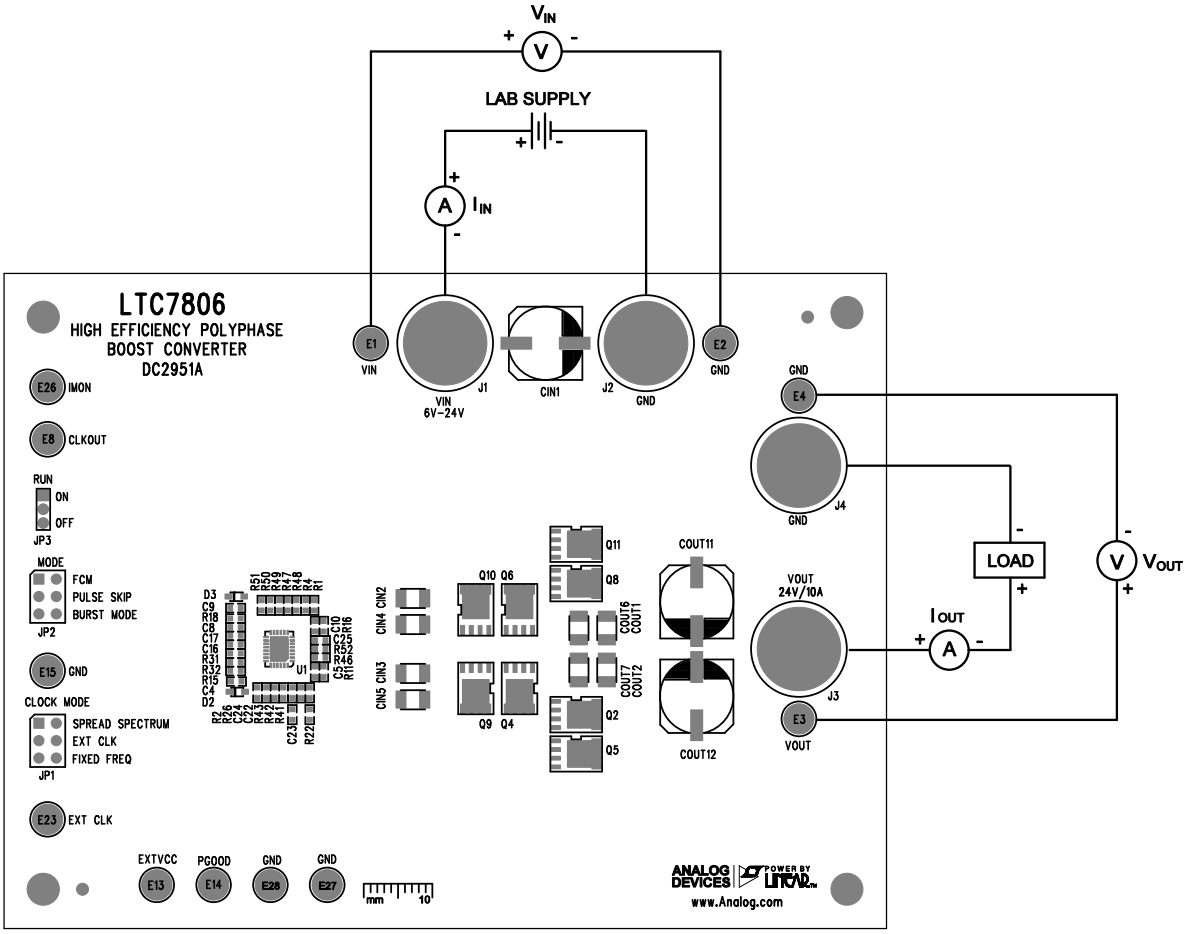


Figure 1. Proper Measurement Equipment Setup

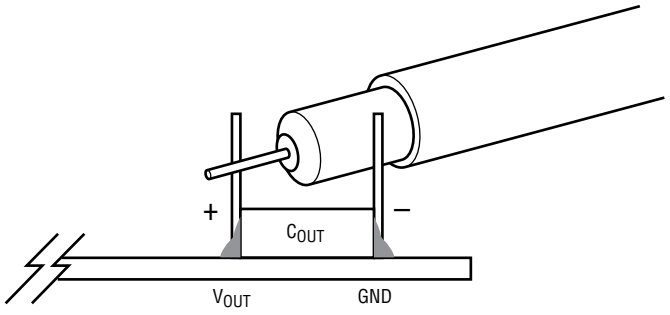


Figure 2. Measuring Input or Output Ripple

QUICK START PROCEDURE

Changing the Output Voltage

To change the output voltage from the programmed 24V, change the voltage setting resistors connected to LTC7806 FB pin (see Schematic Diagram section).

Converter Efficiency and Output Current

The DC2951A output current depends on the input voltage. Typical performance of DC2951A is shown in Figure 3. From Figure 3, the maximum output current is 20A with 12V input. The efficiency is high even at light loads thanks to Burst Mode® operation.

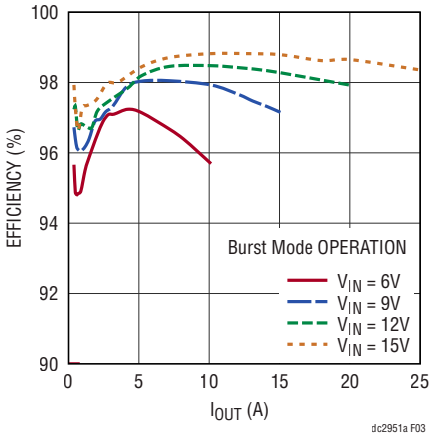
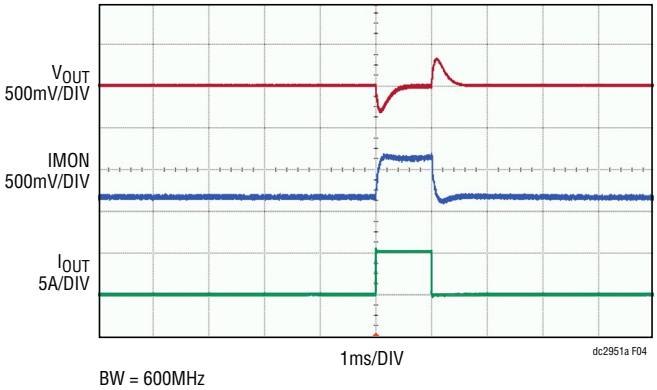


Figure 3. The 12V Input Efficiency is 98% with 20A Load

Output Load Step Response

The load step response of DC2951A 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 5A 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.

The IMON function is used to monitor the input current and can be used by the system to limit the input current under heavy loads.



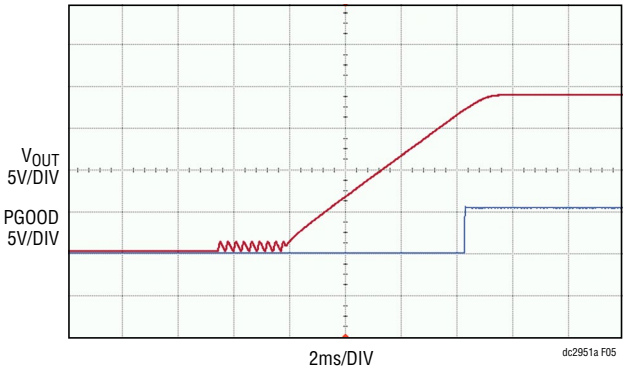
BW = 600MHz
V_{IN} = 6V, V_{OUT} = 24V, I_{OUT} = 4A
FCM 5A LOAD STEP

Figure 4. The LTC7806 Has Good Load Step Response with Small Output Capacitors

Start-up and Soft-Start Function

The DC2951A features soft-start circuit that ramps the output voltage up in monotonic fashion as shown in Figure 5. The soft-start circuit also prevents output voltage overshoot when output voltage ramp reaches regulation.

When RUN pin is enabled the output voltage will be kept close to V_{IN} level until soft-start function reaches the V_{IN} level at which point the controller starts ramping the output voltage up.



BW = 600MHz
V_{IN} = 6V, V_{OUT} = 24V, I_{OUT} = 4A
FCM RUN-START-UP

Figure 5. The DC2951A Ramps the Output Slowly at Startup without Output Voltage Overshoot

QUICK START PROCEDURE

Thermal Performance

The LTC7806 features excellent thermal performance due to high efficiency of synchronous boost circuit. The temperature rises of LTC7806 with 12V input and 10A load is shown in Figure 6.

The six-layer PCB layout features solid copper planes that provide heat spreading across the whole board.

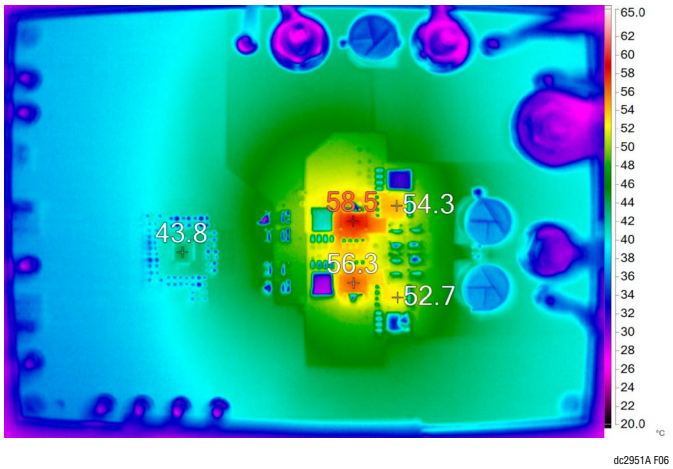
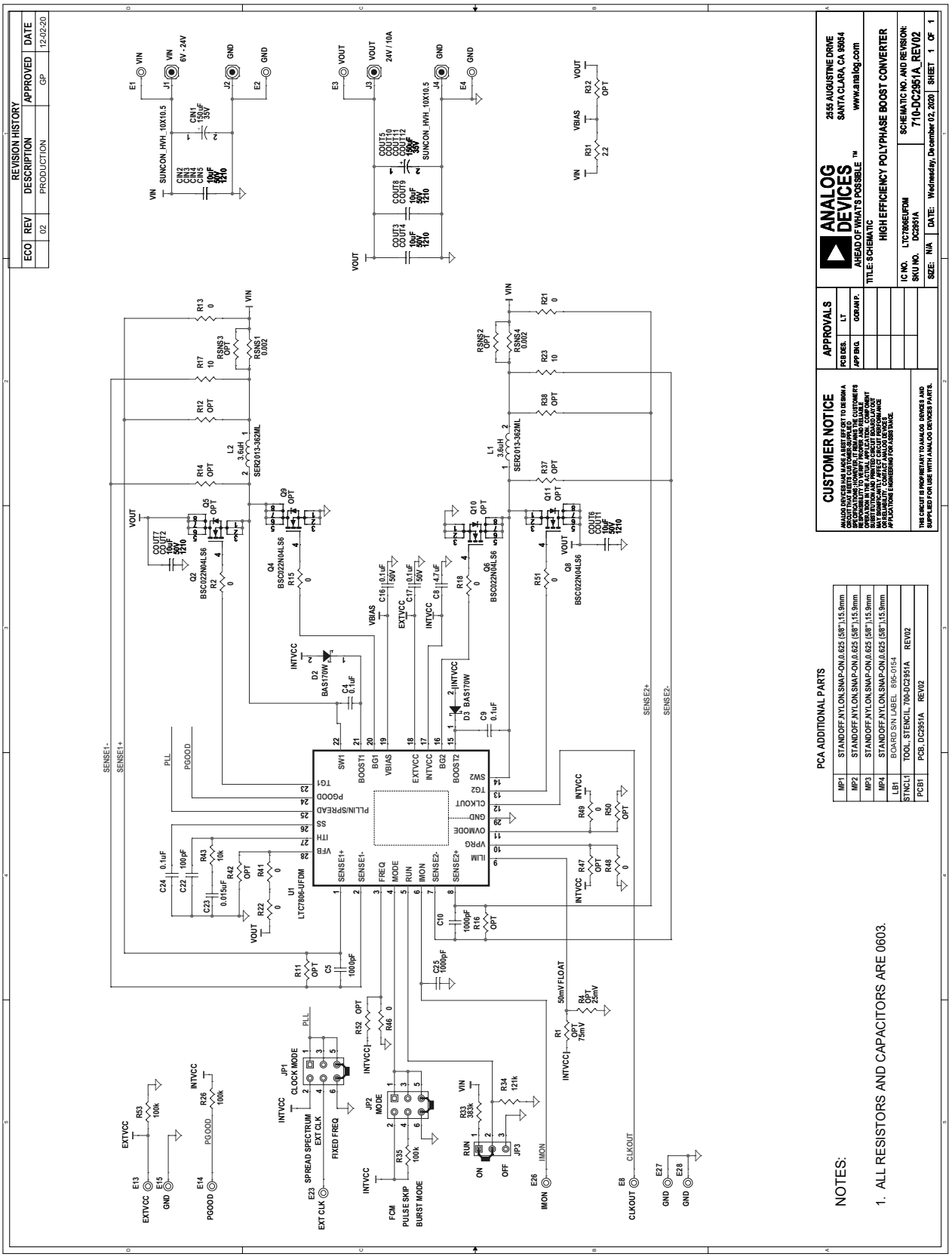


Figure 6. The LTC7806 Has Only 33.5°C Temperature Rise with 9V Input, 24V Output with 10A Load (T_A = 25°C, No Cooling Fan)

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	3	C4, C9, C24	CAP., 0.1µF, X7R, 16V, 10%, 0603	WURTH ELEKTRONIK, 885012206046
2	3	C5, C10, C25	CAP., 1000pF, C0G, 25V, 10%, 0603	AVX, 06033A102KAT2A
3	1	C8	CAP., 4.7µF, X5R, 25V, 20%, 0603	MURATA, GRM188R61E475ME11D
4	2	C16, C17	CAP., 0.1µF, X7R, 50V, 10%, 0603	AVX, 06035C104KAT2A
5	1	C22	CAP., 100pF, C0G, 50V, 10%, 0603	AVX, 06035A101KAT2A
6	1	C23	CAP., 0.015µF, X7R, 50V, 5%, 0603	AVX, 06035C153JAT2A
7	5	CIN1, COUT5, COUT10-COUT12	CAP., 150µF, ALUM. ELECT., 35V, 20%, 10mm × 10.5mm RADIAL, SMD, AEC-Q200, HVH SERIES	SUN ELECTRONIC IND. 35HVH150M
8	12	CIN2-CIN5, COUT1-COUT4, COUT6-COUT9	CAP., 10µF, X5R, 50V, 10%, 1210	TDK, C3225X5R1H106K250AB
9	2	D2, D3	DIODE, SCHOTTKY, 70V, 70mA, SOD-323, AEC-Q101	INFINEON, BAS170W
10	2	L1, L2	IND., 3.6µH, PWR, SHIELDED, 20%, 30A, 1.82mΩ, 19.69mm × 19.56mm × 12.95mm, SER2013, AEC-Q200	COILCRAFT, SER2013-362MLB
11	4	Q2, Q4, Q6, Q8	XSTR., MOSFET, N-CH, 40V, 100A, TDSON-8 FL	INFINEON, BSC022N04LS6
12	2	R17, R23	RES., 10Ω, 5%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060310R0JNEA
13	2	R26, R53	RES., 100k, 5%, 1/10W, 0603, AEC-Q200	NIC, NRC06J104TRF
14	1	R31	RES., 2.2Ω, 5%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3GEYJ2R2V
15	1	R33	RES., 383k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF3833V
16	1	R34	RES., 121k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF1213V
17	1	R35	RES., 100k, 1%, 1/10W, 0603	STACKPOLE ELECTRONICS, INC., RMCF0603FG100K
18	1	R43	RES., 10k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060310K0FKEA
19	2	RSNS1, RSNS4	RES., 0.002Ω, 1%, 1/2W, 2010, METAL, SENSE, AEC-Q200	VISHAY, WSL20102L000FEA
20	1	U1	IC, 2-PHASE SYN STEP-DOWN CTRLR, QFN-28, 40V LOW I_Q, DUAL	ANALOG DEVICES, LTC7806EUFDM#PBF
Additional Demo Board Circuit Components				
1	0	Q5, Q9-Q11	XSTR., OPTION, MOSFET N-CH, PG-TDSON-8	
2	0	R1, R4, R11, R12, R14, R16, R32, R37, R38, R42, R47, R50, R52	RES., OPTION, 0603	
3	11	R2, R13, R15, R18, R21, R22, R41, R46, R48, R49, R51	RES., 0Ω, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06030000Z0EA
4	0	RSNS2, RSNS3	RES., OPTION, CURRENT SENSE	

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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