

LTC7803EMSE High Frequency, Low I_Q Synchronous Step-Down Controller

DESCRIPTION

Demonstration circuit DC2834A is a DC/DC synchronous step-down converter featuring the [LTC®7803](#) (MSE package) spread spectrum or constant frequency current mode synchronous step-down controller. The DC2834A generates 3.3V of output voltage and able to provide (with some modifications) output voltage up to 36V.

The 500kHz constant switching frequency operation results in a small and efficient circuit.

The main features of this board include:

- Wide input voltage range: from 5V to 38V
- High load current, up to 20A
- Extremely low quiescent current, it's 15 μ A at sleep mode and as low as 1 μ A at shutdown
- Onboard low power bias supply
- Ability to select spread spectrum or fixed frequency
- Pulse-skipping mode, forced continuous operation or low ripple Burst Mode® operation at light loads
- Synchronization with external clock

- The DC2834A supports R_{SENSE} or inductor DCR current sensing.

The converter provides high output voltage accuracy (typically $\pm 2\%$) over wide load range with no minimum load requirement.

The DC2834A supports two ways of biasing step-up controllers: directly from the input voltage or output rail. The third possibility is connecting voltage source to EXT V_{CC} terminal.

The DC2834A extremely wide switching frequency range from 100kHz to 3MHz. It can be synchronized to the external clock anywhere inside this range. The spread spectrum operation for reducing the peak radiated and conducted noise to simplify compliance with electromagnetic interference (EMI) standards.

The DC2834A has small circuit footprint. It is a high performance and cost-effective solution for telecom, automotive and Power over Ethernet applications.

[Design files for this circuit board are available.](#)

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PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

PARAMETER	CONDITIONS	MIN	UNITS
Minimum Input Supply Voltage		5	V
Maximum Input Supply Voltage		38	V
Output Voltage Range	$V_{IN} = 5\text{V to } 35\text{V}, I_{OUT1} = 0\text{A to } 20\text{A}$	$3.3 \pm 2\%$	V
Typical Switching Frequency		500	kHz
Typical Output Ripple ($V_{OUT}, 3.3\text{V}$)	$I_{LOAD} = 10\text{A}$	50	mV
Efficiency Typical ($V_{OUT}, 3.3\text{V}, V_{IN} 12\text{V}$)		95	%

QUICK START PROCEDURE

Demonstration circuit 2834 is easy to set up to evaluate the performance of the LTC7803 controllers. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

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. Place jumper RUN (J2) in ON position, place jumper MODE (JP1) in PULSE SKIP position, place jumper FREQ SET (JP3) into FIX FREQ position.
2. With power off, connect the input power supply to V_{IN} and GND.

Turn the input power source on and slowly increase the input voltage to 12V. Be careful not to exceed 38V.

NOTE: Make sure that the input voltage V_{IN} does not exceed 38V. If higher operating voltage is required, power components with higher voltage ratings should be used.

3. Check for the proper output voltage of 3.3V. 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 voltages are established, adjust the load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

To synchronize DC2834A with external clock insert jumper FREQ SET (JP3) in SYNC position and apply clock signals to terminal SYNC (E4).

CONVERTER EFFICIENCY

DC2834SA exceeds 95% efficiency at 12V input voltage generating 3.3V at 20A, see Figure 3. The converter efficiency varies for given load current at different input voltages, which is illustrated by Figure 3 as well. The thermal image of DC2834 at full load presented Figure 4. All efficiency measurements were conducted at room temperature, natural convection cooling with no air flow.

DC2834A SPREAD SPECTRUM

The demo board DC2834A shipped with fixed frequency operation setting. To employ the spread spectrum operation, insert the jumper FREQ SET (JP3) in into SPREAD position. In this setting the switching frequency will change in $\pm 15\%$ range relatively to the preset value.



QUICK START PROCEDURE

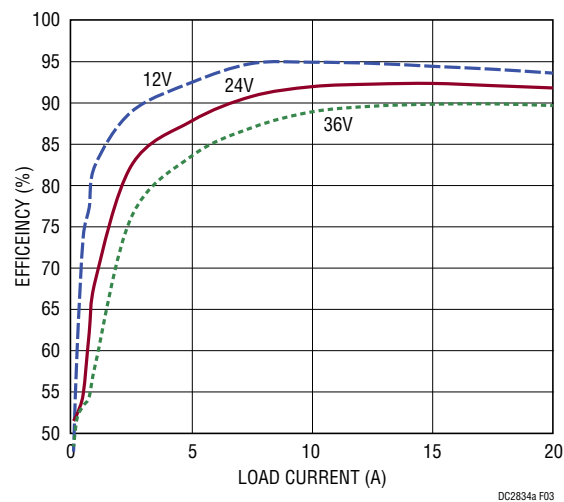


Figure 3. DC2834A, Efficiency vs Load for Different Input Voltages

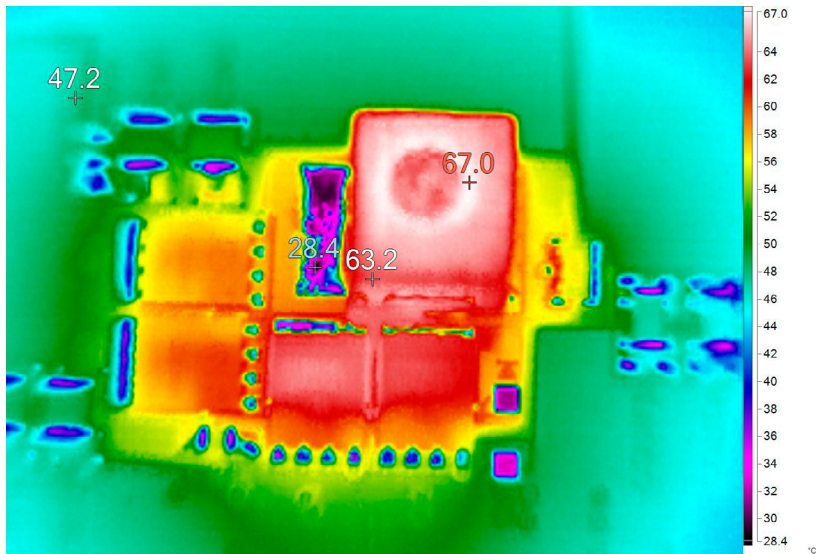


Figure 4. Thermal Image, V_{IN} 12V, V_{OUT} 3.3V at 20A

PARTS LIST

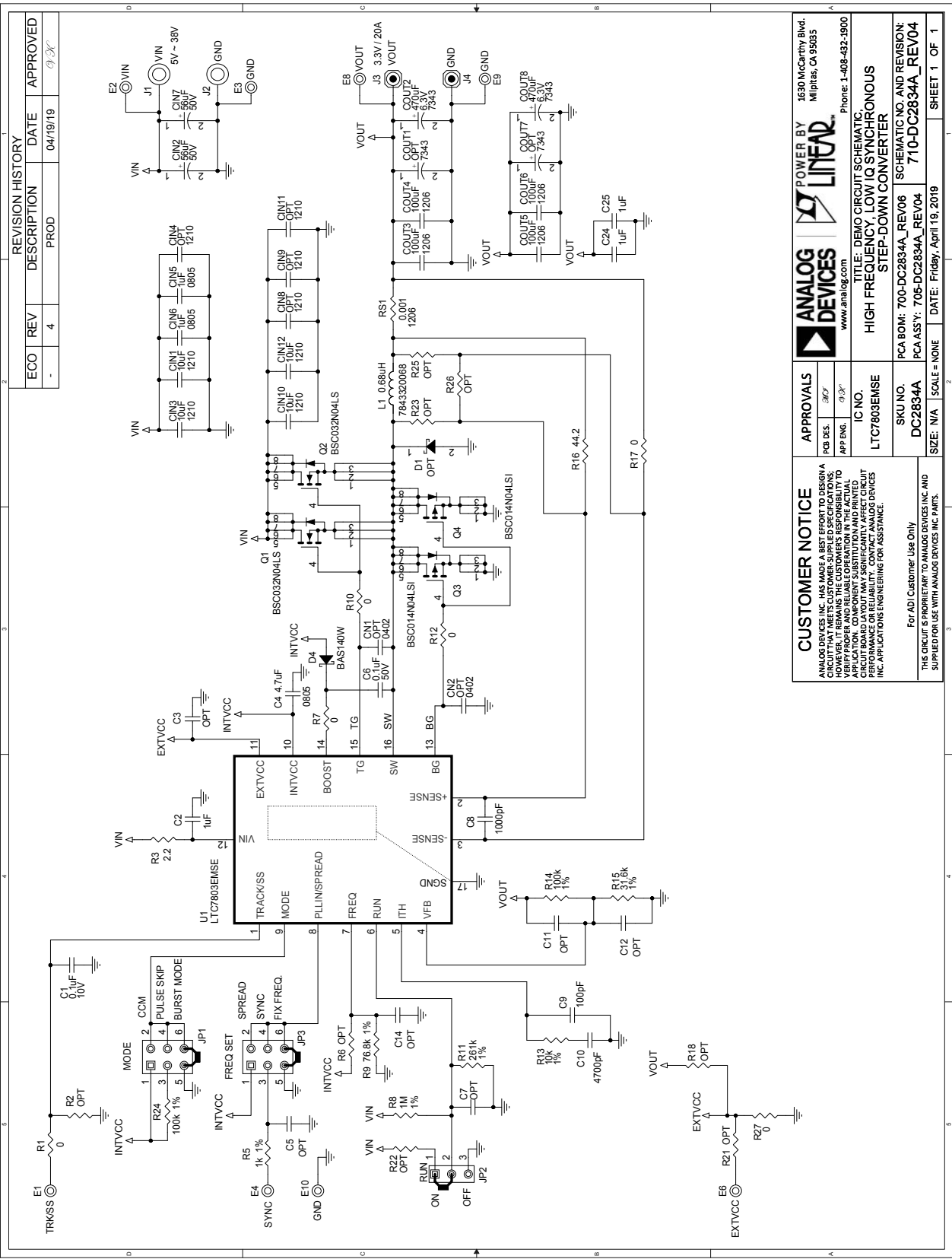
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1	CAP, 0.1 μ F, X7R, 10V, 10%, 0603	AVX, 0603ZC104KAT2A
2	1	C2	CAP, 1 μ F, X7R, 25V, 10%, 0603, AEC-Q200	MURATA, GCM188R71E105KA64D
3	1	C4	CAP, 4.7 μ F, X5R, 50V, 10%, 0805, AEC-Q200	TDK, CGA4J3X5R1H475K125AB
4	1	C6	CAP, 0.1 μ F, X5R, 50V, 10%, 0603	AVX, 06035D104KAT2A
5	1	C8	CAP, 1000pF, C0G, 50V, 5%, 0603	AVX, 06035A102JAT2A
6	1	C9	CAP, 100pF, C0G, 50V, 10%, 0603	AVX, 06035A101KAT2A
7	1	C10	CAP, 4700pF, C0G, 50V, 5%, 0603	AVX, 06035A472JAT2A
8	4	C24, C25, CIN5, CIN6	CAP, 1 μ F, X7R, 50V, 10%, 0805	AVX, 08055C105KAT2A
9	4	CIN1, CIN3, CIN10, CIN12	CAP, 10 μ F, X7R, 63V, 10%, 1210	SAMSUNG, CL32B106KMVNNWE
10	2	CIN2, CIN7	CAP, 56 μ F, ALUM ELECT, 50V, 20%, 10 \times 10.5mm RADIAL, HVH	SUN ELECTRONIC INDUSTRIES CORP, 50HVH56M
11	2	COUT2, COUT8	CAP, 470 μ F, TANT POSCAP, 6.3V, 20%, 7343, 18m Ω , TPE, NO SUBS. ALLOWED	PANASONIC, 6TPE470MI
12	4	COUT3 TO COUT6	CAP, 100 μ F, X5R, 6.3V, 20%, 1206	MURATA, GRM31CR60J107ME39L
13	1	L1	IND, 0.68 μ H, HCC SMD HIGH CURRENT, 20%, 26A, 1.85m Ω , 12.4mm \times 11.7mm	WURTH ELEKTRONIK, 7843320068
14	4	Q1, Q2, Q3, Q4	XSTR, MOSFET, N-CH, 40V, 98A, TDSO-8	INFINEON, BSC032N04LS
15	6	R1, R7, R10, R12, R17, R27	RES, AEC-Q200, 0 Ω , 1/10W, 0603	VISHAY, CRCW06030000Z0EA
16	1	R3	RES, AEC-Q200, 2.2 Ω , 5%, 1/10W, 0603	STACKPOLE ELECTRONICS, INC, RMCF0603JT2R20
17	1	R5	RES, AEC-Q200, 1k Ω , 1%, 1/10W, 0603	VISHAY, CRCW06031K00FKEA
18	1	R8	RES, AEC-Q200, 1M Ω , 1%, 1/10W, 0603	VISHAY, CRCW06031M00FKEA
19	1	R9	RES, AEC-Q200, 76.8k Ω , 1%, 1/10W, 0603	VISHAY, CRCW060376K8FKEA
20	1	R11	RES, AEC-Q200, 261k Ω S, 1%, 1/10W, 0603	VISHAY, CRCW0603261KFKEA
21	1	R13	RES, AEC-Q200, 10k Ω , 1%, 1/10W, 0603	VISHAY, CRCW060310K0FKEA
22	2	R14, R24	RES, AEC-Q200, 100k Ω , 1%, 1/10W, 0603	VISHAY, CRCW0603100KFKEA
23	1	R15	RES, AEC-Q200, 31.6k Ω , 1%, 1/10W, 0603	VISHAY, CRCW060331K6FKEA
24	1	R16	RES, 44.2 Ω , 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060344R2FKEA
25	1	RS1	RES, LONG-SIDE TERM, SENSE, AEC-Q200, 0.001 Ω , 5%, 1W, 1206	SUSUMU, KRL3216-C-R001-J-T1
26	1	U1	LOW I _Q SYNCHRONOUS STEP-DOWN CONVERTER, 16 PIN SSOP	ANALOG DEVICES, INC, LTC7803EMSE#PBF

DEMO MANUAL DC2834A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	0	C3, C5, C7, C11, C12, C14	CAP, OPTION, 0603	
2	0	CIN4, CIN8, CIN9, CIN11	CAP, OPTION, 1210	
3	0	CN1, CN2	CAP, OPTION, 0402	
4	0	COUT1, COUT7	CAP, OPTION, 7343	
5	0	D1	DIODE, SCHOTTKY BARRIER RECT, 60V, 2A, SOD-123H	COMCHIP, CDBMT260-HF
6	0	D4	DIODE, SCHOTTKY, 40V, 120mA, SOD323-2, AEC-Q101	INFINEON, BAS140W
7	0	L1 TO L4	IND, 6.8 μ H, PWR, SHIELDED, 20%, 11.3A, 14.5m Ω , 8.8mm \times 8.3mm, XAL8080	COILCRAFT, XAL8080-682MEB
8	0	R2, R6, R18, R21 TO R23, R25, R26	RES, OPTION, 0603	
Hardware: For Demo Board Only				
1	8	E1 TO E4, E6, E8 TO E10	TEST POINT, TURRET, 0.094", MTG. HOLE	MILL-MAX, 2501-2-00-80-00-00-07-0
2	2	J1, J2	CONN, BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE	KEYSTONE, 575-4
3	2	J3, J4	STUD, FASTENER, #10-32	PENNENGINEERING, KFH-032-10ET
4	2	J3, J4	RING, LUG, CRIMP, #10, NON-INSULATED, SOLDERLESS TERMINALS	KEYSTONE, 8205
5	4	J3, J4	NUT, HEX, #10-32, BRASS	PENCOM, NU1132
6	2	JP1, JP3	CONN, HDR, MALE, 2 \times 3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000621121
7	1	JP2	CONN, HDR, MALE, 1 \times 3, 2mm, STR, THT, NO SUBS ALLOWED	WURTH ELEKTRONIK, 62000311121
8	2	J3, J4	WASHER, #10, LOCK, EXT, TIN FINISH	PENCOM, WA4526
9	4	MH1 TO MH4	STANDOFF, NYLON, SNAP-ON, 0.625"	KEYSTONE, 8834
10	3	XJP1 TO XJP3	CONN, SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421

SCHEMATIC DIAGRAM



DEMO MANUAL DC2834A



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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