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), a spread spectrum or constant frequency current mode synchronous step-down controller. The DC2834A generates a 3.3V of output voltage.

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: 15µA in sleep mode and as low as 1µA at shutdown
- Ability to select spread spectrum or fixed frequency
- Selectable pulse-skipping, 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 (optional).

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

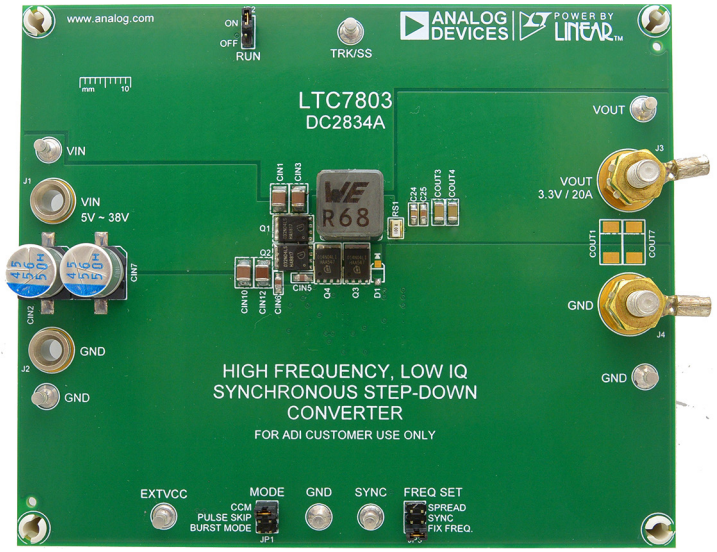
The DC2834A supports two ways of biasing the controller: directly from the input voltage or output rail through $EXTV_{CC}$. The third possibility is connecting an external voltage source to $EXTV_{CC}$ terminal.

The DC2834A supports extremely wide switching frequency range from 100kHz to 3MHz. The spread spectrum operation reduces the peak radiated and conducted noise to simplify compliance with electromagnetic interference (EMI) standards.

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

Design files for this circuit board are available.

BOARD PHOTO



PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	UNITS
Minimum Input Supply Voltage		5	V
Maximum Input Supply Voltage		38	V
Output Voltage Range	V_{IN} = 5V to 35V, I_{OUT1} = 0A to 20A	3.3 ± 2%	V
Typical Switching Frequency		500	kHz
Typical Output Ripple (V_{OUT}, 3.3V)	I_{LOAD} = 10A	50	mV
Efficiency Typical (V_{OUT}, 3.3V, V_{IN} 12V)	I_{LOAD} = 10A	94.5	%
Maximum Output Current		20	A

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 approaches 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 ±15% range relatively to the preset value.

QUICK START PROCEDURE

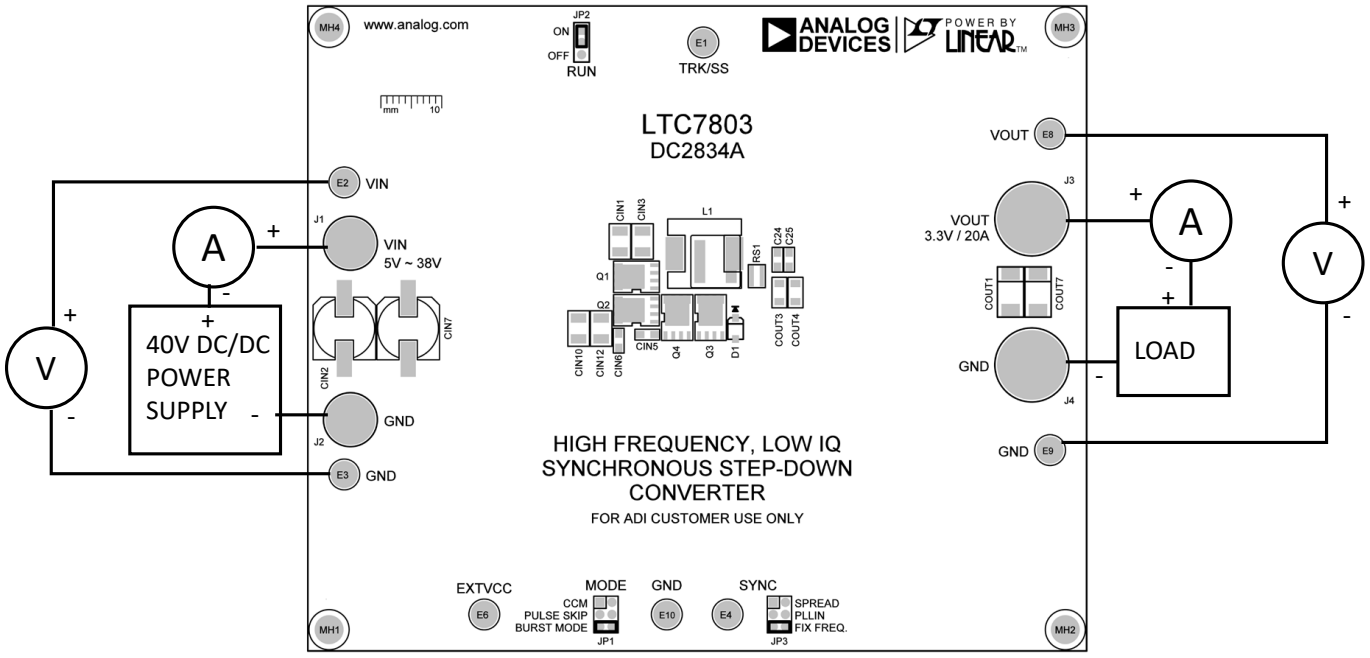


Figure 1. Proper Measurement Equipment Setup

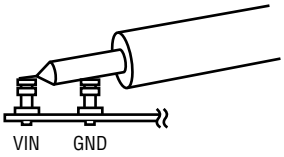


Figure 2. Measuring Input or Output Ripple

QUICK START PROCEDURE

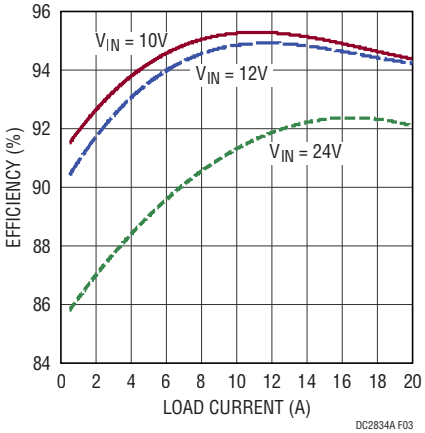


Figure 3. DC2834A, Efficiency vs Load for Different Input Voltages, Burst Mode Operation

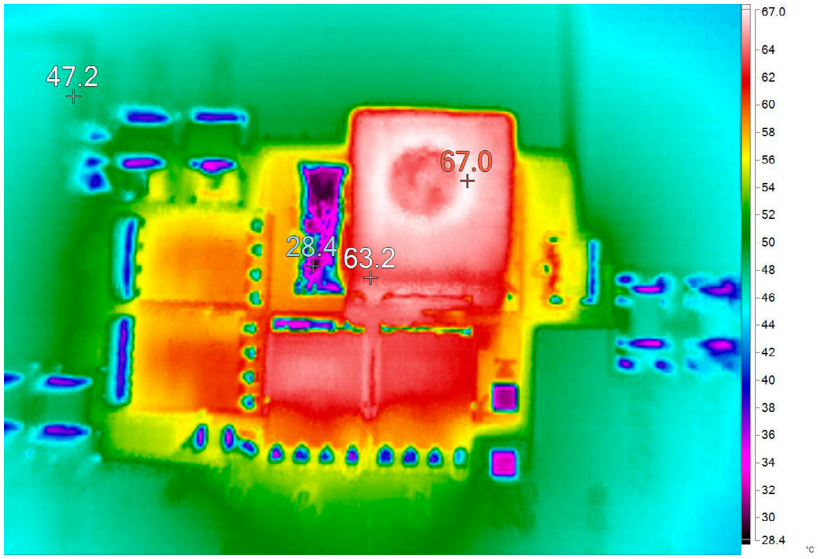


Figure 4. Thermal Image, V_{IN} 12V, V_{OUT} 3.3V at 20A, T_A = 25°C No Airflow, Natural Convection Cooling

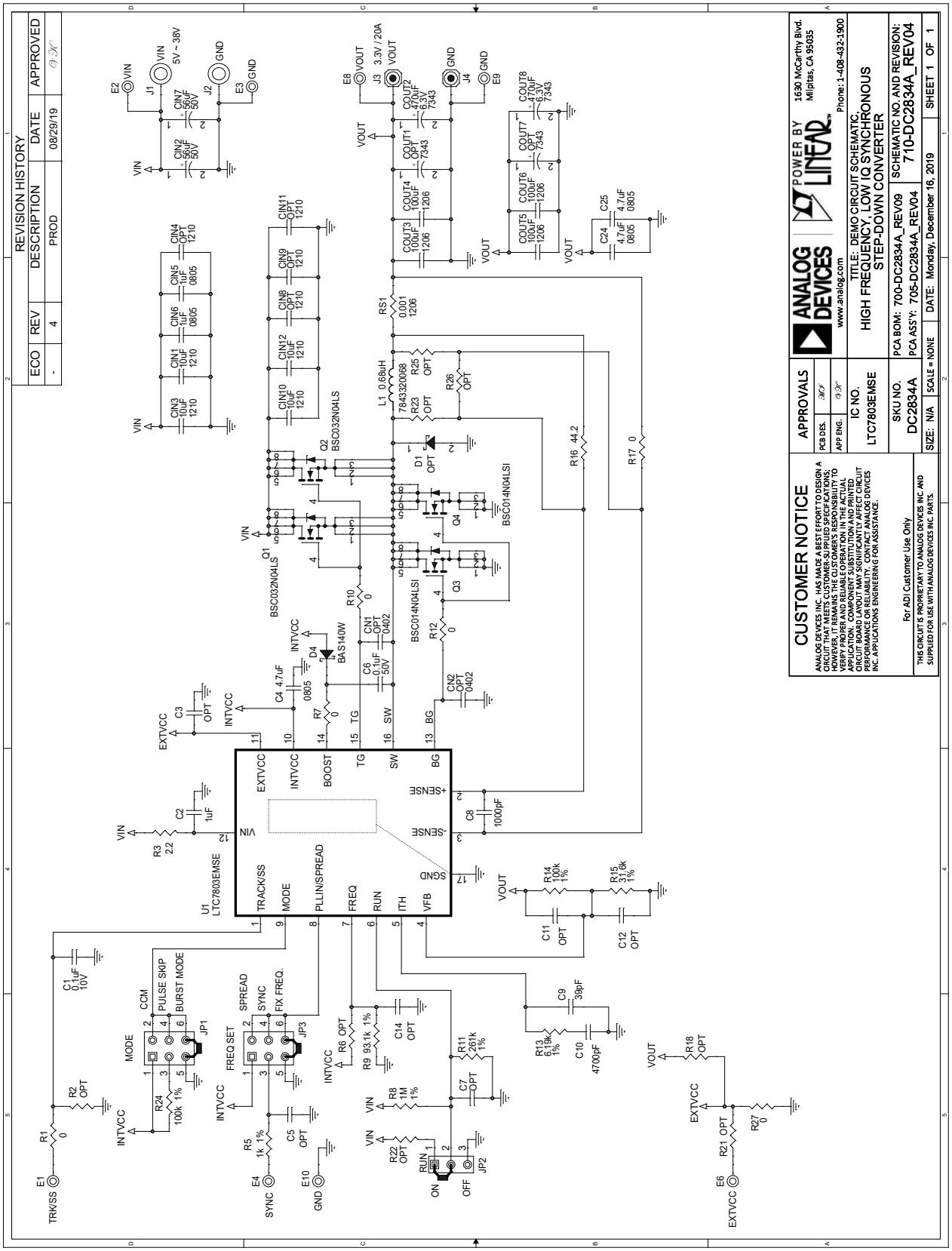
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	C1	CAP., 0.1µF, X7R, 10V, 10%, 0603	WURTH ELEKTRONIK, 885012206020
2	1	C2	CAP., 1µF, X5R, 50V, 10%, 0603, AEC-Q200, NO SUBS. ALLOWED	MURATA, GRT188R61H105KE13D
3	1	C4	CAP., 4.7µF, X5R, 50V, 10%, 0805, AEC-Q200	TDK, CGA4J3X5R1H475K125AB
4	1	C6	CAP., 0.1µF, X5R, 50V, 10%, 0603	AVX, 06035D104KAT2A
5	1	C8	CAP., 1000pF, C0G, 50V, 5%, 0603	MURATA, GRM1885C1H102JA01D
6	1	C9	CAP., 39pF, C0G, 50V, 5%, 0603	AVX, 06035A390JAT2A
7	1	C10	CAP., 4700pF, C0G, 50V, 5%, 0603	MURATA, GRM1885C1H472JA01D
8	2	C24, C25	CAP., 4.7µF, X5R, 16V, 10%, 0805	AVX, 0805YC475KAT2A
9	4	CIN1, CIN3, CIN10, CIN12	CAP., 10µF, X7R, 63V, 10%, 1210	SAMSUNG, CL32B106KMVNNWE
10	2	CIN2, CIN7	CAP., 56µF, ALUM. ELECT., 50V, 20%, 10x10.5mm RADIAL, HVH	SUN ELECTRONIC INDUSTRIES CORP, 50HVH56M
11	2	CIN5, CIN6	CAP., 1µF, X7R, 50V, 10%, 0805	AVX, 08055C105KAT2A
12	2	COUT2, COUT8	CAP., 470µF, TANT. POSCAP, 6.3V, 20%, 7343, 18mΩ, TPE, NO SUBS. ALLOWED	PANASONIC, 6TPE470MI
13	4	COUT3-COUT6	CAP., 100µF, X5R, 6.3V, 20%, 1206	MURATA, GRM31CR60J107ME39L
14	1	D4	DIODE, SCHOTTKY, 40V, 120mA, SOD323-2, AEC-Q101	INFINEON, BAS140W
15	1	L1	IND., 0.68µH, WE-CHSA SMD HIGH CURRENT, 20%, 26A, 1.7mΩ, 12.2mm × 12.2mm	WURTH ELEKTRONIK, 7843320068
16	2	Q1, Q2	XSTR., MOSFET, N-CH, 40V, 98A, TDSON-8	INFINEON, BSC032N04LS
17	2	Q3, Q4	XSTR., MOSFET, N-CH, 40V, 100A, TDSON-8 FL	INFINEON, BSC014N04LSI
18	6	R1, R7, R10, R12, R17, R27	RES., AEC-Q200, 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
19	1	R3	RES., AEC-Q200, 2.2Ω, 5%, 1/10W, 0603	VISHAY, CRCW06032R20JNEA
20	1	R5	RES., AEC-Q200, 1k, 1%, 1/10W, 0603	VISHAY, CRCW06031K00FKEA
21	1	R8	RES., AEC-Q200, 1MΩ, 1%, 1/10W, 0603	VISHAY, CRCW06031M00FKEA
22	1	R9	RES., AEC-Q200, 76.8k, 1%, 1/10W, 0603	VISHAY, CRCW060376K8FKEA
23	1	R11	RES., AEC-Q200, 261k, 1%, 1/10W, 0603	VISHAY, CRCW0603261KFKEA
24	1	R13	RES., 6.19k, 1/10W, 1%, 0603	YAGEO, RC0603FR-076K19L
25	2	R14, R24	RES., AEC-Q200, 100k, 1%, 1/10W, 0603	VISHAY, CRCW0603100KFKEA
26	1	R15	RES., AEC-Q200, 31.6k, 1%, 1/10W, 0603	VISHAY, CRCW060331K6FKEA
27	1	R16	RES., 44.2Ω, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060344R2FKEA
28	1	RS1	RES., 0.002Ω, 2%, 1.5W, 1206, LONG-SIDE TERM., METAL, SENSE, AEC-Q200, LOW EMF	SUSUMU, KRL3216E-M-R002-G-T5
29	1	U1	LOW I_Q SYNCHRONOUS STEP-DOWN CONVERTER, 16-PIN SSOP	ANALOG DEVICES, INC., LTC7803EMSE#PBF

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, OPTION, SOD-123	
6	0	L1-L4	IND., 0.68µH, POWER, 20%, 38A, 1.65mΩ, 8.8mm × 8.3mm	COILCRAFT, XAL8080-681MEB
7	0	R2, R6, R18, R21-R23, R25, R26	RES., OPTION, 0603	
Hardware				
1	8	E1-E4, E6, E8-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 × 3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000621121
7	1	JP2	CONN., HDR, MALE, 1 × 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-MH4	STANDOFF, NYLON, SNAP-ON, 0.625"	KEYSTONE, 8834
10	3	XJP1-XJP3	CONN., SHUNT, FEMALE, 2 POS, 2mm	WURTH ELEKTRONIK, 60800213421

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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