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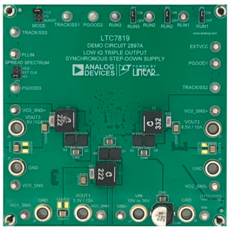
Manuals+

User Manuals Simplified.



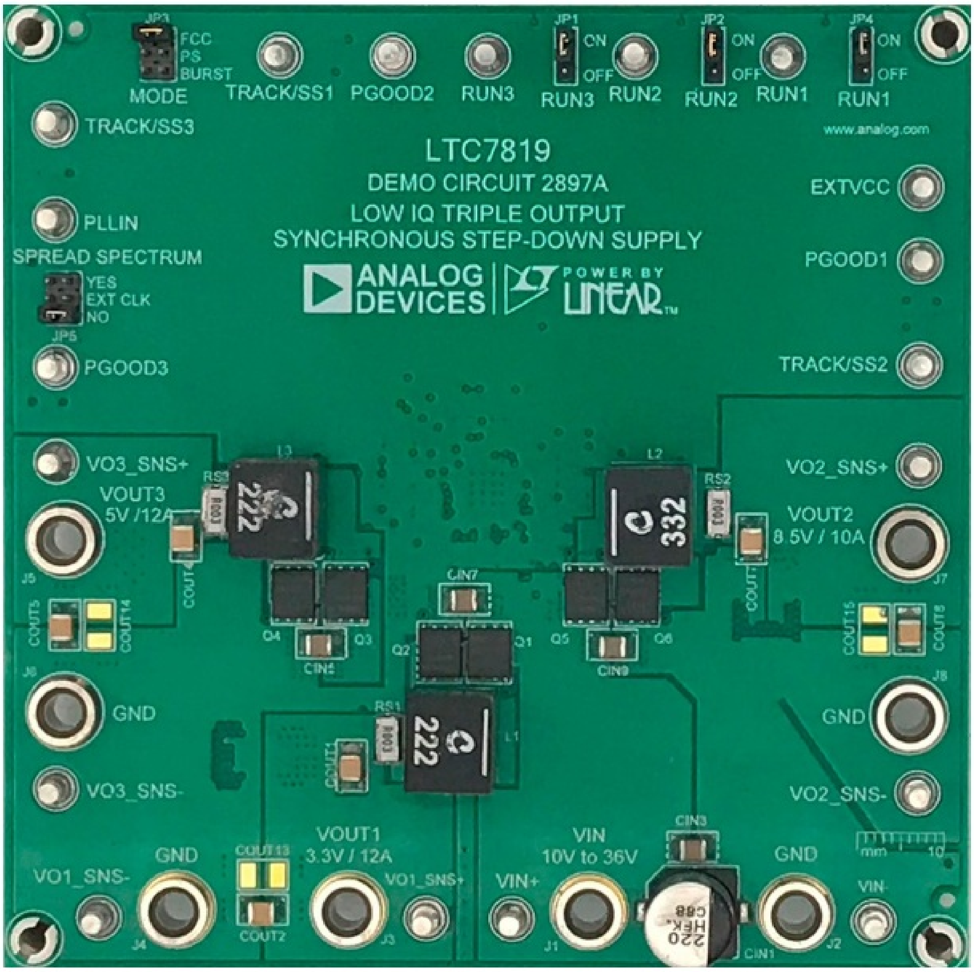
ANALOG DEVICES DC2897A Evaluation Board User Manual

Home » Analog Devices » ANALOG DEVICES DC2897A Evaluation Board User Manual

Contents hide

ANALOG DEVICES

ANALOG DEVICES DC2897A Evaluation Board



DESCRIPTION

Demonstration circuit 2897A is a low IQ, triple output, synchronous step-down supply featuring the LTC®7819. The circuit is optimized for high efficiency. It provides outputs of 3.3V at 12A, 8.5V at 10A and 5.0V at 12A over an input voltage range of 10V to 36V with a switching frequency of 380kHz. Each rail uses a 3mΩ sense resistor to sense the current and provides optional footprints for DCR sensing. Typical applications include automotive, transportation, industrial, military and avionics systems. Features of the DC2897A include pin selectable light load operating modes of forced continuous mode, pulse-skipping and Burst Mode® operation. Optional spread spectrum modulation to reduce EMI, a PLLIN pin to synchronize to an external clock, optional DCR sensing footprints, an EXTVCC pin to reduce losses in the controller and optional footprints to parallel two or three channels. The LTC7819 data sheet provides a complete description of the part, operational details, and application information. DC2897A must be read in conjunction with the data sheet. Design files for this circuit board are available.

PERFORMANCE SUMMARY

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		10	36		V
Output Voltage #1, VOUT1	VIN = 10V to 36V, IOUT1 = 0A – 12A	3.3			V
Output Voltage #2, VOUT2	VIN = 10V to 36V, IOUT2 = 0A – 10A	8.5			V
Output Voltage #3, VOUT3	VIN = 10V to 36V, IOUT3 = 0A – 12A	5.0			V
Maximum Output Current, IOUT1	VIN = 10V to 36V, VOUT1 = 3.3V	12			A
Maximum Output Current, IOUT2	VIN = 10V to 36V, VOUT2 = 8.5V	10			A
Maximum Output Current, IOUT3	VIN = 10V to 36V, VOUT3 = 5.0V	12			A
Switching Frequency		380			kHz
Efficiency (fSW = 380kHz)	VIN = 12V, VOUT1 = 3.3V, IOUT1 = 12A VIN = 12V, VOUT2 = 8.5V, IOUT2 = 10A	94.9 97.9			% %
	VIN = 12V, VOUT3 = 5.0V, IOUT3 = 12A	96.4			%

QUICK START PROCEDURE

Demonstration circuit 2897A is easy to set up for evaluating the LTC7819. Please refer to Figure 1 for the proper measurement equipment setup and follow the procedure below.

1. Connect the input power supply to VIN (10V – 36V) and GND (input return).
2. Preset the load for each output to 0A and the input supply to 0V.
3. Place jumpers in the following positions:
   JP4: RUN1 ON
   JP2: RUN2 ON
   JP1: RUN3 ON
   JP3: MODE FCC
   JP5: SPREAD SPECTRUM NO
4. Set the input voltage to within the specified range and check VOUT1, VOUT2 and VOUT3.
5. Once the proper output voltages have been confirmed, observe the output voltage ripple, efficiency, and other parameters.

LIGHT LOAD OPERATION, SYNCHRONIZATION TO AN EXTERNAL CLOCK AND SPREAD SPECTRUM

To synchronize the LTC7819 to an external clock, place the SPREAD SPECTRUM jumper (JP5) in the EXT CLK position and apply an external clock between the PLLIN turret and GND. The phase-lockable frequency range is 100kHz to 3MHz. The low clock level should be 0.5V or lower and the high clock level should be 2.2V or higher. For spread spectrum, place the jumper in the YES posi-tion. With spread spectrum enabled, the frequency will be modulated between 100% and 120% of the programmed frequency (380kHz to 456kHz). This will help reduce the peak emission levels. To allow the converter to free run at is programmed frequency (380kHz), place the jumper in the NO position which is the default setting. Demonstration circuit 2897A can be programmed to operate in either forced continuous conduction mode (FCC), pulse-skipping mode (PS) or Burst Mode opera-tion (BURST) at no load or light load with JP3. Forced continuous mode (default setting) provides the clean-est output voltage ripple. Pulse-skipping mode provides higher efficiency at light load, but the output voltage ripple is less regular. Burst Mode operation provides the highest light load efficiency, but the output voltage ripple is the least regular and highest of the three modes.

QUICK START PROCEDURE

OPTIONAL DCR SENSING

Demonstration circuit 2897A has optional footprints for DCR sensing. The benefit of DCR sensing is a lower parts count and high efficiency but at the expense of a less accurate current sensing and current limit. To imple-ment DCR sensing refer to Table 1 and the Applications Information section of the data sheet. Be sure to stuff a 0mΩ copper shunt or a short, thick piece of copper at RS1, RS2 and/or RS3.

EXTVCC BIAS OPTION

The EXTVCC pin of the LTC7819 on the standard demo board is connected to the 5V output (VOUT3) to reduce the losses in the controller and improve efficiency. If nec-
essary, the EXTVCC pin can be tied to an external supply by following these steps:

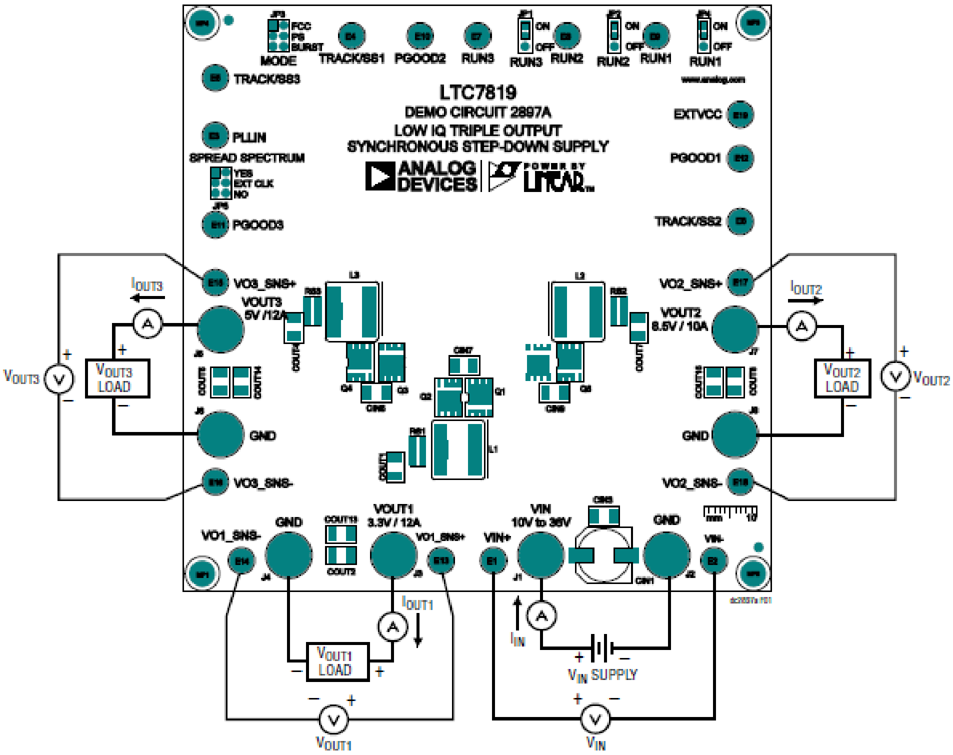
1. Remove the 0Ω jumper at R20.
2. Connect a DC voltage from the EXTVCC turret to a GND turret. The DC voltage should be between 5V and 30V.

PARALLELING CHANNELS

For higher power, two or more channels of demonstra-tion circuit 2897A can be paralleled. Given that the chan-nels operate 120 degrees out of phase with each other, paralleling channels provides the benefit of ripple cur-rent cancelation in the output and input capacitors. This in turn provides lower output voltage and input voltage ripple. Another benefit of interleaved channels is a faster load step response. When paralleling phases channel 1 is always the master and channels 2 and 3 are slaves. In addition, each phase should have the same inductor, sense resistor–if used and MOSFETs. Detailed instruc-tions are below:

Table 1. Optional Inductor DCR Sensing

CONFIGURATION	**CHANNEL 1**	**RS1**	**R30**	**R29**	**C14**	**R45**	**R47**	**R61**
	CHANNEL 2	**RS2**	**R52**	**R54**	**C56**	**R50**	**R49**	**R46**
	CHANNEL 3	**RS3**	**R40**	**R39**	**C15**	**R51**	**R53**	**R62**
RSENSE (DEFAULT)		3mΩ	0Ω	0Ω	1nF	Open	Open	Open
DCR SENSING		0mΩ Cu	Open	Open	Refer to Data Sheet			0Ω



NOTE FOR ACCURATE EFFICIENCY MEASUREMENTS:
MONITOR V_{OUT1}, V_{OUT2} AND V_{OUT3} ACROSS C_{OUT1}, C_{OUT7} AND C_{OUT4}, RESPECTIVELY.
MONITOR V_{IN} ACROSS EITHER C_{IN7} (CH1), C_{IN9} (CH2) OR C_{IN5} (CH3).

Figure 1. Proper Measurement Equipment Setup

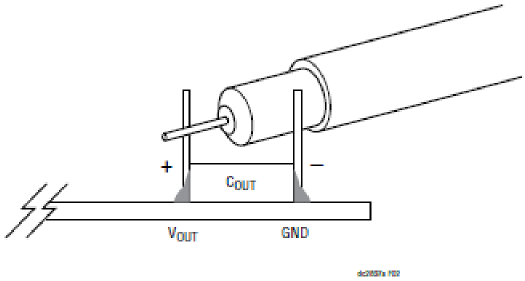


Figure 2. How to Measure the Output or Input Voltage Ripple

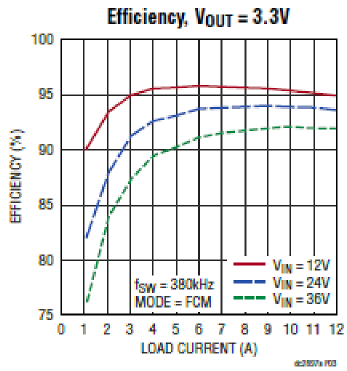


Figure 3. Efficiency of the 3.3V/12A Rail (V_{OUT1}) Over the Input Voltage Range, the Other Two Rails Were Disabled, No Voltage Was Applied to the $EXTV_{CC}$ Pin and the PGOOD Pull-Ups Were Removed

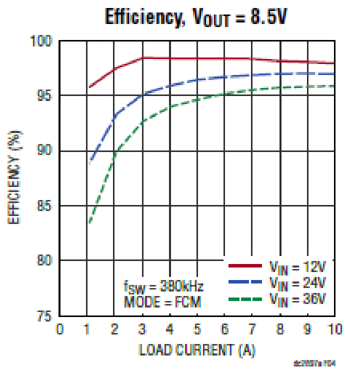


Figure 4. Efficiency of the 8.5V/10A Rail (V_{OUT2}) Over the Input Voltage Range, the Other Two Rails Were Disabled, No Voltage Was Applied to the $EXTV_{CC}$ Pin and the PGOOD Pull-Ups Were Removed

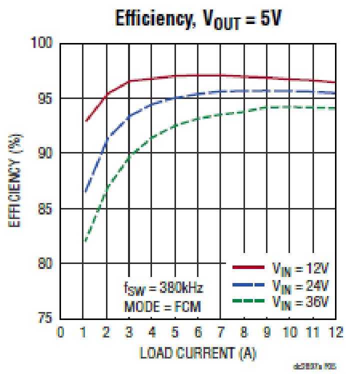


Figure 5. Efficiency of the 5V/12A Rail (V_{OUT3}) Over the Input Voltage Range, the Other Two Rails Were Disabled, the 5V Output was Tied to the $EXTV_{CC}$ Pin and the PGOOD Pull-Ups Were Removed

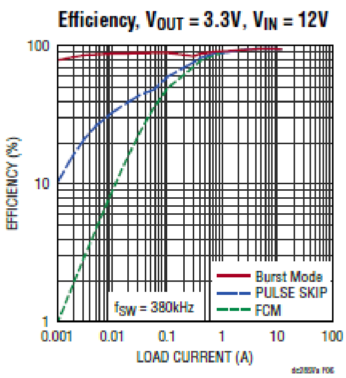


Figure 6. Efficiency of the 3.3V/12A Rail (V_{OUT1}) at $12V_{IN}$ for the Three Light Load Operating Modes, the Other Two Rails Were Disabled, No Voltage Was Applied to the $EXTV_{CC}$ Pin and the PGOOD Pull-Ups Were Removed

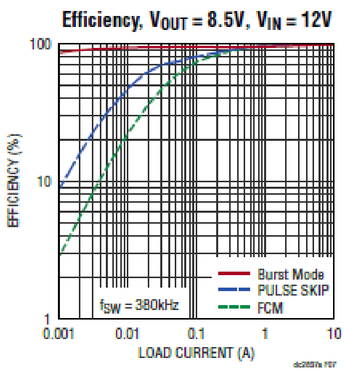


Figure 7. Efficiency of the 8.5V/10A Rail (V_{OUT2}) at $12V_{IN}$ for the Three Light Load Operating Modes, the Other Two Rails Were Disabled, No Voltage Was Applied to the $EXTV_{CC}$ Pin and the PGOOD Pull-Ups Were Removed

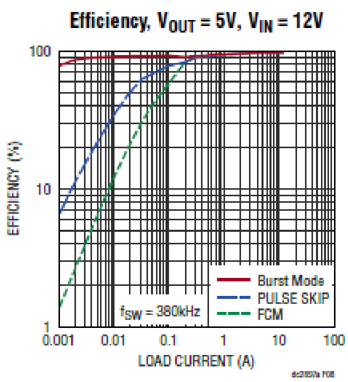


Figure 8. Efficiency of the 5V/12A Rail (V_{OUT3}) for the Three Light Load Operating Modes, the Other Two Rails Were Disabled, the 5V Output Was Tied to the $EXTV_{CC}$ Pin and the PGOOD Pull-Ups Were Removed

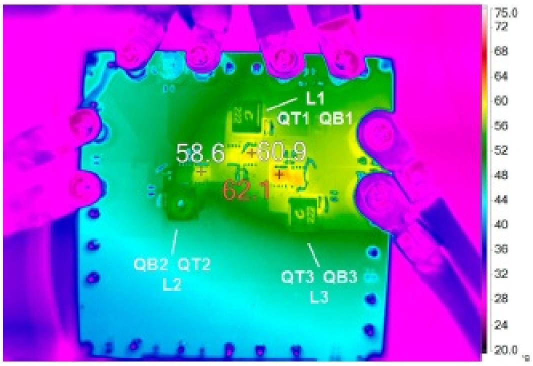


Figure 9. Thermal Image with Full Load on Each Rail at $12V_{IN}$, f_{SW} = 380kHz, No Airflow, T_A = 23°C, Markers Show the Hot Spot for Each Channel

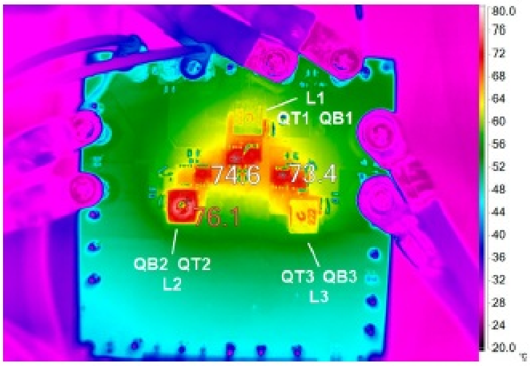


Figure 10. Thermal Image with Full Load on Each Rail at $36V_{IN}$, f_{SW} = 380kHz, No Airflow, T_A = 23°C, Markers Show the Hot Spot for Each Channel

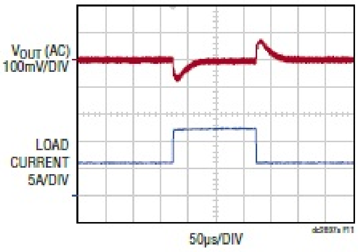


Figure 11. 50% to 100% Load Step Response of the 3.3V/12A Rail (V_{OUT1})

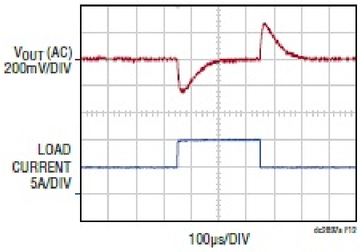


Figure 12. 50% to 100% Load Step Response of the 8.5V/10A Rail (V_{OUT2})

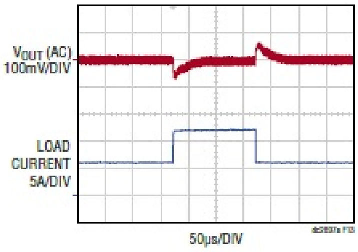


Figure 13. 50% to 100% Load Step Response of the 5.0V/12A Rail (V_{OUT3})

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
1	5	C1, C14, C15, C43, C56	CAP., 1000pF, C0G, 50V, 10%, 0603	AVX, 06035A102KAT2A
2	1	C11	CAP., 4.7µF, X5R, 10V, 10%, 0805	KEMET, C0805C475K8PACTU MURATA, GRM21BR61A475KA73L SAMSUNG, CL21A475KPFNNNF TDK, C2012X5R1A475K125AA
3	8	C2, C4, C20, C21, C47, C52, C61, C74	CAP., 0.1µF, X7R, 50V, 10%, 0603	AVX, 06035C104KAT2A KEMET, C0603C104K5RAC7867; C0603C104K5RACTU TDK, C1608X7R1H104K080AA
4	1	C41	CAP., 2200pF, X7R, 50V, 10%, 0603	AVX, 06035C222KAT2A MURATA, GRM188R71H222KA01D SAMSUNG, CL10B222KB8NFNC

5	2	C42, C44	CAP., 47pF, X7R, 50V, 10%, 0603	AVX, 06035C470KAT2A KEMET, C0603C470K5RACTU
6	1	C53	CAP., 0.01µF, C0G, 50V, 5%, 0603	MURATA, GRM1885C1H103JA01D TDK, C1608C0G1H103J080AA
7	1	C54	CAP., 220pF, X7R, 50V, 10%, 0603	AVX, 06035C221KAT2A KEMET, C0603C221K5RACTU NIC, NMC0603X7R221K50TRPF
8	2	C69, C70	CAP., 1µF, X7R, 10V, 10%, 0603	AVX, 0603ZC105KAT2A KEMET, C0603C105K8RACTU MURATA, GRM188R71A105KA61D TDK, C1608X7R1A105K080AC
9	1	CIN1	CAP., 220µF, ALUM ELECT, 50V, 20%, 10mm × 10.2mm, RADIAL, SMD, AEC-Q200	PANASONIC, EEEFK1H221GP CORNELL DUBILIER, AFK227M50G24T-F
10	8	CIN3, CIN4, CIN5, CIN6, CIN7, CIN8, CIN9, CIN10	CAP., 4.7µF, X7R, 50V, 10%, 1210	AVX, 12105C475KAT2A KEMET, C1210C475K5RACTU MURATA, GRM32ER71H475KA88L YAGEO, CC1210KKX7R9BB475
11	6	COUT1, COUT2, COUT4, COUT5, COUT7, COUT8	CAP., 47µF, X7R, 10V, 10%, 1210	AVX, 1210ZC476KAT2A MURATA, GRM32ER71A476KE15L TAIYO YUDEN, LMK325B7476KM-PR; LMK325B7476KM-TR
12	2	COUT10, COUT11	CAP., 470µF, TANT, POSCAP, 6.3V, 20%, 7343, 10mΩ, TCF	PANASONIC, 6TCF470MAH
13	1	COUT12	CAP., 150µF, TANT. POSCAP, 10V, 20%, 7343, D3L	PANASONIC, 10TPF150ML
14	3	D1, D2, D6	DIODE, SCHOTTKY, 100V, 1A, POWERDI-123, AEC-Q101	DIODES INC., DFLS1100Q-7
15	2	L1, L3	IND., 2.2µH, PWR., 20%, 11.8mm × 10.5mm SMD, AEC-Q200	COILCRAFT, XAL1010-222MEB; XAL1010-222MED
16	1	L2	IND., 3.3µH, PWR., 20%, 25A, 4.10mΩ, 11.8mm × 10.5mm, XAL1010, AEC-Q200	COILCRAFT, XAL1010-332MEB; XAL1010-332MED
17	3	Q1, Q3, Q5	XSTR., MOSFET, N-CH, 40V, 59A, TDSON-8 FL	INFINEON, BSC059N04LS6; BSC059N04LS6ATMA1
18	3	Q2, Q4, Q6	XSTR., MOSFET, N-CH, 40V, 100A, TDSON-8 FL	INFINEON, BSC022N04LS6; BSC022N04LS6ATMA1

19	16	R1, R3, R4, R5, R9, R25, R27, R29, R30, R39, R40, R44, R52, R54, R83, R84	RES., 0Ω, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06030000Z0EA; CRCW06030000Z0EB NIC, NRC06ZOTRF

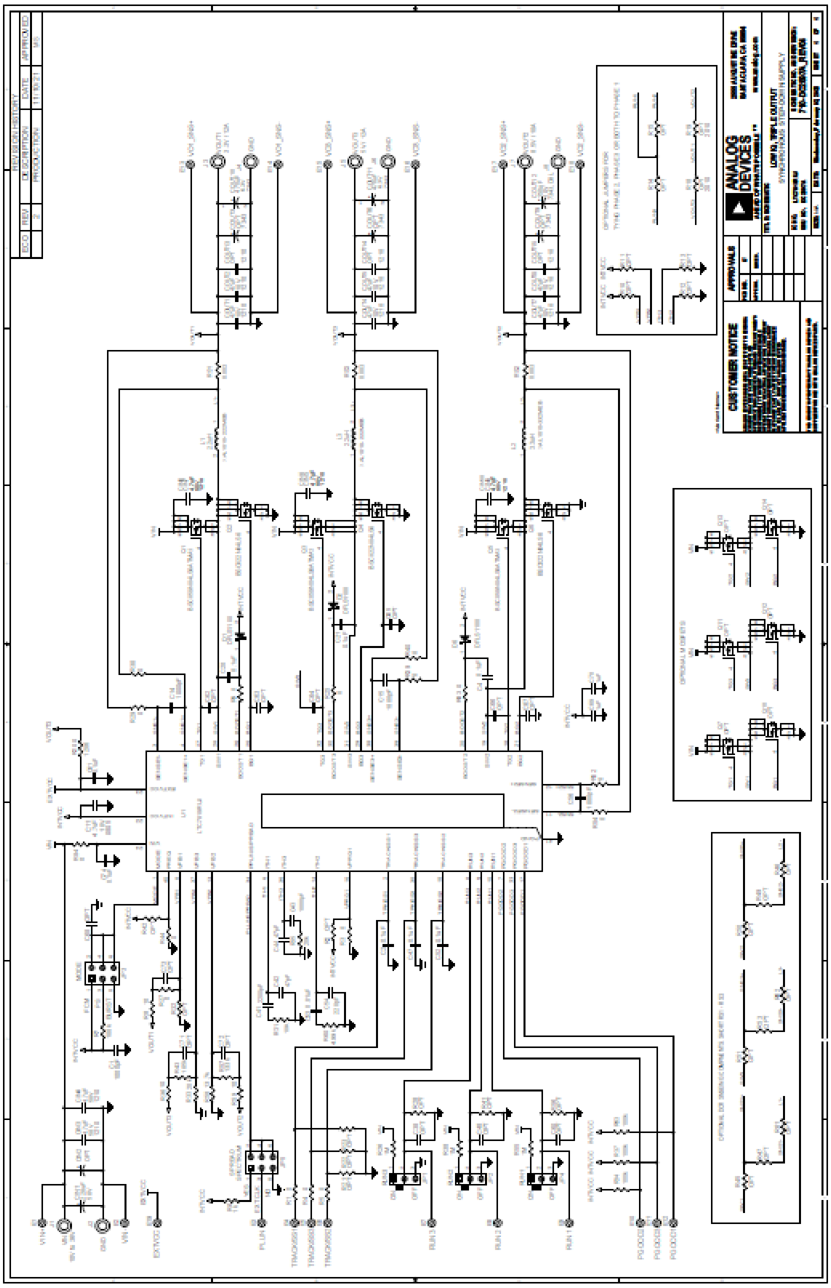
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
20	1	R20	RES., 0Ω, 1/4W, 1206, AEC-Q200	VISHAY, CRCW12060000Z0EA PANASONIC, ERJ8GEY0R00V NIC, NRC12ZOTRF
21	3	R26, R38, R55	RES., 1M, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1004TRF PANASONIC, ERJ3EKF1004V VISHAY, CRCW06031M00FKEA
22	1	R31	RES., 10k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF1002V VISHAY, CRCW060310K0FKEA; CRCW060310K0FKEB KOA SPEER, RK73H1JTTD1002F
23	2	R33, R35	RES., 20k, 1%, 1/10W, 0603	NIC, NRC06F2002TRF VISHAY, CRCW060320K0FKEA PANASONIC, ERJ3EKF2002V YAGEO, RC0603FR-0720KL
24	1	R43	RES., 105k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603105KFKEA NIC, NRC06F1053TRF
25	1	R57	RES., 133k, 1%, 1/10W, 0603	BOURNS, CR0603-FX-1333ELF YAGEO, RC0603FR-07133KL
26	1	R58	RES., 13.7k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060313K7FKEA PANASONIC, ERJ3EKF1372V
27	1	R6	RES., 1k, 5%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3GEYJ102V
28	1	R60	RES., 4.99k, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF4991V YAGEO, RC0603FR-074K99L
29	4	R7, R34, R37, R63	RES., 100k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW0603100KFKEA NIC, NRC06F1003TRF PANASONIC, ERJ3EKF1003V
30	3	R8, R36, R59	RES., 10Ω, 1%, 1/10W, 0603	VISHAY, CRCW060310R0FKEA NIC, NRC06F10R0TRF PANASONIC, ERJ3EKF10R0V ROHM, MCR03EZPFX10R0 YAGEO, RC0603FR-0710RL
31	3	RS1, RS2, RS3	RES., 0.003, 0Ω, 1%, 2W, 2010 LONG- SIDE TERM, METAL, SENSE, AEC-Q200	SUSUMU, KRL5025E-C-R003-F-T1
32	1	U1	IC, SYN. STEP-DOWN CONVERTER, 40-PIN QFN	ANALOG DEVICES, LTC7819RUJ#PBF; LTC7819RUJ#TRPBF

Additional Circuit Components

1	0	C38, C48, C60, C62, C63, C64, C65, C66, C67, C68, C71, C72, C73	CAP., OPTION, 0603	
2	0	CIN2	CAP., OPTION, ALUM. ELECT., SMD	
3	0	COUT13, COUT14, COUT15	CAP., OPTION, 1210	
4	0	COUT3, COUT6, COUT9	CAP., OPTION, 7343	
5	0	Q7, Q10, Q11, Q12, Q13, Q14	XSTR., OPTION, MOSFET N-CH, PG-TDSON-8	
6	0	R18, R19	RES., OPTION, 2010	
7	0	R2, R10, R11, R12, R13, R14, R15, R21, R22, R23, R28, R32, R41, R42, R45, R46, R47, R49, R50, R51, R53, R56, R61, R62	RES., OPTION, 0603	

Hardware: For Demo Board Only

1	19	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15, E16, E17, E18, E19	TEST POINT, TURRET, 0.094″ MTG. HOLE, PCB 0.062″ THK	MILL-MAX, 2501-2-00-80-00-00-07-0
2	8	J1, J2, J3, J4, J5, J6, J7, J8	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218″	KEYSTONE, 575-4
3	3	JP1, JP2, JP4	CONN., HDR, MALE, 1×3, 2mm, VERT, ST, THT, NO SUBS. ALLOWED	WURTH ELEKTRONIK, 62000311121
4	2	JP3, JP5	CONN., HDR, MALE, 2×3, 2mm, VERT, ST, THT	WURTH ELEKTRONIK, 62000621121
5	8	MP1, MP2, MP3, MP4, MP5, MP6, MP7, MP8	STANDOFF, NYLON, SNAP-ON, 0.625″ (5/8″), 15.9mm	KEYSTONE, 8834
6	3	XJP1, XJP2, XJP4	CONN., SHUNT, FEMALE, 2-POS, 2mm	WURTH ELEKTRONIK, 60800213421



SCHEMATIC DIAGRAM

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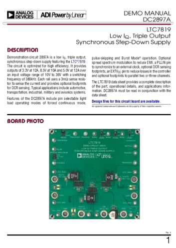
RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED “AS IS” AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER’S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI’S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS ($100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.

Documents / Resources



ANALOG DEVICES DC2897A Evaluation Board [pdf] User Manual
DC2897A, Evaluation Board, DC2897A Evaluation Board, LTC7819

References

- **Mixed-signal and digital signal processing ICs | Analog Devices**