

LTC7805

Dual 12V_{IN} to 36V_{IN}, 5V/15A and 12V/10A Output Synchronous Buck Converter with Spread Spectrum

DESCRIPTION

Demonstration circuit 3138A is a dual output step-down DC/DC converter that operates over a 12V to 36V input voltage range. It provides two outputs of 5V at 15A and 12V at 10A, and features the **LTC®7805** dual output synchronous step-down controller.

Key features of this board include:

- FREQUENCY jumper for spread spectrum or external clock
- EXT_{VCC} jumper to use V_{OUT2}, EXT_{VCC}, or other derived V_{CC}
- MODE jumper that allows the converter to run in FCM, pulse-skipping, or Burst Mode® operation

- PGOOD signals for each output

The two channels can be paralleled for higher output current. See the data sheet for more information on setting-up the board for paralleling the two outputs.

The LTC7805 data sheet gives a complete description of the device, its operation and application information. The data sheet must be read in conjunction with this demo manual prior to working on or modifying demo circuit 3138A.

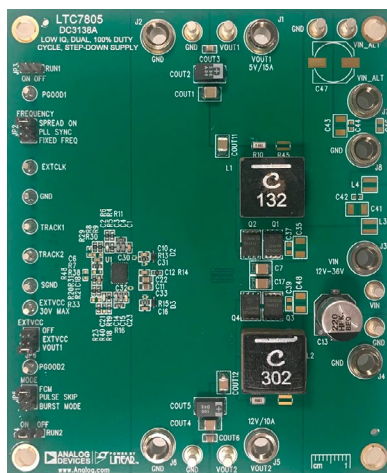
Design files for this circuit board are available.

All registered trademarks and trademarks are the property of their respective owners.

PERFORMANCE SUMMARY Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V _{IN}	Input Supply Range		12		36	V
f _{SW}	Switching Frequency			350		kHz
V _{OUT1}	Output Voltage		4.9	4.98	5.06	V
I _{OUT1}	Output Current				15	A
V _{OUT1(AC)}	Output Ripple	V _{IN} = 24V, I _{OUT1} = 15A, 20MHz		40		mV _{p-p}
V _{OUT2}	Output Voltage		11.72	11.92	12.12	V
I _{OUT2}	Output Current				10	A
V _{OUT2(AC)}	Output Ripple	V _{IN} = 24V, I _{OUT2} = 10A, 20MHz		90		mV _{p-p}
η	Efficiency	V _{IN} = 24V, I _{OUT1} = 15A, I _{OUT2} = 10A		96.1		%
η	Efficiency	V _{IN} = 24V, I _{OUT1} = 15A, V _{OUT2} = 0V		93.1		%
η	Efficiency	V _{IN} = 24V, V _{OUT1} = 0V, I _{OUT2} = 10A		96.7		%

BOARD PHOTO



DEMO MANUAL DC3138A

QUICK START PROCEDURE

Demo circuit 3138A is an easy way to evaluate the performance of the LTC7805. Refer to Figure 1 for proper measurement equipment setup, and follow the procedure below:

1. With power off, connect the input power supply “+” to V_{IN} and “-” to GND. Connect the loads from V_{OUT1} to GND, and V_{OUT2} to GND.
2. Set voltage of the DC power supply at 13V. Turn on the power at the input.

NOTE: Make sure that the input voltage does not exceed 36V.

3. Check for the proper output voltage between V_{OUT1} and GND ($V_{OUT1} = 5V$). Check for the proper output voltage between V_{OUT2} and GND ($V_{OUT2} = 12V$).

NOTE: If there is no output, or output voltage value is out of the spec, temporarily disconnect the load to make sure that the load is not set too high.

NOTE: The circuit features frequency foldback to protect the power switches during a fault or output current overload.

4. Once the proper output voltage at each channel is established, adjust the load within the operating range and measure the output voltage regulation, ripple voltage, efficiency and other parameters.

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} and GND terminals, V_{OUT1} and GND terminals, or V_{OUT2} and GND terminals. See Figure 2 for proper scope probe technique.

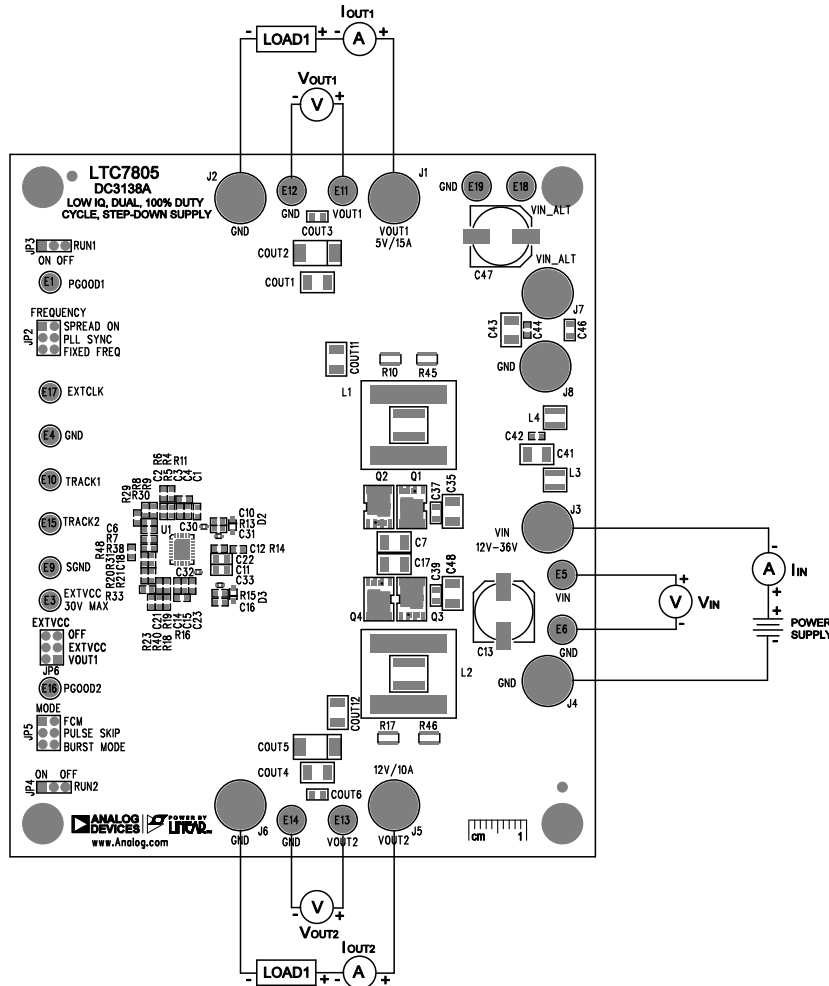


Figure 1. DC3138A Proper Equipment Setup

QUICK START PROCEDURE

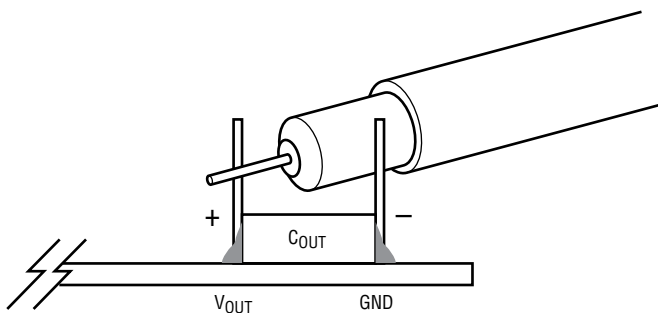


Figure 2. Measuring Input or Output Ripple

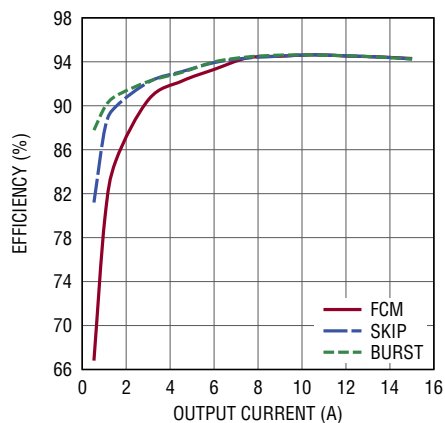


Figure 3. DC3138A 5V Output Efficiency vs Output Current ($V_{IN} = 24V$, $T_A = 25^\circ C$)

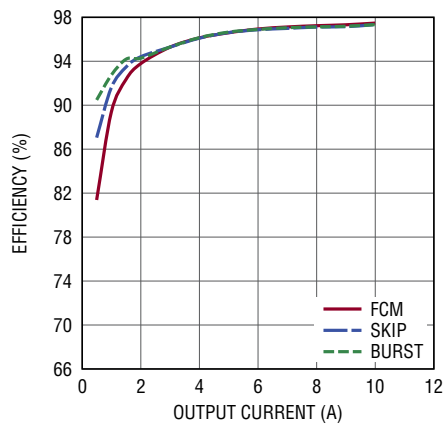


Figure 4. DC3138A 12V Output Efficiency vs Output Current ($V_{IN} = 24V$, $T_A = 25^\circ C$)

QUICK START PROCEDURE

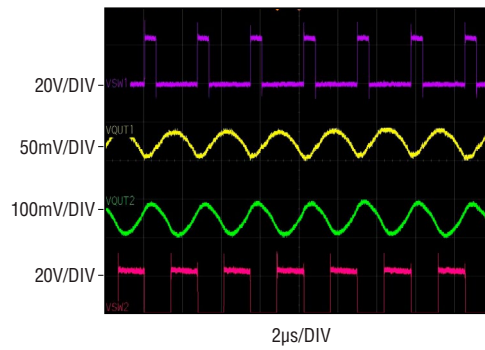


Figure 5. DC3138A Output1 (5V) and Output2 (12V) Output Ripple ($24V_{IN}$, $I_{OUT1} = 15A$, $I_{OUT2} = 10A$, 20MHz)

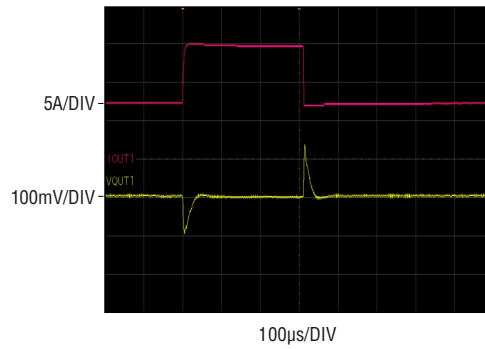


Figure 6. DC3138A 5V Output Transient Response ($24V_{IN}$, $I_{OUT} = 7.5A$ to $15A$)

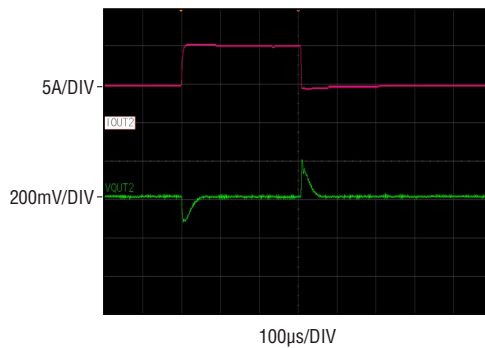


Figure 7. DC3138A 12V Output Transient Response ($24V_{IN}$, $I_{OUT} = 5A$ to $10A$)

QUICK START PROCEDURE

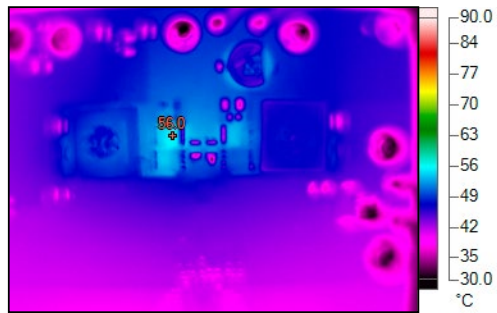


Figure 8. DC3138A Thermal Performance (13.5V_{IN}, I_{OUT1} = 15A, I_{OUT2} = 10A, T_A = 25°C, Free Air)

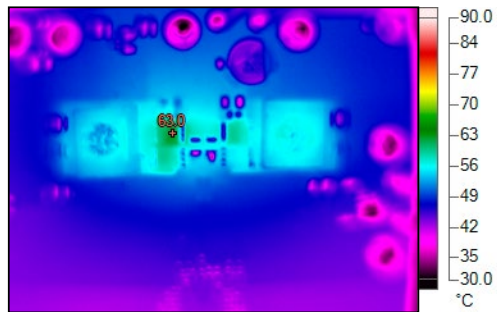


Figure 9. DC3138A Thermal Performance (24V_{IN}, I_{OUT1} = 15A, I_{OUT2} = 10A, T_A = 25°C, Free Air)

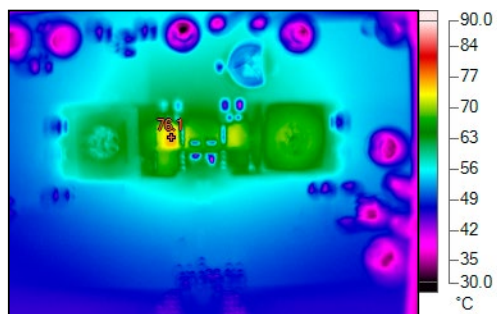


Figure 10. DC3138A Thermal Performance (36V_{IN}, I_{OUT1} = 15A, I_{OUT2} = 10A, T_A = 25°C, Free Air)

DEMO MANUAL DC3138A

PARTS LIST

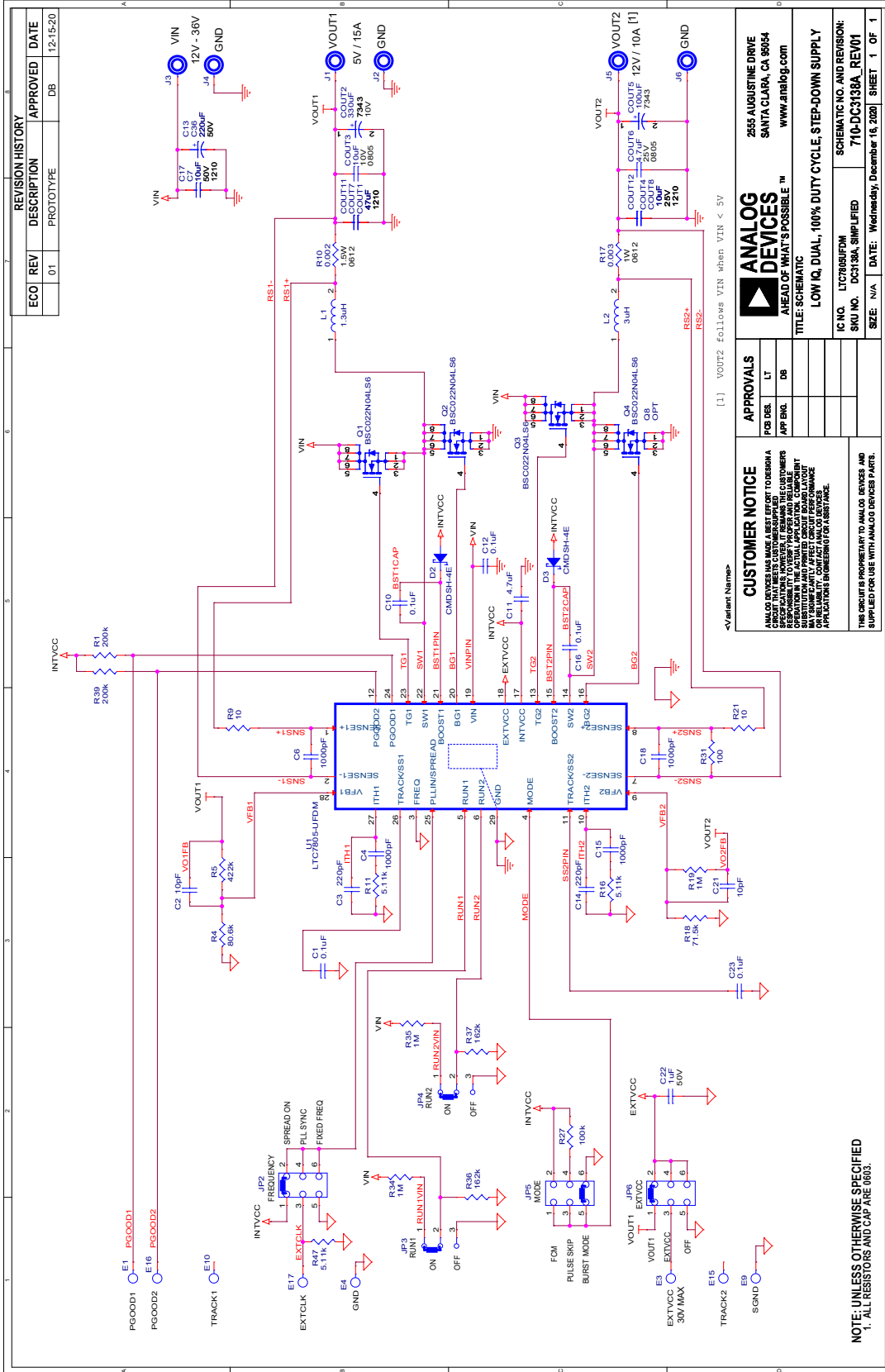
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	5	C1, C10, C12, C16, C23	CAP., 0.1 μ F, X7R, 25V, 10%, 0603	AVX, 06033C104KAT2A
2	1	C2	CAP., 10pF, C0G, 50V, 5%, 0603	AVX, 06035A100JAT2A
3	2	C3, C14	CAP., 220pF, C0G, 50V, 5%, 0603, AEC-Q200	TDK, CGA3E2C0G1H221J080AA
4	2	C4, C15	CAP., 1000pF, C0G, 50V, 5%, 0603, AEC-Q200	TDK, CGA3E2C0G1H102J
5	2	C6, C18	CAP., 1000pF, X7R, 25V, 10%, 0603	AVX, 06033C102KAT2A
6	2	C7, C17	CAP., 10 μ F, X7R, 50V, 10%, 1210	AVX, 12105C106KAT2A
7	1	C11	CAP., 4.7 μ F, X7R, 16V, 10%, 0805	AVX, 0805YC475KAT2A
8	2	C13, C36	CAP., 220 μ F, ALUM ELECT, 50V, 20%, 10x10.2mm, RADIAL, SMD, AEC-Q200	PANASONIC, EEEFK1H221GP
9	1	C21	CAP., 10pF, NPO, 10V, 5%, 0603	KEMET, C0603C100J8GAC7867
10	1	C22	CAP., 1 μ F, X7R, 50V, 10%, 0805	AVX, 08055C105KAT2A
11	3	COUT1, COUT7, COUT11	CAP., 47 μ F, X5R, 25V, 20%, 1210	TAIYO YUDEN, TMK325ABJ476MM-P
12	1	COUT2	CAP., 330 μ F, TANT, POSCAP, 10V, 20%, 7343, TPE Series	PANASONIC, 10TPE330M
13	1	COUT3	CAP., 10 μ F, X7R, 10V, 10%, 0805	AVX, 0805ZC106KAT2A
14	3	COUT4, COUT8, COUT12	CAP., 10 μ F, X7R, 25V, 10%, 1210	AVX, 12103C106KAT2A
15	1	COUT5	CAP., 100 μ F, TANT, POSCAP, 20V, 20%, 7343, 55m Ω , TQC, NO SUBS. ALLOWED	PANASONIC, 20TQC100MYF
16	1	COUT6	CAP., 4.7 μ F, X7R, 25V, 10%, 0805	AVX, 08053C475KAT2A
17	2	D2, D3	DIODE, SCHOTTKY, 40V, 200mA, 250mW, SOD-323	CENTRAL SEMI., CMDSH-4E TR LEAD FREE
18	1	L1	IND., 1.3 μ H, PWR, SHIELDED, 20%, 46.7A, 1.38m Ω , 16.4 x 15.4mm, AEC-Q200	COILCRAFT, XAL1580-132MEB
19	1	L2	IND., 3 μ H, PWR, SHIELDED, 20%, 16.4mm x 15.4mm, AEC-Q200	COILCRAFT, XAL1580-302MEB
20	4	Q1-Q4	XSTR., MOSFET, N-CH, 40V, 100A, TDSON-8 FL	INFINEON, BSC022N04LS6
21	2	R1, R39	RES., 200k, 1%, 1/10W, 0603	NIC, NRC06F2003TRF
22	1	R4	RES., 80.6k, 1%, 1/10W, 0603	VISHAY, CRCW060380K6FKEA
23	1	R5	RES., 422k, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F4223TRF
24	2	R9, R21	RES., 10 Ω , 5%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060310R0JNEA
25	1	R10	RES., 0.002 Ω , 2%, 1.5W, 1206, LONG-SIDE TERM., METAL, SENSE, AEC-Q200, low EMF	SUSUMU, KRL3216E-M-R002-G-T5
26	3	R11, R16, R47	RES., 5.11k, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF5111V
27	1	R17	RES., 0.003 Ω , 1%, 1W, 1206, AEC-Q200 LONG SIDE TERM SENSE	SUSUMU, KRL3216-C-R003-F-T1
28	1	R18	RES., 71.5k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060371K5FKEA
29	2	R19, R35	RES., 1M, 1%, 1/10W, 0603, AEC-Q200	NIC, NRC06F1004TRF
30	1	R27	RES., 100k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF1003V
31	1	R31	RES., 100 Ω , 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF1000V
32	1	R34	RES., 1M, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06031M00FKEA
33	2	R36, R37	RES., 162k, 1%, 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3EKF1623V
34	1	U1	IC, 2-PHASE SYN STEP-DOWN CTRLR, QFN-28, 40V LOW IQ, DUAL	ANALOG DEVICES, LTC7805EUFDM#PBF

DEMO MANUAL DC3138A

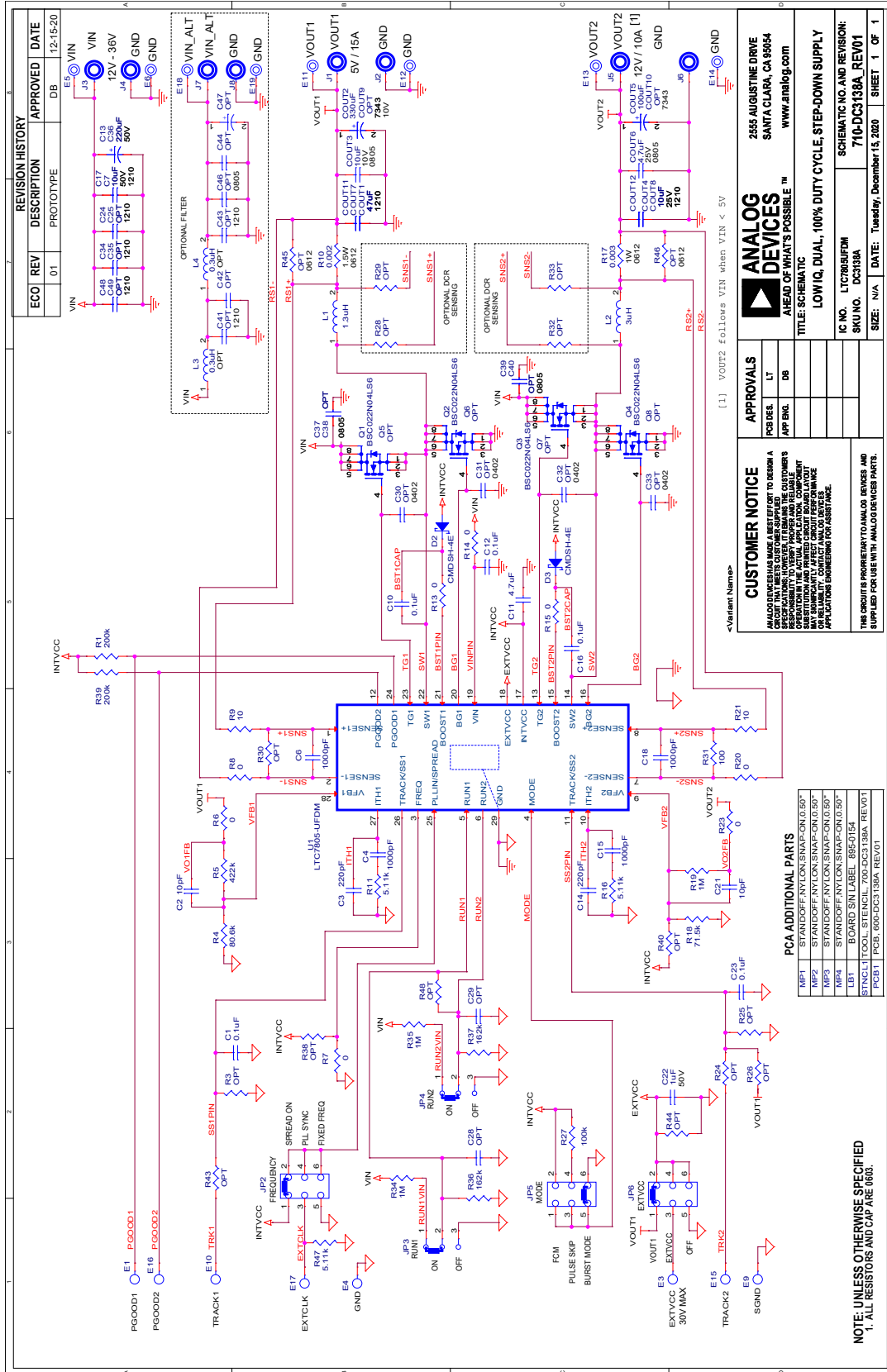
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	0	C24, C25, C34, C35, C41, C43, C48, C49	CAP, OPTION, 1210	
2	0	C28, C29, C42, C44	CAP, OPTION, 0603	
3	0	C30-C33	CAP, OPTION, 0402	
4	0	C37-C40, C46	CAP, OPTION, 0805	
5	0	C47	CAP, OPTION, ALUM. ELECT., SMD	
6	0	COU9, COU10	CAP, OPTION, 7343	
7	0	L3, L4	IND., 0.3 μ H, PWR, SHIELDED, 20%, 18.9A, 3.1m Ω , 4.3x4.3mm, XEL4030, AEC-Q200	COILCRAFT, XEL4030-301MEB
8	0	Q5-Q8	XSTR., OPTION, MOSFET N-CH, PG-TDSON-8	
9	0	R3, R24-R26, R28-R30, R32, R33, R38, R40, R43, R44, R48	RES., OPTION, 0603	
10	6	R6-R8, R14, R20, R23	RES., 0 Ω , 1/10W, 0603, AEC-Q200	VISHAY, CRCW06030000Z0EA
11	2	R13, R15	RES., 0 Ω , 1/10W, 0603, AEC-Q200	PANASONIC, ERJ3GEY0R00V
12	0	R45, R46	RES., OPTION, 1206, LONG-SIDE TERMINAL, SENSE	
Hardware: For Demo Board Only				
1	8	E1, E3, E4, E9, E10, E15-E17	TEST POINT, TURRET, 0.064" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2308-2-00-80-00-00-07-0
2	8	E5, E6, E11-E14, E18, E19	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2501-2-00-80-00-00-07-0
3	8	J1-J8	CONN., BANANA JACK, FEMALE, THT, NON-INSULATED, SWAGE, 0.218"	KEYSTONE, 575-4
4	3	JP2, JP5, JP6	CONN., HDR, MALE, 2x3, 2mm, VERT, ST, THT	SAMTEC, TMM-103-02-L-D
5	2	JP3, JP4	CONN., HDR, MALE, 1x3, 2mm, VERT, ST, THT, NO SUBS. ALLOWED	SAMTEC, TMM-103-02-L-S
6	4	MP1-MP4	STANDOFF, NYLON, SNAP-ON, 0.50"	KEYSTONE, 8833
7	5	XJP2-XJP6	CONN., SHUNT, FEMALE, 2-POS, 2mm	SAMTEC, 2SN-BK-G

DEMO MANUAL DC3138A

SCHEMATIC DIAGRAM – SIMPLIFIED



SCHEMATIC DIAGRAM – FULL





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.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL 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 NON-INFRINGEMENT 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.