

LTC7131-1 25A Monolithic Synchronous DC/DC Step-Down Converter with PMBus Interface

DESCRIPTION

Demonstration circuit 2824A-A is a single output buck converter with 4.5V to 20V input voltage range featuring the [LTC®7131-1](#), a 25A monolithic synchronous step-down converter with a PMBus interface. The output voltage is adjustable from 0.4V to 4V and the converter can supply up to 25A of load current.

The DC2824A-A powers up to default settings and produces power based on configuration resistors without the need for any serial bus communication, which allows easy evaluation of the DC/DC converter.

To fully explore the extensive power system management features of the part, download the GUI software [LTpowerPlay®](#) onto your PC and use ADI's USB-to-PMBus dongle [DC1613A](#) to connect to the board.

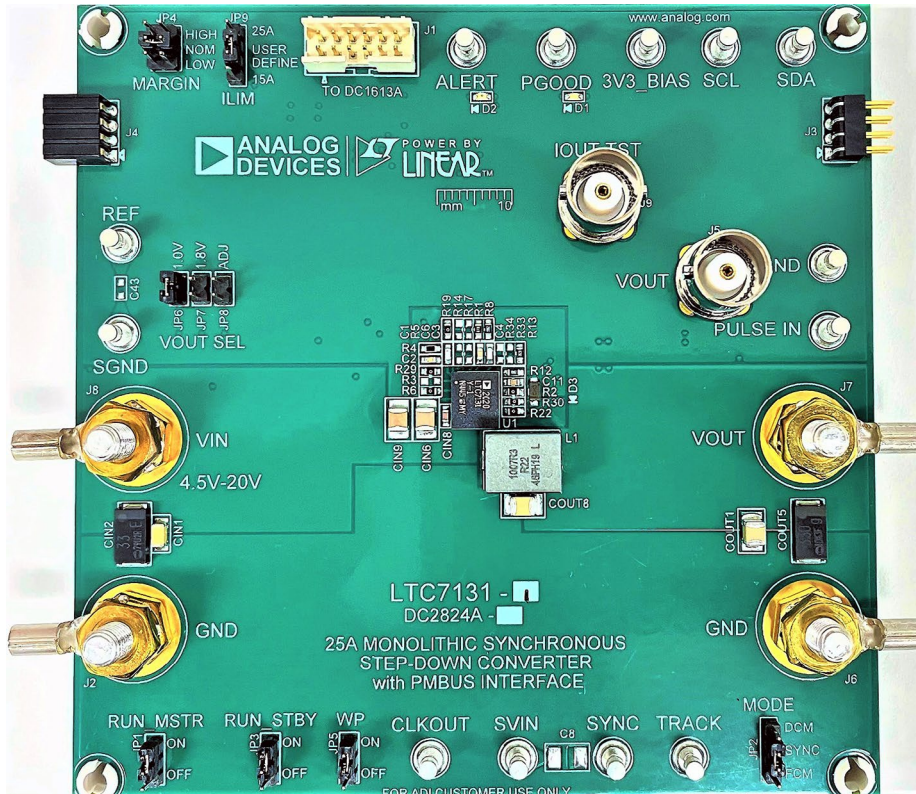
LTpowerPlay allows users to monitor fault status and real-time telemetry of input and output voltages, input and output current, and internal IC die temperature. Programmable parameters include device address, output voltage, on/off control, and fault response to output overvoltage and output overcurrent.

The LTC7131-1 data sheet gives a complete description of this part, its operation and application information and must be read in conjunction with this quick start guide for DC2824A-A.

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

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BOARD PHOTO



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

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		4.5	12	20	V
Output Voltage, V_{OUT}	$V_{IN} = 4.5\text{V to } 20\text{V}$, $I_{OUT} = 0\text{A to } 25\text{A}$	0.4	1	4	V
Maximum Output Current, I_{OUT}	$V_{IN} = 4.5\text{V to } 20\text{V}$, $V_{OUT} = 0.4\text{V to } 4\text{V}$			25	A
Typical Efficiency	$V_{IN} = 12\text{V}$, $V_{OUT} = 1\text{V}$, $I_{OUT} = 25\text{A}$, $f_{SW} = 480\text{kHz}$		87.7 (See Figure 3)		%
	$V_{IN} = 12\text{V}$, $V_{OUT} = 1.8\text{V}$, $I_{OUT} = 25\text{A}$, $f_{SW} = 480\text{kHz}$		91.4 (See Figure 3)		%
Default Switching Frequency			480		kHz

QUICK START PROCEDURE

Demonstration circuit 2824A-A is easy to set up to evaluate the performance of the LTC7131-1. Refer to Figure 1 for the proper measurement equipment setup and follow the procedure below.

- With power off, connect the input power supply to V_{IN} (4.5V to 20V) and GND (input return). Make sure the input power supply is capable of 25A at 4.5V (to satisfy the power requirement at 4V out with 25A load).
- Connect the 1V output load between V_{OUT} and GND (Initial load: no load).
- Connect the DVMs to the input and outputs. Set default jumper position: RUN_MSTR(JP1): ON; RUN_STBY(JP3): ON; MODE(JP2): FCM; MARGIN (JP4): NOM; ILIM(JP9): 25A; V_{OUT} SEL: JP6. WP(JP5): OFF.
- Turn on the input power supply and check for the proper output voltages. V_{OUT} should be $1\text{V} \pm 0.5\%$.
- Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, ripple voltage and other parameters.
- Connect the dongle and control the output voltage from the GUI. See LTpowerPlay for LTC7131-1 Quick Start Procedure section for details.

Notes

- When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See Figure 1 for the proper scope probe technique. Short, stiff leads need to be soldered to the (+) and (-) terminals of an output capacitor. The probe's ground ring needs to touch the (-) lead and the probe tip needs to touch the (+) lead.

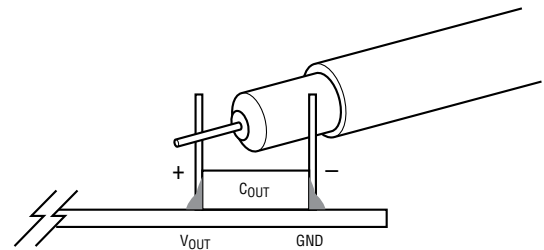


Figure 1. Measuring Output Voltage Ripple

A BNC test terminal (J5) is also implemented on board to measure output voltage and its ripple for the convenience of evaluation.

- The default 215nH inductor installed on this demo board is chosen based on 1V and 1.8V output at 480kHz default switching frequency. However, when changing the output voltage and/or switching frequency, please determine if the inductance is still suitable by calculating the peak-peak inductor current ripple and make sure it stays at 30% to 50% of load current. Refer to the Inductor Selection section of LTC7131-1 data sheet for more information.

TEST SETUP DIAGRAM

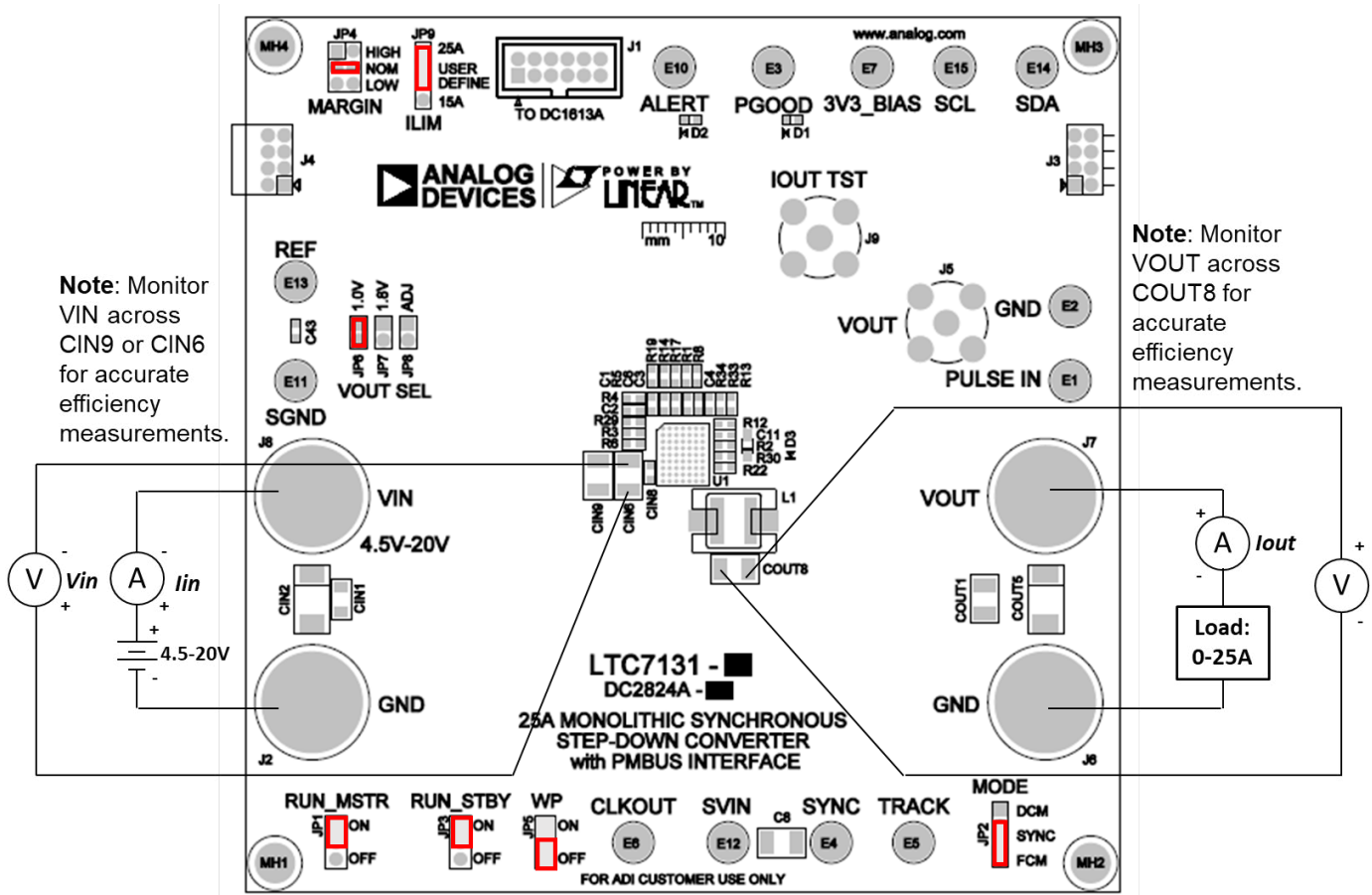


Figure 2. Proper Measurement Equipment Setup

TEST RESULTS

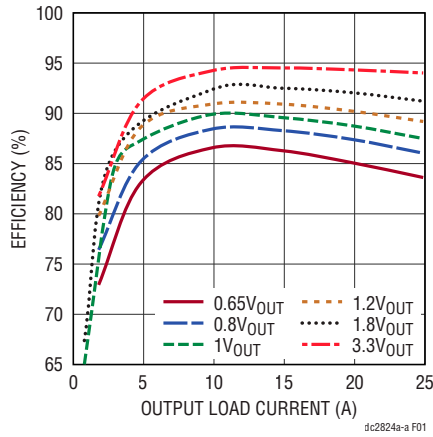
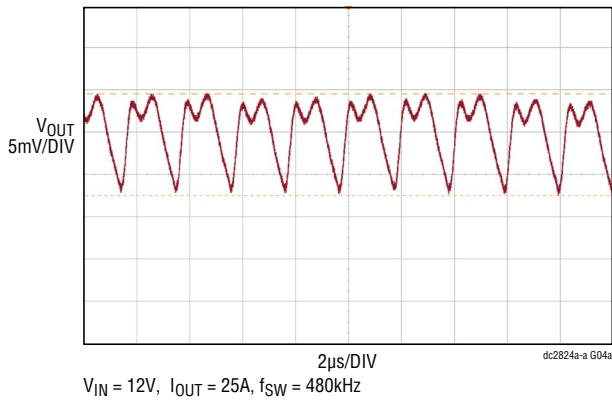
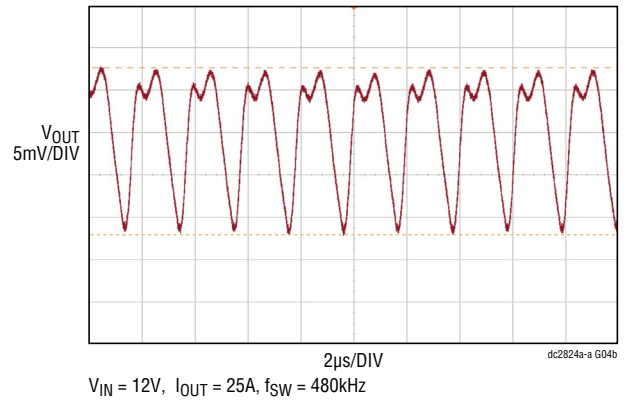


Figure 3. Efficiency vs load Current with $V_{IN} = 12V$, $f_{SW} = 480kHz$

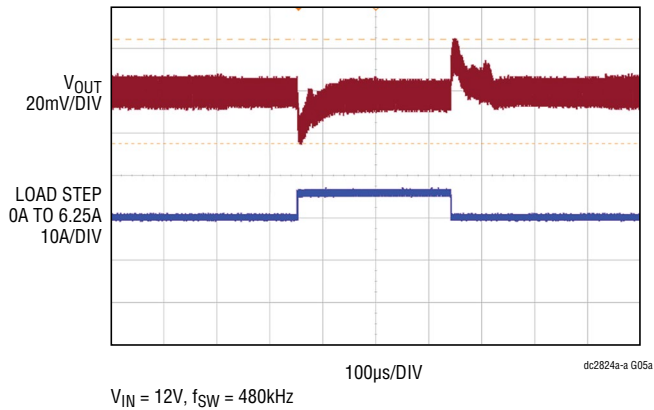


(a) $V_{OUT} = 1V$

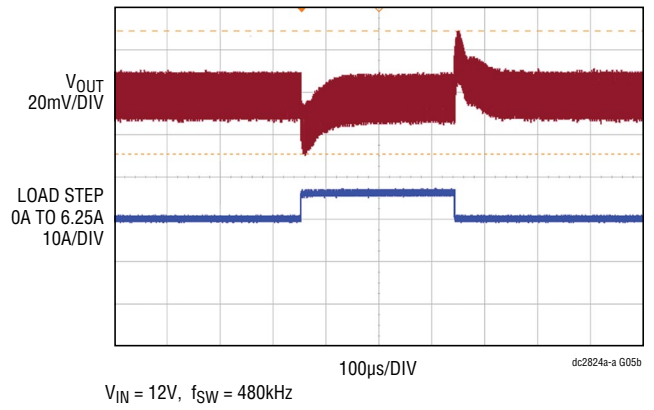


(b) $V_{OUT} = 1.8V$

Figure 4. V_{OUT} Voltage Ripple



(a) $V_{OUT} = 1V$



(b) $V_{OUT} = 1.8V$

Figure 5. V_{OUT} Load Transient Response

THERMAL IMAGE

An example thermal image shows the temperature distribution on DC2824A-A. The test is done in still air at room temperature (23°C). Figure 6 shows a thermal image of

DC2824A-A operating at 12V_{IN} configured for a 1V 25A (25W) output load. No heat sink or forced airflow is used for the measurements.

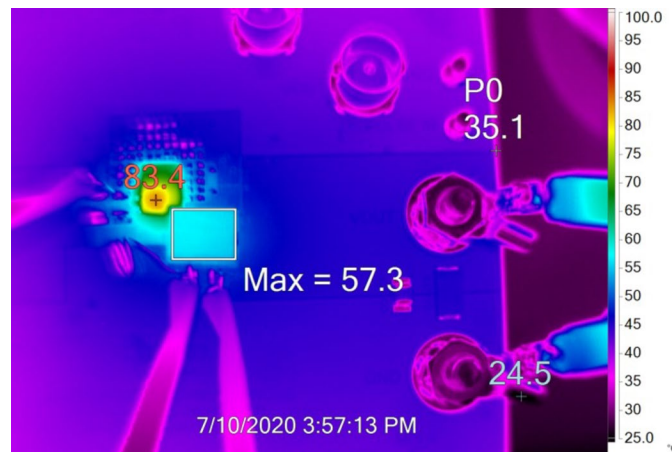


Figure 6. Thermal Measurement at $V_{IN} = 12V$, $V_{OUT} = 1V$, $I_{OUT} = 25A$, $f_{SW} = 480kHz$, $T_A = 23^{\circ}C$, No Airflow

LTpowerPlay SOFTWARE GUI

LTpowerPlay is a powerful Windows-based development environment that supports Analog Devices power system management ICs and μ Modules[®], including LTM[®]4675, LTM4676, LTM4677, LTM4678, LTM4680, LTM4700, LTM4664, LTC3880, LTC3882, LTC3883, LTC3884, LTC7880 and LTC7131-1. The software supports a variety of different tasks. You can use LTpowerPlay to evaluate Analog Devices ICs by connecting to a demo board system. LTpowerPlay can also be used in an off-line mode (with no hardware present) in order to build a multichip configuration file that can be saved and reloaded at a later time. LTpowerPlay provides unprecedented diagnostic and debug features. It becomes a valuable diagnostic tool during board bring-up to program or tweak the power

management scheme in a system, or to diagnose power issues when bringing up rails. LTpowerPlay utilizes the DC1613A USB-to-SMBus controller to communicate with one of many potential targets, including LTM4675, LTM4676, LTM4677, LTM4678, LTM4680, LTM4700, LTM4664, LTC3880, LTC3882, LTC3883, LTC3884, LTC7880 and LTC7131-1's demo system, or a customer board. The software also provides an automatic update feature to keep the software current with the latest set of device drivers and documentation. The LTpowerPlay software can be downloaded [here](#).

To access technical support documents for digital power products, visit the LTpowerPlay Help menu. Online help is also available through the LTpowerPlay.

LTpowerPlay FOR LTC7131-1 QUICK START PROCEDURE

The following procedure describes how to use LTpowerPlay to monitor and change the settings of LTC7131-1.

1. Download and install the [LTpowerPlay GUI](#).
2. Connect the DC2824A-A board to the USB port of the PC or laptop through the [DC1613A](#) dongle.
3. Launch the LTpowerPlay GUI.
 - a. The GUI should automatically identify the dongle connected as shown in the picture below. Select "Detect Chips" to allow LTpowerPlay to detect the LTC7131-1.

- b. After LTC7131-1 is detected, the LTpowerPlay main interface appears as shown in Figure 7, and a message box like below also shows for a few seconds in the lower left-hand corner, confirming that LTC7131-1 is communicating.

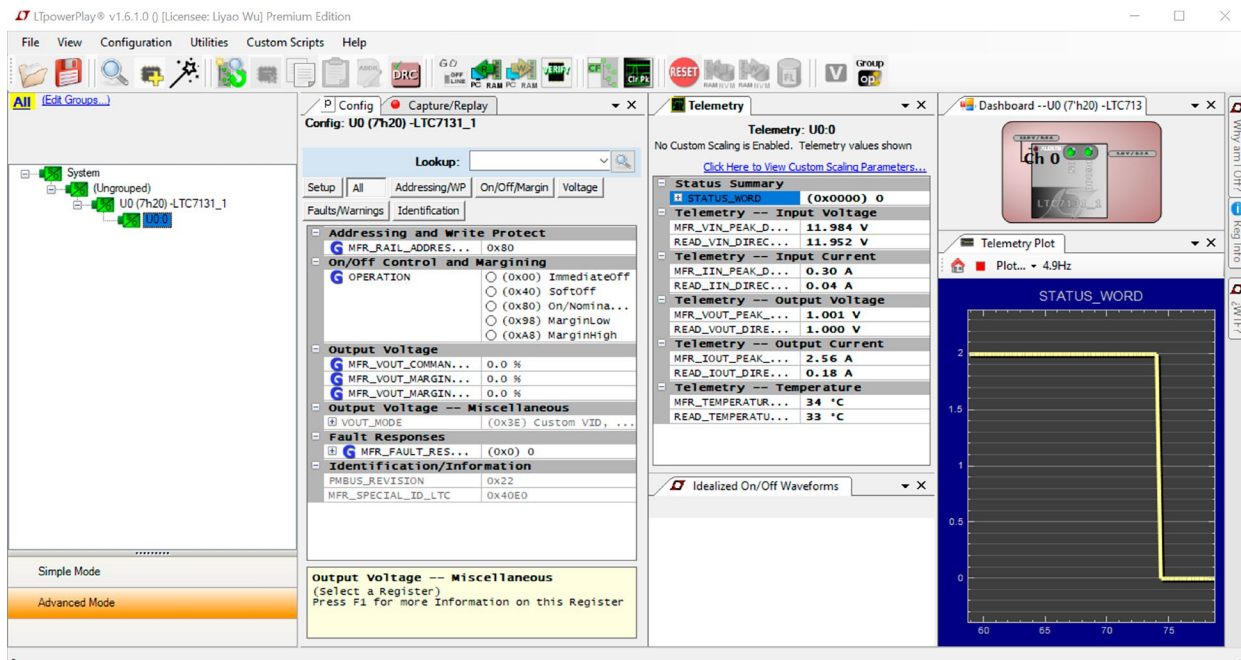
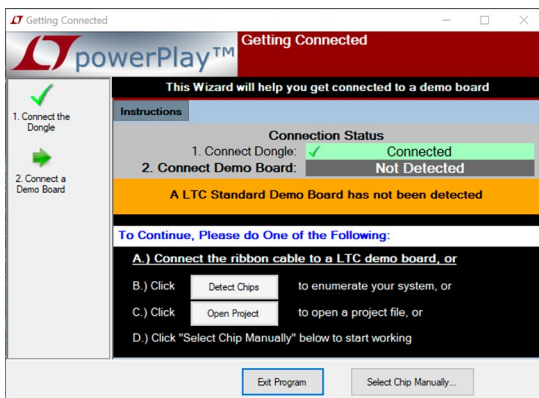
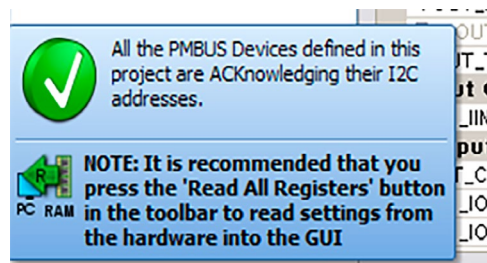
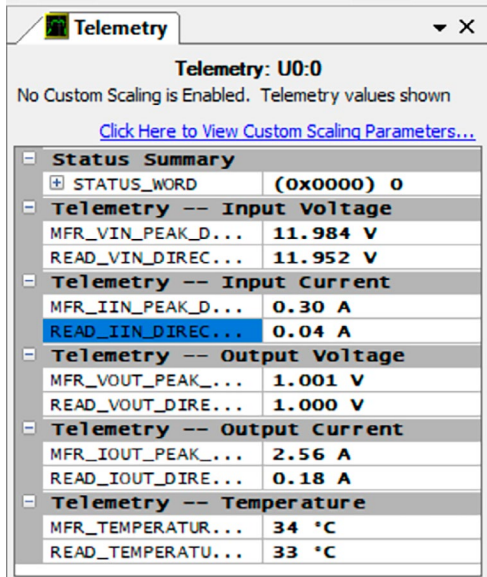


Figure 7. LTpowerPlay Main Interface

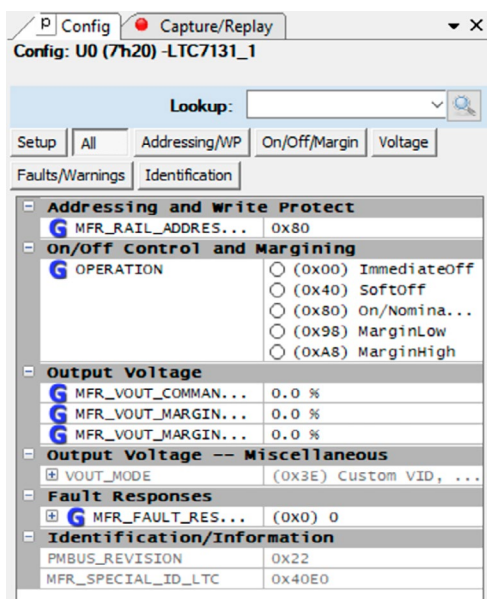
LTpowerPlay FOR LTC7131-1 QUICK START PROCEDURE

- c. The LTC7131-1 supports telemetry read-back within the LTpowerPlay which allows read-back of input/output voltages and currents as well as the device temperature, as shown below.



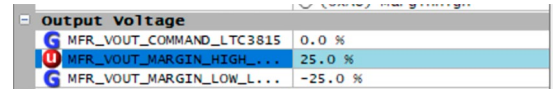
Telemetry: U0:0	
No Custom Scaling is Enabled. Telemetry values shown	
Click Here to View Custom Scaling Parameters...	
Status Summary	
STATUS_WORD	(0x0000) 0
Telemetry -- Input Voltage	
MFR_VIN_PEAK_DIREC...	11.984 V
READ_VIN_DIREC...	11.952 V
Telemetry -- Input Current	
MFR_IIN_PEAK_DIREC...	0.30 A
READ_IIN_DIREC...	0.04 A
Telemetry -- Output Voltage	
MFR_VOUT_PEAK_DIREC...	1.001 V
READ_VOUT_DIREC...	1.000 V
Telemetry -- Output Current	
MFR_IOUT_PEAK_DIREC...	2.56 A
READ_IOUT_DIREC...	0.18 A
Telemetry -- Temperature	
MFR_TEMPERATUR...	34 °C
READ_TEMPERATU...	33 °C

- d. The LTC7131-1 features the PMBus Lite with a reduced command list as shown below. The available commands include immediate/soft turn-off, turn-on or returning to normal operation, margining output voltage high or low, and choosing the fault response modes.



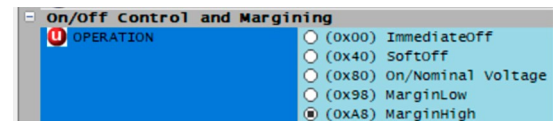
Config: U0 (7h20) -LTC7131_1	
Lookup: []	
Setup	All Addressing/WP On/Off/Margin Voltage
Faults/Warnings Identification	
Addressing and Write Protect	
MFR_RAIL_ADDRES...	0x80
On/Off Control and Margining	
OPERATION	<input type="radio"/> (0x00) ImmediateOff <input type="radio"/> (0x40) SoftOff <input type="radio"/> (0x80) On/Nomina... <input type="radio"/> (0x98) MarginLow <input checked="" type="radio"/> (0xA8) MarginHigh
Output Voltage	
MFR_VOUT_COMMAN...	0.0 %
MFR_VOUT_MARGIN...	0.0 %
MFR_VOUT_MARGIN...	0.0 %
Output Voltage -- Miscellaneous	
VOUT_MODE	(0x3E) Custom VID, ...
Fault Responses	
MFR_FAULT_RES...	(0x0) 0
Identification/Information	
PMBUS_REVISION	0x22
MFR_SPECIAL_ID_LTC	0x40E0

- e. Here is an example of margining the output voltage high. First, enter the desired margin-high percentage (25%) in the MFR_VOUT_MARGIN_HIGH field, under “Output Voltage” tab. Note that the percentage must be within the range of -25% to 25% for both margin-high and margin-low commands.



Output Voltage	
MFR_VOUT_COMMAND_LTC3815	0.0 %
MFR_VOUT_MARGIN_HIGH...	25.0 %
MFR_VOUT_MARGIN_LOW...	-25.0 %

- f. Then, select the “MarginHigh” operation from the “On/off Control and Margining” tab.



On/Off Control and Margining	
OPERATION	<input type="radio"/> (0x00) ImmediateOff <input type="radio"/> (0x40) SoftOff <input type="radio"/> (0x80) On/Nominal voltage <input type="radio"/> (0x98) MarginLow <input checked="" type="radio"/> (0xA8) MarginHigh

- g. Next, click the “W” (PC to RAM) icon to write these register values to the LTC7131-1. Please make sure that the WP jumper (JP5) is at “OFF” position.



After finishing this step, if the write is successful, you will see the following message, and the output voltage will become 25% higher than its nominal value.

DEMO MANUAL

DC2824A-A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit				
1	1	C1	CAP., 47pF, C0G, 50V, 5%, 0603	VISHAY, VJ0603A470JXAAC
2	1	C2	CAP., 4700pF, X7R, 50V, 10%, 0603	AVX, 06035C472KAT2A
3	1	C3	CAP., 0.01μF, X7R, 25V, 10%, 0603	AVX, 06033C103KAT2A
4	1	C4	CAP., 47pF, X7R, 50V, 10%, 0603	AVX, 06035C470KAT2A
5	2	C5, C9	CAP., 0.1μF, X7R, 50V, 10%, 0603	AVX, 06035C104KAT2A
6	1	C7	CAP., 1μF, X7R, 25V, 10%, 0603	KEMET, C0603C105K3RACTU
7	2	C11, CIN8	CAP., 4.7μF, X5R, 25V, 20%, 0603	MURATA, GRM188R61E475ME11D
8	1	C41	CAP., 2.2μF, X7R, 25V, 10%, 0805	SAMSUNG, CL21B225KAFNNNE
9	1	C42	CAP., 0.1μF, X7R, 25V, 10%, 0603	AVX, 06033C104KAT2A
10	3	CIN1, CIN3, CIN5	CAP., 22μF, X5R, 25V, 10%, 1206	AVX, 12063D226KAT2A
11	2	CIN2, CIN4	CAP., 33μF, ALUM POLY, 25V, 20%, 7343	PANASONIC, EEFCX1E330R
12	4	CIN6, CIN7, CIN9, CIN10	CAP., 10μF, X7R, 25V, 10%, 1210	AVX, 12103C106KAT2A
13	2	COU1, COU8	CAP., 100μF, X5R, 6.3V, 20%, 1210	MURATA, GRM32ER60J107ME20L
14	3	COU5-COU7	CAP., 330μF, ALUM POLY, 4V, 20%, 7343	PANASONIC, EEF-SX0G331XE
15	1	D1	LED, GREEN, WATER CLEAR, 0603	WURTH ELEKTRONIK, 150060GS75000
16	1	D2	LED, RED, WATER CLEAR, 0603	WURTH ELEKTRONIK, 150060RS75000
17	1	D3	DIODE, SCHOTTKY, 30V, 100mA, SOD-323	CENTRAL SEMI., CMHSH-3 TR
18	4	J2, J6-J8	EVAL BOARD STUD HARDWARE SET, #10-32	ANALOG DEVICES, 720-0010
19	1	L1	IND., 215nH, PWR, FERRITE, 10%, 61A, 0.29mΩ, 10.4mm × 8.0mm SMD	EATON, FP1007R3-R22-R
20	1	Q1	XSTR., MOSFET, P-CH, 20V, 5.9A, TO-236 (SOT23-3)	VISHAY, Si2365EDS-T1-GE3
21	1	Q2	XSTR., MOSFET N-CH, 60V, 300mA, SOT-23	VISHAY, 2N7002K-T1-GE3
22	1	Q15	XSTR., MOSFET, N-CH, 30V, 30A, LPAK	RENESAS, RJK0305DPB-00#J0
23	1	R1	RES., 1k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06031K00FKEA
24	6	R2, R6, R19, R22, R29, R30	RES., 0Ω, 1/10W, 0603, AEC-Q200	VISHAY, CRCW06030000Z0EA
25	1	R4	RES., 6.04k, 1%, 1/10W, 0603, AEC-Q200	KOA SPEER, RK73H1JTDD6041F
26	2	R7, R20	RES., 10Ω, 1%, 1/10W, 0603	VISHAY, CRCW060310R0FKEA
27	5	R8-R10, R12, R58	RES., 10k, 1%, 1/10W, 0603, AEC-Q200	VISHAY, CRCW060310K0FKEA
28	1	R11	RES., 10k, 0.1%, 1/8W, 0603, ANTI-SULFUR, AEC-Q200	VISHAY, TNPW060310K0BEEA
29	1	R13	RES., AEC-Q200, 2.2Ω, 1%, 1/10W, 0603	NIC, NRC06F2R20TRF
30	2	R15, R16	RES., 4.99k, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF4991V
31	1	R18	RES., 18k, 0.1%, 1/10W, 0603, AEC-Q200	VISHAY, TNPW060318K0BEEA
32	1	R27	RES., 200Ω, 1%, 1/10W, 0603	VISHAY, CRCW0603200RFKEA
33	1	R28	RES., AEC-Q200, 127Ω, 1%, 1/10W, 0603	NIC, NRC06F1270TRF
34	1	R68	RES., 0.01Ω, 1%, 1W, 2512, METAL, SENSE	PANASONIC, ERJM1WSF10MU

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
35	1	U1	IC, 25A MONOLITHIC SYNCHRONOUS DC/DC STEP-DOWN CONVERTER WITH PMBus INTERFACE, BGA	ANALOG DEVICES, LTC7131IY-1#PBF
36	1	U2	IC, MEMORY, EEPROM, 2Kb (256x8), TSSOP-8, 400kHz	MICROCHIP, 24LC025-I/ST

Additional Demo Board Circuit Components

1	0	C6, C43	CAP., OPTION, 0603	
2	0	C8, COUT2, COUT9-COUT12	CAP., OPTION, 1210	
3	0	L2	IND., OPTION	
4	0	R3, R5, R14, R17, R21, R23-R26, R33, R34, R69-R71	RES., OPTION, 0603	

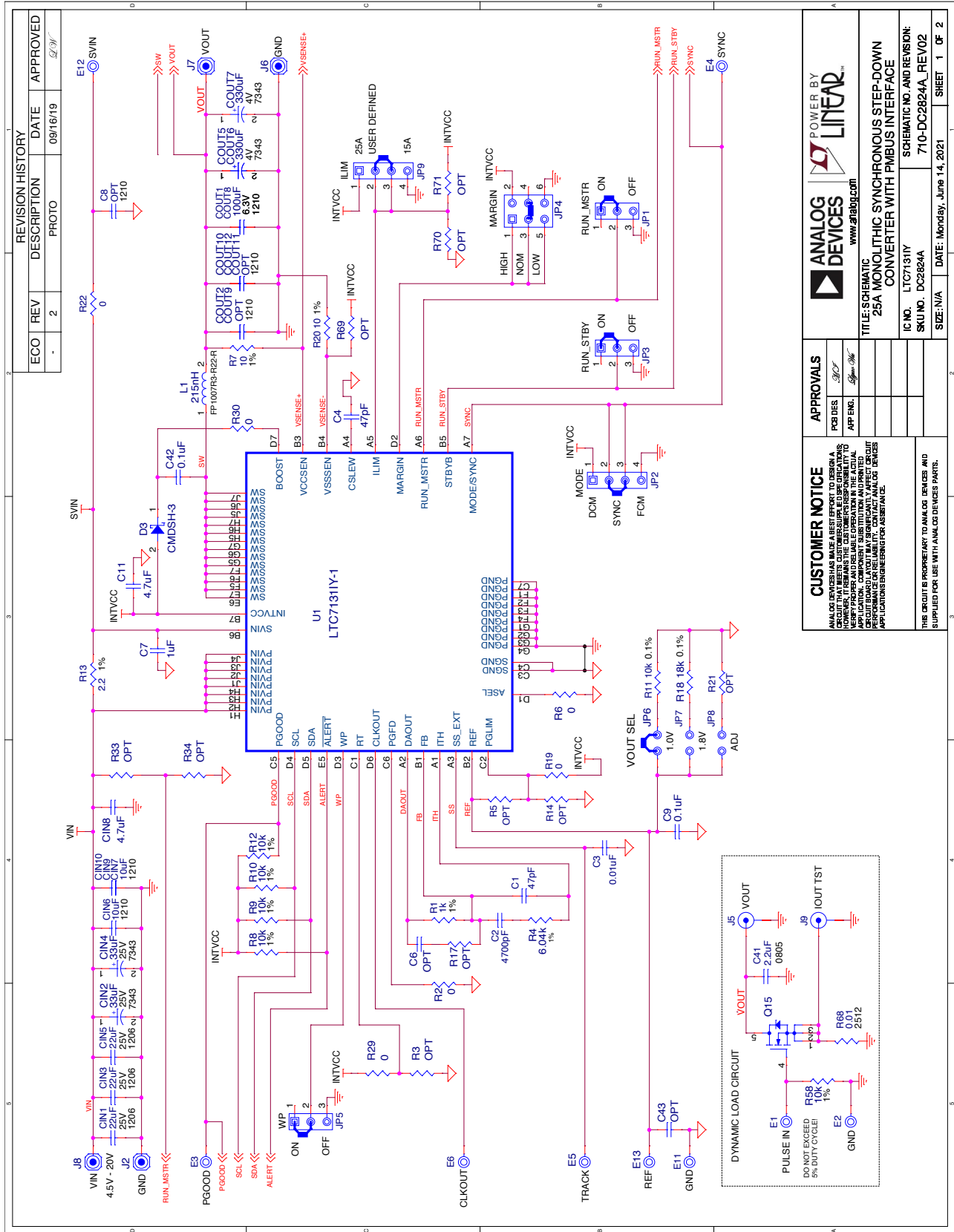
Hardware: For Demo Board Only

1	13	E1-E7, E10-E15	TEST POINT, TURRET, 0.094" MTG. HOLE, PCB 0.062" THK	MILL-MAX, 2501-2-00-80-00-00-07-0
2	1	J1	CONN., SHROUDED HDR, MALE, 2x6, 2mm, VERT, STR, THT	AMPHENOL, 98414-G06-12ULF
3	1	J3	CONN., HDR, MALE, 2x4, 2mm, R/A THT	MOLEX, 87760-0816
4	1	J4	CONN., HDR, FEMALE, 2x4, 2mm, R/A THT	SULLINS CONNECTOR SOLUTIONS, NPPN042FJFN-RC
5	2	J5, J9	CONN., RF, BNC, RCPT JACK, 5-PIN, STR, THT, 50Ω	AMPHENOL RF, 112404
6	3	JP1, JP3, JP5	CONN., HDR, MALE, 1x3, 2mm, VERT, STR, THT, NO SUBS. ALLOWED	WURTH ELEKTRONIK, 62000311121
7	2	JP2, JP9	CONN., HDR, MALE, 1x4, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000411121
8	1	JP4	CONN., HDR., MALE, 2x3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000621121
9	3	JP6-JP8	CONN., HDR, MALE, 1x2, 2mm, STR, THT	WURTH ELEKTRONIK, 62000211121
10	4	MH1-MH4	STAND-OFF, NYLON, SNAP-ON, 0.25" (6.4mm)	KEYSTONE, 8831
11	7	XJP1-XJP6, XJP9	CONN., SHUNT, FEMALE, 2-POS, 2mm	WURTH ELEKTRONIK, 60800213421

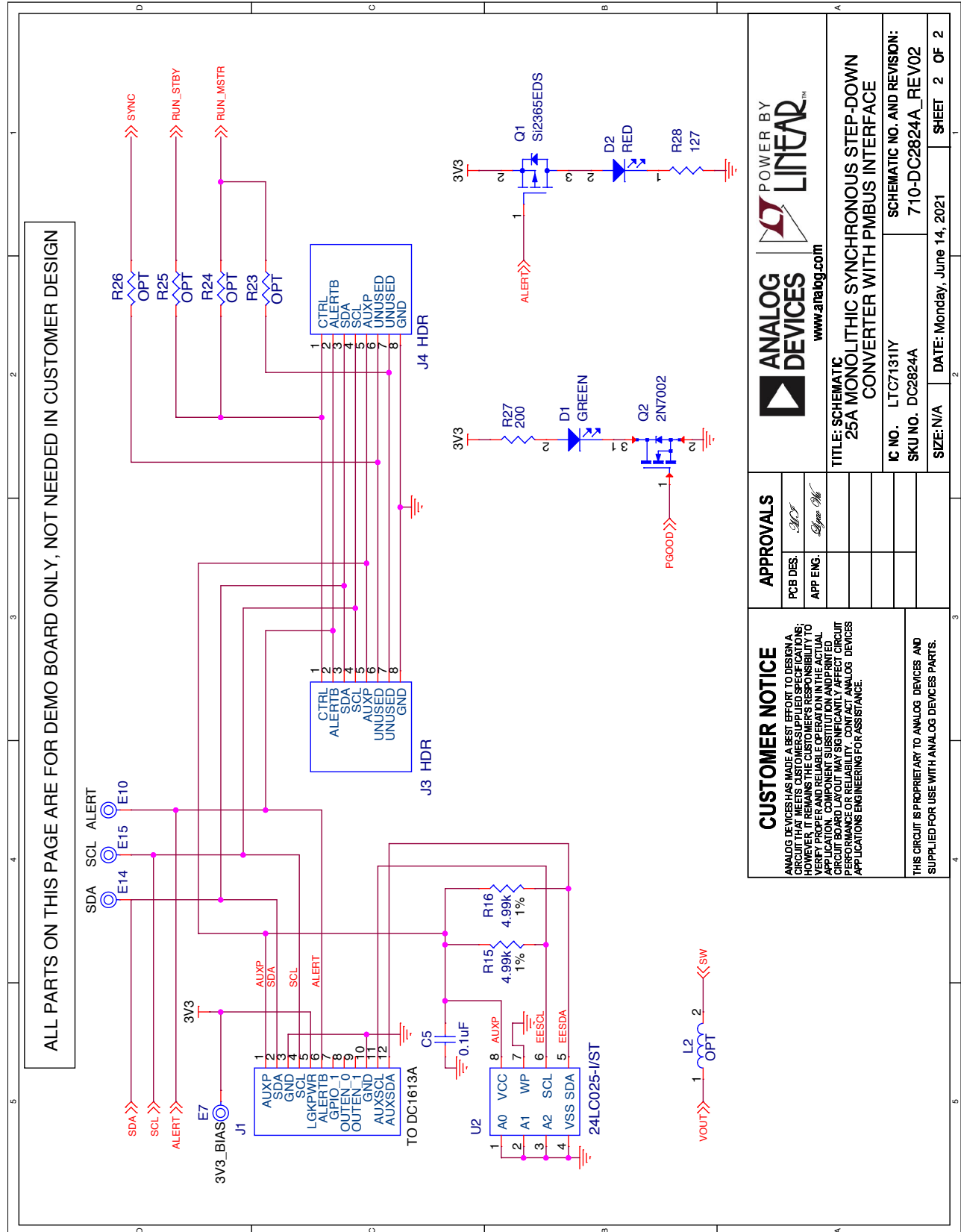
DEMO MANUAL

DC2824A-A

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



APPROVALS PCB DES: <i>W</i> APP ENG: <i>Edgar</i>		TITLE: SCHEMATIC 25A MONOLITHIC SYNCHRONOUS STEP-DOWN CONVERTER WITH PMBUS INTERFACE	
CUSTOMER NOTICE ANALOG DEVICES HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT MEETS CUSTOMER-SUPPLIED SPECIFICATIONS; HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY THE PERFORMANCE OF THE CIRCUIT IN THE FINAL APPLICATION. COMPONENT SUBSTITUTION AND PRINTED CIRCUIT BOARD LAYOUT MAY SIGNIFICANTLY AFFECT CIRCUIT PERFORMANCE OR RELIABILITY. CONTACT ANALOG DEVICES APPLICATIONS ENGINEERING FOR ASSISTANCE.		IC NO. LTC71311Y SKU NO. DC2824A SIZE: N/A DATE: Monday, June 14, 2021	
THIS CIRCUIT IS PROPRIETARY TO ANALOG DEVICES AND SUPPLIED FOR USE WITH ANALOG DEVICES PARTS.		SCHEMATIC NO. AND REVISION: 710-DC2824A_REV02 SHEET 2 OF 2	



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.