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.

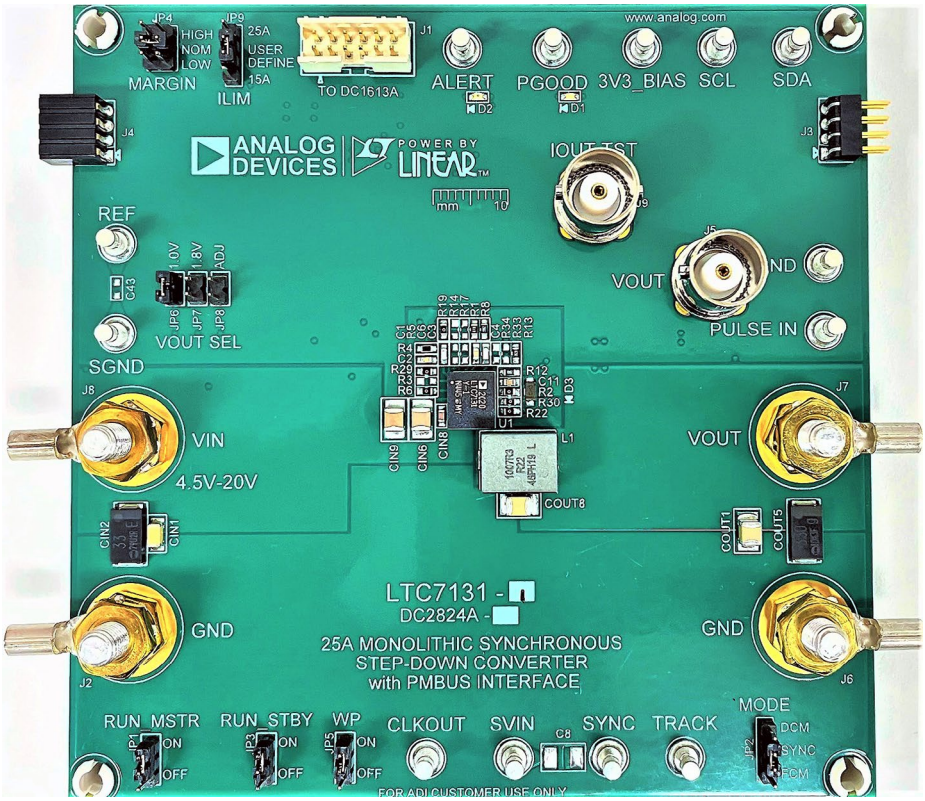
To fully explore the extensive power system management features of the part, download the GUI software LTpowerPlay® onto your PC and use ADI's USB-to-PMBus dongle DC1613A to connect to the board.

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.

BOARD PHOTO



PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

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

1. 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).
2. Connect the 1V output load between V_{OUT} and GND (Initial load: no load).
3. 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.
4. Turn on the input power supply and check for the proper output voltages. V_{OUT} should be 1V ± 0.5%.
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.
6. Connect the dongle and control the output voltage from the GUI. See LTpowerPlay for LTC7131-1 Quick Start Procedure section for details.

Notes

1. 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.

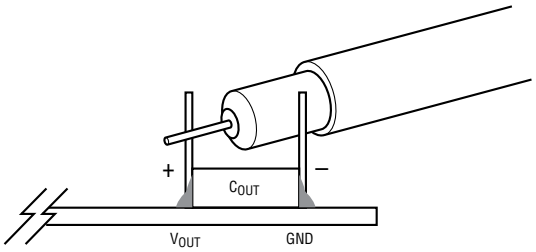


Figure 1. Measuring Output Voltage Ripple

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

2. 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

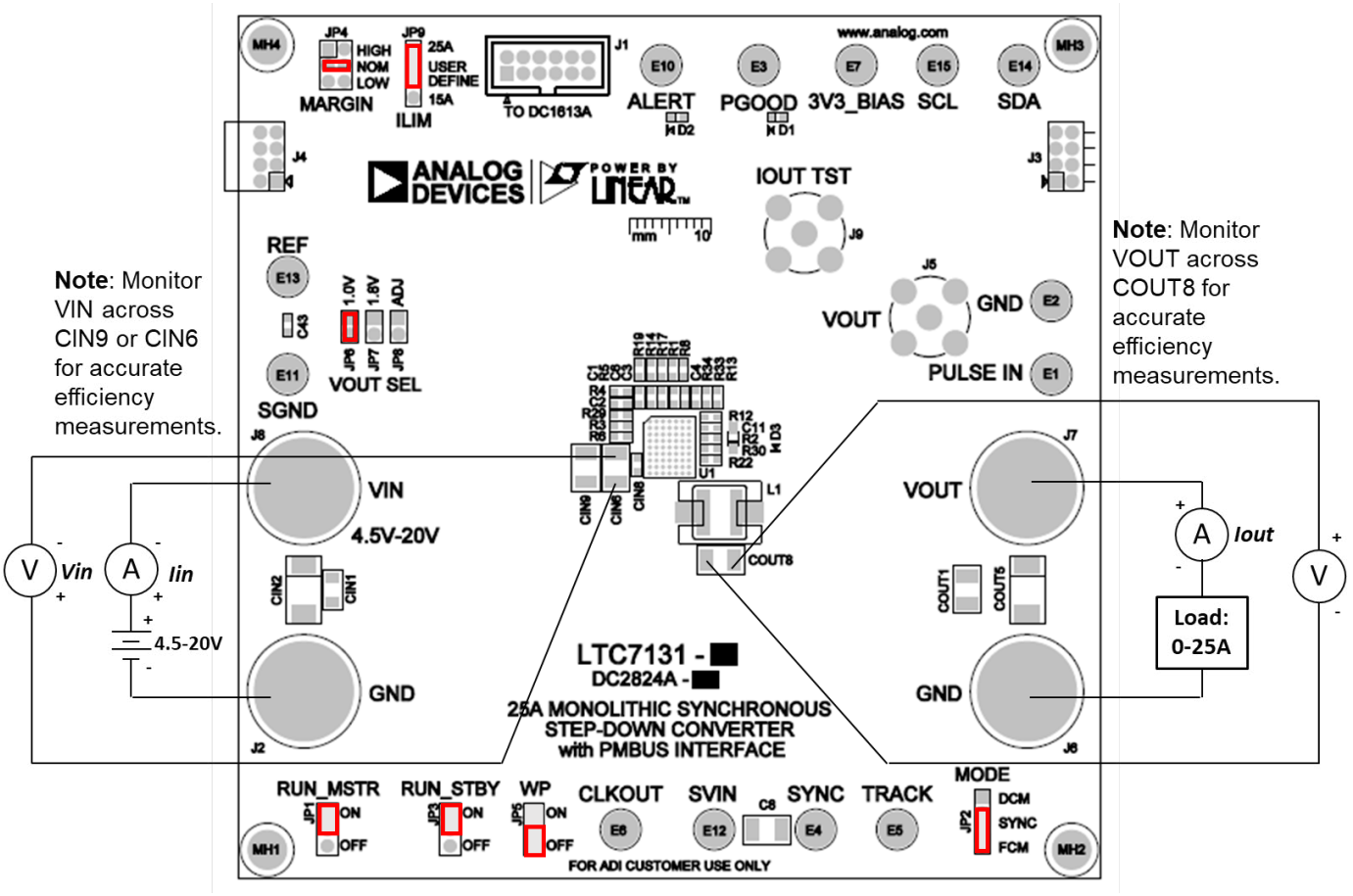


Figure 2. Proper Measurement Equipment Setup

TEST RESULTS

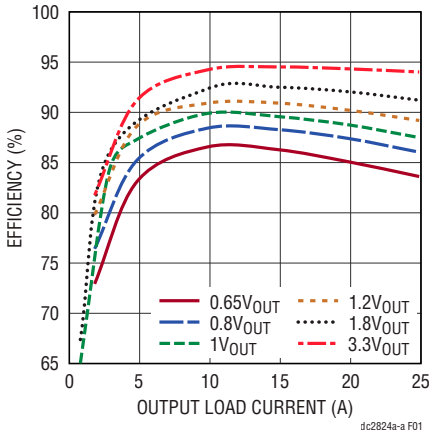
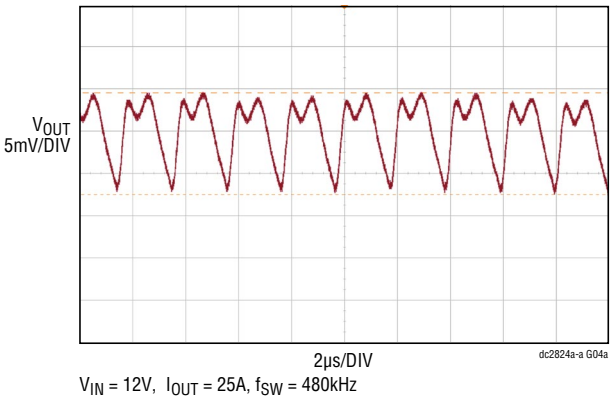
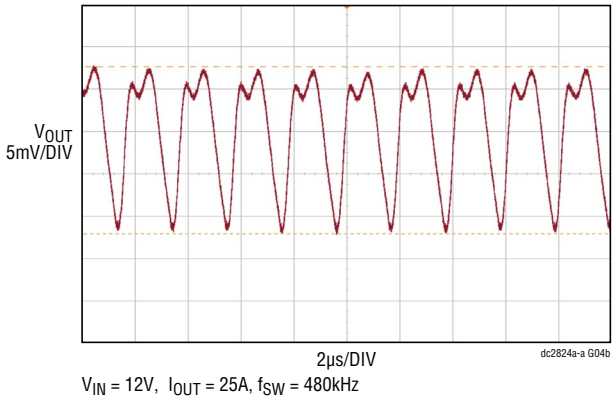


Figure 3. Efficiency vs load Current with V_{IN} = 12V, f_{SW} = 480kHz

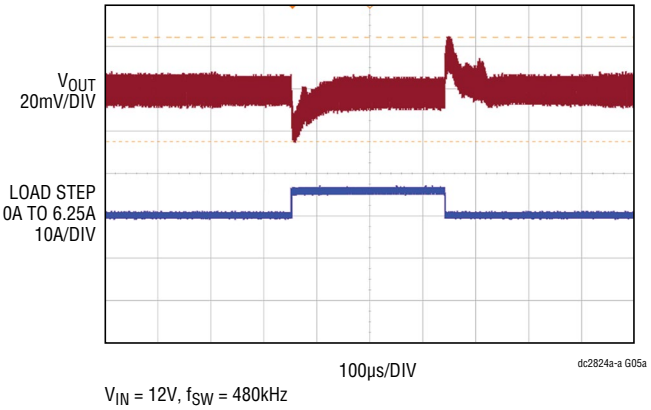


(a) V_{OUT} = 1V

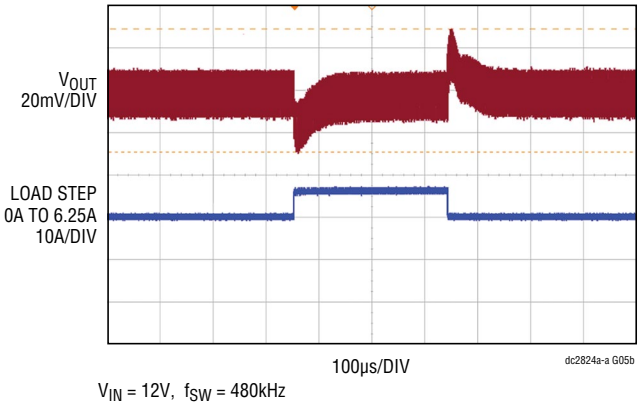


(b) V_{OUT} = 1.8V

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.

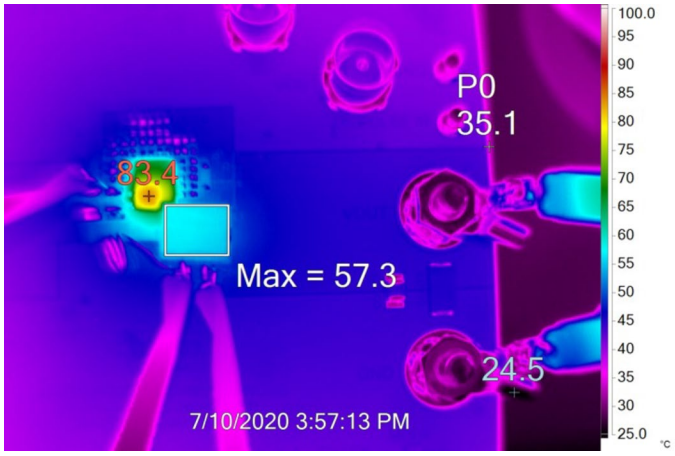


Figure 6. Thermal Measurement at V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 25A, f_{SW} = 480kHz, T_A = 23°C, No Airflow

LTpowerPlay SOFTWARE GUI

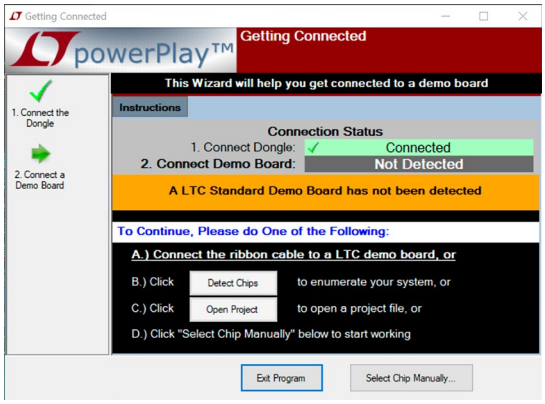
LTpowerPlay is a powerful Windows-based development environment that supports Analog Devices power system management ICs and µModules®, including LTM®4675, LTM4676, LTM4677, LTM4678, LTM4680, LTM4700, LTM4664, LTC3880, LTC3882, LTC3883, LTC3884, LTC7880 and LTC7131-1. The software supports a variety 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.

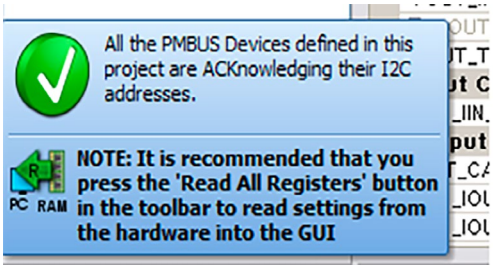
LTpowerPlay FOR LTC7131-1 QUICK START PROCEDURE

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.



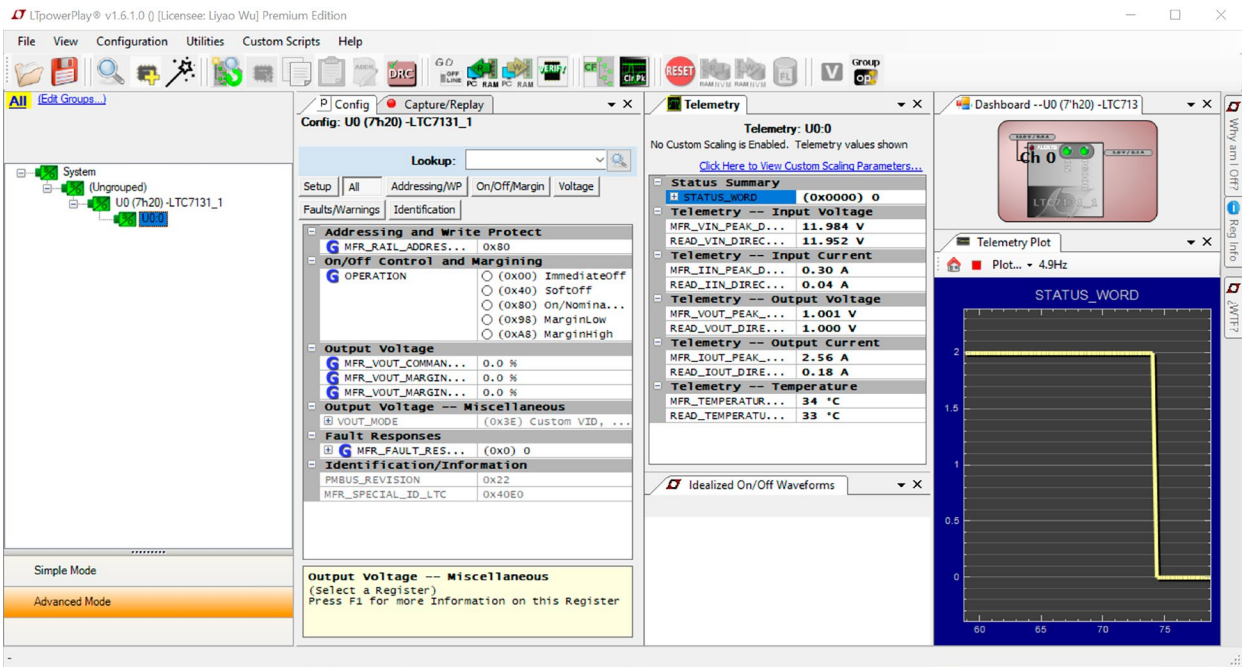
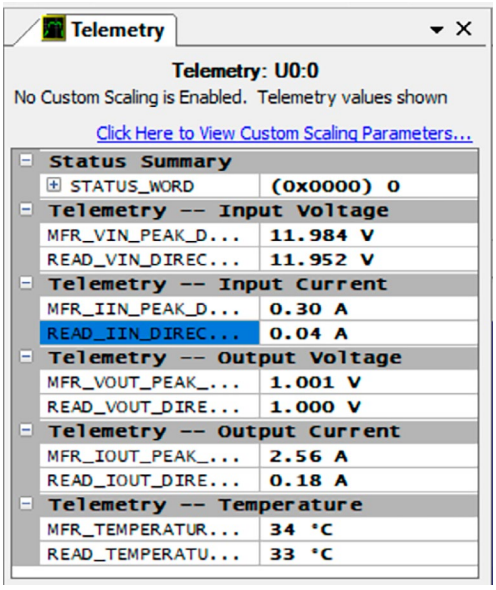


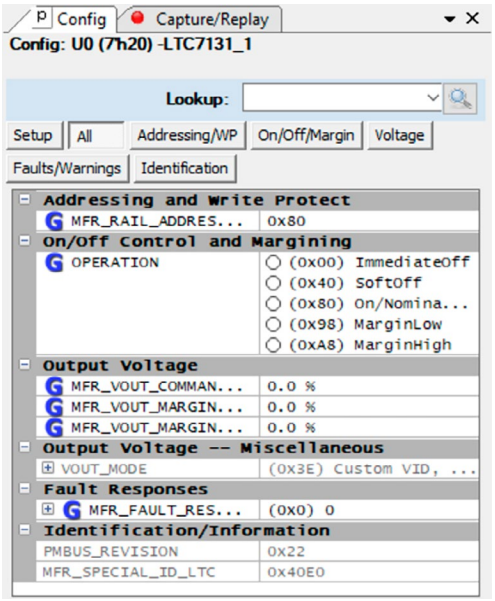
Figure 7. LTpowerPlay Main Interface

LTpowerPlay FOR LTC7131-1 QUICK START PROCEDURE

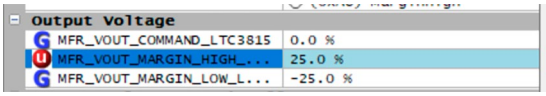
c. The LTC7131-1 supports telemetry read-back within the LTpowerPlay which allows read-back of input/output voltages and currents as well as the device temperature, as shown below.



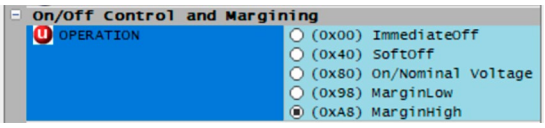
d. The LTC7131-1 features the PMBus Lite with a reduced command list as shown below. The available commands include immediate/soft turn-off, turn-on or returning to normal operation, margining output voltage high or low, and choosing the fault response modes.



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.



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



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.

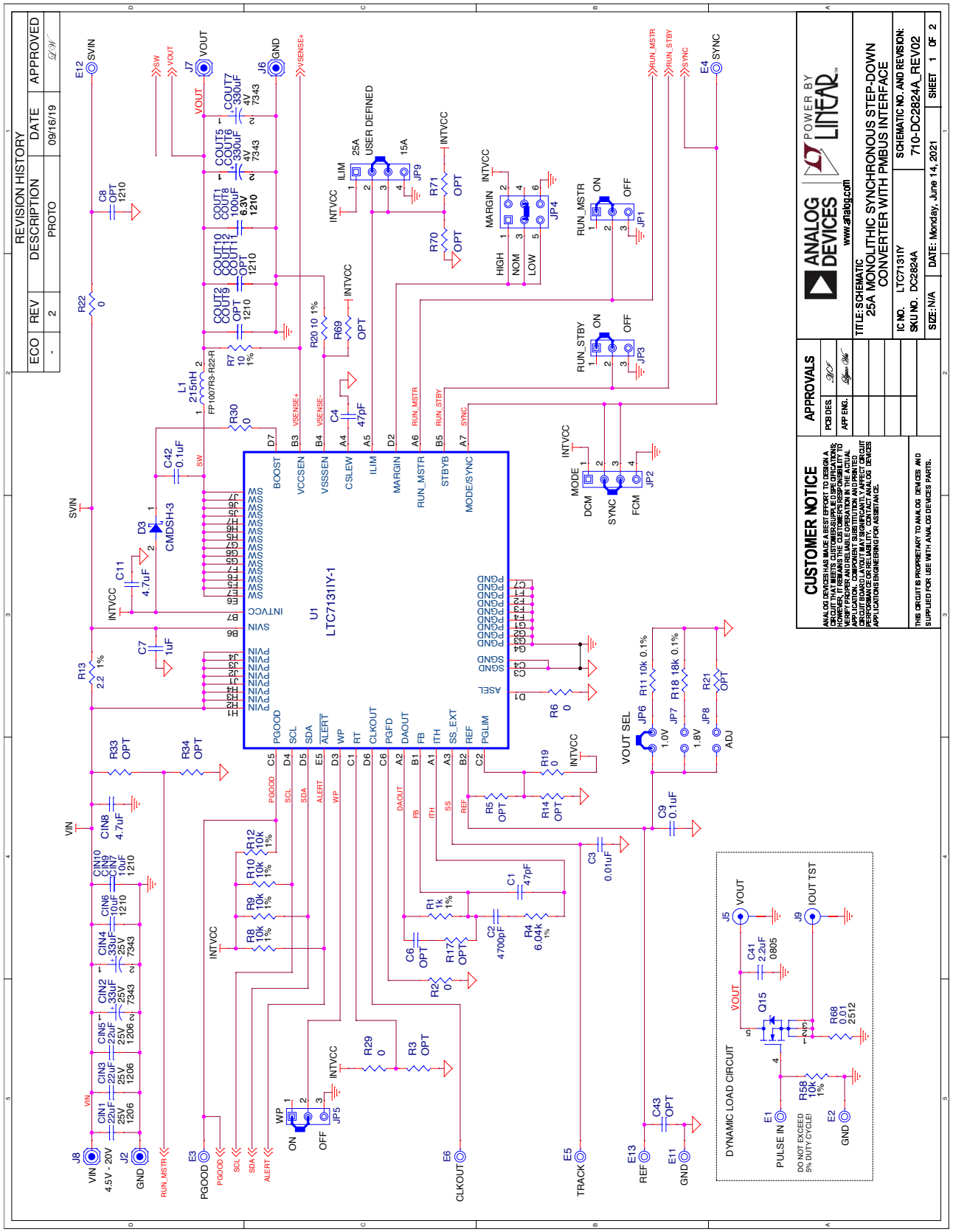
PARTS LIST

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	COUT1, COUT8	CAP., 100µF, X5R, 6.3V, 20%, 1210	MURATA, GRM32ER60J107ME20L
14	3	COUT5-COUT7	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, LFPAK	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, RK73H1JTTD6041F
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

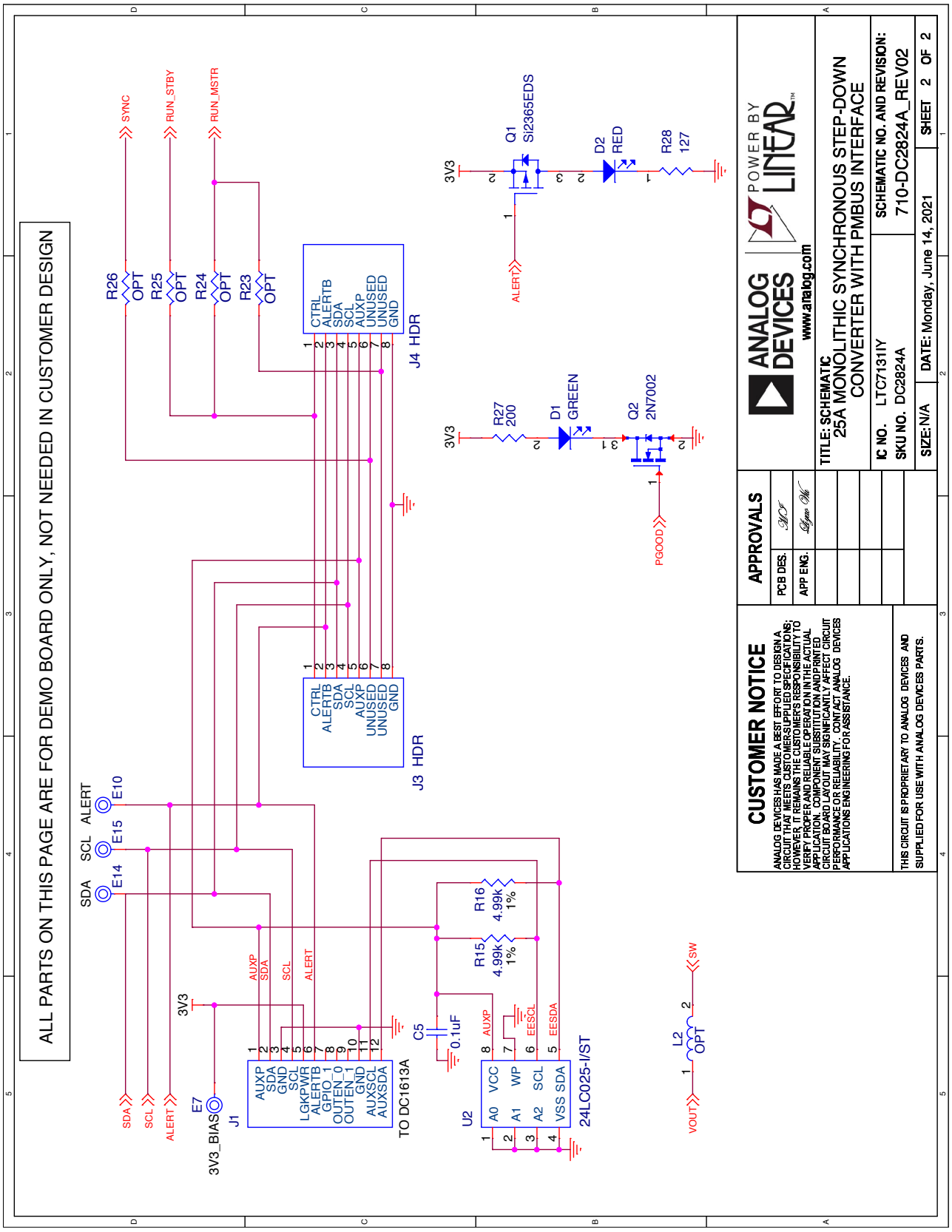
PARTS LIST

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 (256×8), 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, 2×6, 2mm, VERT, STR, THT	AMPHENOL, 98414-G06-12ULF
3	1	J3	CONN., HDR, MALE, 2×4, 2mm, R/A THT	MOLEX, 87760-0816
4	1	J4	CONN., HDR, FEMALE, 2×4, 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, 1×4, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000411121
8	1	JP4	CONN., HDR., MALE, 2×3, 2mm, VERT, STR, THT	WURTH ELEKTRONIK, 62000621121
9	3	JP6-JP8	CONN., HDR, MALE, 1×2, 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

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



Rev. 0

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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