

24A, 4V Dual-Phase Silent Switcher Step-Down Regulator with Digital Power System Management

General Description

The evaluation kit EVAL-LT7175-1-AZ is a dual-phase, single-output monolithic DC/DC synchronous step-down regulator featuring the [LT[®]7175-1](#), with a 2.7V to 4V input range. With 3V to 12V EXT_{VCC} provided, the input voltage can be as low as 1.5V. The output can supply a continuous load current of 24A. The Silent Switcher[®] regulator structure is incorporated into the LT7175-1 to minimize EMI and reduce PCB layout sensitivity. It also integrates digital power system management functionality, allowing programmability and telemetry through a PMBus/I²C compliant serial interface. Refer to the LT7175-1 data sheet for more detailed information.

The EVAL-LT7175-1-AZ evaluation board is designed for 0.5V output with a switching frequency set at 1.5MHz. The controlled on-time valley current-mode control with 25ns typical minimum on-time enables high switching frequency at low output voltage, along with excellent transient response in a small overall solution size.

The EVAL-LT7175-1-AZ powers up with default settings and produces power based on the NVM configuration without the need for any serial bus communication. This allows for easy evaluation of the DC/DC converter. To fully explore the power system management features of the

part, download the LTpowerPlay[®] GUI software onto a PC and use ADI's I²C/SMBus/PMBus dongle (DC1613A) to connect to the board. LTpowerPlay allows the user to reconfigure the part on the fly, store the configuration in NVM, and view telemetry of voltage, current, temperature, and fault status. The NVM can be programmed up to three times.

GUI Download

The software can be downloaded from [LTpowerPlay](#).

The LT7175-1 data sheet provides a complete description of the part, operation, and application information. The data sheet must be read in conjunction with this demo manual for EVAL-LT7175-1-AZ.

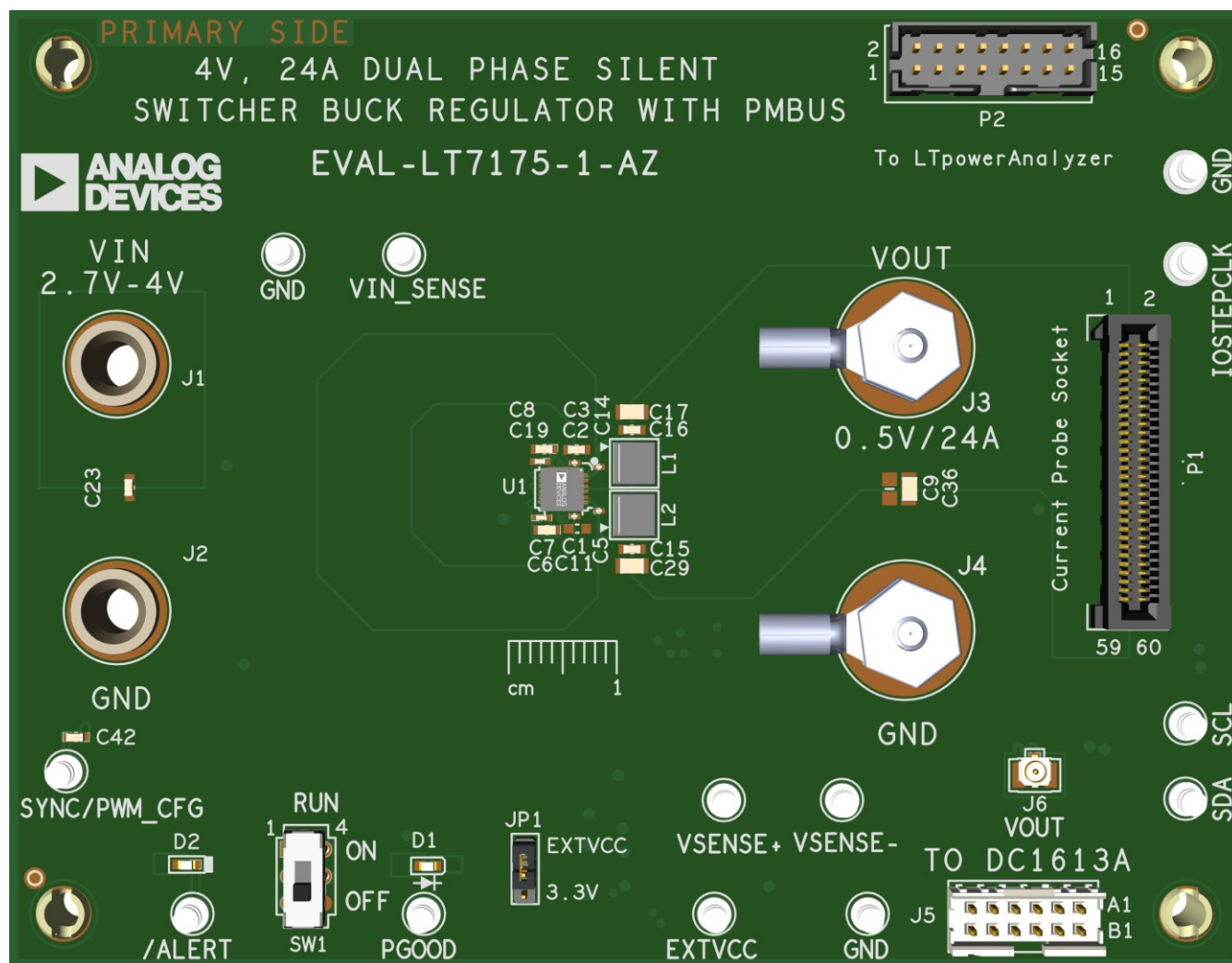
For more details and instructions for LTpowerPlay, refer to the LTpowerPlay GUI and the LT7175-1 Quick Start Guide.

[Ordering Information](#) appears at end of data sheet.

Performance Summary Specifications are at T_A = 25°C

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	V _{IN}		2.7		4	V
Default Output Voltage	V _{OUT}			0.5		V
Maximum Continuous Output Current	I _{OUT}			24		A
Switching Frequency	f _{SW}		1.35	1.5	1.65	MHz
Efficiency	Eff	V _{IN} = 3.3V, I _{OUT} = 20A		76		%

EVAL-LT7175-1-AZ Evaluation Board



Quick Start Procedure

The EVAL-LT7175-1-AZ is easy to set up to evaluate the performance of the LT7175-1. See [Figure 1](#) for the proper measurement equipment setup and follow the procedure below:

1. Set the input power supply capable of 4V/7A, then turn it off.
2. With the power off, connect the power supply to the input terminals V_{IN} and GND. Set the default jumper position to SW1: ON.
3. Turn on the power at the input.

Note: Make sure the input voltage does not exceed 4V.

4. Check the output voltage for $0.5V \pm 0.4\%$ (0.498V to 0.502V). Turn off the input power.
5. Once the proper output voltage is established, connect variable loads capable of sinking 24A at 0.5V to the V_{OUT} and GND output terminals. Set the current to 0A.
6. If efficiency measurements are desired, ammeters can be placed in series with the power supply to measure the EVAL-LT7175-1-AZ's input current and in series with the output load to measure the output current, or the output current can be read directly from the electronic load.
 - a. A Voltmeter can be placed across the output terminals (VSENSE+, VSENSE-) to obtain accurate output voltage measurements.
 - b. A Voltmeter can be placed across the input terminals (VIN_SENSE, GND) to obtain accurate input voltage measurements.
 - c. To achieve the best efficiency, remove R11 and R16, then populate 0 Ω resistors for R17 and R21 on the bottom layer of the board.
 - d. To achieve the best output accuracy, remove R17 and R21, then populate 0 Ω resistors for R11 and R16 on the bottom layer of the board.
7. Turn on power at the input.

Note: If there is no output, temporarily disconnect the load to ensure it is not set too high.

8. After the proper output voltages are re-established, adjust the load and/or input within the operating range and observe output voltage regulation, ripple voltage, efficiency, and other desired parameters.
9. When measuring output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. See [Figure 2](#) for the proper scope probe setup. Short, stiff leads should be soldered to the (+) and (-) terminals of the output capacitor. The probe's ground ring should touch the (-) lead, and the probe tip should touch the (+) lead.

In addition, the output voltage ripple can also be measured at the J6 V_{OUT} test point. J6 is designed for a 50 Ω coaxial U.FL cable to minimize high-frequency noise that could otherwise couple into the oscilloscope probes. See [Figure 3](#) for the proper coaxial cable setup.

10. Connect the dongle and control the output voltages from the GUI. See the LT7175-1 LTpowerPlay Quick Start Procedure for details.
11. The EVAL-LT7175-1-AZ includes an onboard load transient circuit. To test the load transient response, apply a pulsed signal from a signal generator between the IOSTEPCLK and GND turrets on the board. Measure the voltage across the sensing resistor R7 at the IOSTEP test point to observe the current ($V_{IOSTEP}/10\text{ m}\Omega$). Adjust the pulse amplitude to achieve the desired transient and modify the rising and falling edges of the pulse to set the required ramp rate. For more details, refer to the load transient circuit in the EVAL-LT7175-1-AZ schematic.
12. The EVAL-LT7175-1-AZ is compatible with LTpowerAnalyzer and can be connected to the LTpowerAnalyzer board at the P2 Molex socket with a 16-pin ribbon cable. LTpowerAnalyzer features the measurements of loop response, transient response, and output impedance. For details and instructions on LTpowerAnalyzer, refer to the [LTpowerAnalyzer](#) for user guide, software, and evaluation kit. Attach the load slammer through the on-board socket P1 for easy loop response and load transient testing setup.

Note: To test the loop response of the EVAL-LT7175-1-AZ, remove R17, R21, and R11, then populate a 0 Ω resistor at R16 and a 20 Ω resistor at R1 on the bottom layer of the board.

Connecting a PC to EVAL-LT7175-1-AZ

Use a PC to reconfigure the power management features of the LT7175-1, such as V_{OUT} , current limit, switching frequency, OV/UV limits, control-loop compensation, temperature fault limits, sequencing parameters, fault responses, and other functions. The DC1613A dongle may be plugged in while a V_{IN} is present. [Figure 4](#) shows a demo setup of a PC connected to the EVAL-LT7175-1-AZ.

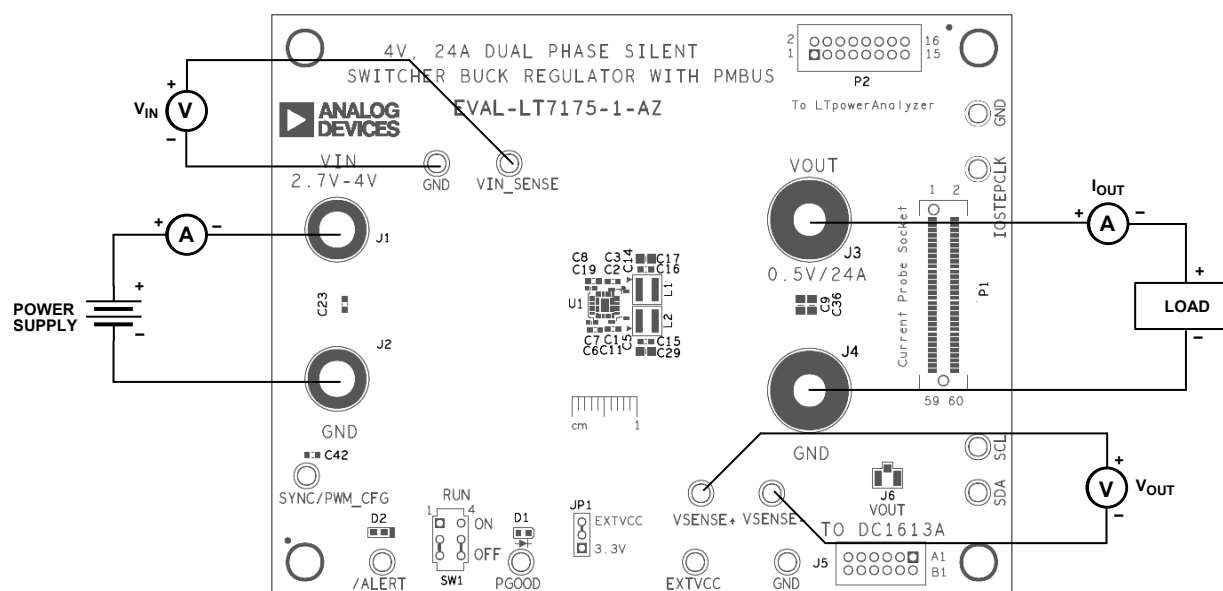


Figure 1. Proper Measurement Equipment Setup

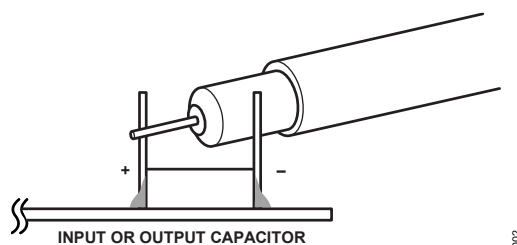


Figure 2. Scope Probe Placement for Measuring Input or Output Voltage Ripple



Figure 3. Coaxial Cable Placement for Measuring Output Voltage Ripple

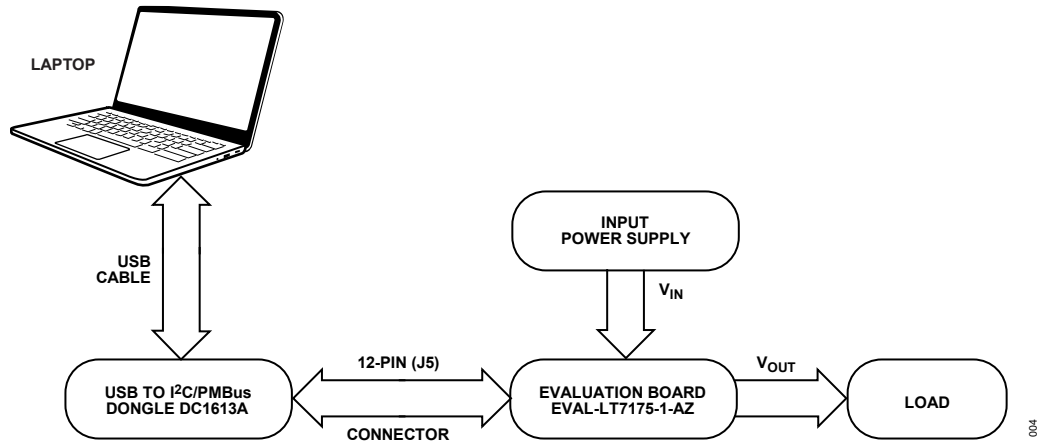


Figure 4. Demo Setup with PC

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Typical Performance Characteristics

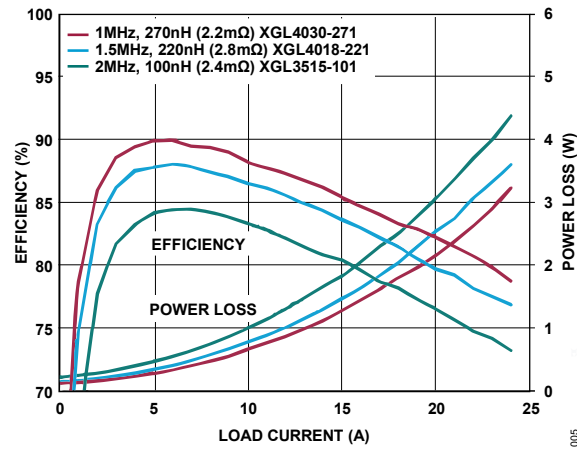


Figure 5. Efficiency vs. Load Current at $V_{OUT} = 0.5V$

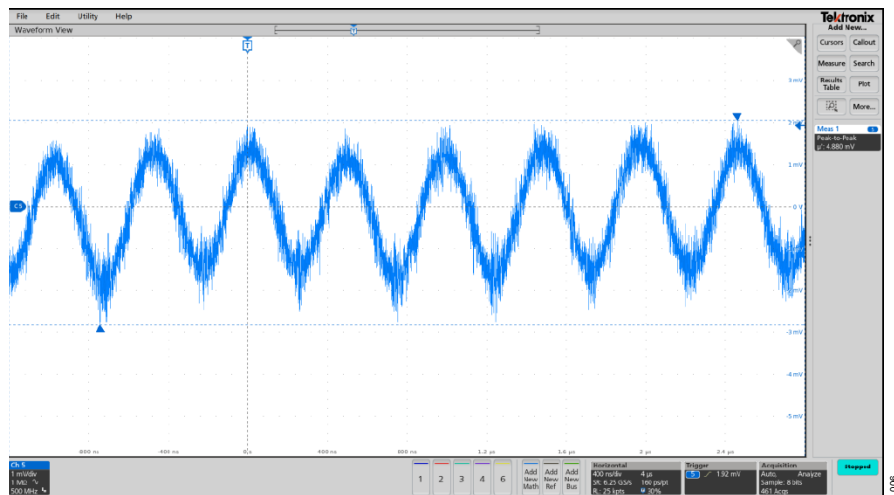


Figure 6. Output Voltage Ripple at $V_{IN} = 3.3V$, $V_{OUT} = 0.5V$, $f_{SW} = 2MHz$, $I_{LOAD} = 24A$

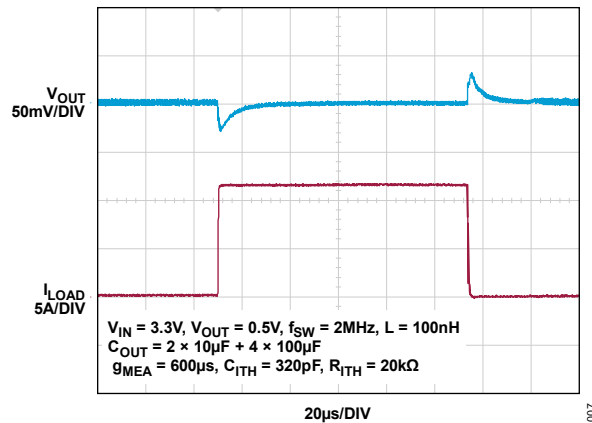


Figure 7. Load Transient Response

LTpowerPlay Software GUI

LTpowerPlay is a powerful, Windows®-based development environment supporting Analog Devices' digital power system management (DPSM) ICs and μ Module® regulators. The software supports a variety of tasks. Use LTpowerPlay to evaluate Analog Devices' ICs by connecting to an evaluation board system. LTpowerPlay can also be used in offline mode (with no hardware present) to build a multichip configuration file that can be saved and reloaded at a later time. LTpowerPlay provides unprecedented diagnostic and debug features and is a valuable diagnostic tool during board bring-up to program or tune the power management scheme in a system or diagnose power issues when bringing up rails. LTpowerPlay utilizes the DC1613A USB-to-SMBus controller to communicate with one of many potential demo systems 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 from the [LTpowerPlay | Analog Devices](#).

To access technical support documents for Analog Devices' Digital Power Products, visit the LTpowerPlay Help menu. Online help is also available through LTpowerPlay.

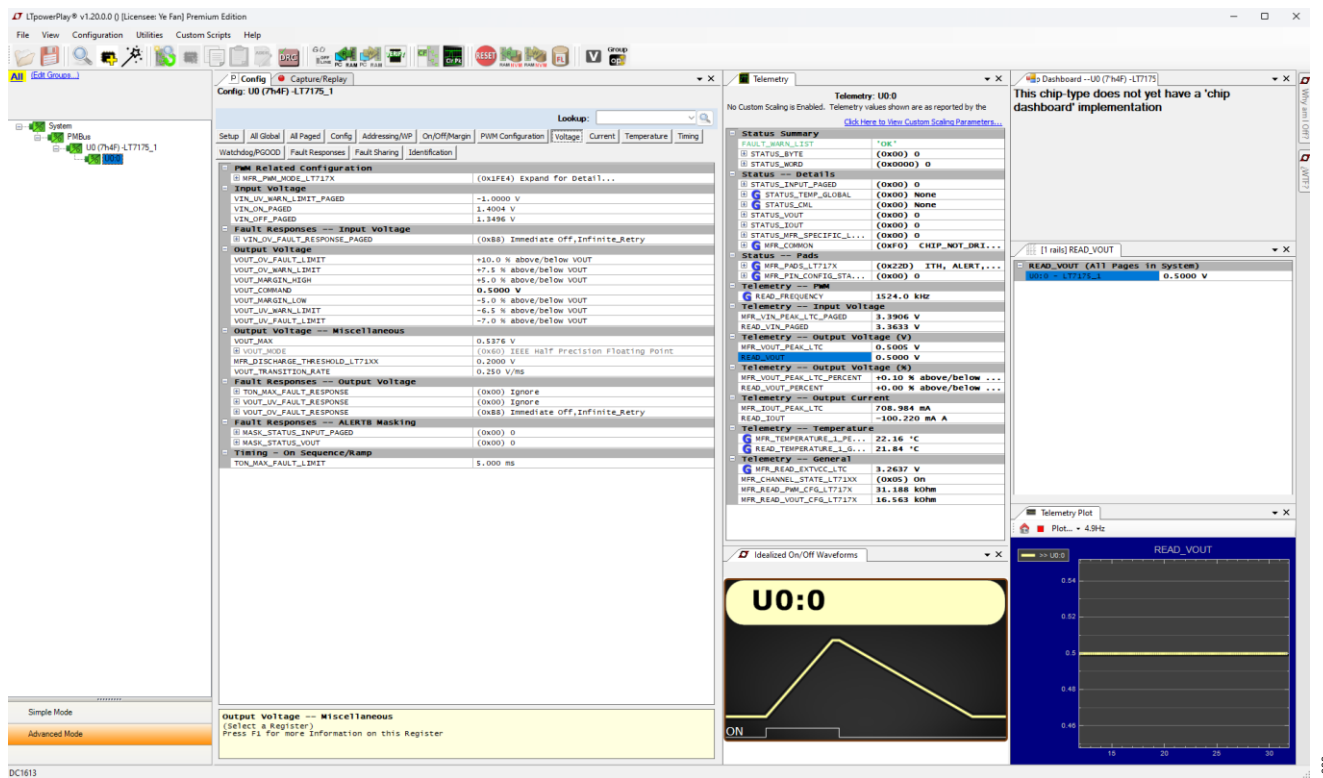
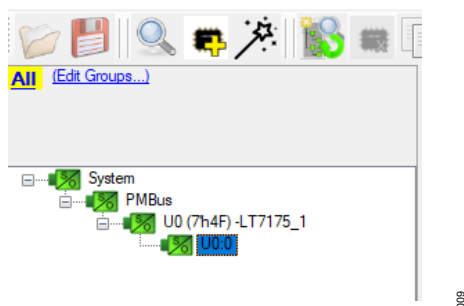


Figure 8. LTpowerPlay Main Interface

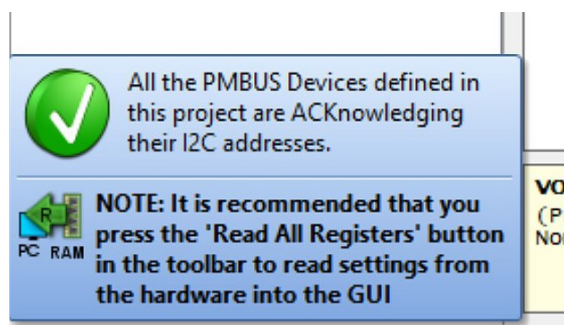
LTpowerPlay Quick Start Procedure

The following procedure describes how to use LTpowerPlay to monitor and change the settings of LT7175-1.

1. Download and install the LTpowerPlay GUI: [LTpowerPlay | Analog Devices](#).
2. Launch the LTpowerPlay GUI.
3. The GUI should automatically identify the EVAL-LT7175-1-AZ. The system tree on the left-hand side should appear as shown in the image below.



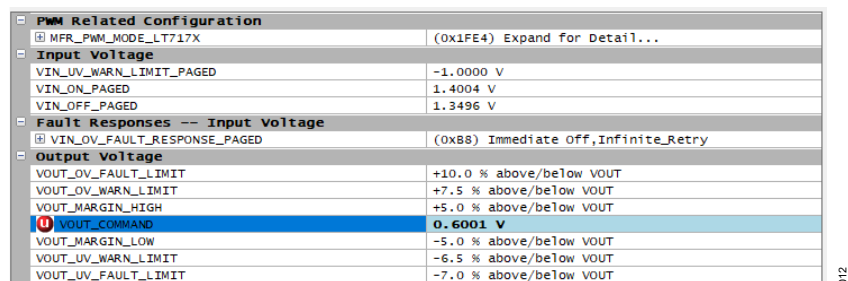
4. A green message box shows for a few seconds in the lower left-hand corner, confirming that LT7175-1 is communicating:



5. In the toolbar, click the **R** (RAM to PC) icon to read the RAM from the LT7175-1. This reads the configuration from the RAM of the LT7175-1 and loads it into the GUI.



6. To change the output voltage to a different value, like 0.6V, in the **Config** tab, type in 0.6 in the **VOUT_COMMAND** box under the **Voltage** tab, as shown below.

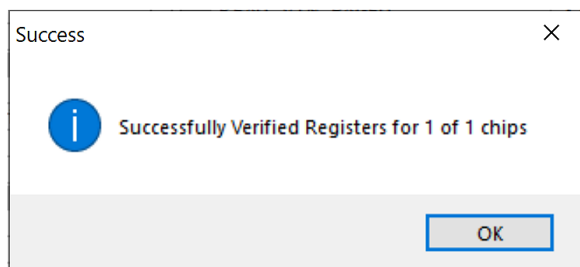


7. Then, click the **W** (PC to RAM) icon to write the register values to the LT7175-1. After finishing this step, the output voltage changes to 0.6V.



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8. If the write is successful, the following message appears.



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9. To save changes to NVM in the toolbar, make sure $EXTV_{CC}$ is biased between 9.6V to 13.2V. Then, click the RAM-to-NVM button.



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10. Save the evaluation board configuration to a (*.proj) file. Click the Save icon and save the file with a new name.

Ordering Information

PART	TYPE
EVAL-LT7175-1-AZ	Evaluation Kit

Z = RoHS-compliant part.

EVAL-LT7175-1-AZ Bill of Materials

ITEM	QTY	REFERENCE	DESCRIPTION	MFG_PART_NUMBER	MANUFACTURER
1	1	N/A	PCB	08_084060b	Analog Devices Supplied
2	4	C1, C2, C5, C14	Capacitors ceramic, 0.1µF, 10V, 10%, X7S, 0201	GRM033C71A104KE14D	MURATA
5	6	C12, C13, C24, C28, C30, C33	Capacitors ceramic, 10µF, 10V, 10%, X7R, 0805	CL21B106KPQNNNE	SAMSUNG
6	2	C15, C16	Capacitors ceramic, 10µF, 4V, 10%, X7T, 0603, AEC-Q200	CGA3E1X7T0G106M080AC	TDK
7	4	C17, C29, C36, C37	Capacitors ceramic, 100µF, 4V, 20%, X6S, 0805	GRM21BC80G107ME15K	MURATA
8	3	C18, C41, C44	Capacitors ceramic, 1µF, 25V, 10%, X7R, 0603, AEC-Q200	GCM188R71E105KA64D	MURATA
9	1	C19	Capacitor ceramic, 1µF, 25V, 10%, X5R, 0402, AEC-Q200	GRT155R61E105KE01D	MURATA
10	4	C20, C21, C38, C39	Capacitors ceramic, 4.7µF, 25V, 10%, X6S, 0603	GRM188C81E475KE11D	MURATA
11	2	C22, C25	Capacitors ceramic, 1µF, 10V, 10%, X7S, 0402	C1005X7S1A105K050BC	TDK
12	1	C23	Capacitor ceramic, 1µF, 10V, 10%, X7R, 0603	C0603C105K8RACTU	KEMET
14	1	C3	Capacitor ceramic, 4.7µF, 10V, 10%, X7S, 0603, Low ESR	C1608X7S1A475K080AC	TDK
15	1	C31	Capacitor ceramic, 0.1µF, 10V, 10%, X7R, 0603	C0603C104K8RACTU	KEMET
16	3	C32, C34, C35	Capacitors ceramic, 1µF, 6.3V, 10%, X7R, 0402	GRM155R70J105KA12D	MURATA
17	1	C4	Capacitor, Aluminum, 330µF, 10V, 20%, 0.2Ω, 0.41A, 3000H, AEC-Q200	EEE-TC1A331UP	PANASONIC
18	1	C40	Capacitor ceramic, 0.01µF, 25V, 10%, X7R 0603	CL10B103KA8NNNC	SAMSUNG
19	1	C42	Capacitor ceramic, 1500pF, 25V, 10%, X7R, 0603	CC0603KRX7R8BB152	YAGEO
20	1	C45	Capacitor ceramic, 22µF, 25V, 20%, X6S, 0805, AEC-Q200	GRT21BC81A226ME13L	MURATA
21	1	C6	Capacitor ceramic, 10µF, 10V, 10%, X6S, 0603	ZRB18AC81A106KE01L	MURATA
22	1	C7	Capacitor ceramic, 2.2µF, 10V, 10%, X7S, 0402, Low ESR	C1005X7S1A225K	TDK
23	1	C8	Capacitor ceramic, 10µF, 10V, 10%, X5R, 0603, Low ESR	C1608X5R1A106K080AC	TDK
24	1	D1	Diode hyper bright low current LED (GREEN)	LG L29K-G2J1-24-Z	OSRAM OPTO SEMICONDUCTORS
25	1	D2	LED SMARTLED 630nm red	LS L29K-H1J2-1-Z	OSRAM OPTO SEMICONDUCTORS
27	13	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E15	Connector-PCB solder terminal test point turret, 0.094 inch manufacturing hole PCB, 0.062 inch, thick	2501-2-00-80-00-00-07-0	MILL-MAX
28	1	FB1	IND ferrite bead multi layer 100Ω at 100MHz, 25%, 8A, 0.006Ω, 1812, AEC-Q200	7.43E+10	WURTH ELEKTRONIK

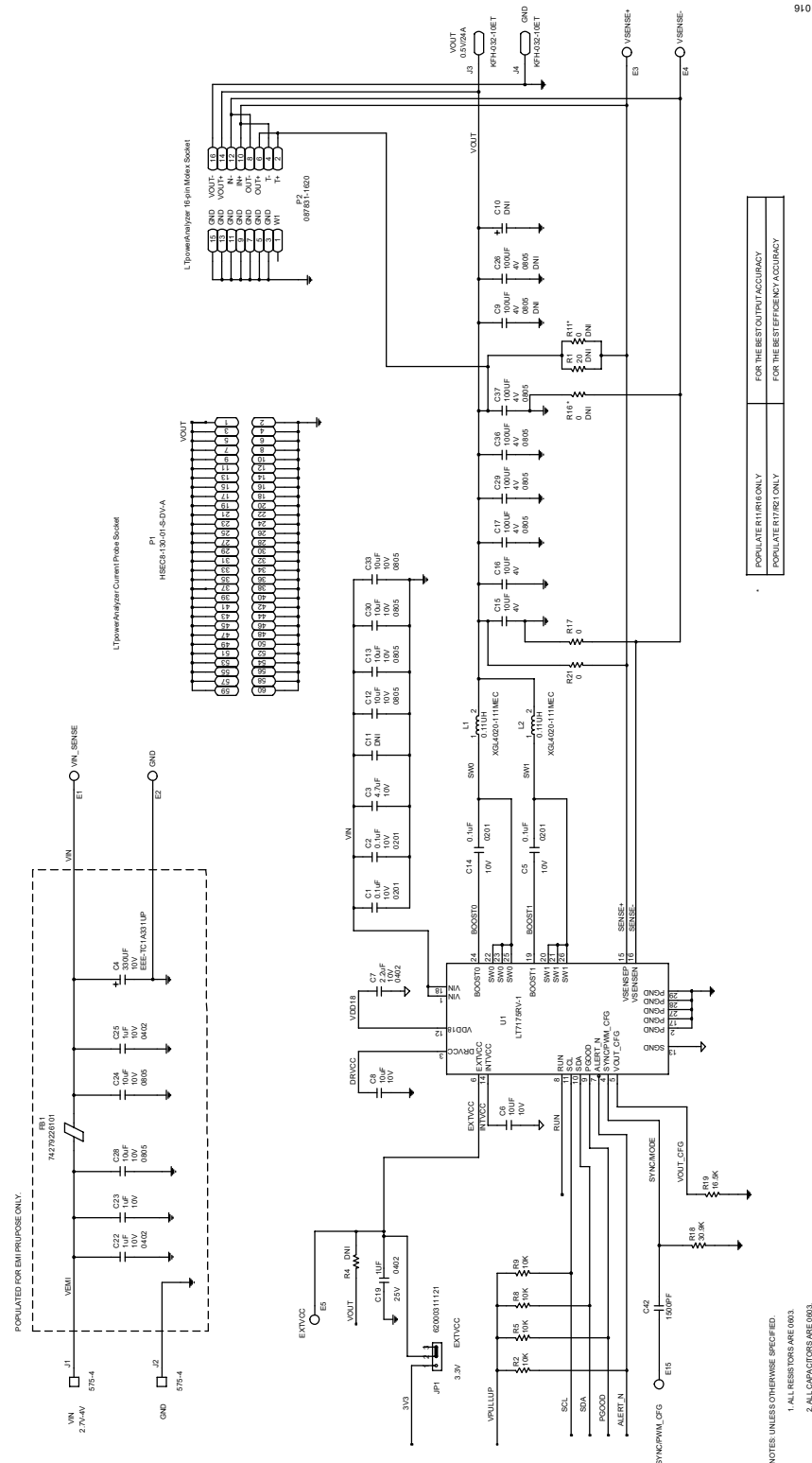
EVAL-LT7175-1-AZ Bill of Materials (continued)

ITEM	QTY	REFERENCE	DESCRIPTION	MFG_PART_NUMBER	MANUFACTURER
29	2	J1, J2	Connector-PCB, banana jack, female, non-insulated, THT, swage, 0.218 inches length	575-4	KEYSTONE ELECTRONICS
30	2	J3, J4	Connector-PCB threaded broaching stud, 625mil, length	KFH-032-10ET	PENN ENGINEERING
31	1	J5	Connector-PCB, 12 positions shrouder HDR, 2mm pitch, 4mm post height, 2.5mm solder tail	98414-G06-12ULF	AMPHENOL
32	2	J6, J7	Connector-PCB coax RCPT male 0Hz to 6GHz, 50Ω	RSP-122811-01	SAMTEC INC.
33	1	JP1	Connector-PCB 3 positions male HDR unshrouded single row ST, 2mm pitch, 2.70mm solder tail	6.2E+10	WURTH ELEKTRONIK
34	2	L1, L2	Inductor power shielded wirewound, 0.11μH, 20%, 1MHz, 29A, 0.0017Ω, DCR, 1515, AEC-Q200	XGL4020-111MEC	COILCRAFT INC.
35	1	P1	Connector-PCB 60 positions, vertical edge rate card socket	HSEC8-130-01-S-DV-A	SAMTEC INC.
36	1	P2	Connector-PCB milli-grid, header vertical 16 positions, 2mm pitch, 2.5mm, solder tail, 3.9mm, Post height	087831-1620	MOLEX
37	1	Q1	Transistor, MOSFET N-Channel, 25V, 70A	PSMN5R4-25YLDX	NEXPERIA
38	1	Q2	Transistor MOSFET N-Channel, 60V, 0.3A, SOT-23, (TO-236)	2N7002K-T1-GE3	VISHAY
40	1	R10	Resistor SMD, 49.9Ω, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF49R9V	PANASONIC
42	2	R3, R12	Resistor SMD, 866Ω, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF8660V	PANASONIC
43	2	R6, R13	Resistors SMD, 4.99kΩ, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF4991V	PANASONIC
44	1	R14	Resistor SMD, 1MΩ, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF1004V	PANASONIC
45	2	R17, R21	Resistors SMD, 0Ω, jumper, 1/10W, 0603, AEC-Q200	ERJ-3GEY0R00V	PANASONIC
46	1	R18	Resistor SMD 30.9kΩ, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF3092V	PANASONIC
47	1	R19	Resistor SMD 16.5kΩ, 1%, 1/10W, 0603, AEC-Q200	CRCW060316K5FKEA	VISHAY
48	4	R2, R5, R8, R9	Resistors SMD, 10kΩ, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF1002V	PANASONIC
50	1	R7	Resistor SMD, 0.01Ω, 1%, 3W, 2512, AEC-Q200, long side term	KRL6432E-C-R010-F-T1	SUSUMU CO, LTD
51	1	SW1	Switch slide DPDT, 300mA, 6V	JS202011CQN	C&K
52	1	U1	Prelim, IC-ADI LT7175RV-1	LT7175RV-1#TRPBF	ANALOG DEVICES
53	1	U2	IC EEPROM 2Kbit I2C serial EEPROM, 400kHz	24LC025-I/ST	MICROCHIP TECHNOLOGY

EVAL-LT7175-1-AZ Bill of Materials (continued)

ITEM	QTY	REFERENCE	DESCRIPTION	MFG_PART_NUMBER	MANUFACTURER
54	2	U3, U4	IC-ADI 18V, 12A, Ideal Diode	LTC4450AV#TRMPBF	ANALOG DEVICES
55	1	U5	IC-ADI 100mA, Low noise, LDO micropower regulators IN TSOT-23	LT1761ES5-2.8#TRMPBF	ANALOG DEVICES
56	1	U6	IC-ADI or controller P-Channel single 0.14Ω, 5.5V, 10LD DFN EP	LTC4413EDD#PBF	ANALOG DEVICES
MECHANICAL PARTS					
2	1	?	Shunt female 2Positions 2mm	6.08E+10	WURTH ELEKTRONIK
3	2	?	Washer, External-Tooth Lock #10, 0.19x0.41x0.03	98438A230	MCMMASTER-CARR
4	2	?	Connector ring LUG Terminal, 10 Crimp, non-insulated	8205	KEYSTONE
5	4	?	Hex Nut, Brass 10-32 thread	92671A195	MCMMASTER CARR
6	4	?	Standoff, Board support, snap fit 12.7mm, length	8833	KEYSTONE
THE FOLLOWING COMPONENTS ARE PART OF THE PCB OR ARE NOT TO BE INSTALLED					
3	1	C10	Capacitor tantalum, 470μF, 4V, 20%, 7343, Low ESR, 0.018Ω	4TPE470MIL	PANASONIC
4	1	C11	Do not install (TBD_C0603) Please use SYM_3 and/or SYM_4	TBD0603	TBD0603
13	2	C9, C26	Capacitors ceramic, 100μF, 4V, 20%, X6S, 0805	GRM21BC80G107ME15K	MURATA
26	2	D3, D4	Dio Schottky, rectifier 30V, 1A, SOD-323	SDM100K30L-7	DIODES INCORPORATED
39	1	R1	Resistor SMD 20Ω, 1%, 1/10W, 0603, AEC-Q200	CRCW060320R0FKEA	VISHAY
41	2	R11, R16	Resistors SMD, 0Ω, Jumper, 1/10W, 0603, AEC-Q200, Precision power	CRCW06030000Z0EA	VISHAY
49	1	R4	Do not install (TBD_R0603), Use SYM_3 and/or SYM_4	TBD0603	TBD0603

EVAL-LT7175-1-AZ Schematic Diagram



110



Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	10/26	Initial release	—

Notes

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