Evaluation Board User Guide

EVAL-LT7175-AZ

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

General Description

The evaluation kit EVAL-LT7175-AZ is a single-phase, single-output monolithic DC/DC synchronous step-down regulator featuring the LT®7175, with a 2.7V to 4V input range. With 3V to 12V $EXTV_{CC}$ 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 to minimize EMI and reduce PCB layout sensitivity. It also integrates digital power system management functionality, allowing programmability and telemetry through a PMBus/I^2C-compliant serial interface. Refer to the LT7175 data sheet for more detailed information.

The EVAL-LT7175-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 a 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-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 I^2C/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 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-AZ.

For more details and instructions for LTpowerPlay, refer to the LTpowerPlay GUI and the LT7175 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		%

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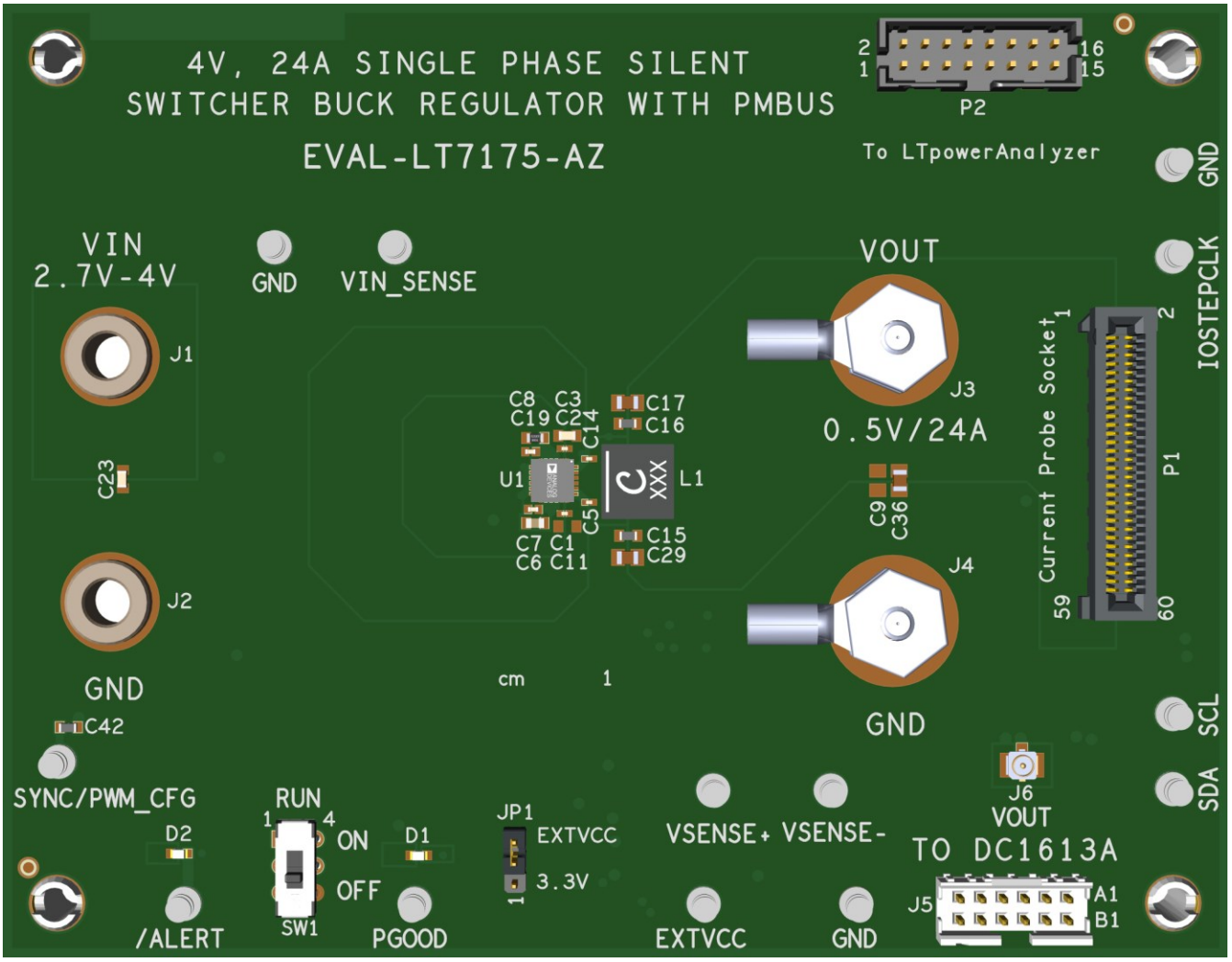
EVAL-LT7175-AZ Evaluation Board



Quick Start Procedure

The EVAL-LT7175-AZ is easy to set up to evaluate the performance of the LT7175. 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 ±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-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 0Ω 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 0Ω 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 50Ω 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 using the GUI. See the LT7175 LTpowerPlay Quick Start Procedure for details.
11. The EVAL-LT7175-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 (VIOSTEP/10 mΩ). 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-AZ schematic.
12. The EVAL-LT7175-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 measurements of loop response, transient response, and output impedance. For details and instructions on LTpowerAnalyzer, refer to the *LTpowerAnalyzer* user guide, software, and evaluation kit. Attach the load slammer through the on-board socket P1 for an easy loop response and load transient testing setup.

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

Connecting a PC to EVAL-LT7175-AZ

Use a PC to reconfigure the power management features of the LT7175, 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 V_{IN} is present. *Figure 4* shows a demo setup of a PC connected to the EVAL-LT7175-AZ.

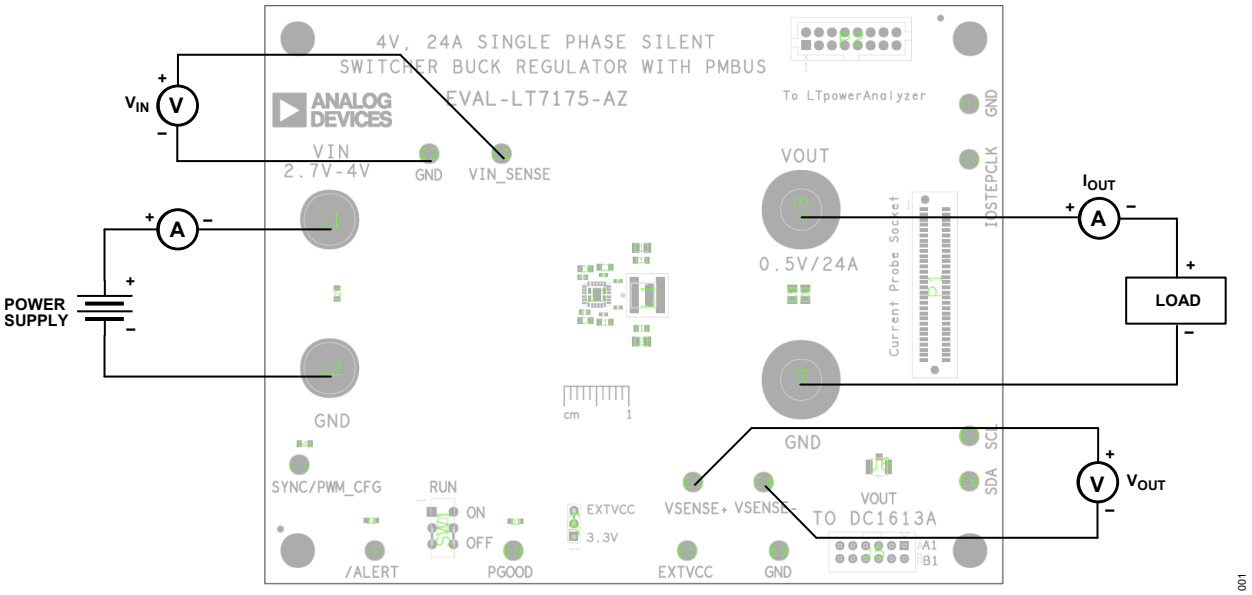


Figure 1. Proper Measurement Equipment Setup

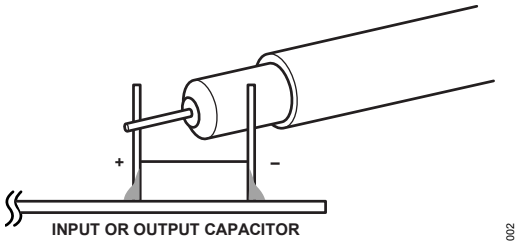


Figure 2. Scope Probe Placement for Measuring Input or Output Voltage Ripple

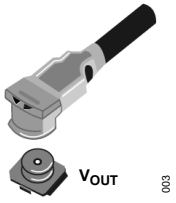


Figure 3. Coaxial Cable Placement for Measuring Output Voltage Ripple

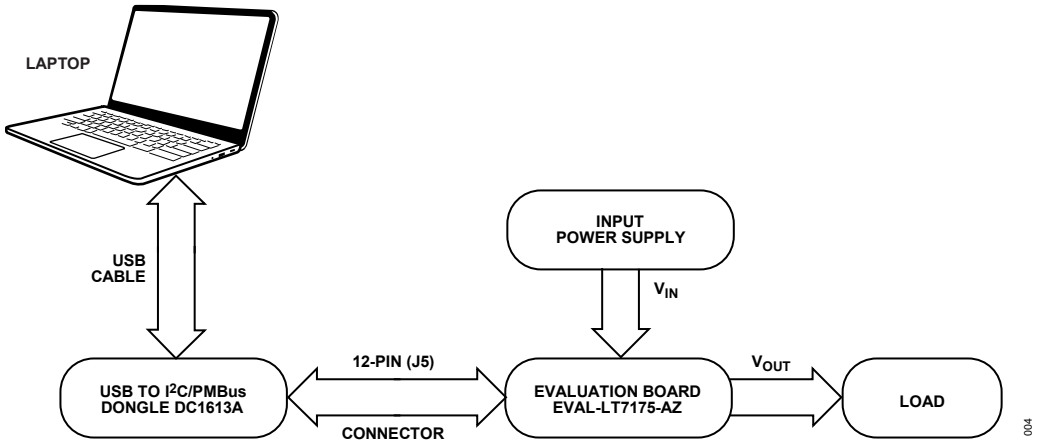


Figure 4. Demo Setup with PC

Typical Performance Characteristics

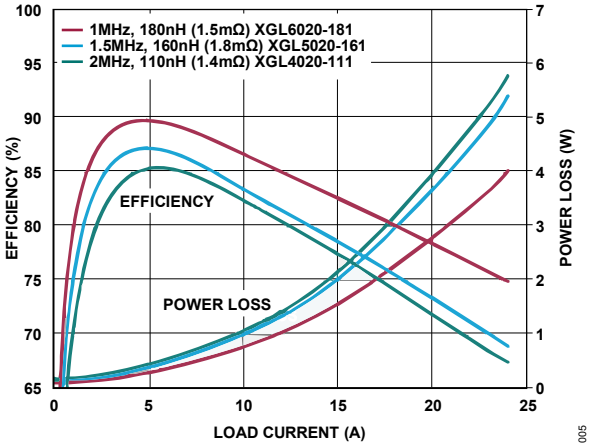


Figure 5. Efficiency vs. Load Current at V_{OUT} = 0.5V

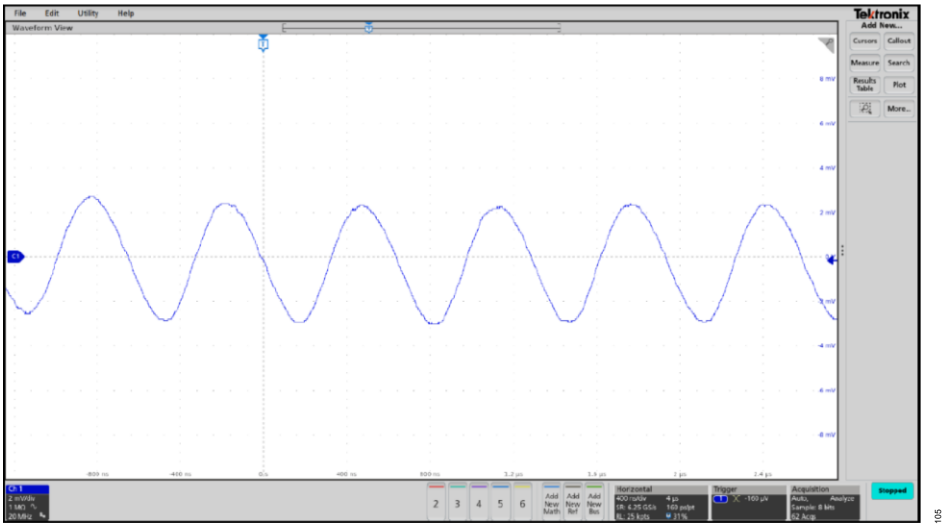


Figure 6. Output Voltage Ripple at V_{IN} = 3.3V, V_{OUT} = 0.5V, f_{SW} = 1.5MHz, I_{LOAD} = 0A

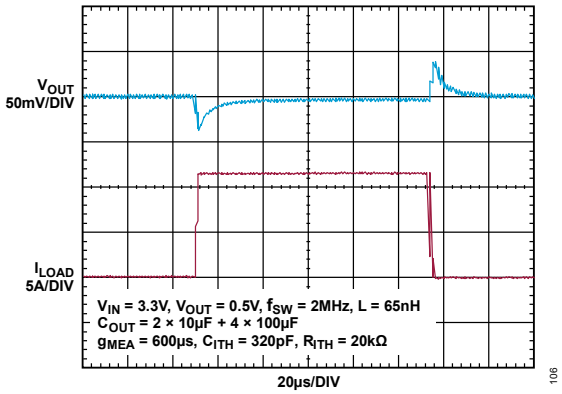


Figure 7. Load Transient Response

LTpowerPlay Software GUI

LTpowerPlay is a powerful, Windows®-based development environment supporting Analog Devices' digital power system management (DPSM) ICs and µModule® 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 uses 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. 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.

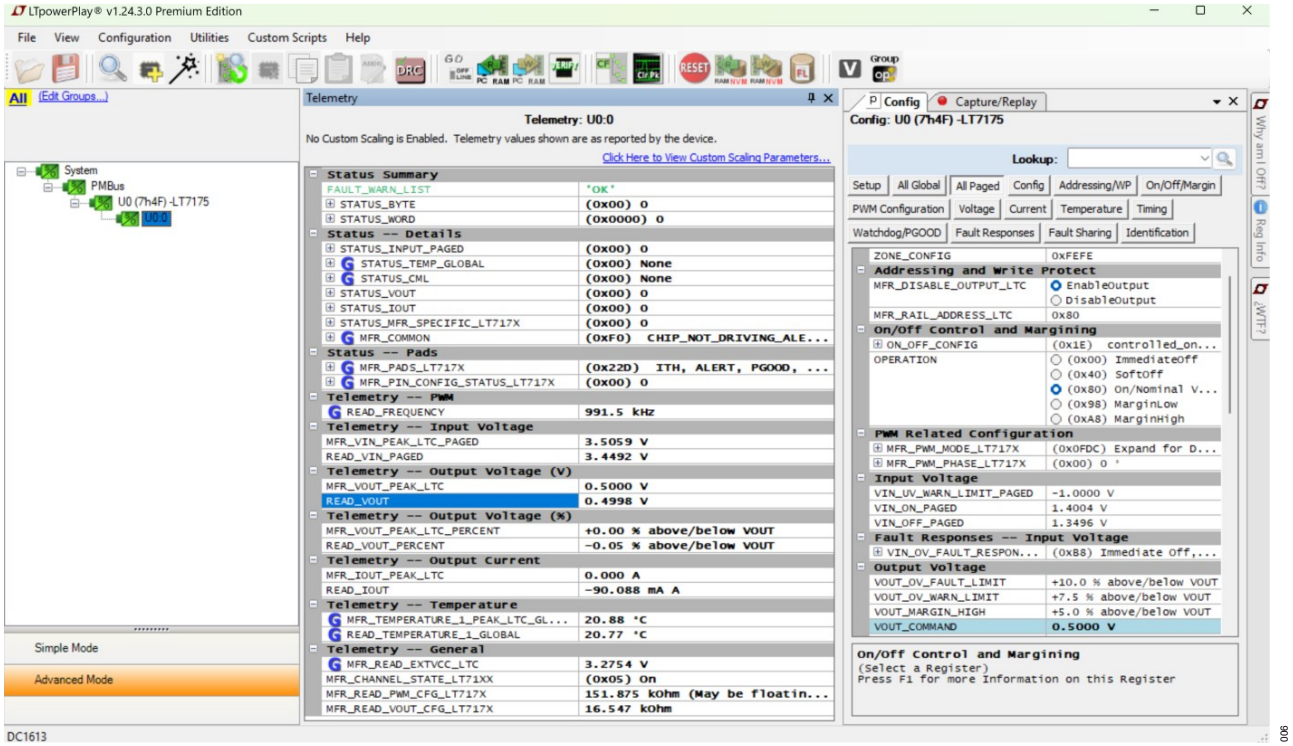
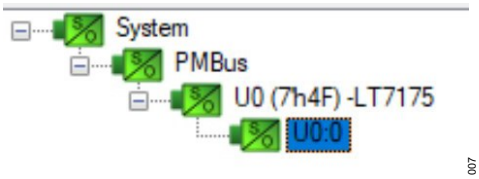


Figure 8. LTpowerPlay Main Interface

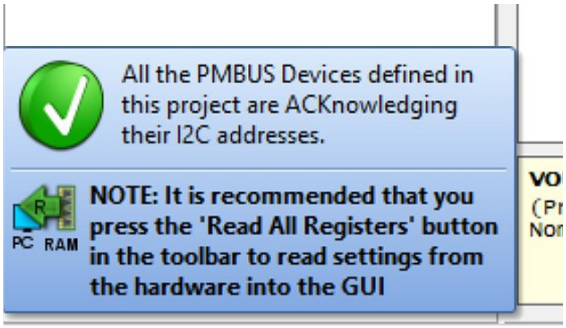
LTpowerPlay Quick Start Procedure

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

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

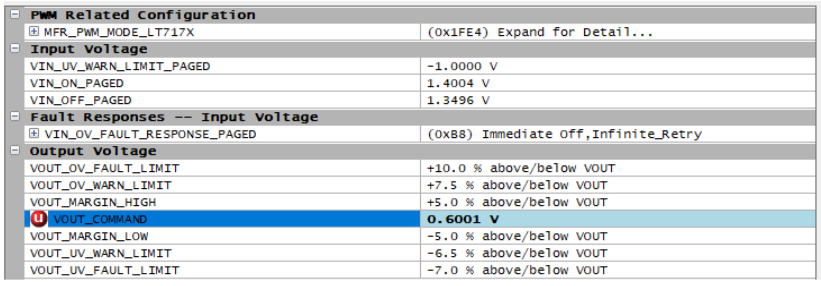


4. A green message box shows for a few seconds in the lower-left corner, confirming that LT7175 is communicating:



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

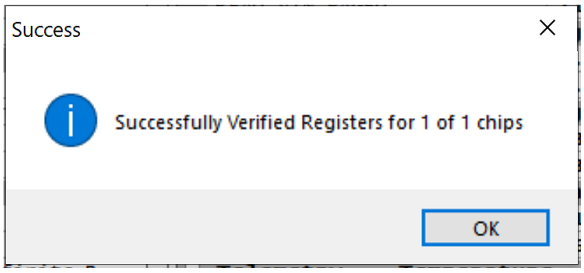
6. To change the output voltage to a different value, such as 0.6V, in the **Config** tab, type in 0.6 in the **VOUT_COMMAND** box under the **Voltage** tab, as shown below.



PWM Related Configuration	
MFR_PWM_MODE_LT717X	(0x1FE4) Expand for Detail...
Input Voltage	
VIN_UV_WARN_LIMIT_PAGED	-1.0000 V
VIN_ON_PAGED	1.4004 V
VIN_OFF_PAGED	1.3496 V
Fault Responses -- Input Voltage	
VIN_OV_FAULT_RESPONSE_PAGED	(0x88) Immediate Off,Infinite_Retry
Output Voltage	
VOUT_OV_FAULT_LIMIT	+10.0 % above/below VOUT
VOUT_OV_WARN_LIMIT	+7.5 % above/below VOUT
VOUT_MARGIN_HIGH	+5.0 % above/below VOUT
VOUT_COMMAND	**0.6001 V**
VOUT_MARGIN_LOW	-5.0 % above/below VOUT
VOUT_UV_WARN_LIMIT	-6.5 % above/below VOUT
VOUT_UV_FAULT_LIMIT	-7.0 % above/below VOUT

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

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



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

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-AZ	Evaluation Kit

Z = RoHS-compliant part.

EVAL-LT7175-AZ Bill of Materials

ITEM	QTY	REFERENCE	DESCRIPTION	MFG_PART_NUMBER	MANUFACTURER
1	1	N/A	PCB	N/A	PCB MANUFACTURING
2	4	C1, C2, C5, C14	Capacitors ceramic, 0.1µF, 10V, 10%, X7S, 0201	GRM033C71A104KE14D	MURATA
3	6	C12, C13, C24, C28, C30, C33	Capacitors ceramic, 10µF, 10V, 10%, X7R, 0805	CL21B106KPQNNNE	SAMSUNG
4	2	C15, C16	Capacitors ceramic, SMD, 0603, 10µF, 20%, 4V, X5R	GRM188R60G106ME47D	MURATA
5	4	C17, C29, C36, C37	Capacitors ceramic, 100µF, 4V, 20%, X6S, 0805	GRM21BC80G107ME15K	MURATA
6	3	C18, C41, C44	Capacitors ceramic, 1µF, 25V, 10%, X7R, 0603, AEC-Q200	GCM188R71E105KA64D	MURATA
7	1	C19	Capacitor ceramic, 1µF, 25V, 10%, X5R, 0402, AEC-Q200	GRT155R61E105KE01D	MURATA
8	4	C20, C21, C38, C39	Capacitors ceramic, SMD, 0603, 4.7µF, 10%, 25V, X6S	GRM188C81E475KE11D	MURATA
9	2	C22, C25	Capacitors ceramic, 1µF, 10V, 10%, X7S, 0402	C1005X7S1A10,5K050BC	TDK
10	1	C23	Capacitor ceramic, 1µF, 10V, 10%, X7R, 0603	C0603C105K8RACTU	KEMET
11	1	C3	Capacitor ceramic, 4.7µF, 10V, 10%, X7S, 0603, Low ESR	C1608X7S1A475K080AC	TDK
12	1	C31	Capacitor ceramic, 0.1µF, 10V, 10%, X7R, 0603	Capacitor ceramic	KEMET
13	3	C32, C34, C35	Capacitors ceramic, 1µF, 6.3V, 10%, X7R, 0402	Capacitor ceramic	MURATA
14	1	C4	Capacitor, SMD, 330µF, 20%, 10V, Aluminum electrolytic	EEETC1A331UP	PANASONIC
15	1	C40	Capacitor ceramic, 0.01µF, 25V, 10%, X7R, 0603	CL10B103KA8NNNC	SAMSUNG
16	1	C42	Capacitor ceramic, SMD, 0603, 1500pF, 10%, 25V, X7R	CC0603KRX7R8BB152	YAGEO
17	1	C45	Capacitor ceramic, 22µF, 25V, 20%, X6S, 0805, AEC-Q200	GRT21BC81A226ME13L	MURATA
18	1	C6	Capacitor ceramic, SMD, 0603, 10µF, 10%, 10V, X6S	ZRB18AC81A106KE01L	MURATA
19	1	C7	Capacitor ceramic, 2.2µF, 10V, 10%, X7S, 0402, Low ESR	C1005X7S1A225K	TDK
20	1	C8	Capacitor ceramic, SMT (0603), 10µF, 10%, 10V, X5R	C1608X5R1A106K080AC	TDK
21	1	D1	Diode hyper bright low current LED (green), Note: Status set to obsolete per IHS (Accuris) BOM intelligence report	LG L29K-G2J1-24-Z	OSRAM OPTO SEMICONDUCTORS
22	1	D2	LED SMARTLED, 630nm red, Note: Status set to obsolete per IHS (Accuris) BOM intelligence report	LS L29K-H1J2-1-Z	OSRAM OPTO SEMICONDUCTORS
23	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

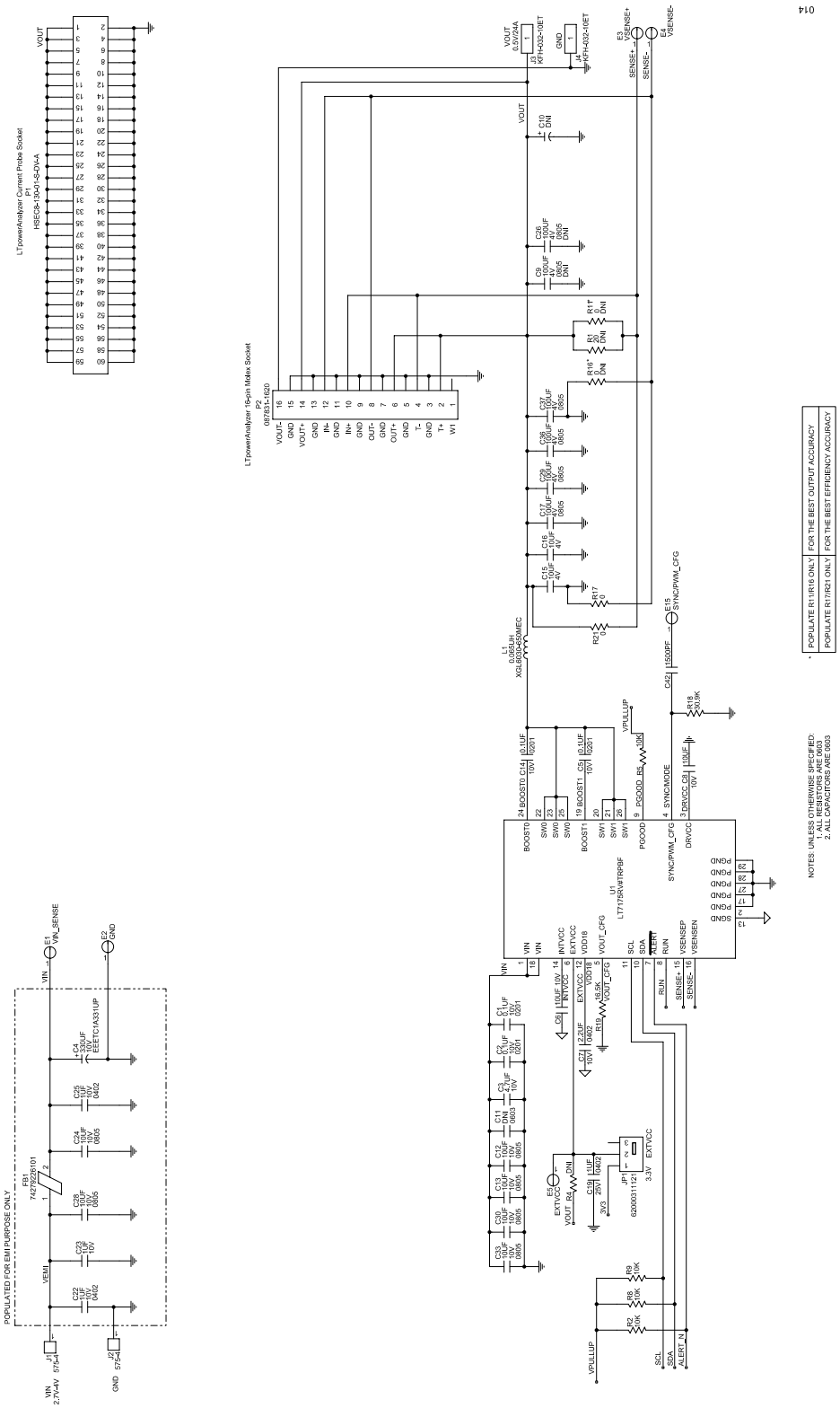
EVAL-LT7175-AZ Bill of Materials (continued)

ITEM	QTY	REFERENCE	DESCRIPTION	MFG_PART_NUMBER	MANUFACTURER
24	1	FB1	IND EMI suppression ferrite bead, 0.006Ω, MAX DCR, 8A	74279226101	WURTH ELEKTRONIK
25	2	J1, J2	Connectors-PCB banana jack	575-4	KEYSTONE ELECTRONICS
26	2	J3, J4	Custom, Connector, Assembly, TH, Broaching studs, Length 0.625 inch, Head diameter 0.250 inch, Shank 0.065 inch, 10-32 thread, phosphor bronze	KFH-032-10ET	PENN ENGINEERING
27	1	J5	Connector, Male, Straight, TH, 12 position, Shrouded header, 650V, 2A	98414-G06-12ULF	AMPHENOL
28	2	J6, J7	Connectors, SMT, Coax RCPT Male 0Hz to 6GHz, 50Ω, 3Pins	RSP-122811-01	SAMTEC
29	1	JP1	Connector, Male, Through hole, WR-PHD THT, Straight single pin header, straight, 3Pins	62000311121	WURTH ELECTRONICS
30	1	L1	Inductor, SMD, 0.065µH, 20%, 43A, Composite	XGL6030-650MEC	COILCRAFT INC.
31	4	MECH1, MECH2, MECH3, MECH4	Standoff, Board support snap Lock/Screw mount nylon 12.7mm, Long, 6.6 OD, 3.2 ID	8833	KEYSTONE
32	1	P1	Connector, SMT, Female, High speed edge connector, 2 rows, 60Pins	HSEC8-130-01-S-DV-A	SAMTEC INC.
33	1	P2	Connector-PCB Milli-Grid header vertical 16 position, 2mm pitch, 2.5mm solder tail, 3.9mm, Post height	087831-1620	MOLEX
34	1	Q1	Transistor, N-Channel, SMD, 5P, LFPAK56, 25V, 70A	PSMN5R4-25YLDX	NEXPERIA
35	1	Q2	Transistor, N-Channel, MOSFET 60V, 0.3A, SOT-23 (TO-236)	2N7002K-T1-GE3	VISHAY
36	1	R10	Resistor SMD, 49.9Ω, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF49R9V	PANASONIC
37	2	R17, R21	Resistors SMD, 0Ω, Jumper, 1/10W, 0603, AEC-Q200, Precision power	CRCW06030000Z0EA	VISHAY
38	2	R3, R12	Resistors SMD, 866Ω, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF8660V	PANASONIC
39	2	R6, R13	Resistors SMD, 4.99kΩ, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF4991V	PANASONIC
40	1	R14	Resistor SMD, 1MΩ, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF1004V	PANASONIC
41	1	R18	Resistor SMD, 30.9kΩ, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF3092V	PANASONIC
42	1	R19	Resistor SMD, 16.5kΩ, 1%, 1/10W, 0603, AEC-Q200	CRCW060316K5FKEA	VISHAY
43	4	R2, R5, R8, R9	Resistors SMD, 10kΩ, 1%, 1/10W, 0603, AEC-Q200	ERJ-3EKF1002V	PANASONIC

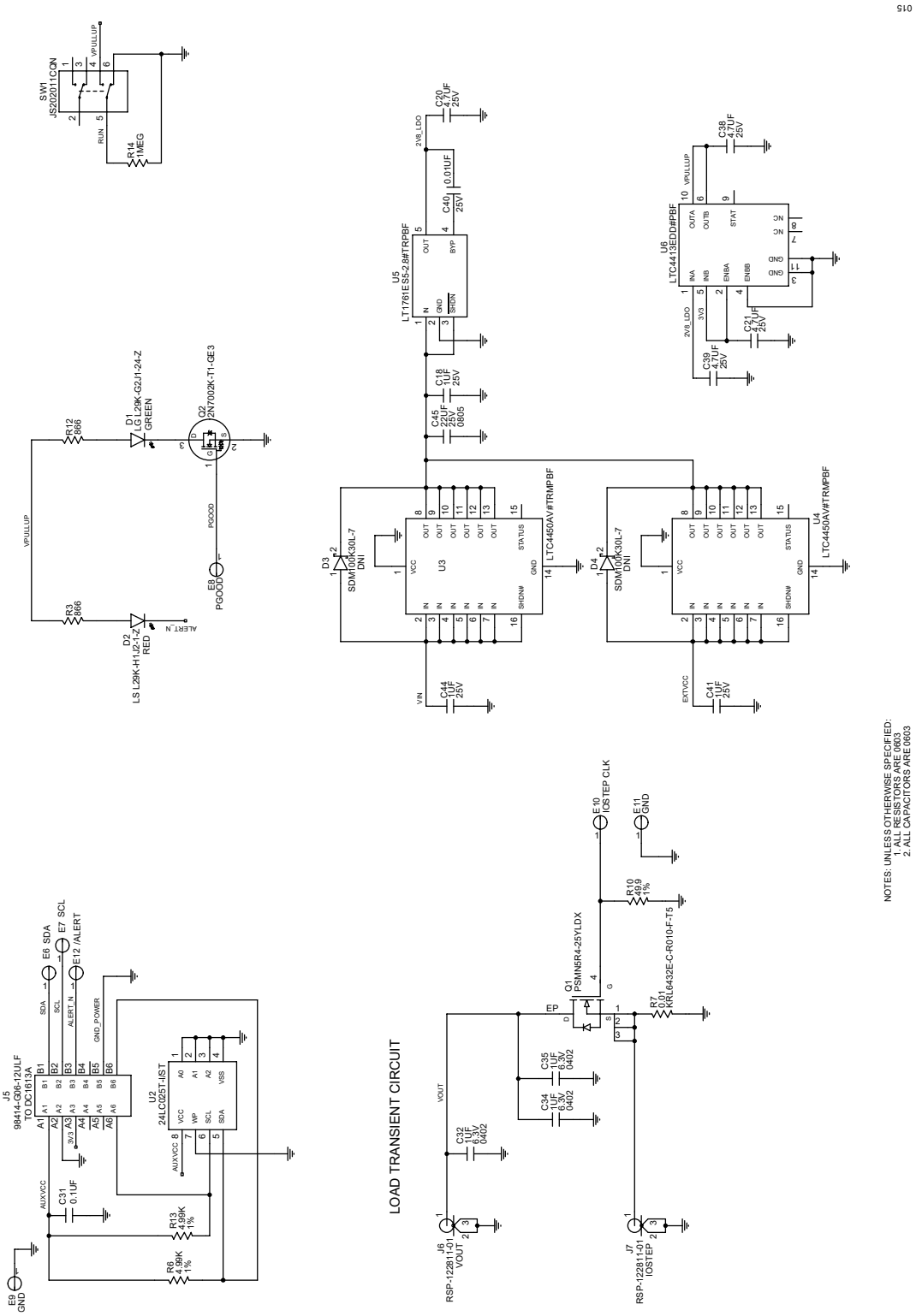
EVAL-LT7175-AZ Bill of Materials (continued)

ITEM	QTY	REFERENCE	DESCRIPTION	MFG_PART_NUMBER	MANUFACTURER
44	1	R7	Resistor, SMD, 1225, Current sensing, 0.01, 1%, Metal foil	KRL6432E-C-R010-F-T5	SUSUMU CO, LTD
45	1	SW1	Switch slide, DPDT, 300mA, 6V	JS202011CQN	C&K COMPONENTS
46	1	U1	Custom, IC, 24A, 4V, Single-Phase, Silent switcher step-down regulators with digital power system management, Note: Preliminary data sheet	LT7175RV#TRPBF	ANALOG DEVICES
47	1	U2	IC, EEPROM 2Kbit I2C, 8-TSSOP	24LC025T-I/ST	MICROCHIP TECHNOLOGY
48	2	U3, U4	IC, 18V, 12A, Ideal Diode, 16-LQFN	LTC4450AV#TRMPBF	ANALOG DEVICES
49	1	U5	IC, Regulator, SMD, 100mA, Low noise, LDO Micropower regulators, 1.8 VOUT, TSOT-23	LT1761ES5-2.8#TRPBF	ANALOG DEVICES
50	1	U6	IC, OR Controller source selector, 10-DFN-EP	LTC4413EDD#PBF	ANALOG DEVICES
MECHANICAL COMPONENT LIST					
1	1	N/A	Connector, WR-PHD 2.00mm, Jumper with test point	60800213421	WURTH ELEKTRONIK
2	2	N/A	Washer, 400 series stainless steel external-tooth lock washer, stainless steel	98438A230	MCMASTER CARR
3	2	N/A	LUG, Solderless ring tongue terminal, Wire range 16/14, AWG, Copper	8205	KEYSTONE
4	4	N/A	NUT, Hex nut, Diameter 3/8 inch, Thickness, 1/8 inch, 10-32, Thread, Brass	92671A195	MCMASTER CARR
DNI COMPONENT LIST: Parts NOT installed on the PCB and NOT purchased					
1	1	C10	Capacitor tantalum, 470µF, 4V, 20%, 7343, Low ESR, 0.018Ω	4TPE470MIL	PANASONIC
2	1	C11	Capacitor ceramic, 10pF, 100V, 10%, C0G, 0603	06031A100KAT2A	AVX CORPORATION
3	2	C9, C26	Capacitor ceramic, 100µF, 4V, 20%, X6S, 0805	GRM21BC80G107ME15K	MURATA
4	2	D3, D4	Diode Schottky Rectifier, 30V, 1A, SOD-323	SDM100K30L-7	DIODES INCORPORATED
5	1	R1	Resistor, SMD, 20Ω, 1%, 1/10W, 0603, AEC-Q200	CRCW060320R0FKEA	VISHAY
6	3	R4, R11, R16	Resistors, SMD 0Ω, Jumper, 1/10W, 0603, AEC-Q200, Precision power	CRCW06030000Z0EA	VISHAY

EVAL-LT7175-AZ Schematic Diagrams



EVAL-LT7175-AZ Schematic Diagrams (continued)



Revision History

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

Notes

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