Evaluation Board User Guide

EVAL-LT7171-AZ

LT7171 16V PolyPhase Silent Switcher Step-Down Regulator with Digital Power System Management
2xLT7171, 40A

General Description

Evaluation kit EVAL-LT7171-AZ has two single-phase monolithic DC/DC synchronous step-down regulators with a 2.9V to 16V input range featuring LT®7171. The output can supply up to 40A continuous load current. The Silent Switcher® structure is incorporated into the LT7171 to minimize EMI and reduce PCB layout sensitivity. It also integrates digital power system management functionality, allowing for programmability and telemetry with a PMBus/I^{2}C compliant serial interface. Refer to the LT7171 data sheet for more detailed information.

The EVAL-LT7171-AZ evaluation board is designed for 1.0V output with a switching frequency set at 1MHz. The controlled on-time valley current-mode control with 25ns typical minimum on-time enables a high switching frequency at a low output voltage with excellent transient response in a small overall solution size.

The EVAL-LT7171-AZ powers up to default settings and produces power based on the NVM configuration without the need for any serial bus communication. This allows easy evaluation of the DC/DC converter. To fully explore the power system management features of the part, download the GUI software LTpowerPlay® onto the PC and use ADI's I^{2}C/SMBus/PMBus dongle DC1613A to connect to the board. LTpowerPlay allows the user to reconfigure the part on the fly, and store the configuration in NVM, view telemetry of voltage, current, temperature, and fault status. The NVM can be programmed up to three times.

The EVAL-LT7171-AZ reserves two locations for evaluations, up to a total of four LT7171 IC parallel operations. For a detailed parallel configuration, refer to the LT7171 data sheet.

GUI Download

The software can be downloaded from LTpowerPlay.

The LT7171 data sheet gives a complete description of the part, operation, and application information. The data sheet must be read in conjunction with this demo manual for EVAL-LT7171-AZ.

For more details and instructions of the LTpowerPlay, refer to LTpowerPlay GUI for the LT7171 Quick Start Guide.

Performance Summary **Specifications are at T_A = 25°C**

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX..	UNITS
Input Voltage Range	V_{IN}		2.9		16	V
Default Output Voltage	V_{OUT}			1.0		V
Maximum Continuous Output Current	I_{OUT}	Two Phases		40		A
Switching Frequency	f_{SW}		0.925	1	1.075	MHz
Efficiency	Eff	V_{IN} = 12V, I_{OUT} = 20A		87.5		%

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Setup and Operation

The EVAL-LT7171-AZ is easy to set up to evaluate the performance of the LT7171. See *Figure 1* for proper measurement equipment setup, and follow the procedure below:

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. See *Figure 2* for the proper scope technique.

1. Set an input power supply that is capable of 16V/10A. Then turn off the supply.
2. With power off, connect the supply to the input terminals VEMI and GND. Set the default jumper position: SW1: ON.
3. Turn on the power at the input.

   NOTE: Make sure that the input voltage never exceeds 16V.
4. Check for the proper output voltages of 1.0V ±0.25% (0.997V~1.003V). Turn off the power at the input.
5. Connect variable loads capable of sinking 40A at 1.0V to the output terminals V_{OUT} and GND. Set the current to 0A.
   a. If efficiency measurements are desired, ammeters can be put in series with the output load to measure the EVAL-LT7171-AZ's output current and in series with the power supply to measure the input current.
   b. Voltmeters can be placed across the output sense turrets (VSENSE+, VSENSE-) to get accurate output voltage measurements.
   c. Voltmeters can be placed across the input sense turrets (VIN_SENSE, GND) to get accurate input voltage measurements.
   d. To achieve the best efficiency measurement accuracy, populate R58 and R59 only. To achieve the best output voltage accuracy at the output terminal, populate R27 and R28 only.
6. Turn on the power at the input.

   NOTE: If there is no output, temporarily disconnect the load to make sure that the load is not set too high.
7. Once the proper output voltages are established again, adjust the load and/or input within the operating range and observe the output voltage regulation, ripple voltage, efficiency, and other desired parameters.
8. Connect the dongle and control the output voltages from the GUI. See the LTpowerPlay GUI for the LT7171 Quick Start Guide for details.

NOTE: When measuring the output or input voltage ripple, do not use the long ground lead on the oscilloscope probe. J6 can be used for measuring output voltage ripple. If using a probe is desired, see *Figure 2* 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.

NOTE: When evaluating a single IC, customers may remove the 0 ohm resistor connected to RUN and refer to the data sheet to adjust configuration resistors or registers if needed.

Connecting a PC to EVAL-LT7171-AZ

Use a PC to reconfigure the power management features of the LT7171, such as V_{OUT}, current limit, switching frequency, OV/UV limits, temperature fault limits, sequencing parameters, the fault log, fault responses, and other functionalities. The DC1613A dongle may be plugged in when a V_{IN} is present. *Figure 3* shows a demo setup of connecting a PC to EVAL-LT7171-AZ.

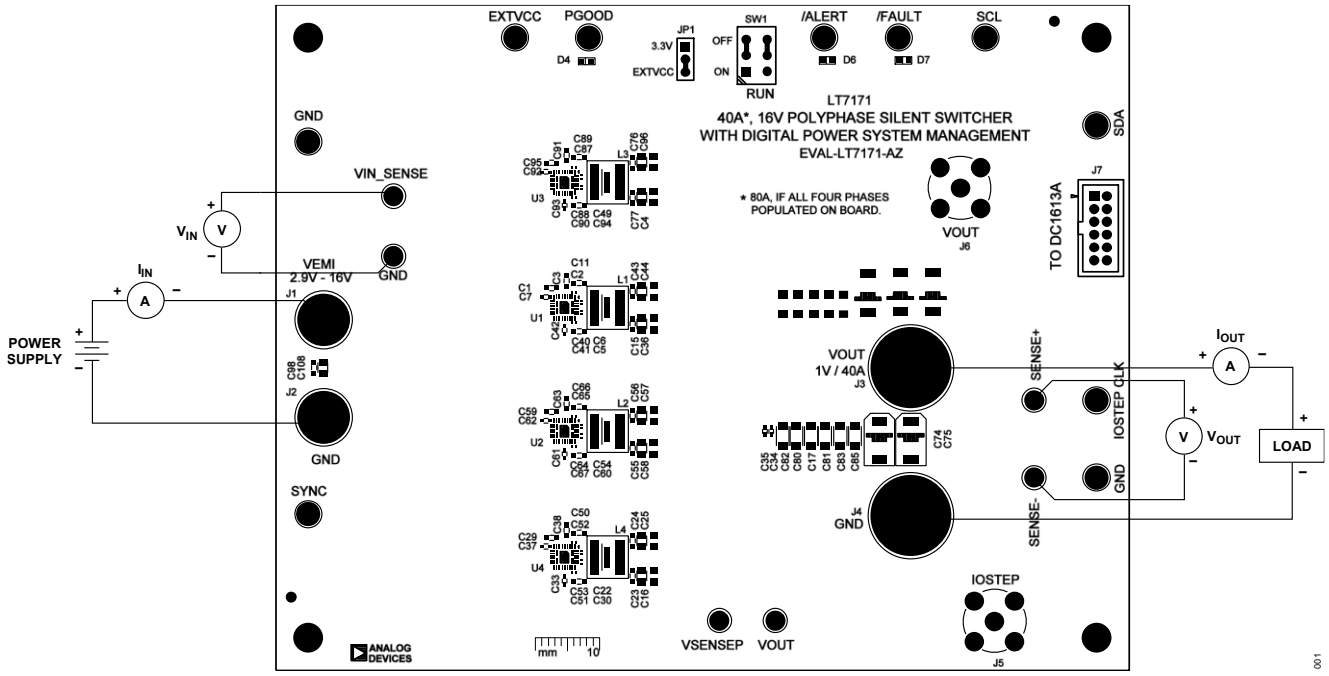


Figure 1. Proper Measurement Equipment Setup

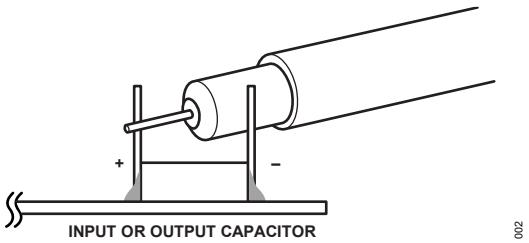


Figure 2. Scope Probe Placement for Measuring Input or Output Voltage Ripple

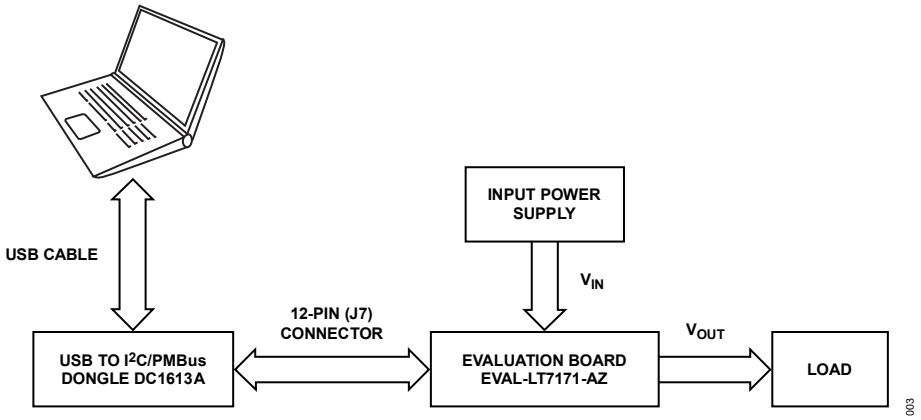


Figure 3. Demo Setup with PC

Typical Performance Characteristics

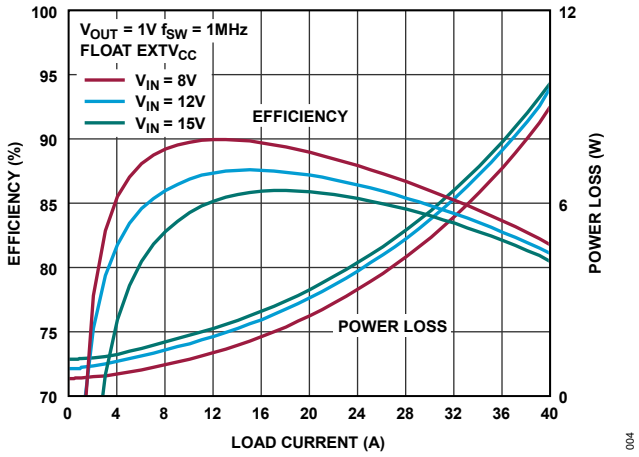


Figure 4. Efficiency vs. Load Current at 1MHz Switching Frequency™

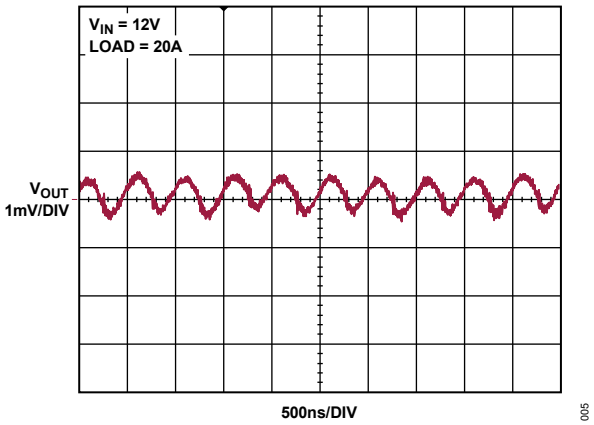


Figure 5. EVAL-LT7171-AZ V_{OUT} Ripple

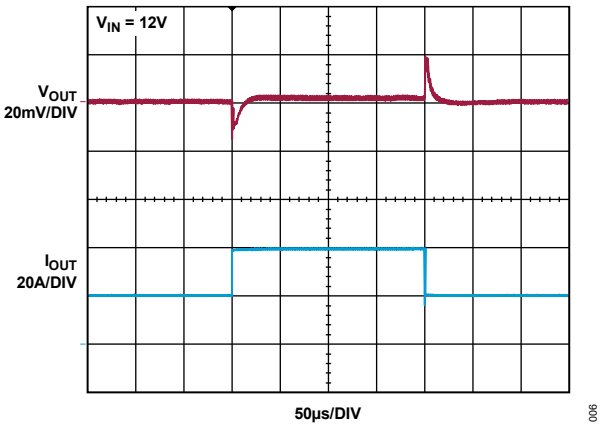


Figure 6. Transient Output Response

LTpowerPlay Software GUI

LTpowerPlay is a powerful, Windows®-based development environment supporting Analog Devices' Digital Power System Management (DPSM) ICs and µModules. The software supports a variety of different 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) 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 to 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 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 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.

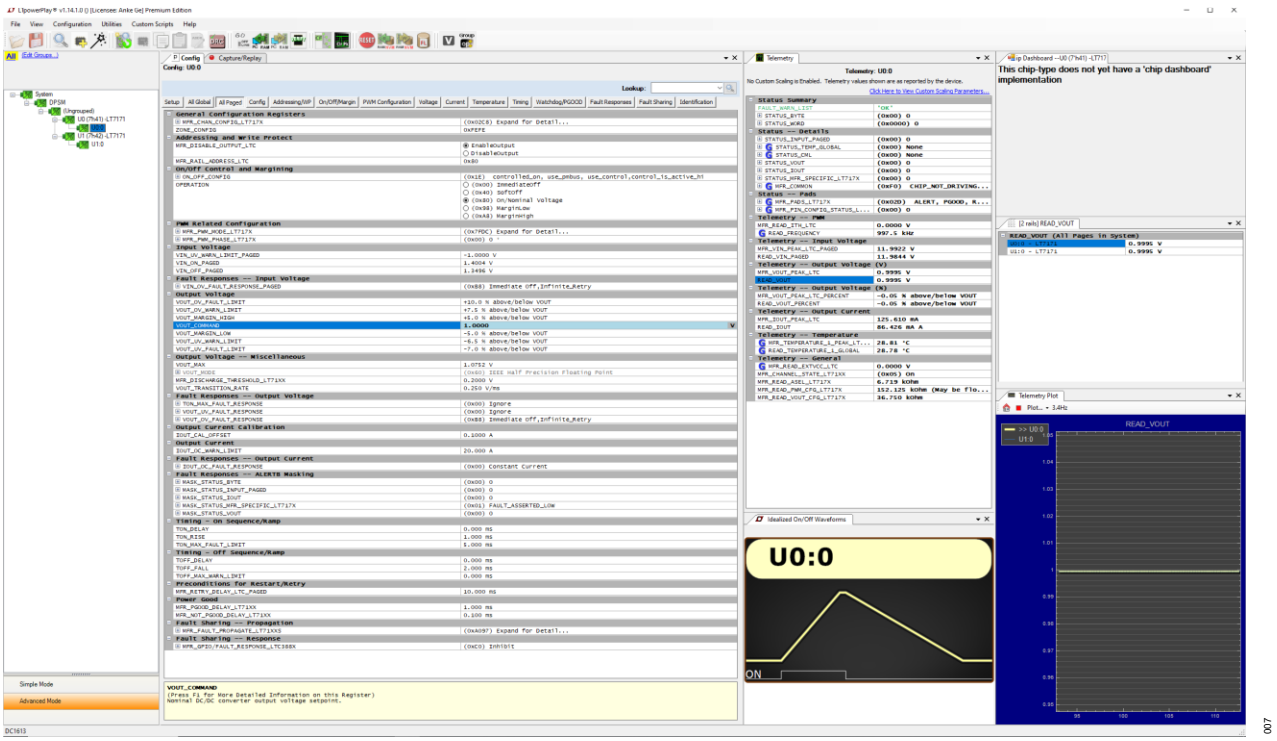
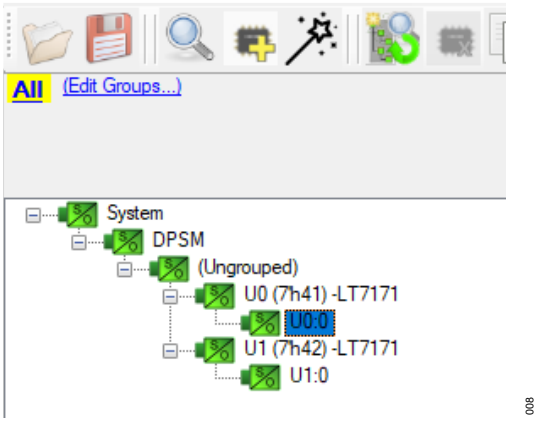


Figure 7. LTpowerPlay Main Interface

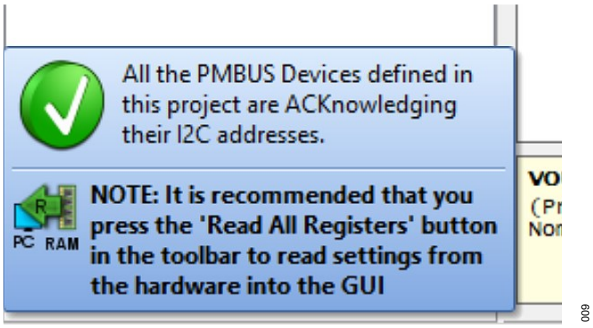
LTpowerPlay Quick Start Procedure

The following procedure describes how to use LTpowerPlay to monitor and change the settings of LT7171.

1. Download and install the LTPowerPlay GUI: LTpowerPlay | Analog Devices.
2. Launch the LTpowerPlay GUI.
3. The GUI should automatically identify the EVAL-LT7171-AZ. The system tree on the left-hand side should look like the image below.

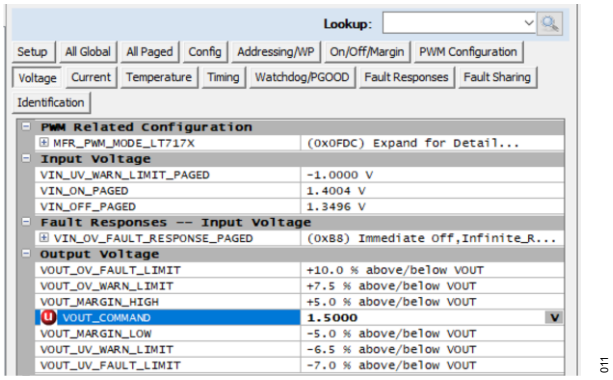


4. A green message box shows for a few seconds in the lower left-hand corner, confirming that LT7171 is communicating.



5. In the toolbar, click the **R** (RAM to PC) icon to read the RAM from the LT7171. This reads the configuration from the RAM of the LT7171 and loads it into the GUI.

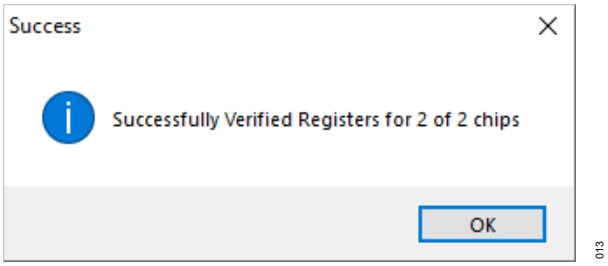
6. To change the output voltage to a different value, like 1.5V, in the **Config** tab, type in 1.5 in the **VOUT_COMMAND** box under the **Voltage** tab, as shown below.



7. Select U1 in the left window and repeat Step 6 for changes such as VOUT_COMMAND, VOUT_MAX, VOUT_RANGE, etc.

8. Then, click the **W** (PC to RAM) icon to write the register values to the LT7171. After finishing this step, the output voltage changes to 1.5V.

9. If the write is successful, the following message will appear.



10. To save the changes to NVM in the tool bar, click the **RAM to NVM** button.

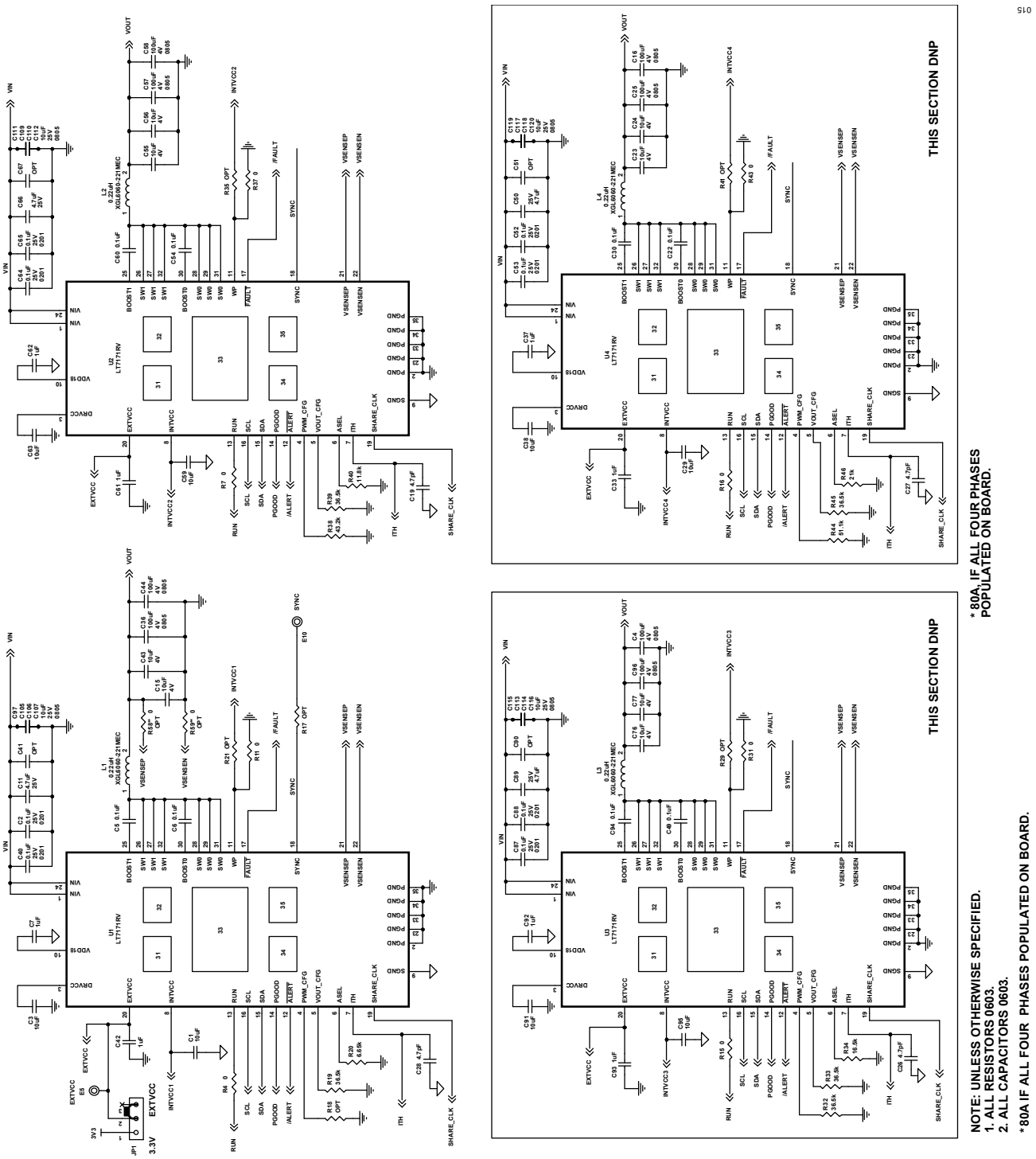
11. Save the evaluation board configuration to a (*.proj) file. Click the **Save** icon and save the file with a new name.

Bill of Materials

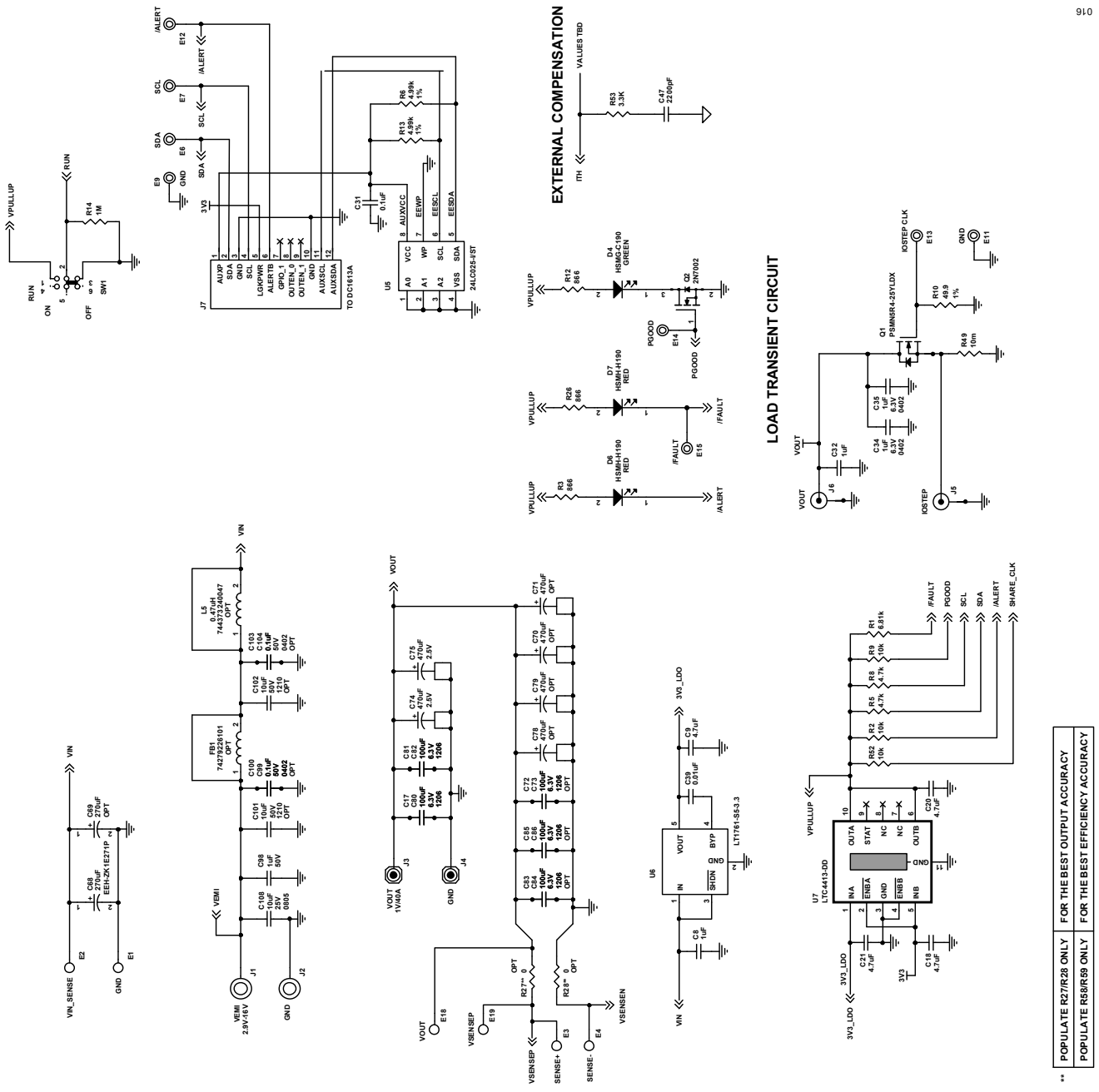
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
REQUIRED CIRCUIT COMPONNENTS				
1	4	C1, C3, C59, C63	CAP.,10µF, X6S, 10V, 10%, 0603	MURATA, ZRB18AC81A106KE01L
2	8	C2, C5, C6, C40, C54, C60, C64, C65	CAP., 0.1µF, X6S, 25V, 10%, 0201	Taiyo Yuden, TMK063C6104KP-F
3	4	C7, C42, C61, C62	CAP., 1µF, X7S, 10V, 10%, 0402	MURATA, GCM155C71A105KE38D
4	2	C11, C66	CAP., 4.7µF, X6S, 25V, 10%, 0603	MURATA, GRM188C81E475KE11D
5	1	C8	CAP., 1µF, X7R, 25V, 10%, 0603	KEMET, C0603C105K3RACTU
6	4	C17, C80, C81, C82	CAP., 100µF, X6S, 4V, 10%, 0805	MURATA, GRM31CR60J107KE39L
7	2	C19, C28	CAP., 4.7pF, C0G/NP0, 50V, ±0.25pF, 0603	MURATA, GRM1885C1H4R7CA01D
8	4	C15, C43, C55, C56	CAP., 10µF, X7S, 4V, 20%, 0603	TDK, C1608X7S0G106M080AB
9	4	C36, C44, C57, C58	CAP., 100µF, X6S, 4V, 20%, 0805	MURATA, GRM21BC80G107ME15L
10	2	C74, C75	CAP., 470µF, ALUM. POLY., 2.5V, 20%, 3-TERM. 7343	PANASONIC, EEFGX0E471L
11	1	C47	CAP., 2200pF, C0G, 50V, 5%, 0603	MURATA, GCM1885C1H222JA16D
12	8	C97, C105, C106, C107, C109, C110, C111, C112	CAP., 10µF, X7S, 25V, 10%, 0805	MURATA, GRM21BC71E106KE11L
13	2	L1, L2	IND., 0.22µH, 28.5A, 1.3mΩ	COILCRAFT, XGL6060-221MEC
14	1	R1	RES., 6.81kΩ, 1%, 1/10W,0603	PANASONIC, ERJ3EKF6811V
15	3	R2, R9, R52	RES.,10kΩ,1%,1/10W,0603	PANASONIC, ERJ3EKF1002V
16	6	R4, R7, R11, R37, R58, R59	RES.,0Ω,1/10W,0603	VISHAY, CRCW06030000Z0EA
17	2	R5, R8	RES.,4.7kΩ,1%,1/10W,0603	VISHAY, CRCW06034K70FKEA
18	1	R14	RES.,1MΩ,1%,1/10W,0603	PANASONIC, ERJ3EKF1004V
19	2	R19, R39	RES., 36.5kΩ, 1%, 1/10W, 0603	VISHAY, CRCW060336K5FKEA
20	1	R20	RES., 6.65kΩ, 1%, 1/10W, 0603	VISHAY, CRCW06036K65FKEA
21	1	R38	RES., 43.2kΩ, 1%, 1/10W, 0603	VISHAY, CRCW060343K2FKEA
22	1	R40	RES., 11.8kΩ, 1%, 1/10W, 0603	VISHAY, CRCW060311K8FKEA
23	1	R53	RES., 3.3KΩ, 5%, 1/10W, 0603	PANASONIC, ERJ3GEYJ332V
24	2	U1, U2	IC, 20A, 16V REGULATOR, LQFN-30	ANALOG DEVICES, LT7171RV#TRPBF
ADDITIONAL EVALUATION BOARD CIRCUIT COMPONENTS				
1	1	C9	CAP., 4.7µF, X7S, 16V, 10%, 0603	MURATA, GRM188C71C475KE21D
2	1	C108	CAP., 10µF, X7S, 25V, 10%, 0805	MURATA, GRM21BC71E106KE11L
3	3	C18, C20, C21	CAP., 4.7µF, X5R, 25V, 10%, 0603	MURATA, GRM188R61E475KE15D
4	1	C31	CAP., 0.1µF, X7R, 10V, 20%, 0603	AVX, 0603ZC104MAT2A

5	3	C32, C34, C35	CAP., 1µF, X7R, 6.3V, 10%, 0402	MURATA, GRM155R70J105KA12D
6	1	C38	CAP., 1µF, X7R, 50V, 10%, 0603	AVX, 06035C105KAT2A
7	1	C39	CAP., 0.01µF, X7R, 25V, 10%, 0603	AVX, 06033C103K4Z2A
8	1	C68	CAP., 270µF, ALUM POLY HYB, 25V, 20%, 8x10.2mm	PANASONIC, EEH-ZK1E271P
9	1	C98	CAP., 1µF, X5R, 50V, 10%, 0603	TDK, CGA3E3X5R1H105K080AB
10	1	D4	LED, GREEN, DIFFUSED, 0603	BROADCOM INC., HSMG-C190
11	1	D6, D7	LED, RED, DIFFUSED, 0603	BROADCOM INC., HSMH-H190
12	3	R3, R12, R26	RES., 866Ω, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF8660V
13	2	R6, R13	RES., 4.99kΩ, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF4991V
14	1	R10	RES., 49.9Ω, 1%, 1/10W, 0603	PANASONIC, ERJ3EKF49R9V
15	1	R49	RES., 10mΩ, 1%, 3W, 6.3 X3.1mm	SUSUMU, KRL6432E-C-R010-F-T1
16	1	Q1	MOSFET, N-CH, 25V, 70A, Power-SO8	NEXPERIA, PSMN5R4-25YLDX
17	1	Q2	MOSFET, N-CH, 60V, 300mA, SOT-23-3	VISHAY, 2N7002K-T1-GE3
18	1	U5	IC, EEPROM, 2Kb (256x8), TSSOP-8	MICROCHIP, 24LC025-I/ST
19	1	U6	IC, 2.6A, 2.5V-5.5V IDEAL DIO, 10DFN	ANALOG DEVICES, LTC4413EDD#PBF
20	1	U7	IC, 200mA LDO, MSOP-8	ANALOG DEVICES, LT3063EMS8E-3.3#PBF
HARDWARE: FOR EVALUATION BOARD ONLY				
1	6	E1, E2, E3, E4, E18, E19	TEST POINT, TURRET, 0.064"	MILL-MAX, 2308-2-00-80-00-00-07-0
2	10	E5, E6, E7, E9, E10, E11, E12, E13, E14, E15	TEST POINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
3	2	J1, J2	BANANA JACK, FEMALE	KEYSTONE, 575-4
4	2	J3, J4	STUD, FASTENER, #10-32	PENNENGINEERING, KFH-032-10ET
5	2	J5, J6	CONN., RF, BNC, RCPT	AMPHENOL RF, 112404
6	1	J7	CONN., HDR, MALE, 2x6, 2mm	AMPHENOL, 98414-G06-12ULF
7	1	JP1	CONN., HDR, MALE, 1x3, 2mm	WURTH ELEKTRONIK, 62000311121
8	4	MP1, MP2, MP3, MP4	STANDOFF, NYLON, SNAP-ON, 0.625"	KEYSTONE, 8834
9	1	SW1	SWITCH, SLIDE, DPDT, 0.3A, 6VDC, PTH	C&K, JS202011CQN
10	1	XJP1	CONN., SHUNT, FEMALE, 2-POS, 2mm	WURTH ELEKTRONIK, 60800213421

Schematic Diagram



Schematic Diagram (continued)



Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGE NUMBER
0	04/24	Initial Release	—

Notes

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Analog Devices Inc.:

EVAL-LT7171-AZ