Evaluation Board User Guide

EVAL-LT7184S-AZ

Dual Channel 9A, 16V, PolyPhase Step-Down Silent Switcher 2 with Digital Power System Management

General Description

The EVAL-LT7184S-AZ evaluation board is a dual-output PolyPhase® monolithic DC/DC synchronous step-down regulator with a 2.9V or 1.5V with EXTVCC to 16V input range featuring ***LT®7184S***. Each output can supply -8A to +9A continuous current and simultaneously deliver up to 7A of continuous current from both channels. The second-generation *Silent Switcher®* regulator structure is incorporated into the LT7184S to minimize EMI and reduce Printed circuit board (PCB) layout sensitivity. It also integrates digital power system management functions, allowing for programmability and telemetry with a PMBus/I2C-compliant serial interface. Refer to the *LT®7184S* datasheet for more detailed information.

The EVAL-LT7184S-AZ evaluation board is designed for 1.2V output0 and 3.3V output1 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 evaluation board has Electromagnetic interference (EMI) filters installed for both channels. The EMI performances of the board are shown in *Figure 5*. The red lines in *Figure 5* are the CISPR25 CLASS 5 limit.

The EVAL-LT7184S-AZ powers up to default settings and produces power based on the configuration resistors 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 Graphic user interface (GUI) software LTpowerPlay® onto the PC and use Analog Devices' I2C/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 Electrically erasable programmable read-only memory (EEPROM), viewing telemetry of voltage, current, temperature, and fault status.

Graphic User Interface (GUI) Download

The software can be downloaded from *LTpowerPlay*.

The LT7184S datasheet 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-LT7184S-AZ.

For more details and instructions on the LTpowerPlay, see the *LTpowerPlay Software GUI* section for the LT7184S 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
Output 0 Voltage	V_{OUT0}			1.2		V
Maximum Continuous Output 0 Current	I_{OUT0}			9		A
Output 1 Voltage	V_{OUT1}			3.3		V
Maximum Continuous Output 1 Current	I_{OUT1}			9		A
Switching Frequency	f_{SW}		0.925	1	1.075	MHz
Efficiency	Eff	V_{IN} = 12V, I_{OUT0} = 4.5A, I_{OUT1} off		86.3		%
		V_{IN} = 12V, I_{OUT0} off, I_{OUT1} = 4.5A		92.8		

**LT7184S is capable of minimum V_{IN} of 1.5V with separate 3V ≤ $EXTV_{CC}$ ≤ 5.5V.*

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Quick Start Procedure

The EVAL-LT7184S-AZ evaluation board is easy to set up to evaluate the performance of the LT7184S. See *Figure 1* for proper measurement equipment setup, and use the following procedure:

1. Set an input power supply that is capable of 16V/18A. Then, turn off the supply.
2. With power off, connect the supply to the input terminals V_{EMI} and GND. Set the default jumper position: SW1: ON; SW2: 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 1.2V ±0.25% (1.197V~1.203V), and 3.3V ±0.5% (3.284V~3.317V). Turn off the power at the input.
5. Once the proper output voltage is established, connect variable loads capable of sinking 9A at 1.2V and 3.3V to the output terminals V_{OUT0} / V_{OUT1} 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-LT7184S-AZ's output current and in series with the power supply to measure the input current.
   b. Voltmeters can be placed across the output terminals to get accurate output voltage measurements.
   c. Voltmeters can be placed across the input terminals to get accurate input voltage measurements.
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 LT7184S 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. 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.

Connecting a PC to EVAL-LT7184S-AZ

Use a PC to reconfigure the power management features of the LT7184S, such as V_{OUT}, current limit, switching frequency, OV/UV limits, control loop compensation, temperature fault limits, sequencing parameters, the fault log, fault responses, and other functionalities. The DC1613A dongle may be plugged in when V_{IN} is present. *Figure 3* shows a demo setup of connecting a PC to EVAL-LT7184S-AZ.

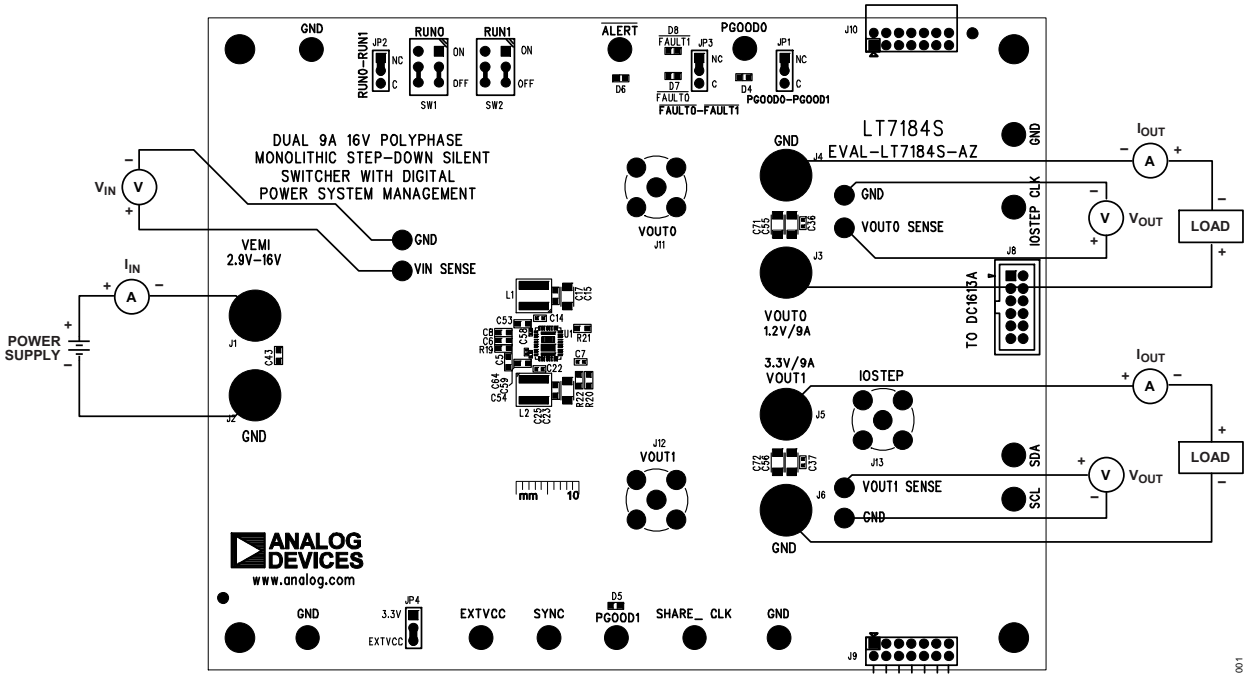


Figure 1. Proper Measurement Equipment Setup

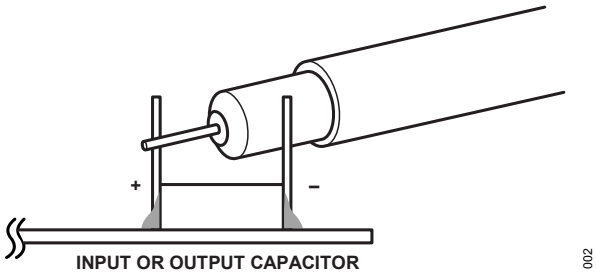


Figure 2. Scope Probe Placement for Measuring the Input or Output Voltage Ripple

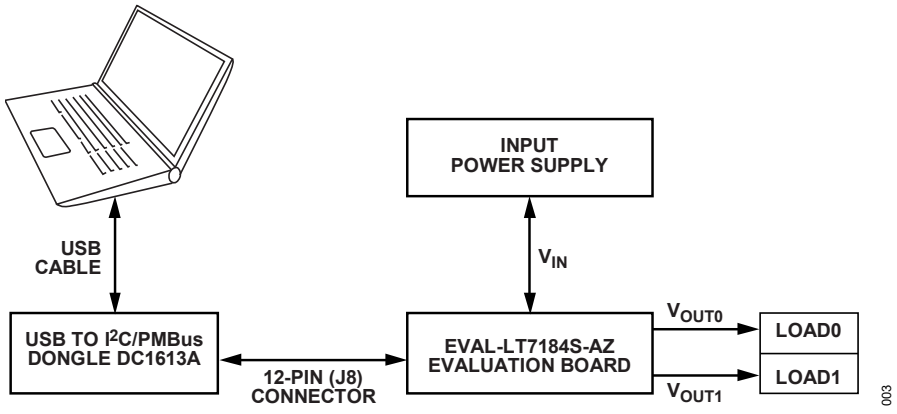


Figure 3. Demo Setup with the PC

Typical Performance Characteristics

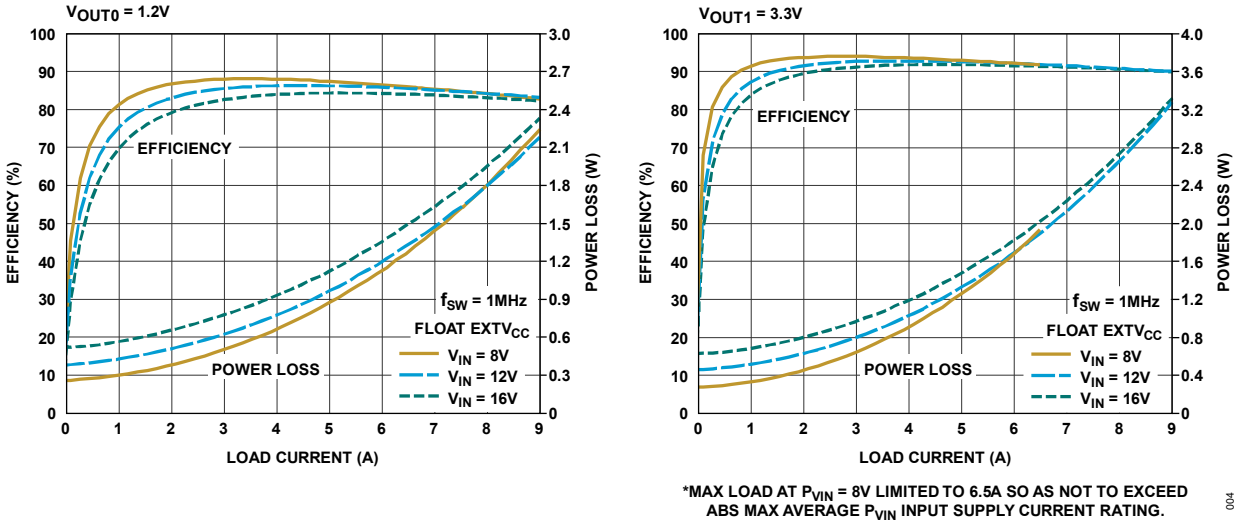


Figure 4. Efficiency vs. Load Current at 1MHz Switching Frequency

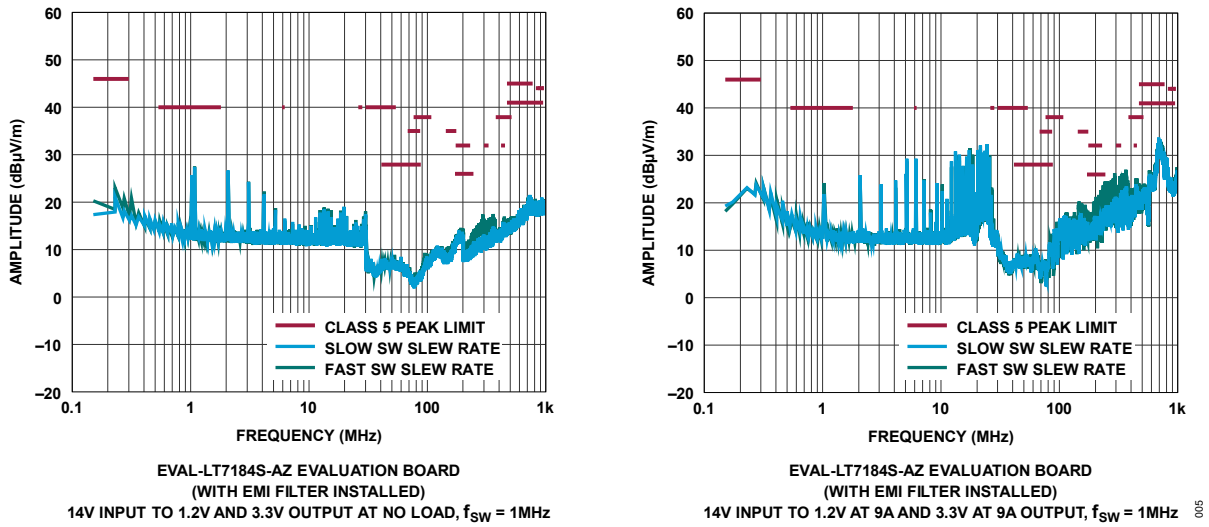


Figure 5. EVAL-LT7184S-AZ Radiated EMI Performance

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 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 tweaks 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, refer to the LTpowerPlay Help menu. Online help is also available through LTpowerPlay.

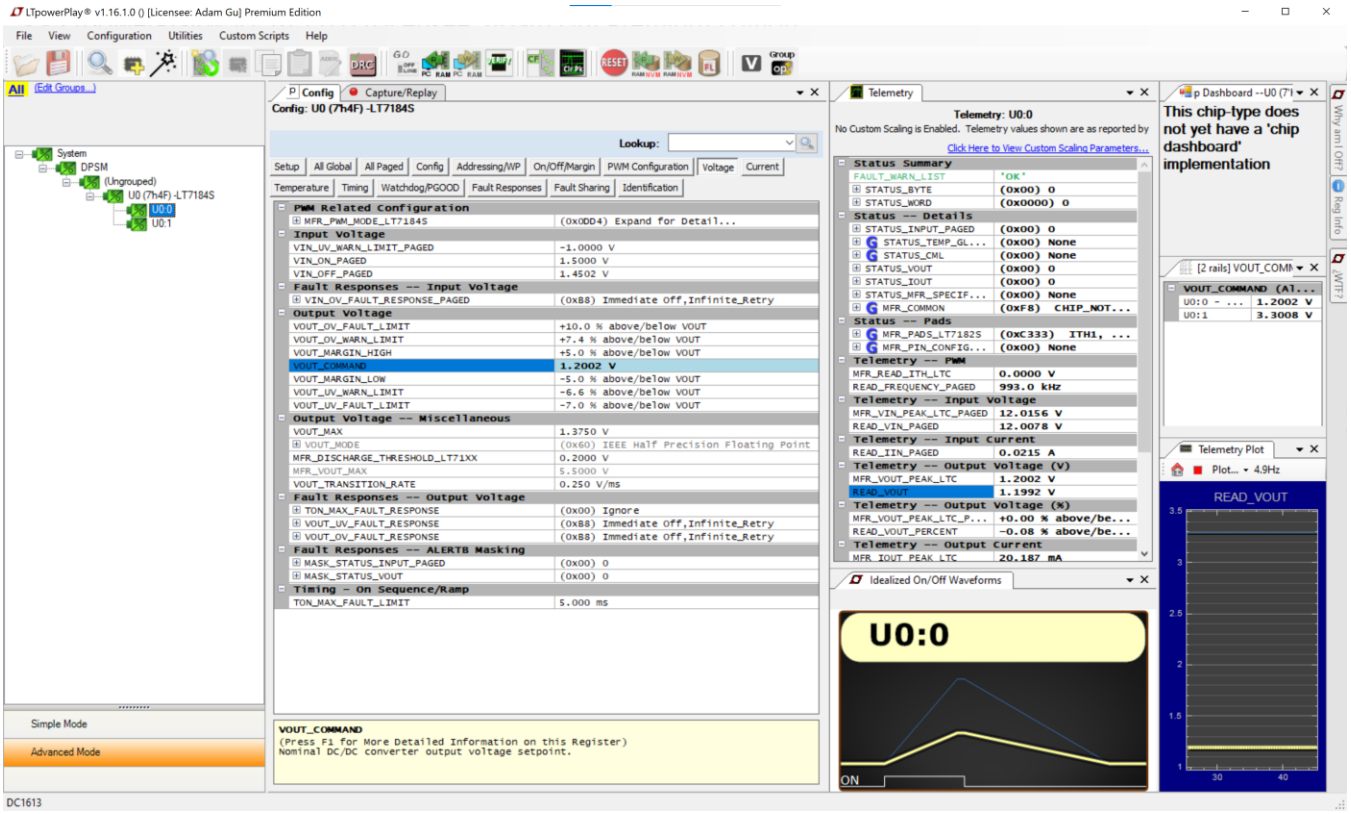
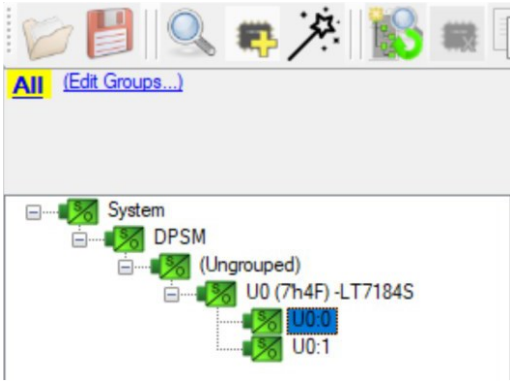


Figure 6. LTpowerPlay Main Interface

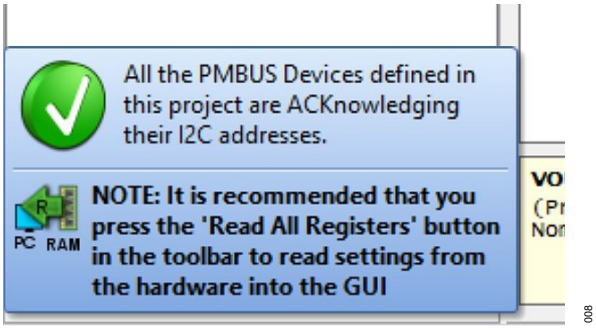
LTpowerPlay Quick Start Procedure

The following procedure describes how to use LTpowerPlay to monitor and change the settings of LT7184S.

1. Download and install the LTpowerPlay GUI: *LTpowerPlay | Analog Devices*.
2. Launch the LTpowerPlay GUI.
3. The GUI should automatically identify the EVAL-LT7184S-AZ. The system tree on the left-hand side should look like the following image.

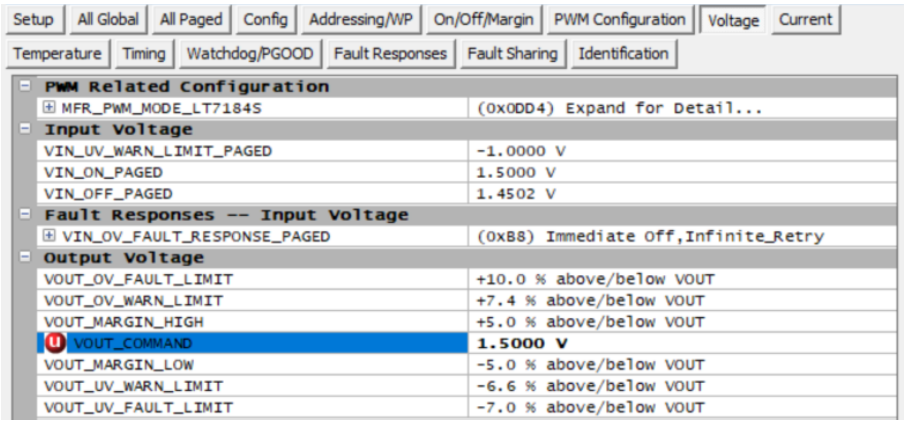


4. A green message box shows for a few seconds in the lower left-hand corner, confirming that the LT7184S is communicating with the software.



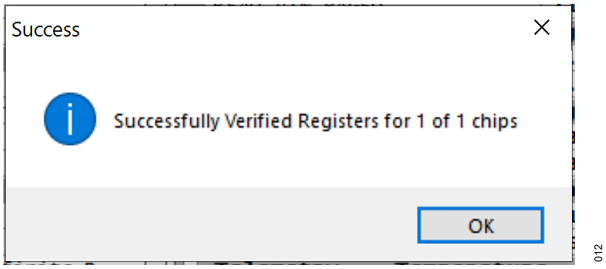
5. In the toolbar, click the **R** (RAM to PC) icon to read the RAM from the LT7184S. This reads the configuration from the RAM of the LT7184S and loads it into the GUI.

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



7. Then, click the **W** (PC to RAM) icon to write the register values to the LT7184S. After finishing this step, the output voltage changes to 1.5V.

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



9. To save the changes to NVM in the toolbar, 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.

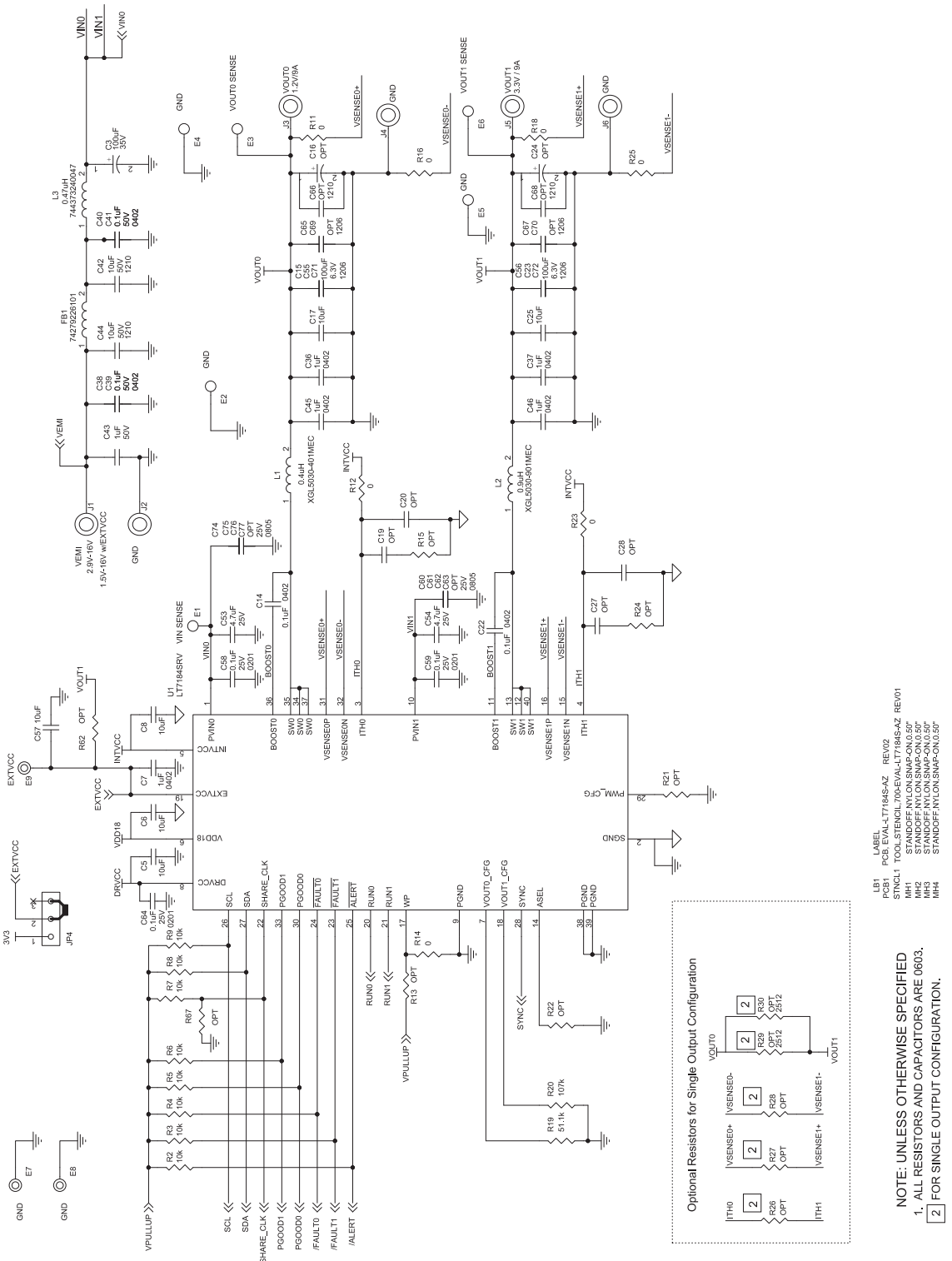
Bill of Materials

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
REQUIRED CIRCUIT COMPONENTS				
1	4	C5, C6, C8, C57	CAP., 10µF, X6S, 10V, 10%, 0603	MURATA, ZRB18AC81A106KE01L
2	1	C7	CAP., 1µF, X6S, 16V, 10%, 0402	MURATA, GRM155C81C105KE11D
3	2	C14, C22	CAP., 0.1µF, X7R, 25V, 10%, 0402	MURATA, GRM155R71E104KE14
4	4	C15, C23, C55, C56, C71, C72	CAP., 100µF, X5R, 6.3V, 10%, 1206	MURATA, GRM31CR60J107KE39L
5	2	C17, C25	CAP., 10µF, X5R, 10V, 10%, 0603	AVX, 0603ZD106KAT2A
6	2	C36, C37, C45, C46	CAP., 1µF, X5R, 35V, 10%, 0402	MURATA, GRM155R6YA105KE11D
7	2	C53, C54	CAP., 4.7µF, X6S, 25V, 10%, 0603	MURATA, GRM188C81E475KE11D
8	3	C58, C59, C64	CAP., 0.1µF, X6S, 25V, 10%, 0201	Taiyo Yuden, TMK063C6104KP-F
9	1	L1	IND., 0.4µH, 25.1A, 2.7mΩ	COILCRAFT, XGL5030-401MEC
10	1	L2	IND., 0.9µH, 19.7A, 5.2mΩ	COILCRAFT, XGL5030-901MEC
11	6	R11, R12, R16, R18, R23, R25	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
12	8	R2, R3, R4, R5, R6, R7, R8, R9	RES., 10kΩ, 1%, 1/10W, 0603	VISHAY, CRCW060310K0FKEA
13	1	R19	RES., 51.1kΩ, 1%, 1/10W, 0603	VISHAY, CRCW060351K1FKEA
14	1	R20	RES., 107kΩ, 1%, 1/10W, 0603	VISHAY, CRCW0603107KFKEA
15	1	U1	IC, REGULATOR, LQFN-36	ANALOG DEVICES, LT7184SRV#PBF
ADDITIONAL EVALUATION BOARD CIRCUIT COMPONENTS				
1	1	C1	CAP., 1µF, X5R, 50V, 10%, 0603	AVX, 06035D105KAT2A
2	1	C2	CAP., 100pF, C0G/NP0, 25V, 5%, 0603	AVX, 06033A101JAT2A
3	1	C3	CAP., 100µF, ALUM, 35V, 20%, SMD	PANASONIC, EEHZK1V101XP
4	1	C4	CAP., 4.7µF, X7R, 10V, 10%, 0805	AVX, 0805ZC475KAT2A
5	0	C16, C24	CAP., OPTION, 7343	
6	0	C19, C20, C27, C28	CAP., OPTION, 0603	
7	2	C29, C30	CAP., 0.01µF, X5R, 25V, 10%, 0603	AVX, 06033D103KAT2A
8	1	C31	CAP., 0.1µF, X7R,10V, 20%, 0603	AVX, 0603ZC104MAT2A
9	2	C32, C33	CAP., 1µF, X5R, 10V, 10%, 0603	AVX, 0603ZD105KAT2A
10	2	C34, C35	CAP., 0.01µF, X5R, 50V,10%, 0603	AVX, 06035D103KAT2A
11	4	C38, C39, C40, C41	CAP., 0.1µF, X7R,50V,10%, 0402	MURATA, GCM155R71H104KE02D
12	2	C42, C44	CAP., 10µF, X5R, 50V, 10%,1210	TDK, C3225X5R1H106K250AB

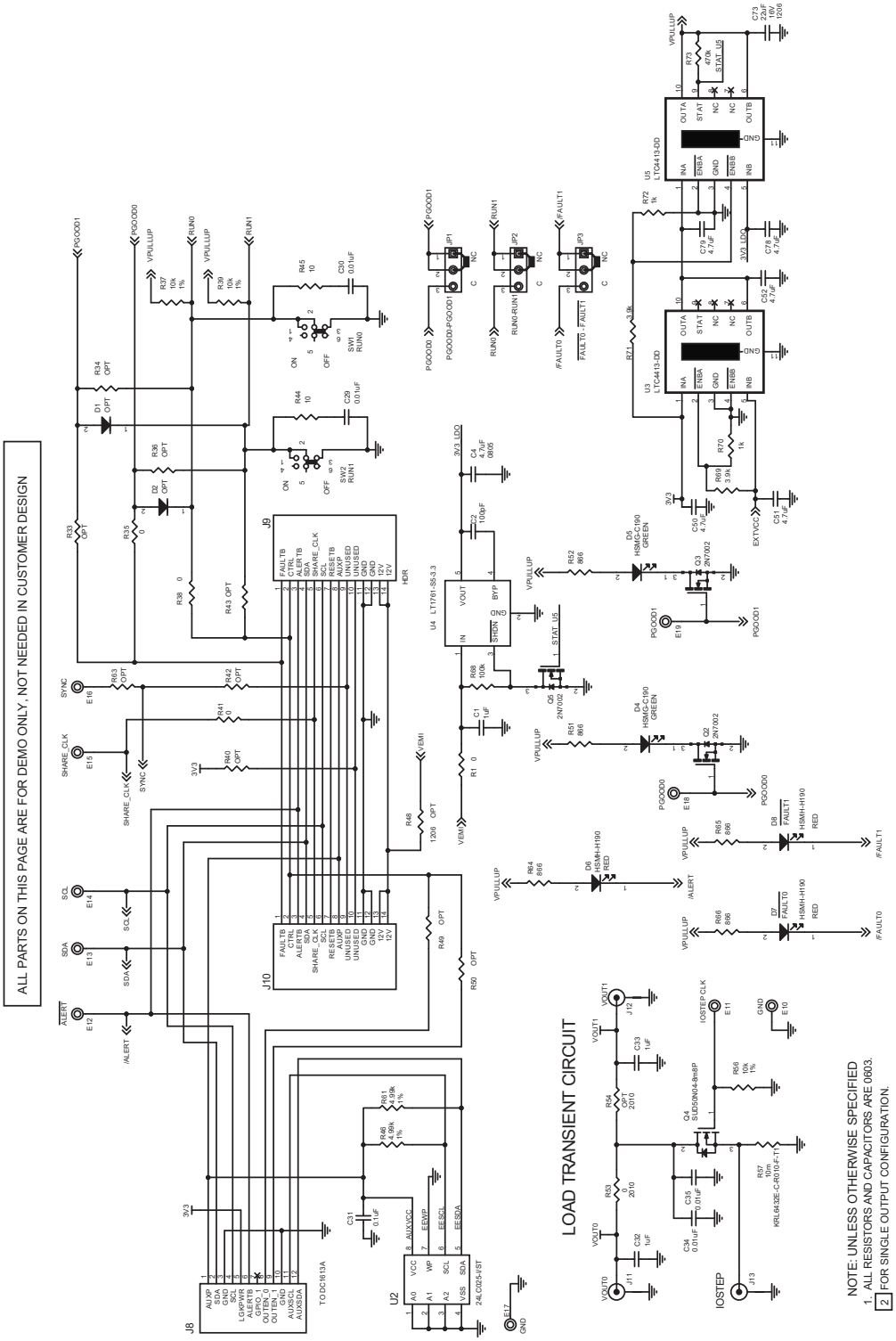
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
13	1	C43	CAP., 1µF, X5R, 50V, 10%, 0603	TDK, CGA3E3X5R1H105K080AB
14	5	C50, C51, C52, C78, C79	CAP., 4.7µF, X5R, 25V, 10%, 0603	TDK, C1608X5R1E475K080AC
15	0	C60, C61, C62, C63, C74, C75, C76, C77	CAP., OPTION, 0805	
16	0	C65, C67, C69, C70	CAP., OPTION, 1206	
17	0	C66, C68	CAP., OPTION, 1210	
18	1	C73	CAP., 22µF, X5R, 16V, 10%, 1206	AVX, 1206YD226KAT2A
19	0	D1, D2	DIODE, OPTION, SOD-323	
20	2	D4, D5	LED, GREEN, DIFFUSED, 0603	BROADCOM INC., HSMG-C190
21	3	D6, D7, D8	LED, RED, DIFFUSED,0603	BROADCOM INC., HSMH-H190
22	1	FB1	FERRITE BEAD, 100Ω@100MHz, 1812	WÜRTH ELEKTRONIK, 74279226101
23	1	L3	IND., 0.47µH, 6.8A, 14mΩ	WÜRTH ELEKTRONIK, 744373240047
24	3	Q2, Q3, Q5	MOSFET, N-CH, SOT-23-3	VISHAY, 2N7002K-T1-GE3
25	1	Q4	MOSFET, N-CH, DPAK	VISHAY, SUD50N04-8M8P-4GE3
26	5	R1, R14, R35, R38, R41	RES., 0Ω,1/10W,0603	VISHAY, CRCW06030000Z0EA
27	3	R37, R39, R56	RES.,10kΩ,1%,1/10W,0603	VISHAY, CRCW060310K0FKEA
28	0	R13, R15, R21, R22, R24, R26, R27, R28, R33, R34, R36, R40, R42, R43, R49, R50, R62, R63, R67	RES., OPTION, 0603	
29	0	R29, R30	RES., OPTION, 2512	
30	2	R44, R45	RES., 10Ω, 5%,1/10W, 0603	VISHAY, CRCW060310R0JNEA
31	2	R46, R61	RES., 4.99kΩ, 1%, 1/10W, 0603	VISHAY, CRCW06034K99FKEA
32	0	R48	RES., OPTION, 1206	
33	5	R51, R52, R64, R65, R66	RES., 866Ω, 1%, 1/10W, 0603	VISHAY, CRCW0603866RFKEA
34	1	R53	RES., 0Ω, 1W, 2010	VISHAY, CRCW20100000Z0EFHP
35	0	R54	RES., OPTION, 2010	
36	1	R57	RES., 10mΩ, 1%, 3W, 2512	SUSUMU, KRL6432E-C-R010-F-T1
37	1	R68	RES., 100kΩ, 1%, 1/10W, 0603	YAGEO, RC0603FR-07100KL
38	2	R69, R71	RES., 3.9kΩ, 1%, 1/10W, 0603	VISHAY, CRCW06033K90FKEA

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
39	2	R70, R72	RES.,1kΩ,1%,1/10W,0603	VISHAY, CRCW06031K00FKEA
40	1	R73	RES., 470kΩ, 5%, 1/10W, 0603	VISHAY, CRCW0603470KJNEA
41	1	U2	IC, EEPROM, 2Kb (256x8), TSSOP-8	Microchip, 24LC025-I/ST
42	2	U3, U5	IC, IDEAL DIO, 10DFN	ANALOG DEVICES, LTC4413EDD#PBF
43	1	U4	IC, LDO, TSOT23-5	ANALOG DEVICES, LT1761ES5-3.3#TRPBF
HARDWARE: FOR EVALUATION BOARD ONLY				
1	6	E1-E6	TEST POINT, TURRET, 0.064"	MILL-MAX, 2308-2-00-80-00-00-07-0
2	13	E7-E19	TEST POINT, TURRET, 0.094"	MILL-MAX, 2501-2-00-80-00-00-07-0
3	6	J1-J6	CONN., BANANA JACK, FEMALE	KEYSTONE, 575-4
4	1	J8	CONN., HDR, MALE, 2x6 ,2mm	AMPHENOL, 98414-G06-12ULF
5	1	J9	CONN., HDR, MALE, 2x7, 2mm	MOLEX, 0877601416
6	1	J10	CONN., HDR, FEMALE, 2x7, 2mm	SULL. CONN. SOLU., NPPN072FJFN-RC
7	3	J11-J13	CONN., BNC, 50Ω	AMPHENOL RF, 112404
8	4	JP1-JP4	CONN., HDR, MALE,1x3,2mm	Wurth Elektronik, 62000311121
9	4	MH1-MH4	STANDOFF, NYLON, SNAP-ON,0.50"	KEYSTONE, 8833
10	2	SW1, SW2	SWITCH, SLIDE, DPDT, 0.3A, 6VDC, PTH	C&K, JS202011CQN
11	4	XJP1-XJP4	CONN., SHUNT, FEMALE, 2 POS, 2mm	WÜRTH ELEKTRONIK, 60800213421

Schematic Diagram



Schematic Diagram (continued)



Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	10/24	Initial release	—

Notes