Evaluation Board User Guide

EVAL-LT83203-AZ/ EVAL-LT83205-AZ

18V, 3A/5A Step-Down Silent Switcher 3 with Ultra-Low Noise Reference

General Description

The EVAL-LT83203-AZ and EVAL-LT83205-AZ (abbreviated as EVAL-LT83203/5-AZ) demonstration boards are 18V, 3A, and 5A Silent Switcher® 3 step-down regulators with ultra-low noise, high efficiency, and power density, featuring the LT83203 and LT83205 (abbreviated as LT83203/5), respectively. The input voltage range of the EVAL-LT83203/5-AZ is 2.8V to 18V. The default demo board setting is 1V output with a maximum DC output current of 3A/5A. The LT83203/5 is a compact, ultra-low noise, ultra-low emission, high efficiency, high-speed synchronous monolithic step-down switching regulator. The uniquely designed combination of the ultra-low noise reference and third-generation Silent Switcher architecture enables the LT83203/5 to achieve excellent wideband noise performance. A minimum on-time of 15ns allows high V_{IN} to low V_{OUT} conversion at high frequency.

The LT83203/5 switching frequency can be programmed either through an external resistor R_T or an external clock, over a range of 300kHz to 6MHz. The default frequency of the EVAL-LT83203/5-AZ demo board is 2MHz. The SYNC/MODE pin headers (JP1) on the demo board are connected to PULSE SKIP MODE by default for pulse-skip mode operation. To synchronize to an external clock, move JP1 to the SYNC position and apply the external clock to the SYNC terminal. Moving JP1 to FCM may set the SYNC/MODE to forced continuous mode (FCM).

Figure 1 and *Figure 2* show the efficiency of the EVAL-LT83203/5-AZ at 5V and 12V input in FCM operation. *Figure 3* shows the temperature rise of the LT83203 on the EVAL-LT83203-AZ demo board under 2A and 3A load conditions across the full input voltage range. *Figure 4* shows the temperature rise of the LT83205 on the EVAL-LT83205-AZ demo board under 4A and 5A load conditions across the full input voltage range. The case temperature rise was measured by the peak IC temperature, as shown in thermal images *Figure 13* and *Figure 14*.

Both demo boards have an electromagnetic interference (EMI) filter installed by default, with VIN_EMI as its input terminal. The EMI performance of the EVAL-LT83203/5-AZ is shown in *Figure 5* and *Figure 6*. The red line in the Radiated EMI Performance figures represents the CISPR32 Class B limit, indicating that both the EVAL-LT83203-AZ and EVAL-LT83205-AZ meet the CISPR32 standard.

The LT83203/5 also features ultra-low noise across a wide frequency range. *Figure 7* shows the noise spectral density of an LT83203 typical application circuit with 3.3V output and 6MHz switching frequency. The noise hump near 100kHz does not exceed $10nV/\sqrt{HZ}$. For details of this typical application circuits, refer to the LT83203/5 data sheet. *Figure 8* shows the noise spectral density of the LT83205 mounted on a modified EVAL-LT83205-AZ board under various loads. The modified EVAL-LT83205-AZ board uses R_C = 1.82kΩ and C_C = 2.2nF for faster transient response and lower noise spectral density.

Figure 9 and *Figure 10* show the output ripple of EVAL-LT83203/5-AZ boards. The transient response of EVAL-LT83203/5-AZ demo boards is shown in *Figure 11* and *Figure 12*. Refer to the LT83203/5 data sheet for figures showing faster transient response with corresponding modifications.

The LT83203/5 data sheet provides a comprehensive description, including operational and application information, and serves as a valuable reference in conjunction with this user guide for the EVAL-LT83203/5-AZ demo boards. The LT83203/5 is assembled in a 3mm x 2mm x 0.75mm LFCSP package with exposed ground pads for low thermal resistance. The layout recommendations for low EMI operation and maximum thermal performance are available in the LT83203/5 data sheet section PCB Layout Recommendations.

Design files for this circuit board are available in the Design Center at *www.analog.com*.

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Performance Summary (T_A = 25°C)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range V_{IN}		2.8		18	V
Output Voltage		0.992	1.0	1.008	V
Default Switching Frequency			2		MHz
Maximum Output Current	EVAL-LT83203-AZ Derating Necessary for Certain V_{IN}, V_{OUT}, and Thermal Conditions	3			A
	EVAL-LT83205-AZ Derating Necessary for Certain V_{IN}, V_{OUT}, and Thermal Conditions	5			A
Efficiency	EVAL-LT83203-AZ V_{IN} = 12V F_{SW} = 2MHz V_{OUT} = 1V at I_{OUT} = 1.5A		82.4		%
	EVAL-LT83205-AZ V_{IN} = 12V F_{SW} = 2MHz V_{OUT} = 1V at I_{OUT} = 2.5A		80.9		%

Typical Performance Characteristics

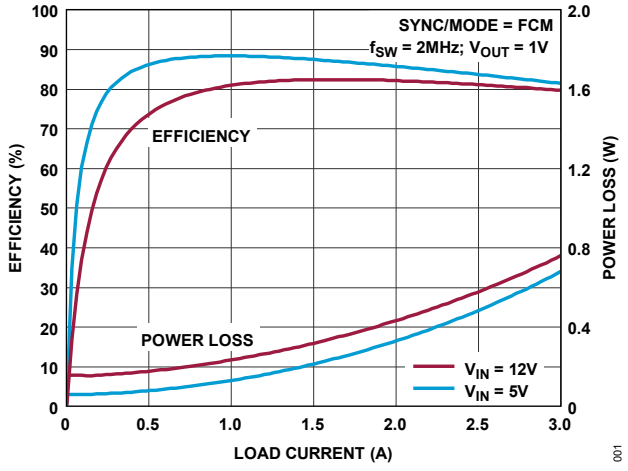


Figure 1. EVAL-LT83203-AZ Efficiency vs. Load Current (Input from V_{IN} Terminal)

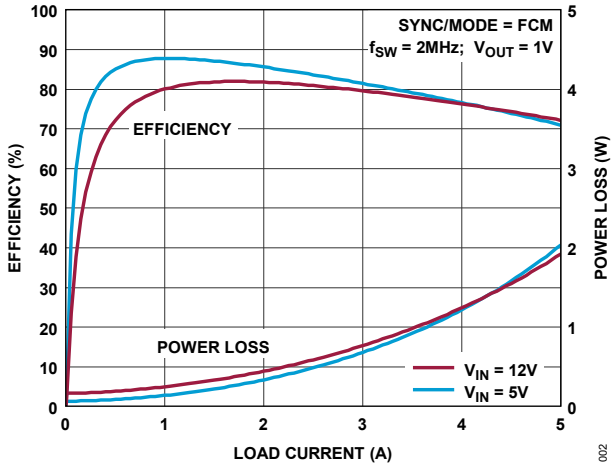


Figure 2. EVAL-LT83205-AZ Efficiency vs. Load Current (Input from V_{IN} Terminal)

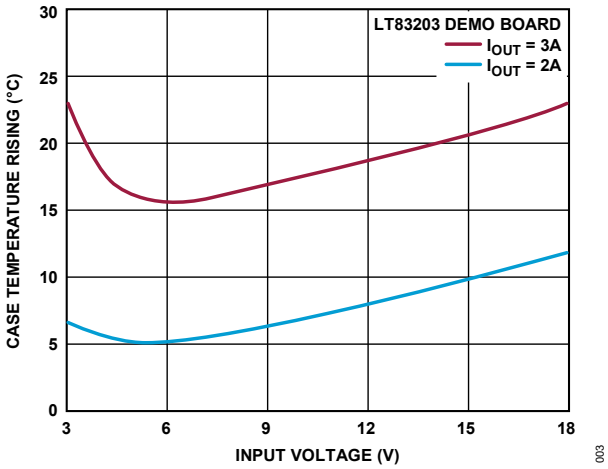


Figure 3. EVAL-LT83203-AZ Temperature Rising vs. V_{IN}

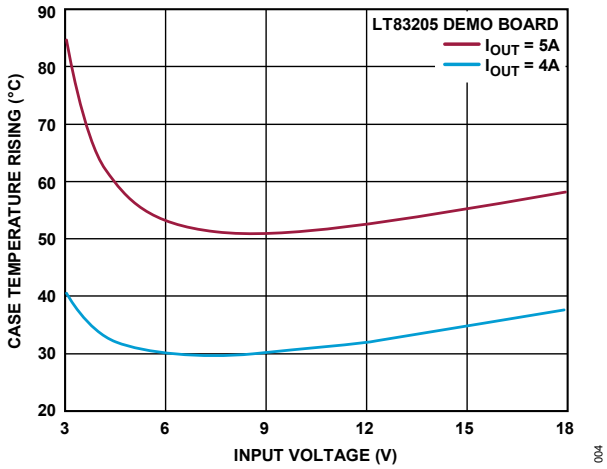


Figure 4. EVAL-LT83205-AZ Temperature Rising vs. V_{IN}

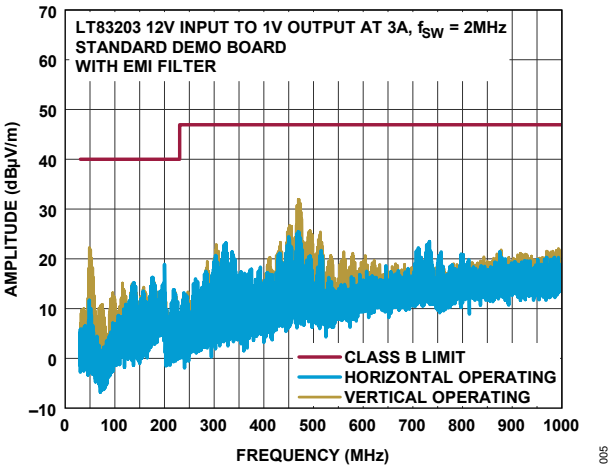


Figure 5. EVAL-LT83203-AZ Radiated EMI Performance

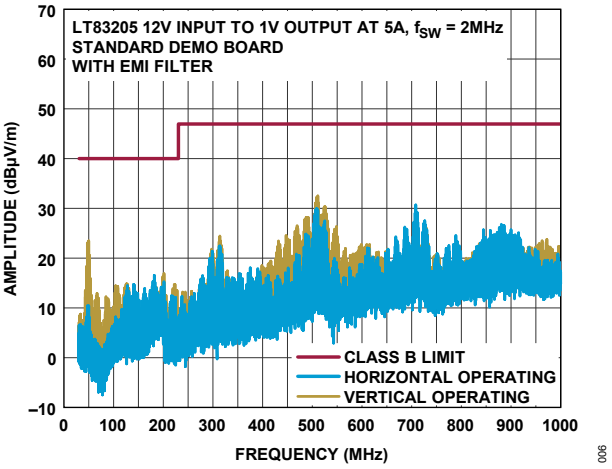


Figure 6. EVAL-LT83205-AZ Radiated EMI Performance

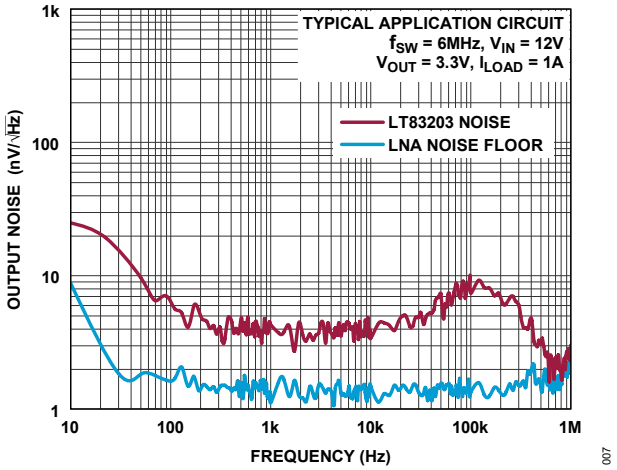


Figure 7. LT83203 Typical Application Circuit Noise Spectral Density

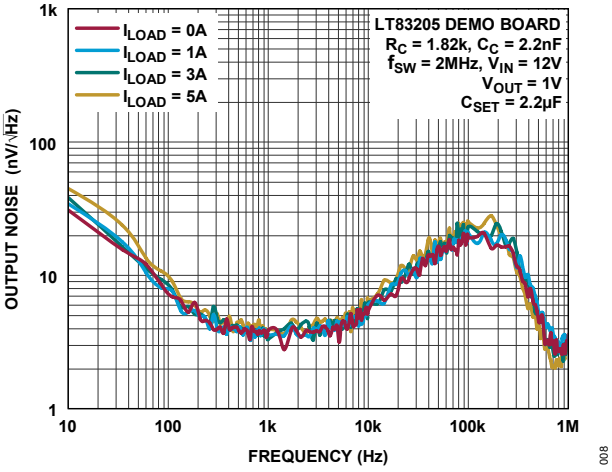


Figure 8. LT83205 Modified Demo Board Noise Spectral Density

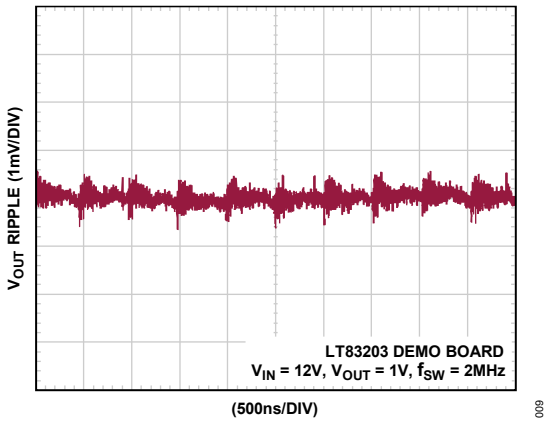


Figure 9. EVAL-LT83203-AZ Output Voltage Ripple Measured Through J6 (I_{OUT} = 3A)

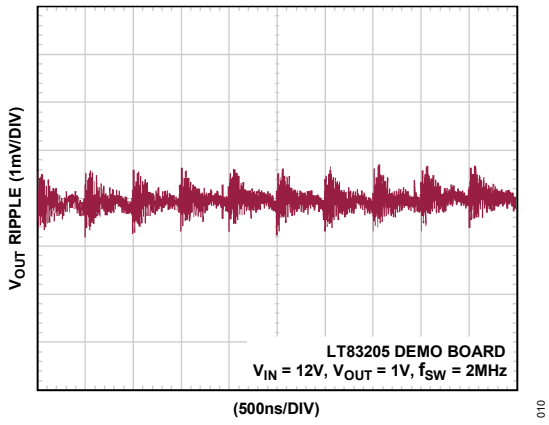


Figure 10. EVAL-LT83205-AZ Output Voltage Ripple Measured Through J6 (I_{OUT} = 5A)

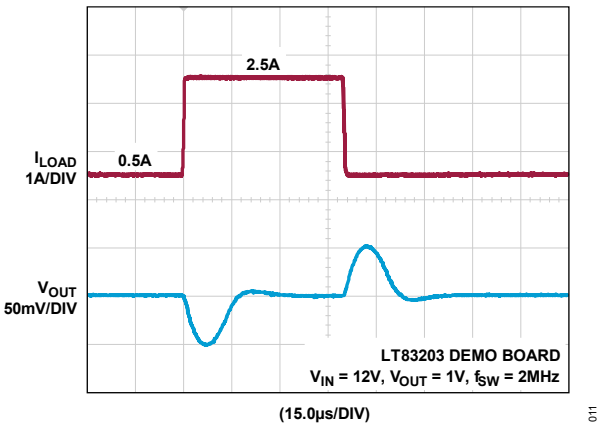


Figure 11. EVAL-LT83203-AZ Transient Response with Load Steps from 0.5A to 2.5A to 0.5A. V_{OUT} Measured at VO SENSE

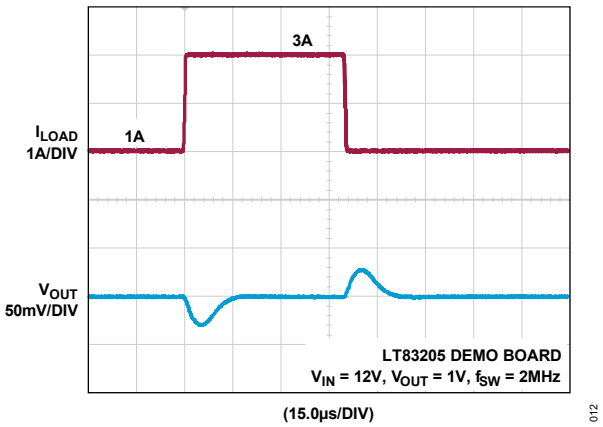


Figure 12. EVAL-LT83205-AZ Transient Response with Load Steps from 1A to 3A to 1A. V_{OUT} Measured at VO SENSE

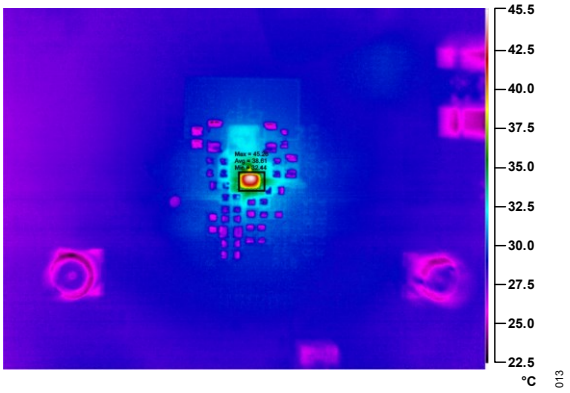


Figure 13. EVAL-LT83203-AZ Thermal Performance, V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 3A

Figure 14. EVAL-LT83205-AZ Thermal Performance, V_{IN} = 12V, V_{OUT} = 1V, I_{OUT} = 5A

Quick Start Procedure

The EVAL-LT83203/5-AZ demo boards are easy to set up to evaluate the performance of LT83203 and LT83205. See *Figure 15* for a proper test setup and follow this test procedure. EVAL-LT83203-AZ uses the same test setup as EVAL-LT83205-AZ shown in *Figure 15*.

NOTE: When measuring the input or output voltage ripple, be careful to avoid a long ground lead on the oscilloscope probe. For the input and output voltage ripple, measure them through the SMA connectors — "V_{IN} SENSE" (J5), and "V_{OUT} SENSE" (J6), respectively. *Figure 9* and *Figure 10* show the output voltage ripple measured at the "V_{OUT} SENSE" SMA connector (J6).

1. Place JP1 on the FCM position.
2. With power off, connect the input power supply to V_{IN} (J1) and GND (J2).
3. With power off, connect the load to V_{OUT} (J3) and GND (J4).
4. Connect the digital multimeters (DMM) between the input test points: "V_{IN} SENSE" and "GND SENSE" to monitor the input voltage. Connect another DMM between "VO SENSE" and "GND SENSE" to monitor the output voltage.
5. Set the power supply voltage to 12V and turn it on.
6. Check for the proper output voltage (V_{OUT} = 1V).
7. Once the input and output voltages are properly established, adjust the load current within the operating range of 0A to 3A maximum (EVAL-LT83203-AZ) or 5A maximum (EVAL-LT83205-AZ). Observe the output voltage regulation, output voltage ripples, switching node waveform, load transient response, and other parameters.
8. (Optional) Add an external clock to the SYNC terminal when using the SYNC function (JP1 on the SYNC position). Choose the R_T resistor (R4) to set the LT82302/5 switching frequency at least 20% below the lowest SYNC frequency.

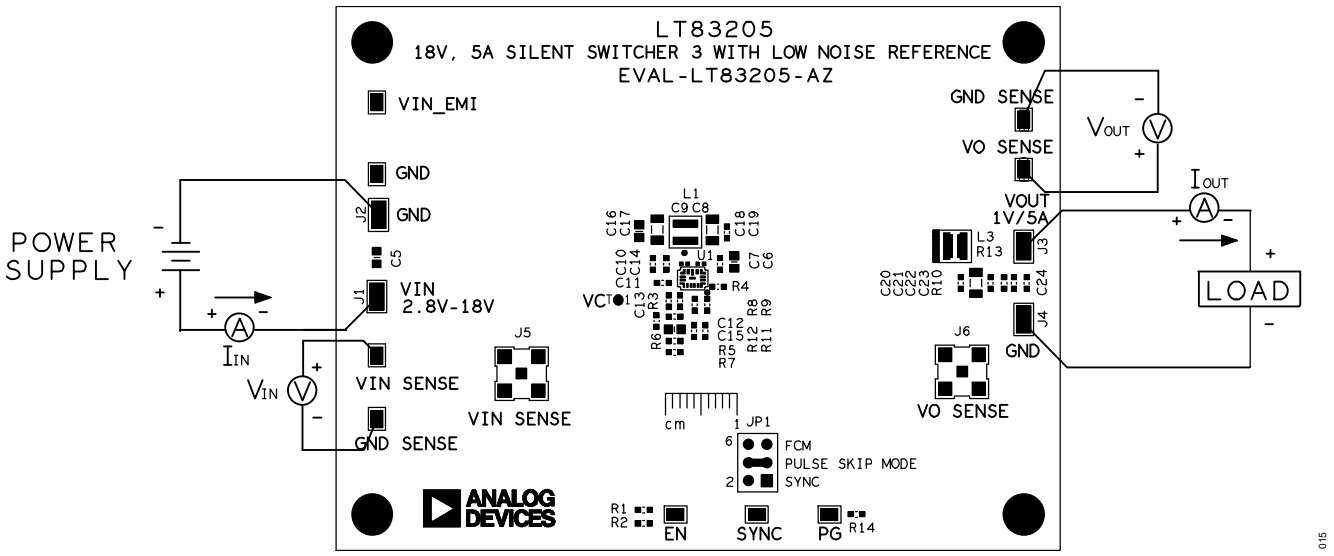


Figure 15. Demo Board Test Setup

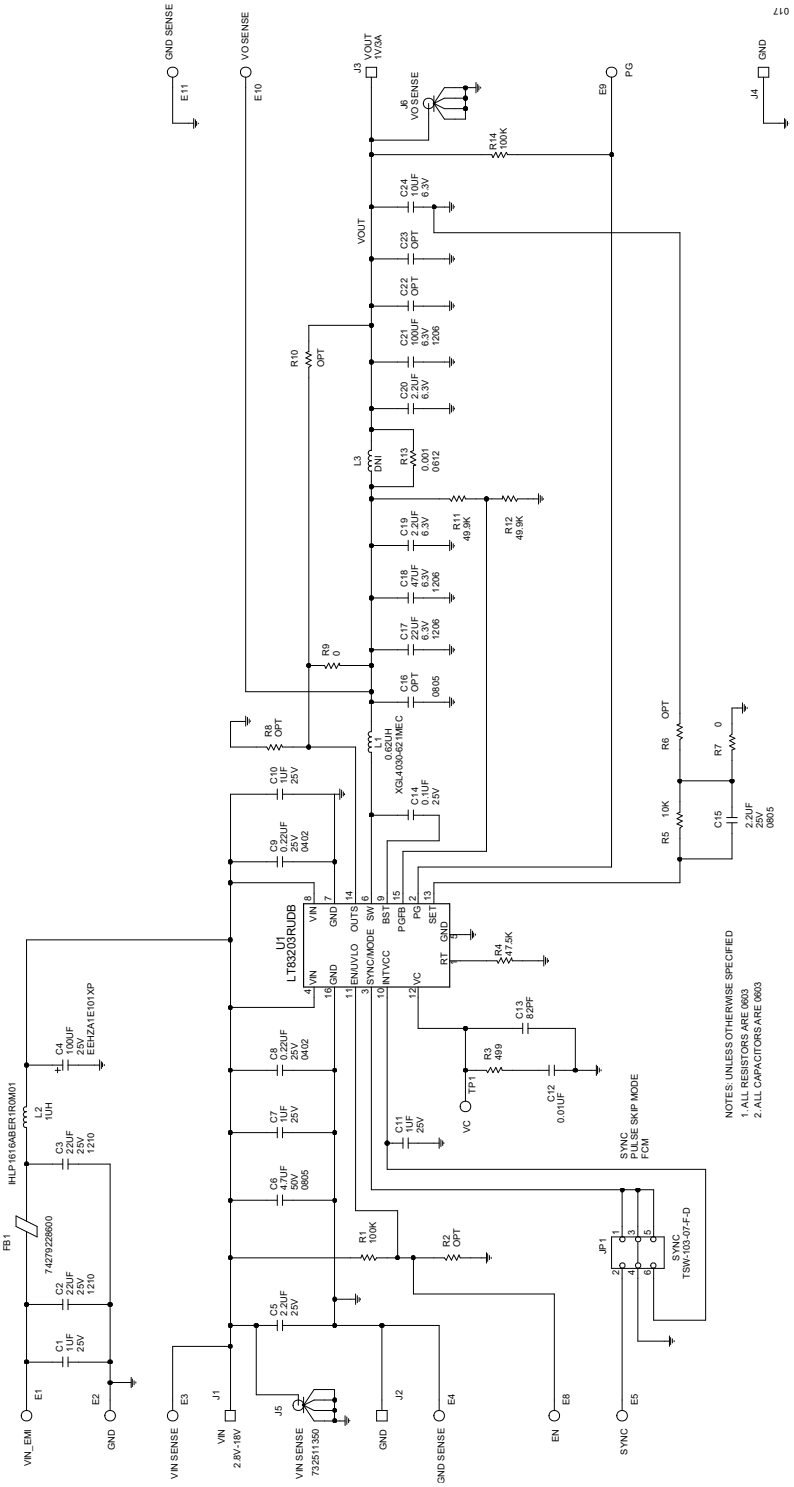
Bill of Materials

ITEM	QTY	DESIGNATOR	DESCRIPTION	MANUFACTURER PART NUMBER
REQUIRED CIRCUIT COMPONENTS				
1	4	C1, C7, C10, C11	CAP CER 1µF, 25V, 10%, X7R, 0603 AEC-Q200	MURATA GCM188R71E105KA64D
2	1	C12	CAP CER 0.01µF, 50V, 10%, X7R, 0603 AEC-Q200	KEMET C0603C103K5RECAUTO
3	1	C13	CAP CER 82pF, 50V, 5%, C0G 0603	AVX CORPORATION 06035A820JAT2A
4	1	C14	CAP CER 0.1µF, 25V, 10%, X7R 0603	KEMET C0603C104K3RACTU
5	1	C15	EVAL-LT83203-AZ: CAP CER 2.2µF, 25V, 10%, X7R, 0805 AEC-Q200	MURATA GCM21BR71E225KA73L
			EVAL-LT83205-AZ: CAP CER 2.2µF, 6.3V, 10%, X7R, 0805	YAGEO CC0805KKX7R5BB225
6	1	C17	CAP CER 22µF, 6.3V, 10%, X7R, 1206	MURATA GRM31CR70J226KE19L
7	1	C18	CAP CER 47µF, 6.3V, 20%, X5R, 1206	MURATA GRM31CR60J476ME19L
8	2	C19, C20	CAP CER 2.2µF, 6.3V, 10%, X7R, 0603 AEC-Q200	MURATA GCM188R70J225KE22D
9	2	C2, C3	CAP CER 22µF, 25V, 10%, X7R, 1210	SAMSUNG CL32B226KAJNNNE
10	1	C21	CAP CER 100µF, 6.3V, 10%, X5R, 1206	MURATA GRM31CR60J107KE39L
11	1	C24	CAP CER 10µF, 6.3V, 20%, X5R, 0603	MURATA GRM188R60J106ME47D
12	1	C4	CAP ALUM POLY 100µF, 25V, 20%, 6.3x7.7mm, AEC-Q200, 0.03Ω, 2000mA, 10000H	PANASONIC EEHZA1E101XP
13	1	C5	CAP CER 2.2µF, 25V, 10%, X7R, 0805, AEC-Q200	MURATA GCM21BR71E225KA73L
14	1	C6	CAP CER 4.7µF, 50V, 10%, X7R, 0805	MURATA GRM21BZ71H475KE15L
15	2	C8, C9	CAP CER 0.22µF, 25V, 10%, X7R, 0402, AEC-Q200, LOW ESR	TDK CGA2B3X7R1E224K050BB
16	9	E1, E2, E3, E4, E5, E8, E9, E10, E11	CONN-PCB PROBE PAD TEST POINT	TE CONNECTIVITY RCT-0C
17	1	FB1	IND FERRITE BEAD 60Ω, 25%, 100MHz, 5.1A 0.015Ω, DCR 0603	WURTH ELEKTRONIK 74279228600
18	4	J1, J2, J3, J4	CONN-PCB TEST POINT COMPACT MINI	KEYSTONE ELECTRONICS 5019
19	2	J5, J6	CONN-PCB SMA FEMALE JACK RCP, 50Ω	MOLEX 732511350

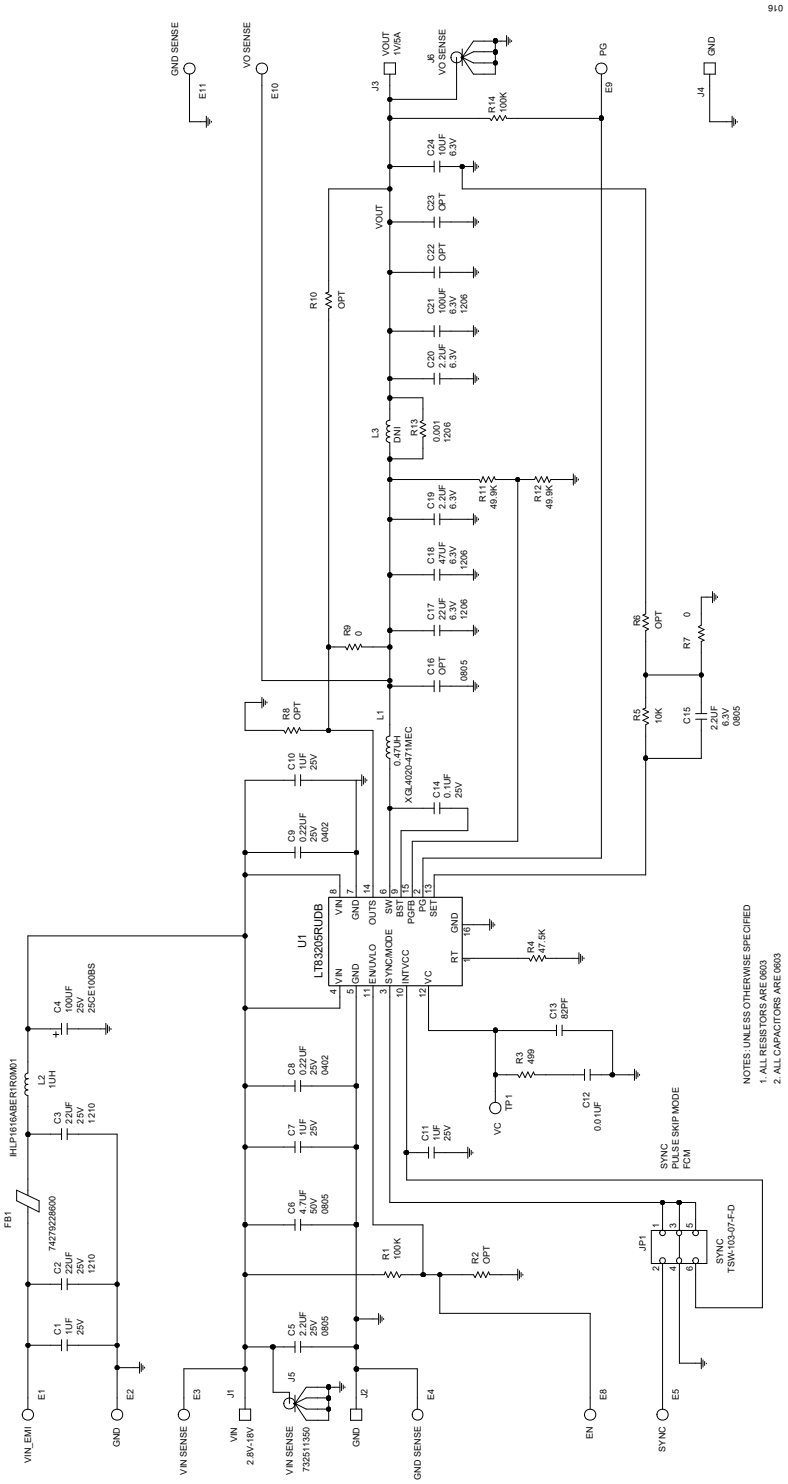
20	1	JP1	CONN-PCB 6POS MALE HDR UNSHROUDED DOUBLE ROW ST, 2.54mm PITCH, 5.84mm POST HEIGHT, 2.54mm SOLDER TAIL	SAMTEC INC. TSW-103-07-F-D
21	1	L1	EVAL-LT83203-AZ: IND POWER SHIELDED WIREWOUND 0.62µH, 20%, 1MHZ, 15A, 0.0046Ω, DCR AEC-Q200	COILCRAFT INC. XGL4030-621MEC
			EVAL-LT83205-AZ: IND SHIELDED POWER, 0.0051Ω DCR, 19.7A	COILCRAFT INC. XGL4020-471MEC
22	1	L2	IND POWER SHIELDED WIREWOUND 1µH, 20%, 100KHZ 4A, 52.5MΩ 1616	VISHAY IHLP1616ABER1R0M01
23	2	R1, R14	RES SMD 100KΩ, 1%, 1/10W, 0603 AEC-Q200	PANASONIC ERJ-3EKF1003V
24	2	R11, R12	RES SMD 49.9KΩ, 1%, 1/10W, 0603 AEC-Q200	PANASONIC ERJ-3EKF4992V
25	1	R13	RES SMD 0.001Ω, 1%, 1W, 1206	BOURNS CRK0612-FZ-R001E
26	1	R3	RES SMD 499Ω, 1%, 1/10W, 0603, AEC-Q200	PANASONIC ERJ-3EKF4990V
27	1	R4	RES SMD 47.5KΩ, 1%, 1/10W 0603, AEC-Q200	VISHAY CRCW060347K5FKEA
28	1	R5	RES SMD 10KΩ 1% 1/10W, 0603, AEC-Q200	PANASONIC ERJ-3EKF1002V
29	2	R7, R9	RES SMD 0Ω JUMPER 1/10W, 0603, AEC-Q200 PRECISION POWER	VISHAY CRCW06030000Z0EA
30	1	U1	EVAL-LT83203-AZ: IC-ADI 18V, 3A STEP-DOWN SILENT SWITCHER	ANALOG DEVICES LT83203RUDB#PBF
			EVAL-LT83205-AZ: IC-ADI 18V, 5A STEP-DOWN SILENT SWITCHER	ANALOG DEVICES LT83205RUDB#TRMPBF

OPTIONAL CIRCUIT COMPONENTS				
1	0	C16	CAP., OPTION, 0805	
2	0	C22, C23	CAP., OPTION, 0603	
3	0	R2, R6, R8, R10	RES., OPTION, 0603	
4	0	L3	IND., OPTION, XGL4030-222MEC	
MECHANICAL PARTS				
1	1	SOCKET	SOCKET, 2POS, 0.100 PITCH, CONN SHUNT	SAMTEC SNT-100-BK-G
2	4	STANDOFF	STANDOFF, BRD SPT SNAP FIT 15.9mm LENGTH	KEYSTONE 8834

EVAL-LT83203-AZ Schematic



EVAL-LT83205-AZ Schematic



Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGE NUMBER
0	2/25	Initial release	—

Notes