Evaluation Board User Guide

EVAL-LTM4723-AZ

LTM4723

Low V_{IN}, Ultrathin Dual 5A or Single 10A Step-Down DC-to-DC µModule Regulator

General Description

The EVAL-LTM4723-AZ evaluation board features the LTM®4723, a high-efficiency, high-power density DC-to-DC step-down µModule® regulator that operates as either a dual 5A or a single 10A supply. The evaluation board supports an input voltage range of 2.25V to 5.5V. By default, V_{OUT1} (Channel 1) is configured for 1.2V at 5A Max, and V_{OUT2} (Channel 2) is configured for 1.8V at 5A Max. The typical switching frequency is 2MHz.

The integrated loop compensation simplifies design optimization, requiring only a few output capacitors and an optional feedforward capacitor to achieve the desired loop bandwidth and load transient performance. A user-selectable operating mode allows optimization for either light-load efficiency or low-noise operation. Pulse-skipping mode (PSM) and Burst Mode® (BM) operation provide higher efficiency at light loads, while forced continuous mode (FCM) is preferred for noise-sensitive applications.

The LTM4723 employs a constant-frequency, peak current mode control architecture with integrated internal compensation, delivering fast transient response to input voltage and load changes while maintaining loop stability and providing cycle-by-cycle current limiting.

Review the LTM4723 data sheet and this user guide before operating or modifying the EVAL-LTM4723-AZ evaluation board.

Features and Benefits

- **Ultra-Compact Footprint:** Combines a Switching Controller, MOSFETs, Inductors, and Supported Components into a Tiny 4.25mm × 4.25mm × 1.15mm Land Grid Array (LGA) Package, Saving Significant Board Space and Simplifying Layout.
- **Flexible Dual/Single Output:** Delivers Dual 5A Outputs or can be Paralleled into a Single 10A Output to Power Multiple Rails or Single High-Current Loads.
- **Wide Voltage Range and Precision:** Supports a 2.25V to 5.5V Input and a Highly Precise, Programmable 0.5V to 3.6V Output (±1% regulation) for Sensitive Digital Logic, Field-Programmable Gate Arrays (FPGAs), and Application-Specific Integrated Circuits (ASICs).

EVAL-LTM4723-AZ Files

FILE	DESCRIPTION
EVAL-LTM4723-AZ	Evaluation board design files.

Ordering Information appears at end of this user guide.

Evaluation Board Photo

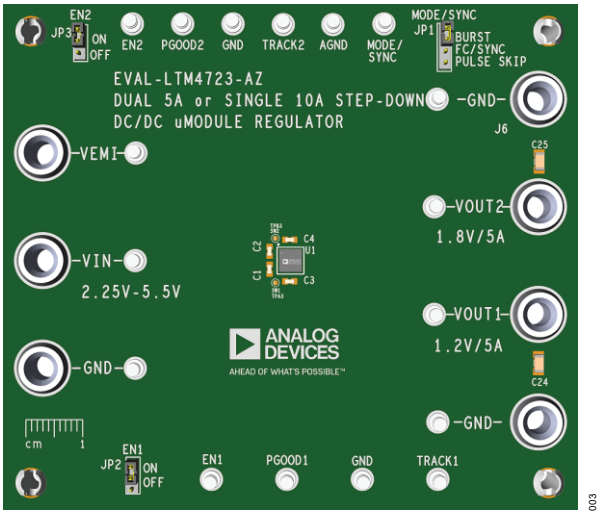


Figure 1. EVAL-LTM4723-AZ Evaluation Board Photo

One Analog Way, Wilmington, MA 01887-2356, U.S.A. | Tel: 781.329.4700

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Performance Summary

Specifications are at T_A = 25°C

PARAMETER	CONDITIONS	MIN	TYP	MAX	VALUE
Input voltage range, V_{IN}		2.25		5.5	V
Evaluation board default output voltages, V_{OUTn}	f_{SW} = 2MHz, V_{IN} = 2.25V to 5.5V, I_{LOAD} = 0A to 5A V_{OUT1} V_{OUT2}			 1.2 ± 1% 1.8 ± 1%	 V V
Default switching frequency	Programmed frequency with an external resistor from the RT pin to AGND		2		MHz
Maximum continuous output current I_{OUT} per channel (I_{OUT1} and I_{OUT2})	f_{SW} = 2MHz, V_{IN} = 2.25V to 5.5V (V_{OUT} < V_{IN}), V_{OUT} = 1.2V, 1.8V			5	A
Efficiency	V_{IN} = 3.3V, f_{SW} = 2MHz V_{OUT1} = 1.2V at I_{OUT1} = 5A V_{OUT2} = 1.8V at I_{OUT2} = 5A	 87.2, see *Figure 4a* 91.1, see *Figure 4b*			 % %
Thermal performance (peak temperature)	V_{IN} = 3.3V, f_{SW} = 2MHz, V_{OUT1} = 1.2V, V_{OUT2} = 1.8V, I_{OUT} = 5A per channel, T_A = 25°C, no heatsink, no forced airflow	62.7, see *Figure 5a* and *Figure 5b*			°C
Dynamic load transient response (peak-to-peak), V_{OUT1}, V_{OUT2}	V_{IN} = 3.3V, f_{SW} = 2MHz, Mode = FCM C_{OUT} = 1 × 100µF and 1 × 22µF per channel V_{OUT1} = 1.2V, I_{OUT1_STEP} = 2.5A to 5A V_{OUT2} = 1.8V, I_{OUT2_STEP} = 2.5A to 5A	 V_{OUT1} pk-pk = 47mV, see *Figure 6a* V_{OUT2} pk-pk = 61mV, see *Figure 6b*			 mV mV
Output voltage ripples (peak-to-peak), V_{OUT1}, V_{OUT2}	V_{IN} = 3.3V, f_{SW} = 2MHz C_{OUT} = 1 × 100µF and 1 × 22µF per channel V_{OUT1} = 1.2V at I_{OUT1} = 5A V_{OUT2} = 1.8V at I_{OUT2} = 5A	 V_{OUT1} pk-pk = 11.3mV, see *Figure 7a* V_{OUT2} pk-pk = 12.5mV, see *Figure 7b*			 mV mV

Quick Start

Required Equipment

- One power supply that can deliver 2.25V to 6V at 10A.
- Two electronic loads that can deliver 5A at 0.5V each load.
- Four digital multimeters (DMMs).

Procedure

The EVAL-LTM4723-AZ is easy to set up to evaluate the LTM4723's performance. See *Figure 2* for the evaluation board measurement setup and use the following procedure.

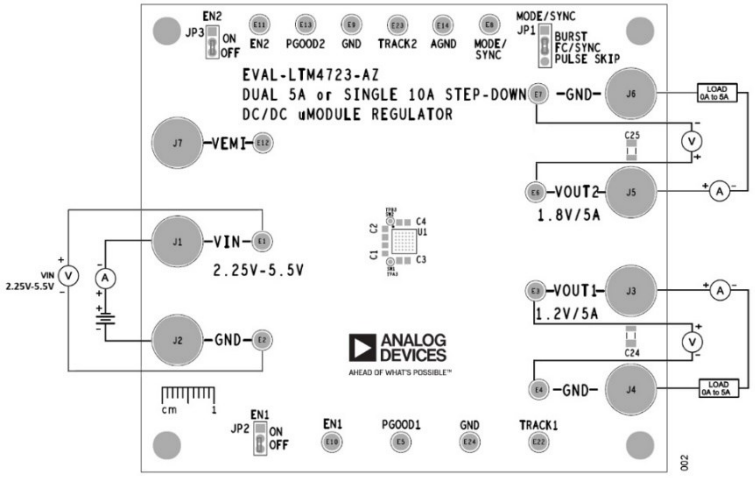


Figure 2. EVAL-LTM4723-AZ Evaluation Board Measurement Setup

1. Before applying input power to the evaluation board, verify that the jumpers are set to the following positions.

JUMPER NAME	JP1	JP2	JP3
DESCRIPTION	MODE/SYNC	EN1	EN2
POSITION	FC/SYNC	OFF	OFF

2. With power off, connect the input power supply between VIN (J1) and GND (J2). Connect the DMM between VIN (E1) and GND (E2) to monitor the input voltage. Connect an ammeter in series with the input voltage to monitor the input current (see *Figure 1*).
3. Connect the first load between VOUT1 (J3) and GND (J4), on channel 1. Connect the second load between VOUT2 (J5) and GND (J6), on channel 2. Preset all the loads to 0A.
4. Connect the first DMM between the VOUT1 (E3) and GND (E4) test points, and connect the second DMM between the VOUT2 (E6) and GND (E7) test points to monitor the output voltages of both channels, respectively. Do not apply any load between the VOUT1 (E3) and GND (E4), VOUT2 (E6) and GND (E7) test points.
5. Apply the power supply at the input. Measure and verify that the input supply voltage is 5V. Place EN1 (JP2) and EN2 (JP3) jumpers at the ON position. The output voltages should be V_{OUT1} = 1.2V ± 1% (or 1.188V ≤ V_{OUT1} ≤ 1.212V), and V_{OUT2} = 1.8V ± 1% (or 1.782V ≤ V_{OUT2} ≤ 1.818V).
6. Using the test conditions from Step 5, verify the switching node waveforms and switching frequency. Measure the switching-node waveforms: SW1 at TPA3 (channel 1) and SW2 at TPB3 (channel 2) using an oscilloscope, with the probe tip touching SW1 at TPA3, then SW2 at TPB3 test point pads, while the probe ground is connected to a GND test point. Use the oscilloscope's quick measure function to verify that the switching frequency at SW1 and SW2 is 2MHz, typical.

7. Once the input and output voltages are properly established, adjust the loads within the operating range (0A to 5A ± 0.1% max, or 4.995A ≤ I_{LOAD} ≤ 5.005A max) per channel, adjust V_{IN} from 3.3V to 5.5V max, and observe the output voltage regulation, output voltage ripple, switching-node waveforms, and the load transient response. To accurately measure input or output voltage ripple, do not use the oscilloscope probe's long ground lead. Instead, solder short leads directly to the positive (+) and negative (−) terminals of the output capacitor. Place the probe tip on the (+) terminal and the probe ground ring on the (−) terminal. *Figure 3* illustrates the recommended probing technique for ripple measurements.

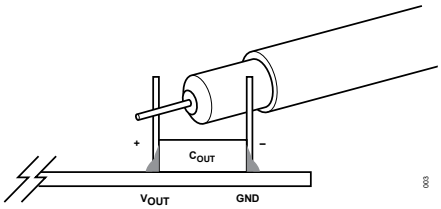


Figure 3. Oscilloscope Probe Placement for Output Ripple Measurement

Switching Frequency Programming.

By default, the EVAL-LTM4723-AZ operates at a switching frequency of 2MHz, typically. This is achieved by connecting the RT pin directly to AV_{IN}.

For applications requiring a different switching frequency, disconnect the RT pin from AV_{IN} and connect a resistor between the RT pin and AGND. The required resistor value is calculated using Equation *1*.

$$R_T = \frac{73.4}{fsw} - 1.9 \qquad (1)$$

where R_T is in kΩ and f_{SW} is the desired switching frequency in MHz, ranging from 1MHz to 3MHz.

Table 1 provides the corresponding R_T values for common switching frequencies.

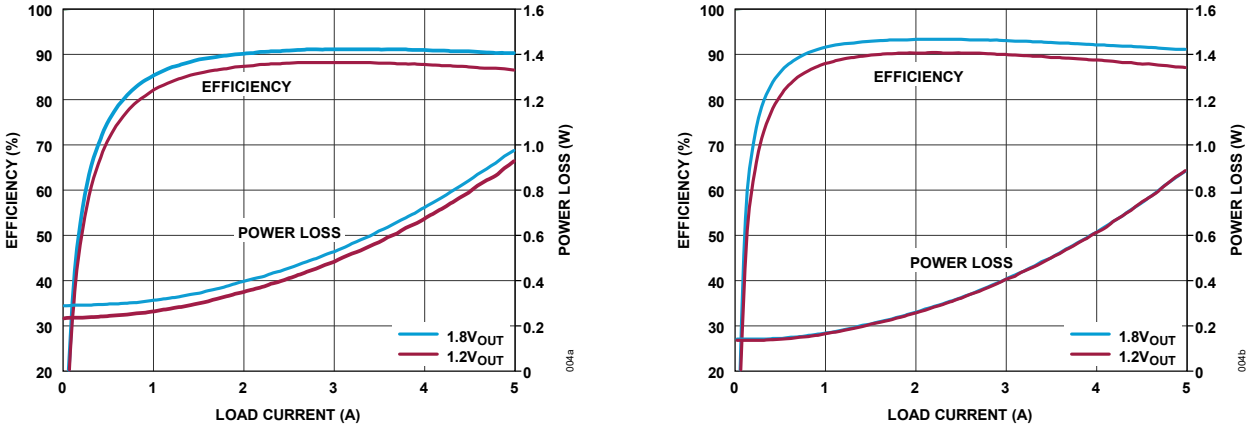
Table 1. R_T Resistor Value vs. Switching Frequency

f_{SW} (MHz)	R_T (kΩ)
1	71.5
1.2	59
1.4	51.1
1.6	44.2
1.8	39.2
2.0	34.8
2.2	31.6
2.4	28.7
2.6	26.1
2.8	24.3
3.0	22.6

External Frequency Synchronization

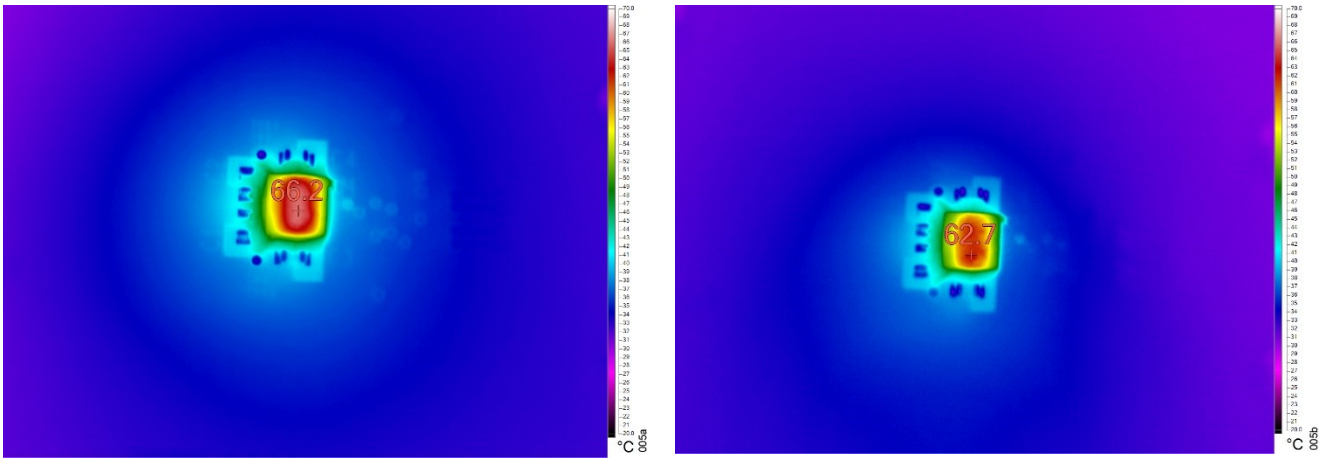
The MODE/SYNC pin can be used to synchronize the LTM4723's internal oscillator to an external clock source. To synchronize the LTM4723 to an external clock, place JP1 (MODE/SYNC) in the FC/SYNC position and apply the clock signal to the MODE/SYNC test point (E8). The supported synchronization frequency range is 1MHz to 3MHz. Do not exceed the 6V absolute maximum voltage rating of the MODE/SYNC pin.

Typical Performance Characteristics



(a) $5V_{IN}$, 2MHz *(b) $3.3V_{IN}$, 2MHz*

Figure 4. Efficiency vs. Load Current, Forced Continous Mode

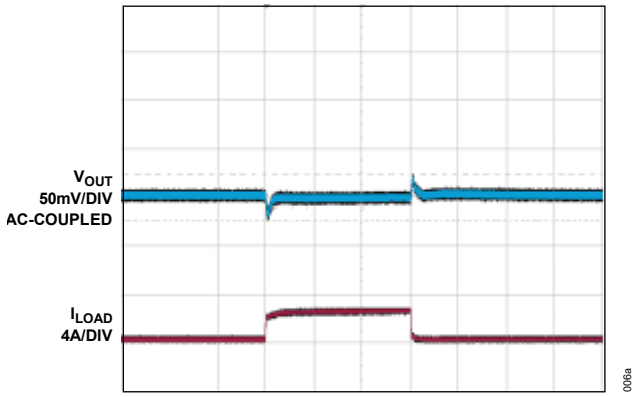


(a) V_{OUT1} = 1.2V, V_{OUT2} = 1.8V *(b) V_{OUT1} = 1.2V, V_{OUT2} = 1.8V*

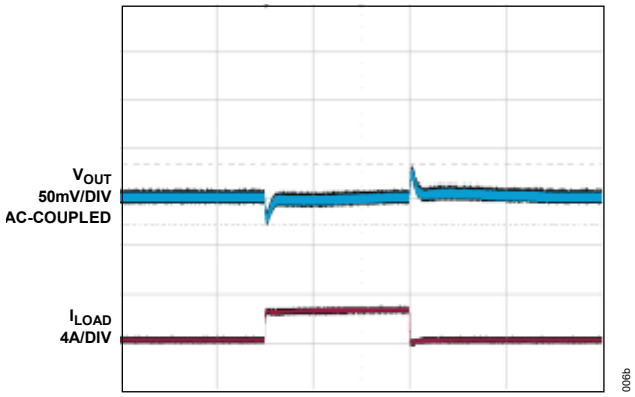
V_{IN} (V)	AIRFLOW	HEATSINK	AMBIENT (°C)
5	Natural convection	None	25

V_{IN} (V)	AIRFLOW	HEATSINK	AMBIENT (°C)
3.3	Natural convection	None	25

Figure 5. Measured Thermal Performance at 2MHz, 5A Per Channel

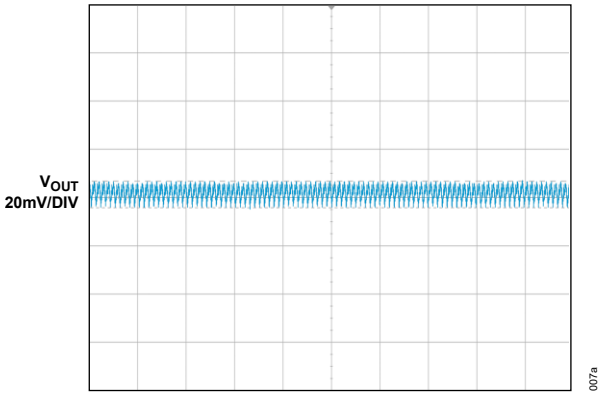


(a) V_{OUT1} (Channel 1) Measured across C3

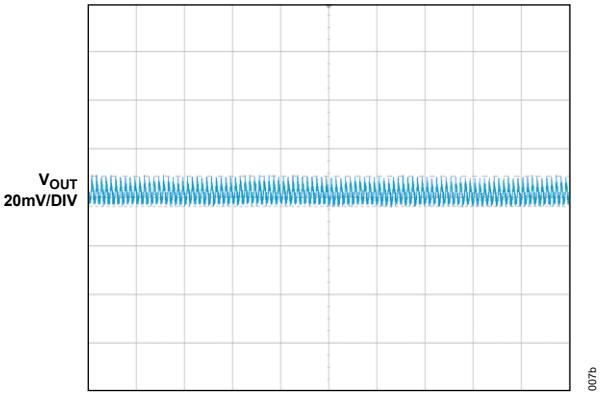


(b) V_{OUT2} (Channel 2) Measured across C4

Figure 6. Load Transient Response



(a) V_{OUT1} (Channel 1) Measured at C3



(b) V_{OUT2} (Channel 2) Measured at C4

Figure 7. Output Ripple Voltage

EVAL-LTM4723-AZ Evaluation Board Bill of Materials

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
REQUIRED CIRCUIT COMPONENTS				
1	6	C1, C2, C15, C16, C20, C21	Ceramic Capacitor 10µF, 16V, 10% X5R 0603	Murata, GRM188R61C106KAALD
2	2	C13, C14	Ceramic Capacitor 100µF, 6.3V, 20% X5R 0805	Murata, GRM21BR60J107ME15K
3	2	C17, C18	Ceramic Capacitor 0.1µF, 16V, 10% X7R 0402	Kemet, C0402C104K4RACTU
4	2	C3, C4	Ceramic Capacitor 22µF, 10V, 20% X5R 0603	Murata, GRM188R61A226ME15D
5	2	C5, C6	Ceramic Capacitor 4.7pF 50V, C0G 0402 AEC-Q200	Murata, GCM1555C1H4R7CA16D
6	1	C7	Ceramic Capacitor 22µF, 10V, 20% X5R 0805	Murata, GRM21BR61A226ME51L
7	1	C8	Polymer Capacitor TANT 100µF, 8V, 20% 3528	Panasonic, 8TPE100MAZB
8	1	C23	Ceramic Capacitor 4.7µF, 10V, 10% X5R 0402 low ESR	TDK, C1005X5R1A475K050BC
9	17	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E22, E23, E24	Connector–PCB solder terminal test point turret	MILL-MAX, 2501-2-00-80-00-00-07-0
10	7	J1, J2, J3, J4, J5, J6, J7	Connector–PCB, banana jack, female	Keystone Electronics, 575-4
11	1	JP1	Connector–PCB 4POS male HDR unshrouded single row	Samtec INC., TMM-104-02-L-S
12	2	JP2, JP3	Connector–PCB 3POS male HDR unshrouded single row	Samtec INC., TMM-103-02-L-S
13	1	R1	Resistor SMD 140kΩ, 1% 1/16W 0402 AEC-Q200	Vishay, CRCW0402140KFKED
14	4	R2, R4, R9, R10	Resistor SMD 100kΩ, 1% 1/10W 0402 AEC-Q200	Panasonic, ERJ-2RKF1003X
15	4	R5, R11, R12, R13	Resistor SMD 1MΩ, 1% 1/10W 0402	Vishay, MCS04020C1004FE000
16	4	R15, R17, R20, R21	Resistor SMD 0Ω, jumper 1/16W 0402 AEC-Q200	Yageo, AC0402JR-070RL
17	1	R3	Resistor SMD 261kΩ, 1% 1/10W 0402 AEC-Q200	Panasonic, ERJ-2RKF2613X

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
18	2	R6, R7	Resistor SMD 10Ω, 1% 1/10W 0402 AEC-Q200	Panasonic, ERJ-2RKF10R0X
19	1	R8	RES. SMD 10kΩ 1% 1/16W 0402 AEC-Q200	VISHAY, CRCW040210K0FKED
20	1	U1	IC-ADI dual 5A, single 10A step-down DC-TO-DC µModule regulator	Analog Devices Inc., LTM4723EV#PBF
ADDITIONAL DEMO BOARD CIRCUIT COMPONENTS				
1	0	C9, C10, C24, C25	Do not install	TBD1206, TBD1206
2	0	C11, C12	Do not install	TBD0402, TBD0402
3	0	C19, C22	Do not install	TBD0805, TBD0805
4	0	L1	Do not install	TBD1812, TBD1812
5	0	R14, R18, R19, R23, R27	Do not install	TBD0402, TBD0402
6	0	R16, R22, R24	Resistor SMD 0Ω, jumper 1/16W 0402 AEC-Q200	Yageo, AC0402JR-070RL
7	0	R25, R26	Do not install	TBD1210, TBD1210
HARDWARE: FOR DEMO BOARD ONLY				
1	3		Shunt, 2-POS, 2mm pitch, black	Samtec Inc., 2SN-BK-G
2	4		Standoff, self-retaining spacer, 12.7mm length	Würth Elektronik, 702935000

EVAL-LTM4723-AZ Evaluation Board Schematic

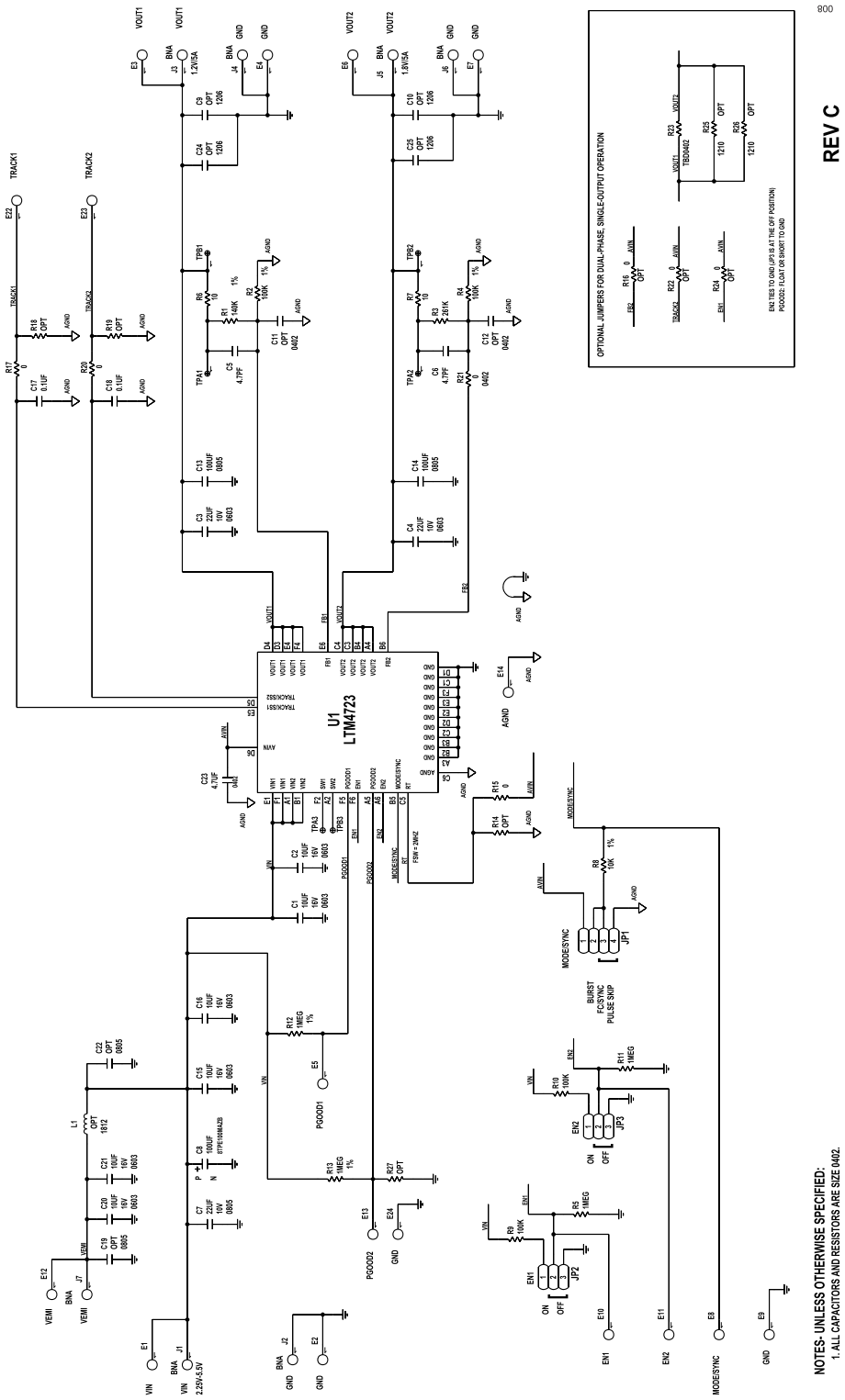


Figure 8. EVAL-LTM4723-AZ Evaluation Board Schematic Diagram

Ordering Information

PART	TYPE
EVAL-LTM4723-AZ	Evaluation board featuring the LTM4723, an ultra-thin dual 5A or single 10A DC-to-DC µModule regulator configured as dual outputs.

Revision History

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

Notes

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