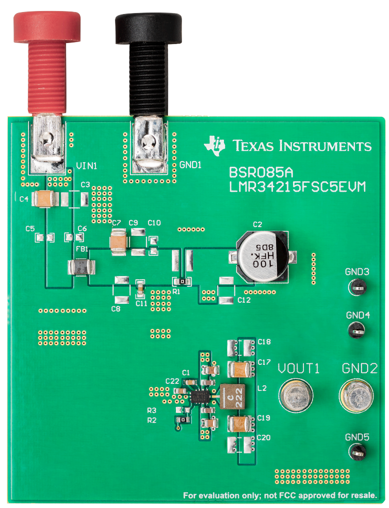
LMR34215FSC5EVM User's Guide

The Texas Instruments LMR34215FSC5EVM evaluation module (EVM) helps designers evaluate the operation and performance of the LMR34215-Q1 wide-input buck regulator. The LMR34215-Q1 is an easy-to-use synchronous step-down DC/DC converter capable of driving up to 1.5 A of load current from an input voltage of up to 42 V. The LMR34206-Q1 can use the same EVM, but some components may need to change for the 0.6 A device. The LMR34215FSC5EVM features a LMR34215-Q1 fixed output voltage of 5 V and a switching frequency 2.1 MHz. See the *LMR34206-Q1 4.2-V to 42-V, 0.6-A Ultra-Small Synchronous Step-Down Converter Data Sheet* and the *LMR34215-Q1 4.2-V to 42-V, 1.5-A Ultra-Small Synchronous Step-Down Converter Data Sheet* for additional features, detailed descriptions, and available options.

Table 1 shows the variant used for the LMR34215FSC5EVM.

Table 1. Device and Package Configuration

EVM	U1	SPREAD SPECTRUM	FPWM	FREQUENCY	OUTPUT VOLTAGE	OUTPUT CURRENT
LMR34215FSC5EVM	LMR34215FSC5RNXTQ1	Yes	Yes	2100 kHz	5-V Fixed	1.5 A



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1 Posts, Probes, and Jumpers

This section describes the test points and connectors on the EVM and how to properly connect, set up, and use the LMR34215FSC5EVM.

1.1 Input and Output Terminals

The terminals on the top of the board can be used to connect to the input and output of the EVM. See Figure 1 for the terminal connections. The functions of the terminal connections are:

VIN— Input supply to EVM including EMI filter. Connect to a suitable input supply. See the *LMR34206-Q1 4.2-V to 42-V, 0.6-A Ultra-Small Synchronous Step-Down Converter Data Sheet* and *LMR34215-Q1 4.2-V to 42-V, 1.5-A Ultra-Small Synchronous Step-Down Converter Data Sheet* for input supply requirements.

GND— System ground

VOUT— Output of EVM — connect to desired load.

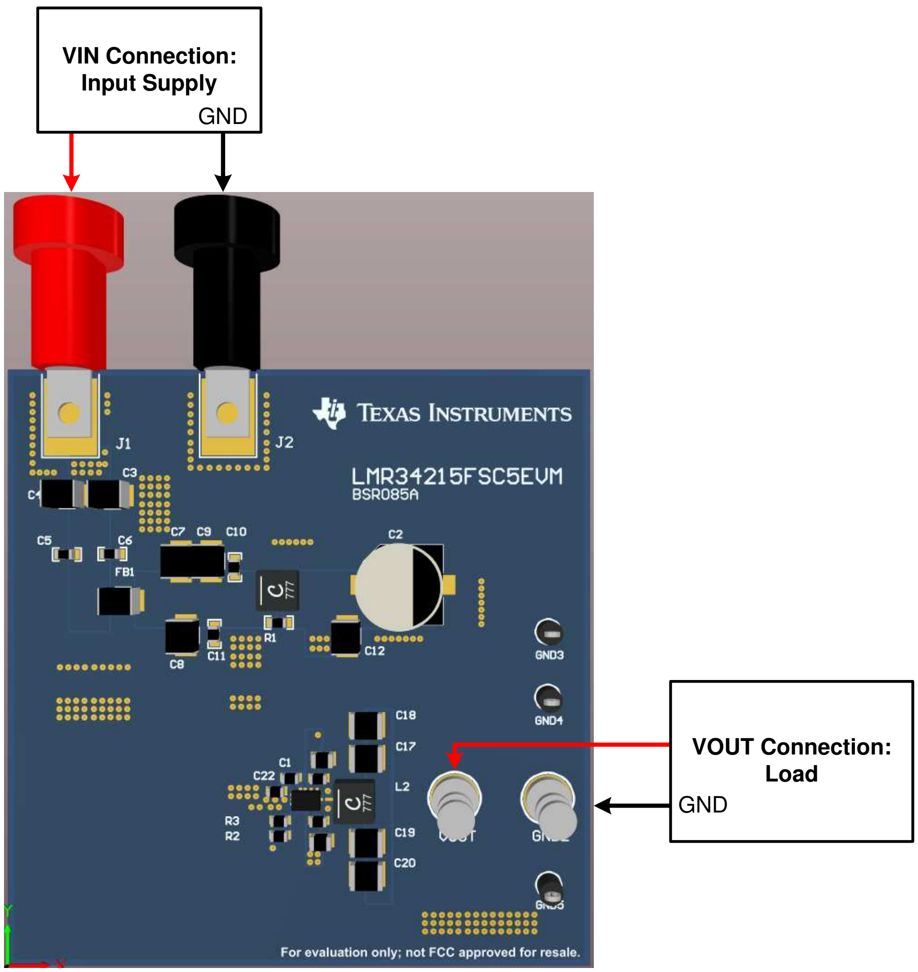

Figure 1. EVM Board Connections

1.2 Test Points

VOUT— Output voltage sense connection; connect to DMM. Also, use for frequency response analyzer connection.

GND2, GND3, GND4, and GND5— Ground sense point for analog measurements; connect to DMM.

2 Operation

2.1 Quick Start

1. Connect the voltage supply between VIN and GND banana jack connectors using short and thick wires.
2. Connect the load between VOUT and GND connectors using short and thick wires.
3. Set the supply voltage at an appropriate level between 4.2 V to 42 V.
4. Set the current limit of the supply to an appropriate level.
5. Turn on the power supply. With the default configuration, the EVM powers up and provides V_{OUT} = 5 V.
6. Monitor the output voltage. The maximum load current must be 1.5 A with the LMR34215-Q1 device or 600 mA with the LMR34206-Q1 device.

2.2 Efficiency Measurement

1. Connect the power supply to VIN and GND terminal connectors and make sure the power supply provides sufficient current.

NOTE: There is no reverse polarity protection or fuse on the evaluation board.

2. Connect the electronic load to VOUT and GND terminal connectors. It is preferable to use twisted lab wires for all power wires. If the power supply wires are very long (> 50 cm), solder an additional 470-µF, 100-V bulk capacitor to posts VIN and GND. Use sufficient power wires to avoid voltage drops, and use short sense probe connection for the measurement.

NOTE: These sense lines are not designed to carry power.

3. Use the connectors and test points to accurately sense input and output voltages. Alternatively, sense wires can be soldered directly over input capacitors C_{13} or C_{14} and the output capacitors C_{17} or C_{19}.

2.3 Measure Load Transient

1. Connect power supply to VIN and GND banana jack connectors, and make sure the power supply can provide sufficient peak current.

NOTE: There is no reverse polarity protection or fuse on the evaluation board.

2. Connect the transient load to VOUT and GND terminal connectors. Use preferable twisted lab wires for all power wires. If the power supply wires are very long (> 50 cm), solder an additional 470-µF, 100-V bulk capacitor to posts VIN and GND. Use short sense probe connection for the measurement.
3. To accurately sense the output voltage, place the scope probe directly over the output capacitors C_{17} or C_{19}. Connect scope probe GND ring directly to the output capacitor GND pad for minimal ground loop. Ground loops can introduce ringing in observed waveforms, which is an artifact and not present on the PCB. Alternatively, use differential probe over output capacitors C_{17} or C_{19}. Do not use wires to differential probe and always probe directly with shortest possible pins.

3 Schematic

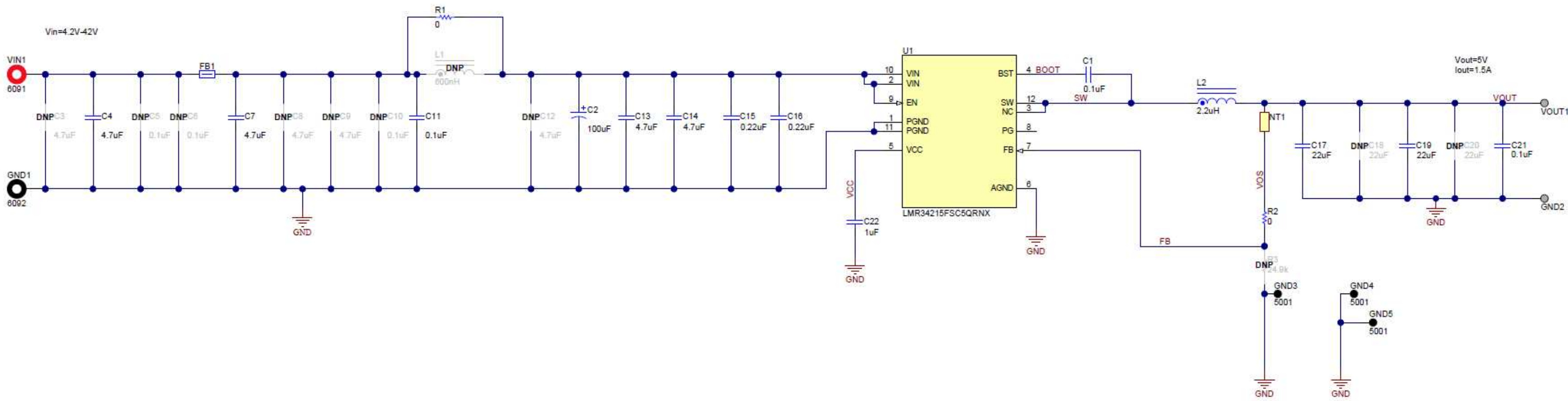

Figure 2. LMR34206 and LMR34215 EVM Schematic

4 Board Layout

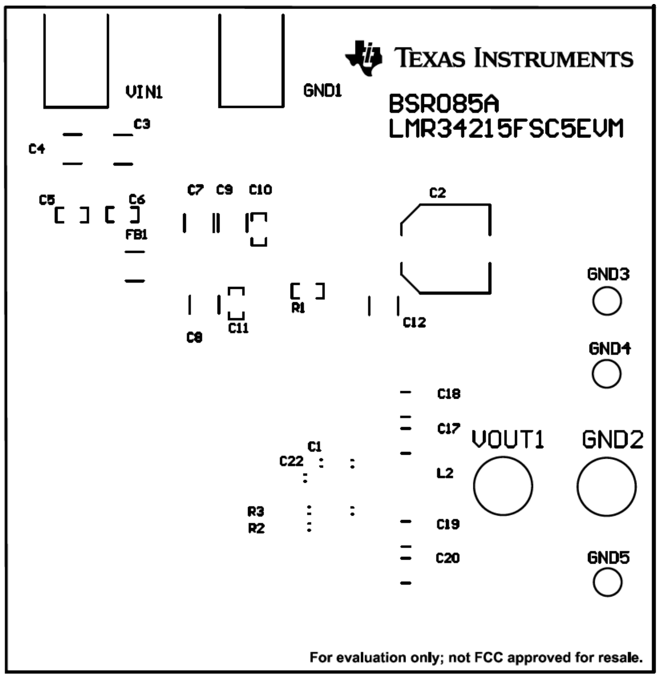

Figure 3. Top View of the EVM

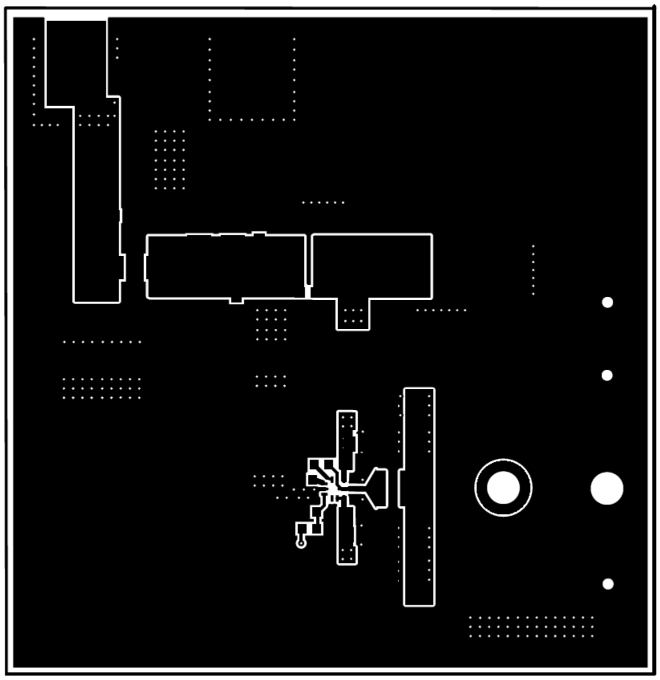

Figure 4. EVM Top Copper Layer

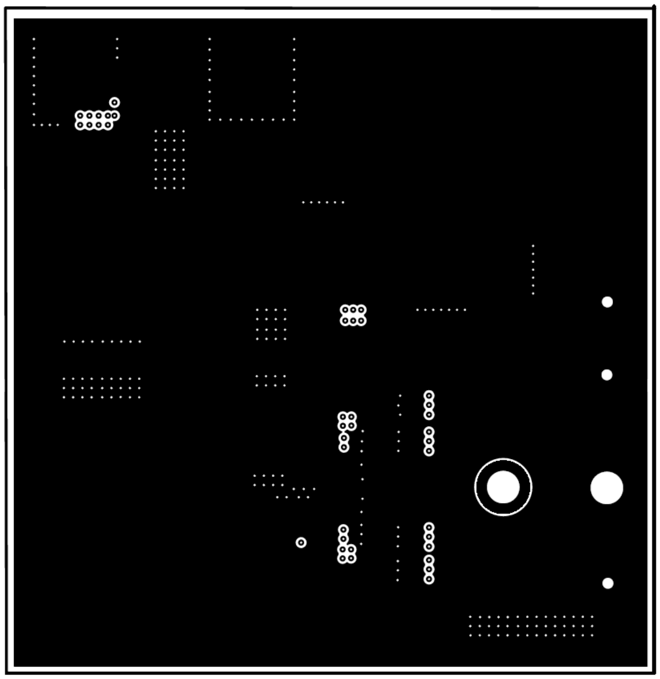

Figure 5. EVM Mid-Layer One

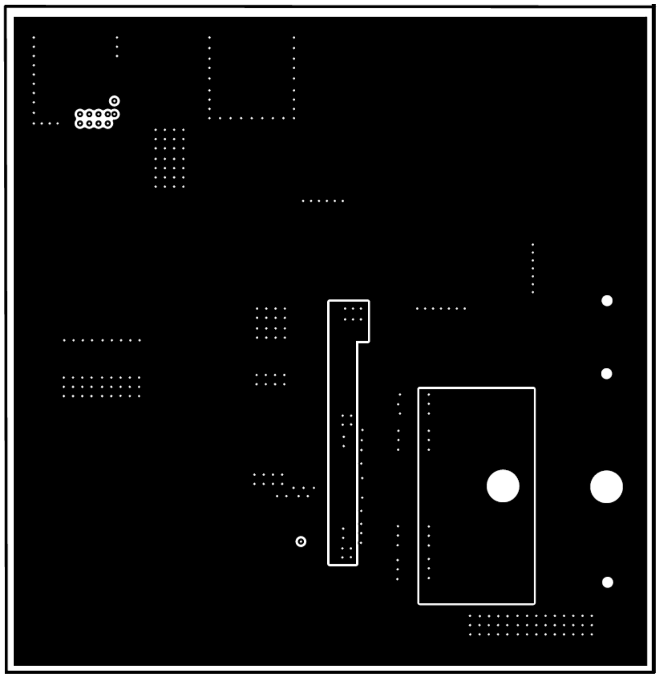

Figure 6. EVM Mid-Layer Two

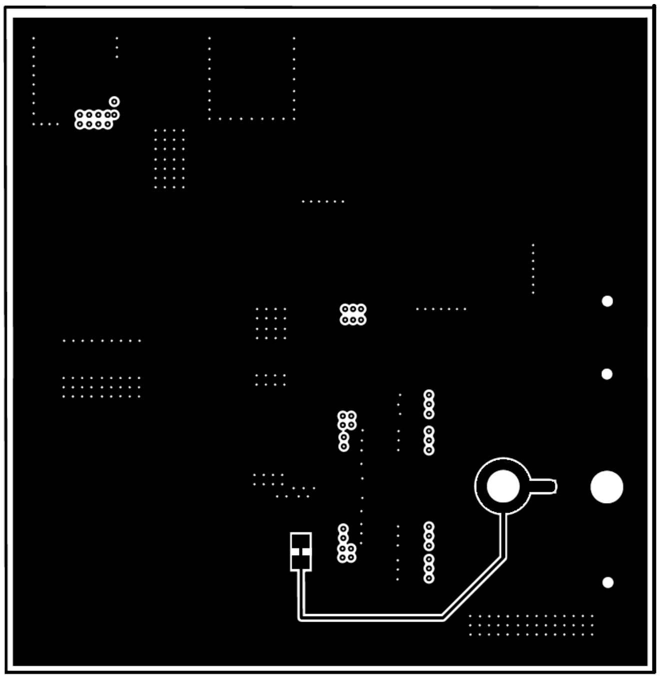

Figure 7. EVM Bottom Copper Layer

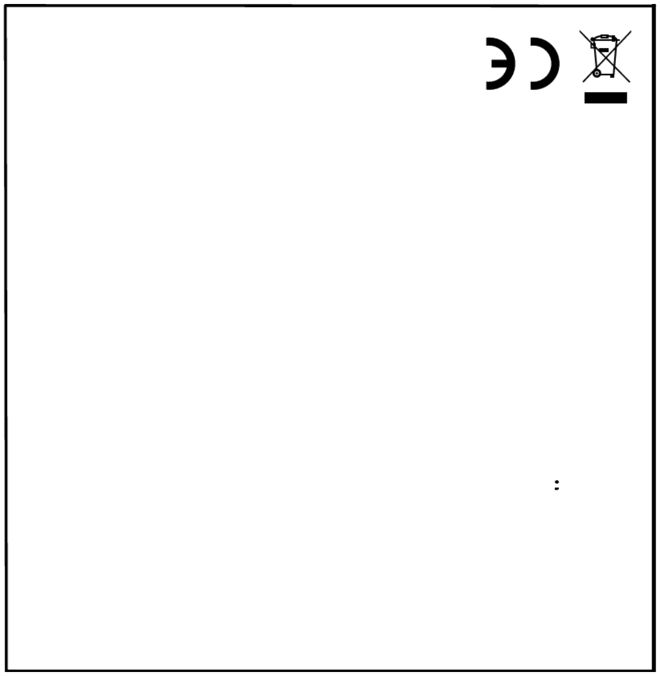

Figure 8. EVM Bottom View

5 Bill of Materials

Table 2. Bill of Materials

DESIGNATOR	DESCRIPTION	MANUFACTURER	PART NUMBER	QUANTITY
C1, C21	CAP, CERM, 0.1 µF, 25 V, ±10%, X7R, 0603	AVX	06033C104KAT2A	2
C2	CAP, AL, 100 µF, 50 V, ±20%, 0.34 Ω, AEC-Q200 Grade 2, SMD	Panasonic	EEE-FK1H101P	1
C4, C7	CAP, CERM, 4.7 µF, 50 V, ±20%, X7R, AEC-Q200 Grade 1, 1210	TDK	CGA6P3X7R1H475M250AB	2
C11	CAP, CERM, 0.1 µF, 50 V, ±10%, X7R, 0603	MuRata	GCM188R71H104KA57D	1
C13, C14	CAP, CERM, 4.7 µF, 50 V, ±10%, X5R, 0805	TDK	C2012X5R1H475K125AB	2
C15, C16	CAP, CERM, 0.22 µF, 50 V, ±10%, X7R, 0603	TDK	C1608X7R1H224K080AB	2
C17, C19	CAP, CERM, 22 µF, 25 V, ±10%, X5R, 1210	Samsung Electro-Mechanics	CL32A226KAJNNNE	2
C22	CAP, CERM, 1 µF, 25 V, ±10%, X7R, 0603	Wurth Elektronik	885012206076	1
FB1	Ferrite Bead, 600 Ω at 100 MHz, 3 A, 1210	Taiyo Yuden	FBMH3225HM601NT	1
GND1	Standard Banana Jack, Insulated, Black	Keystone	6092	1
GND2, VOUT1	Terminal, Turret, TH, Double	Keystone	1503-2	2
GND3, GND4, GND5	Test Point, Miniature, Black, TH	Keystone	5001	3
L2	Inductor, Shielded, Composite, 2.2 µH, 5.5 A, 0.04 Ω, AEC-Q200 Grade 1, SMD	Coilcraft	XAL4020-222MEB	1
R1, R2	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW06030000Z0EA	2
U1	LMR342XX-Q1 SIMPLE SWITCHER® 42-V, 600-mA/1.5-A Synchronous Buck Converter, RNX0012B (VQFN-HR-12)	Texas Instruments	LMR34215FSC5RNXTQ1	1
VIN1	Standard Banana Jack, Insulated, Red	Keystone	6091	1
C3, C8, C9, C12	CAP, CERM, 4.7 µF, 50 V, ±20%, X7R, AEC-Q200 Grade 1, 1210	TDK	CGA6P3X7R1H475M250AB	0
C5, C6, C10	CAP, CERM, 0.1 µF, 50 V, ±10%, X7R, 0603	MuRata	GCM188R71H104KA57D	0
C18, C20	CAP, CERM, 22 µF, 25 V, ±10%, X5R, 1210	Samsung Electro-Mechanics	CL32A226KAJNNNE	0
L1	Inductor, Shielded, Composite, 600 nH, 10.38 A, 0.01 Ω, AEC-Q200 Grade 1, SMD	Coilcraft	XAL4020-601MEB	0
R3	RES, 24.9 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060324K9FKEA	0

6 Test Results

Section 6.1 details the test results from the LMR34215FSC5EVM.

6.1 *LMR34215FSC5EVM Test Results*

The LMR34215FSC5EVM variant is used for all figures from Figure 9 to Figure 22.

6.1.1 Efficiency and Load Regulation

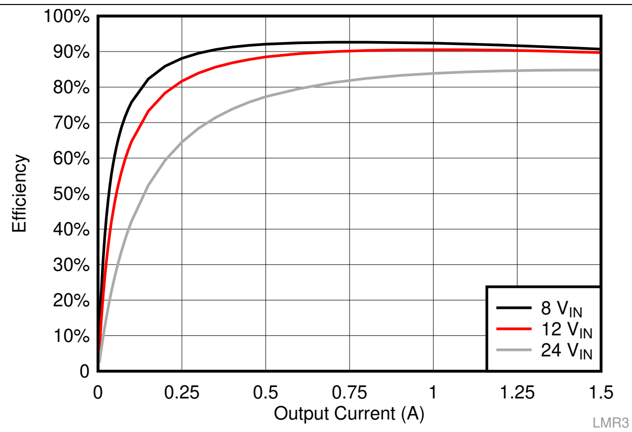

Figure 9. LMR34215FSC5EVM 5 V_{OUT} Efficiency

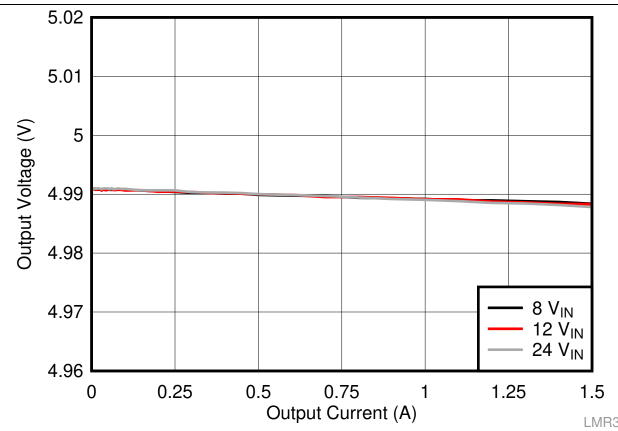

Figure 10. LMR34215FSC5EVM 5 V_{OUT} Load Regulation

6.1.2 Load Transients and Start-up Waveforms

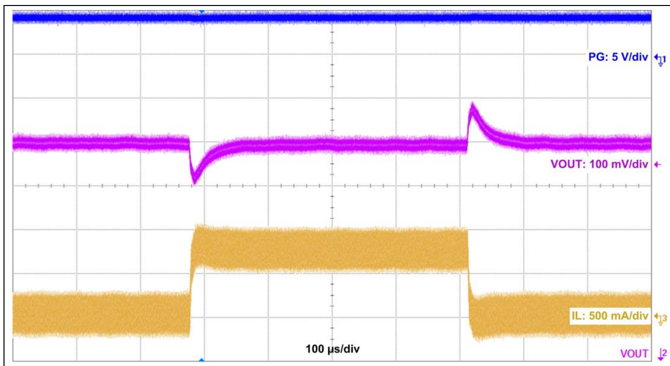

Figure 11. LMR34215FSC5EVM 5 V_{OUT} Load Transient, I_{OUT} = 0 A to 1.5 A, Slew Rate = 1 A/µs

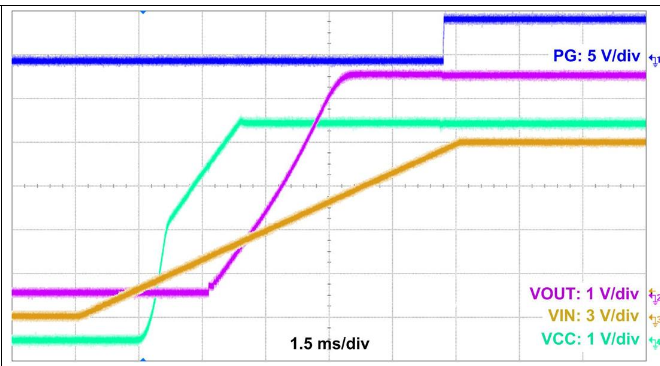

Figure 12. LMR34215FSC5EVM 5 V_{OUT} Start-Up Waveform

6.1.3 Conducted EMII

Conducted EMI testing is done versus CISPR25 peak and average limits. The yellow waveforms are the peak signals and the blue waveforms are the average signals. The test is done with 13.5 V input voltage, 5.0 V output voltage, and 1.5 A load current.

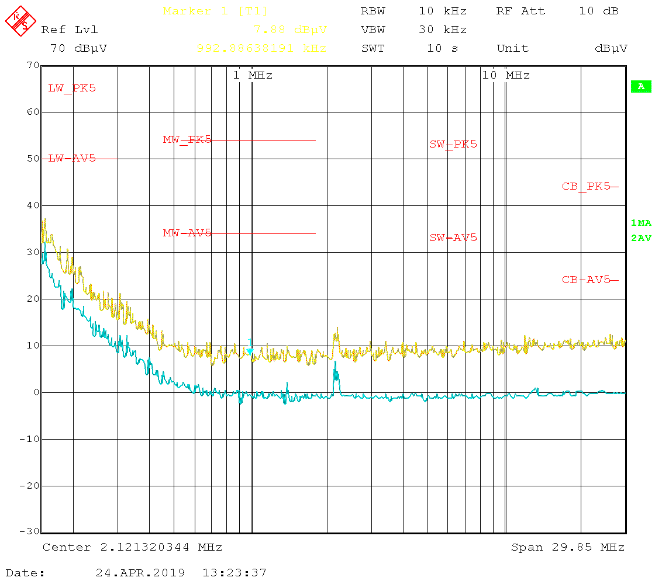

Figure 13. Conducted EMI Versus CISPR25 Limits, 150 kHz to 30 Mhz

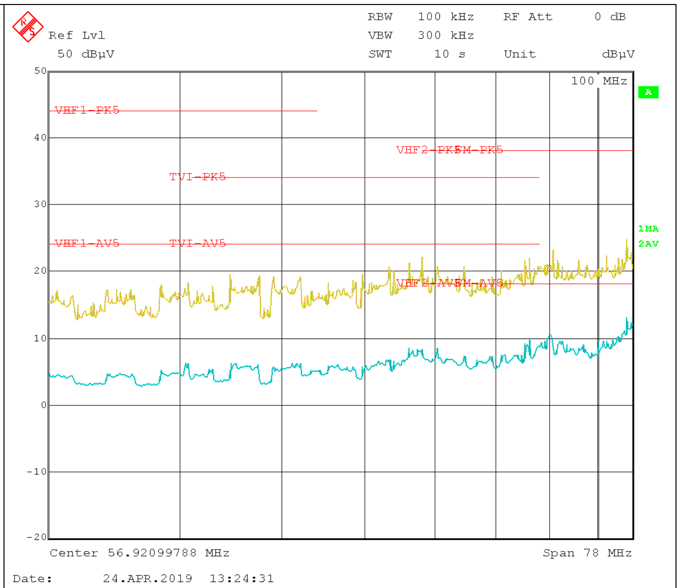

Figure 14. Conducted EMI Versus CISPR25 Limits, 30 Mhz to 108 MHz

6.1.4 Radiated EMII

Radiated EMI testing is done versus CISPR25 peak and average limits. The black waveforms are the peak signals and the blue waveforms are the average signals. The test is done with 13.5 V input voltage, 5.0 V output voltage, and 1.5 A load current.

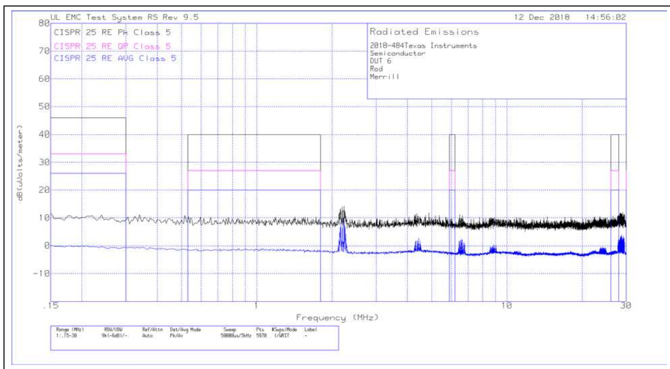

Figure 15. . Radiated EMI Rod Versus CISPR25 Limits, 150 kHz to 30 MHz

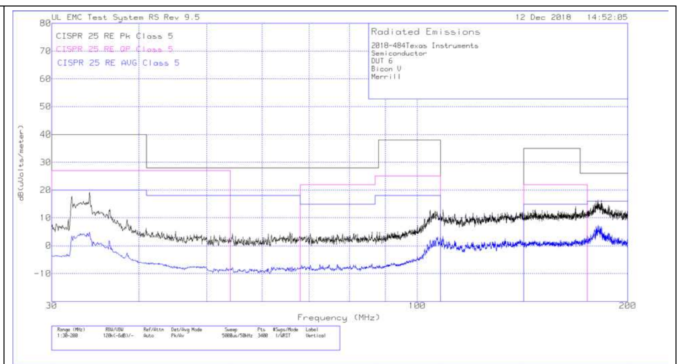

Figure 16. Radiated EMI Bicon Vertical Versus CISPR25 Limits, 30 MHz to 200 MHz

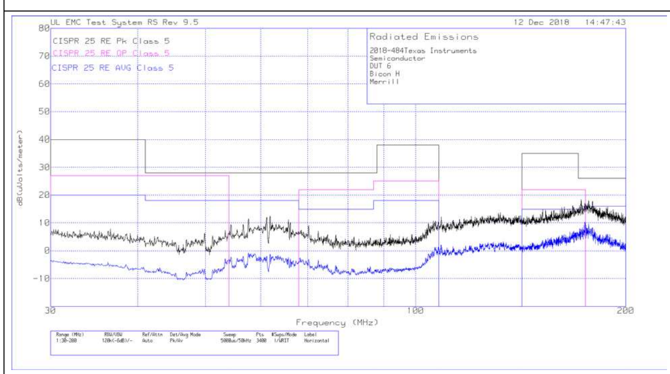

Figure 17. Radiated EMI Bicon Horizontal Versus CISPR25 Limits, 30 MHz to 200 MHz

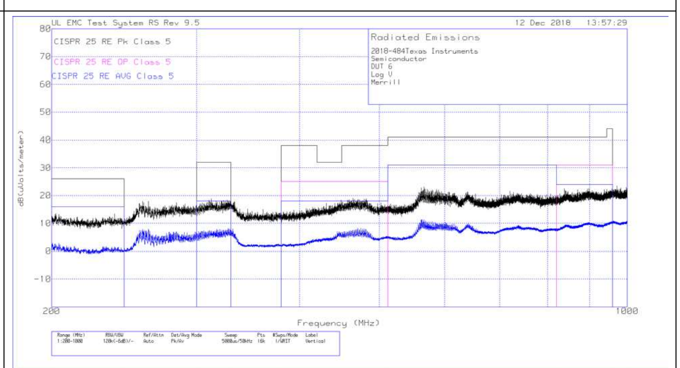

Figure 18. 4. Radiated EMI Log Vertical Versus CISPR25 Limits, 200 MHz to 1 GHz

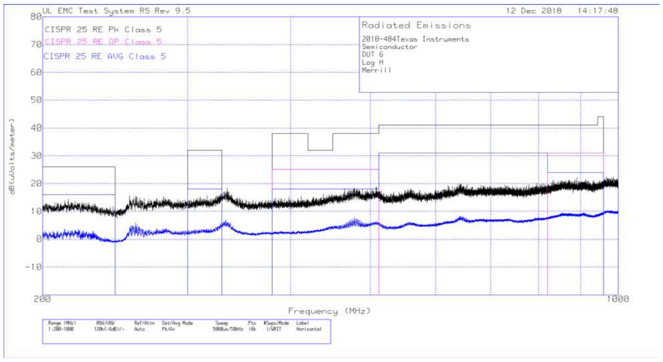

Figure 19. Radiated EMI Log Horizontal Versus CISPR25 Limits, 200 Mhz to 1 GHz

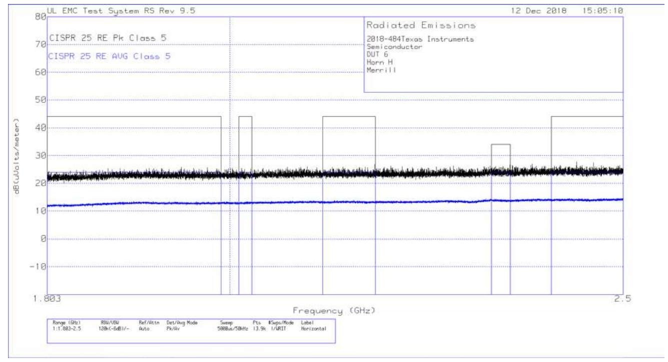

Figure 20. Radiated EMI Horn Vertical Versus CISPR25 Limits, 1.8 GHz to 2.5 GHz

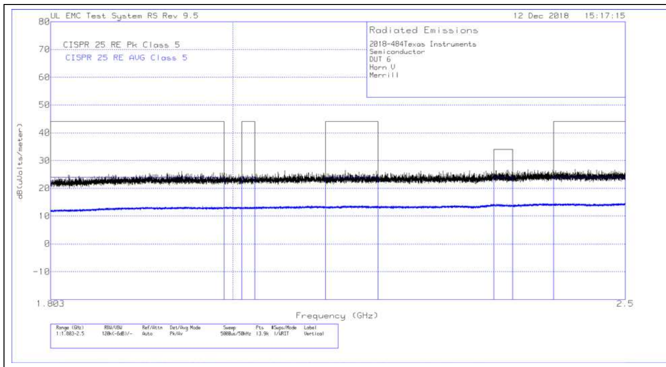

Figure 21. Radiated EMI Horn Horizontal Versus CISPR25 Limits, 1.8 GHz to 2.5 GHz

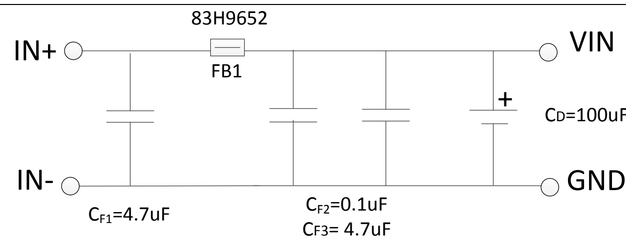

Figure 22. Recommended Input EMI Filter