LMZ20502 SIMPLE SWITCHER® Evaluation Board

1 Introduction

The LMZ20501/02 nano modules are easy-to-use DC-DC converters optimized for space-constrained applications. The LMZ20502 is capable of delivering up to 2A with excellent power conversion efficiency, output voltage accuracy, line and load regulation, and load transient response. The LMZ20501 is a 1.0A version, that is pin-to-pin compatible with the LMZ20502.

This engineering evaluation board is designed for rapid prototyping with large pads and extra components. In addition, jumpers are provided to allow the user to enable the converter and select the operating mode. A jumper for connecting a network analyzer is also provided, to measure regulator loop response. Please refer to Figure 1 for the schematic of the EVM.

2 Specifications

- V_{IN} = 2.7V to 5.5V
- V_{OUT} = 1.8V
- I_{OUT} = 1A (LMZ20501)
- I_{OUT} = 2A (LMZ20502)
- 2.7cm x 6.4 cm overall PCB size

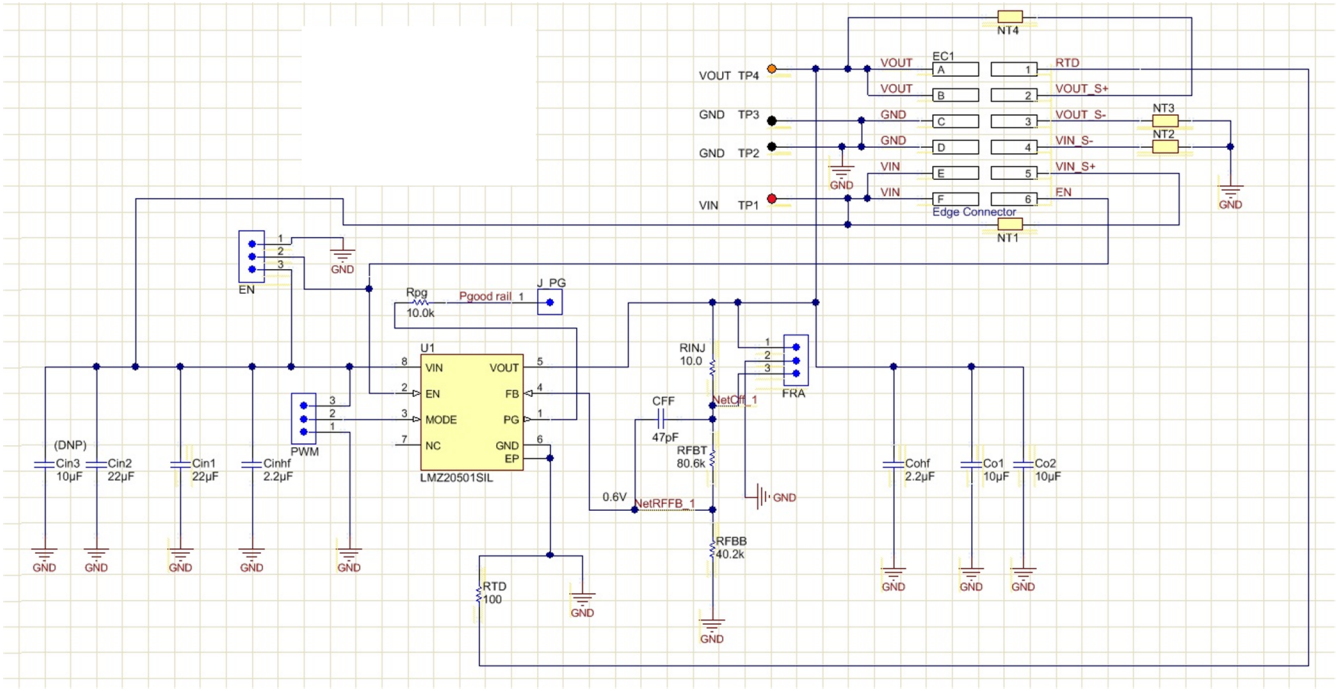


Figure 1. EVM Schematic

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3 Set-Up and Operation

Please refer to Figure 2 through Figure 5 while setting up the EVM module. All that is required is to apply an input supply to the module, connect the desired load and select the enable and mode jumper positions. The input supply is connected between the VIN and GND pins. The load is connected between the VOUT and GND pins. The output voltage can be monitored between the VOUTS and GNDS pins, or at the test points provided on the module.

Figure 2 shows the enable jumper configuration; the left side of the figure shows the jumper in the "ON" position. While the right side of the figure shows the "OFF" position. Figure 3 shows the MODE selection jumpers. With the jumper in the "PFM" position, the device will automatically switch between PFM and PWM mode depending on load. With the jumper in the "PWM" position, the part will remain in constant frequency PWM mode regardless of load.

To remotely enable the module, remove the EN jumper and connect the control signal to the EN pad on the edge connector. A valid input voltage must be present on VIN before the EN pin is asserted. The maximum voltage on this pin is 5.5V or VIN, whichever is smaller.

A three pin header is provided to allow the user to inject a signal from a network analyzer into the control loop of the regulator. The connections are shown in Figure 4

The expected input current to the module can be approximated by using Equation 1

$$I_{IN} = \frac{V_{OUT} \cdot I_{OUT}}{V_{IN} \cdot \eta} \quad (1)$$

In some cases an electrolytic capacitor may be required on the input to the module. This is especially true if long leads/traces are used to connect the input supply to the device. The moderate ESR of this capacitor can help to damp any ringing on the input supply caused by long power leads. A value of about 100µF is usually adequate.

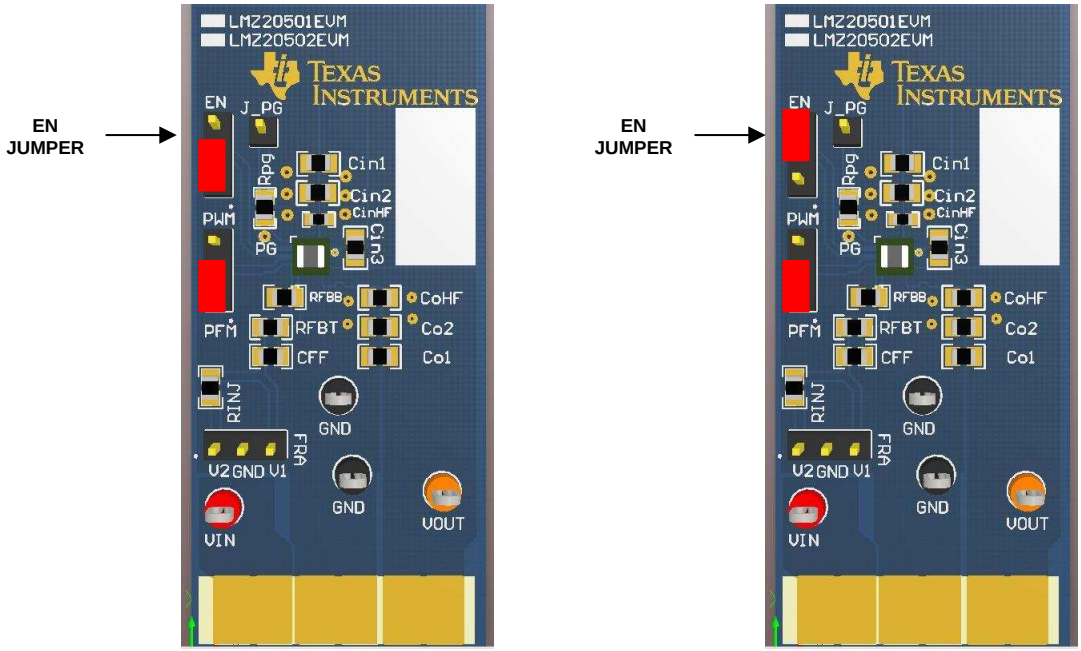


Figure 2. EN Jumper Configuration

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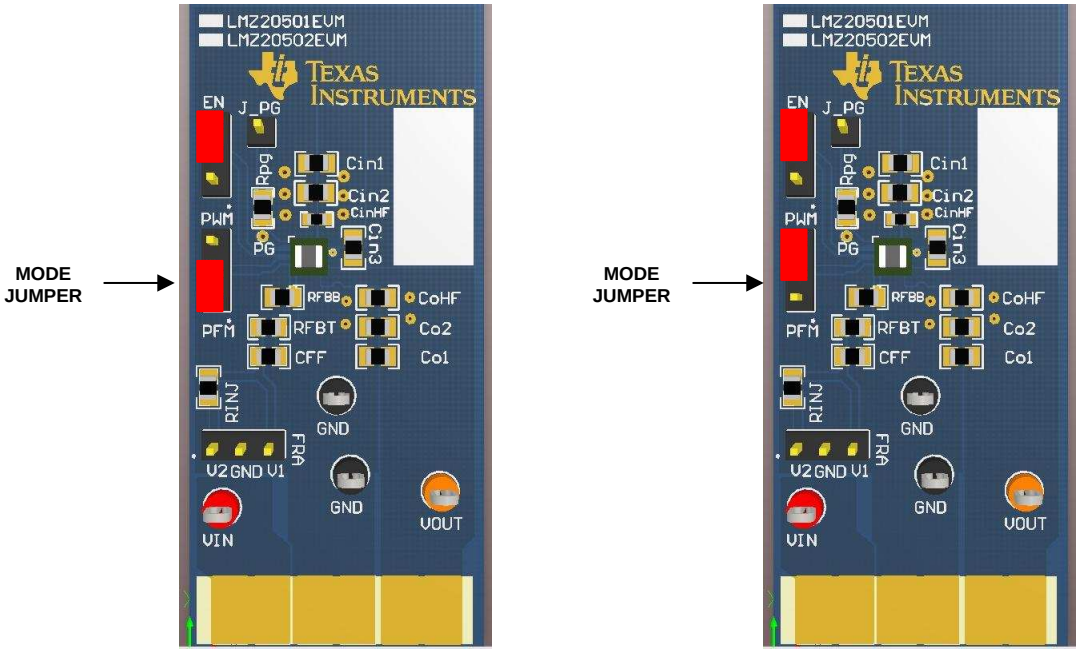


Figure 3. MODE Jumper Configuration

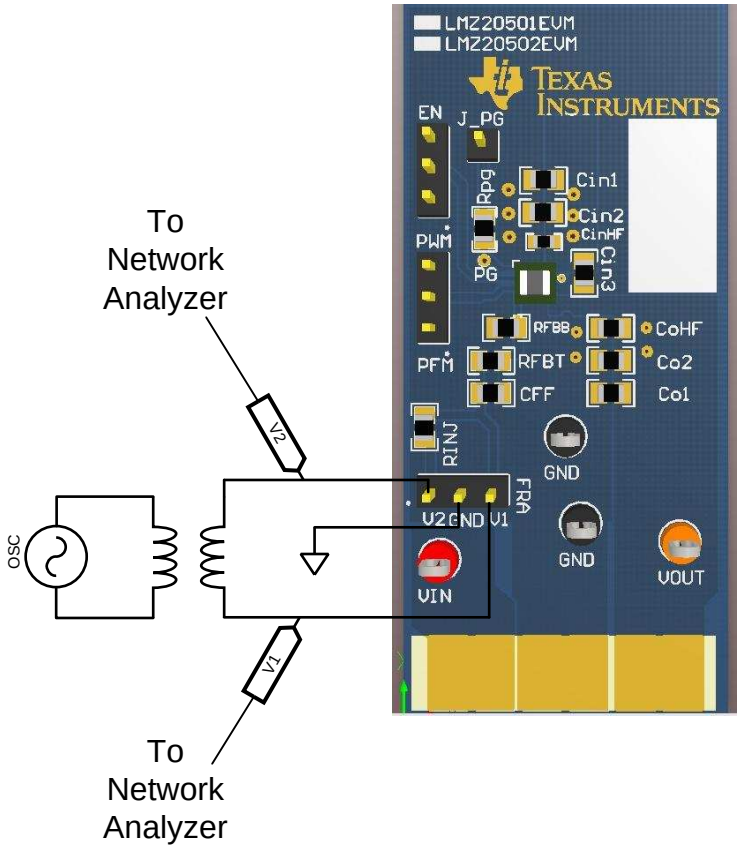


Figure 4. Frequency Response Analyzer Connections

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3.1 Edge Connector Description

VIN– Input supply to the module. Connect the supply from these pins to GND. Apply a voltage of between 2.7V and 5.5V from a supply that is capable of providing the required input current.

GND– Ground connection for the module.

VOUT– Output voltage connection. The user load should be connected between these pins and GND.

EN– Remote enable input of the converter. Remove the EN jumper and connect a control signal to this pin to remotely enable the converter.

VINS– Input voltage sense pin. For accurate input voltage measurements, the DMM should be connected between this pin and GNDS.

GNDS–Ground sense for all voltage measurements.

VOUTS– Output voltage sense pin. For accurate output voltage measurements, the DMM should be connected between this pin and GNDS.

RTD– A 100Ω RTD is connected from this pin to GNDS. It can be used to measure the temperature of the bottom of the board, if desired.

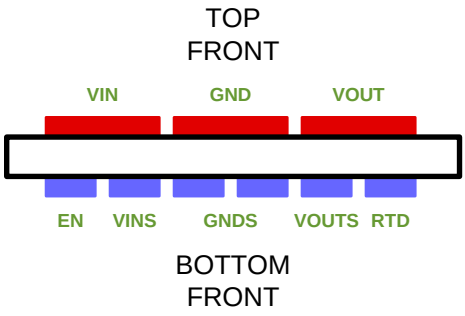


Figure 5. Edge Connector Layout

4 Typical Performance

Figure 6 through Figure 11 shows examples of typical performance curves. These curves are applicable to the circuit and components found in Figure 1 and are not guaranteed. The EMI results are valid for this EVM only and will depend on the physical layout of the board and its connections.

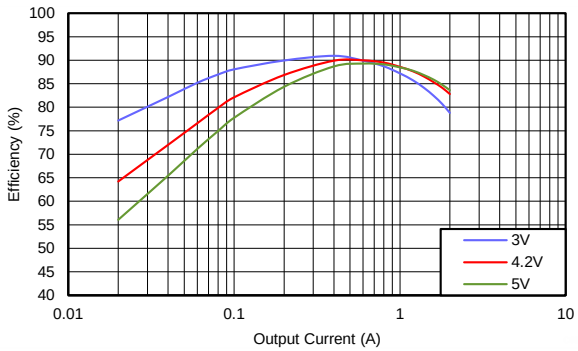


Figure 6. Efficiency, V_{OUT}=1.8V AUTO MODE

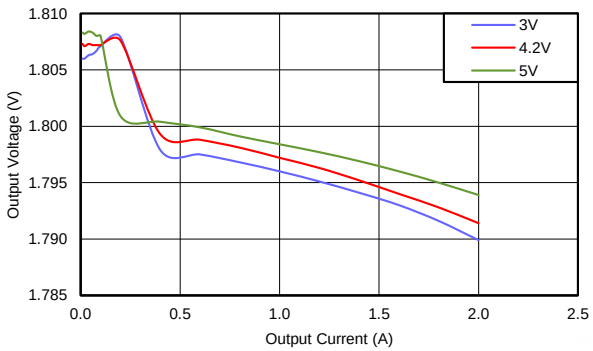


Figure 7. Regulation, AUTO MODE

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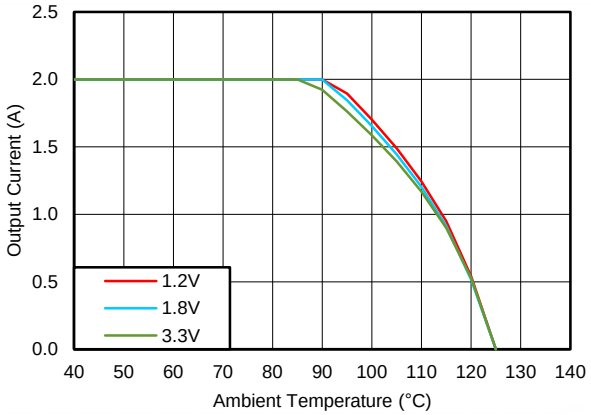


Figure 8. Maximum Output Current vs. Ambient Temperature for LMZ20502 θ_{JA}=44°C/W, Vin = 5V

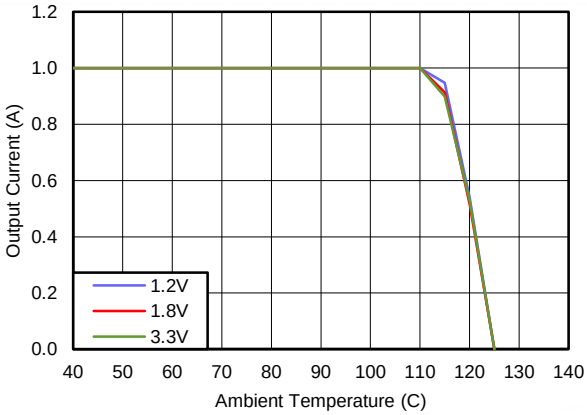


Figure 9. Maximum Output Current vs. Ambient Temperature for LMZ20501 θ_{JA}=44°C/W, Vin = 5V

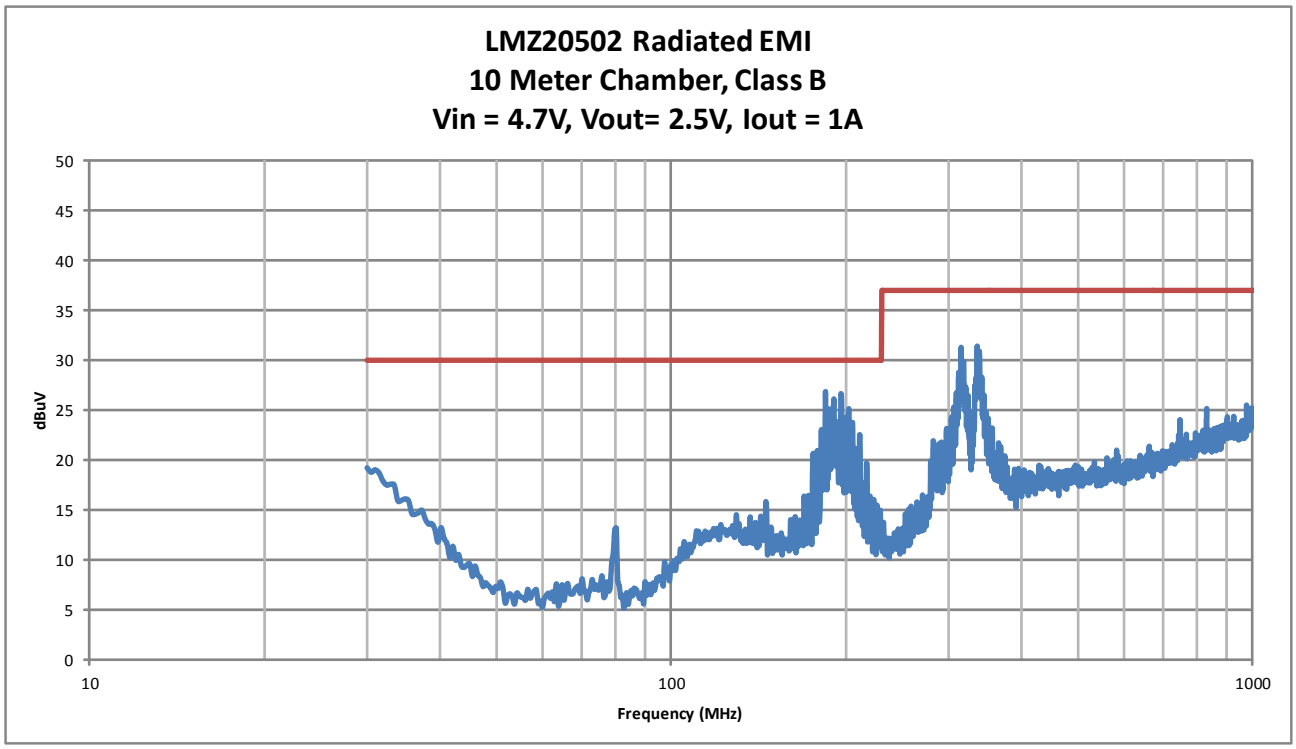


Figure 10. Radiated EMI, CISPR22, V_{OUT} = 2.5V, V_{IN} = 4.7V, I_{OUT} = 1A

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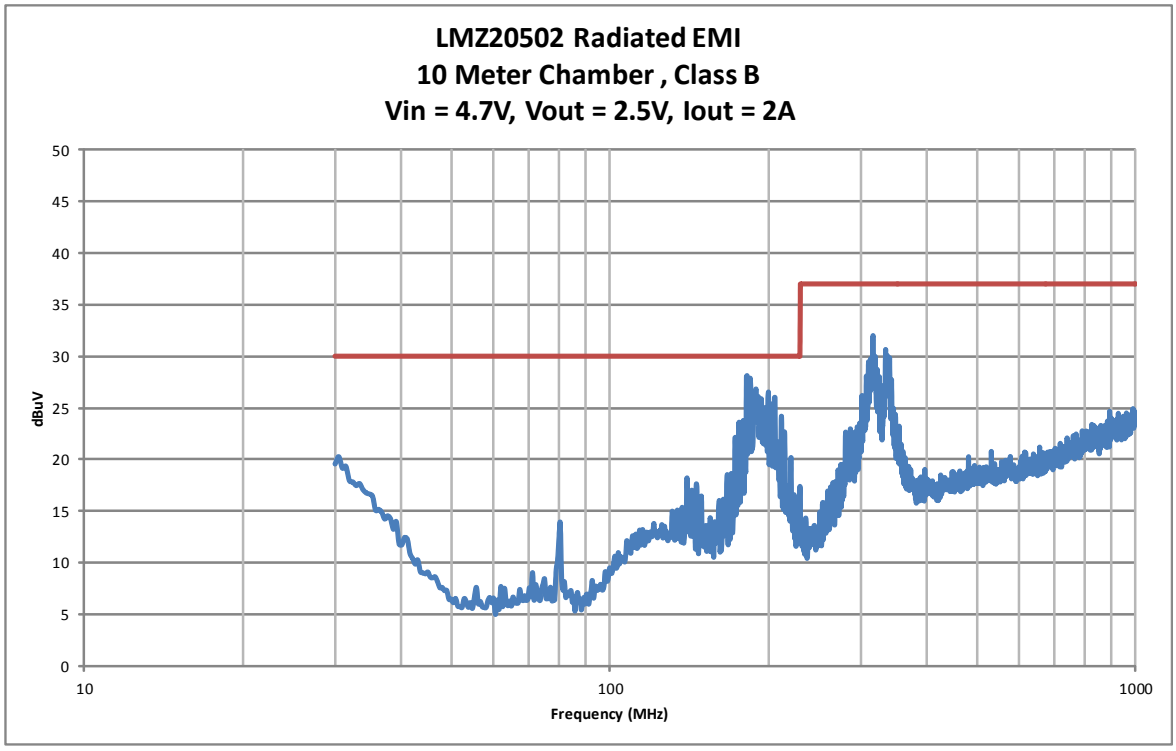


Figure 11. Radiated EMI, CISPR22, V_{OUT} = 2.5V, V_{IN} = 4.7V, I_{OUT} = 2A

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5 Board Layout

Figure 12 and Figure 13 show plots of the EVM PCB. The outer layers are two oz. copper; the inner layers are one oz. copper.

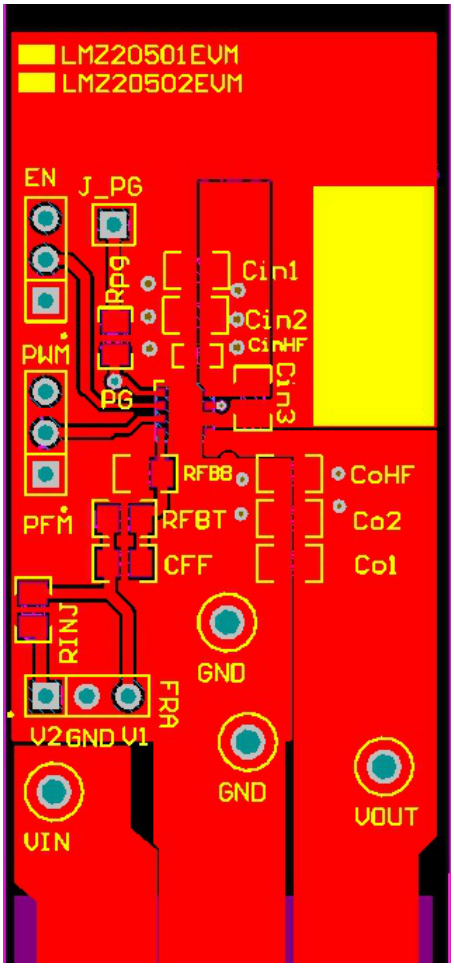


Figure 12. Top Metal of EVM

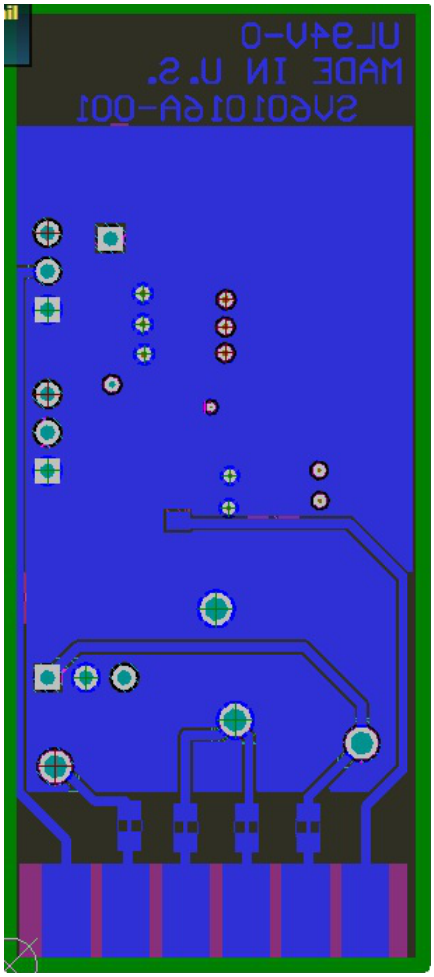


Figure 13. Bottom Metal of EVM

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6 Bill Of Materials

Figure 14 shows the BOM for the EVM module.

Designator	Quantity	Value	Description	Package	PartNumber	Manufacturer
CFF	1	47pF	CAP, CERM, 47pF, 100V, +/-5%, C0G/NP0, 0805	0805	08051A470JAT2A	AVX
Cin1, Cin2	2	22uF	CAP, CERM, 22uF, 10V, +80/-20%, Y5V, 1206	1206	C3216Y5V1A226Z	TDK
Cin3	1	10uF	CAP, CERM, 10uF, 10V, +/-10%, X7R, 0805	0805	GRM21BR71A106KE51L	MuRata
Cinhf	1	2.2uF	CAP, CERM, 2.2uF, 10V, +/-10%, X5R, 0603	0603	C0603C225K8PACTU	Kemet
Co1, Co2	2	10uF	CAP, CERM, 10uF, 10V, +/-10%, X5R, 0805	0805	C0805C106K8PACTU	Kemet
Cohf	1	2.2uF	CAP, CERM, 2.2uF, 16V, +/-10%, X5R, 0805	0805	0805YD225KAT2A	AVX
EN, FRA, PWM	3		Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator		TSW-103-07-G-S	Samtec, Inc.
J_PG	1		Header, TH, 100mil, 1pos, Gold plated, 230 mil above insulator	Testpoint	TSW-101-07-G-S	Samtec, Inc.
RFBB	1	40.2k	RES, 40.2k ohm, 1%, 0.125W, 0805	0805	CRCW080540K2FKEA	Vishay-Dale
RFBT	1	80.6k	RES, 80.6k ohm, 1%, 0.125W, 0805	0805	CRCW080580K6FKEA	Vishay-Dale
RINJ	1	10.0	RES, 10.0 ohm, 1%, 0.125W, 0805	0805	CRCW080510R0FKEA	Vishay-Dale
Rpg	1	10.0k	RES, 10.0k ohm, 1%, 0.1W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
RTD	1	100	RES, 100 ohm, 1%, 0.125W, 0805	0805	CRCW0805100RFKEA	Vishay-Dale
TP1	1	Red	Test Point, TH, Multipurpose, Red		5010	Keystone Electronics
TP2, TP3	2	Black	Test Point, TH, Multipurpose, Black		5011	Keystone Electronics
TP4	1	Orange	Test Point, TH, Multipurpose, Orange		5013	Keystone Electronics
U1	1		1A/2A Buck Simple Switcher Nano Module, SIL0008B	SIL0008B	LMZ20501SIL/LMZ20502SIL	Texas Instruments

Figure 14. EVM BOM

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      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

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      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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