

Using LMZ31506HEVM-692, LMZ31503EVM-692 and LMZ31506EVM-692 Evaluation Module

User's Guide



Literature Number: SNVU295

JULY 2013

LMZ31506H, LMZ31503 and LMZ31506 Simple Switcher® Power Module Evaluation Module

This user's guide contains background information for the LMZ31506H, LMZ31503, and LMZ31506 and support documentation for the LMZ31506HEVM-692, LMZ31503EVM-692 and LMZ31506EVM-692 evaluation module (LMZ3150xEVM-692).

1 Introduction

The LMZ31506H & LMZ31506 Simple Switcher® power modules provide up to 6-A of output current and the LMZ31503 provides up to 3-A of output current. These power modules have dual-voltage inputs for the power stage and control circuitry. The power stage input (PVIN) is rated for 1.6 V to 14.5 V whereas the control input (VIN) is rated for 4.5 V to 14.5 V. The LMZ3150xEVM-692 provides both inputs but is designed and tested with PVIN connected to VIN. Rated input voltage and output current range for the evaluation module are given in [Table 1](#).

1.1 Features

- Complete Integrated Power Module Allows Small Footprint, Low-Profile Design
- Efficiencies Up To 96%
- Wide-Output Voltage Adjust 0.6 V to 5.5 V, with 1% Reference Accuracy
- Adjustable Switching Frequency

1.2 Background

This evaluation module is designed to demonstrate the small printed-circuit-board areas that may be achieved when designing with the LMZ31506H, LMZ31503, and LMZ31506 power modules. The high-side and low-side MOSFETs are incorporated inside the device's package along with the gate drive circuitry. The low drain-to-source on-resistance of the MOSFET allows the LMZ31506H, LMZ31503, and LMZ31506 to achieve high efficiencies and helps keep the junction temperature low at high output currents. The compensation components are internal to the device, and external resistors and jumpers allow for adjustable output voltage and frequency adjustment. Additionally, the LMZ31506H, LMZ31503, and LMZ31506 provide adjustable slow start, tracking, and undervoltage lockout inputs. The absolute maximum input voltage is 15 V.

Table 1. Input Voltage and Output Current Summary

EVM	INPUT VOLTAGE RANGE	OUTPUT CURRENT RANGE
LMZ31506HEVM-692	PVIN = VIN = 4.5 V to 14.5 V	0 A to 6 A
LMZ31503EVM-692	PVIN = VIN = 4.5 V to 14.5 V	0 A to 3 A
LMZ31506EVM-692	PVIN = VIN = 4.5 V to 14.5 V	0 A to 6 A

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2 Schematic

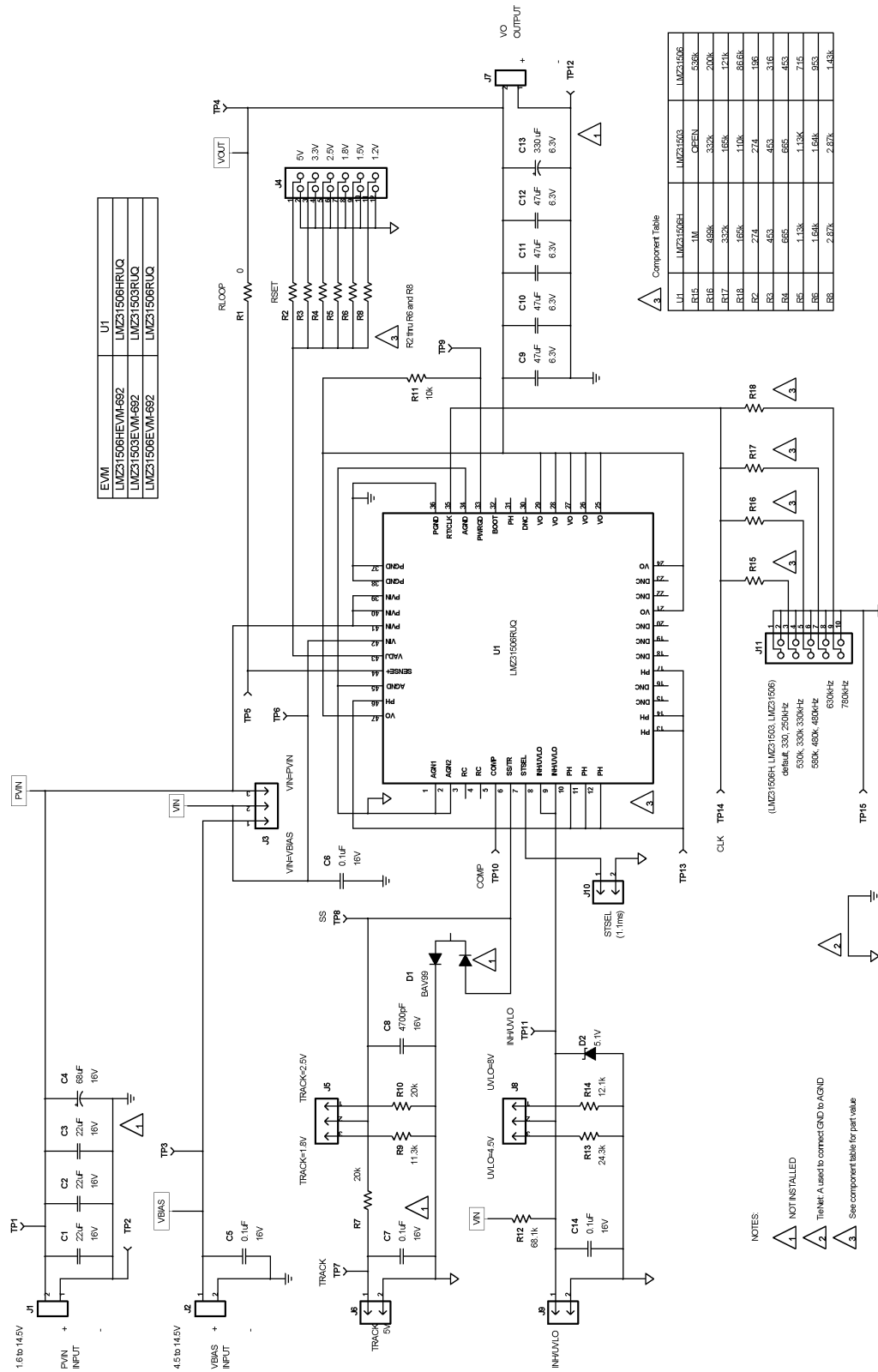


Figure 1. LMZ3150XEVM-692 Schematic

3 Modifying the EVM

These evaluation modules are designed to provide access to the features of the LMZ31506H, LMZ31503, and LMZ31506.

3.1 Output Voltage Setpoint

Select the output voltage at J4. Use the silk screen to select the desired voltage preprogrammed on the module (see [Figure 13](#)). If a different voltage is needed, the RSET resistor (any of R2 thru R6 and R8) may be changed to a value listed in the component data sheet (LMZ31506H, LMZ31503, and LMZ31506).

When all jumpers on J4 are open, the default output voltage for the components is selected. See [Table 2](#).

Table 2. Component Default Output Voltage

COMPONENT	DEFAULT VOLTAGE
LMZ31506H	Not recommended
LMZ31503	0.8 V
LMZ31506	0.6 V

3.2 Frequency Select

The Switching frequency is selected at J11. [Table 3](#) shows the selection options for each of the three evaluation modules.

Table 3. Selection Options

JUMPER POSITION	LMZ31506HEVM-692	LMZ31503EVM-692	LMZ31506EVM-692
MIN	480 kHz	330 kHz	250 kHz
1	530 kHz	330 kHz	330 kHz
2	580 kHz	480 kHz	480 kHz
3	630 kHz	630 kHz	630 kHz
MAX	780 kHz	780 kHz	780 kHz

3.3 Slow Start Time

The slow start time can be adjusted by changing the value of C8. See the slow start table in the LMZ31506H, LMZ31503, and LMZ31506 data sheets for more information. The EVM is set for a slow start time of 2.8 ms, (C8 = 4700 pF and J10 installed).

3.4 Track In

The LMZ31506H, LMZ31503, and LMZ31506 can track an external voltage during start-up. The J6 connector is provided to allow connection to an external voltage. Ratio-metric or simultaneous tracking can be implemented using the provided resistor dividers with J5. See the product data sheet for details.

3.5 Adjustable UVLO

The undervoltage lockout (UVLO) can be adjusted as described in the LMZ31506H, LMZ31503 and LMZ31506 data sheets. The EVM provides two selectable UVLO setpoints using the provided resistor dividers and J8. J9 provides an inhibit input.

3.6 Input Voltage Rails

The EVM is designed to accommodate different input voltage levels for the power stage and control logic. During normal operation, the PVIN and VIN inputs are connected using a jumper across the top two pins of J3 (VIN = PVIN position). The single input voltage is supplied at J1. If desired, input voltage may be separated by moving the J3 jumper to the lower two pins (VIN = VBIAS position). Dual input voltages must then be provided at both J1 and J2.

4 TEST SET-UP

This section describes how to properly set-up and use the LMZ3150xEVM-692 evaluation module.

4.1 Input/Output Connections

The LMZ3150xEVM-692 is provided with input/output connectors and test points as shown in [Table 4](#). A power supply capable of supplying 4 A must be connected to J1 through a pair of 20 AWG wires. The jumper across J3 must be in place. See [Section 3.6](#) for split input voltage rail operation. The load must be connected to J7 through a pair of 20 AWG wires. The maximum load current capability must be 6 A. Wire lengths must be minimized to reduce losses in the wires. Test-point TP1 provides a place to monitor the V_{IN} input voltages with TP2 providing a convenient ground reference. TP4 is used to monitor the output voltage with TP12 as the ground reference.

Table 4. EVM Connectors and Test Points

REF DES	LABEL	DESCRIPTION
J1	PVIN	Primary VIN connector
J2	VBIAS	VBIAS input voltage input connector
J3	VIN	Jumper used to connect VIN to PVIN. EVM default setting connects VIN to PVIN.
J7	VOUT	VOUT connector
J4	VADJ	VOUT selection. Default VOUT is 3.3 V.
J11	FREQ	Switching frequency selection. Default frequency is 630 kHz.
J6	TR_IN	TRACK IN connector. J5 provides two divider settings.
J5	SS_TR	Track voltage select jumper. Used with J6.
J9	INH_UVLO	Enable jumper. Install shunt to inhibit the power supply.
J8	INH_UVLO	Selects UVLO for power supply turn on. Default setting is for 8-V UVLO.
J10	STSEL	Internal slow start select jumper. Install shunt for internal slow start.
TP1	PVIN	PVIN circuit point
TP3	VBIAS	VBIAS circuit point
TP6	VIN	VIN circuit point
TP4	VOUT	VOUT circuit point
TP2, TP12	GND	Power grounds
TP15	AGND	Analog ground
TP7	TR_IN	Track input
TP8	SS_TR	Tracking input after divider
TP9	PWRGD	Power good status
TP14	RT/CLK	SYNC input
TP10	COMP	Error amplifier output
TP13	PH	Switch node
TP11	INH_UVLO	Inhibit and UVLO input
TP5	SENSE+	VOUT remote sense node connected to J7 pin 2. TP5 can be used for measuring the loop response along with changing R1 to 49.9 Ω .

5 Typical Performance Data

Figure 2 through Figure 12 present characteristic performance data taken from the LMZ31506HEVM-692 only. For data regarding the LMZ31503 and the LMZ31506 please see the product data sheet.

5.1 Efficiency vs Input Voltage

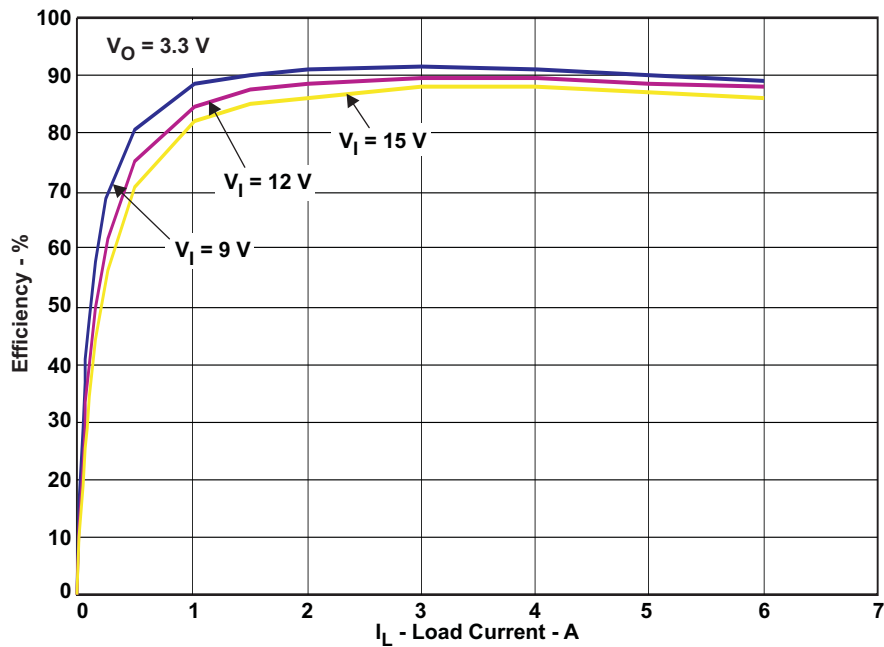


Figure 2. Efficiency vs Voltage at 25°C

5.2 Light-Load Efficiency vs Input Voltage

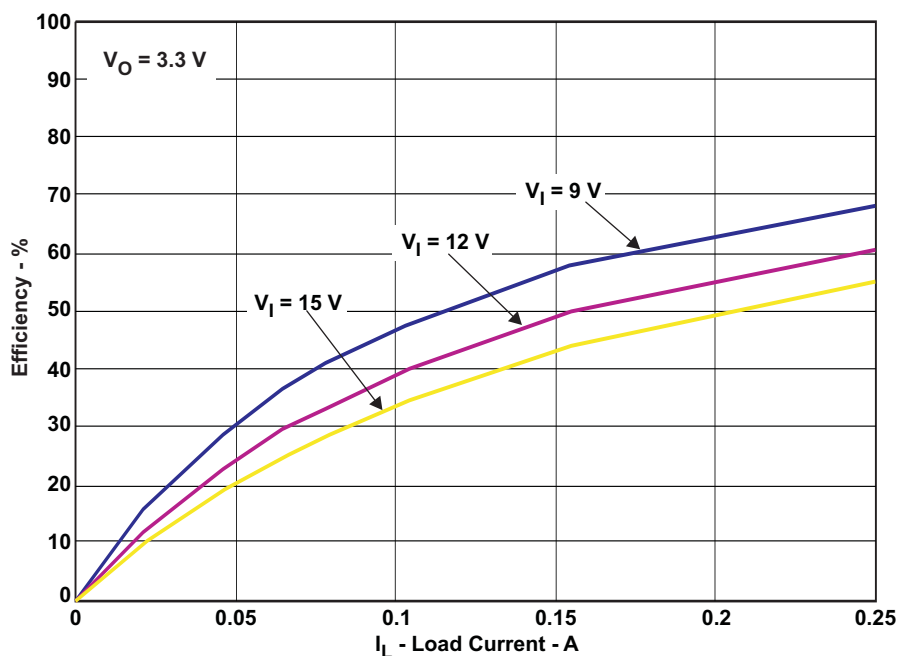


Figure 3. Light-Load Efficiency vs Input Voltage at 25°C

5.3 Efficiency vs Output Voltage/Frequency, $P_{VIN} = 12\text{ V}$

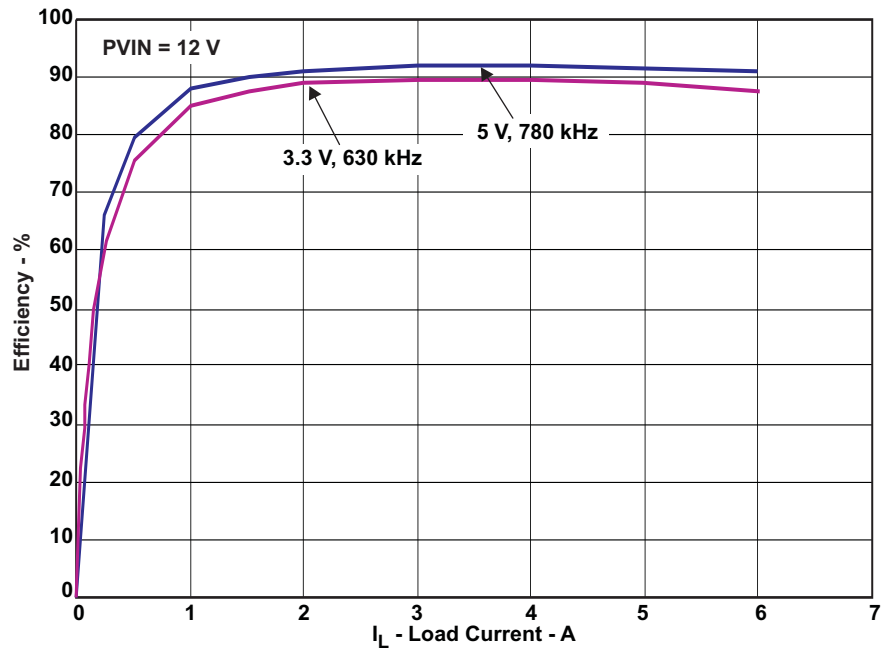


Figure 4. Efficiency vs Output Voltage at 25°C

5.4 Efficiency vs Output Voltage/Frequency, $P_{VIN} = 5\text{ V}$

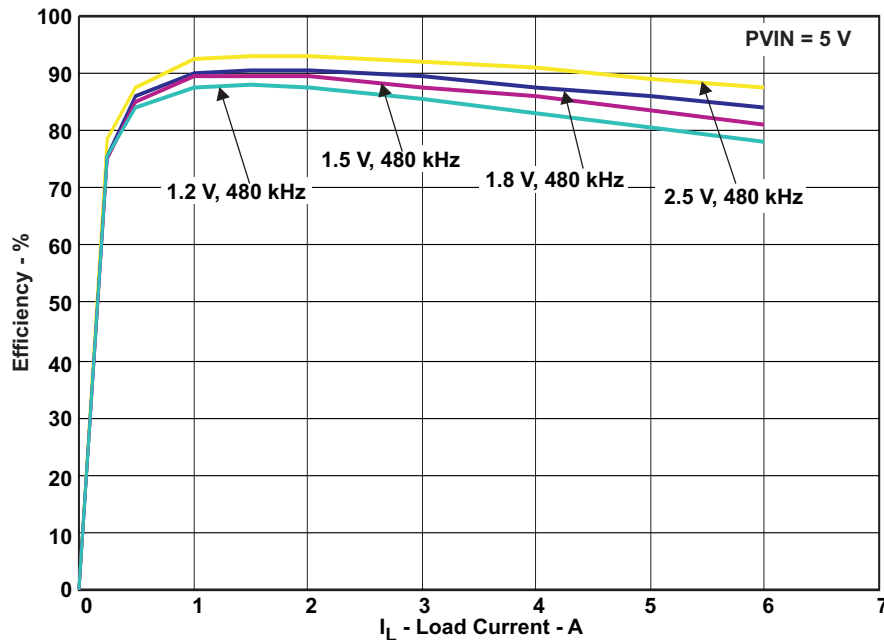


Figure 5. Efficiency vs Output Voltage/Frequency at 25°C

5.5 Output Voltage Load Regulation

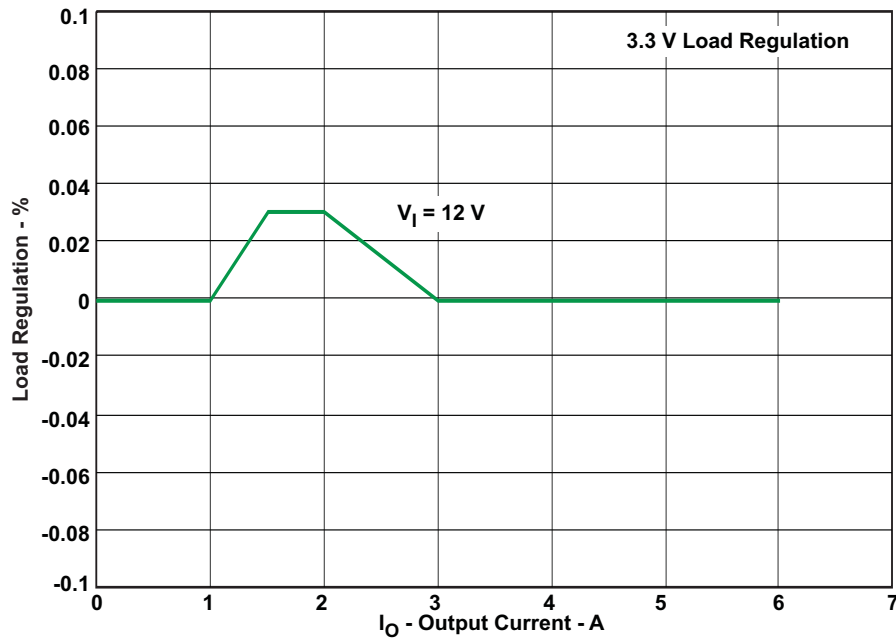


Figure 6. Load Regulation at 25°C

5.6 Output Voltage Line Regulation

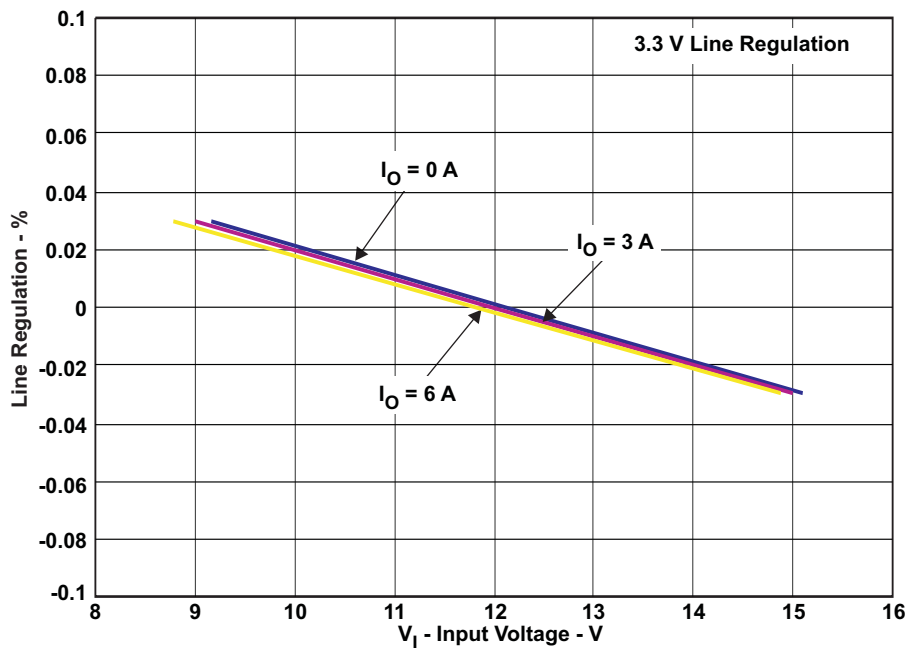


Figure 7. Line Regulation at 25°C

5.7 3.3-V LMZ31506EVM-692 Response to Load Transients

Figure 8 shows the LMZ31506EVM-692 response to load transients. The current step is from 1.5 A to 4.5 A at 12-V input. Total peak-to-peak voltage variation is as shown, including ripple and noise on the output.

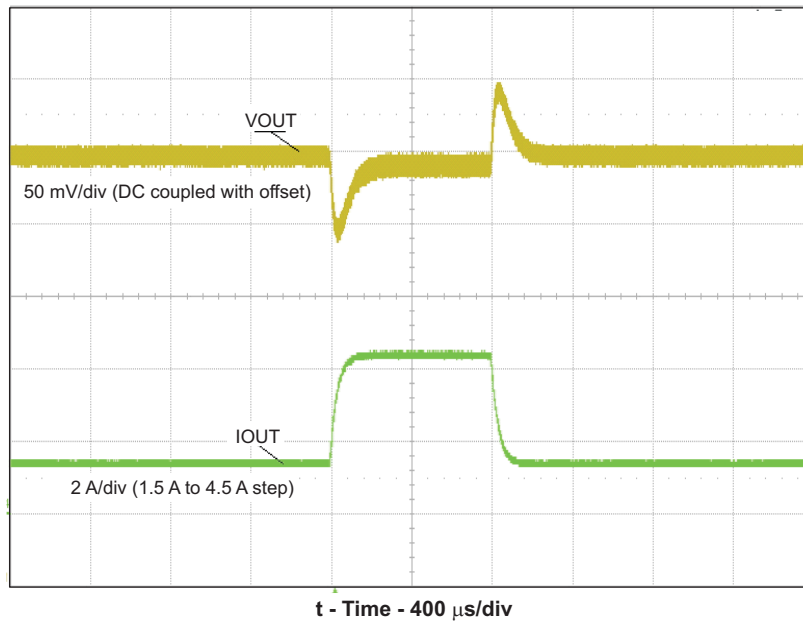


Figure 8. 3.3-V LMZ31506HEVM-692 Transient Response at 25°C

5.8 LMZ31506 Loop Response

Figure 9 shows the LMZ31506EVM-692 loop response. The unity gain bandwidth is 50 kHz, phase margin is 70 degrees, gain margin is 19 dB and the gain slope is -1 .

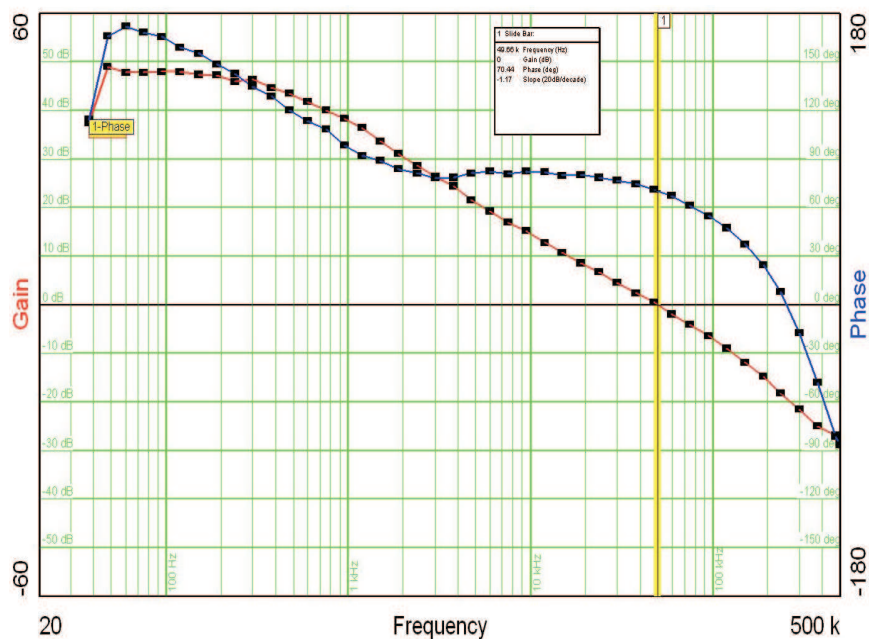


Figure 9. LMZ31506EVM-692 Loop Response at 25°C

5.9 LMZ31506EVM-692 Voltage Ripple

Figure 10 shows the LMZ31506EVM-692 output voltage ripple when operating from 12 V with an output load of 6 A.

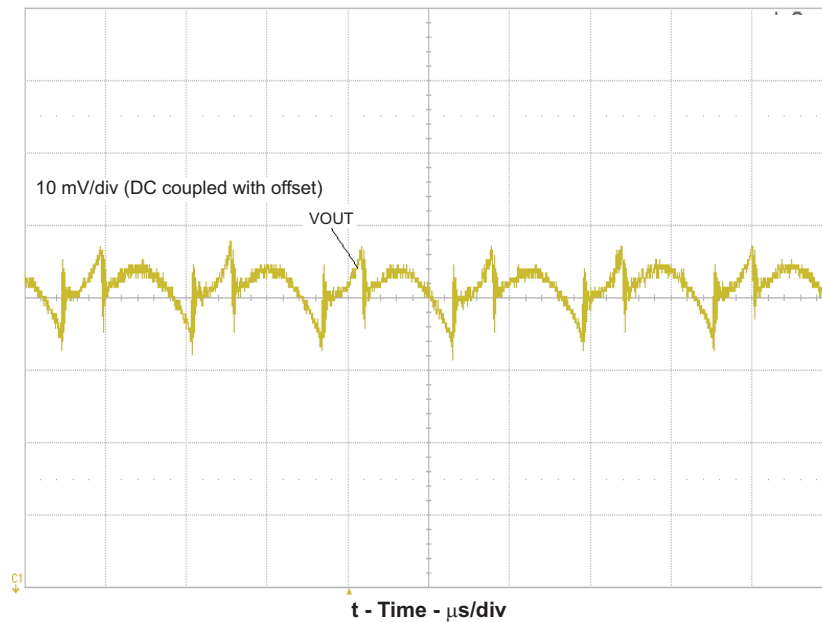


Figure 10. LMZ31506EVM-692 Output Voltage Ripple

Figure 11 shows the LMZ31506EVM-692 input voltage ripple when operating from 12 V with an output load of 6 A.

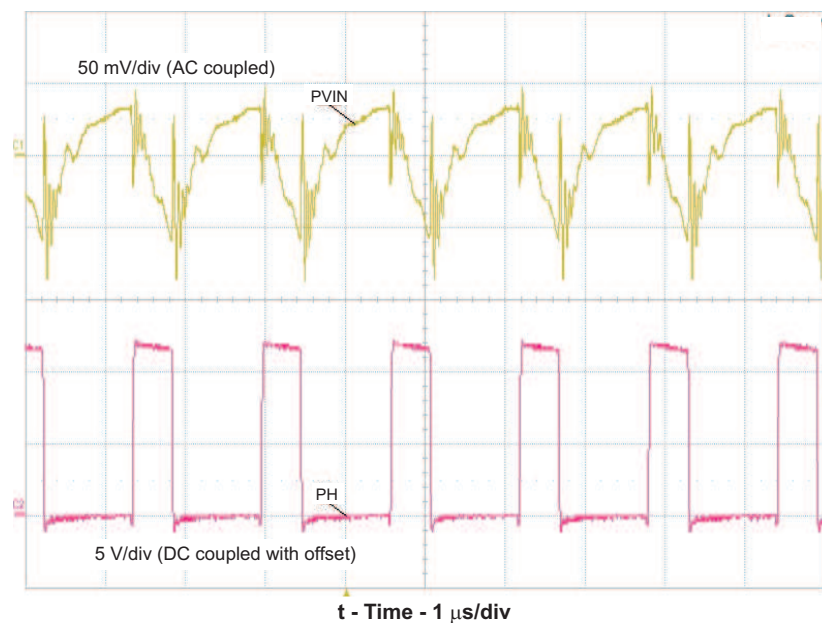


Figure 11. LMZ31506EVM-692 Input Voltage Ripple

5.10 Power Up

Figure 12 shows the LMZ31506EVM-692 start-up waveforms with rising PVIN. In Figure 12, the output starts to rise when PVIN reaches the rising UVLO of 8 V. J9 can also be used to inhibit VOUT when PVIN is present.

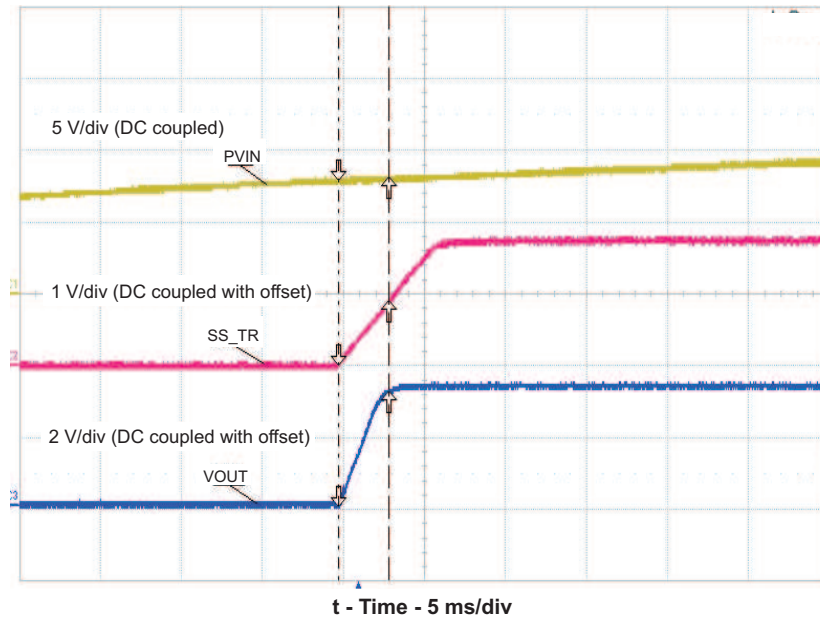


Figure 12. LMZ31506EVM-692 Start-Up Waveforms With Rising PVIN

6 Board Layout/Assembly Drawing

This section provides a description of the LMZ3150xEVM-692, board layout, and layer illustrations.

6.1 Layout

The board layout for the LMZ3150xEVM-692 is shown in Figure 13 through Figure 16. The topside layer of the EVM is laid out with test points and jumpers to easily evaluate the power module in any operating condition. The top, bottom, and internal layers are 2-oz. copper. A basic set of layout guidelines include:

- Place the input capacitors close to the PVIN and PGND terminals.
- Place the output capacitors close to the VO and PGND terminals.
- AGND is a 0-Vdc reference for the analog control circuitry.
- Connect AGND to PGND at a single point.
- AGND, terminal 45 provides a means to remove heat from the device and must be connected to an AGND plane with multiple vias as shown in the product data sheet.
- The SENSE+ pin (pin 44) provides a remote sense function for the device. Connect the SENSE+ pin to VO near the load.
- Analog control pins: Connect the analog control pins (VADJ, RT/CLK, INH/UVLO, STSEL, and SS/TR) to AGND using the recommended circuit components.

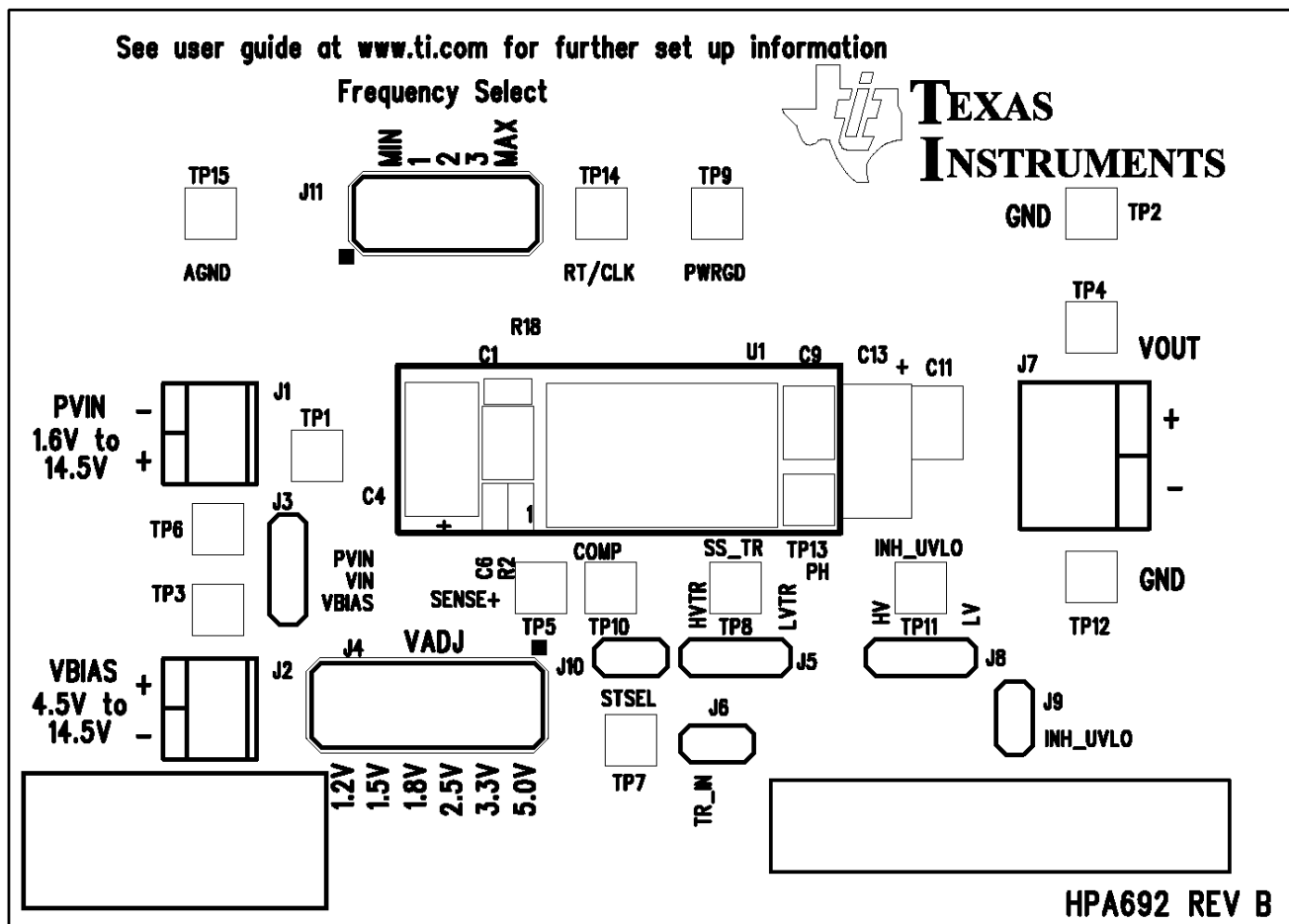


Figure 13. LMZ3150xEVM-692 Top-Side Layer and Assembly

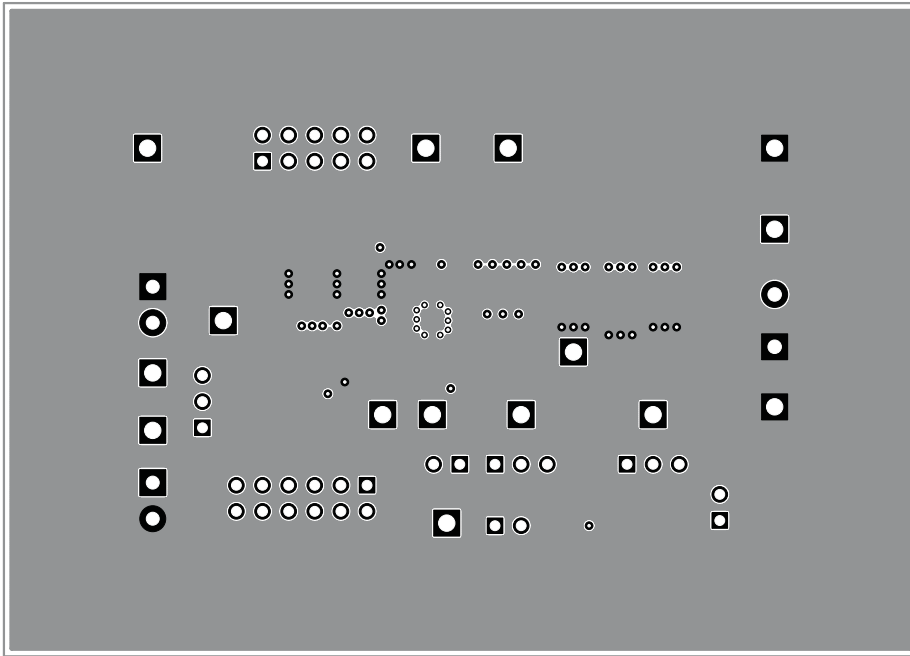


Figure 14. LMZ3150xEVM-692 Layer 2

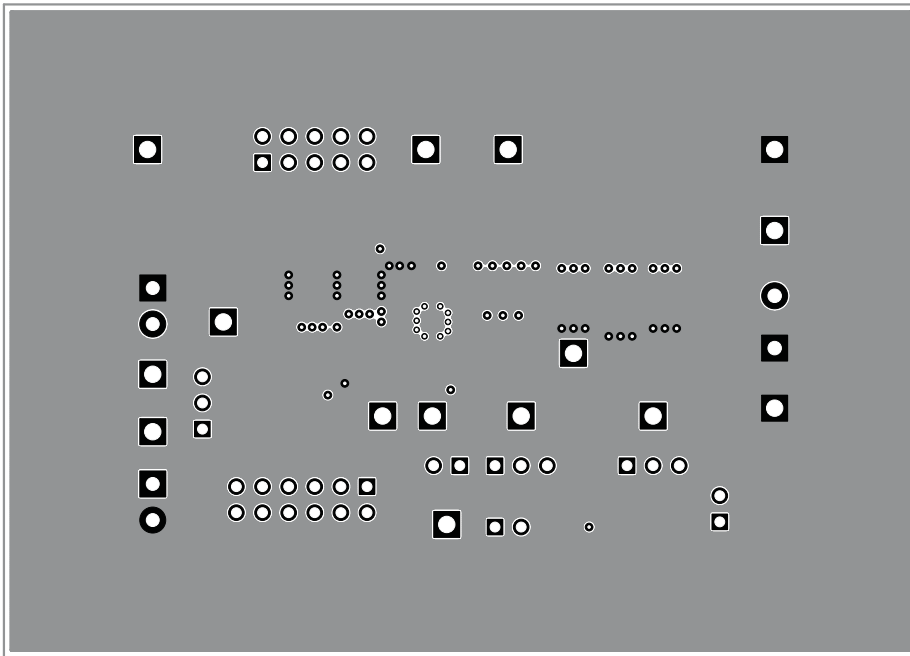


Figure 15. LMZ3150xEVM-692 Layer 3

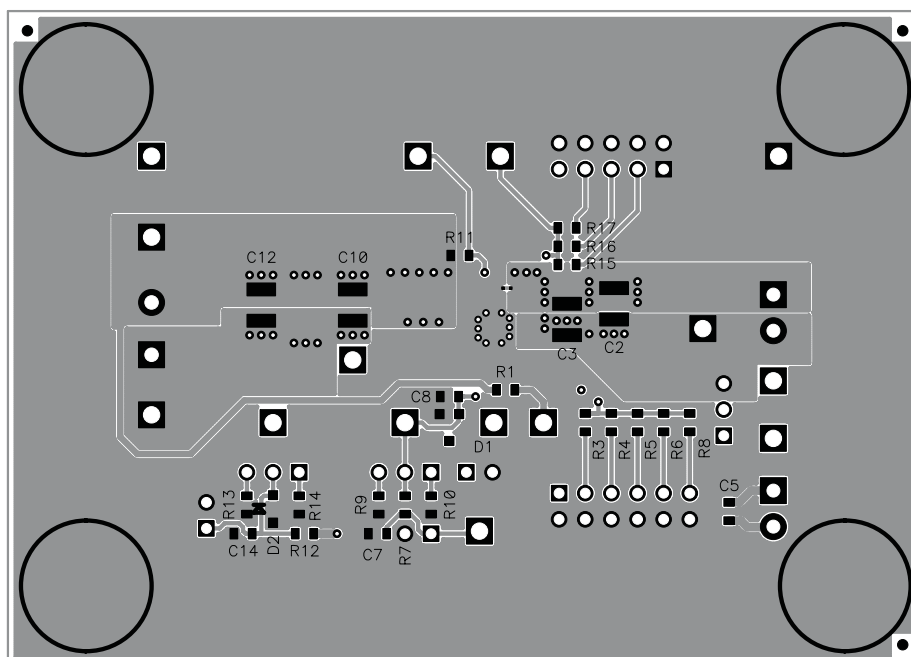


Figure 16. LMZ3150xEVM-692 Bottom-Side Layer and Assembly

6.2 Estimated Circuit Area

The estimated printed-circuit board area for the components used in this design is 0.55 in² (354 mm²). This area does not include test point or connectors.

7 List of Materials

Table 5 presents the List of Materials for the LMZ31506HEVM-692, LMZ31503EVM-692 and LMZ31506EVM-692.

Table 5. LMZ3150xEVM-692 List of Materials

-003	-002	-001	REF DES	DESCRIPTION	PART NUMBER	MFR
2	2	2	C1, C2	Capacitor, ceramic, 16 V, X5R, 10%, 22 μ F, 1210	GRM32ER61E226K	Murata
0	0	0	C3	Capacitor, ceramic, 16 V, X5R, 10%, 22 μ F, 1210	GRM32ER61E226K	Murata
0	0	0	C13	Capacitor, polymer tant, 6.3 V, \pm 20%, 330 μ F, 7343(D)	T530D337M006ATE006	Kemet
1	1	1	C4	Capacitor, polymer tantalum, 16 V, 20%, 68 μ F, 7343(D)	16TQC68M	Sanyo
3	3	3	C5, C6, C14	Capacitor, ceramic, 16 V, X7R, 10%, 0.1 μ F, 0603	Std	Std
0	0	0	C7	Capacitor, ceramic, 16 V, X7R, 10%, 0.1 μ F, 0603	Std	Std
1	1	1	C8	Capacitor, ceramic, 16 V, X7R, 10%, 4700 pF, 0603	Std	Std
4	4	4	C9, C10, C11, C12	Capacitor, ceramic, 6.3 V, X5R, 10%, 47 μ F, 1210	GRM32ER60J476M	Murata
0	0	0	D1	Diode, dual ultra fast, series, 200 mA, 70 V, BAV99, SOT23	BAV99	Fairchild
1	1	1	D2	Diode, Zener, 200 mW, 5.1 V, SOD-323	BZT52C5V1S	Diodes Inc.
2	2	2	J1, J2	Terminal block, 2 pin, 6 A, 3.5 mm, 0.27 inch x 0.25 inch	ED555/2DS	OST
1	1	1	J11	Header, male 2x5 pin, 100-mil spacing, 0.100 inch x 5 inch x 2 inch	PEC05DAAN	Sullins
3	3	3	J3, J5, J8	Header, male 3 pin, 100-mil spacing, 0.100 inch x 3 inch	PEC03SAAN	Sullins
1	1	1	J4	Header, male 2x6 pin, 100-mil spacing, 0.100 inch x 2 inch x 6 inch	PEC06DAAN	Sullins
3	3	3	J6, J9, J10	Header, male 2-pin, 100mil spacing, 0.100 inch x 2 inch	PEC02SAAN	Sullins
1	1	1	J7	Terminal block, 2 pin, 15 A, 5.1 mm, 0.40 inch x 0.35 inch	ED120/2DS	OST
1	1	1	R1	Resistor, chip, 1/10 W, -100/+600 ppm/ $^{\circ}$ C, 0 Ω , 0603	Std	Std

Table 5. LMZ3150xEVM-692 List of Materials (continued)

-003	-002	-001	REF DES	DESCRIPTION	PART NUMBER	MFR
1	1	1	R11	Resistor, chip, 1/16 W, 1%, 10 kΩ, 0603	Std	Std
1	1	1	R12	Resistor, chip, 1/16 W, 1%, 68.1 kΩ, 0603	Std	Std
1	1	1	R13	Resistor, chip, 1/16 W, 1%, 24.3 kΩ, 0603	Std	Std
1	1	1	R14	Resistor, chip, 1/16 W, 1%, 12.1 kΩ, 0603	Std	Std
0	0	1	R15	Resistor, chip, 1/16 W, 1%, 1 MΩ, 0603	Std	Std
1	0	0	R15	Resistor, chip, 1/16 W, 1%, 536 kΩ, 0603	Std	Std
0	0	1	R16	Resistor, chip, 1/16 W, 1%, 499 kΩ, 0603	Std	Std
0	1	0	R16	Resistor, chip, 1/16 W, 1%, 332 kΩ, 0603	Std	Std
1	0	0	R16	Resistor, chip, 1/16 W, 1%, 200 kΩ, 0603	Std	Std
0	0	1	R17	Resistor, chip, 1/16 W, 1%, 332 kΩ, 0603	Std	Std
0	1	0	R17	Resistor, chip, 1/16 W, 1%, 165 kΩ, 0603	Std	Std
1	0	0	R17	Resistor, chip, 1/16 W, 1%, 121 kΩ, 0603	Std	Std
0	0	1	R18	Resistor, chip, 1/16 W, 1%, 165 kΩ, 0603	Std	Std
0	1	0	R18	Resistor, chip, 1/16 W, 1%, 110 kΩ, 0603	Std	Std
1	0	0	R18	Resistor, chip, 1/16 W, 1%, 86.6 kΩ, 0603	Std	Std
0	1	1	R2	Resistor, chip, 1/16 W, 1%, 274 Ω, 0603	Std	Std
1	0	0	R2	Resistor, chip, 1/16 W, 1%, 196 Ω, 0603	Std	Std
0	1	1	R3	Resistor, chip, 1/16 W, 1%, 453 Ω, 0603	Std	Std
1	0	0	R3	Resistor, chip, 1/16 W, 1%, 316 Ω, 0603	Std	Std
0	1	1	R4	Resistor, chip, 1/16 W, 1%, 665 Ω, 0603	Std	Std
1	0	0	R4	Resistor, chip, 1/16 W, 1%, 453 Ω, 0603	Std	Std
0	1	1	R5	Resistor, chip, 1/16 W, 1%, 1.13 kΩ, 0603	Std	Std
1	0	0	R5	Resistor, chip, 1/16 W, 1%, 715 Ω, 0603	Std	Std
0	1	1	R6	Resistor, chip, 1/16 W, 1%, 1.64 kΩ, 0603	Std	Std
1	0	0	R6	Resistor, chip, 1/16 W, 1%, 953 Ω, 0603	Std	Std
0	1	1	R8	Resistor, chip, 1/16 W, 1%, 2.87 kΩ, 0603	Std	Std
1	0	0	R8	Resistor, chip, 1/16 W, 1%, 1.43 kΩ, 0603	Std	Std
2	2	2	R7, R10	Resistor, chip, 1/16 W, 1%, 20 kΩ, 0603	Std	Std
0	0	0	R6	Resistor, chip, 1/16 W, 1%, 0603	Std	Std
1	1	1	R9	Resistor, chip, 1/16 W, 1%, 11.3 kΩ, 0603	Std	Std

Table 5. LMZ3150xEVM-692 List of Materials (continued)

-003	-002	-001	REF DES	DESCRIPTION	PART NUMBER	MFR
4	4	4	TP1, TP3, TP4, TP6	Test point, red, thru hole, 5010, 0.125 inch x 0.125 inch	5010	Keystone
3	3	3	TP2, TP12, TP15	Test point, black, thru hole, 5011, 0.125 inch x 0.125 inch	5011	Keystone
3	3	3	TP5, TP10, TP13	Test point, orange, thru hole, 5013, 0.125 inch x 0.125 inch	5013	Keystone
5	5	5	TP7, TP8, TP9, TP11, TP14	Test point, white, thru hole, 5012, 0.125 inch x 0.125 inch	5012	Keystone
0	0	1	U1	5-V Input, 6-A Sync. Buck, SWIFT Module, QFN	LMZ31506HRUQ	TI
0	1	0	U1	5-V Input, 3-A Sync. Buck, SWIFT Module, QFN	LMZ31503RUQ	TI
1	0	0	U1	5-V Input, 6-A Sync. Buck, SWIFT Module, QFN	LMZ31506RUQ	TI
4	4	4		Bumpon hemisphere 0.44 x 0.20 black	SJ-5003	3M
5	5	5		Shunt, black, 100 mil	929950-00	3M
1	1	1	--	PCB, 3.5 inch x 2.5 inch x 0.062 inch	HPA692	Any

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

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As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

Concerning EVMs including detachable antennas

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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EVALUATION BOARD/KIT/MODULE (EVM) WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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