SN6501 Multi-Transformer EVM User's Guide

This user's guide explains how to quickly obtain the push-pull converter performance results with the SN6501 evaluation module (EVM). This EVM provides five push-pull converters for various input-to-output voltage conversions utilizing regulated and non-regulated outputs. All push-pull converters use low-power, center-tapped transformers from Wurth-Electronics/Midcom whose designs have been optimized in form-factor, turns ratio, and saturation product to operate in combination with the SN6501 transformer driver. Table 1 lists the push-pull converter configurations with their associated transformers and Figure 3 shows the EVM schematic.

Table 1. Push-pull Converters Provided on the SN6501 EVM

Converter Configuration	Application VIN : VOUT	LDO	Xfmr No.	Turns Ratio	V-T (Vμs)	Performance Characteristics
1	3.3 V : 3.3 V	No	T1	1.0:1.1	7	Figure 6 and Figure 7
2	5 V : 5 V		T2	1.0:1.1	11	Figure 8 and Figure 9
3	3.3 V : 5 V		T3	1.0:1.7		Figure 10 and Figure 11
4	3.3 V : 5 V	Yes	T4	1.0:2.0		Figure 12 and Figure 13
5a	3.3 V : 3.3 V		T5	1.0:1.3		Figure 14 and Figure 15
5b	5 V : 5 V					Figure 16 andFigure 17

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1 Performance Measurements

Figure 1 shows the principle measurement set-up when using discrete volt and amp meters. Note: Sense lines have been used to prevent efficiency losses due to I^2R heating.

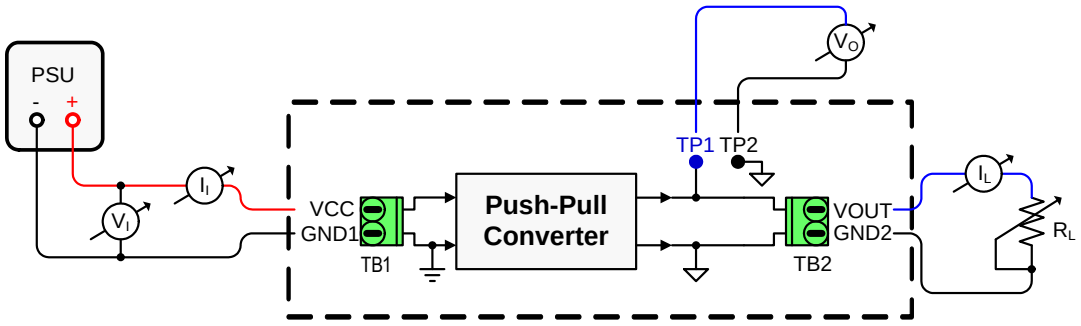

Figure 1. Measurement Set-Up for Measuring Output Voltage and Efficiency as a Function of Load Current

The nominal input voltage V_I of 3.3 V or 5 V, depending on the push-pull converter configuration, is applied to the input terminal block, while measuring the input current I_I. The output voltage V_O, taken from the output and ground test pins TPx, is recorded as a function of the load current I_L, which is adjusted with the load resistor R_L, that connects to the output terminal block. While the above measurement principle applies to all push-pull converters, the 5th converter providing two regulated outputs allows for only one linear regulator (LDO) to be active while the other one must be disabled. Thus, for a 3.3 Vin-to-3.3 Vout or a 5 Vin-to-5 Vout configuration, apply the jumper settings as shown in Figure 2.

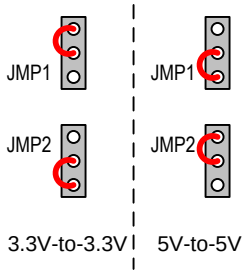

Figure 2. Jumper Settings

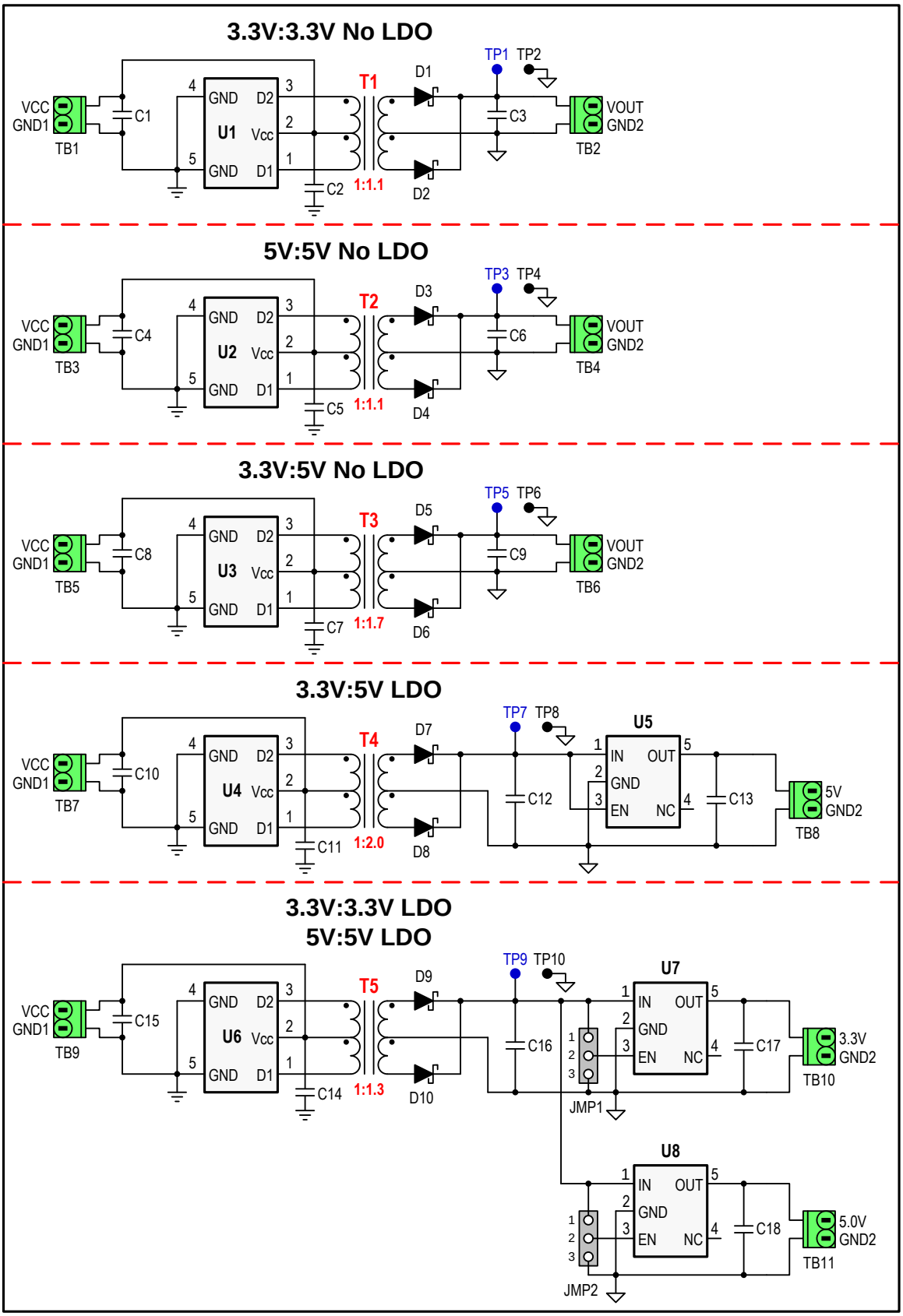

Figure 3. SN6501 EVM Schematic

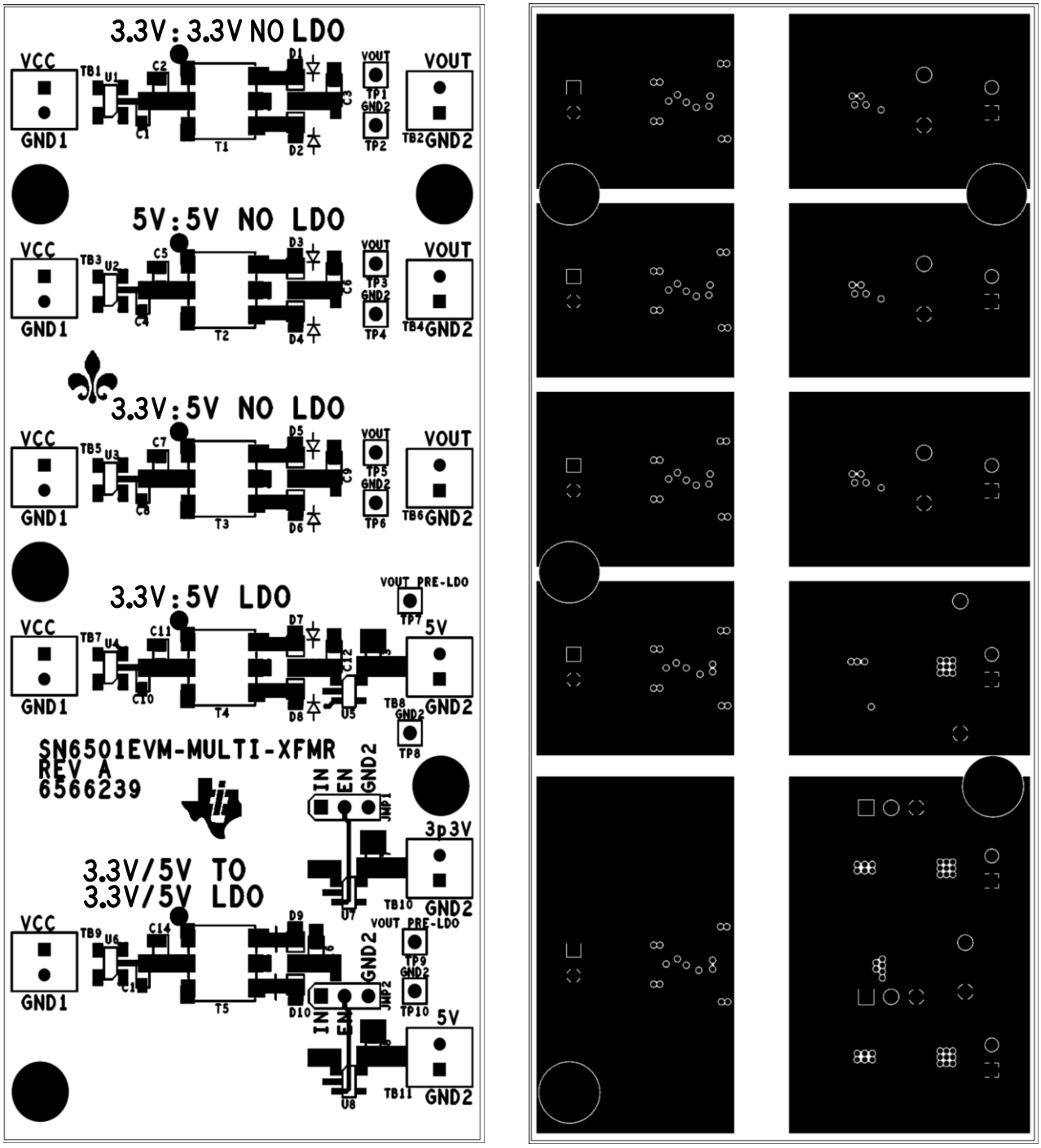

Figure 4. Top Layer (Left) and Layer 2 (Right)

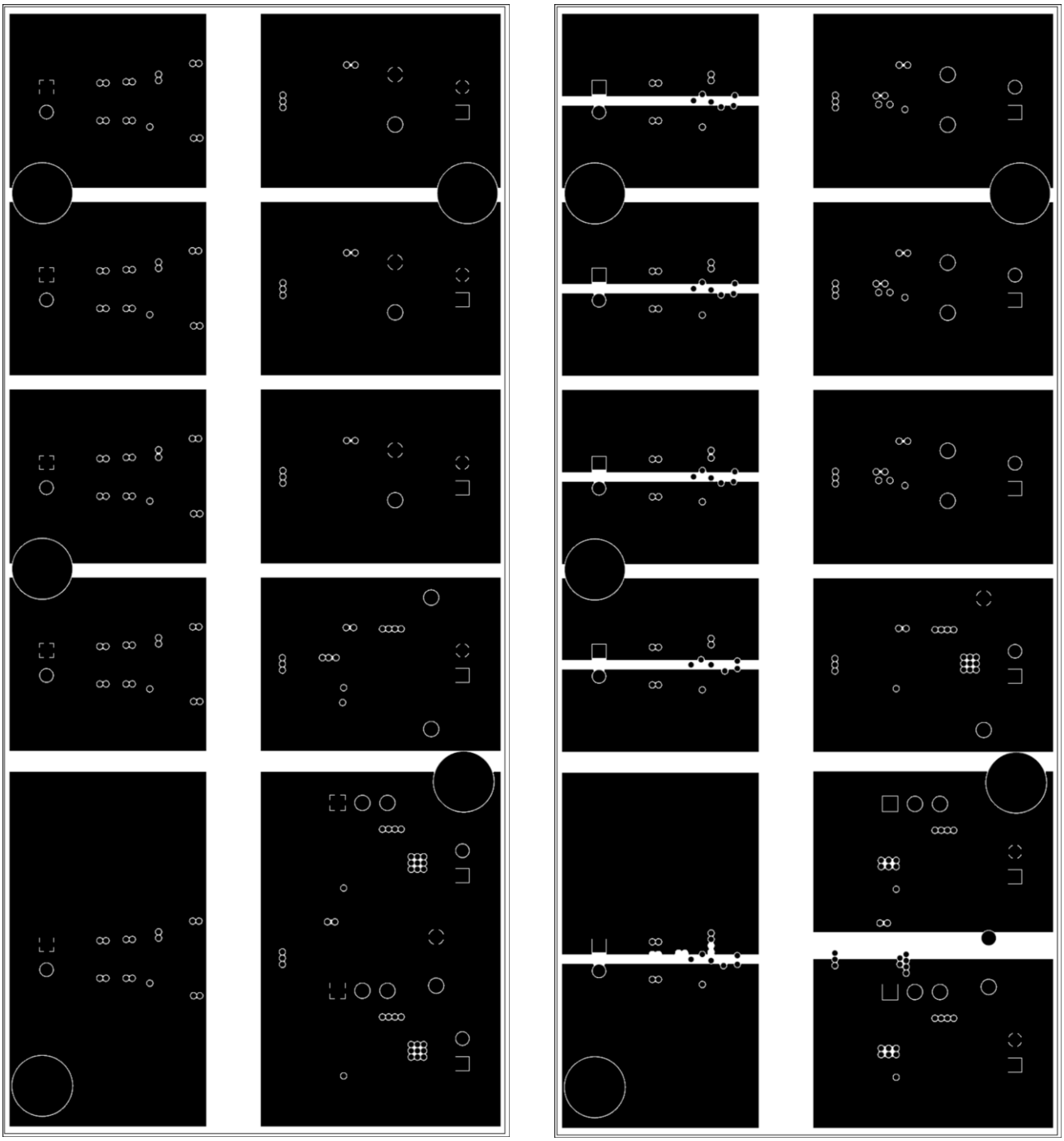

Figure 5. Layer 3 (Left) and Bottom Layer (Right)

1.1 Bill Of Materials

DESIGNATOR	VALUE	DESCRIPTION	PACKAGE	MFR	PART NUMBER
C1, C4, C8, C10, C15	1µF, 10%, 10V, X5R	Capacitor	0402	Taiyo Yuden	LMK105BJ105KV-F
C2, C3, C5, C6, C7, C9, C11, C12, C14, C16	1µF, 10%, 16V, X7R	Capacitor	0603	TDK	C1608X7R1C105K
C13, C17, C18	4.7µF, 10%, 6.3V, X5R	Capacitor	0603	TDK	C1608X5R0J475K/0.80
D1, D2, D3, D4, D5, D6, D7, D8, D9, D10	MBR0520L	Rectifier Diode	SOD-123	ON-Semi	MBR0520LT1G
U1, U2, U3, U4, U6	SN6501	Transformer Driver	DBV	TI	SN6501DBV
U7	TPS76333	3.3 V, 3% LDO	DBV	TI	TPS76333DBVR
U5, U8	TPS76350	5 V, 3% LDO	DBV	TI	TPS76350DBVR
T1	1:1.1, 7Vµs	Transformer	6.73 x 7.14 x 4.06 mm	Wurth Electronics/Midcom	760390011
T2	1:1.1, 11Vµs				760390012
T3	1:1.7, 11Vµs				760390013
T4	1:2.0, 11Vµs				760390015
T5	1:1.3, 11Vµs				760390014
TP1, TP3, TP5, TP7, TP9	Test Loop - Black	Test Point	0.04	Keystone Electronics	5001
TP2, TP4, TP6, TP8, TP10	Test Loop - Blue	Test Point	0.04	Components Corporation	TP-105-40-06
JMP1, JMP2	1 x 3 Jumper	Jumper	0.1"	Samtec	HTSW-150-07-G-S
TB1 to TB11	2-pin female	Terminal Block	2.54 cm	Phoenix Contact	1725656

1.2 Performance Characteristics (Push-Pull Converters with Non-Regulated Outputs)

Figure 6 through Figure 11 show performance characteristics for push-pull converters with non-regulated outputs.

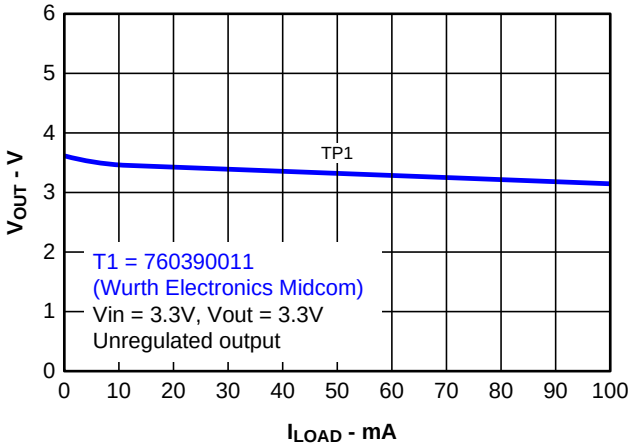

Figure 6. Output Voltage Versus Load Current Vin = 3.3 V, Vout = 3.3 V

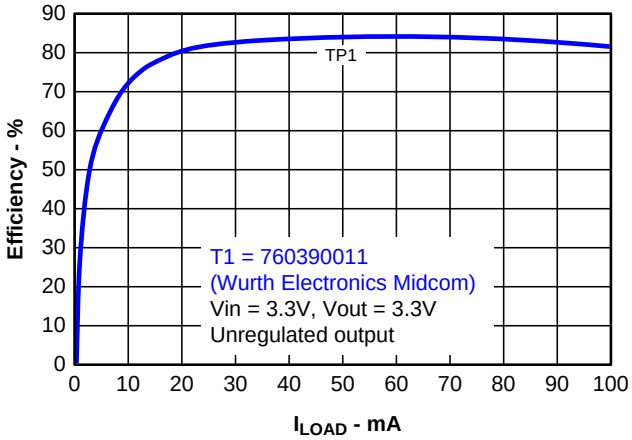

Figure 7. Efficiency Versus Load Current Vin = 3.3 V, Vout = 3.3 V

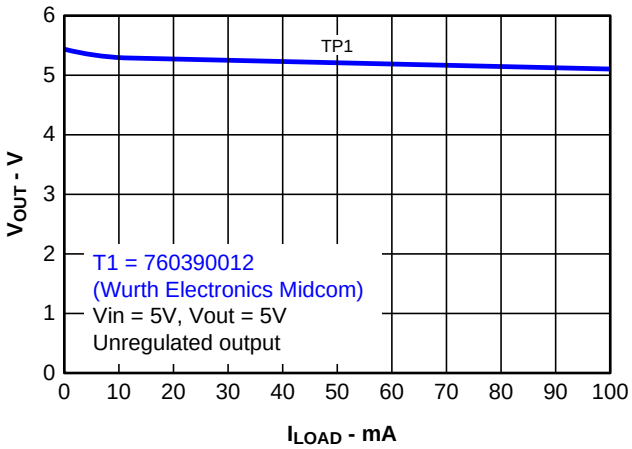

Figure 8. Output Voltage Versus Load Current Vin = 5 V, Vout = 5 V

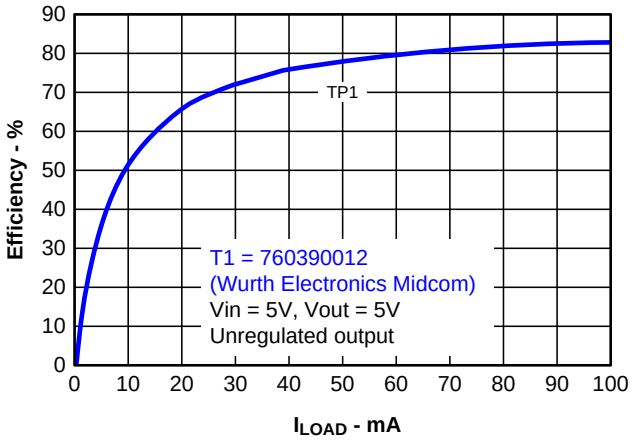

Figure 9. Efficiency Versus Load Current Vin = 5 V, Vout = 5 V

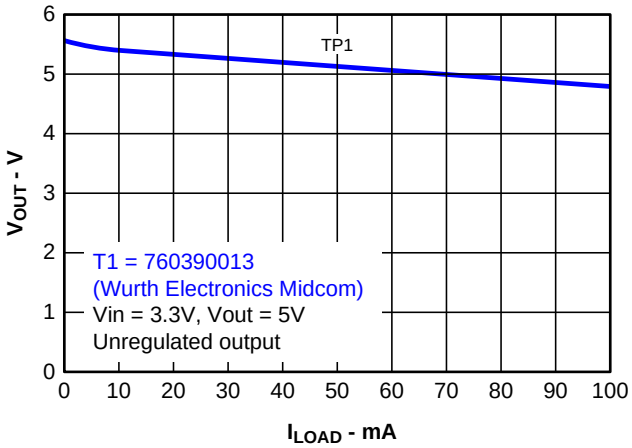

Figure 10. Output Voltage Versus Load Current Vin = 3.3 V, Vout = 5 V

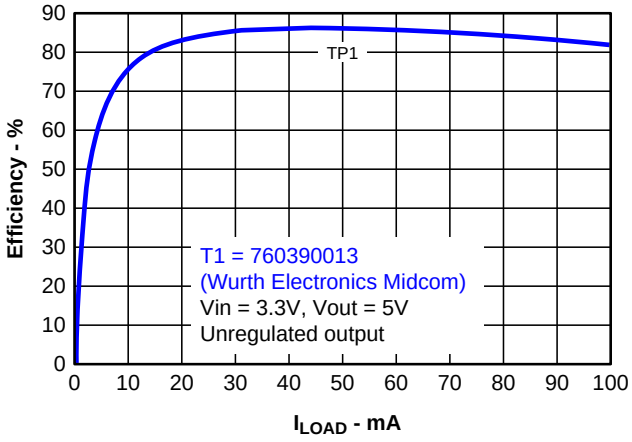

Figure 11. Efficiency Versus Load Current Vin = 3.3 V, Vout = 5 V

1.2.1 Performance Characteristics (Push-Pull Converters with Regulated Outputs)

Figure 12 through Figure 17 show performance characteristics for push-pull converters with regulated outputs.

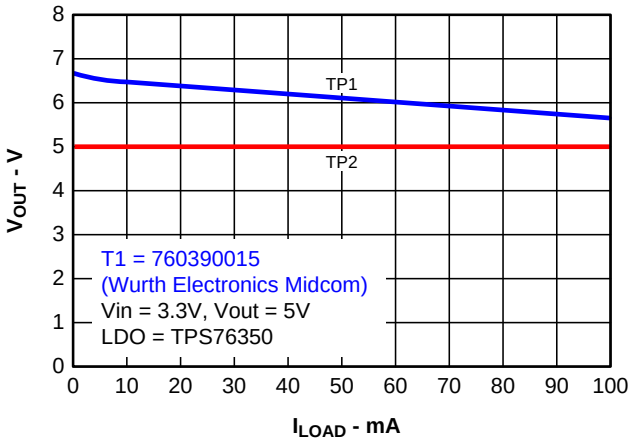

Figure 12. Output Voltage Versus Load Current Vin = 3.3 V, Vout = 5 V

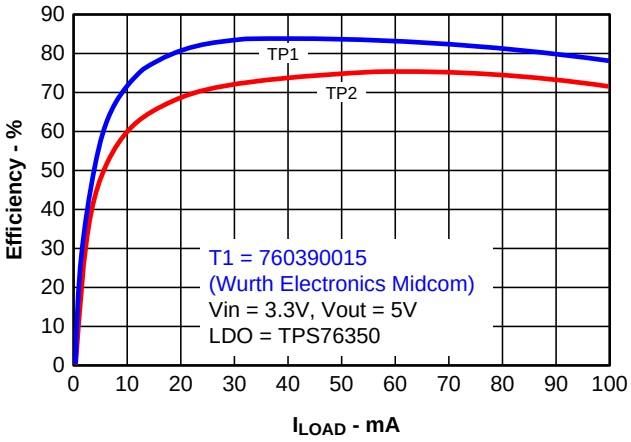

Figure 13. Efficiency Versus Load Current Vin = 3.3 V, Vout = 5 V

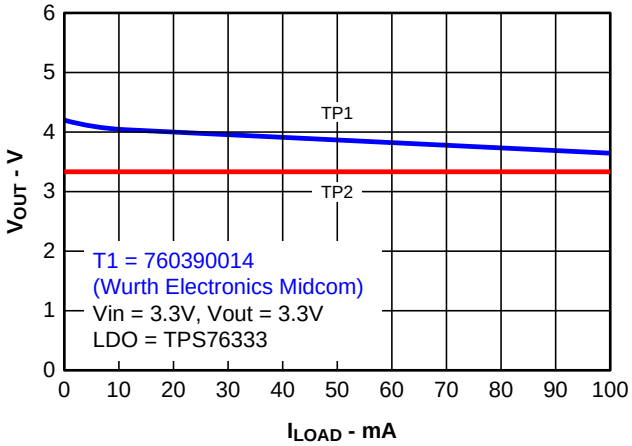

Figure 14. Output Voltage Versus Load Current Vin = 3.3 V, Vout = 3.3 V

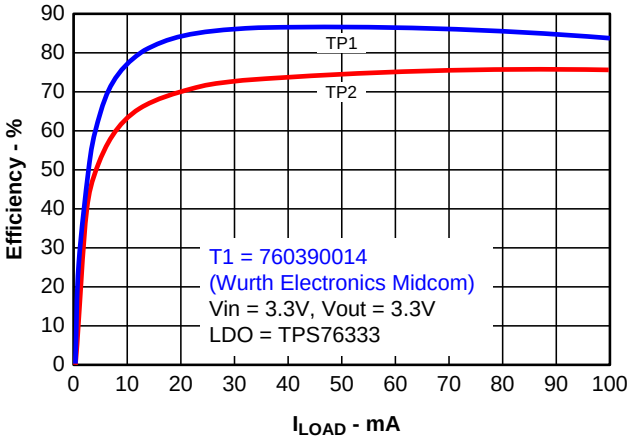

Figure 15. Efficiency Versus Load Current Vin = 3.3 V, Vout = 3.3 V

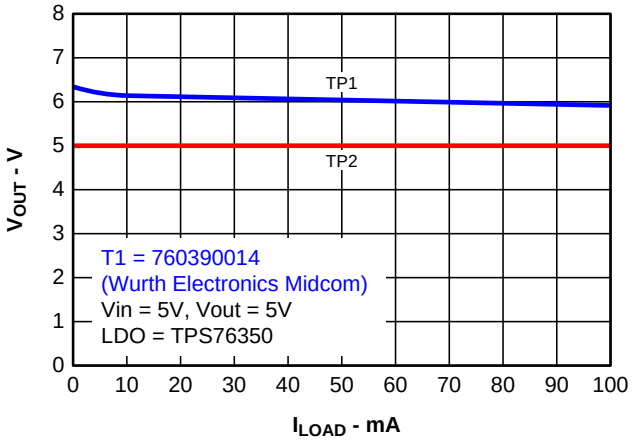

Figure 16. Output Voltage Versus Load Current Vin = 5 V, Vout = 5 V

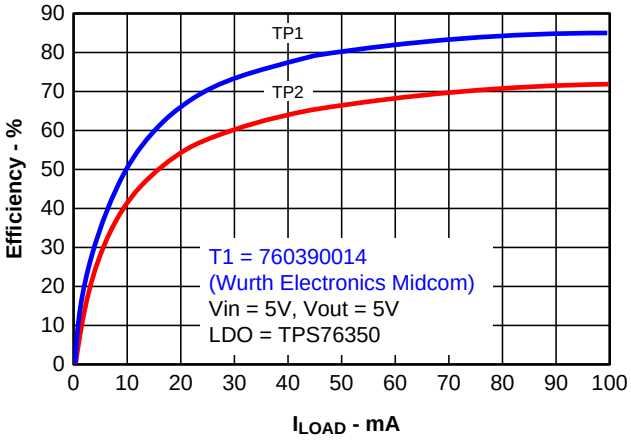

Figure 17. Efficiency Versus Load Current Vin = 5 V, Vout = 5 V

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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.

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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

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.

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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.

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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:

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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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4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

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Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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