



TLV61048 14-V Output Voltage Non-synchronous Boost Converter in SOT-23 package

1 Features

- Input voltage 2.65 V to 5.5 V (falling 2.4 V)
- Output voltage up to 14 V
- Integrated low-side FET: 85 mΩ at 3.3 V_{IN}
- 3.7-A (Typical) switch current limit
- Up to 90% Efficiency at 3.3-V Input and 12-V Output
- 600-kHz or 1-MHz Selectable switching frequency
- Internal Compensation
- 1-μA Shutdown current
- ±2.5% Output-voltage accuracy
- PFM operation mode at light load
- Internal 2-ms soft-start time
- Thermal shutdown protection
- 2.9-mm × 1.6-mm 6-Pin SOT-23 package

2 Applications

- PLC backup power
- LCD bias supply
- Industrial isolation DC/DC

3 Description

The TLV61048 is a non-synchronous boost converter that provides a power-supply solution for products powered by a low-voltage super capacitor and a single-cell Li-ion battery. The TLV61048 integrates a power switch with 3.7-A typical current limit to extend the discharge capability of the input source without sacrificing maximal load delivery.

The TLV61048 could be configured at 600 kHz for higher efficiency or 1 MHz for smaller inductor and output capacitor. At the light load, the device enters into the PFM operation to achieve higher efficiency. The TLV61048 has built-in 2-ms soft start to minimize the inrush current.

The TLV61048 is available in a 2.9-mm × 1.6-mm 6-pin SOT-23 package.

Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TLV61048	SOT-23 (6)	2.90 mm × 1.60 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Simplified Schematic

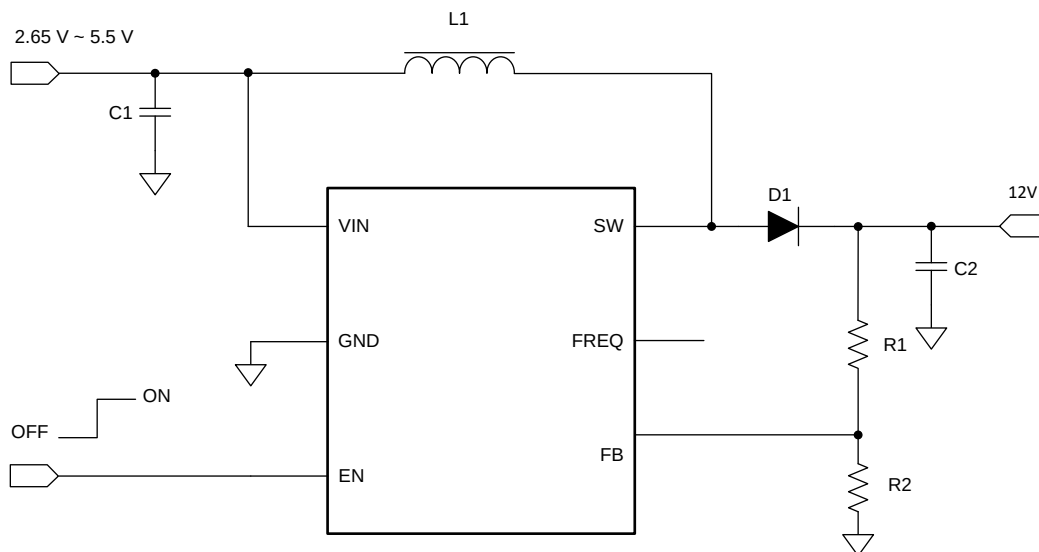


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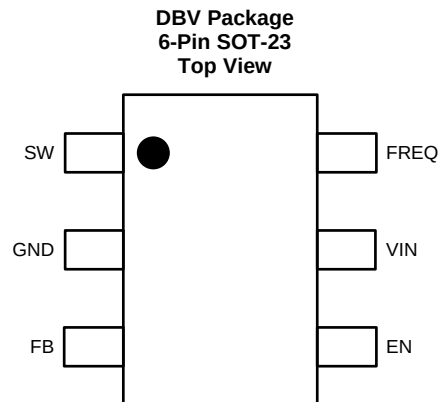
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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (March 2019) to Revision A	Page
• Changed to production data release with typical characteristics curves.	1

5 Pin Configuration and Functions



Pin Functions

PIN		I/O	DESCRIPTION
NO.	NAME		
1	SW	PWR	The switch pin of the converter. It is connected to the drain of the internal power MOSFET.
2	GND	PWR	Ground
3	FB	I	Voltage feedback of output voltage. Connected to the center tap of a resistor divider to program the output voltage.
4	EN	I	Enable logic input. Logic high voltage enables the device. Logic low voltage disables the device and turns it into shutdown mode.
5	VIN	I	IC power supply input
6	FREQ	I	Frequency select pin. The device operates at 600 kHz if FREQ is left floating or pulled high and at 1 MHz if connected to GND.

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) ⁽¹⁾

		MIN	MAX	UNIT
Voltage range at terminals ⁽²⁾	VIN, EN, FREQ	–0.3	6	V
	SW	–0.3	18	V
	FB	–0.3	3.6	V
Operating junction temperature range, T _J		–40	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values are with respect to network ground terminal.

6.2 ESD Ratings

			VALUE	UNIT
V _(ESD) ⁽¹⁾	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽²⁾	±2000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽³⁾	±500	V

- (1) Electrostatic discharge (ESD) to measure device sensitivity and immunity to damage caused by assembly line electrostatic discharges in to the device.
- (2) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (3) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	TYP	MAX	UNIT
V _{IN}	Input voltage range	2.65		5.5	V
V _{OUT}	Output voltage range	3.3		14	V
L	Effective inductance range	2.2	4.7	10	μH
C _{IN}	Effective input capacitance range	0.22	1		μF
C _{OUT}	Effective output capacitance range	3			μF
T _J	Operating junction temperature	–40		125	°C

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		TLV61048	UNIT
		DBV (SOT23)	
		6 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	177.7	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	120.6	°C/W
R _{θJB}	Junction-to-board thermal resistance	33.2	°C/W
ψ _{JT}	Junction-to-top characterization parameter	21.5	°C/W
ψ _{JB}	Junction-to-board characterization parameter	32.6	°C/W
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	n/a	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC package thermal metrics application report](#).

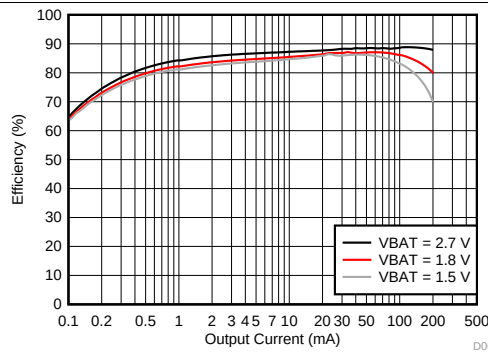
6.5 Electrical Characteristics

$T_A = -40^{\circ}\text{C}$ to 85°C , $V_{IN} = 3.3\text{ V}$. Typical values are at $T_A = 25^{\circ}\text{C}$, unless otherwise noted.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
POWER SUPPLY						
V_{IN}	Input voltage range		2.65		5.5	V
V_{IN_UVLO}	Under voltage lockout threshold	V_{IN} rising		2.55	2.65	V
		V_{IN} falling	2.3	2.4		
V_{IN_HYS}	VIN UVLO hysteresis			150		mV
I_{Q_VIN}	Quiescent current into VIN pin	IC enabled, no load, no switching		100		μA
I_{SD}	Shutdown current into VIN pin	IC disabled, $V_{IN} = 2.6\text{ V}$ to 5.5 V , $T_A = 25^{\circ}\text{C}$			1.0	μA
OUTPUT						
V_{OUT}	Output voltage range		3.3		14	V
V_{REF}	Feedback voltage	PWM mode, $T_A = -40^{\circ}\text{C}$ to 125°C	0.78	0.8	0.82	V
		PFM mode, $T_A = 25^{\circ}\text{C}$		0.81		V
I_{FB_LKG}	Leakage current into FB pin	$T_A = 25^{\circ}\text{C}$			50	nA
I_{SW_LKG}	Leakage current into SW pin	IC disabled, $SW = 5.5\text{V}$			500	nA
POWER SWITCH						
$R_{DS(on)}$	Low-side MOSFET on resistance	$V_{IN} = 3.3$, $V_{OUT} = 12\text{V}$		85		m Ω
f_{SW}	Switching frequency	$V_{IN} = 3.3\text{ V}$, $V_{OUT} = 12\text{ V}$, PWM mode	430	550	630	kHz
		$V_{IN} = 3.3\text{ V}$, $V_{OUT} = 12\text{ V}$, PWM mode	850	1000	1250	
t_{OFF_min}	Min. off time			130		ns
I_{LIM_SW}	Peak switch current limit	600kHz, $V_{IN} = 3.3\text{V}$	2.9	3.7	4.5	A
$t_{STARTUP}$	Startup time			2		ms
LOGIC INTERFACE						
V_{EN_H}	EN Logic high threshold				1.2	V
V_{EN_L}	EN Logic low threshold		0.4			V
R_{EN}	EN Pull Down Resistor			1		M Ω
R_{FREQ}	FREQ pull up resistance			950		k Ω
V_{FREQ_H}	FREQ logic high threshold				1.2	V
V_{FREQ_L}	FREQ logic low threshold		0.4			V
PROTECTION						
T_{SD}	Thermal shutdown threshold	T_J rising		150		$^{\circ}\text{C}$
T_{SD_HYS}	Thermal shutdown hysteresis	T_J falling below T_{SD}		20		$^{\circ}\text{C}$

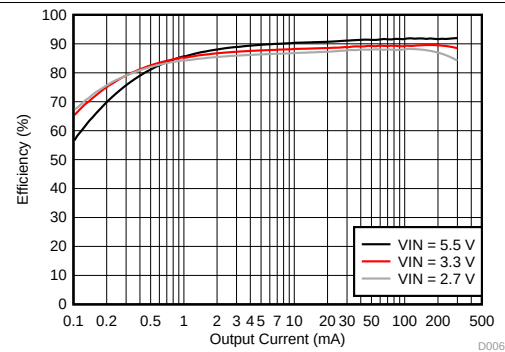
6.6 Typical Characteristics

$V_{IN} = 3.3\text{ V}$, $V_{OUT} = 12\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted



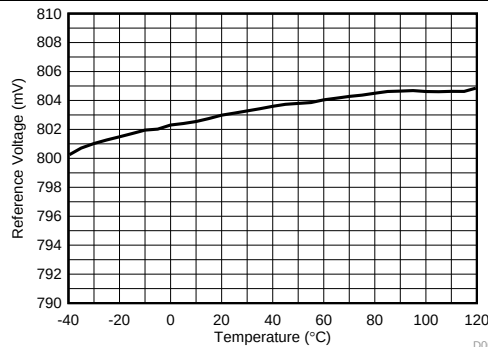
$V_{IN} = 3.3\text{ V}$ $V_{OUT} = 12\text{ V}$ VBAT is Power Stage Input

Figure 1. Efficiency vs Output Current



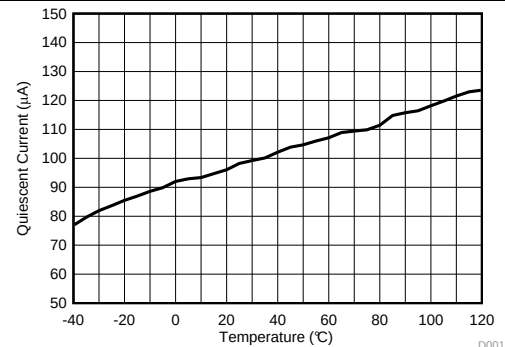
$V_{OUT} = 12\text{ V}$ $V_{IN} = V_{BAT}$

Figure 2. Efficiency vs Output Current



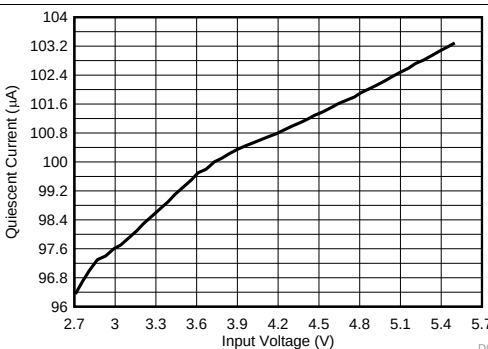
$V_{IN} = 3.3\text{ V}$ $V_{OUT} = 12\text{ V}$ PWM mode

Figure 3. FB Reference Voltage vs Temperature



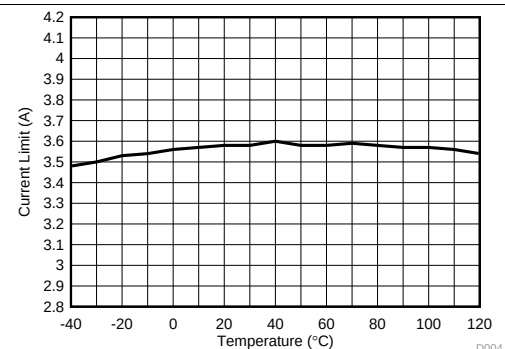
$V_{IN} = 3.3\text{ V}$ $V_{OUT} = 12\text{ V}$ No Switching

Figure 4. Quiescent Current into VIN vs Temperature



$V_{IN} = 2.7\text{ V} \sim 5.5\text{ V}$ $V_{OUT} = 12\text{ V}$ No Switching

Figure 5. Quiescent Current into VIN vs Input Voltage



$V_{IN} = 3.3\text{ V}$ $V_{OUT} = 12\text{ V}$

Figure 6. Current Limit vs Temperature

7 Detailed Description

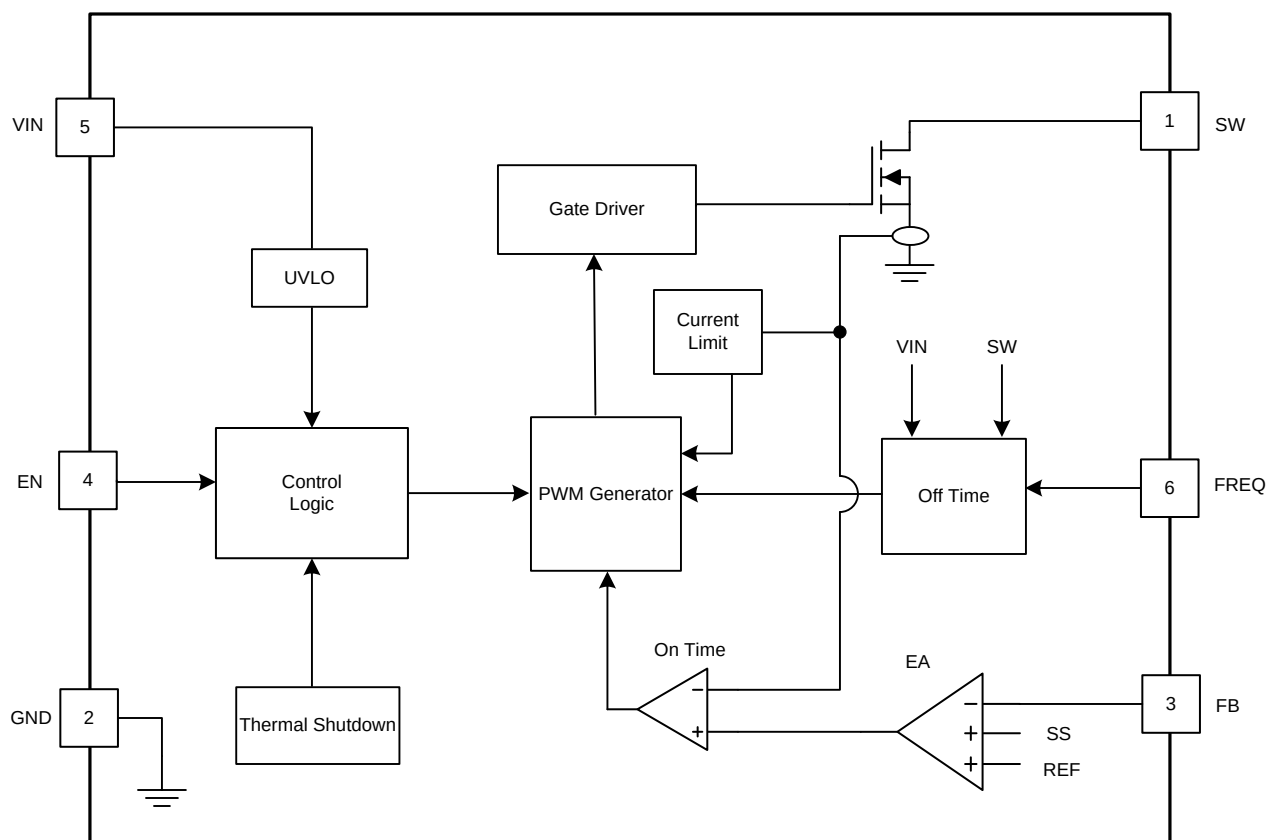
7.1 Overview

The TLV61048 is a non-synchronous boost converter supporting output voltage up to 14 V with input ranging from 2.65 V to 5.5 V. The TLV61048 integrates a power switch with current limit up to 3.7 A (typical). The device operates in a current mode scheme with quasi-constant frequency with internal loop compensation built in. The switching frequency is selectable between 600 kHz and 1 MHz. There is internal fixed soft start time which is 2 ms typically to control the inrush current during startup.

Topology of the TLV61048 boost converter is adaptive off-time with peak current control, which provides superior load and line transient responses. The selectable switching frequency offers the possibility to optimize the design either for the use of small sized inductor (1 MHz) or for higher system efficiency (600 kHz).

The converter operates in continuous conduction mode (CCM) when the inductor valley current is above zero, while switches into discontinuous conduction mode (DCM) if valley current crossing zero. If the load is further lowered, the device enters into PFM operation to achieve even higher efficiency.

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Undervoltage Lockout

An undervoltage lockout (UVLO) circuit stops the operation of the converter when the input voltage drops below the typical UVLO falling threshold of 2.4 V. A hysteresis of 150 mV is added so that the device cannot be enabled again until the input voltage goes up to typical UVLO rising threshold of 2.55 V. This function is implemented in order to prevent malfunctioning of the device when the input voltage is between 2.4 V and 2.55 V.

Feature Description (continued)

7.3.2 Enable and Disable

When the input voltage is above typical UVLO rising threshold of 2.55 V and the EN pin is pulled high, the TLV61048 is enabled. When the EN pin is pulled low, the TLV61048 stops the PWM switch and turns off the low side switch. The EN pin has an internal pull-down resistance of 1M Ω , the device is disabled when the EN pin is floating. In shutdown mode, less than 1- μ A input current is consumed.

7.3.3 Soft Start

The soft-start feature helps the regulator to gradually reach the steady state operating point, thus reducing start-up stresses and surge. When the input voltage is applied, the output capacitor is charged to VIN through the inductor and high side rectifier diode. After reaching the 2.55 V (typical) UVLO rising threshold, the internal soft-start control circuit initiates to ramp the reference voltage to 0.8 V within 2 ms (typical), while the low side FET starts switching after output capacitor is charged to the input voltage.

7.3.4 Frequency Select (FREQ)

The frequency select pin FREQ allows to set the switching frequency of the device to 600 kHz (FREQ = floating/high) or 1 MHz (FREQ = GND). Higher switching frequency improves load transient response but reduces efficiency slightly. The other benefit of higher switching frequency is lower output ripple voltage.

7.4 Device Functional Modes

The TLV61048 has two operation modes: PWM mode and PFM mode.

7.4.1 PWM Mode

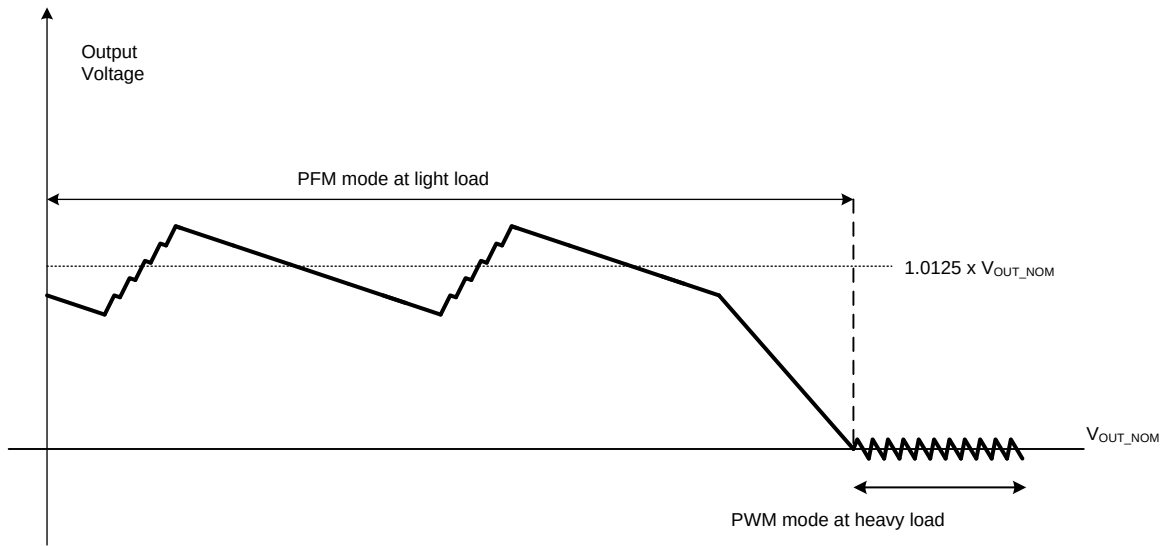
The TLV61048 uses a quasi-constant frequency pulse width modulation (PWM) at moderate to heavy load currents. Based on the VIN/VOUT ratio, a circuit predicts the required off-time. At the beginning of the switching cycle, the integrated NMOS switching FET, shown in the functional block diagram, is turned on. The input voltage is applied across the inductor and the inductor current ramps up. In this phase, the output capacitor is discharged by the load current. When the inductor current hits the current threshold that is set by the error amplifier output, the PWM switch is turned off, and the external power diode is forward-biased. The inductor transfers its stored energy to replenish the output capacitor and supply the load. When the off-time is expired, the next switching cycle starts again. The error amplifier compares the FB pin voltage with an internal reference, and its output determines the duty cycle of the PWM switching.

The TLV61048 has a built-in compensation circuit that can accommodate a wide range of input and output voltages for stable operation.

7.4.2 PFM Mode

The TLV61048 integrates a power save mode with pulse frequency modulation (PFM) to improve efficiency at light load. When the load current decreases, the inductor peak current set by the output of the error amplifier declines to regulate the output voltage. When the inductor peak current hits the low limit (400 mA typical), the output voltage exceeds the set threshold voltage as the load current decreases further. When the FB voltage hits the PFM reference voltage, the TLV61048 goes into power-save mode. In the power-save mode, the device only switches when the output voltage trips below a set threshold voltage. It ramps up the output with several pulses and enters the power save mode when the output voltage exceeds the set threshold voltage.

Device Functional Modes (continued)



8 Application and Implementation

NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

8.1 Application Information

TLV61048 is a boost DC/DC converter integrating a power switch and loop compensation circuits. The device has input range from 2.65 V to 5.5 V. The device can operate down to 1.5 V if an external 3.3-V bias supply is applied to the VIN pin. The TLV61048 adopts the current-mode control with adaptive constant off-time. The switching frequency is quasi-constant and selectable between 600 kHz and 1 MHz. The following design procedure can be used to select component values for the TLV61048.

8.2 Typical Applications

8.2.1 12-V Output Boost Converter With External Bias

In this design example, TLV61048 VIN pin is supplied by an external 3.3-V bias voltage to keep internal circuitry on in order to extend power stage operating V_{IN} to 1.5 V. 600-kHz switching frequency is selected to reduce switching loss in order to improve overall efficiency.

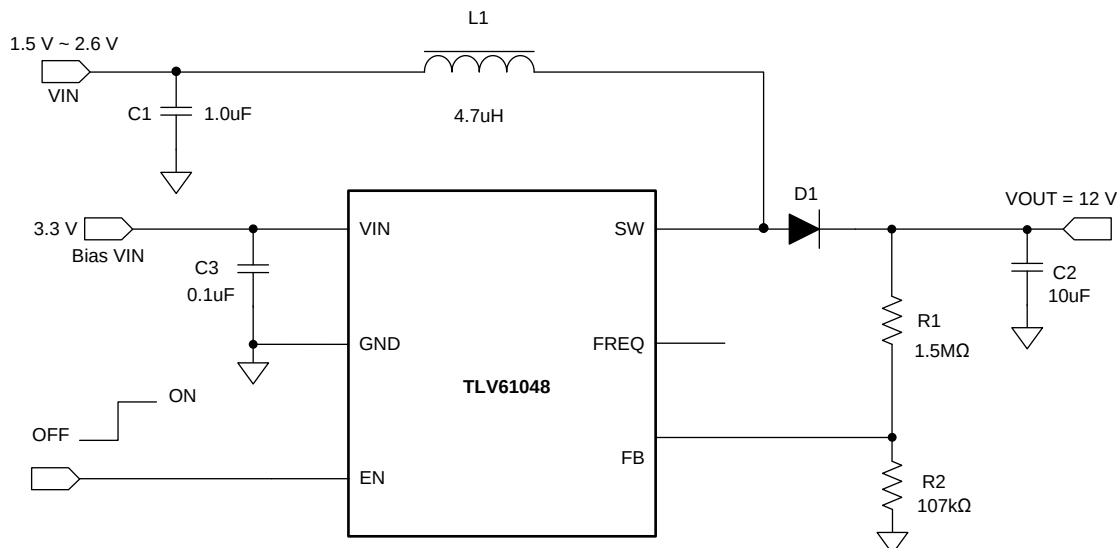


Figure 7. 12-V Boost Converter With External Bias

8.2.1.1 Design Requirements

For this design example, see parameters are shown in [Table 1](#):

Table 1. Design Requirements

PARAMETERS	VALUE
Power input voltage	1.5 V to 2.6 V
Control input voltage	3.3 V
Output voltage	12 V
Frequency	600 kHz
Output current	0 - 200 mA

8.2.1.2 Detailed Design Procedure

8.2.1.2.1 Programming the Output Voltage

Output voltage is programmed via external resistor divider. By selecting the external resistor divider R1 and R2, as shown in [Equation 1](#), the output voltage is programmed to the desired value. When the output voltage is regulated, the typical voltage at the FB pin is V_{REF} of 800 mV.

$$R1 = \left(\frac{V_{OUT}}{V_{REF}} - 1 \right) \times R2$$

where

- V_{OUT} is the desired output voltage
 - V_{REF} is the internal reference voltage at the FB pin
- (1)

For best accuracy, R2 should be kept smaller than 150 k Ω to ensure the current flowing through R2 is at least 100 times larger than the FB pin leakage current. Changing R2 towards a lower value increases the immunity against noise injection. Changing the R2 towards a higher value reduces the quiescent current for achieving higher efficiency at low load currents.

8.2.1.2.2 Inductor Selection

Because the selection of the inductor affects steady state operation, transient behavior, and loop stability, the inductor is the most important component in power regulator design. There are three important inductor specifications, inductor value, saturation current, and DC resistance (DCR). The TLV61048 is designed to work with inductor values between 2.2 μ H and 10 μ H. Use [Equation 2](#) to [Equation 4](#) to calculate the peak current of the application inductor. To calculate the current in the worst case, use the minimum input voltage, maximum output voltage, and maximum load current of the application. To have enough design margin, choose the inductor value with –30% tolerance, and a low power-conversion efficiency for the calculation. In a boost regulator, the inductor dc current can be calculated with [Equation 2](#).

$$I_{L(DC)} = \frac{V_{OUT} \times I_{OUT}}{V_{IN} \times \eta}$$

where

- V_{OUT} = output voltage
 - I_{OUT} = output current
 - V_{IN} = input voltage
 - η = power conversion efficiency, use 80% for most applications
- (2)

The inductor ripple current is calculated with the [Equation 3](#) for an asynchronous boost converter in continuous conduction mode (CCM).

$$\Delta I_{L(P-P)} = \frac{V_{IN} \times (V_{OUT} + 0.8V - V_{IN})}{L \times f_{SW} \times (V_{OUT} + 0.8V)}$$

where

- $\Delta I_{L(P-P)}$ = inductor ripple current
 - L = inductor value
 - f_{SW} = switching frequency
 - V_{OUT} = output voltage
 - V_{IN} = input voltage
- (3)

Therefore, the inductor peak current is calculated with [Equation 4](#).

$$I_{L(P)} = I_{L(DC)} + \frac{\Delta I_{L(P-P)}}{2}$$
(4)

Normally, it is advisable to work with an inductor peak-to-peak current of less than 40% of the average inductor current for maximum output current. A smaller ripple from a larger valued inductor reduces the magnetic hysteresis losses in the inductor and EMI. However, in the same way, load transient response time is increased. [Table 2](#) lists the recommended inductor for the TLV61048 in the 600-kHz configuration.

Table 2. Recommended Inductors for the TLV61048 at 600-kHz Configuration

PART NUMBER	L (μH)	DCR MAX (mΩ)	SATURATION CURRENT TYPICAL (A)	SIZE (L×W×H) (mm)	VENDOR ⁽¹⁾
SWPA5040S4R7NT	4.7	39	3.9	5 × 5 × 4	Sunlord
XAL4030-472ME	4.7	44.1	4.5	4 × 4 × 3	Coilcraft
SWPA5040S100MT	10	83	2.9	5 × 5 × 4	Sunlord
XAL4040-103ME	10	92.4	3	4 × 4 × 4	Coilcraft

(1) See [Third-party Products Disclaimer](#)

8.2.1.2.3 Input and Output Capacitor Selection

The output capacitor is mainly selected to meet the requirements for output ripple and loop stability. This ripple voltage is related to the capacitor's capacitance and its equivalent series resistance (ESR). Assuming a ceramic capacitor with zero ESR, the minimum capacitance needed for a given ripple can be calculated by:

$$C_{OUT} = \frac{I_{OUT} \times D_{MAX}}{f_{SW} \times V_{RIPPLE}}$$

where

- D_{MAX} = maximum switching duty cycle
 - V_{RIPPLE} = peak to peak output voltage ripple
- (5)

The ESR impact on the output ripple must be considered if tantalum or aluminum electrolytic capacitors are used.

Take care when evaluating the derating of a ceramic capacitor under DC bias, aging, and AC signal. For example, the DC bias can significantly reduce capacitance. A ceramic capacitor can lose more than 50% of its capacitance at its rated voltage. Therefore, always leave margin on the voltage rating to ensure adequate capacitance at the required output voltage.

TI recommends using the output capacitor with effective capacitance in the range of 3.3 μF to 10 μF for 600-kHz configuration. TI also recommends placing a small 1 μF capacitor right across the rectifier diode cathode to the GND pin of the TLV61048 to reduce the high RMS current loop's inductance. The output capacitor affects the small signal control loop stability of the boost regulator. If the output capacitor is below the range, the boost regulator can potentially become unstable. Increasing the output capacitor makes the output voltage ripple smaller in PWM mode. [Table 3](#) lists the recommended capacitor for the TLV61048.

Table 3. Recommended Output Capacitors for the TLV61048

PART NUMBER	C _{OUT} (μF)	RATING	PACKAGE	VENDOR ⁽¹⁾
TMK316BLD106KL	10	25 V, X5R	1206	Taiyo Yuden
CC1206KKX5R8BB106	10	25 V, X5R	1206	Yageo

(1) See [Third-party Products Disclaimer](#)

For input capacitor, a ceramic capacitor with more than 1 μF is enough for most applications.

8.2.1.2.4 Diode Rectifier Selection

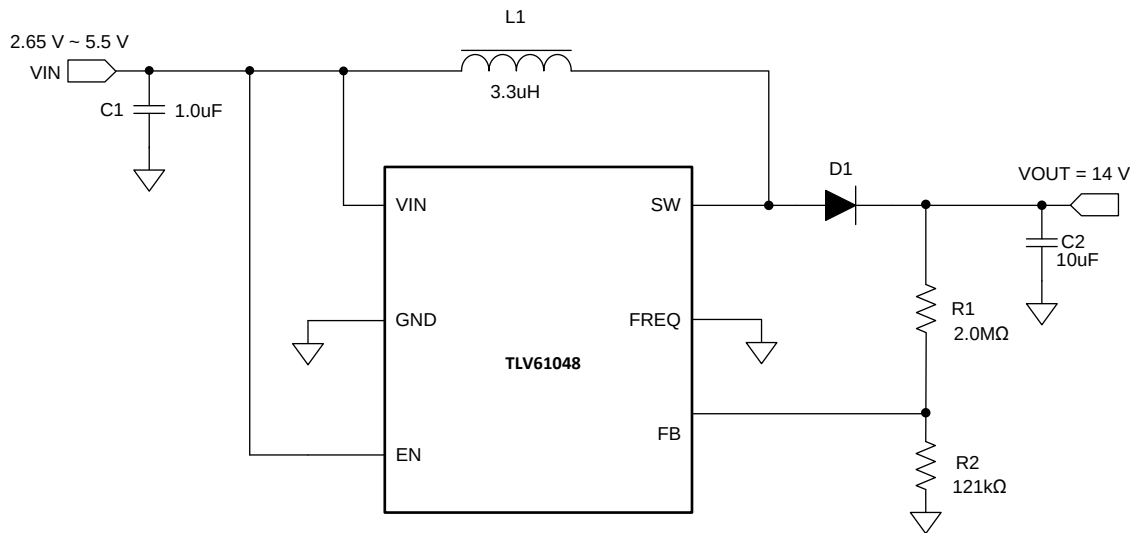
Voltage rating of high side rectifier diode in boost topology should be higher than the DC output voltage, in addition, margin should be added to withstand switching spikes. Average current going through the rectifier is approximately the DC load current. For this 12 V output application, a 20 V, 1 A Schottky diode B120AF-13 is selected to provide minimal forward voltage drop to improve efficiency.

8.2.1.3 Application Curves



8.2.2 14-V Output Boost Converter

In this design example, TLV61048 is configured to output 14-V DC voltage. 1-MHz switching frequency is selected to reduce output ripple. TI recommends placing an RC snubber from the switch node to the ground node to ensure voltage spike does not exceed the specified absolute maximum rating.


Figure 14. 14-V Boost Converter

8.2.2.1 Design Requirements

Table 4. Design Requirements

PARAMETER	VALUE
Power input voltage	2.65 V to 5.5 V
Output voltage	14 V
Frequency	1 MHz
Output current	0 to 300 mA

8.2.2.2 Detailed Design Procedure

8.2.2.2.1 Inductor Selection

A smaller inductance is selected to push the right-half-plane-zero to a higher frequency beyond the crossover frequency of the control loop as well as reducing output ripple voltage. The recommended inductors for 1-MHz operation are listed in [Table 5](#).

Table 5. Recommended Inductors for the TLV61048 at 1-MHz Configuration

PART NUMBER	L (μH)	DCR MAX (mΩ)	SATURATION CURRENT TYPICAL (A)	SIZE (LxWxH) (mm)	VENDOR ⁽¹⁾
SWPA5040S2R2NT	2.2	25	5.6	5 × 5 × 4	Sunlord
XAL4020-222ME	2.2	38.7	5.6	4 × 4 × 3	Coilcraft
SWPA5040S3R3NT	3.3	31	4.6	5 × 5 × 4	Sunlord
XAL4030-332ME	3.3	28.6	5.5	4 × 4 × 4	Coilcraft

(1) See [Third-party Products Disclaimer](#).

8.2.2.2.2 Input and Output Capacitor Selection

For 1-MHz configuration, use the information provided in [Input and Output Capacitor Selection](#).

9 Power Supply Recommendations

The device is designed to operate from an input voltage supply range between 1.5 V to 5.5 V. This input supply must be well regulated. If the input supply is located more than a few inches from the converter, additional bulk capacitance may be required in addition to the ceramic bypass capacitors. A typical choice is an electrolytic or tantalum capacitor with a value of 47 μ F. Output current of the input power supply must be rated according to the supply voltage, output voltage and output current of the TLV61048.

10 Layout

10.1 Layout Guidelines

As for all switching power supplies, especially those running at high switching frequency and high currents, layout is an important design step. If the layout is not carefully done, the regulator could suffer from instability and noise problems. To maximize efficiency, switch rise and fall time are very fast. To prevent radiation of high frequency noise (for example, EMI), proper layout of the high-frequency switching path is essential. Minimize the length and area of all traces connected to the SW pin, and always use a ground plane under the switching regulator to minimize interplane coupling. The input capacitor must not only be close to the VIN pin, but also to the GND pin in order to reduce input supply ripple.

The most critical current path for all boost converters is from the switching FET, through the rectifier diode, then the output capacitors, and back to ground of the switching FET. This high current path contains nanosecond rise and fall time and must be kept as short as possible. Therefore, the output capacitor must not only be close to the GND pin, but also to the cathode of the high side rectifier to reduce the overshoot at the SW pin.

10.2 Layout Example

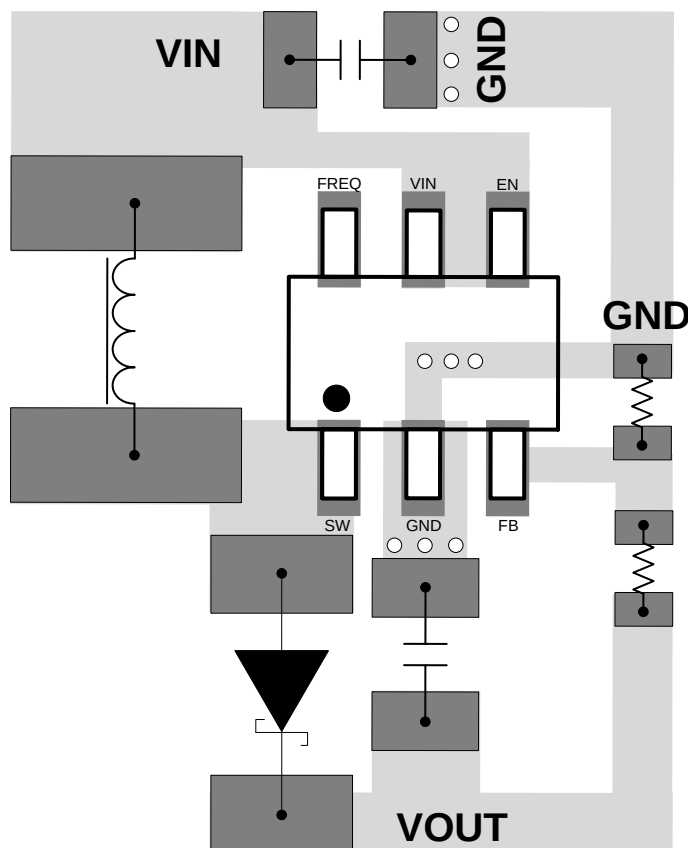


Figure 15. TLV61048 Layout

11 Device and Documentation Support

11.1 Device Support

11.1.1 Third-Party Products Disclaimer

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11.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

11.3 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

11.4 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

11.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

11.6 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TLV61048DBVR	Active	Production	SOT-23 (DBV) 6	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	1VSF
TLV61048DBVR.A	Active	Production	SOT-23 (DBV) 6	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	1VSF
TLV61048DBVRG4	Active	Production	SOT-23 (DBV) 6	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	1VSF
TLV61048DBVRG4.A	Active	Production	SOT-23 (DBV) 6	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	1VSF
TLV61048DBVT	Active	Production	SOT-23 (DBV) 6	250 SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	1VSF
TLV61048DBVT.A	Active	Production	SOT-23 (DBV) 6	250 SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	1VSF

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

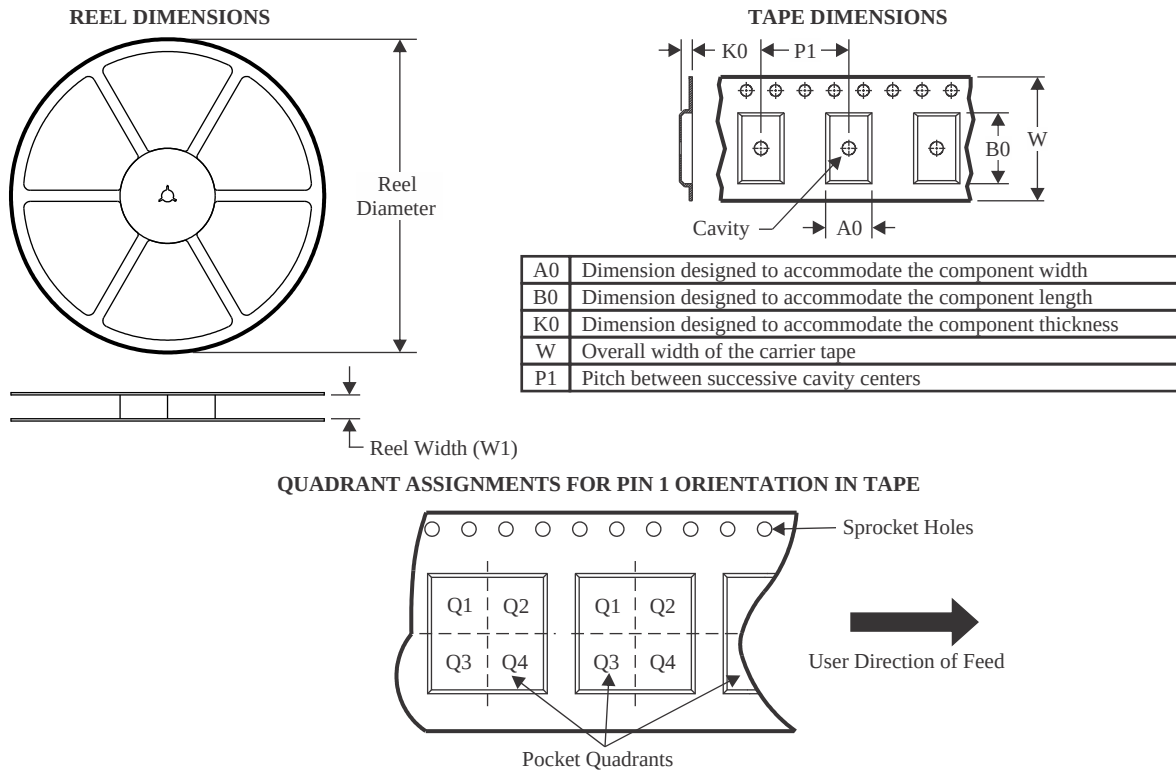
⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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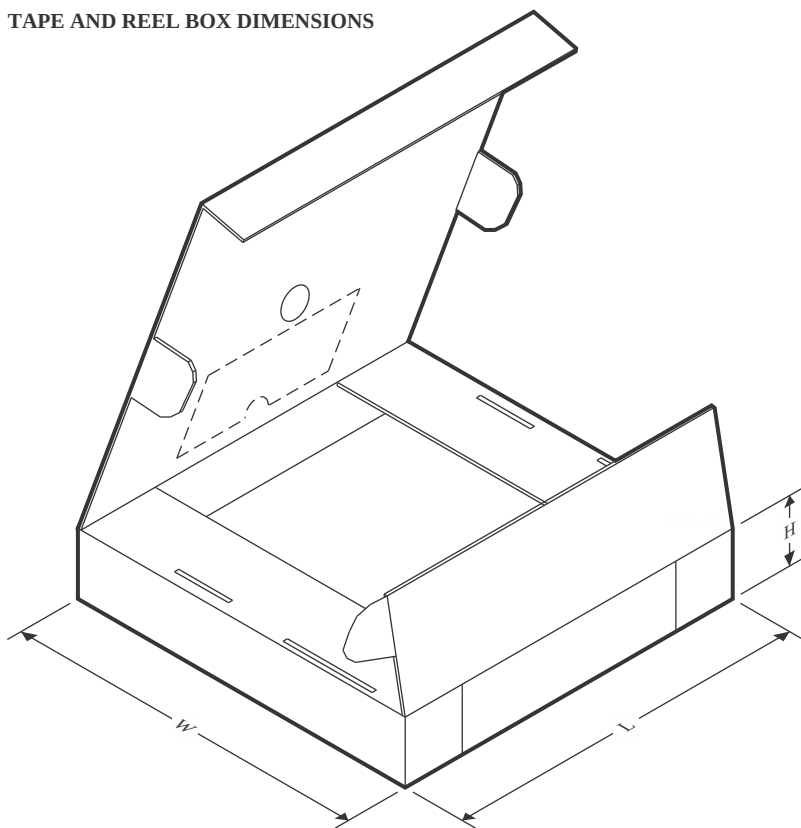
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLV61048DBVR	SOT-23	DBV	6	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV61048DBVRG4	SOT-23	DBV	6	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TLV61048DBVT	SOT-23	DBV	6	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS

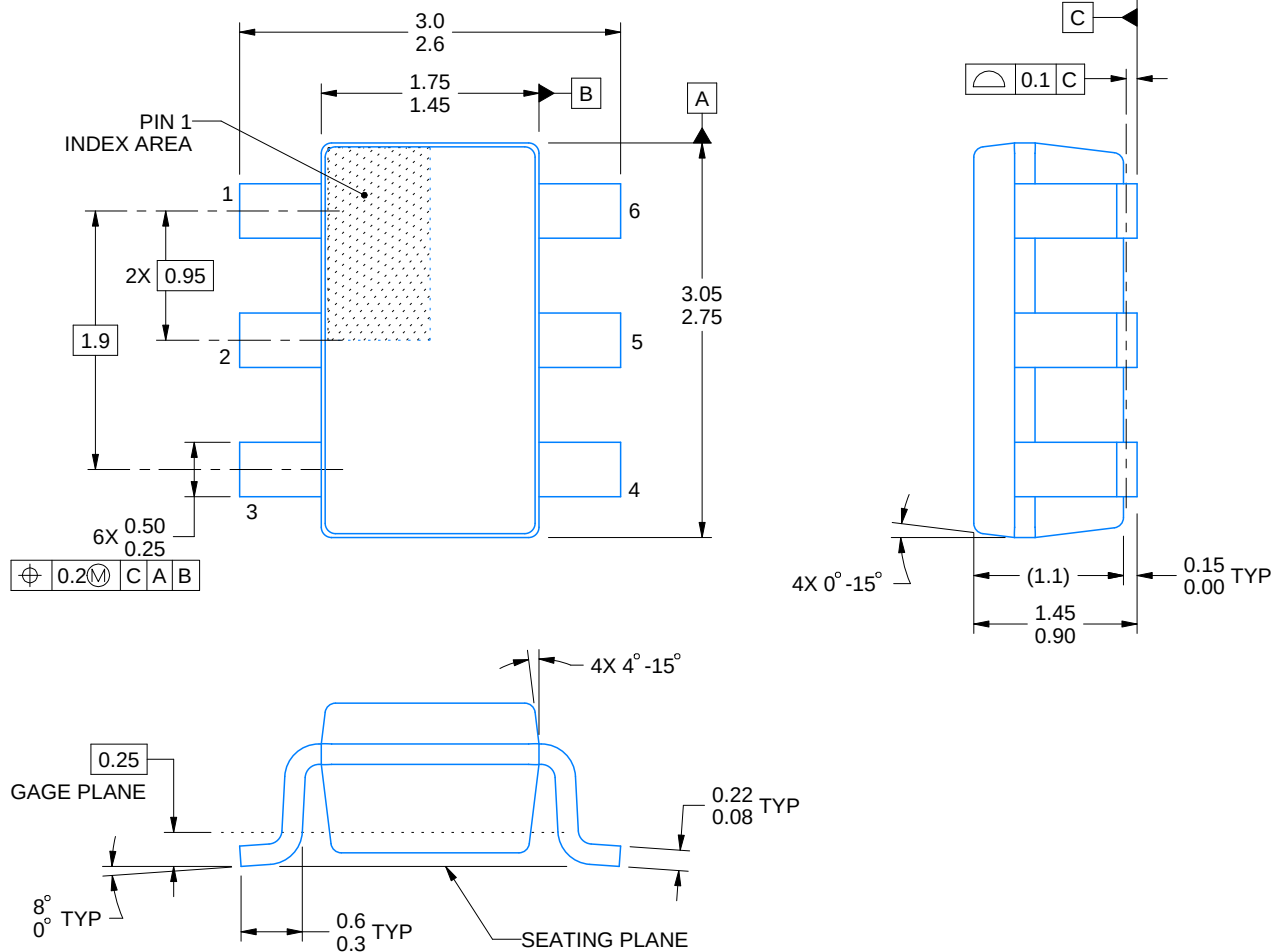


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV61048DBVR	SOT-23	DBV	6	3000	210.0	185.0	35.0
TLV61048DBVRG4	SOT-23	DBV	6	3000	210.0	185.0	35.0
TLV61048DBVT	SOT-23	DBV	6	250	210.0	185.0	35.0

DBV0006A**PACKAGE OUTLINE****SOT-23 - 1.45 mm max height**

SMALL OUTLINE TRANSISTOR



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NOTES:

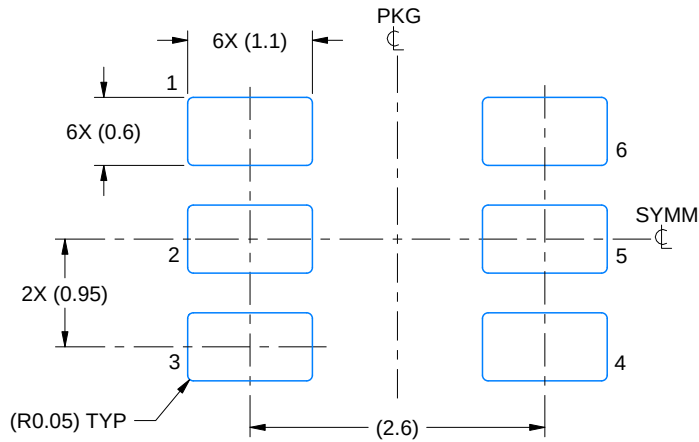
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.25 per side.
4. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
5. Reference JEDEC MO-178.

EXAMPLE BOARD LAYOUT

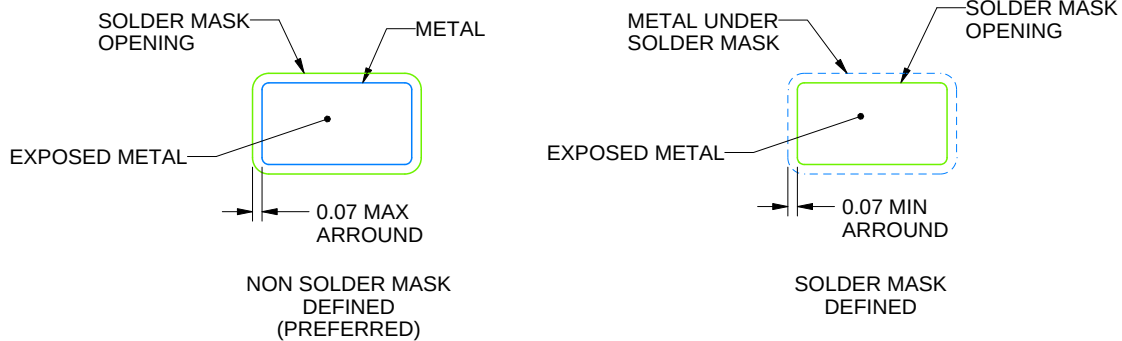
DBV0006A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

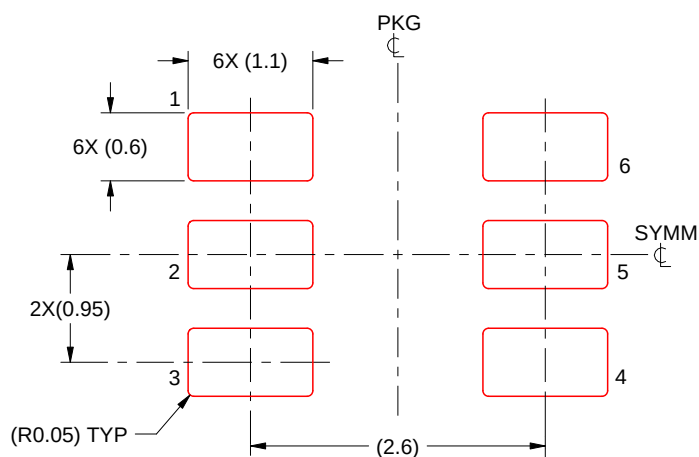
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DBV0006A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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