LOW INPUT VOLTAGE STEP-UP CONVERTER IN THIN SOT-23 PACKAGE

Check for Samples: TLV61220

FEATURES

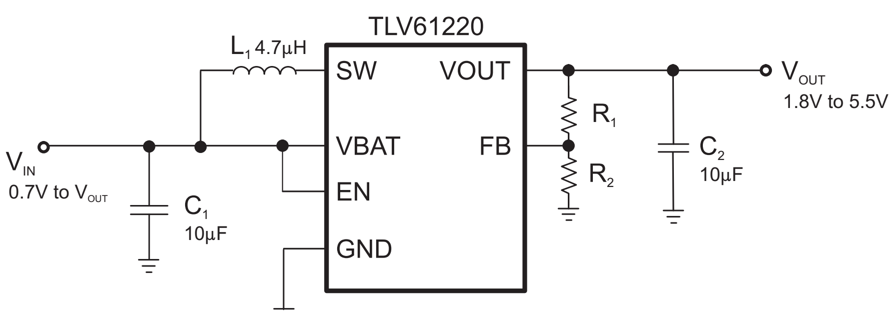
- **Up to 95% Efficiency at Typical Operating Conditions**
- **5.5 µA Quiescent Current**
- **Startup Into Load at 0.7 V Input Voltage**
- **Operating Input Voltage from 0.7 V to 5.5 V**
- **Pass-Through Function during Shutdown**
- **Minimum Switching Current 200 mA**
- **Protections:**
  - **Output Overvoltage**
  - **Overtemperature**
  - **Input Undervoltage Lockout**
- **Adjustable Output Voltage from 1.8 V to 5.5 V**
- **Small 6-pin Thin SOT-23 Package**

APPLICATIONS

- **Battery Powered Applications**
  - **1 to 3 Cell Alkaline, NiCd or NiMH**
  - **1 Cell Li-Ion or Li-Primary**
- **Solar or Fuel Cell Powered Applications**
- **Consumer and Portable Medical Products**
- **Personal Care Products**
- **White or Status LEDs**
- **Smartphones**

DESCRIPTION

The TLV61220 provides a power-supply solution for products powered by either a single-cell, two-cell, or three-cell alkaline, NiCd or NiMH, or one-cell Li-Ion or Li-polymer battery. Possible output currents depend on the input-to-output voltage ratio. The boost converter is based on a hysteretic controller topology using synchronous rectification to obtain maximum efficiency at minimal quiescent currents. The output voltage of the adjustable version can be programmed by an external resistor divider, or is set internally to a fixed output voltage. The converter can be switched off by a featured enable pin. While being switched off, battery drain is minimized. The device is packaged in a 6-pin thin SOT-23 package (DBV).



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

AVAILABLE DEVICE OPTIONS

T_A	OUTPUT VOLTAGE DC/DC	PACKAGE	PART NUMBER
–40°C to 85°C	Adjustable	6-Pin SOT-23	TLV61220DBV

ABSOLUTE MAXIMUM RATINGS

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

		MIN	MAX	UNIT
V_{IN}	Input voltage range on VBAT, SW, VOUT, EN, FB	– 0.3 to	7.5	V
T_J	Operating junction temperature range	–40	150	°C
T_{stg}	Storage temperature range	–65	150	°C
ESD	Human Body Model (HBM) (2)		2	kV
	Charged Device Model (CDM)(2)		1.5	kV

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) ESD testing is performed according to the respective JESD22 JEDEC standard.

DISSIPATION RATINGS TABLE

PACKAGE	THERMAL RESISTANCE Θ_{JA} (1)	THERMAL RESISTANCE Θ_{JB}	THERMAL RESISTANCE Θ_{JC}	POWER RATING $T_A \le 25°C$	DERATING FACTOR ABOVE $T_A = 25°C$
DBV	130 °C/W	27 °C/W	41 °C/W	769 mW	7.7 mW/°C

(1) Thermal ratings are determined assuming a high K PCB design according to JEDEC standard JESD51-7.

RECOMMENDED OPERATING CONDITIONS

		MIN	NOM	MAX	UNIT
V_{IN}	Supply voltage at VIN	0.7		5.5	V
T_A	Operating free air temperature range	–40		85	°C
T_J	Operating virtual junction temperature range	–40		125	°C

ELECTRICAL CHARACTERISTICS

over recommended free-air temperature range and over recommended input voltage range (typical at an ambient temperature range of 25°C) (unless otherwise noted)

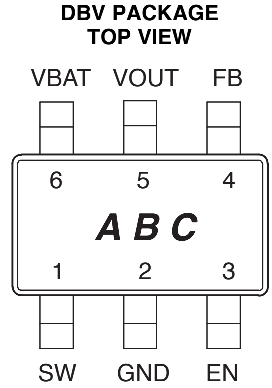
DC/DC STAGE

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IN}	Input voltage range			0.7		5.5	V
V_{IN}	Minimum input voltage at startup		R_{Load} ≥ 150 Ω			0.7	V
V_{OUT}	TLV61220 output voltage range		$V_{IN} < V_{OUT}$	1.8		5.5	V
V_{FB}	TLV61220 feedback voltage			483	500	513	mV
I_{LH}	Inductor current ripple				200		mA
I_{SW}	switch current limit		V_{OUT} = 3.3 V, V_{IN} = 1.2 V, T_A = 25 °C	220	400		mA
			V_{OUT} = 3.3 V, T_A = -40°C to 85 °C	180	400		mA
			V_{OUT} = 3.3 V, T_A = 0°C to 85 °C	200	400		mA
$R_{DS(on)}$	Rectifying switch on resistance, HSD		V_{OUT} = 3.3 V		1000		mΩ
			V_{OUT} = 5 V		700		mΩ
	Main switch on resistance, LSD		V_{OUT} = 3.3 V		600		mΩ
			V_{OUT} = 5 V		550		mΩ
	Line regulation		$V_{IN} < V_{OUT}$		0.5 %		
	Load regulation		$V_{IN} < V_{OUT}$		0.5 %		
I_Q	Quiescent current	V_{IN}	I_O = 0 mA, $V_{EN} = V_{IN}$ = 1.2 V, V_{OUT} = 3.3 V		0.5	0.9	μA
		V_{OUT}			5	7.5	μA
I_{SD}	Shutdown current	V_{IN}	V_{EN} = 0 V, V_{IN} = 1.2 V, $V_{OUT} \geq V_{IN}$		0.2	0.5	μA
I_{LKG}	Leakage current into VOUT		V_{EN} = 0 V, V_{IN} = 1.2 V, V_{OUT} = 3.3 V		1		μA
	Leakage current into SW		V_{EN} = 0 V, V_{IN} = 1.2 V, V_{SW} = 1.2 V, $V_{OUT} \geq V_{IN}$		0.01	0.2	μA
I_{FB}	TLV61220 Feedback input current		V_{FB} = 0.5 V		0.01		μA
I_{EN}	EN input current		Clamped on GND or V_{IN} (V_{IN} < 1.5 V)		0.005	0.1	μA

CONTROL STAGE

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IL}	EN input low voltage	V_{IN} ≤ 1.5 V			0.2 × V_{IN}	V
V_{IH}	EN input high voltage	V_{IN} ≤ 1.5 V	0.8 × V_{IN}			V
V_{IL}	EN input low voltage	5 V > V_{IN} > 1.5 V			0.4	V
V_{IH}	EN input high voltage	5 V > V_{IN} > 1.5 V	1.2			V
V_{UVLO}	Undervoltage lockout threshold for turn off	V_{IN} decreasing		0.5	0.7	V
	Overvoltage protection threshold		5.5		7.5	V
	Overtemperature protection			140		°C
	Overtemperature hysteresis			20		°C

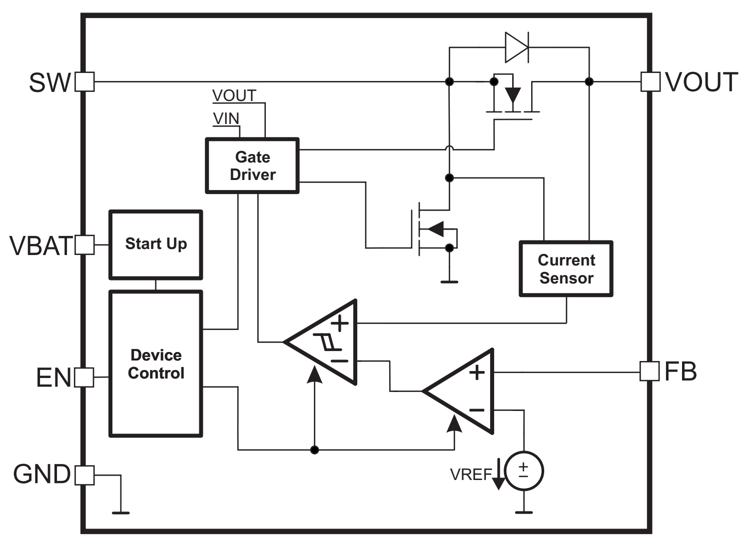
PIN ASSIGNMENTS



Terminal Functions

TERMINAL		I/O	DESCRIPTION
NAME	NO.		
EN	3	I	Enable input (VBAT enabled, GND disabled)
FB	4	I	Voltage feedback for programming the output voltage
GND	2		IC ground connection for logic and power
SW	1	I	Boost and rectifying switch input
VBAT	6	I	Supply voltage
VOUT	5	O	Boost converter output

FUNCTIONAL BLOCK DIAGRAM (ADJUSTABLE VERSION)



PARAMETER MEASUREMENT INFORMATION

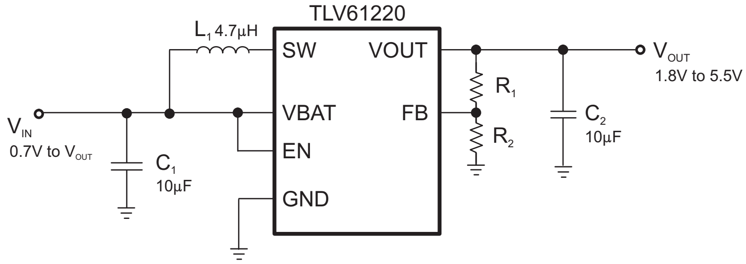


Table 1. List of Components:

COMPONENT REFERENCE	PART NUMBER	MANUFACTURER	VALUE
C_1	GRM188R60J106ME84D	Murata	10 µF, 6.3V. X5R Ceramic
C_2	GRM188R60J106ME84D	Murata	10 µF, 6.3V. X5R Ceramic
L_1	1269AS-H-4ZR7N	Toko	4.7 µH
R_1, R_2			R_1= 1MΩ, R_2= Values depending on the programmed output voltage

TYPICAL CHARACTERISTICS

Table of Graphs

		FIGURE
Output Current	Input Voltage, I_{SW} = 330 mA, Minimum I_{SW}= 200 mA, V_O = 1.8V	1
	Input Voltage, I_{SW} = 400 mA, Minimum I_{SW} = 200 mA, V_O = 3.3V	2
	Input Voltage, I_{SW} = 380 mA, Minimum I_{SW} = 200 mA, V_O = 5V	3
Efficiency	vs Output Current, V_O = 1.8 V, V_I = [0.7 V; 1.2 V; 1.5 V]	4
	vs Output Current, V_O = 3.3 V, V_I = [0.7 V; 1.2 V; 2.4V; 3V]	5
	vs Output Current, V_O = 5 V, V_I = [0.7 V; 1.2 V; 3.6V; 4.2V]	6
Efficiency	vs Input Voltage, V_O = 1.8 V, I_O = [100μA; 1mA ; 10mA; 50mA]	7
	vs Input Voltage, V_O = 3.3 V, I_O = [100μA; 1mA ; 10mA; 50mA]	8
	vs Input Voltage, V_O = 5 V, I_O = [100μA; 1mA ; 10mA; 50mA]	9
Output Voltage	vs Output Current, , V_O = 1.8 V, V_I = [0.7 V; 1.2 V]	10
	vs Output Current, , V_O = 3.3 V, V_I = [0.7 V; 1.2 V; 2.4 V]	11
Waveforms	Load transient, V_I = 1.2 V, V_O = 3.3 V, I_O = 5mA to 20 mA	12
	Line transient, V_I = 1.8 V to 2.4V, V_O = 3.3 V, I_O = 30 mA	13
	Startup after Enable, V_I = 1.2 V, V_O = 3.3 V, R_{LOAD} = 50 Ω	14

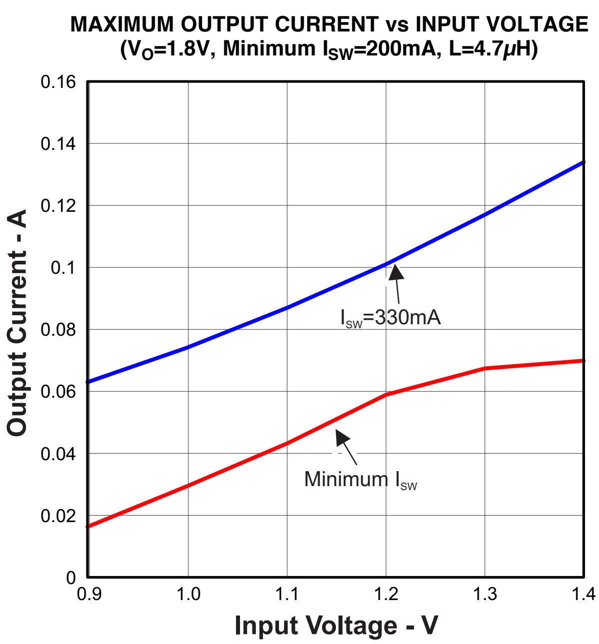


Figure 1.

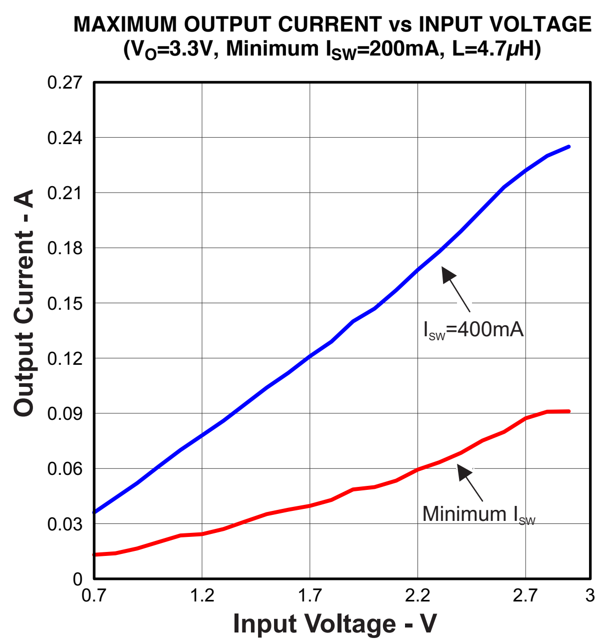


Figure 2.

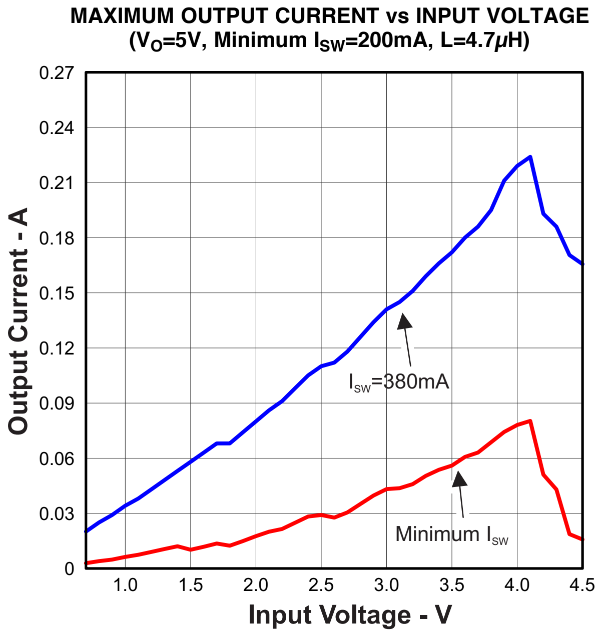


Figure 3.

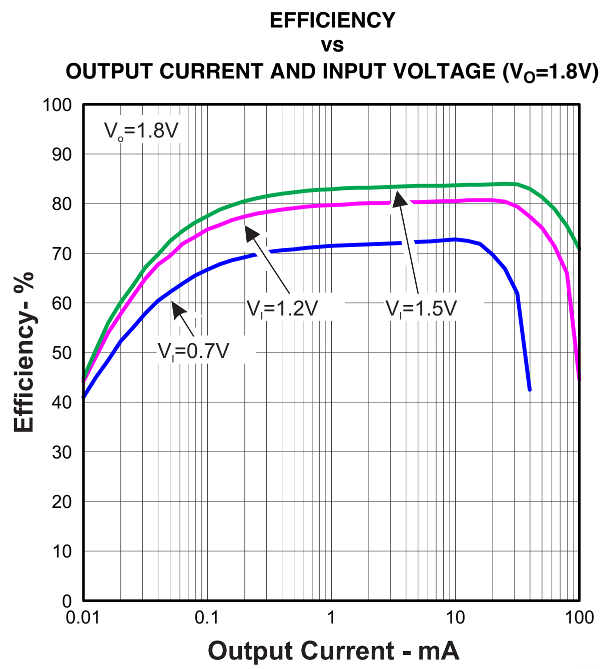


Figure 4.

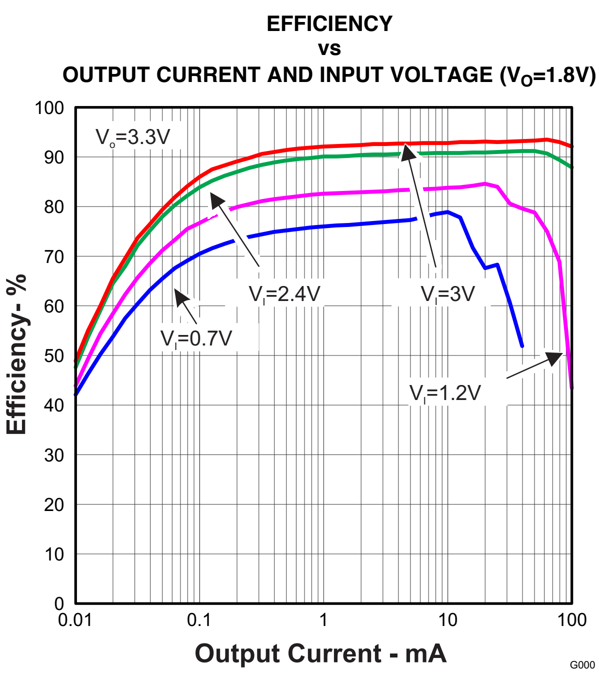


Figure 5.

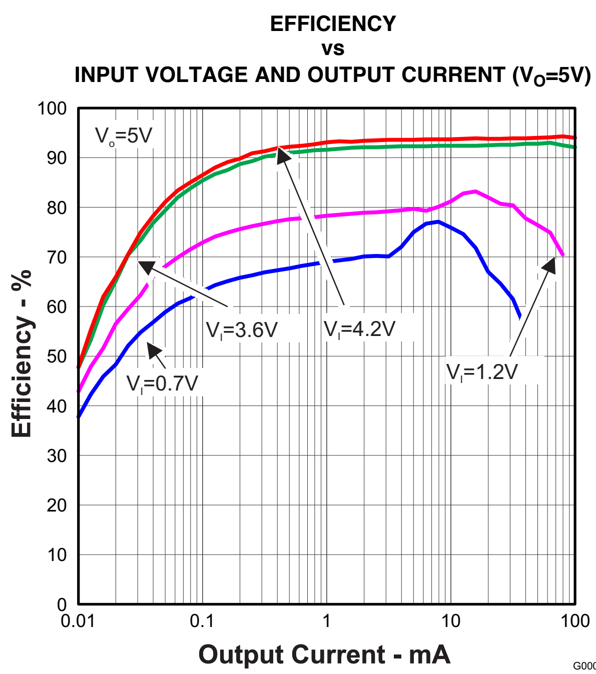


Figure 6.

EFFICIENCY vs INPUT VOLTAGE AND OUTPUT CURRENT (V_O=1.8V)

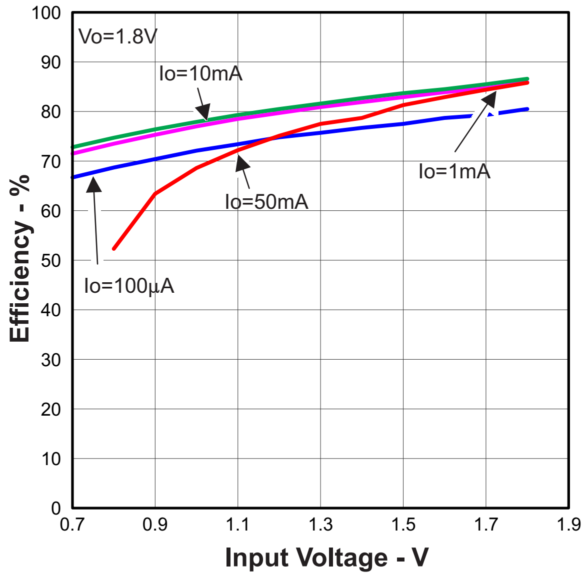


Figure 7.

EFFICIENCY vs INPUT VOLTAGE AND OUTPUT CURRENT (V_O=3.3V)

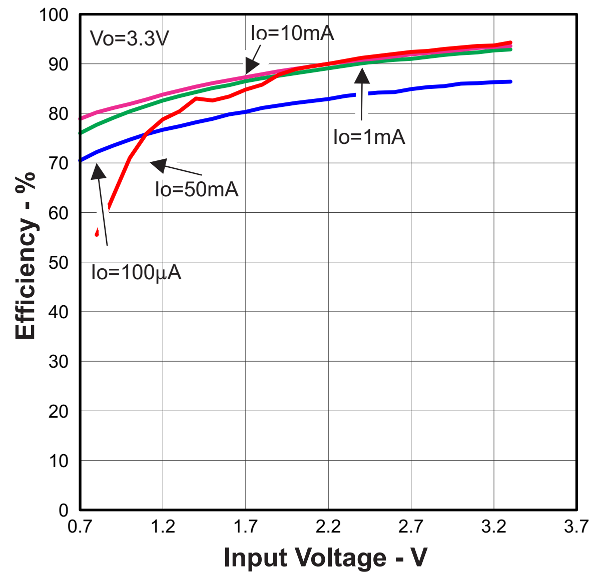


Figure 8.

EFFICIENCY vs INPUT VOLTAGE AND OUTPUT CURRENT (V_O=5V)

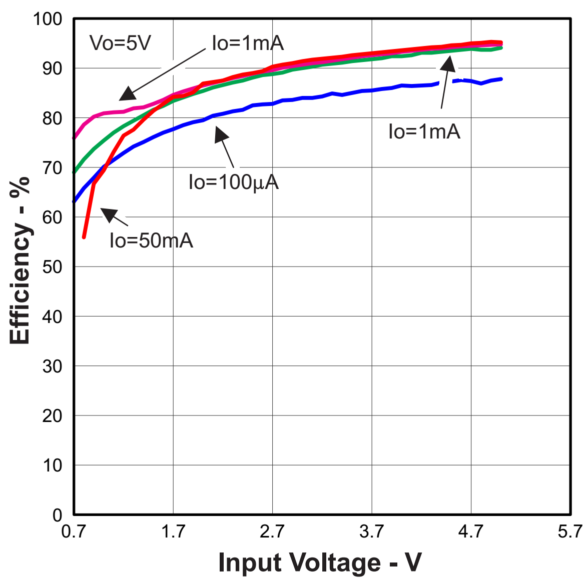


Figure 9.

OUTPUT VOLTAGE vs OUTPUT CURRENT AND INPUT VOLTAGE (V_O=1.8V)

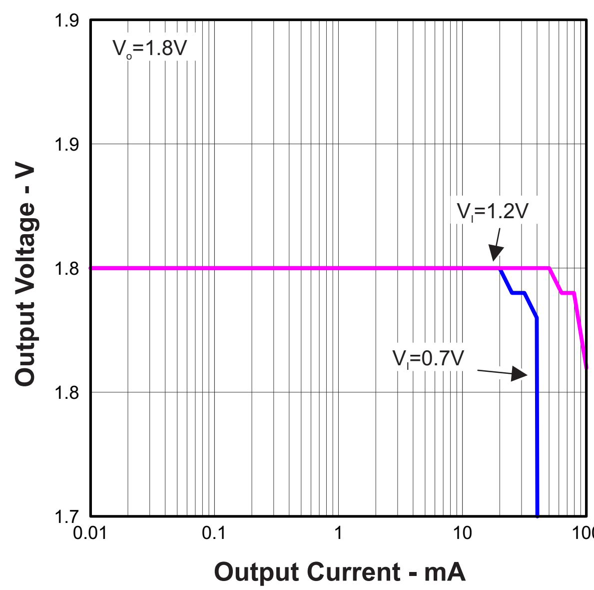


Figure 10.

OUTPUT VOLTAGE
vs
OUTPUT CURRENT AND INPUT VOLTAGE (V_O=3.3V)

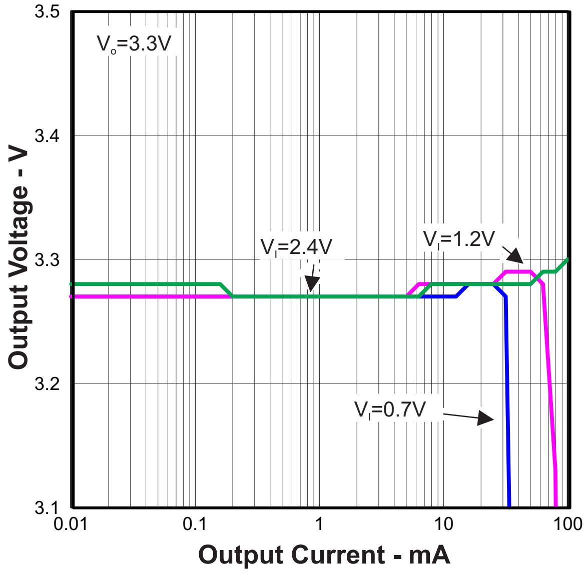


Figure 11.

LOAD TRANSIENT RESPONSE

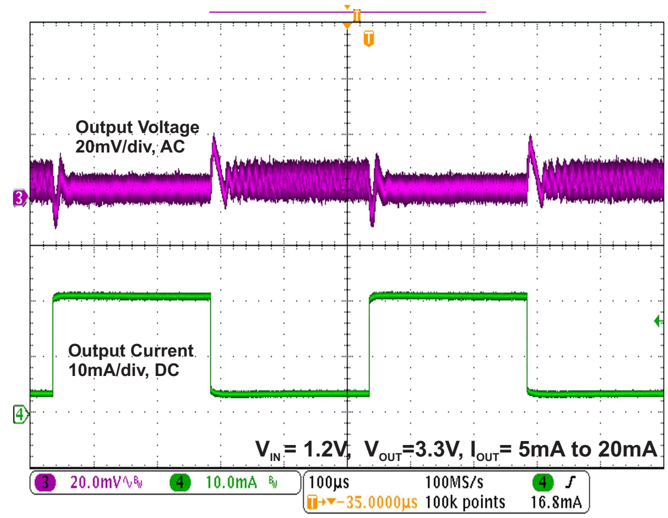


Figure 12.

LINE TRANSIENT RESPONSE

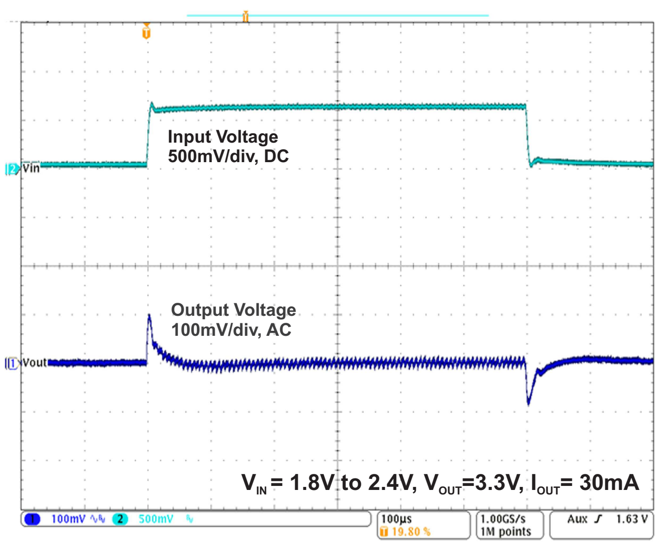


Figure 13.

START UP AFTER ENABLE

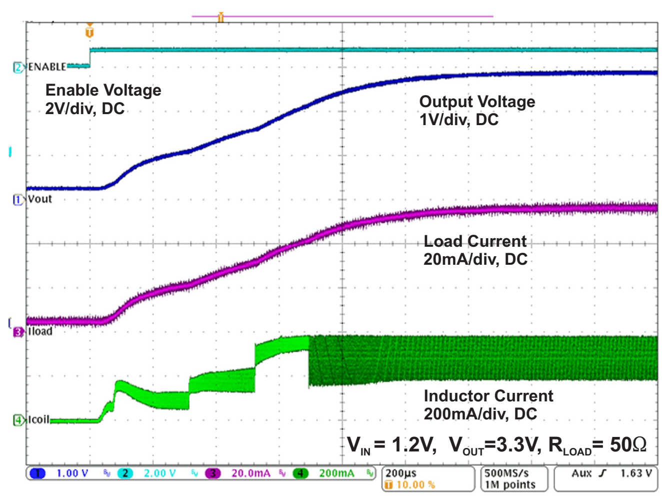


Figure 14.

DETAILED DESCRIPTION

OPERATION

The TLV61220 is a high performance, high efficient boost converter. To achieve high efficiency the power stage is realized as a synchronous boost topology. For the power switching two actively controlled low $R_{DS(on)}$ power MOSFETs are implemented.

CONTROLLER CIRCUIT

The device is controlled by a hysteretic current mode controller. This controller regulates the output voltage by keeping the inductor ripple current constant in the range of 200 mA and adjusting the offset of this inductor current depending on the output load. In case the required average input current is lower than the average inductor current defined by this constant ripple the inductor current gets discontinuous to keep the efficiency high at low load conditions.

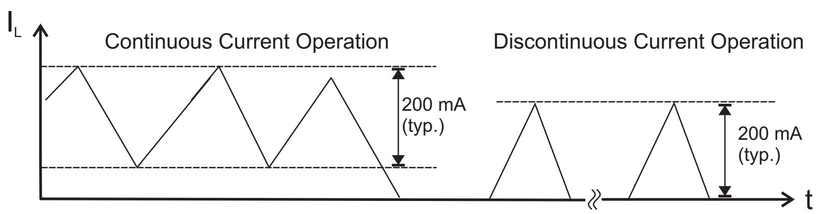


Figure 15. Hysteretic Current Operation

The output voltage V_{OUT} is monitored via the feedback network which is connected to the voltage error amplifier. To regulate the output voltage, the voltage error amplifier compares this feedback voltage to the internal voltage reference and adjusts the required offset of the inductor current accordingly. At fixed output voltage versions an internal feedback network is used to program the output voltage, at adjustable versions an external resistor divider needs to be connected.

The self oscillating hysteretic current mode architecture is inherently stable and allows fast response to load variations. It also allows using inductors and capacitors over a wide value range.

Device Enable and Shutdown Mode

The device is enabled when EN is set high and shut down when EN is low. During shutdown, the converter stops switching and all internal control circuitry is turned off. In this case the input voltage is connected to the output through the back-gate diode of the rectifying MOSFET. This means that there always will be voltage at the output which can be as high as the input voltage or lower depending on the load.

Startup

After the EN pin is tied high, the device starts to operate. In case the input voltage is not high enough to supply the control circuit properly a startup oscillator starts to operate the switches. During this phase the switching frequency is controlled by the oscillator and the maximum switch current is limited. As soon as the device has built up the output voltage to about 1.8 V, high enough for supplying the control circuit, the device switches to its normal hysteretic current mode operation. The startup time depends on input voltage and load current.

Operation at Output Overload

If in normal boost operation the inductor current reaches the internal switch current limit threshold the main switch is turned off to stop further increase of the input current.

In this case the output voltage will decrease since the device can not provide sufficient power to maintain the set output voltage.

If the output voltage drops below the input voltage the backgate diode of the rectifying switch gets forward biased and current starts flow through it. This diode cannot be turned off, so the current finally is only limited by the remaining DC resistances. As soon as the overload condition is removed, the converter resumes providing the set output voltage.

Undervoltage Lockout

An implemented undervoltage lockout function stops the operation of the converter if the input voltage drops below the typical undervoltage lockout threshold. This function is implemented in order to prevent malfunctioning of the converter.

Overvoltage Protection

If, for any reason, the output voltage is not fed back properly to the input of the voltage amplifier, control of the output voltage will not work anymore. Therefore an overvoltage protection is implemented to avoid the output voltage exceeding critical values for the device and possibly for the system it is supplying. For this protection the TLV61220 output voltage is also monitored internally. In case it reaches the internally programmed threshold of 6.5 V typically the voltage amplifier regulates the output voltage to this value.

If the TLV61220 is used to drive LEDs, this feature protects the circuit if the LED fails.

Overtemperature Protection

The device has a built-in temperature sensor which monitors the internal IC junction temperature. If the temperature exceeds the programmed threshold (see electrical characteristics table), the device stops operating. As soon as the IC temperature has decreased below the programmed threshold, it starts operating again. To prevent unstable operation close to the region of overtemperature threshold, a built-in hysteresis is implemented.

APPLICATION INFORMATION

DESIGN PROCEDURE

The TLV61220 is intended for systems powered by a single cell battery to up to three Alkaline, NiCd or NiMH cells with a typical terminal voltage between 0.7 V and 5.5 V. They can also be used in systems powered by one-cell Li-Ion or Li-Polymer batteries with a typical voltage between 2.5 V and 4.2 V. Additionally, any other voltage source with a typical output voltage between 0.7 V and 5.5 V can be used with the TLV61220.

Adjustable output voltage version

An external resistor divider is used to adjust the output voltage. The resistor divider needs to be connected between VOUT, FB and GND as shown in Figure 16. When the output voltage is regulated properly, the typical voltage value at the FB pin is 500 mV for the adjustable devices. The maximum recommended value for the output voltage is 5.5 V. The current through the resistive divider should be about 100 times greater than the current into the FB pin. The typical current into the FB pin is 0.01 µA, and the voltage across the resistor between FB and GND, R_2, is typically 500 mV. Based on those two values, the recommended value for R_2 should be lower than 500 kΩ, in order to set the divider current to 1 µA or higher. The value of the resistor connected between VOUT and FB, R_1, depending on the needed output voltage (V_{OUT}), can be calculated using Equation 1:

$$R_1 = R_2 \times \left(\frac{V_{OUT}}{V_{FB}} - 1 \right) \quad (1)$$

As an example, if an output voltage of 3.3 V is needed, a 1-MΩ resistor is calculated for R_1 when for R_2 a 180-kΩ has been selected.

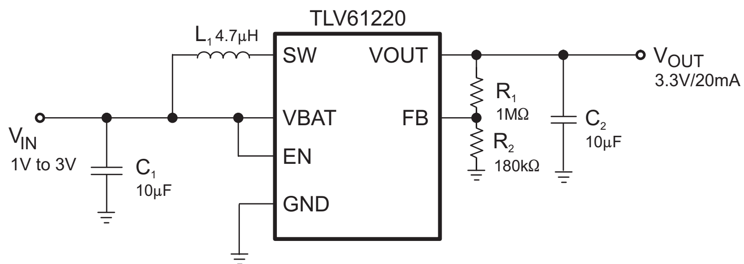


Figure 16. Typical Application Circuit for Adjustable Output Voltage Option

Inductor Selection

To make sure that the TLV61220 can operate, a suitable inductor must be connected between pin VBAT and pin SW. Inductor values of 4.7 µH show good performance over the whole input and output voltage range .

Choosing other inductance values affects the switching frequency *f* proportional to 1/L as shown in Equation 2.

$$L = \frac{1}{f \times 200\ \text{mA}} \times \frac{V_{IN} \times (V_{OUT} - V_{IN})}{V_{OUT}} \quad (2)$$

Choosing inductor values higher than 4.7 µH can improve efficiency due to reduced switching frequency and; therefore, with reduced switching losses. Using inductor values below 2.2 µH is not recommended.

Having selected an inductance value, the peak current for the inductor in steady state operation can be calculated. Equation 3 gives the peak current estimate.

$$I_{L,MAX} = \begin{cases} \dfrac{V_{OUT} \times I_{OUT}}{0.8 \times V_{IN}} + 100\ \text{mA}; & \text{continous current operation} \\ 200\ \text{mA}; & \text{discontinuous current operation} \end{cases} \quad (3)$$

For selecting the inductor this would be the suitable value for the current rating. It also needs to be taken into account that load transients and error conditions may cause higher inductor currents.

Equation 4 helps to estimate whether the device will work in continuous or discontinuous operation depending on the operating points. As long as the inequation is true, continuous operation is typically established. If the inequation becomes false, discontinous operation is typically established.

$$\frac{V_{OUT} \times I_{OUT}}{V_{IN}} > 0.8 \times 100\ \text{mA} \tag{4}$$

The following inductor series from different suppliers have been used with TLV61220 converters:

Table 2. List of Inductors

VENDOR	INDUCTOR SERIES
Toko	DFE252010C
Coilcraft	EPL3015
	EPL2010
Murata	LQH3NP
Taiyo Yuden	NR3015
Wurth Elektronik	WE-TPC Typ S

Capacitor Selection

Input Capacitor

At least a 10-µF input capacitor is recommended to improve transient behavior of the regulator and EMI behavior of the total power supply circuit. A ceramic capacitor placed as close as possible to the VBAT and GND pins of the IC is recommended.

Output Capacitor

For the output capacitor C_2 , it is recommended to use small ceramic capacitors placed as close as possible to the VOUT and GND pins of the IC. If, for any reason, the application requires the use of large capacitors which can not be placed close to the IC, the use of a small ceramic capacitor with an capacitance value of around 2.2µF in parallel to the large one is recommended. This small capacitor should be placed as close as possible to the VOUT and GND pins of the IC.

A minimum capacitance value of 4.7 µF should be used, 10 µF are recommended. If the inductor value exceeds 4.7 µH, the value of the output capacitance value needs to be half the inductance value or higher for stability reasons, see Equation 5.

$$C_2 \geq \frac{L}{2} \times \frac{\mu F}{\mu H} \tag{5}$$

The TLV61220 is not sensitive to the ESR in terms of stability. Using low ESR capacitors, such as ceramic capacitors, is recommended anyway to minimize output voltage ripple. If heavy load changes are expected, the output capacitor value should be increased to avoid output voltage drops during fast load transients.

Layout Considerations

As for all switching power supplies, the layout is an important step in the design, especially at high peak currents and high switching frequencies. If the layout is not carefully done, the regulator could show stability problems as well as EMI problems. Therefore, use wide and short traces for the main current path and for the power ground paths. The input and output capacitor, as well as the inductor should be placed as close as possible to the IC.

The feedback divider should be placed as close as possible to the control ground pin of the IC. To lay out the ground, it is recommended to use short traces as well, separated from the power ground traces. This avoids ground shift problems, which can occur due to superimposition of power ground current and control ground current. Assure that the ground traces are connected close to the device GND pin.

THERMAL INFORMATION

Implementation of integrated circuits in low-profile and fine-pitch surface-mount packages typically requires special attention to power dissipation. Many system-dependent issues such as thermal coupling, airflow, added heat sinks and convection surfaces, and the presence of other heat-generating components affect the power-dissipation limits of a given component.

Three basic approaches for enhancing thermal performance are listed below.

- Improving the power-dissipation capability of the PCB design
- Improving the thermal coupling of the component to the PCB
- Introducing airflow in the system

For more details on how to use the thermal parameters in the dissipation ratings table please check the Thermal Characteristics Application Note (SZZA017) and the IC Package Thermal Metrics Application Note (SPRA953).

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
TLV61220DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VUAI	Samples
TLV61220DBVT	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VUAI	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

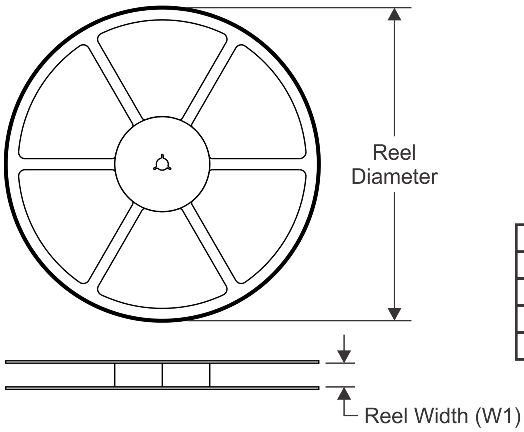
(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

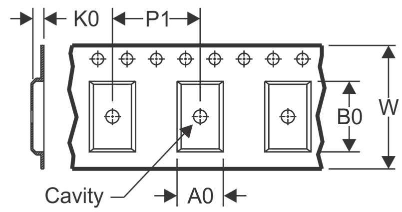
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

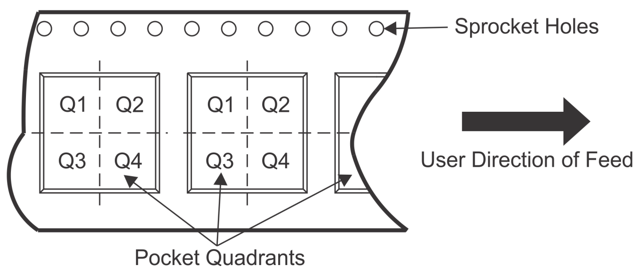


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

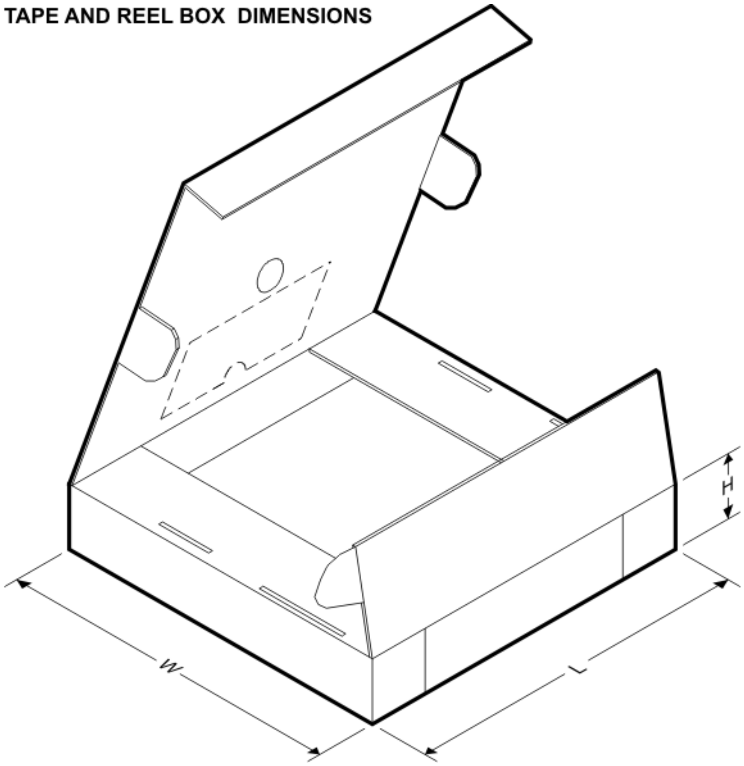
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TLV61220DBVR	SOT-23	DBV	6	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TLV61220DBVT	SOT-23	DBV	6	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3

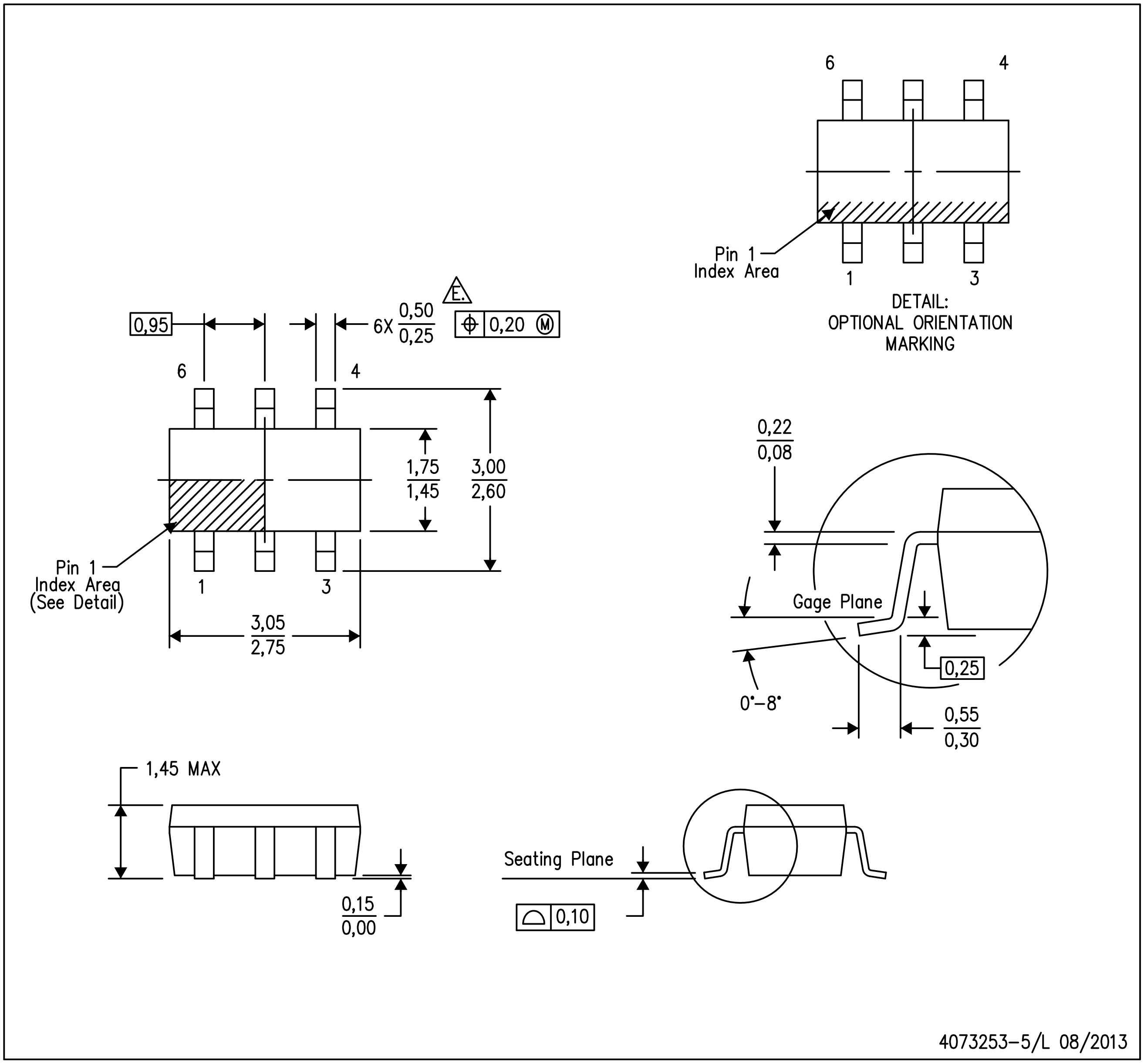
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

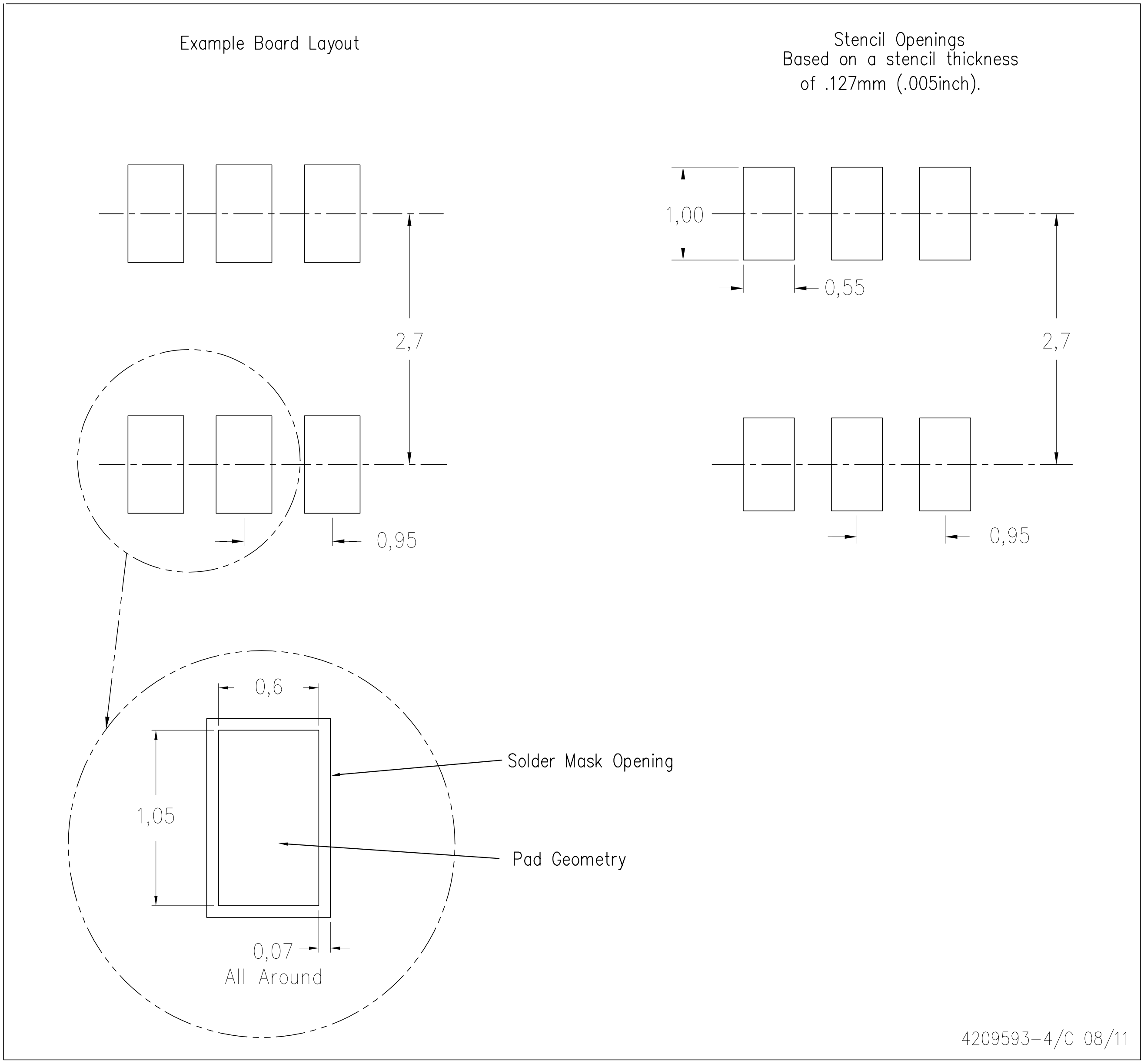
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLV61220DBVR	SOT-23	DBV	6	3000	180.0	180.0	18.0
TLV61220DBVT	SOT-23	DBV	6	250	180.0	180.0	18.0

DBV (R-PDSO-G6) PLASTIC SMALL-OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
E. Falls within JEDEC MO-178 Variation AB, except minimum lead width.

DBV (R-PDSO-G6) PLASTIC SMALL OUTLINE



NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
- D. Publication IPC-7351 is recommended for alternate designs.
- E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.