LM2621 Low Input Voltage, Step-Up DC-DC Converter

1 Features

- Small VSSOP8 Package (Half the Footprint of Standard 8-Pin SOIC Package)
- 1.09-mm Package Height
- Up to 2-MHz Switching Frequency
- 1.2-V to 14-V Input Voltage
- 1.24-V to 14-V Adjustable Output Voltage
- Up to 1A Load Current
- 0.17-Ω Internal MOSFET
- Up to 90% Regulator Efficiency
- 80-µA Typical Operating Current
- < 2.5-µA Specified Supply Current In Shutdown

2 Applications

- PDAs, Cellular Phones
- 2-Cell and 3-Cell Battery-Operated Equipment
- PCMCIA Cards, Memory Cards
- Flash Memory Programming
- TFT/LCD Applications
- 3.3-V to 5.0-V Conversion
- GPS Devices
- Two-Way Pagers
- Palmtop Computers
- Hand-Held Instruments

3 Description

The LM2621 is a high efficiency, step-up DC-DC switching regulator for battery-powered and low input voltage systems. It accepts an input voltage between 1.2 V and 14 V and converts it into a regulated output voltage. The output voltage can be adjusted between 1.24 V and 14 V. It has an internal 0.17-Ω N-Channel MOSFET power switch. Efficiencies up to 90% are achievable using the LM2621.

The high switching frequency (adjustable up to 2 MHz) of the LM2621 allows for tiny surface mount inductors and capacitors. Because of the unique constant-duty-cycle gated oscillator topology very high efficiencies are realized over a wide load range. The supply current is reduced to 80 µA because of the BiCMOS process technology. In the shutdown mode, the supply current is less than 2.5 µA.

The LM2621 is available in a VSSOP-8 package. This package uses half the board area of a standard 8-pin SOIC and has a height of just 1.09 mm.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM2621	VSSOP (8)	3.00 mm x 3.00 mm

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

Typical Application Circuit

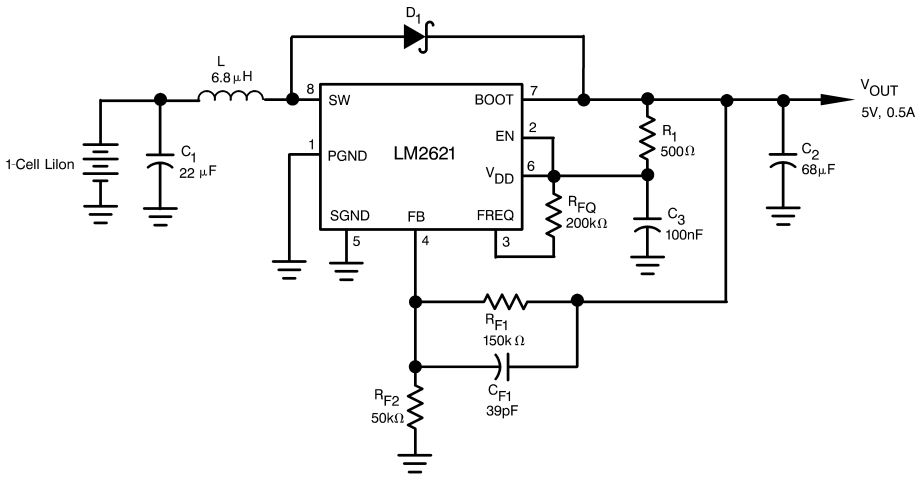


Table of Contents

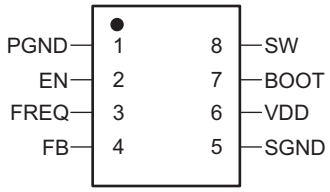
4 Revision History

Changes from Revision C (November 2012) to Revision D **Page**

- Added *Pin Configuration and Functions* section, *Handling Rating* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1

5 Pin Configuration and Functions

DGK Package
8-Pin VSSOP
Top View



Pin Functions

PIN		TYPE(1)	DESCRIPTION
NAME	NO.		
PGND	1	GND	Power Ground
EN	2	I	Active-Low Shutdown Input
FREQ	3	A	Frequency Adjust. An external resistor connected between this pin and Pin 6 (V_{DD}) sets the switching frequency of the LM2621.
FB	4	A	Output Voltage Feedback
SGND	5	GND	Signal Ground
V_{DD}	6	PWR	Power Supply for Internal Circuitry
BOOT	7	PWR	Bootstrap Supply for the Gate Drive of Internal MOSFET Power Switch
SW	8	PWR	Drain of the Internal MOSFET Power Switch

(1) I = Input, O = Output, PWR = Power, GND = Ground, A = Analog

6 Specifications

6.1 Absolute Maximum Ratings

See (1)(2)

	MIN	MAX	UNIT
SW Pin Voltage	–0.5	14.5	V
BOOT, V_{DD}, EN and FB Pins	–0.5	10	V
FREQ Pin		100	µA
Power Dissipation (T_A=25°C) (3)		500	mW
T_{Jmax}(3)		150	°C
Lead Temp. (Soldering, 5 sec)		260	°C
Storage temperature, T_{stg}	–65	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) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
(3) The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{jmax} (maximum junction temperature), θ_{JA} (junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{dmax} = (T_{jmax} - T_A)/ \theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.

6.2 Recommended Operating Conditions

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

	MIN	NOM	MAX	UNIT
V_{DD}	2.5		5	V
FB	0		V_{DD}	V
EN	0		V_{DD}	V
BOOT	0		10	V
Ambient Temperature, T_A	–40		85	°C

6.3 Thermal Information

THERMAL METRIC[1]		LM2621 DGK (VSSOP) 8 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance [2]	160	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	52.7	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	80.1	°C/W
ψ_{JT}	Junction-to-top characterization parameter	5.5	°C/W
ψ_{JB}	Junction-to-board characterization parameter	78.8	°C/W
$R_{\theta JC(bot)}$	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, SPRA953.
(2) The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{jmax} (maximum junction temperature), θ_{JA} (junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{dmax} = (T_{jmax} - T_A)/ \theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower.

6.4 Electrical Characteristics

Unless otherwise specified: V_{DD}= V_{OUT}= 3.3 V, T_J = 25°C.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IN_ST}	Minimum Start-Up Supply Voltage[1]	I_{LOAD} = 0 mA		1.1		V
		I_{LOAD} = 0 mA, –40°C to 85°C			1.2	
V_{IN_OP}	Minimum Operating Supply Voltage (once started)	I_{LOAD} = 0 mA		0.65		V
V_{FB}	FB Pin Voltage			1.24		V
		–40°C to 85°C	1.2028		1.2772	
V_{OUT_MAX}	Maximum Output Voltage			14		V
V_{HYST}	Hysteresis Voltage[2]			30		mV
		–40°C to 85°C			45	
η	Efficiency	V_{IN} = 3.6 V; V_{OUT} = 5 V; I_{LOAD} = 500 mA		87%		
		V_{IN} = 2.5 V; V_{OUT} = 3.3 V; I_{LOAD} = 200 mA		87%		
D	Switch Duty Cycle			70%		
		−40°C to 85°C	60%		80%	
I_{DD}	Operating Quiescent Current[3]	FB Pin > 1.3 V; EN Pin at V_{DD}		80		µA
		FB Pin > 1.3 V; EN Pin at V_{DD}, –40°C to 85°C			110	
I_{SD}	Shutdown Quiescent Current[4]	V_{DD}, BOOT and SW Pins at 5.0 V; EN Pin < 200 mV		0.01		µA
		V_{DD}, BOOT and SW Pins at 5.0 V; EN Pin < 200 mV, –40°C to 85°C			2.5	
I_{CL}	Switch Peak Current Limit			2.85		A

(1) Output in regulation, V_{OUT} = $V_{OUT\ (NOMINAL)}$ ± 5%
(2) This is the hysteresis value of the internal comparator used for the gated-oscillator control scheme.
(3) This is the current into the V_{DD} pin.
(4) This is the total current into pins V_{DD}, BOOT, SW and FREQ.

Electrical Characteristics (continued)

Unless otherwise specified: V_{DD}= V_{OUT}= 3.3 V, T_J = 25°C.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
R_{DS_ON}	MOSFET Switch On Resistance			0.17		Ω
ENABLE SECTION						
V_{EN_LO}	EN Pin Voltage Low(5)	–40°C to 85°C			$0.15V_{DD}$	V
V_{EN_HI}	EN Pin Voltage High(5)	–40°C to 85°C	$0.7V_{DD}$			V

(5) When the EN pin is below V_{EN_LO}, the regulator is shut down; when it is above V_{EN_HI}, the regulator is operating.

6.5 Typical Characteristics

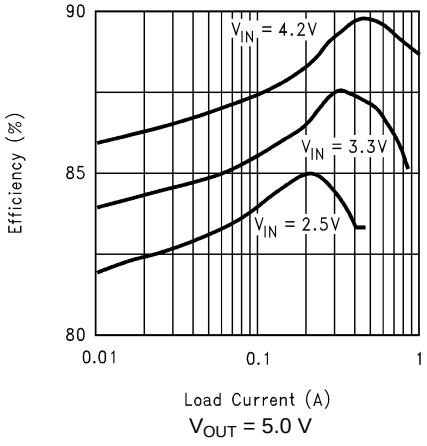


Figure 1. Efficiency vs Load Current

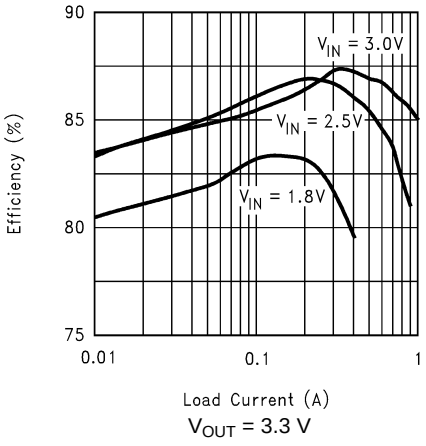


Figure 2. Efficiency vs Load Current

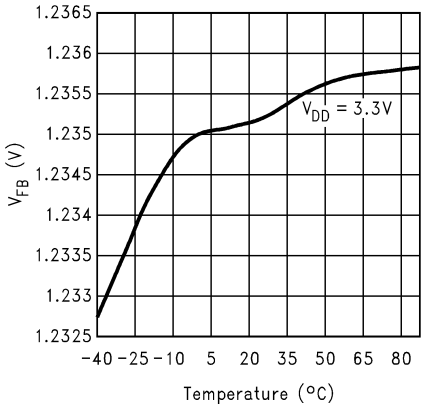


Figure 3. V_{FB} vs Temperature

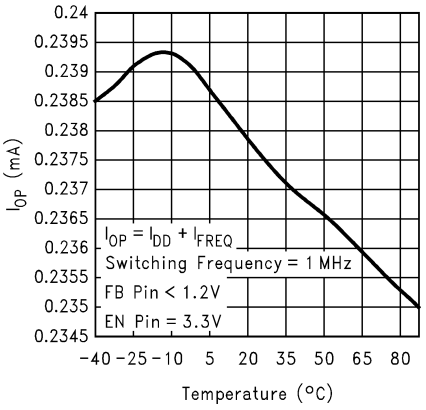


Figure 4. I_{OP} vs Temperature

Typical Characteristics (continued)

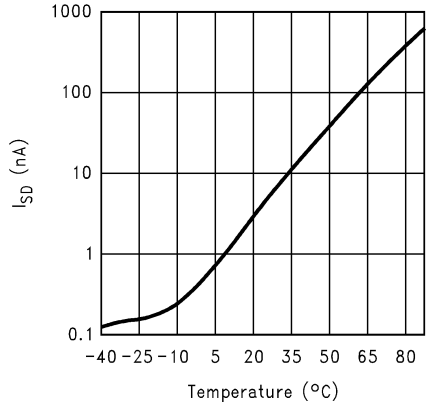


Figure 5. I_{SD} vs Temperature

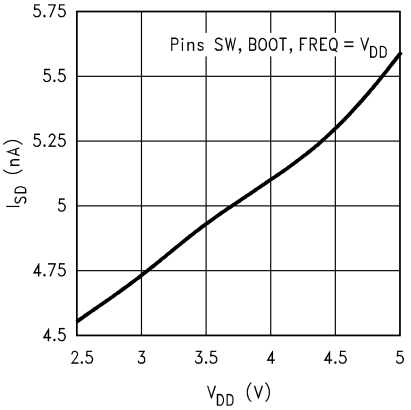


Figure 6. I_{SD} vs V_{DD}

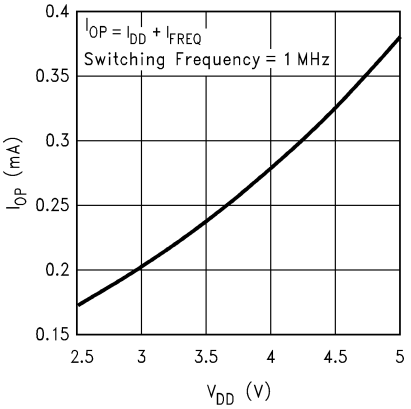


Figure 7. I_{OP} vs V_{DD}

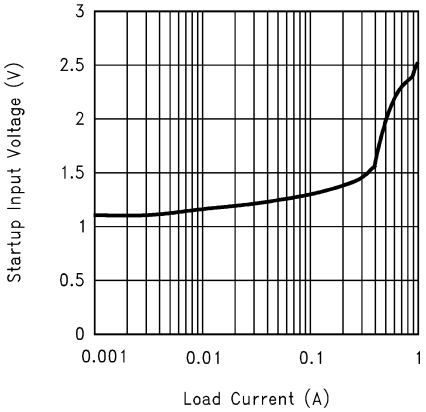


Figure 8. V_{IN_ST} vs Load Current

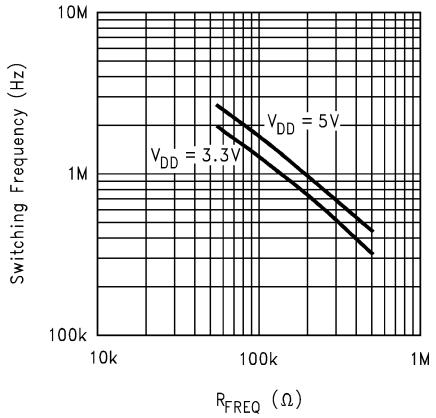


Figure 9. Switching Frequency vs R_{FQ}

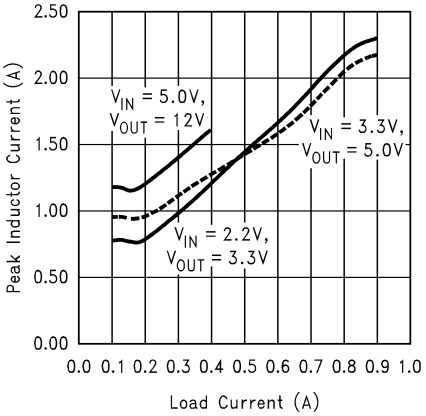


Figure 10. Peak Inductor Current vs Load Current

Typical Characteristics (continued)

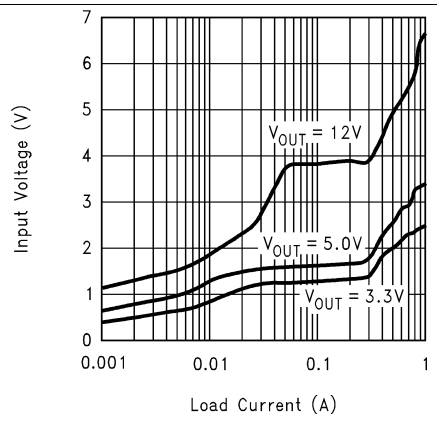


Figure 11. Maximum Load Current vs Input Voltage

7 Detailed Description

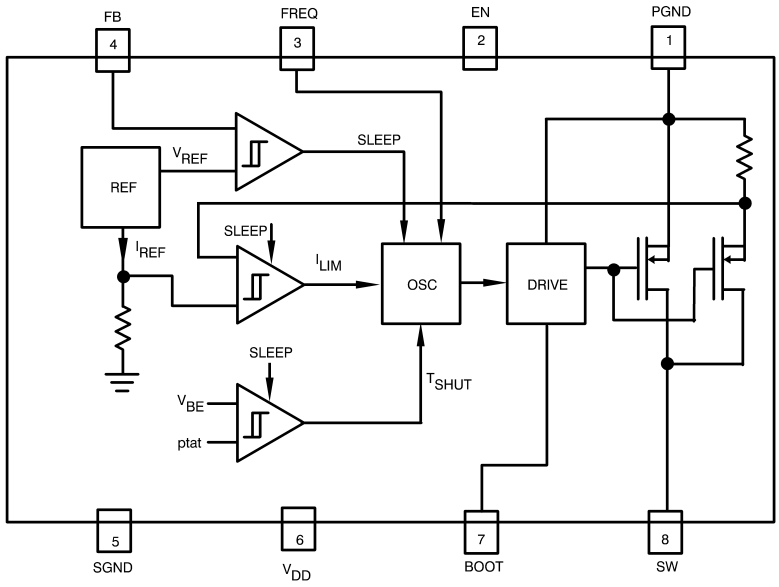
7.1 Overview

The LM2621 is designed to provide step-up DC-DC voltage regulation in battery-powered and low-input voltage systems. It combines a step-up switching regulator, N-channel power MOSFET, built-in current limit, thermal limit, and voltage reference in a single 8-pin VSSOP package *Pin Configuration and Functions*. The switching DC-DC regulator boosts an input voltage between 1.2 V and 14 V to a regulated output voltage between 1.24 V and 14 V. The LM2621 starts from a low 1.1-V input and remains operational down to 0.65 V.

This device is optimized for use in cellular phones and other applications requiring a small size, low profile, as well as low quiescent current for maximum battery life during stand-by and shutdown. A high-efficiency gated-oscillator topology offers an output of up to 1 A.

Additional features include a built-in peak switch current limit, and thermal protection circuitry.

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Gated Oscillator Control Scheme

A unique gated oscillator control scheme enables the LM2621 to have an ultra-low quiescent current and provides a high efficiency over a wide load range. The switching frequency of the internal oscillator is programmable using an external resistor and can be set between 300 kHz and 2 MHz.

This control scheme uses a hysteresis window to regulate the output voltage. When the output voltage is below the upper threshold of the window, the LM2621 switches continuously with a fixed duty cycle of 70% at the switching frequency selected by the user. During the first part of each switching cycle, the internal N-channel MOSFET switch is turned on. This causes the current to ramp up in the inductor and store energy. During the second part of each switching cycle, the MOSFET is turned off. The voltage across the inductor reverses and forces current through the diode to the output filter capacitor and the load. Thus when the LM2621 switches continuously, the output voltage starts to ramp up. When the output voltage hits the upper threshold of the window, the LM2621 stops switching completely. This causes the output voltage to droop because the energy stored in the output capacitor is depleted by the load. When the output voltage hits the lower threshold of the hysteresis window, the LM2621 starts switching continuously again causing the output voltage to ramp up towards the upper threshold. Figure 12 shows the switch voltage and output voltage waveforms.

Because of this type of control scheme, the quiescent current is inherently very low. At light loads the gated oscillator control scheme offers a much higher efficiency compared to the conventional PWM control scheme.

Feature Description (continued)

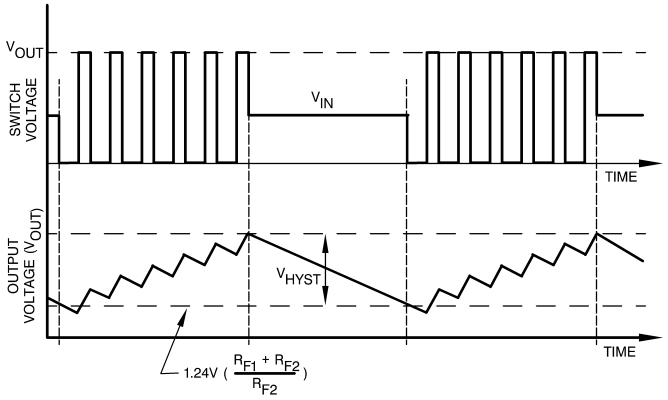


Figure 12. Typical Step-Up Regulator Waveforms

7.3.2 Low Voltage Start-Up

The LM2621 can start-up from input voltages as low as 1.1 V. On start-up, the control circuitry switches the N-channel MOSFET continuously at 70% duty cycle until the output voltage reaches 2.5 V. After this output voltage is reached, the normal step-up regulator feedback and gated oscillator control scheme take over. Once the device is in regulation it can operate down to a 0.65-V input, since the internal power for the IC can be boot-strapped from the output using the V_{DD} pin.

7.3.3 Output Voltage Ripple Frequency

A major component of the output voltage ripple is due to the hysteresis used in the gated oscillator control scheme. The frequency of this voltage ripple is proportional to the load current. The frequency of this ripple does not necessitate the use of larger inductors and capacitors however, since the size of these components is determined by the switching frequency of the oscillator which can be set up to 2 MHz using an external resistor.

7.3.4 Internal Current Limit and Thermal Protection

An internal cycle-by-cycle current limit serves as a protection feature. This is set high enough (2.85 A typical, approximately 4 A maximum) so as not to come into effect during normal operating conditions. An internal thermal protection circuitry disables the MOSFET power switch when the junction temperature (T_J) exceeds about 160°C. The switch is re-enabled when T_J drops below approximately 135°C.

7.4 Device Functional Modes

7.4.1 Shutdown

The LM2621 features a shutdown mode that reduces the quiescent current to less than a specified 2.5-µA overtemperature. This extends the life of the battery in battery powered applications. During shutdown, all feedback and control circuitry is turned off. The regulator's output voltage drops to one diode drop below the input voltage. Entry into the shutdown mode is controlled by the active-low logic input pin EN (Pin 2). When the logic input to this pin pulled below 0.15 V_{DD}, the device goes into shutdown mode. The logic input to this pin should be above 0.7 V_{DD} for the device to work in normal step-up mode.

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

The LM2621 is primarily used as a Boost type step-up converter. The following section provides information regarding connection and component choices to build a successful boost converter. Examples of typical applications are also provided including a SEPIC step-up/step-down topology. More details on designing a SEPIC converter can be found here: SLYT309.

8.2 Typical Applications

8.2.1 Step-Up DC-DC Converter Typical Application Using LM2621

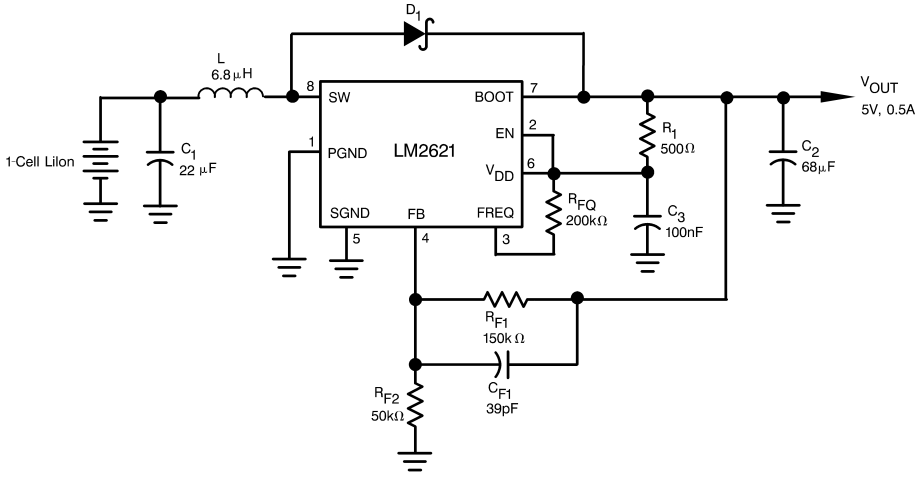


Figure 13. Typical Circuit

8.2.1.1 Design Requirements

In order to successfully build an application, the designer should have the following parameters:

- Output voltage to set the feedback voltage divider and to assess the source for biasing the V_{DD} pin.
- Input voltage range (min and max) to ensure safe operation within absolute max. rating of the IC.
- Output current to ensure that the system will not hit the internal peak current limit of the IC (2.85 A typical) during normal operation.

8.2.1.2 Detailed Design Procedure

8.2.1.2.1 Setting the Output Voltage

The output voltage of the step-up regulator can be set between 1.24 V and 14 V by connecting a feedback resistive divider made of R_{F1} and R_{F2}. The resistor values are selected as follows:

$$R_{F2} = R_{F1} / [(V_{OUT} / 1.24) - 1] \quad (1)$$

A value of 150 kΩ is suggested for R_{F1}. Then, R_{F2} can be selected using the above equation. A 39-pF capacitor (C_{F1}) connected across R_{F1} helps in feeding back most of the AC ripple at V_{OUT} to the FB pin. This helps reduce the peak-to-peak output voltage ripple as well as improve the efficiency of the step-up regulator, because a set hysteresis of 30 mV at the FB pin is used for the gated oscillator control scheme.

Typical Applications (continued)

8.2.1.2.2 Bootstrapping

When the output voltage (V_{OUT}) is between 2.5 V and 5.0 V a bootstrapped operation is suggested. This is achieved by connecting the V_{DD} pin (Pin 6) to V_{OUT}. However if the V_{OUT} is outside this range, the V_{DD} pin should be connected to a voltage source whose range is between 2.5 V and 5 V. This can be the input voltage (V_{IN}), V_{OUT} stepped down using a linear regulator, or a different voltage source available in the system. This is referred to as non-bootstrapped operation. The maximum acceptable voltage at the BOOT pin (Pin 7) is 10 V.

8.2.1.2.3 Setting the Switching Frequency

The switching frequency of the oscillator is selected by choosing an external resistor (R_{FQ}) connected between FREQ and V_{DD} pins. See Figure 9 for choosing the R_{FQ} value to achieve the desired switching frequency. A high switching frequency allows the use of very small surface mount inductors and capacitors and results in a very small solution size. A switching frequency between 300 kHz and 2 MHz is recommended.

8.2.1.2.4 Inductor Selection

The LM2621's high switching frequency enables the use of a small surface mount inductor. A 6.8-µH shielded inductor is suggested. The inductor should have a saturation current rating higher than the peak current it will experience during circuit operation (see Figure 10). Less than 100-mΩ ESR is suggested for high efficiency.

Open-core inductors cause flux linkage with circuit components and interfere with the normal operation of the circuit. They should be avoided. For high efficiency, choose an inductor with a high frequency core material, such as ferrite, to reduce the core losses. To minimize radiated noise, use a toroid, pot core or shielded core inductor. The inductor should be connected to the SW pin as close to the IC as possible. See Table 1 for a list of the inductor manufacturers.

8.2.1.2.5 Output Diode Selection

A Schottky diode should be used for the output diode. The forward current rating of the diode should be higher than the load current, and the reverse voltage rating must be higher than the output voltage. Do not use ordinary rectifier diodes, since slow switching speeds and long recovery times cause the efficiency and the load regulation to suffer. Table 1 shows a list of the diode manufacturers.

8.2.1.2.6 Input and Output Filter Capacitors Selection

Tantalum chip capacitors are recommended for the input and output filter capacitors. A 22-µF capacitor is suggested for the input filter capacitor. It should have a DC working voltage rating higher than the maximum input voltage. A 68-µF tantalum capacitor is suggested for the output capacitor. The DC working voltage rating should be greater than the output voltage. Very high ESR values (> 3Ω) should be avoided.

8.2.1.3 Application Curves

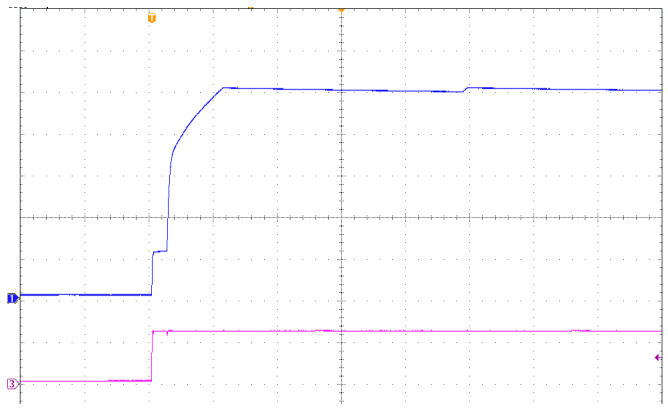


Figure 14. Startup Vin=1.2V,Vout-5V, 10ms/div 1V/div (Ch3:Vin,Ch1:Vout)

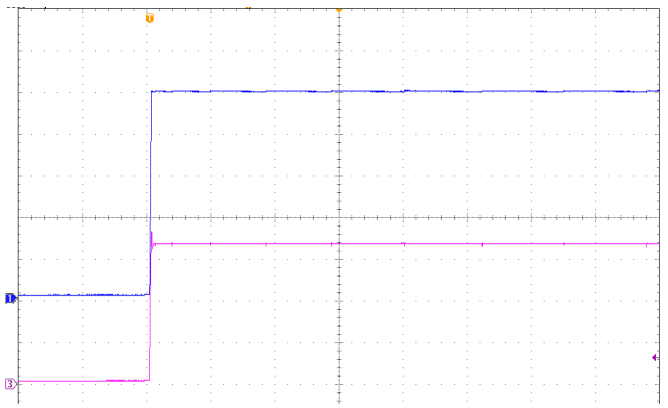


Figure 15. Startup Vin=3.3V,Vout-5V, 10ms/div 1V/div (Ch3:Vin,Ch1:Vout)

Typical Applications (continued)

8.2.2 5-V / 0.5-A Step-Up Regulator

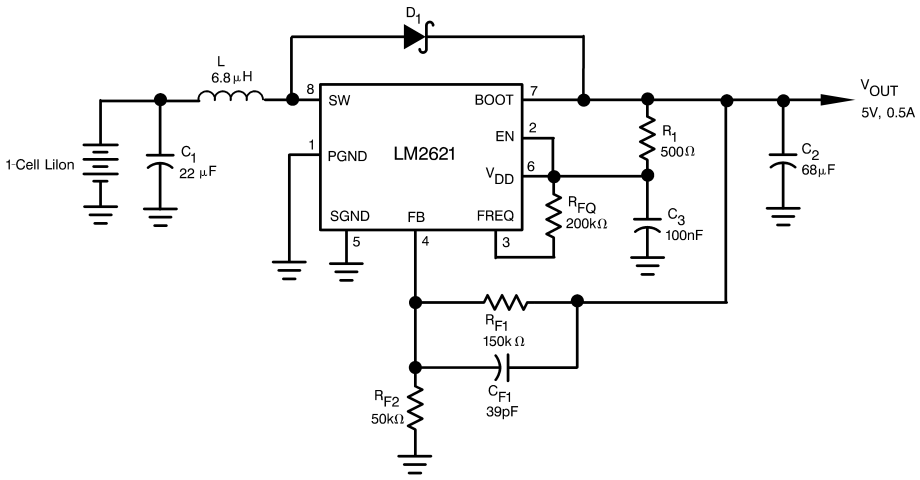


Figure 16. 5-V/0.5A Step-Up Regulator

8.2.2.1 Design Requirements

Design requirement is the same to the typical application shown earlier. Components have been chosen that comply with the required maximum height. See *Design Requirements* for the design requirement and following sections for the detailed design procedure.

8.2.2.2 Detailed Design Procedure

Follow the detailed design procedure in *Detailed Design Procedure*.

Typical Applications (continued)

Table 1. Bill of Materials

	Manufacturer	Part Number
U1	TI	LM2621MM
C1	Vishay/Sprague	595D226X06R3B2T, Tantalum
C2	Vishay/Sprague	595D686X0010C2T, Tantalum
D1	Motorola	MBRS140T3
L	Coilcraft	DT1608C-682

8.2.3 2-mm Tall 5-V / 0.2-A Step-Up Regulator for Low Profile Applications

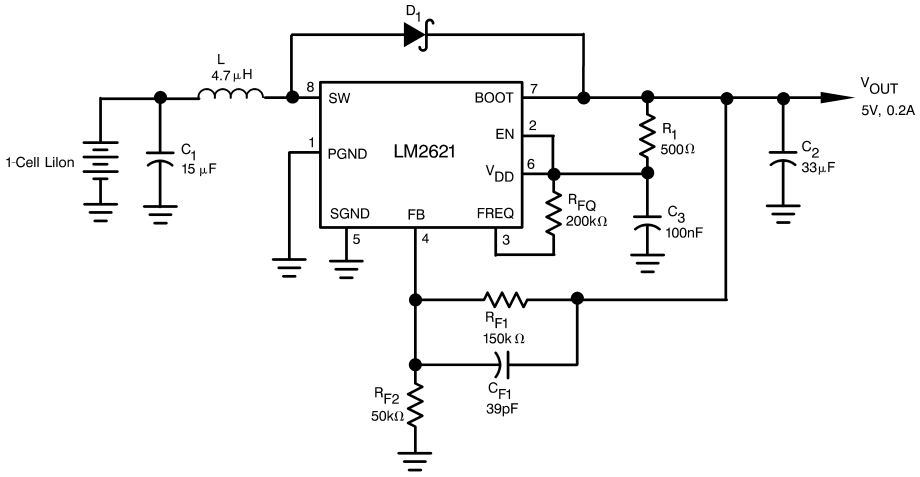


Figure 17. 2-mm Tall 5-V/0.2A Step-Up Regulator for Low Profile Applications

8.2.3.1 Design Requirements

Design requirement is the same to the typical application shown earlier. Components have been chosen that comply with the required maximum height. See *Design Requirements* for the design requirement and following sections for the detailed design procedure.

8.2.3.2 Detailed Design Procedure

Follow the detailed design procedure in *Detailed Design Procedure*.

Table 2. Bill of Materials

	Manufacturer	Part Number
U1	TI	LM2621MM
C1	Vishay/Sprague	592D156X06R3B2T, Tantalum
C2	Vishay/Sprague	592D336X06R3C2T, Tantalum
D1	Motorola	MBRS140T3
L	Vishay/Dale	ILS-3825-03

8.2.4 3.3-V / 0.5-A SEPIC Regulator

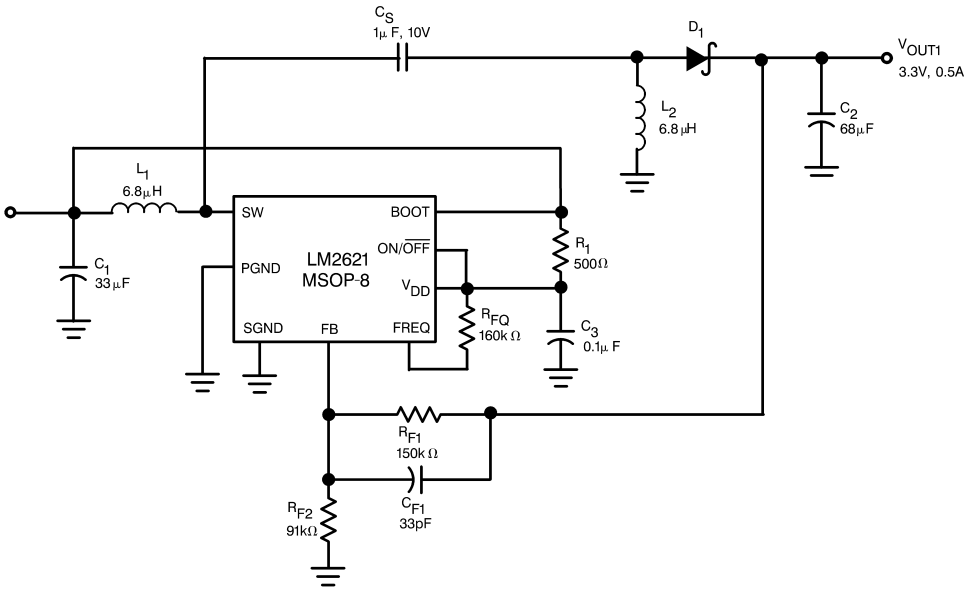


Figure 18. 3.3-V/0.5-A SEPIC Regulator

8.2.4.1 Design Requirements

Design requirement for the SEPIC is similar to that of a boost but the current flowing through the switch is the addition of the current flowing through L1 and L2. As a result, the peak current through the main switch is $I_{IN}+I_{OUT}+0.5xDeltaI_{L1}+0.5xDeltaI_{L2}$. See SLYT309 for detail on the specific design requirement of a SEPIC converter.

8.2.4.2 Detailed Design Procedure

Follow the detailed design procedure in *Detailed Design Procedure*.

Table 3. Bill of Materials

	Manufacturer	Part Number	Description
U1	TI	LM2621MM	Low Input Voltage Regulator
C1	Sanyo	10CV220AX, SMT AL-Electrolytic	220 µF
C2	TDK	C2012X7R1C225M, MLCC	2.2 µF
C3	Vishay	VJ0603A331KXXAT	33 pF
C4	TDK	C3225X7R0J107MT	100 µF
C5, C6	Vishay	VJ0603Y104KXXAT	0.1 µF
D1	Philips	BAT54C	VR = 1V
D2	Vishay	MBRS120	1A / VR = 20V
L1, L2	Coilcraft	DO1813P-682HC	6.8 µH
R1	Vishay	CRCW08054990FRT6	499 Ω
R2	Vishay	CRCW08051503FRT6	150 kΩ
R3	Vishay	CRCW08053923FRT6	392 kΩ
R4	Vishay	CRCW08059092FRT6	90.9 kΩ

9 Power Supply Recommendations

The power line feeding the LM2621 should have low impedance. The input capacitor of the system should be placed as close to VIN as possible. If the power supply is very noisy, an additional bulk capacitor might be necessary in the system to ensure that clean power is delivered to the IC.

10 Layout

10.1 Layout Guidelines

High switching frequencies and high peak currents make a proper layout of the PC board an important part of design. Poor design can cause excessive EMI and ground-bounce, both of which can cause malfunction and loss of regulation by corrupting voltage feedback signal and injecting noise into the control section.

Power components - such as the inductor, input and output filter capacitors, and output diode - should be placed as close to the regulator IC as possible, and their traces should be kept short, direct and wide. The ground pins of the input and output filter capacitors and the PGND and SGND pins of LM2621 should be connected using short, direct and wide traces. The voltage feedback network (R_{F1}, R_{F2}, and C_{F1}) should be kept very close to the FB pin. Noisy traces, such as from the SW pin, should be kept away from the FB and V_{DD} pins. The traces that run between V_{out} and the FB pin of the IC should be kept away from the inductor flux. Always provide sufficient copper area to dissipate the heat due to power loss in the circuitry and prevent the thermal protection circuitry in the IC from shutting the IC down.

10.2 Layout Example

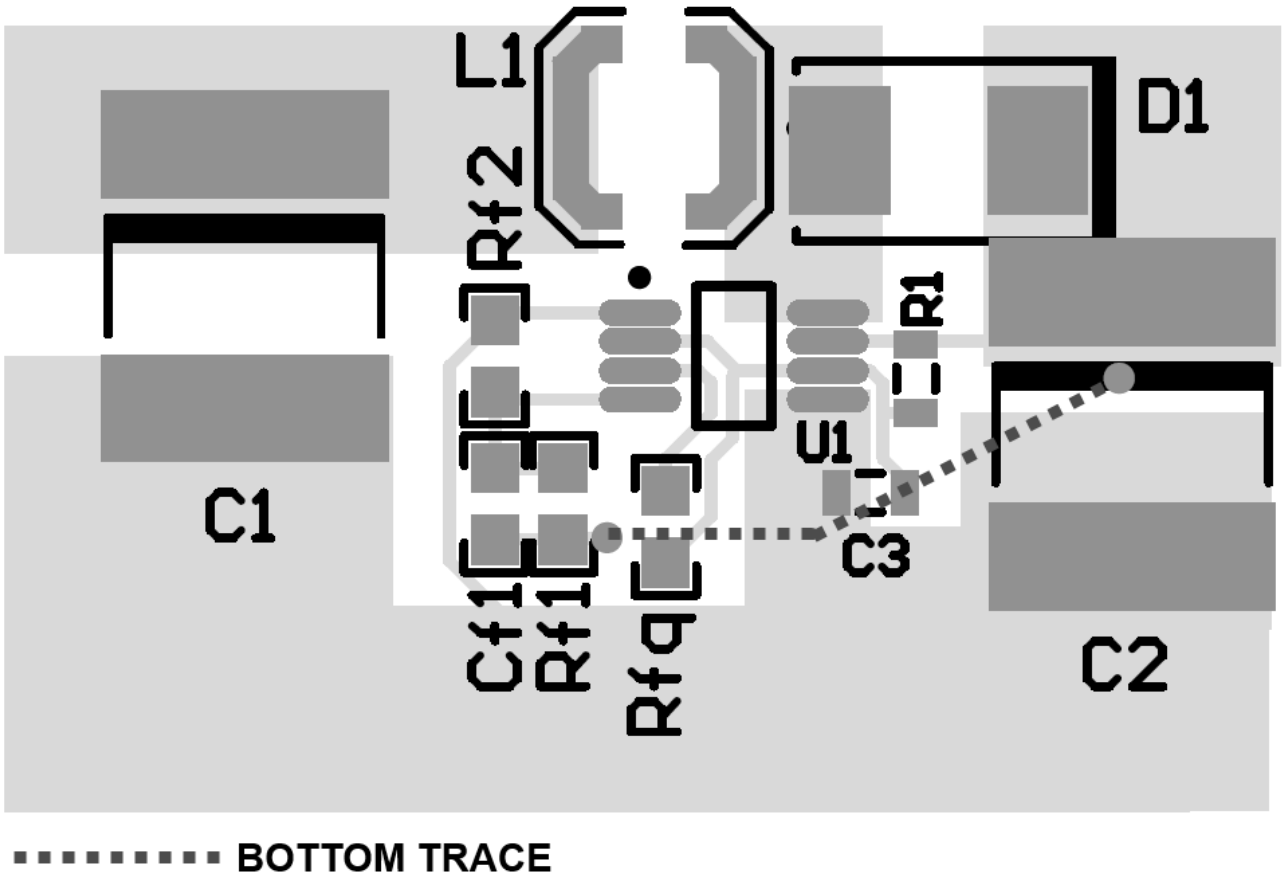


Figure 19. LM2621 PCB Layout

11 Device and Documentation Support

11.1 Device Support

11.1.1 Third-Party Products Disclaimer

TI'S PUBLICATION OF INFORMATION REGARDING THIRD-PARTY PRODUCTS OR SERVICES DOES NOT CONSTITUTE AN ENDORSEMENT REGARDING THE SUITABILITY OF SUCH PRODUCTS OR SERVICES OR A WARRANTY, REPRESENTATION OR ENDORSEMENT OF SUCH PRODUCTS OR SERVICES, EITHER ALONE OR IN COMBINATION WITH ANY TI PRODUCT OR SERVICE.

11.2 Documentation Support

11.2.1 Related Documentation

For related documentation, see the following:

- *Designing DC/DC converters based on SEPIC topology,* SLYT309

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

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.

11.6 Glossary

SLYZ022 — *TI Glossary*.

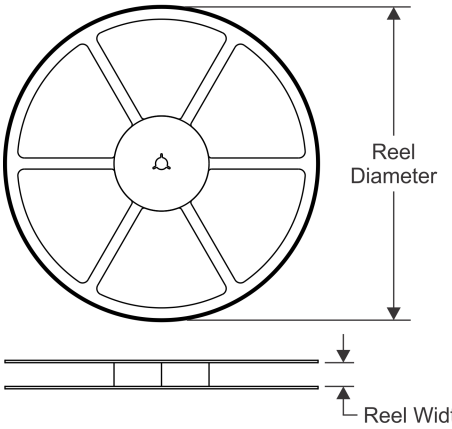
This glossary lists and explains terms, acronyms, and definitions.

12 Mechanical, Packaging, and Orderable Information

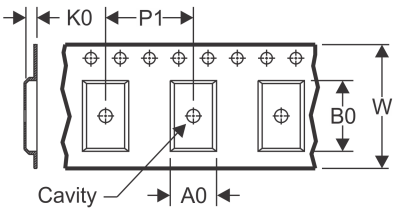
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand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

TAPE AND REEL INFORMATION

REEL DIMENSIONS

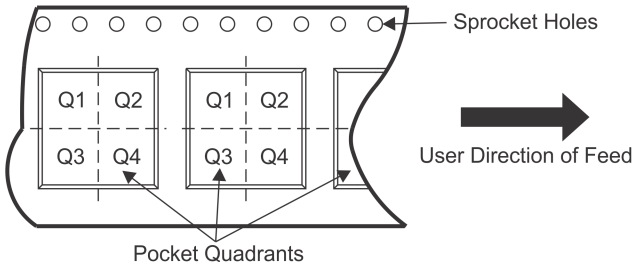


TAPE DIMENSIONS



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

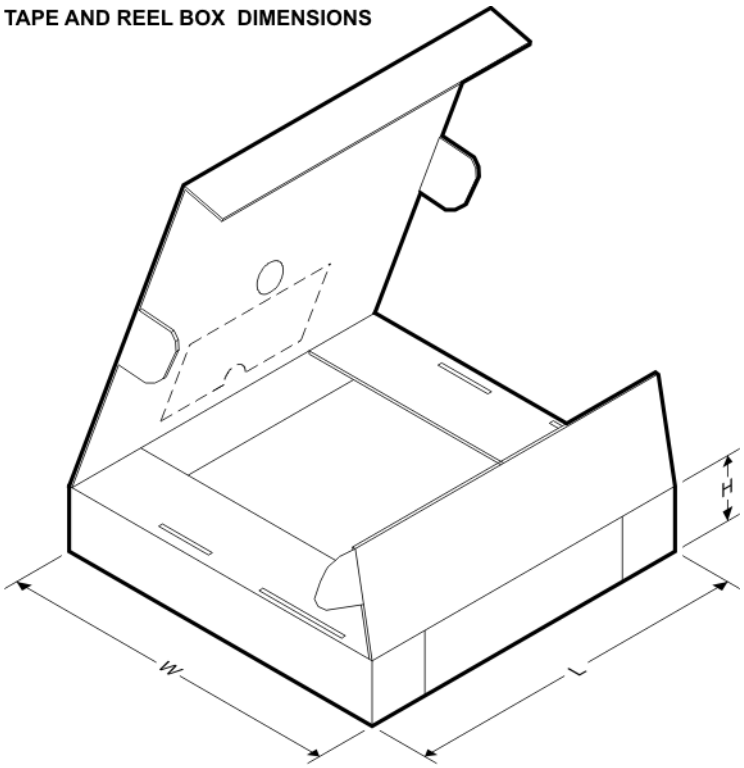
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
LM2621MM/NOPB	VSSOP	DGK	8	1000	178.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
LM2621MMX/NOPB	VSSOP	DGK	8	3500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1

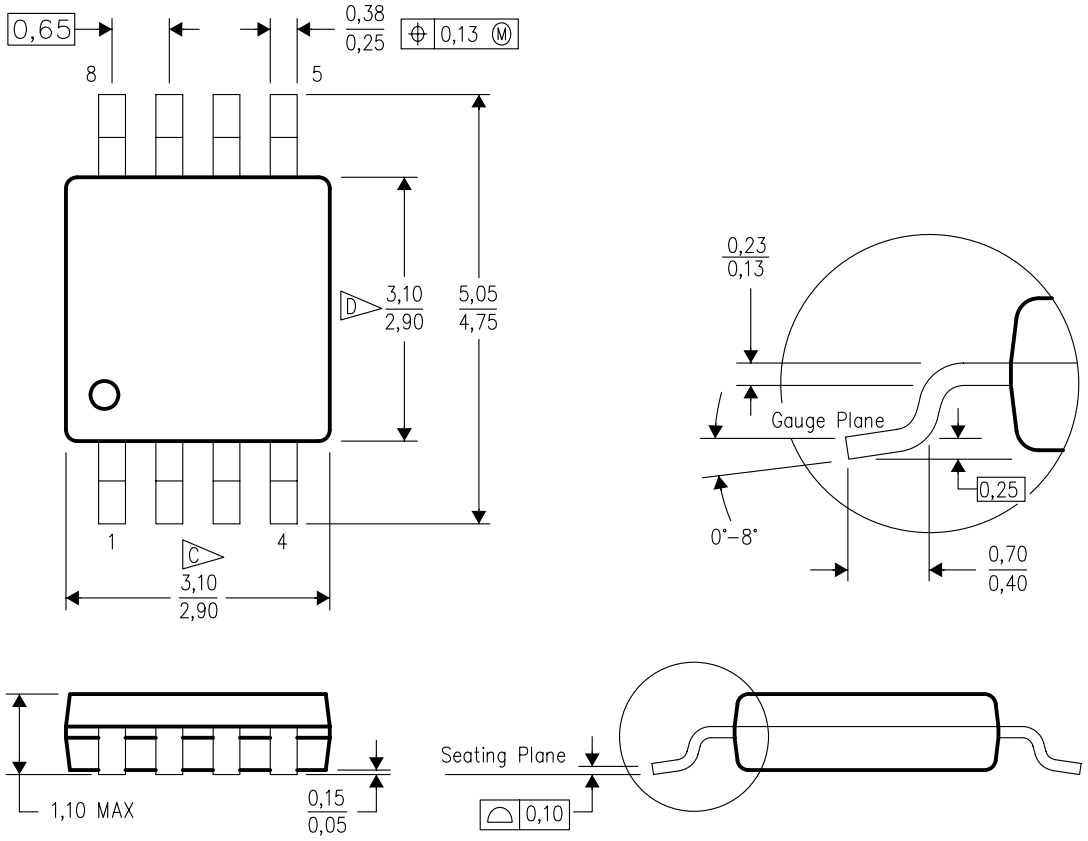
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM2621MM/NOPB	VSSOP	DGK	8	1000	210.0	185.0	35.0
LM2621MMX/NOPB	VSSOP	DGK	8	3500	367.0	367.0	35.0

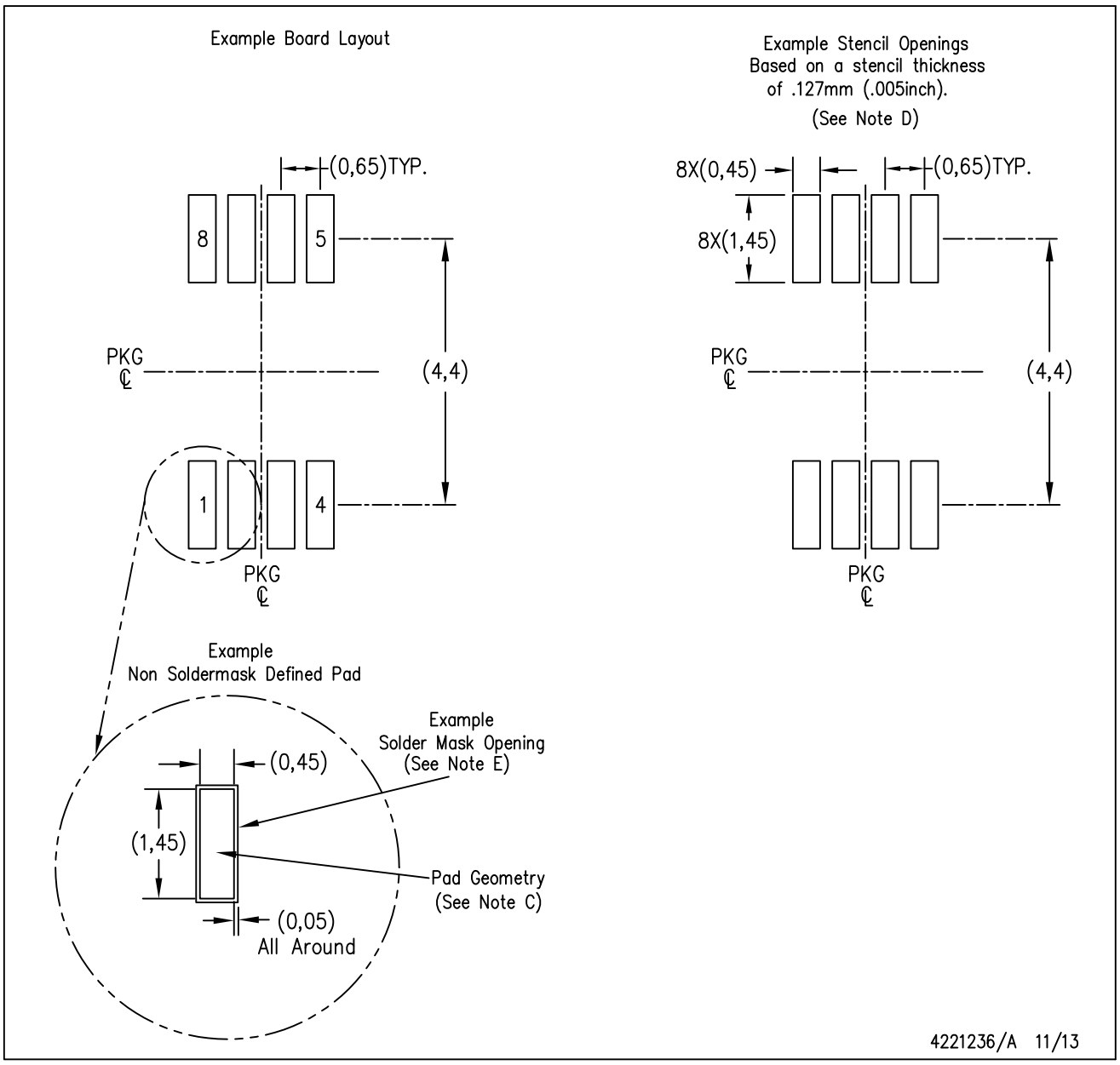
DGK (S–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE



4073329/E 05/06

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
E. Falls within JEDEC MO–187 variation AA, except interlead flash.

DGK (S–PDSO–G8) PLASTIC SMALL OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. 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. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated (TI) reserves the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

TI's published terms of sale for semiconductor products (http://www.ti.com/sc/docs/stdterms.htm) apply to the sale of packaged integrated circuit products that TI has qualified and released to market. Additional terms may apply to the use or sale of other types of TI products and services.

Reproduction of significant portions of TI information in TI data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such reproduced documentation. Information of third parties may be subject to additional restrictions. Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyers and others who are developing systems that incorporate TI products (collectively, "Designers") understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers' applications and compliance of their applications (and of all TI products used in or for Designers' applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include TI products, Designer will thoroughly test such applications and the functionality of such TI products as used in such applications.

TI's provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using TI Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer's company) agrees to use any particular TI Resource solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

Designer is authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Unless TI has explicitly designated an individual product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949 and ISO 26262), TI is not responsible for any failure to meet such industry standard requirements.

Where TI specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designer may not use any TI products in life-critical medical equipment unless authorized officers of the parties have executed a special contract specifically governing such use. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Such equipment includes, without limitation, all medical devices identified by the U.S. Food and Drug Administration as Class III devices and equivalent classifications outside the U.S.

TI may expressly designate certain products as completing a particular qualification (e.g., Q100, Military Grade, or Enhanced Product). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers' own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection.

Designer will fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer's non-compliance with the terms and provisions of this Notice.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265