

LM2623 General-Purpose, Gated-Oscillator-Based DC-DC Boost Converter

1 Features

- Good Efficiency Over a Very Wide Load Range
- Very Low Output Voltage Ripple
- Up to 2-MHz Switching Frequency
- 0.8-V to 14-V Operating Voltage
- 1.1-V Start-up Voltage
- 1.24-V to 14-V Adjustable Output Voltage
- Up to 2-A Load Current at Low Output Voltages
- 0.17- Ω Internal MOSFET
- Up to 90% Regulator Efficiency
- 80- μ A Typical Operating Current (Into V_{DD} Pin of Supply)
- < 2.5- μ A Ensured Supply Current In Shutdown
- Small 8-Pin VSSOP Package (Half the Footprint of Standard 8-Pin SOIC Package); 1.09-mm Package Height
- 4-mm x 4-mm Thermally Enhanced WSON Package Option

2 Applications

- Cameras, Pagers and Cell Phones
- PDAs, Palmtop Computers, GPS devices
- White LED Drive, TFT, or Scanned LCDs
- Flash Memory Programming
- Hand-Held Instruments
- 1, 2, 3, or 4 Cell Alkaline Systems
- 1, 2, or 3 Cell Lithium-ion Systems

3 Description

The LM2623 is a high-efficiency, general-purpose, step-up DC-DC switching regulator for battery-powered and low input voltage systems. It accepts an input voltage between 0.8 V and 14 V and converts it into a regulated output voltage between 1.24 V and 14 V. Efficiencies up to 90% are achievable with the LM2623.

In order to adapt to a number of applications, the LM2623 allows the designer to vary the output voltage, the operating frequency (300 kHz to 2 MHz) and duty cycle (17% to 90%) to optimize the part's performance. The selected values can be fixed or can vary with battery voltage or input to output voltage ratio. The LM2623 uses a very simple, on/off regulation mode to produce good efficiency and stable operation over a wide operating range. It normally regulates by skipping switching cycles when it reaches the regulation limit (Pulse Frequency Modulation).

Note: See [Non-Linear Effect](#) and [Choosing The Correct C3 Capacitor](#) so that any challenges with designing with this part can be taken into account before a board design/layout is finalized.

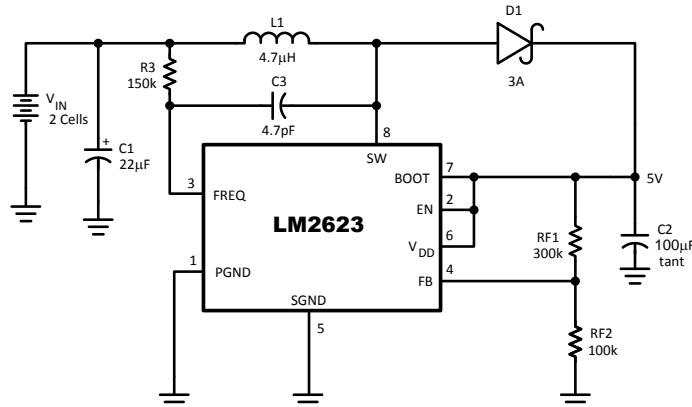
For alternative solutions, See Also: LM2700, LM2622, LM2731, LM2733, and LM2621.

Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|-----------|-------------------|
| LM2623 | WSON (14) | 4.00 mm x 4.00 mm |
| | VSSOP (8) | 3.00 mm x 3.00 mm |

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

Typical Application Circuit



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

Table of Contents

| | | | | | |
|----------|--|----------|-----------|---|-----------|
| 1 | Features | 1 | 8 | Applications And Implementation | 10 |
| 2 | Applications | 1 | 8.1 | Application Information | 10 |
| 3 | Description | 1 | 8.2 | Typical Application | 10 |
| 4 | Revision History | 2 | 9 | Power Supply Recommendations | 12 |
| 5 | Pin Configuration And Functions | 3 | 10 | Layout | 12 |
| 6 | Specifications | 4 | 10.1 | Layout Guidelines | 12 |
| | 6.1 Absolute Maximum Ratings | 4 | 10.2 | Layout Example | 13 |
| | 6.2 ESD Ratings | 4 | 10.3 | WSON Package Devices | 13 |
| | 6.3 Recommended Operating Conditions | 4 | 11 | Device And Documentation Support | 14 |
| | 6.4 Thermal Information | 4 | 11.1 | Device Support | 14 |
| | 6.5 Electrical Characteristics | 5 | 11.2 | Documentation Support | 14 |
| | 6.6 Typical Characteristics | 5 | 11.3 | Receiving Notification of Documentation Updates | 14 |
| 7 | Detailed Description | 7 | 11.4 | Community Resources | 14 |
| | 7.1 Overview | 7 | 11.5 | Trademarks | 14 |
| | 7.2 Functional Block Diagram | 7 | 11.6 | Electrostatic Discharge Caution | 14 |
| | 7.3 Feature Description | 7 | 11.7 | Glossary | 14 |
| | 7.4 Device Functional Modes | 9 | 12 | Mechanical, Packaging, And Orderable Information | 14 |

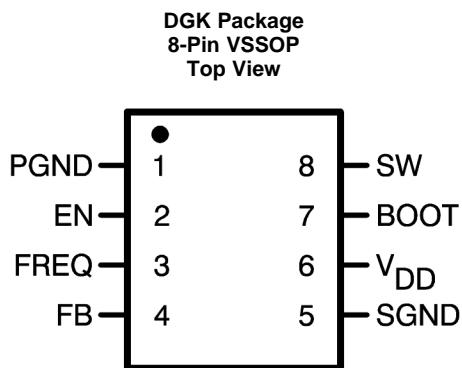
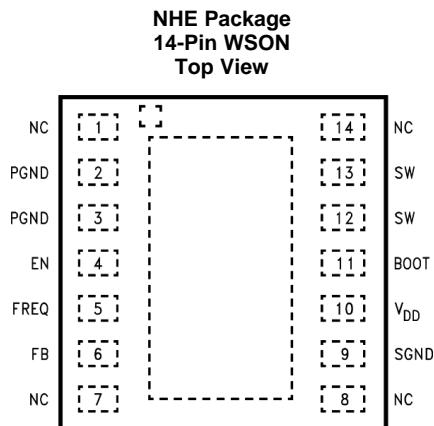
4 Revision History

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

| Changes from Revision H (November 2014) to Revision I | Page |
|--|-------------|
| • Changed <i>Handling Ratings</i> table to <i>ESD Ratings</i> to comply with current format | 4 |
| • Moved Storage temperature spec to <i>Abs Max</i> table | 4 |
| • Added separate row for SW pin HBM ESD rating | 4 |
| • Added condition to <i>Recommended Operating Conditions</i> table | 4 |
| • Changed Updated $R_{\theta JA}$ value for NHE package from "40 – 56" to "46.5" °C/W and DGK package from "240" to 152.5" °C/W; added additional thermal information..... | 4 |

| Changes from Revision G (December 2005) to Revision H | Page |
|---|-------------|
| • Added <i>Device Information</i> and <i>Handling Rating</i> tables, <i>Feature Description</i> , <i>Device Functional Modes</i> , <i>Application and Implementation</i> , <i>Power Supply Recommendations</i> , <i>Layout</i> , <i>Device and Documentation Support</i> , and <i>Mechanical, Packaging, and Orderable Information</i> sections; moved some curves to <i>Application Curves</i> section | 1 |

5 Pin Configuration And Functions



Pin Functions

| PIN | | | TYPE | DESCRIPTION |
|--------|-------|-----------------|---------|--|
| WSON | VSSOP | NAME | | |
| 1 | — | NC | N/A | No Connect |
| 2, 3 | 1 | PGND | GND | Power Ground (WSON Pins 2 and 3 must be shorted together). |
| 4 | 2 | EN | Digital | Active-Low Shutdown Input |
| 5 | 3 | FREQ | Analog | Frequency Adjust. An external resistor connected between this pin and a voltage source sets the switching frequency of the LM2623. |
| 6 | 4 | FB | Analog | Output Voltage Feedback |
| 7 | — | NC | N/A | No Connect |
| 8 | — | NC | N/A | No connect |
| 9 | 5 | SGND | GND | Signal Ground |
| 10 | 6 | V _{DD} | Power | Power Supply for Internal Circuitry |
| 11 | 7 | BOOT | Analog | Bootstrap Supply for the Gate Drive of Internal MOSFET Power Switch |
| 12, 13 | 8 | SW | Analog | Drain of the Internal MOSFET Power Switch. (WSON pins 12 and 13 must be shorted together.) |
| 14 | — | NC | N/A | No Connect |
| DAP | — | DAP | Thermal | To be soldered to board for enhanced thermal dissipation. To be electrically isolated/floating. |

6 Specifications

6.1 Absolute Maximum Ratings⁽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 |
| T _{jmax} ⁽³⁾ | | 150 | °C |
| Lead temp. (soldering, 5 sec) | | 260 | °C |
| Power dissipation (T _A =25°C) ⁽³⁾ | | 500 | mW |
| 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, 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), R_{θJA} (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) / R_{θJA} or the number given in the *Absolute Maximum Ratings*, whichever is lower.

6.2 ESD Ratings

| | | VALUE | UNIT |
|--------------------|----------------------------|---|-------|
| V _(ESD) | Electrostatic discharge | All pins except SW pin | ±2000 |
| | | SW pin (VSSOP package pin 8) (WSON package pin 12 and pin 13) | ±1000 |
| | | All pins | ±500 |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) 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)⁽¹⁾

| | MIN | MAX | UNIT |
|---------------------------------------|-----|-----|-----------------|
| V _{DD} pin | 3 | 5 | V |
| FB, EN pins | 0 | | V _{DD} |
| BOOT pin | 0 | 10 | V |
| Ambient temperature (T _A) | -40 | 85 | °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.

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | LM2623 | | UNIT |
|--|------------|-------------|------|
| | NHE (WSON) | DGK (VSSOP) | |
| | 14 PINS | 8 PINS | |
| R _{θJA} Junction-to-ambient thermal resistance | 46.5 | 152.5 | °C/W |
| R _{θJC(top)} Junction-to-case (top) thermal resistance | 37.7 | 53.9 | °C/W |
| R _{θJB} Junction-to-board thermal resistance | 23.6 | 73.2 | °C/W |
| Ψ _{JT} Junction-to-top characterization parameter | 0.4 | 5.5 | °C/W |
| Ψ _{JB} Junction-to-board characterization parameter | 23.8 | 72.0 | °C/W |
| R _{θJC(bot)} Junction-to-case (bottom) thermal resistance | 4.6 | N/A | °C/W |

- (1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report.

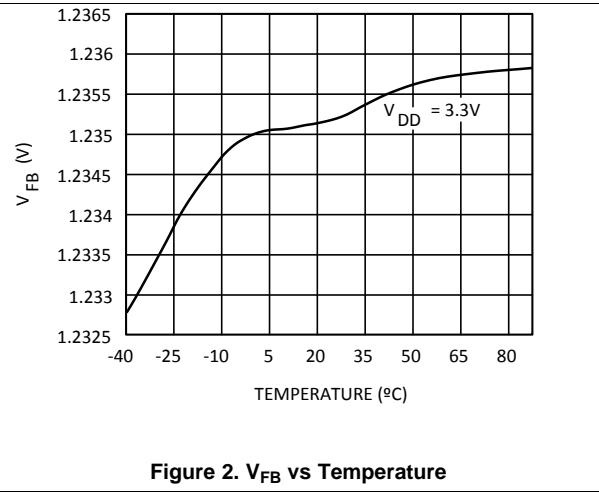
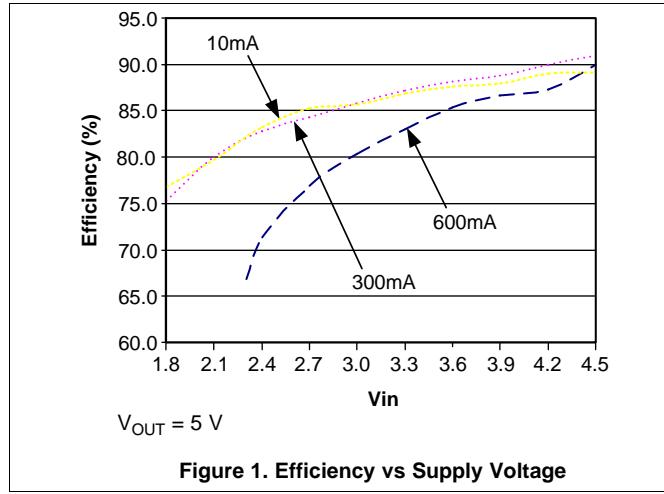
6.5 Electrical Characteristics

Limits apply for $T_J = 25^\circ\text{C}$ and $V_{DD} = V_{OUT} = 3.3\text{ V}$, unless otherwise specified.

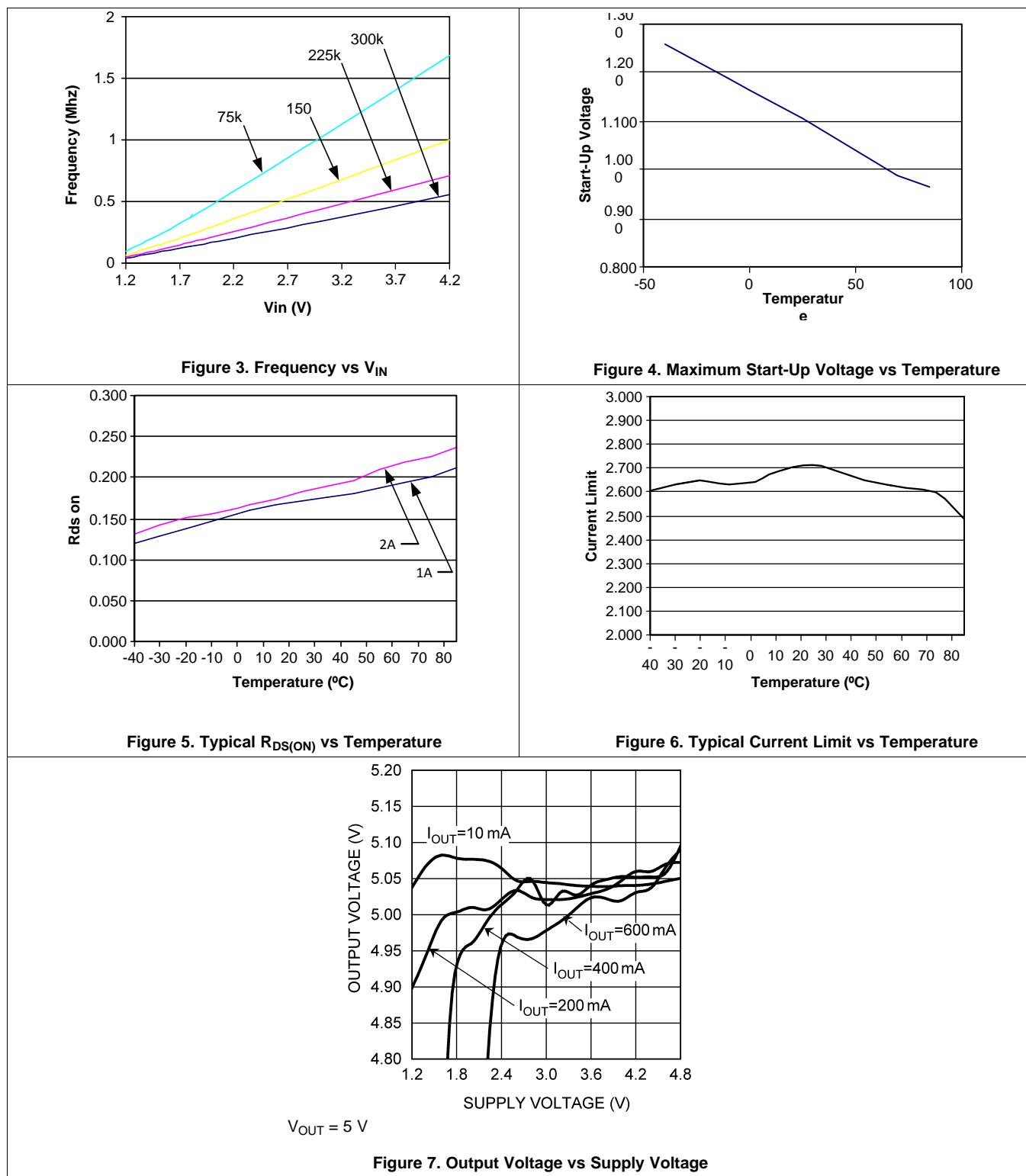
| PARAMETER | TEST CONDITION | MIN | TYP | MAX | UNIT |
|-----------------------|--|--------------|---------------|--------|---------------|
| V_{DD_ST} | Start-up supply voltage 25°C $I_{LOAD} = 0\text{ mA}^{(1)}$ | | | 1.1 | V |
| V_{IN_OP} | Minimum operating supply voltage (once started) $I_{LOAD} = 0\text{ mA}$ | | 0.65 | 0.8 | V |
| V_{FB} | FB pin voltage -40°C to 85°C | | 1.24 | | V |
| | | 1.2028 | | 1.2772 | |
| V_{OUT_MAX} | Maximum output voltage | | 14 | | V |
| η | Efficiency $V_{IN} = 3.6\text{ V}; V_{OUT} = 5\text{ V}; I_{LOAD} = 500\text{ mA}$ $V_{IN} = 2.5\text{ V}; V_{OUT} = 3.3\text{ V}; I_{LOAD} = 200\text{ mA}$ | | 87% | | |
| | | | 87% | | |
| D | Switch duty cycle | | 17 | | |
| I_{DD} | Operating quiescent current ⁽²⁾ 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 ⁽³⁾ V_{DD} , BOOT and SW Pins at 5 V; EN Pin < 200 mV | | 0.01 | | μA |
| | | | 2.5 | | |
| I_{CL} | Switch peak current limit LM2623A | 2.2 | 2.85 | | A |
| I_C | Switch peak current limit LM2623 | 1.2 | | | |
| R_{DS_ON} | MOSFET switch on resistance -40°C to 85°C | | 0.17 | | Ω |
| | | | 0.26 | | |
| ENABLE SECTION | | | | | |
| V_{EN_LO} | EN pin voltage low ⁽⁴⁾ -40°C to 85°C | | 0.15 V_{DD} | | V |
| V_{EN_HI} | EN pin voltage high ⁽⁴⁾ -40°C to 85°C | 0.7 V_{DD} | | | |

- (1) V_{DD} tied to BOOT and EN pins. Frequency pin tied to V_{DD} through 121- $\text{K}\Omega$ resistor. $V_{DD_ST} = V_{DD}$ when start-up occurs. V_{IN} is $V_{DD} + D1$ voltage (usually 10 mV to 50 mV at start-up).
- (2) This is the current into the V_{DD} pin.
- (3) This is the total current into pins V_{DD} , BOOT, SW, and FREQ.
- (4) 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.

6.6 Typical Characteristics



Typical Characteristics (continued)



7 Detailed Description

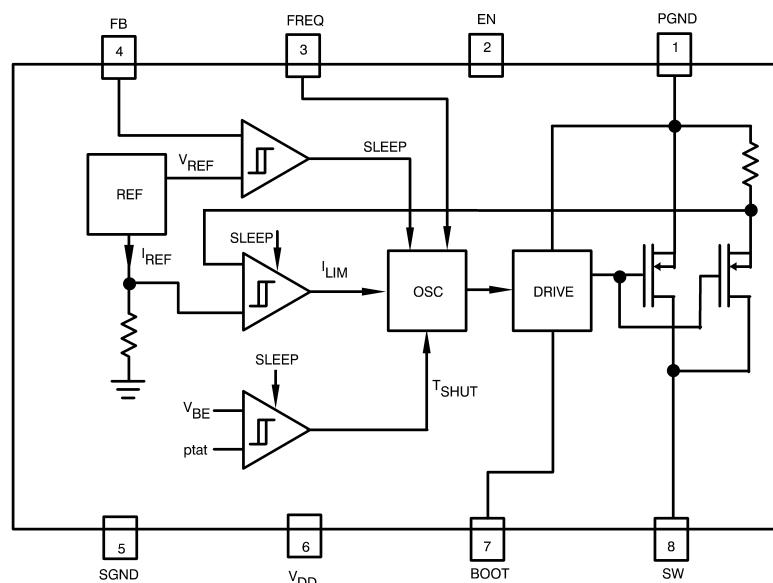
7.1 Overview

The LM2623 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 [Functional Block Diagram](#). The switching DC-DC regulator boosts an input voltage between 0.8 V and 14 V to a regulated output voltage between 1.24 V and 14 V. The LM2623 starts from a low 1.1 V input and remains operational down to below 0.8 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 2 A at low output voltages.

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.

The on/off regulation mode of the LM2623, along with its ultra-low quiescent current, results in good efficiency over a very wide load range. The internal oscillator frequency can be programmed using an external resistor to be constant or vary with the battery voltage. Adding a capacitor to program the frequency allows the designer to adjust the duty cycle and optimize it for the application. Adding a resistor in addition to the capacitor allows the duty cycle to dynamically compensate for changes to the input/output voltage ratio. We call this a Ratio Adaptive Gated Oscillator circuit. See the [Typical Application](#) for sample application circuits. Using the correct RC components to adjust the oscillator allows the part to run with low ripple and high efficiency over a wide range of loads and input/output voltages.

Feature Description (continued)

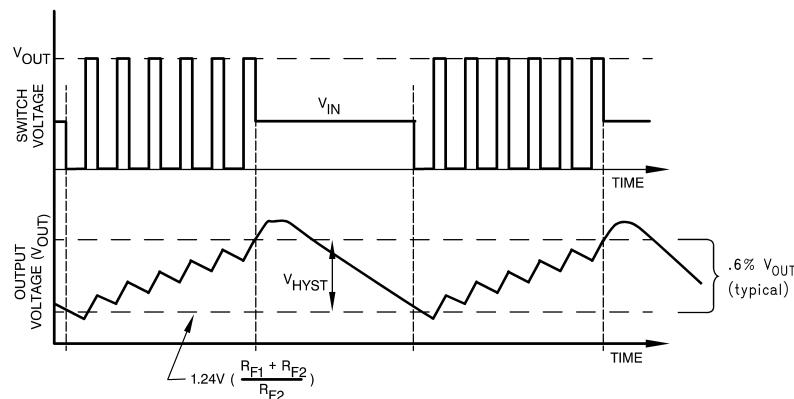


Figure 8. Typical Step-Up Regulator Waveforms

7.3.2 Cycle-To-Cycle Pfm

When the load doesn't vary over a wide range (like zero to full load), ratio adaptive circuit techniques can be used to achieve cycle to cycle PFM regulation and lower ripple (or smaller output capacitors). The key to success here is matching the duty cycle of the circuit closely to what is required by the input to output voltage ratio. This ratio then needs to be dynamically adjusted for input voltage changes (usually caused by batteries running down). The chosen ratio should allow most of the energy in each switching cycle to be delivered to the load and only a small amount to be stored. When the regulation limit is reached, the overshoot will be small and the system will settle at an equilibrium point where it adjusts the off time in each switching cycle to meet the current requirements of the load. The off time adjustment is done by exceeding the regulation limit during each switching cycle and waiting until the voltage drops below the limit again to start the next switching cycle. The current in the coil never goes to zero like it frequently does in the hysteretic operating mode of circuits with wide load variations or duty cycles that aren't matched to the input/output voltage ratio. Optimizing the duty cycle for a given set of input/output voltages conditions can be done by using the circuit values in the Application Notes.

7.3.3 Shutdown

The LM2623 features a shutdown mode that reduces the quiescent current to less than an ensured 2.5 μ A over temperature. 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 is 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 stepup mode.

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 circuit 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 Pulse Frequency Modulation (Pfm)

Pulse Frequency Modulation is typically accomplished by switching continuously until the voltage limit is reached and skipping cycles after that to just maintain it. This results in a somewhat hysteretic mode of operation. The coil stores more energy each cycle as the current ramps up to high levels. When the voltage limit is reached, the system usually overshoots to a higher voltage than required, due to the stored energy in the coil (see [Figure 8](#)). The system will also undershoot somewhat when it starts switching again because it has depleted all the stored energy in the coil and needs to store more energy to reach equilibrium with the load. Larger output capacitors and smaller inductors reduce the ripple in these situations. The frequency being filtered, however, is not the basic switching frequency. It is a lower frequency determined by the load, the input/output voltage and the circuit parameters. This mode of operation is useful in situations where the load variation is significant. Power managed computer systems, for instance, may vary from zero to full load while the system is on and this is usually the preferred regulation mode for such systems.

7.4.2 Low Voltage Start-Up

The LM2623 can start up from voltages as low as 1.1 V. On start-up, the control circuitry switches the N-channel MOSFET continuously until the output reaches 3 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 below 0.8 V input, since the internal power for the IC can be boot-strapped from the output using the V_{DD} pin.

8 Applications 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 LM2623 features a shutdown mode, entry into the shutdown mode is controlled by the active-low logic input pin EN (pin 2). When the logic input to this pin is pulled below $0.15\text{ V}_{\text{DD}}$, 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 start-up mode.

8.2 Typical Application

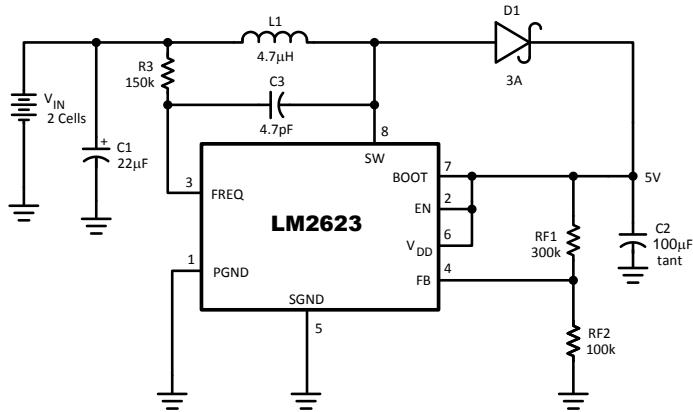


Figure 9. LM2623 Typical Application

8.2.1 Design Requirements

The LM2623 allows the designer to vary output voltage, operating frequency and duty cycle to optimize the part performance, please read [Detailed Design Procedure](#) for details.

8.2.2 Detailed Design Procedure

8.2.2.1 Non-Linear Effect

The LM2623 is very similar to the LM2621. The LM2623 is based on the LM2621, except for the fact that the LM2623 takes advantage of a non-linear effect that allows for the duty cycle to be programmable. The C3 capacitor is used to dump charge on the FREQ pin in order to manipulate the duty cycle of the internal oscillator. The part is being tricked to behave in a certain manner, in the effort to make this Pulse Frequency Modulated (PFM) boost switching regulator behave as a Pulse Width Modulated (PWM) boost switching regulator.

8.2.2.2 Choosing The Correct C3 Capacitor

The C3 capacitor allows for the duty cycle of the internal oscillator to be programmable. Choosing the correct C3 capacitor to get the appropriate duty cycle for a particular application circuit is a trial and error process. The non-linear effect that C3 produces is dependent on the input voltage and output voltage values. The correct C3 capacitor for particular input and output voltage values cannot be calculated. Choosing the correct C3 capacitance is best done by trial and error, in conjunction with the checking of the inductor peak current to make sure you are not too close to the current limit of the device. As the C3 capacitor value increases, so does the duty cycle. And conversely as the C3 capacitor value decreases, the duty cycle decreases. An incorrect choice of the C3 capacitor can result in the part prematurely tripping the current limit and/or double pulsing, which could lead to the output voltage not being stable.

Typical Application (continued)

8.2.2.3 Setting The Output Voltage

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

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

A value of 50k to 100k is suggested for R_{F2} . Then, R_{F1} can be selected using [Equation 1](#).

8.2.2.4 V_{DD} Supply

The V_{DD} supply must be between 3 V to 5 V for the LM2623. This voltage can be bootstrapped from a much lower input voltage by simply connecting the V_{DD} pin to V_{OUT} . In the event that the V_{DD} supply voltage is not a low ripple voltage source (less than 200 millivolts), it may be advisable to use an RC filter to clean it up. Excessive ripple on V_{DD} may reduce the efficiency.

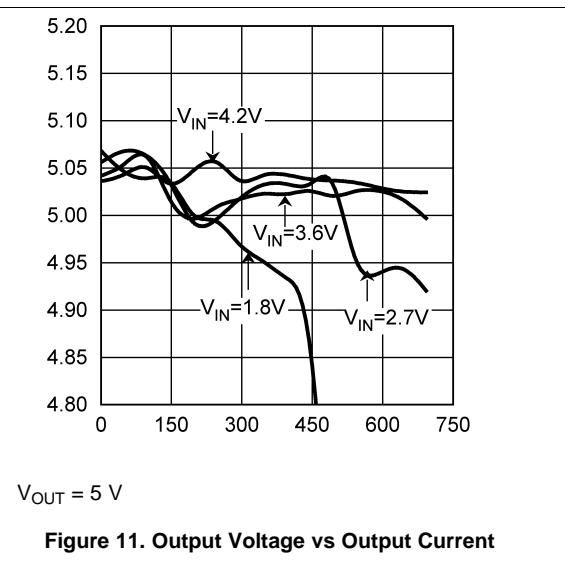
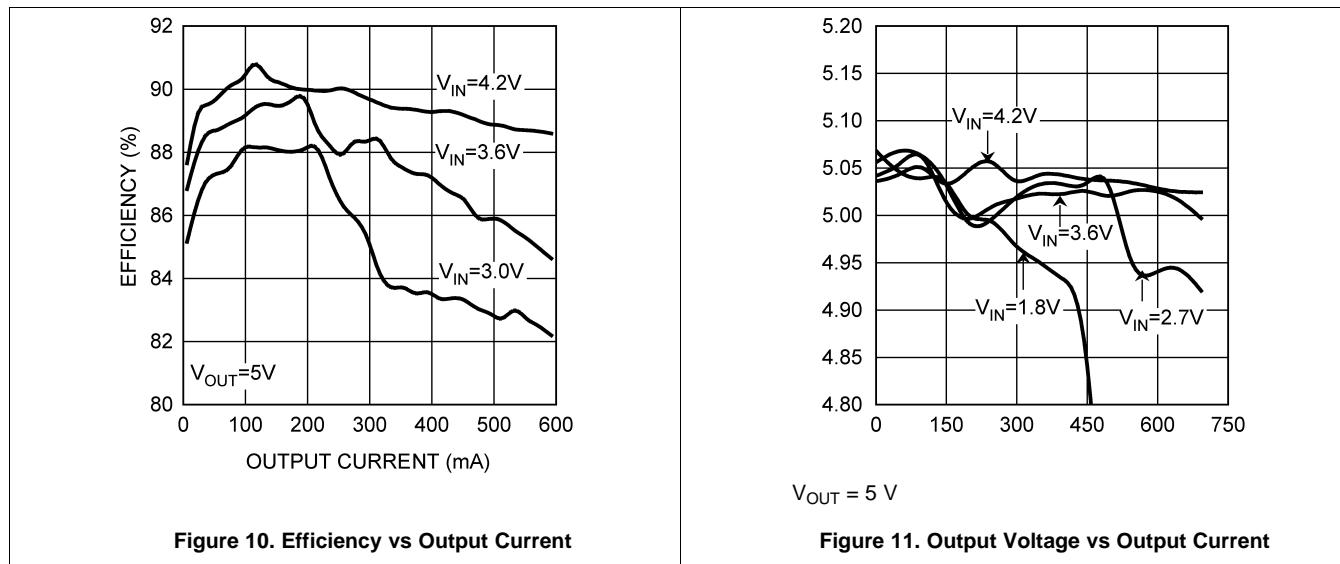
8.2.2.5 Setting The Switching Frequency

The switching frequency of the oscillator is selected by choosing an external resistor (R3) connected between V_{IN} and the FREQ pin. See [Figure 3](#) in the [Typical Characteristics](#) section of the data sheet for choosing the R3 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.

8.2.2.6 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 peak input 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.

8.2.3 Application Curves



9 Power Supply Recommendations

The LM2623 can start up from voltages as low as 1.1 V. On start-up, the control circuitry switches the N-channel MOSFET continuously until the output reaches 3 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 below 0.8 V input, since the internal power for the IC can be boot-strapped from the output using the V_{DD} pin.

10 Layout

10.1 Layout Guidelines

The example layouts below follow proper layout guidelines and should be used as a guide for laying out the LM2623 circuit. The LM2623 inductive boost converter sees a high switched voltage at the SW pin, and a step current through the Schottky diode and output capacitor each switching cycle. The high switching voltage can create interference into nearby nodes due to electric field coupling ($I = C \times dV/dt$). The large step current through the diode and the output capacitor can cause a large voltage spike at the SW and BOOST pins due to parasitic inductance in the step current conducting path ($V = L \times di/dt$). Board layout guidelines are geared towards minimizing this electric field coupling and conducted noise.

[Boost Output Capacitor Placement](#), [Schottky Diode Placement](#), and [Boost Input / \$V_{DD}\$ Capacitor Placement](#) detail the main (layout sensitive) areas of the LM2623 inductive boost converter in order of decreasing importance:

10.1.1 Boost Output Capacitor Placement

Because the output capacitor is in the path of the inductor current discharge path, it will see a high-current step from 0 to IPEAK each time the switch turns off and the Schottky diode turns on. Any inductance along this series path from the diodes cathode, through COUT, and back into the LM2623 GND pin will contribute to voltage spikes at SW. These spikes can potentially over-voltage the SW and BOOST pins, or feed through to GND. To avoid this, COUT+ must be connected as close as possible to the cathode of the Schottky diode, and COUT- must be connected as close as possible to the LM2623 GND bumps. The best placement for COUT is on the same layer as the LM2623 to avoid any vias that can add excessive series inductance.

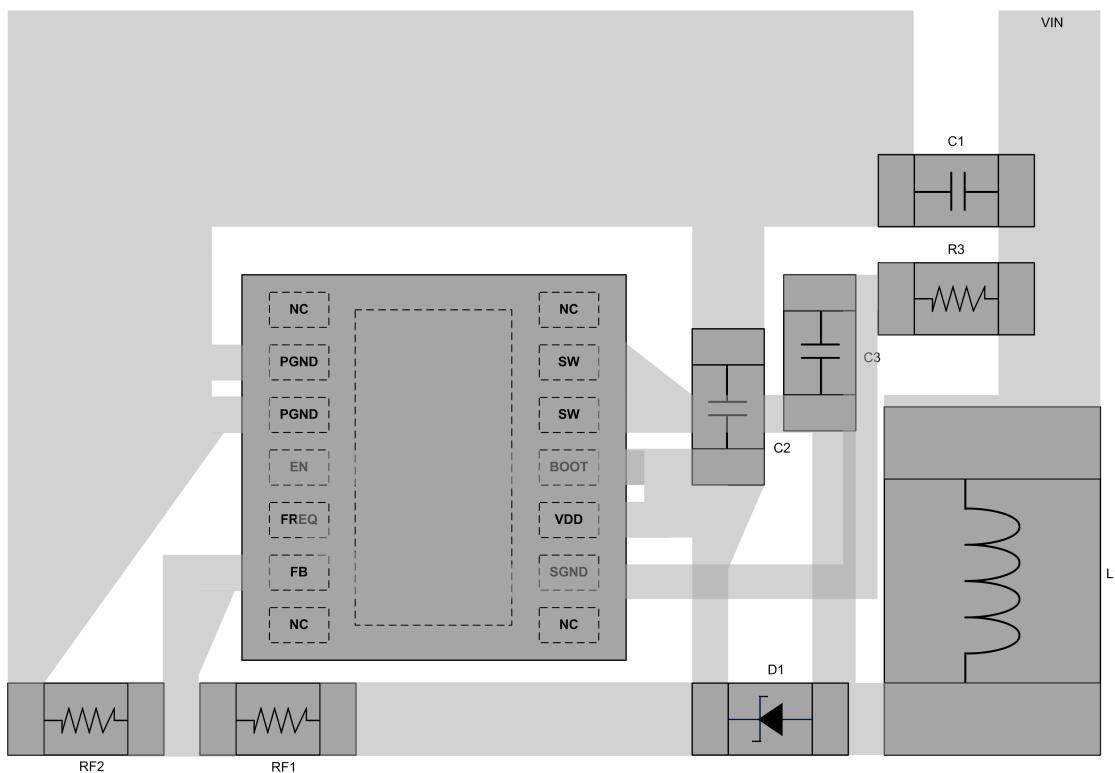
10.1.2 Schottky Diode Placement

In the LM2623 device boost circuit the Schottky diode is in the path of the inductor current discharge. As a result the Schottky diode sees a high-current step from 0 to IPEAK each time the switch turns off, and the diode turns on. Any inductance in series with the diode will cause a voltage spike at SW. This can potentially over-voltage the SW pin, or feed through to VOUT and through the output capacitor, into GND. Connecting the anode of the diode as close as possible to the SW pin, and connecting the cathode of the diode as close as possible to COUT+, will reduce the inductance (LP₋) and minimize these voltage spikes.

10.1.3 Boost Input / V_{DD} Capacitor Placement

The LM2623 input capacitor filters the inductor current ripple and the internal MOSFET driver currents. The inductor current ripple can add input voltage ripple due to any series resistance in the input power path. The MOSFET driver currents can add voltage spikes on the input due to the inductance in series with the VIN/ V_{DD} and the input capacitor. Close placement of the input capacitor to the V_{DD} pin and to the GND pin is critical since any series inductance between VIN/ V_{DD} and CIN+ or CIN- and GND can create voltage spikes that could appear on the VIN/VDD supply line and GND.

10.2 Layout Example



10.3 WSON Package Devices

The LM2623 is offered in the 14-lead WSON surface mount package to allow for increased power dissipation compared to the VSSOP-8. For details of the thermal performance as well as mounting and soldering specifications, refer to [Application Note AN-1187 Leadless Leadframe Package \(LLP\) \(SNOA401\)](#).

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:

[Application Note AN-1187 Leadless Leadframe Package \(LLP\)](#)

11.3 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.

11.4 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.

11.5 Trademarks

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

11.6 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.

11.7 Glossary

[SLY022](#) — **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 Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|------------------|--------------------------------------|----------------------|--------------|-------------------------|---|
| LM2623ALD/NOPB | ACTIVE | WSON | NHE | 14 | 1000 | RoHS & Green | SN | Level-3-260C-168 HR | -40 to 85 | 2623A | Samples |
| LM2623AMM | NRND | VSSOP | DGK | 8 | 1000 | Non-RoHS & Green | Call TI | Level-1-260C-UNLIM | -40 to 85 | S46A | |
| LM2623AMM/NOPB | ACTIVE | VSSOP | DGK | 8 | 1000 | RoHS & Green | SN | Level-1-260C-UNLIM | -40 to 85 | S46A | Samples |
| LM2623AMMX/NOPB | ACTIVE | VSSOP | DGK | 8 | 3500 | RoHS & Green | SN | Level-1-260C-UNLIM | -40 to 85 | S46A | Samples |
| LM2623LD/NOPB | ACTIVE | WSON | NHE | 14 | 1000 | RoHS & Green | SN | Level-3-260C-168 HR | -40 to 85 | 2623AB | Samples |
| LM2623LDX/NOPB | ACTIVE | WSON | NHE | 14 | 4500 | RoHS & Green | SN | Level-3-260C-168 HR | -40 to 85 | 2623AB | Samples |
| LM2623MM/NOPB | ACTIVE | VSSOP | DGK | 8 | 1000 | RoHS & Green | SN | Level-1-260C-UNLIM | -40 to 85 | S46B | Samples |
| LM2623MMX/NOPB | ACTIVE | VSSOP | DGK | 8 | 3500 | RoHS & Green | SN | Level-1-260C-UNLIM | -40 to 85 | S46B | 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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device 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 Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

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.

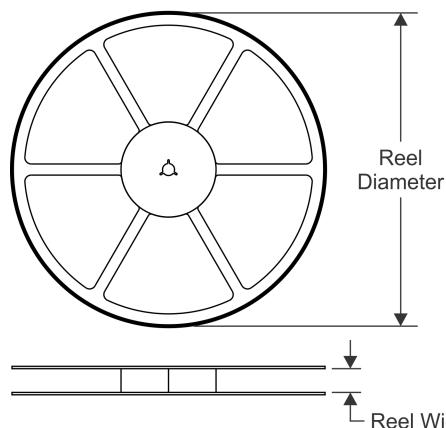
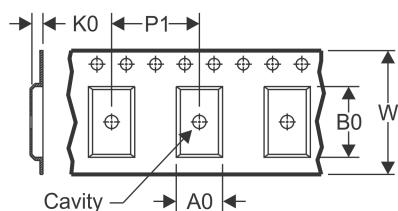
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF LM2623 :

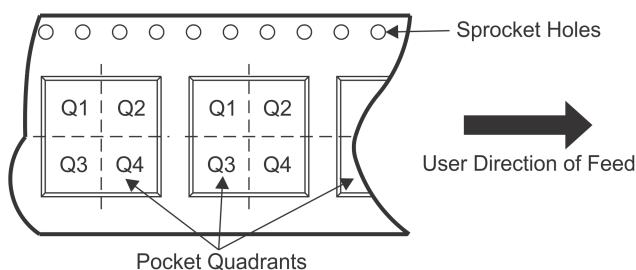
- Automotive : [LM2623-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

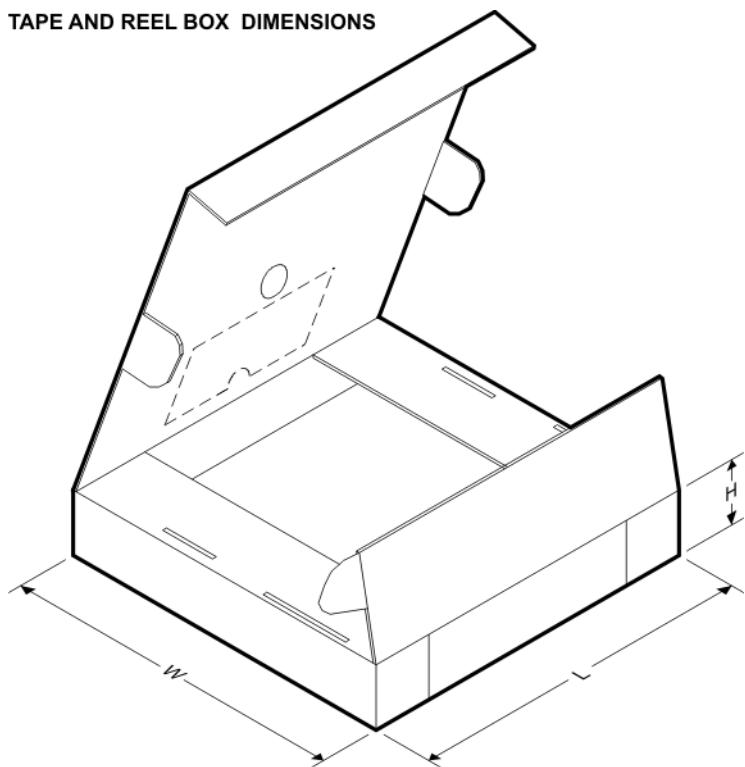
TAPE AND REEL INFORMATION
REEL DIMENSIONS

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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM2623ALD/NOPB | WSOP | NHE | 14 | 1000 | 178.0 | 12.4 | 4.3 | 4.3 | 1.3 | 8.0 | 12.0 | Q1 |
| LM2623AMM | VSSOP | DGK | 8 | 1000 | 178.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| LM2623AMM/NOPB | VSSOP | DGK | 8 | 1000 | 178.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| LM2623AMMX/NOPB | VSSOP | DGK | 8 | 3500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| LM2623LD/NOPB | WSOP | NHE | 14 | 1000 | 178.0 | 12.4 | 4.3 | 4.3 | 1.3 | 8.0 | 12.0 | Q1 |
| LM2623LDX/NOPB | WSOP | NHE | 14 | 4500 | 330.0 | 12.4 | 4.3 | 4.3 | 1.3 | 8.0 | 12.0 | Q1 |
| LM2623MM/NOPB | VSSOP | DGK | 8 | 1000 | 178.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| LM2623MMX/NOPB | VSSOP | DGK | 8 | 3500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |

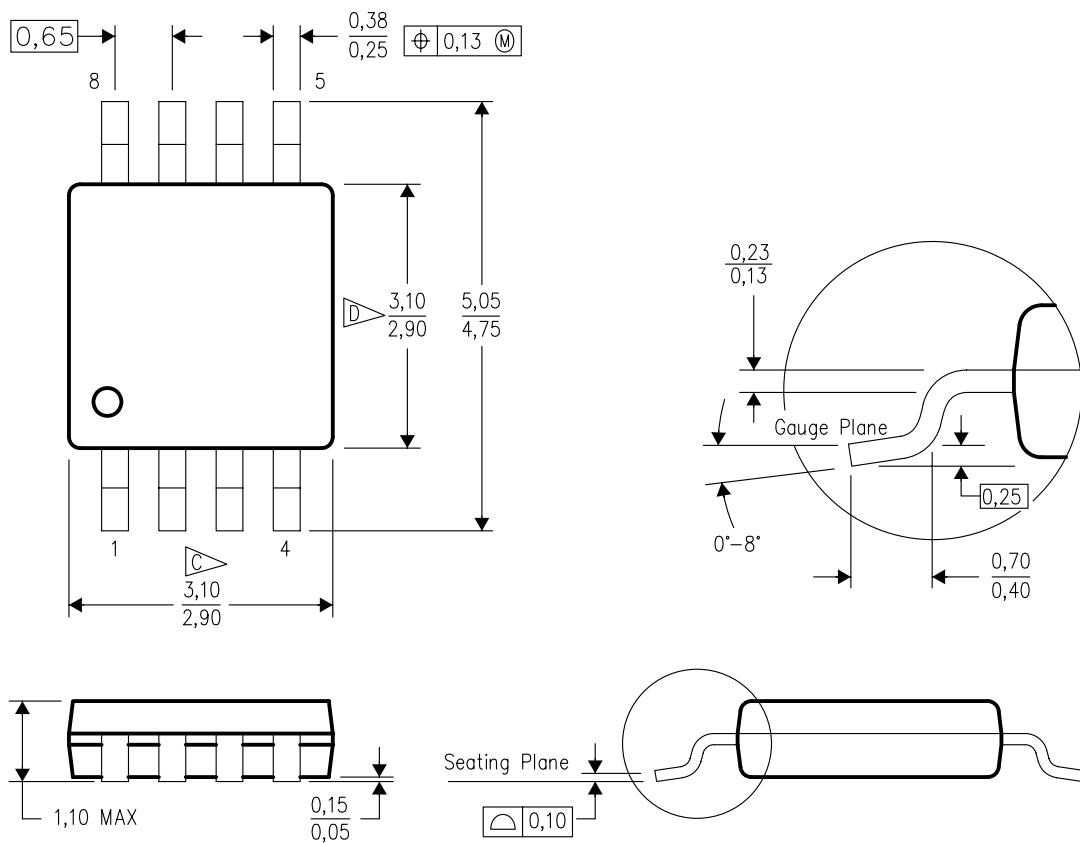
TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM2623ALD/NOPB | WSON | NHE | 14 | 1000 | 208.0 | 191.0 | 35.0 |
| LM2623AMM | VSSOP | DGK | 8 | 1000 | 210.0 | 185.0 | 35.0 |
| LM2623AMM/NOPB | VSSOP | DGK | 8 | 1000 | 210.0 | 185.0 | 35.0 |
| LM2623AMMX/NOPB | VSSOP | DGK | 8 | 3500 | 367.0 | 367.0 | 35.0 |
| LM2623LD/NOPB | WSON | NHE | 14 | 1000 | 208.0 | 191.0 | 35.0 |
| LM2623LDX/NOPB | WSON | NHE | 14 | 4500 | 853.0 | 449.0 | 35.0 |
| LM2623MM/NOPB | VSSOP | DGK | 8 | 1000 | 210.0 | 185.0 | 35.0 |
| LM2623MMX/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.

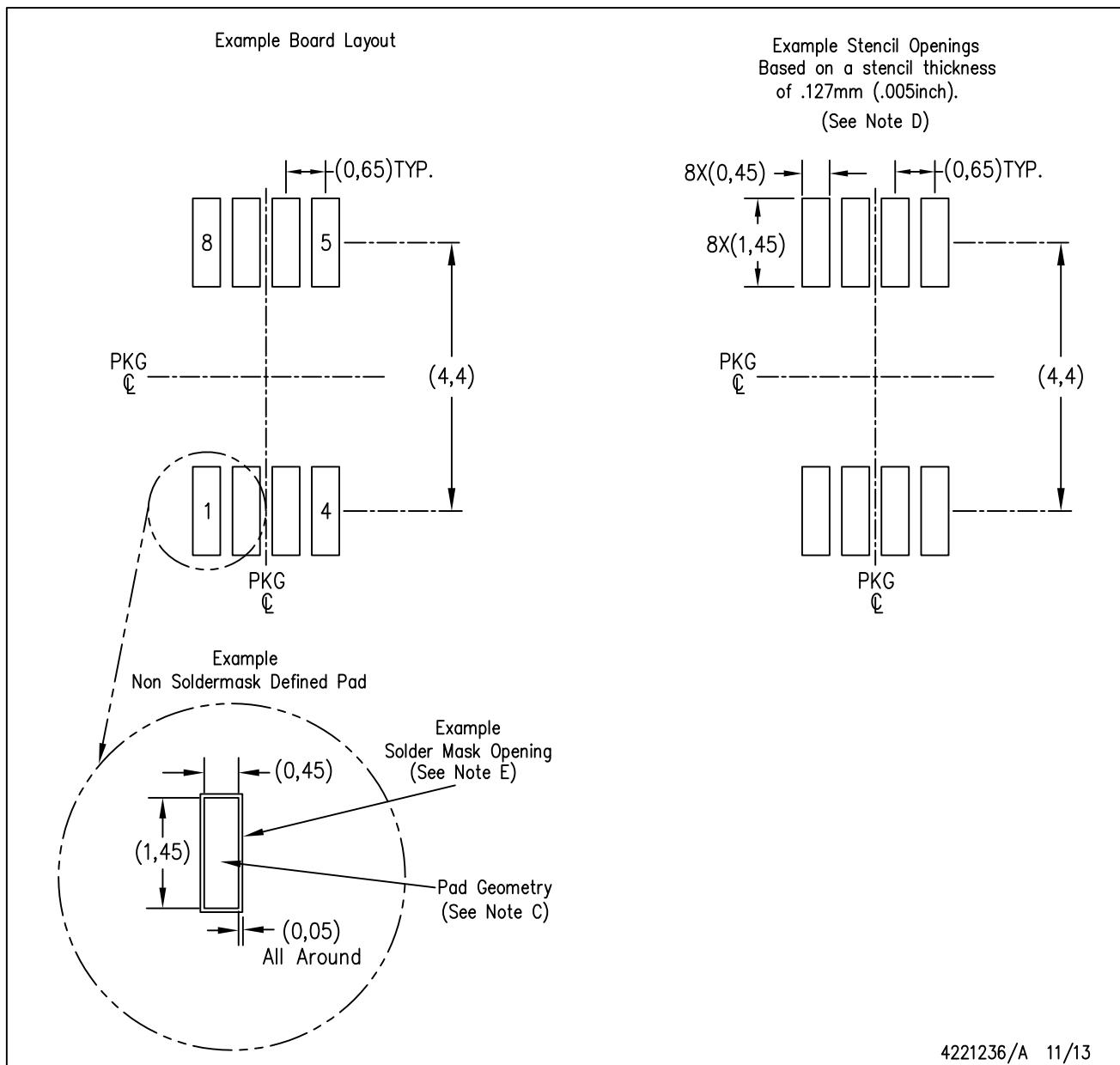
 Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.

 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

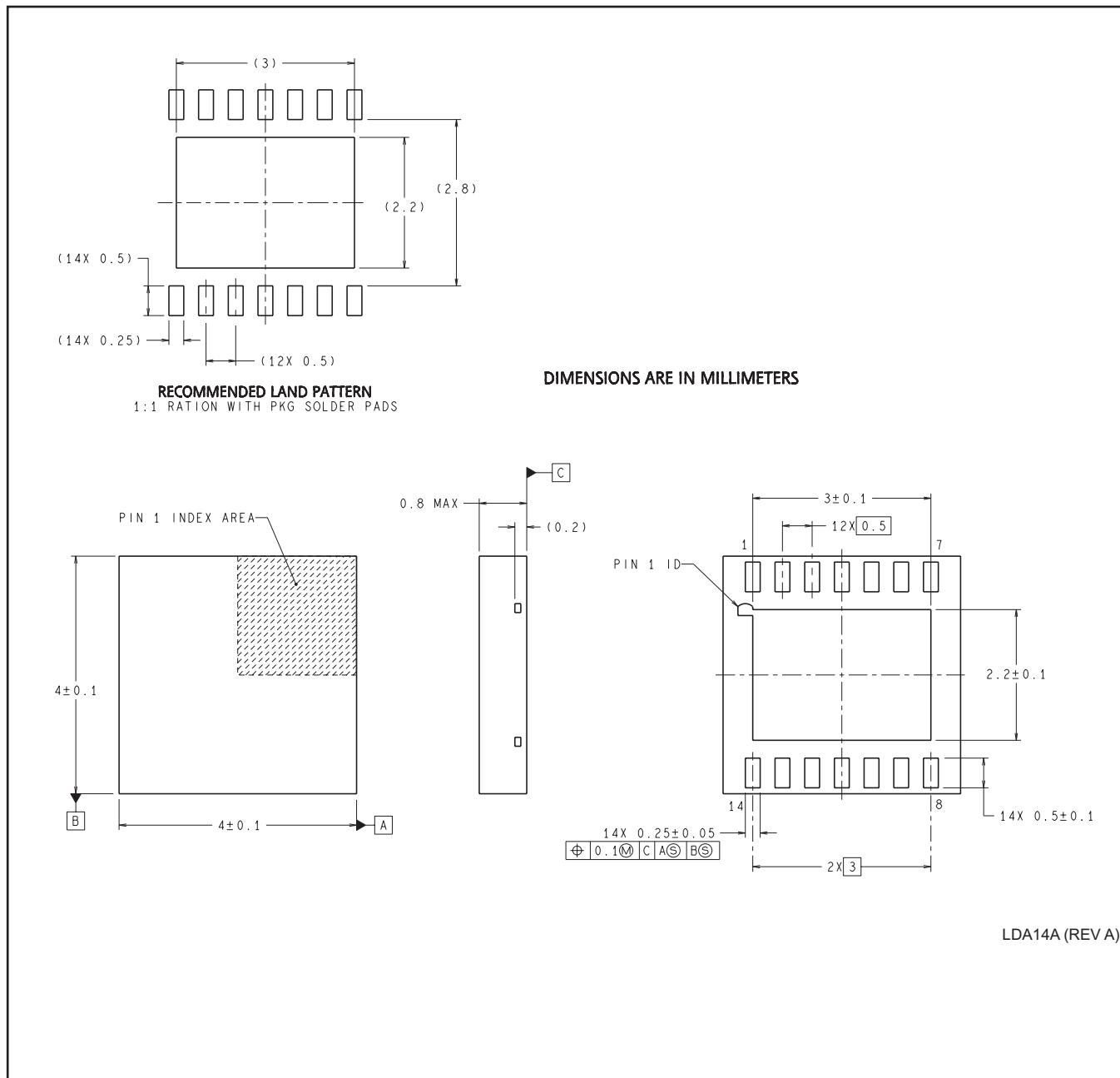


NOTES:

- 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.

MECHANICAL DATA

NHE0014A



IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2021, Texas Instruments Incorporated