

## LMR16020 SIMPLE SWITCHER® 60 V, 2 A Step-Down Converter

### 1 Features

- 4.5 V to 60 V Input Range
- 2 A Continuous Output Current
- Ultra-low 40  $\mu$ A Operating Quiescent Current
- 155 m $\Omega$  High-Side MOSFET
- Minimum Switch-On Time: 90 ns
- Current Mode Control
- Adjustable Switching Frequency from 200 kHz to 2.5 MHz
- Frequency Synchronization to External Clock
- Internal Compensation for Ease of Use
- High Duty Cycle Operation Supported
- Precision Enable Input
- 1  $\mu$ A Shutdown Current
- External Soft-start
- Thermal, Overvoltage and Short Protection
- 8-Pin HSOIC with PowerPAD™ Package

### 2 Applications

- Automotive Battery Regulation
- Industrial Power Supplies
- Telecom and Datacom Systems
- General Purpose Wide Vin Regulation

### 3 Description

The LMR16020 is a 60 V, 2 A SIMPLE SWITCHER® step down regulator with an integrated high-side MOSFET. With a wide input range from 4.5 V to 60 V, it's suitable for various applications from industrial to automotive for power conditioning from unregulated sources. The regulator's quiescent current is 40  $\mu$ A in Sleep-mode, which is suitable for battery powered systems. An ultra-low 1  $\mu$ A current in shutdown mode can further prolong battery life. A wide adjustable switching frequency range allows either efficiency or external component size to be optimized. Internal loop compensation means that the user is free from the tedious task of loop compensation design. This also minimizes the external components of the device. A precision enable input allows simplification of regulator control and system power sequencing. The device also has built-in protection features such as cycle-by-cycle current limit, thermal sensing and shutdown due to excessive power dissipation, and output overvoltage protection.

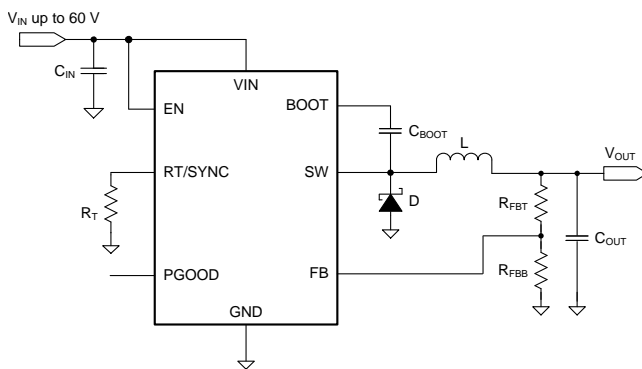
The LMR16020 is available in an 8-pin HSOIC package with exposed pad for low thermal resistance.

#### Device Information (1)

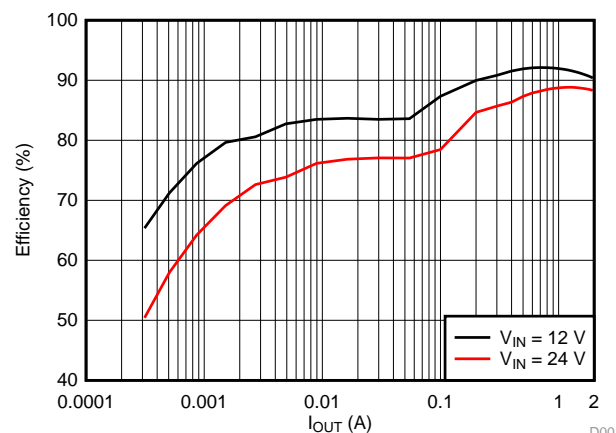
PART NUMBER	PACKAGE	BODY SIZE (NOM)
LMR16020PDDA	HSOIC (8)	4.89 mm x 3.90 mm

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

#### Simplified Schematic



#### Efficiency vs Output Current Vout = 5 V, fs = 500 KHz



D001



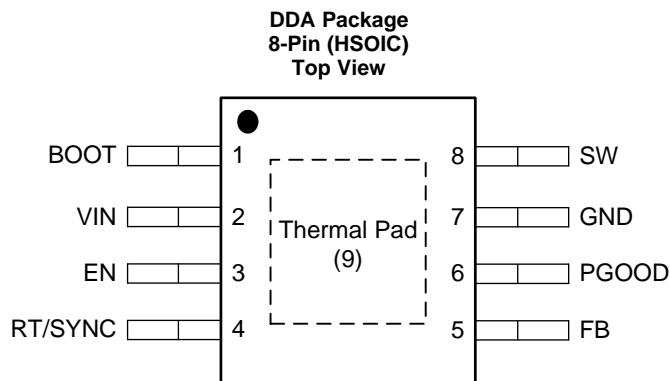
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## 4 Revision History

DATE	REVISION	NOTES
December 2015	*	Initial release.

## 5 Pin Configuration and Functions



### Pin Functions

PIN		TYPE <sup>(1)</sup>	DESCRIPTION
NAME	NO.		
BOOT	1	P	Bootstrap capacitor connection for high-side MOSFET driver. Connect a high quality 0.1 $\mu$ F capacitor from BOOT to SW.
VIN	2	P	Connect to power supply and bypass capacitors $C_{IN}$ . Path from VIN pin to high frequency bypass $C_{IN}$ and GND must be as short as possible.
EN	3	I	Enable pin, with internal pull-up current source. Pull below 1.2 V to disable. Float or connect to VIN to enable. Adjust the input under voltage lockout with two resistors. See the Enable and Adjusting Under voltage lockout section.
RT/SYNC	4	I	Resistor Timing or External Clock input. An internal amplifier holds this pin at a fixed voltage when using an external resistor to ground to set the switching frequency. If the pin is pulled above the PLL upper threshold, a mode change occurs and the pin becomes a synchronization input. The internal amplifier is disabled and the pin is a high impedance clock input to the internal PLL. If clocking edges stop, the internal amplifier is re-enabled and the operating mode returns to frequency programming by resistor.
FB	5	I	Feedback input pin, connect to the feedback divider to set $V_{OUT}$ . Do not short this pin to ground during operation.
PGOOD	6	O	Open drain output for power-good flag. Use a 10 k $\Omega$ to 100 k $\Omega$ pull-up resistor to logic rail or other DC voltage no higher than 7 V.
GND	7	G	System ground pin.
SW	8	P	Switching output of the regulator. Internally connected to high-side power MOSFET. Connect to power inductor.
Thermal Pad	9	G	Major heat dissipation path of the die. Must be connected to ground plane on PCB.

(1) I = Input, O = Output, G = Ground, P = Power

**PRODUCT PREVIEW**

## 6 Device and Documentation Support

### 6.1 Device Support

#### 6.1.1 Third-Party Products Disclaimer

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### 6.2 Community Resources

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## 6.1 Trademarks

PowerPAD, E2E are trademarks of Texas Instruments.  
SIMPLE SWITCHER is a registered trademark of Texas Instruments.

## 6.2 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.

## 6.3 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 7 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/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LMR16020PDDA	PREVIEW	SO PowerPAD	DDA	8		TBD	Call TI	Call TI	-40 to 85		
LMR16020PDDAR	PREVIEW	SO PowerPAD	DDA	8		TBD	Call TI	Call TI	-40 to 85		

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

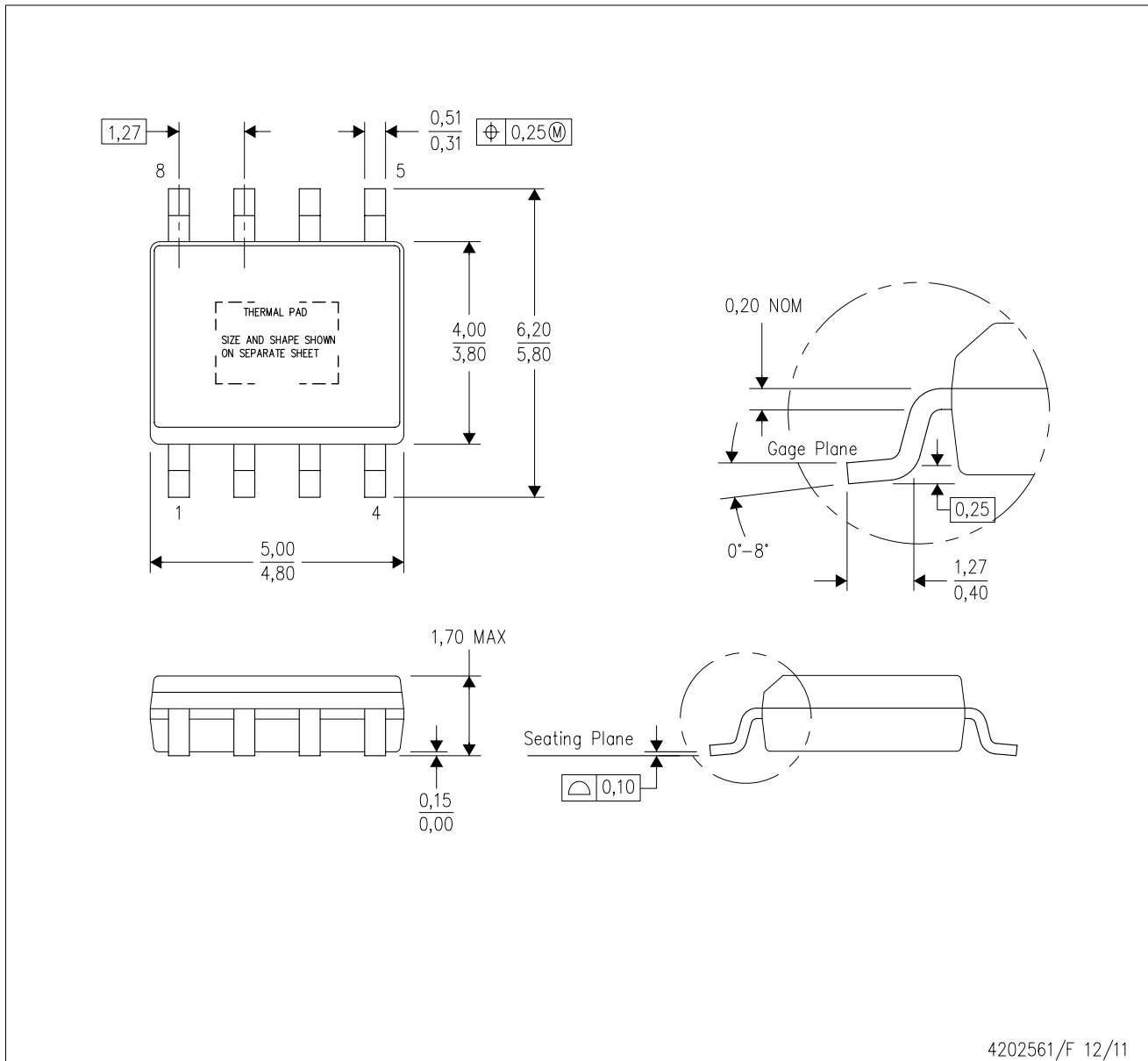
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DDA (R-PDSO-G8)

PowerPAD™ PLASTIC SMALL-OUTLINE



4202561/F 12/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5-1994.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
  - D. This package is designed to be soldered to a thermal pad on the board. Refer to Technical Brief, PowerPad Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 for information regarding recommended board layout. This document is available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
  - F. This package complies to JEDEC MS-012 variation BA

PowerPAD is a trademark of Texas Instruments.

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

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
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Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
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Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
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Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
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