

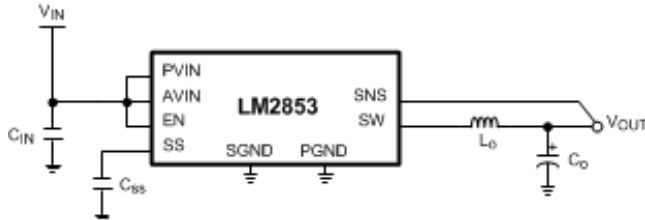
## LM2853 3A 550kHz 同步降压稳压器

### 1 特性

- 输入电压范围：3V 至 5.5V
- 厂家 EEPROM 设定的输出电压范围为 0.8V 至 3.3V（以 100mV 递增）
- 最大负载电流为 3A
- 电压模式控制
- 内部 III 型补偿
- 开关频率为 550kHz
- 低待机电流 (12μA)
- 内部 40mΩ MOSFET 开关
- 标准电压选项
  - 0.8/1.0/1.2/1.5/1.8/2.5/3.0/3.3 伏特
- 裸露焊盘 14 引线 HTSSOP (PWP) 封装

### 2 应用

- 低电压负载点稳压
  - 面向现场可编程门阵列 (FPGA)/数字信号处理器 (DSP)/特定用途集成电路 (ASIC) 内核电源的本地解决方案
  - 宽带联网和通信基础设施
- 典型应用电路



### 3 说明

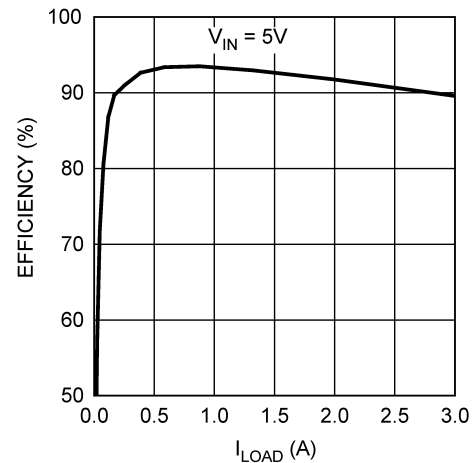
LM2853 同步降压稳压器是一款 550kHz 降压开关电压稳压器，能够驱动高达 3A 的负载，并且拥有出色的线路和负载调节性能。LM2853 的输入电压范围为 3V 至 5.5V，输出电压可由厂家编程设定，设定范围为 0.8V 至 3.3V（以 100mV 为单位增量）。内部 III 型补偿支持低组件数解决方案，并且能够极大地简化外部组件选择。HTSSOP-14 (PWP) 封装可以增强 LM2853 的热性能。

器件信息<sup>(1)</sup>

| 器件型号   | 封装          | 封装尺寸（标称值）       |
|--------|-------------|-----------------|
| LM2853 | HTSSOP (14) | 5.00mm x 4.40mm |

(1) 如需了解所有可用封装，请参阅产品说明书末尾的可订购产品附录。

效率与  $I_{LOAD}$  间的关系



## 目录

|          |                                              |          |           |                                                      |           |
|----------|----------------------------------------------|----------|-----------|------------------------------------------------------|-----------|
| <b>1</b> | <b>特性</b> .....                              | <b>1</b> | 7.2       | Functional Block Diagram .....                       | <b>8</b>  |
| <b>2</b> | <b>应用</b> .....                              | <b>1</b> | <b>8</b>  | <b>Application and Implementation</b> .....          | <b>9</b>  |
| <b>3</b> | <b>说明</b> .....                              | <b>1</b> | 8.1       | Application Information.....                         | <b>9</b>  |
| <b>4</b> | <b>修订历史记录</b> .....                          | <b>2</b> | 8.2       | Typical Application .....                            | <b>13</b> |
| <b>5</b> | <b>Pin Configuration and Functions</b> ..... | <b>3</b> | <b>9</b>  | <b>Layout</b> .....                                  | <b>14</b> |
| <b>6</b> | <b>Specifications</b> .....                  | <b>4</b> | 9.1       | Layout Guidelines .....                              | <b>14</b> |
| 6.1      | Absolute Maximum Ratings .....               | <b>4</b> | 9.2       | Example Circuit Schematic and Bill of Materials .... | <b>14</b> |
| 6.2      | ESD Ratings .....                            | <b>4</b> | <b>10</b> | <b>器件和文档支持</b> .....                                 | <b>16</b> |
| 6.3      | Recommended Operating Conditions.....        | <b>4</b> | 10.1      | 接收文档更新通知 .....                                       | <b>16</b> |
| 6.4      | Thermal Information .....                    | <b>4</b> | 10.2      | 社区资源 .....                                           | <b>16</b> |
| 6.5      | Electrical Characteristics.....              | <b>5</b> | 10.3      | 商标.....                                              | <b>16</b> |
| 6.6      | Typical Characteristics .....                | <b>6</b> | 10.4      | 静电放电警告 .....                                         | <b>16</b> |
| <b>7</b> | <b>Detailed Description</b> .....            | <b>8</b> | 10.5      | Glossary .....                                       | <b>16</b> |
| 7.1      | Overview .....                               | <b>8</b> | <b>11</b> | <b>机械、封装和可订购信息</b> .....                             | <b>16</b> |

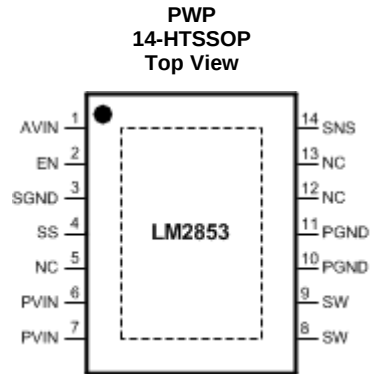
## 4 修订历史记录

### Changes from Original (October 2006) to Revision A

### Page

|                                                                                   |          |
|-----------------------------------------------------------------------------------|----------|
| • 已添加 添加了应用和实施 部分、器件信息表、引脚配置和功能部分、ESD 额定值表、热性能信息表、器件和文档支持部分以及机械、封装和可订购信息部分。 ..... | <b>1</b> |
| • 将产品说明书的布局更改成了 TI 格式 .....                                                       | <b>1</b> |

## 5 Pin Configuration and Functions



**Pin Functions**

| NO.         | NAME | DESCRIPTION                                                                                                                                                       |
|-------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | AVIN | Input Voltage for Control Circuitry                                                                                                                               |
| 2           | EN   | Enable                                                                                                                                                            |
| 3           | SGND | Low noise ground                                                                                                                                                  |
| 4           | SS   | Soft-Start Pin                                                                                                                                                    |
| 5           | NC   | No Connect. This pin must be tied to ground.                                                                                                                      |
| 6,7         | PVIN | Input Voltage for Power Circuitry                                                                                                                                 |
| 8,9         | SW   | Switch Pin                                                                                                                                                        |
| 10,11       | PGND | Power Ground                                                                                                                                                      |
| 12,13       | NC   | No-Connect. These pins must be tied to ground.                                                                                                                    |
| 14          | SNS  | Output Voltage Sense Pin                                                                                                                                          |
| Exposed Pad | EP   | The exposed pad is internally connected to GND, but it cannot be used as the primary GND connection. The exposed pad should be soldered to an external GND plane. |

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                                         |                      | MIN                | MAX | UNIT |
|-----------------------------------------|----------------------|--------------------|-----|------|
| AVIN, PVIN, EN, SNS, SW, SS             |                      | –0.3               | 6   | V    |
| Power Dissipation                       |                      | Internally Limited |     | V    |
| 14-Pin Exposed Pad HTSSOP Package (PWP) | Infrared (15 sec)    |                    | 220 | °C   |
|                                         | Vapor Phase (60 sec) |                    | 215 | °C   |
|                                         | Soldering (10 sec)   |                    | 260 | °C   |
| Maximum junction temperature            |                      |                    | 150 | °C   |
| Storage temperature, T <sub>stg</sub>   |                      | –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.

### 6.2 ESD Ratings

|                    |                         |                                                                   | VALUE | UNIT |
|--------------------|-------------------------|-------------------------------------------------------------------|-------|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup> | ±2    | kV   |

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

### 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                                                | MIN | MAX | UNIT |
|------------------------------------------------|-----|-----|------|
| PVIN to GND                                    | 1.5 | 5.5 | V    |
| AVIN to GND                                    | 3   | 5.5 | V    |
| Operation junction temperature, T <sub>J</sub> | –40 | 125 | °C   |

- (1) Absolute maximum ratings indicate limits beyond which damage to the device may occur. Operating Range indicates conditions for which the device is intended to be functional, but does not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics.

### 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                        | LM2853       | UNIT |
|-------------------------------|----------------------------------------|--------------|------|
|                               |                                        | PWP (HTSSOP) |      |
|                               |                                        | 14 PINS      |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance | 38           | °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

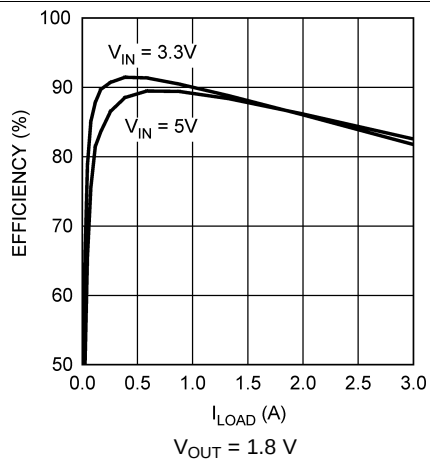
Specifications with standard typeface are for  $T_J = 25^\circ\text{C}$ . Minimum and Maximum limits are ensured through test, design or statistical correlation. Typical values represent the most likely parametric norm at  $T_J = 25^\circ\text{C}$  and are provided for reference purposes only. Unless otherwise specified  $AVIN = PVIN = 5\text{ V}$ .

| PARAMETER                            |                                  | TEST CONDITIONS                                                                                                                                 | MIN                                             | TYP    | MAX | UNIT             |
|--------------------------------------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--------|-----|------------------|
| <b>SYSTEM PARAMETERS</b>             |                                  |                                                                                                                                                 |                                                 |        |     |                  |
| $V_{OUT}$                            | Voltage tolerance <sup>(1)</sup> | $V_{OUT} = 0.8\text{ V option}$                                                                                                                 | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 0.782  | 0.8 | 0.818            |
|                                      |                                  | $V_{OUT} = 1\text{ V option}$                                                                                                                   | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 0.9775 | 1   | 1.0225           |
|                                      |                                  | $V_{OUT} = 1.2\text{ V option}$                                                                                                                 | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 1.1730 | 1.2 | 1.227            |
|                                      |                                  | $V_{OUT} = 1.5\text{ V option}$                                                                                                                 | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 1.4663 | 1.5 | 1.5337           |
|                                      |                                  | $V_{OUT} = 1.8\text{ V option}$                                                                                                                 | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 1.7595 | 1.8 | 1.8405           |
|                                      |                                  | $V_{OUT} = 2.5\text{ V option}$                                                                                                                 | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 2.4437 | 2.5 | 2.5563           |
|                                      |                                  | $V_{OUT} = 3\text{ V option}$                                                                                                                   | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 2.9325 | 3   | 3.0675           |
|                                      |                                  | $V_{OUT} = 3.3\text{ V option}$                                                                                                                 | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 3.2257 | 3.3 | 3.3743           |
| $\Delta V_{OUT}/\Delta A_{VIN}$      | Line regulation <sup>(1)</sup>   | $V_{OUT} = 0.8\text{ V, } 1\text{ V, } 1.2\text{ V, } 1.5\text{ V, } 1.8\text{ V or } 2.5\text{ V}$<br>$3\text{ V} \leq AVIN \leq 5.5\text{ V}$ | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 0.2    | 1.1 | %                |
|                                      |                                  | $V_{OUT} = 3\text{ V or } 3.3\text{ V}$<br>$3.5\text{ V} \leq AVIN \leq 5.5\text{ V}$                                                           | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 0.2    | 1.1 | %                |
| $\Delta V_{OUT}/\Delta I_O$          | Load regulation                  | Normal operation                                                                                                                                |                                                 | 2      |     | mV/A             |
| $V_{ON}$                             | UVLO Threshold ( $AVIN$ )        | Rising                                                                                                                                          | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 2.47   | 3   | V                |
|                                      |                                  | Falling hysteresis                                                                                                                              | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 50     | 155 | 260              |
| $R_{DS(ON)-P}$                       | PFET On resistance               | $I_{SW} = 3\text{ A}$                                                                                                                           | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 40     | 120 | m $\Omega$       |
| $R_{DS(ON)-N}$                       | NFET On resistance               | $I_{SW} = 3\text{ A}$                                                                                                                           | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 32     | 100 | m $\Omega$       |
| $R_{SS}$                             | Soft-Start resistance            |                                                                                                                                                 |                                                 | 450    |     | k $\Omega$       |
| $I_{CL}$                             | Peak current limit threshold     |                                                                                                                                                 | 3.6                                             | 5      |     | A                |
| $I_Q$                                | Operating current                | Non-switching                                                                                                                                   | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 0.85   | 2   | mA               |
| $I_{SD}$                             | Shutdown quiescent current       | $EN = 0\text{ V}$                                                                                                                               | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 12     | 50  | $\mu\text{A}$    |
| $R_{SNS}$                            | Sense pin resistance             |                                                                                                                                                 |                                                 | 432    |     | k $\Omega$       |
| <b>PWM</b>                           |                                  |                                                                                                                                                 |                                                 |        |     |                  |
| $f_{osc}$                            | Switching frequency              | .                                                                                                                                               | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 325    | 550 | 725              |
| $D_{range}$                          | Duty cycle range                 |                                                                                                                                                 | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 0      | 100 | %                |
| <b>ENABLE CONTROL <sup>(2)</sup></b> |                                  |                                                                                                                                                 |                                                 |        |     |                  |
| $V_{IH}$                             | EN Pin minimum high input        |                                                                                                                                                 | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ | 75     |     | % of $AVIN$      |
| $V_{IL}$                             | EN Pin maximum low input         |                                                                                                                                                 | $T_J = -40^\circ\text{C to } 125^\circ\text{C}$ |        | 25  | % of $AVIN$      |
| $I_{EN}$                             | EN Pin pullup current            | $EN = 0\text{ V}$                                                                                                                               |                                                 | 1.5    |     | $\mu\text{A}$    |
| <b>THERMAL CONTROLS</b>              |                                  |                                                                                                                                                 |                                                 |        |     |                  |
| $T_{SD}$                             | Thermal shutdown threshold       |                                                                                                                                                 |                                                 | 165    |     | $^\circ\text{C}$ |
| $T_{SD-HYS}$                         | Hysteresis for thermal shutdown  |                                                                                                                                                 |                                                 | 10     |     | $^\circ\text{C}$ |

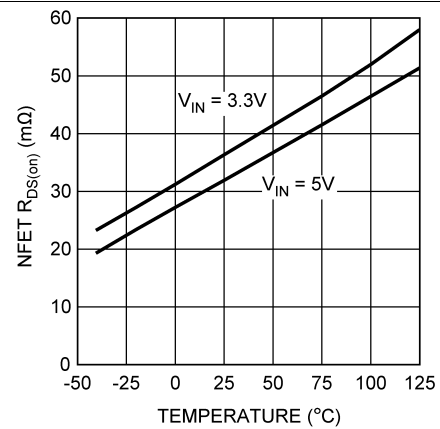
(1)  $V_{OUT}$  measured in a non-switching, closed-loop configuration at the SNS pin.

(2) The enable pin is internally pulled up, so the LM2853 is automatically enabled unless an external enable voltage is applied.

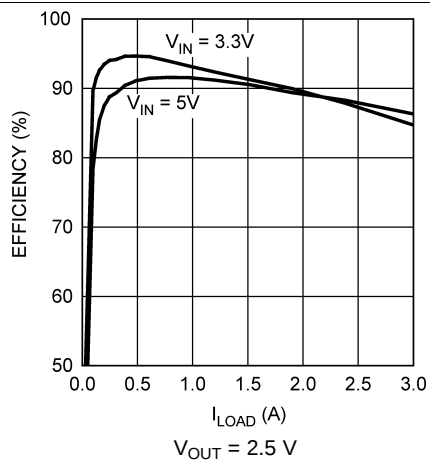
## 6.6 Typical Characteristics



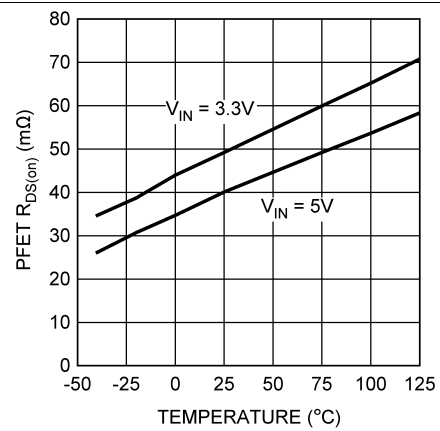
**Figure 1. Efficiency vs  $I_{LOAD}$**



**Figure 2. NFET  $R_{DS(on)}$  vs Temperature**

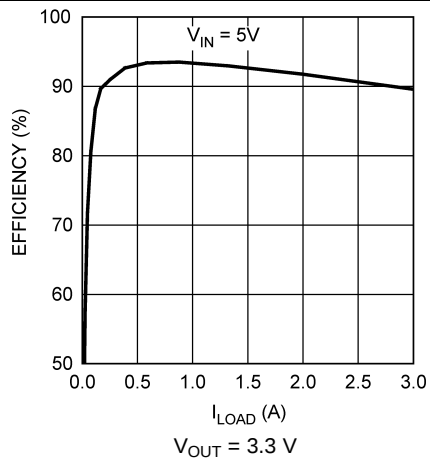


**Figure 3. Efficiency vs  $I_{LOAD}$**

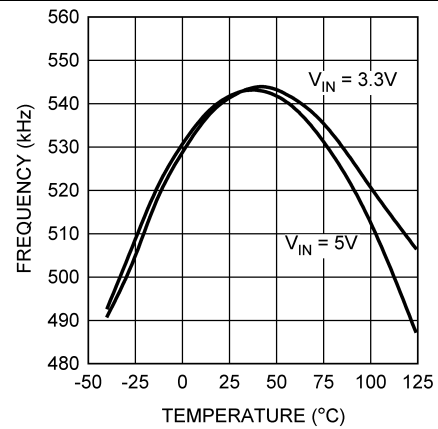


**Figure 4. PFET  $R_{DS(on)}$  vs Temperature**

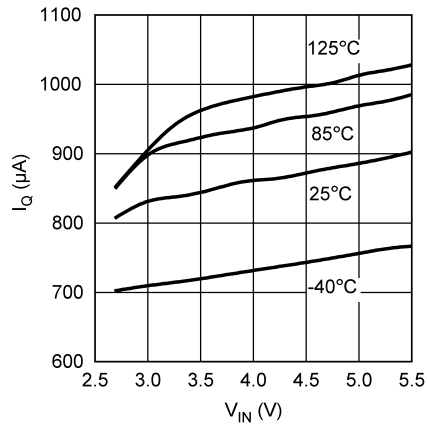
## Typical Characteristics (continued)



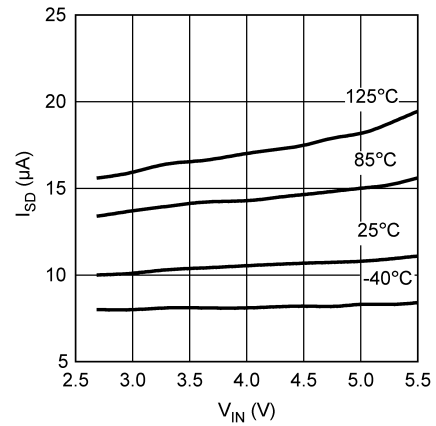
**Figure 5. Efficiency vs  $I_{LOAD}$**



**Figure 6. Switching Frequency vs Temperature**



**Figure 7.  $I_Q$  vs  $V_{IN}$  and Temperature**



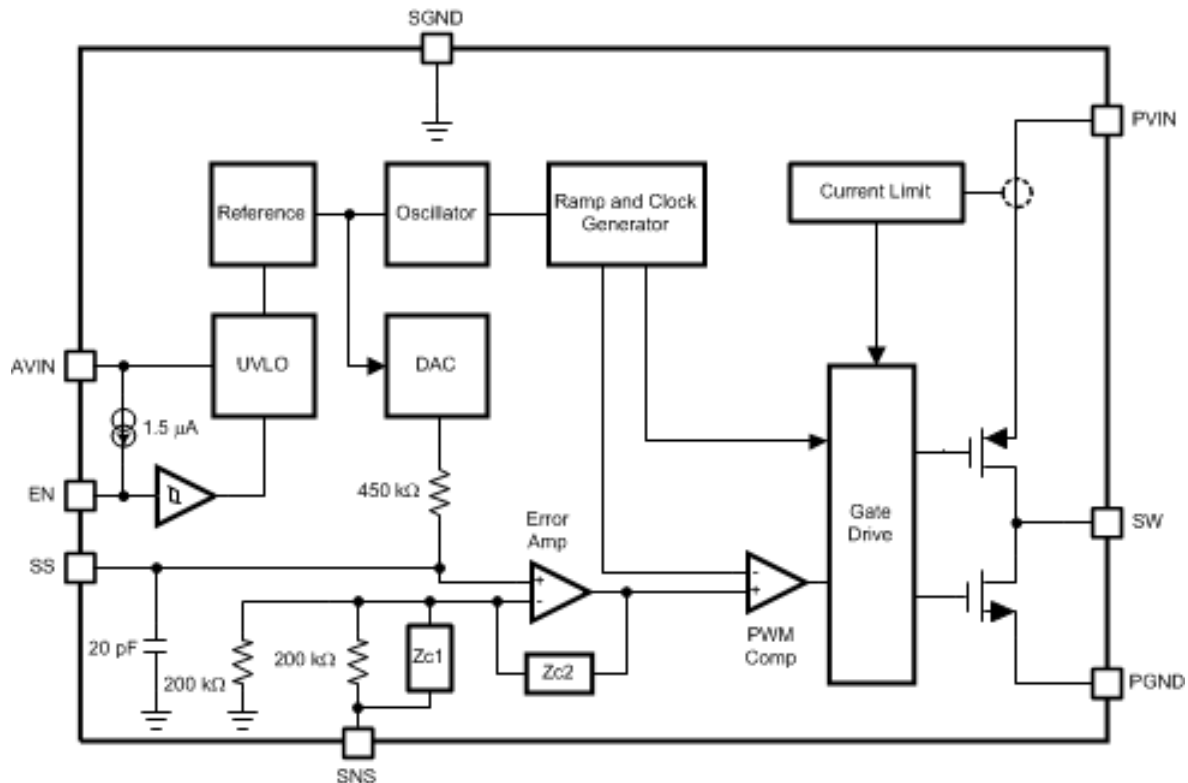
**Figure 8.  $I_{SD}$  vs  $V_{IN}$  and Temperature**

## 7 Detailed Description

### 7.1 Overview

The LM2853 is a DC-DC buck regulator belonging to Texas Instrument's synchronous family. Integration of the PWM controller, power switches and compensation network greatly reduces the component count required to implement a switching power supply. A typical application requires only four components: an input capacitor, a soft-start capacitor, an output filter capacitor and an output filter inductor.

### 7.2 Functional Block Diagram



## 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

#### 8.1.1 Input Capacitor ( $C_{IN}$ )

Fast switching of large currents in the buck converter places a heavy demand on the voltage source supplying PVIN. The input capacitor,  $C_{IN}$ , supplies extra charge when the switcher needs to draw a burst of current from the supply. The RMS current rating and the voltage rating of the  $C_{IN}$  capacitor are therefore important in the selection of  $C_{IN}$ . The RMS current specification can be approximated by:

$$I_{RMS} = I_{LOAD} \sqrt{D(1-D)} \quad (1)$$

where D is the duty cycle,  $V_{OUT}/V_{IN}$ .  $C_{IN}$  also provides filtering of the supply. Trace resistance and inductance degrade the benefits of the input capacitor, so  $C_{IN}$  should be placed very close to PVIN in the layout. A 22  $\mu$ F or 47  $\mu$ F ceramic capacitor is typically sufficient for  $C_{IN}$ . In parallel with the large input capacitance a smaller capacitor should be added such as a 1  $\mu$ F ceramic for higher frequency filtering. Ceramic capacitors with high quality dielectrics such as X5R or X7R should be used to provide a constant capacitance across temperature and line variations. For improved load regulation and transient performance, the use of a small 1  $\mu$ F ceramic capacitor is also recommended as a local bypass for the AVIN pin.

#### 8.1.2 Soft-Start Capacitor ( $C_{SS}$ )

The DAC that sets the reference voltage of the error amplifier sources a current through a resistor to set the reference voltage. The reference voltage is one half of the output voltage of the switcher due to the 200 k $\Omega$  divider connected to the SNS pin. Upon start-up, the output voltage of the switcher tracks the reference voltage with a two to one ratio as the DAC current charges the capacitance connected to the reference voltage node. Internal capacitance of 20 pF is permanently attached to the reference voltage node which is also connected to the soft start pin, SS. Adding a soft-start capacitor externally increases the time it takes for the output voltage to reach its final level. The charging time required for the reference voltage can be estimated using the RC time constant of the DAC resistor and the capacitance connected to the SS pin. Three RC time constant periods are needed for the reference voltage to reach 95% of its final value. The actual start up time will vary with differences in the DAC resistance and higher-order effects.

If little or no soft-start capacitance is connected, then the start up time may be determined by the time required for the current limit current to charge the output filter capacitance. The capacitor charging equation  $I = C\Delta V/\Delta t$  can be used to estimate the start-up time in this case. For example, a part with a 3 V output, a 100  $\mu$ F output capacitance and a 5A current limit threshold would require a time of 60  $\mu$ s:

$$\Delta t = C \frac{\Delta V}{I} = 100 \mu F \frac{3V}{5A} = 60 \mu s \quad (2)$$

Since it is undesirable for the power supply to start up in current limit, a soft-start capacitor must be chosen to force the LM2853 to start up in a more controlled fashion based on the charging of the soft-start capacitance. In this example, suppose a 3 ms start time is desired. Three time constants are required for charging the soft-start capacitor to 95% of the final reference voltage. So in this case  $RC = 1$  ms. The DAC resistor, R, is 450 k $\Omega$  so C can be calculated to be 2.2 nF. A 2.2 nF ceramic capacitor can be chosen to yield approximately a 3 ms start-up time.

## Application Information (continued)

### 8.1.3 Soft-Start Capacitor (C<sub>SS</sub>) and Fault Conditions

Various fault conditions such as short circuit and UVLO of the LM2853 activate internal circuitry designed to control the voltage on the soft-start capacitor. For example, during a short circuit current limit event, the output voltage typically falls to a low voltage. During this time, the soft-start voltage is forced to track the output so that once the short is removed, the LM2853 can restart gracefully from whatever voltage the output reached during the short circuit event. The range of soft-start capacitors is therefore restricted to values 1 nF to 50 nF.

### 8.1.4 Compensation

The LM2853 provides a highly integrated solution to power supply design. The compensation of the LM2853, which is type-three, is included on-chip. The benefit of integrated compensation is straight-forward, simple power supply design. Since the output filter capacitor and inductor values impact the compensation of the control loop, the range of L<sub>O</sub>, C<sub>O</sub> and C<sub>ESR</sub> values is restricted in order to ensure stability.

### 8.1.5 Output Filter Values

Table 1 details the recommended inductor and capacitor ranges for the LM2853 that are suggested for various typical output voltages. Values slightly different than those recommended may be used, however the phase margin of the power supply may be degraded. For best performance when output voltage ripple is a concern, ESR values near the minimum of the recommended range should be paired with capacitance values near the maximum. If a minimum output voltage ripple solution from a 5 V input voltage is desired, a 6.8 µH inductor can be paired with a 220 µF (50 mΩ) capacitor without degraded phase margin.

**Table 1. Recommended L<sub>O</sub> and C<sub>O</sub> Values**

| V <sub>OUT</sub> (V) | V <sub>IN</sub> (V) | L <sub>O</sub> (µH) |     | C <sub>O</sub> (µF) |     | C <sub>ESR</sub> (mΩ) |     |
|----------------------|---------------------|---------------------|-----|---------------------|-----|-----------------------|-----|
|                      |                     | MIN                 | MAX | MIN                 | MAX | MIN                   | MAX |
| 0.8                  | 5                   | 4.7                 | 6.8 | 120                 | 220 | 70                    | 100 |
|                      | 3.3                 | 4.7                 | 4.7 | 150                 | 220 | 50                    | 100 |
| 1                    | 5                   | 4.7                 | 6.8 | 120                 | 220 | 70                    | 100 |
|                      | 3.3                 | 4.7                 | 4.7 | 150                 | 220 | 50                    | 100 |
| 1.2                  | 5                   | 4.7                 | 6.8 | 120                 | 220 | 70                    | 100 |
|                      | 3.3                 | 4.7                 | 4.7 | 120                 | 220 | 60                    | 100 |
| 1.5                  | 5                   | 4.7                 | 6.8 | 120                 | 220 | 70                    | 100 |
|                      | 3.3                 | 4.7                 | 4.7 | 120                 | 220 | 60                    | 100 |
| 1.8                  | 5                   | 4.7                 | 6.8 | 120                 | 220 | 70                    | 120 |
|                      | 3.3                 | 4.7                 | 4.7 | 100                 | 220 | 70                    | 120 |
| 2.5                  | 5                   | 4.7                 | 6.8 | 120                 | 220 | 70                    | 150 |
|                      | 3.3                 | 4.7                 | 4.7 | 100                 | 220 | 80                    | 150 |
| 3.0                  | 5                   | 4.7                 | 6.8 | 120                 | 220 | 70                    | 150 |
|                      | 3.3                 | 4.7                 | 4.7 | 100                 | 220 | 80                    | 150 |
| 3.3                  | 5                   | 4.7                 | 6.8 | 120                 | 220 | 70                    | 150 |

### 8.1.6 Choosing an Inductance Value

The current ripple present in the output filter inductor is determined by the input voltage, output voltage, switching frequency and inductance according to Equation 3.

$$\Delta I_L = \frac{D \times (V_{IN} - V_{OUT})}{f \times L_O} \quad (3)$$

where  $\Delta I_L$  is the peak to peak current ripple,  $D$  is the duty cycle  $V_{OUT}/V_{IN}$ ,  $V_{IN}$  is the input voltage applied to the output stage,  $V_{OUT}$  is the output voltage of the switcher,  $f$  is the switching frequency and  $L_O$  is the inductance of the output filter inductor. Knowing the current ripple is important for inductor selection since the peak current through the inductor is the load current plus one half the ripple current. Care must be taken to ensure the peak inductor current does not reach a level high enough to trip the current limit circuitry of the LM2853. As an example, consider a 5 V to 1.2 V conversion and a 550 kHz switching frequency. According to [Table 1](#), a 4.7  $\mu$ H inductor may be used. Calculating the expected peak-to-peak ripple,

$$\Delta I_L = \frac{\frac{1.2V}{5V} \times (5V - 1.2V)}{550 \text{ kHz} \times 4.7 \mu\text{F}} = 353 \text{ mA} \quad (4)$$

The maximum inductor current for a 3A load would therefore be 3A plus 177 mA, 3.177A. As shown in the ripple equation ([Equation 4](#)), the current ripple is inversely proportional to inductance.

### 8.1.7 Output Filter Inductors

Once the inductance value is chosen, the key parameter for selecting the output filter inductor is its saturation current ( $I_{SAT}$ ) specification. Typically  $I_{SAT}$  is given by the manufacturer as the current at which the inductance of the coil falls to a certain percentage of the nominal inductance. The  $I_{SAT}$  of an inductor used in an application should be greater than the maximum expected inductor current to avoid saturation. [Table 2](#) lists inductors that are suitable in LM2853 applications.

**Table 2. Recommended Inductors**

| INDUCTANCE  | PART NUMBER   | VENDOR    |
|-------------|---------------|-----------|
| 4.7 $\mu$ F | DO3308P-472ML | Coilcraft |
| 4.7 $\mu$ F | DO3316P-472ML | Coilcraft |
| 4.7 $\mu$ F | MSS1260-472ML | Coilcraft |
| 5.2 $\mu$ F | MSS1038-522NL | Coilcraft |
| 5.6 $\mu$ F | MSS1260-562ML | Coilcraft |
| 6.8 $\mu$ F | DO3316P-682ML | Coilcraft |
| 6.8 $\mu$ F | MSS1260-682ML | Coilcraft |

### 8.1.8 Output Filter Capacitors

The recommended capacitors that may be used in the output filter with the LM2853 are limited in value and ESR range according to [Table 1](#).

[Table 3](#) shows some examples of capacitors that can typically be used in a LM2853 application.

**Table 3. Recommended Capacitors**

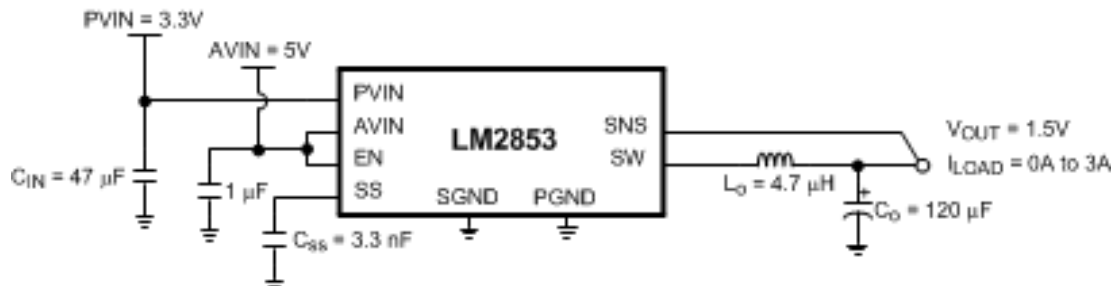
| CAPACITANCE<br>( $\mu$ F) | PART NUMBER        | CHEMISTRY     | VENDOR         |
|---------------------------|--------------------|---------------|----------------|
| 100                       | 594D107X_010C2T    | Tantalum      | Vishay-Sprague |
| 100                       | 593D107X_010D2_E3  | Tantalum      | Vishay-Sprague |
| 100                       | TPSC107M006#0075   | Tantalum      | AVX            |
| 100                       | NOSD107M006#0080   | Niobium Oxide | AVX            |
| 100                       | NOSC107M004#0070   | Niobium Oxide | AVX            |
| 120                       | 594D127X_6R3C2T    | Tantalum      | Vishay-Sprague |
| 150                       | 594D157X_010C2T    | Tantalum      | Vishay-Sprague |
| 150                       | 595D157X_010D2T    | Tantalum      | Vishay-Sprague |
| 150                       | 591D157X_6R3C2_20H | Tantalum      | Vishay-Sprague |
| 150                       | TPSD157M006#0050   | Tantalum      | AVX            |
| 150                       | TPSC157M004#0070   | Tantalum      | AVX            |
| 150                       | NOSD157M006#0070   | Niobium Oxide | AVX            |
| 220                       | 594D227X_6R3D2T    | Tantalum      | Vishay-Sprague |

**Table 3. Recommended Capacitors (continued)**

| CAPACITANCE<br>( $\mu$ F) | PART NUMBER        | CHEMISTRY     | VENDOR         |
|---------------------------|--------------------|---------------|----------------|
| 220                       | 591D227X_6R3D2_20H | Tantalum      | Vishay-Sprague |
| 220                       | 591D227X_010D2_20H | Tantalum      | Vishay-Sprague |
| 220                       | 593D227X_6R3D2_E3  | Tantalum      | Vishay-Sprague |
| 220                       | TPSD227M006#0050   | Tantalum      | AVX            |
| 220                       | NOSD227M0040060    | Niobium Oxide | AVX            |

### 8.1.9 Split-Rail Operation

The LM2853 can be powered using two separate voltages for AVIN and PVIN. AVIN is the supply for the control logic; PVIN is the supply for the power FETs. The output filter components need to be chosen based on the value of PVIN. For PVIN levels lower than 3.3 V, use output filter component values recommended for 3.3 V. PVIN must always be equal to or less than AVIN.

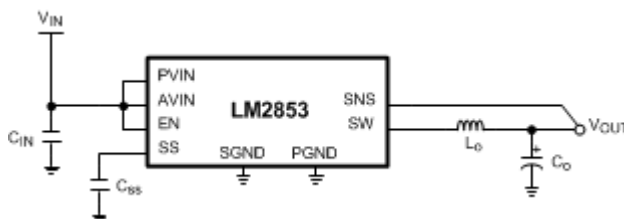


**Figure 9. Split-Rail Operation Example Circuit**

### 8.1.10 Switch Node Protection

The LM2853 includes protection circuitry that monitors the voltage on the switch pin. Under certain fault conditions, switching is disabled in order to protect the switching devices. One side effect of the protection circuitry may be observed when power to the LM2853 is applied with no or light load on the output. The output will regulate to the rated voltage, but no switching may be observed. As soon as the output is loaded, the LM2853 will begin normal switching operation.

## 8.2 Typical Application



**Figure 10. LM2853 Typical Application Circuit**

## 9 Layout

### 9.1 Layout Guidelines

These are several guidelines to follow while designing the PCB layout for an LM2853 application.

1. The input bulk capacitor,  $C_{IN}$ , should be placed very close to the PVIN pin to keep the resistance as low as possible between the capacitor and the pin. High current levels will be present in this connection.
2. All ground connections must be tied together. Use a broad ground plane, for example a completely filled back plane, to establish the lowest resistance possible between all ground connections.
3. The sense pin connection should be made as close to the load as possible so that the voltage at the load is the expected regulated value. The sense line should not run too close to nodes with high  $dV/dt$  or  $dI/dt$  (such as the switch node) to minimize interference.
4. The switch node connections should be low resistance to reduce power losses. Low resistance means the trace between the switch pin and the inductor should be wide. However, the area of the switch node should not be too large since EMI increases with greater area. So connect the inductor to the switch pin with a short, but wide trace. Other high current connections in the application such as PVIN and  $V_{OUT}$  assume the same trade off between low resistance and EMI.
5. Allow area under the chip to solder the entire exposed die attach pad to ground for improved thermal performance. Lab measurements also show improved regulation performance when the exposed pad is well grounded.

### 9.2 Example Circuit Schematic and Bill of Materials

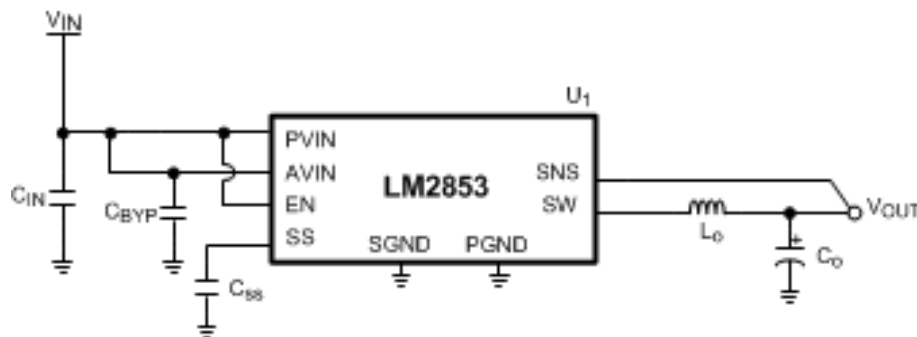


Figure 11. LM2853 Example Circuit Schematic

Table 4. Bill of Materials for 5 V to 3.3 V Conversion

| ID               | PART NUMBER       | TYPE      | SIZE      | PARAMETERS                   | QTY | VENDOR          |
|------------------|-------------------|-----------|-----------|------------------------------|-----|-----------------|
| U <sub>1</sub>   | LM2853MH-3.3      | 3A Buck   | HTSSOP-14 | 3.3 V                        | 1   | TI              |
| C <sub>IN</sub>  | GRM31CR60J476ME19 | Capacitor | 1206      | 47 $\mu$ F                   | 1   | Murata          |
| C <sub>BYP</sub> | GRM21BR71C105KA01 | Capacitor | 0805      | 1 $\mu$ F                    | 1   | Murata          |
| C <sub>SS</sub>  | VJ0805Y222KXXA    | Capacitor | 0603      | 2.2 nF                       | 1   | Vishay-Vitramon |
| L <sub>O</sub>   | DO3316P-682       | Inductor  | DO3316P   | 6.8 $\mu$ H                  | 1   | Coilcraft       |
| C <sub>O</sub>   | 594D127X06R3C2T   | Capacitor | C Case    | 120 $\mu$ F (85 m $\Omega$ ) | 1   | Vishay-Sprague  |

Table 5. Bill of Materials for 3.3 V to 1.2 V Conversion

| ID               | PART NUMBER       | TYPE      | SIZE      | PARAMETERS  | QTY | VENDOR          |
|------------------|-------------------|-----------|-----------|-------------|-----|-----------------|
| U <sub>1</sub>   | LM2853MH-1.2      | 3A Buck   | HTSSOP-14 | 1.2 V       | 1   | TI              |
| C <sub>IN</sub>  | GRM31CR60J476ME19 | Capacitor | 1206      | 47 $\mu$ F  | 1   | Murata          |
| C <sub>BYP</sub> | GRM21BR71C105KA01 | Capacitor | 0805      | 1 $\mu$ F   | 1   | Murata          |
| C <sub>SS</sub>  | VJ0805Y222KXXA    | Capacitor | 0603      | 2.2 nF      | 1   | Vishay-Vitramon |
| L <sub>O</sub>   | DO3316P-472       | Inductor  | DO3316P   | 4.7 $\mu$ H | 1   | Coilcraft       |

**Table 5. Bill of Materials for 3.3 V to 1.2 V Conversion (continued)**

| ID             | PART NUMBER      | TYPE      | SIZE   | PARAMETERS                   | QTY | VENDOR |
|----------------|------------------|-----------|--------|------------------------------|-----|--------|
| C <sub>O</sub> | NOSD157M006R0070 | Capacitor | D Case | 150 $\mu$ F (70 m $\Omega$ ) | 1   | AVX    |

## 10 器件和文档支持

### 10.1 接收文档更新通知

要接收文档更新通知，请转至 [TI.com](http://ti.com) 上的器件产品文件夹。单击右上角的通知我 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

### 10.2 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的《使用条款》。

**TI E2E™ 在线社区** [TI 的工程师对工程师 \(E2E\) 社区](http://e2e.ti.com)。此社区的创建目的在于促进工程师之间的协作。在 e2e.ti.com 中，您可以咨询问题、分享知识、拓展思路并与同行工程师一道帮助解决问题。

**设计支持** [TI 参考设计支持](#) 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

### 10.3 商标

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

### 10.4 静电放电警告



ESD 可能会损坏该集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理措施和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

### 10.5 Glossary

[SLYZ022](#) — *TI Glossary*.

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

## 11 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件的最新可用数据。这些数据如有变更，恕不另行通知和修订此文档。如欲获取此产品说明书的浏览器版本，请参阅左侧的导航。

## PACKAGING INFORMATION

| Orderable Device   | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|--------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM2853MH-1.0/NOPB  | ACTIVE        | HTSSOP       | PWP                | 14   | 94             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-1.0          | <a href="#">Samples</a> |
| LM2853MH-1.2/NOPB  | ACTIVE        | HTSSOP       | PWP                | 14   | 94             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-1.2          | <a href="#">Samples</a> |
| LM2853MH-1.5/NOPB  | ACTIVE        | HTSSOP       | PWP                | 14   | 94             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-1.5          | <a href="#">Samples</a> |
| LM2853MH-1.8/NOPB  | ACTIVE        | HTSSOP       | PWP                | 14   | 94             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-1.8          | <a href="#">Samples</a> |
| LM2853MH-2.5/NOPB  | ACTIVE        | HTSSOP       | PWP                | 14   | 94             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-2.5          | <a href="#">Samples</a> |
| LM2853MH-3.0/NOPB  | ACTIVE        | HTSSOP       | PWP                | 14   | 94             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-3.0          | <a href="#">Samples</a> |
| LM2853MH-3.3/NOPB  | ACTIVE        | HTSSOP       | PWP                | 14   | 94             | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-3.3          | <a href="#">Samples</a> |
| LM2853MHX-1.0/NOPB | ACTIVE        | HTSSOP       | PWP                | 14   | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-1.0          | <a href="#">Samples</a> |
| LM2853MHX-1.2/NOPB | ACTIVE        | HTSSOP       | PWP                | 14   | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-1.2          | <a href="#">Samples</a> |
| LM2853MHX-1.5/NOPB | ACTIVE        | HTSSOP       | PWP                | 14   | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-1.5          | <a href="#">Samples</a> |
| LM2853MHX-1.8/NOPB | ACTIVE        | HTSSOP       | PWP                | 14   | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-1.8          | <a href="#">Samples</a> |
| LM2853MHX-2.5/NOPB | ACTIVE        | HTSSOP       | PWP                | 14   | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-2.5          | <a href="#">Samples</a> |
| LM2853MHX-3.3/NOPB | ACTIVE        | HTSSOP       | PWP                | 14   | 2500           | RoHS & Green    | SN                                   | Level-1-260C-UNLIM   | -40 to 125   | LM2853<br>-3.3          | <a href="#">Samples</a> |

(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.

<sup>(2)</sup> **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  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm threshold requirement.

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

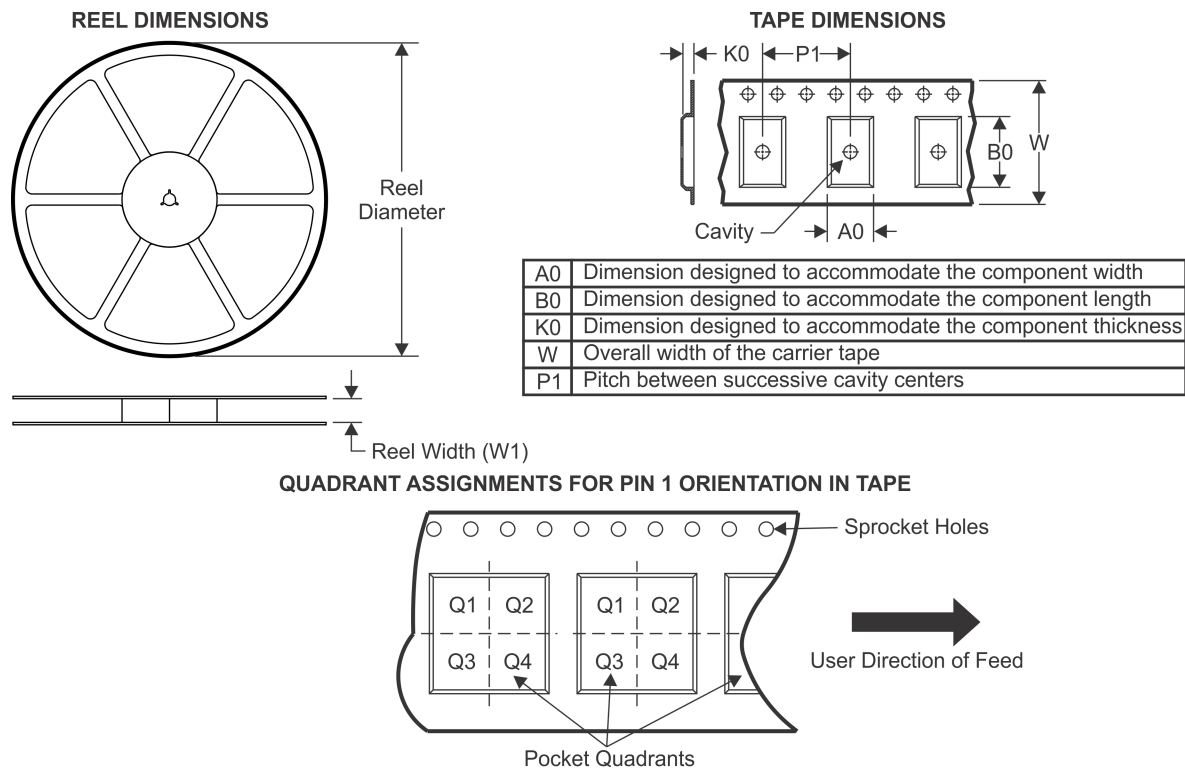
<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

<sup>(5)</sup> 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.

<sup>(6)</sup> 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.

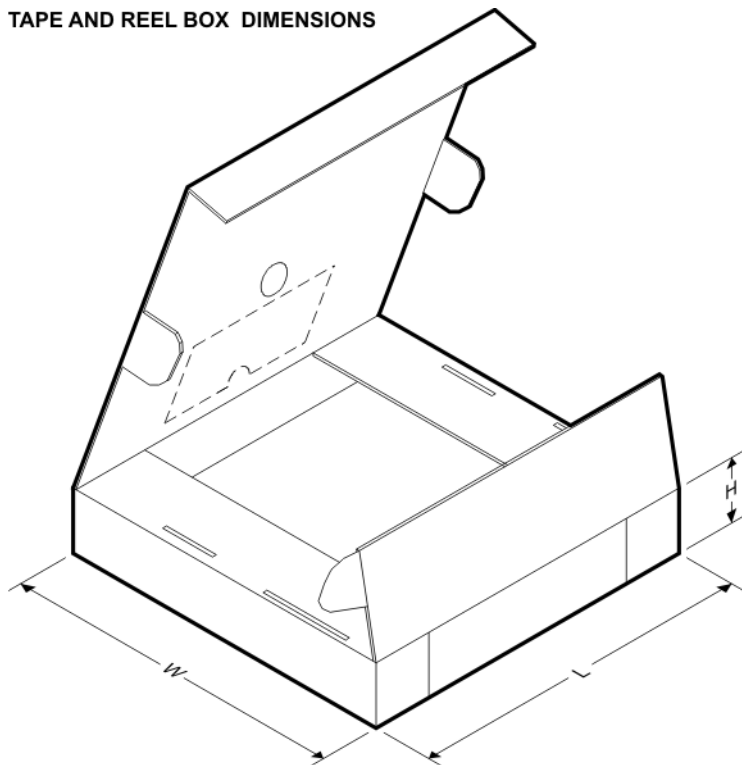
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM2853MHX-1.0/NOPB | HTSSOP       | PWP             | 14   | 2500 | 330.0              | 12.4               | 6.95    | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2853MHX-1.2/NOPB | HTSSOP       | PWP             | 14   | 2500 | 330.0              | 12.4               | 6.95    | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2853MHX-1.5/NOPB | HTSSOP       | PWP             | 14   | 2500 | 330.0              | 12.4               | 6.95    | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2853MHX-1.8/NOPB | HTSSOP       | PWP             | 14   | 2500 | 330.0              | 12.4               | 6.95    | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2853MHX-2.5/NOPB | HTSSOP       | PWP             | 14   | 2500 | 330.0              | 12.4               | 6.95    | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| LM2853MHX-3.3/NOPB | HTSSOP       | PWP             | 14   | 2500 | 330.0              | 12.4               | 6.95    | 5.6     | 1.6     | 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) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM2853MHX-1.0/NOPB | HTSSOP       | PWP             | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LM2853MHX-1.2/NOPB | HTSSOP       | PWP             | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LM2853MHX-1.5/NOPB | HTSSOP       | PWP             | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LM2853MHX-1.8/NOPB | HTSSOP       | PWP             | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LM2853MHX-2.5/NOPB | HTSSOP       | PWP             | 14   | 2500 | 367.0       | 367.0      | 35.0        |
| LM2853MHX-3.3/NOPB | HTSSOP       | PWP             | 14   | 2500 | 367.0       | 367.0      | 35.0        |



## 重要声明和免责声明

TI 均以“原样”提供技术性 & 可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证其中不含任何瑕疵，且不做任何明示或暗示的担保，包括但不限于对适销性、适合某特定用途或不侵犯任何第三方知识产权的暗示担保。

所述资源可供专业开发人员应用 TI 产品进行设计使用。您将对以下行为独自承担全部责任：(1) 针对您的应用选择合适的 TI 产品；(2) 设计、验证并测试您的应用；(3) 确保您的应用满足相应标准以及任何其他安全、安保或其他要求。所述资源如有变更，恕不另行通知。TI 对您使用所述资源的授权仅限于开发资源所涉及 TI 产品的相关应用。除此之外不得复制或展示所述资源，也不提供其它 TI 或任何第三方的知识产权授权许可。如因使用所述资源而产生任何索赔、赔偿、成本、损失及债务等，TI 对此概不负责，并且您须赔偿由此对 TI 及其代表造成的损害。

TI 所提供产品均受 TI 的销售条款 (<http://www.ti.com.cn/zh-cn/legal/termsofsale.html>) 以及 [ti.com.cn](http://www.ti.com.cn) 上或随附 TI 产品提供的其他可适用条款的约束。TI 提供所述资源并不扩展或以其他方式更改 TI 针对 TI 产品所发布的可适用的担保范围或担保免责声明。

邮寄地址：上海市浦东新区世纪大道 1568 号中建大厦 32 楼，邮政编码：200122  
Copyright © 2020 德州仪器半导体技术（上海）有限公司