

## DESCRIPTION

The MP8903 is a 150mA low-dropout linear regulator that can operate from 2.7V to 6.5V input. It regulates the output with 2% accuracy and comes with preset 2.5V, 2.85V or 3.3V output. An external resistor divider may be used to adjust the output voltage from 1.25V to 5V.

The MP8903 has thermal protection to guard against harsh operating conditions, and is available in small QFN8 (2x2mm) and 5-pin TSOT23 packages.

## FEATURES

- 2.7V to 6.5V Input Voltage Range
- Fixed Output Voltage Options of 2.5V, 2.85V or 3.3V
- Adjustable Output Voltage from 1.25V to 5V using an External Resistor Divider
- Low 100mV Dropout at 100mA Output
- 2% Accurate Output Voltage
- Stable With Low-ESR Output Capacitors
- Thermal Protection
- Available in Tiny QFN8 (2x2mm) and TSOT23-5 Packages

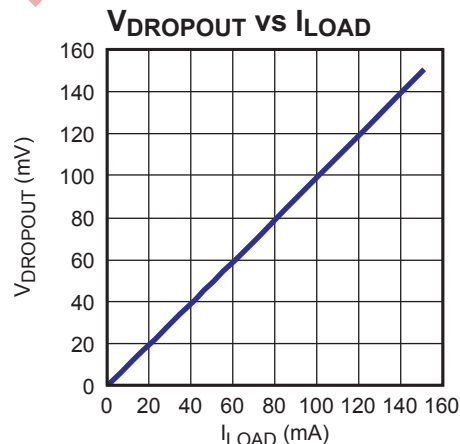
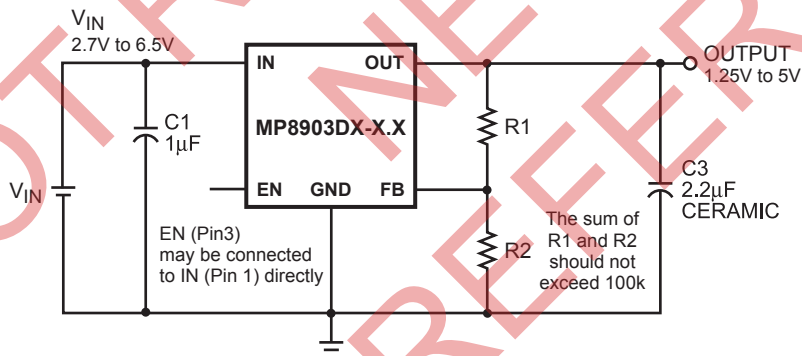
## APPLICATIONS

- 802.11 PC Cards
- Mobile Handset PLL Power
- Audio Codec Power

All MPS parts are lead-free and adhere to the RoHS directive. For MPS green status, please visit MPS website under Products, Quality Assurance page.

"MPS" and "The Future of Analog IC Technology" are registered trademarks of Monolithic Power Systems, Inc.

## TYPICAL APPLICATION



## ORDERING INFORMATION

| Part Number   | Package      | Top Marking | Free Air Temperature (T <sub>A</sub> ) |
|---------------|--------------|-------------|----------------------------------------|
| MP8903DG-2.5* | QFN8 (2x2mm) | R4          | -40°C to +85°C                         |
| MP8903DG-2.85 |              | R5          |                                        |
| MP8903DG-3.3  |              | R6          |                                        |
| MP8903DJ-2.5  | TSOT23-5     | R4          |                                        |
| MP8903DJ-2.85 |              | R5          |                                        |
| MP8903DJ-3.3  |              | R6          |                                        |

\* For Tape & Reel, add suffix -Z (e.g. MP8903DG-2.85-Z);  
For RoHS Compliant Packaging, add suffix -LF (e.g. MP8903DG-2.85-LF-Z)

## PACKAGE REFERENCE

|                                                   |                                               |
|---------------------------------------------------|-----------------------------------------------|
| <p><b>TOP VIEW</b></p> <p><b>QFN8 (2x2mm)</b></p> | <p><b>TOP VIEW</b></p> <p><b>TSOT23-5</b></p> |
|---------------------------------------------------|-----------------------------------------------|

### ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>

|                                                                      |                                  |
|----------------------------------------------------------------------|----------------------------------|
| IN Supply Voltage                                                    | -0.3V to +7.0V                   |
| FB Voltage                                                           | -0.3V to V <sub>OUT</sub> + 0.3V |
| All Other Pins                                                       | -0.3V to +6V                     |
| Continuous Power Dissipation (T <sub>A</sub> = +25°C) <sup>(2)</sup> |                                  |
| TSOT23-5                                                             | 0.57W                            |
| QFN8 (2x2mm)                                                         | 1.6W                             |
| Junction Temperature                                                 | 150°C                            |
| Lead Temperature                                                     | 260°C                            |
| Storage Temperature                                                  | -65°C to +150°C                  |

### Recommended Operating Conditions <sup>(3)</sup>

|                                          |                |
|------------------------------------------|----------------|
| Input Voltage                            | 2.7V to 6.5V   |
| Output Voltage                           | 1.25V to 5V    |
| Load Current                             | 150mA Maximum  |
| Operating Temperature                    | -40°C to +85°C |
| Maximum Junction Temp. (T <sub>J</sub> ) | +125°C         |

| Thermal Resistance <sup>(4)</sup> | θ <sub>JA</sub> | θ <sub>JC</sub> |
|-----------------------------------|-----------------|-----------------|
| TSOT23-5                          | 220             | 110             |
| QFN8 (2x2mm)                      | 80              | 16              |

#### Notes:

- Exceeding these ratings may damage the device.
- The maximum allowable power dissipation is a function of the maximum junction temperature T<sub>J</sub>(MAX), the junction-to-ambient thermal resistance θ<sub>JA</sub>, and the ambient temperature T<sub>A</sub>. The maximum allowable continuous power dissipation at any ambient temperature is calculated by P<sub>D</sub>(MAX)=(T<sub>J</sub>(MAX)-T<sub>A</sub>)/ θ<sub>JA</sub>. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
- The device is not guaranteed to function outside of its operating conditions.
- Measured on JESD51-7 4-layer board.

**ELECTRICAL CHARACTERISTICS** **$V_{IN} = 5V$ ,  $T_A = +25^{\circ}C$ , unless otherwise noted.**

| Parameter                                    | Symbol | Condition                                                                                         | Min   | Typ       | Max       | Units       |
|----------------------------------------------|--------|---------------------------------------------------------------------------------------------------|-------|-----------|-----------|-------------|
| Operating Voltage                            |        | $I_{OUT} = 1mA$                                                                                   | 2.7   |           | 6.5       | V           |
| Output Voltage Accuracy                      |        | $I_{OUT} = 1mA$ , $V_{OUT} = 1.5V$ to $5V$                                                        |       | $\pm 1.0$ | $\pm 2.0$ | %           |
| Shutdown Current                             |        | $V_{EN} = 0V$ , $V_{IN} = 5V$                                                                     |       | 0.1       | 1         | $\mu A$     |
| FB Regulation Voltage                        |        |                                                                                                   | 1.197 | 1.222     | 1.246     | V           |
|                                              |        | $-40^{\circ}C \leq T_A \leq +85^{\circ}C$                                                         | 1.194 | 1.222     | 1.249     |             |
| Dropout Voltage <sup>(6)</sup>               |        | $I_{OUT} = 150mA$ , $V_{OUT} = 3V$                                                                |       | 150       |           | mV          |
|                                              |        | $V_{OUT} = 4V$                                                                                    |       | 125       |           |             |
| Line Regulation                              |        | $I_{OUT} = 1mA$ ,<br>$V_{IN} = (V_{OUT} + 0.5V)$ to $6.5V$ <sup>(7)</sup>                         |       | 0.005     | 0.08      | %/V         |
| Load Regulation                              |        | $I_{OUT} = 1mA$ to $150mA$ ,<br>$V_{IN} = V_{OUT} + 0.5V$ <sup>(7)</sup>                          |       | 0.001     | 0.02      | %/mA        |
| PSRR                                         |        | $V_{IN} > V_{OUT} + 0.5V$ , $C3 = 2.2\mu F$ ,<br>$V_{IN(AC)} = 100mV$ , $f = 1kHz$ <sup>(5)</sup> |       | 50        |           | dB          |
|                                              |        | $V_{IN} > V_{OUT} + 0.5V$ , $C3 = 2.2\mu F$ ,<br>$V_{IN(AC)} = 100mV$ , $f = 1MHz$ <sup>(5)</sup> |       | 20        |           | dB          |
| EN Input High Voltage                        |        |                                                                                                   | 1.5   |           |           | V           |
| EN Input Low Voltage                         |        |                                                                                                   |       |           | 0.4       | V           |
| EN Input Bias Current                        |        | $V_{EN} = 0V$                                                                                     |       | 0.01      | 1         | $\mu A$     |
| Thermal Protection <sup>(5)</sup>            |        |                                                                                                   |       | 155       |           | $^{\circ}C$ |
| Thermal Protection Hysteresis <sup>(5)</sup> |        |                                                                                                   |       | 30        |           | $^{\circ}C$ |

**Notes:**

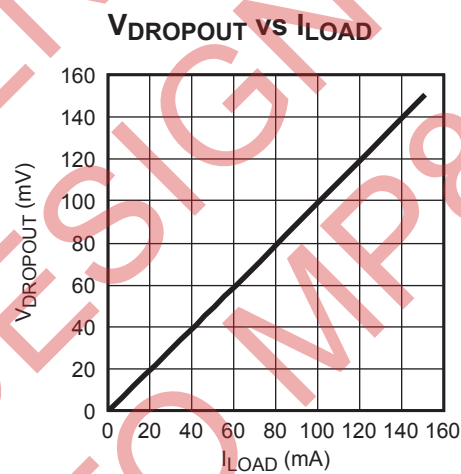
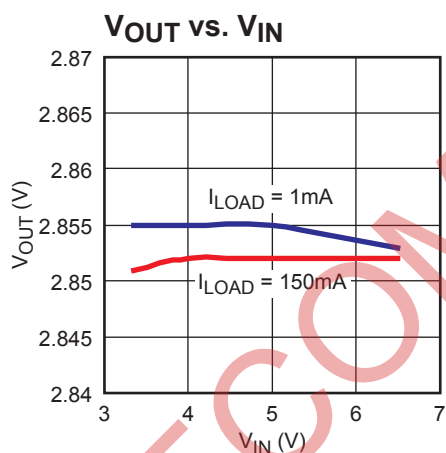
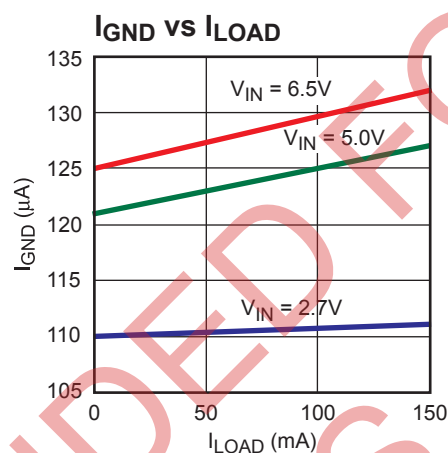
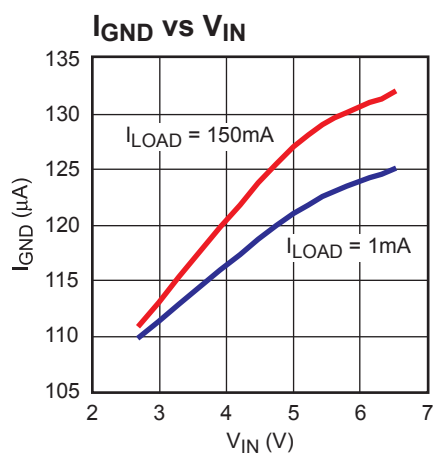
5) Parameter is guaranteed by design, not production tested.

6) Dropout Voltage is defined as the input to output differential when the output voltage drops 1% below its normal value.

7)  $V_{IN} = 2.7V$  for  $V_{OUT} = 1.25V$  to  $2.2V$

## TYPICAL PERFORMANCE CHARACTERISTICS

$V_{IN} = 4.5V$ ,  $V_{OUT} = 2.85V$ ,  $C1 = 1\mu F$ ,  $C2 = 0.1\mu F$ ,  $C3 = 2.2\mu F$ ,  $T_A = +25^\circ C$  unless otherwise noted.



## PIN FUNCTIONS

| QFN8<br>(2x2mm)<br>Pin # | TSOT23-5<br>Pin # | Name | Description                                                                                                                                                  |
|--------------------------|-------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                        | 2                 | GND  | Ground.                                                                                                                                                      |
| 2                        | 3                 | EN   | Enable Input. Drive EN high to turn on the MP8903; low to turn it off. For automatic startup, connect EN to IN.                                              |
| 3, 4                     | 1                 | IN   | Power Source Input. IN supplies the internal power to the MP8903 and is the source of the pass transistor. Bypass IN to GND with a 1μF or greater capacitor. |
| 5, 6                     | 5                 | OUT  | Regulator Output. OUT is the output of the linear regulator. Bypass OUT to GND with a 1μF or greater capacitor.                                              |
| 7                        |                   | NC   | No Connect.                                                                                                                                                  |
| 8                        | 4                 | FB   | Feedback Input. Connect a resistive voltage divider from OUT to FB to set the output voltage. The OUT feedback threshold is 1.222V.                          |

## OPERATION

The MP8903 is a low-current, low-dropout linear regulator. The MP8903 uses a PMOS pass element and features internal thermal shutdown. The normally fixed output MP8903

may be converted to an adjustable output device by applying a resistor divider network as shown in Figure 2. An optional feed-forward capacitor,  $C_{BYP}$ , may be added for an improved transient response.

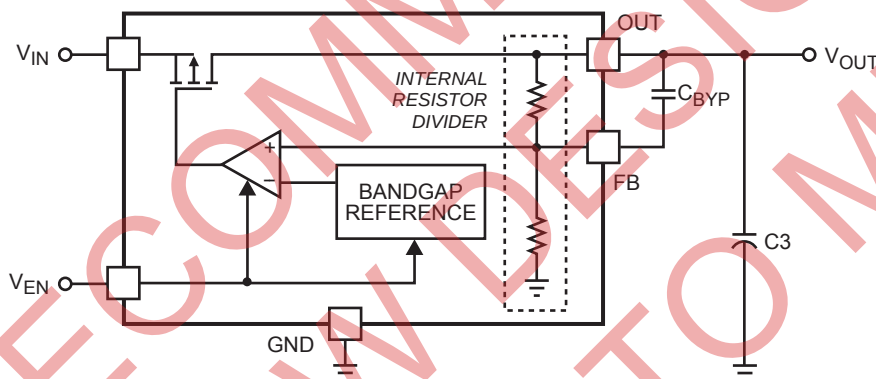


Figure 1—Fixed Output Regulator

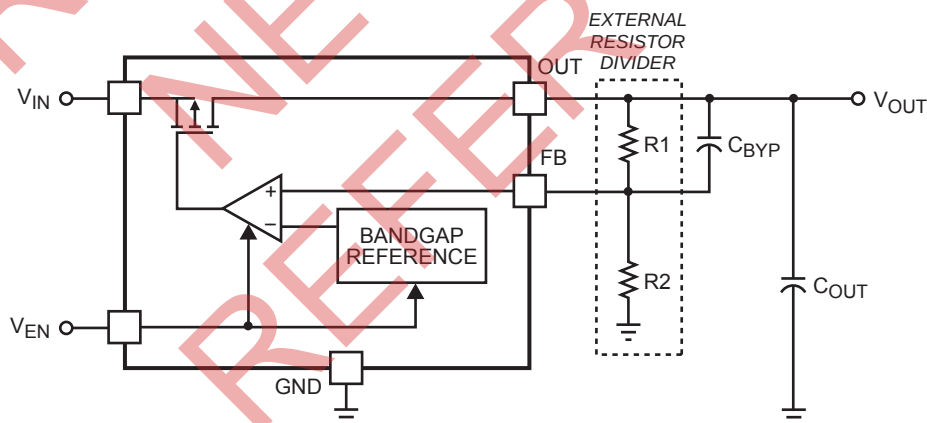


Figure 2—Adjustable Regulator:  $V_{OUT} = V_{FB} (1 + (R1/R2))$

## APPLICATION INFORMATION

### Setting the Output Voltage

The fixed output voltage of the MP8903 is set to 2.5V, 2.85V or 3.3V, depending on the internal resistor divider (Figure 1). You can also adjust the output voltage by using an external resistor divider (R1 and R2 in Figure 2). However, the sum of R1 and R2 should not exceed 100kΩ in order to minimize the impact of the internal resistor divider. For an accurate output-voltage setting, use 10kΩ (±1%) for the low-side resistor R2 of the voltage divider, while the high-side resistor R1 can be determined by the equation:

$$R1 = R2 \times \left( \frac{V_{OUT} - V_{FB}}{V_{FB}} \right)$$

Where  $V_{FB}$  is the OUT feedback threshold voltage equal to 1.222V.

Example: For 2.5V Output

$$R1 = \frac{2.5V - 1.222V}{\left( \frac{1.222V}{10k\Omega} \right)} = 10.41k\Omega$$

You can select a standard 10.5kΩ (±1%) resistor for R1.

The following table lists the selected R1 values for some typical output voltages:

**Table 1—Adjustable Output Voltage R1 Values**

| V <sub>OUT</sub> (V) | R1 (Ω) | R2 (Ω) |
|----------------------|--------|--------|
| 1.25                 | 232    | 10k    |
| 1.5                  | 2.26k  |        |
| 1.8                  | 4.75k  |        |
| 2                    | 6.34k  |        |
| 2.5                  | 10.5k  |        |
| 2.8                  | 13k    |        |
| 3                    | 14.7k  |        |
| 3.3                  | 16.9k  |        |
| 4                    | 22.6k  |        |
| 5                    | 30.9k  |        |

In Figures 3 and 4, C2 is added for an improved transient response.

### Input Capacitor Selection

For proper operation, place a ceramic capacitor (C1) between 1μF and 10μF of dielectric type X5R or X7R between the input pin and ground. Larger values in this range will help improve line transient response at the drawback of increased size.

### Output Capacitor Selection

For stable operation, use a ceramic capacitor (C3) of type X5R or X7R between 1μF and 10μF. Larger values in this range will help improve load transient response and reduce noise with the drawback of increased size. Output capacitors of other dielectric types may be used, but are not recommended as their capacitance can deviate greatly from their rated value over temperature.

To improve load transient response, add a small ceramic (X5R, X7R or Y5V dielectric) 100nF feed forward capacitor in parallel with R1. The feed forward capacitor is not required for stable operation.

## TYPICAL APPLICATION CIRCUIT

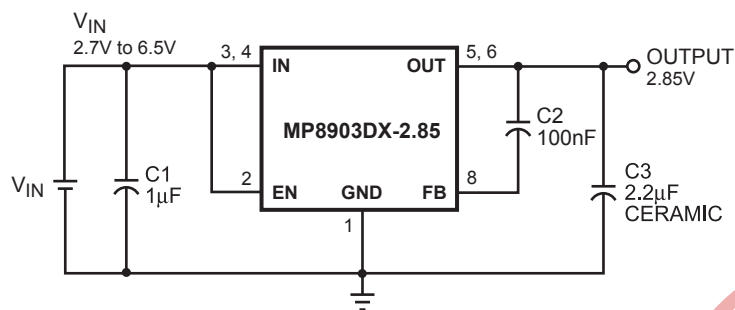


Figure 3—Typical Application Circuit (Fixed)

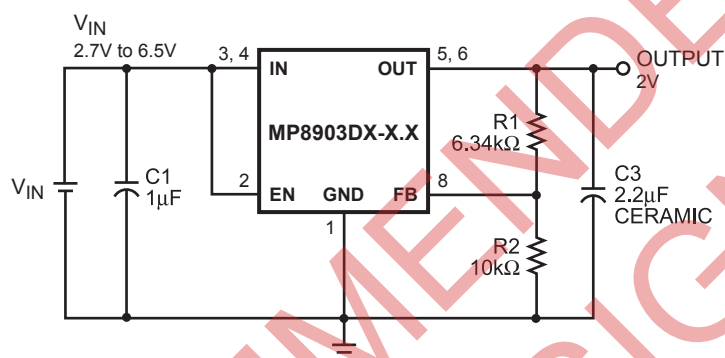


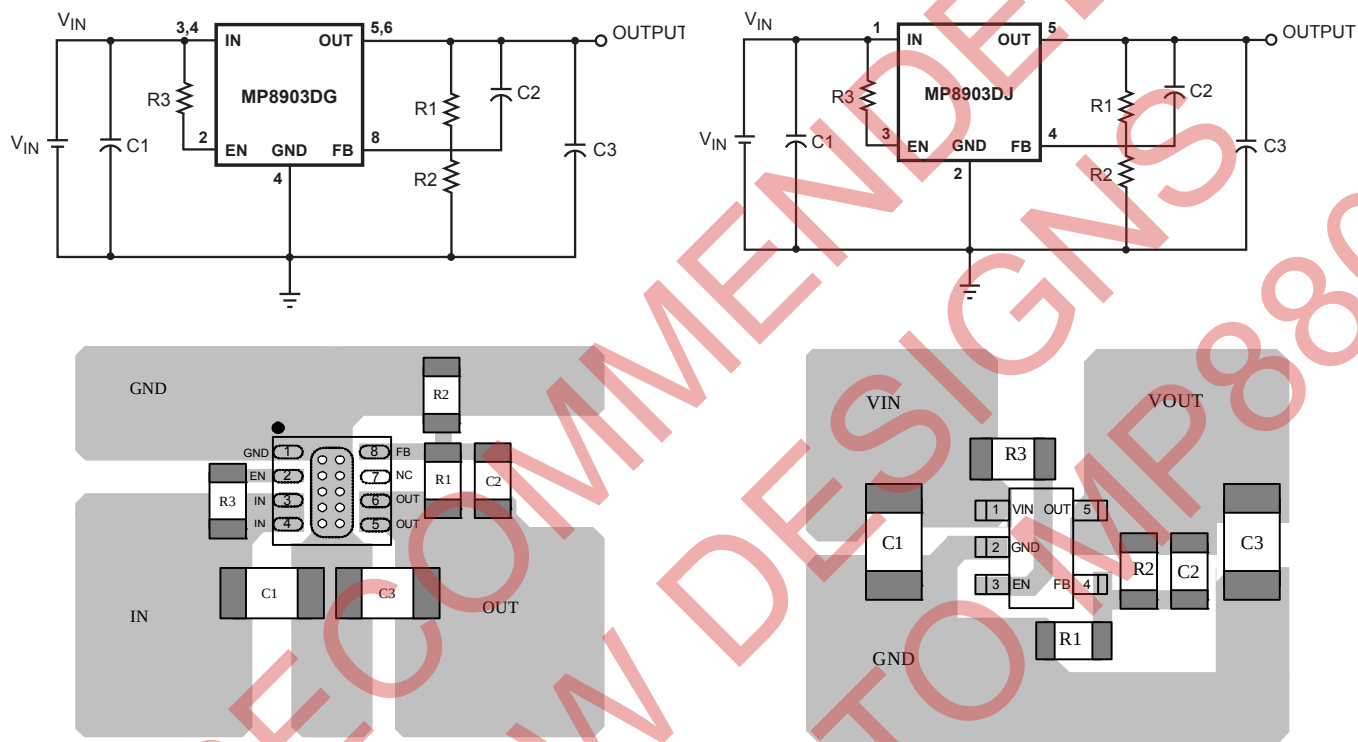
Figure 4—Typical Application Circuit (Adjustable)

## PCB LAYOUT GUIDE

PCB layout is very important to achieve good regulation, ripple rejection, transient response and thermal performance. It is highly recommended to duplicate EVB layout for optimum performance.

If change is necessary, please follow these guidelines and take figure 5 for reference.

- 1) Input and output bypass ceramic capacitors are suggested to be put close to the IN Pin and OUT Pin respectively.
- 2) Ensure all feedback connections are short and direct. Place the feedback resistors and compensation components as close to the chip as possible.
- 3) Connect IN, OUT and especially GND respectively to a large copper area to cool the chip to improve thermal performance and long-term reliability.

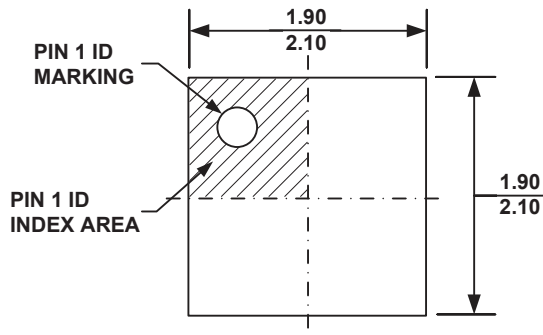


Top Layer

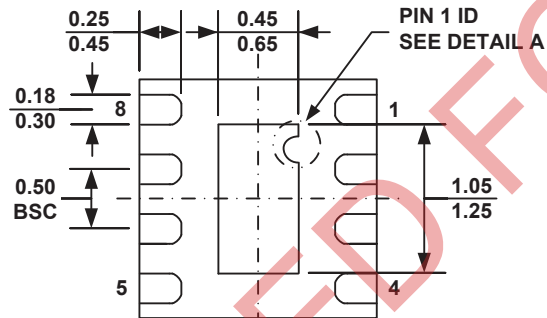
Figure 5—PCB Layout

## PACKAGE INFORMATION

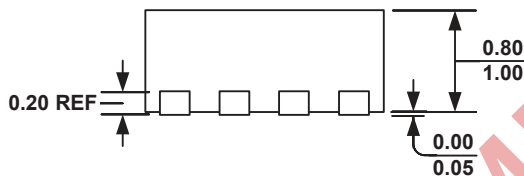
### QFN8 (2x2mm)



**TOP VIEW**



**BOTTOM VIEW**



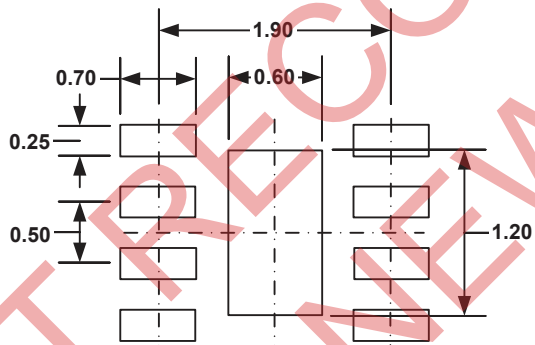
**SIDE VIEW**

PIN 1 ID OPTION A  
R0.20 TYP.

PIN 1 ID OPTION B  
R0.20 TYP.



**DETAIL A**

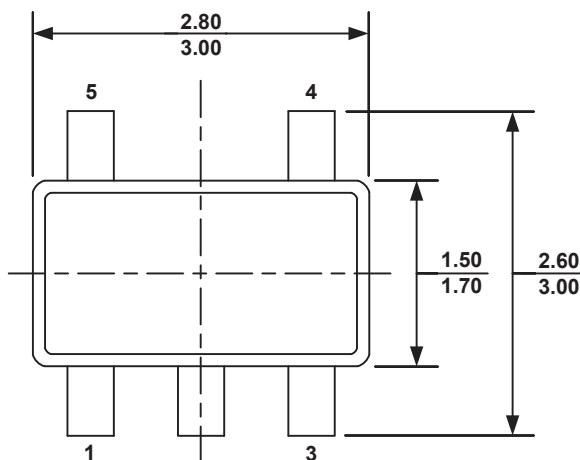


**RECOMMENDED LAND PATTERN**

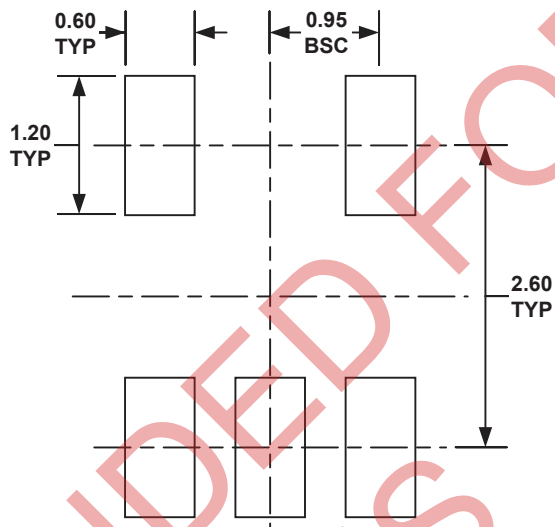
#### NOTE:

- 1) ALL DIMENSIONS ARE IN MILLIMETERS.
- 2) EXPOSED PADDLE SIZE DOES NOT INCLUDE MOLD FLASH.
- 3) LEAD COPLANARITY SHALL BE 0.10 MILLIMETER MAX.
- 4) DRAWING CONFORMS TO JEDEC MO-229, VARIATION VCCD-3.
- 5) DRAWING IS NOT TO SCALE.

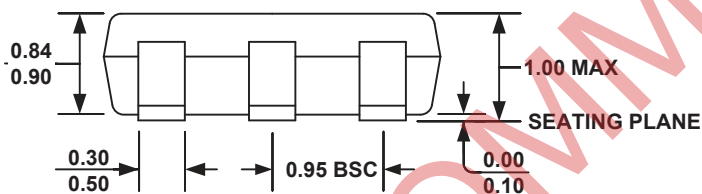
**TSOT23-5**



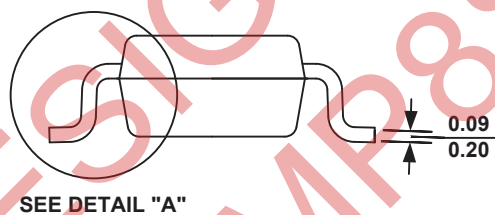
**TOP VIEW**



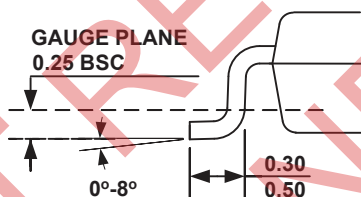
**RECOMMENDED LAND PATTERN**



**FRONT VIEW**



**SIDE VIEW**



**DETAIL A**

**NOTE:**

- 1) ALL DIMENSIONS ARE IN MILLIMETERS.
- 2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR.
- 3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
- 4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.10 MILLIMETERS MAX.
- 5) DRAWING CONFORMS TO JEDEC MO-193, VARIATION AA.
- 6) DRAWING IS NOT TO SCALE.

**NOTICE:** The information in this document is subject to change without notice. Users should warrant and guarantee that third party Intellectual Property rights are not infringed upon when integrating MPS products into any application. MPS will not assume any legal responsibility for any said applications.



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.