

### POWER MANAGEMENT

#### Description

The SC1563 is a high performance positive voltage regulator designed for use in applications requiring very low dropout voltage at up to 500mA. Since it has superior dropout characteristics compared to regular LDOs, it can be used to supply 2.5V on motherboards or 2.8V on peripheral cards from the 3.3V supply with no heatsink. Additionally, the SC1563 has a shutdown pin to further reduce power dissipation while shut down. The SC1563 provides excellent regulation over variations in line, load and temperature.

A wide range of fixed output voltage options are available. In addition, the output voltage of every device can be adjusted between 1.2V and 4.8V using external resistors. The SC1563 comes in both 5-pin SOT-23 and 8-pin MSOP packages to allow the user to select a package suitable for their spacing and heat dissipation needs.

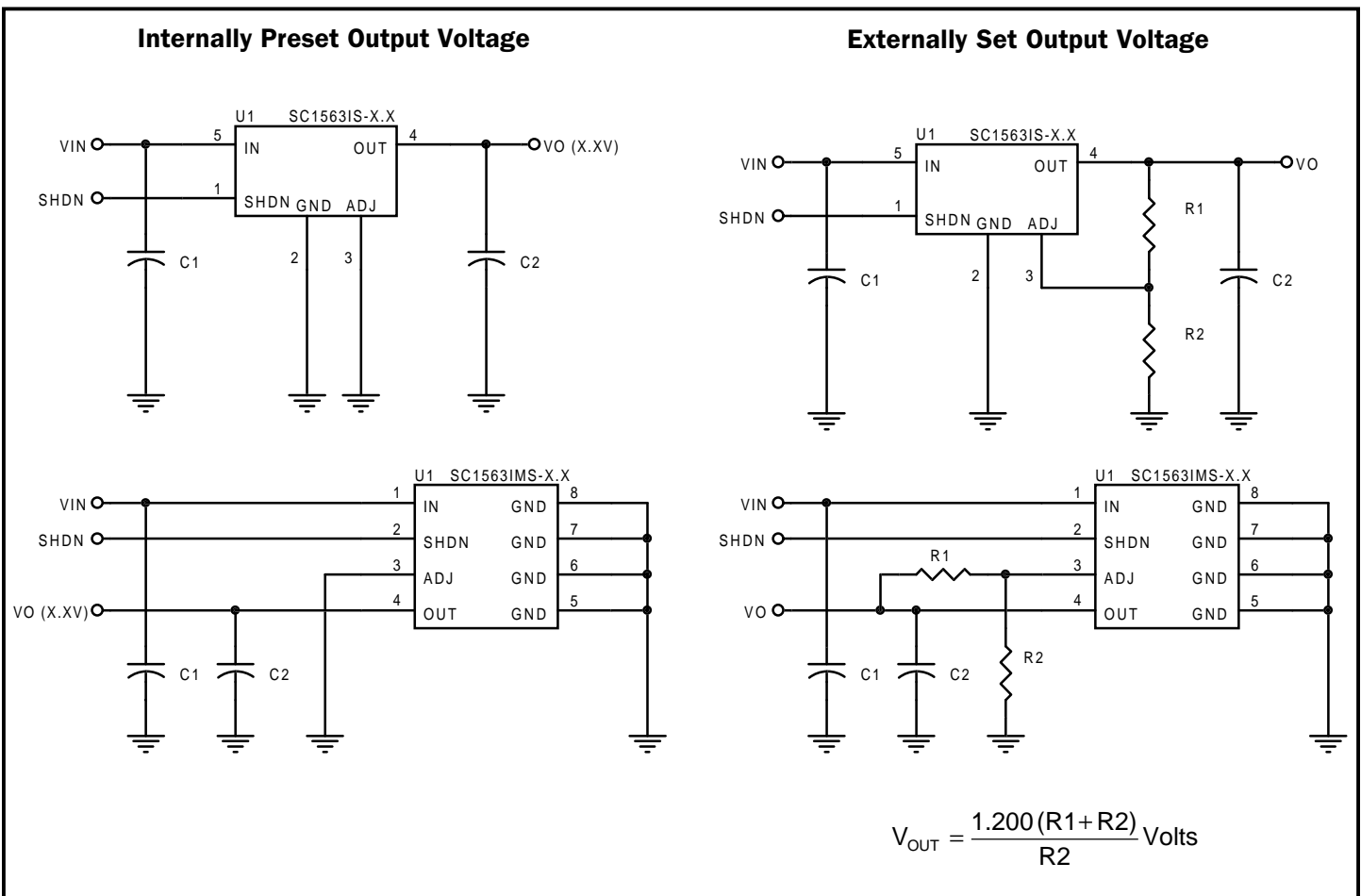
#### Features

- ◆ 350mV dropout @ 500mA
- ◆ Designed to operate with ceramic capacitors
- ◆ Adjustable output from 1.2V to 4.8V
- ◆ Multiple output voltage options (all parts also adjustable externally using resistors)
- ◆ Over current and over temperature protection
- ◆ 2µA quiescent current in shutdown
- ◆ No minimum load current requirement
- ◆ Low reverse leakage (output to input)
- ◆ Full industrial temperature range
- ◆ SOT-23-5 and MSOP-8 surface mount packages

#### Applications

- ◆ Personal Digital Assistants
- ◆ Battery powered systems
- ◆ Motherboards
- ◆ Peripheral cards
- ◆ PCMCIA cards

#### Typical Application Circuits



**POWER MANAGEMENT**
**Absolute Maximum Ratings**

Parameter	Symbol	Maximum	Units
Input Voltage	$V_{IN}$	-0.3 to 7	V
Shutdown Voltage	$V_{SHDN}$	-0.3 to $V_{IN}$	V
Power Dissipation	$P_D$	Internally Limited	W
Thermal Resistance Junction to Ambient MSOP-8 <sup>(1)</sup> MSOP-8 <sup>(2)</sup> SOT-23-5 <sup>(1)</sup>	$\theta_{JA}$	206 95 256	°C/W
Thermal Resistance Junction to Case MSOP-8 SOT-23-5	$\theta_{JC}$	39 81	°C/W
Operating Ambient Temperature Range	$T_A$	-40 to 85	°C
Operating Junction Temperature Range	$T_J$	-40 to 150	°C
Storage Temperature Range	$T_{STG}$	-65 to 150	°C
Lead Temperature (Soldering) 10 sec	$T_{LEAD}$	300	°C
ESD Rating	$V_{ESD}$	2	kV

**Notes:**

- (1) Minimum pad size.
- (2) 1 square inch of FR-4, double sided, 1oz. minimum copper weight.

**Electrical Characteristics**

Unless specified:  $V_{SHDN} = 0V$ , Adjustable mode ( $V_{ADJ} > V_{TH(ADJ)}$ ):  $V_{IN} = 2.2V$  to  $5.5V$  and  $I_{OUT} = 0A$  to  $500mA$ ,  
Fixed mode ( $V_{ADJ} = GND$ ):  $V_{IN} = (V_{OUT} + 0.7V)$  to  $5.5V$  and  $I_{OUT} = 0A$  to  $500mA$ . Values in **bold** apply over full operating temperature range.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
<b>IN</b>						
Supply Voltage Range	$V_{IN}$		<b>2.2</b>		<b>6.5</b>	V
Quiescent Current	$I_Q$	$V_{IN} = 3.3V$		85	<b>150</b>	$\mu A$
		$V_{IN} = 6.5V, V_{SHDN} = \text{Open}$		0.01	<b>2.00</b>	$\mu A$
<b>OUT</b>						
Output Voltage <sup>(1)</sup> (Internal Fixed Voltage)	$V_{OUT}$	$V_{IN} = V_{OUT} + 0.7V, I_{OUT} = 10mA$	-1%	$V_{OUT}$	+1%	V
			<b>-2%</b>		<b>+2%</b>	
Line Regulation <sup>(1)</sup>	$REG_{(LINE)}$	$V_{IN} = (V_{OUT} + 0.25V)$ to $5.5V, I_{OUT} = 10mA$		0.1	<b>0.4</b>	%
Load Regulation <sup>(1)</sup>	$REG_{(LOAD)}$	$V_{IN} = V_{OUT} + 0.7V$		0.15	<b>0.40</b>	%

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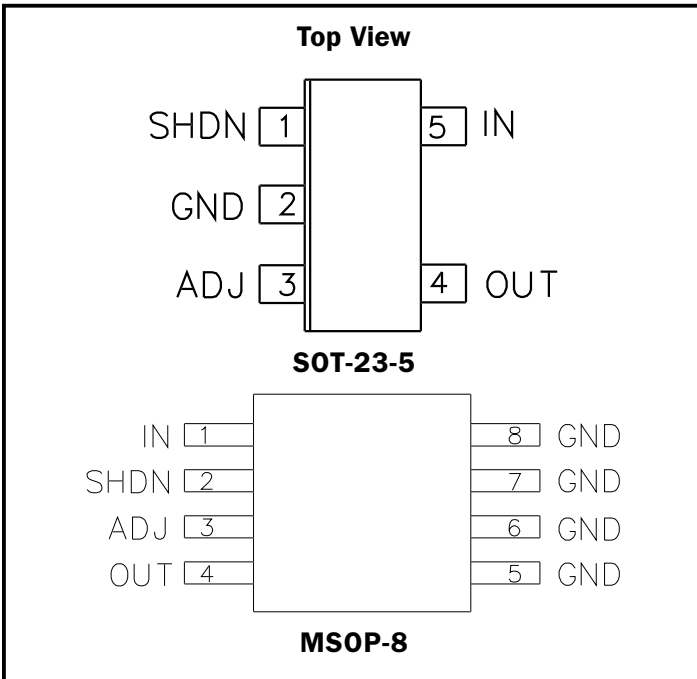
Parameter	Symbol	Conditions	Min	Typ	Max	Units
<b>OUT (Cont.)</b>						
Dropout Voltage <sup>(1)(2)</sup>	$V_D$	$I_{OUT} = 2mA$		1	5	mV
					<b>10</b>	
		$I_{OUT} = 100mA$		70	100	mV
					<b>150</b>	
		$I_{OUT} = 250mA$		175	250	mV
					<b>350</b>	
		$I_{OUT} = 500mA$		350	500	mV
					<b>700</b>	
Current Limit	$I_{LIM}$		<b>0.5</b>		<b>1.0</b>	A
<b>ADJ</b>						
Reference Voltage <sup>(1)</sup>	$V_{REF}$	$V_{IN} = 2.2V, V_{ADJ} = V_{OUT}, I_{OUT} = 10mA$	1.188	1.200	1.212	V
			<b>1.176</b>		<b>1.224</b>	
Adjust Pin Current <sup>(3)</sup>	$I_{ADJ}$	$V_{ADJ} = V_{REF}$		65	<b>150</b>	nA
Adjust Pin Threshold <sup>(4)</sup>	$V_{TH(ADJ)}$		<b>0.10</b>	0.25	<b>0.40</b>	V
<b>SHDN</b>						
Shutdown Pin Current	$I_{SHDN}$	$V_{SHDN} = 0V, V_{IN} = 3.3V$		1.5	<b>5.0</b>	$\mu A$
Shutdown Pin Threshold	$V_{IH}$	$V_{IN} = 3.3V$	<b>1.8</b>			V
	$V_{IL}$	$V_{IN} = 3.3V$			<b>0.4</b>	
<b>Over Temperature Protection</b>						
High Trip Level	$T_{HI}$			170		$^{\circ}C$
Hysteresis	$T_{HYST}$			10		$^{\circ}C$

**Notes:**

- (1) Low duty cycle pulse testing with Kelvin connections required.
- (2) Defined as the input to output differential at which the output voltage drops to 1% below the value measured at a differential of 0.7V for  $2.5V \leq V_{OUT} \leq 3.4V$ . Not measurable on outputs less than 2.2V due to minimum  $V_{IN}$  constraints. See typical characteristics curves.
- (3) Guaranteed by design.
- (4) When  $V_{ADJ}$  exceeds this threshold, the "Sense Select" switch disconnects the internal feedback chain from the error amplifier and connects  $V_{ADJ}$  instead.

**POWER MANAGEMENT**

**Pin Configurations**



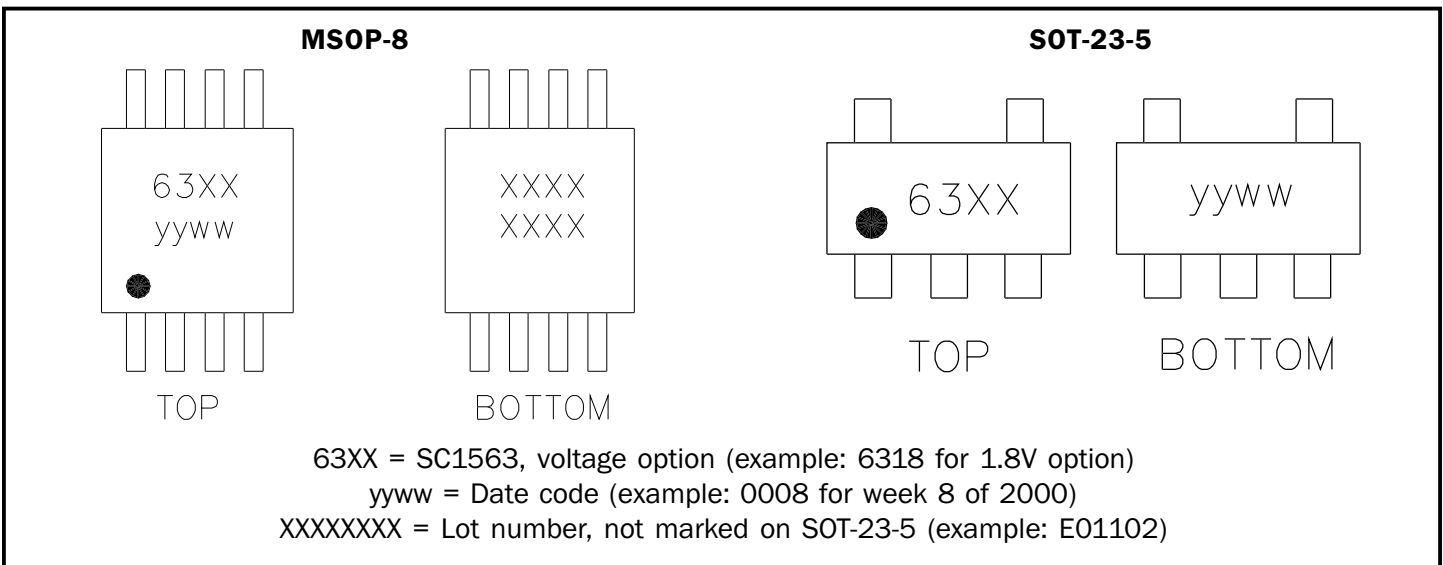
**Ordering Information**

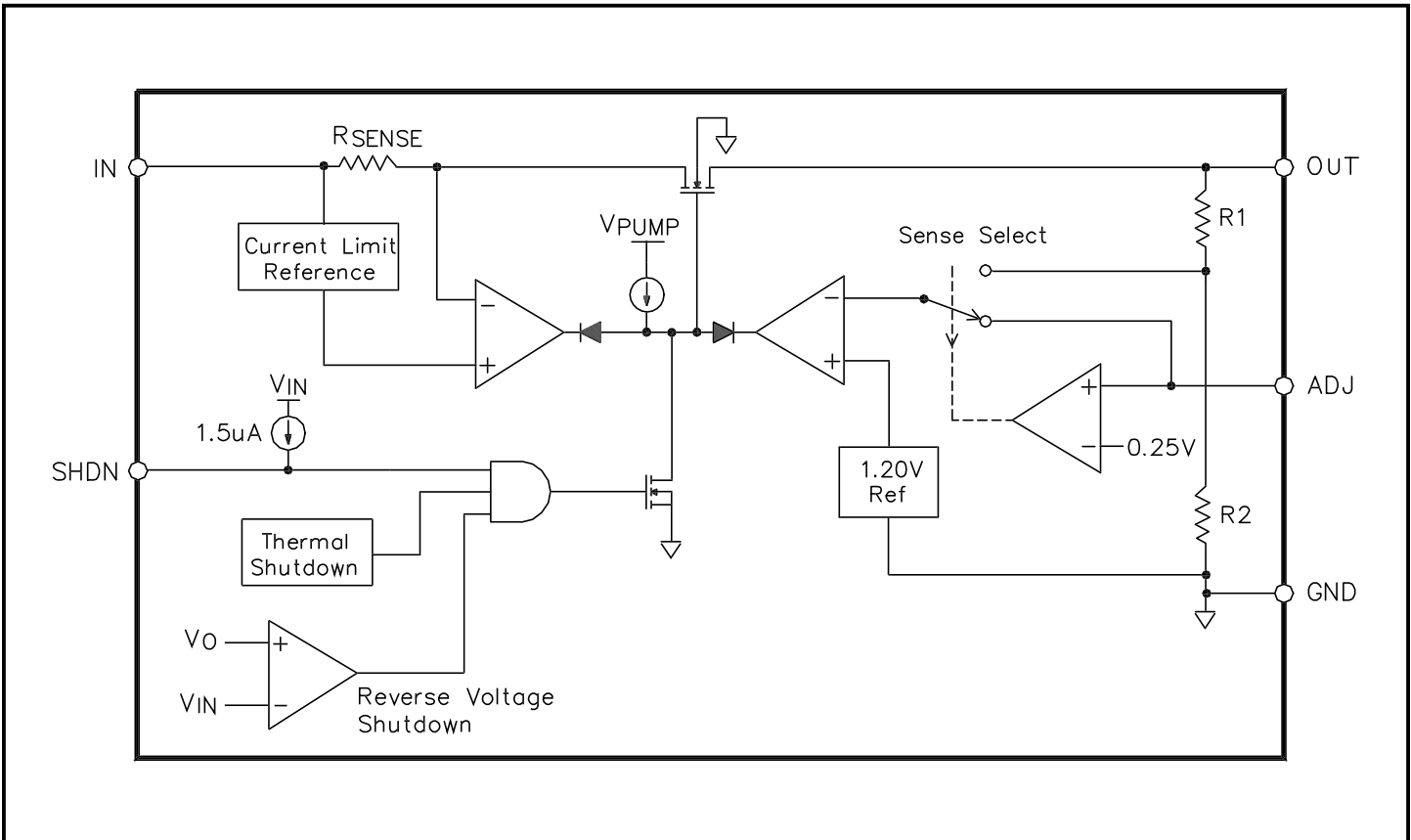
Part Number <sup>(1)(2)(3)</sup>	Package
SC1563IMS-X.XTR	MSOP-8
SC1563ISK-X.XTR	SOT-23-5

**Note:**

- (1) Where -X.X denotes voltage options. Available voltages are: 1.8V, 2.5V, 2.8V, 3.0V, 3.1V, 3.3V and 3.4V.
- (2) Output voltage can be adjusted using external resistors, see Pin Descriptions.
- (3) Only available in tape and reel packaging. A reel contains 2500 devices (MSOP-8) or 3000 devices (SOT-23-5).

**Marking Information**



**POWER MANAGEMENT**
**Block Diagram**

**Pin Descriptions**

Pin Name	Pin Number		Pin Function
	MSOP-8	SOT-23-5	
ADJ	3	3	This pin, when grounded, sets the output voltage to that set by the internal feedback resistors. If external feedback resistors are used, the output voltage will be (See Application Circuit on page 1): $V_{OUT} = \frac{1.200(R1+R2)}{R2} \text{ Volts}$
GND	5-8	2	Reference ground. Connect all MSOP-8 pins. These pins may be used for heatsinking purposes.
IN	1	5	Input voltage. For regulation at full load, the input to this pin must be between ( $V_{OUT} + 0.7V$ ) and 6.5V. Minimum $V_{IN} = 2.2V$ .
OUT	4	4	This pin is the power output of this device, sourcing up to 500mA.
SHDN	2	1	Shutdown Input. Leaving this pin open turns the regulator off, reducing the quiescent current to a fraction of its operating value (typically < 300nA). The device will be enabled if this pin is pulled below 0.4V. Connect to GND if not being used.

**POWER MANAGEMENT**
**Applications Information**
**Introduction**

The SC1563 is intended for applications such as graphics cards where high current capability and very low dropout voltage are required. It provides a very simple, low cost solution that uses little pcb real estate. Additional features include a shutdown pin to allow for a very low power consumption standby mode, and a fully adjustable output.

**Component Selection**

**Input capacitor** - a 1 $\mu$ F ceramic capacitor is recommended. This allows for the device being some distance from any bulk capacitance on the rail. Additionally, input droop due to load transients is reduced, improving load transient response. Additional capacitance may be added if required by the application.

**Output capacitor** - a minimum bulk capacitance of 1 $\mu$ F, along with a 0.1 $\mu$ F ceramic decoupling capacitor is recommended. Increasing the bulk capacitance will improve the overall transient response. The use of multiple lower value ceramic capacitors in parallel to achieve the desired bulk capacitance will not cause stability issues. Although designed for use with ceramic output capacitors, the SC1563 is extremely tolerant of output capacitor ESR values and thus will also work comfortably with tantalum output capacitors.

**External voltage selection resistors** - the use of 1% resistors, and designing for a current flow  $\geq 10\mu$ A is recommended to ensure a well regulated output (thus  $R2 \leq 120k\Omega$ ).

**Thermal Considerations**

The power dissipation in the SC1563 is approximately equal to the product of the output current and the input to output voltage differential:

$$P_D \approx (V_{IN} - V_{OUT}) \cdot I_{OUT}$$

The absolute worst-case dissipation is given by:

$$P_{D(MAX)} = (V_{IN(MAX)} - V_{OUT(MIN)}) \cdot I_{OUT(MAX)} + V_{IN(MAX)} \cdot I_{Q(MAX)}$$

For a typical scenario,  $V_{IN} = 3.3V \pm 5\%$ ,  $V_{OUT} = 2.5V$  and  $I_{OUT} = 500mA$ , therefore:

$$\begin{aligned} V_{IN(MAX)} &= 3.465V, \\ V_{OUT(MIN)} &= 2.450V \text{ and} \\ I_{Q(MAX)} &= 150\mu A, \end{aligned}$$

$$\text{Thus } P_{D(MAX)} = 0.508W.$$

Using this figure, and assuming  $T_{A(MAX)} = 70^\circ C$ , we can calculate the maximum thermal impedance allowable to maintain  $T_J \leq 150^\circ C$ :

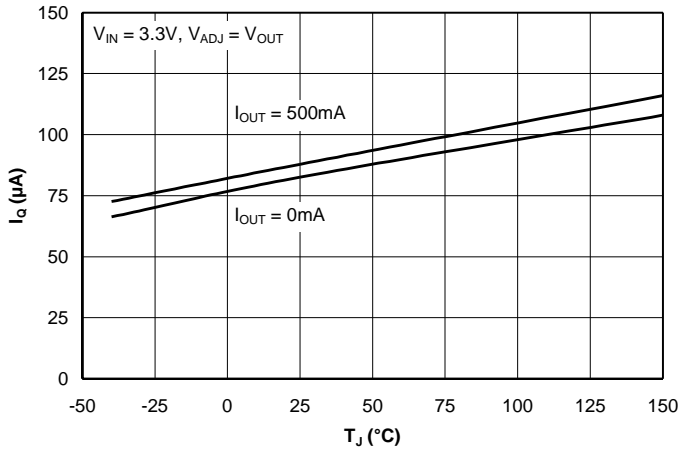
$$R_{TH(J-A)(MAX)} = \frac{(T_{J(MAX)} - T_{A(MAX)})}{P_{D(MAX)}} = \frac{(150 - 70)}{0.508} = 157^\circ C/W$$

This should be achievable with the SOT-23-5 package using pcb copper area to aid in conducting the heat away from the device. Internal ground/power planes and air flow will also assist in removing heat. For higher ambient temperatures and/or lower target  $R_{TH(J-A)}$  the MSOP-8 package should be considered.

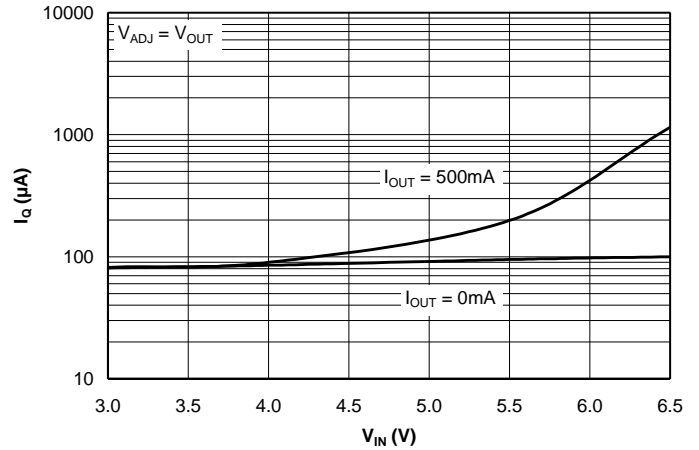
**POWER MANAGEMENT**

**Typical Characteristics**

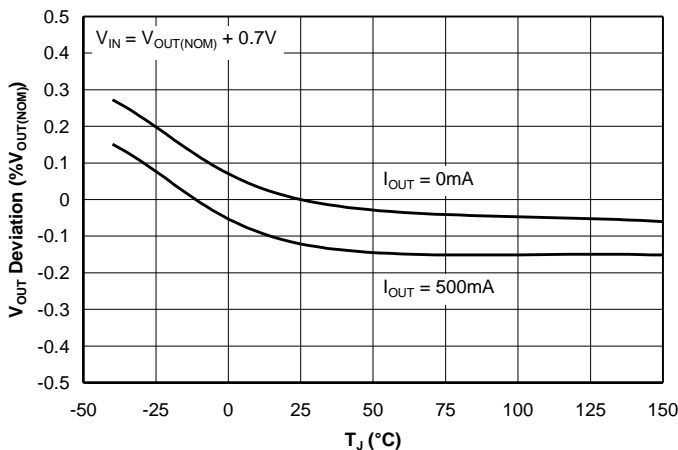
**Quiescent Current vs. Junction Temperature  
vs. Output Current**



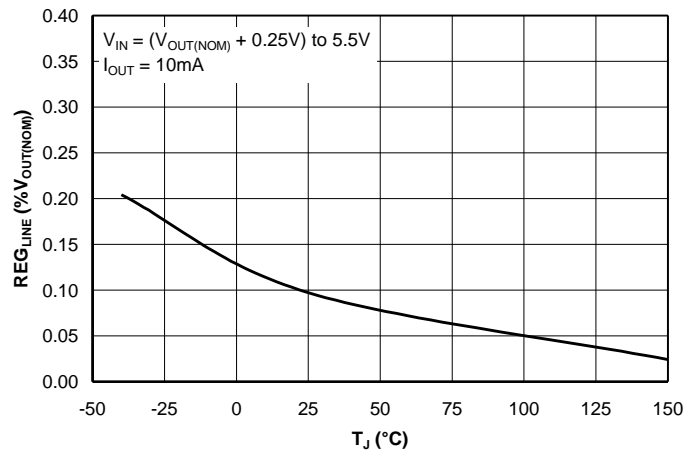
**Quiescent Current vs. Input Voltage  
vs. Output Current**



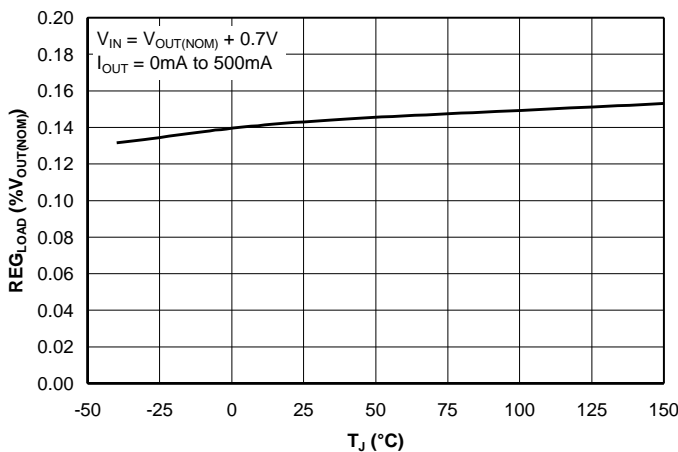
**Output Voltage vs. Junction Temperature  
vs. Output Current**



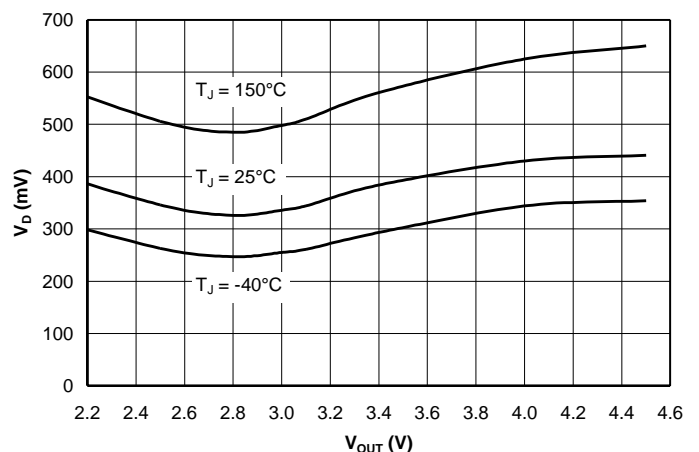
**Line Regulation vs. Junction Temperature  
vs. Input Voltage Change**



**Load Regulation vs.  
Junction Temperature**



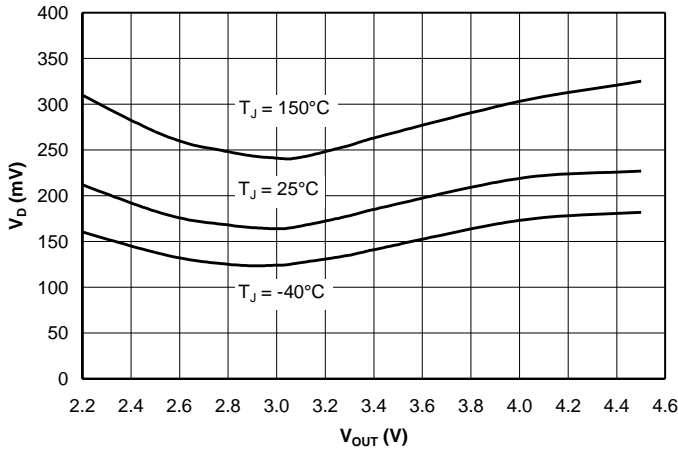
**Dropout Voltage ( $I_{OUT} = 0.5A$ ) vs. Output  
Voltage vs. Junction Temperature**



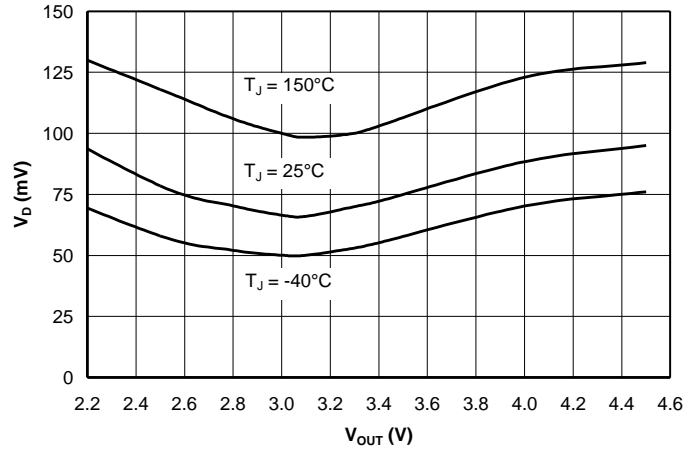
**POWER MANAGEMENT**

**Typical Characteristics (Cont.)**

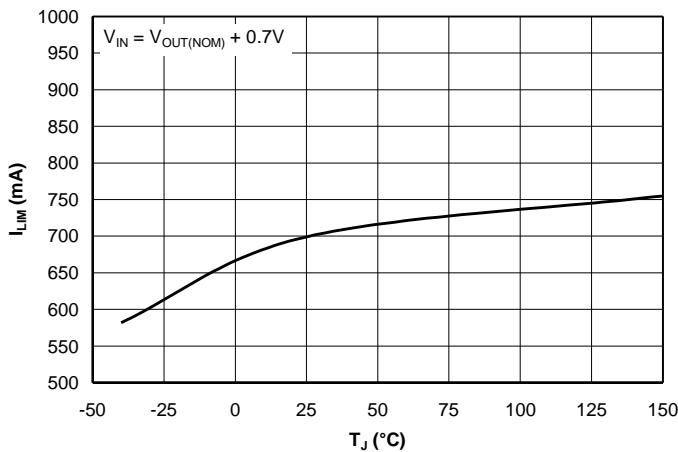
**Dropout Voltage ( $I_{OUT} = 0.25A$ ) vs. Output Voltage vs. Junction Temperature**



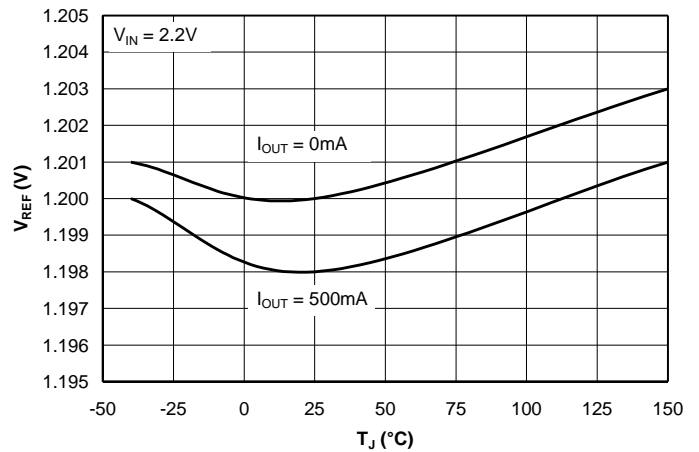
**Dropout Voltage ( $I_{OUT} = 0.1A$ ) vs. Output Voltage vs. Junction Temperature**



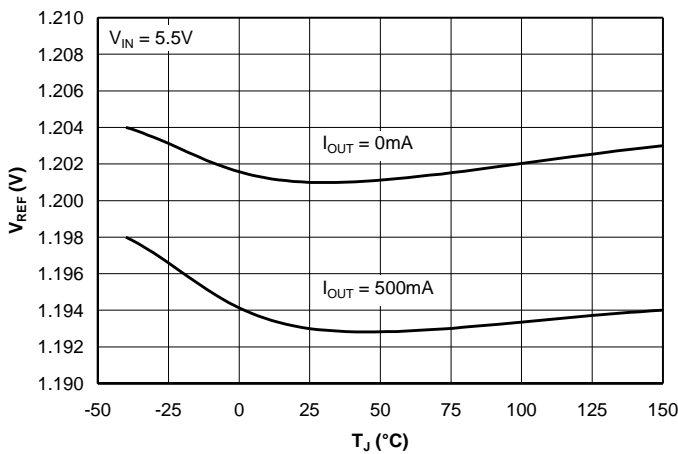
**Current Limit vs. Junction Temperature**



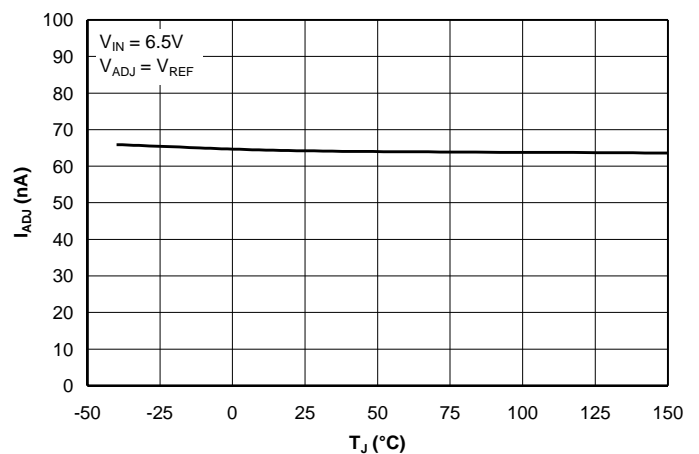
**Reference Voltage ( $V_{IN} = 2.2V$ ) vs. Junction Temperature vs. Output Current**



**Reference Voltage ( $V_{IN} = 5.5V$ ) vs. Junction Temperature vs. Output Current**



**Adjust Pin Current vs. Junction Temperature**

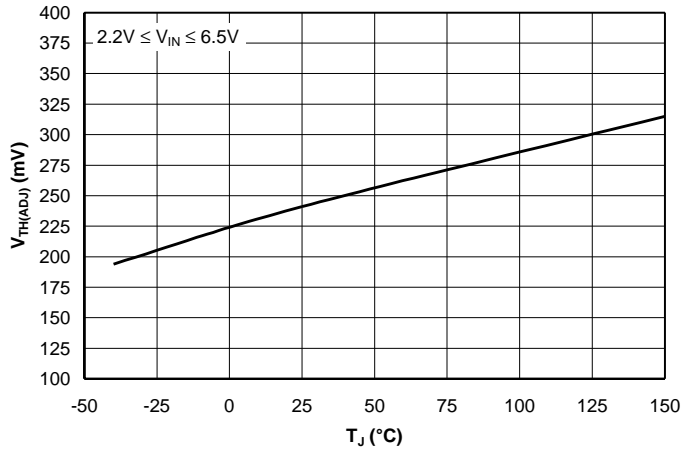




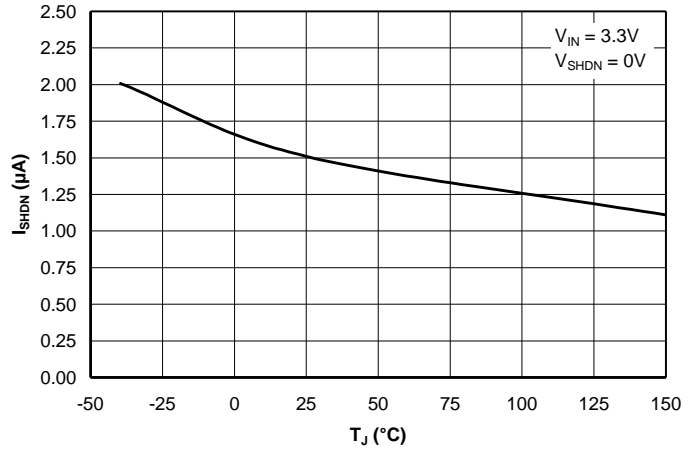
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**Typical Characteristics (Cont.)**

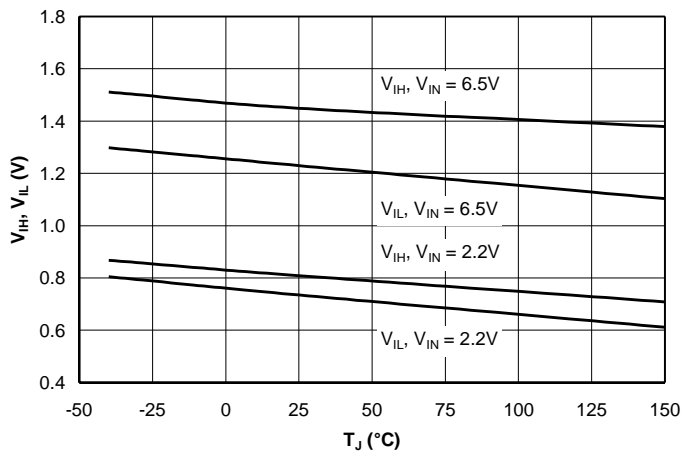
**Adjust Pin Threshold Voltage vs. Junction Temperature**



**Shutdown Pin Current vs. Junction Temperature**

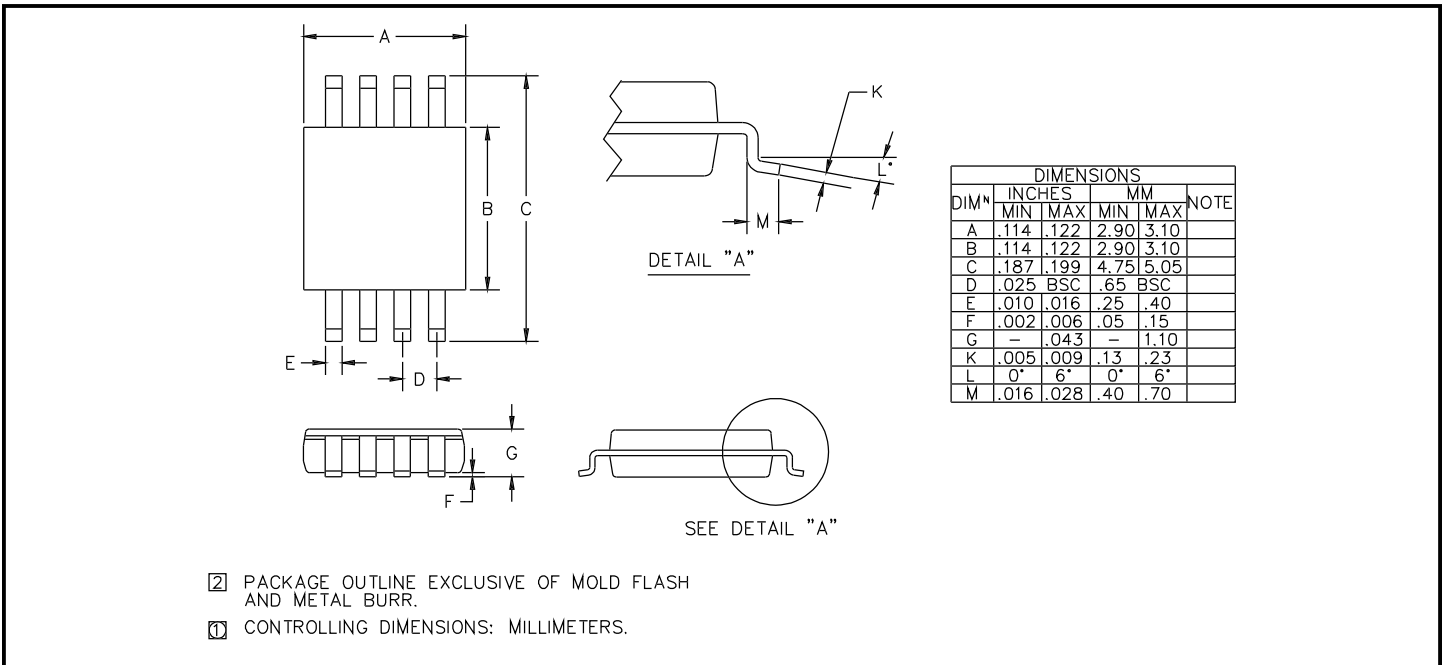


**Shutdown Pin Threshold Voltage vs. Junction Temperature vs. Input Voltage**

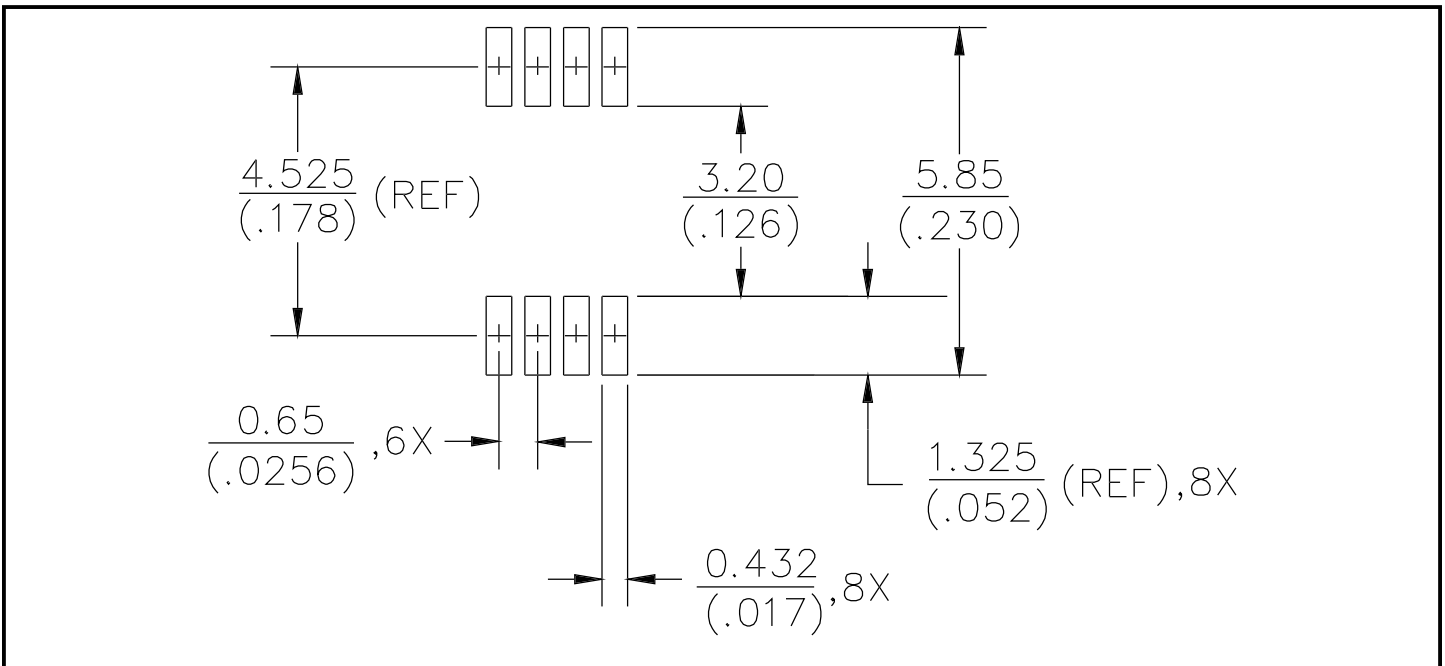


POWER MANAGEMENT

Outline Drawing - MSOP-8

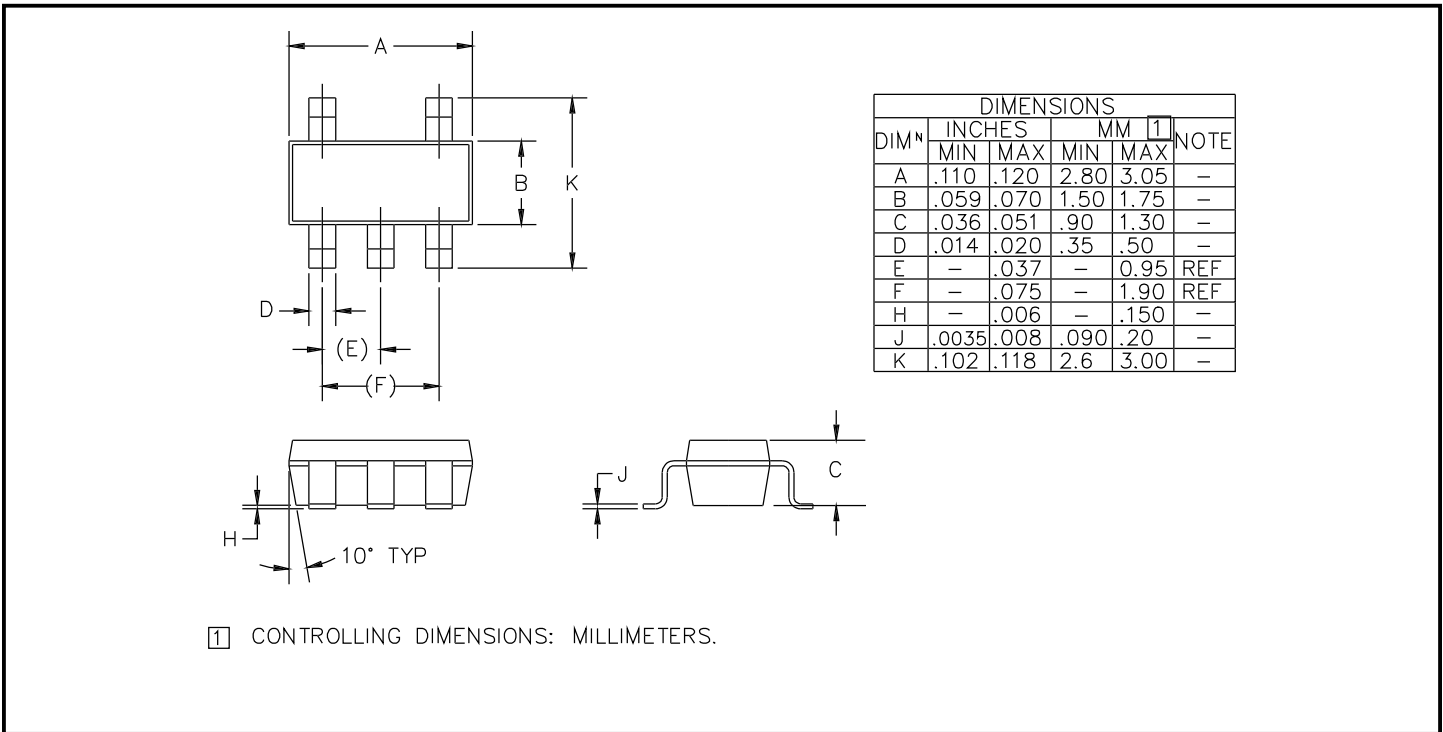


Land Pattern - MSOP-8

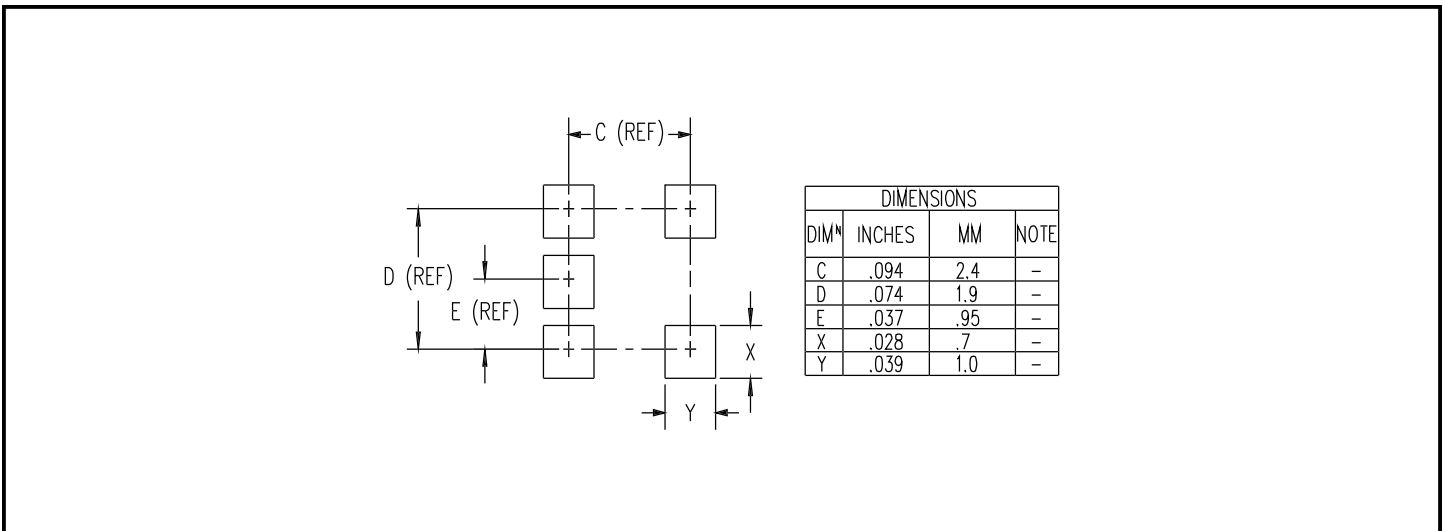


**POWER MANAGEMENT**

**Outline Drawing - SOT-23-5**



**Land Pattern - SOT-23-5**



**Contact Information**

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