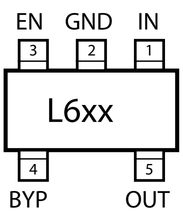
Ordering Information

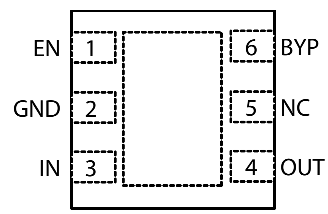
Part Number		Marking		Voltage	Junction Temp. Range	Package
Standard	Pb-Free	Standard	Pb-Free			
MIC5252-1.8BM5	MIC5252-1.8YM5	L618	L618	1.8V	-40°C to +125°C	SOT-23-5
MIC5252-2.5BM5	MIC5252-2.5YM5	L625	L625	2.5V	-40°C to +125°C	SOT-23-5
MIC5252-2.8BM5	MIC5252-2.8YM5	L628	L628	2.8V	-40°C to +125°C	SOT-23-5
MIC5252-2.85BM5	MIC5252-2.85YM5	L62J	L62J	2.85V	-40°C to +125°C	SOT-23-5
MIC5252-3.0BM5	MIC5252-3.0YM5	L630	L630	3.0V	-40°C to +125°C	SOT-23-5
MIC5252-4.75BM5	MIC5252-4.75YM5	L64H	L64H	4.75V	-40°C to +125°C	SOT-23-5
MIC5252-2.8BML	MIC5252-2.8YML	628	628	2.8V	-40°C to +125°C	6-Pin 2x2 MLF™
MIC5252-2.85BML	MIC5252-2.85YML	62J	62J	2.85V	-40°C to +125°C	6-Pin 2x2 MLF™
MIC5252-3.0BML	MIC5252-3.0YML	630	630	3.0V	-40°C to +125°C	6-Pin 2x2 MLF™

Other voltages available. Contact Micrel for details.

Pin Configuration



MIC5252-x.xBM5
SOT-23-5 (M5)
(Top View)



MIC5252-x.xBML
6-Pin 2mm × 2mm MLF™ (ML)
(Top View)

Pin Description

Pin Number SOT-23-5	Pin Number 6-MLF™	Pin Name	Pin Function
1	3	IN	Supply Input.
2	2	GND	Ground.
3	1	EN	Enable/Shutdown (Input): CMOS compatible input. Logic high = enable; logic low = shutdown. Do not leave open.
4	6	BYP	Reference Bypass: Connect external 0.01μF ≤ C_{BYP} ≤ 1.0μF capacitor to GND to reduce output noise. May be left open.
5	4	OUT	Regulator Output.
–	5	NC	No internal connection.
–	EP	GND	Ground: Internally connected to the exposed pad. Connect externally to GND pin.

Absolute Maximum Ratings[1]

Supply Input Voltage (V_{IN}) .... 0V to +7V
Enable Input Voltage (V_{EN}) .... 0V to +7V
Power Dissipation (P_D) .... Internally Limited[3]
Junction Temperature (T_J) .... –40°C to +125°C
Storage Temperature .... –65°C to +150°C
Lead Temperature (soldering, 5 sec.) .... 260°C
ESD[4] 2kV

Operating Ratings[2]

Input Voltage (V_{IN}) .... +2.7V to +6V
Enable Input Voltage (V_{EN}) .... 0V to V_{IN}
Junction Temperature (T_J) .... –40°C to +125°C
Thermal Resistance
SOT-23 (θ_{JA}) .... 235°C/W
2x2 MLF™ (θ_{JA}) .... 90°C/W

Electrical Characteristics[5]

$V_{IN} = V_{OUT} + 1V$, $V_{EN} = V_{IN}$; $I_{OUT} = 100\mu A$; $T_J = 25°C$, **bold** values indicate –40°C ≤ T_J ≤ +125°C; unless noted.

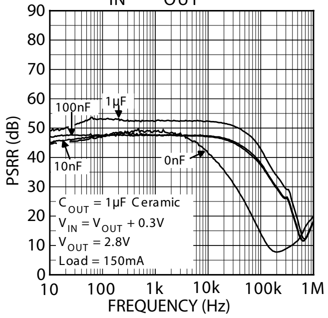
Symbol	Parameter	Conditions	Min	Typical	Max	Units
V_O	Output Voltage Accuracy	I_{OUT} = 100μA	–1 **–3**		1 **3**	% %
ΔV_{LNR}	Line Regulation	$V_{IN} = V_{OUT}$ + 1V to 6V		0.02	0.2	%
ΔV_{LDR}	Load Regulation	I_{OUT} = 0.1mA to 150mA[6]		0.6	**1.5**	%
$V_{IN} - V_{OUT}$	Dropout Voltage[7]	I_{OUT} = 100μA		0.1	5	mV
		I_{OUT} = 100mA		90	150	mV
		I_{OUT} = 150mA		135	200 **250**	mV mV
I_Q	Quiescent Current	V_{EN} ≤ 0.4V (shutdown)		0.2	**1**	μA
I_{GND}	Ground Pin Current[8]	I_{OUT} = 0mA		90	**150**	μA
		I_{OUT} = 150mA		117	**200**	μA
PSRR	Ripple Rejection; I_{OUT} = 150mA	f = 10Hz, C_{OUT} = 1.0μF, C_{BYP} = 0.01μF		63		dB
		f = 10Hz, $V_{IN} = V_{OUT}$ + 0.3V		48		dB
		f = 10kHz, $V_{IN} = V_{OUT}$ + 0.3V		48		dB
I_{LIM}	Current Limit	V_{OUT} = 0V	250	425		mA
e_n μV(rms)	Output Voltage Noise	C_{OUT} = 1.0μF, C_{BYP} = 0.01μF, f = 10Hz to 100kHz		30		
Enable Input						
V_{IL}	Enable Input Logic-Low Voltage	V_{IN} = 2.7V to 5.5V, regulator shutdown			**0.4**	V
V_{IH}	Enable Input Logic-High Voltage	V_{IN} = 2.7V to 5.5V, regulator enabled	**1.6**			V
I_{EN}	Enable Input Current	V_{IL} ≤ 0.4V, regulator shutdown		0.01	**1**	μA
		V_{IH} ≥ 1.6V, regulator enabled		0.01	**1**	μA
	Shutdown Resistance Discharge			500		Ω
Thermal Protection						
	Thermal Shutdown Temperature			150		°C
	Thermal Shutdown Hysteresis			10		°C

Notes:

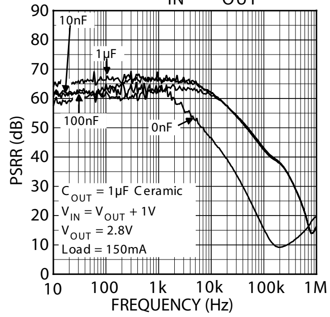
1. Exceeding the absolute maximum rating may damage the device.
2. The device is not guaranteed to function outside its operating rating.
3. The maximum allowable power dissipation of any T_A (ambient temperature) is $P_D(max) = (T_J(max)–T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown. The θ_{JA} of the MIC5252-x.xBM5 (all versions) is 235°C/W on a PC board. See *"Thermal Considerations"* section for further details.
4. Devices are ESD sensitive. Handling precautions recommended.
5. Specification for packaged product only.
6. Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1mA to 150mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.
7. Dropout Voltage is defined as the input-to-output differential at which the output voltage drops 2% below its nominal value measured at 1V differential. For outputs below 2.7V, dropout voltage is the input-to-output voltage differential with the minimum input voltage 2.7V. Minimum input operating voltage is 2.7V.
8. Ground pin current is the regulator quiescent current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

Typical Characteristics

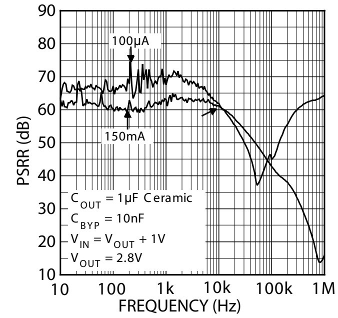
PSRR with Bypass Variation ($V_{IN} = V_{OUT} + 0.3V$)



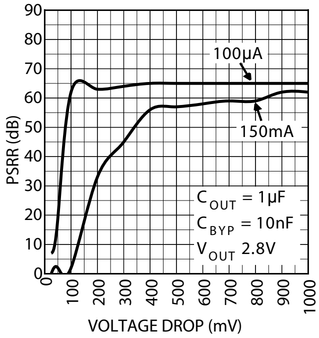
PSRR with Bypass Cap Variation ($V_{IN} = V_{OUT} + 1V$)



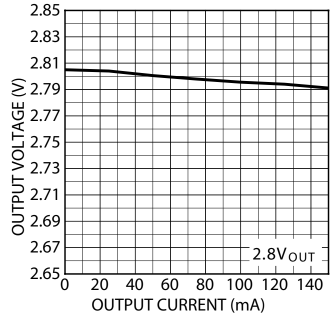
PSRR with Load Variation



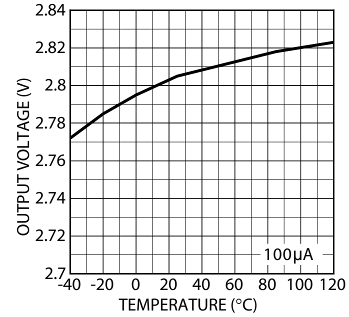
PSRR at 100Hz



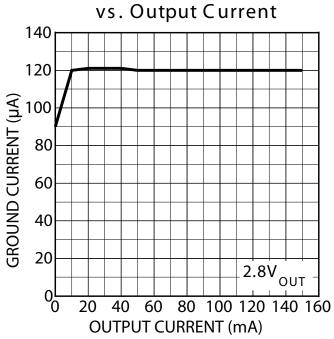
Output Voltage vs. Load Current



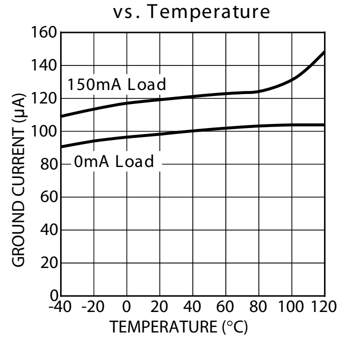
Output Voltage vs. Temperature



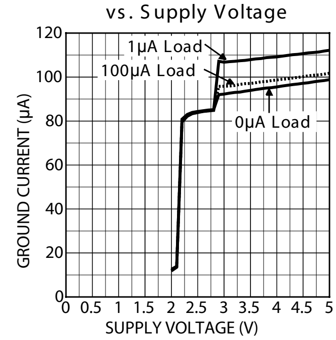
Ground Current vs. Output Current



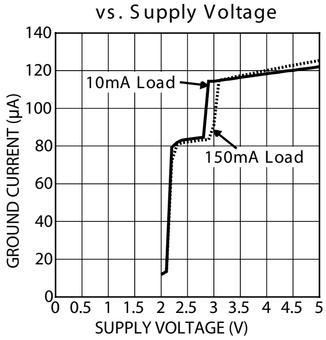
Ground Current vs. Temperature



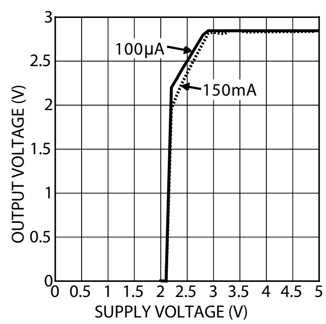
Ground Current vs. Supply Voltage



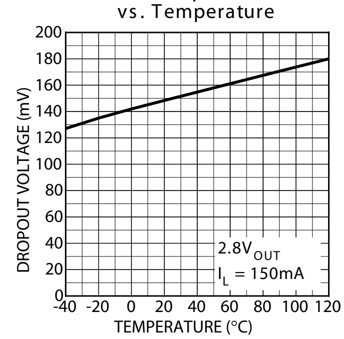
Ground Current vs. Supply Voltage

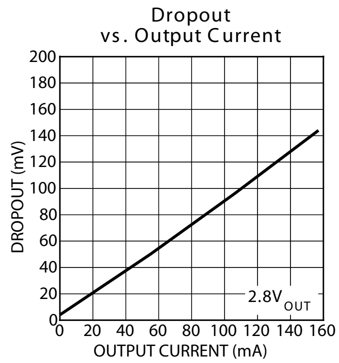


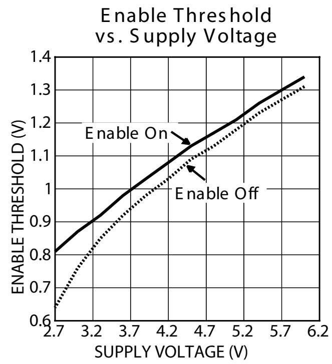
Dropout Characteristics

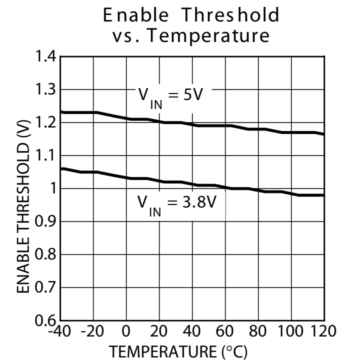


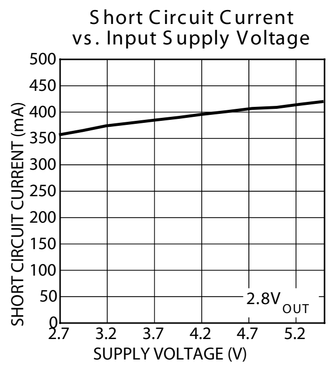
Dropout vs. Temperature




Dropout
vs. Output Current
DROPOUT (mV)
OUTPUT CURRENT (mA)
2.8V OUT
200
180
160
140
120
100
80
60
40
20
0
0 20 40 60 80 100 120 140 160

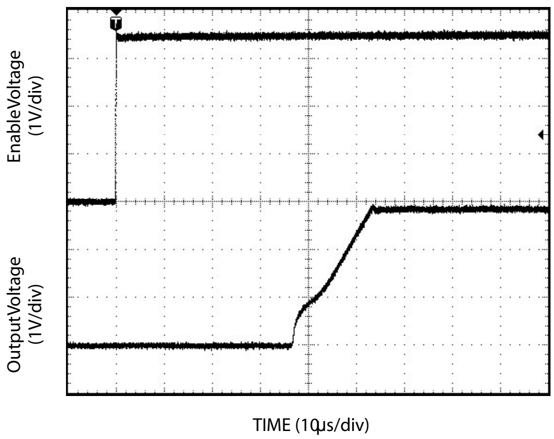

Enable Threshold
vs. Supply Voltage
ENABLE THRESHOLD (V)
SUPPLY VOLTAGE (V)
Enable On
Enable Off
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
2.7 3.2 3.7 4.2 4.7 5.2 5.7 6.2


Enable Threshold
vs. Temperature
ENABLE THRESHOLD (V)
TEMPERATURE (°C)
V IN = 5V
V IN = 3.8V
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
-40 -20 0 20 40 60 80 100 120

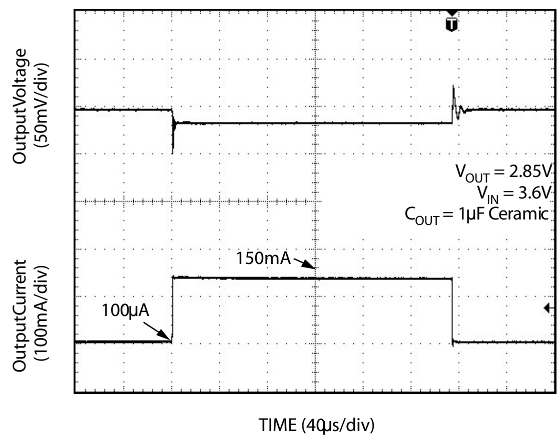

Short Circuit Current
vs. Input Supply Voltage
SHORT CIRCUIT CURRENT (mA)
SUPPLY VOLTAGE (V)
2.8V OUT
500
450
400
350
300
250
200
150
100
50
0
2.7 3.2 3.7 4.2 4.7 5.2

Functional Characteristics

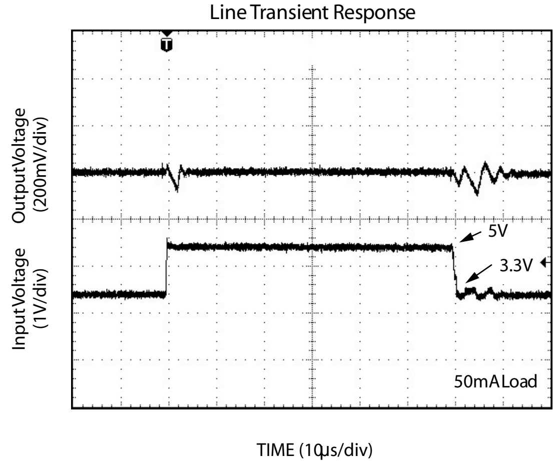
Enable Pin Delay



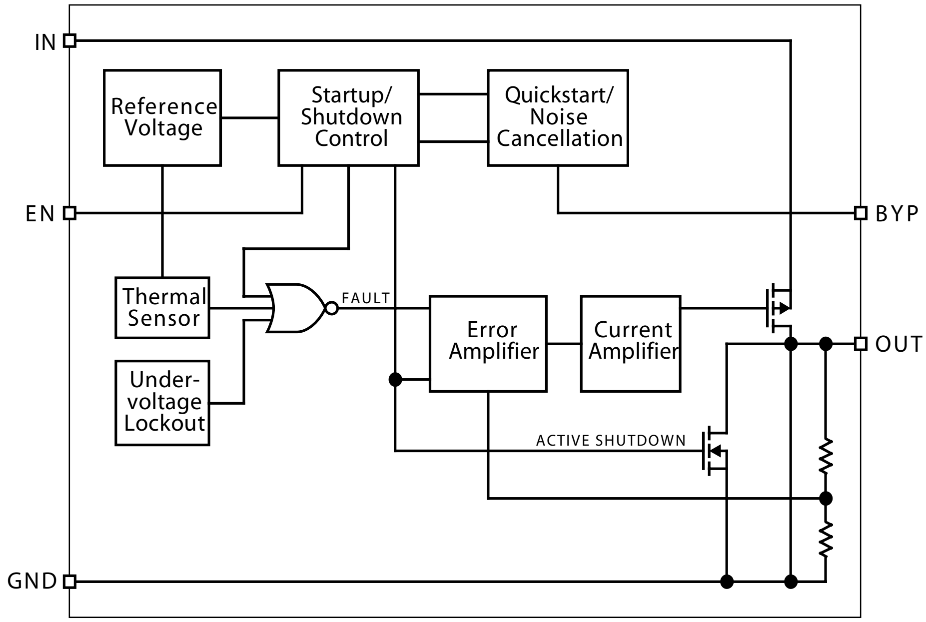
Load Transient Response



Line Transient Response



Block Diagram



Applications Information

Enable/Shutdown

The MIC5252 comes with an active-high enable pin that allows the regulator to be disabled. Forcing the enable pin low disables the regulator and sends it into a "zero" off-mode-current state. In this state, current consumed by the regulator goes nearly to zero. Forcing the enable pin high enables the output voltage. This part is CMOS and the enable pin cannot be left floating; a floating enable pin may cause an indeterminate state on the output.

Input Capacitor

The MIC5252 is a high performance, high bandwidth device. Therefore, it requires a well-bypassed input supply for optimal performance. A 1µF capacitor is required from the input to ground to provide stability. Low-ESR ceramic capacitors provide optimal performance at a minimum of space. Additional high-frequency capacitors, such as small valued NPO dielectric type capacitors, help filter out high frequency noise and are good practice in any RF based circuit.

Output Capacitor

The MIC5252 requires an output capacitor for stability. The design requires 1µF or greater on the output to maintain stability. The design is optimized for use with low-ESR ceramic chip capacitors. High ESR capacitors may cause high frequency oscillation. The maximum recommended ESR is 300mΩ. The output capacitor can be increased, but performance has been optimized for a 1µF ceramic output capacitor and does not improve significantly with larger capacitance.

X7R/X5R dielectric-type ceramic capacitors are recommended because of their temperature performance. X7R-type capacitors change capacitance by 15% over their operating temperature range and are the most stable type of ceramic capacitors. Z5U and Y5V dielectric capacitors change value by as much as 50% and 60%, respectively, over their operating temperature ranges. To use a ceramic chip capacitor with Y5V dielectric, the value must be much higher than an X7R ceramic capacitor to ensure the same minimum capacitance over the equivalent operating temperature range.

Bypass Capacitor

A capacitor is required from the noise bypass pin to ground to reduce output voltage noise. The capacitor bypasses the internal reference. A 0.01µF capacitor is recommended for applications that require low-noise outputs. The bypass capacitor can be increased, further reducing noise and improving PSRR. Turn-on time increases slightly with respect to bypass capacitance. A unique quick-start circuit allows the MIC5252 to drive a large capacitor on the bypass pin without significantly slowing turn-on time. Refer to the "Typical Characteristics" section for performance with different bypass capacitors.

Active Shutdown

The MIC5252 also features an active shutdown clamp, which is an N-Channel MOSFET that turns on when the device is disabled. This allows the output capacitor and load to discharge, de-energizing the load.

No-Load Stability

The MIC5252 will remain stable and in regulation with no load unlike many other voltage regulators. This is especially important in CMOS RAM keep-alive applications.

Thermal Considerations

The MIC5252 is designed to provide 150mA of continuous current in a very small package. Maximum power dissipation can be calculated based on the output current and the voltage drop across the part. To determine the maximum power dissipation of the package, use the junction-to-ambient thermal resistance of the device and the following basic equation:

$$P_D(max) = \left(\frac{T_J(max) - T_A}{\theta_{JA}}\right)$$

$T_J(max)$ is the maximum junction temperature of the die, 125°C, and T_A is the ambient operating temperature. θ_{JA} is layout dependent; Table 1 shows examples of junction-to-ambient thermal resistance for the MIC5252.

Package	θ_{JA} Recommended Minimum Footprint	θ_{JA} 1" Square Copper Clad	θ_{JC}
SOT-23-5 (M5 or D5)	235°C/W	185°C/W	145°C/W

Table 1. SOT-23-5 Thermal Resistance

The actual power dissipation of the regulator circuit can be determined using the equation:

$$P_D = (V_{IN} - V_{OUT})\, I_{OUT} + V_{IN}\, I_{GND}$$

Substituting $P_D(max)$ for P_D and solving for the operating conditions that are critical to the application will give the maximum operating conditions for the regulator circuit. For example, when operating the MIC5252-2.8BM5 at 50°C with a minimum footprint layout, the maximum input voltage for a set output current can be determined as follows:

$$P_D(max) = \left(\frac{125°C - 50°C}{235°C/W}\right)$$

$$P_D(max) = 315mW$$

The junction-to-ambient thermal resistance for the minimum footprint is 235°C/W, from Table 1. The maximum power dissipation must not be exceeded for proper operation. Using the output voltage of 2.8V and an output current of 150mA, the maximum input voltage can be determined. Because this device is CMOS and the ground current is typically 100µA over the load range, the power dissipation contributed by the ground current is < 1% and can be ignored for this calculation.

$$315mW = (V_{IN} - 2.8V)\, 150mA$$

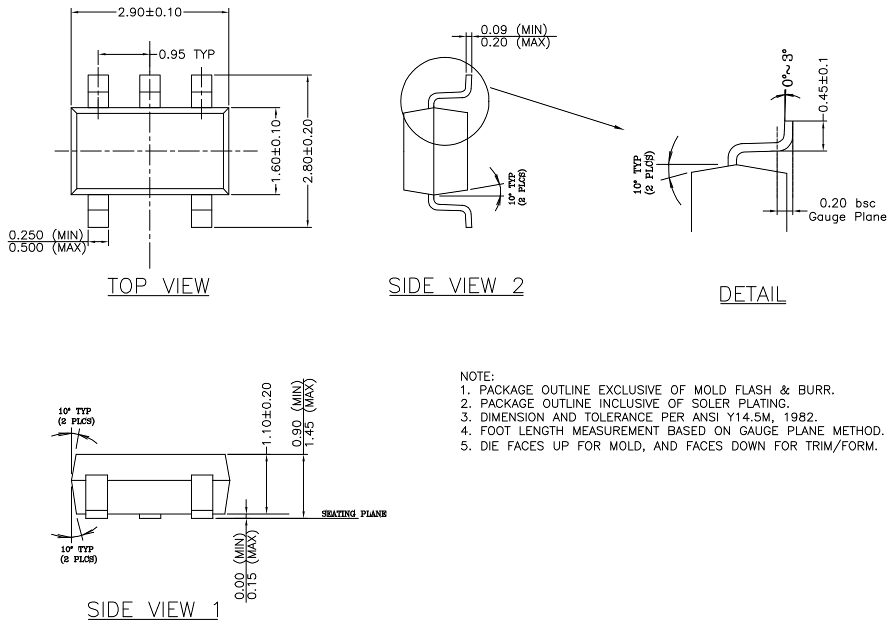
$$315mW = V_{IN} \times 150mA - 420mW$$

$$735mW = V_{IN} \times 150mA$$

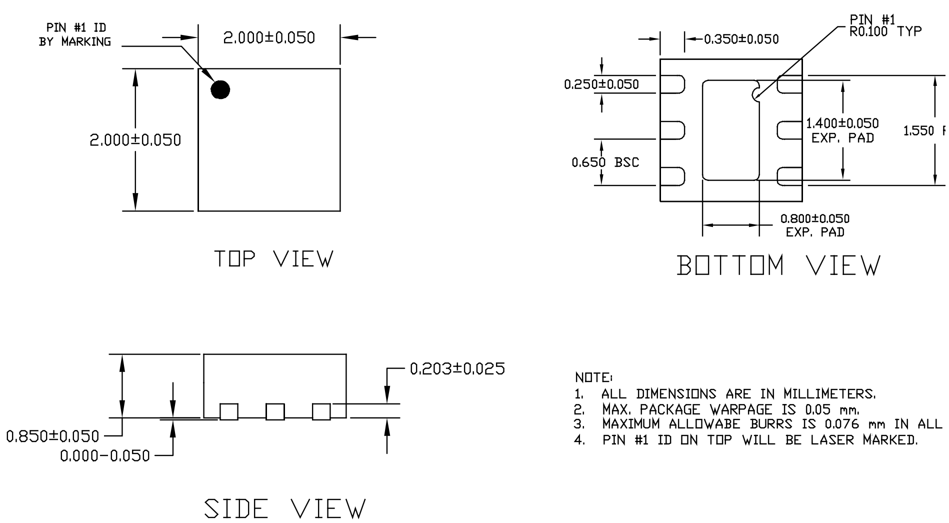
$$V_{IN}(max) = 4.9V$$

Therefore, a 2.8V application at 150mA of output current can accept a maximum input voltage of 4.9V in a SOT-23-5 package. For a full discussion of heat sinking and thermal effects on voltage regulators, refer to the "Regulator Thermals" section of Micrel's Designing with Low-Dropout Voltage Regulators handbook.

Package Information



SOT-23-5 (M5)



6-Pin MLF™ (ML)

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