MAQ5283

120V_{IN}, 150mA, Ultra-Low I_Q, High-PSRR Linear Regulator

Automotive

General Description

The MAQ5283 high-performance linear regulator offers a very-wide input operating voltage range, up to 120V DC, and supplies an output current of up to 150mA.

The MAQ5283 is ideal for high input voltage applications such as automotive, industrial, and telecom, because it offers ±3% initial accuracy, extremely high power supply rejection ratio (75dB at 10kHz) and an ultra-low quiescent current of 8µA. The MAQ5283 is optimized for high-voltage line transients, making it ideal for harsh environment applications.

The MAQ5283 is offered in both fixed output voltage (3.3V or 5.0V) and adjustable output voltage (1.23V to 5.5V) options.

The MAQ5283 operates over a –40°C to +125°C temperature range and is available in a lead-free, RoHS-compliant, ePad SOIC-8 package.

Data sheet and support documentation are available on the Micrel website: www.micrel.com.

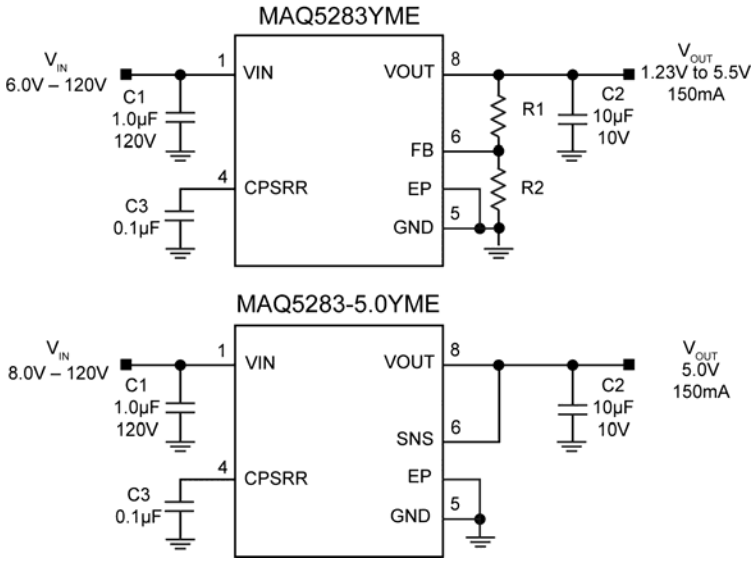
Features

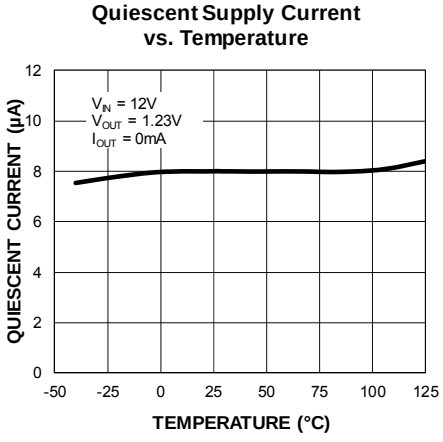
- AEC-Q100 qualified
- Wide input voltage range: 6V to 120V DC
- Ultra-low quiescent current: 8µA
- 150mA guaranteed output current
- Adjustable output from 1.23V to 5.5V
- Stable with ceramic capacitors
- Ultra-high PSRR (75dB at 10kHz)
- Ultra-high line rejection (load dump)
- High output accuracy:
  - ±3% initial accuracy
- Thermal-shutdown and current-limit protection
- Thermally efficient, 8-pin ePad SOIC package

Applications

- Automotive
- Industrial applications
- Remote keyless entry power supply
- Telecom applications
- Off-line power supplies

Typical Applications

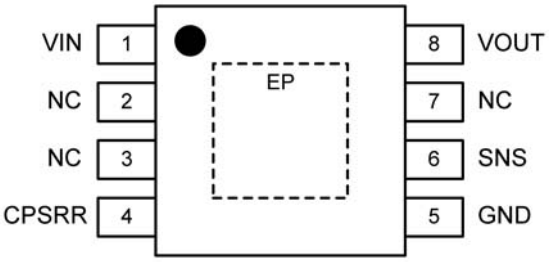




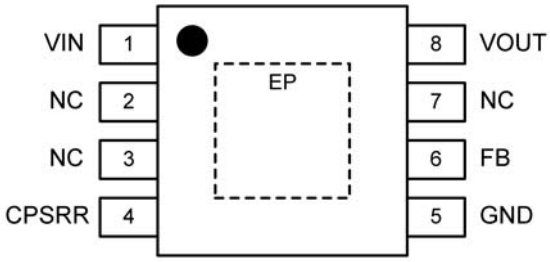
Ordering Information

Part Number	Output Voltage	Top Mark	Temperature Range	Package	Lead Finish
MAQ5283YME	Adjustable	MAQ5283YME	–40°C to +125°C	8-Pin ePad SOIC	Pb-Free
MAQ5283-3.3YME	3.3V	MAQ5283-33YME	–40°C to +125°C	8-Pin ePad SOIC	Pb-Free
MAQ5283-5.0YME	5.0V	MAQ5283-50YME	–40°C to +125°C	8-Pin ePad SOIC	Pb-Free

Pin Configuration



8-Pin ePAD SOIC
MAQ5283-x.xYME
Fixed Voltage Output
(TOP VIEW)



8-Pin ePAD SOIC
MAQ5283YME
Adjustable Voltage Output
(TOP VIEW)

Pin Description

Pin Number		Name	Function
Adjustable Output	Fixed Output		
1	1	VIN	Supply Voltage Input. Connect 1µF capacitor from VIN to GND.
2, 3, 7	2, 3, 7	NC	Not internally connected. Connect NC to GND or leave unconnected.
4	4	CPSRR	Bypass Capacitor Connection. Connect 0.1µF capacitor from CPSRR to GND.
5	5	GND	Ground.
6	—	FB	Feedback Connection. For external resistor divider to set V_{OUT}.
—	6	SNS	Sense input. Connect SNS to VOUT.
8	8	VOUT	Regulator Output. Connect 10µF capacitor from VOUT to GND.
EP	EP	ePad	Exposed Pad (ePad) for Thermal Dissipation. Connect to GND.

Absolute Maximum Ratings[1]

V_{IN} to GND ..... –0.3V to +125V
V_{CPSRR} to GND ..... –0.3 to +14V
V_{FB}, V_{SNS}, V_{OUT} to GND ..... –0.3V to +6V
Lead Temperature (soldering, 10s) ..... +260°C
Junction Temperature ..... $–40°C \le T_J \le +125°C$
Storage Temperature ..... $–65°C \le T_A \le +150°C$
ESD Ratings[4]
HBM 2kV
MM 200V

Operating Ratings[2]

V_{IN} ..... +6V to +120V
V_{OUT} Adjust Range ..... +1.23V to +5.5V
Junction Temperature ..... $–40°C \le T_J \le +125°C$
Power Dissipation (P_D) ..... Internally Limited[3]
Junction Thermal Resistance (θ_{JA})
8-pin ePad SOIC ..... 41°C/W

Electrical Characteristics[5]

V_{IN} = 12V, C_{IN} = 1.0µF, C_{PSRR} = 0.1µF, C_{OUT} = 10µF, I_{OUT} = 100µA, T_J = 25°C, **bold** values indicate $–40°C \le T_J \le +125°C$, unless noted.

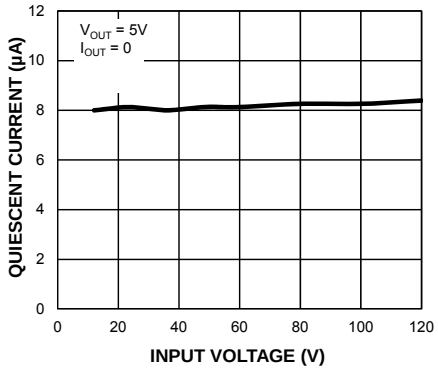
Parameter	Condition		Min.	Typ.	Max.	Units
Power Supply Input						
Input Voltage Range			**6**		**120**	V
Quiescent Supply Current	I_{OUT} = 0			8	**14**	µA
Output Voltage						
Output Voltage Accuracy	Variation from nominal V_{OUT} 100µA ≤ I_{OUT} ≤ 150mA		**-5**		**+5**	%
Line Regulation	V_{IN} = 10V to 120V		**–0.5**	0.04	**+0.5**	%
Feedback Input (Adjustable)						
FB Voltage	100µA ≤ I_{OUT} ≤ 150mA		**1.167**	1.228	**1.289**	V
FB Current				3.2		nA
Current Limit						
Current Limit	V_{OUT} = 0V		**180**	300	**500**	mA
Ripple Rejection						
Power Supply Rejection Ratio	I_{OUT} = 50mA	100Hz ≤ f ≤ 1kHz		70		dB
		1kHz < f ≤ 30kHz		75		dB
		30kHz < f ≤ 100kHz		65		dB
Power Dropout Voltage						
Dropout Voltage	I_{OUT} = 150mA			1.8	**2.8**	V
Thermal Protection						
Thermal-Shutdown Temperature	T_J rising			155		°C
Thermal-Shutdown Hysteresis				15		°C

Notes:

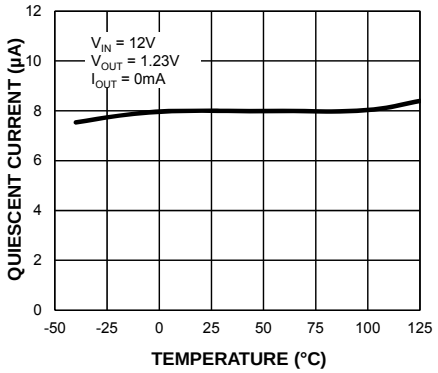
1. Exceeding an absolute maximum rating may damage the device.
2. The device is not guaranteed to function outside its operating rating.
3. The maximum allowable power dissipation at any T_A (ambient temperature) is $P_{D(max)} = (T_{J(max)} – T_A) / \theta_{JA}$. Exceeding the maximum allowable power dissipation results in excessive die temperature, and causes the regulator to enter thermal shutdown.
4. Devices are ESD sensitive; use proper handling precautions. Human body model, 1.5kΩ in series with 100pF.
5. Specifications are for packaged products only.

Typical Characteristics

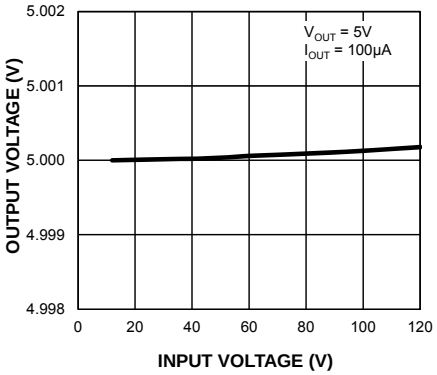
Quiescent Supply Current vs. Input Voltage



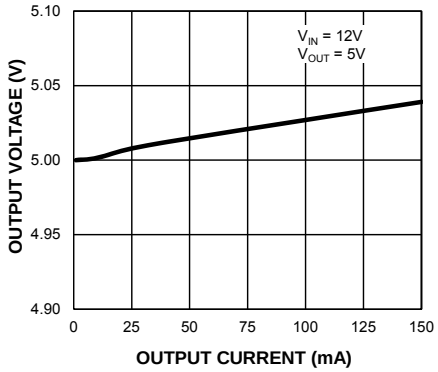
Quiescent Supply Current vs. Temperature



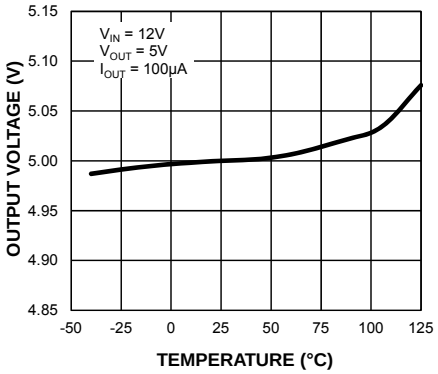
Output Voltage vs. Input Voltage



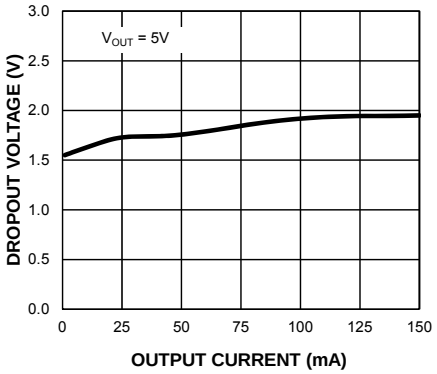
Output Voltage vs. Output Current



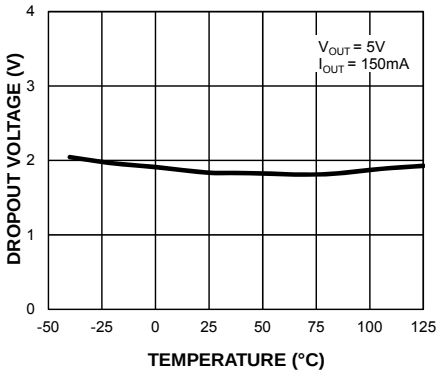
Output Voltage vs. Temperature



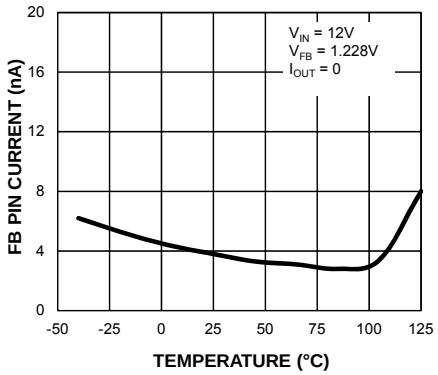
Dropout Voltage vs. Output Current



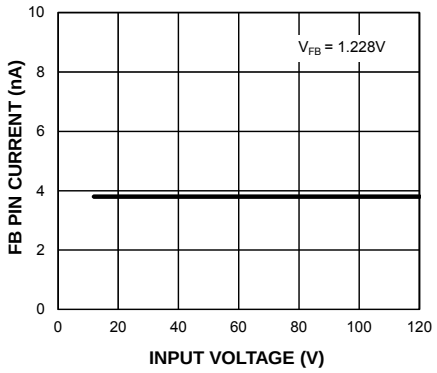
Dropout Voltage vs. Temperature



Feedback Pin Current vs. Temperature

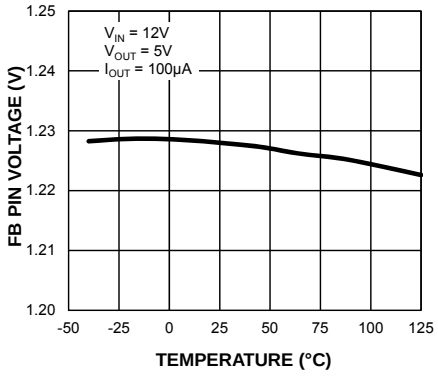


Feedback Pin Current vs. Input Voltage

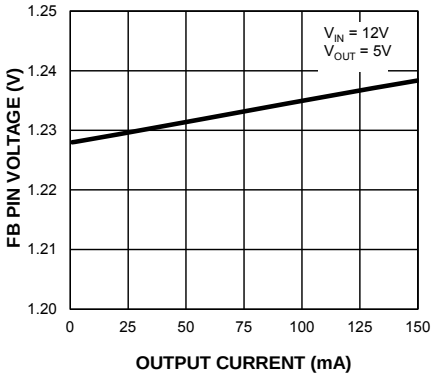


Typical Characteristics (Continued)

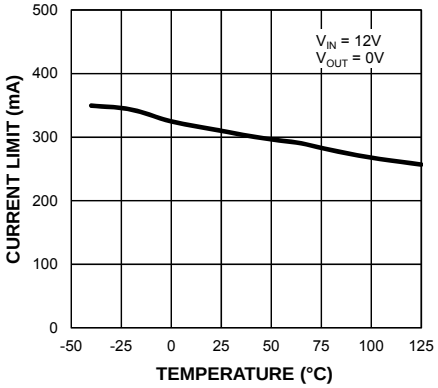
Feedback Pin Voltage vs. Temperature



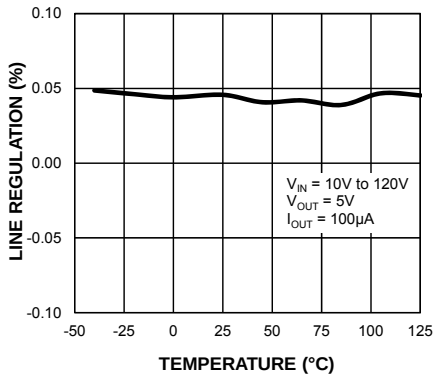
Feedback Pin Voltage vs. Output Current



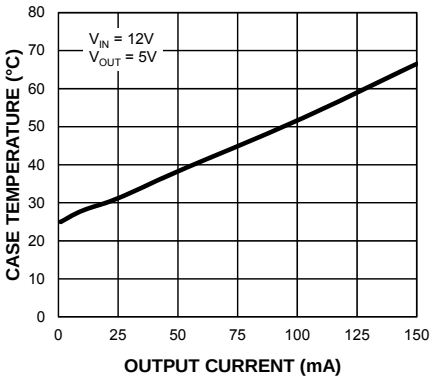
Current Limit vs. Temperature



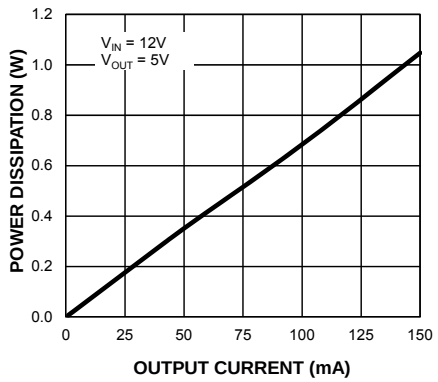
Line Regulation vs. Temperature



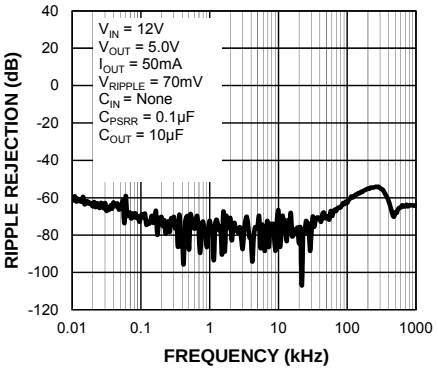
Case Temperature* (ME) vs. Output Current



Power Dissipation (ME) vs. Output Current



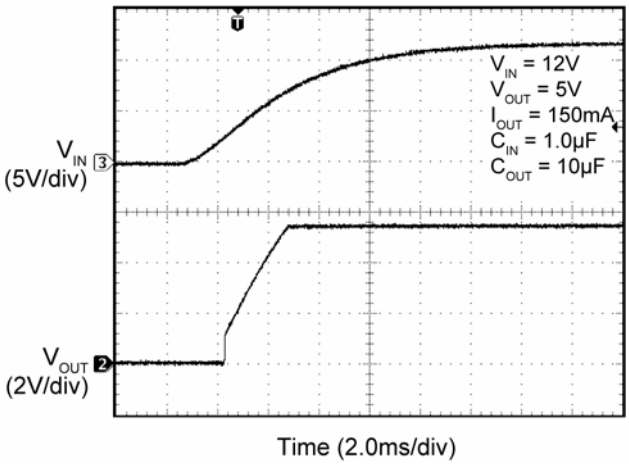
PSRR vs. Frequency



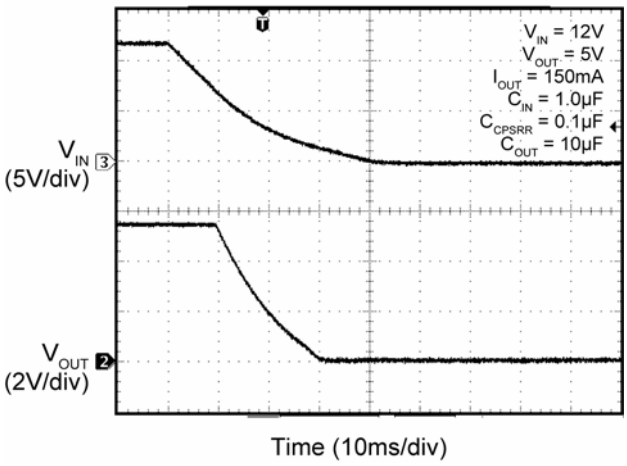
Case Temperature*: The temperature measurement was taken at the hottest point on the MAQ5283 case mounted on a 2.25-square-inch PCB at an ambient temperature of 25°C; see the "Thermal Measurements" section. Actual results depend on the size of the PCB, ambient temperature, and proximity to other heat emitting components.

Functional Characteristics

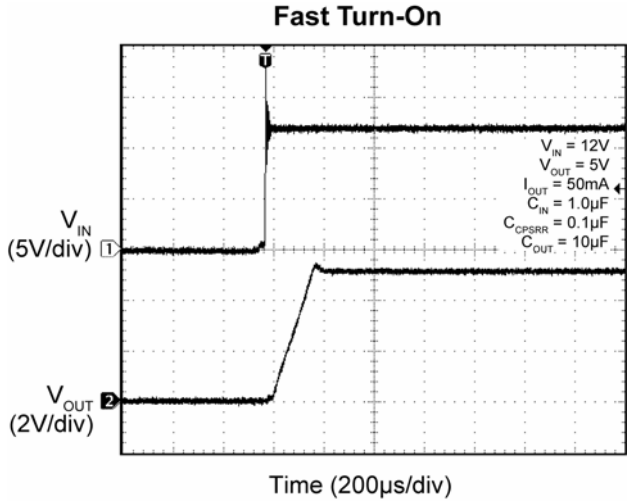
Soft Turn-On into Full Load



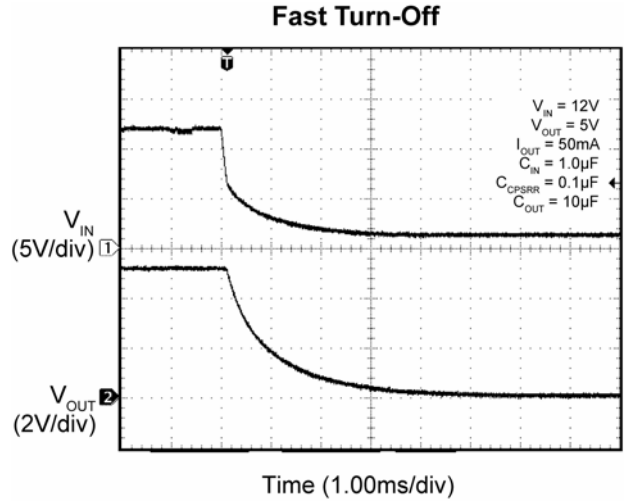
Soft Turn-Off



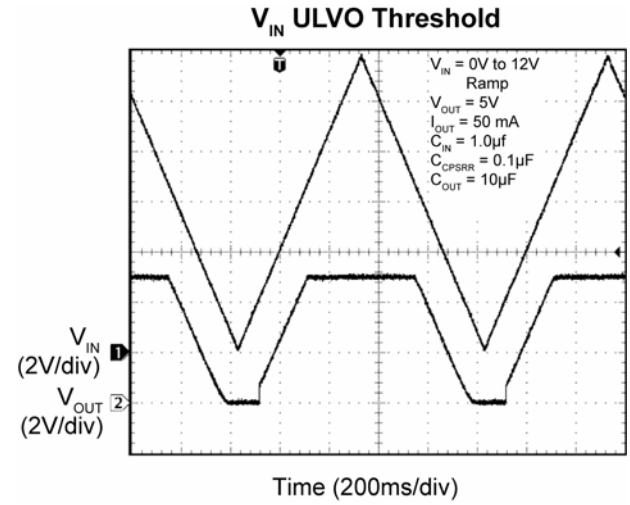
Fast Turn-On



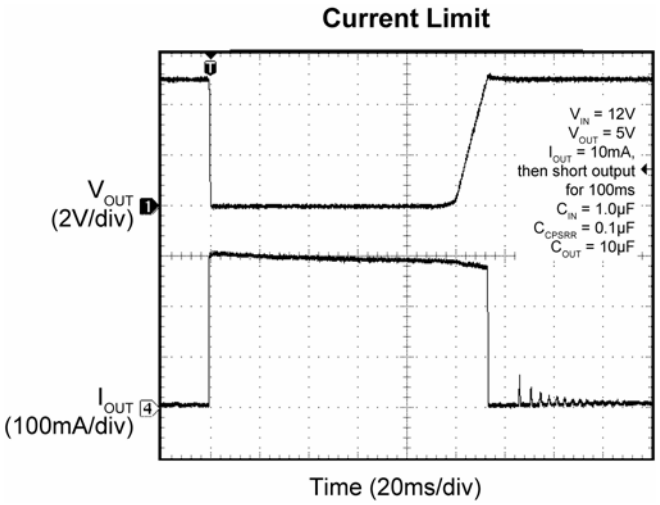
Fast Turn-Off



V_{IN} ULVO Threshold

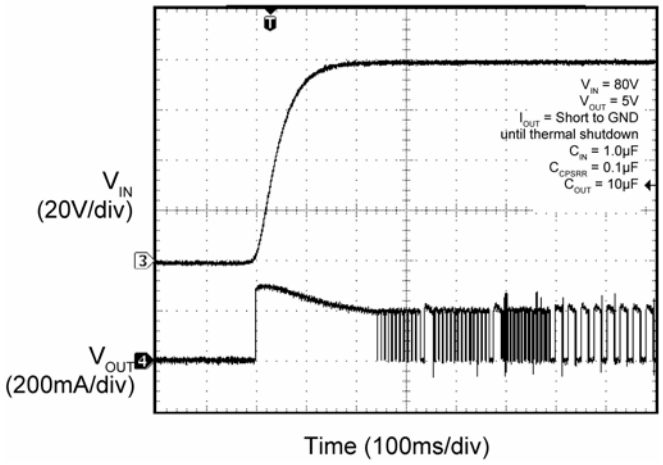


Current Limit

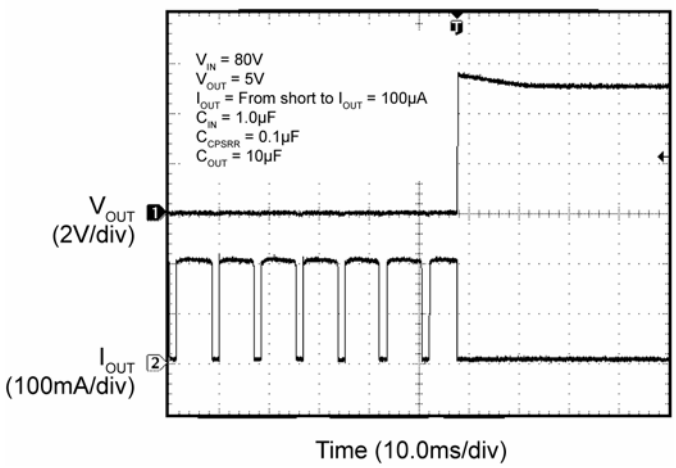


Functional Characteristics (Continued)

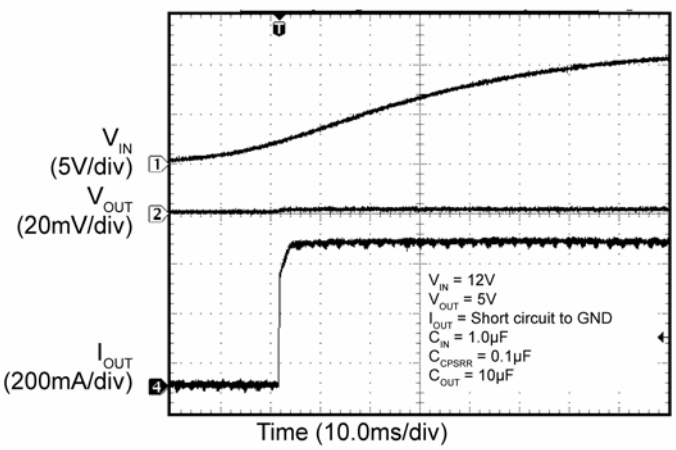
Thermal Shutdown Response



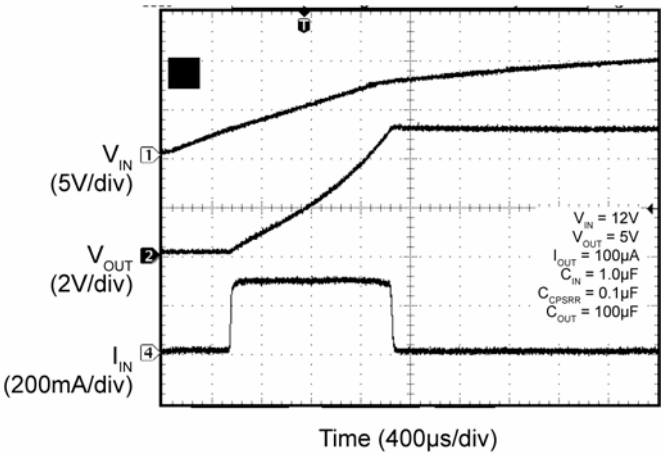
V_{OUT} Recovery from Thermal Shutdown



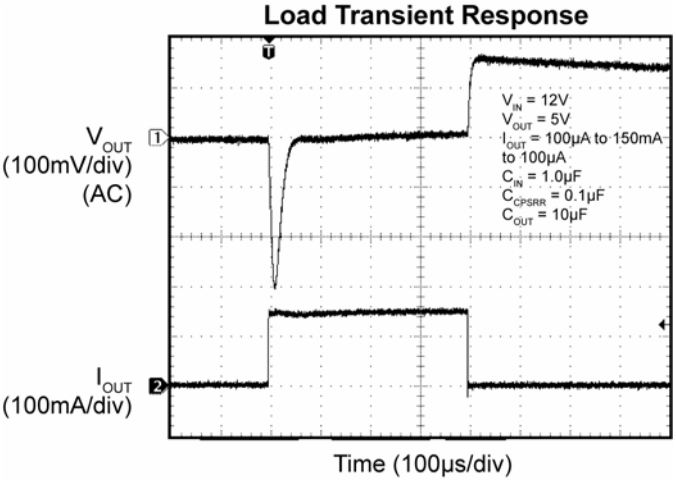
Turn-On into Short Circuit



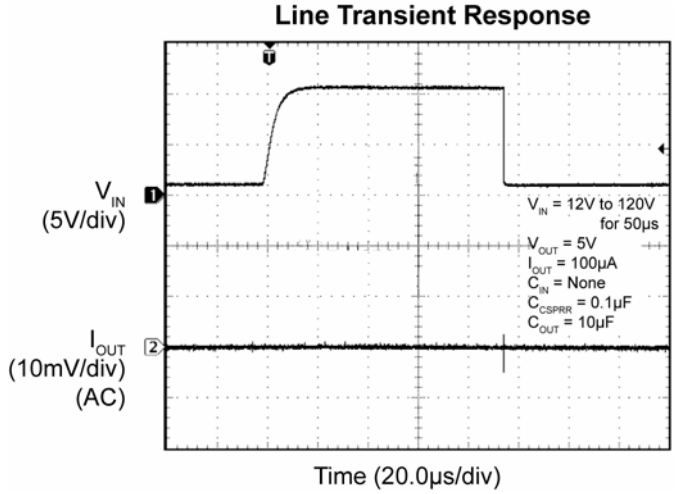
Inrush Current Response



Load Transient Response



Line Transient Response



Detailed Description

The MAQ5283 voltage regulator accepts a 6V to 120V input voltage and has an ultra-low 8µA typical quiescent current while offering an excellent line transient response and PSRR. These features make it ideal for harsh, noisy environments. All options offer 150mA of output current. The MAQ5283YME offers an adjustable output voltage from 1.23V to 5.5V. The MAQ5283-3.3YME offers a fixed 3.3V output and the MAQ5283-5.0YME offers a fixed 5.0V output. The YME packaged devices feature a heat slug to remove heat from the die more effectively.

Applications Information

Thermal Protection

The MAQ5283 has internal thermal shutdown to protect it from excessive heating of the die. When the junction temperature exceeds approximately +155°C, the output is disabled and the device begins to cool down. The device turns back on when the junction temperature cools by 15°C. This results in a cycled output during continuous thermal-overload conditions.

Current Limit

The MAQ5283 features output current-limit protection. The output sustains a continuous short circuit to GND without damage to the device, but thermal shutdown often results. The typical value for the current limit of the MAQ5283 is 300mA.

Input Capacitor

Connect a 1.0µF capacitor from VIN to GND. Micrel recommends the C5750X7R2E105M, 1.0µF, 250V capacitor made by TDK. When using a different capacitor, make sure that the voltage rating of the capacitor has enough headroom to withstand any potential transient.

CPSRR Capacitor

To maintain high power supply rejection, connect a 0.1µF capacitor from CPSRR to GND. The voltage rating of the capacitor must be at least 14V.

Output Capacitor

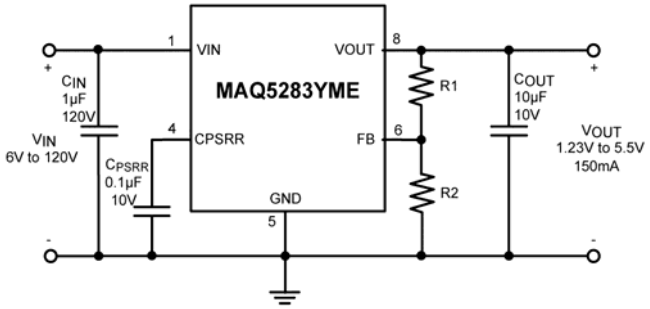
Connect a 10µF capacitor from VOUT to GND. Make sure that the voltage rating of the capacitor is greater than the designed output voltage of the MAQ5283.

Output Voltage Setting

For the MAQ5283YME, V_{OUT} is programmable from 1.23V to 5.5V using an external resistive divider. V_{OUT} is set using the following equation:

$$V_{OUT} = V_{REF} \times \left(\frac{R1}{R2} + 1 \right) \qquad \text{Eq. 1}$$

where V_{REF} = 1.228V, and R1 and R2 form the feedback voltage divider from V_{OUT} to ground.

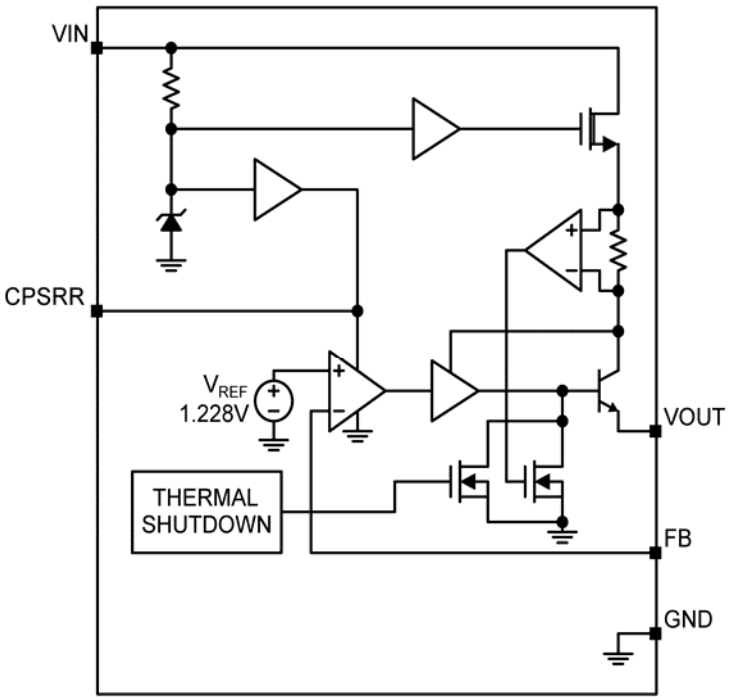


Thermal Measurements

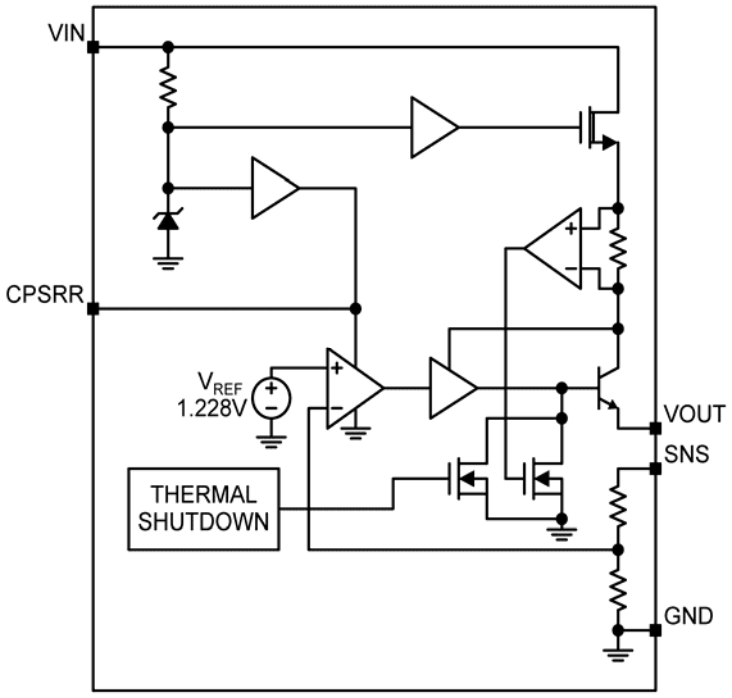
It is always a good idea to measure an IC's case temperature to make sure that it is within operating limits, but it is easy to get false results. The standard thermocouple that comes with many voltage meters uses a large wire gauge that behaves like a heat-sink. This causes artificially low case temperature measurements. Use a thermocouple of 36-gauge wire or smaller, such as the Omega (5SC-TT-K-36-36), to minimize the heat-sinking effect. Also, apply a thermal compound to maximize heat transfer between the IC and the thermocouple.

An infrared thermometer is a recommended alternative. The IR thermometer from Optris has a 1mm spot size, which is ideal for monitoring small surface-mount packages. Also, the optional stand makes it easy to keep the beam on the IC for long periods of time.

Functional Diagram

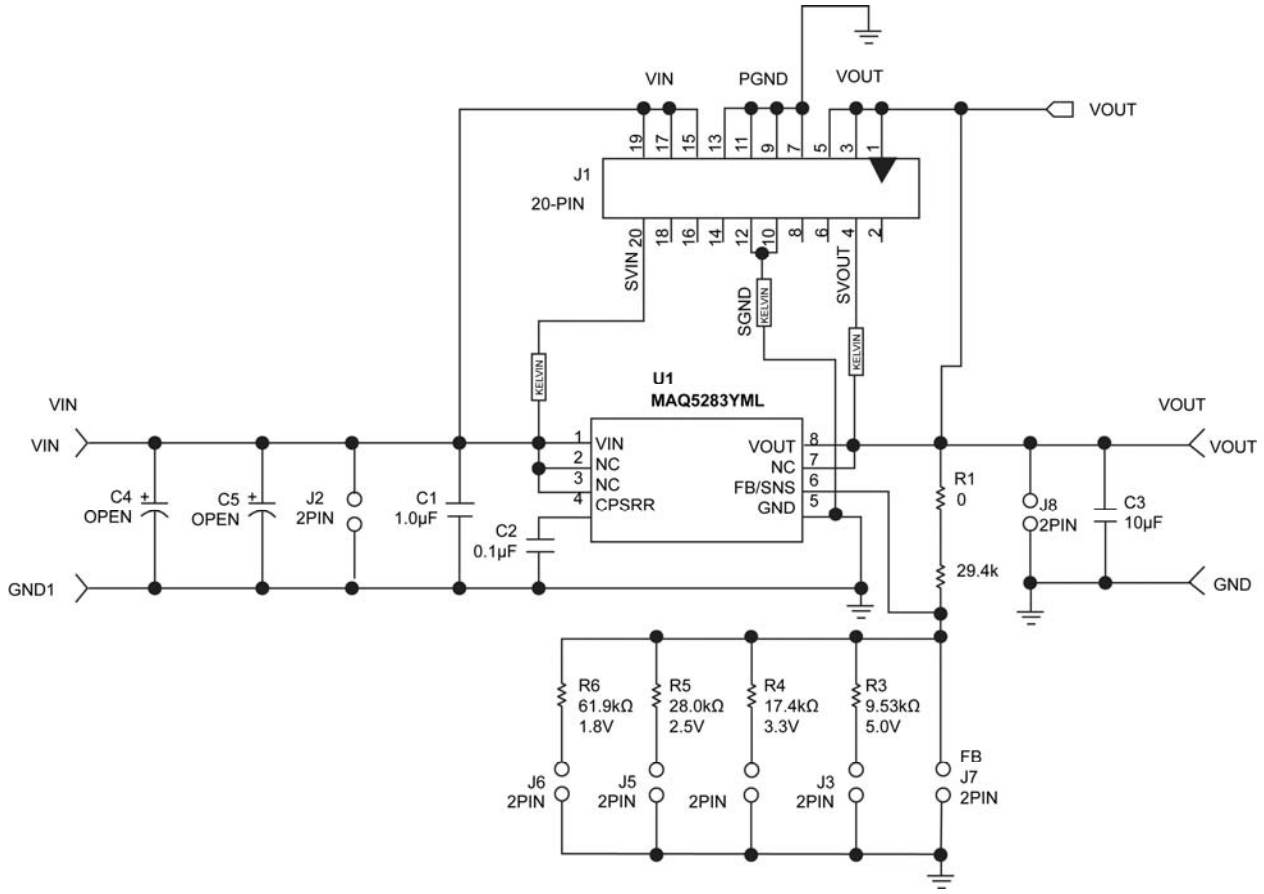


MAQ5283 Adjustable Version



MAQ5283 Fixed Version

MAQ5283 Evaluation Board Schematic



MAQ5283 Evaluation Board Schematic

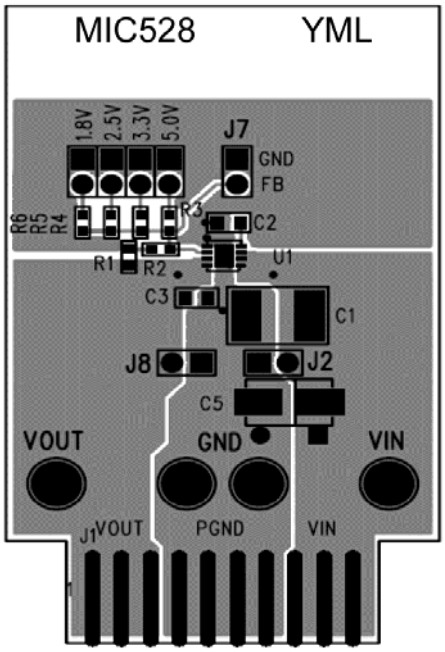
Bill of Materials

Item	Part Number	Manufacturer	Description	Qty.
C1	C5750X7R2E105M	TDK[1]	1.0µF, 250V, 20%, X7R capacitor (2220)	1
C2	08053C104KAT2A	AVX[2]	0.1µF 25V 20%, X7R capacitor (0805)	1
C3	0805ZD106KAT2A	AVX	10µF, 10V, 20%, X5R, capacitor (0805)	1
R1	CRCW06030000F	Vishay/Dale[3]	0Ω, 1% resistor, 0603	1
R2	CRCW06032942F	Vishay/Dale	29.4kΩ, 1% resistor, 0603	1
R3	CRCW06039531F	Vishay[3]	9.53kΩ Film Resistor, Size 0603, 1%	1
R4	CRCW06031742F	Vishay	17.4kΩ Film Resistor, Size 0603, 1%	1
R5	CRCW06032802F	Vishay	28.0kΩ Film Resistor, Size 0603, 1%	1
R6	CRCW06036192F	Vishay	61.9kΩ Film Resistor, Size 0603, 1%	1
U1	**MAQ5283YML**	**Micrel[4]**	**120V_{IN}, 150mA, Ultra-Low I_Q, High-PSRR Linear Regulator**	**1**

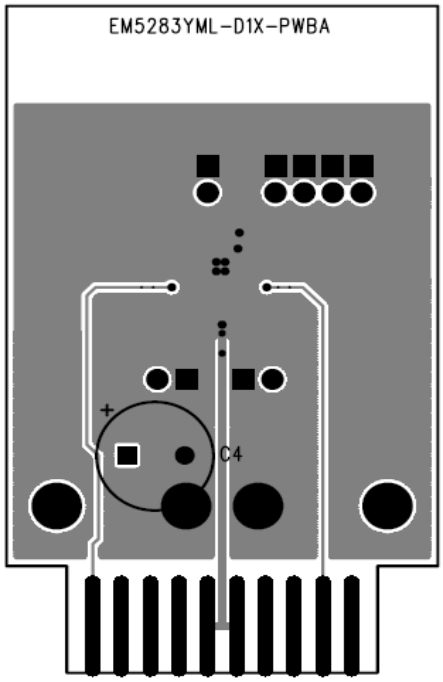
Notes:

1. TDK: www.tdk.com.
2. AVX: www.avx.com.
3. Vishay Tel: www.vishay.com.
4. **Micrel, Inc.: www.micrel.com.**

PCB Evaluation Board Layout

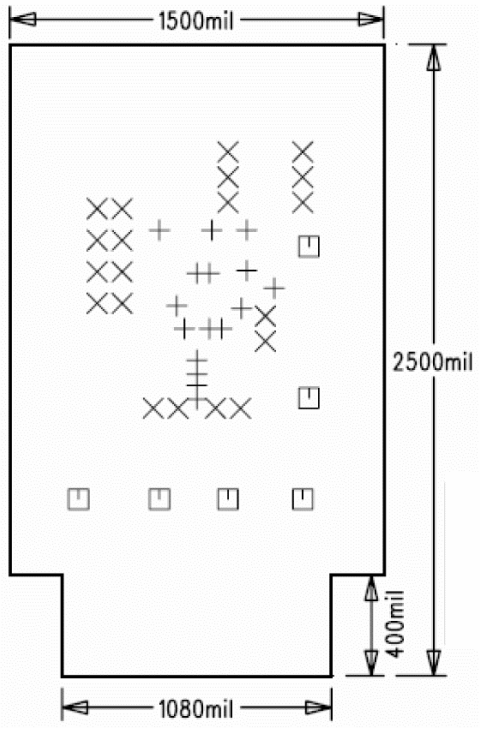


Top Layer



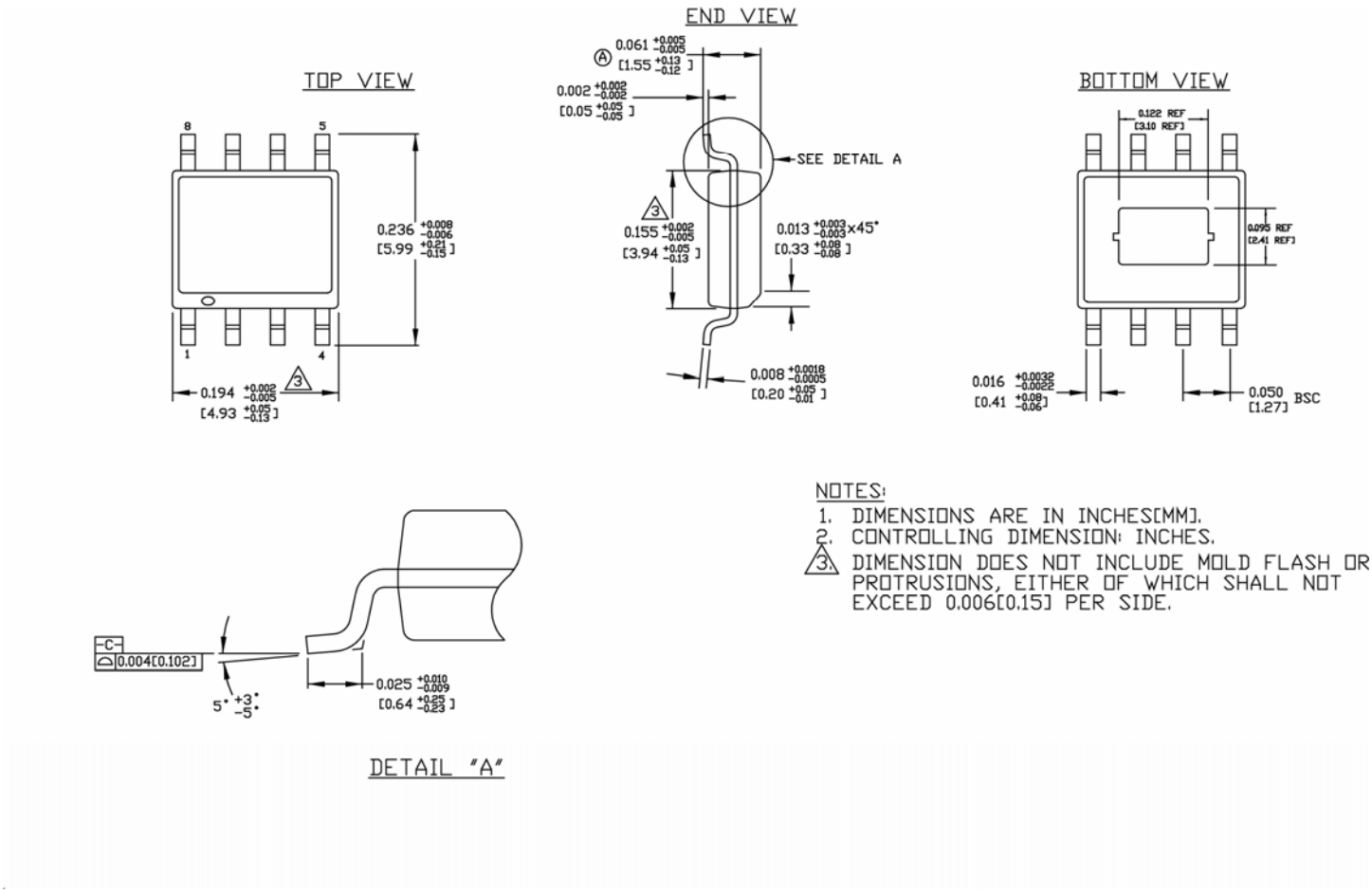
Bottom Layer

PCB Evaluation Board Layout (Continued)



Evaluation Board Dimensions

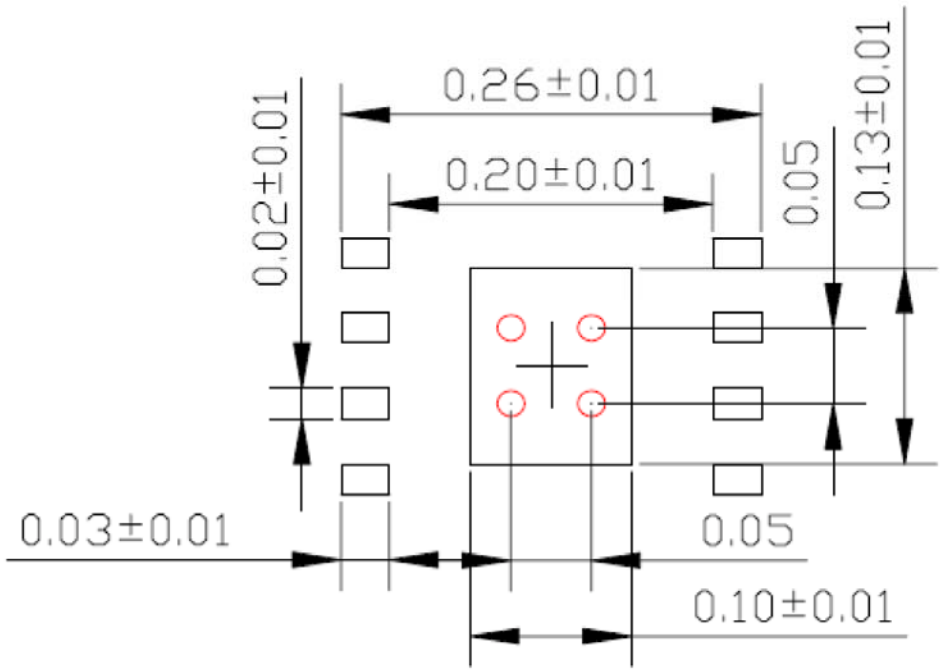
Package Information



8-Pin Exposed Pad SOIC (ME)

Recommended Land Pattern

LP # SOICNEP-8LD-LP-1
All units are in inches
Tolerance ± 0.05 if not noted



A red circle indicates a Thermal Via. Size should be .015-.017 inches in diameter and it should be connected to GND plane for maximum thermal performance.

8-Pin Exposed Pad SOIC

MICREL, INC. 2180 FORTUNE DRIVE SAN JOSE, CA 95131 USA
TEL +1 (408) 944-0800 FAX +1 (408) 474-1000 WEB http://www.micrel.com

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