MIC5283

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

General Description

The MIC5283 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.

Ideal for high input voltage applications such as industrial and telecom, the MIC5283 offers ±3% initial accuracy, extremely high-power supply rejection ratio (75dB at 10kHz) and an ultra-low quiescent current of 8µA. The MIC5283 is optimized for high-voltage line transients, making it ideal for harsh environment applications.

The MIC5283 is offered in both fixed output voltage (3.3V or 5.0V) and adjustable output voltage (1.22V to 5.5V) options.

The MIC5283 operates over a –40°C to +125°C temperature range and is available in lead-free, RoHS-compliant, ePad SOIC-8 and 3mm x 3mm MLF® packages.

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

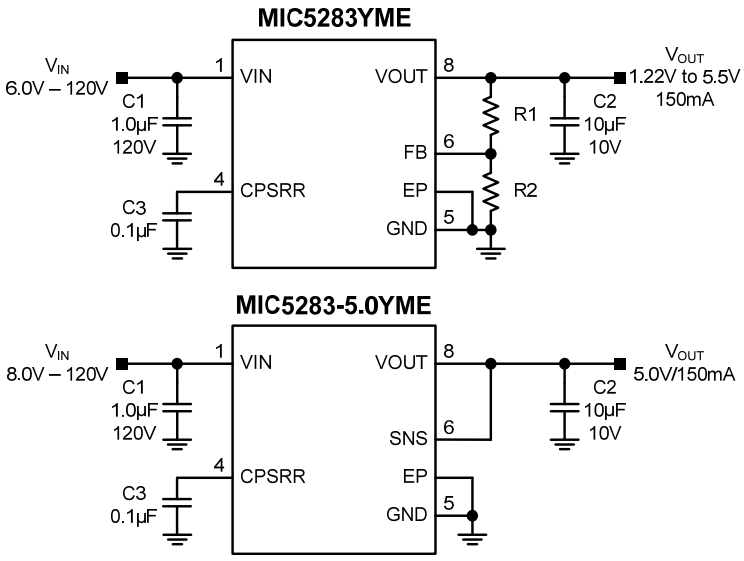
Features

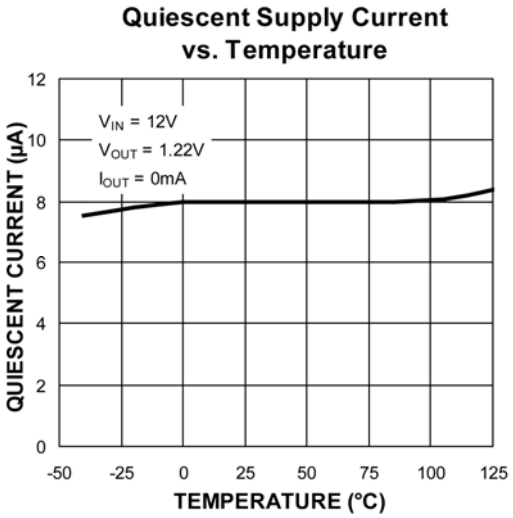
- Wide input voltage range: 6V to 120V DC
- Ultra-low quiescent current: 8µA
- 150mA guaranteed output current
- Adjustable output from 1.22V to 5.5V
- Stable with ceramic capacitors
- Ultra-high PSRR (75dB at 10kHz)
- Ultra-high line rejection (load dump)
- High output accuracy:
  - ±3% initial accuracy
- Thermal-shutdown and current-limit protection
- Thermally-efficient, 8-pin ePad SOIC package
- Very low-profile 3mm x 3mm MLF® package

Applications

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

Typical Applications





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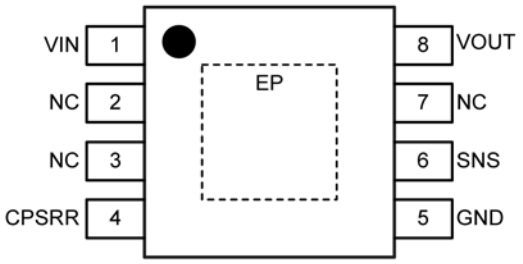
Ordering Information

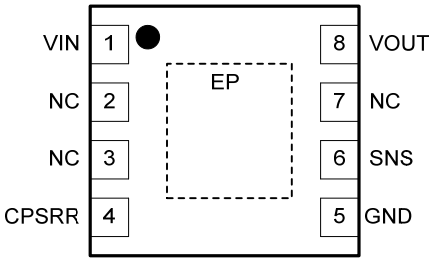
Part Number	Output Voltage	Top Mark	Temperature Range	Package	Lead Finish
MIC5283YME	Adjustable	5283YME	–40°C to +125°C	8-Pin ePad SOIC	Pb-Free
MIC5283-3.3YME	3.3V	5283-33YME	–40°C to +125°C	8-Pin ePad SOIC	Pb-Free
MIC5283-5.0YME	5.0V	5283-50YME	–40°C to +125°C	8-Pin ePad SOIC	Pb-Free
MIC5283YML	Adjustable	A83	–40°C to +125°C	3mmx3mm MLF®-8L	Pb-Free
MIC5283-3.3YML	3.3V	8S3	–40°C to +125°C	3mmx3mm MLF®-8L	Pb-Free
MIC5283-5.0YML	5.0V	583	–40°C to +125°C	3mmx3mm MLF®-8L	Pb-Free

Pin Configuration



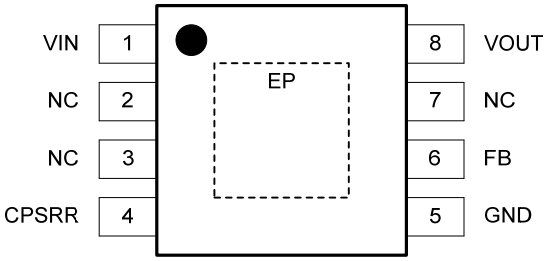
8-Pin ePAD SOIC
MIC5283-x.xYME
Fixed Voltage Output

(TOP VIEW)



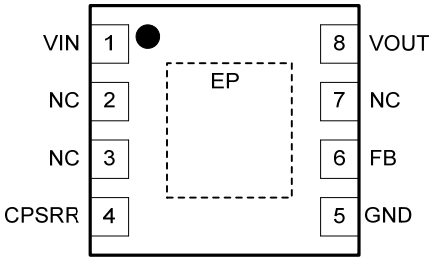
3mm x 3mm MLF®-8L
MIC5283-x.xYML
Fixed Voltage Output

(TOP VIEW)



8-Pin ePAD SOIC
MIC5283YME
Adjustable Voltage Output

(TOP VIEW)



3mm x 3mm MLF®-8L
MIC5283YML
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	EP	Exposed Pad (ePad) for Thermal Dissipation. Connect EP 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 ..... +1.22V 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
3mm x 3mm MLF®-8 ..... 60°C/W

Electrical Characteristics[5]

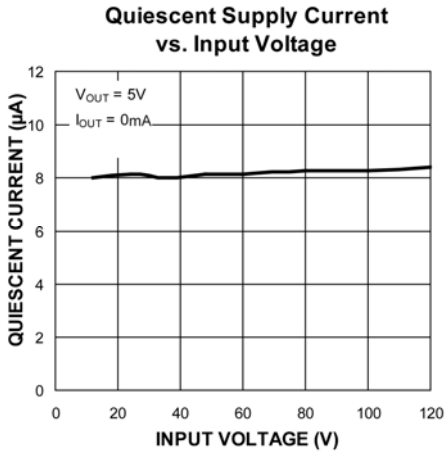
V_{IN} = 12V, C_{IN} = 1.0µF, C_{PSRR} = 0.1µF, C_{OUT} = 10µF, V_{OUT} = 5.0V or 3.3V, I_{OUT} = 100µA, T_A = 25°C, **bold** values indicate $-40°C \le T_J \le +125°C$, unless noted.

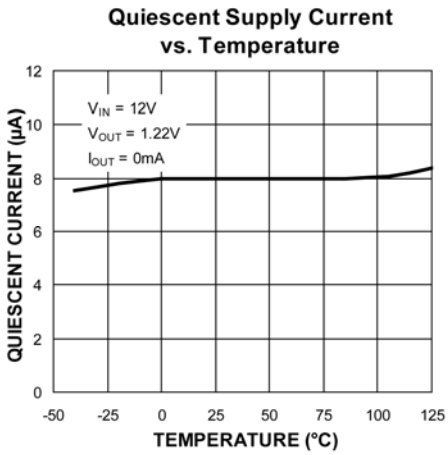
Parameter	Condition		Min.	Typ.	Max.	Units
Power Supply Input						
Input Voltage Range			6		120	V
Quiescent Supply Current	I_{OUT} = 0			8	**14**	µA
Output Voltage						
Output Voltage Accuracy	Variation from nominal V_{OUT}		-3		+3	%
	100µA ≤ I_{OUT} ≤ 150mA		**-5**		**+5**	%
Line Regulation[6]	10V ≤ V_{IN} ≤ 120V		**-0.5**	0.04	**+0.5**	%/V
Feedback Input (Adjustable)						
FB Voltage	100µA ≤ I_{OUT} ≤ 150mA		1.183	1.220	1.256	V
			1.159	1.220	**1.281**	
FB Current	V_{FB} = 1.22V			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

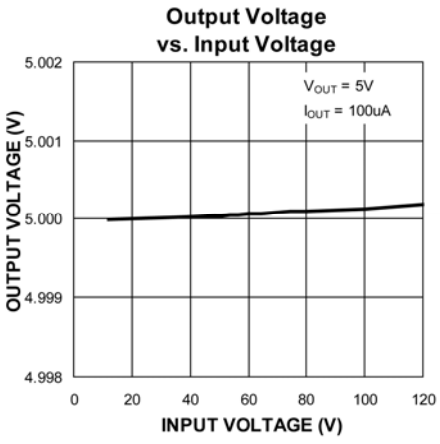
Notes:

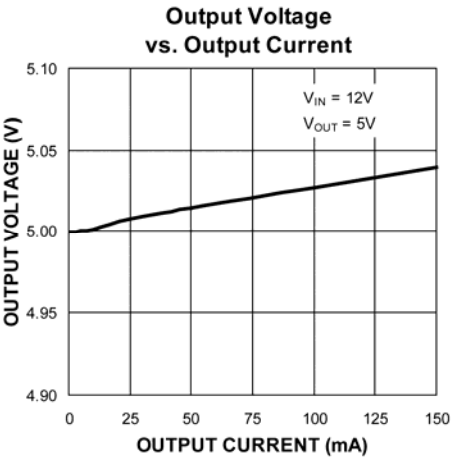
1. Exceeding an absolute maximum rating may damage the device.
2. The device is not guaranteed to function outside its operating rating.
3. The maximum allowable power dissipation at any T_A (ambient temperature) is $P_{D(max)} = (T_{J(max)} - T_A) / \theta_{JA}$. Exceeding the maximum allowable power dissipation results in excessive die temperature, and causes the regulator to enter thermal shutdown.
4. Devices are ESD sensitive; use proper handling precautions.
5. Specifications are for packaged products only.
6. Line regulation is a percentage of V_{OUT}.

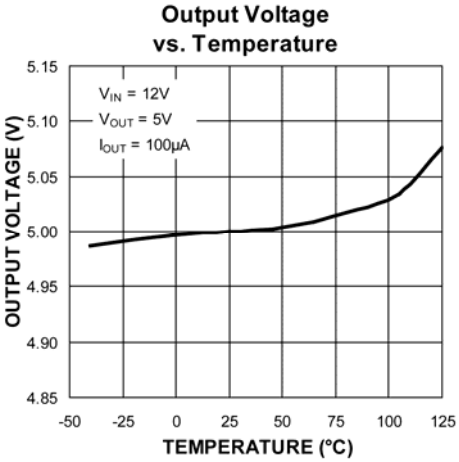
Typical Characteristics

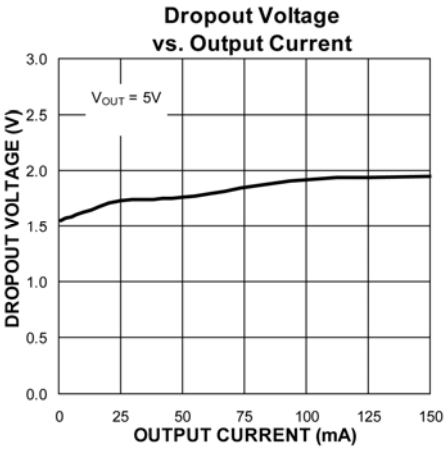


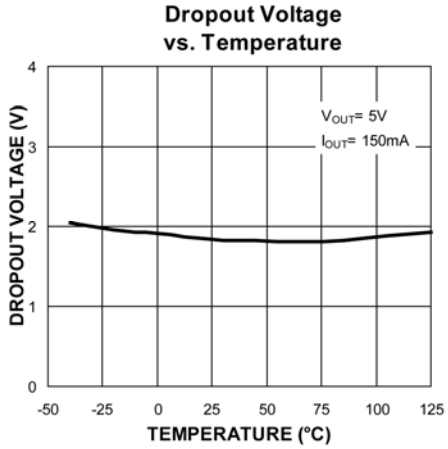


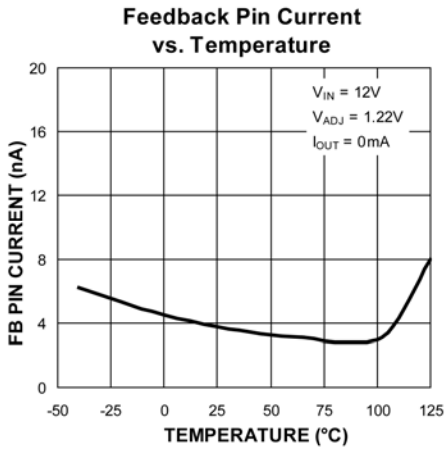


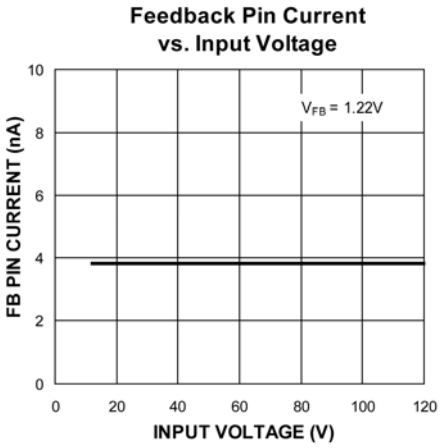




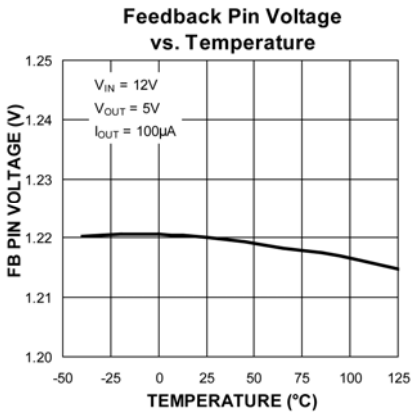


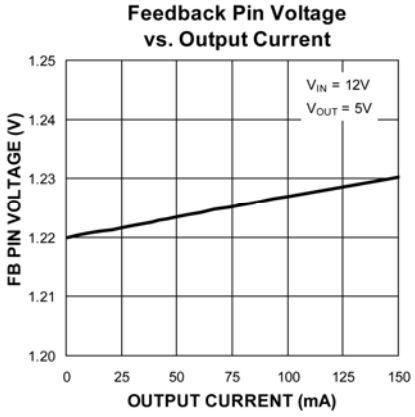


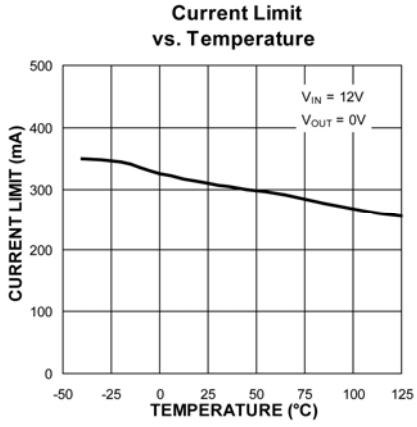


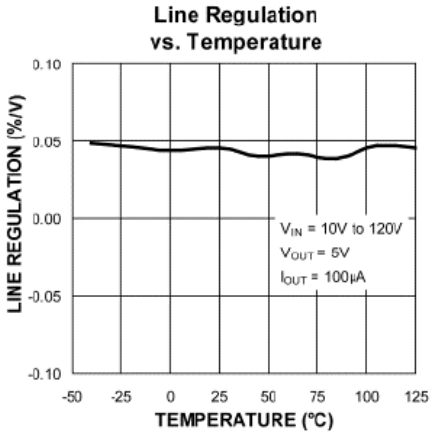


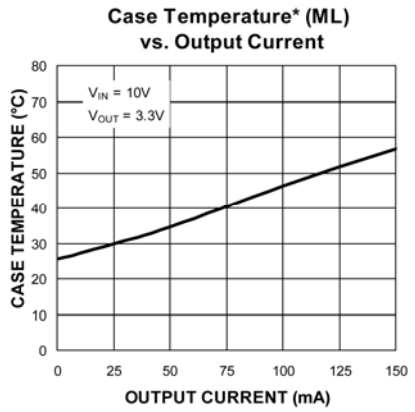
Typical Characteristics (Continued)

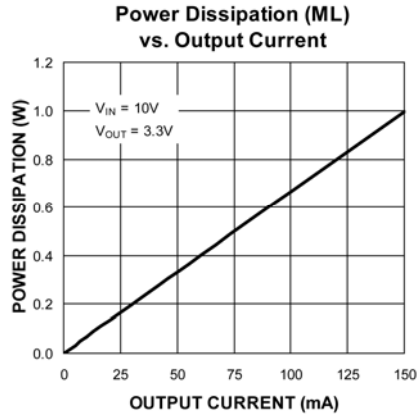


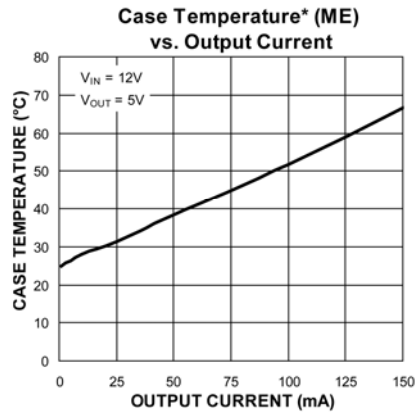


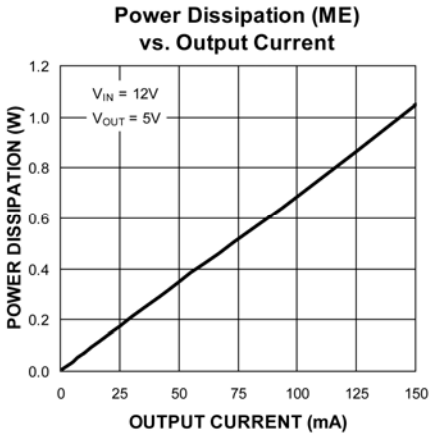


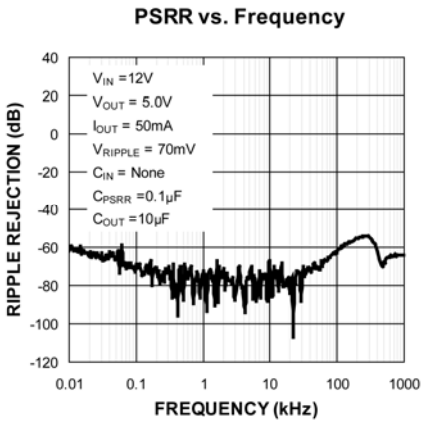








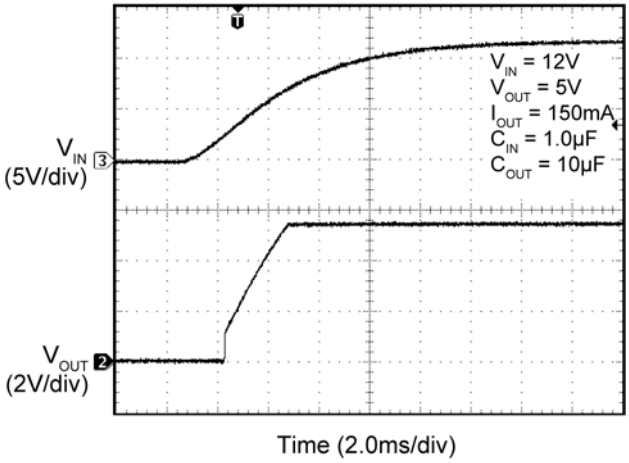




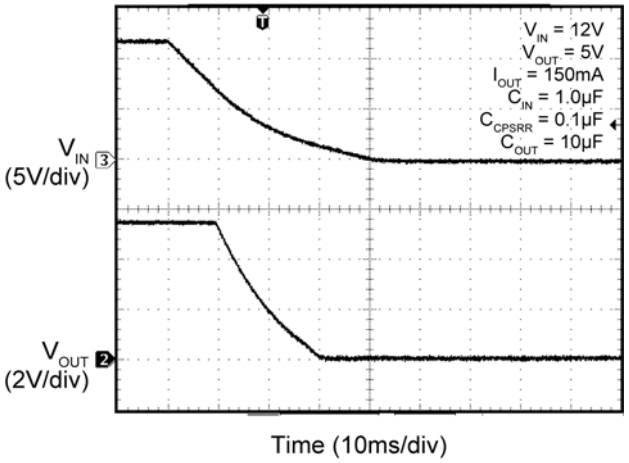
Case Temperature*: The temperature measurement was taken at the hottest point on the MIC5283 case mounted on a 2.25 square inch PCB at an ambient temperature of 25°C; see “Thermal Measurement” section. Actual results will depend upon the size of the PCB, ambient temperature and proximity to other heat emitting components.

Functional Characteristics

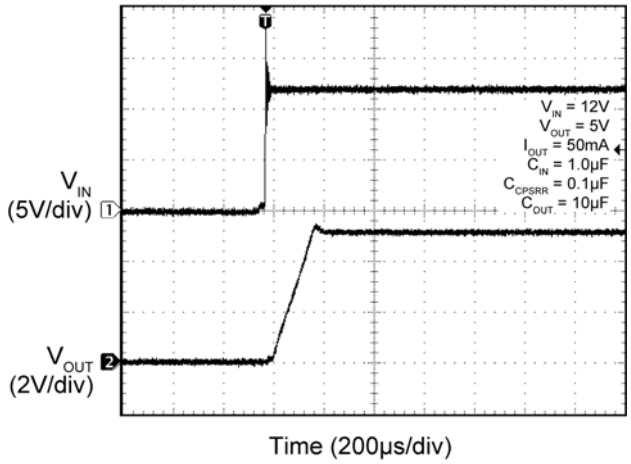
Soft Turn-On into Full Load



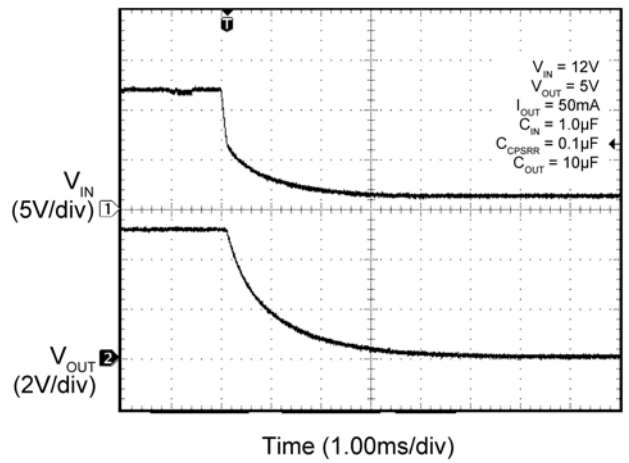
Soft Turn-Off



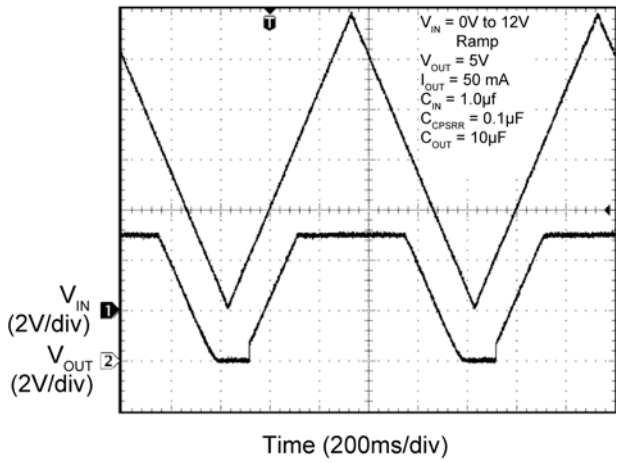
Fast Turn-On



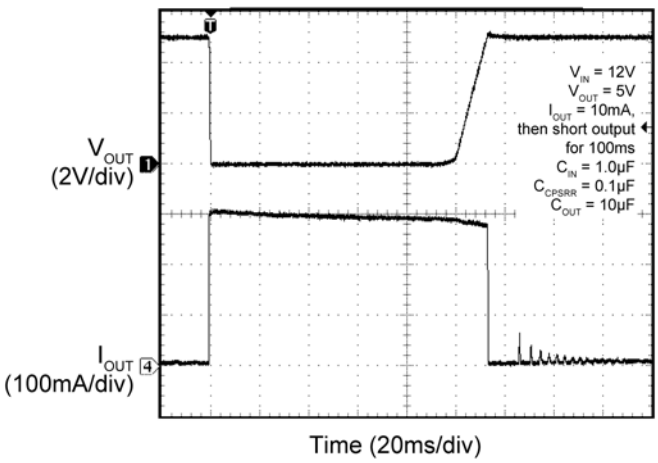
Fast Turn-Off



V_{IN} ULVO Threshold

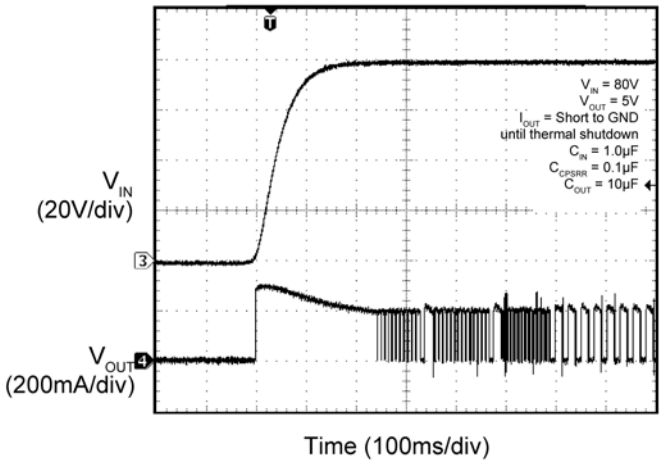


Current Limit

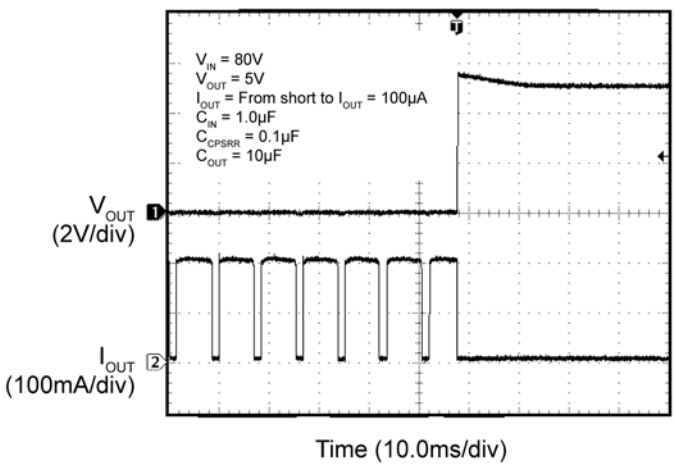


Functional Characteristics (Continued)

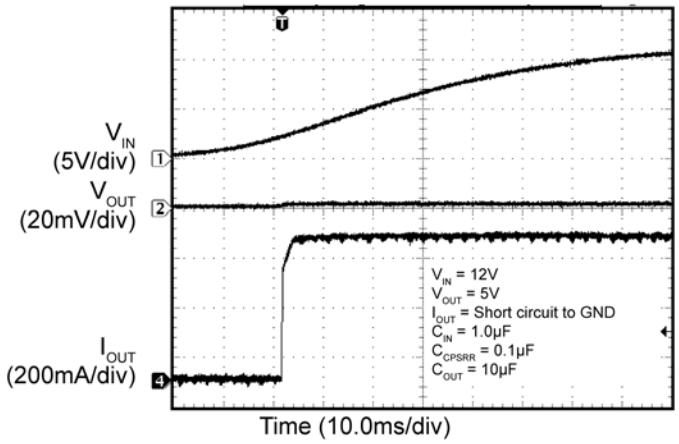
Thermal Shutdown Response



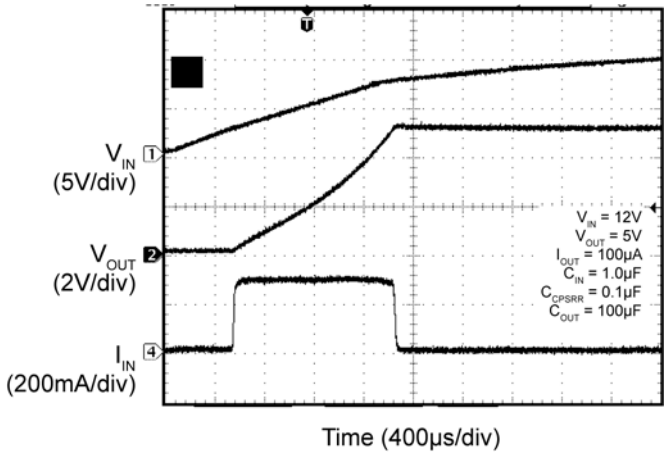
V_{OUT} Recovery from Thermal Shutdown



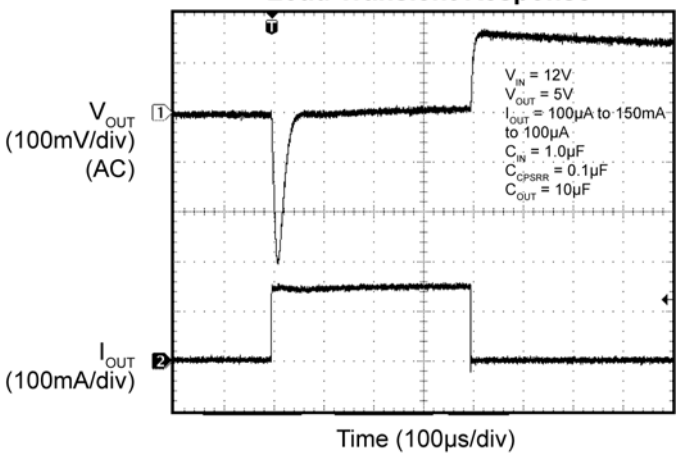
Turn-On into Short Circuit



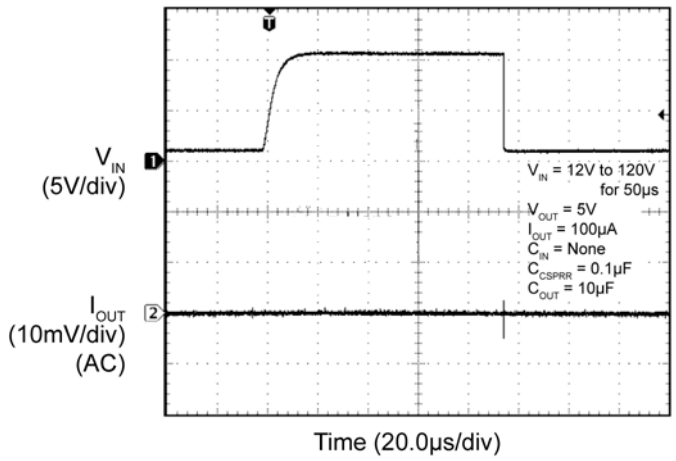
Inrush Current Response



Load Transient Response



Line Transient Response



Detailed Description

The MIC5283 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 MIC5283YML and MIC5283YME offer an adjustable output voltage from 1.22V to 5.5V. The MIC5283-3.3YML and MIC5283-3.3YME offer fixed 3.3V outputs and the MIC5283-5.0YML and MIC5283-5.0YME offer fixed 5.0V outputs. The YME packaged devices feature a heat slug to more effectively remove heat from the die.

Applications Information

Thermal Protection

The MIC5283 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 will result in a cycled output during continuous thermal-overload conditions.

Current Limit

The MIC5283 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 MIC5283 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, assure that the voltage rating of the capacitor has adequate 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

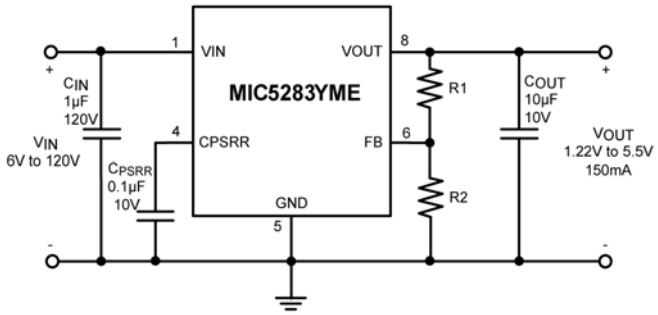
Connect a 10µF capacitor from VOUT to GND. Assure that the voltage rating of the capacitor exceeds the designed output voltage of the MIC5283.

Output Voltage Setting

For the MIC5283YML and MIC5283YME, V_{OUT} is programmable from 1.22V to 5.5V using an external resistive divider. V_{OUT} is set using the following equation:

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

where V_{REF} = 1.22V, and R1 and R2 form the feedback voltage divider from V_{OUT} to ground.

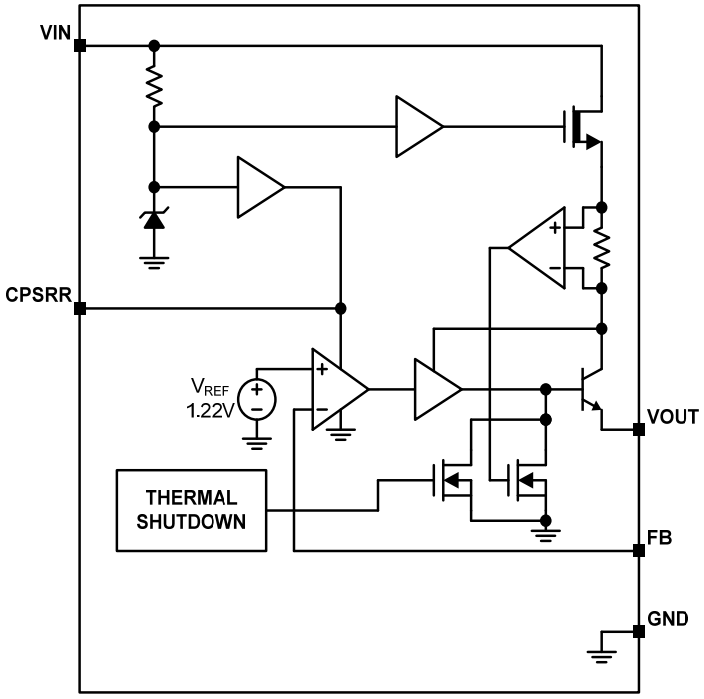


Thermal Measurements

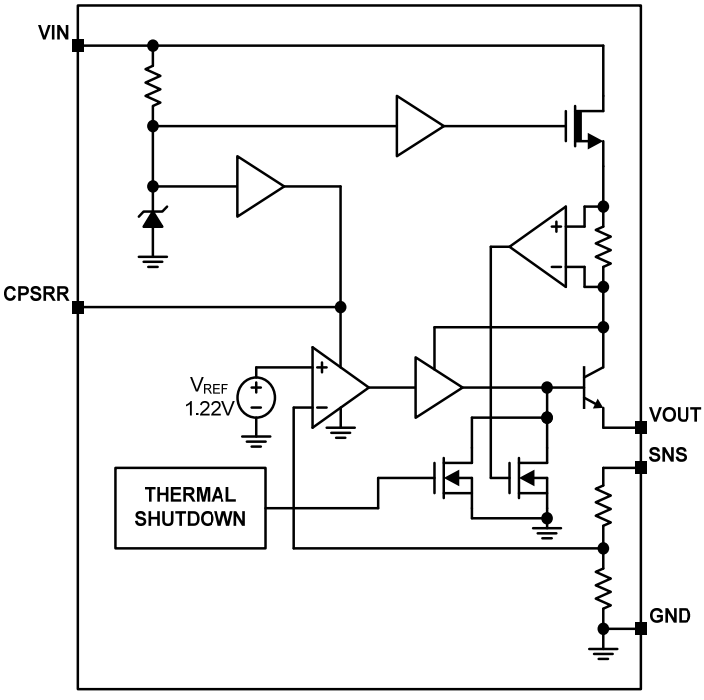
It is always prudent to measure an IC's case temperature to make sure that it is within operating limits, but it is easy to get erroneous results. The standard thermocouple that comes with many voltage meters uses a large wire gauge that behaves like a heat-sink, resulting in artificially low case temperature 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, 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

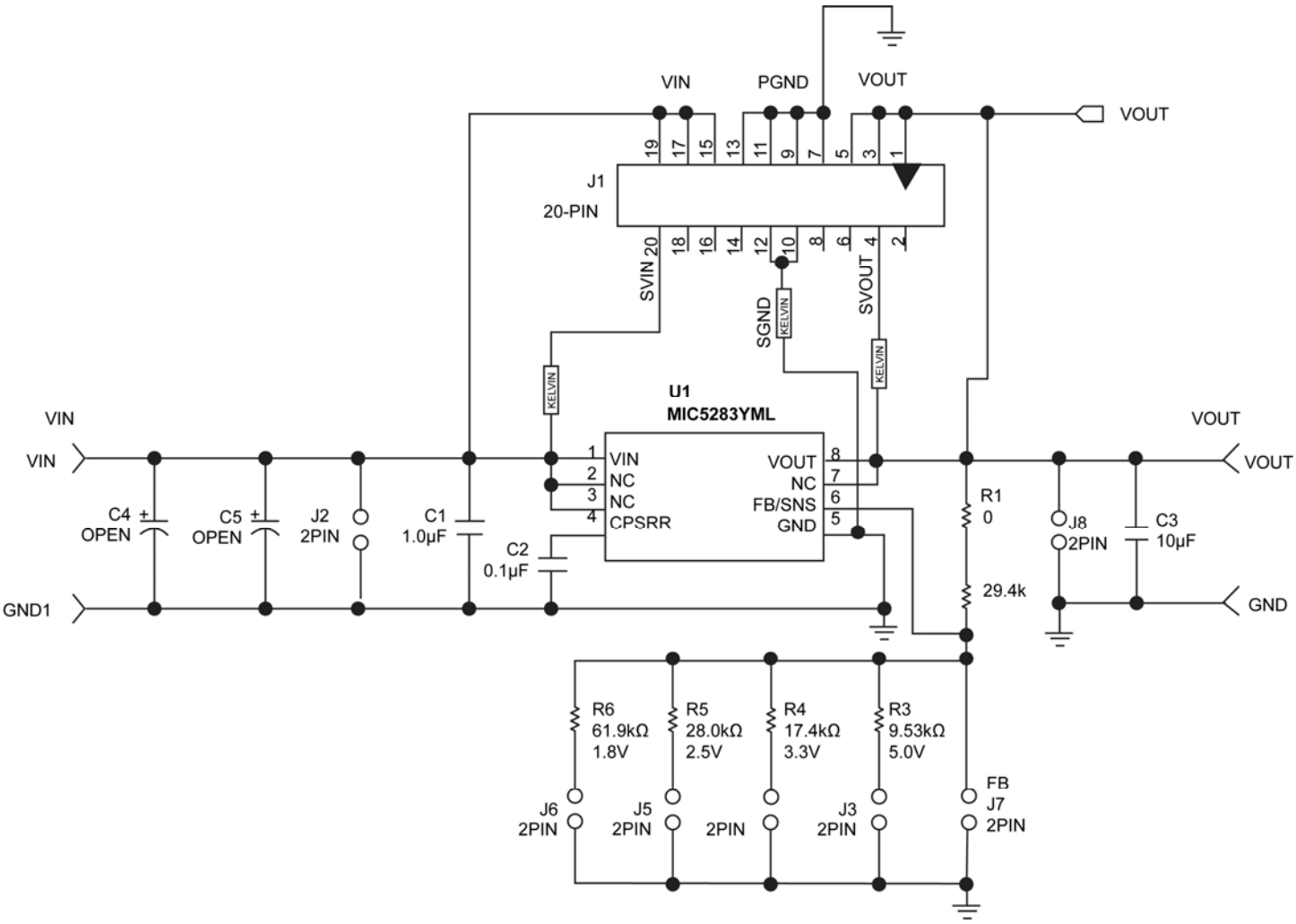


MIC5283 Adjustable Version



MIC5283 Fixed Version

MIC5283 Evaluation Board Schematic



MIC5283 Evaluation Board Schematic

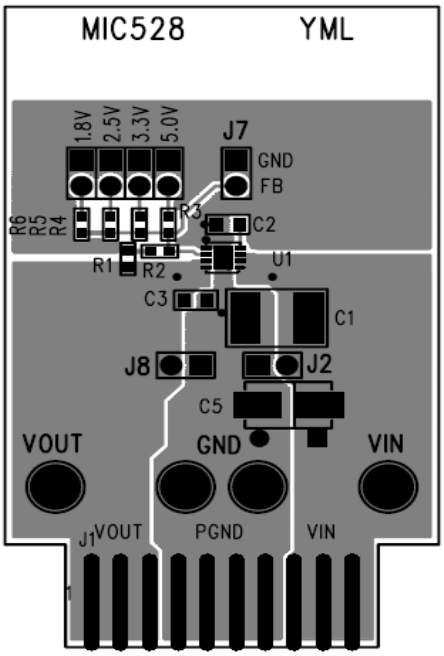
Bill of Materials

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[2]	10µF, 10V, 20%, X5R, capacitor (0805)	1
R1	CRCW06030000F	Vishay/Dale[3]	0Ω, 1% resistor, 0603	1
R2	CRCW06032942F	Vishay/Dale[3]	29.4kΩ, 1% resistor, 0603	1
R3	CRCW06039531F	Vishay[3]	9.53kΩ Film Resistor, Size 0603, 1%	1
R4	CRCW06031742F	Vishay[3]	17.4kΩ Film Resistor, Size 0603, 1%	1
R5	CRCW06032802F	Vishay[3]	28.0kΩ Film Resistor, Size 0603, 1%	1
R6	CRCW06036192F	Vishay[3]	61.9kΩ Film Resistor, Size 0603, 1%	1
U1	**MIC5283YML**	**Micrel[4]**	**120V_{IN}, 150mA, Ultra-Low I_Q, High-PSRR Linear Regulator**	**1**

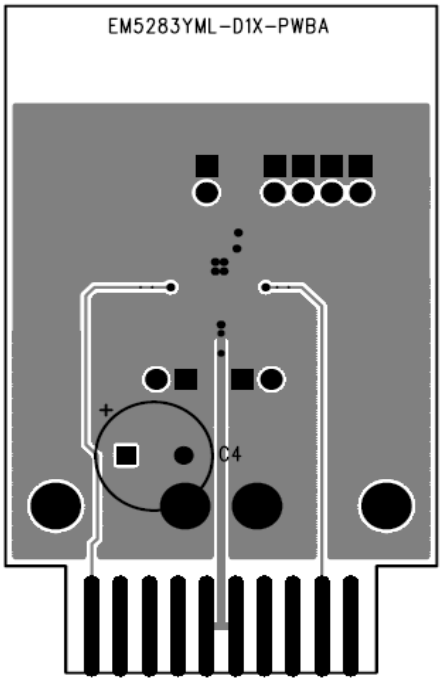
Notes:

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

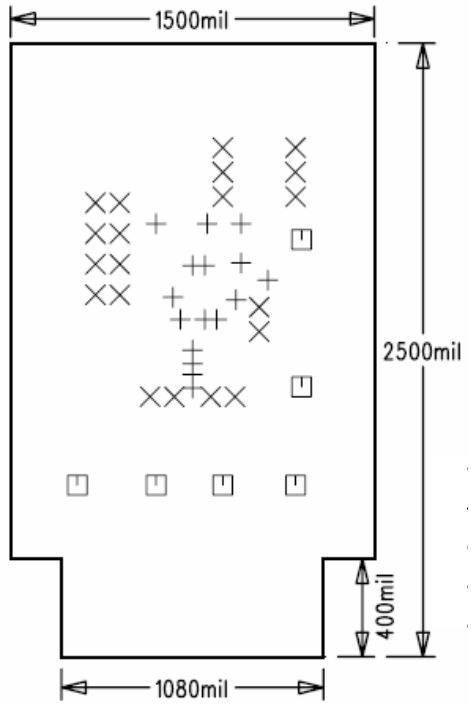


Top Layer



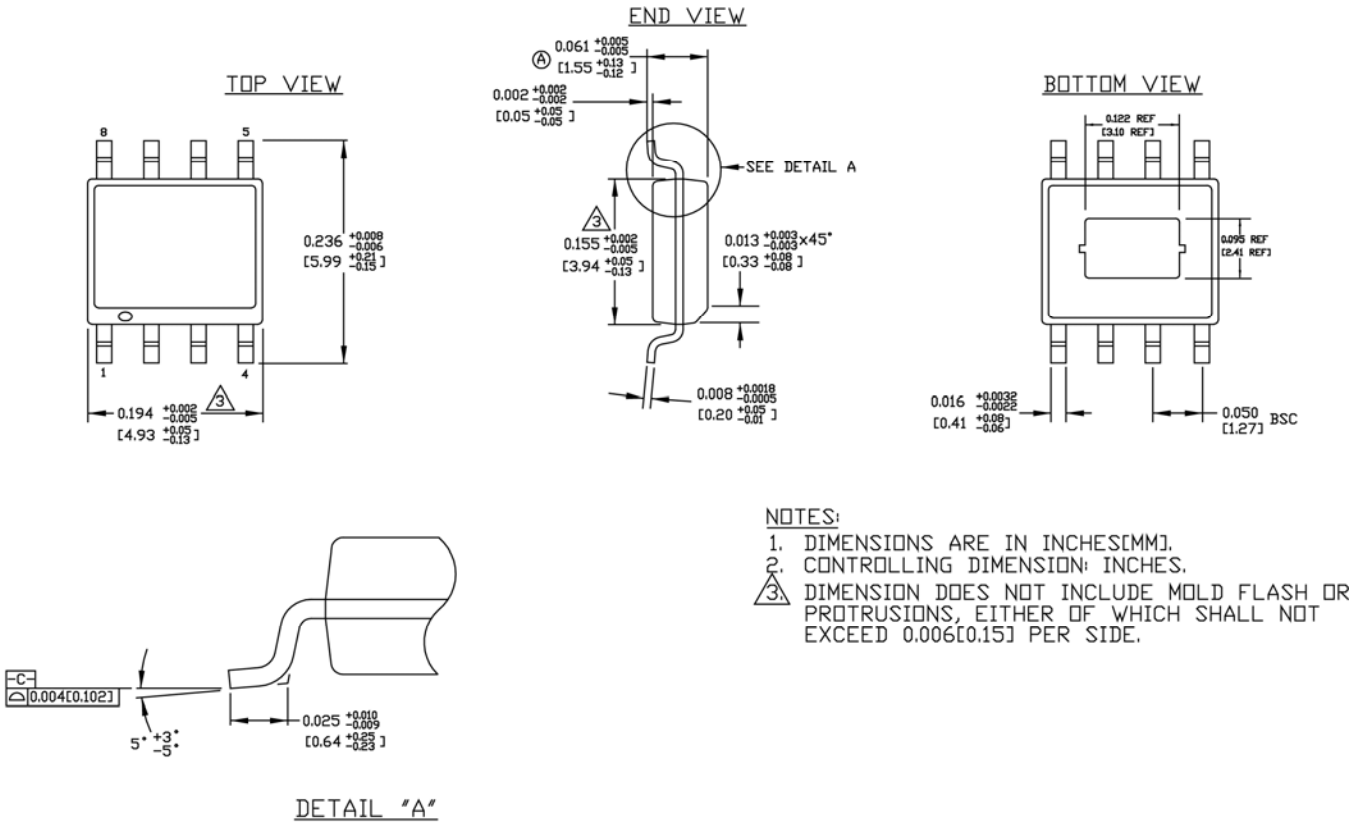
Bottom Layer

PCB Evaluation Board Layout (Continued)



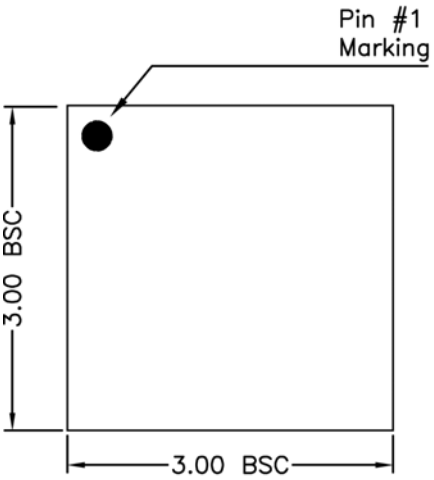
EV Board Dimensions

Package Information

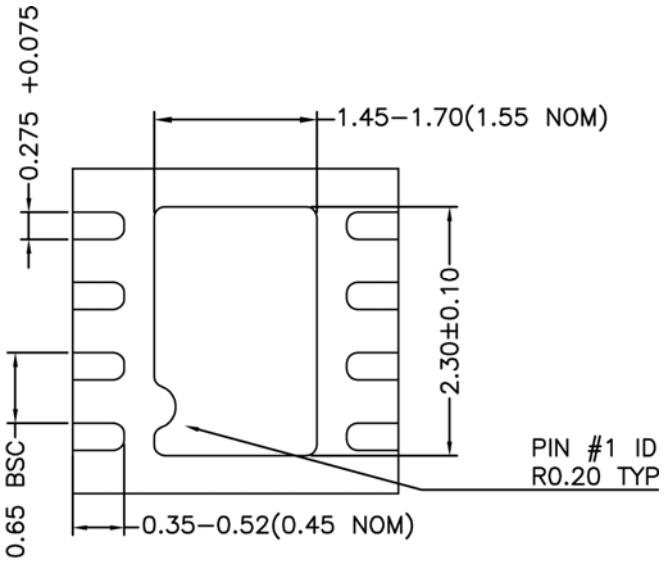


8-Pin Exposed Pad SOIC (ME)

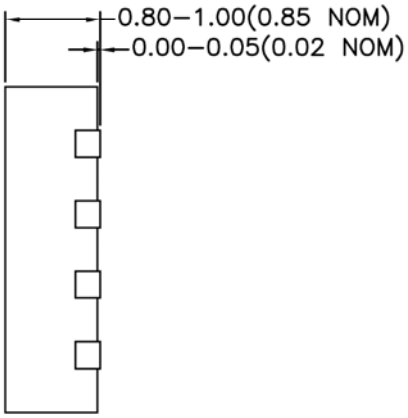
Package Information (Continued)



TOP VIEW



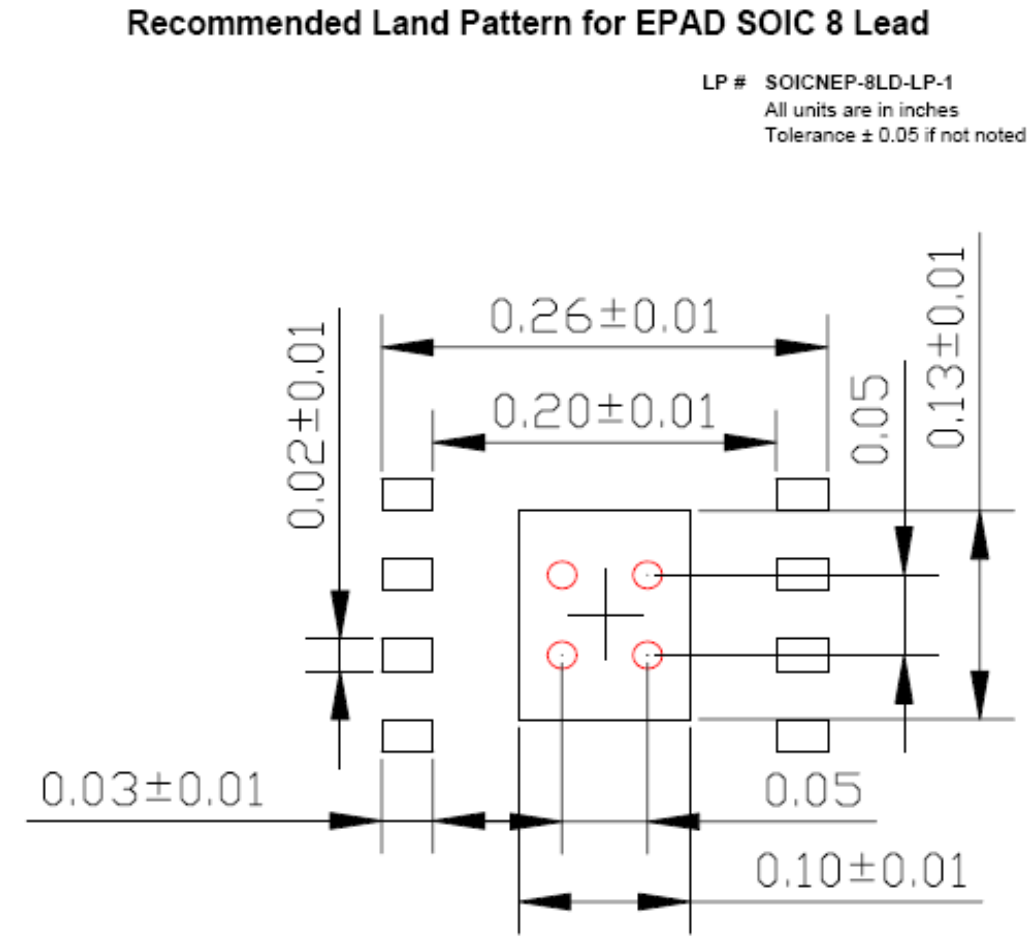
BOTTOM VIEW



SIDE VIEW

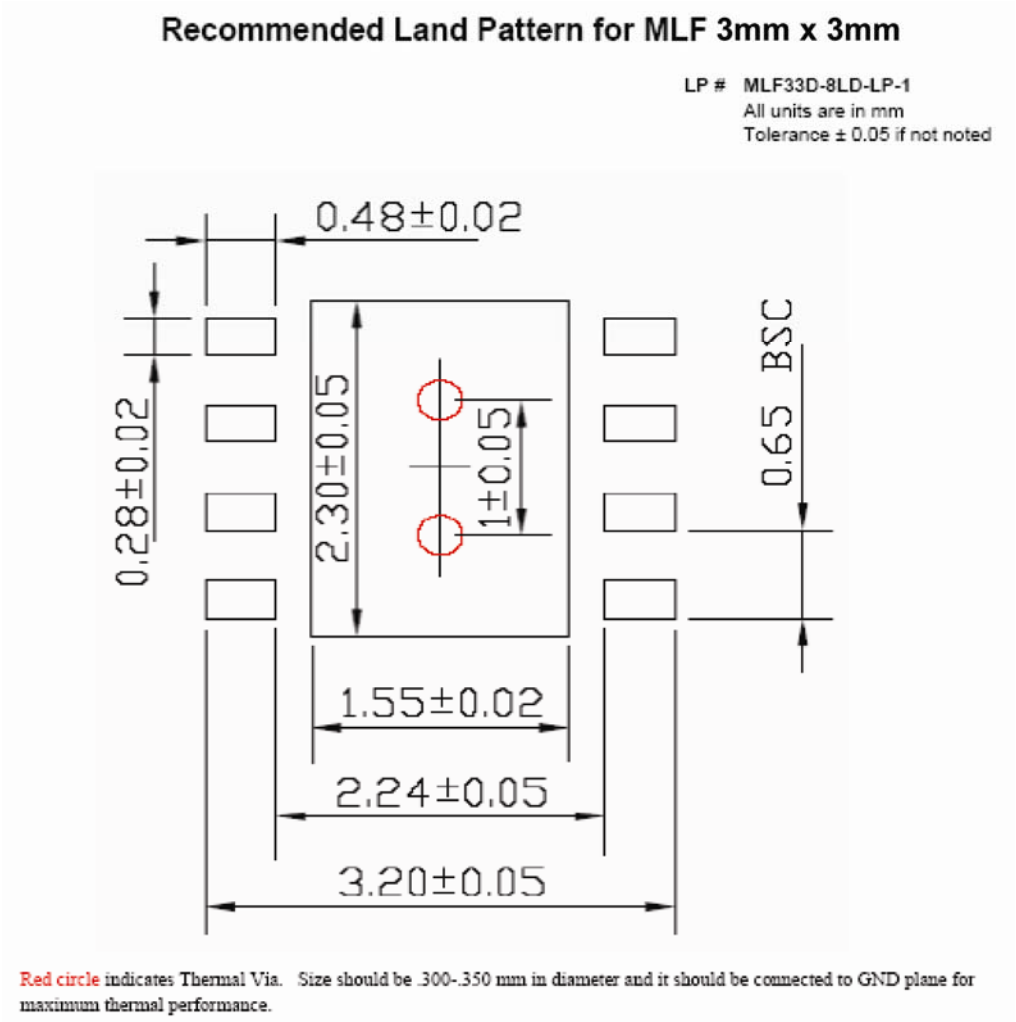
8-Pin 3mmx3mm MLF® (ML)

Recommended Land Pattern



8-Pin Exposed Pad SOIC

Recommended Land Pattern (Continued)



8-Pin 3mm x 3mm MLF®

Red circle indicates Thermal Via. Size should be .300mm – .350mm in diameter, 1.00mm pitch, and it should be connected to GND plane for maximum thermal performance.

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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Телефон: 8 (812) 309-75-97 (многоканальный)
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Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А