MIC5212

Dual 500 mA LDO Regulator

Features

- Fused-Lead Frame SOIC-8
- Up to 500 mA per Regulator Output
- Low Quiescent Current
- Low Dropout Voltage
- Tight Load and Line Regulation
- Low Temperature Coefficient
- Current and Thermal Limiting
- Reversed Input Polarity Protection

Applications

- Hard Disk Drives
- CD R/W
- Barcode Scanners
- SMPS Post Regulator and DC/DC Modules
- High-Efficiency Linear Power Supplies

General Description

The MIC5212 is a dual linear voltage regulator with very low dropout voltage (typically 10 mV at light loads and 350 mV at 500 mA), very low ground current (225 µA at 10 mA output), and better than 1% initial accuracy.

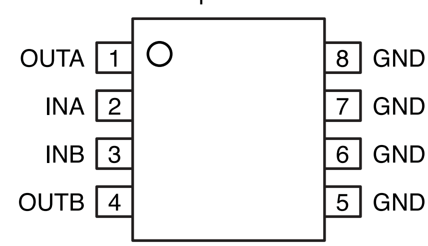
Both regulator outputs can supply up to 500 mA at the same time as long as each regulator's maximum junction temperature is not exceeded.

Key features include current limiting, overtemperature shutdown, and protection against reversed battery.

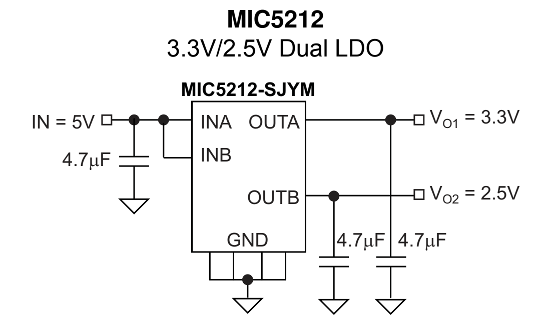
The MIC5212 is available in a fixed 3.3V/2.5V output voltage configuration. Other voltages are available; contact Microchip for details.

Package Type

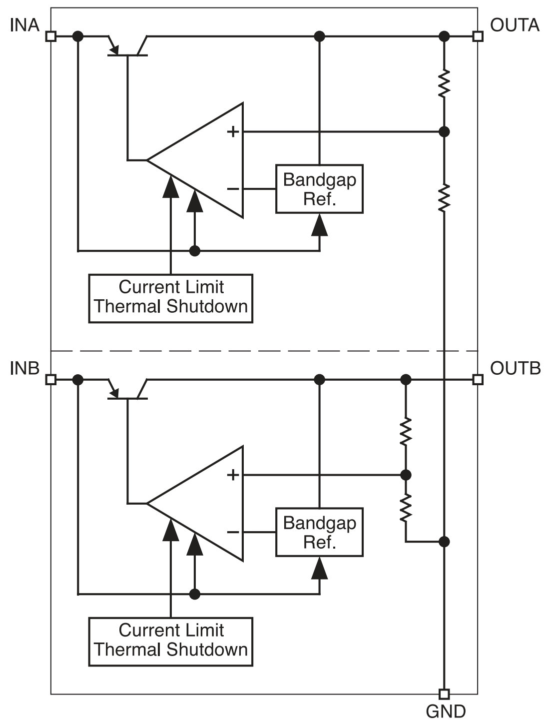
MIC5212
SOIC-8
Top View



Typical Application Circuit



Functional Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Input Voltage, (V_{IN} A or B) .... –20V to +20V
Power Dissipation .... Internally Limited

Operating Ratings ††

Supply Input Voltage, (V_{IN}) .... +2.5V to +16V

† Notice: Exceeding the absolute maximum rating may damage the device.
†† Notice: The device is not guaranteed to function outside its operating rating.

DC CHARACTERISTICS

Electrical Characteristics: Unless otherwise indicated, Regulator A and B $V_{IN} = V_{OUT}$ + 1V; I_L = 100 µA; C_L = 4.7 µF; T_J = +25°C, bold values indicate –40°C ≤ T_J ≤ +125°C.

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Voltage Accuracy	V_O	–1	—	1	%	Variation from specified V_{OUT}
		–2	—	**2**	%	
Output Voltage Temperature Coefficient	$\Delta V_O/\Delta T$	—	**40**	—	ppm/°C	Note 1
Line Regulation	$\Delta V_O/V_O$	—	0.009	0.05	%/V	$V_{IN} = V_{OUT}$ + 1V to 16V
		—	—	**0.1**	%/V	
Load Regulation	$\Delta V_O/V_O$	—	0.05	0.7	%	I_L = 0.1 mA to 500 mA, Note 2
		—	—	**1**	%	
Dropout Voltage, **Note 3** (per regulator)	$V_{IN} - V_O$	—	175	275	mV	I_L = 150 mA
		—	—	**350**	mV	
		—	350	500	mV	I_L = 150 mA
		—	—	**600**	mV	
Ground Pin Current, **Note 4** (per regulator)	I_{GND}	—	1.5	2.5	mA	I_L = 150 mA
		—	—	**3.0**	mA	
		—	12	20	mA	I_L = 150 mA
		—	—	**25**	mA	
Ripple Rejection	PSRR	—	75	—	dB	f = 120 Hz, I_L = 150 mA
Current Limit	I_{LIMIT}	—	**750**	1000	mA	V_{OUT} = 0V
Spectral Noise Density	—	—	500	—	$nV/\sqrt{Hz}$	V_{OUT} = 2.5V, I_{OUT} = 50 mA, C_{OUT} = 2.2 µF

Note 1: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

2: Regulation is measured at constant junction temperature using low duty cycle pulse testing. Parts are tested for load regulation in the load range from 0.1 mA to 500 mA. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

3: 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.

4: Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Storage Temperature Range	T_A	–60	—	+150	°C	—
Lead Temperature	T_J	—	+260	—	°C	Soldering, 5 sec.
Junction Temperature	T_J	–40	—	+125	°C	—
Package Thermal Resistances						
Thermal Resistance, SOIC-8Ld	θ_{JC}	—	20	—	°C/W	Note 2
	θ_{JA}	—	63	—	°C/W	

Note 1: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +125°C rating. Sustained junction temperatures above +125°C can impact the device reliability.

2: Absolute maximum ratings indicate limits beyond which damage to the component may occur. Electrical specifications do not apply when operating the device outside of its operating ratings. The maximum allowable power dissipation is a function of the maximum junction temperature, $T_{J(max)}$, the junction-to-ambient thermal resistance, θ_{JA}, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using: $P_{D(max)} = (T_{J(max)} – T_A) \div \theta_{JA}$. 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 8-lead SOIC (M) is 63°C/W mounted on a PC board.

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

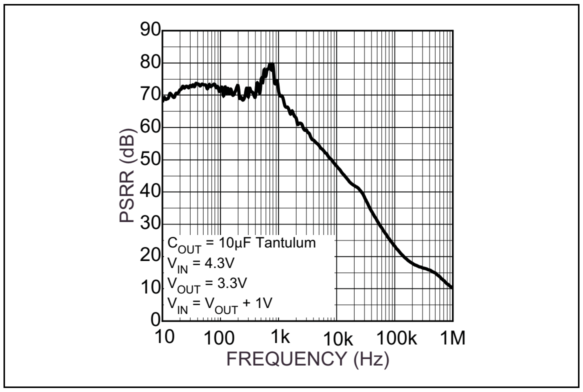


FIGURE 2-1: MIC5212-3.3 PSRR 150 mA Load.

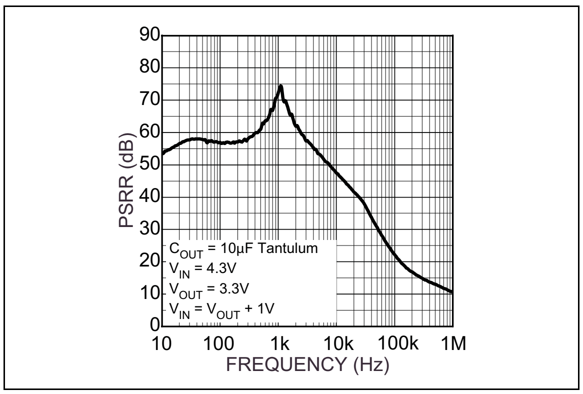


FIGURE 2-2: MIC5212-3.3 PSRR 500 mA Load.

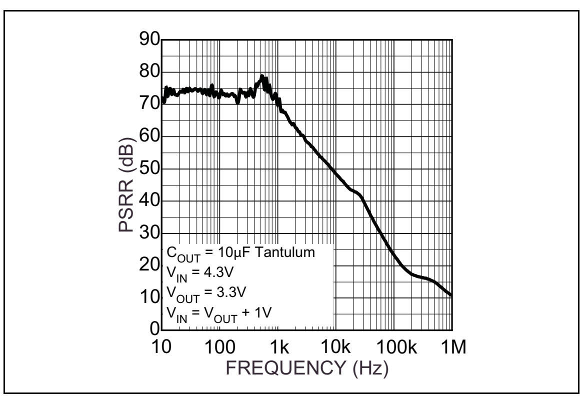


FIGURE 2-3: MIC5212-2.5 PSRR 150 mA Load.

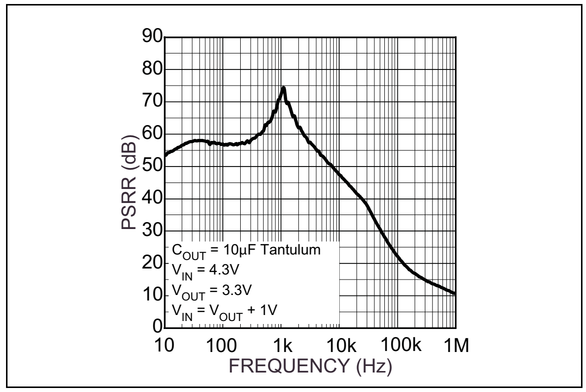


FIGURE 2-4: MIC5212-2.5 PSRR 500 mA Load.

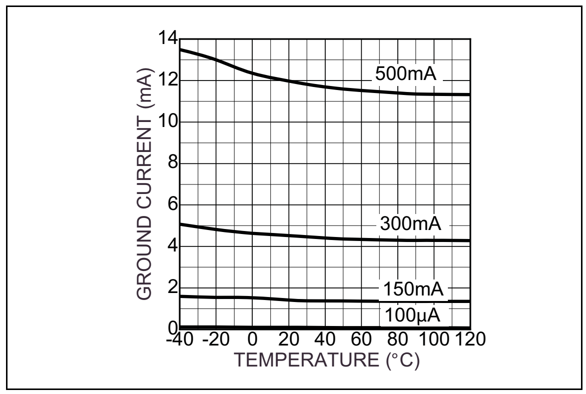


FIGURE 2-5: Ground Current vs. Temperature.

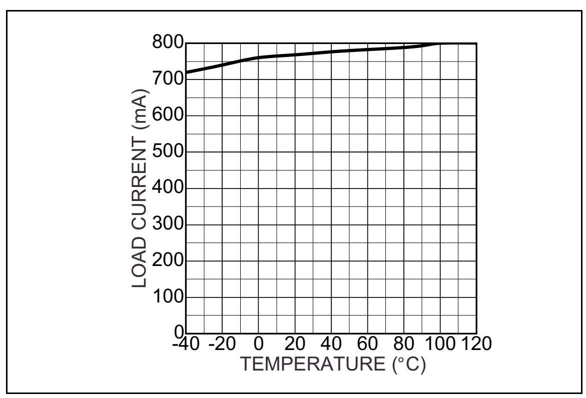


FIGURE 2-6: Short Circuit Current vs. Temperature.

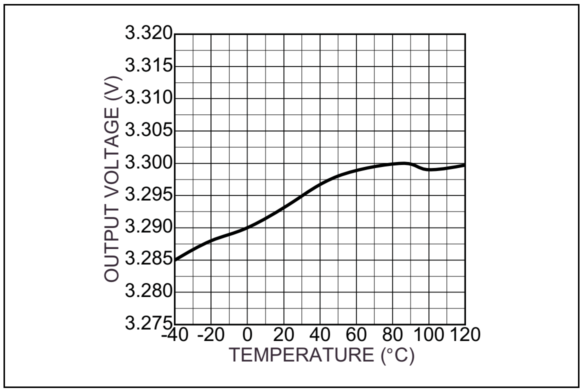


FIGURE 2-7: *Output Voltage vs. Temperature.*

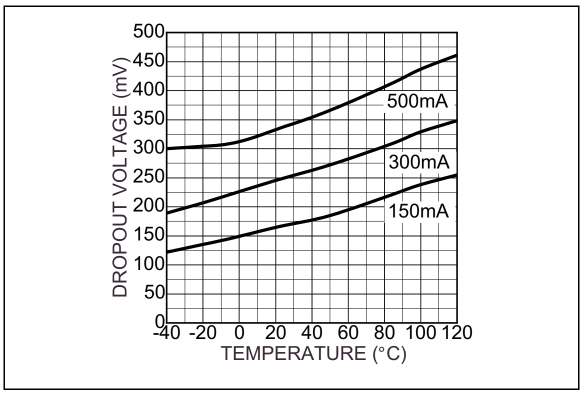


FIGURE 2-8: *Dropout Voltage vs. Temperature.*

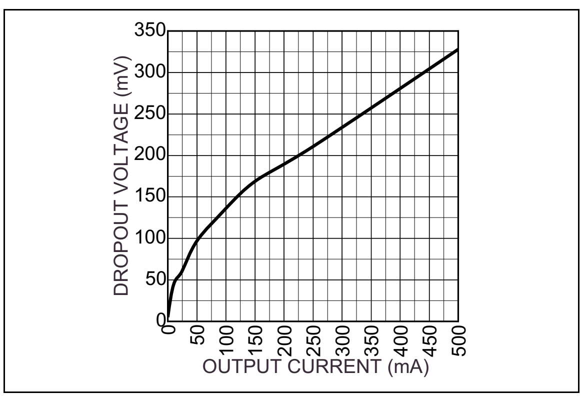


FIGURE 2-9: *Dropout Voltage vs. Load Current.*

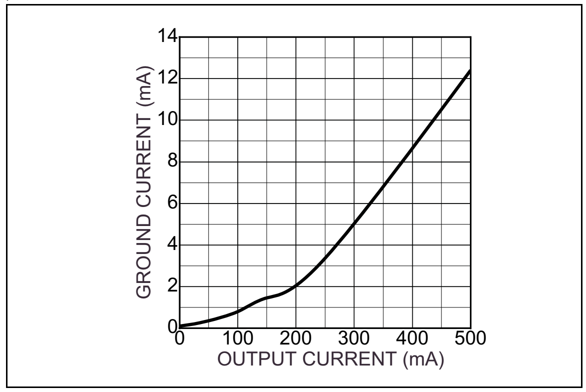


FIGURE 2-10: *Ground Current vs. Load Current.*

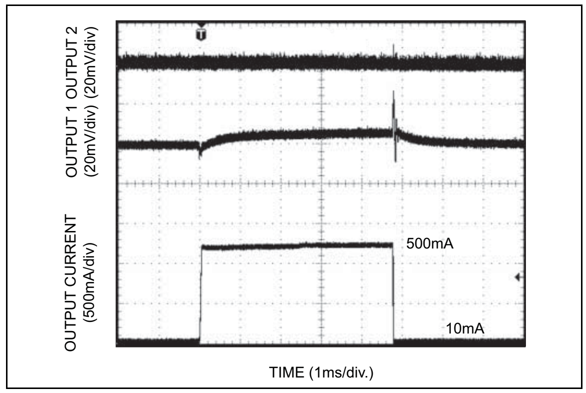


FIGURE 2-11: *Output 1 Load Transient Response.*

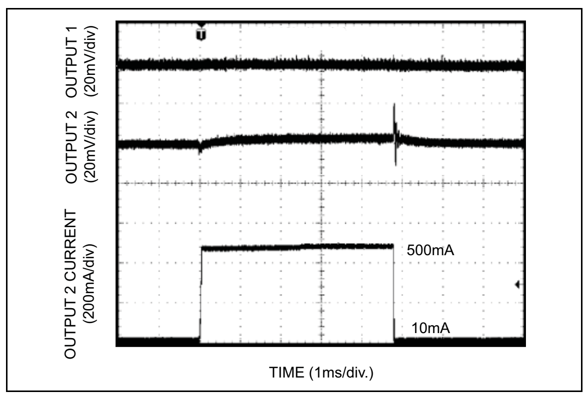


FIGURE 2-12: *Output 2 Load Transient Response.*

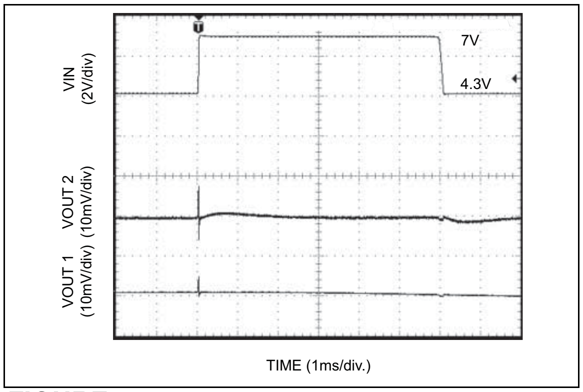


FIGURE 2-13: *Line Transient Response.*

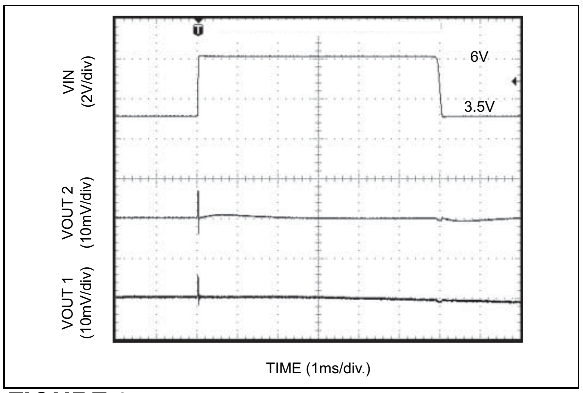


FIGURE 2-14: *Line Transient Response.*

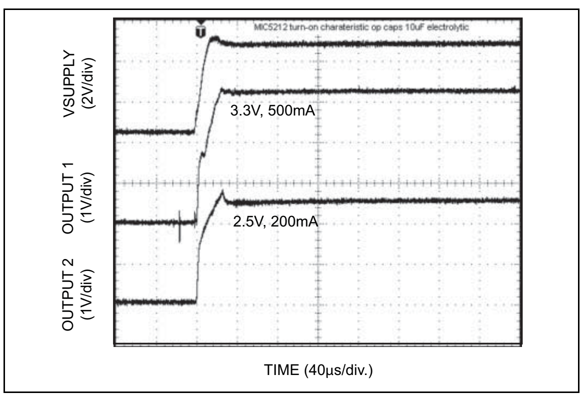


FIGURE 2-15: *Turn-On Response.*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	OUTA	Regulator A Output.
2	INA	Regulator A Input.
3	INB	Regulator B Input.
4	OUTB	Regulator B Output.
5, 6, 7, 8	GND	Ground.

4.0 DEVICE OVERVIEW

4.1 Input Capacitor

A 1 µF capacitor should be placed from IN to GND if there is more than 10 inches of wire between the input and the AC filter capacitor or if a battery is used as the input.

4.2 Output Capacitor

An output capacitor is required between OUT and GND to prevent oscillation. 1.0 µF minimum is recommended. Larger values improve the regulator's transient response. The output capacitor value may be increased without limit.

The output capacitor should have an ESR (Effective Series Resistance) of about 5Ω or less and a resonant frequency above 1 MHz. Ultra-low-ESR capacitors may cause a low-amplitude oscillation and/or underdamped transient response. Most tantalum or aluminum electrolytic capacitors are adequate; film types will work, but are more expensive. Since many aluminum electrolytic capacitors have electrolytes that freeze at about –30°C, solid tantalum capacitors are recommended for operation below –25°C.

At lower values of output current, less output capacitance is required for output stability. The capacitor can be reduced to 0.47 µF for current below 10 mA or 0.33 µF for currents below 1 mA.

4.3 No-Load Stability

The MIC5212 will remain stable and in regulation with no load (other than the internal voltage divider) unlike many other voltage regulators. This is especially important in CMOS RAM keep-alive applications.

4.4 Dual-Supply Operation

When used in dual supply systems where the regulator load is returned to a negative supply, the output voltage must be diode clamped to ground.

4.4.1 POWER SO-8 THERMAL CHARACTERISTICS

One of the secrets of the MIC5212's performance is its power SO-8 package featuring half the thermal resistance of a standard SO-8 package. Lower thermal resistance means more output current or higher input voltage for a given package size.

Lower thermal resistance is achieved by joining the four ground leads with the die attach paddle to create a single-unit electrical and thermal conductor. This concept has been used by MOSFET manufacturers for years, proving very reliable and cost effective for the user.

Thermal resistance consists of two main elements, θ_{JC} (junction-to-case thermal resistance) and θ_{CA} (case-to-ambient thermal resistance). See Figure 4-1. θ_{JC} is the resistance from the die to the leads of the package. θ_{CA} is the resistance from the leads to the ambient air and it includes θ_{CS} (case-to-sink thermal resistance) and θ_{SA} (sink-to-ambient thermal resistance).

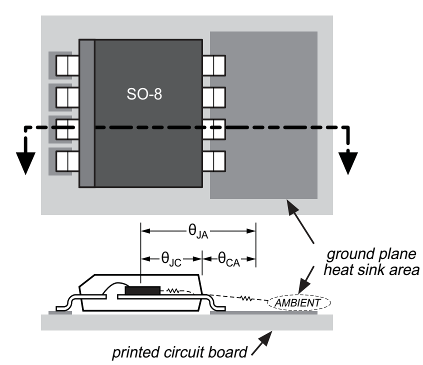


FIGURE 4-1: *Thermal Resistance.*

Using the power SO-8 reduces the θ_{JC} dramatically and allows the user to reduce θ_{CA}. The total thermal resistance, θ_{JA} (junction-to-ambient thermal resistance) is the limiting factor in calculating the maximum power dissipation capability of the device. Typically, the power SO-8 has a θ_{JC} of 20°C/W, this is significantly lower than the standard SO-8 which is typically 75°C/W. θ_{CA} is reduced because pins 5 through 8 can now be soldered directly to a ground plane which significantly reduces the case-to-sink thermal resistance and sink to ambient thermal resistance.

These low dropout linear regulators are rated to a maximum junction temperature of 125°C. It is important not to exceed this maximum junction temperature during operation of the device. To prevent this maximum junction temperature from being exceeded, the appropriate ground plane heat sink must be used.

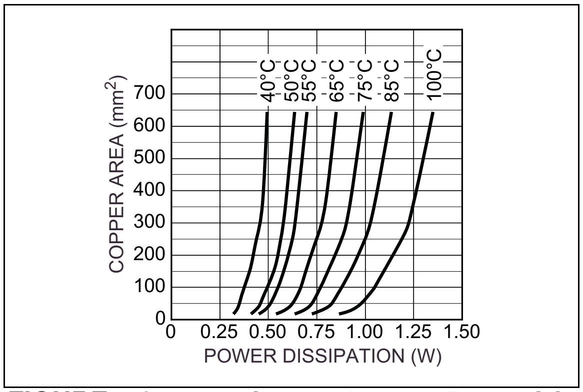


FIGURE 4-2: *Copper Area vs. Power-SO Power Dissipation (ΔT_{JA}).*

Figure 4-2 shows copper area versus power dissipation with each trace corresponding to a different temperature rise above ambient.

From these curves, the minimum area of copper necessary for the part to operate safely can be determined. The maximum allowable temperature rise must be calculated to determine operation along which curve.

EQUATION 4-1:

$$\Delta T = T_{J(max)} - T_{A(max)}$$

Where:

$T_{J(max)}$	=	125°C
$T_{A(max)}$	=	Maximum ambient operating temperature

For example, the maximum ambient temperature is 50°C, the ΔT is determined as shown in Equation 4-2.

EQUATION 4-2:

ΔT	=	125°C – 50°C
ΔT	=	75°C

Using Figure 4-2, the minimum amount of required copper can be determined based on the required power dissipation.

Power dissipation in a linear regulator is calculated as shown in Equation 4-3.

EQUATION 4-3:

$$P_D = (V_{IN1} - V_{OUT1}) \times I_{OUT1} + V_{IN1} \times I_{GND1} + (V_{IN2} - V_{OUT2}) \times I_{OUT2} + V_{IIN2} \times I_{GND2}$$

With a common 5V input, a 3.3V, 300 mA output on LDO 1 and a 2.5V, 150 mA output on LDO 2, power dissipation is as follows:

EQUATION 4-4:

$$P_D = (5V - 3.3V) \times 300mA + 5V \times 5mA + (5V - 2.5V) \times 150mA + 5V \times 1.8mA$$

$$P_D = 0.919W$$

From Figure 4-2, the minimum amount of copper required to operate this application at a ΔT of 75°C is 500 mm².

4.4.2 QUICK METHOD

Determine the power dissipation requirements for the design along with the maximum ambient temperature at which the device will be operated. Refer to Figure 4-3, which shows safe operating curves for three different ambient temperatures: 25°C, 50°C and 85°C. From these curves, the minimum amount of copper can be determined by knowing the maximum power dissipation required. If the maximum ambient temperature is 50°C and the power dissipation is as above, 920 mW, the curve in Figure 4-3 shows that the required area of copper is 500 mm².

The θ_{JA} of this package is ideally 63°C/W, but it will vary depending upon the availability of copper ground plane to which it is attached.

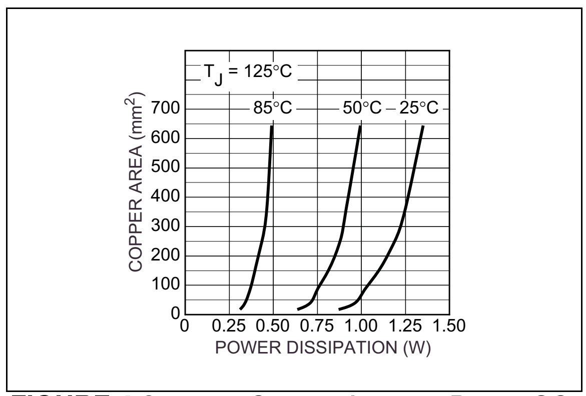
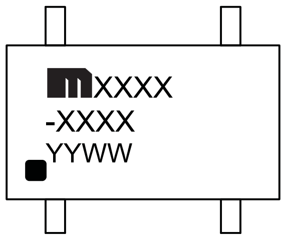


FIGURE 4-3: *Copper Area vs. Power-SO Power Dissipation (T_A).*

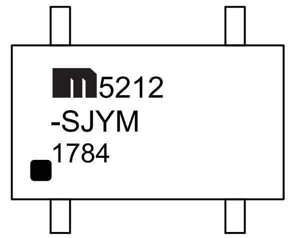
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

8-lead SOIC*



Example



Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
	●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).

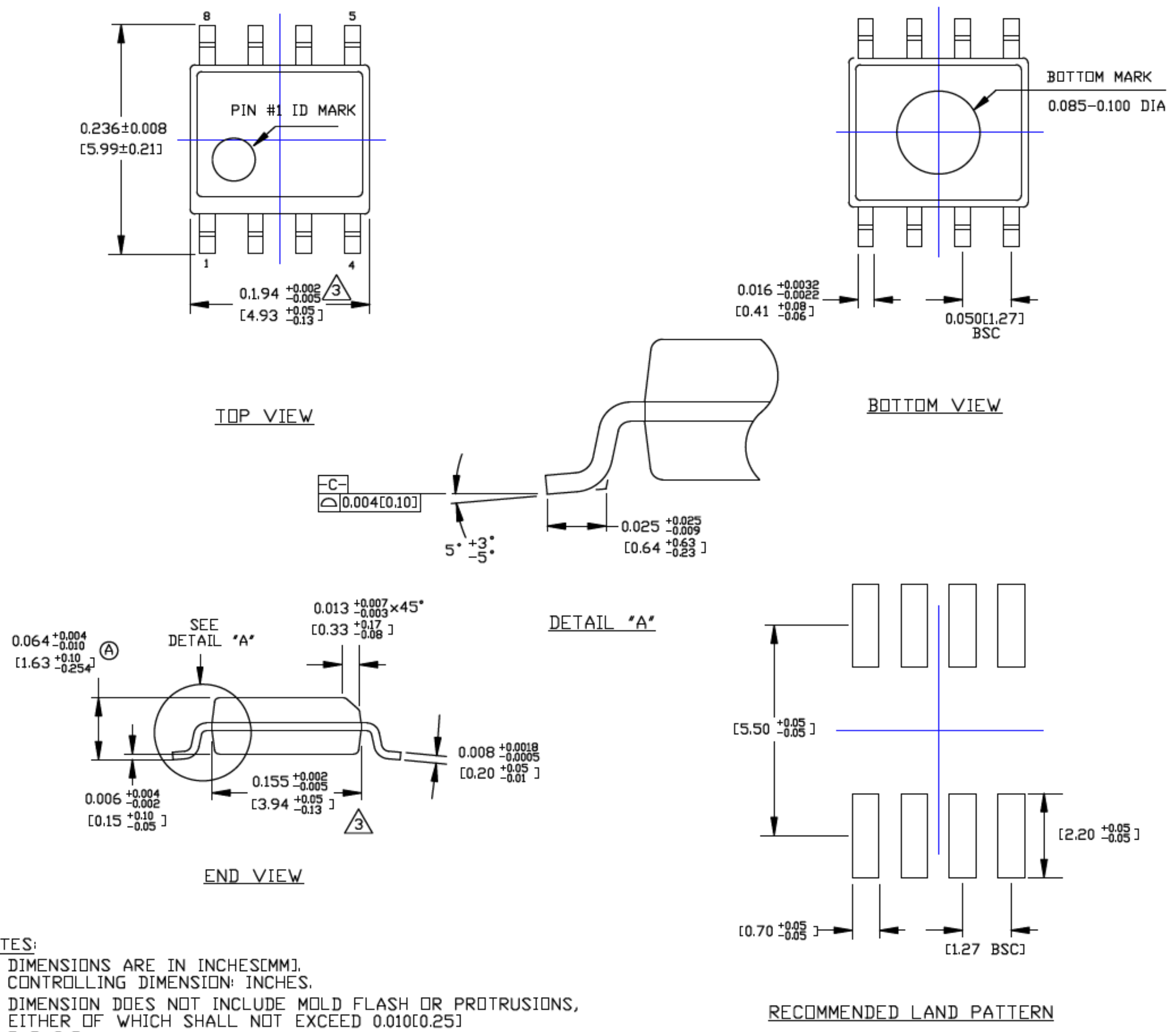
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

Underbar (_) and/or Overbar (‾) symbol may not be to scale.

8-Lead SOICN Package Outline & Recommended Land Pattern

TITLE
8 LEAD SOICN PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	SOICN-8LD-PL-1	**UNIT**	INCH [MM]



NOTES:
1. DIMENSIONS ARE IN INCHES[MM].
2. CONTROLLING DIMENSION: INCHES.
3. (△) DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.010[0.25] PER SIDE.

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

APPENDIX A: REVISION HISTORY

Revision A (June 2017)

- Converted Micrel document MIC5212 to Microchip data sheet template DS20005774A.
- Minor grammatical text changes throughout.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART NO.	-X	X	X	XX	-XX
Device	Fixed Output Voltage	Accuracy	Temperature Range	Package	Media Type

Device:	MIC5212:		Dual 500 mA LDO Regulator
Fixed Output Voltage:	S	=	3.3V/2.5V
Accuracy	J	=	1.0%
Temperature Range:	Y	=	–40°C to +125°C (RoHS Compliant)
Package:	M	=	8-Lead SOIC
Media Type:	TR	=	2,500/Reel
	<blank>	=	95/Tube

Examples:

a) MIC5212-SJYM: Dual 500 mA LDO Regulator, 3.3V/2.5V Output Voltage, 1% Accuracy, –40°C to +125°C Temperature Range, 8-Lead SOIC, 95/Tube

b) MIC5212-SJYM-TR: Dual 500 mA LDO Regulator, 3.3V/2.5V Output Voltage, 1% Accuracy, –40°C to +125°C Temperature Range, 8-Lead SOIC, 2,500/Reel

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

NOTES:

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