

250 mA Low Dropout Regulator

Features

- High Accuracy 5V, Ensured 250 mA Output
- Low Quiescent Current
- Low Dropout Voltage
- Extremely Tight Load and Line Regulation
- Very Low Temperature Coefficient
- Current and Thermal Limiting
- Input Withstands –20V Reverse Battery and +60V Positive Transients
- Error Flag Warns of Output Dropout
- Logic-Controlled Electronic Shutdown
- Output Programmable from 1.24V to 29V (MIC2954-07/-08)
- Available in TO-220-3 and Surface-Mount SOT-223 and SOIC-8 Packages

Applications

- Battery-Powered Equipment
- Cellular Telephones
- Laptop, Notebook, and Palmtop Computers
- PCMCIA V_{CC} and V_{PP} Regulation/Switching
- Barcode Scanners
- Automotive Electronics
- SMPS Post-Regulators/DC-DC Modules
- Voltage Reference
- High-Efficiency Linear Power Supplies

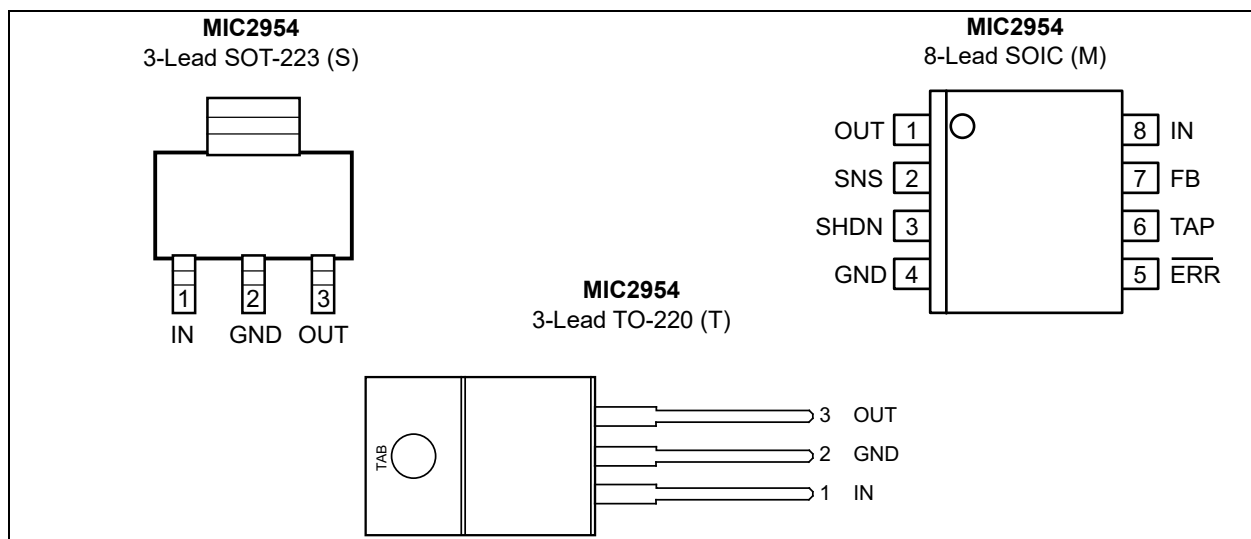
General Description

The MIC2954 is an efficient voltage regulator with very low dropout voltage (typically 40 mV at light loads and 375 mV at 250 mA), and low quiescent current (120 μ A typical). The quiescent current of the MIC2954 increases only slightly in dropout, thus prolonging battery life. Key MIC2954 features include protection against reversed battery, fold-back current limiting, and automotive load dump protection (60V positive transient).

The MIC2954-07/08YM is an adjustable version that includes an error flag output that warns of a low output voltage, which is often due to failing batteries on the input. This may also be used as a power-on reset. A logic-compatible shutdown input is provided that enables the regulator to be switched on and off. This part may be pin-strapped for 5V output or programmed from 1.24V to 29V with the use of two external resistors.

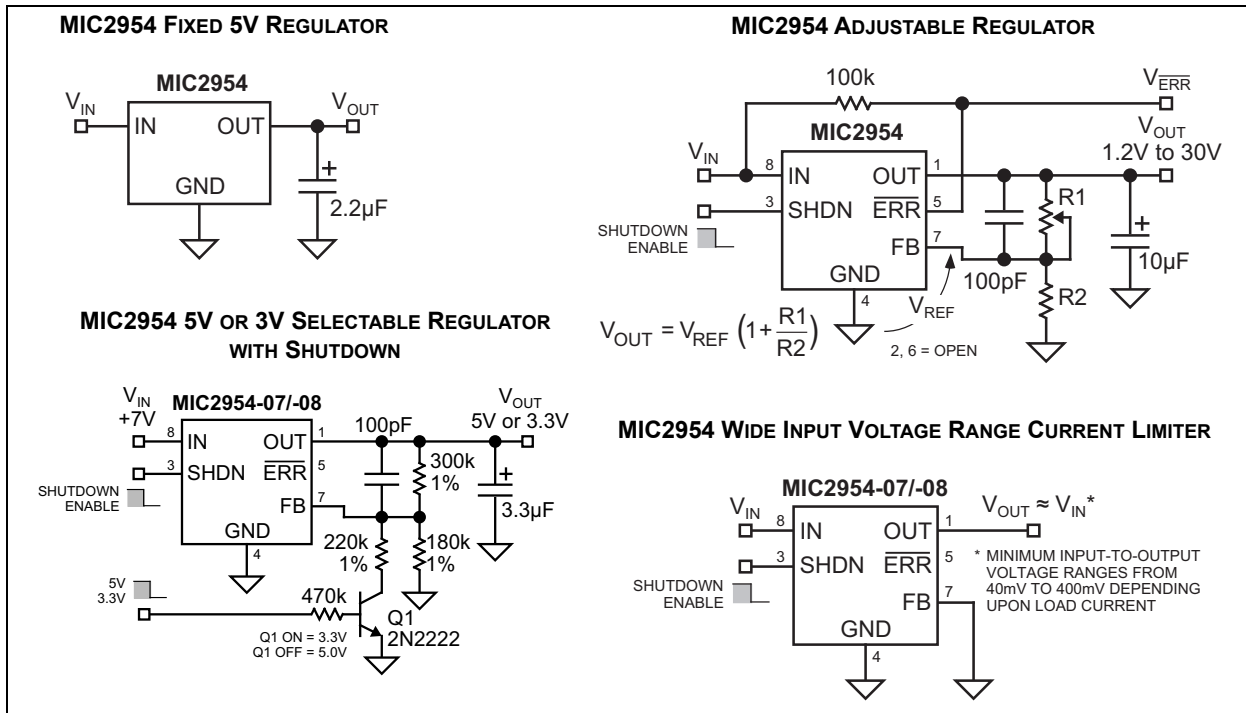
The MIC2954 is available in two voltage tolerances, $\pm 0.5\%$ maximum and $\pm 1\%$ maximum. Both are guaranteed for junction temperatures from -40°C to $+125^{\circ}\text{C}$.

Package Types

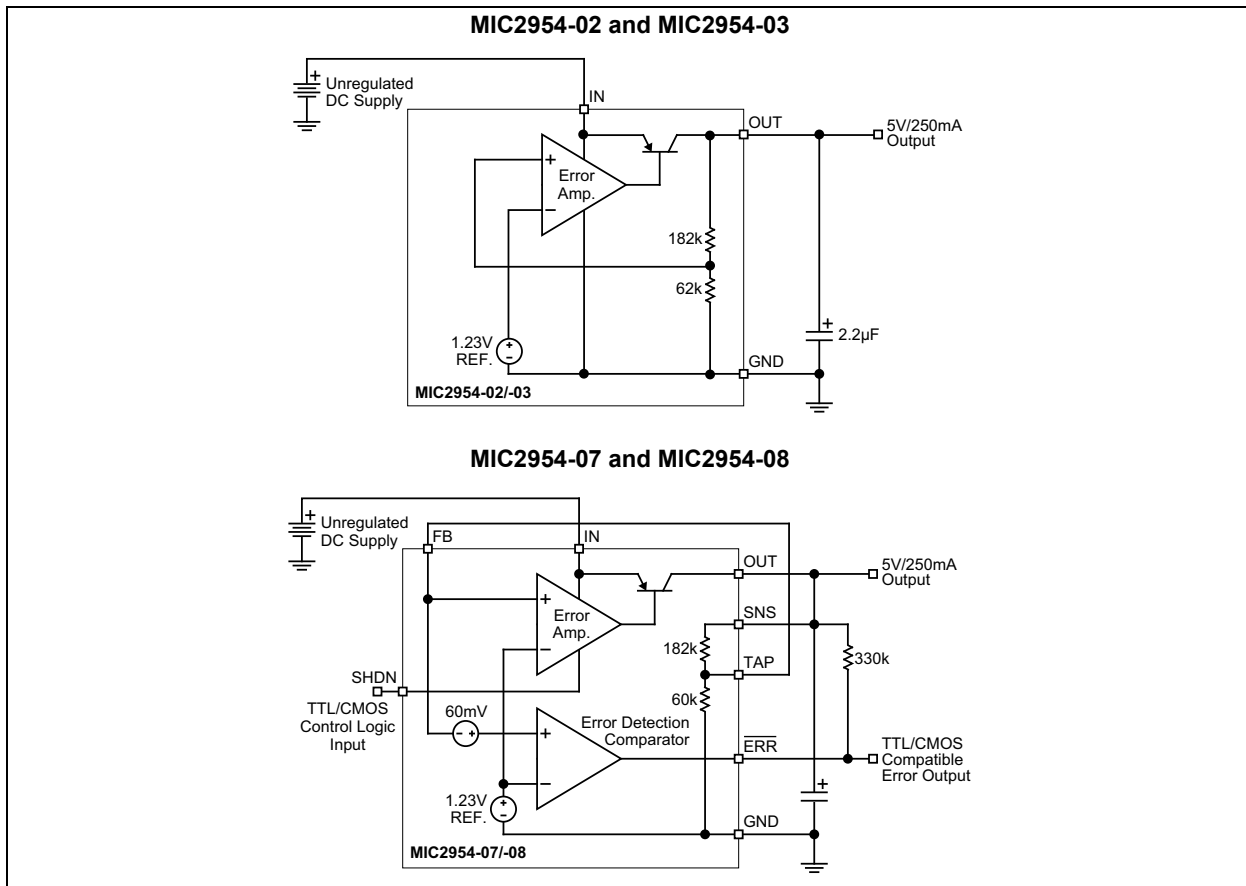


MIC2954

Typical Application Circuits



Functional Block Diagrams



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{IN})	–20V to +60V
Feedback Voltage (Note 9, Note 10)	–1.5V to +26V
Shutdown Input Voltage (V_{SHDN})	–0.3V to +30V
Error Output Voltage (V_{ERR})	–0.3V to +30V
Power Dissipation (Note 1)	Internally Limited
ESD Rating	Note 2

Operating Ratings ‡

Supply Voltage (V_{IN})	+2.0V to +30V
-----------------------------	---------------

† **Notice:** Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ **Notice:** The device is not guaranteed to function outside its operating ratings.

Note 1: $P_{D(MAX)} = (T_{J(MAX)} - T_A) \div \theta_{JC}$. Exceeding $T_{J(MAX)}$ will cause thermal shutdown.

2: Devices are ESD sensitive. Handling precautions recommended.

DC CHARACTERISTICS

Electrical Characteristics: MIC2954-07/08: $V_{FB} = V_{TAP}$; $V_{SNS} = V_{OUT}$; $V_{SHDN} \leq 0.6V$. All versions: $V_{IN} = 6V$; $I_L = 1\text{ mA}$; $C_L = 2.2\ \mu\text{F}$; $T_J = +25^\circ\text{C}$, **bold** values valid for $-40^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$, unless noted. (Note 3)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Voltage	V_{OUT}	4.975	5.000	5.025	V	MIC2954-02/-07 ($\pm 0.5\%$)
		4.940	—	5.060		MIC2954-02/-07 ($\pm 0.5\%$), 1 mA $\leq I_L \leq$ 250 mA
		4.930	5.000	5.070		MIC2954-03/-08 ($\pm 1\%$)
		4.950	5.000	5.050		MIC2954-03/-08 ($\pm 1\%$), 1 mA $\leq I_L \leq$ 250 mA
		4.900	—	5.100		
Output Voltage Temperature Coefficient, Note 1	$\Delta V_{OUT}/\Delta T$	—	20	100	ppm/ $^\circ\text{C}$	MIC2954-02/-07 ($\pm 0.5\%$)
		—	20	150		MIC2954-03/-08 ($\pm 1\%$)
Line Regulation, Note 2	$\Delta V_{OUT}/V_{OUT}$	—	0.03	0.10	%/ V	MIC2954-02/-07 ($\pm 0.5\%$), $V_{IN} = 6V$ to 26V
		—	—	0.20		MIC2954-03/-08 ($\pm 1\%$), $V_{IN} = 6V$ to 26V
		—	0.03	0.20		
Load Regulation, Note 3	$\Delta V_{OUT}/V_{OUT}$	—	0.04	0.16	%	MIC2954-02/-07 ($\pm 0.5\%$), $I_L = 1\text{ mA}$ to 250 mA
		—	—	0.20		MIC2954-03/-08 ($\pm 1\%$), $I_L = 1\text{ mA}$ to 250 mA
		—	0.04	0.20		
		—	—	0.30		

MIC2954

DC CHARACTERISTICS (CONTINUED)

Electrical Characteristics: MIC2954-07/08: $V_{FB} = V_{TAP}$; $V_{SNS} = V_{OUT}$; $V_{SHDN} \leq 0.6V$. All versions: $V_{IN} = 6V$; $I_L = 1\text{ mA}$; $C_L = 2.2\text{ }\mu\text{F}$; $T_J = +25^\circ\text{C}$, **bold** values valid for $-40^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$, unless noted. (Note 3)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Dropout Voltage, Note 4	$V_{IN} - V_{OUT}$	—	60	100	mV	$I_L = 1\text{ mA}$
		—	—	150		
		—	220	250		$I_L = 50\text{ mA}$
		—	—	420		
		—	250	300		$I_L = 100\text{ mA}$
		—	—	450		
		—	375	450		
		—	—	600		$I_L = 250\text{ mA}$
Ground Pin Current, Note 5	I_{GND}	—	140	200	μA	$I_L = 1\text{ mA}$
		—	—	300	mA	$I_L = 50\text{ mA}$
		—	0.5	1		
		—	—	2		
		—	1.7	2.5		$I_L = 100\text{ mA}$
		—	—	3.5		
		—	5	9		$I_L = 250\text{ mA}$
—	—	12				
Ground Pin Current at Dropout, Note 5	$I_{GND(DO)}$	—	180	300	μA	$V_{IN} = 4.5V$
Current Limit, Note 6	I_{LIMIT}	—	—	750	mA	$V_{OUT} = 0V$
		—	—	800		
Thermal Regulation, Note 7	$\frac{\Delta V_{OUT}}{\Delta P_D}$	—	0.05	0.2	%/W	—
Output Noise Voltage (10 Hz to 100 kHz)	e_n	—	400	—	μV_{RMS}	$I_L = 100\text{ mA}$, $C_L = 2.2\text{ }\mu\text{F}$
		—	260	—		$I_L = 100\text{ mA}$, $C_L = 33\text{ }\mu\text{F}$
Reference Voltage	V_{REF}	1.220	1.235	1.250	V	MIC2954-02/-07 ($\pm 0.5\%$)
		1.200	—	1.260		
		1.210	1.235	1.260		MIC2954-03/-08 ($\pm 1\%$)
		1.200	—	1.270		
		1.190	—	1.270		MIC2954-02/-07 ($\pm 0.5\%$), Note 8
		1.185	—	1.285		MIC2954-03/-08 ($\pm 1\%$), Note 8
Feedback Pin Bias Current	—	—	20	40	nA	—
		—	—	60		
Reference Voltage Temperature Coefficient, Note 7	—	—	20	—	ppm/ $^\circ\text{C}$	MIC2954-02/-07 ($\pm 0.5\%$)
		—	50	—		MIC2954-03/-08 ($\pm 1\%$)
Feedback Pin Bias Current Temperature Coefficient	—	—	0.1	40	nA/ $^\circ\text{C}$	—
Error Comparator						
Output Leakage Current	—	—	0.01	1.00	μA	$V_{OH} = 30V$
		—	—	2.00		
Output Low Voltage	V_{OL}	—	150	250	mV	$V_{IN} = 4.5V$, $I_{OL} = 400\text{ }\mu\text{A}$
		—	—	400		

DC CHARACTERISTICS (CONTINUED)

Electrical Characteristics: MIC2954-07/08: $V_{FB} = V_{TAP}$; $V_{SNS} = V_{OUT}$; $V_{SHDN} \leq 0.6V$. All versions: $V_{IN} = 6V$; $I_L = 1\text{ mA}$; $C_L = 2.2\text{ }\mu\text{F}$; $T_J = +25^\circ\text{C}$, **bold** values valid for $-40^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$, unless noted. (Note 3)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Upper Threshold Voltage	—	—	60	40	mV	Note 9
		—	—	25		
Lower Threshold Voltage	—	—	75	95	mV	Note 9
		—	—	140		
Hysteresis	—	—	15	—	mV	Note 9
Shutdown Input						
Input Logic Voltage	—	—	1.3	0.7	V	Low (on)
		2.0	—	—		High (off)
Shutdown Pin Input Current	—	—	30	50	μA	$V_{SHDN} = 2.4V$
		—	—	100		
		—	450	600		$V_{SHDN} = 30V$
		—	—	750		
Regular Output Current in Shutdown	—	—	3	10	μA	Note 10
		—	—	20		

- Note 1:** Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.
- 2:** Line regulation for the MIC2954 is tested at 125°C for $I_L = 1\text{ mA}$. For $I_L = 100\text{ }\mu\text{A}$ and $T_J = 125^\circ\text{C}$, line regulation is ensured by design to 0.2%.
- 3:** Regulation is measured at constant junction temperature using low duty cycle pulse testing. Changes in output voltage due to heating effects are covered by the thermal regulation specification.
- 4:** Dropout Voltage is defined as the input to output differential at which the output voltage drops 100 mV below its nominal value measured at 1V differential. At very low values of programmed output voltage, the minimum input supply voltage of 2V (2.3V over temperature) must be taken into account.
- 5:** Ground pin current is the regulator quiescent current. The total current drawn from the source is the sum of the load current plus the ground pin current.
- 6:** The MIC2954 features fold-back current limiting. The short-circuit ($V_{OUT} = 0V$) current limit is less than the maximum current with normal output voltage.
- 7:** Thermal regulation is defined as the change in output voltage at a time t after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a 200 mA load pulse at $V_{IN} = 20V$ (a 4W pulse) for $t = 10\text{ ms}$.
- 8:** $V_{REF} \leq V_{OUT} \leq (V_{IN} - 1V)$, $2.3V \leq V_{IN} \leq 30V$, $100\text{ }\mu\text{A} < I_L \leq 250\text{ mA}$, $T_J \leq T_{J(MAX)}$.
- 9:** Comparator thresholds are expressed in terms of a voltage differential at the FB pin below the nominal reference voltage measured at 6V input. To express these thresholds in terms of output voltage change, multiply by the error amplifier gain $= V_{OUT}/V_{REF} = (R1 + R2)/R2$. For example, at a programmed output voltage of 5V, the error output is ensured to go low when the output drops by $95\text{ mV} \times 5V/1.235V = 384\text{ mV}$. Thresholds remain constant as a percent of V_{OUT} as V_{OUT} is varied, with the dropout warning occurring at typically 5% below nominal, 7.5% guaranteed.
- 10:** $V_{SHDN} \geq 2V$, $V_{IN} \leq 30V$, $V_{OUT} = 0$, with the FB pin connected to TAP.
- 11:** 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.
- 12:** Maximum positive supply voltage of 60V must be of limited duration (<10 ms) and duty cycle (<1%). The maximum continuous supply voltage is 30V.

MIC2954

TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Junction Temperature Range	T_J	-40	—	+125	°C	—
Lead Temperature	—	—	—	+260	°C	Soldering, 5 sec.
Storage Temperature	T_S	-65	—	+150	°C	—
Package Thermal Resistance						
Thermal Resistance, SOT-223 3-Ld	θ_{JC}	—	15	—	°C/W	—
Thermal Resistance, TO-220 3-Ld	θ_{JC}	—	2.5	—	°C/W	—
Thermal Resistance, SOIC 8-Ld	θ_{JA}	—	160	—	°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.

2.0 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.

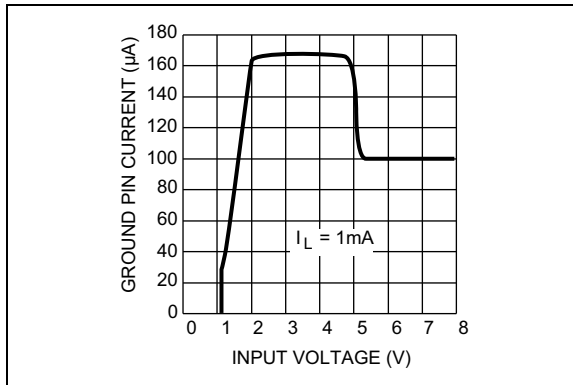


FIGURE 2-1: Ground Pin Current.

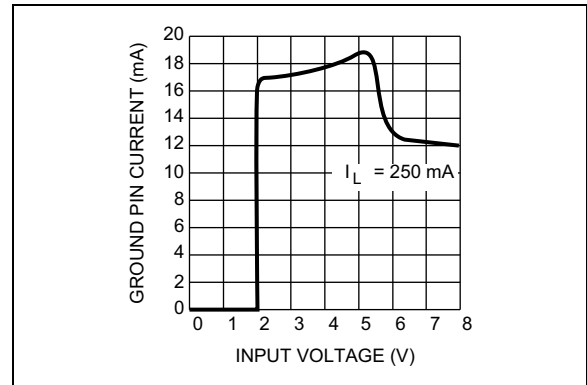


FIGURE 2-4: Ground Pin Current.

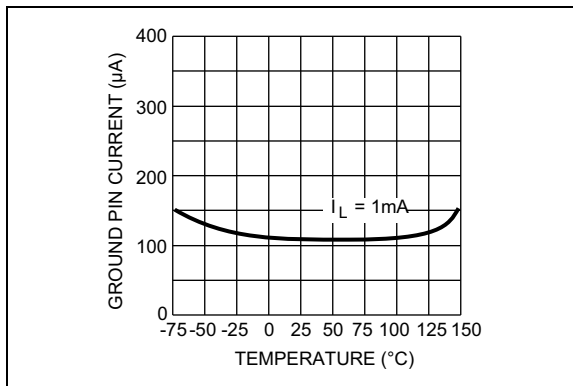


FIGURE 2-2: Ground Pin Current.

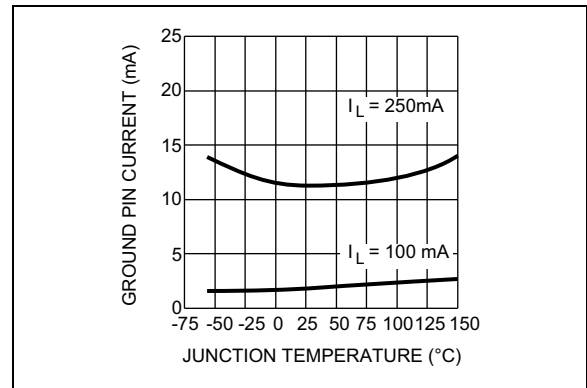


FIGURE 2-5: Ground Pin Current.

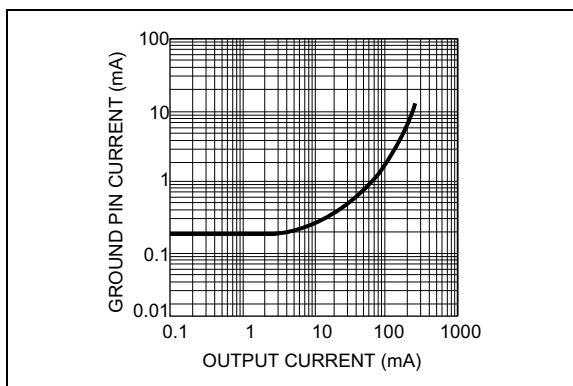


FIGURE 2-3: Ground Pin Current vs. Load.

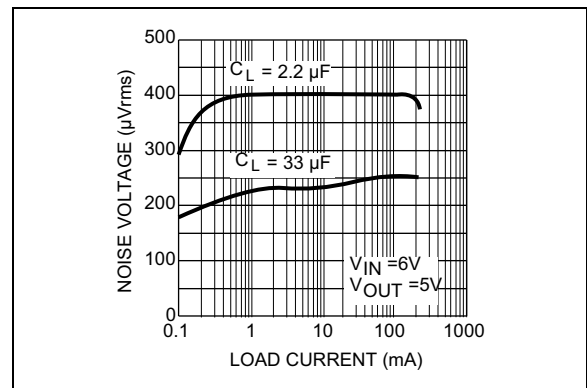


FIGURE 2-6: Output Noise Voltage.

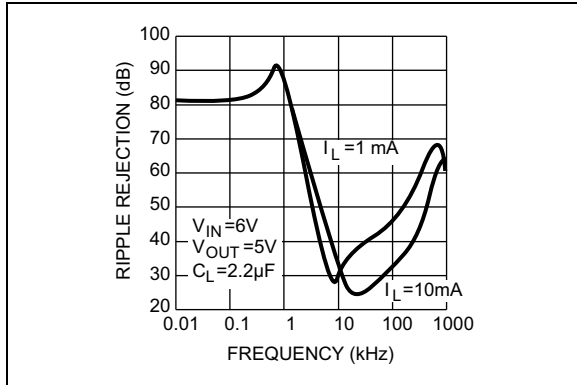


FIGURE 2-7: *Ripple Rejection.*

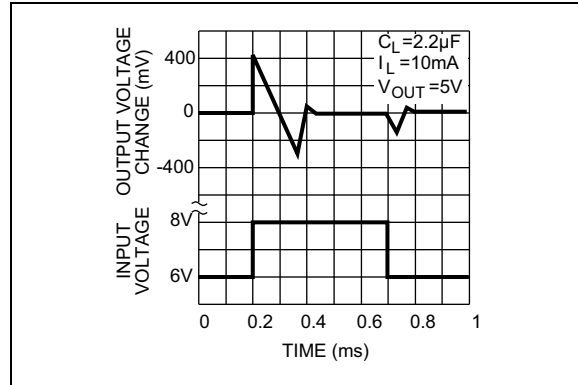


FIGURE 2-10: *Line Transient Response.*

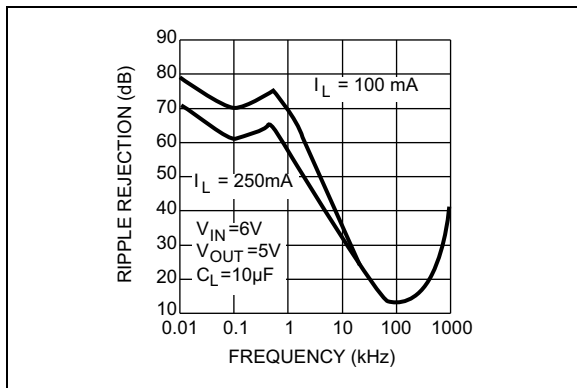


FIGURE 2-8: *Ripple Rejection.*

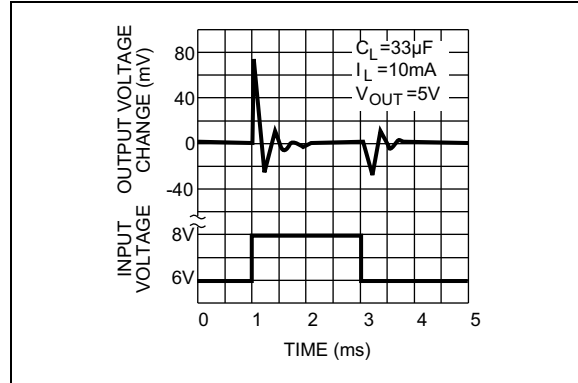


FIGURE 2-11: *Line Transient Response.*

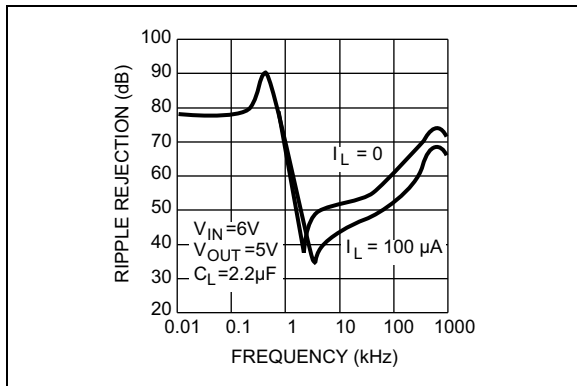


FIGURE 2-9: *Ripple Rejection.*

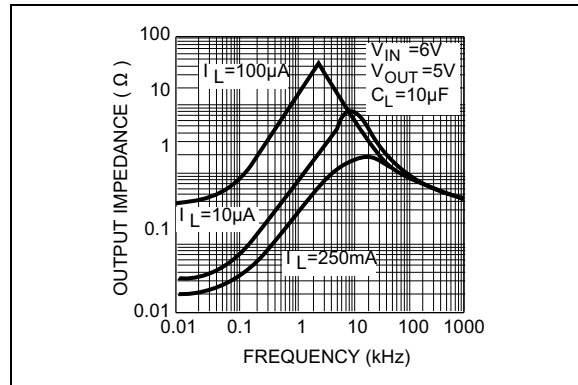


FIGURE 2-12: *Output Impedance.*

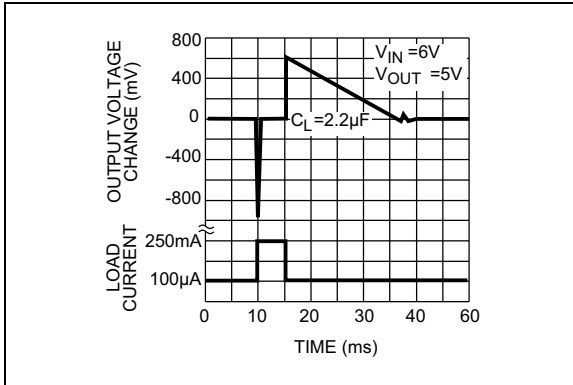


FIGURE 2-13: Load Transient Response.

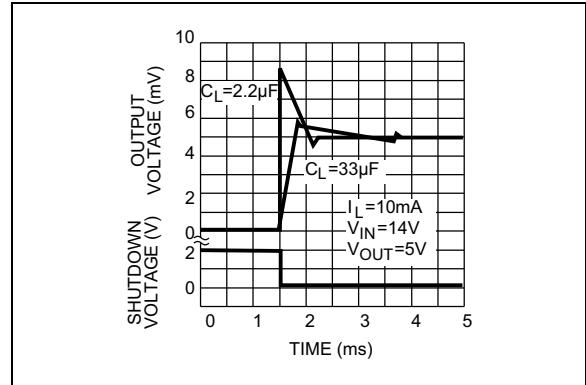


FIGURE 2-16: Enable Transient.

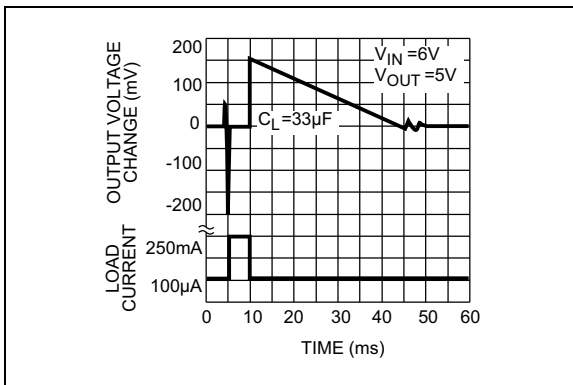


FIGURE 2-14: Load Transient Response.

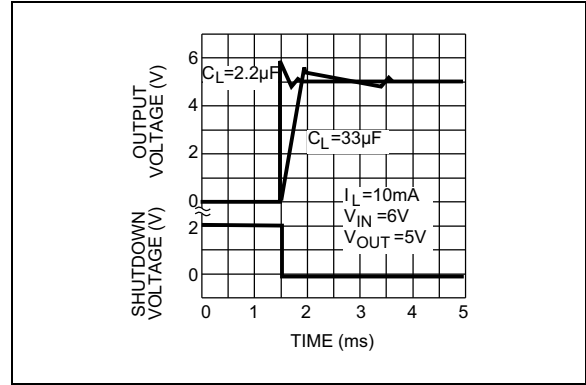


FIGURE 2-17: Enable Transient.

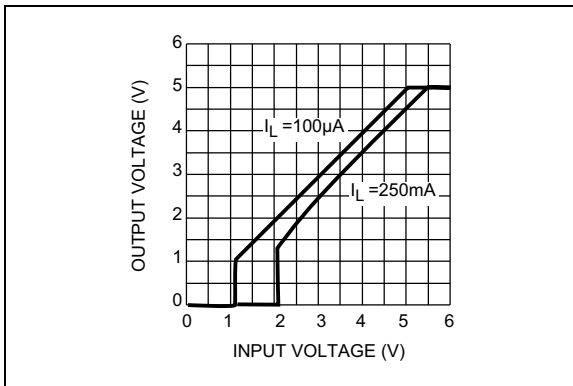


FIGURE 2-15: Dropout Characteristics.

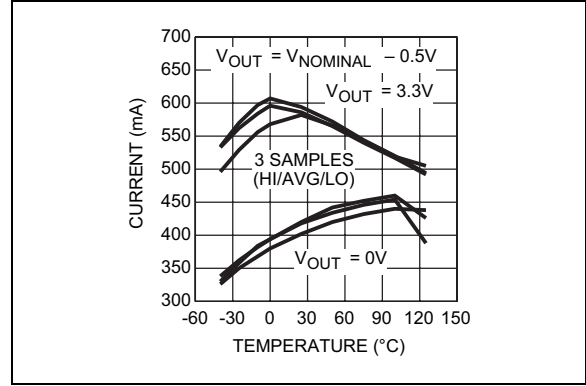


FIGURE 2-18: Short Circuit and Maximum Current vs. Temperature.

MIC2954

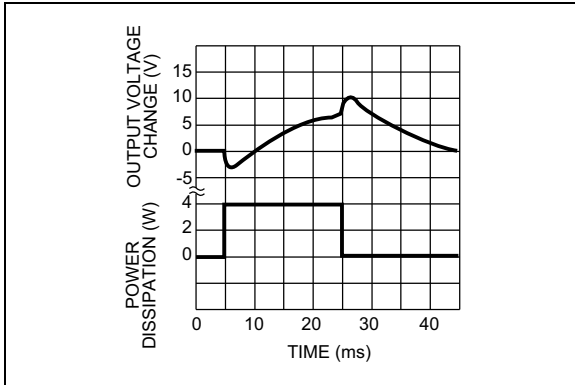


FIGURE 2-19: *Thermal Regulation.*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 3-1](#).

TABLE 3-1: PIN FUNCTION TABLE

Pin Number SOIC-8	Pin Number SOT-223	Pin Number TO-220	Pin Name	Description
8	1	1	IN	Supply Input.
4	2, TAB	2	GND	Ground.
1	3	3	OUT	Regulator Output.
2	—	—	SNS	Sense (Input): Output-sense-voltage end of internal resistive divider. Connect to OUT ($V_{OUT} = 5V$) for fixed 5V operation; also see TAP. Not used in adjustable configuration.
3	—	—	SHDN	Shutdown (Input): Active-low input enables regulator. (Low = enable; high = shutdown.)
5	—	—	/ERR	Error Flag (Output): Open collector (active-low) output. Active state indicates an output (V_{OUT}) undervoltage condition. (Low = error, floating = normal.)
6	—	—	TAP	Divider Tap (Output): Resistive voltage divider tap. With 5V applied to SNS, V_{TAP} is approximately 1.23V. Connect to FB for 5V operation. Not used in adjustable configuration.
7	—	—	FB	Feedback (Input): Error amplifier input. Compared to internal 1.23V reference. Connect to external voltage divider for adjustable operation or internal voltage divider (TAP) for 5V operation (see SNS, TAP).

MIC2954

4.0 APPLICATIONS INFORMATION

4.1 External Capacitors

A 2.2 μ F (or greater) capacitor is required between the MIC2954 output and ground to prevent oscillations due to instability. Most types of tantalum or aluminum electrolytics will be adequate; film types will work, but are costly and therefore not recommended. Many aluminum electrolytics have electrolytes that freeze at about -30°C , so solid tantalums are recommended for operation below -25°C . The important parameters of the capacitor are an effective series resistance of about 5Ω or less and a resonant frequency above 500kHz. The value of this capacitor may be increased without limit.

At lower values of output current, less output capacitance is required for output stability. The capacitor can be reduced to 0.5 μ F for current below 10mA or 0.15 μ F for currents below 1mA. Adjusting the MIC2954-07/-08 to voltages below 5V runs the error amplifier at lower gains so that more output capacitance is needed. For the worst-case situation of a 250mA load at 1.23V output (output shorted to feedback) a 5 μ F (or greater) capacitor should be used.

The MIC2954 will remain in regulation with a minimum load of 1mA. When setting the output voltage of the MIC2954-07/-08 version with external resistors, the current through these resistors may be included as a portion of the minimum load.

A 0.1 μ F capacitor should be placed from the MIC2954 input to ground 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 Error Detection Comparator Output (MIC2954-07/-08)

A logic-low output will be produced by the comparator whenever the MIC2954-07/-08 output falls out of regulation by more than approximately 5%. This figure is the comparator's built-in offset of about 60 mV divided by the 1.235V reference voltage. (Refer to the [Functional Block Diagrams](#)). This trip level remains 5% below normal regardless of the programmed output voltage of the MIC2954-07/-08. For example, the error flag trip level is typically 4.75V for a 5V output or 11.4V for a 12V output. The out-of-regulation condition may be due either to low input voltage, current limiting, or thermal limiting.

[Figure 4-1](#) is a timing diagram depicting the /ERR signal and the regulated output voltage as the MIC2954-07/-08 input is ramped up and down. The /ERR signal becomes valid (low) at about 1.3V input. It goes high at about 5V input (the input voltage at which $V_{OUT} = 4.75$). Because the MIC2954-07/-08's dropout voltage is load-dependent, the input voltage trip point

(about 5V) will vary with the load current. The output voltage trip point (approximately 4.75V) does not vary with load.

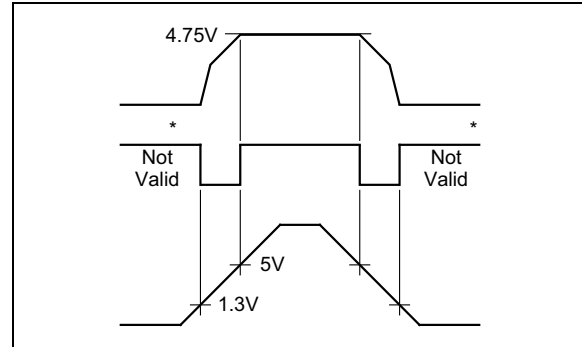


FIGURE 4-1: *ERROR Output Timing.*

The error comparator has an open-collector output that requires an external pull-up resistor. Depending on system requirements, this resistor may be returned to the 5V output or some other supply voltage. In determining a value for this resistor, note that while the output is rated to sink 400 μ A, this sink current adds to battery drain in a low battery condition. Suggested values range from 100 k Ω to 1 M Ω . The resistor is not required if this output is unused.

4.3 Programming the Output Voltage (MIC29202/MIC29204)

The MIC2954-07/-08 may be pin-strapped for 5V using its internal voltage divider by tying Pin 1 (OUT) to Pin 2 (SNS) and Pin 7 (FB) to Pin 6 (TAP). Alternatively, it may be programmed for any output voltage between its 1.235V reference and its 30V maximum rating. An external pair of resistors is required, as shown in the [Typical Application Circuits](#).

The complete equation for the output voltage is:

EQUATION 4-1:

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

Where:

V_{REF} = The nominal 1.235V reference voltage.

I_{FB} = The Adjust pin bias current, nominally -20 nA.

The minimum recommended load current of 1 μ A forces an upper limit of 1.2 M Ω on the value of R2, if the regulator must work with no load (a condition often found in CMOS in standby), I_{FB} will produce a 2% typical error in V_{OUT} that may be eliminated at room temperature by trimming R1. For better accuracy, choosing R2 = 100 k Ω reduces this error to 0.17% while increasing the resistor program current to 12 μ A.

Because the MIC2954-07/-08 typically draws 110 μA at no load with pin 2 (SNS) open-circuited, this is a negligible addition.

4.4 Reducing Output Noise

In reference applications it may be advantageous to reduce the AC noise present at the output. One method is to reduce the regulator bandwidth by increasing the size of the output capacitor. This is relatively inefficient because increasing the capacitor from 1 μF to 220 μF only decreases the noise from 430 μV_{RMS} to 160 μV_{RMS} for a 100 kHz bandwidth at 5V output. Noise can be reduced fourfold using a bypass capacitor across R1 because it reduces the high frequency gain from 4 to unity. Pick:

EQUATION 4-2:

$$C_{\text{BYPASS}} = \frac{1}{2\pi R1 \times 200\text{Hz}}$$

or about 0.01 μF . When doing this, the output capacitor must be increased to 3.3 μF to maintain stability. These changes reduce the output noise from 430 μV_{RMS} to 100 μV_{RMS} for a 100 kHz bandwidth at 5V output. With the bypass capacitor added, noise no longer scales with output voltage so that improvements are more dramatic at higher output voltages.

4.5 Automotive Applications

The MIC2954 is ideally suited for automotive applications for a variety of reasons. It will operate over a wide range of input voltages with very low dropout voltages (40 mV at light loads), and very low quiescent currents (75 μA typical). These features are necessary for use in battery-powered systems, such as automobiles. It is a robust device with the ability to survive both reverse battery (negative transients up to 20V below ground), and load dump (positive transients up to 60V) conditions. A wide operating temperature range with low temperature coefficients is yet another reason to use these versatile regulators in automotive designs.

4.6 Thermal Calculations

4.6.1 LAYOUT CONSIDERATIONS

The MIC2954-07YM/-08YM (8-lead surface-mount package) has the following thermal characteristics when mounted on a single layer copper-clad printed circuit board.

PC Board Dielectric Material and θ_{JA} :

- FR4 160°C/W
- Ceramic 120°C/W

Multilayer boards having a ground plane, wide traces near the pads, and large supply bus lines provide better thermal conductivity.

Our calculations will use the “worst case” value of 160°C/W, which assumes no ground plane, minimum trace widths, and a FR4 material board.

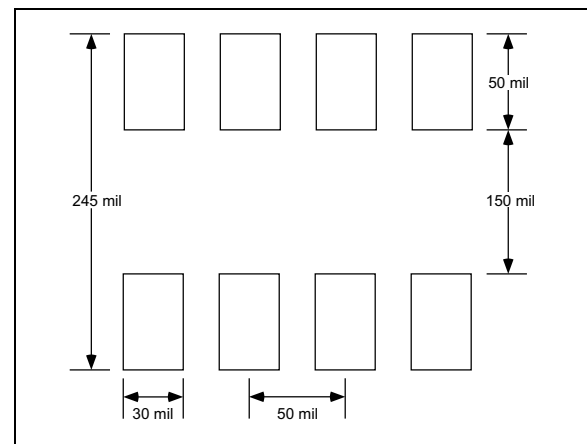


FIGURE 4-2: Pad Layout (Minimum Recommended Geometry).

4.6.2 NOMINAL POWER DISSIPATION AND DIE TEMPERATURE

The MIC2954-07YM/-08YM at a 55°C ambient temperature will operate reliably at up to 440 mW power dissipation when mounted in the “worst case” manner described above. This power level is equivalent to a die temperature of 125°C, the recommended maximum temperature for nonmilitary grade silicon integrated circuits.

MIC2954

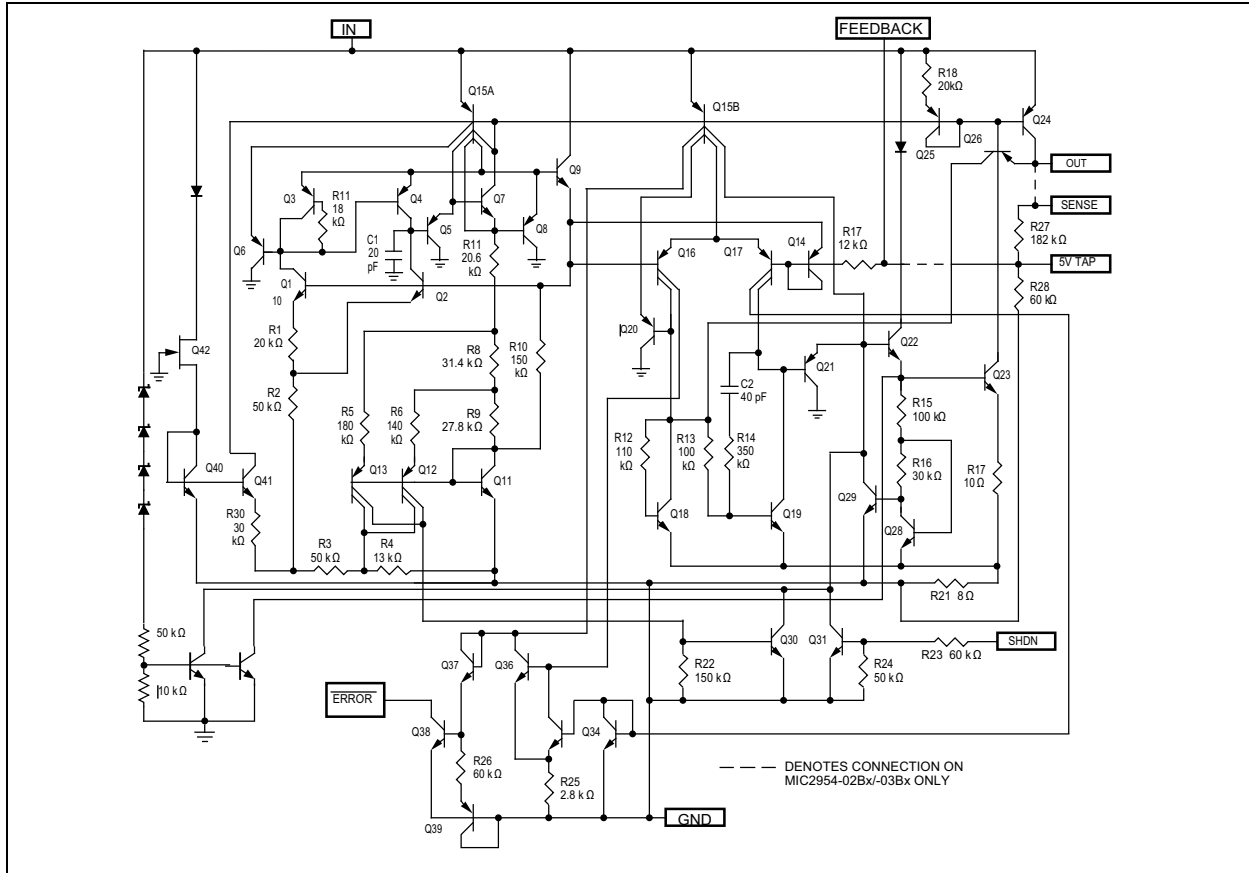
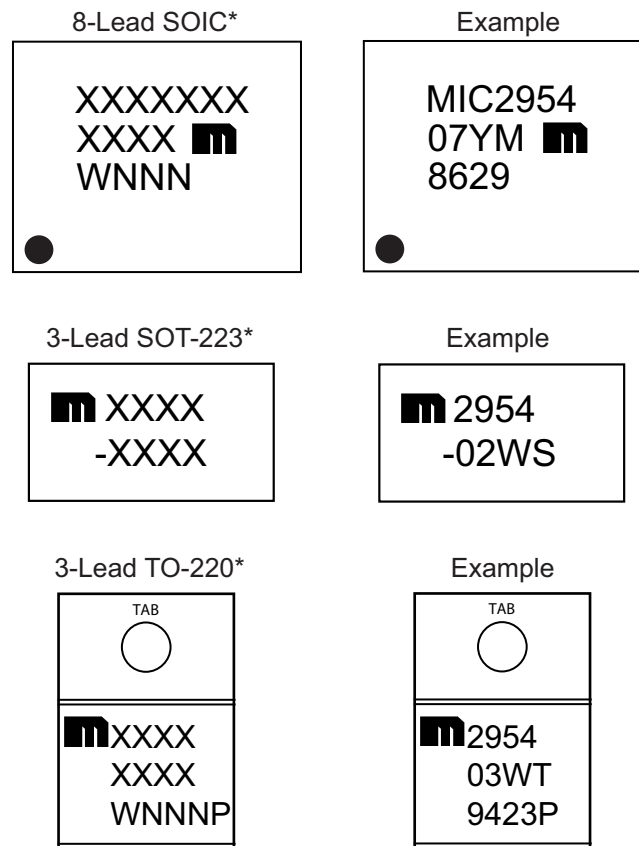


FIGURE 4-3: Schematic Diagram.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information



<p>Legend:</p> <p>XX...X Product code or customer-specific information</p> <p>Y Year code (last digit of calendar year)</p> <p>YY Year code (last 2 digits of calendar year)</p> <p>WW Week code (week of January 1 is week '01')</p> <p>NNN Alphanumeric traceability code</p> <p>(e3) Pb-free JEDEC® designator for Matte Tin (Sn)</p> <p>* This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.</p> <p>•, ▲, ▼ Pin one index is identified by a dot, delta up, or delta down (triangle mark).</p>	<p>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.</p> <p>Underbar () and/or Overbar () symbol may not be to scale.</p>
---	---

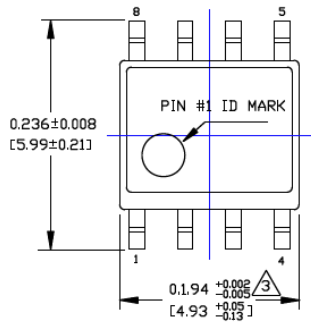
MIC2954

8-Lead SOIC Package Outline and Recommended Land Pattern

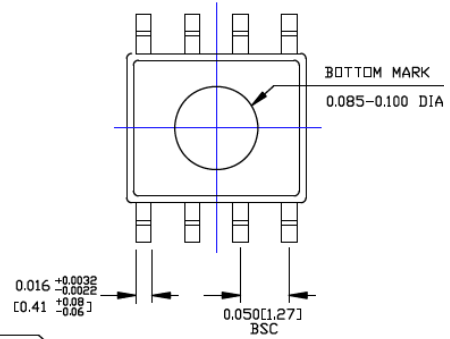
TITLE

8 LEAD SOICN PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

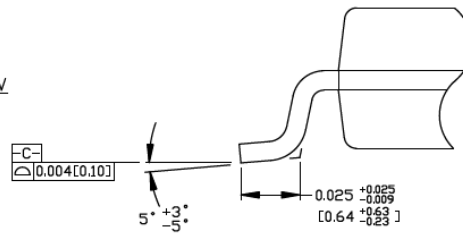
DRAWING #	SOICN-8LD-PL-1	UNIT	INCH [MM]
-----------	----------------	------	-----------



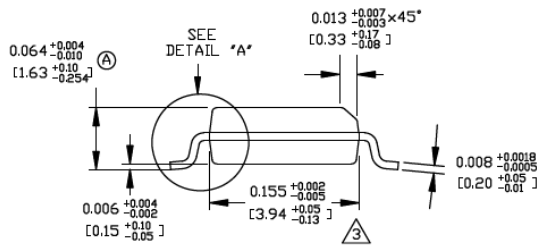
TOP VIEW



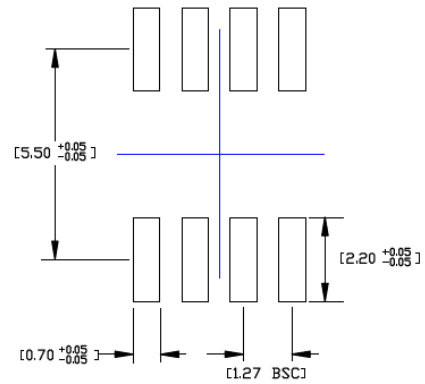
BOTTOM VIEW



DETAIL "A"



END VIEW



RECOMMENDED LAND PATTERN

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.

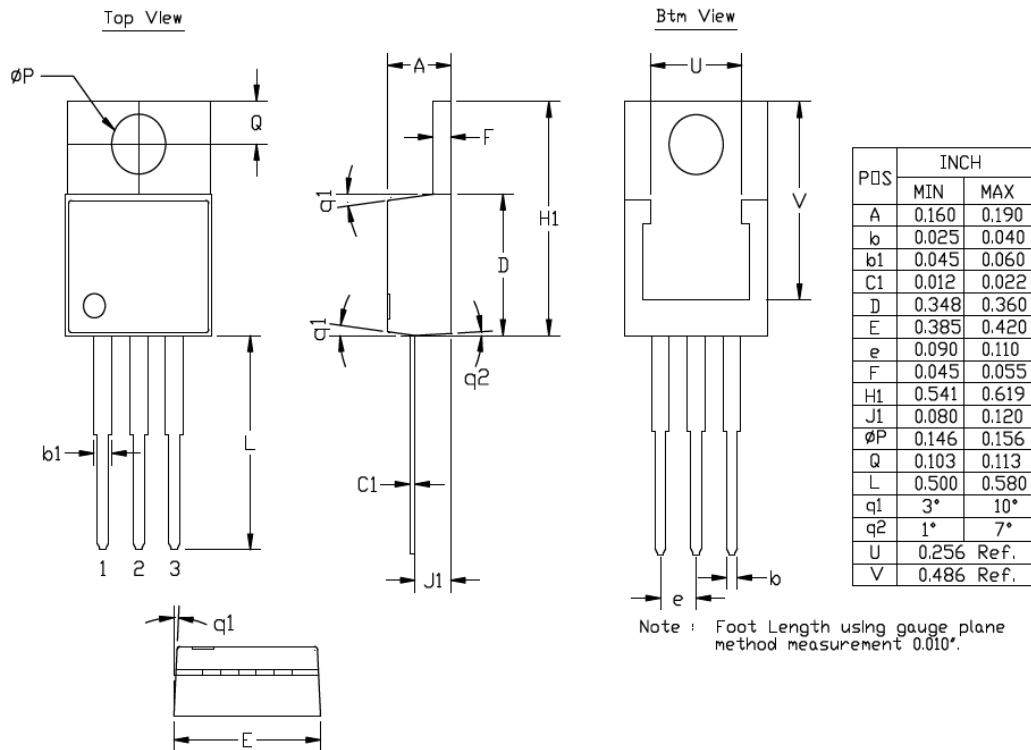
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

3-Lead TO-220 Package Outline and Recommended Land Pattern

TITLE

3 LEAD TO220 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

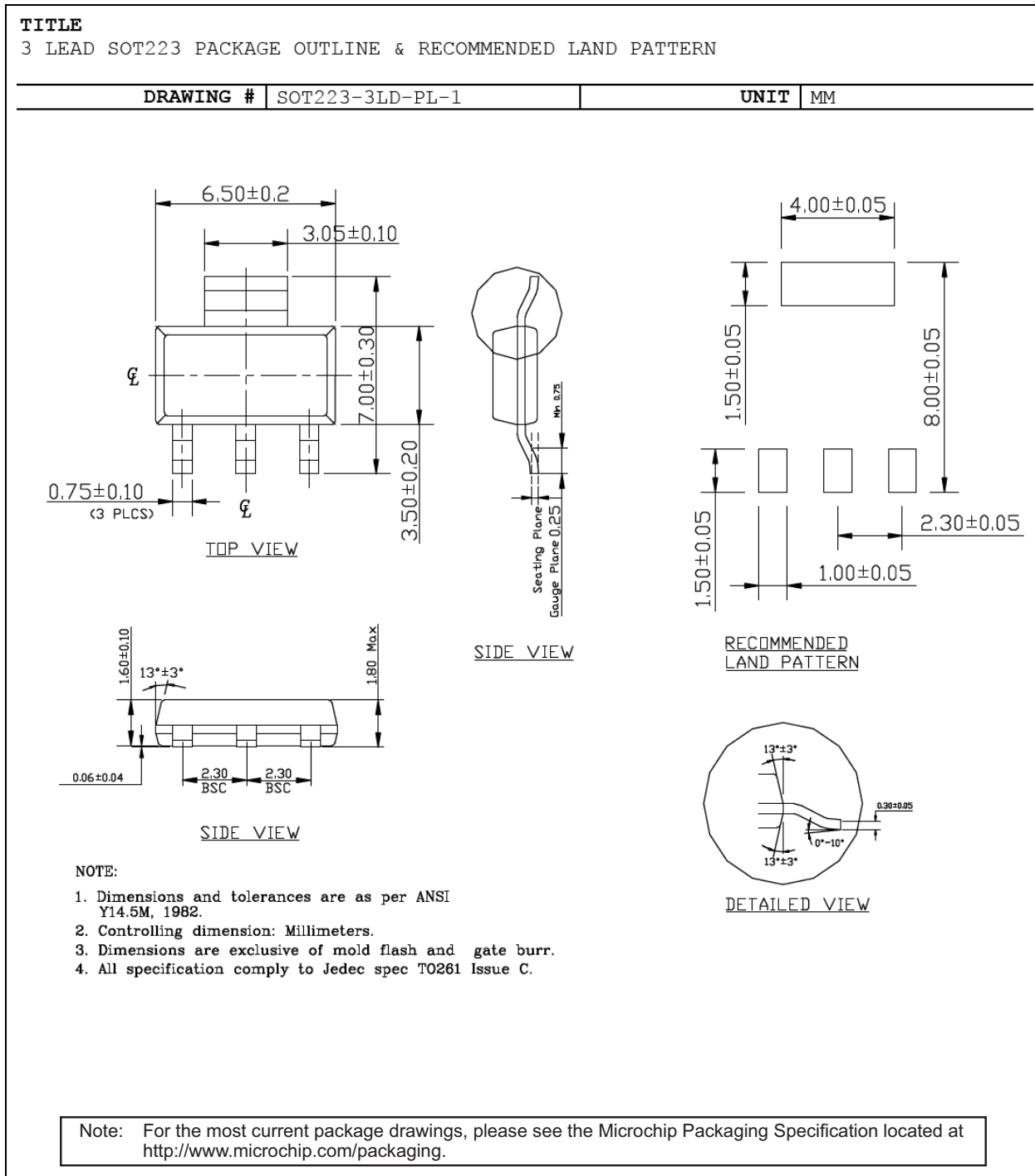
DRAWING #	TO220-3LD-PL-1	UNIT	INCH
Lead Frame	Copper Alloy	Lead Finish	Matte Tin



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

MIC2954

3-Lead SOT-223 Package Outline and Recommended Land Pattern



APPENDIX A: REVISION HISTORY

Revision A (July 2021)

- Converted Micrel document MIC2954 to Microchip data sheet DS20006563A.
- Minor text changes throughout.
- Removed all reference to discontinued leaded parts and the TO-92 package option.

MIC2954

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

<u>PART No.</u>	<u>-XX</u>	<u>X</u>	<u>X</u>	<u>-XX</u>	Examples:	
Device	Accuracy	Junction Temp. Range	Package	Media Type		
Device:	MIC2954:	250 mA Low Dropout Regulator			a) MIC2954-02WT:	250 mA Low Dropout Regulator 0.5% Accuracy with Fixed Output Voltage, -40°C to +125°C Temp. Range, 3-Lead TO-220, 50/Tube
Accuracy:	-02	=	0.5% (with Fixed Output Voltage)		b) MIC2954-03WS-TR:	250 mA Low Dropout Regulator 1.0% Accuracy with Fixed Output Voltage, -40°C to +125°C Temp. Range, 3-Lead SOT-223, 2,500/Reel
	-03	=	1.0% (with Fixed Output Voltage)			
	-07	=	0.5% (with Adjustable Output Voltage)		c) MIC2954-07YM:	250 mA Low Dropout Regulator 0.5% Accuracy with Adjustable Output Voltage, -40°C to +125°C Temp. Range, 8-Lead SOIC, 95/Tube
	-08	=	1.0% (with Adjustable Output Voltage)		d) MIC2954-08YM-TR:	250 mA Low Dropout Regulator 1.0% Accuracy with Adjustable Output Voltage, -40°C to +125°C Temp. Range, 8-Lead SOIC, 2,500/Reel
Junction Temperature Range:	W	=	-40°C to +125°C		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.
	Y	=	-40°C to +125°C			
Package:	M	=	8-Lead SOIC			
	S	=	3-Lead SOT-223			
	T	=	3-Lead TO-220			
Media Type:	(blank)	=	50/Tube (TO-220 option)			
	(blank)	=	78/Tube (SOT-223 option)			
	(blank)	=	95/Tube (SOIC option)			
	TR	=	2,500/Reel (SOT-223 & SOIC options)			

MIC2954

NOTES:

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods being used in attempts to breach the code protection features of the Microchip devices. We believe that these methods require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Attempts to breach these code protection features, most likely, cannot be accomplished without violating Microchip's intellectual property rights.
- Microchip is willing to work with any customer who is concerned about the integrity of its code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable." Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication is provided for the sole purpose of designing with and using Microchip products. Information regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL OR CONSEQUENTIAL LOSS, DAMAGE, COST OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, HELDO, IGL00, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PackeTime, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, FlashTec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2021, Microchip Technology Incorporated, All Rights Reserved.

ISBN: 978-1-5224-8573-5

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.



MICROCHIP

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta

Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX

Tel: 512-257-3370

Boston

Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago

Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas

Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit

Novi, MI
Tel: 248-848-4000

Houston, TX

Tel: 281-894-5983

Indianapolis

Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles

Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC

Tel: 919-844-7510

New York, NY

Tel: 631-435-6000

San Jose, CA

Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto

Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880-3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4485-5910
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820