MIC2954

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

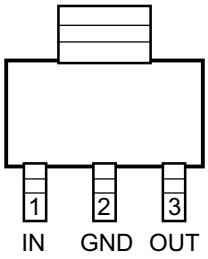
The MIC2954 is an efficient voltage regulator with very low dropout voltage (typically 40 mV at light loads and 375 mV at 250 mA), and low quiescent current (120 µA typical). The quiescent current of the MIC2954 increases only slightly in dropout, thus prolonging battery life. Key MIC2954 features include 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.

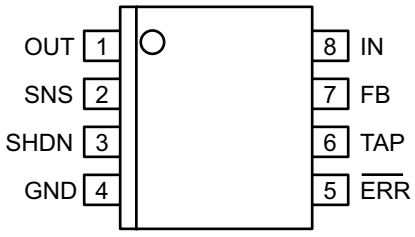
The MIC2954 is available in two voltage tolerances, ±0.5% maximum and ±1% maximum. Both are guaranteed for junction temperatures from –40°C to +125°C.

Package Types

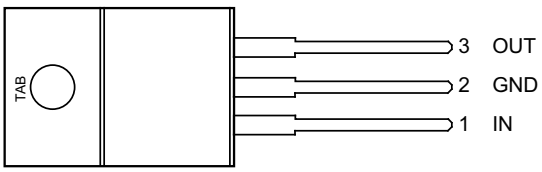
MIC2954
3-Lead SOT-223 (S)



MIC2954
8-Lead SOIC (M)

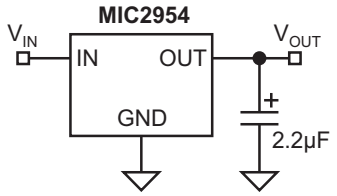


MIC2954
3-Lead TO-220 (T)

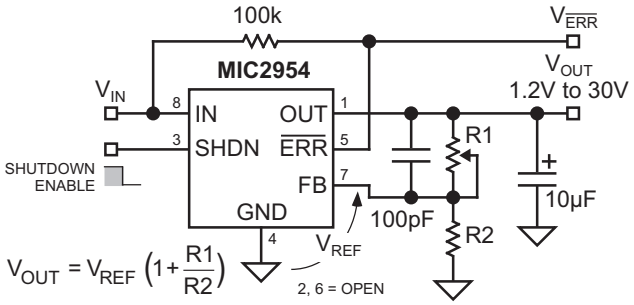


Typical Application Circuits

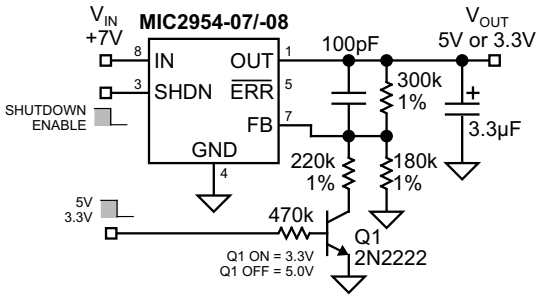
MIC2954 FIXED 5V REGULATOR



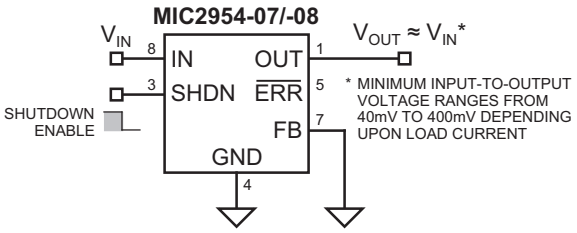
MIC2954 ADJUSTABLE REGULATOR



MIC2954 5V OR 3V SELECTABLE REGULATOR WITH SHUTDOWN

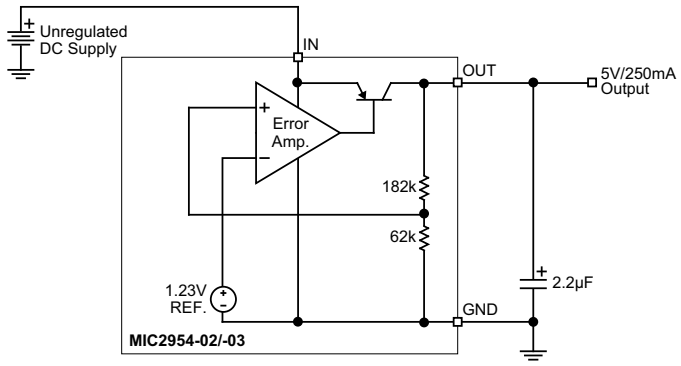


MIC2954 WIDE INPUT VOLTAGE RANGE CURRENT LIMITER

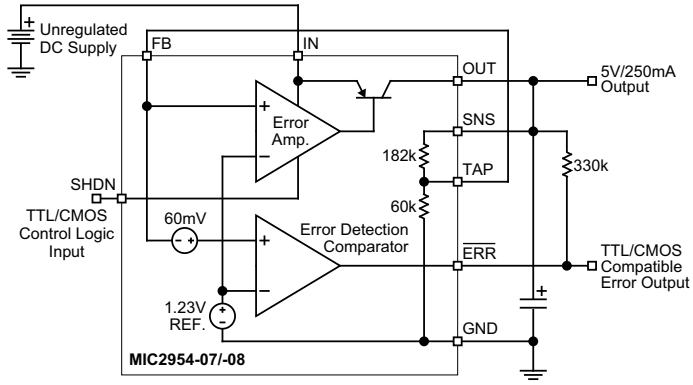


Functional Block Diagrams

MIC2954-02 and MIC2954-03



MIC2954-07 and MIC2954-08



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: $V_{FB} = V_{TAP}$; $V_{SNS} = V_{OUT}$; $V_{SHDN} \le 0.6V$. All versions: $V_{IN} = 6V$; $I_L = 1$ mA; $C_L = 2.2$ µF; $T_J = +25°C$, **bold** values valid for $–40°C \le T_J \le +125°C$, 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 (±0.5%)
		4.940	—	**5.060**		
		4.930	**5.000**	**5.070**		MIC2954-02/-07 (±0.5%), 1 mA ≤ I_L ≤ 250 mA
		4.950	5.000	5.050		MIC2954-03/-08 (±1%)
		4.900	—	**5.100**		
		4.880	**5.000**	**5.120**		MIC2954-03/-08 (±1%), 1 mA ≤ I_L ≤ 250 mA
Output Voltage Temperature Coefficient, Note 1	$\Delta V_{OUT}/\Delta T$	—	**20**	**100**	ppm/°C	MIC2954-02/-07 (±0.5%)
		—	**20**	**150**		MIC2954-03/-08 (±1%)
Line Regulation, Note 2	$\Delta V_{OUT}/V_{OUT}$	—	0.03	0.10	%/V	MIC2954-02/-07 (±0.5%), V_{IN} = 6V to 26V
		—	—	**0.20**		
		—	0.03	0.20		MIC2954-03/-08 (±1%), V_{IN} = 6V to 26V
		—	—	**0.40**		
Load Regulation, Note 3	$\Delta V_{OUT}/V_{OUT}$	—	0.04	0.16	%	MIC2954-02/-07 (±0.5%), I_L = 1 mA to 250 mA
		—	—	**0.20**		
		—	0.04	0.20		MIC2954-03/-08 (±1%), I_L = 1 mA to 250 mA
		—	—	**0.30**		

DC CHARACTERISTICS (CONTINUED)

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

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

DC CHARACTERISTICS (CONTINUED)

Electrical Characteristics: MIC2954-07/08: $V_{FB} = V_{TAP}$; $V_{SNS} = V_{OUT}$; $V_{SHDN} \le 0.6V$. All versions: $V_{IN} = 6V$; $I_L = 1$ mA; $C_L = 2.2$ µF; $T_J = +25°C$, **bold** values valid for $–40°C \le T_J \le +125°C$, 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 $I_L = 1$ mA. For $I_L = 100$ µA and $T_J = 125°C$, 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 ms.

8: $V_{REF} \le V_{OUT} \le (V_{IN} – 1V)$, $2.3V \le V_{IN} \le 30V$, $100\ µA < I_L \le 250$ mA, $T_J \le T_{J(MAX)}$.

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 mV × 5V/1.235V = 384 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: $V_{SHDN} \ge 2V$, $V_{IN} \le 30V$, $V_{OUT} = 0$, 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.

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.

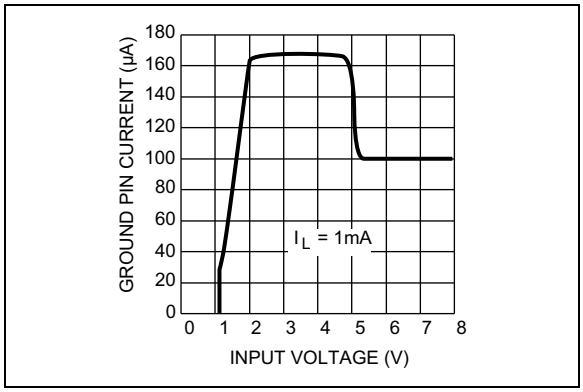


FIGURE 2-1: *Ground Pin Current.*

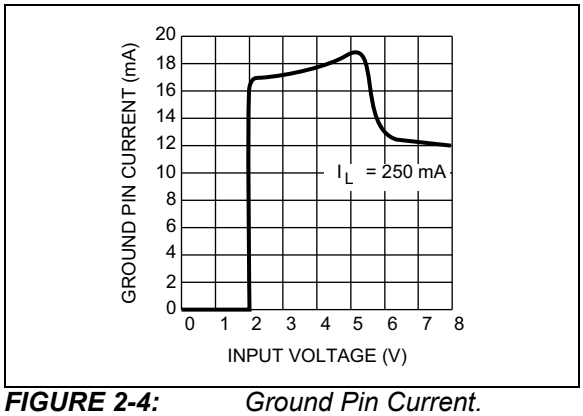


FIGURE 2-4: *Ground Pin Current.*

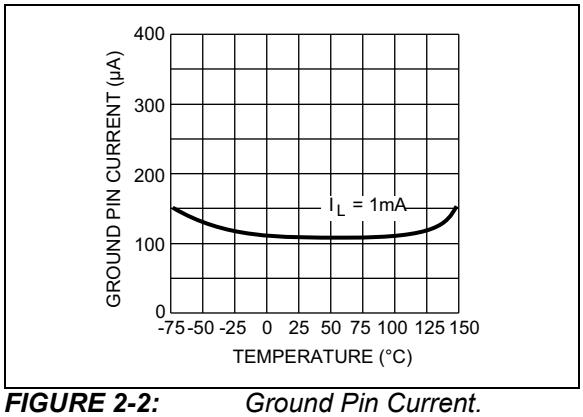


FIGURE 2-2: *Ground Pin Current.*

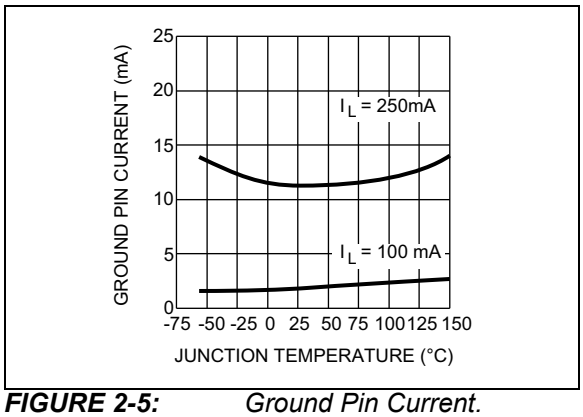


FIGURE 2-5: *Ground Pin Current.*

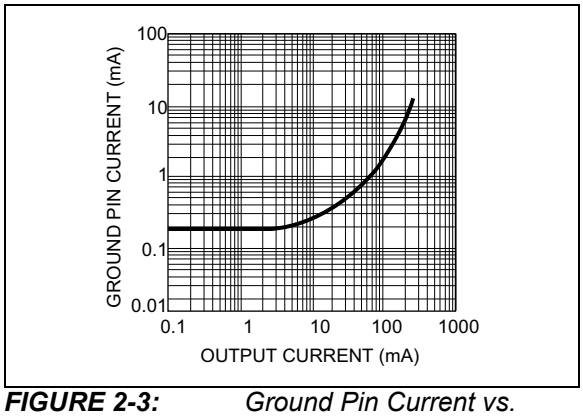


FIGURE 2-3: *Ground Pin Current vs. Load.*

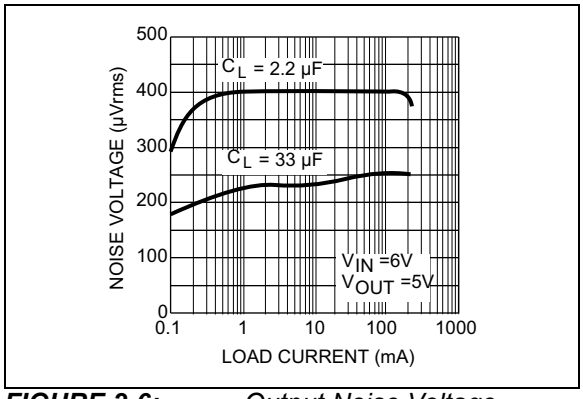


FIGURE 2-6: *Output Noise Voltage.*

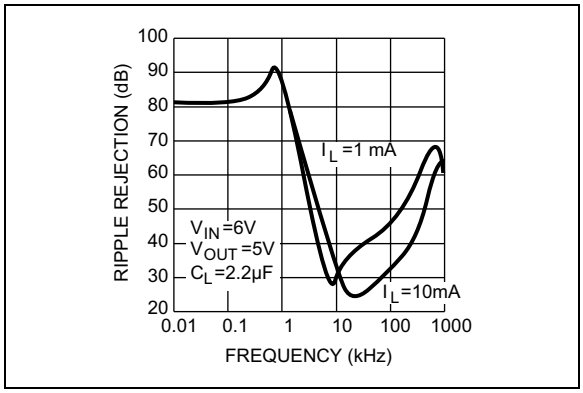


FIGURE 2-7: *Ripple Rejection.*

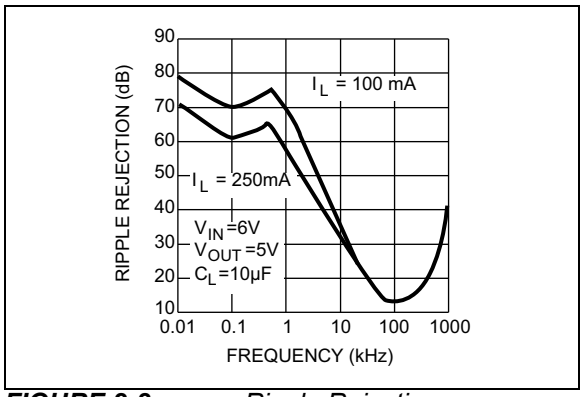


FIGURE 2-8: *Ripple Rejection.*

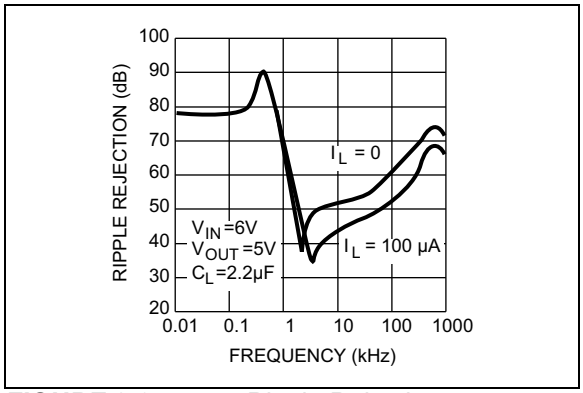


FIGURE 2-9: *Ripple Rejection.*

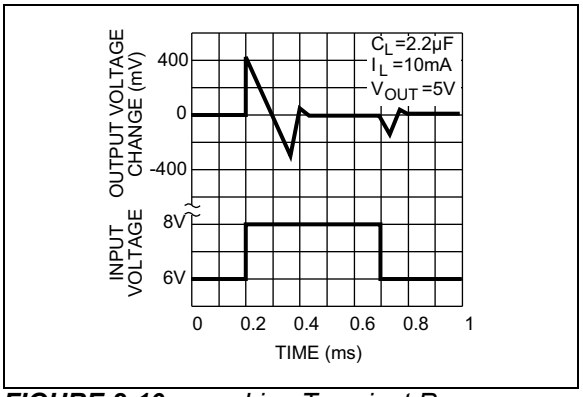


FIGURE 2-10: *Line Transient Response.*

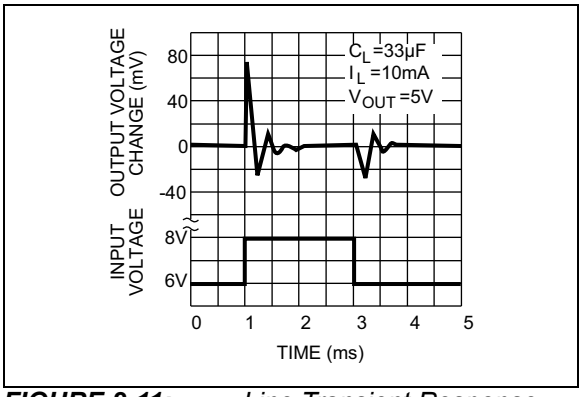


FIGURE 2-11: *Line Transient Response.*

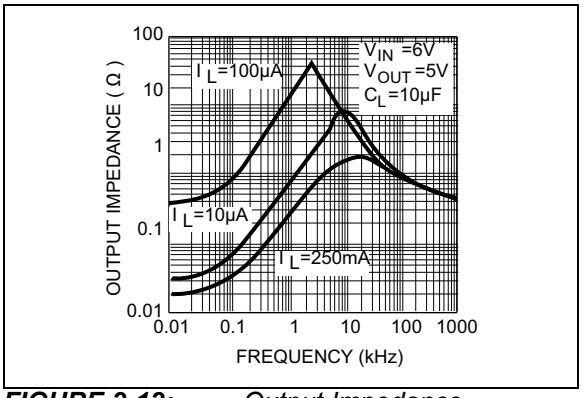


FIGURE 2-12: *Output Impedance.*

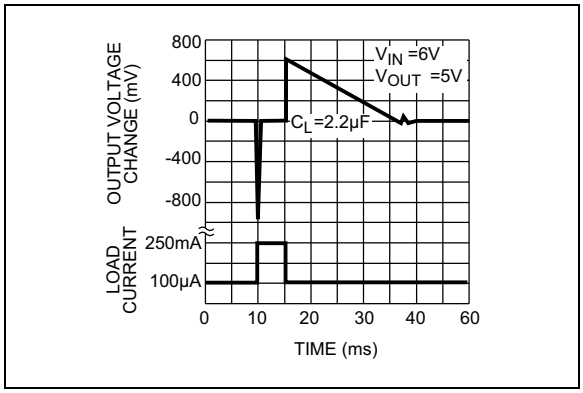


FIGURE 2-13: *Load Transient Response.*

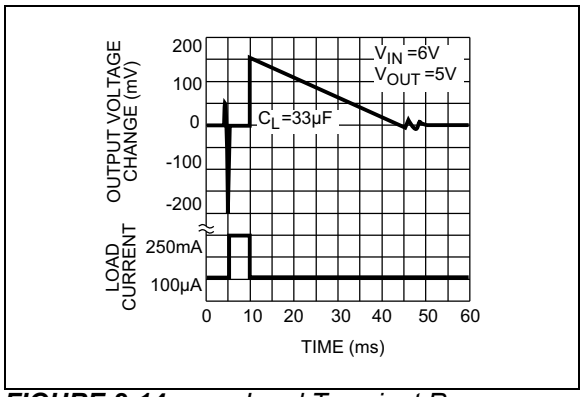


FIGURE 2-14: *Load Transient Response.*

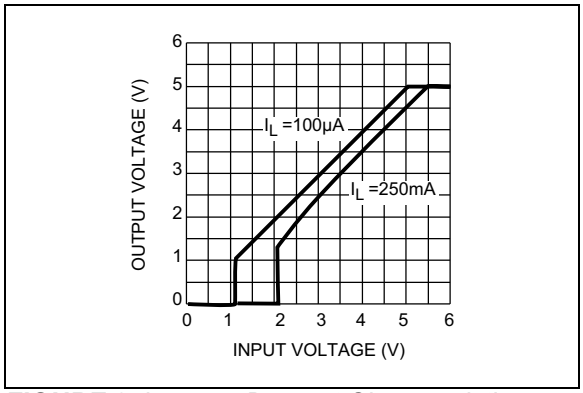


FIGURE 2-15: *Dropout Characteristics.*

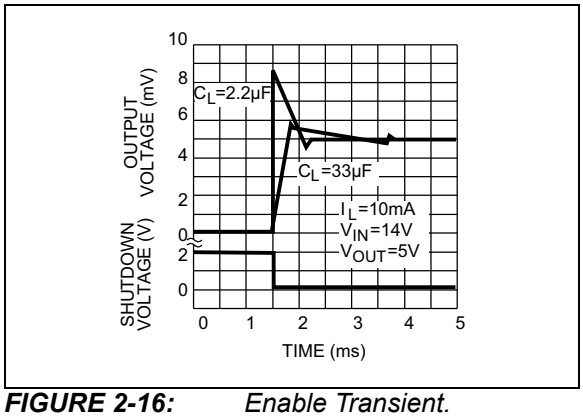


FIGURE 2-16: *Enable Transient.*

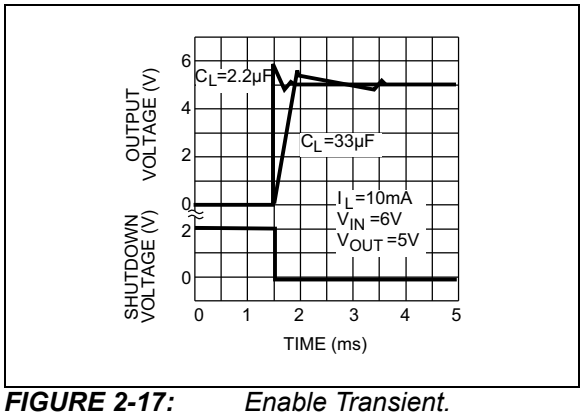


FIGURE 2-17: *Enable Transient.*

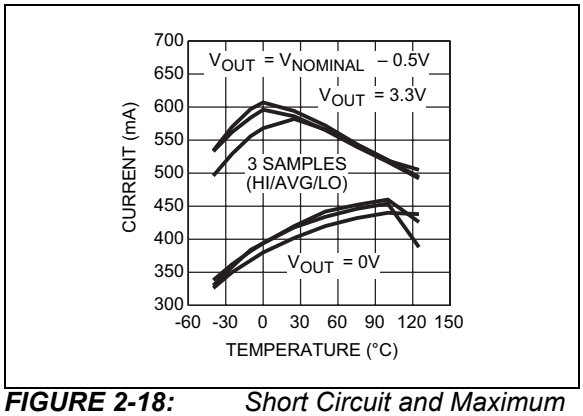


FIGURE 2-18: *Short Circuit and Maximum Current vs. Temperature.*

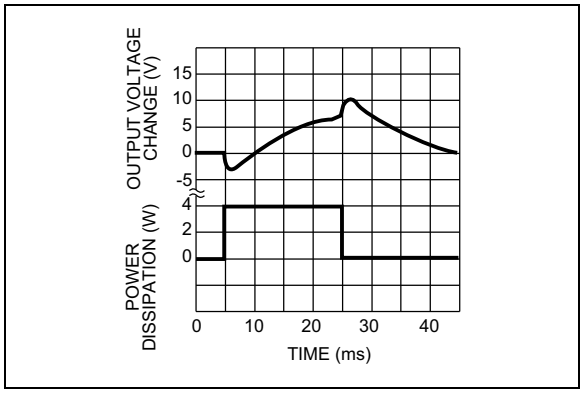


FIGURE 2-19: *Thermal Regulation.*

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).

4.0 APPLICATIONS INFORMATION

4.1 External Capacitors

A 2.2µF (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 0.5µF for current below 10mA or 0.15µF 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 5µF (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 0.1µF 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 a12V 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.

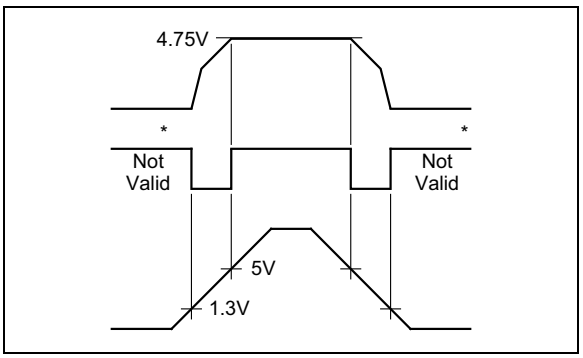


FIGURE 4-1: *$\overline{ERROR}$ Output Timing.*

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 µA, this sink current adds to battery drain in a low battery condition. Suggested values range from 100 kΩ to 1 MΩ. 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 µA forces an upper limit of 1.2 MΩ 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 kΩ reduces this error to 0.17% while increasing the resistor program current to 12 µA.

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:

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

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.

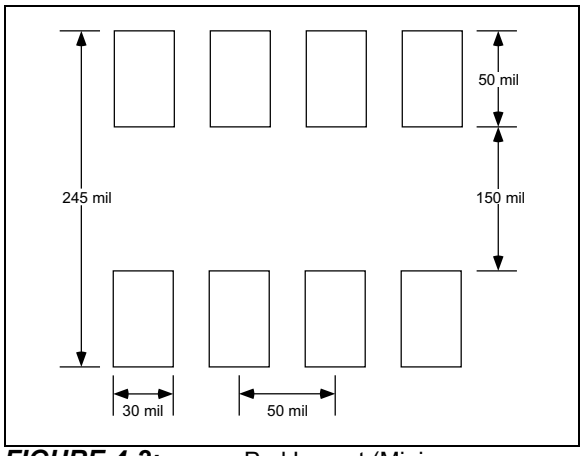


FIGURE 4-2: Pad Layout (Minimum Recommended Geometry).

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.

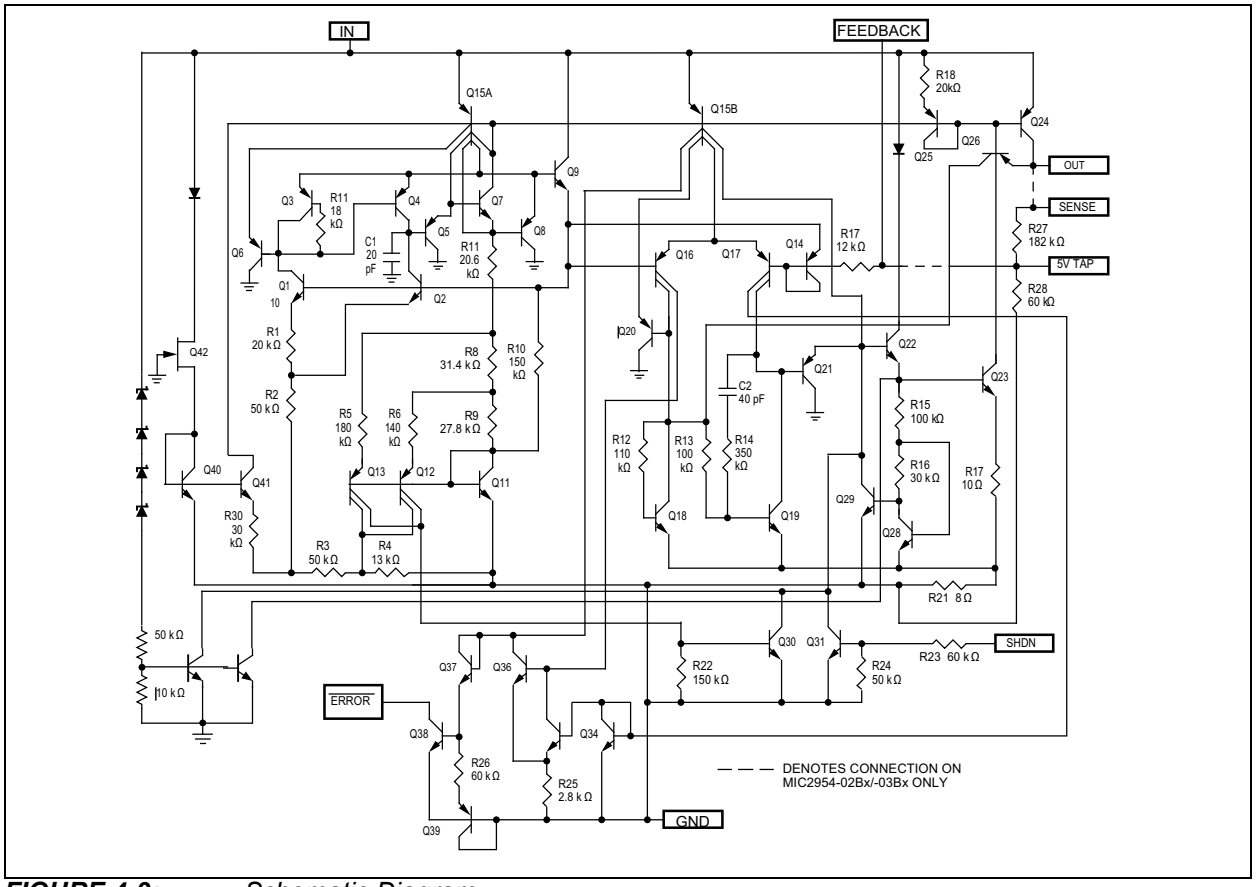
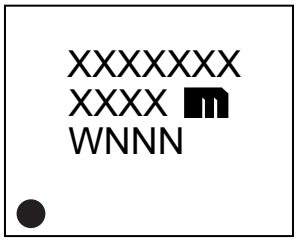


FIGURE 4-3: *Schematic Diagram.*

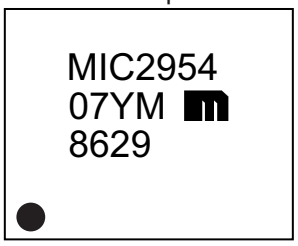
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

8-Lead SOIC*



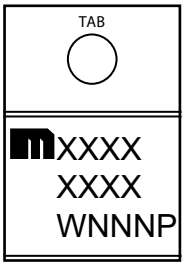
Example



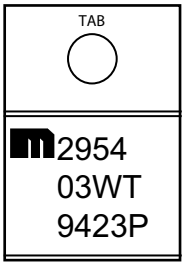
3-Lead SOT-223*

Example

3-Lead TO-220*



Example

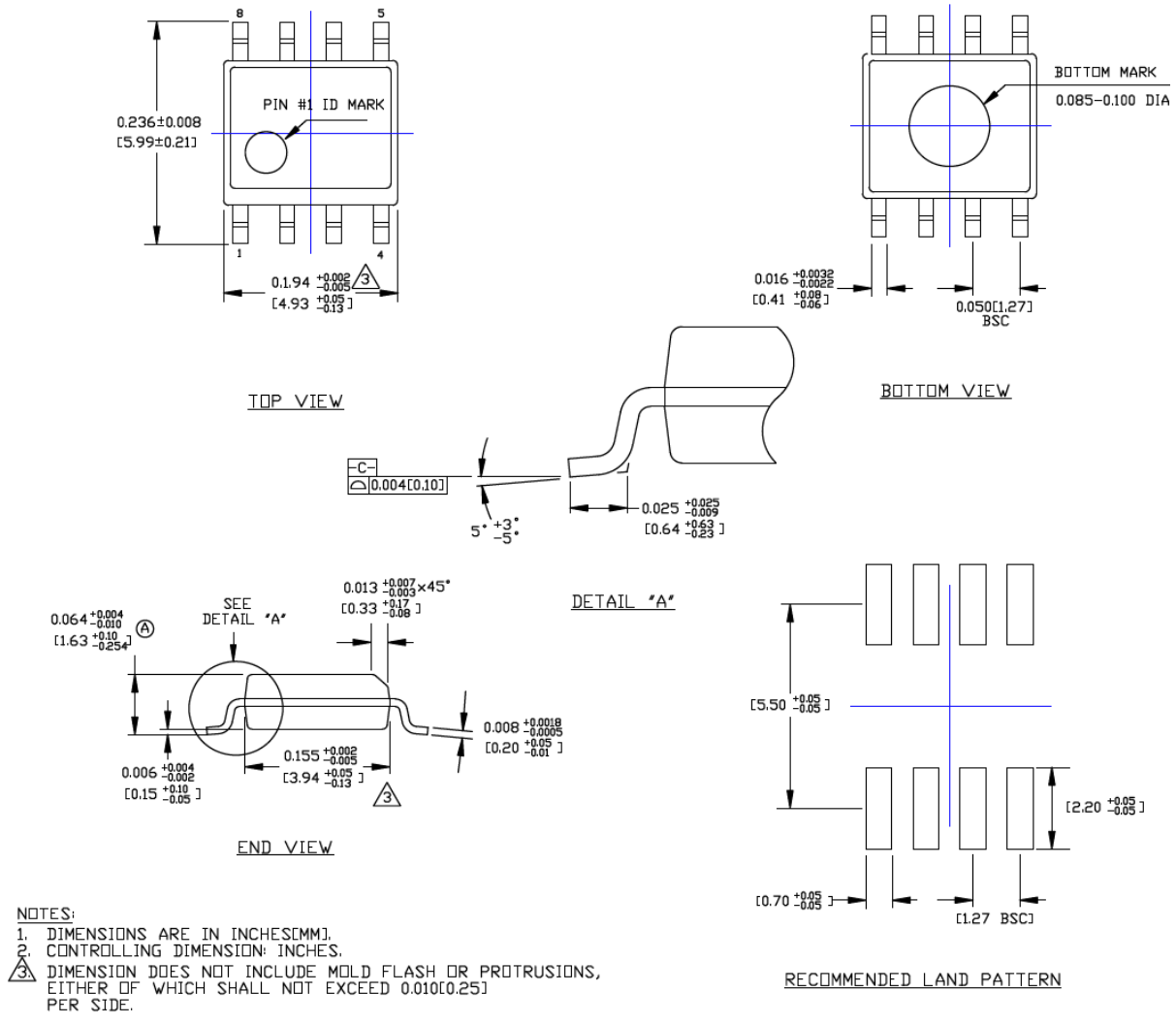


Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package 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 SOIC Package Outline and Recommended Land Pattern

TITLE
8 LEAD SOICN PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

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



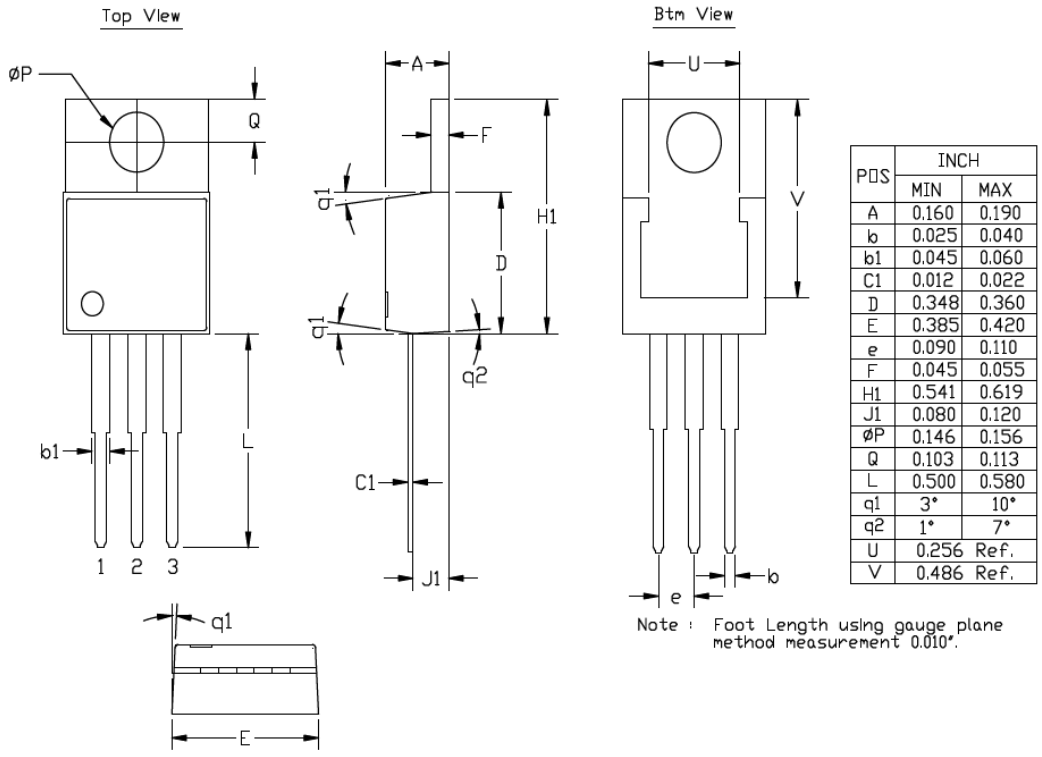
NOTES:
1. DIMENSIONS ARE IN INCHES[MM].
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.010[0.25] PER SIDE.

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

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



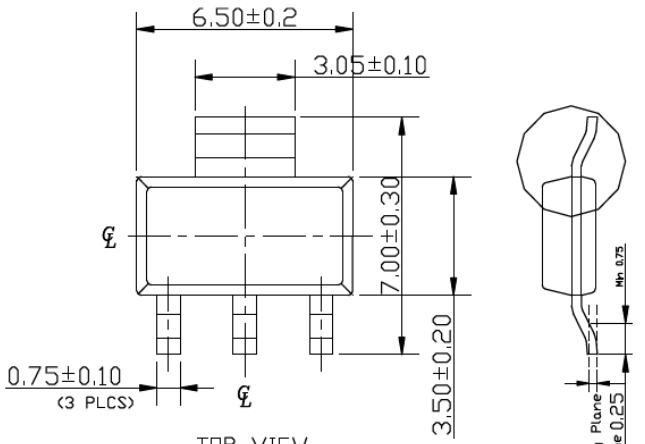
POS	INCH	
	MIN	MAX
A	0.160	0.190
b	0.025	0.040
b1	0.045	0.060
C1	0.012	0.022
D	0.348	0.360
E	0.385	0.420
e	0.090	0.110
F	0.045	0.055
H1	0.541	0.619
J1	0.080	0.120
øP	0.146	0.156
Q	0.103	0.113
L	0.500	0.580
q1	3°	10°
q2	1°	7°
U	0.256 Ref.	
V	0.486 Ref.	

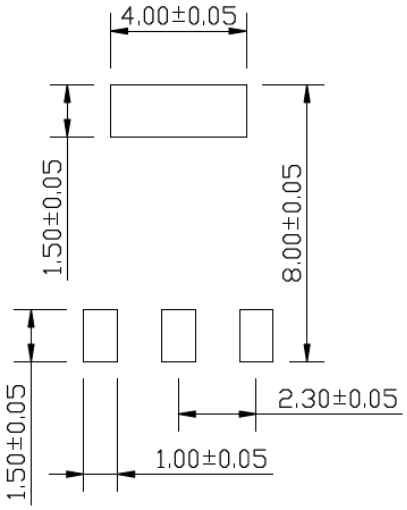
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

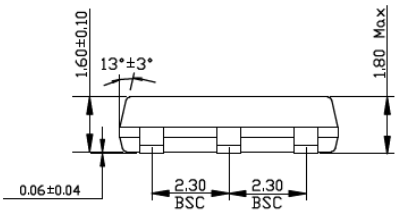
3-Lead SOT-223 Package Outline and Recommended Land Pattern

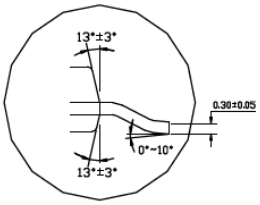
TITLE
3 LEAD SOT223 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	SOT223-3LD-PL-1	UNIT	MM









NOTE:

1. Dimensions and tolerances are as per ANSI Y14.5M, 1982.
2. Controlling dimension: Millimeters.
3. Dimensions are exclusive of mold flash and gate burr.
4. All specification comply to Jedec spec TO261 Issue C.

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 (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.

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.	-XX	X	X	-XX
Device	Accuracy	Junction Temp. Range	Package	Media Type

Device:	MIC2954:	250 mA Low Dropout Regulator
Accuracy:	-02 = 0.5% (with Fixed Output Voltage) -03 = 1.0% (with Fixed Output Voltage) -07 = 0.5% (with Adjustable Output Voltage) -08 = 1.0% (with Adjustable Output Voltage)	
Junction Temperature Range:	W = –40°C to +125°C 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)	

Examples:

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

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

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

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

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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