MIC2937A/1/2

750 mA Low Dropout Voltage Regulator

Features

- High Output Voltage Accuracy
- 750 mA Output
- Low Quiescent Current
- Low Dropout Voltage
- Extremely Tight Load and Line Regulation
- Very Low Temperature Coefficient
- Current and Thermal Limiting
- Input Can Withstand –20V Reverse Battery and +60V Positive Transients
- Error Flag Warns of Output Dropout
- Logic-Controlled Electronic Shutdown
- Output Programmable from 1.24V to 26V (MIC29372)
- MIC2937A Available in TO-220-3 or TO-263-3 Packages
- MIC23971 and MIC29372 Available in TO-220-5 or TO-263-5 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-Regulator/DC-to-DC Modules
- High Efficiency Linear Power Supplies

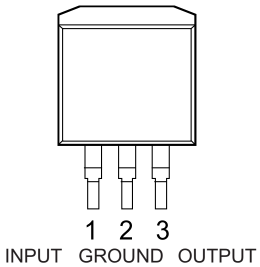
General Description

The MIC2937 family are efficient voltage regulators with very low dropout voltage (typically 40 mV at light loads and 300 mV at 500 mA) and very low quiescent current (160 µA typical). The quiescent current of the MIC2937 increases only slightly in dropout, thus prolonging battery life. Key MIC2937 features include protection against reversed battery, fold-back current limiting, and automotive “load dump” protection (60V positive transient).

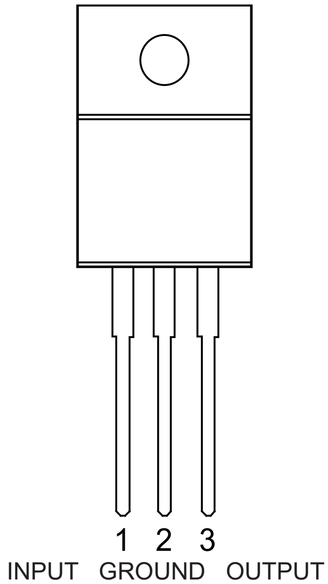
The MIC2937 is available in several configurations. The MIC2937A-xx devices are three-pin fixed-voltage regulators with 3.3V, 5V, and 12V outputs available. The MIC29371 is a fixed-voltage regulator offering logic compatible ON/OFF switching input and an error flag output. This flag may also be used as a power-on reset signal. A logic-compatible shutdown input is provided on the adjustable MIC29372, which enables the regulator to be switched on and off.

Package Types

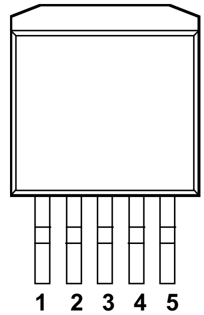
MIC2937A
3-Lead TO-263 (WU)
(Top View)



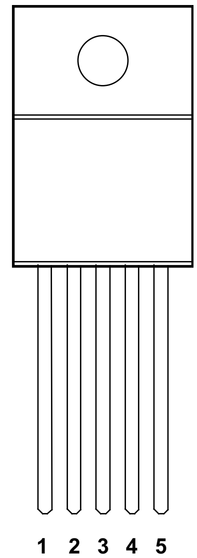
MIC2937A
3-Lead TO-220 (WT)
(Top View)



MIC29371/MIC29372
5-Lead TO-263 (WU)
(Top View)



MIC29371/MIC29372
5-Lead TO-220 (WT)
(Top View)



The descriptions of the pins are listed below.

PIN FUNCTION TABLE

Pin Number MIC2937A	Pin Number MIC29371	Pin Number MIC29372	Pin Name	Description
—	1	—	Error	Error flag output signal that indicates an output fault condition.
—	—	1	Adjust	Adjustable regulator feedback input that connects to the resistor voltage divider that is placed from Output to Ground to set the output voltage.
1	2	4	Input	Input supply.
2	3	3	Ground	Ground.
3	4	5	Output	Regulator output voltage.
—	5	2	Shutdown	Enable/Disable control.

Note: The TAB is Ground on the TO-220 and TO-263 packages.

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Input Supply Voltage .... –20V to +60V
Power Dissipation (P_D) .... Note 1, Internally Limited

Operating Ratings ‡

Operating Input Supply Voltage (Note 2) .... +2V to +26V
Adjust Input Voltage (Note 3, Note 4) .... –1.5V to +26V
Shutdown Input Voltage .... –0.3V to +30V
Error Comparator Output Voltage .... –0.3V 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: 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: $P_{D(MAX)} = (T_{J(MAX)} – T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.

2: Across the full operating temperature, the minimum input voltage range for full output current is 4.3V to 26V. Output will remain in regulation at lower output voltages and low current loads down to an input of 2V at 25°C.

3: Comparator thresholds are expressed in terms of a voltage differential at the Adjust terminal below the nominal reference voltage measured at 6V input (for a 5V regulator). 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 x 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, 7.7% ensured.

4: Circuit of Figure 3 with R1 ≥ 150 kΩ. $V_{SHUTDOWN}$ ≥ 2V and V_{IN} ≤ 26V, V_{OUT} = 0.

ELECTRICAL CHARACTERISTICS

Limits in standard typeface are for T_J = +25°C and limits in **bold** apply over the full operating temperature range. Unless otherwise specified, $V_{IN} = V_{OUT}$ + 1V, I_L = 5 mA, C_L = 10 µF. The MIC29372 are programmed for a 5V output voltage and $V_{SHUTDOWN}$ ≤ 0.6V (MIC29371-xx and MIC29372 only).

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Voltage Accuracy	V_O	–1	—	1	%	Variation from factory-trimmed V_{OUT}
		–2	—	**2**		
		–2.5	—	**2.5**		5 mA ≤ I_L ≤ 500 mA
		–1.5	—	1.5		MIC2937A-12 and 29371-12 only:
		–3	—	**3**		
		–4	—	**4**		5 mA ≤ I_L ≤ 500 mA
Output Voltage Temperature Coefficient	$\Delta V_O/\Delta T$	—	20	**100**	ppm/°C	Note 1
		—	80	**350**		Output voltage > 10V
Line Regulation	$\Delta V_O/V_O$	—	0.03	0.10	%	$V_{IN} = V_{OUT}$ + 1V to 26V
		—	—	**0.40**		
Load Regulation	$\Delta V_O/V_O$	—	0.04	0.16	%	I_L = 5 mA to 500 mA
		—	—	**0.30**		Note 2

ELECTRICAL CHARACTERISTICS (CONTINUED)

Limits in standard typeface are for T_J = +25°C and limits in **bold** apply over the full operating temperature range. Unless otherwise specified, $V_{IN} = V_{OUT}$ + 1V, I_L = 5 mA, C_L = 10 µF. The MIC29372 are programmed for a 5V output voltage and $V_{SHUTDOWN}$ ≤ 0.6V (MIC29371-xx and MIC29372 only).

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Dropout Voltage (Note 3)	$V_{IN} - V_O$	—	80	150	mV	I_L = 5 mA
		—	—	**180**		
		—	200	—		I_L = 100 mA
		—	240	—		Output voltage > 10V
		—	300	—		I_L = 500 mA
		—	420	—		Output voltage > 10V
		—	370	600		I_L = 750 mA
		—	—	**750**		
Ground Pin Current (Note 4)	I_{GND}	—	160	250	µA	I_L = 5 mA
		—	—	**300**		
		—	1	2.5	mA	I_L = 100 mA
		—	—	**3**		
		—	8	13		I_L = 500 mA
		—	—	**16**		
		—	15	25		I_L = 750 mA
Ground Pin Current at Dropout (Note 4)	I_{GNDDO}	—	200	**500**	µA	V_{IN} = 0.5V less than designed V_{OUT} (V_{OUT} ≥ 3.3V), I_O = 5 mA
Current Limit	I_{LIMIT}	—	1.1	1.5	A	V_{OUT} = 0V, Note 5
		—	—	**2**		
Thermal Regulation	$\Delta V_O/\Delta P_D$	—	0.05	0.2	%/W	Note 6
Output Noise Voltage (10 Hz to 100 kHz, I_L = 100 mA)	e_n	—	400	—	$µV_{RMS}$	C_L = 10 µF
		—	260	—		C_L = 100 µF
MIC29372						
Reference Voltage	V_{REF}	1.223	1.235	1.247	V	—
		1.210	—	1.260	V_{MAX}	
Reference Voltage	V_{REF}	**1.204**	—	**1.266**	V	Note 7
Adjust Pin Bias Current	I_{BIAS}	—	20	40	nA	—
		—	—	**60**		
Reference Voltage Temperature Coefficient		—	20	—	ppm/°C	Note 6
Adjust Pin Bias Current Temperature Coefficient		—	0.1	—	nA/°C	—
Error Comparator MIC29371						
Output Leakage Current		—	0.01	1.00	µA	V_{OH} = 26V
		—	—	**2.00**		
Output Low Voltage	V_{OL}	—	150	250	mV	V_{IN} = 4.5V, I_{OL} = 250 µA
		—	—	**400**		
Upper Threshold Voltage		40	60	—	mV	Note 8
		25	—	—		
Lower Threshold Voltage		—	75	95	mV	Note 8
		—	—	**140**		
Hysteresis		—	15	—	mV	Note 8

ELECTRICAL CHARACTERISTICS (CONTINUED)

Limits in standard typeface are for T_J = +25°C and limits in **bold** apply over the full operating temperature range. Unless otherwise specified, V_{IN} = V_{OUT} + 1V, I_L = 5 mA, C_L = 10 µF. The MIC29372 are programmed for a 5V output voltage and $V_{SHUTDOWN}$ ≤ 0.6V (MIC29371-xx and MIC29372 only).

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Shutdown Input MIC29371/MIC29372						
Input Logic Voltage Low (ON)		—	1.3	—	V	—
		—	—	**0.7**		
		2.0	—	—		High (OFF)
Shutdown Pin Input Current		—	30	50	µA	$V_{SHUTDOWN}$ = 2.4V
		—	—	**100**		
Regulator Output Current in Shutdown		—	450	600	µA	$V_{SHUTDOWN}$ = 26V
		—	—	**750**		
		—	3	10		Note 9
		—	—	**20**		

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. 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 100 mV below its nominal value measured at 1V differential. At low values of programmed output voltage, the minimum input supply voltage of 4.3V over temperature must be taken into account. The MIC2937A operates down to 2V of input at reduced output current at 25°C.

4: 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.

5: The MIC2937A family features fold-back current limiting. The short circuit (V_{OUT} = 0V) current limit is less than the maximum current with normal output voltage.

6: 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.

7: $V_{REF} \leq V_{OUT} \leq (V_{IN} – 1V)$, 4.3V ≤ V_{IN} ≤ 26V, 5 mA < I_L ≤ 750 mA, $T_J \leq T_{J(MAX)}$.

8: Comparator thresholds are expressed in terms of a voltage differential at the Adjust terminal below the nominal reference voltage measured at 6V input (for a 5V regulator). 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 x 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, 7.7% ensured.

9: Circuit of Figure 3 with R1 ≥ 150 kΩ. $V_{SHUTDOWN}$ ≥ 2V and V_{IN} ≤ 26V, V_{OUT} = 0.

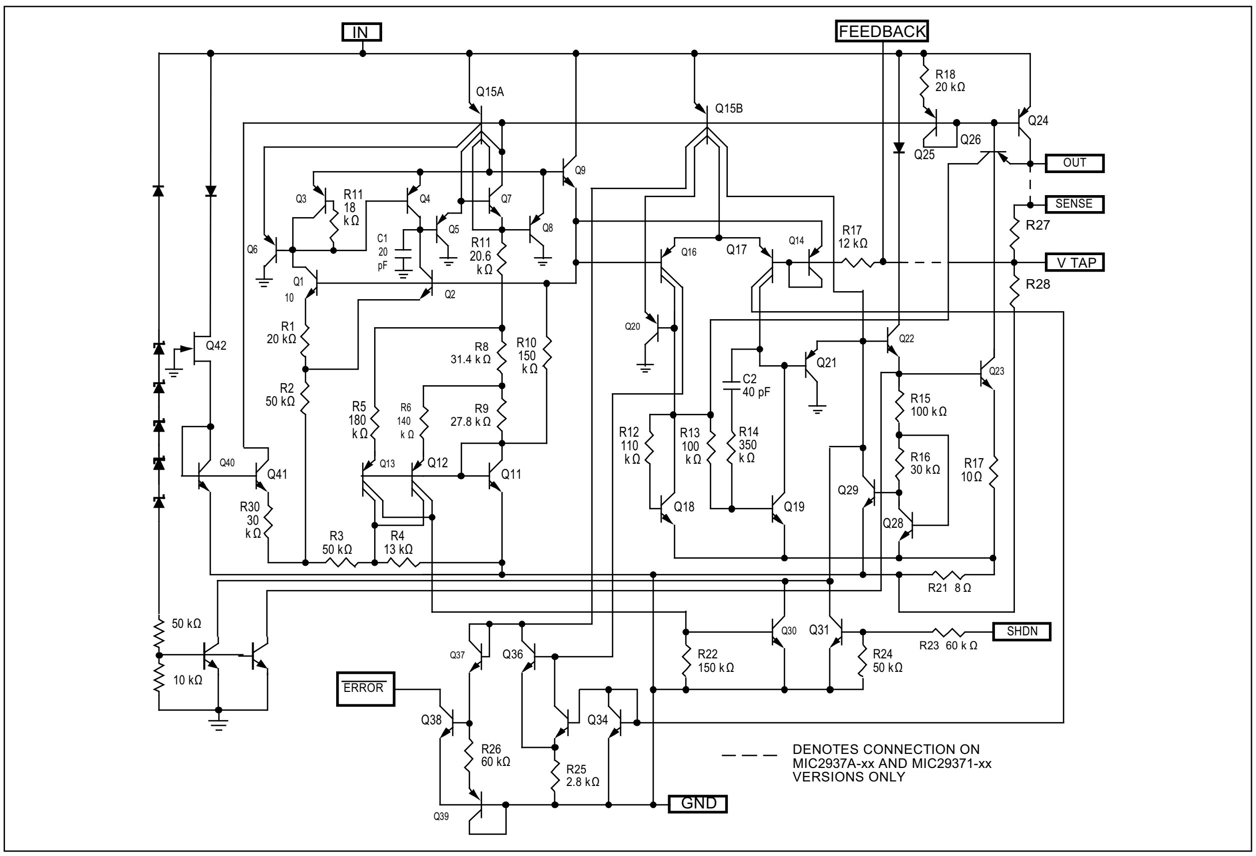
10: When used in dual supply systems where the regulator load is returned to a negative supply, the output voltage must be diode clamped to ground.

11: Maximum positive supply voltage of 60V must be of limited duration (<100 ms) and duty cycle (≤1%). The maximum continuous supply voltage is 26V.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Operating Junction Temperature Range	T_J	–40	—	+125	°C	—
Storage Temperature	T_S	–65	—	+150	°C	—
Lead Temperature	T_{LEAD}	—	—	+260	°C	Soldering, 5 sec.
Package Thermal Resistances						
Thermal Resistance, TO-220	θ_{JC}	—	2.5	—	°C/W	—
Thermal Resistance, TO-263	θ_{JC}	—	2.5	—	°C/W	—

Schematic Diagram



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.

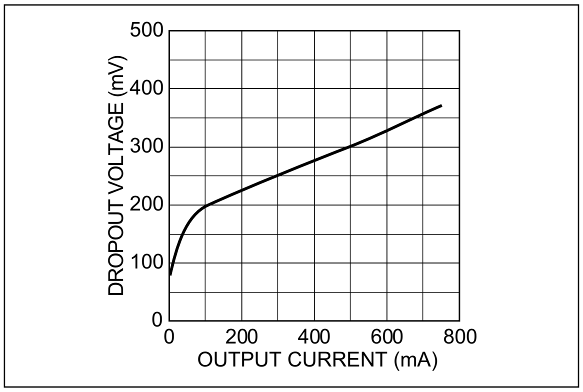


FIGURE 2-1: *Dropout Voltage vs. Output Current.*

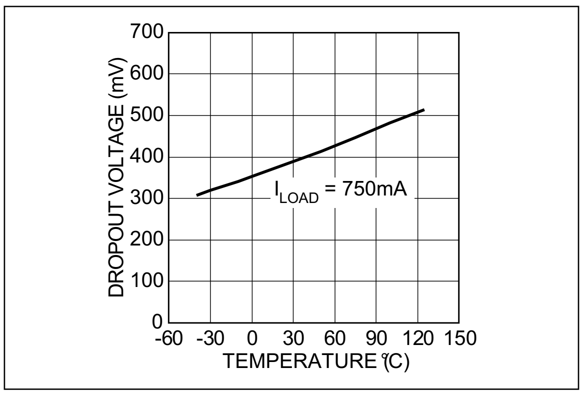


FIGURE 2-2: *Dropout Voltage vs. Temperature.*

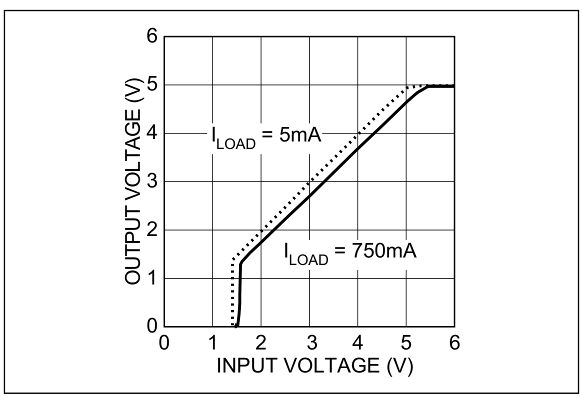


FIGURE 2-3: *Dropout Characteristics.*

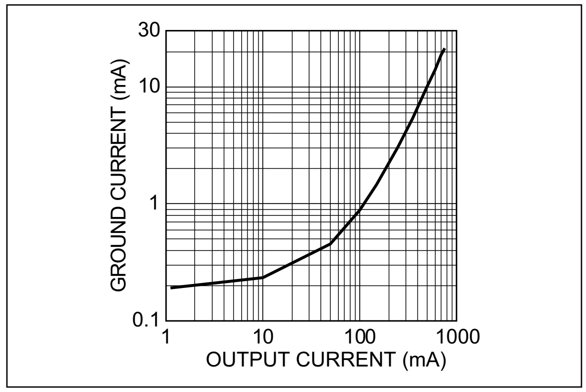


FIGURE 2-4: *Ground Current vs. Output Current.*

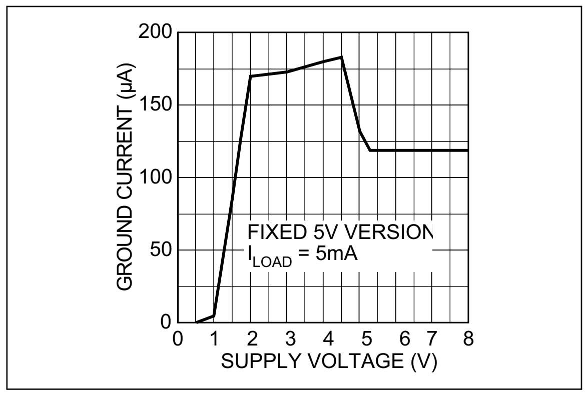


FIGURE 2-5: *Ground Current vs Supply Voltage.*

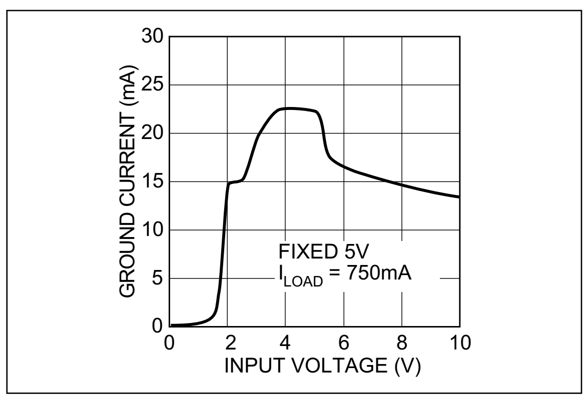


FIGURE 2-6: *Ground Current vs. Supply Voltage.*

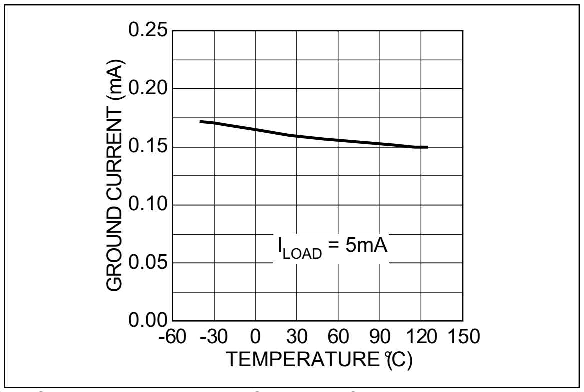


FIGURE 2-7: *Ground Current vs. Temperature.*

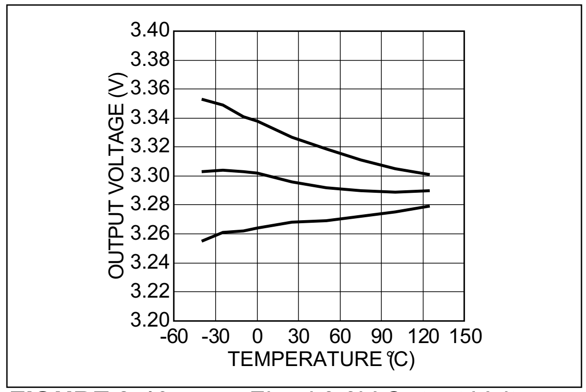


FIGURE 2-10: *Fixed 3.3V Output Voltage vs. Temperature.*

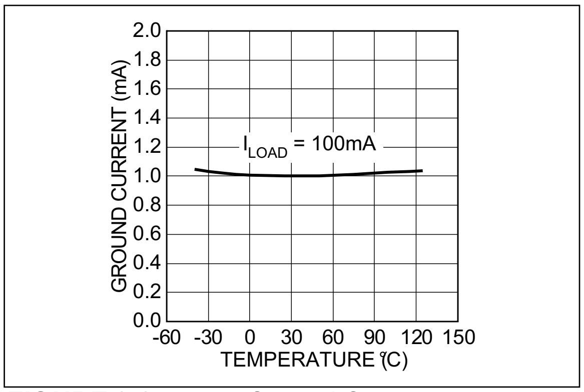


FIGURE 2-8: *Ground Current vs. Temperature.*

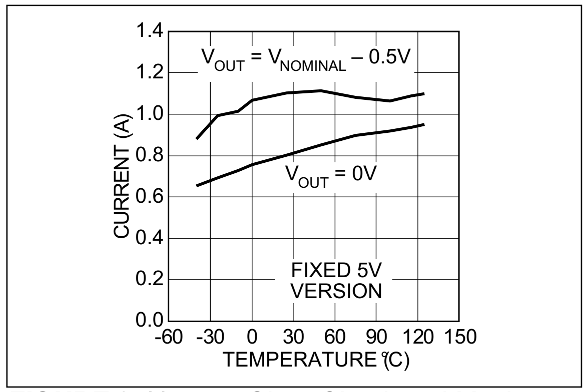


FIGURE 2-11: *Short Circuit and Maximum Current vs. Temperature.*

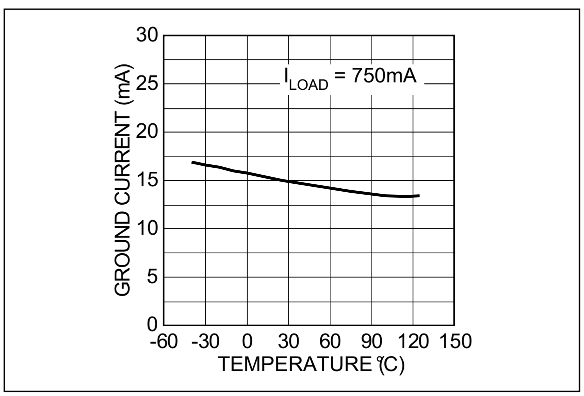


FIGURE 2-9: *Ground Current vs. Temperature.*

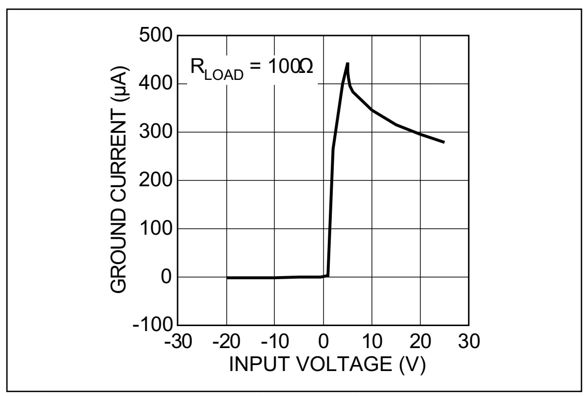


FIGURE 2-12: *Ground Current vs. Input Voltage.*

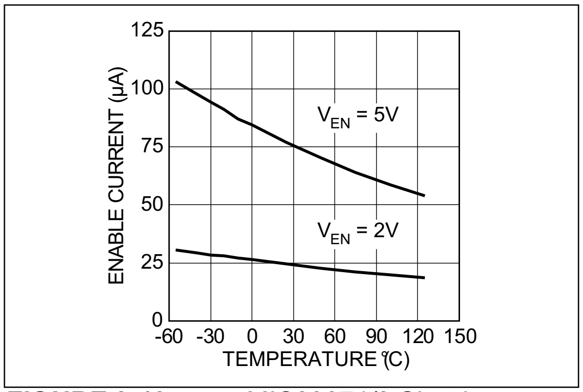


FIGURE 2-13: *MIC29371/2 Shutdown Current vs. Temperature.*

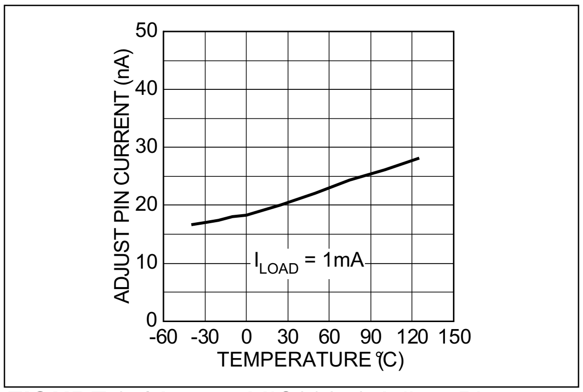


FIGURE 2-14: *MIC29372 Adjust Pin Current vs. Temperature.*

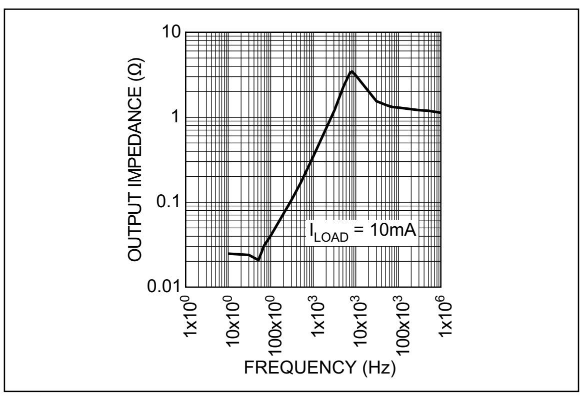


FIGURE 2-15: *Output Impedance vs. Frequency.*

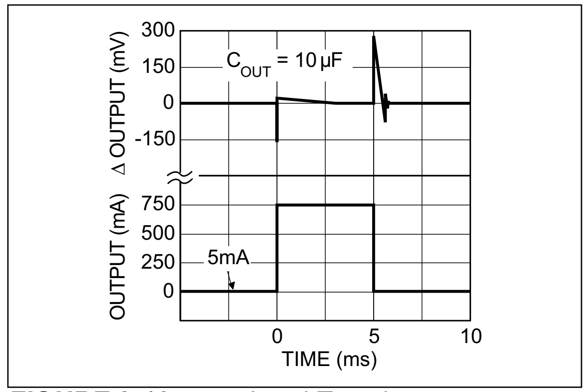


FIGURE 2-16: *Load Transient.*

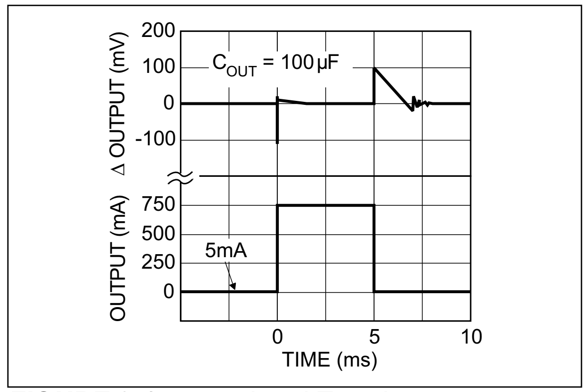


FIGURE 2-17: *Load Transient.*

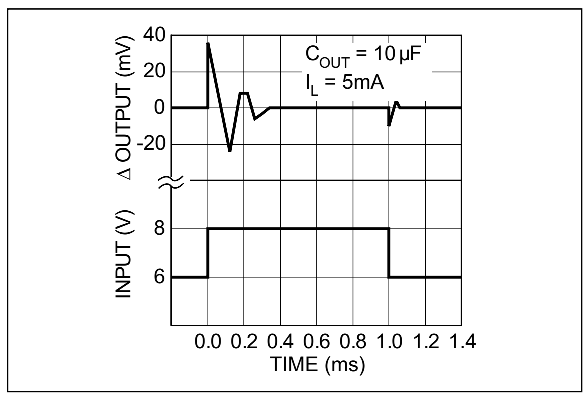


FIGURE 2-18: *Line Transient.*

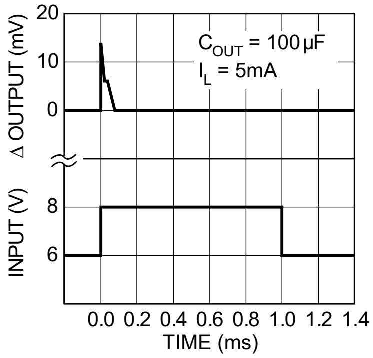


FIGURE 2-19: *Line Transient.*

3.0 APPLICATION INFORMATION

3.1 External Capacitors

A 10 µF (or greater) capacitor is required between the MIC2937A 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 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 500 kHz. 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 µF for current below 10 mA or 0.15 µF for currents below 1 mA. Adjusting the MIC29372 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 750 mA load at 1.23V output (Output shorted to Adjust) a 22 µF (or greater) capacitor should be used.

The MIC2937A and MIC29371 will remain in regulation with a minimum load of 5 mA. When setting the output voltage of the MIC29372 version with external resistors, the current through these resistors may be included as a portion of the minimum load.

A 0.1 µF capacitor should be placed from the 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.

3.2 Error Detection Comparator Output (MIC29371)

A logic low output will be produced by the comparator whenever the MIC29371 output falls out of regulation by more than approximately 5%. This figure is the comparator's built-in offset of about 75mV divided by the 1.235V reference voltage. (Refer to the Schematic Diagram). This trip level remains 5% below normal regardless of the programmed output voltage of the MIC29371. 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, extremely high input voltage, current limiting, or thermal limiting.

Figure 3-1 is a timing diagram depicting the $\overline{\text{ERROR}}$ signal and the regulated output voltage as the MIC29371 input is ramped up and down. The $\overline{\text{ERROR}}$ 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 MIC29371's dropout voltage is load-dependent (see curve in Typical Performance Curves), 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.

The error comparator has an NPN 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 250 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.

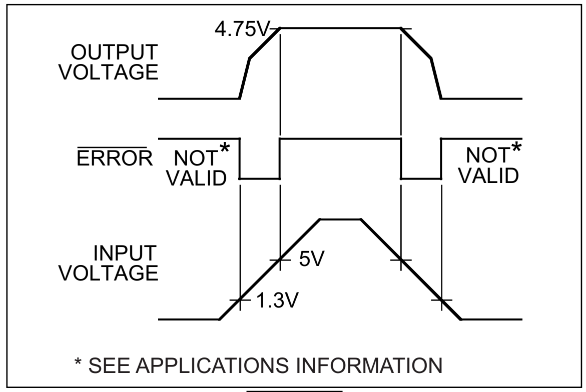


FIGURE 3-1: *$\overline{\text{ERROR}}$ Output Timing.*

3.3 Programming the Output Voltage (MIC29372)

The MIC29372 may programmed for any output voltage between its 1.235V reference and its 26V maximum rating. An external pair of resistors is required, as shown in Figure 3-3.

The complete equation for the output voltage is:

EQUATION 3-1:

$$V_{OUT} = V_{REF} \times (1 + R_1 / R_2) - |I_{FB}| R_1$$

Where:

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

I_{FB} = The Adjust pin bias current, nom. 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} which 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 MIC29372 typically draws 100 µA at no load with SHUTDOWN open-circuited, this is a negligible addition.

3.4 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, as 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 by a factor of four with the adjustable regulators with a bypass capacitor across R_1, since it reduces the high frequency gain from 4 to unity. Pick

EQUATION 3-2:

$$C_{BYPASS} \cong \frac{1}{2\pi R_1 \times 200Hz}$$

or about 0.01 µF. When doing this, the output capacitor must be increased to 10 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.

3.5 Automotive Applications

The MIC2937A 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 (100 µA typical). These features are necessary for use in battery powered systems, such as automobiles. It is a 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.

3.6 Typical Applications

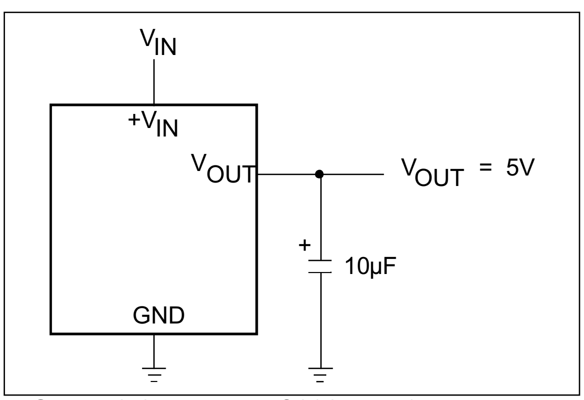


FIGURE 3-2: MIC2937A-5.0 Fixed +5V Regulator.

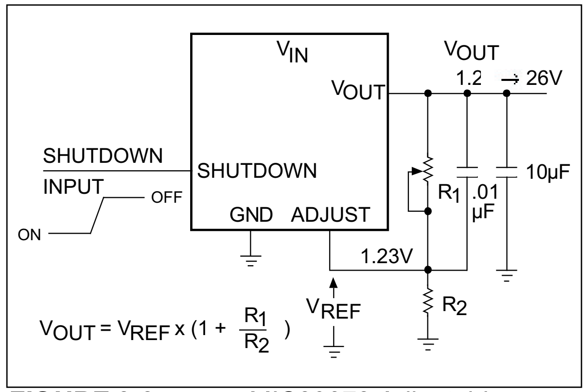


FIGURE 3-3: MIC29372 Adjustable Regulator.

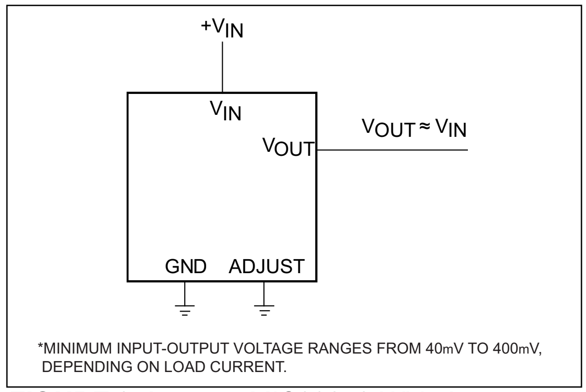


FIGURE 3-4: MIC29372 Wide Input Voltage Range Current Limiter.

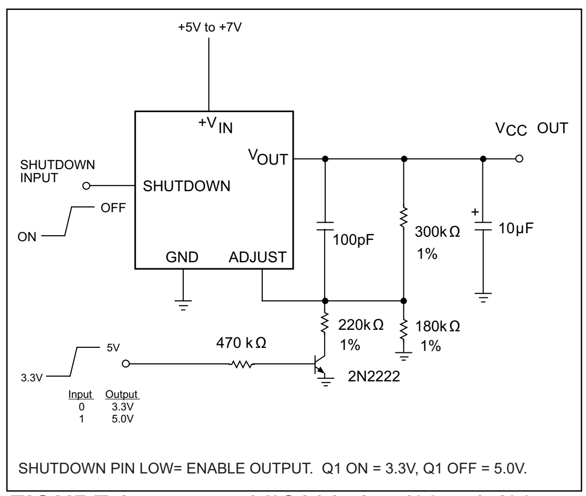


FIGURE 3-5: MIC29372 5.0V or 3.3V Selectable Regulator with Shutdown.

4.0 PACKAGING INFORMATION

4.1 Package Marking Information

Package	Marking	Example
12V MIC2937A/371 3 or 5-Lead TO-220*	XXXXX XXXX WNNNP	2937A 12WT 8PF6P
12V MIC2937A/371 3 or 5-Lead TO-263*	XXXXX XXXX WNNNP	29371 12WU 45TGP
3.3V or 5V MIC2937A/371 3 or 5-Lead TO-220*	XXXXXXXX X.XXX WNNNP	MIC29371 3.3WT 5O3LP
3.3V or 5V MIC2937A/371 3 or 5-Lead TO-263*	XXXXXXXX X.XXX WNNNP	MIC2937A 5.0WU 1BF8P
MIC29372 5-Lead TO-220*	XXXXXXXX XX WNNNP	MIC29372 WT 3M78P
MIC29372 5-Lead TO-263*	XXXXXXXX XX WNNNP	MIC29372 WU 9C1YP

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).

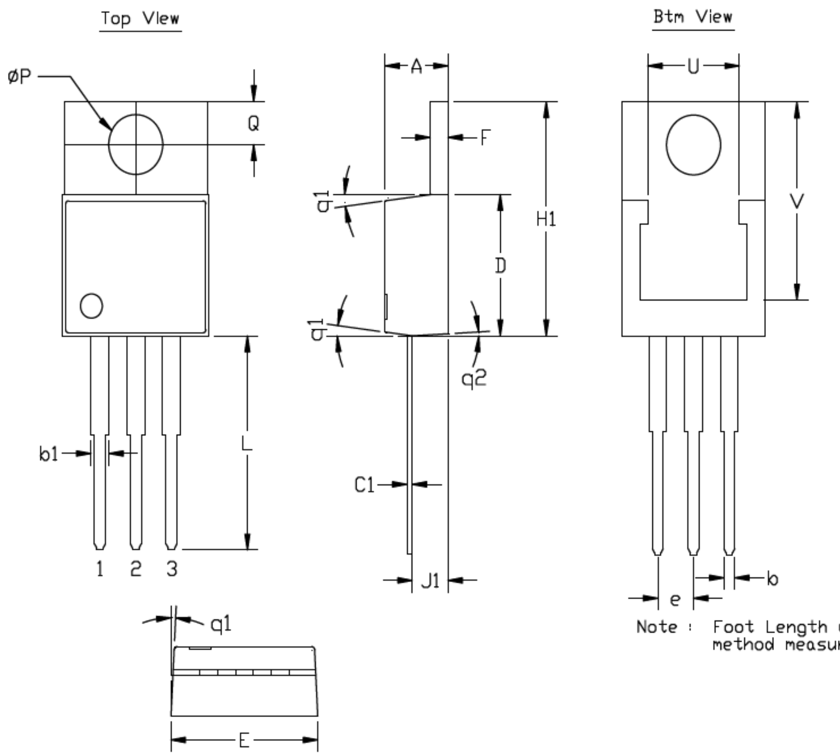
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

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

Note: If the full seven-character YYWWNNN code cannot fit on the package, the following truncated codes are used based on the available marking space:
6 Characters = YWWNNN; 5 Characters = WWNNN; 4 Characters = WNNN; 3 Characters = NNN;
2 Characters = NN; 1 Character = N

TITLE
3 LEAD TO220 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

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

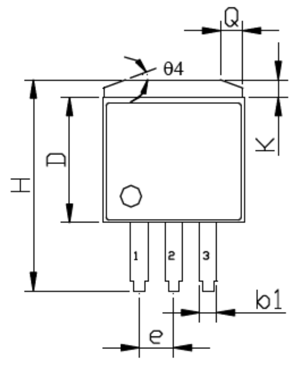


POS	INCH	
	MIN	MAX
A	0.160	0.190
b	0.025	0.040
b1	0.045	0.060
C1	0.012	0.022
D	0.348	0.360
E	0.385	0.420
e	0.090	0.110
F	0.045	0.055
H1	0.541	0.619
J1	0.080	0.120
ØP	0.146	0.156
Q	0.103	0.113
L	0.500	0.580
q1	3°	10°
q2	1°	7°
U	0.256 Ref.	
V	0.486 Ref.	

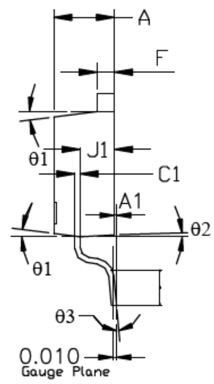
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

TITLE
3 LEAD TO263 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	TO263-3LD-PL-1	**UNIT**	INCH/MM

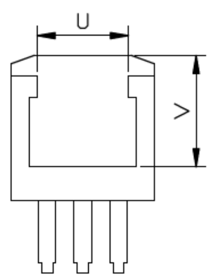


TOP VIEW

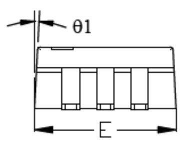


SIDE VIEW 1

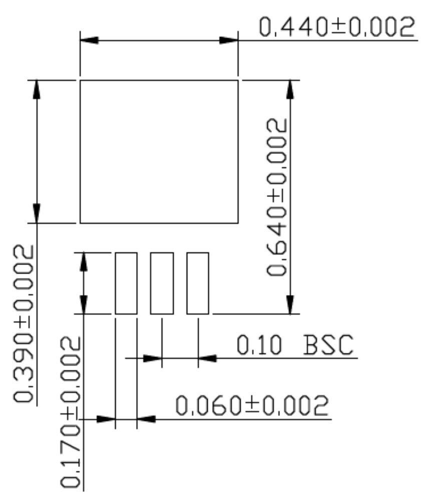
POS	INCH MIN	INCH MAX	MM MIN	MM MAX
A	0.170	0.181	4.318	4.597
A1	0.000	0.012	0.000	0.305
b1	0.047	0.053	1.194	1.346
C1	0.012	0.023	0.305	0.584
D	0.330	0.361	8.382	9.169
E	0.396	0.420	10.058	10.668
e	0.095	0.105	2.413	2.667
F	0.045	0.055	1.143	1.397
H	0.575	0.625	14.605	15.875
J1	0.080	0.120	2.032	3.048
L1	0.090	0.110	2.286	2.794
K	0.045	0.066	1.143	1.676
θ1	3°	10°	3°	10°
θ2	1°	7°	1°	7°
θ3	0°	8°	0°	8°
θ4	18°	22°	18°	22°
Q	0.055	0.075	1.397	1.905
U	0.256 Ref.		6.502 Ref.	
V	0.303 Ref.		7.696 Ref.	



BOTTOM VIEW



SIDE VIEW 2



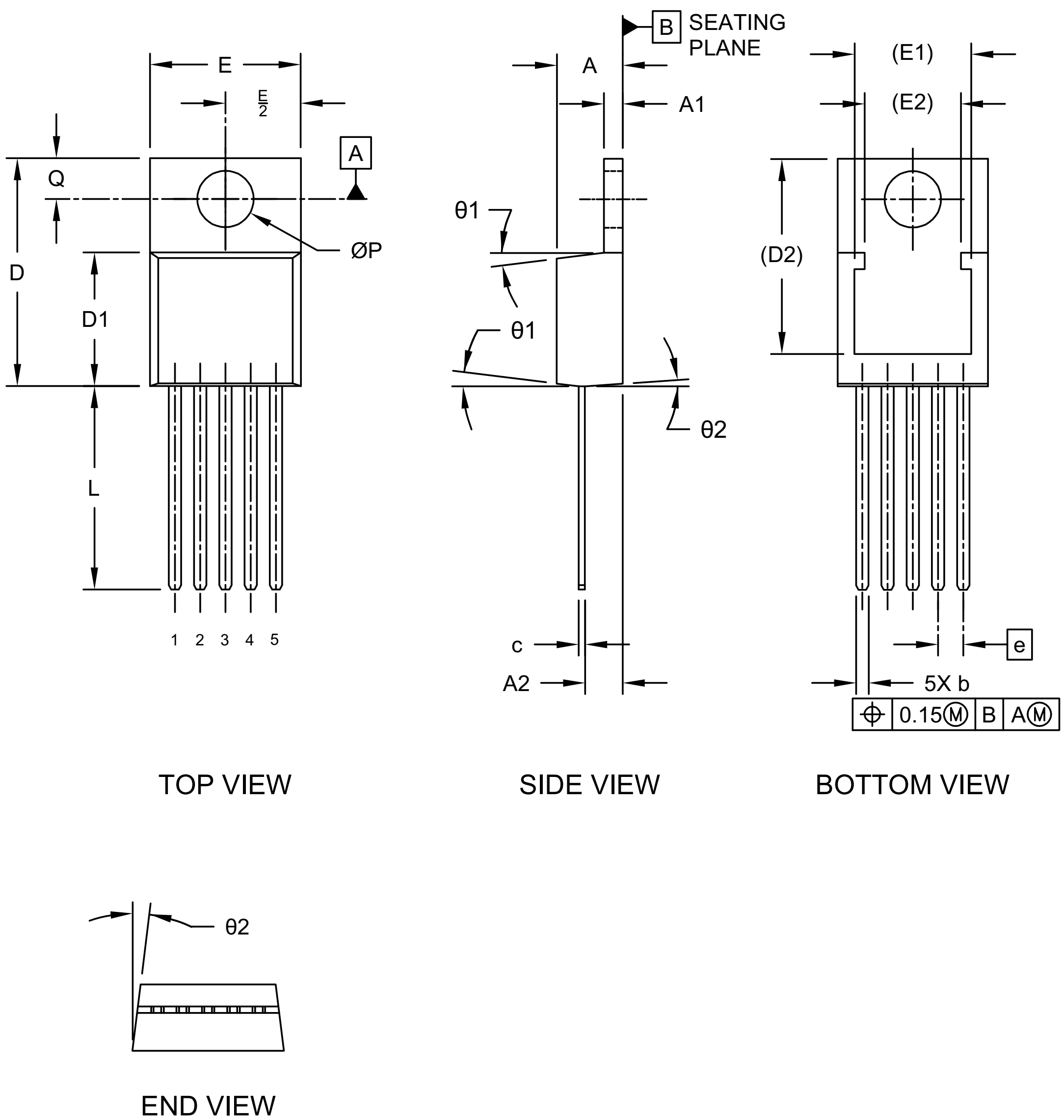
RECOMMENDED LAND PATTERN (UNIT: INCH)

NOTES:
FOOT LENGTH USE GUAGE PLANE METHOD MEASUREMENT 0.010"

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

5-Lead Transistor Outline Type LB03 (B8X) - [TO-220]
Micrel Legacy Package TO220-LB03-5LD-PL-1

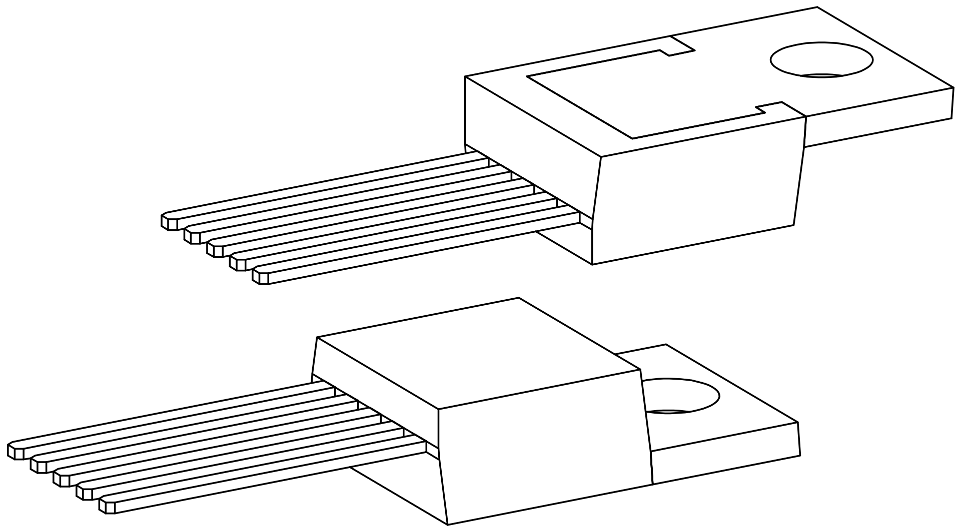
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-036-B8X Rev E Sheet 1 of 2

5-Lead Transistor Outline Type LB03 (B8X) - [TO-220] Micrel Legacy Package TO220-LB03-5LD-PL-1

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



		INCHES		
Dimension Limits		Min	Nom	Max
Number of Leads	N		5	
Pitch	e		.067 BSC	
Overall Height	A	.160	.175	.190
Tab Height	A1	.045	.050	.055
Seating Plane to Lead	A2	.080	.098	.115
Lead Width	b	.025	.033	.040
Lead Thickness	c	.012	.016	.020
Lead Length	L	.500	.540	.580
Total Body Length Including Tab	D	.542	.580	.619
Molded Body Length	D1	.348	.354	.360
Total Width	E	.380	.400	.420
Pad Width	E1		0.256 REF	
Pad Length	D2		0.486 REF	
Hole Diameter	ØP	.146	.151	.156
Hole Center to Tab Edge	Q	.103	.108	.113
Molded Body Draft Angle	θ1	3	7	10
Molded Body Draft Angle	θ2	1	4	7

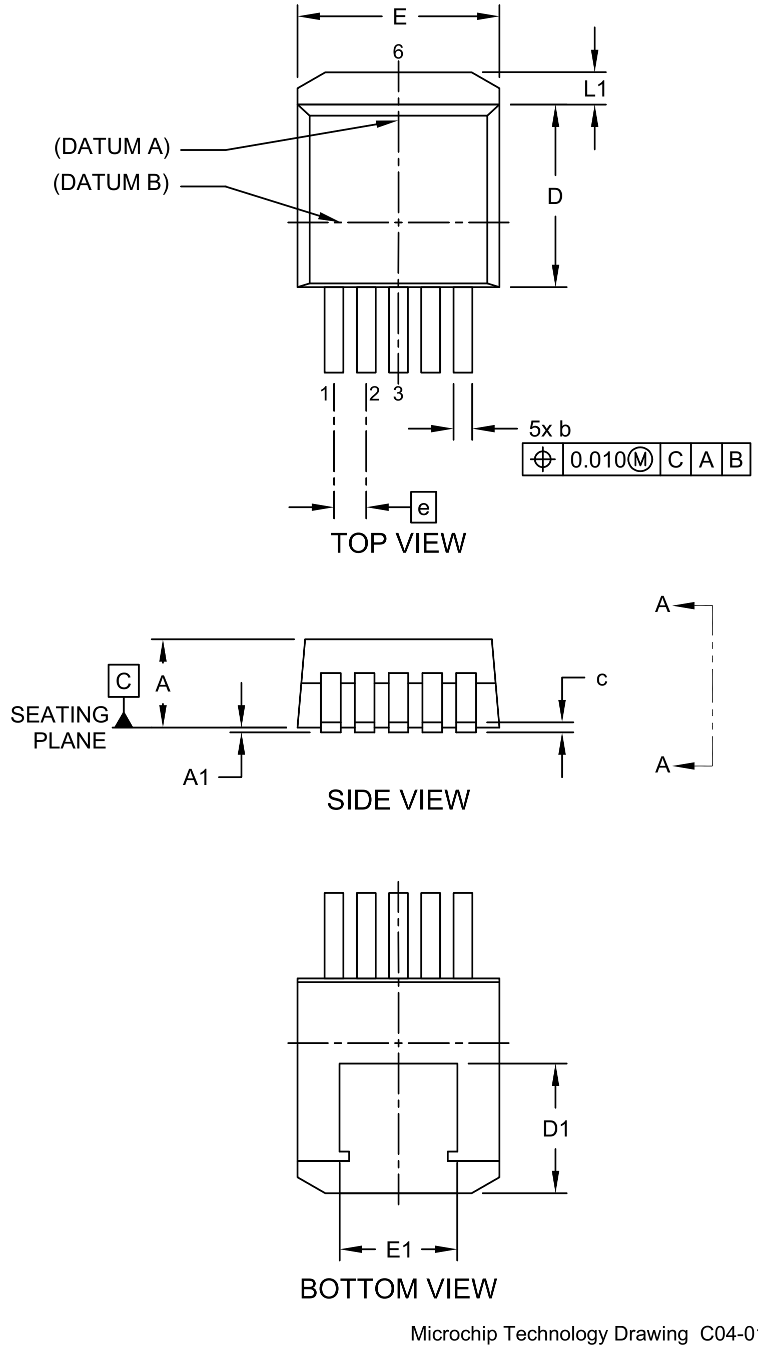
Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-036-B8X Rev E Sheet 2 of 2

5-Lead Plastic Double Deca-Watt Package (ET, ETX, J7X) [DDPAK]

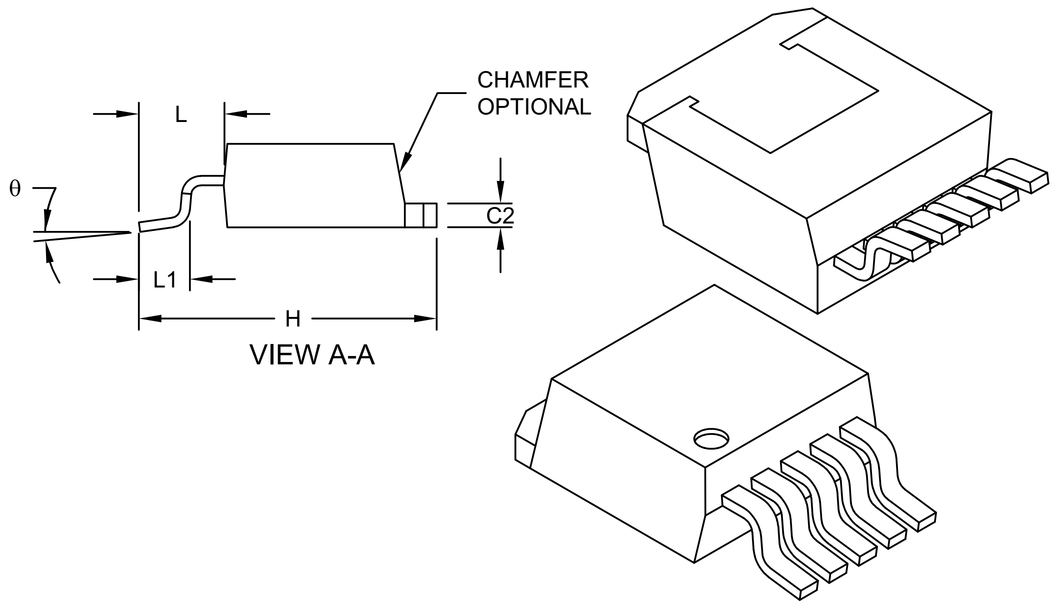
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-012 Rev C Sheet 1 of 2

5-Lead Plastic Double Deca-Watt Package (ET, ETX, J7X) [DDPAK]

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



Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		5	
Pitch	e		.067 BSC	
Molded Package Thickness	A	.160	-	.190
Standoff	A1	.000	-	.010
Overall Length	H	.575	-	.625
Overall Width	E	.380	-	.420
Exposed Pad Width	E1	.245	-	-
Molded Package Length	D	.330	-	.380
Exposed Pad Length	D1	.270	-	-
Lead Thickness	c	.015	-	.029
Lower Lead Width	b	.020	-	.039
Pad Thickness	C2	.045	-	.065
Foot Length	L	.070	-	.110
Pad Length	L1	-	-	.066
Foot Angle	θ	0°	-	8°

Notes:

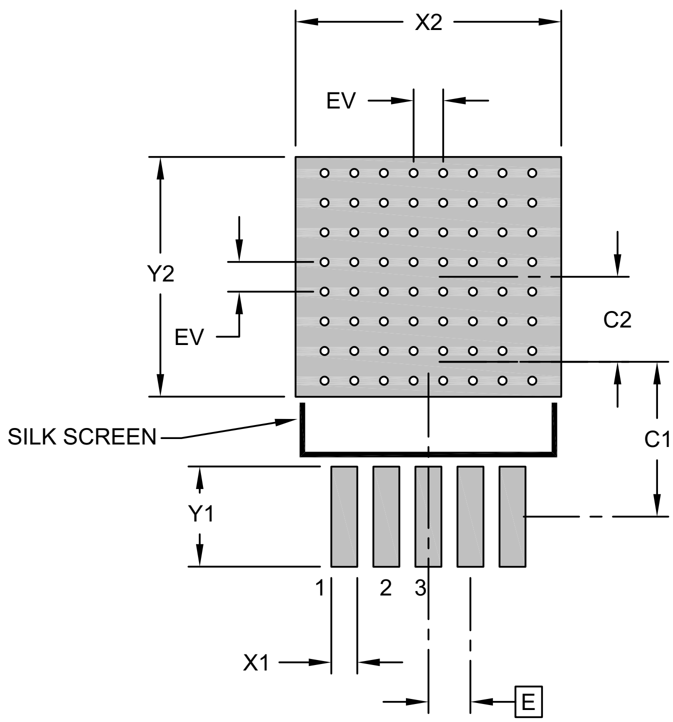
1. § Significant Characteristic
2. Dimensions D and E do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
3. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-012 Rev C Sheet 2 of 2

5-Lead Plastic Double Deca-Watt Package (ET, ETX, J7X) [DDPAK]

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



RECOMMENDED LAND PATTERN

	Units	INCHES		
	Dimension Limits	MIN	NOM	MAX
Contact Pitch	E		.067 BSC	
Optional Contact Pad Width	X2			.423
Optional Contact Pad Length	Y2			.382
Contact Pad Spacing	C1		.246	
Contact Pad Spacing	C2		.136	
Contact Pad Width (X3)	X1			.041
Contact Pad Length (X3)	Y1			.159
Thermal Via Diameter	V		.013	
Thermal Via Pitch	EV		.047	

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-2012 Rev C

APPENDIX A: REVISION HISTORY

Revision A (August 2023)

- Converted Micrel document MIC2937A/1/2 to Microchip data sheet DS20006798A.
- Minor 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 Number	[-X.X]	XX	[-XX]
Device	Output Voltage	Package	Media Type

Device:	MIC2937A:		750 mA Low Dropout Voltage Regulator
	MIC29371:		750 mA Low Dropout Voltage Regulator with Logic-Compatible ON/OFF Switching and Error Flag Output
	MIC29372:		750 mA Low Dropout Voltage Regulator with Adjustable Output Voltage and Logic-Compatible Shutdown Input
Output Voltage:	<blank>	=	Adjustable (MIC29372 only)
	3.3	=	3.3V
	5.0	=	5.0V
	12	=	12V
Package:	WT	=	3-Lead TO-220 (MIC2937A only)
	WT	=	5-Lead TO-220 (MIC29371/2 only)
	WU	=	3-Lead TO-263 (MIC2937A only)
	WU	=	5-Lead TO-263 MIC29371/2 only)
Media Type:	<blank>	=	50/Tube
	TR	=	750/Reel (WU package only)

Examples:

a) MIC2937A-3.3WU-TR:	MIC2937A, 3.3V Output Voltage, –40°C to +125°C Temp. Range, 3-Lead TO-263, 750/Reel
b) MIC29371-5.0WT:	MIC29371, 5.0V Output Voltage, –40°C to +125°C Temp. Range, 5-Lead TO-220, 50/Tube
c) MIC29372WU-TR:	MIC29372, Adj. Output Voltage, –40°C to +125°C Temp. Range, 5-Lead TO-263, 750/Reel
d) MIC2937A-12WT:	MIC2937A, 12V Output Voltage, –40°C to +125°C Temp. Range, 3-Lead TO-220, 50/Tube
e) MIC29371-5.0WU-TR:	MIC29371, 5.0V Output Voltage, –40°C to +125°C Temp. Range, 5-Lead TO-263, 750/Reel
e) MIC29372WT:	MIC29372, Adj. Output Voltage, –40°C to +125°C Temp. Range, 5-Lead TO-220, 50/Tube

Note: 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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