

3A, Low Voltage Low Dropout Regulator

Features

- 3.0A Minimum Guaranteed Output Current
- 550 mV Maximum Dropout Voltage over Temperature
- Ideal for 3.0V to 2.5V Conversion
- Ideal for 2.5V to 1.8V Conversion
- 1% Initial Accuracy
- Low Ground Current
- Current Limiting and Thermal Shutdown
- Reversed-Battery Protection
- Reversed-Leakage Protection
- Fast Transient Response
- TO-263 (D²Pak) and TO-220 Packaging
- TTL/CMOS Compatible Enable Pin (MIC39301/2 Only)
- Error Flag Output (MIC39301 Only)
- Adjustable Output (MIC39302 Only)

Applications

- LDO Linear Regulator for PC Add-In Cards
- High-Efficiency Linear Power Supplies
- SMPS Post Regulator
- Multimedia and PC Processor Supplies
- Low Voltage Microcontrollers
- StrongARM Processor Supply

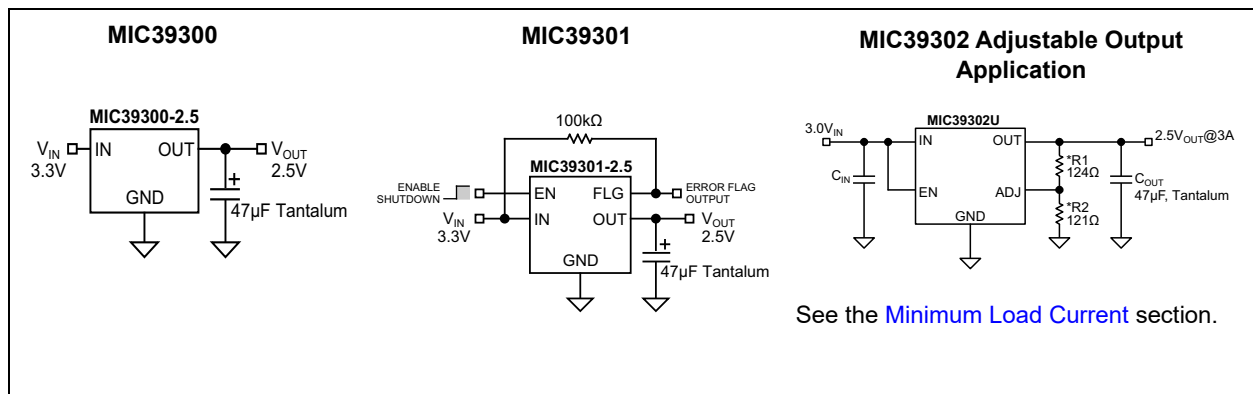
General Description

The MIC39300, MIC39301, and MIC39302 are 3.0A low-dropout linear voltage regulators that provide a low voltage, high-current output with a minimum of external components. Utilizing Microchip's proprietary Super β PNP pass element, the MIC39300/1/2 offers extremely low dropout (typically 385 mV at 3.0A) and low ground current (typically 36 mA at 3.0A).

The MIC39300/1/2 are ideal for PC add-in cards that need to convert from standard 3.3V to 2.5V or 2.5V to 1.8V. A guaranteed maximum dropout voltage of 500 mV over all operating conditions allows the MIC39300/1/2 to provide 2.5V from a supply as low as 3V, and 1.8V from a supply as low as 2.5V. The MIC39300/1/2 also have fast transient response for heavy switching applications. The device requires only 47 μ F of output capacitance to maintain stability and achieve fast transient response.

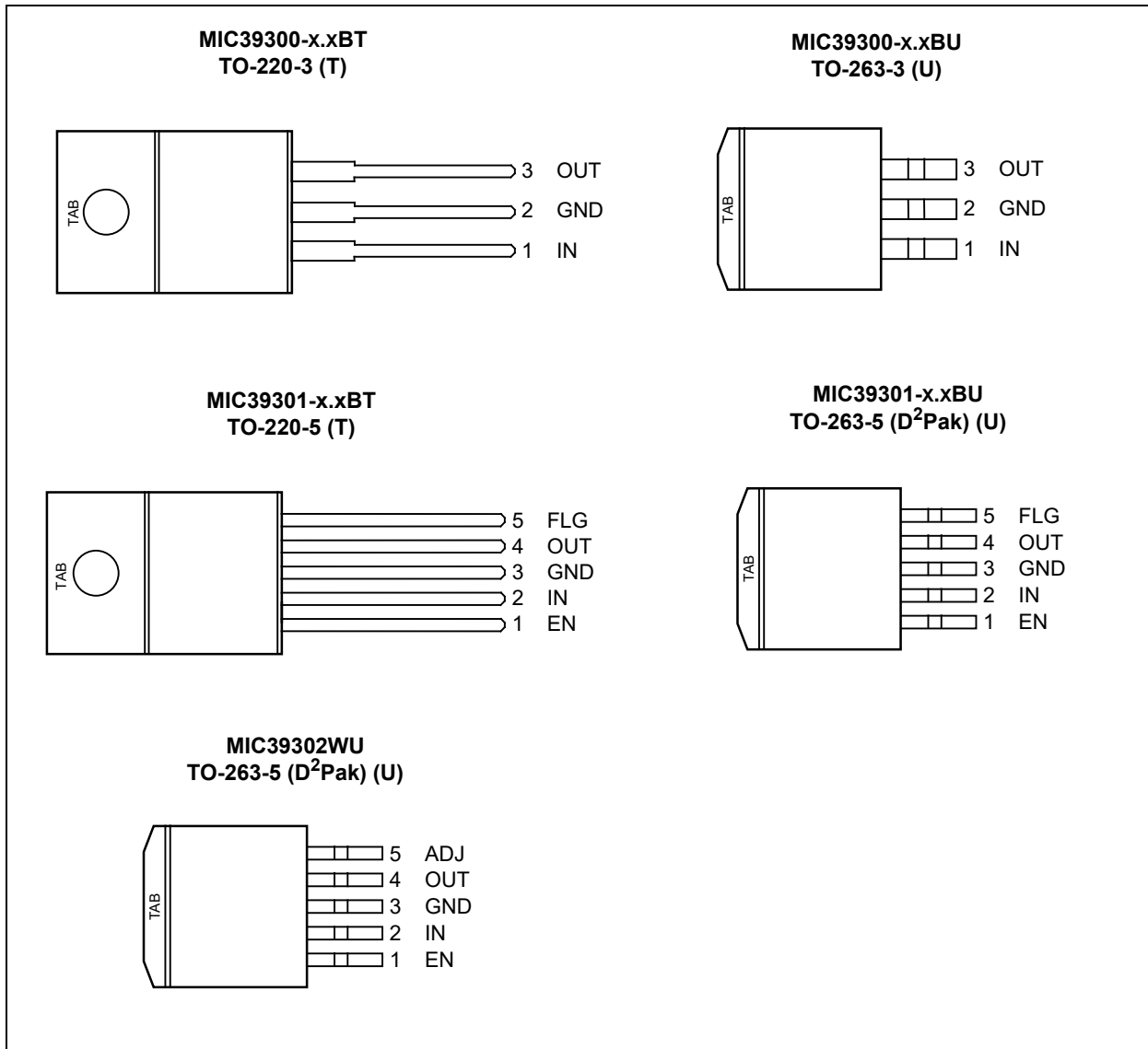
The MIC39300/1/2 are fully protected with overcurrent limiting, thermal shutdown, reversed-battery protection, reversed-leakage protection, and reversed-lead insertion. The MIC39301 offers a TTL-logic compatible enable pin and an error flag that indicates undervoltage and overcurrent conditions. Offered in fixed voltages, the MIC39300/1 come in the TO-220 and TO-263 (D²Pak) packages and are an ideal upgrade to older, NPN-based linear voltage regulators. The MIC39302 adjustable option allows programming the output voltage anywhere between 1.24V and 15.5V and is offered in a 5-Pin TO-263 (D²Pak) package.

Typical Application Circuits

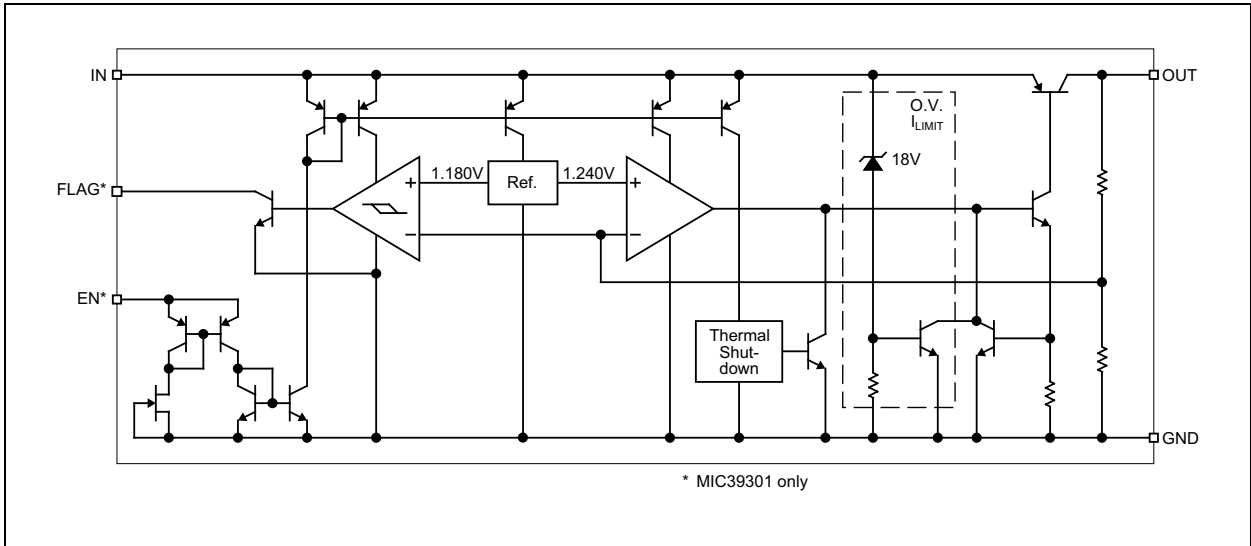


MIC39300/01/02

Package Types



Functional Block Diagram



MIC39300/01/02

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{IN}).....	-20V to +20V
Enable Voltage (V_{EN}).....	+20V
ESD Rating (Note 1).....	ESD Sensitive

Operating Ratings ‡

Supply Voltage (V_{IN}).....	+2.5V to +16V
Enable Voltage (V_{EN}).....	+16V
Maximum Power Dissipation ($P_{D(max)}$).....	(Note 2)

† **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. Specifications are for packaged product only.

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

Note 1: Devices are ESD sensitive. Handling precautions are recommended.

2: $P_{D(max)} = (T_{J(max)} - T_A) \div \theta_{JA}$, where θ_{JA} depends upon the printed circuit layout. See the [Application Information](#) section.

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $T_J = 25^\circ\text{C}$, **Bold** values indicate $-40^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$; unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Voltage	V_{OUT}	-1	—	1	%	10 mA
		-2		2	%	$10 \text{ mA} \leq I_{OUT} \leq 3\text{A}, V_{OUT} + 1\text{V} \leq V_{IN} \leq 8\text{V}$
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	—	0.06	0.5	%	$I_{OUT} = 10 \text{ mA}, V_{OUT} + 1\text{V} \leq V_{IN} \leq 8\text{V}$
Load Regulation	$\Delta V_{OUT}/V_{OUT}$	—	0.2	1	%	$V_{IN} = V_{OUT} + 1\text{V}, 10 \text{ mA} \leq I_{OUT} \leq 3\text{A}$
Output Voltage Temperature Coefficient (Note 1)	$\Delta V_{OUT}/\Delta T$	—	20	100	ppm/°C	—
Dropout Voltage (Note 2), (Note 4)	V_{DO}	—	65	200	mV	$I_{OUT} = 100 \text{ mA}, \Delta V_{OUT} = -1\%$
		—	185	—	mV	$I_{OUT} = 750 \text{ mA}, \Delta V_{OUT} = -1\%$
		—	250	—	mV	$I_{OUT} = 1.5\text{A}, \Delta V_{OUT} = -1\%$
		—	385	550	mV	$I_{OUT} = 3\text{A}, \Delta V_{OUT} = -1\%$
Ground Current (Note 3)	I_{GND}	—	10	20	mA	$I_{OUT} = 750 \text{ mA}, V_{IN} = V_{OUT} + 1\text{V}$
		—	17	—	mA	$I_{OUT} = 1.5\text{A}, V_{IN} = V_{OUT} + 1\text{V}$
		—	45	—	mA	$I_{OUT} = 3\text{A}, V_{IN} = V_{OUT} + 1\text{V}$
Dropout Ground Pin Current	$I_{GND(do)}$	—	6	—	mA	$V_{IN} \leq V_{OUT}(\text{nominal}) - 0.5\text{V}, I_{OUT} = 10 \text{ mA}$
Current Limit	$I_{OUT(lim)}$	—	4.5	—	A	$V_{OUT} = 0\text{V}, V_{IN} = V_{OUT} + 1\text{V}$
Enable Input (MIC39301)						
Enable Input Voltage	V_{EN}	—	—	0.8	V	Logic low (OFF)
		2.5	—	—	V	Logic high (ON)
Enable Input Current	I_{IN}	—	15	75	μA	$V_{EN} = 2.5\text{V}$
		—	—	90	μA	$V_{EN} = 16\text{V}$
		—	—	4	μA	$V_{EN} = 0.8\text{V}$

Electrical Characteristics: $T_J = 25^\circ\text{C}$, **Bold** values indicate $-40^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$; unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Shutdown Output Current (Note 5)	$I_{\text{OUT(shdn)}}$	—	10	20	μA	—
Flag Output (MIC39301)						
Output Leakage Current	$I_{\text{FLG(leak)}}$	—	0.01	1	μA	$V_{\text{IN}} = 16\text{V}$
		—	—	2		
Output Low Voltage (Note 4)	$V_{\text{FLG(do)}}$	—	220	300	mV	$V_{\text{IN}} = 2.50\text{V}$, $I_{\text{OL}} = 250 \mu\text{A}$
		—	—	400		
Low Threshold	V_{FLG}	93	—	—	%	% of V_{OUT}
High Threshold		—	—	99.2	%	% of V_{OUT}
Hysteresis		—	1	—	%	—
Reference (Adjust Pin) - MIC39302 Only						
Reference Voltage	V_{ADJ}	1.228	1.240	1.252	V	—
		1.215	—	1.265		
Reference Voltage Temp. Coefficient (Note 6)	V_{TC}	—	20	—	ppm/ $^\circ\text{C}$	—
Adjust Pin Bias Current	I_{ADJ}	—	40	80	nA	—
		—	—	120		
Adjust Pin Bias Current Temp. Coefficient	I_{TC}	—	0.1	—	nA/ $^\circ\text{C}$	—

- 1: Output voltage temperature coefficient is $\Delta V_{\text{OUT(worst case)}} \div (T_{\text{J(max)}} - T_{\text{J(min)}})$ where $T_{\text{J(max)}}$ is $+125^\circ\text{C}$ and $T_{\text{J(min)}}$ is -40°C .
- 2: $V_{\text{DO}} = V_{\text{IN}} - V_{\text{OUT}}$ when V_{OUT} decreases to 99% of its nominal output voltage with $V_{\text{IN}} = V_{\text{OUT}} + 1\text{V}$. For output voltages below 2.5V, dropout voltage is the input-to-output voltage differential with the minimum input voltage being 2.5V. Minimum input operating voltage is 2.5V.
- 3: I_{GND} is the quiescent current. $I_{\text{IN}} = I_{\text{GND}} + I_{\text{OUT}}$.
- 4: For a 1.8V device, $V_{\text{IN}} = 2.5\text{V}$.
- 5: $V_{\text{EN}} \leq 0.8\text{V}$, $V_{\text{IN}} \leq 8\text{V}$, and $V_{\text{OUT}} = 0\text{V}$.
- 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 $V_{\text{IN}} = 8\text{V}$ for $t = 10 \text{ms}$.

MIC39300/01/02

TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Lead Temperature	—	—	—	260	°C	Soldering, 5 sec.
Junction Operating Temperature Range	T_J	-40	—	+125	°C	—
Storage Temperature Range	T_S	-65	—	+150	°C	—
Package Thermal Resistances						
Thermal Resistance TO-263	θ_{JC}	—	2	—	°C/W	—
Thermal Resistance TO-220	θ_{JC}	—	2	—	°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.

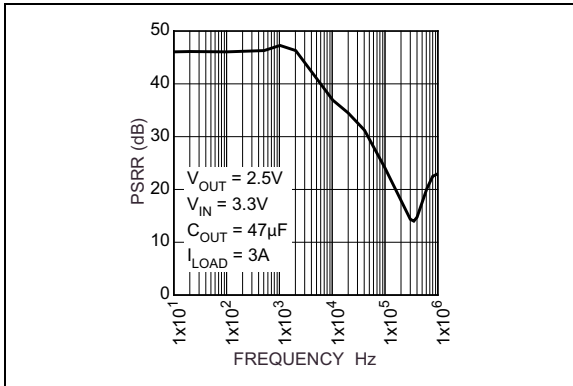


FIGURE 2-1: Power Supply vs. Ripple Rejection.

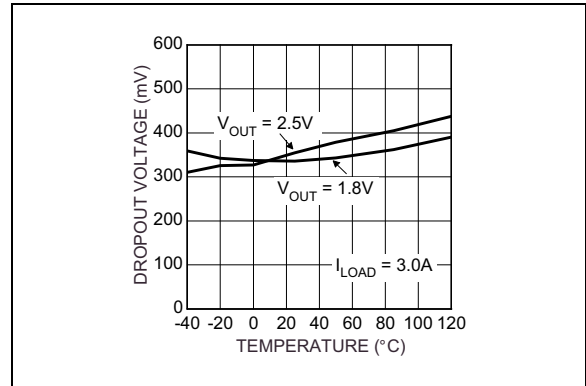


FIGURE 2-4: Dropout Voltage vs. Temperature.

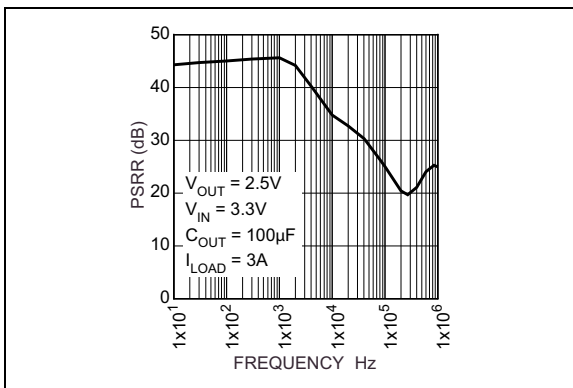


FIGURE 2-2: Power Supply vs. Ripple Rejection.

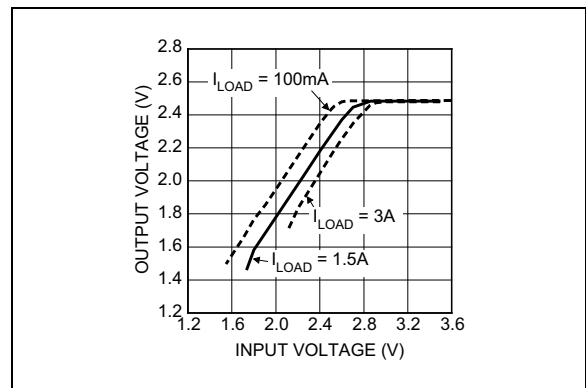


FIGURE 2-5: Dropout Characteristics.

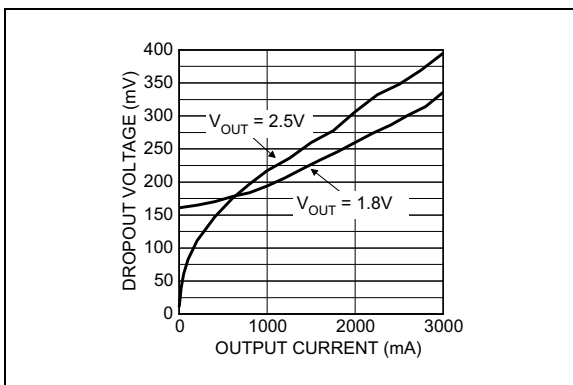


FIGURE 2-3: Dropout Voltage vs. Output Current.

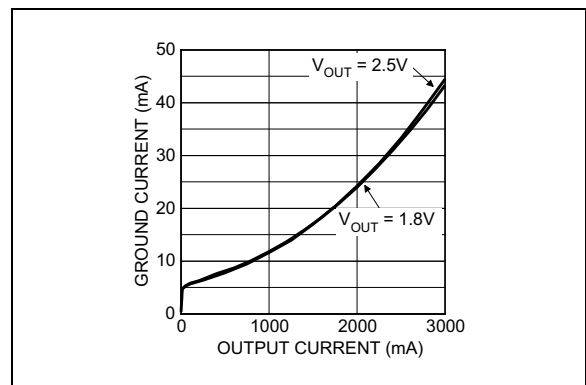


FIGURE 2-6: Ground Current vs. Output Current.

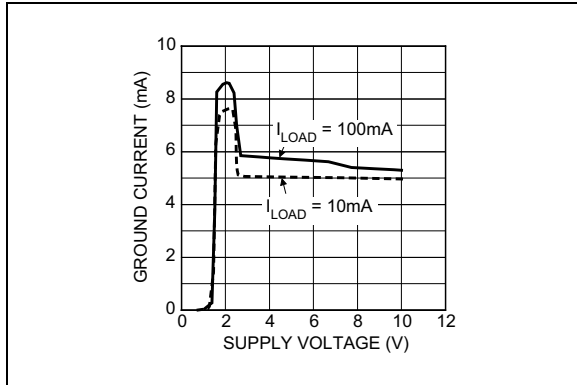


FIGURE 2-7: Ground Current vs. Supply Voltage.

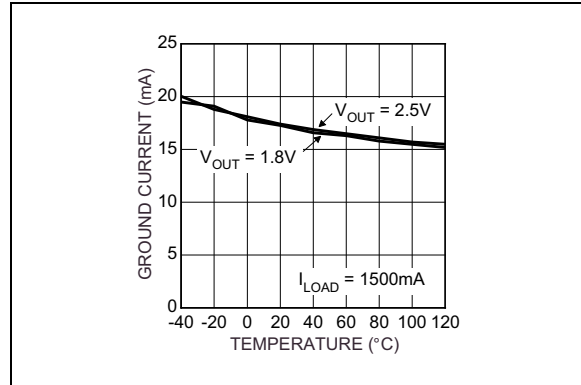


FIGURE 2-10: Ground Current vs. Temperature.

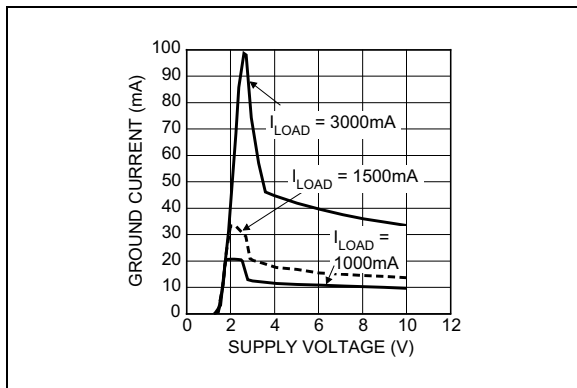


FIGURE 2-8: Ground Current vs. Supply Voltage.

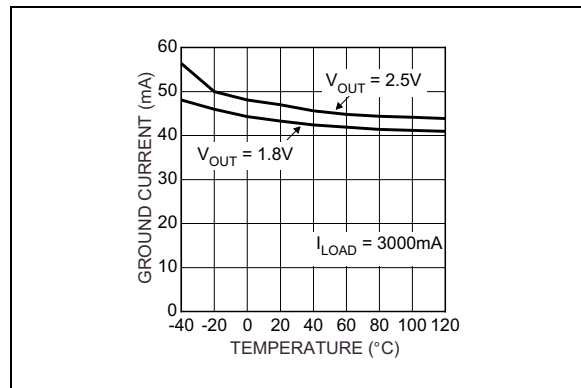


FIGURE 2-11: Ground Current vs. Temperature.

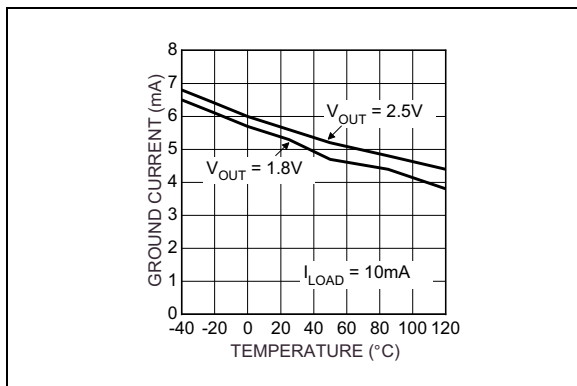


FIGURE 2-9: Ground Current vs. Temperature.

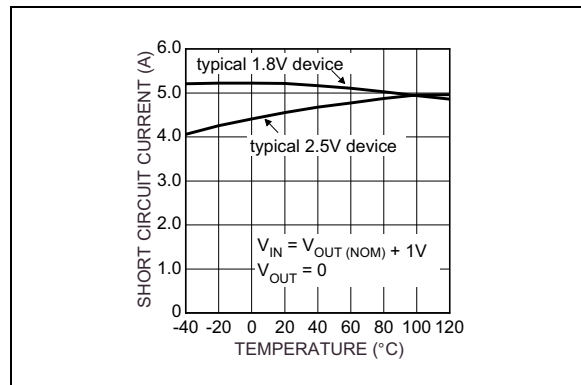


FIGURE 2-12: Short Circuit vs. Temperature.

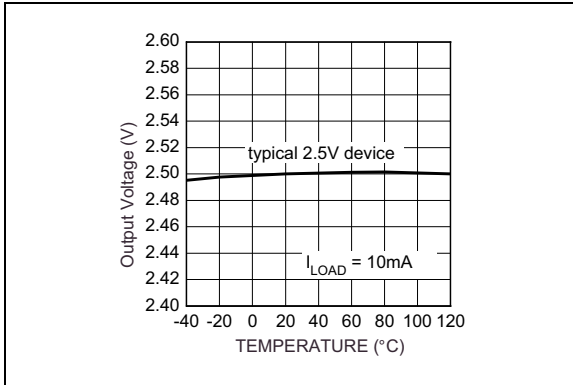


FIGURE 2-13: Output Voltage vs. Temperature.

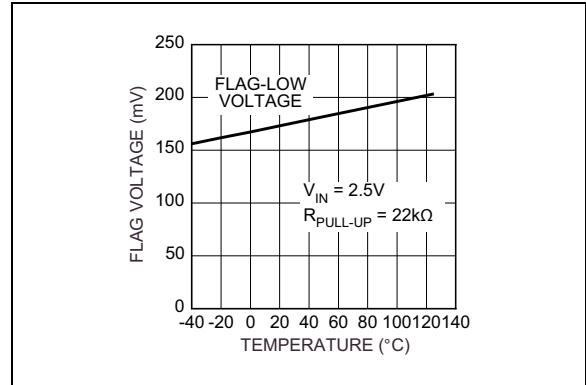


FIGURE 2-16: Flag-Low Voltage vs. Temperature.

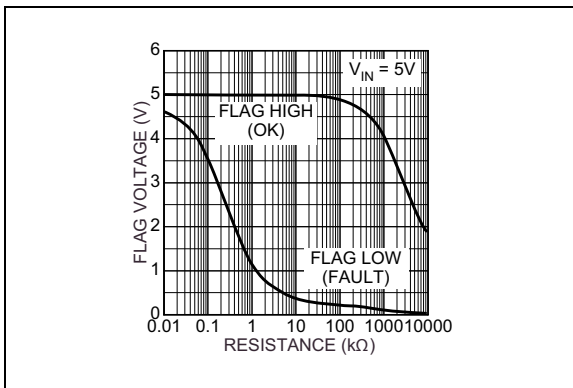


FIGURE 2-14: Error Flag Pull-Up Resistor.

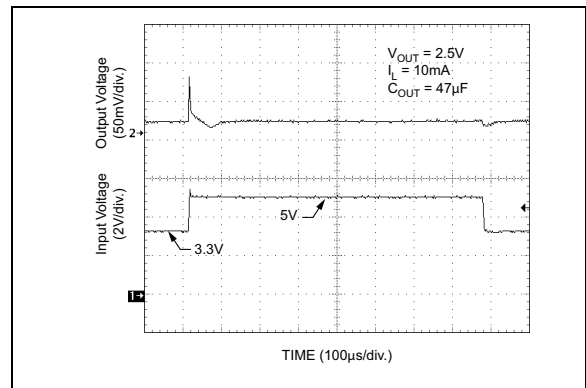


FIGURE 2-17: Line Transient Response.

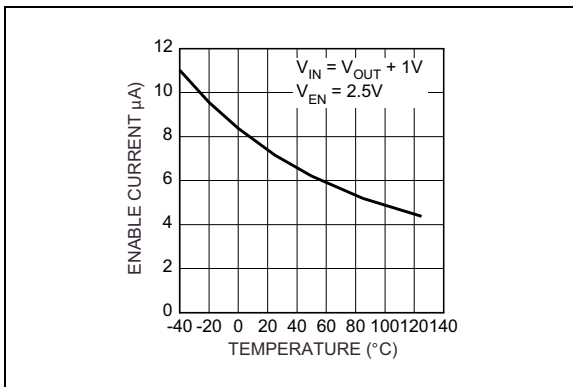


FIGURE 2-15: Enable Current vs. Temperature.

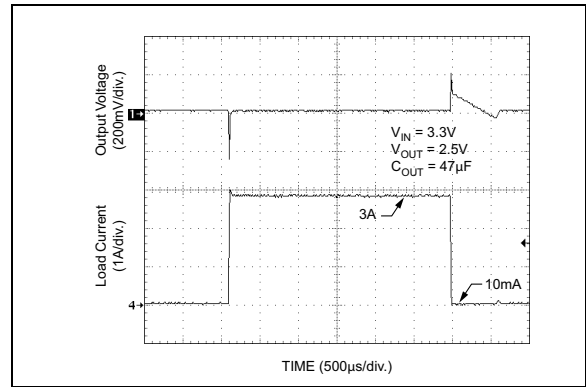


FIGURE 2-18: Load Transient Response.

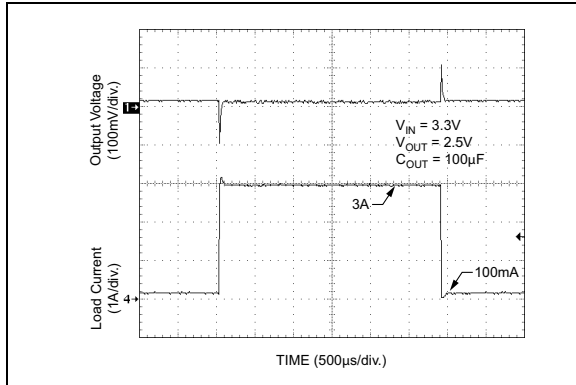


FIGURE 2-19: Load Transient Response.

3.0 PIN DESCRIPTIONS

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

TABLE 3-1: PIN FUNCTION TABLE

Pin Number MIC39300	Pin Number MIC39301	Pin Number MIC39302	Pin Name	Description
—	1	1	EN	Enable (Input): TTL/CMOS compatible input. Logic-high = enable; logic-low or open = shutdown.
1	2	2	IN	Unregulated Input: +16V maximum supply.
2, TAB	3, TAB	3, TAB	GND	Ground: Ground pin and TAB are internally connected.
3	4	4	OUT	Regulator Output.
—	5	—	FLG	Error Flag (Output): Open-collector indicates an output fault condition. Active low.
—	—	5	ADJ	Adjustable Regulator Feedback Input: Connect to the resistor voltage divider that is placed from OUT to GND in order to set the output voltage.

4.0 APPLICATION INFORMATION

The MIC39300/1/2 are high-performance, low-dropout voltage regulators suitable for moderate to high-current voltage regulator applications. Its 550 mV dropout voltage at full load makes it especially valuable in battery-powered systems and as a high-efficiency noise filter in post-regulator applications. Unlike older NPN-pass transistor designs, where the minimum dropout voltage is limited by the base-to-emitter voltage drop and collector-to-emitter saturation voltage, dropout performance of the PNP output of these devices is limited only by the low V_{CE} saturation voltage.

A trade-off for the low dropout voltage is a varying base drive requirement. Microchip's Super β PNP process reduces this drive requirement to only 2% to 5% of the load current.

The MIC39300/1/2 regulators are fully protected from damage due to fault conditions. Current limiting is provided. This limiting is linear; output current during overload conditions is constant. Thermal shutdown disables the device when the die temperature exceeds the maximum safe operating temperature. Transient protection allows device (and load) survival even when the input voltage spikes above and below nominal. The output structure of these regulators allows voltages in excess of the desired output voltage to be applied without reverse current flow.

4.1 Thermal Design

Linear regulators are simple to use. The most complicated design parameters to consider are thermal characteristics. Thermal design requires four application-specific parameters:

- Maximum ambient temperature (T_A)
- Output Current (I_{OUT})
- Output Voltage (V_{OUT})
- Input Voltage (V_{IN})
- Ground Current (I_{GND})

Calculate the power dissipation of the regulator from these numbers and the device parameters from this data sheet, where the ground current is taken from the data sheet.

EQUATION 4-1:

$$P_D = (V_{IN} - V_{OUT})I_{OUT} + V_{IN} \times I_{GND}$$

The heat sink thermal resistance is determined by:

EQUATION 4-2:

$$\theta_{SA} = \frac{T_{J(MAX)} - T_A}{P_D} - (\theta_{JC} + \theta_{CS})$$

Where:

$$\begin{aligned} T_{J(MAX)} &\leq 125^\circ\text{C} \\ \theta_{CS} &\text{ Between } 0^\circ\text{C/W and } 2^\circ\text{C/W} \end{aligned}$$

The heat sink may be significantly reduced in applications where the minimum input voltage is known and is large compared with the dropout voltage. Use a series input resistor to drop excessive voltage and distribute the heat between this resistor and the regulator. The low dropout properties of Microchip's Super β PNP regulators allow significant reductions in regulator power dissipation and the associated heat sink without compromising performance. When this technique is employed, a capacitor of at least 1.0 μF is needed directly between the input and regulator ground.

Refer to [Application Note 9](#) for further details and examples on thermal design and heat sink specification.

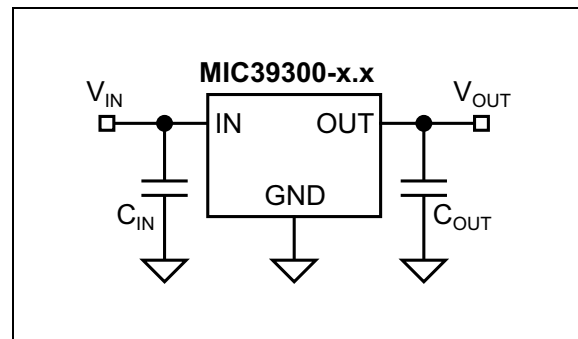


FIGURE 4-1: Capacitor Requirements.

4.2 Output Capacitor

The MIC39300/1/2 requires an output capacitor to maintain stability and improve transient response. Proper capacitor selection is important to ensure proper operation. The MIC39300/1/2 output capacitor selection is dependent upon the ESR (equivalent series resistance) of the output capacitor to maintain stability. When the output capacitor is 47 μF or greater, the output capacitor should have less than 1 Ω of ESR. This will improve transient response as well as promote stability. Ultra low ESR capacitors, such as ceramic chip capacitors may promote instability. These very low ESR levels may cause an oscillation and/or underdamped transient response. A low-ESR solid tantalum capacitor works extremely well and provides

good transient response and stability over temperature. Aluminum electrolytics can also be used, as long as the ESR of the capacitor is $< 1\Omega$.

The value of the output capacitor can be increased without limit. Higher capacitance values help to improve transient response and ripple rejection and reduce output noise.

4.3 Input Capacitor

An input capacitor of $1\mu\text{F}$ or greater is recommended when the device is more than 4 inches away from the bulk AC supply capacitance or when the supply is a battery. Small, surface mount, ceramic chip capacitors can be used for bypassing. Larger values will help to improve ripple rejection by bypassing the input to the regulator, further improving the integrity of the output voltage.

4.4 Transient Response and 3.3V to 2.5V and 2.5V to 1.8V Conversions

The MIC39300/1/2 has excellent transient response to variations in input voltage and load current. The device has been designed to respond quickly to load current variations and input voltage variations. Large output capacitors are not required to obtain this performance. A standard $47\mu\text{F}$ output capacitor, preferably tantalum, is all that is required. Larger values help to improve performance even further.

By virtue of its low dropout voltage, this device does not saturate into dropout as readily as similar NPN-based designs. When converting from 3.3V to 2.5V or 2.5V to 1.8V, the NPN-based regulators are already operating in dropout, with typical dropout requirements of 1.2V or greater. To convert down to 2.5V without operating in dropout, NPN-based regulators require an input voltage of 3.7V at the very least. The MIC39300/1 regulator will provide excellent performance with an input as low as 3.0V or 2.5V. This gives the PNP-based regulators a distinct advantage over older, NPN-based linear regulators.

4.5 Minimum Load Current

The MIC39300/1/2 regulators are specified between finite loads. If the output current is too small, leakage currents dominate and the output voltage rises. A 10 mA minimum load current is necessary for proper regulation.

4.6 Error Flag

The MIC39301 version features an error flag circuit that monitors the output voltage and signals an error condition when the voltage drops 5% below the nominal output voltage. The error flag is an open-collector output that can sink 10 mA during a fault condition.

Low output voltage can be caused by a number of problems, including an overcurrent fault (device in current limit) or low input voltage. The flag is inoperative during overtemperature shutdown.

When the error flag is not used, it is best to leave it open. A pull-up resistor from FLG to either V_{IN} or V_{OUT} is required for proper operation.

4.7 Enable Input

The MIC39301/2 feature an enable input for on/off control of the device. The enable input's shutdown state draws "zero" current (only microamperes of leakage). The enable input is TTL/CMOS compatible for simple logic interface, but can be connected to up to 20V. When enabled, it draws approximately $15\mu\text{A}$.

4.8 Adjustable Regulator Design

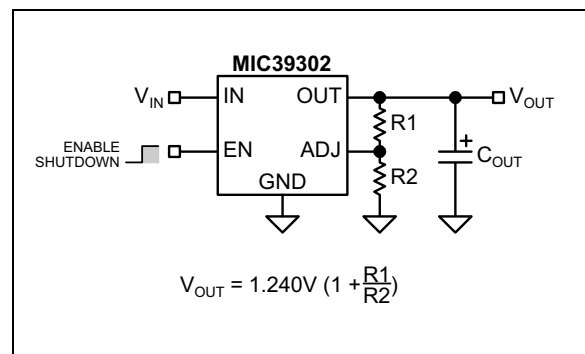


FIGURE 4-2: Adjustable Regulator with Resistors.

The MIC39302 allows programming the output voltage anywhere between 1.24V and 15.5V. Two resistors are used. The resistor values are calculated by:

EQUATION 4-3:

$$R1 = R2 \left(\frac{V_{\text{OUT}}}{1.240} - 1 \right)$$

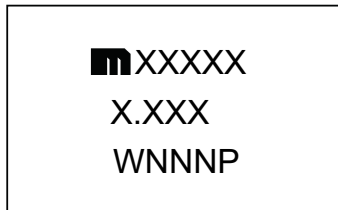
Where V_{OUT} is the desired output voltage. Figure 4-2 shows the component definition. Applications with widely varying load currents may scale the resistors to draw the minimum load current required for proper operation (see the [Minimum Load Current](#) section).

MIC39300/01/02

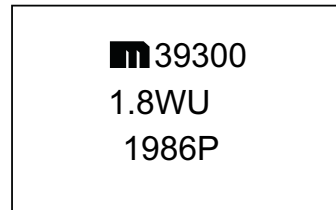
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

3-Lead TO-263*



Example



5-Lead TO-220*



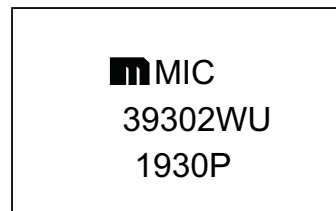
Example



D²PAK*



Example



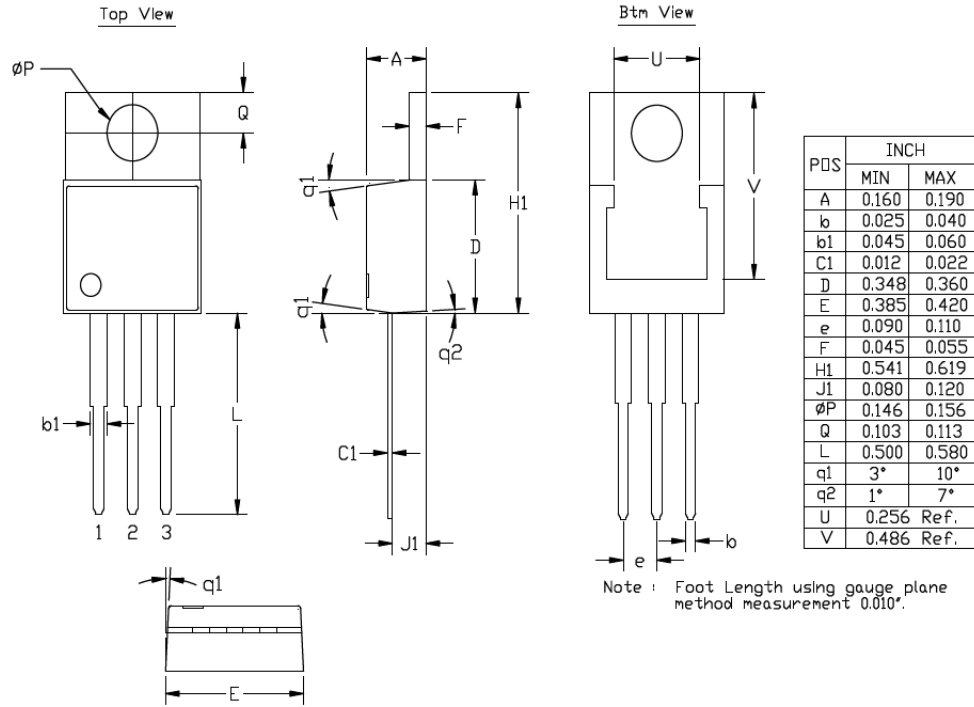
Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package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

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>.

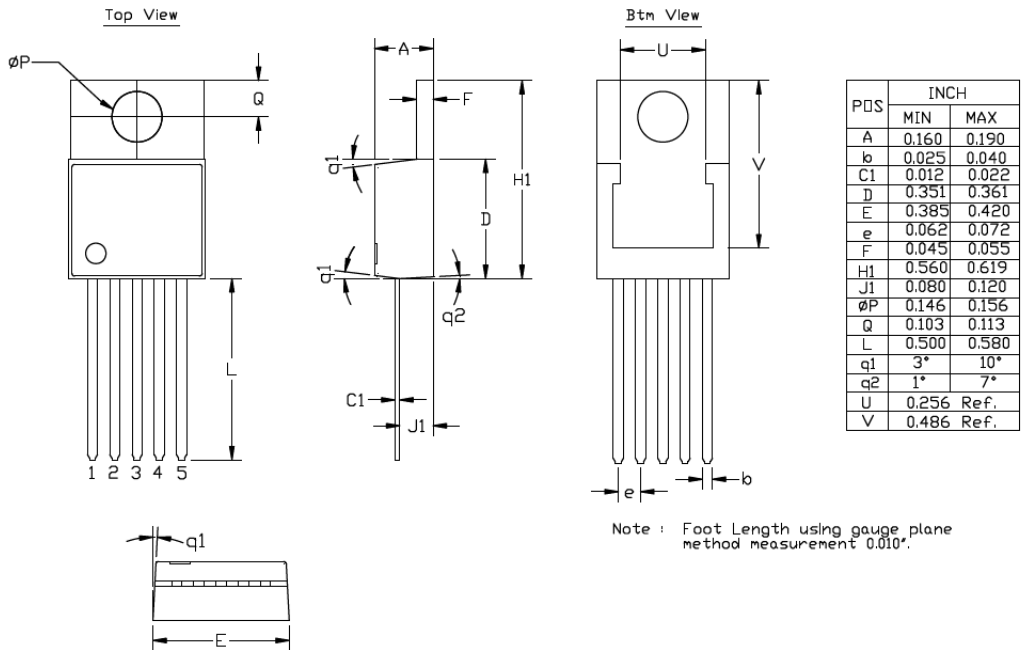
MIC39300/01/02

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

TITLE

5 LEAD TO220 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	TO220-5LD-PL-1	UNIT	INCH
Lead Frame	Copper Alloy	Lead Finish	Matte Tin



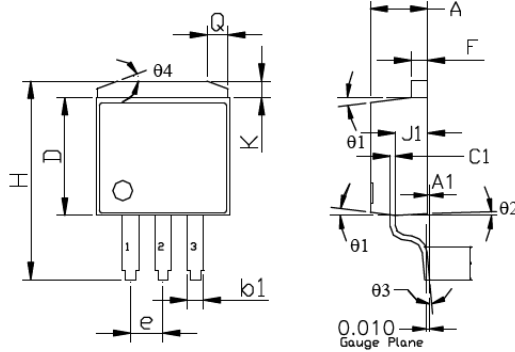
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

3-Lead TO-263 Package Outline and Recommended Land Pattern

TITLE

3 LEAD TO263 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

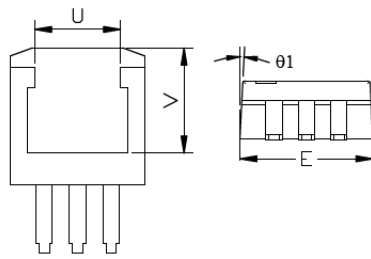
DRAWING #	TO263-3LD-PL-1	UNIT	INCH/MM
------------------	----------------	-------------	---------



TOP VIEW

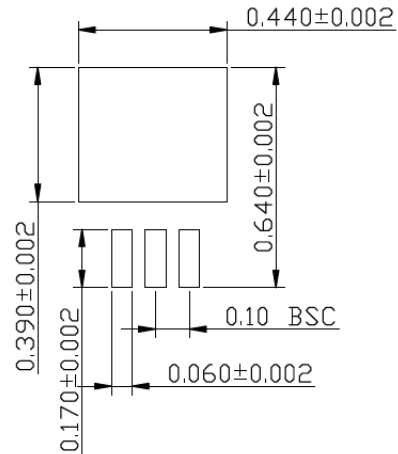
SIDE VIEW 1

PDS	INCH		MM	
	MIN	MAX	MIN	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
theta1	3°	10°	3°	10°
theta2	1°	7°	1°	7°
theta3	0°	8°	0°	8°
theta4	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 GAUGE 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>.

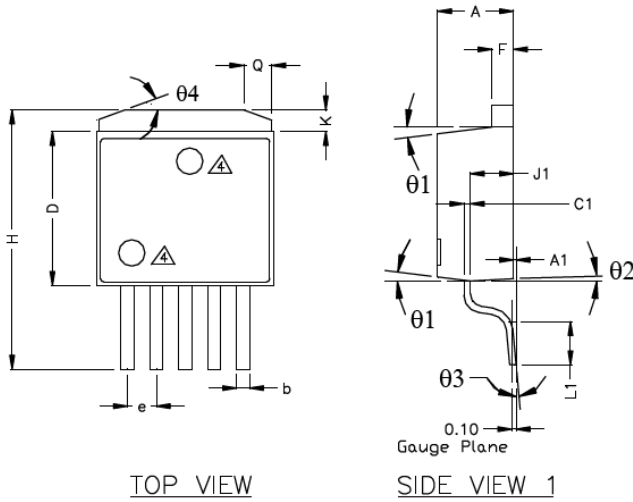
MIC39300/01/02

5-Lead TO-263 Package Outline and Recommended Land Pattern

TITLE

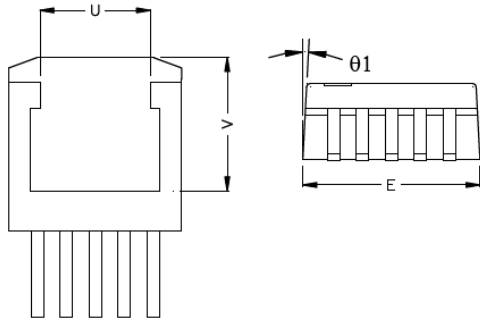
5 LEAD T0263 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	T0263-5LD-PL-1	UNIT	INCH/MM
------------------	----------------	-------------	---------



TOP VIEW

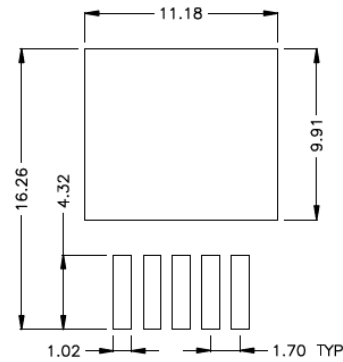
SIDE VIEW 1



BOTTOM VIEW

SIDE VIEW 2

POS	INCH		MM	
	MIN	MAX	MIN	MAX
A	0.170	0.181	4.318	4.597
A1	0.000	0.012	0.000	0.305
b	0.026	0.036	0.660	0.914
C1	0.012	0.023	0.305	0.584
D	0.330	0.361	8.392	9.169
E	0.396	0.420	10.058	10.668
e	0.062	0.072	1.575	1.829
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
K	0.045	0.066	1.143	1.676
L1	0.090	0.110	2.286	2.794
theta 1	3°	10°	3°	10°
theta 2	1°	7°	1°	7°
theta 3	0°	8°	0°	8°
theta 4	18°	22°	18°	22°
Q	0.055	0.075	1.397	1.905
U	0.256	Ref.	6.502	Ref.
V	0.305	Ref.	7.747	Ref.



RECOMMENDED LAND PATTERN
(UNIT : mm)

- NOTE:
1. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
 2. PACKAGE OUTLINE INCLUSIVE OF PLATING THICKNESS.
 3. FOOT LENGTH USING GAUGE PLANE METHOD MEASUREMENT 0.010"
 4. PACKAGE TOP MARK MAY BE IN TOP CENTER OR LOWER LEFT CORNER
 5. ALL DIMENSIONS ARE IN INCHES/MILLIMETERS.

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 (May 2018)

- Converted Micrel document MIC39300/01/02 to Microchip data sheet DS20006017A.
- Minor text changes throughout.

Revision B (January 2022)

- Updated values and conditions for Enable Input Current in the [Electrical Characteristics](#) table.

MIC39300/01/02

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>-X.X</u>	<u>X</u>	<u>X</u>	<u>-XX</u>
Device	Output Voltage	Junction Temperature Range	Package	Media Type
Device:	MIC393xx: 3A Low-Voltage μ Cap LDO Regulator MIC39300: Fixed V_{OUT} MIC39301: Fixed V_{OUT} with Enable + Output Error Flag + Shutdown MIC39302: Adjustable Wide V_{IN} LDO			
Output Voltage:	x.x = Fixed (MIC39300/39301) 1.8 = 1.8V 2.5 = 2.5V <blank> = Adjustable (MIC39302)			
Junction Temperature Range:	W = -40°C to +125°C, RoHS Compliant*			
Package:	T = 3-Lead TO-220 (MIC39300) T = 5-Lead TO-220 (MIC39301) U = 3-Lead TO-263 (MIC39300) U = 5-Lead D ² PAK (MIC39301/39302)			
Media Type:	<Blank> = 50/Tube TR = 750/Reel (U, 3L & 5L)			

* RoHS compliant with "high-melting solder" exemption.

Examples:

- a) MIC39300-1.8WT: 3A, 1% Low-Voltage LDO Regulator, 1.8V Fixed Output Voltage, -40°C to +125°C Junction Temperature Range, RoHS Compliant*, 3-Lead TO-220 Package, 50/Tube
- b) MIC39300-2.5WT: 3A, 1% Low-Voltage LDO Regulator, 2.5V Fixed Output Voltage, -40°C to +125°C Junction Temperature Range, RoHS Compliant*, 3-Lead TO-220 Package, 50/Tube
- c) MIC39300-2.5WU: 3A, 1% Low-Voltage LDO Regulator, 2.5V Fixed Output Voltage, -40°C to +125°C Junction Temperature Range, RoHS Compliant*, 3-Lead TO-263 Package, 50/Tube
- d) MIC39300-2.5WU-TR: 3A, 1% Low-Voltage LDO Regulator, 2.5V Fixed Output Voltage, -40°C to +125°C Junction Temperature Range, RoHS Compliant*, 3-Lead TO-263 Package, 750/Reel
- e) MIC39301-1.8WT: 3A, 1% Low-Voltage LDO Regulator with Enable, Output Error Flag + Shutdown, 1.8V Fixed Output Voltage, -40°C to +125°C Junction Temperature Range, RoHS Compliant*, 5-Lead TO-220 Package, 50/Tube
- f) MIC39301-1.8WU: 3A, 1% Low-Voltage LDO Regulator with Enable, Output Error Flag + Shutdown, 1.8V Fixed Output Voltage, -40°C to +125°C Junction Temperature Range, RoHS Compliant*, 5-Lead DDPACK Package, 50/Tube
- g) MIC39301-1.8WU-TR: 3A, 1% Low-Voltage LDO Regulator with Enable, Output Error Flag + Shutdown, 1.8V Fixed Output Voltage, -40°C to +125°C Junction Temperature Range, RoHS Compliant*, 5-Lead DDPACK Package, 750/Reel
- h) MIC39302WU-TR: 3A Low-Voltage μ Cap LDO Regulator, Adjustable Output Voltage, -40° to +125°C Junction Temperature Range, RoHS Compliant*, 8-Lead SPAK Package, 2500/Reel
- i) MIC39302WU-TR: 3A, 1% Adjustable Wide VIN LDO, Adjustable Output Voltage (1.24V to 15.5V), -40°C to +125°C Junction Temperature Range, RoHS Compliant*, 5-Lead DDPACK Package, 750/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.

MIC39300/01/02

NOTES:

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

- 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, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- 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. Microchip is committed to continuously improving the code protection features of our products.

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications 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. Contact your local Microchip sales office for additional support or, obtain additional support at <https://www.microchip.com/en-us/support/design-help/client-support-services>.

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.

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

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, 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, QuietWire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, 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, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, NVM Express, NVMe, 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, SmartHLS, SMART-I.S., storClad, SQL, 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, Symmcom, and Trusted Time 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.

© 2018 - 2022, Microchip Technology Incorporated and its subsidiaries.

All Rights Reserved.

ISBN: 978-1-5224-9582-6



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