MIC39300/01/02

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 (D^2Pak) 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

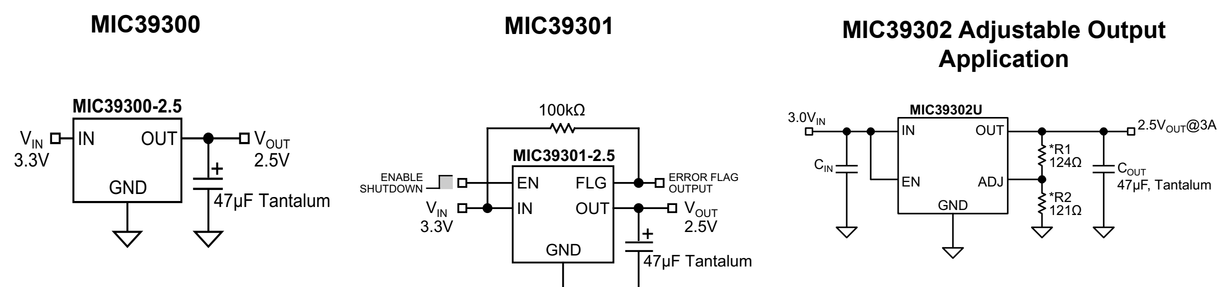
General Description

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 βeta 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 µF 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 (D^2Pak) 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 (D^2Pak) package.

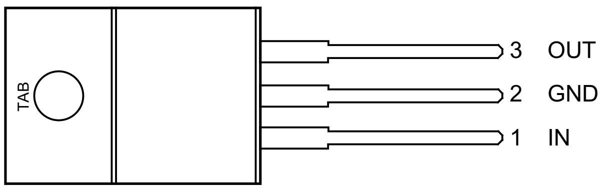
Typical Application Circuits



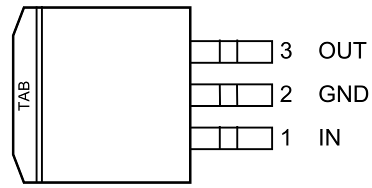
See (**Section 4.5 "Minimum Load Current"**)

Package Types

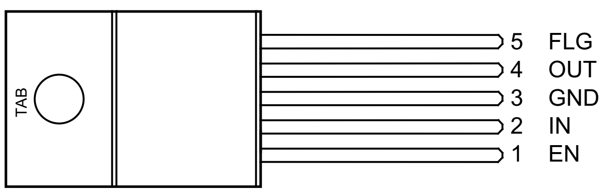
MIC39300-x.xBT
TO-220-3 (T)



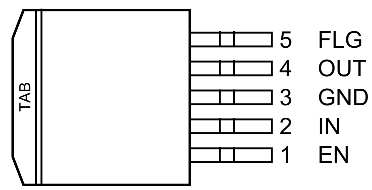
MIC39300-x.xBU
TO-263-3 (U)



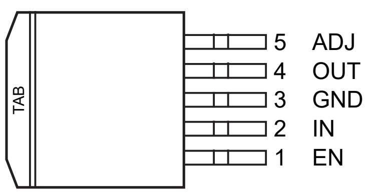
MIC39301-x.xBT
TO-220-5 (T)



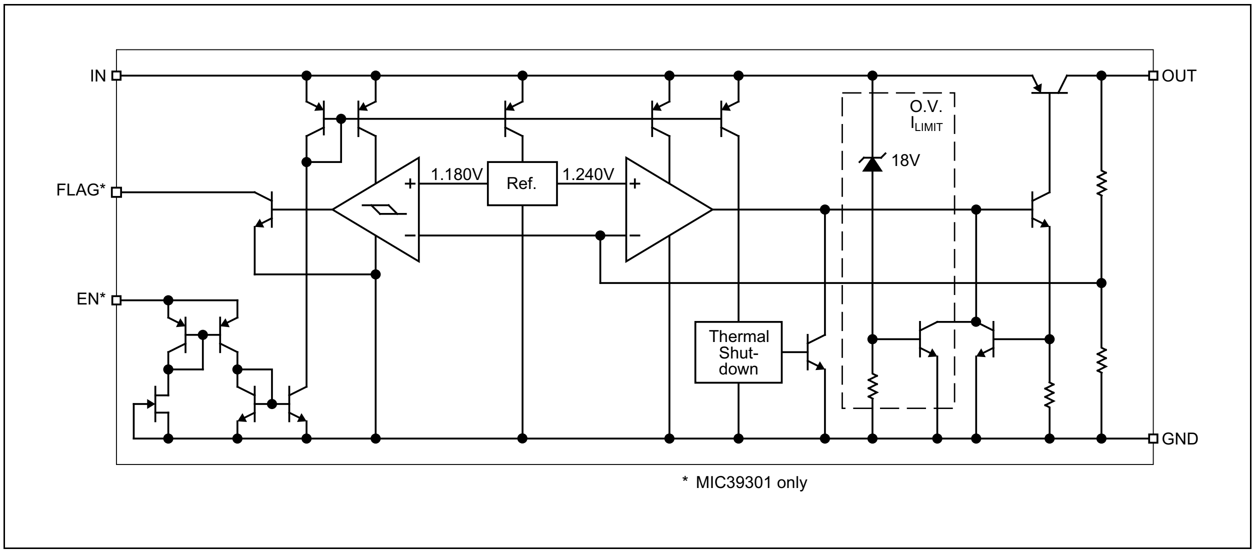
MIC39301-x.xBU
TO-263-5 (D^{2}Pak) (U)



MIC39302WU
TO-263-5 (D^{2}Pak) (U)



Functional Block Diagram



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: $P_{D(max)} = (T_{J(max)} – T_A) ÷ θ_{JA}$, where $θ_{JA}$ depends upon the printed circuit layout. See **Section 4.0 "Application Information"** section.

TABLE 1-1: ELECTRICAL CHARACTERISTICS

Electrical Characteristics: T_J = 25°C, **Bold** values indicate –40°C ≤ T_J ≤ +125°C; unless otherwise specified.

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

Electrical Characteristics: T_J = 25°C, **Bold** values indicate –40°C ≤ T_J ≤ +125°C; unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Enable Input Current	I_{IN}	1	15	**30**	µA	V_{EN} = 2.5V
		—	—	**75**	µA	
		—	—	2	µA	V_{EN} = 0.8V
		—	—	**4**	µA	
Shutdown Output Current (Note 5)	$I_{OUT(shdn)}$	—	10	**20**	µA	—
Flag Output (MIC39301)						
Output Leakage Current	$I_{FLG(leak)}$	—	0.01	**1**	µA	V_{IN} = 16V
		—	—	**2**		
Output Low Voltage (Note 4)	$V_{FLG(do)}$	—	220	300	mV	V_{IN} = 2.50V, I_{OL} = 250 µA
		—	—	**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/°C	—
Adjust Pin Bias Current	I_{ADJ}	—	40	80	nA	—
		—	—	**120**		
Adjust Pin Bias Current Temp. Coefficient	I_{TC}	—	0.1	—	nA/°C	—

1: Output voltage temperature coefficient is ΔV_{OUT}(worst case) ÷ ($T_{J(max)} - T_{J(min)}$) where $T_{J(max)}$ is +125°C and $T_{J(min)}$ is –40°C.

2: $V_{DO} = V_{IN} - V_{OUT}$ when V_{OUT} decreases to 99% of its nominal output voltage with $V_{IN} = V_{OUT}$ + 1V. 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. $I_{IN} = I_{GND} + I_{OUT}$.

4: For a 1.8V device, V_{IN} = 2.5V.

5: V_{EN} ≤ 0.8V, V_{IN} ≤ 8V, and V_{OUT} = 0V.

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} = 8V for t = 10 ms.

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.

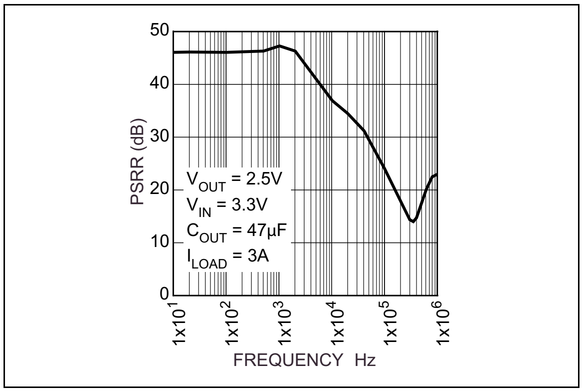


FIGURE 2-1: *Power Supply vs. Ripple Rejection.*

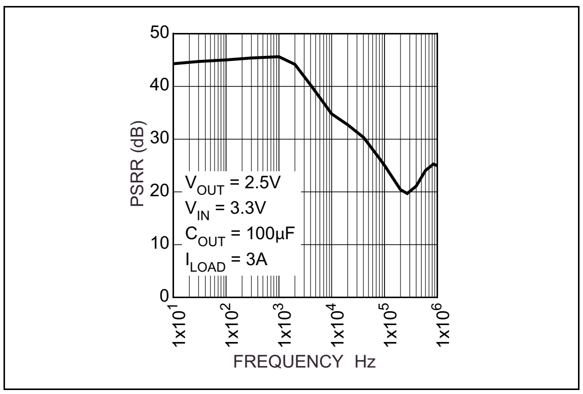


FIGURE 2-2: *Power Supply vs. Ripple Rejection.*

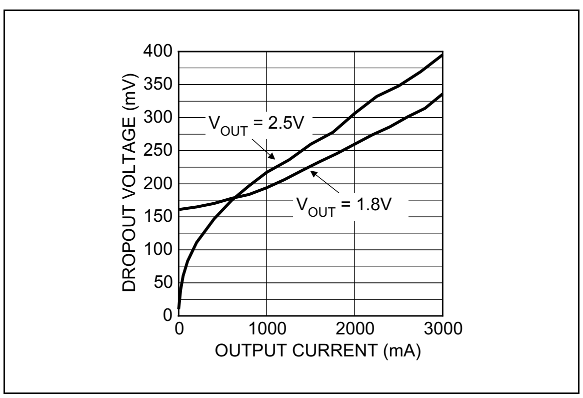


FIGURE 2-3: *Dropout Voltage vs. Output Current.*

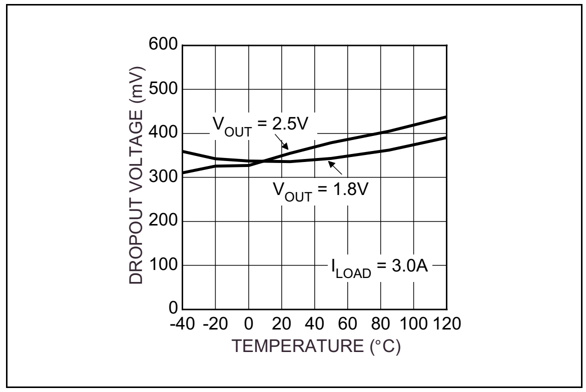


FIGURE 2-4: *Dropout Voltage vs. Temperature.*

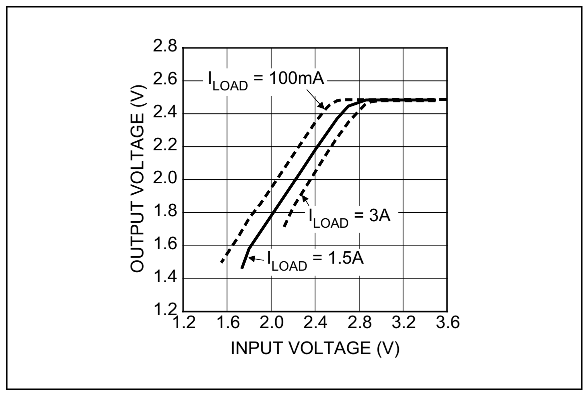


FIGURE 2-5: *Dropout Characteristics.*

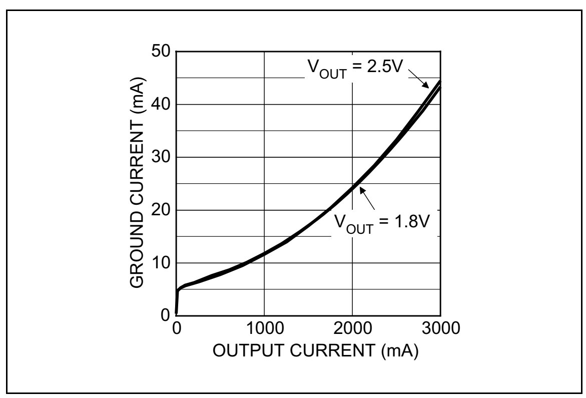


FIGURE 2-6: *Ground Current vs. Output Current.*

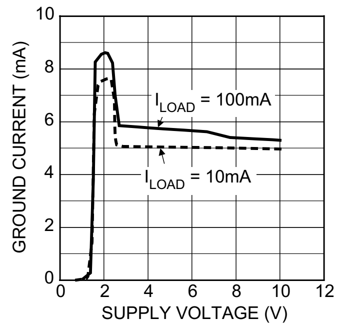


FIGURE 2-7: *Ground Current vs. Supply Voltage.*

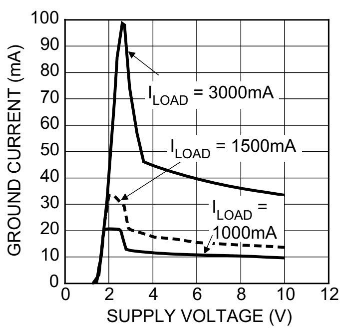


FIGURE 2-8: *Ground Current vs. Supply Voltage.*

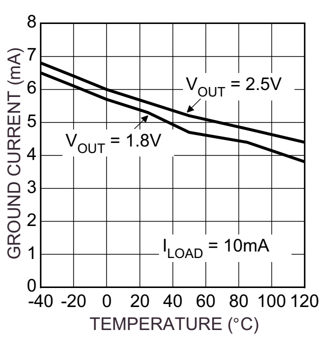


FIGURE 2-9: *Ground Current vs. Temperature.*

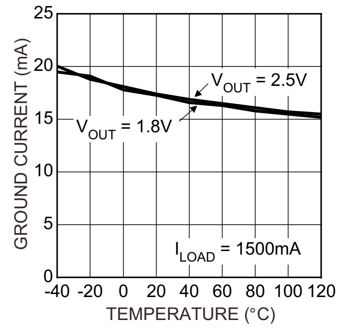


FIGURE 2-10: *Ground Current vs. Temperature.*

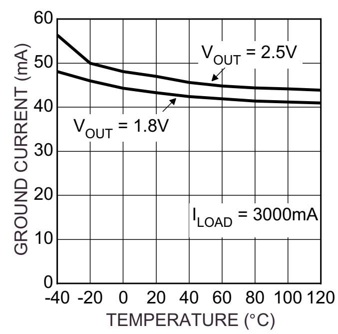


FIGURE 2-11: *Ground Current vs. Temperature.*

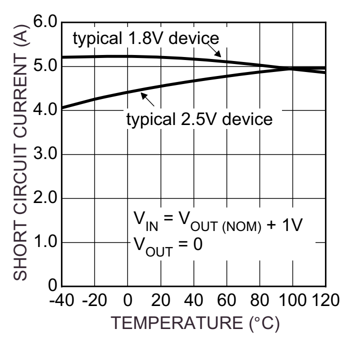


FIGURE 2-12: *Short Circuit vs. Temperature.*

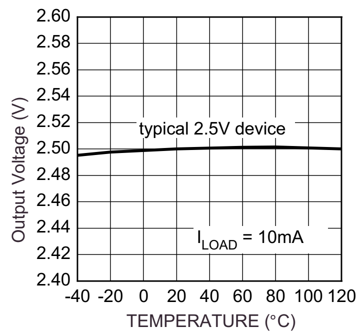


FIGURE 2-13: *Output Voltage vs. Temperature.*

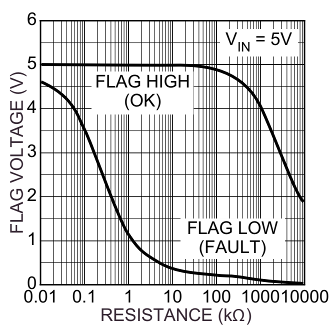


FIGURE 2-14: *Error Flag Pull-Up Resistor.*

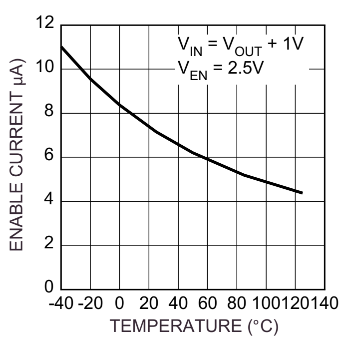


FIGURE 2-15: *Enable Current vs. Temperature.*

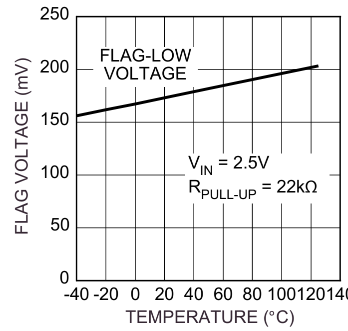


FIGURE 2-16: *Flag-Low Voltage vs. Temperature.*

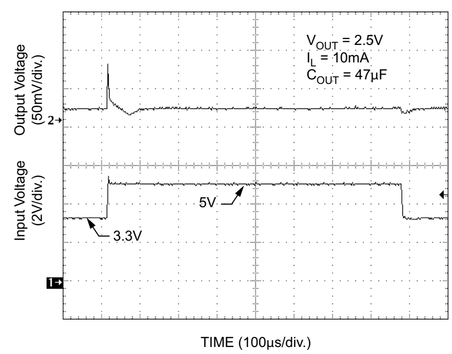


FIGURE 2-17: *Line Transient Response.*

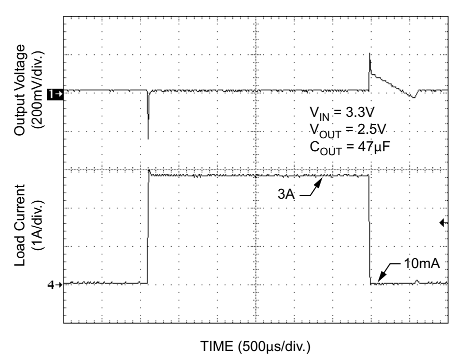


FIGURE 2-18: *Load Transient Response.*

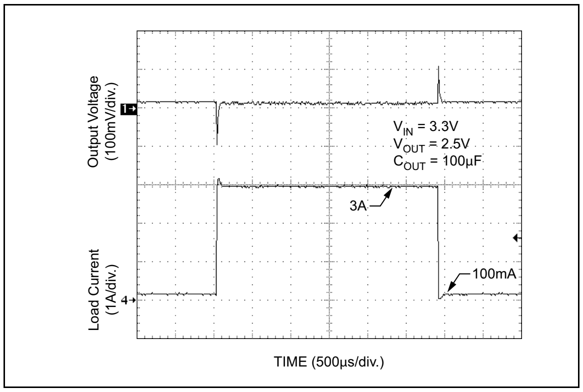


FIGURE 2-19: *Load Transient Response.*

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 βeta 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 datasheet, 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:

$T_{J(MAX)} \leq$	125°C
θ_{CS}	Between 0°C/W and 2°C/W

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 βeta 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.

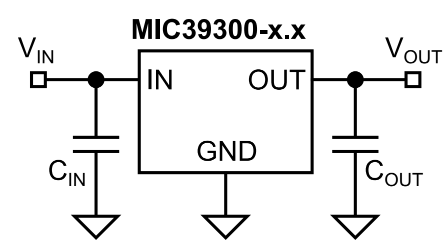


FIGURE 4-1: Capacitor Requirements.

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 1Ω 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 < 1Ω.

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 µF 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 µF 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.

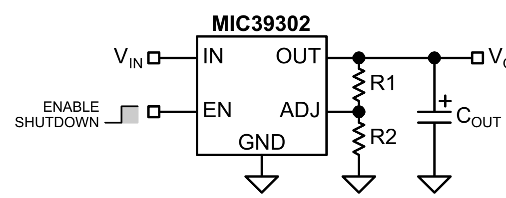
Low output voltage can be caused by a number of problems, including an overcurrent fault (device in current limit) or low input voltage. The flag is inoperative during overtemperature shutdown.

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 µA.

4.8 Adjustable Regulator Design



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

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:

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

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 **Section 4.5 "Minimum Load Current"**).

5.0 PACKAGING INFORMATION

5.1 Package Marking Information

3-Lead TO-263*	Example
XXXXX X.XXX WNNNP	39300 1.8WU 1986P

5-Lead TO-220*	Example
XXXXX X.XXX WNNNP	39301 2.5WT 2102P

D^2PAK*	Example
XXX XXXXXXX WNNNP	MIC 39302WU 1930P

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).

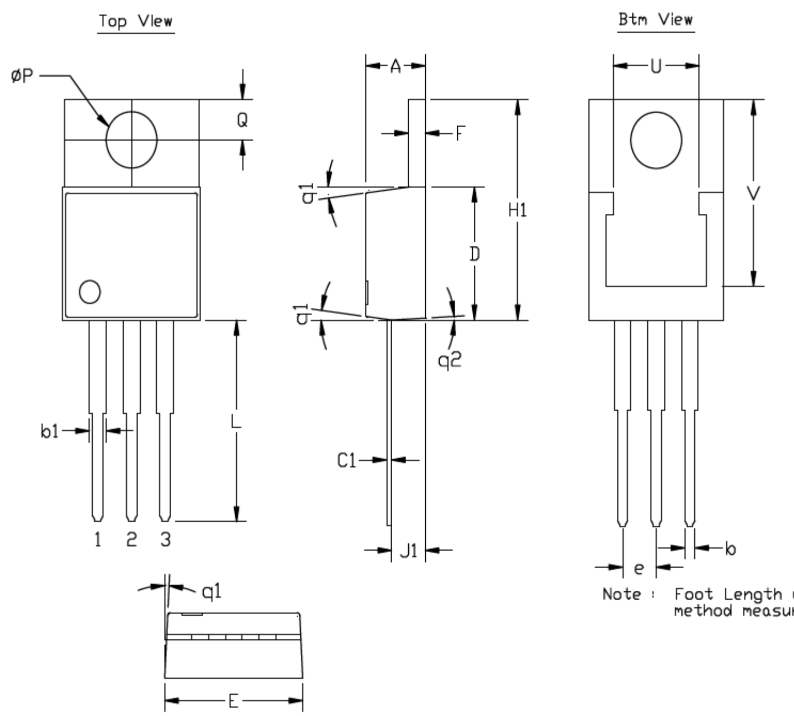
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

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



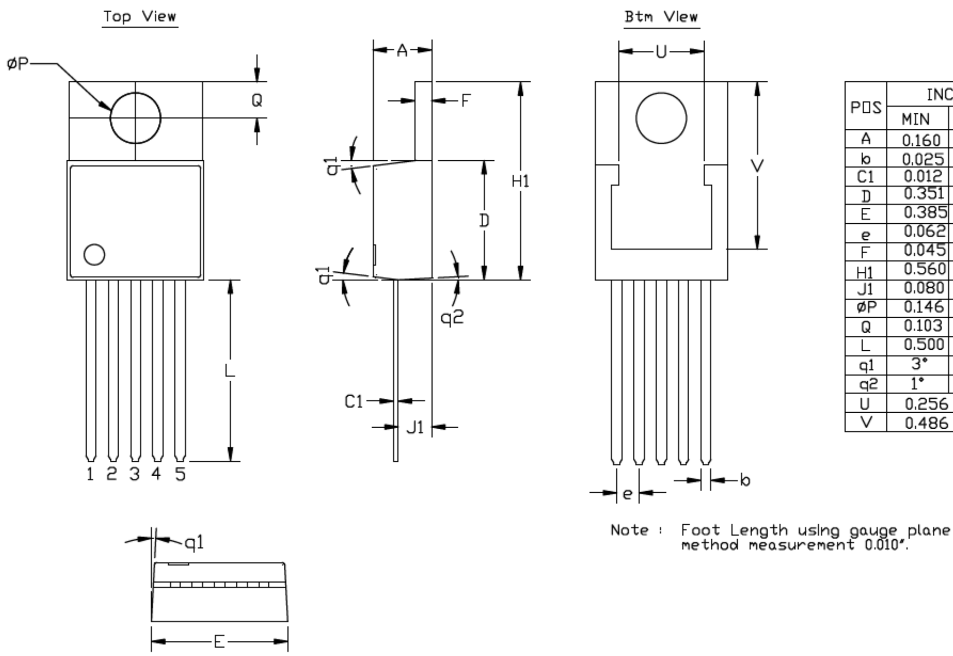
POS	INCH	
	MIN	MAX
A	0.160	0.190
b	0.025	0.040
b1	0.045	0.060
C1	0.012	0.022
D	0.348	0.360
E	0.385	0.420
e	0.090	0.110
F	0.045	0.055
H1	0.541	0.619
J1	0.080	0.120
øP	0.146	0.156
Q	0.103	0.113
L	0.500	0.580
q1	3°	10°
q2	1°	7°
U	0.256 Ref.	
V	0.486 Ref.	

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

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



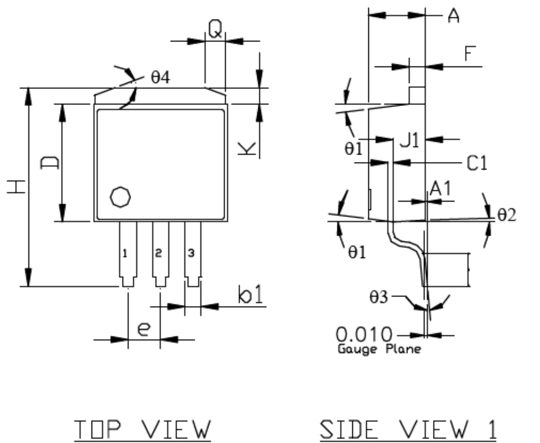
POS	INCH MIN	INCH MAX
A	0.160	0.190
b	0.025	0.040
C1	0.012	0.022
D	0.351	0.361
E	0.385	0.420
e	0.062	0.072
F	0.045	0.055
H1	0.560	0.619
J1	0.080	0.120
ØP	0.146	0.156
Q	0.103	0.113
L	0.500	0.580
q1	3°	10°
q2	1°	7°
U	0.256 Ref.	
V	0.486 Ref.	

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

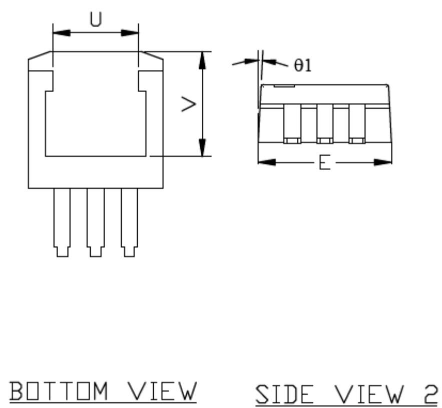
3-Lead TO-263 Package Outline and Recommended Land Pattern

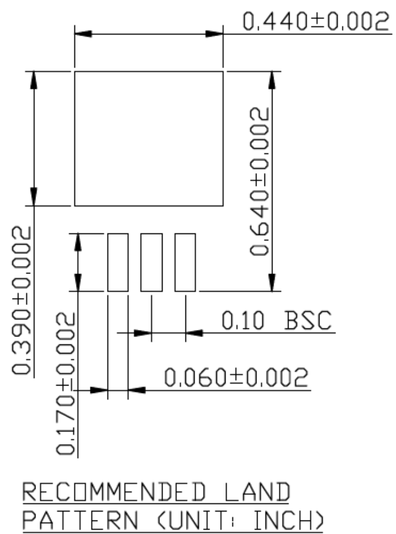
TITLE
3 LEAD TO263 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

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



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.	





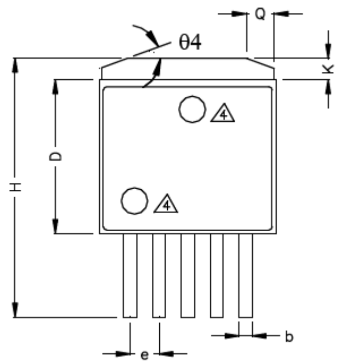
NOTES:
FOOT LENGTH USE GUAGE PLANE METHOD MEASUREMENT 0.010"

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

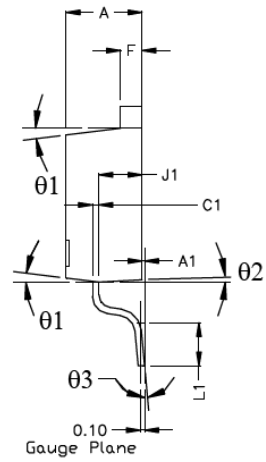
5-Lead TO-263 Package Outline and Recommended Land Pattern

TITLE
5 LEAD T0263 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

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

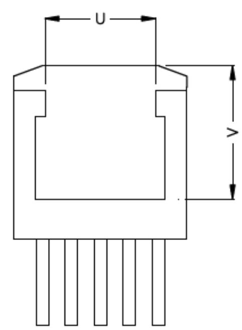


TOP VIEW

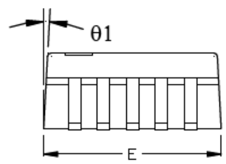


SIDE VIEW 1

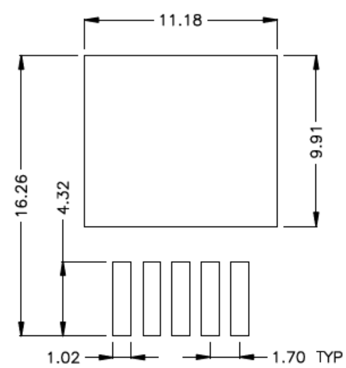
POS	INCH		MM	
	MIN	MAX	MIN	MAX
A	0.170	0.181	4.318	4.597
A1	0.000	0.012	0.000	0.305
b	0.026	0.036	0.660	0.914
C1	0.012	0.023	0.305	0.584
D	0.330	0.361	8.392	9.169
E	0.396	0.420	10.058	10.668
e	0.062	0.072	1.575	1.829
F	0.045	0.055	1.143	1.397
H	0.575	0.625	14.605	15.875
J1	0.080	0.120	2.032	3.048
K	0.045	0.066	1.143	1.676
L1	0.090	0.110	2.286	2.794
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	0.305 Ref.		7.747 Ref.	



BOTTOM VIEW



SIDE VIEW 2



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.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

PART NO.	–X.X	X	X	–XX
Device	Output Voltage	Junction Temperature Range	Package	Media Type

Device:	MIC393xx: 3A Low-Voltage µCap 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^2PAK (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 DDPAK 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 DDPAK Package, 750/Reel

h) MIC39302WU-TR: 3A Low-Voltage µCap 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 DDPAK 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.

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