

Single Supply V_{IN} , Low V_{IN} , Low V_{OUT} , 3A LDO

Features

- Input Voltage Range V_{IN} : +1.65V to +5.5V
- Maximum Dropout ($V_{IN} - V_{OUT}$) of 500 mV over Temperature
- Adjustable Output Voltage Down to 0.5V
- Stable with 10 μ F Ceramic Output Capacitor
- Excellent Line and Load Regulation
- Logic Controlled Shutdown
- Thermal Shutdown and Current-Limit Protection
- Error Flag Output
- 5-Lead TO-263 Package
- 5-Lead S-PAK Package
- ePad SOIC-8 Package
- 12-Lead 4 mm x 4 mm DFN Package (MIC69303 Only)
- -40°C to $+125^{\circ}\text{C}$ Junction Temperature Range

Applications

- Point-of-Load Applications
- Industrial Power
- Sensitive RF Applications

General Description

The MIC69301, MIC69302, MIC69303 are the 3A output current members of the MIC69xxx family of high current, low voltage regulators that support currents of 1A, 1.5A, 3A, and 5A. This family operates from a single low voltage supply and offers high precision and ultra low dropout of 500 mV under worst case conditions.

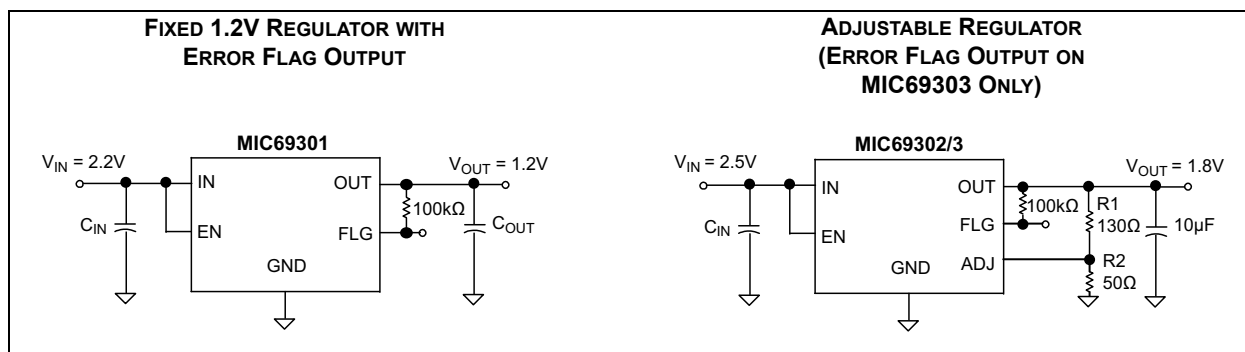
The MIC69301/2/3 operate from an input voltage of 1.65V to 5.5V. It is designed to drive digital circuits that require low voltage at high currents (i.e., PLDs, DSP, microcontroller, etc.). These regulators are available in adjustable and fixed output voltages. The adjustable version can support output voltages down to 0.5V.

The μ Cap design of the MIC69301/2/3 is optimized for stability with low value, low-ESR ceramic output capacitors.

Features of the MIC69301/2/3 include thermal shutdown and current limit protection. Logic enable and error flag pins are also available.

The MIC69301/2/3 are offered in TO-263, S-PAK, and the ePad SOIC-8 packages. The MIC69303 is also available in a 12-lead 4 mm x 4 mm DFN package. All packages have an operating temperature range of -40°C to $+125^{\circ}\text{C}$.

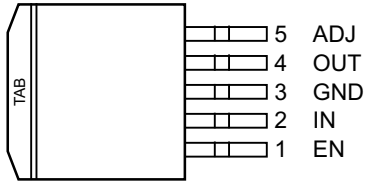
Typical Application Circuits



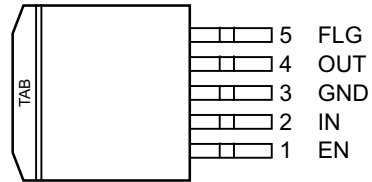
MIC69301/2/3

Pin Configurations

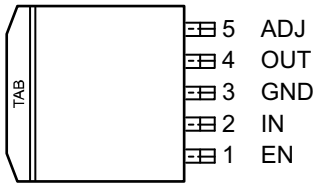
MIC69301/2
5-Lead TO-263 (U)
Adjustable Voltage



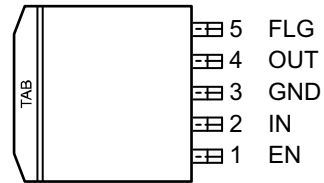
MIC69301/2
5-Lead TO-263 (U)
Fixed Voltage with Flag



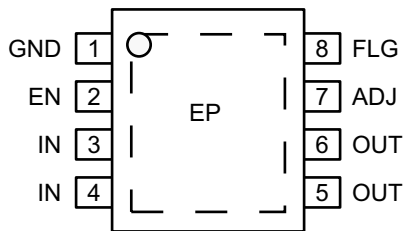
MIC69301/2
5-Lead S-PAK (R)
Adjustable Voltage



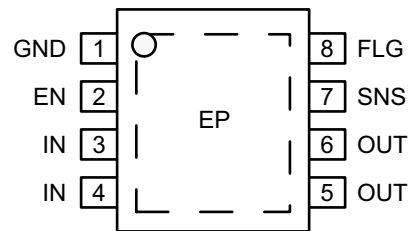
MIC69301/2
5-Lead S-PAK (R)
Fixed Voltage with Flag



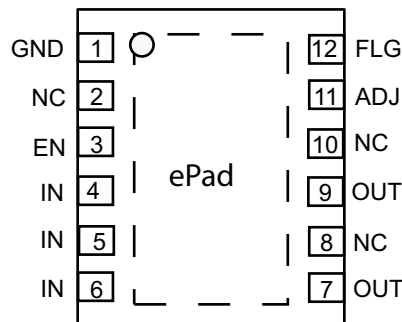
MIC69301/3
8-Lead ePad SOIC (ME)
Adjustable Voltage



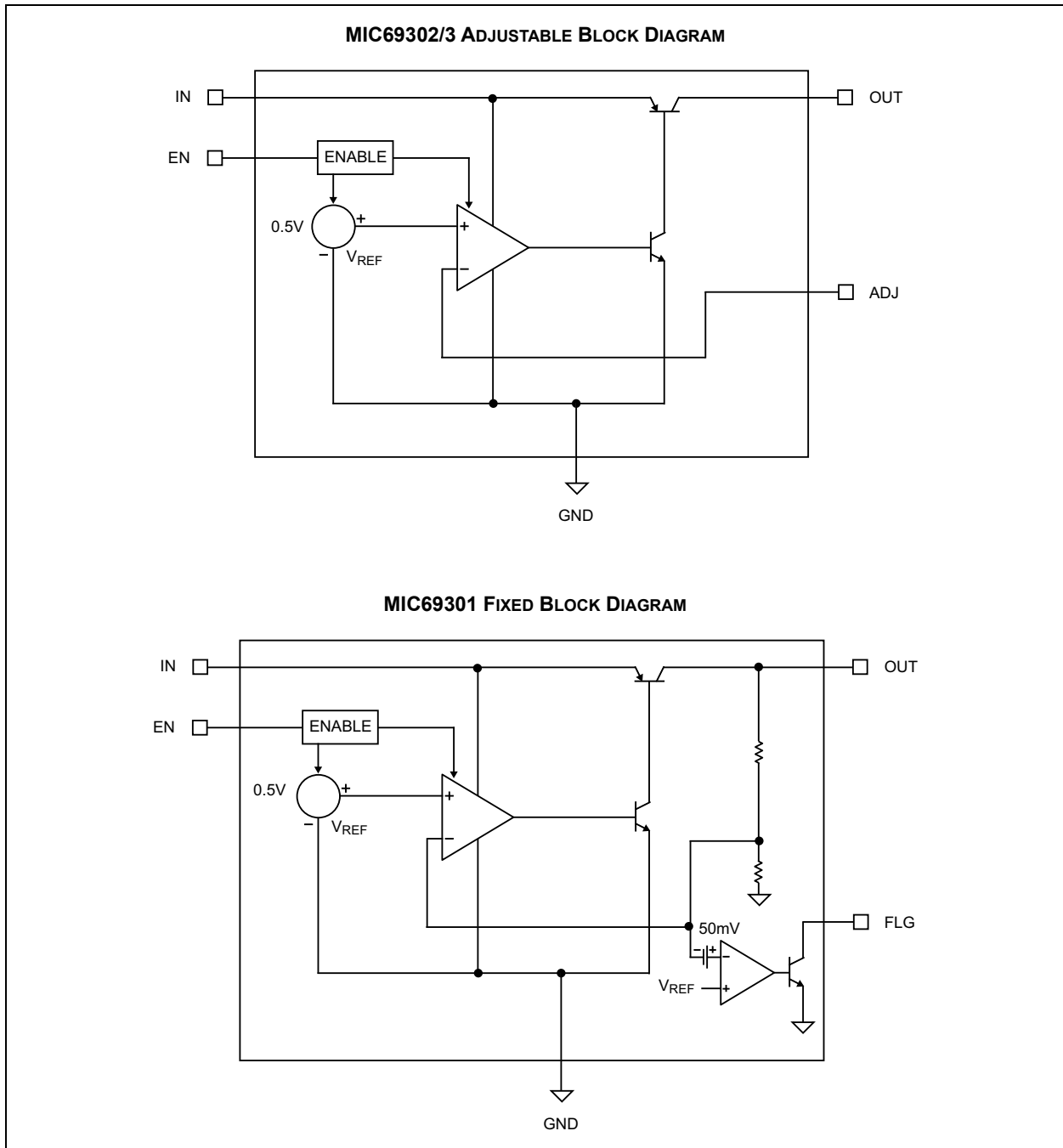
MIC69301/3
8-Lead ePad SOIC (ME)
Fixed Voltage with Flag



MIC69303
12-Lead 4 mm x 4 mm DFN (ML)
Adjustable Voltage with Flag



Functional Block Diagrams



MIC69301/2/3

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

| | |
|--|------------------------------|
| Supply Input Voltage (V_{IN} to GND)..... | -0.3V to +6V |
| Logic Input Voltage (V_{EN} to GND)..... | -0.3V to ($V_{IN} + 0.3V$) |
| Fault Flag (V_{FLG} to GND)..... | -0.3V to +6V |
| ESD Rating (Note 1)..... | 2 kV |

Operating Ratings ††

| | |
|--|--------------------|
| Supply Voltage (V_{IN})..... | +1.65V to +5.5V |
| Enable Input Voltage (V_{EN})..... | 0V to V_{IN} |
| Power Dissipation (Note 2)..... | Internally Limited |

† **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: Specification for packaged product only.

2: The maximum allowable power dissipation of any T_A (ambient temperature) is $P_{D(MAX)} = (T_{J(MAX)} - T_A) \div \theta_{JA}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $T_A = +25^\circ\text{C}$ with $V_{IN} = V_{OUT} + 1V$; **bold** values indicate $-40^\circ\text{C} < T_J < +125^\circ\text{C}$; $I_{OUT} = 10\text{ mA}$; $C_{OUT} = 10\text{ }\mu\text{F}$ ceramic, unless noted. [Note 1](#)

| Parameter | Sym. | Min. | Typ. | Max. | Units | Conditions |
|--|-----------|----------------------|-----------|----------------------|---------------|--|
| Power Input Supply | | | | | | |
| Input Voltage Range | V_{IN} | 1.65 | — | 5.5 | V | — |
| Ground Pin Current | I_{GND} | — | 1.2 | 5 | mA | $I_{OUT} = 10\text{ mA}$ |
| | | — | 12 | 30 | mA | $I_{OUT} = 1.5\text{ A}$ |
| | | — | 32 | 75 | mA | $I_{OUT} = 3\text{ A}$ |
| Ground Pin Current in Shutdown | — | — | 1 | — | μA | $V_{EN} = 0V$; $V_{IN} = 2.0V$; $V_{OUT} = 0V$ |
| Output Voltage | | | | | | |
| Output Voltage (Fixed) | V_{OUT} | $V_R - \mathbf{2.0}$ | — | $V_R + \mathbf{2.0}$ | V | Note 2 |
| Load Regulation | — | — | ± 0.3 | — | % | $I_{OUT} = 10\text{ mA}$ to 3A |
| Line Regulation (Note 3) | — | — | 0.2 | 0.3 | %/V | $V_{IN} = (V_{OUT} + 1.0V)$ to 5.5V |

Note 1: Specification for packaged product only.

2: V_R is the nominal regulator output voltage when the input voltage is $V_{IN} = V_{OUT} + 1V$ or $V_{IN} = 1.65V$ (whichever is greater).

3: Minimum input for line regulation test is set to $V_{OUT} + 1V$ relative to the highest output voltage.

4: Dropout voltage is defined as the input-to-output differential at which the output voltage drops 2% below its nominal value measured at 1V differential. For outputs below 1.65V, dropout voltage is considered the input-to-output voltage differential with the minimum input voltage of 1.65V. Minimum input operating voltage is 1.65V.

ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: $T_A = +25^\circ\text{C}$ with $V_{IN} = V_{OUT} + 1\text{V}$; **bold** values indicate $-40^\circ\text{C} < T_J < +125^\circ\text{C}$; $I_{OUT} = 10\text{ mA}$; $C_{OUT} = 10\text{ }\mu\text{F}$ ceramic, unless noted. [Note 1](#)

| Parameter | Sym. | Min. | Typ. | Max. | Units | Conditions |
|--|--------------------|--------------|------|--------------|------------------|--|
| Reference (Adjustable) | | | | | | |
| Feedback Reference Voltage (ADJ Pin) | — | 0.490 | 0.5 | 0.510 | V | $\pm 2.0\%$ |
| Feedback Bias Current | — | — | 0.25 | 1.0 | μA | $V_{ADJ} = 0.5\text{V}$ |
| Current Limit | | | | | | |
| Current Limit | I_{LIM} | 3.3 | 5.2 | — | A | $V_{OUT} = 0\text{V}$ |
| Power Dropout Voltage | | | | | | |
| Dropout Voltage (Note 4) | $V_{IN} - V_{OUT}$ | — | 200 | 300 | mV | $I_{OUT} = 1.5\text{A}$ |
| | | — | 275 | 500 | mV | $I_{OUT} = 3\text{A}$ |
| Enable Input | | | | | | |
| Enable Input Threshold | — | 0.8 | 0.57 | — | V | Regulator Enabled |
| | | — | — | 0.2 | | Regulator Shut Down |
| Enable Pin Bias Current | — | — | 0.0 | — | μA | $V_{EN} \leq 0.2\text{V}$ (Regulator Shutdown) |
| | | — | 7.0 | — | | $V_{EN} \geq 0.8\text{V}$ (Regulator Enabled) |
| Turn-On Time | t_{ON} | — | 10 | 150 | μs | 90% of typical V_{OUT} ; $V_{EN} = V_{IN}$ |
| Fault Output | | | | | | |
| Fault Threshold Voltage | — | 7.5 | 10 | 14 | % | % of V_{OUT} below nominal output (V_{OUT} Falling) |
| Fault Hysteresis | — | — | 2.0 | — | % | — |
| Fault Output Low Voltage | — | — | 150 | — | mV | $I_{FLG} = 250\text{ }\mu\text{A}$ (sinking), $V_{EN} = 0\text{V}$ |
| Fault Leakage Current | — | — | 0.05 | — | μA | $V_{FLG} = 5.0\text{V}$; $V_{EN} = 0\text{V}$ |
| Thermal Protection | | | | | | |
| Overtemperature Shutdown | — | — | 165 | — | $^\circ\text{C}$ | T_J rising |
| Overtemperature Shutdown Hysteresis | — | — | 10 | — | $^\circ\text{C}$ | — |

Note 1: Specification for packaged product only.

2: V_R is the nominal regulator output voltage when the input voltage is $V_{IN} = V_{OUT} + 1\text{V}$ or $V_{IN} = 1.65\text{V}$ (whichever is greater).

3: Minimum input for line regulation test is set to $V_{OUT} + 1\text{V}$ relative to the highest output voltage.

4: Dropout voltage is defined as the input-to-output differential at which the output voltage drops 2% below its nominal value measured at 1V differential. For outputs below 1.65V, dropout voltage is considered the input-to-output voltage differential with the minimum input voltage of 1.65V. Minimum input operating voltage is 1.65V.

MIC69301/2/3

TEMPERATURE SPECIFICATIONS

| Parameters | Sym. | Min. | Typ. | Max. | Units | Conditions |
|--------------------------------------|---------------|------|------|------|-------|------------|
| Temperature Ranges | | | | | | |
| Operating Junction Temperature Range | T_J | -40 | — | +125 | °C | Note 1 |
| Storage Temperature Range | T_S | -65 | — | +125 | °C | — |
| Lead Temperature | T_{LEAD} | — | — | +260 | °C | — |
| Package Thermal Resistance | | | | | | |
| Thermal Resistance, S-PAK 5-Ld | θ_{JC} | — | 2 | — | °C/W | — |
| Thermal Resistance, S-PAK 5-Ld | θ_{JA} | — | 38 | — | °C/W | — |
| Thermal Resistance, TO-263 5-Ld | θ_{JC} | — | 2 | — | °C/W | — |
| Thermal Resistance, ePad SOIC 8-Ld | θ_{JA} | — | 41 | — | °C/W | — |
| Thermal Resistance, DFN 12-Ld | θ_{JA} | — | 60 | — | °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.

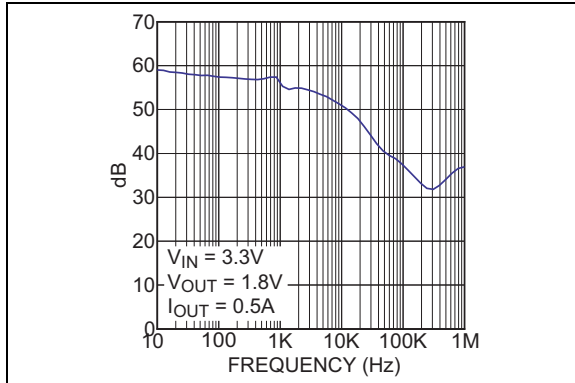


FIGURE 2-1: Power Supply Rejection Ratio.

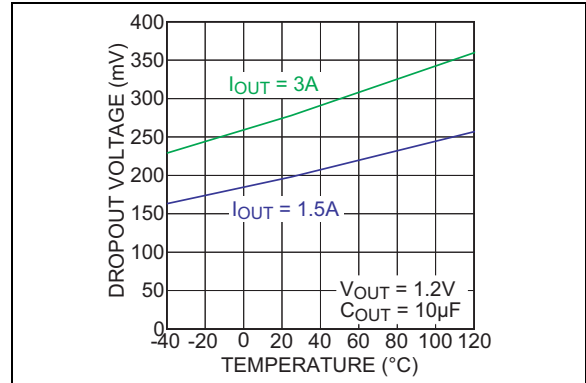


FIGURE 2-4: Dropout Voltage vs. Temperature.

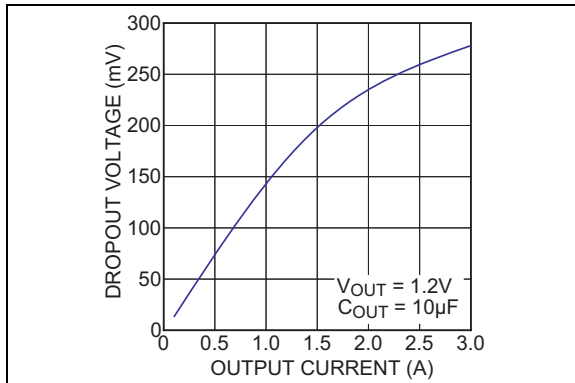


FIGURE 2-2: Dropout Voltage vs. Output Current.

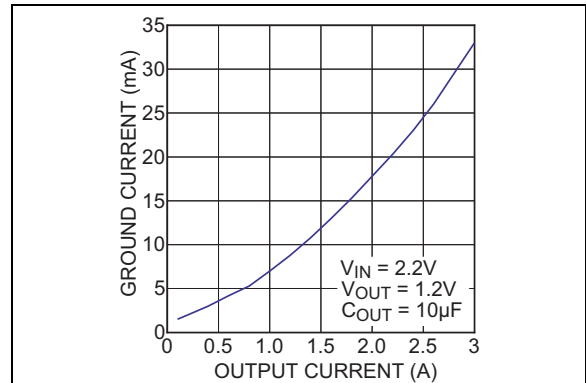


FIGURE 2-5: Ground Current vs. Output Current.

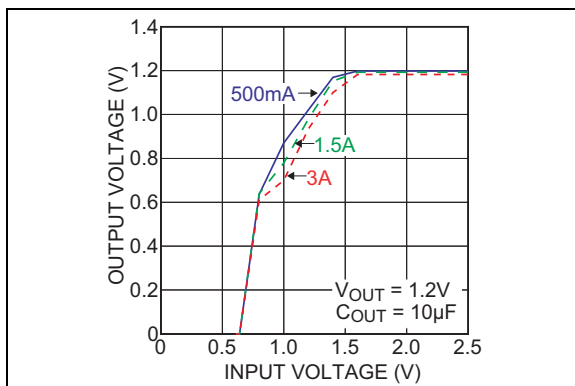


FIGURE 2-3: Dropout Voltage vs. Input Voltage.

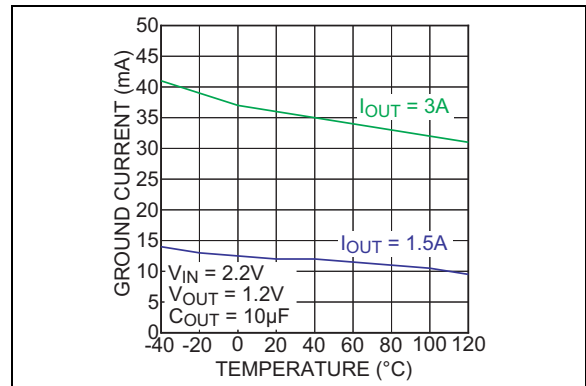


FIGURE 2-6: Ground Current vs. Temperature.

MIC69301/2/3

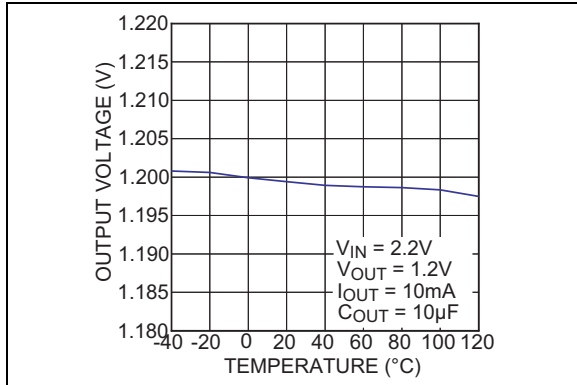


FIGURE 2-7: Output Voltage vs. Temperature.

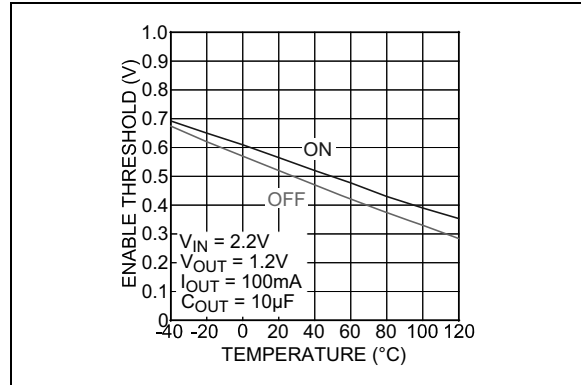


FIGURE 2-10: Enable Threshold vs. Temperature.

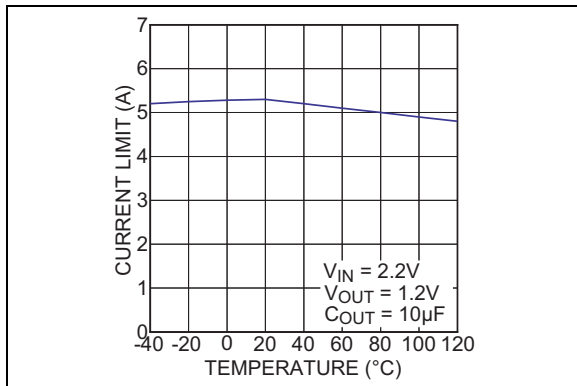


FIGURE 2-8: Current Limit vs. Temperature.

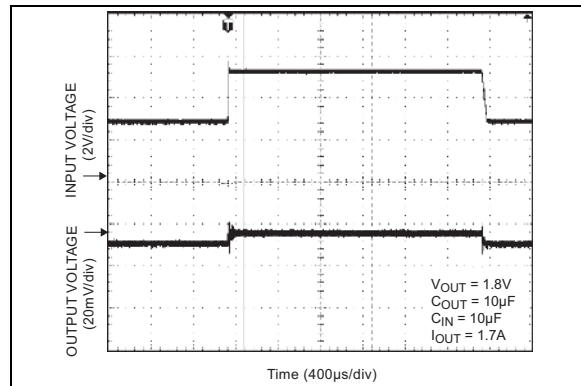


FIGURE 2-11: Line Transient.

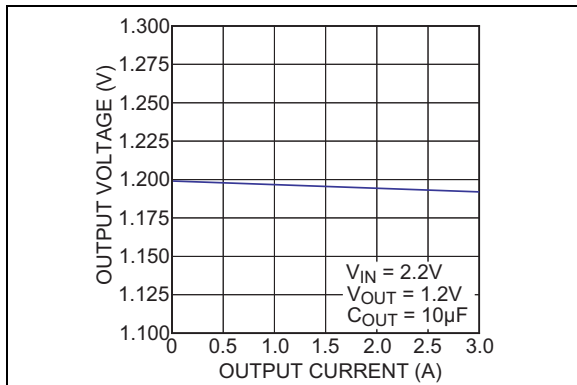


FIGURE 2-9: Load Regulation.

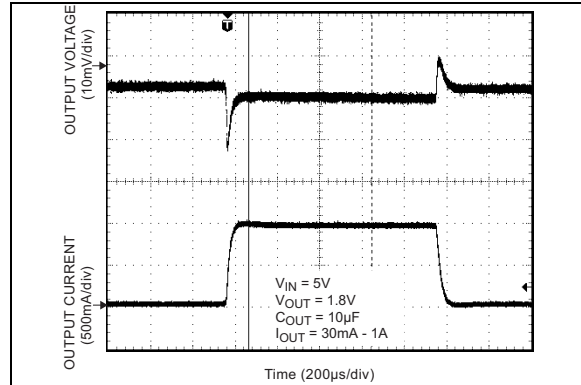


FIGURE 2-12: Load Transient.

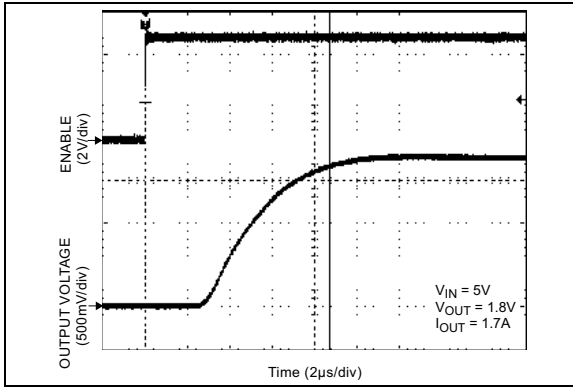


FIGURE 2-13: *Enable Turn-On.*

MIC69301/2/3

3.0 PIN DESCRIPTIONS

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

TABLE 3-1: PIN FUNCTION TABLE

| Pin Number (Fixed) S-PAK, TO-263 | Pin Number (Adj.) S-PAK, TO-263 | Pin Number (Fixed) ePad SOIC | Pin Number (Adj.) ePad SOIC | Pin Number (Adj.) ePad DFN | Pin Name | Description |
|---|--|------------------------------------|-----------------------------------|----------------------------------|----------|--|
| 1 | 1 | 2 | 2 | 3 | EN | Enable (Input): CMOS compatible input. Logic high = enable, logic low = shutdown. Do not leave pin floating. |
| 2 | 2 | 3, 4 | 3, 4 | 4, 5, 6 | IN | Input voltage that supplies current to the output power device. |
| 3, TAB | 3, TAB | 1 | 1 | 1 | GND | Ground (TAB is connected to ground on S-PAK and TO-263). |
| 4 | 4 | 5, 6 | 5, 6 | 7, 9 | OUT | Regulator Output. |
| — | — | 7 | — | — | SNS | Output voltage sense. Connect to output voltage. |
| — | 5 | — | 7 | 11 | ADJ | Adjustable regulator feedback input. Connect to resistor voltage divider. |
| 5 | — | 8 | 8 | 12 | FLG | Error Flag (Output): Open collector output. Active-low indicates an output fault condition. |
| — | — | EP | EP | EP | EP | Exposed pad. Connect to GND. |
| — | — | — | — | 2, 8, 10 | NC | No Connect. Not internally connected. |

4.0 FUNCTIONAL DESCRIPTION

The MIC69301/2/3 are ultra-high performance low dropout linear regulators designed for high current applications that require a fast transient response. It utilizes a single input supply and has a very low dropout voltage that is perfect for low-voltage DC-to-DC conversions. The MIC69301/2/3 require a minimum number of external components.

The MIC69301/2/3 regulators are fully protected from damage due to fault conditions offering constant current limiting and thermal shutdown.

4.1 Input Supply Voltage

V_{IN} provides a high current to the collector of the pass transistor. The minimum input voltage is 1.65V, allowing conversion from low voltage supplies.

4.2 Output Capacitor

The MIC69301/2/3 require a minimum of output capacitance to maintain stability. However, proper capacitor selection is important to ensure desired transient response. The MIC69301/2/3 are specifically designed to be stable with low-ESR ceramic chip capacitors. A 10 μ F ceramic chip capacitor should satisfy most applications. Output capacitance can be increased without bound. See the [Typical Performance Curves](#) for examples of load transient response.

X7R dielectric ceramic capacitors are recommended because of their temperature performance. X7R-type capacitors change capacitance by only 15% over their operating temperature range and are the most stable type of ceramic capacitors. Z5U and Y5V dielectric capacitors change value by as much as 50% and 60%, respectively over their operating temperature ranges. To use a ceramic chip capacitor with Y5V dielectric the value must be much higher than an X7R ceramic or a tantalum capacitor to ensure the same capacitance value over the operating temperature range. Tantalum capacitors have a very stable dielectric (10% over their operating temperature range) and can also be used with this device.

4.3 Input Capacitor

An input capacitor of 1 μ F or greater is recommended when the device is more than 4 inches away from the bulk supply capacitance or when the supply is a battery. Small, surface mount, ceramic chip capacitors can be used for the bypassing. The capacitor should be placed within 1 inch of the device for optimal performance. 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 Minimum Load Current

The MIC69301/2/3 regulator is 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 operation.

4.5 Adjustable Regulator Design

The MIC69302 and MIC69303 adjustable version allows programming the output voltage anywhere between 0.5V and 5.0V with two resistors. The resistor value between V_{OUT} and the adjust pin should not exceed 10 k Ω . Larger values can cause instability. The resistor values are calculated by:

EQUATION 4-1:

$$V_{OUT} = 0.5 \times \left(\frac{R1}{R2} + 1 \right)$$

Where:

V_{OUT} = Desired output voltage.

4.6 Enable

The fixed output voltage versions of the MIC69301 feature an active-high enable input (EN) that allows on-off control of the regulator. Current drain reduces to near zero when the device is shutdown, with only microamperes of leakage current. EN may be directly tied to V_{IN} and pulled up to the maximum supply voltage.

4.7 Thermal Design

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

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

First, calculate the power dissipation of the regulator from these numbers and the device parameters from this data sheet.

EQUATION 4-2:

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

MIC69301/2/3

The ground current is approximated by using numbers from the [Electrical Characteristics](#) table or [Typical Performance Curves](#) section. The heat sink thermal resistance is then determined with this formula:

EQUATION 4-3:

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

Where:

$T_{J(MAX)} \leq 125^{\circ}\text{C}$.

θ_{CS} = Between 0°C/W and 2°C/W .

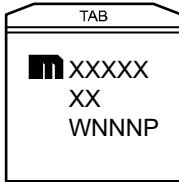
The heat sink may be significantly reduced in applications where the minimum input voltage is known and is large compared with the dropout voltage. Use a series input resistor to drop excessive voltage and distribute the heat between this resistor and the regulator. The low dropout properties of Microchip 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 $1.0 \mu\text{F}$ 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 applications.

5.0 PACKAGING INFORMATION

5.1 Package Marking Information

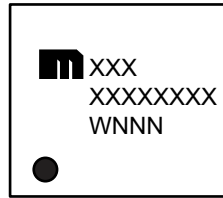
5-Lead Adj. TO-263*



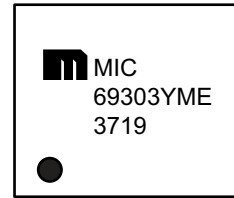
Example



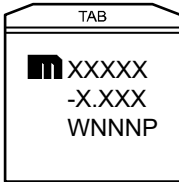
8-Lead Adj. SOIC*



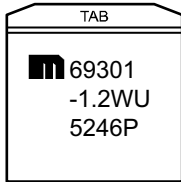
Example



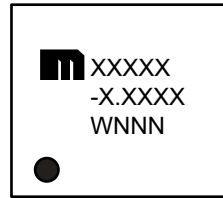
5-Lead Fixed TO-263*



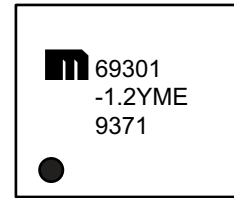
Example



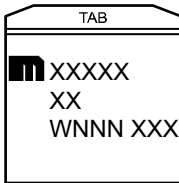
8-Lead Fixed SOIC*



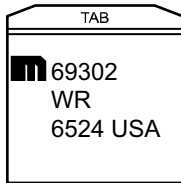
Example



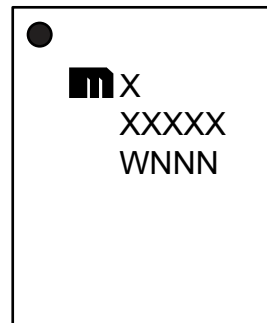
5-Lead Adj. S-PAK*



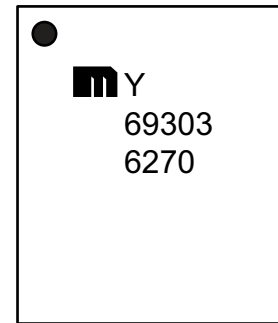
Example



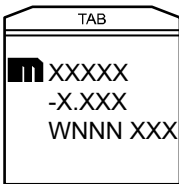
12-Lead DFN*



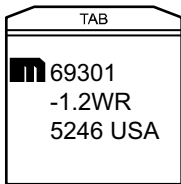
Example



5-Lead Fixed S-PAK*



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. | |

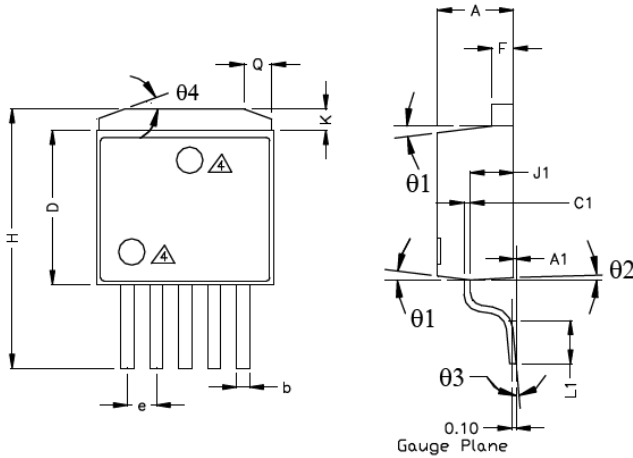
MIC69301/2/3

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

TITLE

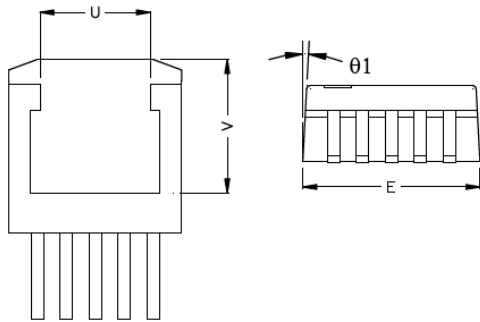
5 LEAD T0263 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

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



TOP VIEW

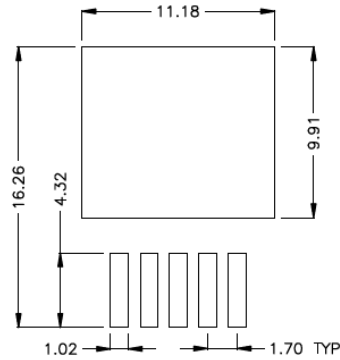
SIDE VIEW 1



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 |
| 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 | 0.305 | 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.

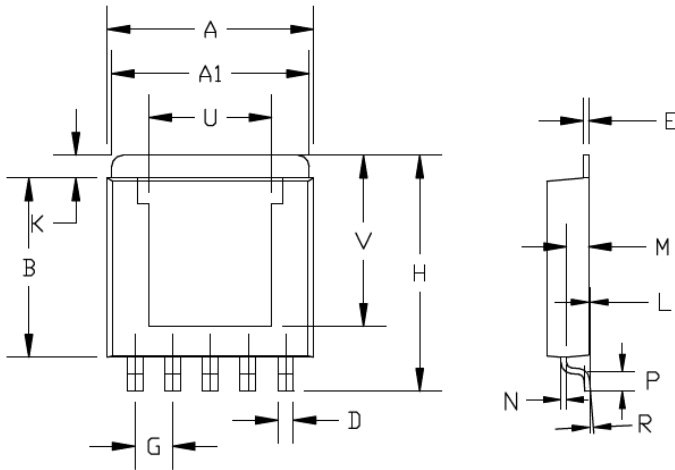
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

5-Lead S-PAK Package Outline and Recommended Land Pattern

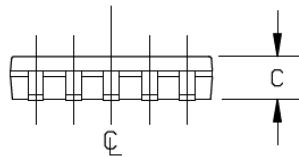
TITLE

5 LEAD SPAK PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

| | | | |
|------------------|---------------|-------------|----|
| DRAWING # | SPAK-5LD-PL-1 | UNIT | MM |
|------------------|---------------|-------------|----|

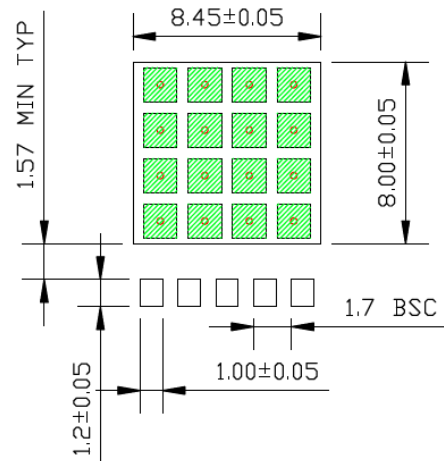


| | INCHES | | MILLIMETERS | |
|----|--------|-------|-------------|-------|
| | A | 0.365 | 0.375 | 9.27 |
| A1 | 0.350 | 0.360 | 8.89 | 9.14 |
| B | 0.310 | 0.320 | 7.87 | 8.13 |
| C | 0.070 | 0.080 | 1.78 | 2.03 |
| D | 0.025 | 0.031 | 0.63 | 0.79 |
| E | 0.010 | BSC | 0.25 | BSC |
| G | 0.067 | BSC | 1.70 | BSC |
| H | 0.410 | 0.420 | 10.41 | 10.67 |
| K | 0.030 | 0.050 | 0.76 | 1.27 |
| L | 0.001 | 0.005 | 0.03 | 0.13 |
| M | 0.035 | 0.045 | 0.89 | 1.14 |
| N | 0.010 | BSC | 0.25 | BSC |
| P | 0.031 | 0.041 | 0.79 | 1.04 |
| R | 0° | 6° | 0° | 6° |
| U | 0.220 | BSC | 5.58 | BSC |
| V | 0.296 | BSC | 7.52 | BSC |



NOTE:

1. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
2. DIMENSION INCLUDES PLATING THICKNESS. SOLDER MASK OPENING
3. RED CIRCLES IN LAND PATTERN REPRESENT THERMAL VIA, 0.30MM IN DIAMETER & SHOULD BE CONNECTED TO GND FOR MAXIMUM PERFORMANCE
4. GREEN RECTANGLES IN LAND PATTERN REPRESENT SOLDER STENCIL OPENING (OPTIONAL), 1.50X1.50MM.



**RECOMMENDED
LAND PATTERN**

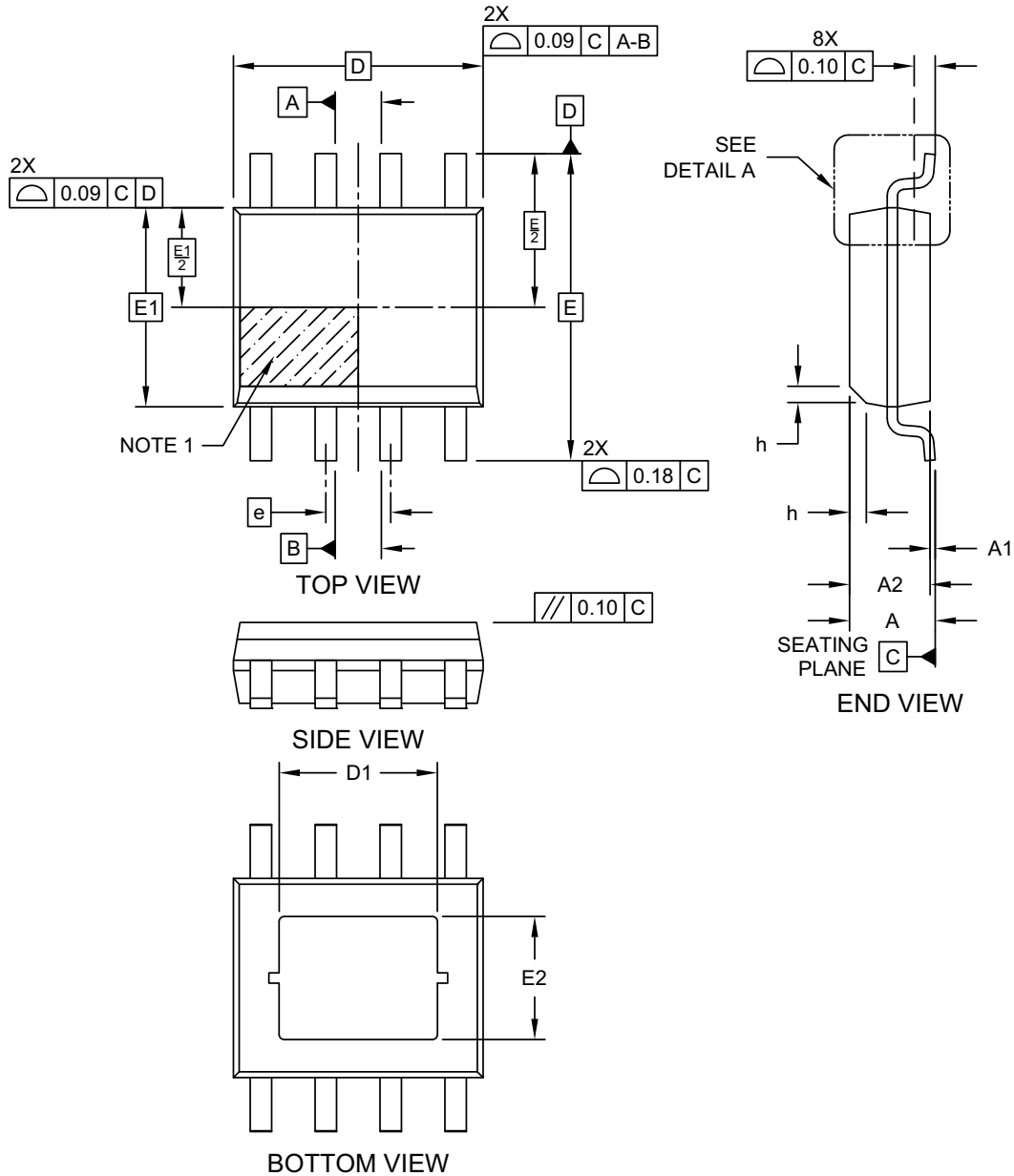
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

MIC69301/2/3

8-Lead SOIC Package Outline and Recommended Land Pattern

8-Lead Small Outline Integrated Circuit Package (EQA) - 3.90 mm (1.50 In) Body [SOIC] With 3.10x2.41 mm Exposed Pad

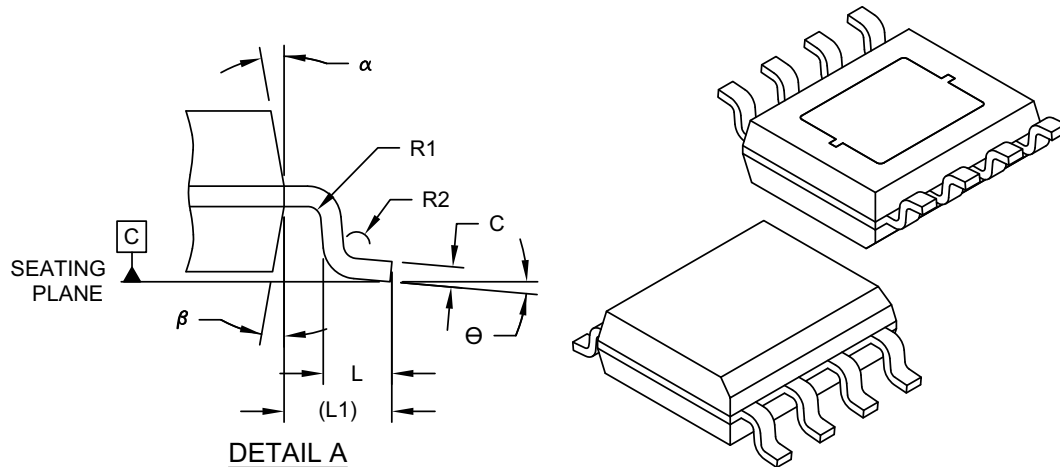
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-1136 Rev A Sheet 1 of 2

8-Lead Small Outline Integrated Circuit Package (EQA) - 3.90 mm (1.50 In) Body [SOIC] With 3.10x2.41 mm Exposed Pad

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



| Dimension Limits | Units | MILLIMETERS | | |
|--------------------------|-------|-------------|------|------|
| | | MIN | NOM | MAX |
| Number of Terminals | N | 8 | | |
| Pitch | e | 1.27 BSC | | |
| Overall Height | A | 1.43 | 1.55 | 1.68 |
| Standoff | A1 | 0.00 | 0.05 | 0.10 |
| Molded Package Thickness | A2 | 1.25 | - | - |
| Overall Length | D | 4.89 BSC | | |
| Exposed Pad Length | D1 | - | 3.10 | - |
| Overall Width | E | 6.02 BSC | | |
| Molded Package Width | E1 | 3.90 BSC | | |
| Exposed Pad Width | E2 | - | 2.41 | - |
| Terminal Width | b | 0.35 | 0.41 | 0.49 |
| Lead Thickness | c | 0.19 | 0.20 | 0.25 |
| Terminal Length | L | 0.41 | 0.64 | 0.89 |
| Terminal-to-Exposed-Pad | L1 | 1.04 REF | | |
| Foot Angle | Θ | 0° | 5° | 8° |
| Lead Bend Radius | R1 | 0.07 | - | - |
| Terminal Length | R2 | 0.07 | - | - |
| Mold Draft Angle | α | 5° | - | 15° |
| Mold Draft Angle | β | 5° | - | 15° |

Notes:

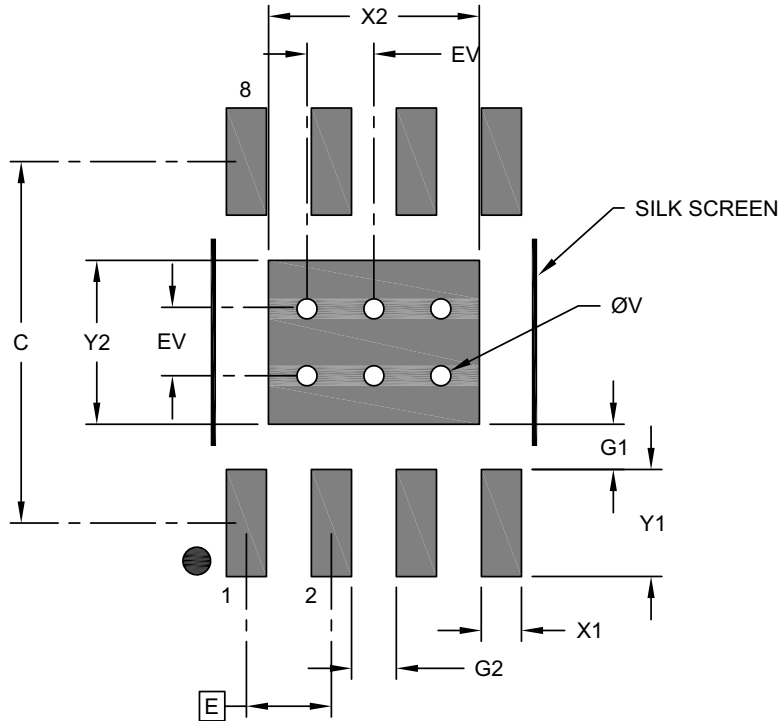
- Pin 1 visual index feature may vary, but must be located within the hatched area.
- Package is saw singulated
- Dimensioning and tolerancing per ASME Y14.5M
 BSC: Basic Dimension. Theoretically exact value shown without tolerances.
 REF: Reference Dimension, usually without tolerance, for information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

Microchip Technology Drawing C04-1136 Rev A Sheet 2 of 2

MIC69301/2/3

8-Lead Small Outline Integrated Circuit Package (EQA) - 3.90 mm (1.50 In) Body [SOIC] With 3.10x2.41 mm Exposed Pad

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



RECOMMENDED LAND PATTERN

| Dimension Limits | Units | MILLIMETERS | | |
|---------------------------------|-------|-------------|------|------|
| | | MIN | NOM | MAX |
| Contact Pitch | E | 1.27 BSC | | |
| Optional Center Pad Width | X2 | | | 3.15 |
| Optional Center Pad Length | Y2 | | | 2.45 |
| Contact Pad Spacing | C | | 5.40 | |
| Contact Pad Width (X8) | X1 | | | 0.60 |
| Contact Pad Length (X8) | Y1 | | | 1.60 |
| Contact Pad to Center Pad (X8) | G1 | 0.68 | | |
| Contact Pad to Contact Pad (X6) | G2 | 0.67 | | |
| Thermal Via Diameter | V | | 0.30 | |
| Thermal Via Pitch | EV | | 1.00 | |

Notes:

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

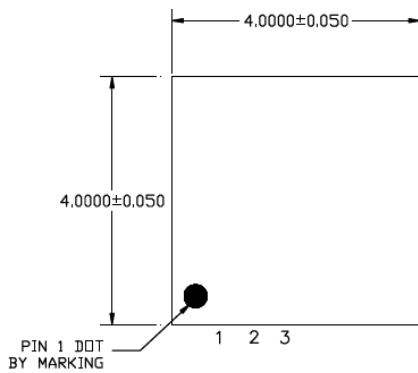
Microchip Technology Drawing C04-1136 Rev A

12-Lead DFN 4 mm x 4 mm Package Outline and Recommended Land Pattern

TITLE

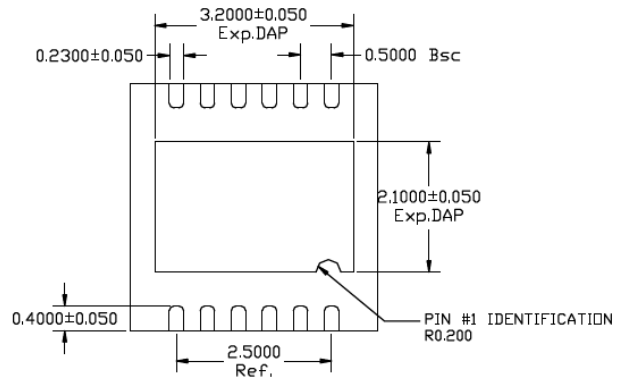
12 LEAD DFN 4.0 x 4.0 mm PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

| | | | |
|------------------|-----------------|-------------|----|
| DRAWING # | DFN44-12LD-PL-1 | UNIT | MM |
|------------------|-----------------|-------------|----|



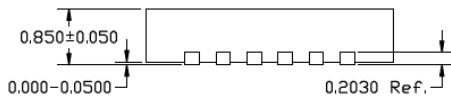
TOP VIEW

NOTE: 1, 2, 3



BOTTOM VIEW

NOTE: 1, 2



SIDE VIEW

NOTE: 1, 2

NOTE:

1. MAX PACKAGE WARPAGE IS 0.05MM
2. MAX ALLOWABLE BURR IS 0.076MM IN ALL DIRECTIONS
3. PIN #1 IS ON TOP WILL BE LASER MARKED
4. GREEN RECTANGLES (SHADED AREA) REPRESENT STENCIL OPENING ON EXPOSED AREA. SIZE IS 0.85X0.87 MM, 1.07 MM PITCH SPACING
5. RED CIRCLES REPRESENT THERMAL VIAS & SHOULD BE CONNECTED TO GND FOR MAX PERFORMANCE. 0.30 - 0.35 MM RECOMMENDED DIAMETER, 1.0MM PITCH SPACING

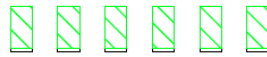
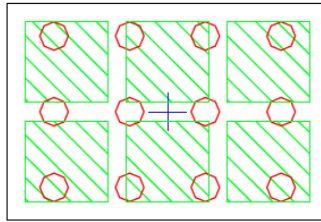
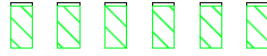
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

MIC69301/2/3

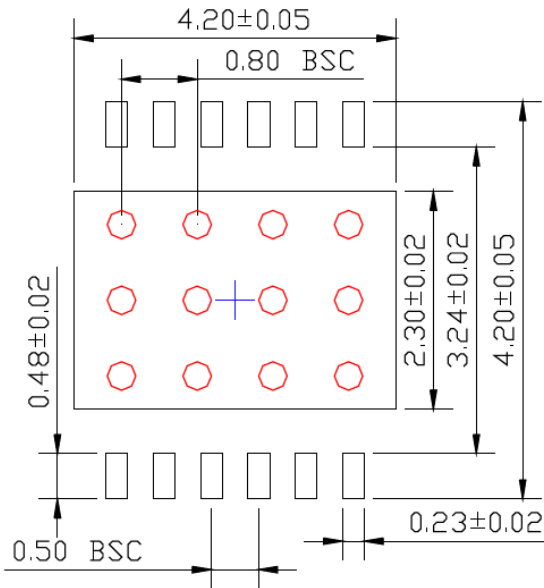
POD-Land Pattern drawing # DFN44-12LD-PL-1

RECOMMENDED LAND PATTERN

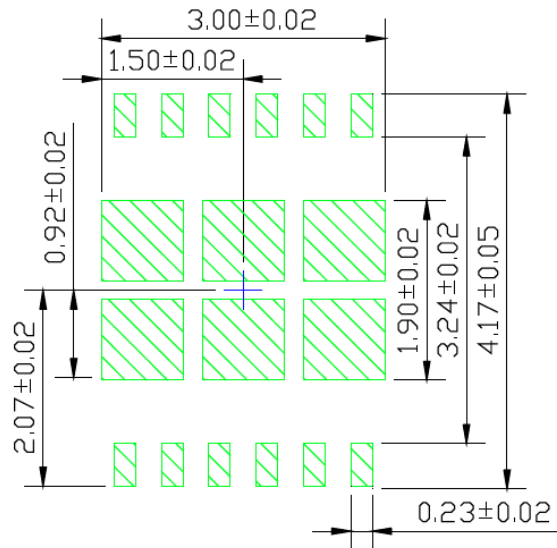
NOTE: 4, 5



STACKED-UP



EXPOSED METAL TRACE



SOLDER STENCIL OPENING

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 (December 2021)

- Converted Micrel document MIC69301/2/3 to Microchip data sheet template DS20006625A.
- Minor grammatical text changes throughout.

MIC69301/2/3

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

| <u>Device</u> | <u>-X.X</u> | <u>X</u> | <u>XX</u> | <u>-XX</u> | |
|------------------------------------|----------------|---|-----------|------------|---|
| Part No. | Output Voltage | Junction Temp. Range | Package | Media Type | |
| Device: | MIC69301: | Single Supply V_{IN} , Low V_{IN} , Low V_{OUT} , 3A LDO with Error Flag Output | | | |
| | MIC69302: | Single Supply V_{IN} , Low V_{IN} , Low V_{OUT} , 3A LDO | | | |
| | MIC69303: | Single Supply V_{IN} , Low V_{IN} , Low V_{OUT} , 3A LDO with Error Flag Output | | | |
| Output Voltage: | <blank>= | Adjustable | | | |
| | 1.2 = | 1.2V | | | |
| Junction Temperature Range: | Y = | -40°C to +125°C, RoHS-Compliant | | | |
| Package: | WU = | 5-Lead TO-263 | | | |
| | WR = | 5-Lead S-PAK | | | |
| | ME = | 8-Lead ePad SOIC | | | |
| | ML = | 12-Lead 4 mm x 4 mm DFN | | | |
| Media Type: | <blank>= | 48/Tube (WR Package option) | | | |
| | <blank>= | 50/Tube (WU Package option) | | | |
| | TR = | 750/Reel (WR & WU Package options) | | | |
| | TR = | 2,500/Reel (ME Package option) | | | |
| | TR = | 5,000/Reel (ML Package option) | | | |
| | | | | | Examples: |
| | | | | | a) MIC69301-1.2WU: MIC69301, 1.2V Output Voltage, -40°C to +125°C Temperature Range, 5-Lead TO-263, 50/Tube |
| | | | | | b) MIC69301-1.2WU-TR: MIC69301, 1.2V Output Voltage, -40°C to +125°C Temperature Range, 5-Lead TO-263, 750/Reel |
| | | | | | c) MIC69301-1.2WR: MIC69301, 1.2V Output Voltage, -40°C to +125°C Temperature Range, 5-Lead S-PAK, 48/Tube |
| | | | | | d) MIC69301-1.2WR-TR: MIC69301, 1.2V Output Voltage, -40°C to +125°C Temperature Range, 5-Lead S-PAK, 750/Reel |
| | | | | | e) MIC69301-1.2YME-TR: MIC69301, 1.2V Output Voltage, -40°C to +125°C Temperature Range, 8-Lead SOIC, 2,500/Reel |
| | | | | | f) MIC69302WU: MIC69302, Adjustable Output Voltage, -40°C to +125°C Temperature Range, 5-Lead TO-263, 50/Tube |
| | | | | | g) MIC69302WU-TR: MIC69302, Adjustable Output Voltage, -40°C to +125°C Temperature Range, 5-Lead TO-263, 750/Reel |
| | | | | | h) MIC69302WR: MIC69302, Adjustable Output Voltage, -40°C to +125°C Temperature Range, 5-Lead S-PAK, 48/Tube |
| | | | | | i) MIC69302WR-TR: MIC69302, Adjustable Output Voltage, -40°C to +125°C Temperature Range, 5-Lead S-PAK, 750/Reel |
| | | | | | j) MIC69303YME-TR: MIC69303, Adjustable Output Voltage, -40°C to +125°C Temperature Range, 8-Lead SOIC, 2,500/Reel |
| | | | | | k) MIC69303YML-TR: MIC69303, Adjustable Output Voltage, -40°C to +125°C Temperature Range, 12-Lead DFN, 5,000/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. |

MIC69301/2/3

NOTES:

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