

1A, 1.2 MHz PWM Boost Converter

Features

- 2.5V to 10V Input Voltage Range
- Output Voltage Adjustable to 34V
- Over 1A Switch Current
- 1.2 MHz PWM Operation
- Stable with Ceramic Capacitors
- <1% Line and Load Regulation
- Low Output Voltage Ripple
- <1 μ A Shutdown Current
- Undervoltage Lockout
- Output Overvoltage Protection (MIC2288YML)
- Overtemperature Shutdown
- Thin SOT23-5 Package Option
- 2 mm x 2 mm leadless VDFN-8 Package Option
- -40°C to $+125^{\circ}\text{C}$ Junction Temperature Range

Applications

- Organic EL Power Supply
- TFT-LCD Bias Supply
- 12V Supply for DSL Applications
- Multi-Output DC/DC Converters
- Positive and Negative Output Regulators
- SEPIC Converters

General Description

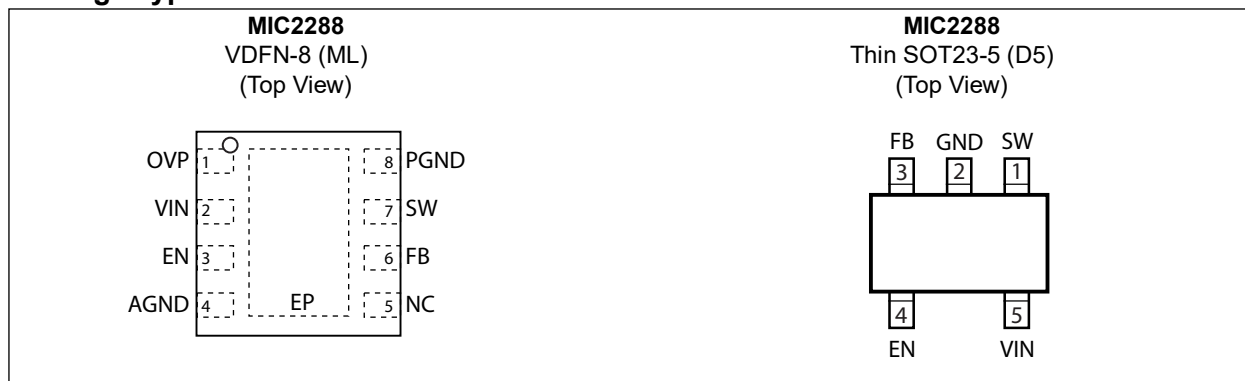
The MIC2288 is a 1.2 MHz PWM, DC/DC boost switching regulator available in low-profile Thin SOT23 and 2 mm x 2 mm VDFN package options. High power density is achieved with the MIC2288's internal 34V/1A switch, allowing it to power large loads in a tiny footprint.

The MIC2288 implements a constant frequency, 1.2 MHz PWM, current mode control scheme with internal compensation that offers excellent transient response and output regulation performance. The high frequency operation saves board space by allowing small, low-profile, external components. The fixed frequency PWM topology also reduces spurious switching noise and ripple to the input power source.

The MIC2288 is available in a low-profile Thin SOT23-5 package and a 2 mm x 2 mm VDFN-8 leadless package. The VDFN package option has an output overvoltage protection feature.

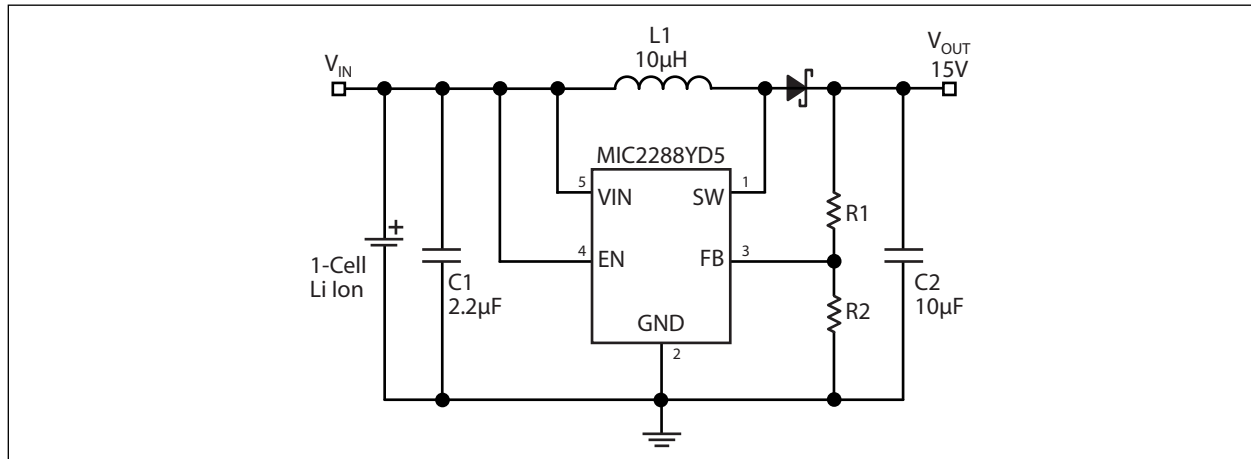
The MIC2288 has a junction temperature range of -40°C to $+125^{\circ}\text{C}$.

Package Types

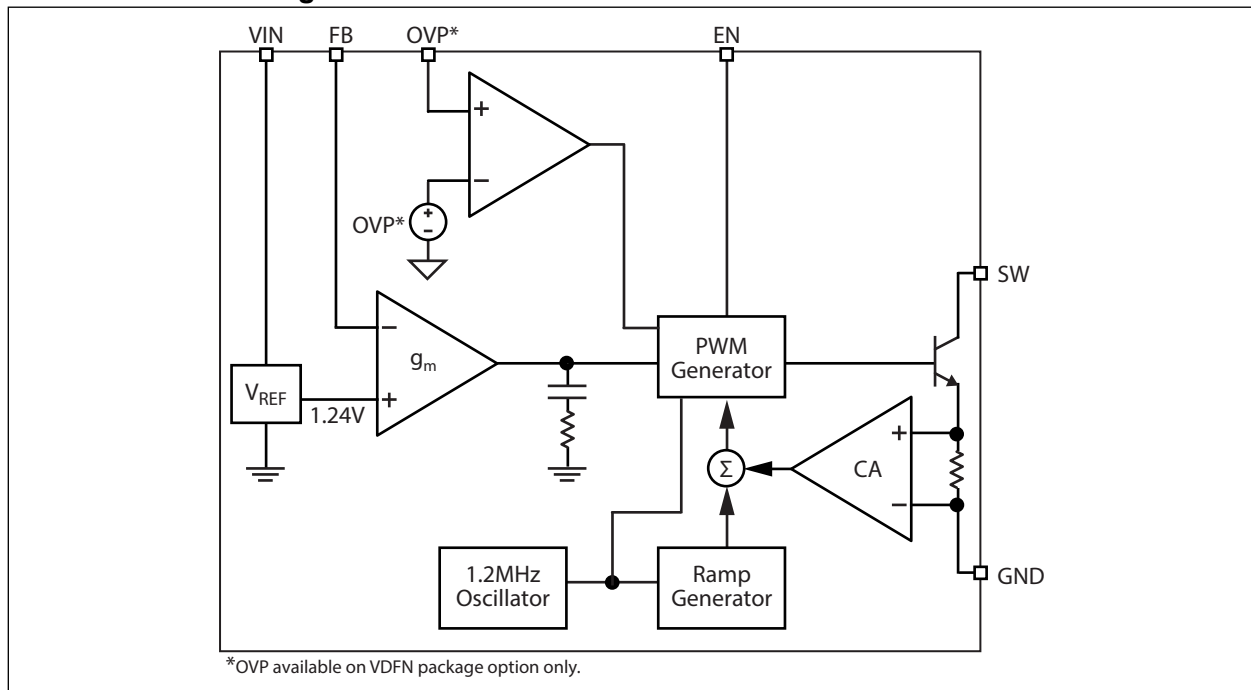


MIC2288

Typical Application Circuit



Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

| | |
|---|-------------------|
| Supply Voltage (V_{IN}) | +12V |
| Switch Voltage (V_{SW}) | –0.3V to +34V |
| Enable Pin Voltage (V_{EN}) | –0.3V to V_{IN} |
| FB Voltage (V_{FB}) | +6.0V |
| Switch Current (I_{SW}) | 2A |
| ESD Rating (Note 1) | +2 kV |

Operating Ratings ††

| | |
|-----------------------------------|---------------|
| Supply Voltage (V_{IN}) | +2.5V to +10V |
|-----------------------------------|---------------|

† 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: Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5 k Ω in series with 100 pF.

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $T_A = +25^\circ\text{C}$, $V_{IN} = V_{EN} = 3.6\text{V}$, $V_{OUT} = 10\text{V}$, $I_{OUT} = 20\text{ mA}$, unless otherwise noted. **Bold** values valid for $-40^\circ\text{C} \leq T_J \leq \pm 125^\circ\text{C}$. [Note 1](#)

| Parameter | Sym. | Min. | Typ. | Max. | Units | Conditions |
|------------------------------------|------------|--------------|------|--------------|------------------|---|
| Supply Voltage Range | V_{IN} | 2.5 | — | 10 | V | — |
| Undervoltage Lockout | V_{UVLO} | 1.8 | 2.1 | 2.4 | V | — |
| Quiescent Current | I_{VIN} | — | 2.8 | 5 | mA | $V_{FB} = 2\text{V}$, not switching |
| Shutdown Current | I_{SD} | — | 0.1 | 1 | μA | $V_{EN} = 0\text{V}$, Note 2 |
| Feedback Voltage | V_{FB} | 1.227 | 1.24 | 1.252 | V | $\pm 1\%$ |
| | | 1.215 | — | 1.265 | | $\pm 2\%$, over temperature |
| Feedback Input Current | I_{FB} | — | –450 | — | nA | $V_{FB} = 1.24\text{V}$ |
| Line Regulation | — | — | 0.1 | 1 | % | $3\text{V} \leq V_{IN} \leq 5\text{V}$ |
| Load Regulation | — | — | 0.2 | — | % | $5\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| Maximum Duty Cycle | D_{MAX} | 85 | 90 | — | % | — |
| Switch Current Limit | I_{SW} | — | 1.2 | — | A | — |
| Switch Saturation Voltage | V_{SW} | — | 550 | — | mV | $I_{SW} = 1\text{A}$ |
| Switch Leakage Current | I_{SW} | — | 0.01 | 5 | μA | $V_{EN} = 0\text{V}$, $V_{SW} = 10\text{V}$ |
| Enable Threshold | V_{EN} | 1.5 | — | — | V | Turn on |
| | | — | — | 0.4 | | Turn off |
| Enable Pin Current | I_{EN} | — | 20 | 40 | μA | $V_{EN} = 10\text{V}$ |
| Oscillator Frequency | f_{SW} | 1.05 | 1.2 | 1.35 | MHz | — |
| Output Overvoltage Protection | V_{OVP} | 30 | 32 | 34 | V | VDFN package option only |
| Overtemperature Threshold Shutdown | T_J | — | 150 | — | $^\circ\text{C}$ | — |
| | | — | 10 | — | | Hysteresis |

Note 1: Specification for packaged product only.

2: $I_{SD} = I_{VIN}$.

TEMPERATURE SPECIFICATIONS

| Parameters | Sym. | Min. | Typ. | Max. | Units | Conditions |
|------------------------------------|---------------|------|------|------|-------|------------|
| Temperature Ranges | | | | | | |
| Junction Operating Temperature | T_J | -40 | — | +125 | °C | — |
| Storage Temperature Range | T_S | -65 | — | +150 | °C | — |
| Package Thermal Resistances | | | | | | |
| Thermal Resistance, 2x2 VDFN 8-Ld | θ_{JA} | — | 93 | — | °C/W | — |
| Thermal Resistance, TSOT23-5 | θ_{JA} | — | 256 | — | °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.

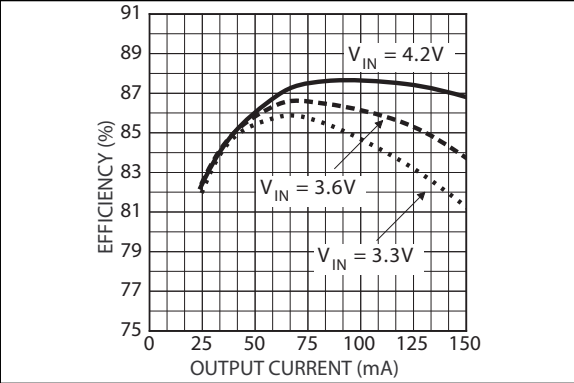


FIGURE 2-1: Efficiency at $V_{OUT} = 12V$.

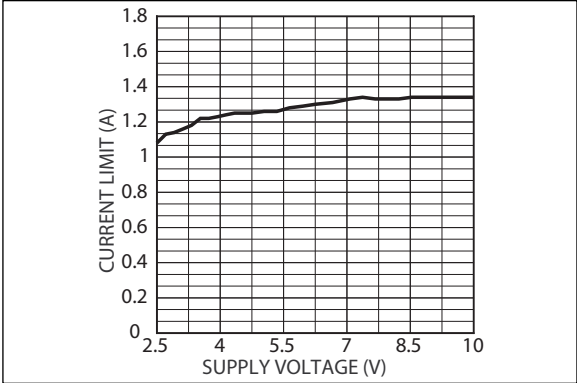


FIGURE 2-4: Current-Limit vs. Supply Voltage.

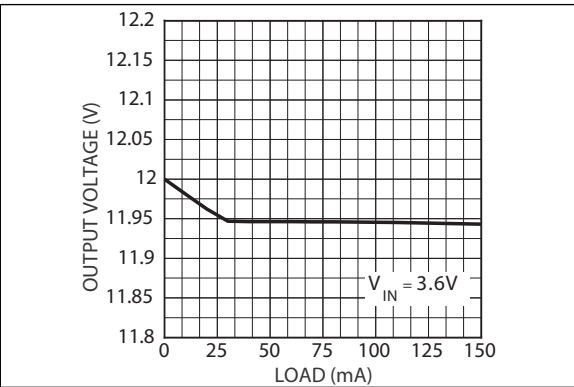


FIGURE 2-2: Load Regulation.

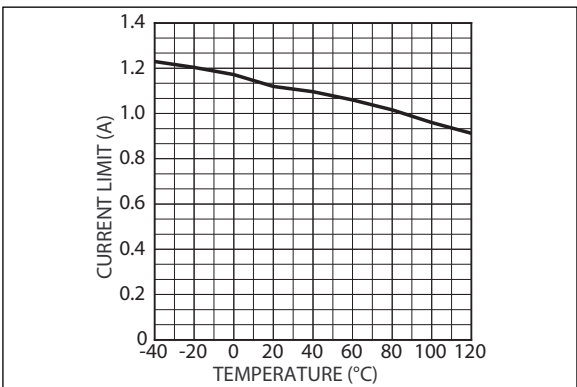


FIGURE 2-5: Current-Limit vs. Temperature.

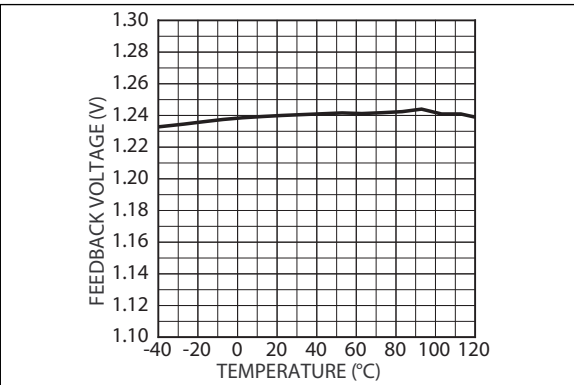


FIGURE 2-3: Feedback Voltage vs. Temperature.

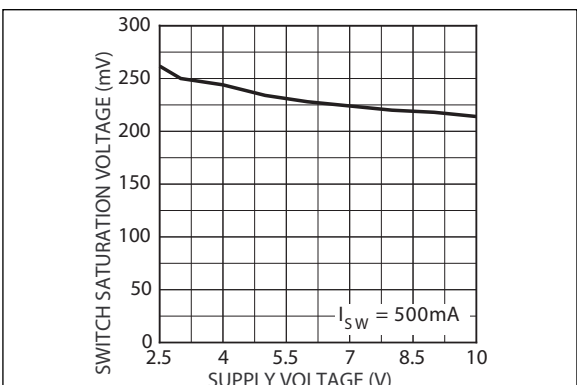


FIGURE 2-6: Switch Saturation vs. Supply Voltage.

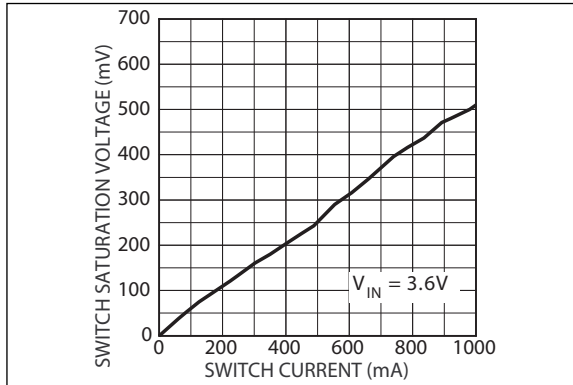


FIGURE 2-7: Switch Saturation vs. Switch Current.

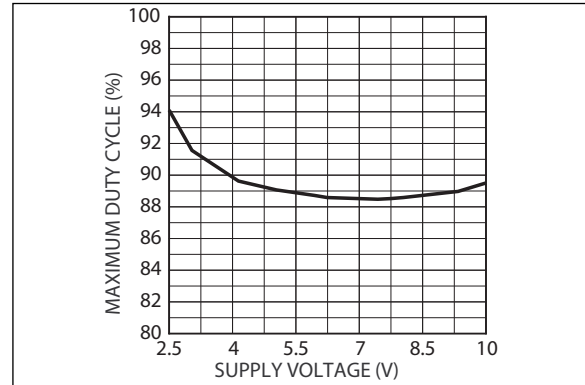


FIGURE 2-10: Maximum Duty Cycle vs. Supply Voltage.

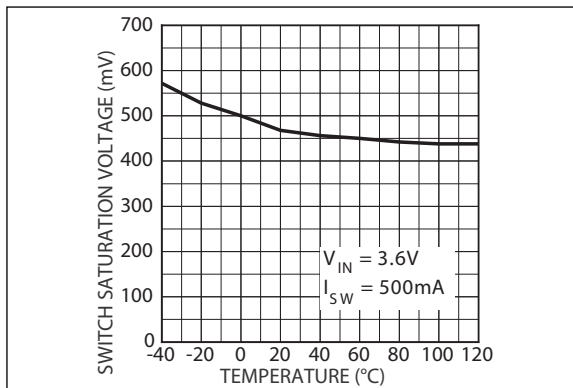


FIGURE 2-8: Switch Saturation vs. Temperature.

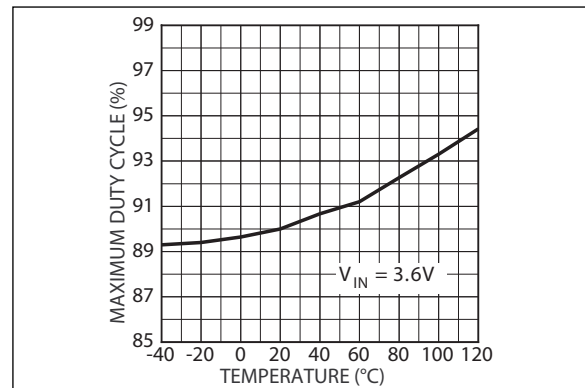


FIGURE 2-11: Maximum Duty Cycle vs. Temperature.

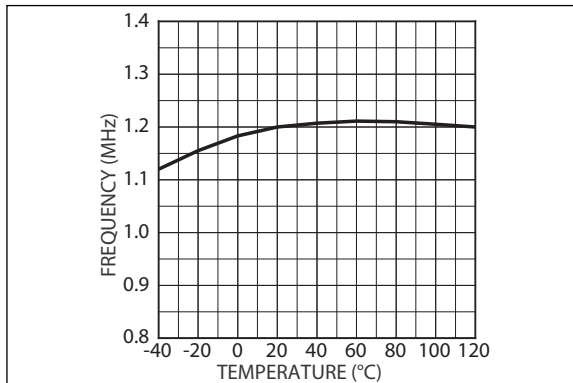


FIGURE 2-9: Frequency vs. Temperature.

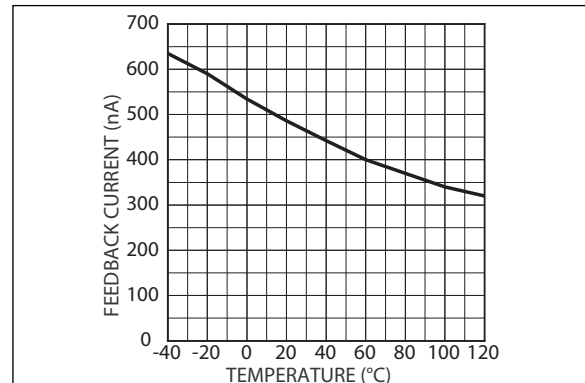


FIGURE 2-12: FB Pin Current vs. Temperature.

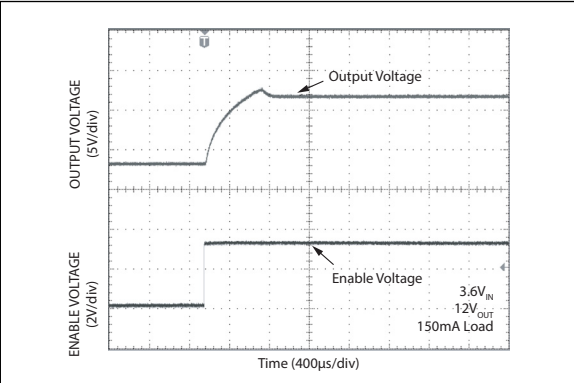


FIGURE 2-13: Enable Characteristics.

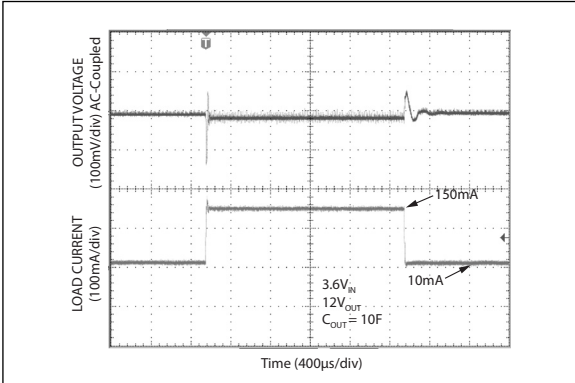


FIGURE 2-15: Load Transient Response.

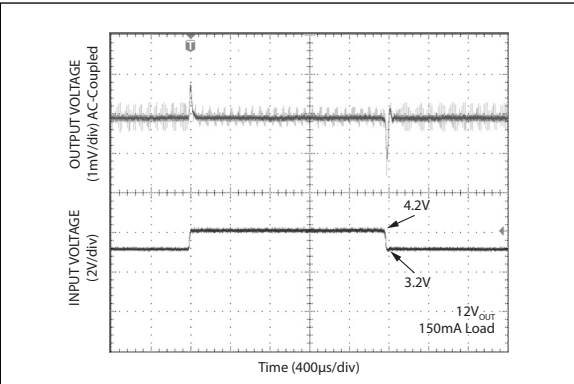


FIGURE 2-14: Line Transient Response.

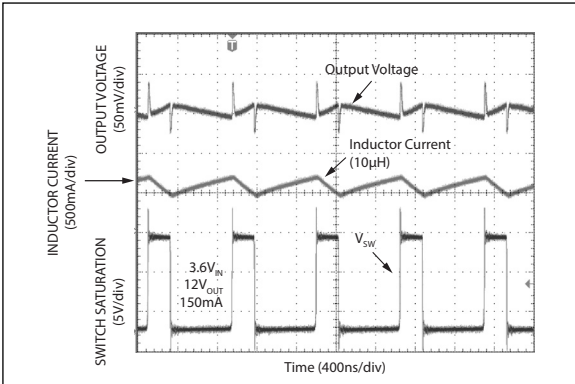


FIGURE 2-16: Output Voltage Ripple and Switching Waveforms.

3.0 PIN DESCRIPTIONS

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

TABLE 3-1: PIN FUNCTION TABLE

| Pin Number TSOT23-5 | Pin Number VDFN-8 | Pin Name | Description |
|------------------------|----------------------|----------|---|
| 1 | 7 | SW | Switch Node (Input): Internal power bipolar collector. |
| 2 | — | GND | Ground (Return): Ground. |
| 3 | 6 | FB | Feedback (Input): 1.24V output voltage sense node. |
| 4 | 3 | EN | Enable (input): Logic-high enables regulator. Logic-low shuts down regulator. Do not leave floating. |
| 5 | 2 | VIN | Supply (Input): 2.5V to 10V input voltage. |
| — | 1 | OVP | Output Overvoltage Protection (Input): Tie this pin to VOUT to clamp the output voltage to 34V maximum in fault conditions. Tie this pin to ground if OVP function is not required. |
| — | 5 | NC | No Connect: No internal connection to die. |
| — | 4 | AGND | Analog ground. |
| — | 8 | PGND | Power ground. |
| — | EP | GND | Exposed backside pad. |

4.0 FUNCTIONAL DESCRIPTION

The MIC2288 is a constant frequency, PWM current mode boost regulator. See the [Functional Block Diagram](#). The MIC2288 is composed of an oscillator, slope compensation ramp generator, current amplifier, g_m error amplifier, PWM generator, and a 1A bipolar output transistor. The oscillator generates a 1.2 MHz clock. The clock's two functions are to trigger the PWM generator that turns on the output transistor and to reset the slope compensation ramp generator. The current amplifier is used to measure the switch current by amplifying the voltage signal from the internal sense resistor. The output of the current amplifier is summed with the output of the slope compensation ramp generator. This summed current-loop signal is fed to one of the inputs of the PWM generator.

The g_m error amplifier measures the feedback voltage through the external feedback resistors and amplifies the error between the detected signal and the 1.24V reference voltage. The output of the g_m error amplifier provides the voltage-loop signal that is fed to the other input of the PWM generator. When the current-loop signal exceeds the voltage-loop signal, the PWM generator turns off the bipolar output transistor. The next clock period initiates the next switching cycle, maintaining the constant frequency current-mode PWM control.

5.0 APPLICATION INFORMATION

5.1 DC/DC PWM Boost Conversion

The MIC2288 is a constant-frequency boost converter. It operates by taking a DC input voltage and regulating a higher DC output voltage. Figure 5-1 shows a typical circuit. Boost regulation is achieved by turning on an internal switch, which draws current through the inductor (L1). When the switch turns off, the inductor's magnetic field collapses, causing the current to be discharged into the output capacitor through an external Schottky diode (D1). Voltage regulation is achieved by modulating the pulse width or pulse-width modulation (PWM).

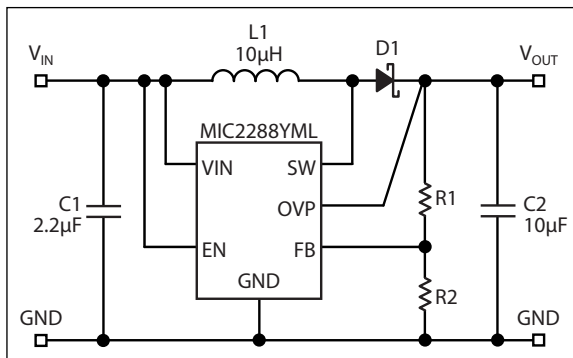


FIGURE 5-1: Typical Application Circuit.

5.2 Duty Cycle Considerations

Duty cycle refers to the switch on-to-off time ratio and can be calculated as follows for a boost regulator:

EQUATION 5-1:

$$D = 1 - \frac{V_{IN}}{V_{OUT}}$$

The duty cycle required for voltage conversion should be less than the maximum duty cycle of 85%. Also, in light load conditions where the input voltage is close to the output voltage, the minimum duty cycle can cause pulse skipping. This is due to the energy stored in the inductor causing the output to overshoot slightly over the regulated output voltage. During the next cycle, the error amplifier detects the output as being high and skips the following pulse. This effect can be reduced by increasing the minimum load or by increasing the inductor value. Increasing the inductor value reduces peak current, which in turn reduces energy transfer in each cycle.

5.3 Overvoltage Protection

For the VDFN package option, there is an overvoltage protection function. If the feedback resistors are disconnected from the circuit or the feedback pin is shorted to ground, the feedback pin will fall to ground potential. This will cause the MIC2288 to switch at full duty cycle in an attempt to maintain the feedback voltage. As a result, the output voltage will climb out of control. This may cause the switch node voltage to exceed its maximum voltage rating, possibly damaging the IC and the external components. To ensure the highest level of protection, the MIC2288 OVP pin will shut the switch off when an overvoltage condition is detected, saving the regulator and other sensitive circuitry downstream.

5.4 Component Selection

5.4.1 INDUCTOR

Inductor selection is a balance between efficiency, stability, cost, size, and rated current. For most applications, 10 µH is the recommended inductor value. It is usually a good balance between these considerations.

Larger inductance values reduce the peak-to-peak ripple current, affecting efficiency. This has the effect of reducing both the DC losses and the transition losses. There is also a secondary effect of an inductor's DC resistance (DCR). The DCR of an inductor will be higher for more inductance in the same package size. This is due to the longer windings required for an increase in inductance. Because the majority of input current (minus the MIC2288 operating current) is passed through the inductor, higher DCR inductors will reduce efficiency.

To maintain stability, increasing the inductor value will have to be associated with an increase in output capacitance. This is due to the unavoidable "right half plane zero" effect for the continuous current boost converter topology. The frequency at which the right half plane zero occurs can be calculated as follows:

EQUATION 5-2:

$$f_{RHPZ} = \frac{V_{IN}^2}{V_{OUT} \times L \times I_{OUT} \times 2\pi}$$

The right half plane zero has the undesirable effect of increasing gain, while decreasing phase. This requires that the loop gain is rolled off before this has significant effect on the total loop response. This can be accomplished by either reducing inductance (increasing RHPZ frequency) or increasing the output capacitor value (decreasing loop gain).

5.4.2 OUTPUT CAPACITOR

Output capacitor selection is also a trade-off between performance, size, and cost. Increasing output capacitance will lead to an improved transient response, but also an increase in size and cost. X5R or X7R dielectric ceramic capacitors are recommended for designs with the MIC2288. Y5V values may be used but to compensate their drift over temperature, more capacitance is required. The following table shows the recommended ceramic (X5R) output capacitor value vs. output voltage.

TABLE 5-1: OUTPUT CAPACITOR SELECTION

| Output Voltage | Recommended Output Capacitance |
|----------------|--------------------------------|
| <6V | 22 μ F |
| <16V | 10 μ F |
| <34V | 4.7 μ F |

5.4.3 DIODE SELECTION

The MIC2288 requires an external diode for operation. A Schottky diode is recommended for most applications due to their lower forward voltage drop and reverse recovery time. Ensure the diode selected can deliver the peak inductor current and the maximum reverse voltage is rated greater than the output voltage.

5.4.4 INPUT CAPACITOR

A minimum 1 μ F ceramic capacitor is recommended for designing with the MIC2288. Increasing input capacitance will improve performance and greater noise immunity on the source. The input capacitor should be as close as possible to the inductor and the MIC2288, with short traces for good noise performance.

5.4.5 FEEDBACK RESISTORS

The MIC2288 utilizes a feedback pin to compare the output to an internal reference. The output voltage is adjusted by selecting the appropriate feedback resistor network values. The R2 resistor value must be less than or equal to 5 k Ω ($R2 \leq 5 \text{ k}\Omega$). The desired output voltage can be calculated as follows:

EQUATION 5-3:

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

Where:

$V_{REF} = 1.24\text{V}$

6.0 APPLICATION CIRCUITS

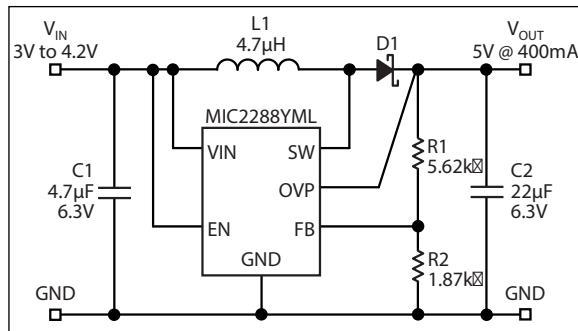


FIGURE 6-1: 3.0V to 4.2V V_{IN} to 5V $_{OUT}$ @ 400 mA.

| Ref | Description | Part Number | Vendor |
|-----------|--------------------------------|----------------|----------|
| C1 | 4.7 µF, 6.3V, 0805 X5R Cer Cap | 08056D475MAT | AVX |
| C2 | 22 µF, 6.3V, 0805 X5R Cer Cap | 12066D226KAT | AVX |
| D1 | 1A, 40V Schottky Diode | MBRM140T3 | On Semi. |
| L1 | 4.7 µH, 650 mA Inductor | LQH32CN4R7M33L | Murata |

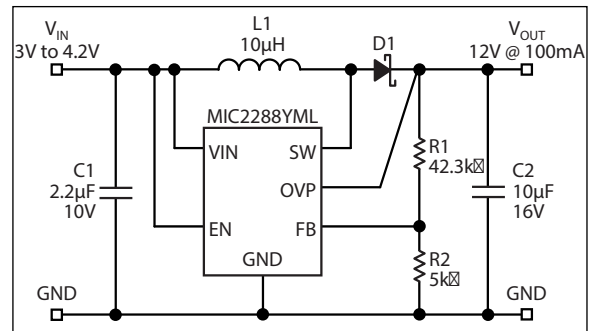


FIGURE 6-3: 3.0V to 4.2V V_{IN} to 12V $_{OUT}$ @ 100 mA.

| Ref | Description | Part Number | Vendor |
|-----------|--------------------------------|---------------|----------|
| C1 | 4.7 µF, 6.3V, 0805 X5R Cer Cap | 08056D475MAT | AVX |
| C2 | 10 µF, 16V, 1206 X5R Cer Cap | 1206YD106MAT | AVX |
| D1 | 1A, 40V Schottky Diode | MBRM140T3 | On Semi. |
| L1 | 4.7 µH, 650 mA Inductor | LQH43CN100K03 | Murata |

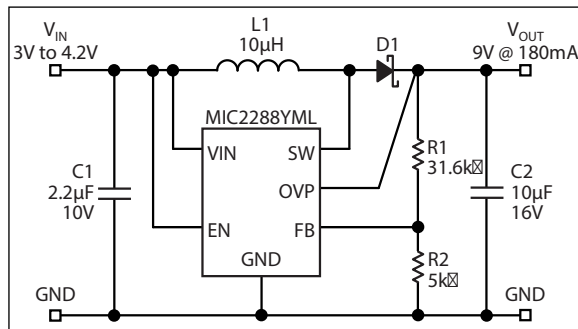


FIGURE 6-2: 3.0V to 4.2V V_{IN} to 9V $_{OUT}$ @ 180 mA.

| Ref | Description | Part Number | Vendor |
|-----------|-------------------------------|---------------|----------|
| C1 | 2.2 µF, 10V, 0805 X5R Cer Cap | 08052D225KAT | AVX |
| C2 | 10 µF, 16V, 1206 X5R Cer Cap | 1206YD106MAT | AVX |
| D1 | 1A, 40V Schottky Diode | MBRM140T3 | On Semi. |
| L1 | 10 µH, 650 mA Inductor | LQH43CN100K03 | Murata |

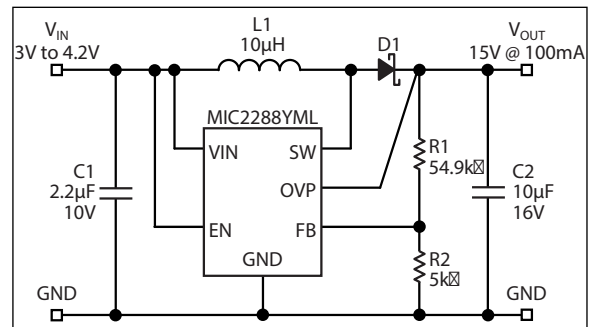


FIGURE 6-4: 3.0V to 4.2V V_{IN} to 15V $_{OUT}$ @ 100 mA.

| Ref | Description | Part Number | Vendor |
|-----------|-------------------------------|---------------|----------|
| C1 | 2.2 µF, 10V, 0805 X5R Cer Cap | 08052D225KAT | AVX |
| C2 | 10 µF, 16V, 1206 X5R Cer Cap | 1206YD106MAT | AVX |
| D1 | 1A, 40V Schottky Diode | MBRM140T3 | On Semi. |
| L1 | 10 µH, 650 mA Inductor | LQH43CN100K03 | Murata |

MIC2288

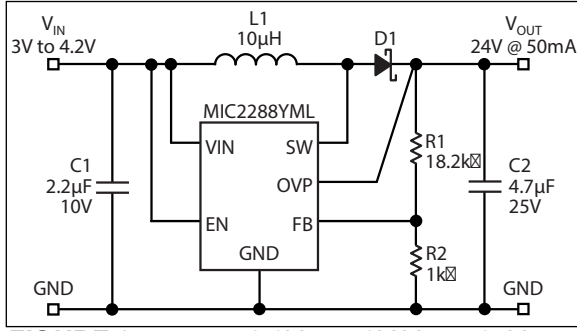


FIGURE 6-5: 3.0V to 4.2V V_{IN} to 24V V_{OUT} @ 50 mA.

| Ref | Description | Part Number | Vendor |
|-----------|-------------------------------|---------------|----------|
| C1 | 2.2 µF, 10V, 0805 X5R Cer Cap | 08052D225KAT | AVX |
| C2 | 4.7 µF, 25V, 1206 X5R Cer Cap | 12063D475KAT | AVX |
| D1 | 1A, 40V Schottky Diode | MBRM140T3 | On Semi. |
| L1 | 10 µH, 650 mA Inductor | LQH43CN100K03 | Murata |

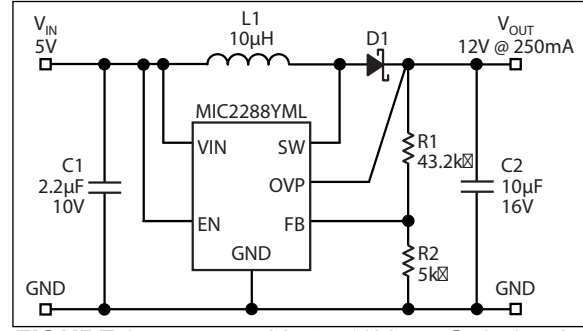


FIGURE 6-7: 5V V_{IN} to 12V V_{OUT} @ 250 mA.

| Ref | Description | Part Number | Vendor |
|-----------|-------------------------------|---------------|----------|
| C1 | 2.2 µF, 10V, 0805 X5R Cer Cap | 08052D225KAT | AVX |
| C2 | 10 µF, 16V, 1206 X5R Cer Cap | 1206YD106MAT | AVX |
| D1 | 1A, 40V Schottky Diode | MBRM140T3 | On Semi. |
| L1 | 10 µH, 650 mA Inductor | LQH43CN100K03 | Murata |

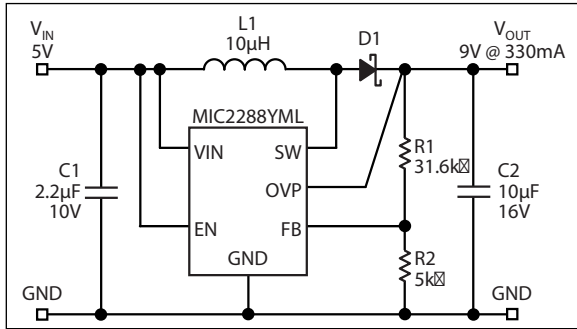


FIGURE 6-6: 5V V_{IN} to 9V V_{OUT} @ 330 mA.

| Ref | Description | Part Number | Vendor |
|-----------|-------------------------------|---------------|----------|
| C1 | 2.2 µF, 10V, 0805 X5R Cer Cap | 08052D225KAT | AVX |
| C2 | 10 µF, 16V, 1206 X5R Cer Cap | 1206YD106MAT | AVX |
| D1 | 1A, 40V Schottky Diode | MBRM140T3 | On Semi. |
| L1 | 10 µH, 650 mA Inductor | LQH43CN100K03 | Murata |

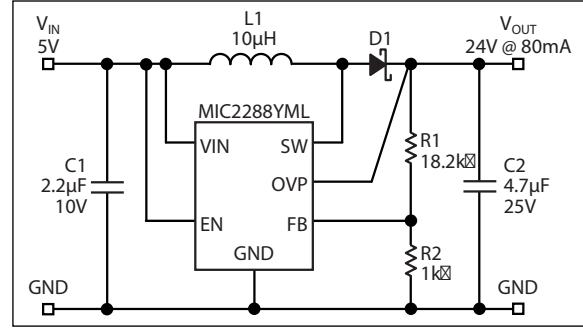
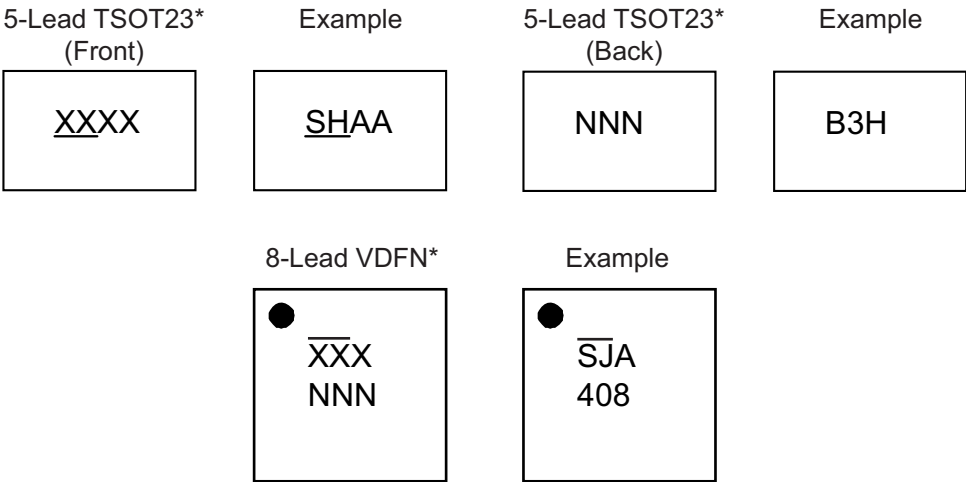


FIGURE 6-8: 5V V_{IN} to 24V V_{OUT} @ 80 mA.

| Ref | Description | Part Number | Vendor |
|-----------|-------------------------------|---------------|----------|
| C1 | 2.2 µF, 10V, 0805 X5R Cer Cap | 08052D225KAT | AVX |
| C2 | 4.7 µF, 25V, 1206 X5R Cer Cap | 12066D475KAT | AVX |
| D1 | 1A, 40V Schottky Diode | MBRM140T3 | On Semi. |
| L1 | 10 µH, 650 mA Inductor | LQH43CN100K03 | Murata |

7.0 PACKAGING INFORMATION

7.1 Package Marking Information



Legend:

XX...X

Y

YY

WW

NNN

e3

*

●, ▲, ▼

Product code or customer-specific information

Year code (last digit of calendar year)

Year code (last 2 digits of calendar year)

Week code (week of January 1 is week '01')

Alphanumeric traceability code

Pb-free JEDEC® designator for Matte Tin (Sn)

This package is Pb-free. The Pb-free JEDEC designator (

e3

) can be found on the outer packaging for this package.

Pin one index is identified by a dot, delta up, or delta down (triangle mark).

Note:

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

Underbar (

_

) and/or Overbar (

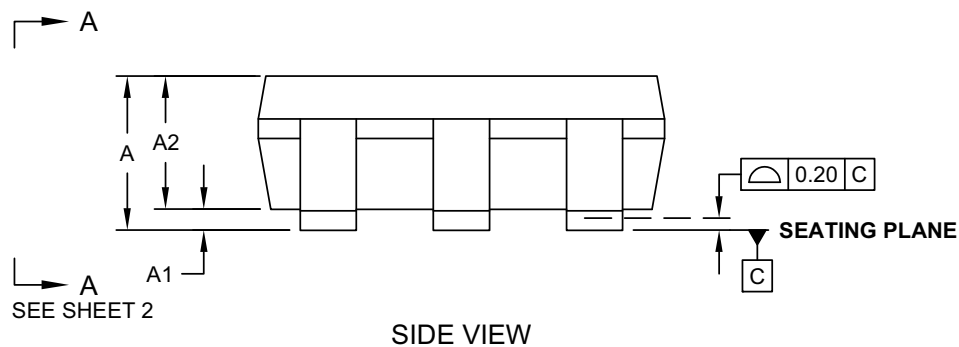
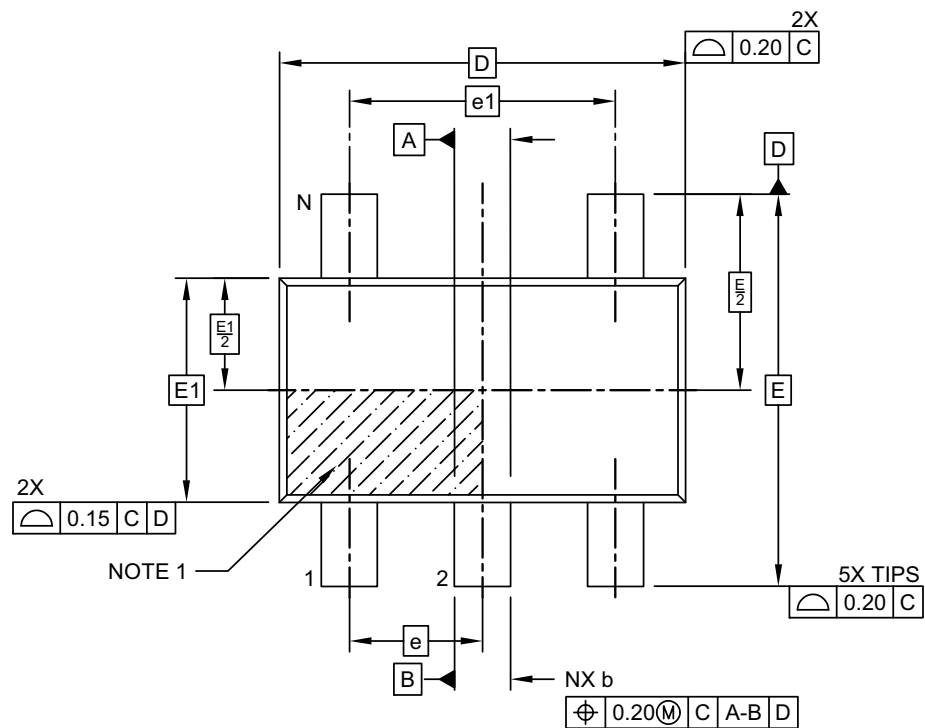
¯

) symbol may not be to scale.

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

5-Lead Plastic Thin Small Outline Transistor (D5A) [TSOT] Micrel Legacy Package TSOT-5LD-PL-1

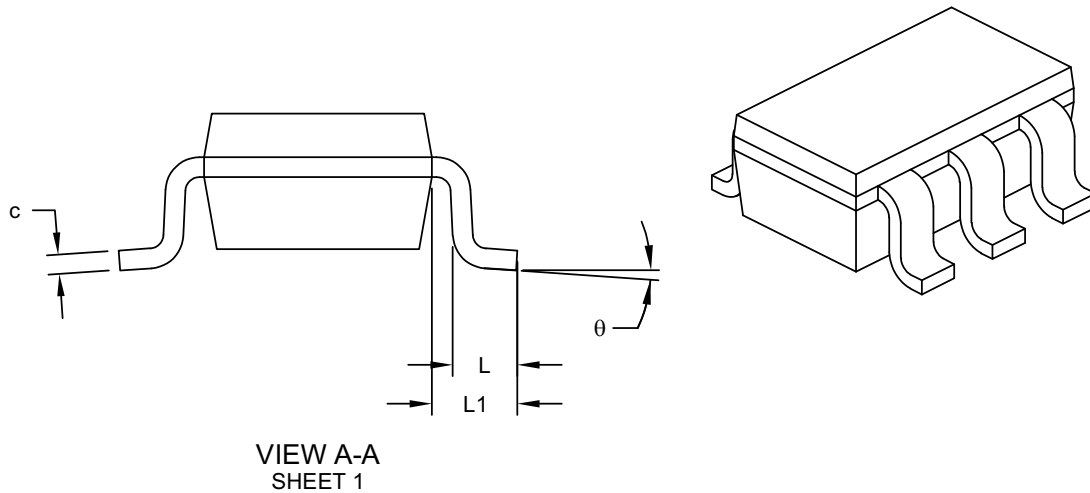
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-1179 Rev A Sheet 1 of 2

5-Lead Plastic Thin Small Outline Transistor (D5A) [TSOT] Micrel Legacy Package TSOT-5LD-PL-1

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 Leads | N | 5 | | |
| Pitch | e | 0.95 BSC | | |
| Outside lead pitch | e1 | 1.90 BSC | | |
| Overall Height | A | - | - | 1.00 |
| Molded Package Thickness | A2 | 0.84 | 0.87 | 0.90 |
| Standoff | A1 | 0.00 | - | 0.10 |
| Overall Width | E | 2.80 BSC | | |
| Molded Package Width | E1 | 1.60 BSC | | |
| Overall Length | D | 2.90 BSC | | |
| Foot Length | L | 0.30 | 0.40 | 0.50 |
| Footprint | L1 | 0.60 REF | | |
| Foot Angle | φ | 0° | - | 4° |
| Lead Thickness | c | 0.127 REF | | |
| Lead Width | b | 0.30 | - | 0.50 |

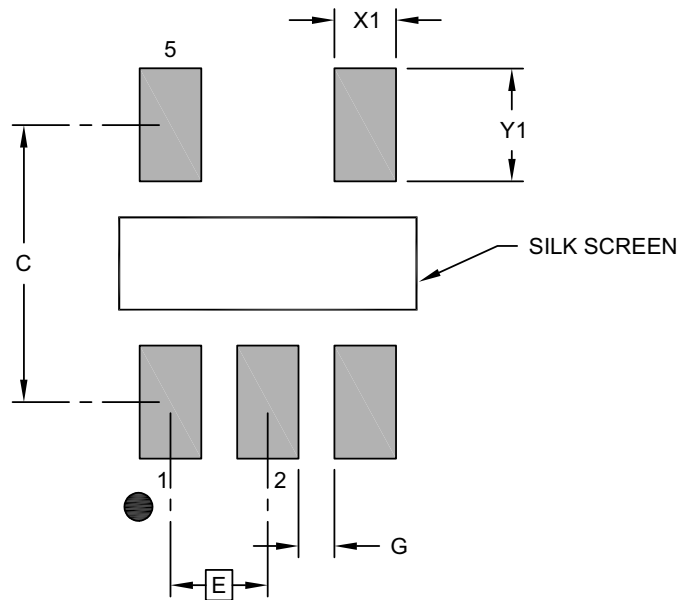
Notes:

- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25mm per side.
- 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 C04-1179 Rev A Sheet 1 of 2

5-Lead Plastic Thin Small Outline Transistor (D5A) [TSOT] Micrel Legacy Package TSOT-5LD-PL-1

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 | 0.95 BSC | | |
| Contact Pad Spacing | C | | 2.60 | |
| Contact Pad Width (X5) | X1 | | | 0.60 |
| Contact Pad Length (X5) | Y1 | | | 1.10 |
| Contact Pad to Center Pad (X2) | G | 0.20 | | |

Notes:

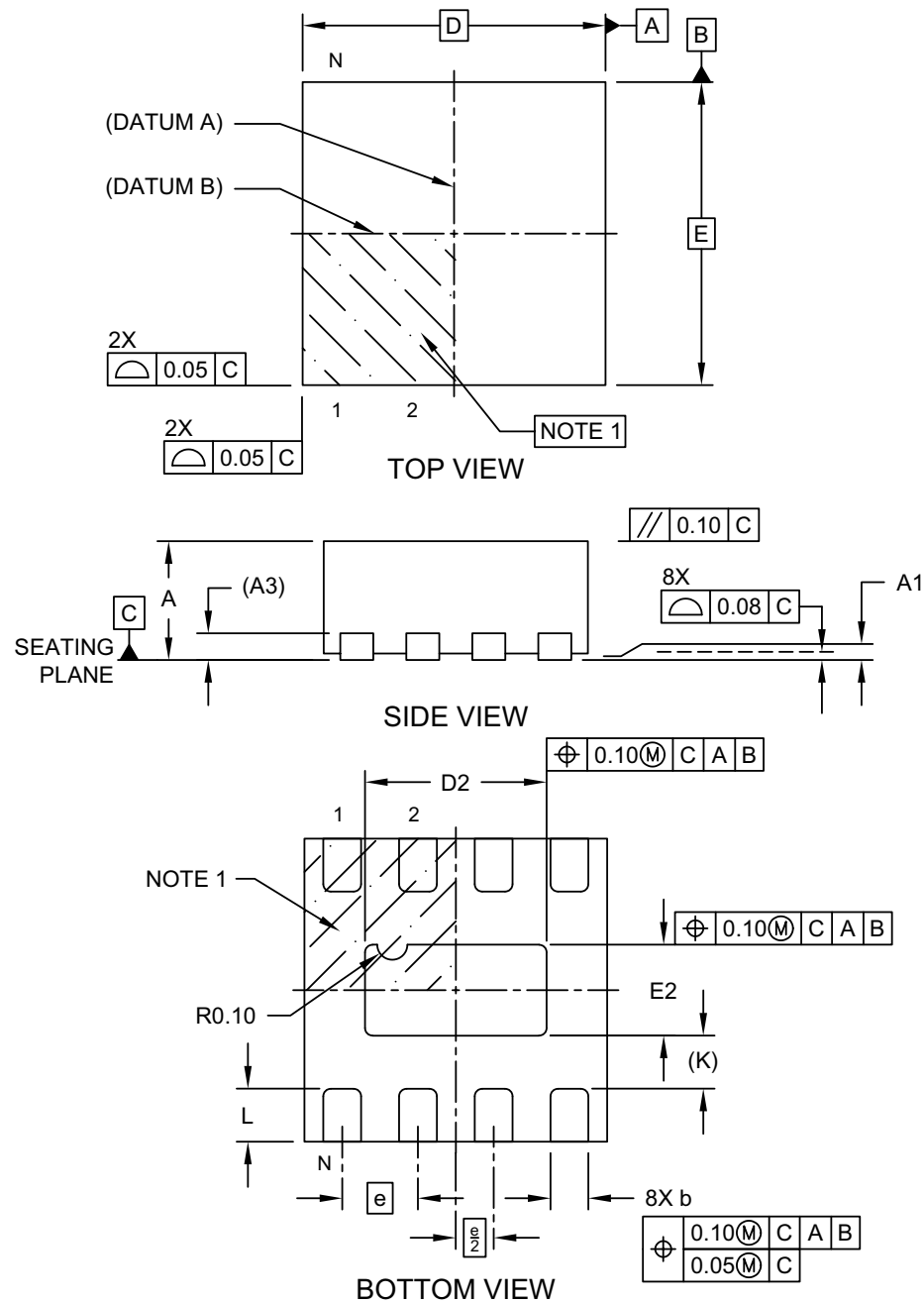
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing C04-3179 Rev A

8-Lead Very Thin Plastic Dual Flat, No Lead Package (H2A) - 2x2x0.9 mm Body [VDFN] With 1.20x0.6 mm Exposed Pad

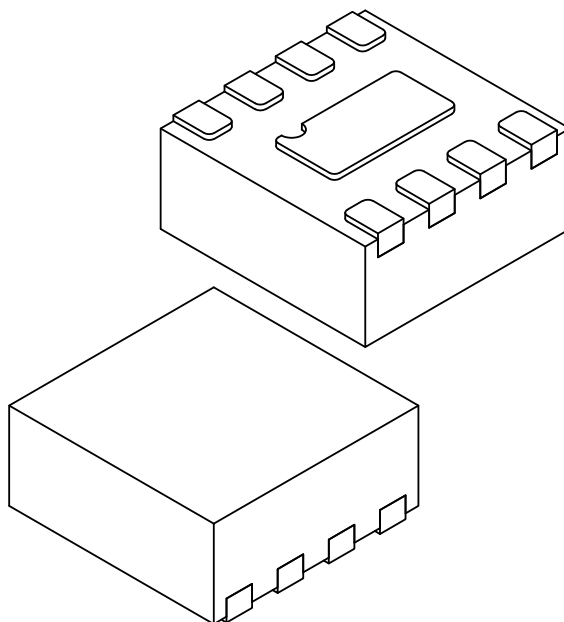
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-1247 Rev A Sheet 1 of 2

8-Lead Very Thin Plastic Dual Flat, No Lead Package (H2A) - 2x2x.9 mm Body [VDFN] With 1.20x0.6 mm Exposed Pad

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



| Units | | MILLIMETERS | | |
|-------------------------|----|-------------|------|------|
| Dimension Limits | | MIN | NOM | MAX |
| Number of Terminals | N | 8 | | |
| Pitch | e | 0.50 BSC | | |
| Overall Height | A | 0.80 | 0.85 | 0.90 |
| Standoff | A1 | 0.00 | 0.02 | 0.05 |
| Terminal Thickness | A3 | 0.203 REF | | |
| Overall Length | D | 2.00 BSC | | |
| Exposed Pad Length | D2 | 1.10 | 1.20 | 1.30 |
| Overall Width | E | 2.00 BSC | | |
| Exposed Pad Width | E2 | 0.50 | 0.60 | 0.70 |
| Terminal Width | b | 0.20 | 0.25 | 0.30 |
| Terminal Length | L | 0.30 | 0.35 | 0.40 |
| Terminal-to-Exposed-Pad | K | 0.35 REF | | |

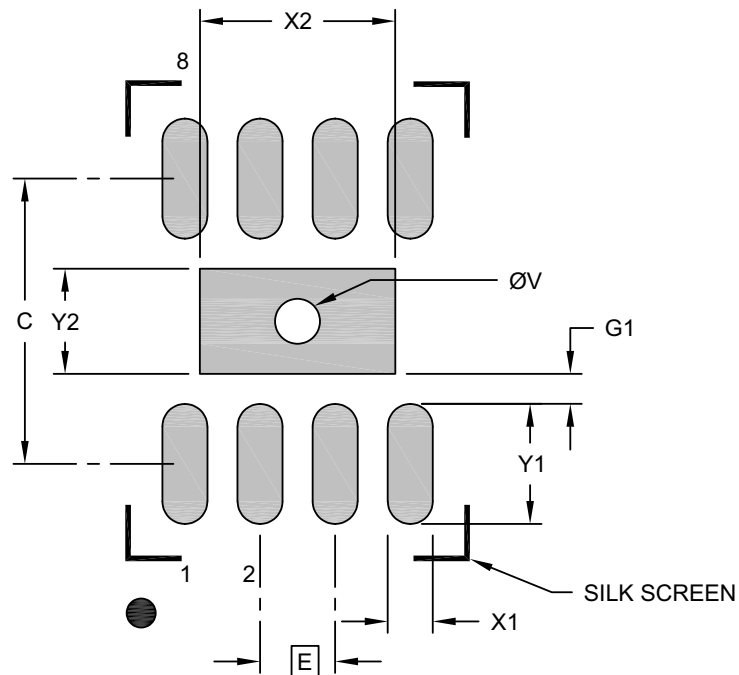
Notes:

- 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 C04-1247 Rev A Sheet 2 of 2

8-Lead Very Thin Plastic Dual Flat, No Lead Package (H2A) - 2x2 mm Body [VDFN] Micrel Legacy Package

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 | | 0.50 BSC | |
| Optional Center Pad Width | X2 | | | 0.70 |
| Optional Center Pad Length | Y2 | | | 1.30 |
| Contact Pad Spacing | C | | 1.90 | |
| Contact Pad Width (X8) | X1 | | | 0.30 |
| Contact Pad Length (X8) | Y1 | | | 0.80 |
| Contact Pad to Center Pad (X8) | G1 | 0.20 | | |
| Thermal Via Diameter | V | | 0.30 | |

Notes:

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

Microchip Technology Drawing C04-3247 Rev. A

MIC2288

NOTES:

APPENDIX A: REVISION HISTORY

Revision A (May 2018)

- Converted Micrel document MIC2288 to Microchip data sheet template DS20006034A.
- Minor grammatical text changes throughout.
- Updated Low Output Voltage Ripple in [Features](#).
- Added clarification to EN description in [Table 3-1](#).
- Updated drawing for EN in [Figure 5-1](#).
- Updated drawings and figure captions for each entry in [Section 6.0 “Application Circuits”](#).

Revision B (September 2018)

- Updated values for C2 in the table beneath [Figure 6-3](#).

Revision C (June 2020)

- Updated part numbers C2 and L1 ([Figure 6-1](#)).
- Updated part number L1 ([Figure 6-3](#)).
- Updated part number C2 ([Figure 6-5](#)).
- Updated part numbers C2 and L1 ([Figure 6-8](#)).

Revision D (August 2023)

- Updated both Package Outline Drawings with the most current Microchip versions.

MIC2288

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

| Device | <u>X</u> | <u>XX</u> | <u>-XX</u> |
|--|----------------------|-----------|------------|
| Part No. | Junction Temp. Range | Package | Media Type |
| Device: MIC2288: 1A, 1.2 MHz PWM Boost Converter | | | |
| Junction Temperature Range: Y = -40°C to +125°C, RoHS-Compliant | | | |
| Package: D5 = 5-Lead Thin SOT23 ML = 8-Lead 2 mm x 2 mm VDFN | | | |
| Media Type: TX = 3,000/Reel (Reverse T/R, TSOT only) TR = 3,000/Reel (TSOT only) TR = 5,000/Reel (VDFN only) | | | |
| Examples: a) MIC2288YD5-TX: MIC2288, -40°C to +125°C Temperature Range, 5-Lead TSOT23, 3,000/Reel (Reverse T/R) b) MIC2288YD5-TR: MIC2288, -40°C to +125°C Temperature Range, 5-Lead TSOT, 3,000/Reel c) MIC2288YML-TR: MIC2288, -40°C to +125°C Temperature Range, 8-Lead VDFN, 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. | | | |

MIC2288

NOTES:

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

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