

Low Input Voltage, Single-Supply High-Current LDO

Features

- Single V_{IN} Rail: 1.1V to 3.6V
- Output Voltage Accuracy: $\pm 2.5\%$ Across Temperature
- Typical Dropout of 75 mV at Room Temperature
 - Maximum Dropout of 200 mV at Full Load Across Temperature
- C_{OUT} as low as 22 μF (Ceramic Capacitor)
- Output Voltage Adjustable down to 0.5V
- Soft-start Control via External Capacitor
- Excellent Line and Load Regulation
- Logic Controlled Shutdown
- Thermal-Shutdown and Current-Limit Protection
- Two Package Options: 10-Lead ePad MSOP or 10-Lead 3 mm $\times$ 3 mm VDFN
- Junction Temperature Range from $-40^{\circ}C$ to $+125^{\circ}C$

Applications

- Point-of-Load Applications
- ASIC / Microprocessor Power Supply
- FPGA Power Supply
- Telecom / Networking Cards
- Wireless Infrastructure

General Description

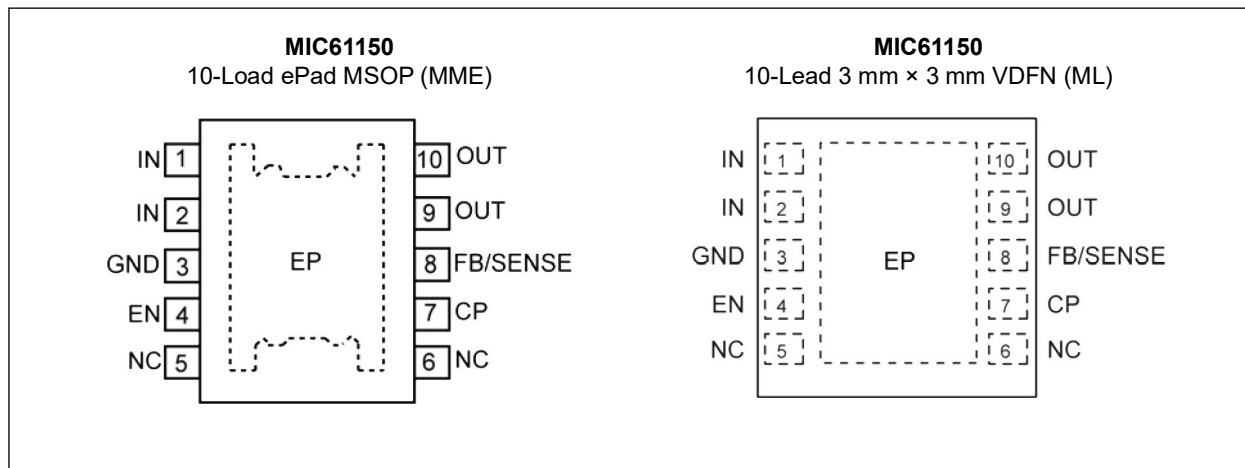
The Microchip MIC61150 is a 1.5A output, low input voltage, single-supply regulator. This regulator operates over a single input voltage range of 1.1V to 3.6V and offers an ultra-low dropout less than 200 mV over the entire operating temperature range.

The MIC61150 is designed to drive digital circuits requiring low voltages at high currents such as DSPs, FPGAs, microcontrollers, etc. The regulator is available as a 1.0V fixed-output voltage option or as an adjustable-output voltage option.

The MIC61150 is stable with a 22 μF , low-ESR ceramic output capacitor and includes protection features such as thermal shutdown, current limiting and logic enable.

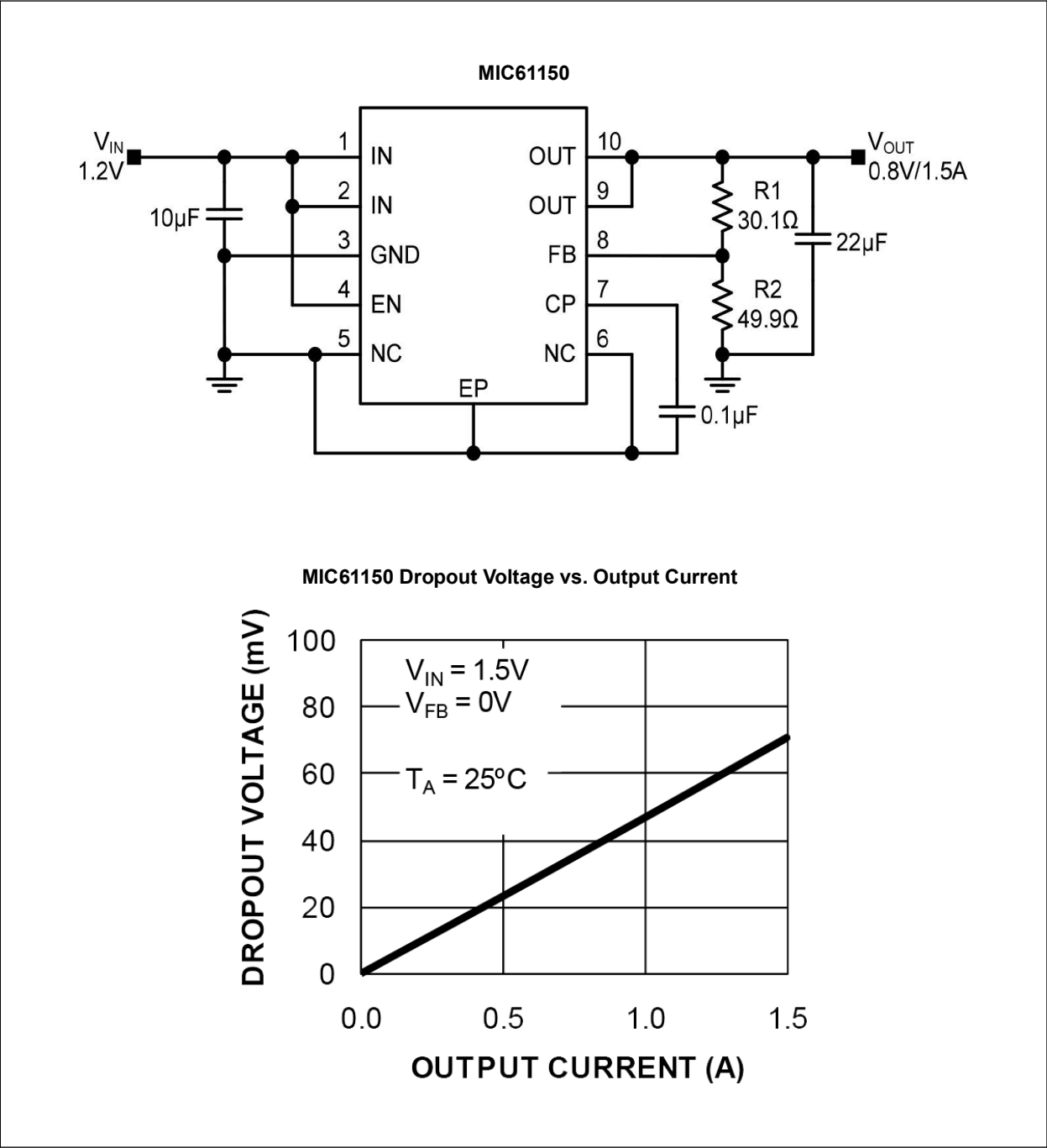
The MIC61150 is offered in two different packages: a low-profile, leadless 10-lead 3 mm $\times$ 3 mm VDFN and a 10-lead ePad MSOP. The MIC61150 has an operating junction temperature range of $-40^{\circ}C$ to $+125^{\circ}C$.

Package Types

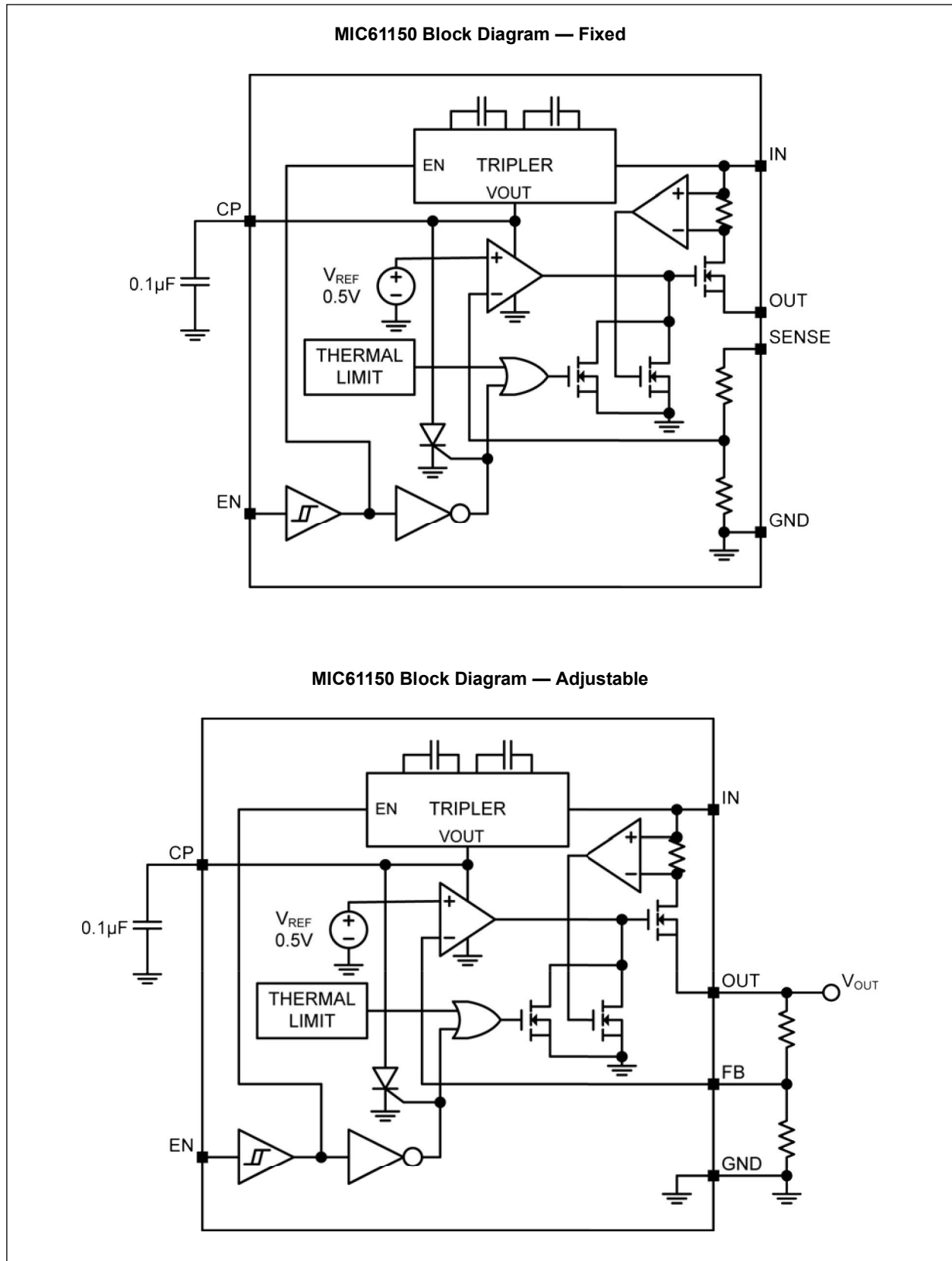


MIC61150

Typical Application Circuits



Functional Block Diagram



MIC61150

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †, [Note 1](#)

V_{IN} to GND	-0.3V to 4.5V
V_{CP} to GND	-0.3V to 5.5V
V_{OUT} to GND	-0.3V to V_{IN}
V_{SENSE} to GND	-0.3V to V_{IN}
V_{EN} to GND	-0.3V to 4.5V
V_{FB} to GND	-0.3V to V_{IN}

Operating Ratings ‡

Supply Voltage (V_{IN})	1.1V to 3.6V
Enable Voltage (V_{EN})	-0.3V to 3.6V
Output Voltage Range (V_{OUT})	0.5V to 3.0V
Maximum Power Dissipation (P_D)	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.

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

Note 1: Devices are ESD sensitive. Handling precautions recommended. Human body model (HBM), 1.5k in series with 100 pF.

2: $P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$, where θ_{JA} , depends upon the printed circuit layout. See “Applications Information.”

ELECTRICAL CHARACTERISTICS

$V_{IN} = V_{OUT} + 0.2V$; $V_{EN} = 1.1V$; $I_{OUT} = 10$ mA; $C_{CP} = 0.1$ μF ; $C_{OUT} = 22$ μF ; $T_J = 25^\circ C$. **Bold** values indicate $-40^\circ C \leq T_J \leq +125^\circ C$, unless noted. ([Note 1](#))

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Power Supply Input						
Input Voltage Range	V_{IN}	1.1	—	3.6	V	—
Ground Pin Current	I_{GND}	—	1.8	—	mA	$I_{OUT} = 1.5A$; $V_{IN} = 1.2V$
		—	7.6	15	mA	$I_{OUT} = 1.5A$; $V_{IN} = 3.6V$
Ground Current in Shutdown	I_{SHDN}	—	0.1	10	μA	$V_{EN} = 0V$; $V_{IN} = 2V$; $V_{OUT} = 0V$
Reference						
Feedback Pin Voltage (FB Pin)	V_{FB}	0.495	0.500	0.505	V	Adjustable Output
		0.4875	0.500	0.5125	V	
Output Voltage Accuracy (SENSE Pin)	V_O	-1	—	+1	%	Fixed Output
		-2.5	—	+2.5	%	
Load Regulation	$\Delta V_{OUT}/V_{OUT}$	-0.3	—	0.3	%	$I_{OUT} = 10$ mA to 1.5A
Line Regulation (Note 2)	$\Delta V_{OUT}/(V_{OUT} \times \Delta V_{IN})$	-0.2	0.08	0.2	%/V	$V_{IN} = (V_{OUT} + 0.2V)$ to 3.6V
FB Pin Current	I_{FB}	—	0.01	1	μA	$V_{FB} = 0.5V$

Note 1: Specification for packaged product only.

2: $\Delta V_{OUT} (\%) = 0.08 \times \Delta V_{IN}$

ELECTRICAL CHARACTERISTICS (CONTINUED)

$V_{IN} = V_{OUT} + 0.2V$; $V_{EN} = 1.1V$; $I_{OUT} = 10\text{ mA}$; $C_{CP} = 0.1\text{ }\mu\text{F}$; $C_{OUT} = 22\text{ }\mu\text{F}$; $T_J = 25^\circ\text{C}$. Bold values indicate $-40^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$, unless noted. (Note 1)						
Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Current Limit						
Current Limit	I_{LIM}	1.7	3.5	—	A	$V_{OUT} = 0V$
Dropout Voltage						
Dropout Voltage	$V_{IN} - V_{OUT}$	—	75	200	mV	$I_{OUT} = 1.5A$
Enable Input						
EN Logic Level High	V_{IL}	1.1	0.6	—	V	—
EN Logic Level Low	V_{IH}	—	0.5	0.2	V	—
EN Hysteresis	$V_{EN\text{ HYS}}$	—	100	—	mV	—
EN Pin Current	I_{EN}	—	0.02	—	μA	$V_{EN} = 0.2V$ (Regulator Shutdown)
		—	15	—	μA	$V_{EN} = 3.6V$ (Regulator Enable)
Start-Up Time	$t_{START-UP}$	—	250	750	μs	$C_{CP} = 0.1\text{ }\mu\text{F}$; $C_{OUT} = 10\text{ }\mu\text{F}$ $V_{IN} = 1.2V$, $V_{OUT} = 0.5V$
Minimum Load Current						
Minimum Load Current		10	—	—	mA	—
Thermal Protection						
Over-Temperature Shutdown		—	160	—	$^\circ\text{C}$	T_J Rising
Over-Temperature Shutdown Hysteresis		—	5	—	$^\circ\text{C}$	—

Note 1: Specification for packaged product only.

2: $\Delta V_{OUT} (\%) = 0.08 \times \Delta V_{IN}$

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Junction Temperature Range	T_J	−40	—	+125	$^\circ\text{C}$	—
Ambient Temperature Range	T_A	−40	—	+85	$^\circ\text{C}$	—
Storage Temperature Range	T_S	−65	—	+150	$^\circ\text{C}$	—
Lead Temperature	T_{LEAD}	—	+260	—	$^\circ\text{C}$	Soldering, 10 seconds
Package Thermal Resistance						
3 mm × 3 mm VDFN	θ_{JA}	—	60.7	—	$^\circ\text{C/W}$	—
ePad MSOP-10	θ_{JA}	—	76.7	—	$^\circ\text{C/W}$	—

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.

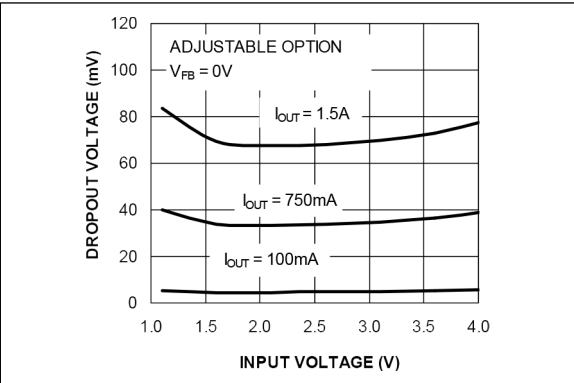


FIGURE 2-1: Drop out Voltage vs. Input Voltage.

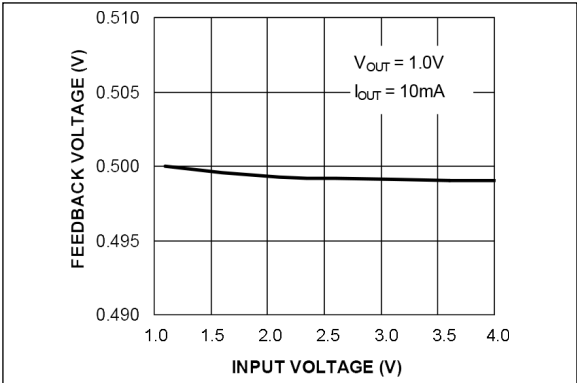


FIGURE 2-4: Feedback Voltage vs. Input Voltage.

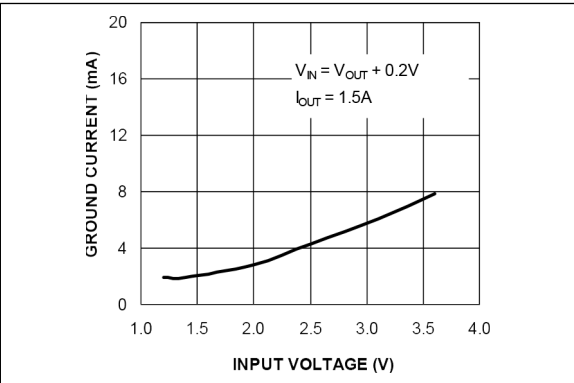


FIGURE 2-2: GND Pin Current vs. Input Voltage.

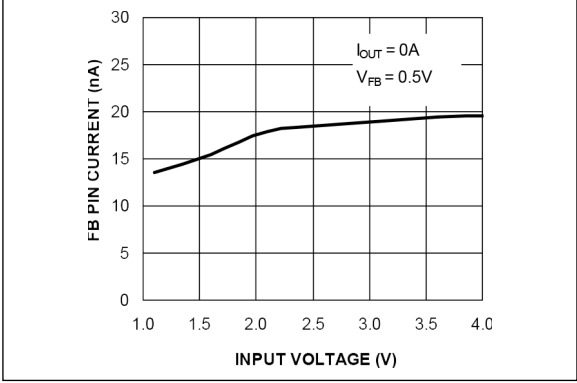


FIGURE 2-5: Feedback Pin Current vs. Input Voltage.

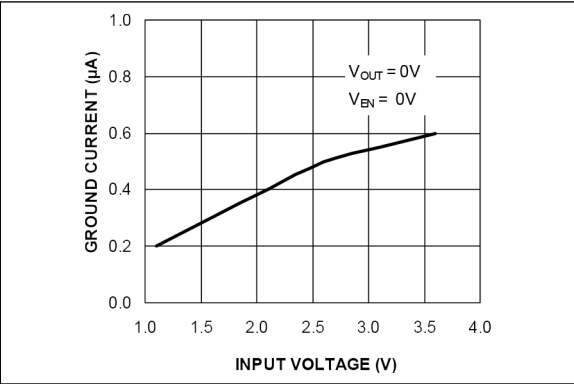


FIGURE 2-3: Shutdown Ground Current vs. Input Voltage.

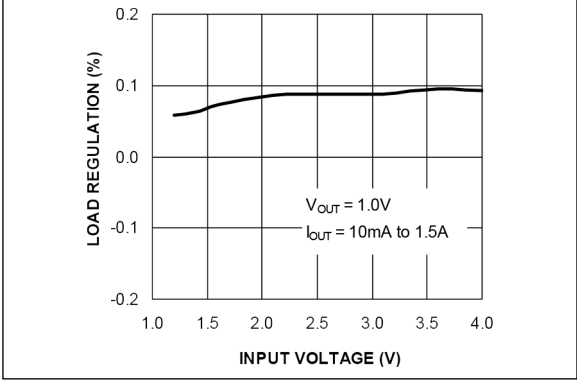


FIGURE 2-6: Load Regulation vs. Input Voltage.

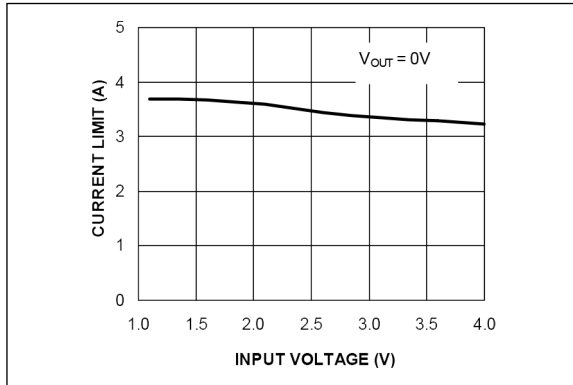


FIGURE 2-7: Short-Circuit Current vs. Input Voltage.

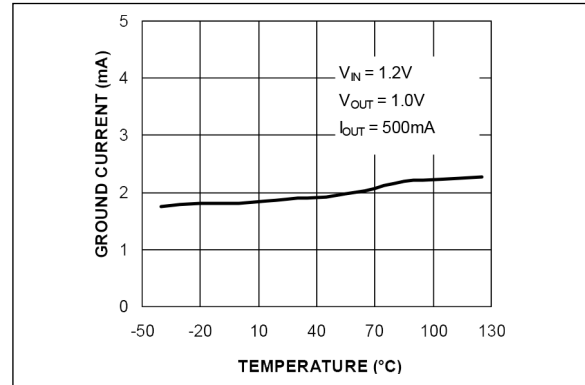


FIGURE 2-10: GND Pin Current vs. Temperature.

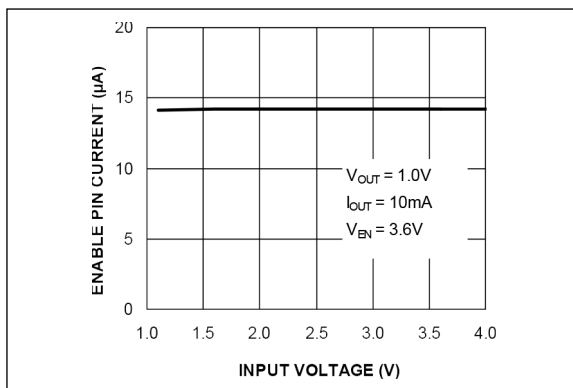


FIGURE 2-8: Enable Pin Current vs. Input Voltage.

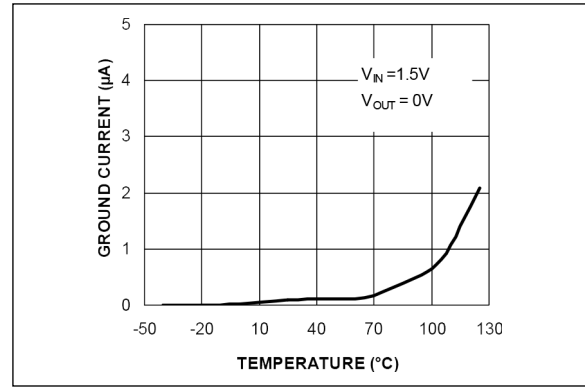


FIGURE 2-11: Shutdown Ground Current vs. Temperature.

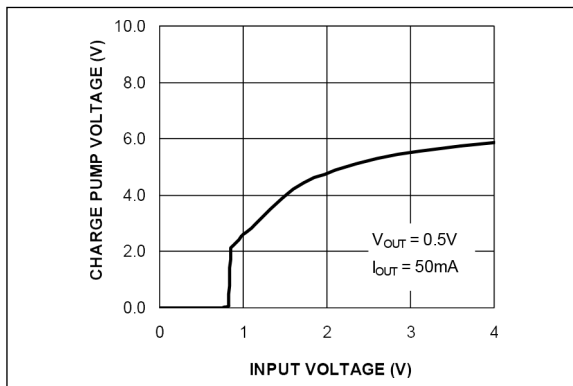


FIGURE 2-9: Charge Pump Voltage vs. Input Voltage.

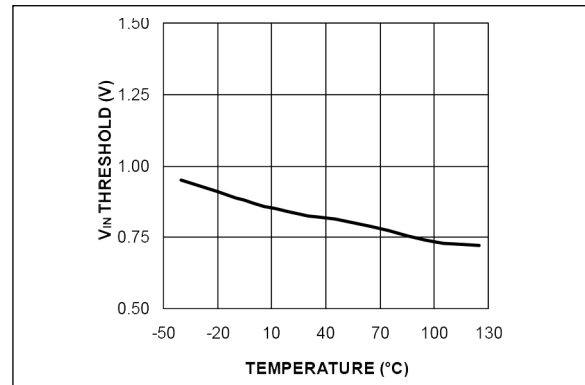


FIGURE 2-12: V_{IN} Turn-On Threshold vs. Temperature.

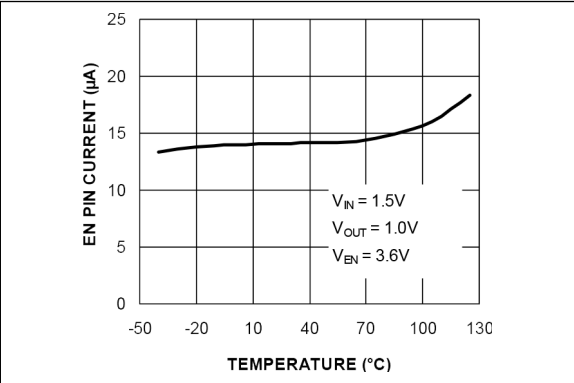


FIGURE 2-13: EN Pin Current vs. Temperature.

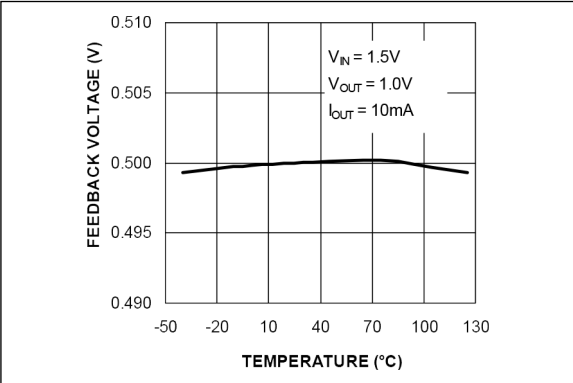


FIGURE 2-16: Feedback Pin Voltage vs. Temperature.

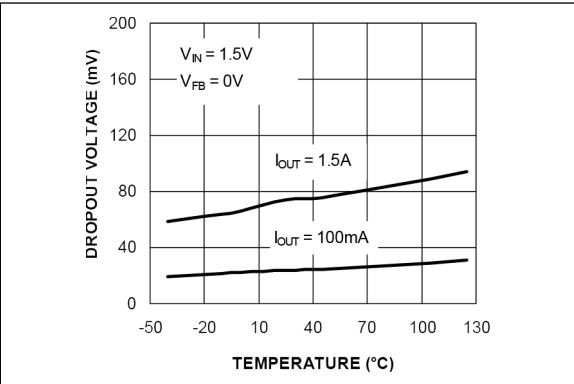


FIGURE 2-14: Dropout Voltage vs. Temperature.

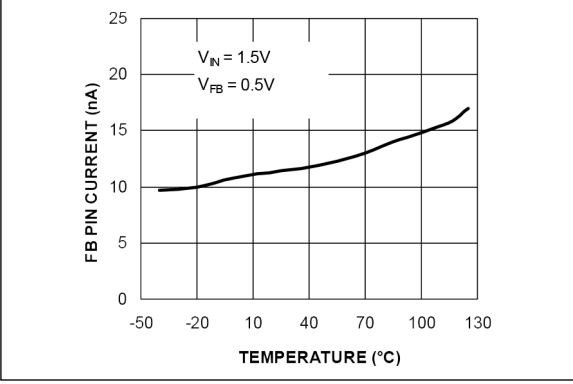


FIGURE 2-17: Feedback Pin Current vs. Temperature.

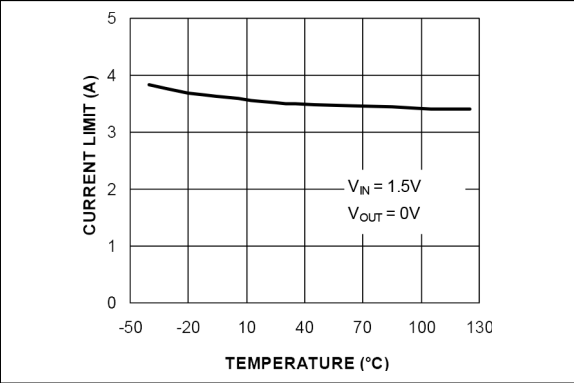


FIGURE 2-15: Short-Circuit Current vs. Temperature.

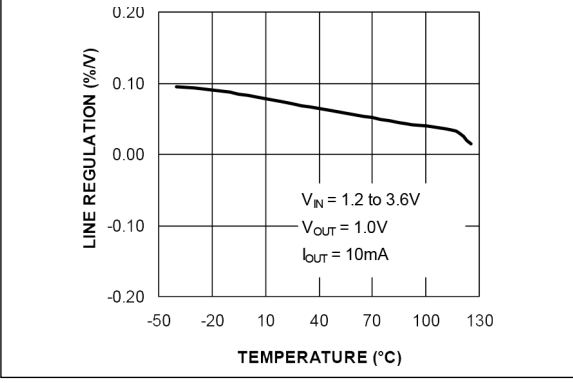


FIGURE 2-18: Line Regulation vs. Temperature.

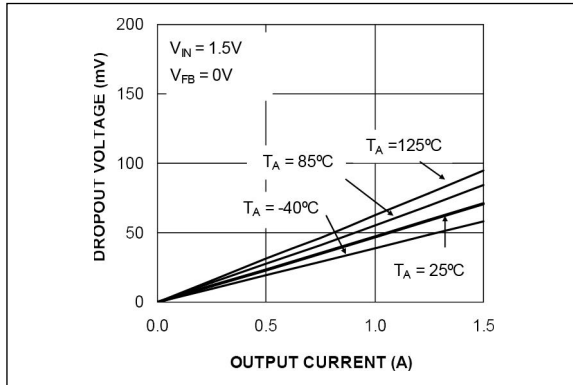


FIGURE 2-19: Dropout Voltage vs. Output Current.

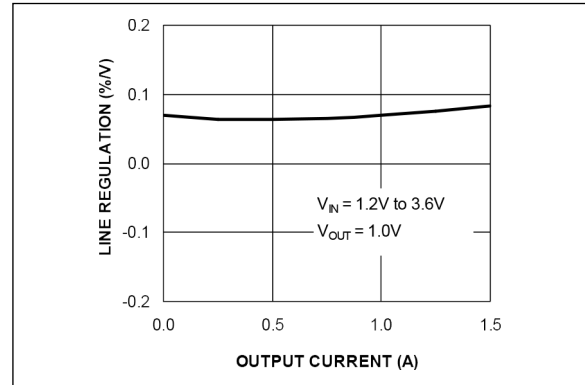


FIGURE 2-22: Line Regulation vs. Output Current.

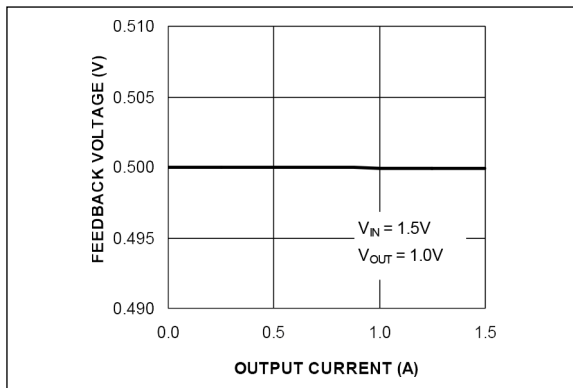


FIGURE 2-20: Feedback Voltage vs. Output Current.

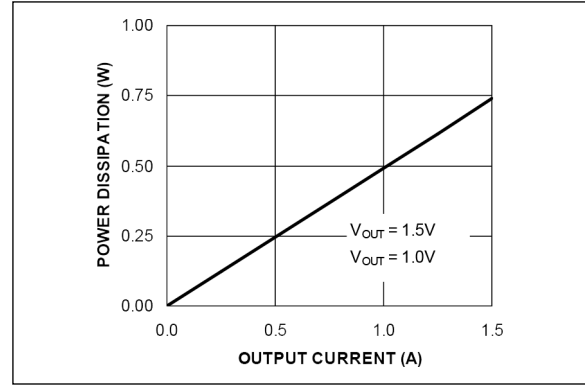


FIGURE 2-23: Power Dissipation vs. Output Current.

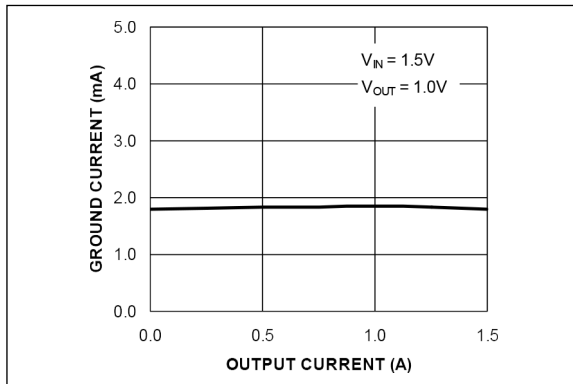


FIGURE 2-21: GND Pin Current vs. Output Current.

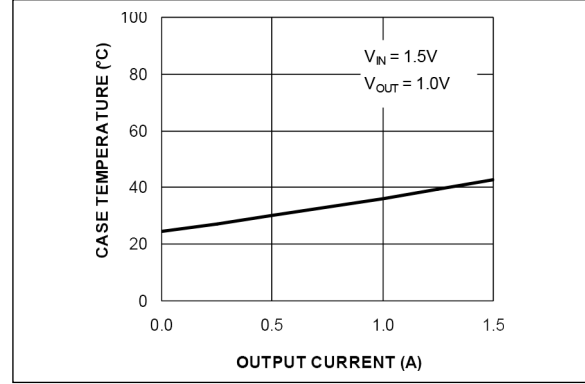


FIGURE 2-24: Case Temperature* (ML) vs. Output Current.

* **Case Temperature:** The temperature measurement was taken at the hottest point on the MIC61150 case mounted on a 2.25 square inch PCB at an ambient temperature of 25°C; see “Thermal Measurement” section. Actual results will depend upon the size of the PCB, ambient temperature and proximity to other heat emitting components.

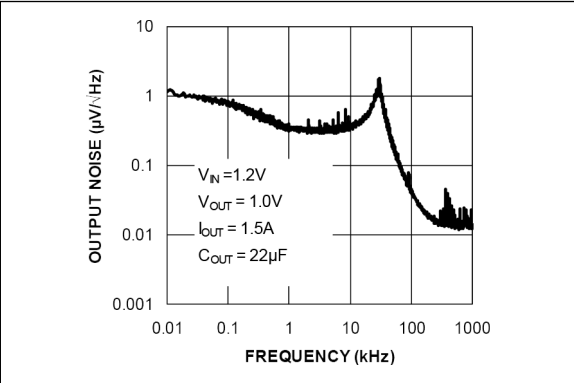


FIGURE 2-25: Output Noise.

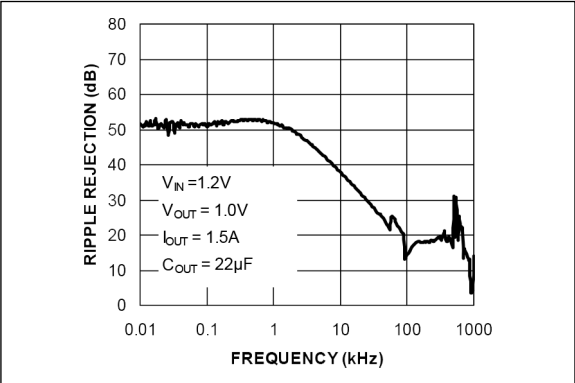


FIGURE 2-27: Ripple Rejection.

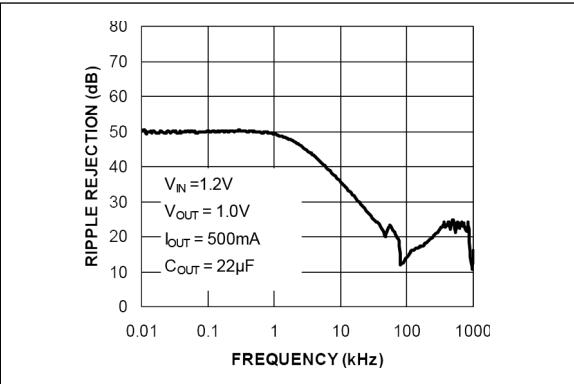


FIGURE 2-26: Ripple Rejection.

3.0 FUNCTIONAL CHARACTERISTICS

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.

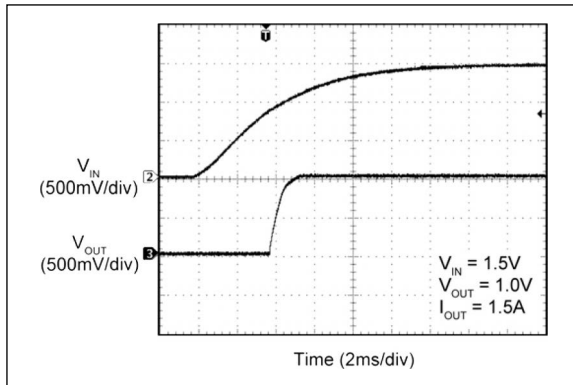


FIGURE 3-1: V_{IN} Soft Turn-On.

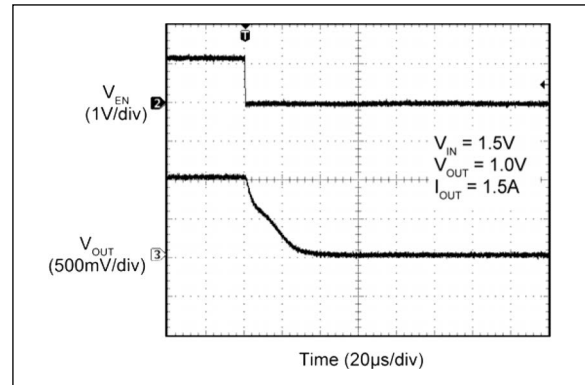


FIGURE 3-4: Enable Turn-Off.

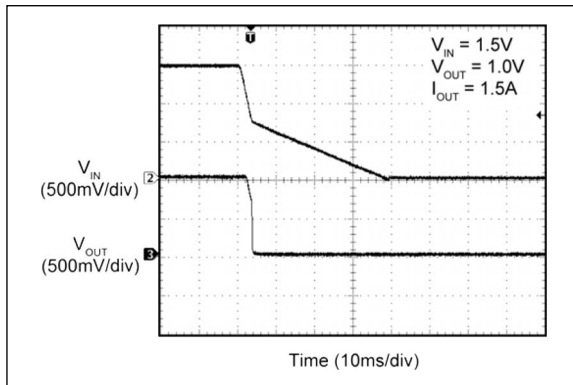


FIGURE 3-2: V_{IN} Soft Turn-Off.

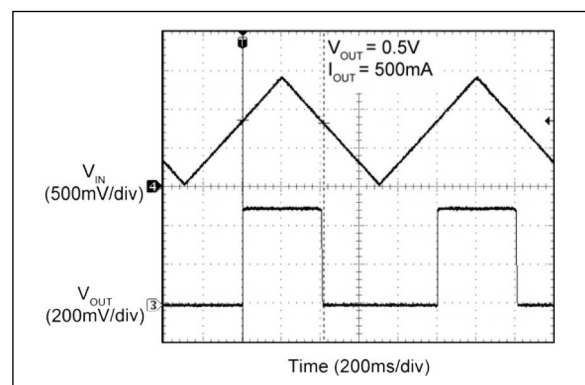


FIGURE 3-5: V_{IN} UVLO Threshold.

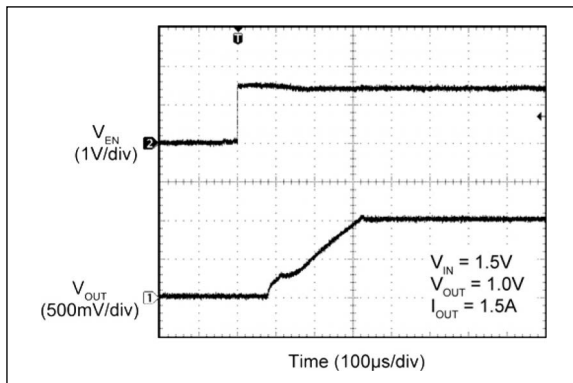


FIGURE 3-3: Enable Turn-On.

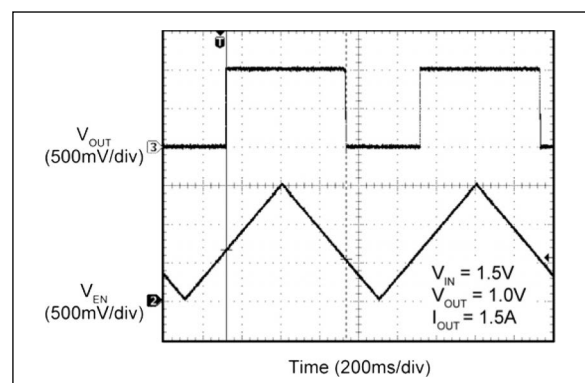


FIGURE 3-6: Enable Threshold.

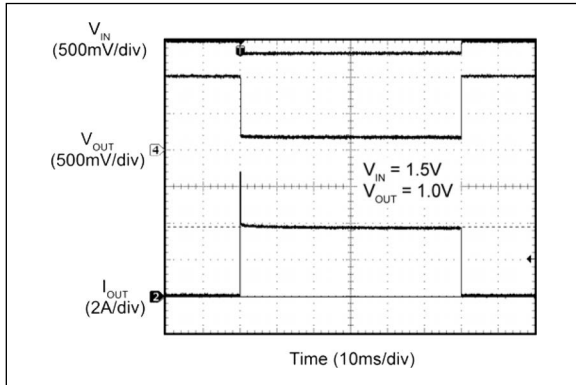


FIGURE 3-7: Current-Limit Threshold.

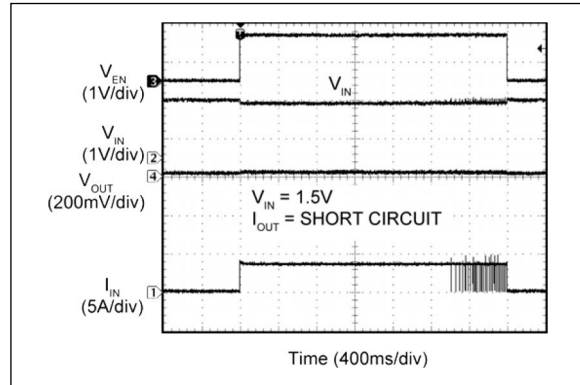


FIGURE 3-10: Enable Turn-On into Short Circuit.

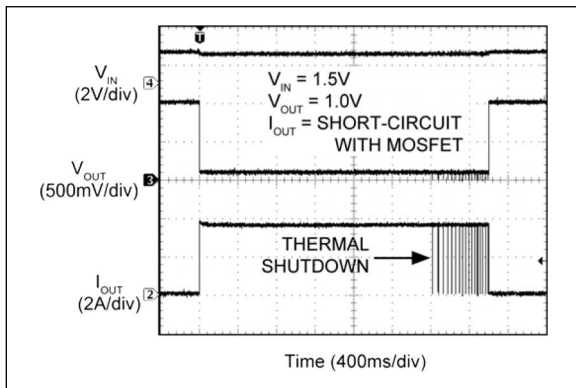


FIGURE 3-8: Thermal Shutdown, Short Circuit.

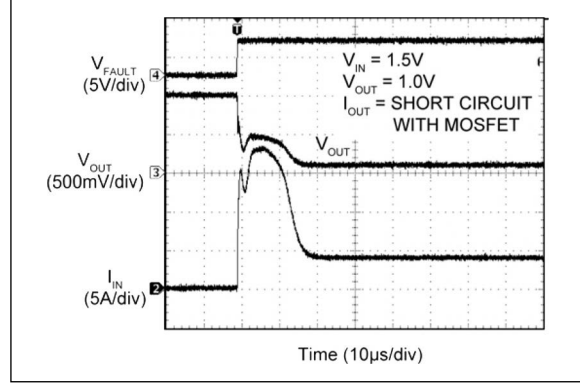


FIGURE 3-11: Short-Circuit Response Time.

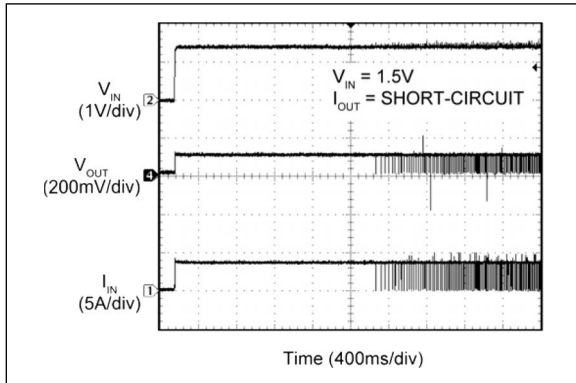


FIGURE 3-9: Turn-On into Short.

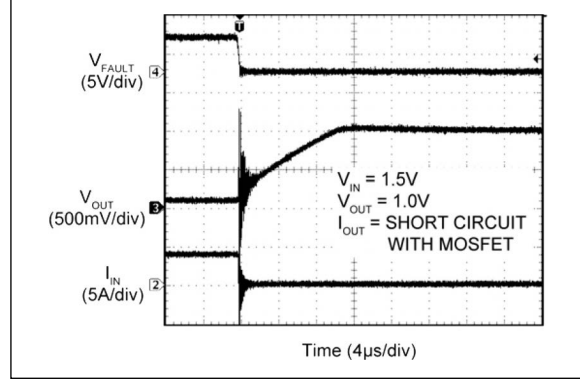


FIGURE 3-12: Short-Circuit Output Voltage Recovery.

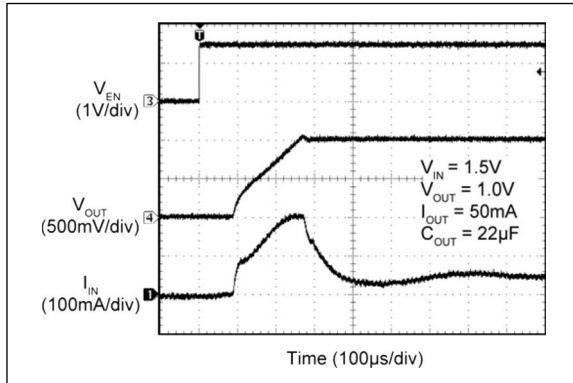


FIGURE 3-13: Inrush Current, $C_{OUT} = 22\mu F$.

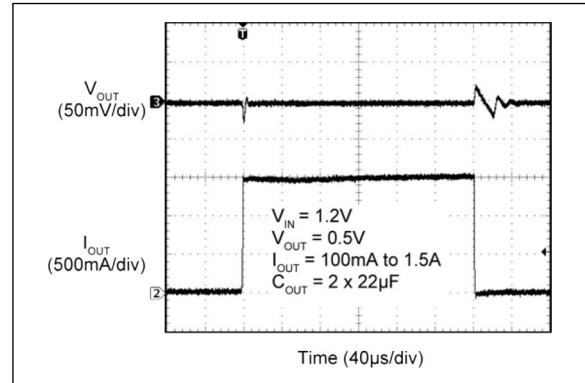


FIGURE 3-16: Transient Response, $V_{OUT} = 0.5V$ with $22\mu F (\times 2)$.

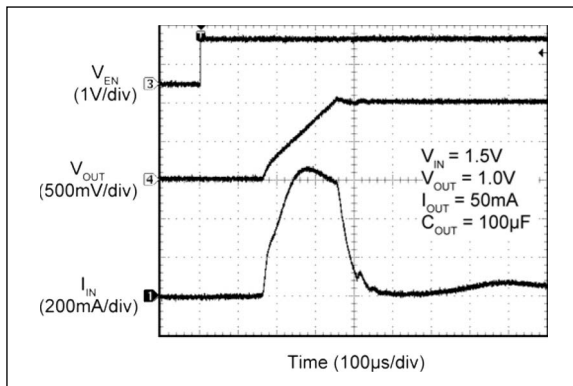


FIGURE 3-14: Inrush Current, $C_{OUT} = 100\mu F$.

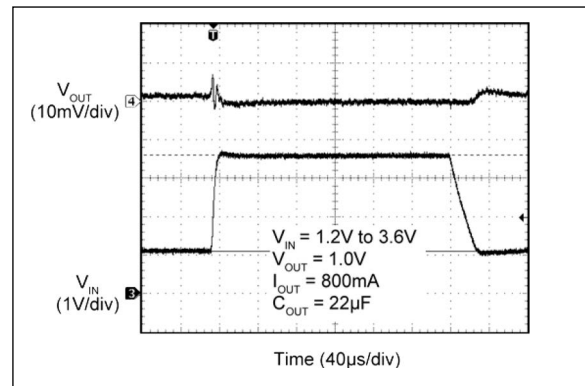


FIGURE 3-17: Line Transient Response.

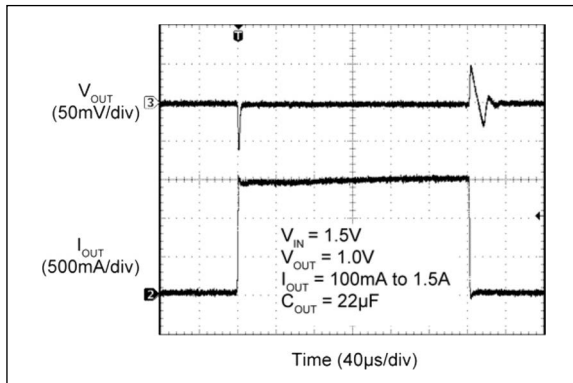


FIGURE 3-15: Transient Response, $V_{OUT} = 1.0V$ with $22\mu F$.

MIC61150

4.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 4-1](#).

TABLE 4-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1, 2	IN	Input Voltage.
3	GND	Ground: Input and output return pin. Connect GND near the point-of-load.
4	EN	Enable: Active-high control. input that allows turn-on/turn-off of the LDO.
5, 6	NC	No external function. Tie to ground.
7	CP	Internal Charge Pump Circuit Output: Connect a 0.1 μF capacitor from CP pin to GND to control the ramp rate of the output.
8	FB	Adjustable Regulator Feedback Input: Connect to the resistor voltage divider network that is placed from OUT pin to GND pin in order to set the output voltage. See Typical Applications Circuit.
	SENSE	Fixed-Output Voltage Sense Input: Connect the SENSE pin of the fixed output option at the point-of-load to accurately monitor the output voltage level.
9, 10	OUT	Regulator Output: The output voltage is set by the resistor divider connected from V_{OUT} to GND (with the divided connection tied to FB). A 22 μF ceramic capacitor with low ESR is required to maintain stability. See Applications Information.
EP	GND	Connect to GND.

5.0 FUNCTIONAL DESCRIPTION

The MIC61150 is an ultra high-performance, low-dropout linear regulator designed for high-current applications that require low input voltage operation. The MIC61150 operates from a single input supply and generates an internal supply that is higher than the input voltage to drive an on-chip N-Channel MOSFET. The N-Channel MOSFET significantly reduces the dropout voltage when compared to a traditional P-Channel MOSFET.

P-Channel MOSFETs are usually used in single-supply low-dropout linear voltage regulators. However, for input voltages below 1.5V, there is not sufficient gate drive to turn on the P-Channel. To solve this issue, the MIC61150 uses a simple internal charge pump to drive the internal N-Channel MOSFET's gate higher than the input voltage (see Functional Diagram).

The N-Channel MOSFET greatly reduces the dropout voltage for the same die area when compared to that of a P-Channel. Other added benefits of the charge pump include the ability to control the output voltage rise time and to improve the power supply rejection ratio (PSRR). This is accomplished by using the VCP supply to power the error amplifier.

The other significant advantage of the MIC61150 over a P-Channel regulator is its transient response. The N-Channel in the follower configuration is much faster than its P-channel counter part and is simpler to compensate. Any type of output capacitor can be placed in parallel with it as long as the minimum value output ceramic capacitor is placed next to the MIC61150.

See the Output Capacitor section for specific details. Also, the regulator is fully protected from damage due to fault conditions by offering linear current limiting and thermal shutdown.

5.1 Soft-Start

Soft-start reduces the power supply input surge current at startup by controlling the output voltage rise time. The input surge appears while the output capacitor is charged up. A slower output rise time will draw a lower input surge current.

The CP pin is the output of the internal charge pump. The soft-start rise time is controlled by the external capacitor connected from CP pin to GND. During soft-start, the charge pump feeds a current to C_{CP} .

The output voltage rise time is dependent upon the value of C_{CP} , the input voltage, output voltage and the current limit. The value of the charge pump external capacitor selected is recommended in the range of 0.1 μF to 1 μF , although larger value capacitors can be used for a longer turn-on time.

5.2 Input Capacitor

A 10 μF ceramic input capacitor is all that is required for most applications. However, fast load transient and low headroom ($V_{IN} - V_{OUT}$) requires additional bulk bypass capacitance to ensure that the regulator does not drop out of regulation.

The input capacitor must be placed on the same side of the board and next to the MIC61150 to minimize the dropout voltage and voltage ringing during transient and short circuit conditions. It is also recommended to use two vias for each end of the capacitor to connect to the power and ground plane.

X7R or X5R dielectric ceramic capacitors are recommended because of their temperature performance. X7R-type capacitors change capacitance by 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 in parallel with the ceramic capacitor(s).

See Typical Characteristics section for examples of load transient response.

5.3 Output Capacitor

As part of the frequency compensation, the MIC61150 requires a 22 μF ceramic output capacitor. However, any other type of capacitor can be placed in parallel as long as the 22 μF ceramic output capacitor is placed next to the MIC61150.

Output voltages below 0.8V require either a 47 μF or $2 \times 22 \mu\text{F}$ output capacitance for large output transients. The increased output capacitance reduces the output voltage drop caused by load transients, which increases as a percentage of the output voltage as the output voltage is lowered.

The output capacitor type and placement criteria are the same as the input capacitor. See the Input Capacitor section for a detailed description.

5.4 Minimum Load Current

The MIC61150 requires a minimum load of 10 mA to maintain output voltage regulation

5.5 Adjustable Regulator Design

The MIC61150 adjustable version allows programming the output voltage from 0.5V to 3.0V by placing a resistor divider network (R1, R2) from V_{OUT} to GND (see Application Circuit). The high side of R1 should be connected at the point-of-load for high-accuracy Kelvin sensing. V_{OUT} is determined by the following equation:

EQUATION 5-1:

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

Where V_{OUT} is the desired output voltage.

The resistor (R2) value between the FB pin and GND is selected to maintain a minimum 10mA load on the output.

The resistor values are calculated from the previous equation, resulting in the following:

EQUATION 5-2:

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

Table 1 is a list of resistor combinations to set the output voltage. A 1% tolerance is recommended for both R1 and R2. For a unity gain, 0.5V output voltage, connect the FB pin directly to the output.

TABLE 5-1: RESISTOR SELECTION FOR SPECIFIC V_{OUT}

V _{OUT}	R1	R2
0.5V	—	49.9Ω
0.6V	10.0Ω	49.9Ω
0.7V	20.0Ω	49.9Ω
0.8V	30.1Ω	49.9Ω
0.9V	40.2Ω	49.9Ω
1.0V	49.9Ω	49.9Ω
1.1V	60.4Ω	49.9Ω
1.2V	69.8Ω	49.9Ω
1.5V	100.0Ω	49.9Ω
1.8V	130.0Ω	49.9Ω
2.2V	169.0Ω	49.9Ω

5.6 Thermal Design

Linear regulators are simple to use. The most complicated design parameters to consider are thermal characteristics. To help reduce the thermal resistance, the ePad (underneath the IC) should be soldered to the PCB ground and the placement of thermal vias either underneath or near the ePad is highly recommended. The 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 5-3:

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

Where the ground current (I_{GND}) is approximated by using numbers from the Electrical Characteristics or Typical Characteristics sections.

For example, given an expected maximum ambient temperature (T_A) of 75°C with V_{IN} = 1.2V, V_{OUT} = 0.9V, and I_{OUT} = 1.5A, first calculate the expected P_D using Equation 4-1, like this:

EQUATION 5-4:

$$P_D = ([1.2V - 0.9V] \times 1.5A) + (1.2V \times 0.015A) \\ = 0.468W$$

Next, determine the junction temperature for the expected power dissipation above using the thermal resistance (θ_{JA}) of the 10-lead 3 mm × 3 mm VDFN (YML) adhering to the following criteria for the PCB design:

EQUATION 5-5:

When 1 oz. copper and 100 mm² copper area for the MIC61150, then:

$$T_J = (\theta_{JA} \times P_D) + T_A \\ T_J = (60.7^\circ C/W \times 0.468W) + 75^\circ C \\ T_J = 103.4^\circ C$$

To determine the maximum power dissipation allowed that would not exceed the IC's maximum junction temperature (125°C) when operating at a maximum ambient temperature of 75°C by:

EQUATION 5-6:

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}} \\ P_{D(MAX)} = \frac{125^\circ C - 75^\circ C}{60.7^\circ C/W} \\ P_{D(MAX)} = 0.824W$$

5.7 Thermal Measurements

It is always wise to measure the IC's case temperature to make sure that it is within its operating limits. Although this might seem like a very elementary task, it is very easy to get erroneous results. The most common mistake is to use the standard thermal couple that comes with the thermal voltage meter.

This thermal couple wire gauge is large, typically 22 gauge, and behaves like a heatsink, resulting in a lower case measurement.

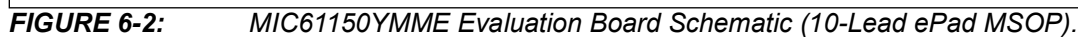
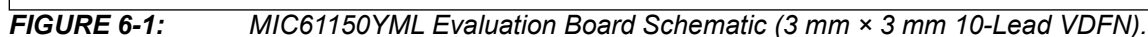
There are two suggested methods for measuring the IC case temperature: a thermal couple or an infrared thermometer. If a thermal couple is used, it must be constructed of 36 gauge wire or higher to minimize the wire heatsinking effect. In addition, the thermal couple tip must be covered in either thermal grease or thermal glue to make sure that the thermal couple junction is making good contact to the case of the IC. This thermal couple from Omega (5SC-TT-K-36-36) is adequate for most applications.

To avoid this messy thermal couple grease or glue, an infrared thermometer is recommended. Most infrared thermometers' spot size are too large for an accurate reading on small form factor ICs. However, an IR thermometer from Optris has a 1 mm spot size, which makes it ideal for the 3 mm × 3 mm VDFN package. Also, get the optional stand. The stand makes it easy to hold the beam on the IC for long periods of time.

5.8 Enable

The MIC61150 features an active high enable input (EN) that allows ON/OFF control of the regulator. The current through the device reduces to near "zero" when the device is shutdown, with only microamperes of leakage current. The EN input may be directly tied to V_{IN} or driven by a voltage that is higher than V_{IN} as long as the voltage does not exceed the maximum operating rating of the EN pin.

6.0 EVALUATION BOARD SCHEMATICS



7.0 PCB LAYOUT RECOMMENDATIONS

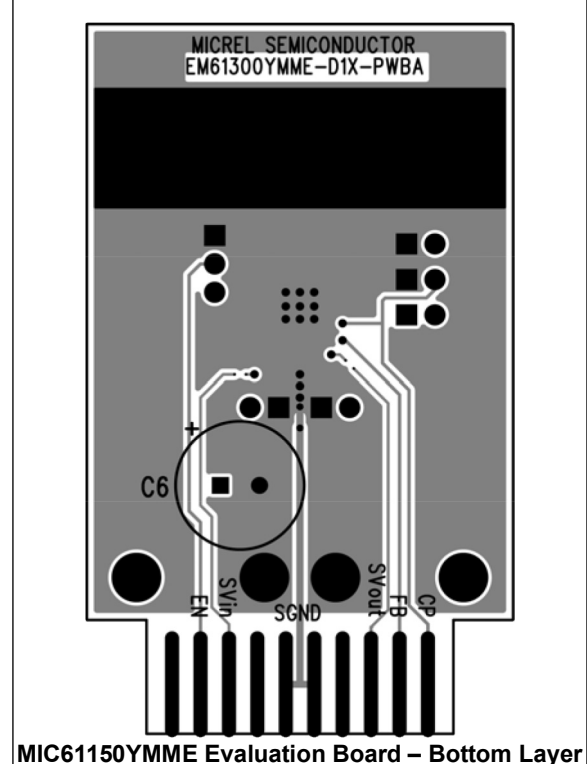
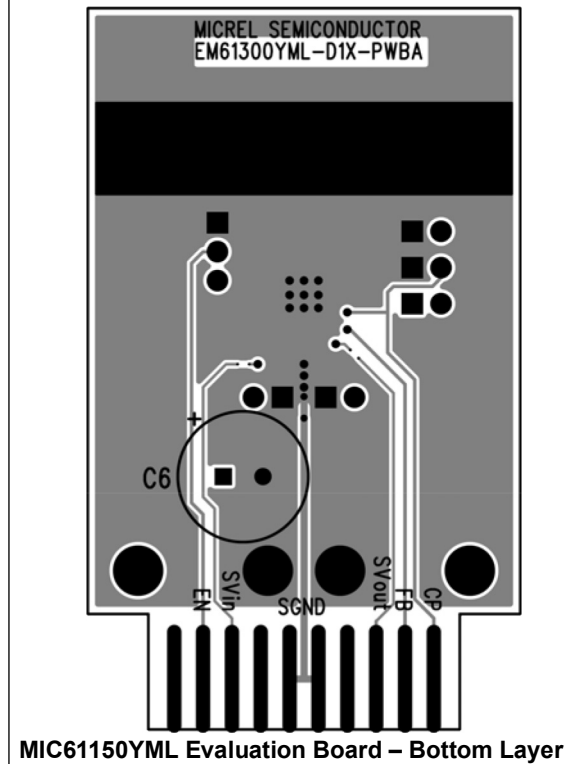
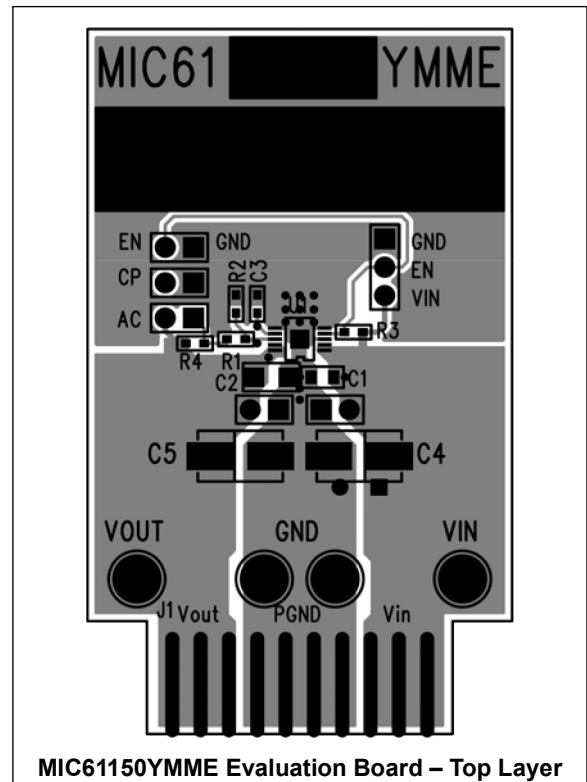
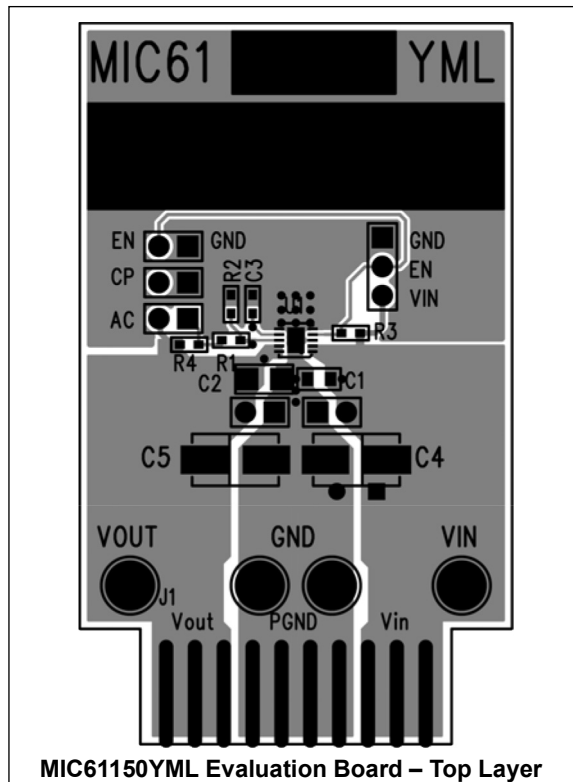


FIGURE 7-1: MIC61150YML PCB Layout Recommendations – Fixed.

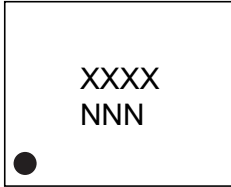
FIGURE 7-2: MIC61150YMME PCB Layout Recommendations – Adjustable.

MIC61150

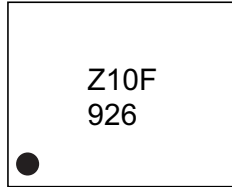
8.0 PACKAGING INFORMATION

8.1 Package Marking Information

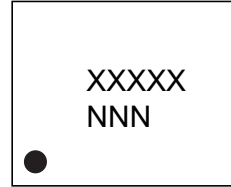
10-Lead ePad MSOP
(Fixed)*



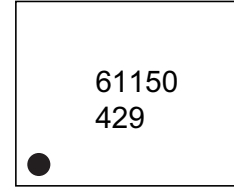
Example



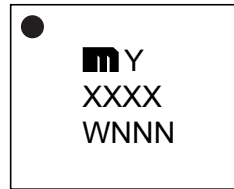
10-Lead ePad MSOP
(Adjustable)*



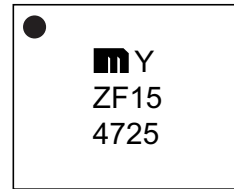
Example



10-Lead VDFN
(Fixed or Adj.)*



Example



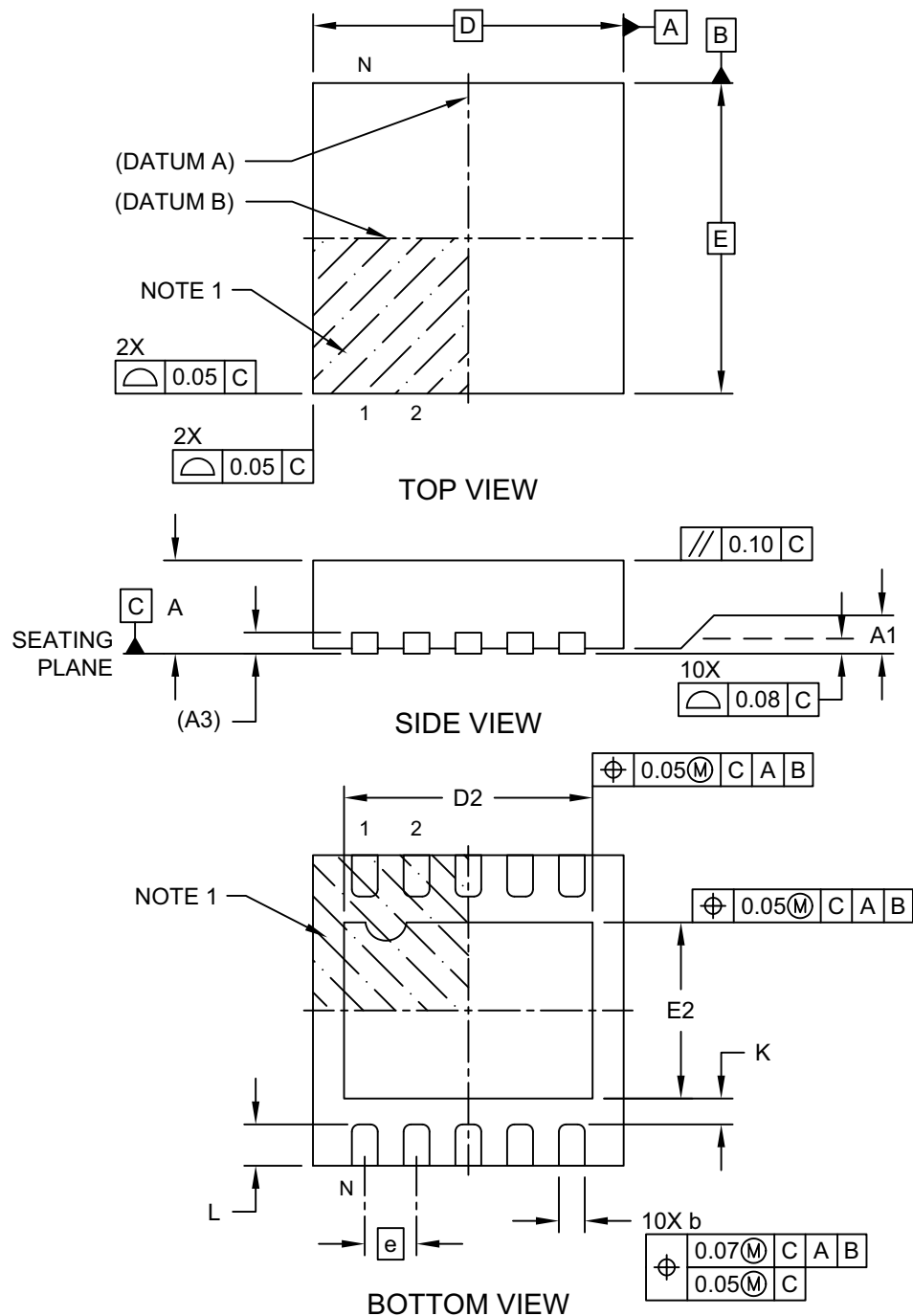
PACKAGE MARKING DRAWING SYMBOLS LEGEND

Symbol	Definition
XX . . . X	Product code or customer-specific information. (Note 1 , Note 2)
YYWW	Date code, where YY is the last 2 digits of calendar year and WW is the work week (i.e., week of January 1 is week 01). (Note 3)
M	Month of assembly (if applicable). January is represented by "A" and each month thereafter follows the order of the alphabet through "L" for December.
NNN	Alphanumeric traceability code. (Note 3 , Note 4)
(e3)	Pb-free JEDEC designator for Matte Tin (Sn).
*	Indicates this package is Pb-free. The Pb-free JEDEC designator (the symbol in the row above this one) 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 1:** If the full Microchip part number cannot fit on one line, it will be carried over to the next line, limiting the number of available characters for customer-specific information. The package may or may not include the corporate logo.
- 2:** Any underbar (_) and/or overbar (¯) symbols shown in a package marking drawing may not be to scale.
- 3:** If the full date code (YYWW) and the alphanumeric traceability code (NNN)—usually marked together on the last or only line of a package marking as the seven-character YYWWNNN—cannot fit on the package together, the codes will be truncated based on the number of available character spaces, as follows:
6 characters = YWWNNN; 5 characters = WWNNN; 4 characters = WNNN; 3 characters = NNN;
2 characters = NN; 1 character = N.
- 4:** Some products might have a "Y" symbol at the end of the last or only line in a package marking, usually at the end of the alphanumeric traceability code (NNN or truncated versions), to indicate the product is Pb-free.

10-Lead 3.0 mm × 3.0 mm VDFN [JFA] Package Outline and Recommended Land Pattern

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

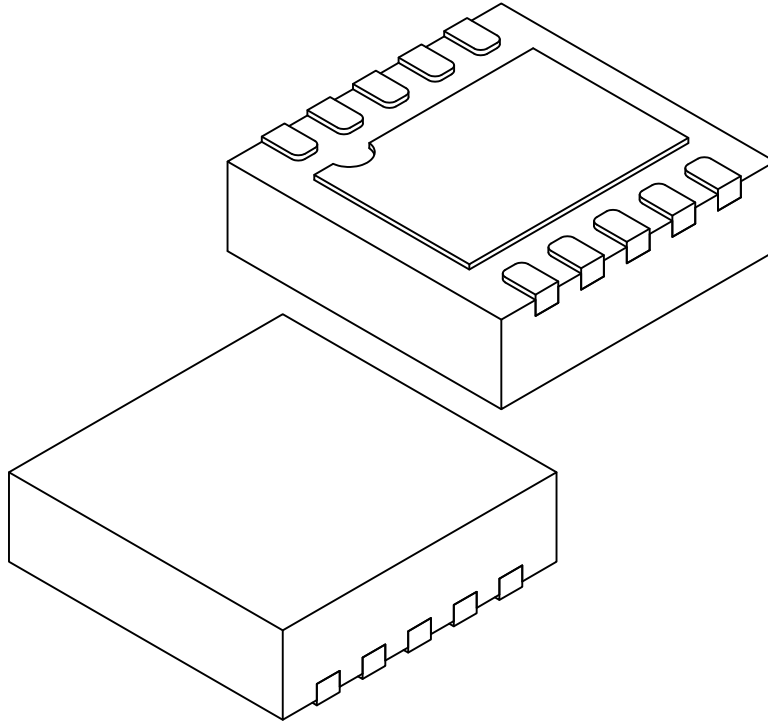


Microchip Technology Drawing C04-1019-JFA Rev B Sheet 1 of 2

MIC61150

10-Lead 3.0 mm × 3.0 mm VDFN [JFA] Package Outline and Recommended Land Pattern

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		10		
Pitch	e		0.50 BSC		
Overall Height	A		0.80	0.90	1.00
Standoff	A1		0.00	0.02	0.05
Terminal Thickness	A3		0.203 REF		
Overall Length	D		3.00 BSC		
Exposed Pad Length	D2		2.35	2.40	2.45
Overall Width	E		3.00 BSC		
Exposed Pad Width	E2		1.65	1.70	1.75
Terminal Width	b		0.17	0.22	0.27
Terminal Length	L		0.35	0.40	0.45
Terminal-to-Exposed-Pad	K		0.25	—	—

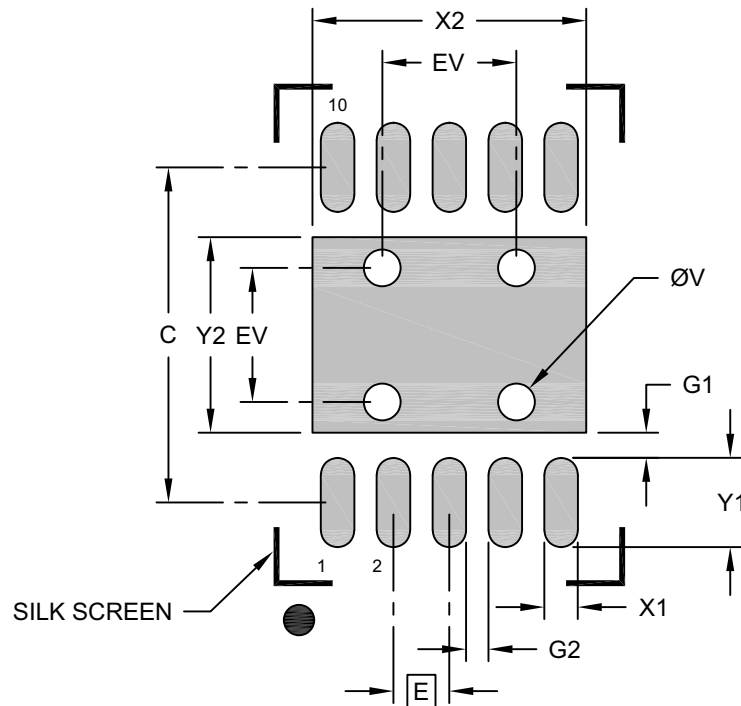
Notes:

- 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 C04-1019-JFA Rev B Sheet 2 of 2

10-Lead 3.0 mm × 3.0 mm VDFN [JFA] Package Outline and Recommended Land Pattern

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			2.45
Optional Center Pad Length	Y2			1.75
Contact Pad Spacing	C		3.00	
Contact Pad Width (Xnn)	X1			0.30
Contact Pad Length (Xnn)	Y1			0.80
Contact Pad to Center Pad (Xnn)	G1	0.23		
Contact Pad to Contact Pad (Xnn)	G2	0.20		
Thermal Via Diameter	V		0.33	
Thermal Via Pitch	EV		1.20	

Notes:

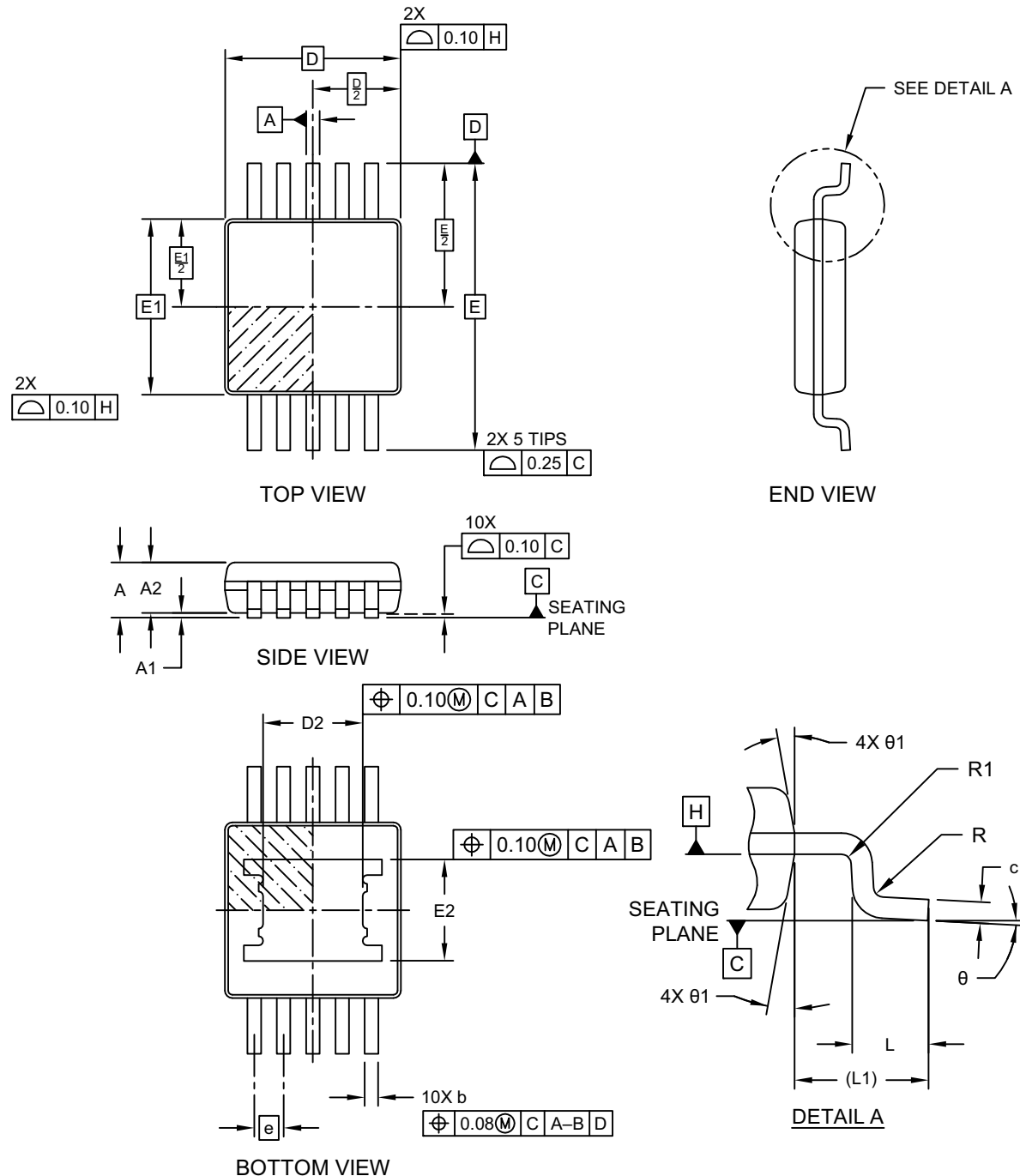
- Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
- For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-3019-JFA Rev B

MIC61150

10-Lead 3.0 mm × 3.0 mm ePad MSOP [DSA] Package Outline and Recommended Land Pattern

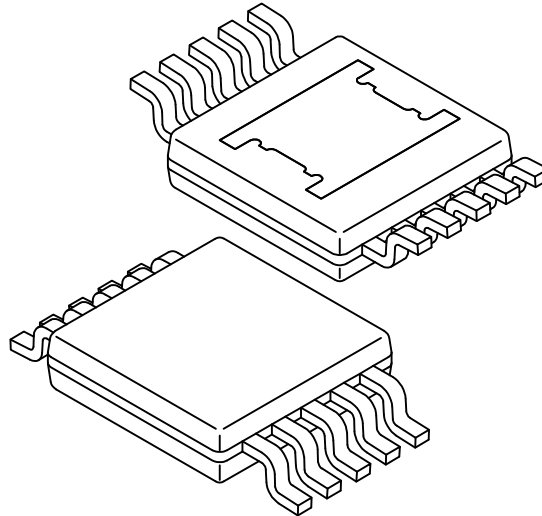
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-1083-DSA Rev A Sheet 1 of 2

10-Lead 3.0 mm × 3.0 mm ePad MSOP [DSA] Package Outline and Recommended Land Pattern

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	10		
Pitch	e	0.50 BSC		
Overall Height	A	0.84	0.94	1.04
Standoff	A1	0.03	0.08	0.13
Molded Package Thickness	A2	0.81	0.86	0.91
Overall Length	D	3.00 BSC		
Exposed Pad Length	D2	1.60	1.70	1.80
Overall Width	E	4.90 BSC		
Molded Package Width	E1	3.00 BSC		
Exposed Pad Width	E2	1.63	1.73	1.83
Terminal Width	b	0.18	0.23	0.28
Terminal Thickness	c	0.10	0.15	0.20
Terminal Length	L	0.43	0.53	0.63
Footprint	L1	0.95 REF		
Lead Bend Radius	R	0.07	-	-
Lead Bend Radius	R1	0.07	-	-
Foot Angle	θ	0°	-	8°
Mold Draft Angle	θ1	5°	-	15°

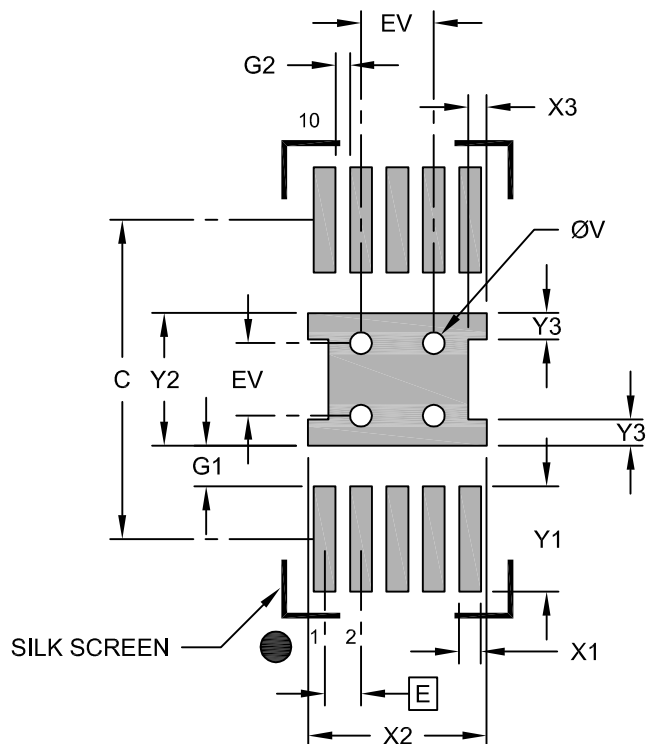
Notes:

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- 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.

MIC61150

10-Lead 3.0 mm × 3.0 mm ePad MSOP [DSA] Package Outline and Recommended Land Pattern

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	0.50 BSC		
Center Pad Width	X2			2.46
Center Pad Length	Y2			1.83
Contact Pad Spacing	C		4.40	
Center Pad Extension	X3		0.25	
Center Pad Extension	Y3		0.36	
Contact Pad Width (X10)	X1			0.30
Contact Pad Length (X10)	Y1			1.45
Contact Pad to Center Pad (X10)	G1	0.56		
Contact Pad to Contact Pad (X8)	G2	0.20		
Thermal Via Diameter	V		0.30	
Thermal Via Pitch	EV		1.00	

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 C04-3083-DSA Rev A

APPENDIX A: REVISION HISTORY

Revision A (July 2025)

- Converted Micrel MIC61150 datasheet to Microchip format as datasheet DS20006999A.
- Minor text changes throughout.

MIC61150

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

Part Number	-XX	X	XX or XXX	-XX
Device	Output Voltage Option	Junction Temperature Range	Package Type	Media Type
Device:	MIC61150	=	Low Input Voltage, Single-Supply High-Current LDO	
Output Voltage Option:	<blank> -10	=	Adjustable Output Voltage 1.0V Fixed-Output Voltage	
Junction Temperature Range:	Y	=	-40°C to +125°C	
Package Type:	MME ML	=	10-Lead ePad MSOP 10-Lead 3 mm × 3 mm VDFN	
Media Type:	<blank> -TR -TR	=	100/Tube 2500/Reel (MME option only) 5000/Reel (ML option only)	
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.			

Examples:

- MIC61150-10YMME**
Low Input Voltage, Single-Supply High-Current LDO, 1.0V Fixed-Output Voltage, -40°C to +125°C Junction Temperature Range, 10-Lead ePad MSOP, 100/Tube
- MIC61150YMME**
Low Input Voltage, Single-Supply High-Current LDO, Adjustable Output Voltage, -40°C to +125°C Junction Temperature Range, 10-Lead ePad MSOP, 100/Tube
- MIC61150-10YMME-TR**
Low Input Voltage, Single-Supply High-Current LDO, 1.0V Fixed-Output Voltage, -40°C to +125°C Junction Temperature Range, 10-Lead ePad MSOP, 2500/Reel
- MIC61150YMME-TR**
Low Input Voltage, Single-Supply High-Current LDO, Adjustable Output Voltage, -40°C to +125°C Junction Temperature Range, 10-Lead ePad MSOP, 2500/Reel
- MIC61150-10YML-TR**
Low Input Voltage, Single-Supply High-Current LDO, 1.0V Fixed-Output Voltage, -40°C to +125°C Junction Temperature Range, 10-Lead 3 mm × 3 mm VDFN, 5000/Reel
- MIC61150YML-TR**
Low Input Voltage, Single-Supply High-Current LDO, Adjustable Output Voltage, -40°C to +125°C Junction Temperature Range, 10-Lead 3 mm × 3 mm VDFN, 5000/Reel

MIC61150

BILL OF MATERIALS

TABLE 0-1: MIC61150YML (3 ,MM × 3 MM 10-LEAD EPAD MLF®) BILL OF MATERIALS

Item	Part Number	Manufacturer	Description	Qty.
C1	C0805ZD106KAT2A	AVX (Note 1)	10µF/10V Ceramic Capacitor, X5R,Size 0805	1
	C2012X5R1C106M	TDK (Note 2)	10µF/10V Ceramic Capacitor, X5R,Size 0805	
	GRM219R61A106KE44D	Murata (Note 3)	10µF/10V Ceramic Capacitor, X5R,Size 0805	
C2	C2012X5R0J226M	TDK (Note 2)	22µF/6.3V Ceramic Capacitor, X5R, Size 0805 or	1
	GRM21BR60J226ME39L	Murata (Note 3)	22µF/6.3V Ceramic Capacitor, X5R, Size 0805 or	
	08056D226MAT2A	AVX (Note 1)	22µF/6.3V Ceramic Capacitor, X5R, Size 0805	
C3	C06035C104KAT2A	AVX (Note 1)	0.1µF/50V Ceramic Capacitor, X7R, Size 0603	1
	GRM188R71H104KA93D	Murata (Note 3)	0.1µF/50V Ceramic Capacitor, X7R, Size 0603	
R1	CRCW060369R8FKEA	Vishay (Note 4)	69.8Ω Film Resistor, Size 0603, 1%	1
R2	CRCW060349R9FKEA	Vishay (Note 4)	49.9Ω Film Resistor, Size 0603, 1%	1
R3	CRCW060310K0FKEA	Vishay (Note 4)	10kΩ Film Resistor, Size 0603, 1%	1
R4	CRCW080500R0F	Vishay (Note 4)	0Ω Film Resistor, Size 0603, 1%	1
U1	MIC61150YML	Microchip (Note 5)	1.5A Low-Voltage, Single-Supply LDO	1
Note 1: AVX: www.avx.com Note 2: TDK: www.tdk.com Note 3: Murata: www.murata.com Note 4: Vishay: www.vishay.com Note 5: Microchip: www.microchip.com				

TABLE 0-2: MIC61150YMME (10-PIN EPAD MSOP) BILL OF MATERIALS

Item	Part Number	Manufacturer	Description	Qty.
C1	C0805ZD106KAT2A	AVX (Note 1)	10µF/10V Ceramic Capacitor, X5R,Size 0805	1
	C2012X5R1C106M	TDK (Note 2)	10µF/10V Ceramic Capacitor, X5R,Size 0805	
	GRM219R61A106KE44D	Murata (Note 3)	10µF/10V Ceramic Capacitor, X5R,Size 0805	
C2	C2012X5R0J226M	TDK (Note 2)	22µF/6.3V Ceramic Capacitor, X5R, Size 0805 or	1
	GRM21BR60J226ME39L	Murata (Note 3)	22µF/6.3V Ceramic Capacitor, X5R, Size 0805 or	
	08056D226MAT2A	AVX (Note 1)	22µF/6.3V Ceramic Capacitor, X5R, Size 0805	
C3	C06035C104KAT2A	AVX (Note 1)	0.1µF/50V Ceramic Capacitor, X7R, Size 0603	1
	GRM188R71H104KA93D	Murata (Note 3)	0.1µF/50V Ceramic Capacitor, X7R, Size 0603	
R1	CRCW060369R8FKEA	Vishay (Note 4)	69.8Ω Film Resistor, Size 0603, 1%	1
R2	CRCW060349R9FKEA	Vishay (Note 4)	49.9Ω Film Resistor, Size 0603, 1%	1
R3	CRCW060310K0FKEA	Vishay (Note 4)	10kΩ Film Resistor, Size 0603, 1%	1
R4	CRCW080500R0F	Vishay (Note 4)	0Ω Film Resistor, Size 0603, 1%	1
U1	MIC61150YMME	Microchip (Note 5)	1.5A Low-Voltage, Single-Supply LDO	1
Note 1: AVX: www.avx.com Note 2: TDK: www.tdk.com Note 3: Murata: www.murata.com Note 4: Vishay: www.vishay.com Note 5: Microchip: www.microchip.com				

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