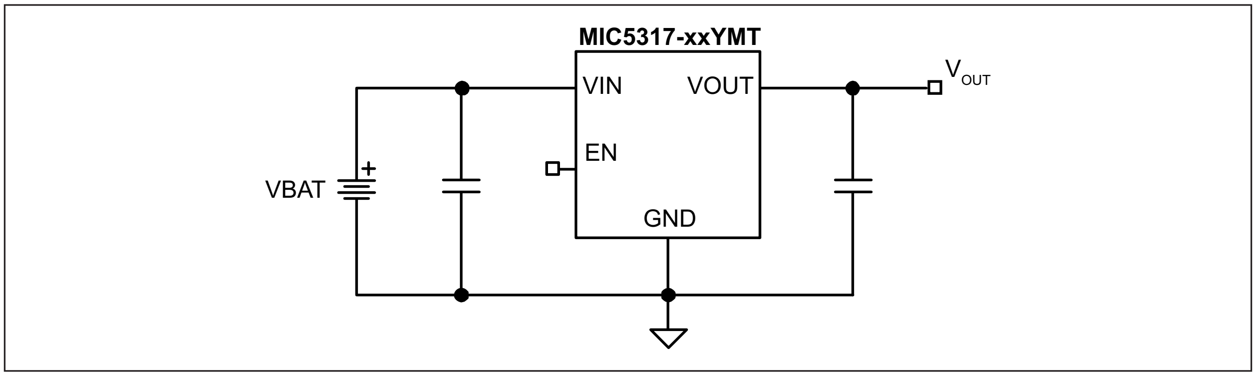
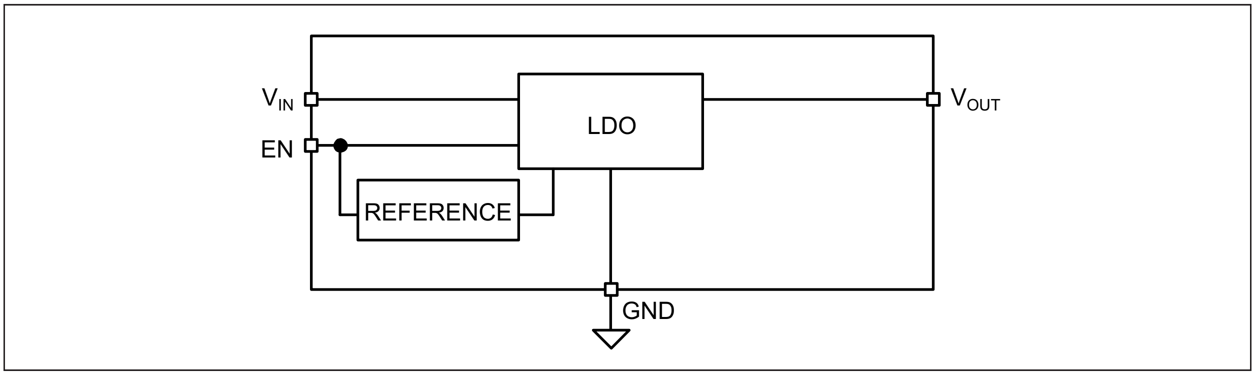
Typical Application Circuit



Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{IN}) .... 0V to +7V
Enable Voltage (V_{EN}) .... 0V to V_{IN}
Power Dissipation (P_D) .... Internally Limited (Note 1)
ESD Rating (HBM, Note 2) .... 2 kV

Operating Ratings ††

Supply Voltage (V_{IN}) .... +2.5V to +6V
Enable Voltage (V_{EN}) .... 0V to V_{IN}

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

2: Devices are ESD sensitive. Handling precautions are recommended. Human body model, 1.5 kΩ in series with 100 pF.

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $V_{IN} = V_{EN} = V_{OUT} + 1V$; $C_{IN} = C_{OUT} = 1$ µF; $I_{OUT} = 100$ µA; $T_J = +25°C$, **bold** values valid for –40°C to +125°C, unless noted. Note 1

Parameter	Sym.	Min.	Typ.	Max.	Units	Conditions
Output Voltage Accuracy		–2.0	—	2.0	%	Variation from nominal V_{OUT}
		–3.0	—	**3.0**		Variation from nominal V_{OUT}: –40°C to +125°C
Line Regulation		—	0.02	**0.3**	%	$V_{IN} = V_{OUT}$ +1V to 6V; $I_{OUT} = 100$ µA
Load Regulation (Note 2)		—	10	25	mV	$I_{OUT} = 100$ µA to 150 mA
Dropout Voltage (Note 3)	V_{DO}	—	55	**110**	mV	$I_{OUT} = 50$ mA; $V_{OUT} \geq 2.8V$
		—	155	**310**		$I_{OUT} = 150$ mA; $V_{OUT} \geq 2.8V$
		—	60	**135**		$I_{OUT} = 50$ mA; $V_{OUT} < 2.8V$
		—	180	**380**		$I_{OUT} = 150$ mA; $V_{OUT} < 2.8V$
Ground Pin Current (Note 4)	I_{GND}	—	29	**39**	µA	$I_{OUT} = 0$ mA
Ground Pin Current in Shutdown	I_{SHDN}	—	0.05	1	µA	$V_{EN} = 0V$
Ripple Rejection	PSRR	—	80	—	dB	f = Up to 1 kHz; $C_{OUT} = 1$ µF
		—	65	—		f = 1 kHz to 10 kHz; $C_{OUT} = 1$ µF
Current Limit	I_{LIM}	200	325	550	mA	$V_{OUT} = 0V$
Output Voltage Noise	e_N	—	200	—	$µV_{RMS}$	$C_{OUT} = 1$ µF, 10 Hz to 100 kHz
Enable Input						
Enable Input Voltage	V_{EN}	—	—	**0.2**	V	Logic low
		1.2	—	—		Logic high
Enable Input Current	I_{EN}	—	0.01	**1**	µA	$V_{IL} \leq 0.2V$
		—	0.01	**1**		$V_{IH} \geq 1.2V$
Turn-On Time	t_{ON}	—	50	**125**	µs	$C_{OUT} = 1$ µF; $I_{OUT} = 150$ mA

Note 1: Specification for packaged product only.

2: Regulation is measured at constant junction temperature using low duty cycle pulse testing; changes in output voltage due to heating effects are covered by the thermal regulation specification.

3: 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 2.5V, dropout voltage is the input-to-output differential with the minimum input voltage 2.5V.

4: Ground pin current is the regulator quiescent current. The total current drawn from the supply is the sum of the load current plus the ground pin current.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Max. Junction Temperature Range	T_J	–40	—	+150	°C	—
Operating Junction Temperature Range	T_J	–40	—	+125	°C	—
Storage Temperature Range	T_S	–65	—	+150	°C	—
Lead Temperature	—	—	—	+260	°C	Soldering, 10 sec.
Package Thermal Resistances						
Thermal Resistance, 1x1 4-Ld UDFN	θ_{JA}	—	240	—	°C/W	—
Thermal Resistance, SOT23-5	θ_{JA}	—	253	—	°C/W	—
Thermal Resistance, TSOT23-5	θ_{JA}	—	253	—	°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.

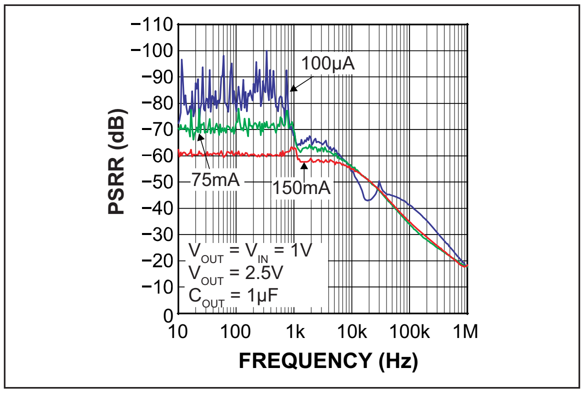


FIGURE 2-1: Power Supply Rejection Ratio.

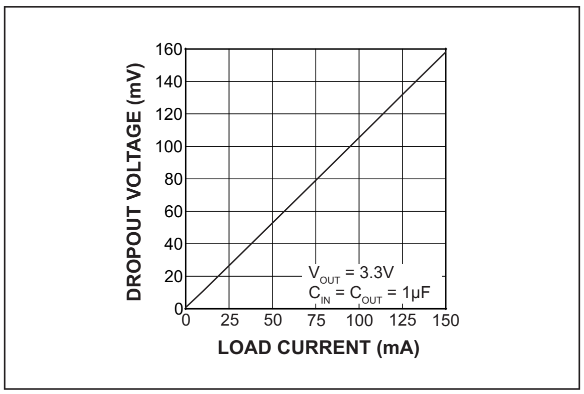


FIGURE 2-2: Dropout Voltage vs. Load Current.

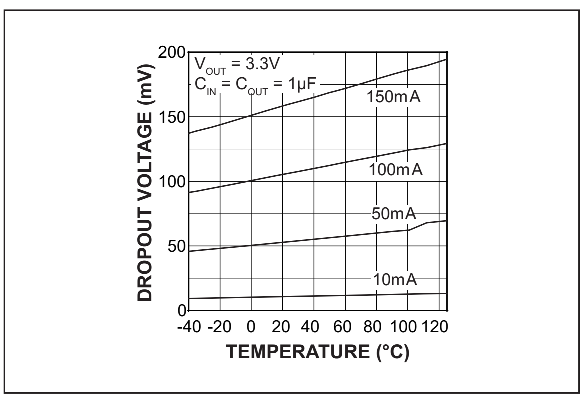


FIGURE 2-3: Dropout Voltage vs. Temperature.

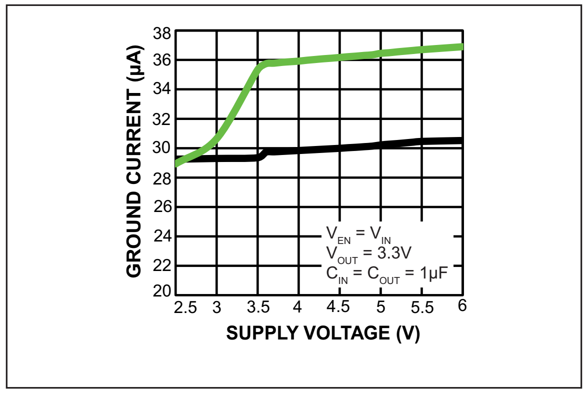


FIGURE 2-4: Ground Current vs. Supply Voltage.

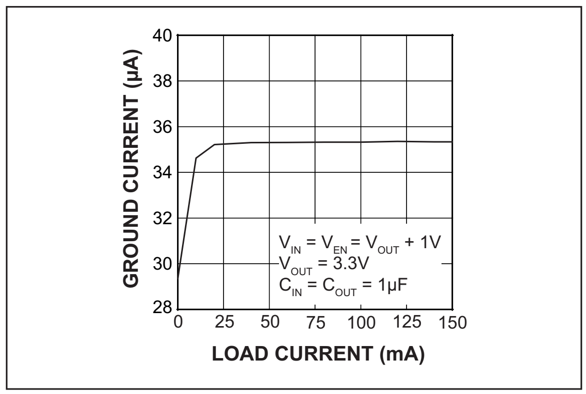


FIGURE 2-5: Ground Current vs. Load Current.

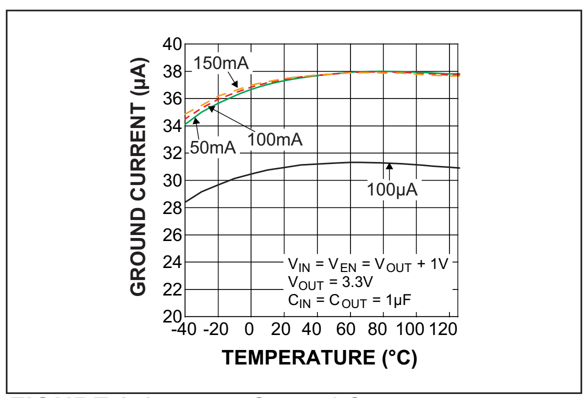


FIGURE 2-6: Ground Current vs. Temperature.

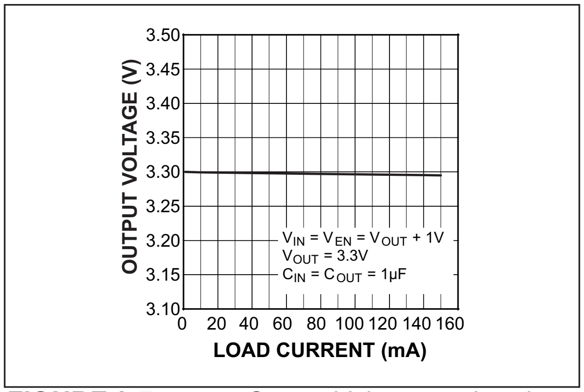


FIGURE 2-7: *Output Voltage vs. Load Current.*

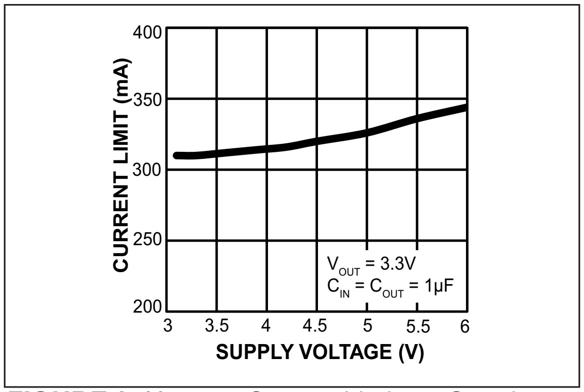


FIGURE 2-10: *Current Limit vs. Supply Voltage.*

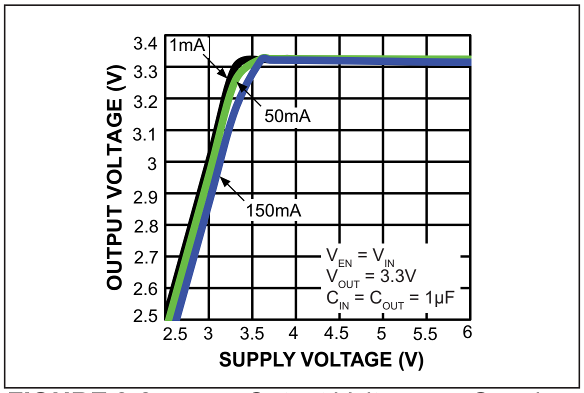


FIGURE 2-8: *Output Voltage vs. Supply Voltage.*

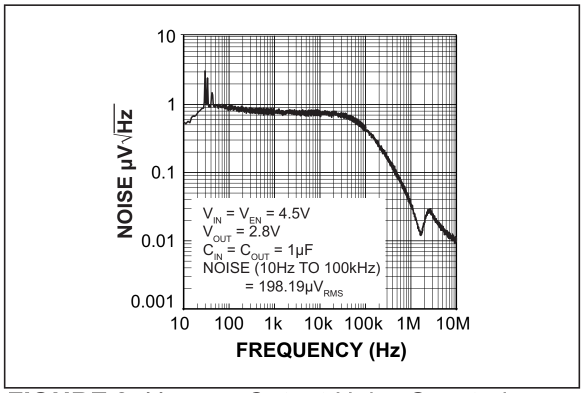


FIGURE 2-11: *Output Noise Spectral Density.*

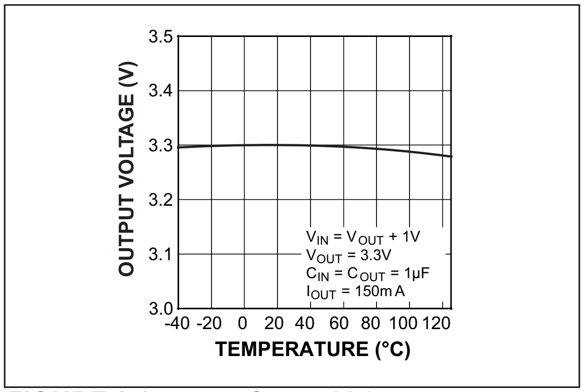


FIGURE 2-9: *Output Voltage vs. Temperature.*

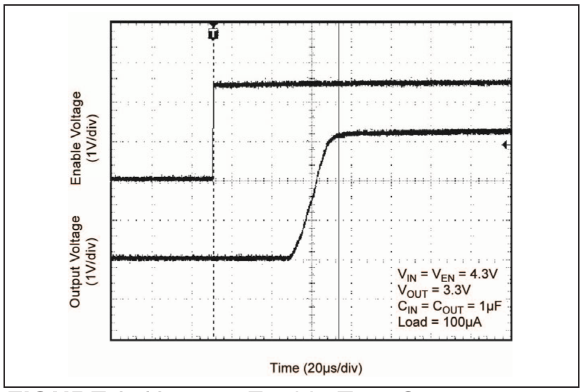


FIGURE 2-12: *Enable Turn-On.*

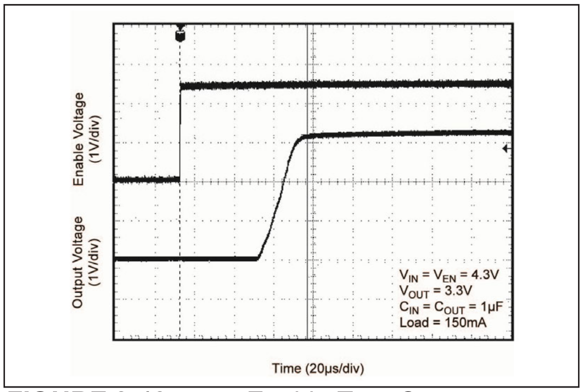


FIGURE 2-13: *Enable Turn-On.*

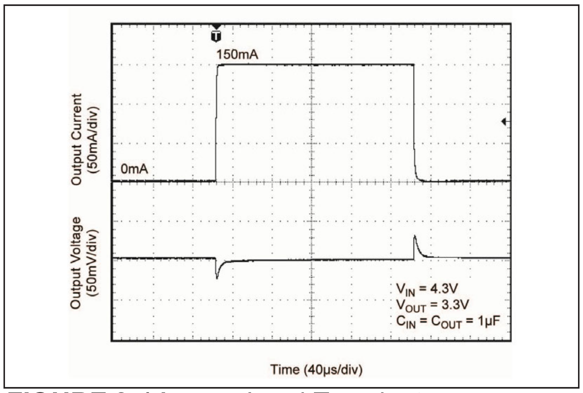


FIGURE 2-14: *Load Transient.*

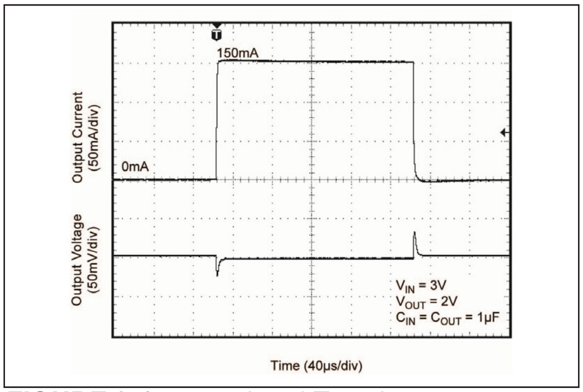


FIGURE 2-15: *Load Transient.*

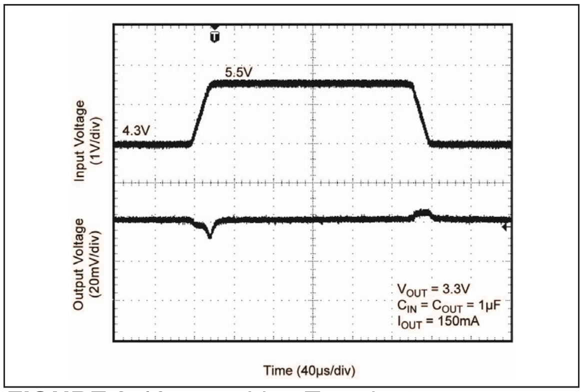


FIGURE 2-16: *Line Transient.*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin Number	Pin Name UDFN-4	Pin Name SOT23-5	Pin Name TSOT23-5	Description
1	VOUT	—	—	Output voltage.
1	—	VIN	VIN	Supply input.
2	GND	GND	GND	Ground.
3	EN	EN	EN	Enable Input: Active-High. High = ON; Low = OFF. Do not leave floating.
4	VIN	—	—	Supply input.
4	—	NC	NC	No connect. Not internally connected.
5	—	VOUT	VOUT	Output voltage.
EP	ePAD	N/A	N/A	Exposed heat sink pad. Connect to ground.

4.0 APPLICATION INFORMATION

MIC5317 is a low-noise 150 mA LDO. The MIC5317 regulator is fully protected from damage due to fault conditions, offering linear current limiting and thermal shutdown.

4.1 Input Capacitor

The MIC5317 is a high-performance, high-bandwidth device. An input capacitor of 1 µF is required from the input to ground to provide stability. Low-ESR ceramic capacitors provide optimal performance at a minimum of space. Additional high-frequency capacitors, such as small-valued NPO dielectric-type capacitors, help filter out high-frequency noise and are good practice in any RF-based circuit. X5R or X7R dielectrics are recommended for the input capacitor. Y5V dielectrics lose most of their capacitance over temperature and are therefore, not recommended.

4.2 Output Capacitor

The MIC5317 requires an output capacitor of 1 µF or greater to maintain stability. The design is optimized for use with low-ESR ceramic chip capacitors. High-ESR capacitors are not recommended because they may cause high-frequency oscillation. The output capacitor can be increased, but performance has been optimized for a 1 µF ceramic output capacitor and does not improve significantly with larger capacitance.

X7R/X5R dielectric-type 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 capacitor to ensure the same minimum capacitance over the equivalent operating temperature range.

4.3 No-Load Stability

Unlike many other voltage regulators, the MIC5317 will remain stable and in regulation with no load. This is especially important in CMOS RAM keep-alive applications.

4.4 Enable/Shutdown

The MIC5317 comes with an active-high enable pin that allows the regulator to be disabled. Forcing the enable pin low disables the regulator and sends it into a “zero” off-mode current state. In this state, current consumed by the regulator goes nearly to zero. Forcing the enable pin high enables the output voltage. The active-high enable pin uses CMOS technology and the enable pin cannot be left floating. A floating enable pin may cause an indeterminate state on the output.

4.5 Thermal Considerations

The MIC5317 is designed to provide 150 mA of continuous current in a very small package. Maximum ambient operating temperature can be calculated based on the output current and the voltage drop across the part. For example if the input voltage is 3.6V, the output voltage is 2.8V, and the output current = 150 mA. The actual power dissipation of the regulator circuit can be determined using Equation 4-1.

EQUATION 4-1:

$$P_D = (V_{IN} - V_{OUT1}) \times I_{OUT} + V_{IN} \times I_{GND}$$

Because this device is CMOS and the ground current is typically <100 µA over the load range, the power dissipation contributed by the ground current is <1% and can be ignored for Equation 4-2.

EQUATION 4-2:

$$P_D = (3.6V - 2.8V) \times 150mA = 0.120W$$

To determine the maximum ambient operating temperature of the package, use the junction-to-ambient thermal resistance of the device and Equation 4-3.

EQUATION 4-3:

$$P_{D(MAX)} = \left(\frac{T_{J(MAX)} - T_A}{\theta_{JA}}\right)$$

$T_{J(MAX)}$ = 125°C, the maximum junction temperature of the die, θ_{JA} thermal resistance = 240°C/W for the YMT package and 253°C/W for the SOT23-5 and TSOT23-5 packages.

Substituting P_D for $P_{D(MAX)}$ and solving for the ambient operating temperature will give the maximum operating conditions for the regulator circuit. The junction-to-ambient thermal resistance for the minimum footprint is 240°C/W.

The maximum power dissipation must not be exceeded for proper operation.

For example, when operating the MIC5317-2.8YMT at an input voltage of 3.6V and 150 mA load with a minimum footprint layout, the maximum ambient operating temperature (T_A) can be determined as shown in Equation 4-4:

EQUATION 4-4:

$$0.120W = (125°C - T_A)/(240°C/W)$$

$$T_A = 96°C$$

Therefore the maximum ambient operating temperature of 96°C is allowed in a 1 mm × 1 mm UDFN package. For a full discussion of heat sinking and thermal effects on voltage regulators, refer to the "Regulator Thermals" section of Microchip's Designing with Low-Dropout Voltage Regulators handbook.

5.0 TYPICAL APPLICATION SCHEMATICS

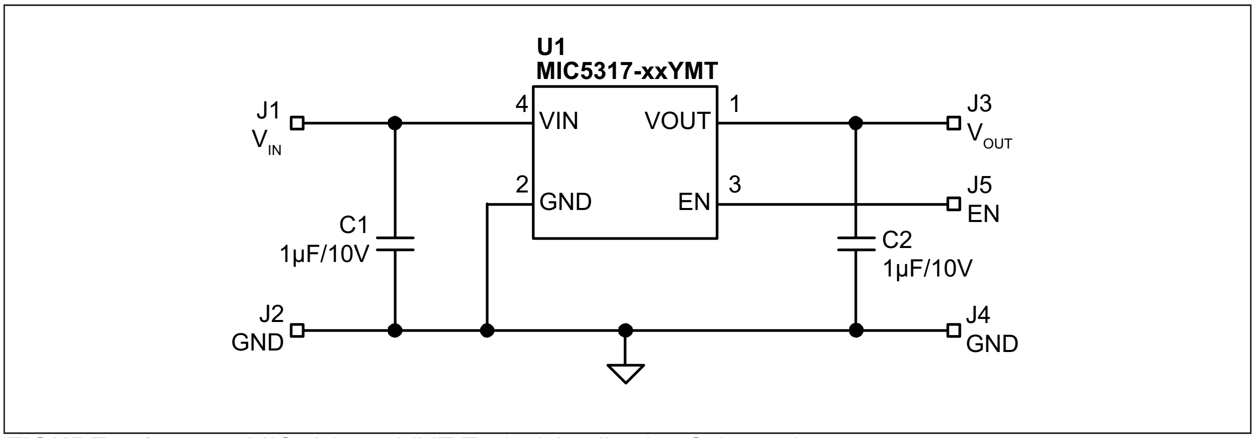


FIGURE 5-1: MIC5317-x.xYMT Typical Application Schematic.

TABLE 5-1: BILL OF MATERIALS

Item	Part Number	Manufacturer	Description	Qty.
C1, C2	GRM155R61A105KE15D	Murata	Capacitor, 1 µF Ceramic, 10V, X5R, Size 0402	2
U1	**MIC5317-x.xYMT**	**Microchip**	**High-Performance Single 150 mA LDO**	**1**

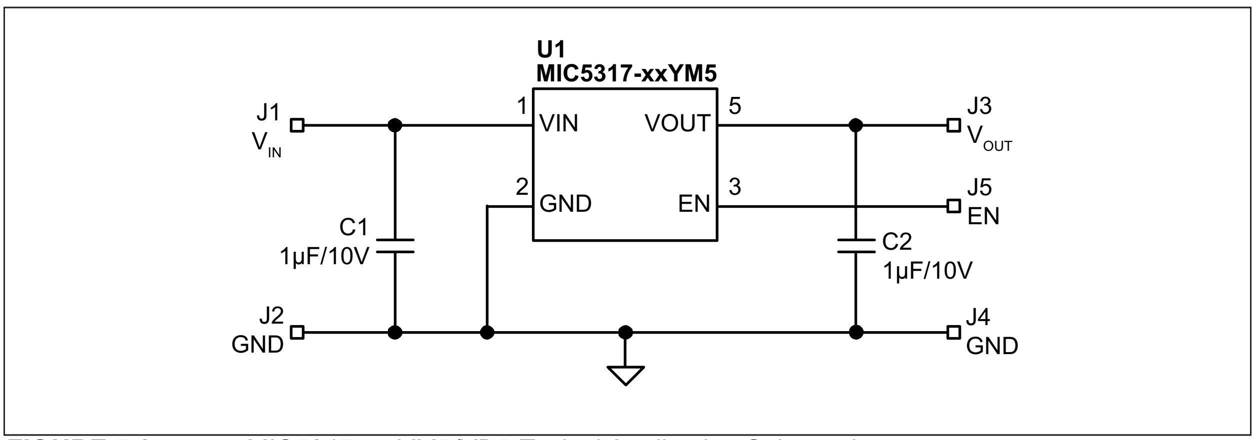


FIGURE 5-2: MIC5317-x.xYM5/YD5 Typical Application Schematic.

TABLE 5-2: BILL OF MATERIALS

Item	Part Number	Manufacturer	Description	Qty.
C1, C2	C1005X5R1A105K	TDK	Capacitor, 1 µF Ceramic, 10V, X5R, Size 0402	2
U1	**MIC5317-x.xYM5/YD5**	**Microchip**	**High-Performance Single 150 mA LDO**	1

6.0 PCB LAYOUT RECOMMENDATIONS

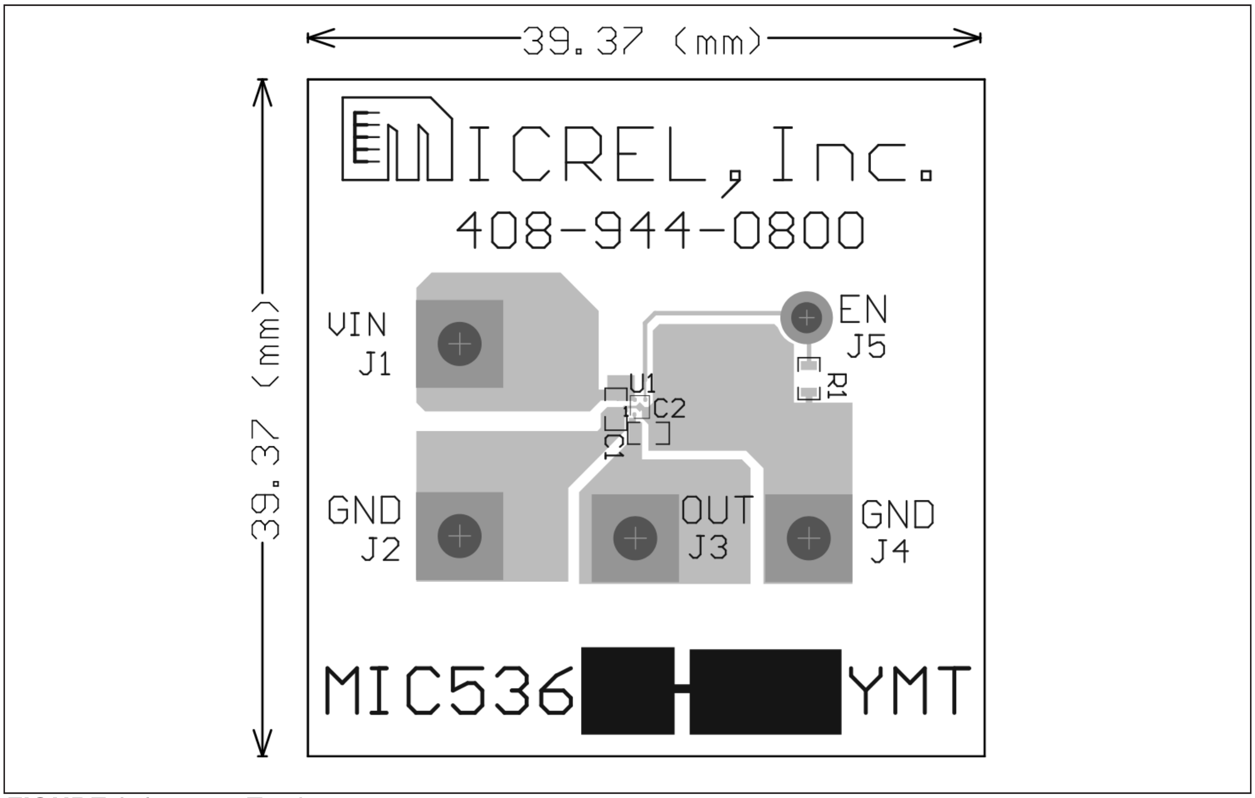


FIGURE 6-1: *Top Layer.*

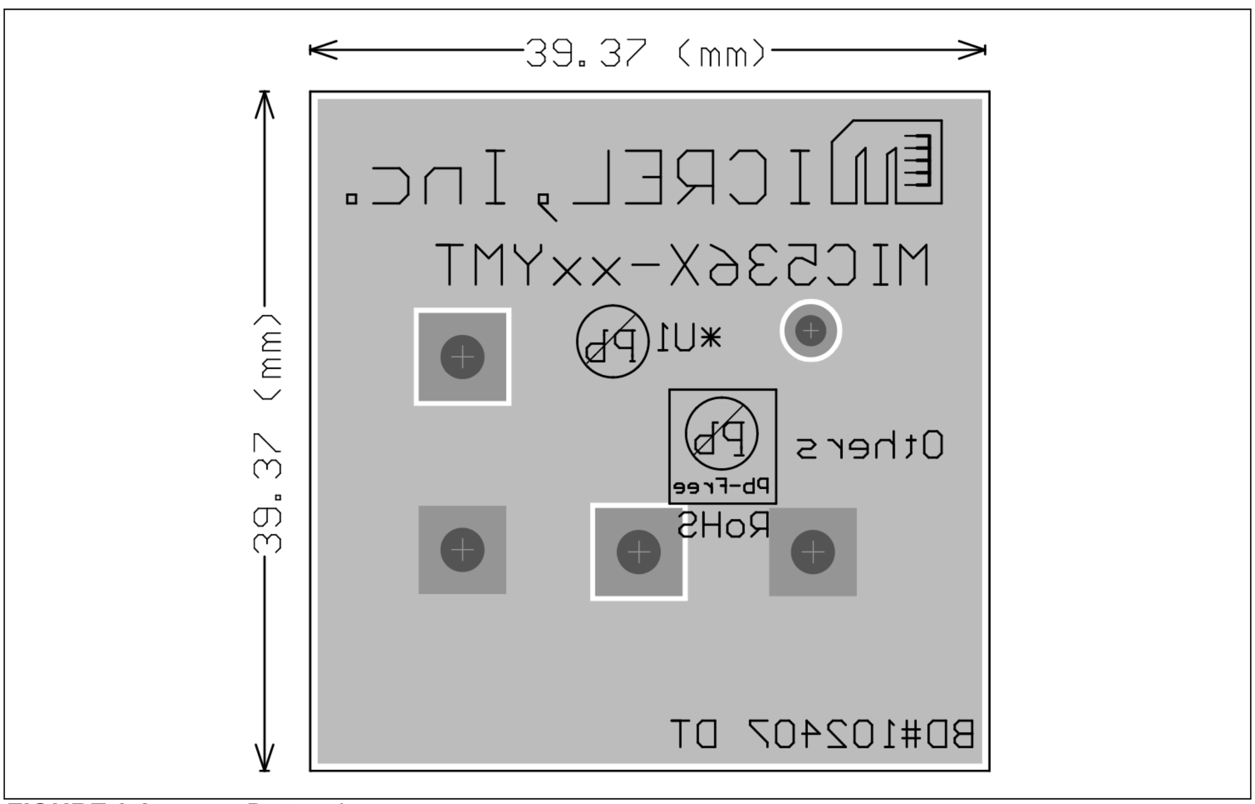


FIGURE 6-2: *Bottom Layer.*

7.0 PACKAGING INFORMATION

7.1 Package Marking Information

4-Lead UDFN*	Example
XX	71

SOT23-5*	Example
XXX	1F7

TSOT23-5*	Example
XXX	1P7

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.

TABLE 7-1: MARKING CODES

Part Number	Marking Code	Output Voltage
MIC5317-1.0YMT	71	1.0V
MIC5317-1.2YMT	72	1.2V
MIC5317-1.5YMT	73	1.5V
MIC5317-1.8YMT	74	1.8V
MIC5317-2.5YMT	76	2.5V
MIC5317-2.8YMT	77	2.8V
MIC5317-3.0YMT	78	3.0V

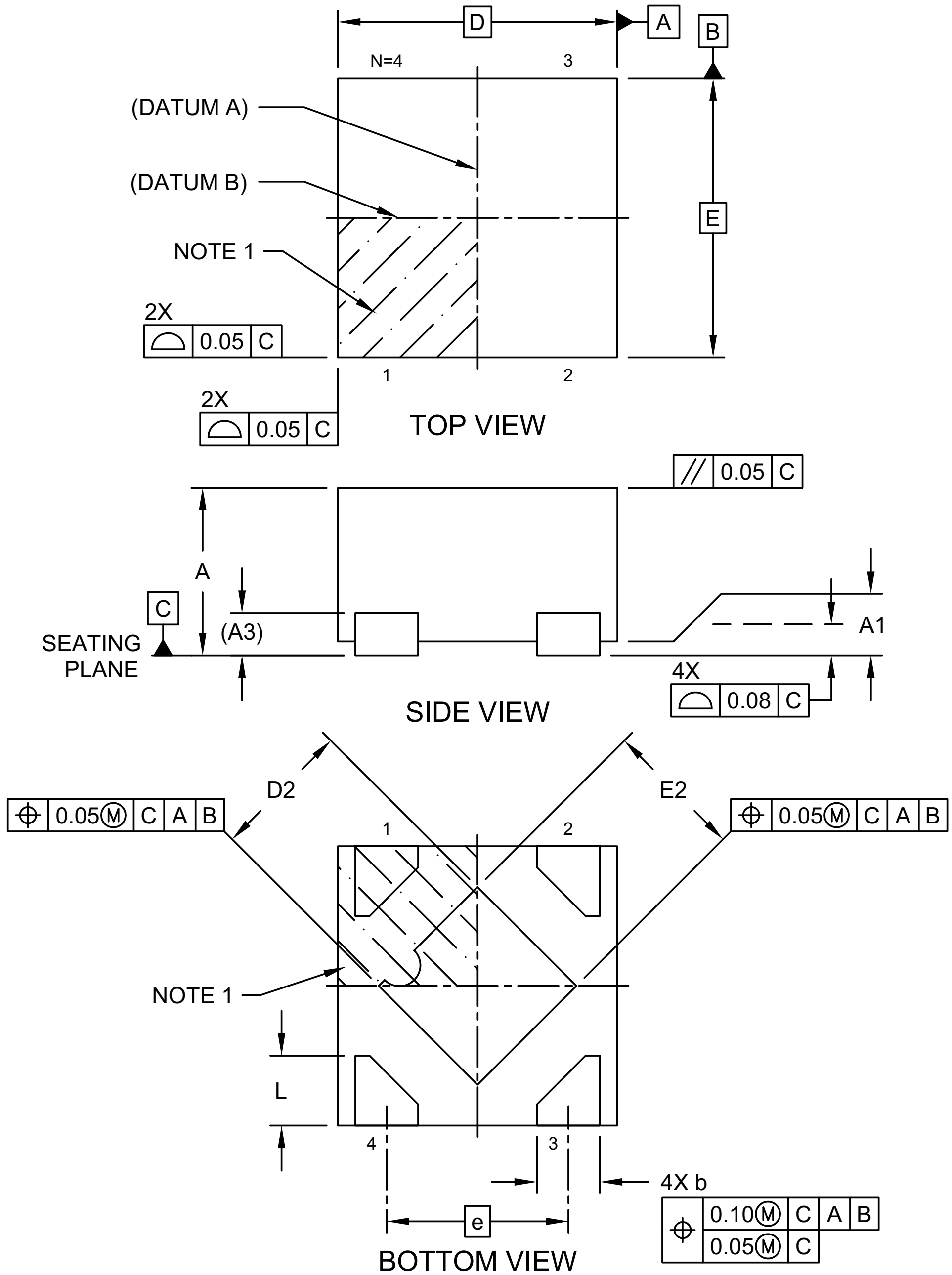
TABLE 7-1: MARKING CODES (CONTINUED)

Part Number	Marking Code	Output Voltage
MIC5317-3.3YMT	79	3.3V
MIC5317-1.0YM5	1C7	1.0V
MIC5317-1.2YM5	147	1.2V
MIC5317-1.5YM5	1F7	1.5V
MIC5317-1.8YM5	1G7	1.8V
MIC5317-2.5YM5	1J7	2.5V
MIC5317-2.8YM5	1M7	2.8V
MIC5317-3.0YM5	1P7	3.0V
MIC5317-3.3YM5	1S7	3.3V
MIC5317-1.0YD5	1C7	1.0V
MIC5317-1.2YD5	147	1.2V
MIC5317-1.5YD5	1F7	1.5V
MIC5317-1.8YD5	1G7	1.8V
MIC5317-2.5YD5	1J7	2.5V
MIC5317-2.8YD5	1M7	2.8V
MIC5317-3.0YD5	1P7	3.0V
MIC5317-3.3YD5	1S7	3.3V

4-Lead 1 mm x 1 mm UDFN Package Outline & Recommended Land Pattern

4-Lead Ultra Thin Plastic Dual Flat, No Lead Package (HCA) - 1x1 mm Body [UDFN]

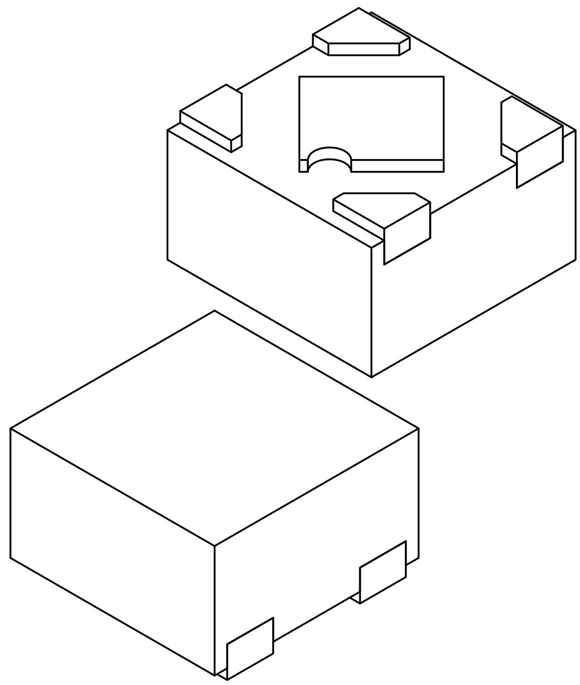
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-1149 Rev A Sheet 1 of 2

4-Lead Ultra Thin Plastic Dual Flat, No Lead Package (HCA) - 1x1 mm Body [UDFN]

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		4	
Pitch	e		0.65 BSC	
Overall Height	A	0.50	0.55	0.60
Standoff	A1	0.00	0.02	0.05
Terminal Thickness	A3		0.152 REF	
Overall Length	D		1.00 BSC	
Exposed Pad Length	D2	0.45	0.50	0.55
Overall Width	E		1.00 BSC	
Exposed Pad Width	E2	0.45	0.50	0.55
Terminal Width	b	0.175	0.225	0.275
Terminal Length	L	0.20	0.25	0.30

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M

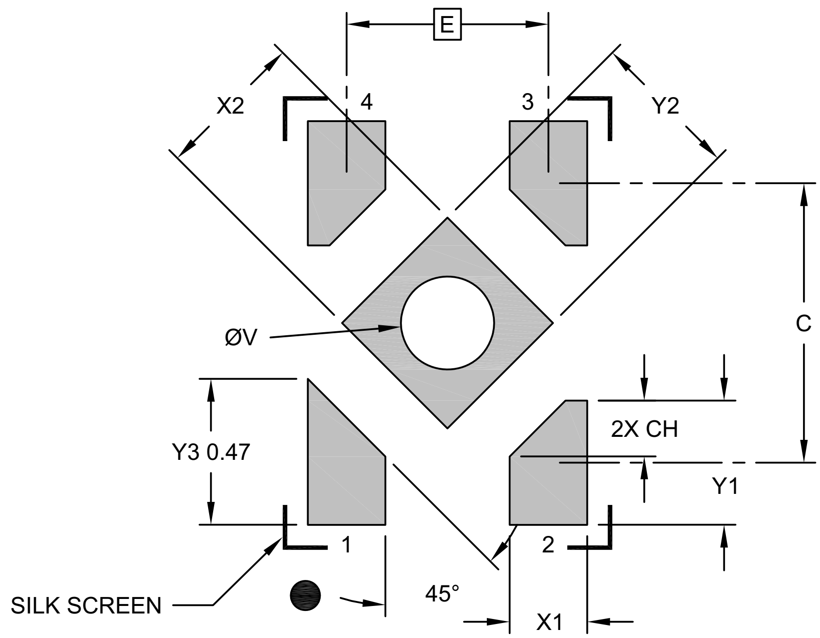
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-1149 Rev A Sheet 2 of 2

4-Lead Ultra Thin Plastic Dual Flat, No Lead Package (HCA) - 1x1 mm Body [UDFN]

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		0.65 BSC	
Center Pad Width	X2			0.48
Center Pad Length	Y2			0.48
Contact Pad Spacing	C		0.90	
Contact Pad Width (X4)	X1			0.25
Contact Pad Length (X3)	Y1			0.40
Terminal 1 Pad Length	Y3			0.47
Contact Pad Chamfer (X3)	CH		0.18	
Thermal Via Diameter	V		0.30	

Notes:

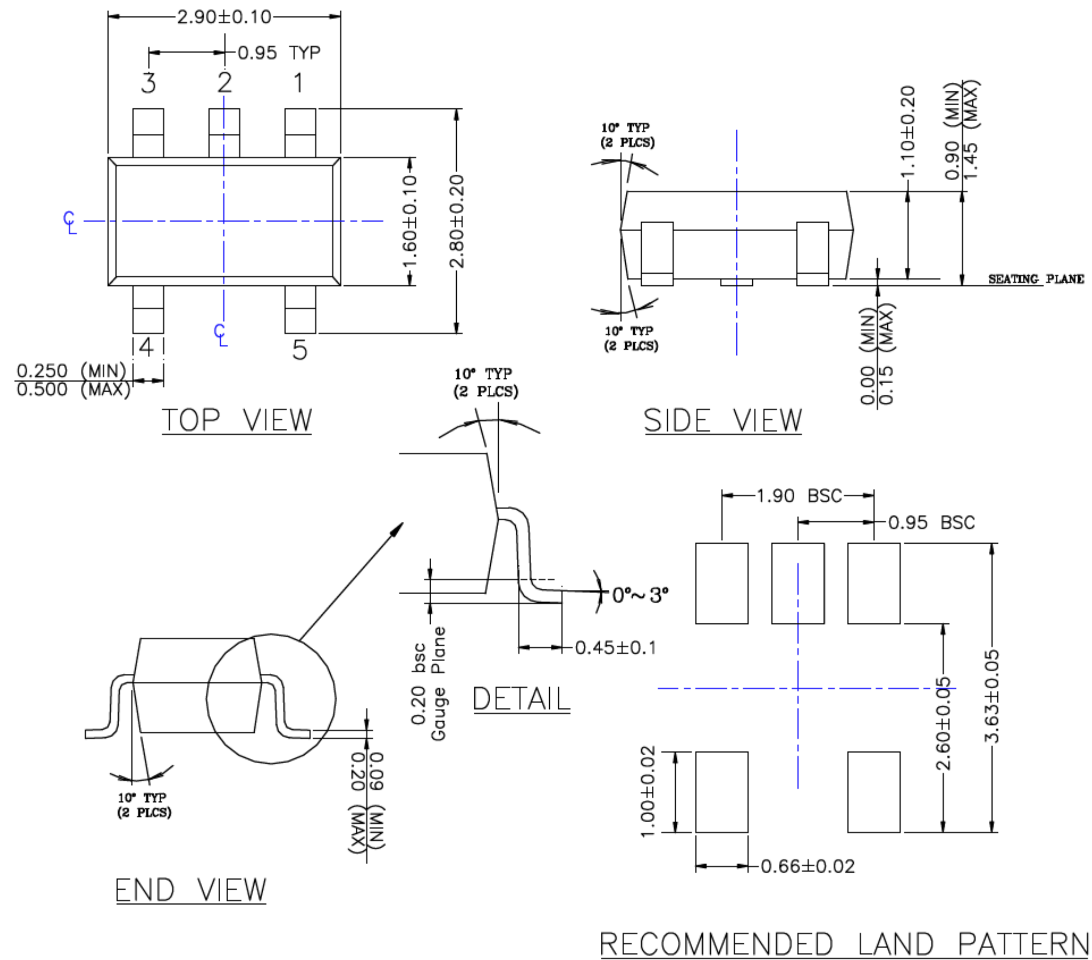
1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-3149 Rev A

5-Lead SOT23 Package Outline and Recommended Land Pattern

TITLE
5 LEAD SOT23 PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	SOT23-5LD-PL-1	UNIT	MM



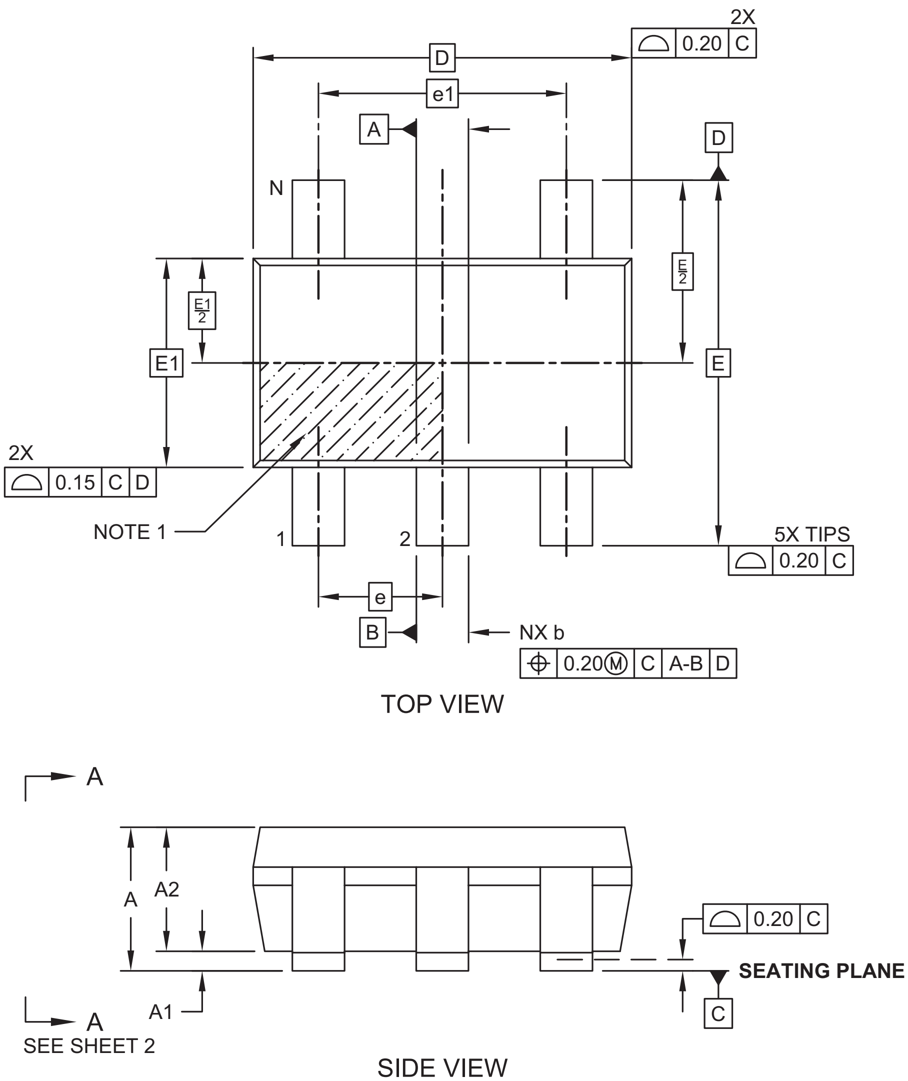
NOTE:
1. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & BURR.
2. PACKAGE OUTLINE INCLUSIVE OF SOLER PLATING.
3. DIMENSION AND TOLERANCE PER ANSI Y14.5M, 1982.
4. FOOT LENGTH MEASUREMENT BASED ON GAUGE PLANE METHOD.
5. DIE FACES UP FOR MOLD, AND FACES DOWN FOR TRIM/FORM.
6. ALL DIMENSIONS ARE IN MILLIMETERS.

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

5-Lead TSOT23 Package Outline and Recommended Land Pattern

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



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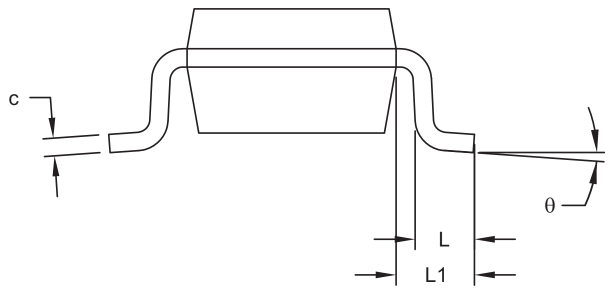
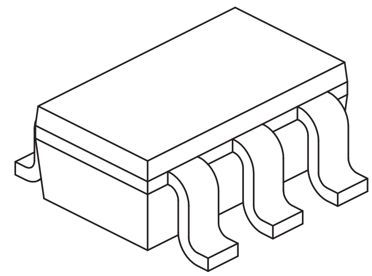
5-Lead Plastic Thin Small Outline Transistor (D5A) [TSOT]
Micrel Legacy Package TSOT-5LD-PL-1

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



VIEW A-A
SHEET 1



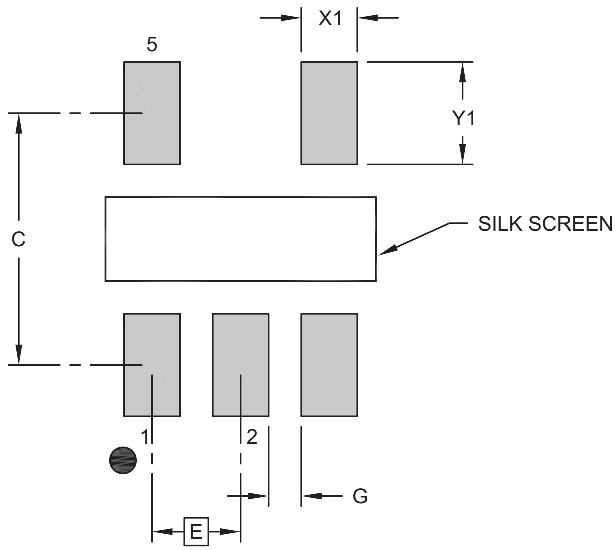
Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Leads	N		5	
Pitch	e		0.95 BSC	
Outside lead pitch	e1		1.90 BSC	
Overall Height	A	-	-	1.00
Molded Package Thickness	A2	0.84	0.87	0.90
Standoff	A1	0.00	-	0.10
Overall Width	E		2.80 BSC	
Molded Package Width	E1		1.60 BSC	
Overall Length	D		2.90 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:
1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25mm per side.
2. 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

Units		MILLIMETERS		
Dimension Limits		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

APPENDIX A: REVISION HISTORY

Revision A (April 2019)

- Converted Micrel document MIC5317 to Microchip data sheet template DS20006195A.
- Minor grammatical text changes throughout.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

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

Device	-X.X	X	XX	-XX
Part No.		Junction Temp. Range	Package	Media Type

Device:	MIC5317:		High Performance Single 150mA LDO
Output Voltage:	1.0	=	1.0V
	1.2	=	1.2V
	1.5	=	1.5V
	1.8	=	1.8V
	2.5	=	2.5V
	2.8	=	2.8V
	3.0	=	3.0V
	3.3	=	3.3V
Junction Temperature Range:	Y	=	–40°C to +125°C, RoHS-Compliant
Package:	MT	=	4-Lead 1 mm x 1 mm UDFN
	M5	=	5-Lead SOT23
	D5	=	5-Lead Thin SOT23
Media Type:	TR	=	3,000/Reel
	TZ	=	10,000/Reel (MT Package Option Only)

Examples:

a) MIC5317-1.0YMT-TR: MIC5317, 1.0V Output Voltage, –40°C to +125°C Temperature Range, 4-Lead 1 mm x 1 mm UDFN, 3,000/Reel

b) MIC5317-1.5YM5-TR: MIC5317, 1.5V Output Voltage, –40°C to +125°C Temperature Range, 5-Lead SOT23, 3,000/Reel

c) MIC5317-2.5YD5-TR: MIC5317, 2.5V Output Voltage, –40°C to +125°C Temperature Range, 5-Lead Thin SOT23, 3,000/Reel

d) MIC5317-2.8YMT-TZ: MIC5317, 2.8V Output Voltage, –40°C to +125°C Temperature Range, 4-Lead 1 mm x 1 mm UDFN, 10,000/Reel

e) MIC5317-3.0YM5-TR: MIC5317, 3.0V Output Voltage, –40°C to +125°C Temperature Range, 5-Lead SOT23, 3,000/Reel

f) MIC5317-3.3YD5-TR: MIC5317, 3.3V Output Voltage, –40°C to +125°C Temperature Range, 5-Lead Thin SOT23, 3,000/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.

NOTES:

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