

800 mA Fixed Low Dropout Positive Regulator

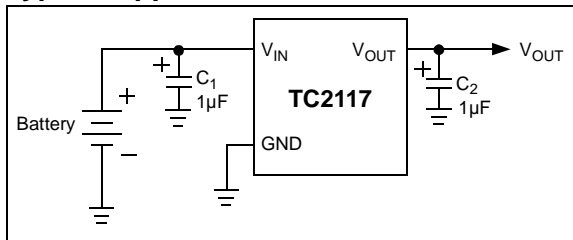
Features:

- Fixed Output Voltages: 1.8V, 2.5V, 3.0V, 3.3V
- Very Low Dropout Voltage
- Rated 800 mA Output Current
- High Output Voltage Accuracy
- Standard or Custom Output Voltages
- Overcurrent and Overtemperature Protection
- Space Saving SOT-223 Package

Applications:

- 5V to 3.3V Linear Regulator
- Portable Computers
- Instrumentation
- Battery Operated Systems
- Linear Post-Regulator for SMPS
- Core Voltage Supply for FPGAs, PLDs, CPUs and DSPs

Typical Application

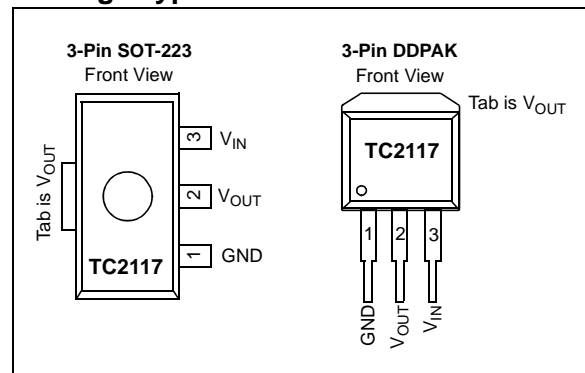


General Description:

The TC2117 is a fixed, high-accuracy (typically $\pm 0.5\%$) CMOS low dropout regulator. Designed specifically for battery operated systems, the TC2117's CMOS construction eliminates wasted ground current, significantly extending battery life. Total supply current is typically 80 μA at full load (20 to 60 times lower than in bipolar regulators).

TC2117 key features include ultra low noise, very low dropout voltage (typically 450 mV at full load), and fast response to step changes in load. The TC2117 incorporates both overtemperature and overcurrent protection. The TC2117 is stable with an output capacitor of only 1 μF and has a maximum output current of 800 mA. This device is available in 3-Pin SOT-223 and 3-Pin DDPAK packages.

Package Types



TC2117

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Input Voltage	6.5V
Output Voltage.....	(V _{SS} - 0.3) to (V _{IN} + 0.3V)
Power Dissipation.....	Internally Limited (Note 7)
Maximum Voltage on Any Pin	V _{IN} +0.3V to -0.3V
Operating Temperature	-40°C < T _J < +125°C
Storage temperature	-65°C to +150°C

† **Notice:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

DC CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, V _{IN} = V _R + 1.5V, (Note 1), I _L = 100 μA, C _L = 3.3 μF, T _A = +25°C. Boldface type specifications apply for junction temperatures of -40°C to +125°C.						
Parameters	Sym	Min	Typ	Max	Units	Conditions
Input Operating Voltage	V _{IN}	2.7	—	6.0	V	Note 2
Maximum Output Current	I _{OUTMAX}	800	—	—	mA	
Output Voltage	V _{OUT}	V_R - 2.5%	V _R ± 0.5%	V_R + 2.5%	V	V _R ≥ 2.5V
		V_R - 2%	V _R ± 0.5%	V_R + 3%		V _R = 1.8V
V _{OUT} Temperature Coefficient	ΔV _{OUT} /ΔT	—	40	—	ppm/°C	Note 3
Line Regulation	ΔV _{OUT} /ΔV _{IN}	—	0.007	0.35	%	(V _R + 1V) ≤ V _{IN} ≤ 6V
Load Regulation (Note 4)	ΔV _{OUT} /V _{OUT}	-0.01	0.002	0	%/mA	I _L = 0.1 mA to I _{OUTMAX}
Dropout Voltage (Note 5)	V _{IN} -V _{OUT}	—	20	30	mV	V _R ≥ 2.5V, I _L = 100 μA
		—	50	160		I _L = 100 mA
		—	150	480		I _L = 300 mA
		—	260	800		I _L = 500 mA
		—	450	1300		I _L = 800 mA
		—	1000	1200		V _R = 1.8V, I _L = 500 mA
		—	1200	1400		I _L = 800 mA
Supply Current	I _{DD}	—	80	130	μA	$\overline{\text{SHDN}} = V_{IH}, I_L = 0$
Power Supply Rejection Ratio	PSRR	—	55	—	db	F ≤ 1 kHz
Output Short Circuit Current	I _{OUTSC}	—	1200	—	mA	V _{OUT} = 0V
Thermal Regulation	ΔV _{OUT} /ΔP _D	—	0.04	—	V/W	Note 6
Output Noise	eN	—	300	—	nV/√Hz	I _L = 100 mA, F = 10 kHz

- Note 1:** V_R is the regulator output voltage setting.
- 2:** The minimum V_{IN} has to justify the conditions: V_{IN} ≥ V_R + V_{DROPOUT} and V_{IN} ≥ 2.7V for I_L = 0.1 mA to I_{OUTMAX}.
- 3:**
- $$TCV_{OUT} = \frac{(V_{OUTMAX} - V_{OUTMIN}) - 10^6}{V_{OUT} \times \Delta T}$$
- 4:** Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 0.1 mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.
- 5:** Dropout voltage is defined as the input-to-output differential at which the output voltage drops 2% below its nominal value measured at a 1.5V differential.
- 6:** Thermal regulation is defined as the change in output voltage at a time T after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a current pulse equal to I_{LMAX} at V_{IN} = 6V for T = 10 ms.
- 7:** 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 causes the device to initiate thermal shutdown. Please see **Section 4.2 "Thermal Considerations"** for more details.

TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, $V_{IN} = V_R + 1.5V$, $I_L = 100 \mu A$, $C_L = 3.3 \mu F$, $\overline{SHDN} > V_{IH}$, $T_A = +25^\circ C$.						
Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges						
Specified Temperature Range	T_A	-40	—	+125	$^\circ C$	(Note 1)
Operating Temperature Range	T_J	-40	—	+125	$^\circ C$	
Storage Temperature Range	T_A	-65	—	+150	$^\circ C$	
Thermal Package Resistances						
Thermal Resistance, 3L-SOT-223	θ_{JA}	—	59	—	$^\circ C/W$	
Thermal Resistance, 3L-DDPAK	θ_{JA}	—	71	—	$^\circ C/W$	

Note 1: Operation in this range must not cause T_J to exceed Maximum Junction Temperature (+125 $^\circ C$).

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.

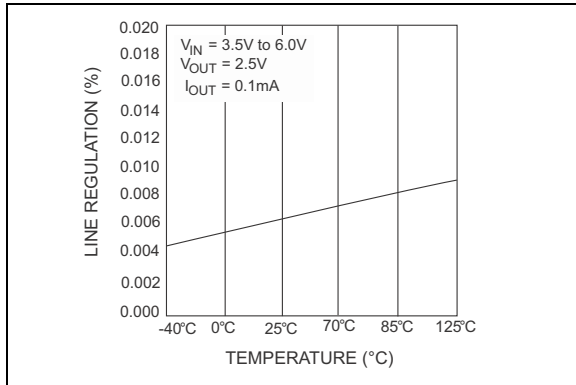


FIGURE 2-1: Line Regulation vs. Temperature.

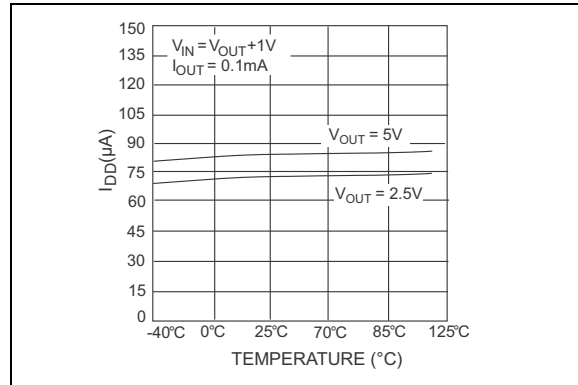


FIGURE 2-4: I_{DD} vs. Temperature.

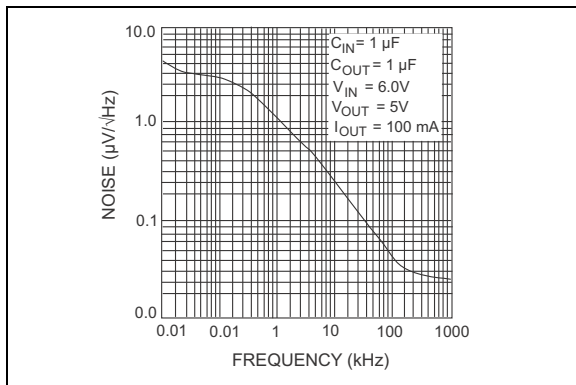


FIGURE 2-2: Output Noise vs. Frequency.

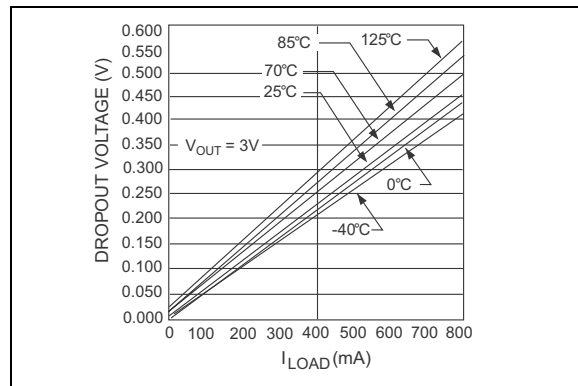


FIGURE 2-5: Dropout Voltage vs. I_{LOAD} .

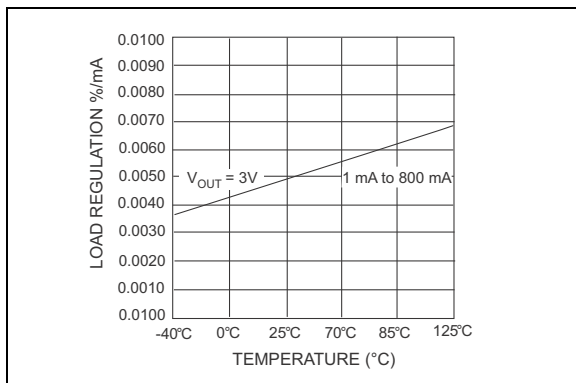


FIGURE 2-3: Load Regulation vs. Temperature.

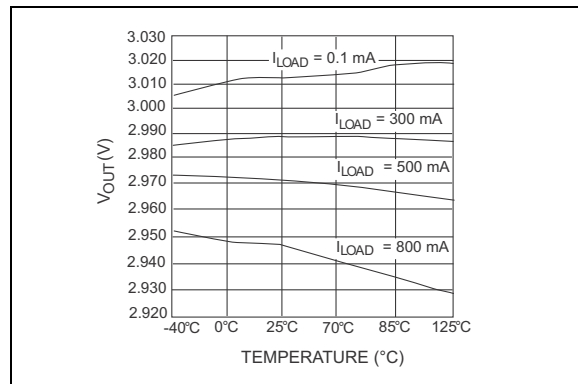


FIGURE 2-6: 3.0V V_{OUT} vs. Temperature.

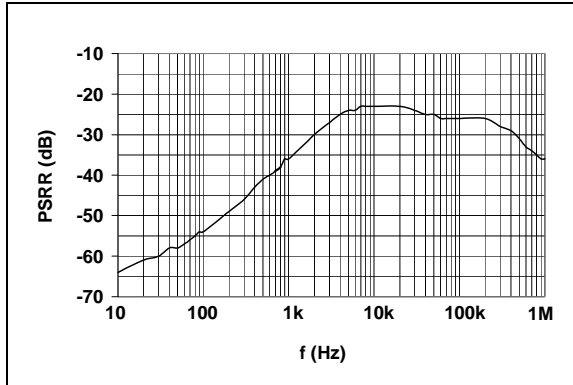


FIGURE 2-7: Power Supply Rejection Ratio.

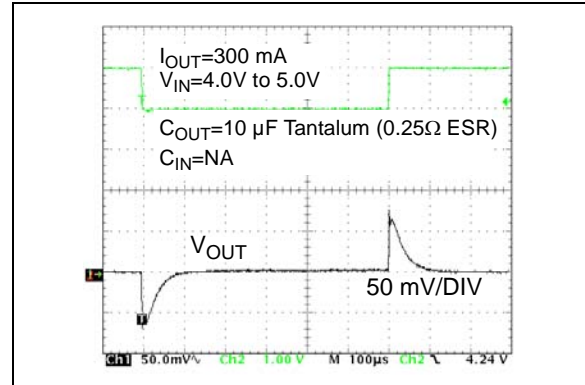


FIGURE 2-9: Line Step Response

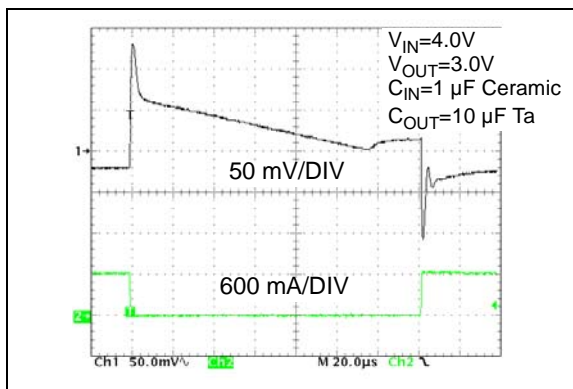


FIGURE 2-8: Load Step Response.

3.0 PIN DESCRIPTIONS

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

TABLE 3-1: PIN FUNCTION TABLE

Pin No. (3-Pin SOT-223) (3-Pin DDPAK)	Symbol	Description
1	GND	Ground Terminal.
2	V_{OUT}	Regulated output voltage.
3	V_{IN}	Unregulated Supply input.

3.1 Ground (GND)

Ground terminal.

3.2 Regulated Output Voltage (V_{OUT})

Regulated voltage output.

3.3 Unregulated Supply (V_{IN})

Unregulated supply input.

4.0 DETAILED DESCRIPTION

The TC2117 is a precision, positive output LDO. Unlike bipolar regulators, the TC2117 supply current does not increase proportionally with load current. In addition, V_{OUT} remains stable and within regulation over the entire 0 mA to 800 mA operating load range.

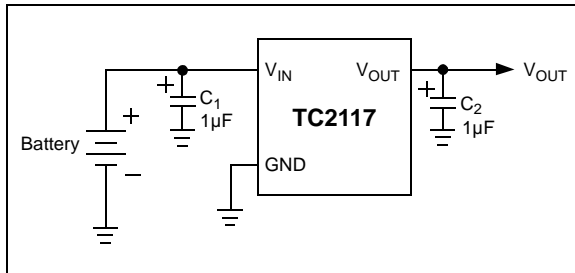


FIGURE 4-1: Typical Application Circuit.

4.1 Output Capacitor

A 1 μF (min) capacitor from V_{OUT} to ground is required. The output capacitor should have an effective series resistance of 0.2 Ω to 10 Ω . A 1 μF capacitor should be connected from V_{IN} to GND if there is more than 10 inches of wire between the regulator and the AC filter capacitor, or if a battery is used as the power source. Aluminum electrolytic or tantalum capacitor types can be used. (Since many aluminum electrolytic capacitors freeze at approximately -30°C, solid tantalums are recommended for applications operating below -25°C.) When operating from sources other than batteries, supply noise rejection and transient response can be improved by increasing the value of the input and output capacitors and employing passive filtering techniques.

4.2 Thermal Considerations

4.2.1 THERMAL SHUTDOWN

Integrated thermal protection circuitry shuts the regulator off when die temperature exceeds 160°C. The regulator remains off until the die temperature drops to approximately 150°C.

4.2.2 POWER DISSIPATION

The amount of power the regulator dissipates is primarily a function of input and output voltage, and output current. The following equation is used to calculate the worst-case actual power dissipation:

EQUATION 4-1:

$$P_D = (V_{INMAX} - V_{OUTMIN})I_{LOADMAX}$$

Where:

- P_D = Worst-case actual power dissipation
- V_{INMAX} = Maximum voltage on V_{IN}
- V_{OUTMIN} = Minimum regulator output voltage
- $I_{LOADMAX}$ = Maximum output (load) current

The maximum *allowable* power dissipation (Equation 4-2) is a function of the maximum ambient temperature (T_{AMAX}), the maximum allowable die temperature (+125°C) and the thermal resistance from junction-to-air (θ_{JA}).

EQUATION 4-2:

$$P_{DMAX} = \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}}$$

Where all terms are previously defined.

Table 4-2 shows various values of θ_{JA} for the TC2117 mounted on a 1/16 inch, 2-layer PCB with 1 oz. copper foil.

TABLE 4-2: THERMAL RESISTANCE GUIDELINES FOR TC2117 IN 3-PIN SOT-223 PACKAGE

Copper Area (Topside)*	Copper Area (Backside)	Board Area	Thermal Resistance
2500 sq mm	2500 sq mm	2500 sq mm	45°C/W
1000 sq mm	2500 sq mm	2500 sq mm	45°C/W
225 sq mm	2500 sq mm	2500 sq mm	53°C/W
100 sq mm	2500 sq mm	2500 sq mm	59°C/W
1000 sq mm	1000 sq mm	1000 sq mm	52°C/W
1000 sq mm	0 sq mm	1000 sq mm	55°C/W

* Tab of device attached to topside copper.

TC2117

TABLE 4-3: THERMAL RESISTANCE GUIDELINES FOR TC2117 IN 3-PIN DDPK PACKAGE

Copper Area (Topside)*	Copper Area (Backside)	Board Area	Thermal Resistance (θ_{JA})
2500 sq mm	2500 sq mm	2500 sq mm	25°C/W
1000 sq mm	2500 sq mm	2500 sq mm	27°C/W
125 sq mm	2500 sq mm	2500 sq mm	35°C/W

*Tab of device attached to topside copper.

Equation 4-1 can be used in conjunction with Equation 4-2 to ensure regulator thermal operation is within limits. For example:

Given:

$$\begin{aligned}V_{INMAX} &= 5.0V \pm 5\% \\V_{OUTMIN} &= 3.3V \pm 0.5\% \\I_{LOADMAX} &= 400 \text{ mA} \\T_{JMAX} &= 125^\circ\text{C} \\T_{AMAX} &= 55^\circ\text{C} \\\theta_{JA} &= 59^\circ\text{C/W (SOT-223)}\end{aligned}$$

Find: 1. Actual power dissipation
2. Maximum allowable dissipation

Actual power dissipation:

$$\begin{aligned}P_D &\approx (V_{INMAX} - V_{OUTMIN})I_{LOADMAX} \\&= [(5.0 \times 1.05) - (3.3 \times .995)] 400 \times 10^{-3} \\&= 786 \text{ mW}\end{aligned}$$

Maximum allowable power dissipation:

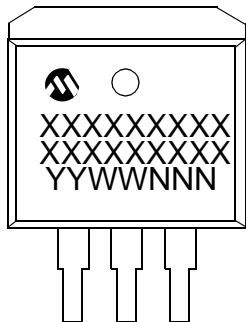
$$\begin{aligned}P_{DMAX} &= \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}} \\&= \frac{(125 - 55)}{59} \\&= 1.186\text{W}\end{aligned}$$

In this example, the TC2117 dissipates a maximum of only 786 mW, which is below the allowable limit of 1.186W. In a similar manner, Equation 4-1 and Equation 4-2 can be used to calculate the maximum current and/or input voltage limits.

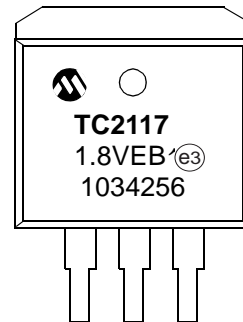
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

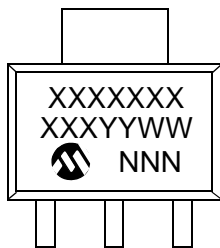
3-Lead DDPAK



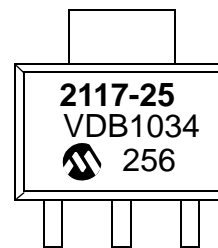
Example



3-Lead SOT-223



Example



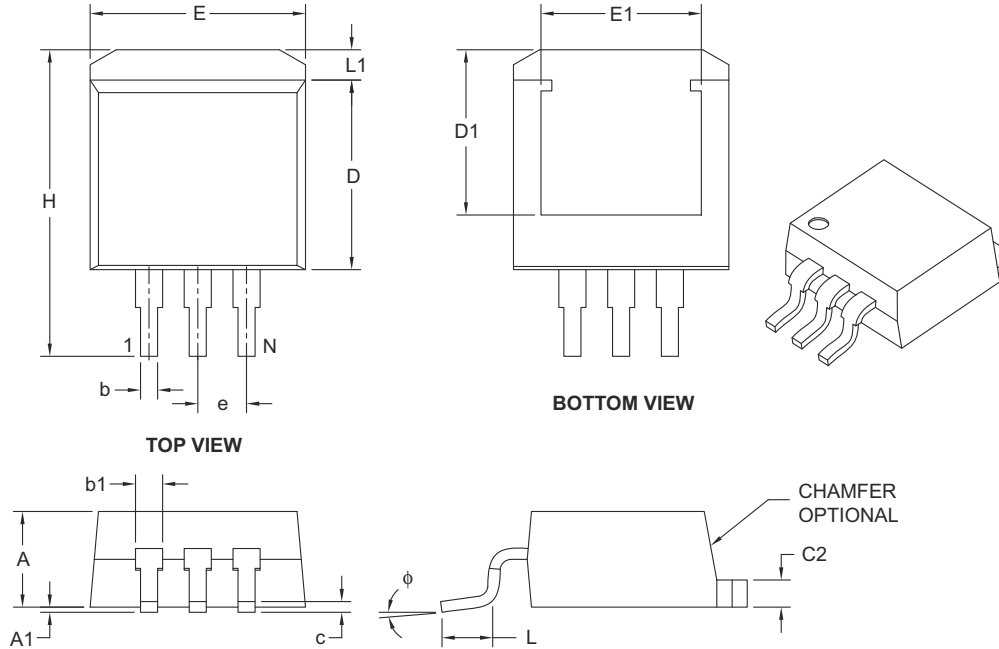
Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.

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.

TC2117

3-Lead Plastic (EB) [DDPAK]

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



Dimension Limits	Units	INCHES		
		MIN	NOM	MAX
Number of Pins	N	3		
Pitch	e	.100 BSC		
Overall Height	A	.160	–	.190
Standoff §	A1	.000	–	.010
Overall Width	E	.380	–	.420
Exposed Pad Width	E1	.245	–	–
Molded Package Length	D	.330	–	.380
Overall Length	H	.549	–	.625
Exposed Pad Length	D1	.270	–	–
Lead Thickness	c	.014	–	.029
Pad Thickness	C2	.045	–	.065
Lower Lead Width	b	.020	–	.039
Upper Lead Width	b1	.045	–	.070
Foot Length	L	.068	–	.110
Pad Length	L1	–	–	.067
Foot Angle	ϕ	0°	–	8°

Notes:

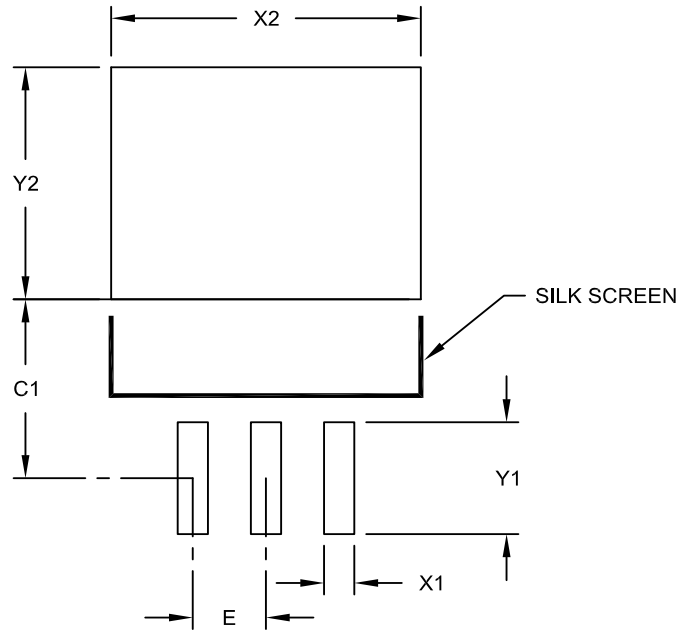
- § Significant Characteristic.
- Dimensions D and E do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" per side.
- Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-011B

3-Lead Plastic (EB) [DDPAK]

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	INCHES		
		MIN	NOM	MAX
Contact Pitch	E	.100 BSC		
Pad Width	X2			.423
Pad Length	Y2			.327
Contact Pad Spacing	C1		.252	
Contact Pad Width (X3)	X1			.041
Contact Pad Length (X3)	Y1			.157

Notes:

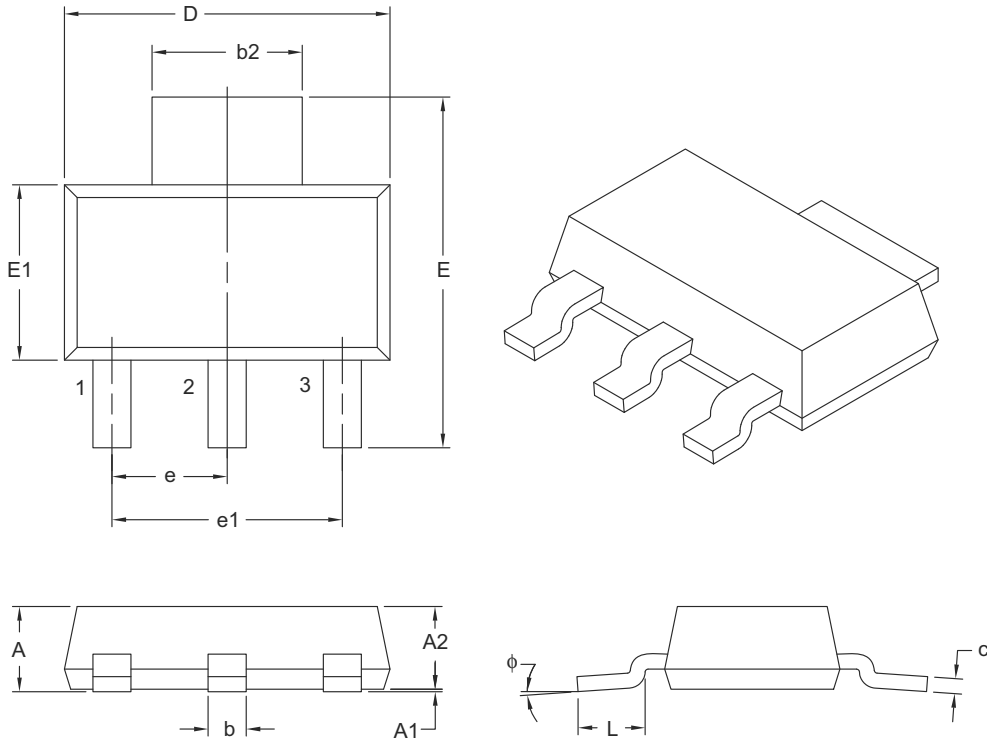
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2011A

3-Lead Plastic Small Outline Transistor (DB) [SOT-223]

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	3		
Lead Pitch	e	2.30 BSC		
Outside Lead Pitch	e1	4.60 BSC		
Overall Height	A	–	–	1.80
Standoff	A1	0.02	–	0.10
Molded Package Height	A2	1.50	1.60	1.70
Overall Width	E	6.70	7.00	7.30
Molded Package Width	E1	3.30	3.50	3.70
Overall Length	D	6.30	6.50	6.70
Lead Thickness	c	0.23	0.30	0.35
Lead Width	b	0.60	0.76	0.84
Tab Lead Width	b2	2.90	3.00	3.10
Foot Length	L	0.75	–	–
Lead Angle	ϕ	0°	–	10°

Notes:

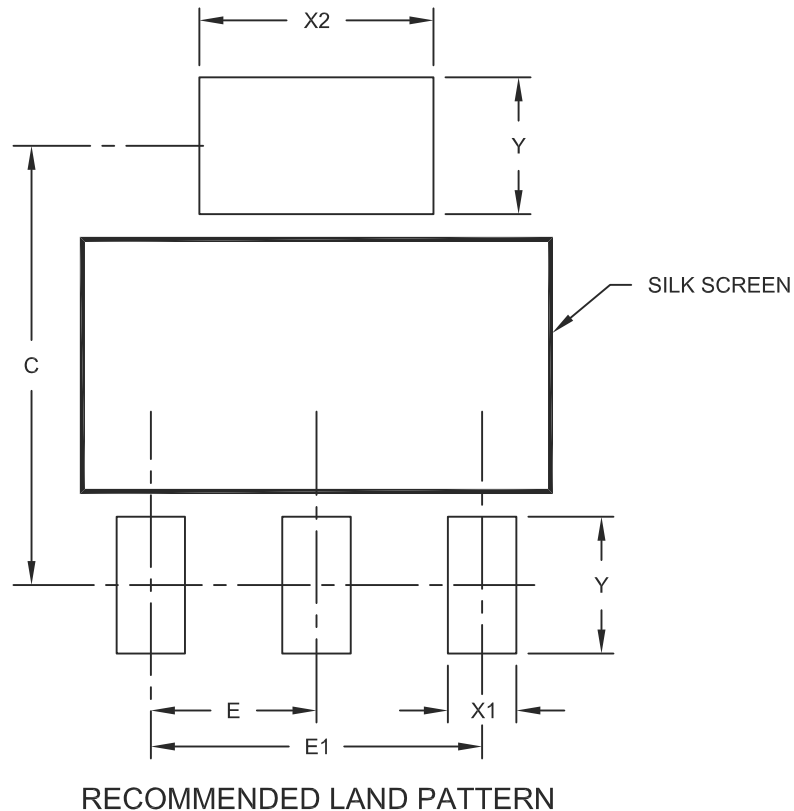
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.127 mm per side.
- Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-032B

3-Lead Plastic Small Outline Transistor (DB) [SOT-223]

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
Contact Pitch	E		2.30 BSC	
Overall Pitch	E1		4.60 BSC	
Contact Pad Spacing	C		6.10	
Contact Pad Width	X1			0.95
Contact Pad Width	X2			3.25
Contact Pad Length	Y			1.90

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2032A

TC2117

NOTES:

APPENDIX A: REVISION HISTORY

Revision D (September 2010)

The following is the list of modifications:

1. Updated [Figure 2-4](#).
2. Updated package drawings (C04-011B, C04-2011A, C04-032B, C04-2032A).

Revision C (October 2006)

The following is the list of modifications:

1. **Section 1.0 “Electrical Characteristics”**: Changed dropout voltage typical value for $I_L = 500$ mA from 700 to 1000 and maximum value from 1000 to 1200 for. Changed typical value for $I_L = 800$ mA from 890 to 1200.
2. **Section 5.0 “Packaging information”**: Added package marking information and package outline drawings.
3. Added disclaimer to package outline drawings.
4. Added Appendix A Revision History.

Revision B (May 2002)

- Undocumented Changes.

Revision A (May 2001)

- Original Release of this Document.

TC2117

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	<u>X.XX</u>	<u>XX</u>	<u>XX</u>
Device	Voltage Option	Package	Tape and Reel
Device	TC2117 Fixed Output CMOS LDO Positive Regulator		
Voltage Option:*	1.8V = 1.8V 2.5V = 2.5V 3.0V = 3.0V 3.3V = 3.3V * Other output voltages are available. Please contact your local Microchip sales office for details.		
Package	DB = Plastic (SOT-223), 3-lead DBTR = Plastic (SOT-223), 3-lead, Tape and Reel EB = Plastic Transistor Outline (DDPAK), 3-Lead EBTR = Plastic Transistor Outline (DDPAK), 3-Lead, Tape and Reel		
Examples:			
a)	TC2117-1.8VEBTR	1.8V LDO, DDPAK-3 pkg., Tape and Reel	
b)	TC2117-2.5VEBTR	2.5V LDO, DDPAK-3 pkg., Tape and Reel	
c)	TC2117-3.0VEBTR	3.0V LDO, DDPAK-3 pkg., Tape and Reel	
d)	TC2117-3.3VEBTR	3.3V LDO, DDPAK-3 pkg., Tape and Reel	
a)	TC2117-1.8VDB	1.8V LDO, SOT-223 pkg.	
b)	TC2117-1.8VDBTR	1.8V LDO, SOT-223 pkg., Tape and Reel	
c)	TC2117-2.5VDB	2.5V LDO, SOT-223 pkg.	
d)	TC2117-2.5VDBTR	2.5V LDO, SOT-223 pkg., Tape and Reel	
e)	TC2117-3.0VDB	3.0V LDO, SOT-223 pkg.	
f)	TC2117-3.0VDBTR	3.0V LDO, SOT-223 pkg., Tape and Reel	
g)	TC2117-3.3VDB	3.3V LDO, SOT-223 pkg.	
h)	TC2117-3.3VDBTR	3.3V LDO, SOT-223 pkg., Tape and Reel	

TC2117

NOTES:

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

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as “unbreakable.”

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, dsPIC, KEELOQ, KEELOQ logo, MPLAB, PIC, PICmicro, PICSTART, PIC³² logo, rPIC and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

FilterLab, Hampshire, HI-TECH C, Linear Active Thermistor, MXDEV, MXLAB, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, HI-TIDE, In-Circuit Serial Programming, ICSP, Mindi, MiWi, MPASM, MPLAB Certified logo, MPLIB, MPLINK, mTouch, Omniscent Code Generation, PICC, PICC-18, PICDEM, PICDEM.net, PICkit, PICTail, REAL ICE, rLAB, Select Mode, Total Endurance, TSHARC, UniWinDriver, WiperLock and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2010, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

ISBN: 978-1-60932-563-3

Microchip received ISO/TS-16949:2002 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

**QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
== ISO/TS 16949:2002 ==**



MICROCHIP

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://support.microchip.com>
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Cleveland
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Chongqing
Tel: 86-23-8980-9588
Fax: 86-23-8980-9500

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-6578-300
Fax: 886-3-6578-370

Taiwan - Kaohsiung
Tel: 886-7-213-7830
Fax: 886-7-330-9305

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

08/04/10