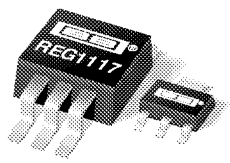
BURR - BROWN®



REG1117
REG1117A

800mA and 1A Low Dropout Positive Regulator 2.85V, 3.3V, 5V, and Adjustable

FEATURES

- 2.85V, 3.3V, 5V, and ADJUSTABLE VERSIONS
- 2.85V MODEL FOR SCSI-2 ACTIVE TERMINATION
- OUTPUT CURRENT:
  REG1117: 800mA max
  REG1117A: 1A max
- OUTPUT TOLERANCE: ±1% max
- DROPOUT VOLTAGE:
  REG1117: 1.2V max at I_O = 800mA
  REG1117A: 1.3V max at I_O = 1A
- INTERNAL CURRENT LIMIT
- THERMAL OVERLOAD PROTECTION
- SOT-223 AND DDPAK SURFACE MOUNT PACKAGES

APPLICATIONS

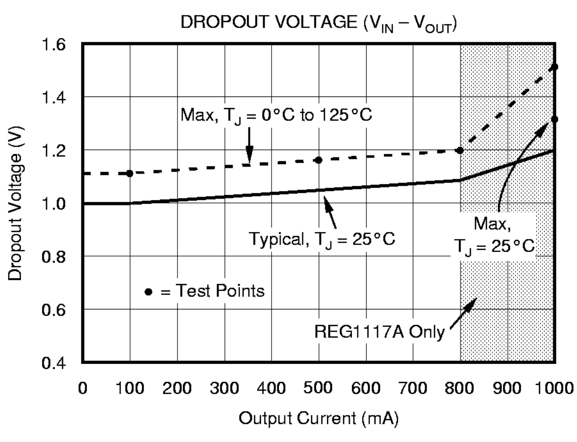
- SCSI-2 ACTIVE TERMINATION
- HAND-HELD DATA COLLECTION DEVICES
- HIGH EFFICIENCY LINEAR REGULATORS
- 5V LINEAR REGULATORS
- BATTERY POWERED INSTRUMENTATION
- BATTERY MANAGEMENT CIRCUITS FOR NOTEBOOK AND PALMTOP PCs

DESCRIPTION

The REG1117 is a family of three-terminal voltage regulators capable of up to 800mA output. The REG1117 is offered in 2.85V, 3.3V, and 5V fixed output versions as well as an adjustable version. The REG1117A provides 1A of output current in an adjustable version. Output voltage of the adjustable versions is set with two external resistors. The REG1117's low dropout voltage allows its use with as little as 1V input-output voltage differential.

Laser trimming assures excellent output voltage accuracy without adjustment. An NPN output stage allows output stage drive to contribute to the load current for maximum efficiency.

REG1117 (all versions) and REG1117A are packaged in an SOT-223 surface-mount package, suitable for reflow soldering techniques. In addition, REG1117-3.3 and REG1117A are available in a 3-Lead DDPAK surface-mount power package.



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PDS-1162G

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SPECIFICATIONS

At T_J = +25°C, unless otherwise noted.

PARAMETER		CONDITIONS	REG1117, REG1117A MIN	TYP	MAX	UNITS
OUTPUT VOLTAGE						
REG1117-2.85		I_O = 10mA, V_{IN} = 4.85V	2.82	2.85	2.88	V
	Note 1	I_O = 0 to 800mA, V_{IN} = 4.05 to 10V	2.79	2.85	2.91	V
REG1117-3.3		I_O = 10mA, V_{IN} = 5.3V	3.27	3.30	3.33	V
	Note 1	I_O = 0 to 800mA, V_{IN} = 4.8 to 10V	3.24	3.30	3.36	V
REG1117-5		I_O = 10mA, V_{IN} = 7V	4.95	5.00	5.05	V
	Note 1	I_O = 0 to 800mA, V_{IN} = 6.5 to 10V	4.90	5.00	5.10	V
REFERENCE VOLTAGE						
REG1117 (Adjustable)		I_O = 10mA, $V_{IN} - V_O$ = 2V	1.238	1.250	1.262	V
	Note 1	I_O = 10 to 800mA, $V_{IN} - V_O$ = 1.4 to 10V	1.225	1.250	1.280	V
REG1117A (Adjustable)		I_O = 10mA, $V_{IN} - V_O$ = 2V	1.238	1.250	1.262	V
	Note 1	I_O = 10mA to 1A, $V_{IN} - V_O$ = 1.4 to 10V	1.225	1.250	1.280	V
LINE REGULATION						
REG1117-2.85	Note 1	I_O = 0, V_{IN} = 4.25 to 10V		1	7	mV
REG1117-3.3	Note 1	I_O = 0, V_{IN} = 4.8 to 10V		2	7	mV
REG1117-5	Note 1	I_O = 0, V_{IN} = 6.5 to 15V		3	10	mV
REG1117 (Adjustable)	Note 1	I_O = 10mA, $V_{IN} - V_O$ = 1.5 to 13.75V		0.1	0.4	%
REG1117A (Adjustable)	Note 1	I_O = 10mA, $V_{IN} - V_O$ = 1.5 to 13.75V		0.1	0.4	%
LOAD REGULATION						
REG1117-2.85	Note 1	I_O = 0 to 800mA, V_{IN} = 4.25V		2	10	mV
REG1117-3.3	Note 1	I_O = 0 to 800mA, V_{IN} = 4.8V		3	12	mV
REG1117-5	Note 1	I_O = 0 to 800mA, V_{IN} = 6.5V		3	15	mV
REG1117 (Adjustable)	Note 1, 2	I_O = 10 to 800mA, $V_{IN} - V_O$ = 3V		0.1	0.4	%
REG1117A (Adjustable)	Note 1, 2	I_O = 10mA to 1A, $V_{IN} - V_O$ = 3V		0.1	0.4	%
DROPOUT VOLTAGE	Note 3					
All Models	Note 1	I_O = 100mA		1.00	1.10	V
	Note 1	I_O = 500mA		1.05	1.15	V
REG1117 Models	Note 1	I_O = 800mA		1.10	1.20	V
REG1117A		I_O = 1A		1.2	1.30	V
	Note 1	I_O = 1A		1.2	1.55	V
CURRENT LIMIT						
REG1117 Models		$V_{IN} - V_O$ = 5V	800	950	1200	mA
REG1117A		$V_{IN} - V_O$ = 5V	1000	1250	1600	mA
MINIMUM LOAD CURRENT						
Adjustable Models	Note 1, 2	$V_{IN} - V_O$ = 13.75V		1.7	5	mA
QUIESCENT CURRENT						
Fixed-Voltage Models	Note 1	$V_{IN} - V_O$ = 5V		4	10	mA
Adjust Pin Current	Note 1, 2	I_O = 10mA, $V_{IN} - V_O$ = 1.4 to 10V		50	120	µA
vs Load Current, REG1117	Note 1	I_O = 10mA to 800mA, $V_{IN} - V_O$ = 1.4 to 10V		0.5	5	µA
vs Load Current, REG1117A	Note 1	I_O = 10mA to 1A, $V_{IN} - V_O$ = 1.4 to 10V		0.5	5	µA
THERMAL REGULATION						
All Models	Note 4	30ms Pulse		0.01	0.1	%/W
RIPPLE REJECTION						
All Models		f = 120Hz, $V_{IN} - V_{OUT}$ = 3V+1V_{PP} Ripple		62		dB
TEMPERATURE DRIFT						
Fixed-Voltage Models		T_J = 0°C to +125°C		0.5		%
Adjustable Models		T_J = 0°C to +125°C		2		%
LONG-TERM STABILITY						
All Models		T_A = +125°C, 1000Hr		0.3		%
OUTPUT NOISE						
rms Noise, All Models		f = 10Hz to 10kHz		0.003		%
THERMAL RESISTANCE						
Operating Junction Temperature Range			0		+125	°C
Storage Range			–65		+150	°C
Thermal Resistance, θ_{JC}		(Junction-to-Case at Tab)				
3-Lead SOT-223 Surface-Mount				15		°C/W
3-Lead DDPAK Surface-Mount		f > 50Hz		2		°C/W
		dc		3		°C/W
Thermal Resistance, θ_{JA}		(Junction-to-Case at Tab)				
3-Lead DDPAK Surface-Mount		No Heat Sink		65		°C/W

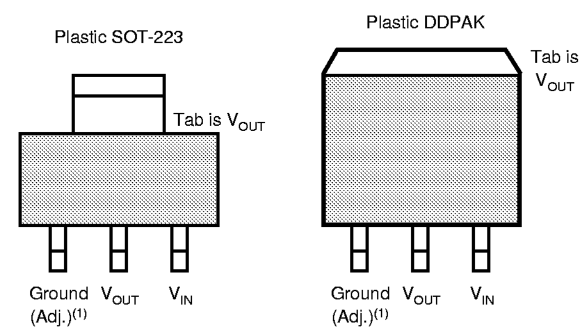
NOTES: (1) Specification applies over the full operating Junction temperature range, 0°C to 125°C. (2) REG1117 and REG1117A adjustable versions require a minimum load current for ±3% regulation. (3) Dropout voltage is the Input voltage minus output voltage that produces a 1% decrease in output voltage. (4) Percentage change in unloaded output voltage before vs after a 30ms power pulse of I_O = 800mA (REG1117 models), I_O = 1A (REG1117A), $V_{IN} - V_O$ = 1.4V (Reading taken 10ms after pulse).

ABSOLUTE MAXIMUM RATINGS[1]

Power Dissipation	Internally Limited
Input Voltage	15V
Operating Junction Temperature Range	0°C to +125°C
Storage Temperature Range	–65°C to +150°C
Lead Temperature (soldering, 10s)[2]	+300°C

NOTE: (1) Stresses above these ratings may cause permanent damage. (2) See "Soldering Methods."

CONNECTION DIAGRAM



NOTE: (1) Adjustable-Voltage Model.

ORDERING INFORMATION

PRODUCT[1]	PART MARKING	PACKAGE
800mA Current Out		
REG1117-2.85	BB11172	Plastic SOT-223
REG1117-3.3	BB11174	Plastic SOT-223
REG1117F-3.3	REG1117F4	Plastic 3-Lead DDPAK
REG1117-5	BB11175	Plastic SOT-223
REG1117	BB1117	Plastic SOT-223
1A Current Out		
REG1117A	BB1117A	Plastic SOT-223
REG1117FA	REG1117FA	Plastic 3-Lead DDPAK

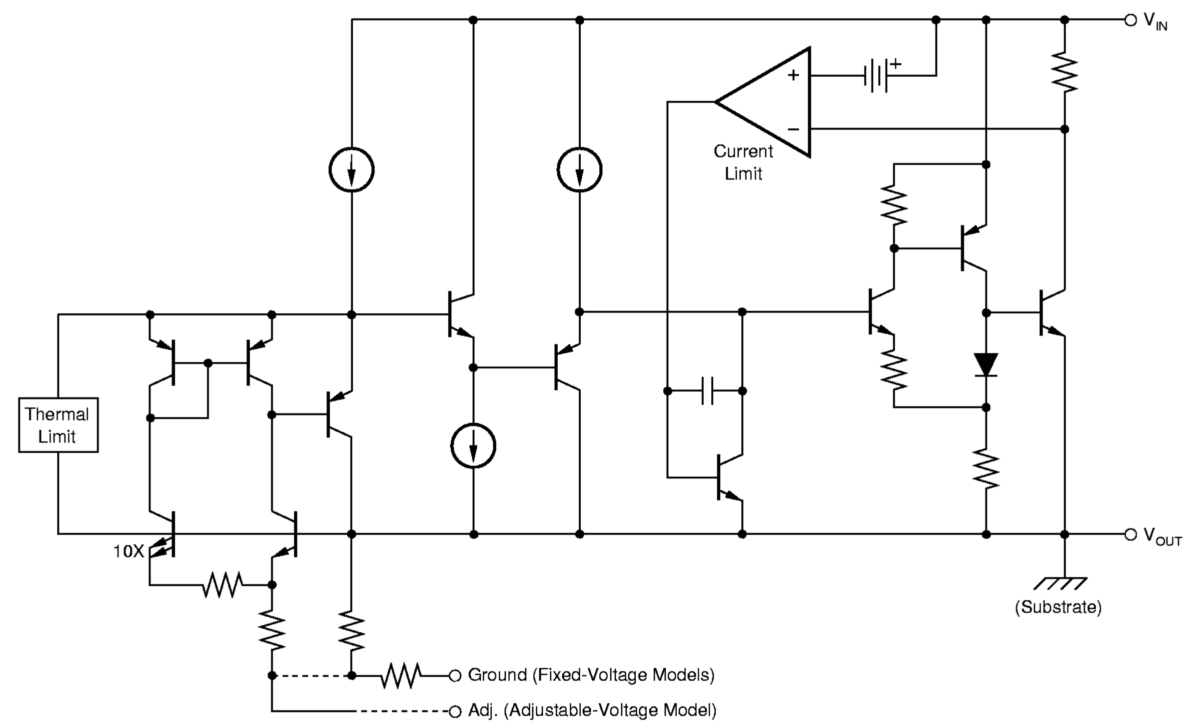
NOTE: (1) Available in Tape and Reel, add –TR to Model Number.

PACKAGE INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER[1]
800mA Current Out		
REG1117-2.85	Plastic SOT-223	311
REG1117-3.3	Plastic SOT-223	311
REG1117F-3.3	Plastic 3-Lead DDPAK	339
REG1117-5	Plastic SOT-223	311
REG1117	Plastic SOT-223	311
1A Current Out		
REG1117A	Plastic SOT-223	311
REG1117FA	Plastic 3-Lead DDPAK	339

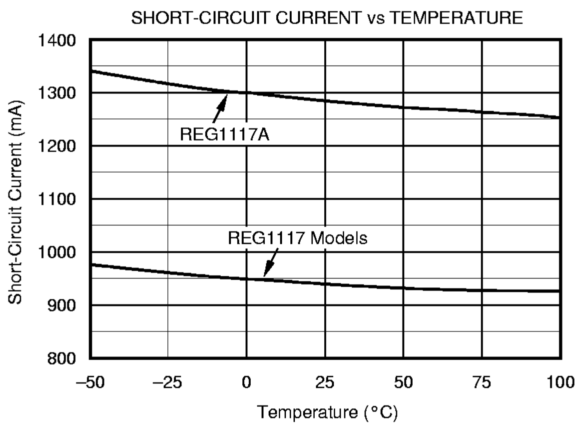
NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

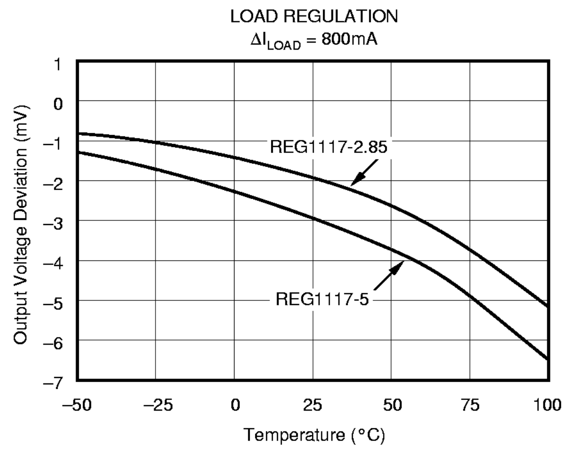
SIMPLIFIED SCHEMATIC

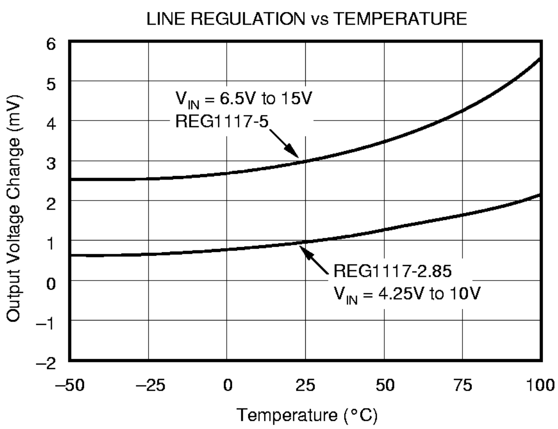


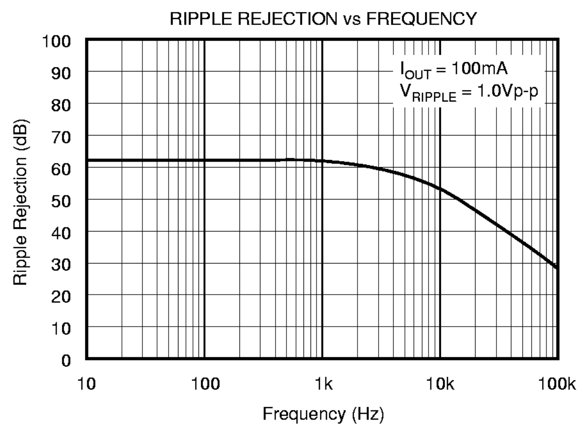
TYPICAL PERFORMANCE CURVE

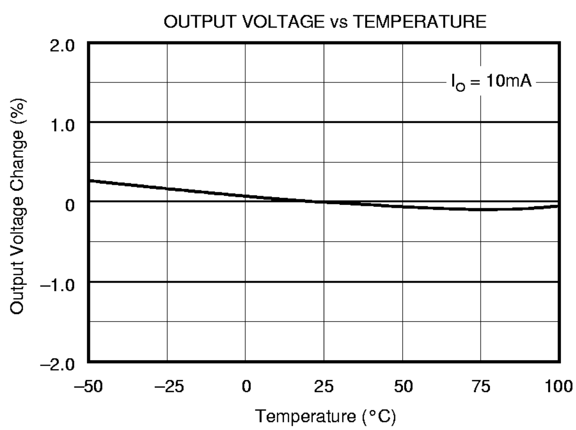
At T_J = +25°C, all models, unless otherwise specified.

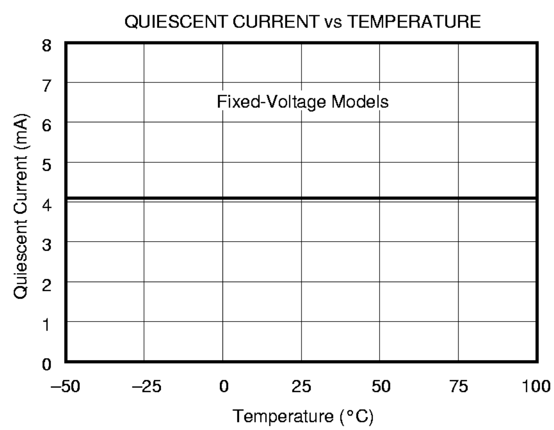






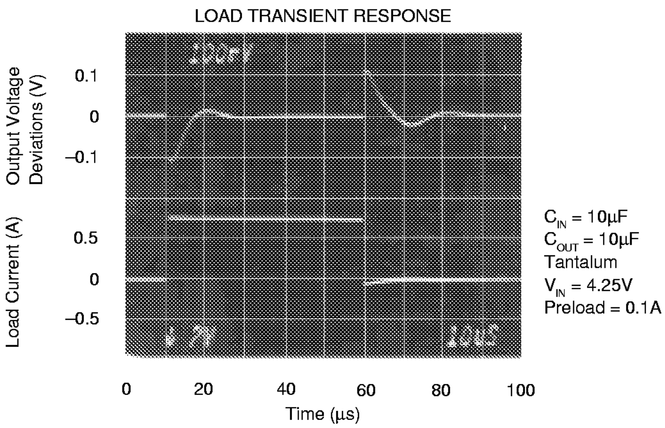


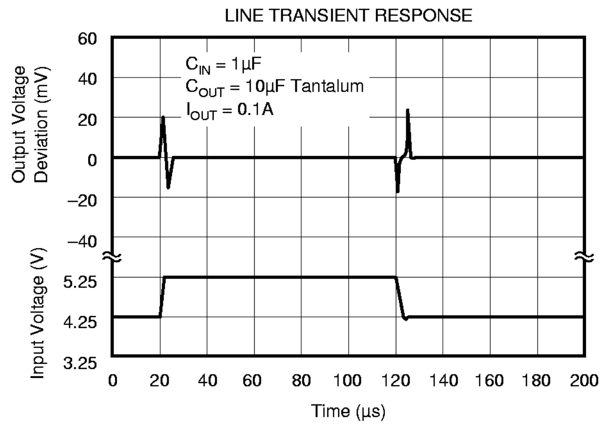




TYPICAL PERFORMANCE CURVE (CONT)

At $T_J = +25°C$, all models, unless otherwise specified.





APPLICATIONS INFORMATION

Figure 1 shows the basic hookup diagram for fixed-voltage models. All models require an output capacitor for proper operation and to improve high frequency load regulation. A 10µF tantalum capacitor is recommended. Aluminum electrolytic types of 50µF or greater can also be used. A high quality capacitor should be used to assure that the ESR (effective series resistance) is less than 0.5Ω.

Figure 2 shows a hookup diagram for the adjustable voltage model. Resistor values are shown for some commonly used output voltages. Values for other voltages can be calculated from the equation shown in Figure 2. For best load regulation, connect R_1 close to the output pin and R_2 close to the ground side of the load as shown.

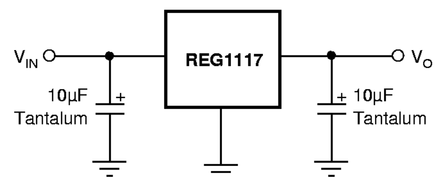
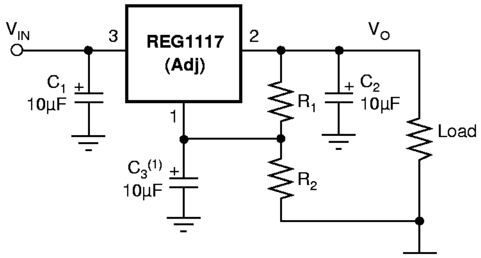


FIGURE 1. Fixed-Voltage Model—Basic Connections.



$$V_O = \frac{R_1 + R_2}{R_1} \bullet (1.25V) + \underbrace{(50\mu A)\,(R_2)}$$

This term is negligible with proper choice of values—see table at right.

V_{OUT} (V)	R_1 (Ω)(2)	R_2 (Ω)(2)
1.25	Open	Short
1.5	750	147
2.1	158	107
2.85	169	215
3	137	191
3.3	115	187
5	113	340
10	113	787

NOTE: (1) C_3 optional. Improves high-frequency line rejection. (2) Resistors are standard 1% values.

FIGURE 2. Adjustable-Voltage Model—Basic Connections.

THERMAL CONSIDERATIONS

The REG1117 has current limit and thermal shutdown circuits that protect it from overload. The thermal shutdown activates at approximately $T_J = 165°C$. For continuous operation, however, the junction temperature should not be allowed to exceed 125°C. Any tendency to activate the thermal shutdown in normal use is an indication of an inadequate heat sink or excessive power dissipation. The power dissipation is equal to:

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

The junction temperature can be calculated by:

$$T_J = T_A + P_D\ (\theta_{JA})$$

where T_A is the ambient temperature, and
θ_{JA} is the junction-to-ambient thermal resistance

A simple experiment will determine whether the maximum recommended junction temperature is exceeded in an actual circuit board and mounting configuration: Increase the ambient temperature above that expected in normal operation until the device's thermal shutdown is activated. If this occurs at more than 40°C above the maximum expected ambient temperature, then the T_J will be less than 125°C during normal operation.

The internal protection circuitry of the REG1117 was designed to protect against overload conditions. It was not intended to replace proper heat sinking. Continuously running the REG1117 into thermal shutdown will degrade reliability.

LAYOUT CONSIDERATIONS

The DDPAK (REG1117F-3.3 and REG1117FA) is a surface-mount power package that has excellent thermal characteristics. For best thermal performance, its mounting tab should be soldered directly to a circuit board copper area (see Figure 3). Increasing the copper area improves heat dissipation. Figure 4 shows typical thermal resistance from junction-to-ambient as a function of the copper area.

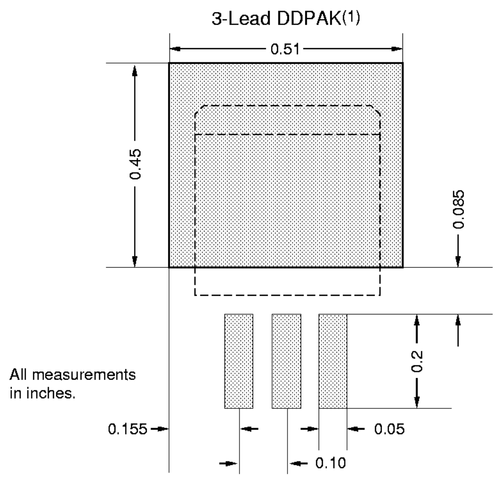


FIGURE 3. DDPAK Thermal Resistance vs Circuit Board Copper Area.

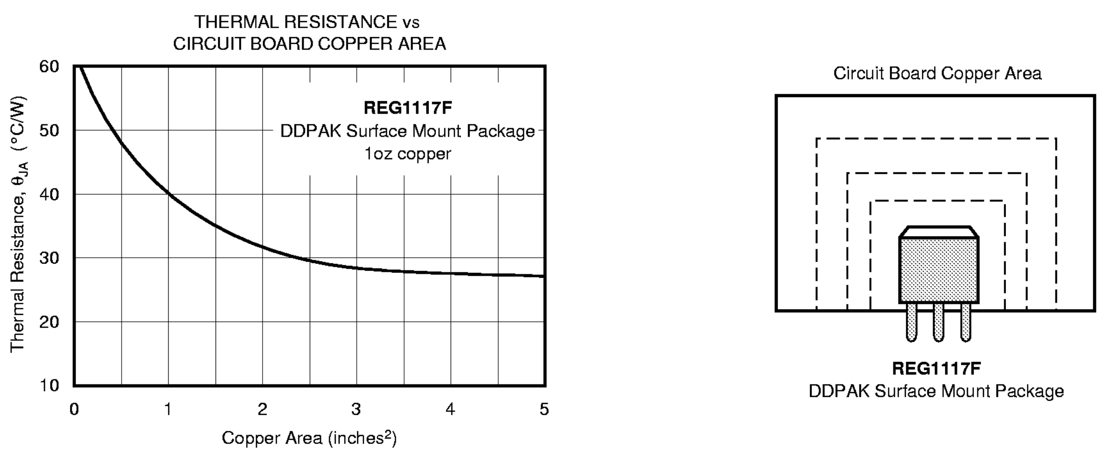


FIGURE 4. DDPAK Thermal Resistance vs Circuit Board Copper Area.

The SOT-223 package derives heat sinking from conduction through its copper leads, especially the large mounting tab. These must be soldered to a circuit board with a substantial amount of copper remaining (see Figure 5). Circuit board traces connecting the tab and the leads should be made as large as practical. The mounting tab of both packages is electrically connected to V_{OUT}.

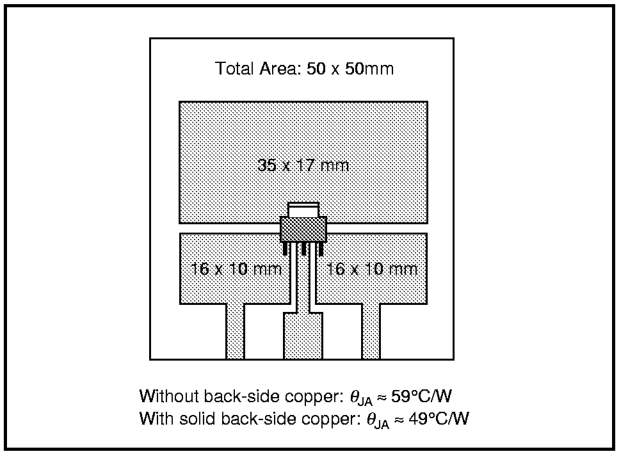


FIGURE 5. SOT-223 Circuit Board Layout Example.

Other nearby circuit traces, including those on the back side of the circuit board, help conduct heat away from the device, even though they may not be electrically connected. Make all nearby copper traces as wide as possible and leave only narrow gaps between traces.

Table I shows approximate values of θ_{JA} for various circuit board and copper areas for the SOT-223 package. Nearby heat dissipating components, circuit board mounting conditions and ventilation can dramatically affect the actual θ_{JA}. Proper heat sinking significantly increases the maximum power dissipation at a given ambient temperature as shown in Figure 6.

SOLDERING METHODS

Both REG1117 packages are suitable for infrared reflow and vapor-phase reflow soldering techniques. The high rate of temperature change that occurs with wave soldering, or hand soldering can damage the REG1117.

TOTAL PC BOARD AREA	TOPSIDE(1) COPPER AREA	BACKSIDE COPPER AREA	SOT-223 THERMAL RESISTANCE JUNCTION-TO-AMBIENT
2500mm^2	2500mm^2	2500mm^2	46°C/W
2500mm^2	1250mm^2	2500mm^2	47°C/W
2500mm^2	950mm^2	2500mm^2	49°C/W
2500mm^2	2500mm^2	0	51°C/W
2500mm^2	1800mm^2	0	53°C/W
1600mm^2	600mm^2	1600mm^2	55°C/W
2500mm^2	1250mm^2	0	58°C/W
2500mm^2	915mm^2	0	59°C/W
1600mm^2	600mm^2	0	67°C/W
900mm^2	340mm^2	900mm^2	72°C/W
900mm^2	340mm^2	0	85°C/W

NOTE: (1) Tab is attached to the topside copper.

TABLE I.

INSPEC Abstract Number: B91007604, C91012627
Kelly, E.G. "Thermal Characteristics of Surface 5WK9Ω Packages." The Proceedings of SMTCON. Surface Mount Technology Conference and Exposition: *Competitive Surface Mount Technology*, April 3-6, 1990, Atlantic City, NJ, USA. *Abstract Publisher*: IC Manage, 1990, Chicago, IL, USA.

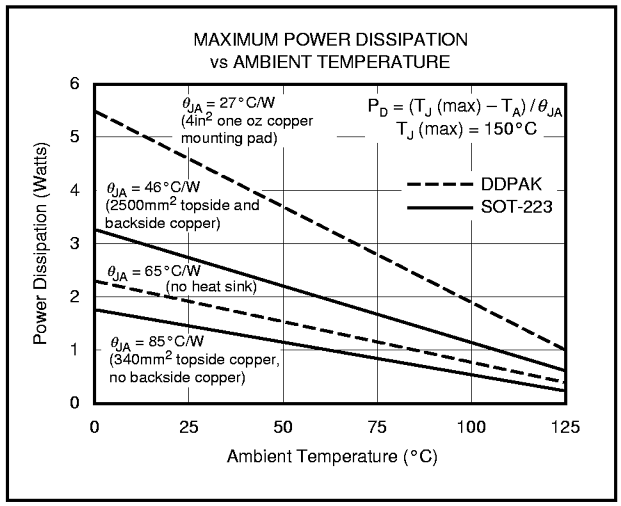


FIGURE 6. Maximum Power Dissipation vs Ambient Temperature.

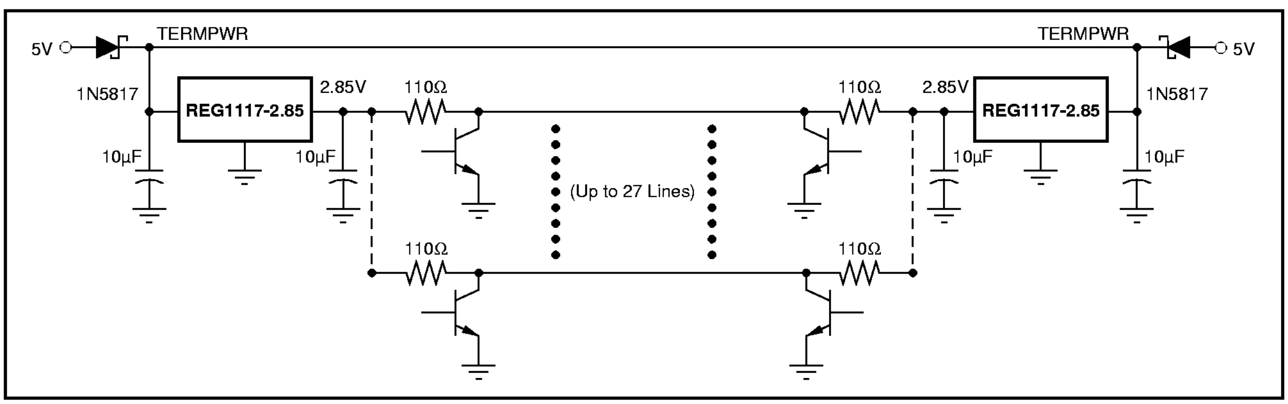


FIGURE 7. SCSI Active Termination Configuration.

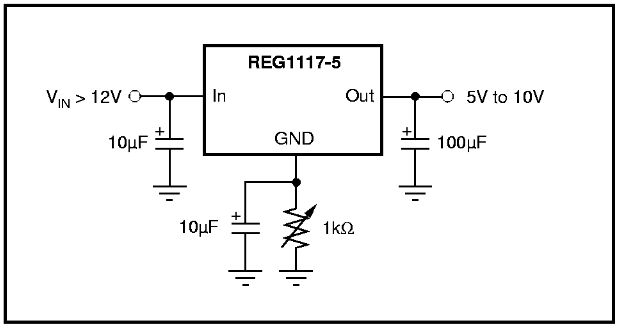


FIGURE 8. Adjusting Output of Fixed Voltage Models.

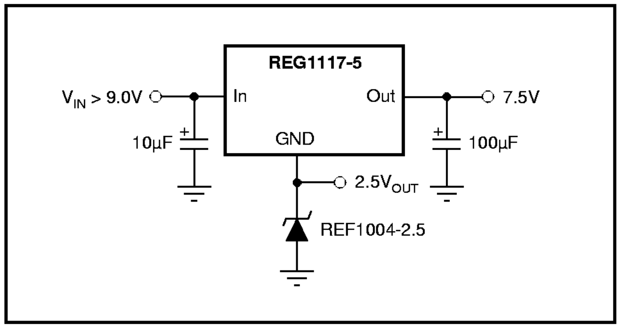


FIGURE 9. Regulator with Reference.

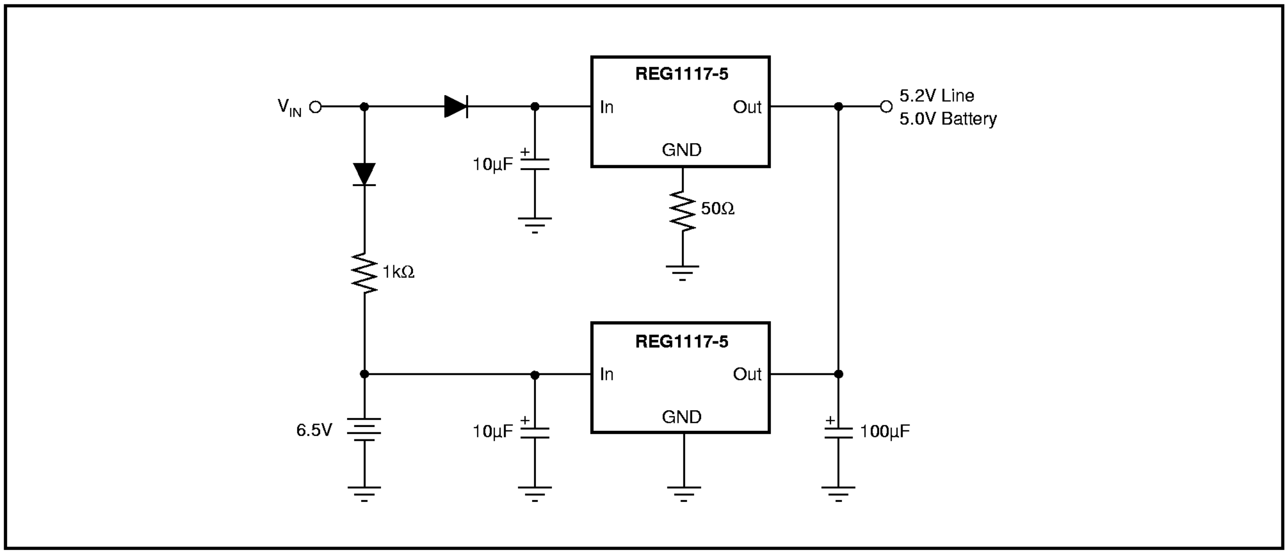


FIGURE 10. Battery Backed-Up Regulated Supply.

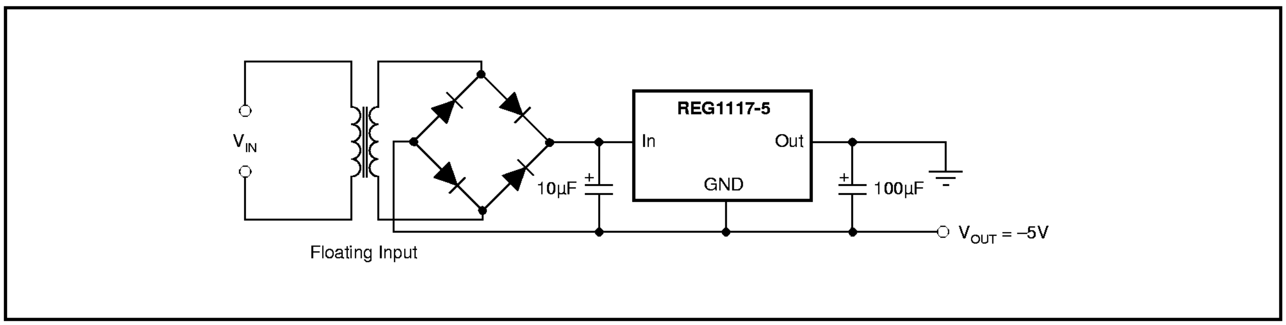
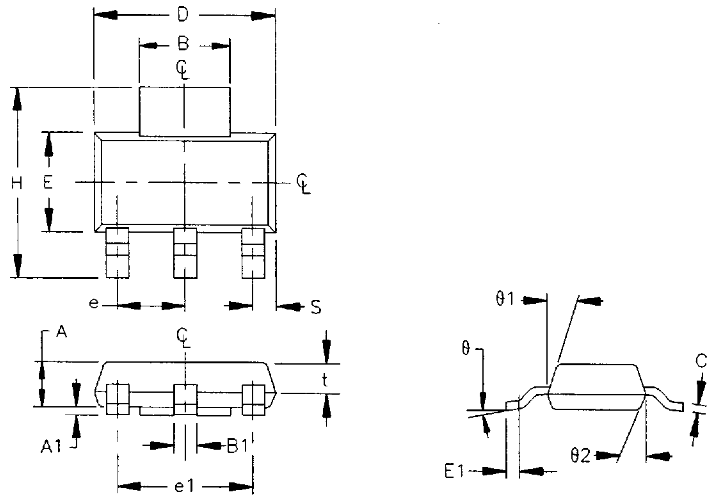


FIGURE 11. Low Dropout Negative Supply.

Package Number 311 - 4-Lead SOT



DIM	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.	NOTE
A	.060	.067	1.50	1.70	
A1	.0008	.004	0.02	0.10	
B	.116	.124	2.95	3.15	
B1	.026	.033	0.66	0.73	
C	.010	.014	0.25	0.35	
D	.248	.264	6.30	6.70	
E	.130	.146	3.30	3.70	
E1	.012 MIN.		0.30 MIN.		
e	.0905 NOM.		2.30 NOM.		
e1	.181 NOM.		4.60 NOM.		
H	.264	.287	6.70	7.30	
S	.033	.041	0.85	1.05	
t	.043	.051	1.10	1.30	
θ	10° MAX.		10° MAX.		

DIM	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.	NOTE
θ1	10°	16°	10°	16°	
θ2	10°	16°	10°	16°	

NOTES:

PACKAGE NUMBER: ZZ311 REV.: A
JEDEC NUMBER: NONE