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1.0 A Low-Dropout Positive Fixed and Adjustable Voltage Regulators

NCP1117, NCP1117I,



SOT−223
ST SUFFIX
CASE 318H

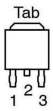


DPAK
DT SUFFIX
CASE 369C

PIN CONFIGURATION



SOT−223
(Top View)



DPAK
(Top View)

Pin: 1. Adjust/Ground
2. Output
3. Input

Heatsink tab is connected to Pin 2.

The NCP1117 series are low dropout positive voltage regulators that are capable of providing an output current that is in excess of 1.0 A with a maximum dropout voltage of 1.2 V at 800 mA over temperature. This series contains nine fixed output voltages of 1.5 V, 1.8 V, 1.9 V, 2.0 V, 2.5 V, 2.85 V, 3.3 V, 5.0 V, and 12 V that have no minimum load requirement to maintain regulation. Also included is an adjustable output version that can be programmed from 1.25 V to 18.8 V with two external resistors. On chip trimming adjusts the reference/output voltage to within ±1.0% accuracy. Internal protection features consist of output current limiting, safe operating area compensation, and thermal shutdown. The NCP1117 series can operate with up to 20 V input. Devices are available in SOT−223 and DPAK packages.

Features

- Output Current in Excess of 1.0 A
- 1.2 V Maximum Dropout Voltage at 800 mA Over Temperature
- Fixed Output Voltages of 1.5 V, 1.8 V, 1.9 V, 2.0 V, 2.5 V, 2.85 V, 3.3 V, 5.0 V, and 12 V
- Adjustable Output Voltage Option
- No Minimum Load Requirement for Fixed Voltage Output Devices
- Reference/Output Voltage Trimmed to ±1.0%
- Current Limit, Safe Operating and Thermal Shutdown Protection
- Operation to 20 V Input

- These are Pb-Free Devices

Applications

- Consumer and Industrial Equipment Point of Regulation
- Active SCSI Termination for 2.85 V Version
- Switching Power Supply Post Regulation
- Hard Drive Controllers
- Battery Chargers

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TYPICAL APPLICATIONS

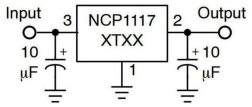

Figure 1. Fixed Output Regulator

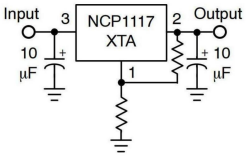

Figure 2. Adjustable Output Regulator

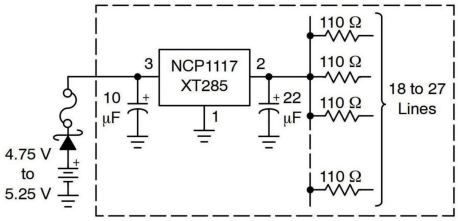

Figure 3. Active SCSI Bus Terminator

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage (Note 1)	V_{in}	20	V
Output Short Circuit Duration (Notes 2 and 3)	–	Infinite	–
Power Dissipation and Thermal Characteristics Case 318H (SOT−223) Power Dissipation (Note 2) Thermal Resistance, Junction−to−Ambient, Minimum Size Pad Thermal Resistance, Junction−to−Case Case 369A (DPAK) Power Dissipation (Note 2) Thermal Resistance, Junction−to−Ambient, Minimum Size Pad Thermal Resistance, Junction−to−Case	 P_D $R_{\theta JA}$ $R_{\theta JC}$ P_D $R_{\theta JA}$ $R_{\theta JC}$	 Internally Limited 160 15 Internally Limited 67 6.0	 W °C/W °C/W W °C/W °C/W
Maximum Die Junction Temperature Range	T_J	−55 to 150	°C
Storage Temperature Range	T_{stg}	−65 to 150	°C
Operating Ambient Temperature Range NCP1117 NCP1117I NCV1117	T_A	 0 to +125 −40 to +125 −40 to +125	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. This device series contains ESD protection and exceeds the following tests:
   Human Body Model (HBM), Class 2, 2000 V
   Machine Model (MM), Class B, 200 V
   Charge Device Model (CDM), Class IV, 2000 V.
2. Internal thermal shutdown protection limits the die temperature to approximately 175°C. Proper heatsinking is required to prevent activation.
   The maximum package power dissipation is: $P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$
3. The regulator output current must not exceed 1.0 A with V_{in} greater than 12 V.

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ELECTRICAL CHARACTERISTICS

(C_{in} = 10 μF, C_{out} = 10 μF, for typical value T_A = 25°C, for min and max values T_A is the operating ambient temperature range that applies unless otherwise noted.) (Note 4)

Characteristic	Symbol	Min	Typ	Max	Unit
Reference Voltage, Adjustable Output Devices (V_{in}–V_{out} = 2.0 V, I_{out} = 10 mA, T_A = 25°C) (V_{in}–V_{out} = 1.4 V to 10 V, I_{out} = 10 mA to 800 mA) (Note 4)	V_{ref}	 1.238 1.225	 1.25 –	 1.262 1.270	V
Output Voltage, Fixed Output Devices	V_{out}				V
1.5 V (V_{in} = 3.5 V, I_{out} = 10 mA, T_A = 25 °C)		1.485	1.500	1.515	
(V_{in} = 2.9 V to 11.5 V, I_{out} = 0 mA to 800 mA) (Note 4)		1.470	–	1.530	
1.8 V (V_{in} = 3.8 V, I_{out} = 10 mA, T_A = 25 °C)		1.782	1.800	1.818	
(V_{in} = 3.2 V to 11.8 V, I_{out} = 0 mA to 800 mA) (Note 4)		1.755	–	1.845	
1.9 V (V_{in} = 3.9 V, I_{out} = 10 mA, T_A = 25 °C)		1.872	1.900	1.929	
(V_{in} = 3.3 V to 11.9 V, I_{out} = 0 mA to 800 mA) (Note 4)		1.862	1.900	1.938	
2.0 V (V_{in} = 4.0 V, I_{out} = 10 mA, T_A = 25 °C)		1.970	2.000	2.030	
(V_{in} = 3.4 V to 12 V, I_{out} = 0 mA to 800 mA) (Note 4)		1.960	–	2.040	
2.5 V (V_{in} = 4.5 V, I_{out} = 10 mA, T_A = 25 °C)		2.475	2.500	2.525	
(V_{in} = 3.9 V to 10 V, I_{out} = 0 mA to 800 mA,) (Note 4)		2.450	–	2.550	
2.85 V (V_{in} = 4.85 V, I_{out} = 10 mA, T_A = 25 °C)		2.821	2.850	2.879	
(V_{in} = 4.25 V to 10 V, I_{out} = 0 mA to 800 mA) (Note 4)		2.790	–	2.910	
(V_{in} = 4.0 V, I_{out} = 0 mA to 500 mA) (Note 4)		2.790	–	2.910	
3.3 V (V_{in} = 5.3 V, I_{out} = 10 mA, T_A = 25 °C)		3.267	3.300	3.333	
(V_{in} = 4.75 V to 10 V, I_{out} = 0 mA to 800 mA) (Note 4)		3.235	–	3.365	
5.0 V (V_{in} = 7.0 V, I_{out} = 10 mA, T_A = 25 °C)		4.950	5.000	5.050	
(V_{in} = 6.5 V to 12 V, I_{out} = 0 mA to 800 mA) (Note 4)		4.900	–	5.100	
12 V (V_{in} = 14 V, I_{out} = 10 mA, T_A = 25 °C)		11.880	12.000	12.120	
(V_{in} = 13.5 V to 20 V, I_{out} = 0 mA to 800 mA) (Note 4)		11.760	–	12.240	
Line Regulation (Note 5) Adjustable (V_{in} = 2.75 V to 16.25 V, I_{out} = 10 mA)	Reg_{line}	–	0.04	0.1	%
1.5 V (V_{in} = 2.9 V to 11.5 V, I_{out} = 0 mA)		–	0.3	1.0	mV
1.8 V (V_{in} = 3.2 V to 11.8 V, I_{out} = 0 mA)		–	0.4	1.0	
1.9 V (V_{in} = 3.3 V to 11.9 V, I_{out} = 0 mA)		–	0.5	2.5	
2.0 V (V_{in} = 3.4 V to 12 V, I_{out} = 0 mA)		–	0.5	2.5	
2.5 V (V_{in} = 3.9 V to 10 V, I_{out} = 0 mA)		–	0.5	2.5	
2.85 V (V_{in} = 4.25 V to 10 V, I_{out} = 0 mA)		–	0.8	3.0	
3.3 V (V_{in} = 4.75 V to 15 V, I_{out} = 0 mA)		–	0.8	4.5	
5.0 V (V_{in} = 6.5 V to 15 V, I_{out} = 0 mA)		–	0.9	6.0	
12 V (V_{in} = 13.5 V to 20 V, I_{out} = 0 mA)		–	1.0	7.5	
Load Regulation (Note 5) Adjustable (I_{out} = 10 mA to 800 mA, V_{in} = 4.25 V)	Reg_{line}	–	0.2	0.4	%
1.5 V (I_{out} = 0 mA to 800 mA, V_{in} = 2.9 V)		–	2.3	5.5	mV
1.8 V (I_{out} = 0 mA to 800 mA, V_{in} = 3.2 V)		–	2.6	6.0	
1.9 V (I_{out} = 0 mA to 800 mA, V_{in} = 3.3 V)		–	2.7	6.0	
2.0 V (I_{out} = 0 mA to 800 mA, V_{in} = 3.4 V)		–	3.0	6.0	
2.5 V (I_{out} = 0 mA to 800 mA, V_{in} = 3.9 V)		–	3.3	7.5	
2.85 V (I_{out} = 0 mA to 800 mA, V_{in} = 4.25 V)		–	3.8	8.0	
3.3 V (I_{out} = 0 mA to 800 mA, V_{in} = 4.75 V)		–	4.3	10	
5.0 V (I_{out} = 0 mA to 800 mA, V_{in} = 6.5 V)		–	6.7	15	
12 V (I_{out} = 0 mA to 800 mA, V_{in} = 13.5 V)		–	16	28	
Dropout Voltage (Measured at V_{out} – 100 mV) (I_{out} = 100 mA) (I_{out} = 500 mA) (I_{out} = 800 mA)	V_{in}–V_{out}	 – – –	 0.95 1.01 1.07	 1.10 1.15 1.20	V
Output Current Limit (V_{in}–V_{out} = 5.0 V, T_A = 25°C, Note 6)	I_{out}	1000	1500	2200	mA
Minimum Required Load Current for Regulation, Adjustable Output Devices (V_{in} = 15 V)	$I_{L(min)}$	–	0.8	5.0	mA

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ELECTRICAL CHARACTERISTICS (continued)
(C_{in} = 10 μF, C_{out} = 10 μF, for typical value T_A = 25°C, for min and max values T_A is the operating ambient temperature range that applies unless otherwise noted.) (Note 4)

Characteristic	Symbol	Min	Typ	Max	Unit
Quiescent Current	I_Q				mA
1.5 V (V_{in} = 11.5 V)		–	3.6	10	
1.8 V (V_{in} = 11.8 V)		–	4.2	10	
1.9 V (V_{in} = 11.9 V)		–	4.3	10	
2.0 V (V_{in} = 12 V)		–	4.5	10	
2.5 V (V_{in} = 10 V)		–	5.2	10	
2.85 V (V_{in} = 10 V)		–	5.5	10	
3.3 V (V_{in} = 15 V)		–	6.0	10	
5.0 V (V_{in} = 15 V)		–	6.0	10	
12 V (V_{in} = 20 V)		–	6.0	10	
Thermal Regulation (T_A = 25°C, 30 ms Pulse)		–	0.01	0.1	%/W
Ripple Rejection (V_{in}–V_{out} = 6.4 V, I_{out} = 500 mA, 10 V_{pp} 120 Hz Sinewave)	RR				dB
Adjustable		67	73	–	
1.5 V		66	72	–	
1.8 V		66	70	–	
1.9 V		66	72	–	
2.0 V		64	70	–	
2.5 V		62	68	–	
2.85 V		62	68	–	
3.3 V		60	64	–	
5.0 V		57	61	–	
12 V		50	54	–	
Adjustment Pin Current (V_{in} = 11.25 V, I_{out} = 800 mA)	I_{adj}	–	52	120	μA
Adjust Pin Current Change (V_{in}–V_{out} = 1.4 V to 10 V, I_{out} = 10 mA to 800 mA)	ΔI_{adj}	–	0.4	5.0	μA
Temperature Stability	S_T	–	0.5	–	%
Long Term Stability (T_A = 25°C, 1000 Hrs End Point Measurement)	S_t	–	0.3	–	%
RMS Output Noise (f = 10 Hz to 10 kHz)	N	–	0.003	–	%V_{out}

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. NCP1117: T_{low} = 0°C, T_{high} = 125°C
   NCP1117I: T_{low} = −40°C, T_{high} = 125°C
   NCV1117: T_{low} = −40°C, T_{high} = 125°C
5. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.
6. The regulator output current must not exceed 1.0 A with V_{in} greater than 12 V.

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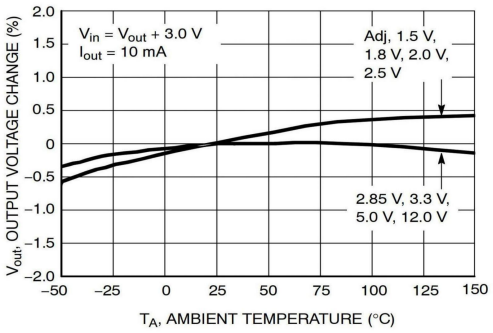

Figure 4. Output Voltage Change vs. Temperature

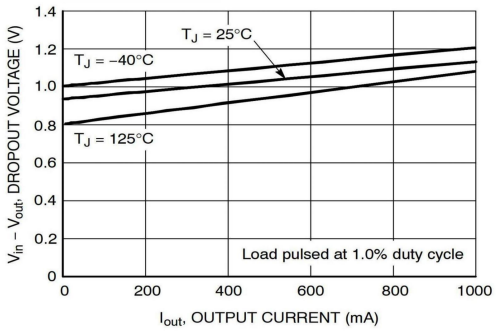

Figure 5. Dropout Voltage vs. Output Current

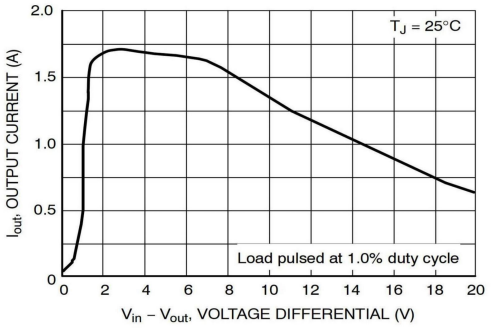

Figure 6. Output Short Circuit Current vs. Differential Voltage

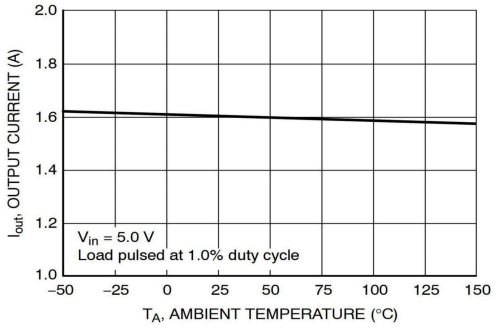

Figure 7. Output Short Circuit Current vs. Temperature

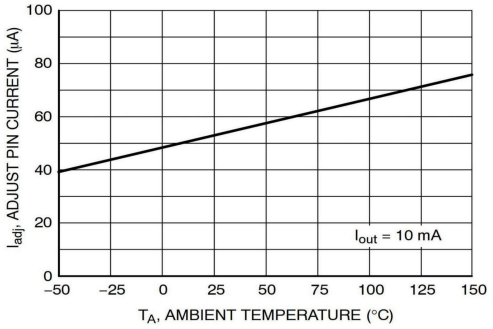

Figure 8. Adjust Pin Current vs. Temperature

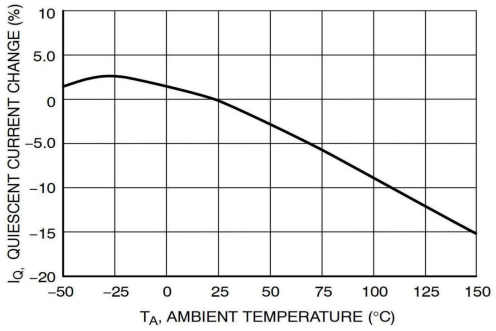

Figure 9. Quiescent Current Change vs. Temperature

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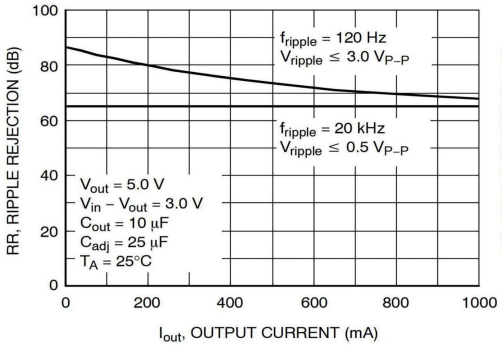

Figure 10. NCP1117XTA Ripple Rejection vs. Output Current

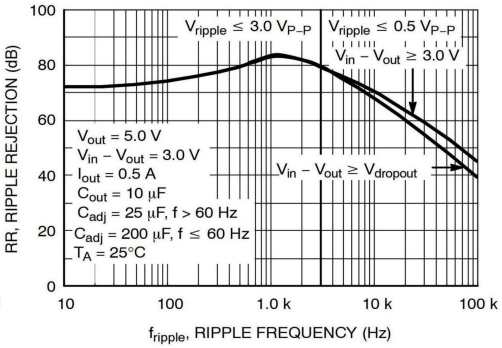

Figure 11. NCP1117XTA Ripple Rejection vs. Frequency

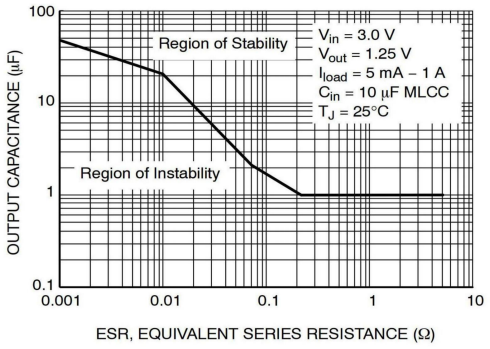

Figure 12. Output Capacitance vs. ESR

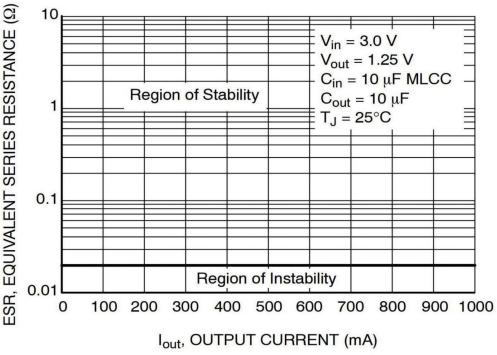

Figure 13. Typical ESR vs. Output Current

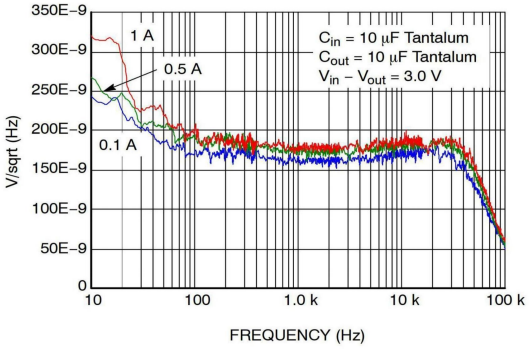

Figure 14. Output Spectral Noise Density vs. Frequency, V_{out} = 1V5

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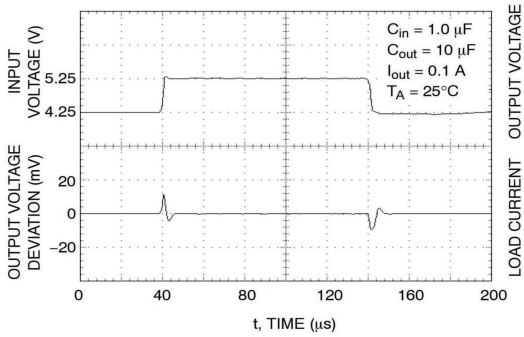

Figure 15. NCP1117XT285 Line Transient Response

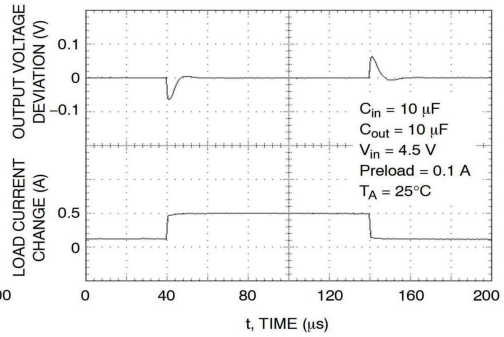

Figure 16. NCP1117XT285 Load Transient Response

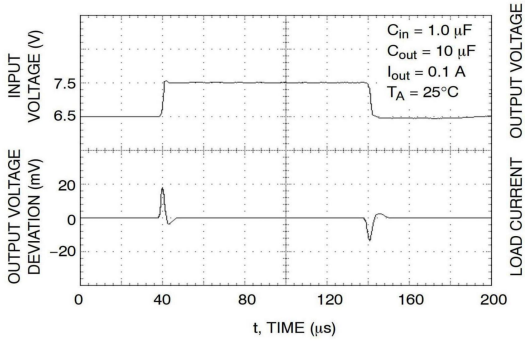

Figure 17. NCP1117XT50 Line Transient Response

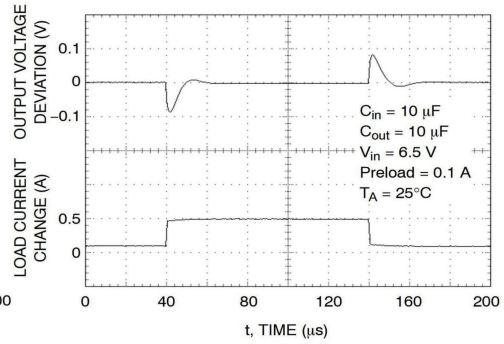

Figure 18. NCP1117XT50 Load Transient Response

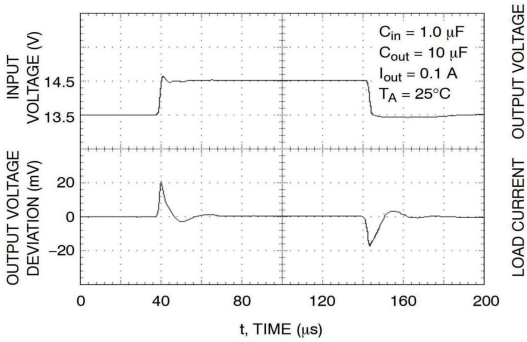

Figure 19. NCP1117XT12 Line Transient Response

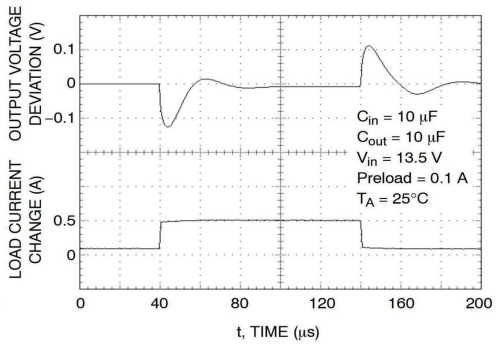

Figure 20. NCP1117XT12 Load Transient Response

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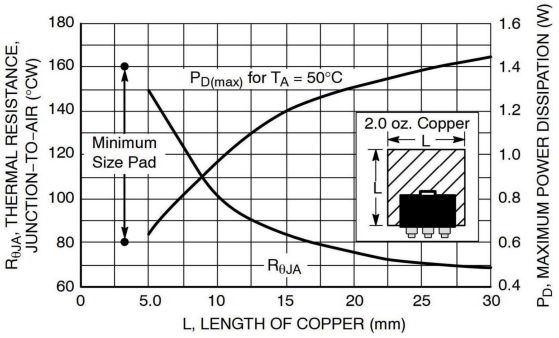

Figure 21. SOT−223 Thermal Resistance and Maximum Power Dissipation vs. P.C.B. Copper Length

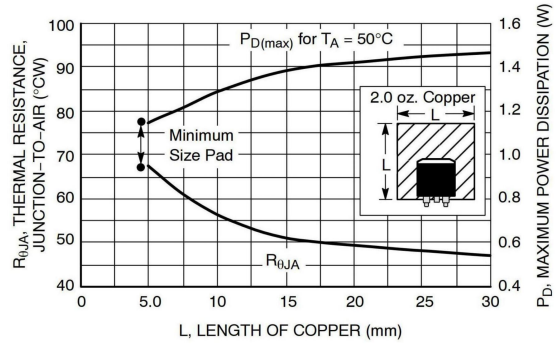

Figure 22. DPAK Thermal Resistance and Maximum Power Dissipation vs. P.C.B. Copper Length

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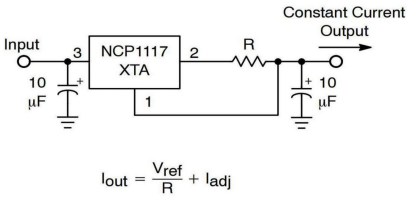


Figure 27. Constant Current Regulator

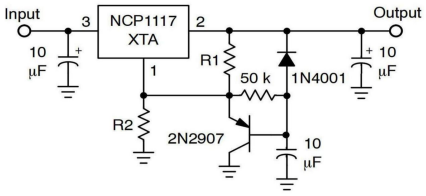


Figure 28. Slow Turn−On Regulator

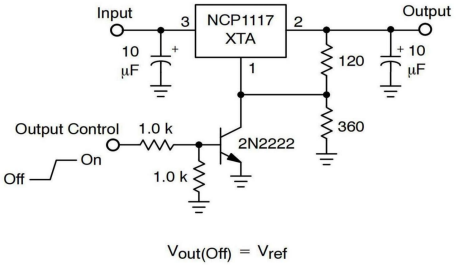
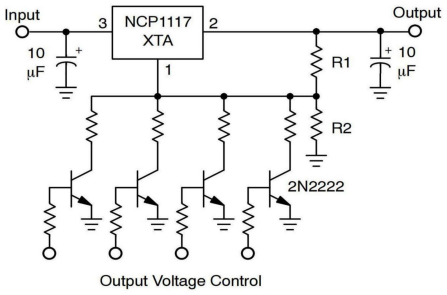
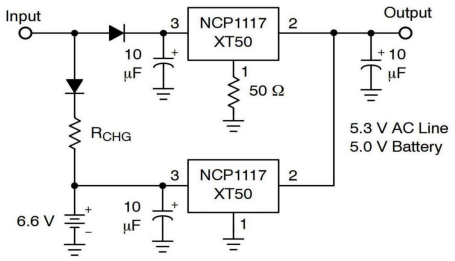


Figure 29. Regulator with Shutdown



Resistor R2 sets the maximum output voltage. Each transistor reduces the output voltage when turned on.

Figure 30. Digitally Controlled Regulator



The 50 Ω resistor that is in series with the ground pin of the upper regulator level shifts its output 300 mV higher than the lower regulator. This keeps the lower regulator off until the input source is removed.

Figure 31. Battery Backed−Up Power Supply

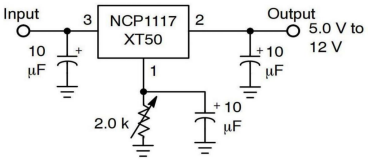


Figure 32. Adjusting Output of Fixed Voltage Regulators

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ORDERING INFORMATION – (NCP1117)

Device	Nominal Output Voltage	Package	Shipping†
NCP1117STAT3G	Adjustable	SOT−223 (Pb−Free)	4000 / Tape & Reel
NCP1117ST15T3G	1.5		
NCP1117ST18T3G	1.8		
NCP1117ST20T3G	2.0		
NCP1117ST25T3G	2.5		
NCP1117ST33T3G	3.3		
NCP1117ST50T3G	5.0		
NCP1117ST12T3G	12		
NCP1117DTARKG	Adjustable	DPAK (Pb−Free)	2500 / Tape & Reel
NCP1117DTAT5G	Adjustable		2500 / Tape & Reel
NCP1117DT15RKG	1.5		2500 / Tape & Reel
NCP1117DT18RKG	1.8		2500 / Tape & Reel
NCP1117DT18T5G	1.8		2500 / Tape & Reel
NCP1117DT19RKG	1.9		2500 / Tape & Reel
NCP1117DT20RKG	2.0		2500 / Tape & Reel
NCP1117DT25RKG	2.5		2500 / Tape & Reel
NCP1117DT25T5G	2.5		2500 / Tape & Reel
NCP1117DT285RKG	2.85		2500 / Tape & Reel
NCP1117DT33RKG	3.3		2500 / Tape & Reel
NCP1117DT33T5G	3.3		2500 / Tape & Reel
NCP1117DT50RKG	5.0		2500 / Tape & Reel
NCP1117DT12RKG	12		2500 / Tape & Reel

ORDERING INFORMATION – (NCP1117I)

Device	Nominal Output Voltage	Package	Shipping†
NCP1117ISTAT3G	Adjustable	SOT−223 (Pb−Free)	4000 / Tape & Reel
NCP1117IST18T3G	1.8		
NCP1117IST33T3G	3.3		
NCP1117IST50T3G	5.0		
NCP1117IDTAT4G	Adjustable	DPAK (Pb−Free)	2500 / Tape & Reel
NCP1117IDT33T4G	3.3		
NCP1117IDT50T4G	5.0		

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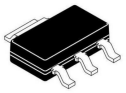
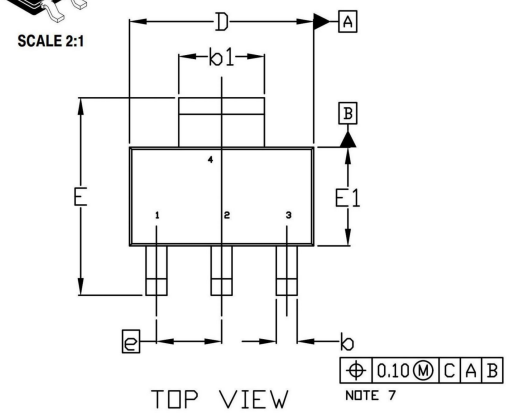
SOT-223
CASE 318H
ISSUE B

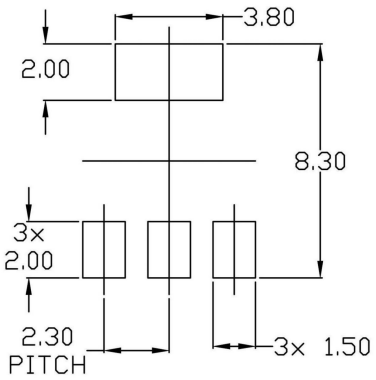


SCALE 2:1

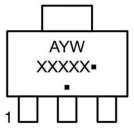


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D & E1 ARE DETERMINED AT DATUM H. DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. SHALL NOT EXCEED 0.23mm PER SIDE.
4. LEAD DIMENSIONS b AND b1 DO NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBBAR PROTRUSION IS 0.08mm PER SIDE.
5. DATUMS A AND B ARE DETERMINED AT DATUM H.
6. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
7. POSITIONAL TOLERANCE APPLIES TO DIMENSIONS b AND b1.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	---	---	1.80
A1	0.02	0.06	0.11
b	0.60	0.74	0.88
b1	2.90	3.00	3.10
c	0.24	---	0.35
D	6.30	6.50	6.70
E	6.70	7.00	7.30
E1	3.30	3.50	3.70
e	2.30 BSC		
L	0.25	---	---
θ	0°	---	10°



GENERIC MARKING DIAGRAM*



A = Assembly Location
Y = Year
W = Work Week
XXXXX = Specific Device Code
▪ = Pb-Free Package
(Note: Microdot may be in either location)

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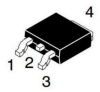
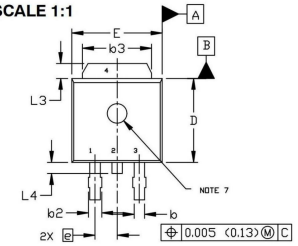
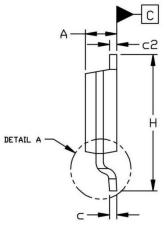
DPAK (SINGLE GAUGE)
CASE 369C
ISSUE G



SCALE 1:1



TOP VIEW

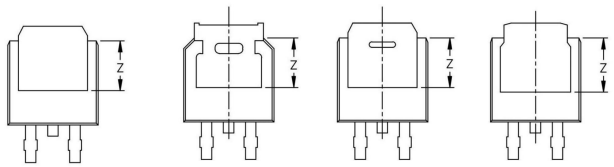


SIDE VIEW

NOTES:

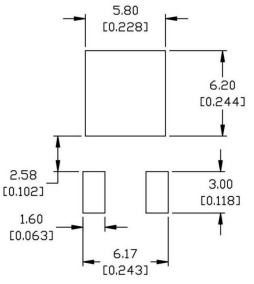
1. DIMENSIONING AND TOLERANCING ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3, AND Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.
7. OPTIONAL MOLD FEATURE.

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.086	0.094	2.18	2.38
A1	0.000	0.005	0.00	0.13
b	0.025	0.035	0.63	0.89
b2	0.028	0.045	0.72	1.14
b3	0.180	0.215	4.57	5.46
c	0.018	0.024	0.46	0.61
c2	0.018	0.024	0.46	0.61
D	0.235	0.245	5.97	6.22
E	0.250	0.265	6.35	6.73
e	0.090 BSC		2.29 BSC	
H	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.114 REF		2.90 REF	
L2	0.020 BSC		0.51 BSC	
L3	0.035	0.050	0.89	1.27
L4	----	0.040	---	1.01
Z	0.155	----	3.93	---

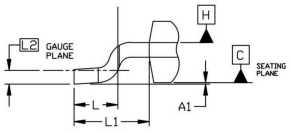


BOTTOM VIEW

BOTTOM VIEW

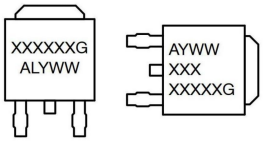


ALTERNATE CONSTRUCTIONS



DETAIL A
ROTATED 90° CW

GENERIC MARKING DIAGRAM*



IC **Discrete**

XXXXXX	= Device Code
A	= Assembly Location
L	= Wafer Lot
Y	= Year
WW	= Work Week
G	= Pb−Free Package

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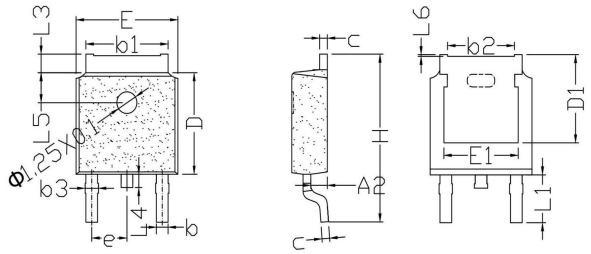
Ordering Information

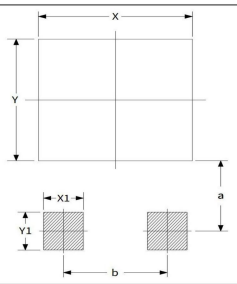
PACKAGE	PACKAGE CODE	UNIT WEIGHT(g)	REEL(pcs)	BOX(pcs)	CARTON(pcs)	DELIVERY MODE
TO-252	R3	0.305	2500	5000	25000	13''

Package Outline Dimensions (TO-252)



Symbol	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A2	0.90	1.10	0.035	0.043
b	0.66	0.86	0.026	0.034
b1	5.10	5.46	0.201	0.215
b2	4.27	4.37	0.168	0.172
b3	0.78	0.90	0.031	0.035
c	0.45	0.55	0.018	0.022
D	5.90	6.30	0.232	0.248
D1	5.35 REF.		0.211REF.	
E	6.30	6.70	0.248	0.264
E1	4.83 REF.		0.190 REF.	
e	2.18	2.38	0.086	0.094
H	9.80	10.4	0.386	0.409
L1	2.70	3.10	0.106	0.122
L3	0.80	1.20	0.031	0.047
L4	0.60	1.00	0.024	0.039
L5	1.8 REF.		0.071 REF.	
L6	-	0.12	-	0.005

Suggested Pad Layout



Symbol	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
a	3.70	-	0.146	-
b	4.37	-	0.172	-
X	-	5.80	-	0.228
X1	-	1.20	-	0.047
Y	-	5.85	-	0.230
Y1	-	2.00	-	0.079