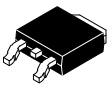
1.0 A Low-Dropout Positive Fixed and Adjustable Voltage Regulators



SOT−223
ST SUFFIX
CASE 318H

DPAK
DT SUFFIX
CASE 369C

NCP1117, NCP1117I, NCV1117

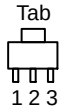
The NCP1117 series are low dropout positive voltage regulators that are capable of providing an output current that is in excess of 1.0 A with a maximum dropout voltage of 1.2 V at 800 mA over temperature. This series contains nine fixed output voltages of 1.5 V, 1.8 V, 1.9 V, 2.0 V, 2.5 V, 2.85 V, 3.3 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.

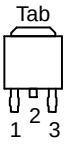
Features

- 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
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- 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





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

Heatsink tab is connected to Pin 2.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 12 of this data sheet.

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 14 of this data sheet.

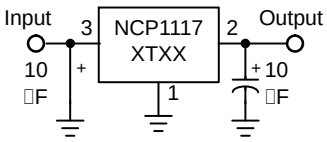


Figure 1. Fixed Output Regulator

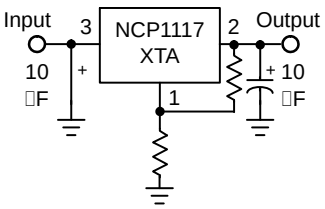
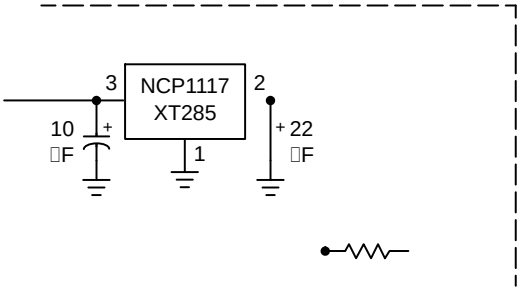


Figure 2. Adjustable Output Regulator

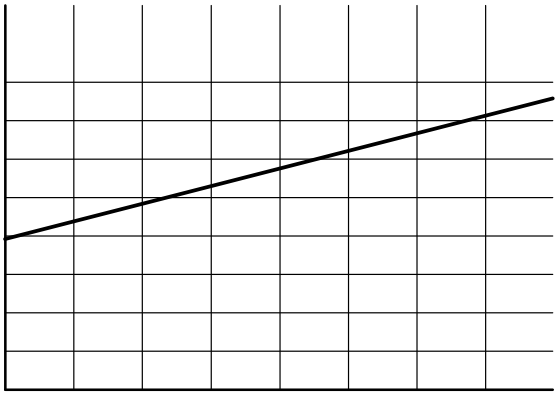


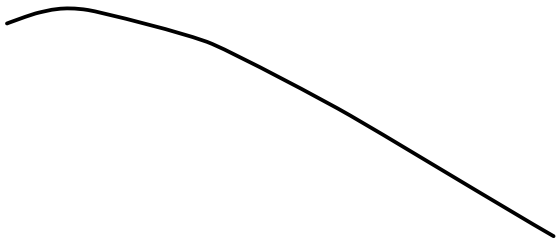
ELECTRICAL CHARACTERISTICS

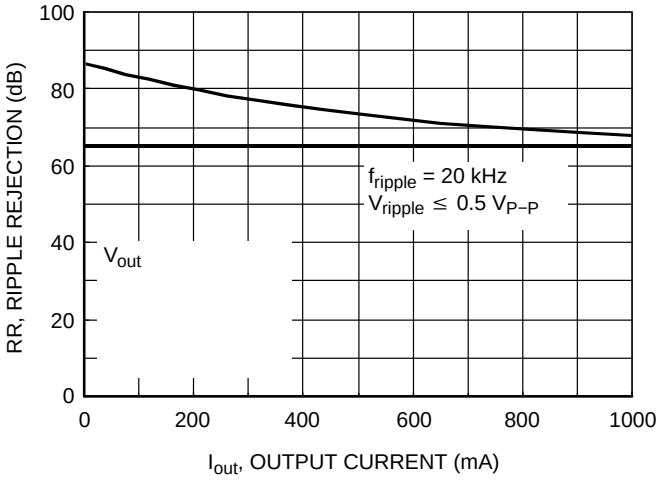
(C_{in} = 10 □F, C_{out} = 10 □F, for typical value T_A = 25°C, for min and max values T_A is the operating ambient temperature range that applies unless otherwise noted.) (Note 4)

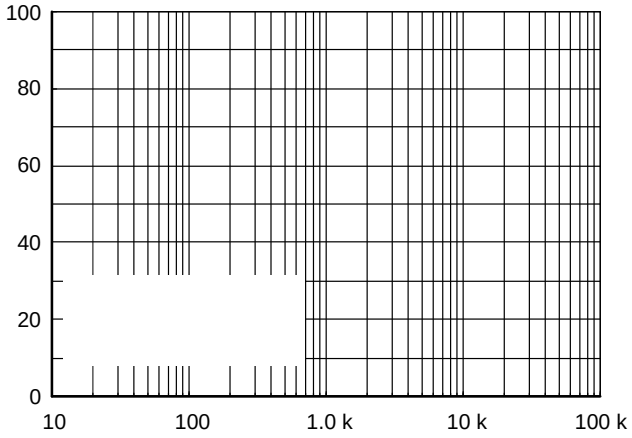
Characteristic	Symbol	Min	Typ

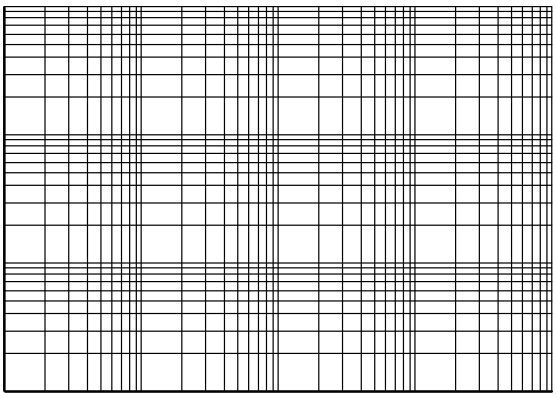
$V_{in} - V_{out}$, DROPOUT VOLTAGE (V)

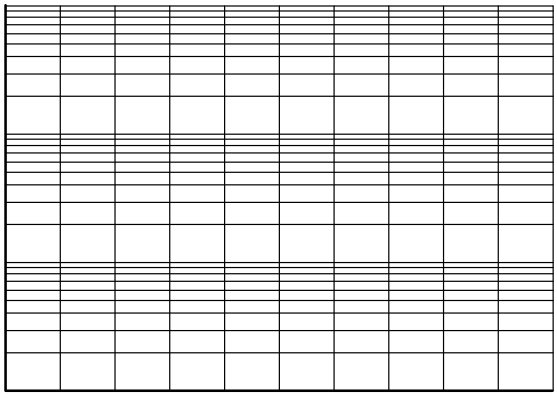





100
80
60
40
20
0
RR, RIPPLE REJECTION (dB)
0
200
400
600
800
1000
I_{out}, OUTPUT CURRENT (mA)
f_{ripple} = 20 kHz
$V_{ripple} \leq 0.5\ V_{P-P}$
V_{out}


100
80
60
40
20
0
10
100
1.0 k
10 k
100 k





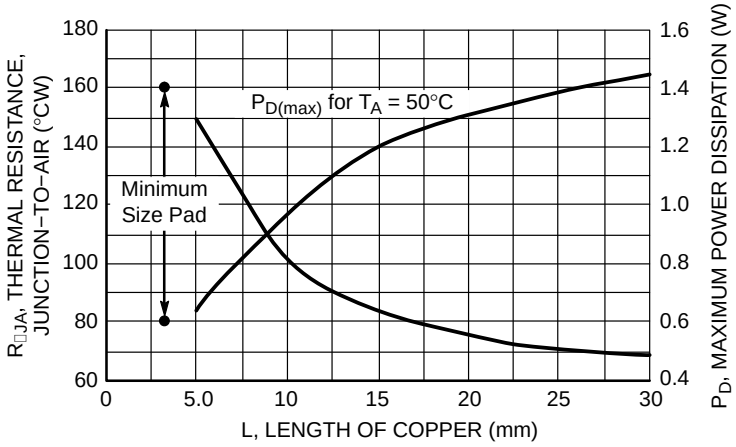


Figure 21. SOT−223 Thermal Resistance and Maximum Power Dissipation vs. P.C.B. Copper Length

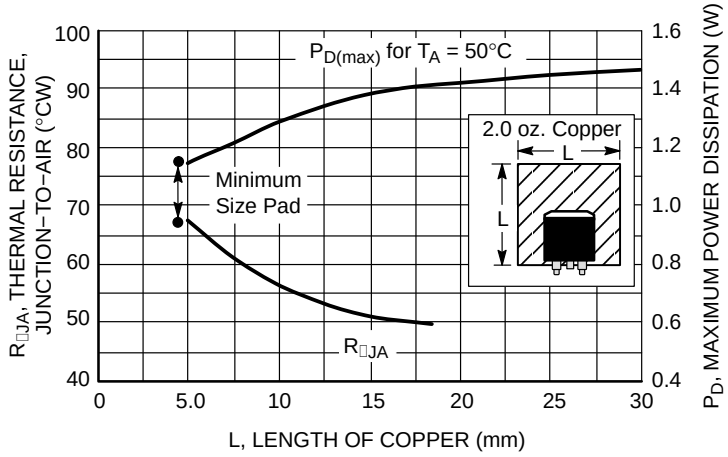


Figure 22. DPAK Thermal Resistance and Maximum Power Dissipation vs. P.C.B. Copper Length

APPLICATIONS INFORMATION

Introduction

The NCP1117 features a significant reduction in dropout voltage along with enhanced output voltage accuracy and temperature stability when compared to older industry standard three−terminal adjustable regulators. These devices contain output current limiting, safe operating area compensation and thermal shutdown protection making them designer friendly for powering numerous consumer and industrial products. The NCP1117 series is pin compatible with the older LM317 and its derivative device types.

Output Voltage

The typical application circuits for the fixed and adjustable output regulators are shown in Figures 23 and 24. The adjustable devices are floating voltage regulators. They develop and maintain the nominal 1.25 V reference voltage between the output and adjust pins. The reference voltage is programmed to a constant current source by resistor R1, and this current flows through R2 to ground to set the output voltage. The programmed current level is usually selected to be greater than the specified 5.0 mA minimum that is required for regulation. Since the adjust pin current, I_{adj}, is significantly lower and constant with respect to the programmed load current, it generates a small output voltage error that can usually be ignored. For the fixed output devices R1 and R2 are included within the device and the ground current I_{gnd}, ranges from 3.0 mA to 5.0 mA depending upon the output voltage.

External Capacitors

Input bypass capacitor C_{in} may be required for regulator stability if the device is located more than a few inches from the power source. This capacitor will reduce the circuit's sensitivity when powered from a complex source impedance and significantly enhance the output transient response. The input bypass capacitor should be mounted with the shortest possible track length directly across the regulator's input and ground terminals. A 10 □F ceramic or tantalum capacitor should be adequate for most applications.

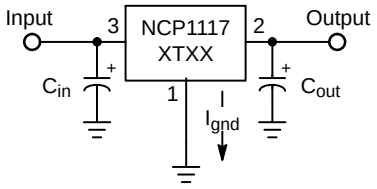
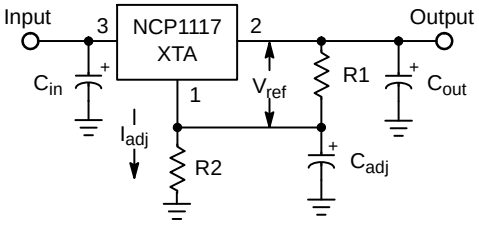


Figure 23. Fixed Output Regulator

Frequency compensation for the regulator is provided by capacitor C_{out} and its use is mandatory to ensure output stability. A minimum capacitance value of 4.7 □F with an equivalent series resistance (ESR) that is within the limits of 33 m□ (typ) to 2.2 □ is required. See Figures 12 and 13. The capacitor type can be ceramic, tantalum, or aluminum electrolytic as long as it meets the minimum capacitance value and ESR limits over the circuit's entire operating temperature range. Higher values of output capacitance can be used to enhance loop stability and transient response with the additional benefit of reducing output noise.



$$V_{out} = V_{ref}\left(1 + \frac{R2}{R1}\right) + I_{adj}\,R2$$

Figure 24. Adjustable Output Regulator

The output ripple will increase linearly for fixed and adjustable devices as the ratio of output voltage to the reference voltage increases. For example, with a 12 V regulator, the output ripple will increase by 12 V/1.25 V or 9.6 and the ripple rejection will decrease by 20 log of this ratio or 19.6 dB. The loss of ripple rejection can be restored to the values shown with the addition of bypass capacitor C_{adj}, shown in Figure 24. The reactance of C_{adj} at the ripple frequency must be less than the resistance of R1. The value of R1 can be selected to provide the minimum required load current to maintain regulation and is usually in the range of 100 □ to 200 □.

$$C_{adj} > \frac{1}{2\,□\,f_{ripple}\,R1}$$

The minimum required capacitance can be calculated from the above formula. When using the device in an application that is powered from the AC line via a transformer and a full wave bridge, the value for C_{adj} is:

$f_{ripple} = 120\ Hz,\ R1 = 120\ □,$ then $C_{adj} > 11.1\ □F$

The value for C_{adj} is significantly reduced in applications where the input ripple frequency is high. If used as a post regulator in a switching converter under the following conditions:

$f_{ripple} = 50\ kHz,\ R1 = 120\ □,$ then $C_{adj} > 0.027\ □F$

Figures 10

Protection Diodes

The NCP1117 family has two internal low impedance diode paths that normally do not require protection when used in the typical regulator applications. The first path connects between V_{out} and V_{in}, and it can withstand a peak surge current of about 15 A. Normal cycling of V_{in} cannot generate a current surge of this magnitude. Only when V_{in}

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		
NCP1117DTAG	Adjustable	DPAK (Pb−Free)	75 Units / Rail
NCP1117DTARKG	Adjustable		2500 / Tape & Reel
NCP1117DTAT5G	Adjustable		2500 / Tape & Reel
NCP1117DT15G	1.5		75 Units / Rail
NCP1117DT15RKG	1.5		2500 / Tape & Reel
NCP1117DT18G	1.8		75 Units / Rail
NCP1117DT18RKG	1.8		2500 / Tape & Reel
NCP1117DT18T5G	1.8		2500 / Tape & Reel
NCP1117DT19RKG	1.9		2500 / Tape & Reel
NCP1117DT20G	2.0		75 Units / Rail
NCP1117DT20RKG	2.0		2500 / Tape & Reel
NCP1117DT25G	2.5		75 Units / Rail
NCP1117DT25RKG	2.5		2500 / Tape & Reel
NCP1117DT25T5G	2.5		2500 / Tape & Reel
NCP1117DT285G	2.85		75 Units / Rail
NCP1117DT285RKG	2.85		2500 / Tape & Reel
NCP1117DT33G	3.3		75 Units / Rail
NCP1117DT33RKG	3.3		2500 / Tape & Reel
NCP1117DT33T5G	3.3		2500 / Tape & Reel
NCP1117DT50G	5.0		75 Units / Rail
NCP1117DT50RKG	5.0		2500 / Tape & Reel
NCP1117DT12G	12		75 Units / Rail
NCP1117DT12RKG	12		2500 / Tape & Reel

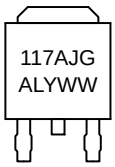
5.eff BT8 0 0 8 63.6094 251.9433 Tm08 465.7323 309.4866 Tm-0016 Tc(75 Units / Rail]ng paF)128 0 0 8 225.7512 583.2001 Tm9.109 au.043g pa Rail80and

ORDERING INFORMATION − (NCV1117)

Device	Nominal Output Voltage	Package	Shipping†
NCV1117STAT3G*	Adjustable	SOT−223 (Pb−Free)	4000 / Tape & Reel
NCV1117ST15T3G*	1.5		
NCV1117ST18T3G*	1.8		
NCV1117ST20T3G*	2.0		
NCV1117ST25T3G*	2.5		
NCV1117ST33T3G*	3.3		
NCV1117ST50T3G*	5.0		
NCV1117ST12T3G*	12		
NCV1117DTARKG*	Adjustable	DPAK (Pb−Free)	2500 / Tape & Reel
NCV1117DT15RKG*	1.5		
NCV1117DT18RKG*	1.8		
NCV1117DT18T5G*	1.8		
NCV1117DT20RKG*	2.0		
NCV1117DT25RKG*	2.5		
NCV1117DT33T4G*	3.3		
NCV1117DT33T5G*	3.3		
NCV1117DT50RKG*	5.0		
NCV1117DT12RKG*	12		

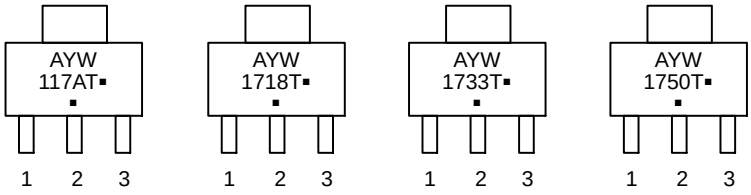
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable



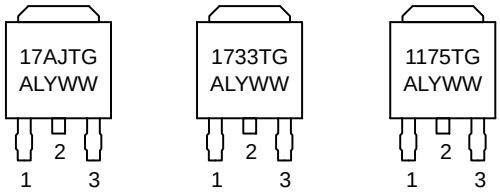
MARKING DIAGRAMS − NCP1117I

SOT−223
ST SUFFIX
CASE 318H



Adjustable **1.8 V** **3.3 V** **5.0 V**

DPAK
DT SUFFIX
CASE 369C



Adjustable **3.3 V** **5.0 V**

A = Assembly Location
L = Wafer Lot
Y = Year
WW, W = Work Week
▪ or G = Pb−Free Package

(Note: Microdot may be in either location)

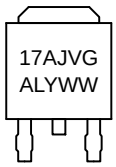
MARKING DIAGRAMS − NCV1117

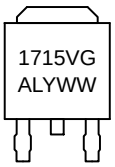
SOT−223
ST SUFFIX
CASE 318H

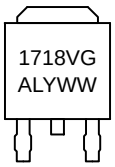
AYW
117AV ▪
▪

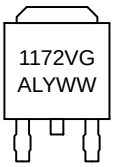
1

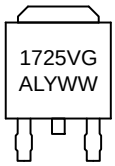
AK cm 0 5Tfb551 TD▪0013 Tc0 g005 Tw1

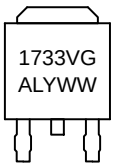


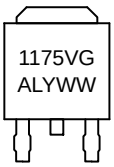












A = Assembly Location
L = Wafer Lot
Y = Year
WW, W = Work Week
▪ or G = Pb−Free Package

SOT 223
CASE 318H
ISSUE B

DATE 13 MAY 2020

URRS. SHALL NOT

EX

TOP VIEW NOTE 7

	0.60	0.74	0.88
b1	2.90	3.00	3.10

PROTRUSIONS OR GATE B LUDE MOLD FLASH

E	6.7	7.00	7.30

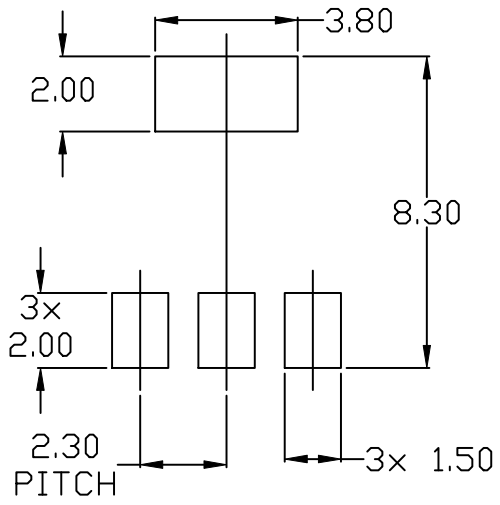
10 C

SIDE VIEW END VIEW

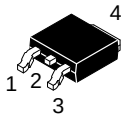
L	0.25	---	---

A1

DETAIL A



RECOMMENDED MOUNTING FOOTPRINT



SCALE 1:1

DPAK (SINGLE GAUGE)
CASE 369C
ISSUE G

DATE 31 MAY 2023

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 2:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 3:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

STYLE 4:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

STYLE 5:
PIN 1. GATE
2. ANODE
3. CATHODE
4. ANODE

STYLE 6:
PIN 1. MT1
2. MT2
3. GATE
4. MT2

STYLE 7:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 8:
PIN 1. N/C
2. CATHODE
3. ANODE
4. CATHODE

STYLE 9:
PIN 1. ANODE
2. CATHODE
3. RESISTOR ADJUST
4. CATHODE

STYLE 10:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. ANODE