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These linear low drop voltage regulators provide up to 500 mA over a user-adjustable output range of 1.25 V to 5.0 V, or at a fixed output voltage of 1.5 V, 3.3 V or 5.0 V, with typical output voltage accuracy better than 3%. An internal PNP pass transistor permits low dropout voltage and operation at full load current at the minimum input voltage. NCV versions are qualified for demanding automotive applications that require extended temperature operation and site and change control. NCP5500 and NCV5500 versions include an Enable/Shutdown function and are available in a DPAK 5 and SOIC 8 packages. NCP5501 and NCV5501 versions are available in DPAK 3 for applications that do not require logical on/off control.

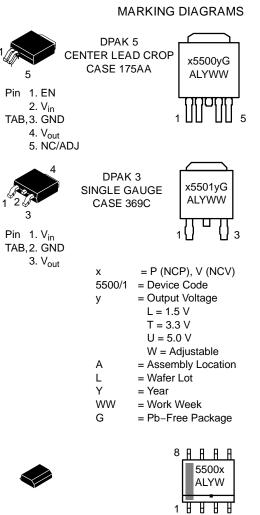
This regulator family is ideal for applications that require a broad input voltage range, and low dropout performance up to 500 mA load using low cost ceramic capacitors. Integral protection features include short circuit current and thermal shutdown.

Features

- Output Current up to 500 mA
- 2.9% Output Voltage Accuracy
- Low Dropout Voltage (230 mV at 500 mA)
- Enable Control Pin (NCP5500 / NCV5500)
- Reverse Bias Protection
- Short Circuit Protection
- Thermal Shutdown
- Wide Operating Temperature Range NCV 5500 / NCV 5501; -40°C to +125°C Ambient Temperature NCP5500 / NCP5501; -40°C to +85°C Ambient Temperature
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC–Q100 Qualified and PPAP Capable
- Stable with Low Cost Ceramic Capacitors
- These are Pb-Free Devices

Typical Applications

- Automotive
- Industrial and Consumer
- Post SMPS Regulation
- Point of Use Regulation



ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.

NOTE: Some of the devices on this data sheet have been DISCONTINUED. Please refer to the table on page 10.

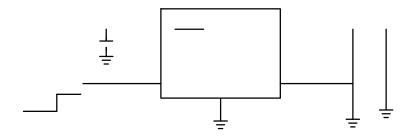


Figure 1. Typical Application Circuit

ABSOLUTE MAXIMUM RATINGS

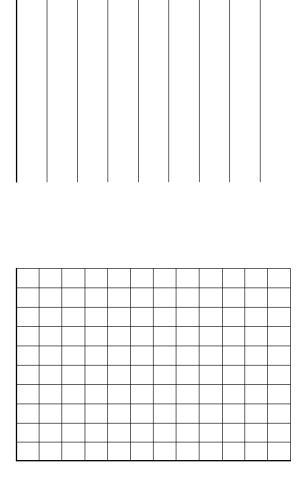
Rating	Symbol	Min	Max	Unit
Input Voltage (Note 1)				•

ELECTRICAL CHARACTERISTICS V _{in} = 2.5 V or V _{out} + 1.0 V (whichever is higher), C _{in} = 10 µF, C _{out} = 4.7 µF, for typical values T _A
= 25°C, for min/max values $T_A = -40$ °C to 85°C (NCP Version), $T_A = -40$ °C to 125°C (NCV Version) unless otherwise noted (Note 13).

Characteristic	Symbol	Test Conditions	Min	Тур	Max	Unit
OUTPUT						
Output Voltage (Note 14) 5 V Regulator 3.3 V Regulator 1.5 V Regulator ADJ Regulator	V _{out}	$T_A = 25^{\circ}C$, $I_{out} = 50 \text{ mA}$		V _{NOM} ±2.9%		V V V
Output Voltage (Note 8) 5 V Regulator 3.3 V Regulator 1.5 V Regulator ADJ Regulator	V _{out}	1.0 mA < l _{out} < 500 mA	(-4.9%) 4.755 3.138 1.427 1.189	V _{NOM} 5.0 3.3 1.5 1.25	(+4.9%) 5.245 3.462 1.574 1.311	V V V
Line Regulation	REG _{LINE}	l _{out} = 50 mA 2.5 V or (V _{out} + 1.0 V) < V _{in} < 16 V	-1.0	0.1	1.0	%
Load Regulation	REG_LOAD	1.0 mA < I _{out} < 500 mA	-1.0	0.35	1.0	%
Dropout Voltage (Note 9) 5.0 V Version 3.3 V Version 1.5 V Version (Note 10) Adjustable Version (Note 11)	V _{DO}	$\begin{array}{l} I_{out} = 1.0 \text{ mA}, \ \Delta V_{out} = -2\% \\ I_{out} = 500 \text{ mA}, \ \Delta V_{out} = -2\% \\ I_{out} = 1.0 \text{ mA}, \ \Delta V_{out} = -2\% \\ I_{out} = 500 \text{ mA}, \ \Delta V_{out} = -2\% \\ I_{out} = 1.0 \text{ mA}, \ \Delta V_{out} = -2\% \\ I_{out} = 500 \text{ mA}, \ \Delta V_{out} = -2\% \\ I_{out} = 500 \text{ mA}, \ \Delta V_{out} = -2\% \\ I_{out} = 500 \text{ mA}, \ \Delta V_{out} = -2\% \end{array}$	- - - - - -	5 230 5 230 - - 5 230	90 700 90 700 1073 1073 90 700	mV
Ground Current	I _{GND}	I _{out} = 100 μA I _{out} = 500 mA		300 10	500 20	μA mA
Disable Current in Shutdown (NCP5500, NCV5500)	I _{SD}	Adjustable and 1.5 V versions All other versions		30 40	50 50	μΑ
Current Limit	I _{out(LIM)}	$V_{out} = 90\%$ of $V_{out(nom)}$	500	700	900	mA
Ripple Rejection Ratio (Notes 9 & 14)	RR	120 Hz I _{out} = 100 mA, 1 kHz 10 kHz		75 75 70	- - -	dB
Output Noise Voltage (Notes 12 & 14)	V _n	f = 10 Hz to 100 kHz, V_{in} = 2.5 V V_{out} = 1.25 V, I_{out} = 1.0 mA				-
		$ f = 10 \text{ Hz to } 100 \text{ kHz}, \text{ V}_{in} = 2.5 \text{ V} \\ V_{out} = 1.25 \text{ V}, \text{ I}_{outo \ u \ t} $				



TYPICAL CHARACTERISTICS



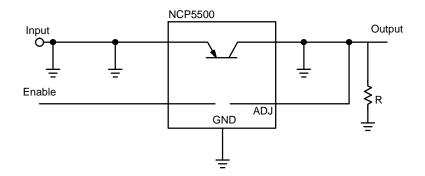


Figure 21. Measuring Circuits

Calculating Resistors for the ADJ Versions

The adjustable version uses feedback resistors to adjust the output to the desired output voltage. With V_{out} connected to ADJ, the adjustable version will regulate at 1.25 V \pm 4.9% (1250 \pm 61.25 mV).

Output voltage formula with an external resistor divider:

$$V_{out} = \left(1.25 \text{ V} - \left[60\text{E}-9 \cdot \frac{(\text{R}_1 \cdot \text{R}_2)}{(\text{R}_1 + \text{R}_2)} \right] \right) \cdot \left(\frac{(\text{R}_1 + \text{R}_2)}{\text{R}_2} \right)$$

Where

 R_1 = value of the divider resistor connected between V_{out} and ADJ,

 R_2 = value of the divider resistor connected between ADJ and GND,

The term "1.25 V" has a tolerance of \pm 4.9%; the term "60E–9" can vary in the range 15E–9 to 60E–9.

For values of R_2 less than 15 K Ω , the term within brackets ([]) will evaluate to less than 1 mV and can be ignored. This simplifies the output voltage formula to:

 V_{out} = 1.25 V * ((R1 + R2) / R2)) with a tolerance of \pm 4.9%, which is the tolerance of the 1.25 V output when delivering up to 500 mA of output current.

DEFINITION OF TERMS

Dropout Voltage: The input-to-output voltage differential at which the circuit ceases to regulate against further reduction input voltage. Measured when the output voltage has dropped 2% relative to the value measured at nominal input voltage. Dropout voltage is dependent upon load current and junction temperature.

Input Voltage: The DC voltage applied to the input terminals with respect to ground.

Line Regulation: The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

Load Regulation: The change in output voltage for a change in load current at constant chip temperature. Pulse loading techniques are employed such that the average chip temperature is not significantly affected.

Quiescent and Ground Current: The quiescent current is the current which flows through the ground when the LDO operates without a load on its output: internal IC operation, bias, etc. When the LDO becomes loaded, this term is called the Ground current. It is actually the difference between the input current (measured through the LDO input pin) and the output current. Ripple Rejection: The ratio of the peak-to-peak input ripple voltage to the peak-to-peak output ripple voltage.

Current Limit: Peak current that can be delivered to the output.

Calculating Power Dissipation

The maximum power dissipation for a single output regulator (Figure 21) is:

$$P_{D(max)} = \left[V_{in(max)} - V_{out(min)} \right] I_{out(max)} + V_{in(max)} I_{GND}^{(eq. 1)}$$

Where

V_{in(max)} is the maximum input voltage,

Vout(min) is the minimum output voltage,

 $I_{out(max)}$ is the maximum output current for the application, I_{GND} is the ground current at $I_{out(max)}$.

Once the value of $P_{D(max)}$ is known, the maximum permissible value of $R_{\theta JA}$ can be calculated:

$$R_{\theta JA} = \frac{(150^{\circ}C - T_A)}{P_D}$$
 (eq. 2)

The value of $R_{\theta,JA}$ can then be compared with those in the Thermal Characteristics table. Those packages with $R_{\theta,JA}$ less than the calculated value in Equation 2 will keep the die temperature below 150°C.

In some cases, none of the packages will be sufficient to dissipate the heat generated by the IC, and an external heat sink will be required.

Heat Sinks

A heat sink effectively increases the surface area of the package to improve the flow of heat away from the IC and into the surrounding air.

Each material in the heat flow path between the IC and the outside environment will have a thermal resistance. Like series electrical resistances, these resistances are summed to determine the value of $R_{\theta,JA}$:

$$\mathsf{R}_{\theta \mathsf{J}\mathsf{A}} = \mathsf{R}_{\theta \mathsf{J}\mathsf{C}} + \mathsf{R}_{\theta \mathsf{C}\mathsf{S}} + \mathsf{R}_{\theta \mathsf{S}\mathsf{A}} \tag{eq. 3}$$

where

 $R_{\theta JC}$ is the junction–to–case thermal resistance, $R_{\theta CS}$ is the case–to–heatsink thermal resistance,

 $R_{\theta SA}$ is the heatsink-to-ambient thermal resistance.

 $R_{\theta JC}$ appears in the Thermal Characteristics table. Like $R_{\theta JA}$, it too is a function of package type. $R_{\theta CS}$ and $R_{\theta SA}$ are functions of the package type, heat sink and the interface between them. These values appear in data sheets of heat sink manufacturers.

Thermal, mounting, and heat sink considerations are further discussed in onsemi Application Note AN1040/D.

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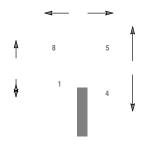


DATE 31 MAY 2023

STYLE 1: PIN 1. BASE 2. COLLE 3. EMITT 4. COLLE	ER 3. SO	AIN 2. CATH JRCE 3. ANOE	ODE 2. ANODE DE 3. GATE	STYLE 5: PIN 1. GATE 2. ANODE 3. CATHODE 4. ANODE
STYLE 6:	STYLE 7:	3. ANODE	STYLE 9:	STYLE 10:
PIN 1. MT1	PIN 1. GATE		PIN 1. ANODE	PIN 1. CATHODE
2. MT2	2. COLLECTOF		2. CATHODE	2. ANODE
3. GATE	3. EMITTER		3. RESISTOR ADJUST	3. CATHODE
4. MT2	4. COLLECTOF		4. CATHODE	4. ANODE



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SEATING PLANE



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