# **<u>Linear Regulator</u>** - Low **Dropout**

# 1.5 A

The NCP566 low dropout linear regulator will provide 1.5 A at a fixed output voltage. The fast loop response and low dropout voltage make this regulator ideal for applications where low voltage and good load transient response are important. Device protection includes current limit, short circuit protection, and thermal shutdown.

#### **Features**

- Ultra Fast Transient Response (<1.0 µs)
- Low Ground Current (1.5 mA @ Iout = 1.5 A)
- Low Dropout Voltage (0.9 V @ Iout = 1.5 A)
- Low Noise (37 µVrms)
- 1.2 V, 1.8 V, 2.5 V Fixed Output Versions. Other Fixed Voltages Available on Request
- Current Limit Protection
- Thermal Shutdown Protection
- These are Pb-Free Devices

#### **Typical Applications**

- Servers
- ASIC Power Supplies
- EIS NOT RECONTACTOR

  EPLEASENTATIVE FOR

  REPRESENTATIVE FOR • Post Regulation for Power Supplies
- Constant Current Source
- LCD Monitors
- Networking Equipment
- Battery Powered Systems
- Motherboards
- Peripheral Cards
- Set Top Boxes
- Medical Equipment
- Notebook Computers



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SOT-223 CASE 318E



Voltage Rating

12 = 1.2 V

18 = 1.8 V

25 = 2.5 VAssembly Location

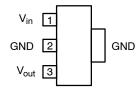
Year

Date Code

Pb-Free Package

(Note: Microdot may be in either location)

#### PIN CONNECTIONS



#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

#### **PIN DESCRIPTION**

Pin No.	Symbol	Description
1	$V_{in}$	Positive Power Supply Input Voltage
2, Tab	Ground	Power Supply Ground
3	V <sub>out</sub>	Regulated Output Voltage

#### **MAXIMUM RATINGS**

Rating		Value	Unit
Input Voltage (Note 1)		9.0	V
Output Pin Voltage		-0.3 to V <sub>in</sub> + 0.3	V
Thermal Characteristics (Notes 2, 3) Thermal Resistance, Junction-to-Ambient Thermal Resistance, Junction-to-Pin		107 12	°C/W
Operating Junction Temperature Range		-40 to 150	°C
Operating Ambient Temperature Range		-40 to 125	°C
Storage Temperature Range	T <sub>stg</sub>	-55 to 150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

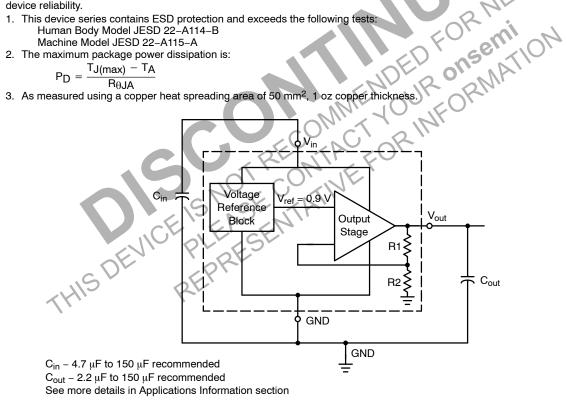


Figure 1. Typical Schematic

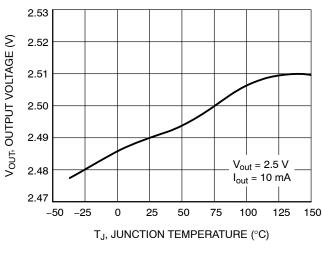
 $\textbf{ELECTRICAL CHARACTERISTICS} \ (V_{in} = V_{out} + 1.6 \ V, \ \text{for typical values} \ T_{J} = 25^{\circ}\text{C}, \ \text{for min/max values} \ T_{J} = -40^{\circ}\text{C} \ \text{to} \ + 125^{\circ}\text{C}, \ \text{for min/max} \ \text{Values} \ T_{J} = -40^{\circ}\text{C} \ \text{to} \ + 125^{\circ}\text{C}, \ \text{for min/max} \ \text{Values} \ T_{J} = -40^{\circ}\text{C} \ \text{to} \ + 125^{\circ}\text{C}, \ \text{for min/max} \ \text{Values} \ T_{J} = -40^{\circ}\text{C} \ \text{to} \ + 125^{\circ}\text{C}, \ \text{for min/max} \ \text{Values} \ T_{J} = -40^{\circ}\text{C} \ \text{to} \ + 125^{\circ}\text{C}, \ \text{for min/max} \ \text{Values} \ T_{J} = -40^{\circ}\text{C} \ \text{to} \ + 125^{\circ}\text{C}, \ \text{for min/max} \ \text{Values} \ T_{J} = -40^{\circ}\text{C} \ \text{to} \ \text{C} \ \text{C}, \ \text{for min/max} \ \text{Values} \ T_{J} = -40^{\circ}\text{C} \ \text{to} \ \text{C} \ \text{C}, \ \text{C} \ \text{C} \ \text{C}, \ \text{C} \ \text{C}$ (Note 4) unless otherwise noted.)

V <sub>out</sub> V <sub>out</sub> V <sub>out</sub>	1.176 (-2%) 1.164 (-3%) 1.764 (-2%)	1.2	1.224 (+2%) 1.236 (+3%) 1.836	V
V <sub>out</sub>	(-3%) 1.764		(+3%)	
		1.8	1.836	\/
V <sub>out</sub>		1	(+2%)	V
	1.746 (-3%)	1.8	1.854 (+3%)	V
V <sub>out</sub>	2.450 (-2%)	2.5	2.550 (+2%)	V
V <sub>out</sub>	2.425 (-3%)	2.5	2.575 (+3%)	V
Reg <sub>line</sub>	-	0.02	- ~	%
Reg <sub>load</sub>		0.04	~IΘ,	%
Vdo	-	0.9	1.3	V
lim	1.6	3.5	-	Α
RR		85	-	dB
RR	5 /4.	75	-	dB
0.5	0	160	-	°C
lq	C6/,	1.5	3.0	mA
$V_n$	7/2	37	-	μVrms
Hoad.	)/~			
	Vout  Regline Regload Vdo Vlim RR	(-2%)  Vout 2.425 (-3%)  Reg <sub>line</sub> -  Reg <sub>load</sub> -  Vdo -  I <sub>lim</sub> 1.6  RR -	(-2%)  Vout 2.425 2.5 (-3%)  Reg <sub>line</sub> - 0.02  Reg <sub>load</sub> - 0.04  Vdo - 0.9  V <sub>lim</sub> 1.6 3.5  RR - 85  RR - 75	(-2%)       (+2%)         Vout       2.425 (-3%)       2.5 (2.575 (+3%))         Regline       -       0.02 -         Regload       -       0.04 -         Vdo       -       0.9 1.3         Ifim       1.6 3.5 -       -         RR       -       85 -         RR       -       75 -         -       160 -       -         Iq       1.5 3.0         Vn       -       37 -

<sup>4.</sup> Refer to Application Information section for capacitor details.

Dropout voltage is a measurement of the minimum input/output differential at full load.

# **TYPICAL CHARACTERISTICS**



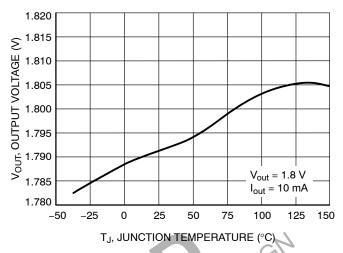
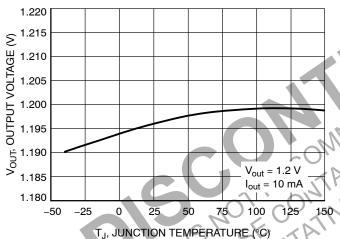


Figure 2. Output Voltage vs. Temperature

Figure 3. Output Voltage vs. Temperature



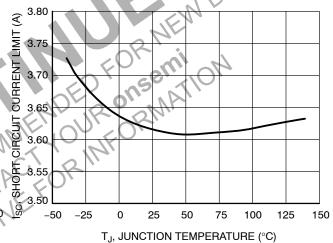


Figure 4. Output Voltage vs. Temperature

Figure 5. Short Circuit Current Limit vs. Temperature

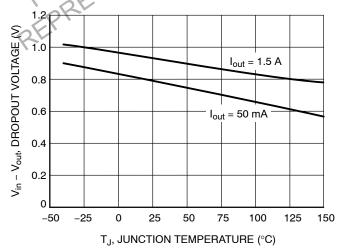
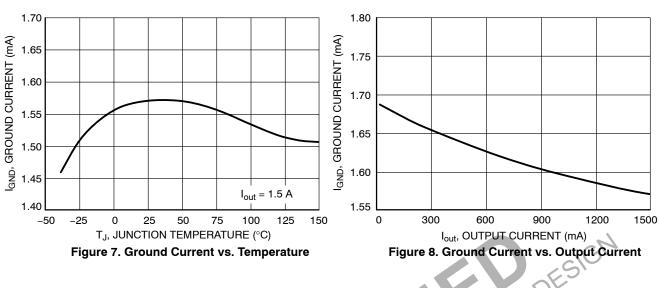
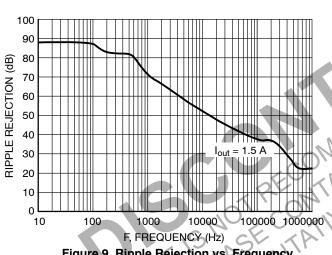


Figure 6. Dropout Voltage vs. Temperature

## **TYPICAL CHARACTERISTICS**







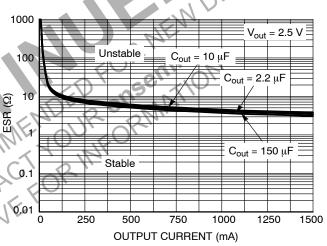


Figure 10. Output Capacitor ESR Stability vs. **Output Current** 

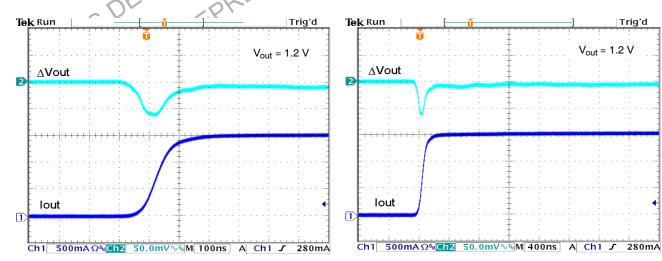


Figure 11. Load Transient from 10 mA to 1.5 A

Figure 12. Load Transient from 10 mA to 1.5 A

# **TYPICAL CHARACTERISTICS**

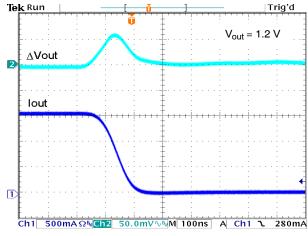


Figure 13. Load Transient from 1.5 A to 10 mA

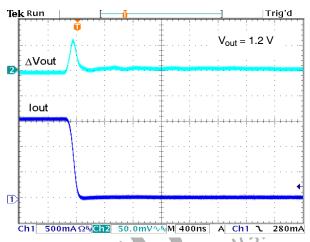
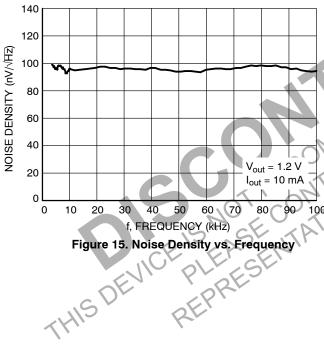


Figure 14. Load Transient from 1.5 A to 10 mA



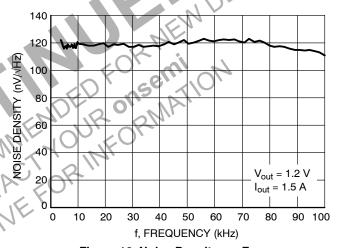


Figure 16. Noise Density vs. Frequency

#### **APPLICATION INFORMATION**

The NCP566 low dropout linear regulator provides fixed voltages at currents up to 1.5 A. It features ultra fast transient response and low dropout voltage. These devices contain output current limiting, short circuit protection and thermal shutdown protection.

# Input, Output Capacitor and Stability

Typical values of parameters in Electrical Characteristics section and in Typical Characteristics section were measured with input and output capacitors equal to  $150~\mu F$  unless otherwise noted.

An input bypass capacitor is recommended to improve transient response or if the regulator is located more than a few inches from the power source. This will reduce the circuit's sensitivity to the input line impedance at high frequencies and significantly enhance the output transient response. Different types and different sizes of input capacitors can be chosen dependent on the quality of power supply. The range of 4.7  $\mu F$  to 150  $\mu F$  should cover most of the applications. The higher capacitance the lower change of input voltage due to line and load transients. The bypass capacitor should be mounted with shortest possible lead or track length directly across the regulator's input terminals.

The output capacitor is required for stability. The NCP566 remains stable with ceramic, tantalum, and aluminum–electrolytic capacitors with a minimum value of 1.0  $\mu F$  with ESR between 50 m $\Omega$  and 2.5  $\Omega$ . The range of 2.2  $\mu F$  to

 $150~\mu F$  should cover most of the applications. The higher capacitance the better load transient response. When a high value capacitor is used, a low value capacitor is also recommended to be put in parallel. The NCP566 is optimized for use with a  $150~\mu F$  OSCON 16SA150M type in parallel with a  $10~\mu F$  OSCON 10SL10M type from Sanyo. The  $10~\mu F$  capacitor is used for best AC stability while  $150~\mu F$  capacitor is used for achieving excellent load transient response. The output capacitors should be placed as close as possible to the output pin of the device. If not, the excellent load transient response of NCP566 will be degraded.

## **Load Transient Measurement**

Large load current changes are always presented in microprocessor applications. Therefore good load transient performance is required for the power stage. NCP566 has the feature of ultra fast transient response. Its load transient responses in Figures 11 through 14 are tested on evaluation board shown in Figure 17. The evaluation board consists of NCP566 regulator circuit with decoupling and filter capacitors and the pulse controlled current sink to obtain load current transitions. The load current transitions are measured by current probe. Because the signal from current probe has some time delay, it causes un–synchronization between the load current transition and output voltage response, which is shown in Figures 11 through 14.

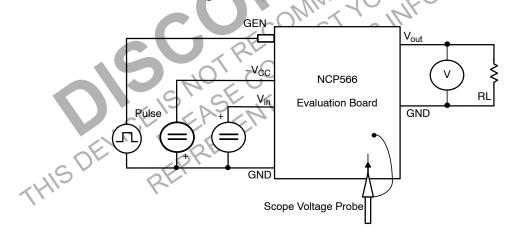


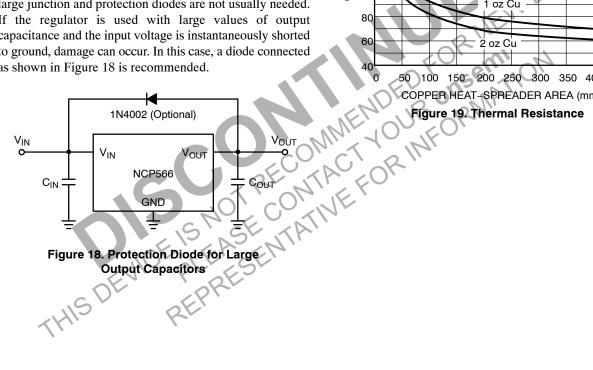
Figure 17. Schematic for Transient Response Measurement

#### **PCB Layout Considerations**

Good PCB layout plays an important role in achieving good load transient performance. Because it is very sensitive to its PCB layout, particular care has to be taken when tackling Printed Circuit Board (PCB) layout. For microprocessor applications it is customary to use an output capacitor network consisting of several capacitors in parallel. This reduces the overall ESR and reduces the instantaneous output voltage drop under transient load conditions. The output capacitor network should be as close as possible to the load for the best results.

#### **Protection Diodes**

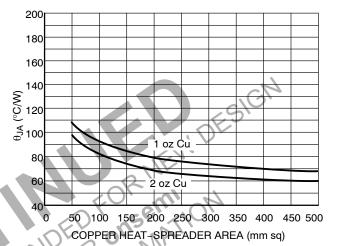
When large external capacitors are used with a linear regulator it is sometimes necessary to add protection diodes. If the input voltage of the regulator gets shorted, the output capacitor will discharge into the output of the regulator. The discharge current depends on the value of the capacitor, the output voltage and the rate at which Vin drops. In the NCP566 linear regulator, the discharge path is through a large junction and protection diodes are not usually needed. If the regulator is used with large values of output capacitance and the input voltage is instantaneously shorted to ground, damage can occur. In this case, a diode connected as shown in Figure 18 is recommended.



#### Thermal Considerations

This series contains an internal thermal limiting circuit that is designed to protect the regulator in the event that the maximum junction temperature is exceeded. This feature provides protection from a catastrophic device failure due to accidental overheating. It is not intended to be used as a substitute for proper heat sinking. The maximum device power dissipation can be calculated by:

$$P_D = \frac{T_J(max) - T_A}{R_{\theta JA}}$$



## **ORDERING INFORMATION**

Device	Nominal Output Voltage*	Package	Shipping <sup>†</sup>
NCP566ST12T3G	1.2 V	SOT-223 (Pb-Free)	4000 / Tape & Reel
NCP566ST18T3G	1.8 V	SOT-223 (Pb-Free)	4000 / Tape & Reel
NCP566ST25T3G	2.5 V	SOT-223 (Pb-Free)	4000 / Tape & Reel

<sup>\*</sup>For other fixed output versions, please contact the factory.
†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.



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