

NCP4586

Voltage Regulator - Low Noise, Low Dropout

150 mA

The NCP4586 is a CMOS 150 mA low dropout linear with low noise, high ripple rejection, low dropout, high output voltage accuracy and low supply current. The device is available in three configurations: enable high, enable low and enable high plus auto-discharge. Small packages allow mounting on high density PCBs. This is an excellent general purpose regulator, well suited to many applications.

Features

- Operating Input Voltage Range: 1.7 V to 6.5 V
- Output Voltage Range: 1.2 to 5.0 V (available in 0.1 V steps)
- Very Low Dropout: 320 mV Typ. at 150 mA
- $\pm 1\%$ Output Voltage Accuracy ($V_{OUT} > 2\text{ V}$, $T_J = 25^\circ\text{C}$)
- High PSRR: 80 dB at 1 kHz
- Current Fold Back Protection
- Stable with a 0.47 μF Ceramic Capacitors
- Available in 1.0 x 1.0 UDFN, SC-82AB and SOT23-5 Package
- These are Pb-Free Devices

Typical Applications

- Battery Powered Equipment
- Portable Communication Equipment
- Cameras, MP3 Players and Camcorder
- High Stability Voltage Reference

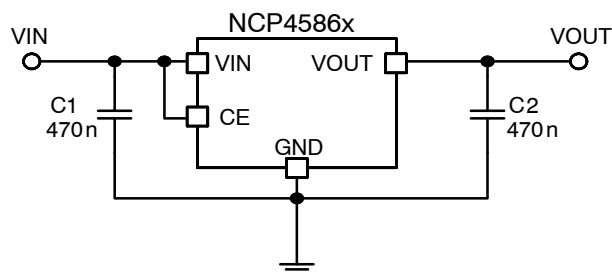


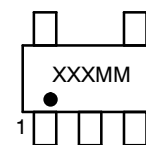
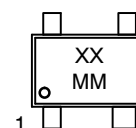
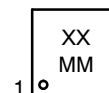
Figure 1. Typical Application Schematic



ON Semiconductor™

<http://onsemi.com>

MARKING DIAGRAMS



XX, XXX = Specific Product Code
MM = Lot Number

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 15 of this data sheet.

NCP4586

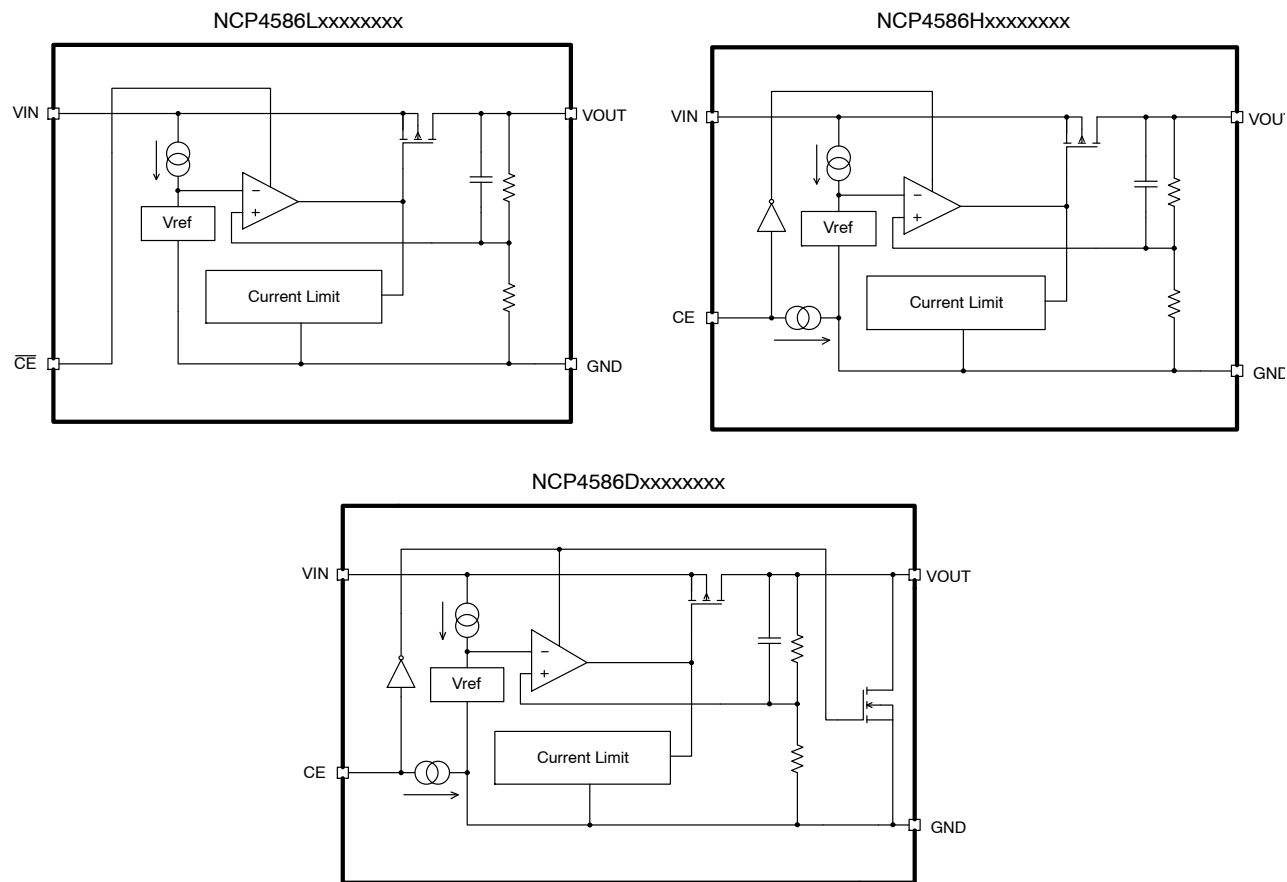


Figure 2. Simplified Schematic Block Diagram

PIN FUNCTION DESCRIPTION

Pin No. UDFN4	Pin No. SC82-AB	Pin No. SOT23-5	Pin Name	Description
4	4	1	VIN	Input pin
2	2	2	GND	Ground
3	1	3	CE/CE	Chip enable pin ("L" active / "H" active)
1	3	5	VOUT	Output pin
-	-	4	NC	No connection

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage (Note 1)	V_{IN}	7	V
Output Voltage	V_{OUT}	-0.3 to $V_{IN} + 0.3$	V
Chip Enable Input	V_{CE}	-0.3 to 7	V
Output Current	I_{OUT}	200	mA
Power Dissipation UDFN4	P_D	400	mW
Power Dissipation SC-82AB		380	
Power Dissipation SOT23-5		420	
Maximum Junction Temperature	$T_{J(MAX)}$	+150	°C
Operating Ambient Temperature	T_A	-40 to +85	°C
Storage Temperature	T_{STG}	-55 to +125	°C
ESD Capability, Human Body Model (Note 2)	ESD_{HBM}	2000	V
ESD Capability, Machine Model (Note 2)	ESD_{MM}	200	V

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.

1. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.
2. This device series incorporates ESD protection and is tested by the following methods:
ESD Human Body Model tested per AEC-Q100-002 (EIA/JESD22-A114)
ESD Machine Model tested per AEC-Q100-003 (EIA/JESD22-A115)
Latchup Current Maximum Rating tested per JEDEC standard: JESD78.

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal Characteristics, UDFN4 Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	250	°C/W
Thermal Characteristics, SOT23-5 Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	238	°C/W
Thermal Characteristics, SC 82AB Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	263	°C/W

NCP4586

ELECTRICAL CHARACTERISTICS $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$; $V_{\text{IN}} = V_{\text{OUT(NOM)}} + 1\text{ V}$ or 2.5 V , whichever is greater; $I_{\text{OUT}} = 1\text{ mA}$, $C_{\text{IN}} = C_{\text{OUT}} = 0.47\text{ }\mu\text{F}$, unless otherwise noted. Typical values are at $T_A = +25^{\circ}\text{C}$.

Parameter	Test Conditions		Symbol	Min	Typ	Max	Unit
Operating Input Voltage			V_{IN}	1.7		6.5	V
Output Voltage	$T_A = +25^{\circ}\text{C}$	$V_{\text{OUT}} > 2\text{ V}$	V_{OUT}	$\times 0.99$		$\times 1.01$	V
		$V_{\text{OUT}} \leq 2\text{ V}$		-20		20	mV
	$-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$	$V_{\text{OUT}} > 2\text{ V}$		$\times 0.985$		$\times 1.015$	V
		$V_{\text{OUT}} \leq 2\text{ V}$		-30		30	mV
Output Voltage Temp. Coefficient	$T_A = -40\text{ to }85^{\circ}\text{C}$				± 20		ppm/ $^{\circ}\text{C}$
Line Regulation	$V_{\text{IN}} = V_{\text{OUT}} + 0.5\text{ V to }5\text{ V}$		Line_{Reg}		0.02	0.10	%/V
Load Regulation	$I_{\text{OUT}} = 1\text{ mA to }150\text{ mA}$		Load_{Reg}		10	30	mV
Dropout Voltage	$I_{\text{OUT}} = 150\text{ mA}$	$1.2\text{ V} \leq V_{\text{OUT}} < 1.5\text{ V}$	V_{DO}		0.67	1.00	V
		$1.5\text{ V} \leq V_{\text{OUT}} < 1.7\text{ V}$			0.54	0.81	
		$1.7\text{ V} \leq V_{\text{OUT}} < 2.0\text{ V}$			0.46	0.68	
		$2.0\text{ V} \leq V_{\text{OUT}} < 2.5\text{ V}$			0.41	0.60	
		$2.5\text{ V} \leq V_{\text{OUT}} < 4.0\text{ V}$			0.32	0.51	
		$4.0\text{ V} \leq V_{\text{OUT}}$			0.24	0.37	
Output Current			I_{OUT}	150			mA
Short Current Limit	$V_{\text{OUT}} = 0\text{ V}$		I_{SC}		40		mA
Quiescent Current	$I_{\text{OUT}} = 0\text{ mA}$		I_{Q}		38	58	μA
Standby Current	$V_{\text{CE}} = V_{\text{IN}}$ (L version), $V_{\text{CE}} = 0\text{ V}$ (H and D version), $T_A = 25^{\circ}\text{C}$		I_{STB}		0.1	1	μA
$\overline{\text{CE}}$ /CE Pin Threshold Voltage	$\overline{\text{CE}}$ / CE Input Voltage "H"		V_{CEH}	1.0			V
	$\overline{\text{CE}}$ / CE Input Voltage "L"		V_{CEL}			0.4	
CE Pull Down Current	H and D version		I_{PD}		0.4		μA
Power Supply Rejection Ratio	$V_{\text{IN}} = V_{\text{OUT}} + 1\text{ V}$ or 3.0 V whichever is higher, $I_{\text{OUT}} = 30\text{ mA}$, $f = 1\text{ kHz}$		PSRR		80		dB
Output Noise Voltage	$V_{\text{OUT}} = 1.2\text{ V}$, $I_{\text{OUT}} = 30\text{ mA}$, $f = 10\text{ Hz to }100\text{ kHz}$		V_{N}		30		μV_{rms}
Low Output N-ch Tr. On Resistance	D Version only, $V_{\text{IN}} = 4\text{ V}$, $V_{\text{CE}} = 0\text{ V}$		R_{LOW}		30		Ω

TYPICAL CHARACTERISTICS

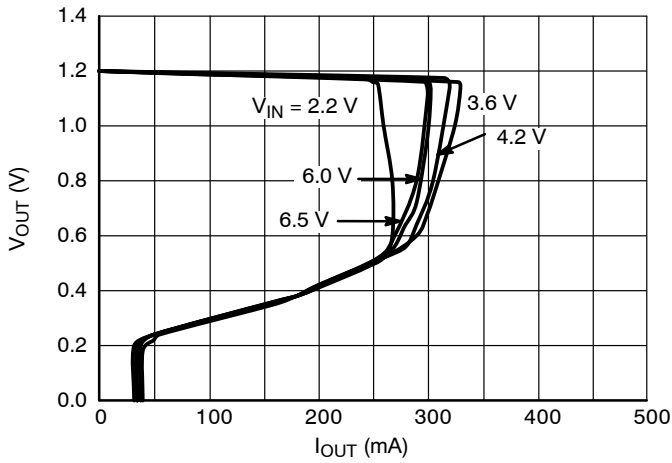


Figure 3. Output Voltage vs. Output Current
1.2 V Version ($T_A = 25^\circ\text{C}$)

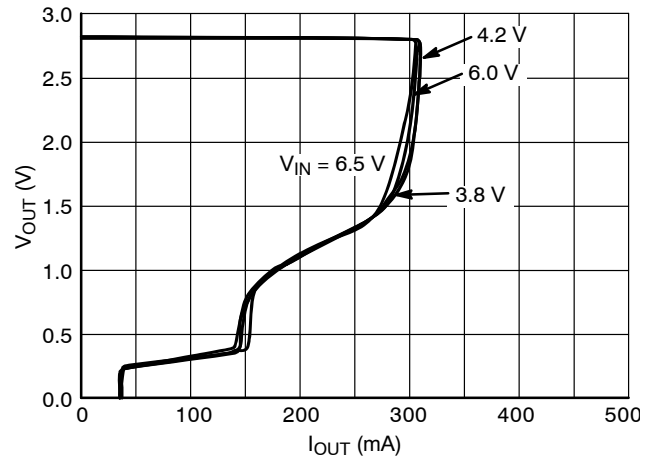


Figure 4. Output Voltage vs. Output Current
2.8 V Version ($T_A = 25^\circ\text{C}$)

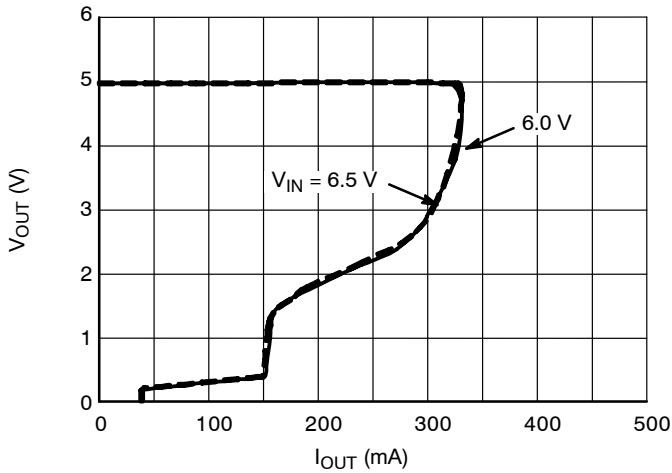


Figure 5. Output Voltage vs. Output Current
5.0 V version ($T_A = 25^\circ\text{C}$)

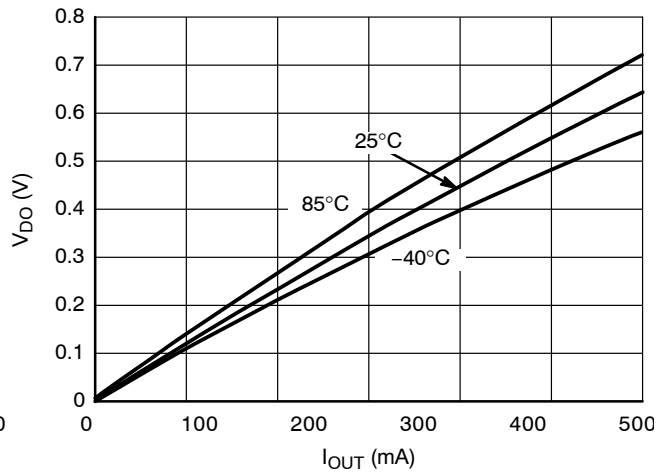


Figure 6. Dropout Voltage vs. Output Current
1.2 V version

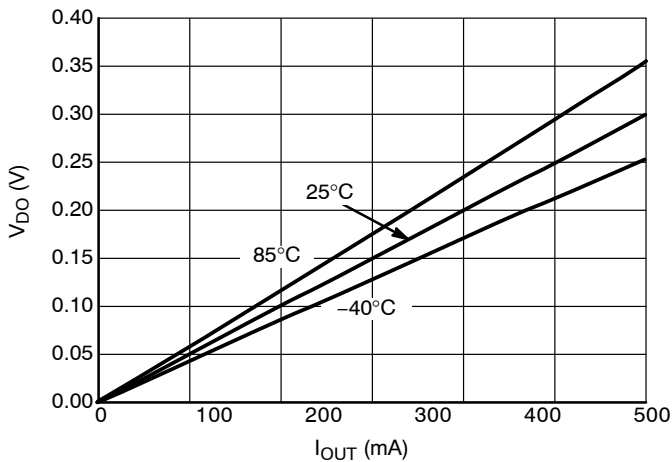


Figure 7. Dropout Voltage vs. Output Current
2.8 V Version

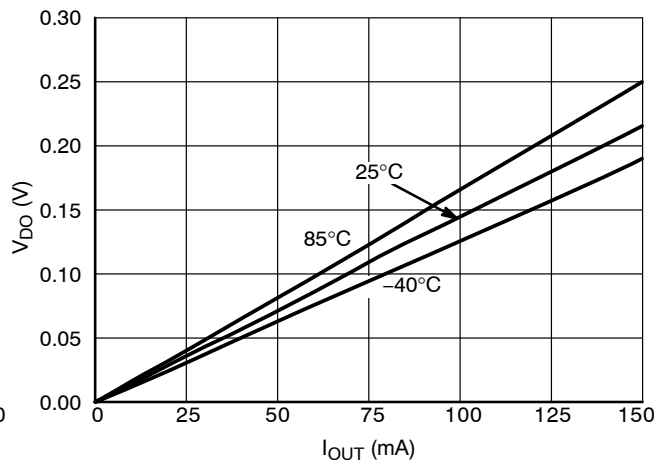


Figure 8. Dropout Voltage vs. Output Current
5.0 V Version

TYPICAL CHARACTERISTICS

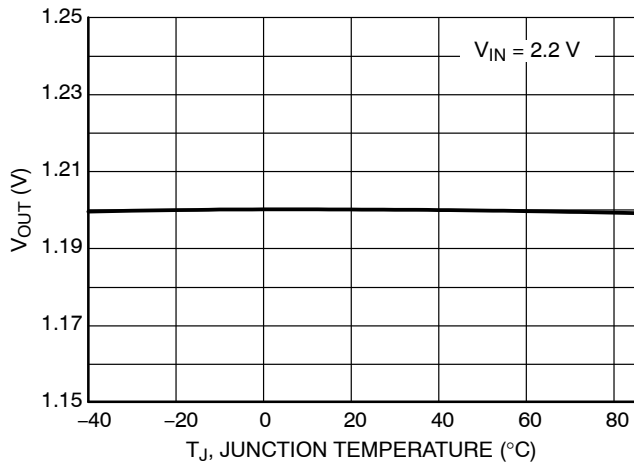


Figure 9. Output Voltage vs. Temperature, 1.2 V Version

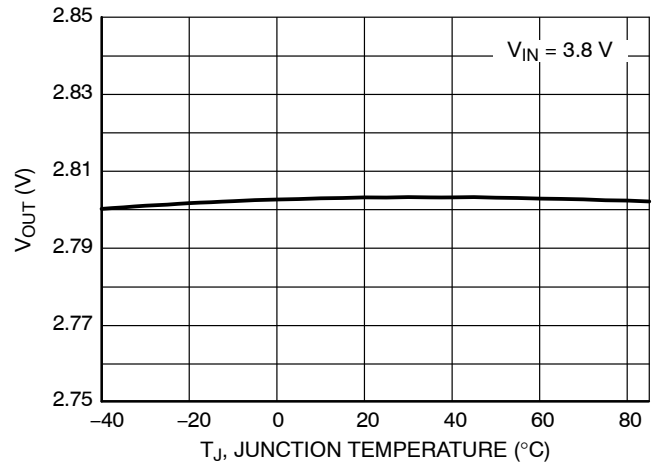


Figure 10. Output Voltage vs. Temperature, 2.8 V version

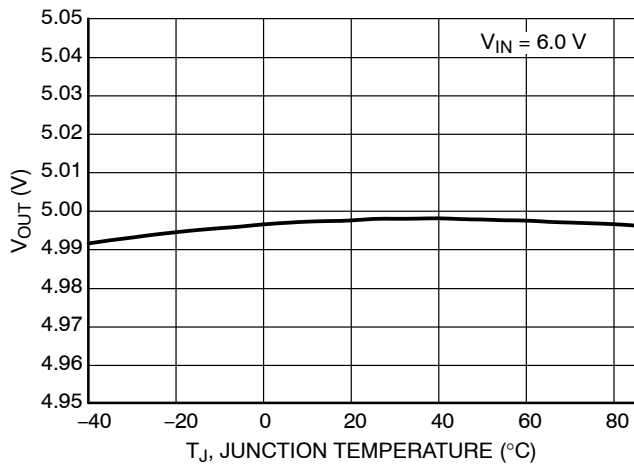


Figure 11. Output Voltage vs. Temperature, 5.0 V Version

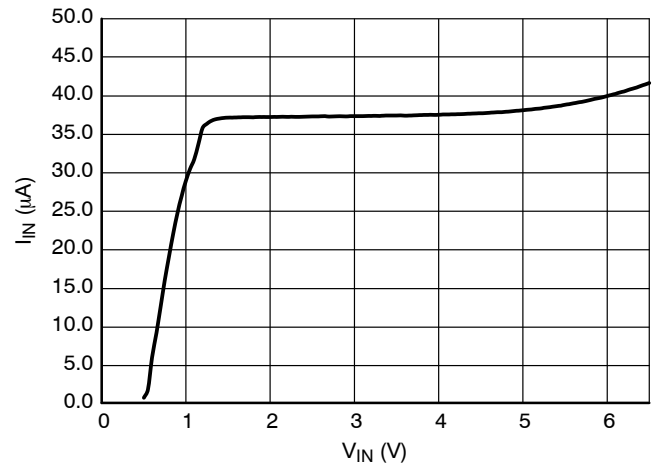


Figure 12. Supply Current vs. Input Voltage, 1.2 V Version

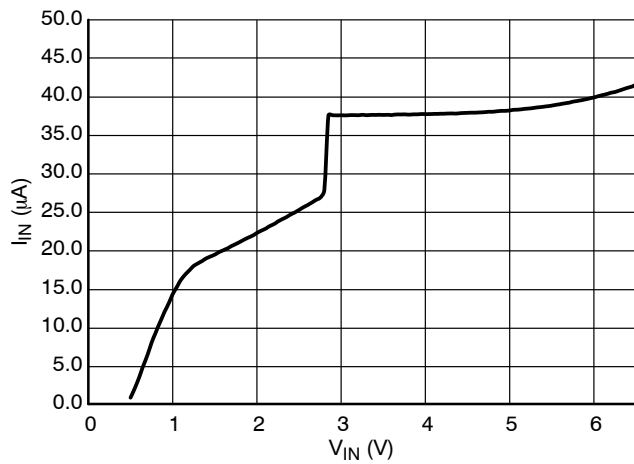


Figure 14. Supply Current vs. Input Voltage, 2.8 V Version

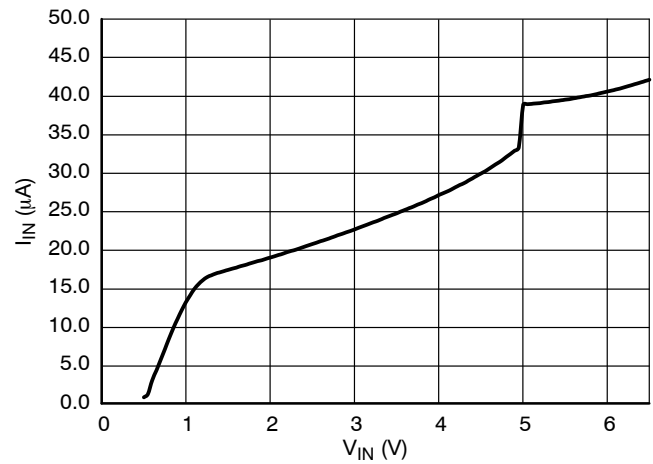


Figure 13. Supply Current vs. Input Voltage, 5.0 V version

TYPICAL CHARACTERISTICS

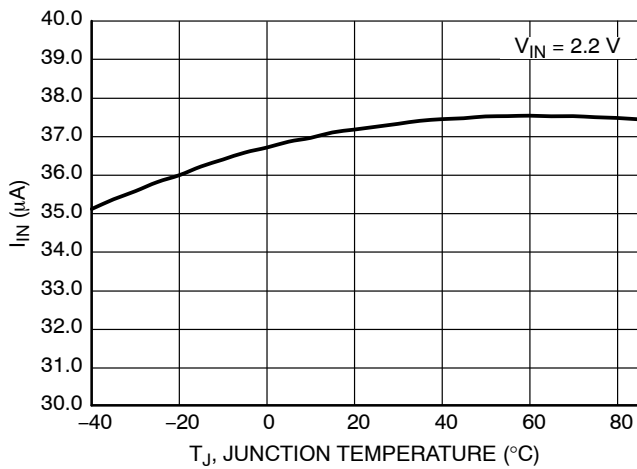


Figure 15. Supply Current vs. Temperature, 1.2 V Version

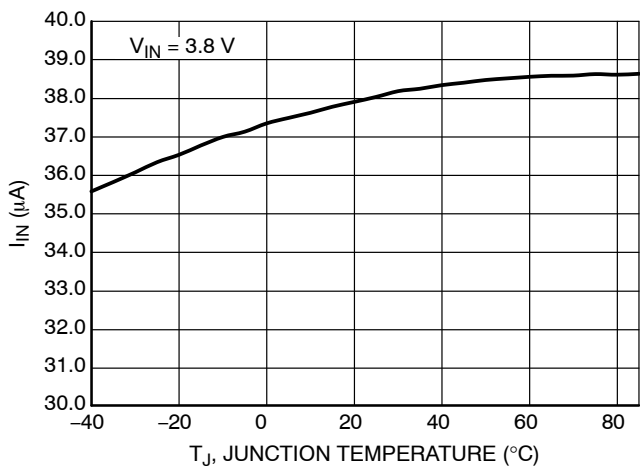


Figure 16. Supply Current vs. Temperature, 2.8 V Version

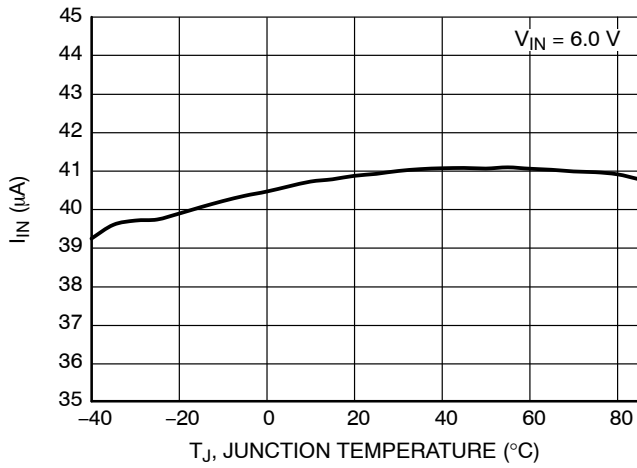


Figure 17. Supply Current vs. Temperature, 5.0 V Version

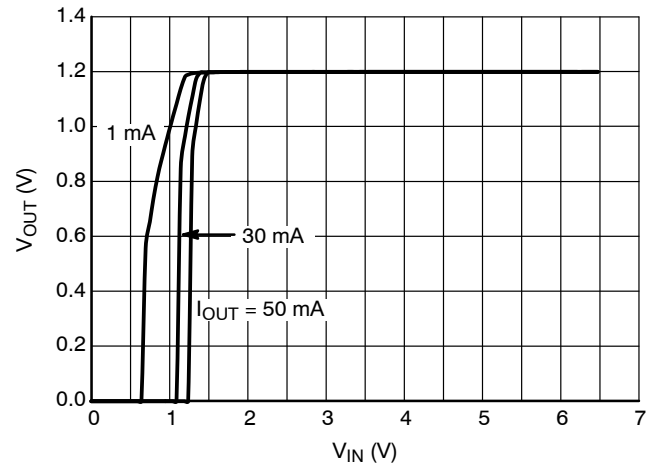


Figure 18. Output Voltage vs. Input Voltage, 1.2 V Version

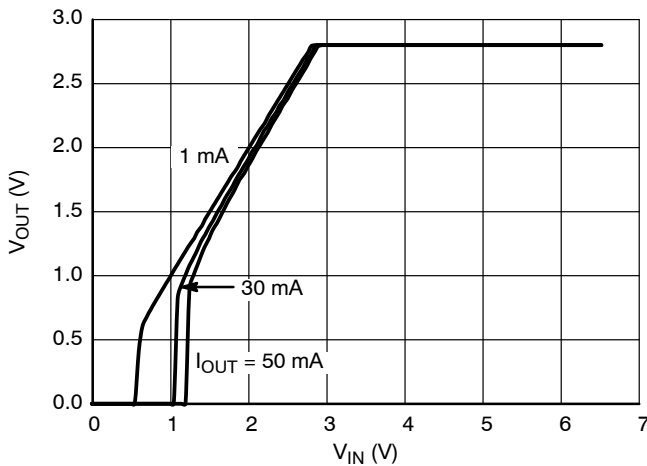


Figure 19. Output Voltage vs. Input Voltage, 2.8 V Version

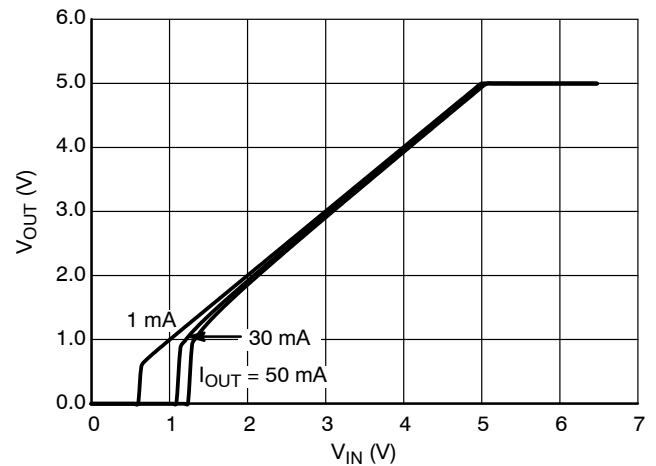


Figure 20. Output Voltage vs. Input Voltage, 5.0 V Version

TYPICAL CHARACTERISTICS

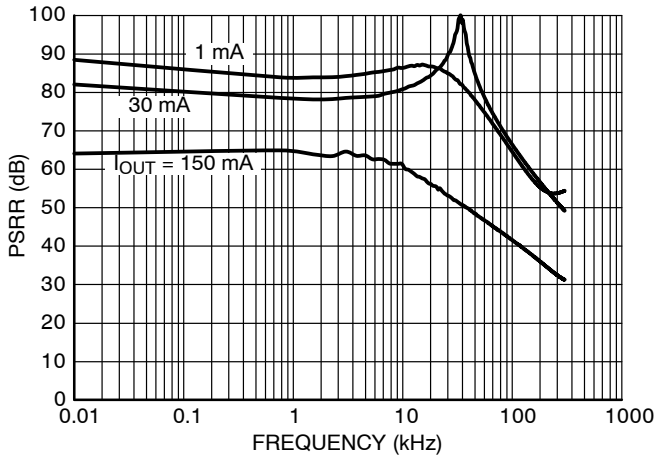


Figure 21. PSRR, 1.2 V Version

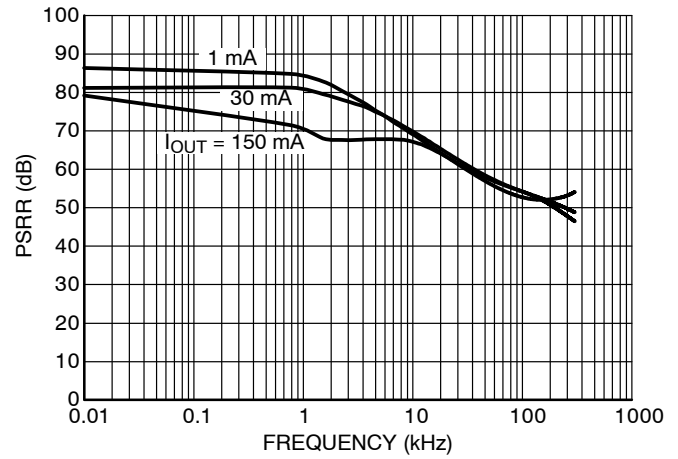


Figure 22. PSRR, 2.8 V Version

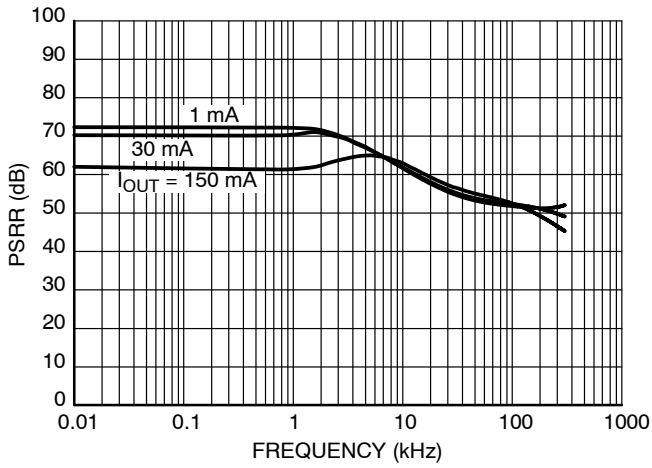


Figure 23. PSRR, 5.0 V Version

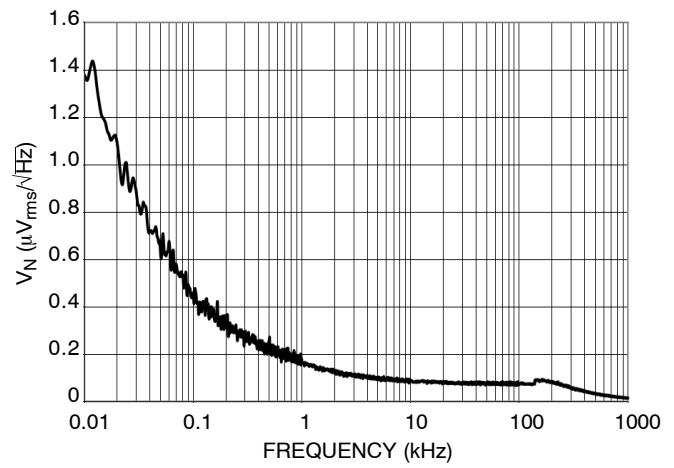


Figure 24. Output Voltage Noise, 1.2 V Version

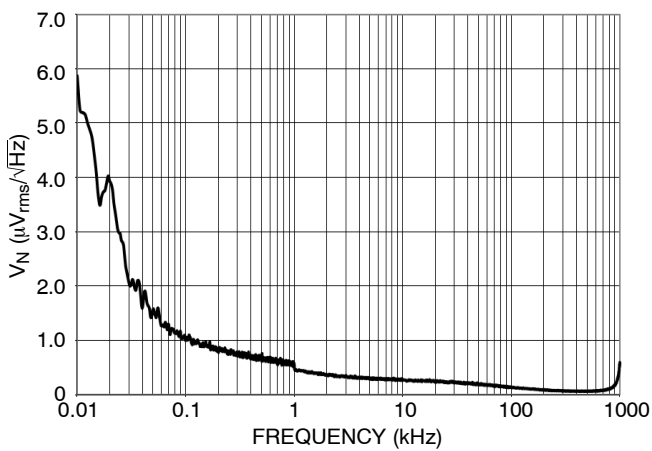


Figure 25. Output Voltage Noise, 2.8 V Version

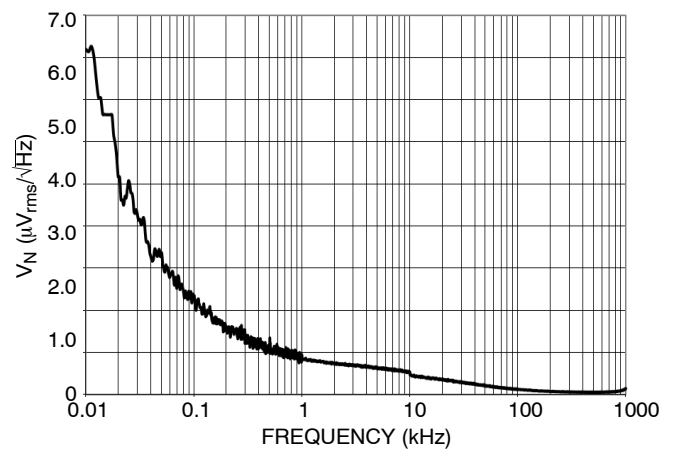
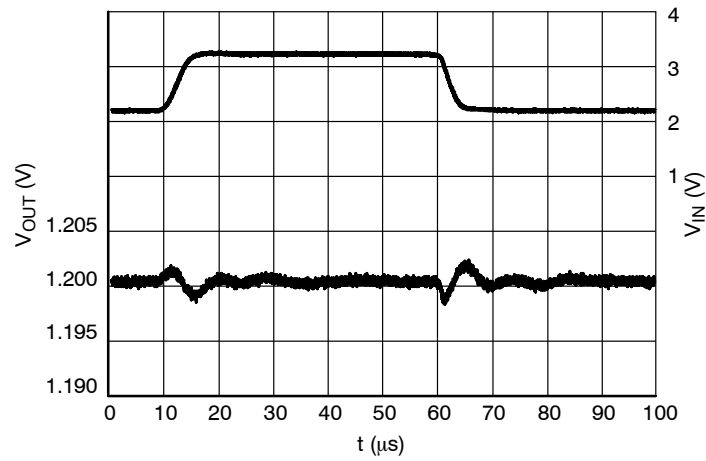


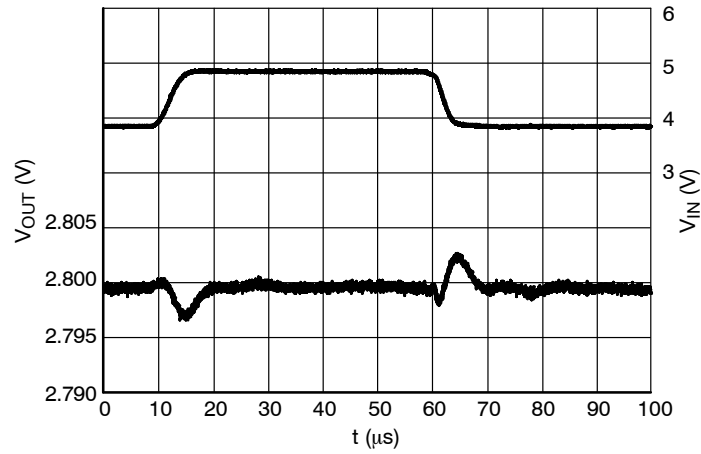
Figure 26. Output Voltage Noise, 5.0 V Version

NCP4586

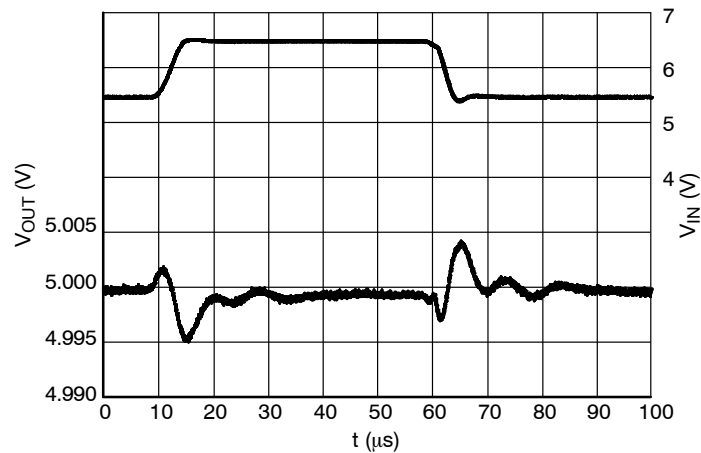
TYPICAL CHARACTERISTICS



**Figure 27. Line Transients, 1.2 V Version,
 $t_R = t_F = 5 \mu\text{s}$, $I_{OUT} = 30 \text{ mA}$**



**Figure 28. Line Transients, 2.8 V Version,
 $t_R = t_F = 5 \mu\text{s}$, $I_{OUT} = 30 \text{ mA}$**



**Figure 29. Line Transients, 5.0 V Version, $t_R =$
 $t_F = 5 \mu\text{s}$, $I_{OUT} = 30 \text{ mA}$**

TYPICAL CHARACTERISTICS

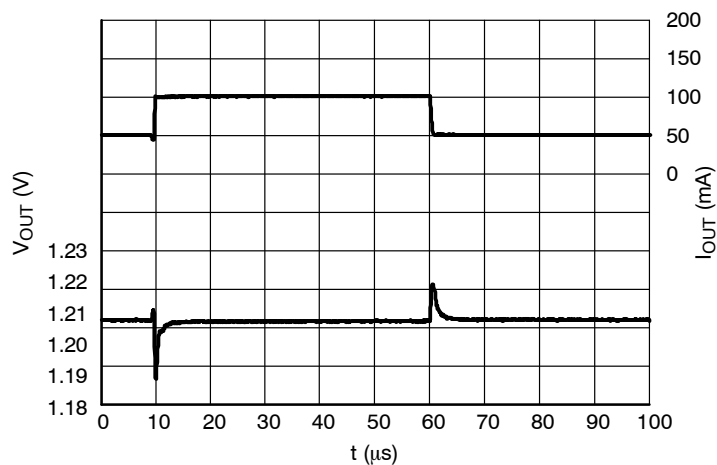


Figure 30. Load Transients, 1.2 V Version,
 $I_{OUT} = 50 - 100 \text{ mA}$, $t_R = t_F = 0.5 \mu\text{s}$, $V_{IN} = 2.2 \text{ V}$

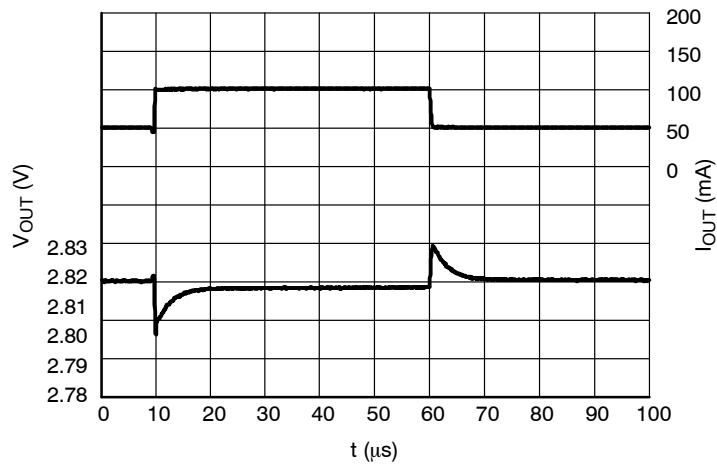


Figure 31. Load Transients, 2.8 V Version,
 $I_{OUT} = 50 - 100 \text{ mA}$, $t_R = t_F = 0.5 \mu\text{s}$, $V_{IN} = 3.8 \text{ V}$

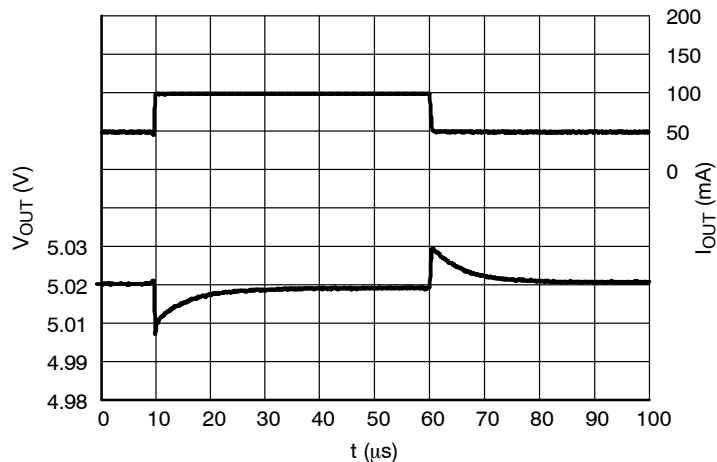


Figure 32. Load Transients, 5.0 V Version,
 $I_{OUT} = 50 - 100 \text{ mA}$, $t_R = t_F = 0.5 \mu\text{s}$, $V_{IN} = 6.0 \text{ V}$

TYPICAL CHARACTERISTICS

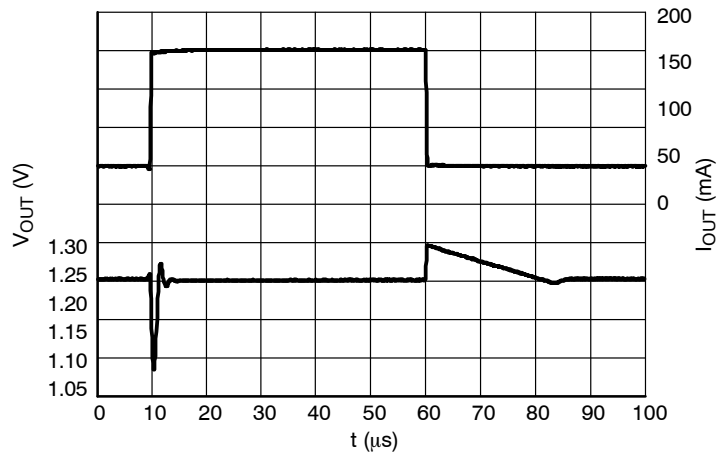


Figure 33. Load Transients, 1.2 V Version,
 $I_{OUT} = 1 - 150 \text{ mA}$, $t_R = t_F = 0.5 \mu\text{s}$, $V_{IN} = 2.2 \text{ V}$

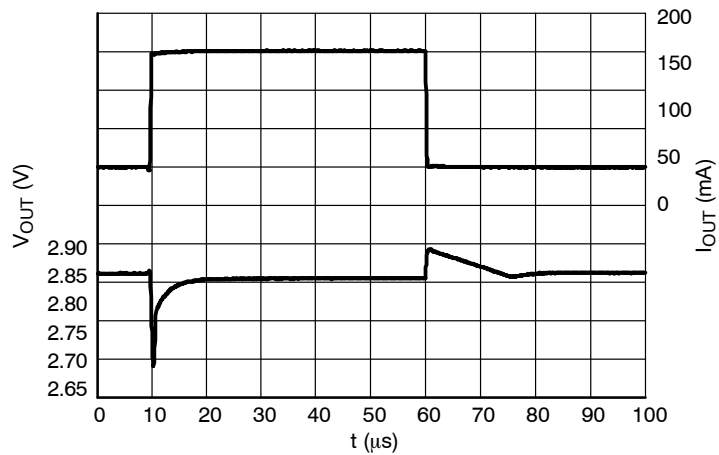


Figure 34. Load Transients, 2.8 V Version,
 $I_{OUT} = 1 - 150 \text{ mA}$, $t_R = t_F = 0.5 \mu\text{s}$, $V_{IN} = 3.8 \text{ V}$

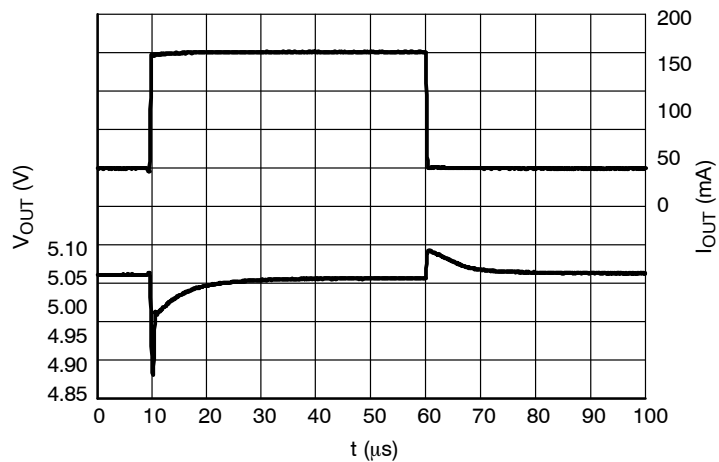


Figure 35. Load Transients, 5.0 V Version,
 $I_{OUT} = 1 - 150 \text{ mA}$, $t_R = t_F = 0.5 \mu\text{s}$, $V_{IN} = 6.0 \text{ V}$

NCP4586

TYPICAL CHARACTERISTICS

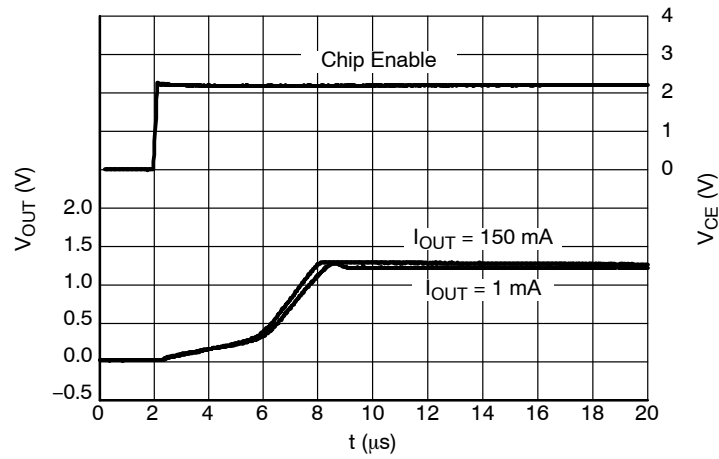


Figure 36. Start-up, 1.2 V Version, $V_{IN} = 2.2 V$

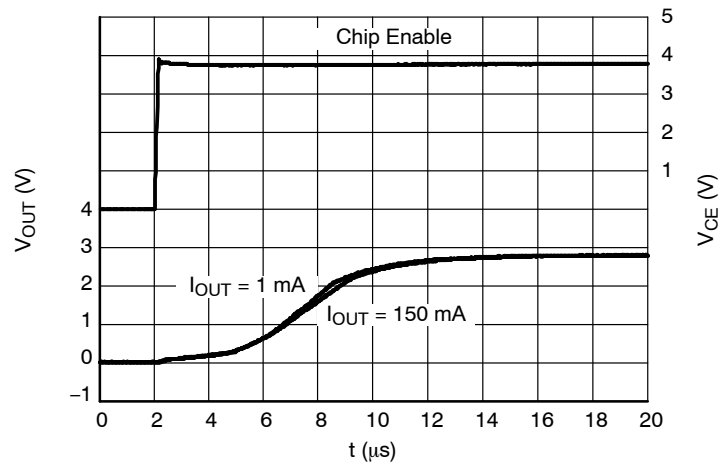


Figure 37. Start-up, 2.8 V Version, $V_{IN} = 3.8 V$

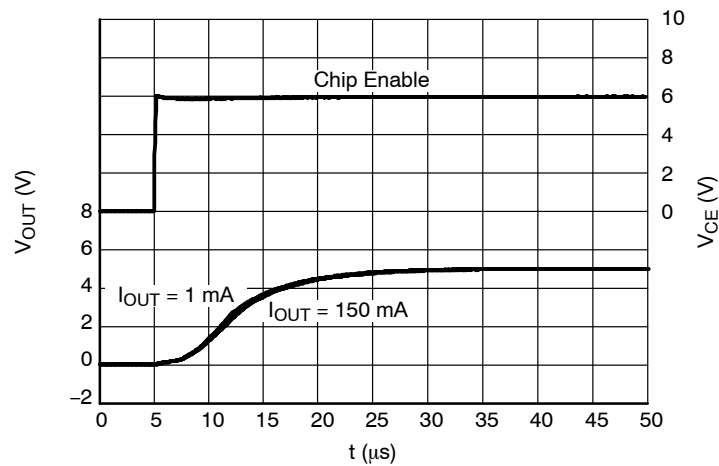


Figure 38. Start-up, 5.0 V Version, $V_{IN} = 6.0 V$

TYPICAL CHARACTERISTICS

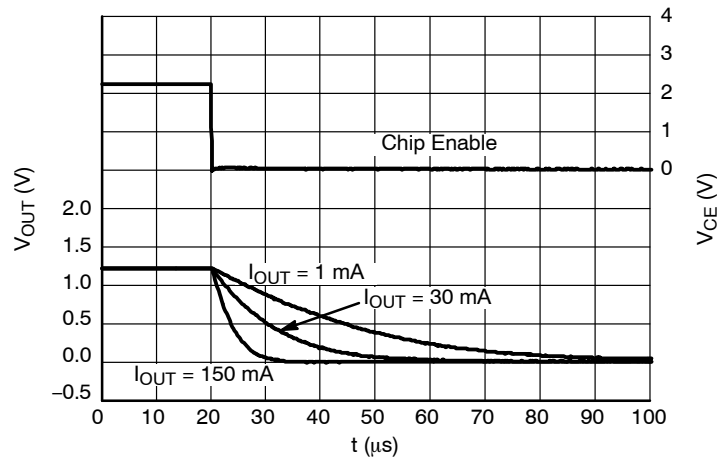


Figure 39. Shutdown, 1.2 V Version D,
 $V_{IN} = 2.2 \text{ V}$

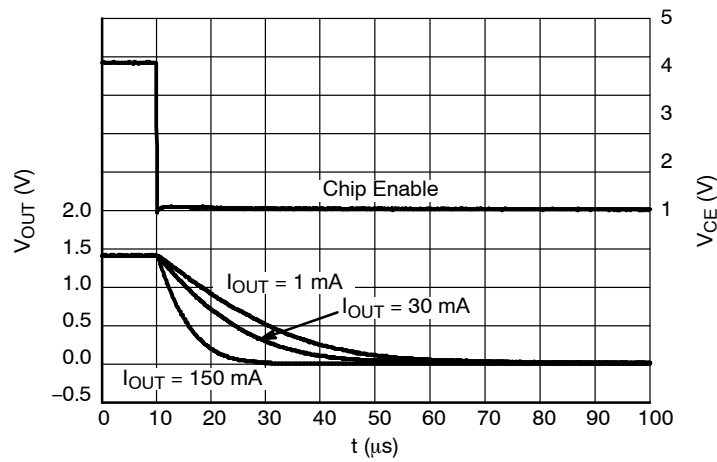


Figure 40. Shutdown, 2.8 V Version D,
 $V_{IN} = 3.8 \text{ V}$

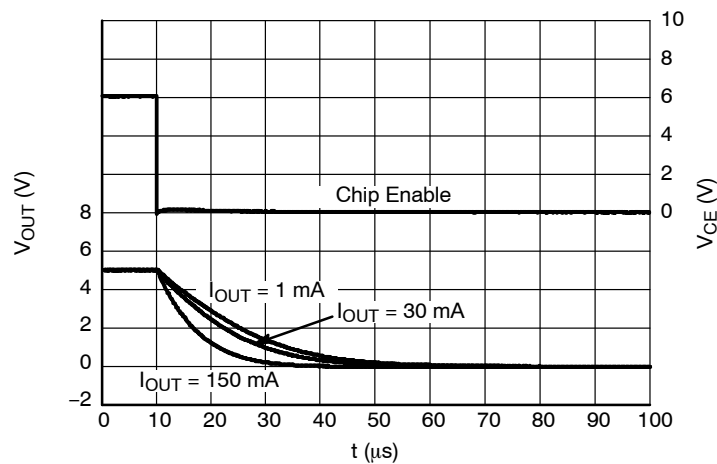


Figure 41. Shutdown, 5.0 V version D,
 $V_{IN} = 6.0 \text{ V}$

APPLICATION INFORMATION

A typical application circuit for NCP4586 series is shown in Figure 42.

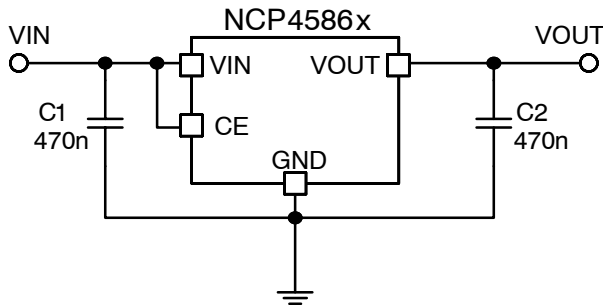


Figure 42. Typical Application Schematic

Input Decoupling Capacitor (C1)

A 470 nF ceramic input decoupling capacitor should be connected as close as possible to the input and ground pin of the NCP4586. Higher values and lower ESR improves line transient response.

Output Decoupling Capacitor (C2)

A 470 nF or larger ceramic output decoupling capacitor is sufficient to achieve stable operation of the IC. If a tantalum capacitor is used, and its ESR is high, loop oscillation may result. The capacitors should be connected as close as possible to the output and ground pins. Larger values and lower ESR improves dynamic parameters.

Enable Operation

The Enable pin $\overline{CE}$ or CE may be used for turning the regulator on and off. Control polarity is dependent on

version of IC. Active high or low versions are available; please see the ordering information table. The Enable pin has an internal pull down current source for versions H and D. If the enable function is not needed connect the $\overline{CE}$ pin to ground for version L or connect the CE pin to VIN for versions H and D.

Output Discharger

The D version includes a transistor between VOUT and GND that is used for faster discharging of the output capacitor. This function is activated when the IC goes into disable mode.

Thermal

As power across the IC increases, it might become necessary to provide some thermal relief. The maximum power dissipation supported by the device is dependent upon board design and layout. Mounting pad configuration on the PCB, the board material, and also the ambient temperature affect the rate of temperature rise for the part. That is to say, when the device has good thermal conductivity through the PCB, the junction temperature will be relatively low with high power dissipation applications.

PCB Layout

Make VIN and GND line sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect capacitors C1 and C2 as close as possible to the IC, and make wiring as short as possible.

NCP4586

ORDERING INFORMATION

Device	Nominal Output Voltage	Description	Marking	Package	Shipping [†]
NCP4586DSQ12T1G	1.2 V	Enable High, Auto discharge	LA	SC82AB (Pb-Free)	3000 / Tape & Reel
NCP4586DSQ18T1G	1.8 V		LG		
NCP4586DSQ28T1G	2.8 V		MH		
NCP4586DSQ30T1G	3.0 V		NA		
NCP4586DSQ33T1G	3.3 V		ND		
NCP4586DSQ50T1G	5.0 V		QA		
NCP4586DMU12TCG	1.2 V		VA	UDFN4 (Pb-Free)	10000 / Tape & Reel
NCP4586DMU14TCG	1.4 V		VC		
NCP4586DMU15TCG	1.5 V		VD		
NCP4586DMU18TCG	1.8 V		VG		
NCP4586DMU25TCG	2.5 V		VQ		
NCP4586DMU28TCG	2.8 V		VT		
NCP4586DMU30TCG	3.0 V		VW		
NCP4586DMU33TCG	3.3 V		VZ		
NCP4586DMU50TCG	5.0 V		WS		
NCP4586DSN12T1G	1.2 V		H2A	SOT-23-5 (Pb-Free)	3000 / Tape & Reel
NCP4586DSN18T1G	1.8 V		H2G		
NCP4586DSN28T1G	2.8 V		H2T		
NCP4586DSN30T1G	3.0 V		H2W		
NCP4586DSN33T1G	3.3 V		H2Z		
NCP4586DSN50T1G	5.0 V		J2S		

[†]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.

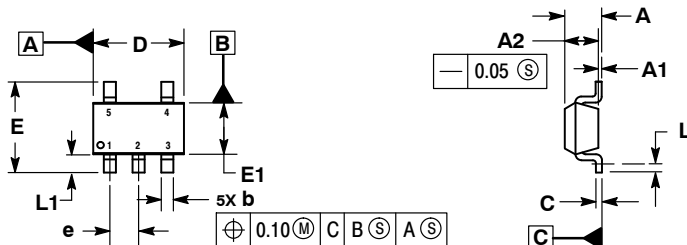
NOTE: To order other package and voltage variants, please contact your ON Semiconductor sales representative.



SCALE 2:1

SOT-23 5-LEAD
CASE 1212
ISSUE A

DATE 28 JAN 2011

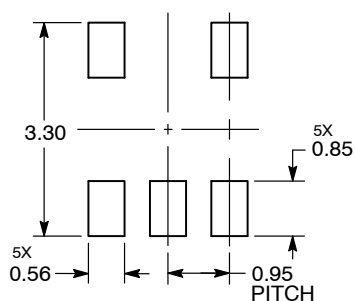


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSIONS: MILLIMETERS.
3. DATUM C IS THE SEATING PLANE.

	MILLIMETERS	
DIM	MIN	MAX
A	---	1.45
A1	0.00	0.10
A2	1.00	1.30
b	0.30	0.50
c	0.10	0.25
D	2.70	3.10
E	2.50	3.10
E1	1.50	1.80
e	0.95 BSC	
L	0.20	---
L1	0.45	0.75

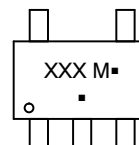
RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual. SOLDERRM/D.

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code

M = Date Code

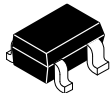
- = Pb-Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking.
Pb-Free indicator, "G" or microdot "▪", may or may not be present.

DOCUMENT NUMBER:	98ASH70518A	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SOT-23 5-LEAD	PAGE 1 OF 1

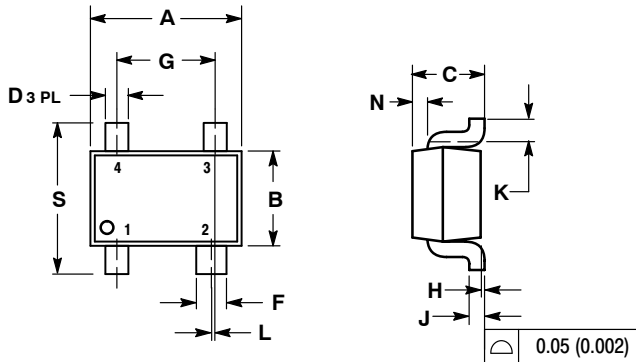
onsemi and **onsemi** are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. **onsemi** does not convey any license under its patent rights nor the rights of others.



SCALE 4:1

SC-82AB
CASE 419C-02
ISSUE F

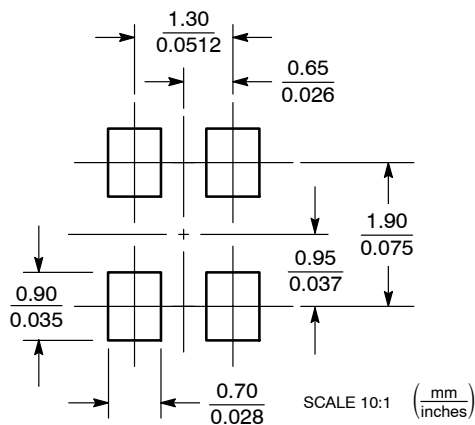
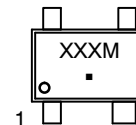
DATE 22 JUN 2012



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. 419C-01 OBSOLETE. NEW STANDARD IS 419C-02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.80	2.20	0.071	0.087
B	1.15	1.35	0.045	0.053
C	0.80	1.10	0.031	0.043
D	0.20	0.40	0.008	0.016
F	0.30	0.50	0.012	0.020
G	1.10	1.50	0.043	0.059
H	0.00	0.10	0.000	0.004
J	0.10	0.26	0.004	0.010
K	0.10	---	0.004	---
L	0.05 BSC		0.002 BSC	
N	0.20 REF		0.008 REF	
S	1.80	2.40	0.07	0.09

SOLDERING FOOTPRINT*

GENERIC MARKING DIAGRAM*


XXX = Specific Device Code
M = Month Code
▪ = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

DOCUMENT NUMBER:	98ARB18939C	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SC-82AB	PAGE 1 OF 1

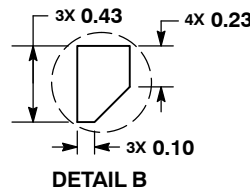
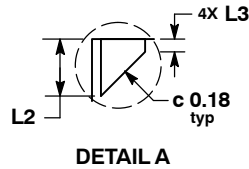
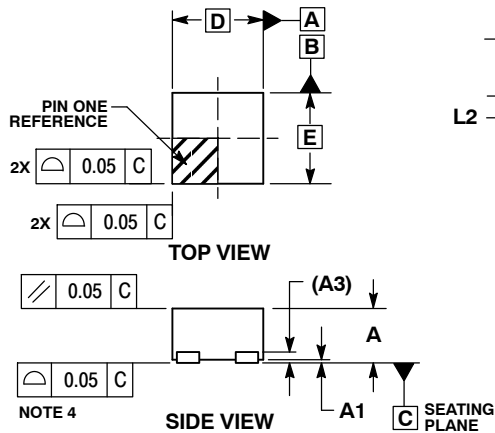
onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.



SCALE 4:1

UDFN4 1.0x1.0, 0.65P
CASE 517BR
ISSUE O

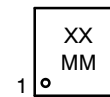
DATE 27 OCT 2010



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.20 mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

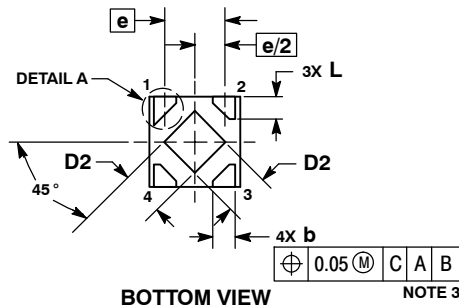
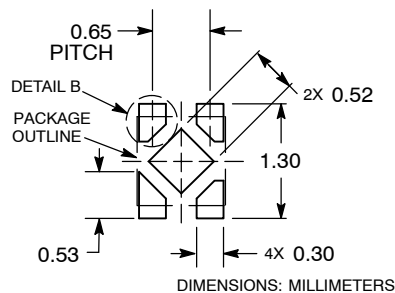
MILLIMETERS		
DIM	MIN	MAX
A	---	0.60
A1	0.00	0.05
A3	0.10	REF
b	0.20	0.30
D	1.00	BSC
D2	0.43	0.53
E	1.00	BSC
e	0.65	BSC
L	0.20	0.30
L2	0.27	0.37
L3	0.02	0.12

GENERIC MARKING DIAGRAM*


XX = Specific Device Code

MM = Date Code

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.


RECOMMENDED MOUNTING FOOTPRINT*


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

DOCUMENT NUMBER:	98AON53254E	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	UDFN4 1.0x1.0, 0.65P	PAGE 1 OF 1

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at
www.onsemi.com/support/sales

