NCP553, NCV553

80 mA CMOS Low Iq NOCAP™ Voltage Regulator

This series of fixed output NOCAP linear regulators are designed for handheld communication equipment and portable battery powered applications which require low quiescent. This series features an ultra−low quiescent current of 2.8 μA. Each device contains a voltage reference unit, an error amplifier, a PMOS power transistor, resistors for setting output voltage, current limit, and temperature limit protection circuits.

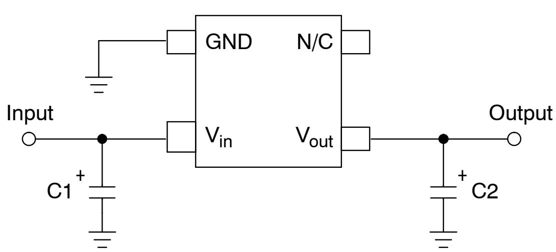
These voltage regulators have been designed to be used with low cost ceramic capacitors. The devices have the ability to operate without an output capacitor. The devices are housed in the micro−miniature SC82−AB surface mount package. Standard voltage versions are 1.5, 1.8, 2.5, 2.7, 2.8, 3.0, 3.3, and 5.0 V. Other voltages are available in 100 mV steps.

Features

- Pb−Free Packages are Available*
- Low Quiescent Current of 2.8 μA Typical
- Low Output Voltage Option
- Output Voltage Accuracy of 2.0%
- Industrial Temperature Range of −40°C to 85°C
  (NCV553, T_A = −40°C to +125°C)

Typical Applications

- Battery Powered Consumer Products
- Hand−Held Instruments
- Camcorders and Cameras
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes

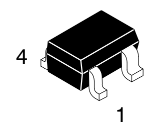


This device contains 32 active transistors

Figure 1. Typical Application Diagram

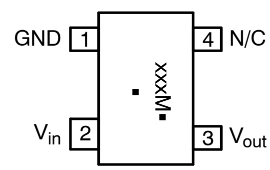
ON Semiconductor®

http://onsemi.com



SC82−AB (SC70−4)
SQ SUFFIX
CASE 419C

PIN CONNECTIONS & MARKING DIAGRAMS



(NCP553, NCV553 Top View)

xxx = Device Code
M = Date Code8
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or position may vary depending upon manufacturing location.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

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

PIN FUNCTION DESCRIPTION

Pin	Pin Name	Description
1	GND	Power supply ground.
2	Vin	Positive power supply input voltage.
3	Vout	Regulated output voltage.
−	Enable	This input is used to place the device into low−power standby. When this input is pulled low, the device is disabled. If this function is not used, Enable should be connected to Vin.
4	N/C	No internal connection.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage	V_{in}	12	V
Output Voltage	V_{out}	−0.3 to V_{in} +0.3	V
Power Dissipation and Thermal Characteristics Power Dissipation Thermal Resistance, Junction−to−Ambient	 P_D $R_{\theta JA}$	 Internally Limited 400	 W °C/W
Operating Junction Temperature	T_J	+125	°C
Operating Ambient Temperature NCP553 NCV553	T_A	 −40 to +85 −40 to +125	°C
Storage Temperature	T_{stg}	−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.

1. This device series contains ESD protection and exceeds the following tests:
   Human Body Model 2000 V per MIL−STD−883, Method 3015
   Machine Model Method 200 V
2. Latch up capability (85°C) ±200 mA DC with trigger voltage.

ELECTRICAL CHARACTERISTICS (V_{in} = $V_{out(nom.)}$ + 1.0 V, V_{enable} = V_{in}, C_{in} = 1.0 μF, C_{out} = 1.0 μF, T_J = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (T_A = 25°C, I_{out} = 10 mA)	V_{out}				V
1.5 V		1.455	1.5	1.545	
1.8 V		1.746	1.8	1.854	
2.5 V		2.425	2.5	2.575	
2.7 V		2.646	2.7	2.754	
2.8 V		2.744	2.8	2.856	
3.0 V		2.94	3.0	3.06	
3.3 V		3.234	3.3	3.366	
5.0 V		4.900	5.0	5.100	
Output Voltage (T_A = −40°C to 85°C, I_{out} = 10 mA)	V_{out}				V
1.5 V		1.455	1.5	1.545	
1.8 V		1.746	1.8	1.854	
2.5 V		2.425	2.5	2.575	
2.7 V		2.619	2.7	2.781	
2.8 V		2.716	2.8	2.884	
3.0 V		2.910	3.0	3.09	
3.3 V		3.201	3.3	3.399	
5.0 V		4.900	5.0	5.100	
Output Voltage (T_A = −40°C, I_{out} = 10 mA) NCV553 −5.0 V	V_{out}	4.900	5.0	5.100	V
Output Voltage (T_A = +125°C, I_{out} = 10 mA) NCV553 −5.0 V	V_{out}	4.850	5.0	5.150	V
Line Regulation (V_{in} = V_{out} + 1.0 V to 12 V, I_{out} = 10 mA)	Reg_{line}	–	2.0	4.5	mV/V
Load Regulation (I_{out} = 1.0 mA to 80 mA, V_{in} = V_{out} + 2.0 V)	Reg_{load}	–	0.3	0.8	mV/mA
Output Current (V_{out} = (V_{out} at I_{out} = 80 mA) −3.0%)	$I_{o(nom.)}$				mA
1.5 V−3.9 V (V_{in} = $V_{out(nom.)}$ + 2.0 V)		80	180	–	
4.0 V−5.0 V (V_{in} = 6.0 V)		80	180	–	
Dropout Voltage (T_A = −40°C to 125°C, I_{out} = 80 mA, Measured at V_{out} −3.0%)	$V_{in}−V_{out}$				mV
1.5 V		–	1300	1800	
1.8 V		–	1100	1600	
2.5 V		–	800	1400	
2.7 V		–	750	1200	
2.8 V		–	730	1200	
3.0 V		–	680	1000	
3.3 V		–	650	1000	
5.0 V		–	470	800	
Quiescent Current	I_Q				μA
(Enable Input = 0 V)		–	0.1	1.0	
(Enable Input = V_{in}, I_{out} = 1.0 mA to $I_{o(nom.)}$, V_{in} = V_{out} +2.0 V)		–	2.8	6.0	
Output Short Circuit Current (V_{out} = 0 V)	$I_{out(max)}$				mA
1.5 V−3.9 V (V_{in} = $V_{out(nom.)}$ + 2.0 V)		100	300	450	
4.0 V−5.0 V (V_{in} = 6.0 V)		100	300	450	
Output Voltage Noise (f = 20 Hz to 100 kHz, I_{out} = 10 mA) (C_{out} = 1.0 μF)	V_n	–	90	–	μVrms
Output Voltage Temperature Coefficient	T_C	–	±100	–	ppm/°C

3. Maximum package power dissipation limits must be observed.

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

4. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.

DEFINITIONS

Load Regulation

The change in output voltage for a change in output current at a constant temperature.

Dropout Voltage

The input/output differential at which the regulator output no longer maintains regulation against further reductions in input voltage. Measured when the output drops 3.0% below its nominal. The junction temperature, load current, and minimum input supply requirements affect the dropout level.

Maximum Power Dissipation

The maximum total dissipation for which the regulator will operate within its specifications.

Quiescent 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.

Line Regulation

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

Line Transient Response

Typical over and undershoot response when input voltage is excited with a given slope.

Thermal Protection

Internal thermal shutdown circuitry is provided to protect the integrated circuit in the event that the maximum junction temperature is exceeded. When activated at typically 160°C, the regulator turns off. This feature is provided to prevent failures from accidental overheating.

Maximum Package Power Dissipation

The maximum power package dissipation is the power dissipation level at which the junction temperature reaches its maximum operating value, i.e. 125°C. Depending on the ambient power dissipation and thus the maximum available output current.

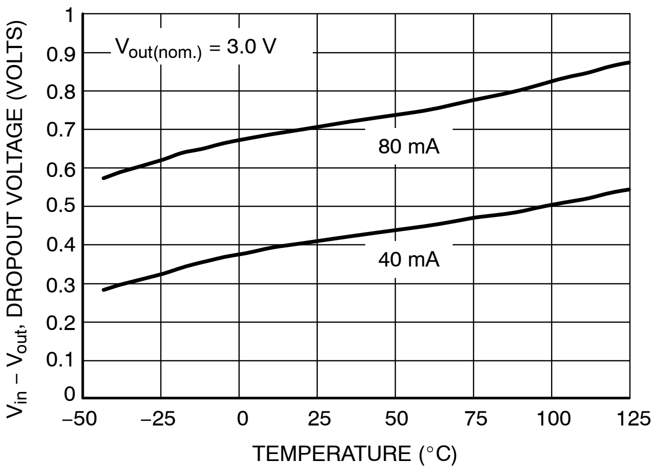


Figure 2. Dropout Voltage versus Temperature

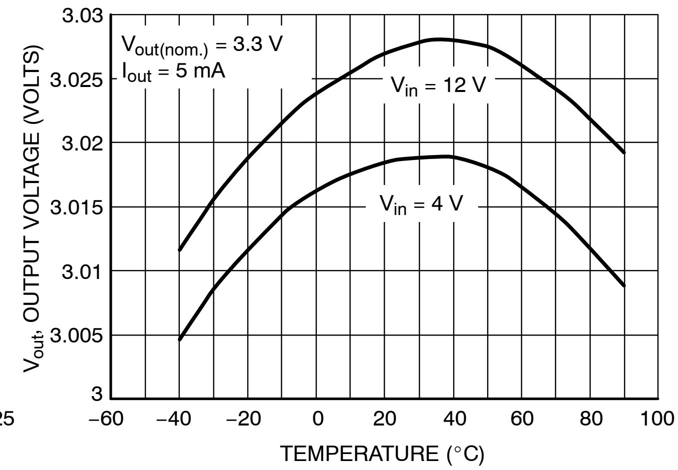


Figure 3. Output Voltage versus Temperature

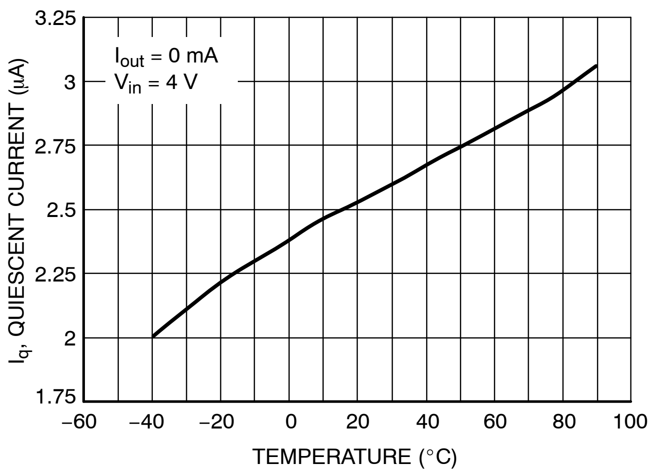


Figure 4. Quiescent Current versus Temperature

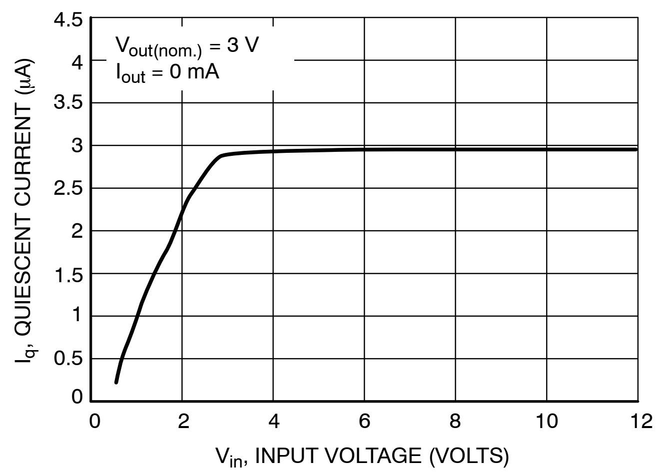


Figure 5. Quiescent Current versus Input Voltage

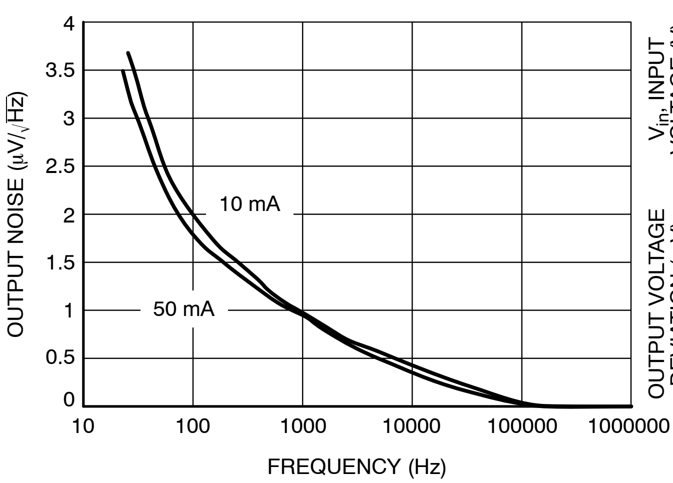


Figure 6. Output Noise Density

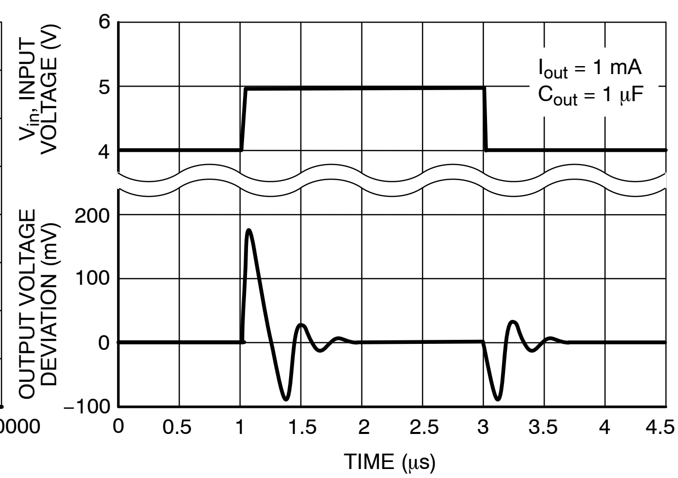


Figure 7. Line Transient Response

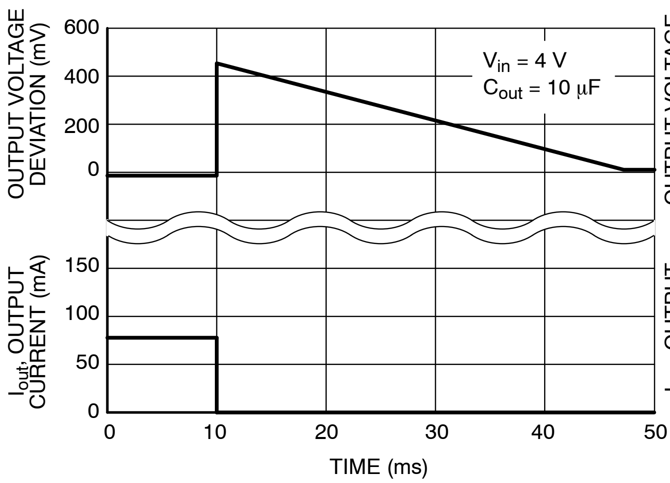


Figure 8. Load Transient Response

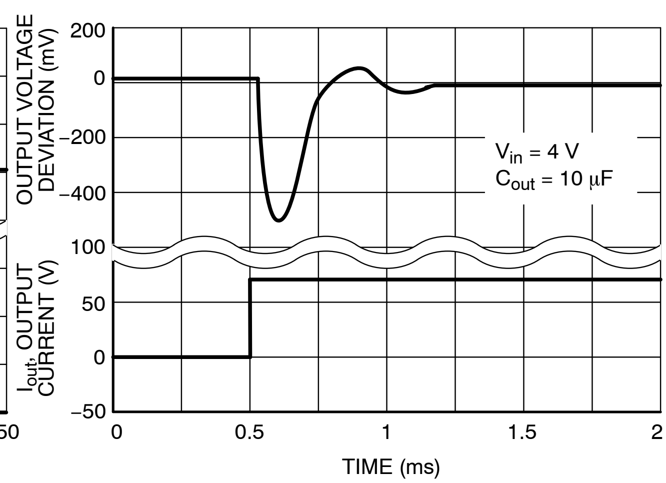


Figure 9. Load Transient Response

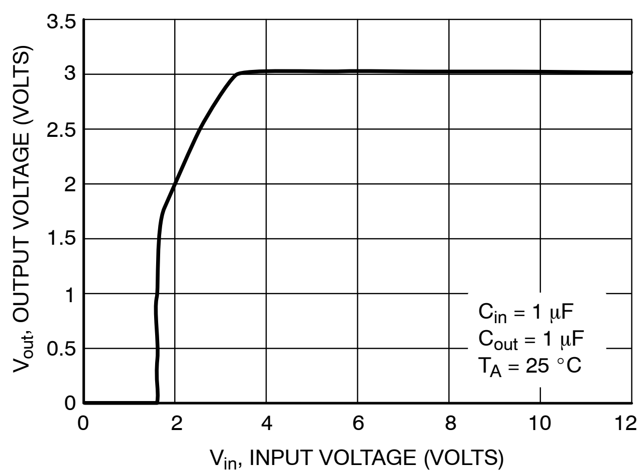


Figure 10. Output Voltage versus Input Voltage

APPLICATIONS INFORMATION

A typical application circuit for the NCP553 series is shown in Figure 1, front page.

Input Decoupling (C1)

A 1.0 μF capacitor either ceramic or tantalum is recommended and should be connected close to the package. Higher values and lower ESR will improve the overall line transient response. If large line or load transients are not expected, then it is possible to operate the regulator without the use of a capacitor.

TDK capacitor: C2012X5R1C105K, or C1608X5R1A105K

Output Decoupling (C2)

The NCP553 are very stable regulators and do not require any specific Equivalent Series Resistance (ESR) or a minimum output current. If load transients are not to be expected, then it is possible for the regulator to operate with no output capacitor. Otherwise, capacitors exhibiting ESRs ranging from a few mΩ up to 10 Ω can thus safely be used. The minimum decoupling value is 0.1 μF and can be augmented to fulfill stringent load transient requirements. The regulator accepts ceramic chip capacitors as well as tantalum devices. Larger values improve noise rejection and load regulation transient response.

TDK capacitor: C2012X5R1C105K, C1608X5R1A105K, or C3216X7R1C105K

Hints

Please be sure the Vin and GND lines are sufficiently wide. When the impedance of these lines is high, there is a chance to pick up noise or cause the regulator to malfunction.

Set external components, especially the output capacitor, as close as possible to the circuit, and make leads as short as possible.

Thermal

As power across the NCP553 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 effect the rate of temperature rise for the part. This is stating that when the devices have good thermal conductivity through the PCB, the junction temperature will be relatively low with high power dissipation applications.

The maximum dissipation the package can handle is given by:

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

If junction temperature is not allowed above the maximum 125°C, then the NCP553 can dissipate up to 250 mW @ 25°C.

The power dissipated by the NCP553 can be calculated from the following equation:

$$P_{tot} = \left[V_{in} * I_{gnd}(I_{out})\right] + [V_{in} - V_{out}] * I_{out}$$

or

$$V_{inMAX} = \frac{P_{tot} + V_{out} * I_{out}}{I_{gnd} + I_{out}}$$

If an 80 mA output current is needed then the ground current from the data sheet is 2.8 μA. For an NCP553 (3.0 V), the maximum input voltage will then be 6.12 V.

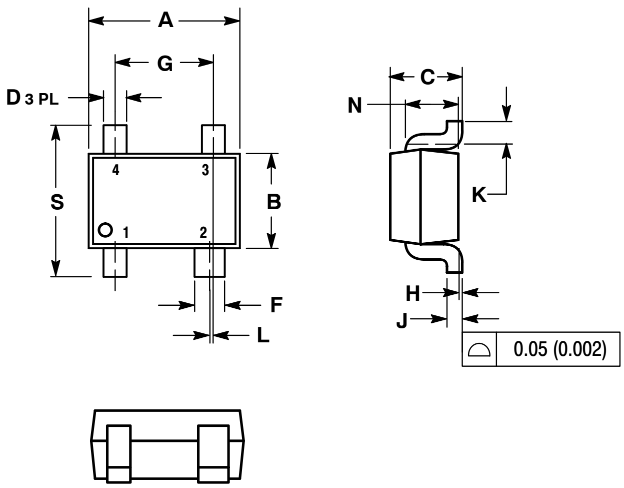
ORDERING INFORMATION

Device	Nominal Output Voltage (Note 5)	Marking	Package	Shipping†
NCP553SQ15T1G	1.5	LBE	SC82−AB (SC70−4) (Pb−Free)	3000 Units/ 8″ Tape & Reel
NCP553SQ18T1G	1.8	LBF		
NCP553SQ25T1G	2.5	LBG		
NCP553SQ27T1G	2.7	LBH		
NCP553SQ28T1G	2.8	LBI		
NCP553SQ30T1G	3.0	LBJ		
NCP553SQ33T1G	3.3	LBK		
NCP553SQ50T1G	5.0	LBL		
NCV553SQ15T1G (Note 6)	1.5	AAF		
NCV553SQ50T1G (Note 6)	5.0	LFT		

†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.
5. Additional voltages in 100 mV steps are available upon request by contacting your ON Semiconductor representative.
6. Automotive qualified.

PACKAGE DIMENSIONS

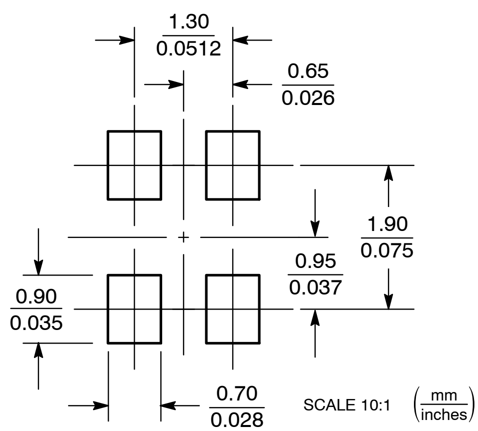
SC82−AB (SC70−4)
SQ SUFFIX
CASE 419C−02
ISSUE E



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.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	1.8	2.2	0.071	0.087
B	1.15	1.35	0.045	0.053
C	0.8	1.1	0.031	0.043
D	0.2	0.4	0.008	0.016
F	0.3	0.5	0.012	0.020
G	1.1	1.5	0.043	0.059
H	0.0	0.1	0.000	0.004
J	0.10	0.26	0.004	0.010
K	0.1	−−−	0.004	−−−
L	0.05 BSC		0.002 BSC	
N	0.2 REF		0.008 REF	
S	1.8	2.4	0.07	0.09

SOLDERING 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.

NOCAP is a trademark of Semiconductor Components Industries, LLC.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative