NCV8518

Low Dropout Linear Regulator with Watchdog, Wake Up, $\overline{\text{RESET}}$, and ENABLE

The NCV8518 device is a precision micropower voltage regulator. It has a fixed output voltage of 5.0 V and regulates within ±2%. It is suitable for use in all automotive environments and contains all the required functions to control a microprocessor. This device has low dropout voltage and low quiescent current. It includes a watchdog timer, adjustable reset, wake up and enable function. Also encompassed in this device are safety features such as thermal shutdown and short circuit protection. It is capable of handling up to 45 V transients.

Features

- Output Voltage of 5.0 V
- ±2% Output Voltage
- I_{OUT} up to 250 mA
- Micropower Compatible Control Functions:
  - ENABLE
  - Watchdog
  - $\overline{\text{RESET}}$
  - Wake Up
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes
- Low Dropout Voltage
- Low Quiescent Current of 100 μA
- Protection Features:
  - Thermal Shutdown
  - Short Circuit
  - 45 V Operation
- Low Sleep Mode Current less than 1.0 μA

Applications

- Tire Pressure Monitor
- Battery Powered Consumer Electronics

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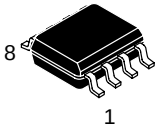
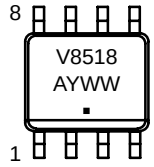
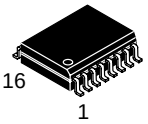
MARKING DIAGRAMS

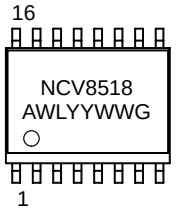


SOIC−8
EXPOSED PAD
D SUFFIX
CASE 751AC





SOIC−16 LEAD
WIDE BODY
EXPOSED PAD
PDW SUFFIX
CASE 751R

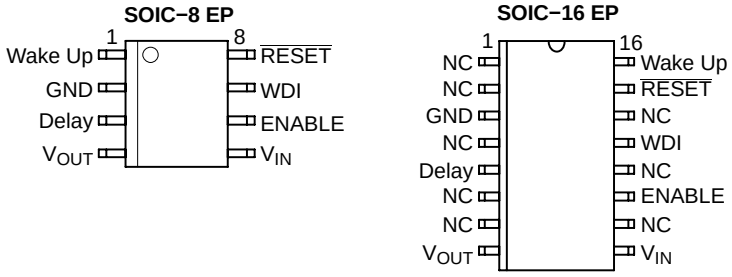


A	= Assembly Location
WL	= Wafer Lot
YY, Y	= Year
WW	= Work Week
▪, G	= Pb−Free Package

ORDERING INFORMATION

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

PIN CONNECTIONS



PIN FUNCTION DESCRIPTION

Pin		Symbol	Description
SOIC−8 EP	SOIC−16 E PAD		
4	8	V_{OUT}	Regulated output voltage.
5	9	V_{IN}	Input supply voltage.
7	13	WDI	CMOS compatible input lead. The watchdog function monitors the falling edge of the incoming signal.
2	3	GND	Ground connection.
6	11	ENABLE	ENABLE control for the IC. Positive logic.
8	15	$\overline{RESET}$	CMOS compatible output $\overline{RESET}$ goes low whenever V_{OUT} drops by more than 7.0% from nominal, or during the absence of a correct watchdog signal.
3	5	Delay	Buffered reference voltage used to create timing current for $\overline{RESET}$ and Watchdog threshold frequency from $R_{Delay.}$
−	1, 2, 4, 6, 7, 10, 12, 14	NC	No Connection.
1	16	Wake Up	Continuously generated signal that interrupts the microprocessor from sleep mode.

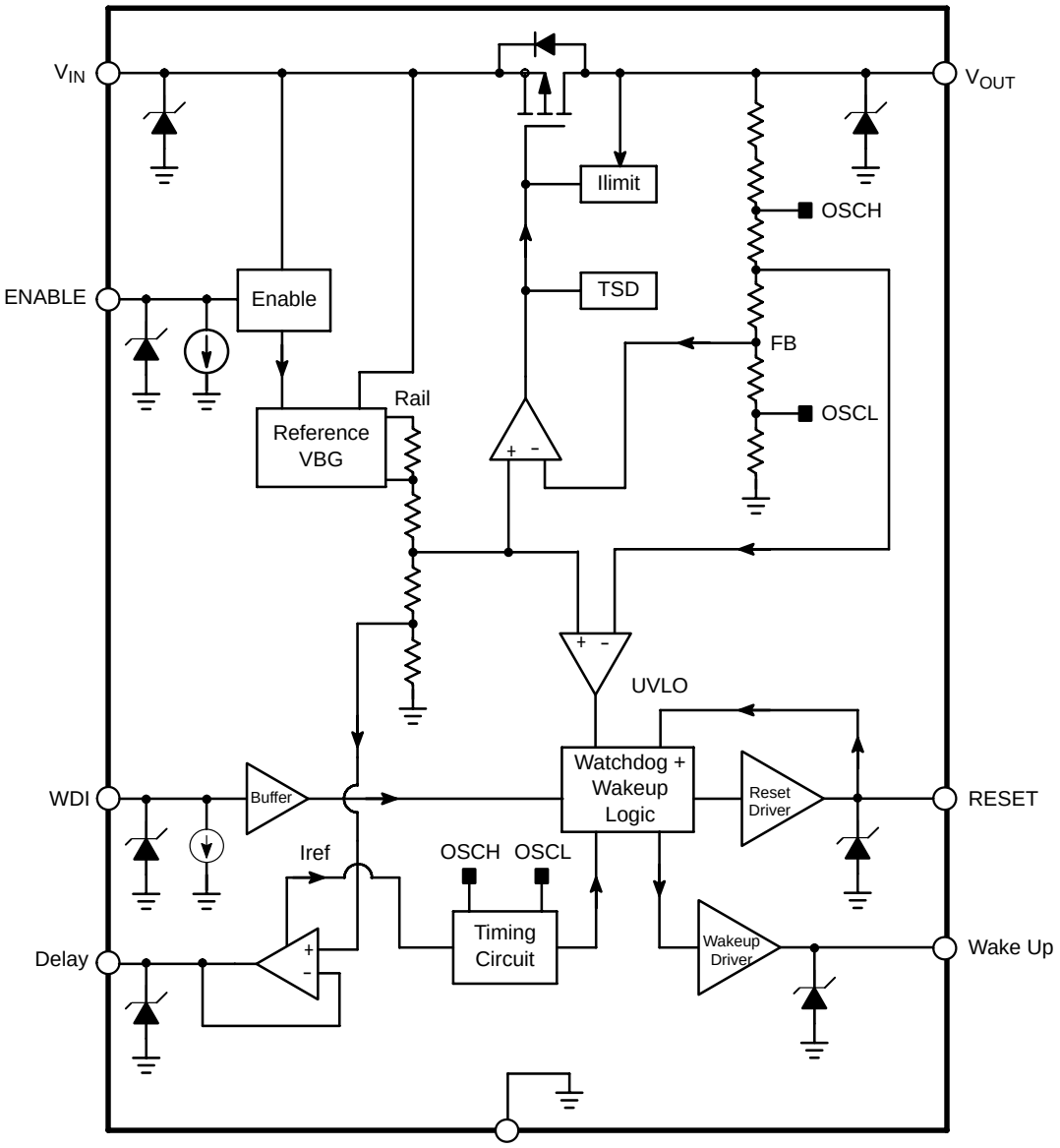


Figure 1. Block Diagram

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage	V_{IN}, ENABLE	−0.3 to 45	V
Output Voltage	V_{OUT}	−0.3 to +7.0	V
ESD Susceptibility (Human Body Model)	−	2.0	kV
Logic Inputs/Outputs (Reset, WDI, Wake Up, Delay)	−	−0.3 to +7.0	V
Operating Junction Temperature	T_J	−40 to150	°C
Storage Temperature Range	T_S	−55 to +150	°C
Package Thermal Resistance, SOIC−8 EP (Please refer to Thermal Characteristics table)	−	−	−
Package Thermal Resistance, SOIC−16 EP (Note 1) Junction−to−Case Junction−to−Ambient	 $R_{\theta JC}$ $R_{\theta JA}$	 15 56	 °C/W °C/W
Moisture Sensitivity Level SOIC−16 EP (Case 751R) SOIC−8 EP (Case 751AC)	MSL	 1 1	
Lead Temperature Soldering: Reflow			
Leaded Part 60−150 sec above 183°C, 30 sec max at peak	−	240 peak	°C
Lead−Free Part 60−150 sec above 217°C, 40 sec max at peak	−	265 peak	°C

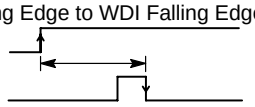
Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

THERMAL CHARACTERISTICS (SOIC−8 EP)

Rating	Typical	Unit
Junction−to−Lead Single Layer PCB (Note 2) Single Layer PCB (Note 3) 4−Layer PCB (Note 4)	 61 26 21	°C/W
Junction−to−Ambient Single Layer PCB (Note 2) Single Layer PCB (Note 3) 4−Layer PCB (Note 4)	 189 93 68	°C/W

1. Single Layer PCB, 2−oz copper.
2. 1−oz copper, 0.079 inch^2 (50 mm^2) copper area, 0.062″ thick FR4.
3. 1−oz copper, 0.804 inch^2 (518 mm^2) copper area, 0.062″ thick FR4.
4. 1−oz copper, 0.804 inch^2 (518 mm^2) copper area, 0.062″ thick FR4.

ELECTRICAL CHARACTERISTICS ($-40°C \le T_J \le 150°C$; $6.0\ V \le V_{IN} \le 28\ V$, $100\ \mu A \le I_{OUT} \le 150\ mA$, $C_2 = 1.0\ \mu F$, $R_{Delay} = 60\ k$; unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output					
Output Voltage	V_{OUT}	4.9 −2%	5.00	5.10 +2%	V
Dropout Voltage ($V_{IN} - V_{OUT}$, $I_{OUT} = 150\ mA$) (Note 5)	V_{DO}	−	425	750	mV
Load Regulation ($V_{IN} = 13.5\ V$, $100\ \mu A \le I_{OUT} \le 150\ mA$)	Reg_{load}	−	5.0	30	mV
Line Regulation ($6.0\ V \le V_{IN} \le 28\ V$, $I_{OUT} = 5.0\ mA$)	Reg_{line}	−	5.0	20	mV
Current Limit	I_{lim}	255	400	−	mA
Thermal Shutdown (Guaranteed by Design)	T_{Jmax}	150	180	210	°C
Quiescent Current ($V_{IN} = 13.5\ V$, $I_{OUT} = 100\ \mu A$, 150 mA, ENABLE = 2.0 V) (ENABLE = 0 V)	I_Q	 − −	 100 −	 150 1.0	µA
$\overline{\text{RESET}}$					
Threshold Voltage 	−	4.50	4.65	4.75	V
Output Low ($R_{LOAD} = 10\ k$ to V_{OUT}, $V_{OUT} = 1.0\ V$)	−	−	0.2	0.4	V
Output High ($R_{LOAD} = 10\ k$ to GND)	−	$V_{OUT} - 0.4$	$V_{OUT} - 0.2$	−	V
Power On Reset Delay Time ($V_{IN} = 13.5\ V$, $R_{Delay} = 60\ k$, $I_{OUT} = 5.0\ mA$) ($V_{IN} = 13.5\ V$, $R_{Delay} = 120\ k$, $I_{OUT} = 5.0\ mA$)	t_D	 2.0 −	 3.0 6.0	 4.0 −	ms
Watchdog Input					
Threshold	WDI_{high}	30	50	70	$\%V_{OUT}$
Hysteresis 	WDI_{hys}	25	100	−	mV
Input Current (WDI = 6.0 V)	−	−	0.1	2.0	µA
Wake Up Rising Edge to WDI Falling Edge Delay Wake Up WDI 	−	5.0	−	−	µs
ENABLE (Note 6)					
Input Threshold Logic Low Logic High	$V_{th(EN)}$	 − 2.0	 − −	 0.8 −	V
Input Current (ENABLE = 2.0 V)	−	−	3.0	10	µA

5. Measured when the output voltage has dropped 2% from the nominal value.
6. A 20 kΩ resistor must be used if the ENABLE pin is tied to V_{IN}.

ELECTRICAL CHARACTERISTICS (continued) ($-40°C \le T_J \le 150°C$; $6.0\ V \le V_{IN} \le 28\ V$, $100\ \mu A \le I_{OUT} \le 150\ mA$, $C_2 = 1.0\ \mu F$, $R_{Delay} = 60\ k$; unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit
Wake Up Output ($V_{IN} = 14\ V$, $I_{OUT} = 5.0\ mA$)					
Wake Up Period ($R_{DELAY} = 60\ k$) ($R_{DELAY} = 120\ k$)	–	 18 –	 25 50	 32 –	ms
Wake Up Duty Cycle Nominal	–	45	50	55	%
$\overline{RESET}$ HIGH to Wake Up Rising Delay Time ($R_{DELAY} = 60\ k$) 50% $\overline{RESET}$ Rising Edge to 50% Wake Up Edge ($R_{DELAY} = 120\ k$)	–	 9.0 –	 12.5 25	 16 –	ms
Wake Up Response to Watchdog Input 50% WDI Falling Edge to 50% Wake Up Falling Edge	–	–	0.1	5.0	μs
Wake Up Response to $\overline{RESET}$ 50% $\overline{RESET}$ Falling Edge to 50% Wake Up Falling Edge ($V_{OUT} = 5.0\ V \rightarrow 4.5\ V$)	–	–	0.1	5.0	μs
Output Low ($R_{LOAD} = 10\ k$)	–	–	0.2	0.4	V
Output High ($R_{LOAD} = 10\ k$)	–	$V_{OUT} - 0.5$	$V_{OUT} - 0.25$	–	V
Delay					
Output Voltage ($R_{DELAY} = 60\ k, 120\ k$)	–	–	0.48	–	V

TIMING DIAGRAMS

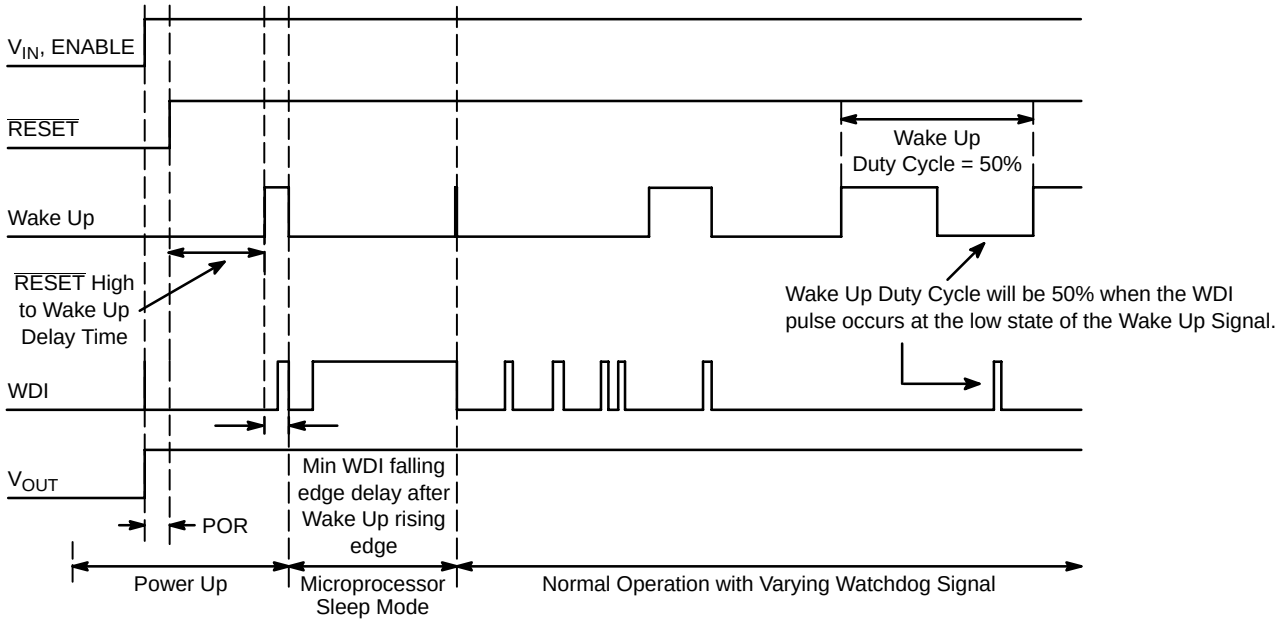


Figure 2. Power Up, Sleep Mode and Normal Operation

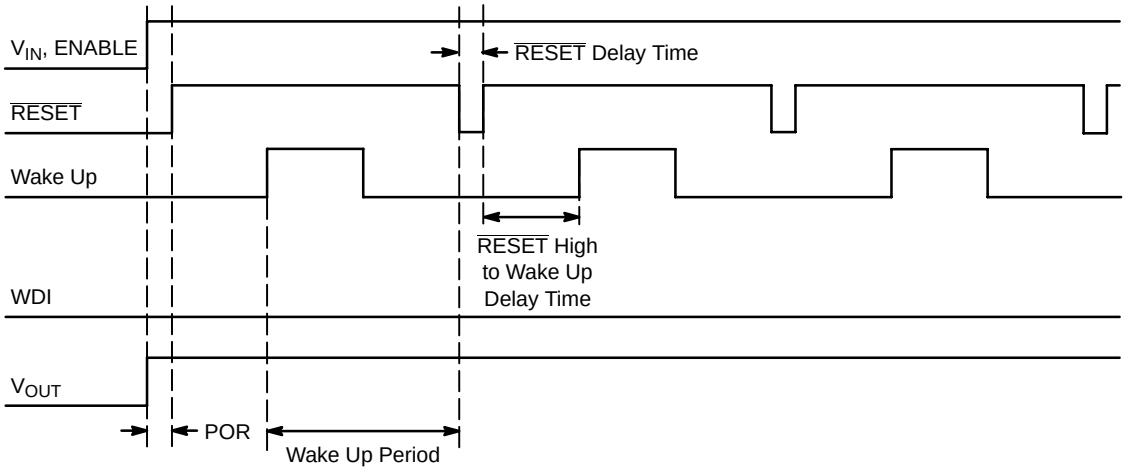


Figure 3. Error Condition: Watchdog Remains Low and a RESET is Issued

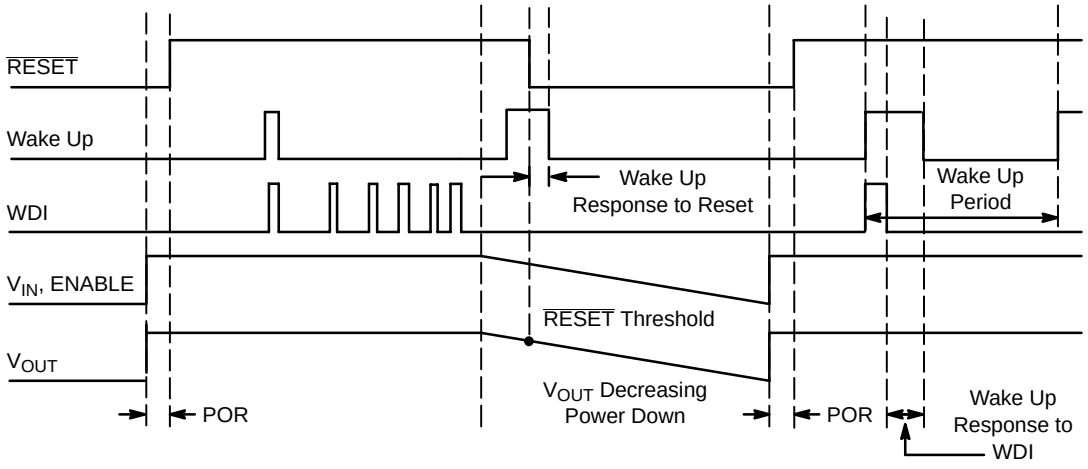


Figure 4. Power Down, Restart Sequence, and Wake Up Response to WDI

OPERATING DESCRIPTION

The NCV8518 is a precision micropower voltage regulator. It has a fixed output voltage of 5.0 V and regulates within ±2%. It is suitable for the automotive environment and for use in battery operated microprocessor controlled applications. It includes a watchdog timer, adjustable reset, wake up and enable function. The safety features are thermal shutdown and short circuit protection at 400 mA of current. It is capable of handling up to 45 V transients.

Watchdog and Wake Up

It is necessary to have a device of this sort to monitor a microprocessor that has gone into sleep mode or low power consumption mode and to interrupt and wake up the microprocessor. The NCV8518 constantly generates a Wake Up 5.0 V square wave signal and is frequency programmed via an external resistor R_{DELAY}. During sleep mode, the microprocessor receives a rising edge wake up signal from the device and in turn issues a watchdog pulse to itself to check if it will remain in sleep mode or resume normal operation. If the WDI pulse occurs at the low state of the Wake Up signal, the Wake Up duty cycle will be 50%.

The falling edge of the watchdog signal causes the Wake Up function to a low state if the Wake Up duty cycle is less than 50%. The Wake Up will stay low until the next cycle occurs. Below is the equation for the Wake Up period:

$$\text{Wake Up Period} = (417 \times 10^{-9})\ R_{DELAY}$$

$\overline{\text{Reset}}$

During powerup of the NCV8518, the reset signal remains low until it reaches regulation. A $\overline{\text{Reset}}$ signal is initialized if the regulated output voltage falls to 7% of the nominal voltage or if there is an absence of a watchdog falling edge within a wake up cycle. The $\overline{\text{Reset}}$ delay time is programmed via an external resistor. This is the time it takes for the Reset signal to return to a high state or the time it takes to restore the wake up function. Below are the equations for programming the $\overline{\text{Reset}}$ Delay time:

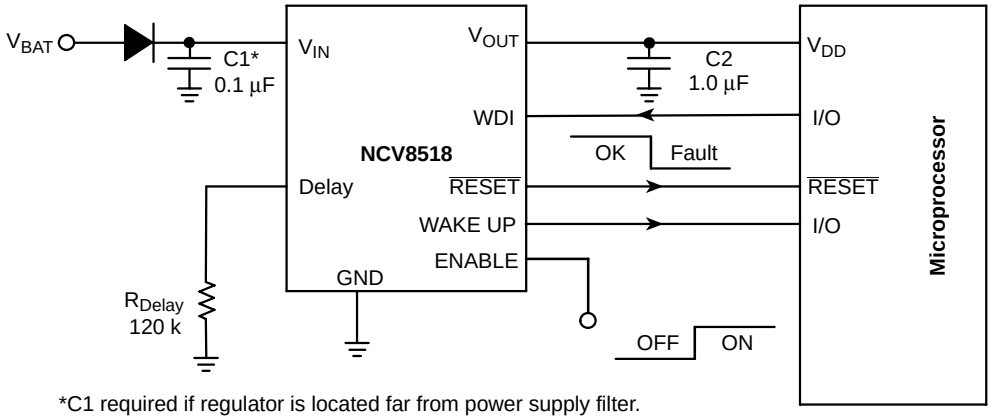
$$\text{Reset Delay Time} = (52 \times 10^{-9})\ R_{DELAY}$$

$$\text{Reset High to Wake Up} = (208 \times 10^{-9})\ R_{DELAY}$$

The Reset function is guaranteed to fully operate with an output voltage as low as 1.5 V.

Enable

The Enable function will turn the device on or off. If the Enable pin is grounded, this indicates that the device is in the OFF state. The threshold limitations are covered in the electrical characteristics of the device.



*C1 required if regulator is located far from power supply filter.

Figure 5. Application Circuit

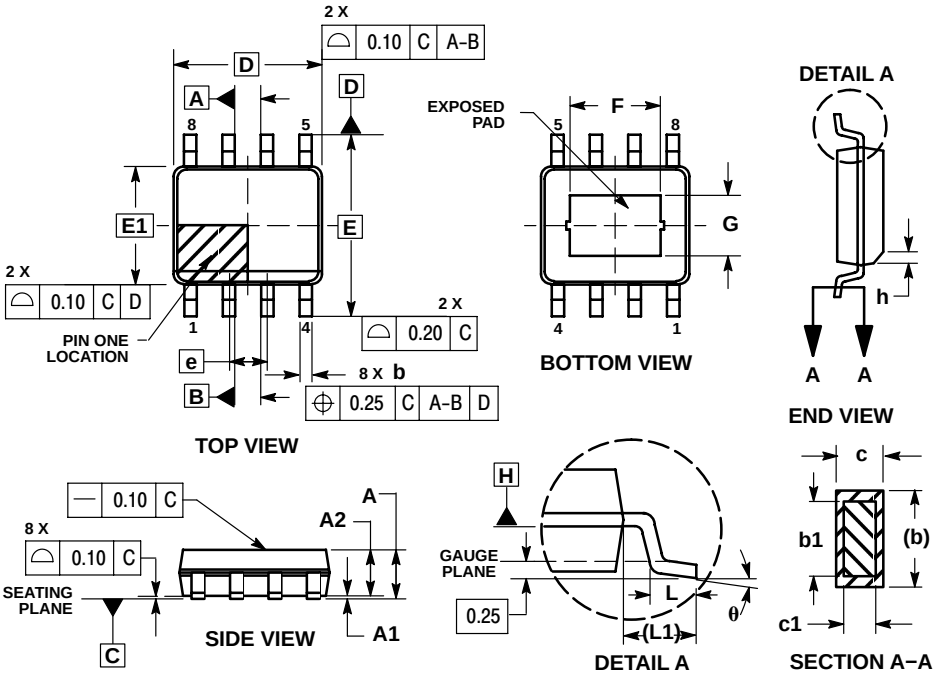
ORDERING INFORMATION

Device	Output Voltage	Package	Shipping†
NCV8518PDG	5.0 V	SOIC−8 EP (Pb−Free)	98 Units/Rail
NCV8518PDR2G		SOIC−8 EP (Pb−Free)	2500 Tape & Reel
NCV8518PWG		SOIC−16 EP (Pb−Free)	47 Units/Rail
NCV8518PWR2G		SOIC−16 EP (Pb−Free)	1000 Tape & Reel

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

PACKAGE DIMENSIONS

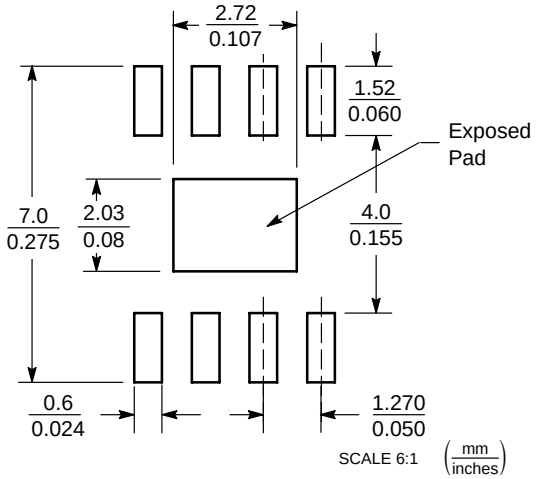
SOIC−8 EP
D SUFFIX
CASE 751AC−01
ISSUE A



NOTES:
1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS IN MILLIMETERS (ANGLES IN DEGREES).
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 MM TOTAL IN EXCESS OF THE "b" DIMENSION AT MAXIMUM MATERIAL CONDITION.
4. DATUMS A AND B TO BE DETERMINED AT DATUM PLANE H.

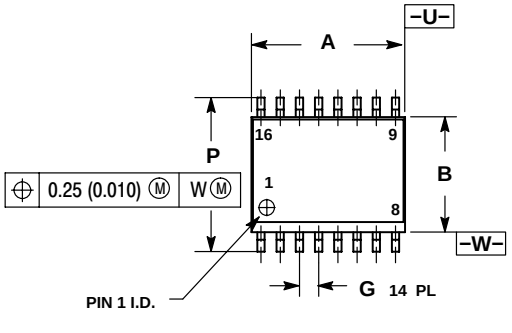
	MILLIMETERS	
DIM	MIN	MAX
A	1.35	1.75
A1	0.00	0.10
A2	1.35	1.65
b	0.31	0.51
b1	0.28	0.48
c	0.17	0.25
c1	0.17	0.23
D	4.90 BSC	
E	6.00 BSC	
E1	3.90 BSC	
e	1.27 BSC	
L	0.40	1.27
L1	1.04 REF	
F	2.24	3.20
G	1.55	2.51
h	0.25	0.50
θ	0 °	8 °

SOLDERING FOOTPRINT

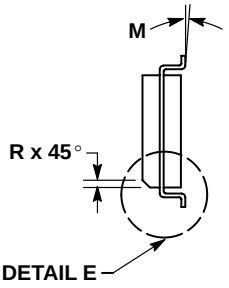


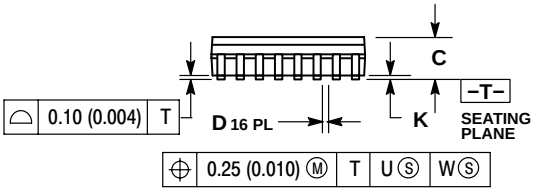
PACKAGE DIMENSIONS

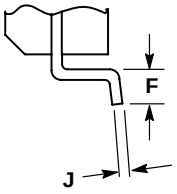
SOIC−16 LEAD WIDE BODY
EXPOSED PAD
PDW SUFFIX
CASE 751R−02
ISSUE A



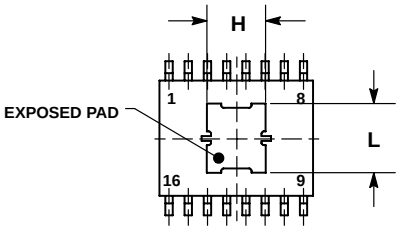
TOP SIDE







DETAIL E



BACK SIDE

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751R−01 OBSOLETE, NEW STANDARD 751R−02.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	10.15	10.45	0.400	0.411
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27 BSC		0.050 BSC	
H	3.76	3.86	0.148	0.152
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
L	4.58	4.78	0.180	0.188
M	0 °	7 °	0 °	7 °
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 61312, Phoenix, Arizona 85082−1312 USA
Phone: 480−829−7710 or 800−344−3860 Toll Free USA/Canada
Fax: 480−829−7709 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada

Japan: ON Semiconductor, Japan Customer Focus Center
2−9−1 Kamimeguro, Meguro−ku, Tokyo, Japan 153−0051
Phone: 81−3−5773−3850

ON Semiconductor Website: http://onsemi.com

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

For additional information, please contact your local Sales Representative.

NCV8518/D