

# CS3361

## Alternator Voltage Regulator FET Driver

The CS3361 integral alternator regulator integrated circuit provides the voltage regulation for automotive, 3-phase alternators.

It drives an external logic level N channel enhancement power FET for control of the alternator field current. In the event of a charge fault, a lamp output pin is provided to drive an external darlington transistor capable of switching on a fault indicator lamp. An overvoltage or no Stator signal condition activates the lamp output.

This IC has customized current sense circuitry enabling it to drive FET transistors. The CS3361 is available in an SOIC-14 package.

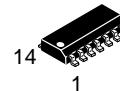
### Features

- Drives Logic Level Power NFET
- 80 V Load Dump
- Temperature Compensated Regulation Voltage
- Shorted Field Protection Duty Cycle, Self Clearing
- This is a Pb-Free Device



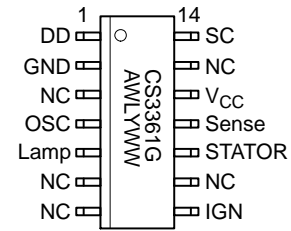
ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)



SOIC-14  
D SUFFIX  
CASE 751A

### PIN CONNECTIONS AND MARKING DIAGRAM



A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

Device	Package	Shipping†
CS3361YDR14G	SOIC-14 (Pb-Free)	2500 / 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.

# CS3361

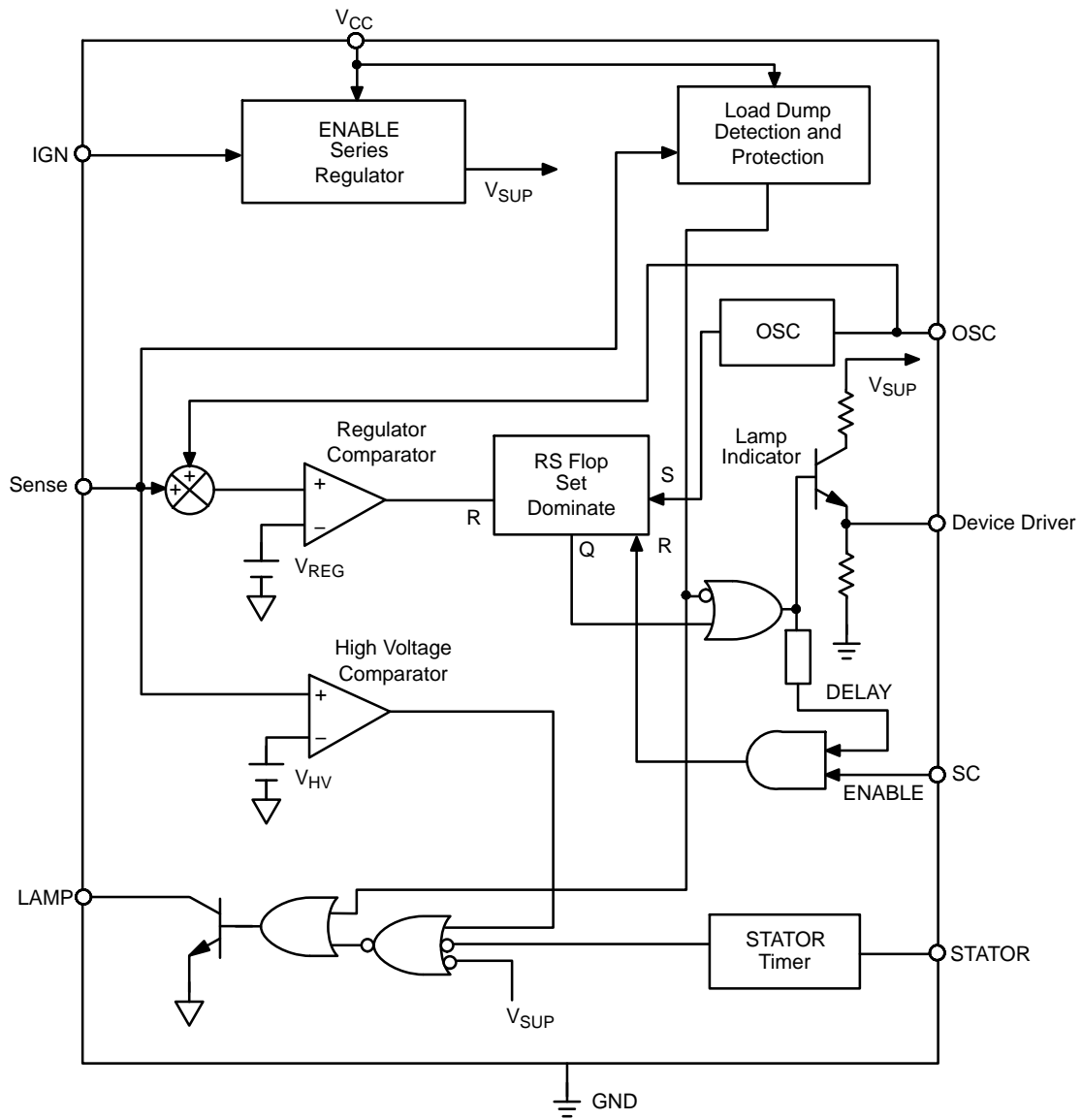


Figure 1. Block Diagram

# CS3361

## PACKAGE PIN DESCRIPTION

PIN NO.	PIN SYMBOL	FUNCTION
1	Driver	Output driver for external power switch.
2	GND	Ground.
3, 6, 7, 9, 13	NC	No Connection.
4	OSC	Timing capacitor for oscillator.
5	Lamp	Base driver for lamp driver indicates no stator signal or overvoltage condition.
8	IGN	Switched ignition power up.
10	Stator	Stator signal input for stator timer.
11	Sense	Battery sense voltage regulator comparator input and protection.
12	V <sub>CC</sub>	Supply for IC.
14	SC	Short circuit sensing.

## MAXIMUM RATINGS

Rating	Value	Unit
Storage Temperature Range, T <sub>S</sub>	-55 to +165	°C
Junction Temperature Range	-40 to 150	°C
Continuous Supply	27	V
I <sub>CC</sub> Load Dump (@ V <sub>CC</sub> = 80 V <sub>peak</sub> )	400	mA
Lead Temperature Soldering: Reflow: (SMD styles only) (Note 1)	260 peak	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. 60 second maximum above 183°C.

## PACKAGE THERMAL DATA

Parameter		SO-14	Unit
R <sub>θJC</sub>	Typical	30	°C/W
R <sub>θJA</sub>	Typical	125	°C/W

# CS3361

## ELECTRICAL CHARACTERISTICS (–40°C < T<sub>A</sub> < 125°C, –40°C < T<sub>J</sub> < 150°C, 9.0 V ≤ V<sub>CC</sub> ≤ 17 V; unless otherwise specified.)

Characteristic	Test Conditions	Min	Typ	Max	Unit
----------------	-----------------	-----	-----	-----	------

### Supply

Supply Current Enabled	–	–	–	10	mA
Supply Current Disabled	–	–	–	50	μA

### Driver Stage

Output High Voltage	–	5.5	–	12	V
Output Low Voltage	I <sub>OL</sub> = 25 μA	–	–	0.35	V
Output High Current	V <sub>DD</sub> = 1.2 V	–10	–6.0	–4.0	mA
Minimum ON Time	C <sub>OSC</sub> = 0.022 μF	200	–	–	μs
Minimum Duty Cycle	–	–	6.0	10	%
Short Circuit Duty Cycle	–	1.0	–	5.0	%
Field Switch Turn On Rise Time	–	15	–	75	μs
Field Switch Turn On Fall Time	–	15	–	75	μs

### Stator

Input High Voltage	–	10	–	–	V
Input Low Voltage	–	–	–	6.0	V
Stator Time Out	High to Low	6.0	100	600	ms

### Lamp

Output High Current	V <sub>LAMP</sub> @ 3.0 V	–	–	50	μA
Output Low Voltage	I <sub>LAMP</sub> @ 30 mA	–	–	0.35	V

### Ignition

Input High Voltage	I <sub>CC</sub> > 1.0 mA	1.8	–	–	V
Input Low Voltage	I <sub>CC</sub> < 100 μA	–	–	0.5	V

### Oscillator

Oscillator Frequency	C <sub>OSC</sub> = 0.022 μF	90	–	210	Hz
Rise Time/Fall Time	C <sub>OSC</sub> = 0.022 μF	–	17	–	–
Oscillator High Threshold	C <sub>OSC</sub> = 0.022 μF	–	–	4.5	V

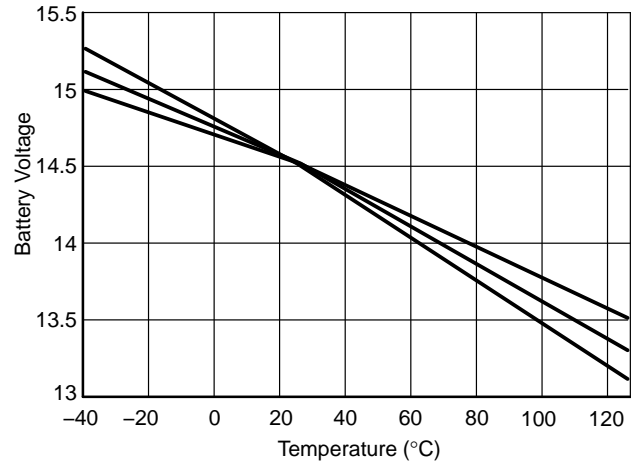
### Battery Sense

Input Current	–	–10	–	+10	μA
Regulation Voltage	@25°C, R <sub>1</sub> = 100 kΩ, R <sub>2</sub> = 50 kΩ	13.8	–	15.8	V
Proportional Control	–	0.10	–	0.25	V
High Voltage Threshold Ratio	$\frac{V_{\text{High Voltage@LampOn}}}{V_{\text{Regulation@50%Duty Cycle}}}$	1.083	–	1.190	V/V
High Voltage Hysteresis	–	0.020	–	0.600	V

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

# CS3361

## TYPICAL PERFORMANCE CHARACTERISTICS



**Figure 2. CS3361 Battery Voltage vs. Temperature (°C) Over Process Variation**

## APPLICATIONS INFORMATION

The CS3361 is designed for use in an alternator charging system.

In a standard alternator design (Figure 3), the rotor carries the field winding. An alternator rotor usually has several N and S poles. The magnetic field for the rotor is produced by forcing current through a field or rotor winding. The stator windings are formed into a number of coils spaced around a cylindrical core. The number of coils equals the number of pairs of N and S poles on the rotor. The alternating current in the stator windings is rectified by the diodes and applied to the regulator. By controlling the amount of field current, the magnetic field strength is controlled and hence the output voltage of the alternator.

Referring to Figure 7, a typical application diagram, the oscillator frequency is set by an external capacitor connected between OSC and ground. The sawtooth waveform ramps between 1.0 V and 3.0 V and provides the timing for the system. For the circuit shown the oscillator frequency is approximately 140 Hz. The alternator voltage is sensed at Terminal A via the resistor divider network R1/R2 on the Sense pin of the IC. The voltage at the sense pin determines the duty cycle for the regulator. The voltage is adjusted by potentiometer R2. A relatively low voltage on the sense pin causes a long duty cycle that increases the field current. A high voltage results in a short duty cycle.

The ignition Terminal (I) switches power to the IC through the  $V_{CC}$  pin. The Stator pin monitors the voltage from the stator and senses a stopped engine condition. It drives the Lamp pin high after the stator timeout expires. The Lamp pin also goes high when an overvoltage condition

is detected on the sense pin. This causes the darlington lamp drive transistor to switch on and pull current through the lamp. If the system voltage continues to increase, the field and lamp output turn off as in an overvoltage or load dump condition.

The SC or Short Circuit pin monitors the field voltage. If the drive output and the SC voltage are simultaneously high for a predetermined period, a short circuit condition is assumed and the output is disabled. The regulator is forced to a minimum short circuit duty cycle.

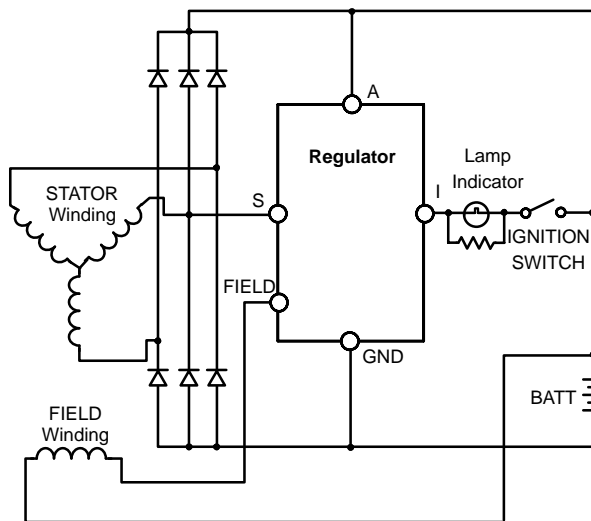


Figure 3. IAR System Block Diagram

REGULATION WAVEFORMS

The CS3361 utilizes proportion control to maintain regulation. Waveforms depicting operation are shown in Figures 4, 5 and 6, where  $V_{BAT/N}$  is the divided down voltage present on the Sense pin using R1 and R2 (Figure 7). A sawtooth waveform is generated internally. The amplitude of this waveform is listed in the electric parameter section as proportion control. The oscillator voltage is summed with  $V_{BAT/N}$ , and compared with the internal voltage regulator ( $V_{REG}$ ) in the regulation comparator which controls the field through the output "Device Driver."

Figure 4 shows typical steady-state operation. A 50% duty cycle is maintained.

Figure 5 shows the effect of a drop in voltage on ( $V_{BAT/N} + V_{OSC}$ ). Notice the duty cycle increase to the field drive.

Figure 6 shows the effect of an increase in voltage (above the regulation voltage) on ( $V_{BAT/N} + V_{OSC}$ ). Notice the decrease in field drive.

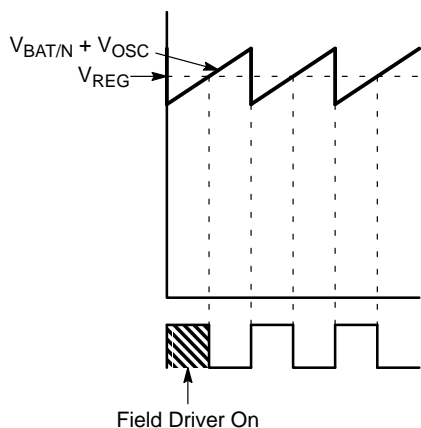


Figure 4. 50% Duty Cycle, Steady State

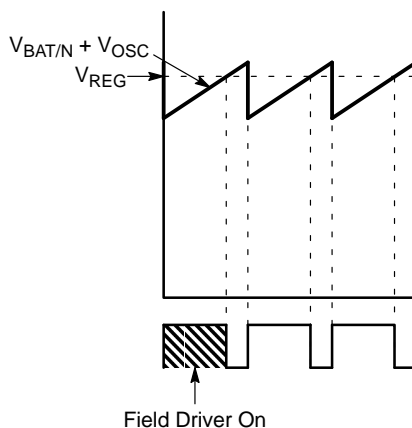


Figure 5. > 50% Duty Cycle, Increased Load

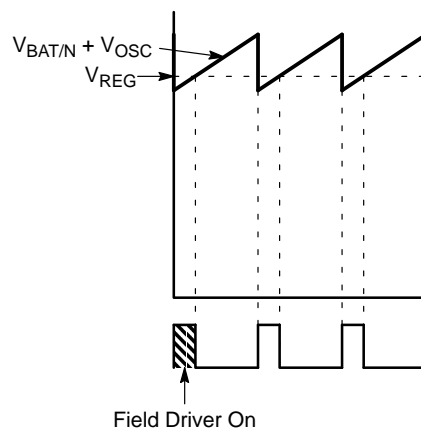


Figure 6. < 50% Duty Cycle, Decreased Load

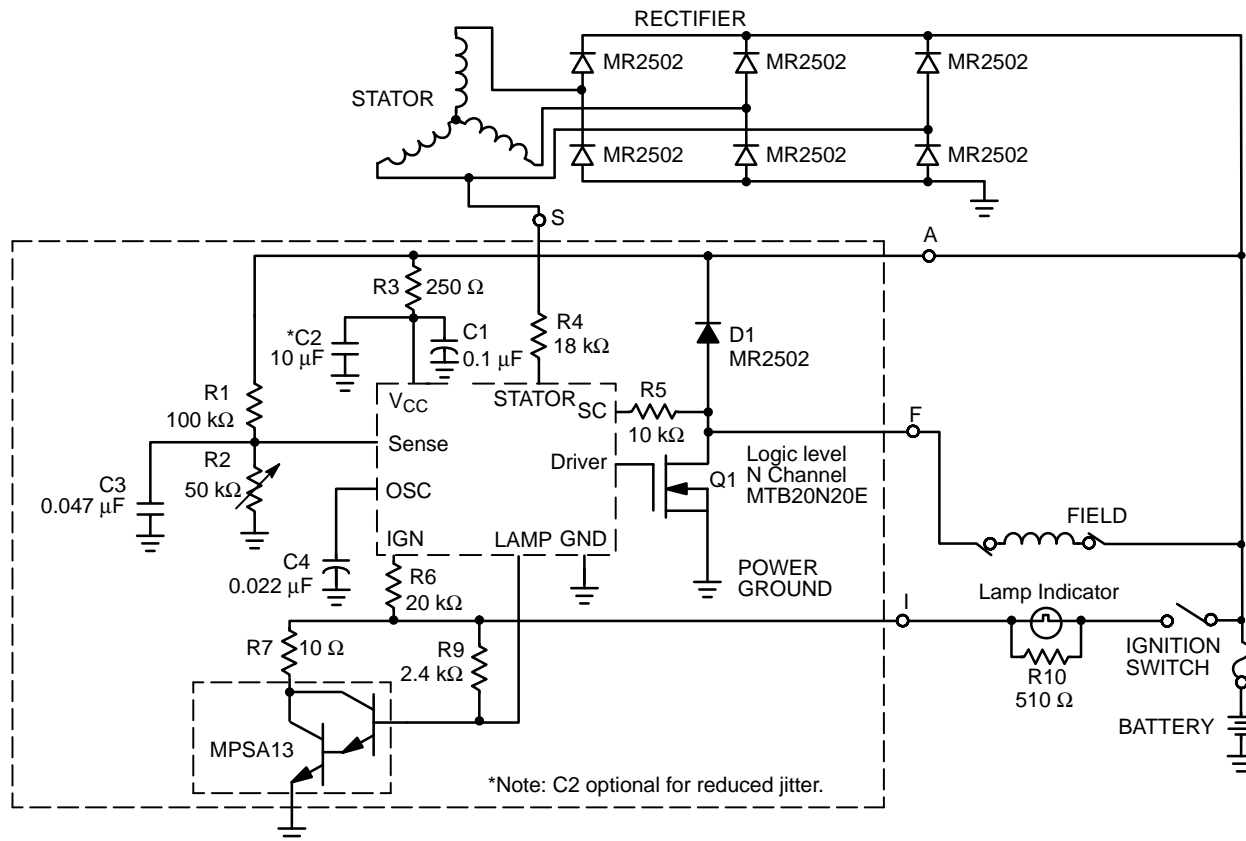


Figure 7. Typical Application Diagram

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 1:1

SOIC-14 NB  
CASE 751A-03  
ISSUE L

DATE 03 FEB 2016



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
  4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
  5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0°	7°	0°	7°

### SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

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

### GENERIC MARKING DIAGRAM\*



- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- Y = Year
- WW = Work Week
- G = 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.

### STYLES ON PAGE 2

DOCUMENT NUMBER:	98ASB42565B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SOIC-14 NB	PAGE 1 OF 2

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.



**SOIC-14**  
**CASE 751A-03**  
**ISSUE L**

DATE 03 FEB 2016

STYLE 1:  
 PIN 1. COMMON CATHODE  
 2. ANODE/CATHODE  
 3. ANODE/CATHODE  
 4. NO CONNECTION  
 5. ANODE/CATHODE  
 6. NO CONNECTION  
 7. ANODE/CATHODE  
 8. ANODE/CATHODE  
 9. ANODE/CATHODE  
 10. NO CONNECTION  
 11. ANODE/CATHODE  
 12. ANODE/CATHODE  
 13. NO CONNECTION  
 14. COMMON ANODE

STYLE 2:  
 CANCELLED

STYLE 3:  
 PIN 1. NO CONNECTION  
 2. ANODE  
 3. ANODE  
 4. NO CONNECTION  
 5. ANODE  
 6. NO CONNECTION  
 7. ANODE  
 8. ANODE  
 9. ANODE  
 10. NO CONNECTION  
 11. ANODE  
 12. ANODE  
 13. NO CONNECTION  
 14. COMMON CATHODE

STYLE 4:  
 PIN 1. NO CONNECTION  
 2. CATHODE  
 3. CATHODE  
 4. NO CONNECTION  
 5. CATHODE  
 6. NO CONNECTION  
 7. CATHODE  
 8. CATHODE  
 9. CATHODE  
 10. NO CONNECTION  
 11. CATHODE  
 12. CATHODE  
 13. NO CONNECTION  
 14. COMMON ANODE

STYLE 5:  
 PIN 1. COMMON CATHODE  
 2. ANODE/CATHODE  
 3. ANODE/CATHODE  
 4. ANODE/CATHODE  
 5. ANODE/CATHODE  
 6. NO CONNECTION  
 7. COMMON ANODE  
 8. COMMON CATHODE  
 9. ANODE/CATHODE  
 10. ANODE/CATHODE  
 11. ANODE/CATHODE  
 12. ANODE/CATHODE  
 13. NO CONNECTION  
 14. COMMON ANODE

STYLE 6:  
 PIN 1. CATHODE  
 2. CATHODE  
 3. CATHODE  
 4. CATHODE  
 5. CATHODE  
 6. CATHODE  
 7. CATHODE  
 8. ANODE  
 9. ANODE  
 10. ANODE  
 11. ANODE  
 12. ANODE  
 13. ANODE  
 14. ANODE

STYLE 7:  
 PIN 1. ANODE/CATHODE  
 2. COMMON ANODE  
 3. COMMON CATHODE  
 4. ANODE/CATHODE  
 5. ANODE/CATHODE  
 6. ANODE/CATHODE  
 7. ANODE/CATHODE  
 8. ANODE/CATHODE  
 9. ANODE/CATHODE  
 10. ANODE/CATHODE  
 11. COMMON CATHODE  
 12. COMMON ANODE  
 13. ANODE/CATHODE  
 14. ANODE/CATHODE

STYLE 8:  
 PIN 1. COMMON CATHODE  
 2. ANODE/CATHODE  
 3. ANODE/CATHODE  
 4. NO CONNECTION  
 5. ANODE/CATHODE  
 6. ANODE/CATHODE  
 7. COMMON ANODE  
 8. COMMON ANODE  
 9. ANODE/CATHODE  
 10. ANODE/CATHODE  
 11. NO CONNECTION  
 12. ANODE/CATHODE  
 13. ANODE/CATHODE  
 14. COMMON CATHODE

<b>DOCUMENT NUMBER:</b>	<b>98ASB42565B</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>SOIC-14 NB</b>	<b>PAGE 2 OF 2</b>

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor 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 ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor 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 ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor 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 ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Email Requests to: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

### TECHNICAL SUPPORT

North American Technical Support:  
Voice Mail: 1 800-282-9855 Toll Free USA/Canada  
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative