



**THE DATASHEET OF  
NCV1009D**



# NCV1009

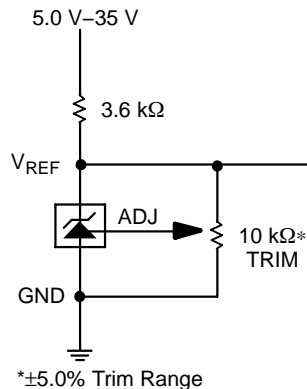
## 2.5 Volt Reference

The NCV1009 is a precision trimmed 2.5 V  $\pm 5.0$  mV shunt regulator diode. The low dynamic impedance and wide operating current range enhances its versatility. The tight reference tolerance is achieved by on-chip trimming which minimizes voltage tolerance and temperature drift.

A third terminal allows the reference voltage to be adjusted  $\pm 5.0\%$  to calibrate out system errors. In many applications, the NCV1009Z can be used as a pin-to-pin replacement of the LT1009CZ and the LM136Z-2.5 with the external trim network eliminated.

### Features

- 0.2% Initial Tolerance Max.
- Guaranteed Temperature Stability
- Maximum 0.6  $\Omega$  Dynamic Impedance
- Wide Operating Current Range
- Directly Interchangeable with LT1009 and LM136 for Improved Performance
- No Adjustments Needed for Minimum Temperature Coefficient
- Meets Mil Std 883C ESD Requirements
- Extended Operating Temperature Range for Use in Automotive Applications
- NCV Prefix, for Automotive and Other Applications Requiring Site and Change Control
- Pb-Free Packages are Available



If the external trim resistor is not used, the "ADJ. PIN" should be left floating. The 10k trim potentiometer does not effect the temperature coefficient of the device.

**Figure 1. Application Diagram**



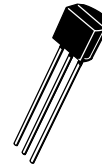
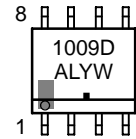
**ON Semiconductor®**

<http://onsemi.com>

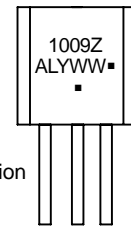
### MARKING DIAGRAMS



**SOIC-8  
D SUFFIX  
CASE 751**



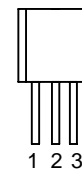
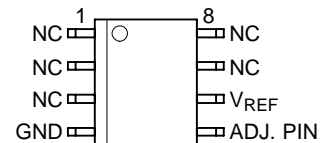
**TO-92  
Z SUFFIX  
CASE 29**



- A = Assembly Location
- L = Wafer Lot
- Y = Year
- WW, W = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

### PIN CONNECTIONS



- Pin 1. ADJ. PIN
- Pin 2. VREF
- Pin 3. GND

### ORDERING INFORMATION

Device	Package	Shipping
NCV1009D	SOIC-8	95 Units/Rail
NCV1009DR2	SOIC-8	2500 Tape & Reel
NCV1009DR2G	SOIC-8 (Pb-Free)	2500 Tape & Reel
NCV1009Z	TO-92	2000 Units/Rail
NCV1009ZG	TO-92 (Pb-Free)	2000 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.

# NCV1009

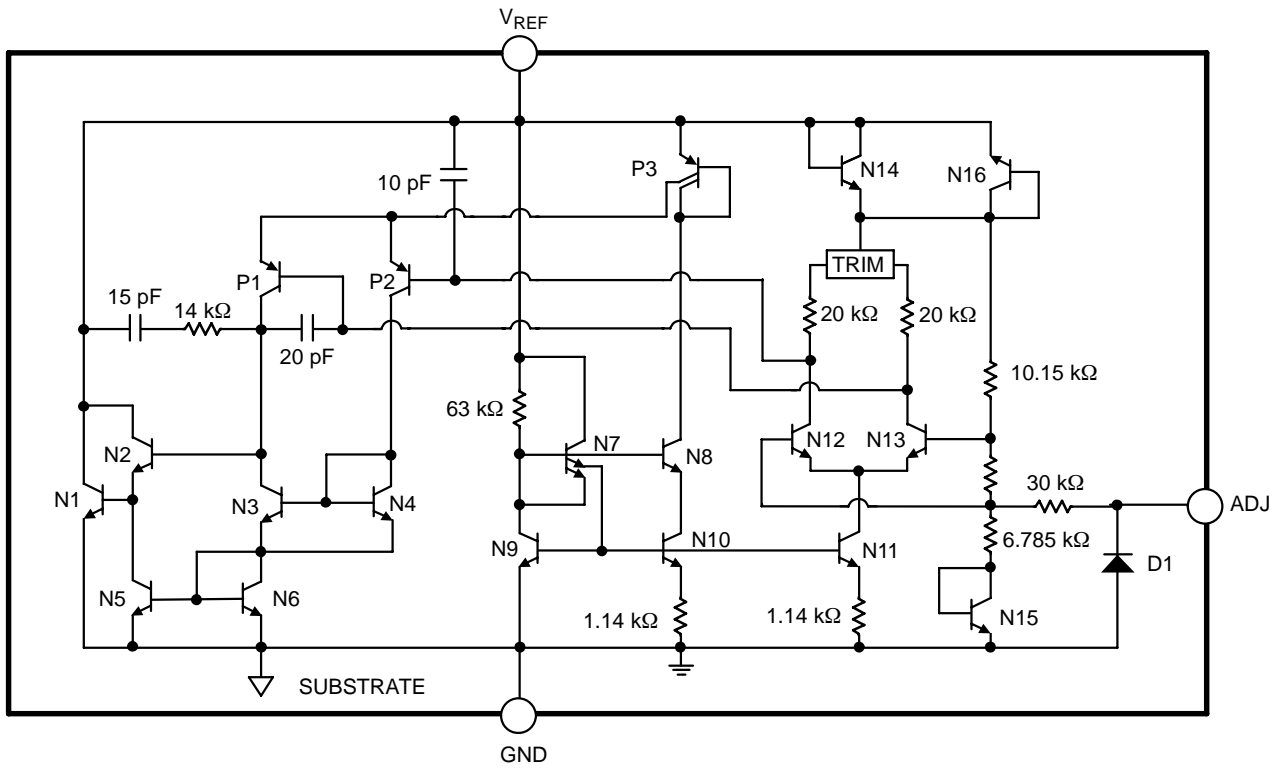


Figure 2. Block Diagram

# NCV1009

## MAXIMUM RATINGS\*

Rating	Value	Unit
Reverse Current	20	mA
Forward	10	mA
Package Thermal Resistance, SOIC-8: Junction-to-Case, $R_{\theta JC}$ Junction-to-Ambient, $R_{\theta JA}$	45 165	$^{\circ}C/W$ $^{\circ}C/W$
Package Thermal Resistance, TO-92: Junction-to-Case, $R_{\theta JC}$ Junction-to-Ambient, $R_{\theta JA}$	- 170	$^{\circ}C/W$ $^{\circ}C/W$
Operating Temperature Range	-40 to +125	$^{\circ}C$
Storage Temperature Range	-65 to +150	$^{\circ}C$
Lead Temperature Soldering:	Wave Solder (through hole styles only) (Note 1) Reflow: (SMD styles only) (Notes 2, 3)	260 peak 240 peak $^{\circ}C$ $^{\circ}C$

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.

\*The maximum package power dissipation must be observed.

1. 10 second maximum
2. 60 second maximum above 183 $^{\circ}C$ .
3. -5 $^{\circ}C$  / +0 $^{\circ}C$  allowable conditions.

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^{\circ}C$ unless otherwise specified.)

Characteristic	Test Conditions	Min	Typ	Max	Unit
Reverse Breakdown Voltage	$I_R = 1.0 \text{ mA}$	2.492	2.500	2.508	V
Reverse Breakdown Voltage	$-40^{\circ}C \leq T_A \leq 125^{\circ}C$	2.480	2.500	2.508	V
Reverse Breakdown Voltage Change with Current	$400 \mu A \leq I_R \leq 10 \text{ mA}$ (Note 4)	- -	2.6 3.0	5.0 6.0	mV mV
Reverse Dynamic Impedance	$I_R = 1.0 \text{ mA}$ (Note 4)	- -	0.2 0.4	1.0 1.4	$\Omega$ $\Omega$
Temperature Stability Average Temperature Coefficient	$0^{\circ}C \leq T_A \leq 70^{\circ}C$ , (Note 5) $0^{\circ}C \leq T_A \leq 70^{\circ}C$ , (Note 5)	- -	1.8 15	- -	mV ppm/ $^{\circ}C$
Long Term Stability	$T_A = 25^{\circ}C \pm 0.1 C$ , $I_R = 1.0 \text{ mA}$	-	20	-	ppm/kHr

4. Denotes the specifications which apply over full operating temperature range.
5. Average temperature coefficient is defined as the total voltage change divided by the specified temperature range.

TYPICAL PERFORMANCE CHARACTERISTICS

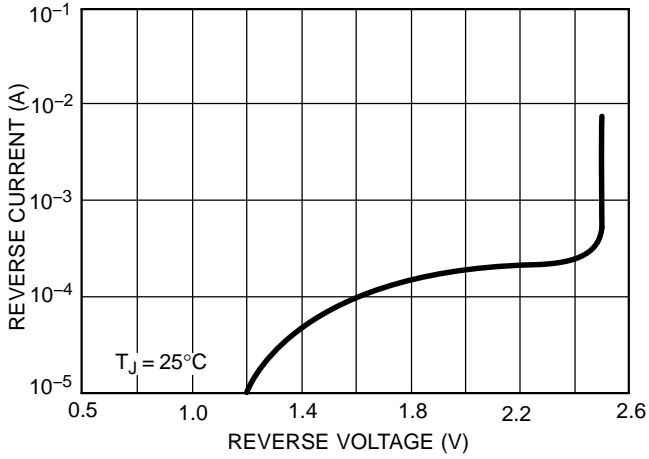


Figure 3. Reverse Current vs. Reverse Voltage

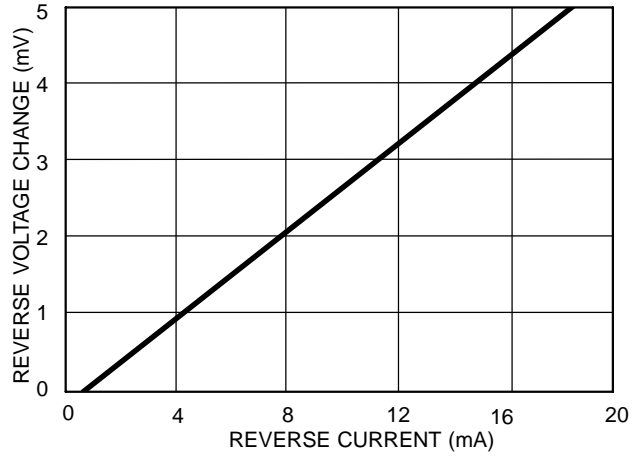


Figure 4. Change in Reverse Voltage vs. Reverse Current

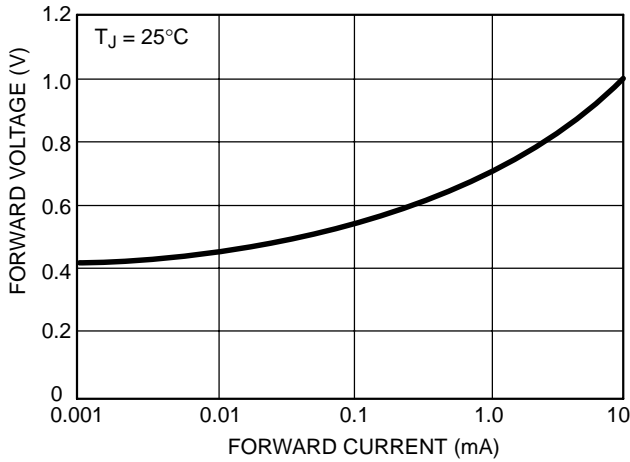


Figure 5. Forward Voltage vs. Forward Current

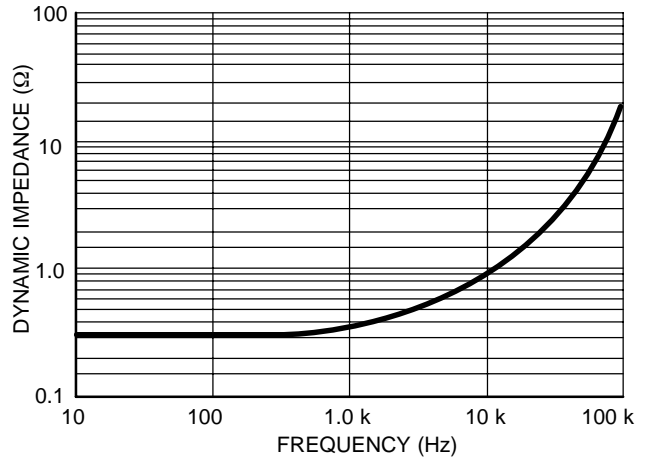


Figure 6. Dynamic Impedance vs. Frequency

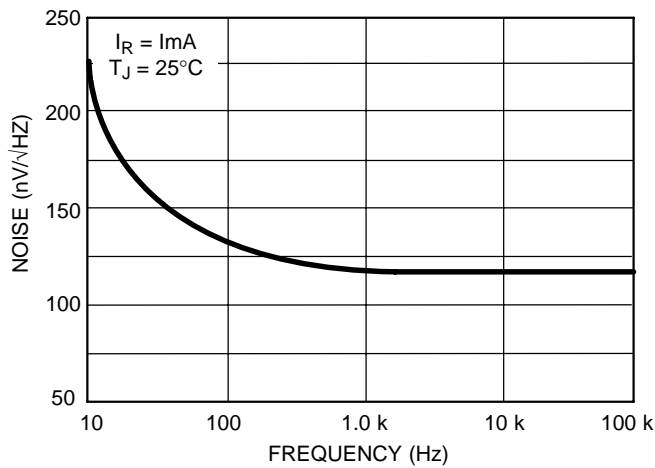


Figure 7. Zener Noise Voltage vs. Frequency

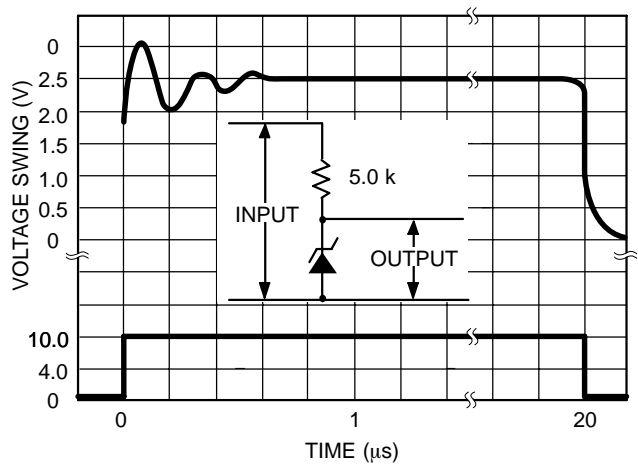


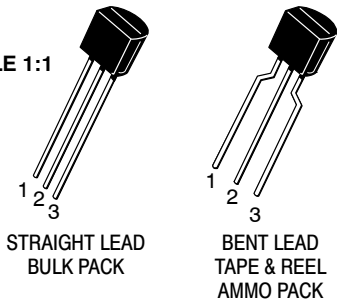
Figure 8. Response Time

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®

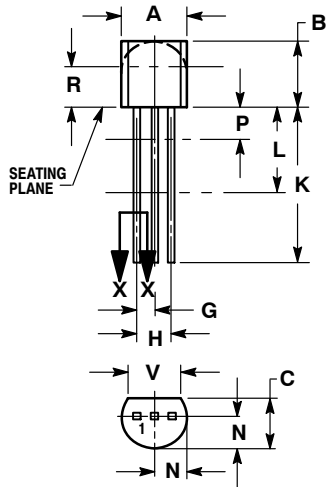


SCALE 1:1

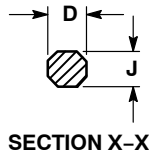


TO-92 (TO-226)  
CASE 29-11  
ISSUE AM

DATE 09 MAR 2007



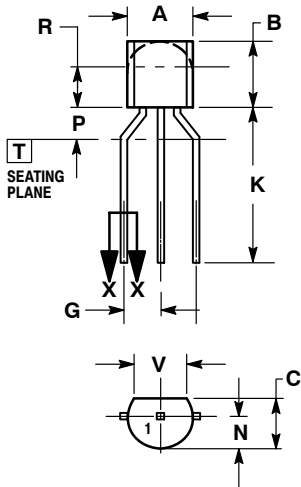
STRAIGHT LEAD  
BULK PACK



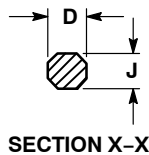
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.175	0.205	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.021	0.407	0.533
G	0.045	0.055	1.15	1.39
H	0.095	0.105	2.42	2.66
J	0.015	0.020	0.39	0.50
K	0.500	---	12.70	---
L	0.250	---	6.35	---
N	0.080	0.105	2.04	2.66
P	---	0.100	---	2.54
R	0.115	---	2.93	---
V	0.135	---	3.43	---



BENT LEAD  
TAPE & REEL  
AMMO PACK



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	MILLIMETERS	
	MIN	MAX
A	4.45	5.20
B	4.32	5.33
C	3.18	4.19
D	0.40	0.54
G	2.40	2.80
J	0.39	0.50
K	12.70	---
N	2.04	2.66
P	1.50	4.00
R	2.93	---
V	3.43	---

STYLES ON PAGE 2

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STATUS:	ON SEMICONDUCTOR STANDARD	
NEW STANDARD:		
DESCRIPTION:	TO-92 (TO-226)	PAGE 1 OF 3

**TO-92 (TO-226)**  
**CASE 29-11**  
**ISSUE AM**

DATE 09 MAR 2007

STYLE 1:  
 PIN 1. EMITTER  
 2. BASE  
 3. COLLECTOR

STYLE 2:  
 PIN 1. BASE  
 2. EMITTER  
 3. COLLECTOR

STYLE 3:  
 PIN 1. ANODE  
 2. ANODE  
 3. CATHODE

STYLE 4:  
 PIN 1. CATHODE  
 2. CATHODE  
 3. ANODE

STYLE 5:  
 PIN 1. DRAIN  
 2. SOURCE  
 3. GATE

STYLE 6:  
 PIN 1. GATE  
 2. SOURCE & SUBSTRATE  
 3. DRAIN

STYLE 7:  
 PIN 1. SOURCE  
 2. DRAIN  
 3. GATE

STYLE 8:  
 PIN 1. DRAIN  
 2. GATE  
 3. SOURCE & SUBSTRATE

STYLE 9:  
 PIN 1. BASE 1  
 2. EMITTER  
 3. BASE 2

STYLE 10:  
 PIN 1. CATHODE  
 2. GATE  
 3. ANODE

STYLE 11:  
 PIN 1. ANODE  
 2. CATHODE & ANODE  
 3. CATHODE

STYLE 12:  
 PIN 1. MAIN TERMINAL 1  
 2. GATE  
 3. MAIN TERMINAL 2

STYLE 13:  
 PIN 1. ANODE 1  
 2. GATE  
 3. CATHODE 2

STYLE 14:  
 PIN 1. EMITTER  
 2. COLLECTOR  
 3. BASE

STYLE 15:  
 PIN 1. ANODE 1  
 2. CATHODE  
 3. ANODE 2

STYLE 16:  
 PIN 1. ANODE  
 2. GATE  
 3. CATHODE

STYLE 17:  
 PIN 1. COLLECTOR  
 2. BASE  
 3. EMITTER

STYLE 18:  
 PIN 1. ANODE  
 2. CATHODE  
 3. NOT CONNECTED

STYLE 19:  
 PIN 1. GATE  
 2. ANODE  
 3. CATHODE

STYLE 20:  
 PIN 1. NOT CONNECTED  
 2. CATHODE  
 3. ANODE

STYLE 21:  
 PIN 1. COLLECTOR  
 2. EMITTER  
 3. BASE

STYLE 22:  
 PIN 1. SOURCE  
 2. GATE  
 3. DRAIN

STYLE 23:  
 PIN 1. GATE  
 2. SOURCE  
 3. DRAIN

STYLE 24:  
 PIN 1. EMITTER  
 2. COLLECTOR/ANODE  
 3. CATHODE

STYLE 25:  
 PIN 1. MT 1  
 2. GATE  
 3. MT 2

STYLE 26:  
 PIN 1. V<sub>CC</sub>  
 2. GROUND 2  
 3. OUTPUT

STYLE 27:  
 PIN 1. MT  
 2. SUBSTRATE  
 3. MT

STYLE 28:  
 PIN 1. CATHODE  
 2. ANODE  
 3. GATE

STYLE 29:  
 PIN 1. NOT CONNECTED  
 2. ANODE  
 3. CATHODE

STYLE 30:  
 PIN 1. DRAIN  
 2. GATE  
 3. SOURCE

STYLE 31:  
 PIN 1. GATE  
 2. DRAIN  
 3. SOURCE

STYLE 32:  
 PIN 1. BASE  
 2. COLLECTOR  
 3. EMITTER

STYLE 33:  
 PIN 1. RETURN  
 2. INPUT  
 3. OUTPUT

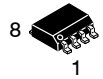
STYLE 34:  
 PIN 1. INPUT  
 2. GROUND  
 3. LOGIC

STYLE 35:  
 PIN 1. GATE  
 2. COLLECTOR  
 3. EMITTER

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<b>NEW STANDARD:</b>		
<b>DESCRIPTION:</b>	<b>TO-92 (TO-226)</b>	<b>PAGE 2 OF 3</b>



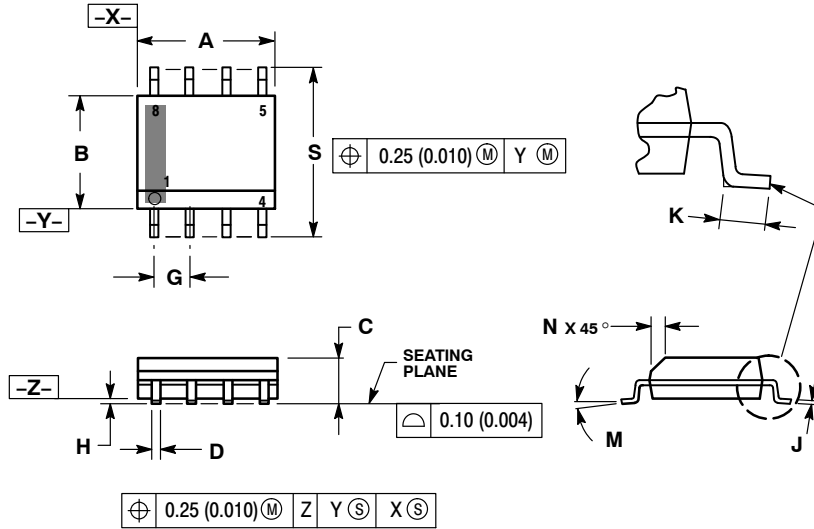
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1

SOIC-8 NB  
CASE 751-07  
ISSUE AK

DATE 16 FEB 2011

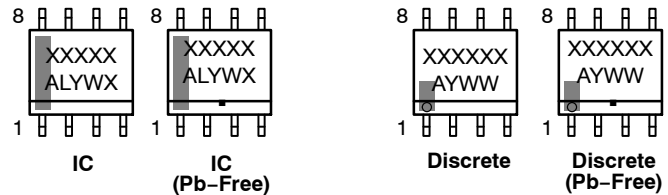
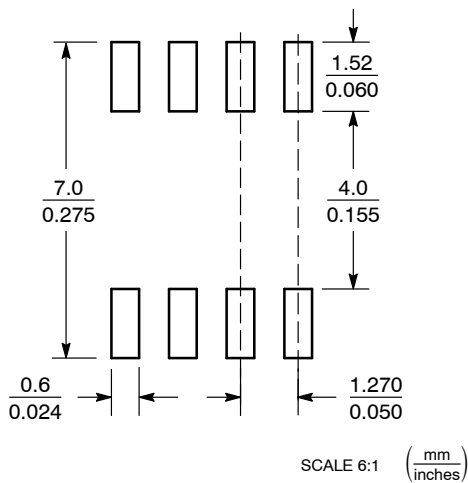


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
  6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

## GENERIC MARKING DIAGRAM\*

### SOLDERING FOOTPRINT\*



XXXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

XXXXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = 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 ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

## STYLES ON PAGE 2

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**SOIC-8 NB**  
**CASE 751-07**  
**ISSUE AK**

DATE 16 FEB 2011

- |   |  |  |  |
|---|--|--|--|
| <p>STYLE 1:<br/>         PIN 1. EMITTER<br/>         2. COLLECTOR<br/>         3. COLLECTOR<br/>         4. EMITTER<br/>         5. EMITTER<br/>         6. BASE<br/>         7. BASE<br/>         8. EMITTER</p>   | <p>STYLE 2:<br/>         PIN 1. COLLECTOR, DIE, #1<br/>         2. COLLECTOR, #1<br/>         3. COLLECTOR, #2<br/>         4. COLLECTOR, #2<br/>         5. BASE, #2<br/>         6. EMITTER, #2<br/>         7. BASE, #1<br/>         8. EMITTER, #1</p>               | <p>STYLE 3:<br/>         PIN 1. DRAIN, DIE #1<br/>         2. DRAIN, #1<br/>         3. DRAIN, #2<br/>         4. DRAIN, #2<br/>         5. GATE, #2<br/>         6. SOURCE, #2<br/>         7. GATE, #1<br/>         8. SOURCE, #1</p>                            | <p>STYLE 4:<br/>         PIN 1. ANODE<br/>         2. ANODE<br/>         3. ANODE<br/>         4. ANODE<br/>         5. ANODE<br/>         6. ANODE<br/>         7. ANODE<br/>         8. COMMON CATHODE</p>   |
| <p>STYLE 5:<br/>         PIN 1. DRAIN<br/>         2. DRAIN<br/>         3. DRAIN<br/>         4. DRAIN<br/>         5. GATE<br/>         6. GATE<br/>         7. SOURCE<br/>         8. SOURCE</p>   | <p>STYLE 6:<br/>         PIN 1. SOURCE<br/>         2. DRAIN<br/>         3. DRAIN<br/>         4. SOURCE<br/>         5. SOURCE<br/>         6. GATE<br/>         7. GATE<br/>         8. SOURCE</p>  | <p>STYLE 7:<br/>         PIN 1. INPUT<br/>         2. EXTERNAL BYPASS<br/>         3. THIRD STAGE SOURCE<br/>         4. GROUND<br/>         5. DRAIN<br/>         6. GATE 3<br/>         7. SECOND STAGE Vd<br/>         8. FIRST STAGE Vd</p>                    | <p>STYLE 8:<br/>         PIN 1. COLLECTOR, DIE #1<br/>         2. BASE, #1<br/>         3. BASE, #2<br/>         4. COLLECTOR, #2<br/>         5. COLLECTOR, #2<br/>         6. EMITTER, #2<br/>         7. EMITTER, #1<br/>         8. COLLECTOR, #1</p>                              |
| <p>STYLE 9:<br/>         PIN 1. EMITTER, COMMON<br/>         2. COLLECTOR, DIE #1<br/>         3. COLLECTOR, DIE #2<br/>         4. EMITTER, COMMON<br/>         5. EMITTER, COMMON<br/>         6. BASE, DIE #2<br/>         7. BASE, DIE #1<br/>         8. EMITTER, COMMON</p> | <p>STYLE 10:<br/>         PIN 1. GROUND<br/>         2. BIAS 1<br/>         3. OUTPUT<br/>         4. GROUND<br/>         5. GROUND<br/>         6. BIAS 2<br/>         7. INPUT<br/>         8. GROUND</p>  | <p>STYLE 11:<br/>         PIN 1. SOURCE 1<br/>         2. GATE 1<br/>         3. SOURCE 2<br/>         4. GATE 2<br/>         5. DRAIN 2<br/>         6. DRAIN 2<br/>         7. DRAIN 1<br/>         8. DRAIN 1</p>   | <p>STYLE 12:<br/>         PIN 1. SOURCE<br/>         2. SOURCE<br/>         3. SOURCE<br/>         4. GATE<br/>         5. DRAIN<br/>         6. DRAIN<br/>         7. DRAIN<br/>         8. DRAIN</p>   |
| <p>STYLE 13:<br/>         PIN 1. N.C.<br/>         2. SOURCE<br/>         3. SOURCE<br/>         4. GATE<br/>         5. DRAIN<br/>         6. DRAIN<br/>         7. DRAIN<br/>         8. DRAIN</p>  | <p>STYLE 14:<br/>         PIN 1. N-SOURCE<br/>         2. N-GATE<br/>         3. P-SOURCE<br/>         4. P-GATE<br/>         5. P-DRAIN<br/>         6. P-DRAIN<br/>         7. N-DRAIN<br/>         8. N-DRAIN</p>   | <p>STYLE 15:<br/>         PIN 1. ANODE 1<br/>         2. ANODE 1<br/>         3. ANODE 1<br/>         4. ANODE 1<br/>         5. CATHODE, COMMON<br/>         6. CATHODE, COMMON<br/>         7. CATHODE, COMMON<br/>         8. CATHODE, COMMON</p>               | <p>STYLE 16:<br/>         PIN 1. EMITTER, DIE #1<br/>         2. BASE, DIE #1<br/>         3. EMITTER, DIE #2<br/>         4. BASE, DIE #2<br/>         5. COLLECTOR, DIE #2<br/>         6. COLLECTOR, DIE #2<br/>         7. COLLECTOR, DIE #1<br/>         8. COLLECTOR, DIE #1</p> |
| <p>STYLE 17:<br/>         PIN 1. VCC<br/>         2. V2OUT<br/>         3. V1OUT<br/>         4. TXE<br/>         5. RXE<br/>         6. VEE<br/>         7. GND<br/>         8. ACC</p>  | <p>STYLE 18:<br/>         PIN 1. ANODE<br/>         2. ANODE<br/>         3. SOURCE<br/>         4. GATE<br/>         5. DRAIN<br/>         6. DRAIN<br/>         7. CATHODE<br/>         8. CATHODE</p>   | <p>STYLE 19:<br/>         PIN 1. SOURCE 1<br/>         2. GATE 1<br/>         3. SOURCE 2<br/>         4. GATE 2<br/>         5. DRAIN 2<br/>         6. MIRROR 2<br/>         7. DRAIN 1<br/>         8. MIRROR 1</p>   | <p>STYLE 20:<br/>         PIN 1. SOURCE (N)<br/>         2. GATE (N)<br/>         3. SOURCE (P)<br/>         4. GATE (P)<br/>         5. DRAIN<br/>         6. DRAIN<br/>         7. DRAIN<br/>         8. DRAIN</p>   |
| <p>STYLE 21:<br/>         PIN 1. CATHODE 1<br/>         2. CATHODE 2<br/>         3. CATHODE 3<br/>         4. CATHODE 4<br/>         5. CATHODE 5<br/>         6. COMMON ANODE<br/>         7. COMMON ANODE<br/>         8. CATHODE 6</p>  | <p>STYLE 22:<br/>         PIN 1. I/O LINE 1<br/>         2. COMMON CATHODE/VCC<br/>         3. COMMON CATHODE/VCC<br/>         4. I/O LINE 3<br/>         5. COMMON ANODE/GND<br/>         6. I/O LINE 4<br/>         7. I/O LINE 5<br/>         8. COMMON ANODE/GND</p> | <p>STYLE 23:<br/>         PIN 1. LINE 1 IN<br/>         2. COMMON ANODE/GND<br/>         3. COMMON ANODE/GND<br/>         4. LINE 2 IN<br/>         5. LINE 2 OUT<br/>         6. COMMON ANODE/GND<br/>         7. COMMON ANODE/GND<br/>         8. LINE 1 OUT</p> | <p>STYLE 24:<br/>         PIN 1. BASE<br/>         2. EMITTER<br/>         3. COLLECTOR/ANODE<br/>         4. COLLECTOR/ANODE<br/>         5. CATHODE<br/>         6. CATHODE<br/>         7. COLLECTOR/ANODE<br/>         8. COLLECTOR/ANODE</p>                                      |
| <p>STYLE 25:<br/>         PIN 1. VIN<br/>         2. N/C<br/>         3. REXT<br/>         4. GND<br/>         5. IOUT<br/>         6. IOUT<br/>         7. IOUT<br/>         8. IOUT</p>   | <p>STYLE 26:<br/>         PIN 1. GND<br/>         2. dv/dt<br/>         3. ENABLE<br/>         4. ILIMIT<br/>         5. SOURCE<br/>         6. SOURCE<br/>         7. SOURCE<br/>         8. VCC</p>  | <p>STYLE 27:<br/>         PIN 1. ILIMIT<br/>         2. OVLO<br/>         3. UVLO<br/>         4. INPUT+<br/>         5. SOURCE<br/>         6. SOURCE<br/>         7. SOURCE<br/>         8. DRAIN</p>  | <p>STYLE 28:<br/>         PIN 1. SW_TO_GND<br/>         2. DASIC_OFF<br/>         3. DASIC_SW_DET<br/>         4. GND<br/>         5. V_MON<br/>         6. VBULK<br/>         7. VBULK<br/>         8. VIN</p>  |
| <p>STYLE 29:<br/>         PIN 1. BASE, DIE #1<br/>         2. EMITTER, #1<br/>         3. BASE, #2<br/>         4. EMITTER, #2<br/>         5. COLLECTOR, #2<br/>         6. COLLECTOR, #2<br/>         7. COLLECTOR, #1<br/>         8. COLLECTOR, #1</p>                        | <p>STYLE 30:<br/>         PIN 1. DRAIN 1<br/>         2. DRAIN 1<br/>         3. GATE 2<br/>         4. SOURCE 2<br/>         5. SOURCE 1/DRAIN 2<br/>         6. SOURCE 1/DRAIN 2<br/>         7. SOURCE 1/DRAIN 2<br/>         8. GATE 1</p>                           |  |  |

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