

# NLSX3012

## 2-Bit 100 Mb/s Configurable Dual-Supply Level Translator

The NLSX3012 is a 2-bit configurable dual-supply bidirectional level translator without a direction control pin. The I/O  $V_{CC}$  and I/O  $V_L$  ports are designed to track two different power supply rails,  $V_{CC}$  and  $V_L$  respectively. The  $V_{CC}$  supply rail is configurable from 1.3 V to 4.5 V while the  $V_L$  supply rail is configurable from 0.9 V to ( $V_{CC} - 0.4$ ) V. This allows lower voltage logic signals on the  $V_L$  side to be translated into higher voltage logic signals on the  $V_{CC}$  side, and vice-versa. Both I/O ports are auto-sensing; thus, no direction pin is required.

The Output Enable (EN) input, when Low, disables both I/O ports by putting them in 3-state. This significantly reduces the supply currents from both  $V_{CC}$  and  $V_L$ . The EN signal is designed to track  $V_L$ .

### Features

- Wide High-Side  $V_{CC}$  Operating Range: 1.3 V to 4.5 V  
Wide Low-Side  $V_L$  Operating Range: 0.9 V to ( $V_{CC} - 0.4$ ) V
- High-Speed with 140 Mb/s Guaranteed Data Rate for  $V_L > 1.8$  V
- Low Bit-to-Bit Skew
- Overvoltage Tolerant Enable and I/O Pins
- Non-preferential Powerup Sequencing
- Small packaging: UDFN8, SO-8, Micro8
- These are Pb-Free Devices

### Typical Applications

- Mobile Phones, PDAs, Other Portable Devices
- PC and Laptops



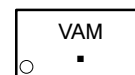
ON Semiconductor®

<http://onsemi.com>

### MARKING DIAGRAMS



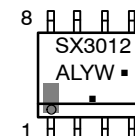
UDFN8  
MU SUFFIX  
CASE 517AJ



VA = Specific Device Code  
M = Date Code  
■ = Pb-Free Package



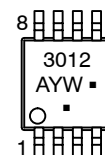
SO-8  
D SUFFIX  
CASE 751



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



Micro8  
DM SUFFIX  
CASE 846A



A = Assembly Location  
Y = Year  
W = Work Week  
■ = Pb-Free Package

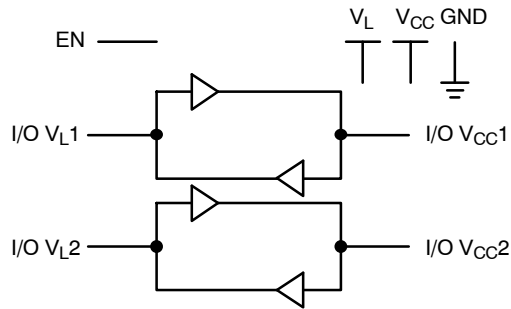
### ORDERING INFORMATION

| Device        | Package             | Shipping†        |
|---------------|---------------------|------------------|
| NLSX3012MUTAG | UDFN8<br>(Pb-Free)  | 3000/Tape & Reel |
| NLSX3012DR2G  | SO-8<br>(Pb-Free)   | 2500/Tape & Reel |
| NLSX3012DMR2G | Micro8<br>(Pb-Free) | 4000/Tape & Reel |

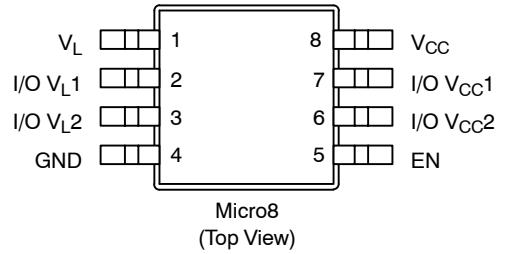
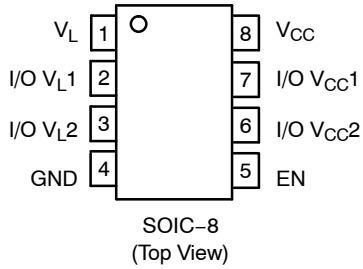
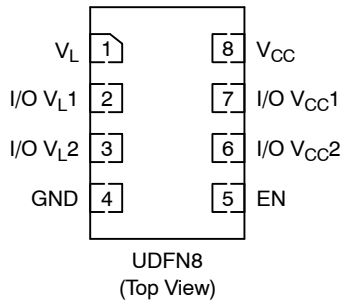
† For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# NLSX3012

## LOGIC DIAGRAM



## PIN ASSIGNMENTS



## PIN ASSIGNMENT

| Pins                  | Description                             |
|-----------------------|---|
| V <sub>CC</sub>       | V <sub>CC</sub> Input Voltage           |
| V <sub>L</sub>        | V <sub>L</sub> Input Voltage            |
| GND                   | Ground                                  |
| EN                    | Output Enable                           |
| I/O V <sub>CC</sub> n | I/O Port, Referenced to V <sub>CC</sub> |
| I/O V <sub>L</sub> n  | I/O Port, Referenced to V <sub>L</sub>  |

## FUNCTION TABLE

| EN | Operating Mode      |
|----|---------------------|
| L  | Hi-Z                |
| H  | I/O Buses Connected |

# MAXIMUM RATINGS

| Symbol       | Parameter                                    | Value                      | Condition   | Unit |
|--------------|--|----------------------------|-------------|------|
| $V_{CC}$     | $V_{CC}$ Supply Voltage                      | -0.5 to +5.5               |             | V    |
| $V_L$        | $V_L$ Supply Voltage                         | -0.5 to +5.5               |             | V    |
| I/O $V_{CC}$ | $V_{CC}$ -Referenced DC Input/Output Voltage | -0.5 to ( $V_{CC} + 0.3$ ) |             | V    |
| I/O $V_L$    | $V_L$ -Referenced DC Input/Output Voltage    | -0.5 to ( $V_L + 0.3$ )    |             | V    |
| $V_{EN}$     | Enable Control Pin DC Input Voltage          | -0.5 to +5.5               |             | V    |
| $I_{IK}$     | Input Diode Clamp Current                    | -50                        | $V_I < GND$ | mA   |
| $I_{OK}$     | Output Diode Clamp Current                   | -50                        | $V_O < GND$ | mA   |
| $I_{CC}$     | DC Supply Current Through $V_{CC}$           | $\pm 100$                  |             | mA   |
| $I_L$        | DC Supply Current Through $V_L$              | $\pm 100$                  |             | mA   |
| $I_{GND}$    | DC Ground Current Through Ground Pin         | $\pm 100$                  |             | mA   |
| $T_{STG}$    | Storage Temperature                          | -65 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.

# RECOMMENDED OPERATING CONDITIONS

| Symbol              | Parameter   | Min                       | Max            | Unit |
|---------------------|---|---------------------------|----------------|------|
| $V_{CC}$            | $V_{CC}$ Supply Voltage   | 1.3                       | 4.5            | V    |
| $V_L$               | $V_L$ Supply Voltage  | 0.9                       | $V_{CC} - 0.4$ | V    |
| $V_{EN}$            | Enable Control Pin Voltage  | GND                       | 4.5            | V    |
| $V_{IO}$            | Bus Input/Output Voltage  | I/O $V_{CC}$<br>I/O $V_L$ | 4.5<br>4.5     | V    |
| $T_A$               | Operating Temperature Range   | -40                       | +85            | °C   |
| $\Delta I/\Delta V$ | Input Transition Rise or Rate<br>$V_I, V_{IO}$ from 30% to 70% of $V_{CC}$ ; $V_{CC} = 3.3 V \pm 0.3 V$ | 0                         | 10             | ns   |

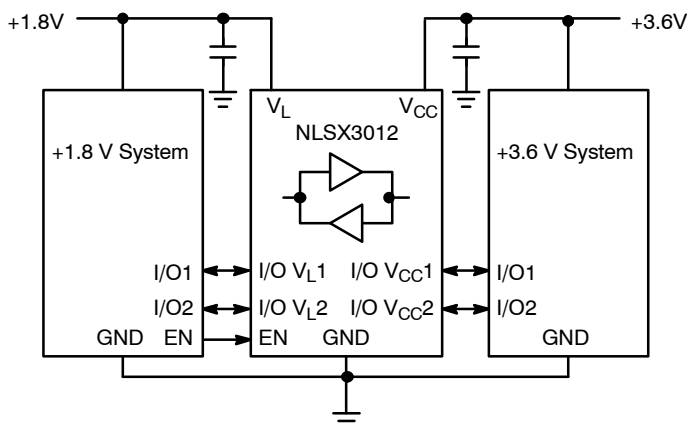


Figure 1. Typical Application Circuit

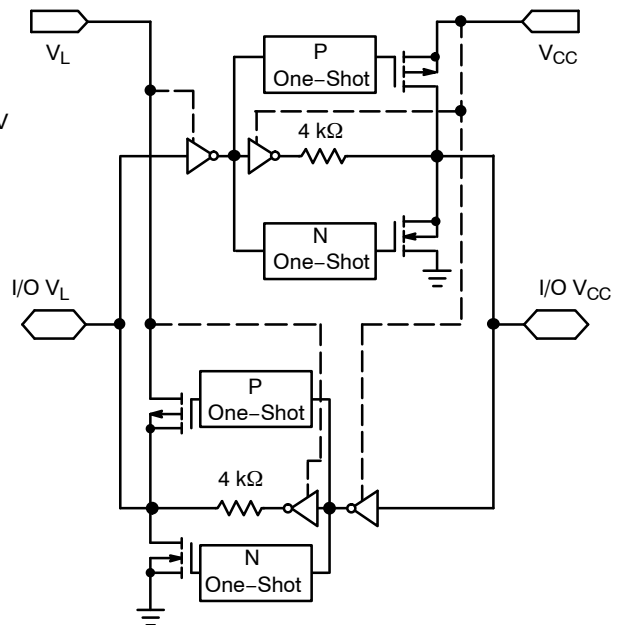


Figure 2. Simplified Functional Diagram (1 I/O Line)  
(EN = 1)

## DC ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter                               | Test Conditions<br>(Note 1)                | V <sub>CC</sub> (V)<br>(Note 2) | V <sub>L</sub> (V)<br>(Note 3) | -40°C to +85°C        |                 |                       | Unit |
|------------------|---|--|---------------------------------|--------------------------------|-----------------------|-----------------|-----------------------|------|
|                  |   |  |                                 |                                | Min                   | Typ<br>(Note 4) | Max                   |      |
| V <sub>IHC</sub> | I/O V <sub>CC</sub> Input HIGH Voltage  |  | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | 0.8 * V <sub>CC</sub> | –               | –                     | V    |
| V <sub>ILC</sub> | I/O V <sub>CC</sub> Input LOW Voltage   |  | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | –                     | –               | 0.2 * V <sub>CC</sub> | V    |
| V <sub>IHL</sub> | I/O V <sub>L</sub> Input HIGH Voltage   |  | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | 0.8 * V <sub>L</sub>  | –               | –                     | V    |
| V <sub>ILL</sub> | I/O V <sub>L</sub> Input LOW Voltage    |  | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | –                     | –               | 0.2 * V <sub>L</sub>  | V    |
| V <sub>IH</sub>  | Control Pin Input HIGH Voltage          | T <sub>A</sub> = +25°C                     | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | 0.8 * V <sub>L</sub>  | –               | –                     | V    |
| V <sub>IL</sub>  | Control Pin Input LOW Voltage           | T <sub>A</sub> = +25°C                     | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | –                     | –               | 0.2 * V <sub>L</sub>  | V    |
| V <sub>OHC</sub> | I/O V <sub>CC</sub> Output HIGH Voltage | I/O V <sub>CC</sub> Source Current = 20 µA | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | 0.8 * V <sub>CC</sub> | –               | –                     | V    |
| V <sub>OLC</sub> | I/O V <sub>CC</sub> Output LOW Voltage  | I/O V <sub>CC</sub> Sink Current = 20 µA   | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | –                     | –               | 0.2 * V <sub>CC</sub> | V    |
| V <sub>OHL</sub> | I/O V <sub>L</sub> Output HIGH Voltage  | I/O V <sub>L</sub> Source Current = 20 µA  | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | 0.8 * V <sub>L</sub>  | –               | –                     | V    |
| V <sub>OLL</sub> | I/O V <sub>L</sub> Output LOW Voltage   | I/O V <sub>L</sub> Sink Current = 20 µA    | 1.3 to 4.5                      | 0.9 to (V <sub>CC</sub> - 0.4) | –                     | –               | 0.2 * V <sub>L</sub>  | V    |

1. Normal test conditions are V<sub>EN</sub> = 0 V, C<sub>I0VCC</sub> = 15 pF and C<sub>I0VL</sub> = 15 pF, unless otherwise specified.
2. V<sub>CC</sub> is the supply voltage associated with the high voltage port, and V<sub>CC</sub> ranges from +1.3 V to 4.5 V under normal operating conditions.
3. V<sub>L</sub> is the supply voltage associated with the low voltage port. V<sub>L</sub> must be less than or equal to (V<sub>CC</sub> - 0.4) V during normal operation. However, during startup and shutdown conditions, V<sub>L</sub> can be greater than (V<sub>CC</sub> - 0.4) V.
4. Typical values are for V<sub>CC</sub> = +2.8 V, V<sub>L</sub> = +1.8 V and T<sub>A</sub> = +25°C. All units are production tested at T<sub>A</sub> = +25°C. Limits over the operating temperature range are guaranteed by design.

## POWER CONSUMPTION

| Symbol              | Parameter   | Test Conditions<br>(Note 5)   | V <sub>CC</sub> (V)<br>(Note 6) | V <sub>L</sub> (V)<br>(Note 7) | -40°C to +85°C |     |      | Unit |
|---------------------|---|---|---------------------------------|--------------------------------|----------------|-----|------|------|
|                     |   |   |                                 |                                | Min            | Typ | Max  |      |
| I <sub>Q-VCC</sub>  | Supply Current from V <sub>CC</sub>                 | EN = V <sub>L</sub> ; I/O V <sub>CCn</sub> = 0 V, I/O V <sub>Ln</sub> = 0 V, I/O V <sub>CCn</sub> = V <sub>CC</sub> or I/O V <sub>Ln</sub> = V <sub>L</sub> and I <sub>o</sub> = 0            | 1.3 to 3.6                      | 0.9 to (V <sub>CC</sub> - 0.4) | –              | –   | 1.0  | μA   |
| I <sub>Q-VL</sub>   | Supply Current from V <sub>L</sub>                  | EN = V <sub>L</sub> ; I/O V <sub>CCn</sub> = 0 V, I/O V <sub>Ln</sub> = 0 V, I/O V <sub>CCn</sub> = V <sub>CC</sub> or I/O V <sub>Ln</sub> = V <sub>L</sub> and I <sub>o</sub> = 0            | 1.3 to 3.6                      | 0.9 to (V <sub>CC</sub> - 0.4) | –              | –   | 1.0  | μA   |
|                     |   | EN = V <sub>L</sub> ; I/O V <sub>CCn</sub> = 0 V, I/O V <sub>Ln</sub> = 0 V, I/O V <sub>CCn</sub> = V <sub>CC</sub> or I/O V <sub>Ln</sub> = (V <sub>CC</sub> - 0.2 V) and I <sub>o</sub> = 0 |                                 | < (V <sub>CC</sub> - 0.2)      | –              | –   | 2.0  |      |
| I <sub>TS-VCC</sub> | V <sub>CC</sub> Tristate Output Mode Supply Current | EN = 0 V  | 1.3 to 3.6                      | 0.9 to (V <sub>CC</sub> - 0.4) | –              | –   | 1.0  | μA   |
| I <sub>TS-VL</sub>  | V <sub>L</sub> Tristate Output Mode Supply Current  | EN = 0 V  | 1.3 to 3.6                      | 0.9 to (V <sub>CC</sub> - 0.4) | –              | –   | 0.2  | μA   |
|                     |   | EN = 0 V  |                                 | V <sub>CC</sub> - 0.2          | –              | –   | 2.0  |      |
| I <sub>OZ</sub>     | I/O Tristate Output Mode Leakage Current            | EN = 0 V  | 1.3 to 3.6                      | 0.9 to (V <sub>CC</sub> - 0.4) | –              | –   | 0.15 | μA   |
|                     |   | EN = 0 V  |                                 | V <sub>CC</sub> - 0.2          | –              | –   | 2.0  |      |
| I <sub>EN</sub>     | Output Enable Pin Input Current                     | –   | 1.3 to 3.6                      | 0.9 to (V <sub>CC</sub> - 0.4) | –              | –   | 1.0  | μA   |

5. Normal test conditions are V<sub>EN</sub> = 0 V, C<sub>IOVCC</sub> = 15 pF and C<sub>IOVL</sub> = 15 pF, unless otherwise specified.

6. V<sub>CC</sub> is the supply voltage associated with the high voltage port, and V<sub>CC</sub> ranges from +1.3 V to 4.5 V under normal operating conditions.

7. V<sub>L</sub> is the supply voltage associated with the low voltage port. V<sub>L</sub> must be less than or equal to (V<sub>CC</sub> - 0.4) V during normal operation. However, during startup and shutdown conditions, V<sub>L</sub> can be greater than (V<sub>CC</sub> - 0.4) V.

8. Typical values are for V<sub>CC</sub> = +2.8 V, V<sub>L</sub> = +1.8 V and T<sub>A</sub> = +25°C. All units are production tested at T<sub>A</sub> = +25°C. Limits over the operating temperature range are guaranteed by design.

## TIMING CHARACTERISTICS

| Symbol                 | Parameter   | Test Conditions<br>(Note 9)  | V <sub>CC</sub> (V)<br>(Note 10) | V <sub>L</sub> (V)<br>(Note 11) | -40°C to +85°C |                  |     | Unit |
|------------------------|---|--|----------------------------------|---------------------------------|----------------|------------------|-----|------|
|                        |   |  |                                  |                                 | Min            | Typ<br>(Note 12) | Max |      |
| t <sub>R-VCC</sub>     | I/O V <sub>CC</sub> Rise Time<br>(Output = I/O_V <sub>CC</sub> )                              | C <sub>IOVCC</sub> = 15 pF   | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 0.7              | 2.4 | ns   |
| t <sub>F-VCC</sub>     | I/O V <sub>CC</sub> Falltime<br>(Output = I/O_V <sub>CC</sub> )                               | C <sub>IOVCC</sub> = 15 pF   | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 0.5              | 1.0 | ns   |
| t <sub>R-VL</sub>      | I/O V <sub>L</sub> Risettime<br>(Output = I/O_V <sub>L</sub> )                                | C <sub>IOVL</sub> = 15 pF  | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 1.0              | 3.8 | ns   |
| t <sub>F-VL</sub>      | I/O V <sub>L</sub> Falltime<br>(Output = I/O_V <sub>L</sub> )                                 | C <sub>IOVL</sub> = 15 pF  | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 0.6              | 1.2 | ns   |
| Z <sub>O-VCC</sub>     | I/O V <sub>CC</sub> One-Shot<br>Output Impedance  |  | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 30               |     | Ω    |
| Z <sub>O-VL</sub>      | I/O V <sub>L</sub> One-Shot<br>Output Impedance   |  | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 30               |     | Ω    |
| t <sub>PD_VL-VCC</sub> | Propagation Delay<br>(Output = I/O_V <sub>CC</sub> ,<br>t <sub>PHL</sub> , t <sub>PLH</sub> ) | C <sub>IOVCC</sub> = 15 pF   | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 4.5              | 12  | ns   |
| t <sub>PD_VCC-VL</sub> | Propagation Delay<br>(Output = I/O_V <sub>L</sub> ,<br>t <sub>PHL</sub> , t <sub>PLH</sub> )  | C <sub>IOVL</sub> = 15 pF  | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 3.0              | 7.2 | ns   |
| t <sub>SK_VL-VCC</sub> | Channel-to-Channel<br>Skew (Output =<br>I/O_V <sub>CC</sub> )                                 | C <sub>IOVCC</sub> = 15 pF   | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 0.2              | 0.3 | nS   |
| t <sub>SK_VCC-VL</sub> | Channel-to-Channel<br>Skew<br>(Output = I/O_V <sub>L</sub> )                                  | C <sub>IOVCC</sub> = 15 pF   | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  |                | 0.2              | 0.3 | nS   |
| MDR                    | Maximum Data Rate   | (Output = I/O_V <sub>CC</sub> ,<br>C <sub>IOVCC</sub> = 15 pF)<br>(Output = I/O_V <sub>L</sub> ,<br>C <sub>IOVL</sub> = 15 pF) | 1.3 to 4.5                       | 0.9 to (V <sub>CC</sub> - 0.4)  | 110            |                  |     | Mb/s |
|                        |   |  | > 2.2                            | > 1.8                           | 140            |                  |     |      |

9. Normal test conditions are V<sub>EN</sub> = 0 V, C<sub>IOVCC</sub> = 15 pF and C<sub>IOVL</sub> = 15 pF, unless otherwise specified.

10. V<sub>CC</sub> is the supply voltage associated with the high voltage port, and V<sub>CC</sub> ranges from +1.3 V to 4.5 V under normal operating conditions.

11. V<sub>L</sub> is the supply voltage associated with the low voltage port. V<sub>L</sub> must be less than or equal to (V<sub>CC</sub> - 0.4) V during normal operation. However, during startup and shutdown conditions, V<sub>L</sub> can be greater than (V<sub>CC</sub> - 0.4) V.

12. Typical values are for V<sub>CC</sub> = +2.8 V, V<sub>L</sub> = +1.8 V and T<sub>A</sub> = +25°C. All units are production tested at T<sub>A</sub> = +25°C. Limits over the operating temperature range are guaranteed by design.

ENABLE / DISABLE TIME MEASUREMENTS

| Symbol        | Parameter  | Test Conditions<br>(Note 13) | $V_{CC}$ (V)<br>(Note 14) | $V_L$ (V)<br>(Note 15)    | -40°C to +85°C |                  |     | Unit |
|---------------|--|------------------------------|---------------------------|---------------------------|----------------|------------------|-----|------|
|               |  |                              |                           |                           | Min            | Typ<br>(Note 16) | Max |      |
| $t_{EN-VCC}$  | Turn-On Enable Time (Output = I/O $V_{CC}$ , $t_{pZH}$ )   | $C_{IOVCC} = 15$ pF          | 1.3 to 4.5                | 0.9 to ( $V_{CC} - 0.4$ ) |                | 150              | 200 | ns   |
|               | Turn-On Enable Time (Output = I/O $V_{CC}$ , $t_{pZL}$ )   | $C_{IOVL} = 15$ pF           | 1.3 to 4.5                | 0.9 to ( $V_{CC} - 0.4$ ) |                | 130              | 180 | ns   |
| $t_{EN-VL}$   | Turn-On Enable Time (Output = I/O $V_L$ , $t_{pZH}$ )      | $C_{IOVCC} = 15$ pF          | 1.3 to 4.5                | 0.9 to ( $V_{CC} - 0.4$ ) |                | 95               | 225 | ns   |
|               | Turn-On Enable Time (Output = I/O $V_L$ , $t_{pZL}$ )      | $C_{IOVL} = 15$ pF           | 1.3 to 4.5                | 0.9 to ( $V_{CC} - 0.4$ ) |                | 75               | 100 | ns   |
| $t_{DIS-VCC}$ | Turn-Off Disable Time (Output = I/O $V_{CC}$ , $t_{pHZ}$ ) | $C_{IOVCC} = 15$ pF          | 1.3 to 4.5                | 0.9 to ( $V_{CC} - 0.4$ ) |                | 175              | 250 | ns   |
|               | Propagation Delay (Output = I/O $V_{CC}$ , $t_{PLZ}$ )     | $C_{IOVL} = 15$ pF           | 1.3 to 4.5                | 0.9 to ( $V_{CC} - 0.4$ ) |                | 140              | 160 | ns   |
| $t_{DIS-VL}$  | Turn-Off Disable Time (Output = I/O $V_L$ , $t_{pHZ}$ )    | $C_{IOVCC} = 15$ pF          | 1.3 to 4.5                | 0.9 to ( $V_{CC} - 0.4$ ) |                | 180              | 275 | ns   |
|               | Propagation Delay (Output = I/O $V_L$ , $t_{PLZ}$ )        | $C_{IOVL} = 15$ pF           | 1.3 to 4.5                | 0.9 to ( $V_{CC} - 0.4$ ) |                | 160              | 220 | ns   |

13. Normal test conditions are  $V_{EN} = 0$  V,  $C_{IOVCC} = 15$  pF and  $C_{IOVL} = 15$  pF, unless otherwise specified.

14.  $V_{CC}$  is the supply voltage associated with the high voltage port, and  $V_{CC}$  ranges from +1.3 V to 4.5 V under normal operating conditions.

15.  $V_L$  is the supply voltage associated with the low voltage port.  $V_L$  must be less than or equal to ( $V_{CC} - 0.4$ ) V during normal operation. However, during startup and shutdown conditions,  $V_L$  can be greater than ( $V_{CC} - 0.4$ ) V.

16. Typical values are for  $V_{CC} = +2.8$  V,  $V_L = +1.8$  V and  $T_A = +25$  °C. All units are production tested at  $T_A = +25$  °C. Limits over the operating temperature range are guaranteed by design.

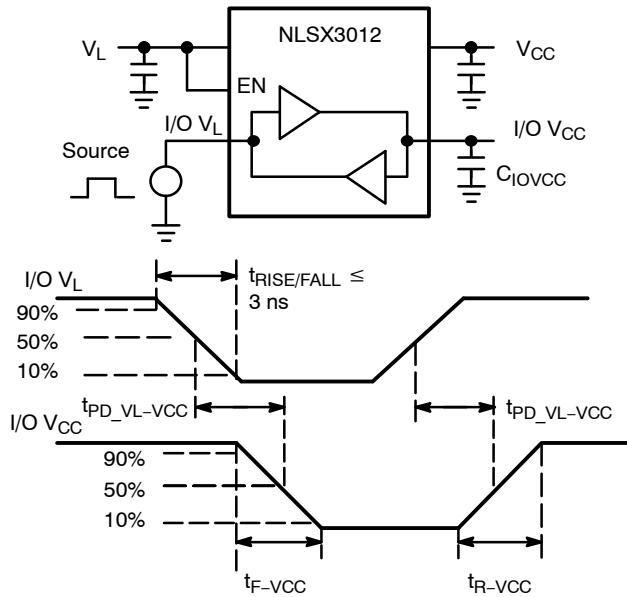


Figure 3. Driving I/O  $V_L$  Test Circuit and Timing

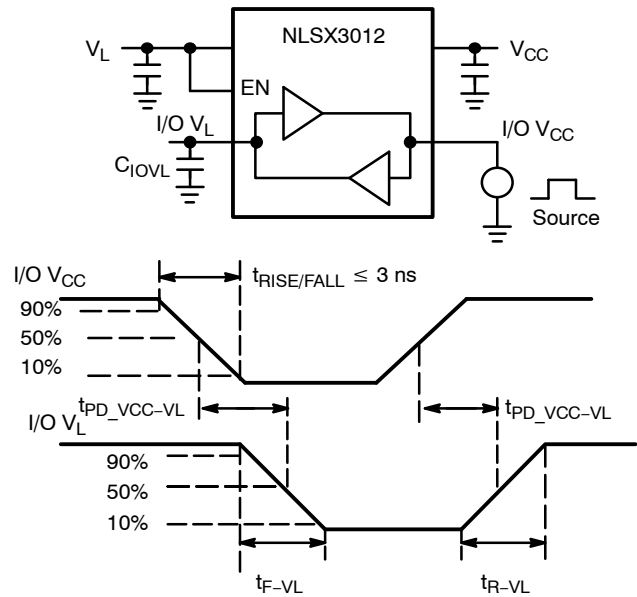
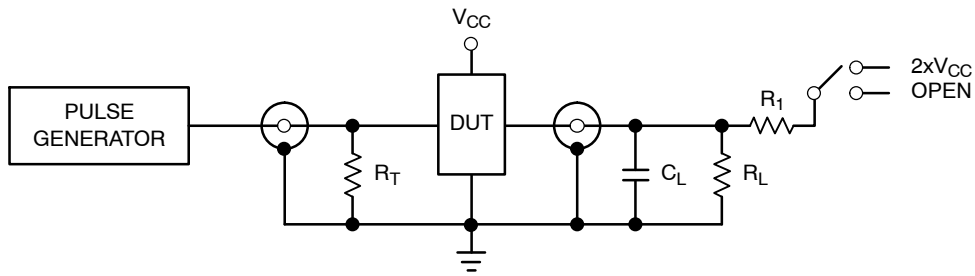


Figure 4. Driving I/O  $V_{CC}$  Test Circuit and Timing

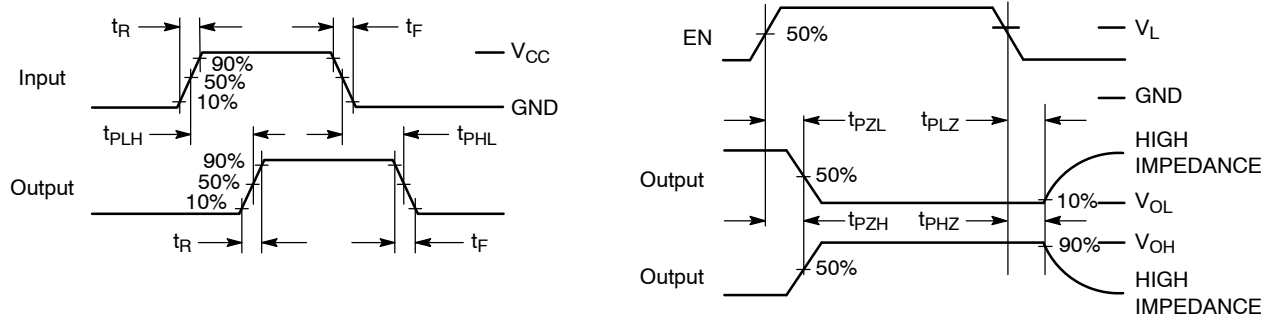
# NLSX3012



| Test                  | Switch            |
|-----------------------|-------------------|
| $t_{PZH}$ , $t_{PHZ}$ | Open              |
| $t_{PZL}$ , $t_{PLZ}$ | $2 \times V_{CC}$ |

$C_L = 15 \text{ pF}$  or equivalent (Includes jig and probe capacitance)  
 $R_L = R_1 = 50 \text{ k}\Omega$  or equivalent  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50 \Omega$ )

**Figure 5. Test Circuit for Enable/Disable Time Measurement**



**Figure 6. Timing Definitions for Propagation Delays and Enable/Disable Measurement**



## IMPORTANT APPLICATIONS INFORMATION

### Level Translator Architecture

The NLSX3012 auto sense translator provides bi-directional voltage level shifting to transfer data in multiple supply voltage systems. This device has two supply voltages,  $V_L$  and  $V_{CC}$ , which set the logic levels on the input and output sides of the translator. When used to transfer data from the  $V_L$  to the  $V_{CC}$  ports, input signals referenced to the  $V_L$  supply are translated to output signals with a logic level matched to  $V_{CC}$ . In a similar manner, the  $V_{CC}$  to  $V_L$  translation shifts input signals with a logic level compatible to  $V_{CC}$  to an output signal matched to  $V_L$ .

The NLSX3012 consists of four bi-directional channels that independently determine the direction of the data flow without requiring a directional pin. The one-shot circuits are used to detect the rising or falling input signals. In addition, the one shots decrease the rise and fall time of the output signal for high-to-low and low-to-high transitions.

### Input Driver Requirements

Auto sense translators such as the NLSX3012 have a wide bandwidth, but a relatively small DC output current rating. The high bandwidth of the bi-directional I/O circuit is used to quickly transform from an input to an output driver and vice versa. The I/O ports have a modest DC current output specification so that the output driver can be over driven when data is sent to in the opposite direction.

For proper operation, the input driver to the auto sense translator should be capable of driving 2 mA of peak output current with an output impedance less than 25  $\Omega$ . The bi-directional configuration of the translator results in both input stages being active for a very short time period. Although the peak current from the input signal circuit is relatively large, the average current is small and consistent with a standard CMOS input stage.

### Output Load Requirements

The NLSX3012 is designed to drive CMOS inputs. Resistive pullup or pulldown loads of less than 50 k $\Omega$  should not be used with this device. The NLSX3373 or NLSX3378 open-drain auto sense translators are alternate

translator options for an application such as the I<sup>2</sup>C bus that requires pullup resistors.

### Enable Input (EN)

The NLSX3012 has an Enable pin (EN) that provides tri-state operation at the I/O pins. Driving the Enable pin to a low logic level minimizes the power consumption of the device and drives the I/O  $V_{CC}$  and I/O  $V_L$  pins to a high impedance state. Normal translation operation occurs when the EN pin is equal to a logic high signal. The EN pin is referenced to the  $V_L$  supply and has Over-Voltage Tolerant (OVT) protection.

### Uni-Directional versus Bi-Directional Translation

The NLSX3012 can function as a non-inverting uni-directional translator. One advantage of using the translator as a uni-directional device is that each I/O pin can be configured as either an input or output. The configurable input or output feature is especially useful in applications such as SPI that use multiple uni-directional I/O lines to send data to and from a device. The flexible I/O port of the auto sense translator simplifies the trace connections on the PCB.

### Power Supply Guidelines

It is recommended that the  $V_L$  supply should be less than or equal to the value of the  $V_{CC}$  minus 0.4 V. The sequencing of the power supplies will not damage the device during the power up operation; however, the current consumption of the device will increase if  $V_L$  exceeds  $V_{CC}$  minus 0.4 V. In addition, the I/O  $V_{CC}$  and I/O  $V_L$  pins are in the high impedance state if either supply voltage is equal to 0 V.

For optimal performance, 0.01 to 0.1  $\mu$ F decoupling capacitors should be used on the  $V_L$  and  $V_{CC}$  power supply pins. Ceramic capacitors are a good design choice to filter and bypass any noise signals on the power supply voltage lines to the ground plane of the PCB. The noise immunity will be maximized by placing the capacitors as close as possible to the supply and ground pins, along with minimizing the PCB connection traces.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

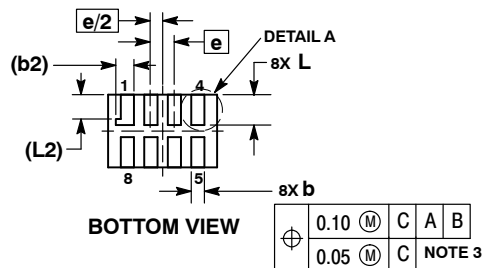
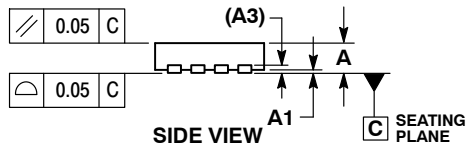
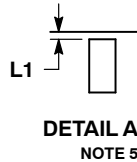
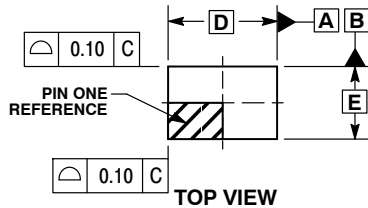
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SCALE 4:1

UDFN8 1.8x1.2, 0.4P  
CASE 517AJ-01  
ISSUE O

DATE 08 NOV 2006

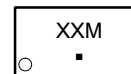


### NOTES:

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 0.30 mm FROM TERMINAL TIP.
4. MOLD FLASH ALLOWED ON TERMINALS ALONG EDGE OF PACKAGE. FLASH MAY NOT EXCEED 0.03 ONTO BOTTOM SURFACE OF TERMINALS.
5. DETAIL A SHOWS OPTIONAL CONSTRUCTION FOR TERMINALS.

| MILLIMETERS |       |      |
|-------------|-------|------|
| DIM         | MIN   | MAX  |
| A           | 0.45  | 0.55 |
| A1          | 0.00  | 0.05 |
| A3          | 0.127 | REF  |
| b           | 0.15  | 0.25 |
| b2          | 0.30  | REF  |
| D           | 1.80  | BSC  |
| E           | 1.20  | BSC  |
| e           | 0.40  | BSC  |
| L           | 0.45  | 0.55 |
| L1          | 0.00  | 0.03 |
| L2          | 0.40  | REF  |

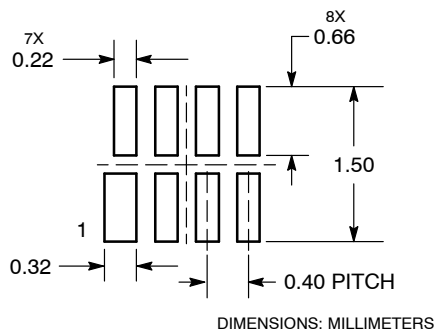
### GENERIC MARKING DIAGRAM\*



XX = Specific Device Code  
M = Date 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.

### MOUNTING FOOTPRINT SOLDERMASK DEFINED



**DOCUMENT NUMBER:** 98AON23417D

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**DESCRIPTION:** UDFN8 1.8X1.2, 0.4P

**PAGE 1 OF 1**

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

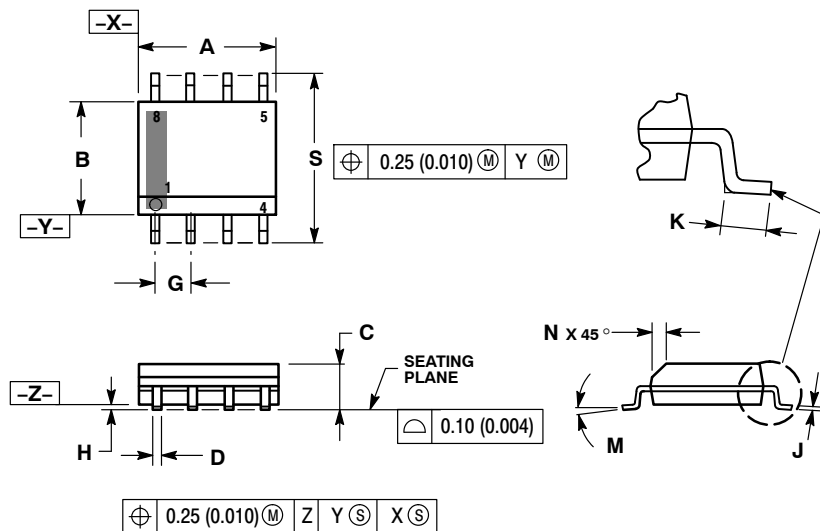
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SCALE 1:1

SOIC-8 NB  
CASE 751-07  
ISSUE AK

DATE 16 FEB 2011

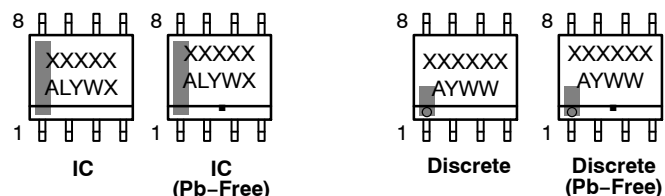
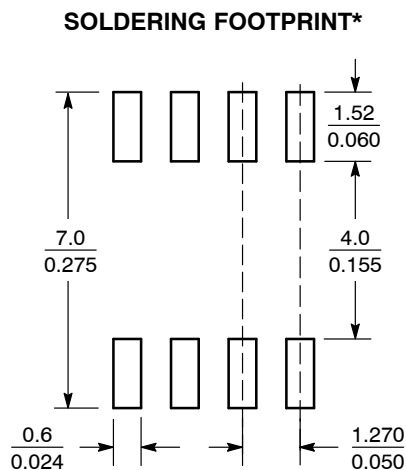


### NOTES:

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\*



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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| DESCRIPTION:     | SOIC-8 NB   | PAGE 1 OF 2  |


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

DATE 16 FEB 2011

|   |  |  |  |
|---|--|--|--|
| <b>STYLE 1:</b><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   | <b>STYLE 2:</b><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               | <b>STYLE 3:</b><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                            | <b>STYLE 4:</b><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   |
| <b>STYLE 5:</b><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   | <b>STYLE 6:</b><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  | <b>STYLE 7:</b><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                    | <b>STYLE 8:</b><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                              |
| <b>STYLE 9:</b><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 | <b>STYLE 10:</b><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  | <b>STYLE 11:</b><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   | <b>STYLE 12:</b><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   |
| <b>STYLE 13:</b><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  | <b>STYLE 14:</b><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   | <b>STYLE 15:</b><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               | <b>STYLE 16:</b><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 |
| <b>STYLE 17:</b><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  | <b>STYLE 18:</b><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   | <b>STYLE 19:</b><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   | <b>STYLE 20:</b><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   |
| <b>STYLE 21:</b><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  | <b>STYLE 22:</b><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 | <b>STYLE 23:</b><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 | <b>STYLE 24:</b><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                                      |
| <b>STYLE 25:</b><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   | <b>STYLE 26:</b><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  | <b>STYLE 27:</b><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  | <b>STYLE 28:</b><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  |
| <b>STYLE 29:</b><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                        | <b>STYLE 30:</b><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                           |  |  |

|                         |                    |   |
|-------------------------|--------------------|---|
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| <b>DESCRIPTION:</b>     | <b>SOIC-8 NB</b>   | <b>PAGE 2 OF 2</b>  |

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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

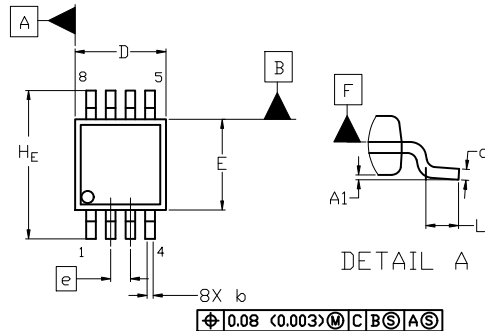
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SCALE 2:1

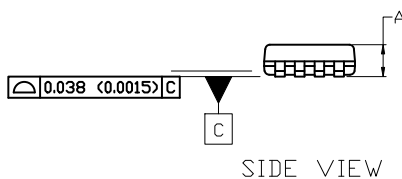
## Micro8 CASE 846A-02 ISSUE K

DATE 16 JUL 2020

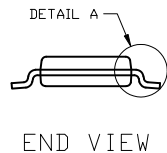


TOP VIEW

NOTE 3

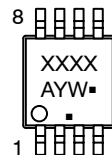


SIDE VIEW



END VIEW

### GENERIC MARKING DIAGRAM\*



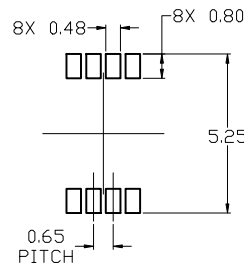
XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(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. Some products may not follow the Generic Marking.

### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION  $b$  DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.10 mm IN EXCESS OF MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS  $D$  AND  $E$  DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 mm PER SIDE. DIMENSION  $E$  DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 mm PER SIDE. DIMENSIONS  $D$  AND  $E$  ARE DETERMINED AT DATUM  $F$ .
5. DATUMS  $A$  AND  $B$  ARE TO BE DETERMINED AT DATUM  $F$ .
6.  $A1$  IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.



### 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, [SOLDERM-10](#).

| DIM            | MILLIMETERS |      |      |
|----------------|-------------|------|------|
|                | MIN.        | NOM. | MAX. |
| A              | ---         | ---  | 1.10 |
| A1             | 0.05        | 0.08 | 0.15 |
| b              | 0.25        | 0.33 | 0.40 |
| c              | 0.13        | 0.18 | 0.23 |
| D              | 2.90        | 3.00 | 3.10 |
| E              | 2.90        | 3.00 | 3.10 |
| e              | 0.65 BSC    |      |      |
| H <sub>E</sub> | 4.75        | 4.90 | 5.05 |
| L              | 0.40        | 0.55 | 0.70 |

### STYLE 1:

- PIN 1. SOURCE
- SOURCE
- SOURCE
- GATE
- DRAIN
- DRAIN
- DRAIN
- DRAIN

### STYLE 2:

- PIN 1. SOURCE 1
- GATE 1
- SOURCE 2
- GATE 2
- DRAIN 2
- DRAIN 2
- DRAIN 1
- DRAIN 1

### STYLE 3:

- PIN 1. N-SOURCE
- N-GATE
- P-SOURCE
- P-GATE
- P-DRAIN
- P-DRAIN
- N-DRAIN
- N-DRAIN

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