2-Bit Dual-Supply Level Translator

NL3V2T244, NL3V2T240

The NL3V2T244 / NL3V2T240 are 2−bit configurable dual−supply level translators with 3−state outputs. The A− and B− ports are designed to track two different power supply rails, V_{CCA} and V_{CCB} respectively. Both supply rails are configurable from 0.9 V to 3.6 V allowing universal voltage level translation between the A to B ports.

The NL3V2T244 is a 2−bit level translator that allows non−inverting translations from A to B ports. The NL3V4T240 is a 2−bit level translator that allows inverting translations from A to B ports.

The output enable pin ($\overline{OE}$), when High, disables all the output ports by putting them in 3−state. The $\overline{OE}$ pin is designed to track V_{CCA}.

Features

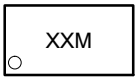
- Wide V_{CCA} and V_{CCB} Operating Range: 0.9 V to 3.6 V
- Balanced Output Drive: ±24 mA @ 3.0 V
- High−Speed w/ Balanced Propagation Delay:
  2.8 ns max at 3.0 to 3.6 V
- Input/Output Pins OVT to 3.6 V
- Non−preferential V_{CC} Sequencing
- Outputs at 3−State until Active V_{CC} is Reached
- Partial Power−Off Protection
- Outputs Switch to 3−State with either V_{CC} at GND
- Typical Max Data Rates:
  380 Mbps (≥1.8−V to 3.3−V Translation)
  200 Mbps (≥1.1−V to [1.8−V, 2.5−V, 3.3−V] Translation)
  150 Mbps (≥1.1−V to 1.5−V Translation)
  100 Mbps (≥1.1−V to 1.2−V Translation)
- Small Pb−Free Packaging:
  SOIC−8, Micro8, UDFN8
- −Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable*
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Typical Applications

- Mobile Phones, PDAs, Other Portable Devices
- Automotive
- Industrial

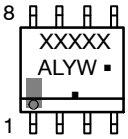
MARKING DIAGRAMS

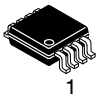
UDFN8
MU SUFFIX
CASE 517AJ



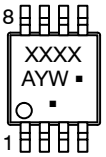
XX = Specific Device Code
M = Date Code
▪ = Pb−Free Package

SO−8
D SUFFIX
CASE 751





Micro8
DM SUFFIX
CASE 846A



A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

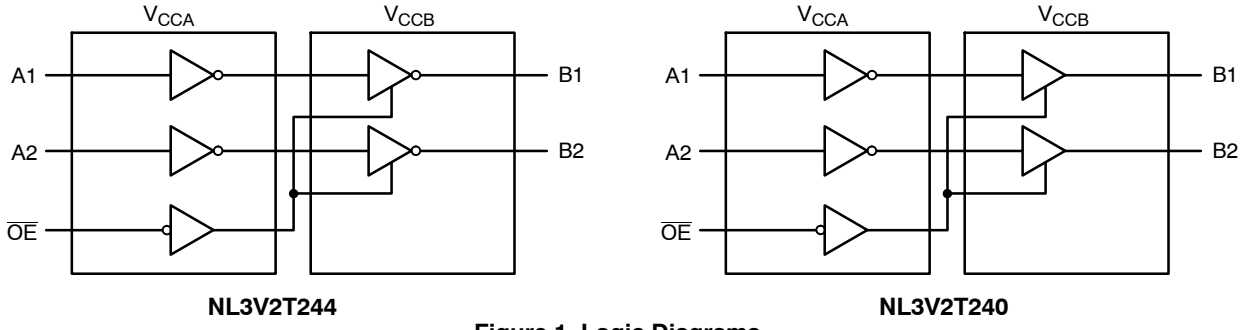


Figure 1. Logic Diagrams

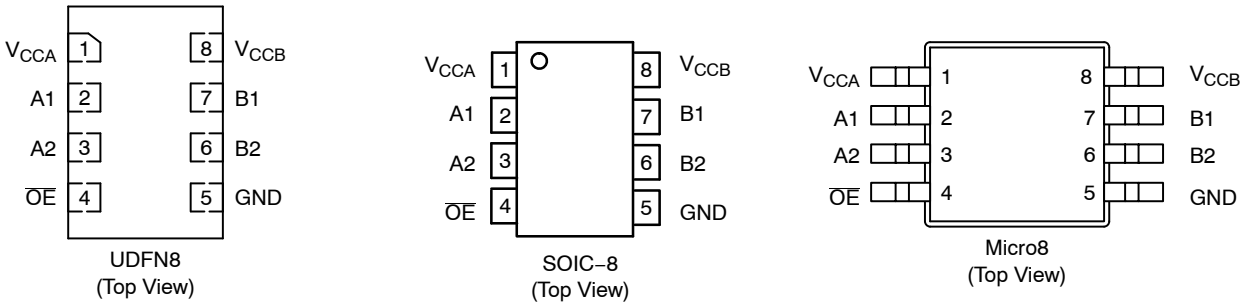


Figure 2. Pin Assignments (Top View)

FUNCTION TABLE

INPUTS		NL3V2T244 OUTPUT	NL3V2T240 OUTPUT
$\overline{OE}$	A_n	B_n	B_n
L	L	L	H
L	H	H	L
H	X	3−State	3−State

PIN NAMES

PINS	DESCRIPTION
V_{CCA}	A Port DC Supply
V_{CCB}	B Port DC Supply
GND	Ground
$\overline{OE}$	Output Enable
A1, A2	Input Ports
B1, B2	Output Ports

Application Recommendations

During power−up and power−down, it is recommended that the $\overline{OE}$ pin be connected to V_{CC} through pull−up resistors to ensure high impedance at the I/O ports.

MAXIMUM RATINGS

Symbol	Rating		Value	Condition	Unit
V_{CCA}, V_{CCB}	DC Supply Voltage		−0.5 to +4.3		V
V_I	DC Input Voltage		−0.5 to +4.3		V
V_O	DC Output Voltage	(Power Down Mode)	−0.5 to +4.3	V_{CCA} = V_{CCB} = 0	V
		(3−State Mode)	−0.5 to +4.3		
		(Active Mode)	−0.5 to V_{CCB}+0.5		
I_{IK}	DC Input Diode Current		−50	V_I < GND	mA
I_{OK}	DC Output Diode Current		−50	V_O < GND	mA
I_O	DC Output Source/Sink Current		±50		mA
I_{CC}	DC Supply Current Per Supply Pin		±100		mA
I_{GND}	DC Ground Current per Ground Pin		±100		mA
T_{STG}	Storage Temperature Range		−65 to +150		°C
θ_{JA}	Thermal Resistance (Note 1)	SOIC−8 Micro8 UDFN8		134 167 231	°C/W
P_D	Power Dissipation in Still Air	SOIC−8 Micro8 UDFN8		935 748 541	mW
MSL	Moisture Sensitivity Level			Level 1	−
F_R	Flammability Rating	Oxygen Index: 28 to 34		UL 94 V−0 @ 0.125 in	−
V_{ESD}	ESD Withstand Voltage (Note 2)	Human Body Model Charged Device Model		2 1	kV
$I_{LATCHUP}$	Latchup Performance (Note 3)			±100	mA

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. Measured with minimum pad spacing on an FR4 board, using 76mm−by−114mm, 2−ounce copper trace no air flow per JESD51−7.
2. HBM tested to ANSI/ESDA/JEDEC JS−001−2017. CDM tested to EIA/JESD22−C101−A. JEDEC recommends that ESD qualification to EIA/JESD22−A115A (Machine Model) be discontinued per JEDEC/JEP172A.
3. Tested to EIA/JESD78 Class II.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V_{CCA}, V_{CCB}	Positive DC Supply Voltage		0.9	3.6	V
V_I	Input Voltage		GND	3.6	V
V_O	Output Voltage	(Power Down Mode)	GND	3.6	V
		(3−State Mode)	GND	3.6	
		(Active Mode)	GND	V_{CCB}	
T_A	Operating Temperature Range		−40	+125	°C
$\Delta t / \Delta V$	Input Transition Rise or Rate		0	5	nS/V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

DC ELECTRICAL CHARACTERISTICS – INPUT VOLTAGES

Symbol	Parameter	Test Conditions	Port	V_{CCA} (V)	V_{CCB} (V)	–40°C to +85°C			–40°C to +125°C		Unit
						Min	Typ (Note 4)	Max	Min	Max	
V_{IH}	Input HIGH Voltage		$\overline{OE}$, A	2.7 – 3.6	0.9 – 3.6	2.0	–	–	2.0	–	V
				2.3 – 2.7		1.6	–	–	1.6	–	
				1.65–1.95		0.65 V_{CCA}	–	–	0.65 V_{CCA}	–	
				1.1 – 1.6		0.7 V_{CCA}	–	–	0.7 V_{CCA}	–	
				0.9		–	0.9 V_{CCA}	–	–	–	
V_{IL}	Input LOW Voltage		$\overline{OE}$, A	2.7 – 3.6	0.9 – 3.6	–	–	0.8	–	0.8	V
				2.3 – 2.7		–	–	0.7	–	0.7	
				1.65–1.95		–	–	0.35 V_{CCA}	–	0.35 V_{CCA}	
				1.1 – 1.6		–	–	0.3 V_{CCA}	–	0.3 V_{CCA}	
				0.9		–	0.1 V_{CCA}	–	–	–	

4. All typical values are at T_A = 25°C.

DC ELECTRICAL CHARACTERISTICS – OUTPUT VOLTAGES

Symbol	Parameter	Test Conditions	V_{CCA} (V)	V_{CCB} (V)	–40°C to +85°C			–40°C to +125°C		Unit
					Min	Typ (Note 4)	Max	Min	Max	
V_{OH}	Output HIGH Voltage	V_I = V_{IH} or V_{IL}:								V
		I_{OH} = –100 μA	0.9	0.9	–	V_{CCB} – 0.1	–	–	–	
			1.1 – 3.6	1.1 – 3.6	V_{CCB} – 0.1	–	–	V_{CCB} – 0.1	–	
		I_{OH} = –3 mA	1.1	1.1	0.85	–	–	0.85	–	
		I_{OH} = –6 mA	1.4	1.4	1.05	–	–	1.05	–	
		I_{OH} = –8 mA	1.65	1.65	1.2	–	–	1.2	–	
		I_{OH} = –12 mA	2.3	2.3	1.8	–	–	1.8	–	
			2.7	2.7	2.2	–	–	2.2	–	
		I_{OH} = –18 mA	2.3	2.3	1.7	–	–	1.7	–	
			3.0	3.0	2.4	–	–	2.4	–	
		I_{OH} = –24 mA	3.0	3.0	2.2	–	–	2.2	–	
V_{OL}	Output LOW Voltage	V_I = V_{IH} or V_{IL}:								V
		I_{OL} = 100 μA	0.9	0.9	–	0.1	–	–	–	
			1.1 – 3.6	1.1 – 3.6	–	–	0.1	–	0.1	
		I_{OL} = 3 mA	1.1	1.1	–	–	0.25	–	0.25	
		I_{OL} = 6 mA	1.4	1.4	–	–	0.35	–	0.35	
		I_{OL} = 8 mA	1.65	1.65	–	–	0.3	–	0.3	
		I_{OL} = 12 mA	2.3	2.3	–	–	0.4	–	0.4	
			2.7	2.7	–	–	0.4	–	0.4	
		I_{OL} = 18 mA	2.3	2.3	–	–	0.4	–	0.4	
			3.0	3.0	–	–	0.4	–	0.4	
		I_{OL} = 24 mA	3.0	3.0	–	–	0.55	–	0.55	

DC ELECTRICAL CHARACTERISTICS – LEAKAGE AND SUPPLY CURRENTS

Symbol	Parameter	Test Conditions	V_{CCA} (V)	V_{CCB} (V)	–40°C to +85°C		–40°C to +125°C		Unit
					Min	Max	Min	Max	
I_I	Input Leakage Current	V_I = 3.6 V or GND	0.9 – 3.6	0.9 – 3.6	–	±1.0	–	±5.0	μA
I_{OZ}	3–State Output Leakage	$\overline{OE}$ = V_{IH} ; V_O = GND to 3.6 V	3.6	3.6	–	±1.0	–	±5.0	μA
I_{OFF}	Power–Off Leakage Current	V_I or V_O = 0 to 3.6 V A	0	0.9 – 3.6	–	±1.0	–	±5.0	μA
		B	0.9 – 3.6	0	–	±1.0	–	±5.0	
I_{CCA}	Quiescent Supply Current	V_I = V_{CCA} or GND; I_O = 0	0.9 – 3.6	0.9 – 3.6	–	5.0	–	10	μA
			0	0.9 – 3.6	–	–1.0	–	–5.0	
			0.9 – 3.6	0	–	5.0	–	10	
I_{CCB}	Quiescent Supply Current	V_I = V_{CCA} or GND; I_O = 0	0.9 – 3.6	0.9 – 3.6	–	5.0	–	10	μA
			0	0.9 – 3.6	–	5.0	–	10	
			0.9 – 3.6	0	–	–1.0	–	–5.0	

NOTE: Connect ground before applying supply voltage V_{CCA} or V_{CCB}. This device is designed with the feature that the power–up sequence of V_{CCA} and V_{CCB} will not damage the IC.

AC ELECTRICAL CHARACTERISTICS (Notes 5 and 6)

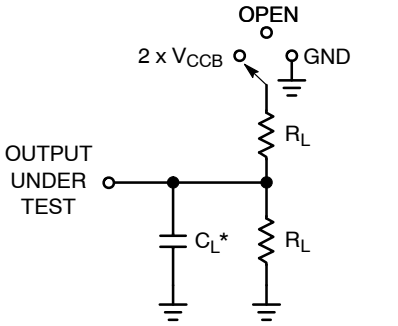
Symbol	Parameter	V_{CCA} (V)	T_A = –40°C to +85°C					T_A = –40°C to +125°C					Unit
			V_{CCB} (V)					V_{CCB} (V)					
			3.3	2.5	1.8	1.5	1.2	3.3	2.5	1.8	1.5	1.2	
			Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	
t_{PLH}, t_{PHL}	Propagation Delay, A to B	3.3	2.9	3.3	4.5	5.6	9.3	3.3	3.8	5.0	6.2	9.5	nS
		2.5	3.6	3.7	4.6	5.7	9.4	4.0	4.0	5.1	6.3	9.6	
		1.8	3.9	4.0	4.9	6.0	9.6	4.3	4.3	5.4	6.6	9.8	
		1.5	4.2	4.3	5.2	6.3	9.8	4.7	4.7	5.8	7.0	10.0	
		1.2	5.1	5.2	6.2	7.1	11.0	5.7	5.8	6.9	7.9	11.2	
t_{PZH}, t_{PZL}	Output Enable, $\overline{OE}$ to B	3.3	3.8	4.7	6.8	8.7	11.6	4.2	5.2	7.5	9.6	12.4	nS
		2.5	4.0	4.8	7.0	8.8	11.6	4.4	5.3	7.7	9.7	12.4	
		1.8	4.6	5.3	7.4	9.2	11.9	5.1	5.9	8.2	10.2	12.9	
		1.5	5.6	5.8	7.7	9.6	12.5	6.2	6.4	8.5	10.6	13.3	
		1.2	7.7	7.9	8.9	10.0	13.9	8.5	8.7	9.8	11.0	14.7	
t_{PHZ}, t_{PLZ}	Output Disable, $\overline{OE}$ to B	3.3	6.2	6.4	8.1	9.3	10.2	6.9	7.1	9.0	10.3	11.3	nS
		2.5	5.2	6.2	8.2	8.8	10.4	5.8	6.9	9.1	10.4	11.5	
		1.8	6.9	6.9	8.7	9.9	10.9	7.6	7.6	9.6	10.9	12.0	
		1.5	7.6	7.4	9.1	10.3	11.3	8.2	8.4	10.1	11.4	12.5	
		1.2	8.1	8.1	9.5	9.6	12.4	9.0	10.1	10.5	10.6	13.7	

5. Propagation delays defined per Figure 3.
6. These parameters are guaranteed by characterization and are not production tested.

CAPACITANCE

Symbol	Parameter	Test Conditions	Typ (Note 4)	Unit
C_{IN}	Control Pin Input Capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_I = 0 V or V_{CCA}	2.5	pF
$C_{I/O}$	I/O Pin Input Capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_I = 0 V or V_{CCA}	5.0	pF
C_{PD} (Note 7)	Power Dissipation Capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_I = 0 V or V_{CCA}, f = 10 MHz	12	pF

7. C_{PD} is defined as the value of the IC's equivalent capacitance from which the operating current can be calculated from: $I_{CC(operating)} \cong C_{PD} \times V_{CC} \times f_{IN} \times N_{SW}$ where $I_{CC} = I_{CCA} + I_{CCB}$ and N_{SW} = total number of outputs switching.



*C_L Includes probe and jig capacitance

Figure 3. AC Test Circuit

Test	Switch	C_L	R_L
t_{PLH}, t_{PHL}	OPEN	15 pF	2 kΩ
t_{PLZ}, t_{PZL}	2 x V_{CCB}		
t_{PHZ}, t_{PZH}	GND		
C_L includes probe and jig capacitance Pulse generator Z_O = 50 Ω Input f = 1.0 MHz; t_W = 500 ns			

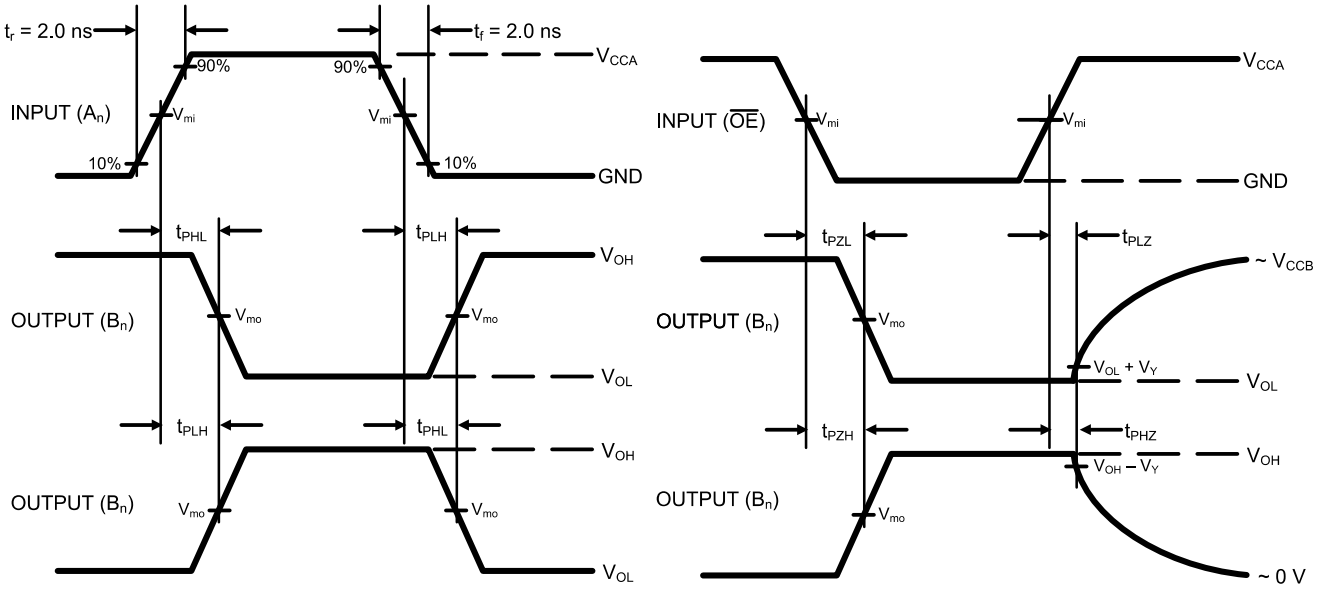


Figure 4. AC Waveforms

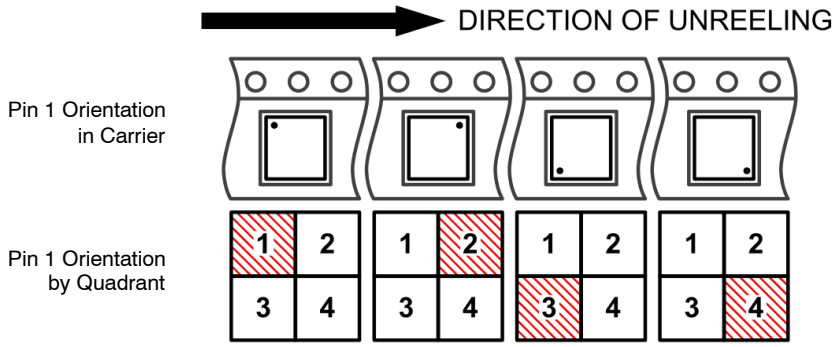
Symbol	V_{CC}				
	3.0 V – 3.6 V	2.3 V – 2.7 V	1.65 V – 1.95 V	1.4 V – 1.6 V	1.1 V – 1.3 V
V_{mi}	V_{CCA}/2	V_{CCA}/2	V_{CCA}/2	V_{CCA}/2	V_{CCA}/2
V_{mo}	V_{CCB}/2	V_{CCB}/2	V_{CCB}/2	V_{CCB}/2	V_{CCB}/2
V_Y	0.3 V	0.15 V	0.15 V	0.1 V	0.1 V

ORDERING INFORMATION

Device	Marking	Package	Pin 1 Quadrant	Shipping†
NL3V2T244MUTAG	AD	UDFN8	1	3000 Units / Tape & Reel
NL3V2T244DR2G (Contact **onsemi** sales)	TBD	SOIC−8	1	2500 Units / Tape & Reel
NL3V2T244DMR2G	T244	Micro8	1	4000 Units / Tape & Reel
NL3V2T244DMR2G−Q*	T244	Micro8	1	4000 Units / Tape & Reel
NL3V2T240MUTAG	AK	UDFN8	1	3000 Units / Tape & Reel

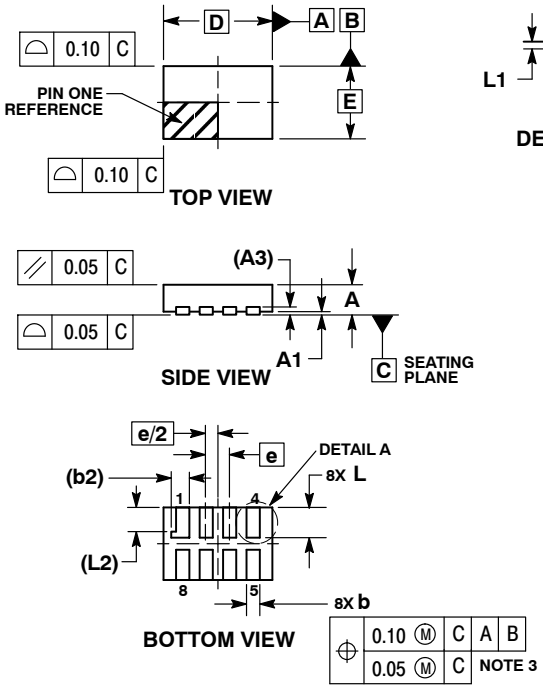
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

Pin 1 Orientation in Tape and Reel



PACKAGE DIMENSIONS

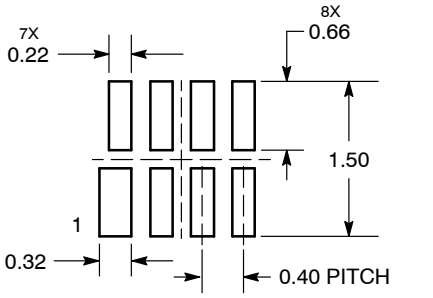
UDFN8 1.8 x 1.2, 0.4P
CASE 517AJ
ISSUE O



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	

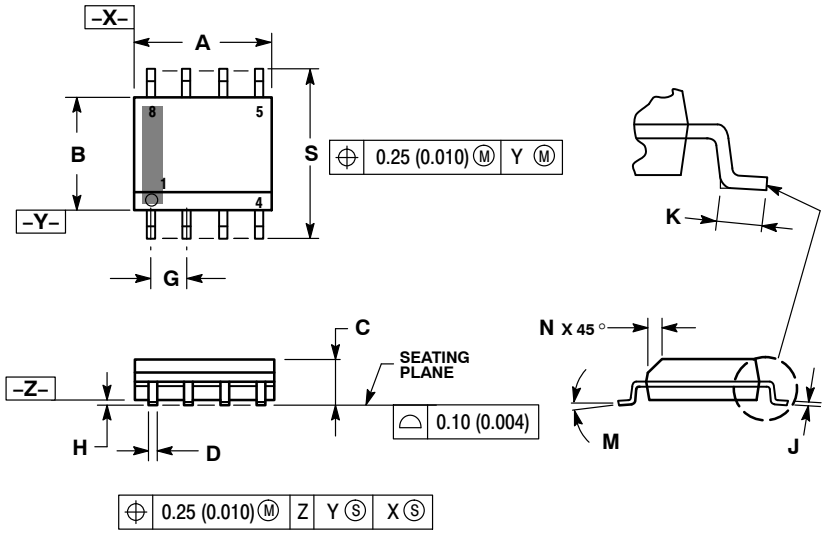
MOUNTING FOOTPRINT
SOLDERMASK DEFINED



DIMENSIONS: MILLIMETERS

PACKAGE DIMENSIONS

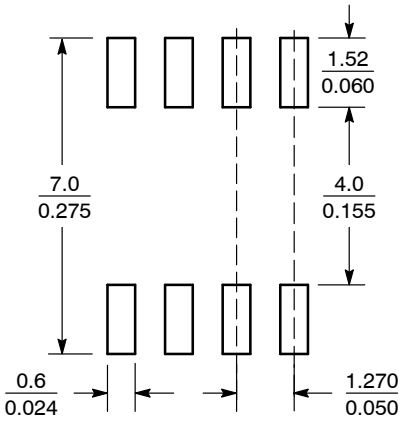
SO−8
CASE 751−07
ISSUE AK



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.

	MILLIMETERS		INCHES	
DIM	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

SOLDERING FOOTPRINT*

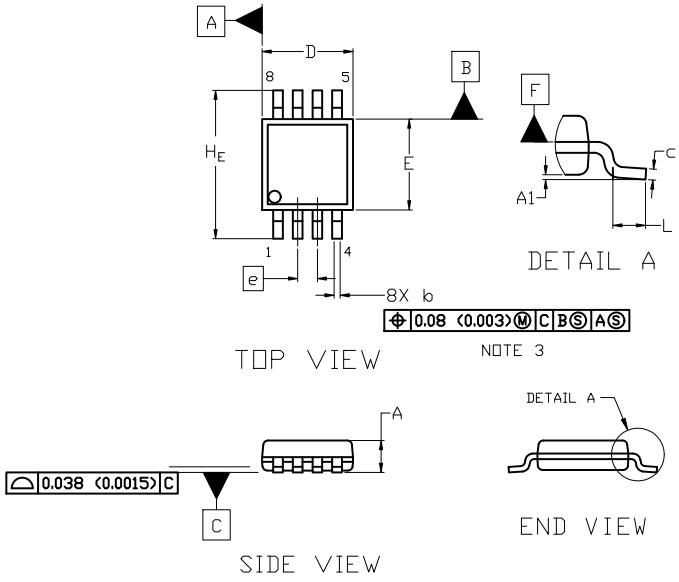


SCALE 6:1 (mm / inches)

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

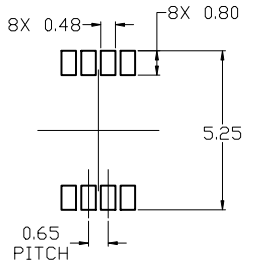
PACKAGE DIMENSIONS

Micro8
CASE 846A−02
ISSUE K



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, SOLDERRM/D.

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_E	4.75	4.90	5.05
L	0.40	0.55	0.70

ADDITIONAL INFORMATION

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