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4-Bit 140 Mb/s Configurable Dual-Supply Level Translator

NL3X5004

The NL3X5004 is a 4−bit configurable dual−supply autosensing bidirectional level translator that does not require direction control pins. The A− and B−ports are designed to track two different power supply rails, V_{CCA} and V_{CCB} respectively. Both the V_{CCA} and the V_{CCB} supply rails are independently − configurable from 0.9 V to 3.6 V.

The NL3X5004 has high dynamic output current capability, allowing the translator to drive high capacitive loads.

Enable input pins are available to reduce the power consumption. These pins may be used to disable both A− and B−ports by putting them in 3−state significantly reducing the supply current from both V_{CCA} and V_{CCB}. These pins are referenced to the V_{CCA} supply. The NL3X5004 has an active−High enable (EN).

Features

- Wide V_{CCA}, V_{CCB} Operating Range: 0.9 V to 3.6 V
- V_{CCA} and V_{CCB} are independent
  - V_{CCA} may be greater than, equal to, or less than V_{CCB}
- High 100 pF Capacitive Drive Capability
- High−Speed w/ 140 Mbps Guaranteed Date Rate for V_{CCA}, V_{CCB} > 1.8 V
- Low Bit−to−Bit skew
- Overvoltage Tolerant Enable and I/O Pins
- Non−preferential Power−Up Sequencing
- Partial Power−Off Protection
- Available packaging:
  UQFN−12, QFN−14
- −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 RoHS Compliant

Typical Applications

- Mobile Phones, Infotainment Systems, Other Devices

Important Information

- ESD Protection for All Pins:
  HBM (Human Body Model) − 4000 V



UQFN12
MU SUFFIX
CASE 523AE



QFN14
MN SUFFIX
CASE 485AL

MARKING DIAGRAMS





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

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information on page 16 of this data sheet.

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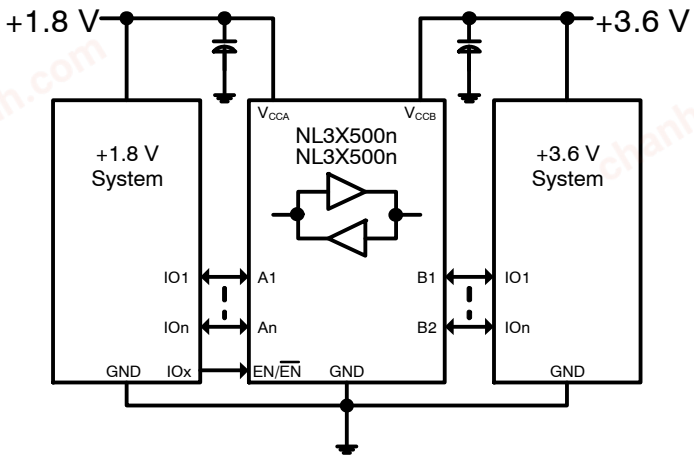


Figure 1. Typical Application Circuit

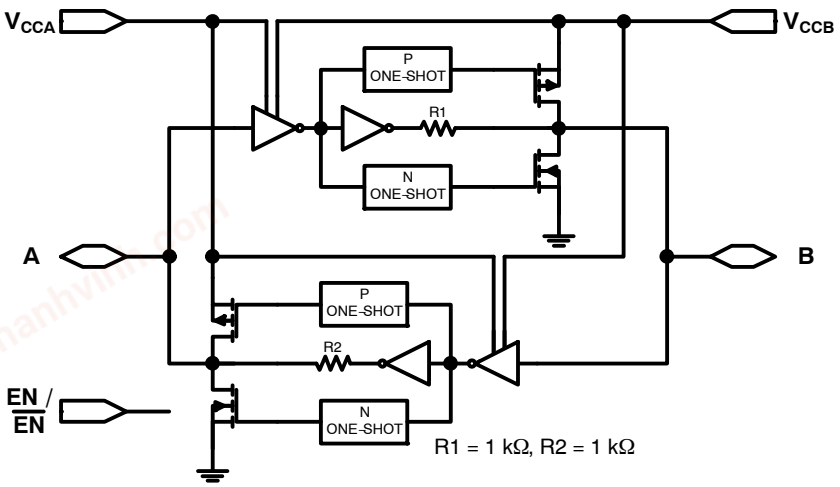


Figure 2. Functional Diagram (1 I/O Line)

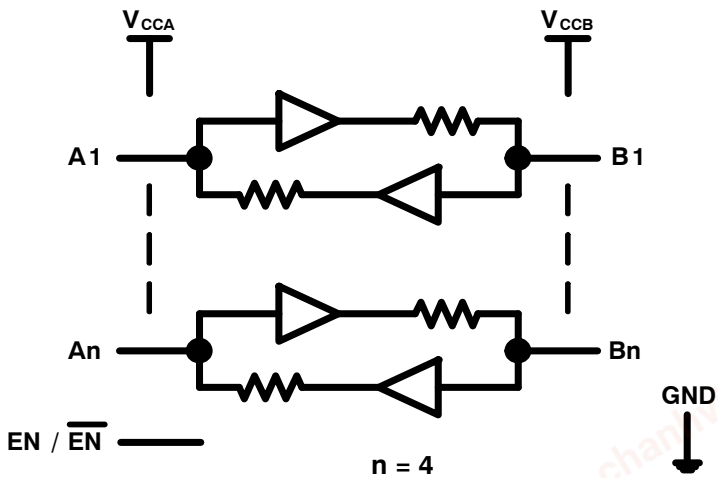


Figure 3. Logic Diagram

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PIN ASSIGNMENTS

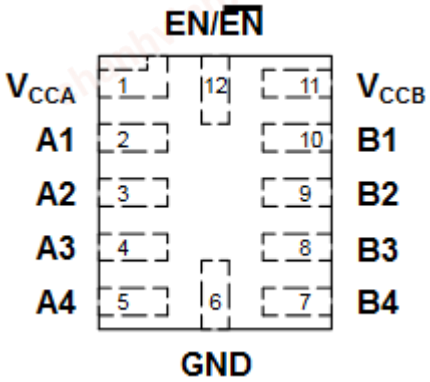


Figure 4. UQFN12

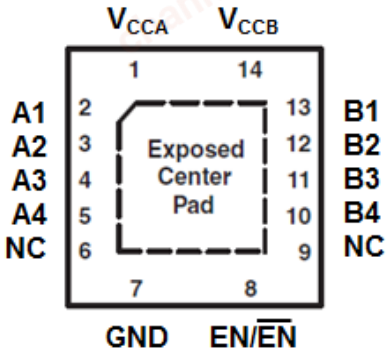


Figure 5. QFN14 (3.5 x 3.5)

PIN DESCRIPTIONS

Pins	Description
V_{CCA}	A−Port Supply Voltage
V_{CCB}	B−Port Supply Voltage
GND	Ground
EN	Active−High Enable (NL3X500n), Referenced to V_{CCA}
An	A−Port, Referenced to V_{CCA}
Bn	B−Port, Referenced to V_{CCB}

FUNCTION TABLE

NL3X500n	Operating
EN	**Mode**
L	An and Bn at Hi−Z
H	An and Bn Connected

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Table 1. MAXIMUM RATINGS

Symbol	Parameter		Value	Condition	Unit
V_{CCA}	A−side DC Supply Voltage		−0.5 to +4.3		V
V_{CCB}	B−side DC Supply Voltage		−0.5 to +4.3		V
V_{IN}	Input/Output Voltage EN/$\overline{EN}$		−0.5 to +4.3		V
	Power Down Mode (V_{CCA} and/or V_{CCB} = 0 V)		−0.5 to +4.3		
	Tri−State Mode (EN = L or $\overline{EN}$ = H)		−0.5 to +4.3		
	Active Mode	A−Port	−0.5 to V_{CCA}+0.5		
		B−Port	−0.5 to V_{CCB}+0.5		
I_{IK}	DC Input Diode Current		−50	V_{IN} < GND	mA
I_{OK}	DC Output Diode Current		−50	V_O < GND	mA
I_{CCA}	DC Supply Current Through V_{CCA}		±100		mA
I_{CCB}	DC Supply Current Through V_{CCB}		±100		mA
I_{GND}	DC Ground Current Through Ground Pin		±100		mA
T_{STG}	Storage Temperature		−65 to +150		°C
θ_{JA}	Thermal Resistance (Note 1)	UQFN12 QFN14	143 130		°C/W
P_D	Power Dissipation in Still Air	UQFN12 QFN14	875 962		mW

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.

Table 2. RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V_{CCA}	A−Port Supply Voltage		0.9	3.6	V
V_{CCB}	B−Port Supply Voltage		0.9	3.6	V
V_I	Input/Output Voltage EN/$\overline{EN}$		GND	3.6	V
	Power Down Mode (V_{CCA} and/or V_{CCB} = 0 V)		GND	3.6	
	Tri−State Mode (EN = L or $\overline{EN}$ = H)		GND	3.6	
	Active Mode	A−Port	GND	V_{CCA}	
		B−Port	GND	V_{CCB}	
T_A	Operating Temperature Range		−40	+125	°C
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate V_I from 30% to 70% of V_{CCA}/V_{CCB}		0	10	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.

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Table 3. DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions (Note 2)	Pin/Port	V_{CCA} (V)	V_{CCB} (V)	–40 °C to +85 °C			–40 °C to +125 °C		Unit
						Min	Typ (Note 3)	Max	Min	Max	
V_{IH}	Input HIGH Voltage		A, EN/$\overline{EN}$	0.9	0.9 – 3.6	–	0.65 * V_{CCA}	–	–	–	V
				1.1 – 3.6	1.1 – 3.6	0.65 * V_{CCA}	–	–	0.65 * V_{CCA}	–	
			B	0.9 – 3.6	0.9	–	0.65 * V_{CCB}	–	–	–	
				1.1 – 3.6	1.1 – 3.6	0.65 * V_{CCB}	–	–	0.65 * V_{CCB}	–	
V_{IL}	Input LOW Voltage		A, EN/$\overline{EN}$	0.9	0.9 – 3.6	–	0.35 * V_{CCA}	–	–	–	V
				1.1 – 3.6	1.1 – 3.6	–	–	0.35 * V_{CCA}	–	0.35 * V_{CCA}	
			B	0.9 – 3.6	0.9	–	0.35 * V_{CCB}	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	–	0.35 * V_{CCB}	–	0.35 * V_{CCB}	
V_{OH}	Output HIGH Voltage	I_{OH} = –20 μA	A	0.9	0.9 – 3.6	–	0.9 * V_{CCA}	–	–	–	V
				1.1 – 3.6	1.1 – 3.6	0.9 * V_{CCA}	–	–	0.9 * V_{CCA}	–	
			B	0.9 – 3.6	0.9	–	0.9 * V_{CCB}	–	–	–	
				1.1 – 3.6	1.1 – 3.6	0.9 * V_{CCB}	–	–	0.9 * V_{CCB}	–	
V_{OL}	Output LOW Voltage	I_{OL} = 20 μA	A	0.9	0.9 – 3.6	–	0.2	–	–	–	V
				1.1 – 3.6	1.1 – 3.6	–	–	0.2	–	0.2	
			B	0.9 – 3.6	0.9	–	0.2	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	–	0.2	–	0.2	
I_{OZ}	Tristate Output Leakage	(EN = 0V or = V_{CCA}); (A = 0 V or V_{CCA}) (B = 0 V or V_{CCB})									μA
			A	0.9 – 3.6	0.9 – 3.6	–	0.01	±1.5	–	±4.5	
			B	0.9 – 3.6	0.9 – 3.6	–	0.01	±1	–	±3.5	
I_I	Input Pin Leakage	V_{IN} = 0 V to V_{CCA}	EN/$\overline{EN}$	0.9 – 3.6	0.9 – 3.6	–	0.01	±1	–	±3	μA
I_{CC}	Supply Current	(EN = V_{CCA} or = 0 V);	V_{CCA}	0.9 – 3.6	0.9 – 3.6	–	0.4	2.0	–	6.0	μA
		I_O = 0 A, (A = 0 V, B = 0 V) or (A = V_{CCA}, B = V_{CCB})	V_{CCB}	0.9 – 3.6	0.9 – 3.6	–	0.4	2.0	–	6.0	
I_{CCZ}	Tristate Output Mode Supply Current	(EN = 0V or = V_{CCA}), (A = 0 V, B = 0 V) or (A = V_{CCA}, B = V_{CCB})	V_{CCA}	0.9 – 3.6	0.9 – 3.6	–	0.2	1.5	–	7.0	μA
			V_{CCB}	0.9 – 3.6	0.9 – 3.6	–	0.2	1.5	–	6.0	

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Table 3. DC ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions (Note 2)	Pin/Port	V_{CCA} (V)	V_{CCB} (V)	−40 °C to +85 °C			−40 °C to +125 °C		Unit
						Min	Typ (Note 3)	Max	Min	Max	
I_{OFF}	Power Off Leakage	A = 0 to 3.6 V, B = 0 to 3.6 V	A, B	0	0	–	0.02	1.5	–	5.0	μA
				0.9 – 3.6	0	–	0.01	1.5	–	5.0	
				0	0.9 – 3.6	–	0.01	1.5	–	5.0	

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.

2. Normal test conditions are V_I = 0 V, $C_{LA} \leq 15$ pF and $C_{LB} \leq 15$ pF, unless otherwise specified.
3. Typical values are for T_A = +25°C. All units are production tested at T_A = +25°C.

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Table 4. TIMING CHARACTERISTICS

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	
t_{PD}	Propagation Delay	C_L = 15 pF	A to B	0.9 – 3.6	0.9 – 3.6	–	24	–	–	–	ns
				1.1 – 3.6	1.1 – 3.6	–	8.8	30	–	35	
				1.2	1.8	–	7.3	9	–	9	
				1.8	1.2	–	9.9	12	–	12	
				1.8	2.8	–	4.9	7	–	7	
				2.8	1.8	–	5.8	7.5	–	7.5	
				1.8	3.3	–	4.6	6	–	6	
				3.3	1.8	–	5.7	7	–	7	
				1.8 – 3.6	1.8 – 3.6	–	4.3	9.5	–	10	
			B to A	0.9 – 3.6	0.9 – 3.6	–	24	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	8.8	30	–	35	
				1.2	1.8		9.9	12	–	12	
				1.8	1.2	–	7.3	9	–	9	
				1.8	2.8	–	5.8	7.5	–	7.5	
				2.8	1.8	–	4.9	7	–	7	
				1.8	3.3	–	5.7	7	–	7	
				3.3	1.8	–	4.6	6	–	6	
				1.8 – 3.6	1.8 – 3.6	–	4.3	9.5	–	10	
		C_L = 30 pF	A to B	0.9 – 3.6	0.9 – 3.6	–	27	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	9.1	32	–	35	
				1.2	1.8	–	7.8	9.3	–	9.3	
				1.8	1.2	–	10.8	12.6	–	12.6	
				1.8	2.8	–	6.2	7.4	–	7.4	
				2.8	1.8	–	6.0	7.9	–	8.0	
				1.8	3.3	–	6.1	7.4	–	7.4	
				3.3	1.8	–	4.2	6.5	–	6.5	
				1.8 – 3.6	1.8 – 3.6	–	4.5	10	–	10.5	
			B to A	0.9 – 3.6	0.9 – 3.6	–	27	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	9.1	32	–	35	
				1.2	1.8	–	10.8	12.6	–	12.6	
				1.8	1.2	–	7.8	9.3	–	9.3	
				1.8	2.8	–	6.0	7.9	–	8.0	
				2.8	1.8	–	6.2	7.4	–	7.4	

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Table 4. TIMING CHARACTERISTICS (continued)

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	
t_{PD}	Propagation Delay	C_L = 30 pF	B to A	1.8	3.3	–	4.2	6.5	–	6.5	ns
				3.3	1.8	–	6.1	7.4	–	7.4	
				1.8 – 3.6	1.8 – 3.6	–	4.5	10	–	10.5	
		C_L = 50 pF	A to B	0.9 – 3.6	0.9 – 3.6	–	31	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	9.4	35	–	37	
				1.2	1.8	–	8.1	9.5	–	9.5	
				1.8	1.2	–	11.1	13.6	–	13.6	
				1.8	2.8	–	6.5	7.6	–	7.6	
				2.8	1.8	–	6.2	8.2	–	8.3	
				1.8	3.3	–	6.3	7.6	–	7.6	
				3.3	1.8	–	4.3	6.6	–	6.6	
				1.8 – 3.6	1.8 – 3.6	–	4.7	10.3	–	10.8	
			B to A	0.9 – 3.6	0.9 – 3.6	–	31	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	9.4	35	–	37	
				1.2	1.8	–	11.1	13.6	–	13.6	
				1.8	1.2	–	8.1	9.5	–	9.5	
				1.8	2.8	–	6.2	8.2	–	8.3	
				2.8	1.8	–	6.5	7.6	–	7.6	
				1.8	3.3	–	4.3	6.6	–	6.6	
				3.3	1.8	–	6.3	7.6	–	7.6	
				1.8 – 3.6	1.8 – 3.6	–	4.7	10.3	–	10.8	
		C_L = 100 pF	A to B	0.9 – 3.6	0.9 – 3.6	–	41	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	12	21	–	21	
				1.2	1.8	–	8.4	10	–	10	
				1.8	1.2	–	11.5	15	–	15	
				1.8	2.8	–	5.5	8.3	–	8.3	
				2.8	1.8	–	6.9	8.9	–	9	
				1.8	3.3	–	5.1	6.7	–	6.8	
				3.3	1.8	–	6.8	8.2	–	8.2	
				1.8 – 3.6	1.8 – 3.6	–	5.0	11	–	11.5	
			B to A	0.9 – 3.6	0.9 – 3.6	–	41	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	12	21	–	21	

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Table 4. TIMING CHARACTERISTICS (continued)

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	
t_{PD}	Propagation Delay	C_L = 100 pF	B to A	1.2	1.8	–	11.5	15	–	15	ns
				1.8	1.2	–	8.4	10	–	10	
				1.8	2.8	–	6.9	8.9	–	9	
				2.8	1.8	–	5.5	8.3	–	8.3	
				1.8	3.3	–	6.8	8.2	–	8.2	
				3.3	1.8	–	5.1	6.7	–	6.8	
				1.8 – 3.6	1.8 – 3.6	–	5.0	11	–	11.5	
t_R	Output Rise Time	C_L = 15 pF	A	0.9	0.9 – 3.6	–	11.1	–	–	–	ns
				1.1 – 1.2	1.1 – 3.6	–	2.5	4.5	–	4.5	
				1.2 – 1.8		–	2.0	3.5	–	3.5	
				1.8 – 2.8		–	0.6	2.0	–	2.0	
				2.8 – 3.6		–	0.5	2.0	–	2.0	
			B	0.9 – 3.6	0.9	–	11.1	–	–	–	
				1.1 – 3.6	1.1 – 1.2	–	2.5	4.5	–	4.5	
					1.2 – 1.8	–	2.0	3.5	–	3.5	
					1.8 – 2.8	–	0.6	2.0	–	2.0	
					2.8 – 3.6	–	0.5	2.0	–	2.0	
t_F	Output Fall Time	C_L = 15 pF	A	0.9	0.9 – 3.6	–	12.2	–	–	–	ns
				1.1 – 1.2	1.1 – 3.6	–	2.5	6.0	–	6.0	
				1.2 – 1.8		–	1.8	3	–	3	
				1.8 – 2.8		–	0.6	2.0	–	2.0	
				2.8 – 3.6		–	0.5	2.0	–	2.0	
			B	0.9 – 3.6	0.9	–	12.2	–	–	–	
				1.1 – 3.6	1.1 – 1.2	–	2.5	6.0	–	6.0	
					1.2 – 1.8	–	1.8	3	–	3	
					1.8 – 2.8	–	0.6	2.0	–	2.0	
					2.8 – 3.6	–	0.5	2.0	–	2.0	

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Table 4. TIMING CHARACTERISTICS (continued)

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	
t_{SK}	Channel–to–Channel Skew		0.9 – 3.6	0.9 – 3.6	–	0.15	–	–	–	ns
MDR	Maximum Data Rate	C_L = 15 pF	0.9 – 3.6	0.9 – 3.6	–	50	–	–	–	Mbps
			1.1 – 3.6	1.1 – 3.6	50	–	–	50	–	
			1.8 – 3.6	1.8 – 3.6	140	–	–	140	–	
		C_L = 30 pF	0.9 – 3.6	0.9 – 3.6	–	40	–	–	–	
			1.1 – 3.6	1.1 – 3.6	40	–	–	40	–	
			1.8 – 3.6	1.8 – 3.6	120	–	–	120	–	
		C_L = 50 pF	0.9 – 3.6	0.9 – 3.6	–	30	–	–	–	
			1.1 – 3.6	1.1 – 3.6	30	–	–	30	–	
			1.8 – 3.6	1.8 – 3.6	100	–	–	100	–	
		C_L = 100 pF	0.9 – 3.6	0.9 – 3.6	–	20	–	–	–	
			1.1 – 3.6	1.1 – 3.6	20	–	–	20	–	
			1.8 – 3.6	1.8 – 3.6	60	–	–	60	–	

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Table 4. TIMING CHARACTERISTICS (continued)

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	
t_{EN}	Output Enable Time	C_L = 15 pF; B = V_{CCB}	EN/$\overline{EN}$ to A	0.9 – 3.6	0.9 – 3.6	–	125	–	–	–	ns
				1.1 – 3.6	1.1 – 3.6	–	116.3	200	–	200	
				1.2 – 1.8	1.2 – 1.8	–	64.5	180	–	180	
				1.8 – 2.8	1.8 – 2.8	–	49.6	150	–	150	
				1.8 – 3.6	1.8 – 3.6	–	42.5	100	–	100	
		C_L = 15 pF; B = 0 V		0.9 – 3.6	0.9 – 3.6	–	205	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	113.4	300	–	300	
				1.2 – 1.8	1.2 – 1.8	–	100	250	–	250	
				1.8 – 2.8	1.8 – 2.8	–	94.3	200	–	200	
				1.8 – 3.6	1.8 – 3.6	–	90.9	170	–	170	
		C_L = 15 pF; A = V_{CCA}	EN/$\overline{EN}$ to B	0.9 – 3.6	0.9 – 3.6	–	125	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	116.3	200	–	200	
				1.2 – 1.8	1.2 – 1.8	–	64.5	180	–	180	
				1.8 – 2.8	1.8 – 2.8	–	49.6	150	–	150	
				1.8 – 3.6	1.8 – 3.6	–	42.5	100	–	100	
		C_L = 15 pF; A = 0 V		0.9 – 3.6	0.9 – 3.6	–	205	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	113.4	300	–	300	
				1.2 – 1.8	1.2 – 1.8	–	100	250	–	250	
				1.8 – 2.8	1.8 – 2.8	–	94.3	200	–	200	
				1.8 – 3.6	1.8 – 3.6	–	90.9	170	–	170	

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Table 4. TIMING CHARACTERISTICS (continued)

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	
t_{DIS}	Output Disable Time	C_L = 15 pF; B = V_{CCB}	EN/$\overline{EN}$ to A	0.9 – 3.6	0.9 – 3.6	–	270	–	–	–	ns
				1.1 – 3.6	1.1 – 3.6	–	255	600	–	600	
				1.2 – 1.8	1.2 – 1.8	–	180	350	–	350	
				1.8 – 2.8	1.8 – 2.8	–	166.7	350	–	350	
				1.8 – 3.6	1.8 – 3.6	–	155.6	300	–	300	
		C_L = 15 pF; B = 0 V		0.9 – 3.6	0.9 – 3.6	–	180	–	–	–	
				1.1 – 3.6	1.1 – 3.6	–	156.7	400	–	400	
				1.2 – 1.8	1.2 – 1.8	–	140	300	–	300	
				1.8 – 2.8	1.8 – 2.8	–	130.2	300	–	300	
				1.8 – 3.6	1.8 – 3.6	–	124.6	250	–	250	
		C_L = 15 pF; A = V_{CCA}	EN/$\overline{EN}$ to B	0.9 – 3.6	0.9 – 3.6	–	270	–	–	–	
				0.9 – 3.6	0.9 – 3.6	–	255	600	–	600	
				1.2 – 1.8	1.2 – 1.8	–	180	350	–	350	
				1.8 – 2.8	1.8 – 2.8	–	166.7	350	–	350	
				1.8 – 3.6	1.8 – 3.6	–	155.6	300	–	300	
		C_L = 15 pF; A = 0 V		0.9 – 3.6	0.9 – 3.6	–	180	–	–	–	
				0.9 – 3.6	0.9 – 3.6	–	156.7	400	–	400	
				1.2 – 1.8	1.2 – 1.8	–	140	300	–	300	
				1.8 – 2.8	1.8 – 2.8	–	130.2	300	–	300	
				1.8 – 3.6	1.8 – 3.6	–	124.6	250	–	250	
I_{I_PEAK}	Input Driver Peak Current	EN = V_{CCA} or = 0 V;									mA
		A = 1 MHz Sq Wave, Amplitude = V_{CCA}	A	0.9 – 3.6	0.9 – 3.6	–	–	5.0	–	5.0	
		B = 1 MHz Sq Wave, Amplitude = V_{CCB}	B	0.9 – 3.6	0.9 – 3.6	–	–	5.0	–	5.0	

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Table 4. TIMING CHARACTERISTICS (continued)

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	
Z_O (Note 4)	1–Shot Output Impedance		A	0.9 – 3.6	0.9 – 3.6	–	55	–	–	–	Ω
				1.1	1.1 – 3.6	–	37	–	–	–	
				1.8		–	20	–	–	–	
				3.6		–	10	–	–	–	
			B	0.9 – 3.6	0.9 – 3.6	–	55	–	–	–	
				1.1 – 3.6	1.1	–	37	–	–	–	
					1.8	–	20	–	–	–	
					3.6	–	10	–	–	–	

4. Typical values are for T_A = +25°C.

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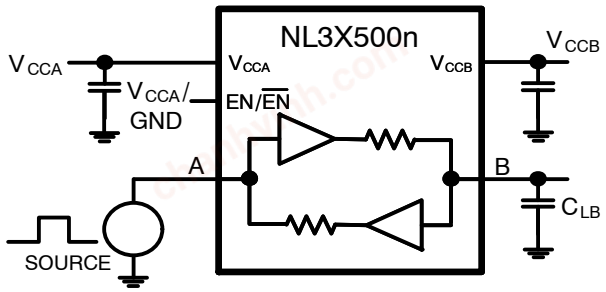


Figure 6. Driving A−Port Test Circuit (t_{PD})

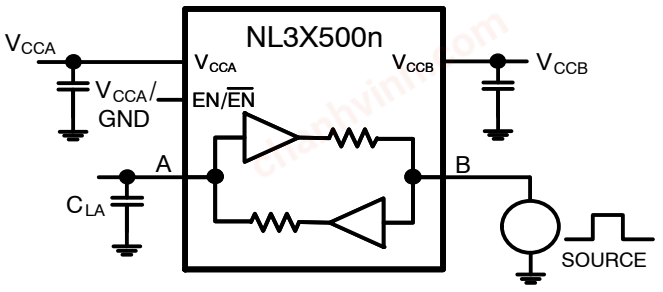


Figure 7. Driving B−Port Test Circuit (t_{PD})

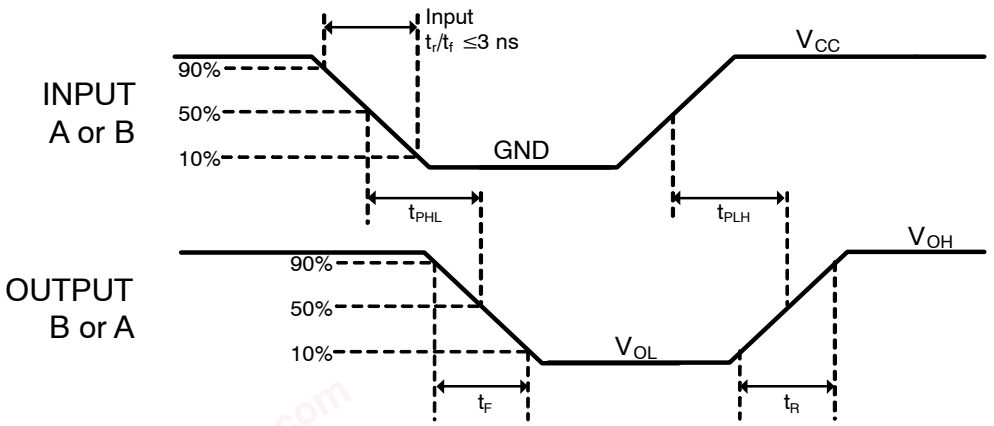


Figure 8. t_{PD} (t_{PLH}/t_{PHL}) Propagation Delay Measurements

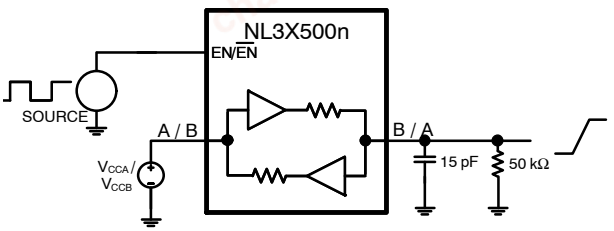


Figure 9. Enable/Disable Test Circuit (t_{PZH}/t_{PHZ})

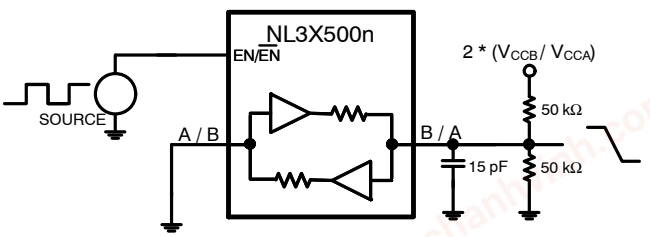


Figure 10. Enable/Disable Test Circuit (t_{PZL}/t_{PLZ})

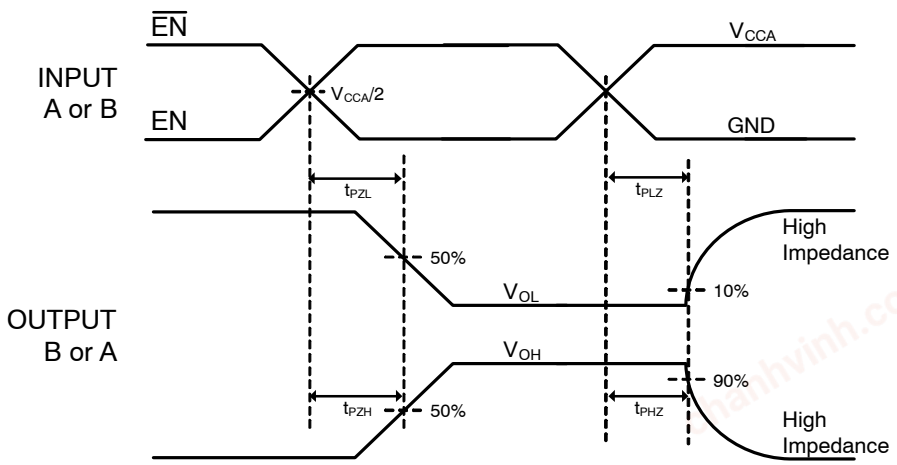


Figure 11. t_{EN}/t_{DIS} (t_{PZL}/t_{PLZ}/t_{PZH}/t_{PHZ}) Propagation Delay Measurements

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IMPORTANT APPLICATIONS INFORMATION

Level Translator Architecture

The NL3X5004 auto−sense translator provides bi−directional logic voltage level shifting to transfer data in multiple supply voltage systems. These level translators have two supply voltages, V_{CCA} and V_{CCB}, which set the logic levels on the input and output sides of the translator. When used to transfer data from the A to the B ports, input signals referenced to the V_{CCA} supply are translated to output signals with a logic level matched to V_{CCB}. In a similar manner, the B to A translation shifts input signals with a logic level compatible to V_{CCB} to an output signal matched to V_{CCA}.

The NL3X5004 translator consists of bi−directional channels that independently determine the direction of the data flow without requiring a directional pin. One−shot circuits are used to detect the rising or falling input signals. In addition, the one−shots decrease the rise and fall times of the output signal for high−to−low and low−to−high transitions.

Input Driver Requirements

The NL3X5004 supports high data rates, but these translators have relatively modest DC output current drive. The high data rate of the bi−directional I/O circuit is used to quickly transform from an input to an output driver and vice versa. Each I/O port has a modest DC current output so that the internal output driver can be over−driven when data is sent in the opposite direction. *For proper operation, the input driver to the auto−sense translator should be capable of driving 5.0 mA of peak output current.* The bi−directional configuration of the translator results in both input stages being active for a very short time period. Although the peak current required from the input signal circuit is relatively large, the average current is small and consistent with a standard CMOS input stage.

Enable Input (EN/$\overline{\text{EN}}$)

The NL3X5004 translator has enable pins that provide tri−state operation at the I/O ports.

Driving the NL3X5004 Enable pin (EN) to a low logic level minimizes the power consumption of the device and drives the A− and B−ports to high impedance states. Normal translation operation occurs when the EN pin is equal to a logic high signal referenced to the V_{CCA} supply. The EN pin is also Over−Voltage Tolerant (OVT).

Uni−Directional versus Bi−Directional Translation

The NL3X5004 translator can function as a non−inverting uni−directional translator. One advantage of using these translators as uni−directional devices is that each I/O−port can be configured as either an input or an 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

The values of the V_{CCA} and V_{CCB} supplies can be set to anywhere between 0.9 and 3.6 V. Design flexibility is maximized because V_{CCA} may be either greater than, equal to or less than the V_{CCB} supply.

The sequencing of the power supplies will not damage the device during power−up operation. In addition, the A− and B−ports are in high impedance states if either supply voltage is equal to 0 V. For optimal performance, 0.01 to 0.1 μF decoupling capacitors should be used on the V_{CCA} and V_{CCB} power supply pins. Ceramic capacitors are a good design choice to filter and bypass any noise signals on the 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.

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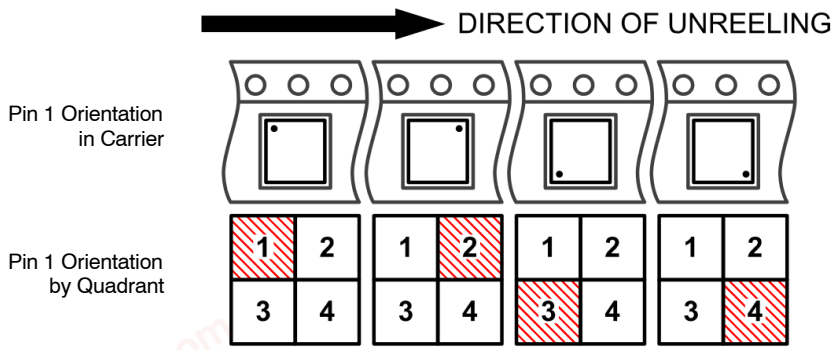
DEVICE ORDERING INFORMATION

Device Order Number	Device Marking	Package Type	Tape & Reel Size†
NL3X5004MU2TAG	AA2	UQFN−12, 1.7 x 2.0	3000 / Tape & Reel
NL3X5004MU2TAG−Q*	AA2	UQFN−12, 1.7 x 2.0	3000 / Tape & Reel
NL3X5004MN1TXG	V4	QFN14, 3.5 x 3.5 x 0.5P	3000 / Tape & Reel
NL3X5004MN1TXG−Q*	V4	QFN14, 3.5 x 3.5 x 0.5P	3000 / 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.

* −Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable.

Pin 1 Orientation in Tape and Reel



REVISION HISTORY

Revision	Description of Changes	Date
1	Revision to remove three package order options and OPNs	02/02/2026

* Please note that this document has been previously updated prior to the inclusion of this revision history table and that the changes tracked only reflect what has occurred on the noted approval dates.

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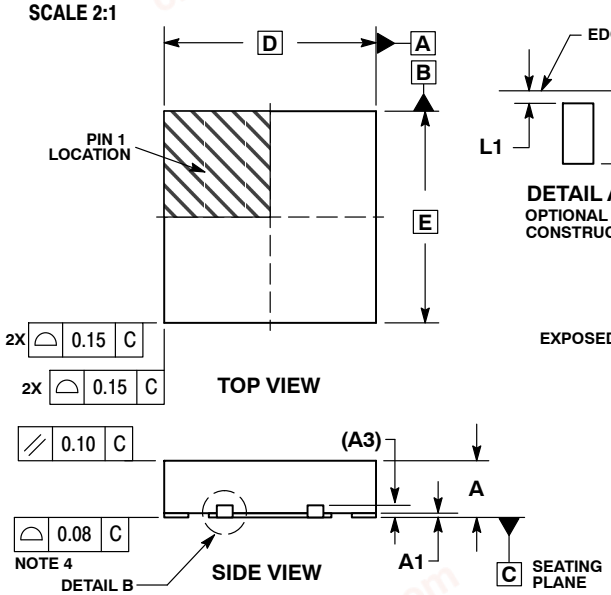
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

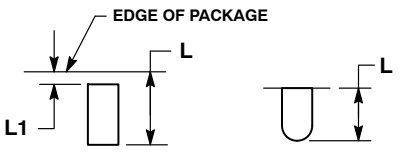
QFN14 3.5x3.5, 0.5P
CASE 485AL−01
ISSUE O

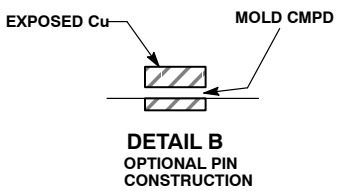
DATE 03 OCT 2007

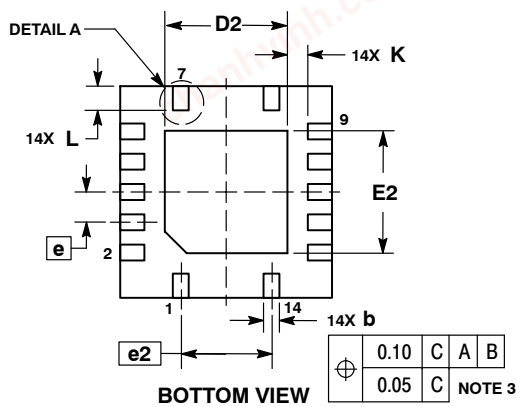


SCALE 2:1









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. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.80	1.00
A1	0.00	0.05
A3	0.20 REF	
b	0.18	0.30
D	3.50 BSC	
D2	1.90	2.15
E	3.50 BSC	
E2	1.90	2.15
e	0.50 BSC	
e2	1.50 BSC	
K	0.20	---
L	0.30	0.50
L1	0.00	0.03

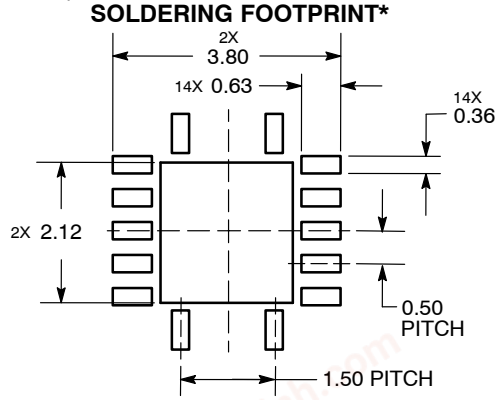
GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
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.

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.

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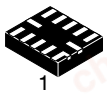
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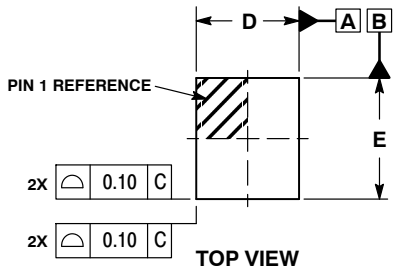
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

UQFN12 1.7x2.0, 0.4P
CASE 523AE
ISSUE A

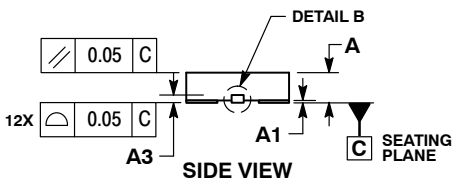
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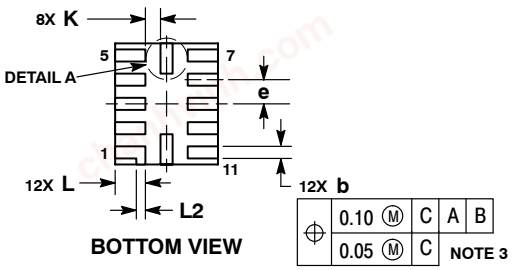
SCALE 4:1



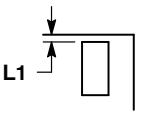
TOP VIEW



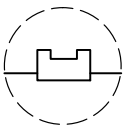
SIDE VIEW



BOTTOM VIEW



DETAIL A
NOTE 5

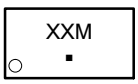


DETAIL B
OPTIONAL CONSTRUCTION

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 0.03 MAX ON 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
D	1.70 BSC	
E	2.00 BSC	
e	0.40 BSC	
K	0.20	----
L	0.45	0.55
L1	0.00	0.03
L2	0.15 REF	

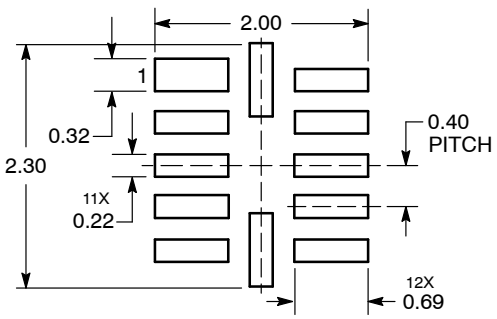
GENERIC MARKING DIAGRAM*



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
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DIMENSIONS: MILLIMETERS

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