

# 2.5 V/3.3 V ECL DUAL Differential 2:1 Multiplexer

## NB100LVEP56

### Description

The NB100LVEP56 is a dual, fully differential 2:1 multiplexer. The differential data path makes the device ideal for multiplexing low skew clock or differential data signals. The device features both individual and common select inputs to address both data path and random logic applications. Common and individual selects can accept both LVECL and LVCMOS input voltage levels. Multiple  $V_{BB}$  pins are provided.

The  $V_{BB}$  pin, an internally generated voltage supply, is available to this device only. For single-ended input operation, the unused differential input is connected to  $V_{BB}$  as a switching reference voltage.  $V_{BB}$  may also rebias AC coupled inputs. When used, decouple  $V_{BB}$  and  $V_{CC}$  via a 0.01  $\mu$ F capacitor and limit current sourcing or sinking to 0.5 mA. When not used,  $V_{BB}$  should be left open.

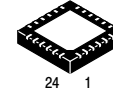
### Features

- Maximum Input Clock Frequency > 2.5 GHz Typical
- Maximum Input Data Rate > 2.5 Gb/s Typical
- 525 ps Typical Propagation Delays
- Low Profile QFN Package
- PECL Mode Operating Range:  
 $V_{CC} = 2.375$  V to 3.8 V with  $V_{EE} = 0$  V
- NECL Mode Operating Range:  
 $V_{CC} = 0$  V with  $V_{EE} = -2.375$  V to  $-3.8$  V
- Separate, Common Select, and Individual Select  
(Compatible with ECL and CMOS Input Voltage Levels)
- Q Output Will Default LOW with Inputs Open or at  $V_{EE}$
- Multiple  $V_{BB}$  Outputs
- These Devices are Pb-Free and are RoHS Compliant



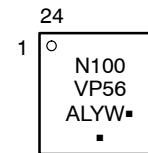
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QFN24  
MN SUFFIX  
CASE 485L

### MARKING DIAGRAM\*



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

(Note: Microdot may be in either location)  
\*For additional marking information, refer to Application Note [AND8002/D](#).

### ORDERING INFORMATION

Device	Package	Shipping†
NB100LVEP56MNG	QFN24 (Pb-Free)	92 Units / Tube
NB100LVEP56MNR2G	QFN24 (Pb-Free)	3000 / Tape & Reel

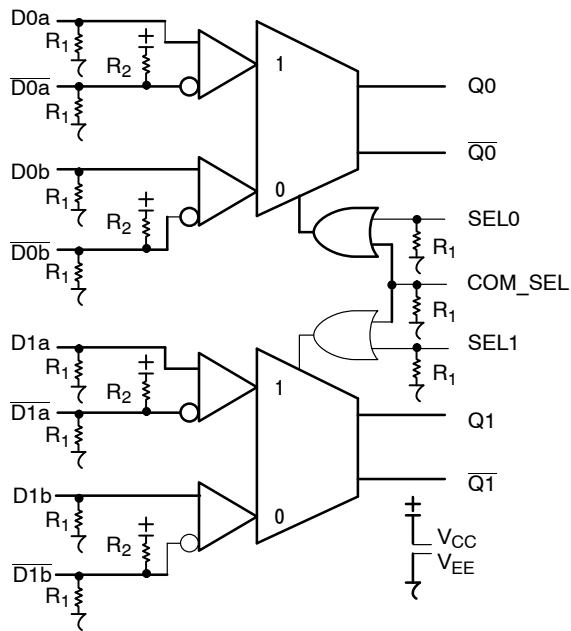
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

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**Table 1. PIN FUNCTION DESCRIPTION**

Pin No.	Name	I/O	Default State	Description
3,9,18,19,20	V <sub>CC</sub>	–	–	Positive Supply Voltage. All VCC Pins must be Externally Connected to Power Supply to Guarantee Proper Operation.
15,24	V <sub>EE</sub>	–	–	Negative Supply Voltage. All VEE Pins must be Externally Connected to Power Supply to Guarantee Proper Operation.
6,12	V <sub>BB0</sub> , V <sub>BB1</sub>	–	–	ECL Reference Voltage Output
4	D0a	ECL Input	Low	Noninverted Differential Data a Input to MUX 0. Internal 75 kΩ to V <sub>EE</sub> .
5	$\overline{D0a}$	ECL Input	High	Inverted Differential Data a Input to MUX 0. Internal 75 kΩ to V <sub>EE</sub> and 37 kΩ to V <sub>CC</sub> .
7	D0b	ECL Input	Low	Noninverted Differential Data b Input to MUX 0. Internal 75 kΩ to V <sub>EE</sub> .
8	$\overline{D0b}$	ECL Input	High	Inverted Differential Data b Input to MUX 0. Internal 75 kΩ to V <sub>EE</sub> and 37 kΩ to V <sub>CC</sub> .
10	D1a	ECL Input	Low	Noninverted Differential Data a Input to MUX 1. Internal 75 kΩ to V <sub>EE</sub> .
11	$\overline{D1a}$	ECL Input	High	Inverted Differential Data a Input to MUX 1. Internal 75 kΩ to V <sub>EE</sub> and 37 kΩ to V <sub>CC</sub> .
13	D1b	ECL Input	Low	Noninverted Differential Data b Input to MUX 1. Internal 75 kΩ to V <sub>EE</sub> .
14	$\overline{D1b}$	ECL Input	High	Inverted Differential Data b Input to MUX 1. Internal 75 kΩ to V <sub>EE</sub> and 37 kΩ to V <sub>CC</sub> .
2	Q0	ECL Output	–	Noninverted Differential Output MUX 0. Typically Terminated with 50 Ω to V <sub>TT</sub> = V <sub>CC</sub> – 2.0 V.
1	$\overline{Q0}$	ECL Output	–	Inverted Differential Output MUX 0. Typically Terminated with 50 Ω to V <sub>TT</sub> = V <sub>CC</sub> – 2.0 V.
17	Q1	ECL Output	–	Noninverted Differential Output MUX 1. Typically Terminated with 50 Ω to V <sub>TT</sub> = V <sub>CC</sub> – 2.0 V.
16	$\overline{Q1}$	ECL Output	–	Inverted Differential Output MUX 1. Typically Terminated with 50 Ω to V <sub>TT</sub> = V <sub>CC</sub> – 2.0 V.
23	SEL0	ECL, CMOS Input	Low	Noninverted Differential Select Input to MUX 0. Internal 75 kΩ to V <sub>EE</sub> .
22	COM_SEL	ECL, CMOS Input	Low	Noninverted Differential Common Select Input to Both MUX. Internal 75 kΩ to V <sub>EE</sub> .
21	SEL1	ECL, CMOS Input	Low	Noninverted Differential Select Input to MUX 1. Internal 75 kΩ to V <sub>EE</sub> .
–	EP	–		Exposed Pad. The exposed pad (EP) on the package bottom must be attached to a heat-sinking conduit. The exposed pad may only be electrically connected to V <sub>EE</sub> .

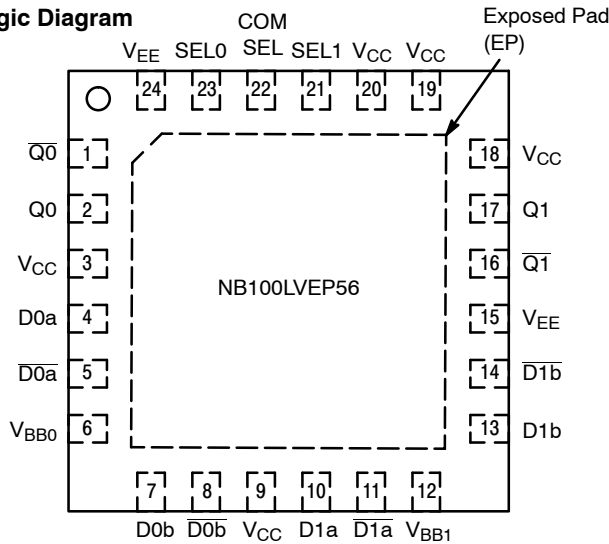
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**Table 2. TRUTH TABLE**

SEL0	SEL1	COM_SEL	Q0, Q0̄	Q1, Q1̄
X	X	H	a	a
L	L	L	b	b
L	H	L	b	a
H	H	L	a	a
H	L	L	a	b

**Figure 1. Logic Diagram**



**Figure 2. QFN-24 Lead Pinout (Top View)**

**Table 3. ATTRIBUTES**

Characteristics	Value
Internal Input Pulldown Resistor (R1)	75 kΩ
Internal Input Pullup Resistor (R2)	37 kΩ
ESD Protection Human Body Model Machine Model Charged Device Model	> 2 kV > 150 V > 2 kV
Moisture Sensitivity (Note 1) QFN-24	Pb-Free Pkg Level 1
Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
Transistor Count	354 Devices
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

1. For additional information, see Application Note [AND8003/D](#).

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**Table 4. MAXIMUM RATINGS**

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V <sub>CC</sub>	Positive Mode Power Supply	V <sub>EE</sub> = 0 V		6	V
V <sub>EE</sub>	Negative Mode Power Supply	V <sub>CC</sub> = 0 V		-6	V
V <sub>I</sub>	Positive Mode Input Voltage Negative Mode Input Voltage	V <sub>EE</sub> = 0 V V <sub>CC</sub> = 0 V	V <sub>I</sub> ≤ V <sub>CC</sub> V <sub>I</sub> ≥ V <sub>EE</sub>	6 -6	V V
I <sub>out</sub>	Output Current	Continuous Surge		50 100	mA mA
I <sub>BB</sub>	V <sub>BB</sub> Sink/Source			±0.5	mA
T <sub>A</sub>	Operating Temperature Range			-40 to +85	°C
T <sub>stg</sub>	Storage Temperature Range			-65 to +150	°C
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient) JEDEC 51-6 (2S2P-Multi Layer Test Board) with Filled Thermal Vias	0 lfpm 500 lfpm	QFN-24 QFN-24	37 32	°C/W °C/W
θ <sub>JC</sub>	Thermal Resistance (Junction-to-Case)	Standard Board	QFN-24	11	°C/W
T <sub>sol</sub>	Wave Solder (Pb-Free)			265	°C

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

**Table 5. DC CHARACTERISTICS, PECL V<sub>CC</sub> = 2.5 V, V<sub>EE</sub> = 0 V (Note 2)**

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I <sub>EE</sub>	Negative Power Supply Current	35	45	55	35	45	55	35	48	58	mA
V <sub>OH</sub>	Output HIGH Voltage (Note 3)	1355	1480	1605	1355	1480	1605	1355	1480	1605	mV
V <sub>OL</sub>	Output LOW Voltage (Note 3)	555	775	900	555	775	900	555	775	900	mV
V <sub>IH</sub>	Input HIGH Voltage (SEL0, SEL1, COM_SEL) Input HIGH Voltage (D Inputs) (Note 4)	1335 1335		V <sub>CC</sub> 1620	1335 1335		V <sub>CC</sub> 1620	1275 1275		V <sub>CC</sub> 1620	mV
V <sub>IL</sub>	Input LOW Voltage (SEL0, SEL1, COM_SEL) Input LOW Voltage (D Inputs) (Note 4)	V <sub>EE</sub> 555		875 875	V <sub>EE</sub> 555		875 875	V <sub>EE</sub> 555		875 875	mV
V <sub>IHCMR</sub>	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 5)	1.2		2.5	1.2		2.5	1.2		2.5	V
I <sub>IH</sub>	Input HIGH Current (@V <sub>IH</sub> )			150			150			150	μA
I <sub>IL</sub>	Input LOW Current (@V <sub>IL</sub> )	D D̄ SEL	0.5 -150 -150		0.5 -150 -150			0.5 -150 -150			μA

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm.

- Input and output parameters vary 1:1 with V<sub>CC</sub>. V<sub>EE</sub> can vary -0.125 V to +1.3 V.
- All loading with 50 Ω to V<sub>CC</sub> - 2.0 V.
- Do not use V<sub>BB</sub> at V<sub>CC</sub> < 3.0 V.
- V<sub>IHCMR</sub> min varies 1:1 with V<sub>EE</sub>. V<sub>IHCMR</sub> max varies 1:1 with V<sub>CC</sub>. The V<sub>IHCMR</sub> range is referenced to the most positive side of the differential input signal.

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**Table 6. DC CHARACTERISTICS, PECL**  $V_{CC} = 3.3\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (Note 6)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Negative Power Supply Current	35	45	55	35	45	55	35	48	58	mA
$V_{OH}$	Output HIGH Voltage (Note 7)	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
$V_{OL}$	Output LOW Voltage (Note 7)	1355	1575	1700	1355	1575	1700	1355	1575	1700	mV
$V_{IH}$	Input HIGH Voltage (SEL0, SEL1, COM_SEL) Input HIGH Voltage (D Inputs)	2135 2135		$V_{CC}$ 2420	2135 2135		$V_{CC}$ 2420	2135 2135		$V_{CC}$ 2420	mV
$V_{IL}$	Input LOW Voltage (SEL0, SEL1, COM_SEL) Input LOW Voltage (D Inputs)	$V_{EE}$ 1355		1675 1675	$V_{EE}$ 1355		1675 1675	$V_{EE}$ 1355		1675 1675	mV
$V_{BB}$	Output Reference Voltage (Note 8)	1775	1875	1975	1775	1875	1975	1775	1875	1975	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 9)	1.2		3.3	1.2		3.3	1.2		3.3	V
$I_{IH}$	Input HIGH Current (@ $V_{IH}$ )			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current (@ $V_{IL}$ )	D $\bar{D}$ SEL	0.5 -150 -150		0.5 -150 -150			0.5 -150 -150			$\mu\text{A}$

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm.

6. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +0.5 V to -0.3 V.

7. All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .

8. Single-Ended input operation is limited to  $V_{CC} \geq 3.0\text{ V}$  in PECL mode.

9.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

**Table 7. DC CHARACTERISTICS, NECL**  $V_{CC} = 0\text{ V}$ ,  $V_{EE} = -3.8\text{ V}$  to  $-2.375\text{ V}$  (Note 10)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Negative Power Supply Current	35	45	55	35	45	55	35	48	58	mA
$V_{OH}$	Output HIGH Voltage (Note 11)	-1145	-1020	-895	-1145	-1020	-895	-1145	-1020	-895	mV
$V_{OL}$	Output LOW Voltage (Note 11)	-1945	-1725	-1600	-1945	-1725	-1600	-1945	-1725	-1600	mV
$V_{IH}$	Input HIGH Voltage (SEL0, SEL1, COM_SEL) Input HIGH Voltage (D Inputs)	-1165 -1165		$V_{CC}$ -880	-1165 -1165		$V_{CC}$ -880	-1165 -1165		$V_{CC}$ -880	mV
$V_{IL}$	Input LOW Voltage (SEL0, SEL1, COM_SEL) Input LOW Voltage ( $\bar{D}$ Inputs)	$V_{EE}$ -1945		-1600 -1600	$V_{EE}$ -1945		-1600 -1600	$V_{EE}$ -1945		-1600 -1600	mV
$V_{BB}$	Output Reference Voltage (Note 12)	-1525	-1425	-1325	-1525	-1425	-1325	-1525	-1425	-1325	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 13)	$V_{EE}+1.2$		0.0	$V_{EE}+1.2$		0.0	$V_{EE}+1.2$		0.0	V
$I_{IH}$	Input HIGH Current (@ $V_{IH}$ )			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current (@ $V_{IL}$ )	D $\bar{D}$ SEL	0.5 -150 -150		0.5 -150 -150			0.5 -150 -150			$\mu\text{A}$

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm.

10. Input and output parameters vary 1:1 with  $V_{CC}$ .

11. All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .

12. Single-Ended input operation is limited to  $V_{EE}$  from -3.0 V to -5.5 V in NECL mode.

13.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

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**Table 8. AC CHARACTERISTICS**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -2.375\text{ V}$  to  $-3.8\text{ V}$  or  $V_{CC} = 2.375\text{ V}$  to  $3.8\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 14)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$V_{OUTPP}$	Output Voltage Amplitude (See Figure 3) $f_{in} \leq 1\text{ GHz}$ $f_{in} = 2\text{ GHz}$ $f_{in} = 2.5\text{ GHz}$	525 500 400	700 600 500		550 500 350	700 600 450		500 400 200	700 500 300		mV
$t_{PLH}$ , $t_{PHL}$	Propagation Delay to Output Differential  D to Q, $\bar{Q}$ SEL to Q, $\bar{Q}$ COM_SEL to Q, $\bar{Q}$	375 575 550	500 775 750	625 975 950	400 625 600	525 825 800	650 1025 1000	450 700 700	575 900 900	700 1100 1100	ps
$t_{Skew}$	Pulse Skew (Note 15) Within Device Input Skew (Note 16) Within Device Output Skew (Note 17) Device-to-Device Skew (Note 18)		10 5 15 50	50 30 50 200		10 5 15 50			10 5 15 50	50 30 50 200	ps
$t_{JITTER}$	RMS Random Clock Jitter (Note 19)  @ $\leq 1.0\text{ GHz}$ @ $\leq 1.5\text{ GHz}$ @ $\leq 2.0\text{ GHz}$ @ $\leq 2.5\text{ GHz}$  Peak-to-Peak Data Dependent Jitter (Note 20) @ $0.5\text{ GHz}$ @ $1.25\text{ GHz}$ @ $2.488\text{ GHz}$		0.269 0.306 0.250 0.339	0.4 0.4 0.4 0.8		0.307 0.303 0.305 0.895	0.4 0.4 0.5 2.0		0.371 0.391 0.722 2.443	0.5 0.6 1.2 7.7	ps
$V_{INPP}$	Input Voltage Swing (Differential Configuration) (Note 21)	150	800	1200	150	800	1200	150	800	1200	mV
$t_r$ $t_f$	Output Rise/Fall Times @ $50\text{ MHz}$ (20% – 80%) Q, $\bar{Q}$	60	110	150	60	120	170	90	140	230	ps

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lpm.

14. Measured using a 750 mV source, 50% duty cycle clock source. All loading with  $50\ \Omega$  to  $V_{CC} - 2.0\text{ V}$ . Input edge rates 150 ps (20% – 80%).

15. Pulse Skew  $|t_{PLH} - t_{PHL}|$

16. Worst case difference between D0a and D0b (or between D1a or D1b), when both output come from same input.

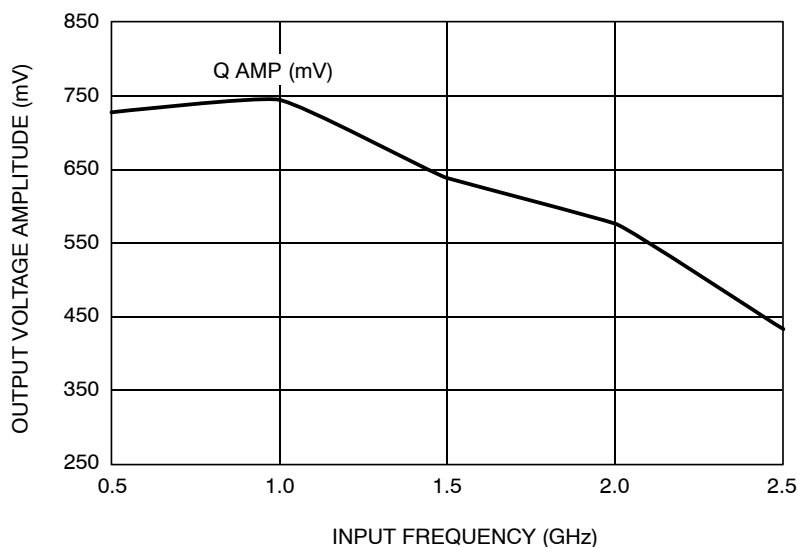
17. Worst case difference between Q0 and Q1 outputs.

18. Skew is measured between outputs under identical transitions.

19. Additive RMS jitter with 50% Duty Cycle Clock Signal.

20. Additive Peak-to-Peak jitter with input NRZ data at PRBS  $2^{31}-1$ .

21. Input voltage swing is a single-ended measurement operating in differential mode.



**Figure 3. Output Voltage Amplitude ( $V_{OUTPP}$ ) vs. Input Frequency ( $f_{in}$ ) at  $V_{CC} = 2.5\text{ V}$ ,  $25^\circ\text{C}$**

## NB100LVEP56

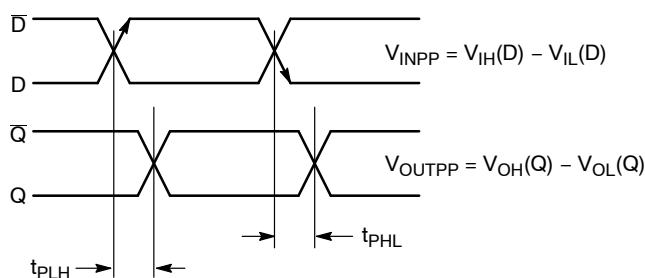


Figure 4. AC Reference Measurement

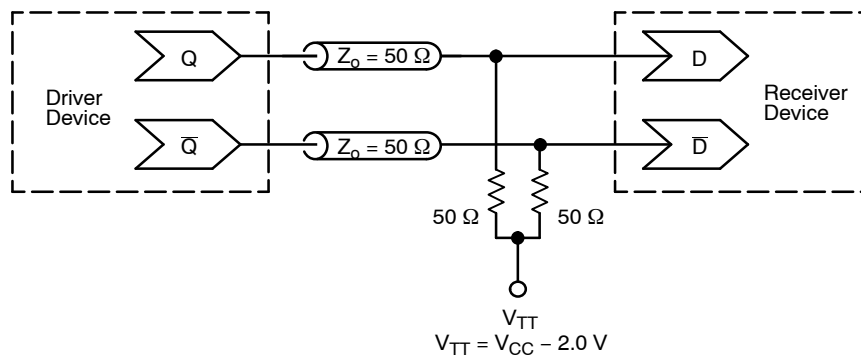


Figure 5. Typical Termination for Output Driver and Device Evaluation  
(See Application Note [AND8020/D](#) – Termination of ECL Logic Devices.)

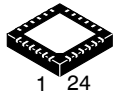
### Resource Reference of Application Notes

- AN1405/D – ECL Clock Distribution Techniques
- AN1406/D – Designing with PECL (ECL at +5.0 V)
- AN1503/D – ECLinPS™ I/O SPICE Modeling Kit
- AN1504/D – Metastability and the ECLinPS Family
- AN1568/D – Interfacing Between LVDS and ECL
- AN1672/D – The ECL Translator Guide
- AND8001/D – Odd Number Counters Design
- AND8002/D – Marking and Date Codes
- AND8020/D – Termination of ECL Logic Devices
- AND8066/D – Interfacing with ECLinPS
- AND8090/D – AC Characteristics of ECL Devices

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®

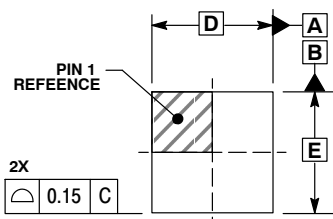


1 24

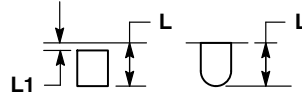
SCALE 2:1

QFN24, 4x4, 0.5P  
CASE 485L  
ISSUE B

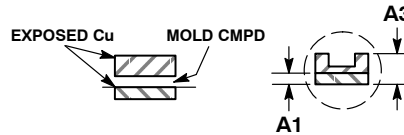
DATE 05 JUN 2012



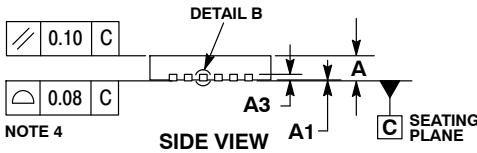
TOP VIEW



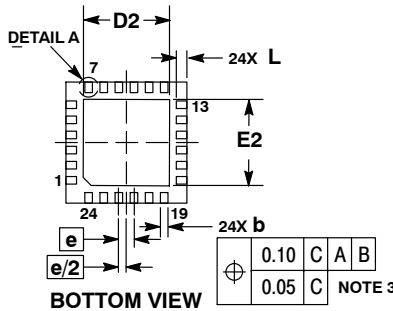
DETAIL A  
ALTERNATE  
CONSTRUCTIONS



DETAIL B  
ALTERNATE TERMINAL  
CONSTRUCTIONS



SIDE VIEW



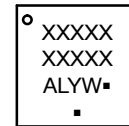
BOTTOM VIEW

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 0.25 AND 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

DIM	MILLIMETERS	
	MIN	MAX
A	0.80	1.00
A1	0.00	0.05
A3	0.20	REF
b	0.20	0.30
D	4.00	BSC
D2	2.70	2.90
E	4.00	BSC
E2	2.70	2.90
e	0.50	BSC
L	0.30	0.50
L1	0.05	0.15

### GENERIC MARKING DIAGRAM\*

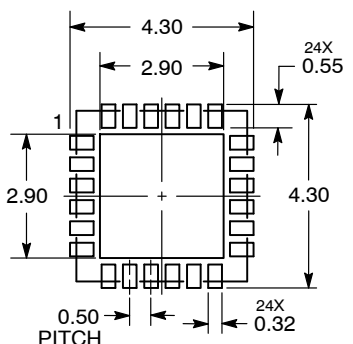


- XXXXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- = Pb-Free Package

(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.

### RECOMMENDED SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

DOCUMENT NUMBER:	98AON11783D	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	QFN24, 4X4, 0.5P	PAGE 1 OF 1

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