

# 2.5 V/3.3 V 2:1:15 Differential ECL/PECL $\div 1/\div 2$ Clock Driver

## NB100LVEP222

The NB100LVEP222 is a low skew 2:1:15 differential  $\div 1/\div 2$  ECL fanout buffer designed with clock distribution in mind. The LVECL/LVPECL input signal pairs can be used in a differential configuration or single-ended (with  $V_{BB}$  output reference bypassed and connected to the unused input of a pair). Either of two fully differential clock inputs may be selected. Each of the four output banks of 2, 3, 4, and 6 differential pairs may be independently configured to fanout 1X or 1/2X of the input frequency. When the output banks are configured with the  $\div 1$  mode, data can also be distributed. The LVEP222 specifically guarantees low output to output skew. Optimal design, layout, and processing minimize skew within a device and from lot to lot. This device is an improved version of the MC100LVE222 with higher speed capability and reduced skew.

The fsel pins and CLK\_Sel pin are asynchronous control inputs. Any changes may cause indeterminate output states requiring an MR pulse to resynchronize any 1/2X outputs (See Figure 3). Unused output pairs should be left unterminated (open) to reduce power and switching noise.

The NB100LVEP222, as with most ECL devices, can be operated from a positive  $V_{CC}/V_{CC0}$  supply in LVPECL mode. This allows the LVEP222 to be used for high performance clock distribution in +2.5/3.3 V systems. In a PECL environment series or Thevenin line, terminations are typically used as they require no additional power supplies. For more information on using PECL, designers should refer to Application Note AN1406/D. For a SPICE model, refer to Application Note AN1560/D.

The  $V_{BB}$  pin, an internally generated voltage supply, is available to this device only. For single-ended LVPECL input conditions, 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  $V_{CC}/V_{CC0}$  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. Single-ended CLK input operation is limited to a  $V_{CC}/V_{CC0} \geq 3.0$  V in LVPECL mode, or  $V_{EE} \leq -3.0$  V in NECL mode.

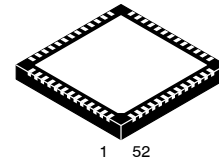
### Features

- 20 ps Output-to-Output Skew
- 85 ps Part-to-Part Skew
- Selectable 1x or 1/2x Frequency Outputs
- LVPECL Mode Operating Range:  
 $V_{CC}/V_{CC0} = 2.375$  V to 3.8 V with  $V_{EE} = 0$  V
- NECL Mode Operating Range:  
 $V_{CC}/V_{CC0} = 0$  V with  $V_{EE} = -2.375$  V to  $-3.8$  V
- Internal Input Pulldown Resistors
- Performance Upgrade to ON Semiconductor's MC100LVE222
- $V_{BB}$  Output
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant



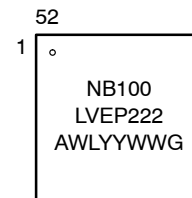
ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)



QFN-52  
MN SUFFIX  
CASE 485M

### MARKING DIAGRAM\*



- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

\*For additional marking information, refer to Application Note [AND8002/D](#).

### ORDERING INFORMATION

Device	Package	Shipping
NB100LVEP222MNG	QFN-52 (Pb-Free)	260 Units / Tray

# NB100LVEP222

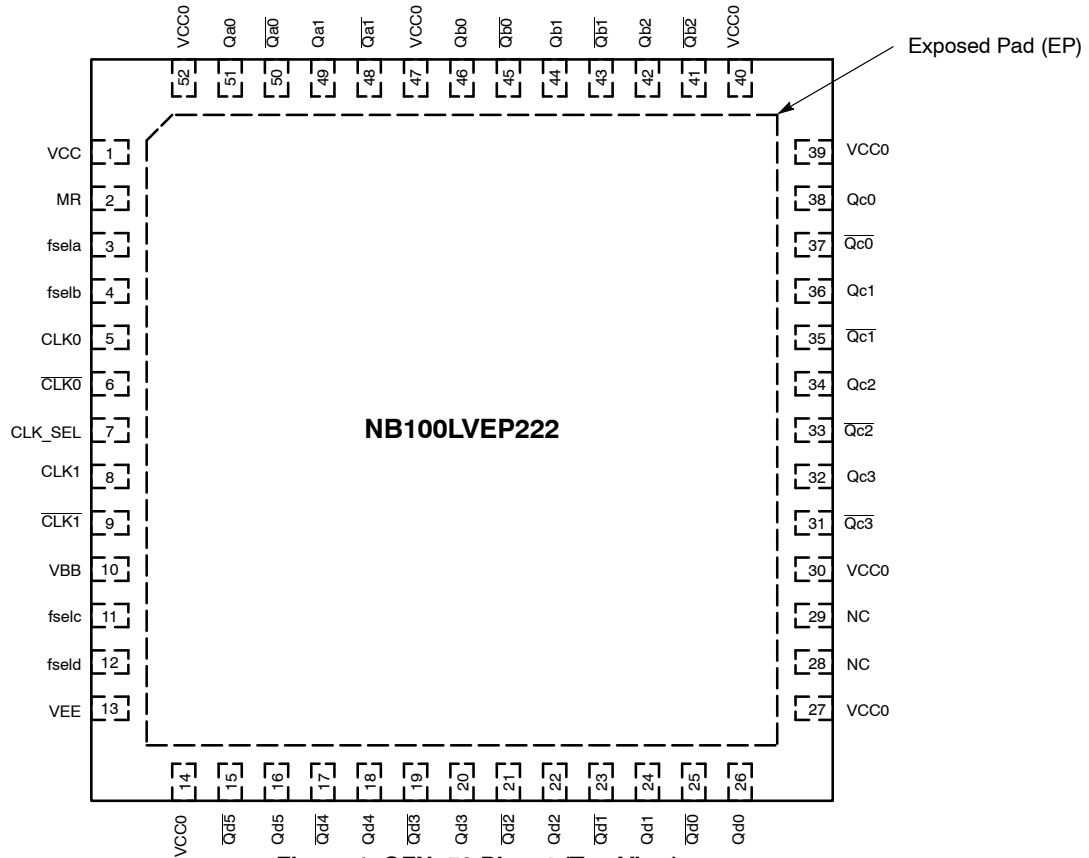


Figure 1. QFN-52 Pinout (Top View)

Table 1. PIN DESCRIPTION

PIN	FUNCTION
CLK0*, $\overline{\text{CLK0}}$ **	ECL Differential Input Clock
CLK1*, $\overline{\text{CLK1}}$ **	ECL Differential Input Clock
CLK_Sel*	ECL Clock Select
MR*	ECL Master Reset
Qa0:1, $\overline{\text{Qa0}}$ :1	ECL Differential Outputs
Qb0:2, $\overline{\text{Qb0}}$ :2	ECL Differential Outputs
Qc0:3, $\overline{\text{Qc0}}$ :3	ECL Differential Outputs
Qd0:5, $\overline{\text{Qd0}}$ :5	ECL Differential Outputs
fseln*	ECL $\div 1$ or $\div 2$ Select
V <sub>BB</sub>	Reference Voltage Output
V <sub>CC</sub> , V <sub>CC0</sub>	Positive Supply, V <sub>CC</sub> = V <sub>CC0</sub>
V <sub>EE</sub> ***	Negative Supply
NC	No Connect

\* Pins will default LOW when left open.

\*\* Pins will default HIGH when left open.

\*\*\* The thermally conductive exposed pad on the bottom of the package is electrically connected to V<sub>EE</sub> internally.

Table 2. FUNCTION TABLE

Input	Function	
	L	H
MR	Active	Reset
CLK_Sel	CLK0	CLK1
fseln	$\div 1$	$\div 2$

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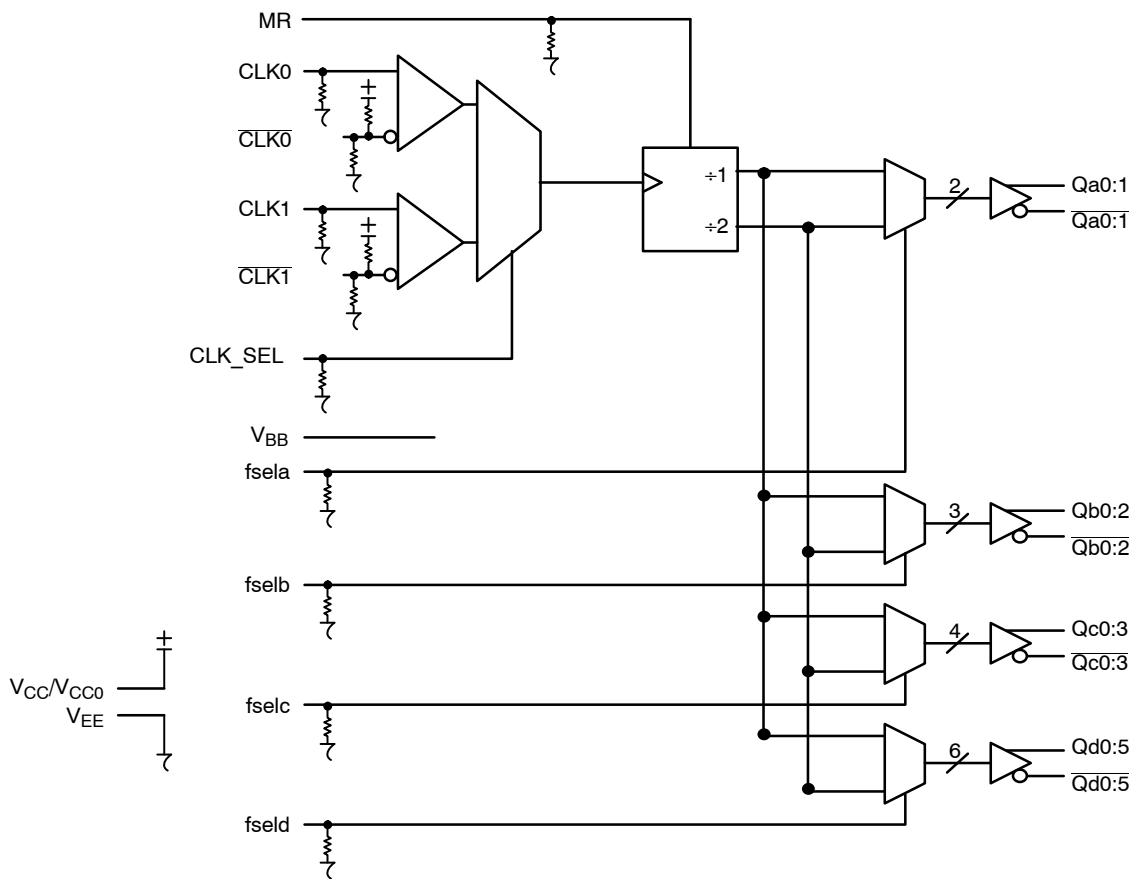


Figure 2. Logic Diagram

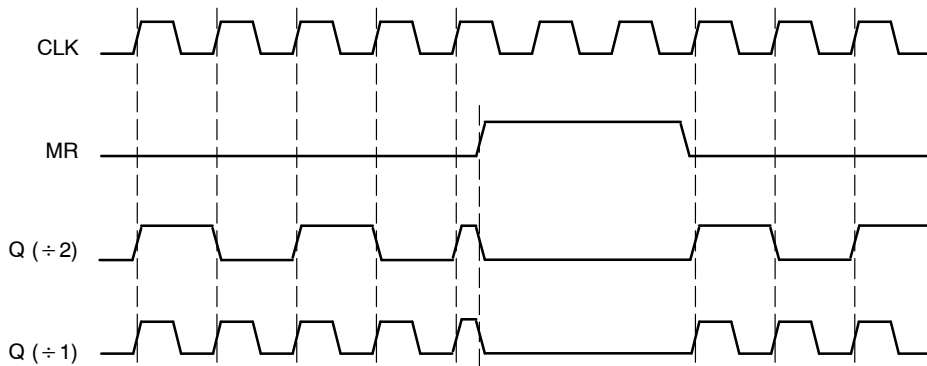


Figure 3. Master Reset (MR) Timing Diagram

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**Table 3. ATTRIBUTES**

Characteristics	Value
Internal Input Pulldown Resistor	75 kΩ
Internal Input Pullup Resistor	37.5 kΩ
ESD Protection Human Body Model Machine Model Charged Device Model	> 2 kV > 200 V > 2 kV
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)	Pb-Free Pkg
QFN-52	Level 2
Flammability Rating Oxygen Index: 28 to 34	UL 94 V-O @ 0.125 in
Transistor Count	821 Devices
Meets or Exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

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

**Table 4. MAXIMUM RATINGS**

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
$V_{CC}/V_{CC0}$	PECL Mode Power Supply	$V_{EE} = 0\text{ V}$		6	V
$V_{EE}$	NECL Mode Power Supply	$V_{CC}/V_{CC0} = 0\text{ V}$		-6	V
$V_I$	PECL Mode Input Voltage NECL Mode Input Voltage	$V_{EE} = 0\text{ V}$ $V_{CC}/V_{CC0} = 0\text{ V}$	$V_I \leq V_{CC}/V_{CC0}$ $V_I \geq V_{EE}$	6 to 0 -6 to 0	V V
$I_{out}$	Output Current	Continuous Surge		50 100	mA mA
$I_{BB}$	$V_{BB}$ Sink/Source			±0.5	mA
$T_A$	Operating Temperature Range			-40 to +85	°C
$T_{stg}$	Storage Temperature Range			-65 to +150	°C
$\theta_{JA}$	Thermal Resistance (Junction-to-Ambient) (Note )	0 lfpm 500 lfpm	QFN-52 QFN-52	25 19.6	°C/W °C/W
$\theta_{JC}$	Thermal Resistance (Junction-to-Case) (Note )	2S2P	QFN-52	21	°C/W
$T_{sol}$	Wave Solder	< 2 to 3 sec @ 248°C		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.

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**Table 5. LVPECL DC CHARACTERISTICS**  $V_{CC} = V_{CC0} = 2.5\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 2)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	100	125	150	104	130	156	112	140	168	mA
$V_{OH}$	Output HIGH Voltage (Note 3)	1355	1480	1605	1355	1480	1605	1355	1480	1605	mV
$V_{OL}$	Output LOW Voltage (Note 3)	555	680	900	555	680	900	555	680	900	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended) (Note 4)	1335		1620	1335		1620	1275		1620	mV
$V_{IL}$	Input LOW Voltage (Single-Ended) (Note 4)	555		900	555		900	555		900	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 5) (Figure 5)	1.2		2.5	1.2		2.5	1.2		2.5	V
$I_{IH}$	Input HIGH Current			150			150			150	μA
$I_{IL}$	Input LOW Current	CLK CLK	0.5 -150		0.5 -150			0.5 -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 lfm.

- Input and output parameters vary 1:1 with  $V_{CC}/V_{CC0}$ .  $V_{EE}$  can vary + 0.125 V to -1.3 V.
- All loading with 50 Ω to  $V_{CC}/V_{CC0} - 2.0\text{ V}$ .
- Do not use  $V_{BB}$  Pin #10 at  $V_{CC}/V_{CC0} < 3.0\text{ V}$  (see [AND8066/D](#)).
- $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}/V_{CC0}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

**Table 6. LVPECL DC CHARACTERISTICS**  $V_{CC} = V_{CC0} = 3.3\text{ V}$ ;  $V_{EE} = 0.0\text{ V}$  (Note 6)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	100	125	150	104	130	156	112	140	168	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	1480	1700	1355	1480	1700	1355	1480	1700	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	2135		2420	2135		2420	2135		2420	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	1355		1700	1355		1700	1355		1700	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) (Figure 5)	1.2		3.3	1.2		3.3	1.2		3.3	V
$I_{IH}$	Input HIGH Current			150			150			150	μA
$I_{IL}$	Input LOW Current	CLK CLK	0.5 -150		0.5 -150			0.5 -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 lfm.

- Input and output parameters vary 1:1 with  $V_{CC}/V_{CC0}$ .  $V_{EE}$  can vary + 0.925 V to -0.5 V.
- All loading with 50 Ω to  $V_{CC}/V_{CC0} - 2.0\text{ V}$ .
- Single-Ended input operation is limited  $V_{CC}/V_{CC0} \geq 3.0\text{ V}$  in LVPECL mode.
- $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}/V_{CC0}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

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**Table 7. LVNECL DC CHARACTERISTICS**  $V_{CC} = V_{CC0} = 0.0\text{ V}$ ;  $V_{EE} = -3.8\text{ V}$  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	
$I_{EE}$	Power Supply Current	100	125	150	104	130	156	112	140	168	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	-1820	-1600	-1945	-1820	-1600	-1945	-1820	-1600	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	-1165		-880	-1165		-880	-1165		-880	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	-1945		-1600	-1945		-1600	-1945		-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) (Figure 5)	$V_{EE} + 1.2$		0.0	$V_{EE} + 1.2$		0.0	$V_{EE} + 1.2$		0.0	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	CLK CLK	0.5 -150		0.5 -150			0.5 -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 lpm.

10. Input and output parameters vary 1:1 with  $V_{CC}/V_{CC0}$ .

11. All loading with  $50\ \Omega$  to  $V_{CC}/V_{CC0} - 2.0\text{ V}$ .

12. Single-Ended input operation is limited  $V_{EE} \leq -3.0\text{ V}$  in NECL mode.

13.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}/V_{CC0}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

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**Table 8. AC CHARACTERISTICS**  $V_{CC} = V_{CC0} = 2.375$  to  $3.8$  V;  $V_{EE} = 0.0$  V or  $V_{CC} = V_{CC0} = 0.0$  V;  $V_{EE} = -2.375$  to  $-3.8$  V  
(Note 14)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$V_{Opp}$	Differential Output Voltage (Figure 4) $f_{out} = 50$ MHz $f_{out} = 0.8$ GHz $f_{out} = 1.0$ GHz	500 550 500	600 650 650		500 525 425	600 650 650		500 500 400	600 650 600		mV
$t_{PLH}$ $t_{PHL}$	Propagation Delay (Differential Configuration) CLKx-Qx MR-Qxx	650 700	800 900	900 1200	700 700	875 900	1000 1200	850 700	975 900	1150 1200	ps
$t_{skew}$	Within-Device Skew (Note 15) (+1 Mode) - Qa[0:1] - Qb[0:2] - Qc[0:3] - Qd[0:5]  - QaN, QbN, QdN - All Outputs		10 10 20 10	40 40 60 40		10 10 20 10	40 40 60 40		10 10 20 10	40 40 60 40	ps
$t_{skew}$	Within-Device Skew (Note 15) (+2 Mode) - Qa[0:1] - Qb[0:2] - Qc[0:3] - Qd[0:5]  - QaN, QbN, QdN - All Outputs		15 15 20 15	70 70 70 70		10 10 20 10	40 40 50 40		15 10 15 15	70 40 70 70	ps
$t_{skew}$	Device-to-Device Skew (Differential Configuration) (Note 16)		85	300		85	300		85	300	ps
$t_{JITTER}$	Random Clock Jitter (Figure 4) (RMS)		1	5		1	4		1	5	ps
$V_{PP}$	Input Swing (Differential Configuration) (Note 17) (Figure 5)	150	800	1200	150	800	1200	150	800	1200	mV
DCO	Output Duty Cycle	49.5	50	50.5	49.5	50	50.5	49.5	50	50.5	%
$t_r/t_f$	Output Rise/Fall Time 20%–80%	100	200	300	100	200	300	150	250	350	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 lfm.

14. Measured with LVPECL 750 mV source, 50% duty cycle clock source. All outputs loaded with 50  $\Omega$  to  $V_{CC}/V_{CC0} - 2.0$  V.

15. Skew is measured between outputs under identical transitions and operating conditions.

16. Device-to-Device skew for identical transitions at identical  $V_{CC}/V_{CC0}$  levels.

17.  $V_{PP}$  is the differential configuration input voltage swing required to maintain AC characteristics including  $t_{PD}$  and device-to-device skew.

# NB100LVEP222

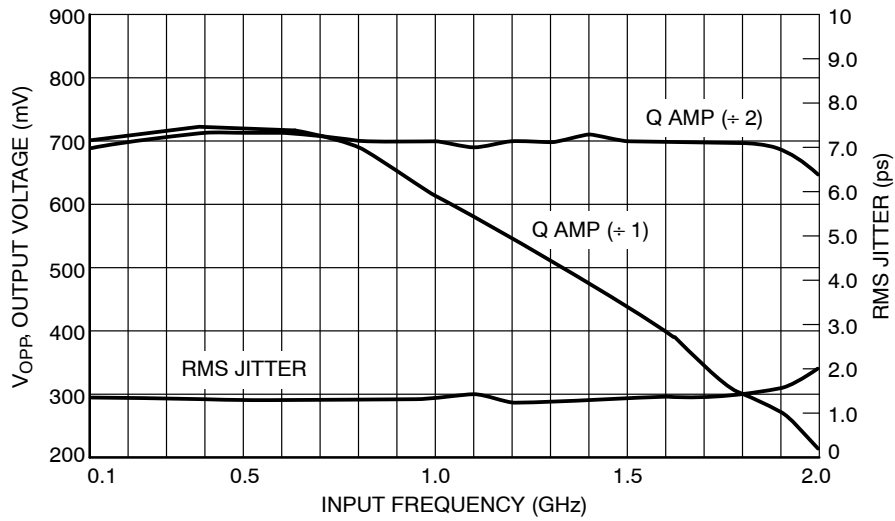


Figure 4. Output Voltage ( $V_{OPP}$ ) versus Input Frequency and Random Clock Jitter ( $t_{JITTER}$ ) @ 25°C

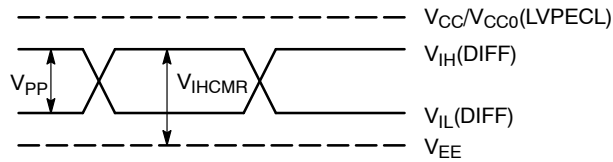


Figure 5. LVPECL Differential Input Levels

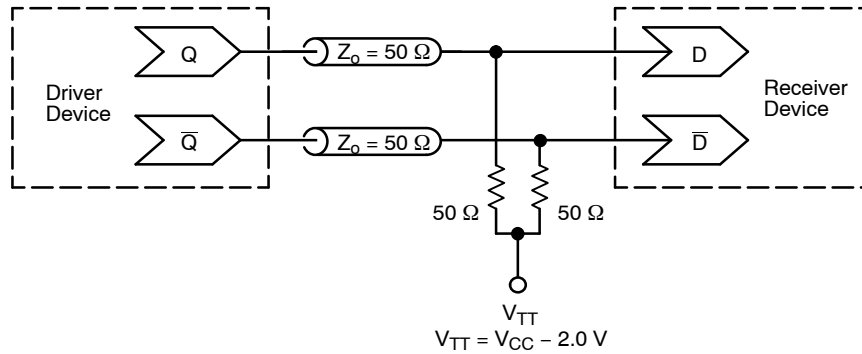


Figure 6. Typical Termination for Output Driver and Device Evaluation (See Application Note [AND8020/D](#) – Termination of ECL Logic Devices.)



## 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
- AN1642/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

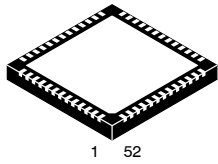
## PACKAGE DIMENSIONS

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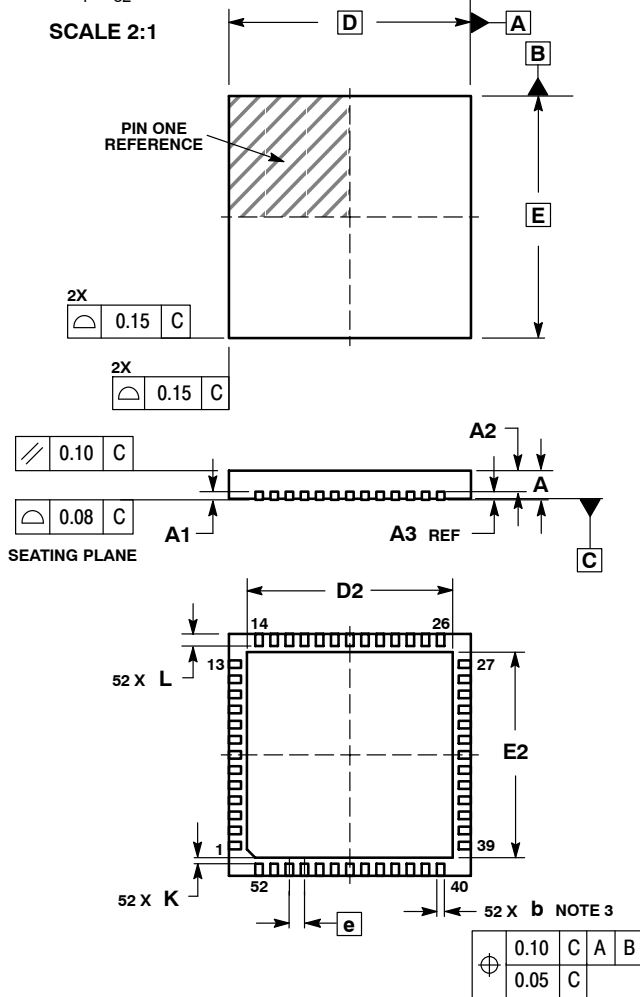


**QFN52 8x8, 0.5P**  
CASE 485M-01  
ISSUE C

DATE 16 FEB 2010



SCALE 2:1

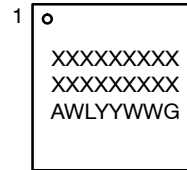


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

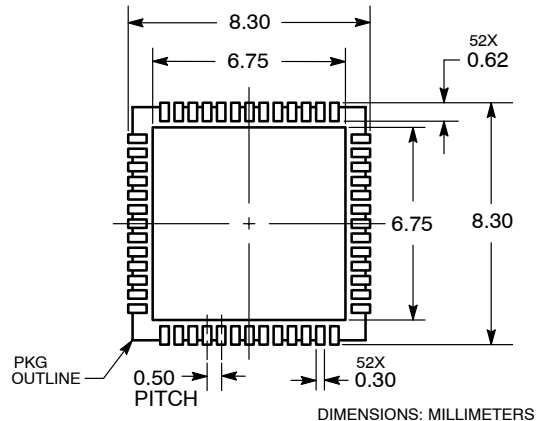
MILLIMETERS		
DIM	MIN	MAX
A	0.80	1.00
A1	0.00	0.05
A2	0.60	0.80
A3	0.20	REF
b	0.18	0.30
D	8.00	BSC
D2	6.50	6.80
E	8.00	BSC
E2	6.50	6.80
e	0.50	BSC
K	0.20	---
L	0.30	0.50

**GENERIC MARKING DIAGRAM**



- XXXXXXXXXX = Device Code
- A = Assembly Site
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

**RECOMMENDED SOLDERING FOOTPRINT**



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