

# NB100LVEP91

## 2.5V / 3.3V Any Level Positive Input to -2.5V / -3.3V / -5V NECL Output Translator

The NB100LVEP91 is a triple any level positive input to NECL output translator. The device accepts LVPECL, LVTTTL, LVCMOS, HSTL, CML or LVDS signals, and translates them to differential NECL output signals (-2.5 V / -3.3 V / -5 V).

To accomplish the level translation the LVEP91 requires three power rails. The  $V_{CC}$  supply should be connected to the positive supply, and the  $V_{EE}$  pin should be connected to the negative power supply. The GND pins are connected to the system ground plane. Both  $V_{EE}$  and  $V_{CC}$  should be bypassed to ground via 0.01  $\mu$ F capacitors.

Under open input conditions, the  $\bar{D}$  input will be biased at  $V_{CC}/2$  and the D input will be pulled to GND. These conditions will force the Q outputs to a low, ensuring stability.

The  $V_{BB}$  pin, an internally generated voltage supply, is available to this device only. For single-ended 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  $V_{CC}$  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.

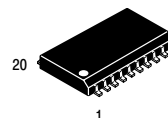
- Typical Maximum Frequency > 2.0 GHz
- 430 ps Typical Propagation Delay
- Operating Range:  $V_{CC}$  = 2.375 V to 3.8 V;  
 $V_{EE}$  = -2.375 V to -5.5 V; GND = 0 V
- Q Output will Default LOW with Inputs Open or at GND



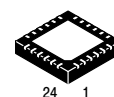
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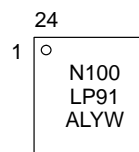
### MARKING DIAGRAM\*



SO-20  
DW SUFFIX  
CASE 751D



24 PIN QFN  
MN SUFFIX  
CASE 485L



A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week

\*For additional information, see Application Note  
AND8002/D

### ORDERING INFORMATION

Device	Package	Shipping
NB100LVEP91DW	SO-20	38 Units/Rail
NB100LVEP91DWR2	SO-20	1000/Tape & Reel
NB100LVEP91MN	QFN-24	93 Units/Rail
NB100LVEP91MNR2	QFN-24	3000/Tape & Reel

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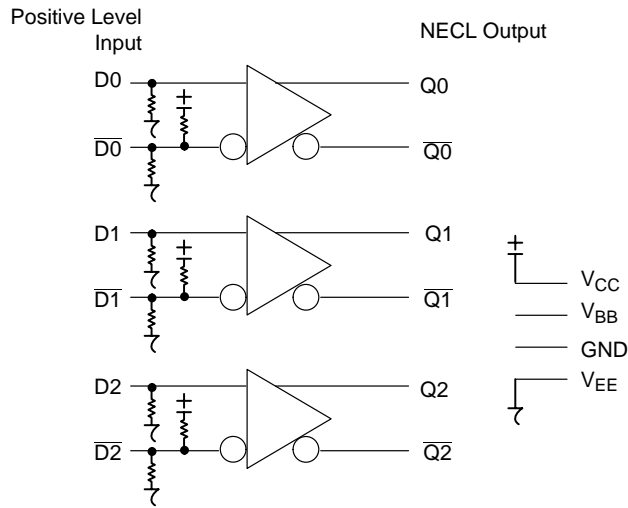
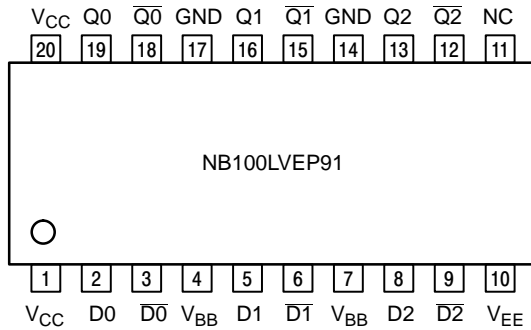


Figure 1. Logic Diagram



Warning: All V<sub>CC</sub>, V<sub>EE</sub>, and GND pins must be externally connected to Power Supply to guarantee proper operation.

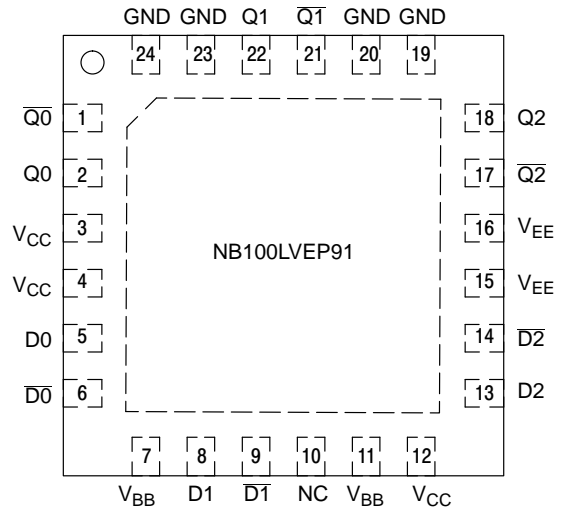
Figure 2. SOIC-20 Lead Pinout (Top View)

## PIN DESCRIPTION

PIN	FUNCTION
Dn*, Dn**	Any Level Inputs
Qn, Qn	ECL Outputs
V <sub>BB</sub>	PECL Reference Voltage Output
V <sub>CC</sub>	Positive Supply (2.5 V, 3.3 V)
V <sub>EE</sub>	Negative Supply (-2.5 V, -3.3 V, -5 V)
GND	Ground
NC	No Connect

\*Pins will default differentially LOW when left open.

\*\*Pins will default to V<sub>CC</sub>/2 when left open.



Warning: All V<sub>CC</sub>, V<sub>EE</sub>, and GND pins must be externally connected to Power Supply to guarantee proper operation. The thermally conductive exposed pad on package bottom (see case drawing) must be attached to a heat-sinking conduit.

Figure 3. QFN-24 Lead Pinout (Top View)

## ATTRIBUTES

Characteristics	Value
Internal Input Pulldown Resistor	75 kΩ
Internal Input Pullup Resistor	75 kΩ
ESD Protection	Human Body Model Machine Model Charged Device Model
	> 2 kV > 150 V > 2 kV
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)	Level 1
Flammability Rating	Oxygen Index: 28 to 34 UL 94 V-0 @ 0.125 in
Transistor Count	446 Devices
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

1. For additional information, see Application Note AND8003/D.

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## MAXIMUM RATINGS (Note 2)

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V <sub>CC</sub>	PECL Power Supply	GND = 0 V		3.8 to 0	V
V <sub>EE</sub>	NECL Power Supply	GND = 0 V		-5.5 to 0	V
V <sub>I</sub>	PECL Input Voltage	GND = 0 V	V <sub>I</sub> ≤ V <sub>CC</sub>	3.8 to 0	V
V <sub>OP</sub>	Operating Voltage	GND = 0 V	V <sub>CC</sub> - V <sub>EE</sub>	9.3 to 0	V
I <sub>out</sub>	Output Current	Continuous Surge		50 100	mA mA
I <sub>BB</sub>	PECL V <sub>BB</sub> Sink/Source			± 0.5	mA
TA	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) JESD 51-3 (1S-Single Layer Test Board)	0 IFPM 500 LFPM	20 SOIC 20 SOIC	90 60	°C/W °C/W
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient) JESD 51-6 (2S2P Multilayer Test Board) with Filled Thermal Vias	0 LFPM	24 QFN	47.3	°C/W
θ <sub>JC</sub>	Thermal Resistance (Junction-to-Case)	std bd	20 SOIC	30 to 35	°C/W
T <sub>sol</sub>	Wave Solder	<2 to 3 sec @ 248°C		265	°C

2. Maximum Ratings are those values beyond which device damage may occur.

## LVPECL INPUT DC CHARACTERISTICS V<sub>CC</sub> = 2.5 V, V<sub>EE</sub> = -2.375 to -5.5 V, GND = 0 V (Note 3)

Symbol	Characteristic	-40 °C			25 °C			85 °C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I <sub>CC</sub>	Power Supply Current	10	14	20	10	14	20	10	14	20	mA
V <sub>IH</sub>	Input HIGH Voltage	1335		V <sub>CC</sub>	1335		V <sub>CC</sub>	1275		V <sub>CC</sub>	mV
V <sub>IL</sub>	Input LOW Voltage	GND		875	GND		875	GND		875	mV
V <sub>IHCMR</sub>	Input HIGH Voltage Common Mode Range (Differential) (Note 4)	0		2.5	0		2.5	0		2.5	V
I <sub>IH</sub>	Input HIGH Current			150			150			150	μA
I <sub>IL</sub>	Input LOW Current	D D	0.5 -150		0.5 -150			0.5 -150			μA

NOTE: Devices are designed to meet the DC specifications shown in the above table, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse air flow greater than 500 lfpm is maintained.

3. Input parameters vary 1:1 with V<sub>CC</sub>. V<sub>CC</sub> can vary +1.3 V / -0.125 V.

4. V<sub>IHCMR</sub> min varies 1:1 with GND. V<sub>IHCMR</sub> max varies 1:1 with V<sub>CC</sub>.

## LVPECL INPUT DC CHARACTERISTICS V<sub>CC</sub> = 3.3 V; V<sub>EE</sub> = -2.375 V to -5.5 V; GND = 0 V (Note 5)

Symbol	Characteristic	-40 °C			25 °C			85 °C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I <sub>CC</sub>	V <sub>CC</sub> Power Supply Current	10	16	24	10	16	24	10	16	24	mA
V <sub>IH</sub>	Input HIGH Voltage (Single-Ended)	2135		V <sub>CC</sub>	2135		V <sub>CC</sub>	2135		V <sub>CC</sub>	mV
V <sub>IL</sub>	Input LOW Voltage (Single-Ended)	GND		1675	GND		1675	GND		1675	mV
V <sub>BB</sub>	Output Voltage Reference (Note 6)	1775	1875	1975	1775	1875	1975	1775	1875	1975	mV
V <sub>IHCMR</sub>	Input HIGH Voltage Common Mode Range (Differential) (Note 6)	0		3.3	0		3.3	0		3.3	V
I <sub>IH</sub>	Input HIGH Current			150			150			150	μA
I <sub>IL</sub>	Input LOW Current	D D	0.5 -150		0.5 -150			0.5 -150			μA

NOTE: Devices are designed to meet the DC specifications shown in the above table, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse air flow greater than 500 lfpm is maintained.

5. Input parameters vary 1:1 with V<sub>CC</sub>. V<sub>CC</sub> can vary +0.5 / -0.925 V.

6. V<sub>IHCMR</sub> min varies 1:1 with GND. V<sub>IHCMR</sub> max varies 1:1 with V<sub>CC</sub>.

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## NECL OUTPUT DC CHARACTERISTICS $V_{CC} = 2.375 \text{ V to } 3.8 \text{ V}$ ; $V_{EE} = -2.375 \text{ V to } -5.5 \text{ V}$ ; $GND = 0 \text{ V}$ (Note 7)

Symbol	Characteristic	-40 °C			25 °C			85 °C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	$V_{EE}$ Power Supply Current	40	50	60	38	50	68	38	50	68	mA
$V_{OH}$	Output HIGH Voltage (Note 8)	-1145	-1020	-895	-1145	1020	-895	-1030	-1020	-895	mV
$V_{OL}$	Output LOW Voltage (Note 8)	-1945	-1725	-1600	-1945	-1725	-1600	-1945	-1725	-1600	mV

NOTE: Devices are designed to meet the DC specifications shown in the above table, after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse air flow greater than 500 lfm is maintained.

7. Output parameters vary 1:1 with GND.

8. All loading with 50  $\Omega$  resistor to GND-2 volts.

## AC CHARACTERISTICS $V_{CC} = 2.375 \text{ V to } 3.8 \text{ V}$ ; $V_{EE} = -2.375 \text{ V to } -5.5 \text{ V}$ ; $GND = 0 \text{ V}$

Symbol	Characteristic	-40 °C			25 °C			85 °C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$V_{opp}$	Output Voltage Amplitude (Figure 4) $f_{in} < 1.0 \text{ GHz}$ $f_{in} < 1.5 \text{ GHz}$	575 525	800 750		600 525	800 750		550 400	800 750		mV
$t_{PLH}$ $t_{PHL0}$	Propagation Delay D to Q Differential Single-Ended	375 300	500 450	600 650	375 300	500 450	600 675	400 300	550 500	650 750	ps
$t_{SKEW}$	Pulse Skew (Note 9) Output-to-Output (Note 10) Part-to-Part (Diff) (Note 10)		15 25 50	75 95 125		15 30 50	75 105 125		15 30 70	80 105 150	ps
$t_{JITTER}$	RMS Random Clock Jitter (Note 11) $f_{in} = 2.0 \text{ GHz}$ Peak-to-Peak Data Dependant Jitter $f_{in} = 2.0 \text{ Gbps}$ (Note 12)		0.5 20	2.0		0.5 20	2.0		0.5 20	2.0	ps
$V_{PP}$	Input Voltage Swing (Note 13)	200	800	1200	200	800	1200	200	800	1200	mV
$t_r, t_f$	Output Rise/Fall Times Q (20% - 80%)	75	150	250	75	150	250	75	150	275	ps

9. Pulse Skew =  $|t_{PLH} - t_{PHL}|$

10. Skews are valid across specified voltage range, part-to-part skew is for a given temperature.

11. RMS Jitter with 50% Duty Cycle Input Clock Signal.

12. Peak-to-Peak Jitter with input NRZ PRBS  $2^{31}-1$  at 2.0 Gbps.

13. Input voltage swing is a single-ended measurement operating in differential mode. The device has a DC gain of  $\approx 50$ .

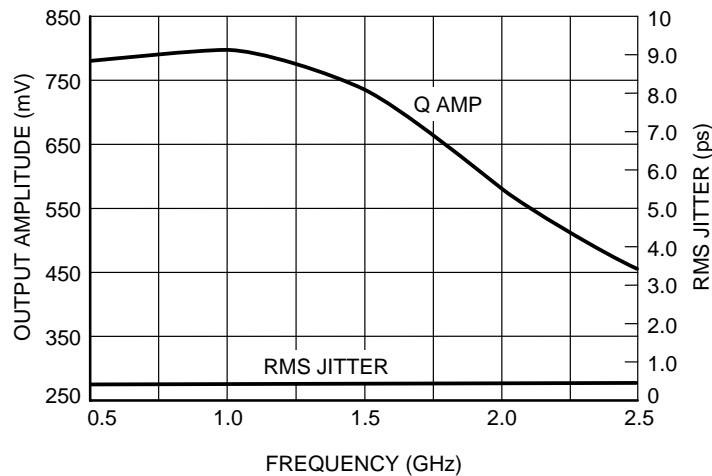


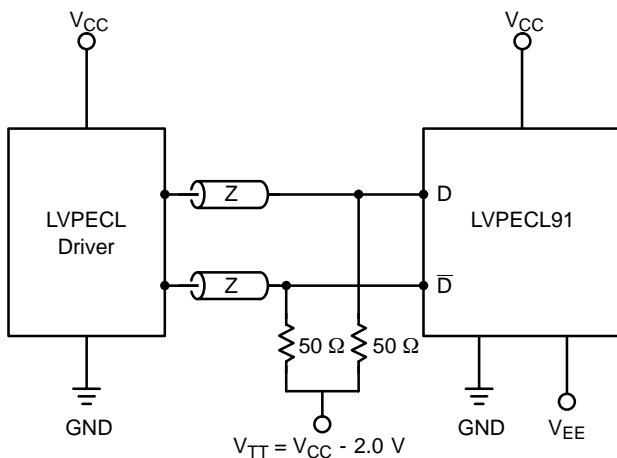
Figure 4.

# NB100LVEP91

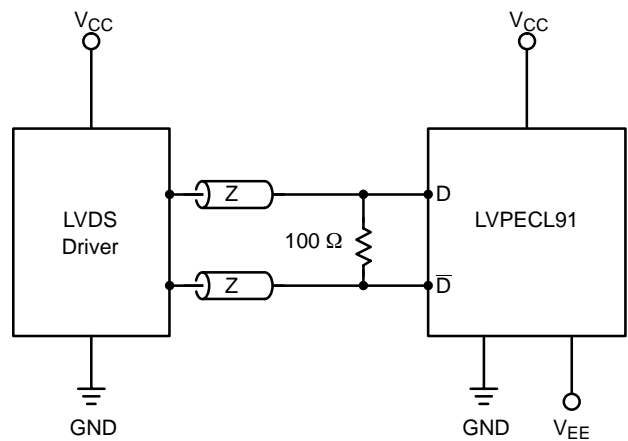
## Application Information

All NB100LVPE91 inputs can accept LVPECL, LVTTTL, LVCMOS, HSTL, CML, or LVDS signal levels. The limitations for differential input signal (LVDS, HSTL, LVPECL, or CML) are the minimum input swing of 150 mV

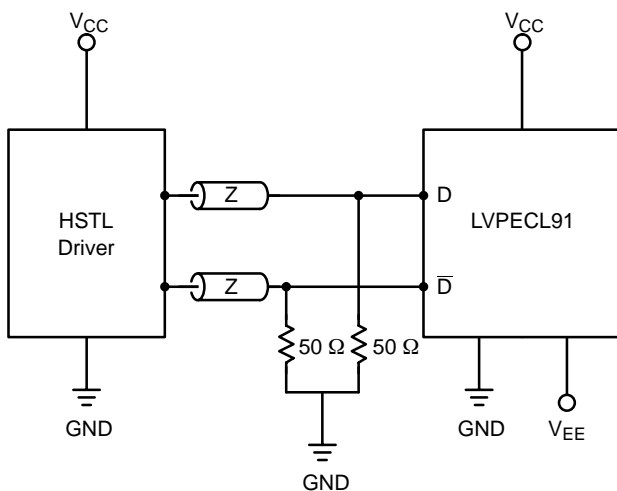
and the maximum input swing of 3.0 V. Within these conditions, the input voltage can range from  $V_{CC}$  to GND. Examples interfaces are illustrated below in a 50  $\Omega$  environment ( $Z = 50 \Omega$ )



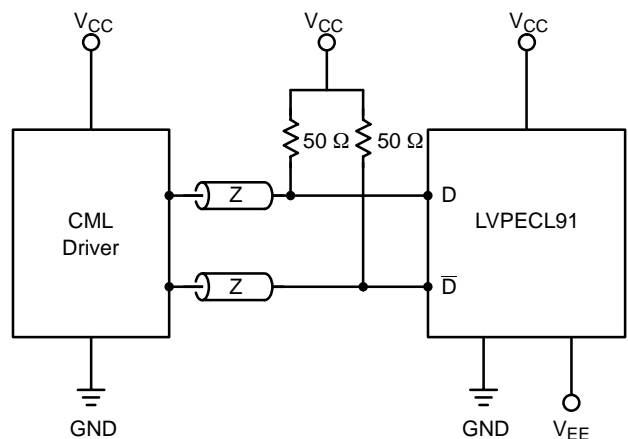
### Figure 5. Standard LVPECL Interface



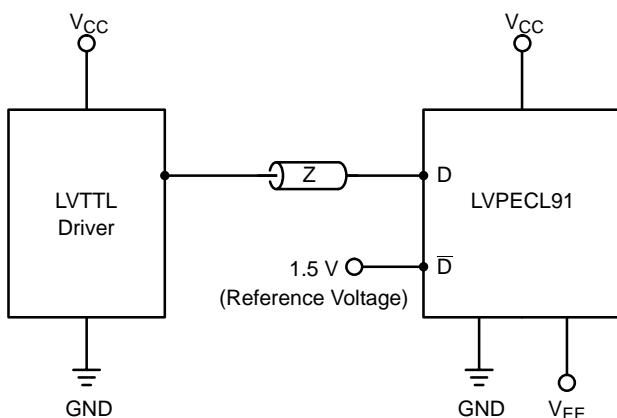
### Figure 6. Standard LVDS Interface



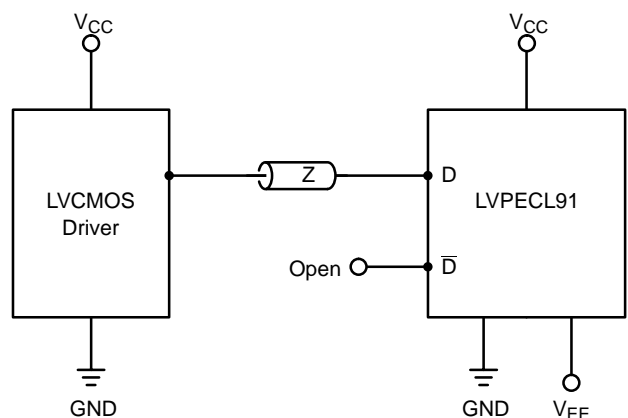
### Figure 7. Standard HSTL Interface



### Figure 8. Standard 50 $\Omega$ Load CML Interface

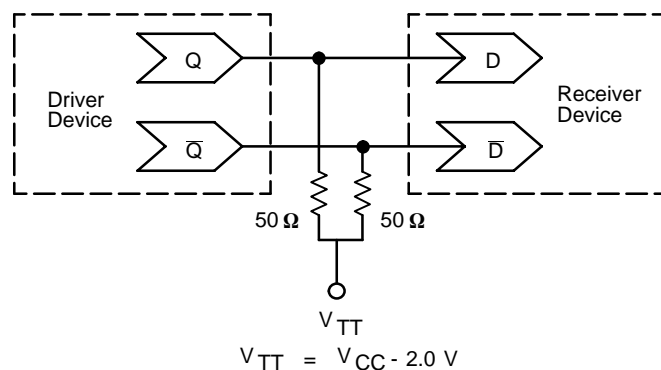


### Figure 9. Standard LVTTTL Interface



**Figure 10. Standard LVCMOS Interface**  
( $\overline{\text{D}}$  will default to  $V_{CC}/2$  when left open. A reference voltage of  $V_{CC}/2$  should be applied to D input, if  $\overline{\text{D}}$  is interfaced to CMOS signals.)

## NB100LVEP91



**Figure 11. Typical Termination for Output Driver and Device Evaluation**  
 (See Application Note AND8020 - Termination of ECL Logic Devices.)

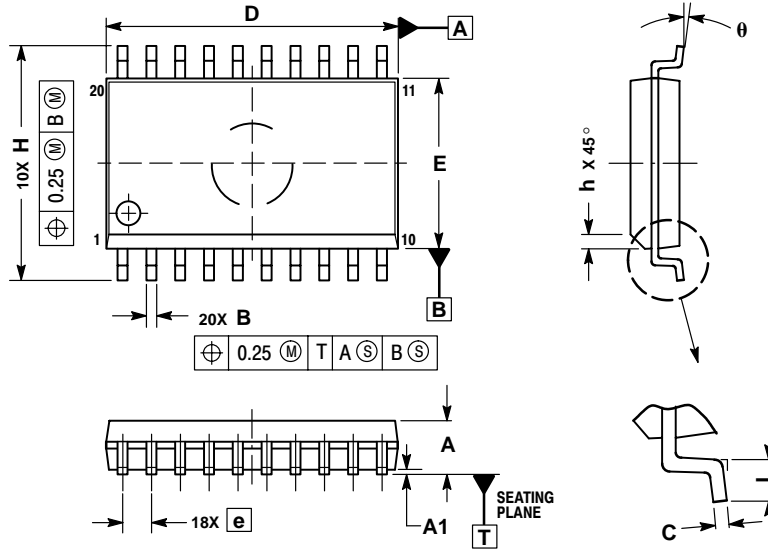
### Resource Reference of Application Notes

<b>AN1404</b>	- ECLinPS Circuit Performance at Non-Standard $V_{IH}$ Levels
<b>AN1405</b>	- ECL Clock Distribution Techniques
<b>AN1503</b>	- ECLinPS I/O SPICE Modeling Kit
<b>AN1504</b>	- Metastability and the ECLinPS Family
<b>AN1560</b>	- Low Voltage ECLinPS SPICE Modeling Kit
<b>AN1650</b>	- Using Wire-OR Ties in ECLinPS Designs
<b>AN1672</b>	- The ECL Translator Guide
<b>AND8002</b>	- Marking and Date Codes
<b>AND8020</b>	- Termination of ECL Logic Devices

# NB100LVEP91

## PACKAGE DIMENSIONS

### SO-20 DW SUFFIX PLASTIC SOIC PACKAGE CASE 751D-05 ISSUE F

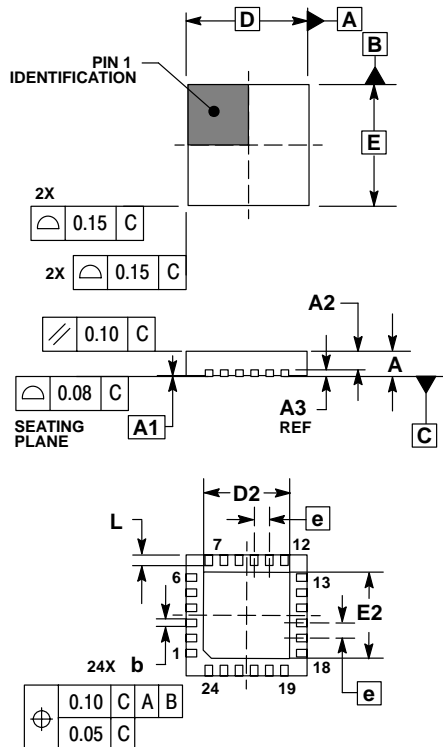


#### NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

MILLIMETERS		
DIM	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0°	7°


### QFN 24 MN SUFFIX 24 PIN QFN, 4x4 CASE 485L-01 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 0.25 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	0.23	0.28
D	4.00	BSC
D2	2.70	2.90
E	4.00	BSC
E2	2.70	2.90
e	0.50	BSC
L	0.35	0.45

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