

NB100LVEP91

2.5 V/3.3 V Any Level Positive Input to -2.5 V/-3.3 V LVNECL Output Translator

Description

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 LVNECL output signals ($-2.5\text{ V} / -3.3\text{ V}$).

To accomplish the level translation the LVEP91 requires three power rails. The V_{CC} pins should be connected to the positive power 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 $0.01\text{ }\mu\text{F}$ 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 state, and Q outputs to a high state, which will ensure 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 $0.01\text{ }\mu\text{F}$ capacitor and limit current sourcing or sinking to 0.5 mA . When not used, V_{BB} should be left open.

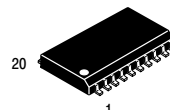
Features

- Maximum Input Clock Frequency > 2.0 GHz Typical
- Maximum Input Data Rate > 2.0 Gb/s Typical
- 500 ps Typical Propagation Delay
- Operating Range:
 - ♦ $V_{CC} = 2.375\text{ V}$ to 3.8 V ; $V_{EE} = -2.375\text{ V}$ to -3.8 V ; GND = 0 V
- Q Output will Default LOW with Inputs Open or at GND
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

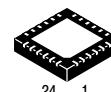


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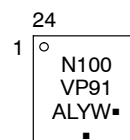
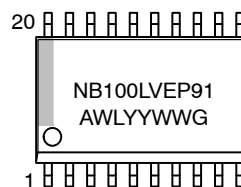


SOIC-20 WB
DW SUFFIX
CASE 751D-05



QFN-24
MN SUFFIX
CASE 485L-01

MARKING DIAGRAMS*



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G or ■ = 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† |
|------------------|----------------------|------------------|
| MB100LVEP91DWG | SOIC-20 WB (Pb-Free) | 38 Units/Tube |
| MB100LVEP91DWR2G | SOIC-20 WB (Pb-Free) | 1000/Tape & Reel |
| MB100LVEP91MNG | QFN-24 (Pb-Free) | 92 Units/Tube |
| MB100LVEP91MNR2G | QFN-24 (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 Specifications Brochure, [BRD8011/D](#).

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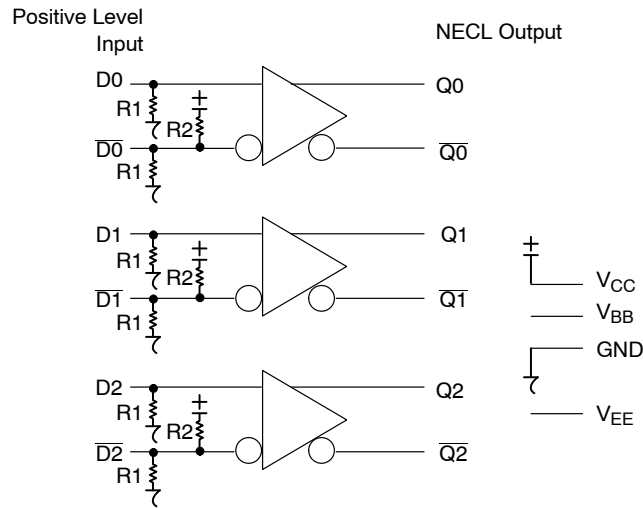


Figure 1. Logic Diagram

Table 1. PIN DESCRIPTION

| Pin | | Name | I/O | Default State | Description |
|------------|----------------|-----------------|---|---------------|---|
| SOIC | QFN | | | | |
| 1, 20 | 3, 4, 12 | V _{CC} | – | – | Positive Supply Voltage. All V _{CC} Pins must be Externally Connected to Power Supply to Guarantee Proper Operation. |
| 10 | 15, 16 | V _{EE} | – | – | Negative Supply Voltage. All V _{EE} Pins must be Externally Connected to Power Supply to Guarantee Proper Operation. |
| 14, 17 | 19, 20, 23, 24 | GND | – | – | Ground. |
| 4, 7 | 7, 11 | V _{BB} | – | – | ECL Reference Voltage Output |
| 2, 5, 8 | 5, 8, 13 | D[0:2] | LVPECL, LVDS, LVTTTL, LVCMOS, CML, HSTL Input | Low | Non-inverted Differential Inputs [0:2]. Internal 75 kΩ to GND. |
| 3, 6, 9 | 6, 9, 14 | D̄[0:2] | LVPECL, LVDS, LVTTTL, LVCMOS, CML, HSTL Input | High | Inverted Differential Inputs [0:2]. Internal 75 kΩ to GND and 75 kΩ to V _{CC} . When Inputs are Left Open They Default to (V _{CC} – GND) / 2. |
| 19, 16, 13 | 2, 22, 18 | Q[0:2] | LVNECL Output | – | Non-inverted Differential Outputs [0:2]. Typically Terminated with 50 Ω to V _{TT} = V _{CC} – 2 V |
| 18, 15, 12 | 1, 21, 17 | Q̄[0:2] | LVNECL Output | – | Inverted Differential Outputs [0:2]. Typically Terminated with 50 Ω to V _{TT} = V _{CC} – 2 V |
| 11 | 10 | NC | – | – | No Connect. The NC Pin is NOT Electrically Connected to the Die and may Safely be Connected to Any Voltage from V _{EE} to V _{CC} . |
| N/A | – | EP | – | – | Exposed Pad. (Note 1) |

1. The thermally conductive exposed pad on the package bottom (see case drawing) must be attached to a heat sinking conduit and may only be electrically connected to V_{EE} (not GND).

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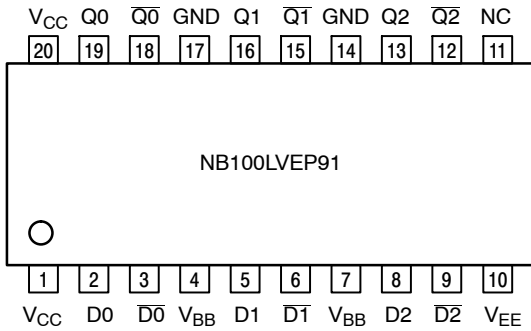


Figure 2. SOIC-20 WB Lead Pinout (Top View)*

*All V_{CC}, V_{EE} and GND pins must be externally connected to a power supply.

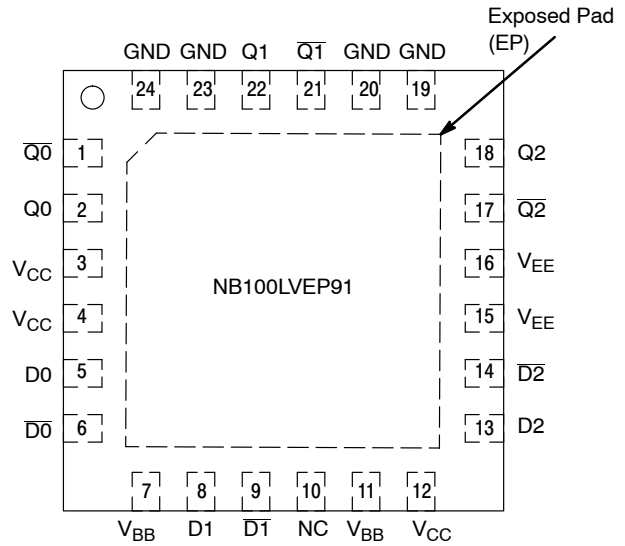


Figure 3. QFN-24 Lead Pinout (Top View)*

*All V_{CC}, V_{EE} and GND pins must be externally connected to a power supply. The thermally conductive exposed pad on the package bottom (see case drawing) must be attached to a sufficient heat-sinking conduit and may only be electronically connected to V_{EE} (not GND).

Table 2. ATTRIBUTES

| Characteristics | Value |
|---|-----------------------------|
| Internal Input Pulldown Resistor (R1) | 75 kΩ |
| Internal Input Pullup Resistor (R2) | 75 kΩ |
| ESD Protection Human Body Model Machine Model Charged Device Model | > 2 kV > 150 V > 2 kV |
| Moisture Sensitivity (Note 1) | Pb-Free Pkg |
| SOIC-20 WB QFN-24 | Level 3 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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Table 3. MAXIMUM RATINGS

| Symbol | Parameter | Condition 1 | Condition 2 | Rating | Unit |
|---------------|---|---------------------|----------------------|----------------|------|
| V_{CC} | Positive Power Supply | GND = 0 V | | 3.8 to 0 | V |
| V_{EE} | Negative Power Supply | GND = 0 V | | -3.8 to 0 | V |
| V_I | Positive Input Voltage | GND = 0 V | $V_I \leq V_{CC}$ | 3.8 to 0 | V |
| V_{OP} | Operating Voltage | GND = 0 V | $V_{CC} - V_{EE}$ | 7.6 to 0 | V |
| I_{out} | Output Current | Continuous Surge | | 50 100 | mA |
| I_{BB} | PECL 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 |
| θ_{JA} | Thermal Resistance (Junction-to-Ambient) JESD 51-3 (1S-Single Layer Test Board) | 0 lfpm 500 lfpm | SOIC-20 WB | 90 60 | °C/W |
| θ_{JA} | Thermal Resistance (Junction-to-Ambient) JESD 51-6 (2S2P Multilayer Test Board) with Filled Thermal Vias | 0 lfpm 500 lfpm | QFN-24 | 37 32 | °C/W |
| θ_{JC} | Thermal Resistance (Junction-to-Case) | Standard Board | SOIC-20 WB QFN-24 | 30 to 35 11 | °C/W |
| T_{sol} | Wave Solder (Pb-Free) | | | 225 | °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 4. DC CHARACTERISTICS POSITIVE INPUTS ($V_{CC} = 2.5$ V, $V_{EE} = -2.375$ to -3.8 V, GND = 0 V (Note 1))

| Symbol | Characteristic | -40°C | | | 25°C | | | 85°C | | | Unit |
|-------------|---|-------|-----|----------|------|-----|----------|------|-----|----------|------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| I_{CC} | Positive Power Supply Current | 10 | 14 | 20 | 10 | 14 | 20 | 10 | 14 | 20 | mA |
| V_{IH} | Input HIGH Voltage (Single-Ended) | 1335 | | V_{CC} | 1335 | | V_{CC} | 1335 | | V_{CC} | mV |
| V_{IL} | Input LOW Voltage (Single-Ended) | GND | | 875 | GND | | 875 | GND | | 875 | mV |
| V_{IHCMR} | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 2) | 0 | | 2.5 | 0 | | 2.5 | 0 | | 2.5 | V |
| I_{IH} | Input HIGH Current (@ V_{IH}) | | | 150 | | | 150 | | | 150 | μA |
| I_{IL} | Input LOW Current (@ V_{IL}) | | | | | | | | | | μA |
| | D | 0.5 | | | 0.5 | | | 0.5 | | | |
| | \bar{D} | -150 | | | -150 | | | -150 | | | |

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. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

1. Input parameters vary 1:1 with V_{CC} . V_{CC} can vary +1.3 V / -0.125 V.
2. V_{IHCMR} min varies 1:1 with GND. V_{IHCMR} max varies 1:1 with V_{CC} .

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Table 5. DC CHARACTERISTICS POSITIVE INPUT ($V_{CC} = 3.3\text{ V}$; $V_{EE} = -2.375\text{ V}$ to -3.8 V ; $GND = 0\text{ V}$ (Note 1))

| Symbol | Characteristic | -40°C | | | 25°C | | | 85°C | | | Unit |
|-------------|--|-------------|------|----------|-------------|------|----------|-------------|------|----------|------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| I_{CC} | Positive Power Supply Current | 10 | 16 | 24 | 10 | 16 | 24 | 10 | 16 | 24 | mA |
| V_{IH} | Input HIGH Voltage (Single-Ended) | 2135 | | V_{CC} | 2135 | | V_{CC} | 2135 | | V_{CC} | mV |
| V_{IL} | Input LOW Voltage (Single-Ended) | GND | | 1675 | GND | | 1675 | GND | | 1675 | mV |
| V_{BB} | PECL Output Voltage Reference | 1775 | 1875 | 1975 | 1775 | 1875 | 1975 | 1775 | 1875 | 1975 | mV |
| V_{IHCMR} | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 2) | 0 | | 3.3 | 0 | | 3.3 | 0 | | 3.3 | V |
| I_{IH} | Input HIGH Current (@ V_{IH}) | | | 150 | | | 150 | | | 150 | μA |
| I_{IL} | Input LOW Current (@ V_{IL}) D D | 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. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

1. Input parameters vary 1:1 with V_{CC} . V_{CC} can vary +0.5 / -0.925 V.
2. V_{IHCMR} min varies 1:1 with GND. V_{IHCMR} max varies 1:1 with V_{CC} .

Table 6. DC CHARACTERISTICS NECL OUTPUT ($V_{CC} = 2.375\text{ V}$ to 3.8 V ; $V_{EE} = -2.375\text{ V}$ to -3.8 V ; $GND = 0\text{ V}$ (Note 1))

| Symbol | Characteristic | -40°C | | | 25°C | | | 85°C | | | Unit |
|----------|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| I_{EE} | Negative Power Supply Current | 40 | 50 | 60 | 38 | 50 | 68 | 38 | 50 | 68 | mA |
| V_{OH} | Output HIGH Voltage (Note 2) | -1145 | -1020 | -895 | -1145 | -1020 | -895 | -1145 | -1020 | -895 | mV |
| V_{OL} | Output LOW Voltage (Note 2) | -1945 | -1770 | -1600 | -1945 | -1770 | -1600 | -1945 | -1770 | -1600 | mV |

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. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

1. Output parameters vary 1:1 with GND.
2. All loading with 50 Ω resistor to GND - 2.0 V.

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Table 7. AC CHARACTERISTICS ($V_{CC} = 2.375\text{ V to }3.8\text{ V}$; $V_{EE} = -2.375\text{ V to }-3.8\text{ V}$; $GND = 0\text{ V}$)

| Symbol | Characteristic | -40°C | | | 25°C | | | 85°C | | | Unit |
|-------------------------|--|-------------------|-------------------|-----------------|-------------------|-------------------|------------------|-------------------|-------------------|------------------|------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| V_{OUTPP} | Output Voltage Amplitude (Figure 4) (Note 1) $f_{in} \pm 1.0\text{ GHz}$ $f_{in} \pm 1.5\text{ GHz}$ $f_{in} \pm 2.0\text{ GHz}$ | 575 525 300 | 800 750 600 | | 600 525 250 | 800 750 550 | | 550 400 150 | 800 750 500 | | mV |
| t_{PLH} t_{PHL0} | Propagation Delay Differential D to Q 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 2) Output-to-Output (Note 3) Part-to-Part (Diff) (Note 3) | | 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 4) $f_{in} = 2.0\text{ GHz}$ Peak-to-Peak Data Dependant Jitter (Note 5) $f_{in} = 2.0\text{ Gb/s}$ | | 0.5 20 | 2.0 | | 0.5 20 | 2.0 | | 0.5 20 | 2.0 | ps |
| V_{INPP} | Input Voltage Swing (Differential Configuration) (Note 6) | 200 | 800 | 1200 | 200 | 800 | 1200 | 200 | 800 | 1200 | mV |
| t_r, t_f | Output Rise/Fall Times @ 50 MHz (20% – 80%) Q, Q | 75 | 150 | 250 | 75 | 150 | 250 | 75 | 150 | 275 | 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. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

1. Measured using a 750 mV source, 50% duty cycle clock source. All loading with 50 Ω to GND – 2.0 V. Input edge rates 150 ps (20% – 80%).
2. Pulse Skew = $|t_{PLH} - t_{PHL}|$
3. Skews are valid across specified voltage range, part-to-part skew is for a given temperature.
4. RMS Jitter with 50% Duty Cycle Input Clock Signal.
5. Peak-to-Peak Jitter with input NRZ PRBS $2^{31}-1$ at 2.0 Gb/s.
6. Input voltage swing is a single-ended measurement operating in differential mode. The device has a DC gain of ≈ 50 .

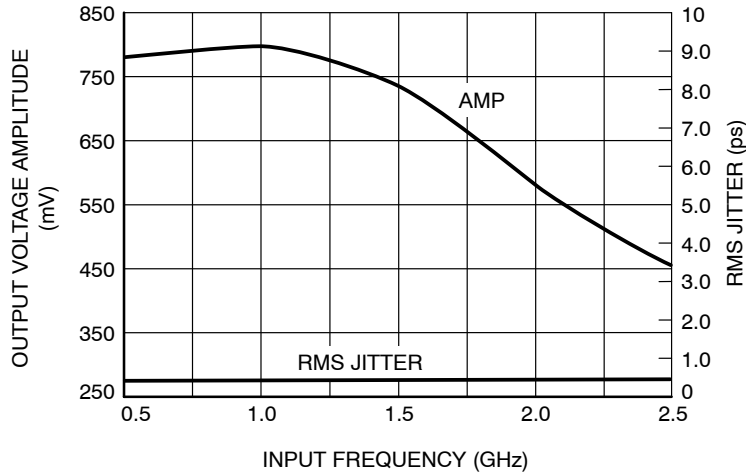


Figure 4. Output Voltage Amplitude (V_{OUTPP}) / RMS Jitter vs. Input Frequency (f_{in}) at Ambient Temperature (Typical)

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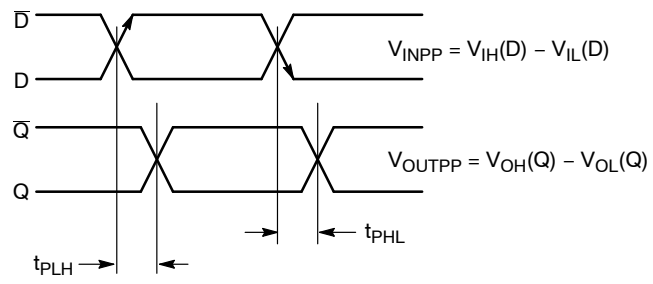


Figure 5. AC Reference Measurement

Application Information

All NB100LVEP91 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 Ω environment ($Z = 50 \Omega$)

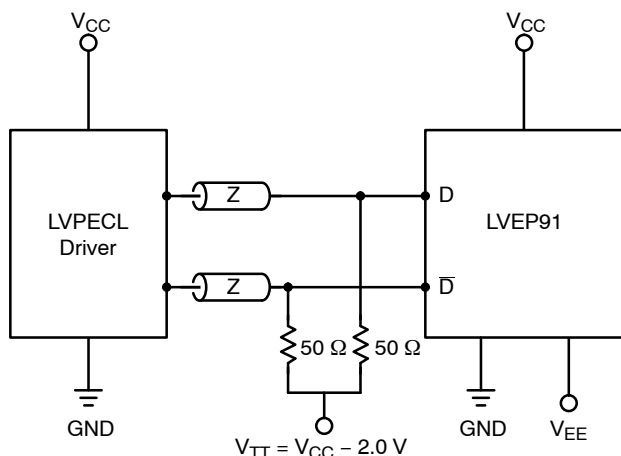


Figure 6. Standard LVPECL Interface

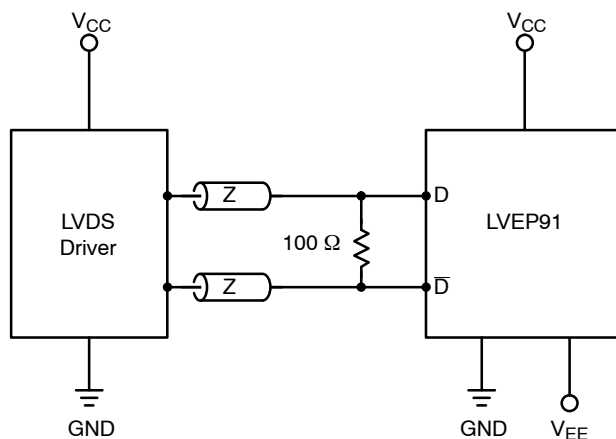


Figure 7. Standard LVDS Interface

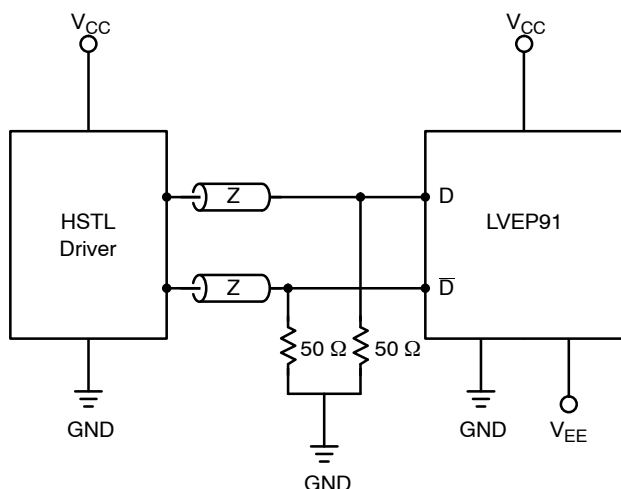


Figure 8. Standard HSTL Interface

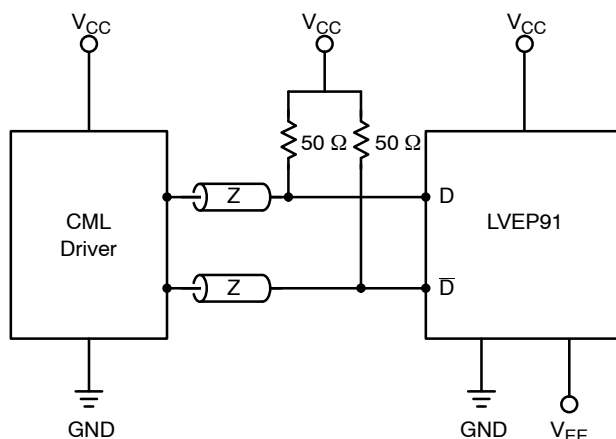


Figure 9. Standard 50 Ω Load CML Interface

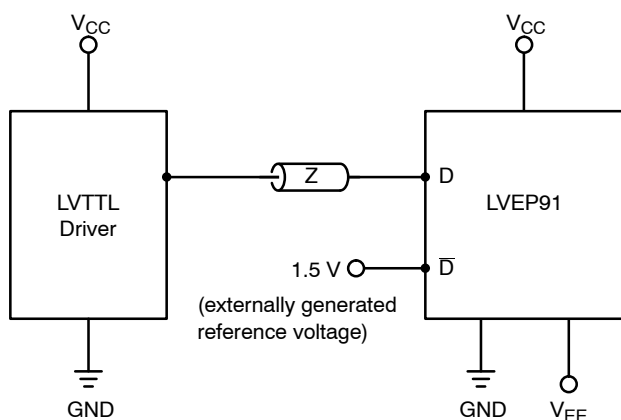


Figure 10. Standard LVTTTL Interface

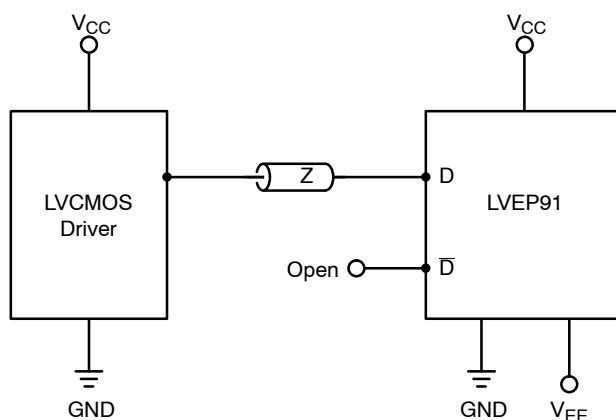


Figure 11. Standard LVCMOS Interface
(\bar{D} Will Default to $V_{CC}/2$ When Left Open.
A Reference Voltage of $V_{CC}/2$ Should be Applied to \bar{D} Input, if \bar{D} is Interfaced to CMOS Signals.)

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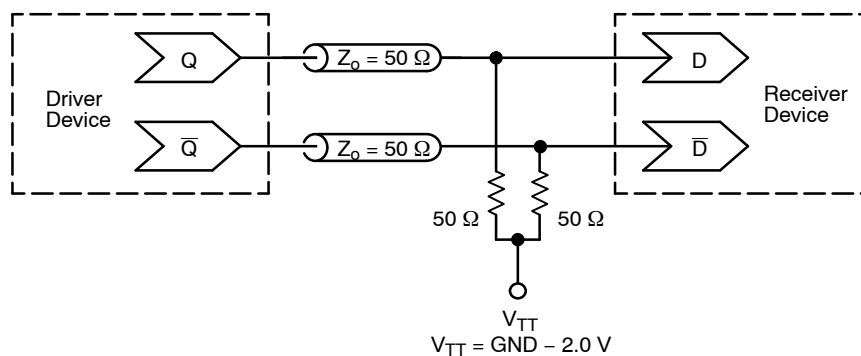


Figure 12. Typical Termination for Output Driver and Device Evaluation
(See Application Note [AND8020/D](#) – Termination of ECL Logic Devices.)

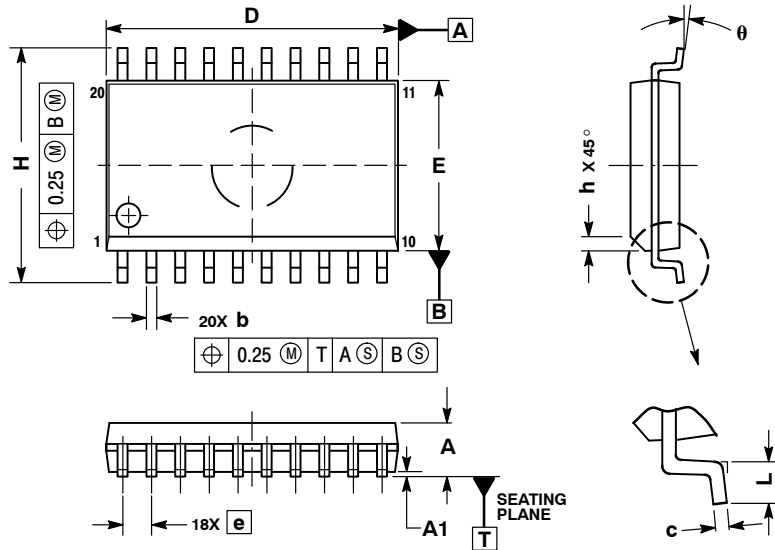
Resource Reference of Application Notes

- 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

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PACKAGE DIMENSIONS

SOIC-20 WB
CASE 751D-05
ISSUE H

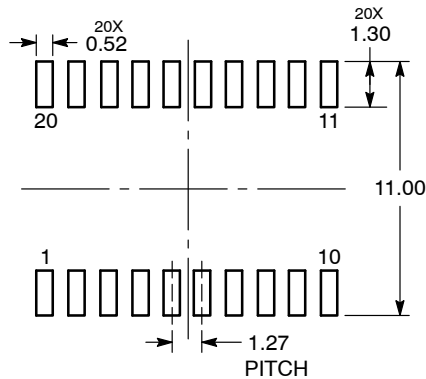


NOTES:

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.

| DIM | MILLIMETERS | |
|-----|-------------|-------|
| | 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° |

RECOMMENDED SOLDERING FOOTPRINT*



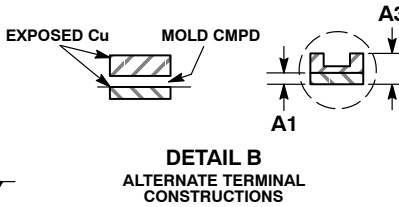
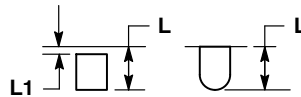
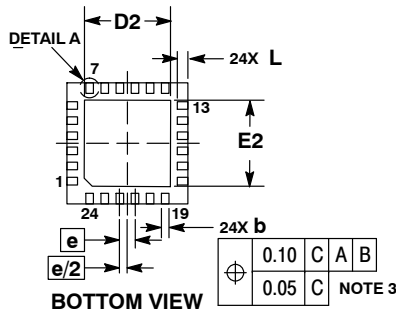
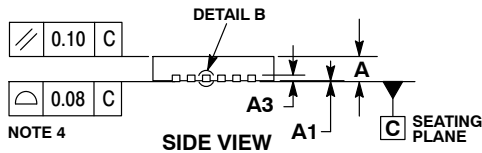
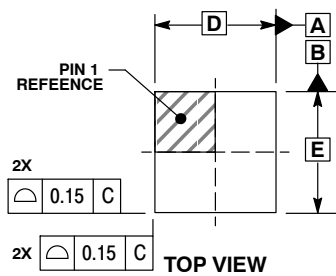
DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, [SOLDERRM/D](http://www.onsemi.com/SOLDERRM/D).

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PACKAGE DIMENSIONS

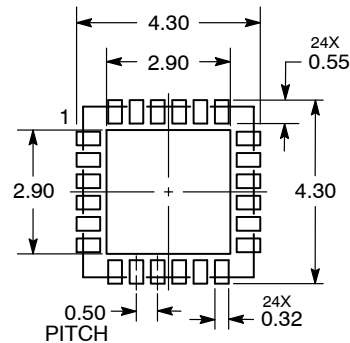
QFN-24, 4x4, 0.5P
CASE 485L
ISSUE B



- 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.

| MILLIMETERS | | |
|-------------|------|------|
| DIM | 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 |

RECOMMENDED 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, [SOLDDRRM/D](#).

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