2.5 V / 3.3 V Dual 2:1 Differential Clock / Data Multiplexer with LVPECL Outputs

Multi−Level Inputs w/ Internal Termination

NB6L56

The NB6L56 is a high performance Dual 2−to−1 Differential Clock or Data multiplexer. The differential inputs incorporate internal 50 Ω termination resistors that are accessed through the VT pin. This feature allows the NB6L56 to accept various Differential logic level standards, such as LVPECL, CML or LVDS. Outputs are 800 mV LVPECL signals. For interface options see Figures 12 − 15.

The NB6L56 produces minimal Clock or Data jitter operating up to 2.5 GHz or 2.5 Gbps, respectively. As such, the NB6L56 is ideal for SONET, GigE, Fiber Channel, Backplane and other Clock/Data distribution applications.

The NB6L56 is offered in a low profile 5 mm x 5 mm 32−pin QFN package and is a member of the ECLinPS MAX™ family of high performance Clock / Data products. Application notes, models, and support documentation are available at www.onsemi.com.

Features

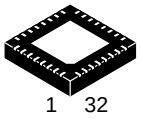
- Maximum Input Data Rate > 2.5 Gbps
- Maximum Input Clock Frequency > 2.5 GHz
- Jitter
  < 1 ps RMS RJ (Data)
  < 10 ps PP DJ (Data)
  < 0.7 ps RMS Crosstalk induced jitter (CLOCK)
- 360 ps Max Propagation Delay
- 180 ps Max Rise and Fall Times
- Operating Range:
  V_{CC} = 2.5 ± 5% (2.375 V to 2.625 V)
  V_{CC} =3.3 ± 10% (3.0 V to 3.6 V)
- Internal 50 Ω Input Termination Resistors
- Industrial Temp. Range (−40°C to 85°C)
- QFN−32 Package
- These are Pb−Free Devices

Applications

- Clock and Data Distribution
- Networking and Communications
- High End Computing
- Wireless and Wired Infrastructure

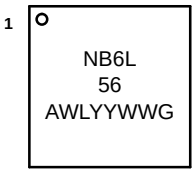
End Products

- Servers
- Ethernet Switch/Routers
- ATE
- Test and Measurement



QFN32
MN SUFFIX
CASE 488AM

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.

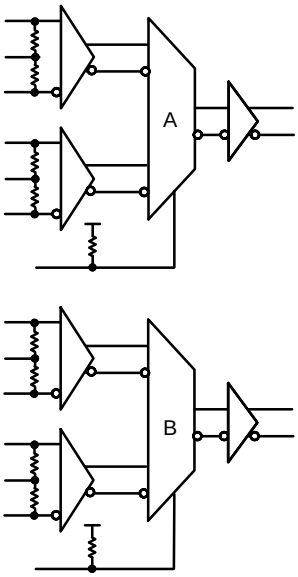


Figure 1. Simplified Logic Diagram

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

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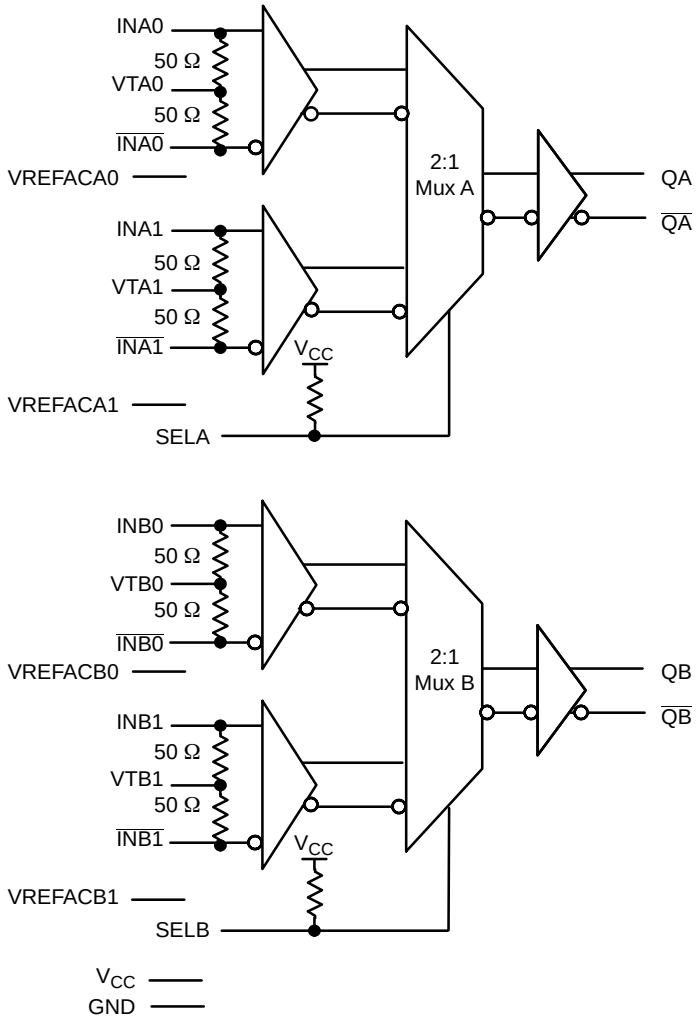

Figure 2. Pin Configuration (Top View)

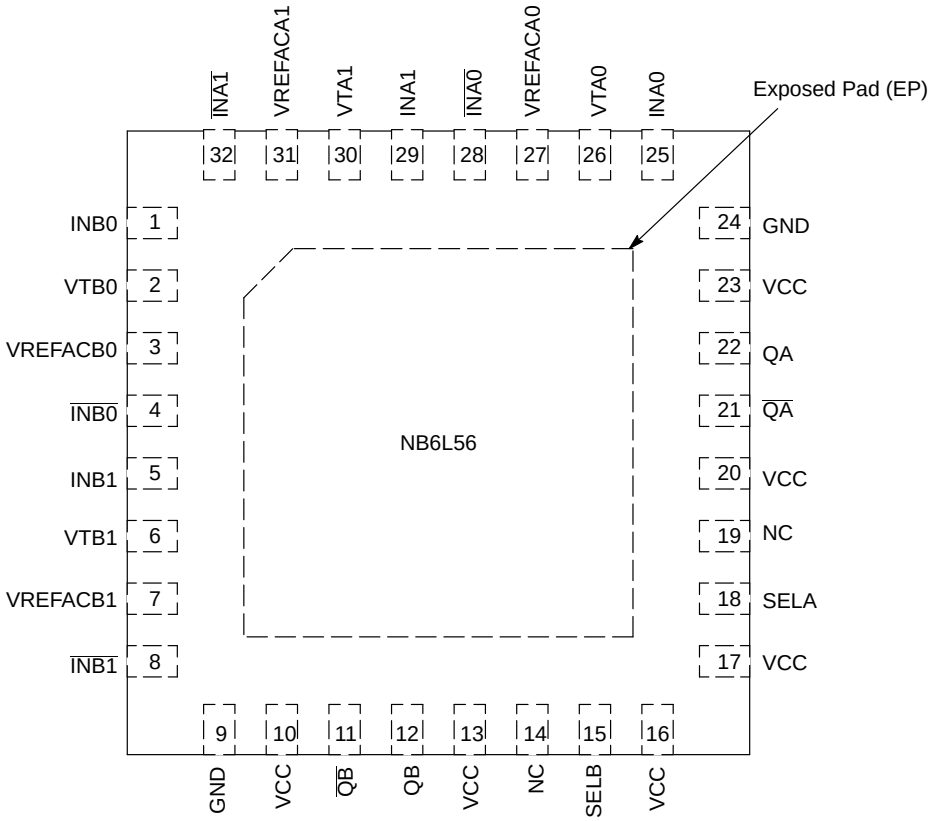

Figure 3. NB6L56 Pinout: QFN−32 (Top View)

Table 1. PIN DESCRIPTION

Pin	Name	I/O	Pin Description
1, 4 5, 8 25, 28 29, 32	INB0, $\overline{\text{INB0}}$ INB1, $\overline{\text{INB1}}$ INA0, $\overline{\text{INA0}}$ INA1, $\overline{\text{INA1}}$	LVPECL, CML, LVDS Input	Noninverted, Inverted Differential Input pairs (Note 1). Default state is indeterminate if left floating open. Do not connect unused input pairs with one input connected to VCC and the complementary input to GND. For differential and single ended interface, see “Interface Applications”.
2, 6 26, 30	VTB0, VTB1 VTA0, VTA1		Internal 100 Ω Center−tapped Termination Pin for Differential Input pairs (Figure 4)
3 7 27 31	VREFACB0 VREFACB1 VREFACA0 VREFACA1	−	Output Voltage Reference for Capacitor−Coupled Inputs or Single Ended Interface (see “Interface Applications”)
15 18	SELB SELA	LVTTL / LVCMOS Input	Input Select pin; LOW for IN0 Inputs, HIGH for IN1 Inputs; defaults HIGH when left open
14, 19	NC	−	No Connect
10, 13,16,17 20, 23	VCC	Power	Positive Supply Voltage. All VCC pins must be connected to the positive power supply for correct DC and AC operation.
11, 12 21, 22	$\overline{\text{QB}}$, QB $\overline{\text{QA}}$, QA	LVPECL Output	Inverted, Non−inverted Differential Outputs Note 1.
9, 24	GND	Ground	Negative Supply Voltage, connected to Ground
−	EP	−	The Exposed Pad (EP) on the package bottom is thermally connected to the die for improved heat transfer out of package. The exposed pad must be attached to a heat−sinking conduit. The pad is connected to the die and must only be connected electrically to GND on the PC board.

1. If no signal is applied on any INxn input pair, the device will be susceptible to self−oscillation.
2. All V_{CC} and GND pins must be externally connected to a power supply for proper operation.

Table 2. INPUT SELECT FUNCTION TABLE

SELA/SELB	Q	$\overline{Q}$
L	INx0	$\overline{INx0}$
H	INx1	$\overline{INx1}$

Table 3. ATTRIBUTES

Characteristic		Value
ESD Protection	Human Body Model Machine Model	>2 kV 200 V
Input Pullup resistor (R_{PU})		75 kΩ
Moisture Sensitivity (Note 3)	QFN32	Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V−0 @ 0.125 in
Transistor Count		1023
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test		

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

Table 4. MAXIMUM RATINGS (Note 4)

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V_{CC}	Positive Power Supply	GND = 0 V		4.0	V
V_{INPP}	Differential Input Voltage |INx − $\overline{INx}$|			1.89	V
I_{IN}	Input Current Through RT (50 Ω Resistor)			±40	mA
I_{OUT}	Output Current	Continuous Surge		±50 ±100	mA
I_{VREFAC}	VREFAC Sink/Source Current			±1.5	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) (Note 4)	0 lfpm 500 lfpm	QFN − 32 QFN − 32	31 27	°C/W
θ_{JC}	Thermal Resistance (Junction−to−Case) (Note 4)	Standard Board	QFN − 32	12	°C/W
ψ_{JC}	Thermal Resistance (Junction−to−Board)			16	°C/W
T_{sol}	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.

4. JEDEC standard 51−6, multilayer board − 2S2P (2 signal, 2 power) with eight filled thermal vias under exposed pad.

Table 5. DC CHARACTERISTICS V_{CC} = 2.5 ± 5% (2.375 V to 2.625 V); V_{CC} = 3.3 ± 10% (3.0 V to 3.6 V) (Note 5)

Symbol	Characteristic	Min	Typ	Max	Unit
I_{CC}	Power Supply Current (Inputs and Outputs Open)		65	85	mA
LVPECL OUTPUTS					
V_{OH}	Output HIGH Voltage	V_{CC} – 1.145		V_{CC} – 0.895	mV
V_{OL}	Output LOW Voltage	V_{CC} – 2.000		V_{CC} – 1.695	mV
V_{OUT}	Output Swing (Single Ended) Output Swing (Differential)	400 800	800 1600		mV
DIFFERENTIAL INPUT DRIVEN SINGLE−ENDED (Note 6) (Figures 5 and 6)					
V_{th}	Input Threshold Reference Voltage Range	1125		V_{CC} − 75	mV
V_{IH}	Single−ended Input HIGH Voltage	V_{th} + 75		V_{CC}	mV
V_{IL}	Single−ended Input LOW Voltage	GND		V_{th} − 75	mV
V_{ISE}	Single−ended Input Voltage (V_{IH} − V_{IL}) (Note 6)	150		3015	mV
DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY (Note 7) (Figures 7 and 8)					
V_{IHD}	Differential Input HIGH Voltage	1200		V_{CC}	mV
V_{ILD}	Differential Input LOW Voltage	GND		V_{IHD} − 100	mV
V_{ID}	Differential Input Voltage (V_{IHD} − V_{ILD})	100		1890	mV
V_{CMR}	Input Common Mode Range (Differential Configuration) (Figure 9)	1150		V_{CC} − 50	mV
I_{IH}	Input HIGH Current (VTnx Open)	−150		150	μA
I_{IL}	Input LOW Current (VTnx Open)	−150		150	μA
LVTTL / LVCMOS INPUTS (SELA/SELB)					
V_{IH}	Input HIGH Voltage	2.0			V
V_{IL}	Input LOW Voltage			0.8	V
I_{IL}	Input LOW Current (V_{IN} = 0.5 V)	−300			μA
I_{IH}	Input HIGH Current (V_{CC})			75	μA
TERMINATION RESISTORS					
R_{TIN}	Internal Input Termination Resistor INxn/$\overline{\text{INxn}}$ to VTxn	45	50	55	Ω
REFERENCE VOLTAGE					
VREF−AC	Output Reference Voltage	V_{CC} − 1.35	V_{CC} − 1.2	V_{CC} − 1.1	V

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.

5. Outputs evaluated with 50 Ω resistors to V_{TT} = V_{CC} − 2.0 V for proper operation (See Figure 16).
6. V_{TH} is applied to the complementary input when operating in single−ended mode. V_{IH}, V_{IL} and V_{TH} parameters must be complied with simultaneously.
7. V_{IHD}, V_{ILD} and V_{CMR} parameters must be complied with simultaneously. V_{CMR} max varies 1:1 with V_{CC}.

Table 6. AC CHARACTERISTICS V_{CC} = 2.5 ± 5% (2.375 V to 2.625 V); V_{CC} = 3.3 ± 10% (3.0 V to 3.6 V) (Note 8)

Symbol	Characteristic	Min	Typ	Max	Unit
f_{MAX}	Maximum Input Clock Frequency $V_{outpp} \geq 400$ mV Maximum Operating Data Rate (NRZ) $V_{outpp} \geq 400$ mV	2.5 2.5			Ghz Gbps
fSEL	Maximum Toggle Frequency, SELA/SELB	25	50		MHz
V_{OUTPP}	Output Voltage Amplitude (Differential Interconnect) $f_{in} \leq 2.5$ GHz	400			mVpp
t_{PLH}, t_{PHL}	Propagation Delay to Differential Outputs, @ 1 GHz, INxn/$\overline{INxn}$ to Qx, $\overline{Qx}$ SELx to Qx, $\overline{Qx}$	 160 100	 250 260	 360 400	ps
t_{PLH} Tempco	Differential Propagation Delay Temperature Coefficient		143		Δfs/°C
tskew	Input to Input per Bank Within Device Output Bank to Output Bank Within Device		10 12	20 25	ps
t_{JITTER}	DATA JITTER R_J for K28.7 at 2.5 GHz (RMS) D_J for NRZ PRBS23 / K28.5 at 2.5 Gbps CLOCK JITTER Cycle to Cycle (1K WFMS; RMS) Total Jitter TJ (PP)			 1 10 1 10	ps
tjit(ϕ)	Integrated Phase Jitter fin = 155.52 MHz and 1GHz 12 kHz − 20 MHz Offset (RMS)		35		fs
t_{JITTER}	Crosstalk Induced Jitter Input to Input per Output Bank Within Device (Note 9)			0.7	psRMS
V_{INPP}	Input Voltage Swing (Differential Configuration) (Note 10)	100		1200	mV
t_r, t_f	Output Rise/Fall Times @ 1 GHz (20% − 80%), Q_x, $\overline{Q_x}$	50	100	180	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 lfpm.

8. Differential 50% duty cycle at $V_{INPPmin}$ clock source. Outputs evaluated with 50 Ω resistors to $V_{TT} = V_{CC}$ − 2.0 V (See Figure 16). Input crosspoint to output crosspoint for INxn/$\overline{INxn}$ to Qx, $\overline{Qx}$; 50% input to output crosspoint for SELx to Qx, $\overline{Qx}$. See Figures 5, 10 and 11.
9. Crosstalk is measured at the output while applying two similar clock frequencies that are asynchronous with respect to each other at the inputs.
10. Input voltage swing is a single−ended measurement operating in differential mode.

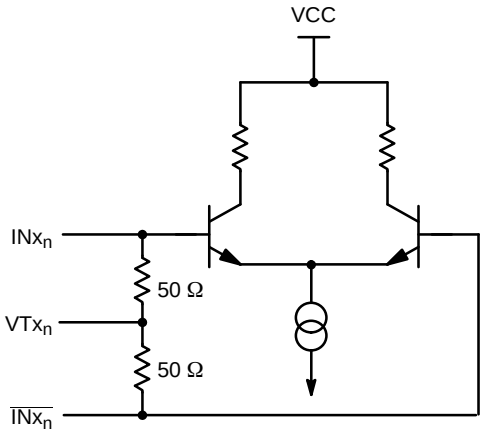

Figure 4. Simplified Input Structure

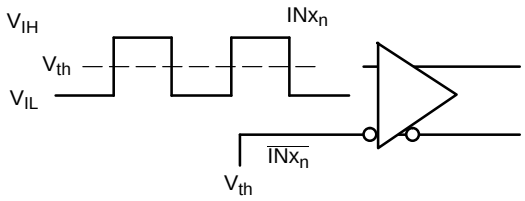

Figure 5. Differential Input Driven Single−Ended

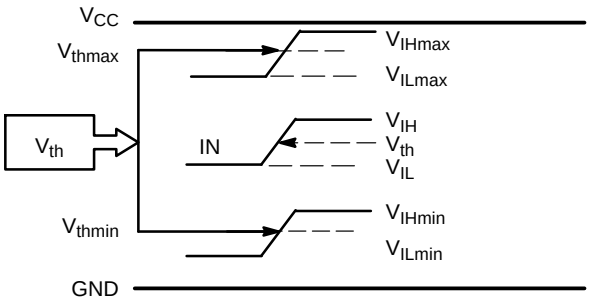

Figure 6. V_{th} Diagram

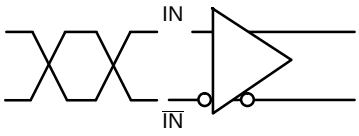

Figure 7. Differential Inputs Driven Differentially

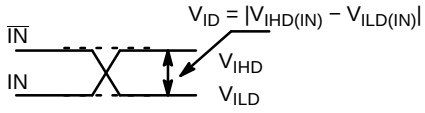

Figure 8. Differential Inputs Driven Differentially

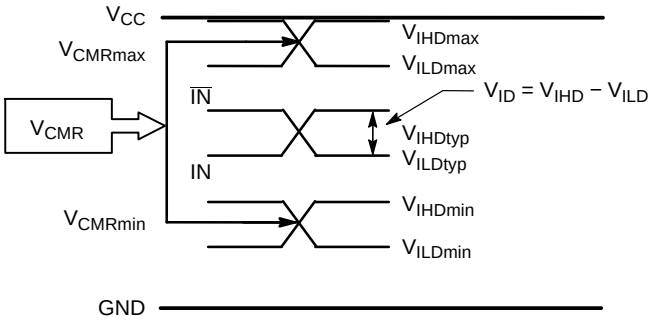

Figure 9. VCMR Diagram

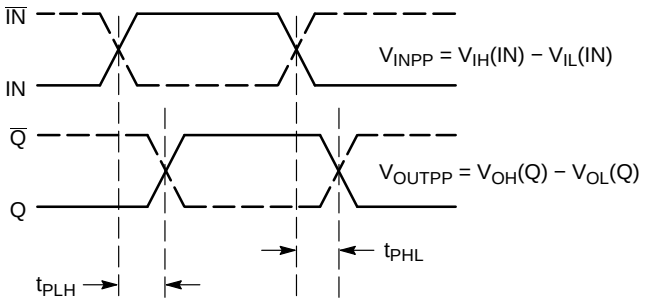

Figure 10. AC Reference Measurement

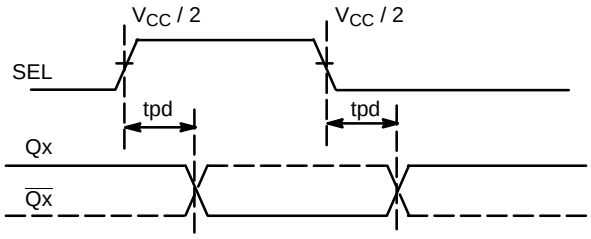

Figure 11. SEL to Qx Timing Diagram

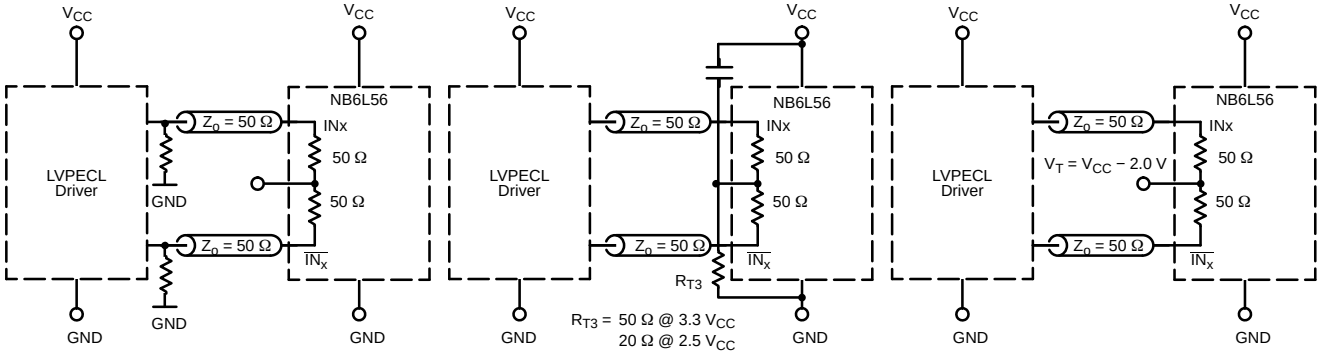

Figure 12. Typical LVPECL Interface (see AND8020)

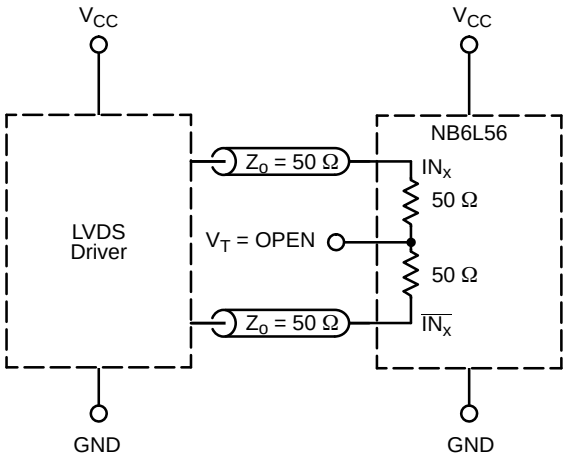

Figure 13. Typical LVDS Interface

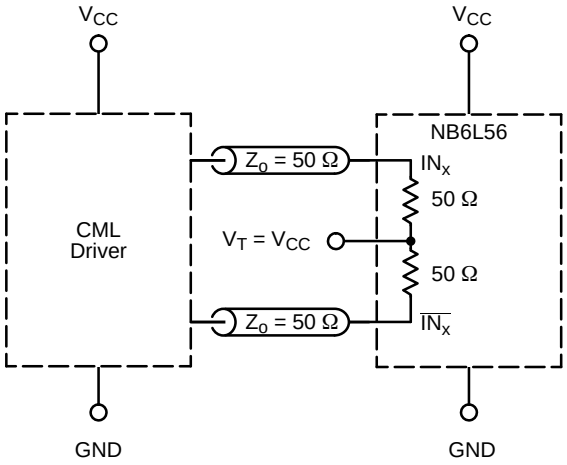

Figure 14. Typical Standard 50 Ω Load CML Interface

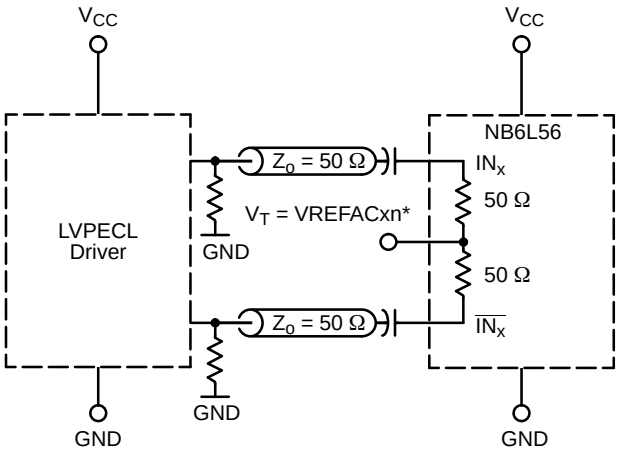

Figure 15. Typical LVPECL Capacitor−Coupled Differential Interface (V_T Connected to V_{REFAC})

*VREFAC bypassed to ground with a 0.01 μF capacitor.

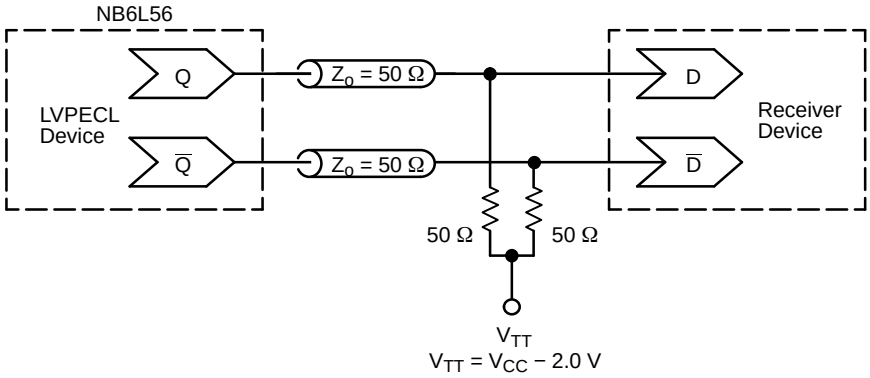

Figure 16. Typical Termination for LVPECL Output Driver and Device Evaluation (See Application Note AND8020/D − Termination of ECL Logic Devices.)

ORDERING INFORMATION

Device	Package	Shipping†
NB6L56MNTXG	QFN32 (Pb−Free)	1000 / 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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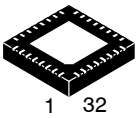
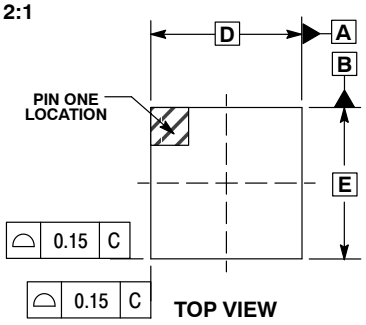
QFN32 5x5, 0.5P
CASE 488AM
ISSUE A

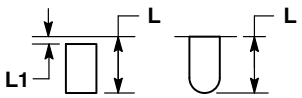
DATE 23 OCT 2013



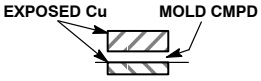
SCALE 2:1



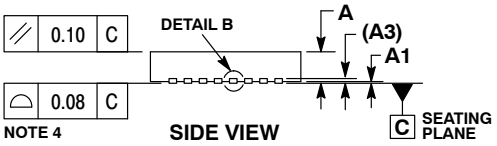
TOP VIEW



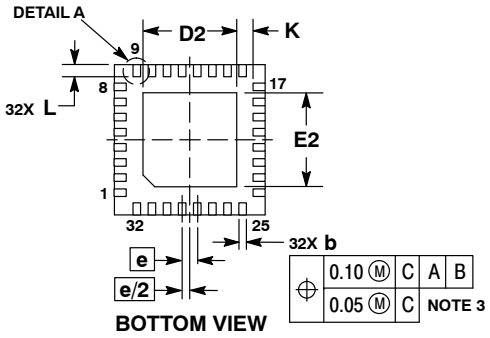
DETAIL A
ALTERNATE TERMINAL CONSTRUCTIONS



DETAIL B
ALTERNATE CONSTRUCTION



SIDE VIEW

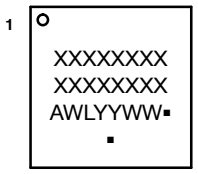


BOTTOM VIEW

NOTES:
1. DIMENSIONS 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 0.30MM 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	---	0.05
A3	0.20 REF	
b	0.18	0.30
D	5.00 BSC	
D2	2.95	3.25
E	5.00 BSC	
E2	2.95	3.25
e	0.50 BSC	
K	0.20	---
L	0.30	0.50
L1	---	0.15

GENERIC MARKING DIAGRAM*

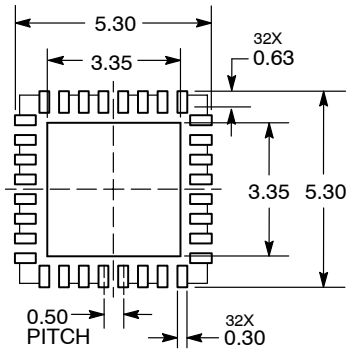


XXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
▪ = Pb−Free Package

(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*



DIMENSION: 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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DESCRIPTION:	**QFN32 5x5 0.5P**	**PAGE 1 OF 1**

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