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NB7L585

2.5V / 3.3V Differential 2:1 Mux Input to 1:6 LVPECL Clock/Data Fanout Buffer / Translator

Multi−Level Inputs w/ Internal Termination

Description

The NB7L585 is a differential 1:6 LVPECL Clock/Data distribution chip featuring a 2:1 Clock/Data input multiplexer with an input select pin. The INx/$\overline{\text{INx}}$ inputs incorporate internal 50 Ω termination resistors and will accept LVPECL, CML, or LVDS logic levels.

The NB7L585 produces six identical output copies of Clock or Data operating up to 5 GHz or 8 Gb/s, respectively. As such, NB7L585 is ideal for SONET, GigE, Fiber Channel, Backplane and other Clock/Data distribution applications.

The NB7L585 is powered with either 2.5 V or 3.3 V supply and is offered in a low profile 5mm x 5mm 32−pin QFN package.

Application notes, models, and support documentation are available at www.onsemi.com.

The NB7L585 is a member of the GigaComm™ family of high performance clock products.

Features

- Maximum Input Data Rate > 8 Gb/s
- Data Dependent Jitter < 15 ps
- Maximum Input Clock Frequency > 5 GHz
- Random Clock Jitter < 0.8 ps RMS
- Low Skew 1:6 LVPECL Outputs, 20 ps max
- 2:1 Multi−Level Mux Inputs
- 175 ps Typical Propagation Delay
- 55 ps Typical Rise and Fall Times
- Differential LVPECL Outputs, 800 mV peak−to−peak, typical
- Operating Range: V_{CC} = 2.375 V to 3.6 V with GND = 0 V
- Internal 50 Ω Input Termination Resistors
- VREFAC Reference Output
- QFN−32 Package, 5mm x 5mm
- −40ºC to +85ºC Ambient Operating Temperature
- These Devices are Pb−Free and are RoHS Compliant

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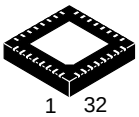
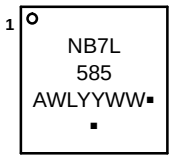


QFN32
MN SUFFIX
CASE 488AM

MARKING DIAGRAM



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

(Note: Microdot may be in either location)

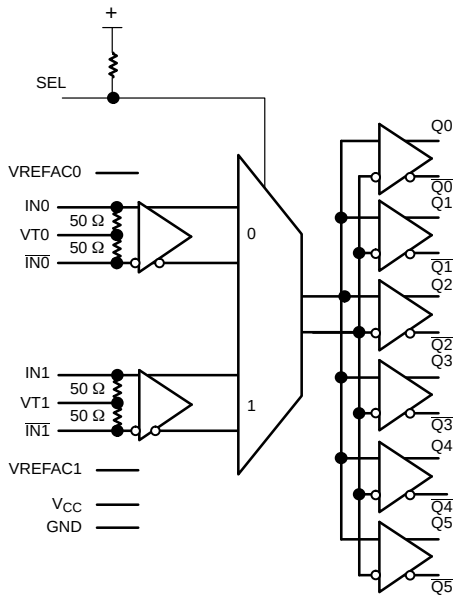


Figure 1. Simplified Block Diagram

ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

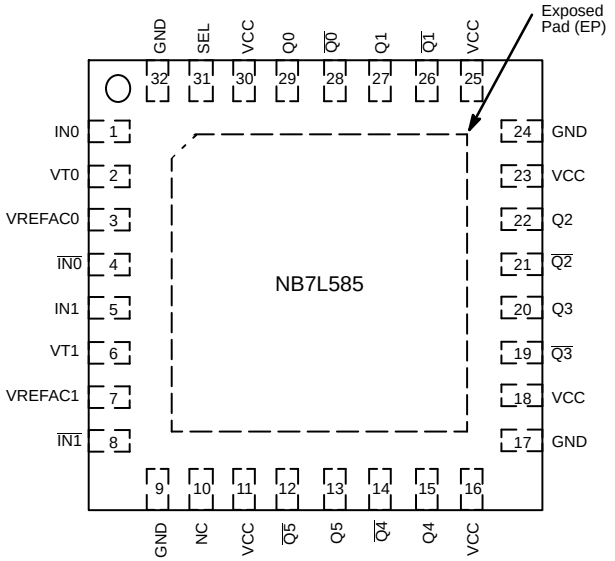


Figure 2. Pinout: QFN−32 (Top View)

Table 1. INPUT SELECT FUNCTION TABLE

SEL*	CLK Input Selected
0	IN0
1	IN1

*Defaults HIGH when left open.

Table 2. PIN DESCRIPTION

Pin Number	Pin Name	I/O	Pin Description
1,4 5,8	IN0, $\overline{IN0}$ IN1, $\overline{IN1}$	LVPECL, CML, LVDS Input	Non−inverted, Inverted, Differential Data Inputs internally biased to $V_{CC}/2$
2,6	VT0, VT1		Internal 100 Ω Center−tapped Termination Pin for IN0 / $\overline{IN0}$ and IN1 / $\overline{IN1}$
31	SEL	LVTTL/LVCMOS Input	Input Select pin; LOW for IN0 Inputs, HIGH for IN1 Inputs; defaults HIGH when left open
10	NC	−	No Connect
11, 16, 18 23, 25, 30	V_{CC}	−	Positive Supply Voltage. All V_{CC} pins must be connected to the positive power supply for correct DC and AC operation.
29, 28 27, 26 22, 21 20, 19 15, 14 13, 12	Q0, $\overline{Q0}$ Q1, $\overline{Q1}$ Q2,$\overline{Q2}$ Q3, $\overline{Q3}$ Q4, $\overline{Q4}$ Q5, $\overline{Q5}$	LVPECL Output	Non−inverted, Inverted Differential Outputs Note 1.
9, 17, 24, 32	GND		Negative Supply Voltage, connected to Ground
3 7	VREFAC0 VREFAC1	−	Output Voltage Reference for Capacitor−Coupled Inputs
−	EP	−	The Exposed Pad (EP) on the QFN−32 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 electrically connected to the die, and must be electrically and thermally connected to GND on the PC board.

1. In the differential configuration when the input termination pins (VT0, VT1) are connected to a common termination voltage or left open, and if no signal is applied on INn/$\overline{INn}$ input, then 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 3. ATTRIBUTES

Characteristics		Value
ESD Protection	Human Body Model Machine Model	> 2 kV > 200 V
R_{PU} − SEL Input Pullup Resistor		75 kΩ
Moisture Sensitivity (Note 3)	QFN−32	Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V−0 @ 0.125 in
Transistor Count		288
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test		

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

Table 4. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V_{CC}	Positive Power Supply	GND = 0 V		+4.0	V
V_{IO}	Input/Output Voltage	GND = 0 V		−0.5 to V_{CC} +0.5	V
V_{INPP}	Differential Input Voltage |IN − $\overline{IN}$|			1.89	V
I_{IN}	Input Current Through R_T (50 Ω Resistor)			±40	mA
I_{out}	Output Current	Continuous Surge		50 100	mA
I_{VREFAC}	VREFAC Sink or 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	QFN32 QFN32	31 27	°C/W
θ_{JC}	Thermal Resistance (Junction−to−Case) (Note 4)		QFN32	12	°C/W
T_{sol}	Wave Solder			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 multilayer board − 2S2P (2 signal, 2 power) with 8 filled thermal vias under exposed pad.

Table 5. DC CHARACTERISTICS POSITIVE LVPECL OUTPUT V_{CC} = 2.375 V to 3.6 V; GND = 0 V; T_A = −40°C to 85°C (Note 5)

Symbol	Characteristic	Min	Typ	Max	Unit
POWER SUPPLY					
V_{CC}	Power Supply Voltage V_{CC} = 3.3V V_{CC} = 2.5V	3.0 2.375	3.3 2.5	3.6 2.625	V
I_{CC}	Power Supply Current (Inputs and Outputs Open)		185	225	mA
LVPECL Outputs					
V_{OH}	Output HIGH Voltage (Note 6) V_{CC} = 3.3 V V_{CC} = 2.5 V	V_{CC} – 1145 2155 1355		V_{CC} – 800 2500 1700	mV
V_{OL}	Output LOW Voltage (Note 6) V_{CC} = 3.3 V V_{CC} = 2.5 V	V_{CC} – 2000 1300 500		V_{CC} – 1500 1800 1000	mV
DIFFERENTIAL CLOCK INPUTS DRIVEN SINGLE−ENDED (Note 7) (Figures 5 & 6)					
V_{IH}	Single−ended Input HIGH Voltage	V_{th} + 100		V_{CC}	mV
V_{IL}	Single−ended Input LOW Voltage	GND		V_{th} − 100	mV
V_{th}	Input Threshold Reference Voltage Range (Note 8)	1100		V_{CC} −100	mV
V_{ISE}	Single−ended Input Voltage (V_{IH} − V_{IL})	200		1200	mV
VREFACx (for Capacitor− Coupled Inputs, Only)					
V_{REFAC}	Output Reference Voltage @100 μA for Capacitor− Coupled Inputs, Only	V_{CC} – 1500	V_{CC} – 1200	V_{CC} – 1000	mV
DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY (Figures 7 & 8) (Note 9)					
V_{IHD}	Differential Input HIGH Voltage (IN, $\overline{IN}$)	1200		V_{CC}	mV
V_{ILD}	Differential Input LOW Voltage (IN , $\overline{IN}$)	GND		V_{IHD} − 100	mV
V_{ID}	Differential Input Voltage (IN , $\overline{IN}$) (V_{IHD} − V_{ILD})	100		1200	mV
V_{CMR}	Input Common Mode Range (Differential Configuration, Note 10) (Figure 9)	1050		V_{CC} − 50	mV
I_{IH}	Input HIGH Current IN/$\overline{IN}$ (VTIN/$\overline{VTIN}$ Open)	−150		150	μA
I_{IL}	Input LOW Current IN/$\overline{IN}$ (VTIN/$\overline{VTIN}$ Open)	−150		150	μA
CONTROL INPUT (SEL Pin)					
V_{IH}	Input HIGH Voltage for Control Pin	2.0		V_{CC}	mV
V_{IL}	Input LOW Voltage for Control Pin	GND		0.8	mV
I_{IH}	Input HIGH Current	−150		150	μA
I_{IL}	Input LOW Current	−150		150	μA
TERMINATION RESISTORS					
R_{TIN}	Internal Input Termination Resistor (Measured from INx to VTx)	45	50	55	Ω

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.

5. Input and output parameters vary 1:1 with V_{CC}.
6. LVPECL outputs (Qn/$\overline{Qn}$) loaded with 50 Ω to V_{CC} – 2 V for proper operation.
7. V_{th}, V_{IH}, $V_{IL,,}$ and V_{ISE} parameters must be complied with simultaneously.
8. V_{th} is applied to the complementary input when operating in single−ended mode.
9. V_{IHD}, V_{ILD}, V_{ID} and V_{CMR} parameters must be complied with simultaneously.
10. V_{CMR} min varies 1:1 with GND, V_{CMR} max varies 1:1 with V_{CC}. The V_{CMR} range is referenced to the most positive side of the differential input signal.

Table 6. AC CHARACTERISTICS V_{CC} = 2.375 V to 3.6 V; GND = 0 V; T_A = −40°C to 85°C (Note 11)

Symbol	Characteristic		Min	Typ	Max	Unit
f_{MAX}	Maximum Input Clock Frequency; $V_{OUTpp} \geq$ 400 mV		5	7		GHz
$f_{DATAMAX}$	Maximum Operating Data Rate (PRBS23)		8	10		Gbps
f_{SEL}	Maximum Toggle Frequency, SEL		1.0	1.5		GHz
V_{OUTpp}	Output Voltage Amplitude (@ $V_{INPPmin}$) (Note 12) (Figures 8 and 10)	$f_{in} \leq$ 4 GHz $f_{in} \leq$ 5 GHz	550 400	800 650		mV
t_{PLH}, t_{PHL}	Propagation Delay to Differential Outputs, @ 1 GHz, measured at differential crosspoint	IN/$\overline{IN}$ to Q/$\overline{Q}$ SEL to Q	125 75	175 200	250 300	ps
t_{PLH} TC	Propagation Delay Temperature Coefficient			50		Δfs/°C
tskew	Output − Output skew (within device) (Note 13) Device − Device skew (tpd max – tpdmin)				20 100	ps
t_{DC}	Output Clock Duty Cycle (Reference Duty Cycle = 50%)	$f_{in} \leq$ 5.0 GHz	45	50	55	%
Φ_N	Phase Noise, f_{in} = 1 GHz	10 kHz 100 kHz 1 MHz 10 MHz 20 MHz 40 MHz		−135 −137 −149 −150 −150 −151		dBc
$t_{\int\Phi N}$	Integrated Phase Jitter (Figure x) fin = 1 GHz, 12 kHz − 20 MHz Offset (RMS)			36		fs
t_{JITTER}	RJ – Output Random Jitter (Note 14) DJ − Residual Output Deterministic Jitter (Note 15)	$f_{in} \leq$ 5.0 GHz ≤ 8 Gbps		0.2 5	0.8 15	ps rms ps pk−pk
	Crosstalk Induced Jitter (Adjacent Channel) (Note 17)				0.7	psRMS
V_{INPP}	Input Voltage Swing (Differential Configuration) (Note 16)		100		1200	mV
t_r, t_f	Output Rise/Fall Times @ 1 GHz (20% − 80%), Q, $\overline{Q}$		25	55	85	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. 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.

11. Measured using a 400 mV pk−pk source, 50% duty cycle clock source. All output loading with external 50 Ω to V_{CC} – 2 V. Input edge rates 40 ps (20% − 80%).
12. Output voltage swing is a single−ended measurement operating in differential mode.
13. Skew is measured between outputs under identical transitions and conditions. Duty cycle skew is defined only for differential operation when the delays are measured from cross−point of the inputs to the crosspoint of the outputs.
14. Additive RMS jitter with 50% duty cycle clock signal.
15. Additive Peak−to−Peak data dependent jitter with input NRZ data at PRBS23.
16. Input voltage swing is a single−ended measurement operating in differential mode.
17. Crosstalk is measured at the output while applying two similar clock frequencies that are asynchronous with respect to each other at the inputs.

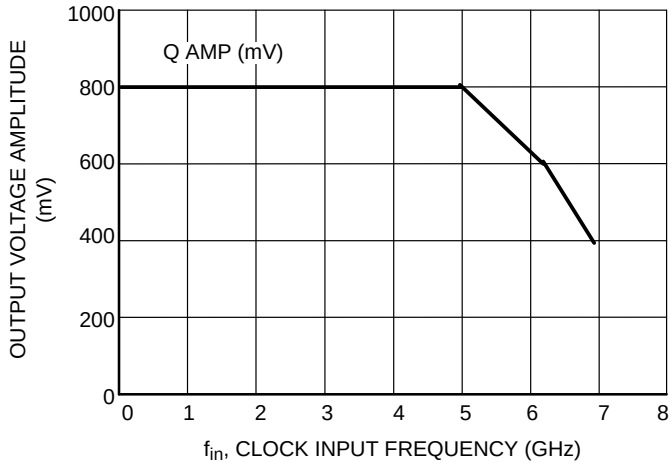


Figure 3. Clock Output Voltage Amplitude (V_{OUTpp}) vs. Input Frequency (f_{in}) at Ambient Temperature (Typical)

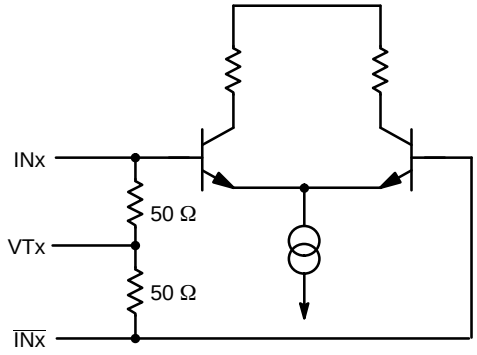


Figure 4. Input Structure

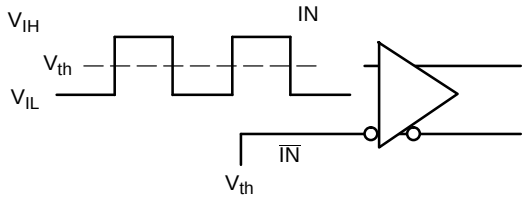


Figure 5. Differential Input Driven Single−Ended

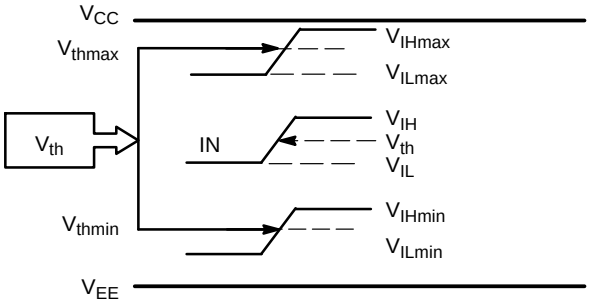


Figure 6. V_{th} Diagram

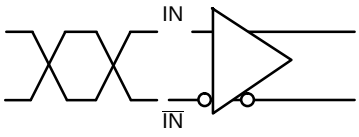


Figure 7. Differential Inputs Driven Differentially

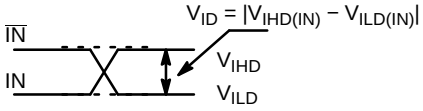


Figure 8. Differential Inputs Driven Differentially

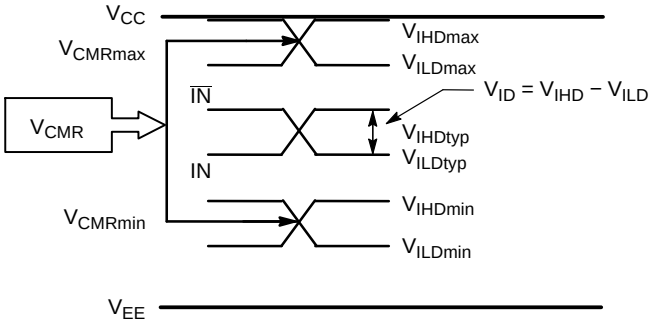


Figure 9. VCMR Diagram

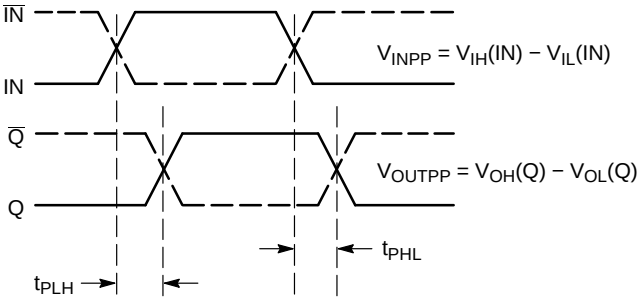


Figure 10. AC Reference Measurement

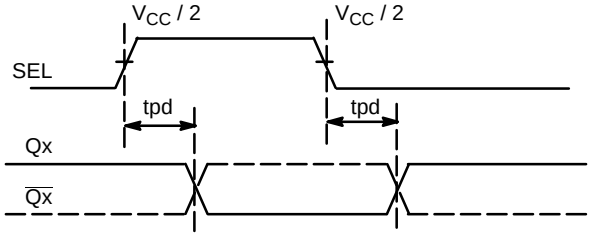


Figure 11. SEL to Qx Timing Diagram

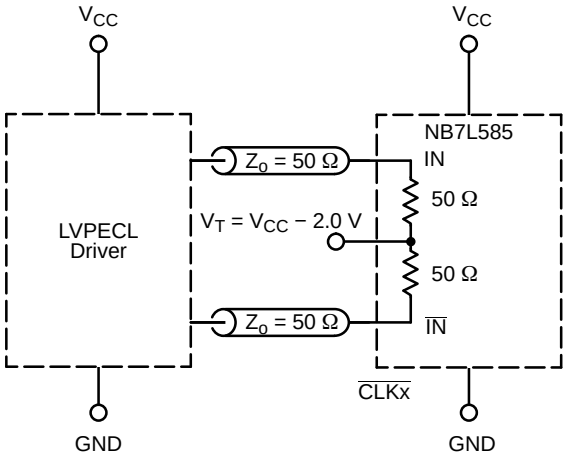


Figure 12. LVPECL Interface

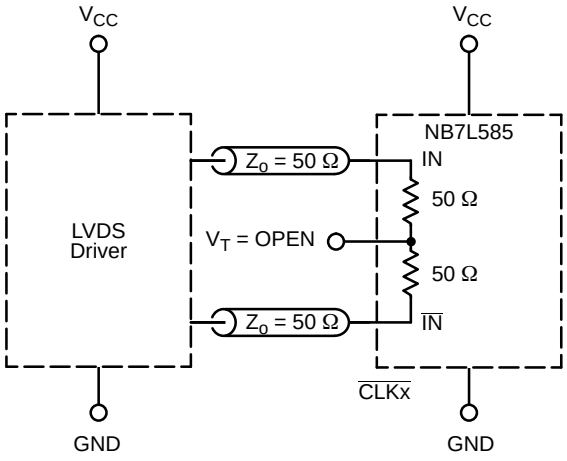


Figure 13. LVDS Interface

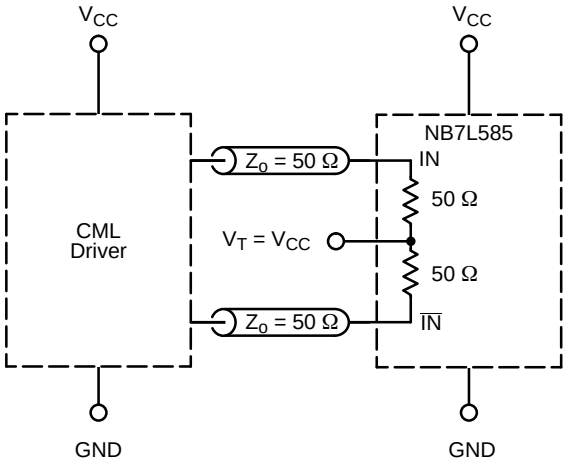


Figure 14. Standard 50 Ω Load CML Interface

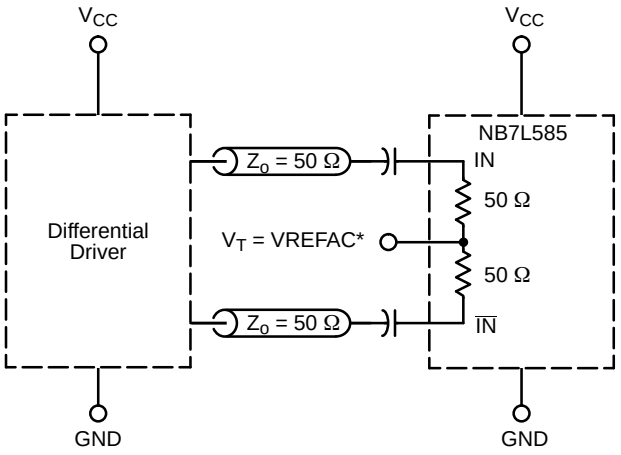


Figure 15. Capacitor−Coupled Differential Interface (V_T Connected to V_{REFAC})

*VREFAC bypassed to ground with a 0.01 μF capacitor.

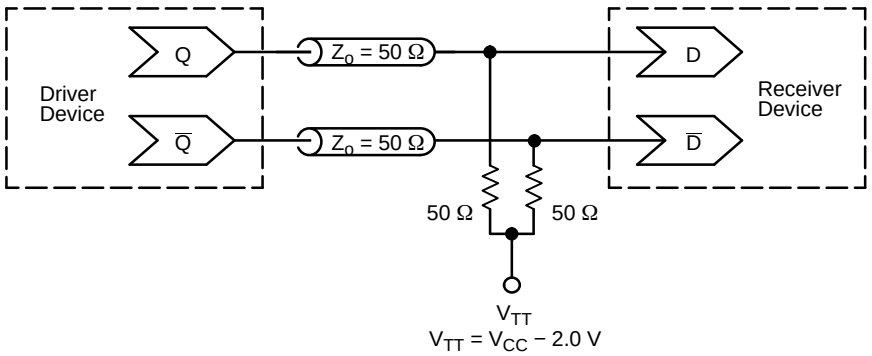


Figure 16. Typical Termination for Output Driver and Device Evaluation (See Application Note AND8020/D − Termination of ECL Logic Devices.)

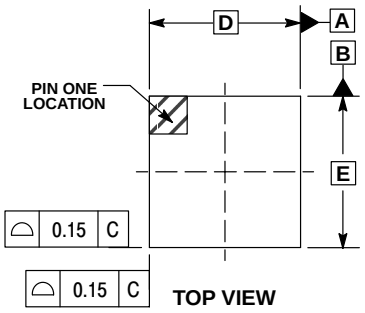
DEVICE ORDERING INFORMATION

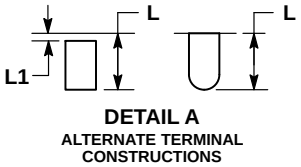
Device	Package	Shipping†
NB7L585MNG	QFN−32 (Pb−Free)	74 Units / Rail
NB7L585MNR4G	QFN−32 (Pb−Free)	1000 / Tape & Reel
NB7L585MNTWG	QFN−32 (Pb−Free)	1000 / Tape & Reel

†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.

PACKAGE DIMENSIONS

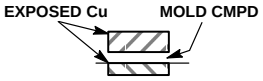
QFN32 5x5, 0.5P
CASE 488AM
ISSUE A

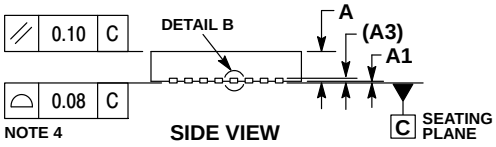


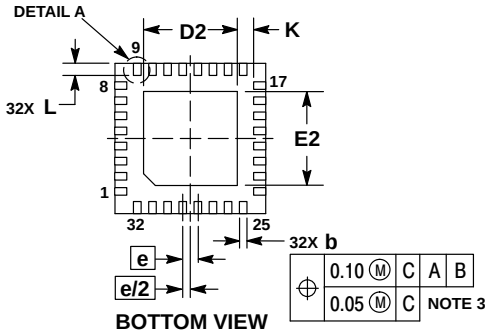


NOTES:
1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

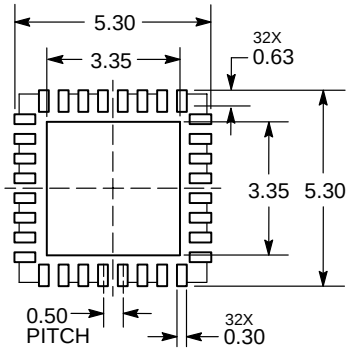
	MILLIMETERS	
DIM	MIN	MAX
A	0.80	1.00
A1	–––	0.05
A3	0.20 REF	
b	0.18	0.30
D	5.00 BSC	
D2	2.95	3.25
E	5.00 BSC	
E2	2.95	3.25
e	0.50 BSC	
K	0.20	–––
L	0.30	0.50
L1	–––	0.15







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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