

NB7L14

2.5V / 3.3V 7GHz/10Gbps Differential 1:4 LVPECL Fanout Buffer

Multi-Level Inputs w/ Internal Termination

Description

The NB7L14 is a differential 1:4 LVPECL fanout buffer. The NB7L14 produces four identical LVPECL output copies of Clock or Data operating up to 7 GHz or 10.7 Gb/s, respectively. As such, the NB7L14 is ideal for SONET, GigE, Fiber Channel, Backplane and other Clock or Data distribution applications.

The differential inputs incorporate internal 50 Ω termination resistors that are accessed through the VT Pin. This feature allows the NB7L14 to accept various logic standards, such as LVPECL, CML, LVDS, LVCMOS or LVTTL logic levels. The V_{REFAC} reference output can be used to rebias capacitor-coupled differential or single-ended input signals. The 1:4 fanout design was optimized for low output skew applications.

The NB7L14 is a member of the GigaComm™ family of high performance clock products.

Features

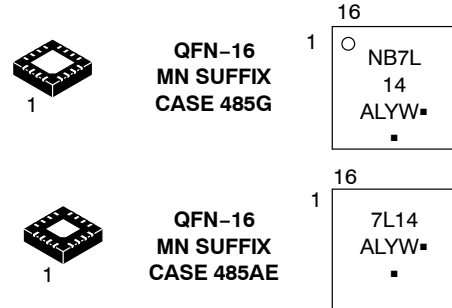
- Input Data Rate > 10.7 Gb/s
- Input Clock Frequency > 7 GHz
- 165 ps Typical Propagation Delay
- 45 ps Typical Rise and Fall Times
- <15 ps max Output Skew
- <0.8 ps maximum RMS Clock Jitter
- <15 ps pp of Data Dependent Jitter
- Differential LVPECL Outputs, 720 mV peak-to-peak, typical
- LVPECL Operating Range: V_{CC} = 2.375 V to 3.6 V with GND = 0 V
- NECL Operating Range: V_{CC} = 0 V with GND = -2.375 V to -3.6 V
- Internal Input Termination Resistors, 50 Ω
- V_{REFAC} Reference Output
- Functionally Compatible with Existing 2.5 V / 3.3 V LVEL, LVEP, EP, and SG Devices
- -40°C to +85°C Ambient Operating Temperature
- These are Pb-Free Devices



ON Semiconductor®

<http://onsemi.com>

MARKING DIAGRAM*



XXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb-Free Package

(Note: Microdot may be in either location)

*For additional marking information, refer to Application Note AND8002/D.

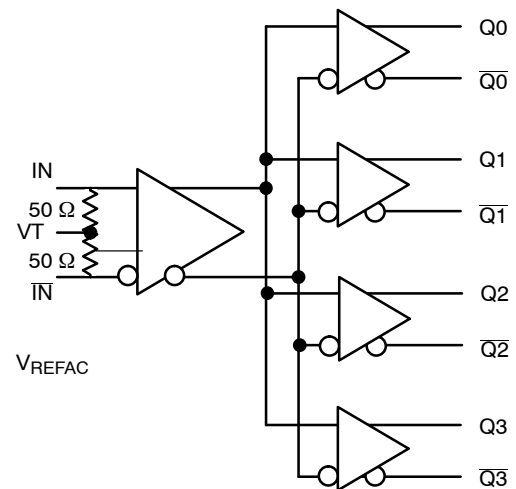


Figure 1. Logic Diagram

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

NB7L14

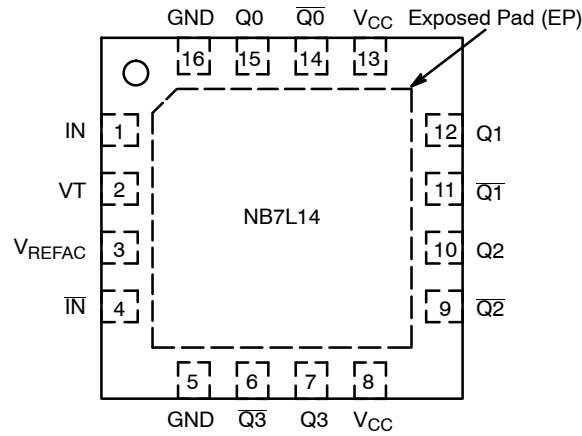


Figure 2. QFN-16 Pinout (Top View)

Table 1. PIN DESCRIPTION

Pin	Name	I/O	Description
1	IN	ECL, CML, LVCMOS, LVDS, LVTTTL Input	Non-inverted Differential Input. Note 1. Internal 50 Ω Resistor to Termination Pin, VT
2	VT	-	Internal 50- Ω Termination Pin for IN/ $\bar{I}N$ inputs.
3	VREFAC		Output Reference Voltage for capacitor-coupled inputs
4	$\bar{I}N$	ECL, CML, LVCMOS, LVDS, LVTTTL Input	Inverted Differential Input. Note 1. Internal 50 Ω Resistor to Termination Pin, VT.
5	GND	-	Negative Supply Voltage
6	$\bar{Q}3$	LVPECL Output	Inverted Differential Output. Typically Terminated with 50 Ω Resistor to $V_{CC} - 2.0$ V.
7	Q3	LVPECL Output	Non-inverted Differential Output. Typically Terminated with 50 Ω Resistor to $V_{CC} - 2.0$ V.
8	VCC	-	Positive Supply Voltage
9	$\bar{Q}2$	LVPECL Output	Inverted Differential Output. Typically Terminated with 50 Ω Resistor to $V_{CC} - 2.0$ V.
10	Q2	LVPECL Output	Non-inverted Differential Output. Typically Terminated with 50 Ω Resistor to $V_{CC} - 2.0$ V.
11	$\bar{Q}1$	LVPECL Output	Inverted Differential Output. Typically Terminated with 50 Ω Resistor to $V_{CC} - 2.0$ V.
12	Q1	LVPECL Output	Non-inverted Differential Output. Typically Terminated with 50 Ω Resistor to $V_{CC} - 2.0$ V.
13	VCC	-	Positive Supply Voltage
14	$\bar{Q}0$	LVPECL Output	Inverted Differential Output. Typically Terminated with 50 Ω Resistor to $V_{CC} - 2.0$ V.
15	Q0	LVPECL Output	Non-inverted Differential Output. Typically Terminated with 50 Ω Resistor to $V_{CC} - 2.0$ V.
16	GND	-	Negative Supply Voltage
-	EP	-	The Exposed Pad (EP) on the QFN-16 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 connected to device GND.

1. In the differential configuration when the input termination pin (VT) is connected to a common termination voltage or left open, and if no signal is applied on IN/ $\bar{I}N$ input, then, the device will be susceptible to self-oscillation.
2. All VCC and GND pins must be externally connected to a power supply for proper operation.

NB7L14

Table 2. ATTRIBUTES

Characteristics		Value
ESD Protection	Human Body Model Machine Model	> 2000 V > 150 V
Moisture Sensitivity (Note 3)	QFN-16	Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
Transistor Count		173
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test		

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

Table 3. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V_{CC}	Positive Power Supply	GND = 0 V		-0.5 V to +4.0	V
V_{IO}	Positive Input/Output Voltage	GND = 0 V	$-0.5 \leq V_{Io} \leq V_{CC} + 0.5$	4.0	V
V_{INPP}	Differential Input Voltage $ D - \bar{D} $			2.8	V
I_{IN}	Input Current Through R_T (50 Ω Resistor)			± 40	mA
I_{OUT}	Output Current (LVPECL Output)	Continuous Surge		50 100	mA
$I_{VFREFAC}$	V_{REFAC} Sink/Source Current			± 1.5	mA
T_A	Operating Temperature Range	QFN-16		-40 to +85	$^{\circ}C$
T_{stg}	Storage Temperature Range			-65 to +150	$^{\circ}C$
θ_{JA}	Thermal Resistance (Junction-to-Ambient) (Note 4)	0 lfpm 500 lfpm	QFN-16 QFN-16	42 35	$^{\circ}C/W$
θ_{JC}	Thermal Resistance (Junction-to-Case) (Note 4)		QFN-16	4	$^{\circ}C/W$
T_{sol}	Wave Solder Pb-Free			265	$^{\circ}C$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

4. JEDEC standard multilayer board – 2S2P (2 signal, 2 power) with 8 filled thermal vias under exposed pad.

NB7L14

Table 4. DC CHARACTERISTICS, MULTI-LEVEL INPUTS $V_{CC} = 2.375\text{ V to }3.6\text{ V}$, $GND = 0\text{ V}$, $T_A = -40^\circ\text{C to }+85^\circ\text{C}$

Symbol	Characteristic	Min	Typ	Max	Unit
--------	----------------	-----	-----	-----	------

POWER SUPPLY CURRENT

V_{CC}	Power Supply Voltage	$V_{CC} = 2.5\text{ V}$ $V_{CC} = 3.3\text{ V}$	2.375 3.0	2.5 3.3	2.625 3.6	V
I_{CC}	Power Supply Current (Inputs and Outputs Open)			85	105	mA

LVPECL OUTPUTS (Notes 5 & 6)

V_{OH}	Output HIGH Voltage	$V_{CC} = 2.5\text{ V}$ $V_{CC} = 3.3\text{ V}$	$V_{CC} - 1145$ 1355 2155	$V_{CC} - 900$ 1600 2400	$V_{CC} - 825$ 1675 2475	mV
V_{OL}	Output LOW Voltage	$V_{CC} = 2.5\text{ V}$ $V_{CC} = 3.3\text{ V}$	$V_{CC} - 2000$ 500 1300	$V_{CC} - 1700$ 800 1600	$V_{CC} - 1500$ 1000 1800	mV

DIFFERENTIAL INPUT DRIVEN SINGLE-ENDED (see Figure 5 & 7) (Note 7)

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_{th}	Input Threshold Reference Voltage Range (Note 8)		1125		$V_{CC} - 75$	mV
V_{ISE}	Single-ended Input Voltage Amplitude ($V_{IH} - V_{IL}$)		150		2800	mV

VREFAC

V_{REFAC}	Output Reference Voltage (100 μA Load)		$V_{CC} - 1400$	$V_{CC} - 1300$	$V_{CC} - 1000$	mV
-------------	---	--	-----------------	-----------------	-----------------	----

DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY (see Figure 6 & 8) (Note 9)

V_{IHD}	Differential Input HIGH Voltage		1200		V_{CC}	mV
V_{ILD}	Differential Input LOW Voltage		0		$V_{IHD} - 50$	mV
V_{ID}	Differential Input Voltage ($V_{IHD} - V_{ILD}$)		100		2800	mV
V_{CMR}	Input Common Mode Range (Differential Configuration) (Note 10) (Figure 9)		950		$V_{CC} - 50$	mV
I_{IH}	Input HIGH Current $I_N / \overline{I_N}$, (VT Open)		-150		150	μA
I_{IL}	Input LOW Current $I_N / \overline{I_N}$, (VT Open)		-150		150	μA

TERMINATION RESISTORS

R_{TIN}	Internal Input Termination Resistor		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 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.

- LVPECL outputs loaded with 50 Ω to $V_{CC} - 2.0\text{ V}$ for proper operation.
- Input and output parameters vary 1:1 with V_{CC} .
- V_{th} , V_{IH} , V_{IL} , and V_{ISE} parameters must be complied with simultaneously.
- V_{th} is applied to the complementary input when operating in single-ended mode.
- V_{IHD} , V_{ILD} , V_{ID} and V_{CMR} parameters must be complied with simultaneously.
- V_{MR} min varies 1:1 with V_{EE} , 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.

NB7L14

Table 5. AC CHARACTERISTICS $V_{CC} = 2.375\text{ V to }3.6\text{ V}$, $GND = 0\text{ V}$, $T_A = -40^\circ\text{C to }+85^\circ\text{C}$; (Note 11)

Symbol	Characteristic	Min	Typ	Max	Unit	
f_{MAX}	Maximum Input Clock Frequency; $V_{OUT} \geq 400\text{ mV}$	7	8		GHz	
$f_{DATAMAX}$	Maximum Operating Data Rate; NRZ, (PRBS23)	10	11		Gbps	
V_{OUTPP}	Output Voltage Amplitude (Note 15) (See Figure 9)	$f_{in} \leq 5\text{ GHz}$ 500 $f_{in} \leq 7\text{ GHz}$ 400	720 450		mV	
t_{PLH} , t_{PHL}	Propagation Delay IN to Q	125	165	200	ps	
t_{SKEW}	Duty Cycle Skew (Note 12) Output – Output Within Device Skew Device to Device Skew		3	15 15 50	ps	
t_{DC}	Output Clock Duty Cycle (Reference Duty Cycle = 50%)	$f_{in} \leq 7\text{ GHz}$	45	50	55	%
t_{JITTER}	RMS Random Clock Jitter (Note 13) Peak-to-Peak Data Dependent Jitter (Note 14)	$f_{in} \leq 7\text{ GHz}$ $f_{in} \leq 10.7\text{ Gb/s}$		0.5 5	0.8 15	ps rms ps pk-pk
V_{INPP}	Input Voltage Swing/Sensitivity (Differential Configuration) (Note 15)	100		1200	mV	
t_r t_f	Output Rise/Fall Times @ 1.0 GHz (20% – 80%)	$Qx, \bar{Q}x$	30	45	60	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 lpm. 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 by forcing $V_{INPP}(\text{min})$ from a 50% duty cycle clock source. All loading with an external $R_L = 50\ \Omega$ to $V_{CC} - 2.0\text{ V}$. Input edge rates 40 ps (20% – 80%).
12. Skew is measured between outputs under identical transitions and conditions @ 0.5 GHz. Duty cycle skew is measured between differential outputs using the deviations of the sum of T_{pw-} and T_{pw+} @ 0.5 GHz.
13. Additive RMS jitter with 50% duty cycle clock signal.
14. Additive peak-to-peak data dependent jitter with input NRZ data at PRBS23.
15. Input and output voltage swing is a single-ended measurement operating in differential mode.

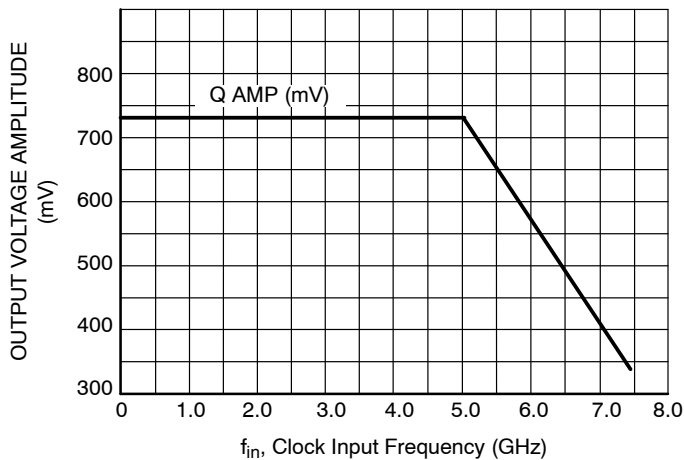


Figure 3. CLOCK Output Voltage Amplitude (V_{OUTPP}) vs. Input Frequency (f_{in}) at Ambient Temperature (Typ)

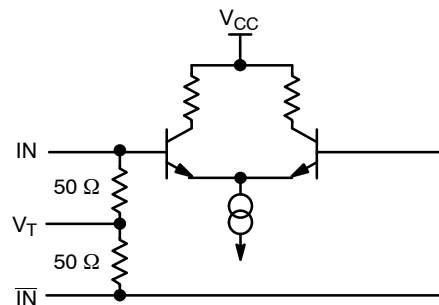


Figure 4. Input Structure

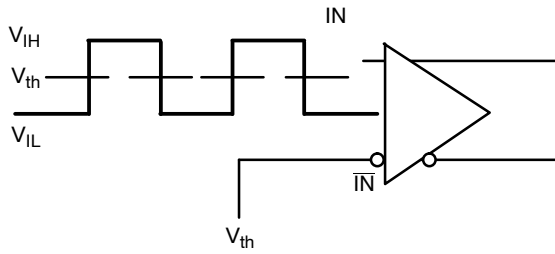


Figure 5. Differential Input Driven Single-Ended

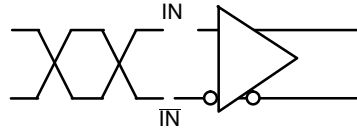


Figure 6. Differential Inputs Driven Differentially

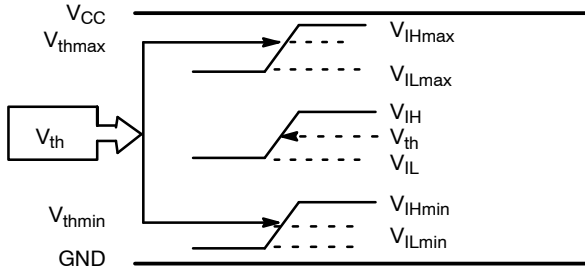


Figure 7. V_{th} Diagram

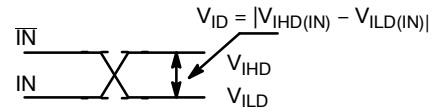


Figure 8. Differential Inputs Driven Differentially

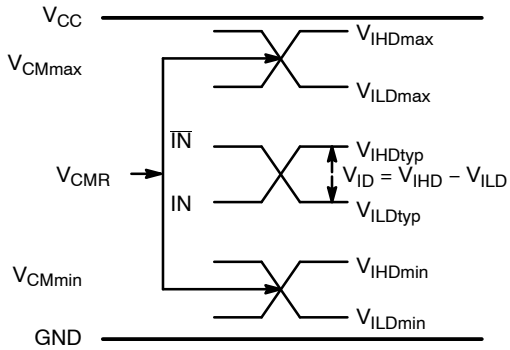


Figure 9. V_{CMR} Diagram

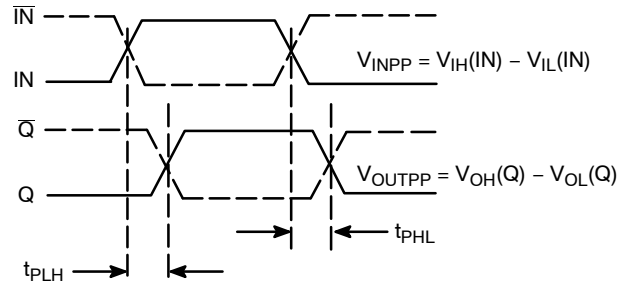


Figure 10. AC Reference Measurement

NB7L14

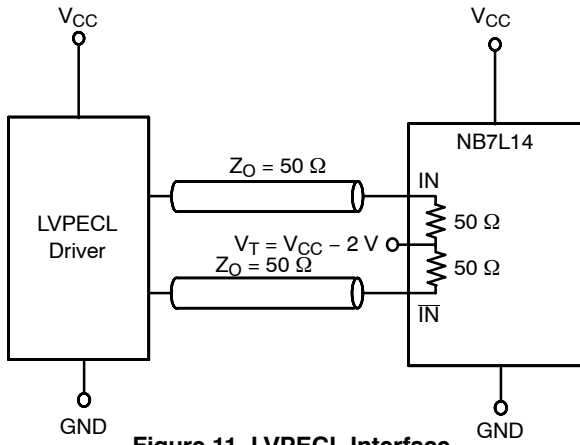


Figure 11. LVPECL Interface

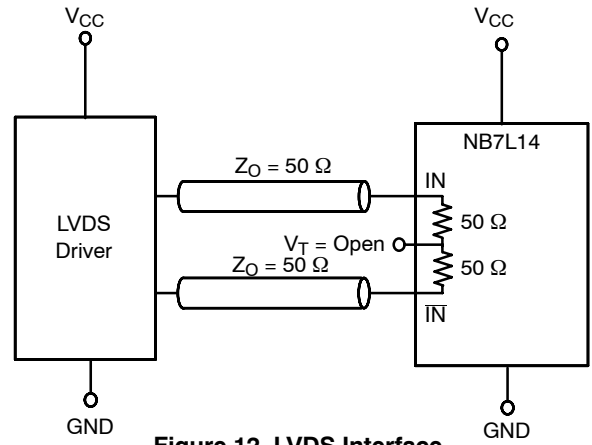


Figure 12. LVDS Interface

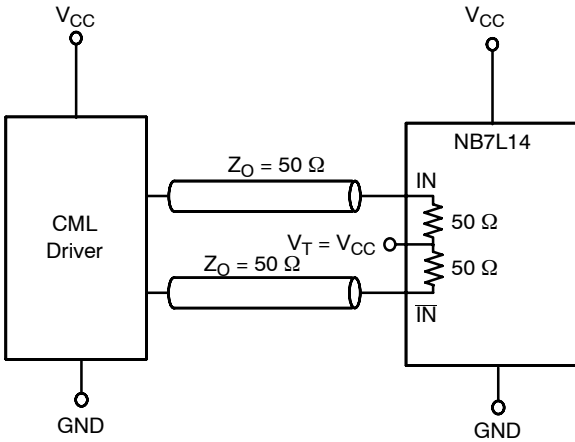


Figure 13. Standard 50 Ω Load CML Interface

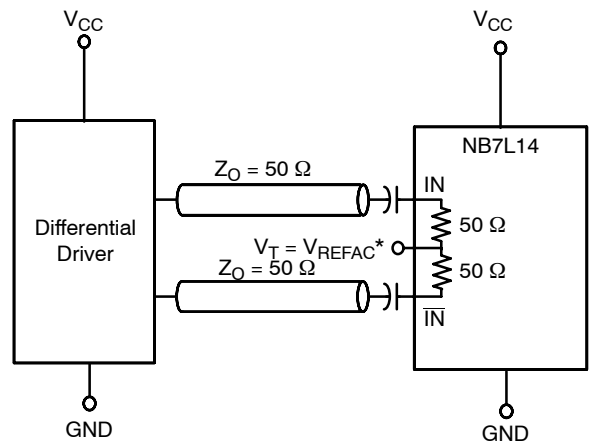


Figure 14. Capacitor-Coupled Differential Interface

(V_T Connected to External V_{REFAC})

* V_{REFAC} bypassed to ground with a 0.01 μF capacitor

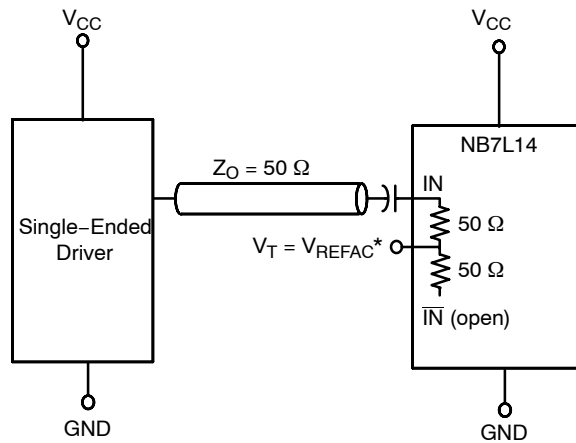
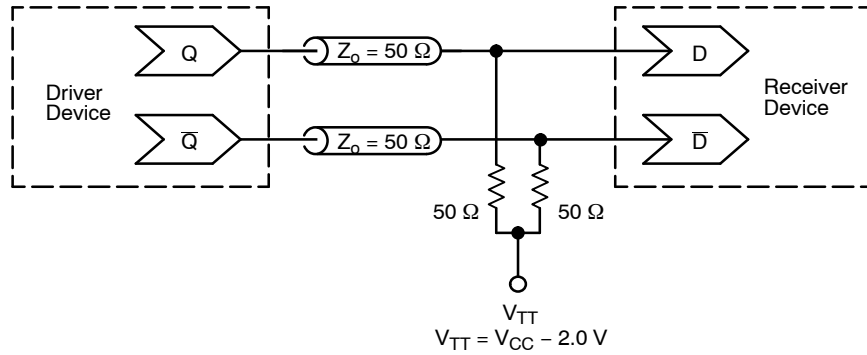


Figure 15. Capacitor-Coupled Differential Interface (V_T Connected to External V_{REFAC})

* V_{REFAC} bypassed to ground with a 0.01 μF capacitor

NB7L14



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

ORDERING INFORMATION

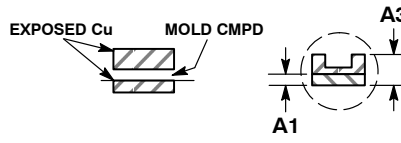
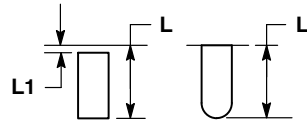
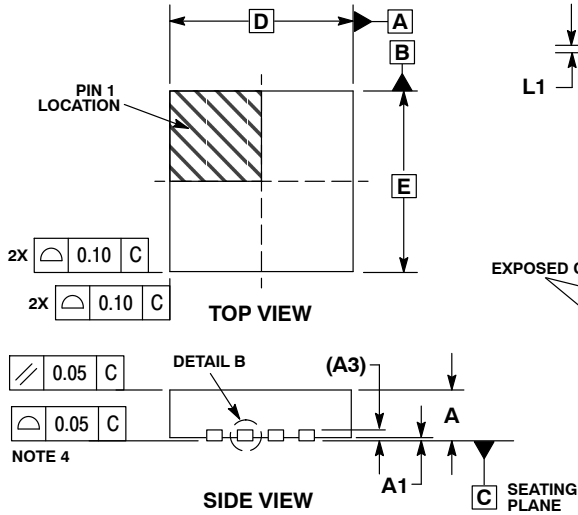
Device	Package	Case	Shipping†
NB7L14MNG	QFN-16 (Pb-Free)	485G	123 Units / Rail
NB7L14MNTXG	QFN-16 (Pb-Free)	485G	3000 / Tape & Reel
NB7L14MN1G	QFN-16 (Pb-Free)	485AE	123 Units / Rail
NB7L14MN1TXG	QFN-16 (Pb-Free)	485AE	3000 / Tape & Reel

†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.

NB7L14

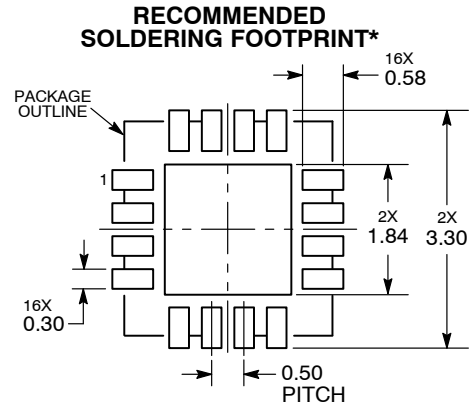
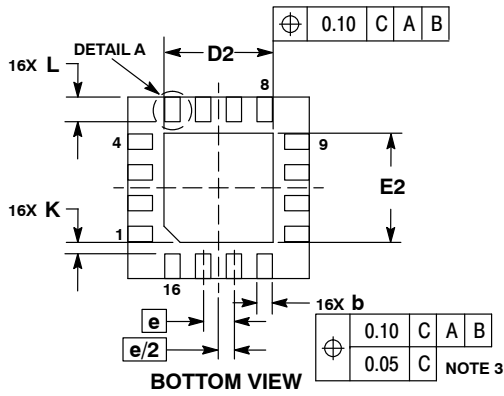
PACKAGE DIMENSIONS

QFN16 3x3, 0.5P
CASE 485G-01
ISSUE E



- 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
A3	0.20	REF
b	0.18	0.30
D	3.00	BSC
D2	1.65	1.85
E	3.00	BSC
E2	1.65	1.85
e	0.50	BSC
K	0.18	TYP
L	0.30	0.50
L1	0.00	0.15



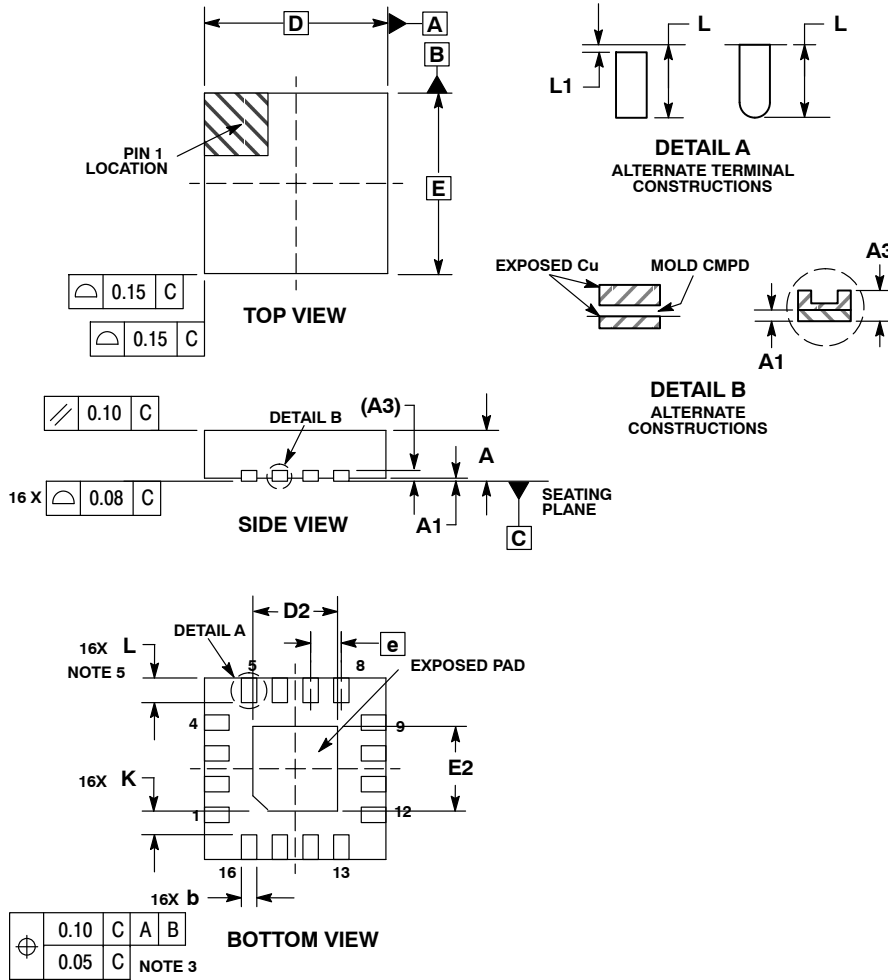
DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NB7L14

PACKAGE DIMENSIONS

QFN16 3x3, 0.5P
CASE 485AE-01
ISSUE A



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.
5. OUTLINE MEETS JEDEC DIMENSIONS PER MO-220, VARIATION VEED-6.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0.00	0.03	0.05
A3	0.20 REF		
b	0.18	0.25	0.30
D	3.00 BSC		
D2	1.25	1.40	1.55
E	3.00 BSC		
E2	1.25	1.40	1.55
e	0.50 BSC		
K	0.20	---	---
L	0.30	0.40	0.50
L1	0.00	---	0.15

GigaComm is a trademark of Semiconductor Components Industries LLC (SCILLC).

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5773-3850

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
For additional information, please contact your local Sales Representative