

# NBSG72A

## 2.5V/3.3V SiGe Differential 2 x 2 Crosspoint Switch with Output Level Select

The NBSG72A is a high-bandwidth fully differential 2 X 2 crosspoint switch with Output Level Select (OLS) capabilities. This is a part of the GigaComm™ family of high performance Silicon Germanium products. The device is housed in a low profile 3 X 3 mm 16-pin QFN package.

Differential inputs incorporate internal 50 Ω termination resistors and accept NECL (Negative ECL), PECL (Positive ECL), LVCMOS/LVTTL, CML, or LVDS. The OLS input is used to program the peak-to-peak output amplitude between 0 mV and 800 mV in five discrete steps. The SELECT inputs are single-ended and can be driven with either LVECL or LVCMOS/LVTTL input levels.

### Features

- Maximum Input Clock Frequency > 7 GHz Typical
- Maximum Input Data Rate > 7 Gb/s Typical
- 200 ps Typical Propagation Delay (OLS = FLOAT)
- 55/45 ps Typical Rise/Fall Times (OLS = FLOAT)
- Selectable Swing PECL Output with Operating Range:  $V_{CC} = 2.375\text{ V to }3.465\text{ V}$  with  $V_{EE} = 0\text{ V}$
- Selectable Swing NECL Output with NECL Inputs with Operating Range:  $V_{CC} = 0\text{ V}$  with  $V_{EE} = -2.375\text{ V to }-3.465\text{ V}$
- Selectable Output Levels (0 mV, 200 mV, 400 mV, 600 mV or 800 mV Peak-to-Peak Output)
- 50 Ω Internal Input Termination Resistors
- Single-Ended LVECL or LVCMOS/LVTTL Select Inputs (SELA, SELB)
- Pb-Free Packages are Available



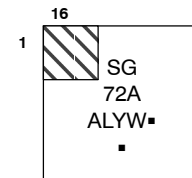
ON Semiconductor®

<http://onsemi.com>

### MARKING DIAGRAM\*



QFN-16  
MN SUFFIX  
CASE 485G



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.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 13 of this data sheet.

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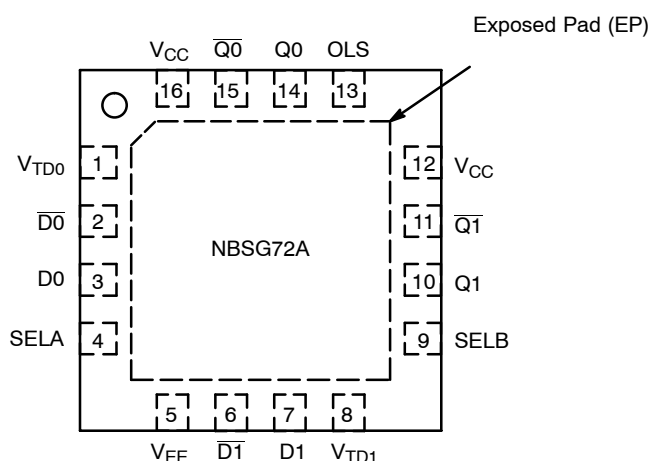


Figure 1. QFN-16 Pinout (Top View)

Table 1. PIN DESCRIPTION

Pin No.	Name	I/O	Description
1	VTD0	-	Common Internal 50 $\Omega$ Termination Pin for D0 and $\overline{D0}$ Input. See Table 4. (Note 1)
2	$\overline{D0}$	LVDS, CML, ECL, LVTTTL, LVCMOS Input	Inverted Differential Input 0.
3	D0	LVDS, CML, ECL, LVTTTL, LVCMOS Input	Noninverted Differential Input 0.
4	SELA	LVECL, LVCMOS Input	Select Logic Input A. Internal 75 k $\Omega$ Pulldown to $V_{EE}$ .
5	$V_{EE}$	-	Negative Supply. All $V_{EE}$ Pins must be Externally Connected to Power Supply to Guarantee Proper Operation.
6	$\overline{D1}$	LVDS, CML, ECL, LVTTTL, LVCMOS Input	Inverted Differential Input 1.
7	D1	LVDS, CML, ECL, LVTTTL, LVCMOS Input	Noninverted Differential Input 1.
8	VTD1	-	Common Internal 50 $\Omega$ Termination Pin for D1 and $\overline{D1}$ Input. See Table 4. (Note 1)
9	SELB	LVECL, LVCMOS Input	Select Logic Input B. Internal 75 k $\Omega$ Pulldown to $V_{EE}$ .
10	Q1	RSECL Output	Noninverted Differential Output.
11	$\overline{Q1}$	RSECL Output	Inverted Differential Output.
12	$V_{CC}$	-	Positive Supply. All $V_{CC}$ Pins must be Externally Connected to Power Supply to Guarantee Proper Operation.
13	OLS (Note 2)	Input	Input Pin for Output Level Select (OLS) See Table 3.
14	Q0	RSECL Output	Noninverted Differential Output Typically Terminated with 50 $\Omega$ Resistor to $V_{TT} = V_{CC} - 2.0$ V.
15	$\overline{Q0}$	RSECL Output	Inverted Differential Output Typically Terminated with 50 $\Omega$ Resistor to $V_{TT} = V_{CC} - 2.0$ V.
16	$V_{CC}$	-	Positive Supply. All $V_{CC}$ Pins must be Externally Connected to Power Supply to Guarantee Proper Operation.
-	EP	-	Exposed Pad. The thermally exposed pad on package bottom (see case drawing) must be attached to a heat-sinking conduit.

1. In the differential configuration when the input termination pins (VTD0, VTD1) are connected to a common termination voltage, and if no signal is applied then the device will be susceptible to self-oscillation.
2. When an output level of 400 mV is desired and  $V_{CC} - V_{EE} > 3.0$  V, 2 k $\Omega$  resistor should be connected from OLS pin to  $V_{EE}$ .

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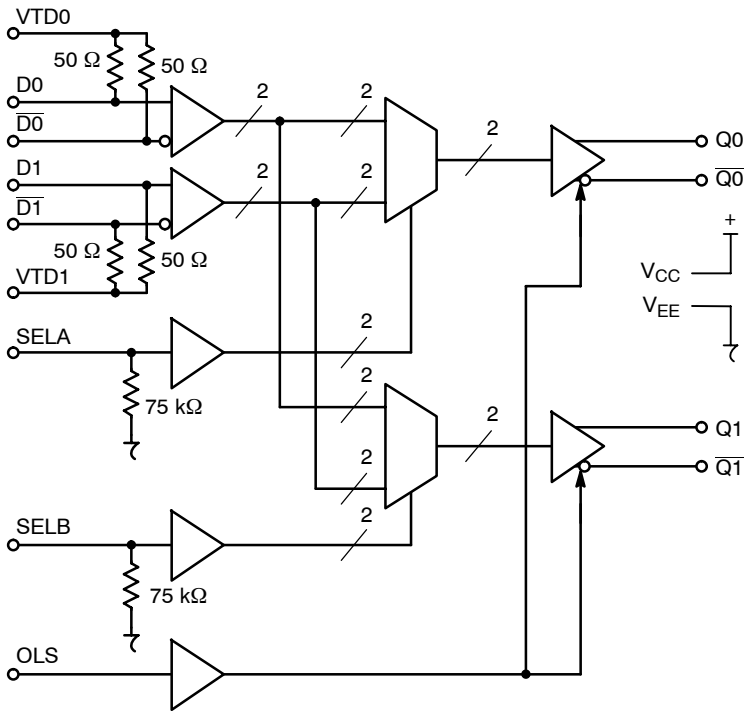


Figure 2. Logic/Block Diagram

Table 2. TRUTH TABLE

SELA	SELB	Q0	Q1
LOW	LOW	D0	D0
HIGH	LOW	D1	D0
LOW	HIGH	D0	D1
HIGH	HIGH	D1	D1

Table 3. OUTPUT LEVEL SELECT (OLS)

OLS	Output Amplitude ( $V_{OUTPP}$ )	OLS Sensitivity
$V_{CC}$	800 mV	OLS - 75 mV
$V_{CC} - 0.4$ V	200 mV	OLS $\pm$ 150 mV
$V_{CC} - 0.8$ V	600 mV	OLS $\pm$ 100 mV
$V_{CC} - 1.2$ V	0	OLS $\pm$ 75 mV
$V_{EE}$ (Note 3)	400 mV	OLS $\pm$ 100 mV
FLOAT	600 mV	N/A

3. When an output level of 400 mV is desired and  $V_{CC} - V_{EE} > 3.0$  V, a 2 k $\Omega$  resistor should be connected from OLS to  $V_{EE}$ .

Table 4. INTERFACING OPTIONS

Interfacing Options	Connections
CML	Connect VTD0 and VTD1 to $V_{CC}$
LVDS	VTD0 and VTD1 Should Be Left Floating.
AC-COUPLED	Bias VTD0 and VTD1 Inputs within Common Mode Range ( $V_{IHCMR}$ )
RSECL, PECL, NECL	Standard ECL Termination Techniques
LVC MOS / LVTTTL	The external voltage should be applied to the unused complementary differential input. Nominal voltage is 1.5 V for LVTTTL and $V_{CC}/2$ for LVC MOS Inputs.

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**Table 5. ATTRIBUTES**

Characteristics	Value
Internal Input Pulldown Resistor (SELA, SELB)	75 k $\Omega$
ESD Protection	Human Body Model Machine Model Charged Device Model
	> 2 kV > 50 V > 1 kV
Moisture Sensitivity (Note 1)	Level 1
Flammability Rating	Oxygen Index: 28 to 34
	UL 94 V-0 @ 0.125 in
Transistor Count	436
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

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

**Table 6. MAXIMUM RATINGS**

Symbol	Parameter	Condition 1	Condition 2	Rating	Units
V <sub>CC</sub>	Positive Power Supply	V <sub>EE</sub> = 0 V		3.6	V
V <sub>EE</sub>	Negative Power Supply	V <sub>CC</sub> = 0 V		-3.6	V
V <sub>I</sub>	Positive Input Negative Input	V <sub>EE</sub> = 0 V V <sub>CC</sub> = 0 V	V <sub>I</sub> ≤ V <sub>CC</sub> V <sub>I</sub> ≥ V <sub>EE</sub>	3.6 -3.6	V V
V <sub>INPP</sub>	Differential Input Voltage  D <sub>X</sub> - $\overline{D}_X$	V <sub>EE</sub> - V <sub>CC</sub> ≥ 2.8 V V <sub>EE</sub> - V <sub>CC</sub> < 2.8 V		2.8  V <sub>CC</sub> - V <sub>EE</sub>	V
I <sub>out</sub>	Output Current	Continuous Surge		25 50	mA mA
I <sub>IN</sub>	Input Current Through R <sub>T</sub> (50 $\Omega$ Resistor)	Static Surge		45 80	mA mA
T <sub>A</sub>	Operating Temperature Range			-40 to +85	°C
T <sub>stg</sub>	Storage Temperature Range			-65 to +150	°C
$\theta_{JA}$	Thermal Resistance (Junction-to-Ambient) (Note 2)	0 lfpm 500 lfpm	QFN-16 QFN-16	42 35	°C/W °C/W
$\theta_{JC}$	Thermal Resistance (Junction-to-Case)	(Note 2)	QFN-16	4	°C/W
T <sub>sol</sub>	Wave Solder	Pb Pb-Free	< 3 sec @ 260°C < 3 sec @ 260°C	265 265	°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.

2. JEDEC standard multilayer board – 1S2P (1 signal, 2 power).

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**Table 7. DC CHARACTERISTICS, INPUT WITH PECL OUTPUT**  $V_{CC} = 2.5\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 3)

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	55	65	40	55	65	40	55	65	mA
$V_{OH}$	Output HIGH Voltage (Note 4)	1460	1510	1560	1490	1540	1590	1515	1565	1615	mV
$V_{OL}$	Output LOW Voltage (Note 4)										mV
	(OLS = $V_{CC}$ )	555	705	855	595	745	895	625	775	925	
	(OLS = $V_{CC} - 0.4\text{ V}$ )	1235	1295	1385	1270	1330	1420	1295	1355	1445	
	(OLS = $V_{CC} - 0.8\text{ V}$ , OLS = FLOAT)	775	895	1015	810	930	1050	840	960	1080	
	(OLS = $V_{CC} - 1.2\text{ V}$ )	1455	1505	1585	1490	1540	1620	1510	1560	1640	
	(OLS = $V_{EE}$ )	1005	1095	1215	1040	1130	1250	1065	1155	1275	
$V_{OUTPP}$	Output Voltage Amplitude										mV
	(OLS = $V_{CC}$ )	670	800		660	795		655	790		
	(OLS = $V_{CC} - 0.4\text{ V}$ )	125	215		120	210		120	210		
	(OLS = $V_{CC} - 0.8\text{ V}$ , OLS = FLOAT)	510	615		505	610		500	605		
	(OLS = $V_{CC} - 1.2\text{ V}$ )	0	5		0	0		0	5		
	(OLS = $V_{EE}$ )	325	415		320	410		320	410		
$V_{IH}$	Input HIGH Voltage (Single-Ended) (Note 6) D0, $\overline{D0}$ , D1, $\overline{D1}$	$V_{EE} + 1275$	$V_{CC} - 1000^*$	$V_{CC}$	$V_{EE} + 1275$	$V_{CC} - 1000^*$	$V_{CC}$	$V_{EE} + 1275$	$V_{CC} - 1000^*$	$V_{CC}$	mV
$V_{IL}$	Input LOW Voltage (Single-Ended) (Note 7) D0, $\overline{D0}$ , D1, $\overline{D1}$	$V_{EE}$	$V_{CC} - 1400^*$	$V_{IH} - 150$	$V_{EE}$	$V_{CC} - 1400^*$	$V_{IH} - 150$	$V_{EE}$	$V_{CC} - 1400^*$	$V_{IH} - 150$	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 5)	1.2		2.5	1.2		2.5	1.2		2.5	V
$R_{TIN}$	Internal Input Termination Resistor	45	50	55	45	50	55	45	50	55	$\Omega$
$I_{IH}$	Input HIGH Current (@ $V_{IH}$ )		35	100		35	100		35	100	$\mu\text{A}$
$I_{IL}$	Input LOW Current (@ $V_{IL}$ )		20	100		20	100		20	100	$\mu\text{A}$

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.

\*Typicals used for testing purposes.

3. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +0.125 V to -0.965 V.

4. All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .

5.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

6.  $V_{IH}$  cannot exceed  $V_{CC}$ .

7.  $V_{IL}$  always  $\geq V_{EE}$ .

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**Table 8. DC CHARACTERISTICS, INPUT WITH PECL OUTPUT**  $V_{CC} = 3.3\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 8)

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	55	65	40	55	65	40	55	65	mA
$V_{OH}$	Output HIGH Voltage (Note 9)	2260	2310	2360	2290	2340	2390	2315	2365	2415	mV
$V_{OL}$	Output LOW Voltage (Note 9)										mV
	(OLS = $V_{CC}$ )	1320	1470	1620	1360	1510	1660	1390	1540	1690	
	(OLS = $V_{CC} - 0.4\text{ V}$ )	2030	2090	2180	2065	2125	2215	2090	2150	2240	
	(OLS = $V_{CC} - 0.8\text{ V}$ , OLS = FLOAT)	1550	1670	1790	1585	1705	1825	1615	1735	1855	
	(OLS = $V_{CC} - 1.2\text{ V}$ )	2260	2310	2390	2290	2340	2420	2315	2365	2445	
	** (OLS = $V_{EE}$ )	1785	1875	1995	1820	1910	2030	1850	1940	2060	
$V_{OUTPP}$	Output Amplitude Voltage										mV
	(OLS = $V_{CC}$ )	705	815		695	805		690	800		
	(OLS = $V_{CC} - 0.4\text{ V}$ )	130	220		125	215		125	215		
	(OLS = $V_{CC} - 0.8\text{ V}$ , OLS = FLOAT)	535	640		530	635		525	630		
	(OLS = $V_{CC} - 1.2\text{ V}$ )	0	0		0	0		0	0		
	** (OLS = $V_{EE}$ )	345	435		340	430		335	425		
$V_{IH}$	Input HIGH Voltage (Single-Ended) (Note 11) D0, $\overline{D0}$ , D1, $\overline{D1}$	$V_{EE} + 1275$	$V_{CC} - 1000^*$	$V_{CC}$	$V_{EE} + 1275$	$V_{CC} - 1000^*$	$V_{CC}$	$V_{EE} + 1275$	$V_{CC} - 1000^*$	$V_{CC}$	mV
$V_{IL}$	Input LOW Voltage (Single-Ended) (Note 12) D0, $\overline{D0}$ , D1, $\overline{D1}$	$V_{IH} - 2600$	$V_{CC} - 1400^*$	$V_{IH} - 150$	$V_{IH} - 2600$	$V_{CC} - 1400^*$	$V_{IH} - 150$	$V_{IH} - 2600$	$V_{CC} - 1400^*$	$V_{IH} - 150$	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 10)	1.2		3.3	1.2		3.3	1.2		3.3	V
$R_{TIN}$	Internal Input Termination Resistor	45	50	55	45	50	55	45	50	55	$\Omega$
$I_{IH}$	Input HIGH Current (@ $V_{IH}$ )		35	100		35	100		35	100	$\mu\text{A}$
$I_{IL}$	Input LOW Current (@ $V_{IL}$ )		20	100		20	100		20	100	$\mu\text{A}$

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.

\*Typicals used for testing purposes.

\*\*When an output level of 400 mV is desired and  $V_{CC} - V_{EE} > 3.0\text{ V}$ , a 2 k $\Omega$  resistor should be connected from OLS to  $V_{EE}$ .

8. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +0.925 V to -0.165 V.

9. All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .

10.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ .  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

11.  $V_{IH}$  cannot exceed  $V_{CC}$ .

12.  $V_{IL}$  always  $\geq V_{EE}$ .

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**Table 9. DC CHARACTERISTICS, NECL INPUT WITH NECL OUTPUT**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -3.465\text{ V}$  to  $-2.375\text{ V}$  (Note 13)

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	55	65	40	55	65	40	55	65	mA
$V_{OH}$	Output HIGH Voltage (Note 14)	-1040	-990	-940	-1010	-960	-910	-985	-935	-885	mV
$V_{OL}$	Output LOW Voltage (Note 14) -3.465 V $\leq$ $V_{EE} \leq$ -3.0 V (OLS = $V_{CC}$ ) (OLS = $V_{CC} - 0.4\text{ V}$ ) (OLS = $V_{CC} - 0.8\text{ V}$ , OLS = FLOAT) (OLS = $V_{CC} - 1.2\text{ V}$ ) **(OLS = $V_{EE}$ ) -3.0 V < $V_{EE} \leq$ -2.375 V (OLS = $V_{CC}$ ) (OLS = $V_{CC} - 0.4\text{ V}$ ) (OLS = $V_{CC} - 0.8\text{ V}$ , OLS = FLOAT) (OLS = $V_{CC} - 1.2\text{ V}$ ) (OLS = $V_{EE}$ )	-1980 -1270 -1750 -1040 -1515 -1945 -1265 -1725 -1045 -1495	-1830 -1210 -1630 -990 -1425 -1795 -1205 -1605 -995 -1405	-1680 -1120 -1510 -910 -1305 -1645 -1115 -1485 -915 -1285	-1940 -1235 -1715 -1010 -1480 -1905 -1230 -1690 -1010 -1460	-1790 -1175 -1595 -960 -1390 -1755 -1170 -1570 -960 -1370	-1640 -1085 -1475 -880 -1270 -1605 -1080 -1450 -880 -1250	-1910 -1210 -1685 -985 -1450 -1875 -1205 -1660 -990 -1435	-1760 -1150 -1565 -935 -1360 -1725 -1145 -1540 -940 -1345	-1610 -1060 -1445 -855 -1240 -1575 -1055 -1420 -860 -1225	mV
$V_{OUTPP}$	Output Voltage Amplitude -3.465 V $\leq$ $V_{EE} \leq$ -3.0 V (OLS = $V_{CC}$ ) (OLS = $V_{CC} - 0.4\text{ V}$ ) (OLS = $V_{CC} - 0.8\text{ V}$ , OLS = FLOAT) (OLS = $V_{CC} - 1.2\text{ V}$ ) **(OLS = $V_{EE}$ ) -3.0 V < $V_{EE} \leq$ -2.375 V (OLS = $V_{CC}$ ) (OLS = $V_{CC} - 0.4\text{ V}$ ) (OLS = $V_{CC} - 0.8\text{ V}$ , OLS = FLOAT) (OLS = $V_{CC} - 1.2\text{ V}$ ) (OLS = $V_{EE}$ )	705 130 535 0 345 670 125 510 0 325	815 220 640 0 435 800 215 615 5 415		695 125 530 0 340 660 120 505 0 320	805 215 635 0 430 795 210 610 0 410		690 125 525 0 335 655 120 500 0 320	800 215 630 0 425 790 210 605 5 410		mV
$V_{IH}$	Input HIGH Voltage (Single-Ended) (Note 16) D0, $\overline{D0}$ , D1, $\overline{D1}$	$V_{EE} + 1275$	$V_{CC} - 1000^*$	$V_{CC}$	$V_{EE} + 1275$	$V_{CC} - 1000^*$	$V_{CC}$	$V_{EE} + 1275$	$V_{CC} - 1000^*$	$V_{CC}$	mV
$V_{IL}$	Input LOW Voltage (Single-Ended) (Note 17) D0, $\overline{D0}$ , D1, $\overline{D1}$	$V_{IH} - 2600$	$V_{CC} - 1400^*$	$V_{IH} - 150$	$V_{IH} - 2600$	$V_{CC} - 1400^*$	$V_{IH} - 150$	$V_{IH} - 2600$	$V_{CC} - 1400^*$	$V_{IH} - 150$	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 15)	$V_{EE} + 1.2$		0.0	$V_{EE} + 1.2$		0.0	$V_{EE} + 1.2$		0.0	V
$R_{TIN}$	Internal Input Termination Resistor	45	50	55	45	50	55	45	50	55	$\Omega$
$I_{IH}$	Input HIGH Current (@ $V_{IH}$ )		35	100		35	100		35	100	$\mu\text{A}$
$I_{IL}$	Input LOW Current (@ $V_{IL}$ )		20	100		20	100		20	100	$\mu\text{A}$
$I_{OLS}$	OLS Input Current (See Figure 9) (OLS = $V_{CC}$ ) (OLS = $V_{CC} - 0.4\text{ V}$ ) (OLS = $V_{CC} - 0.8\text{ V}$ , OLS = FLOAT) (OLS = $V_{CC} - 1.2\text{ V}$ ) -3.0 V < $V_{EE} \leq$ -2.375 V (OLS = $V_{EE}$ ) -3.465 V $\leq$ $V_{EE} \leq$ -3.0 V *(OLS = $V_{EE}$ )		300 100 5 -300 -1000 -1500	900 300 100 -300 -400 -600		300 100 5 -300 -400 -600	900 300 100 -300 -400 -600		300 100 5 -300 -400 -600	900 300 100 -300 -400 -600	$\mu\text{A}$

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.

\*Typicals used for testing purposes.

\*\*When an output level of 400 mV is desired and  $V_{CC} - V_{EE} > 3.0\text{ V}$ , a 2 k $\Omega$  resistor should be connected from OLS to  $V_{EE}$ .

13. Input and output parameters vary 1:1 with  $V_{CC}$ .

14. All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .

15.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ ,  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

16.  $V_{IH}$  cannot exceed  $V_{CC}$ .

17.  $V_{IL}$  always  $\geq V_{EE}$ .

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**Table 10. AC CHARACTERISTICS**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -3.465\text{ V}$  to  $-2.375\text{ V}$  or  $V_{CC} = 2.375\text{ V}$  to  $3.465\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 18)

Symbol	Characteristic	-40°C			25°C			85°C			Unit	
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
V <sub>OUTPP</sub>	Output Voltage Amplitude (Note 18)	$f_{in} < 5\text{ GHz}$	400	590		450	590		440	590		mV
		$f_{in} \leq 7\text{ GHz}$	200	250		180	250		130	250		
t <sub>PLH</sub>	Propagation Delay to Output Differential D0, D1 → Q0, Q1 SELA, SELB → Q0, Q1		170	205	255	170	205	255	170	210	260	ps
			190	265	350	190	265	350	190	265	350	
t <sub>PHL</sub>	Propagation Delay to Output Differential D0, D1 → Q0, Q1 SELA, SELB → Q0, Q1		170	205	255	170	205	255	170	210	260	ps
			150	215	270	150	215	270	150	215	270	
t <sub>SKEW</sub>	Duty Cycle Skew (Note 19) Within-Device Skew Device-to-Device Skew			5.0	25		5.0	25		5.0	25	ps
				5.0	25		5.0	25		5.0	25	
				15	50		15	50		15	50	
t <sub>JITTER</sub>	RMS Random Clock Jitter (Note 20) Peak-to-Peak Data Dependent Jitter (Note 21) $f_{in} \leq 7\text{ Gb/s}$	$\leq 1\text{ GHz}$ OLS = V <sub>CC</sub>		0.16	0.3		0.17	0.3		0.18	0.4	ps
		$\leq 5\text{ GHz}$ OLS = V <sub>CC</sub>		0.14	0.4		0.16	0.4		0.19	0.4	
		$\leq 6.5\text{ GHz}$ OLS = V <sub>CC</sub>		0.21	0.5		0.31	0.7		0.44	0.9	
		$\leq 1\text{ GHz}$ OLS = V <sub>CC</sub> - 400 mV		0.23	0.4		0.23	0.4		0.25	0.4	
		$\leq 5\text{ GHz}$ OLS = V <sub>CC</sub> - 400 mV		0.18	0.5		0.19	0.5		0.23	0.5	
		$\leq 6.5\text{ GHz}$ OLS = V <sub>CC</sub> - 400 mV		0.2	0.5		0.25	0.6		0.32	0.7	
		$\leq 1\text{ GHz}$ OLS = V <sub>CC</sub> - 800 mV		0.17	0.3		0.18	0.3		0.19	0.3	
		$\leq 5\text{ GHz}$ OLS = V <sub>CC</sub> - 800 mV		0.14	0.4		0.16	0.3		0.2	0.3	
		$\leq 6.5\text{ GHz}$ OLS = V <sub>CC</sub> - 800 mV		0.2	0.5		0.27	0.7		0.38	0.9	
		$\leq 1\text{ GHz}$ OLS = V <sub>EE</sub>		0.18	0.3		0.19	0.3		0.2	0.3	
		$\leq 5\text{ GHz}$ OLS = V <sub>EE</sub>		0.16	0.6		0.17	0.4		0.2	0.4	
		$\leq 6.5\text{ GHz}$ OLS = V <sub>EE</sub>		0.18	0.5		0.24	0.6		0.34	0.8	
					12	18		12	18		12	
V <sub>INPP</sub>	Input Voltage Swing/Sensitivity (Differential Configuration) (Note 22)	75		2600	75		2600	75		2600	mV	
t <sub>r</sub> t <sub>f</sub>	Output Rise/Fall Times (Q0, Q1) (20% - 80%) @ 1 GHz		40 30	55 45	70 55	40 30	55 45	70 55	40 30	55 45	70 55	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.

18. Measured using a 75 mV source, 50% duty cycle clock source. All loading with 50 Ω to V<sub>CC</sub> - 2.0 V. OLS = FLOAT. Input edge rates 40 ps (20% - 80%).

19. t<sub>SKEW</sub> = |t<sub>PLH</sub> - t<sub>PHL</sub>| for a nominal 50% differential clock input waveform.

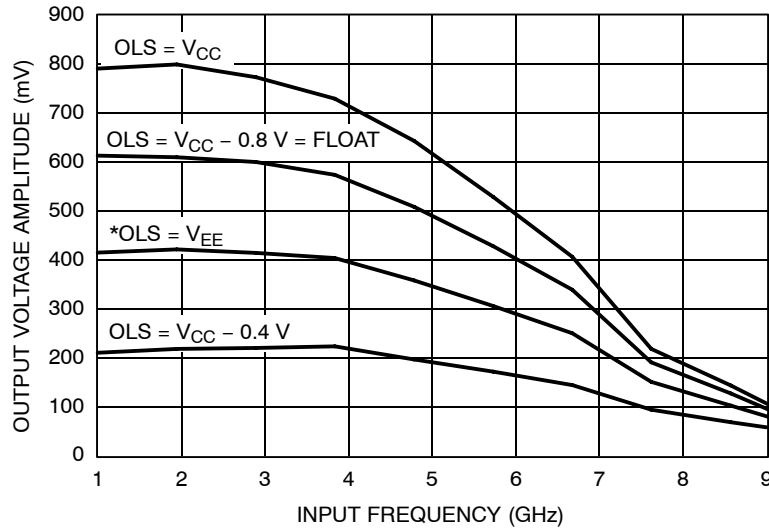
20. Additive RMS jitter with 50% Duty Cycle clock signal.

21. Additive Peak-to-Peak data dependent jitter with NRZ PRBS 2<sup>31</sup>-1 data at 7 Gb/s.

22. Input Voltage Swing is a single-ended measurement operating in differential mode. V<sub>INPP</sub> (max) cannot exceed V<sub>CC</sub> - V<sub>EE</sub>.

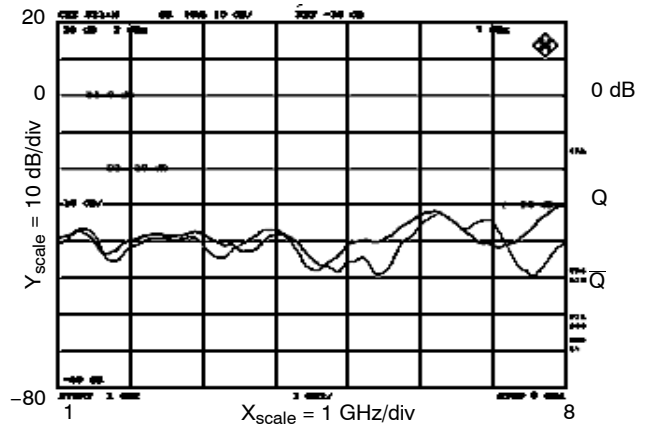
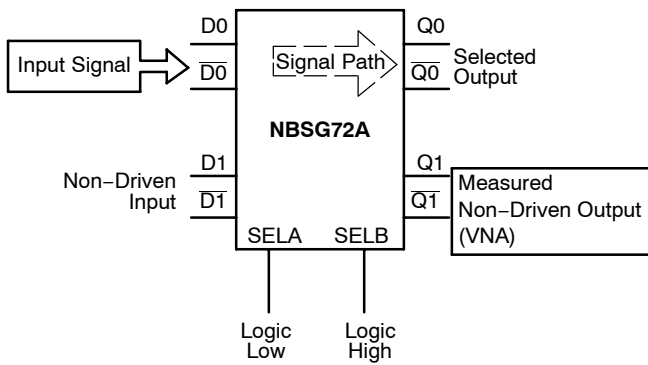


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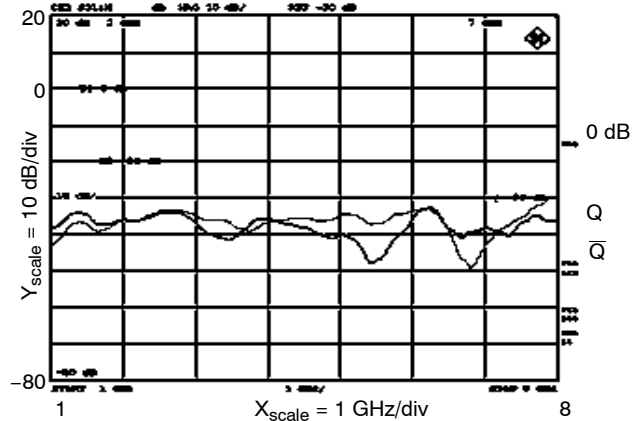
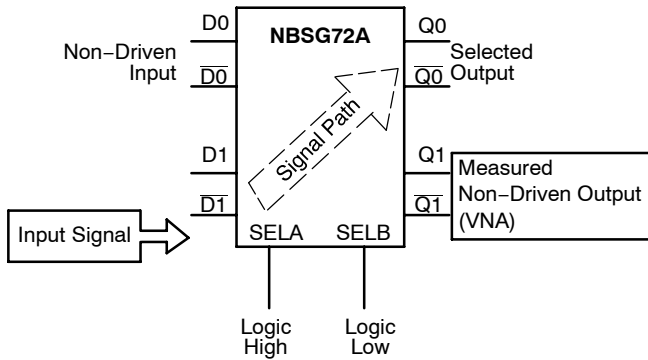


**Figure 3. Output Voltage Amplitude ( $V_{OLTPP}$ ) vs. Input Clock Frequency ( $f_{in}$ ) @ Ambient Temperature (Typical)**

\*When an output level of 400 mV is desired and  $V_{CC} - V_{EE} > 3.0$  V, a 2 k $\Omega$  resistor should be connected from OLS to  $V_{EE}$ .

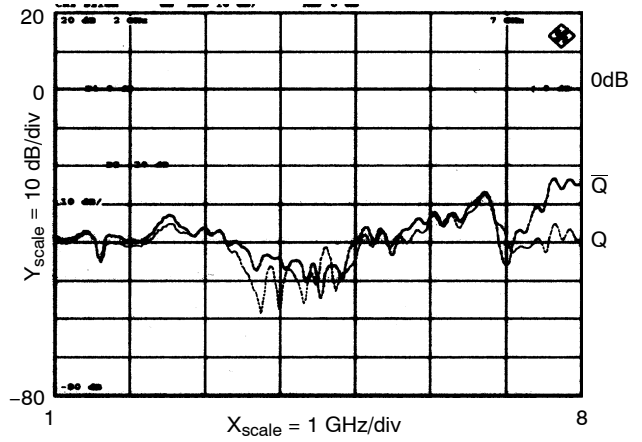
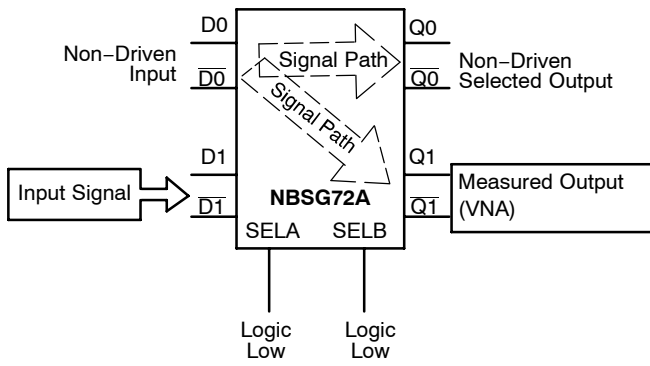


**Figure 4. Channel-to-Channel Crosstalk Isolation at Ambient Temperature (D0 to Q0 Signal Path Selected; SelA = Low, SelB = High)**

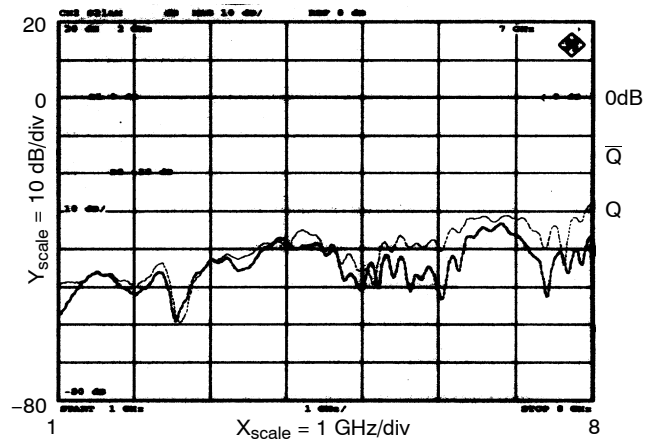
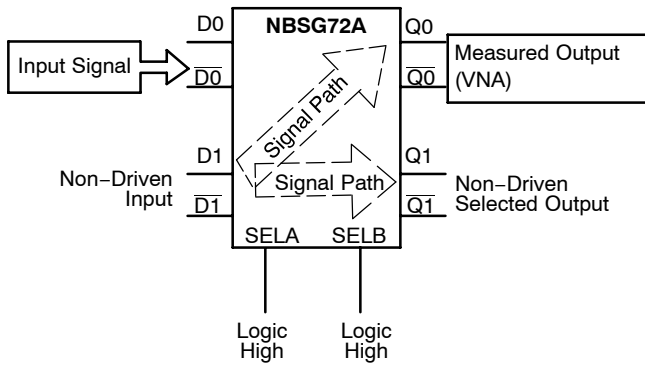


**Figure 5. Channel-to-Channel Crosstalk Isolation at Ambient Temperature (D1 to Q0 Signal Path Selected; SelA = High, SelB = Low)**

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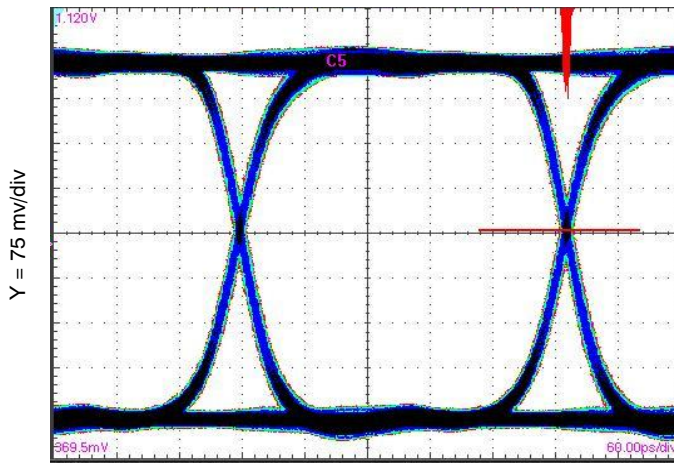


**Figure 6. Channel-to-Channel Crosstalk Isolation at Ambient Temperature (D0 to Q0 and Q1 Signal Path Selected; SelA = Low, SelB = Low)**



**Figure 7. Channel-to-Channel Crosstalk Isolation at Ambient Temperature (D1 to Q0 and Q1 Signal Path Selected; SelA = High, SelB = High)**

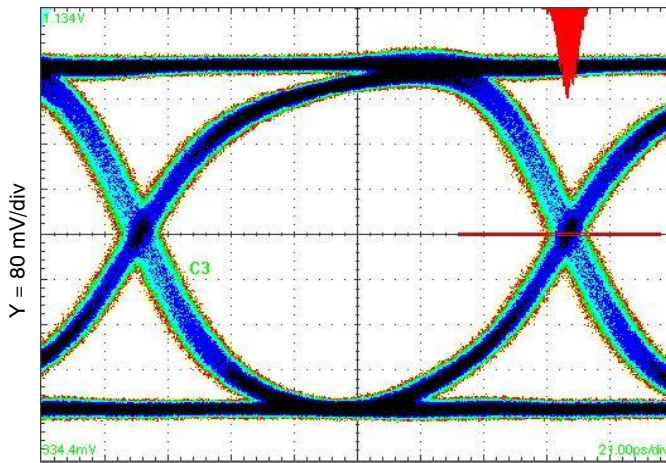
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Total System Jitter = 17.2 ps  
 Input Generator Jitter = 10 ps  
 Device Jitter = 6.8 ps

X = 60 ps/div

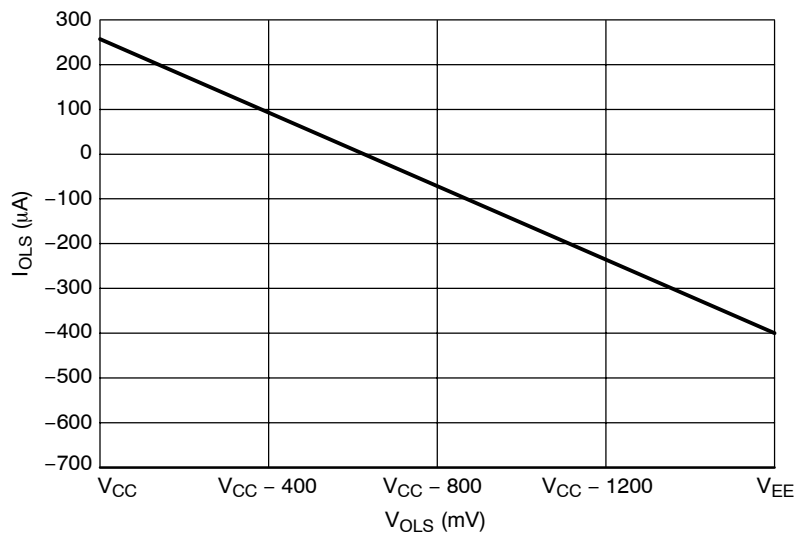
**Figure 8. Eye Diagram at 3.2 Gb/s**  
 ( $V_{CC} - V_{EE} = 3.3$  V, OLS = FLOAT @ 25°C with input pattern of  $2^{31}-1$  PRBS, 5000 Waveforms)



Total System Jitter = 17.2 ps  
 Input Generator Jitter = 10 ps  
 Device Jitter = 7.2 ps

X = 21 ps/div

**Figure 9. Eye Diagram at 7 Gb/s/s**  
 ( $V_{CC} - V_{EE} = 3.3$  V, OLS = FLOAT @ 25°C with input pattern of  $2^{31}-1$  PRBS, 5000 Waveforms)



**Figure 10. Typical OLS Input Current vs. OLS Input Voltage**  
 ( $V_{CC} - V_{EE} = 3.3$  V @ 25°C)

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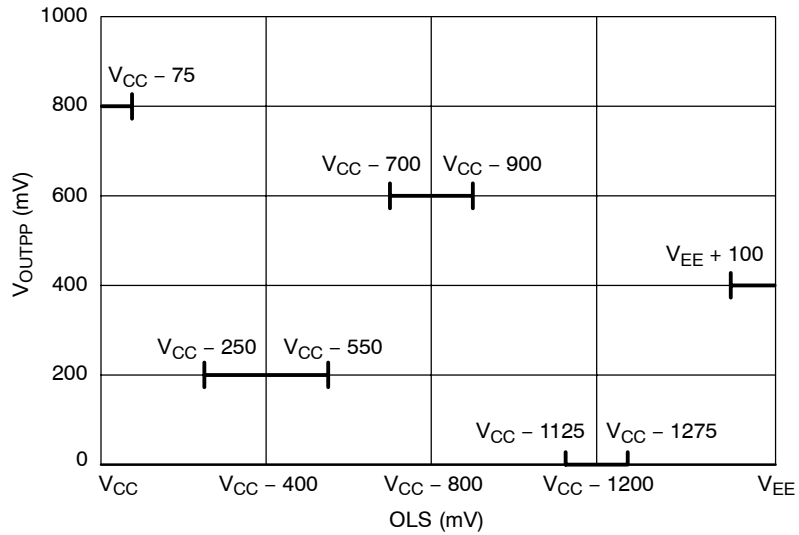


Figure 11. OLS Operating Area

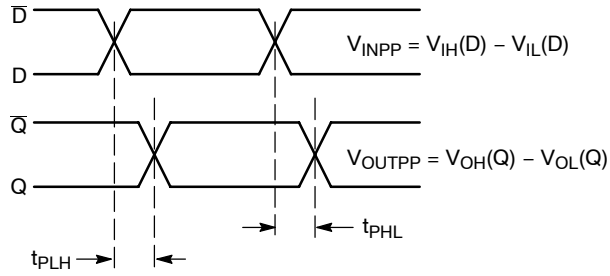


Figure 12. AC Reference Measurement

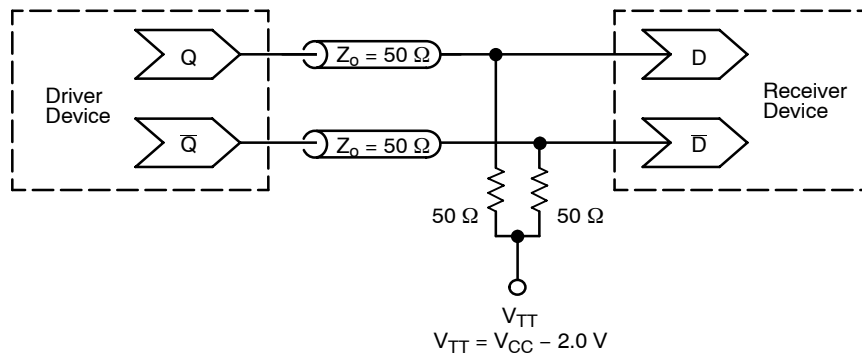


Figure 13. Typical Termination for Output Driver and Device Evaluation  
(See Application Note AND8020/D – Termination of ECL Logic Devices.)

# NBSG72A

## ORDERING INFORMATION

Device	Package	Shipping†
NBSG72AMN	QFN-16	123 Units / Rail
NBSG72AMNG	QFN-16 (Pb-Free)	123 Units / Rail
NBSG72AMNR2	QFN-16	3000 / Tape & Reel
NBSG72AMNR2G	QFN-16 (Pb-Free)	3000 / Tape & Reel

Board	Description
NBSG72AMNEVB	NBSG72AMN Evaluation Board

†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.

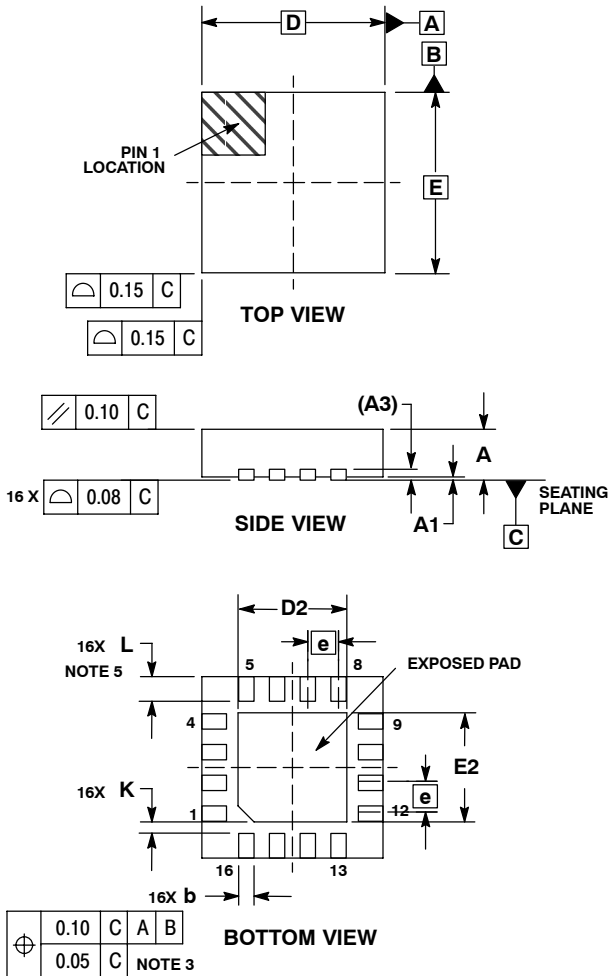
### Resource Reference of Application Notes

- 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

# NBSG72A

## PACKAGE DIMENSIONS

16 PIN QFN  
CASE 485G-01  
ISSUE C



### 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.  $L_{max}$  CONDITION CAN NOT VIOLATE 0.2 MM MINIMUM SPACING BETWEEN LEAD TIP AND FLAG

DIM	MILLIMETERS	
	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

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