

NBSG16VS

2.5 V/3.3 V SiGe Differential Receiver/Driver with Variable Output Swing

Description

The NBSG16VS is a differential receiver/driver targeted for high frequency applications that require variable output swing. The device is functionally equivalent to the EP16VS device with much higher bandwidth and lower EMI capabilities. This device may be used for applications driving VCSEL lasers.

Inputs incorporate internal 50 Ω termination resistors and accept NECL (Negative ECL), PECL (Positive ECL), LVTTTL, LVCMOS, CML, or LVDS. The output amplitude is varied by applying a voltage to the V_{CTRL} input pin. Outputs are variable swing ECL from 100 mV to 750 mV amplitude, optimized for operation from $V_{CC} - V_{EE} = 3.0$ V to 3.465 V.

The V_{BB} and V_{MM} pins are internally generated voltage supplies available to this device only. The V_{BB} is used as a reference voltage for single-ended NECL or PECL inputs and the V_{MM} pin is used as a reference voltage for LVCMOS inputs. For single-ended input operation, the unused complementary differential input is connected to V_{BB} or V_{MM} as a switching reference voltage. V_{BB} or V_{MM} may also rebias AC-coupled inputs. When used, decouple V_{BB} and V_{MM} via a 0.01 μ F capacitor and limit current sourcing or sinking to 0.5 mA. When not used, V_{BB} and V_{MM} outputs should be left open.

Features

- Maximum Input Clock Frequency up to 12 GHz Typical
- Maximum Input Data Rate up to 12 Gb/s Typical
- 40 ps Typical Rise and Fall Times ($V_{CTRL} = V_{CC} - 1$ V)
- 120 ps Typical Propagation Delay ($V_{CTRL} = V_{CC} - 1$ V)
- Variable Swing PECL Output with Operating Range:
 $V_{CC} = 2.375$ V to 3.465 V with $V_{EE} = 0$ V
- Variable Swing NECL Output with NECL Inputs with Operating Range: $V_{CC} = 0$ V with $V_{EE} = -2.375$ V to -3.465 V
- Output Level (100 mV to 750 mV Peak-to-Peak Output; $V_{CC} - V_{EE} = 3.0$ V to 3.465 V), Differential Output Only
- 50 Ω Internal Input Termination Resistors
- Compatible with Existing 2.5 V/3.3 V EP Devices
- V_{BB} and V_{MM} Reference Voltage Output
- These are Pb-Free Devices



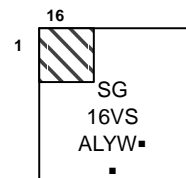
ON Semiconductor®

<http://onsemi.com>



1
QFN-16
MN SUFFIX
CASE 485G

MARKING DIAGRAMS*



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 12 of this data sheet.

NBSG16VS

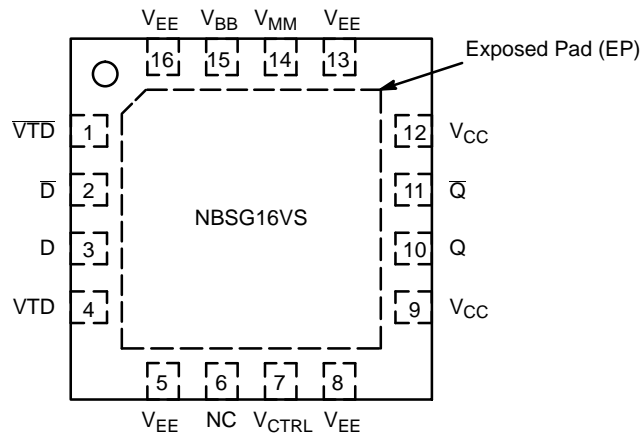


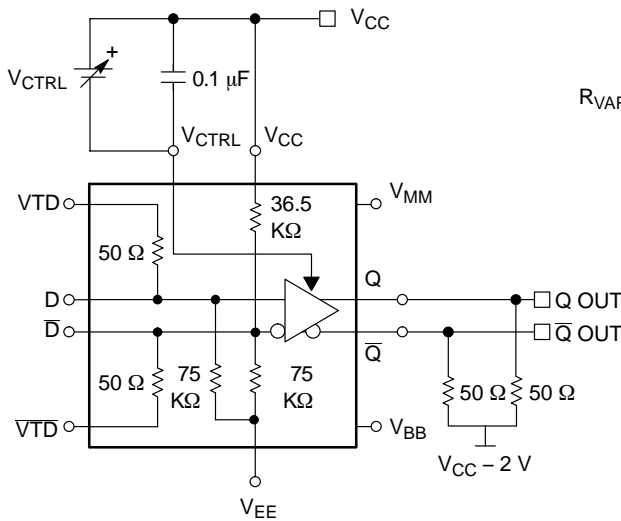
Figure 1. QFN-16 Pinout (Top View)

Table 1. PIN DESCRIPTION

Pin	Name	I/O	Description
1	VTD	-	Internal 50 Ω Termination Pin. See Table 2.
2	\bar{D}	ECL, CML, LVCMOS, LVDS, LVTTTL Input	Inverted Differential Input. Internal 75 k Ω to V_{EE} and 36.5 k Ω to V_{CC} .
3	D	ECL, CML, LVCMOS, LVDS, LVTTTL Input	Noninverted Differential Input. Internal 75 k Ω to V_{EE} .
4	VTD	-	Internal 50 Ω Termination Pin. See Table 2.
5,8,13,16	V_{EE}	-	Negative Supply Voltage
6	NC	-	No Connect
7	V_{CTRL}		Output Amplitude Swing Control. Bypass Pin to V_{CC} through 0.1 μ F Capacitor.
9,12	V_{CC}	-	Positive Supply Voltage
10	Q	RSECL Output	Noninverted Differential Output. Typically Terminated with 50 Ω to $V_{TT} = V_{CC} - 2 V$
11	\bar{Q}	RSECL Output	Inverted Differential Output. Typically Terminated with 50 Ω to $V_{TT} = V_{CC} - 2 V$
14	V_{MM}	-	LVCMOS Reference Voltage Output. $(V_{CC} - V_{EE})/2$
15	V_{BB}	-	ECL Reference Voltage Output
-	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 not electrically connected to the die but may be electrically and thermally connected to V_{EE} on the PC board.

1. All V_{CC} and V_{EE} pins must be externally connected to Power Supply to guarantee proper operation. The thermally exposed pad on package bottom (see case drawing) must be attached to a heat-sinking conduit.
2. In the differential configuration when the input termination pins (VTD, \bar{D} , D) are connected to a common termination voltage, and if no signal is applied then the device will be susceptible to self-oscillation.

NBSG16VS



**Figure 2. Logic Diagram/
Voltage Source Implementation**

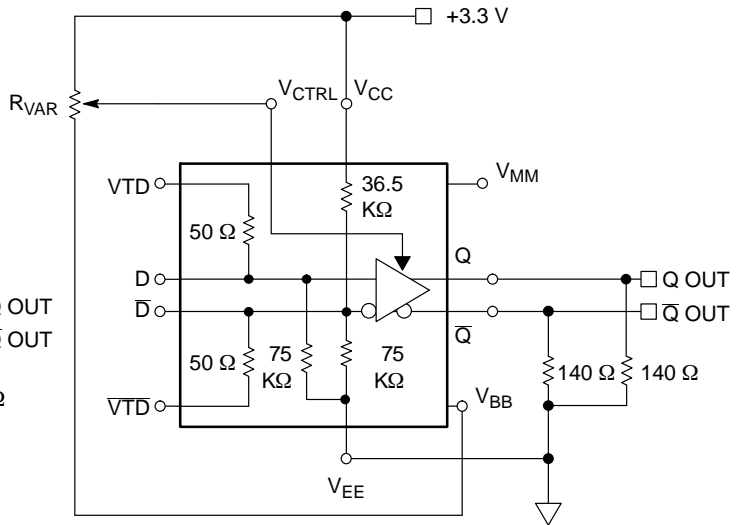


Figure 3. Alternative Voltage Source Implementation

Table 2. INTERFACING OPTIONS

INTERFACING OPTIONS	CONNECTIONS
CML	Connect VTD and \overline{VTD} to V_{CC}
LVDS	Connect VTD and \overline{VTD} Together
AC-COUPLED	Bias VTD and \overline{VTD} Inputs within Common Mode Range (V_{IHCMR})
RSECL, PECL, NECL	Standard ECL Termination Techniques
LVTTL	An external voltage should be applied to the unused complementary differential input. Nominal voltage is 1.5 V for LVTTL.
LVCMOS	V_{MM} should be connected to the unused complementary differential input.

Table 3. ATTRIBUTES

Characteristics	Value
Internal Input Pulldown Resistor (D, \overline{D})	75 k Ω
Internal Input Pullup Resistor (\overline{D})	36.5 k Ω
ESD Protection	Human Body Model Machine Model > 2 kV > 100 V
Moisture Sensitivity (Note 3)	Pb-Free Level 1
Flammability Rating	Oxygen Index: 28 to 34 UL 94 V-0 @ 0.125 in
Transistor Count	192
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

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

NBSG16VS

Table 4. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V_{CC}	Positive Power Supply	$V_{EE} = 0\text{ V}$		3.6	V
V_{EE}	Negative Power Supply	$V_{CC} = 0\text{ V}$		-3.6	V
V_I	Positive Input Negative Input	$V_{EE} = 0\text{ V}$ $V_{CC} = 0\text{ V}$	$V_I \leq V_{CC}$ $V_I \geq V_{EE}$	3.6 -3.6	V V
V_{INPP}	Differential Input Voltage $ D - \bar{D} $	$V_{CC} - V_{EE} \geq 2.8\text{ V}$ $V_{CC} - V_{EE} < 2.8\text{ V}$		2.8 $ V_{CC} - V_{EE} $	V V
I_{OUT}	Output Current	Continuous Surge		25 50	mA mA
I_{IN}	Input Current Through R_T (50 Ω Resistor)	Static Surge		45 80	mA mA
I_{BB}	V_{BB} Sink/Source			1	mA
I_{MM}	V_{MM} Sink/Source			1	mA
T_A	Operating Temperature Range			-40 to +85	$^{\circ}\text{C}$
T_{stg}	Storage Temperature Range			-65 to +150	$^{\circ}\text{C}$
θ_{JA}	Thermal Resistance (Junction-to-Ambient) (Note 4)	0 lfpm 500 lfpm		41.6 35.2	$^{\circ}\text{C}/\text{W}$
θ_{JC}	Thermal Resistance (Junction-to-Case)	2S2P (Note 4)		4.0	$^{\circ}\text{C}/\text{W}$
T_{sol}	Wave Solder Pb-Free			265	$^{\circ}\text{C}$

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

NBSG16VS

Table 5. DC CHARACTERISTICS, INPUT WITH VARIABLE PECL OUTPUT

($V_{CC} = 2.5\text{ V}$; $V_{EE} = 0\text{ V}$) (Note 5)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	

POWER SUPPLY CURRENT

I_{EE}	Negative Power Supply Current	18	25	32	18	25	32	18	25	32	mA
----------	-------------------------------	----	----	----	----	----	----	----	----	----	----

VARIABLE PECL OUTPUTS (Note 6)

V_{OH}	Output HIGH Voltage	1315	1440	1565	1305	1430	1555	1305	1430	1555	mV
V_{OL}	Output LOW Voltage Max Swing $V_{CTRL} = V_{CC} - 600\text{ mV}$	645 1090	765 1210	885 1330	605 1035	725 1155	845 1275	600 1010	720 1130	840 1250	mV

DIFFERENTIAL CLOCK INPUTS DRIVEN SINGLE-ENDED (Figures 9 & 11) (Note 7)

V_{IH}	Input HIGH Voltage	1200		V_{CC}	1200		V_{CC}	1200		V_{CC}	mV
V_{IL}	Input LOW Voltage	0		$V_{IH} - 150$	0		$V_{IH} - 150$	0		$V_{IH} - 150$	mV
V_{th}	Input Threshold Voltage Range (Note 8)	950		$V_{CC} - 75$	950		$V_{CC} - 75$	950		$V_{CC} - 75$	mV
V_{ISE}	Single-Ended Input Voltage ($V_{IH} - V_{IL}$)	150		2600	150		2600	150		260	mV
V_{BB}	PECL Output Voltage Reference	1080	1140	1200	1080	1140	1200	1080	1140	1200	mV

DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY (Figures 10 & 12) (Note 9)

V_{IHD}	Differential Input HIGH Voltage	1200		V_{CC}	1200		V_{CC}	1200		V_{CC}	mV
V_{ILD}	Differential Input LOW Voltage	0		$V_{IHD} - 75$	0		$V_{IHD} - 75$	0		$V_{IHD} - 75$	mV
V_{ID}	Differential Input Voltage ($V_{IHD} - V_{ILD}$)	75		2600	75		2600	75		2600	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Note 10) (Figure 13)	1200		2500	1200		2500	1200		2500	mV
I_{IH}	Input HIGH Current (@ V_{IH})		30	100		30	100		30	100	μA
I_{IL}	Input LOW Current (@ V_{IL})		25	50		25	50		25	50	μA

LVC MOS CONTROL PIN

V_{MM}	CMOS Output Voltage Reference ($V_{CC} - V_{EE}$) / 2	1100	1250	1400	1100	1250	1400	1100	1250	1400	mV
----------	------------------------------------------------------------	------	------	------	------	------	------	------	------	------	----

TERMINATION RESISTORS

R_{TIN}	Internal Input Termination Resistor	45	50	55	45	50	55	45	50	55	Ω
-----------	-------------------------------------	----	----	----	----	----	----	----	----	----	----------

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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.

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

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

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. $V_{th} = (V_{IH} - V_{IL}) / 2$.

9. V_{IHD} , V_{ILD} , V_{ID} and V_{IHCMR} parameters must be complied with simultaneously.

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.

NBSG16VS

Table 6. DC CHARACTERISTICS, INPUT WITH VARIABLE PECL OUTPUT

($V_{CC} = 3.3\text{ V}$; $V_{EE} = 0\text{ V}$) (Note 11)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	

POWER SUPPLY CURRENT

I_{EE}	Negative Power Supply Current	20	27	34	20	27	34	20	27	34	mA
----------	-------------------------------	----	----	----	----	----	----	----	----	----	----

VARIABLE PECL OUTPUTS (Note 12)

V_{OH}	Output HIGH Voltage	2095	2220	2345	2085	2210	2335	2075	2200	2325	mV
V_{OL}	Output LOW Voltage Max Swing $V_{CTRL} = V_{CC} - 600\text{ mV}$	1275 1750	1395 1870	1515 1990	1285 1730	1405 1850	1525 1970	1295 1715	1415 1835	1535 1955	mV

DIFFERENTIAL CLOCK INPUTS DRIVEN SINGLE-ENDED (Figures 9 & 11) (Note 13)

V_{IH}	Input HIGH Voltage	1200		V_{CC}	1200		V_{CC}	1200		V_{CC}	mV
V_{IL}	Input LOW Voltage	0		$V_{IH} - 150$	0		$V_{IH} - 150$	0		$V_{IH} - 150$	mV
V_{th}	Input Threshold Voltage Range (Note 14)	950		$V_{CC} - 75$	950		$V_{CC} - 75$	950		$V_{CC} - 75$	mV
V_{ISE}	Single-Ended Input Voltage ($V_{IH} - V_{IL}$)	150		2600	150		2600	150		260	mV
V_{BB}	PECL Output Voltage Reference	1800	1940	2000	1800	1940	2000	1800	1940	2000	mV

DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY (Figures 10 & 12) (Note 15)

V_{IHD}	Differential Input HIGH Voltage	1200		V_{CC}	1200		V_{CC}	1200		V_{CC}	mV
V_{ILD}	Differential Input LOW Voltage	0		$V_{IHD} - 75$	0		$V_{IHD} - 75$	0		$V_{IHD} - 75$	mV
V_{ID}	Differential Input Voltage ($V_{IHD} - V_{ILD}$)	75		2600	75		2600	75		2600	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Note 16) (Figure 13)	1200		3300	1200		3300	1200		3300	mV
I_{IH}	Input HIGH Current (@ V_{IH})		30	100		30	100		30	100	μA
I_{IL}	Input LOW Current (@ V_{IL})		25	50		25	50		25	50	μA

LVC MOS CONTROL PIN

V_{MM}	CMOS Output Voltage Reference ($V_{CC} - V_{EE}$) / 2	1500	1650	1800	1500	1650	1800	1500	1650	1800	mV
----------	------------------------------------------------------------	------	------	------	------	------	------	------	------	------	----

TERMINATION RESISTORS

R_{TIN}	Internal Input Termination Resistor	45	50	55	45	50	55	45	50	55	Ω
-----------	-------------------------------------	----	----	----	----	----	----	----	----	----	----------

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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.

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

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

13. V_{th} , V_{IH} , V_{IL} , and V_{ISE} parameters must be complied with simultaneously.

14. V_{th} is applied to the complementary input when operating in single-ended mode. $V_{th} = (V_{IH} - V_{IL}) / 2$.

15. V_{IHD} , V_{ILD} , V_{ID} and V_{IHCMR} parameters must be complied with simultaneously.

16. 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.

NBSG16VS

Table 7. DC CHARACTERISTICS, INPUT WITH VARIABLE NECL OUTPUT

($V_{CC} = 0$ V; $V_{EE} = -3.465$ V to -2.375 V) (Note 17)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	

POWER SUPPLY CURRENT

I_{EE}	Negative Power Supply Current	20	27	34	20	27	34	20	27	34	mA
----------	-------------------------------	----	----	----	----	----	----	----	----	----	----

VARIABLE NECL OUTPUTS (Note 18)

V_{OH}	Output HIGH Voltage	-1205 -1185	-1080 -1060	-955 -935	-1215 -1195	-1090 -1070	-965 -945	-1225 -1195	-1100 -1070	-975 -945	mV
V_{OL}	Output LOW Voltage Max Swing $V_{CTRL} = V_{CC} - 600$ mV -3.0 V < $V_{EE} \leq -2.375$ V Max Swing $V_{CTRL} = V_{CC} - 600$ mV	-2000 -1560	-1910 -1440	-1820 -1320	-1990 -1580	-1900 -1460	-1810 -1340	-1980 -1595	-1890 -1475	-1800 -1355	mV
		-1855 -1410	-1620 -1215	-1290 -1000	-1895 -1460	-1705 -1290	-1425 -1100	-1900 -1490	-1730 -1330	-1470 -1150	

DIFFERENTIAL CLOCK INPUTS DRIVEN SINGLE-ENDED (Figures 9 & 11) (Note 19)

V_{IH}	Input HIGH Voltage	$V_{EE} + 1200$		V_{CC}	$V_{EE} + 1200$		V_{CC}	$V_{EE} + 1200$		V_{CC}	mV
V_{IL}	Input LOW Voltage	V_{EE}		$V_{IH} - 150$	V_{EE}		$V_{IH} - 150$	V_{EE}		$V_{IH} - 150$	mV
V_{th}	Input Threshold Voltage Range (Note 20)	$V_{EE} + 950$		$V_{CC} - 75$	$V_{EE} + 950$		$V_{CC} - 75$	$V_{EE} + 950$		$V_{CC} - 75$	mV
V_{ISE}	Single-Ended Input Voltage ($V_{IH} - V_{IL}$)	150		2600	150		2600	150		260	mV
V_{BB}	NECL Output Voltage Reference	-1420	-1360	-1300	-1420	-1360	-1300	-1420	-1360	-1300	mV

DIFFERENTIAL INPUTS DRIVEN DIFFERENTIALLY (Figures 10 & 12) (Note 21)

V_{IHD}	Differential Input HIGH Voltage	$V_{EE} + 1200$		V_{CC}	$V_{EE} + 1200$		V_{CC}	$V_{EE} + 1200$		V_{CC}	mV
V_{ILD}	Differential Input LOW Voltage	V_{EE}		$V_{IHD} - 75$	V_{EE}		$V_{IHD} - 75$	V_{EE}		$V_{IHD} - 75$	mV
V_{ID}	Differential Input Voltage ($V_{IHD} - V_{ILD}$)	75		2600	75		2600	75		2600	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Note 22) (Figure 13)	$V_{EE} + 1200$		0	$V_{EE} + 1200$		0	$V_{EE} + 1200$		0	mV
I_{IH}	Input HIGH Current (@ V_{IH})		30	100		30	100		30	100	μ A
I_{IL}	Input LOW Current (@ V_{IL})		25	50		25	50		25	50	μ A

LVC MOS CONTROL PIN (Note 23)

V_{MM}	CMOS Output Voltage Reference	$V_{MM} - 150$	V_{MM}	$V_{MM} + 150$	$V_{MM} - 150$	V_{MM}	$V_{MM} + 150$	$V_{MM} - 150$	V_{MM}	$V_{MM} + 150$	mV
----------	-------------------------------	----------------	----------	----------------	----------------	----------	----------------	----------------	----------	----------------	----

TERMINATION RESISTORS

R_{TIN}	Internal Input Termination Resistor	45	50	55	45	50	55	45	50	55	Ω
-----------	-------------------------------------	----	----	----	----	----	----	----	----	----	----------

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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.

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

18. All loading with 50Ω to $V_{CC} - 2.0$ V.

19. V_{th} , V_{IH} , V_{IL} , and V_{ISE} parameters must be complied with simultaneously.

20. V_{th} is applied to the complementary input when operating in single-ended mode. $V_{th} = (V_{IH} - V_{IL}) / 2$.

21. V_{IHD} , V_{ILD} , V_{ID} and V_{IHCMR} parameters must be complied with simultaneously.

22. 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.

23. V_{MM} typical = $|V_{CC} - V_{EE}| / 2 + V_{EE} = V_{MMT}$

NBSG16VS

Table 8. AC CHARACTERISTICS

($V_{CC} = 0\text{ V}$; $V_{EE} = -3.465\text{ V}$ to -3.0 V or $V_{CC} = 3.0\text{ V}$ to 3.465 V ; $V_{EE} = 0\text{ V}$)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
f_{\max}	Maximum Input Clock Frequency (See Figure 7) (Note 24)	10 (Note 27)	12		10 (Note 27)	12		10 (Note 27)	12		GHz
t_{PLH} , t_{PHL}	Propagation Delay to Output Differential ($V_{CTRL} = V_{CC} - 2\text{ V}$) $D \rightarrow Q, \bar{Q}$ ($V_{CTRL} = V_{CC} - 1\text{ V}$) $D \rightarrow Q, \bar{Q}$	100 100	140 135	180 180	100 100	140 135	180 180	100 80	140 135	180 220	ps
t_{SKEW}	Duty Cycle Skew (Note 25)		3	20		3	15		3	10	ps
t_{JITTER}	RMS Random Clock Jitter $f_{in} < 10\text{ GHz}$ Peak-to-Peak Data Dependent Jitter $f_{in} < 10\text{ Gb/s}$		0.5 5	2		0.5 5	2		0.5 5	2	ps
V_{INPP}	Input Voltage Swing/Sensitivity (Differential Configuration) (Note 26)	75		2600	75		2600	75		2600	mV
t_r t_f	Output Rise/Fall Times (20% – 80%) @ 1 GHz ($V_{CTRL} = V_{CC} - 2\text{ V}$) Q, \bar{Q} ($V_{CTRL} = V_{CC} - 1\text{ V}$) Q, \bar{Q}	30 30	45 40	55 50	30 30	45 40	55 50	30 30	45 40	55 50	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.

24. Measured using a 500 mV source, 50% duty cycle clock source. All loading with $50\ \Omega$ to $V_{CC} - 2.0\text{ V}$. Input edge rates 40 ps (20% – 80%).

25. $t_{SKEW} = |t_{PLH} - t_{PHL}|$ for a nominal 50% differential clock input waveform. See Figure 14.

26. $V_{INPP(MAX)}$ cannot exceed $V_{CC} - V_{EE}$ (applicable only when $V_{CC} - V_{EE} < 2600\text{ mV}$).

27. Conditions include input amplitude of 500 mV and $V_{CTRL} = V_{CC} - 2\text{ V}$. Minimum output amplitude guarantee of 100 mV (see Output P–P Spec in Figure 7).

Table 9. AC CHARACTERISTICS

($V_{CC} = 0\text{ V}$; $-3.0\text{ V} < V_{EE} \leq -2.375\text{ V}$ or $2.375\text{ V} \leq V_{CC} < 3.0\text{ V}$; $V_{EE} = 0\text{ V}$)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
f_{\max}	Maximum Input Clock Frequency (See Figure 8) (Note 28)	10 (Note 31)	12		10 (Note 31)	12		10 (Note 31)	12		GHz
t_{PLH} , t_{PHL}	Propagation Delay to Output Differential ($V_{CTRL} = V_{CC} - 2\text{ V}$) $D \rightarrow Q, \bar{Q}$ ($V_{CTRL} = V_{CC} - 1\text{ V}$) $D \rightarrow Q, \bar{Q}$	100 100	140 135	180 180	100 100	140 135	180 180	80 100	140 135	180 220	ps
t_{SKEW}	Duty Cycle Skew (Note 29)		3	20		3	15		3	10	ps
t_{JITTER}	RMS Random Clock Jitter $f_{in} < 10\text{ GHz}$ Peak-to-Peak Data Dependent Jitter $f_{in} < 10\text{ Gb/s}$		0.5 5	3		0.5 5	3		0.5 5	3	ps
V_{INPP}	Input Voltage Swing/Sensitivity (Differential Configuration) (Note 30)	75		2600	75		2600	75		2600	mV
t_r t_f	Output Rise/Fall Times (20% – 80%) @ 1 GHz ($V_{CTRL} = V_{CC} - 2\text{ V}$) Q, \bar{Q} ($V_{CTRL} = V_{CC} - 1\text{ V}$) Q, \bar{Q}	25 22	50 45	70 60	25 22	50 45	70 60	25 22	50 45	70 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.

28. Measured using a 500 mV source, 50% duty cycle clock source. All loading with $50\ \Omega$ to $V_{CC} - 2.0\text{ V}$. Input edge rates 40 ps (20% – 80%).

29. $t_{SKEW} = |t_{PLH} - t_{PHL}|$ for a nominal 50% differential clock input waveform. See Figure 14.

30. $V_{INPP(MAX)}$ cannot exceed $V_{CC} - V_{EE}$ (applicable only when $V_{CC} - V_{EE} < 2600\text{ mV}$).

31. Conditions include input amplitude of 500 mV and $V_{CTRL} = V_{CC} - 2\text{ V}$. Minimum output amplitude guarantee of 100 mV (see Output P–P Spec in Figure 8), 80 mV at -40°C .

NBSG16VS

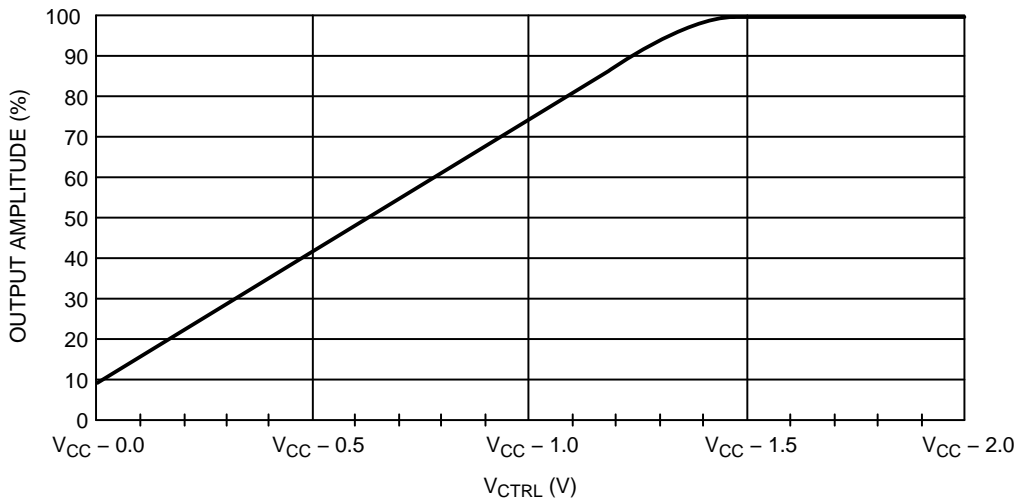


Figure 4. Output Amplitude % vs. V_{CTRL} (pin #A3)

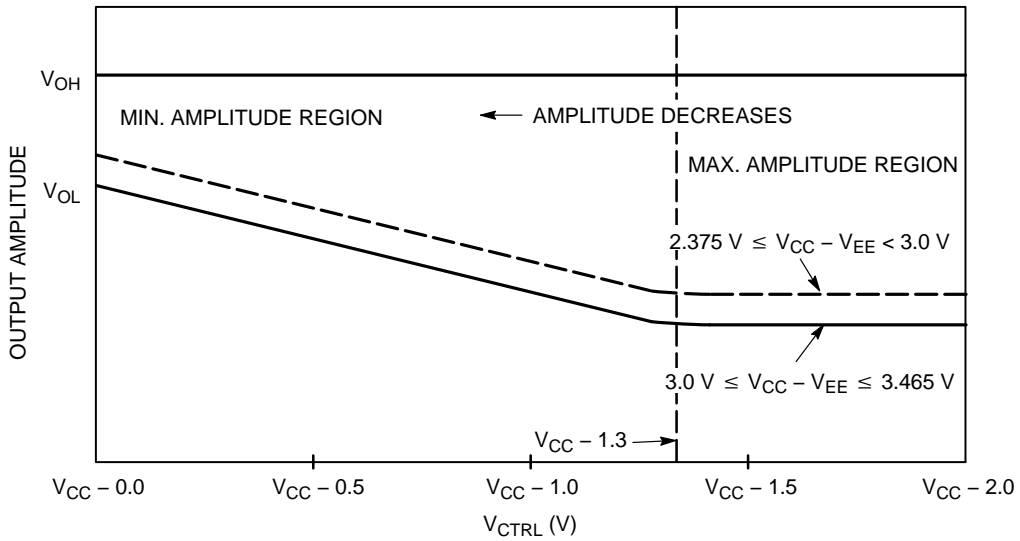


Figure 5. Output Amplitude vs. V_{CTRL} (pin #A3)

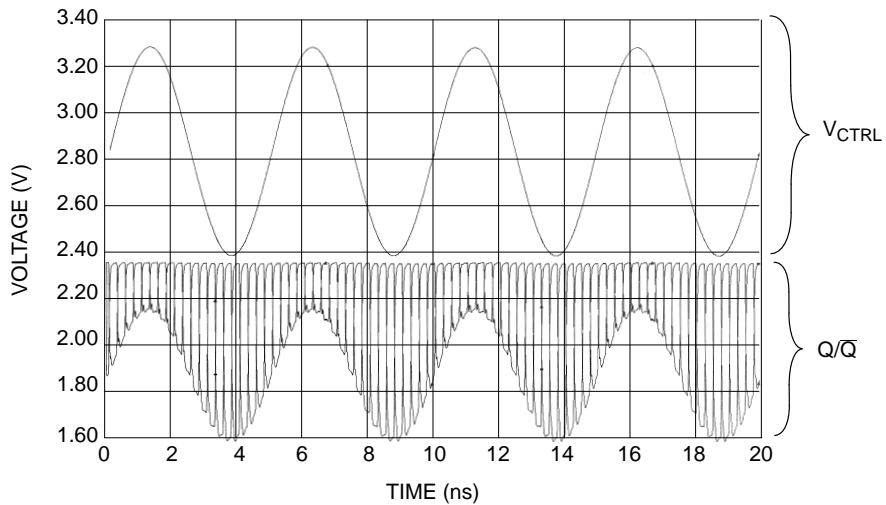


Figure 6. Output Response Under Amplitude Modulation of V_{CTRL}
 (Conditions Include $V_{CC} - V_{EE} = 3.3\text{ V}$ at 25°C , $f_{IN}(V_{CTRL}) = 200\text{ MHz}$, and $f_{IN}(D, \bar{D}) = 2\text{ GHz}$)

NBSG16VS

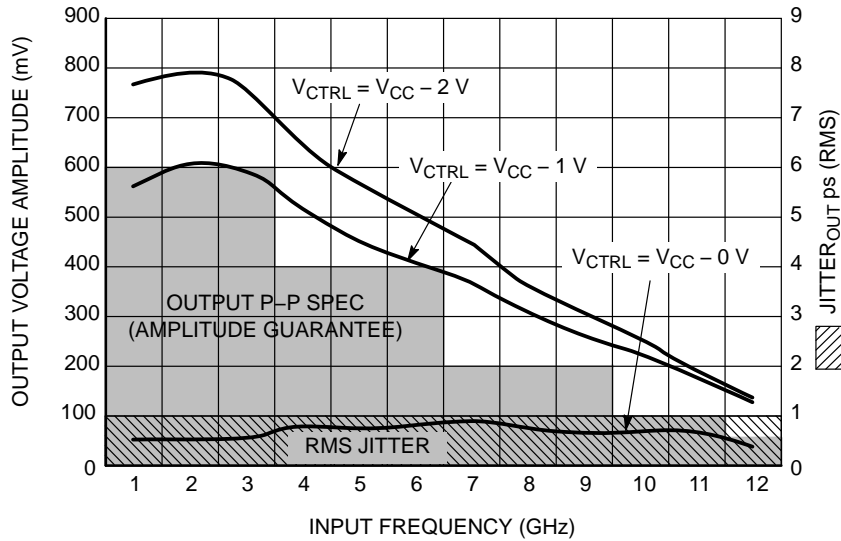


Figure 7. Output Voltage Amplitude (V_{OUTPP}) / RMS Jitter vs. Input Frequency (f_{in}) at Ambient Temperature (Typical) See Table 8 ($V_{CC} = 0V$; $V_{EE} = -3.465V$ to $-3.0V$ or $V_{CC} = 3.0V$ to $3.465V$; $V_{EE} = 0V$)

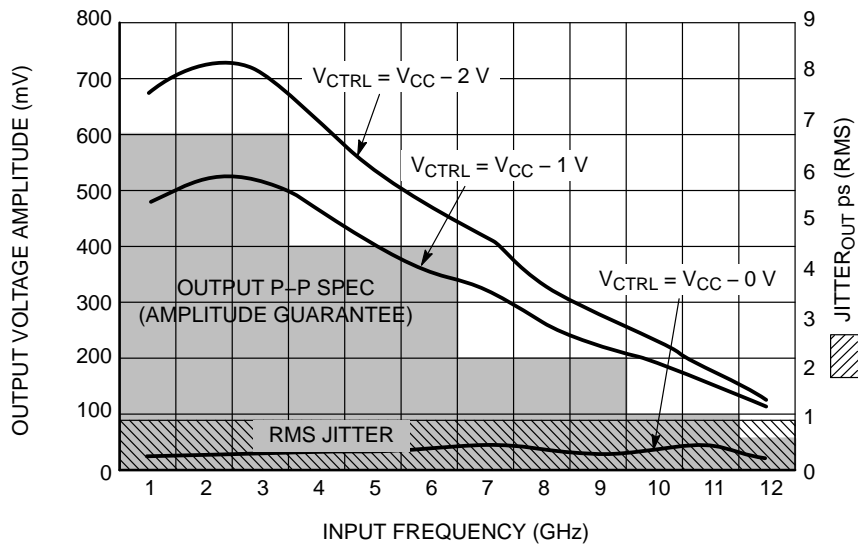


Figure 8. Output Voltage Amplitude (V_{OUTPP}) / RMS Jitter vs. Input Frequency (f_{in}) at Ambient Temperature (Typical) See Table 9 ($V_{CC} = 0V$; $-3.0V$ $V_{EE} -2.375V$ or $2.375V$ $V_{CC} 3.0V$; $V_{EE} = 0V$)

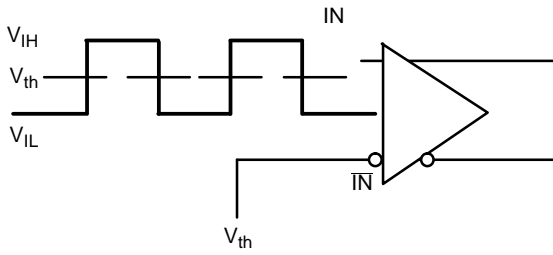


Figure 9. Differential Input Driven Single-Ended

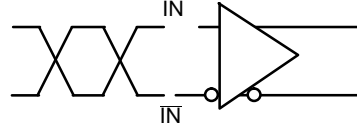


Figure 10. Differential Inputs Driven Differentially

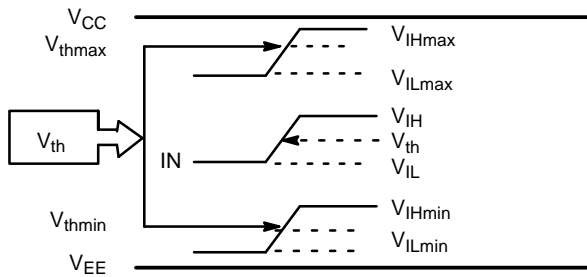


Figure 11. V_{th} Diagram

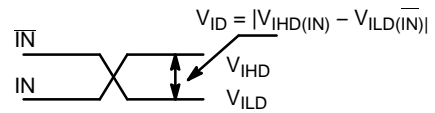


Figure 12. Differential Inputs Driven Differentially

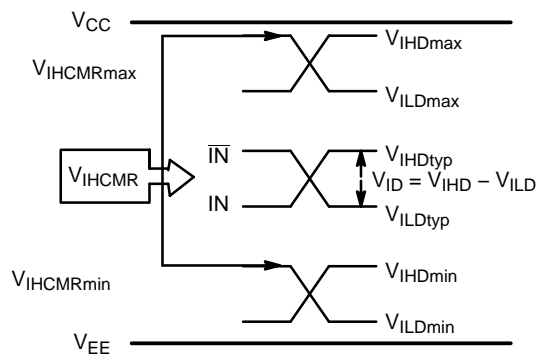


Figure 13. V_{IHCMR} Diagram

NBSG16VS

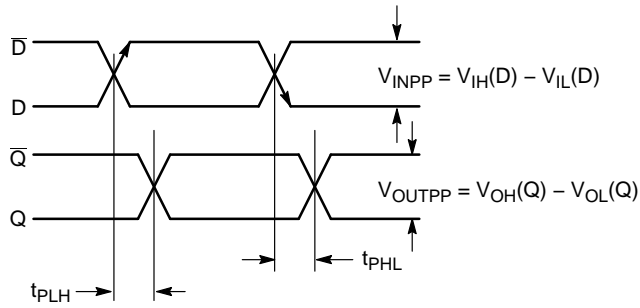


Figure 14. AC Reference Measurement

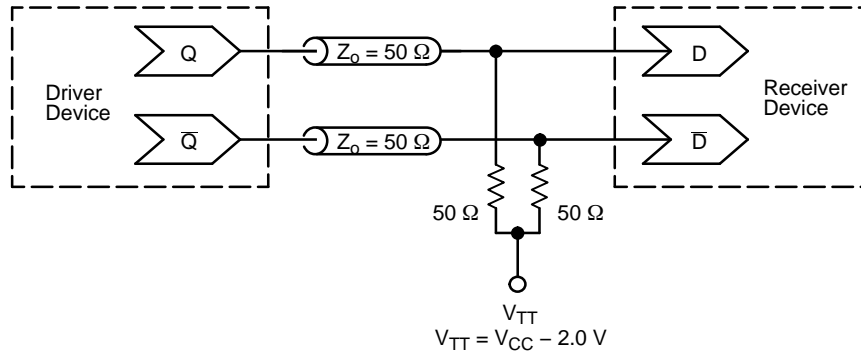


Figure 15. Typical Termination for Output Driver and Device Evaluation
(See Application Note AND8020/D – Termination of ECL Logic Devices.)

ORDERING INFORMATION

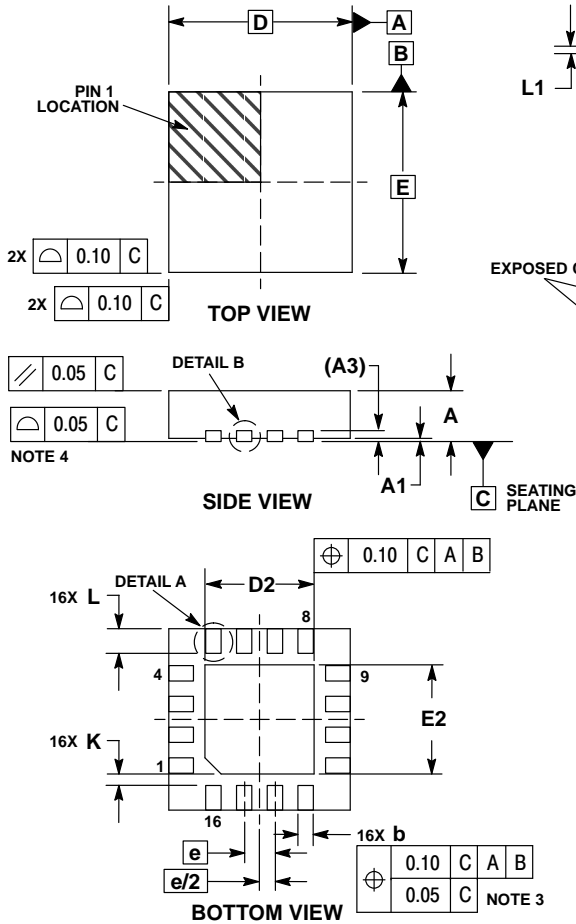
Device	Package	Shipping†
NBSG16VSMNG	QFN-16 (Pb-Free / Halide-Free)	123 Units / Tube
NBSG16VSMNR2G	QFN-16 (Pb-Free / Halide-Free)	3000 / Tape & Reel
NBSG16VSMNHTBG	QFN-16 (Pb-Free / Halide-Free)	100 / Tape & Reel

†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.

NBSG16VS

PACKAGE DIMENSIONS

QFN16 3x3, 0.5P
CASE 485G
ISSUE F



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.

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	0.24	0.30
D	3.00 BSC		
D2	1.65	1.75	1.85
E	3.00 BSC		
E2	1.65	1.75	1.85
e	0.50 BSC		
K	0.18 TYP		
L	0.30	0.40	0.50
L1	0.00	0.08	0.15

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

The products described herein (NBSG16VS), may be covered by U.S. patents including 6,362,644. There may be other patents pending.

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. 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: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative