National Semiconductor

February 1996

# DS3667 TRI-STATE® Bidirectional Transceiver

## General Description

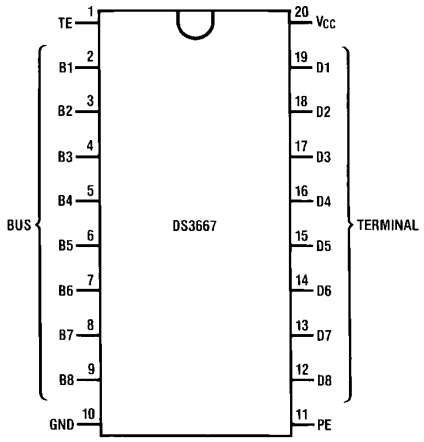
The DS3667 is a high-speed Schottky 8-channel bidirectional transceiver designed for digital information and communication systems. Pin selectable totem-pole/open collector outputs are provided at all driver outputs. This feature, together with the Dumb Mode which puts both driver and receiver outputs in TRI-STATE at the same time, means higher flexibility of system design. PNP inputs are used at all driver inputs for minimum loading, and hysteresis is provided at all receiver inputs for added noise margin. A power up/down protection circuit is included at all outputs to provide glitch-free operation during $V_{CC}$ power up or down.

## Features

- 8-channel bidirectional non-inverting transceivers
- Bidirectional control implemented with TRI-STATE output design
- High speed Schottky design
- Low power consumption
- High impedance PNP inputs (drivers)
- Pin selectable totem-pole/open collector outputs (drivers)
- 500 mV (typ) input hysteresis (receivers)
- Power up/down protection (glitch-free)
- Dumb Mode capability

## Connection Diagram

**Dual-In-Line Package**

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**Top View**

**Order Number DS3667N**
**See NS Package Number N20A**

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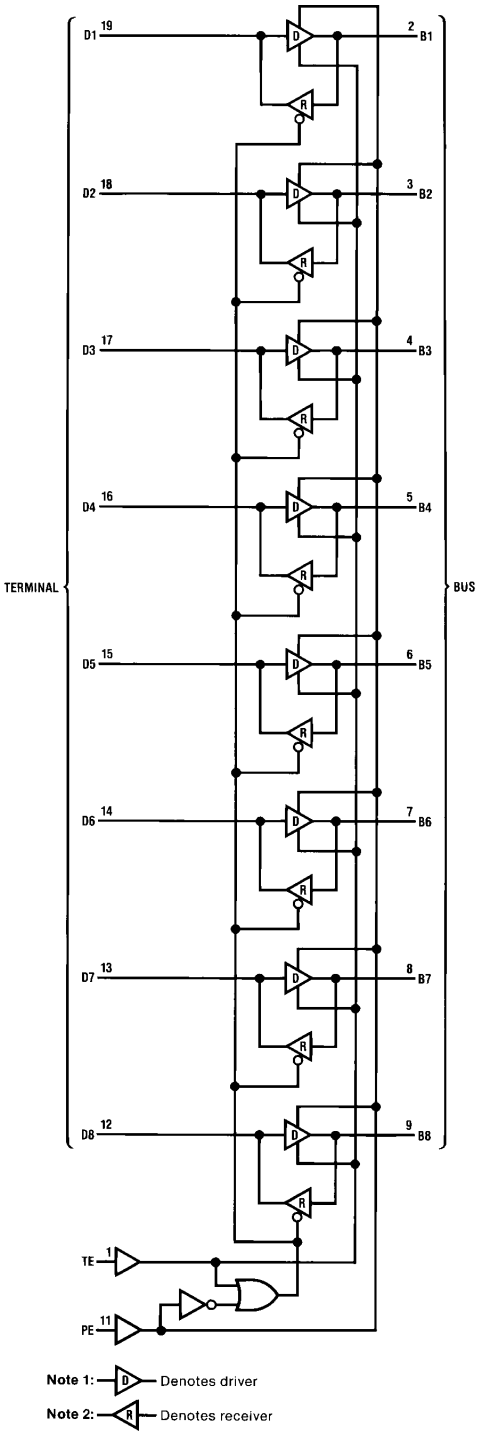
## Logic Diagram

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## Functional Truth Table

| Control Input Level | | Data Transceivers | | |
|---|---|---|---|---|
| **TE** | **PE** | **Mode** | **Bus Port** | **Terminal Port** |
| H | H | T | Totem-Pole Output | Input |
| H | L | T | Open Collector Output | Input |
| L | H | R | Input | Output |
| L | L | D | TRI-STATE | TRI-STATE |

H: High Level Input
L: Low Level Input
T: Transmitting Mode
R: Receiving Mode
D: Dumb Mode

## Absolute Maximum Ratings (Note 1)

**If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.**

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | 7.0V |
| Input Voltage | 5.5V |
| Storage Temperature Range | −65°C to +150°C |
| Maximum Power Dissipation* at 25°C Molded Package | 1832 mW |
| Lead Temperature (Soldering, 4 seconds) | 260°C |

*Derate molded package 14.7 mW/°C above 25°C.

## Operating Conditions

| | Min | Max | Units |
|---|---|---|---|
| $V_{CC}$, Supply Voltage | 4.75 | 5.25 | V |
| $T_A$, Ambient Temperature | 0 | 70 | °C |
| $I_{OL}$, Output Low Current | | | |
| Bus | | 48 | mA |
| Terminal | | 16 | mA |

## Electrical Characteristics (Notes 2 and 3)

| Symbol | Parameter | | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| $V_{IH}$ | High Level Input Voltage | | | 2 | | | V |
| $V_{IL}$ | Low Level Input Voltage | | | | | 0.8 | V |
| $V_{IK}$ | Input Clamp Voltage | | $I_I = -18$ mA | | −0.8 | −1.5 | V |
| $V_{HYS}$ | Input Hysteresis | Bus | | 400 | 500 | | mV |
| $V_{OH}$ | High Level Output Voltage | Terminal | $I_{OH} = -800\ \mu A$ | 2.7 | 3.5 | | V |
| | | Bus | $I_{OH} = -5.2$ mA | 2.5 | 3.4 | | |
| $V_{OL}$ | Low Level Output Voltage | Terminal | $I_{OL} = 16$ mA | | 0.3 | 0.5 | V |
| | | Bus | $I_{OL} = 48$ mA | | 0.4 | 0.5 | |
| $I_{IH}$ | High Level Input Current | TE, PE | $V_I = 5.5V$ | | 0.2 | 100 | μA |
| | | | $V_I = 2.7V$ | | 0.1 | 20 | |
| | | Terminal and Bus | $V_I = 4V$ | | | 200 | |
| $I_{IL}$ | Low Level Input Current | Terminal and TE, PE | $V_I = 0.5V$ | | −10 | −100 | μA |
| | | Bus | | | −0.4 | −1.0 | mA |
| $I_{OS}$ | Short Circuit Output Current | Terminal | $V_I = 2V$, $V_O = 0V$ (Note 4) | −15 | −35 | −75 | mA |
| | | Bus | | −50 | −120 | −200 | |
| $I_{CC}$ | Supply Current | | Transmit, TE = 2V, PE = 2V, $V_I = 0.8V$ | | 75 | 100 | mA |
| | | | Receive, TE = 0.8V, PE = 2V, $V_I = 0.8V$ | | 65 | 90 | |
| $C_{IN}$ | Bus-Port Capacitance | Bus | $V_{CC} = 0V$, $V_I = 0V$, f = 10 kHz (Note 5) | | 20 | 30 | pF |

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the device should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operations.

**Note 2:** Unless otherwise specified, min/max limits apply across the 0°C to +70°C temperature range and the 4.75V to 5.25V power supply range. All typical values are for $T_A = 25°C$ and $V_{CC} = 5.0V$.

**Note 3:** All currents into device pins are shown as positive; all currents out of device pins are shown as negative; all voltages are referenced to ground, unless otherwise specified. All values shown as max or min are so classified on absolute value basis.

**Note 4:** Only one output at a time should be shorted.

**Note 5:** This parameter is guaranteed by design. It is not a tested parameter.

## Switching Characteristics $V_{CC} = 5.0V \pm 5\%$, $T_A = 0°C$ to $+70°C$ (Note 1)

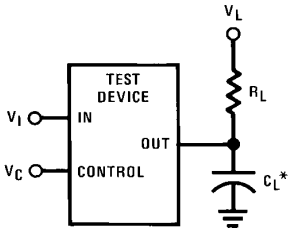
| Symbol | Parameter | From | To | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation Delay Time, Low to High Level Output | Terminal | Bus | $V_L = 2.3V$, $R_L = 38.3\Omega$, $C_L = 30$ pF *(Figure 1)* | | 10 | 20 | ns |
| $t_{PHL}$ | Propagation Delay Time, High to Low Level Output | | | | | 14 | 20 | ns |
| $t_{PLH}$ | Propagation Delay Time, Low to High Level Output | Bus | Terminal | $V_L = 5.0V$, $R_L = 240\Omega$, $C_L = 30$ pF *(Figure 2)* | | 15 | 20 | ns |
| $t_{PHL}$ | Propagation Delay Time, High to Low Level Output | | | | | 10 | 20 | ns |
| $t_{PZH}$ | Output Enable Time to High Level | TE (Notes 2 and 3) | Bus | $V_I = 3.0V$, $V_L = 0V$, $R_L = 480\Omega$, $C_L = 15$ pF *(Figure 1)* | | 19 | 30 | ns |
| $t_{PHZ}$ | Output Disable Time to High Level | | | | | 15 | 20 | ns |
| $t_{PZL}$ | Output Enable Time to Low Level | | | $V_I = 0V$, $V_L = 2.3V$, $R_L = 38.3\Omega$, $C_L = 15$ pF *(Figure 1)* | | 24 | 40 | ns |
| $t_{PLZ}$ | Output Disable Time to Low Level | | | | | 17 | 30 | ns |
| $t_{PZH}$ | Output Enable Time to High Level | TE, PE (Notes 2 and 3) | Terminal | $V_I = 3.0V$, $V_L = 0V$, $R_L = 3\ k\Omega$, $C_L = 15$ pF *(Figure 1)* | | 19 | 35 | ns |
| $t_{PHZ}$ | Output Disable Time to High Level | | | | | 17 | 25 | ns |
| $t_{PZL}$ | Output Enable Time to Low Level | | | $V_I = 0V$, $V_L = 5V$, $R_L = 280\Omega$, $C_L = 15$ pF *(Figure 1)* | | 27 | 40 | ns |
| $t_{PLZ}$ | Output Disable Time to Low Level | | | | | 17 | 30 | ns |
| $t_{PZH}$ | Output Pull-Up Enable Time | PE (Notes 2 and 3) | Bus | $V_I = 3V$, $V_L = 0V$, $R_L = 480\Omega$, $C_L = 15$ pF *(Figure 1)* | | 10 | 20 | ns |
| $t_{PHZ}$ | Output Pull-Up Disable Time | | | | | 10 | 20 | ns |

**Note 1:** All typical values are for $T_A = 25°C$, $V_{CC} = 5V$.

**Note 2:** Refer to Functional Truth Table for control input definition.

**Note 3:** Test configuration should be connected to only one transceiver at a time due to the high current stress caused by the $V_I$ voltage source when the output connected to that input becomes active.

## Switching Load Configurations

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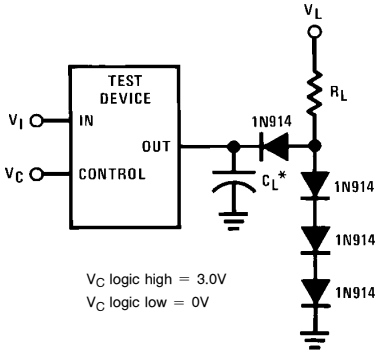
$V_C$ logic high = 3.0V
$V_C$ logic low = 0V

*$C_L$ includes jig and probe capacitance

**FIGURE 1**




$V_C$ logic high = 3.0V
$V_C$ logic low = 0V

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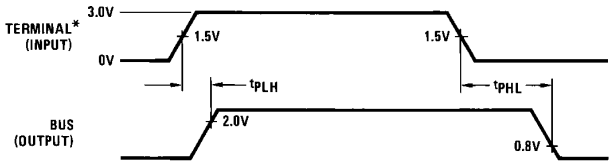
*$C_L$ includes jig and probe capacitance

**FIGURE 2**

## Switching Waveforms

**Transmit Propagation Delays**

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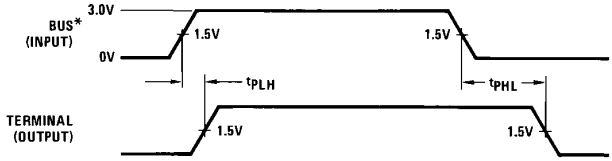
**Receive Propagation Delays**

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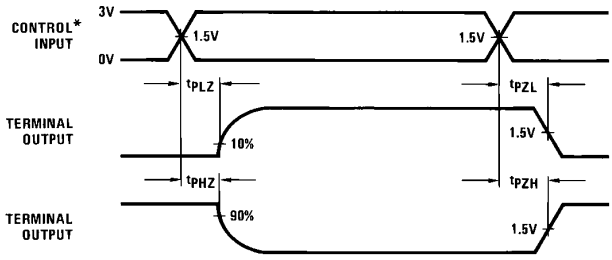
**Terminal Enable/Disable Times**

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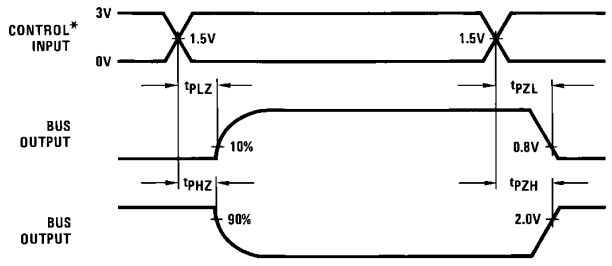
**Bus Enable/Disable Times**

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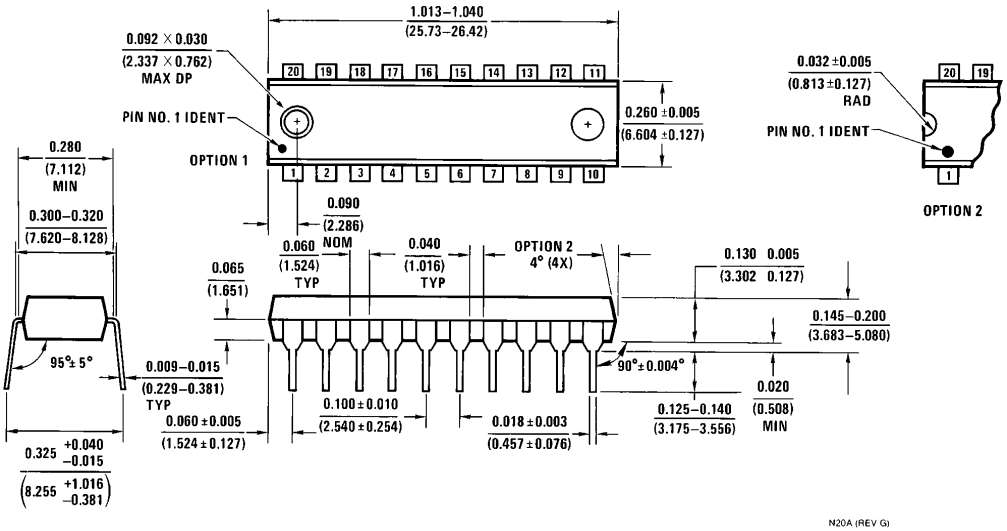
*Input signal: f = 1.0 MHz, 50% duty cycle, $t_r = t_f \leq 5$ ns

## Physical Dimensions inches (millimeters)




**Molded Dual-In-Line Package (N)**
**Order Number DS3667N**
**NS Package Number N20A**

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