National Semiconductor

# DS55113/DS75113 Dual TRI-STATE® Differential Line Driver

## General Description

The DS55113/DS75113 dual differential line drivers with TRI-STATE outputs are designed to provide all the features of the DS55114/DS75114 line drivers with the added feature of driver output controls. There are individual controls for each output pair, as well as a common control for both output pairs. When an output control is low, the associated output is in a high-impedance state and the output can neither drive nor load the bus. This permits many devices to be connected together on the same transmission line for party-line applications.

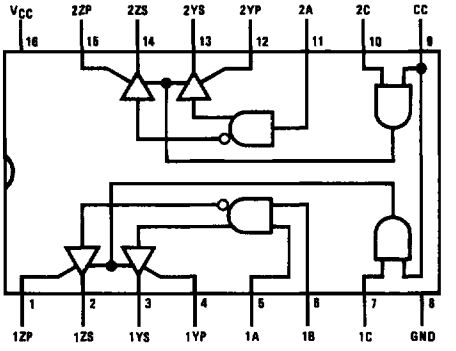
The output stages are similar to TTL totem-pole outputs, but with the sink outputs, YS and ZS, and the corresponding active pull-up terminals, YP and ZP, available on adjacent package pins.

## Features

- Each circuit offers a choice of open-collector or active pull-up (totem-pole) outputs
- Single 5V supply
- Differential line operation
- Dual channels
- TTL/LS compatibility
- High-impedance output state for party-line applications
- Short-circuit protection
- High current outputs
- Single-ended or differential AND/NAND outputs
- Common and individual output controls
- Clamp diodes at inputs
- Easily adaptable to DS55114/DS75114 applications

## Connection Diagram

**Dual-In-Line Package**




Positive logic: $Y = AB$
$Z = \overline{AB}$

Output is OFF when C or CC is low

TL/F/5785–1

**Top View**
**Order Number DS55113J, DS75113M or DS75113N**
**See NS Package Number J16A, M16A or N16A**

**For Complete Military 883 Specifications, see RETS Datasheet.**
**Order Number DS55113J/883**
**See NS Package Number J16A**

## Truth Table

| Inputs | | | | Outputs | |
|---|---|---|---|---|---|
| Output Control | | Data | | AND | NAND |
| C | CC | A | B* | Y | Z |
| L | X | X | X | Z | Z |
| X | L | X | X | Z | Z |
| H | H | L | X | L | H* |
| H | H | X | L | L | H |
| H | H | H | H | H | L |

H = high level
L = low level
X = irrelevant
Z = high impedance (OFF)
*B input and 4th line of truth table applicable only to driver number 1

## 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 ($V_{CC}$) (Note 1) | 7V |
| Input Voltage | 5.5V |
| OFF-State Voltage Applied to Open-Collector Outputs | 12V |
| Maximum Power Dissipation* at 25°C | |
| Cavity Package | 1433 mW |
| Molded DIP Package | 1362 mW |
| SO Package | 1002 mW |
| Operating Free-Air Temperature Range | |
| DS55113 | −55°C to +125°C |
| DS75113 | 0°C to +70°C |
| Storage Temperature Range | −65°C to +150°C |
| Lead Temperature (1/16" from case for 60 seconds): J Package | 300°C |
| Lead Temperature (1/16" from case for 4 seconds): N Package | 260°C |

*Derate cavity package 9.6 mW/°C above 25°C; derate molded DIP package 10.9 mW/°C above 25°C; derate SO package 8.01 mW/°C above 25°C (Note 2).

## Operating Conditions

| | Min | Max | Units |
|---|---|---|---|
| Supply Voltage ($V_{CC}$) | | | |
| DS55113 | 4.5 | 5.5 | V |
| DS75113 | 4.75 | 5.25 | V |
| High Level Output Current ($I_{OH}$) | | −40 | mA |
| Low Level Output Current ($I_{OL}$) | | 40 | mA |
| Operating Free-Air Temperature ($T_A$) | | | |
| DS55113 | −55 | 125 | °C |
| DS75113 | 0 | 70 | °C |

## Electrical Characteristics Over recommended operating free-air temperature range (unless otherwise noted)

| Symbol | Parameter | | Conditions (Note 3) | | | DS55113 | | | DS75113 | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min | Typ (Note 4) | Max | Min | Typ (Note 4) | Max | |
| $V_{IH}$ | High Level Input Voltage | | | | | 2 | | | 2 | | | V |
| $V_{IL}$ | Low Level Input Voltage | | | | | | | 0.8 | | | 0.8 | V |
| $V_{IK}$ | Input Clamp Voltage | | $V_{CC}$ = Min, $I_I$ = −12 mA | | | | −0.9 | −1.5 | | −0.9 | −1.5 | V |
| $V_{OH}$ | High Level Output Voltage | | $V_{CC}$ = Min, $V_{IH}$ = 2V, $V_{IL}$ = 0.8V | | $I_{OH}$ = −10 mA | 2.4 | 3.4 | | 2.4 | 3.4 | | V |
| | | | | | $I_{OH}$ = −40 mA | 2 | 3.0 | | 2 | 3.0 | | |
| $V_{OL}$ | Low Level Output Voltage | | $V_{CC}$ = Min, $V_{IH}$ = 2V, $V_{IL}$ = 0.8V, $I_{OL}$ = 40 mA | | | | 0.23 | 0.4 | | 0.23 | 0.4 | V |
| $V_{OK}$ | Output Clamp Voltage | | $V_{CC}$ = Max, $I_O$ = −40 mA | | | | −1.1 | −1.5 | | −1.1 | −1.5 | V |
| $I_{O(off)}$ | Off-State Open-Collector Output Current | | $V_{CC}$ = Max | $V_{OH}$ = 12V | $T_A$ = 25°C | | 1 | 10 | | | | μA |
| | | | | | $T_A$ = 125°C | | | 200 | | | | |
| | | | | $V_{OH}$ = 5.25V | $T_A$ = 25°C | | | | | 1 | 10 | |
| | | | | | $T_A$ = 70°C | | | | | | 20 | |
| $I_{OZ}$ | Off-State (High-Impedance-State) Output Current | | $V_{CC}$ = Max, Output Controls at 0.8V | $T_A$ = 25°C, $V_O$ = 0 to $V_{CC}$ | | | | ±10 | | | ±10 | μA |
| | | | | $T_A$ = Max | $V_O$ = 0V | | | −150 | | | −20 | |
| | | | | | $V_O$ = 0.4V | | | ±80 | | | ±20 | |
| | | | | | $V_O$ = 2.4V | | | ±80 | | | ±20 | |
| | | | | | $V_O$ = $V_{CC}$ | | | 80 | | | 20 | |
| $I_I$ | Input Current at Maximum Input Voltage | A, B, C | $V_{CC}$ = Max, $V_I$ = 5.5V | | | | | 1 | | | 1 | mA |
| | | CC | | | | | | 2 | | | 2 | |
| $I_{IH}$ | High Level Input Current | A, B, C | $V_{CC}$ = Max, $V_I$ = 2.4V | | | | | 40 | | | 40 | μA |
| | | CC | | | | | | 80 | | | 80 | |
| $I_{IL}$ | Low Level Input Current | A, B, C | $V_{CC}$ = Max, $V_I$ = 0.4V | | | | | −1.6 | | | −1.6 | mA |
| | | CC | | | | | | −3.2 | | | −3.2 | |

7

## Electrical Characteristics

Over recommended operating free-air temperature range (unless otherwise noted) (Continued)

| Symbol | Parameter | Conditions (Note 3) | | DS55113 | | | DS75113 | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ (Note 4) | Max | Min | Typ (Note 4) | Max | |
| $I_{OS}$ | Short-Circuit Output Current (Note 5) | $V_{CC}$ = Max, $V_O$ = 0V | | −40 | −90 | −120 | −40 | −90 | −120 | mA |
| $I_{CC}$ | Supply Current (Both Drivers) | All Inputs at 0V, No Load $T_A$ = 25°C | $V_{CC}$ = Max | | 47 | 65 | | 47 | 65 | mA |
| | | | $V_{CC}$ = 7V | | 65 | 85 | | 65 | 85 | |

**Note 1:** All voltage values are with respect to network ground terminal.

**Note 2:** For operation above 25°C free-air temperature, refer to Dissipation Derating Curves in the Thermal information section.

**Note 3:** All parameters with the exception of OFF-state open-collector output current are measured with the active pull-up connected to the sink output.

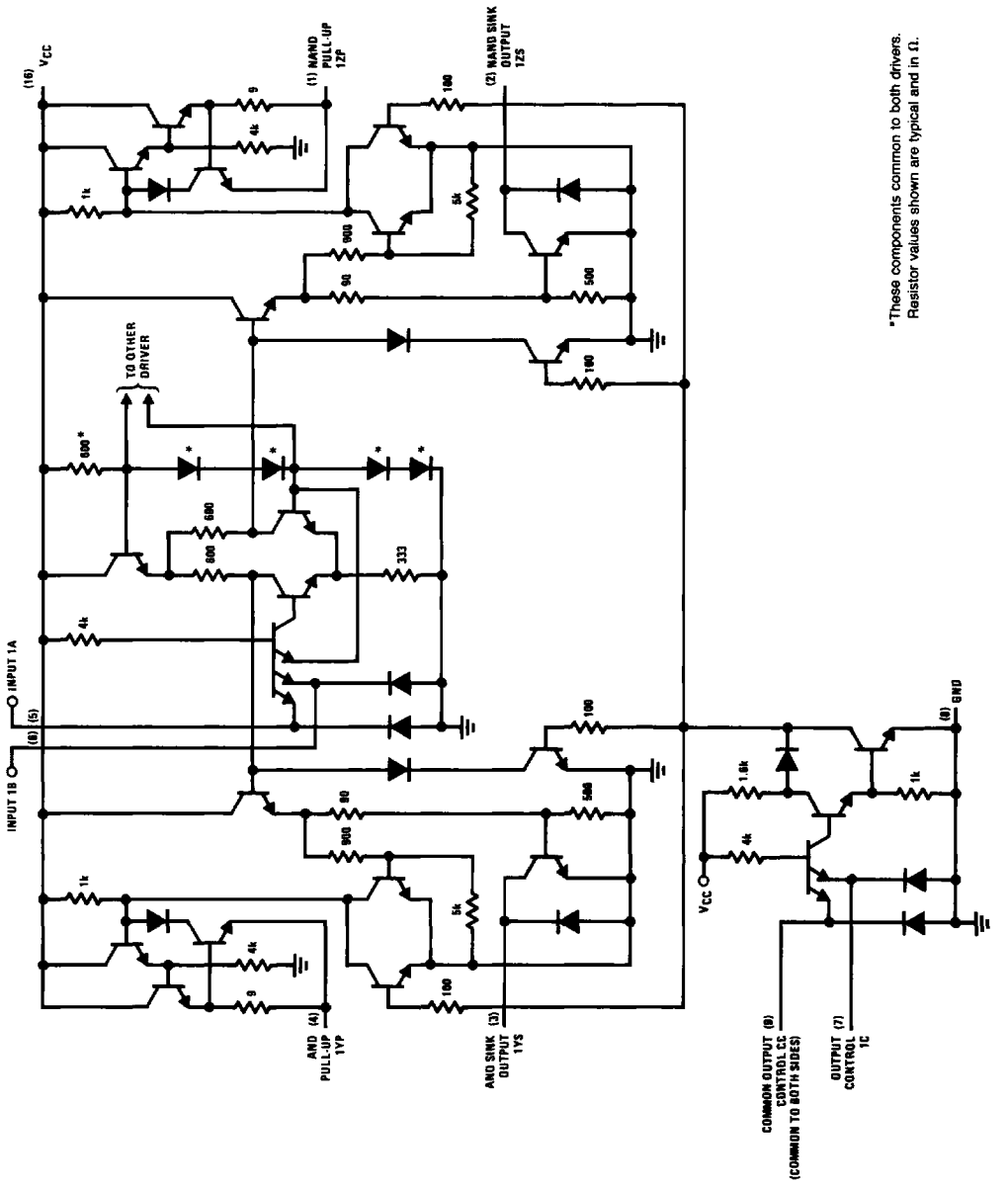
**Note 4:** All typical values are at $T_A$ = 25°C and $V_{CC}$ = 5V, with the exception of $I_{CC}$ at 7V.

**Note 5:** Only one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

## Switching Characteristics $V_{CC}$ = 5V, $C_L$ = 30 pF, $T_A$ = 25°C

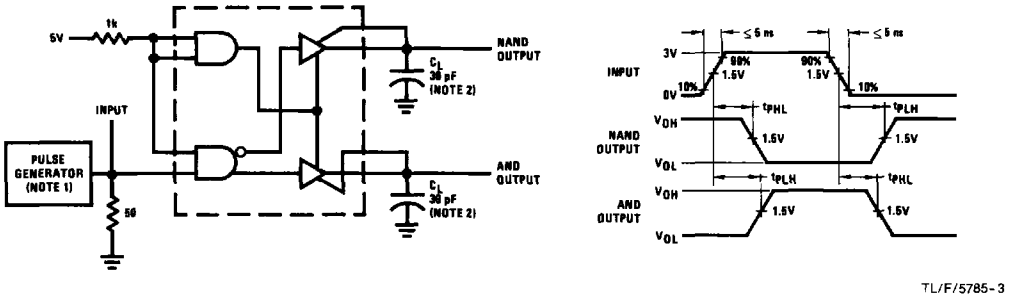
| Symbol | Parameter | Conditions | DS55113 | | | DS75113 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Typ | Max | |
| $t_{PLH}$ | Propagation Delay Time, Low-to High-Level Output | *(Figure 1)* | | 13 | 20 | | 13 | 30 | ns |
| $t_{PHL}$ | Propagation Delay Time, High-to Low-Level Output | | | 12 | 20 | | 12 | 30 | ns |
| $t_{PZH}$ | Output Enable Time to High Level | $R_L$ = 180Ω, *(Figure 2)* | | 7 | 15 | | 7 | 20 | ns |
| $t_{PZL}$ | Output Enable Time to Low Level | $R_L$ = 250Ω, *(Figure 3)* | | 14 | 30 | | 14 | 40 | ns |
| $t_{PHZ}$ | Output Disable Time from High Level | $R_L$ = 180Ω, *(Figure 2)* | | 10 | 20 | | 10 | 30 | ns |
| $t_{PLZ}$ | Output Disable Time from Low Level | $R_L$ = 250Ω, *(Figure 3)* | | 17 | 35 | | 17 | 35 | ns |

## Schematic Diagram (One side shown only)



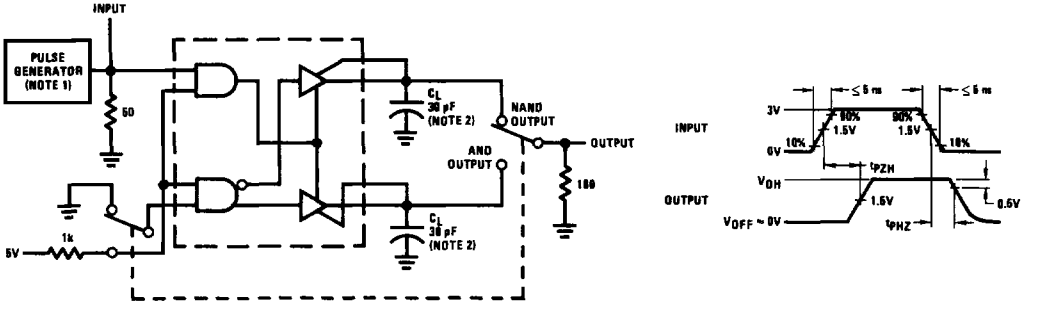

7

## AC Test Circuits and Switching Time Waveforms



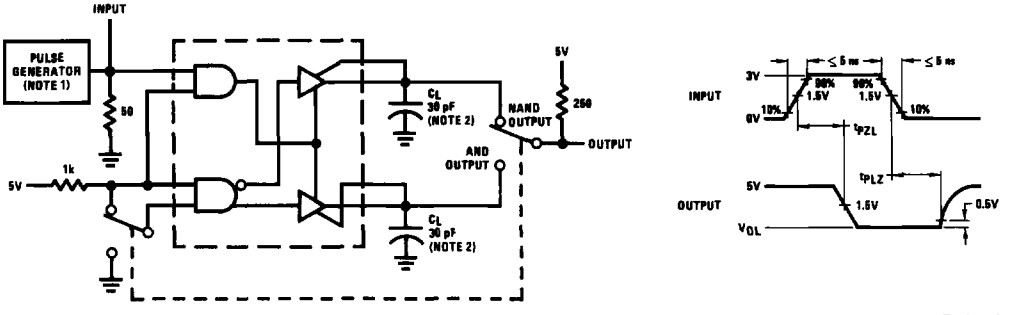

TL/F/5785–3

**FIGURE 1. $t_{PLH}$ and $t_{PHL}$**




TL/F/5785–4

**FIGURE 2. $t_{PZH}$ and $t_{PHZ}$**




TL/F/5785–5

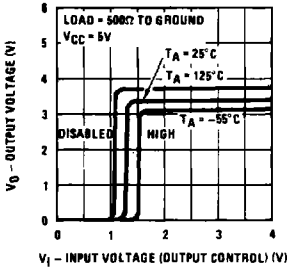
**FIGURE 3. $t_{PZL}$ and $t_{PLZ}$**

**Note 1:** The pulse generator has the following characteristics: $Z_{OUT}$ = 50Ω, PRR = 500 kHz, $t_W$ = 100 ns.

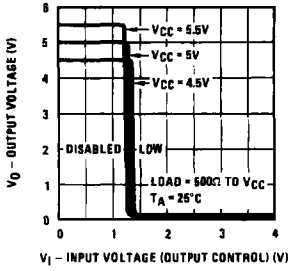
**Note 2:** $C_L$ includes probe and jig capacitance.

# Typical Performance Characteristics*

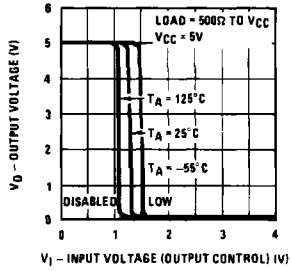
### Output Voltage vs Output Control Voltage



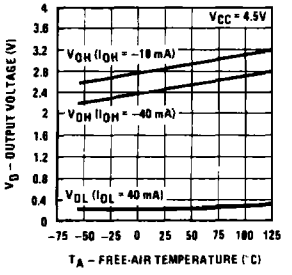

### Output Voltage vs Output Control Voltage



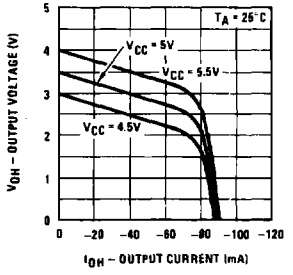

### Output Voltage vs Output Control Voltage



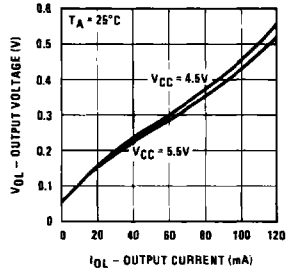

### Output Voltage vs Free-Air Temperature



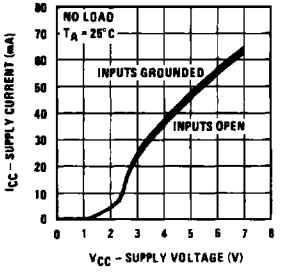

### High Level Output Voltage vs Output Current



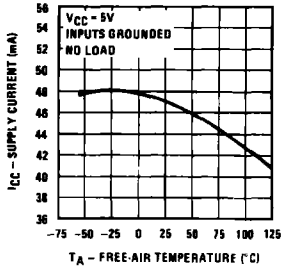

### Low Level Output Voltage vs Output Current



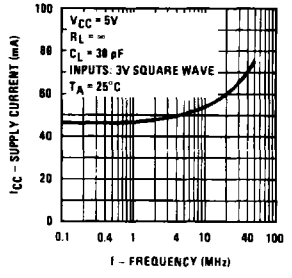

### Supply Current (Both Drivers) vs Supply Voltage



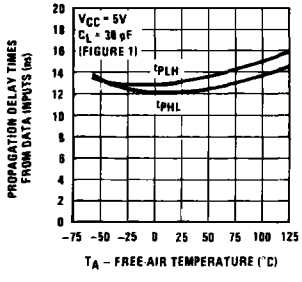

### Supply Current (Both Drivers) vs Free-Air Temperature



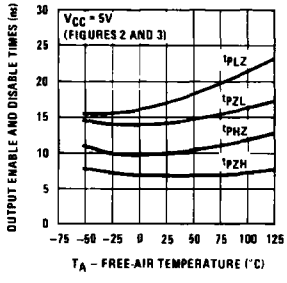

### Supply Current (Both Drivers) vs Frequency




### Propagation Delay Times from Data Inputs vs Free-Air Temperature




### Output Enable and Disable Times vs Free-Air Temperature



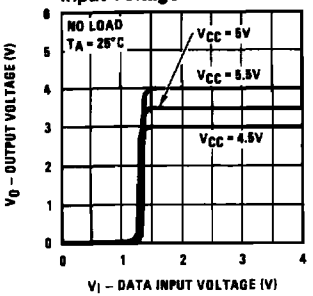

TL/F/5785–7

*Data for temperatures below 0°C and above 70°C and for supply voltages below 4.75V and above 5.25V are applicable to DS55113 circuits only. These parameters were measured with the active pull-up connected to the sink output.

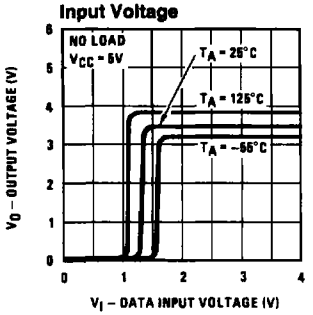
7

## Typical Performance Characteristics* (Continued)

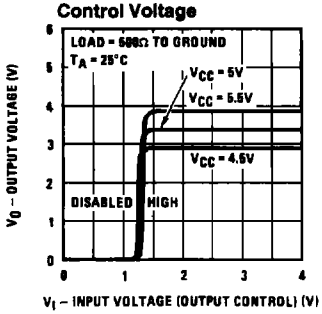
**Output Voltage vs Data Input Voltage**




**Output Voltage vs Data Input Voltage**




**Output Voltage vs Output Control Voltage**




TL/F/5785–6

*Data for temperatures below 0°C and above 70°C and for supply voltages below 4.75V and above 5.25V are applicable to DS55113 circuits only. These parameters were measured with the active pull-up connected to the sink output.