

# SN55138, SN75138 QUADRUPLER BUS TRANSCEIVERS

SLLS079B – SEPTEMBER 1973 – REVISED MAY 1995

- Single 5-V Supply
- High-Input-Impedance, High-Threshold Receivers
- Common Driver Strobe
- TTL-Compatible Driver and Strobe Inputs With Clamp Diodes
- High-Speed Operation
- 100-mA Open-Collector Driver Outputs
- Four Independent Channels
- TTL-Compatible Receiver Output

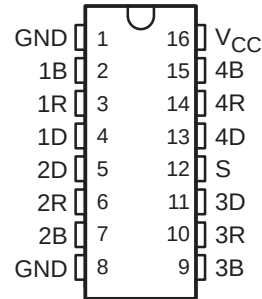
## description

The SN55138 and SN75138 quadruple bus transceivers are designed for two-way data communication over single-ended transmission lines. Each of the four identical channels consists of a driver with TTL inputs and a receiver with a TTL output. The driver open-collector output is designed to handle loads up to 100-mA open collector. The receiver input is internally connected to the driver output, and has a high impedance to minimize loading of the transmission line. Because of the high driver-output current and the high receiver-input impedance, a very large number (typically hundreds) of transceivers may be connected to a single data bus.

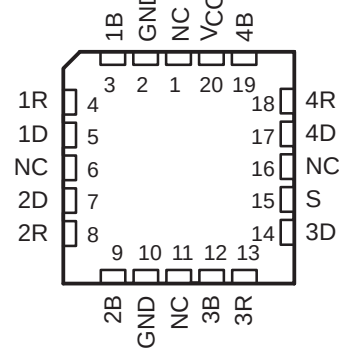
The receiver design also features a threshold of 2.3 V (typical), providing a wider noise margin than would be possible with a receiver having the usual TTL threshold. A strobe turns off all drivers (high impedance) but does not affect receiver operation. These circuits are designed for operation from a single 5-V supply and include a provision to minimize loading of the data bus when the power-supply voltage is zero.

The SN55138 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN75138 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

SN55138 . . . J OR W PACKAGE  
SN75138 . . . D OR N PACKAGE  
(TOP VIEW)



SN55138 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

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# SN55138, SN75138 QUADRUPLE BUS TRANSCEIVERS

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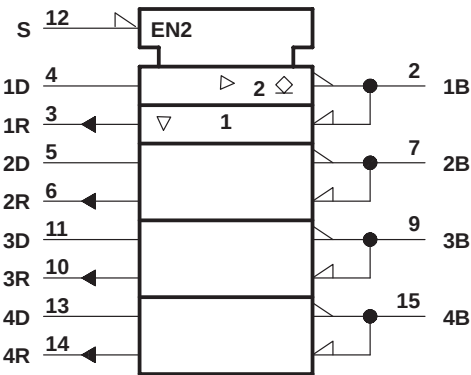
## Function Tables

| TRANSMITTING |   |         |   |
|--------------|---|---------|---|
| INPUTS       |   | OUTPUTS |   |
| S            | D | B       | R |
| L            | H | L       | H |
| L            | L | H       | L |

| RECEIVING |   |   |             |
|-----------|---|---|-------------|
| INPUTS    |   |   | OUTPUT<br>R |
| S         | B | D |             |
| H         | H | X | L           |
| H         | L | X | H           |

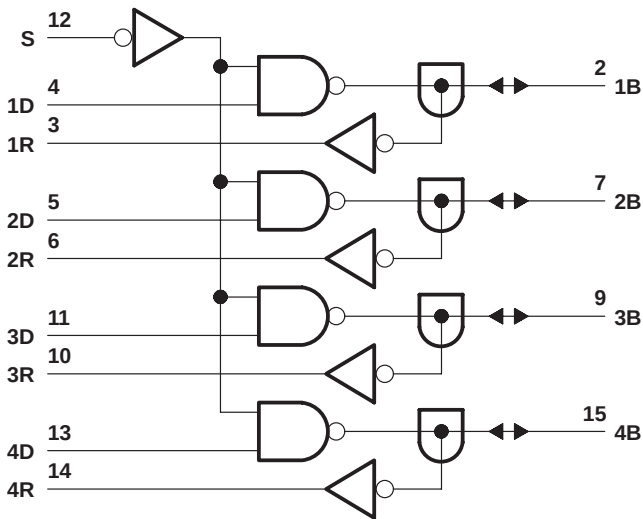
H = high level, L = low level, X = irrelevant

## logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.  
Pin numbers shown are for D, J, N, and W packages.

## logic diagram (positive logic)



## schematics of inputs and outputs

| EQUIVALENT OF EACH STROBE AND DRIVER INPUT | EQUIVALENT OF EACH RECEIVER INPUT | TYPICAL OF ALL DRIVER OUTPUTS | TYPICAL OF ALL RECEIVER OUTPUTS |
|--------------------------------------------|-----------------------------------|-------------------------------|---------------------------------|
|                                            |                                   |                               |                                 |

**absolute maximum ratings over operating free-air temperature (unless otherwise noted)<sup>†</sup>**

|                                                                                  |                              |
|----------------------------------------------------------------------------------|------------------------------|
| Supply voltage, $V_{CC}$ (see Note 1)                                            | 7 V                          |
| Input voltage, $V_I$                                                             | 5.5 V                        |
| Driver off-state output voltage                                                  | 7 V                          |
| Low-level output current into the driver output                                  | 150 mA                       |
| Continuous total dissipation                                                     | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$ : SN55138                            | –55°C to 125°C               |
| SN75138                                                                          | 0°C to 70°C                  |
| Storage temperature range, $T_{stg}$                                             | –65°C to 150°C               |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D, N, or W package | 260°C                        |
| Case temperature for 60 seconds, $T_C$ : FK package                              | 260°C                        |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J package          | 300°C                        |

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: All voltage values are with respect to both ground terminals connected together.

**DISSIPATION RATING TABLE**

| PACKAGE         | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING FACTOR<br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$<br>POWER RATING | $T_A = 125^\circ\text{C}$<br>POWER RATING |
|-----------------|---------------------------------------------|---------------------------------------------------|------------------------------------------|-------------------------------------------|
| D               | 950 mW                                      | 7.6 mW/°C                                         | 608 mW                                   | —                                         |
| FK <sup>‡</sup> | 1375 mW                                     | 11.0 mW/°C                                        | 880 mW                                   | 275 mW                                    |
| J <sup>‡</sup>  | 1375 mW                                     | 11.0 mW/°C                                        | 880 mW                                   | 275 mW                                    |
| N               | 1150 mW                                     | 9.2 mW/°C                                         | 736 mW                                   | —                                         |
| W               | 1000 mW                                     | 8.0 mW/°C                                         | 640 mW                                   | 200 mW                                    |

<sup>‡</sup> In the FK and J packages, the SN55138 chip is alloy mounted.

**recommended operating conditions**

|                                       |                  | SN55138 |     |      | SN75138 |     |      | UNIT |
|---------------------------------------|------------------|---------|-----|------|---------|-----|------|------|
|                                       |                  | MIN     | NOM | MAX  | MIN     | NOM | MAX  |      |
| Supply voltage, $V_{CC}$              |                  | 4.5     |     | 5.5  | 4.75    | 5   | 5.25 | V    |
| High-level input voltage, $V_{IH}$    | Driver or strobe | 2       |     |      | 2       |     |      | V    |
|                                       | Receiver         | 3.2     |     |      | 2.9     |     |      |      |
| Low-level input voltage, $V_{IL}$     | Driver or strobe |         |     | 0.8  |         |     | 0.8  | V    |
|                                       | Receiver         |         |     | 1.5  |         |     | 1.8  |      |
| High-level output current, $I_{OH}$   | Receiver output  |         |     | –400 |         |     | –400 | μA   |
| Low-level output current, $I_{OL}$    | Driver output    |         |     | 100  |         |     | 100  | mA   |
|                                       | Receiver output  |         |     | 16   |         |     | 16   |      |
| Operating free-air temperature, $T_A$ |                  | –55     |     | 125  | 0       |     | 70   | °C   |

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**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

| PARAMETER           |                                        |                         | TEST CONDITIONS†                                                                                                     |  | SN55138 |      |      | SN75138 |      |      | UNIT |
|---------------------|----------------------------------------|-------------------------|----------------------------------------------------------------------------------------------------------------------|--|---------|------|------|---------|------|------|------|
|                     |                                        |                         |                                                                                                                      |  | MIN     | TYP‡ | MAX  | MIN     | TYP‡ | MAX  |      |
| V <sub>IK</sub>     | Input clamp voltage                    | Driver or strobe        | V <sub>CC</sub> = MIN, I <sub>I</sub> = –12 mA                                                                       |  |         |      | –1.5 |         |      | –1.5 | V    |
| V <sub>OH</sub>     | High-level output voltage              | Receiver                | V <sub>CC</sub> = MIN, V <sub>IL(R)</sub> = V <sub>IL</sub> max, V <sub>IH(S)</sub> = 2 V, I <sub>OH</sub> = –400 µA |  | 2.4     | 3.5  |      | 2.4     | 3.5  |      | V    |
| V <sub>OL</sub>     | Low-level output voltage               | Driver                  | V <sub>CC</sub> = MIN, V <sub>IL(S)</sub> = 0.8 V, V <sub>IH(D)</sub> = 2 V, I <sub>OL</sub> = 100 mA                |  |         |      | 0.45 |         |      | 0.45 | V    |
|                     |                                        | Receiver                | V <sub>CC</sub> = MIN, V <sub>IH(S)</sub> = 2 V, V <sub>IH(R)</sub> = V <sub>IH</sub> min, I <sub>OL</sub> = 16 mA   |  |         |      | 0.4  |         |      | 0.4  |      |
| I <sub>I(max)</sub> | Input current at maximum input voltage | Driver or strobe        | V <sub>CC</sub> = MAX, V <sub>I</sub> = V <sub>CC</sub>                                                              |  |         |      | 1    |         |      | 1    | mA   |
| I <sub>IH</sub>     | High-level input current               | Driver or strobe        | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.4 V                                                                        |  |         |      | 40   |         |      | 40   | µA   |
|                     |                                        | Receiver                | V <sub>CC</sub> = 5 V, V <sub>I(S)</sub> = 2 V, V <sub>I(R)</sub> = 4.5 V                                            |  | 25      | 300  |      | 25      | 300  |      |      |
| I <sub>IL</sub>     | Low-level input current                | Driver or strobe        | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V                                                                        |  | –1      | –1.6 |      | –1      | –1.6 |      | mA   |
|                     |                                        | Receiver                | V <sub>CC</sub> = MAX, V <sub>I(S)</sub> = 2 V, V <sub>I(R)</sub> = 0.45 V                                           |  |         | –50  |      |         | –50  |      | µA   |
| I <sub>I(off)</sub> | Input current with power off           | Receiver                | V <sub>CC</sub> = 0, V <sub>I</sub> = 4.5 V                                                                          |  | 1.1     | 1.5  |      | 1.1     | 1.5  |      | mA   |
| I <sub>OS</sub>     | Short-circuit output current§          | Receiver                | V <sub>CC</sub> = MAX                                                                                                |  | –20     |      | –55  | –18     |      | –55  | mA   |
| I <sub>CC</sub>     | Supply current                         | All driver outputs low  | V <sub>CC</sub> = MAX, V <sub>I(S)</sub> = 0.8 V, V <sub>I(D)</sub> = 2 V                                            |  | 50      | 65   |      | 50      | 65   |      | mA   |
|                     |                                        | All driver outputs high | V <sub>CC</sub> = MAX, V <sub>I(S)</sub> = 2 V, V <sub>I(R)</sub> = 3.5 V, Receiver outputs open                     |  | 42      | 55   |      | 42      | 55   |      |      |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions. Parenthetical letters D, R, and S used with V<sub>I</sub> refer to the driver input, receiver input, and strobe input, respectively.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ Not more than one output should be shorted at a time.

**switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C**

| PARAMETER††      | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS                                   |              | MIN | TYP | MAX | UNIT |
|------------------|-----------------|----------------|---------------------------------------------------|--------------|-----|-----|-----|------|
| t <sub>PLH</sub> | Driver          | Driver         | C <sub>L</sub> = 50 pF,    R <sub>L</sub> = 50 Ω, | See Figure 1 | 15  | 24  | ns  |      |
| t <sub>PHL</sub> |                 |                |                                                   |              | 14  | 24  |     |      |
| t <sub>PLH</sub> | Strobe          | Driver         |                                                   |              | 18  | 28  | ns  |      |
| t <sub>PHL</sub> |                 |                |                                                   |              | 22  | 32  |     |      |
| t <sub>PLH</sub> | Receiver        | Receiver       | C <sub>L</sub> = 15 pF    R <sub>L</sub> = 400 Ω, | See Figure 2 | 7   | 15  | ns  |      |
| t <sub>PHL</sub> |                 |                |                                                   |              | 8   | 15  |     |      |

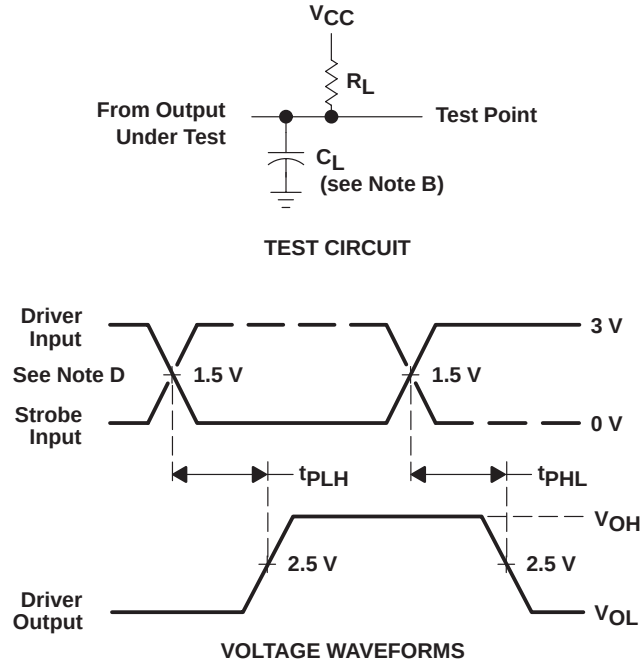
¶ t<sub>PLH</sub> = propagation delay time, low- to high-level output

t<sub>PHL</sub> = propagation delay time, high- to low-level output



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## PARAMETER MEASUREMENT INFORMATION



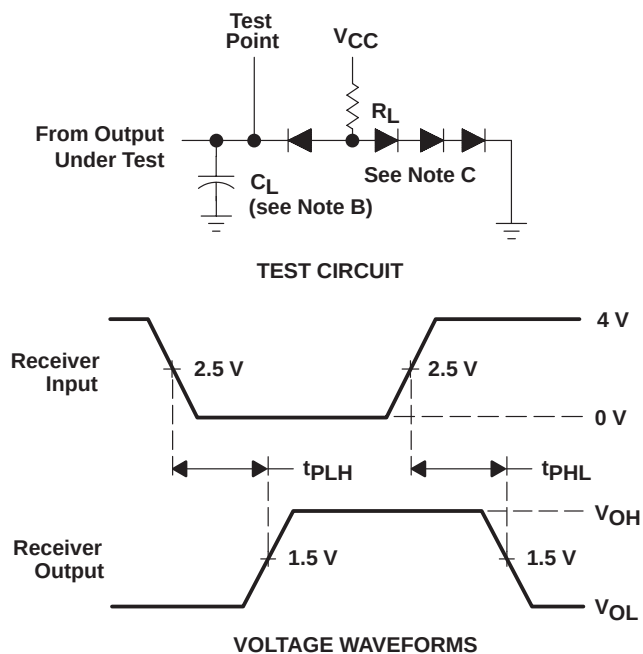
- NOTES: A. Input pulses are supplied by generators having the following characteristics:  $t_W = 100$  ns,  $PRR \leq 1$  MHz,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns,  $Z_O \approx 50 \Omega$ .
- B.  $C_L$  includes probe and jig capacitance.
- C. All diodes are 1N916 or 1N3064.
- D. When testing driver input (solid line) strobe must be low; when testing strobe input (dashed line) driver input must be high.

**Figure 1. Propagation Delay Times From Data and Strobe Inputs**

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## PARAMETER MEASUREMENT INFORMATION



- NOTES: A. Input pulses are supplied by generators having the following characteristics:  $t_W = 100$  ns,  $PRR \leq 1$  MHz,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns,  $Z_O \approx 50 \Omega$ .
- B.  $C_L$  includes probe and jig capacitance.
- C. All diodes are 1N916 or 1N3064.
- D. When testing driver input (solid line) strobe must be low; when testing strobe input (dashed line) driver input must be high.

**Figure 2. Propagation Delay Times From Receiver Input**

TYPICAL CHARACTERISTICS†

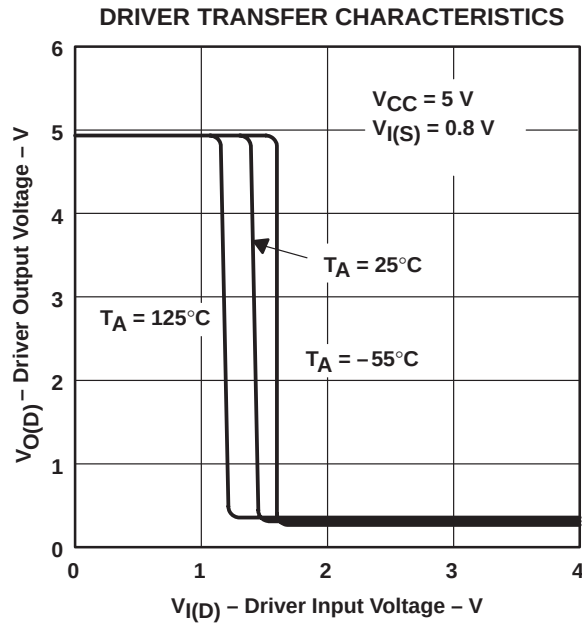


Figure 3

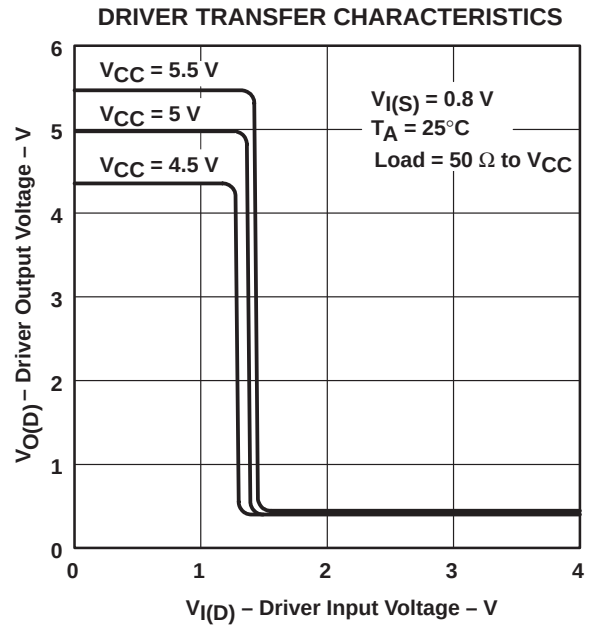


Figure 4

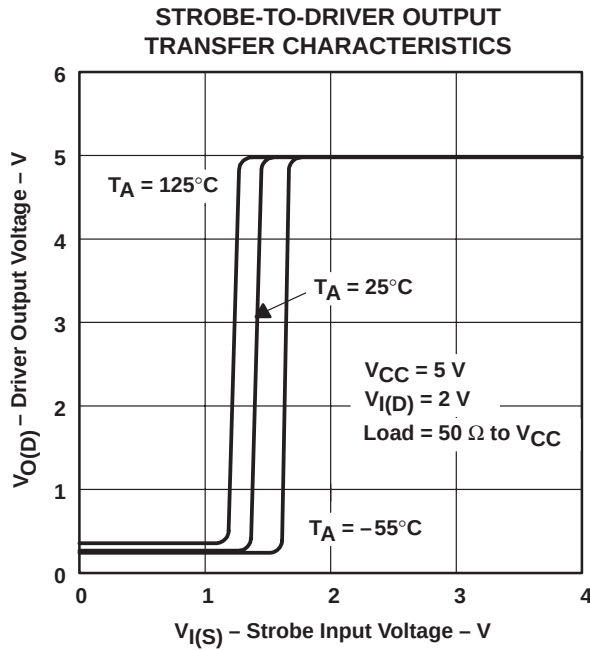


Figure 5

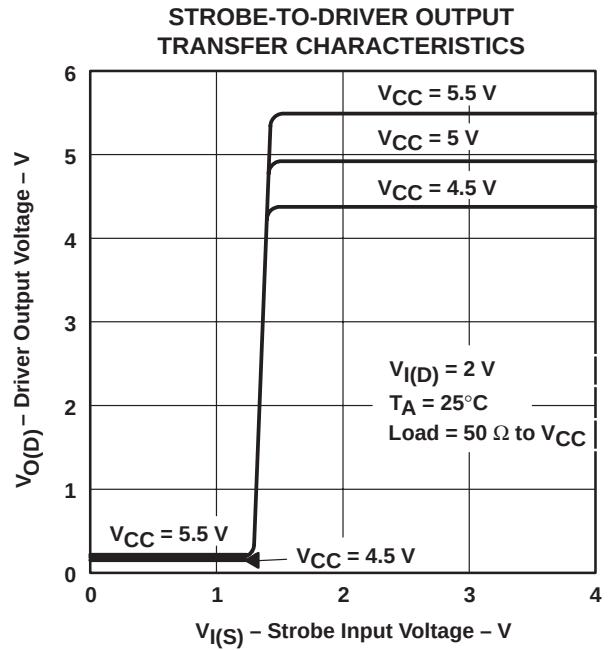


Figure 6

† Data for temperatures below  $0^\circ\text{C}$  and above  $70^\circ\text{C}$  is applicable to SN55138 circuits only.

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TYPICAL CHARACTERISTICS†

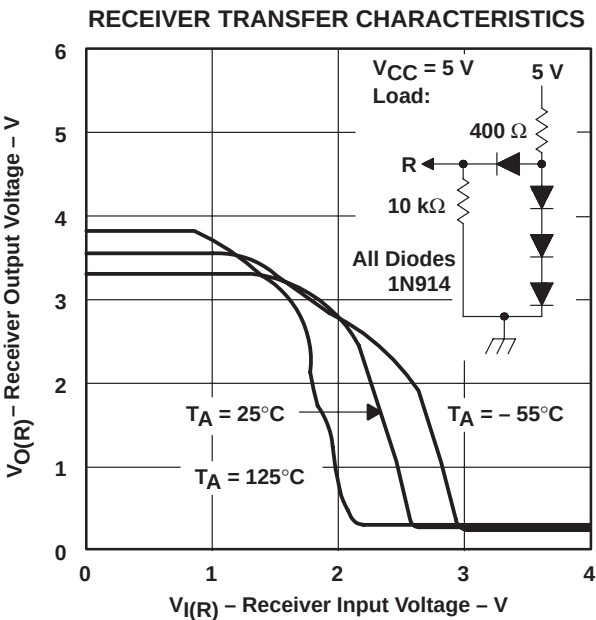


Figure 7

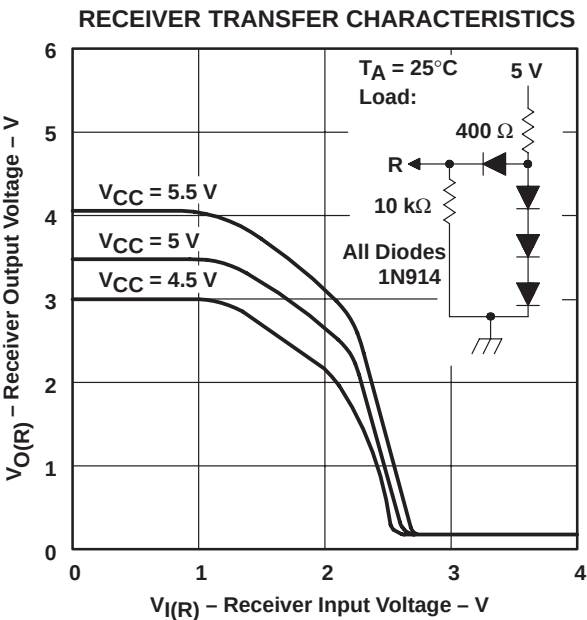


Figure 8

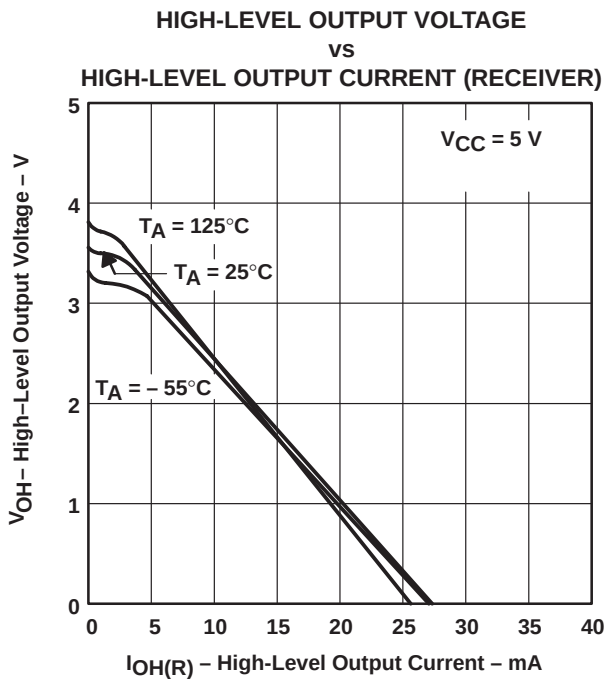


Figure 9

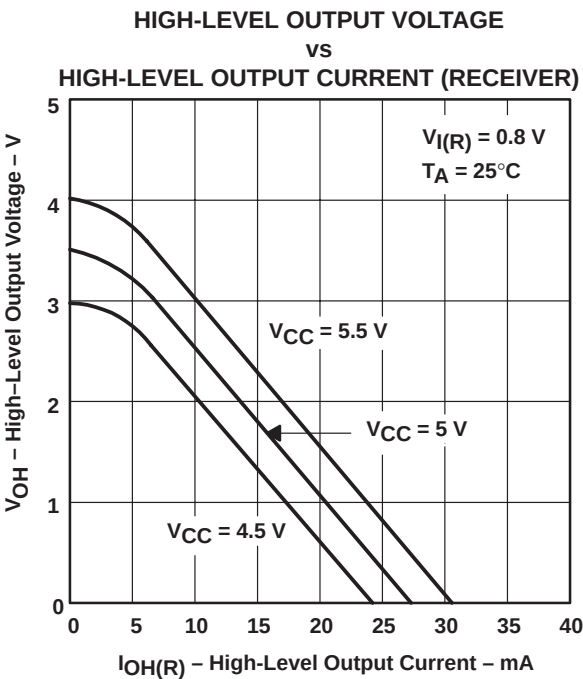


Figure 10

† Data for temperatures below  $0^\circ\text{C}$  and above  $70^\circ\text{C}$  is applicable to SN55138 circuits only.



TYPICAL CHARACTERISTICS†

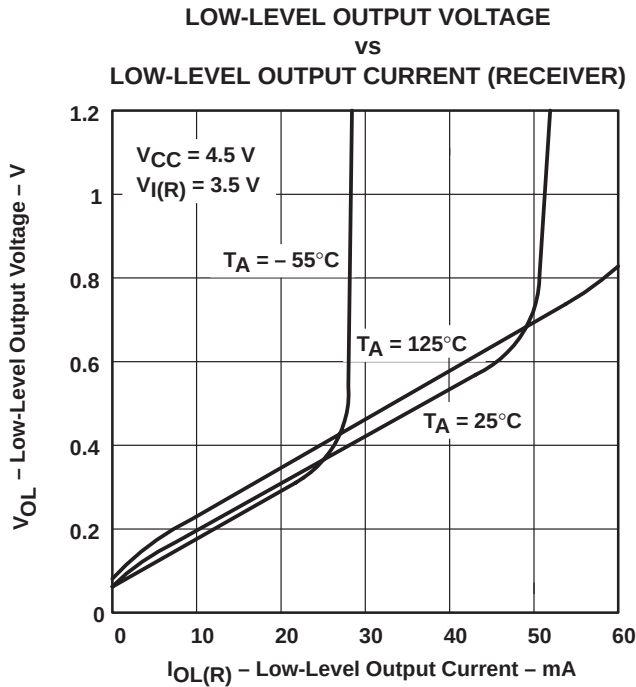


Figure 11

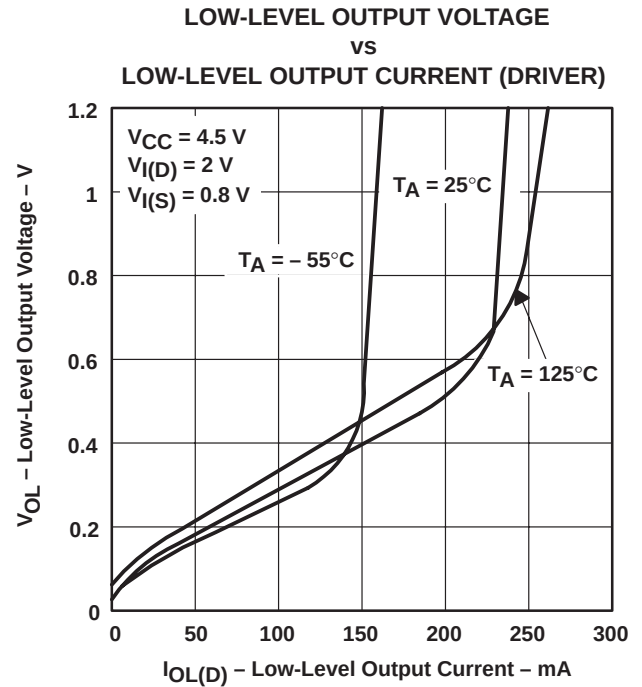


Figure 12

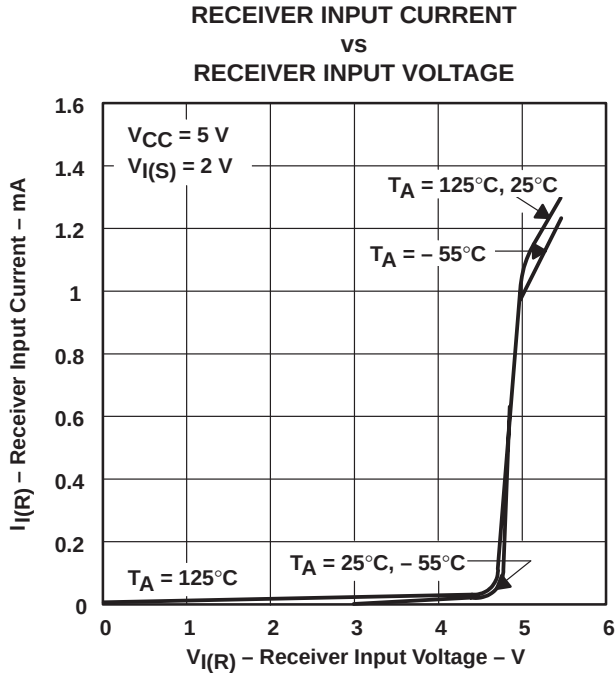


Figure 13

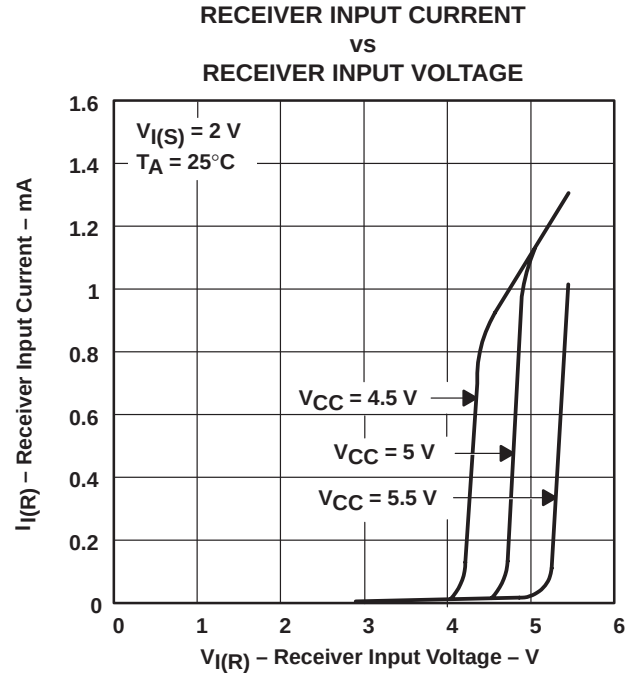


Figure 14

† Data for temperatures below  $0^\circ\text{C}$  and above  $70^\circ\text{C}$  is applicable to SN55138 circuits only.

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## TYPICAL CHARACTERISTICS†

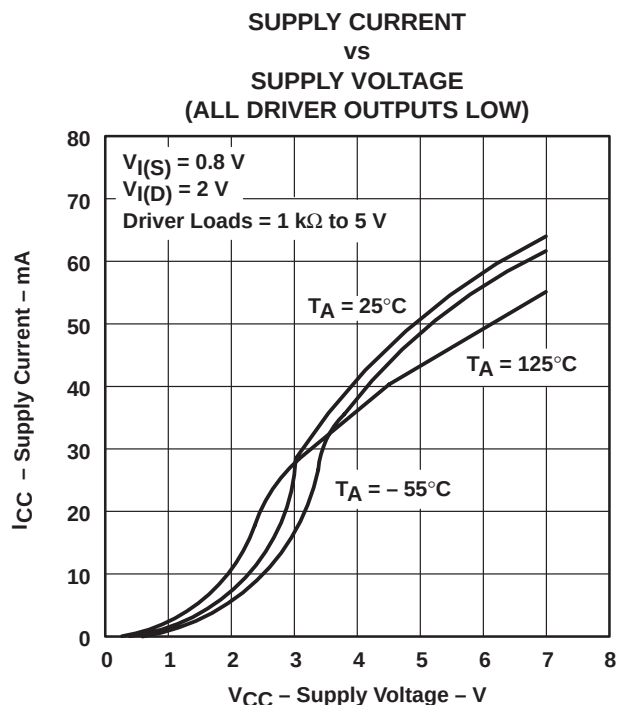


Figure 15

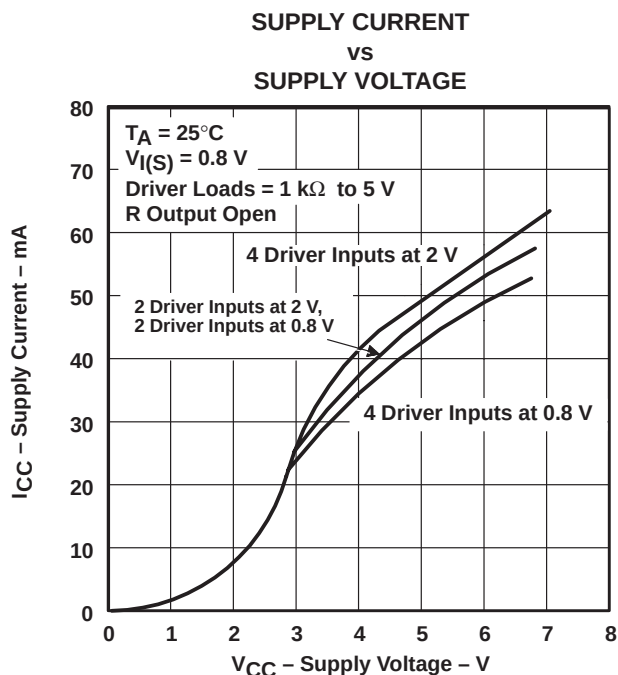


Figure 16

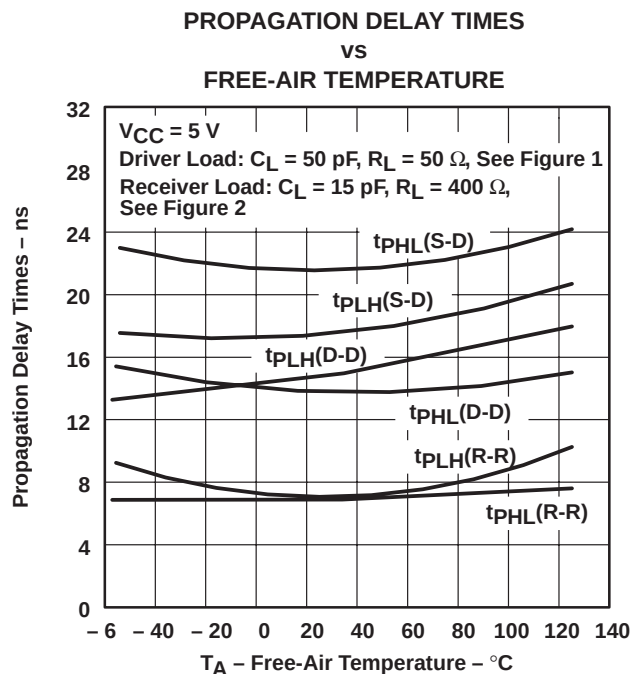


Figure 17

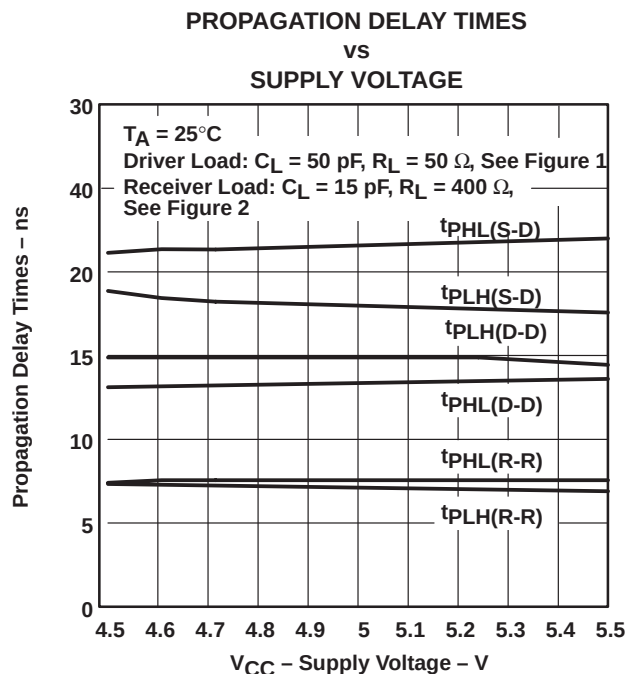
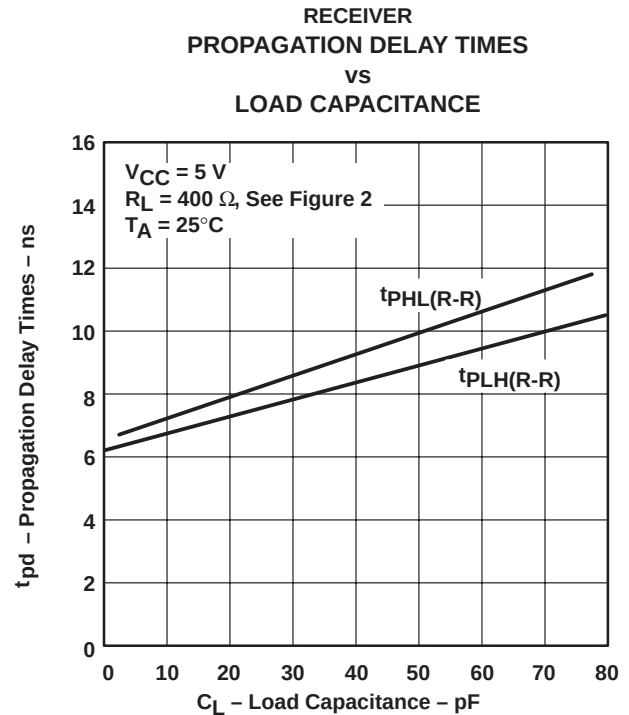
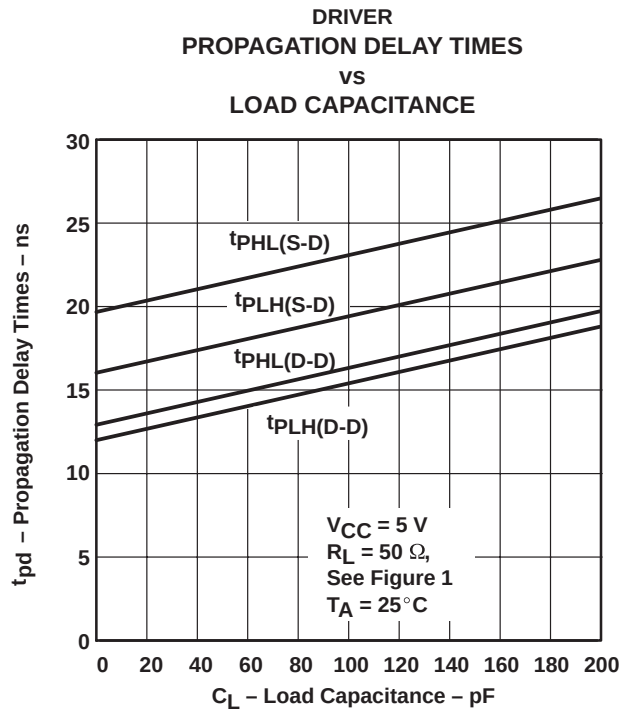


Figure 18

† Data for temperatures below  $0^\circ\text{C}$  and above  $70^\circ\text{C}$  is applicable to SN55138 circuits only.

## TYPICAL CHARACTERISTICS



## APPLICATION INFORMATION

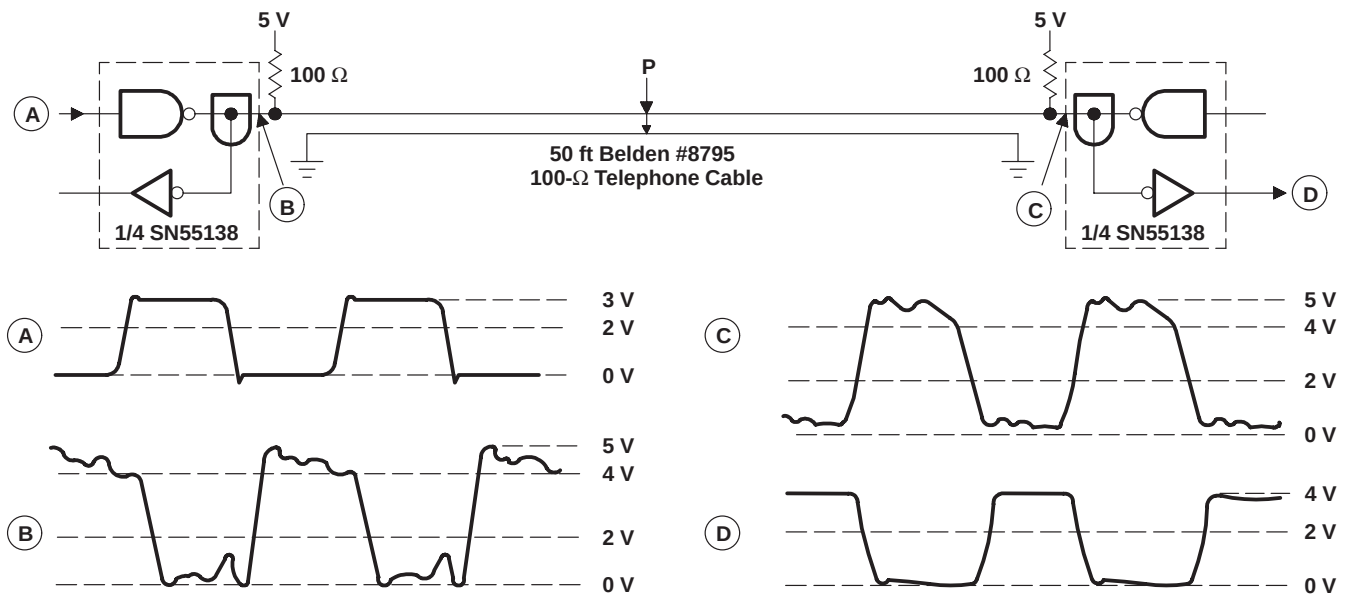
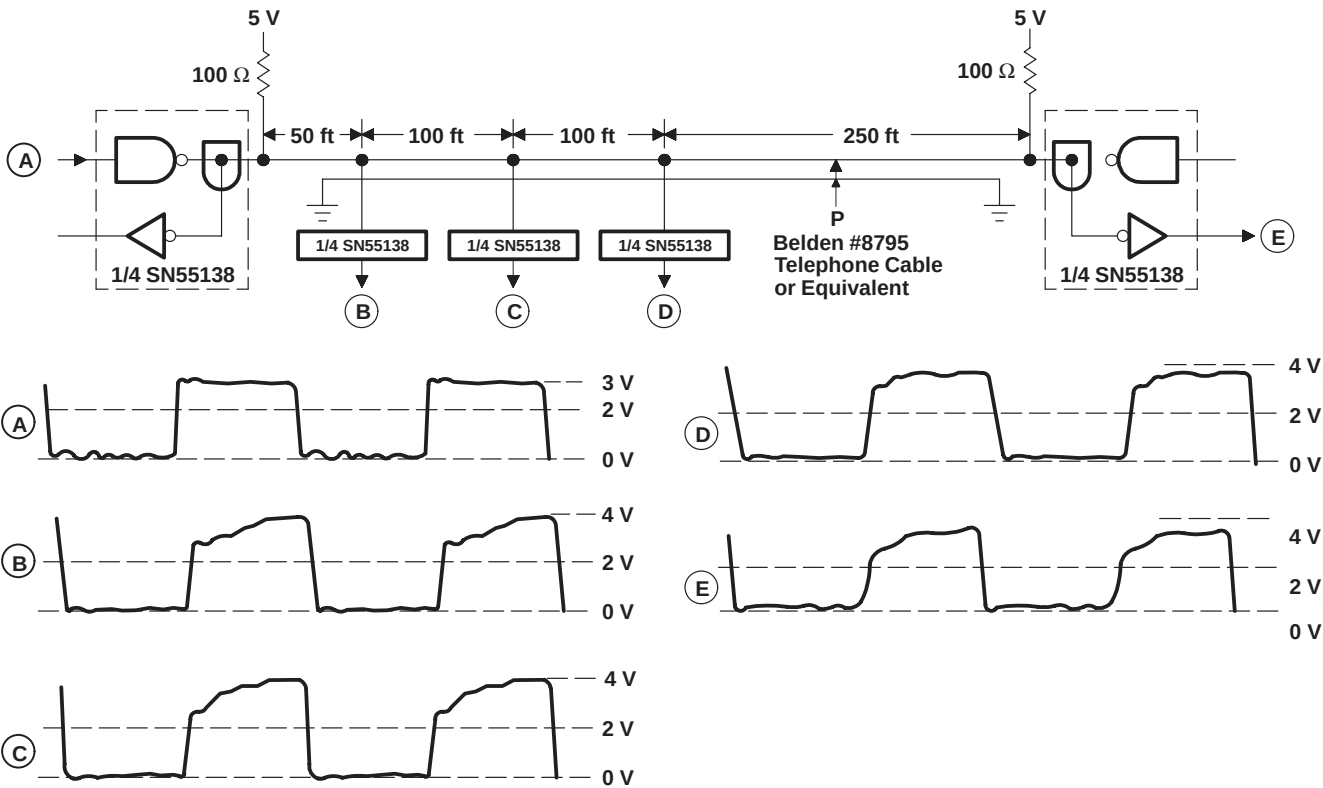


Figure 21. Point-to-Point Communication Over 50 Feet of Twisted Pair at 5 MHz

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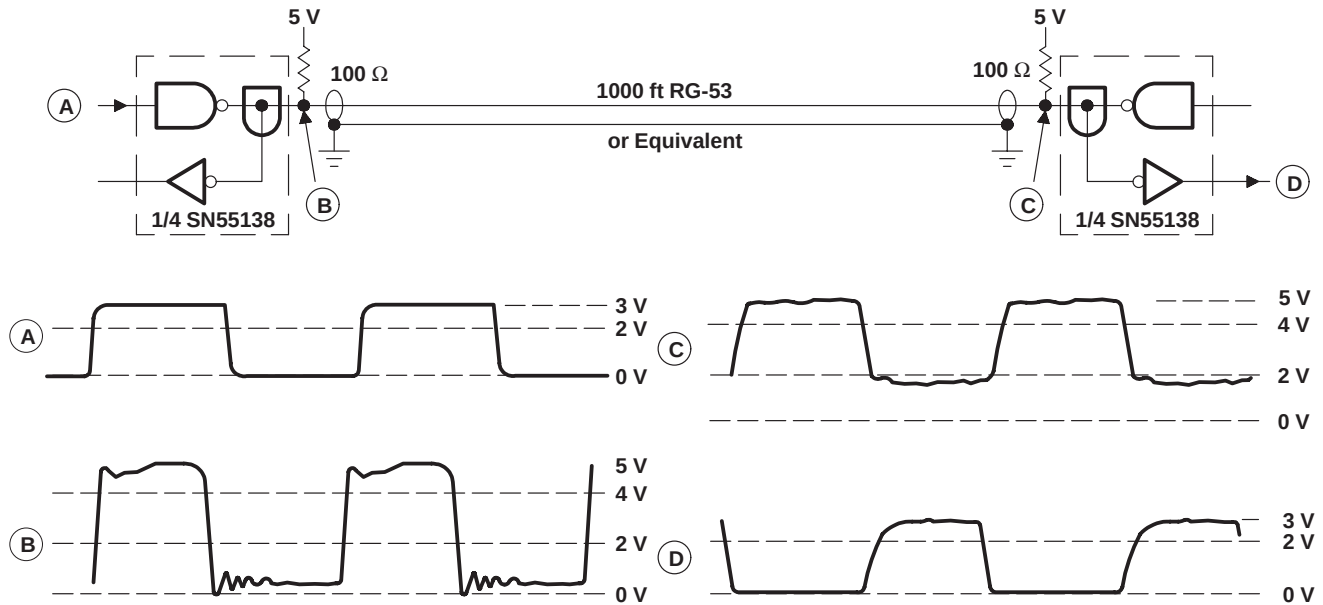
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APPLICATION INFORMATION



TYPICAL VOLTAGE WAVEFORMS

Figure 22. Party-Line Communication on 500 Feet of Twisted Pair at 1 MHz



TYPICAL VOLTAGE WAVEFORMS

Figure 23. Point-to-Point Communication Over 1000 Feet of Coaxial Cable at 1 MHz