

SN55138, SN75138 QUADRUPLE 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

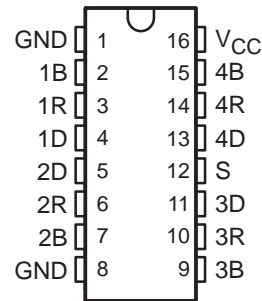
description

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.

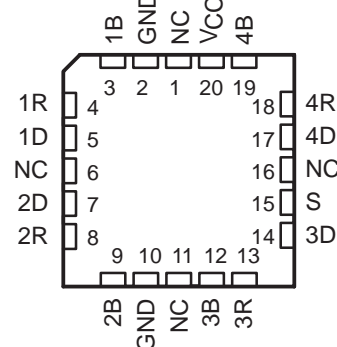
The receiver design also features a threshold of 2.3 V (typical), providing a wider noise margin than would be possible with a receiver having the usual TTL threshold. A strobe turns off all drivers (high impedance) but does not affect receiver operation. These circuits are designed for operation from 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°C to 125°C . The SN75138 is characterized for operation from 0°C to 70°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

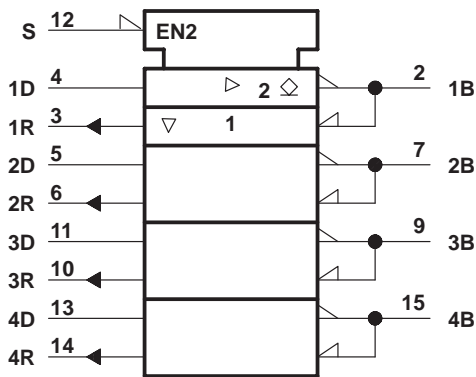
| INPUTS | | OUTPUTS | |
|--------|---|---------|---|
| S | D | B | R |
| L | H | L | H |
| L | L | H | L |

RECEIVING

| INPUTS | | | OUTPUT |
|--------|---|---|--------|
| S | B | D | R |
| H | H | X | L |
| H | L | X | H |

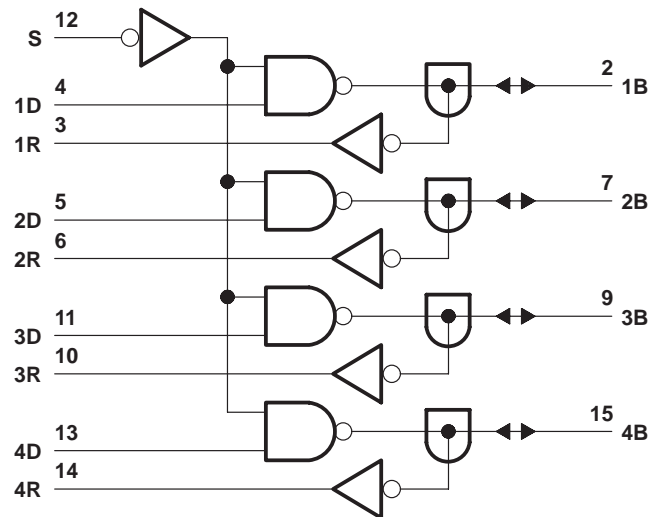
H = high level, L = low level, X = irrelevant

logic symbol†

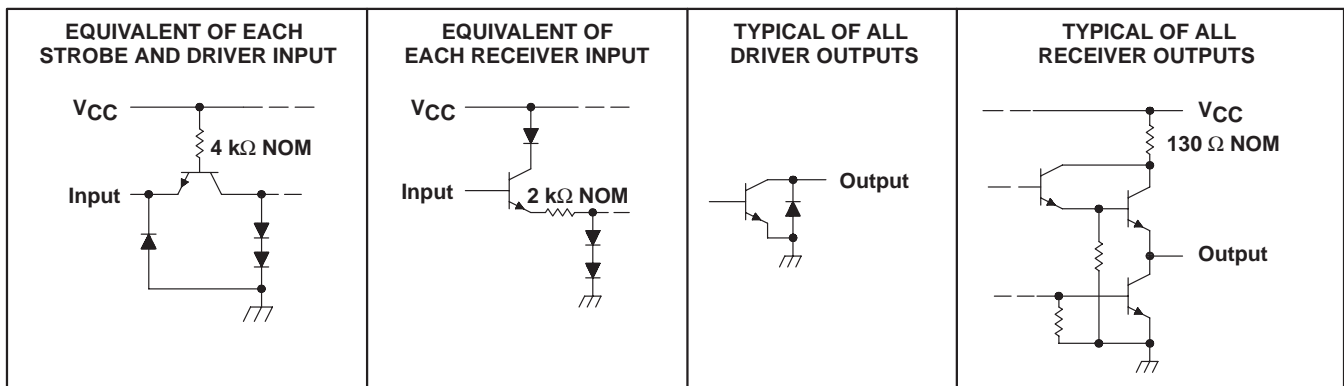


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, N, and W packages.

logic diagram (positive logic)



schematics of inputs and outputs



absolute maximum ratings over operating free-air temperature (unless otherwise noted)†

| | |
|--|------------------------------|
| 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 |

† 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 | $T_A \leq 25^\circ\text{C}$ | DERATING FACTOR | $T_A = 70^\circ\text{C}$ | $T_A = 125^\circ\text{C}$ |
|---------|-----------------------------|--------------------------------|--------------------------|---------------------------|
| | POWER RATING | ABOVE $T_A = 25^\circ\text{C}$ | POWER RATING | POWER RATING |
| D | 950 mW | 7.6 mW/°C | 608 mW | — |
| FK‡ | 1375 mW | 11.0 mW/°C | 880 mW | 275 mW |
| J‡ | 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 |

‡ 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 | | | V |
| | Receiver | | | | 1.5 | | | |
| High-level output current, I_{OH} | Receiver output | | | | –400 | | | μA |
| Low-level output current, I_{OL} | Driver output | | | | 100 | | | mA |
| | Receiver output | | | | 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 _{IK} | Input clamp voltage | Driver or strobe | V _{CC} = MIN, | I _I = -12 mA | | | -1.5 | | | -1.5 | V |
| V _{OH} | High-level output voltage | Receiver | V _{CC} = MIN, V _{IL(R)} = V _{IL} max, | V _{IH(S)} = 2 V, I _{OH} = -400 μA | 2.4 | 3.5 | | 2.4 | 3.5 | | V |
| V _{OL} | Low-level output voltage | Driver | V _{CC} = MIN, V _{IL(S)} = 0.8 V, | V _{IH(D)} = 2 V, I _{OL} = 100 mA | | | 0.45 | | | 0.45 | V |
| | | Receiver | V _{CC} = MIN, V _{IH(S)} = 2 V, | V _{IH(R)} = V _{IH} min, I _{OL} = 16 mA | | | 0.4 | | | 0.4 | |
| I _{I(max)} | Input current at maximum input voltage | Driver or strobe | V _{CC} = MAX, | V _I = V _{CC} | | | 1 | | | 1 | mA |
| I _{IH} | High-level input current | Driver or strobe | V _{CC} = MAX, | V _I = 2.4 V | | | 40 | | | 40 | μA |
| | | Receiver | V _{CC} = 5 V, V _{I(S)} = 2 V | V _{I(R)} = 4.5 V, | | 25 | 300 | | 25 | 300 | |
| I _{IL} | Low-level input current | Driver or strobe | V _{CC} = MAX, | V _I = 0.4 V | | -1 | -1.6 | | -1 | -1.6 | mA |
| | | Receiver | V _{CC} = MAX, V _{I(S)} = 2 V | V _{I(R)} = 0.45 V, | | | -50 | | | -50 | μA |
| I _{I(off)} | Input current with power off | Receiver | V _{CC} = 0, | V _I = 4.5 V | | 1.1 | 1.5 | | 1.1 | 1.5 | mA |
| I _{OS} | Short-circuit output current§ | Receiver | V _{CC} = MAX | | -20 | | -55 | -18 | | -55 | mA |
| I _{CC} | Supply current | All driver outputs low | V _{CC} = MAX, V _{I(S)} = 0.8 V | V _{I(D)} = 2 V, | | 50 | 65 | | 50 | 65 | mA |
| | | All driver outputs high | V _{CC} = MAX, V _{I(S)} = 2 V, Receiver outputs open | V _{I(R)} = 3.5 V, | | 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_I refer to the driver input, receiver input, and strobe input, respectively.

‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.

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

switching characteristics, V_{CC} = 5 V, T_A = 25°C

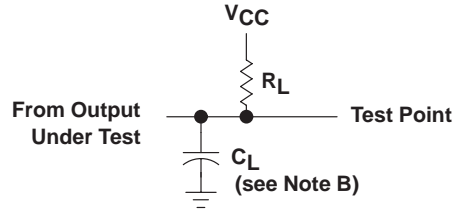
| PARAMETER† | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | | | MIN | TYP | MAX | UNIT |
|------------------|--------------|-------------|---|--------------|--|-----|-----|-----|------|
| t _{PLH} | Driver | Driver | C _L = 50 pF, R _L = 50 Ω, | See Figure 1 | | 15 | 24 | ns | |
| t _{PHL} | | | |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

† t_{PLH} = propagation delay time, low- to high-level output

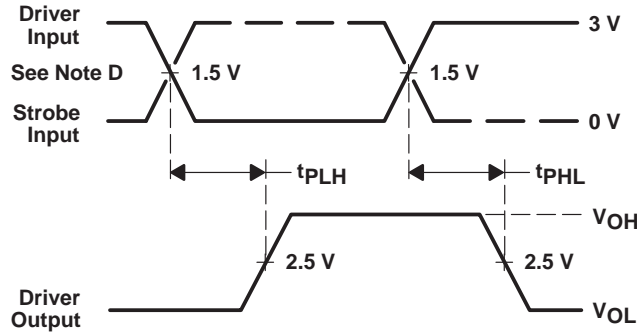
t_{PHL} = propagation delay time, high- to low-level output



PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

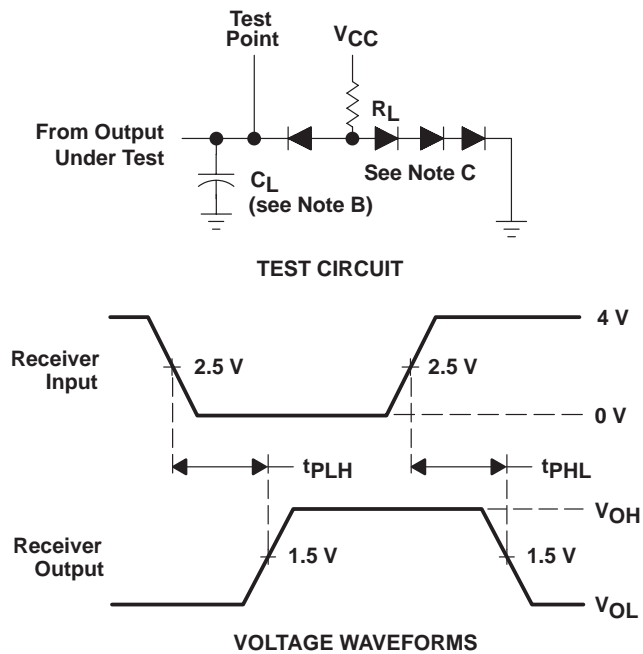
- NOTES: A. Input pulses are supplied by generators having the following characteristics: $t_w = 100$ ns, $PRR \leq 1$ MHz, $t_r \leq 10$ ns, $t_f \leq 10$ ns, $Z_O \approx 50 \Omega$.
 B. C_L includes probe and jig capacitance.
 C. All diodes are 1N916 or 1N3064.
 D. When testing driver input (solid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

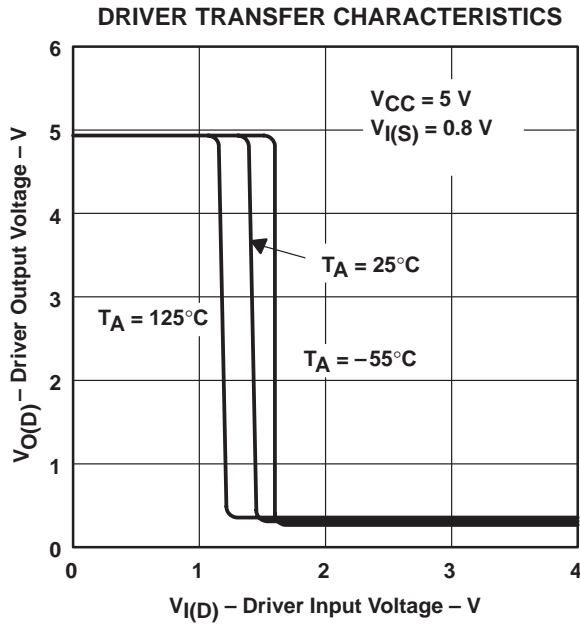


Figure 3

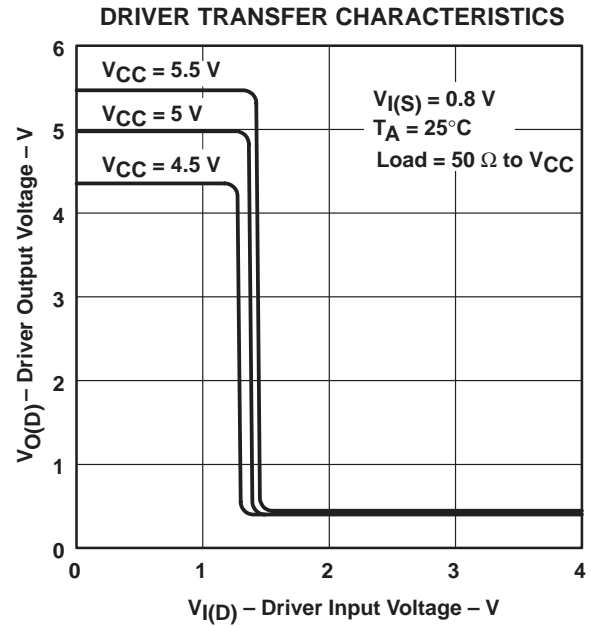


Figure 4

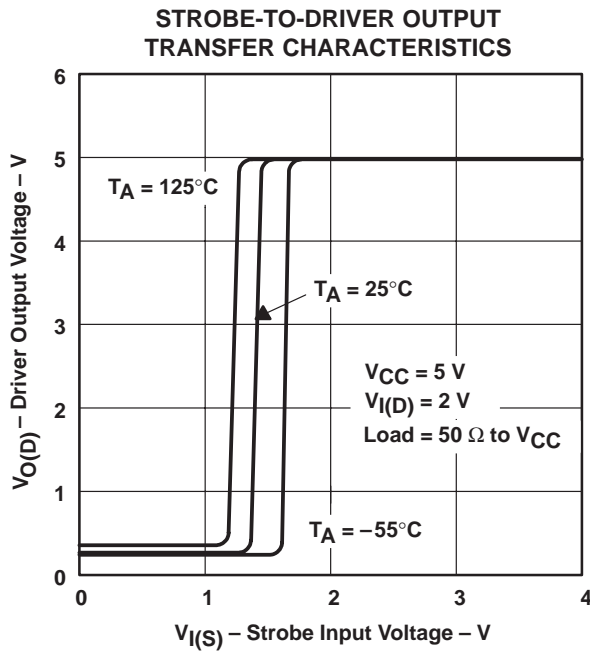


Figure 5

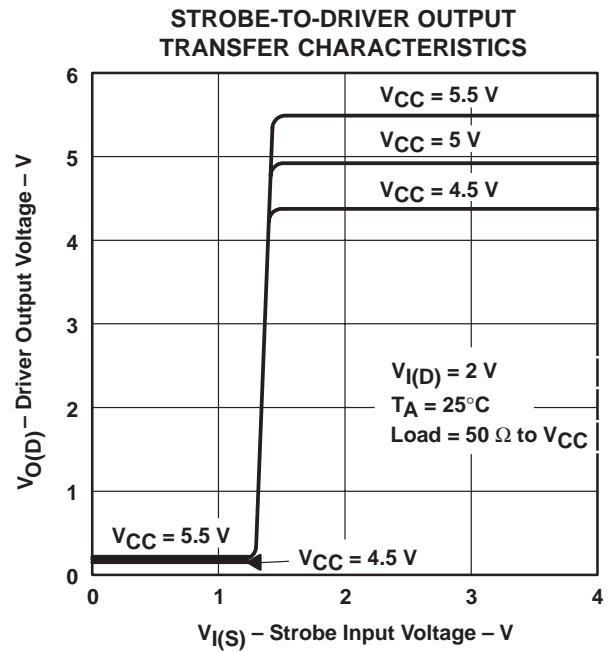


Figure 6

† Data for temperatures below 0°C and above 70°C is applicable to SN55138 circuits only.

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TYPICAL CHARACTERISTICS†

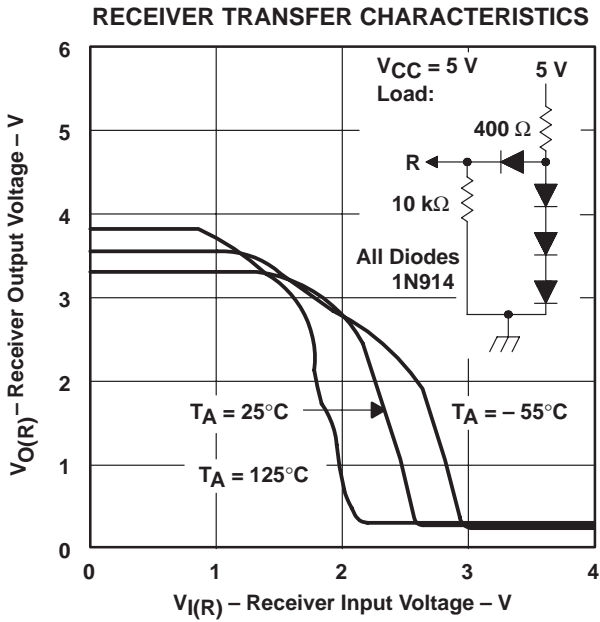


Figure 7

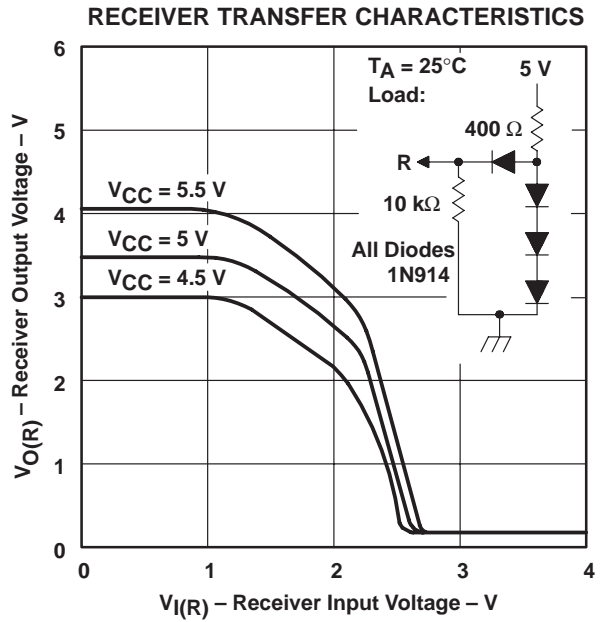


Figure 8

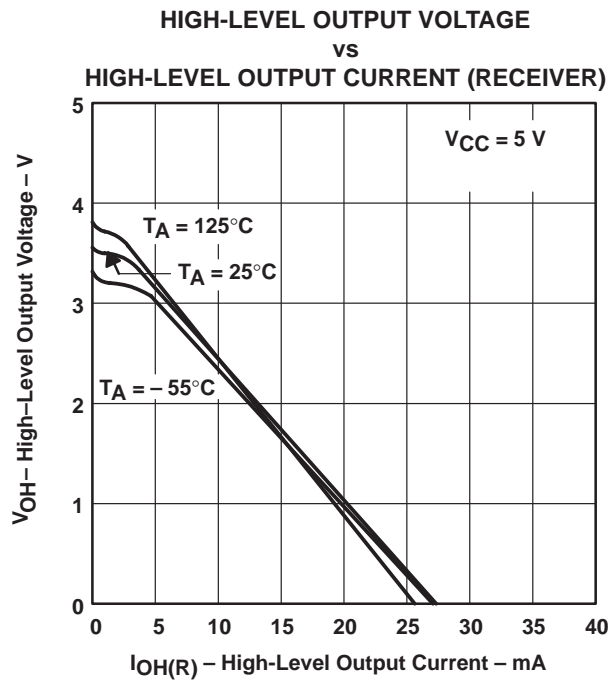


Figure 9

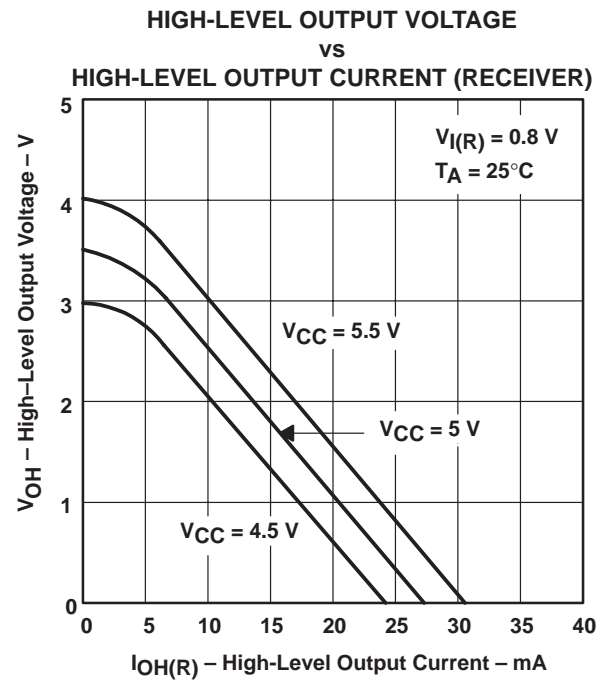


Figure 10

† Data for temperatures below 0°C and above 70°C is applicable to SN55138 circuits only.

TYPICAL CHARACTERISTICS†

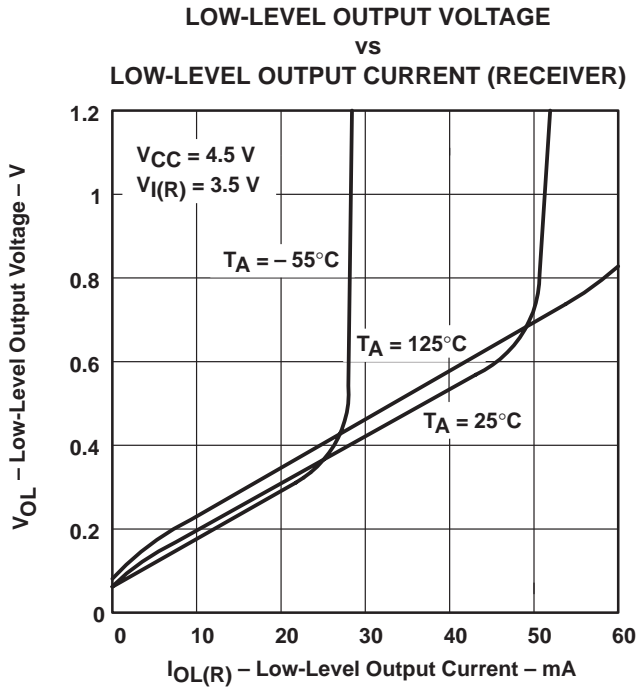


Figure 11

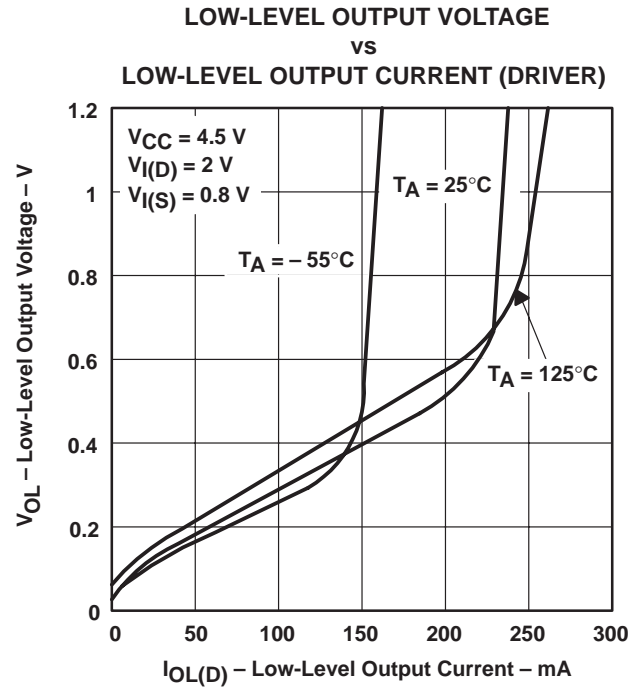


Figure 12

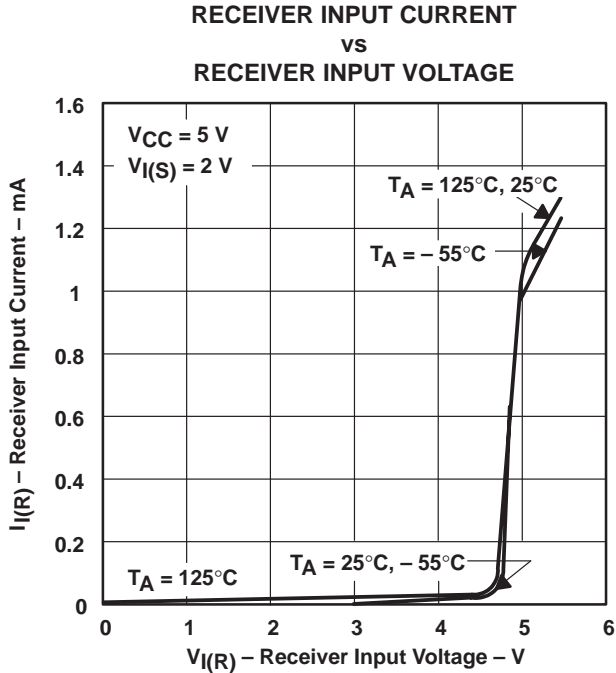


Figure 13

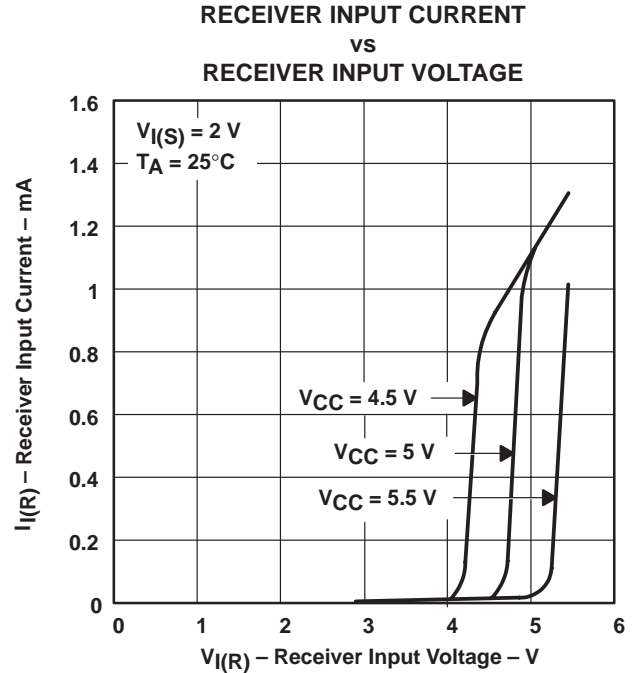
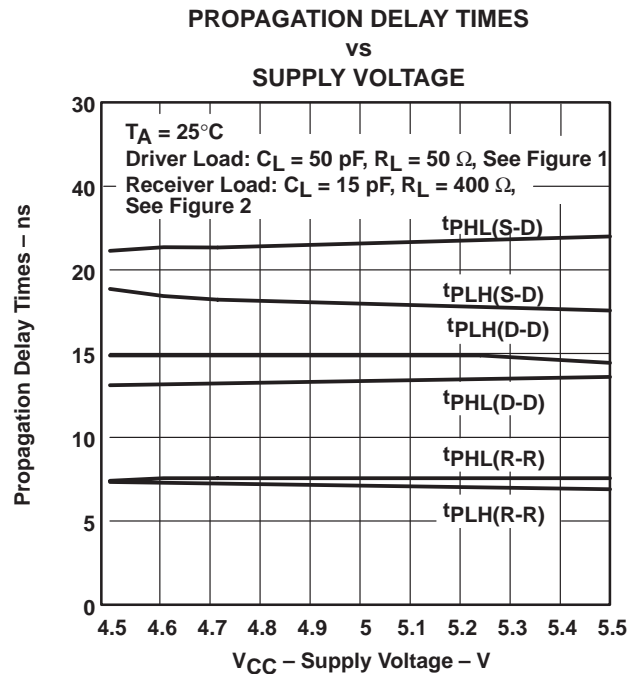
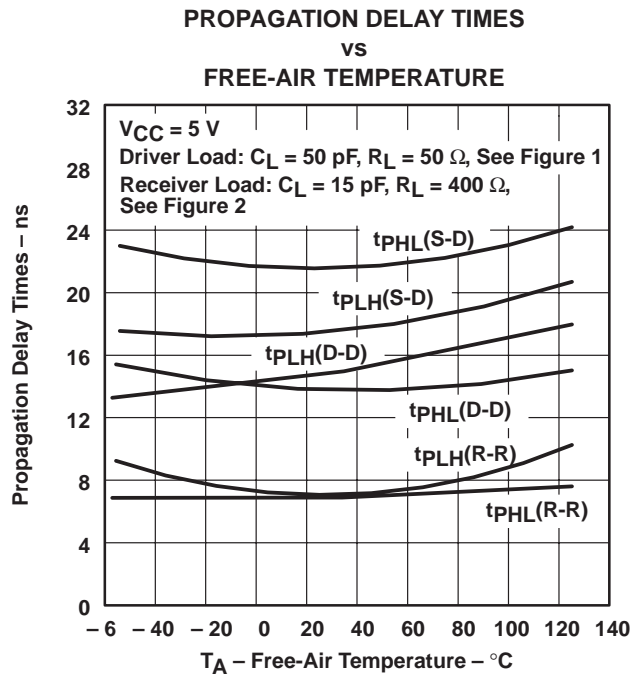
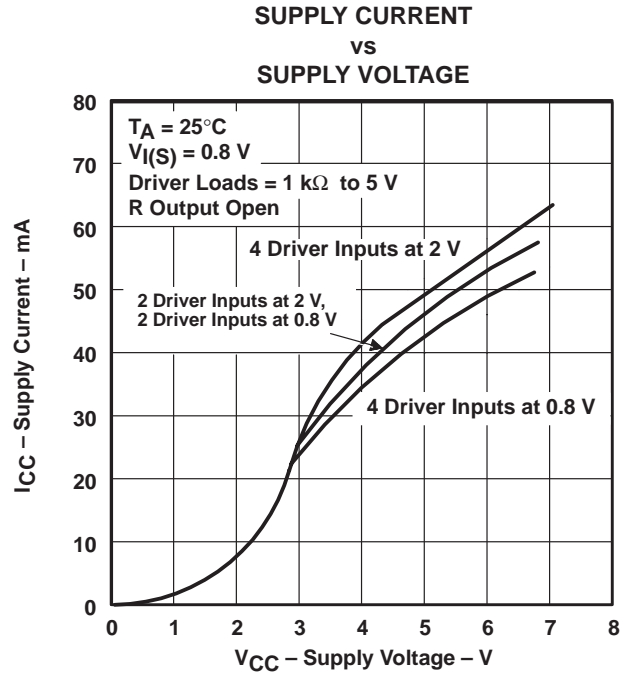
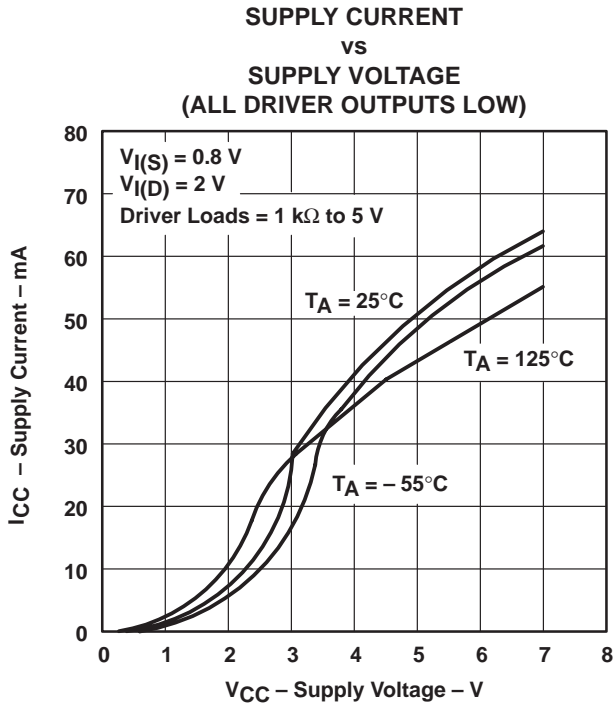


Figure 14

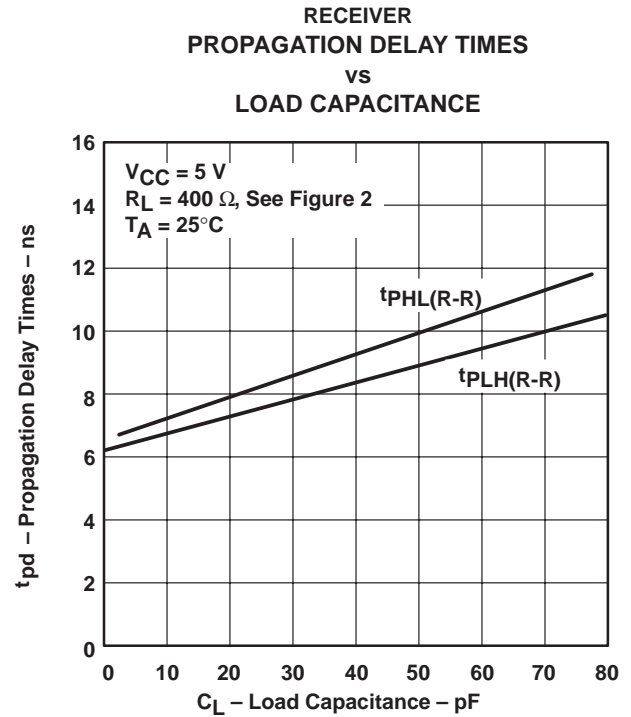
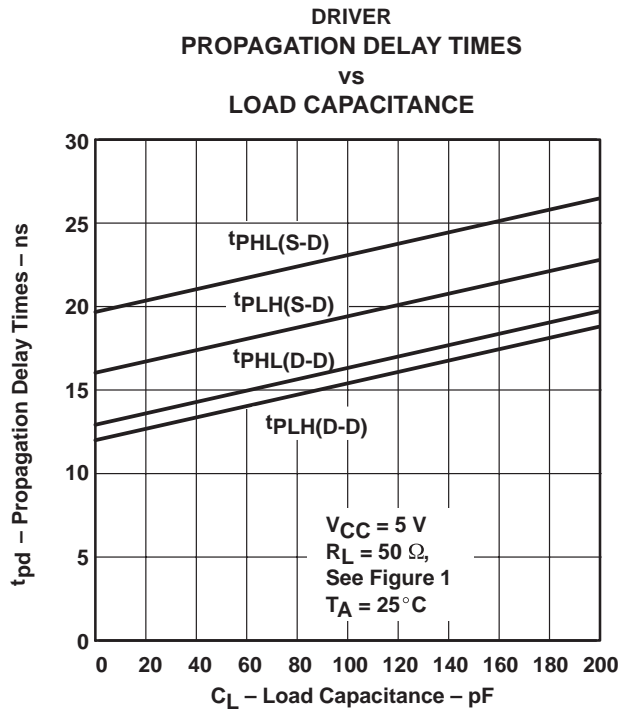
† Data for temperatures below 0°C and above 70°C is applicable to SN55138 circuits only.

TYPICAL CHARACTERISTICS†



† Data for temperatures below 0°C and above 70°C is applicable to SN55138 circuits only.

TYPICAL CHARACTERISTICS



APPLICATION INFORMATION

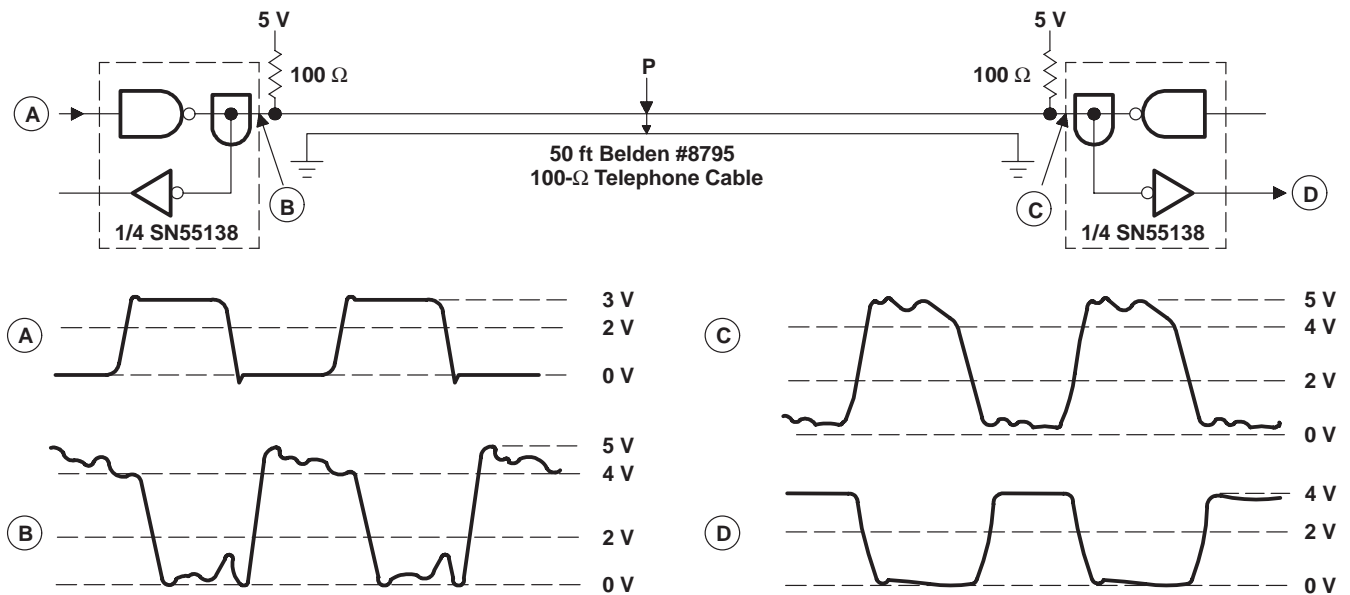
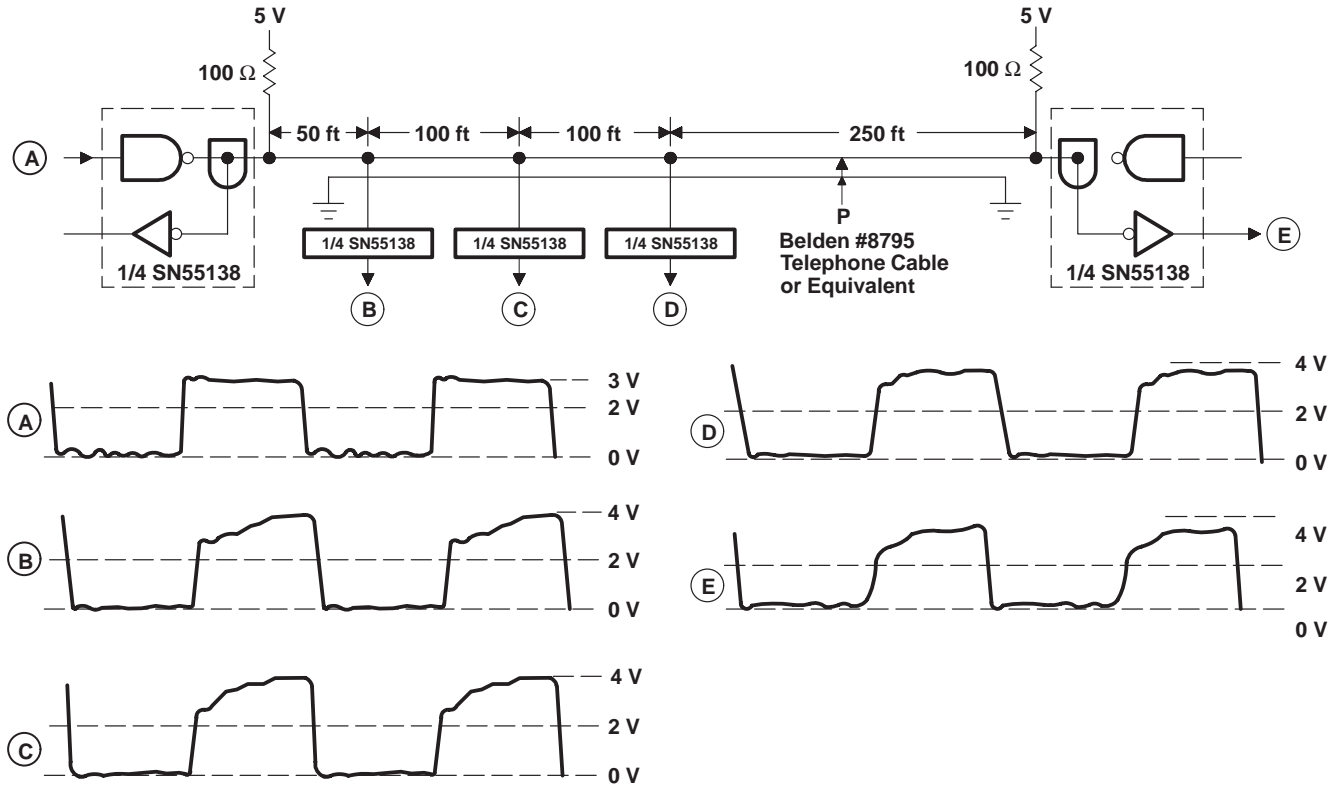


Figure 21. Point-to-Point Communication Over 50 Feet of Twisted Pair at 5 MHz

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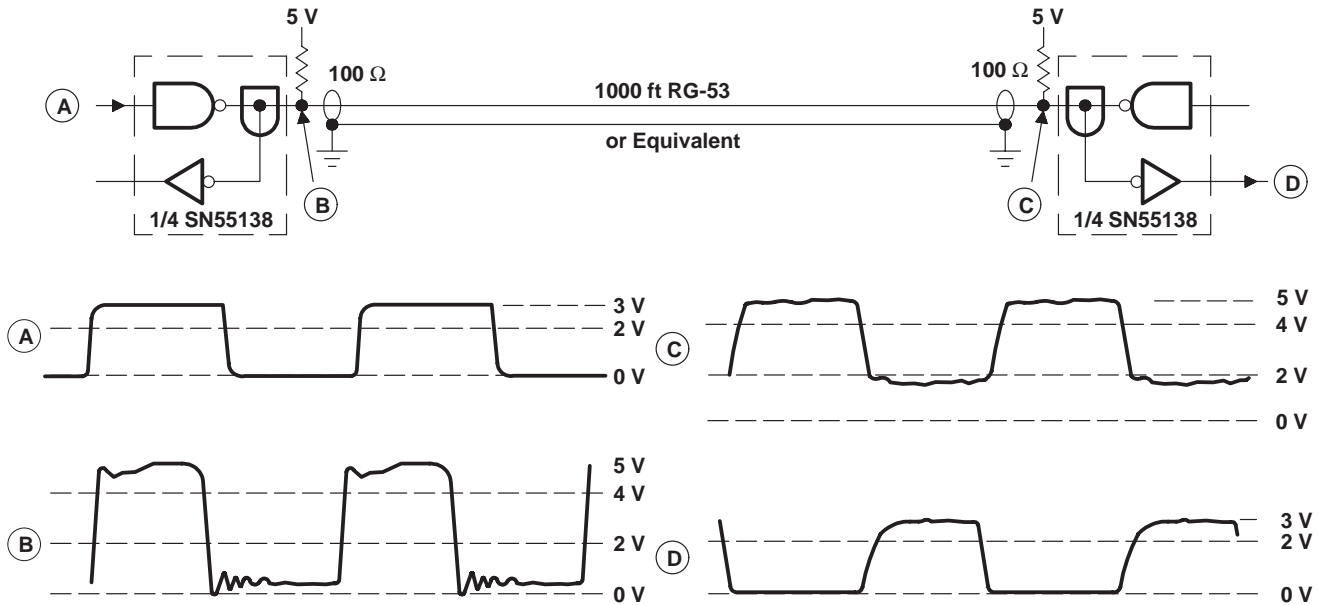
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APPLICATION INFORMATION



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

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--|
| SN55138J | OBSOLETE | CDIP | J | 16 | | None | Call TI | Call TI |
| SN75138D | ACTIVE | SOIC | D | 16 | 40 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN75138DR | ACTIVE | SOIC | D | 16 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN75138N | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| SN75138NSR | ACTIVE | SO | NS | 16 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SNJ55138FK | OBSOLETE | LCCC | FK | 20 | | None | Call TI | Call TI |
| SNJ55138J | OBSOLETE | CDIP | J | 16 | | None | Call TI | Call TI |
| SNJ55138W | OBSOLETE | CFP | W | 16 | | None | Call TI | Call TI |

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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