

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

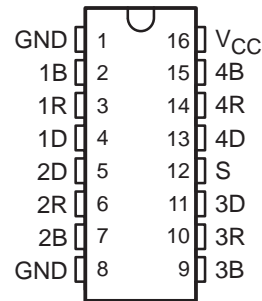
description

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.

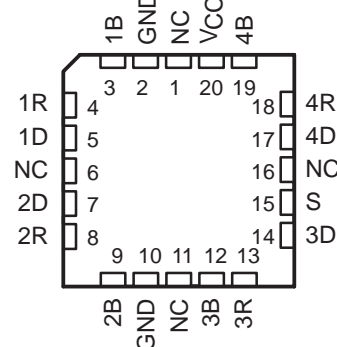
The receiver design also features a threshold of 2.3 V (typical), providing a wider noise margin than would be possible with a receiver having the usual TTL threshold. A strobe turns off all drivers (high impedance) but does not affect receiver operation. These circuits are designed for operation from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

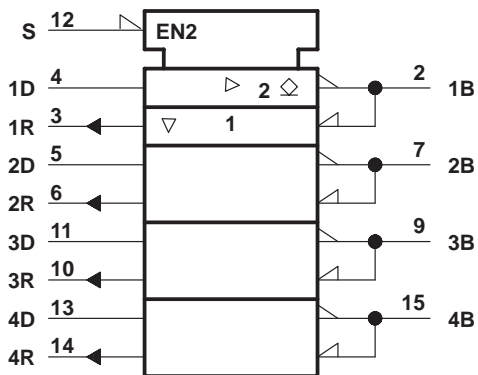
| INPUTS | | OUTPUTS | |
|--------|---|---------|---|
| S | D | B | R |
| L | H | L | H |
| L | L | H | L |

RECEIVING

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

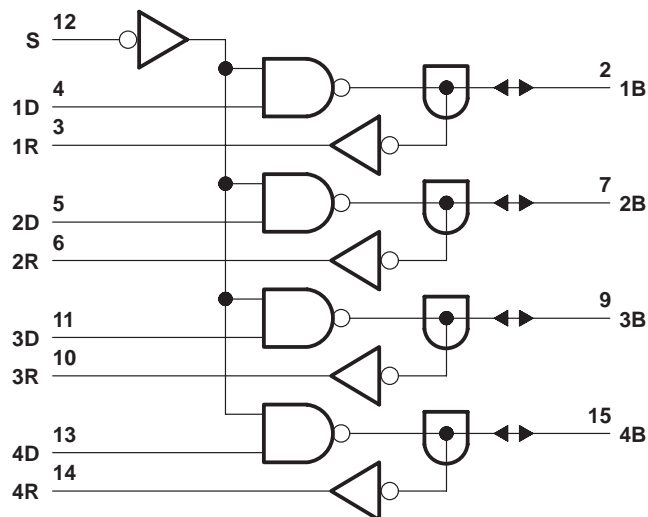
H = high level, L = low level, X = irrelevant

logic symbol†

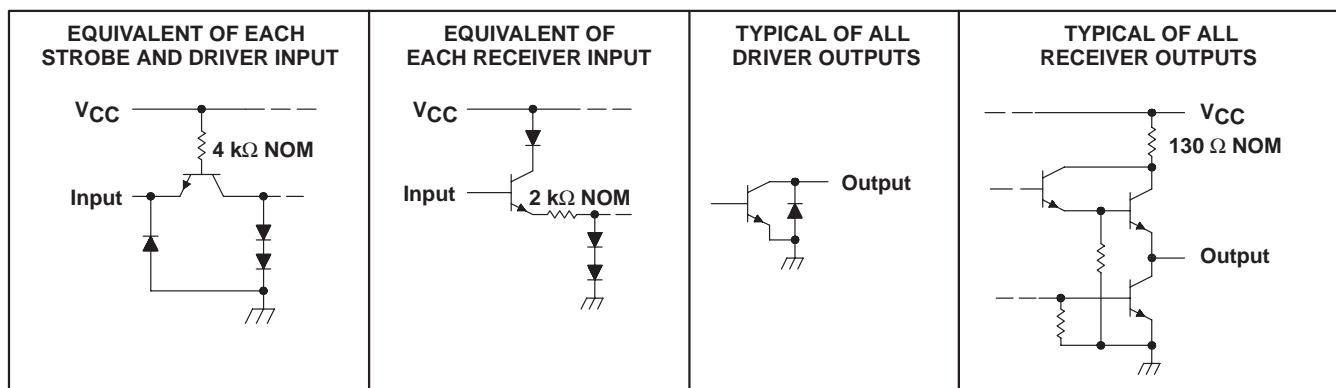


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, N, and W packages.

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 | | | 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 _{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 | | |

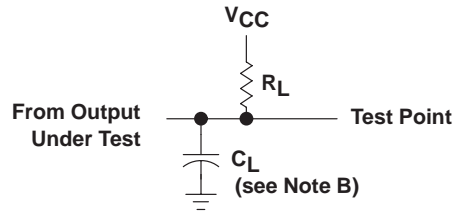
† t_{PLH} = propagation delay time, low- to high-level output

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

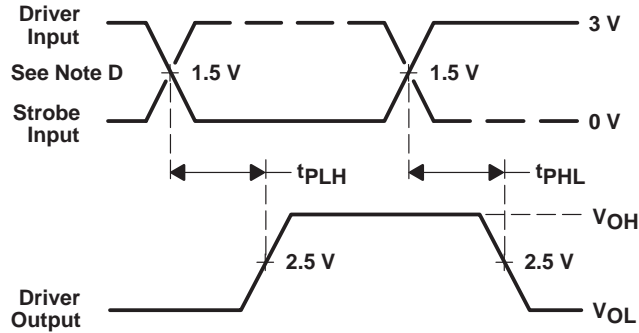


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PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

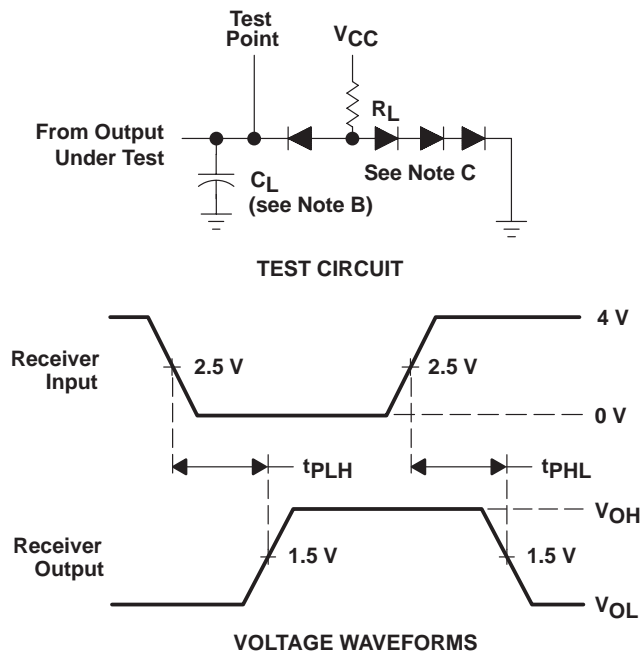
- NOTES: A. Input pulses are supplied by generators having the following characteristics: $t_w = 100$ ns, $PRR \leq 1$ MHz, $t_r \leq 10$ ns, $t_f \leq 10$ ns, $Z_O \approx 50 \Omega$.
- B. C_L includes probe and jig capacitance.
- C. All diodes are 1N916 or 1N3064.
- D. When testing driver input (solid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

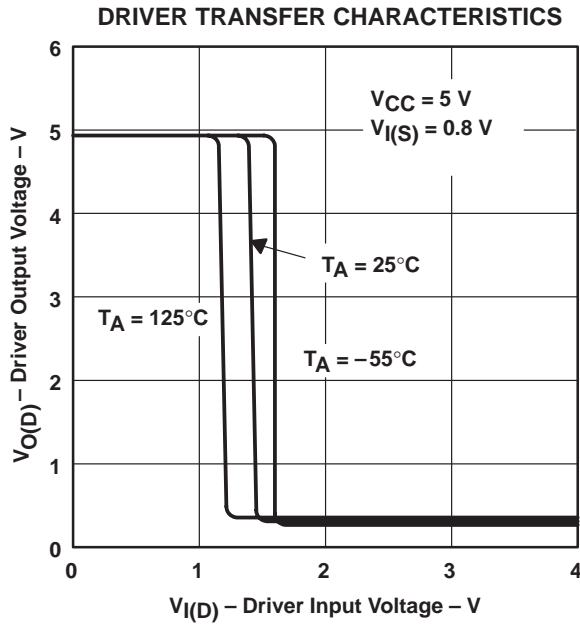


Figure 3

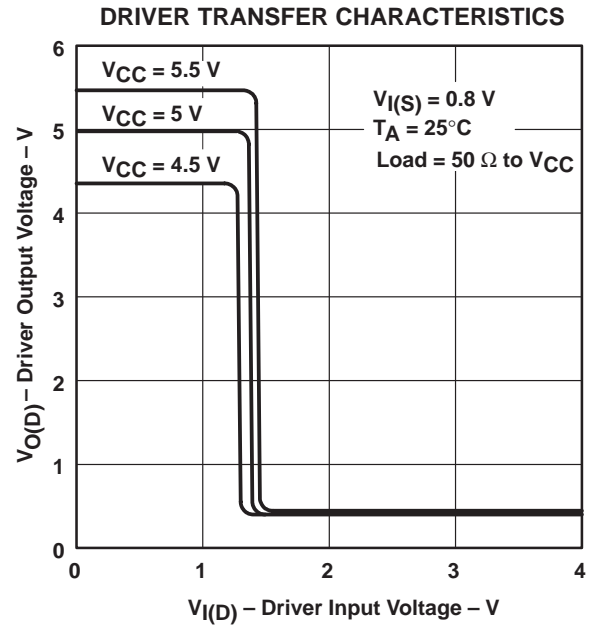


Figure 4

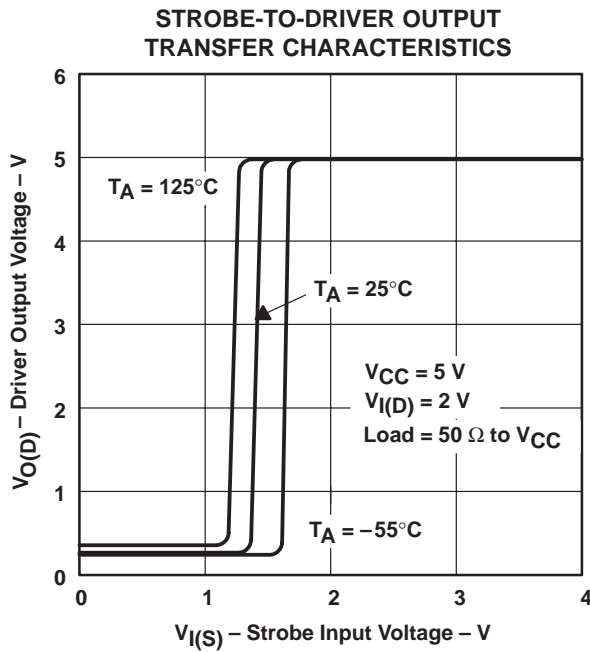


Figure 5

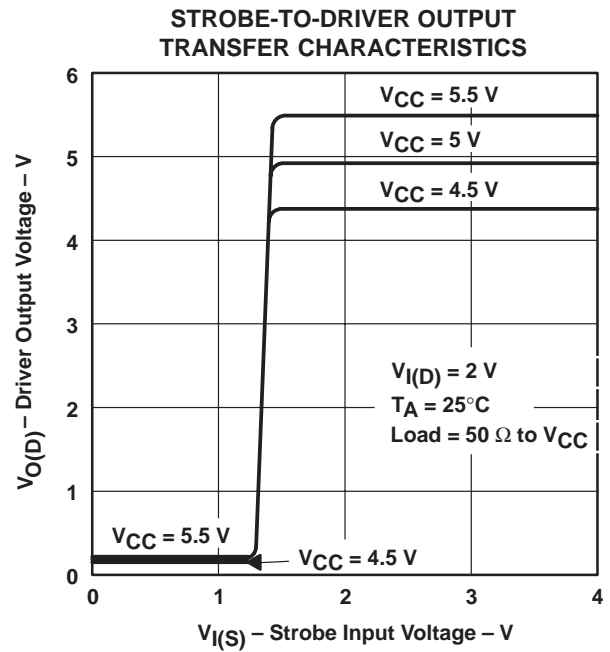


Figure 6

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

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TYPICAL CHARACTERISTICS†

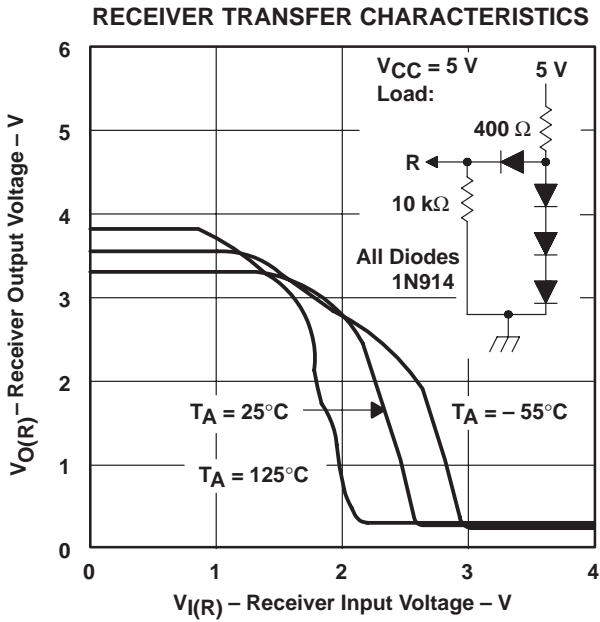


Figure 7

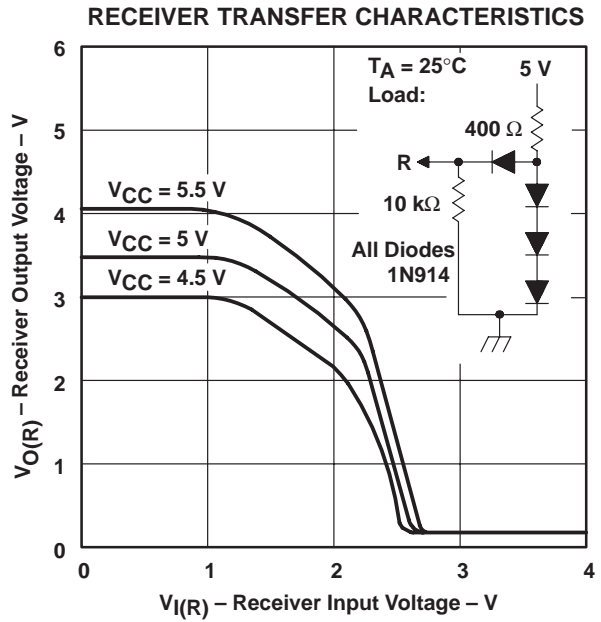


Figure 8

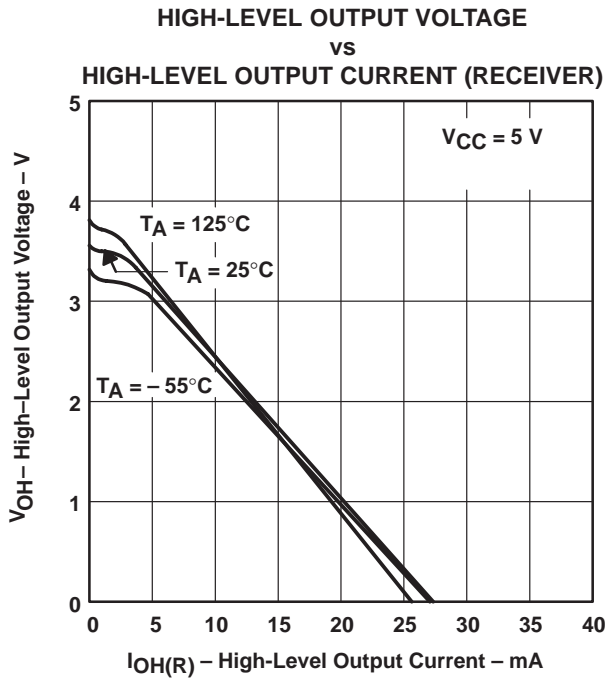


Figure 9

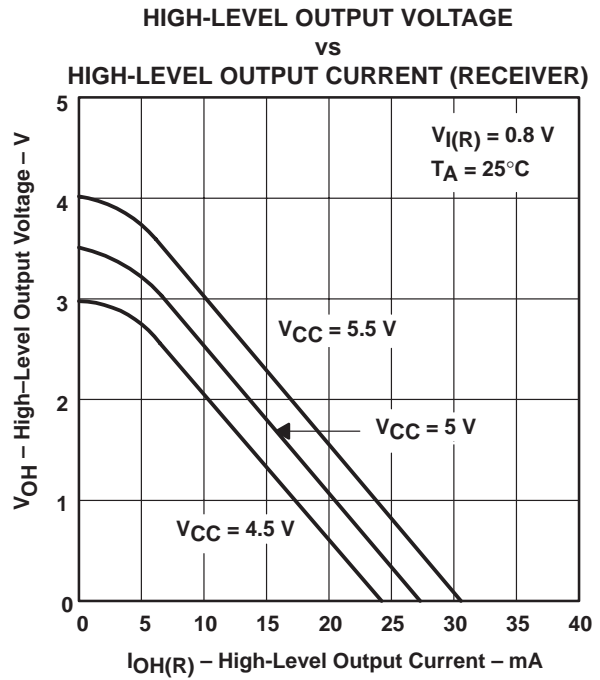


Figure 10

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

TYPICAL CHARACTERISTICS†

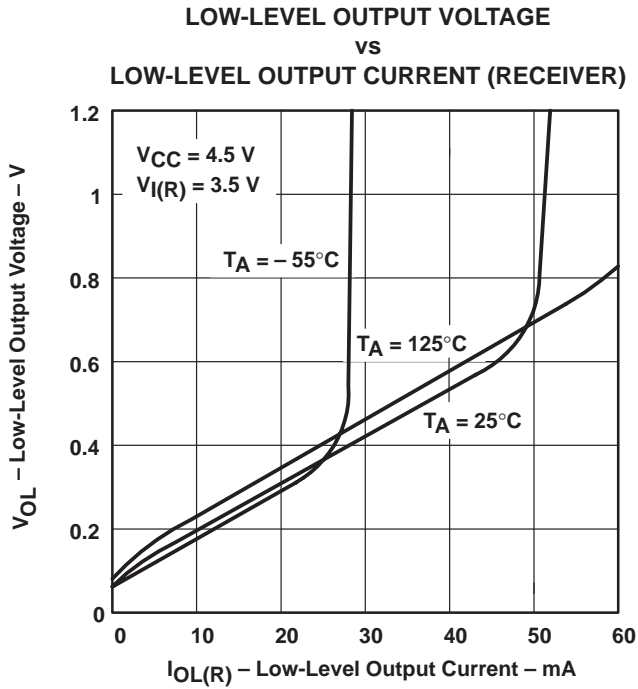


Figure 11

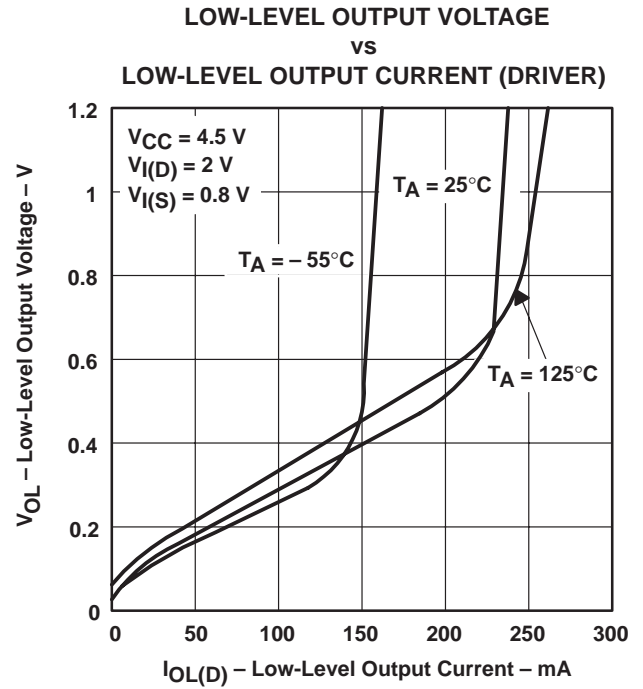


Figure 12

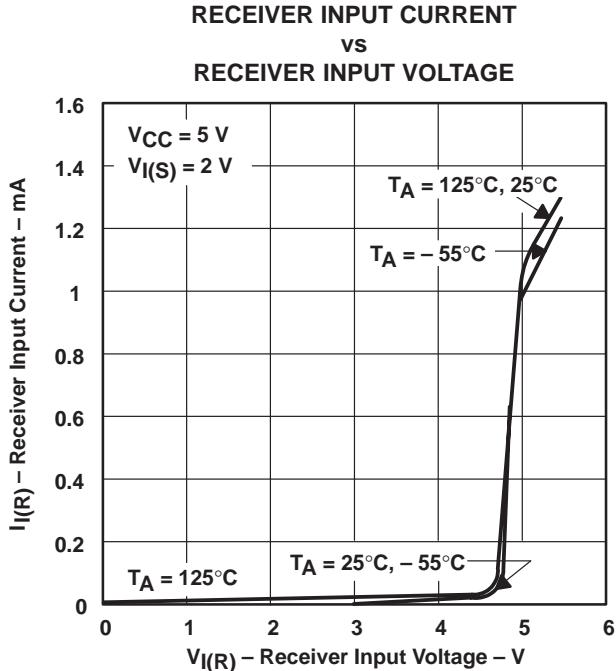


Figure 13

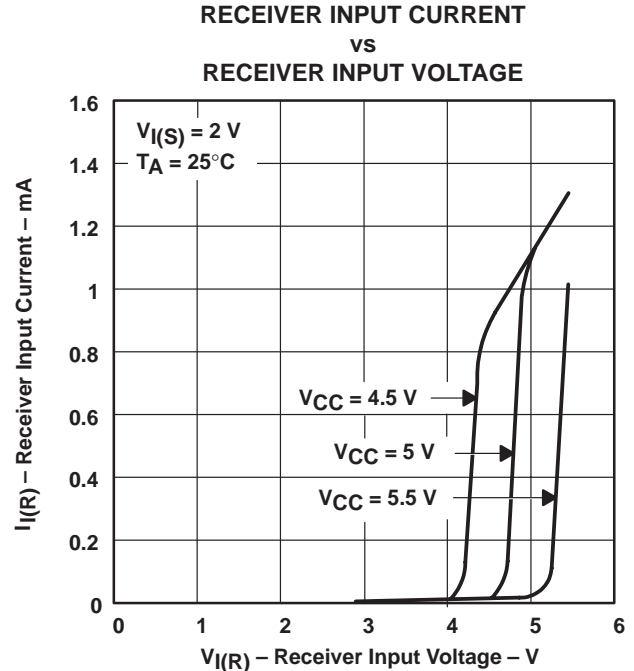


Figure 14

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

TYPICAL CHARACTERISTICS†

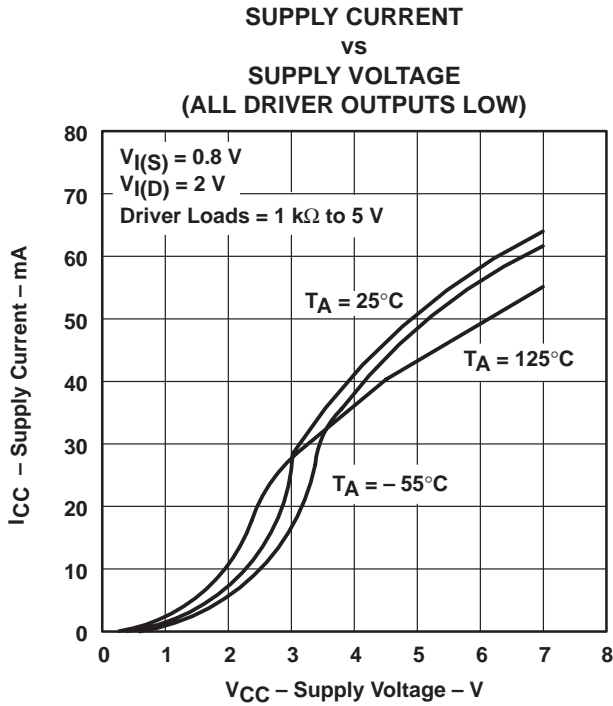


Figure 15

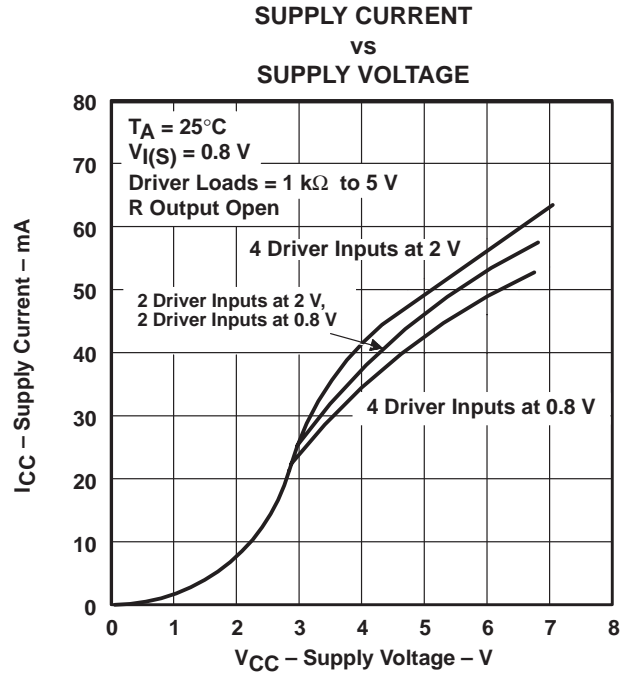


Figure 16

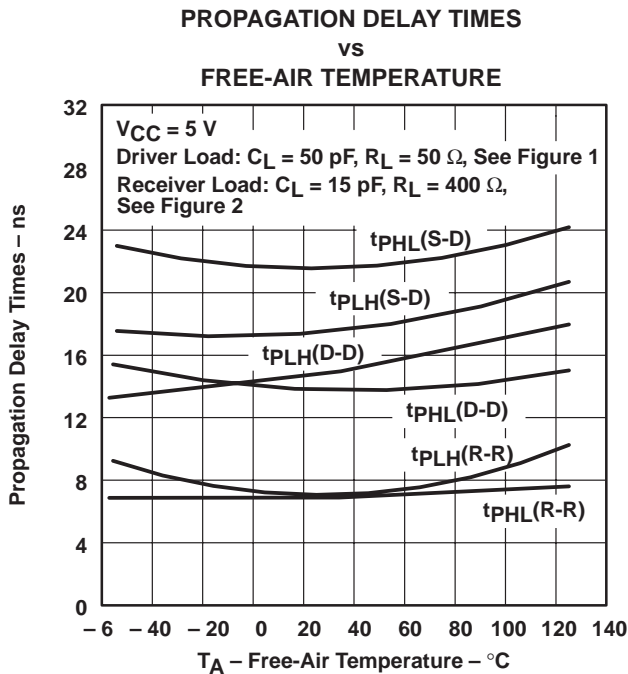


Figure 17

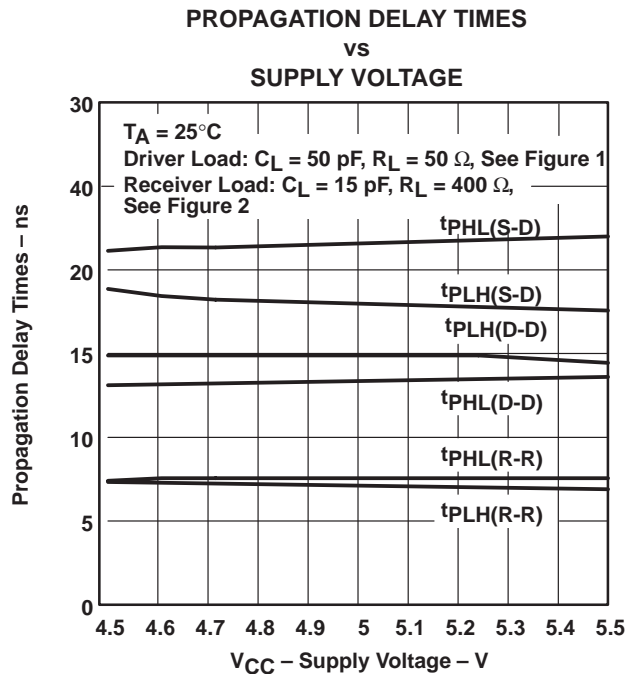
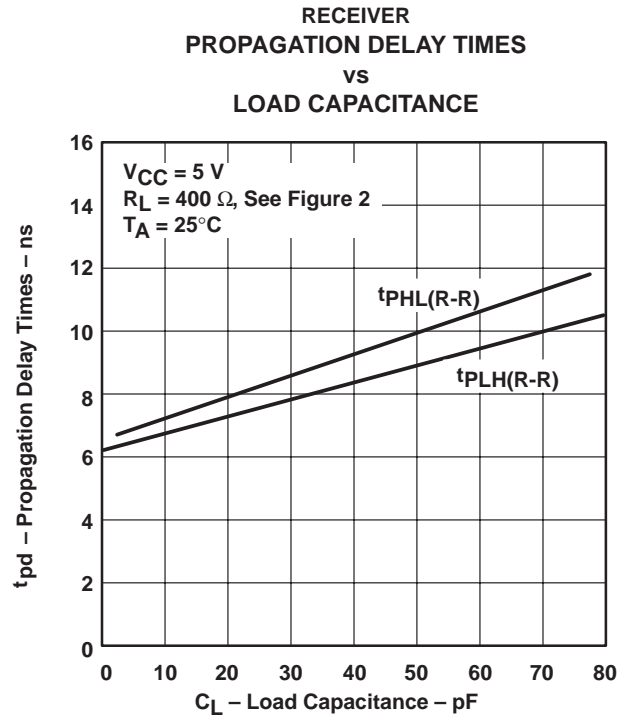
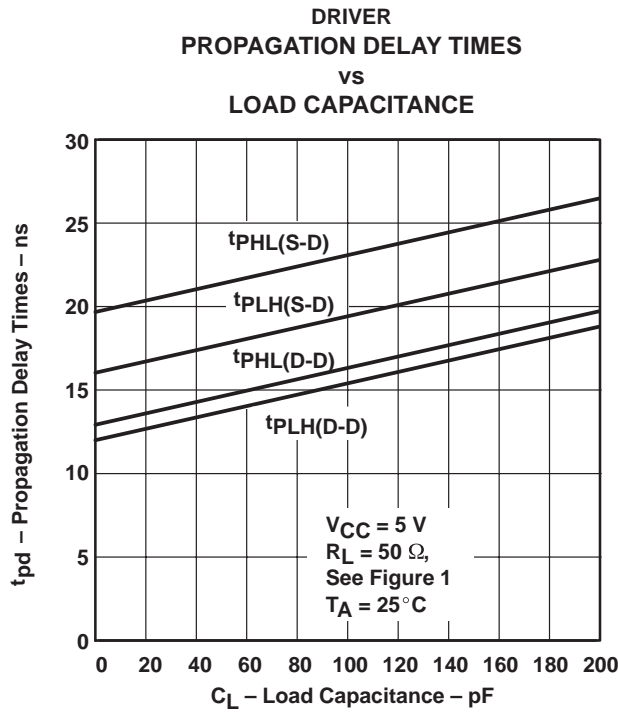


Figure 18

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

TYPICAL CHARACTERISTICS



APPLICATION INFORMATION

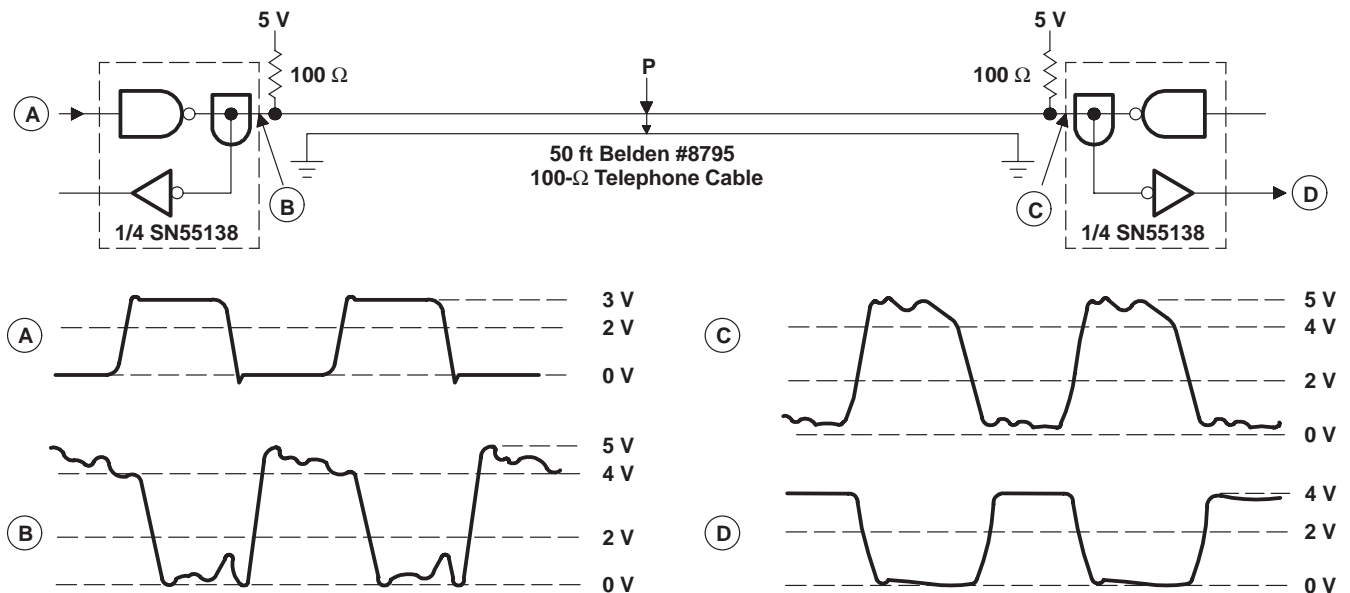
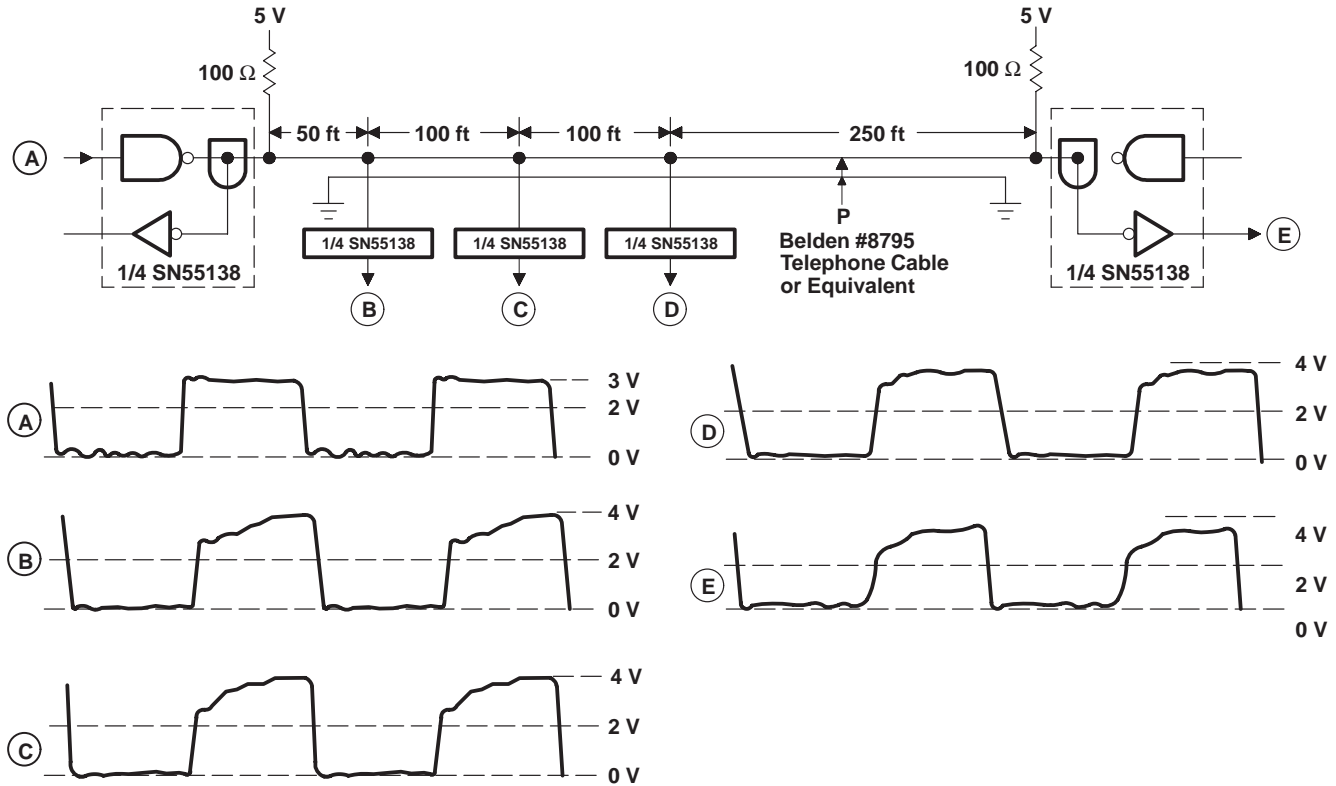


Figure 21. Point-to-Point Communication Over 50 Feet of Twisted Pair at 5 MHz

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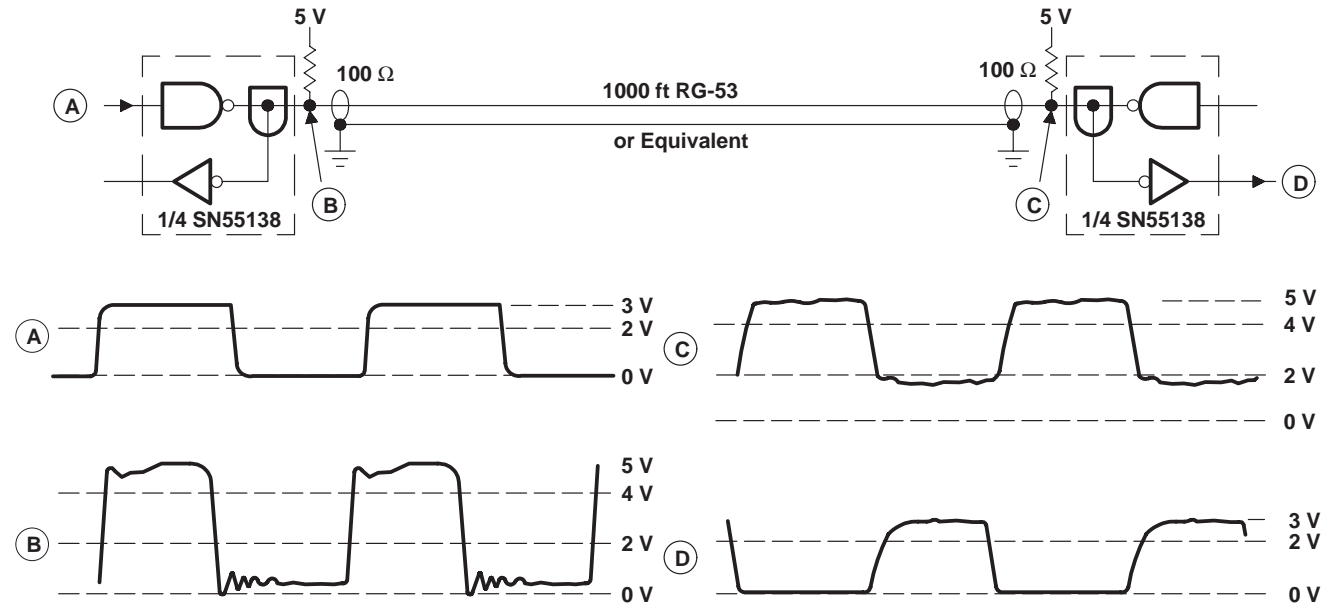
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APPLICATION INFORMATION



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 | | TBD | Call TI | Call TI |
| SN75138D | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75138DE4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75138DG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75138DR | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75138DRE4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75138DRG4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75138N | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN75138NE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN75138NSR | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75138NSRE4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN75138NSRG4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SNJ55138FK | OBSOLETE | LCCC | FK | 20 | | TBD | Call TI | Call TI |
| SNJ55138J | OBSOLETE | CDIP | J | 16 | | TBD | Call TI | Call TI |
| SNJ55138W | OBSOLETE | CFP | W | 16 | | TBD | 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 - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


| | |
|----|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

TAPE AND REEL INFORMATION

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN75138DR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN75138NSR | SO | NS | 16 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN75138DR | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| SN75138NSR | SO | NS | 16 | 2000 | 367.0 | 367.0 | 38.0 |

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only.
 - E. Falls within MIL STD 1835 GDFP1-F16 and JEDEC MO-092AC

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



| NO. OF TERMINALS ** | A | | B | |
|---------------------|------------------|------------------|------------------|------------------|
| | MIN | MAX | MIN | MAX |
| 20 | 0.342 (8,69) | 0.358 (9,09) | 0.307 (7,80) | 0.358 (9,09) |
| 28 | 0.442 (11,23) | 0.458 (11,63) | 0.406 (10,31) | 0.458 (11,63) |
| 44 | 0.640 (16,26) | 0.660 (16,76) | 0.495 (12,58) | 0.560 (14,22) |
| 52 | 0.740 (18,78) | 0.761 (19,32) | 0.495 (12,58) | 0.560 (14,22) |
| 68 | 0.938 (23,83) | 0.962 (24,43) | 0.850 (21,6) | 0.858 (21,8) |
| 84 | 1.141 (28,99) | 1.165 (29,59) | 1.047 (26,6) | 1.063 (27,0) |



4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a metal lid.
 - Falls within JEDEC MS-004

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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