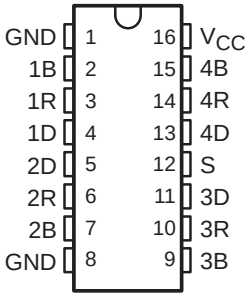
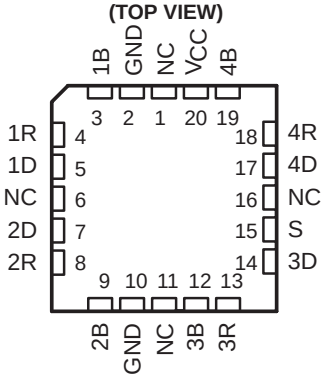
- **Single 5-V Supply**
- **High-Input-Impedance, High-Threshold Receivers**
- **Common Driver Strobe**
- **TTL-Compatible Driver and Strobe Inputs With Clamp Diodes**
- **High-Speed Operation**
- **100-mA Open-Collector Driver Outputs**
- **Four Independent Channels**
- **TTL-Compatible Receiver Output**

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




**SN55138 . . . FK PACKAGE**
**(TOP VIEW)**




NC – No internal connection

## 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.

## Function Tables

**TRANSMITTING**

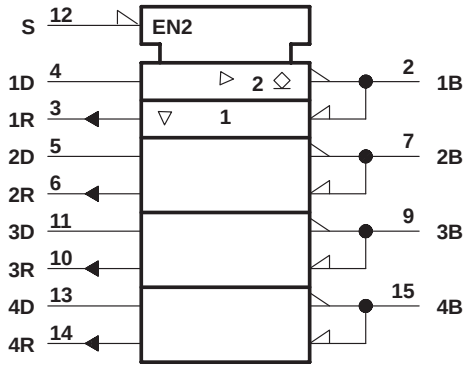
| INPUTS | | OUTPUTS | |
|---|---|---|---|
| S | D | B | R |
| L | H | L | H |
| L | L | H | L |

**RECEIVING**

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

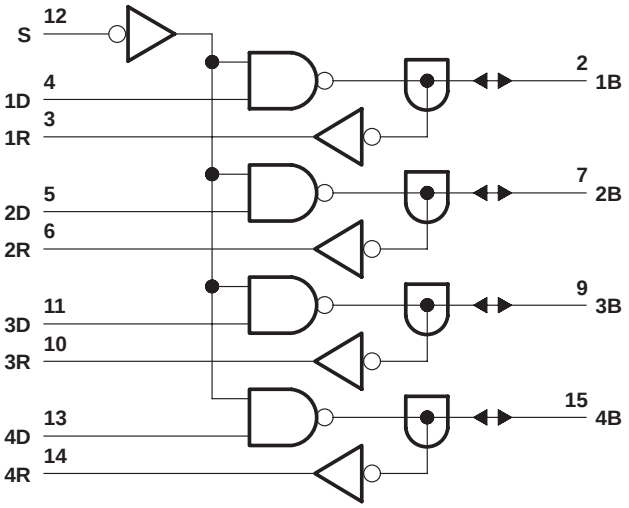
H = high level, L = low level, X = irrelevant

## logic symbol†



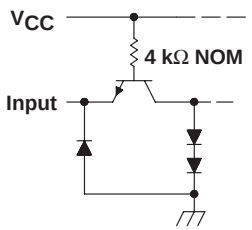

† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, N, and W packages.

## logic diagram (positive logic)

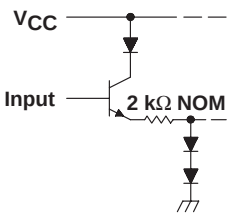



## schematics of inputs and outputs

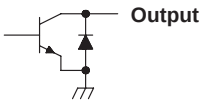
**EQUIVALENT OF EACH STROBE AND DRIVER INPUT**



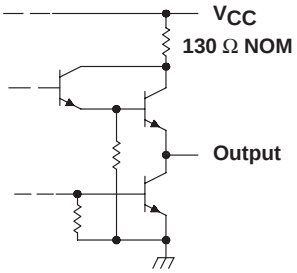

**EQUIVALENT OF EACH RECEIVER INPUT**




**TYPICAL OF ALL DRIVER OUTPUTS**




**TYPICAL OF ALL RECEIVER OUTPUTS**



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

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 | $T_A \le 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ POWER RATING | $T_A = 125°C$ 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 |

## 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 | |

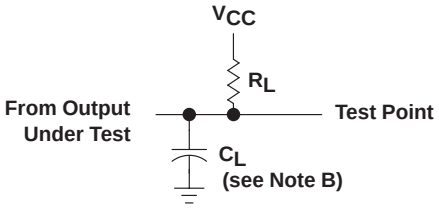
† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions. Parenthetical letters D, R, and S used with $V_I$ refer to the driver input, receiver input, and strobe input, respectively.
‡ All typical values are at $V_{CC}$ = 5 V, $T_A$ = 25°C.
§ Not more than one output should be shorted at a time.

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

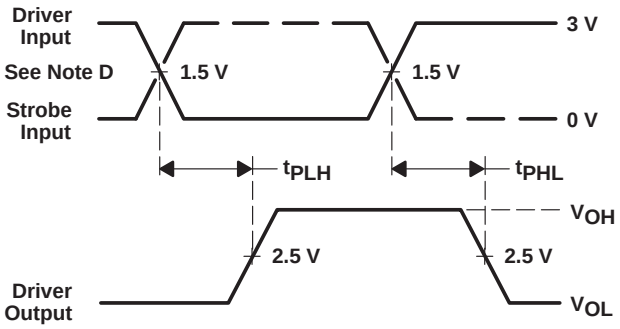
| PARAMETER¶ | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Driver | Driver | $C_L$ = 50 pF, $R_L$ = 50 Ω, | See Figure 1 | | 15 | 24 | ns |
| $t_{PHL}$ | | | | | | 14 | 24 | |
| $t_{PLH}$ | Strobe | Driver | | | | 18 | 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

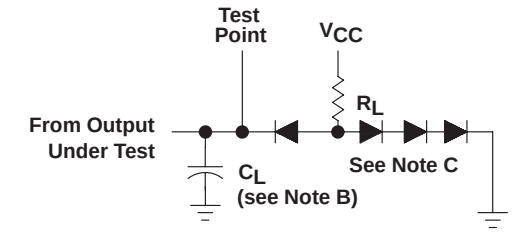



VOLTAGE WAVEFORMS

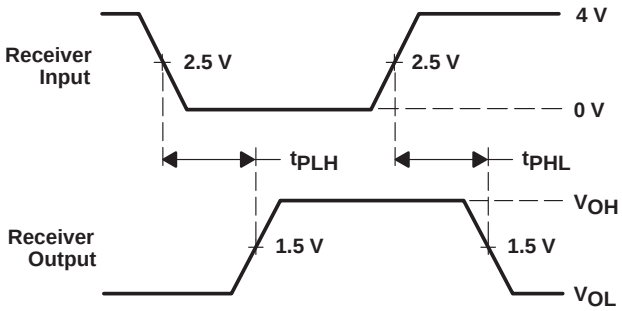
NOTES: A. Input pulses are supplied by generators having the following characteristics: $t_W$ = 100 ns, PRR ≤ 1 MHz, $t_r$ ≤ 10 ns, $t_f$ ≤ 10 ns, $Z_O \approx 50\ \Omega$.
B. $C_L$ includes probe and jig capacitance.
C. All diodes are 1N916 or 1N3064.
D. When testing driver input (solid line) strobe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

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

## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT




VOLTAGE WAVEFORMS

NOTES: A. Input pulses are supplied by generators having the following characteristics: $t_W$ = 100 ns, PRR ≤ 1 MHz, $t_r$ ≤ 10 ns, $t_f$ ≤ 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†

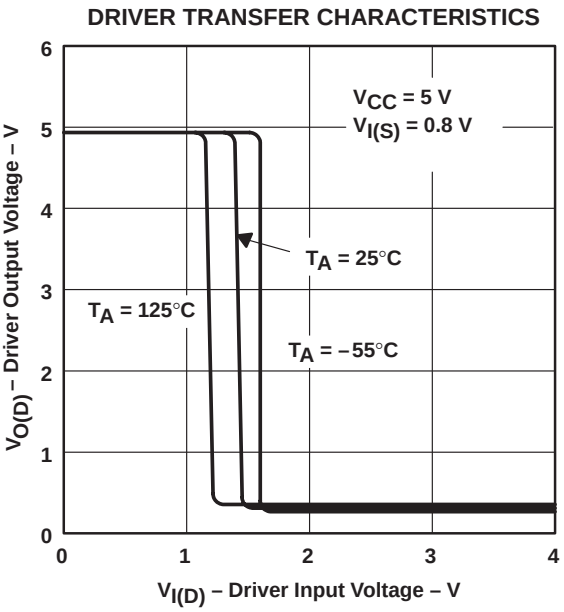



Figure 3

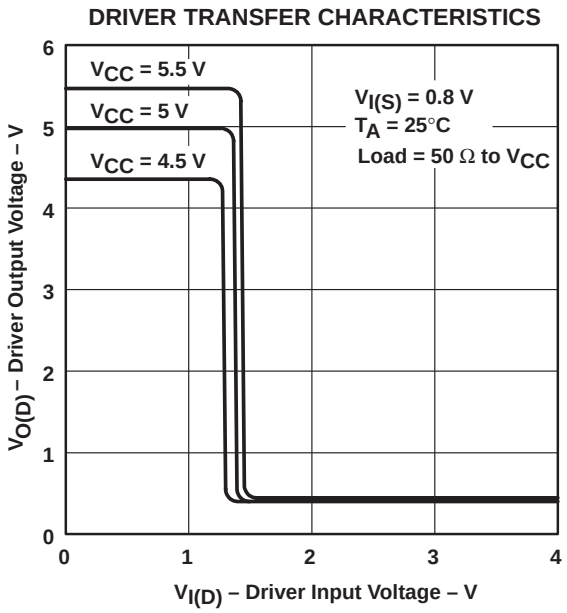



Figure 4

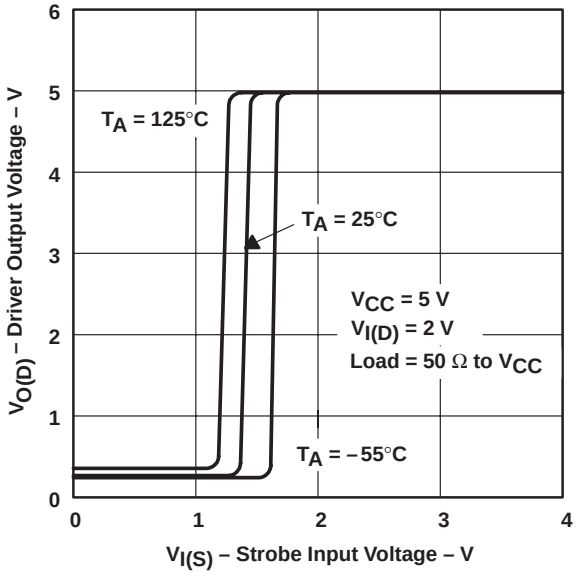



Figure 5

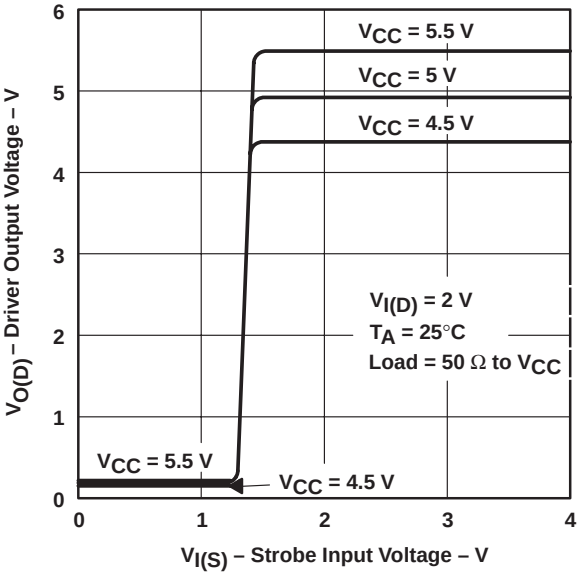



Figure 6

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

## TYPICAL CHARACTERISTICS†

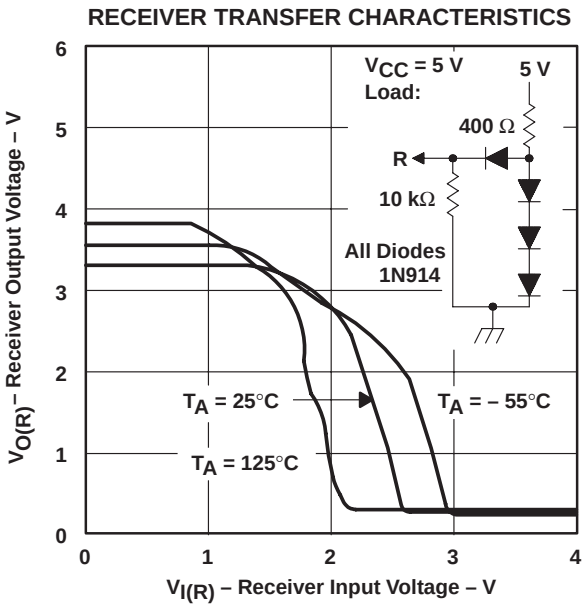



**Figure 7**

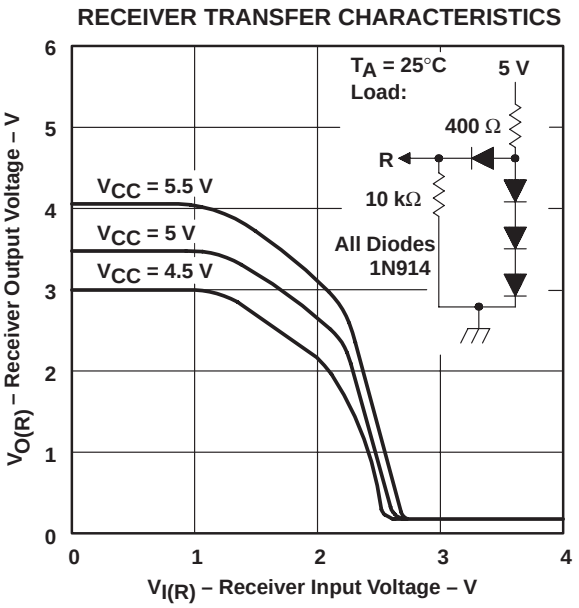



**Figure 8**

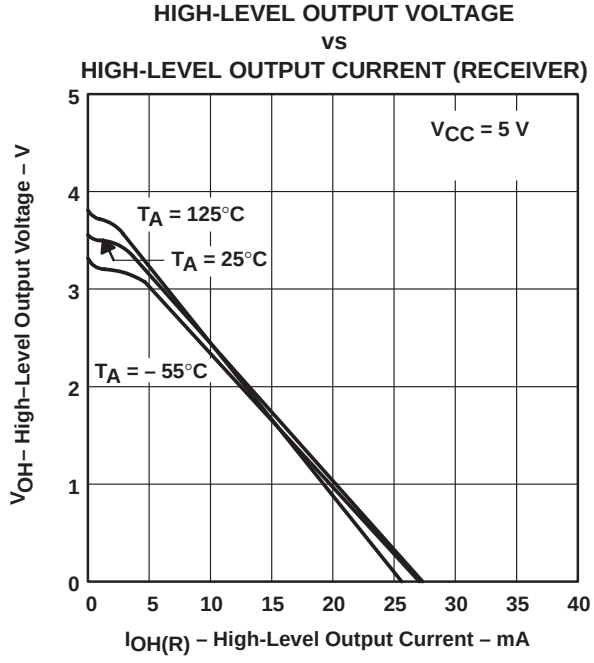



**Figure 9**

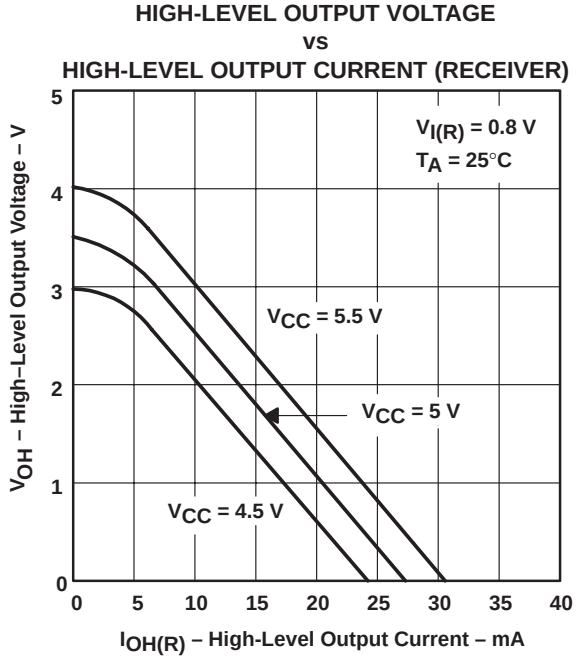



**Figure 10**

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

## TYPICAL CHARACTERISTICS†

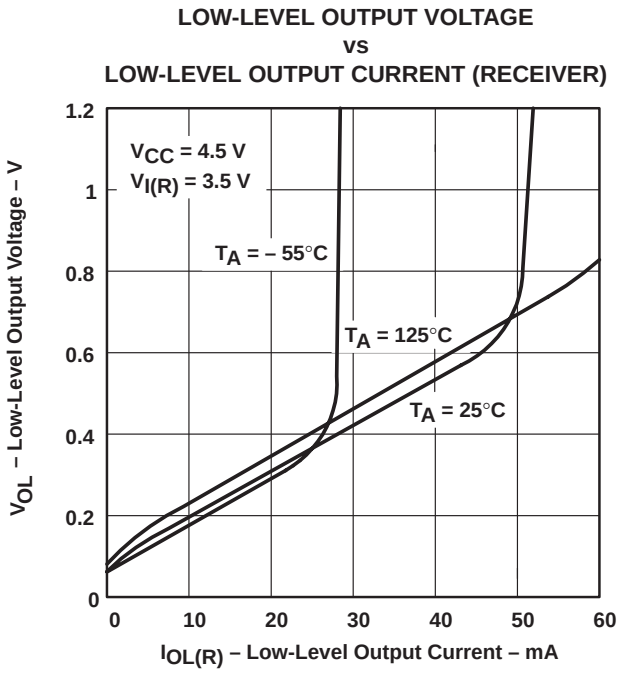



Figure 11

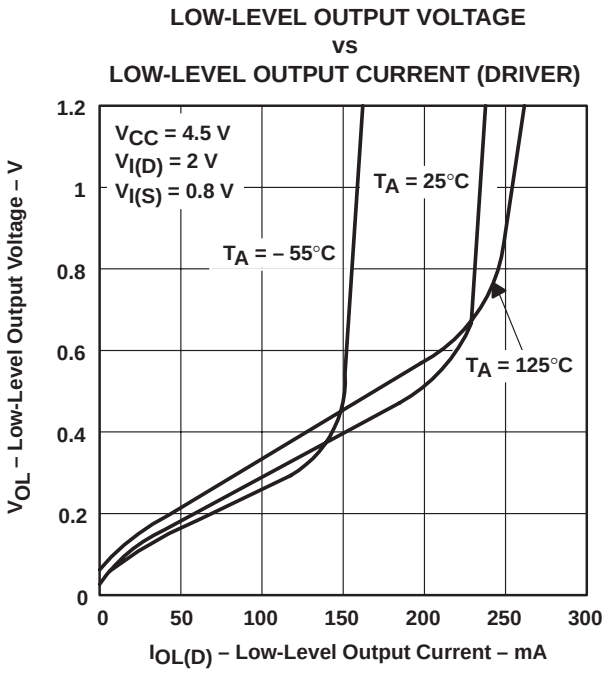



Figure 12

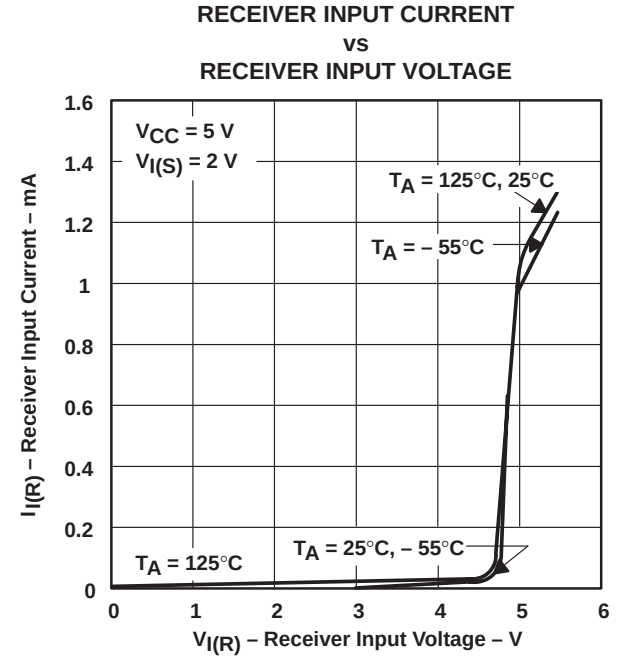



Figure 13

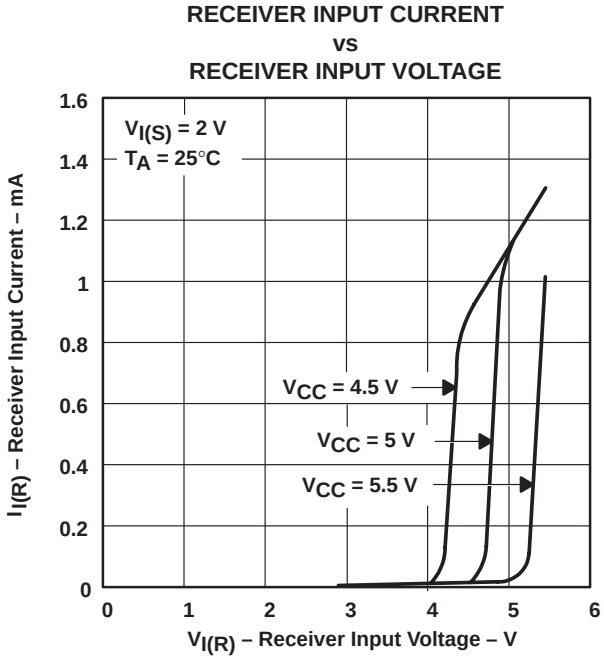



Figure 14

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

## TYPICAL CHARACTERISTICS†

**SUPPLY CURRENT vs SUPPLY VOLTAGE (ALL DRIVER OUTPUTS LOW)**

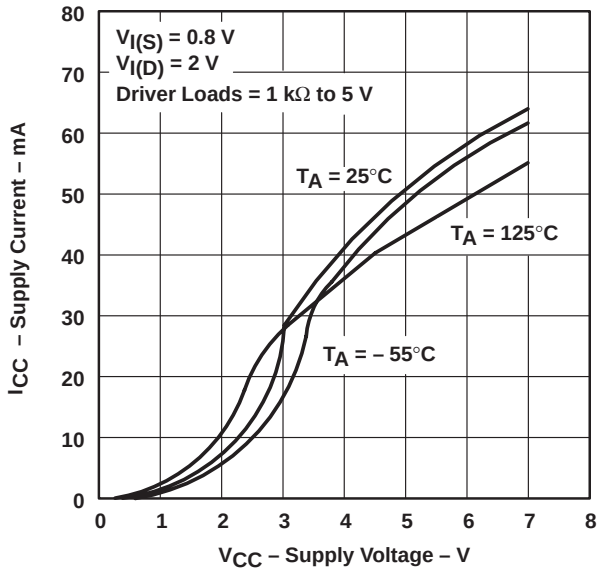



Figure 15

**SUPPLY CURRENT vs SUPPLY VOLTAGE**

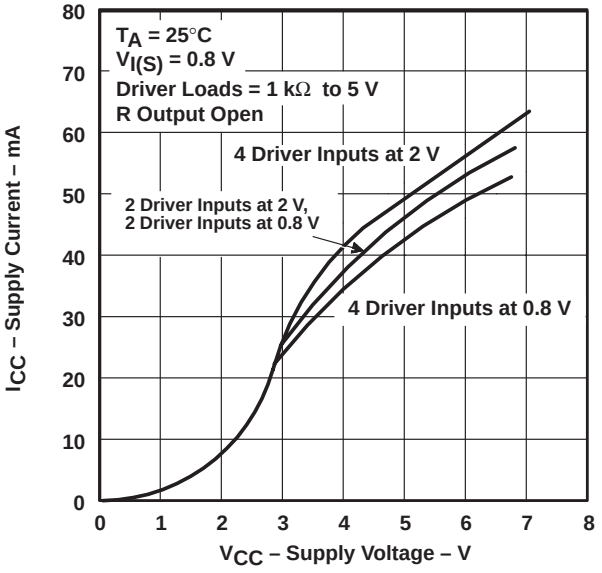



Figure 16

**PROPAGATION DELAY TIMES vs FREE-AIR TEMPERATURE**

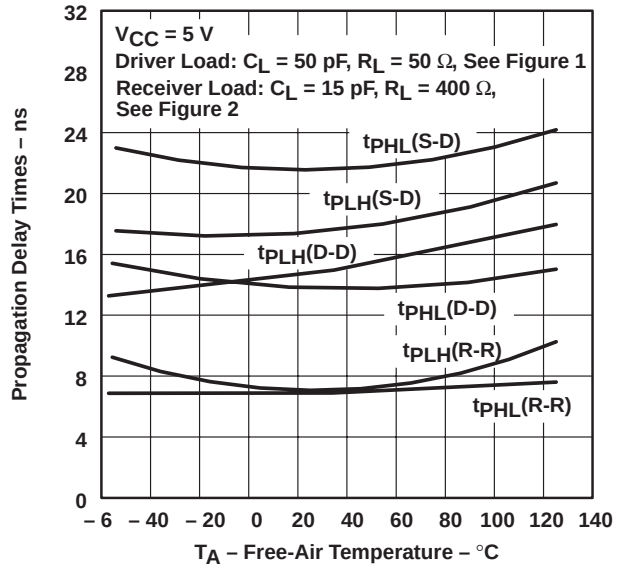



Figure 17

**PROPAGATION DELAY TIMES vs SUPPLY VOLTAGE**

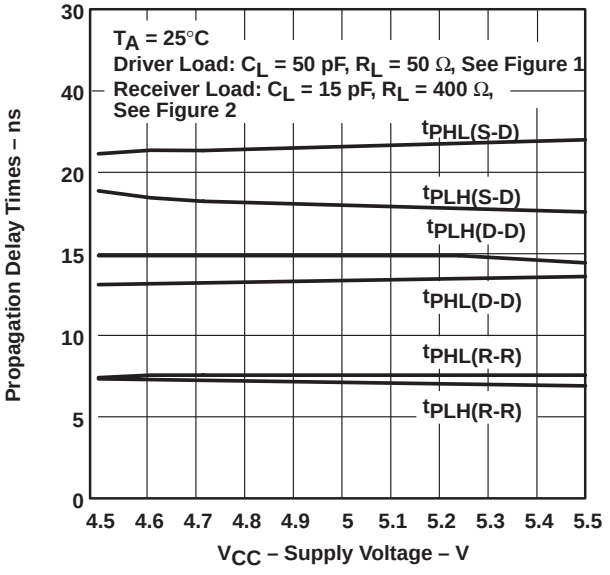



Figure 18

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

## TYPICAL CHARACTERISTICS

**DRIVER**
**PROPAGATION DELAY TIMES**
**vs**
**LOAD CAPACITANCE**

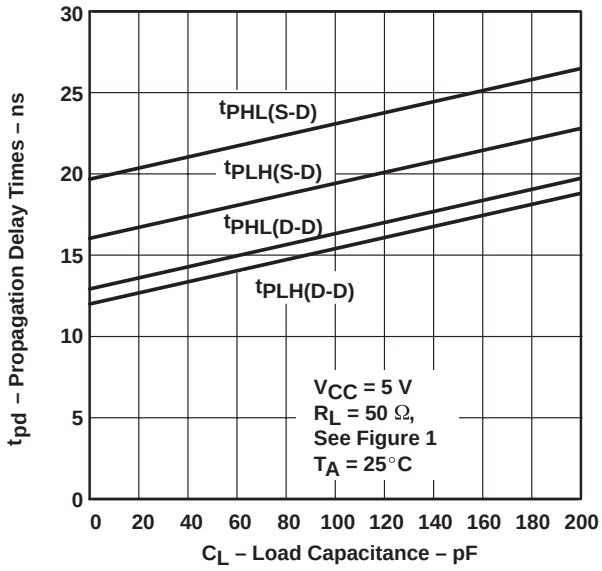



**Figure 19**

**RECEIVER**
**PROPAGATION DELAY TIMES**
**vs**
**LOAD CAPACITANCE**

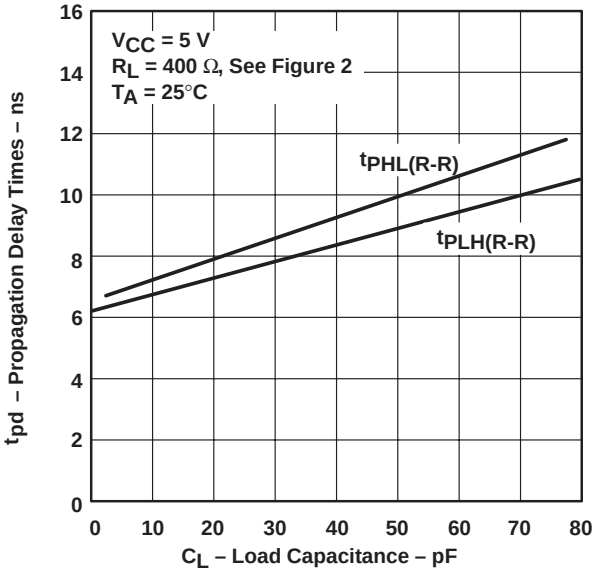
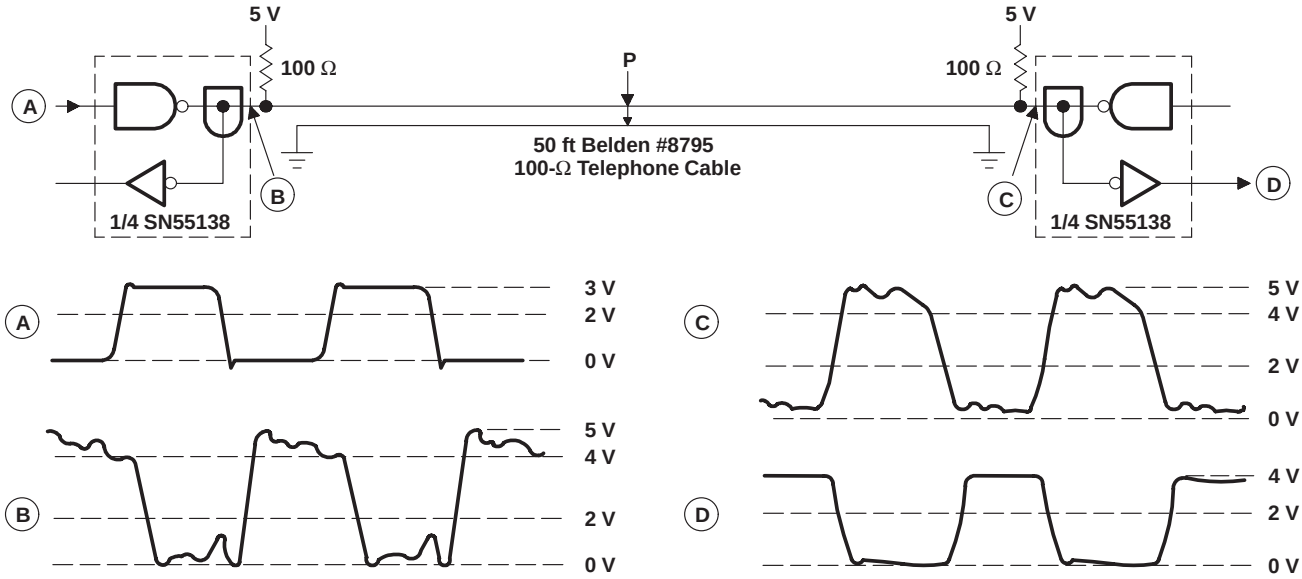



**Figure 20**

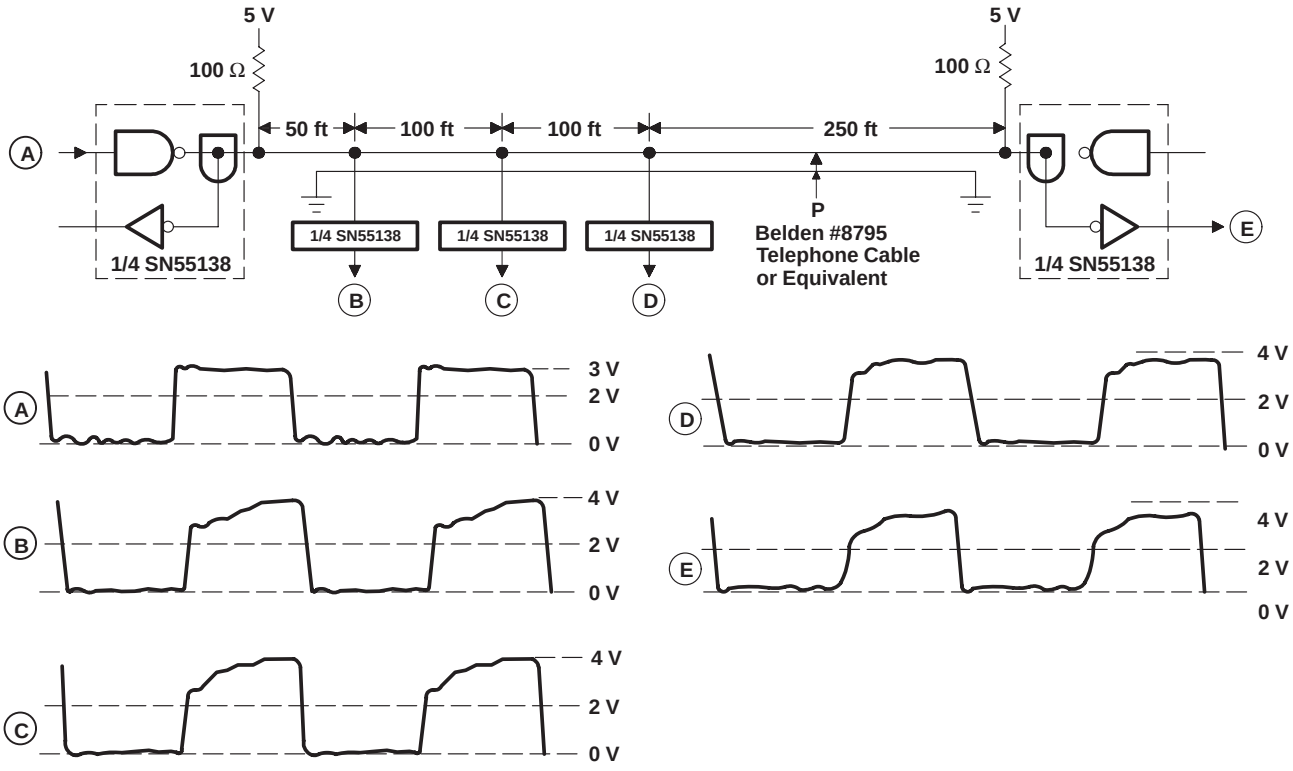
## APPLICATION INFORMATION




**TYPICAL VOLTAGE WAVEFORMS**

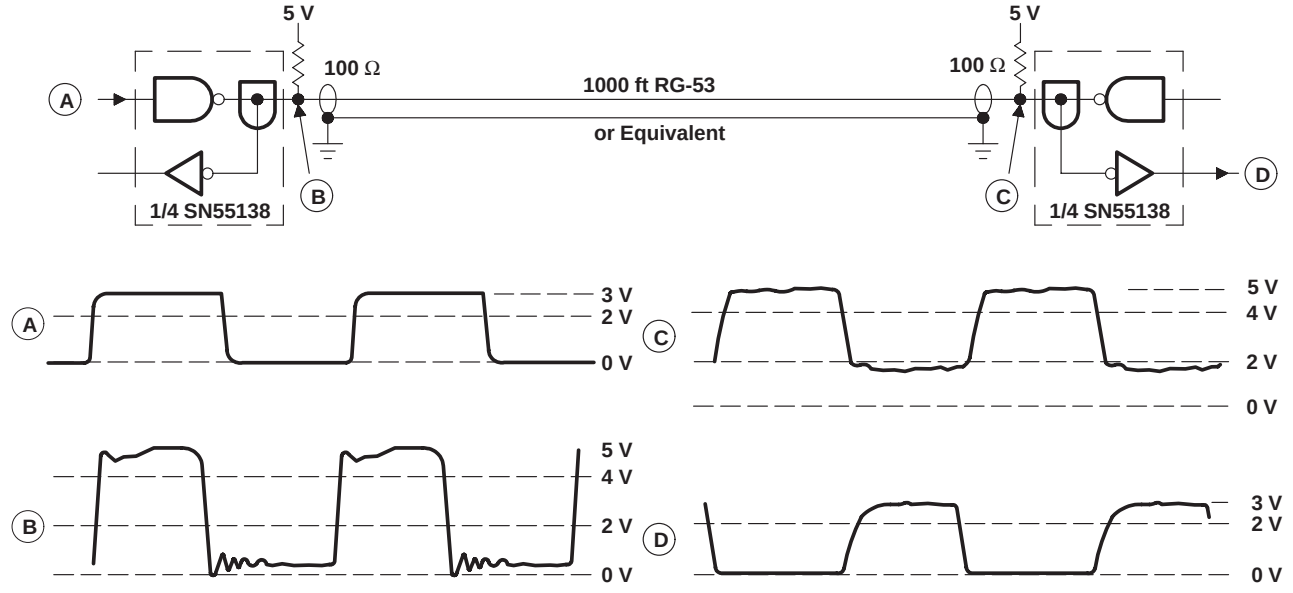
**Figure 21. Point-to-Point Communication Over 50 Feet of Twisted Pair at 5 MHz**

## 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**

## IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.