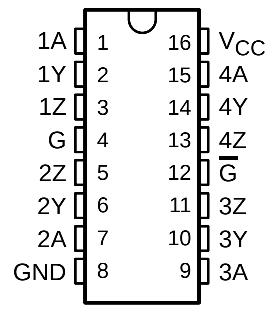
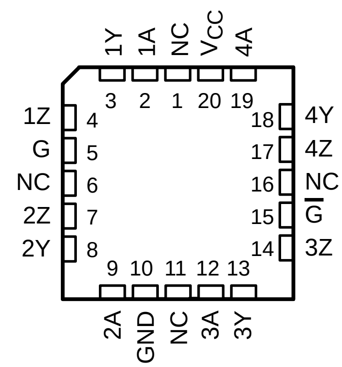
- **Meets or Exceeds the Requirements of TIA/EIA-422-B and ITU Recommendation V.11**
- **Low Power, $I_{CC}$ = 100 μA Typ**
- **Operates From a Single 5-V Supply**
- **High Speed, $t_{PLH}$ = $t_{PHL}$ = 7 ns Typ**
- **Low Pulse Distortion, $t_{sk(p)}$ = 0.5 ns Typ**
- **High Output Impedance in Power-Off Conditions**
- **Improved Replacement for AM26LS31**
- **Available in Q-Temp Automotive**
  - **High-Reliability Automotive Applications**
  - **Configuration Control/Print Support**
  - **Qualification to Automotive Standards**

**AM26C31M . . . J OR W PACKAGE**
**AM26C31C/I/Q . . . D, DB, N, OR NS PACKAGE**
**(TOP VIEW)**




**AM26C31M . . . FK PACKAGE**
**(TOP VIEW)**




NC – No internal connection

## description

The AM26C31 is a differential line driver with complementary outputs, designed to meet the requirements of TIA/EIA-422-B and ITU (formerly CCITT). The 3-state outputs have high-current capability for driving balanced lines, such as twisted-pair or parallel-wire transmission lines, and they provide the high-impedance state in the power-off condition. The enable functions are common to all four drivers and offer the choice of an active-high (G) or active-low ($\overline{G}$) enable input. BiCMOS circuitry reduces power consumption without sacrificing speed.

The AM26C31C is characterized for operation from 0°C to 70°C, the AM26C31I is characterized for operation from –40°C to 85°C, the AM26C31Q is characterized for operation over the automotive temperature range of –40°C to 125°C, and the AM26C31M is characterized for operation over the full military temperature range of –55°C to 125°C.

**AVAILABLE OPTIONS**

| $T_A$ | PACKAGED DEVICES | | | | | |
|---|---|---|---|---|---|---|
| | **PLASTIC SMALL OUTLINE (D, NS)** | **PLASTIC SHRINK SMALL OUTLINE (DB)** | **PLASTIC DIP (N)** | **CERAMIC CHIP CARRIER (FK)** | **CERAMIC DIP (J)** | **CERAMIC DUAL FLATPACK (W)** |
| 0°C to 70°C | AM26C31CD<br>AM26C31CNS | AM26C31CDB<br>— | AM26C31CN<br>— | — | — | — |
| –40°C to 85°C | AM26C31ID<br>AM26C31INS | AM26C31IDB<br>— | AM26C31IN<br>— | — | — | — |
| –40°C to 125°C | AM26C31QD | AM26C31QDB | AM26C31QN | — | — | — |
| –55°C to 125°C | — | — | — | AM26C31MFK | AM26C31MJ | AM26C31MW |

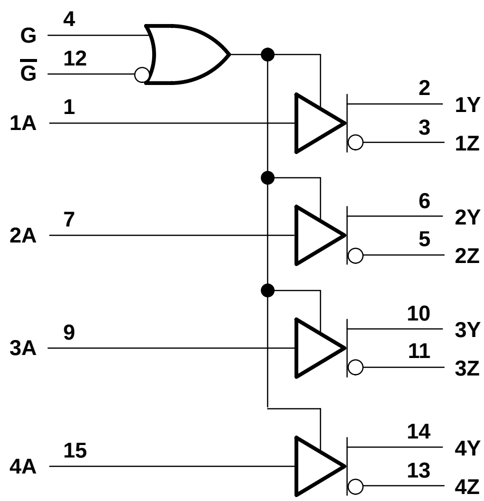
The D package also is available taped and reeled. Add the suffix R to device type (e.g., AM26C31CDR). The DB and NS packages are only available taped and reeled.

**FUNCTION TABLE**
**(each driver)**

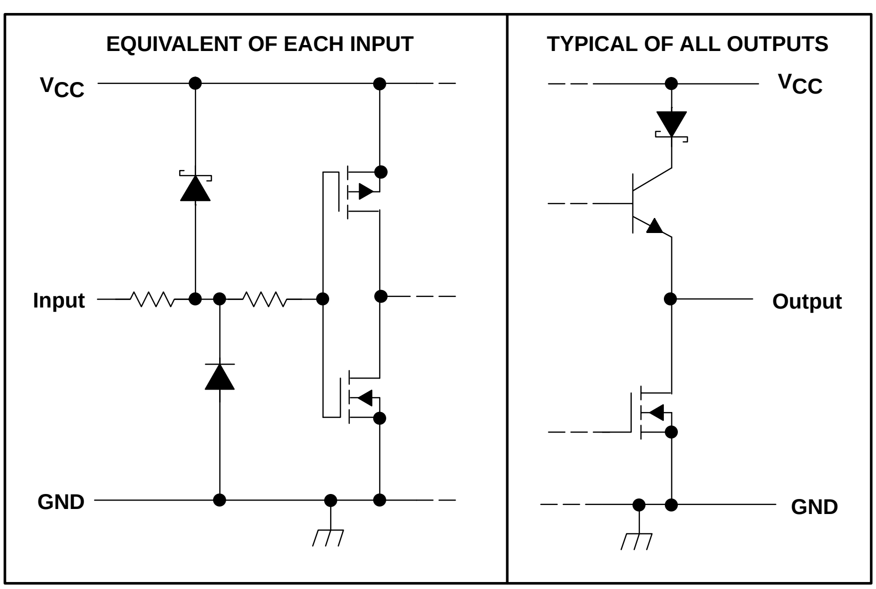
| INPUT | ENABLES | | OUTPUTS | |
|---|---|---|---|---|
| A | G | $\overline{G}$ | Y | Z |
| H | H | X | H | L |
| L | H | X | L | H |
| H | X | L | H | L |
| L | X | L | L | H |
| X | L | H | Z | Z |

H = High level, L = Low level, X = Irrelevant,
Z = High impedance (off)

## logic diagram (positive logic)




## schematics of inputs and outputs



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

Supply voltage range, $V_{CC}$ (see Note 1) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –0.5 V to 7 V
Input voltage range, $V_I$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –0.5 V to $V_{CC}$ + 0.5 V
Differential input voltage range, $V_{ID}$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –14 V to 14 V
Output voltage range, $V_O$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –0.5 V to 7 V
Input or output clamp current, $I_{IK}$ or $I_{OK}$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ±20 mA
Output current, $I_O$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ±150 mA
$V_{CC}$ current . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 200 mA
GND current . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –200 mA
Continuous total power dissipation . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . See Dissipation Rating Table
Package thermal impedance, $\theta_{JA}$ (see Note 2): D package . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 73°C/W
DB package . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 82°C/W
N package . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 67°C/W
NS package . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 64°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 260°C
Storage temperature range, $T_{stg}$ . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . –65°C to 150°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.

NOTES: 1. All voltage values, except differential output voltage ($V_{OD}$), are with respect to the network ground terminal.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 125°C$ POWER RATING |
|---|---|---|---|
| FK | 1375 mW | 11 mW/°C | 275 mW |
| J | 1375 mW | 11 mW/°C | 275 mW |
| W | 1000 mW | 8.0 mW/°C | 200 mW |

## recommended operating conditions

| | | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | | 4.5 | 5 | 5.5 | V |
| $V_{ID}$ | Differential input voltage | | | ±7 | | V |
| $V_{IH}$ | High-level input voltage | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | | 0.8 | V |
| $I_{OH}$ | High-level output current | | | | –20 | V |
| $I_{OL}$ | Low-level output current | | | | 20 | V |
| $T_A$ | Operating free-air temperature | AM26C31C | 0 | | 70 | °C |
| | | AM26C31I | –40 | | 85 | |
| | | AM26C31Q | –40 | | 125 | |
| | | AM26C31M | –55 | | 125 | |

## electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | AM26C31C AM26C31I MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | $I_O$ = –20 mA | | 2.4 | 3.4 | | V |
| $V_{OL}$ | Low-level output voltage | $I_O$ = 20 mA | | | 0.2 | 0.4 | V |
| $\|V_{OD}\|$ | Differential output voltage magnitude | $R_L$ = 100 Ω, | See Figure 1 | 2 | 3.1 | | V |
| $\Delta\|V_{OD}\|$ | Change in magnitude of differential output voltage‡ | $R_L$ = 100 Ω, | See Figure 1 | | | ±0.4 | V |
| $V_{OC}$ | Common-mode output voltage | $R_L$ = 100 Ω, | See Figure 1 | | | 3 | V |
| $\Delta\|V_{OC}\|$ | Change in magnitude of common-mode output voltage‡ | $R_L$ = 100 Ω, | See Figure 1 | | | ±0.4 | V |
| $I_I$ | Input current | $V_I$ = $V_{CC}$ or GND | | | | ±1 | µA |
| $I_{O(off)}$ | Driver output current with power off | $V_{CC}$ = 0 | $V_O$ = 6 V | | | 100 | µA |
| | | | $V_O$ = –0.25 V | | | –100 | |
| $I_{OS}$ | Driver output short-circuit current | $V_O$ = 0 | | –30 | | –150 | mA |
| $I_{OZ}$ | High-impedance off-state output current | $V_O$ = 2.5 V | | | | 20 | µA |
| | | $V_O$ = 0.5 V | | | | –20 | |
| $I_{CC}$ | Quiescent supply current | $I_O$ = 0 | $V_I$ = 0 V or 5 V | | | 100 | µA |
| | | | $V_I$ = 2.4 V or 0.5 V, See Note 3 | | 1.5 | 3 | mA |
| $C_i$ | Input capacitance | | | | 6 | | pF |

† All typical values are at $V_{CC}$ = 5 V and $T_A$ = 25°C.
‡ $\Delta|V_{OD}|$ and $\Delta|V_{OC}|$ are the changes in magnitude of $V_{OD}$ and $V_{OC}$, respectively, that occur when the input is changed from a high level to a low level.
NOTE 3: This parameter is measured per input. All other inputs are at 0 or 5 V.

## switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | AM26C31C AM26C31I MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time, low- to high-level output | S1 is open, | See Figure 2 | 3 | 7 | 12 | ns |
| $t_{PHL}$ | Propagation delay time, high- to low-level output | S1 is open, | See Figure 2 | 3 | 7 | 12 | ns |
| $t_{sk(p)}$ | Pulse skew time ($\|t_{PLH} - t_{PHL}\|$) | S1 is open, | See Figure 2 | | 0.5 | 4 | ns |
| $t_{r(OD)}$, $t_{f(OD)}$ | Differential output rise and fall times | S1 is open, | See Figure 3 | | 5 | 10 | ns |
| $t_{PZH}$ | Output enable time to high level | S1 is closed, | See Figure 4 | | 10 | 19 | ns |
| $t_{PZL}$ | Output enable time to low level | S1 is closed, | See Figure 4 | | 10 | 19 | ns |
| $t_{PHZ}$ | Output disable time from high level | S1 is closed, | See Figure 4 | | 7 | 16 | ns |
| $t_{PLZ}$ | Output disable time from low level | S1 is closed, | See Figure 4 | | 7 | 16 | ns |
| $C_{pd}$ | Power dissipation capacitance (each driver) (see Note 4) | S1 is open, | See Figure 2 | | 170 | | pF |

† All typical values are at $V_{CC}$ = 5 V and $T_A$ = 25°C.
NOTE 4: $C_{pd}$ is used to estimate the switching losses according to $P_D = C_{pd} \times V_{CC}^2 \times f$, where f is the switching frequency.

## electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | AM26C31Q AM26C31M MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | $I_O$ = –20 mA | | 2.2 | 3.4 | | V |
| $V_{OL}$ | Low-level output voltage | $I_O$ = 20 mA | | | 0.2 | 0.4 | V |
| $\|V_{OD}\|$ | Differential output voltage magnitude | $R_L$ = 100 Ω, | See Figure 1 | 2 | 3.1 | | V |
| $\Delta\|V_{OD}\|$ | Change in magnitude of differential output voltage‡ | $R_L$ = 100 Ω, | See Figure 1 | | | ±0.4 | V |
| $V_{OC}$ | Common-mode output voltage | $R_L$ = 100 Ω, | See Figure 1 | | | 3 | V |
| $\Delta\|V_{OC}\|$ | Change in magnitude of common-mode output voltage‡ | $R_L$ = 100 Ω, | See Figure 1 | | | ±0.4 | V |
| $I_I$ | Input current | $V_I = V_{CC}$ or GND | | | | ±1 | µA |
| $I_{O(off)}$ | Driver output current with power off | $V_{CC}$ = 0 | $V_O$ = 6 V | | | 100 | µA |
| | | | $V_O$ = –0.25 V | | | –100 | |
| $I_{OS}$ | Driver output short-circuit current | $V_O$ = 0 | | | | –170 | mA |
| $I_{OZ}$ | High-impedance off-state output current | $V_O$ = 2.5 V | | | | 20 | µA |
| | | $V_O$ = 0.5 V | | | | –20 | |
| $I_{CC}$ | Quiescent supply current | $I_O$ = 0 | $V_I$ = 0 V or 5 V | | | 100 | µA |
| | | $I_O$ = 0 | $V_I$ = 2.4 V or 0.5 V, See Note 3 | | | 3.2 | mA |
| $C_i$ | Input capacitance | | | | 6 | | pF |

† All typical values are at $V_{CC}$ = 5 V and $T_A$ = 25°C.
‡ $\Delta|V_{OD}|$ and $\Delta|V_{OC}|$ are the changes in magnitude of $V_{OD}$ and $V_{OC}$, respectively, that occur when the input is changed from a high level to a low level.
NOTE 3: This parameter is measured per input. All other inputs are at 0 V or 5 V.

## switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | AM26C31Q AM26C31M MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time, low- to high-level output | S1 is open, | See Figure 2 | | 7 | 12 | ns |
| $t_{PHL}$ | Propagation delay time, high- to low-level output | S1 is open, | See Figure 2 | | 6.5 | 12 | ns |
| $t_{sk(p)}$ | Pulse skew time ($\|t_{PLH} – t_{PHL}\|$) | S1 is open, | See Figure 2 | | 0.5 | 4 | ns |
| $t_{r(OD)}$, $t_{f(OD)}$ | Differential output rise and fall times | S1 is open, | See Figure 3 | | 5 | 12 | ns |
| $t_{PZH}$ | Output enable time to high level | S1 is closed, | See Figure 4 | | 10 | 19 | ns |
| $t_{PZL}$ | Output enable time to low level | S1 is closed, | See Figure 4 | | 10 | 19 | ns |
| $t_{PHZ}$ | Output disable time from high level | S1 is closed, | See Figure 4 | | 7 | 16 | ns |
| $t_{PLZ}$ | Output disable time from low level | S1 is closed, | See Figure 4 | | 7 | 16 | ns |
| $C_{pd}$ | Power dissipation capacitance (each driver) (see Note 4) | S1 is open, | See Figure 2 | | 100 | | pF |

† All typical values are at $V_{CC}$ = 5 V and $T_A$ = 25°C.
NOTE 4: $C_{pd}$ is used to estimate the switching losses according to $P_D = C_{pd} \times V_{CC}^2 \times f$, where f is the switching frequency.

## PARAMETER MEASUREMENT INFORMATION

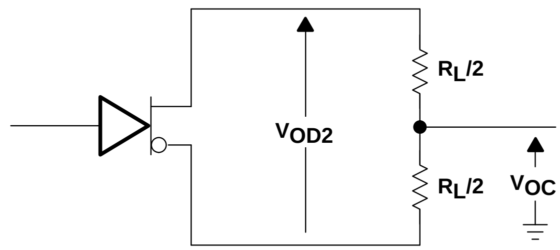
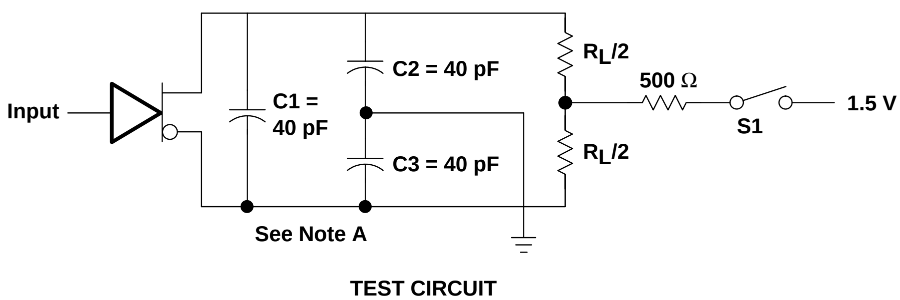
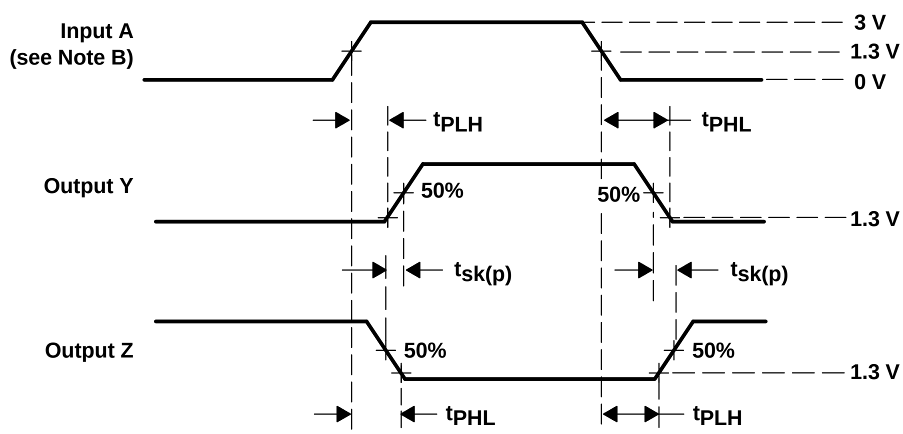



**Figure 1. Differential and Common-Mode Output Voltages**

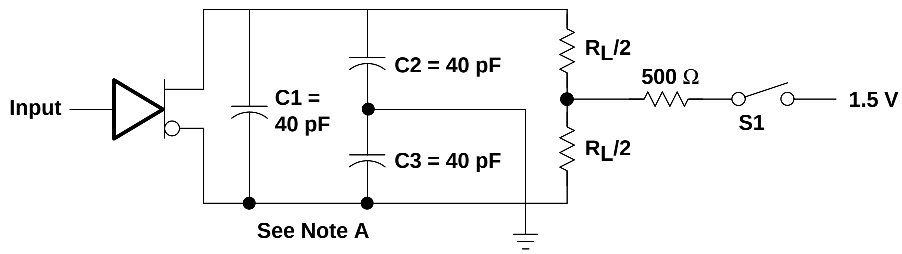


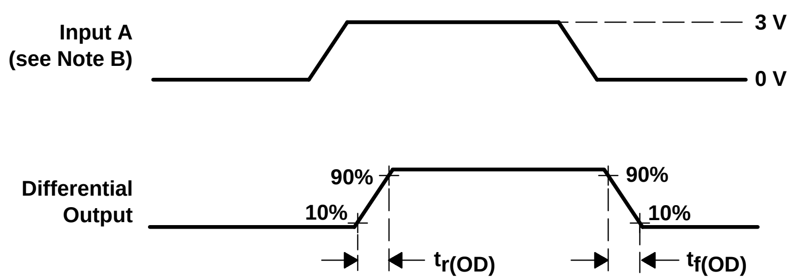

NOTES: A. C1, C2, and C3 include probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, duty cycle ≤ 50%, and $t_r$, $t_f$ ≤ 6 ns.

**Figure 2. Propagation Delay Time and Skew Waveforms and Test Circuit**

## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT

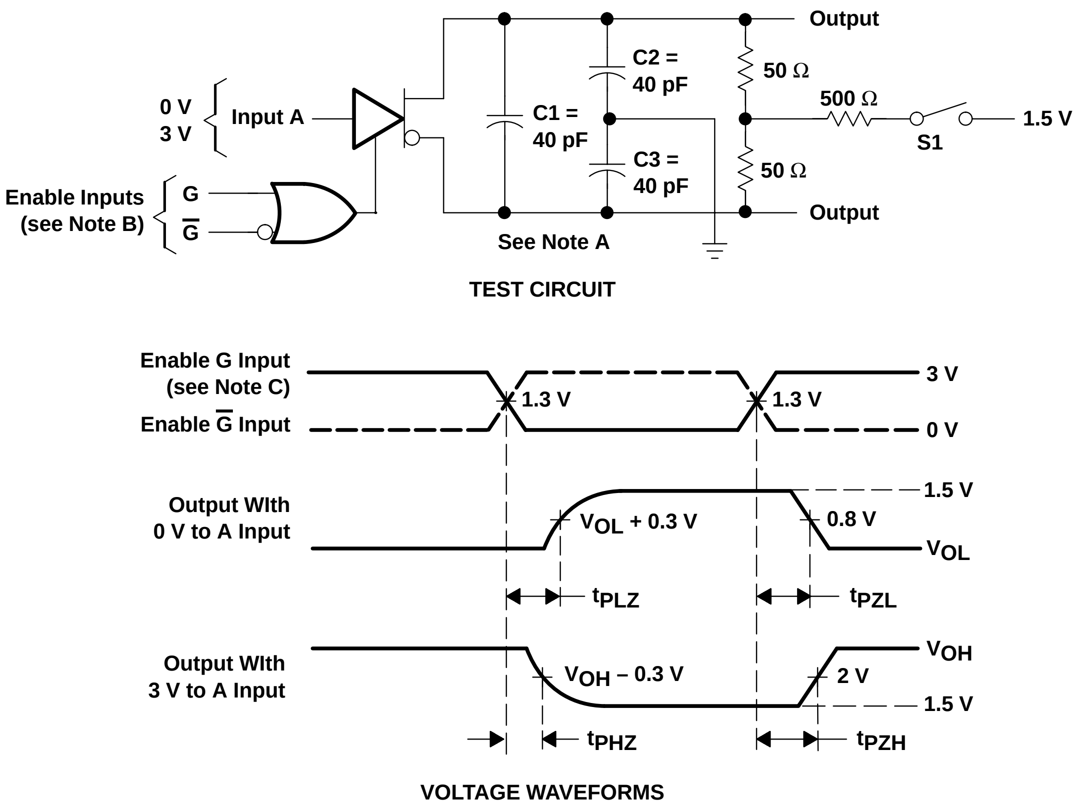



VOLTAGE WAVEFORMS

NOTES: A. C1, C2, and C3 include probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, duty cycle ≤ 50%, and $t_r$, $t_f$ ≤ 6 ns.

**Figure 3. Differential-Output Rise- and Fall-Time Waveforms and Test Circuit**

## PARAMETER MEASUREMENT INFORMATION




NOTES: A. C1, C2, and C3 includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, duty cycle ≤ 50%, $t_r$ < 6 ns, and $t_f$ < 6 ns.
C. Each enable is tested separately.

**Figure 4. Output Enable- and Disable-Time Waveforms and Test Circuit**

## TYPICAL CHARACTERISTICS

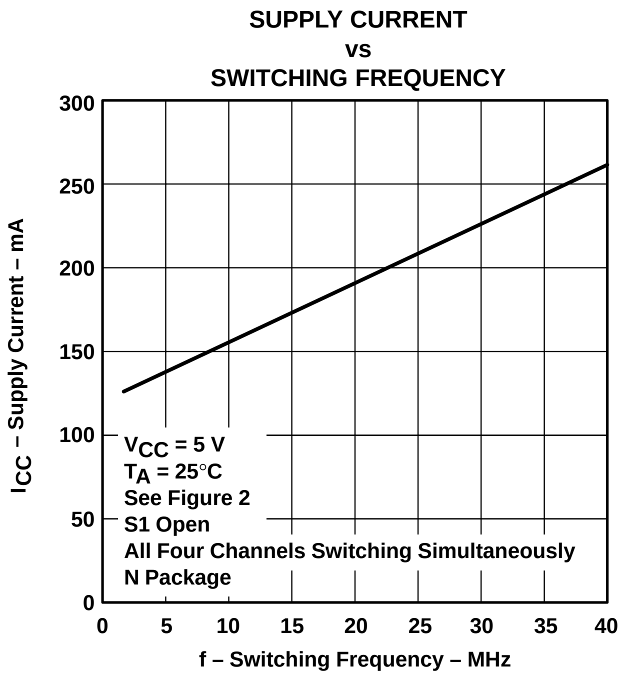



**Figure 5**

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third–party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265