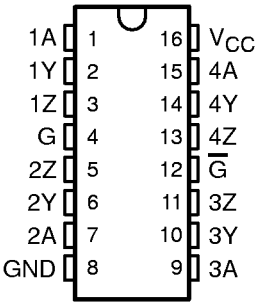
- **Meet or Exceed the Requirements of TIA/EIA-422-B and ITU Recommendation V.11**
- **Low Power, $I_{CC}$ = 100 μA Typ**
- **Operate From a Single 5-V Supply**
- **High Speed, $t_{PLH} = t_{PHL}$ = 7 ns Typ**
- **Low Pulse Distortion, $t_{sk(p)}$ = 0.5 ns Typ**
- **High Output Impedance in Power-Off Conditions**
- **Improved Replacement for AM26LS31**

## description

The AM26C31C, AM26C31I, and AM26C31M are four complementary-output line drivers 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 function is common to all four drivers and offers the choice of an active-high or active-low enable input. BiCMOS circuitry reduces power consumption without sacrificing speed.

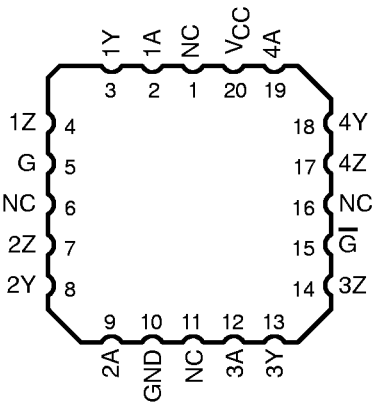
The AM26C31C is characterized for operation from 0°C to 70°C, the AM26C31I is characterized for operation from −40°C to 85°C, and the AM26C31M is characterized for operation from −55°C to 125°C.

**AM26C31C, AM26C31I . . . D OR DB† OR N PACKAGE**
**AM26C31M . . . J OR W PACKAGE**
**(TOP VIEW)**




† The DB package is only available left-ended taped (order AM26C31IDBLE or AM26C31CDBLE).

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




NC – No internal connection

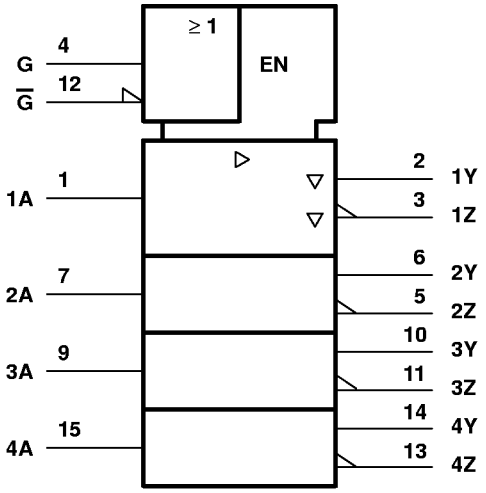
**FUNCTION TABLE**
**(each driver)**

| INPUT A | ENABLES | | OUTPUTS | |
|---|---|---|---|---|
| | 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 |

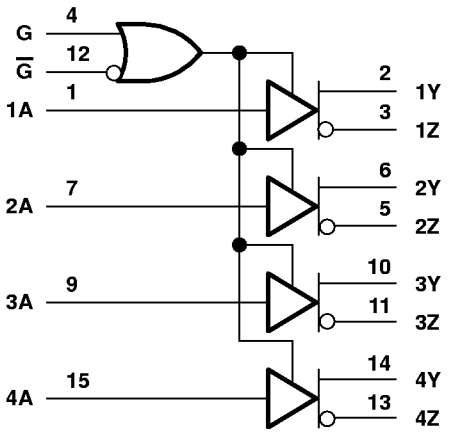
H = high level, L = low level, X = irrelevant, Z = high impedance (off)

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.

## logic symbol†

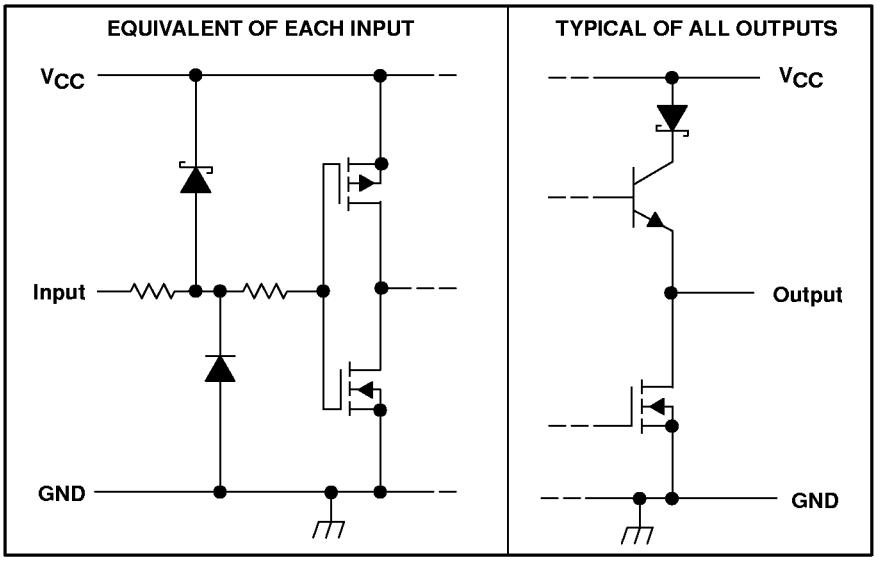



## logic diagram (positive logic)




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

## 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
Storage temperature range, $T_{stg}$ . . . . . −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°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, except differential output voltage ($V_{OD}$), are with respect to the network ground terminal.

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ POWER RATING | $T_A = 85°C$ POWER RATING | $T_A = 125°C$ POWER RATING |
|---|---|---|---|---|---|
| D | 950 mW | 7.6 mW/°C | 608 mW | 494 mW | — |
| DB | 781 mW | 6.2 mW/°C | 502 mW | 409 mW | — |
| N | 1150 mW | 9.2 mW/°C | 736 mW | 598 mW | — |
| 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 |
|---|---|---|---|---|---|
| Supply voltage, $V_{CC}$ | | 4.5 | 5 | 5.5 | V |
| Differential input voltage, $V_{ID}$ | | | ±7 | | V |
| High-level input voltage, $V_{IH}$ | | 2 | | | V |
| Low-level input voltage, $V_{IL}$ | | | | 0.8 | V |
| High-level output current, $I_{OH}$ | | | | −20 | mA |
| Low-level output current, $I_{OL}$ | | | | 20 | mA |
| Operating free-air temperature, $T_A$ | AM26C31C | 0 | | 70 | °C |
| | AM26C31I | −40 | | 85 | |
| | AM26C31M | −55 | | 125 | |

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

| PARAMETER | | TEST CONDITIONS | AM26C31C AM26C31I | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP† | MAX | |
| $V_{OH}$ | 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 | $R_L = 100\ \Omega$, See Figure 1 | 2 | 3.1 | | V |
| $\Delta\|V_{OD}\|$ | Change in magnitude of differential output voltage‡ | | | | ±0.4 | V |
| $V_{OC}$ | Common-mode output voltage | | | | 3 | V |
| $\Delta\|V_{OC}\|$ | Change in magnitude of common-mode output voltage‡ | | | | ±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 |
| | | $V_{CC} = 0$, $V_O = -0.25$ 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 | µA |
| $I_{CC}$ | 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 2 | | 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 2: 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 | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP† | MAX | |
| $t_{PLH}$ | Propagation delay time, low- to high-level output | S1 is open, See Figure 2 | 5.7 | 7 | 12 | ns |
| $t_{PHL}$ | Propagation delay time, high- to low-level output | | 5.4 | 7 | 12 | ns |
| $t_{sk(p)}$ | Pulse skew time ($\|t_{PLH} - t_{PHL}\|$) | | | 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 | | | 10 | 19 | ns |
| $t_{PHZ}$ | Output disable time from high level | | | 7 | 16 | ns |
| $t_{PLZ}$ | Output disable time from low level | | | 7 | 16 | ns |
| $C_{pd}$ | Power dissipation capacitance (each driver) (see Note 3) | S1 is open, See Figure 2 | | 170 | | pF |

† All typical values are at $V_{CC} = 5$ V and $T_A = 25°C$.

NOTE 3: $C_{pd}$ is used to estimate the switching losses according to $P_D = C_{pd} V_{CC}^2 f$, 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 | AM26C31M | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP† | MAX | |
| $V_{OH}$ | 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 | $R_L = 100\ \Omega$, See Figure 1 | 2 | 3.1 | | V |
| $\Delta\|V_{OD}\|$ | Change in magnitude of differential output voltage‡ | | | | ±0.4 | V |
| $V_{OC}$ | Common-mode output voltage | | | | 3 | V |
| $\Delta\|V_{OC}\|$ | Change in magnitude of common-mode output voltage‡ | | | | ±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 |
| | | $V_{CC} = 0$, $V_O = -0.25$ 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 | µA |
| $I_{CC}$ | 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 2 | | | 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 2: 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 | AM26C31M | | | UNIT |
|---|---|---|---|---|---|---|
| | | | MIN | TYP† | MAX | |
| $t_{PLH}$ | 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 | | | 6.5 | 12 | ns |
| $t_{sk(p)}$ | Pulse skew time ($\|t_{PLH} - t_{PHL}\|$) | | | 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 | | | 10 | 19 | ns |
| $t_{PHZ}$ | Output disable time from high level | | | 7 | 16 | ns |
| $t_{PLZ}$ | Output disable time from low level | | | 7 | 16 | ns |
| $C_{pd}$ | Power dissipation capacitance (each driver) (see Note 3) | S1 is open, See Figure 2 | | 100 | | pF |

† All typical values are at $V_{CC} = 5$ V and $T_A = 25°C$.

NOTE 3: $C_{pd}$ is used to estimate the switching losses according to $P_D = C_{pd} \times V_{CC}^2 f$, where f is the switching frequency.

## PARAMETER MEASUREMENT INFORMATION

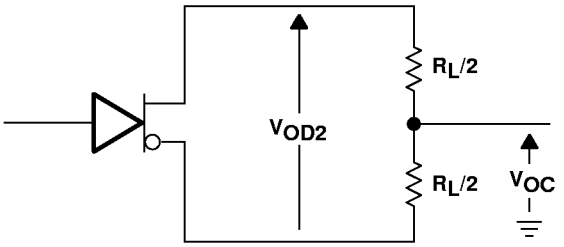
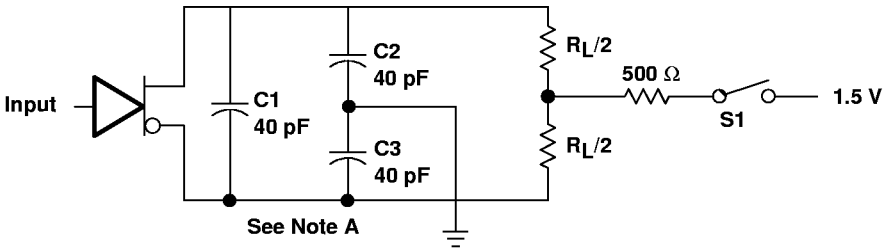
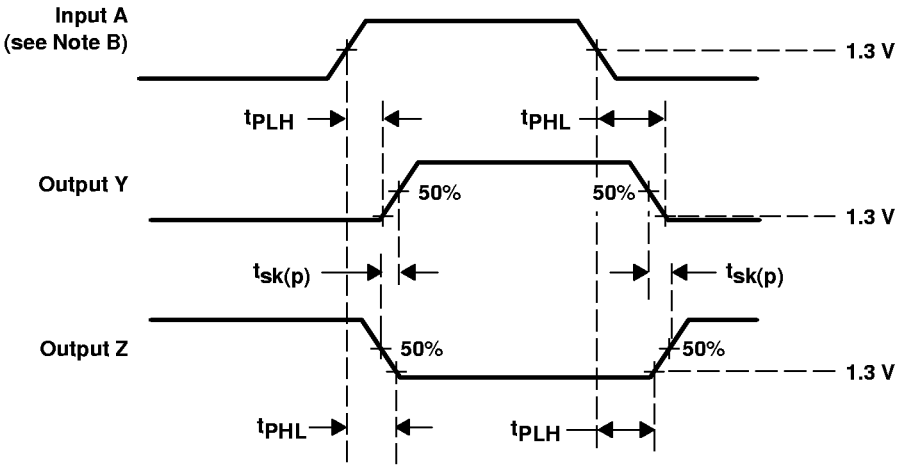



**Figure 1. Differential and Common-Mode Output Voltages**



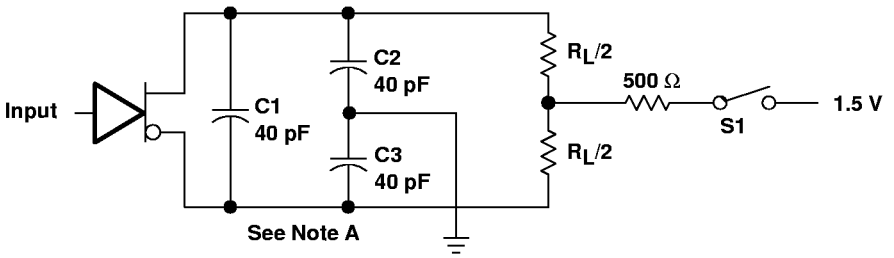

TEST CIRCUIT



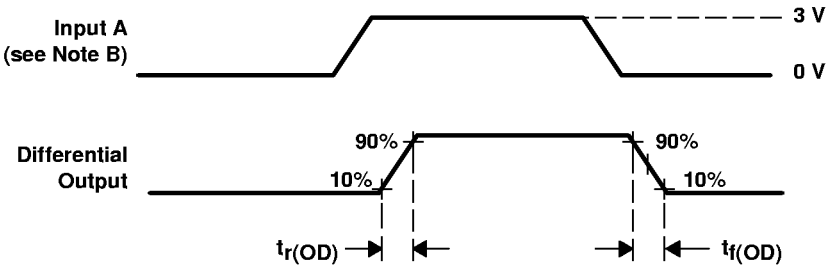

NOTES: A. C1, C2, and C3 include probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, duty cycle ≤ 50%, and $t_r$ $t_f$ ≤ 6 ns.

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

## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT

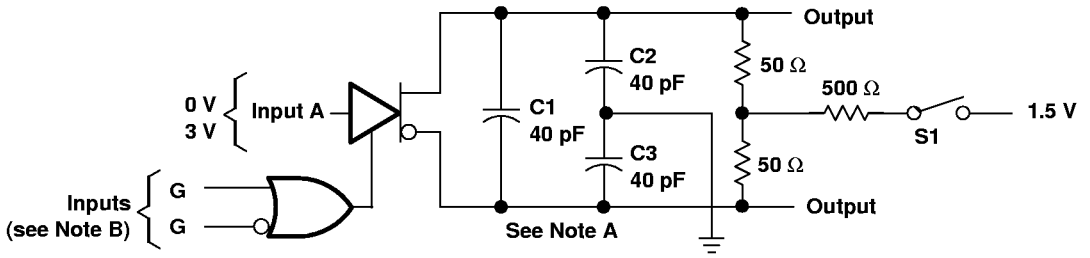



VOLTAGE WAVEFORMS

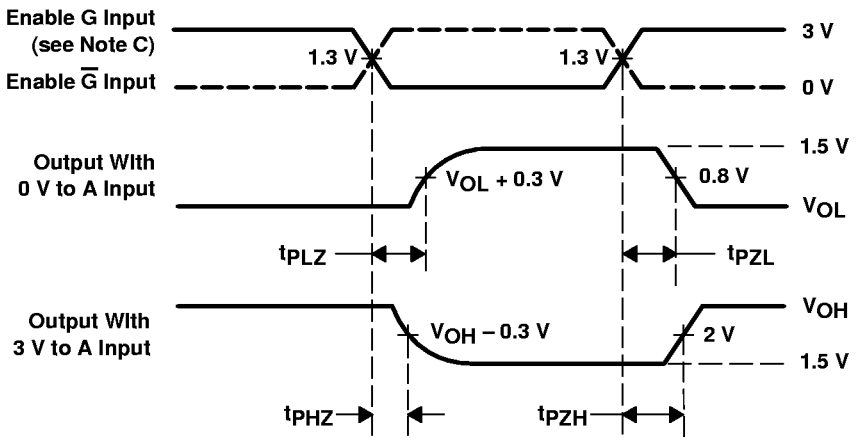
NOTES: A. C1, C2, and C3 include probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, duty cycle ≤ 50%, and $t_r$, $t_f$ ≤ 6 ns.

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

## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT




VOLTAGE WAVEFORMS

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

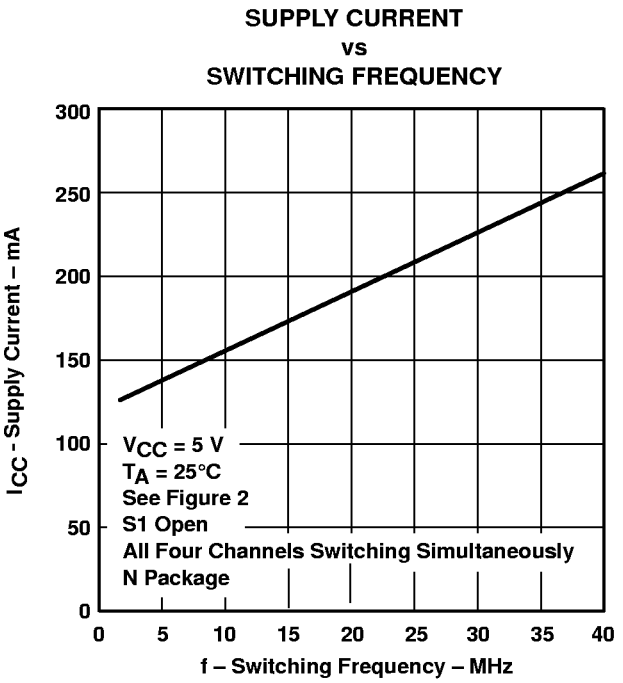



Figure 5

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