

## AM26LS31 四路差分线路驱动器

## 1 特性

- 符合或超出 ANSI TIA/EIA-422-B 和 ITU 的要求
- 由 5V 单电源供电运行
- TTL 兼容
- 互补输出
- 在断电情况下具有高输出阻抗
- 互补输出使能输入
- 提供已通过 MIL-PRF-38535 认证的选项 (M) :  
所有参数均经过测试, 除非另有说明。对于所有其他产品, 生产流程不一定包含对所有参数的测试。

## 2 应用

- 电机编码器
- 现场变送器: 压力传感器和温度传感器
- 军用和航空电子成像
- 采用 Modbus 的温度传感器或控制器

## 3 说明

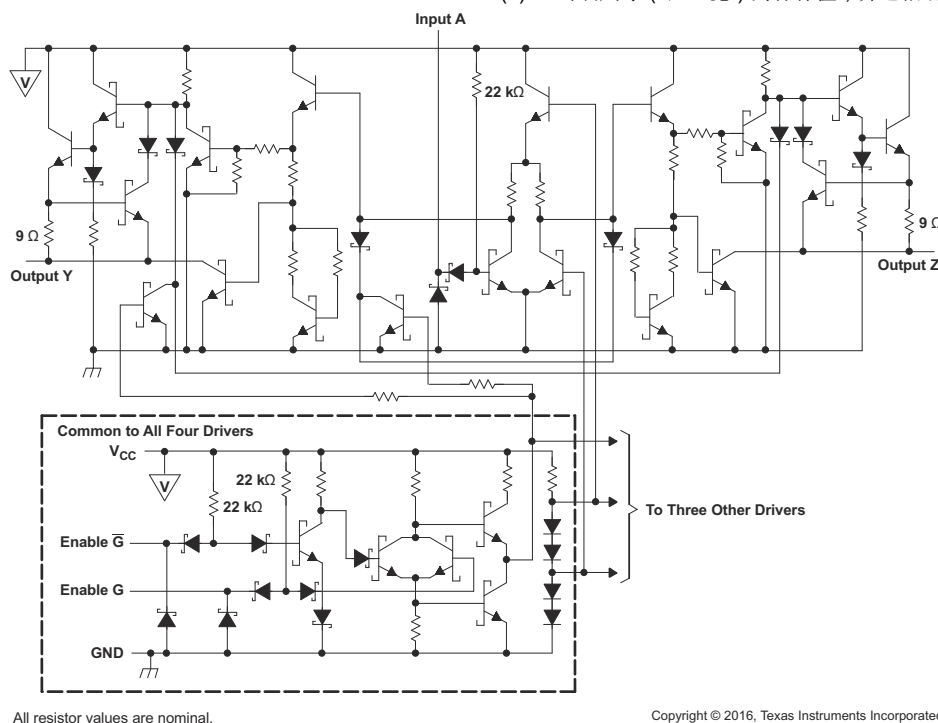
AM26LS31CN-E 系列器件是四路互补输出线路驱动器, 可满足 ANSI TIA/EIA-422-B 和 ITU (原 CCITT) 建议 V.11 的要求。三态输出可提供用于驱动双绞线或平行线传输线路等平衡线路的高电流, 并在断电情况下处于高阻抗状态。四个驱动器均具有使能功能, 该功能提供了两种可选输入: 高电平有效使能和低电平有效使能 ( $G$ 、 $\overline{G}$ ) 输入。低功耗肖特基电路可在不牺牲速度的情况下降低功耗。

## 封装信息

| 器件型号         | 封装 <sup>(1)</sup> | 封装尺寸 <sup>(2)</sup> |
|--------------|-------------------|---------------------|
| AM26LS31MFK  | LCCC (20)         | 8.89mm × 8.89mm     |
| AM26LS31MJ   | CDIP (16)         | 19.6mm × 6.92mm     |
| AM26LS31MW   | CFP (16)          | 10.3mm × 6.73mm     |
| AM26LS31CD   | SOIC (16)         | 9.9mm × 3.91mm      |
| AM26LS31CDB  | SSOP (16)         | 6.2mm × 5.3mm       |
| AM26LS31CN-E | PDIP (16)         | 19.3mm × 6.35mm     |
| AM26LS31xNS  | SO (16)           | 10.3mm × 5.3mm      |

(1) 有关更多信息, 请参阅节 11。

(2) 封装尺寸 (长 × 宽) 为标称值, 并包括引脚 (如适用)。



原理图 (每个驱动器)



## Table of Contents

|                                                  |           |                                                                  |           |
|--------------------------------------------------|-----------|------------------------------------------------------------------|-----------|
| <b>1 特性</b> .....                                | <b>1</b>  | 7.3 Feature Description.....                                     | <b>10</b> |
| <b>2 应用</b> .....                                | <b>1</b>  | 7.4 Device Functional Modes.....                                 | <b>11</b> |
| <b>3 说明</b> .....                                | <b>1</b>  | <b>8 Application and Implementation</b> .....                    | <b>12</b> |
| <b>4 Pin Configuration and Functions</b> .....   | <b>3</b>  | 8.1 Application Information.....                                 | <b>12</b> |
| <b>5 Specifications</b> .....                    | <b>5</b>  | 8.2 Typical Application.....                                     | <b>12</b> |
| 5.1 Absolute Maximum Ratings.....                | <b>5</b>  | 8.3 Power Supply Recommendations.....                            | <b>13</b> |
| 5.2 ESD Ratings.....                             | <b>5</b>  | 8.4 Layout.....                                                  | <b>13</b> |
| 5.3 Recommended Operating Conditions.....        | <b>5</b>  | <b>9 Device and Documentation Support</b> .....                  | <b>15</b> |
| 5.4 Thermal Information.....                     | <b>5</b>  | 9.1 Documentation Support.....                                   | <b>15</b> |
| 5.5 Electrical Characteristics.....              | <b>6</b>  | 9.2 接收文档更新通知.....                                                | <b>15</b> |
| 5.6 Switching Characteristics – AM26LS31.....    | <b>6</b>  | 9.3 支持资源.....                                                    | <b>15</b> |
| 5.7 Switching Characteristics – AM26LS31M.....   | <b>6</b>  | 9.4 Trademarks.....                                              | <b>15</b> |
| 5.8 Typical Characteristics.....                 | <b>7</b>  | 9.5 静电放电警告.....                                                  | <b>15</b> |
| <b>6 Parameter Measurement Information</b> ..... | <b>9</b>  | 9.6 术语表.....                                                     | <b>15</b> |
| <b>7 Detailed Description</b> .....              | <b>10</b> | <b>10 Revision History</b> .....                                 | <b>15</b> |
| 7.1 Overview.....                                | <b>10</b> | <b>11 Mechanical, Packaging, and Orderable Information</b> ..... | <b>16</b> |
| 7.2 Functional Block Diagram.....                | <b>10</b> |                                                                  |           |

## 4 Pin Configuration and Functions

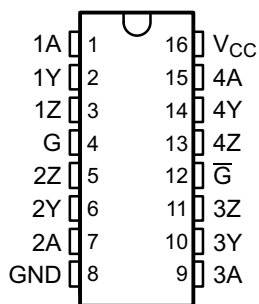


图 4-1. D (SOIC), DB (SSOP), N (PDIP) , NS (SO), J (CDIP), or W (CFP) Packages  
(Top View)

表 4-1. Pin Functions

| PIN            |     | I/O | DESCRIPTION                               |
|----------------|-----|-----|-------------------------------------------|
| NAME           | NO. |     |                                           |
| 1A             | 1   | I   | Logic Data Input to RS422 Driver number 1 |
| 1Y             | 2   | O   | RS-422 Data Line (Driver 1)               |
| 1Z             | 3   | O   | RS-422 Data Line (Driver 1)               |
| G              | 4   | I   | Driver Enable (active high)               |
| $\overline{G}$ | 12  | I   | Driver Enable (active Low)                |
| 2A             | 7   | I   | Logic Data Input to RS422 Driver number 2 |
| 2Y             | 6   | O   | RS-422 Data Line (Driver 2)               |
| 2Z             | 5   | O   | RS-422 Data Line (Driver 2)               |
| 3A             | 9   | I   | Logic Data Input to RS422 Driver number 3 |
| 3Y             | 10  | O   | RS-422 Data Line (Driver 3)               |
| 3Z             | 11  | O   | RS-422 Data Line (Driver 3)               |
| 4A             | 15  | I   | Logic Data Input to RS422 Driver number 4 |
| 4Y             | 14  | O   | RS-422 Data Line (Driver 4)               |
| 4Z             | 13  | O   | RS-422 Data Line (Driver 4)               |
| VCC            | 16  | -   | Power Input. Connect to 5V Power Source.  |
| GND            | 8   | -   | Device Ground Pin                         |

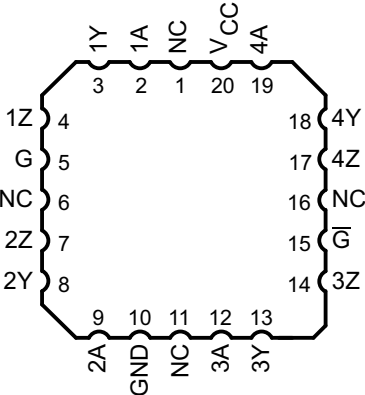


图 4-2. FK (LCCC) 20-Pin Package  
(Top View)

表 4-2. Pin Functions

| PIN            |     | I/O | DESCRIPTION                               |
|----------------|-----|-----|-------------------------------------------|
| NAME           | NO. |     |                                           |
| 1A             | 1   | I   | Logic Data Input to RS422 Driver number 1 |
| 1Y             | 2   | O   | RS-422 Data Line (Driver 1)               |
| 1Z             | 3   | O   | RS-422 Data Line (Driver 1)               |
| G              | 4   | I   | Driver Enable (active high)               |
| $\overline{G}$ | 12  | I   | Driver Enable (active Low)                |
| 2A             | 7   | I   | Logic Data Input to RS422 Driver number 2 |
| 2Y             | 6   | O   | RS-422 Data Line (Driver 2)               |
| 2Z             | 5   | O   | RS-422 Data Line (Driver 2)               |
| 3A             | 9   | I   | Logic Data Input to RS422 Driver number 3 |
| 3Y             | 10  | O   | RS-422 Data Line (Driver 3)               |
| 3Z             | 11  | O   | RS-422 Data Line (Driver 3)               |
| 4A             | 15  | I   | Logic Data Input to RS422 Driver number 4 |
| 4Y             | 14  | O   | RS-422 Data Line (Driver 4)               |
| 4Z             | 13  | O   | RS-422 Data Line (Driver 4)               |
| VCC            | 8   | I   | Power Input. Connect to 5V Power Source.  |
| GND            | 16  | I   | Device Ground Pin                         |

## 5 Specifications

### 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                  |                                                      | MIN       | MAX | UNIT |
|------------------|------------------------------------------------------|-----------|-----|------|
| V <sub>CC</sub>  | Supply voltage <sup>(2)</sup>                        |           | 7   | V    |
| V <sub>I</sub>   | Input voltage                                        |           | 7   | V    |
|                  | Output off-state voltage                             |           | 5.5 | V    |
|                  | Lead temperature 1,6 mm (1/16 in) from case for 10 s |           | 260 | °C   |
|                  | Lead temperature 1,6 mm (1/16 in) from case for 60 s | J package | 300 | °C   |
| T <sub>stg</sub> | Storage temperature                                  | - 65      | 150 | °C   |

- (1) 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.
- (2) All voltage values, except differential output voltage V<sub>OD</sub>, are with respect to network GND.

### 5.2 ESD Ratings

|                    |                         | VALUE                                                                          | UNIT  |
|--------------------|-------------------------|--------------------------------------------------------------------------------|-------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>              | ±2000 |
|                    |                         | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup> | ±1000 |

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 5.3 Recommended Operating Conditions

|                 |                                | MIN       | NOM  | MAX  | UNIT |
|-----------------|--------------------------------|-----------|------|------|------|
| V <sub>CC</sub> | Supply voltage                 | AM26LS31C | 4.75 | 5    | 5.25 |
|                 |                                | AM26LS31M | 4.5  | 5    | 5.5  |
| V <sub>IH</sub> | High-level input voltage       | 2         |      |      | V    |
| V <sub>IL</sub> | Low-level input voltage        |           |      | 0.8  | V    |
| I <sub>OH</sub> | High-level output current      |           |      | - 20 | mA   |
| I <sub>OL</sub> | Low-level output current       |           |      | 20   | mA   |
| T <sub>A</sub>  | Operating free-air temperature | AM26LS31C | 0    | 70   | °C   |
|                 |                                | AM26LS31I | - 40 | 85   |      |
|                 |                                | AM26LS31M | - 55 | 125  |      |

### 5.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                                       | AM26LS31x |           |          |         | UNIT |
|-------------------------------|-------------------------------------------------------|-----------|-----------|----------|---------|------|
|                               |                                                       | D (SOIC)  | DB (SSOP) | N (PDIP) | NS (SO) |      |
|                               |                                                       | 16 PINS   | 16 PINS   | 16 PINS  | 16 PINS |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance <sup>(2)</sup> | 84.6      | 82        | 60.6     | 88.5    | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance             | 43.5      | –         | 48.1     | 46.2    | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance                  | 43.2      | –         | 40.6     | 50.7    | °C/W |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter            | 10.4      | –         | 27.5     | 13.5    | °C/W |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter          | 42.8      | –         | 40.3     | 50.3    | °C/W |

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.
- (2) The package thermal impedance is calculated in accordance with JESD 51-7.

## 5.5 Electrical Characteristics

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

| PARAMETER                                                | TEST CONDITIONS                              | MIN | TYP <sup>(2)</sup> | MAX   | UNIT          |
|----------------------------------------------------------|----------------------------------------------|-----|--------------------|-------|---------------|
| $V_{IK}$ Input clamp voltage                             | $V_{CC} = \text{MIN}, I_I = -18\text{mA}$    |     |                    | -1.5  | V             |
| $V_{OH}$ High-level output voltage                       | $V_{CC} = \text{MIN}, I_{OH} = -20\text{mA}$ | 2.5 |                    |       | V             |
| $V_{OL}$ Low-level output voltage                        | $V_{CC} = \text{MIN}, I_{OL} = 20\text{mA}$  |     |                    | 0.5   | V             |
| $I_{OZ}$ Off-state (high-impedance-state) output current | $V_{CC} = \text{MIN}, V_O = 0.5\text{V}$     |     |                    | -20   | $\mu\text{A}$ |
|                                                          | $V_O = 2.5\text{V}$                          |     |                    | 20    |               |
| $I_I$ Input current at maximum input voltage             | $V_{CC} = \text{MAX}, V_I = 7\text{V}$       |     |                    | 0.1   | mA            |
| $I_{IH}$ High-level input current                        | $V_{CC} = \text{MAX}, V_I = 2.7\text{V}$     |     |                    | 20    | $\mu\text{A}$ |
| $I_{IL}$ Low-level input current                         | $V_{CC} = \text{MAX}, V_I = 0.4\text{V}$     |     |                    | -0.36 | mA            |
| $I_{OS}$ Short-circuit output current <sup>(3)</sup>     | $V_{CC} = \text{MAX}$                        | -30 |                    | -150  | mA            |
| $I_{CC}$ Supply current                                  | $V_{CC} = \text{MAX}$ , all outputs disabled |     | 32                 | 80    | mA            |

(1) For C-suffix devices,  $V_{CC}$  min = 4.75V and  $V_{CC}$  max = 5.25V. For M-suffix devices,  $V_{CC}$  min = 4.5V and  $V_{CC}$  max = 5.5V.

(2) All typical values are at  $V_{CC} = 5\text{V}$  and  $T_A = 25^\circ\text{C}$ .

(3) Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

## 5.6 Switching Characteristics - AM26LS31

$T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{V}$  (see [Figure 6-1](#))

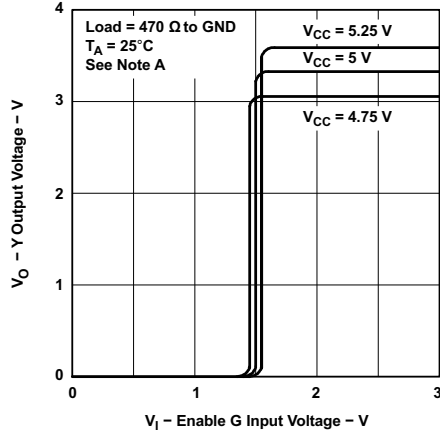
| PARAMETER                                                   | TEST CONDITIONS                        | MIN | TYP | MAX | UNIT |
|-------------------------------------------------------------|----------------------------------------|-----|-----|-----|------|
| $t_{PLH}$ Propagation delay time, low- to high-level output | $C_L = 30\text{pF}$ , S1 and S2 open   |     | 14  | 20  | ns   |
| $t_{PHL}$ Propagation delay time, high- to low-level output |                                        |     | 14  | 20  |      |
| $t_{PZH}$ Output enable time to high level                  | $C_L = 30\text{pF}$                    |     | 25  | 40  | ns   |
| $t_{PZL}$ Output enable time to low level                   |                                        |     | 37  | 45  |      |
| $t_{PHZ}$ Output disable time from high level               | $C_L = 10\text{pF}$ , S1 and S2 closed |     | 21  | 30  | ns   |
| $t_{PLZ}$ Output disable time from low level                |                                        |     | 23  | 35  |      |
| $t_{SKEW}$ Output-to-output skew                            | $C_L = 30\text{pF}$ , S1 and S2 open   |     | 1   | 6   | ns   |

## 5.7 Switching Characteristics - AM26LS31M

$T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{V}$  (see [Figure 6-1](#))

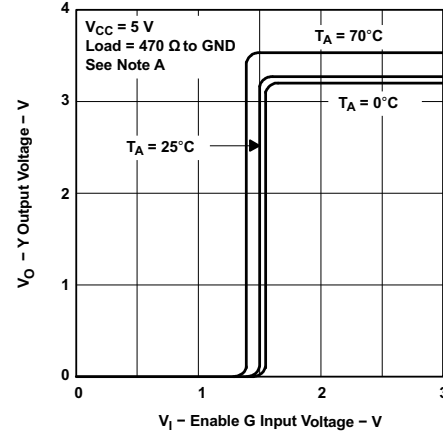
| PARAMETER                                                   | TEST CONDITIONS                        | MIN | MAX | UNIT |
|-------------------------------------------------------------|----------------------------------------|-----|-----|------|
| $t_{PLH}$ Propagation delay time, low- to high-level output | $C_L = 30\text{pF}$ , S1 and S2 open   |     | 30  | ns   |
| $t_{PHL}$ Propagation delay time, high- to low-level output |                                        |     | 30  |      |
| $t_{PZH}$ Output enable time to high level                  | $C_L = 30\text{pF}$                    |     | 60  | ns   |
| $t_{PZL}$ Output enable time to low level                   |                                        |     | 68  |      |
| $t_{PHZ}$ Output disable time from high level               | $C_L = 10\text{pF}$ , S1 and S2 closed |     | 45  | ns   |
| $t_{PLZ}$ Output disable time from low level                |                                        |     | 53  |      |
| $t_{SKEW}$ Output-to-output skew                            | $C_L = 30\text{pF}$ , S1 and S2 open   |     | 9   | ns   |

## 5.8 Typical Characteristics



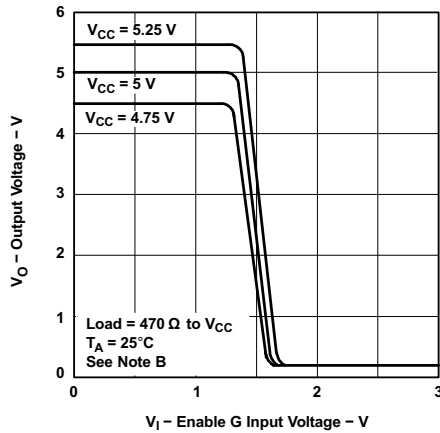
A. The A input is connected to  $V_{CC}$  during testing of the Y outputs and to ground during testing of the Z outputs.

图 5-1. Output Voltage vs Enable G Input Voltage



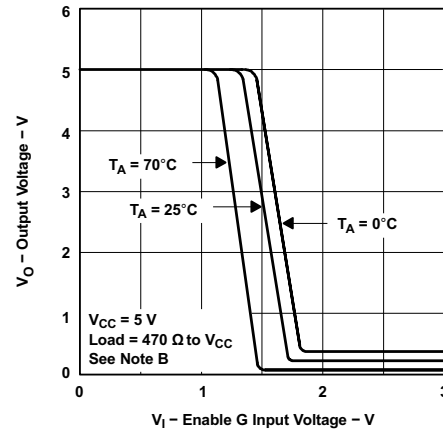
A. The A input is connected to  $V_{CC}$  during testing of the Y outputs and to ground during testing of the Z outputs.

图 5-2. Output Voltage vs Enable G Input Voltage



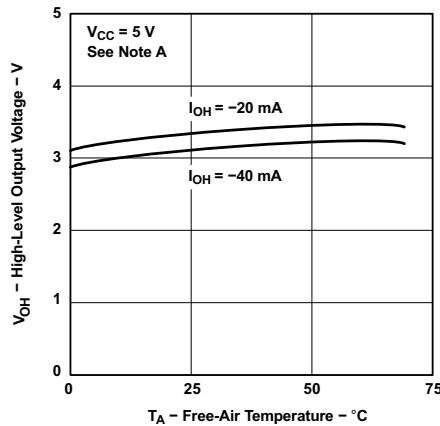
B. The A input is connected to ground during testing of the Y outputs and to  $V_{CC}$  during testing of the Z outputs.

图 5-3. Output Voltage vs Enable G Input Voltage



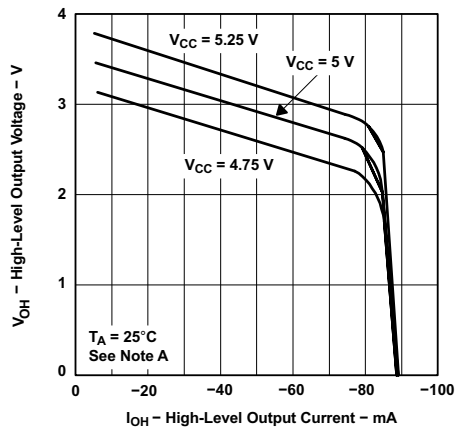
B. The A input is connected to ground during testing of the Y outputs and to  $V_{CC}$  during testing of the Z outputs.

图 5-4. Output Voltage vs Enable G Input Voltage



A. The A input is connected to  $V_{CC}$  during testing of the Y outputs and to ground during testing of the Z outputs.

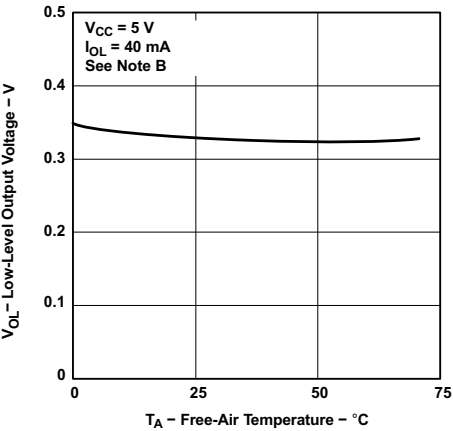
图 5-5. High-Level Output Voltage vs Free-Air Temperature



A. The A input is connected to  $V_{CC}$  during testing of the Y outputs and to ground during testing of the Z outputs.

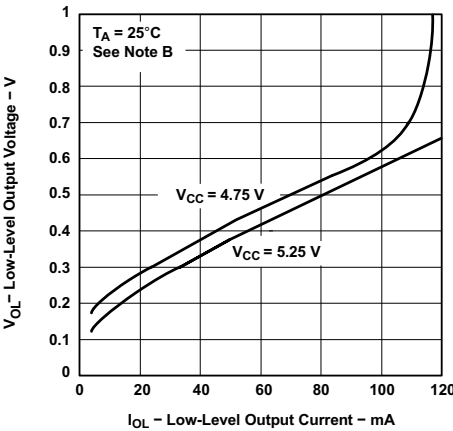
图 5-6. High-Level Output Voltage vs High-Level Output Current

5.8 Typical Characteristics (continued)



B. The A input is connected to ground during testing of the Y outputs and to  $V_{CC}$  during testing of the Z outputs.

图 5-7. Low-Level Output Voltage vs Free-Air Temperature



B. The A input is connected to ground during testing of the Y outputs and to  $V_{CC}$  during testing of the Z outputs.

图 5-8. Low-Level Output Voltage vs Low-Level Output Current

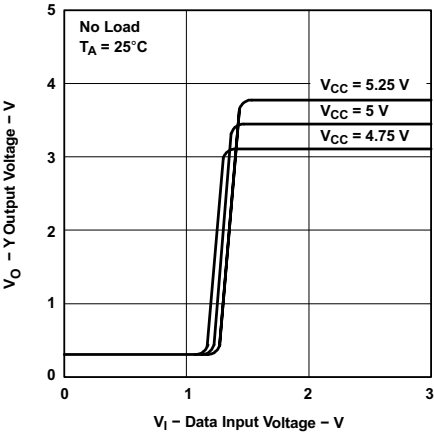


图 5-9. Y Output Voltage vs Data Input Voltage

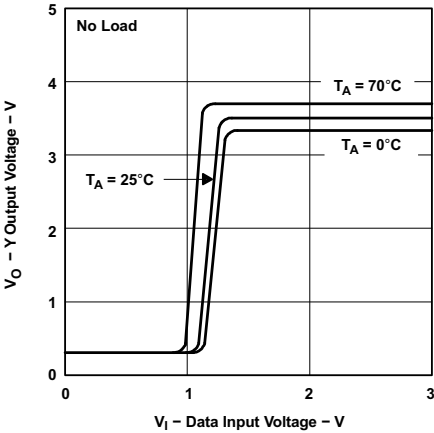
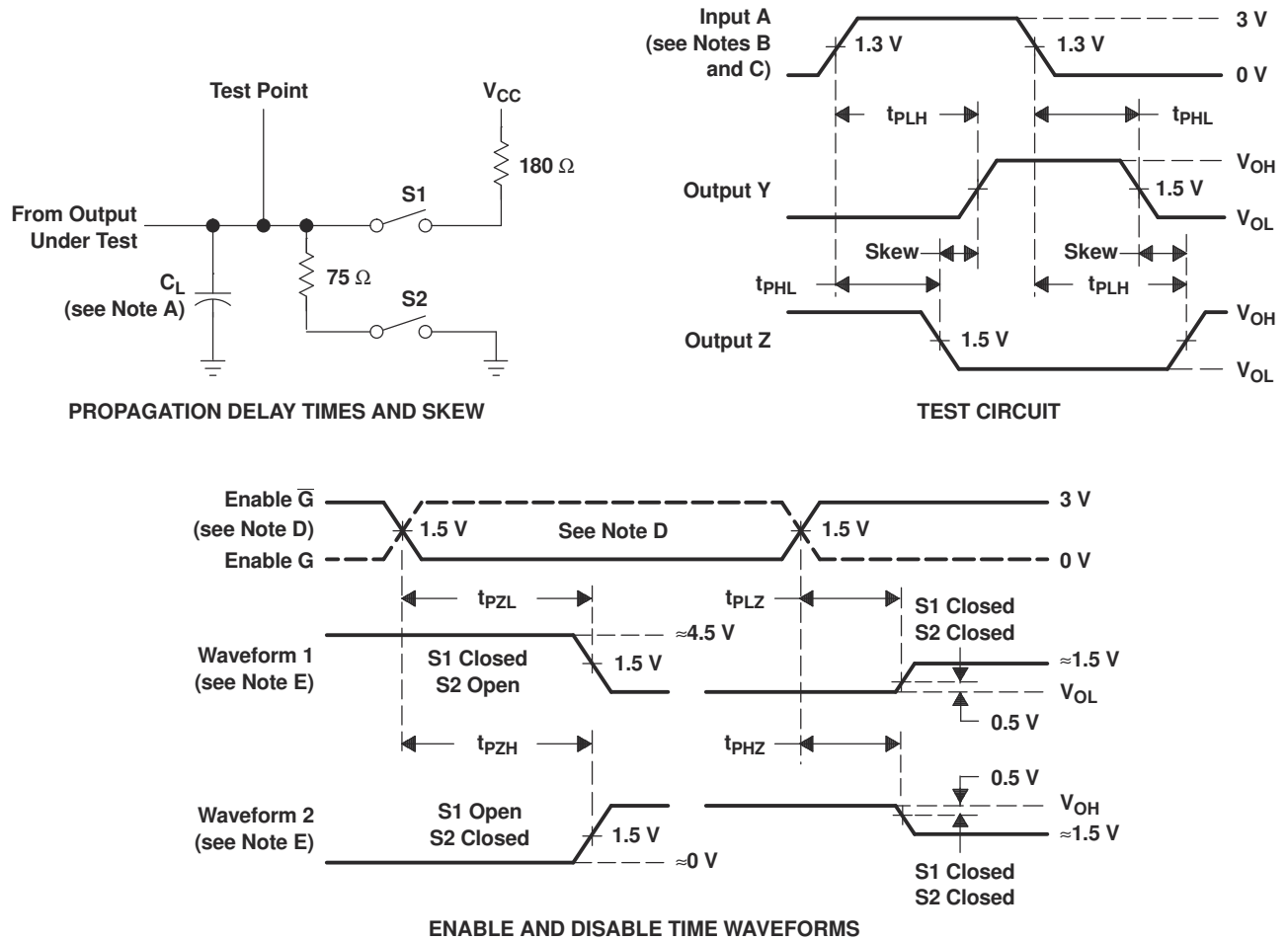


图 5-10. Y Output Voltage vs Data Input Voltage

## 6 Parameter Measurement Information



- NOTES:
- A.  $C_L$  includes probe and jig capacitance.
  - B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O \approx 50 \Omega$ ,  $t_r \leq 15$  ns,  $t_f \leq 6$  ns.
  - C. When measuring propagation delay times and skew, switches S1 and S2 are open.
  - D. Each enable is tested separately.
  - E. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.

图 6-1. Test Circuit and Voltage Waveforms

## 7 Detailed Description

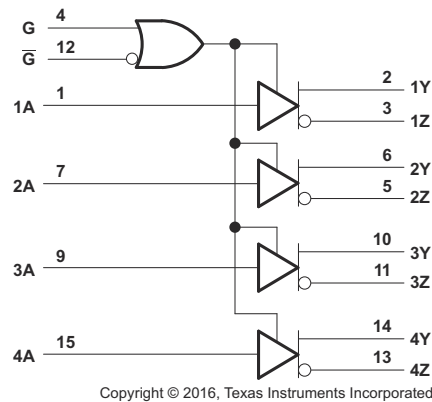
### 7.1 Overview

The AM26LS31x CN-E differential bus transmitter is a monolithic integrated circuit designed for unidirectional data communication on transmission lines. It is designed for balanced transmission lines and meets ANSI Standard EIA/TIA-422-B and ITU Recommendation V.11.

The AM26LS31x CN-E has a four 3-state differential line drivers that operate from a single 5V power supply. The driver also integrates active-high and active-low enables for precise device control.

The driver is designed to handle loads of a minimum of  $\pm 30\text{mA}$  of sink or source current. The driver features positive- and negative-current limiting for protection from line fault conditions.

### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 Complementary Output-Enable Inputs

The AM26LS31x can be configured using the G and  $\bar{G}$  logic inputs to control transmitter outputs. Setting either G to a logic HIGH or  $\bar{G}$  to a logic LOW enables the transmitter outputs. If G is set to logic LOW and  $\bar{G}$  is set to logic HIGH, the transmitter outputs are disabled. See 表 7-1 for a complete truth table.

#### 7.3.2 High Output Impedance in Power-Off Conditions

When the AM26LS31x transmitter outputs are disabled using G and  $\bar{G}$ , the outputs are set to a high impedance state.

#### 7.3.3 Complementary Outputs

The AM26LS31x is the driver half of a pair of devices, with the AM26LS32 being the complementary receiver. TI recommends using these devices together for optimal performance, but any RS-422 compliant receive must ensure proper RS-422 communication and logic level translation.

## 7.4 Device Functional Modes

表 7-1 lists the functional modes of the AM26LS31CN-E.

**表 7-1. Function Table<sup>(1)</sup>**  
**(Each Driver)**

| INPUT<br>A | ENABLES |           | OUTPUTS |   |
|------------|---------|-----------|---------|---|
|            | G       | $\bar{G}$ | 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 |

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

## 8 Application and Implementation

### 备注

以下应用部分中的信息不属于 TI 器件规格的范围，TI 不担保其准确性和完整性。TI 的客户应负责确定器件是否适用于其应用。客户应验证并测试其设计，以确保系统功能。

### 8.1 Application Information

When designing a system that uses drivers, receivers, and transceivers that comply with RS-422 or RS-485, proper cable termination is essential for highly reliable applications with reduced reflections in the transmission line. Because RS-422 allows only one driver on the bus, if termination is used, it is placed only at the end of the cable near the last receiver. In general, RS-485 requires termination at both ends of the cable. Factors to consider when determining the type of termination usually are performance requirements of the application and the ever-present factor, cost. The different types of termination techniques discussed are unterminated lines, parallel termination, AC termination, and multipoint termination. Laboratory waveforms for each termination technique (except multipoint termination) illustrate the usefulness and robustness of RS-422 (and, indirectly, RS-485). Similar results can be obtained if 485-compliant devices and termination techniques are used. For laboratory experiments, 100 feet of 100  $\Omega$ , 24-AWG, twisted-pair cable (Bertek) was used. A single driver and receiver, TI AM26LS31CN-E and AM26LS32C, respectively, were tested at room temperature with a 5V supply voltage. Two plots per termination technique are shown. In each plot, the top waveform is the driver input and the bottom waveform is the receiver output. To show voltage waveforms related to transmission-line reflections, the first plot shows output waveforms from the driver at the start of the cable; the second plot shows input waveforms to the receiver at the far end of the cable.

### 8.2 Typical Application

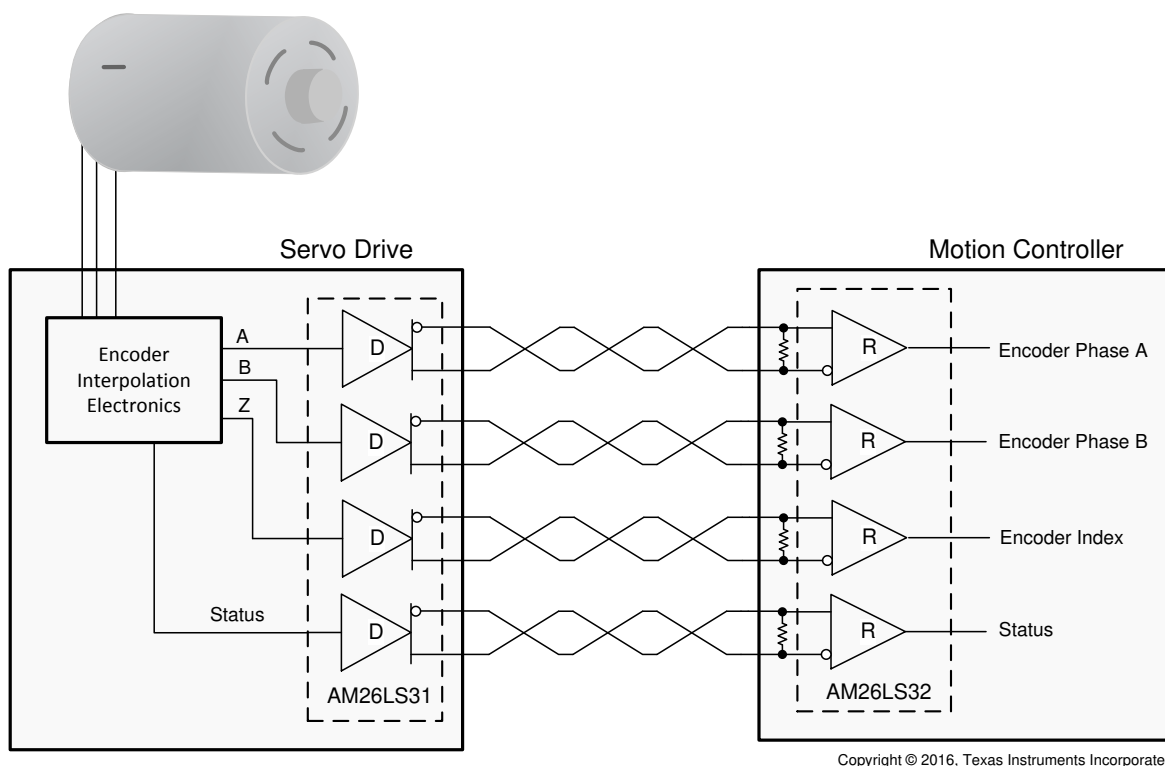


图 8-1. Encoder Application

### 8.2.1 Design Requirements

This example requires the following:

- 5V power source
- RS-485 bus operating at 10Mbps or less
- Connector that makes sure the correct polarity for port pins

### 8.2.2 Detailed Design Procedure

Place the device close to bus connector to keep traces (stub) short to prevent adding reflections to the bus line.

If desired, add external fail-safe biasing to ensure 200mV on the A-B port, if the drive is in high impedance state (see [Fail-safe in RS-485 data buses](#)).

### 8.2.3 Application Curve

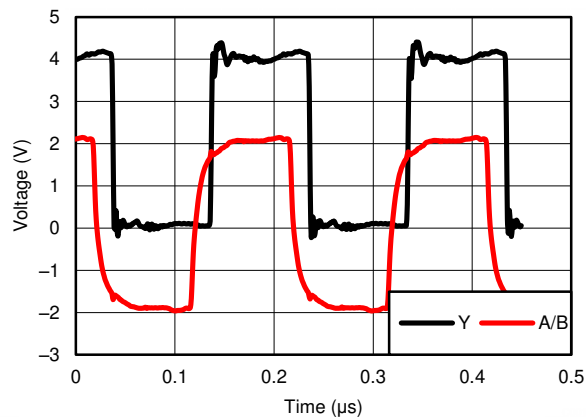


图 8-2. Differential 120-Ω Terminated Output Waveforms (Cat 5E Cable)

## 8.3 Power Supply Recommendations

Place a 0.1  $\mu$ F bypass capacitors close to the power-supply pins to reduce errors coupling in from noisy or high impedance power supplies.

## 8.4 Layout

### 8.4.1 Layout Guidelines

For best operational performance of the device, use good PCB layout practices, including:

- Noise can often propagate into analog circuitry through the power supply of the circuit. Bypass capacitors are used to reduce the coupled noise by providing low impedance power sources local to the analog circuitry.
  - Connect low-ESR, 0.1  $\mu$ F ceramic bypass capacitors between each supply pin and ground, placed as close to the device as possible. A single bypass capacitor from V+ to ground is applicable for single-supply applications.
- Separate grounding for analog and digital portions of circuitry is one of the simplest and most-effective methods of noise suppression. One or more layers on multilayer PCBs are usually devoted to ground planes. A ground plane helps distribute heat and reduces EMI noise pickup. Make sure to physically separate digital and analog grounds, paying attention to the flow of the ground current.
- To reduce parasitic coupling, run the input traces as far away from the supply or output traces as possible. If it is not possible to keep them separate, it is much better to cross the sensitive trace perpendicular as opposed to in parallel with the noisy trace.
- Place the external components as close to the device as possible. Keeping RF and RG close to the inverting input minimizes parasitic capacitance.
- Keep the length of input traces as short as possible. Always remember that the input traces are the most sensitive part of the circuit.

## 8.4.2 Layout Example

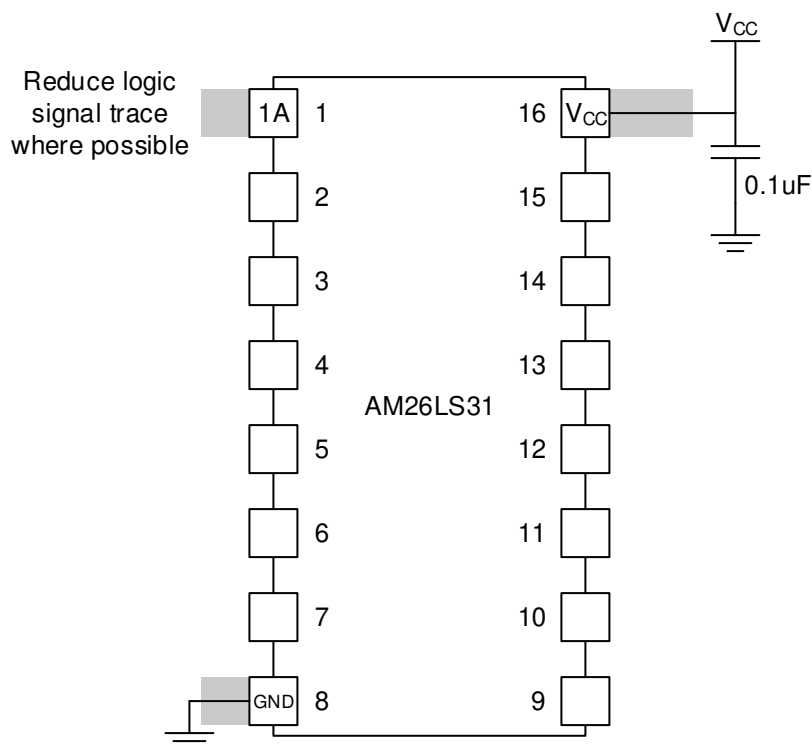


图 8-3. Layout Recommendation

## 9 Device and Documentation Support

### 9.1 Documentation Support

#### 9.1.1 Related Documentation

For related documentation, see the following:

[Failsafe in RS-485 data buses](#) (SLYT080)

### 9.2 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](#) 上的器件产品文件夹。点击 [通知](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

### 9.3 支持资源

[TI E2E™ 中文支持论坛](#) 是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 [使用条款](#)。

### 9.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

所有商标均为其各自所有者的财产。

### 9.5 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

### 9.6 术语表

[TI 术语表](#)      本术语表列出并解释了术语、首字母缩略词和定义。

## 10 Revision History

注：以前版本的页码可能与当前版本的页码不同

| Changes from Revision L (October 2018) to Revision M (March 2024) | Page              |
|-------------------------------------------------------------------|-------------------|
| • 将“器件信息”表更改为 <i>封装信息</i> 表.....                                  | <a href="#">1</a> |
| • Changed the <i>Thermal Information</i> table.....               | <a href="#">5</a> |

| Changes from Revision K (July 2016) to Revision L (October 2018)                | Page              |
|---------------------------------------------------------------------------------|-------------------|
| • Changed VCC pin number From: 8 To: 16 in the <i>Pin Functions</i> table ..... | <a href="#">3</a> |
| • Changed GND pin number From: 16 To: 8 in the <i>Pin Functions</i> table ..... | <a href="#">3</a> |

| Changes from Revision J (January 2014) to Revision K (February 2014)                           | Page |
|------------------------------------------------------------------------------------------------|------|
| • 添加了应用部分、器件信息表、ESD 等级表、特性说明部分、器件功能模式、应用和实施部分、电源相关建议部分、布局部分、器件和文档支持部分以及机械、封装和可订购信息部分.....      | 1    |
| • Split up <i>Switching Characteristics</i> table into two tables specified for each part..... | 6    |

| Changes from Revision I (February 2006) to Revision J (January 2014) | Page |
|----------------------------------------------------------------------|------|
| • 将文档更新为新的 TI 数据表格式 - 无规格变化.....                                     | 1    |
| • 删除了 <i>订购信息</i> 表.....                                             | 1    |
| • 更新了“特性”.....                                                       | 1    |

11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser based versions of this data sheet, refer to the left hand navigation.

## PACKAGING INFORMATION

| Orderable part number           | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6)                     |
|---------------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|-----------------------------------------|
| <a href="#">5962-7802301M2A</a> | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>7802301M2A<br>AM26LS31<br>MFKB |
| <a href="#">5962-7802301MEA</a> | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-7802301ME<br>A<br>AM26LS31MJB      |
| <a href="#">5962-7802301MFA</a> | Active        | Production           | CFP (W)   16   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-7802301MF<br>A<br>AM26LS31MWB      |
| <a href="#">5962-7802301Q2A</a> | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -            | 5962-<br>7802301Q2A<br>AM26LS31M        |
| <a href="#">AM26LS31CD</a>      | Obsolete      | Production           | SOIC (D)   16  | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | AM26LS31C                               |
| <a href="#">AM26LS31CDBR</a>    | Active        | Production           | SSOP (DB)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | SA31C                                   |
| <a href="#">AM26LS31CDR</a>     | Active        | Production           | SOIC (D)   16  | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | AM26LS31C                               |
| <a href="#">AM26LS31CDRG4</a>   | Obsolete      | Production           | SOIC (D)   16  | -                     | -           | Call TI                              | Call TI                           | 0 to 70      | AM26LS31C                               |
| <a href="#">AM26LS31CN</a>      | Active        | Production           | PDIP (N)   16  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | AM26LS31CN                              |
| <a href="#">AM26LS31CNSR</a>    | Active        | Production           | SOP (NS)   16  | 2000   LARGE T&R      | Yes         | NIPDAU   NIPDAU                      | Level-1-260C-UNLIM                | 0 to 70      | 26LS31                                  |
| <a href="#">AM26LS31INSR</a>    | Active        | Production           | SOP (NS)   16  | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | 26LS31                                  |
| <a href="#">AM26LS31MFKB</a>    | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-<br>7802301M2A<br>AM26LS31<br>MFKB |
| <a href="#">AM26LS31MJB</a>     | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-7802301ME<br>A<br>AM26LS31MJB      |
| <a href="#">AM26LS31MWB</a>     | Active        | Production           | CFP (W)   16   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-7802301MF<br>A<br>AM26LS31MWB      |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF AM26LS31, AM26LS31M :**

- Catalog : [AM26LS31](#)
- Military : [AM26LS31M](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

## TAPE AND REEL INFORMATION



\*All dimensions are nominal

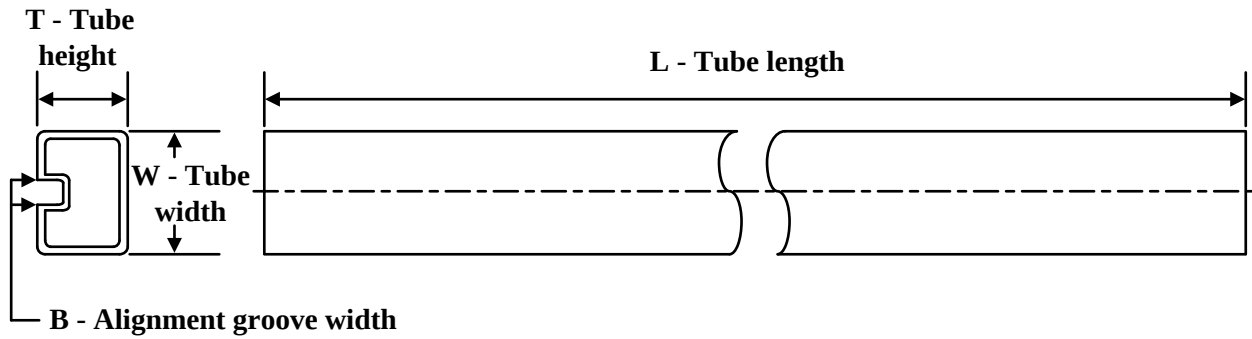
| Device       | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| AM26LS31CDBR | SSOP         | DB              | 16   | 2000 | 330.0              | 16.4               | 8.35    | 6.6     | 2.4     | 12.0    | 16.0   | Q1            |
| AM26LS31CDR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| AM26LS31CDR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| AM26LS31CNSR | SOP          | NS              | 16   | 2000 | 330.0              | 16.4               | 8.1     | 10.4    | 2.5     | 12.0    | 16.0   | Q1            |
| AM26LS31CNSR | SOP          | NS              | 16   | 2000 | 330.0              | 16.4               | 8.1     | 10.4    | 2.5     | 12.0    | 16.0   | Q1            |
| AM26LS31INSR | SOP          | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| AM26LS31CDBR | SSOP         | DB              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| AM26LS31CDR  | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| AM26LS31CDR  | SOIC         | D               | 16   | 2500 | 353.0       | 353.0      | 32.0        |
| AM26LS31CNSR | SOP          | NS              | 16   | 2000 | 353.0       | 353.0      | 32.0        |
| AM26LS31CNSR | SOP          | NS              | 16   | 2000 | 367.0       | 367.0      | 38.0        |
| AM26LS31INSR | SOP          | NS              | 16   | 2000 | 356.0       | 356.0      | 35.0        |

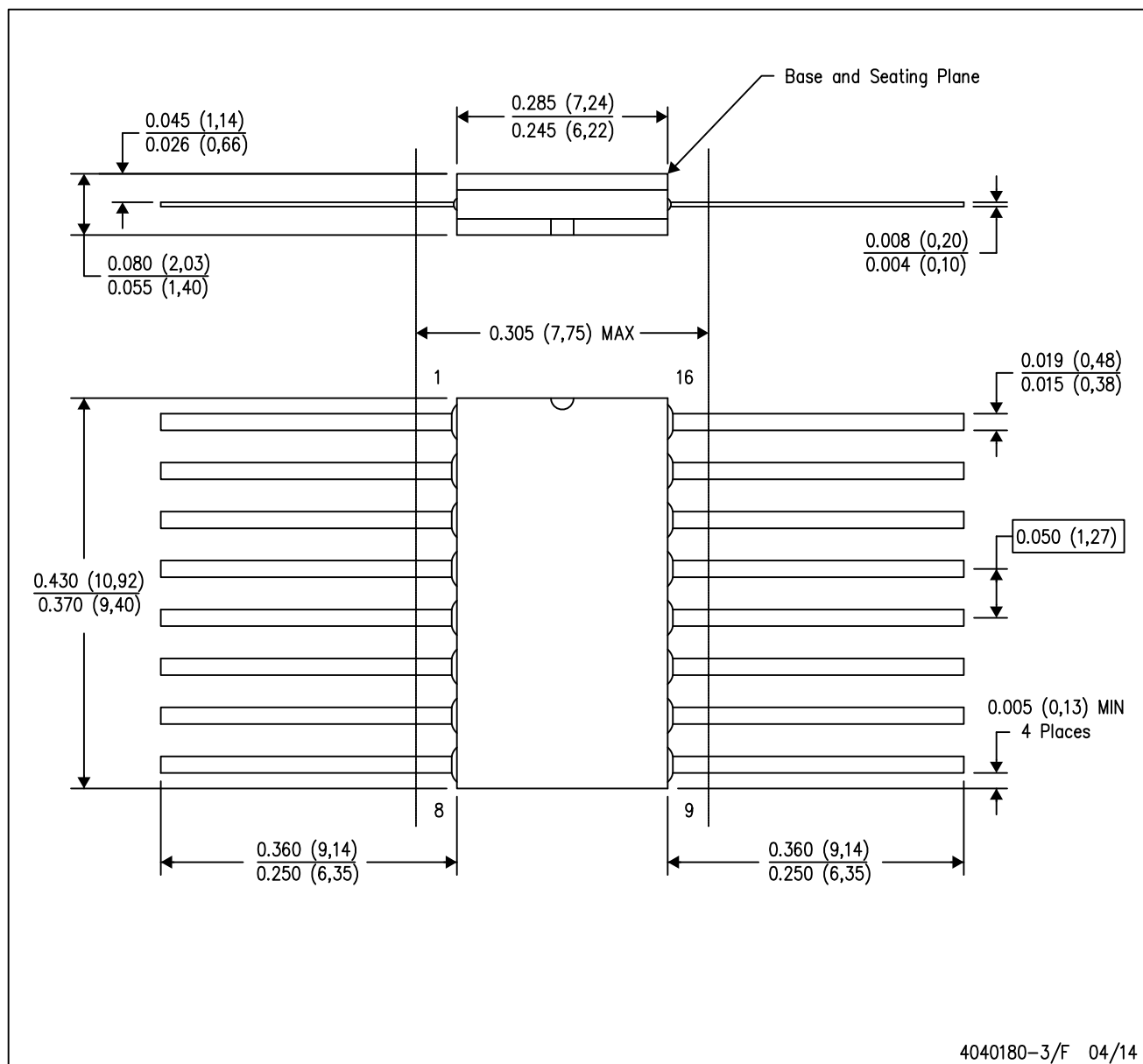
**TUBE**


\*All dimensions are nominal

| Device          | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-7802301M2A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| 5962-7802301MFA | W            | CFP          | 16   | 25  | 506.98 | 26.16  | 6220   | NA     |
| 5962-7802301Q2A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| AM26LS31CN      | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| AM26LS31MFKB    | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| AM26LS31MWB     | W            | CFP          | 16   | 25  | 506.98 | 26.16  | 6220   | NA     |

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only.
  - Falls within MIL STD 1835 GDFP2-F16

## GENERIC PACKAGE VIEW

**FK 20**

**LCCC - 2.03 mm max height**

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



4229370VA\

J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



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

N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



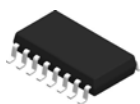
| PINS **<br>DIM      | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |



4040049/E 12/2002

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.

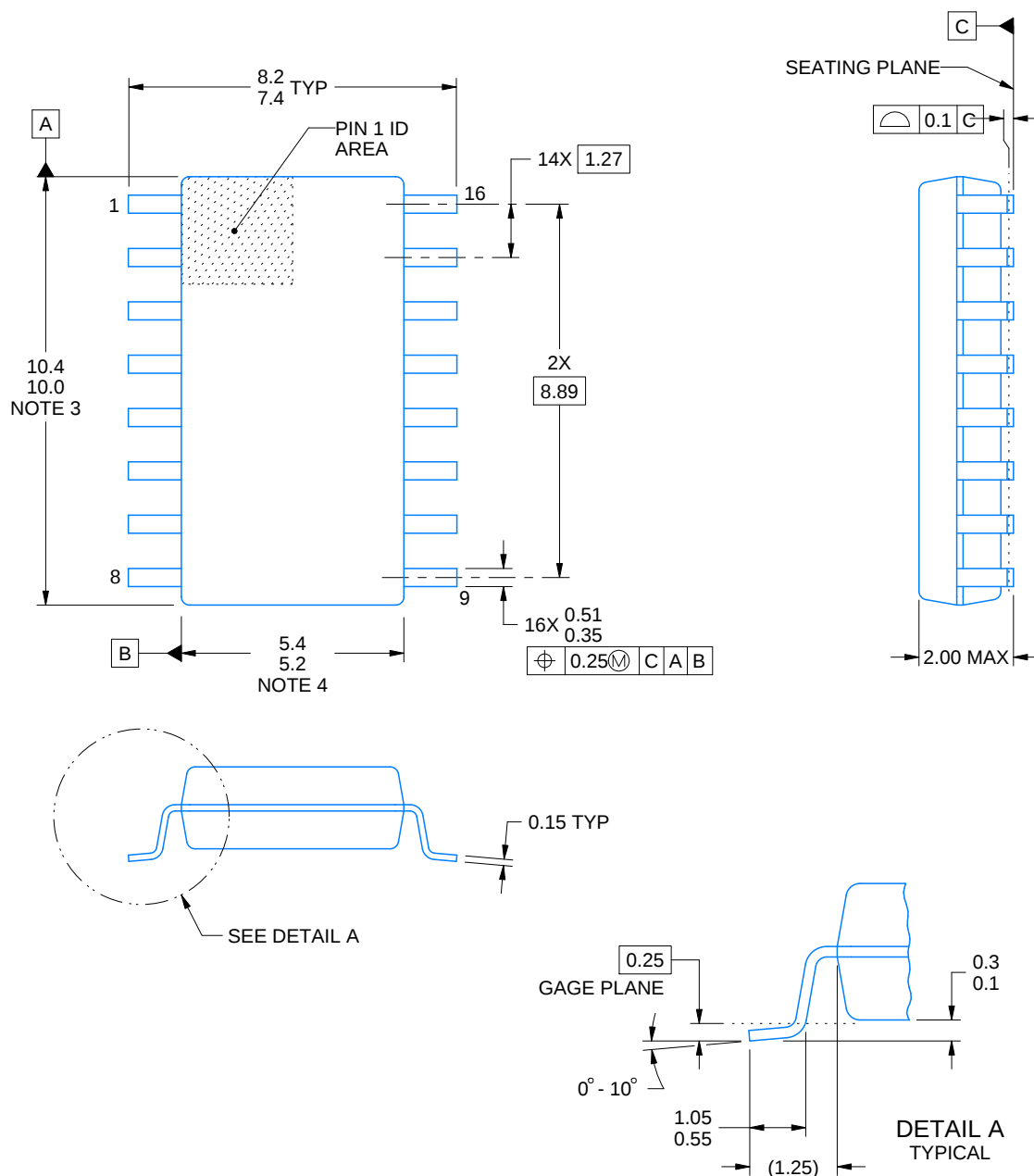


# PACKAGE OUTLINE

NS0016A

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

## NOTES:

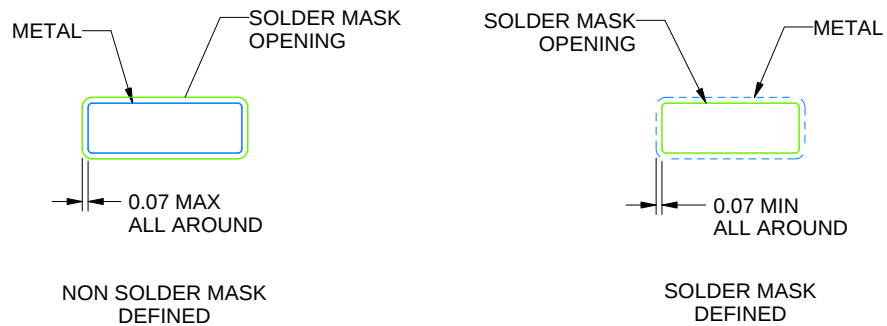
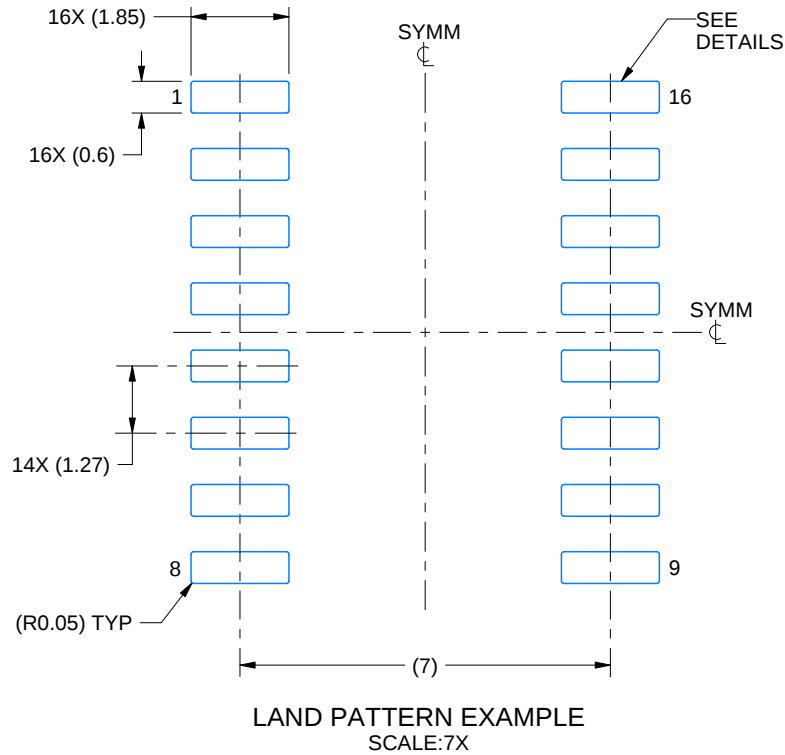
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.

# EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER MASK DETAILS

4220735/A 12/2021

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE  
 BASED ON 0.125 mm THICK STENCIL  
 SCALE:7X

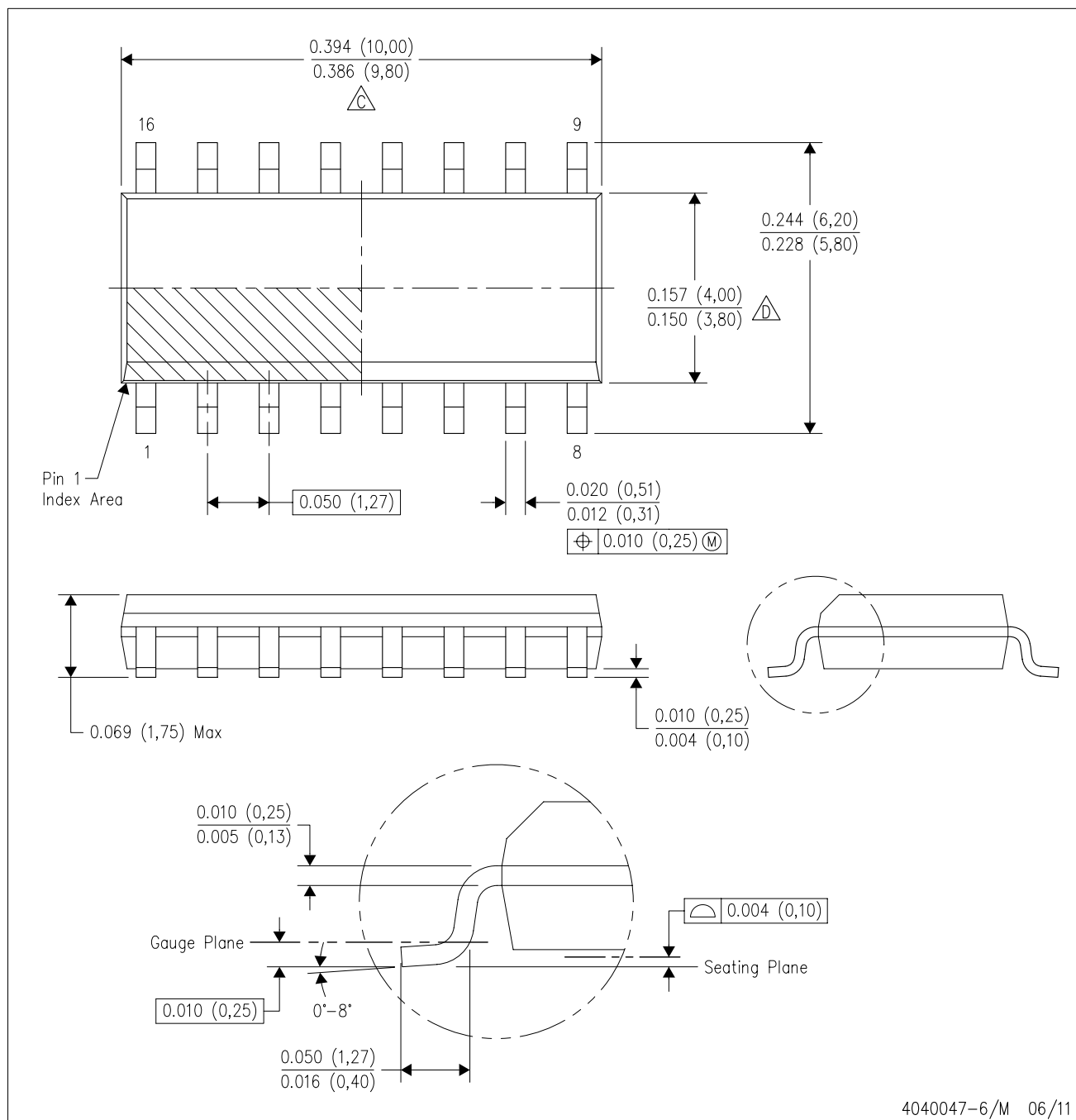
4220735/A 12/2021

NOTES: (continued)

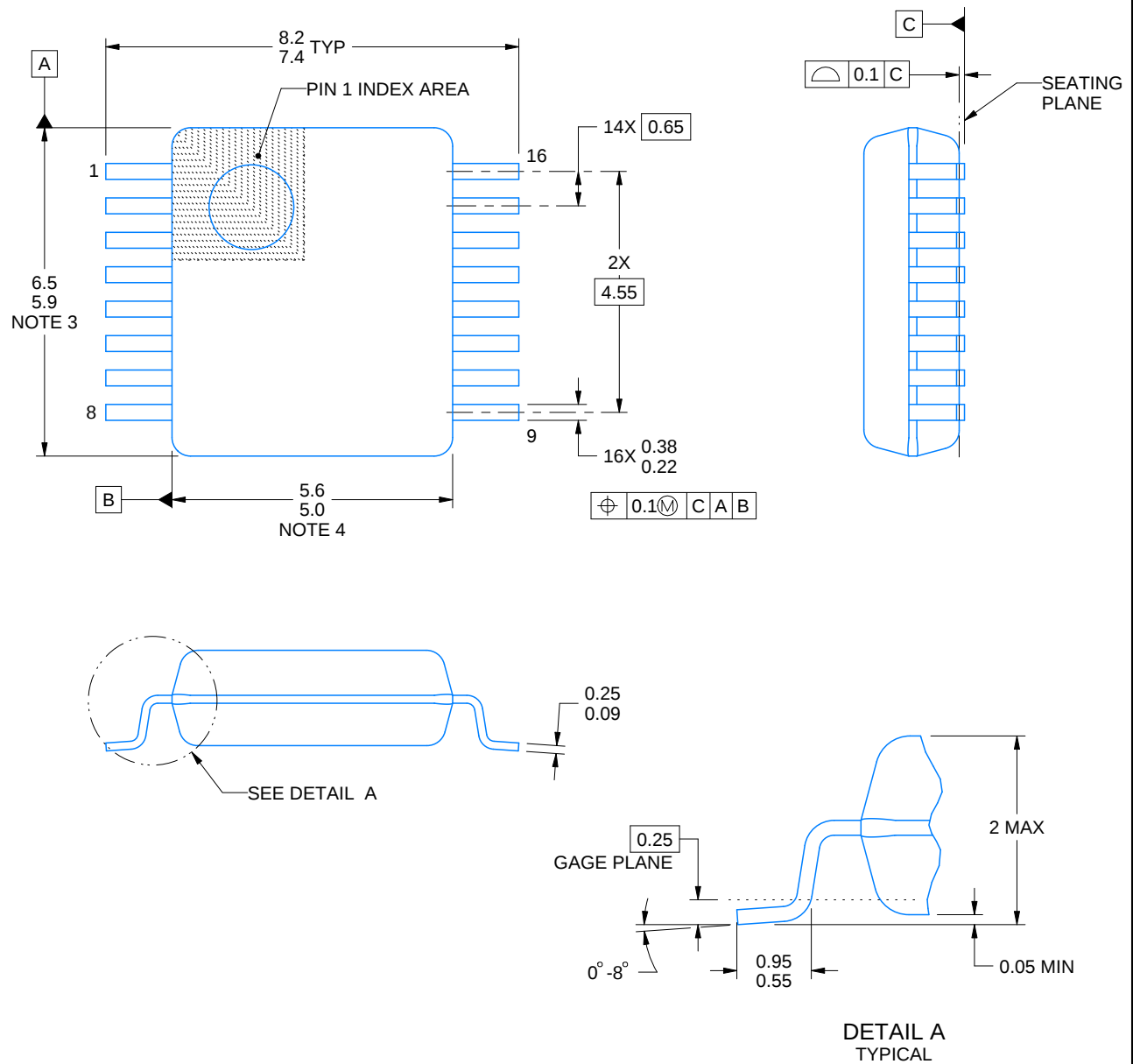
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

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.
  - $\triangle C$  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.
  - $\triangle D$  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.



4220763/A 05/2022

## NOTES:

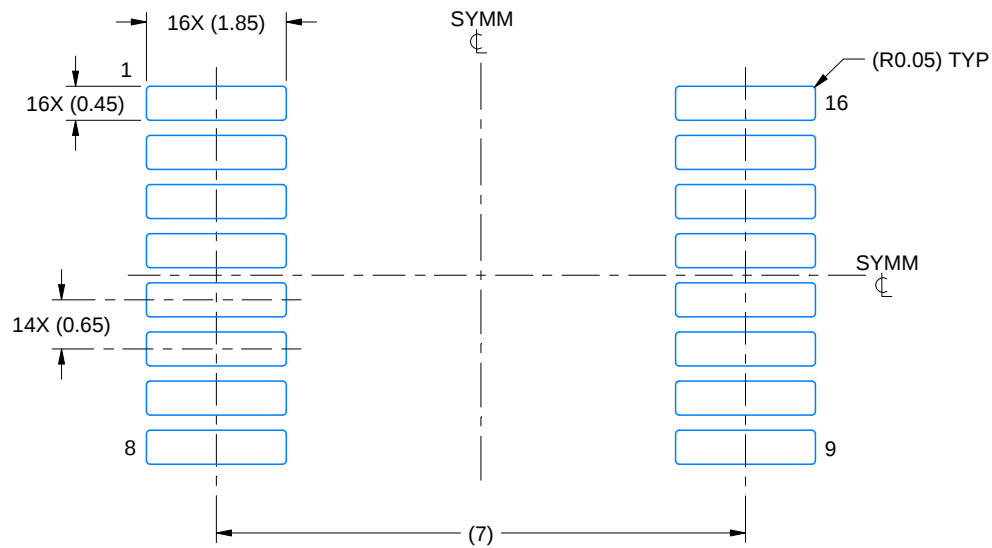
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-150.

# EXAMPLE BOARD LAYOUT

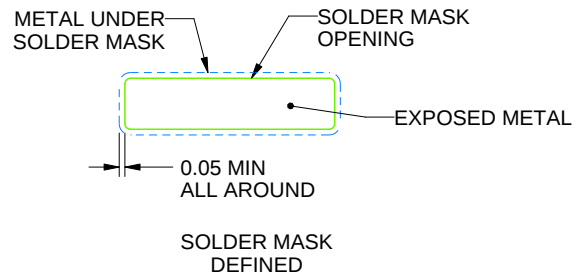
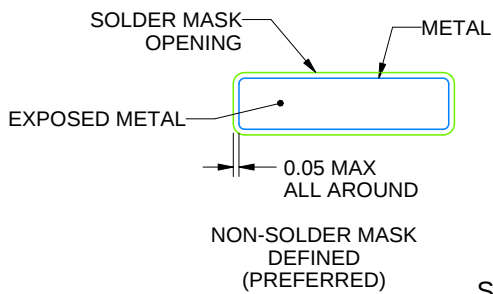
DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220763/A 05/2022

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

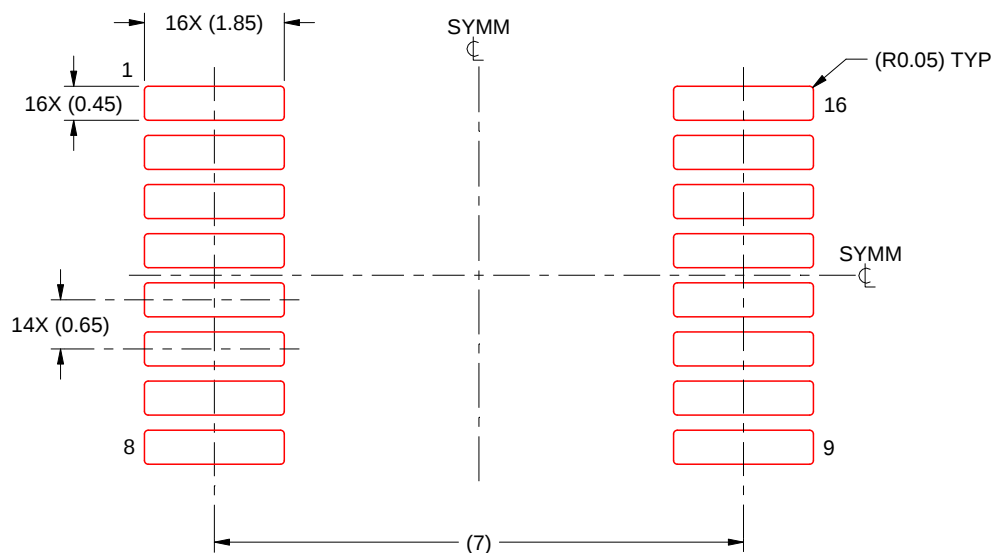
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220763/A 05/2022

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



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

## 重要通知和免责声明

TI“按原样”提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做任何明示或暗示的担保，包括但不限于对适销性、某特定用途方面的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他功能安全、信息安全、监管或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的相关应用。严禁以其他方式对这些资源进行复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。您应全额赔偿因在这些资源的使用中对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，TI 对此概不负责。

TI 提供的产品受 [TI 的销售条款](#) 或 [ti.com](#) 上其他适用条款/TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

邮寄地址：Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
版权所有 © 2025，德州仪器 (TI) 公司