**TEXAS INSTRUMENTS**

AM26LS31, AM26LS31M
JAJSGF9M – JANUARY 1979 – REVISED MARCH 2024

# AM26LS31 クワッド差動ライン ドライバ

## 1 特長

- ANSI TIA/EIA-422-B と ITU の要件を満たす、または上回る性能
- 5V 単一電源で動作
- TTL 互換
- 相補出力
- 電源オフ状況での高い出力インピーダンス
- 相補出力のイネーブル入力
- MIL-PRF-38535 認定オプション (M) を利用可能：特に記述のない限り、すべてのパラメータはテスト済みです。その他のすべての製品については、量産プロセスにすべてのパラメータのテストが含まれているとは限りません。

## 2 アプリケーション

- モータ エンコーダ
- フィールド トランスミッタ：圧力センサおよび温度センサ
- 軍事 / 航空電子機器用の画像処理
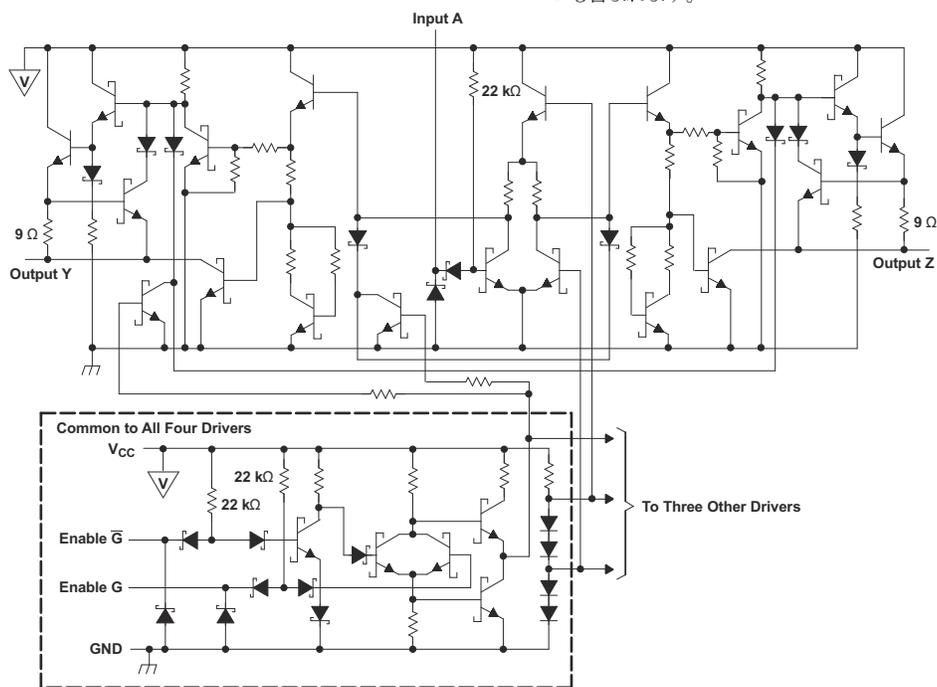- Modbus 使用の温度センサまたはコントローラ

## 3 概要

AM26LS31CN-E ファミリのデバイスは、クワッド相補出力ライン ドライバで、ANSI TIA/EIA-422-B および ITU (従来の CCITT) 勧告 V.11 の要件を満たすよう設計されています。3 ステート出力は、ツイストペアまたは平行線伝送線路などの平衡ラインを駆動するための大電流能力を備え、電源オフ時には高インピーダンス状態になります。イネーブル機能は 4 つのドライバすべてに共通で、アクティブ High またはアクティブ Low のイネーブル (G、$\overline{G}$) 入力を選択できます。低消費電力のショットキー回路により、速度を犠牲にすることなく消費電力を削減しています。

**パッケージ情報**

| 部品番号 | パッケージ [1] | パッケージ サイズ[2] |
|---|---|---|
| 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) 詳細については、セクション 11 を参照してください。
(2) パッケージ サイズ (長さ × 幅) は公称値であり、該当する場合はピンも含まれます。



All resistor values are nominal.
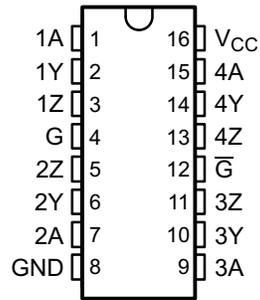
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**回路図（各ドライバ）**

English Data Sheet: SLLS114

# Table of Contents

Product Folder Links: *AM26LS31 AM26LS31M*

English Data Sheet: SLLS114

# 4 Pin Configuration and Functions

```
        ┌───∪───┐
1A  [ 1      16 ]  V_CC
1Y  [ 2      15 ]  4A
1Z  [ 3      14 ]  4Y
 G  [ 4      13 ]  4Z
2Z  [ 5      12 ]  G̅
2Y  [ 6      11 ]  3Z
2A  [ 7      10 ]  3Y
GND [ 8       9 ]  3A
        └───────┘
```

**図 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) |
| G̅ | 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 |

**図 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 |

Product Folder Links: *AM26LS31 AM26LS31M*

English Data Sheet: SLLS114

# 5 Specifications

## 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1]

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage[2] | | | 7 | V |
| $V_I$ | 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 |
| $T_{stg}$ | 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 $V_{OD}$, are with respect to network GND.

## 5.2 ESD Ratings

| | | | VALUE | UNIT |
|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1] | ±2000 | V |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101[2] | ±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 |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | AM26LS31C | 4.75 | 5 | 5.25 | V |
| | | AM26LS31M | 4.5 | 5 | 5.5 | |
| $V_{IH}$ | High-level input voltage | | 2 | | | V |
| $V_{IL}$ | Low-level input voltage | | | | 0.8 | V |
| $I_{OH}$ | High-level output current | | | | –20 | mA |
| $I_{OL}$ | Low-level output current | | | | 20 | mA |
| $T_A$ | Operating free-air temperature | AM26LS31C | 0 | | 70 | °C |
| | | AM26LS31I | –40 | | 85 | |
| | | AM26LS31M | –55 | | 125 | |

## 5.4 Thermal Information

| | | AM26LS31x | | | | |
|---|---|---|---|---|---|---|
| **THERMAL METRIC**[1] | | **D (SOIC)** | **DB (SSOP)** | **N (PDIP)** | **NS (SO)** | **UNIT** |
| | | **16 PINS** | **16 PINS** | **16 PINS** | **16 PINS** | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance[2] | 84.6 | 82 | 60.6 | 88.5 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 43.5 | – | 48.1 | 46.2 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 43.2 | – | 40.6 | 50.7 | °C/W |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 10.4 | – | 27.5 | 13.5 | °C/W |
| $\psi_{JB}$ | 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)[1]

| | PARAMETER | TEST CONDITIONS | | MIN | TYP[2] | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{IK}$ | Input clamp voltage | $V_{CC}$ = MIN, $I_I$ = –18mA | | | | −1.5 | V |
| $V_{OH}$ | High-level output voltage | $V_{CC}$ = MIN, $I_{OH}$ = –20mA | | 2.5 | | | V |
| $V_{OL}$ | Low-level output voltage | $V_{CC}$ = MIN, $I_{OL}$ = 20mA | | | | 0.5 | V |
| $I_{OZ}$ | Off-state (high-impedance-state) output current | $V_{CC}$ = MIN, | $V_O$ = 0.5V | | | −20 | µA |
| | | | $V_O$ = 2.5V | | | 20 | |
| $I_I$ | Input current at maximum input voltage | $V_{CC}$ = MAX, $V_I$ = 7V | | | | 0.1 | mA |
| $I_{IH}$ | High-level input current | $V_{CC}$ = MAX, $V_I$ = 2.7V | | | | 20 | µA |
| $I_{IL}$ | Low-level input current | $V_{CC}$ = MAX, $V_I$ = 0.4V | | | | −0.36 | mA |
| $I_{OS}$ | Short-circuit output current[3] | $V_{CC}$ = MAX | | −30 | | −150 | mA |
| $I_{CC}$ | Supply current | $V_{CC}$ = 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 $V_{CC}$ = 5V and $T_A$ = 25°C.
(3)    Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

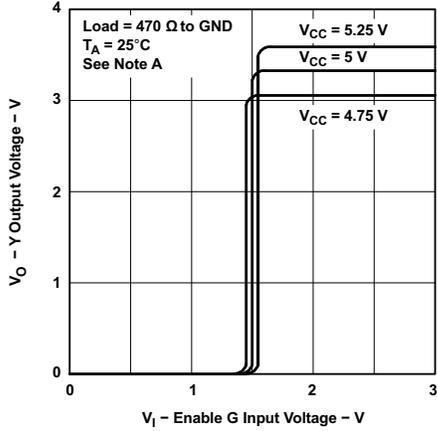## 5.6 Switching Characteristics – AM26LS31

$T_A$ = 25°C, $V_{CC}$ = 5V (see 図 6-1)

| | PARAMETER | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time, low- to high-level output | $C_L$ = 30pF, 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 | $C_L$ = 30pF | $R_L$ = 75Ω | | 25 | 40 | ns |
| $t_{PZL}$ | Output enable time to low level | | $R_L$ = 180Ω | | 37 | 45 | |
| $t_{PHZ}$ | Output disable time from high level | $C_L$ = 10pF, S1 and S2 closed | | | 21 | 30 | ns |
| $t_{PLZ}$ | Output disable time from low level | | | | 23 | 35 | |
| $t_{SKEW}$ | Output-to-output skew | $C_L$ = 30pF, S1 and S2 open | | | 1 | 6 | ns |

## 5.7 Switching Characteristics – AM26LS31M

$T_A$ = 25°C, $V_{CC}$ = 5V (see 図 6-1)

| | PARAMETER | TEST CONDITIONS | | MIN | MAX | UNIT |
|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time, low- to high-level output | $C_L$ = 30pF, 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 | $C_L$ = 30pF | $R_L$ = 75Ω | | 60 | ns |
| $t_{PZL}$ | Output enable time to low level | | $R_L$ = 180Ω | | 68 | |
| $t_{PHZ}$ | Output disable time from high level | $C_L$ = 10pF, S1 and S2 closed | | | 45 | ns |
| $t_{PLZ}$ | Output disable time from low level | | | | 53 | |
| $t_{SKEW}$ | Output-to-output skew | $C_L$ = 30pF, S1 and S2 open | | | 9 | ns |

Product Folder Links: *AM26LS31 AM26LS31M*

English Data Sheet: SLLS114
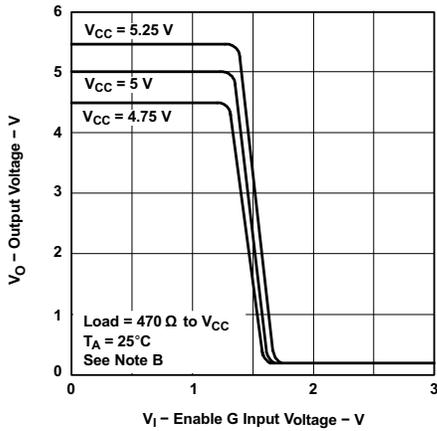
## 5.8 Typical Characteristics



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

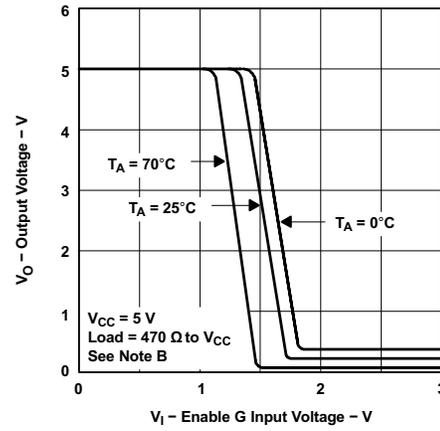**図 5-1. Output Voltage vs Enable G Input Voltage**



A. The A input is connected to $V_{CC}$ during testing of the Y outputs and to ground during testing of the Z outputs.
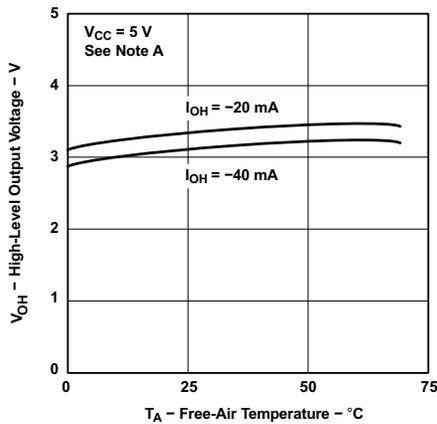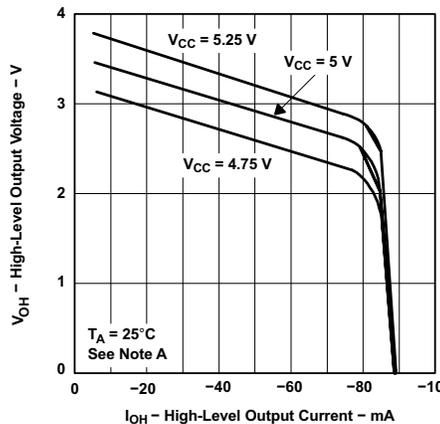
**図 5-2. Output Voltage vs Enable G Input Voltage**



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

**図 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.

**図 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.
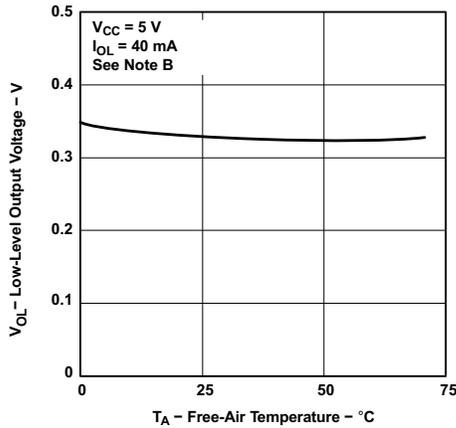
**図 5-5. High-Level Output Voltage vs Free-Air Temperature**



A. The A input is connected to $V_{CC}$ during testing of the Y outputs and to ground during testing of the Z outputs.
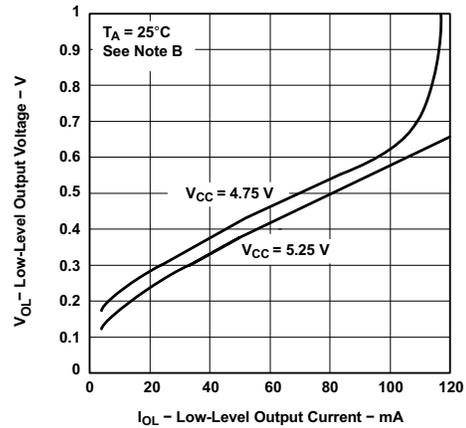
**図 5-6. High-Level Output Voltage vs High-Level Output Current**
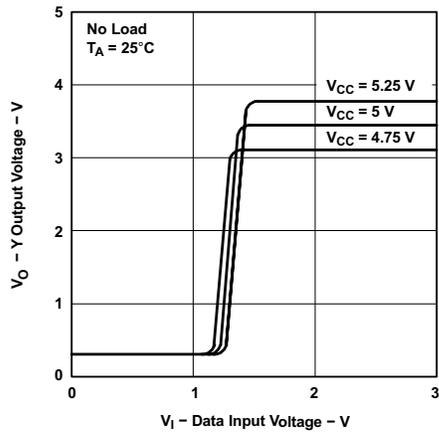
## 5.8 Typical Characteristics (continued)



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

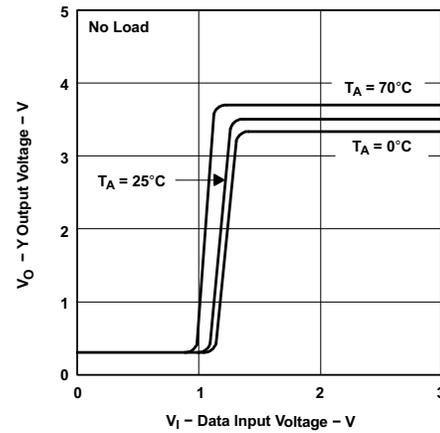**図 5-7. Low-Level Output Voltage vs Free-Air Temperature**



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

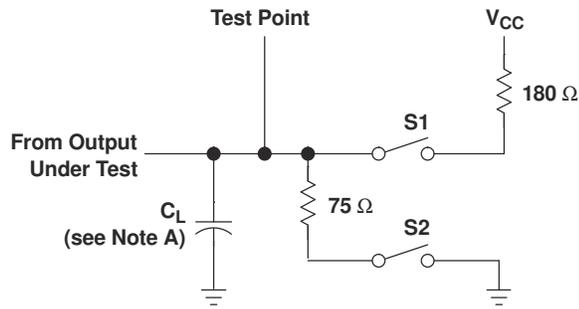**図 5-8. Low-Level Output Voltage vs Low-Level Output Current**



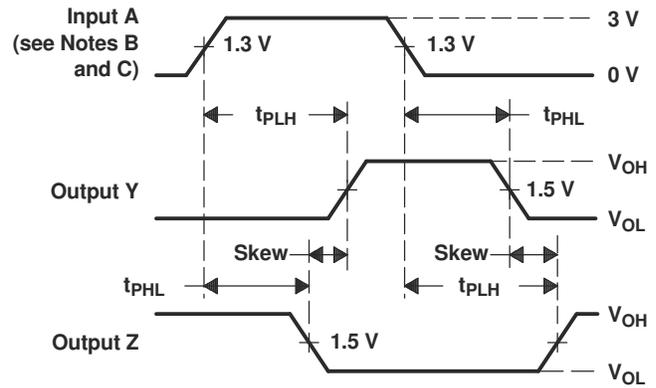**図 5-9. Y Output Voltage vs Data Input Voltage**



**図 5-10. Y Output Voltage vs Data Input Voltage**
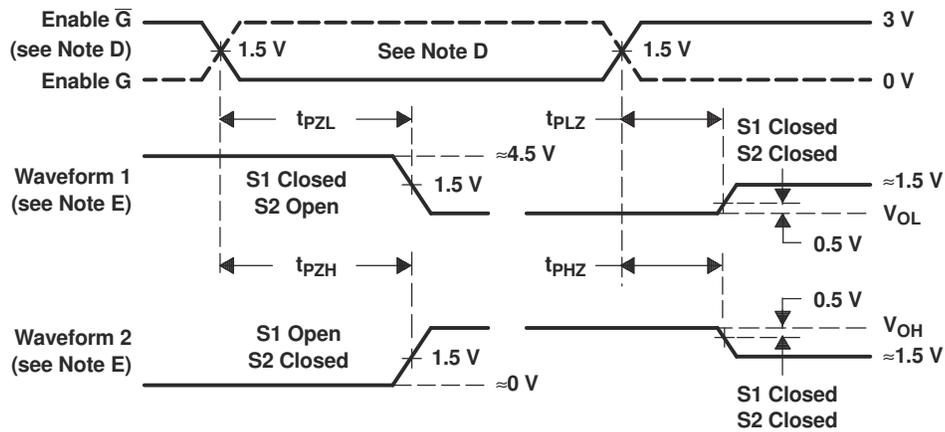
English Data Sheet: SLLS114

# 6 Parameter Measurement Information



PROPAGATION DELAY TIMES AND SKEW

TEST CIRCUIT

ENABLE AND DISABLE TIME WAVEFORMS

NOTES:  A.  $C_L$ includes probe and jig capacitance.
B.  All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, $Z_O$ ≈ 50 Ω, $t_r$ ≤ 15 ns, $t_f$ ≤ 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.

図 6-1. Test Circuit and Voltage Waveforms
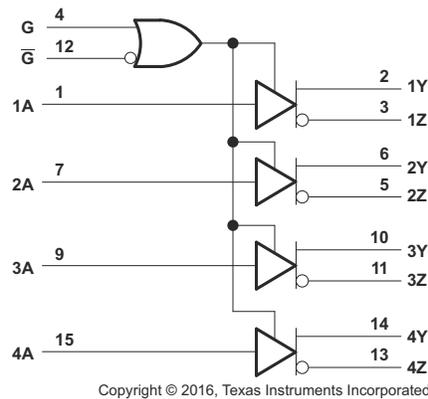
# 7 Detailed Description

## 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 ±30mA of sink or source current. The driver features positive- and negative-current limiting for protection from line fault conditions.

## 7.2 Functional Block Diagram



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## 7.3 Feature Description

### 7.3.1 Complementary Output-Enable Inputs

The AM26LS31x can be configured using the G and $\overline{G}$ logic inputs to control transmitter outputs. Setting either G to a logic HIGH or $\overline{G}$ to an logic LOW enables the transmitter outputs. If G is set to logic LOW and $\overline{G}$ 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 $\overline{G}$, 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.

Product Folder Links: *AM26LS31 AM26LS31M*

English Data Sheet: SLLS114

## 7.4 Device Functional Modes

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

**表 7-1. Function Table**[1]
**(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 |

(1)  H = high level, L = low level,
X = irrelevant,
Z = high impedance (off)
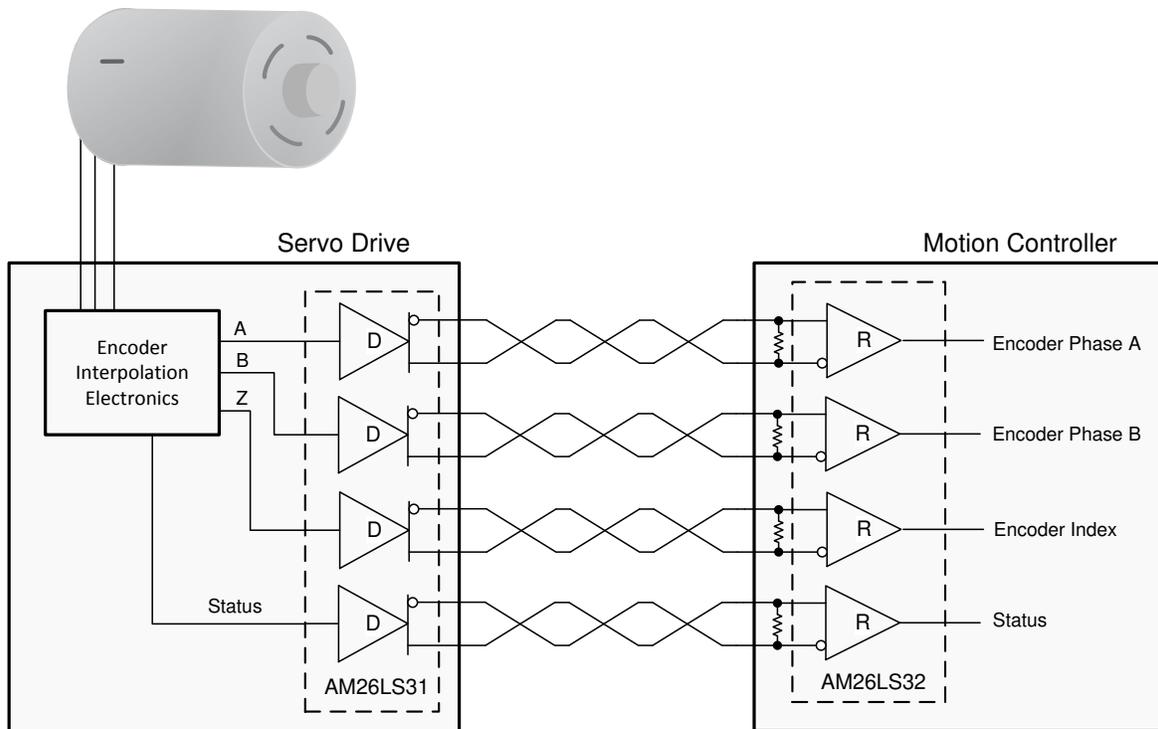
## 8 Application and Implementation

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注

以下のアプリケーション情報は、TI の製品仕様に含まれるものではなく、TI ではその正確性または完全性を
保証いたしません。個々の目的に対する製品の適合性については、お客様の責任で判断していただくことに
なります。お客様は自身の設計実装を検証しテストすることで、システムの機能を確認する必要があります。

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### 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 100Ω, 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



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**図 8-1. Encoder Application**

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Product Folder Links: *AM26LS31 AM26LS31M*

English Data Sheet: SLLS114

### 8.2.1 Design Requirements
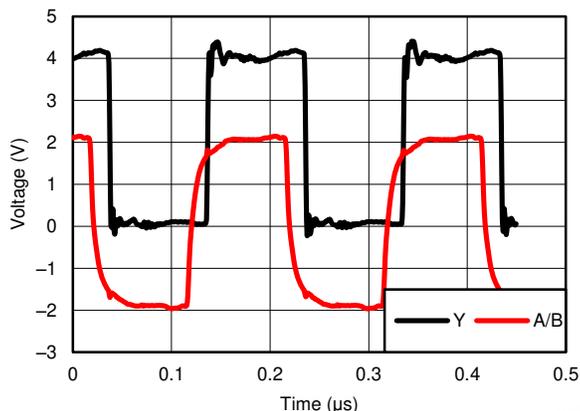
This example requires the following:
- 5V power source
- RS-485 bus operating at 10Mbps or less
- Connector that makes sure the correct polarity for port pins

### 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 *Failsafe in RS-485 data buses*).

### 8.2.3 Application Curve



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

## 8.3 Power Supply Recommendations

Place a 0.1μF bypass capacitors close to the power-supply pins to reduce errors coupling in from noisy or high impedance power supplies.
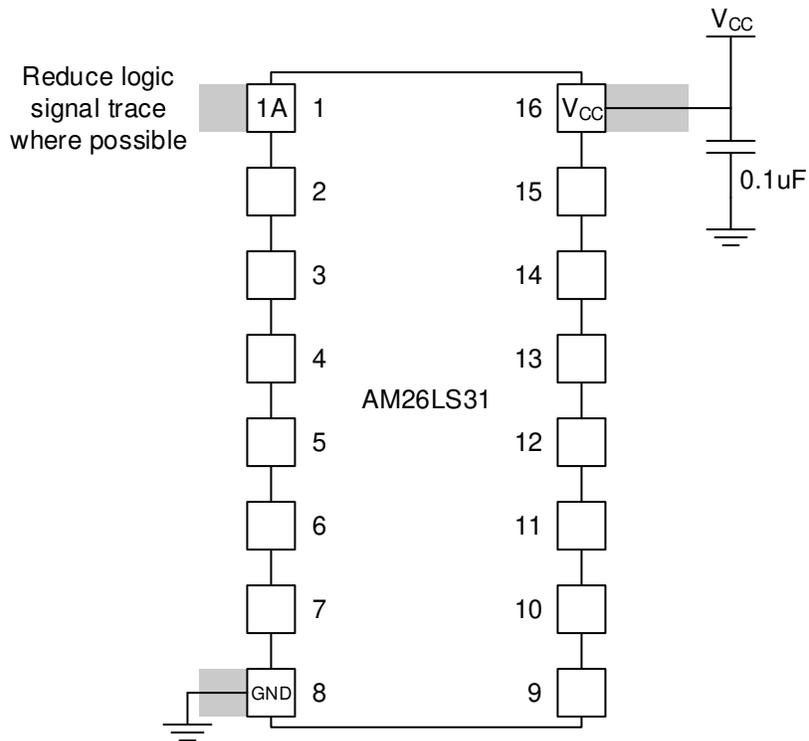
## 8.4 Layout

### 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, 0.1μF 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



**図 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 ドキュメントの更新通知を受け取る方法

ドキュメントの更新についての通知を受け取るには、www.tij.co.jp のデバイス製品フォルダを開いてください。[通知] をクリックして登録すると、変更されたすべての製品情報に関するダイジェストを毎週受け取ることができます。変更の詳細については、改訂されたドキュメントに含まれている改訂履歴をご覧ください。

## 9.3 サポート・リソース

テキサス・インスツルメンツ E2E™ サポート・フォーラムは、エンジニアが検証済みの回答と設計に関するヒントをエキスパートから迅速かつ直接得ることができる場所です。既存の回答を検索したり、独自の質問をしたりすることで、設計で必要な支援を迅速に得ることができます。

リンクされているコンテンツは、各寄稿者により「現状のまま」提供されるものです。これらはテキサス・インスツルメンツの仕様を構成するものではなく、必ずしもテキサス・インスツルメンツの見解を反映したものではありません。テキサス・インスツルメンツの使用条件を参照してください。

## 9.4 Trademarks

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すべての商標は、それぞれの所有者に帰属します。

## 9.5 静電気放電に関する注意事項

この IC は、ESD によって破損する可能性があります。テキサス・インスツルメンツは、IC を取り扱う際には常に適切な注意を払うことを推奨します。正しい取り扱いおよび設置手順に従わない場合、デバイスを破損するおそれがあります。

ESD による破損は、わずかな性能低下からデバイスの完全な故障まで多岐にわたります。精密な IC の場合、パラメータがわずかに変化するだけで公表されている仕様から外れる可能性があるため、破損が発生しやすくなっています。

## 9.6 用語集

テキサス・インスツルメンツ用語集　　この用語集には、用語や略語の一覧および定義が記載されています。

# 10 Revision History

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

**Changes from Revision J (January 2014) to Revision K (February 2014)** **Page**

**Changes from Revision I (February 2006) to Revision J (January 2014)** **Page**

## 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.

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## PACKAGING INFORMATION

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

| Orderable part number | Status (1) | Material type (2) | Package \| Pins | Package qty \| Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---|---|---|---|---|---|---|---|---|---|
| AM26LS31MFKB.A | Active | Production | LCCC (FK) \| 20 | 55 \| TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-7802301M2A AM26LS31 MFKB |
| AM26LS31MJB | Active | Production | CDIP (J) \| 16 | 25 \| TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-7802301ME A AM26LS31MJB |
| AM26LS31MJB.A | Active | Production | CDIP (J) \| 16 | 25 \| TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-7802301ME A AM26LS31MJB |
| AM26LS31MWB | Active | Production | CFP (W) \| 16 | 25 \| TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-7802301MF A AM26LS31MWB |
| AM26LS31MWB.A | Active | Production | CFP (W) \| 16 | 25 \| TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-7802301MF A AM26LS31MWB |

(1) **Status:** For more details on status, see our product life cycle.

(2) **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.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **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.

(5) **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.

(6) **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.

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**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

# PACKAGE MATERIALS INFORMATION

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

**TAPE DIMENSIONS**

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

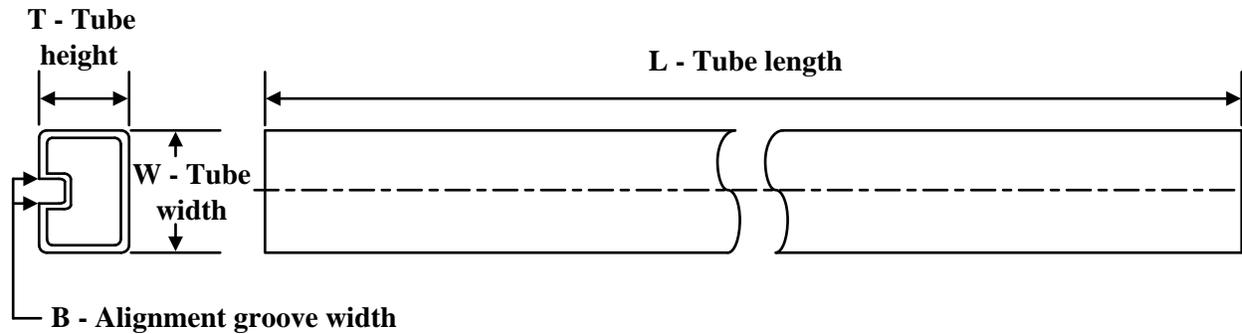**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

*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 |
| AM26LS31INSR | SOP | NS | 16 | 2000 | 330.0 | 16.4 | 8.1 | 10.4 | 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 | 353.0 | 353.0 | 32.0 |
| AM26LS31CDR | SOIC | D | 16 | 2500 | 353.0 | 353.0 | 32.0 |
| AM26LS31CDR | SOIC | D | 16 | 2500 | 340.5 | 336.1 | 32.0 |
| AM26LS31CNSR | SOP | NS | 16 | 2000 | 353.0 | 353.0 | 32.0 |
| AM26LS31INSR | SOP | NS | 16 | 2000 | 353.0 | 353.0 | 32.0 |

## TUBE



T - Tube height

L - Tube length

W - Tube width

B - Alignment groove width

*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 |
| 5962-7802301Q2A.A | FK | LCCC | 20 | 55 | 506.98 | 12.06 | 2030 | NA |
| AM26LS31CN | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| AM26LS31CN.A | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| AM26LS31MFKB | FK | LCCC | 20 | 55 | 506.98 | 12.06 | 2030 | NA |
| AM26LS31MFKB.A | FK | LCCC | 20 | 55 | 506.98 | 12.06 | 2030 | NA |
| AM26LS31MWB | W | CFP | 16 | 25 | 506.98 | 26.16 | 6220 | NA |
| AM26LS31MWB.A | W | CFP | 16 | 25 | 506.98 | 26.16 | 6220 | NA |

W (R−GDFP−F16)                                                CERAMIC DUAL FLATPACK

Base and Seating Plane

$\dfrac{0.045\ (1,14)}{0.026\ (0,66)}$

$\dfrac{0.285\ (7,24)}{0.245\ (6,22)}$

$\dfrac{0.080\ (2,03)}{0.055\ (1,40)}$

$\dfrac{0.008\ (0,20)}{0.004\ (0,10)}$

0.305 (7,75) MAX

1                16

$\dfrac{0.019\ (0,48)}{0.015\ (0,38)}$

$\dfrac{0.430\ (10,92)}{0.370\ (9,40)}$

0.050 (1,27)

0.005 (0,13) MIN
4 Places

8                9

$\dfrac{0.360\ (9,14)}{0.250\ (6,35)}$                          $\dfrac{0.360\ (9,14)}{0.250\ (6,35)}$

4040180−3/F   04/14

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

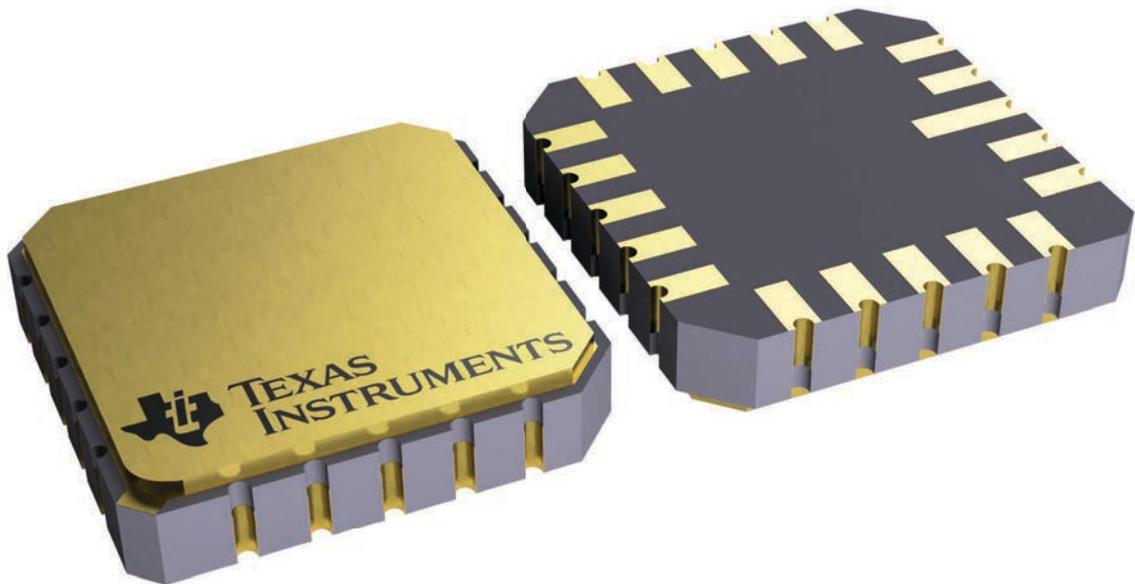This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4229370\VA\

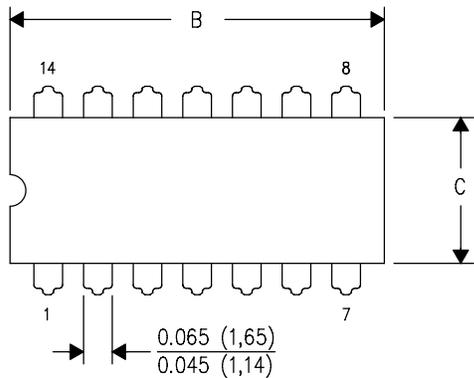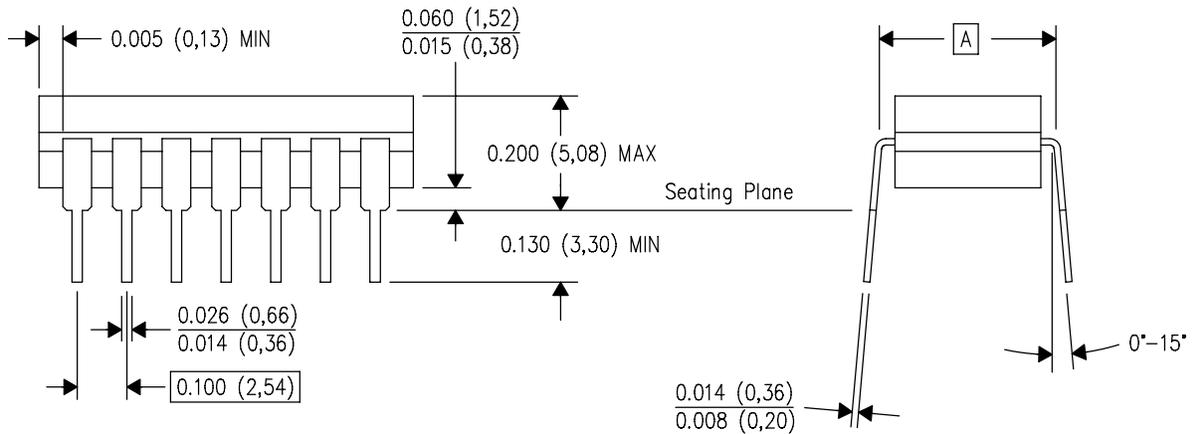J (R—GDIP—T**)                    CERAMIC DUAL IN—LINE PACKAGE
14 LEADS SHOWN

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

B

14                    8

1                     7

0.065 (1,65)
0.045 (1,14)

C

0.005 (0,13) MIN

0.060 (1,52)
0.015 (0,38)

0.200 (5,08) MAX

Seating Plane

0.130 (3,30) MIN

0.026 (0,66)
0.014 (0,36)

0.100 (2,54)

A

0°—15°

0.014 (0,36)
0.008 (0,20)

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

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

0.260 (6,60) / 0.240 (6,10)

0.070 (1,78) / 0.045 (1,14) ⚠D

0.045 (1,14) / 0.030 (0,76) ⚠D

0.020 (0,51) MIN

0.200 (5,08) MAX

Seating Plane

0.125 (3,18) MIN

0.100 (2,54)

0.021 (0,53) / 0.015 (0,38)

⊕ 0.010 (0,25) Ⓜ

0.325 (8,26) / 0.300 (7,62)

0.015 (0,38)

Gauge Plane

0.010 (0,25) NOM

0.430 (10,92) MAX

14/18 Pin Only
20 Pin vendor option ⚠D

4040049/E  12/2002

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

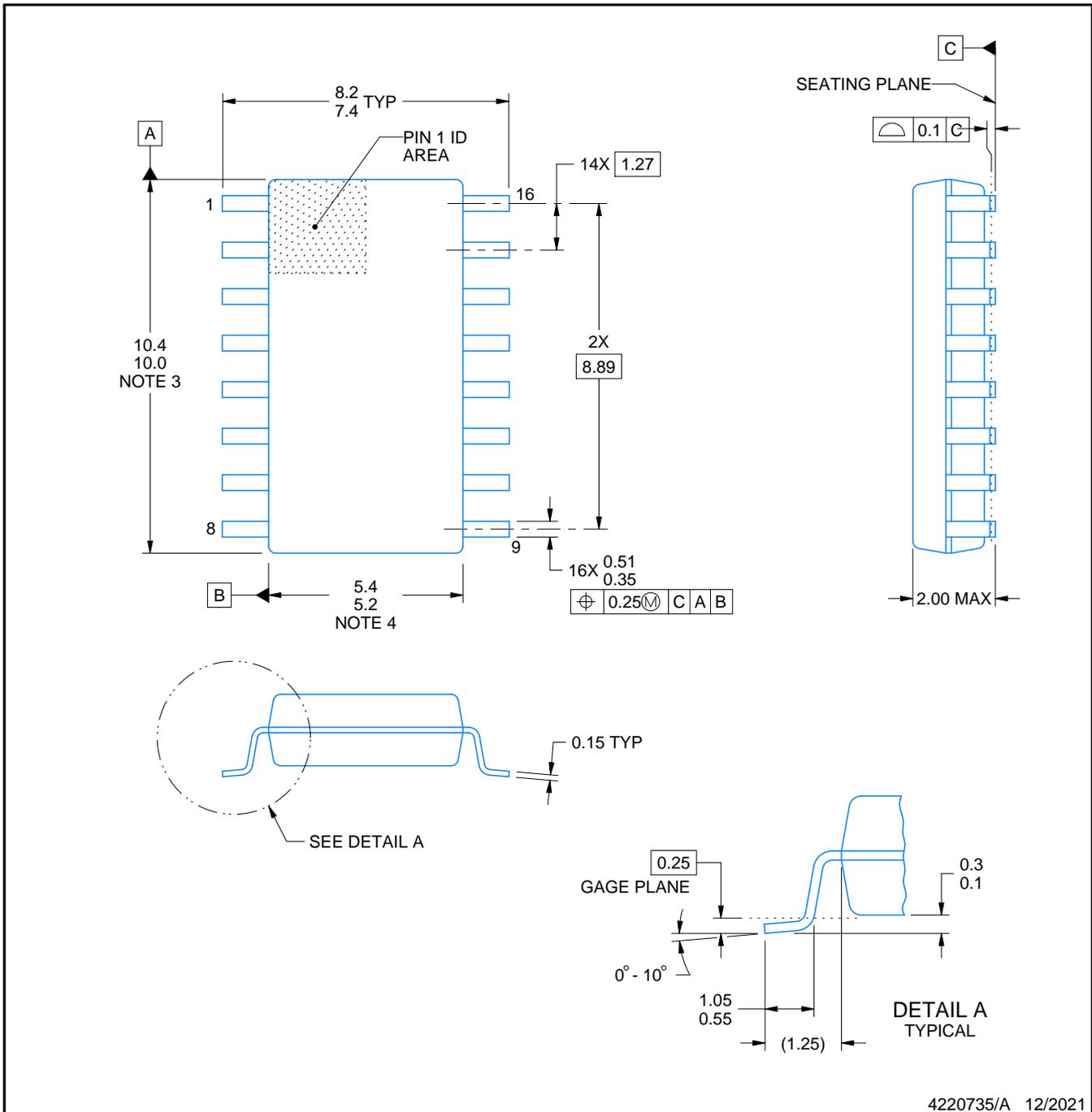**NS0016A**

C

SEATING PLANE

⌒ 0.1 C

8.2
7.4 TYP

A

PIN 1 ID
AREA

14X 1.27

1

16

10.4
10.0
NOTE 3

2X
8.89

8

9

16X 0.51
0.35

⊕ 0.25Ⓜ C A B

B

5.4
5.2
NOTE 4

2.00 MAX

SEE DETAIL A

0.15 TYP

0.25

GAGE PLANE

0.3
0.1

0° - 10°

1.05
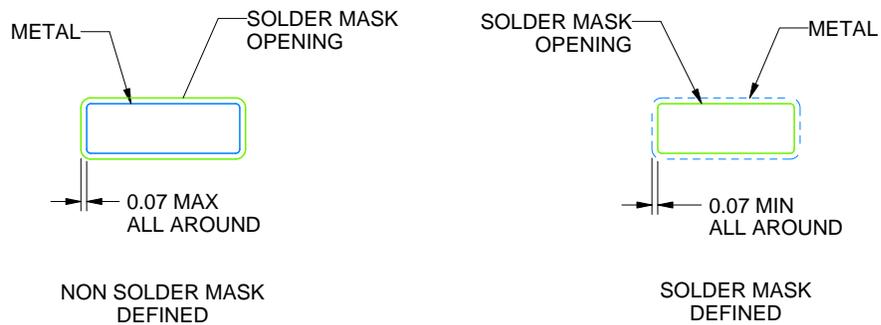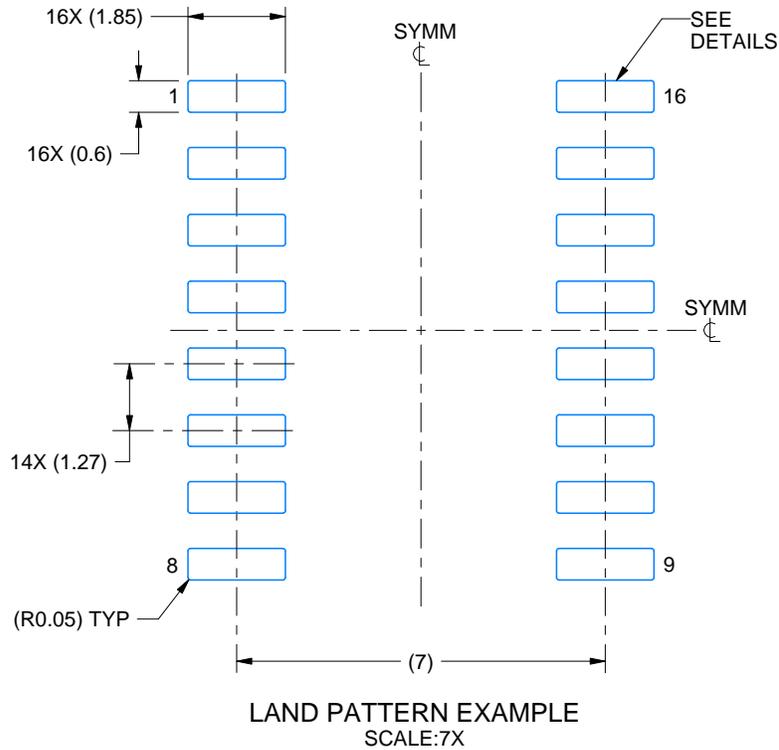0.55

(1.25)

DETAIL A
TYPICAL

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.

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1

16

16X (0.6)

SYMM

14X (1.27)

8

9

(R0.05) TYP

(7)

LAND PATTERN EXAMPLE
SCALE:7X

METAL

SOLDER MASK OPENING

SOLDER MASK OPENING

METAL

0.07 MAX
ALL AROUND

0.07 MIN
ALL AROUND

NON SOLDER MASK DEFINED

SOLDER MASK DEFINED

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.

16X (1.85)

SYMM

1

16X (0.6)

16

SYMM

14X (1.27)

8

9

(R0.05) TYP

(7)

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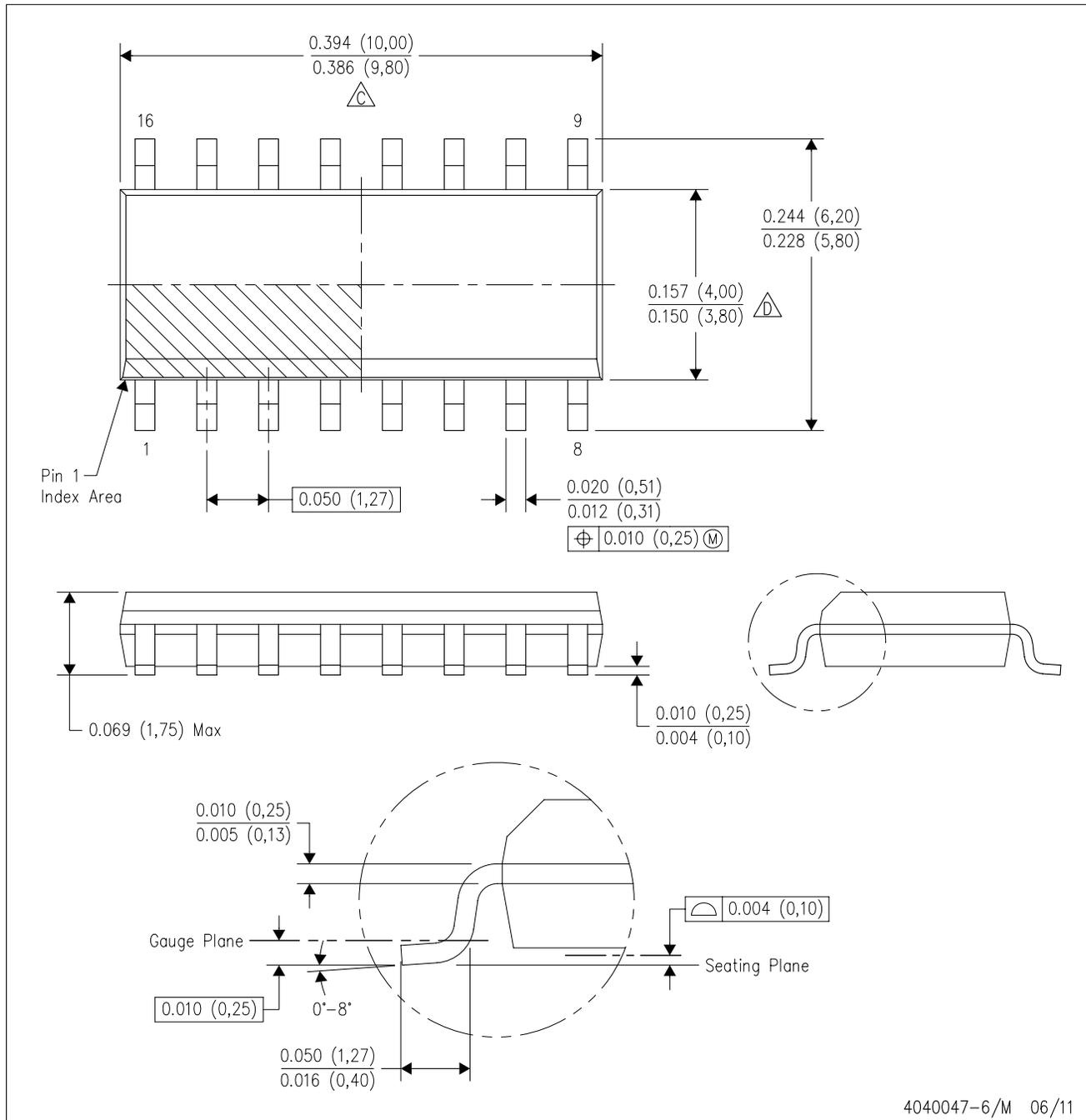BASED ON 0.125 mm THICK STENCIL
SCALE:7X

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



4040047−6/M   06/11

NOTES:   A.  All linear dimensions are in inches (millimeters).
         B.  This drawing is subject to change without notice.
         C.  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
         D.  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
         E.  Reference JEDEC MS−012 variation AC.
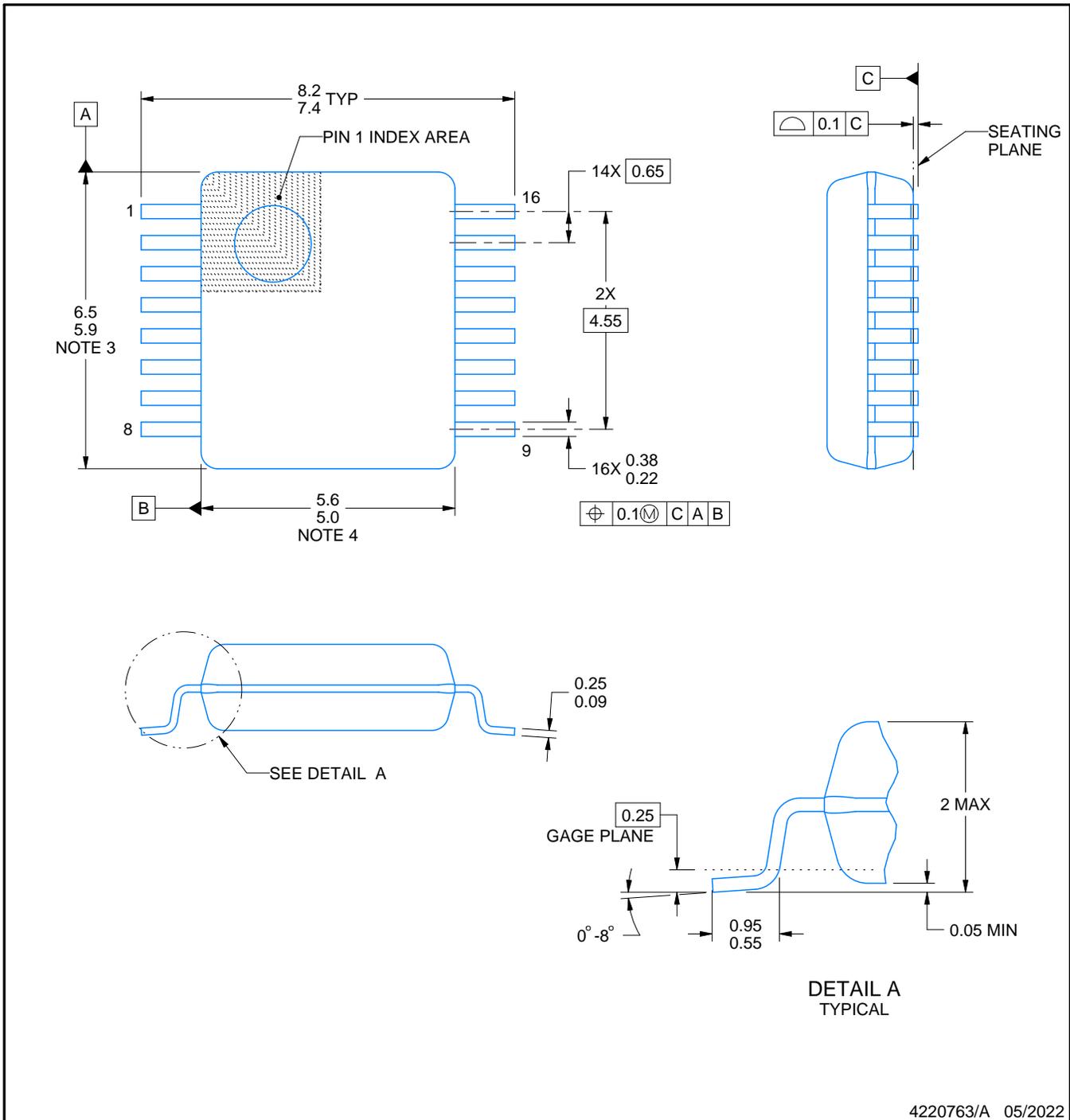
TEXAS INSTRUMENTS
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8.2 / 7.4 TYP

A

PIN 1 INDEX AREA

1

16

14X 0.65

2X 4.55

6.5 / 5.9 NOTE 3

8

9

16X 0.38 / 0.22

B

5.6 / 5.0 NOTE 4

⊕ 0.1 Ⓜ C A B

C

⌒ 0.1 C

SEATING PLANE

0.25 / 0.09

SEE DETAIL A

0.25

GAGE PLANE

0°-8°

0.95 / 0.55

2 MAX

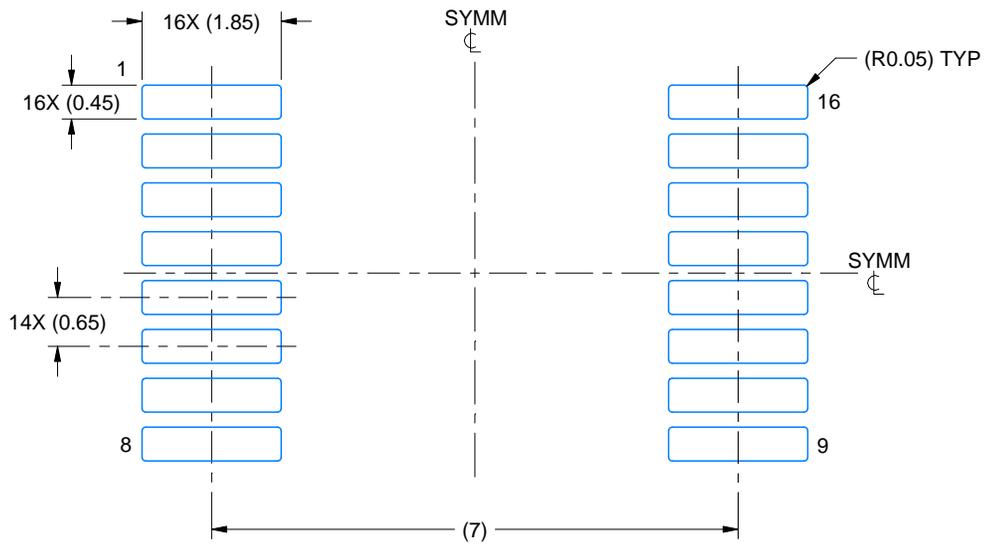0.05 MIN

**DETAIL A**
TYPICAL

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.

16X (1.85)

1

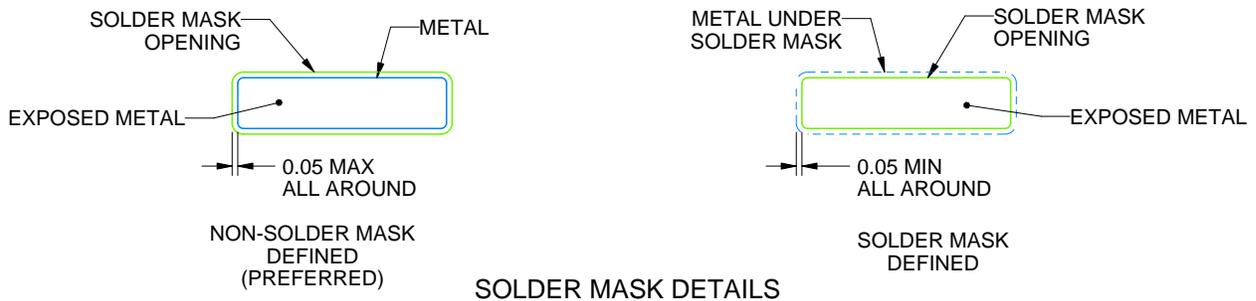16X (0.45)

SYMM

(R0.05) TYP

16

SYMM

14X (0.65)

8

9

(7)

**LAND PATTERN EXAMPLE**
EXPOSED METAL SHOWN
SCALE: 10X

SOLDER MASK OPENING

METAL

EXPOSED METAL

0.05 MAX
ALL AROUND

NON-SOLDER MASK
DEFINED
(PREFERRED)

METAL UNDER
SOLDER MASK

SOLDER MASK
OPENING

EXPOSED METAL

0.05 MIN
ALL AROUND

SOLDER MASK
DEFINED

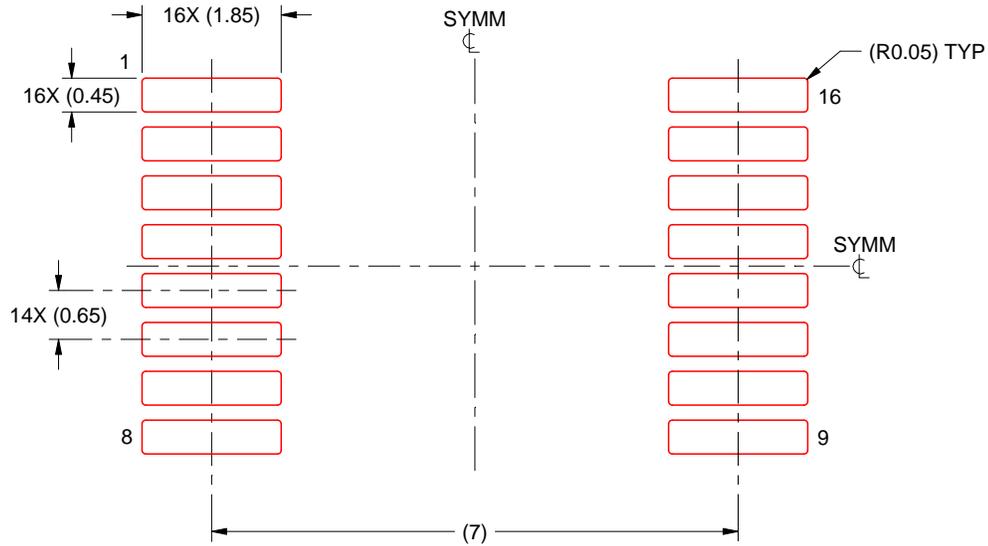**SOLDER MASK DETAILS**

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.

## DB0016A

16X (1.85)

1

16X (0.45)

SYMM

(R0.05) TYP

16

SYMM

14X (0.65)

8

9

(7)

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.

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