

## DS26F31MQML Quad High Speed Differential Line Drivers

Check for Samples: [DS26F31MQML](#)

### FEATURES

- Operation from Single +5.0V Supply
- Outputs Won't Load Line When  $V_{CC} = 0V$
- Output Short Circuit Protection
- Meets the Requirements of EIA Standard RS-422
- High Output Drive Capability for 100 $\Omega$  Terminated Transmission Lines

### DESCRIPTION

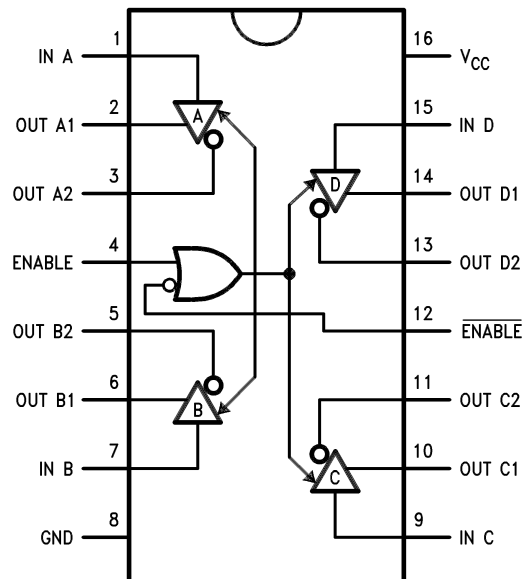
The DS26F31M is a quad differential line driver designed for digital data transmission over balanced lines. The DS26F31M meets all the requirements of EIA Standard RS-422 and Federal Standard 1020. It is designed to provide unipolar differential drive to twisted-pair or parallel-wire transmission lines.

The DS26F31M offers improved performance due to the use of state-of-the-art L-FAST bipolar technology. The L-FAST technology allows for higher speeds and lower currents by utilizing extremely short gate delay times. Thus, the DS26F31M features lower power, extended temperature range, and improved specifications.

The circuit provides an enable and disable function common to all four drivers. The DS26F31M features TRI-STATE outputs and logical OR-ed complementary enable inputs. The inputs are all LS compatible and are all one unit load.

The DS26F31M offers optimum performance when used with the DS26F32 Quad Differential Line Receiver.

### Connection and Logic Diagrams



**Figure 1. 16-Lead CDIP Package- Top View**  
See Package Numbers NFE0016A, NAD0016A, NAC0016A

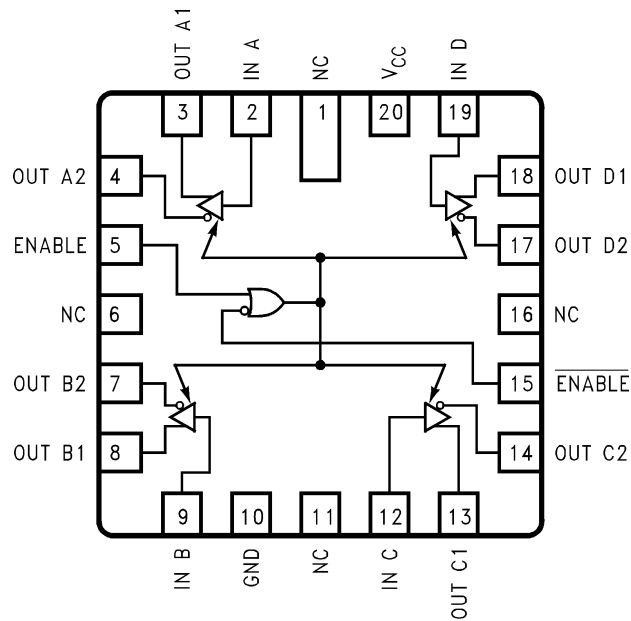


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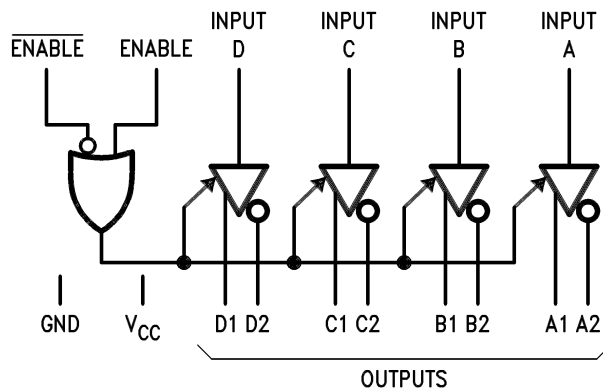
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**Figure 2. 20-Lead LCCC Package**  
See Package Number NAJ0020A



**Figure 3. Logic Symbol**



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### Absolute Maximum Ratings<sup>(1)</sup>

|                                                  |                                                          |
|--------------------------------------------------|----------------------------------------------------------|
| Storage Temperature Range                        | $-65^{\circ}\text{C} \leq T_A \leq +175^{\circ}\text{C}$ |
| Lead Temperature (Soldering, 60 sec.)            | 300°C                                                    |
| Supply Voltage                                   | 7.0V                                                     |
| Input Voltage                                    | 7.0V                                                     |
| Output Voltage                                   | 5.5V                                                     |
| Maximum Power Dissipation at 25°C <sup>(2)</sup> | 450mW                                                    |
| Thermal Resistance                               |                                                          |
| $\theta_{JA}$                                    |                                                          |
| NFE0016A, derate above +25°C @ 11.4mW/°C         | 88°C/mW                                                  |
| NAD0016A, derate above +25°C @ 6.6 mW/°C         | 151°C/mW                                                 |
| NAJ0020A, derate above +25°C @ 12.3 mW/°C        | 81°C/mW                                                  |
| $\theta_{JC}$                                    |                                                          |
| NFE0016A                                         | 14°C/mW                                                  |
| NAD0016A                                         | 13°C/mW                                                  |
| NAJ0020A                                         | 15°C/mW                                                  |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not verify specific performance limits. For verified specifications and test conditions, see the Electrical Characteristics. The verified specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (2) Power dissipation must be externally controlled at elevated temperatures.

### Recommended Operating Range

|                |                                                          |
|----------------|----------------------------------------------------------|
| Temperature    | $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ |
| Supply Voltage | 4.5V to 5.5V                                             |

**Table 1. Radiation Features**

|                 |              |
|-----------------|--------------|
| DS26F31MJFQMLV  | 300 krad(Si) |
| DS26F31MWFQMLV  | 300 krad(Si) |
| DS26F31MWGFQMLV | 300 krad(Si) |

### Quality Conformance Inspection

**Table 2. Mil-Std-883, Method 5005 - Group A**

| Subgroup | Description         | Temp °C |
|----------|---------------------|---------|
| 1        | Static tests at     | 25      |
| 2        | Static tests at     | 125     |
| 3        | Static tests at     | -55     |
| 4        | Dynamic tests at    | 25      |
| 5        | Dynamic tests at    | 125     |
| 6        | Dynamic tests at    | -55     |
| 7        | Functional tests at | 25      |
| 8A       | Functional tests at | 125     |
| 8B       | Functional tests at | -55     |
| 9        | Switching tests at  | 25      |
| 10       | Switching tests at  | 125     |
| 11       | Switching tests at  | -55     |
| 12       | Settling time at    | 25      |
| 13       | Settling time at    | 125     |
| 14       | Settling time at    | -55     |

**DS26F31M Electrical Characteristics DC Parameters <sup>(1)</sup>**

| Parameter           |                              | Test Conditions                                                                                   | Notes | Min   | Max  | Units | Sub-groups |
|---------------------|------------------------------|---------------------------------------------------------------------------------------------------|-------|-------|------|-------|------------|
| V <sub>IH</sub>     | Logical "1" Input Voltage    | V <sub>CC</sub> = 4.5V                                                                            | (2)   | 2.0   |      | V     | 1, 2, 3    |
| V <sub>IL</sub>     | Logical "0" Input Voltage    | V <sub>CC</sub> = 5.5V                                                                            | (2)   |       | 0.8  | V     | 1, 2, 3    |
| V <sub>OH</sub>     | Logical "1" Output Voltage   | V <sub>CC</sub> = 4.5V, I <sub>OH</sub> = -20mA, V <sub>IL</sub> = 0.8V, V <sub>IH</sub> = 2V     |       | 2.5   |      | V     | 1, 2, 3    |
| V <sub>OL</sub>     | Logical "0" Output Voltage   | V <sub>CC</sub> = 4.5V, I <sub>OL</sub> = 20mA, V <sub>IL</sub> = 0.8V, V <sub>IH</sub> = 2V      |       |       | 0.5  | V     | 1, 2, 3    |
| I <sub>IH</sub>     | Logical "1" Input Current    | V <sub>CC</sub> = 5.5V, V <sub>I</sub> = 2.7V                                                     | (3)   | -2.0  | 20   | μA    | 1, 2, 3    |
| I <sub>IL</sub>     | Logical "0" Input Current    | V <sub>CC</sub> = 5.5V, V <sub>I</sub> = 0.4V                                                     | (3)   | 100   | -200 | μA    | 1, 2, 3    |
| I <sub>I</sub>      | Input Reverse Current        | V <sub>CC</sub> = 5.5V, V <sub>I</sub> = 7V                                                       | (3)   | -0.01 | 0.1  | mA    | 1, 2, 3    |
| I <sub>OZ</sub>     | TRI-STATE Output Current     | V <sub>CC</sub> = 5.5V, V <sub>O</sub> = 0.5V                                                     |       |       | -20  | μA    | 1, 2, 3    |
|                     |                              | V <sub>CC</sub> = 5.5V, V <sub>O</sub> = 2.5V                                                     |       |       | 20   | μA    | 1, 2, 3    |
| V <sub>I</sub>      | Input Clamp Voltage          | V <sub>CC</sub> = 4.5V, I <sub>I</sub> = -18mA                                                    |       |       | -1.5 | V     | 1, 2, 3    |
| I <sub>SC Min</sub> | Output Short Circuit Current | V <sub>CC</sub> = 5.5V, V <sub>O</sub> = 0V                                                       |       | -30   |      | mA    | 1, 2, 3    |
| I <sub>SC Max</sub> | Output Short Circuit Current | V <sub>CC</sub> = 5.5V, V <sub>O</sub> = 0V                                                       |       |       | -150 | mA    | 1, 2, 3    |
| I <sub>CC Dis</sub> | Power Supply Current         | V <sub>CC</sub> = 5.5V, V <sub>I</sub> = 0.8V or 2V, V <sub>En</sub> = 0.8V, V <sub>En</sub> = 2V |       |       | 50   | mA    | 1, 2, 3    |
| I <sub>CC En</sub>  | Power Supply Current         | V <sub>CC</sub> = 5.5V, V <sub>En</sub> = 2V, V <sub>En</sub> = 0.8V                              |       |       | 40   | mA    | 1, 2, 3    |

- (1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics, except as listed in the Post Radiation Limits Table — if applicable. Radiation end point limits for the noted parameters are specified only for the conditions, as specified.
- (2) Parameter tested go-no-go only.
- (3) The minimum limits apply to device Class Q & V. The limits specified for the INPUT LOW CURRENT represents the numerical range in which this parameter will pass.

**DS26F31M Electrical Characteristics AC Parameters - Propagation Delay Time**

The following conditions apply, unless otherwise specified.

AC: V<sub>CC</sub> = 5V, C<sub>L</sub> = 50pF or equivalent impedance provided by diode load

| Parameter        |                 | Test Conditions        | Notes | Min | Max | Units | Sub-groups |
|------------------|-----------------|------------------------|-------|-----|-----|-------|------------|
| t <sub>PLH</sub> | Input to Output | C <sub>L</sub> = 30pF  | (1)   |     | 16  | nS    | 9          |
|                  |                 |                        | (1)   |     | 24  | nS    | 10, 11     |
|                  |                 |                        | (2)   |     | 15  | nS    | 9          |
|                  |                 |                        | (2)   |     | 23  | nS    | 10, 11     |
| t <sub>PHL</sub> | Input to Output | C <sub>L</sub> = 30pF  | (1)   |     | 17  | nS    | 9          |
|                  |                 |                        | (1)   |     | 25  | nS    | 10, 11     |
|                  |                 |                        | (2)   |     | 15  | nS    | 9          |
|                  |                 |                        | (2)   |     | 23  | nS    | 10, 11     |
| t <sub>LZ</sub>  | Disable Time    | C <sub>L</sub> = 10 pF | (1)   |     | 38  | nS    | 9          |
|                  |                 |                        | (1)   |     | 56  | nS    | 10, 11     |
|                  |                 |                        | (2)   |     | 35  | nS    | 9          |
|                  |                 |                        | (2)   |     | 53  | nS    | 10, 11     |
| t <sub>HZ</sub>  | Disable Time    | C <sub>L</sub> = 10 pF | (1)   |     | 23  | nS    | 9          |
|                  |                 |                        | (1)   |     | 30  | nS    | 10, 11     |
|                  |                 |                        | (2)   |     | 20  | nS    | 9          |
|                  |                 |                        | (2)   |     | 27  | nS    | 10, 11     |

(1) Tested at 50pF, system capacitance exceed 10 and 30pF.

(2) Testing at 50pF specifies limits at 10 and 30pF.

## DS26F31M Electrical Characteristics AC Parameters - Propagation Delay Time (continued)

The following conditions apply, unless otherwise specified.

AC:  $V_{CC} = 5V$ ,  $C_L = 50pF$  or equivalent impedance provided by diode load

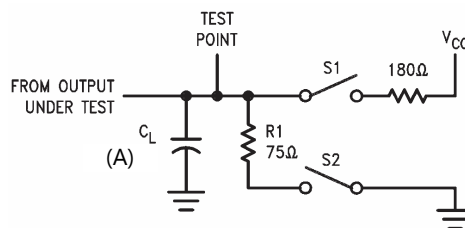
| Parameter |                  | Test Conditions | Notes | Min | Max | Units | Sub-groups |
|-----------|------------------|-----------------|-------|-----|-----|-------|------------|
| $t_{ZL}$  | Enable Time      | $C_L = 30pF$    | (1)   |     | 28  | nS    | 9          |
|           |                  |                 | (1)   |     | 40  | nS    | 10, 11     |
|           |                  |                 | (2)   |     | 25  | nS    | 9          |
|           |                  |                 | (2)   |     | 37  | nS    | 10, 11     |
| $t_{ZH}$  | Enable Time      | $C_L = 30 pF$   | (1)   |     | 32  | nS    | 9          |
|           |                  |                 | (1)   |     | 52  | nS    | 10, 11     |
|           |                  |                 | (2)   |     | 30  | nS    | 9          |
|           |                  |                 | (2)   |     | 50  | nS    | 10, 11     |
| Skew      | Output to Output | $C_L = 30pF$    | (1)   |     | 6.0 | nS    | 9          |
|           |                  |                 | (1)   |     | 9.0 | nS    | 10, 11     |
|           |                  |                 | (2)   |     | 4.5 | nS    | 9          |
|           |                  |                 | (2)   |     | 7.0 | nS    | 10, 11     |

## DS26F31M Electrical Characteristics DC Drift Parameters

This section applies to -QMLV devices only and shall be read & recorded at  $T_A = +25^\circ C$  before and after each burn-in & Subgroup B5, and shall not change by more than the limits indicated. The delta rejects shall be included in the PDA calculations.

| Parameter     |                            | Test Conditions                                                            | Notes | Min  | Max | Units | Sub-groups |
|---------------|----------------------------|----------------------------------------------------------------------------|-------|------|-----|-------|------------|
| $V_{OH}$      | Logical "1" Output Voltage | $V_{CC} = 4.5V$ , $I_{OH} = -20mA$ , $V_{IL} = 0.8V$ , $V_{IH} = 2V$ .     |       | -250 | 250 | mV    | 1          |
| $V_{OL}$      | Logical "0" Output Voltage | $V_{CC} = 4.5V$ , $I_{OL} = 20mA$ , $V_{IL} = 0.8V$ , $V_{IH} = 2V$ .      |       | -50  | 50  | mV    | 1          |
| $I_{CC\ En}$  | Power Supply Current       | $V_{CC} = 5.5V$ , $V_I = 0.8V$ or $2V$ , $V_{En} = 2V$ , $V_{En} = 0.8V$ . |       | -8.0 | 8.0 | mA    | 1          |
| $I_{CC\ Dis}$ | Power Supply Current       | $V_{CC} = 5.5V$ , $V_I = 0.8V$ or $2V$ , $V_{En} = 0.8V$ , $V_{En} = 2V$ . |       | -8.0 | 8.0 | mA    | 1          |

## TEST CIRCUIT AND TIMING WAVEFORMS

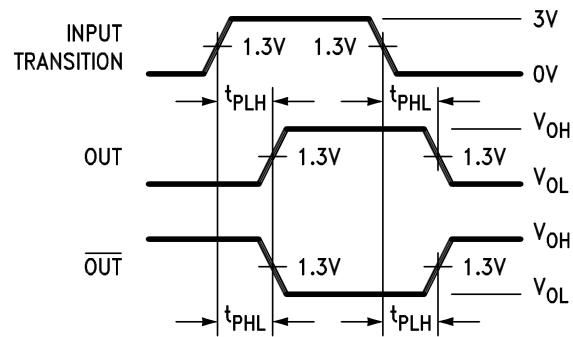


A. Parameter tested go-no-go only.

S1 and S2 of Load Circuit are closed except where shown.

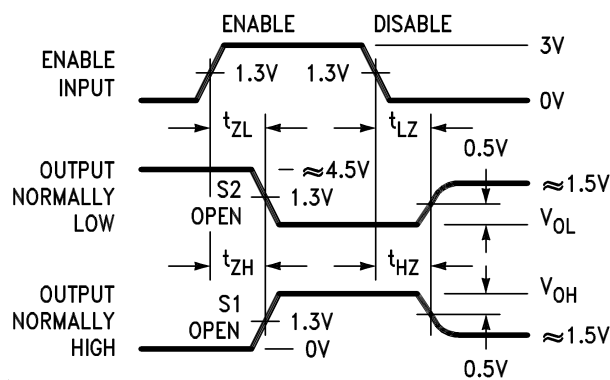
$C_L$  includes probe and jig capacitance.

**Figure 4. AC Load Test Circuit for TRI-STATE Outputs**



Pulse Generator for all Pulses: Rate  $\leq 1.0$  MHz,  $Z_O = 50\Omega$ ,  $t_r \leq 6.0$  ns,  $t_f \leq 6.0$  ns.

**Figure 5. Propagation Delay** <sup>(1)</sup> <sup>(2)</sup>



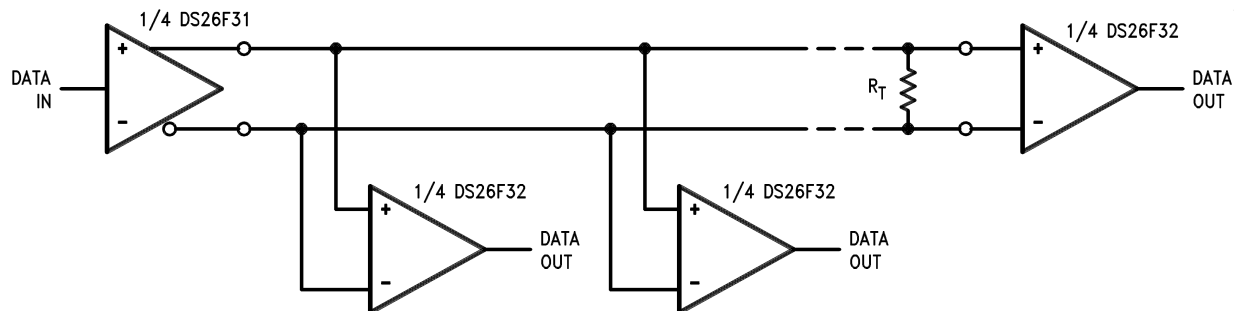
Pulse Generator for all Pulses: Rate  $\leq 1.0$  MHz,  $Z_O = 50\Omega$ ,  $t_r \leq 6.0$  ns,  $t_f \leq 6.0$  ns.

Diagram shown for Enable Low. Switches S1 and S2 open.

**Figure 6. Enable and Disable Times** <sup>(2)</sup>

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not verify specific performance limits. For verified specifications and test conditions, see the Electrical Characteristics. The verified specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (2) All currents into the device pins are positive; all currents out of the device pins are negative. All voltages are referenced to ground unless otherwise specified.

### TYPICAL APPLICATION



**Figure 7. Typical Application**

**REVISION HISTORY**

| Released  | Revision | Section                       | Originator | Changes                                                                                                |
|-----------|----------|-------------------------------|------------|--------------------------------------------------------------------------------------------------------|
| 3/01/06   | *        | New Release, Corporate format | L. Lytle   | 1 MDS data sheet converted into one Corp. data sheet format. MNDS26F31M-X-RH Rev 0B0 will be archived. |
| 4/15/2013 | A        |                               |            | Changed layout of National Data Sheet to TI format                                                     |

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)     | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)                                     | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|---------------------|--------------------------------------|----------------------|--------------|-------------------------------------------------------------|-------------------------|
| 5962-7802302M2A  | ACTIVE        | LCCC         | NAJ                | 20   | 50             | RoHS & Green        | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   | DS26F31ME/<br>883 Q<br>5962-78023<br>02M2A ACO<br>02M2A >T  | <a href="#">Samples</a> |
| 5962-7802302MFA  | ACTIVE        | CFP          | NAD                | 16   | 19             | Non-RoHS<br>& Green | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   | DS26F31MW<br>/883 Q<br>5962-78023<br>02MFA ACO<br>02MFA >T  | <a href="#">Samples</a> |
| 5962F7802302VFA  | ACTIVE        | CFP          | NAD                | 16   | 19             | Non-RoHS<br>& Green | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   | DS26F31MWF<br>QMLV Q<br>5962F78023<br>02VFA ACO<br>02VFA >T | <a href="#">Samples</a> |
| DS26F31ME/883    | ACTIVE        | LCCC         | NAJ                | 20   | 50             | RoHS & Green        | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   | DS26F31ME/<br>883 Q<br>5962-78023<br>02M2A ACO<br>02M2A >T  | <a href="#">Samples</a> |
| DS26F31MW/883    | ACTIVE        | CFP          | NAD                | 16   | 19             | Non-RoHS<br>& Green | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   | DS26F31MW<br>/883 Q<br>5962-78023<br>02MFA ACO<br>02MFA >T  | <a href="#">Samples</a> |
| DS26F31MWFQMLV   | ACTIVE        | CFP          | NAD                | 16   | 19             | Non-RoHS<br>& Green | Call TI                              | Level-1-NA-UNLIM     | -55 to 125   | DS26F31MWF<br>QMLV Q<br>5962F78023<br>02VFA ACO<br>02VFA >T | <a href="#">Samples</a> |

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm threshold requirement.

<sup>(3)</sup> MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

<sup>(5)</sup> Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

<sup>(6)</sup> Lead finish/Ball material - Orderable Devices 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.

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**OTHER QUALIFIED VERSIONS OF DS26F31MQML, DS26F31MQML-SP :**

- Military : [DS26F31MQML](#)
- Space : [DS26F31MQML-SP](#)

NOTE: Qualified Version Definitions:

- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

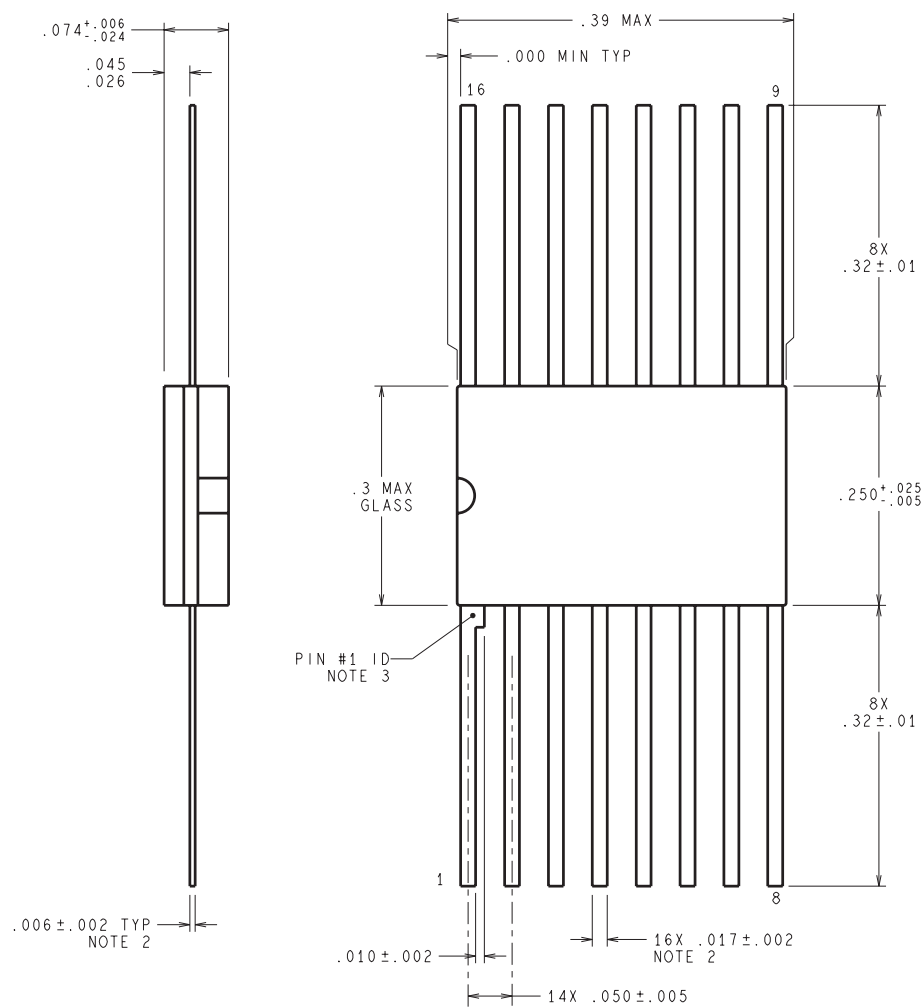
## TUBE



\*All dimensions are nominal

| Device          | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-7802302M2A | NAJ          | LCCC         | 20   | 50  | 470    | 11     | 3810   | 0      |
| 5962-7802302MFA | NAD          | CFP          | 16   | 19  | 502    | 23     | 9398   | 9.78   |
| 5962F7802302VFA | NAD          | CFP          | 16   | 19  | 502    | 23     | 9398   | 9.78   |
| DS26F31ME/883   | NAJ          | LCCC         | 20   | 50  | 470    | 11     | 3810   | 0      |
| DS26F31MW/883   | NAD          | CFP          | 16   | 19  | 502    | 23     | 9398   | 9.78   |
| DS26F31MWFQMLV  | NAD          | CFP          | 16   | 19  | 502    | 23     | 9398   | 9.78   |

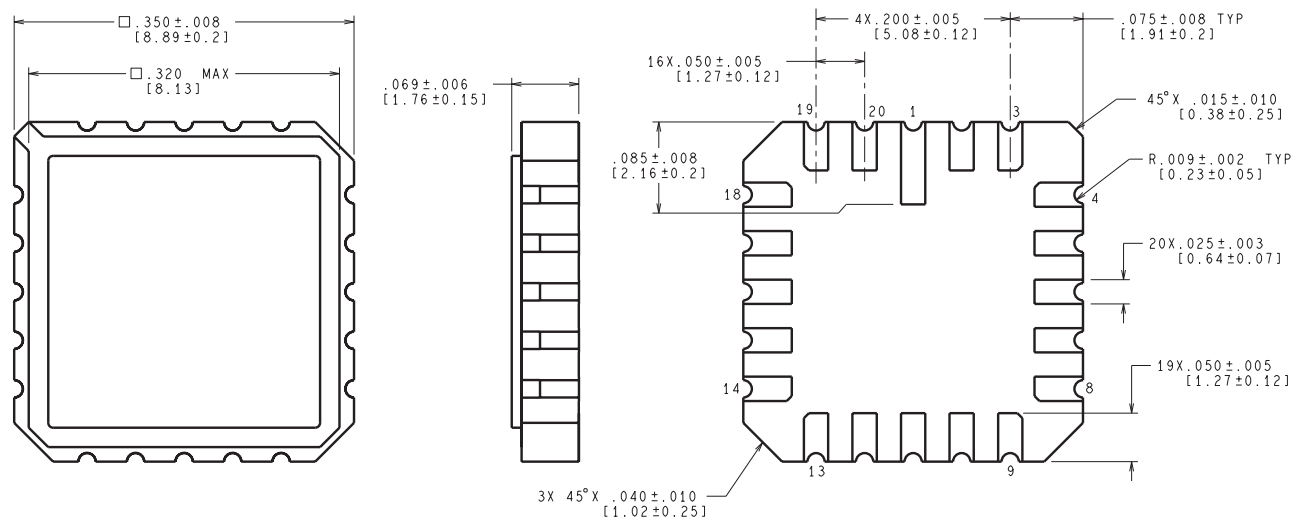
NAD0016A



DIMENSIONS ARE IN INCHES

W16A (Rev T)

NAJ0020A



CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

E20A (Rev F)

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