

DS26LS31MQML

Quad High Speed Differential Line Driver

General Description

The DS26LS31MQML is a quad differential line driver designed for digital data transmission over balanced lines. The DS26LS31MQML 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 circuit provides an enable and disable function common to all four drivers. The DS26LS31MQML features TRI-STATE[®] outputs and logically ANDed complementary outputs. The inputs are all LS compatible and are all one unit load.

The DS26LS31 features a power up/down protection circuit which keeps the output in a high impedance state (TRI-STATE) during power up or down preventing erroneous glitches on the transmission lines.

Features

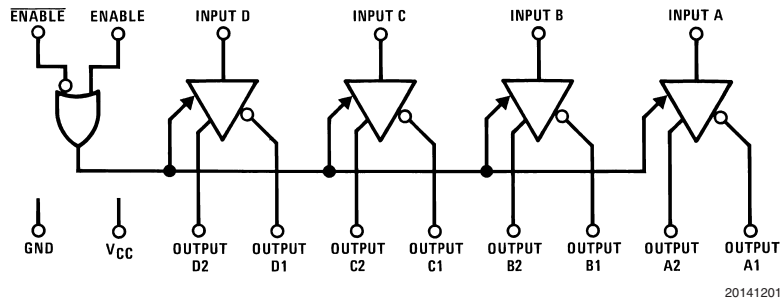
- Operation from single 5V supply
- Outputs won't load line when $V_{CC} = 0V$
- Four line drivers in one package for maximum package density
- Output short-circuit protection
- Complementary outputs
- Meets the requirements of EIA Standard RS-422
- Pin compatible with AM26LS31
- Glitch free power up/down

Ordering Information

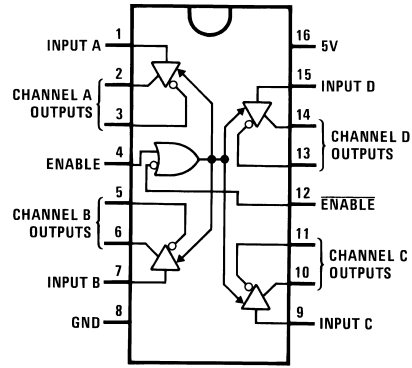
| NS PART NUMBER | SMD PART NUMBER | NS PACKAGE NUMBER | PACKAGE DISCRIPTION |
|-----------------|--------------------------------|-------------------|------------------------------------|
| DS26LS31MEFQML | 5962F7802301Q2A 300k rd(Si) | E20A | 20LD Ceramic Leadless Chip Carrier |
| DS26LS31ME-SMD | 5962-7802301Q2A | E20A | 20LD Ceramic Leadless Chip Carrier |
| DS26LS31MJFQML | 5962F7802301MEA 300k rd(Si) | J16A | 16LD Ceramic Dual-In-Line |
| DS26LS31MJ-SMD | 5962-7802301MEA | J16A | 16LD Ceramic Dual-In-Line |
| DS26LS31MJFQMLV | 5962F7802301VEA 300k rd(Si) | J16A | 16LD Ceramic Dual-In-Line |
| DS26LS31MJ-QMLV | 5962-7802301VEA | J16A | 16LD Ceramic Dual-In-Line |
| DS26LS31MWFQML | 5962F7802301MFA 300k rd(Si) | W16A | 16LD Ceramic Flatpak |
| DS26LS31MW-SMD | 5962-7802301MFA | W16A | 16LD Ceramic Flatpak |
| DS26LS31MWFQMLV | 5962F7802301VFA 300k rd(Si) | W16A | 16LD Ceramic Flatpak |
| DS26LS31MW-QMLV | 5962-7802301VFA | W16A | 16LD Ceramic Flatpak |
| DS26LS31MJ/883 | | J16A | 16LD Ceramic Dual-in-line |
| DS26LS31MW/883 | | W16A | 16LD Ceramic Flatpak |

TRI-STATE[®] is a registered trademark of National Semiconductor Corporation.

Logic and Connection Diagrams



Dual-In-Line Package



Top View
See NS Package E20A, J16A or W16A

Absolute Maximum Ratings (Note 1)

| | |
|--|---|
| Supply Voltage | 7V |
| Input Voltage | 7V |
| Output Voltage | 5.5V |
| Output Voltage (Power OFF) | -0.25 to 6V |
| Maximum Power Dissipation at 25°C (Note 2) | |
| J Package | 1400 mW |
| LCC Package | 1600 mW |
| W Package | 850 mW |
| Junction Temperature (T_J) | +150°C |
| Thermal Resistance, Junction-to-Ambient θ_{JA} | |
| J Package | 94°C/W derate above +25°C at 10.6 mW/°C |
| LCC Package | 83°C/W derate above +25°C at 12 mW/°C |
| W Package | 163°C/W derate above +25°C at 6.1 mW/°C |
| Thermal Resistance, Junction-to-Case θ_{JC} | |
| J Package | 16°C/W |
| LCC Package | 19°C/W |
| W Package | 14°C/W |
| ESD Tolerance | 2500V |

Recommended Operating Conditions

| | |
|--------------------------|-----------------|
| Supply Voltage, V_{CC} | 4.5 V to 5.5 V |
| Temperature, T_A | -55°C to +125°C |

Radiation Features

| | |
|-----------------|----------------|
| DS26LS31MEFQML | 300 Krads (Si) |
| DS26LS31MJFQML | 300 Krads (Si) |
| DS26LS31MJFQMLV | 300 Krads (Si) |
| DS26LS31MWFQML | 300 Krads (Si) |
| DS26LS31MWFQMLV | 300 Krads (Si) |

Quality Conformance Inspection

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 |

DS26LS31M - SMD, QMLV & RH Electrical Characteristics

DC Parameters

The following conditions apply, unless otherwise specified. +V = 5V, $V_{CM} = 0V$. (Note 5)

| Symbol | Parameters | Conditions | Notes | Min | Max | Units | Sub-groups |
|----------|------------------------------|--|--------------|------|------|---------|------------|
| V_{IH} | Logical "1" Input Voltage | $V_{CC} = 4.5V$ | (Notes 3, 4) | 2 | | V | 1, 2, 3 |
| V_{IL} | Logical "0" Input Voltage | $V_{CC} = 5.5V$ | (Notes 3, 4) | | .8 | V | 1, 2, 3 |
| V_{OH} | Logical "1" Output Voltage | $V_{CC} = 4.5V, I_{OH} = -20mA$ | (Note 4) | 2.5 | | V | 1, 2, 3 |
| V_{OL} | Logical "0" Output Voltage | $V_{CC} = 4.5V, I_{OL} = 20mA$ | (Note 4) | | .5 | V | 1, 2, 3 |
| I_{IH} | Logical "1" Input Current | $V_{CC} = 5.5V, V_{IN} = 2.7V$ | (Note 4) | -2.0 | 20 | μA | 1, 2, 3 |
| I_{IL} | Logical "0" Input Current | $V_{CC} = 5.5V, V_{IN} = .4V$ | (Note 4) | 100 | -360 | μA | 1, 2, 3 |
| I_I | Input Reverse Current | $V_{CC} = 5.5V, V_{IN} = 7V$ | (Note 4) | -.01 | .1 | mA | 1, 2, 3 |
| I_O | TRI-STATE Output Current | $V_{CC} = 5.5V, V_O = .5V$ | (Note 4) | | -20 | μA | 1, 2, 3 |
| | | $V_{CC} = 5.5V, V_O = 2.5V$ | (Note 4) | | 20 | μA | 1, 2, 3 |
| V_{IC} | Input Clamp Voltage | $V_{CC} = 4.5V, I_{IN} = -18mA$ | (Note 4) | | -1.5 | V | 1, 2, 3 |
| I_{OS} | Output Short Circuit Current | $V_{CC} = 5.5V$ | (Note 4) | -30 | -150 | mA | 1, 2, 3 |
| I_{CC} | Power Supply Current | $V_{CC} = 5.5V$, All Outputs Disabled or Active | (Note 4) | | 80 | mA | 1, 2, 3 |

AC Parameters - Propagation Delay Time

The following conditions apply, unless otherwise specified. $V_{CC} = 5V, V_{IN} = 1.3V$ to $V_O = 1.3V, V$ (pulse) = 0 to 3V. (Note 5)

| Symbol | Parameters | Conditions | Notes | Min | Max | Unit | Sub-groups |
|------------|------------------|---------------|----------|-----|-----|------|------------|
| t_{PLH} | Input to Output | $C_L = 30 pF$ | (Note 4) | | 20 | nS | 9 |
| | | | | | 30 | nS | 10, 11 |
| t_{PHL} | Input to Output | $C_L = 30 pF$ | (Note 4) | | 20 | nS | 9 |
| | | | | | 30 | nS | 10, 11 |
| t_{Skew} | Output to Output | $C_L = 30 pF$ | (Note 4) | | 6 | nS | 9 |
| | | | | | 9 | nS | 10, 11 |

DS26LS31M - SMD, QMLV & RH Electrical Characteristics (Continued)**AC Parameters - Propagation Delay Time** (Continued)

The following conditions apply, unless otherwise specified. $V_{CC} = 5V$, $V_{IN} = 1.3V$ to $V_O = 1.3V$, V (pulse) = 0 to 3V. (Note 5)

| Symbol | Parameters | Conditions | Notes | Min | Max | Unit | Sub-groups |
|-----------|------------------|---|----------|-----|-----|------|------------|
| t_{PLZ} | Enable to Output | S2 Open, Enable, $C_L = 10$ pF | (Note 4) | | 35 | nS | 9 |
| | | | | | 53 | nS | 10, 11 |
| | | S2 Open, $\overline{\text{Enable}}$, $C_L = 10$ pF | (Note 4) | | 35 | nS | 9 |
| | | | | | 53 | nS | 10, 11 |
| t_{PHZ} | Enable to Output | S1 Open, Enable, $C_L = 10$ pF | (Note 4) | | 30 | nS | 9 |
| | | | | | 45 | nS | 10, 11 |
| | | S1 Open, $\overline{\text{Enable}}$, $C_L = 10$ pF | (Note 4) | | 30 | nS | 9 |
| | | | | | 45 | nS | 10, 11 |
| t_{PZL} | Enable to Output | S2 Open, Enable, $C_L = 30$ pF | (Note 4) | | 45 | nS | 9 |
| | | | | | 68 | nS | 10, 11 |
| | | S2 Open, $\overline{\text{Enable}}$, $C_L = 30$ pF | (Note 4) | | 45 | nS | 9 |
| | | | | | 68 | nS | 10, 11 |
| t_{PZH} | Enable to Output | S1 Open, Enable, $C_L = 30$ pF | (Note 4) | | 40 | nS | 9 |
| | | | | | 60 | nS | 10, 11 |
| | | S1 Open, $\overline{\text{Enable}}$, $C_L = 30$ pF | (Note 4) | | 40 | nS | 9 |
| | | | | | 60 | nS | 10, 11 |

DC Parameters - Drift Values

The following conditions apply, unless otherwise specified. Delta calculations performed on QMLV only devices after burn-in and at Group B5.

| Symbol | Parameters | Conditions | Notes | Min | Max | Units | Sub-groups |
|----------|----------------------|---|----------|------|-----|-------|------------|
| V_{OL} | Output Low Voltage | $V_{CC} = 4.5$, $I_{OL} = 20$ mA | (Note 4) | -50 | 50 | mV | 1 |
| V_{OH} | Output High Voltage | $V_{CC} = 4.5$, $I_{OH} = -20$ mA | (Note 4) | -250 | 250 | mV | 1 |
| I_{CC} | Power Supply Current | $V_{CC} = 5.5$, All outputs disabled or active | (Note 4) | -8 | 8 | mA | 1 |

DS26LS31M - 883 Electrical Characteristics

DC Parameters

| Symbol | Parameters | Conditions | Notes | Min | Max | Unit | Sub-groups |
|----------------|------------------------------|--|--------------|-----|------|---------|------------|
| V_{IH} | Logical "1" Input Voltage | | (Notes 3, 4) | 2 | | V | 1, 2, 3 |
| V_{IL} | Logical "0" Input Voltage | | (Notes 3, 4) | | .8 | V | 1, 2, 3 |
| V_{OH} | Logical "1" Output Voltage | $V_{CC} = 4.5V, I_{OH} = -20mA$ | (Note 4) | 2.5 | | V | 1, 2, 3 |
| V_{OL} | Logical "0" Output Voltage | $V_{CC} = 4.5V, I_{OL} = 20mA$ | (Note 4) | | .5 | V | 1, 2, 3 |
| I_{IH} | Logical "1" Input Current | $V_{CC} = 5.5V, V_{IN} = 2.7V$ | (Note 4) | | 20 | μA | 1, 2, 3 |
| I_{IL} | Logical "0" Input Current | $V_{CC} = 5.5V, V_{IN} = .4V$ | (Note 4) | | -200 | μA | 1, 2, 3 |
| I_I | Input Reverse Current | $V_{CC} = 5.5V, V_{IN} = 7V$ | (Note 4) | | .1 | mA | 1, 2, 3 |
| I_O | TRI-STATE Output Current | $V_{CC} = 5.5V, V_O = .5V$ | (Note 4) | | -20 | μA | 1, 2, 3 |
| | | $V_{CC} = 5.5V, V_O = 2.5V$ | (Note 4) | | 20 | μA | 1, 2, 3 |
| V_{IC} | Input Clamp Voltage | $V_{CC} = 4.5V, I_{IN} = -18mA$ | (Note 4) | | -1.5 | V | 1, 2, 3 |
| $I_{OS} (min)$ | Output Short Circuit Current | $V_{CC} = 5.5V$ | (Note 4) | -30 | | mA | 1, 2, 3 |
| $I_{OS} (max)$ | Output Short Circuit Current | $V_{CC} = 5.5V$ | (Note 4) | | -150 | mA | 1, 2, 3 |
| I_{CC} | Power Supply Current | $V_{CC} = 5.5V, \text{All Outputs Disabled or Active}$ | (Note 4) | | 60 | mA | 1, 2, 3 |

AC Parameters - Propagation Delay Time

The following conditions apply, unless otherwise specified. $V_{CC} = 5V, C_L = 50pF$ or equivalent impedance provided by diode load.

| Symbol | Parameters | Conditions | Notes | Min | Max | Unit | Sub-groups |
|------------|------------------|------------------|--------------|-----|-----|------|------------|
| t_{PLH} | Input to Output | | (Notes 4, 6) | | 15 | nS | 9 |
| | | | | | 30 | nS | 10, 11. |
| t_{PHL} | Input to Output | | (Notes 4, 6) | | 15 | nS | 9 |
| | | | | | 30 | nS | 10, 11. |
| t_{Skew} | Output to Output | | (Notes 4, 6) | | 6 | nS | 9 |
| | | | | | 9 | nS | 10, 11. |
| t_{PLZ} | Enable to Output | S2 Open, Enable | (Notes 4, 6) | | 35 | nS | 9 |
| | | S2 Open, /Enable | (Notes 4, 6) | | 53 | nS | 10, 11. |
| t_{PHZ} | Enable to Output | S1 Open, Enable | (Notes 4, 6) | | 35 | nS | 9 |
| | | S1 Open, /Enable | (Notes 4, 6) | | 53 | nS | 10, 11. |
| t_{PZH} | Enable to Output | S1 Open, Enable | (Notes 4, 6) | | 25 | nS | 9 |
| | | S1 Open, /Enable | (Notes 4, 6) | | 45 | nS | 10, 11. |
| t_{PZL} | Enable to Output | S2 Open, Enable | (Notes 4, 6) | | 25 | nS | 9 |
| | | S2 Open, /Enable | (Notes 4, 6) | | 45 | nS | 10, 11. |
| t_{PZL} | Enable to Output | S2 Open, Enable | (Notes 4, 6) | | 30 | nS | 9 |
| | | S2 Open, /Enable | (Notes 4, 6) | | 68 | nS | 10, 11. |
| t_{PZH} | Enable to Output | S1 Open, Enable | (Notes 4, 6) | | 30 | nS | 9 |
| | | S1 Open, /Enable | (Notes 4, 6) | | 60 | nS | 10, 11. |
| t_{PZH} | Enable to Output | S1 Open, Enable | (Notes 4, 6) | | 30 | nS | 9 |
| | | S1 Open, /Enable | (Notes 4, 6) | | 60 | nS | 10, 11. |

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Electrical Characteristics" provide conditions for actual device operation.

Note 2: Derate CDip = 11.5 mW/°C, CLCC = 13mW/°C, Cerpack = 7.4mW/°C above 25°C.

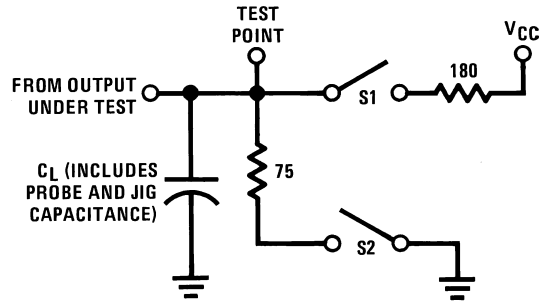
Note 3: Parameter tested go-no-go only.

Note 4: Subgroups 1, 2 and 9, 10: Power dissipation must be externally controlled at elevated temperatures.

Note 5: Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are guaranteed only for the conditions as specified in MIL-STD 883, Method 1019, Condition A.

Note 6: Subgroup 10 and 11 guaranteed but not tested.

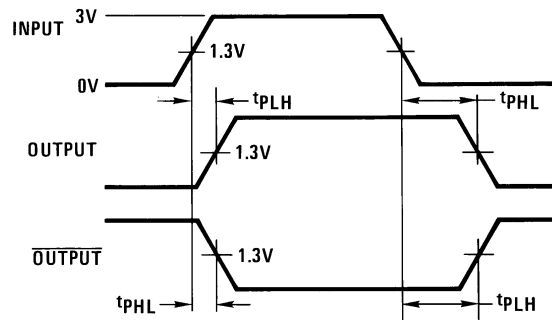
AC Test Circuit and Switching Time Waveforms



20141203

S1 and S2 of load circuit are closed except where shown.

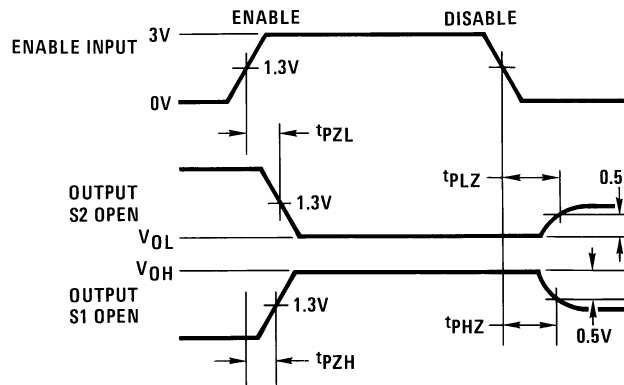
FIGURE 1. AC Test Circuit



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f = 1 MHz, t_r ≤ 15 ns, t_f ≤ 6 ns

FIGURE 2. Propagation Delays



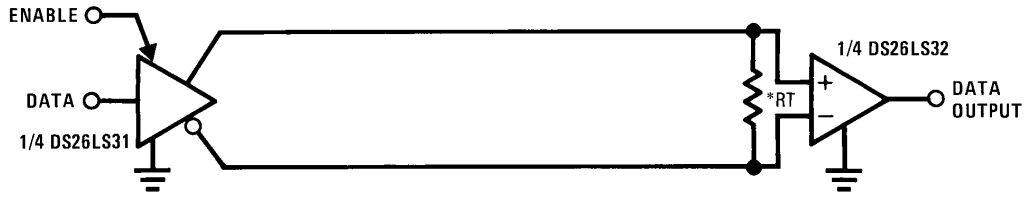
20141205

f = 1 MHz, t_r ≤ 15 ns, t_f ≤ 6 ns

FIGURE 3. Enable and Disable Times

Typical Applications

Two-Wire Balanced System, RS-422

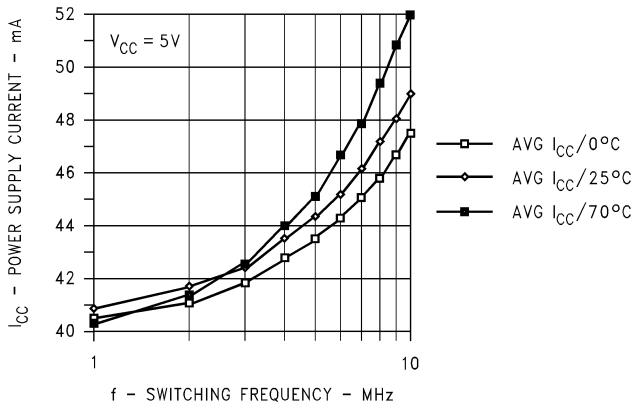


Note 7: R_T is optional although highly recommended to reduce reflection.

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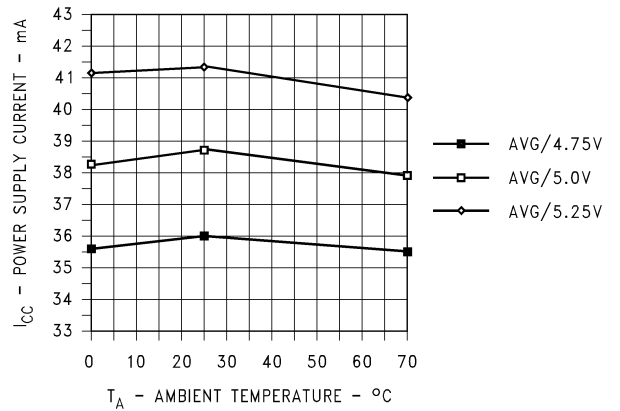
Typical Performance Characteristics

DS26LS31MQMLCN Unloaded I_{CC} vs Frequency vs T_A



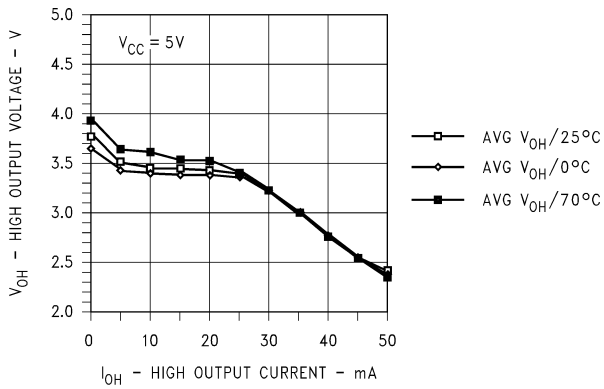
20141207

DS26LS31MQML I_{CC} vs V_{CC} vs T_A



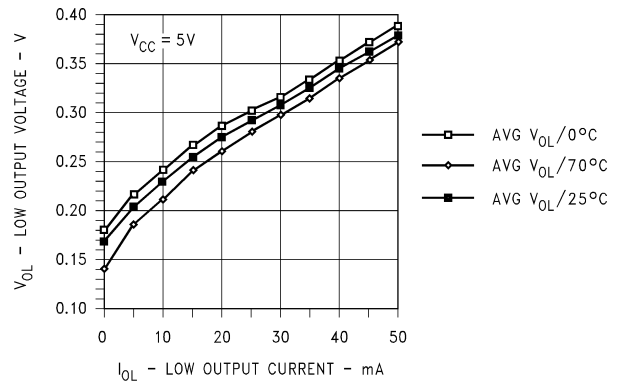
20141208

DS26LS31MQMLCN V_{OH} vs I_{OH} vs T_A



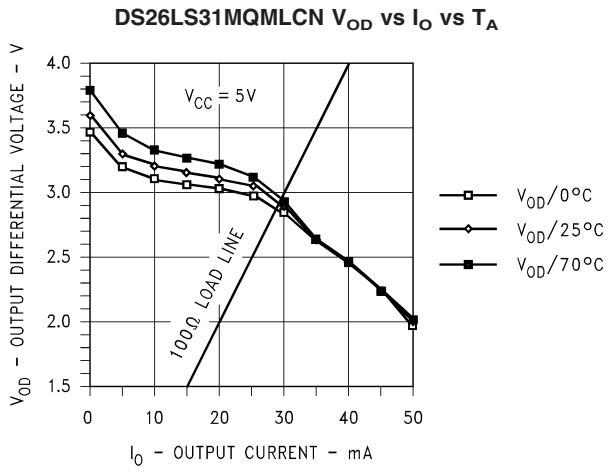
20141209

DS26LS31MQMLCN V_{OL} vs I_{OL} vs T_A



20141210

Typical Performance Characteristics (Continued)

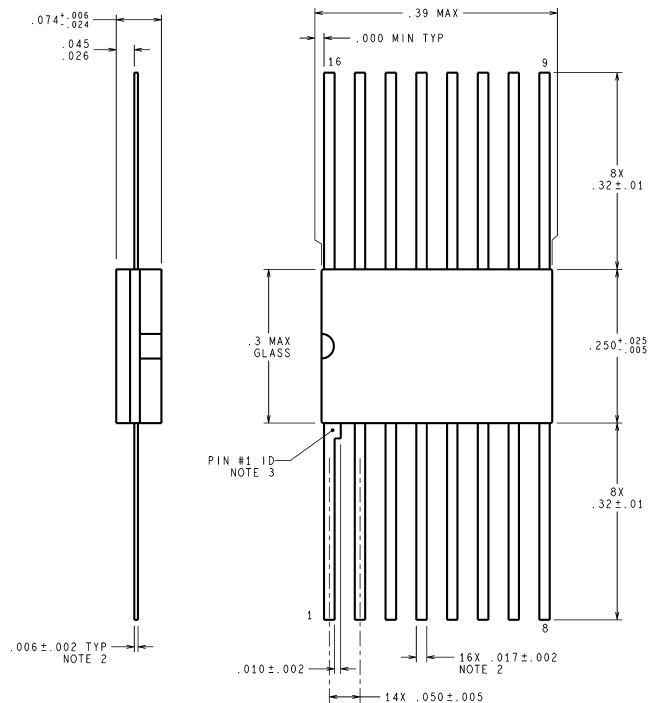


20141211

Revision History Section

| Date Released | Revision | Section | Originator | Changes |
|---------------|----------|---|------------|---|
| 08/04/05 | A | New Release, Corporate format | R. Malone | 2 MDS data sheets converted into a Corp. data sheet format. Following MDS data sheets will be Archived MDDS26LS31M-X-RH, Rev.2A0, MNDS26LS31M-X, Rev. 0A0 |
| 03/01/06 | B | Ordering Info. Table, Absolute Ratings, Maximum Operating Conditions, New Radiation Section. Typo's in QMLV & RH, 883 AC Electrical Characteristics Parameters Column | R. Malone | Added: Junction temp., Thermal Resistance θ_{JA} and θ_{JC} . Added a Radiation Section. Changed: Maximum Operating Conditions to Recommended Operating Conditions, Enable and Disable Time to Enable to Output. Revision A will be archived. |

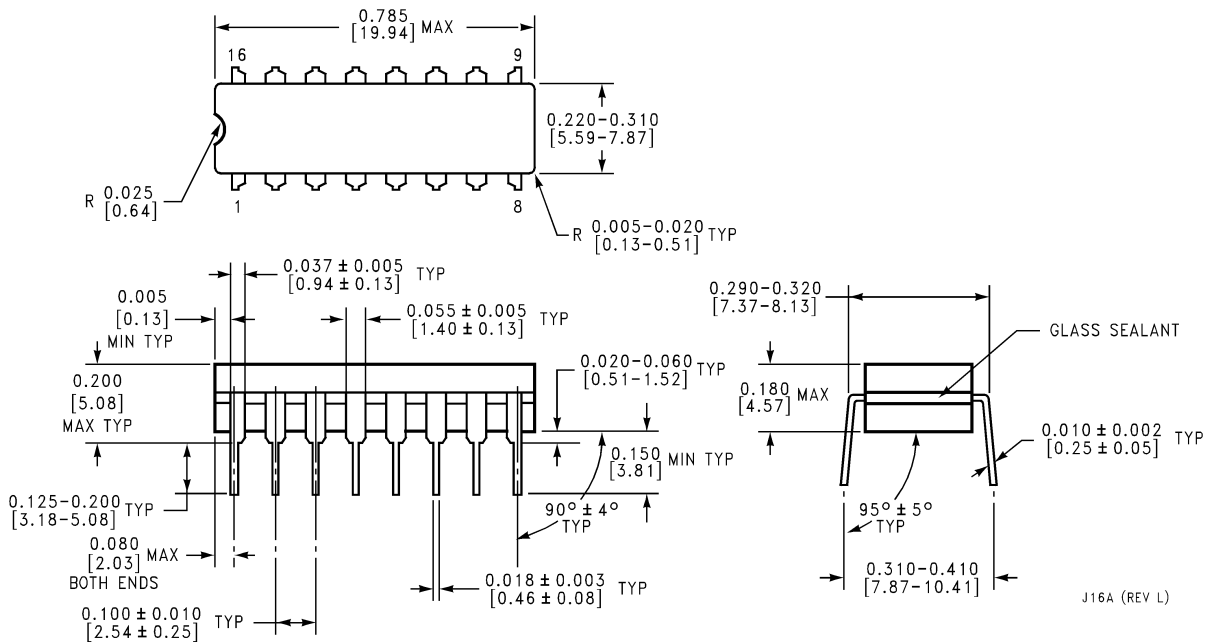
Physical Dimensions inches (millimeters) unless otherwise noted



DIMENSIONS ARE IN INCHES

W16A (Rev T)

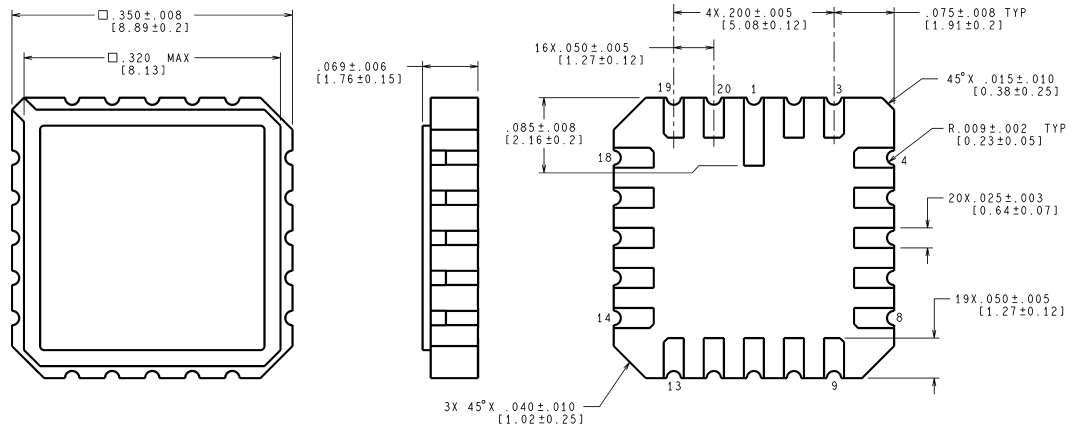
**16 Lead Ceramic Flatpak (W)
NS Package Number W16A**



J16A (REV L)

**16 Lead Ceramic Dual-in-Line Package (J)
NS Package Number J16A**

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS

E20A (Rev F)

**20 Lead Ceramic Leadless Chip Carrier (E)
NS Package Number E20A**

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