DS26LS31MQML Quad High Speed Differential Line Driver

Check for Samples: DS26LS31MQML

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**

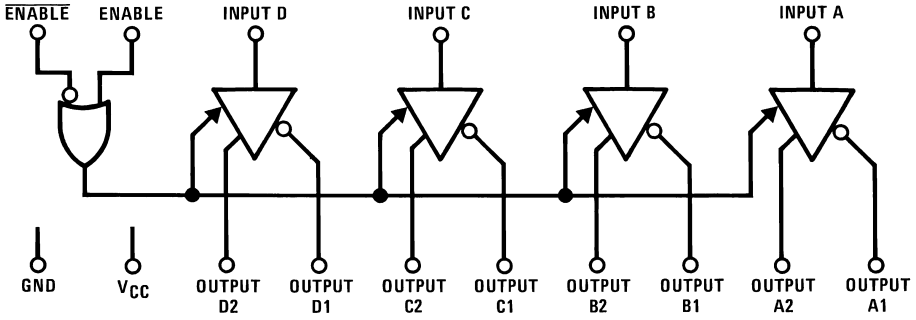
DESCRIPTION

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.

Logic and Connection Diagrams



Top View

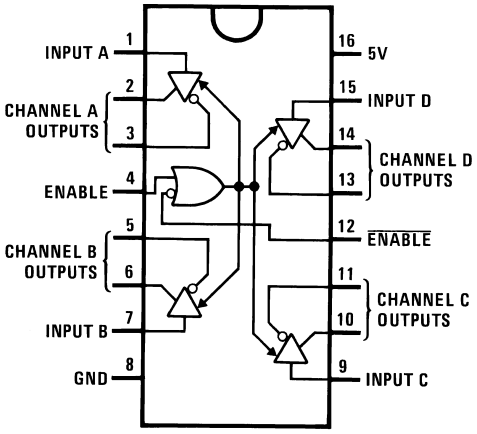


Figure 1. CDIP Package
See Package Numbers NAJ0020A, NFE0016A, NAD0016A

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 (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 (2)	
NFE0016A Package	1400 mW
NAJ0020A Package	1600 mW
NAD0016A Package	850 mW
Junction Temperature (T_J)	+150°C
Thermal Resistance, Junction-to-Ambient θ_{JA}	
NFE0016A Package	94°C/W derate above +25°C at 10.6 mW/°C
NAJ0020A Package	83°C/W derate above +25°C at 12 mW/°C
NAD0016A Package	163°C/W derate above +25°C at 6.1 mW/°C
Thermal Resistance, Junction-to-Case θ_{JC}	
NFE0016A Package	16°C/W
NAJ0020A Package	19°C/W
NAD0016A Package	14°C/W
ESD Tolerance	2500V

(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.
(2) Derate CDIP = 11.5 mW/°C, LCCC = 13mW/°C, CLGA = 7.4mW/°C above 25°C.

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. (1)

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

(1) 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.
(2) Parameter tested go-no-go only.
(3) Subgroups 1, 2 and 9, 10: Power dissipation must be externally controlled at elevated temperatures.

DS26LS31M - SMD, QMLV and RH Electrical Characteristics 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. (1)

Parameter		Test Conditions	Notes	Min	Max	Unit	Sub-groups
t_{PLH}	Input to Output	C_L = 30 pF	(2)		20	ns	9
					30	ns	10, 11
t_{PHL}	Input to Output	C_L = 30 pF	(2)		20	ns	9
					30	ns	10, 11
t_{Skew}	Output to Output	C_L = 30 pF	(2)		6	ns	9
					9	ns	10, 11
t_{PLZ}	Enable to Output	S2 Open, Enable, C_L = 10 pF	(2)		35	ns	9
					53	ns	10, 11
		S2 Open, $\overline{\text{Enable}}$, C_L = 10 pF	(2)		35	ns	9
					53	ns	10, 11
t_{PHZ}	Enable to Output	S1 Open, Enable, C_L = 10 pF	(2)		30	ns	9
					45	ns	10, 11
		S1 Open, $\overline{\text{Enable}}$, CL = 10 pF	(2)		30	ns	9
					45	ns	10, 11
t_{PZL}	Enable to Output	S2 Open, Enable, C_L = 30 pF	(3)		45	ns	9
					68	ns	10, 11
		S2 Open, $\overline{\text{Enable}}$, C_L = 30 pF	(3)		45	ns	9
					68	ns	10, 11
t_{PZH}	Enable to Output	S1 Open, Enable, C_L = 30 pF	(3)		40	ns	9
					60	ns	10, 11
		S1 Open, $\overline{\text{Enable}}$, C_L = 30 pF	(3)		40	ns	9
					60	ns	10, 11

(1) 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.
(2) Subgroups 1, 2 and 9, 10: Power dissipation must be externally controlled at elevated temperatures.
(3) Subgroups 1, 2 and 9, 10: Power dissipation must be externally controlled at elevated temperatures.

DS26LS31M - SMD, QMLV and RH Electrical Characteristics 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.

Parameter		Test Conditions	Notes	Min	Max	Unit	Sub-groups
V_{OL}	Output Low Voltage	V_{CC} = 4.5, I_{OL} = 20 mA	(1)	-50	50	mV	1
V_{OH}	Output High Voltage	V_{CC} = 4.5, I_{OH} = -20 mA	(1)	-250	250	mV	1
I_{CC}	Power Supply Current	V_{CC} = 5.5, All outputs disabled or active	(1)	-8	8	mA	1

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

DS26LS31M - 883 Electrical Characteristics DC Parameters

Parameter		Test Conditions	Notes	Min	Max	Unit	Sub-groups
V_{IH}	Logical "1" Input Voltage		(1) (2)	2		V	1, 2, 3
V_{IL}	Logical "0" Input Voltage		(1) (2)		.8	V	1, 2, 3

(1) Parameter tested go-no-go only.
(2) Subgroups 1, 2 and 9, 10: Power dissipation must be externally controlled at elevated temperatures.

DS26LS31M - 883 Electrical Characteristics DC Parameters (continued)

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

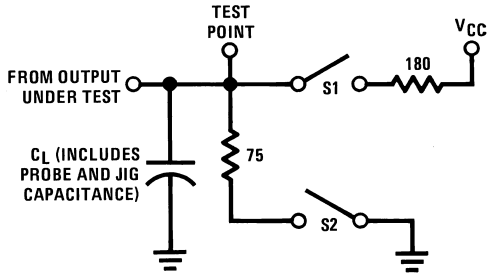
DS26LS31M - 883 Electrical Characteristics AC Parameters - Propagation Delay Time

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

Parameter		Test Conditions	Notes	Min	Max	Unit	Sub-groups
t_{PLH}	Input to Output		(1) (2)		15	ns	9
					30	ns	10, 11.
t_{PHL}	Input to Output		(1) (2)		15	ns	9
					30	ns	10, 11.
t_{Skew}	Output to Output		(1) (2)		6	ns	9
					9	ns	10, 11.
t_{PLZ}	Enable to Output	S2 Open, Enable	(1) (2)		35	ns	9
					53	ns	10, 11.
		S2 Open, /Enable	(1) (2)		35	ns	9
					53	ns	10, 11.
t_{PHZ}	Enable to Output	S1 Open, Enable	(1) (2)		25	ns	9
					45	ns	10, 11.
		S1 Open, /Enable	(1) (2)		25	ns	9
					45	ns	10, 11.
t_{PZL}	Enable to Output	S2 Open, Enable	(1) (2)		30	ns	9
					68	ns	10, 11.
		S2 Open, /Enable	(1) (2)		30	ns	9
					68	ns	10, 11.
t_{PZH}	Enable to Output	S1 Open, Enable	(1) (2)		30	ns	9
					60	ns	10, 11.
		S1 Open, /Enable	(1) (2)		30	ns	9
					60	ns	10, 11.

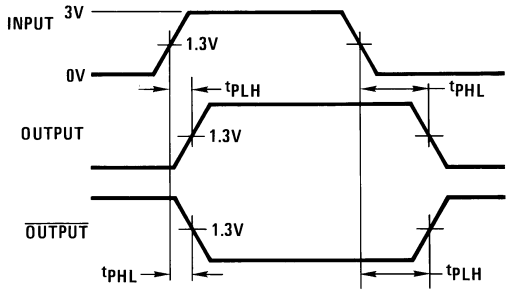
(1) Subgroups 1, 2 and 9, 10: Power dissipation must be externally controlled at elevated temperatures.
(2) Subgroup 10 and 11 guaranteed but not tested.

AC TEST CIRCUIT AND SWITCHING TIME WAVEFORMS



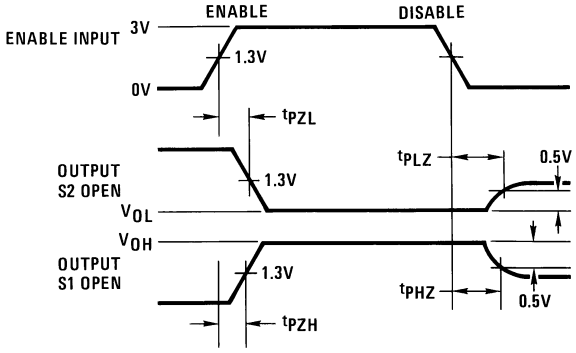
S1 and S2 of load circuit are closed except where shown.

Figure 2. AC Test Circuit



f = 1 MHz, $t_r \leq 15$ ns, $t_f \leq 6$ ns

Figure 3. Propagation Delays

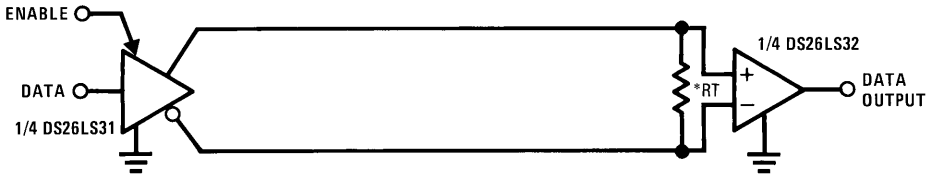


f = 1 MHz, $t_r \leq 15$ ns, $t_f \leq 6$ ns

Figure 4. Enable and Disable Times

TYPICAL APPLICATIONS

Figure 5. Two-Wire Balanced System, RS-422



R_T is optional although highly recommended to reduce reflection.

Typical Performance Characteristics

DS26LS31MQMLCN Unloaded I_C vs Frequency vs T_A

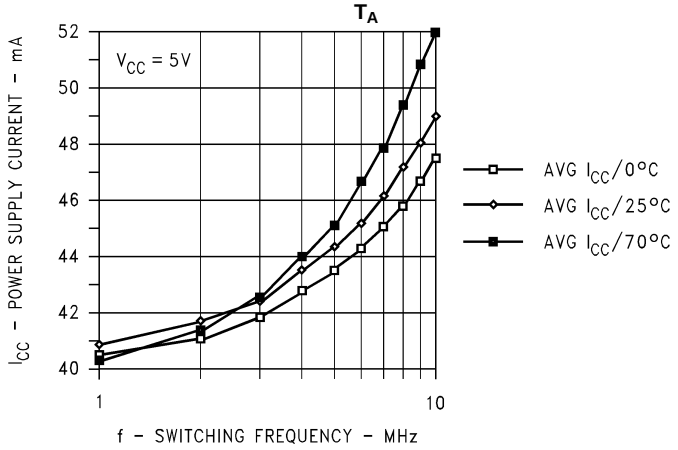


Figure 6.

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

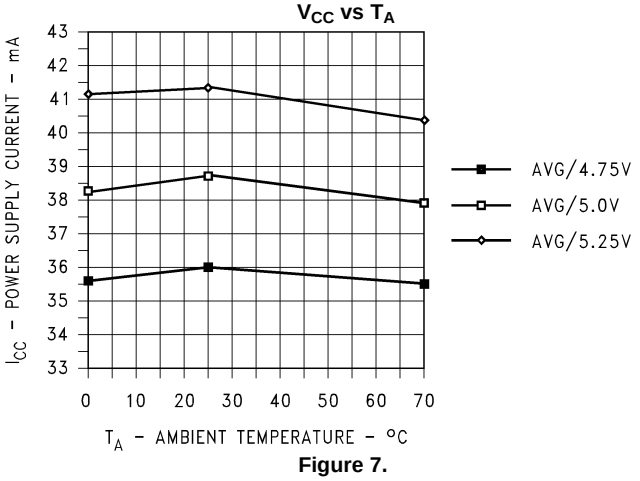


Figure 7.

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

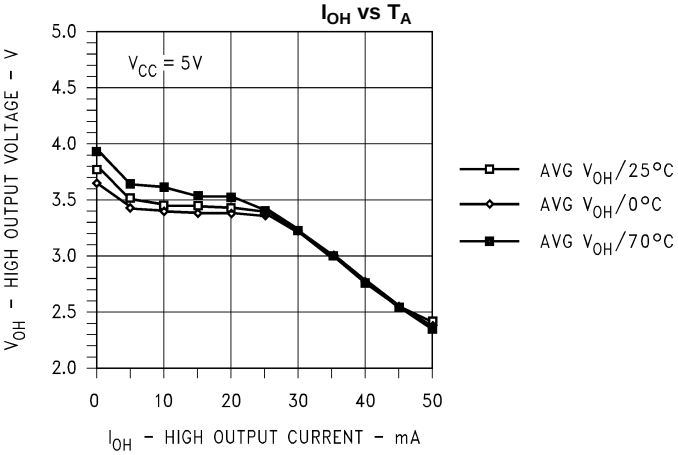


Figure 8.

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

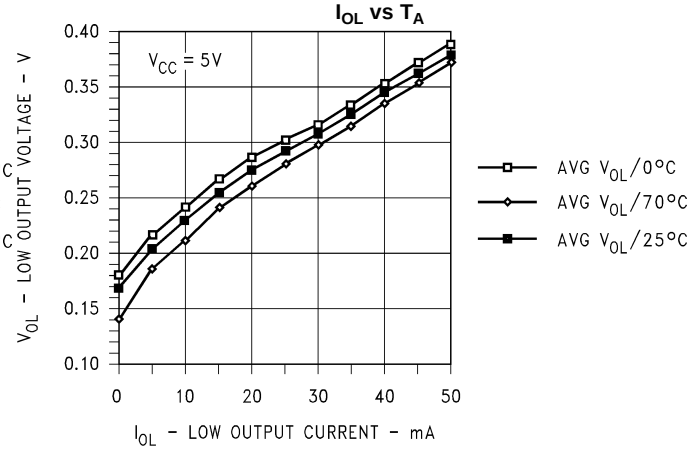


Figure 9.

DS26LS31MQMLCN V_{OD} vs I_O vs T_A

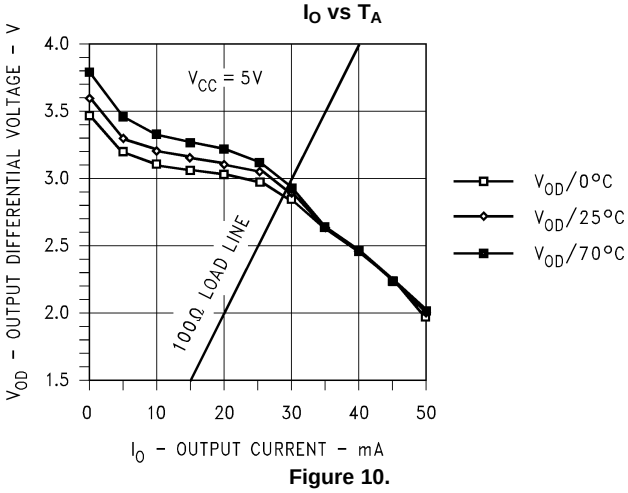


Figure 10.

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. Typos in QMLV & RH, 883 AC Electrical Characteristics Parameters Column	R. Malone	Added: Juction 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.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
5962-7802301VEA	ACTIVE	CDIP	NFE	16	25	TBD	A42 SNPB	Level-1-NA-UNLIM	-55 to 125	DS26LS31MJ-QMLV 5962-7802301VEA Q	Samples
AM26LS31MW/883	ACTIVE	CLGA	NAD	16	19	TBD	CU SNPB	Level-1-NA-UNLIM	-55 to 125	DS26LS31MW /883 Q ACO /883 Q >T	Samples
DS26LS31ME-SMD	ACTIVE	LCCC	NAJ	20	50	TBD	POST-PLATE	Level-1-NA-UNLIM	-55 to 125	DS26LS31ME -SMD Q 5962-78023 01Q2A ACO 01Q2A >T	Samples
DS26LS31MJ-QMLV	ACTIVE	CDIP	NFE	16	25	TBD	A42 SNPB	Level-1-NA-UNLIM	-55 to 125	DS26LS31MJ-QMLV 5962-7802301VEA Q	Samples
DS26LS31MJ-SMD	ACTIVE	CDIP	NFE	16	25	TBD	A42 SNPB	Level-1-NA-UNLIM	-55 to 125	DS26LS31MJ-SMD 5962-7802301MEA Q	Samples
DS26LS31MJ/883	ACTIVE	CDIP	NFE	16	25	TBD	A42 SNPB	Level-1-NA-UNLIM	-55 to 125	DS26LS31MJ/883 Q	Samples
DS26LS31MW/883	ACTIVE	CLGA	NAD	16	19	TBD	CU SNPB	Level-1-NA-UNLIM	-55 to 125	DS26LS31MW /883 Q ACO /883 Q >T	Samples

(1) 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.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) Only one of markings shown within the brackets will appear on the physical device.

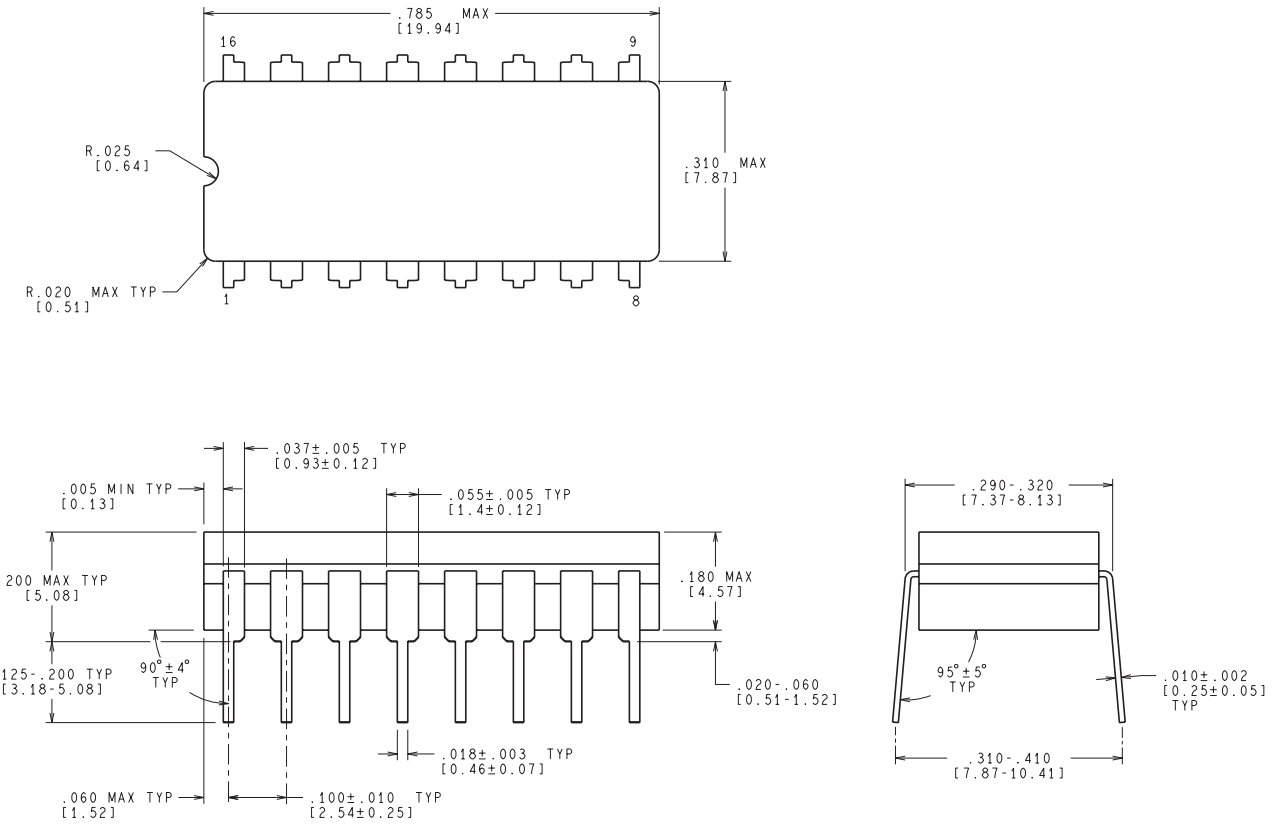
OTHER QUALIFIED VERSIONS OF DS26LS31MQML, DS26LS31MQML-SP :

- Military: DS26LS31MQML
- Space: DS26LS31MQML-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

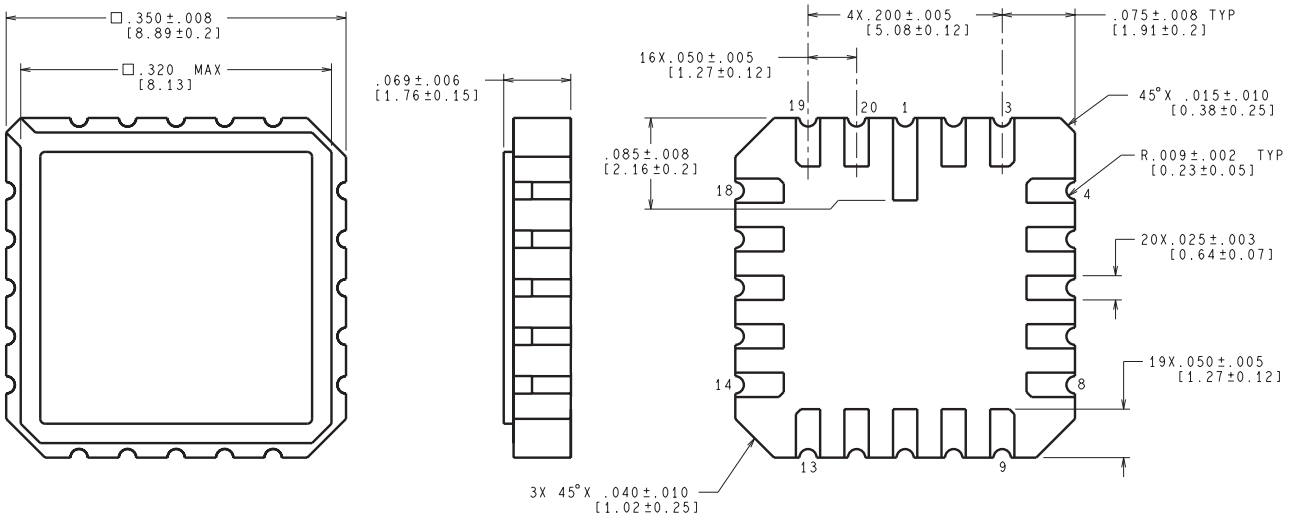
NFE0016A



CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

J16A (REV L)

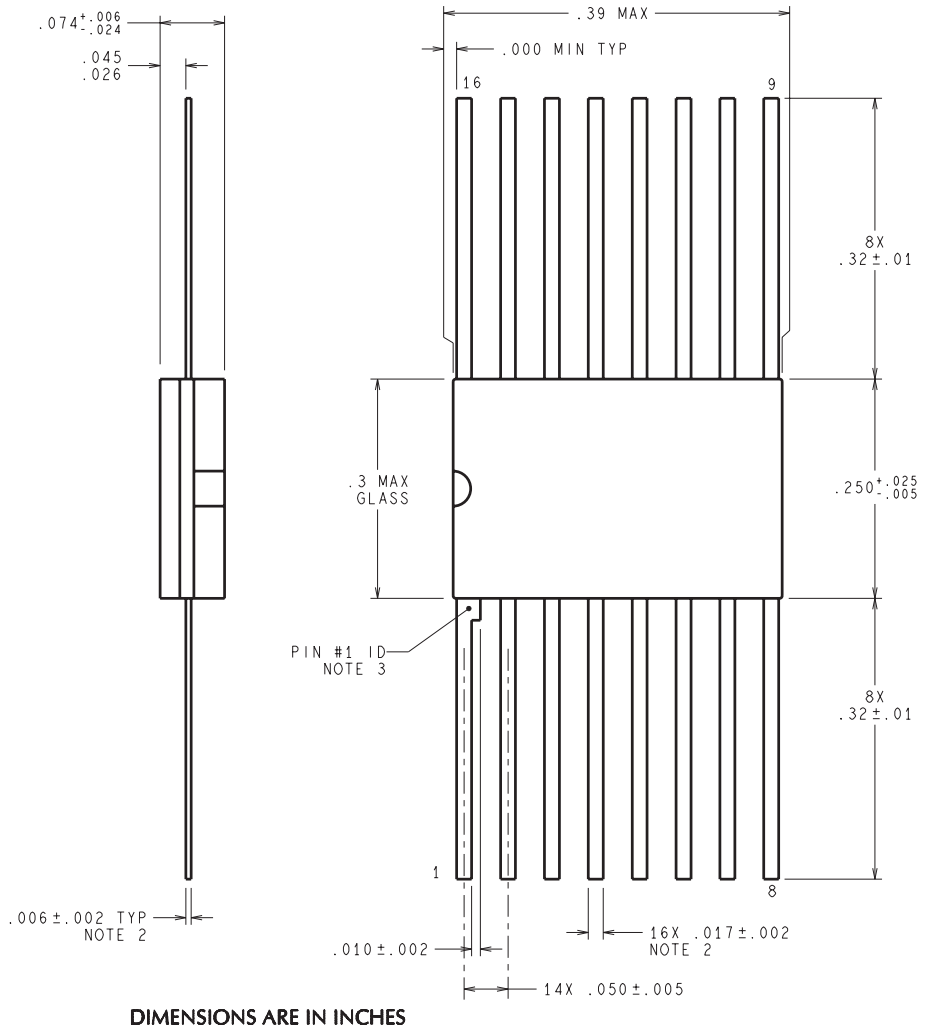
NAJ0020A



CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

E20A (Rev F)

NAD0016A



DIMENSIONS ARE IN INCHES

W16A (Rev T)

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265