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National Semiconductor

March 2006

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 stat (TRI-STATE) during power up or down preventing erroneous glitches on the transmission lines.

Features

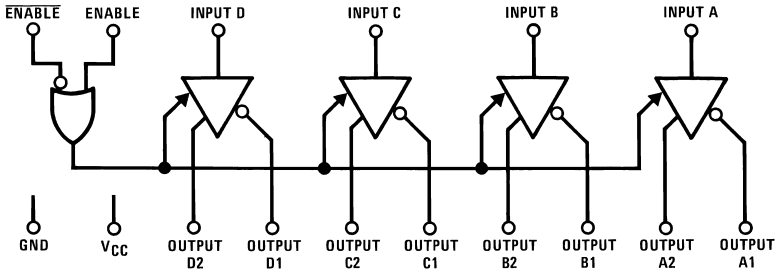
- Operation from single 5V supply
- Outputs won't load line when V_{CC} = 0V
- Four line drivers in one package for maximum package density
- Output short-circuit protection
- Complementary outputs
- Meets the requirements of EIA Standard RS-422
- Pin compatible with AM26LS31
- Glitch free power up/down

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



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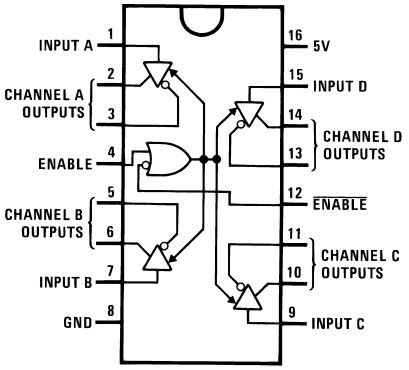
Dual-In-Line Package



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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	uA	1, 2, 3
I_{IL}	Logical "0" Input Current	V_{CC} = 5.5V, V_{IN} = .4V	(Note 4)	100	-360	uA	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	uA	1, 2, 3
		V_{CC} = 5.5V, V_O = 2.5V	(Note 4)		20	uA	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, $\overline{\text{Enable}}$, CL = 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	uA	1, 2, 3
I_{IL}	Logical "0" Input Current	V_{CC} = 5.5V, V_{IN} = .4V	(Note 4)		-200	uA	1, 2, 3
I_I	Input Reverse Current	VCC = 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	uA	1, 2, 3
		V_{CC} = 5.5V, V_O = 2.5V	(Note 4)		20	uA	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, 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
					53	nS	10, 11.
		S2 Open, /Enable	(Notes 4, 6)		35	nS	9
					53	nS	10, 11.
t_{PHZ}	Enable to Output	S1 Open, Enable	(Notes 4, 6)		25	nS	9
					45	nS	10, 11.
		S1 Open, /Enable	(Notes 4, 6)		25	nS	9
					45	nS	10, 11.
t_{PZL}	Enable to Output	S2 Open, Enable	(Notes 4, 6)		30	nS	9
					68	nS	10, 11.
		S2 Open, /Enable	(Notes 4, 6)		30	nS	9
					68	nS	10, 11.
t_{PZH}	Enable to Output	S1 Open, Enable	(Notes 4, 6)		30	nS	9
					60	nS	10, 11.
		S1 Open, /Enable	(Notes 4, 6)		30	nS	9
					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.

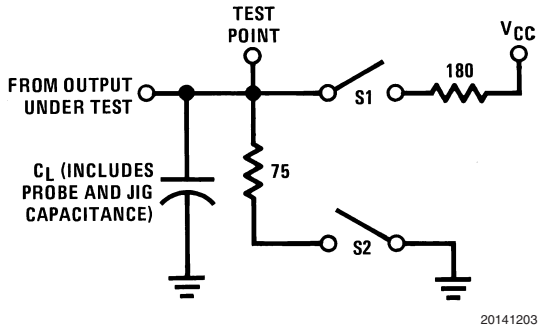
Note 3: Parameter tested go-no-go only.

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.

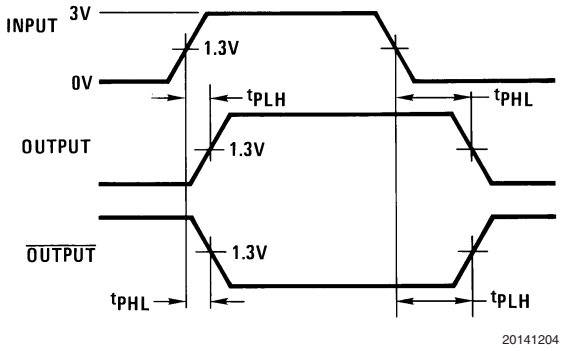
Note 6: Subgroup 10 and 11 guaranteed but not tested.

AC Test Circuit and Switching Time Waveforms



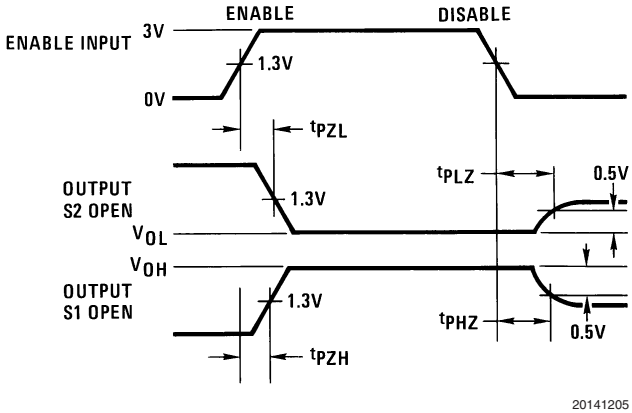
S1 and S2 of load circuit are closed except where shown.

FIGURE 1. AC Test Circuit



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

FIGURE 2. Propagation Delays

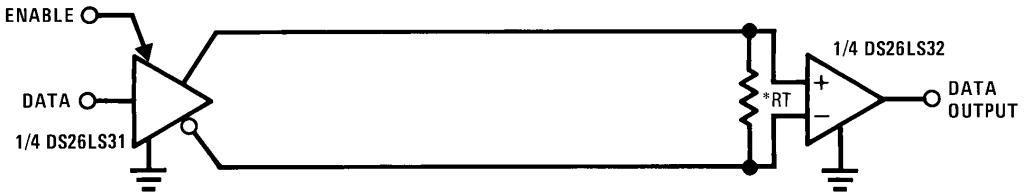


f = 1 MHz, $t_r \leq 15$ ns, $t_f \leq 6$ ns

FIGURE 3. Enable and Disable Times

Typical Applications

Two-Wire Balanced System, RS-422



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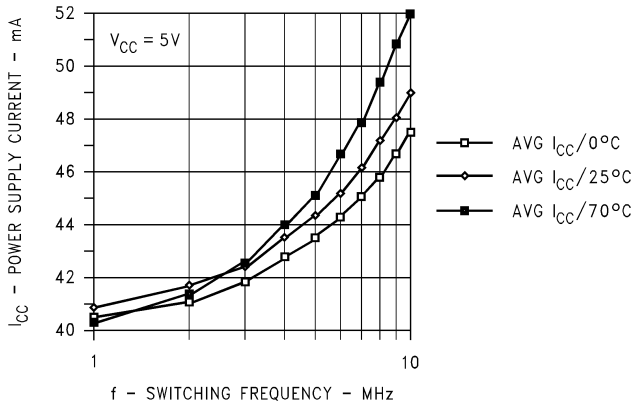
Note 7: R_T is optional although highly recommended to reduce reflection.

Typical Performance Characteristics

DS26LS31MQMLCN Unloaded I_C vs Frequency vs T_A



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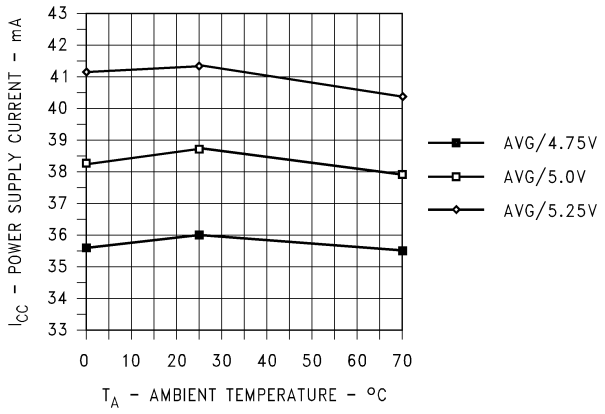
DS26LS31MQML I_{CC} vs V_{CC} vs T_A



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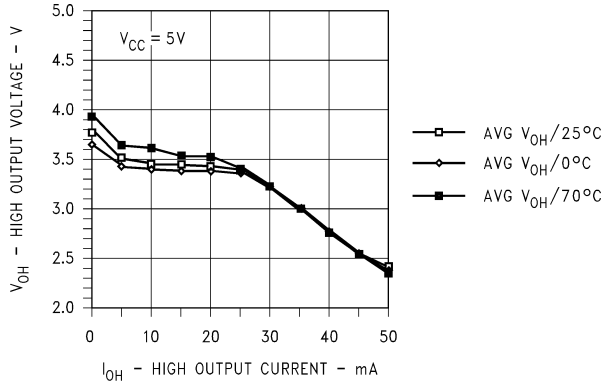
DS26LS31MQMLCN V_{OH} vs I_{OH} vs T_A



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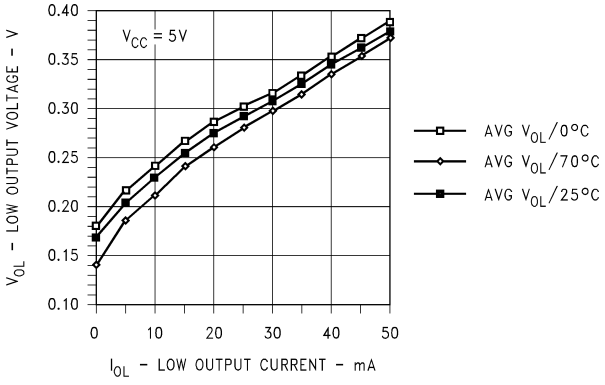
DS26LS31MQMLCN V_{OL} vs I_{OL} vs T_A



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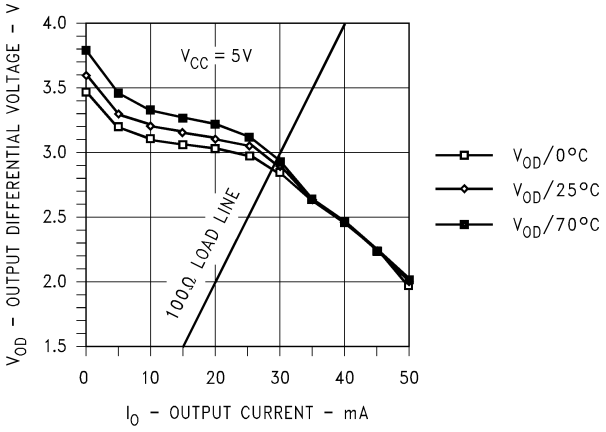
Typical Performance Characteristics (Continued)

DS26LS31MQMLCN V_{OD} vs I_O vs T_A



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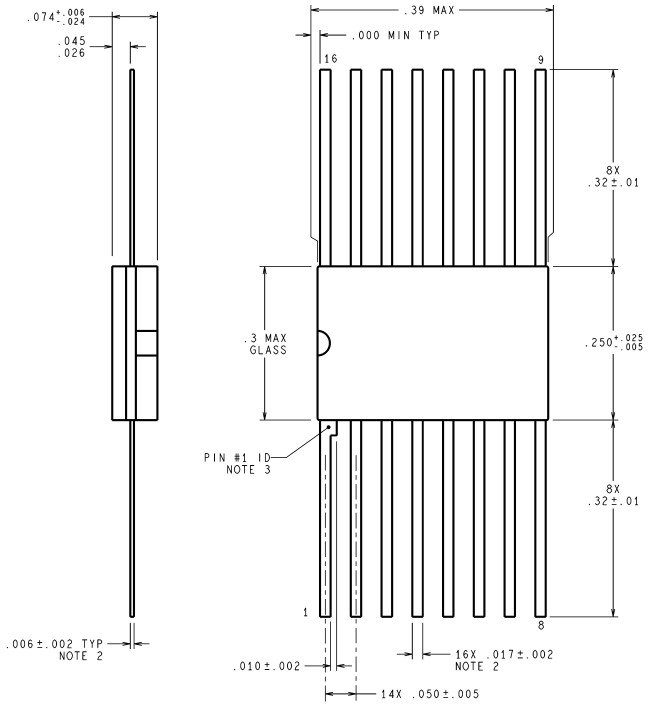
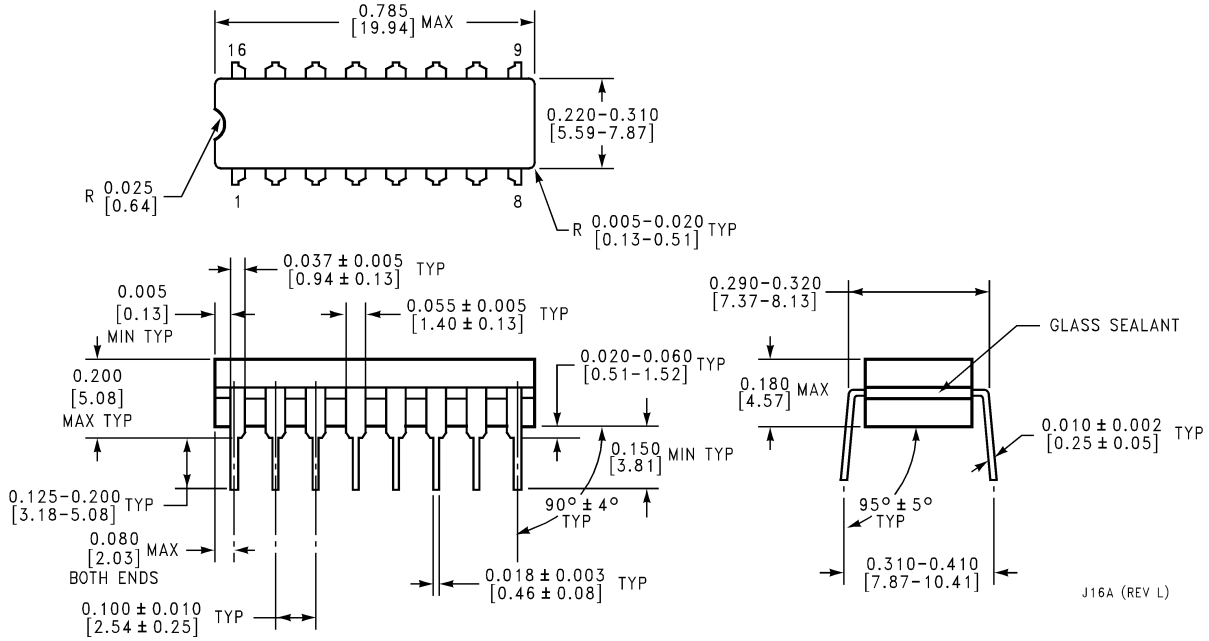
Revision History Section

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: 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.

Physical Dimensions inches (millimeters) unless otherwise noted

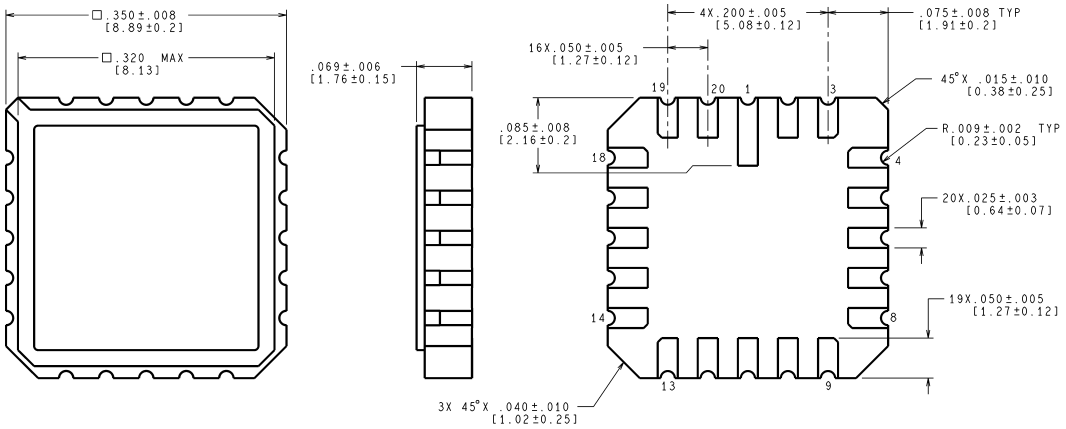


16 Lead Ceramic Flatpak (W)
NS Package Number W16A



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

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



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E20A (Rev F)

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

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