National Semiconductor

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DS26LV32AT
3V Enhanced CMOS Quad Differential Line Receiver

General Description

The DS26LV32A is a high speed quad differential CMOS receiver that meets the requirements of both TIA/EIA-422-B and ITU-T V.11. The CMOS DS26LV32AT features typical low static I_{CC} of 9 mA which makes it ideal for battery powered and power conscious applications. The TRI-STATE® enables, EN and EN*, allow the device to be active High or active Low. The enables are common to all four receivers.

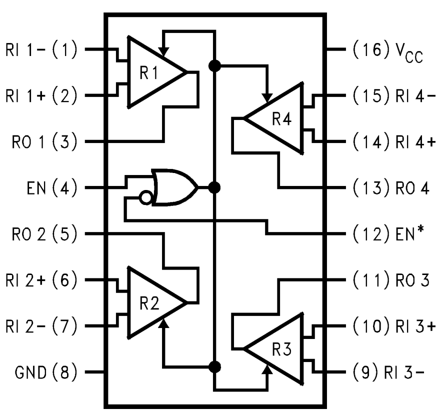
The receiver output (RO) is guaranteed to be High when the inputs are left open. The receiver can detect signals as low as ±200 mV over the common mode range of ±10V. The receiver outputs (RO) are compatible with TTL and LVCMOS levels.

Features

- Low Power CMOS design (30 mW typical)
- Interoperable with existing 5V RS-422 networks
- Industrial and Military Temperature Range
- Conforms to TIA/EIA-422-B (RS-422) and ITU-T V.11 Recommendation
- 3.3V Operation
- ±7V Common Mode Range @ V_{ID} = 3V
- ±10V Common Mode Range @ V_{ID} = 0.2V
- Receiver OPEN input failsafe feature
- Guaranteed AC Parameter:
  - Maximum Receiver Skew: 4 ns
  - Maximum Transition Time: 10 ns
- Pin compatible with DS26C32AT
- 32 MHz Toggle Frequency
- > 6.5k ESD Tolerance (HBM)
- Available in SOIC and Cerpack Packaging
- Standard Microcircuit Drawing (SMD) 5962-98585

Connection Diagram

Dual-In-Line Package



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Top View
Order Number DS26LV32ATM or DS26LV32AW
See NS Package Number M16A or W16A

Truth Table

Enables		Inputs	Output
EN	EN*	RI+–RI−	RO
L	H	X	Z
All Other Combinations of Enable Inputs		$V_{ID} \geq +0.2V$	H
		$V_{ID} \leq -0.2V$	L
		Open†	H

† Open, not terminated
L = Logic Low
H = Logic High
X = Irrelevant
Z = TRI-STATE

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Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage (V_{CC})	−0.5V to +7V
Enable Input Voltage (EN, EN*)	−0.5V to V_{CC} +0.5V
Receiver Input Voltage (V_{ID}: RI+, RI−)	±14V
Receiver Input Voltage (VCM: RI+, RI−)	±14V
Receiver Output Voltage (RO)	−0.5V to V_{CC} +0.5V
Receiver Output Current (RO)	±25 mA Maximum
Maximum Package Power Dissipation @ +25˚C	
M Package	1190 mW
W Package	1087 mW
Derate M Package 9.8 mW/˚C above +25˚C	
Derate W Package 7.3 mW/˚C above +25˚C	
Storage Temperature Range	−65˚C to +150˚C
Lead Temperature Range Soldering (4 Sec.)	+260˚C
ESD Ratings (HBM, 1.5 kΩ, 100 pF)	
Receiver Inputs and Enables	≥ 6.5 kV
Other Pins	≥ 2 kV

Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage (V_{CC})	3.0	3.3	3.6	V
Operating Free Air Temperature Range (T_A)				
DS26LV32AT	−40	+25	+85	˚C
DS26LV32AW	−55	+25	+125	˚C

Electrical Characteristics (Notes 2, 3)

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified.

Symbol	Parameter	Conditions		Pin	Min	Typ	Max	Units
V_{TH}	Differential Input Threshold	V_{OUT} = V_{OH} or V_{OL}	V_{CM} = −7V to +7V, T_A = -40˚C to +85˚C	RI+, RI−	−200	±17.5	+200	mV
			V_{CM} = −0.5V to +5.5V, T_A = -55˚C to +125˚C (Note 9)		-200		+200	mV
V_{HY}	Hysteresis	V_{CM} = 1.5V				35		mV
V_{IH}	Minimum High Level Input Voltage			EN, EN*	2.0			V
V_{IL}	Maximum Low Level Input Voltage						0.8	V
R_{IN}	Input Resistance	V_{IN} = −7V, +7V, T_A = -40˚C to +85˚C (Other Input = GND)		RI+, RI−	5.0	8.5		kΩ
		V_{IN} = −0.5V, +5.5V, T_A = -55˚C to +125˚C (Other Input = GND) (Note 9)			5.0			kΩ
I_{IN}	Input Current (Other Input = 0V, Power On, or V_{CC} = 0V)	V_{IN} = +10V	T_A = -40˚C to +85˚C		0	1.1	1.8	mA
		V_{IN} = +3V			0	0.27		mA
		V_{IN} = 0.5V				−0.02		mA
		V_{IN} = −3V			0	−0.43		mA
		V_{IN} = −10V			0	−1.26	−2.2	mA
		V_{IN} = −0.5V	T_A = -55˚C to +125˚C (Note 9)		0		-1.8	mA
		V_{IN} = 5.5V			0		1.8	mA
I_{EN}	Input Current	V_{IN} = 0V to V_{CC}		EN, EN*			±1	μA

Electrical Characteristics (Notes 2, 3) (Continued)

Over Supply Voltage and Operating Temperature ranges, unless otherwise specified.

Symbol	Parameter	Conditions		Pin	Min	Typ	Max	Units
V_{OH}	High Level Output Voltage	I_{OH} = −6 mA, V_{ID} = +1V I_{OH} = −6 mA, V_{ID} = OPEN		RO	2.4	3		V
V_{OH}	High Level Output Voltage	I_{OH} = −100 µA, V_{ID} = +1V I_{OH} = − 100 µA, V_{ID} = OPEN				V_{CC} −0.1		V
V_{OL}	Low Level Output Voltage	I_{OL} = +6 mA, V_{ID} = −1V				0.13	0.5	V
I_{OZ}	Output TRI-STATE Leakage Current	V_{OUT} = V_{CC} or GND EN = V_{IL}, EN* = V_{IH}					±50	µA
I_{SC}	Output Short Circuit Current	V_O = 0V, V_{ID} ≥ |200 mV| (Note 4)			−10	−35	−70	mA
I_{CC}	Power Supply Current	No Load, All RI+, R1− = OPEN, EN, EN* = V_{CC} or GND	T_A = -40˚C to +85˚C	V_{CC}		9	15	mA
			T_A = -55˚C to +125˚C				20	mA

Switching Characteristics - Industrial (Notes 3, 7, 10, 11)

Over Supply Voltage and -40˚C to +85˚C Operating Temperature range, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL}	Propagation Delay High to Low	C_L = 15 pF, V_{CM} = 1.5V (*Figures 1, 2*)	6	17.5	35	ns
t_{PLH}	Propagation Delay Low to High		6	17.8	35	ns
t_r	Rise Time (20% to 80%)			4.1	10	ns
t_f	Fall Time (80% to 20%)			3.3	10	ns
t_{PHZ}	Disable Time	C_L = 50 pF, V_{CM} = 1.5V (*Figures 3, 4*)			40	ns
t_{PLZ}	Disable Time				40	ns
t_{PZH}	Enable Time				40	ns
t_{PZL}	Enable Time				40	ns
t_{SK1}	Skew, |t_{PHL} − t_{PLH}| (Note 5)	C_L = 15 pF, V_{CM} = 1.5V		0.3	4	ns
t_{SK2}	Skew, Pin to Pin (Note 6)			0.6	4	ns
t_{SK3}	Skew, Part to Part (Note 7)			7	17	ns
f_{MAX}	Maximum Operating Frequency (Note 8)	C_L = 15 pF, V_{CM} = 1.5V	32			MHz

Switching Characteristics - Military (Notes 10, 11)

Over Supply Voltage and -55˚C to +125˚C Operating Temperature range, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Max	Units
t_{PHL}	Propagation Delay High to Low	C_L = 50 pF, V_{CM} = 1.5V (*Figures 1, 2*)	6	45	ns
t_{PLH}	Propagation Delay Low to High		6	45	ns
t_{PHZ}	Disable Time	C_L = 50 pF, V_{CM} = 1.5V (*Figures 3, 4*)		50	ns
t_{PLZ}	Disable Time			50	ns
t_{PZH}	Enable Time			50	ns
t_{PZL}	Enable Time			50	ns
t_{SK1}	Skew, $\|t_{PHL} - t_{PLH}\|$ (Note 5)	C_L = 50 pF, V_{CM} = 1.5V		6	ns
t_{SK2}	Skew, Pin to Pin (Note 6)			6	ns

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 table of "Electrical Characteristics" specifies conditions of device operation.

Note 2: Current into device pins is defined as positive. Current out of device pins is defined as negative. All voltages are referenced to ground except V_{ID}.

Note 3: All typicals are given for: V_{CC} = +3.3V, T_A = +25˚C.

Note 4: Short one output at a time to ground. Do not exceed package.

Note 5: t_{SK1} is the $|t_{PHL} - t_{PLH}|$ of a channel.

Note 6: t_{SK2} is the maximum skew between any two channels within a device, either edge.

Note 7: t_{SK3} is the difference in propagation delay times between any channels of any devices. This specification (maximum limit) applies to devices within V_{CC} ±0.1V of one another,and a Delta T_A = ±5˚C (between devices) within the operating temperature range. This parameter is guaranteed by design and characterization.

Note 8: All channels switching, Output Duty Cycle criteria is 40%/60% measured at 50%. Input = 1V to 2V, 50% Duty Cycle, $t_r/t_f \leq 5$ ns. This parameter is guaranteed by design and characterization.

Note 9: This parameter does not meet the TIA/EIA-422-B specification.

Parameter Measurement Information

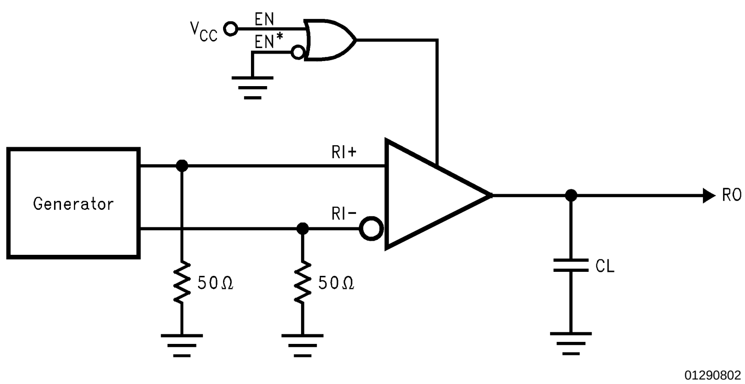
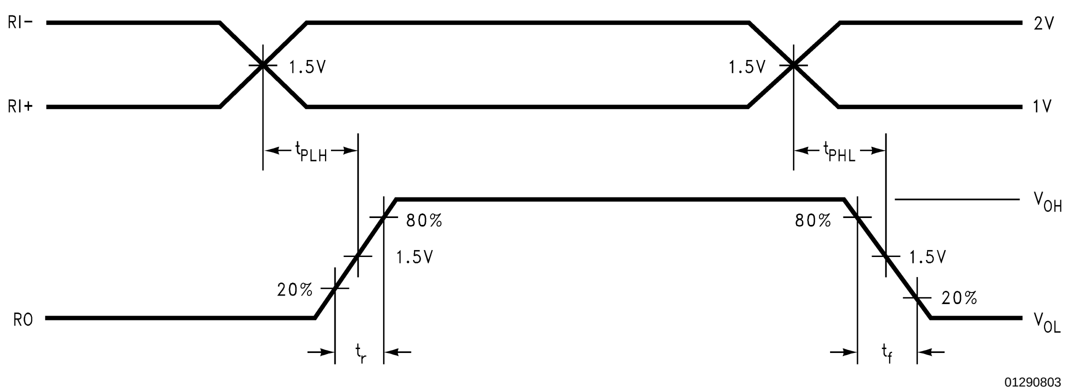


FIGURE 1. Receiver Propagation Delay and Transition Time Test Circuit (Notes 10, 11)

Parameter Measurement Information (Continued)



Note 10: Generator waveform for all tests unless otherwise specified: f = 1 MHz, Duty Cycle = 50%, Z_O = 50Ω, $t_r \le$ 10 ns, $t_f \le$ 10 ns.

Note 11: C_L includes probe and jig capacitance.

Note 12: For military grade product, $t_r \le$ 6ns and $t_f \le$ 6ns.

Note 13: For military grade product the measure point is 1/2 V_{CC} for t_{PLH}, t_{PHL}, t_{PZL}, and t_{PZH}

FIGURE 2. Receiver Propagation Delay and Transition Time Waveform (Notes 10, 11, 12, 13)

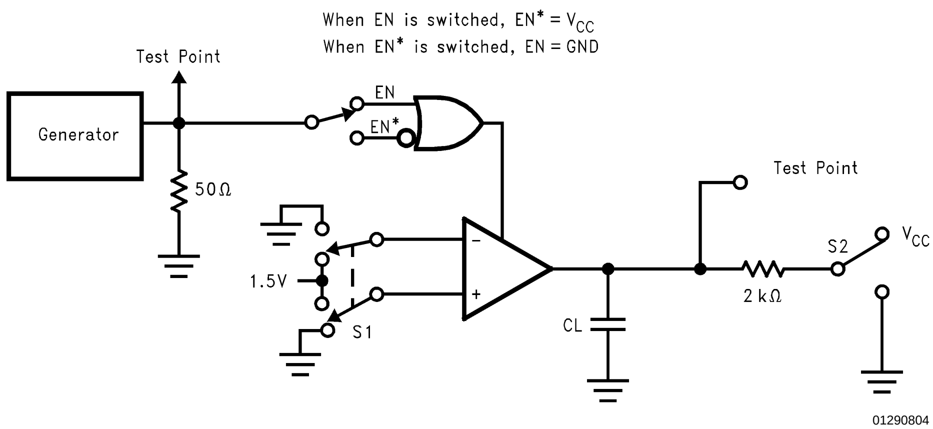


FIGURE 3. Receiver TRI-STATE Test Circuit

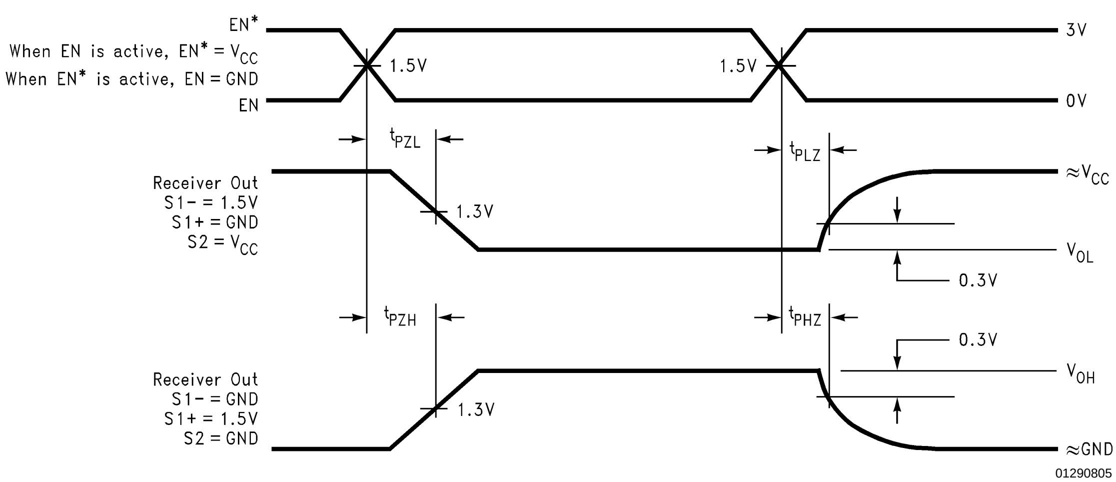


FIGURE 4. Receiver TRI-STATE Output Enable and Disable Waveforms (Notes 10, 11, 12, 13)

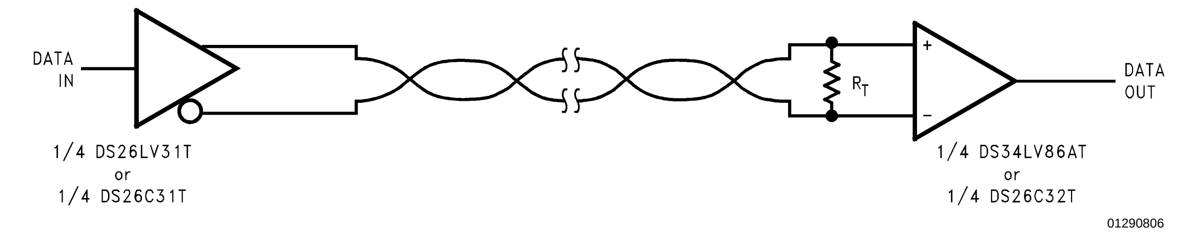
Typical Application Information

General application guidelines and hints for differential drivers and receivers may be found in the following application notes:

AN-214, AN-457, AN-805, AN-847, AN-903, AN-912, AN-916

Power Decoupling Recommendations:

Bypass caps must be used on power pins. High frequency ceramic (surface mount is recommended) 0.1 µF in parallel with 0.01 µF at the power supply pin. A 10 µF or greater solid tantalum or electrolytic should be connected at the power entry point on the printed circuit board.



R_T is optional although highly recommended to reduce reflection

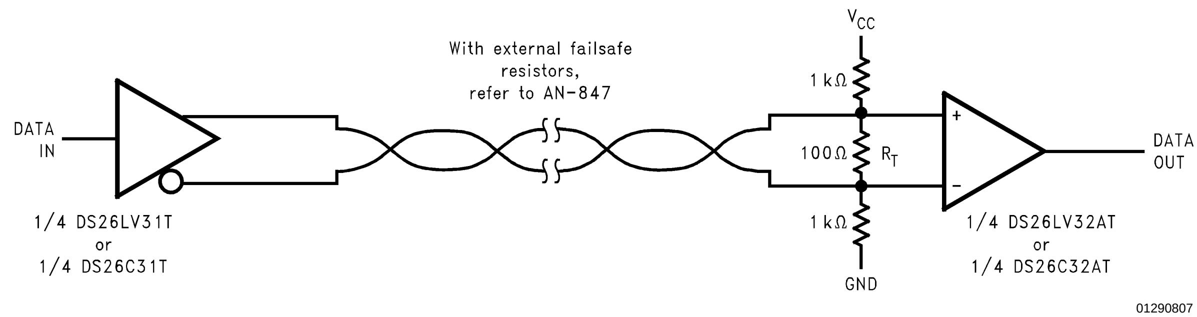


FIGURE 5. Typical Receiver Connections

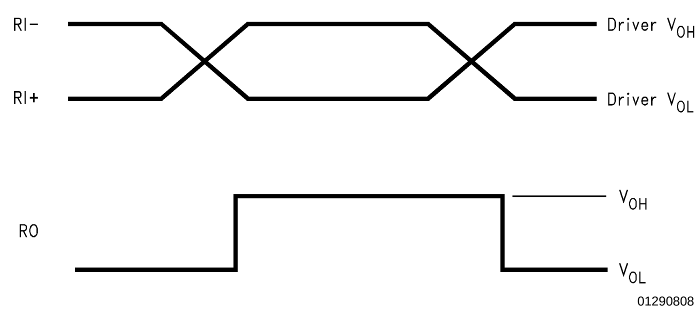


FIGURE 6. Typical Receiver Output Waveforms

Typical Application Information (Continued)

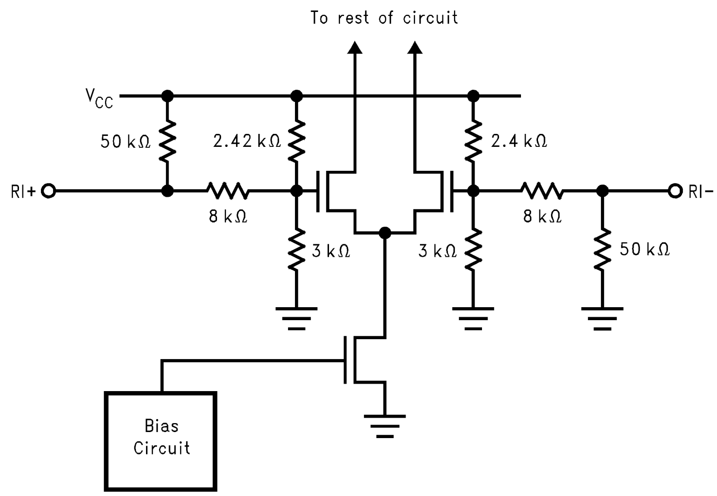


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FIGURE 7. Typical Receiver Input Circuit

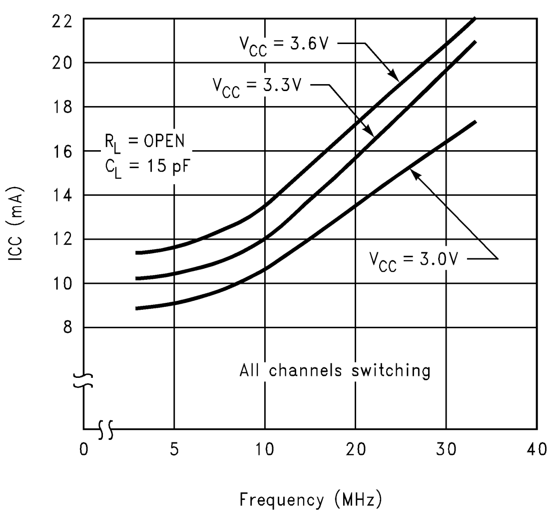

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FIGURE 8. Typical I_{CC} vs Frequency

Typical Application Information (Continued)

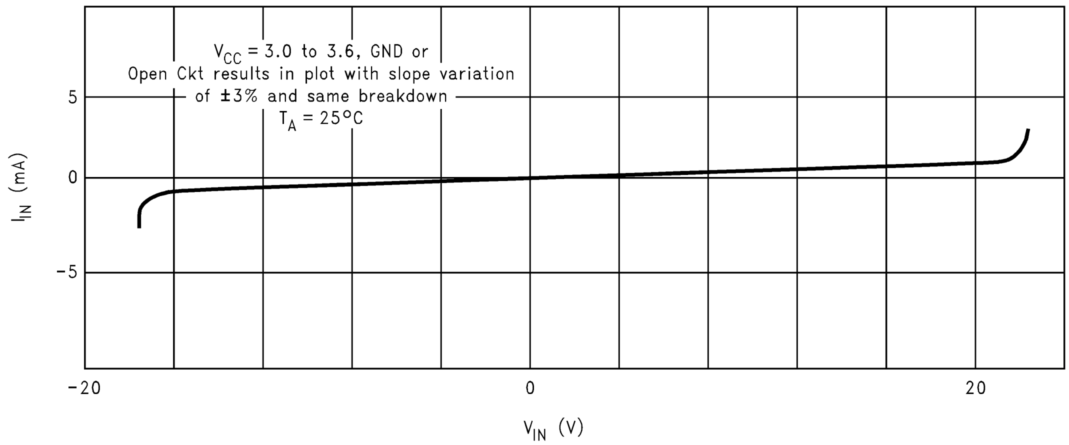

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FIGURE 9. Receiver I_{IN} vs V_{IN} (Power On or Power Off)

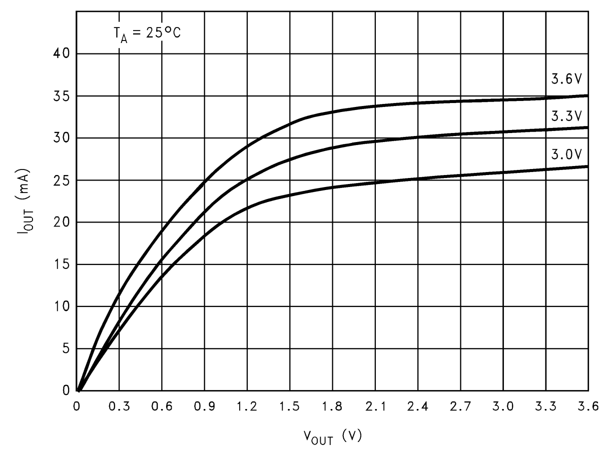

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FIGURE 10. I_{OL} vs V_{OL}

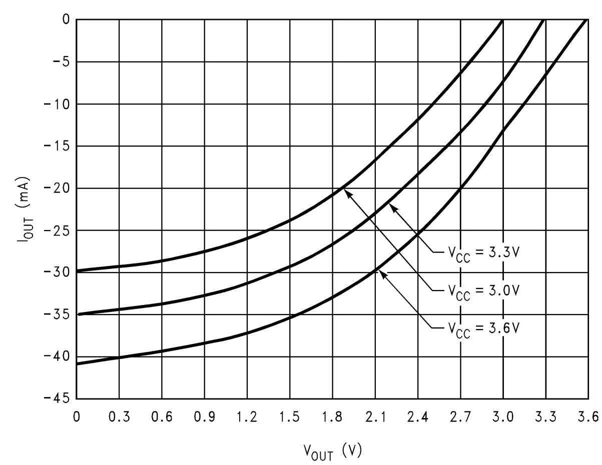

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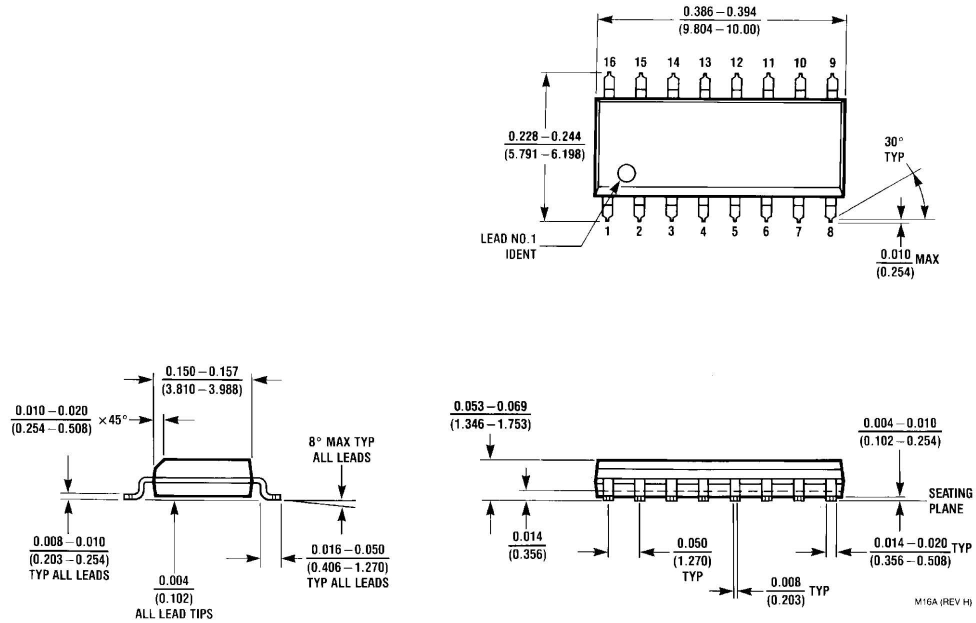
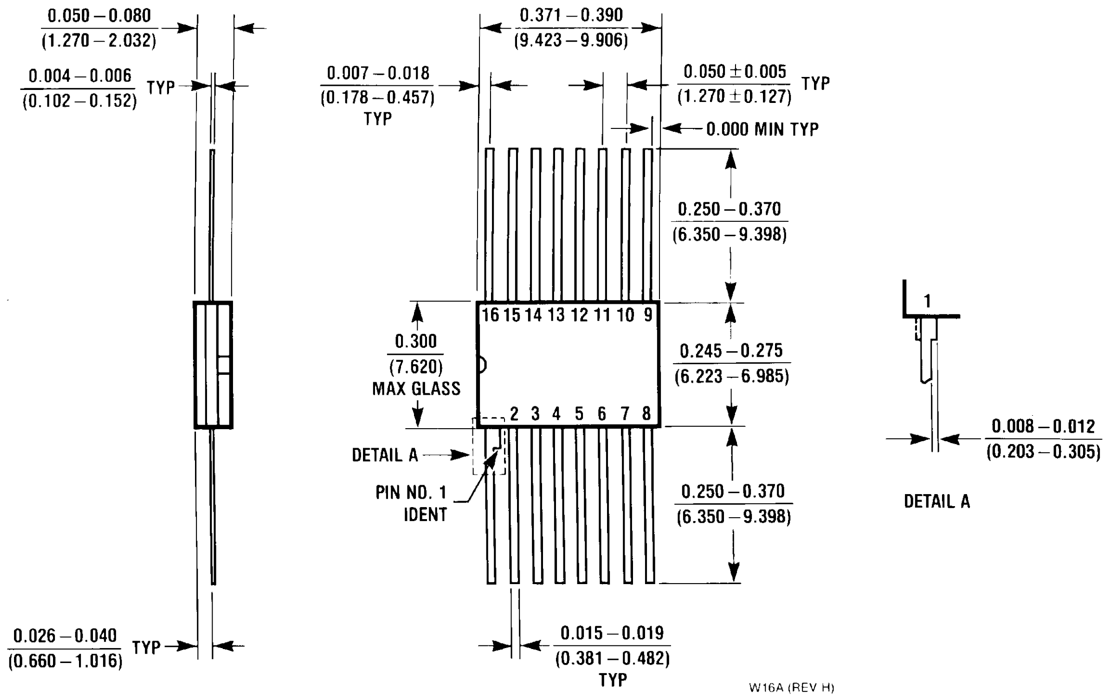
FIGURE 11. I_{OH} vs V_{OH}

Physical Dimensions inches (millimeters) unless otherwise noted



Order Number DS26LV32ATM
NS Package Number M16A

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



Order Number DS26LV32AW
NS Package Number W16A

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