

## DS26C32AT/DS26C32AM Quad Differential Line Receiver

 Check for Samples: [DS26C32AM](#), [DS26C32AT](#)

### FEATURES

- CMOS Design for Low Power
- $\pm 0.2V$  Sensitivity over Input Common Mode Voltage Range
- Typical Propagation Delays: 19 ns
- Typical Input hysteresis: 60 mV
- Inputs Won't Load Line When  $V_{CC} = 0V$
- Meets the Requirements of EIA Standard RS-422
- TRI-STATE Outputs for Connection to System Buses
- Available in Surface Mount
- Mil-Std-883C Compliant

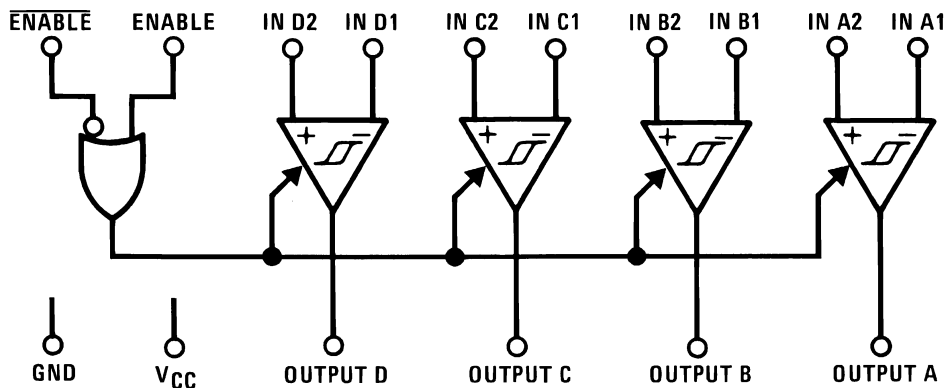
### DESCRIPTION

The DS26C32A is a quad differential line receiver designed to meet the RS-422, RS-423, and Federal Standards 1020 and 1030 for balanced and unbalanced digital data transmission, while retaining the low power characteristics of CMOS.

The DS26C32A has an input sensitivity of 200 mV over the common mode input voltage range of  $\pm 7V$ . The DS26C32A features internal pull-up and pull-down resistors which prevent output oscillation on unused channels.

The DS26C32A provides an enable and disable function common to all four receivers. It also features TRI-STATE outputs with 6 mA source and sink capability. This product is pin compatible with the DS26LS32A and the AM26LS32.

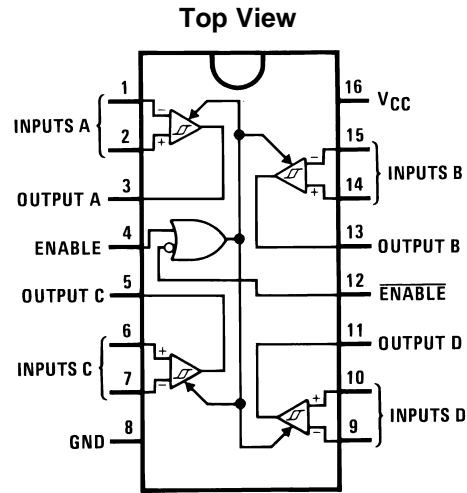
Logic Diagram



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

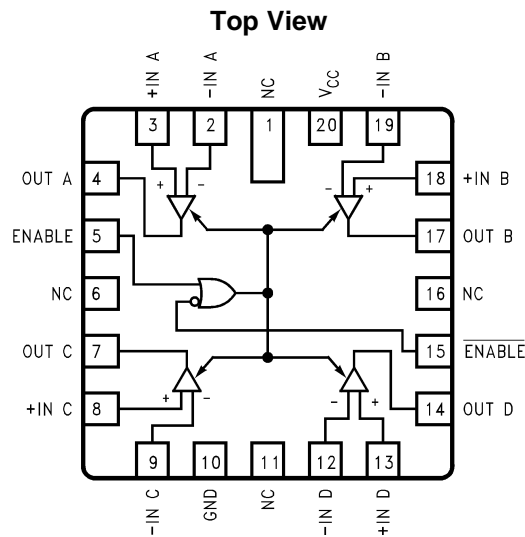
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Connection Diagrams



For Complete Military Product Specifications, refer to the appropriate SMD or MDS.

**Figure 1. PDIP Package**  
 See Package Number D0016A or NFG0016E  
 See Package Number NAJ0020A, NFE0016A or NAD0016A



**Figure 2. 20-Lead Ceramic Leadless Chip Carrier LCCC Package**



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)(2)(3)</sup>**

Supply Voltage ( $V_{CC}$ )	7V
Common Mode Range ( $V_{CM}$ )	$\pm 14V$
Differential Input Voltage ( $V_{DIFF}$ )	$\pm 14V$
Enable Input Voltage ( $V_{IN}$ )	7V
Storage Temperature Range ( $T_{STG}$ )	$-65^{\circ}C$ to $+150^{\circ}C$
Lead Temperature (Soldering 4 sec.)	$260^{\circ}C$
Maximum Power Dissipation at $25^{\circ}C$ <sup>(4)</sup>	
Ceramic NFE0016A Package	2308 mW
Plastic NFG0016E Package	1645 mW
SOIC D0016A Package	1190 mW
Ceramic NAJ0020A Package	2108 mW
Ceramic NAD0016A Package	1215 mW
Maximum Current Per Output	$\pm 25$ mA
This device does not meet 2000V ESD rating. <sup>(5)</sup>	

- (1) Absolute Maximum Ratings are those values beyond which the safety of the device cannot be ensured. They are not meant to imply that the device should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.
- (2) Unless otherwise specified, all voltages are referenced to ground.
- (3) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications
- (4) Ratings apply to ambient temperature at  $25^{\circ}C$ . Above this temperature derate N Package  $13.16$  mW/ $^{\circ}C$ , J Package  $15.38$  mW/ $^{\circ}C$ , M Package  $9.52$  mW/ $^{\circ}C$ , E Package  $12.04$  mW/ $^{\circ}C$ , and W package  $6.94$  mW/ $^{\circ}C$ .
- (5) ESD Rating: HBM (1.5 k $\Omega$ , 100 pF) Inputs  $\geq 2000V$  All other pins  $\geq 1000V$  EIAJ (0 $\Omega$ , 200 pF)  $\geq 350V$

**Operating Conditions**

	Min	Max	Units
Supply Voltage ( $V_{CC}$ )	4.50	5.50	V
Operating Temperature Range ( $T_A$ )			
DS26C32AT	-40	+85	$^{\circ}C$
DS26C32AM	-55	+125	$^{\circ}C$
Enable Input Rise or Fall Times		500	ns

**DC Electrical Characteristics**
 $V_{CC} = 5V \pm 10\%$  (unless otherwise specified)<sup>(1)</sup>

Parameter		Test Conditions	Min	Typ	Max	Units	
$V_{TH}$	Minimum Differential Input Voltage	$V_{OUT} = V_{OH}$ or $V_{OL}$ $-7V < V_{CM} < +7V$	-200	35	+200	mV	
$R_{IN}$	Input Resistance	$V_{IN} = -7V, +7V$ (Other Input = GND)	DS26C32AT	5.0	6.8	10	k $\Omega$
			DS26C32AM	4.5	6.8	11	k $\Omega$
$I_{IN}$	Input Current	$V_{IN} = +10V,$ Other Input = GND	DS26C32AT		+1.1	+1.5	mA
			DS26C32AM		+1.1	+1.8	mA
		$V_{IN} = -10V,$ Other Input = GND	DS26C32AT		-2.0	-2.5	mA
			DS26C32AM		-2.0	-2.7	mA
$V_{OH}$	Minimum High Level Output Voltage	$V_{CC} = \text{Min}, V_{DIFF} = +1V$	3.8	4.2		V	
		$I_{OUT} = -6.0$ mA					
$V_{OL}$	Maximum Low Level Output Voltage	$V_{CC} = \text{Max}, V_{DIFF} = -1V$		0.2	0.3	V	
		$I_{OUT} = 6.0$ mA					
$V_{IH}$	Minimum Enable High Input Level Voltage		2.0			V	
$V_{IL}$	Maximum Enable Low Input Level Voltage				0.8	V	

- (1) Absolute Maximum Ratings are those values beyond which the safety of the device cannot be ensured. They are not meant to imply that the device should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

**DC Electrical Characteristics (continued)** $V_{CC} = 5V \pm 10\%$  (unless otherwise specified)<sup>(1)</sup>

Parameter		Test Conditions	Min	Typ	Max	Units
$I_{OZ}$	Maximum TRI-STATE Output Leakage Current	$V_{OUT} = V_{CC}$ or GND, $\overline{ENABLE} = V_{IL}$ , $ENABLE = V_{IH}$		$\pm 0.5$	$\pm 5.0$	$\mu A$
$I_I$	Maximum Enable Input Current	$V_{IN} = V_{CC}$ or GND			$\pm 1.0$	$\mu A$
$I_{CC}$	Quiescent Power Supply Current	$V_{CC} = \text{Max}$ ,	DS26C32AT	16	23	mA
		$V_{DIF} = +1V$	DS26C32AM	16	25	mA
$V_{HYST}$	Input Hysteresis	$V_{CM} = 0V$		60		mV

**AC Electrical Characteristics** $V_{CC} = 5V \pm 10\%$  <sup>(1)</sup>

Parameter	Test Conditions	Min	Typ	Max		Units	
				DS26C32AT	DS26C32AM		
$t_{PLH}$ , $t_{PHL}$	Propagation Delay Input to Output	$C_L = 50 \text{ pF}$	10	19	30	35	ns
		$V_{DIFF} = 2.5V$					
		$V_{CM} = 0V$					
$t_{RISE}$ , $t_{FALL}$	Output Rise and Fall Times	$C_L = 50 \text{ pF}$		4	9	9	ns
		$V_{DIFF} = 2.5V$					
		$V_{CM} = 0V$					
$t_{PLZ}$ , $t_{PHZ}$	Propagation Delay ENABLE to Output	$C_L = 50 \text{ pF}$		13	22	29	ns
		$R_L = 1000\Omega$					
		$V_{DIFF} = 2.5V$					
$t_{PZL}$ , $t_{PZH}$	Propagation Delay ENABLE to Output	$C_L = 50 \text{ pF}$		13	23	29	ns
		$R_L = 1000\Omega$					
		$V_{DIFF} = 2.5V$					

(1) Unless otherwise specified, Min/Max limits apply over recommended operating conditions. All typicals are given for  $V_{CC} = 5V$  and  $T_A = 25^\circ C$ .

**Comparison Table of Switching Characteristics into “LS-Type” Load**(Figure 6, Figure 7, and Figure 8) <sup>(1)</sup>

Parameter	Test Conditions	DS26C32A	DS26LS32A	Units	
		Typ	Typ		
$t_{PLH}$	Input to Output	$C_L = 15 \text{ pF}$	17	23	ns
$t_{PHL}$			19	23	ns
$t_{LZ}$	ENABLE to Output	$C_L = 5 \text{ pF}$	13	15	ns
$t_{HZ}$			12	20	ns
$t_{ZL}$	ENABLE to Output	$C_L = 15 \text{ pF}$	13	14	ns
$t_{ZH}$			13	15	ns

(1) This table is provided for comparison purposes only. The values in this table for the DS26C32A reflect the performance of the device, but are not tested.

### TEST AND SWITCHING WAVEFORMS

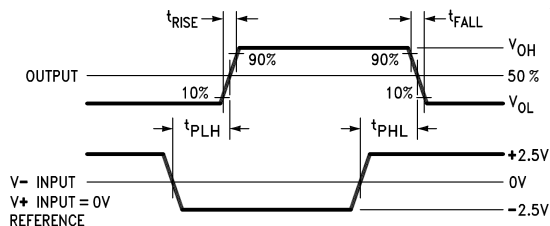
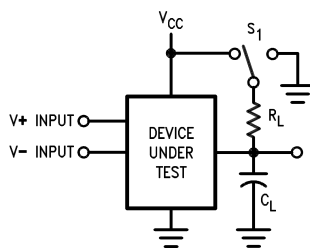


Figure 3. Propagation Delay



$C_L$  includes load and test jig capacitance.  
 $S_1 = V_{CC}$  for  $t_{PZL}$  and  $t_{PLZ}$  measurements.  
 $S_1 = Gnd$  for  $t_{PZH}$  and  $t_{PHZ}$  measurements.

Figure 4. Test Circuit for TRI-STATE Output Tests

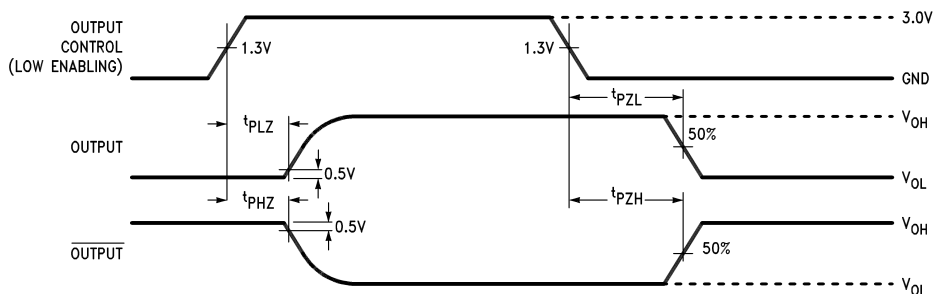


Figure 5. TRI-STATE Output Enable and Disable Waveforms

### AC Test Circuit and Switching Time Waveforms

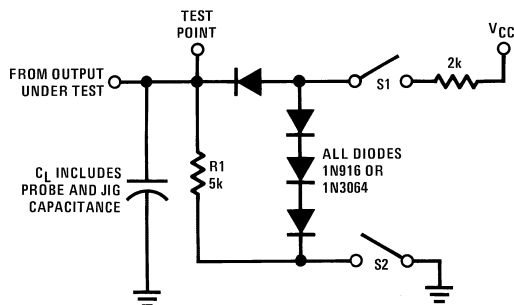


Figure 6. Load Test Circuit for TRI-STATE Outputs for "LS-Type" Load

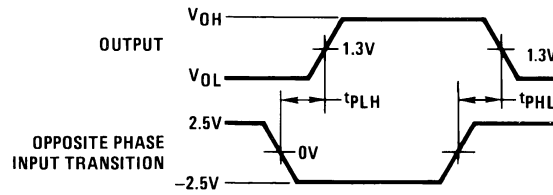
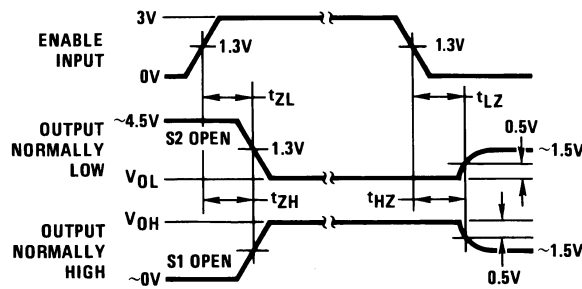


Figure 7. Propagation Delay for “LS-Type” Load



- (1) Diagram shown for  $\overline{\text{ENABLE}}$  low.
- (2) S1 and S2 of load circuit are closed except where shown.
- (3) Pulse generator for all pulses: Rate  $\leq 1.0$  MHz;  $Z_0 = 50\Omega$ ;  $t_r \leq 15$  ns;  $t_f \leq 6.0$  ns.

Figure 8. Enable and Disable Times for “LS-Type” Load

Truth Table<sup>(1)</sup>

ENABLE	$\overline{\text{ENABLE}}$	Input	Output
L	H	X	Z
All Other Combinations of Enable Inputs		$V_{ID} \geq V_{TH} (\text{Max})$	H
		$V_{ID} \leq V_{TH} (\text{Min})$	L
		Open	H

(1) Z = TRI-STATE

TYPICAL APPLICATIONS

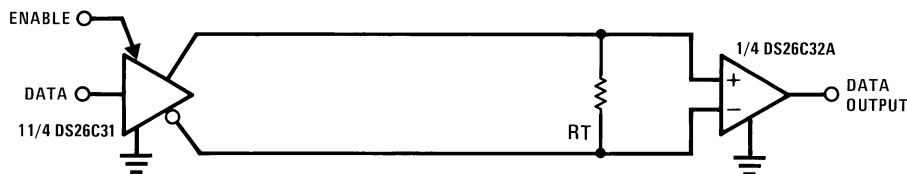


Figure 9. Two-Wire Balanced Systems, RS-422

Typical Performance Characteristics

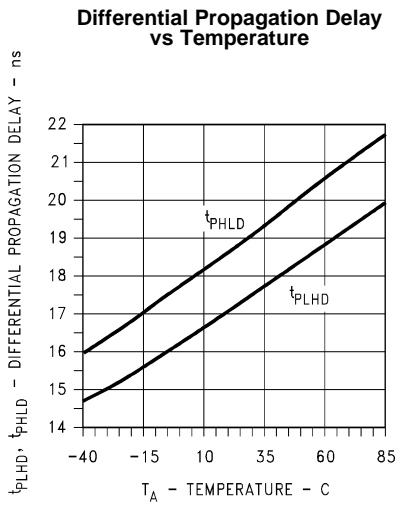


Figure 10.

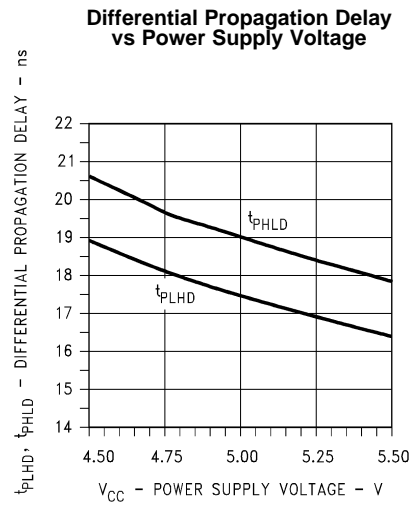


Figure 11.

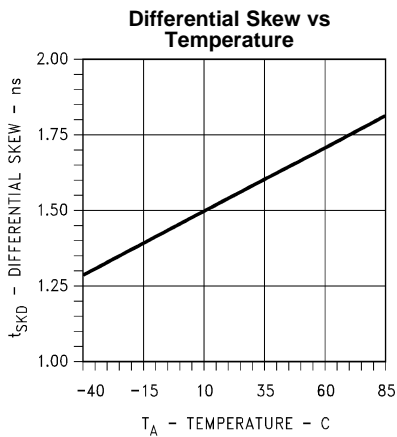


Figure 12.

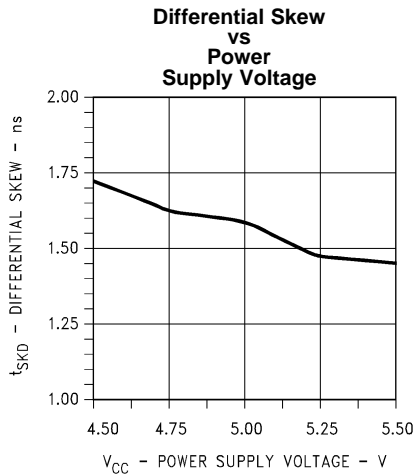


Figure 13.

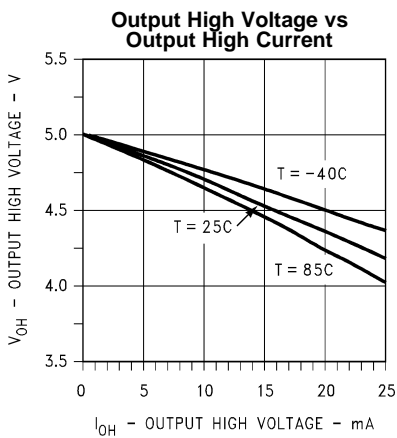


Figure 14.

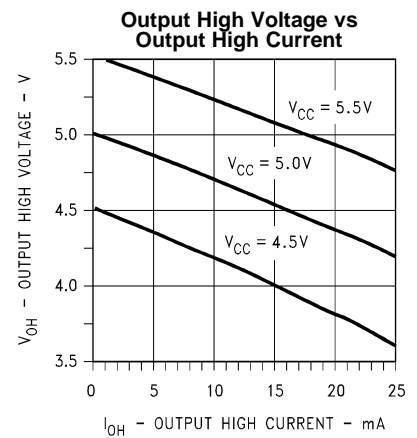


Figure 15.

**Typical Performance Characteristics (continued)**

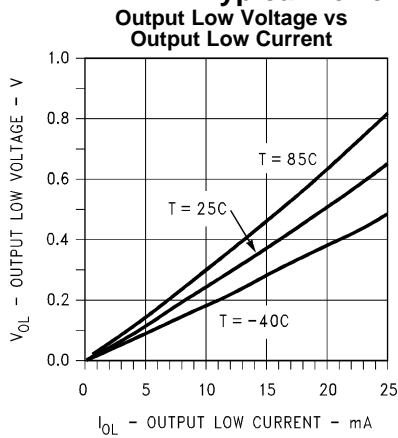


Figure 16.

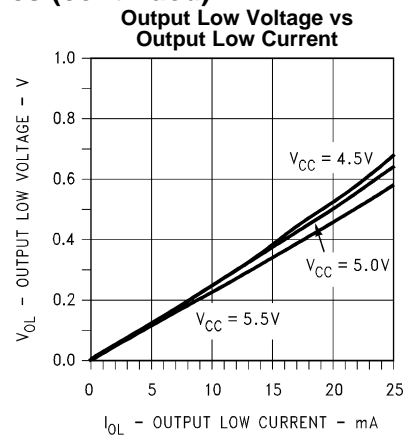


Figure 17.

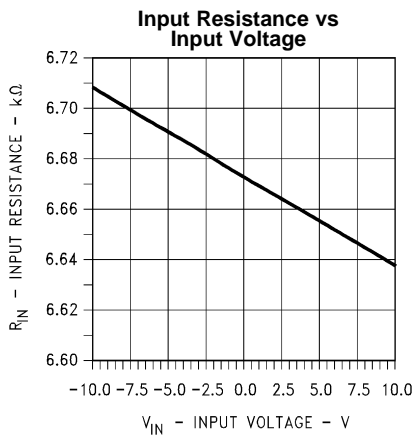


Figure 18.

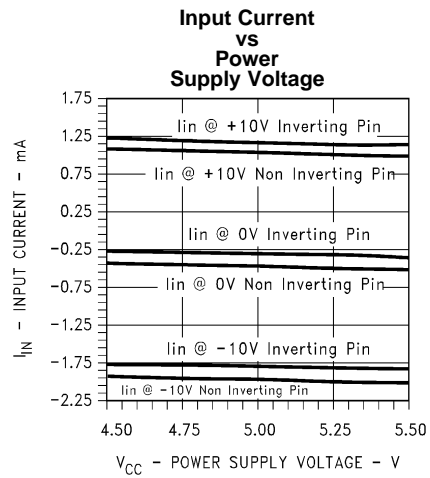


Figure 19.

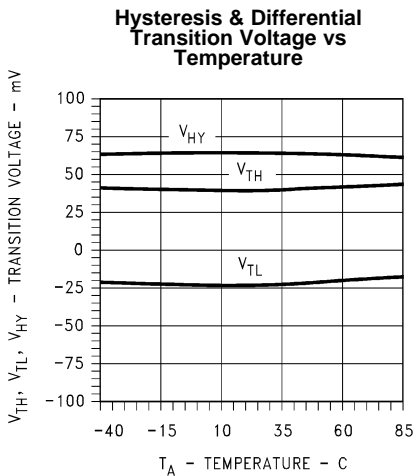


Figure 20.

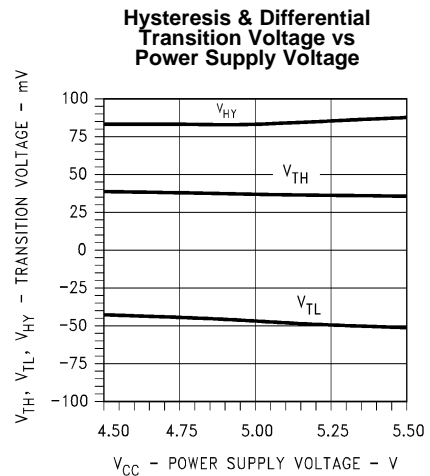


Figure 21.



Typical Performance Characteristics (continued)

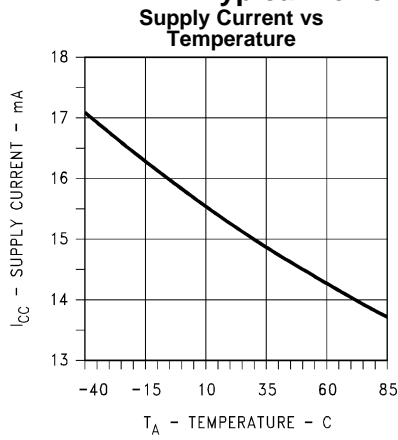


Figure 22.

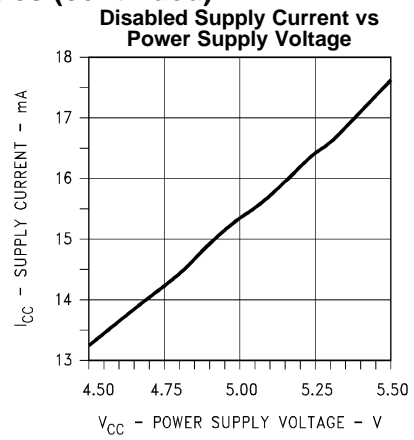


Figure 23.

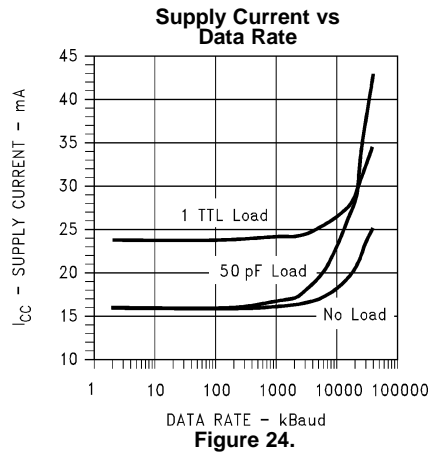


Figure 24.

## REVISION HISTORY

Changes from Revision B (April 2013) to Revision C	Page
• Changed layout of National Data Sheet to TI format .....	<a href="#">9</a>

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DS26C32ATM/NOPB	ACTIVE	SOIC	D	16	48	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	DS26C32ATM	<a href="#">Samples</a>
DS26C32ATMX/NOPB	ACTIVE	SOIC	D	16	2500	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 85	DS26C32ATM	<a href="#">Samples</a>

(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) **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 <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

(5) 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.

(6) 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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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DS26C32ATMX/NOPB	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.3	8.0	16.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS26C32ATMX/NOPB	SOIC	D	16	2500	367.0	367.0	35.0

**TUBE**



\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
DS26C32ATM/NOPB	D	SOIC	16	48	495	8	4064	3.05

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.



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