- ● **Operates With Single 5-V Power Supply**
- ● **LinBiCMOS™ Process Technology**
- ● **Two Drivers and Two Receivers**
- ● **±30-V Input Levels**
- ● **Low Supply Current . . . 8 mA Typ**
- ● **Meets or Exceeds ANSI EIA/TIA-232-E and ITU Recommendation V.28**
- ● **Designed to be Interchangeable With Maxim MAX232**
- ● **Applications**
  EIA/TIA-232-E
  Battery-Powered Systems
  Terminals
  Modems
  Computers
- ● **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015**

D, DW, OR N PACKAGE
(TOP VIEW)

|			
C1+	1	16	V_{CC}
V_{S+}	2	15	GND
C1−	3	14	T1OUT
C2+	4	13	R1IN
C2−	5	12	R1OUT
V_{S-}	6	11	T1IN
T2OUT	7	10	T2IN
R2IN	8	9	R2OUT

description

The MAX232 is a dual driver/receiver that includes a capacitive voltage generator to supply EIA/TIA-232-E voltage levels from a single 5-V supply. Each receiver converts EIA/TIA-232-E inputs to 5-V TTL/CMOS levels. These receivers have a typical threshold of 1.3 V and a typical hysteresis of 0.5 V, and can accept ±30-V inputs. Each driver converts TTL/CMOS input levels into EIA/TIA-232-E levels. The driver, receiver, and voltage-generator functions are available as cells in the Texas Instruments LinASIC™ library.

The MAX232 is characterized for operation from 0°C to 70°C. The MAX232I is characterized for operation from −40°C to 85°C.
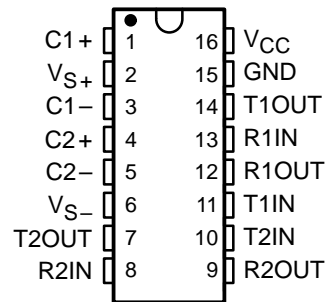
logic symbol†
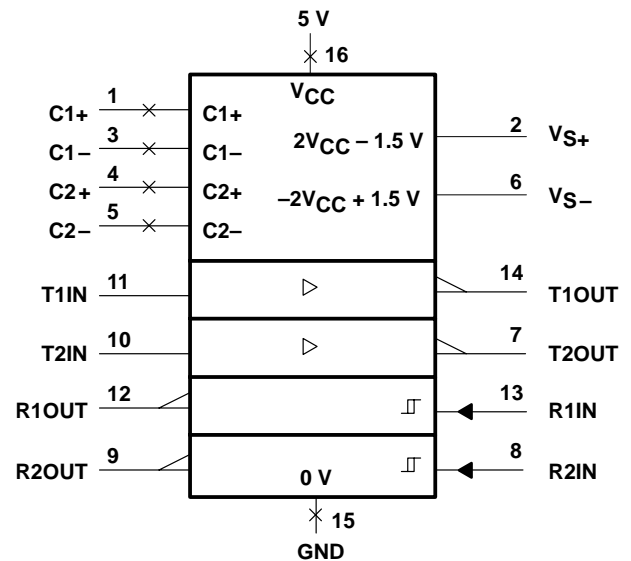
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

LinASIC and LinBiCMOS are trademarks of Texas Instruments Incorporated.

TEXAS INSTRUMENTS

SLLS047E – FEBRUARY 1989 – REVISED SEPTEMBER 1997

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Input supply voltage range, V_{CC} (see Note 1) . . . . −0.3 V to 6 V
Positive output supply voltage range, V_{S+} . . . . V_{CC} −0.3 V to 15 V
Negative output supply voltage range, V_{S-} . . . . −0.3 V to −15 V
Input voltage range, V_I: Driver . . . . −0.3 V to V_{CC} + 0.3 V
                   Receiver . . . . ±30 V
Output voltage range, V_O: T1OUT, T2OUT . . . . V_{S-} −0.3 V to V_{S+} + 0.3 V
                   R1OUT, R2OUT . . . . −0.3 V to V_{CC} + 0.3 V
Short-circuit duration: T1OUT, T2OUT . . . . unlimited
Operating free-air temperature range, T_A: MAX232 . . . . 0°C to 70°C
                                 MAX232I . . . . −40°C to 85°C
Storage temperature range, T_{stg} . . . . −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . 260°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1:   All voltage values are with respect to network ground terminal.

recommended operating conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.5	5	5.5	V
High-level input voltage, V_{IH} (T1IN,T2IN)		2			V
Low-level input voltage, V_{IL} (T1IN, T2IN)				0.8	V
Receiver input voltage, R1IN, R2IN				±30	V
Operating free-air temperature, T_A		0		70	°C

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature range (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{OH}	High-level output voltage	T1OUT, T2OUT	R_L = 3 kΩ to GND		5	7		V
		R1OUT, R2OUT	I_{OH} = −1 mA		3.5			
V_{OL}	Low-level output voltage‡	T1OUT, T2OUT	R_L = 3 kΩ to GND			−7	−5	V
		R1OUT, R2OUT	I_{OL} = 3.2 mA				0.4	
V_{IT+}	Receiver positive-going input threshold voltage	R1IN, R2IN	V_{CC} = 5 V,	T_A = 25°C		1.7	2.4	V
V_{IT-}	Receiver negative-going input threshold voltage	R1IN, R2IN	V_{CC} = 5 V,	T_A = 25°C	0.8	1.2		V
V_{hys}	Input hysteresis voltage	R1IN, R2IN	V_{CC} = 5 V		0.2	0.5	1	V
r_i	Receiver input resistance	R1IN, R2IN	V_{CC} = 5,	T_A = 25°C	3	5	7	kΩ
r_o	Output resistance	T1OUT, T2OUT	V_{S+} = V_{S-} = 0,	V_O = ± 2 V	300			Ω
I_{OS}§	Short-circuit output current	T1OUT, T2OUT	V_{CC} = 5.5 V,	V_O = 0		±10		mA
I_{IS}	Short-circuit input current	T1IN, T2IN	V_I = 0				200	μA
I_{CC}	Supply current		V_{CC} = 5.5 V, T$_A$ = 25°C	All outputs open,		8	10	mA

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ The algebraic convention, in which the least positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.
§ Not more than one output should be shorted at a time.

TEXAS
INSTRUMENTS

switching characteristics, V_{CC} = 5 V, T_A = 25°C

	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH(R)}$	Receiver propagation delay time, low- to high-level output	See Figure 2		500		ns
$t_{PHL(R)}$	Receiver propagation delay time, high- to low-level output	See Figure 2		500		ns
SR	Driver slew rate	R_L = 3 kΩ to 7 kΩ, See Figure 3			30	V/μs
SR(tr)	Driver transition region slew rate	See Figure 4		3		V/μs

APPLICATION INFORMATION
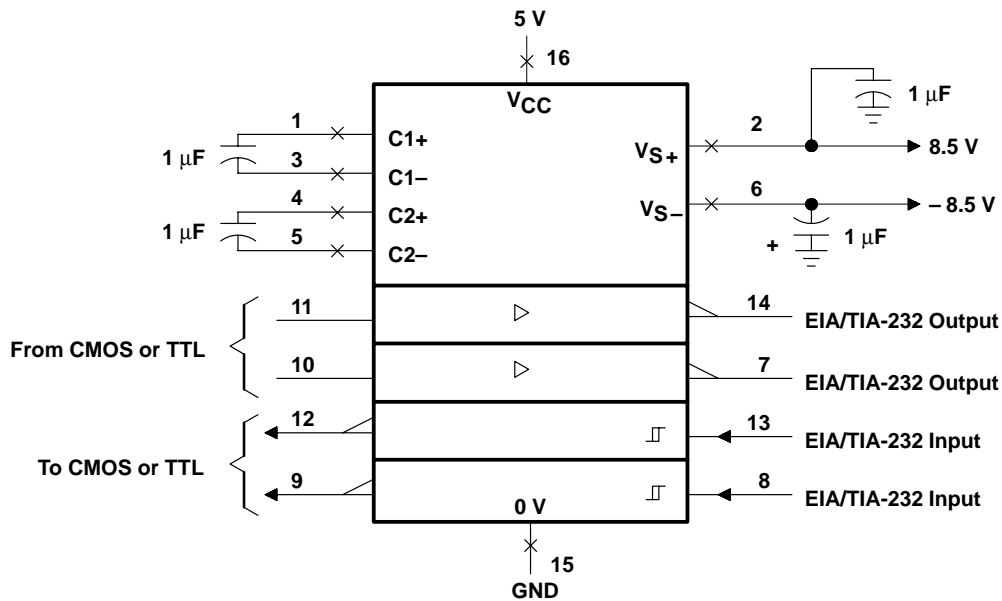
Figure 1. Typical Operating Circuit

PARAMETER MEASUREMENT INFORMATION
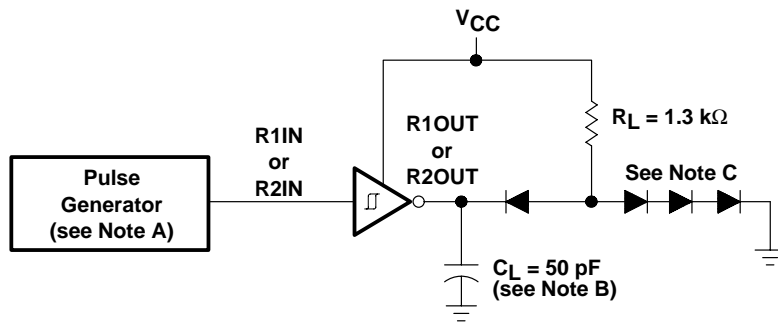
TEST CIRCUIT
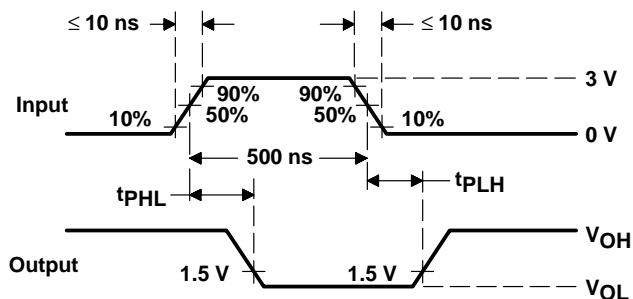
WAVEFORMS

NOTES: A. The pulse generator has the following characteristics: $Z_O = 50\ \Omega$, duty cycle $\leq 50\%$.
        B. C_L includes probe and jig capacitance.
        C. All diodes are 1N3064 or equivalent.

Figure 2. Receiver Test Circuit and Waveforms for t_{PHL} and t_{PLH} Measurement

PARAMETER MEASUREMENT INFORMATION

$$SR = \frac{0.8\ (V_{OH} - V_{OL})}{t_{TLH}} \quad \text{or} \quad \frac{0.8\ (V_{OL} - V_{OH})}{t_{THL}}$$
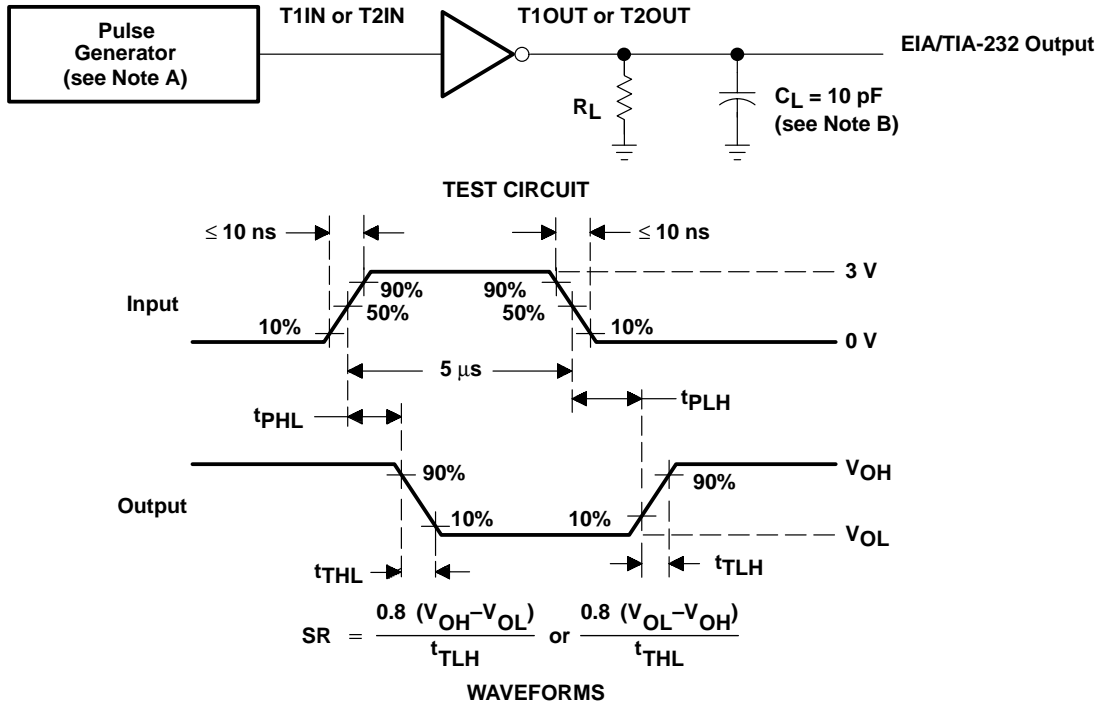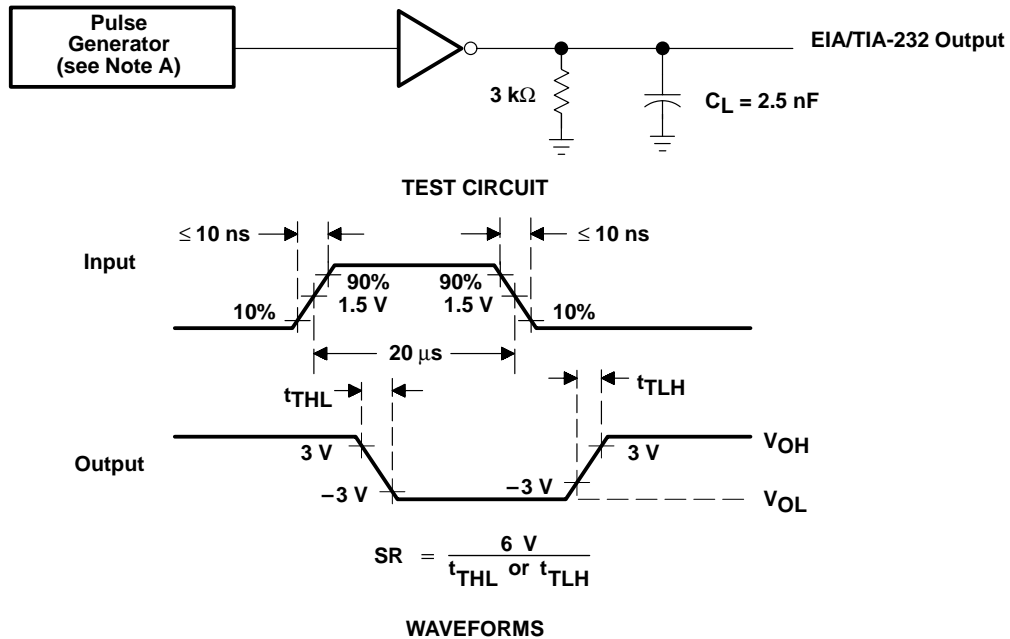
WAVEFORMS

NOTES: A. The pulse generator has the following characteristics: $Z_O = 50\ \Omega$, duty cycle $\leq 50\%$.
　　　　B. C_L includes probe and jig capacitance.

Figure 3. Driver Test Circuit and Waveforms for t_{PHL} and t_{PLH} Measurement (5-μs input)

$$SR = \frac{6\ V}{t_{THL} \quad \text{or} \quad t_{TLH}}$$

WAVEFORMS

NOTE A:　The pulse generator has the following characteristics: $Z_O = 50\ \Omega$, duty cycle $\leq 50\%$.

Figure 4. Test Circuit and Waveforms for t_{THL} and t_{TLH} Measurement (20-μs input)

MECHANICAL INFORMATION

D (R-PDSO-G)**   **PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN

DIM \ PINS **	8	14	16
A MAX	0.197 (5,00)	0.344 (8,75)	0.394 (10,00)
A MIN	0.189 (4,80)	0.337 (8,55)	0.386 (9,80)

0.050 (1,27)

0.020 (0,51) / 0.014 (0,35)   ⊕ 0.010 (0,25) Ⓜ

0.244 (6,20) / 0.228 (5,80)

0.157 (4,00) / 0.150 (3,81)

0.008 (0,20) NOM

Gage Plane

0.010 (0,25)

0°−8°

0.044 (1,12) / 0.016 (0,40)

0.069 (1,75) MAX

0.010 (0,25) / 0.004 (0,10)

Seating Plane

⌒ 0.004 (0,10)

4040047 / D 10/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012

TEXAS
INSTRUMENTS

POST OFFICE BOX 655303 ● DALLAS, TEXAS 75265
POST OFFICE BOX 1443 ● HOUSTON, TEXAS 77251–1443

MECHANICAL INFORMATION

DW (R-PDSO-G**)   **PLASTIC SMALL-OUTLINE PACKAGE**

16 PIN SHOWN

PINS ** DIM	16	20	24	28
A MAX	0.410 (10,41)	0.510 (12,95)	0.610 (15,49)	0.710 (18,03)
A MIN	0.400 (10,16)	0.500 (12,70)	0.600 (15,24)	0.700 (17,78)

0.050 (1,27)

0.020 (0,51) / 0.014 (0,35)   ⊕ 0.010 (0,25) Ⓜ

0.419 (10,65) / 0.400 (10,15)

0.299 (7,59) / 0.293 (7,45)

A

0.104 (2,65) MAX

0.012 (0,30) / 0.004 (0,10)

0.010 (0,25) NOM

Gage Plane

0°−8°

0.010 (0,25)

0.050 (1,27) / 0.016 (0,40)

Seating Plane   ⌒ 0.004 (0,10)

4040000 / B 03/95

NOTES: A. All linear dimensions are in inches (millimeters).
   B. This drawing is subject to change without notice.
   C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
   D. Falls within JEDEC MS-013

MECHANICAL INFORMATION

N (R-PDIP-T)**   **PLASTIC DUAL-IN-LINE PACKAGE**

16 PIN SHOWN
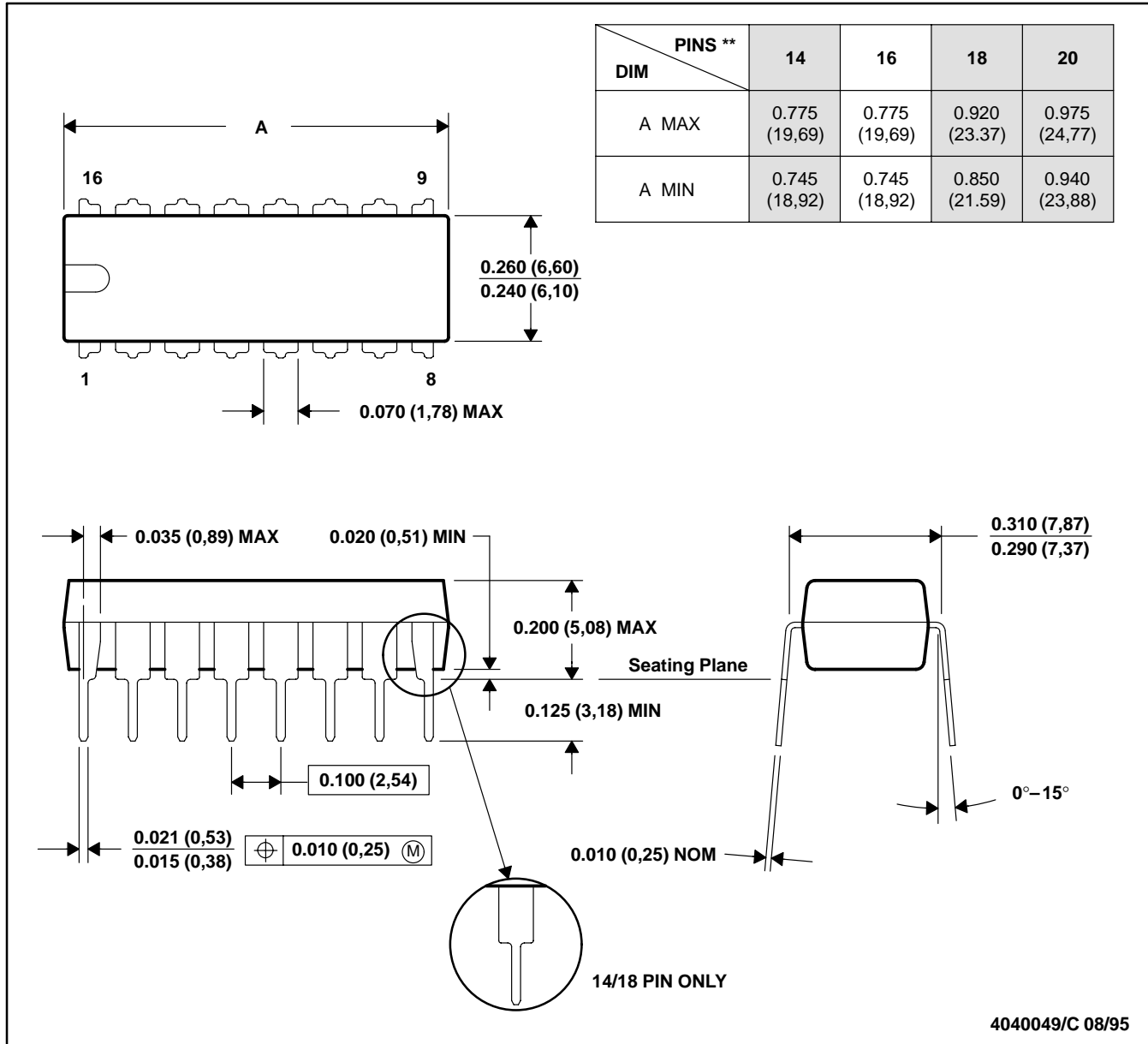
PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23.37)	0.975 (24,77)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21.59)	0.940 (23,88)

A

16   9

0.260 (6,60)
0.240 (6,10)

1   8

0.070 (1,78) MAX

0.035 (0,89) MAX   0.020 (0,51) MIN

0.310 (7,87)
0.290 (7,37)

0.200 (5,08) MAX

Seating Plane

0.125 (3,18) MIN

0.100 (2,54)

0°–15°

0.021 (0,53)
0.015 (0,38)   ⊕ 0.010 (0,25) Ⓜ   0.010 (0,25) NOM

14/18 PIN ONLY

4040049/C 08/95

NOTES: A. All linear dimensions are in inches (millimeters).
       B. This drawing is subject to change without notice.
       C. Falls within JEDEC MS-001 (20 pin package is shorter then MS-001.)

IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI 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 of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.