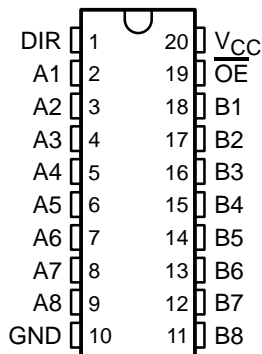


# SN54HC645, SN74HC645 OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

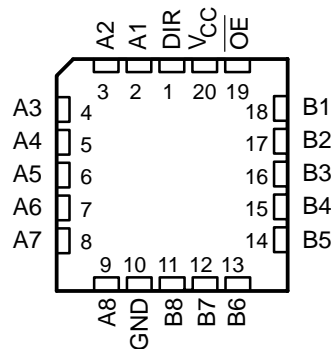
SCLS304B – JANUARY 1996 – REVISED DECEMBER 2002

- Wide Operating Voltage Range of 2 V to 6 V
- High-Current 3-State Outputs Can Drive Up To 15 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Max  $I_{CC}$
- Typical  $t_{pd} = 12$  ns
- $\pm 6$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Max
- True Logic

SN54HC645 . . . J OR W PACKAGE  
SN74HC645 . . . DW, N, OR NS PACKAGE  
(TOP VIEW)



SN54HC645 . . . FK PACKAGE  
(TOP VIEW)



## description/ordering information

These octal bus transceivers are designed for asynchronous two-way communication between data buses. These devices transmit data from the A bus to the B bus or from the B bus to the A bus, depending upon the level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so the buses are effectively isolated.

## ORDERING INFORMATION

T <sub>A</sub>	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
	Package	Form		
-40°C to 85°C	PDIP – N	Tube	SN74HC645N	SN74HC645N
	SOIC – DW	Tube	SN74HC645DW	HC645
		Tape and reel	SN74HC645DWR	
	SOP – NS	Tape and reel	SN74HC645NSR	HC645
-55°C to 125°C	CDIP – J	Tube	SNJ54HC645J	SNJ54HC645J
	CFP – W	Tube	SNJ54HC645W	SNJ54HC645W
	LCCC – FK	Tube	SNJ54HC645FK	SNJ54HC645FK

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

## FUNCTION TABLE

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

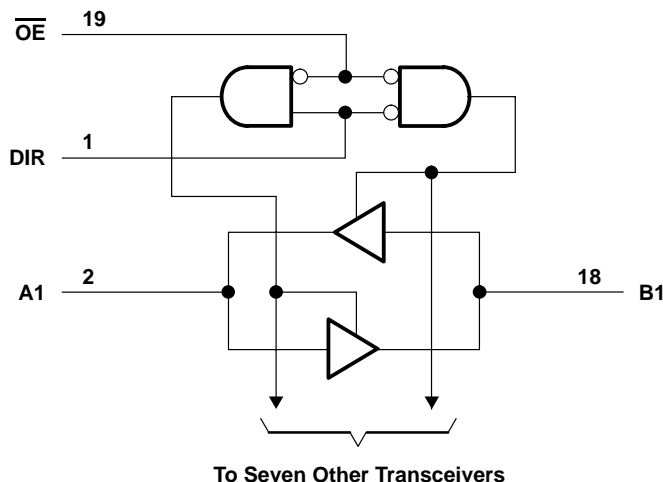
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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

# SN54HC645, SN74HC645 OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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## logic diagram (positive logic)



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

Supply voltage range, $V_{CC}$	-0.5 V to 7 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1)	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1)	$\pm 20$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	$\pm 35$ mA
Continuous current through $V_{CC}$ or GND	$\pm 70$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DW package	58°C/W
N package	69°C/W
NS package	60°C/W
Storage temperature range, $T_{stg}$	-65°C to 150°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.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions (see Note 3)

		SN54HC645			SN74HC645			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	2	5	6	2	5	6	V
$V_{IH}$	High-level input voltage	$V_{CC} = 2$ V		1.5	1.5		V	
		$V_{CC} = 4.5$ V		3.15	3.15			
		$V_{CC} = 6$ V		4.2	4.2			
$V_{IL}$	Low-level input voltage	$V_{CC} = 2$ V		0.5	0.5		V	
		$V_{CC} = 4.5$ V		1.35	1.35			
		$V_{CC} = 6$ V		1.8	1.8			
$V_I$	Input voltage	0	$V_{CC}$		0	$V_{CC}$		V
$V_O$	Output voltage	0	$V_{CC}$		0	$V_{CC}$		V
$\Delta t/\Delta v$	Input transition rise/fall time	$V_{CC} = 2$ V		1000	1000		ns	
		$V_{CC} = 4.5$ V		500	500			
		$V_{CC} = 6$ V		400	400			
$T_A$	Operating free-air temperature	-55	125		-40	85		°C



# SN54HC645, SN74HC645 OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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NOTE 3: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

## electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC645		SN74HC645		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$V_{OH}$	$V_I = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\ \mu\text{A}$	2 V	1.9	1.998		1.9		1.9	V	
			4.5 V	4.4	4.499		4.4		4.4		
			6 V	5.9	5.999		5.9		5.9		
		$I_{OH} = -6\ \text{mA}$	4.5 V	3.98	4.3		3.7		3.84		
			6 V	5.48	5.8		5.2		5.34		
$V_{OL}$	$V_I = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\ \mu\text{A}$	2 V		0.002	0.1		0.1		V	
			4.5 V		0.001	0.1		0.1			0.1
			6 V		0.001	0.1		0.1			0.1
		$I_{OL} = 6\ \text{mA}$	4.5 V		0.17	0.26		0.4			0.33
			6 V		0.15	0.26		0.4			0.33
$I_I$	DIR or $\overline{OE}$	$V_I = V_{CC}$ or 0	6 V		$\pm 0.1$	$\pm 100$		$\pm 1000$		$\pm 1000$	nA
$I_{OZ}$	A or B	$V_O = V_{CC}$ or 0	6 V		$\pm 0.01$	$\pm 0.5$		$\pm 10$		$\pm 5$	$\mu\text{A}$
$I_{CC}$		$V_I = V_{CC}$ or 0, $I_O = 0$	6 V			8		160		80	$\mu\text{A}$
$C_i$	DIR or $\overline{OE}$		2 V to 6 V		3	10		10		10	pF

## switching characteristics over recommended operating free-air temperature range, $C_L = 50\ \text{pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC645		SN74HC645		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A or B	B or A	2 V		40	105		160		130	ns
			4.5 V		15	21		32		26	
			6 V		12	18		27		22	
$t_{en}$	$\overline{OE}$	A or B	2 V		125	230		340		290	ns
			4.5 V		23	46		68		58	
			6 V		20	39		58		49	
$t_{dis}$	$\overline{OE}$	A or B	2 V		74	200		300		250	ns
			4.5 V		25	40		60		50	
			6 V		21	34		51		43	
$t_t$		A or B	2 V		20	60		90		75	ns
			4.5 V		8	12		18		15	
			6 V		6	10		15		13	

**SN54HC645, SN74HC645**  
**OCTAL BUS TRANSCEIVERS**  
**WITH 3-STATE OUTPUTS**

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switching characteristics over recommended operating free-air temperature range,  $C_L = 150 \text{ pF}$   
(unless otherwise noted) (see Figure 1)

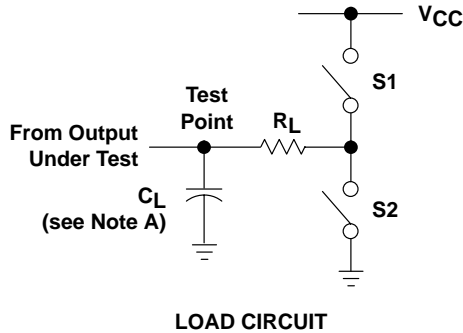
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC645		SN74HC645		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A or B	B or A	2 V		54	135		200		170	ns
			4.5 V		18	27		40		34	
			6 V		15	23		34		29	
$t_{en}$	$\overline{OE}$	A or B	2 V		150	270		405		335	ns
			4.5 V		31	54		81		67	
			6 V		25	46		69		56	
$t_t$		A or B	2 V		45	210		315		265	ns
			4.5 V		17	42		63		53	
			6 V		13	36		53		45	

operating characteristics,  $T_A = 25^\circ\text{C}$

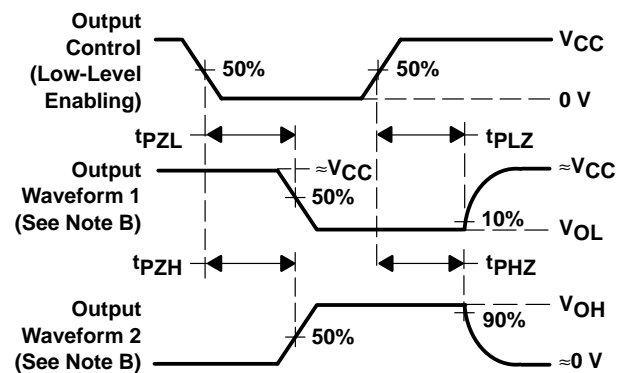
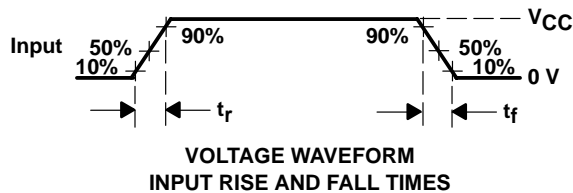
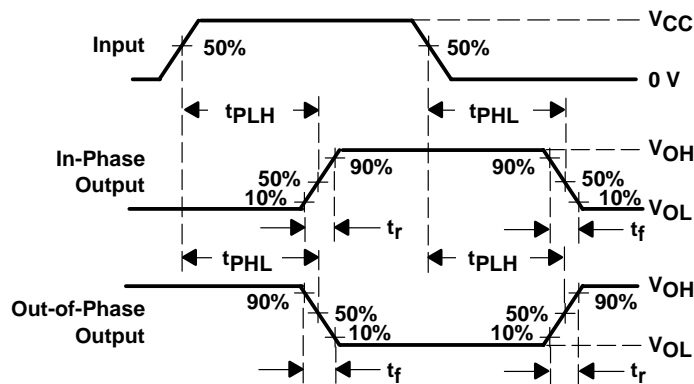
PARAMETER		TEST CONDITIONS	TYP	UNIT
$C_{pd}$	Power dissipation capacitance per transceiver	No load	40	pF



PARAMETER MEASUREMENT INFORMATION



PARAMETER	$R_L$	$C_L$	S1	S2
$t_{en}$	$t_{PZH}$	1 k $\Omega$ 50 pF or 150 pF	Open	Closed
	$t_{PZL}$		Closed	Open
$t_{dis}$	$t_{PHZ}$	1 k $\Omega$ 50 pF	Open	Closed
	$t_{PLZ}$		Closed	Open
$t_{pd}$ or $t_t$	—	50 pF or 150 pF	Open	Open



- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
  - C. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.
  - D. The outputs are measured one at a time with one input transition per measurement.
  - E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN54HC645J	ACTIVE	CDIP	J	20	1	TBD	A42 SNPB	N / A for Pkg Type
SN74HC645DW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC645DWE4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC645DWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC645DWRE4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC645N	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74HC645NE4	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74HC645NSR	ACTIVE	SO	NS	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC645NSRE4	ACTIVE	SO	NS	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54HC645FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54HC645J	ACTIVE	CDIP	J	20	1	TBD	A42 SNPB	N / A for Pkg Type

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

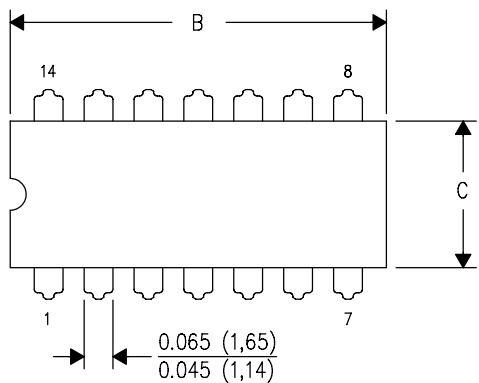
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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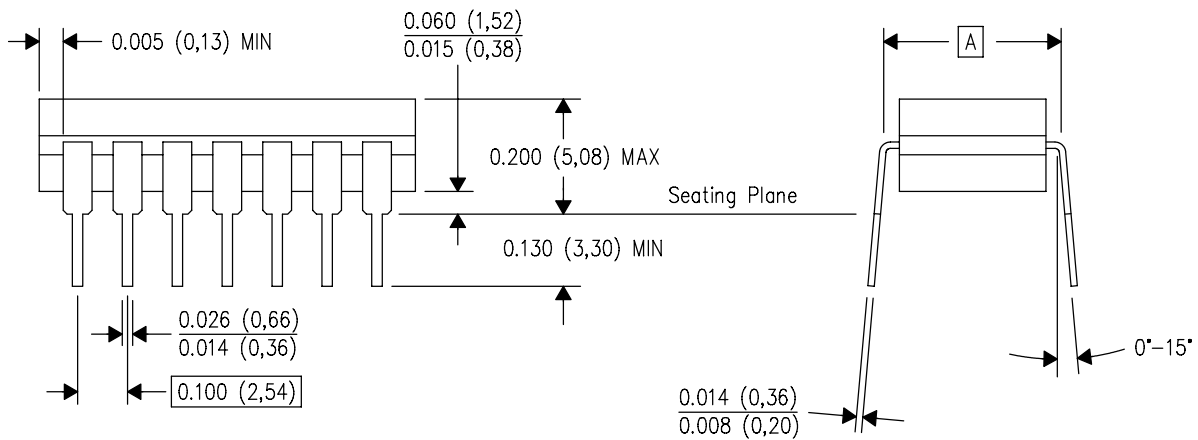
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J (R-GDIP-T\*\*)  
14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004



N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

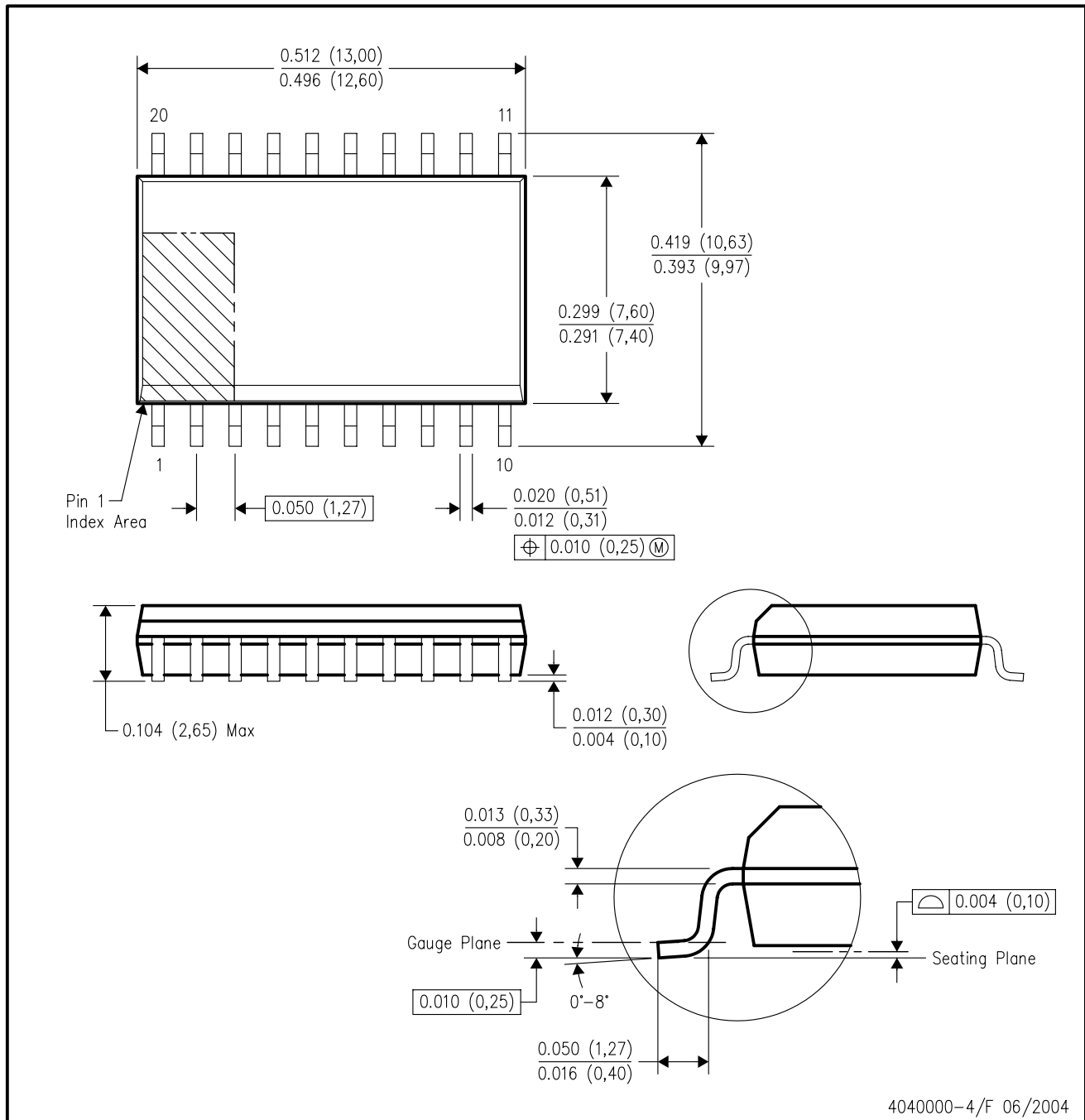
16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

DW (R-PDSO-G20)

PLASTIC SMALL-OUTLINE PACKAGE



- 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 variation AC.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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