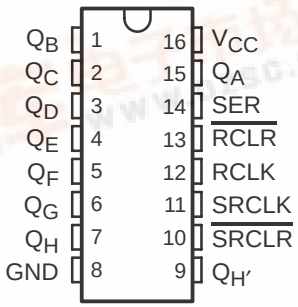
SN54AHCT594, SN74AHCT594
8-BIT SHIFT REGISTERS WITH OUTPUT REGISTERS

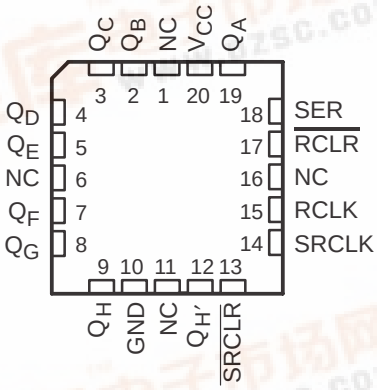
SCLS417H − JUNE 1998 − REVISED SEPTEMBER 2003

- Inputs Are TTL-Voltage Compatible
- 8-Bit Serial-In, Parallel-Out Shift Registers With Storage
- Independent Direct Overriding Clears on Shift and Storage Registers
- Independent Clocks for Both Shift and Storage Registers
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

SN54AHCT594 . . . J OR W PACKAGE
SN74AHCT594 . . . D, DB, N, NS, OR PW PACKAGE
(TOP VIEW)



SN54AHCT594 . . . FK PACKAGE
(TOP VIEW)



NC − No internal connection

description/ordering information

The ’AHCT594 devices contain an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. Separate clocks and direct overriding clear ($\overline{SRCLR}$, $\overline{RCLR}$) inputs are provided on both the shift and storage registers. A serial ($Q_{H'}$) output is provided for cascading purposes.

Both the shift register (SRCLK) and storage register (RCLK) clocks are positive edge triggered. If both clocks are connected together, the shift register always is one count pulse ahead of the storage register.

ORDERING INFORMATION

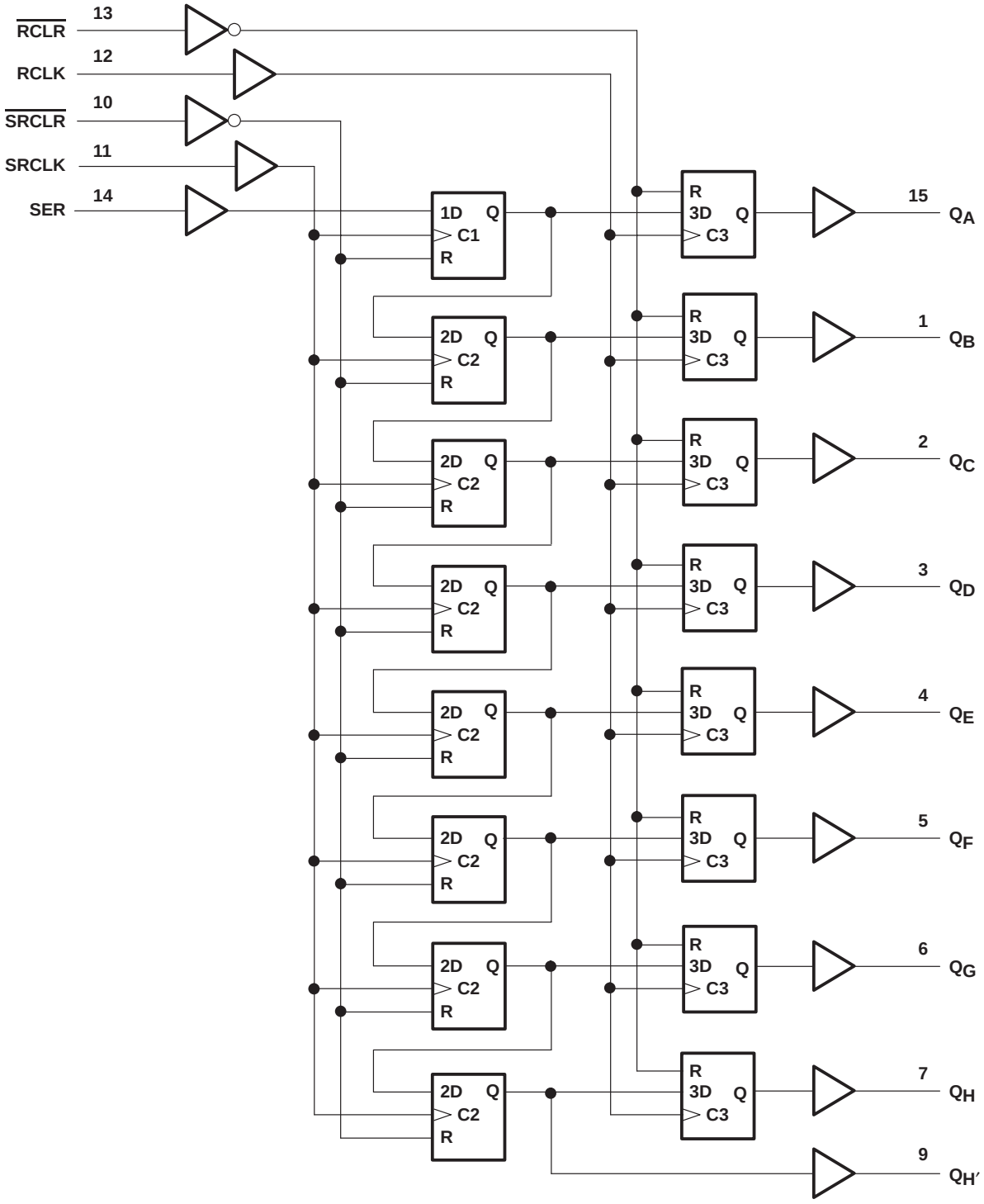
T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	PDIP − N	Tube	SN74AHCT594N	SN74AHCT594N
	SOIC − D	Tube	SN74AHCT594D	AHCT594
		Tape and reel	SN74AHCT594DR	
	SOP − NS	Tape and reel	SN74AHCT594NSR	AHCT594
	SSOP − DB	Tape and reel	SN74AHCT594DBR	HB594
	TSSOP − PW	Tube	SN74AHCT594PW	HB594
		Tape and reel	SN74AHCT594PWR	
−55°C to 125°C	CDIP − J	Tube	SNJ54AHCT594J	SNJ54AHCT594J
	CFP − W	Tube	SNJ54AHCT594W	SNJ54AHCT594W
	LCCC − FK	Tube	SNJ54AHCT594FK	SNJ54AHCT594FK

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

FUNCTION TABLE

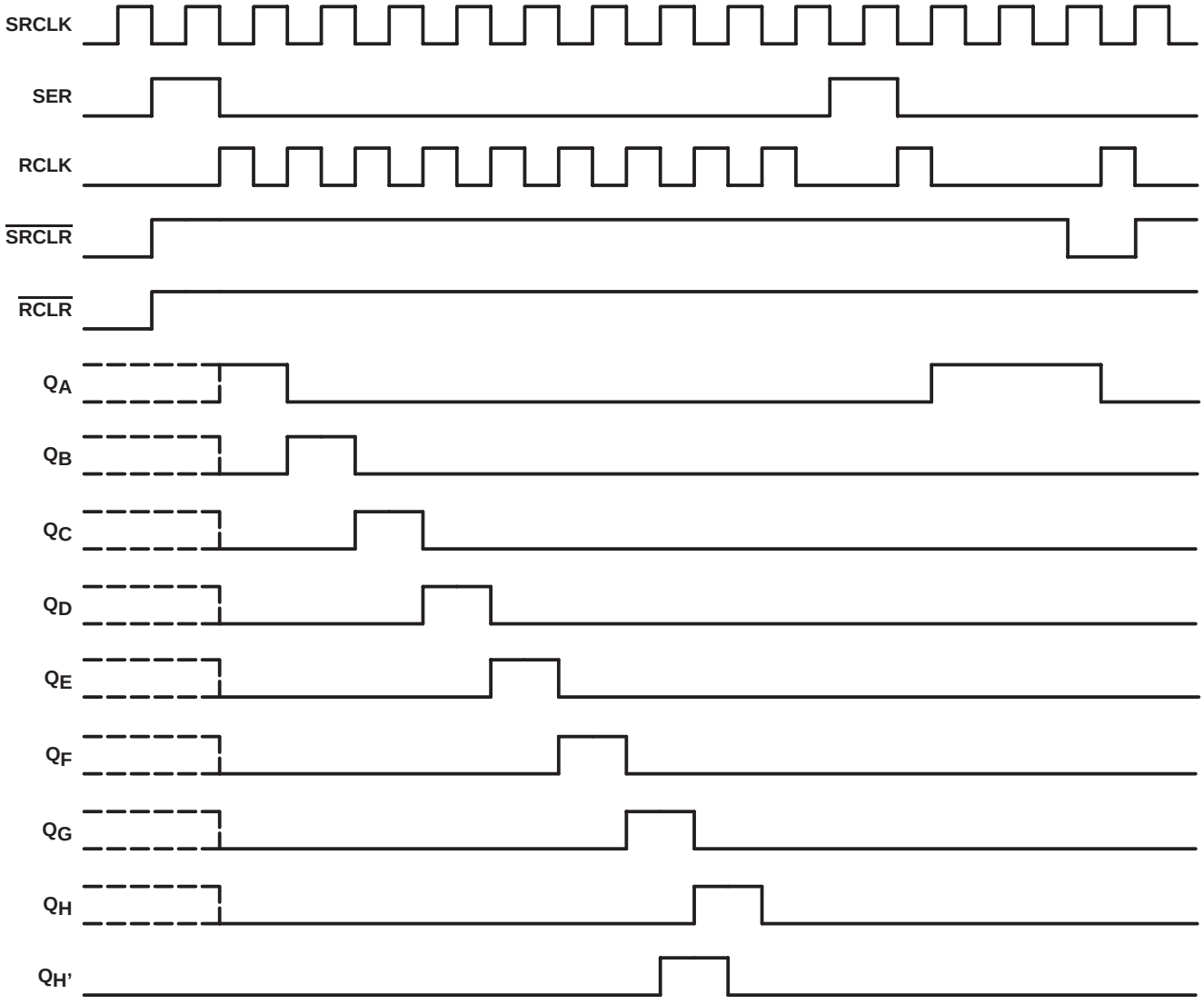
INPUTS					FUNCTION
SER	SRCLK	$\overline{\text{SRCLR}}$	RCLK	$\overline{\text{RCLR}}$	
X	X	L	X	X	Shift register is cleared.
L	↑	H	X	X	First stage of shift register goes low. Other stages store the data of previous stage, respectively.
H	↑	H	X	X	First stage of shift register goes high. Other stages store the data of previous stage, respectively.
L	↓	H	X	X	Shift-register state is not changed.
X	X	X	X	L	Storage register is cleared.
X	X	X	↑	H	Shift-register data is stored in the storage register.
X	X	X	↓	H	Storage-register state is not changed.

logic diagram (positive logic)



Pin numbers shown are for the D, DB, J, N, NS, PW, and W packages.

timing diagram



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

Supply voltage range, V_{CC} . . . . . −0.5 V to 7 V
Input voltage range, V_I (see Note 1) . . . . . −0.5 V to 7 V
Output voltage range, V_O (see Note 1) . . . . . −0.5 V to V_{CC} + 0.5 V
Input clamp current, I_{IK} (V_I < 0) . . . . . −20 mA
Output clamp current, I_{OK} (V_O < 0 or V_O > V_{CC}) . . . . . ±20 mA
Continuous output current, I_O (V_O = 0 to V_{CC}) . . . . . ±25 mA
Continuous current through V_{CC} or GND . . . . . ±75 mA
Package thermal impedance, θ_{JA} (see Note 2): D package . . . . . 73°C/W
DB package . . . . . 82°C/W
N package . . . . . 67°C/W
NS package . . . . . 64°C/W
PW package . . . . . 108°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)

		SN54AHCT594		SN74AHCT594		UNIT
		MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage	4.5	5.5	4.5	5.5	V
V_{IH}	High-level input voltage	2		2		V
V_{IL}	Low-level input voltage		0.8		0.8	V
V_I	Input voltage	0	5.5	0	5.5	V
V_O	Output voltage	0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current		−8		−8	mA
I_{OL}	Low-level output current		8		8	mA
$\Delta t/\Delta v$	Input transition rise or fall rate		20		20	ns/V
T_A	Operating free-air temperature	−55	125	−40	85	°C

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°C			SN54AHCT594		SN74AHCT594		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}	I_{OH} = −50 μA	4.5 V	4.4	4.5		4.4		4.4		V
	I_{OH} = −8 mA		3.94			3.8		3.8		
V_{OL}	I_{OL} = 50 μA	4.5 V			0.1		0.1		0.1	V
	I_{OL} = 8 mA				0.36		0.44		0.44	
I_I	V_I = 5.5 V or GND	0 V to 5.5 V			±0.1		±1*		±1	μA
I_{CC}	V_I = V_{CC} or GND, I_O = 0	5.5 V			2		20		20	μA
ΔI_{CC}†	One input at 3.4 V, Other inputs at V_{CC} or GND	5.5 V			2		2.2		2.2	mA
C_i	V_I = V_{CC} or GND	5 V		2	10				10	pF

* On products compliant to MIL-PRF-38535, this parameter is not production tested at V_{CC} = 0 V.
† This is the increase in supply current for each input at one of the specified TTL voltage levels, rather than 0 V or V_{CC}.

timing requirements over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

			T_A = 25°C		SN54AHCT594		SN74AHCT594		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration	RCLK or SRCLK high or low	5		5.5		5.5		ns
		$\overline{RCLR}$ or $\overline{SRCLR}$ low	5.2		5.5		5.5		
t_{su}	Setup time	SER before SRCLK↑	3		3		3		ns
		SRCLK↑ before RCLK↑‡	5		5		5		
		$\overline{SRCLR}$ low before RCLK↑	5		5		5		
		$\overline{SRCLR}$ high (inactive) before SRCLK↑	2.9		3.3		3.3		
		$\overline{RCLR}$ high (inactive) before RCLK↑	3.4		3.8		3.8		
t_h	Hold time	SER after SRCLK↑	2		2		2		ns

‡ This setup time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.

switching characteristics over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T_A = 25°C			SN54AHCT594		SN74AHCT594		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			C_L = 15 pF	135*	170*		115*		115		MHz
			C_L = 50 pF	120	140		95		95		
t_{PLH}	RCLK	Q_A–Q_H	C_L = 15 pF		3.3*	6.2*	1*	6.5*	1	6.5	ns
t_{PHL}					3.7*	6.5*	1*	6.9*	1	6.9	
t_{PLH}	SRCLK	$Q_{H'}$	C_L = 15 pF		3.7*	6.8*	1*	7.2*	1	7.2	ns
t_{PHL}					4.1*	7.2*	1*	7.6*	1	7.6	
t_{PHL}	$\overline{RCLR}$	Q_A–Q_H	C_L = 15 pF		4.5*	7.6*	1*	8.2*	1	8.2	ns
t_{PHL}	$\overline{SRCLR}$	$Q_{H'}$	C_L = 15 pF		4.1*	7.1*	1*	7.6*	1	7.6	ns
t_{PLH}	RCLK	Q_A–Q_H	C_L = 50 pF		4.9	7.8	1	8.3	1	8.3	ns
t_{PHL}					5.8	8.9	1	9.7	1	9.7	
t_{PLH}	SRCLK	$Q_{H'}$	C_L = 50 pF		5.5	8.6	1	9.1	1	9.1	ns
t_{PHL}					6	9.2	1	10.1	1	10.1	
t_{PHL}	$\overline{RCLR}$	Q_A–Q_H	C_L = 50 pF		6.6	10	1	10.7	1	10.7	ns
t_{PHL}	$\overline{SRCLR}$	$Q_{H'}$	C_L = 50 pF		6	9.2	1	10.1	1	10.1	ns

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

noise characteristics, V_{CC} = 5 V, C_L = 50 pF, T_A = 25°C (see Note 4)

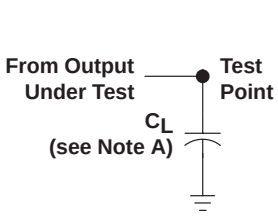
PARAMETER		SN74AHCT594			UNIT
		MIN	TYP	MAX	
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}		1		V
$V_{OL(V)}$	Quiet output, minimum dynamic V_{OL}		−0.6		V
$V_{OH(V)}$	Quiet output, minimum dynamic V_{OH}		3.8		V
$V_{IH(D)}$	High-level dynamic input voltage	2			V
$V_{IL(D)}$	Low-level dynamic input voltage			0.8	V

NOTE 4: Characteristics are for surface-mount packages only.

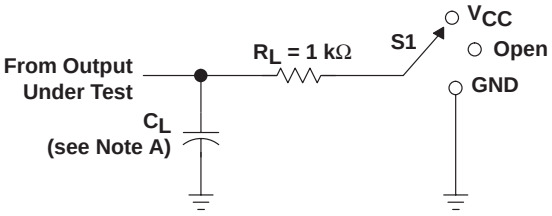
operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS		TYP	UNIT
C_{pd}	Power dissipation capacitance	No load,	f = 1 MHz	112	pF

PARAMETER MEASUREMENT INFORMATION

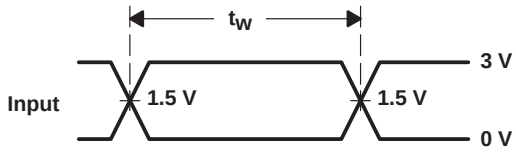


LOAD CIRCUIT FOR
TOTEM-POLE OUTPUTS

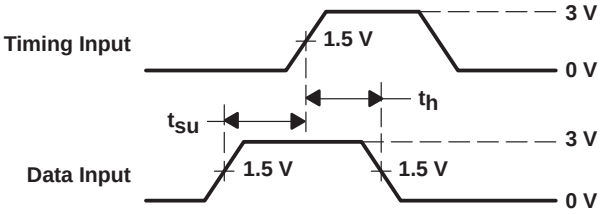


LOAD CIRCUIT FOR
3-STATE AND OPEN-DRAIN OUTPUTS

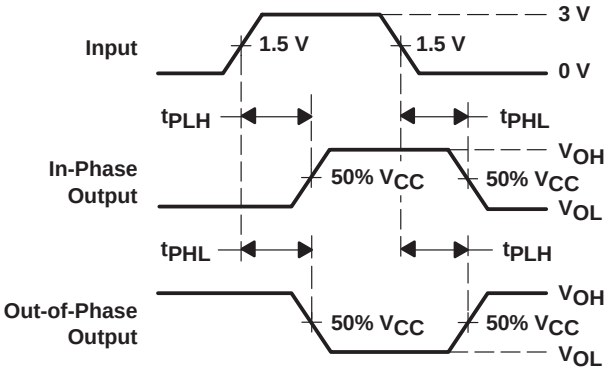
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND
Open Drain	V_{CC}



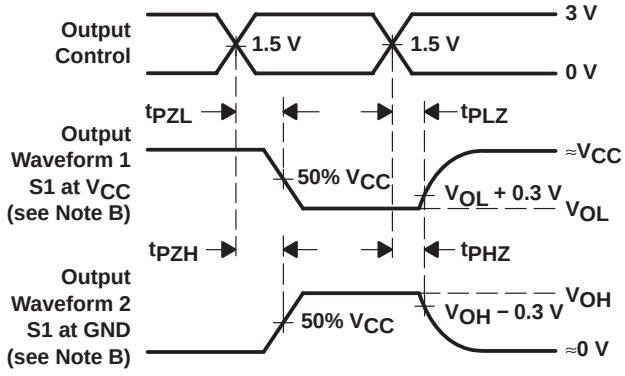
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

NOTES: A. C_L includes probe and jig 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. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r ≤ 3 ns, t_f ≤ 3 ns.
D. The outputs are measured one at a time with one input transition per measurement.
E. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN74AHCT594D	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594DBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594DBRE4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594DBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594DE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594DG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594DR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594DRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594DRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74AHCT594NE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74AHCT594NSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594NSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594NSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594PW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594PWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594PWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594PWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594PWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AHCT594PWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

(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.

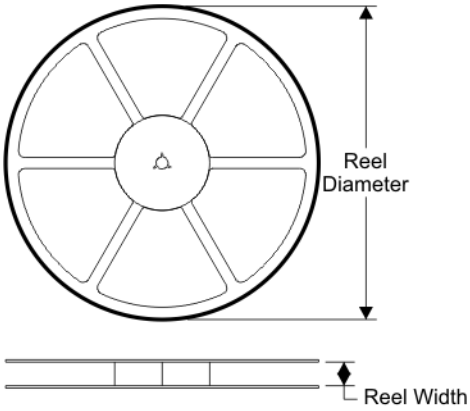
(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.

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)

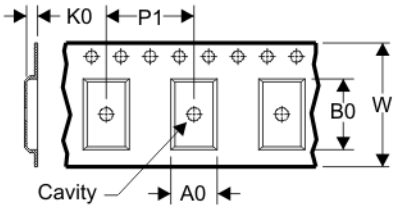
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL BOX INFORMATION

REEL DIMENSIONS

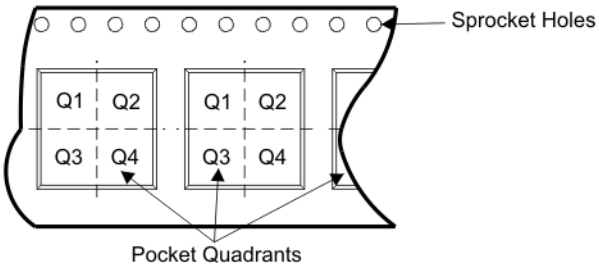


TAPE DIMENSIONS



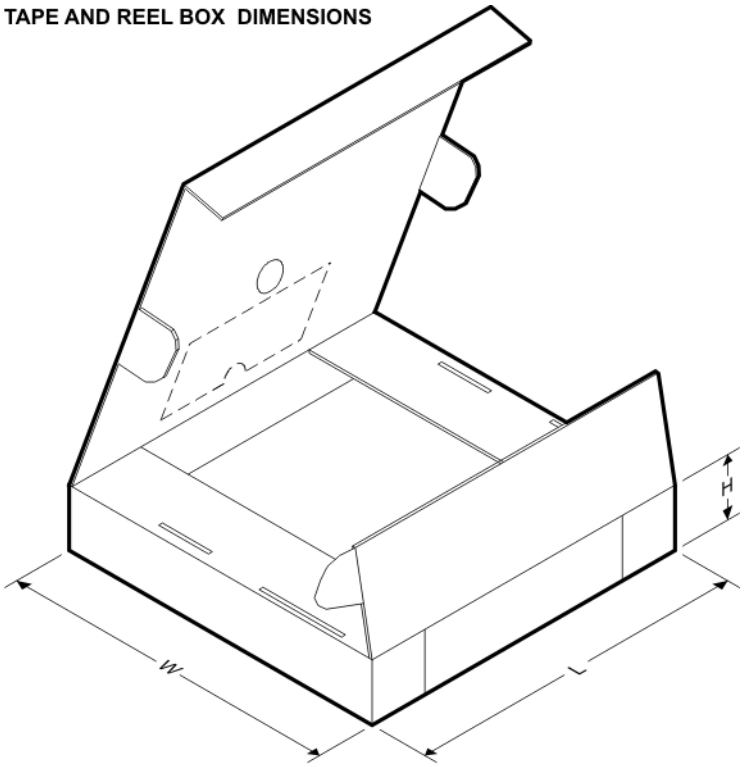
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74AHCT594DBR	DB	16	SITE 41	330	16	8.2	6.6	2.5	12	16	Q1
SN74AHCT594DR	D	16	SITE 27	330	16	6.5	10.3	2.1	8	16	Q1
SN74AHCT594NSR	NS	16	SITE 41	330	16	8.2	10.5	2.5	12	16	Q1
SN74AHCT594PWR	PW	16	SITE 41	330	12	7.0	5.6	1.6	8	12	Q1

TAPE AND REEL BOX DIMENSIONS

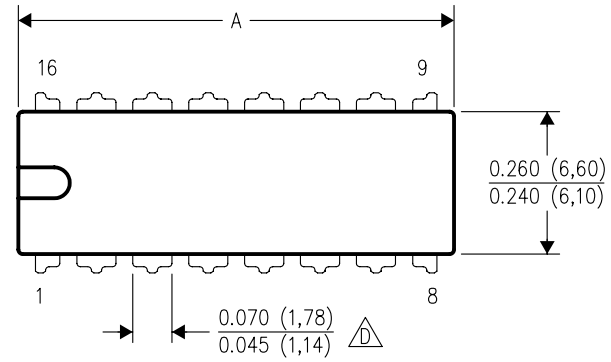


Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
SN74AHCT594DBR	DB	16	SITE 41	346.0	346.0	33.0
SN74AHCT594DR	D	16	SITE 27	342.9	336.6	28.58
SN74AHCT594NSR	NS	16	SITE 41	346.0	346.0	33.0
SN74AHCT594PWR	PW	16	SITE 41	346.0	346.0	29.0

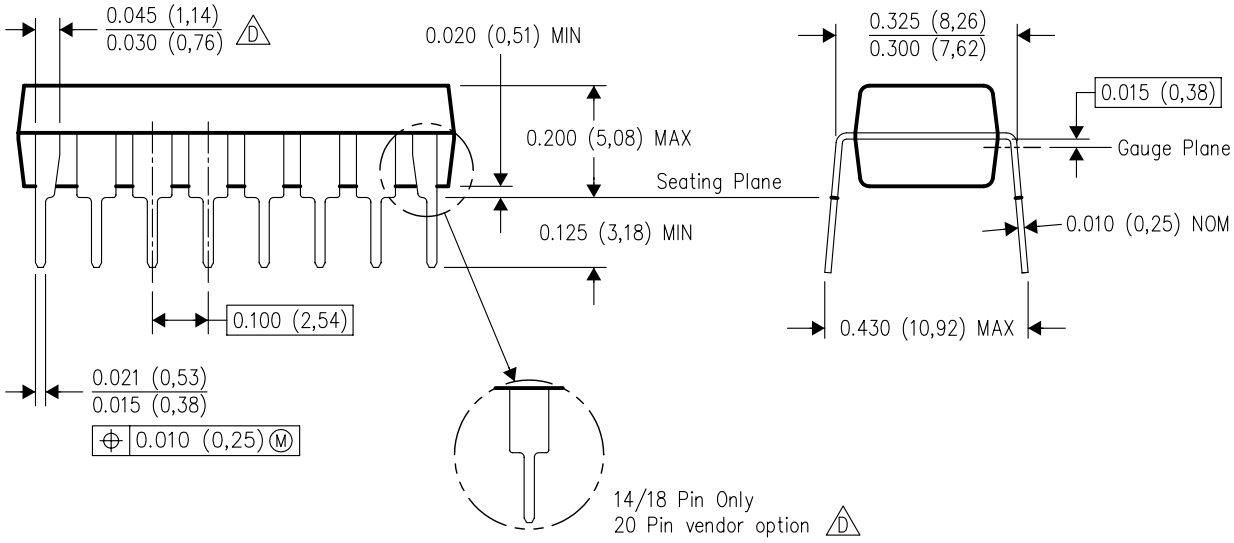
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



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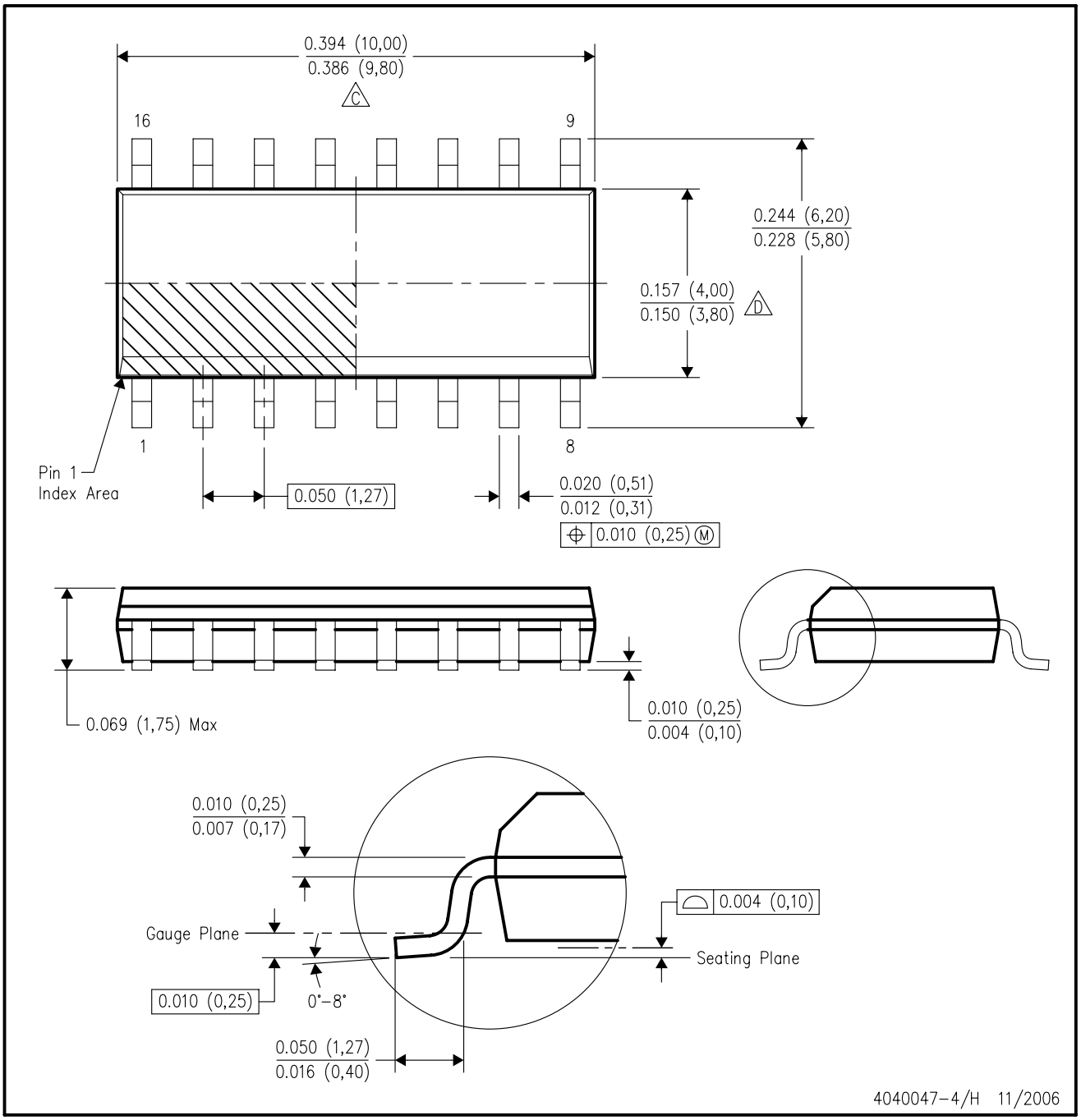
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R–PDSO–G16) PLASTIC SMALL–OUTLINE PACKAGE

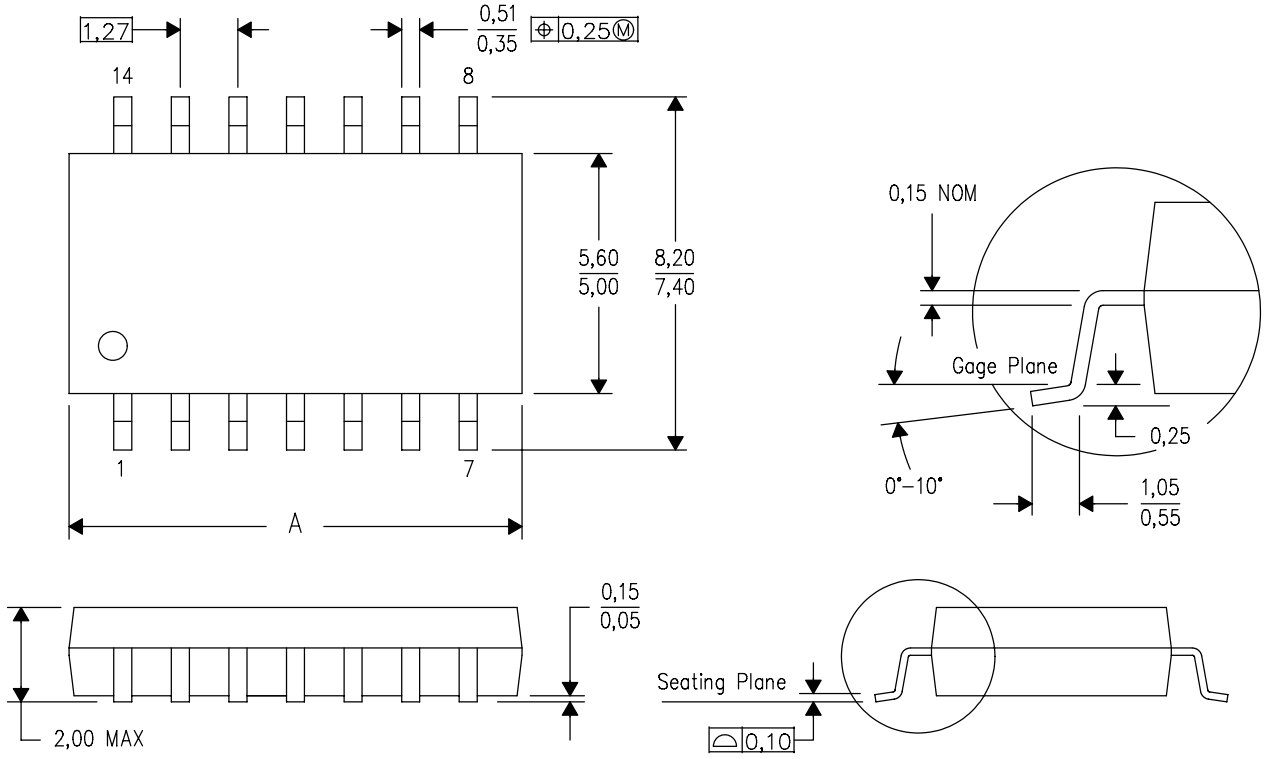


NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
E. Reference JEDEC MS–012 variation AC.

MECHANICAL DATA

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

14-PINS SHOWN



DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

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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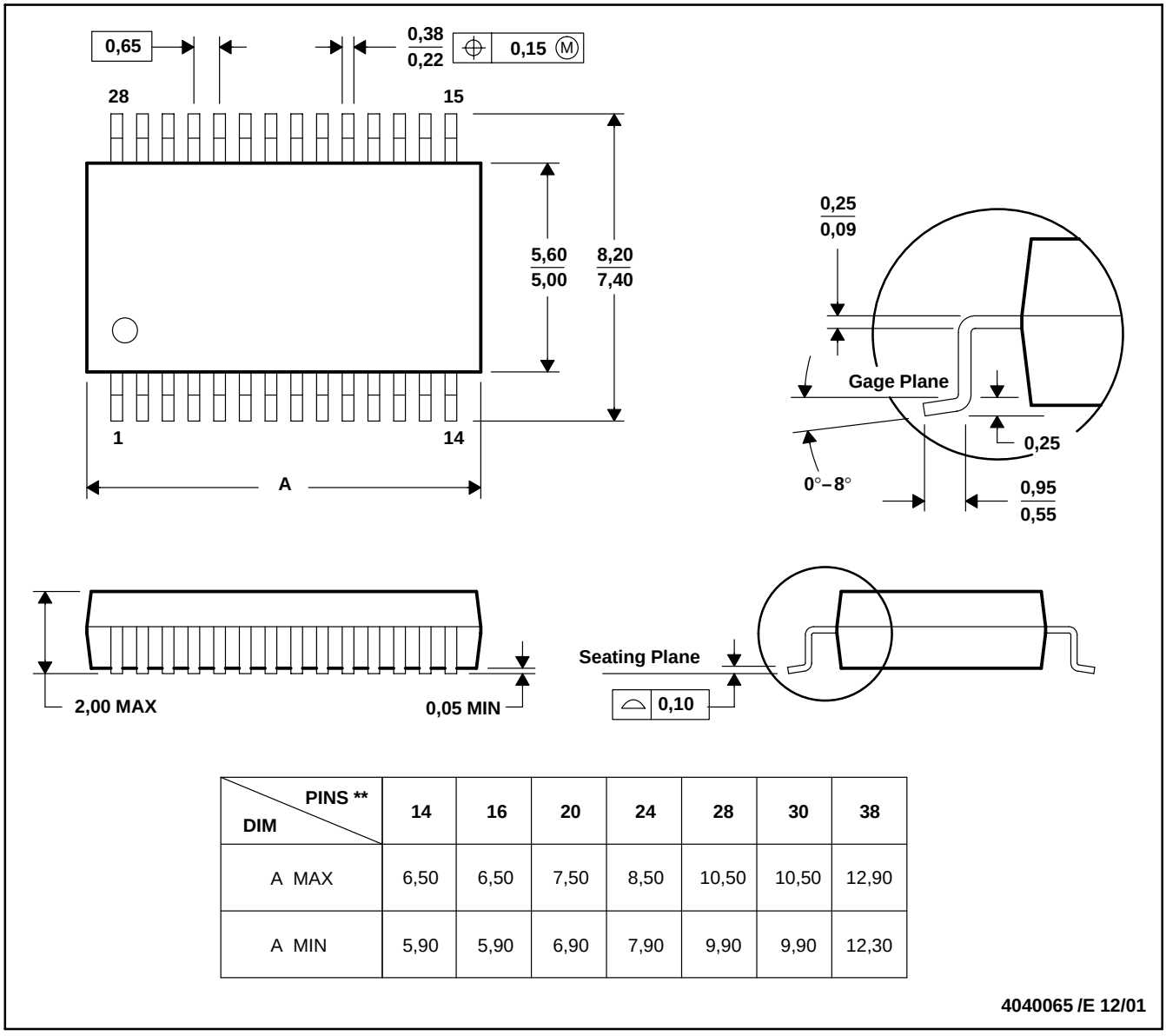
DB (R-PDSO-G)** **PLASTIC SMALL-OUTLINE**

28 PINS SHOWN



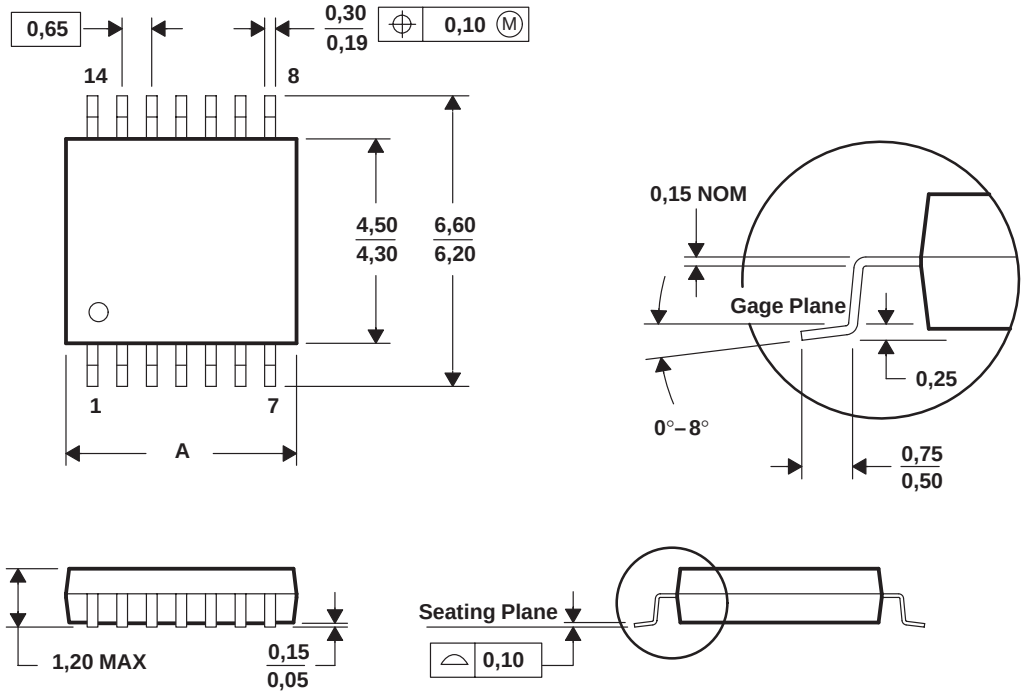
DIM \ PINS **	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

4040065 /E 12/01

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.
D. Falls within JEDEC MO-150

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

14 PINS SHOWN



DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

4040064/F 01/97

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.
D. Falls within JEDEC MO-153

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