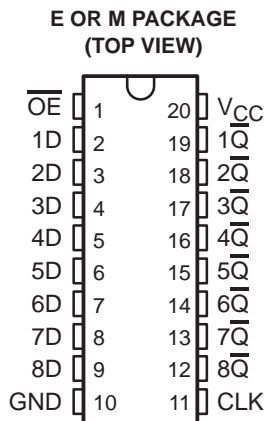


# CD74FCT564

## BiCMOS OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOP WITH 3-STATE OUTPUTS

SCBS743 – JULY 2000

- BiCMOS Technology With Low Quiescent Power
- Buffered Inputs
- Inverted Outputs
- Input/Output Isolation From  $V_{CC}$
- Controlled Output Edge Rates
- 48-mA Output Sink Current
- Output Voltage Swing Limited to 3.7 V
- SCR Latch-Up-Resistant BiCMOS Process and Circuit Design
- 3-State Inverting Outputs Drive Bus Lines Directly
- Full Parallel Access for Loading
- Package Options Include Plastic Small-Outline (M) Package and Standard Plastic (E) DIP



### description

The CD74FCT564 is an octal, D-type, edge-triggered flip-flop that features inverted, 3-state outputs, designed specifically for driving highly capacitive or relatively low-impedance loads. It is particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

This device uses a small-geometry BiCMOS technology. The output stage is a combination of bipolar and CMOS transistors that limits the output high level to two diode drops below  $V_{CC}$ . This resultant lowering of output swing (0 V to 3.7 V) reduces power-bus ringing [a source of electromagnetic interference (EMI)] and minimizes  $V_{CC}$  bounce and ground bounce and their effects during simultaneous output switching. The output configuration also enhances switching speed and is capable of sinking 48 mA.

The eight flip-flops enter data into their registers on the low-to-high transition of the clock (CLK). The output-enable ( $\overline{OE}$ ) input controls the 3-state outputs and is independent of the register operation. When  $\overline{OE}$  is high, the outputs are in the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without interface or pullup components.

On the positive transition of the clock (CLK) input, the  $\overline{Q}$  outputs are set to the inverse logic levels set up at the data (D) inputs.

$\overline{OE}$  does not affect internal operations of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The CD74FCT564 is characterized for operation from 0°C to 70°C.



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.

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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# CD74FCT564

## BiCMOS OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOP WITH 3-STATE OUTPUTS

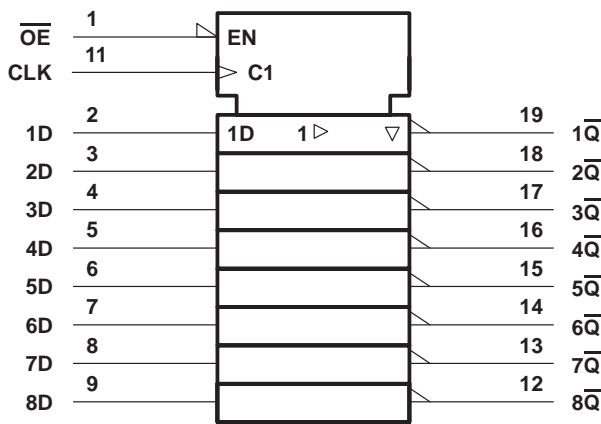
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**FUNCTION TABLE**  
(each flip-flop)

INPUTS			OUTPUT
$\overline{OE}$	CLK	D	$\overline{Q}$
L	↑	H	L
L	↑	L	H
L	H or L	X	$\overline{Q}_0$
H	X	X	Z

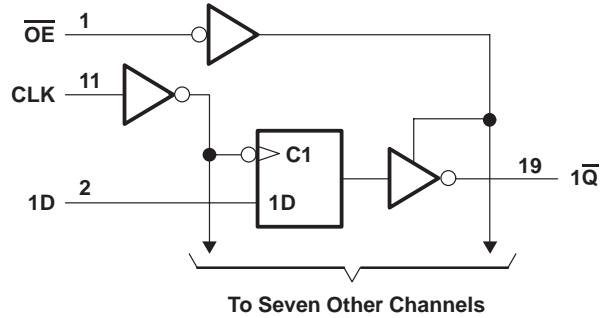
$Q_0$  is the output level before the indicated steady-state input conditions were established.

### logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

### logic diagram (positive logic)



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

DC supply voltage range, $V_{CC}$	-0.5 V to 6 V
DC input clamp current, $I_{IK}$ ( $V_I < -0.5$ V)	-20 mA
DC output clamp current, $I_{OK}$ ( $V_O < -0.5$ V)	-50 mA
DC output sink current per output pin, $I_{OL}$	70 mA
DC output source current per output pin, $I_{OH}$	-30 mA
Continuous current through $V_{CC}$ , $I_{CC}$	140 mA
Continuous current through GND	400 mA
Package thermal impedance, $\theta_{JA}$ (see Note 1): E package	69°C/W
M package	58°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.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51.

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**recommended operating conditions (see Note 2)**

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	4.75	5.25	V
V <sub>IH</sub>	High-level input voltage	2		V
V <sub>IL</sub>	Low-level input voltage		0.8	V
V <sub>I</sub>	Input voltage	0	V <sub>CC</sub>	V
V <sub>O</sub>	Output voltage	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current		-15	mA
I <sub>OL</sub>	Low-level output current		48	mA
Δt/Δv	Input transition rise or fall rate	0	10	ns/V
T <sub>A</sub>	Operating free-air temperature	0	70	°C

NOTE 2: All unused inputs of the device must be held at V<sub>CC</sub> 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 <sub>CC</sub>	T <sub>A</sub> = 25°C		MIN	MAX	UNIT
			MIN	MAX			
V <sub>IK</sub>	I <sub>I</sub> = -18 mA	4.75 V		-1.2		-1.2	V
V <sub>OH</sub>	I <sub>OH</sub> = -15 mA	4.75 V	2.4		2.4		V
V <sub>OL</sub>	I <sub>OL</sub> = 48 mA	4.75 V		0.55		0.55	V
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5.25 V		±0.1		±1	μA
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	5.25 V		±0.5		±10	μA
I <sub>OS</sub> <sup>†</sup>	V <sub>I</sub> = V <sub>CC</sub> or GND, V <sub>O</sub> = 0	5.25 V		-60		-60	mA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.25 V		8		80	μA
ΔI <sub>CC</sub> <sup>‡</sup>	One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND	5.25 V		1.6		1.6	mA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND			10		10	pF
C <sub>o</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND			15		15	pF

<sup>†</sup> Not more than one output should be tested at a time, and the duration of the test should not exceed 100 ms.

<sup>‡</sup> This is the increase in supply current for each input at one of the specified TTL voltage levels rather than 0 V or V<sub>CC</sub>.

**timing requirements over recommended operating temperature conditions (unless otherwise noted) (see Figure 1)**

		MIN	MAX	UNIT
f <sub>clock</sub>	Clock frequency		70	MHz
t <sub>w</sub>	Pulse duration	CLK high or low	7	ns
t <sub>su</sub>	Setup time	Data before CLK↑	2	ns
t <sub>h</sub>	Hold time	Data after CLK↑	2	ns

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**switching characteristics over recommended operating temperature conditions (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T <sub>A</sub> = 25°C		UNIT
			MIN	MAX	
f <sub>max</sub>			70		MHz
t <sub>pd</sub>	CLK	$\overline{Q}$	6.6	1.5 10	ns
t <sub>en</sub>	$\overline{OE}$	$\overline{Q}$	9	1.5 12.5	ns
t <sub>dis</sub>	$\overline{OE}$	$\overline{Q}$	6	1.5 8	ns

**noise characteristics, V<sub>CC</sub> = 5 V, C<sub>L</sub> = 50 pF, T<sub>A</sub> = 25°C**

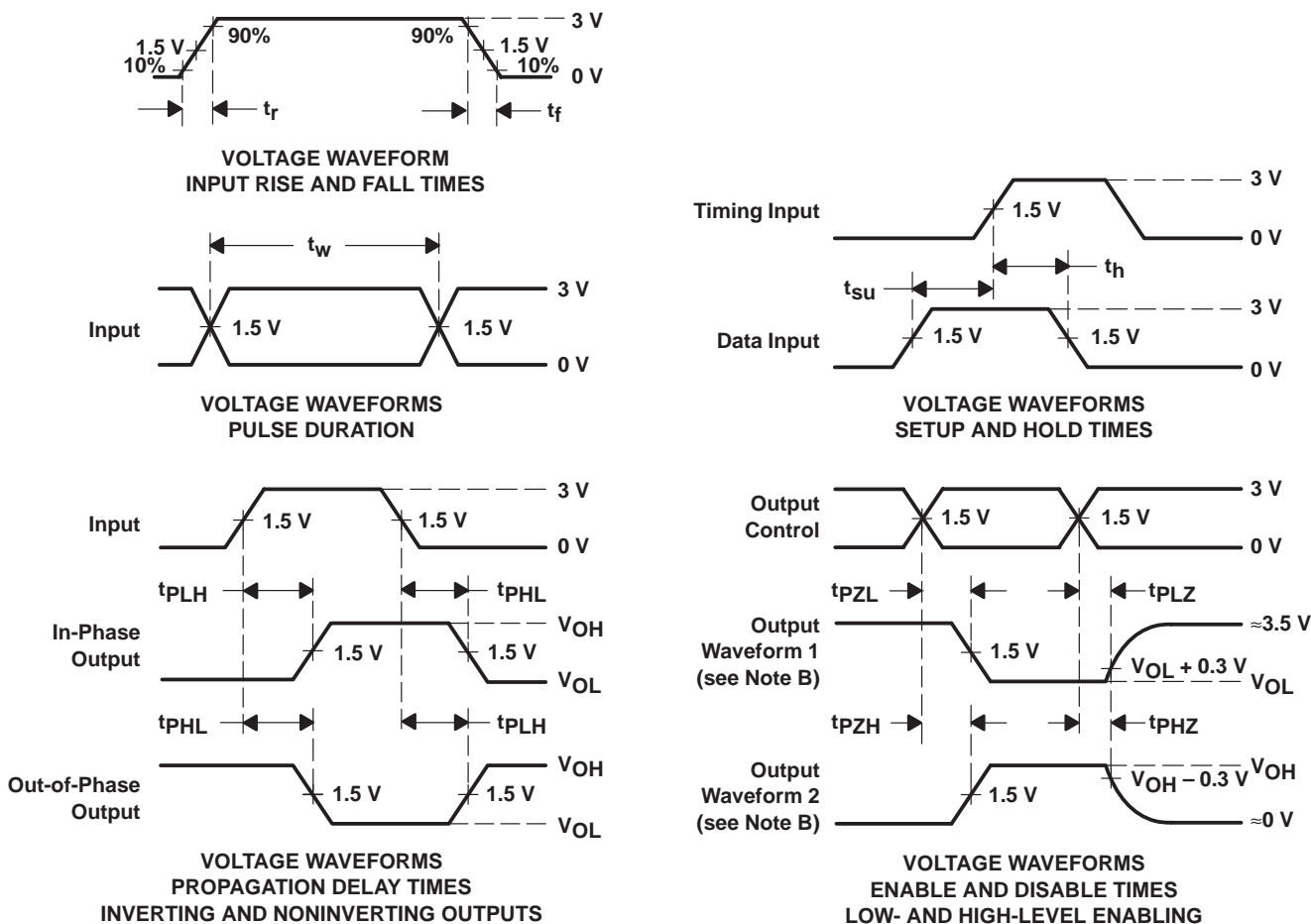
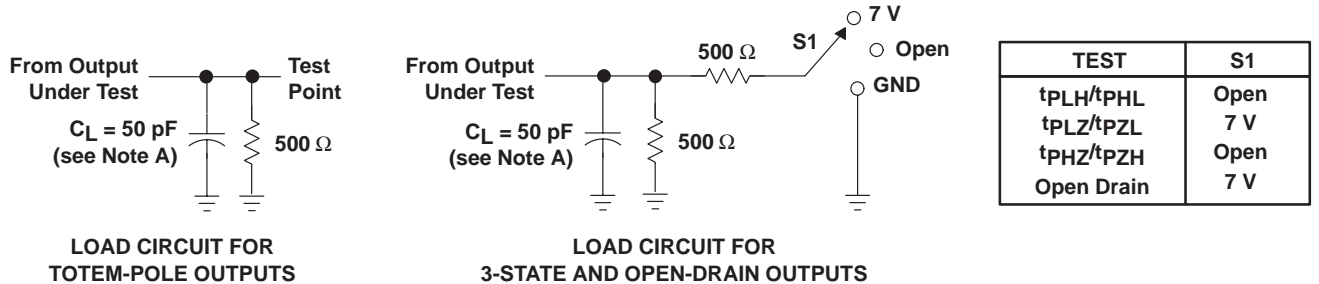
PARAMETER		MIN	TYP	MAX	UNIT
V <sub>OL(P)</sub>	Quiet output, maximum dynamic V <sub>OL</sub>		1		V
V <sub>OH(V)</sub>	Quiet output, minimum dynamic V <sub>OH</sub>		0.5		V
V <sub>IH(D)</sub>	High-level dynamic input voltage	2			V
V <sub>IL(D)</sub>	Low-level dynamic input voltage			0.8	V

**operating characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C**

PARAMETER		TEST CONDITIONS	TYP	UNIT
C <sub>pd</sub>	Power dissipation capacitance	No load, f = 1 MHz	34	pF



### PARAMETER MEASUREMENT INFORMATION



- 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:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r$  and  $t_f = 2.5 \text{ ns}$ .  
 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.  $t_{PHL}$  and  $t_{PLH}$  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>	Samples (Requires Login)
CD74FCT564E	OBSOLETE	PDIP	N	20		TBD	Call TI	Call TI	Samples Not Available
CD74FCT564M	OBSOLETE	SOIC	DW	20		TBD	Call TI	Call TI	Samples Not Available

<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.

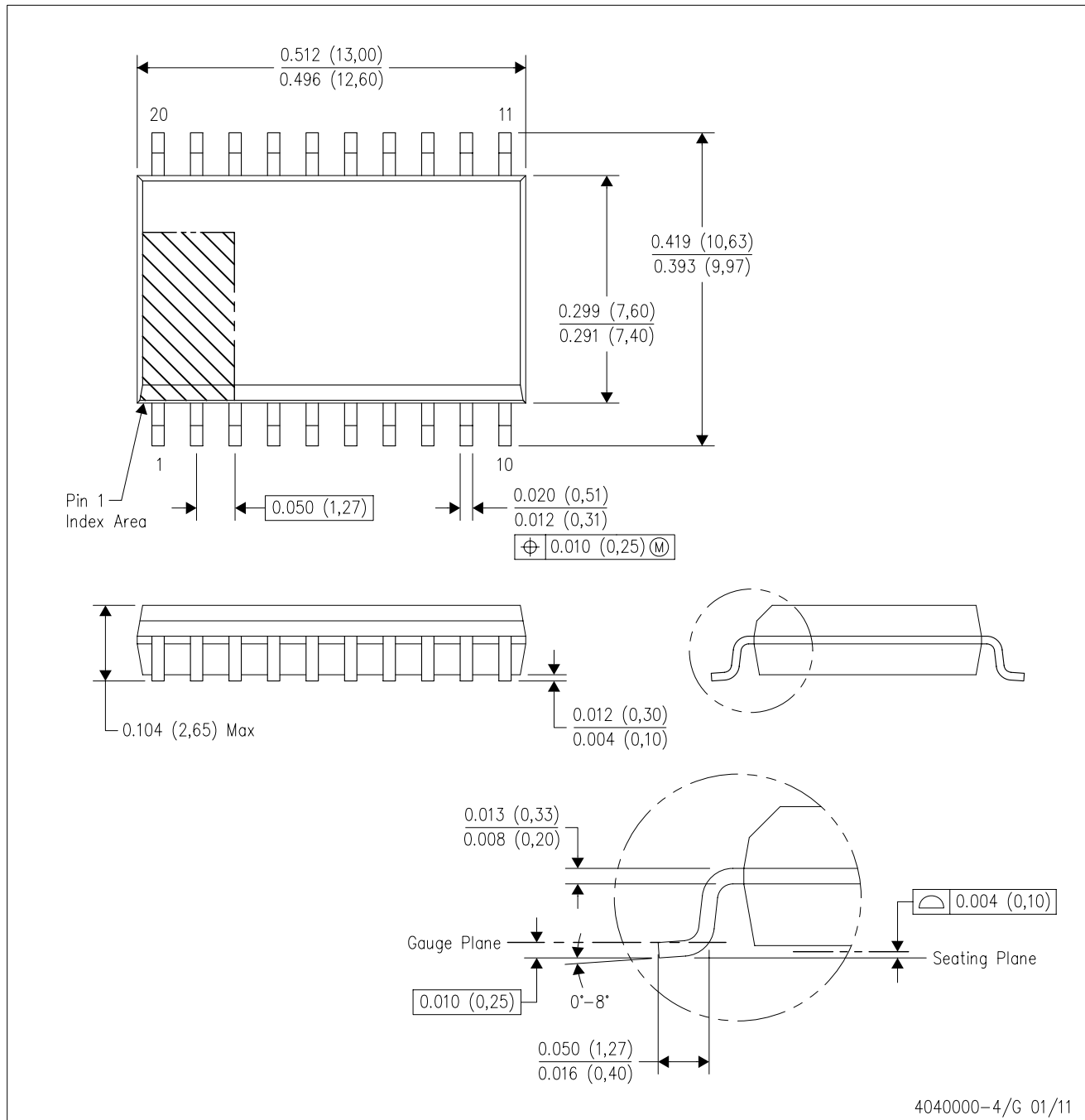
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DW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
  - 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.



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