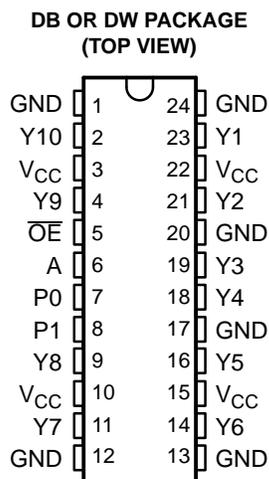


## FEATURES

- Low Output Skew, Low Pulse Skew for Clock-Distribution and Clock-Generation Applications
- Operates at 3.3-V  $V_{CC}$
- LVTTTL-Compatible Inputs and Outputs
- Supports Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V  $V_{CC}$ )
- Distributes One Clock Input to Ten Outputs
- Distributed  $V_{CC}$  and Ground Pins Reduce Switching Noise
- High-Drive Outputs ( $-32\text{-mA } I_{OH}$ ,  $32\text{-mA } I_{OL}$ )
- State-of-the-Art EPIC-IIB™ BiCMOS Design Significantly Reduces Power Dissipation
- Package Options Include Plastic Small-Outline (DW) and Shrink Small-Outline (DB) Packages



## DESCRIPTION

The CDC351 is a high-performance clock-driver circuit that distributes one input (A) to ten outputs (Y) with minimum skew for clock distribution. The output-enable ( $\overline{OE}$ ) input disables the outputs to a high-impedance state. The CDC351 operates at nominal 3.3-V  $V_{CC}$ .

The propagation delays are adjusted at the factory using the P0 and P1 pins. The factory adjustments ensure that the part-to-part skew is minimized and is kept within a specified window. Pins P0 and P1 are not intended for customer use and should be connected to GND.

## FUNCTION TABLE

INPUTS		OUTPUTS
A	$\overline{OE}$	$Y_n$
L	H	Z
H	H	Z
L	L	L
H	L	H

## AVAILABLE OPTIONS

$T_A$	Shrink Small-Outline Package (DB) (1)	Small-Outline Package (DW) (1)
0°C to 70°C	CDC351DB	CDC351DW
-40°C to 85°C	CDC351IDB	CDC351IDW

(1) This package is available tape and reel. Order by adding an R to the orderable part number (e.g., CDC351DBR).

EPIC-IIB is a trademark of Texas Instruments.

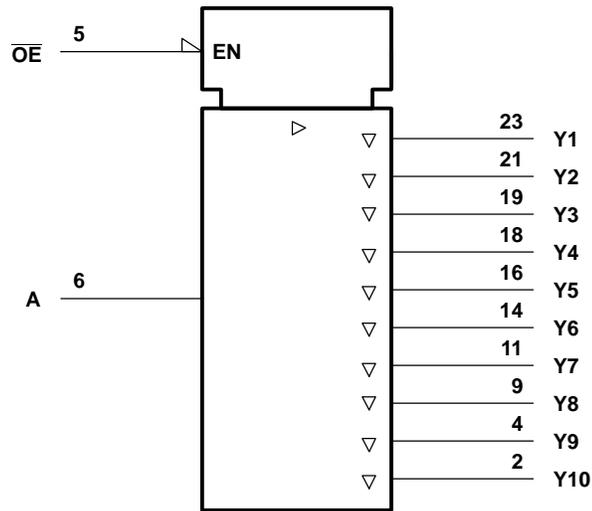


Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

# CDC351. CDC351I 1-LINE TO 10-LINE CLOCK DRIVER WITH 3-STATE OUTPUTS

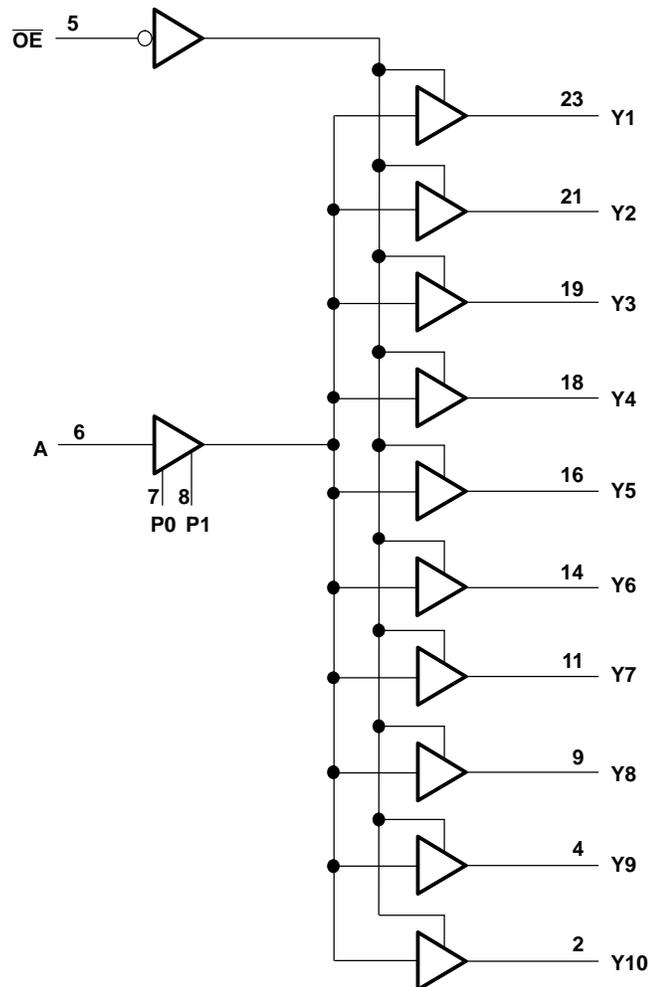
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## LOGIC SYMBOL <sup>A</sup>



Note A: 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) (1)

Supply voltage range, $V_{CC}$		– 0.5 V to 4.6 V
Input voltage range, $V_I$ (2)		– 0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, $V_O$ (2)		– 0.5 V to 3.6 V
Current into any output in the low state, $I_O$		64 mA
Input clamp current, $I_{IK}(V_I < 0)$		– 18 mA
Output clamp current, $I_{OK}(V_I < 0)$		– 50 mA
Package thermal impedance $\Theta_{JA}$ (3):	DB package	147°C/ W
	DW package	101°C/ W
Storage temperature range, $T_{stg}$		– 65°C to 150°C

- (1) 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.
- (2) The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- (3) The package thermal impedance is calculated in accordance with JESD51.

## RECOMMENDED OPERATING CONDITIONS (1)

		MIN	MAX	UNIT	
$V_{CC}$	Supply voltage	3	3.6	V	
$V_{IH}$	High-level input voltage	2		V	
$V_{IL}$	Low-level input voltage		0.8	V	
$V_I$	Input voltage	0	5.5	V	
$I_{OH}$	High-level output current		– 32	mA	
$I_{OL}$	Low-level output current		32	mA	
$f_{clock}$	Input clock frequency		100	MHz	
$T_A$	Operating free-air temperature	Commercial	0	70	°C
		Industrial	– 40	85	°C

- (1) Unused pins (input or I/O) must be held high or low.

## ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{IK}$	$V_{CC} = 3\text{ V}$ ,	$I_I = -18\text{ mA}$			–1.2	V
$V_{OH}$	$V_{CC} = 3\text{ V}$ ,	$I_{OH} = -32\text{ mA}$	2			V
$V_{OL}$	$V_{CC} = 3\text{ V}$ ,	$I_{OL} = 32\text{ mA}$			0.5	V
$I_I$	$V_{CC} = 3.6\text{ V}$ ,	$V_I = V_{CC}$ or GND			±1	µA
$I_O$ (1)	$V_{CC} = 3.6\text{ V}$ ,	$V_O = 2.5\text{ V}$	–15		–150	mA
$I_{oz}$	$V_{CC} = 3.6\text{ V}$ ,	$V_O = 3\text{ V}$ or 0			±10	µA
$I_{CC}$	$V_{CC} = 3.6\text{ V}$ , $I_O = 0$ , $V_I = V_{CC}$ or GND	Outputs high			0.3	mA
		Outputs low			25	
		Outputs disabled			0.3	
$C_i$	$V_I = V_{CC}$ or GND,	$V_{CC} = 3.3\text{ V}$ ,		4		pF
$C_o$	$V_O = V_{CC}$ or GND,	$V_{CC} = 3.3\text{ V}$ ,		6		pF

- (1) Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

# CDC351. CDC351I

## 1-LINE TO 10-LINE CLOCK DRIVER WITH 3-STATE OUTPUTS

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### SWITCHING CHARACTERISTICS

$C_L = 50$  pF (see Figure 1 and Figure 2)

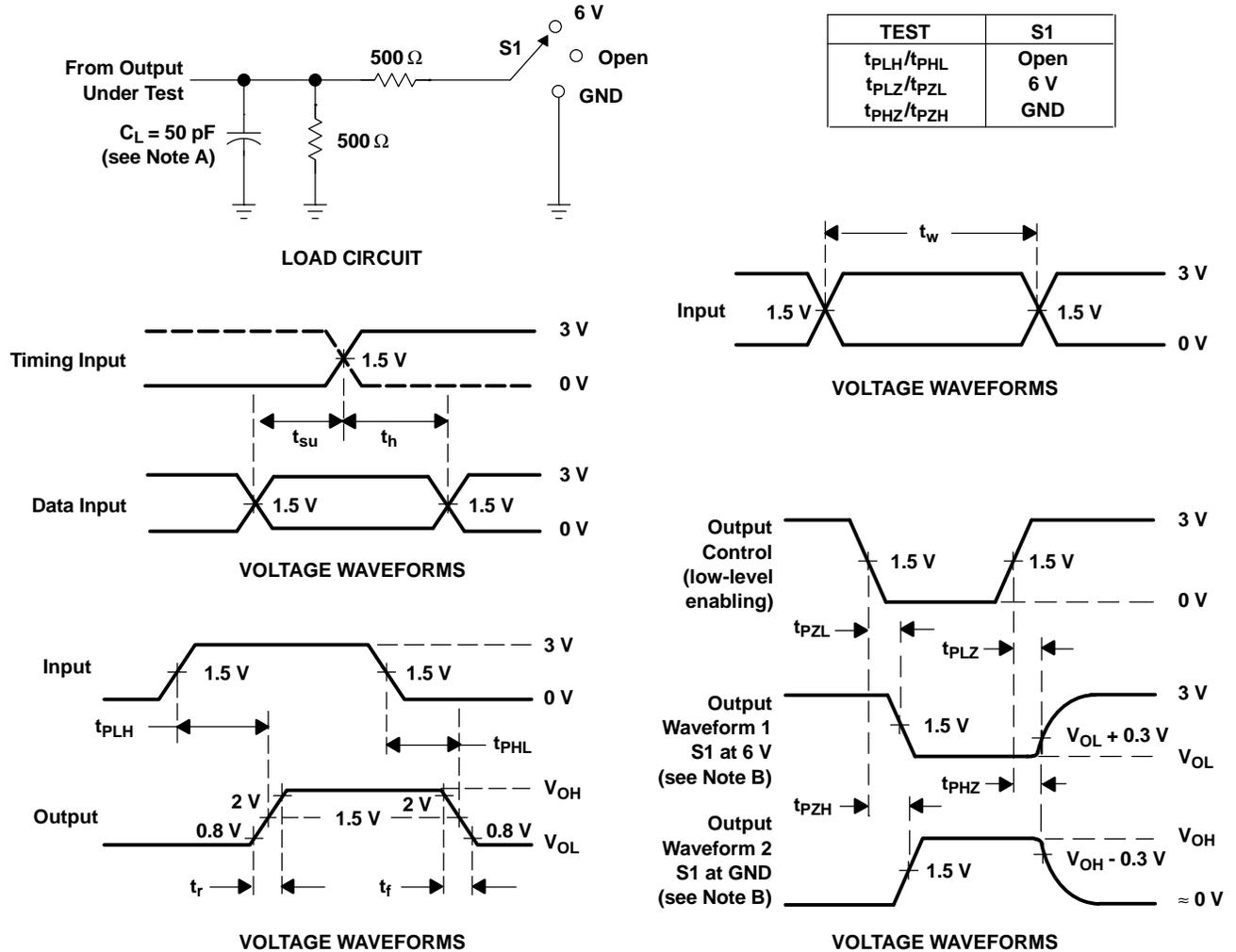
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 3.3$ V, $T_A = 25^\circ$ C			$V_{CC} = 3$ V to 3.6 V, $T_A = 0^\circ$ C to $70^\circ$ C		$V_{CC} = 3$ V to 3.6 V, $T_A = -40^\circ$ C to $85^\circ$ C		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	A	Y	3.2	3.7	4.2					ns
$t_{PHL}$			3	3.5	4					
$t_{PZH}$	$\overline{OE}$	Y	1.8	3.8	5.5	1.3	5.9	1.1	6.1	ns
$t_{PZL}$			1.8	3.8	5.5	1.3	5.9	1.1	6.1	
$t_{PHZ}$	$\overline{OE}$	Y	1.8	3.9	5.9	1.7	6.3	1.5	6.5	ns
$t_{PLZ}$			1.8	4.2	5.9	1.7	6.4	1.5	6.6	
$t_{sk(o)}$	A	Y		0.3	0.5		0.5		0.6	ns
$t_{sk(p)}$	A	Y		0.2	0.8		0.8		0.9	ns
$t_{sk(pr)}$	A	Y			1		1		1.1	ns
$t_r$	A	Y					1.5		1.5	ns
$t_f$	A	Y					1.5		1.5	ns

### SWITCHING CHARACTERISTICS TEMPERATURE AND $V_{CC}$ COEFFICIENTS

over recommended operating free-air temperature and  $V_{CC}$  range (1)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	MIN	MAX	UNIT
$\$t_{PLH}(T)$	Average temperature coefficient of low to high propagation delay	A	Y		65 (2)	ps/ $10^\circ$ C
$\$t_{PHL}(T)$	Average temperature coefficient of high to low propagation delay	A	Y		45 (2)	ps/ $10^\circ$ C
$\$t_{PLH}(V_{CC})$	Average $V_{CC}$ coefficient of low to high propagation delay	A	Y	-140 (3)		ps/ 100 mV
$\$t_{PHL}(V_{CC})$	Average $V_{CC}$ coefficient of high to low propagation delay	A	Y	-120 (3)		ps/ 100 mV

- (1) These data were extracted from characterization material and are not tested at the factory.
- (2)  $\$t_{PLH}(T)$  and  $\$t_{PHL}(T)$  are virtually independent of  $V_{CC}$ .
- (3)  $\$t_{PLH}(V_{CC})$  and  $\$t_{PHL}(V_{CC})$  are virtually independent of temperature.



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.

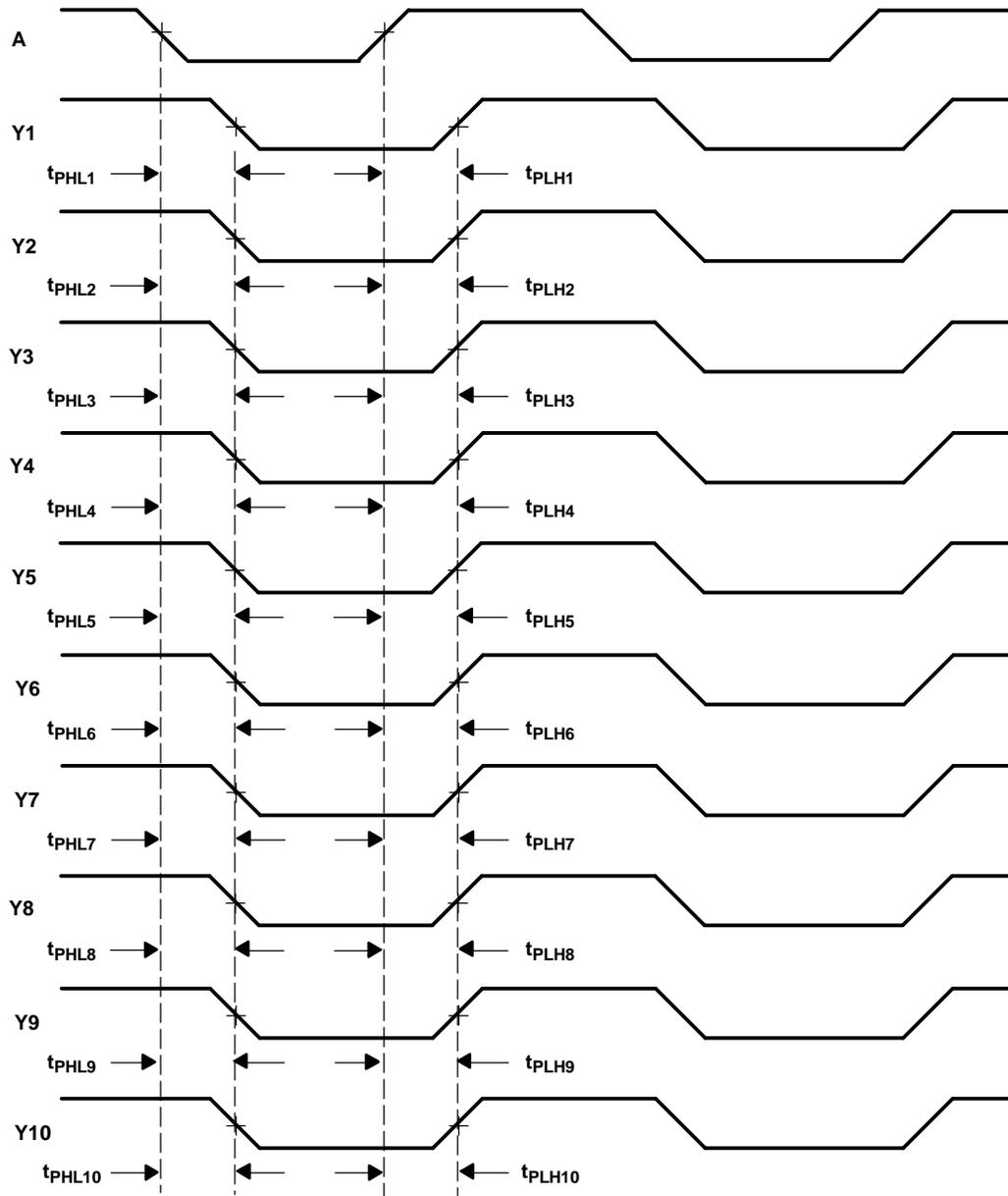
C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .

D. The outputs are measured one at a time with one transition per measurement.

**Figure 1. Load Circuit and Voltage Waveforms**

# CDC351. CDC351I 1-LINE TO 10-LINE CLOCK DRIVER WITH 3-STATE OUTPUTS

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- A. Output skew,  $t_{sk(o)}$ , is calculated as the greater of:
- The difference between the fastest and slowest of  $t_{PLHn}$  ( $n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10$ )
  - The difference between the fastest and slowest of  $t_{PHLn}$  ( $n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10$ )
- B. Pulse skew,  $t_{sk(p)}$ , is calculated as the greater of  $|t_{PLHn} - t_{PHLn}|$  ( $n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10$ ).
- C. Process skew,  $t_{sk(pr)}$ , is calculated as the greater of:
- The difference between the fastest and slowest of  $t_{PLHn}$  ( $n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10$ ) across multiple devices under identical operating conditions
  - The difference between the fastest and slowest of  $t_{PHLn}$  ( $n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10$ ) across multiple devices under identical operating conditions

**Figure 2. Waveforms for Calculation of  $t_{sk(o)}$ ,  $t_{sk(p)}$ ,  $t_{sk(pr)}$**

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
CDC351DB	ACTIVE	SSOP	DB	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	CK351	<a href="#">Samples</a>
CDC351DBG4	ACTIVE	SSOP	DB	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	CK351	<a href="#">Samples</a>
CDC351DBLE	OBSOLETE	SSOP	DB	24		TBD	Call TI	Call TI			
CDC351DBR	ACTIVE	SSOP	DB	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	CK351	<a href="#">Samples</a>
CDC351DBRG4	ACTIVE	SSOP	DB	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	CK351	<a href="#">Samples</a>
CDC351DW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	CDC351	<a href="#">Samples</a>
CDC351DWG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	CDC351	<a href="#">Samples</a>
CDC351DWR	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	CDC351	<a href="#">Samples</a>
CDC351DWRG4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	CDC351	<a href="#">Samples</a>
CDC351IDB	ACTIVE	SSOP	DB	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CK351-I	<a href="#">Samples</a>
CDC351IDBG4	ACTIVE	SSOP	DB	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CK351-I	<a href="#">Samples</a>
CDC351IDBR	ACTIVE	SSOP	DB	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CK351-I	<a href="#">Samples</a>
CDC351IDBRG4	ACTIVE	SSOP	DB	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CK351-I	<a href="#">Samples</a>
CDC351IDW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDC351-I	<a href="#">Samples</a>
CDC351IDWG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	CDC351-I	<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.

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**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.

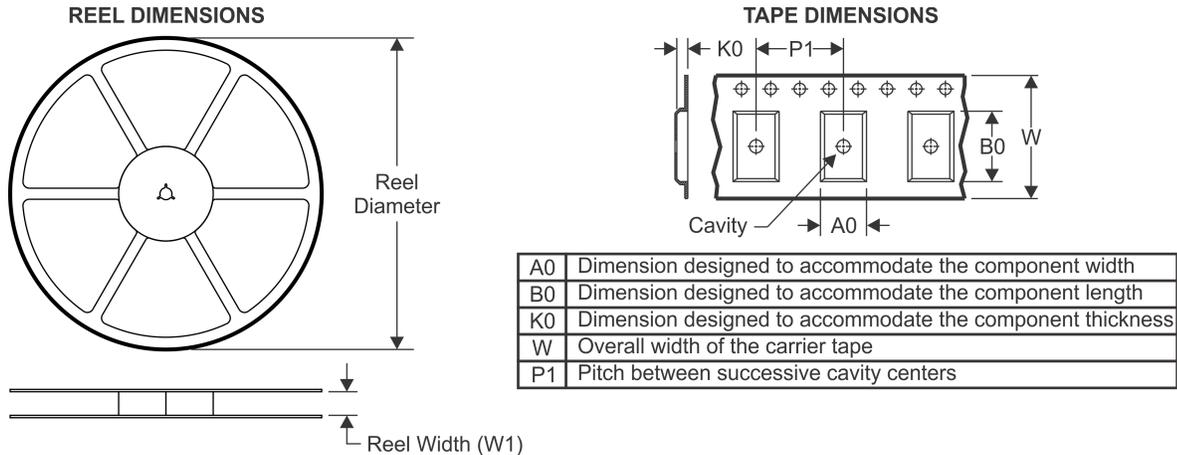
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

<sup>(4)</sup> Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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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
CDC351DBR	SSOP	DB	24	2000	330.0	16.4	8.2	8.8	2.5	12.0	16.0	Q1
CDC351DWR	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
CDC351IDBR	SSOP	DB	24	2000	330.0	16.4	8.2	8.8	2.5	12.0	16.0	Q1

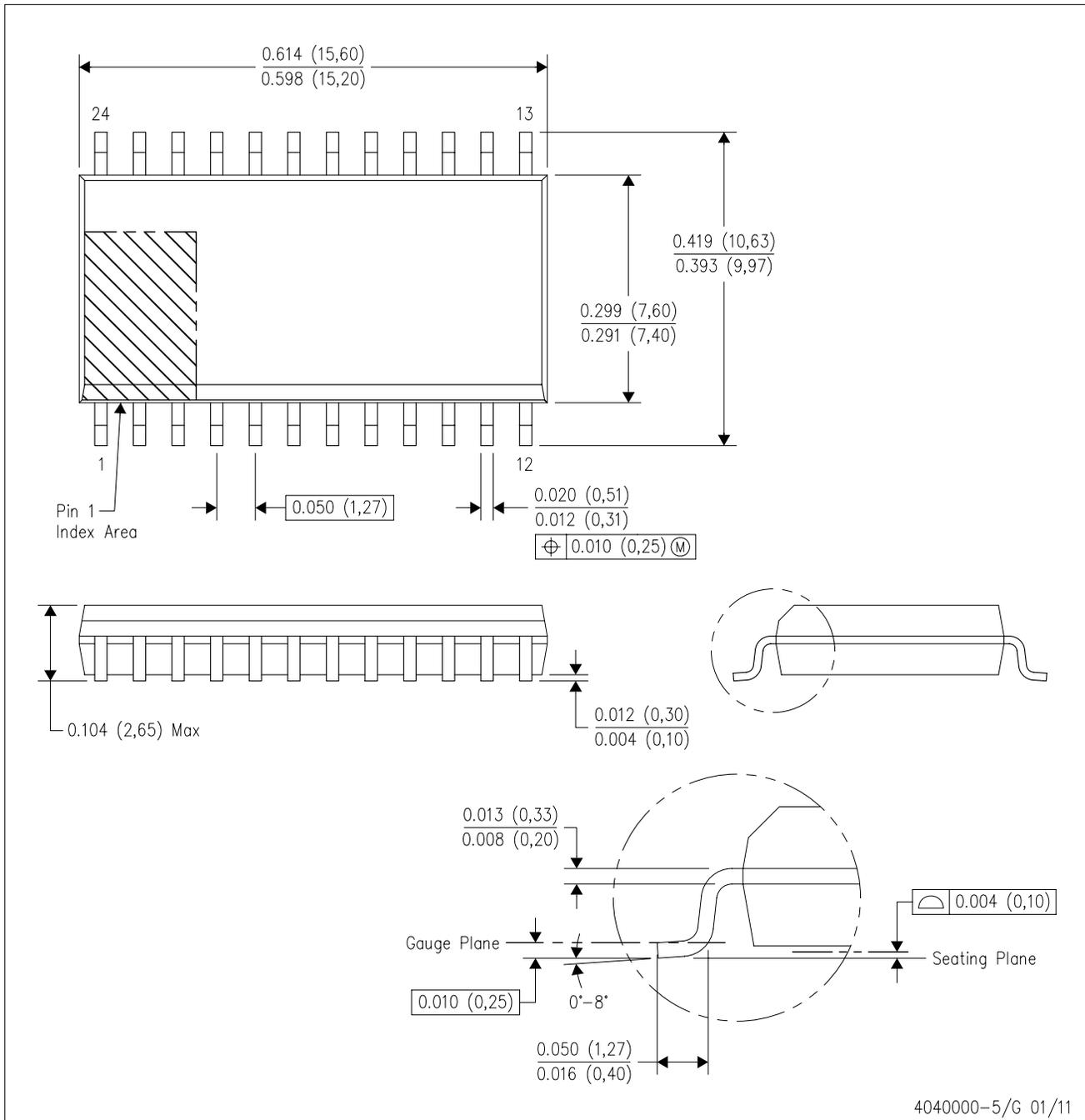
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CDC351DBR	SSOP	DB	24	2000	367.0	367.0	38.0
CDC351DWR	SOIC	DW	24	2000	367.0	367.0	45.0
CDC351IDBR	SSOP	DB	24	2000	367.0	367.0	38.0

DW (R-PDSO-G24)

PLASTIC SMALL OUTLINE

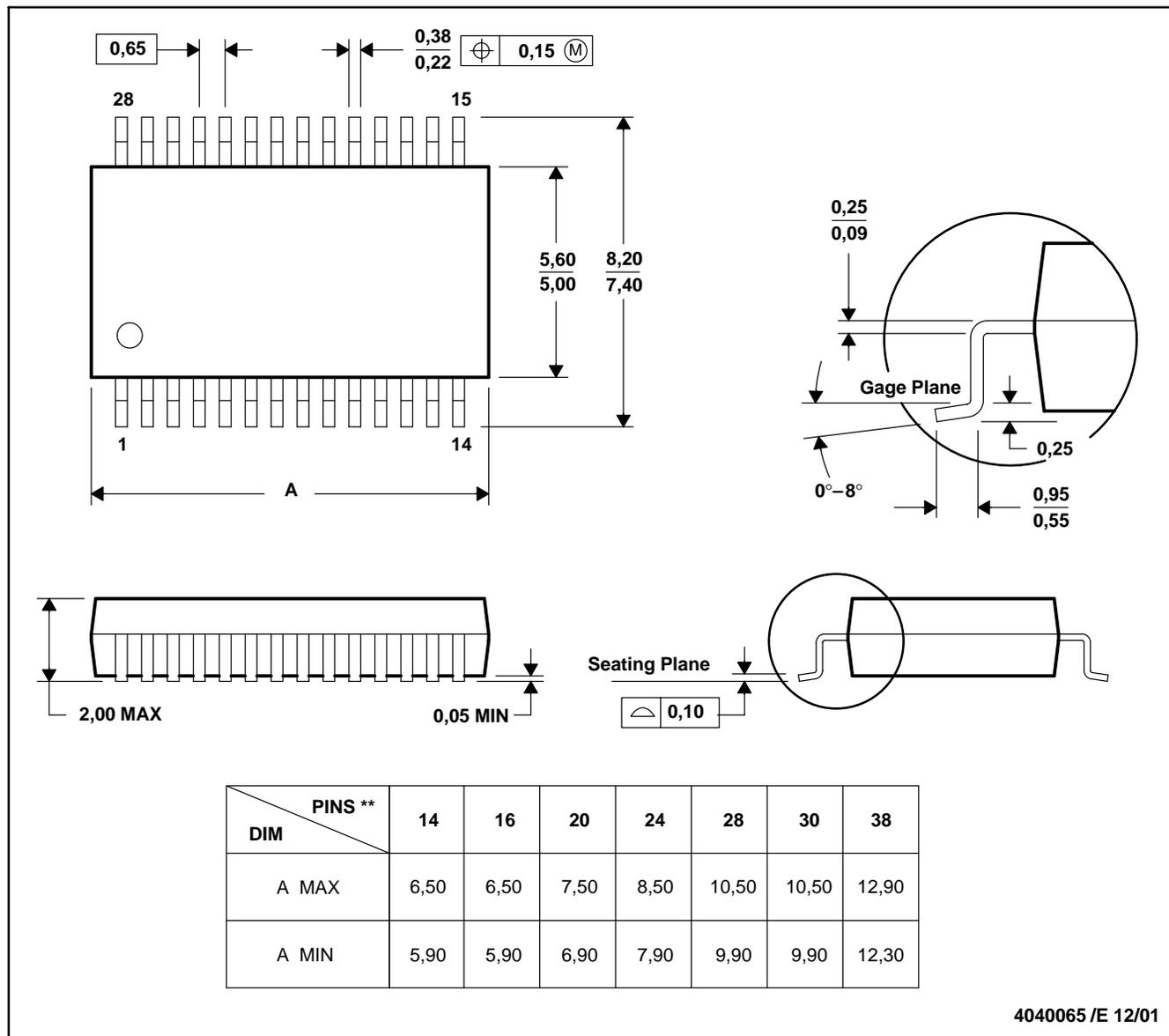


- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-013 variation AD.

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

PLASTIC SMALL-OUTLINE

28 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.  
 D. Falls within JEDEC MO-150

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