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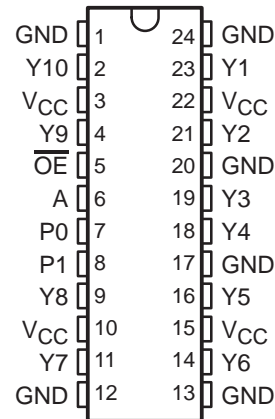
Jameco Part Number 1979804

CDC2351 1-LINE TO 10-LINE CLOCK DRIVER WITH 3-STATE OUTPUTS

SCAS442D – FEBRUARY 1994 – REVISED SEPTEMBER 2000

- 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
- Outputs Have Internal Series Damping Resistor to Reduce Transmission Line Effects
- Distributed V_{CC} and Ground Pins Reduce Switching Noise
- 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
- Available in Q-Temp Automotive High Reliability Automotive Applications Configuration Control / Print Support Qualification to Automotive Standards

DB OR DW PACKAGE
(TOP VIEW)



description

The CDC2351 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. Each output has an internal series damping resistor to improve signal integrity at the load. The CDC2351 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.

The CDC2351 is characterized for operation from 0°C to 70°C. The CDC2351Q is characterized for operation over the full automotive temperature range of -40°C to 125°C.

FUNCTION TABLE

| INPUTS | | OUTPUTS |
|--------|-----------------|---------|
| A | \overline{OE} | In |
| L | H | Z |
| H | H | Z |
| L | L | L |
| H | L | H |



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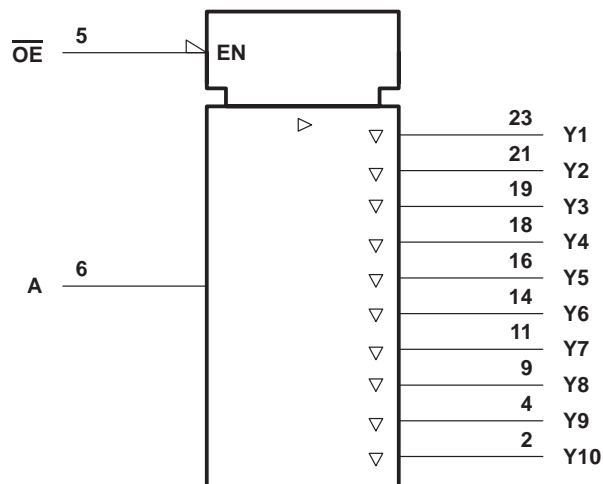


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CDC2351 1-LINE TO 10-LINE CLOCK DRIVER WITH 3-STATE OUTPUTS

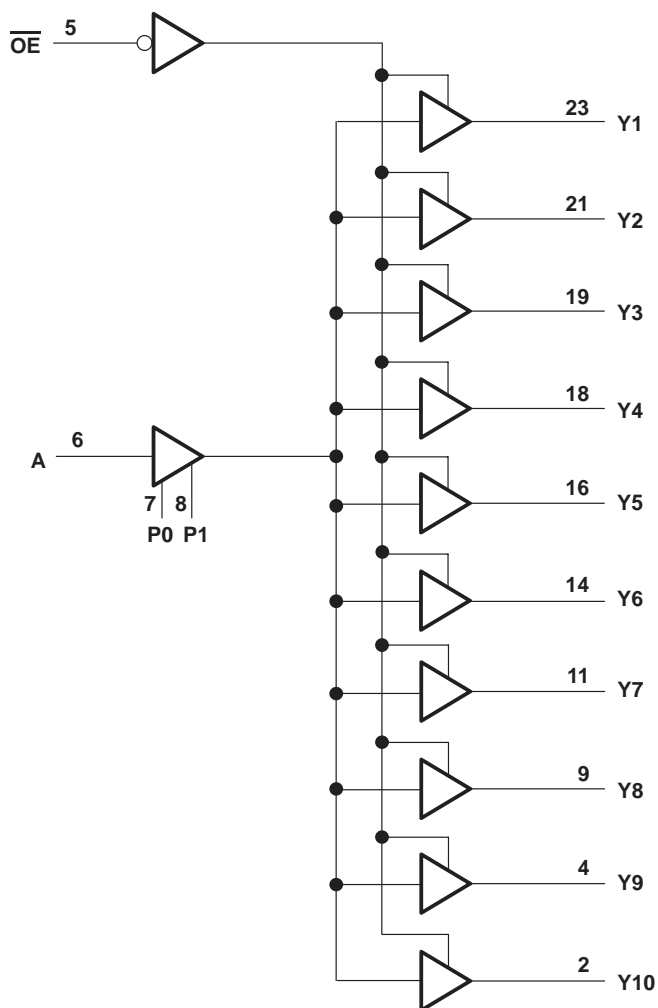
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logic symbol†



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

logic diagram (positive logic)



CDC2351 1-LINE TO 10-LINE CLOCK DRIVER WITH 3-STATE OUTPUTS

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

| | |
|---|-----------------|
| Supply voltage range, V_{CC} | –0.5 V to 4.6 V |
| Input voltage range, V_I (see Note 1) | –0.5 V to 7 V |
| Voltage range applied to any output in the high state or power-off state, V_O (see Note 1) | –0.5 V to 3.6 V |
| Current into any output in the low state, I_O | 24 mA |
| Input clamp current, I_{IK} ($V_I < 0$) | –18 mA |
| Output clamp current, I_{OK} ($V_I < 0$) | –50 mA |
| Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DB package | 0.65 W |
| DW package | 1.7 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 negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
 2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.
 For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

recommended operating conditions (see Note 3)

| | | 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 | | –12 | mA | |
| I_{OL} | Low-level output current | | 12 | mA | |
| f_{clock} | Input clock frequency | | 100 | MHz | |
| T_A | Operating free-air temperature | CDC2351 | 0 | 70 | °C |
| | | CDC2351Q | –40 | 125 | |

NOTE 3: 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} | $V_{CC} = 3\text{ V}$, | $I_{OH} = -12\text{ mA}$ | 2 | | | V |
| V_{OL} | $V_{CC} = 3\text{ V}$, | $I_{OL} = 12\text{ mA}$ | | | 0.8 | V |
| I_I | $V_{CC} = 3.6\text{ V}$, | $V_I = V_{CC}$ or GND | | | ± 1 | μA |
| $I_{O\ddagger}$ | $V_{CC} = 3.6\text{ V}$, | $V_O = 2.5\text{ V}$ | –7 | | –70 | mA |
| I_{OZ} | $V_{CC} = 3.6\text{ V}$, | $V_{CC} = 3\text{ V}$ 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 | | 15 | |
| | | | 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, | $V_{CC} = 3.3\text{ V}$, | $f = 10\text{ MHz}$ | | 6 | pF |

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



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switching characteristics, $C_L = 50 \text{ pF}$ (see Figures 1 and 2)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | CDC2351 | | | CDC2351Q | | CDC2351 | | UNIT |
|--------------|-----------------|-------------|--|-----|-----|---|------|--|-----|------|
| | | | $V_{CC} = 3.3 \text{ V}$, $T_A = 25^\circ\text{C}$ | | | $V_{CC} = 3 \text{ V to } 3.6 \text{ V}$, $T_A = -40^\circ\text{C to } 125^\circ\text{C}$ | | $V_{CC} = 3 \text{ V to } 3.6 \text{ V}$, $T_A = 0^\circ\text{C to } 70^\circ\text{C}$ | | |
| | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| t_{PLH} | A | Y | 3.8 | 4.3 | 4.8 | 1.1 | 11 | | | ns |
| t_{PHL} | | | 3.6 | 4.1 | 4.6 | 1 | 9.7 | | | |
| t_{PZH} | \overline{OE} | Y | 2.4 | 4.9 | 6.0 | 1 | 12 | 1.8 | 6.9 | ns |
| t_{PZL} | | | 2.4 | 4.3 | 6.0 | 1 | 11.1 | 1.8 | 6.9 | |
| t_{PHZ} | \overline{OE} | Y | 2.2 | 4.4 | 6.3 | 1 | 11.1 | 2.1 | 7.1 | ns |
| t_{PLZ} | | | 2.2 | 4.6 | 6.3 | 1 | 11.5 | 2.1 | 7.3 | |
| $t_{sk(o)}$ | A | Y | | 0.3 | 0.5 | | 2.5 | | 0.5 | ns |
| $t_{sk(p)}$ | A | Y | | 0.2 | 0.8 | | 3 | | 0.8 | ns |
| $t_{sk(pr)}$ | A | Y | | | 1 | | | | 1 | ns |
| t_r | A | Y | | | | | 2.5 | | 2.5 | ns |
| t_f | A | Y | | | | | 2.5 | | 2.5 | ns |

switching characteristics temperature and V_{CC} coefficients over recommended operating free-air temperature and V_{CC} range (see Note 4)

| PARAMETER | | FROM (INPUT) | TO (OUTPUT) | MIN | MAX | UNIT |
|---------------------------|--|--------------|-------------|-----|-------------------|---------------|
| $\propto t_{PLH}(T)$ | Average temperature coefficient of low to high propagation delay | A | Y | | 85 [†] | ps/10°C |
| $\propto t_{PHL}(T)$ | Average temperature coefficient of high to low propagation delay | A | Y | | 50 [†] | ps/10°C |
| $\propto t_{PLH}(V_{CC})$ | Average V_{CC} coefficient of low to high propagation delay | A | Y | | -145 [‡] | ps/ 100 mV |
| $\propto t_{PHL}(V_{CC})$ | Average V_{CC} coefficient of high to low propagation delay | A | Y | | -100 [‡] | ps/ 100 mV |

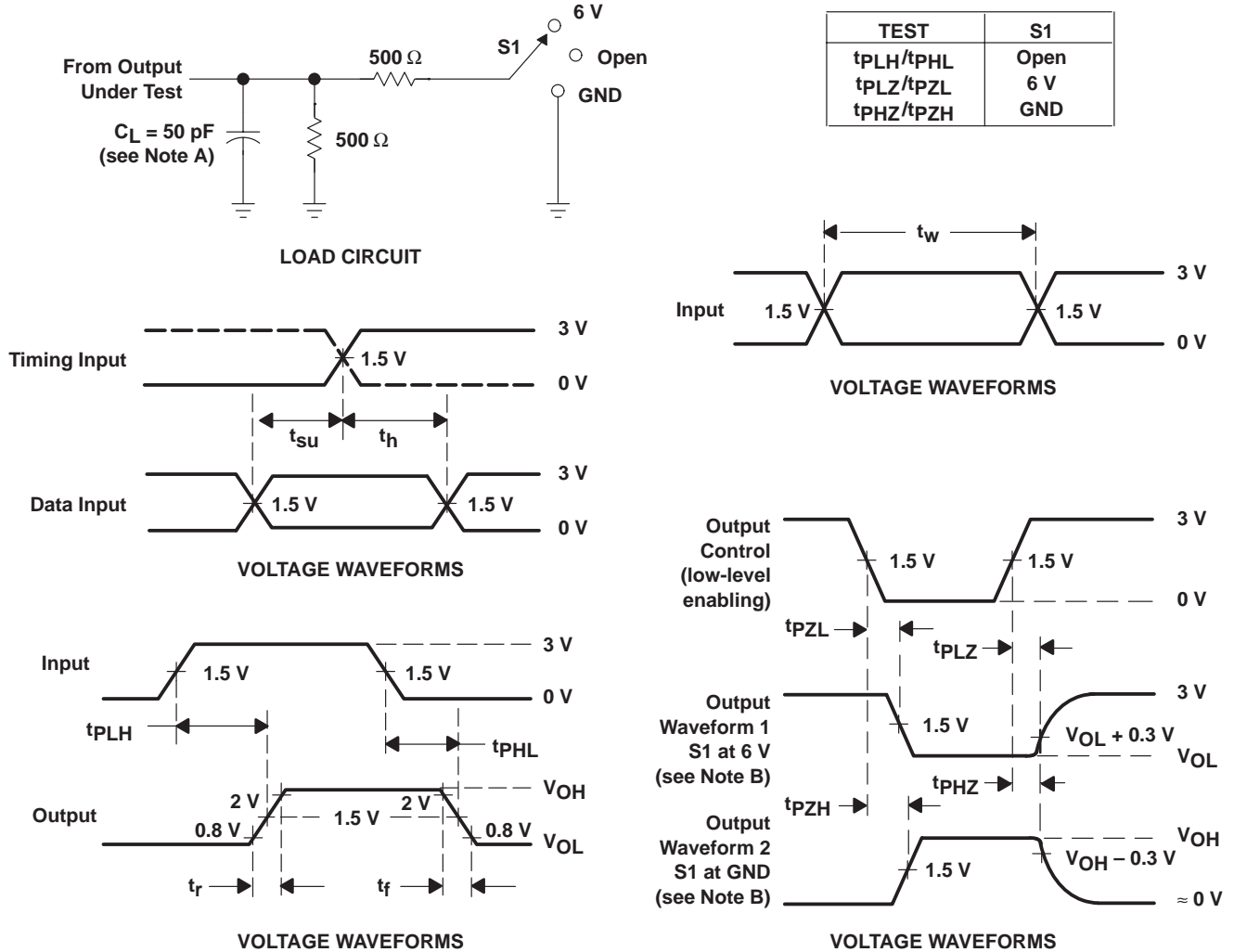
[†] $\propto t_{PLH}(T)$ and $\propto t_{PHL}(T)$ are virtually independent of V_{CC} .

[‡] $\propto t_{PLH}(V_{CC})$ and $\propto t_{PHL}(V_{CC})$ are virtually independent of temperature.

NOTE 4: This data was extracted from characterization material and are not tested at the factory.



PARAMETER MEASUREMENT INFORMATION



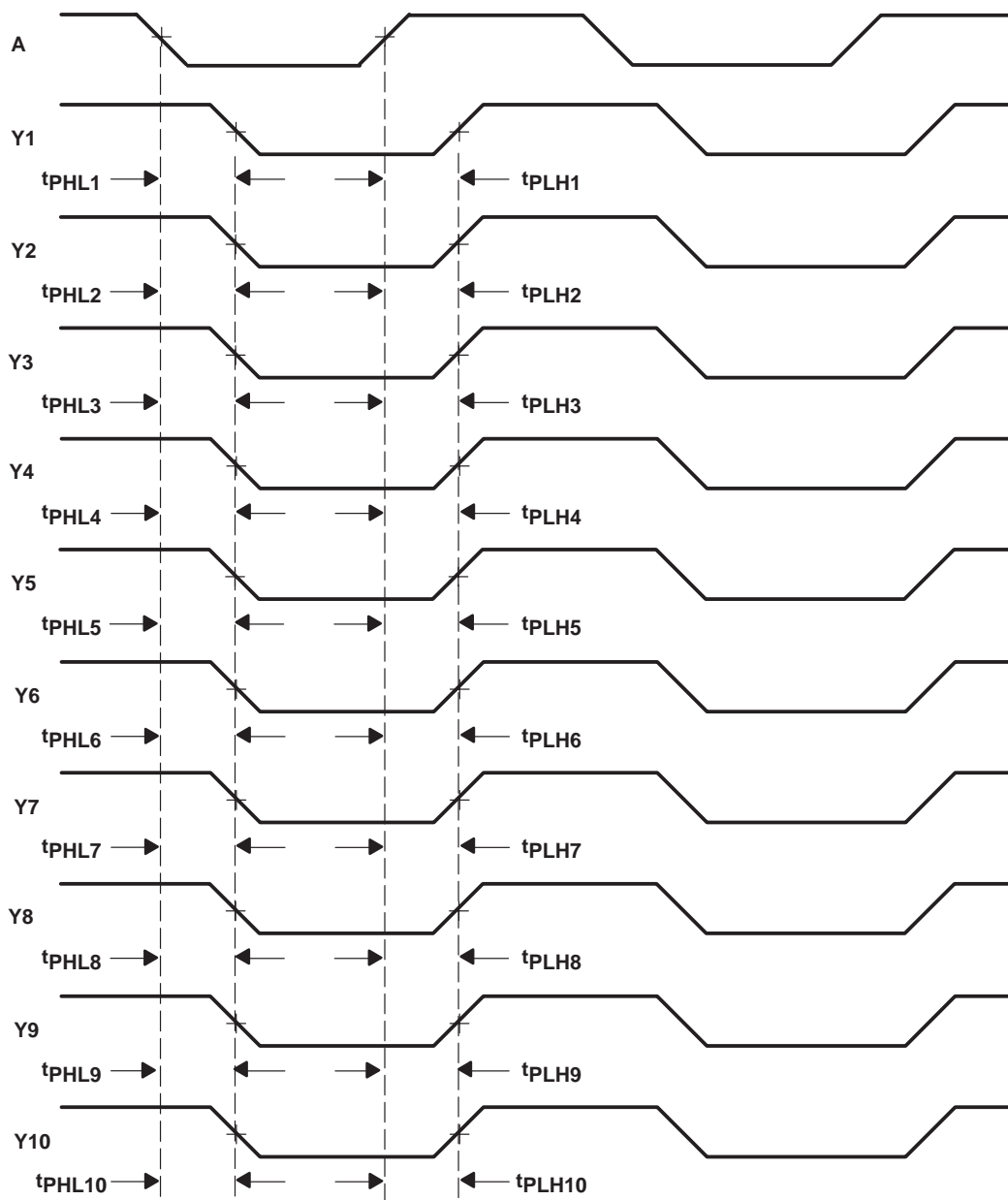
- NOTES: A. C_L includes probe and jig capacitance.
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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PARAMETER MEASUREMENT INFORMATION



- NOTES: 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⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CDC2351DB | ACTIVE | SSOP | DB | 24 | 60 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CDC2351DBG4 | ACTIVE | SSOP | DB | 24 | 60 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CDC2351DBLE | OBSOLETE | SSOP | DB | 24 | | TBD | Call TI | Call TI |
| CDC2351DBR | ACTIVE | SSOP | DB | 24 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CDC2351DBRG4 | ACTIVE | SSOP | DB | 24 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CDC2351DW | ACTIVE | SOIC | DW | 24 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CDC2351DWG4 | ACTIVE | SOIC | DW | 24 | 25 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CDC2351DWR | ACTIVE | SOIC | DW | 24 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CDC2351DWRG4 | ACTIVE | SOIC | DW | 24 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CDC2351QDB | ACTIVE | SSOP | DB | 24 | 60 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| CDC2351QDBG4 | ACTIVE | SSOP | DB | 24 | 60 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CDC2351QDBR | ACTIVE | SSOP | DB | 24 | 2000 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| CDC2351QDBRG4 | ACTIVE | SSOP | DB | 24 | 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.

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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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CDC2351DBR | SSOP | DB | 24 | 2000 | 330.0 | 16.4 | 8.2 | 8.8 | 2.5 | 12.0 | 16.0 | Q1 |
| CDC2351DWR | SOIC | DW | 24 | 2000 | 330.0 | 24.4 | 10.75 | 15.7 | 2.7 | 12.0 | 24.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CDC2351DBR | SSOP | DB | 24 | 2000 | 346.0 | 346.0 | 33.0 |
| CDC2351DWR | SOIC | DW | 24 | 2000 | 346.0 | 346.0 | 41.0 |

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

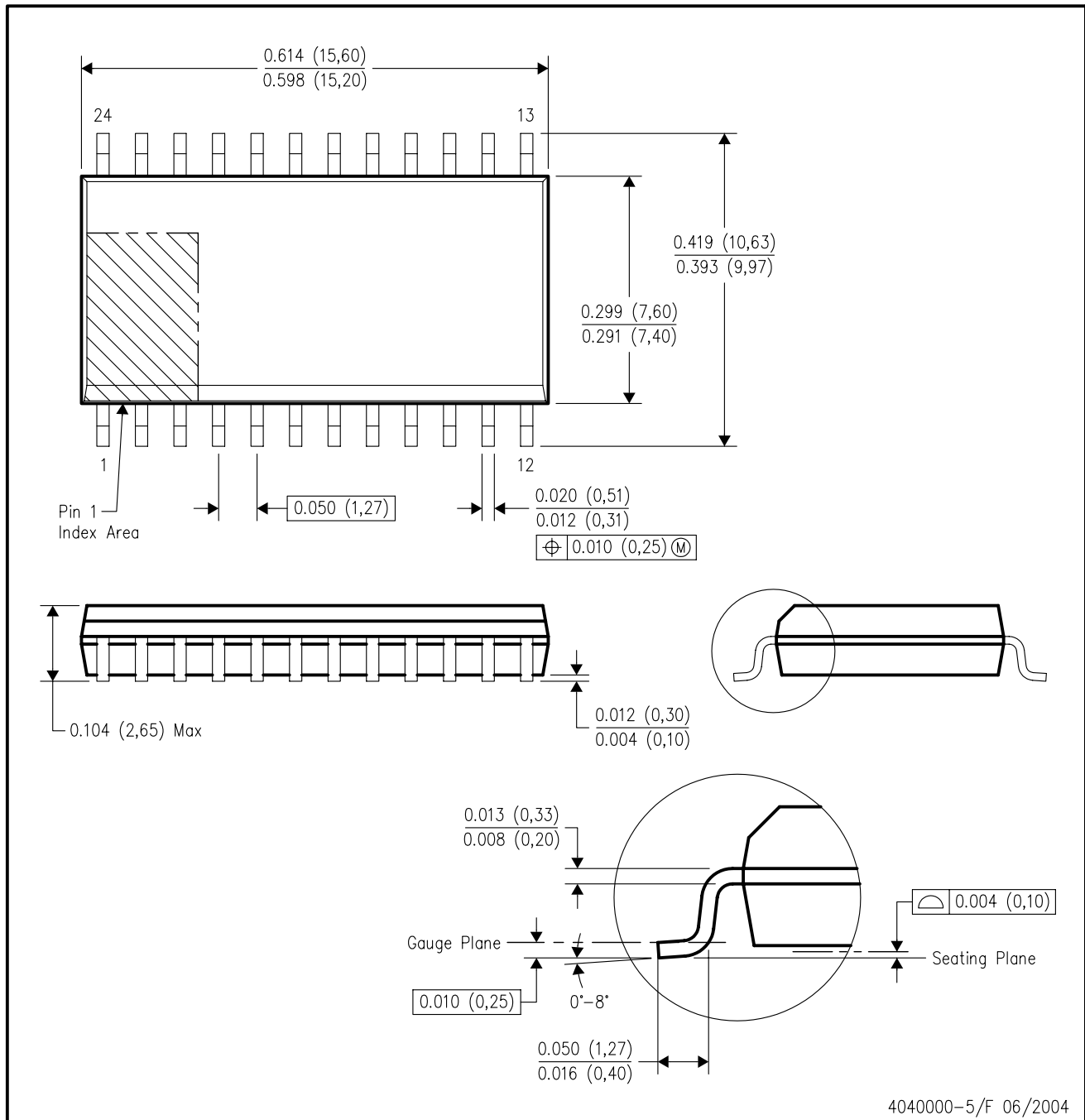
28 PINS SHOWN



- 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

DW (R-PDSO-G24)

PLASTIC SMALL-OUTLINE PACKAGE



4040000-5/F 06/2004

- NOTES:
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