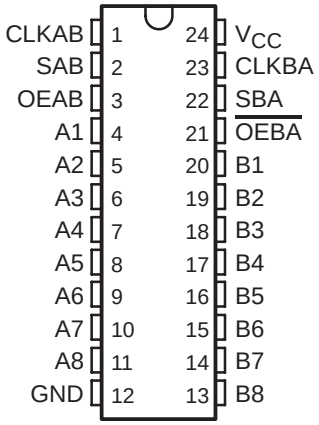
- **State-of-the-Art BiCMOS Design Significantly Reduces I_{CCZ}**
- **Independent Registers for A and B Buses**
- **Multiplexed Real-Time and Stored Data**
- **Inverting Data Paths**
- **Power-Up High-Impedance Mode**
- **Package Options Include Plastic Small-Outline (DW) Packages and Standard Plastic 300-mil DIPs (NT)**

DW OR NT PACKAGE
(TOP VIEW)



description

This SN74BCT651 consists of bus transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Output-enable (OEAB and $\overline{\text{OEBA}}$) inputs are provided to control the transceiver functions. The select-control (SAB and SBA) inputs are provided to select whether real-time or stored data is transferred. A low input level selects real-time data, and a high input level selects stored data. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the SN74BCT651.

Data on the A or B bus, or both, can be stored in the internal D flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) inputs regardless of the select- or enable-control pins. When SAB and SBA are in the real-time transfer mode, it is also possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and $\overline{\text{OEBA}}$. In this configuration, each output reinforces its input. Thus, when all the other data sources to the two sets of bus lines are at high impedance, each set will remain at its last state.

The SN74BCT651 is characterized for operation from 0°C to 70°C.

FUNCTION TABLE

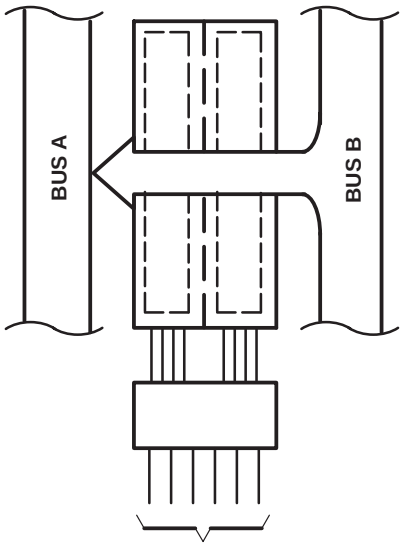
INPUTS						DATA I/O		OPERATION OR FUNCTION
OEAB	$\overline{\text{OEBA}}$	CLKAB	CLKBA	SAB	SBA	A1 THRU A8	B1 THRU B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified†	Store A, hold B
H	H	↑	↑	X‡	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified†	Input	Hold A, store B
L	L	↑	↑	X	X‡	Output	Input	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-time $\overline{\text{B}}$ data to A bus
L	L	X	H or L	X	H	Output	Input	Stored $\overline{\text{B}}$ data to A bus
H	H	X	X	L	X	Input	Output	Real-time $\overline{\text{A}}$ data to B bus
H	H	H or L	X	H	X	Input	Output	Stored $\overline{\text{A}}$ data to B bus
H	L	H or L	H or L	H	H	Output	Output	Stored $\overline{\text{A}}$ data to B bus and stored B data to A bus

† The data output functions may be enabled or disabled by various signals at the OEAB or $\overline{\text{OEBA}}$ inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs.

‡ When select control is low, clocks can occur simultaneously so long as allowances are made for propagation delays from A to B (B to A) plus setup and hold times. When select control is high, clocks must be staggered in order to load both registers.

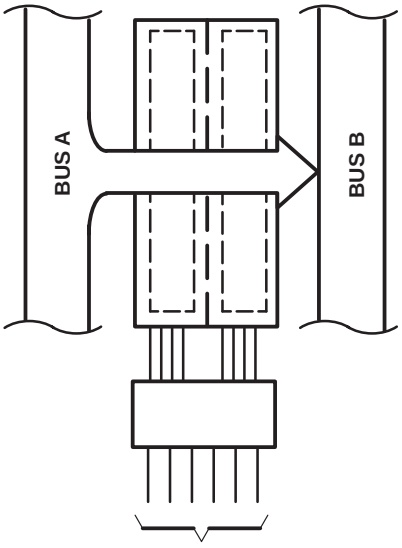
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 1993, Texas Instruments Incorporated



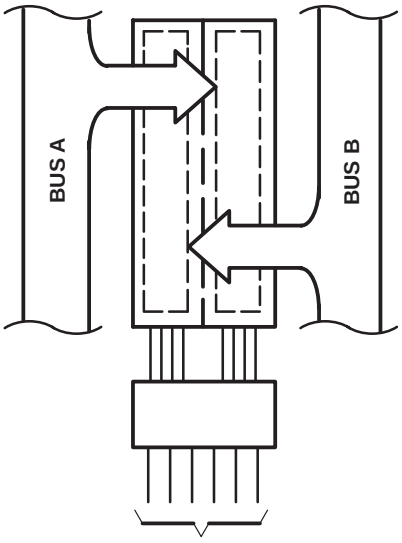
3	21	1	23	2	22
OEAB	$\overline{\text{OEAB}}$	CLKAB	CLKBA	SAB	SBA
L	L	X	X	X	L

REAL-TIME TRANSFER BUS B TO BUS A



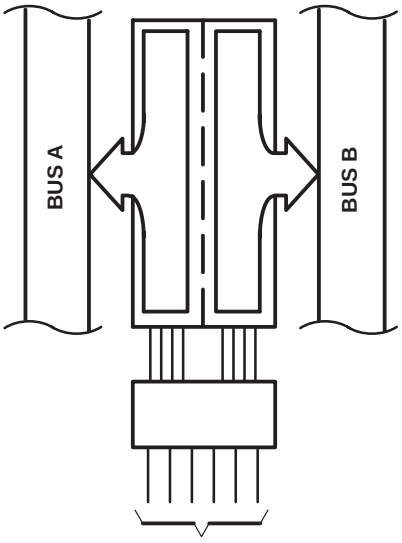
3	21	1	23	2	22
OEAB	$\overline{\text{OEAB}}$	CLKAB	CLKBA	SAB	SBA
H	H	X	X	L	X

REAL-TIME TRANSFER BUS A TO BUS B



3	21	1	23	2	22
OEAB	$\overline{\text{OEAB}}$	CLKAB	CLKBA	SAB	SBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

STORAGE FROM A,B, OR A AND B



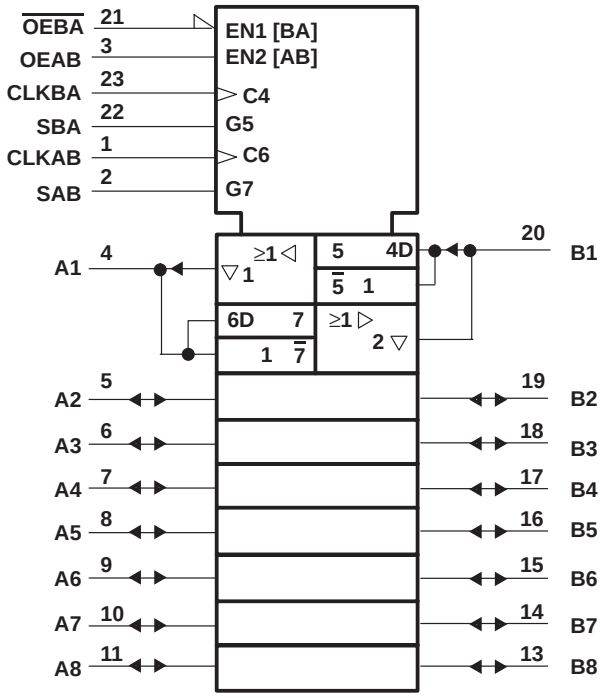
21	3	1	23	2	22
OEAB	$\overline{\text{OEAB}}$	CLKAB	CLKBA	SAB	SBA
H	L	H or L	H or L	H	H

TRANSFER STORED DATA TO A AND/OR B

Figure 1. Bus-Management Functions

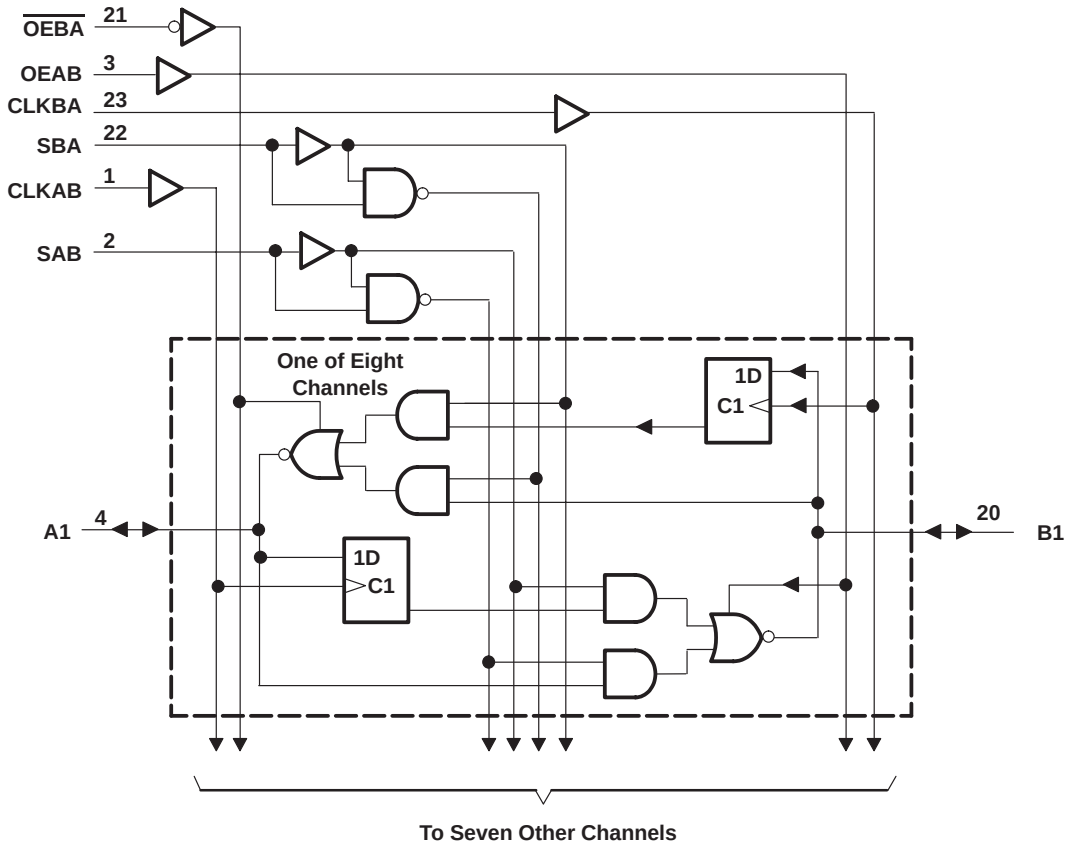
TEXAS INSTRUMENTS
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265
POST OFFICE BOX 1443 • HOUSTON, TEXAS 77251−1443

logic symbol†



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

logic 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: Control inputs (see Note 1) . . . . . − 0.5 V to 7 V
I/O ports (see Note 1) . . . . . − 0.5 V to 5.5 V
Voltage range applied to any output in the disabled or power-off state, V_O . . . . . − 0.5 V to 5.5 V
Voltage range applied to any output in the high state, V_O . . . . . − 0.5 V to V_{CC}
Current into any output in the low state . . . . . 128 mA
Operating free-air temperature range . . . . . 0°C to 70°C
Storage temperature range . . . . . − 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 input and output voltage ratings may be exceeded if the input and output current ratings are observed.

recommended operating conditions

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	4.5	5	5.5	V
V_{IH}	High-level input voltage	2			V
V_{IL}	Low-level input voltage			0.8	V
I_{IK}	Input clamp current			−18	mA
I_{OH}	High-level output current			−15	mA
I_{OL}	Low-level output current			64	mA
T_A	Operating free-air temperature	0		70	°C

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

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{IK}		V_{CC} = 4.5 V,	I_I = −18 mA			−1.2	V
V_{OH}		V_{CC} = 4.5 V	I_{OH} = −3 mA	2.4	3.3		V
			I_{OH} = −15 mA	2	3.1		
		V_{CC} = 4.75 V,	I_{OH} = −3 mA	2.7			
V_{OL}		V_{CC} = 4.5 V,	I_{OL} = 64 mA		0.42	0.55	V
I_I	A or B port	V_{CC} = 5.5 V,	V_I = 5.5 V			1	mA
	Control inputs					1	
I_{IH}‡	A or B port	V_{CC} = 5.5 V,	V_I = 2.7 V			70	µA
	Control inputs					20	
I_{IL}‡	A or B port	V_{CC} = 5.5 V,	V_I = 0.5 V			−0.7	mA
	Control inputs					−0.7	
I_{OS}§		V_{CC} = 5.5 V,	V_O = 0	−100		−225	mA
I_{CCL}	A or B port	V_{CC} = 5.5 V,	V_I = GND		39	62	mA
I_{CCH}	A or B port	V_{CC} = 5.5 V,	V_I = 4.5 V		8	13	mA
I_{CCZ}	A or B port	V_{CC} = 5.5 V,	V_I = GND		10	16	mA
C_i	Control inputs	V_{CC} = 5 V,	V_I = 2.5 V or 0.5 V		5.5		pF
C_{io}	A or B port	V_{CC} = 5 V,	V_O = 2.5 V or 0.5 V		11		pF

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ For I/O ports, the parameters I_{IH} and I_{IL} include the off-state output current.
§ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

			V_{CC} = 5 V, T_A = 25°C		MIN	MAX	UNIT
			MIN	MAX			
f_{clock}	Clock frequency		0	85	0	85	MHz
t_w	Pulse duration	CLK high	4.8		4.8		ns
		CLK low	7		7		
t_{su}	Setup time, A or B before CLK↑		6		6		ns
t_h	Hold time, A or B after CLK↑		1		1		ns

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C_L = 50 pF (unless otherwise noted) (see Note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 5 V, T_A = 25°C			MIN	MAX	UNIT
			MIN	TYP	MAX			
f_{max}			85			85		MHz
t_{PLH}	CLKBA or CLKAB	A or B	3.2	7	10	3.2	11.7	ns
t_{PHL}			3.9	7.3	10.2	3.9	11.8	
t_{PLH}	A or B	B or A	3.2	7.3	10.4	3.2	12.6	ns
t_{PHL}			2.7	5.9	8.5	2.7	9.8	
t_{PLH}	SAB or SBA† (with A or B high)	A or B	2.8	6	8.6	2.8	9.8	ns
t_{PHL}			4.8	9.4	12.8	4.8	15.5	
t_{PLH}	SBA or SAB† (with A or B low)	A or B	3.9	8.6	12.1	3.9	14.6	ns
t_{PHL}			4.4	8.1	11.1	4.4	12.8	
t_{PZH}	$\overline{OEBA}$ or OEAB	A or B	3.3	7.1	9.8	3.3	12	ns
t_{PZL}			3.8	7.8	10.8	3.8	13.1	
t_{PHZ}	$\overline{OEBA}$ or OEAB	A or B	3.6	6.6	9	3.6	10.2	ns
t_{PLZ}			2.8	5.8	8.4	2.8	9.6	
t_{PZH}	DIR	A or B	2.2	5.1	7.3	2.2	8.3	ns
t_{PZL}			2.8	5.9	8.5	2.8	9.7	
t_{PHZ}	DIR	A or B	4.2	8	12.8	4.2	15	ns
t_{PLZ}			3.8	7.4	10.2	3.8	12.3	

† These parameters are measured with the internal output state of the storage register opposite to that of the bus input.
NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN74BCT651DW	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI
SN74BCT651DWR	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI
SN74BCT651NT	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI

(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)

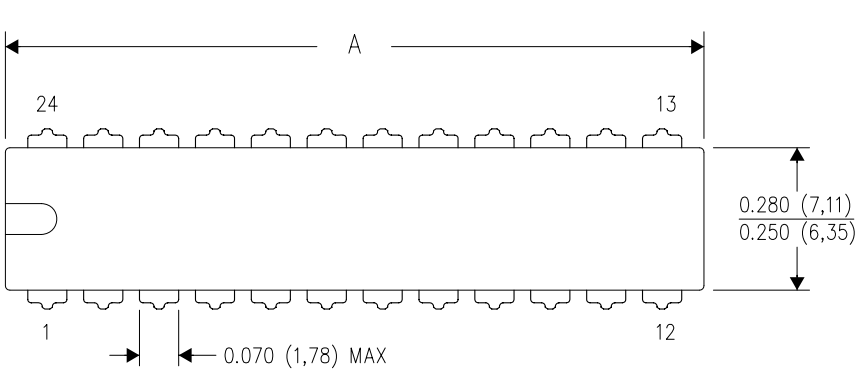
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

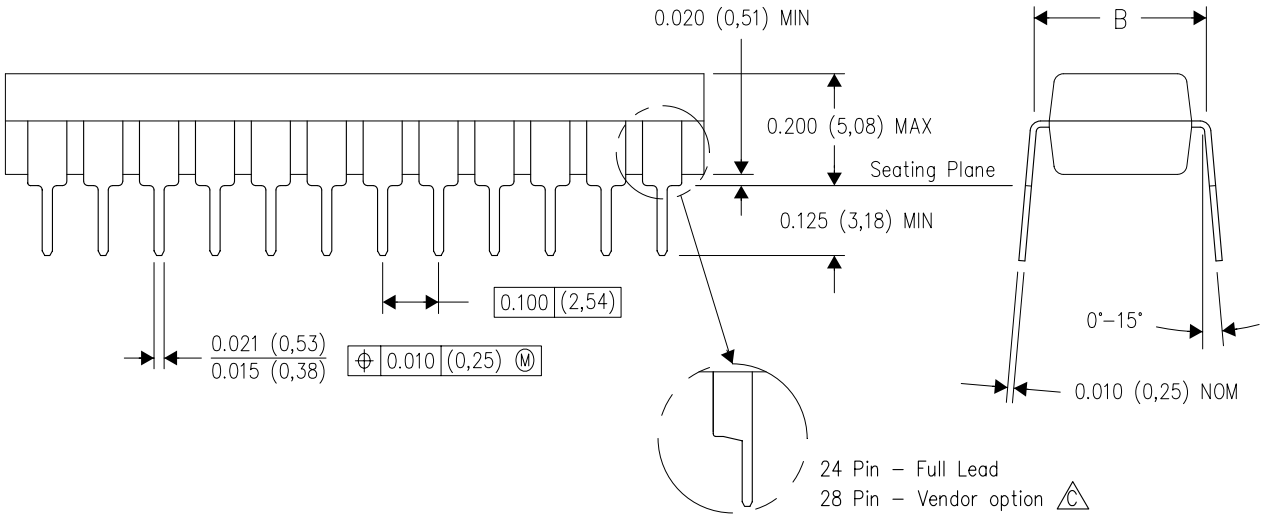
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

NT (R–PDIP–T**) PLASTIC DUAL–IN–LINE PACKAGE

24 PINS SHOWN



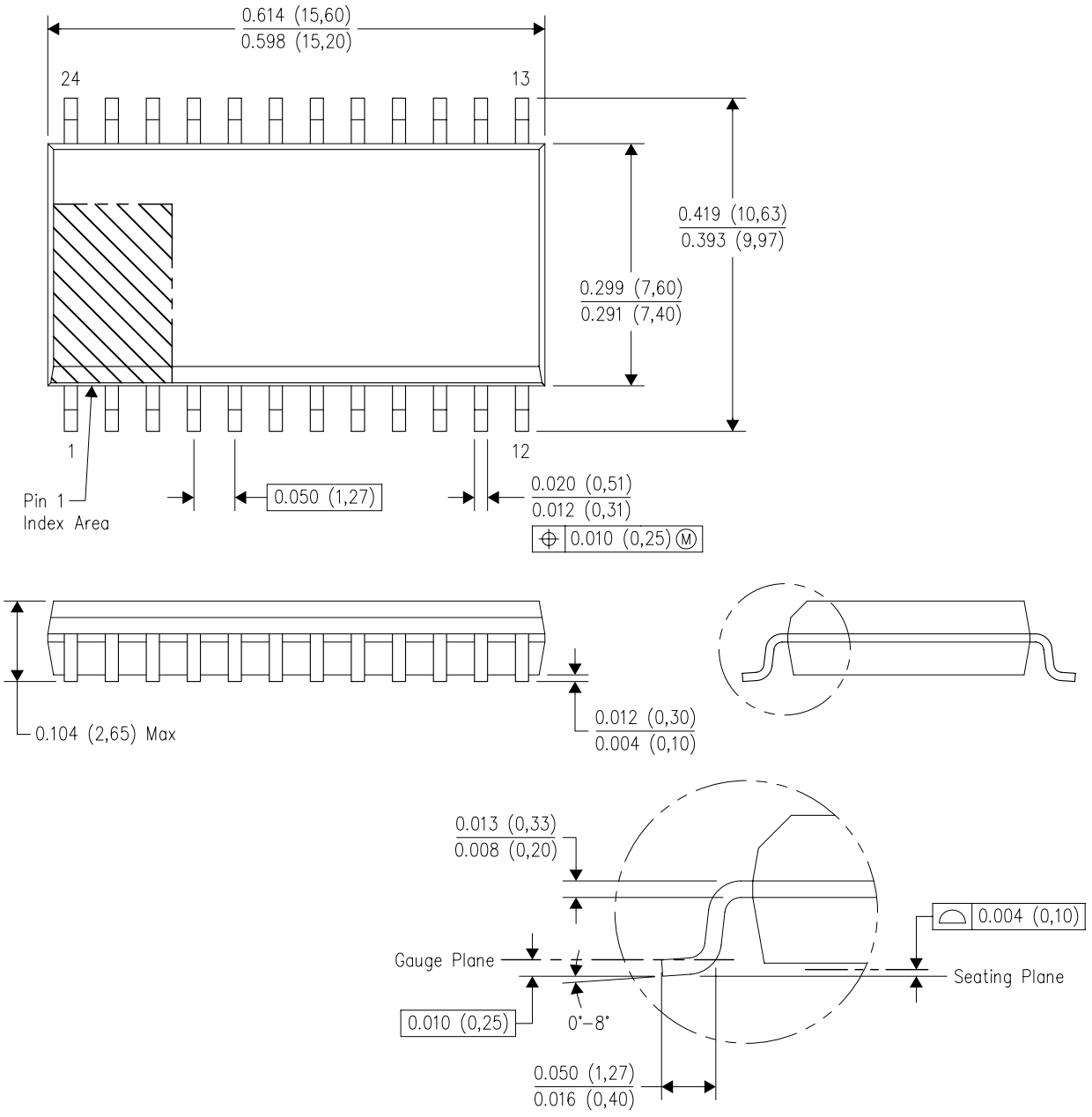
DIM \ PINS **	24	28
A MAX	1.260 (32,04)	1.425 (36,20)
A MIN	1.230 (31,24)	1.385 (35,18)
B MAX	0.310 (7,87)	0.315 (8,00)
B MIN	0.290 (7,37)	0.295 (7,49)



4040050/C 04/09

NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. The 28 pin end lead shoulder width is a vendor option, either half or full width.

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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Audio	www.ti.com/audio	Communications and Telecom	www.ti.com/communications
Amplifiers	amplifier.ti.com	Computers and Peripherals	www.ti.com/computers
Data Converters	dataconverter.ti.com	Consumer Electronics	www.ti.com/consumer-apps
DLP® Products	www.dlp.com	Energy and Lighting	www.ti.com/energy
DSP	dsp.ti.com	Industrial	www.ti.com/industrial
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Security	www.ti.com/security
Logic	logic.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Power Mgmt	power.ti.com	Transportation and Automotive	www.ti.com/automotive
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com	Wireless	www.ti.com/wireless-apps
RF/IF and ZigBee® Solutions	www.ti.com/lprf		
	TI E2E Community Home Page		e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated