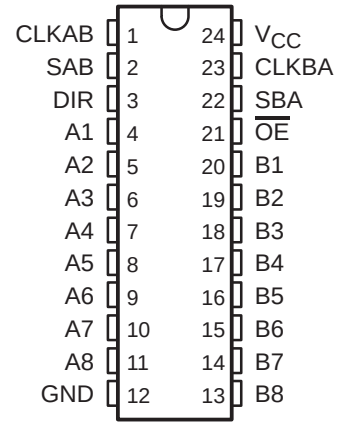
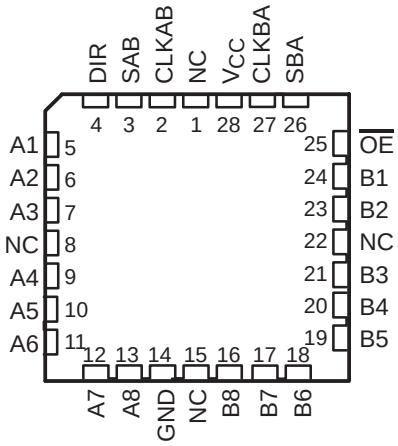
- **State-of-the-Art BiCMOS Design Significantly Reduces I_{CCZ}**
- **Bus Transceivers/Registers**
- **Independent Registers and Enables for A and B Buses**
- **Multiplexed Real-Time and Stored Data**
- **ESD Protection Exceeds JESD 22**
  - **2000-V Human-Body Model (A114-A)**
  - **200-V Machine Model (A115-A)**

SN54BCT646 . . . JT OR W PACKAGE
SN74BCT646 . . . DW OR NT PACKAGE
(TOP VIEW)



SN54BCT646 . . . FK PACKAGE
(TOP VIEW)



NC − No internal connection

description/ordering information

These devices consist of bus transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers. Data on the A or B bus is clocked into the registers on the low-to-high transition of the appropriate clock (CLKAB or CLKBA) input. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the ’BCT646 devices.

Output-enable ($\overline{OE}$) and direction-control (DIR) inputs are provided to control the transceiver functions. In the transceiver mode, data present at the high-impedance port can be stored in either register or in both.

The select-control (SAB and SBA) inputs can multiplex stored and real-time (transparent mode) data. The direction control (DIR) determines which bus will receive data when $\overline{OE}$ is low. In the isolation mode ($\overline{OE}$ high), A data can be stored in one register and/or B data can be stored in the other register.

ORDERING INFORMATION

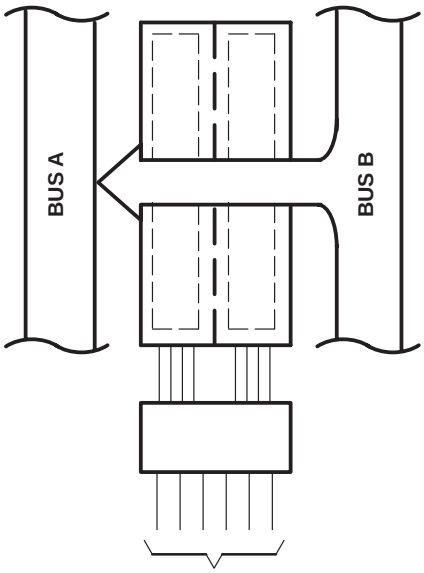
T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP − NT	Tube	SN74BCT646NT	SN74BCT646NT
	SOIC − DW	Tube	SN74BCT646DW	BCT646
		Tape and reel	SN74BCT646DWR	
−55°C to 125°C	CDIP − JT	Tube	SNJ54BCT646JT	SNJ54BCT646JT
	CFP − W	Tube	SNJ54BCT646W	SNJ54BCT646W
	LCCC − FK	Tube	SNJ54BCT646FK	SNJ54BCT646FK

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

description/ordering information(continued)

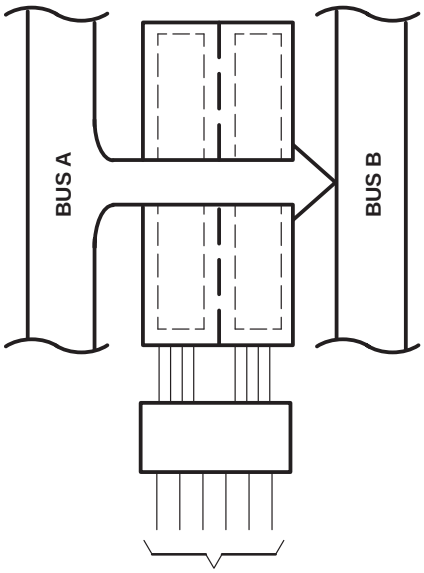
When an output function is disabled, the input function still is enabled and can be used to store and transmit data. Only one of the two buses, A or B, can be driven at a time.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.



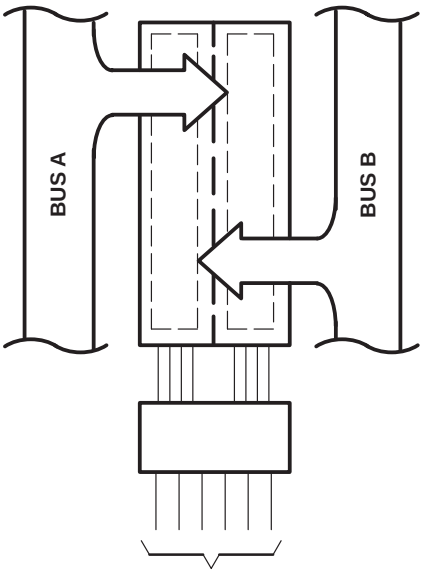
21 $\overline{OE}$	3 DIR	1 CLKAB	23 CLKBA	2 SAB	22 SBA
L	L	X	X	X	L

REAL-TIME TRANSFER
BUS B TO BUS A



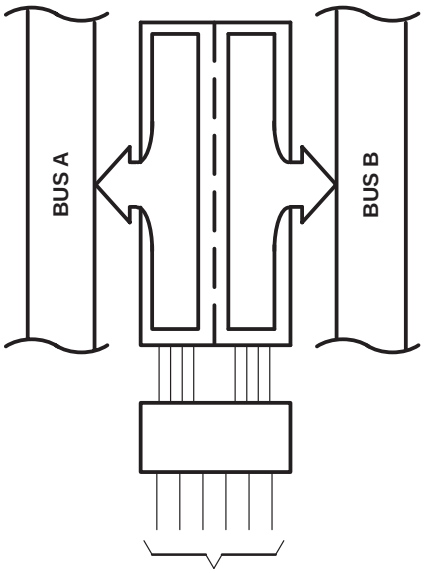
21 $\overline{OE}$	3 DIR	1 CLKAB	23 CLKBA	2 SAB	22 SBA
L	H	X	X	L	X

REAL-TIME TRANSFER
BUS A TO BUS B



21 $\overline{OE}$	3 DIR	1 CLKAB	23 CLKBA	2 SAB	22 SBA
X	X	↑	X	X	X
X	X	X	↑	X	X
H	X	↑	↑	X	X

STORAGE FROM
A, B, OR A AND B



21 $\overline{OE}$	3 DIR	1 CLKAB	23 CLKBA	2 SAB	22 SBA
L	L	X	H or L	X	H
L	H	H or L	X	H	X

TRANSFER STORED DATA
TO A AND/OR B

Pin numbers shown are for the DW, JT, NT, and W packages.

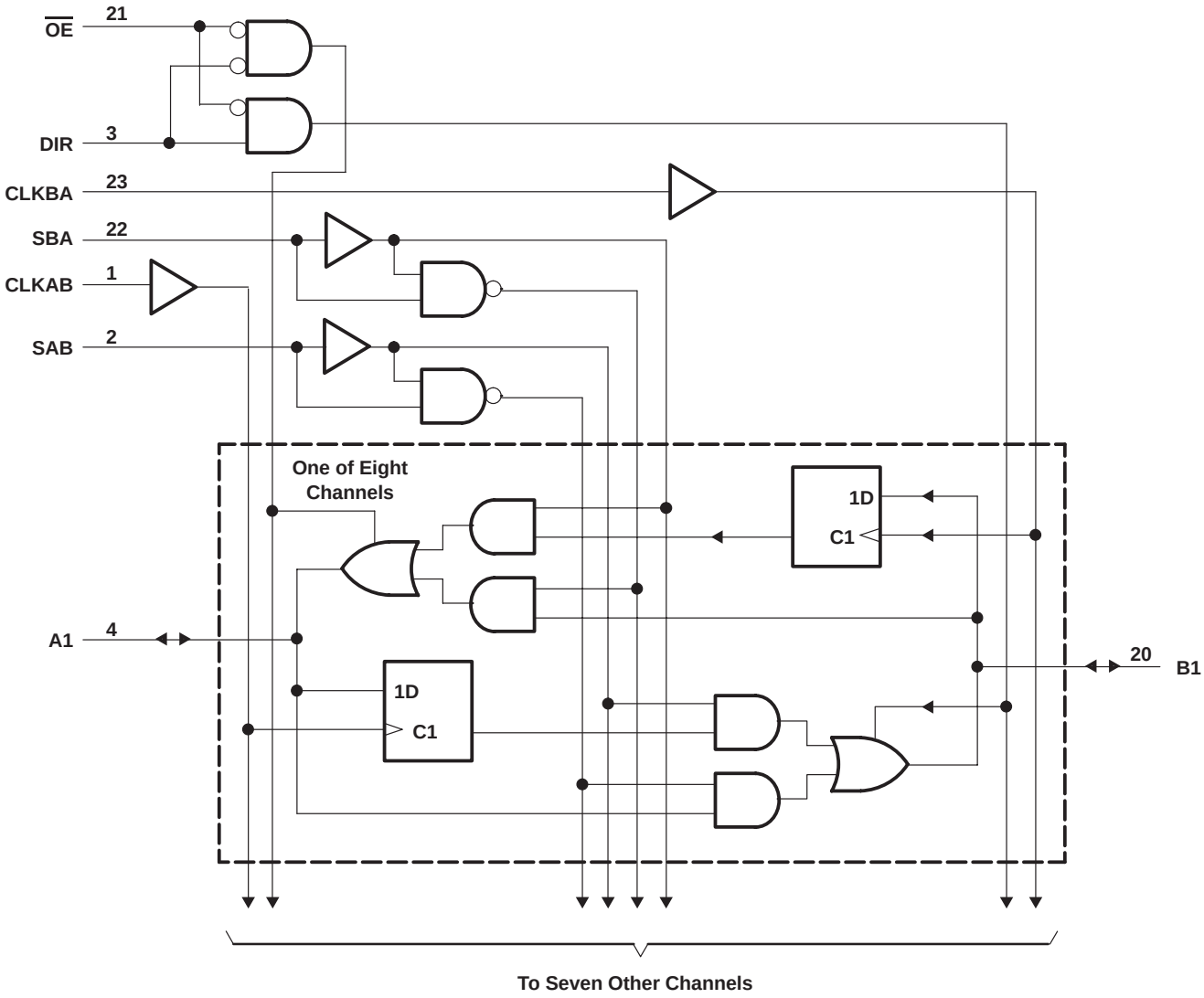
Figure 1. Bus-Management Functions

FUNCTION TABLE

INPUTS						DATA I/O		OPERATION OR FUNCTION
$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA	A1 THRU A8	B1 THRU B8	
X	X	↑	X	X	X	Input	Unspecified†	Store A, B unspecified†
X	X	X	↑	X	X	Unspecified†	Input	Store B, A unspecified†
H	X	↑	↑	X	X	Input	Input	Store A and B data
H	X	H or L	H or L	X	X	Input disabled	Input disabled	Isolation, hold storage
L	L	X	X	X	L	Output	Input	Real-time B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
L	H	X	X	L	X	Input	Output	Real-time A data to B bus
L	H	H or L	X	H	X	Input	Output	Stored A data to B bus

† The data output functions can be enabled or disabled by various signals at the $\overline{OE}$ and DIR inputs. Data input functions always are enabled, i.e., data at the bus pins is stored on every low-to-high transition of the clock inputs.

logic diagram (positive logic)



Pin numbers shown are for the DW, JT, NT, and W packages.

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 7 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: SN54BCT646 . . . . . 96 mA
SN74BCT646 . . . . . 128 mA
Package thermal impedance, θ_{JA} (see Note 2): DW package . . . . . 46°C/W
(see Note 3): NT package . . . . . 67°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.
3. The package thermal impedance is calculated in accordance with JESD 51-3.

recommended operating conditions (see Note 4)

		SN54BCT646			SN74BCT646			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage			0.8			0.8	V
I_{IK}	Input clamp current			−18			−18	mA
I_{OH}	High-level output current			−12			−15	mA
I_{OL}	Low-level output current			48			64	mA
T_A	Operating free-air temperature	−55		125	0		70	°C

NOTE 4: All unused control 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		SN54BCT646			SN74BCT646			UNIT
				MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = −18 mA			−1.2			−1.2	V
V_{OH}		V_{CC} = 4.5 V	I_{OH} = −3 mA	2.4	3.3		2.4	3.3		V
			I_{OH} = −12 mA	2	3.2					
			I_{OH} = −15 mA				2	3.1		
V_{OL}		V_{CC} = 4.5 V	I_{OL} = 48 mA		0.38	0.55				V
			I_{OL} = 64 mA					0.42	0.55	
I_I	A or B port	V_{CC} = 5.5 V,	V_I = 5.5 V			1			1	mA
	Control inputs					1			1	
I_{IH}‡	A or B port	V_{CC} = 5.5 V,	V_I = 2.7 V			70			70	µA
	Control inputs					20			20	
I_{IL}‡	A or B port	V_{CC} = 5.5 V,	V_I = 0.5 V			−0.7			−0.7	mA
	Control inputs					−0.7			−0.7	
I_{OS}§		V_{CC} = 5.5 V,	V_O = 0	−100		−225	−100		−225	mA
I_{CCL}	A or B port	V_{CC} = 5.5 V,	V_I = GND		42	67		42	67	mA
I_{CCH}	A or B port	V_{CC} = 5.5 V,	V_I = 4.5 V		5.6	9		5.6	9	mA
I_{CCZ}	A or B port	V_{CC} = 5.5 V,	V_I = GND		10	16		10	16	mA
C_i	Control inputs	V_{CC} = 5 V,	V_I = 2.5 V or 0.5 V		6			6		pF
C_{io}	A or B port	V_{CC} = 5 V,	V_O = 2.5 V or 0.5 V		12			14		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)

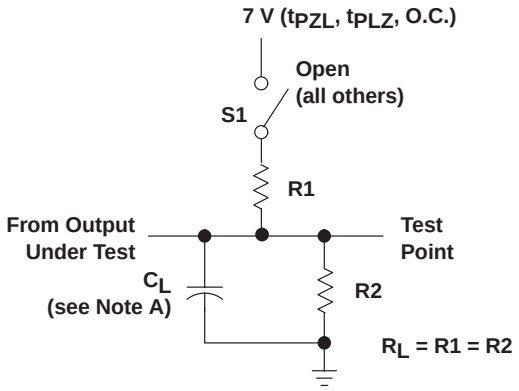
		V_{CC} = 5 V, T_A = 25°C		SN54BCT646		SN7BCT646		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		83		83		83	MHz
t_w	Pulse duration, CLK high or low	6		6		6		ns
t_{su}	Setup time, A or B before CLKAB↑ or CLKBA↑	6		7		6		ns
t_h	Hold time, A or B after CLKAB↑ or CLKBA↑	0.5		0.5		0.5		ns

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

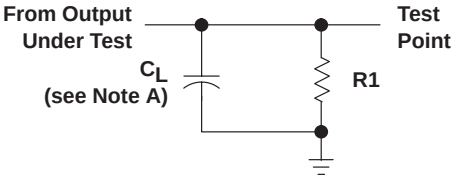
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 5 V, T_A = 25°C			SN54BCT646		SN74BCT646		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			83			83		83		MHz
t_{PLH}	CLKBA or CLKAB	A or B	3.6	7	9.4	3.6	12.4	3.6	11.2	ns
t_{PHL}			3.9	7	9.2	3.9	11.5	3.9	10.6	
t_{PLH}	A or B	B or A	3.1	6	8.1	3.1	11.1	3.1	9.5	ns
t_{PHL}			3.7	6.8	8.9	3.7	12.1	3.7	10.5	
t_{PLH}	SAB or SBA† (with A or B high)	A or B	4.5	8.8	11.2	4.5	15.2	4.5	13.8	ns
t_{PHL}			3.3	6	8.1	3.3	9.8	3.3	9.1	
t_{PLH}	SAB or SBA† (with A or B low)	A or B	3.9	7.7	10.2	3.9	13.3	3.9	12	ns
t_{PHL}			4.7	8.3	10.8	4.7	13.7	4.7	12.9	
t_{PZH}	$\overline{OE}$	A or B	4	7.9	10.7	4	14	4	13.2	ns
t_{PZL}			4.6	8.8	11.8	4.6	15.4	4.6	14.4	
t_{PHZ}	$\overline{OE}$	A or B	4	7.2	9.4	4	12	4	10.9	ns
t_{PLZ}			3.4	7	9.3	3.4	11.6	3.4	10.5	
t_{PZH}	DIR	A or B	2.8	7.8	10.7	2.8	14	2.8	13.1	ns
t_{PZL}			3.8	8.9	11.9	3.8	15.6	3.8	14.6	
t_{PHZ}	DIR	A or B	3.8	8.4	10.7	3.8	13.2	3.8	12.6	ns
t_{PLZ}			3.2	7.3	9.9	3.2	12.6	3.2	11.8	

† These parameters are measured with the internal output state of the storage register opposite that of the bus input.

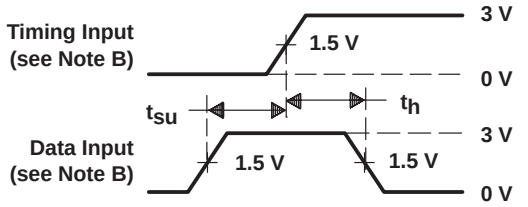
PARAMETER MEASUREMENT INFORMATION



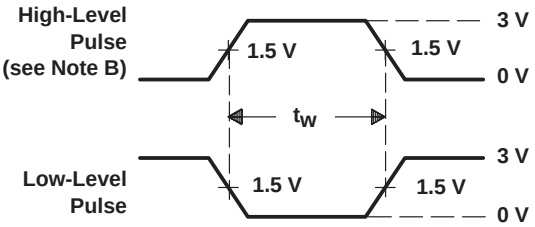
LOAD CIRCUIT FOR
3-STATE AND OPEN-COLLECTOR OUTPUTS



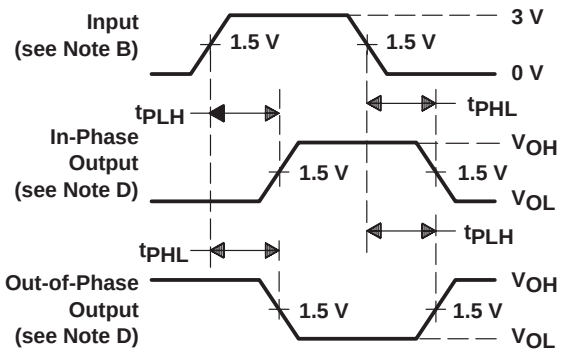
LOAD CIRCUIT FOR
TOTEM-POLE OUTPUTS



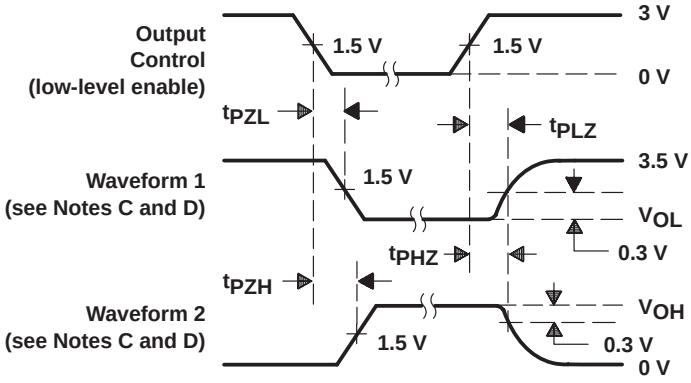
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES (see Note D)



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

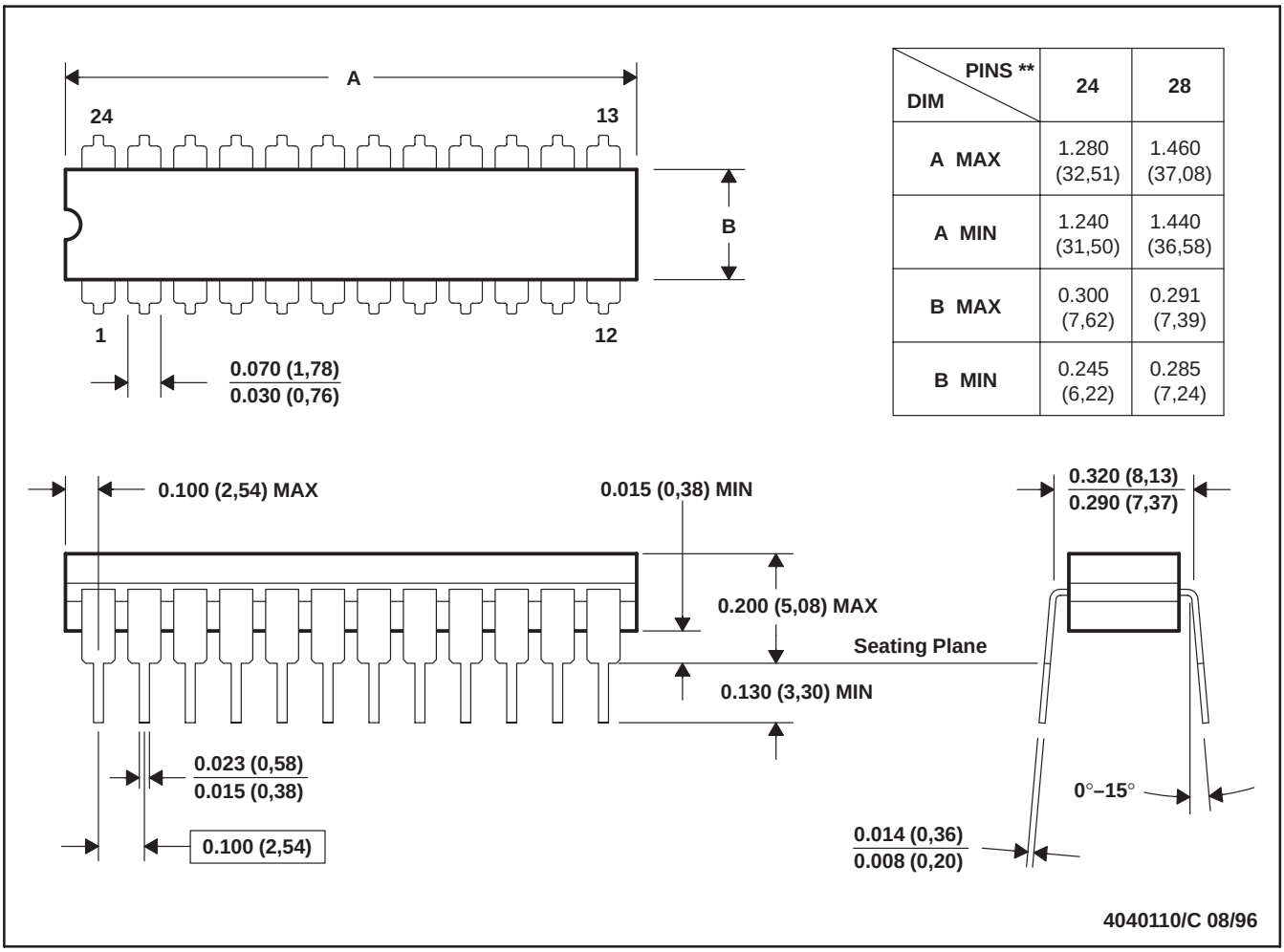
NOTES: A. C_L includes probe and jig capacitance.
B. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, $t_r = t_f \leq 2.5$ ns, duty cycle = 50%.
C. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by 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.
D. The outputs are measured one at a time, with one transition per measurement.
E. When measuring propagation delay times of 3-state outputs, switch S1 is open.
F. All parameters and waveforms are not applicable to all devices.

Figure 2. Load Circuit and Voltage Waveforms

MCER004A – JANUARY 1995 – REVISED JANUARY 1997

JT (R-GDIP-T)** **CERAMIC DUAL-IN-LINE**

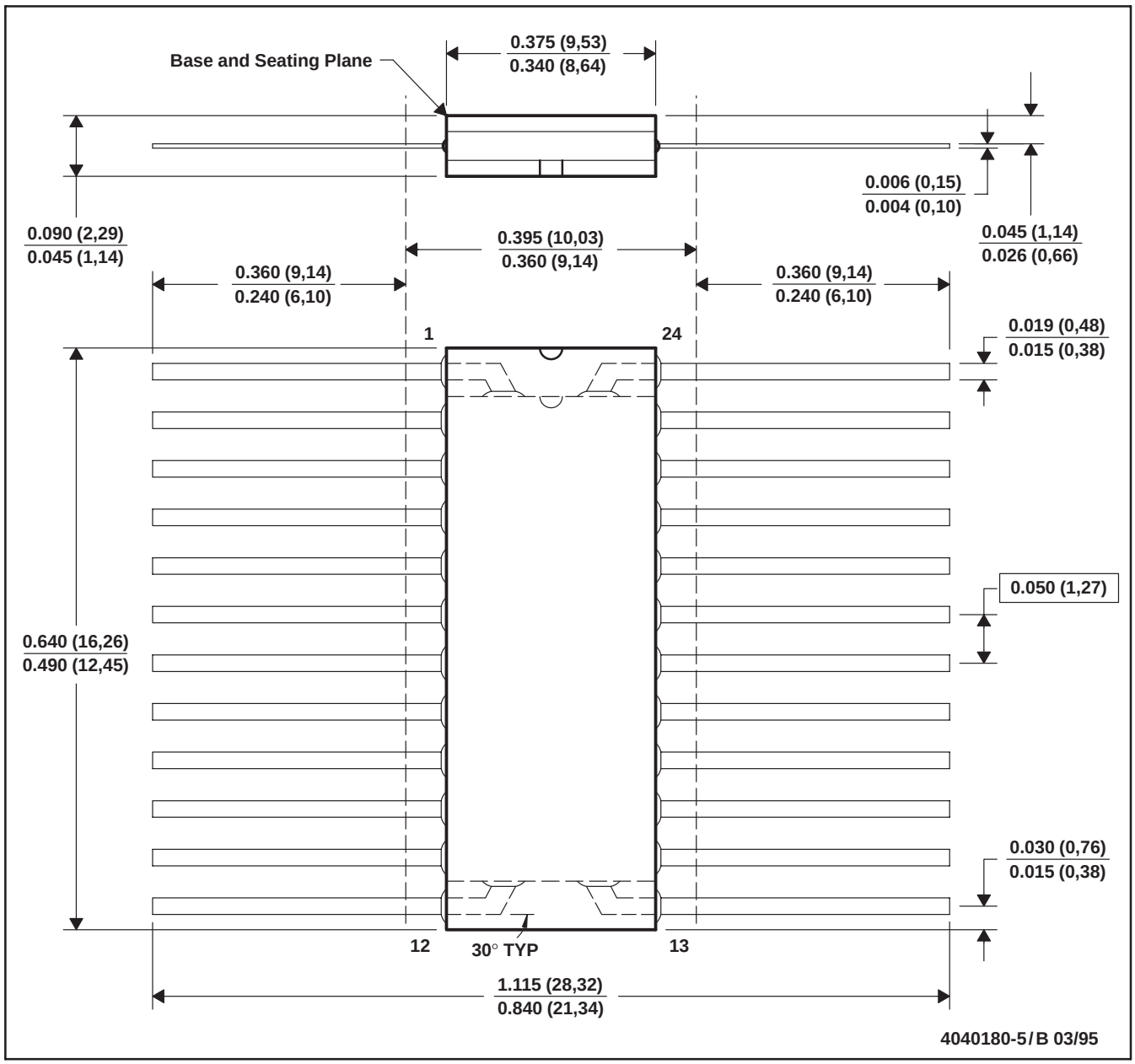
24 LEADS SHOWN



DIM \ PINS **	24	28
A MAX	1.280 (32,51)	1.460 (37,08)
A MIN	1.240 (31,50)	1.440 (36,58)
B MAX	0.300 (7,62)	0.291 (7,39)
B MIN	0.245 (6,22)	0.285 (7,24)

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification.
E. Falls within MIL STD 1835 GDIP3-T24, GDIP4-T28, and JEDEC MO-058 AA, MO-058 AB

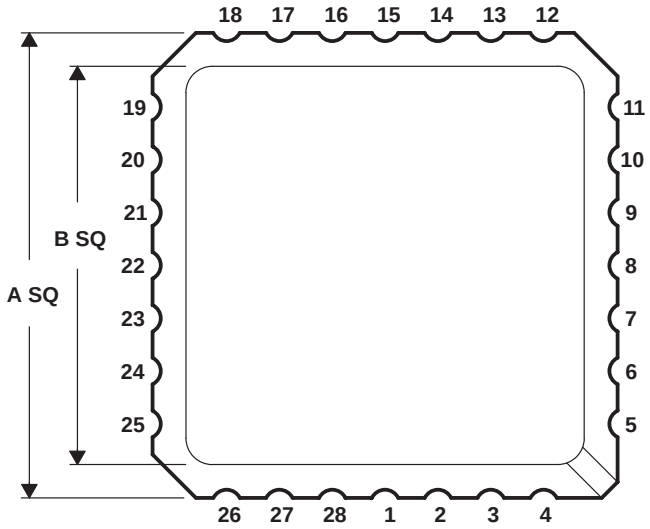
W (R-GDFP-F24) **CERAMIC DUAL FLATPACK**



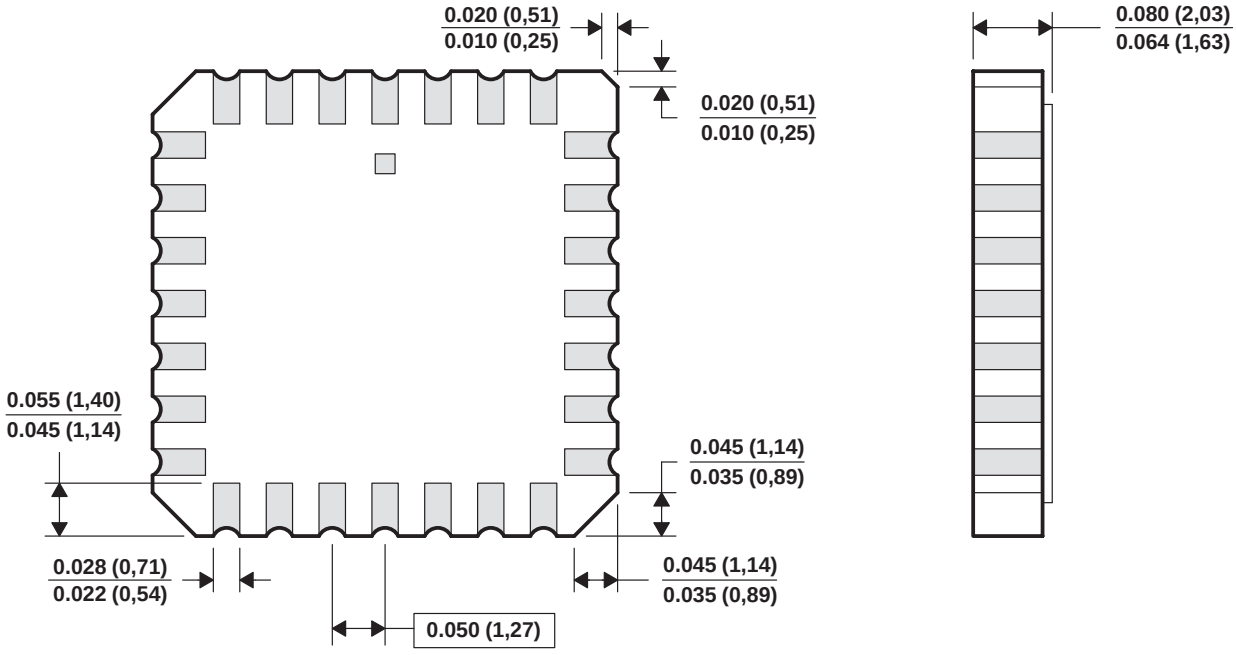
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Falls within MIL-STD-1835 GDFP2-F24 and JEDEC MO-070AD
E. Index point is provided on cap for terminal identification only.

FK (S-CQCC-N)** **LEADLESS CERAMIC CHIP CARRIER**

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.739 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)

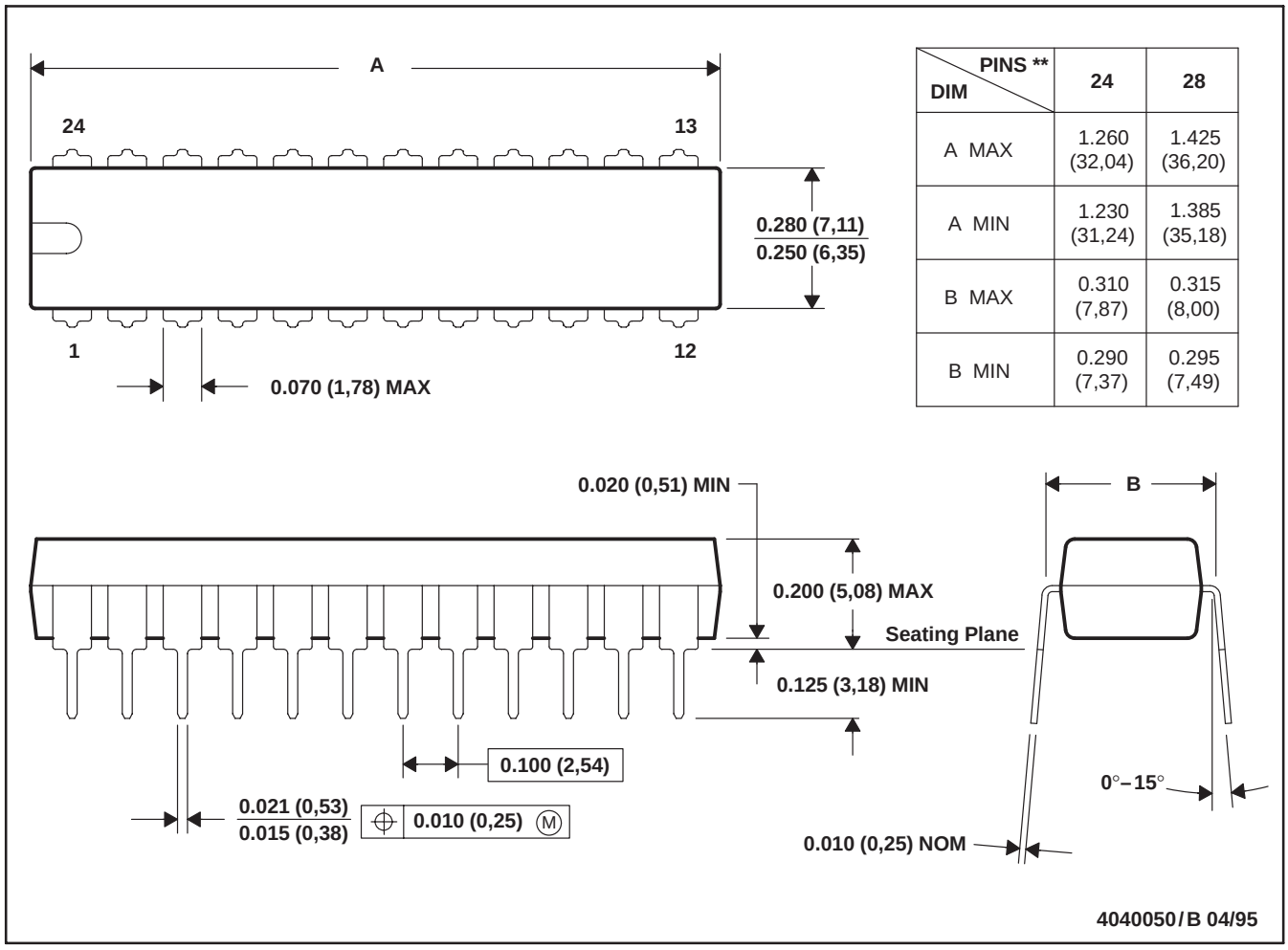


4040140/D 10/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. The terminals are gold plated.
E. Falls within JEDEC MS-004

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

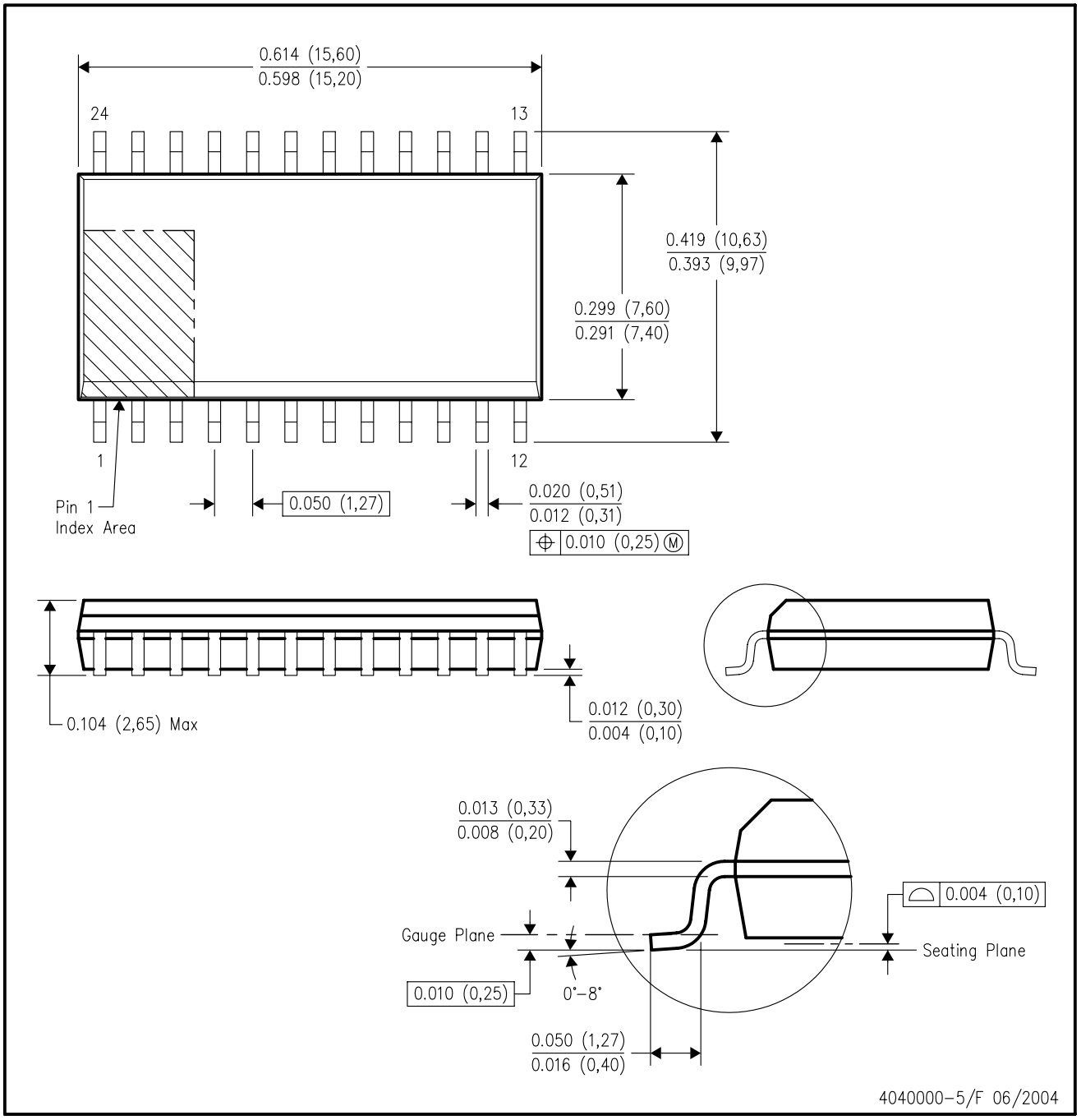
24 PINS SHOWN



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)

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.

DW (R–PDSO–G24) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
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.

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