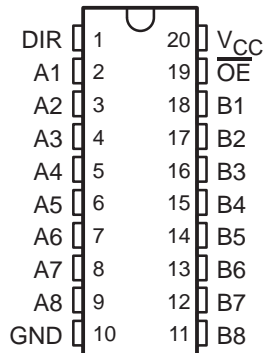


# SN74LVCR2245A OCTAL BUS TRANSCEIVER WITH 3-STATE OUTPUTS

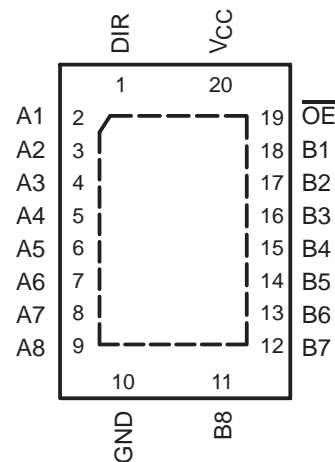
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- Operates From 1.65 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Max  $t_{pd}$  of 6.3 ns at 3.3 V
- All Outputs Have Equivalent 26- $\Omega$  Series Resistors, So No External Resistors Are Required
- Typical  $V_{OLP}$  (Output Ground Bounce) <0.8 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot) >2 V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- Supports Mixed-Mode Signal Operation on All Ports (5-V Input/Output Voltage With 3.3-V  $V_{CC}$ )
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 1000-V Charged-Device Model (C101)

DB, DBQ, DGV, DW, NS, OR PW PACKAGE  
(TOP VIEW)



RGY PACKAGE  
(TOP VIEW)



## description/ordering information

### ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING		
-40°C to 85°C	QFN – RGY	Reel of 1000	SN74LVCR2245ARGYR	LER245A		
	SOIC – DW	Tube of 25	SN74LVCR2245ADW	LVCR2245A		
		Reel of 2000	SN74LVCR2245ADWR			
	SOP – NS	Reel of 2000	SN74LVCR2245ANSR	LVCR2245A		
	SSOP – DB	Reel of 2000	SN74LVCR2245ADBR	LER245A		
	SSOP (QSOP) – DBQ	Reel of 2500	SN74LVCR2245ADBQR	LVCR2245A		
			TSSOP – PW	Tube of 70	SN74LVCR2245APW	LER245A
			Reel of 2000	SN74LVCR2245APWR		
	Reel of 250	SN74LVCR2245APWT				
	TVSOP – DGV	Reel of 2000	SN74LVCR2245ADGVR	LER245A		
VFBGA – GQN	Reel of 1000	SN74LVCR2245AGQNR	LER245A			
VFBGA – ZQN (Pb-free)		SN74LVCR2245AZQNR				

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



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# SN74LVCR2245A

## OCTAL BUS TRANSCEIVER

### WITH 3-STATE OUTPUTS

SCAS581M – NOVEMBER 1996 – REVISED SEPTEMBER 2003

#### description/ordering information (continued)

This octal bus transceiver is designed for 1.65-V to 3.6-V  $V_{CC}$  operation.

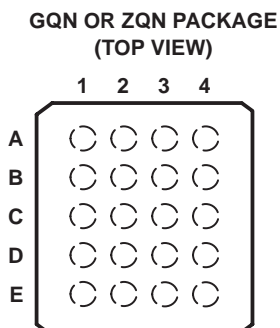
The SN74LVCR2245A is designed for asynchronous communication between data buses. The device transmits data from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so the buses are effectively isolated.

All outputs, which are designed to sink up to 12 mA, include equivalent 26- $\Omega$  resistors to reduce overshoot and undershoot.

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of this device as a translator in a mixed 3.3-V/5-V system environment.

This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

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.



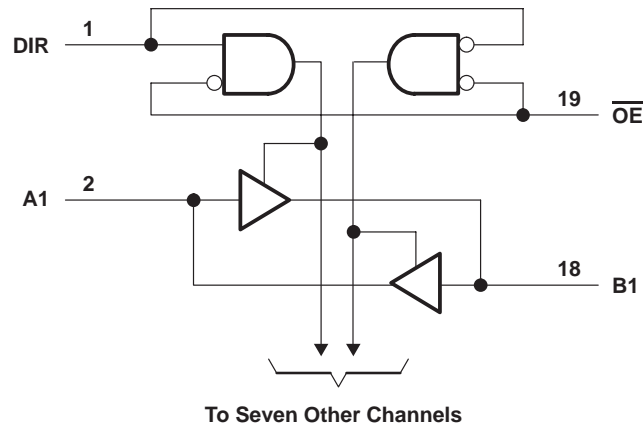
#### terminal assignments

	1	2	3	4
A	A1	DIR	$V_{CC}$	$\overline{OE}$
B	A3	B2	A2	B1
C	A5	A4	B4	B3
D	A7	B6	A6	B5
E	GND	A8	B8	B7

#### FUNCTION TABLE

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

**logic diagram (positive logic)**



Pin numbers shown are for the DB, DBQ, DGV, DW, NS, PW, and RGY packages.

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

Supply voltage range, $V_{CC}$ .....	-0.5 V to 6.5 V
Input voltage range, $V_I$ (see Note 1) .....	-0.5 V to 6.5 V
Voltage range applied to any output in the high-impedance or power-off state, $V_O$ (see Note 1) .....	-0.5 V to 6.5 V
Voltage range applied to any output in the high or low state, $V_O$ (see Notes 1 and 2) .....	-0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	-50 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	-50 mA
Continuous output current, $I_O$ .....	$\pm 50$ mA
Continuous current through $V_{CC}$ or GND .....	$\pm 100$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 3): DB package .....	70°C/W
(see Note 3): DBQ package .....	68°C/W
(see Note 3): DGV package .....	92°C/W
(see Note 3): DW package .....	58°C/W
(see Note 3): GQN/ZQN package .....	78°C/W
(see Note 3): NS package .....	60°C/W
(see Note 3): PW package .....	83°C/W
(see Note 4): RGY package .....	37°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 negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The value of  $V_{CC}$  is provided in the recommended operating conditions table.  
3. The package thermal impedance is calculated in accordance with JESD 51-7.  
4. The package thermal impedance is calculated in accordance with JESD 51-5.

**SN74LVCR2245A**  
**OCTAL BUS TRANSCEIVER**  
**WITH 3-STATE OUTPUTS**

SCAS581M – NOVEMBER 1996 – REVISED SEPTEMBER 2003

**recommended operating conditions (see Note 5)**

		MIN	MAX	UNIT	
V <sub>CC</sub>	Supply voltage	Operating	1.65	3.6	V
		Data retention only	1.5		
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 × V <sub>CC</sub>		V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7		
		V <sub>CC</sub> = 2.7 V to 3.6 V	2		
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 1.65 V to 1.95 V	0.35 × V <sub>CC</sub>		V
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.7		
		V <sub>CC</sub> = 2.7 V to 3.6 V	0.8		
V <sub>I</sub>	Input voltage	0	5.5	V	
V <sub>O</sub>	Output voltage	High or low state	0	V <sub>CC</sub>	V
		3-state	0	5.5	
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 1.65 V	-2		mA
		V <sub>CC</sub> = 2.3 V	-4		
		V <sub>CC</sub> = 2.7 V	-8		
		V <sub>CC</sub> = 3 V	-12		
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 1.65 V	2		mA
		V <sub>CC</sub> = 2.3 V	4		
		V <sub>CC</sub> = 2.7 V	8		
		V <sub>CC</sub> = 3 V	12		
Δt/Δv	Input transition rise or fall rate		10	ns/V	
T <sub>A</sub>	Operating free-air temperature	-40	85	°C	

NOTE 5: 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.



# SN74LVCR2245A OCTAL BUS TRANSCEIVER WITH 3-STATE OUTPUTS

SCAS581M – NOVEMBER 1996 – REVISED SEPTEMBER 2003

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

PARAMETER			V <sub>CC</sub>	MIN	TYP†	MAX	UNIT	
V <sub>OH</sub>		I <sub>OH</sub> = -100 μA	1.65 V to 3.6 V	V <sub>CC</sub> -0.2			V	
		I <sub>OH</sub> = -2 mA	1.65 V	1.2				
		I <sub>OH</sub> = -4 mA	2.3 V	1.7				
			2.7 V	2.2				
		I <sub>OH</sub> = -6 mA	3 V	2.4				
		I <sub>OH</sub> = -8 mA	2.7 V	2				
	I <sub>OH</sub> = -12 mA	3 V	2					
V <sub>OL</sub>		I <sub>OL</sub> = 100 μA	1.65 V to 3.6 V			0.2	V	
		I <sub>OL</sub> = 2 mA	1.65 V			0.45		
		I <sub>OL</sub> = 4 mA	2.3 V			0.7		
			2.7 V			0.4		
		I <sub>OL</sub> = 6 mA	3 V			0.55		
		I <sub>OL</sub> = 8 mA	2.7 V			0.6		
	I <sub>OL</sub> = 12 mA	3 V			0.8			
I <sub>I</sub>	Control inputs	V <sub>I</sub> = 0 to 5.5 V	3.6 V			±5	μA	
I <sub>off</sub>		V <sub>I</sub> or V <sub>O</sub> = 5.5 V	0			±10	μA	
I <sub>OZ</sub> ‡		V <sub>O</sub> = 0 to 5.5 V	3.6 V			±10	μA	
I <sub>CC</sub>		V <sub>I</sub> = V <sub>CC</sub> or GND	3.6 V	I <sub>O</sub> = 0			10	μA
		3.6 V ≤ V <sub>I</sub> ≤ 5.5 V§					10	
ΔI <sub>CC</sub>		One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND	2.7 V to 3.6 V			500	μA	
C <sub>i</sub>	Control inputs	V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V			4	pF	
C <sub>io</sub>	A or B ports	V <sub>O</sub> = V <sub>CC</sub> or GND	3.3 V			5.5	pF	

† All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

‡ For I/O ports, the parameter I<sub>OZ</sub> includes the input leakage current.

§ This applies in the disabled state only.

**switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 1.8 V ± 0.15 V		V <sub>CC</sub> = 2.5 V ± 0.2 V		V <sub>CC</sub> = 2.7 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	A or B	B or A	¶	¶	¶	¶	7.3		1.5	6.3	ns
t <sub>en</sub>	$\overline{\text{OE}}$	A or B	¶	¶	¶	¶	9.5		1.5	8.2	ns
t <sub>dis</sub>	$\overline{\text{OE}}$	A or B	¶	¶	¶	¶	8.5		1.7	7.8	ns
t <sub>sk(o)</sub>									1		ns

¶ This information was not available at the time of publication.

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

PARAMETER		TEST CONDITIONS	V <sub>CC</sub> = 1.8 V	V <sub>CC</sub> = 2.5 V	V <sub>CC</sub> = 3.3 V	UNIT
			TYP	TYP	TYP	
C <sub>pd</sub>	Power dissipation capacitance per transceiver	Outputs enabled	¶	¶	48	pF
		Outputs disabled	¶	¶	4	

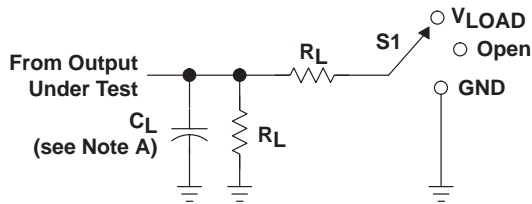
¶ This information was not available at the time of publication.



# SN74LVCR2245A OCTAL BUS TRANSCEIVER WITH 3-STATE OUTPUTS

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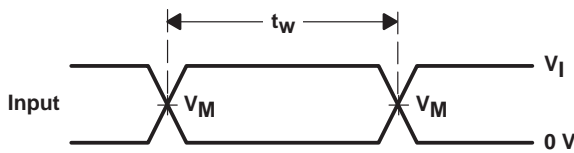
## PARAMETER MEASUREMENT INFORMATION



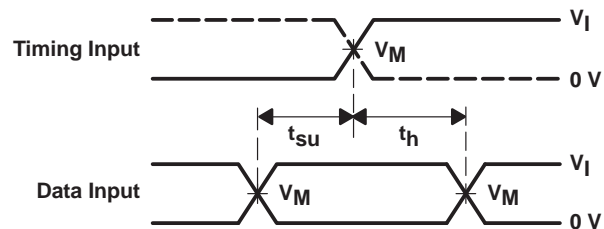
LOAD CIRCUIT

TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$V_{LOAD}$
$t_{PHZ}/t_{PZH}$	$GND$

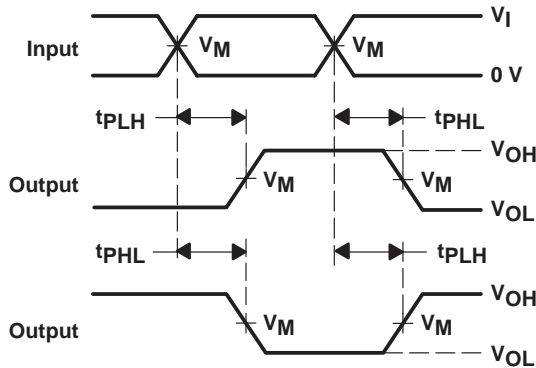
$V_{CC}$	INPUTS		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
$1.8 V \pm 0.15 V$	$V_{CC}$	$\leq 2 \text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k $\Omega$	0.15 V
$2.5 V \pm 0.2 V$	$V_{CC}$	$\leq 2 \text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 $\Omega$	0.15 V
2.7 V	2.7 V	$\leq 2.5 \text{ ns}$	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V
$3.3 V \pm 0.3 V$	2.7 V	$\leq 2.5 \text{ ns}$	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V



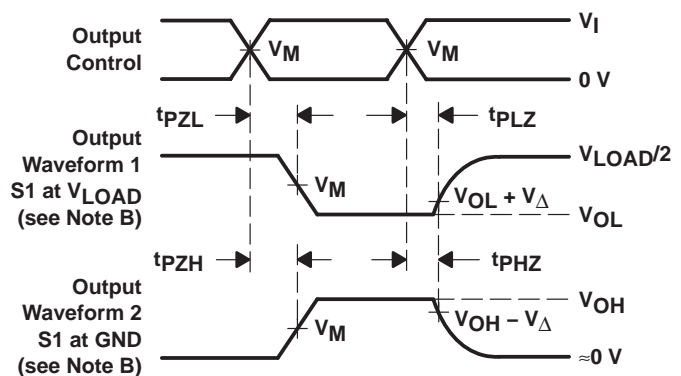
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



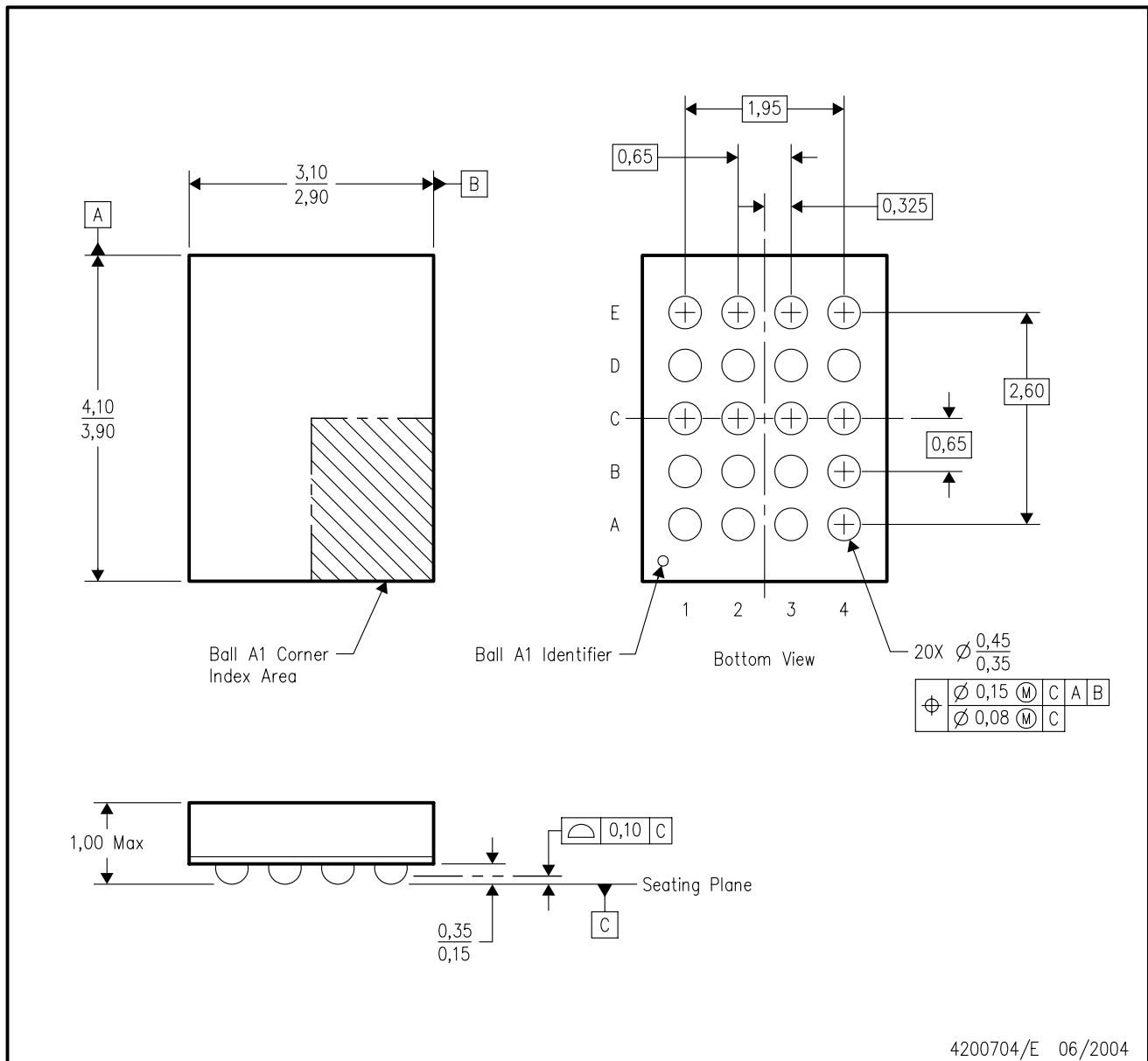
VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- NOTES:
- $C_L$  includes probe and jig capacitance.
  - 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.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ .
  - The outputs are measured one at a time with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

GQN (R-PBGA-N20)

PLASTIC BALL GRID ARRAY

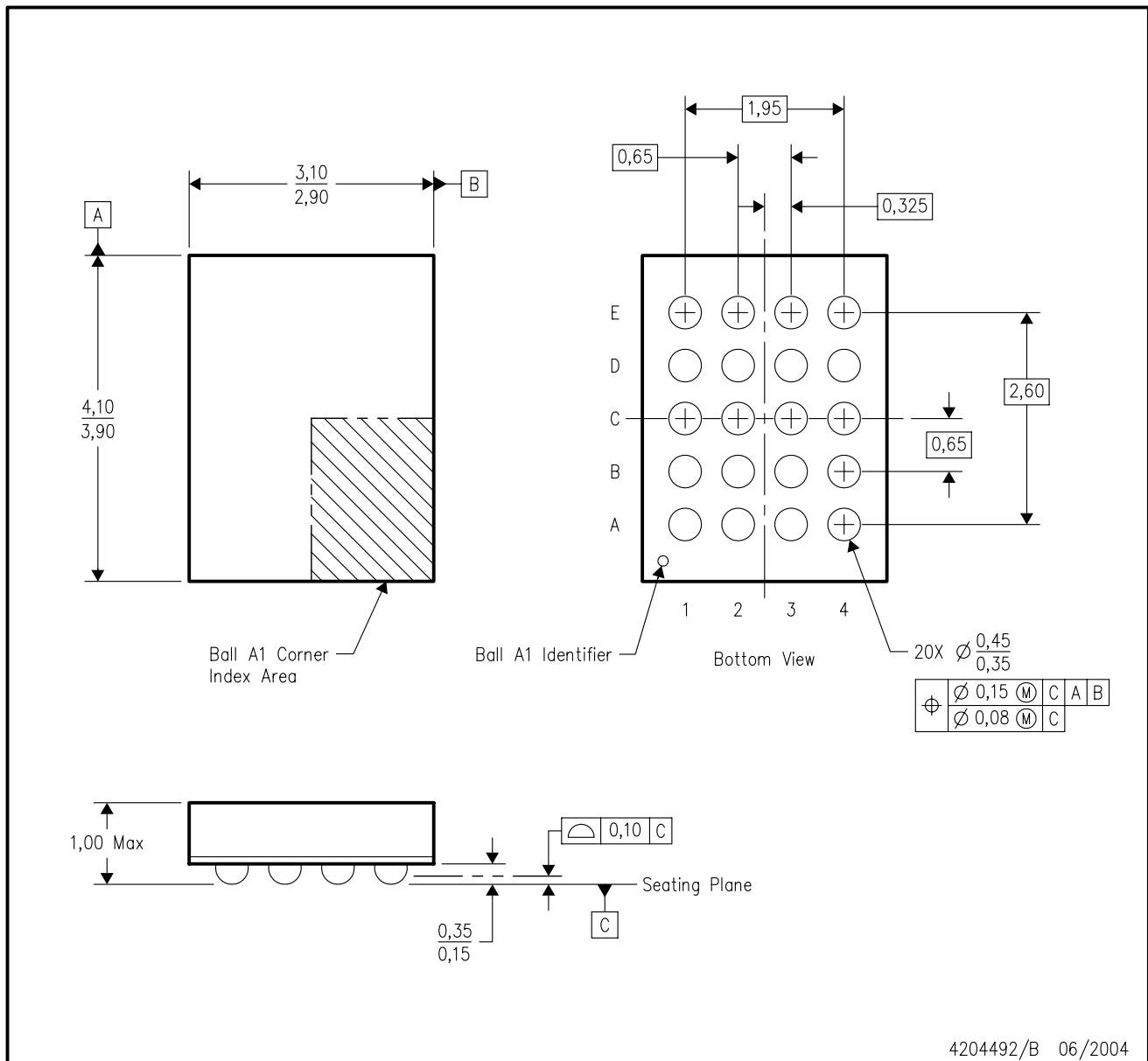


4200704/E 06/2004

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MO-225 variation BC.
  - D. This package is tin-lead (SnPb). Refer to the 20 ZQN package (drawing 4204492) for lead-free.

ZQN (R-PBGA-N20)

PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MO-225 variation BC.
  - D. This package is lead-free. Refer to the 20 GQN package (drawing 4200704) for tin-lead (SnPb).

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

PLASTIC SMALL-OUTLINE

24 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 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

DW (R-PDSO-G20)

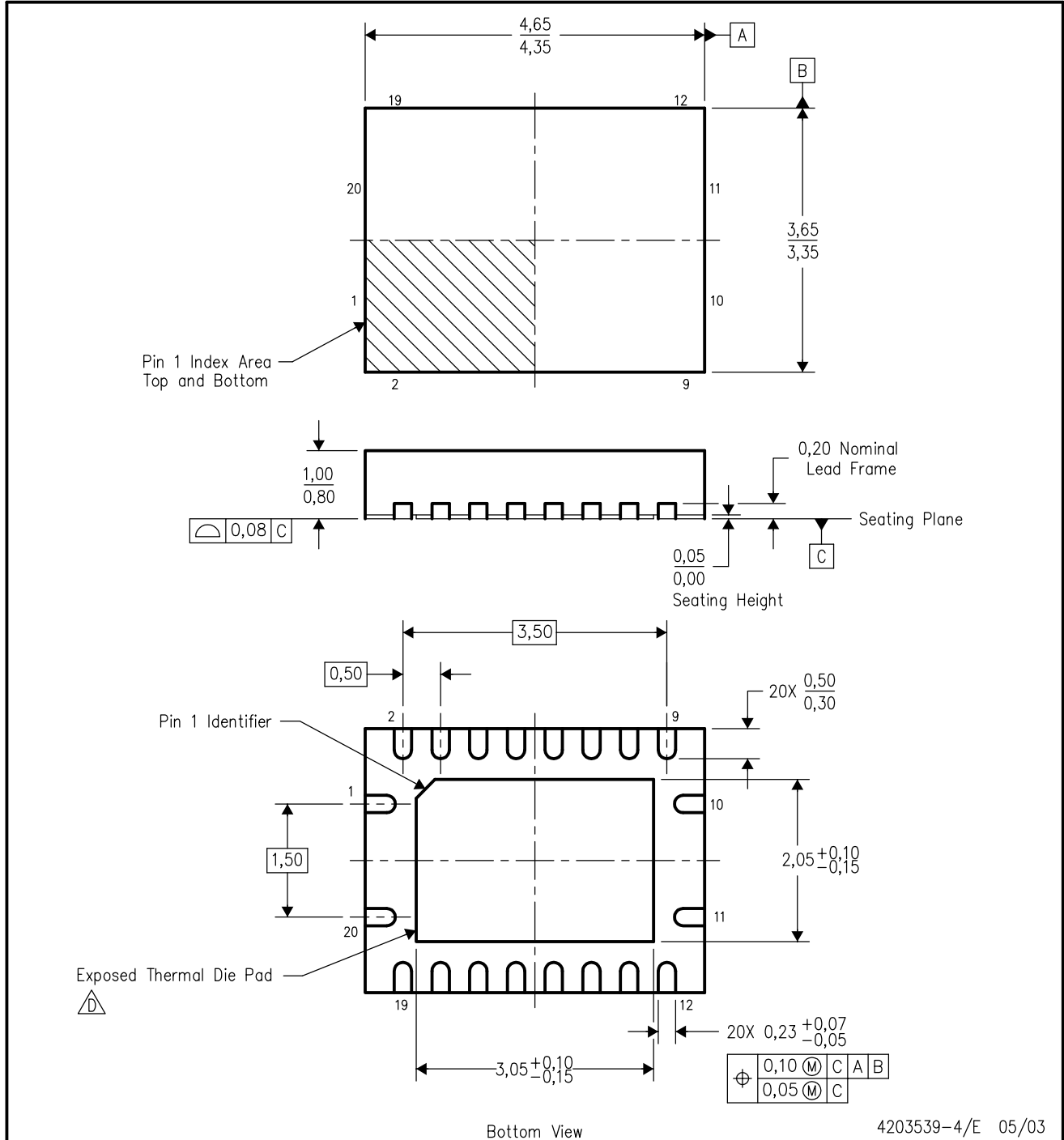
PLASTIC SMALL-OUTLINE PACKAGE



- 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 AC.

RGY (R-PQFP-N20)

PLASTIC QUAD FLATPACK



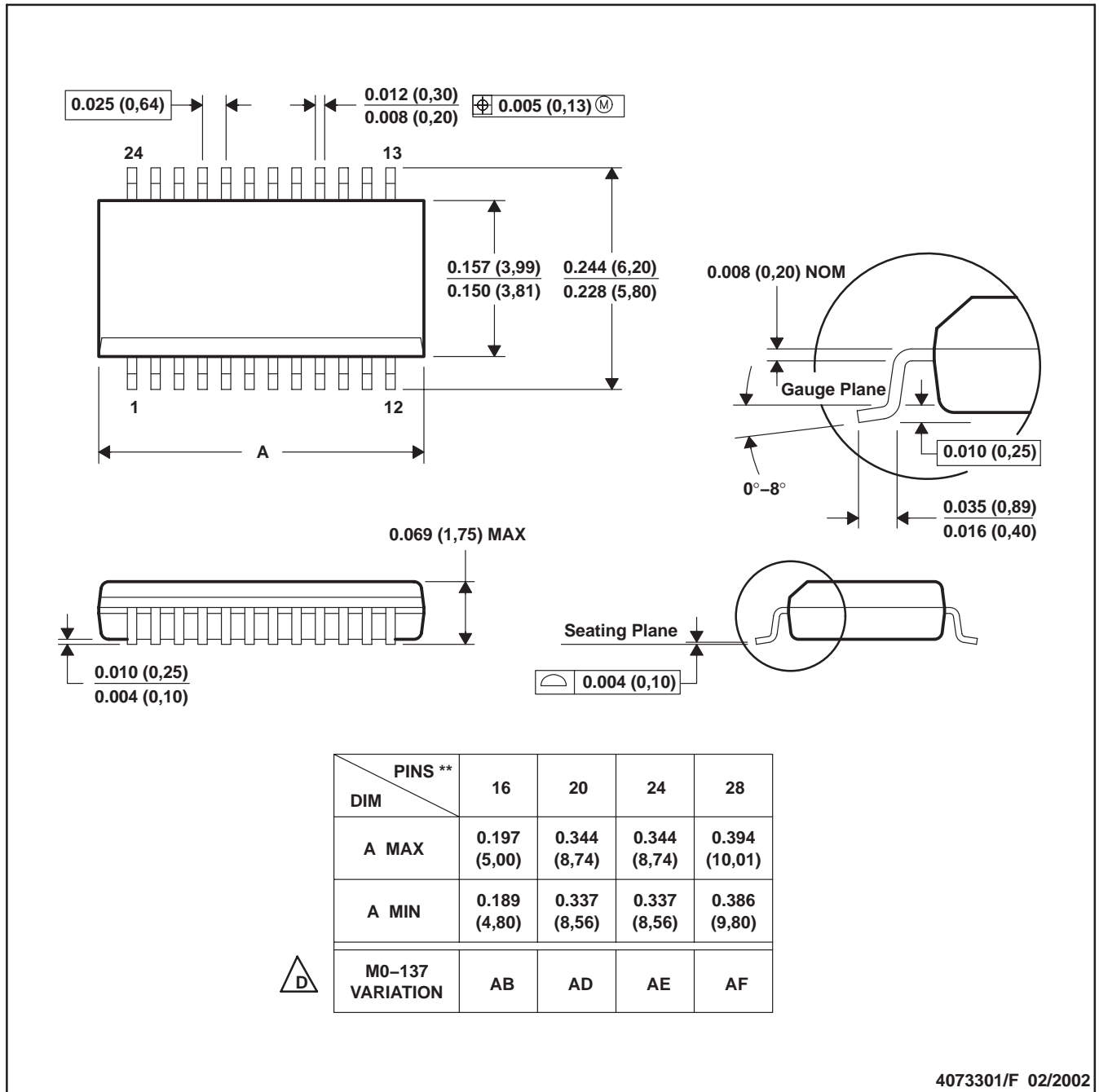
Bottom View

4203539-4/E 05/03

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. QFN (Quad Flatpack No-Lead) package configuration.
  - D. The package thermal performance may be enhanced by bonding the thermal die pad to an external thermal plane. This pad is electrically and thermally connected to the backside of the die and possibly selected ground leads.
  - E. Package complies to JEDEC MO-241 variation BC.

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

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 MO-137.

# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-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.

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

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

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- 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-153

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