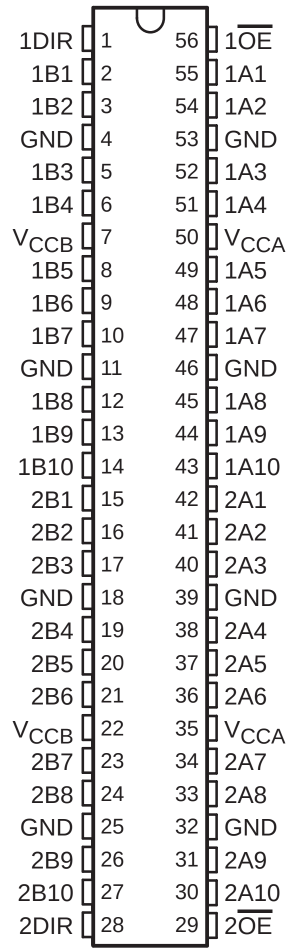
- **Control Inputs V_{IH}/V_{IL} Levels are Referenced to V_{CCA} Voltage**
- **V_{CC} Isolation Feature − If Either V_{CC} Input Is at GND, Both Ports Are in the High-Impedance State**
- **Overvoltage-Tolerant Inputs/Outputs Allow Mixed-Voltage-Mode Data Communications**
- **Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.4-V to 3.6-V Power-Supply Range**
- **I_{off} Supports Partial-Power-Down Mode Operation**
- **I/Os Are 4.6-V Tolerant**

DGG OR DGV PACKAGE
(TOP VIEW)



description/ordering information

This 20-bit noninverting bus transceiver uses two separate configurable power-supply rails. The A-port is designed to track V_{CCA}. V_{CCA} accepts any supply voltage from 1.4 V to 3.6 V. The B-port is designed to track V_{CCB}. V_{CCB} accepts any supply voltage from 1.4 V to 3.6 V. This allows universal low-voltage bidirectional translation between any of the 1.5-V, 1.8-V, 2.5-V, and 3.3-V voltage nodes.

The SN74AVC20T245 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 outputs so the buses are effectively isolated.

The SN74AVC20T245 is designed so that the control (1DIR, 2DIR, 1$\overline{OE}$, and 2$\overline{OE}$) inputs are supplied by V_{CCA}.

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.

The V_{CC} isolation feature ensures that if either V_{CC} input is at GND, both ports are in the high-impedance state.

PRODUCT PREVIEW

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	TSSOP − DGG	Tape and reel	SN74AVC20T245DGGR	TBD
	TVSOP − DGV	Tape and reel	SN74AVC20T245DGVR	TBD
	VFBGA − GQL	Tape and reel	SN74AVC20T245GQLR	TBD

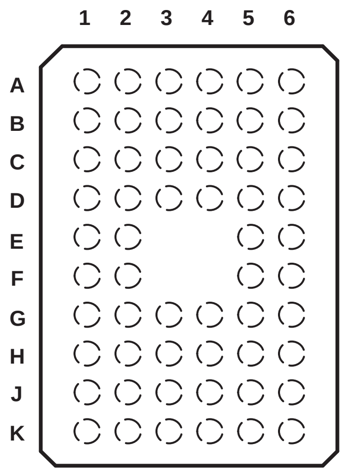
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

PRODUCT PREVIEW

description/ordering information (continued)

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.

GQL PACKAGE
(TOP VIEW)



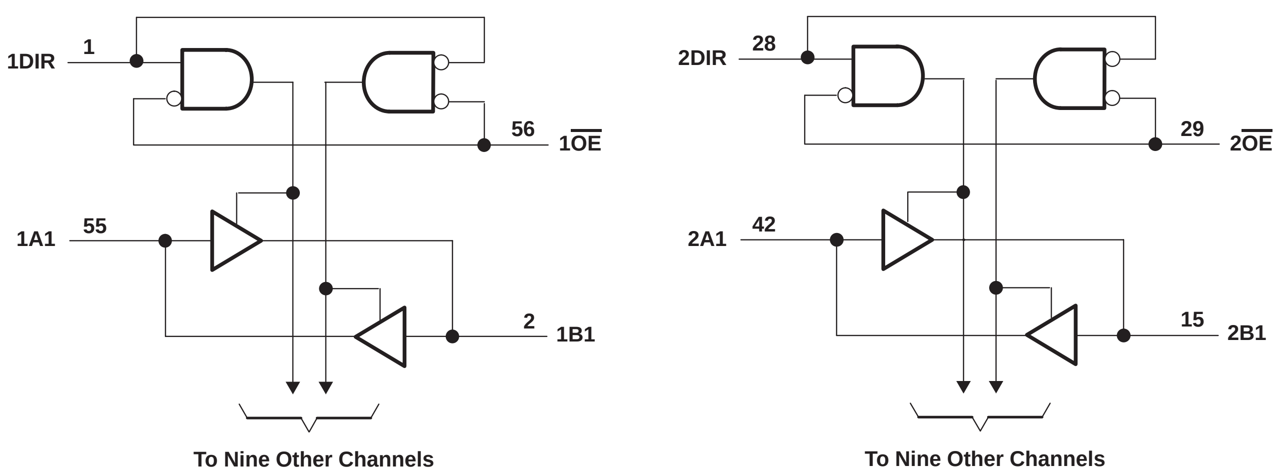
terminal assignments

	1	2	3	4	5	6
A	1B1	1B2	1DIR	1$\overline{OE}$	1A2	1A1
B	1B3	1B4	GND	GND	1A4	1A3
C	1B5	1B6	V_{CCB}	V_{CCA}	1A6	1A5
D	1B7	1B8	GND	GND	1A8	1A7
E	1B9	1B10			1A10	1A9
F	2B1	2B2			2A2	2A1
G	2B3	2B4	GND	GND	2A4	2A3
H	2B5	2B6	V_{CCB}	V_{CCA}	2A6	2A5
J	2B7	2B8	GND	GND	2A8	2A7
K	2B9	2B10	2DIR	2$\overline{OE}$	2A10	2A9

FUNCTION TABLE
(each 10-bit section)

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 DGG and DGV packages.

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

Supply voltage range, V_{CCA} and V_{CCB} . . . . . −0.5 V to 4.6 V
Input voltage range, V_I (see Note 1): I/O ports (A port) . . . . . −0.5 V to 4.6 V
I/O ports (B port) . . . . . −0.5 V to 4.6 V
Control inputs . . . . . −0.5 V to 4.6 V
Voltage range applied to any output in the high-impedance or power-off state, V_O
(see Note 1): A port . . . . . −0.5 V to 4.6 V
B port . . . . . −0.5 V to 4.6 V
Voltage range applied to any output in the high or low state, V_O
(see Notes 1 and 2): A port . . . . . −0.5 V to V_{CCA} + 0.5 V
B port . . . . . −0.5 V to V_{CCB} + 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 . . . . . ±50 mA
Continuous current through each V_{CCA}, V_{CCB}, and GND . . . . . ±100 mA
Package thermal impedance, θ_{JA} (see Note 3): DGG package . . . . . 64°C/W
DGV package . . . . . 48°C/W
GQL package . . . . . 42°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 voltage and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
2. The output positive-voltage rating may be exceeded up to 4.6 V maximum if the output current rating is observed.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

PRODUCT PREVIEW

PRODUCT PREVIEW

recommended operating conditions (see Notes 4 through 6)

			V_{CCI}	V_{CCO}	MIN	MAX	UNIT
V_{CCA}	Supply voltage				1.4	3.6	V
V_{CCB}	Supply voltage				1.4	3.6	V
V_{IH}	High-level input voltage	Data inputs	1.4 V to 1.95 V		$V_{CCI} \times 0.65$		V
			1.95 V to 2.7 V		1.6		
			2.7 V to 3.6 V		2		
V_{IL}	Low-level input voltage	Data inputs	1.4 V to 1.95 V			$V_{CCI} \times 0.35$	V
			1.95 V to 2.7 V			0.7	
			2.7 V to 3.6 V			0.8	
V_{IH}	High-level input voltage	DIR and $\overline{OE}$ (Referenced to V_{CCA})	1.4 V to 1.95 V		$V_{CCA} \times 0.65$		V
			1.95 V to 2.7 V		1.6		
			2.7 V to 3.6 V		2		
V_{IL}	Low-level input voltage	DIR and $\overline{OE}$ (Referenced to V_{CCA})	1.4 V to 1.95 V			$V_{CCA} \times 0.35$	V
			1.95 V to 2.7 V			0.7	
			2.7 V to 3.6 V			0.8	
V_O	Output voltage	Active state			0	V_{CCO}	V
		3-state			0	3.6	
V_I	Input voltage				0	3.6	V
I_{OH}	High-level output current			1.4 V to 1.6 V		−6	mA
				1.65 V to 1.95 V		−8	
				2.3 V to 2.7 V		−9	
				3 V to 3.6 V		−12	
I_{OL}	Low-level output current			1.4 V to 1.6 V		6	mA
				1.65 V to 1.95 V		8	
				2.3 V to 2.7 V		9	
				3 V to 3.6 V		12	
$\Delta t/\Delta v$	Input transition rise or fall rate					5	ns/V
T_A	Operating free-air temperature				−40	85	°C

NOTES: 4. V_{CCI} is the V_{CC} associated with the data input port.
5. V_{CCO} is the V_{CC} associated with the output port.
6. All unused data inputs of the device must be held at V_{CCI} 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) (see Notes 7 and 8)

PARAMETER		TEST CONDITIONS		V_{CCA}	V_{CCB}	MIN	TYP†	MAX	UNIT
V_{OH}		I_{OH} = −100 µA	$V_I = V_{IH}$	1.4 V to 3.6 V	1.4 V to 3.6 V	V_{CCO}−0.2			V
		I_{OH} = −6 mA	$V_I = V_{IH}$	1.4 V	1.4 V	TBD			
		I_{OH} = −8 mA	$V_I = V_{IH}$	1.65 V	1.65 V	1.2			
		I_{OH} = −9 mA	$V_I = V_{IH}$	2.3 V	2.3 V	1.75			
		I_{OH} = −12 mA	$V_I = V_{IH}$	3 V	3 V	2.3			
V_{OL}		I_{OL} = 100 µA	$V_I = V_{IL}$	1.4 V to 3.6 V	1.4 V to 3.6 V			0.2	V
		I_{OL} = 6 mA	$V_I = V_{IL}$	1.4 V	1.4 V			0.35	
		I_{OL} = 8 mA	$V_I = V_{IL}$	1.65 V	1.65 V			0.45	
		I_{OL} = 9 mA	$V_I = V_{IL}$	2.3 V	2.3 V			0.55	
		I_{OL} = 12 mA	$V_I = V_{IL}$	3 V	3 V			0.7	
I_I	Control inputs	$V_I = V_{CCA}$ or GND		1.4 V to 3.6 V	3.6 V			±2.5	µA
I_{off}	A port	V_I or V_O= 0 to 3.6 V		0 V	0 to 3.6 V			±10	µA
	B port			0 to 3.6 V	0 V			±10	
I_{OZ}‡	A or B ports	$V_O = V_{CCO}$ or GND, $V_I = V_{CCI}$ or GND	$\overline{OE} = V_{IH}$	3.6 V	3.6 V		±2.5	±5	µA
	B port		$\overline{OE}$ = don't care	0 V	3.6 V		±2.5	±5	
	A port			3.6 V	0 V		±2.5	±5	
I_{CCA}		$V_I = V_{CCI}$ or GND,	$I_O = 0$	1.6 V	1.6 V			8	µA
				1.95 V	1.95 V			9	
				2.7 V	2.7 V			13	
				0 V	3.6 V			−1	
				3.6 V	0 V			12	
				3.6 V	3.6 V			20	
I_{CCB}		$V_I = V_{CCI}$ or GND,	$I_O = 0$	1.6 V	1.6 V			8	µA
				1.95 V	1.95 V			9	
				2.7 V	2.7 V			13	
				0 V	3.6 V			12	
				3.6 V	0 V			−1	
				3.6 V	3.6 V			20	
$I_{CCA} + I_{CCB}$ (see Table 1)		$V_I = V_{CCI}$ or GND,	$I_O = 0$	1.4 V to 3.6 V	1.4 V to 3.6 V			TBD	µA
C_i	Control inputs	V_I = 3.3 V or GND		3.3 V	3.3 V				pF
C_{io}	A or B ports	V_O = 3.3 V or GND		3.3 V	3.3 V				pF

† All typical values are at T_A = 25°C.
‡ For I/O ports, the parameter I_{OZ} includes the input leakage current.
NOTES: 7. V_{CCO} is the V_{CC} associated with the output port.
8. V_{CCI} is the V_{CC} associated with the input port.

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switching characteristics over recommended operating free-air temperature range, V_{CCA} = 1.5 V ± 0.1 V (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B									ns
t_{PHL}											
t_{PLH}	B	A									ns
t_{PHL}											
t_{PZH}	$\overline{OE}$	A									ns
t_{PZL}											
t_{PZH}	$\overline{OE}$	B									ns
t_{PZL}											
t_{PHZ}	$\overline{OE}$	A									ns
t_{PLZ}											
t_{PHZ}	$\overline{OE}$	B									ns
t_{PLZ}											

switching characteristics over recommended operating free-air temperature range, V_{CCA} = 1.8 V ± 0.15 V (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B									ns
t_{PHL}											
t_{PLH}	B	A									ns
t_{PHL}											
t_{PZH}	$\overline{OE}$	A									ns
t_{PZL}											
t_{PZH}	$\overline{OE}$	B									ns
t_{PZL}											
t_{PHZ}	$\overline{OE}$	A									ns
t_{PLZ}											
t_{PHZ}	$\overline{OE}$	B									ns
t_{PLZ}											

switching characteristics over recommended operating free-air temperature range, V_{CCA} = 2.5 V ± 0.2 V (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B									ns
t_{PHL}											
t_{PLH}	B	A									ns
t_{PHL}											
t_{PZH}	$\overline{OE}$	A									ns
t_{PZL}											
t_{PZH}	$\overline{OE}$	B									ns
t_{PZL}											
t_{PHZ}	$\overline{OE}$	A									ns
t_{PLZ}											
t_{PHZ}	$\overline{OE}$	B									ns
t_{PLZ}											

switching characteristics over recommended operating free-air temperature range, V_{CCA} = 3.3 V ± 0.3 V (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	B									ns
t_{PHL}											
t_{PLH}	B	A									ns
t_{PHL}											
t_{PZH}	$\overline{OE}$	A									ns
t_{PZL}											
t_{PZH}	$\overline{OE}$	B									ns
t_{PZL}											
t_{PHZ}	$\overline{OE}$	A									ns
t_{PLZ}											
t_{PHZ}	$\overline{OE}$	B									ns
t_{PLZ}											

PRODUCT PREVIEW

operating characteristics, V_{CCA} and V_{CCB} = 3.3 V, T_A = 25°C

PARAMETER			TEST CONDITIONS	TYP	UNIT
C_{pdA}	Power dissipation capacitance per transceiver, A port input, B port output	Outputs enabled	C_L = 0, f = 10 MHz		pF
		Outputs disabled			
	Power dissipation capacitance per transceiver, B port input, A port output	Outputs enabled			
		Outputs disabled			
C_{pdB}	Power dissipation capacitance per transceiver, A port input, B port output	Outputs enabled	C_L = 0, f = 10 MHz		pF
		Outputs disabled			
	Power dissipation capacitance per transceiver, B port input, A port output	Outputs enabled			
		Outputs disabled			

typical total static power consumption (I_{CCA} and I_{CCB})

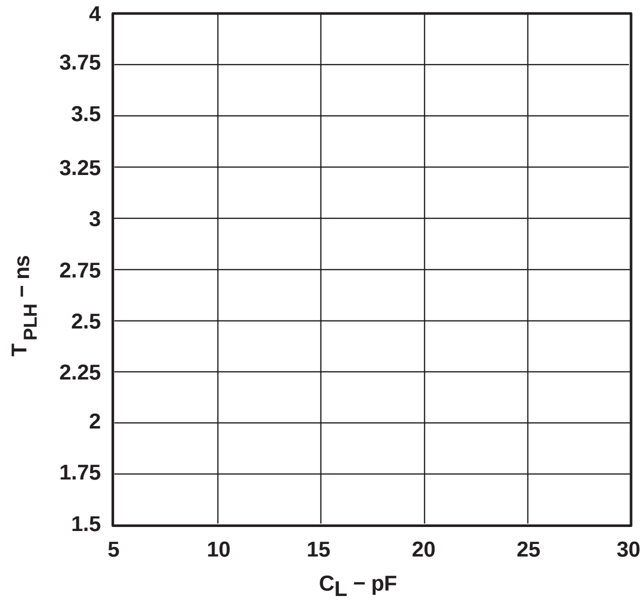
V_{CCB}	V_{CCA}				UNIT
	1.5 V	**1.8 V**	**2.5 V**	**3.3 V**	
1.5 V	TBD	TBD	TBD	TBD	nA
1.8 V	TBD	TBD	TBD	TBD	
2.5 V	TBD	TBD	TBD	TBD	
3.3 V	TBD	TBD	TBD	TBD	

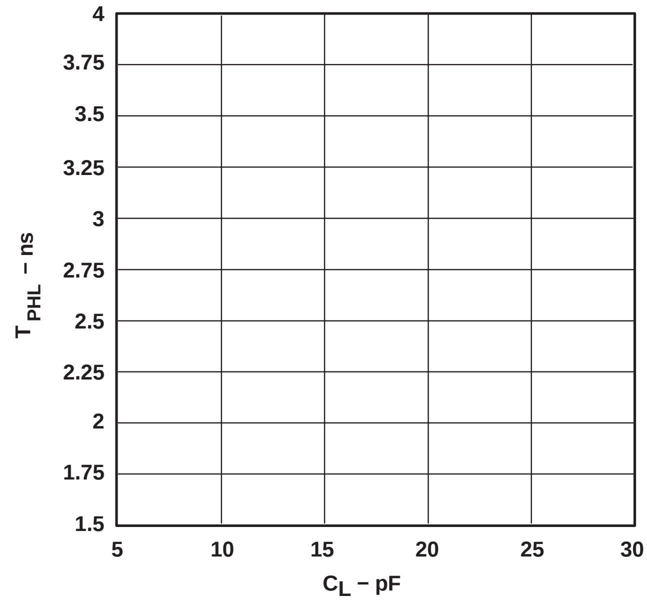
TABLE 1

PRODUCT PREVIEW

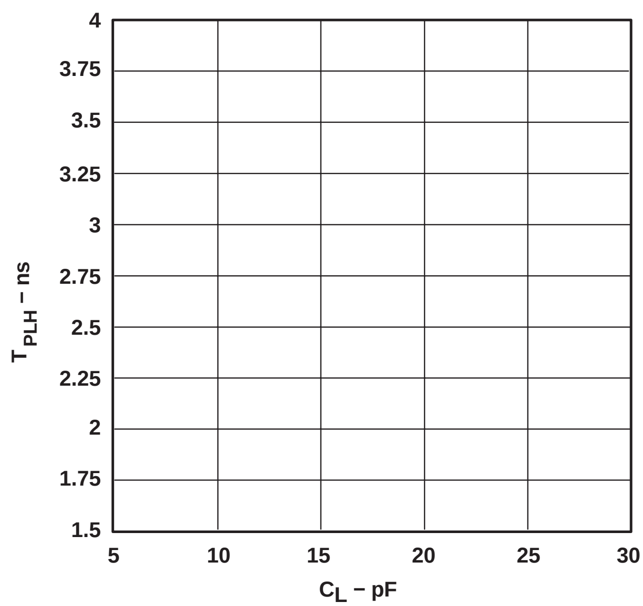
TYPICAL CHARACTERISTICS

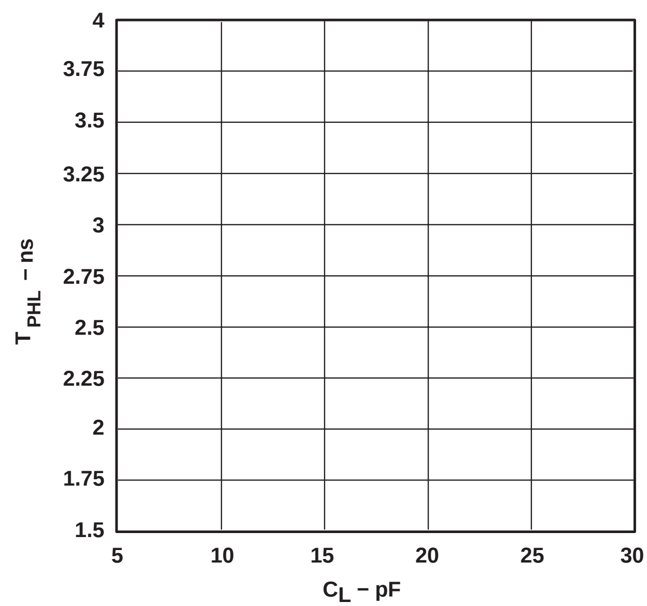
TYPICAL PROPAGATION DELAY vs LOAD CAPACITANCE, T_A = 25°C, V_{CCA} = 1.5 V ±0.1 V





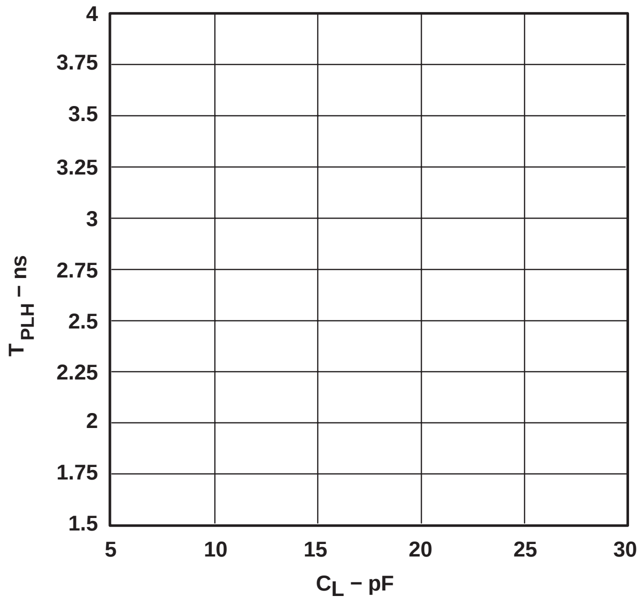
TYPICAL PROPAGATION DELAY vs LOAD CAPACITANCE, T_A = 25°C, V_{CCA} = 1.8 V ±0.15 V

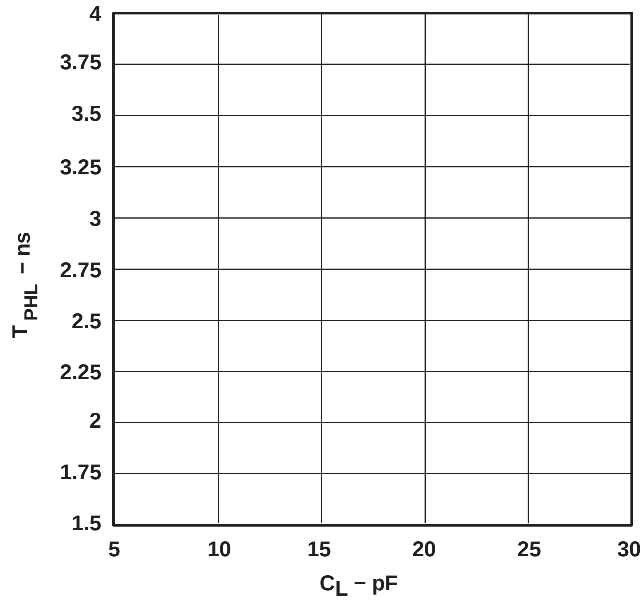




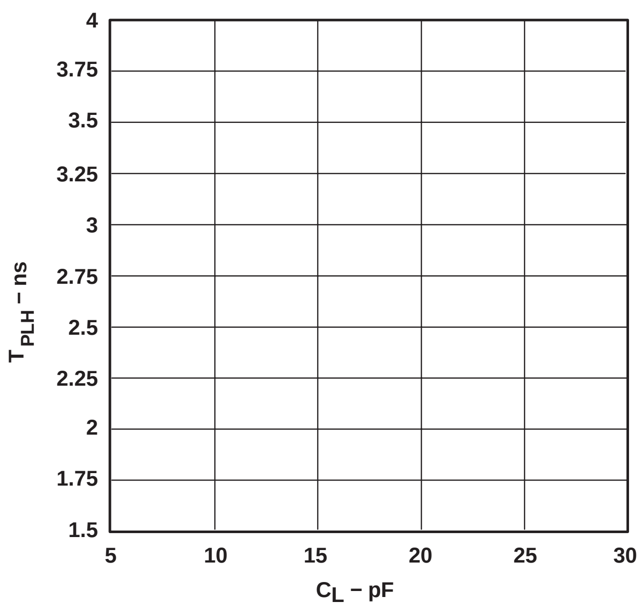
PRODUCT PREVIEW

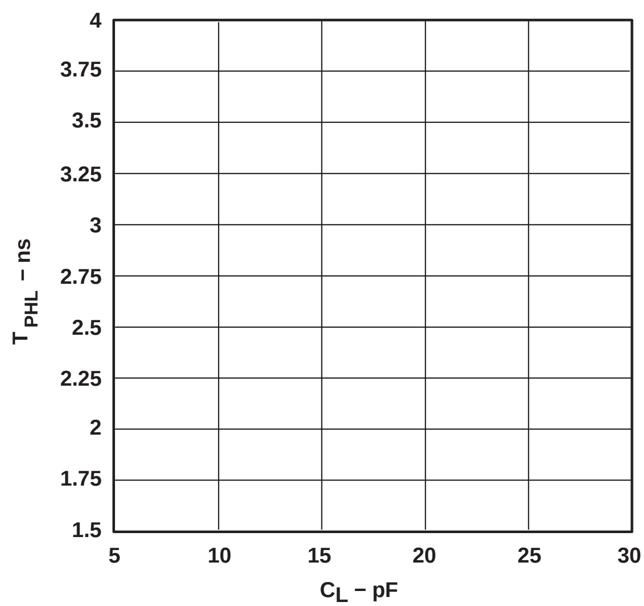
TYPICAL PROPAGATION DELAY vs LOAD CAPACITANCE, T_A = 25°C, V_{CCA} = 2.5 V ±0.2 V



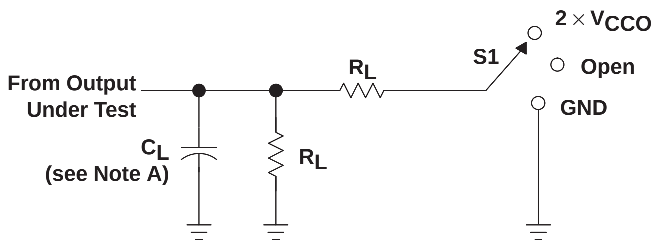


TYPICAL PROPAGATION DELAY vs LOAD CAPACITANCE, T_A = 25°C, V_{CCA} = 3.3 V ±0.3 V





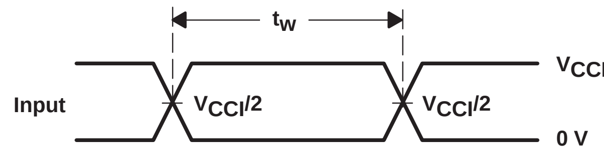
PARAMETER MEASUREMENT INFORMATION



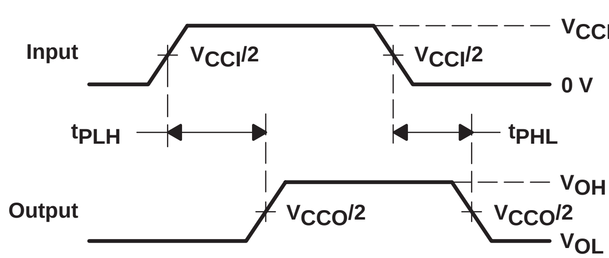
LOAD CIRCUIT

TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	2 × V_{CCO}
t_{PHZ}/t_{PZH}	GND

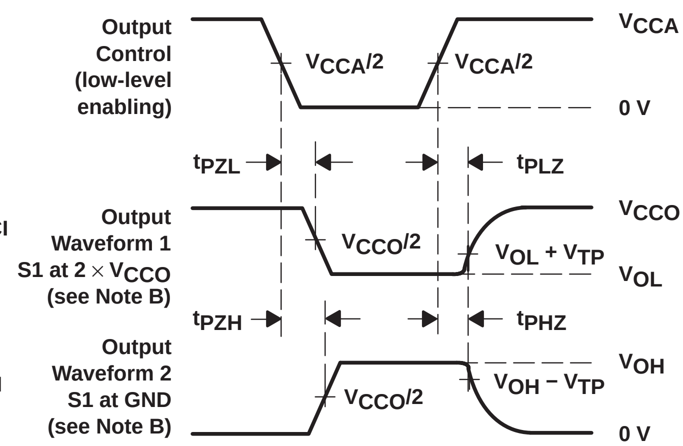
V_{CCO}	C_L	R_L	V_{TP}
1.5 V ± 0.1 V	15 pF	2 kΩ	0.1 V
1.8 V ± 0.15 V	15 pF	2 kΩ	0.15 V
2.5 V ± 0.2 V	15 pF	2 kΩ	0.15 V
3.3 V ± 0.3 V	15 pF	2 kΩ	0.3 V



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



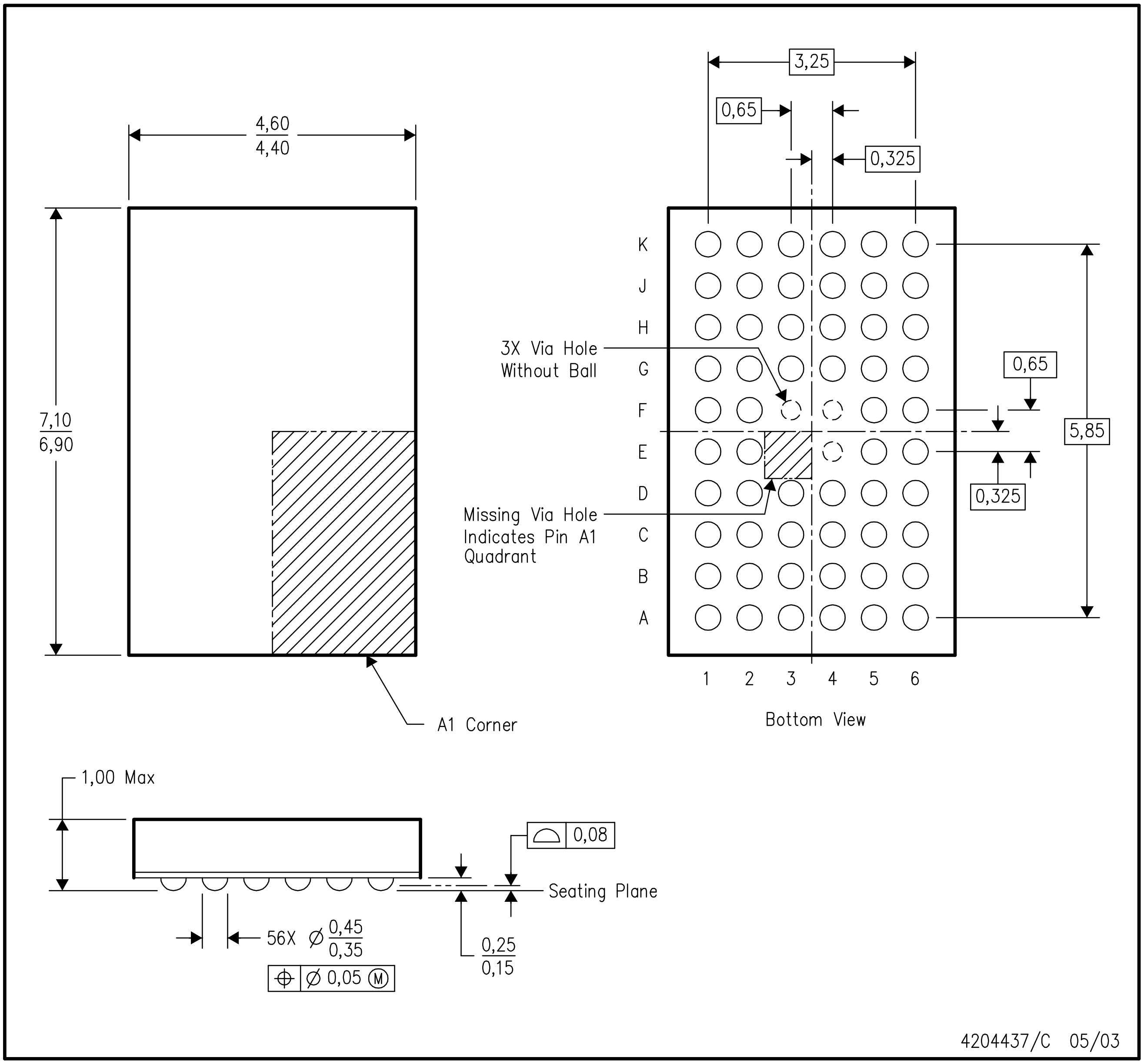
VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

PRODUCT PREVIEW

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 ≤ 10 MHz, Z_O = 50 Ω, dv/dt ≥ 1 V/ns, dv/dt ≥1 V/ns.
D. The outputs are measured one at a time with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. t_{PLH} and t_{PHL} are the same as t_{pd}.
H. V_{CCI} is the V_{CC} associated with the input port.
I. V_{CCO} is the V_{CC} associated with the output port.

Figure 1. Load Circuit and Voltage Waveforms

ZQL (R–PBGA–N56) PLASTIC BALL GRID ARRAY

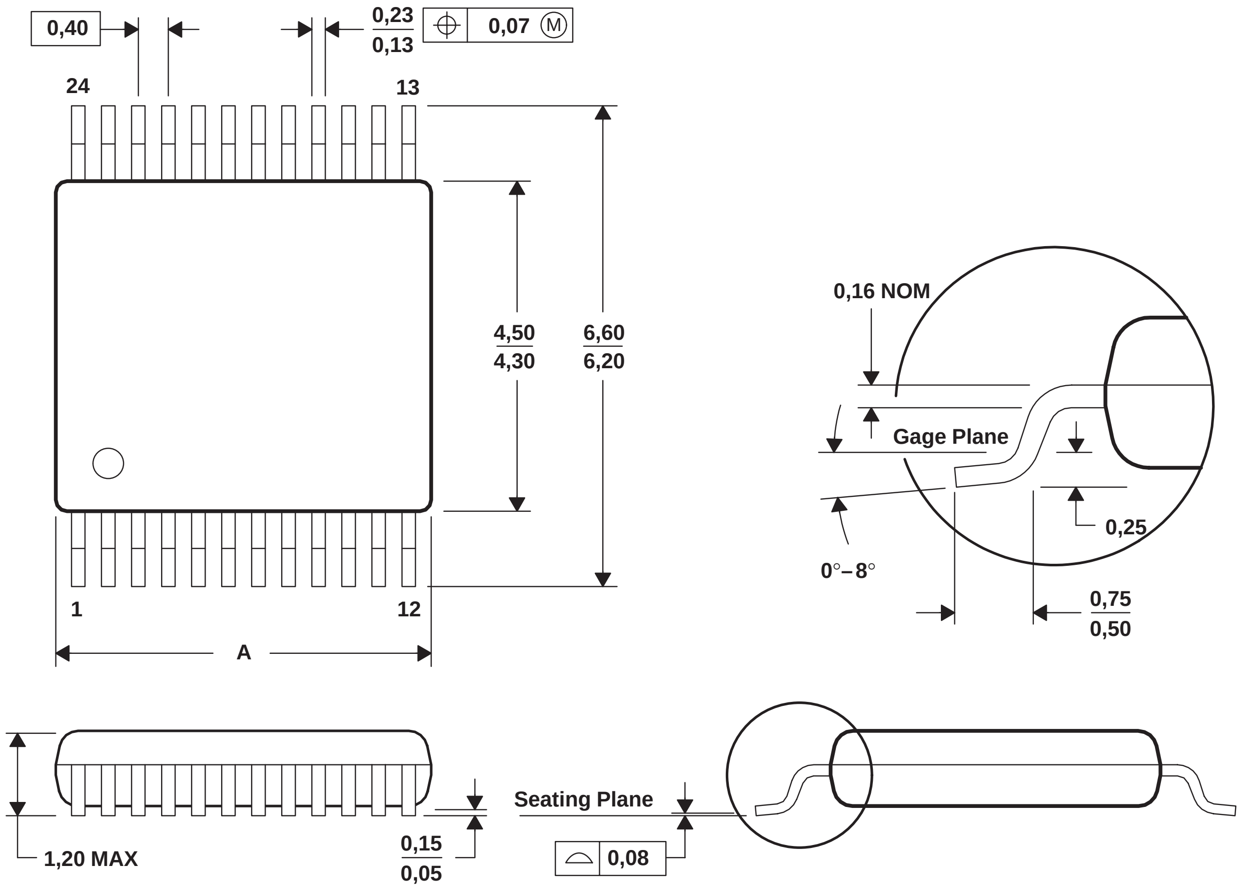


NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. MicroStar Junior™ BGA configuration.
D. Falls within JEDEC MO-225 variation BA.
E. This package is lead-free. Refer to the 56 GQL package (drawing 4200583) for tin-lead (SnPb).

MPDS006C – FEBRUARY 1996 – REVISED AUGUST 2000

DGV (R-PDSO-G)** **PLASTIC SMALL-OUTLINE**

24 PINS SHOWN



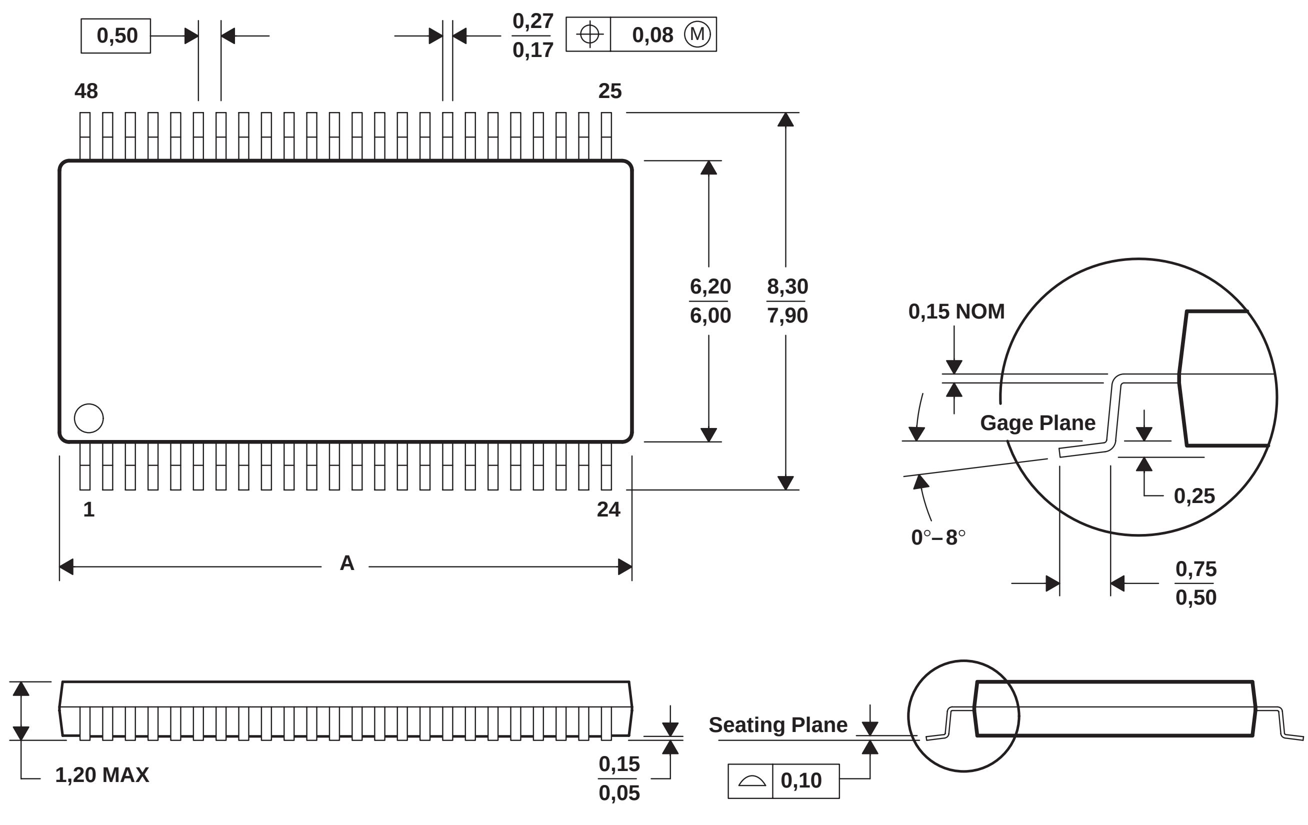
PINS ** / DIM	14	16	20	24	38	48	56
A MAX	3,70	3,70	5,10	5,10	7,90	9,80	11,40
A MIN	3,50	3,50	4,90	4,90	7,70	9,60	11,20

4073251/E 08/00

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

DGG (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

48 PINS SHOWN



PINS ** / DIM	48	56	64
A MAX	12,60	14,10	17,10
A MIN	12,40	13,90	16,90

4040078 / F 12/97

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

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