

# SN74AVCBH164245 16-BIT DUAL-SUPPLY BUS TRANSCEIVER WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

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- Member of the Texas Instruments Widebus™ Family
- DOC™ Circuitry Dynamically Changes Output Impedance, Resulting in Noise Reduction Without Speed Degradation
- Dynamic Drive Capability Is Equivalent to Standard Outputs With  $I_{OH}$  and  $I_{OL}$  of  $\pm 24$  mA at 2.5-V  $V_{CC}$
- Control Inputs  $V_{IH}/V_{IL}$  Levels are Referenced to  $V_{CCB}$  Voltage
- 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
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Fully Configurable Dual-Rail Design Allows Each Port to Operate Over the Full 1.4-V to 3.6-V Power-Supply Range
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

## description/ordering information

This 16-bit (dual-octal) 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 for 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 SN74AVCBH164245 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 SN74AVCBH164245 is designed so that the control pins (1DIR, 2DIR,  $1\overline{OE}$ , and  $2\overline{OE}$ ) are supplied by  $V_{CCB}$ .

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

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

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. If either  $V_{CC}$  input is at GND, both ports are in the high-impedance state.

## ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	TSSOP – DGG	Tape and reel	SN74AVCBH164245GR	AVCBH164245
	TVSOP – DGV	Tape and reel	SN74AVCBH164245VR	WBH4245
	VFBGA – GQL	Tape and reel	SN74AVCBH164245KR	WBH4245

† 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).

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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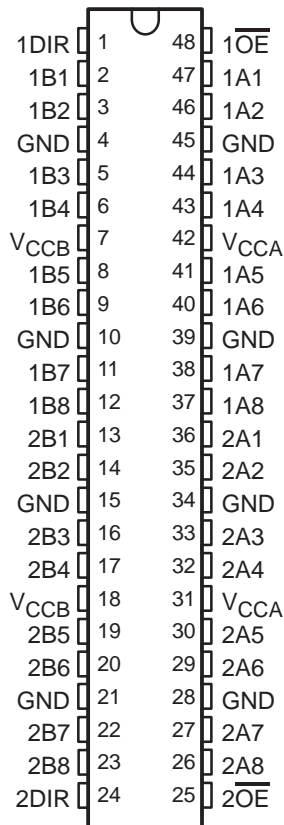
## 16-BIT DUAL-SUPPLY BUS TRANSCEIVER

### WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS

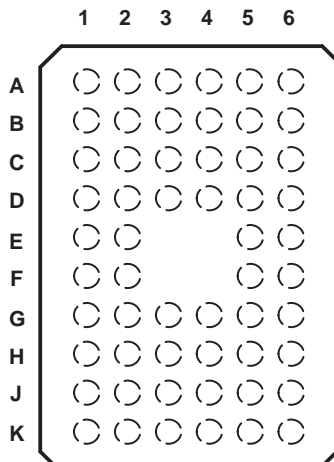
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#### terminal assignments

DGG OR DGV PACKAGE  
(TOP VIEW)



GQL PACKAGE  
(TOP VIEW)



#### terminal assignments

	1	2	3	4	5	6
A	1DIR	NC	NC	NC	NC	1OE
B	1B2	1B1	GND	GND	1A1	1A2
C	1B4	1B3	VCCB	VCCA	1A3	1A4
D	1B6	1B5	GND	GND	1A5	1A6
E	1B8	1B7			1A7	1A8
F	2B1	2B2			2A2	2A1
G	2B3	2B4	GND	GND	2A4	2A3
H	2B5	2B6	VCCB	VCCA	2A6	2A5
J	2B7	2B8	GND	GND	2A8	2A7
K	2DIR	NC	NC	NC	NC	2OE

NC – No internal connection

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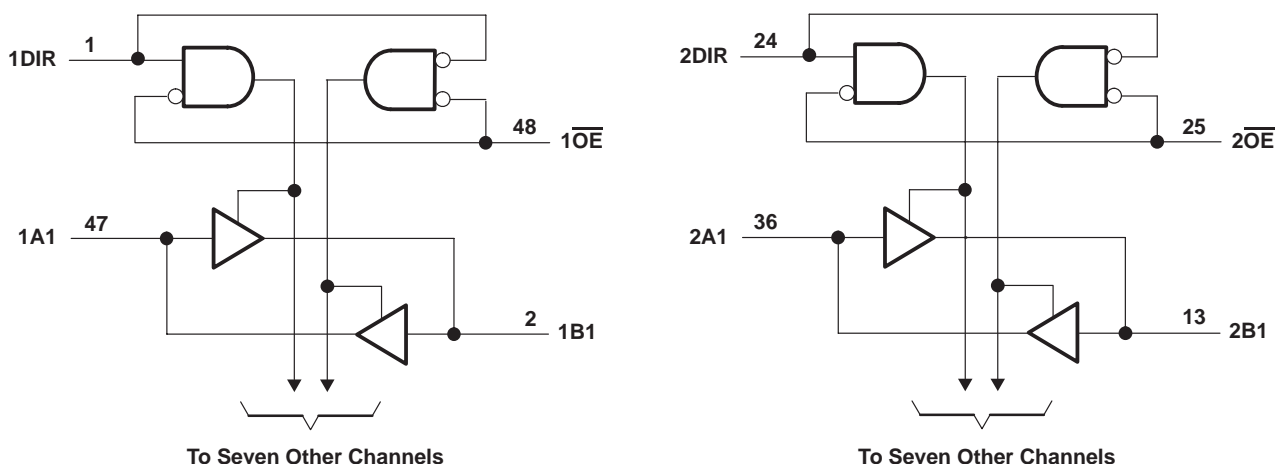
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FUNCTION TABLE  
(each 8-bit section)

INPUTS		OPERATION
$\overline{\text{OE}}$	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 $V_{CCA}$ , $V_{CCB}$ , or GND .....	±100 mA
Package thermal impedance, $\theta_{JA}$ (see Note 3): DGG package .....	70°C/W
DGV package .....	58°C/W
GQL package .....	28°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 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.

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**recommended operating conditions (see Notes 4 through 6)**

		V <sub>CCI</sub>	V <sub>CCO</sub>	MIN	MAX	UNIT
V <sub>CCA</sub>	Supply voltage			1.4	3.6	V
V <sub>CCB</sub>	Supply voltage			1.4	3.6	V
V <sub>IH</sub>	High-level input voltage	Data inputs	1.4 V to 1.95 V	V <sub>CCI</sub> × 0.65		V
			1.95 V to 2.7 V	1.7		
			2.7 V to 3.6 V	2		
V <sub>IL</sub>	Low-level input voltage	Data inputs	1.4 V to 1.95 V	V <sub>CCI</sub> × 0.35		V
			1.95 V to 2.7 V	0.7		
			2.7 V to 3.6 V	0.8		
V <sub>IH</sub>	High-level input voltage	Control inputs (Referenced to V <sub>CCB</sub> )	1.4 V to 1.95 V	V <sub>CCB</sub> × 0.65		V
			1.95 V to 2.7 V	1.7		
			2.7 V to 3.6 V	2		
V <sub>IL</sub>	Low-level input voltage	Control inputs (Referenced to V <sub>CCB</sub> )	1.4 V to 1.95 V	V <sub>CCB</sub> × 0.35		V
			1.95 V to 2.7 V	0.7		
			2.7 V to 3.6 V	0.8		
V <sub>I</sub>	Input voltage			0	3.6	V
V <sub>O</sub>	Output voltage	Active state		0	V <sub>CCO</sub>	V
		3-state		0	3.6	
I <sub>OH</sub>	High-level output current		1.4 V to 1.6 V	-2		mA
			1.65 V to 1.95 V	-4		
			2.3 V to 2.7 V	-8		
			3 V to 3.6 V	-12		
I <sub>OL</sub>	Low-level output current		1.4 V to 1.6 V	2		mA
			1.65 V to 1.95 V	4		
			2.3 V to 2.7 V	8		
			3 V to 3.6 V	12		
Δt/Δv	Input transition rise or fall rate				5	ns/V
T <sub>A</sub>	Operating free-air temperature			-40	85	°C

- NOTES: 4. V<sub>CCI</sub> is the V<sub>CC</sub> associated with the data input port.  
5. V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.  
6. All unused data inputs of the device must be held at V<sub>CCI</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Note 7)

PARAMETER		TEST CONDITIONS	V <sub>CCA</sub>	V <sub>CCB</sub>	MIN	TYP <sup>†</sup>	MAX	UNIT
V <sub>OH</sub>		I <sub>OH</sub> = -100 μA    V <sub>I</sub> = V <sub>IH</sub>	1.4 V to 3.6 V	1.4 V to 3.6 V	V <sub>CCO</sub> -0.2 V			V
		I <sub>OH</sub> = -2 mA    V <sub>I</sub> = V <sub>IH</sub>	1.4 V	1.4 V	1.05			
		I <sub>OH</sub> = -4 mA    V <sub>I</sub> = V <sub>IH</sub>	1.65 V	1.65 V	1.2			
		I <sub>OH</sub> = -8 mA    V <sub>I</sub> = V <sub>IH</sub>	2.3 V	2.3 V	1.75			
		I <sub>OH</sub> = -12 mA    V <sub>I</sub> = V <sub>IH</sub>	3 V	3 V	2.3			
V <sub>OL</sub>		I <sub>OH</sub> = 100 μA    V <sub>I</sub> = V <sub>IL</sub>	1.4 V to 3.6 V	1.4 V to 3.6 V			0.2	V
		I <sub>OH</sub> = 2 mA    V <sub>I</sub> = V <sub>IL</sub>	1.4 V	1.4 V			0.35	
		I <sub>OH</sub> = 4 mA    V <sub>I</sub> = V <sub>IL</sub>	1.65 V	1.65 V			0.45	
		I <sub>OH</sub> = 8 mA    V <sub>I</sub> = V <sub>IL</sub>	2.3 V	2.3 V			0.55	
		I <sub>OH</sub> = 12 mA    V <sub>I</sub> = V <sub>IL</sub>	3 V	3 V			0.7	
I <sub>I</sub>	Control inputs	V <sub>I</sub> = V <sub>CCB</sub> or GND	1.4 V to 3.6 V	3.6 V			±2.5	μA
I <sub>BHL</sub> <sup>‡</sup>		V <sub>I</sub> = 0.49 V	1.4 V	1.4 V			11	μA
		V <sub>I</sub> = 0.57 V	1.65 V	1.65 V			25	
		V <sub>I</sub> = 0.7 V	2.3 V	2.3 V			45	
		V <sub>I</sub> = 0.8 V	3 V	3 V			75	
I <sub>BHH</sub> <sup>§</sup>		V <sub>I</sub> = 0.91 V	1.4 V	1.4 V			-11	μA
		V <sub>I</sub> = 1.07 V	1.65 V	1.65 V			-25	
		V <sub>I</sub> = 1.7 V	2.3 V	2.3 V			-45	
		V <sub>I</sub> = 2 V	3 V	3 V			-75	
I <sub>BHLO</sub> <sup>¶</sup>	V <sub>I</sub> = 0 to V <sub>CC</sub>		1.6 V	1.6 V			100	μA
			1.95 V	1.95 V			200	
			2.7 V	2.7 V			300	
			3.6 V	3.6 V			525	
I <sub>BHHO</sub> <sup>#</sup>	V <sub>I</sub> = 0 to V <sub>CC</sub>		1.6 V	1.6 V			-100	μA
			1.95 V	1.95 V			-200	
			2.7 V	2.7 V			-300	
			3.6 V	3.6 V			-525	
I <sub>off</sub>	A port	V <sub>I</sub> or V <sub>O</sub> = 0 to 3.6 V	0 V	0 to 3.6 V			±10	μA
	B port		0 to 3.6 V	0 V			±10	

<sup>†</sup> All typical values are at T<sub>A</sub> = 25°C.

<sup>‡</sup> The bus-hold circuit can sink at least the minimum low sustaining current at V<sub>IL</sub> max. I<sub>BHL</sub> should be measured after lowering V<sub>IN</sub> to GND and then raising it to V<sub>IL</sub> max.

<sup>§</sup> The bus-hold circuit can source at least the minimum high sustaining current at V<sub>IH</sub> min. I<sub>BHH</sub> should be measured after raising V<sub>IN</sub> to V<sub>CC</sub> and then lowering it to V<sub>IH</sub> min.

<sup>¶</sup> An external driver must source at least I<sub>BHLO</sub> to switch this node from low to high.

<sup>#</sup> An external driver must sink at least I<sub>BHHO</sub> to switch this node from high to low.

NOTE 7: V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

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**electrical characteristics over recommended operating free-air temperature range (continued)**  
**(unless otherwise noted) (see Notes 8 and 9)**

PARAMETER		TEST CONDITIONS		VCCA	VCCB	MIN	TYP†	MAX	UNIT
I <sub>OZ</sub> ‡	A or B ports	V <sub>O</sub> = V <sub>CCO</sub> or GND, V <sub>I</sub> = V <sub>CCI</sub> or GND	$\overline{OE} = V_{IH}$	3.6 V	3.6 V			±12.5	μA
	B port		$\overline{OE} = \text{don't care}$	0 V	3.6 V			±12.5	
	A port			3.6 V	0 V			±12.5	
I <sub>CCA</sub>		V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0		1.6 V	1.6 V			20	μA
				1.95 V	1.95 V			20	
				2.7 V	2.7 V			30	
				0 V	3.6 V			-40	
				3.6 V	0 V			40	
				3.6 V	3.6 V			40	
I <sub>CCB</sub>		V <sub>I</sub> = V <sub>CCI</sub> or GND, I <sub>O</sub> = 0		1.6 V	1.6 V			20	μA
				1.95 V	1.95 V			20	
				2.7 V	2.7 V			30	
				0 V	3.6 V			40	
				3.6 V	0 V			-40	
				3.6 V	3.6 V			40	
C <sub>i</sub>	Control inputs	V <sub>I</sub> = 3.3 V or GND		3.3 V	3.3 V		4	pF	
C <sub>io</sub>	A or B ports	V <sub>O</sub> = 3.3 V or GND		3.3 V	3.3 V		5	pF	

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

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

NOTES: 8. V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

9. V<sub>CCI</sub> is the V<sub>CC</sub> associated with the input port.

**switching characteristics over recommended operating free-air temperature range,**  
**VCCA = 1.5 V ± 0.1 V (see Figure 2)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	VCCB = 1.5 V ± 0.1 V		VCCB = 1.8 V ± 0.15 V		VCCB = 2.5 V ± 0.2 V		VCCB = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>pd</sub>	A	B	1.7	6.7	1.9	6.3	1.8	5.5	1.7	5.8	ns
	B	A	1.8	6.8	2.2	7.4	2.1	7.6	2.1	7.3	
t <sub>en</sub>	$\overline{OE}$	A	2.5	8.4	2.4	7.4	2.1	5.2	1.9	4.2	ns
	$\overline{OE}$	B	2.1	9	2.9	9.8	3.2	10	3	9.8	
t <sub>dis</sub>	$\overline{OE}$	A	2.2	6.9	2.3	6.1	1.3	3.6	1.3	3	ns
	$\overline{OE}$	B	2.1	7.1	2.3	6.4	1.7	5.1	1.6	4.8	

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switching characteristics over recommended operating free-air temperature range,  
 $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$  (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.7	6.4	1.8	6	1.7	4.7	1.6	4.3	ns
	B	A	1.4	5.5	1.8	6	1.8	5.8	1.8	5.5	
$t_{en}$	$\overline{OE}$	A	2.6	8.5	2.5	7.5	2.2	5.3	1.9	4.2	ns
	$\overline{OE}$	B	1.8	7.6	2.6	7.7	2.6	7.6	2.6	7.4	
$t_{dis}$	$\overline{OE}$	A	2.3	7	2.3	6.1	1.3	3.6	1.3	3	ns
	$\overline{OE}$	B	1.8	7	2.5	6.3	1.8	4.7	1.7	4.4	

switching characteristics over recommended operating free-air temperature range,  
 $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$  (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.6	6	1.8	5.6	1.5	4	1.4	3.4	ns
	B	A	1.3	4.6	1.7	4.4	1.5	4	1.4	3.7	
$t_{en}$	$\overline{OE}$	A	3.1	8.5	2.5	7.5	2.2	5.3	1.9	4.2	ns
	$\overline{OE}$	B	1.7	5.7	2.2	5.5	2.2	5.3	2.2	5.1	
$t_{dis}$	$\overline{OE}$	A	2.4	7	3	6.1	1.4	3.6	1.2	3	ns
	$\overline{OE}$	B	1.2	5.8	1.9	5	1.4	3.6	1.3	3.3	

switching characteristics over recommended operating free-air temperature range,  
 $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$  (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CCB} = 1.5 \text{ V} \pm 0.1 \text{ V}$		$V_{CCB} = 1.8 \text{ V} \pm 0.15 \text{ V}$		$V_{CCB} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CCB} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	A	B	1.5	5.9	1.7	5.4	1.5	3.7	1.4	3.1	ns
	B	A	1.3	4.5	1.6	3.8	1.5	3.3	1.4	3.1	
$t_{en}$	$\overline{OE}$	A	2.6	8.3	2.5	7.4	2.2	5.2	1.9	4.1	ns
	$\overline{OE}$	B	1.6	4.9	2	4.5	2	4.3	1.9	4.1	
$t_{dis}$	$\overline{OE}$	A	2.3	7	3	6	1.3	3.5	1.2	3.5	ns
	$\overline{OE}$	B	1.3	6.9	2.1	5.5	1.6	3.8	1.5	3.5	

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operating characteristics,  $V_{CCA}$  and  $V_{CCB} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	TYP	UNIT
$C_{pdA}$ ( $V_{CCA}$ )	Power dissipation capacitance per transceiver, A port input, B port output	Outputs enabled	14	pF
		Outputs disabled	7	
	Power dissipation capacitance per transceiver, B port input, A port output	Outputs enabled	20	
		Outputs disabled	7	
$C_{pdB}$ ( $V_{CCB}$ )	Power dissipation capacitance per transceiver, A port input, B port output	Outputs enabled	20	pF
		Outputs disabled	7	
	Power dissipation capacitance per transceiver, B port input, A port output	Outputs enabled	14	
		Outputs disabled	7	

**output description**

The DOC™ circuitry is implemented, which, during the transition, initially lowers the output impedance to effectively drive the load and, subsequently, raises the impedance to reduce noise. Figure 1 shows typical  $V_{OL}$  vs  $I_{OL}$  and  $V_{OH}$  vs  $I_{OH}$  curves to illustrate the output impedance and drive capability of the circuit. At the beginning of the signal transition, the DOC circuit provides a maximum dynamic drive that is equivalent to a high-drive standard-output device. For more information, refer to the TI application reports, *AVC Logic Family Technology and Applications*, literature number SCEA006, and *Dynamic Output Control (DOC™) Circuitry Technology and Applications*, literature number SCEA009.

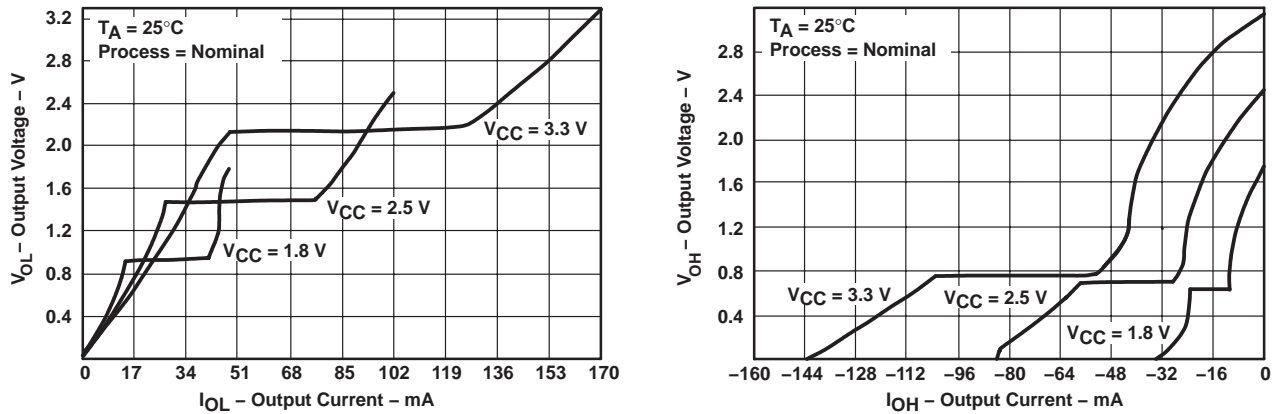
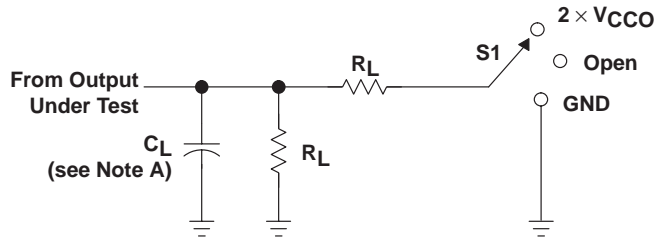


Figure 1. Typical Output Voltage vs Output Current



**SN74AVCBH164245**  
**16-BIT DUAL-SUPPLY BUS TRANSCEIVER**  
**WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS**  
SCES393A – JUNE 2002 – REVISED MAY 2004

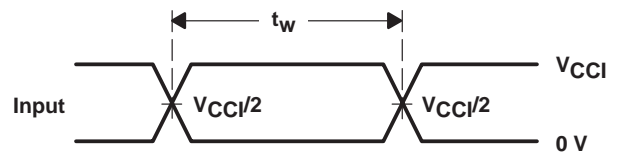
**PARAMETER MEASUREMENT INFORMATION**



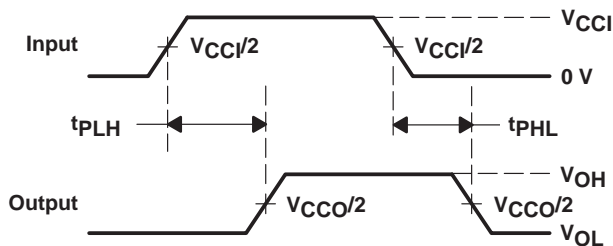
**LOAD CIRCUIT**

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

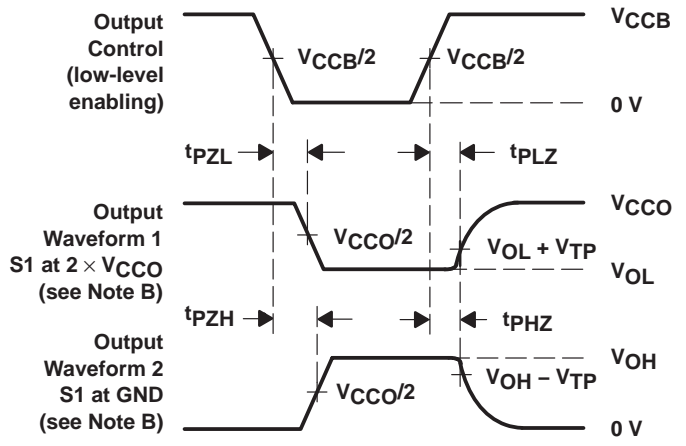
$V_{CCO}$	$C_L$	$R_L$	$V_{TP}$
$1.5\text{ V} \pm 0.1\text{ V}$	15 pF	2 k $\Omega$	0.1 V
$1.8\text{ V} \pm 0.15\text{ V}$	30 pF	1 k $\Omega$	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	30 pF	500 $\Omega$	0.15 V
$3.3\text{ V} \pm 0.3\text{ V}$	30 pF	500 $\Omega$	0.3 V



**VOLTAGE WAVEFORMS  
PULSE DURATION**



**VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES**

- 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:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $dv/dt \geq 1\text{ V/ns}$ ,  $dv/dt \geq 1\text{ V/ns}$ .  
 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 2. Load Circuit and Voltage Waveforms**

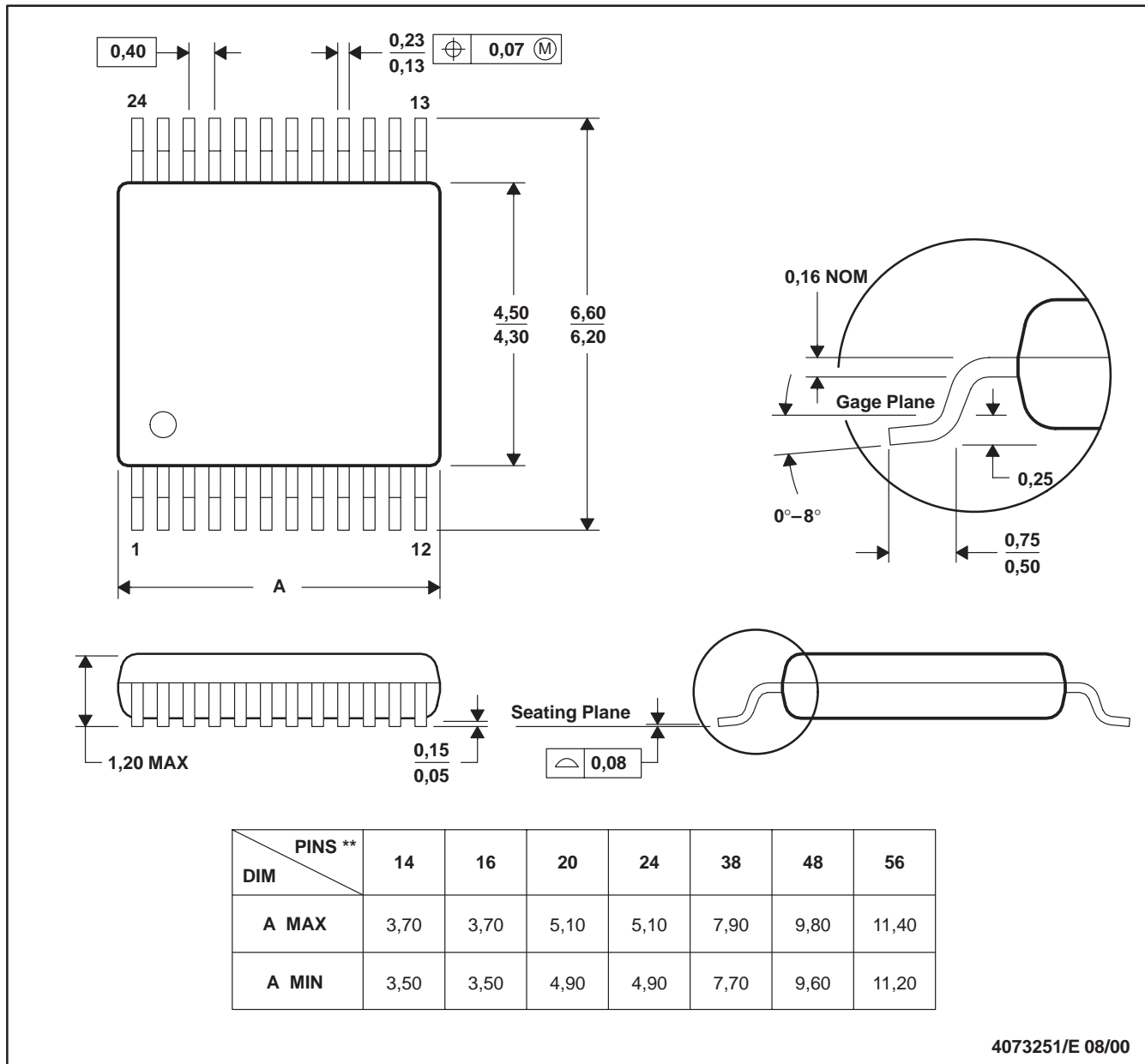
# MECHANICAL DATA

MPDS006C – FEBRUARY 1996 – REVISED AUGUST 2000

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

## PLASTIC SMALL-OUTLINE

24 PINS SHOWN

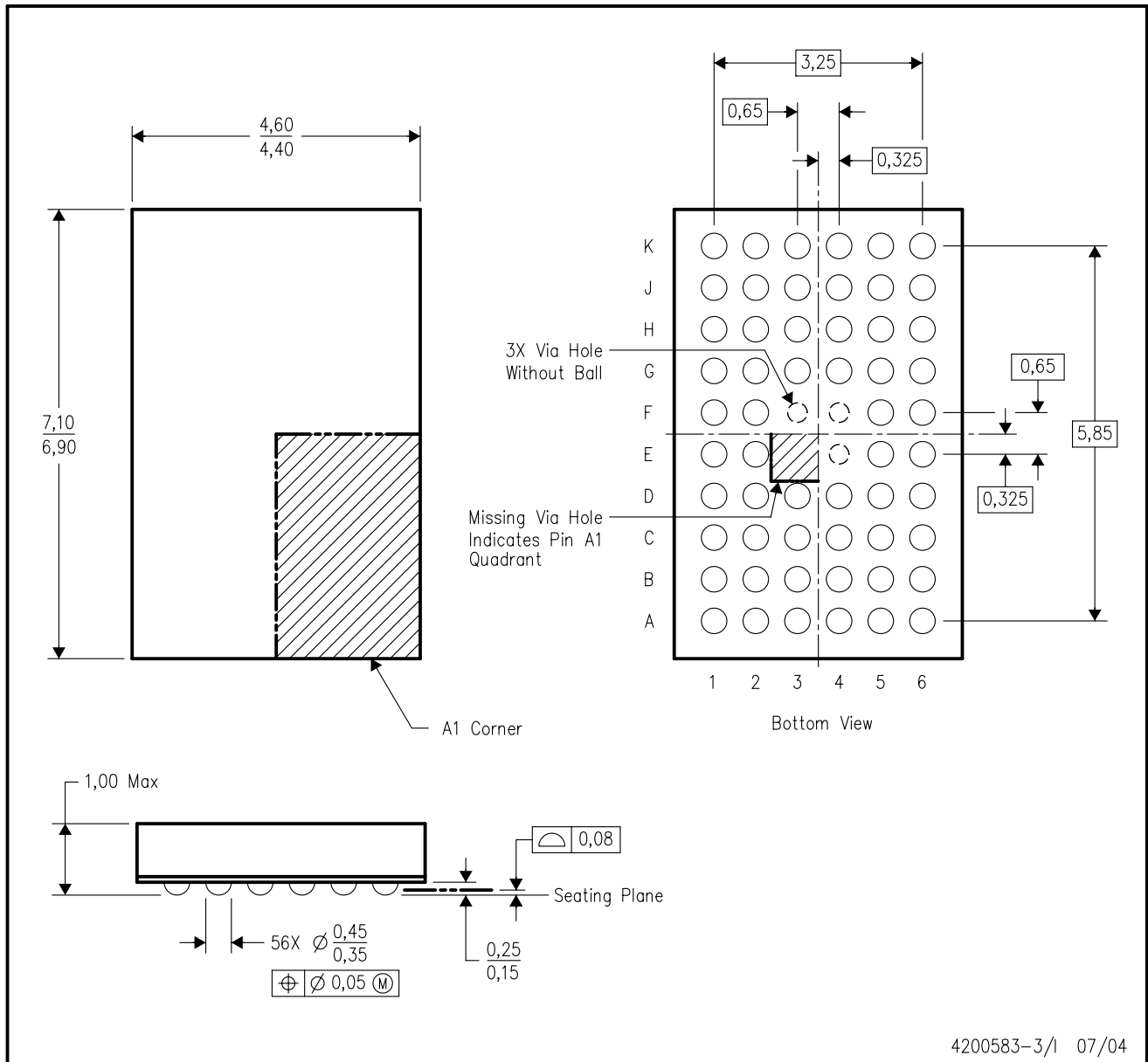


- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

# MECHANICAL DATA

GQL (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. Falls within JEDEC MO-225 variation BA.
  - D. This package is tin-lead (SnPb). Refer to the 56 ZQL package (drawing 4204437) for lead-free.

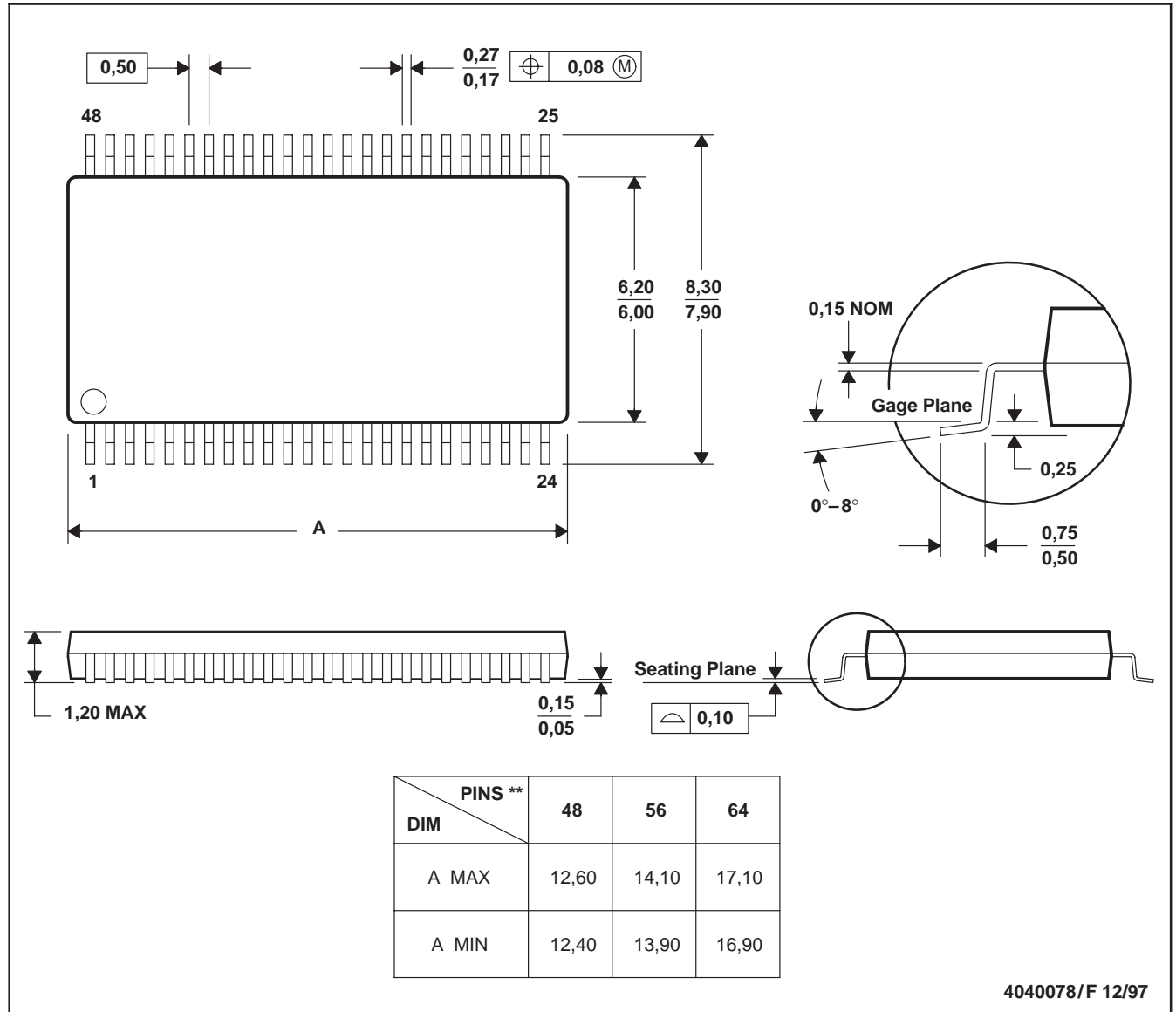
# MECHANICAL DATA

MTSS003D – JANUARY 1995 – REVISED JANUARY 1998

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

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



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

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