

# SN54ABT162245, SN74ABT162245 16-BIT BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCBS239F – MARCH 1993 – REVISED JUNE 2004

- **Members of the Texas Instruments Widebus™ Family**
- **A-Port Outputs Have Equivalent 25-Ω Series Resistors, So No External Resistors Are Required**
- **Typical  $V_{OLP}$  (Output Ground Bounce)  $<1$  V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$**
- **Distributed  $V_{CC}$  and GND Pins Minimize High-Speed Switching Noise**
- **$I_{off}$  Supports Partial-Power-Down Mode Operation**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Latch-Up Performance Exceeds 500 mA Per JESD 17**
- **ESD Protection Exceeds JESD 22**
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)

## description/ordering information

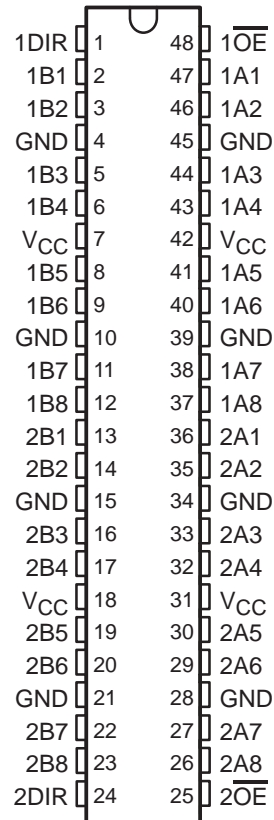
The 'ABT162245 devices are 16-bit noninverting 3-state transceivers designed for synchronous two-way communication between data buses. The control-function implementation minimizes external timing requirements.

These devices can be used as two 8-bit transceivers or one 16-bit transceiver. They allow data transmission 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 that the buses effectively are isolated.

The A-port outputs, which are designed to source or sink up to 12 mA, include equivalent 25-Ω series resistors to reduce overshoot and undershoot.

These devices are fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down.

## SN54ABT162245 . . . WD PACKAGE SN74ABT162245 . . . DGG OR DL PACKAGE (TOP VIEW)



## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SSOP – DL	Tube	SN74ABT162245DL	ABT162245
		Tape and reel	SN74ABT162245DLR	
	TSSOP – DGG	Tape and reel	SN74ABT162245DGGR	ABT162245
–55°C to 125°C	CFP – WD	Tube	SNJ54ABT162245WD	SNJ54ABT162245WD

† 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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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

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**WITH 3-STATE OUTPUTS**

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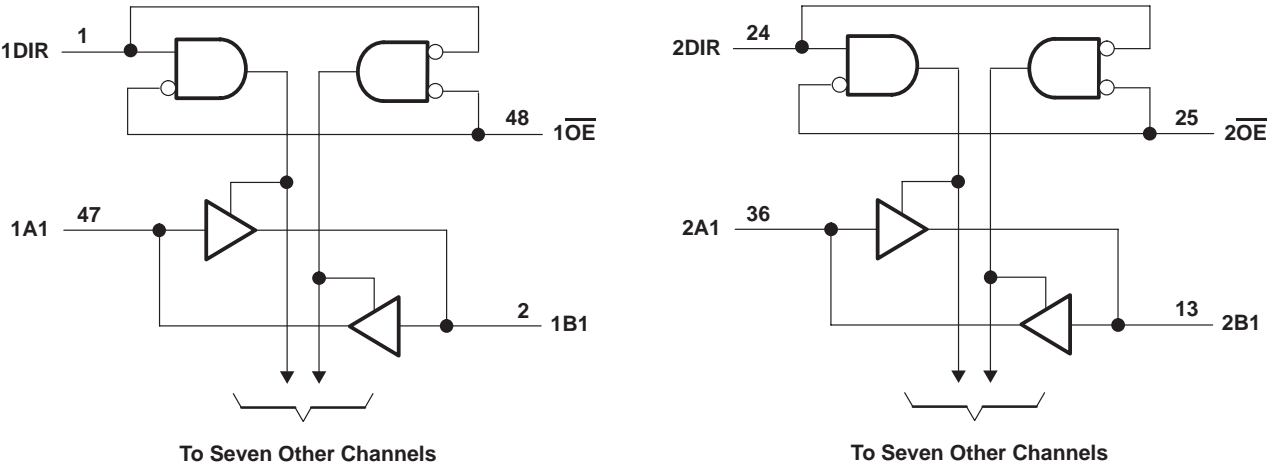
description/ordering information (continued)

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.

**FUNCTION TABLE**  
 (each 8-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)



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

Supply voltage range, $V_{CC}$	–0.5 V to 7 V
Input voltage range, $V_I$ (except I/O ports) (see Note 1)	–0.5 V to 7 V
Voltage range applied to any output in the high or power-off state, $V_O$	–0.5 V to 5.5 V
Current into any output in the low state, $I_O$ : SN54ABT162245 (B port)	96 mA
SN74ABT162245 (B port)	128 mA
SN54/74ABT162245 (A port)	30 mA
Input clamp current, $I_{IK}$ ( $V_I < 0$ )	–18 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ )	–50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DGG package	70°C/W
DL package	63°C/W
Storage temperature range, $T_{stg}$	–65°C to 150°C

<sup>†</sup> 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 clamp-current ratings are observed.  
 2. The package thermal impedance is calculated in accordance with JESD 51–7.

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**recommended operating conditions (see Note 3)**

			SN54ABT162245		SN74ABT162245		UNIT
			MIN	MAX	MIN	MAX	
V <sub>CC</sub>	Supply voltage		4.5	5.5	4.5	5.5	V
V <sub>IH</sub>	High-level input voltage		2		2		V
V <sub>IL</sub>	Low-level input voltage			0.8		0.8	V
V <sub>I</sub>	Input voltage		0	V <sub>CC</sub>	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current	B port		–24		–32	mA
		A port		–3		–12	
I <sub>OL</sub>	Low-level output current	B port		48		64	mA
		A port		12		12	
Δt/Δv	Input transition rise or fall rate	Outputs enabled		10		10	ns/V
T <sub>A</sub>	Operating free-air temperature		–55	125	–40	85	°C

NOTE 3: 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.



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## 16-BIT BUS TRANSCEIVERS

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

PARAMETER		TEST CONDITIONS		T <sub>A</sub> = 25°C			SN54ABT162245		SN74ABT162245		UNIT	
				MIN	TYP†	MAX	MIN	MAX	MIN	MAX		
V <sub>IK</sub>		V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA		-1.2			-1.2		-1.2		V	
V <sub>OH</sub>	A port	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = -1 mA		3.8			2.5		2.5		V	
		V <sub>CC</sub> = 4.5 V	I <sub>OH</sub> = -1 mA	3.3			3		3			
			I <sub>OH</sub> = -3 mA	3.1			3		3.1			
			I <sub>OH</sub> = -12 mA	2.6*					2.6			
	B port	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = -3 mA		3			3		3			
		V <sub>CC</sub> = 4.5 V	I <sub>OH</sub> = -3 mA	2.5			2.5		2.5			
			I <sub>OH</sub> = -24 mA				2					
			I <sub>OH</sub> = -32 mA	2*					2			
V <sub>OL</sub>	A port	V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 12 mA	0.8			0.8		0.8		V	
	B port		I <sub>OL</sub> = 48 mA	0.45			0.45		0.45			
			I <sub>OL</sub> = 64 mA	0.55*					0.55			
V <sub>hys</sub>				100							mV	
I <sub>I</sub>	Control inputs	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND		±1			±1		±1		μA	
	A or B ports			±20			±20		±20			
I <sub>OZH</sub> §		V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.7 V		10			10		10		μA	
I <sub>OZL</sub> §		V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0.5 V		-10			-10		-10		μA	
I <sub>off</sub>		V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> ≤ 4.5 V		±100					±100		μA	
I <sub>CEX</sub>		V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V		Outputs high		50			50		50	μA
I <sub>O</sub> ¶	A port	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V		-25	-50	-100‡	-25	-90	-25	-100	mA	
	B port			-50	-100	-180	-50	-180	-50	-180		
I <sub>CC</sub>	A or B ports	V <sub>CC</sub> = 5.5 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND		Outputs high			2			2		mA
				Outputs low			32			32		
				Outputs disabled			2			2		
ΔI <sub>CC</sub> #	Data inputs	V <sub>CC</sub> = 5.5 V, One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND		Outputs enabled			1			2		mA
				Outputs disabled			0.05			1		
	Control inputs	V <sub>CC</sub> = 5.5 V, One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND		1.5			1.5			1.5		
C <sub>i</sub>		V <sub>I</sub> = 2.5 V or 0.5 V		3							pF	
C <sub>io</sub>		V <sub>O</sub> = 2.5 V or 0.5 V		6							pF	

\* On products compliant to MIL-PRF-38535, this parameter does not apply.

† All typical values are at V<sub>CC</sub> = 5 V.

‡ This limit applies only to the SN74ABT162245.

§ The parameters I<sub>OZH</sub> and I<sub>OZL</sub> include the input leakage current.

¶ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

# This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V<sub>CC</sub> or GND.



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switching characteristics over recommended ranges of supply voltage and operating free-air temperature,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$			SN54ABT162245		SN74ABT162245		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	A	B	1	2.2	3.4	1	4.1	1	3.9	ns
$t_{PHL}$			1	2.3	3.7	1	4.4	1	4.2	
$t_{PLH}$	B	A	1	2.7	4.1	1	4.9	1	4.6	ns
$t_{PHL}$			1.5	3.1	4.6	1.5	5.2	1.5	5.1	
$t_{PZH}$	$\overline{OE}$	B	1	3.6	5.2	1	6.4	1	6.3	ns
$t_{PZL}$			1	3.7	5.4	1	6.5	1	6.4	
$t_{PHZ}$	$\overline{OE}$	B	2	4.4	5.8	2	6.4	2	6.3	ns
$t_{PLZ}$			1.5	3.3	4.7	1.5	5.6	1.5	5.2	
$t_{PZH}$	$\overline{OE}$	A	1.5	4.1	6	1.5	7.2	1.5	7.1	ns
$t_{PZL}$			1.5	4.3	6.1	1.5	7.3	1.5	7	
$t_{PHZ}$	$\overline{OE}$	A	2	4.5	6.1	2	6.8	2	6.6	ns
$t_{PLZ}$			1.5	3.7	5.1	1.5	6.1	1.5	5.7	

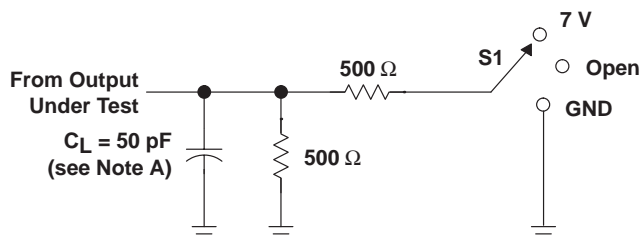
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## 16-BIT BUS TRANSCEIVERS

### WITH 3-STATE OUTPUTS

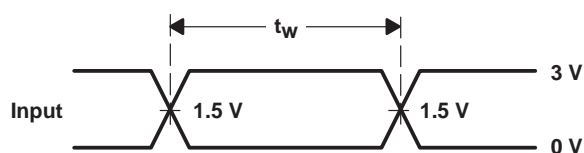
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#### PARAMETER MEASUREMENT INFORMATION

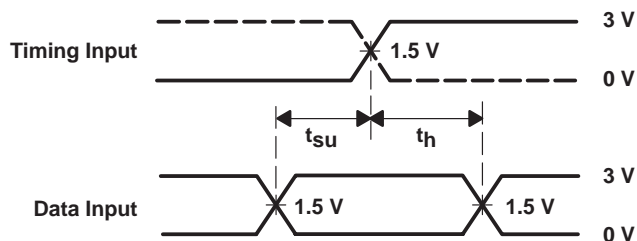


LOAD CIRCUIT

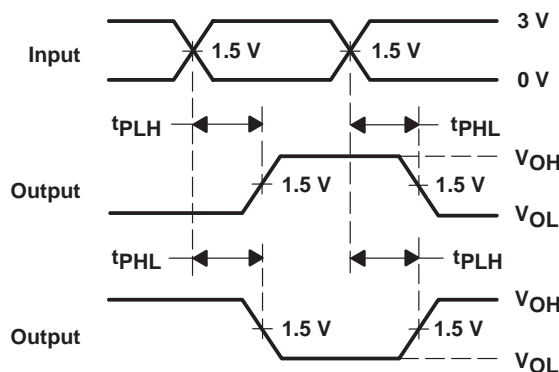
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open



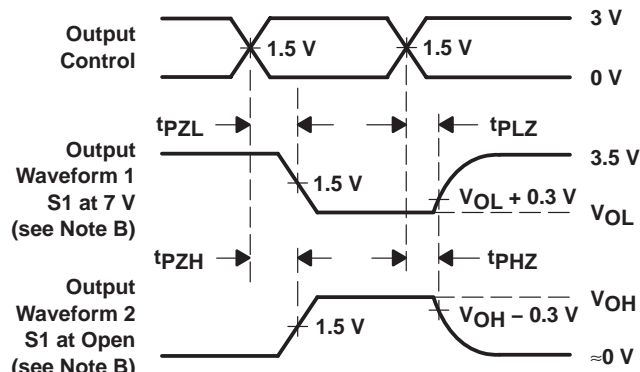
VOLTAGE WAVEFORMS  
PULSE DURATION



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:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
  - The outputs are measured one at a time, with one transition per measurement.
  - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

## PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
5962-9677401QXA	ACTIVE	CFP	WD	48	1	TBD	Call TI	Level-NC-NC-NC
74ABT162245DGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74ABT162245DLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT162245DGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT162245DL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ABT162245DLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54ABT162245WD	ACTIVE	CFP	WD	48	1	TBD	Call TI	Level-NC-NC-NC

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) 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.

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

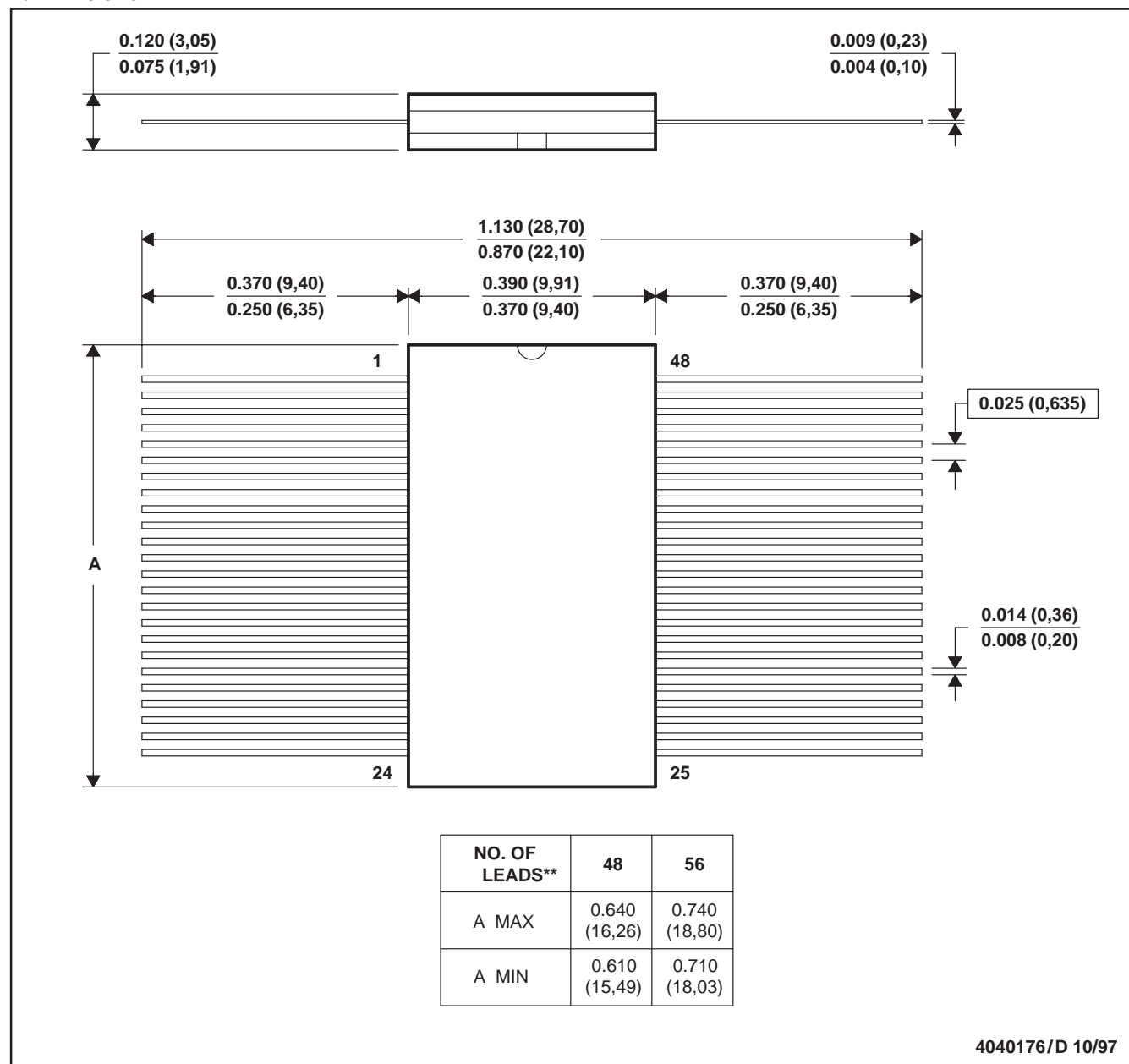
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## WD (R-GDFP-F\*\*)

## CERAMIC DUAL FLATPACK

48 LEADS SHOWN



- 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 only.  
 E. Falls within MIL STD 1835: GDFP1-F48 and JEDEC MO-146AA  
 GDFP1-F56 and JEDEC MO-146AB



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

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- 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-118

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

## PLASTIC SMALL-OUTLINE PACKAGE

48 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 protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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