

54AC16374, 74AC16374 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCAS123B – MARCH 1990 – REVISED APRIL 1996

- Members of the Texas Instruments *Widebus*™ Family
- 3-State True Outputs
- Full Parallel Access for Loading
- Flow-Through Architecture Optimizes PCB Layout
- Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise
- *EPIC*™ (Enhanced-Performance Implanted CMOS) 1-μm Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) Packages Using 25-mil Center-to-Center Pin Spacings and 380-mil Fine-Pitch Ceramic Flat (WD) Packages Using 25-mil Center-to-Center Pin Spacings

54AC16374 . . . WD PACKAGE
74AC16374 . . . DL PACKAGE
(TOP VIEW)

1OE	1	48	1CLK
1Q1	2	47	1D1
1Q2	3	46	1D2
GND	4	45	GND
1Q3	5	44	1D3
1Q4	6	43	1D4
V _{CC}	7	42	V _{CC}
1Q5	8	41	1D5
1Q6	9	40	1D6
GND	10	39	GND
1Q7	11	38	1D7
1Q8	12	37	1D8
2Q1	13	36	2D1
2Q2	14	35	2D2
GND	15	34	GND
2Q3	16	33	2D3
2Q4	17	32	2D4
V _{CC}	18	31	V _{CC}
2Q5	19	30	2D5
2Q6	20	29	2D6
GND	21	28	GND
2Q7	22	27	2D7
2Q8	23	26	2D8
2OE	24	25	2CLK

description

The 'AC16374 are 16-bit edge-triggered D-type flip-flops with 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. They are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The 'AC16374 can be used as two 8-bit flip-flops or one 16-bit flip-flop. On the positive transition of the clock (CLK) input, the Q outputs of the flip-flop take on the logic levels set up at the data (D) inputs.

A buffered output-enable ($\overline{OE}$) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly.

$\overline{OE}$ does not affect the internal operations of the flip-flop. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The 74AC16374 is packaged in TI's shrink small-outline package, which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The 54AC16374 is characterized for operation over the full military temperature range of –55°C to 125°C. The 74AC16374 is characterized for operation from –40°C to 85°C.



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**TEXAS
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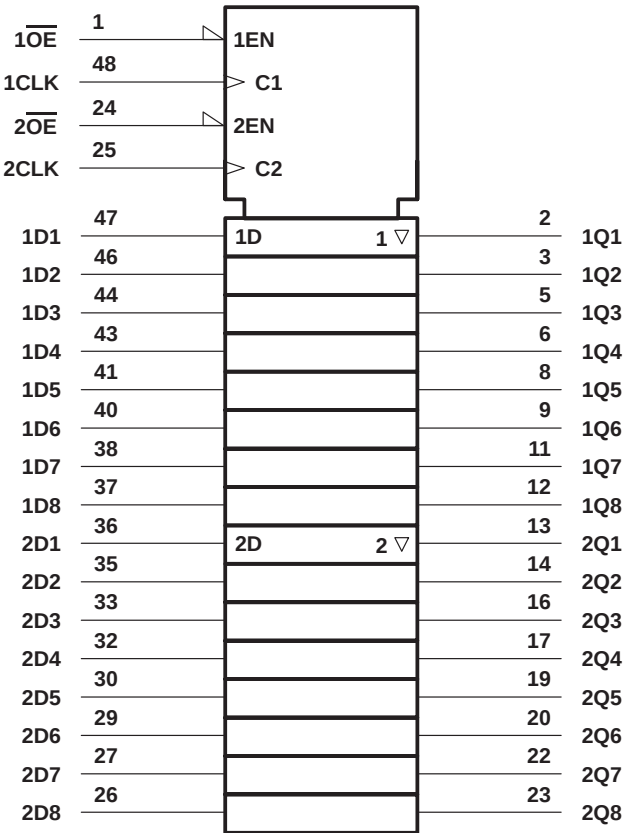
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WITH 3-STATE OUTPUTS

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FUNCTION TABLE

INPUTS			OUTPUT Q
$\overline{OE}$	CLK	D	
L	$\uparrow$	H	H
L	$\uparrow$	L	L
L	X	X	Q_0
L	$\downarrow$	X	Q_0
H	X	X	Z

logic symbol†

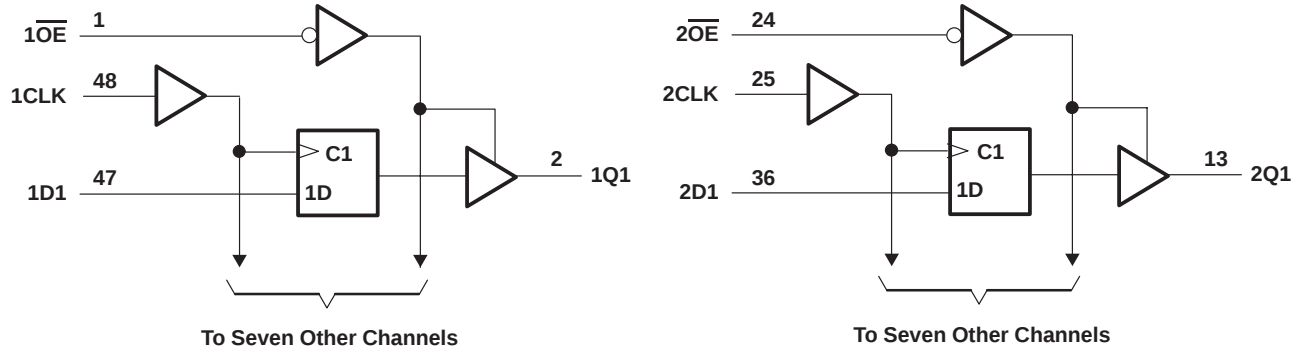


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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logic diagram (positive logic)



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, V_I (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Output voltage range, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$)	±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	±50 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±50 mA
Continuous current through V_{CC} or GND	±400 mA
Maximum power package dissipation at $T_A = 55^\circ\text{C}$ (in still air)(see Note 2): DL package	1.2 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 maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

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recommended operating conditions (see Note 3)

			54AC16374			74AC16374			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V _{CC}	Supply voltage		3	5	5.5	3	5	5.5	V
V _{IH}	High-level input voltage	V _{CC} = 3 V	2.1			2.1			V
		V _{CC} = 4.5 V	3.15			3.15			
		V _{CC} = 5.5 V	3.85			3.85			
V _{IL}	Low-level input voltage	V _{CC} = 3 V	0.9			0.9			V
		V _{CC} = 4.5 V	1.35			1.35			
		V _{CC} = 5.5 V	1.65			1.65			
V _I	Input voltage		0		V _{CC}	0		V _{CC}	V
V _O	Output voltage		0		V _{CC}	0		V _{CC}	V
I _{OH}	High-level output current	V _{CC} = 3 V	−4			−4			mA
		V _{CC} = 4.5 V	−24			−24			
		V _{CC} = 5.5 V	−24			−24			
I _{OL}	Low-level output current	V _{CC} = 3 V	12			12			mA
		V _{CC} = 4.5 V	24			24			
		V _{CC} = 5.5 V	24			24			
Δt/Δv	Input transition rise or fall rate		0		10	0		10	ns/V
T _A	Operating free-air temperature		−55		125	−40		85	°C

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

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

PARAMETER	TEST CONDITIONS	V _{CC}	T _A = 25°C			54AC16374		74AC16374		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V _{OH}	I _{OH} = –50 μA	3 V	2.9			2.9		2.9		V
		4.5 V	4.4			4.4		4.4		
		5.5 V	5.4			5.4		5.4		
	I _{OH} = –4 mA	3 V	2.58			2.48		2.48		
		4.5 V	3.94			3.8		3.8		
		5.5 V	4.94			4.8		4.8		
	I _{OH} = –75 mA [†]	5.5 V				3.85		3.85		
V _{OL}	I _{OL} = 50 μA	3 V			0.1		0.1		0.1	V
		4.5 V			0.1		0.1		0.1	
		5.5 V			0.1		0.1		0.1	
	I _{OL} = 12 mA	3 V			0.36		0.44		0.44	
		4.5 V			0.36		0.44		0.44	
		5.5 V			0.36		0.44		0.44	
	I _{OL} = 75 mA [†]	5.5 V				1.65		1.65		
I _I	V _I = V _{CC} or GND	5.5 V			±0.1		±1		±1	μA
I _{OZ}	V _O = V _{CC} or GND	5.5 V			±0.5		±5		±5	μA
I _{CC}	V _I = V _{CC} or GND, I _O = 0	5.5 V			8		80		80	μA
C _i	V _I = V _{CC} or GND	5 V			3					pF
C _o	V _O = V _{CC} or GND	5 V			11					pF

[†] Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

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timing requirements over recommended operating free-air temperature range
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see Figure 1)

			$T_A = 25^\circ\text{C}$		54AC16374		74AC16374		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	60	0	60	0	60	MHz
t_W	Pulse duration	CLK high or low	8.3		8.3		8.3		ns
t_{su}	Setup time, data before CLK $\uparrow$		7.5		7.5		7.5		ns
t_h	Hold time, data after CLK $\uparrow$		0		0		0		ns

timing requirements over recommended operating free-air temperature range
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)

			$T_A = 25^\circ\text{C}$		54AC16374		74AC16374		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		0	100	0	100	0	100	MHz
t_W	Pulse duration	CLK high or low	5		5		5		ns
t_{su}	Setup time, data before CLK $\uparrow$		5		5		5		ns
t_h	Hold time, data after CLK $\uparrow$		0		0		0		ns

switching characteristics over recommended operating free-air temperature range
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			54AC16374		74AC16374		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			60			60		60		MHz
t_{PLH}	CLK	Q	4.9	12.2	15	4.9	17	4.9	17	ns
t_{PHL}			4.8	11.9	14.3	4.8	15.7	4.8	15.7	
t_{PZH}	$\overline{\text{OE}}$	Q	4.3	11.9	14.7	4.3	16.8	4.3	16.8	ns
t_{PZL}			5.3	15.5	18.7	5.3	21.2	5.3	21.2	
t_{PHZ}	$\overline{\text{OE}}$	Q	4	7.3	9	4	9.8	4	9.8	ns
t_{PLZ}			3.8	7.1	8.8	3.8	9.4	3.8	9.4	

switching characteristics over recommended operating free-air temperature range
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			54AC16374		74AC16374		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			100			100		100		MHz
t_{PLH}	CLK	Q	3.8	7.6	9.5	3.8	10.8	3.8	10.8	ns
t_{PHL}			3.8	7.6	9.5	3.8	10.6	3.8	10.6	
t_{PZH}	$\overline{\text{OE}}$	Q	3.2	7.2	9	3.2	10.2	3.2	10.2	ns
t_{PZL}			3.8	8.7	10.7	3.8	12.1	3.8	12.1	
t_{PHZ}	$\overline{\text{OE}}$	Q	3.7	6	7.5	3.7	8.2	3.7	8.2	ns
t_{PLZ}			3.5	5.8	7.3	3.5	7.9	3.5	7.9	

operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER			TEST CONDITIONS		TYP	UNIT
C_{pd}	Power dissipation capacitance per flip-flop	Outputs enabled	$C_L = 50\text{ pF}$	$f = 1\text{ MHz}$	49	pF
		Outputs disabled			32	

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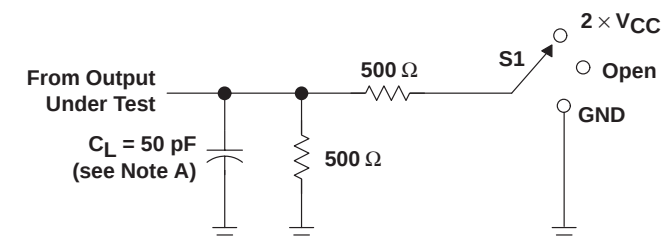
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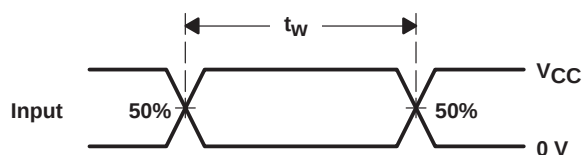
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PARAMETER MEASUREMENT INFORMATION

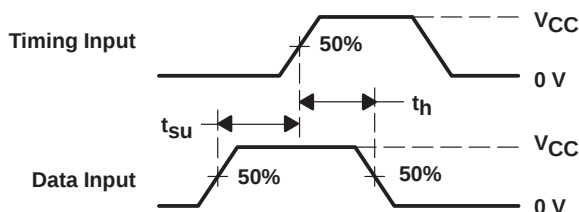


LOAD CIRCUIT

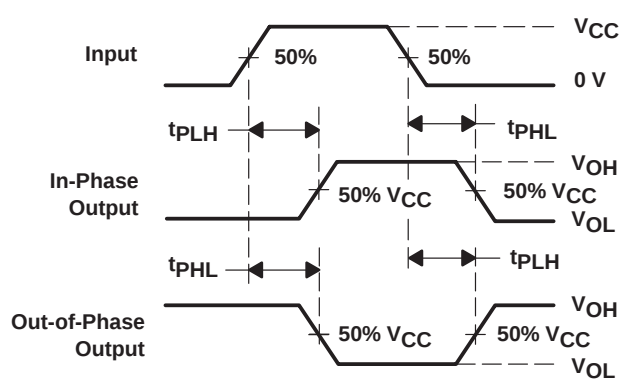
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND



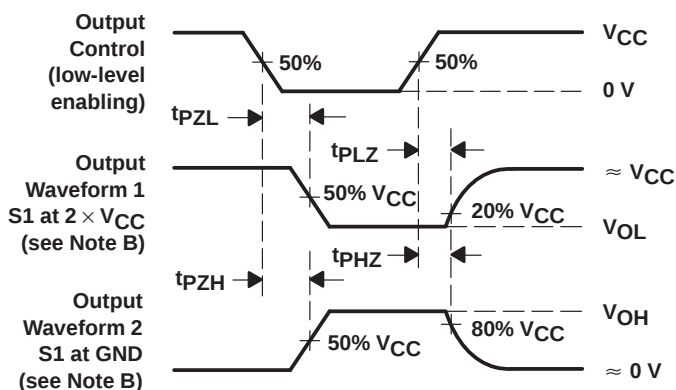
VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS

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: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r = 3 \text{ ns}$, $t_f = 3 \text{ ns}$.

D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
74AC16374DL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AC16374DLG4	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AC16374DLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74AC16374DLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽¹⁾ 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.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), 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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
74AC16374DLR	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	3.1	16.0	32.0	Q1

TAPE AND REEL BOX DIMENSIONS



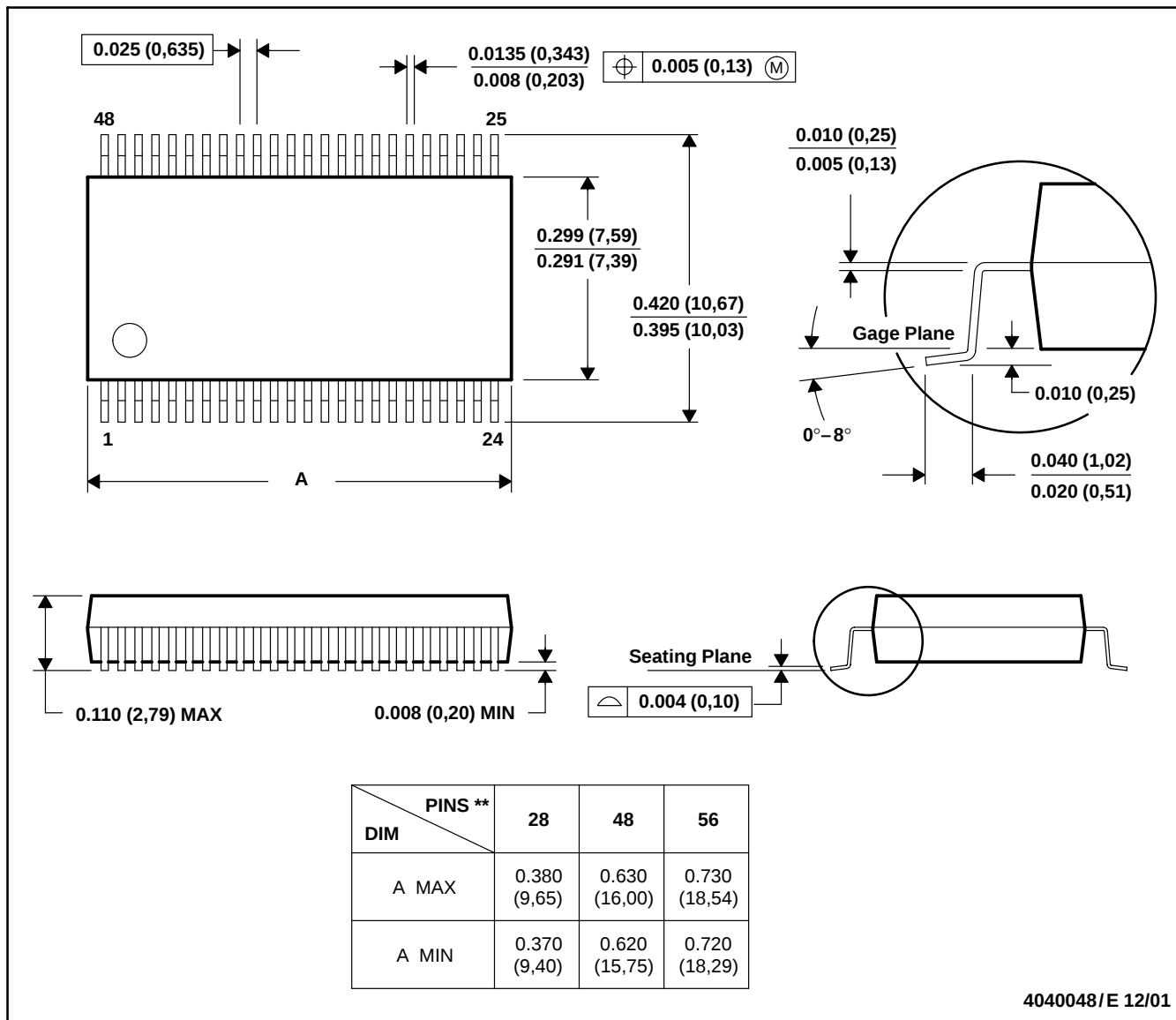
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
74AC16374DLR	SSOP	DL	48	1000	346.0	346.0	49.0

DL (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MO-118

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