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[SN74ALVTH16374KR](#)

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FEATURES

- **State-of-the-Art Advanced BiCMOS Technology (ABT) Widebus™ Design for 2.5-V and 3.3-V Operation and Low Static Power Dissipation**
- **Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 2.3-V to 3.6-V V_{CC})**
- **Typical V_{OLP} (Output Ground Bounce) <0.8 V at $V_{CC} = 3.3 V$, $T_A = 25^\circ C$**
- **High Drive (–24/24 mA at 2.5-V V_{CC} and –32/64 mA at 3.3-V)**
- **Power Off Disables Outputs, Permitting Live Insertion**
- **High-Impedance State During Power Up and Power Down Prevents Driver Conflict**
- **Uses Bus Hold on Data Inputs in Place of External Pullup/Pulldown Resistors to Prevent the Bus From Floating**
- **Auto3-State Eliminates Bus Current Loading When Output Exceeds $V_{CC} + 0.5 V$**
- **Latch-Up Performance Exceeds 250 mA Per JESD 17**
- **ESD Protection**
 - Exceeds 2000 V Per MIL-STD-883, Method 3015
 - Exceeds 200 V Using Machine Model
 - Exceeds 1000 V Using Charged-Device Model, Robotic Method
- **Flow-Through Architecture Facilitates Printed Circuit Board Layout**
- **Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise**
- **Package Options Include Plastic Shrink Small-Outline (DL), Thin Shrink Small-Outline (DGG), Thin Very Small-Outline (DGV) Packages, and 380-mil Fine-Pitch Ceramic Flat (WD) Package**

SN54ALVTH16374...WD PACKAGE
 SN74ALVTH16374...DGG, DGV, OR DL PACKAGE
 (TOP VIEW)

$\overline{1OE}$	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
$\overline{2OE}$	24	25	2CLK

DESCRIPTION/ORDERING INFORMATION

The 'ALVTH16374 devices are 16-bit edge-triggered D-type flip-flops with 3-state outputs designed for 2.5-V or 3.3-V V_{CC} operation, but with the capability to provide a TTL interface to a 5-V system environment. These devices are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

These devices can be used as two 8-bit flip-flops or one 16-bit flip-flop. On the positive transition of the clock (CLK), the flip-flops store the logic levels set up at the data (D) inputs.



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Widebus is a trademark of Texas Instruments.

SN54ALVTH16374, SN74ALVTH16374
2.5-V/3.3-V 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS
WITH 3-STATE OUTPUTS



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DESCRIPTION/ORDERING INFORMATION (CONTINUED)

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. The high-impedance state and the increased drive provide the capability to drive bus lines without need for interface or pullup components.

\overline{OE} does not affect 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.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

When V_{CC} is between 0 and 1.2 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.2 V, \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.

The SN54ALVTH16374 is characterized for operation over the full military temperature range of -55°C to 125°C .

The SN74ALVTH16374 is characterized for operation from -40°C to 85°C .

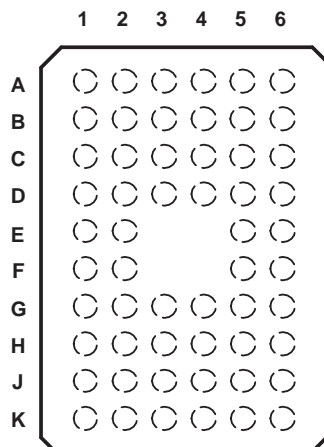
ORDERING INFORMATION

T_A	PACKAGE		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	TSSOP – DGG	Reel of 2000	74ALVTH16374GRE4	
			SN74ALVTH16374GR	
	TVSOP – DGV	Reel of 2000	74ALVTH16374VRE4	
			SN74ALVTH16374VR	
	SSOP – DL	Tube of 25	74ALVTH16374DL	
			SN74ALVTH16374DLG4	
		Reel of 1000	SN74ALVTH16374DLR	
			SN74ALVTH16374DLRG4	

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WITH 3-STATE OUTPUTS

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ZQL PACKAGE
(TOP VIEW)



TERMINAL ASSIGNMENTS⁽¹⁾

	1	2	3	4	5	6
A	$\overline{1OE}$	NC	NC	NC	NC	1CLK
B	1Q2	1Q1	GND	GND	1D1	1D2
C	1Q4	1Q3	V _{CC}	V _{CC}	1D3	1D4
D	1Q6	1Q5	GND	GND	1D5	1D6
E	1Q8	1Q7			1D7	1D8
F	2Q1	2Q2			2D2	2D1
G	2Q3	2Q4	GND	GND	2D4	2D3
H	2Q5	2Q6	V _{CC}	V _{CC}	2D6	2D5
J	2Q7	2Q8	GND	GND	2D8	2D7
K	$\overline{2OE}$	NC	NC	NC	NC	2CLK

(1) NC – No internal connection

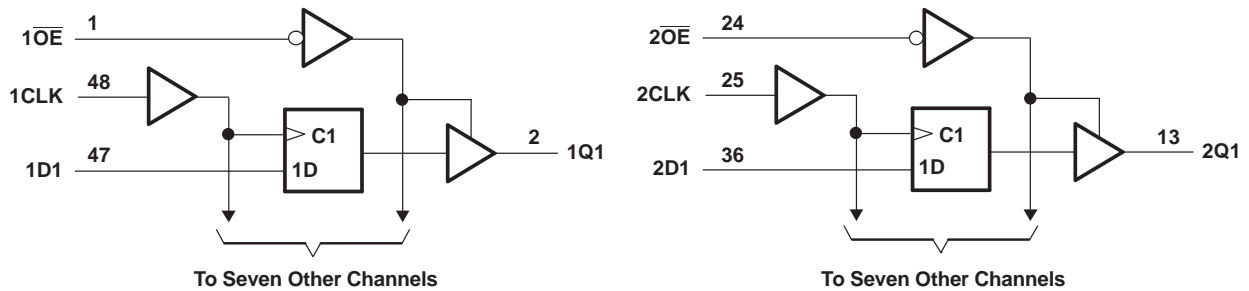
FUNCTION TABLE
(each 8-bit section)

INPUTS			OUTPUT Q
\overline{OE}	CLK	D	
L	↑	H	H
L	↑	L	L
L	H or L	X	Q ₀
H	X	X	Z

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WITH 3-STATE OUTPUTS

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LOGIC DIAGRAM (POSITIVE LOGIC)



Pin numbers shown are for the DGG, DL, and WD packages.

Absolute Maximum Ratings⁽¹⁾

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

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	-0.5	4.6	V
V_I	Input voltage range ⁽²⁾	-0.5	7	V
V_O	Voltage range applied to any output in the high-impedance or power-off state ⁽²⁾	-0.5	7	V
V_O	Voltage range applied to any output in the high state ⁽²⁾	-0.5	7	V
I_O	Output current in the low state	SN54ALVTH16374 ⁽³⁾	96	mA
		SN74ALVTH16374	128	
I_O	Output current in the high state	SN54ALVTH16374 ⁽³⁾	-48	mA
		SN74ALVTH16374	-64	
I_{IK}	Input clamp current	$V_I < 0$	-50	mA
I_{OK}	Output clamp current	$V_O < 0$	-50	mA
θ_{JA}	Package thermal impedance ⁽⁴⁾	DGG package	89	°C/W
		DGV package	93	
		DL package	94	
T_{stg}	Storage temperature range	-65	150	°C

- (1) 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.
- (2) The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- (3) Product preview
- (4) The package thermal impedance is calculated in accordance with JESD 51.

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2.5-V/3.3-V 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS
WITH 3-STATE OUTPUTS

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Recommended Operating Conditions⁽¹⁾

$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$

		SN54ALVTH16374 ⁽²⁾			SN74ALVTH16374			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
V_{CC}	Supply voltage	2.3		2.7	2.3		2.7	V
V_{IH}	High-level input voltage	1.7			1.7			V
V_{IL}	Low-level input voltage			0.7			0.7	V
V_I	Input voltage	0	V_{CC}	5.5	0	V_{CC}	5.5	V
I_{OH}	High-level output current			-6			-8	mA
I_{OL}	Low-level output current			6			8	mA
	Low-level output current; current duty cycle $\leq 50\%$; $f \geq 1\text{ kHz}$			18			24	
$\Delta t/\Delta v$	Input transition rise or fall rate			10			10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate	200			200			$\mu\text{s/V}$
T_A	Operating free-air temperature	-55		125	-40		85	$^{\circ}\text{C}$

(1) All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

(2) Product preview

Recommended Operating Conditions⁽¹⁾

$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$

		SN54ALVTH16374 ⁽²⁾			SN74ALVTH16374			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
V_{CC}	Supply voltage	3		3.6	3		3.6	V
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage			0.8			0.8	V
V_I	Input voltage	0	V_{CC}	5.5	0	V_{CC}	5.5	V
I_{OH}	High-level output current			-24			-32	mA
I_{OL}	Low-level output current			24			32	mA
	Low-level output current; current duty cycle $\leq 50\%$; $f \geq 1\text{ kHz}$			48			64	
$\Delta t/\Delta v$	Input transition rise or fall rate			10			10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate	200			200			$\mu\text{s/V}$
T_A	Operating free-air temperature	-55		125	-40		85	$^{\circ}\text{C}$

(1) All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

(2) Product preview

SN54ALVTH16374, SN74ALVTH16374

2.5-V/3.3-V 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

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Electrical Characteristics

 over operating free-air temperature range $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS		SN54ALVTH16374 ⁽¹⁾		SN74ALVTH16374		UNIT	
			MIN	TYP ⁽²⁾	MAX	MIN		TYP ⁽²⁾
V_{IK}	$V_{CC} = 2.3\text{ V}$,	$I_I = -18\text{ mA}$			-1.2		-1.2	V
V_{OH}	$V_{CC} = 2.3\text{ V to } 2.7\text{ V}$, $I_{OH} = -100\text{ }\mu\text{A}$		$V_{CC} - 0.2$		$V_{CC} - 0.2$			V
	$V_{CC} = 2.3\text{ V}$	$I_{OH} = -6\text{ mA}$	1.8					
V_{OL}		$V_{CC} = 2.3\text{ V to } 2.7\text{ V}$, $I_{OL} = 100\text{ }\mu\text{A}$				0.2	0.2	
	$V_{CC} = 2.3\text{ V}$	$I_{OL} = 6\text{ mA}$			0.4			
		$I_{OL} = 8\text{ mA}$				0.4		
		$I_{OL} = 18\text{ mA}$			0.5			
I_I	Control inputs	$V_{CC} = 2.7\text{ V}$,	$V_I = V_{CC}$ or GND	± 1		± 1		μA
		$V_{CC} = 0$ or 2.7 V ,	$V_I = 5.5\text{ V}$	10		10		
	Data inputs	$V_{CC} = 2.7\text{ V}$	$V_I = 5.5\text{ V}$	10		10		
			$V_I = V_{CC}$	1		1		
			$V_I = 0$	-5		-5		
I_{off}	$V_{CC} = 0$, V_I or $V_O = 0$ to 4.5 V				± 100		μA	
I_{BHL} ⁽³⁾	$V_{CC} = 2.3\text{ V}$,	$V_I = 0.7\text{ V}$	115		115		μA	
I_{BHH} ⁽⁴⁾	$V_{CC} = 2.3\text{ V}$,	$V_I = 1.7\text{ V}$	-10		-10		μA	
I_{BHLO} ⁽⁵⁾	$V_{CC} = 2.7\text{ V}$,	$V_I = 0$ to V_{CC}	300		300		μA	
I_{BHHO} ⁽⁶⁾	$V_{CC} = 2.7\text{ V}$,	$V_I = 0$ to V_{CC}	-300		-300		μA	
I_{EX} ⁽⁷⁾	$V_{CC} = 2.3\text{ V}$,	$V_O = 5.5\text{ V}$	125		125		μA	
$I_{OZ(PU/PD)}$ ⁽⁸⁾	$V_{CC} \leq 1.2\text{ V}$, $V_O = 0.5\text{ V to } V_{CC}$, $V_I = \text{GND or } V_{CC}$, $\text{OE} = \text{don't care}$		± 100		± 100		μA	
I_{OZH}	$V_{CC} = 2.7\text{ V}$, $V_O = 2.3\text{ V}$, $V_I = 0.7\text{ V or } 1.7\text{ V}$		5		5		μA	
I_{OZL}	$V_{CC} = 2.7\text{ V}$, $V_O = 0.5\text{ V}$, $V_I = 0.7\text{ V or } 1.7\text{ V}$		-5		-5		μA	
I_{CC}	$V_{CC} = 2.7\text{ V}$, $I_O = 0$, $V_I = V_{CC}$ or GND	Outputs high	0.04	0.1	0.1		mA	
		Outputs low	2.3	4.5	4.5			
		Outputs disabled	0.04	0.1	0.1			
C_i	$V_{CC} = 2.5\text{ V}$,	$V_I = 2.5\text{ V or } 0$	3.5				pF	
C_o	$V_{CC} = 2.5\text{ V}$,	$V_O = 2.5\text{ V or } 0$	6				pF	

(1) Product preview

 (2) All typical values are at $V_{CC} = 2.5\text{ V}$, $T_A = 25^\circ\text{C}$.

 (3) The bus-hold circuit can sink at least the minimum low sustaining current at V_{IL} max. I_{BHL} should be measured after lowering V_{IN} to GND and then raising it to V_{IL} max.

 (4) The bus-hold circuit can source at least the minimum high sustaining current at V_{IH} min. I_{BHH} should be measured after raising V_{IN} to V_{CC} and then lowering it to V_{IH} min.

 (5) An external driver must source at least I_{BHLO} to switch this node from low to high.

 (6) An external driver must sink at least I_{BHHO} to switch this node from high to low.

 (7) Current into an output in the high state when $V_O > V_{CC}$

(8) High-impedance state during power up or power down

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Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	SN54ALVTH16374 ⁽¹⁾		SN74ALVTH16374		UNIT		
		MIN	TYP ⁽²⁾	MAX	MIN		TYP ⁽²⁾	MAX
V_{IK}	$V_{CC} = 3\text{ V}$, $I_I = -18\text{ mA}$			-1.2		-1.2	V	
V_{OH}	$V_{CC} = 3\text{ V to } 3.6\text{ V}$, $I_{OH} = -100\text{ }\mu\text{A}$	$V_{CC} - 0.2$		$V_{CC} - 0.2$		V		
	$V_{CC} = 3\text{ V}$	2		2				
V_{OL}	$V_{CC} = 3\text{ V to } 3.6\text{ V}$, $I_{OL} = 100\text{ }\mu\text{A}$			0.2	0.2		V	
	$V_{CC} = 3\text{ V}$	$I_{OL} = 16\text{ mA}$			0.4			
		$I_{OL} = 24\text{ mA}$		0.5				
		$I_{OL} = 32\text{ mA}$				0.5		
		$I_{OL} = 48\text{ mA}$		0.55				
$I_{OL} = 64\text{ mA}$					0.55			
I_I	Control inputs	$V_{CC} = 3.6\text{ V}$, $V_I = V_{CC}$ or GND		± 1		± 1	μA	
		$V_{CC} = 0$ or 3.6 V , $V_I = 5.5\text{ V}$		10		10		
	Data inputs	$V_{CC} = 3.6\text{ V}$	$V_I = 5.5\text{ V}$		10			10
			$V_I = V_{CC}$		1			1
$V_I = 0$			-5		-5			
I_{off}	$V_{CC} = 0$, V_I or $V_O = 0$ to 4.5 V					± 100	μA	
I_{BHL} ⁽³⁾	$V_{CC} = 3\text{ V}$, $V_I = 0.8\text{ V}$	75		75		μA		
I_{BHH} ⁽⁴⁾	$V_{CC} = 3\text{ V}$, $V_I = 2\text{ V}$	-75		-75		μA		
I_{BHLO} ⁽⁵⁾	$V_{CC} = 3.6\text{ V}$, $V_I = 0$ to V_{CC}	500		500		μA		
I_{BHHO} ⁽⁶⁾	$V_{CC} = 3.6\text{ V}$, $V_I = 0$ to V_{CC}	-500		-500		μA		
I_{EX} ⁽⁷⁾	$V_{CC} = 3\text{ V}$, $V_O = 5.5\text{ V}$			125	125		μA	
$I_{OZ(PU/PD)}$ ⁽⁸⁾	$V_{CC} \leq 1.2\text{ V}$, $V_O = 0.5\text{ V to } V_{CC}$, $V_I = \text{GND or } V_{CC}$, OE = don't care			± 100	± 100		μA	
I_{OZH}	$V_{CC} = 3.6\text{ V}$, $V_O = 3\text{ V}$, $V_I = 0.8\text{ V or } 27\text{ V}$			5	5		μA	
I_{OZL}	$V_{CC} = 3.6\text{ V}$, $V_O = 0.5\text{ V}$, $V_I = 0.8\text{ V or } 2\text{ V}$			-5	-5		μA	
I_{CC}	$V_{CC} = 3.6\text{ V}$, $I_O = 0$, $V_I = V_{CC}$ or GND	Outputs high		0.07	0.1	0.07	0.1	mA
		Outputs low		3.2	5	3.2	5	
		Outputs disabled		0.07	0.1	0.1		
ΔI_{CC} ⁽⁹⁾	$V_{CC} = 3\text{ V to } 3.6\text{ V}$, One input at $V_{CC} - 0.6\text{ V}$, Other inputs at V_{CC} or GND			0.4		0.4	mA	
C_i	$V_{CC} = 3.3\text{ V}$, $V_I = 3.3\text{ V or } 0$			3.5		3.5	pF	
C_o	$V_{CC} = 3.3\text{ V}$, $V_O = 3.3\text{ V or } 0$			6		6	pF	

(1) Product preview

 (2) All typical values are at $V_{CC} = 2.5\text{ V}$, $T_A = 25^\circ\text{C}$.

 (3) The bus-hold circuit can sink at least the minimum low sustaining current at V_{IL} max. I_{BHL} should be measured after lowering V_{IN} to GND and then raising it to V_{IL} max.

 (4) The bus-hold circuit can source at least the minimum high sustaining current at V_{IH} min. I_{BHH} should be measured after raising V_{IN} to V_{CC} and then lowering it to V_{IH} min.

 (5) An external driver must source at least I_{BHLO} to switch this node from low to high.

 (6) An external driver must sink at least I_{BHHO} to switch this node from high to low.

 (7) Current into an output in the high state when $V_O > V_{CC}$

(8) High-impedance state during power up or power down

 (9) This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

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2.5-V/3.3-V 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS
WITH 3-STATE OUTPUTS



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Timing Requirements

over recommended operating free-air temperature range $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted) (see Figure 1)

		SN54ALVTH16374 ⁽¹⁾		SN74ALVTH16374		UNIT
		MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	150		150		MHz
t_w	Pulse duration, CLK high or low	1.5		1.5		ns
t_{su}	Setup time, data before CLK↑	Data high	1.1	1		ns
		Data low	1.4	1.3		
t_h	Hold time, data after CLK↑	Data high	0.6	0.5		ns
		Data low	0.9	0.8		

(1) Product preview

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 2)

		SN54ALVTH16374 ⁽¹⁾		SN74ALVTH16374		UNIT
		MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	25		250		MHz
t_w	Pulse duration, CLK high or low	1.5		1.5		ns
t_{su}	Setup time, data before CLK↑	Data high	1.1	1		ns
		Data low	1.6	1.5		
t_h	Hold time, data after CLK↑	Data high	0.6	0.5		ns
		Data low	1.1	1		

(1) Product preview

SN54ALVTH16374, SN74ALVTH16374 2.5-V/3.3-V 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

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Switching Characteristics

over recommended operating free-air temperature range, $C_L = 30 \text{ pF}$, $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ALVTH16374 ⁽¹⁾		SN74ALVTH16374		UNIT
			MIN	MAX	MIN	MAX	
f_{max}			150		150		MHz
t_{PLH}	CLK	Q	1.4	3.9	1.5	3.8	ns
t_{PHL}			1.4	3.9	1.5	3.8	
t_{PZH}	\overline{OE}	Q	1	4.2	1	4.1	ns
t_{PZL}			1	3.8	1	3.7	
t_{PHZ}	\overline{OE}	Q	1.7	4.3	1.8	4.2	ns
t_{PLZ}			1	3.5	1	3.4	

(1) Product preview

Switching Characteristics

over recommended operating free-air temperature range, $C_L = 50 \text{ pF}$, $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ALVTH16374 ⁽¹⁾		SN74ALVTH16374		UNIT
			MIN	MAX	MIN	MAX	
f_{max}			250		250		MHz
t_{PLH}	CLK	Q	1	3.4	1	3.2	ns
t_{PHL}			1	3.3	1	3.2	
t_{PZH}	\overline{OE}	Q	1	3.9	1	3.8	ns
t_{PZL}			1	3.4	1	3.3	
t_{PHZ}	\overline{OE}	Q	1	4.7	1	4.6	ns
t_{PLZ}			1	4.4	1	4.2	

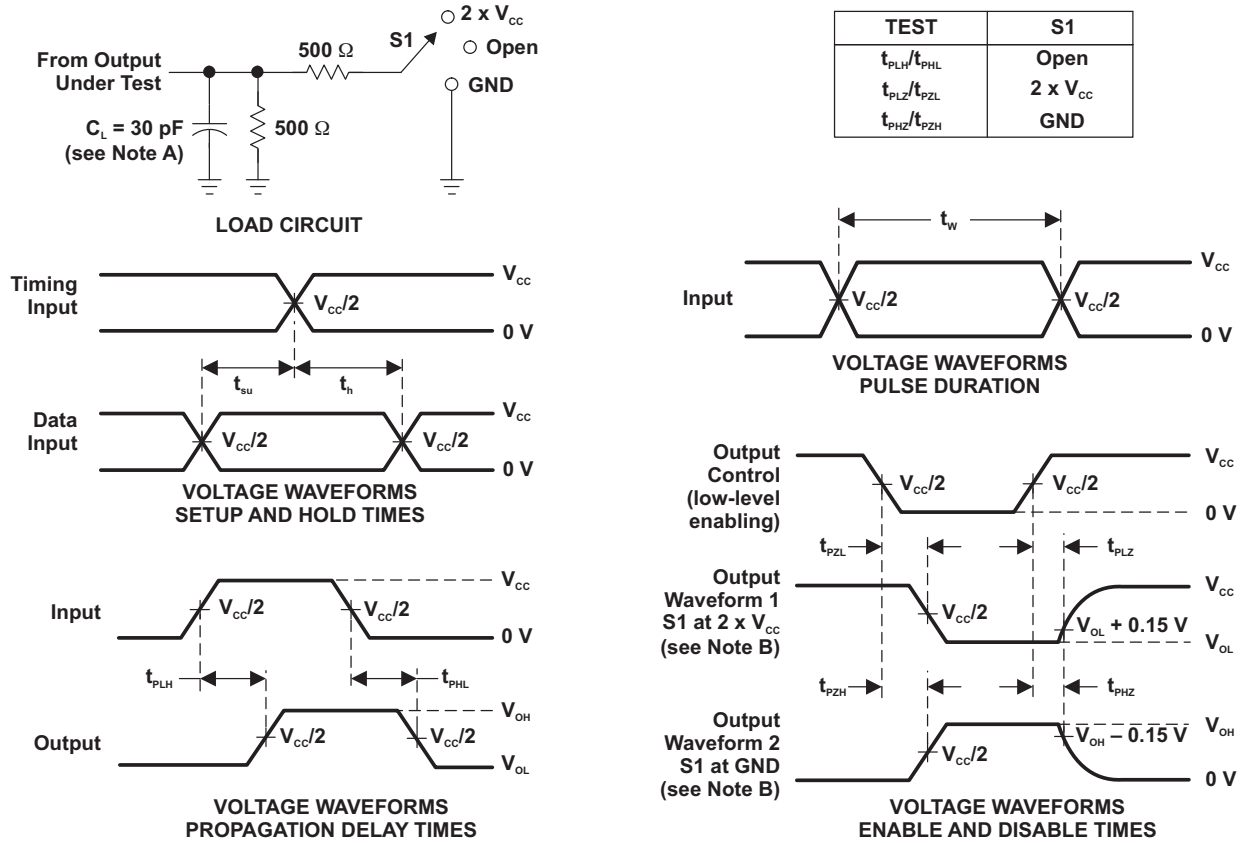
(1) Product preview

SN54ALVTH16374, SN74ALVTH16374
2.5-V/3.3-V 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS
WITH 3-STATE OUTPUTS

SCES068G—JUNE 1996—REVISED NOVEMBER 2006



PARAMETER MEASUREMENT INFORMATION
 $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$



- 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: $PRR \leq 10\text{ MHz}$, $Z_o = 50\ \Omega$, $t_r \leq 2\text{ ns}$, $t_f \leq 2\text{ ns}$.
 D. The outputs are measured one at a time, with one transition per measurement.

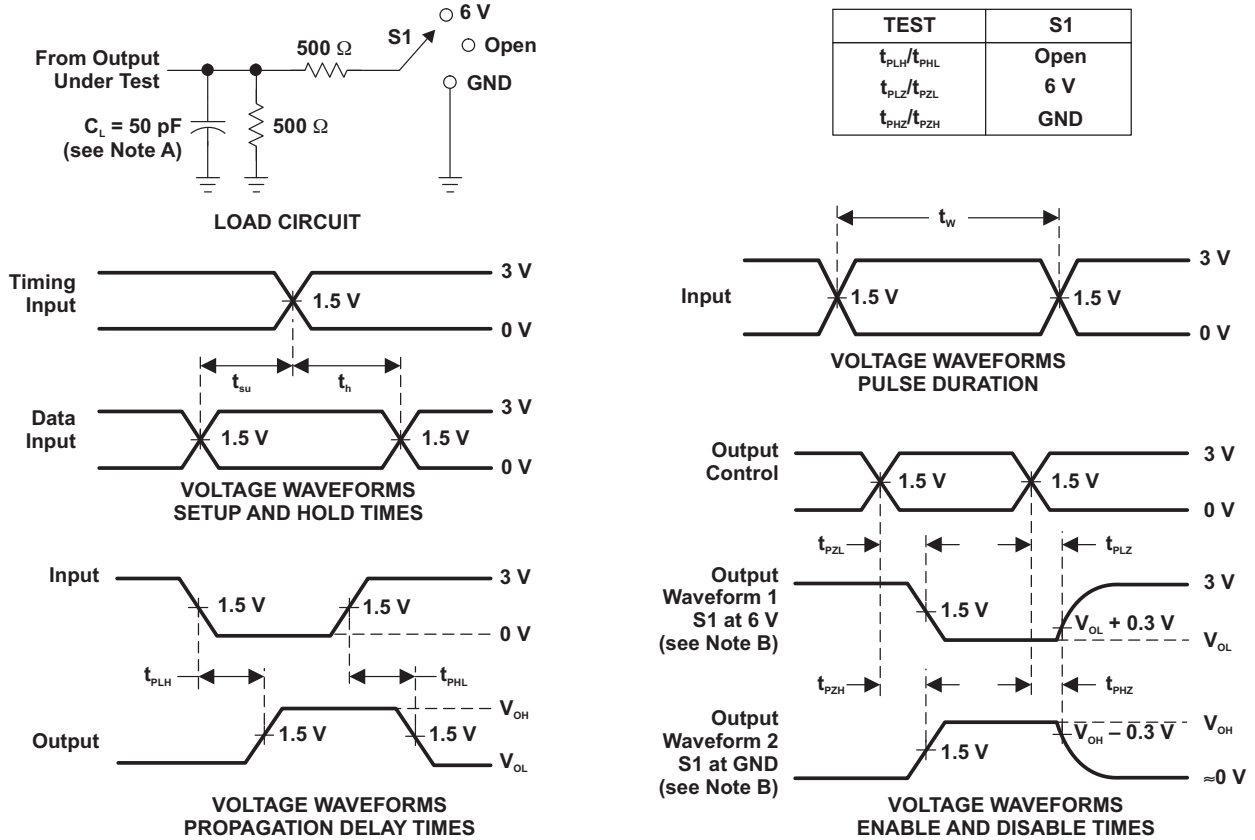
Figure 1. Load Circuit and Voltage Waveforms

SN54ALVTH16374, SN74ALVTH16374
2.5-V/3.3-V 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS
WITH 3-STATE OUTPUTS

SCES068G—JUNE 1996—REVISED NOVEMBER 2006

PARAMETER MEASUREMENT INFORMATION

$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$



- 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: $PRR \leq 10 \text{ MHz}$, $Z_o = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.
 D. The outputs are measured one at a time, with one transition per measurement.

Figure 2. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
74ALVTH16374ZQLR	ACTIVE	BGA MICROSTAR JUNIOR	ZQL	56	1000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	VT374	Samples
SN74ALVTH16374DL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVTH16374	Samples
SN74ALVTH16374DLR	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVTH16374	Samples
SN74ALVTH16374GR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVTH16374	Samples
SN74ALVTH16374KR	OBSOLETE	BGA MICROSTAR JUNIOR	GQL	56		TBD	Call TI	Call TI	-40 to 85		
SN74ALVTH16374VR	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	VT374	Samples

⁽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.

⁽⁴⁾ There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.



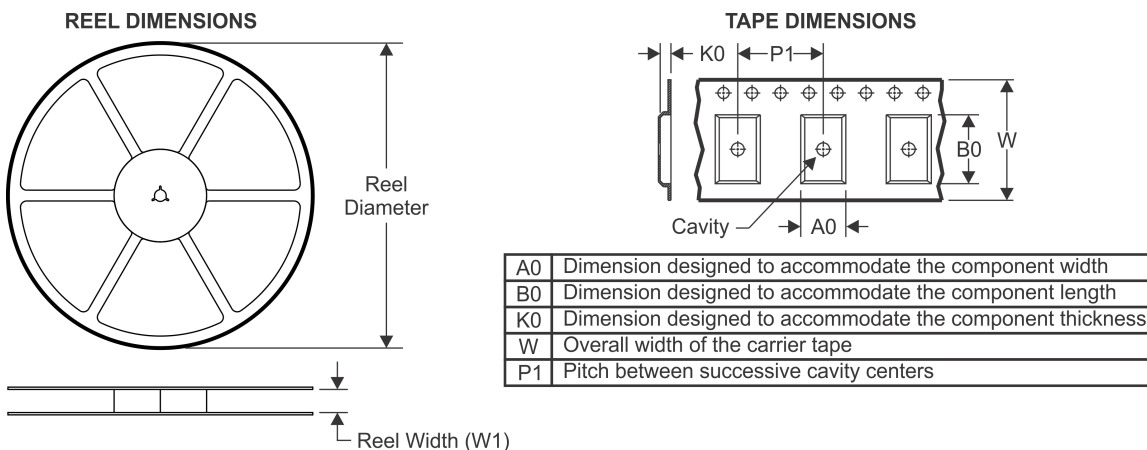
⁽⁵⁾ Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

⁽⁶⁾ Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

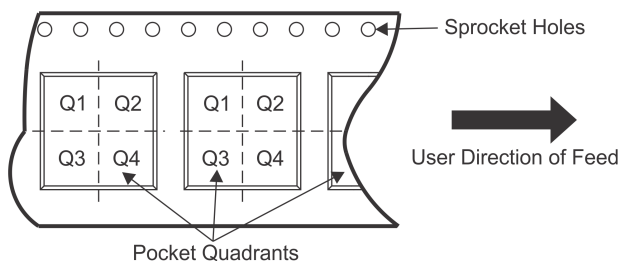
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TAPE AND REEL INFORMATION



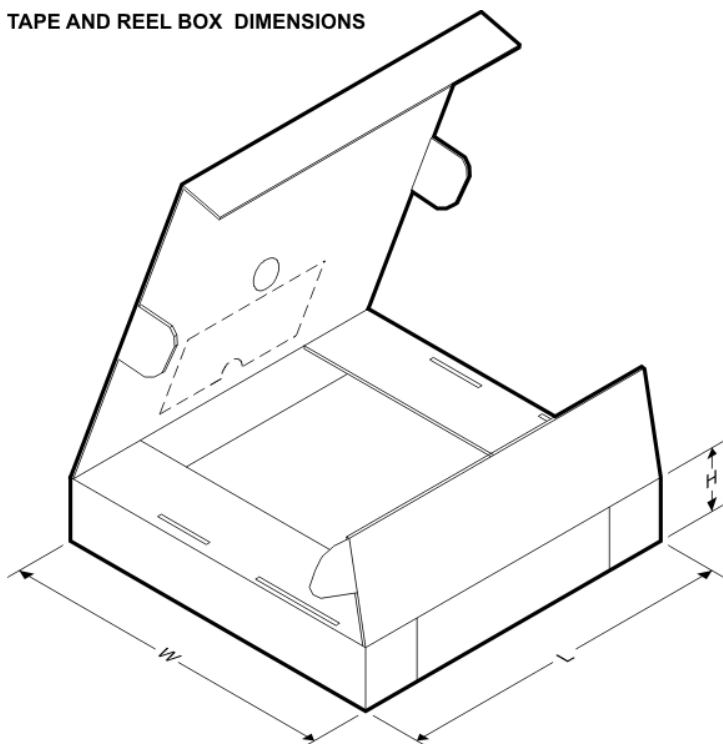
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
74ALVTH16374ZQLR	BGA MICROSTAR JUNIOR	ZQL	56	1000	330.0	16.4	4.8	7.3	1.5	8.0	16.0	Q1
SN74ALVTH16374DLR	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	3.1	16.0	32.0	Q1
SN74ALVTH16374GR	TSSOP	DGG	48	2000	330.0	24.4	8.6	15.8	1.8	12.0	24.0	Q1
SN74ALVTH16374VR	TVSOP	DGV	48	2000	330.0	16.4	7.1	10.2	1.6	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



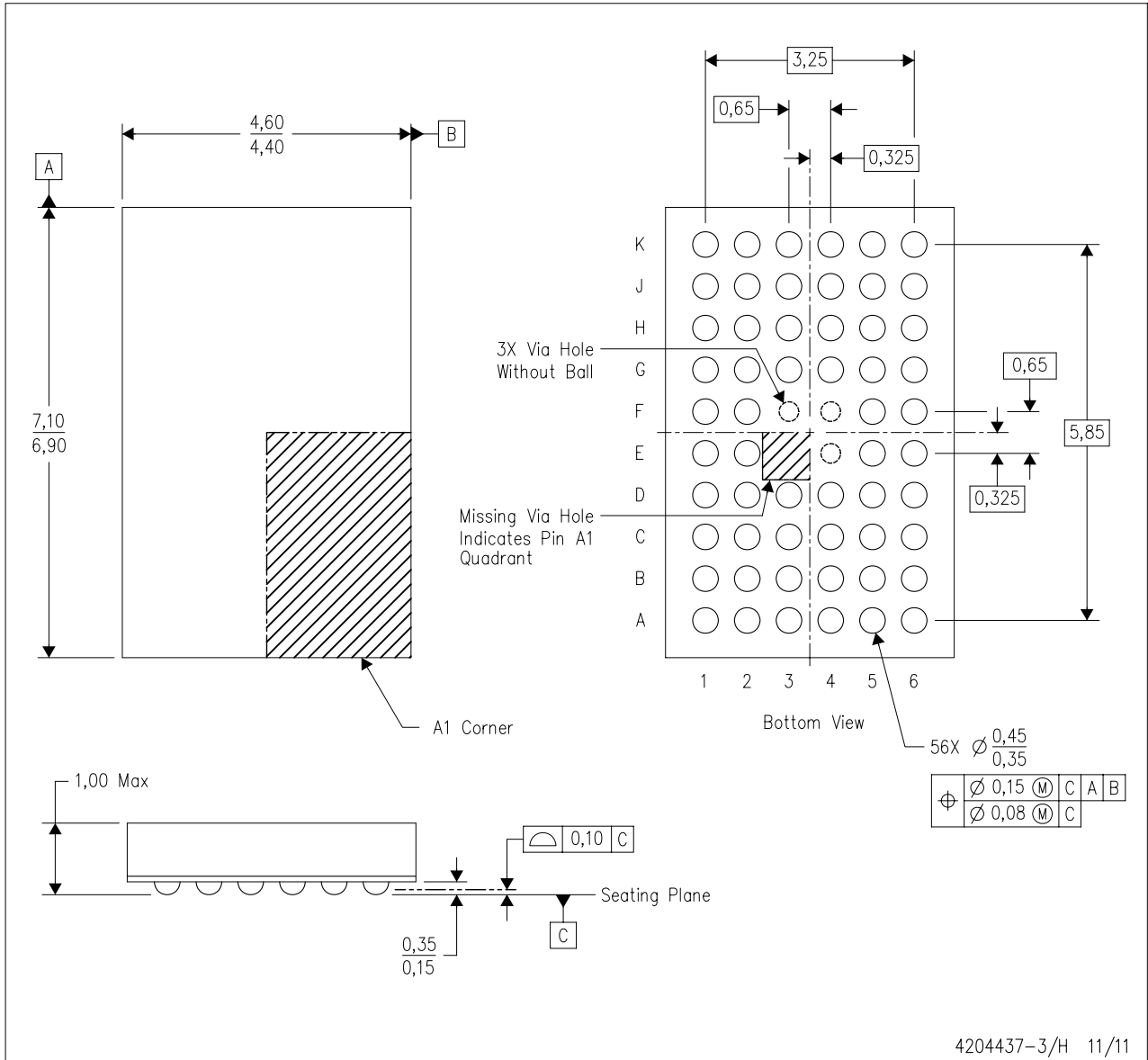
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
74ALVTH16374ZQLR	BGA MICROSTAR JUNIOR	ZQL	56	1000	333.2	345.9	28.6
SN74ALVTH16374DLR	SSOP	DL	48	1000	367.0	367.0	55.0
SN74ALVTH16374GR	TSSOP	DGG	48	2000	367.0	367.0	45.0
SN74ALVTH16374VR	TVSOP	DGV	48	2000	367.0	367.0	38.0

MECHANICAL DATA

ZQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY



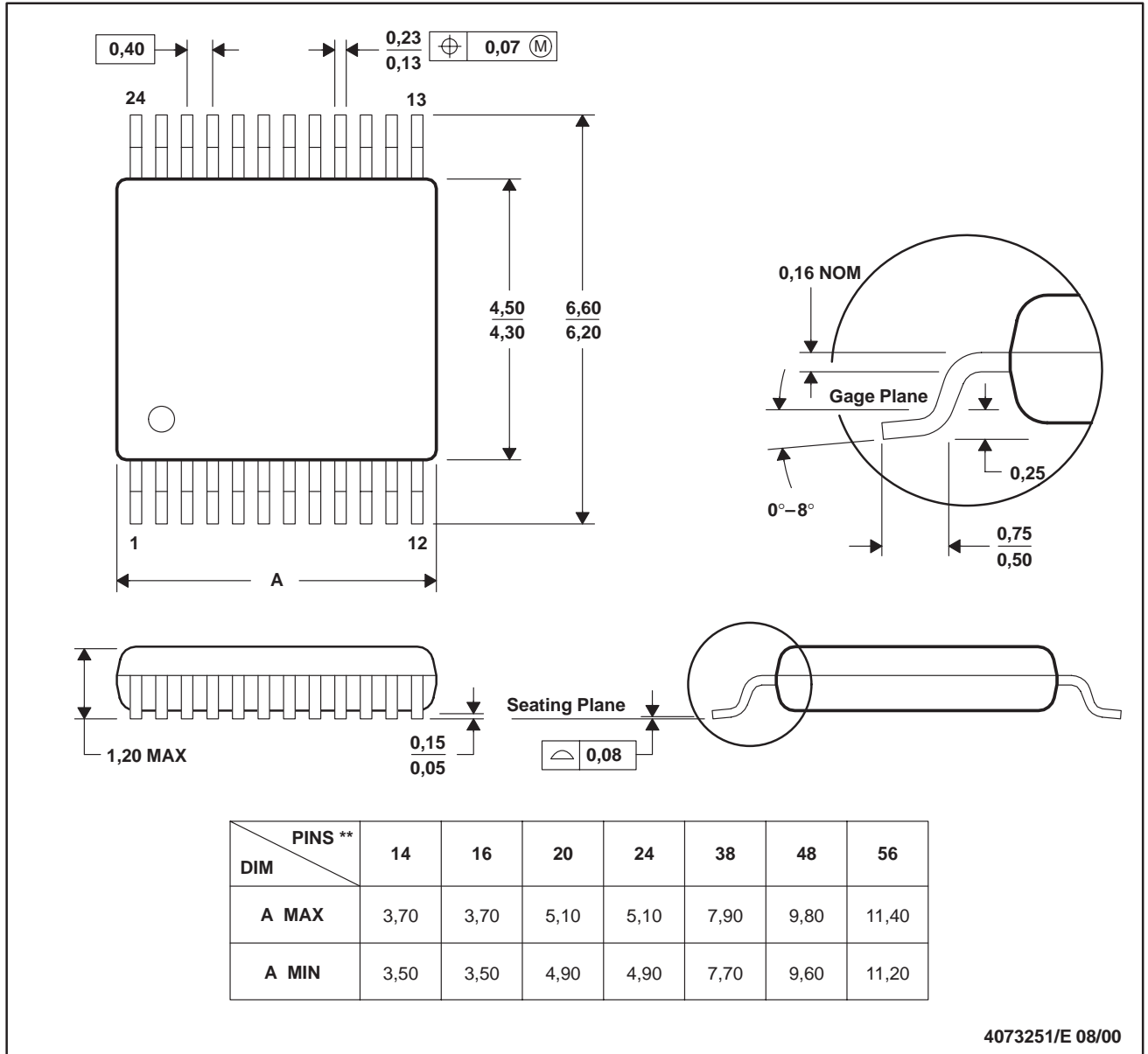
- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-285 variation BA-2.
 - D. This package is Pb-free. Refer to the 56 GQL package (drawing 4200583) for tin-lead (SnPb).

MPDS006C – FEBRUARY 1996 – REVISED AUGUST 2000

DGV (R-PDSO-G)**

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



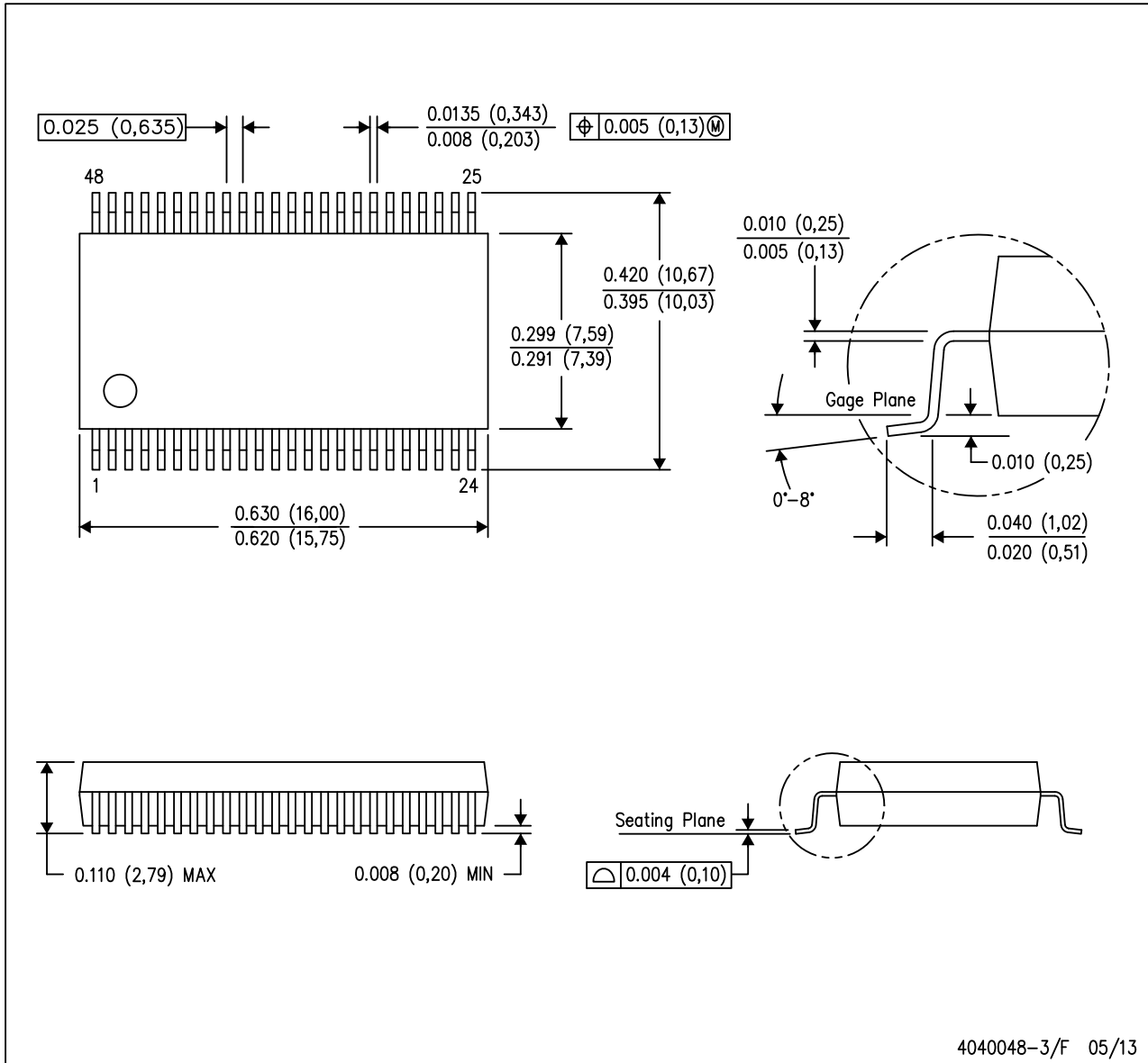
4073251/E 08/00

- 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

MECHANICAL DATA

DL (R-PDSO-G48)

PLASTIC SMALL-OUTLINE PACKAGE



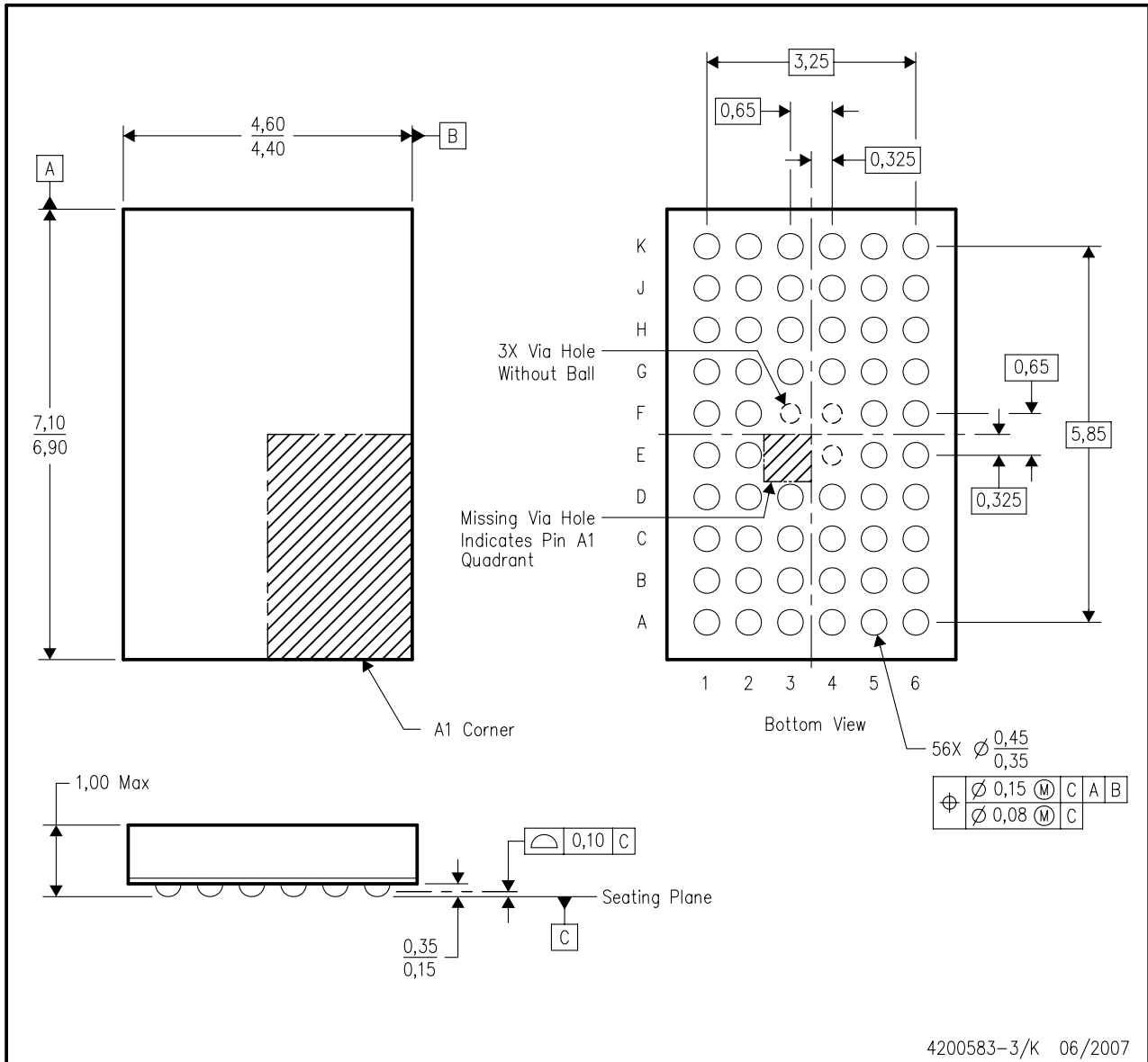
- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MO-118

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MECHANICAL DATA

GQL (R-PBGA-N56)

PLASTIC BALL GRID ARRAY



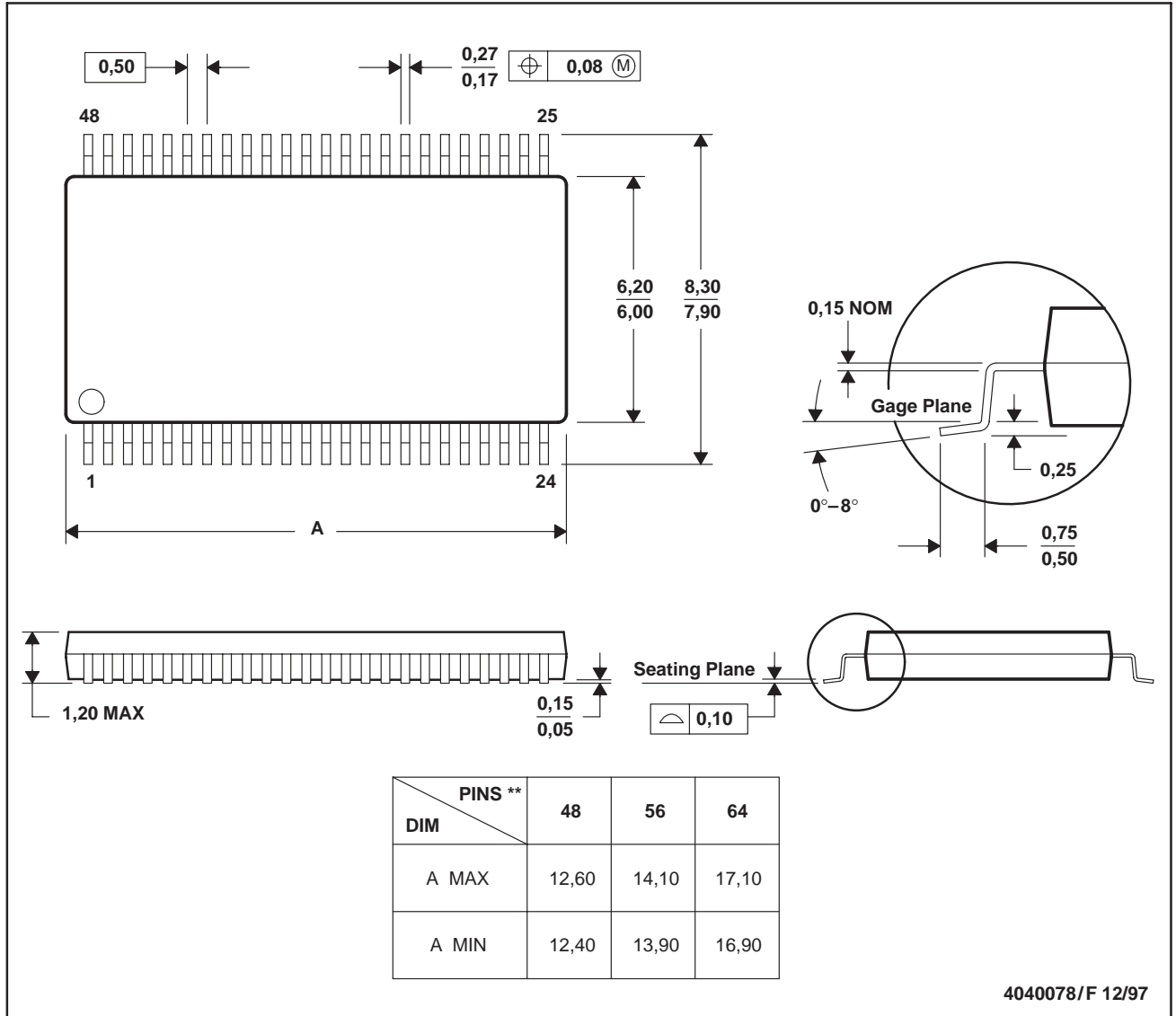
- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MO-285 variation BA-2.
 - D. This package is tin-lead (SnPb). Refer to the 56 ZQL package (drawing 4204437) for lead-free.

MTSS003D – JANUARY 1995 – REVISED JANUARY 1998

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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