

SN54ALS874B, SN74ALS874B, SN74ALS876A SN74AS874, SN74AS876 DUAL 4-BIT D-TYPE EDGE-TRIGGERED FLIP-FLOPS

SDAS061C – APRIL 1982 – REVISED JANUARY 1995

- 3-State Buffer-Type Outputs Drive Bus Lines Directly
- Bus-Structured Pinout
- Choice of True or Inverting Logic
 - SN54ALS874B, SN74ALS874B, SN74AS874 Have True Outputs
 - SN74ALS876A, SN74AS876 Have Inverting Outputs
- Asynchronous Clear
- Package Options Include Plastic Small-Outline (DW) Packages, Plastic (FN) and Ceramic (FK) Chip Carriers, and Standard Plastic (NT) and Ceramic (JT) 300-mil DIPs

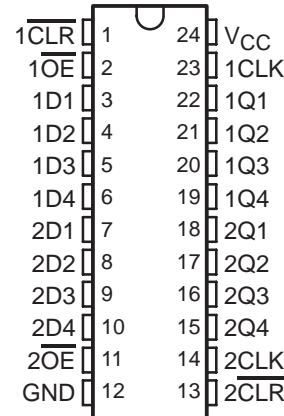
description

These dual 4-bit D-type edge-triggered flip-flops feature 3-state outputs designed specifically as bus drivers. They are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

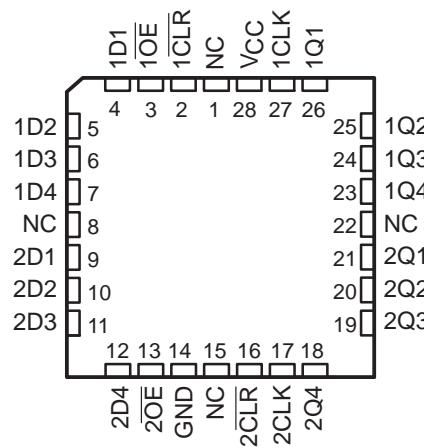
The edge-triggered flip-flops enter data on the low-to-high transition of the clock (CLK) input. The SN54ALS874B, SN74ALS874B, and SN74AS874 have clear (CLR) inputs and noninverting Q outputs. The SN74ALS876A and SN74AS876 have preset (PRE) inputs and inverting \bar{Q} outputs; taking PRE low causes the four Q or \bar{Q} outputs to go low independently of the clock.

The SN54ALS874B is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74ALS874B, SN74ALS876A, SN74AS874, and SN74AS876 devices are characterized for operation from 0°C to 70°C .

SN54ALS874B . . . JT PACKAGE
SN74ALS874B, SN74AS874 . . . DW OR NT PACKAGE
(TOP VIEW)

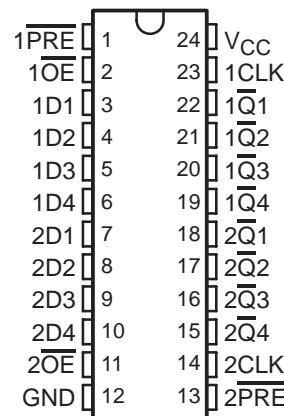


SN54ALS874B . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

SN74ALS876A, SN74AS876 . . . DW OR NT PACKAGE
(TOP VIEW)



**SN54ALS874B, SN74ALS874B, SN74ALS876A
SN74AS874, SN74AS876
DUAL 4-BIT D-TYPE EDGE-TRIGGERED FLIP-FLOPS**

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Function Tables

**SN54ALS874B, SN74ALS874B, SN74AS876
(each flip-flop)**

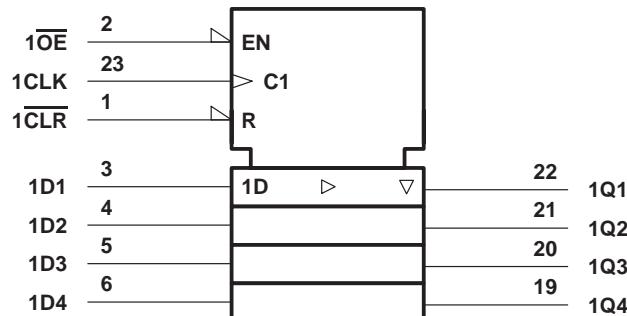
INPUTS				OUTPUT Q
\overline{OE}	\overline{CLR}	CLK	D	
L	L	X	X	L
L	H	\uparrow	H	H
L	H	\uparrow	L	L
L	H	L	X	Q_0
H	X	X	X	Z

**SN74ALS876A, SN74AS876
(each flip-flop)**

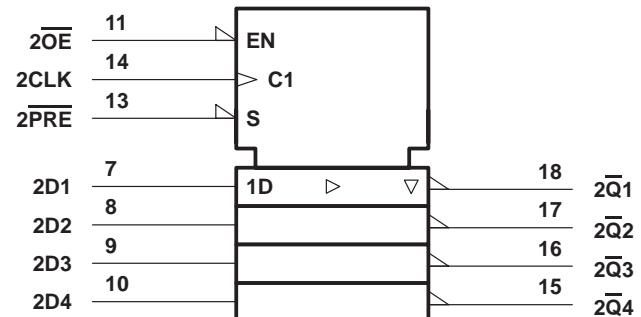
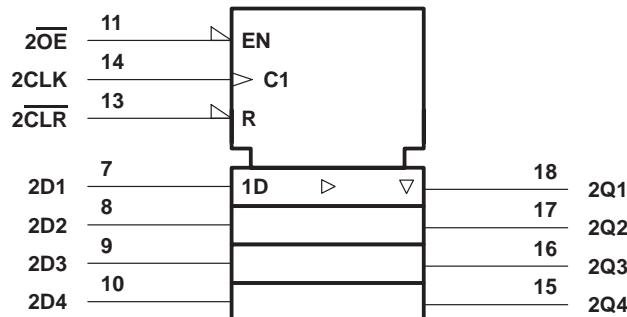
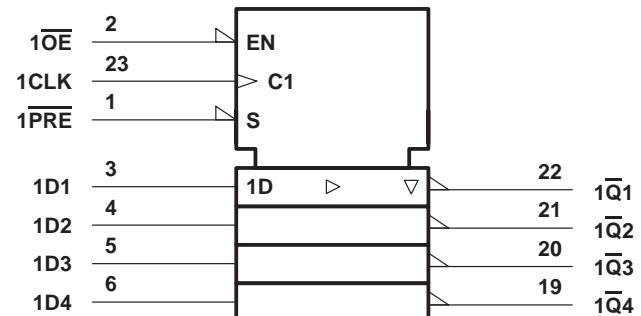
INPUTS				OUTPUT \overline{Q}
\overline{OE}	\overline{PRE}	CLK	D	
L	L	X	X	L
L	H	\uparrow	H	L
L	H	\uparrow	L	H
L	H	L	X	\overline{Q}_0
H	X	X	X	Z

logic symbols[†]

SN54ALS874B, SN74ALS874B, SN74AS876

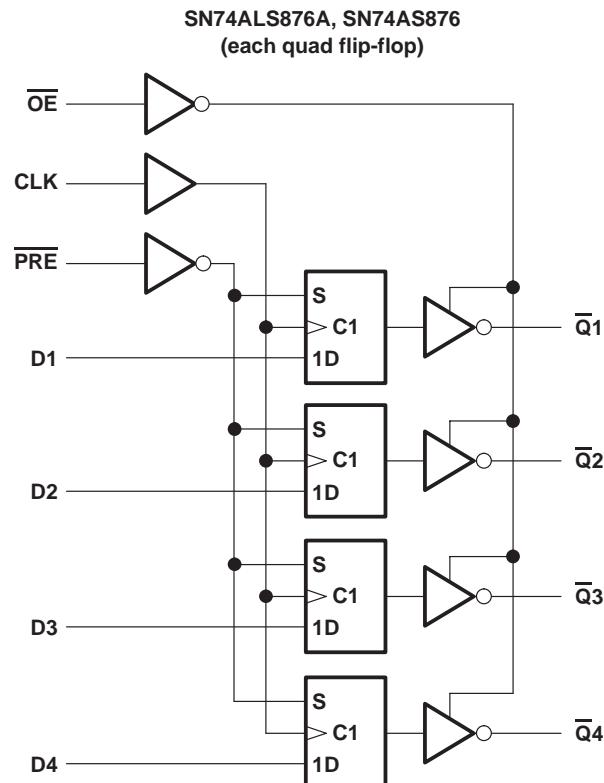
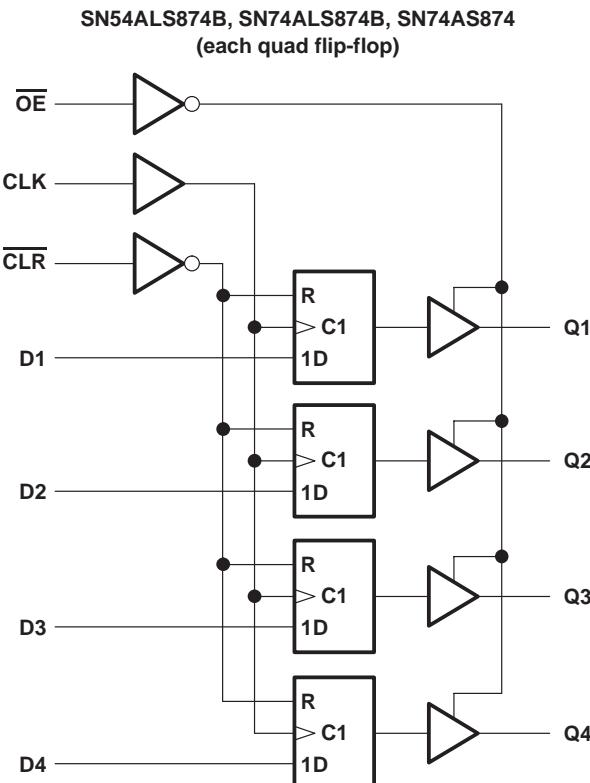


SN74ALS876A, SN74AS876



[†] These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for the DW, JT, and NT packages.

logic diagrams (positive logic)



Pin numbers shown are for the DW, JT, and NT packages.

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

Supply voltage, V_{CC}	7 V
Input voltage, V_I	7 V
Voltage applied to a disabled 3-state output	5.5 V
Operating free-air temperature range, T_A : SN54ALS874B	-55°C to 125°C
SN74ALS874B, SN74ALS876A	0°C to 70°C
Storage temperature range	-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.

**SN54ALS874B, SN74ALS874B, SN74ALS876A
 SN74AS874, SN74AS876
 DUAL 4-BIT D-TYPE EDGE-TRIGGERED FLIP-FLOPS**

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recommended operating conditions

		SN54ALS874B			SN74ALS874B SN74ALS876A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V _{CC}	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
V _{IH}	High-level input voltage	2			2			V
V _{IL}	Low-level input voltage			0.7			0.8	V
I _{OH}	High-level output current			-1			-2.6	mA
I _{OL}	Low-level output current			12			24	mA
f _{clock}	Clock frequency	0	25	0	0	25	30	MHz
t _w	Pulse duration	PRE or CLR low	15		10			ns
		CLK high	20		16.5			
		CLK low	20		16.5			
t _{su}	Setup time before CLK↑	Data	15		15			ns
		PRE or CLR inactive	15		10			
t _h	Hold time, data after CLK↑	4			0			ns
T _A	Operating free-air temperature	-55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS	SN54ALS874B			SN74ALS874B SN74ALS876A			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
V _{IK}	V _{CC} = 4.5 V, I _I = -18 mA			-1.2			-1.2	V
V _{OH}	V _{CC} = 4.5 V to 5.5 V, I _{OH} = -0.4 mA	V _{CC} - 2			V _{CC} - 2			V
	V _{CC} = 4.5 V	I _{OH} = -1 mA	2.4	3.3			2.4	
V _{OL}	V _{CC} = 4.5 V	I _{OL} = 12 mA	0.25	0.4	0.25	0.4		V
		I _{OL} = 24 mA			0.35	0.5		
I _{OZH}	V _{CC} = 5.5 V, V _O = 2.7 V		20		20		20	µA
I _{OZL}	V _{CC} = 5.5 V, V _O = 0.4 V		-20		-20		-20	µA
I _I	V _{CC} = 5.5 V, V _I = 7 V		0.1		0.1		0.1	mA
I _{IH}	V _{CC} = 5.5 V, V _I = 2.7 V		20		20		20	µA
I _{IL}	V _{CC} = 5.5 V, V _I = 0.4 V		-0.2		-0.2		-0.2	mA
I _{O‡}	V _{CC} = 5.5 V, V _O = 2.25 V	-20	-112	-30	-112	-30	-112	mA
I _{CC}	'ALS874B	Outputs high	14	21	14	21		mA
		Outputs low	19	30	19	30		
		Outputs disabled	20	32	20	32		
	SN74ALS876A	Outputs high			14	21		
		Outputs low			18	29		
		Outputs disabled			20	31		

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS}.



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**SN54ALS874B, SN74ALS874B, SN74ALS876A
SN74AS874, SN74AS876**
DUAL 4-BIT D-TYPE EDGE-TRIGGERED FLIP-FLOPS

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switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $C_L = 50 \text{ pF}$, $R1 = 500 \Omega$, $R2 = 500 \Omega$, $T_A = \text{MIN to MAX}^{\dagger}$				UNIT	
			SN54ALS874B		SN74ALS874B			
			MIN	MAX	MIN	MAX		
f_{max}			25	30			MHz	
t_{PLH}	CLK	Any Q	4	18	4	14	ns	
t_{PHL}			4	16	4	14		
t_{PHL}	\overline{CLR}	Any Q	5	23	5	17	ns	
t_{PZH}	\overline{OE}	Any Q	4	24	4	18	ns	
t_{PZL}			4	21	4	18		
t_{PHZ}	\overline{OE}	Any Q	2	15	2	10	ns	
t_{PLZ}			3	22	3	12		

[†] For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $C_L = 50 \text{ pF}$, $R1 = 500 \Omega$, $R2 = 500 \Omega$, $T_A = \text{MIN to MAX}^{\dagger}$				UNIT	
			SN74ALS876A					
			MIN	MAX				
f_{max}			30				MHz	
t_{PLH}	CLK	Any \overline{Q}	4	14			ns	
t_{PHL}			4	14				
t_{PHL}	\overline{PRE}	Any \overline{Q}	6	19			ns	
t_{PZH}	\overline{OE}	Any \overline{Q}	4	18			ns	
t_{PZL}			4	18				
t_{PHZ}	\overline{OE}	Any \overline{Q}	2	10			ns	
t_{PLZ}			3	13				

[†] For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[‡]

Supply voltage, V_{CC}	7 V
Input voltage, V_I	7 V
Operating free-air temperature range, T_A : SN74AS874, SN74AS876	0°C to 70°C
Storage temperature range	-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.

**SN54ALS874B, SN74ALS874B, SN74ALS876A
 SN74AS874, SN74AS876
 DUAL 4-BIT D-TYPE EDGE-TRIGGERED FLIP-FLOPS**

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recommended operating conditions

			SN74AS874			SN74AS876			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V _{CC}	Supply voltage		4.5	5	5.5	4.5	5	5.5	V
V _{IH}	High-level input voltage		2			2			V
V _{IL}	Low-level input voltage				0.8			0.8	V
I _{OH}	High-level output current				-15			-15	mA
I _{OL}	Low-level output current				48			48	mA
f _{clock}	Clock frequency		0	125		0	80		MHz
t _w	Pulse duration	PRE or CLR low		2		4.5			ns
		CLK high		3		6.2			
		CLK low		4		6.2			
t _{su}	Setup time before CLK↑	Data		2		4.5			ns
		PRE or CLR inactive		4		5			
t _h	Hold time, data after CLK↑		1			2			ns
T _A	Operating free-air temperature		0	70		0	70		°C

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

PARAMETER	TEST CONDITIONS			SN74AS874 SN74AS876			UNIT
	MIN	TYP†	MAX	MIN	TYP†	MAX	
V _{IK}	V _{CC} = 4.5 V,	I _I = -18 mA				-1.2	V
V _{OH}	V _{CC} = 4.5 V to 5.5 V,	I _{OH} = -2 mA		V _{CC} – 2			V
	V _{CC} = 4.5 V,	I _{OH} = -15 mA		2.4	3.3		
V _{OL}	V _{CC} = 4.5 V,	I _{OL} = 48 mA		0.35	0.5		V
I _{OZH}	V _{CC} = 5.5 V,	V _O = 2.7 V		50			µA
I _{OZL}	V _{CC} = 5.5 V,	V _O = 0.4 V		-50			µA
I _I	V _{CC} = 5.5 V,	V _I = 7 V		0.1			mA
I _{IH}	V _{CC} = 5.5 V,	V _I = 2.7 V		20			µA
I _{IL}	D	V _{CC} = 5.5 V,			V _I = 0.4 V	-2	mA
	All others					-0.5	
I _O ‡		V _{CC} = 5.5 V,	V _O = 2.25 V	-30	-112		mA
I _{CC}	SN74AS874	V _{CC} = 5.5 V	Outputs high	82	133		mA
			Outputs low	92	149		
			Outputs disabled	100	160		
	SN74AS876	V _{CC} = 5.5 V	Outputs high	88	142		
			Outputs low	94	150		
			Outputs disabled	100	160		

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS}.

**SN54ALS874B, SN74ALS874B, SN74ALS876A
SN74AS874, SN74AS876
DUAL 4-BIT D-TYPE EDGE-TRIGGERED FLIP-FLOPS**

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switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V},$ $C_L = 50 \text{ pF},$ $R1 = 500 \Omega,$ $R2 = 500 \Omega,$ $T_A = \text{MIN to MAX}^\dagger$		UNIT	
			SN74AS874			
			MIN	MAX		
f_{max}			125		MHz	
t_{PLH}	CLK	Any Q	3	8.5	ns	
t_{PHL}			4	10.5		
t_{PHL}	\overline{CLR}	Any Q	4	9.5	ns	
t_{PZH}	\overline{OE}	Any Q	2	7	ns	
t_{PZL}			3	10.5		
t_{PHZ}	\overline{OE}	Any Q	2	6	ns	
t_{PLZ}			2	7.5		

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

switching characteristics (see Figure 1)

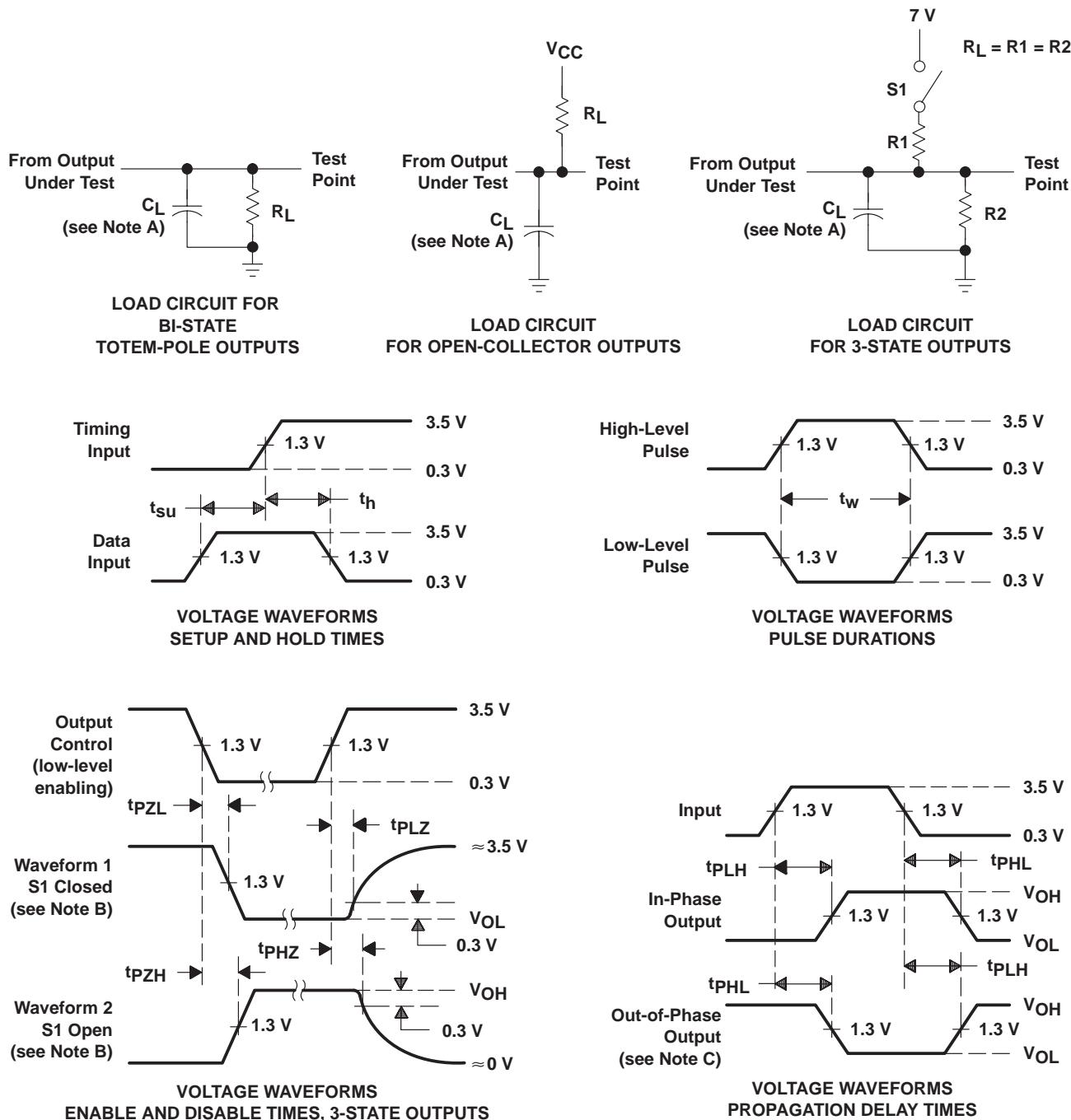
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V},$ $C_L = 50 \text{ pF},$ $R1 = 500 \Omega,$ $R2 = 500 \Omega,$ $T_A = \text{MIN to MAX}^\dagger$		UNIT	
			SN74AS876			
			MIN	MAX		
f_{max}			80		MHz	
t_{PLH}	CLK	Any \overline{Q}	3	8.5	ns	
t_{PHL}			4	10.5		
t_{PHL}	\overline{PRE}	Any \overline{Q}	4	9.5	ns	
t_{PZH}	\overline{OE}	Any \overline{Q}	2	7	ns	
t_{PZL}			3	11		
t_{PHZ}	\overline{OE}	Any \overline{Q}	2	7	ns	
t_{PLZ}			2	7		

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

**SN54ALS874B, SN74ALS874B, SN74ALS876A
SN74AS874, SN74AS876
DUAL 4-BIT D-TYPE EDGE-TRIGGERED FLIP-FLOPS**

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**PARAMETER MEASUREMENT INFORMATION
SERIES 54ALS/74ALS AND 54AS/74AS DEVICES**



- 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. When measuring propagation delay items of 3-state outputs, switch S1 is open.
 D. All input pulses have the following characteristics: $PRR \leq 1 \text{ MHz}$, $t_r = t_f = 2 \text{ ns}$, duty cycle = 50%.
 E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits 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
84010013A	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	84010013A SNJ54ALS 874BFK	Samples
8401001KA	OBsolete	CFP	W	24		TBD	Call TI	Call TI	-55 to 125		
8401001LA	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type	-55 to 125	8401001LA SNJ54ALS874BJT	Samples
SN54ALS874BJT	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type	-55 to 125	SN54ALS874BJT	Samples
SN74ALS874BDW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS874B	Samples
SN74ALS874BDWR	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS874B	Samples
SN74ALS874BDWRE4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS874B	Samples
SN74ALS874BNT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN74ALS874BNT	Samples
SN74ALS876ADW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS876A	Samples
SN74ALS876ANT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN74ALS876ANT	Samples
SN74AS874DW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	AS874	Samples
SN74AS874NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN74AS874NT	Samples
SN74AS876NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN74AS876NT	Samples
SNJ54ALS874BFK	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	84010013A SNJ54ALS 874BFK	Samples
SNJ54ALS874BJT	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type	-55 to 125	8401001LA SNJ54ALS874BJT	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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OTHER QUALIFIED VERSIONS OF SN54ALS874B, SN74ALS874B :

- Catalog: [SN74ALS874B](#)
- Military: [SN54ALS874B](#)

NOTE: Qualified Version Definitions:

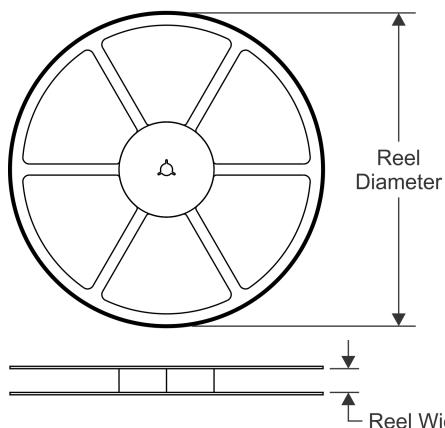
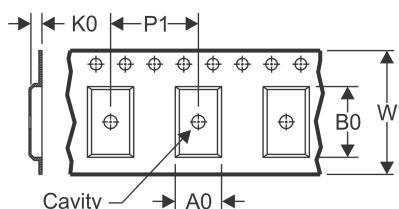


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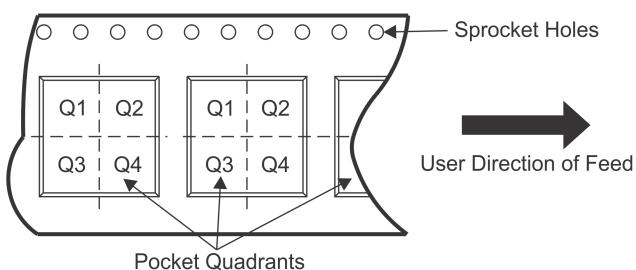
PACKAGE OPTION ADDENDUM

10-Jun-2014

-
- Catalog - TI's standard catalog product
 - Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
SN74ALS874BDWR	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS

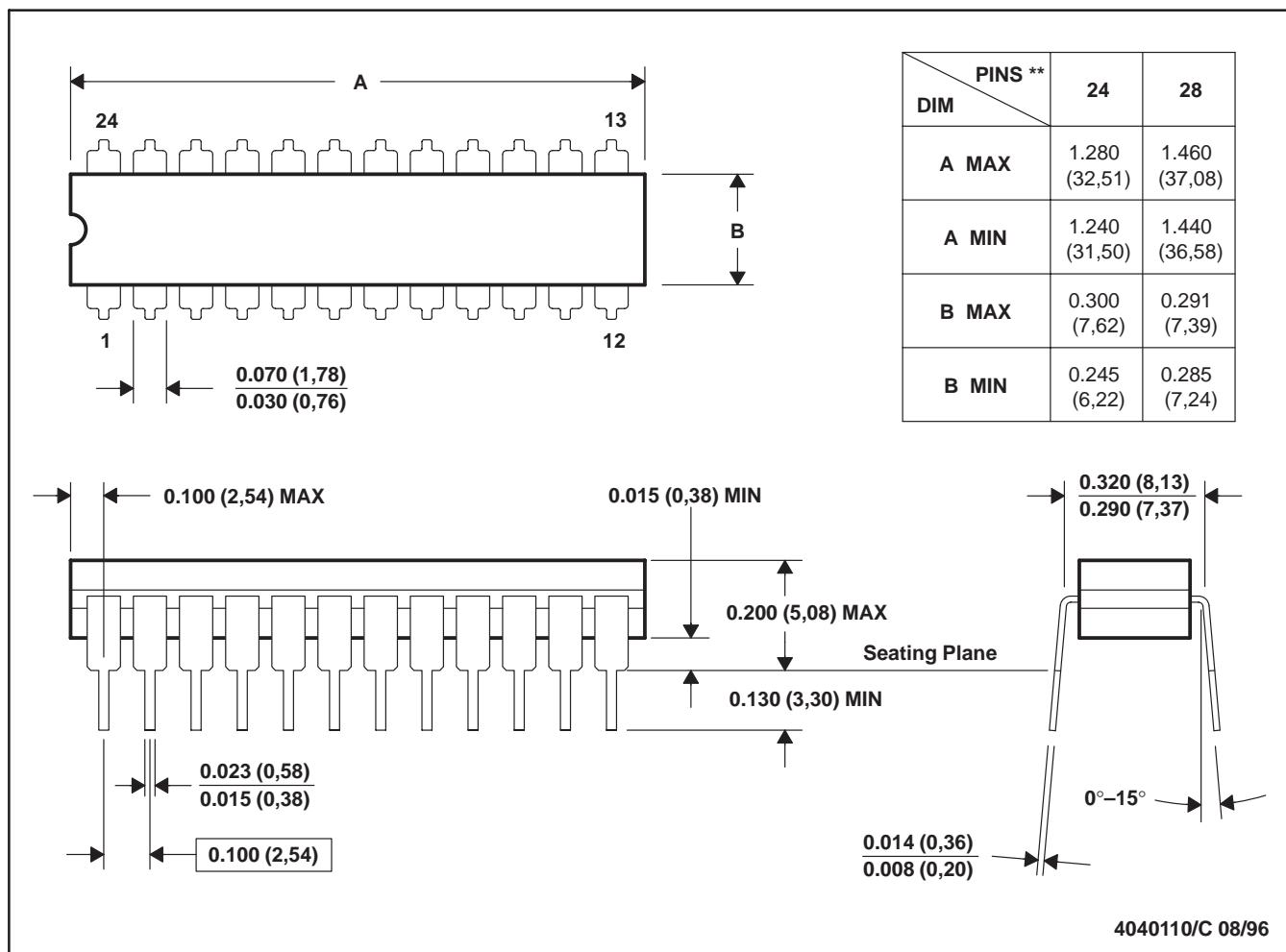
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALS874BDWR	SOIC	DW	24	2000	367.0	367.0	45.0

JT (R-GDIP-T**)

24 LEADS SHOWN

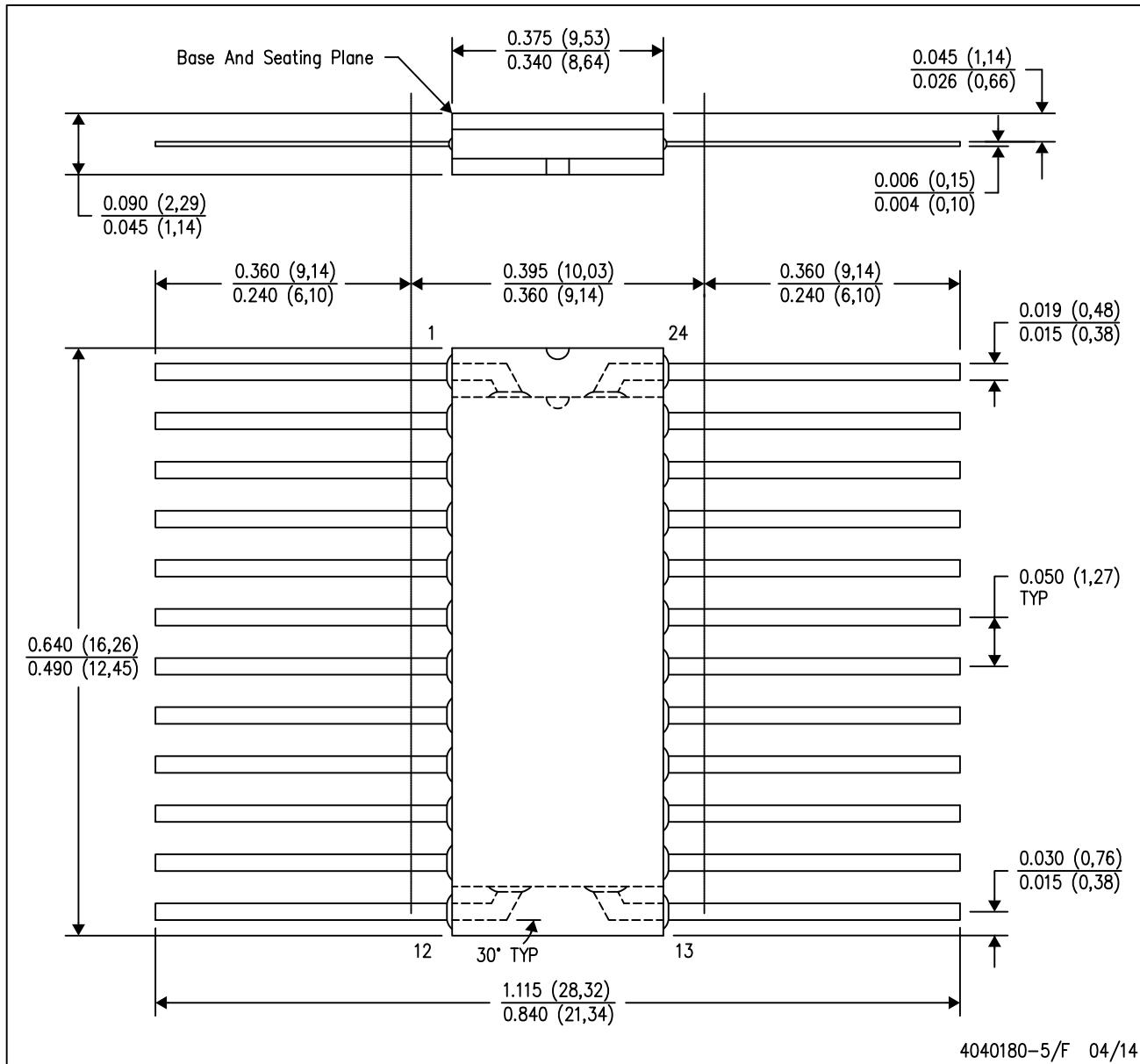
CERAMIC DUAL-IN-LINE



- 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.
 E. Falls within MIL STD 1835 GDIP3-T24, GDIP4-T28, and JEDEC MO-058 AA, MO-058 AB

W (R-GDFP-F24)

CERAMIC DUAL FLATPACK

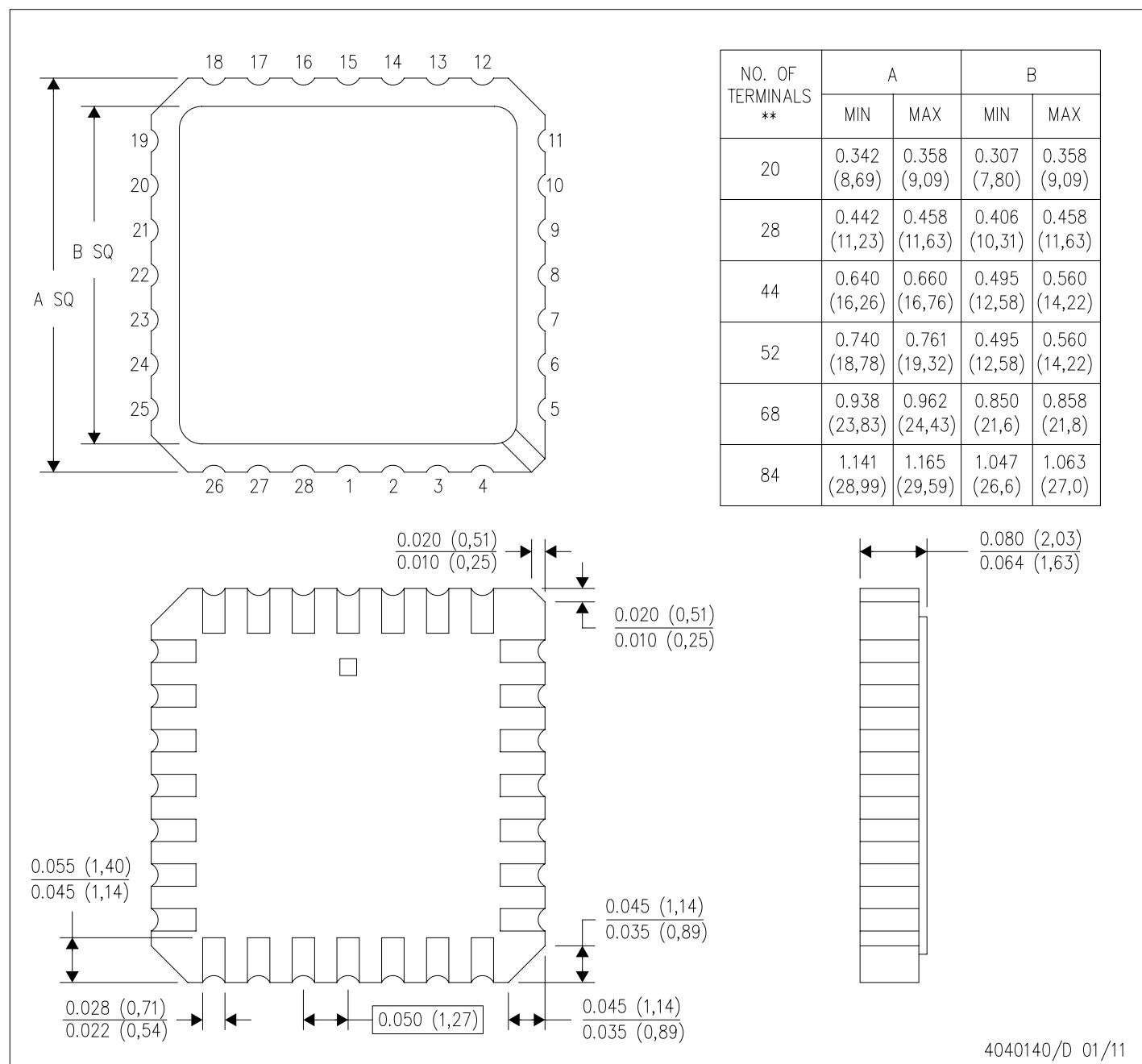


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only.
 - Falls within Mil-Std 1835 GDFP2-F20

FK (S-CQCC-N**)

28 TERMINAL SHOWN

LEADLESS CERAMIC CHIP CARRIER



- 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 metal lid.
 - D. Falls within JEDEC MS-004

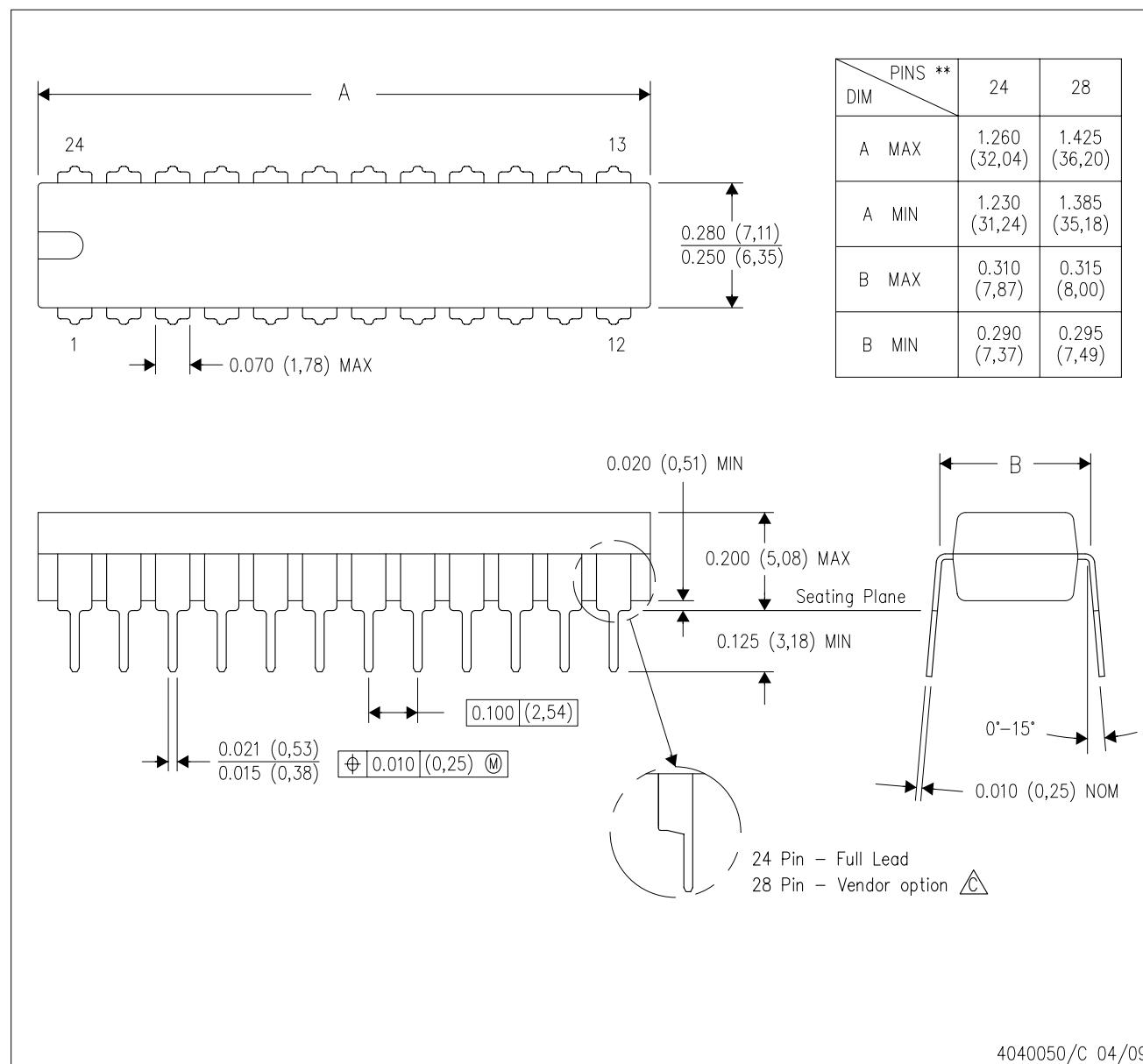
4040140/D 01/11

MECHANICAL DATA

NT (R-PDIP-T**)

24 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



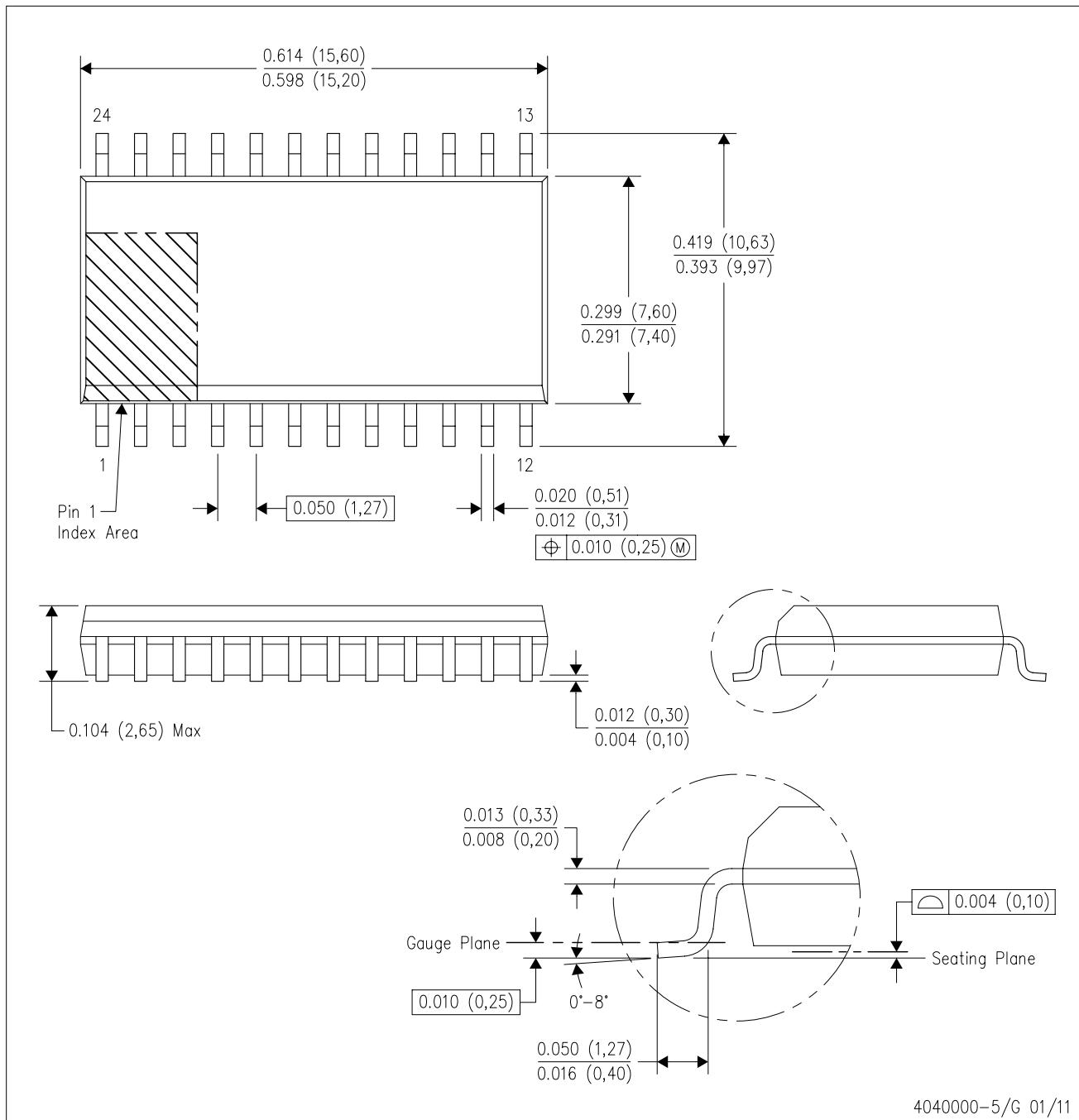
NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.

B. This drawing is subject to change without notice.

 The 28 pin end lead shoulder width is a vendor option, either half or full width.

DW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 - 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 MS-013 variation AD.

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