DUAL 4-BIT D-TYPE EDGE-TRIGGERED FLIP-FLOPS

D2661, APRIL 1982 – REVISED MAY 1986

- **3-State Buffer-Type Outputs Drive Bus-Lines Directly**
- **Bus-Structured Pinout**
- **Choice of True or Inverting Logic**
  'ALS874B, 'AS874 True Outputs
  'ALS876A, 'AS876 Inverting Outputs
- **Asynchronous Clear**
- **Package Options Include Plastic "Small Outline" Packages, Both Plastic and Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs**
- **Dependable Texas Instruments Quality and Reliability**

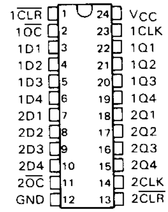
description

These dual four-bit registers feature three-state outputs designed specifically for bus driving. This makes these devices paricularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

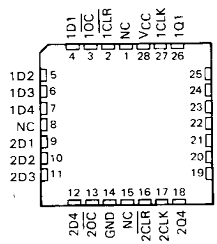
The edge-triggered flip-flops enter data on the low-to-high transition of the clock. The 'ALS874B and 'AS874 have $\overline{\text{CLR}}$ inputs and noninverting Q outputs; the 'ALS876A and 'AS876 have $\overline{\text{PRE}}$ inputs and inverting $\overline{\text{Q}}$ outputs. In each case, taking this input low causes the four Q or $\overline{\text{Q}}$ outputs to go low independently of the clock.

The SN54ALS' and SN54AS' devices are characterized for operation over the full military temperature range of −55°C to 125°C. The SN74ALS' and SN74AS' devices are characterized for operation from 0°C to 70°C.

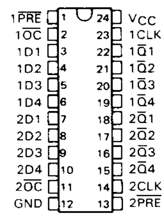
SN54ALS874B, SN54AS874 . . . JT PACKAGE
SN74ALS874B, SN74AS874 . . . DW OR NT PACKAGE
(TOP VIEW)



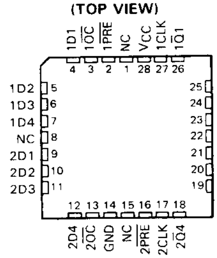
SN54ALS874B, SN54AS874 . . . FK PACKAGE
SN74ALS874B, SN74AS874 . . . FN PACKAGE
(TOP VIEW)



SN54ALS876A, SN54AS876 . . . JT PACKAGE
SN74ALS876A, SN74AS876 . . . DW OR NT PACKAGE
(TOP VIEW)



SN54ALS876A, SN54AS876 . . . FK PACKAGE
SN74ALS876A, SN74AS876 . . . FN PACKAGE
(TOP VIEW)



NC—No internal connection

ALS and AS Circuits

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TEXAS INSTRUMENTS
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FUNCTION TABLES

'ALS874B, 'AS874 (EACH FLIP-FLOP)

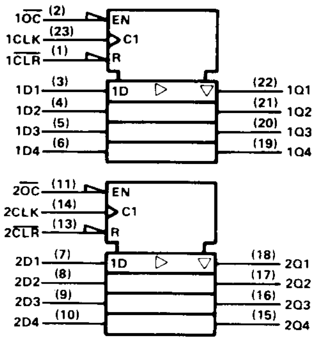
INPUTS				OUTPUT
$\overline{OC}$	$\overline{CLR}$	CLK	D	Q
L	L	X	X	L
L	H	↑	H	H
L	H	↑	L	L
L	H	L	X	Q_0
H	X	X	X	Z

'ALS876A, 'AS876 (EACH FLIP-FLOP)

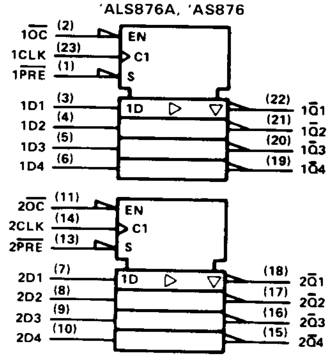
INPUTS				OUTPUT
OC	$\overline{PRE}$	CLK	D	$\overline{Q}$
L	L	X	X	L
L	H	↑	H	L
L	H	↑	L	H
L	H	L	X	$\overline{Q}_0$
H	X	X	X	Z

logic symbols†

'ALS874B, 'AS874



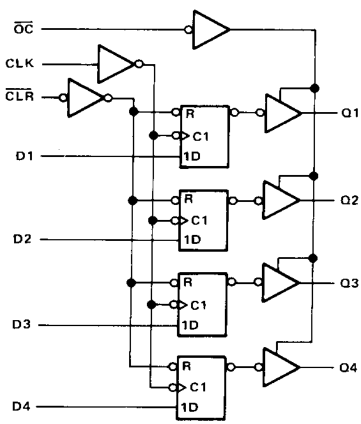
'ALS876A, 'AS876



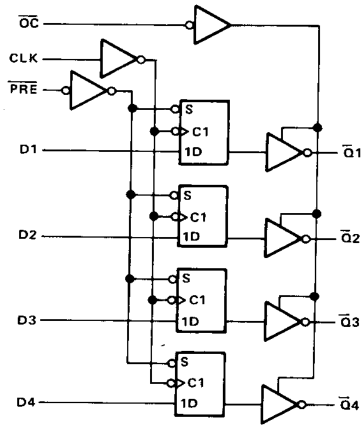
†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617.12.

logic diagrams (positive logic)

'ALS874B, 'AS874 (EACH QUAD FLIP-FLOP)



'ALS876A, 'AS876 (EACH QUAD FLIP-FLOP)



Pin numbers shown are for 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 . . . . 7 V
Voltage applied to a disabled 3-state output . . . . 5.5 V
Operating free-air temperature range: SN54ALS874B, SN54ALS876A . . . . −55 °C to 125 °C
SN74ALS874B, SN74ALS876A . . . . 0 °C to 70 °C
Storage temperature range . . . . −65 °C to 150 °C

recommended operating conditions

			SN54ALS874B SN54ALS876A			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		30	MHz
t_w	Pulse duration	$\overline{PRE}$ or $\overline{CLR}$ low	10			10			ns
		CLK high	20			16.5			
		CLK low	20			16.5			
t_{su}	Setup time before CLK↑	Data	15			15			ns
		$\overline{PRE}$ or $\overline{CLR}$ inactive	10			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 SN54ALS876A			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					
		V_{CC} = 4.5 V,	I_{OH} = −2.6 mA				2.4	3.2		
V_{OL}		V_{CC} = 4.5 V,	I_{OL} = 12 mA		0.25	0.4		0.25	0.4	V
		V_{CC} = 4.5 V,	I_{OL} = 24 mA					0.35	0.5	
I_{OZH}		V_{CC} = 5.5 V,	V_O = 2.7 V			20			20	μA
I_{OZL}		V_{CC} = 5.5 V,	V_O = 0.4 V			−20			−20	μA
I_I		V_{CC} = 5.5 V,	V_I = 7 V			0.1			0.1	mA
I_{IH}		V_{CC} = 5.5 V,	V_I = 2.7 V			20			20	μA
I_{IL}		V_{CC} = 5.5 V,	V_I = 0.4 V			−0.2			−0.2	mA
I_O‡		V_{CC} = 5.5 V,	V_O = 2.25 V	−30		−112	−30		−112	mA
I_{CC}	'ALS874B	V_{CC} = 5.5 V	Output high		14	21		14	21	mA
			Outputs low		19	30		19	30	
			Outputs disabled		20	32		20	32	
	'ALS876A		Outputs high		14	21		14	21	
			Outputs low		18	29		18	29	
			Outputs disabled		20	31		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}.

'ALS874B switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 5 V, C_L = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T_A = 25°C			V_{CC} = 4.5 V to 5.5 V, C_L = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T_A = MIN to MAX				UNIT
			'ALS874B			SN54ALS874B		SN74ALS874B		
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			40	50		25		30		MHz
t_{PLH}	CLK	Any Q		8	10	4	15	4	14	ns
t_{PHL}				8	13	4	15	4	14	
t_{PHL}	$\overline{CLR}$	Any Q		11	14	5	20	5	17	ns
t_{PZH}	$\overline{OC}$	Any Q		9	12	4	21	4	18	ns
t_{PZL}				11	15	4	21	4	18	
t_{PHZ}	$\overline{OC}$	Any Q		6	8	2	12	2	10	ns
t_{PLZ}				5.7	8	3	15	3	12	

'ALS876A switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 5 V, C_L = 50 pF, R_1 = 500 Ω, R_2 = 500 Ω, T_A = 25°C			V_{CC} = 4.5 C to 5.5 V, C_L = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T_A = MIN to MAX				UNIT
			'ALS876A			SN54ALS876A		SN74ALS876A		
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			40	50		25		30		MHz
t_{PLH}	CLK	Any $\overline{Q}$		8	11	4	15	4	14	ns
t_{PHL}				9	12	4	15	4	14	
t_{PHL}	$\overline{PRE}$	Any $\overline{Q}$		10	16	6	22	6	19	ns
t_{PZH}	$\overline{OC}$	Any $\overline{Q}$		10	13	4	21	4	18	ns
t_{PZL}				11	15	4	21	4	18	
t_{PHZ}	$\overline{OC}$	Any $\overline{Q}$		6	8	2	12	2	10	ns
t_{PLZ}				7	10	3	15	3	13	

NOTE 1: Load circuit and voltage waveforms are shown in Section 1.

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

Supply voltage, V_{CC} . . . . . 7 V
Input voltage . . . . . 7 V
Operating free-air temperature range: SN54AS874, SN54AS876 . . . . . −55°C to 125°C
SN74AS874, SN74AS876 . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

recommended operating conditions

			SN54AS874 SN54AS876			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				−12			−15	mA
I_{OL}	Low-level output current				32			48	mA
f_{clock}	Clock frequency		0		100	0		125	MHz
t_w	Pulse duration	$\overline{PRE}$ or $\overline{CLR}$ low	4			2			ns
		CLK high	4			3			
		CLK low	5			4			
t_{su}	Setup time before CLK↑	Data	2.5			2			ns
		$\overline{PRE}$ or $\overline{CLR}$ inactive	5			4			
t_h	Hold time, data after CLK↑		1			1			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			SN54AS874 SN54AS876			SN74AS874 SN74AS876			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} = −2 mA		V_{CC} − 2			V_{CC} − 2			V
		V_{CC} = 4.5 V,	I_{OH} = −12 mA		2.4	3.2					
		V_{CC} = 4.5 V,	I_{OH} = −15 mA					2.4	3.3		
V_{OL}		V_{CC} = 4.5 V,	I_{OL} = 32 mA			0.25	0.4				V
		V_{CC} = 4.5 V	I_{OL} = 48 mA						0.35	0.5	
I_{OZH}		V_{CC} = 5.5 V,	V_O = 2.7 V				50			50	μA
I_{OZL}		V_{CC} = 5.5 V,	V_O = 0.4 V				−50			−50	μA
I_I		V_{CC} = 5.5 V,	V_I = 7 V				0.1			0.1	mA
I_{IH}		V_{CC} = 5.5 V,	V_I = 2.7 V				20			10	μA
I_{IL}	D	V_{CC} = 5.5 V,	V_I = 0.4 V				−3			−2	mA
	All other						−0.5			−0.5	
I_O‡		V_{CC} = 5.5 V,	V_O = 2.25 V		−30		−112	−30		−112	mA
I_{CC}	'AS874	V_{CC} = 5.5 V		Output high		82	133		82	133	mA
				Outputs low		92	149		92	149	
				Outputs disabled		100	160		100	160	
	'AS876			Outputs high		88	142		88	142	
				Outputs low		94	150		94	150	
				Outputs disabled		100	160		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}.

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'AS874 switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 4.5 V to 5.5 V, C_L = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T_A = MIN to MAX				UNIT
			SN54AS874		SN74AS874		
			MIN	MAX	MIN	MAX	
f_{max}			100		125		MHz
t_{PLH}	CLK	Any Q	3	11.5	3	8.5	ns
t_{PHL}			4	12.5	4	10.5	
t_{PHL}	$\overline{CLR}$	Any Q	4	11	4	9.5	ns
t_{PZH}	$\overline{OC}$	Any Q	2	8	2	7	ns
t_{PZL}			3	11.5	3	10.5	
t_{PHZ}	$\overline{OC}$	Any Q	2	7	2	6	ns
t_{PLZ}			2	8.5	2	7.5	

'AS876 switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 4.5 V to 5.5 V, C_L = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T_A = MIN to MAX				UNIT
			SN54AS876		SN74AS876		
			MIN	MAX	MIN	MAX	
f_{max}			100		125		MHz
t_{PLH}	CLK	Any $\overline{Q}$	3	11.5	3	8.5	ns
t_{PHL}			4	12.5	4	10.5	
t_{PHL}	$\overline{PRE}$	Any $\overline{Q}$	4	11	4	9.5	ns
t_{PZH}	$\overline{OC}$	Any $\overline{Q}$	2	8	2	7	ns
t_{PZL}			3	11.5	3	10.5	
t_{PHZ}	$\overline{OC}$	Any $\overline{Q}$	2	7	2	6	ns
t_{PLZ}			2	7	2	6	

NOTE 1: Load circuit and voltage waveforms are shown in Section 1.