SN54LS373, SN54LS374, SN54S373, SN54S374, SN74LS373, SN74LS374, SN74S373, SN74S374
OCTAL D-TYPE TRANSPARENT LATCHES AND EDGE-TRIGGERED FLIP-FLOPS

SDLS165 – OCTOBER 1975 – REVISED MARCH 1988

- Choice of 8 Latches or 8 D-Type Flip-Flops In a Single Package
- 3-State Bus-Driving Outputs
- Full Parallel-Access for Loading
- Buffered Control Inputs
- Clock/Enable Input Has Hysteresis to Improve Noise Rejection ('S373 and 'S374)
- P-N-P Inputs Reduce D-C Loading on Data Lines ('S373 and 'S374)

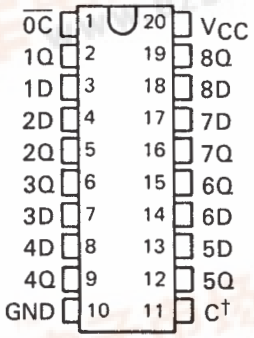
'LS373, 'S373
FUNCTION TABLE

OUTPUT ENABLE	ENABLE LATCH	D	OUTPUT
L	H	H	H
L	H	L	L
L	L	X	Q_0
H	X	X	Z

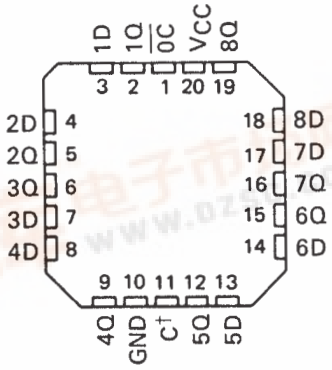
'LS374, 'S374
FUNCTION TABLE

OUTPUT ENABLE	CLOCK	D	OUTPUT
L	↑	H	H
L	↑	L	L
L	L	X	Q_0
H	X	X	Z

SN54LS373, SN54LS374, SN54S373, SN54S374 . . . J OR W PACKAGE
SN74LS373, SN74LS374, SN74S373, SN74S374 . . . DW OR N PACKAGE
(TOP VIEW)



SN54LS373, SN54LS374, SN54S373, SN54S374 . . . FK PACKAGE
(TOP VIEW)



†C for 'LS373 and 'S373; CLK for 'LS374 and 'S374.

description

These 8-bit registers feature three-state outputs designed specifically for driving highly-capacitive or relatively low-impedance loads. The high-impedance third state and increased high-logic-level drive provide these registers with the capability of being connected directly to and driving the bus lines in a bus-organized system without need for interface or pull-up components. They are particularly attractive for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The eight latches of the 'LS373 and 'S373 are transparent D-type latches meaning that while the enable (C) is high the Q outputs will follow the data (D) inputs. When the enable is taken low the output will be latched at the level of the data that was set up.

description (continued)

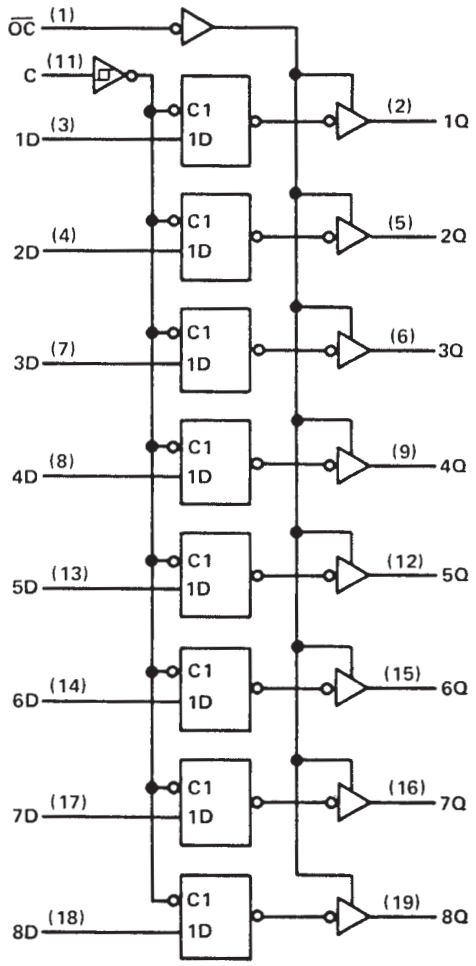
The eight flip-flops of the 'LS374 and 'S374 are edge-triggered D-type flip-flops. On the positive transition of the clock, the Q outputs will be set to the logic states that were setup at the D inputs.

Schmitt-trigger buffered inputs at the enable/clock lines of the 'S373 and 'S374 devices, simplify system design as ac and dc noise rejection is improved by typically 400 mV due to the input hysteresis. A buffered output control 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 output control does not affect the internal operation of the latches or flip-flops. That is, the old data can be retained or new data can be entered even while the outputs are off.

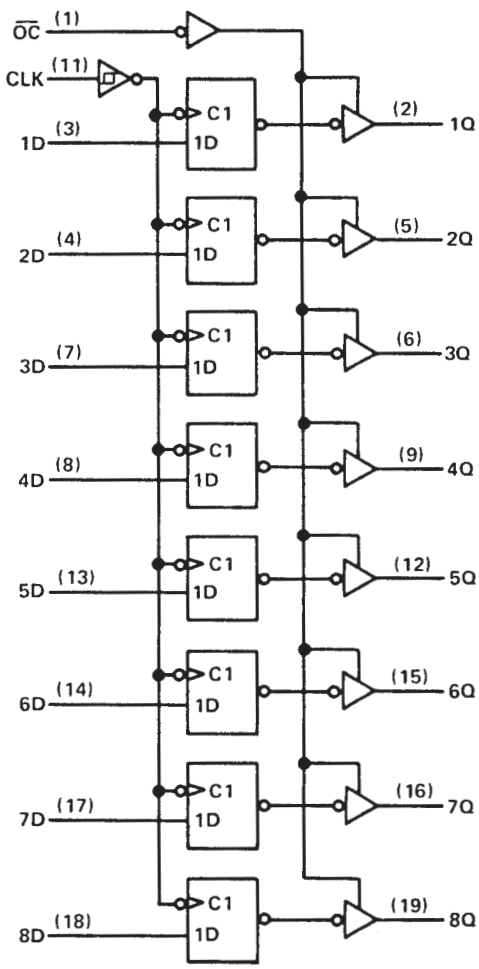
logic diagrams (positive logic)

'LS373, 'S373
TRANSPARENT LATCHES



for 'S373 only

'LS374, 'S374
POSITIVE-EDGE-TRIGGERED FLIP-FLOPS

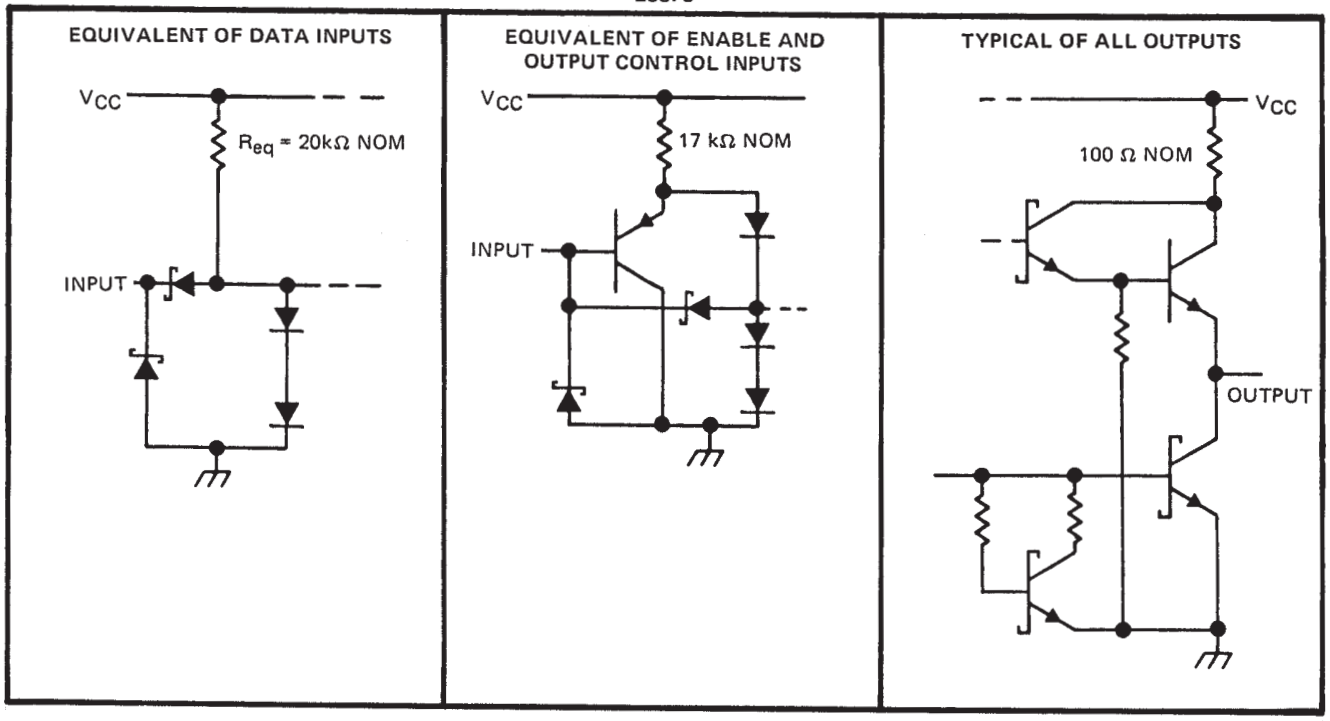


for 'S374 only

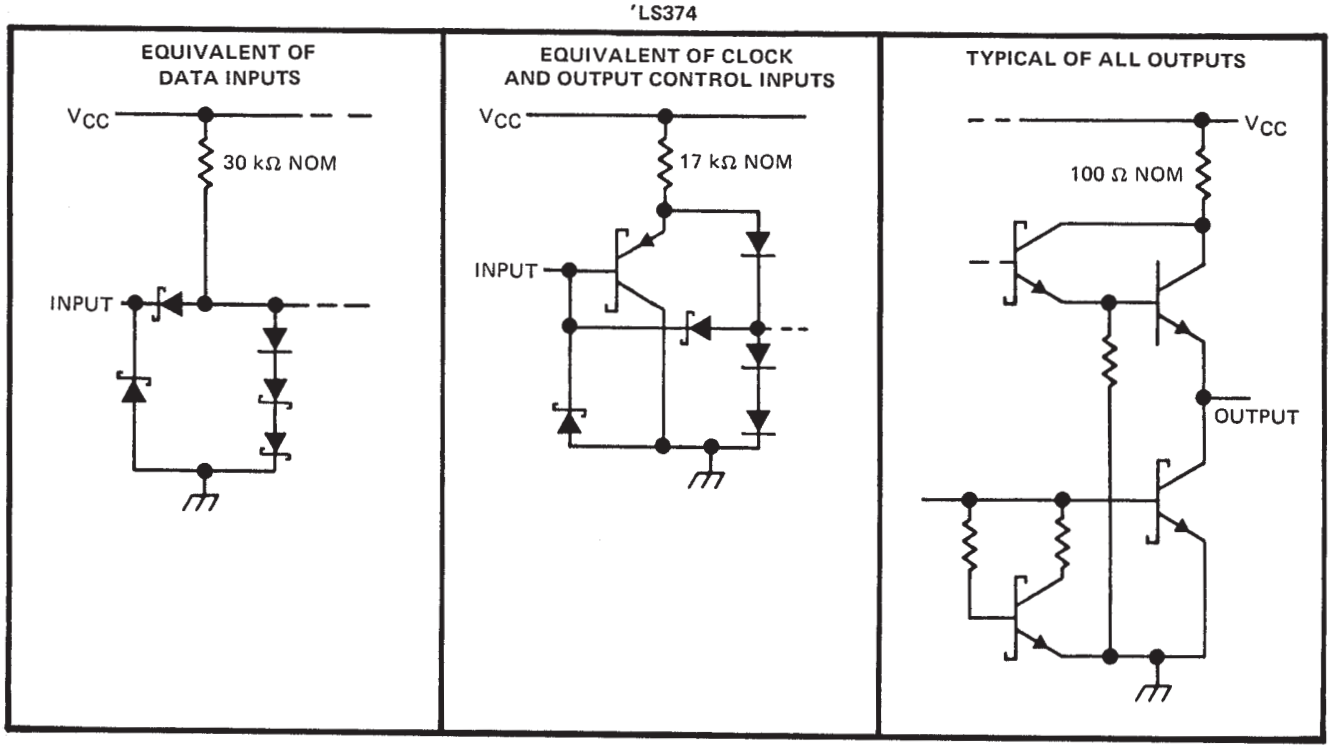
Pin numbers shown are for DW, J, N, and W packages.

schematic of inputs and outputs

'LS373



'LS374



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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 7 V
Off-state output voltage . . . . . 5.5 V
Operating free-air temperature range: SN54LS' . . . . . −55°C to 125°C
SN74LS' . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

			SN54LS'			SN74LS'			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
V_{OH}	High-level output voltage				5.5			5.5	V
I_{OH}	High-level output current				−1			−2.6	mA
I_{OL}	Low-level output current				12			24	mA
t_w	Pulse duration	CLK high	15			15			ns
		CLK low	15			15			
t_{su}	Data setup time	'LS373	5↓			5↓			ns
		'LS374	20↑			20↑			
t_h	Data hold time	'LS373	20↓			20↓			ns
		'LS374†	5↑			0↑			
T_A	Operating free-air temperature		−55		125	0		70	°C

†The t_h specification applies only for data frequency below 10 MHz. Designs above 10 MHz should use a minimum of 5 ns. (Commercial only)

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

PARAMETER		TEST CONDITIONS†		SN54LS'			SN74LS'			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH}	High-level input voltage			2			2			V
V_{IL}	Low-level input voltage					0.7			0.8	V
V_{IK}	Input clamp voltage	V_{CC} = MIN, I_I = −18 mA				−1.5			−1.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL}max, I_{OH} = MAX		2.4	3.4		2.4	3.1		V
V_{OL}	Low-level output voltage	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL}max	I_{OL} = 12 mA		0.25	0.4		0.25	0.4	V
			I_{OL} = 24 mA					0.35	0.5	
I_{OZH}	Off-state output current, high-level voltage applied	V_{CC} = MAX, V_{IH} = 2 V, V_O = 2.7 V				20			20	μA
I_{OZL}	Off-state output current, low-level voltage applied	V_{CC} = MAX, V_{IH} = 2 V, V_O = 0.4 V				−20			−20	μA
I_I	Input current at maximum input voltage	V_{CC} = MAX, V_I = 7 V				0.1			0.1	mA
I_{IH}	High-level input current	V_{CC} = MAX, V_I = 2.7 V				20			20	μA
I_{IL}	Low-level input current	V_{CC} = MAX, V_I = 0.4 V				−0.4			−0.4	mA
I_{OS}	Short-circuit output current§	V_{CC} = MAX		−30		−130	−30		−130	mA
I_{CC}	Supply current	V_{CC} = MAX, Output control at 4.5 V	'LS373		24	40		24	40	mA
			'LS374		27	40		27	40	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

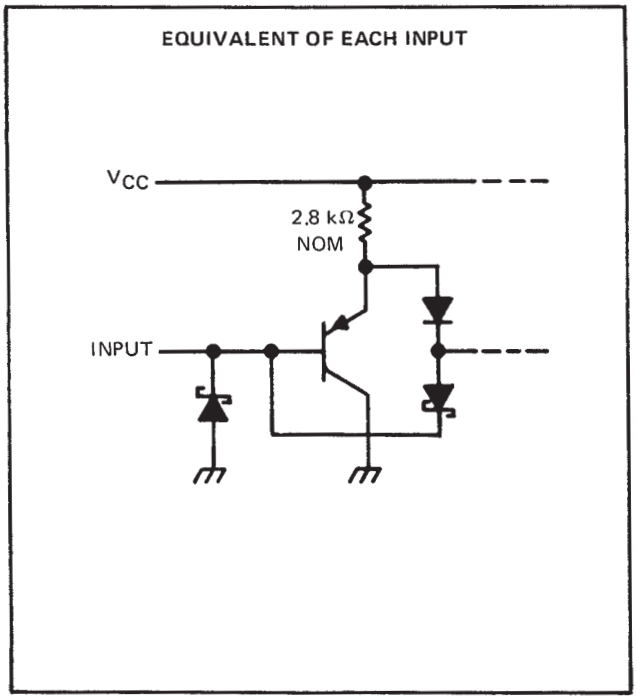
switching characteristics, V_{CC} = 5 V, T_A = 25°C

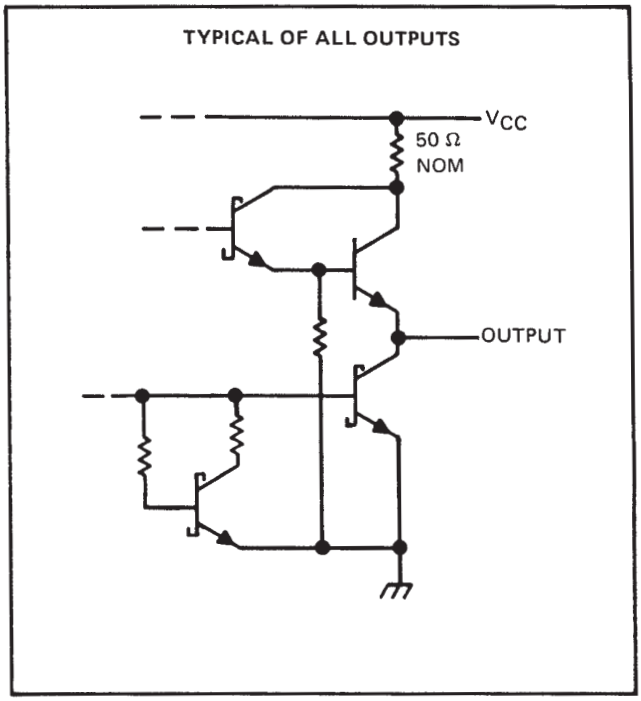
PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS373			'LS374			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f_{max}			C_L = 45 pF, R_L = 667 Ω, See Notes 2 and 3				35	50		MHz
t_{PLH}	Data	Any Q			12	18				ns
t_{PHL}					12	18				
t_{PLH}	Clock or enable	Any Q			20	30		15	28	ns
t_{PHL}					18	30		19	28	
t_{PZH}	Output Control	Any Q			15	28		20	26	ns
t_{PZL}					25	36		21	28	
t_{PHZ}	Output Control	Any Q	C_L = 5 pF, R_L = 667 Ω, See Note 3		15	25		15	28	ns
t_{PLZ}	Output Control	Any Q			12	20		12	20	ns

NOTES: 2. Maximum clock frequency is tested with all outputs loaded.
3. Load circuits and voltage waveforms are shown in Section 1.

f_{max} ≡ maximum clock frequency
t_{PLH} ≡ propagation delay time, low-to-high-level output
t_{PHL} ≡ propagation delay time, high-to-low-level output
t_{PZH} ≡ output enable time to high level
t_{PZL} ≡ output enable time to low level
t_{PHZ} ≡ output disable time from high level
t_{PLZ} ≡ output disable time from low level

schematic of inputs and outputs





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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage . . . . . 5.5 V
Off-state output voltage . . . . . 5.5 V
Operating free-air temperature range: SN54S' . . . . . −55°C to 125°C
SN74S' . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

		SN54S'			SN74S'			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}		4.5	5	5.5	4.75	5	5.25	V
High-level output voltage, V_{OH}				5.5			5.5	V
High-level output current, I_{OH}				−2			−6.5	mA
Width of clock/enable pulse, t_w	High	6			6			ns
	Low	7.3			7.3			
Data setup time, t_{su}	'S373	0↓			0↓			ns
	'S374	5↑			5↑			
Data hold time, t_h	'S373	10↓			10↓			ns
	'S374	2↑			2↑			
Operating free-air temperature, T_A		−55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS†			MIN	TYP‡	MAX	UNIT
V_{IH}					2			V
V_{IL}							0.8	V
V_{IK}		V_{CC} = MIN, I_I = −18 mA					−1.2	V
V_{OH}	SN54S'	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = MAX			2.4	3.4		V
	SN74S'				2.4	3.1		
V_{OL}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 20 mA					0.5	V
I_{OZH}		V_{CC} = MAX, V_{IH} = 2 V, V_O = 2.4 V					50	μA
I_{OZL}		V_{CC} = MAX, V_{IH} = 2 V, V_O = 0.5 V					−50	μA
I_I		V_{CC} = MAX, V_I = 5.5 V					1	mA
I_{IH}		V_{CC} = MAX, V_I = 2.7 V					50	μA
I_{IL}		V_{CC} = MAX, V_I = 0.5 V					−250	μA
I_{OS}§		V_{CC} = MAX			−40		−100	mA
I_{CC}		V_{CC} = MAX	'S373				160	mA
				outputs low			160	
				outputs disabled			190	
			'S374	outputs high			110	
				outputs low			140	
				outputs disabled			160	
				CLK and $\overline{OC}$ at 4 V, D inputs at 0 V			180	

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡All typical values are at V_{CC} = 5 V, T_A = 25°C.
§Not more than one output should be shorted at a time and duration of the short-circuit should not exceed one second.

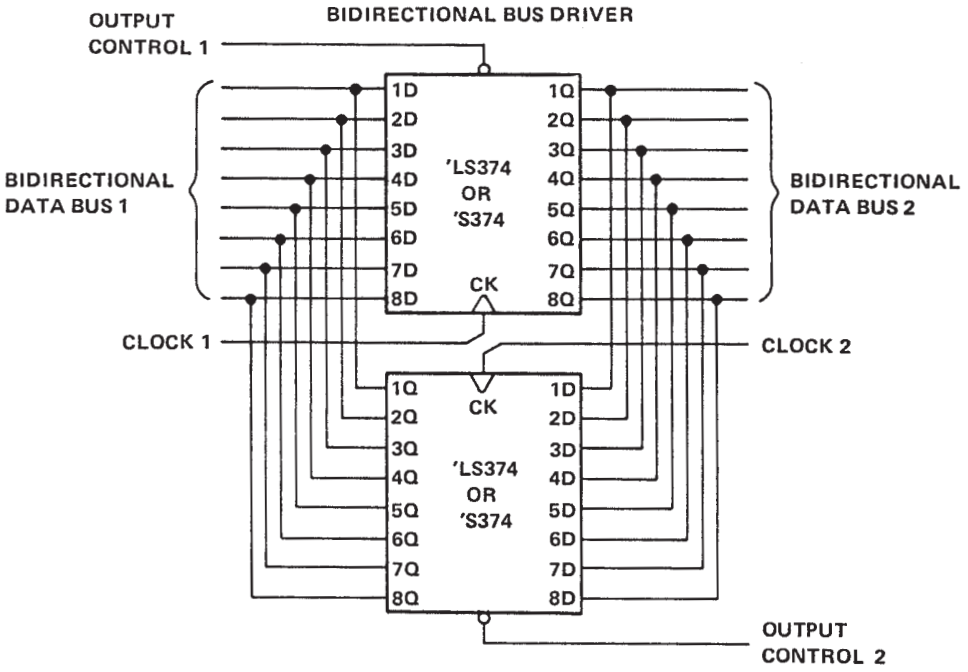
switching characteristics, V_{CC} = 5 V, T_A = 25°C

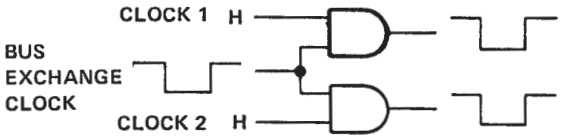
PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'S373			'S374			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f_{max}			C_L = 15 pF, R_L = 280 Ω, See Notes 2 and 4				75	100		MHz
t_{PLH}	Data	Any Q			7	12				ns
t_{PHL}					7	12				
t_{PLH}	Clock or enable	Any Q			7	14		8	15	ns
t_{PHL}					12	18		11	17	
t_{PZH}	Output Control	Any Q			8	15		8	15	ns
t_{PZL}					11	18		11	18	
t_{PHZ}	Output Control	Any Q	C_L = 5 pF, R_L = 280 Ω, See Note 3		6	9		5	9	ns
t_{PLZ}					8	12		7	12	

NOTES: 2. Maximum clock frequency is tested with all outputs loaded.
4. Load circuits and voltage waveforms are shown in Section 1.

f_{max} ≡ maximum clock frequency
t_{PLH} ≡ propagation delay time, low-to-high-level output
t_{PHL} ≡ propagation delay time, high-to-low-level output
t_{PZH} ≡ output enable time to high level
t_{PZL} ≡ output enable time to low level
t_{PHZ} ≡ output disable time from high level
t_{PLZ} ≡ output disable time from low level

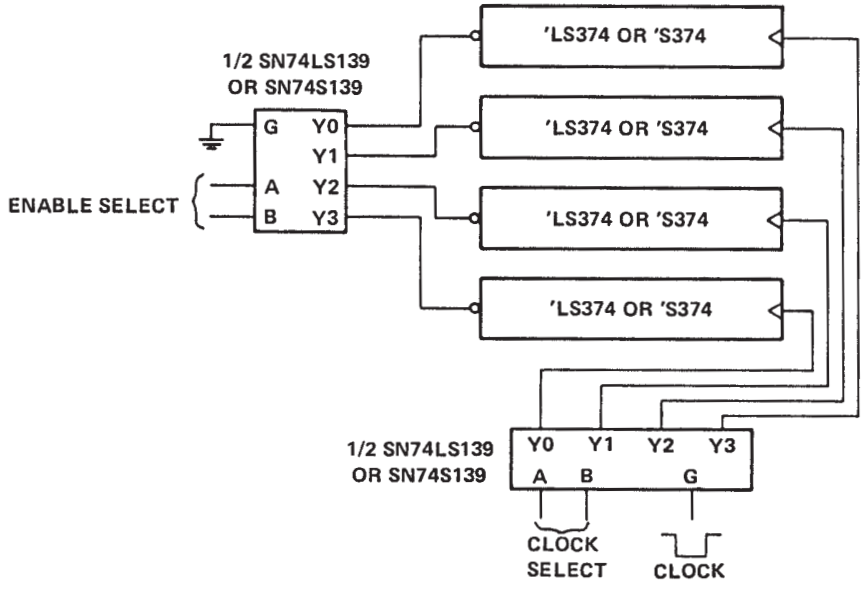
TYPICAL APPLICATION DATA





CLOCK CIRCUIT FOR BUS EXCHANGE

EXPANDABLE 4-WORD-BY-8-BIT GENERAL REGISTER FILE



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