National Semiconductor

DM54S373/DM74S373, DM54S374/DM74S374 TRI-STATE® Octal D-Type Transparent Latches and Edge-Triggered Flip-Flops

General Description

These 8-bit registers feature totem-pole TRI-STATE outputs designed specifically for driving highly-capacitive or relatively low-impedance loads. The high-impedance 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 DM54/74S373 are transparent D-type latches meaning that while the enable (G) 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.

The eight flip-flops of the DM54/74S374 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 set up at the D inputs.

Schmitt-trigger buffered inputs at the enable/clock lines 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.

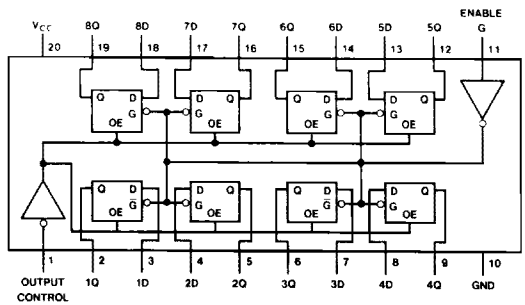
The output control does not affect the internal operation of the latches or flip-flops. That is, the old data can be retained or new data can be entered even while the outputs are off.

Features

- Choice of 8 latches or 8 D-type flip-flops in a single package
- TRI-STATE bus-driving outputs
- Full parallel-access for loading
- Buffered control inputs
- P-N-P input reduce D-C loading on data lines

Connection Diagrams

Dual-In-Line Package



Order Number DM54S373J, DM74S373WM or DM74S373N
See NS Package Number J20A, M20B or N20A

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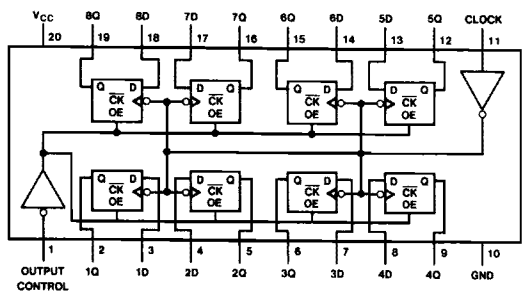
Dual-In-Line Package



Order Number DM54S374J, DM74S374WM or DM74S374N
See NS Package Number J20A, M20B or N20A

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Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	7V
Input Voltage	5.5V
Operating Free Air Temperature Range	
DM54S	−55°C to +125°C
DM74S	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note: *The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.*

Function Tables

DM54/74S373
Truth Table

Output Control	Enable G	D	Output
L	H	H	H
L	H	L	L
L	L	X	Q_0
H	X	X	Z

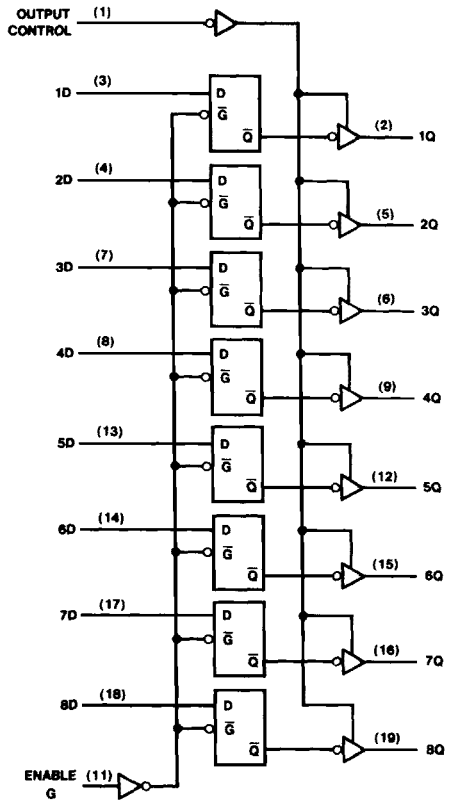
DM54/74S374
Truth Table

Output Control	Clock	D	Output
L	↑	H	H
L	↑	L	L
L	L	X	Q_0
H	X	X	Z

H = High Level (Steady State), L = Low Level (Steady State), X = Don't Care
↑ = Transition from low-to-high level, Z = High Impedance State
Q_0 = The level of the output before steady-state input conditions were established.

Logic Diagrams

DM54/74S373
Transparent Latches



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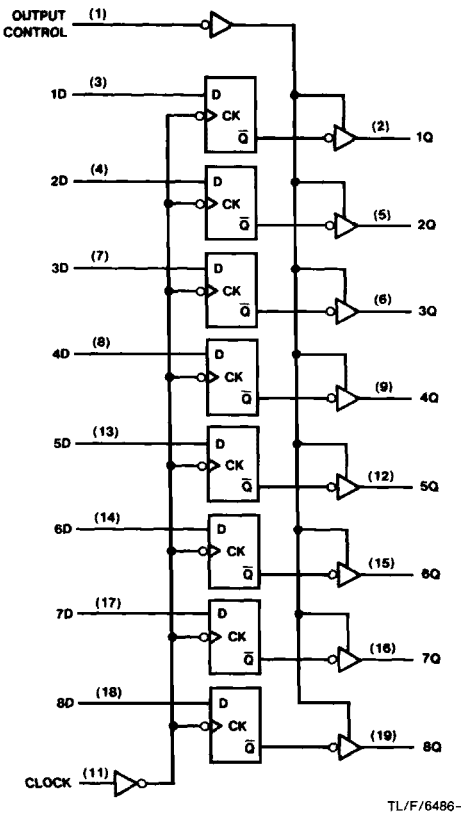
DM54/74S374
Positive-Edge-Triggered Flip-Flops



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'S373 Recommended Operating Conditions (See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter		DM54S373			DM74S373			Units
			Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply Voltage		4.5	5	5.5	4.75	5	5.25	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				−2			−6.5	mA
I_{OL}	Low Level Output Current				20			20	mA
t_W	Pulse Width (Note 2)	Enable High	6			6			ns
		Enable Low	7.3			7.3			
t_{SU}	Data Setup Time (Notes 1 and 3)		0 ↓			0 ↓			ns
t_H	Data Hold Time (Notes 1 and 3)		10 ↓			10 ↓			ns
T_A	Free Air Operating Temperature		−55		125	0		70	°C

Note 1: The symbol (↓) indicates the falling edge of the clock pulse is used for reference.

Note 2: C_L = 15 pF, R_L = 280Ω, T_A = 25°C and V_{CC} = 5V.

Note 3: T_A = 25°C and V_{CC} = 5V.

'S373 Electrical Characteristics over recommended operating free air temperature (unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ (Note 4)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA				−1.2	V
V_{OH}	High Level Output Voltage	V_{CC} = Min, I_{OH} = Max, V_{IL} = Max, V_{IH} = Min	DM54	2.4	3.4		V
			DM74	2.4	3.2		
V_{OL}	Low Level Output Voltage	V_{CC} = Min, I_{OL} = Max, V_{IH} = Min, V_{IL} = Max				0.5	V
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 5.5V				1	mA
I_{IH}	High Level Input Current	V_{CC} = Max, V_I = 2.7V				50	μA
I_{IL}	Low Level Input Current	V_{CC} = Max, V_I = 0.5V				−250	μA
I_{OZH}	Off-State Output Current with High Level Output Voltage Applied	V_{CC} = Max, V_O = 2.4V, V_{IH} = Min, V_{IL} = Max				50	μA
I_{OZL}	Off-State Output Current with Low Level Output Voltage Applied	V_{CC} = Max, V_O = 0.5V, V_{IH} = Min, V_{IL} = Max				−50	μA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 5)	DM54	−40		−100	mA
			DM74	−40		−100	
I_{CC}	Supply Current	V_{CC} = Max	Outputs High or Low		105	160	mA
			Outputs Disabled			190	

Note 4: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 5: Not more than one output should be shorted at a time, and the duration should not exceed one second.

'S373 Switching Characteristics at V_{CC} = 5V and T_A = 25°C

(See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter	From (Input) To (Output)	R_L = 280Ω				Units
			C_L = 15 pF		C_L = 50 pF		
			Min	Max	Min	Max	
t_{PLH}	Propagation Delay Time Low to High Level Output	Data to Any Q		12		14	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Data to Any Q		12		16	ns
t_{PLH}	Propagation Delay Time Low to High Level Output	Enable to Any Q		14		14	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Enable to Any Q		18		21	ns
t_{PZH}	Enable Time to High Level Output	Output Control to Any Q		15		17	ns
t_{PZL}	Output Enable Time to Low Level Output	Output Control to Any Q		18		23	ns
t_{PHZ}	Output Disable Time to High Level Output (Note 1)	Output Control to Any Q		9			ns
t_{PLZ}	Output Disable Time to Low Level Output (Note 1)	Output Control to Any Q		12			ns

Note 1: C_L = 5 pF

'S374 Recommended Operating Conditions

(See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter		DM54S374			DM74S374			Units
			Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply Voltage		4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High Level Input Voltage		2						V
V_{IL}	Low Level Input Voltage				0.8			0.8	V
I_{OH}	High Level Output Current				−2			−6.5	mA
I_{OL}	Low Level Output Current				20			20	mA
f_{CLK}	Clock Frequency (Note 2)		0	100	75	0	100	75	MHz
f_{CLK}	Clock Frequency (Note 3)		0	100	75	0	100	75	MHz
t_W	Pulse Width (Note 2)	Clock High	6			6			ns
		Clock Low	7.3			7.3			
	Pulse Width (Note 3)	Clock High	15			15			
		Clock Low	15			15			
t_{SU}	Data Setup Time (Notes 1 and 4)		5↑			5↑			ns
t_H	Data Hold Time (Notes 1 and 4)		2↑			2↑			ns
T_A	Free Air Operating Temperature		−55		125	0		70	°C

Note 1: The symbol (↑) indicates the rising edge of the clock pulse is used for reference.
Note 2: C_L = 15 pF, R_L = 280Ω, T_A = 25°C and V_{CC} = 5V.
Note 3: C_L = 50 pF, R_L = 280Ω, T_A = 25°C and V_{CC} = 5V.
Note 4: T_A = 25°C and V_{CC} = 5V.

'S374 Electrical Characteristics

over recommended operating free air temperature (unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ (Note 1)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA				−1.2	V
V_{OH}	High Level Output Voltage	V_{CC} = Min, I_{OH} = Max, V_{IL} = Max, V_{IH} = Min	DM54	2.4	3.4		V
			DM74	2.4	3.2		
V_{OL}	Low Level Output Voltage	V_{CC} = Min, I_{OL} = Max, V_{IH} = Min, V_{IL} = Max				0.5	V
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 5.5V				1	mA
I_{IH}	High Level Input Current	V_{CC} = Max, V_I = 2.7V				50	μA
I_{IL}	Low Level Input Current	V_{CC} = Max, V_I = 0.5V				−250	μA
I_{OZH}	Off-State Output Current with High Level Output Voltage Applied	V_{CC} = Max, V_O = 2.4V, V_{IH} = Min, V_{IL} = Max				50	μA
I_{OZL}	Off-State Output Current with Low Level Output Voltage Applied	V_{CC} = Max, V_O = 0.5V, V_{IH} = Min, V_{IL} = Max				−50	μA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 2)	DM54	−40		−100	mA
			DM74	−40		−100	
I_{CC}	Supply Current	V_{CC} = Max	Outputs High			110	mA
			Outputs Low		90	140	
			Outputs Disabled			160	

Note 1: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 2: Not more than one output should be shorted at a time, and the duration should not exceed one second.

'S374 Switching Characteristics at V_{CC} = 5V and T_A = 25°C

(See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter	From (Input) To (Output)	R_L = 280Ω				Units
			C_L = 15 pF		C_L = 50 pF		
			Min	Max	Min	Max	
f_{MAX}	Maximum Clock Frequency			75		75	MHz
t_{PLH}	Propagation Delay Time Low to High Level Output	Clock to Any Q		15		15	ns
t_{PHL}	Propagation Delay Time High to Low Level Output	Clock to Any Q		17		20	ns
t_{PZH}	Output Enable Time to High Level Output	Output Control to Any Q		15		17	ns
t_{PZL}	Output Enable Time to Low Level Output	Output Control to Any Q		18		23	ns
t_{PHZ}	Output Disable Time from High Level Output (Note 1)	Output Control to Any Q		9			ns
t_{PLZ}	Output Disable Time from Low Level Output (Note 1)	Output Control to Any Q		12			ns

Note 1: C_L = 5 pF