

March 1988

MM54C373/MM74C373 TRI-STATE® Octal D-Type Latch MM54C374/MM74C374 TRI-STATE Octal D-Type Flip-Flop

General Description

The MM54C373/MM74C373, MM54C374/MM74C374 are integrated, complementary MOS (CMOS), 8-bit storage elements with TRI-STATE outputs. These outputs have been specially designed to drive high capacitive loads, such as one might find when driving a bus, and to have a fan out of 1 when driving standard TTL. When a high logic level is applied to the OUTPUT DISABLE input, all outputs go to a high impedance state, regardless of what signals are present at the other inputs and the state of the storage elements.

The MM54C373/MM74C373 is an 8-bit latch. When $\overline{\text{LATCH ENABLE}}$ is high, the Q outputs will follow the D inputs. When $\overline{\text{LATCH ENABLE}}$ goes low, data at the D inputs, which meets the set-up and hold time requirements, will be retained at the outputs until $\overline{\text{LATCH ENABLE}}$ returns high again.

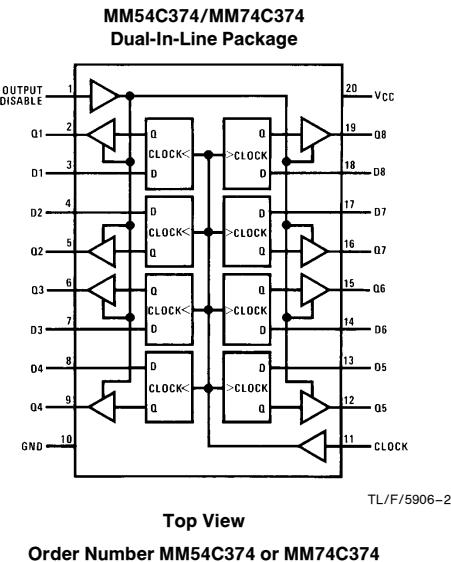
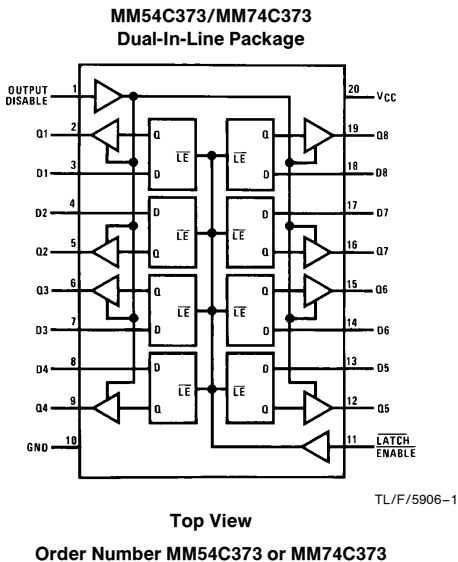
The MM54C374/MM74C374 is an 8-bit, D-type, positive-edge triggered flip-flop. Data at the D inputs, meeting the set-up and hold time requirements, is transferred to the Q outputs on positive-going transitions of the CLOCK input.

Both the MM54C373/MM74C373 and the MM54C374/MM74C374 are being assembled in 20-pin dual-in-line packages with 0.300" pin centers.

Features

- Wide supply voltage range 3V to 15V
- High noise immunity 0.45 V_{CC} (typ.)
- Low power consumption
- TTL compatibility Fan out of 1 driving standard TTL
- Bus driving capability
- TRI-STATE outputs
- Eight storage elements in one package
- Single CLOCK/ $\overline{\text{LATCH ENABLE}}$ and OUTPUT DISABLE control inputs
- 20-pin dual-in-line package with 0.300" centers takes half the board space of a 24-pin package

Connection Diagrams



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MM54C373/MM74C373 TRI-STATE Octal D-Type Latch
MM54C374/MM74C374 TRI-STATE Octal D-Type Flip-Flop

Absolute Maximum Ratings (Note 1)

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

Voltage at Any Pin	−0.3V to $V_{CC} + 0.3V$
Operating Temperature Range (T_A)	−55°C to +125°C MM54C373 −40°C to +85°C MM74C373
Storage Temperature Range (T_S)	−65°C to +150°C

Power Dissipation	700 mW
Dual-In-Line	500 mW
Small Outline	3V to 15V
Operating V_{CC} Range	18V
Absolute Maximum V_{CC}	260°C
Lead Temperature (T_L) (Soldering, 10 seconds)	

DC Electrical Characteristics Min/Max limits apply across temperature range unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
CMOS TO CMOS						
$V_{IN(1)}$	Logical “1” Input Voltage	$V_{CC} = 5V$ $V_{CC} = 10V$	3.5 8.0			V V
$V_{IN(0)}$	Logical “0” Input Voltage	$V_{CC} = 5V$ $V_{CC} = 10V$			1.5 2.0	V V
$V_{OUT(1)}$	Logical “1” Output Voltage	$V_{CC} = 5V, I_O = -10 \mu A$ $V_{CC} = 10V, I_O = -10 \mu A$	4.5 9.0			V V
$V_{OUT(0)}$	Logical “0” Output Voltage	$V_{CC} = 5V, I_O = 10 \mu A$ $V_{CC} = 10V, I_O = 10 \mu A$			0.5 1.0	V V
$I_{IN(1)}$	Logical “1” Input Current	$V_{CC} = 15V, V_{IN} = 15V$		0.005	1.0	μA
$I_{IN(0)}$	Logical “0” Input Current	$V_{CC} = 15V, V_{IN} = 0V$	−1.0	−0.005		μA
I_{OZ}	TRI-STATE Leakage Current	$V_{CC} = 15V, V_O = 15V$ $V_{CC} = 15V, V_O = 0V$	−1.0	0.005 −0.005	1.0	μA μA
I_{CC}	Supply Current	$V_{CC} = 15V$		0.05	300	μA
CMOS/LPTTL INTERFACE						
$V_{IN(1)}$	Logical “1” Input Voltage	54C $V_{CC} = 4.5V$ 74C $V_{CC} = 4.75V$	$V_{CC} - 1.5$ $V_{CC} - 1.5$			V V
$V_{IN(0)}$	Logical “0” Input Voltage	54C $V_{CC} = 4.5V$ 54C $V_{CC} = 4.75V$			0.8 0.8	V V
$V_{OUT(1)}$	Logical “1” Output Voltage	54C $V_{CC} = 4.5V, I_O = -360 \mu A$ 74C $V_{CC} = 4.75V, I_O = -360 \mu A$	$V_{CC} - 0.4$ $V_{CC} - 0.4$			V V
		54C $V_{CC} = 4.5V, I_O = -1.6 mA$ 74C $V_{CC} = 4.75V, I_O = -1.6 mA$	2.4 2.4			V V
$V_{OUT(0)}$	Logical “0” Output Voltage	54C $V_{CC} = 4.5V, I_O = 1.6 mA$ 74C $V_{CC} = 4.75V, I_O = 1.6 mA$			0.4 0.4	V V
OUTPUT DRIVE (Short Circuit Current)						
I_{SOURCE}	Output Source Current	$V_{CC} = 5V, V_{OUT} = 0V$ $T_A = 25^\circ C$ (Note 4)	−12	−24		mA
I_{SOURCE}	Output Source Current	$V_{CC} = 10V, V_{OUT} = 0V$ $T_A = 25^\circ C$ (Note 4)	−24	−48		mA
I_{SINK}	Output Sink Current (N-Channel)	$V_{CC} = 5V, V_{OUT} = V_{CC}$ $T_A = 25^\circ C$ (Note 4)	6	12		mA
I_{SINK}	Output Sink Current (N-Channel)	$V_{CC} = 10V, V_{OUT} = V_{CC}$ $T_A = 25^\circ C$ (Note 4)	24	48		mA

Note 1: “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed. Except for “Operating Temperature Range” they are not meant to imply that the devices should be operated at these limits. The table of “Electrical Characteristics” provides conditions for actual device operation.

AC Electrical Characteristics*

MM54C373/MM74C373, $T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, $t_r = t_f = 20\text{ ns}$, unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{pd0}, t_{pd1}	Propagation Delay, $\overline{\text{LATCH ENABLE}}$ to Output	$V_{CC} = 5\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 5\text{V}, C_L = 150\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 150\text{ pF}$		165 70 195 85	330 140 390 170	ns ns ns ns
t_{pd0}, t_{pd1}	Propagation Delay Data In to Output	$\overline{\text{LATCH ENABLE}} = V_{CC}$ $V_{CC} = 5\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 5\text{V}, C_L = 150\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 150\text{ pF}$		155 70 185 85	310 140 370 170	ns ns ns ns
$t_{\text{SET-UP}}$	Minimum Set-Up Time Data In to $\text{CLOCK}/\overline{\text{LATCH ENABLE}}$	$t_{\text{HOLD}} = 0\text{ ns}$ $V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$		70 35	140 70	ns ns
f_{MAX}	Maximum $\overline{\text{LATCH ENABLE}}$ Frequency	$V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$	3.5 4.5	6.7 9.0		MHz MHz
t_{PWH}	Minimum $\overline{\text{LATCH ENABLE}}$ Pulse Width	$V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$		75 55	150 110	ns ns
t_r, t_f	Maximum $\overline{\text{LATCH ENABLE}}$ Rise and Fall Time	$V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$		NA NA		μs μs
t_{1H}, t_{0H}	Propagation Delay OUTPUT DISABLE to High Impedance State (from a Logic Level)	$R_L = 10\text{k}, C_L = 5\text{ pF}$ $V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$		105 60	210 120	ns ns
t_{H1}, t_{H0}	Propagation Delay OUTPUT DISABLE to Logic Level (from High Impedance State)	$R_L = 10\text{k}, C_L = 50\text{ pF}$ $V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$		105 45	210 90	ns ns
$t_{\text{THL}}, t_{\text{TLH}}$	Transition Time	$V_{CC} = 5\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 5\text{V}, C_L = 150\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 150\text{ pF}$		65 35 110 70	130 70 220 140	ns ns ns ns
C_{LE}	Input Capacitance	$\overline{\text{LE}}$ Input (Note 2)		7.5	10	pF
C_{OD}	Input Capacitance	OUTPUT DISABLE Input (Note 2)		7.5	10	pF
C_{IN}	Input Capacitance	Any Other Input (Note 2)		5	7.5	pF
C_{OUT}	Output Capacitance	High Impedance State (Note 2)		10	15	pF
C_{PD}	Power Dissipation Capacitance	Per Package (Note 3)		200		pF

*AC Parameters are guaranteed by DC correlated testing.

AC Electrical Characteristics* (Continued)

MM54C374/MM74C374, $T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, $t_r = t_f = 20\text{ ns}$, unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{pd0}, t_{pd1}	Propagation Delay, CLOCK to Output	$V_{CC} = 5\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 5\text{V}, C_L = 150\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 150\text{ pF}$		150 65 180 80	300 130 360 160	ns ns ns ns
t_{SET-UP}	Minimum Set-Up Time Data In to CLOCK/LATCH ENABLE	$t_{HOLD} = 0\text{ ns}$ $V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$		70 35	140 70	ns ns
t_{PWH}, t_{PWL}	Minimum CLOCK Pulse Width	$V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$		70 50	140 100	ns ns
f_{MAX}	Maximum CLOCK Frequency	$V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$	3.5 5	7.0 10		MHz MHz
t_{1H}, t_{0H}	Propagation Delay OUTPUT DISABLE to High Impedance State (from a Logic Level)	$R_L = 10\text{k}, C_L = 50\text{ pF}$ $V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$		105 60	210 120	ns ns
t_{H1}, t_{H0}	Propagation Delay OUTPUT DISABLE to Logic Level (from High Impedance State)	$R_L = 10\text{k}, C_L = 50\text{ pF}$ $V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$		105 45	210 90	ns ns
t_{THL}, t_{TLH}	Transition Time	$V_{CC} = 5\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 50\text{ pF}$ $V_{CC} = 5\text{V}, C_L = 150\text{ pF}$ $V_{CC} = 10\text{V}, C_L = 150\text{ pF}$		65 35 110 70	130 70 220 140	ns ns ns ns
t_r, t_f	Maximum CLOCK Rise and Fall Time	$V_{CC} = 5\text{V}$ $V_{CC} = 10\text{V}$	15 5	>2000 >2000		μs μs
C_{CLK}	Input Capacitance	CLOCK Input (Note 2)		7.5	10	pF
C_{OD}	Input Capacitance	OUTPUT DISABLE Input (Note 2)		7.5	10	pF
C_{IN}	Input Capacitance	Any Other Input (Note 2)		5	7.5	pF
C_{OUT}	Output Capacitance	High Impedance State (Note 2)		10	15	pF
C_{PD}	Power Dissipation Capacitance	Per Package (Note 3)		250		pF

*AC Parameters are guaranteed by DC correlated testing.

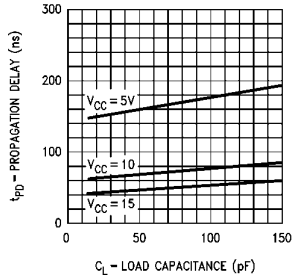
Note 2: Capacitance is guaranteed by periodic testing.

Note 3: C_{PD} determines the no load AC power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics Application Note AN-90.

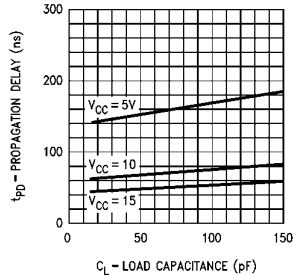
Note 4: These are peak output current capabilities. Continuous output current is rated at 12 mA max.

Typical Performance Characteristics $T_A = 25^\circ\text{C}$

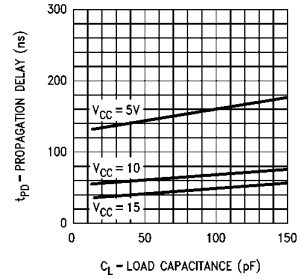
MM54C373/MM74C373
Propagation Delay, **LATCH**
ENABLE to Output vs Load Capacitance



MM54C373/MM74C373
Propagation Delay,
Data In to Output
vs Load Capacitance

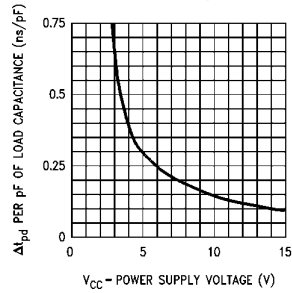


MM54C374/MM74C374
Propagation Delay,
CLOCK to Output
vs Load Capacitance

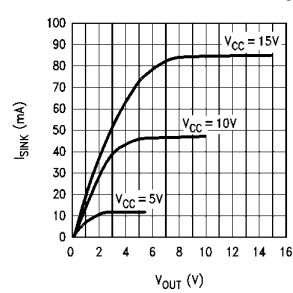


TL/F/5906-3

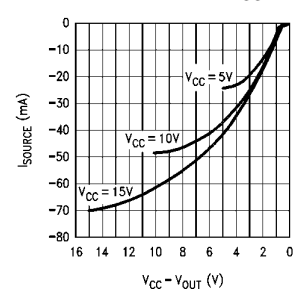
MM54C373/MM74C373,
MM54C374/MM74C374
Change in Propagation Delay per
pF of Load Capacitance ($\Delta t_{PD}/pF$)
vs Power Supply Voltage



MM54C373/MM74C373,
MM54C374/MM74C374
Output Sink Current vs V_{OUT}



MM54C373/MM74C373,
MM54C374/MM74C374 Output
Source Current vs $V_{CC} - V_{OUT}$



TL/F/5906-4

Truth Table

MM54C373/MM74C373

Output Disable	LATCH ENABLE	D	Q
L	H	H	H
L	H	L	L
L	L	X	Q
H	X	X	Hi-Z

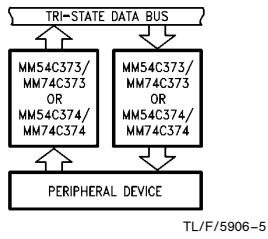
MM54C374/MM74C374

Output Disable	Clock	D	Q
L		H	H
L		L	L
L	L	X	Q
L	H	X	Q
H	X	X	Hi-Z

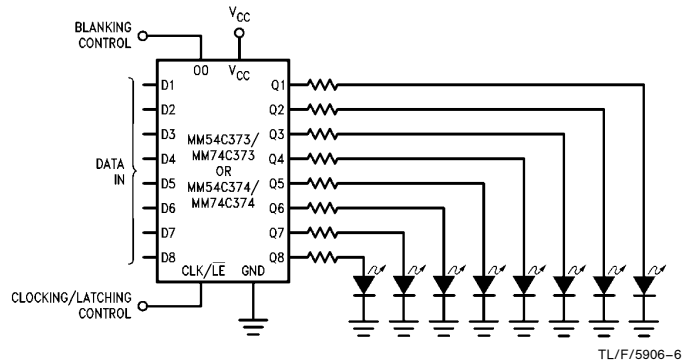
L = Low logic level
H = High logic level
X = Irrelevant
 = Low to high logic level transition
Q = Preexisting output level
Hi-Z = High impedance output state

Typical Applications

Data Bus Interfacing Element

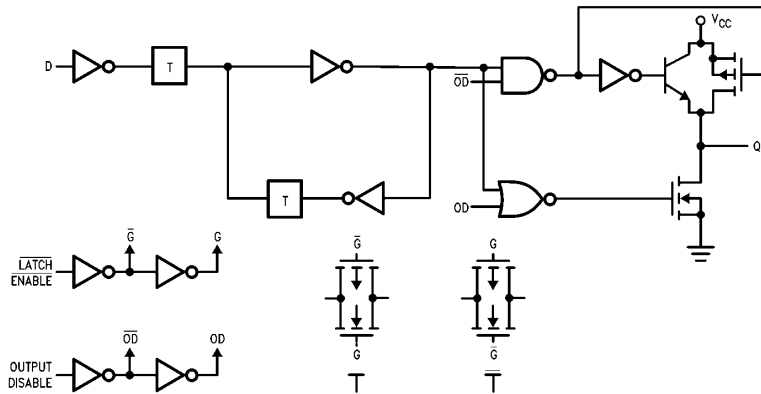


Simple, Latching, Octal, LED Indicator Driver with Blanking for Use as Data Display, Bus Monitor, μ P Front Panel Display, Etc.

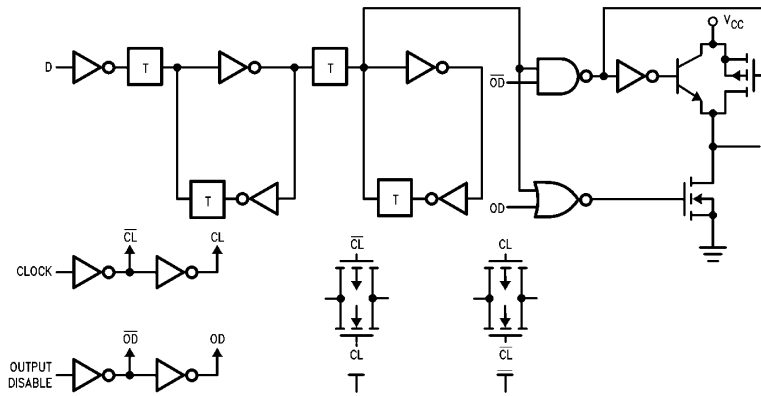


Logic Diagrams

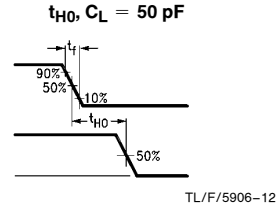
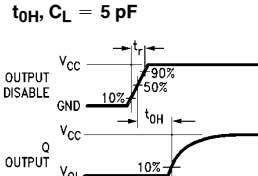
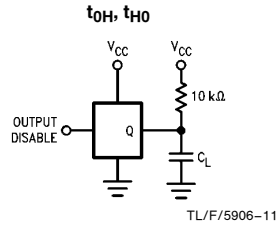
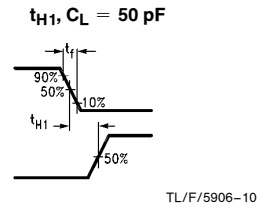
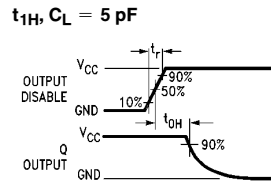
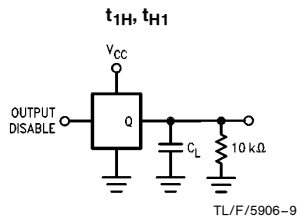
MM54C373/MM74C373 (1 of 8 Latches)



MM54C374/MM74C374 (1 of 8 Flip-Flops)

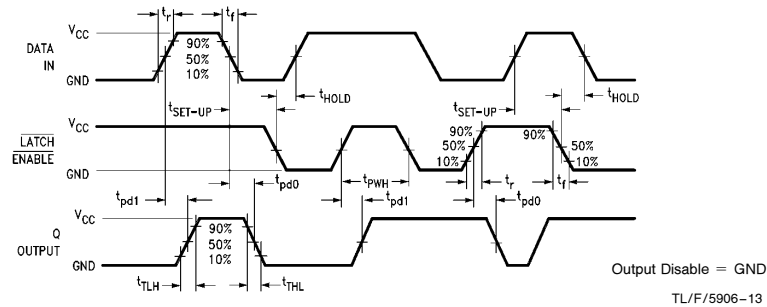


TRI-STATE Test Circuits and Switching Time Waveforms

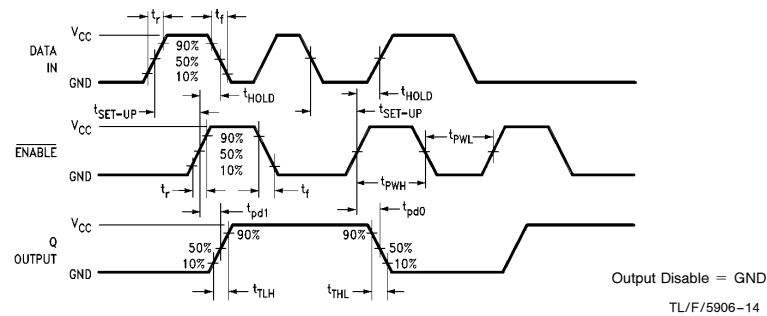


Switching Time Waveforms

MM54C373/MM74C373



MM54C374/MM74C374



Physical Dimensions inches (millimeters)