

# MITSUBISHI LSTTLs M74LS74AP

## DUAL D-TYPE POSITIVE EDGE-TRIGGERED FLIP-FLOPS WITH SET AND RESET

### DESCRIPTION

The M74LS74AP is a semiconductor integrated circuit containing 2 D-type positive edge-triggered flip-flop circuits with discrete terminals for clock input T, data input D and direct set and reset inputs  $\overline{S_D}$  and  $\overline{R_D}$ .

### FEATURES

- Each flip-flop can be used independently.
- Direct set and reset inputs
- Positive edge-triggering
- Q and  $\overline{Q}$  outputs
- Wide operating temperature range ( $T_a = -20 \sim +75^\circ\text{C}$ )

### APPLICATION

General purpose, for use in industrial and consumer equipment.

### FUNCTIONAL DESCRIPTION

When T changes from low to high, the D signal immediately before the change emerges in outputs Q and  $\overline{Q}$  in accordance with the function table. By using  $\overline{S_D}$  and  $\overline{R_D}$ , this IC can be made into a direct R-S flip-flop. When both  $\overline{S_D}$  and  $\overline{R_D}$  are low,  $Q = \overline{Q} = \text{high}$ . However, when both of them change to high at the same time, the status of Q and  $\overline{Q}$  cannot be anticipated. For use as a D-type flip-flop,  $\overline{S_D}$  and  $\overline{R_D}$  must be kept in high.

### FUNCTION TABLE

$\overline{S_D}$	$\overline{R_D}$	T	D	Q	$\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H*	H*
H	H	L	X	$Q^0$	$\overline{Q}^0$
H	H	↑	H	H	L
H	H	↑	L	L	H

Note 1: ↑ : Transition from low to high-level

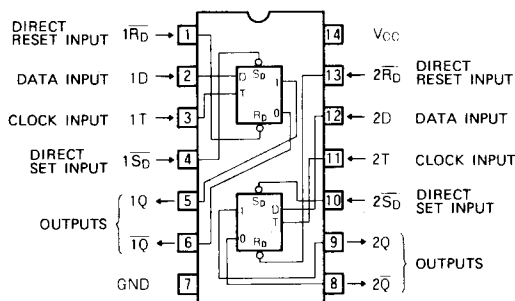
$Q^0$  : level of Q before the indicated steady-state input conditions were established.

$\overline{Q}^0$  : level of  $\overline{Q}$  before the indicated steady-state input conditions were established.

X : Irrelevant

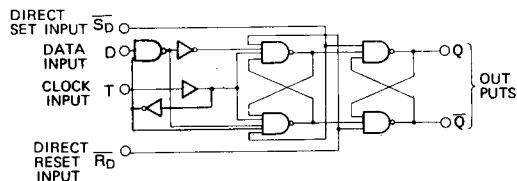
\* : Nonstable; it will not persist when  $\overline{R_D}$ ,  $\overline{S_D}$  inputs return to their inactive (high) level.

### PIN CONFIGURATION (TOP VIEW)



Outline 14P4

### LOGIC DIAGRAM (EACH FLIP-FLOP)



### ABSOLUTE MAXIMUM RATINGS ( $T_a = -20 \sim +75^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
$V_{CC}$	Supply voltage		-0.5 ~ +7	V
$V_I$	Input voltage		-0.5 ~ +5.5	V
$V_O$	Output voltage	High-level state	-0.5 ~ $V_{CC}$	V
$T_{opr}$	Operating free-air ambient temperature range		-20 ~ +75	$^\circ\text{C}$
$T_{stg}$	Storage temperature range		-65 ~ +150	$^\circ\text{C}$

**DUAL D-TYPE POSITIVE EDGE-TRIGGERED FLIP-FLOPS WITH SET AND RESET**

**RECOMMENDED OPERATING CONDITIONS** ( $T_a = -20 \text{ -- } +75 \text{ }^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
$V_{CC}$	Supply voltage		4.75	5	5.25	V
$I_{OH}$	High-level output current	$V_{OH} \geq 2.7\text{V}$	0		-400	$\mu\text{A}$
$I_{OL}$	Low-level output current	$V_{OL} \leq 0.4\text{V}$	0		4	mA
		$V_{OL} \leq 0.5\text{V}$	0		8	mA

**ELECTRICAL CHARACTERISTICS** ( $T_a = -20 \text{ -- } +75 \text{ }^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter		Test conditions	Limits			Unit
				Min	Typ*	Max	
$V_{IH}$	High-level input voltage			2			V
$V_{IL}$	Low-level input voltage					0.8	V
$V_{IC}$	Input clamp voltage		$V_{CC} = 4.75\text{V}$ , $I_{IC} = -18\text{mA}$			1.5	V
$V_{OH}$	High-level output voltage		$V_{CC} = 4.75\text{V}$ , $V_I = 0.8\text{V}$ , $V_I = 2\text{V}$ $I_{OH} = -400\mu\text{A}$	2.7	3.4		V
$V_{OL}$	Low-level output voltage		$V_{CC} = 4.75\text{V}$		0.25	0.4	V
			$V_I = 0.8\text{V}$ , $V_I = 2\text{V}$	$I_{OL} = 4\text{mA}$ $I_{OL} = 8\text{mA}$		0.35	0.5
$I_{IH}$	High-level input current	$D, T$	$V_{CC} = 5.25\text{V}$ , $V_I = 2.7\text{V}$			20	$\mu\text{A}$
		$\bar{S}_D, \bar{R}_D$				40	
		$D, T$	$V_{CC} = 5.25\text{V}$ , $V_I = 10\text{V}$			0.1	mA
		$\bar{S}_D, \bar{R}_D$				0.2	
$I_{IL}$	Low-level input current	$D, T$	$V_{CC} = 5.25\text{V}$ , $V_I = 0.4\text{V}$			0.4	mA
		$\bar{S}_D, \bar{R}_D$				-0.8	
$I_{OS}$	Short-circuit output current (Note 2)		$V_{CC} = 5.25\text{V}$ , $V_O = 0\text{V}$	-20		-100	mA
$I_{CC}$	Supply current		$V_{CC} = 5.25\text{V}$ , (Note 3)		4	8	mA

\* : All typical values are at  $V_{CC} = 5\text{V}$ ,  $T_a = 25^\circ\text{C}$ .

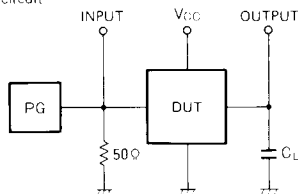
Note 2: All measurements should be done quickly, and not more than one output should be shorted at a time.

Note 3: Measurement circuit

**SWITCHING CHARACTERISTICS** ( $V_{CC} = 5\text{V}$ ,  $T_a = 25 \text{ }^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter		Test conditions	Limits			Unit
				Min	Typ	Max	
$f_{max}$	Maximum clock frequency			25	50		MHz
$t_{PLH}$	Low-to-high-level, high-to-low-level output propagation time, from T to Q, $\bar{Q}$		$C_L = 15\text{pF}$ (Note 4)		11	25	ns
$t_{PHL}$	Low-to-high-level, high-to-low-level output propagation time, from $\bar{S}_D, \bar{R}_D$ to Q, $\bar{Q}$				11	40	ns
$t_{PLH}$	Low-to-high-level, high-to-low-level output propagation time, from T to Q, $\bar{Q}$				8	25	ns
$t_{PHL}$	Low-to-high-level, high-to-low-level output propagation time, from $\bar{S}_D, \bar{R}_D$ to Q, $\bar{Q}$				11	40	ns

Note 4: Measurement circuit



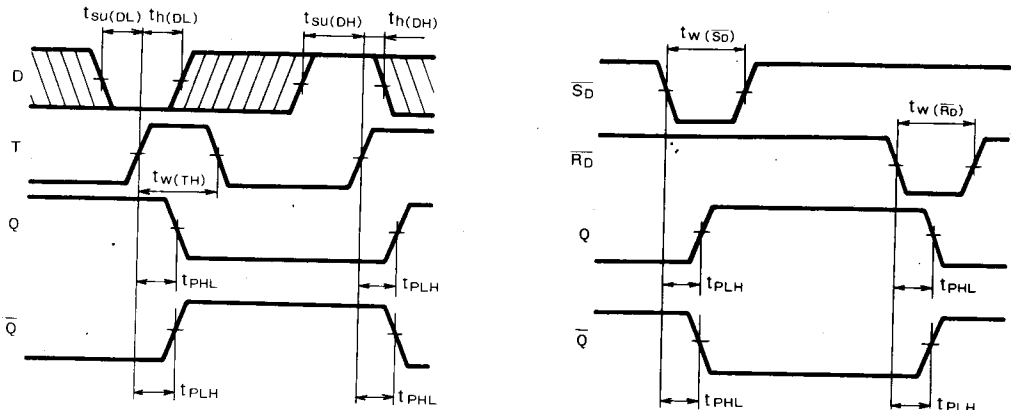
- The pulse generator (PG) has the following characteristics  
 $PRR = 1\text{MHz}$ ,  $t_r = 6\text{ns}$ ,  $t_f = 6\text{ns}$ ,  $t_w = 500\text{ns}$ ,  
 $V_p = 3\text{V}_{p-p}$ ,  $Z_0 = 50\Omega$
- $C_L$  includes probe and jig capacitance.

**DUAL D-TYPE POSITIVE EDGE-TRIGGERED FLIP-FLOPS WITH SET AND RESET**

**TIMING REQUIREMENTS** ( $V_{CC}=5V$ ,  $T_a=25^\circ C$ , unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$t_w(TH)$	Clock input T high pulse width		25	4		ns
$t_w(S_D, R_D)$	Direct set and reset inputs $S_D, R_D$ pulse width		25	4		ns
$t_{su}(DH)$	Setup time high D to T		20	10		ns
$t_{su}(DL)$	Setup time low D to T		20	8		ns
$t_h(DH)$	Hold time high D to T		5	-5		ns
$t_h(DL)$	Hold time low D to T		5	-5		ns

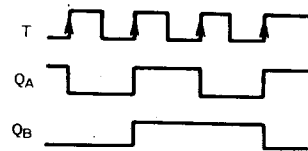
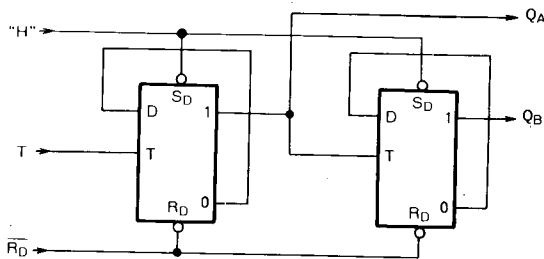
**TIMING DIAGRAM (Reference level = 1.3V)**



Note 4: The shaded areas indicate when the input is permitted to change for predictable output performance.

**APPLICATION EXAMPLE**

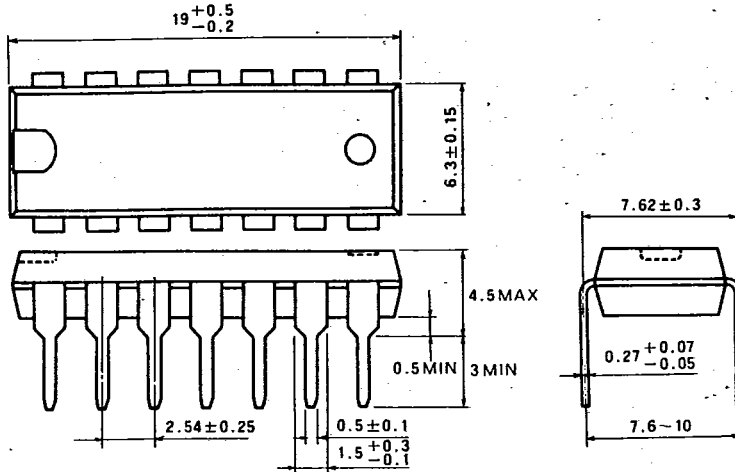
**1/2 divider**



T-90-20

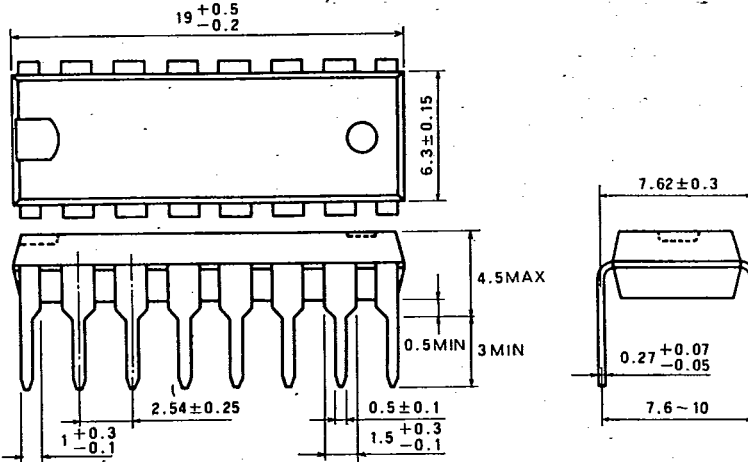
**TYPE 14P4 14-PIN MOLDED PLASTIC DIL**

Dimension in mm



**TYPE 16P4 16-PIN MOLDED PLASTIC DIL**

Dimension in mm



**TYPE 20P4 20-PIN MOLDED PLASTIC DIL**

Dimension in mm

