Dual D-Type Flip-Flop with Set and Clear

With 5V-Tolerant Inputs

The MC74LVX74 is an advanced high speed CMOS D–type flip–flop. The inputs tolerate voltages up to 7V, allowing the interface of 5V systems to 3V systems.

The signal level applied to the D input is transferred to O output during the positive going transition of the Clock pulse.

Clear ($\overline{CD}$) and Set ($\overline{SD}$) are independent of the Clock (CP) and are accomplished by setting the appropriate input Low.

- High Speed: f_{max} = 145MHz (Typ) at V_{CC} = 3.3V
- Low Power Dissipation: I_{CC} = 2µA (Max) at T_A = 25°C
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Low Noise: V_{OLP} = 0.5V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300mA
- ESD Performance: HBM > 2000V; Machine Model > 200V

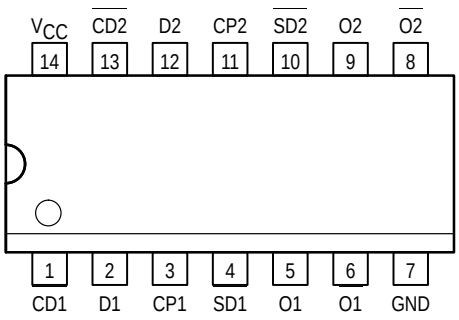


Figure 1. 14–Lead Pinout (Top View)

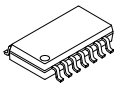
MC74LVX74

LVX

LOW–VOLTAGE CMOS

D SUFFIX
14–LEAD SOIC PACKAGE
CASE 751A–03

DT SUFFIX
14–LEAD TSSOP PACKAGE
CASE 948G–01



M SUFFIX
14–LEAD SOIC EIAJ PACKAGE
CASE 965–01

PIN NAMES

Pins	Function
CP1, CP2	Clock Pulse Inputs
D1, D2	Data Inputs
$\overline{CD1}$, $\overline{CD2}$	Direct Clear Inputs
SD1, $\overline{SD2}$	Direct Set Inputs
On, On	Outputs

MOTOROLA

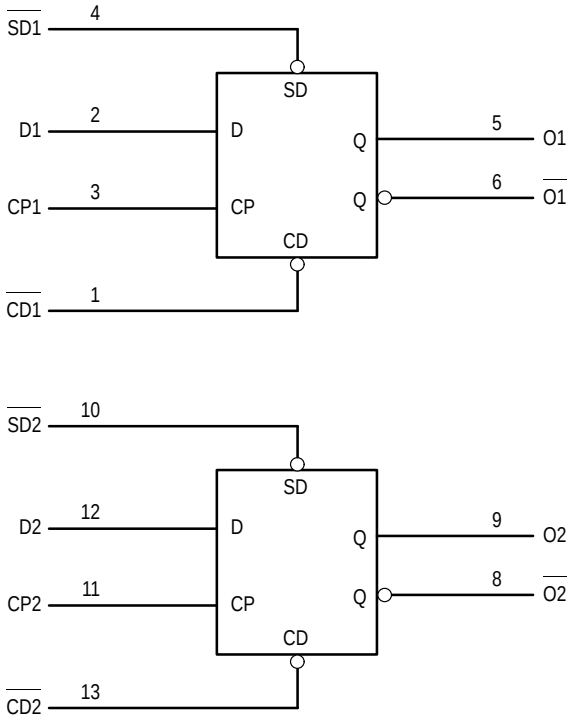


Figure 2. Logic Diagram

INPUTS				OUTPUTS		
SDn	**CDn**	**CPn**	**Dn**	**On**	**On**	**OPERATING MODE**
L	H	X	X	H	L	Asynchronous Set
H	L	X	X	L	H	Asynchronous Clear
L	L	X	X	H	H	Undetermined
H	H	↑	h	H	L	Load and Read Register
H	H	↑	l	L	H	
H	H	↥	X	NC	NC	Hold

H = High Voltage Level; h = High Voltage Level One Setup Time Prior to the Low–to–High Clock Transition; L = Low Voltage Level; l = Low Voltage Level One Setup Time Prior to the Low–to–High Clock Transition; NC = No Change; X = High or Low Voltage Level or Transitions are Acceptable; ↑ = Low–to–High Transition; ↥ = Not a Low–to–High Transition; For I_{CC} Reasons DO NOT FLOAT Inputs

MAXIMUM RATINGS*

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage	–0.5 to +7.0	V
V_{in}	DC Input Voltage	–0.5 to +7.0	V
V_{out}	DC Output Voltage	–0.5 to V_{CC} +0.5	V
I_{IK}	Input Diode Current	–20	mA
I_{OK}	Output Diode Current	±20	mA
I_{out}	DC Output Current, per Pin	±25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins	±50	mA
P_D	Power Dissipation	180	mW
T_{stg}	Storage Temperature	–65 to +150	°C

* Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute–maximum–rated conditions is not implied.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_{CC}	DC Supply Voltage	2.0	3.6	V
V_{in}	DC Input Voltage	0	5.5	V
V_{out}	DC Output Voltage	0	V_{CC}	V
T_A	Operating Temperature, All Package Types	–40	+85	°C
$\Delta t/\Delta V$	Input Rise and Fall Time	0	100	ns/V

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V_{CC} V	T_A = 25°C			T_A = – 40 to 85°C		Unit
				Min	Typ	Max	Min	Max	
V_{IH}	High–Level Input Voltage		2.0 3.0 3.6	1.5 2.0 2.4			1.5 2.0 2.4		V
V_{IL}	Low–Level Input Voltage		2.0 3.0 3.6			0.5 0.8 0.8		0.5 0.8 0.8	V
V_{OH}	High–Level Output Voltage (V_{in} = V_{IH} or V_{IL})	I_{OH} = –50µA I_{OH} = –50µA I_{OH} = –4mA	2.0 3.0 3.0	1.9 2.9 2.58	2.0 3.0		1.9 2.9 2.48		V
V_{OL}	Low–Level Output Voltage (V_{in} = V_{IH} or V_{IL})	I_{OL} = 50µA I_{OL} = 50µA I_{OL} = 4mA	2.0 3.0 3.0		0.0 0.0	0.1 0.1 0.36		0.1 0.1 0.44	V
I_{in}	Input Leakage Current	V_{in} = 5.5V or GND	3.6			±0.1		±1.0	µA
I_{CC}	Quiescent Supply Current	V_{in} = V_{CC} or GND	3.6			2.0		20.0	µA

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ns)

Symbol	Parameter	Test Conditions		$T_A = 25°C$ Min	$T_A = 25°C$ Typ	$T_A = 25°C$ Max	$T_A = -40$ to $85°C$ Min	$T_A = -40$ to $85°C$ Max	Unit
t_{PLH}, t_{PHL}	Propagation Delay CP to O or O	V_{CC} = 2.7V	C_L = 15pF		7.3	15.0	1.0	18.5	ns
			C_L = 50pF		9.8	18.5	1.0	22.0	
		V_{CC} = 3.3 ± 0.3V	C_L = 15pF		5.7	9.7	1.0	11.5	
			C_L = 50pF		8.2	13.2	1.0	15.0	
t_{PLH}, t_{PHL}	Propagation Delay SD or CD to O or O	V_{CC} = 2.7V	C_L = 15pF		8.4	15.6	1.0	18.5	ns
			C_L = 50pF		10.9	19.1	1.0	22.0	
		V_{CC} = 3.3 ± 0.3V	C_L = 15pF		6.6	10.1	1.0	12.0	
			C_L = 50pF		9.1	13.6	1.0	15.5	
f_{max}	Maximum Clock Frequency (50% Duty Cycle)	V_{CC} = 2.7V	C_L = 15pF	55	135		50		MHz
			C_L = 50pF	45	60		40		
		V_{CC} = 3.3 ± 0.3V	C_L = 15pF	95	145		80		
			C_L = 50pF	60	85		50		
t_{OSHL} t_{OSLH}	Output–to–Output Skew (Note 1.)	V_{CC} = 2.7V	C_L = 50pF			1.5		1.5	ns
		V_{CC} = 3.3 ±0.3V	C_L = 50pF			1.5		1.5	

1. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH–to–LOW (t_{OSHL}) or LOW–to–HIGH (t_{OSLH}); parameter guaranteed by design.

TIMING REQUIREMENTS (Input $t_r = t_f = 3.0$ns)

Symbol	Parameter	V_{CC} V	Guaranteed Limit $T_A = 25°C$	Guaranteed Limit $T_A = -40$ to $85°C$	Unit
t_w	Minimum Pulse Width, CP	2.7V	8.5	10.0	ns
		3.3V ±0.3	6.0	7.0	
t_w	Minimum Pulse Width, CD or SD	2.7V	8.5	10.0	ns
		3.3V ±0.3	6.0	7.0	
t_{su}	Minimum Setup Time, D to CP	2.7V	8.0	9.5	ns
		3.3V ±0.3	5.5	6.5	
t_h	Minimum Hold Time, D to CP	2.7V	0.5	0.5	ns
		3.3V ±0.3	0.5	0.5	
t_{rec}	Minimum Recovery Time, SD or CD to CP	2.7V	6.5	7.5	ns
		3.3V ±0.3	5.0	5.0	

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	$T_A = 25°C$ Min	$T_A = 25°C$ Typ	$T_A = 25°C$ Max	$T_A = -40$ to $85°C$ Min	$T_A = -40$ to $85°C$ Max	Unit
C_{in}	Input Capacitance		4	10		10	pF
C_{PD}	Power Dissipation Capacitance (Note 2.)		25				pF

2. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}/2$ (per flip–flop). C_{PD} is used to determine the no–load dynamic power consumption; $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.

NOISE CHARACTERISTICS (Input $t_r = t_f = 3.0$ns, $C_L = 50$pF, $V_{CC} = 3.3$V, Measured in SOIC Package)

Symbol	Characteristic	$T_A = 25°C$ Typ	$T_A = 25°C$ Max	Unit
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	0.3	0.5	V
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	–0.3	–0.5	V
V_{IHD}	Minimum High Level Dynamic Input Voltage		2.0	V
V_{ILD}	Maximum Low Level Dynamic Input Voltage		0.8	V

SWITCHING WAVEFORMS

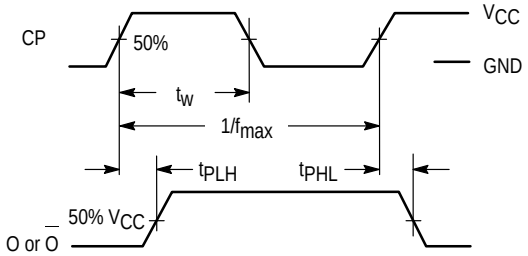


Figure 3.

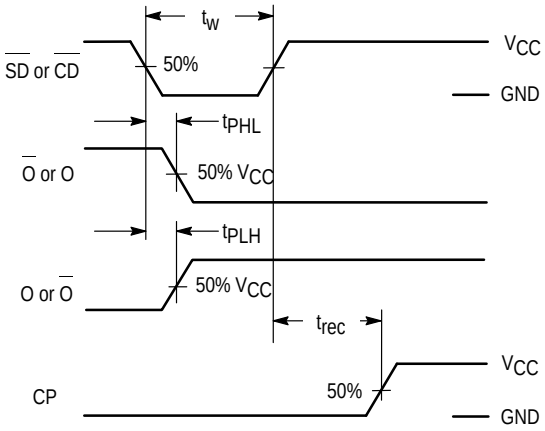


Figure 4.

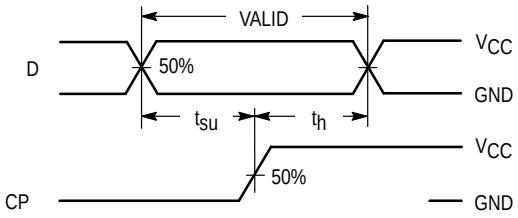
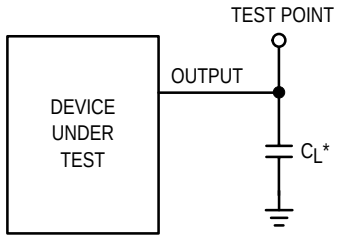


Figure 5.

TEST CIRCUIT

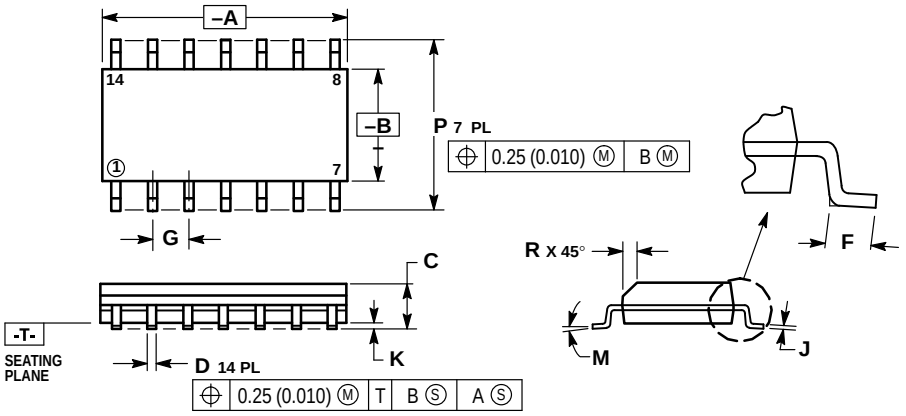


* Includes all probe and jig capacitance

Figure 6.

OUTLINE DIMENSIONS

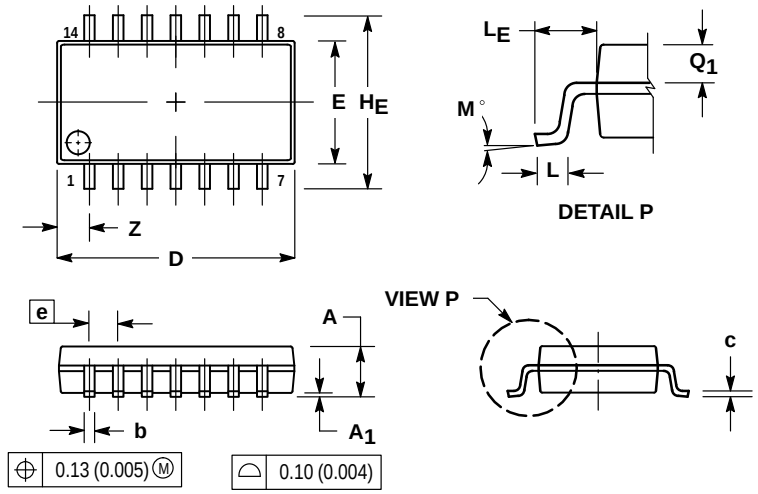
D SUFFIX
PLASTIC SOIC PACKAGE
CASE 751A–03
ISSUE F



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

M SUFFIX
PLASTIC SOIC EIAJ PACKAGE
CASE 965–01
ISSUE O

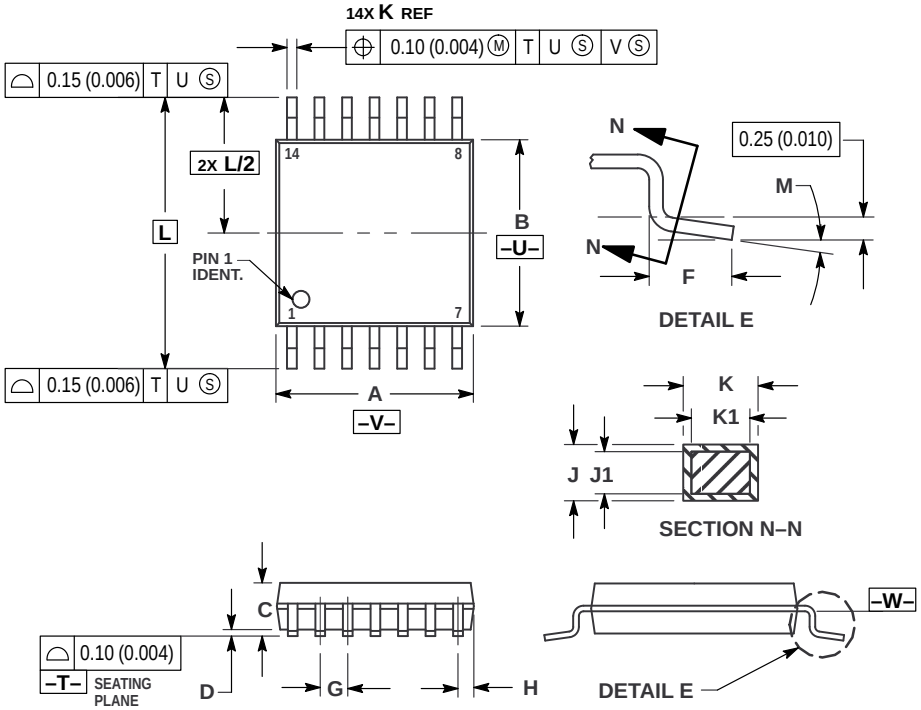


NOTES:
1 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION: MILLIMETER.
3 DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5 THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A_1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.18	0.27	0.007	0.011
D	9.90	10.50	0.390	0.413
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
H_E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L_E	1.10	1.50	0.043	0.059
M	0 °	10 °	0 °	10 °
Q_1	0.70	0.90	0.028	0.035
Z	---	1.42	---	0.056

OUTLINE DIMENSIONS

DT SUFFIX
PLASTIC TSSOP PACKAGE
CASE 948G–01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

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