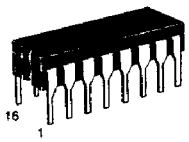
MOTOROLA

MC14175B

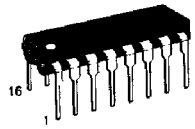
QUAD TYPE D FLIP-FLOP

The MC14175B quad type D flip-flop is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each of the four flip-flops is positive-edge triggered by a common clock input (C). An active-low reset input ($\overline{R}$) asynchronously resets all flip-flops. Each flip-flop has independent Data (D) inputs and complementary outputs (Q and $\overline{Q}$). These devices may be used as shift register elements or as type T flip-flops for counter and toggle applications.

- Complementary Outputs
- Static Operation
- All Inputs and Outputs Buffered
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Output Compatible with Two Low-Power TTL Loads or One Low-Power Schottky TTL Load
- Functional Equivalent to TTL 74175



L SUFFIX
CERAMIC
CASE 620



P SUFFIX
PLASTIC
CASE 648

D SUFFIX
SOIC
CASE 751B

ORDERING INFORMATION

MC14XXXBCP Plastic
MC14XXXBCL Ceramic
MC14XXXBD SOIC

T_A = −55° to 125°C for all packages.

MAXIMUM RATINGS* (Voltages Referenced to V_{SS})

Symbol	Parameter	Value	Unit
V_{DD}	DC Supply Voltage	0.5 to + 18.0	V
V_{in}, V_{out}	Input or Output Voltage (DC or Transient)	− 0.5 to V_{DD} + 0.5	V
I_{in}, I_{out}	Input or Output Current (DC or Transient), per Pin	± 10	mA
P_D	Power Dissipation, per Package†	500	mW
T_{stg}	Storage Temperature	− 65 to + 150	°C
T_L	Lead Temperature (8-Second Soldering)	260	°C

*Maximum Ratings are those values beyond which damage to the device may occur.
†Temperature Derating: Plastic "P and D/DW" Packages: − 7.0 mW/°C From 65°C To 125°C
Ceramic "L" Packages: − 12 mW/°C From 100°C To 125°C

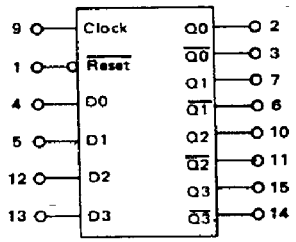
TRUTH TABLE

INPUTS			OUTPUTS		
Clock	Data	$\overline{\text{Reset}}$	Q	$\overline{Q}$	
↑	0	1	0	1	
↑	1	1	1	0	
↓	X	1	Q	$\overline{Q}$	No Change
X	X	0	0	1	

X = Don't Care

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.

BLOCK DIAGRAM



V_{DD} = Pin 16
V_{SS} = Pin 8

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V_{DD} Vdc	−55°C Min	−55°C Max	25°C Min	25°C Typ #	25°C Max	125°C Min	125°C Max	Unit
Output Voltage "0" Level V_{in} = V_{DD} or 0	V_{OL}	5.0	—	0.05	—	0	0.05	—	0.05	Vdc
		10	—	0.05	—	0	0.05	—	0.05	
		15	—	0.05	—	0	0.05	—	0.05	
"1" Level V_{in} = 0 or V_{DD}	V_{OH}	5.0	4.95	—	4.95	5.0	—	4.95	—	Vdc
		10	9.95	—	9.95	10	—	9.95	—	
		15	14.95	—	14.95	15	—	14.95	—	
Input Voltage "0" Level (V_O = 4.5 or 0.5 Vdc)	V_{IL}	5.0	—	1.5	—	2.25	1.5	—	1.5	Vdc
(V_O = 9.0 or 1.0 Vdc)		10	—	3.0	—	4.50	3.0	—	3.0	
(V_O = 13.5 or 1.5 Vdc)		15	—	4.0	—	6.75	4.0	—	4.0	
"1" Level (V_O = 0.5 or 4.5 Vdc)	V_{IH}	5.0	3.5	—	3.5	2.75	—	3.5	—	Vdc
(V_O = 1.0 or 9.0 Vdc)		10	7.0	—	7.0	5.50	—	7.0	—	
(V_O = 1.5 or 13.5 Vdc)		15	11	—	11	8.25	—	11	—	
Output Drive Current (V_{OH} = 2.5 Vdc) Source	I_{OH}	5.0	−3.0	—	−2.4	−4.2	—	−1.7	—	mAdc
(V_{OH} = 4.6 Vdc)		5.0	−0.64	—	−0.51	−0.88	—	−0.36	—	
(V_{OH} = 9.5 Vdc)		10	−1.6	—	−1.3	−2.25	—	−0.9	—	
(V_{OH} = 13.5 Vdc)		15	−4.2	—	−3.4	−8.8	—	−2.4	—	
(V_{OL} = 0.4 Vdc) Sink	I_{OL}	5.0	0.64	—	0.51	0.88	—	0.36	—	mAdc
(V_{OL} = 0.5 Vdc)		10	1.6	—	1.3	2.25	—	0.9	—	
(V_{OL} = 1.5 Vdc)		15	4.2	—	3.4	8.8	—	2.4	—	
Input Current	I_{in}	15	—	±0.1	—	±0.00001	±0.1	—	±1.0	μAdc
Input Capacitance (V_{in} = 0)	C_{in}	—	—	—	—	5.0	7.5	—	—	pF
Quiescent Current (Per Package)	I_{DD}	5.0	—	5.0	—	0.005	5.0	—	150	μAdc
		10	—	10	—	0.010	10	—	300	
		15	—	20	—	0.015	20	—	600	
Total Supply Current**† (Dynamic plus Quiescent, Per Package) (C_L = 50 pF on all outputs, all buffers switching)	I_T	5.0	I_T = (1.7 μA/kHz) f + I_{DD}							μAdc
		10	I_T = (3.4 μA/kHz) f + I_{DD}							
		15	I_T = (5.0 μA/kHz) f + I_{DD}							

#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

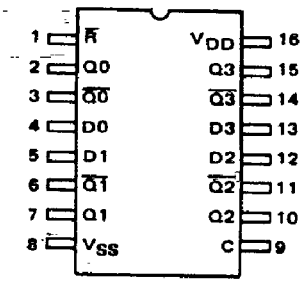
**The formulas given are for the typical characteristics only at 25°C.

†To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50\ pF) + (C_L - 50)\ Vfk$$

where: I_T is in μA (per package), C_L in pF, V = (V_{DD} − V_{SS}) in volts, f in kHz is input frequency, and k = 0.004.

PIN ASSIGNMENT

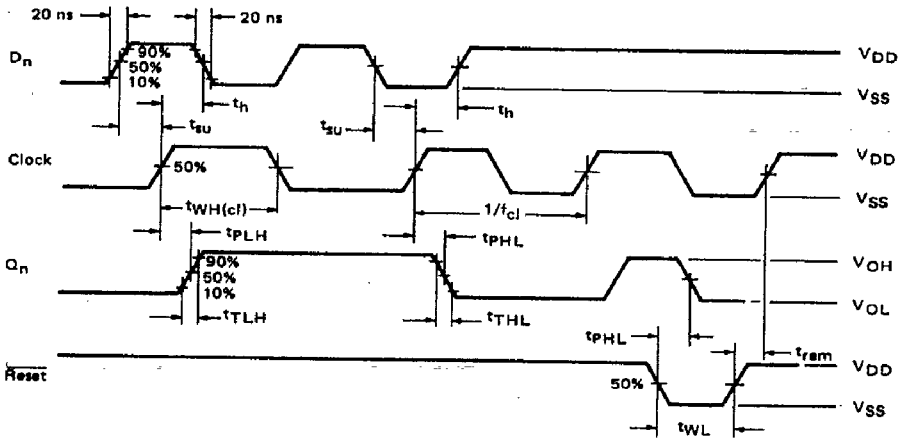


SWITCHING CHARACTERISTICS* (C_L = 50 pF, T_A = 25°C)

Characteristic	Symbol	V_{DD} Vdc	All Types			Unit
			Min	Typ #	Max	
Output Rise and Fall Time t_{TLH}, t_{THL} = (1.35 ns/pF) C_L + 32 ns t_{TLH}, t_{THL} = (0.6 ns/pF)C_L + 20 ns t_{TLH}, t_{THL} = (0.4 ns/pF) C_L + 20 ns	t_{TLH}, t_{THL}	5.0 10 15	– – –	100 50 40	200 100 80	ns
Propagation Delay Time — Clock to Q, $\overline{Q}$ t_{PLH}, t_{PHL} = (0.9 ns/pF) C_L + 175 ns t_{PLH}, t_{PHL} = (0.36 ns/pF) C_L + 72 ns t_{PLH}, t_{PHL} = (0.26 ns/pF) C_L + 57 ns	t_{PLH}, t_{PHL}	5.0 10 15	– – –	220 90 70	400 160 120	ns
Propagation Delay Time — Reset to Q, $\overline{Q}$ t_{PHL} = (0.9 ns/pF) C_L + 280 ns t_{PHL} = (0.36 ns/pF) C_L + 112 ns t_{PHL} = (0.26 ns/pF) C_L + 87 ns	t_{PHL}, t_{PLH}	5.0 10 15	– – –	325 130 100	500 200 150	ns
Clock Pulse Width	t_{WH}	5.0 10 15	250 100 75	110 45 35	– – –	ns
$\overline{\text{Reset}}$ Pulse Width	t_{WL}	5.0 10 15	200 80 60	100 40 30	– – –	ns
Clock Pulse Frequency	f_{cl}	5.0 10 15	– – –	4.5 11 14	2.0 5.0 6.5	MHz
Clock Pulse Rise and Fall Time	t_{TLH}, t_{THL}	5.0 10 15	– – –	– – –	15 5 4	μs
Data Setup Time	t_{su}	5.0 10 15	120 50 40	60 25 20	– – –	ns
Data Hold Time	t_h	5.0 10 15	80 40 30	40 20 15	– – –	ns
$\overline{\text{Reset}}$ Removal Time	t_{rem}	5.0 10 15	250 100 80	125 50 40	– – –	ns

*The formulas given are for the typical characteristics only at 25°C.
#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

TIMING DIAGRAM



FUNCTIONAL BLOCK DIAGRAM