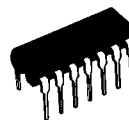


# MHTL INTEGRATED CIRCUITS

MC660 series (−30 to +75°C)

MHTL integrated circuits are especially designed to meet the requirements of industrial applications. Because of the outstanding noise immunity, MHTL circuits provide error-free operation in high noise environments far beyond the tolerance of other integrated circuit families. Multi-function packages and broad operating temperature range further tailor this device family to the industrial designer's requirements.



CASE 93

**FUNCTIONS AND CHARACTERISTICS** ( $V_{cc} = 15\text{ V} \pm 1.0\text{ Vdc}$ ,  $T_A = 25^\circ\text{C}$ )

FUNCTION	TYPE −30 to +75°C	Fan-out Each Output	Propagation Delay $t_{pd}$ ns typ	Total Power Dissipation mW typ
Dual 4-Input Gate NAND/NOR (active pull-up)	MC660P	10	80	60
Dual 4-Input Gate NAND/NOR (passive pull-up)	MC661P	10	100	60
Dual J-K Flip-Flop	MC663P	9	—	225
Master-Slave R-S Flip-Flop	MC664P	8	—	160

**MAXIMUM RATINGS**

RATING	SYMBOL	VALUE	UNIT
Power Supply Voltage	$V_{cc}$	18	$V_{dc}$
Input Voltage	$V_{in}$	+18.0 −1.0	$V_{dc}$
Input Reverse Current (@ 20 V)	—	0.5	mAdc
Operating Temperature Range	$T_A$	−30 to +75	°C
Storage Temperature Range	$T_{stg}$	−55 to +125	°C

# MHTL LOGIC DIAGRAMS

Numbers at ends of terminals represent pin numbers.  
 Numbers in parenthesis indicate loading.  
 ( $V_{cc}$  = PIN 14, GND = PIN 7)

## GATES

<p align="center"><b>MC660P Dual 4-Input Gate NAND/NOR</b> (active pull-up)</p>	<p align="center"><b>MC661P Dual 4-Input Gate NAND/NOR</b> (passive pull-up)</p>
---	--

## FLIP-FLOPS

<p><b>MC663P Dual J-K Flip-Flop</b></p>																																																																																							
	<table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;"><math>t_n</math></th> <th colspan="2" style="text-align: center;"><math>t_{n+1}</math></th> </tr> <tr> <th style="text-align: center;">J</th> <th style="text-align: center;">K</th> <th style="text-align: center;"><math>Q_{n+1}</math></th> <th style="text-align: center;"><math>\bar{Q}_{n+1}</math></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;"><math>Q_n</math></td> <td style="text-align: center;"><math>\bar{Q}_n</math></td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;"><math>\bar{Q}_n</math></td> <td style="text-align: center;"><math>Q_n</math></td> </tr> </tbody> </table> <ol style="list-style-type: none"> <li>1. Direct input (<math>\bar{R}_D</math>) must be high.</li> <li>2. Time period prior to negative transition of clock pulse is <math>t_n</math> and time period subsequent to this transition is <math>t_{n+1}</math>.</li> <li>3. 0 = low state, 1 = high state.</li> <li>4. <math>Q_n</math> = state of Q output in time period <math>t_n</math>.</li> <li>5. Clock (<math>\bar{C}</math>) input must be low when using direct reset input.</li> </ol>	$t_n$		$t_{n+1}$		J	K	$Q_{n+1}$	$\bar{Q}_{n+1}$	0	0	$Q_n$	$\bar{Q}_n$	1	0	1	0	0	1	0	1	1	1	$\bar{Q}_n$	$Q_n$																																																														
$t_n$		$t_{n+1}$																																																																																					
J	K	$Q_{n+1}$	$\bar{Q}_{n+1}$																																																																																				
0	0	$Q_n$	$\bar{Q}_n$																																																																																				
1	0	1	0																																																																																				
0	1	0	1																																																																																				
1	1	$\bar{Q}_n$	$Q_n$																																																																																				
<p><b>MC664P Master-Slave R-S Flip-Flop</b></p>																																																																																							
	<p align="center"><b>CLOCKED OPERATIONS</b></p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th colspan="5" style="text-align: center;"><math>t_n</math></th> <th style="text-align: center;"><math>t_{n+1}</math></th> </tr> <tr> <th style="text-align: center;"><math>S_1</math></th> <th style="text-align: center;"><math>S_2</math></th> <th style="text-align: center;"><math>R_1</math></th> <th style="text-align: center;"><math>R_2</math></th> <th style="text-align: center;">Q</th> <th style="text-align: center;">Q</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">X</td> <td style="text-align: center;">0</td> <td style="text-align: center;">X</td> <td style="text-align: center;"><math>Q_n</math></td> <td style="text-align: center;"><math>Q_n</math></td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">X</td> <td style="text-align: center;">X</td> <td style="text-align: center;">0</td> <td style="text-align: center;"><math>Q_n</math></td> <td style="text-align: center;"><math>Q_n</math></td> </tr> <tr> <td style="text-align: center;">X</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">X</td> <td style="text-align: center;"><math>Q_n</math></td> <td style="text-align: center;"><math>Q_n</math></td> </tr> <tr> <td style="text-align: center;">X</td> <td style="text-align: center;">0</td> <td style="text-align: center;">X</td> <td style="text-align: center;">0</td> <td style="text-align: center;"><math>Q_n</math></td> <td style="text-align: center;"><math>Q_n</math></td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">X</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;">X</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">X</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">X</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">U</td> </tr> </tbody> </table> <p align="center"><b>DIRECT INPUT OPERATION</b></p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><math>\bar{R}_D</math></th> <th style="text-align: center;"><math>\bar{S}_D</math></th> <th style="text-align: center;">Q</th> <th style="text-align: center;"><math>\bar{Q}</math></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">NC</td> <td style="text-align: center;">NC</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">NA</td> <td style="text-align: center;">NA</td> </tr> </tbody> </table> <p>NC = no change.              NA = not allowed.              Clock (<math>\bar{C}</math>) input must be low.</p> <ol style="list-style-type: none"> <li>1. Direct inputs (<math>\bar{R}_D</math>, <math>\bar{S}_D</math>) must be high.</li> <li>2. Time period prior to negative transition of clock pulse is <math>t_n</math> and time period subsequent to this transition is <math>t_{n+1}</math>.</li> <li>3. 0 = low state, 1 = high state.</li> <li>4. <math>Q_n</math> = state of Q output in time period <math>t_n</math>.</li> <li>5. X = state of input does not affect state of circuit.</li> <li>6. U = indeterminate state.</li> </ol>	$t_n$					$t_{n+1}$	$S_1$	$S_2$	$R_1$	$R_2$	Q	Q	0	X	0	X	$Q_n$	$Q_n$	0	X	X	0	$Q_n$	$Q_n$	X	0	0	X	$Q_n$	$Q_n$	X	0	X	0	$Q_n$	$Q_n$	0	X	1	1	0	0	X	0	1	1	0	0	1	1	0	X	1	1	1	1	X	0	1	1	1	1	1	1	1	U	$\bar{R}_D$	$\bar{S}_D$	Q	$\bar{Q}$	1	1	NC	NC	1	0	1	0	0	1	0	1	0	0	NA	NA
$t_n$					$t_{n+1}$																																																																																		
$S_1$	$S_2$	$R_1$	$R_2$	Q	Q																																																																																		
0	X	0	X	$Q_n$	$Q_n$																																																																																		
0	X	X	0	$Q_n$	$Q_n$																																																																																		
X	0	0	X	$Q_n$	$Q_n$																																																																																		
X	0	X	0	$Q_n$	$Q_n$																																																																																		
0	X	1	1	0	0																																																																																		
X	0	1	1	0	0																																																																																		
1	1	0	X	1	1																																																																																		
1	1	X	0	1	1																																																																																		
1	1	1	1	1	U																																																																																		
$\bar{R}_D$	$\bar{S}_D$	Q	$\bar{Q}$																																																																																				
1	1	NC	NC																																																																																				
1	0	1	0																																																																																				
0	1	0	1																																																																																				
0	0	NA	NA																																																																																				