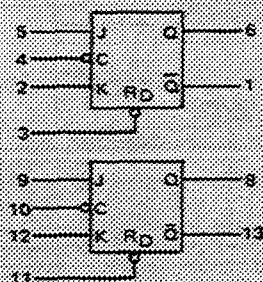


MC663

MC12663



The MC663 and the MC12663 consist of two J-K flip-flops having direct reset inputs in addition to clocked inputs. The 15 volt V_{CC} device (MC663) and the extended 12-15 volt V_{CC} device (MC12663), are schematically identical. The MC12663 meets the MC663 specifications in addition to the 12 volt specifications. Both are available in the 14 pin dual-in-line plastic package (suffix P) and the 14 pin dual-in-line ceramic package (suffix L). A full temperature version of the MC663 dual-in-line ceramic is also available (suffix tL). This device meets the -30 to +75 standard specifications at -55 to +125 respectively.

Input Loading Factor:

\bar{R}_D Input = 2

C Input = 1.5

Other Inputs = 1

Output Loading Factor = 9

$f_{Tog} = 3.0$ MHz typ

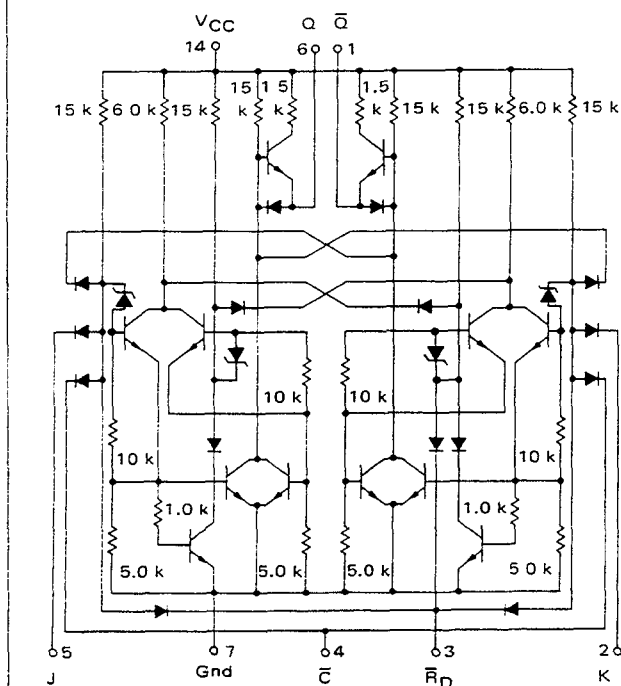
Total Power Dissipation = 200 mW typ

TRUTH TABLE

	t_n				t_{n+1}				
	J_n	K_n	\bar{C}_n	\bar{R}_D	J_{n+1}	K_{n+1}	\bar{C}_{n+1}	\bar{R}_D	Q_{n+1}
See Note e	0	0	X	1	X	X	X	1	Q_n
	1	0	1	1	1	0	0	1	1
	0	1	1	1	0	1	0	1	0
	1	1	1	1	1	1	0	1	\bar{Q}_n
See Note f	X	X	0	1	X	X	0	1	Q_n
	1	X	1	1	0	K_n	1	1	1
	X	1	1	1	J_n	0	1	1	0
	1	1	1	1	0	0	1	1	\bar{Q}_n
See Note g	X	X	X	1	X	X	X	0	0

- t_n refers to the time period immediately prior to an input transition. t_{n+1} applies to the time period after the transition.
- J_n , K_n , etc., denotes the state of the input during the time period t_n ; J_{n+1} , K_{n+1} , etc., denotes the state of the input during the time period t_{n+1} .
- Q_{n+1} denotes the state achieved by the output during the time period t_{n+1} .
- A "0" at an input terminal denotes low state (-1.0 V to 6.5 V), "1" denotes high state (8.5 V to 18 V). An "X" means that either a "0" or "1" may be applied.
- This portion of the truth table refers to synchronous (clocked) operation. Note that a "1" to "0" transition of the J or K input should not occur while the clock input (\bar{C}) is high.
- This portion of the truth table refers to dynamic J-K operation. Note that the clock input (\bar{C}) must remain high for this mode of operation.
- This portion of the truth table refers to asynchronous operation. Note that a low level on \bar{R}_D overrides all other inputs.
- Rise (or fall) time of inputs should be less than 200 nanoseconds measured between 6.5 and 8.5 volts.
- Inputs which are not used should be returned through a resistor (2 k Ω -20 k Ω) to V_{CC} .

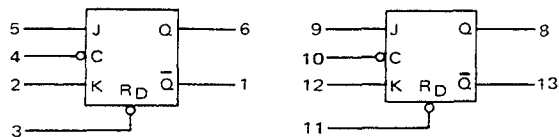
CIRCUIT SCHEMATIC
(1/2 OF CIRCUIT SHOWN)



See General Information section for packaging

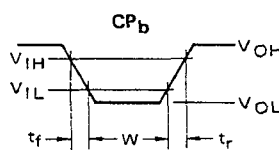
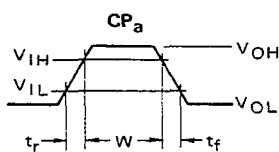
ELECTRICAL CHARACTERISTICS

Unless otherwise noted, tests are shown for only one flip-flop. The other flip-flop is tested in the same manner.



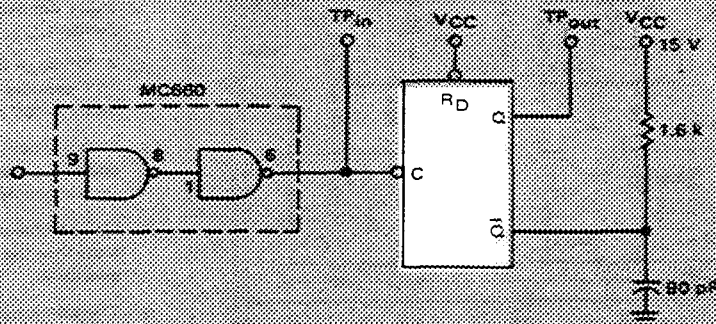
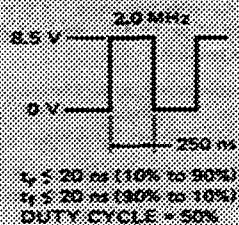
										TEST CURRENT/VOLTAGE VALUES (All Temperatures)												
										mA		Volts										
										I _{OL}	I _{OH}	V _{IL}	V _{IH}	V _F	V _R	V _{CCL}	V _{CCH}					
										10.8	-0.027	6.50	8.50	1.5	16.0	14.0	16.0					
										TEST CURRENT/VOLTAGE APPLIED TO PINS LISTED BELOW:												
										I _{OL}	I _{OH}	V _{IL}	V _{IH}	V _F	V _R	V _{CCL}	V _{CCH}	CP ₃	CP _B	Gnd		
Characteristic	Symbol	Pin Under Test	MC663 Test Limits																			
			-30°C		+25°C		+75°C		Unit													
			Min	Max	Min	Max	Min	Max														
Output voltage	V _{OL}	1	-	1.5	-	1.5	-	1.5	V _{dc}	1	-	2	3.5	-	-	14	-	4	-	7		
		6	-	1.5	-	1.5	-	1.5	V _{dc}	6	-	9	2.3	-	-	14	-	4	-	7		
	V _{OH}	1	-	-	12.5	-	12.5	-	V _{dc}	-	1	2.3	5	-	-	14	-	4	-	7		
		6	-	-	12.5	-	12.5	-	V _{dc}	-	1	5	2.3	-	-	14	-	4	-	7		
Short Circuit	I _{SC}	1	-	-	-6.5	-15	-6.5	-15	mAdc	-	-	3.4	-	-	-	14	-	-	-	1.7		
Reverse Current	I _R	2	-	-	-	2.0	-	2.0	μAdc	-	-	-	-	-	2	14	-	-	-	3.4,5,7		
	3I _R	3	-	-	-	6.0	-	6.0	μAdc	-	-	-	-	-	3	2.4,5,14	-	-	-	7		
	2I _R	4	-	-	-	4.0	-	4.0	μAdc	-	-	-	-	-	4	14	-	-	-	2.3,5,7		
	I _R	5	-	-	-	2.0	-	2.0	μAdc	-	-	-	-	-	5	14	-	-	-	2.3,4,7		
Forward Current	I _F	2	-	-	-	-1.20	-	-1.20	mAdc	-	-	-	-	2	-	14	-	4	-	7		
	2I _F	3	-	-	-	-2.40	-	-2.40	mAdc	-	-	-	-	3	-	14	-	-	-	2.4,5		
	1.5I _F	4	-	-	-	-1.80	-	-1.80	mAdc	-	-	-	-	4	-	2.5,14	-	-	-	7		
	I _F	5	-	-	-	-1.20	-	-1.20	mAdc	-	-	-	-	5	-	14	-	4	-	7		
Power Drain Current (Both Flip-Flops)	I _{CCL}	14	-	-	-	16.7	-	-	mAdc	-	-	-	-	-	-	14	-	-	-	2.3,4,5,7,9,10,11,12		
	I _{CCH}	14	-	-	-	16.7	-	-	mAdc	-	-	-	-	-	-	14	-	-	-	7		

Pins not listed are left open.



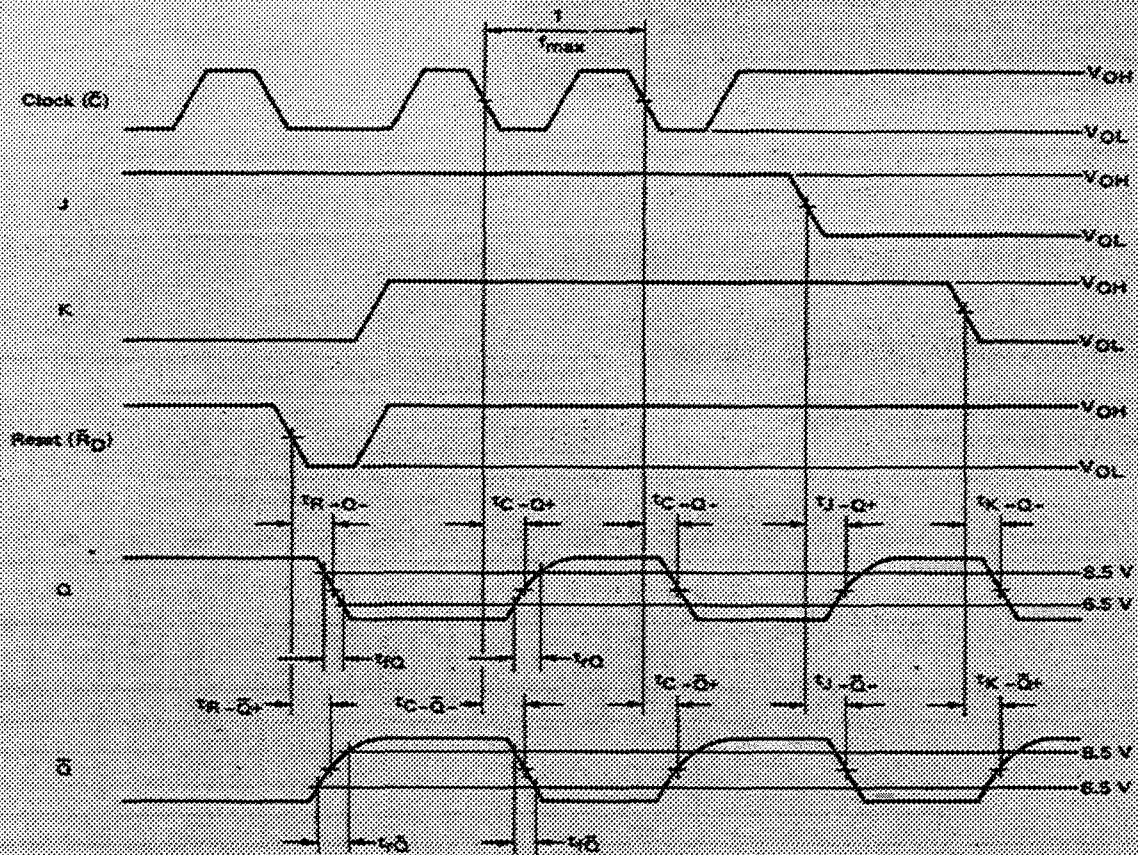
$$\begin{aligned} t_r &\leq 200 \text{ ns} \\ t_f &\leq 200 \text{ ns} \\ W &\geq 200 \text{ ns} \end{aligned}$$

TOGGLE MODE TEST CIRCUIT



VCC and ground connections to the devices are not shown. Frequency at TP_{out} must be 1/2 frequency at TP_{in}.

SWITCHING CHARACTERISTICS



Characteristic	Symbol	-30°C	25°C		+75°C	Units
		Typ	Min	Typ	Typ	
Propagation Delay	t_{R-Q-}	55	—	60	65	ns
	$t_{R-\bar{Q}+}$	150	—	180	210	ns
	t_{C-Q+}, t_{J-Q+}	150	—	180	210	ns
	t_{C-Q-}, t_{J-Q-}	55	—	60	65	ns
	t_{C-Q-}, t_{K-Q-}	55	—	60	65	ns
	$t_{C-\bar{Q}+}, t_{K-\bar{Q}+}$	150	—	180	210	ns
Rise Time	$t_{RQ}, t_{R\bar{Q}}$	35	—	35	40	ns
Fall Time	$t_{FQ}, t_{F\bar{Q}}$	5.0	—	5.0	4.0	ns
Operating Frequency	f_{max}	4.0	2.0	4.0	3.0	MHz

MC12663 — EXTENDED 12-15 VOLT SUPPLY VOLTAGE OPERATION

Most MC663 devices are operable at a V_{CC} as low as 12 volts, there are times when it is necessary to guarantee the 12 volt V_{CC} operation as well as certain maximum and minimum electrical characteristics. The MC12663 is guaranteed to meet both the standard MC663 electrical specifications and the 12 volt electrical characteristics.

ELECTRICAL CHARACTERISTICS — MC12663

Unless otherwise noted, tests are shown for only one flip-flop. The other flip-flop is tested in the same manner.

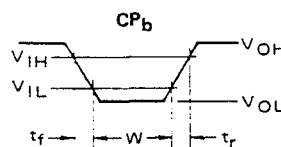
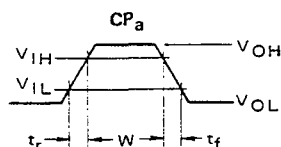
ELECTRICAL CHARACTERISTICS – MC12663

Unless otherwise noted, tests are shown for only one flip-flop. The other flip-flop is tested in the same manner.

TEST CURRENT/VOLTAGE VALUES (All Temperatures)														CP _A	CP _B	Gnd
mA						Volts										
I _{OL}	I _{OH}	V _{IL}	V _{IH}	V _F	V _R	V _{CC}										
8.0	-0.016	6.50	8.50	1.5	12	12										
TEST CURRENT/VOLTAGE APPLIED TO PINS LISTED BELOW:																
Characteristic	Symbol	Pin Under Test	Test Limits		Unit	I _{OL}	I _{OH}	V _{IL}	V _{IH}	V _F	V _R	V _{CC}	CP _A	CP _B	Gnd	
			-30 ≤ T _A ≤ +75 °C	1												
Output Voltage	V _{OL}	1 6	—	1.8	V _{dc} V _{dc}	1 6	—	2 5	3.5 2.3	—	—	14 14	4 4	—	7 7	
	V _{OH}	1 6	1.1 1.1 1.1	—	V _{dc} V _{dc} V _{dc}	—	1 1 6	2.3 5 2	5 2.3 2.3	—	—	14 14 14	4 4 4	—	7 7 7	
Short Circuit Current	I _{CS}	1	-4.5	-12	mA	—	—	3.4	—	—	—	14	—	—	1.7	
Reverse Current	I _R	2	—	2.0	μA	—	—	—	—	—	2	14	—	—	3.4 5.7	
	3I _R	3	—	6.0	μA	—	—	—	—	—	3	2.4 5.14	—	—	7	
	2I _R	4	—	4.0	μA	—	—	—	—	—	4	14	—	—	2.3 5.7	
	I _R	5	—	2.0	μA	—	—	—	—	—	5	14	—	—	2.3 4.7	
Forward Current	I _F	2	-0.55	-1.0	mA	—	—	—	—	2	—	14	—	4	7	
	2I _F	3	-1.10	-2.0	mA	—	—	—	—	3	—	14	—	—	2.4 5	
	1.5I _F	4	-0.80	-1.5	mA	—	—	—	—	4	—	2.5 14	—	—	7	
	I _F	5	-0.55	-1.0	mA	—	—	—	—	5	—	14	—	4	7	
Power Drain Current	I _{CCL}	14	—	12.5	mA	—	—	—	—	—	—	14	—	—	2.3 4.5 7.9 10.11 12	
	I _{CCH}	14	—	12.5	mA	—	—	—	—	—	—	14	—	—	7	

(Both Flip Flops)

① Pins not listed are left open.
Best results obtained if T_A limited to 0°C to 75°C .



$t_r \leq 200 \text{ ns}$
 $t_f \leq 200 \text{ ns}$
 $W \geq 200 \text{ ns}$

APPLICATIONS INFORMATION

The fact that the MC663/12663 may be used as either a synchronous (clocked) flip-flop or in the dynamic J-K mode lends a great deal of versatility to the device. Typical applications — as well as a description of operating principles — may be found in Application Note AN-414

The high degree of noise immunity inherent in MHTL allows the use of diode "AND" gating if desired with very little loss in performance. A discrete 30 k Ω pull-up resistor

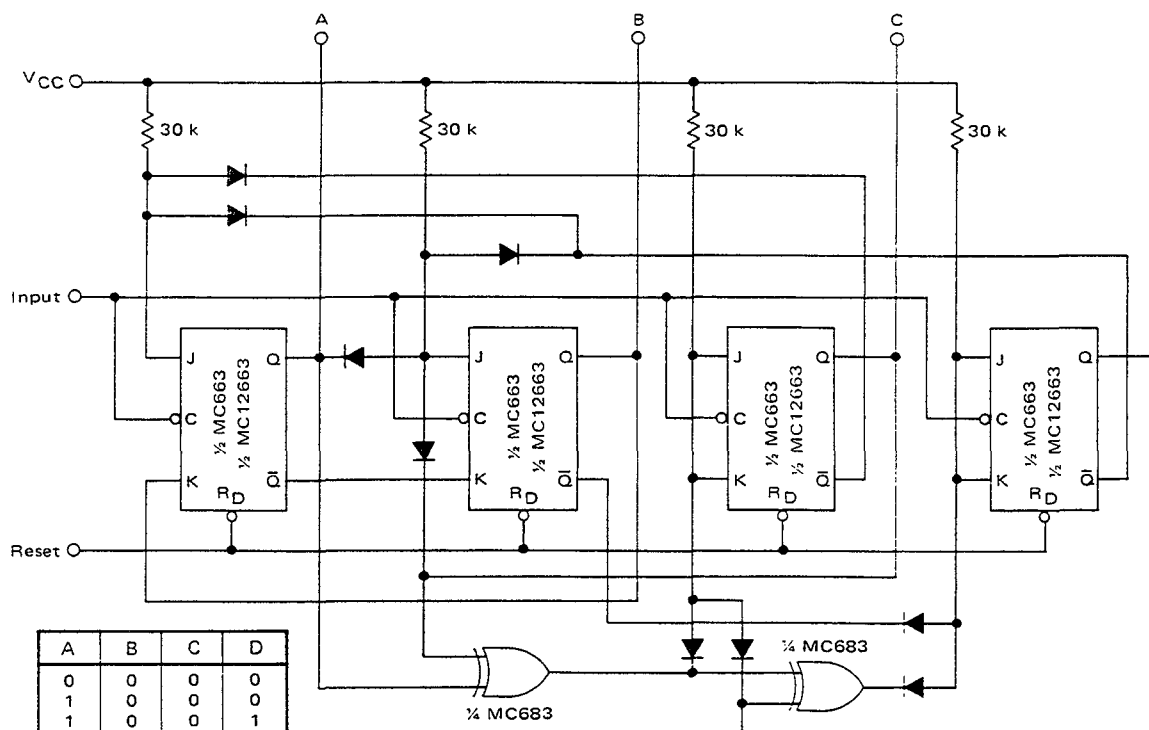
is recommended to charge the capacitance associated with the input and insure "one" state noise immunity. (The resistor adds 0.4 loads to the input loading factor.) The Gray-Code counter circuit below illustrates this technique. The discrete components in this counter may be replaced by three 2-input NAND gates, one 3-input NAND gate, and four inverters if desired

DECIMAL GRAY CODE COUNTER

The circuit diagram shows a sequential logic circuit for a decimal Gray code counter. It consists of four J-K flip-flops (MC12663) and two OR gates (MC683). The flip-flops are labeled A, B, C, and D. The inputs are VCC, Input, and Reset. The outputs are A, B, C, and D. The circuit includes 30k resistors and diodes. The truth table for the Gray code is provided below the circuit.

A	B	C	D
0	0	0	0
1	0	0	0
1	0	0	1
1	0	1	1
1	0	1	0
1	1	1	0
0	1	1	0
0	0	1	0
0	0	1	1
0	0	0	1
0	0	0	0

Each Diode = 1/2 MSD6150 Or Equivalent



A	B	C	D
0	0	0	0
1	0	0	0
1	0	0	1
1	0	1	1
1	0	1	0
1	1	1	0
0	1	1	0
0	0	1	0
0	0	1	1
0	0	0	1
0	0	0	0

Each Diode = 1/2 MSD6150 Or Equivalent


Circuit diagrams utilizing Motorola products are included as a means of illustrating typical semiconductor applications; consequently, complete information sufficient for construction purposes is not necessarily given. The information has been carefully checked and

is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies. Furthermore, such information does not convey to the purchaser of the semiconductor devices described any license under the patent rights of Motorola Inc. or others.



MOTOROLA Semiconductor Products Inc.

This page intentionally left blank.

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters can and do vary in different applications. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

Literature Distribution Centers:

USA: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona 85036.

EUROPE: Motorola Ltd.; European Literature Centre; 88 Tanners Drive, Blakelands, Milton Keynes, MK14 5BP, England.

JAPAN: Nippon Motorola Ltd.; 4-32-1, Nishi-Gotanda, Shinagawa-ku, Tokyo 141, Japan.

ASIA PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Center, No. 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong.



MC663/D

