

14-STAGE RIPPLE-CARRY BINARY COUNTER/ DIVIDER AND OSCILLATOR

GENERAL DESCRIPTION

The MMC 4060 is a monolithic i.c. processed in standard Al-gate CMOS technology. This device consists of an oscillator section and 14 ripple-carry binary counter stages. The oscillator configuration allows design of either RC or crystal oscillator circuits. All counter stages are master-slave flip-flops. The state of the counter is advanced one step in binary order on the negative transition of ϕ_I (and ϕ_0). A high level on the RESET line resets the counter to the all 0's state and disables the oscillator. Schmitt trigger action on the clock line permits unlimited clock rise and fall times. All inputs and outputs are fully buffered.

FEATURES

- Medium-speed operation
- Fully static operation
- Buffered inputs and outputs
- Common reset

ABSOLUTE MAXIMUM RATINGS

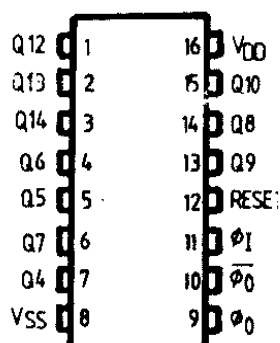
V_{DD}^*	Supply voltage: G and H types E and F types	-0.5 to 20	18	V
V_i	Input voltage	-0.5 to $V_{DD}+0.5$	18	V
I_i	DC input current (any one input)		± 10	mA
P_{tot}	Total power dissipation (per package) Dissipation per output transistor for T_A = full package-temperature range		200	mW
T_A	Operating temperature : G and H types E and F types	-55 to -40 to -65 to	125 85	°C °C
T_{stg}	Storage temperature		150	°C

* All voltage values are referred to V_{SS} pin voltage

RECOMMENDED OPERATING CONDITIONS

V_{DD}^*	Supply voltage: G and H types E and F types	3 to 3 to	18 15	V V
V_i	Input voltage	0 to	V_{DD}	V
T_A	Operating temperature : G and H types E and F types	-55 to -40 to	125 85	°C °C

CONNECTION DIAGRAM



STATIC ELECTRICAL CHARACTERISTICS

(Under recommended operating conditions)

PARAMETER		TEST CONDITIONS				VALUES						UNIT	
		V _I (V)	V _O (V)	I _{IN} (μ A)	V _{DD} (V)	T _{LOW}		25°C			T _{HIGH}		
						min.	max.	min.	typ.	max.	min.		max.
I _Q	Quiescent current	G. H types	0/5			5		5		0.04	5		150
			0/10			10		10		0.04	10		300
			0/15			15		20		0.04	20		600
			0/20			20		100		0.08	100		3000
	E. F types	0/5			5		20		0.04	20		150	
		0/10			10		40		0.04	40		300	
		0/15			15		80		0.04	80		600	
V _{OH}	Output high voltage												
		0/5		< 1	5	4.95		4.95			4.95		
		0/10		< 1	10	9.95		9.95			9.95		
		0/15		< 1	15	14.95		14.95			14.95		
V _{OL}	Output low voltage												
		5/0		< 1	5		0.05			0.05		0.05	
		10/0		< 1	10		0.05			0.05		0.05	
		15/0		< 1	15		0.05			0.05		0.05	
V _{IH}	Input high voltage												
			0.5/4.5	< 1	5	3.5		3.5			3.5		
			1/9	< 1	10	7		7			7		
			1.5/13.5	< 1	15	11		11			11		
V _{IL}	Input low voltage												
			4.5/0.5	< 1	5		1.5			1.5		1.5	
			9/1	< 1	10		3			3		3	
			13.5/1.5	< 1	15		4			4		4	
I _{OH}	Output drive current												
		G. H types	0/5	25		5	-2		1.6	3.2		-1.15	
			0/5	46		5	-0.64		-0.51	-1		-0.36	
			0/10	95		10	-1.6		-1.3	-2.6		-0.9	
			0/15	135		15	-4.2		-3.4	-6.8		-2.4	
		E. F types	0/5	25		5	-1.53		1.36	-3.2		-1.1	
			0/5	46		5	-0.52		-0.44	-1		-0.36	
			0/10	95		10	-1.3		1.1	-2.6		-0.9	
			0/15	135		15	-3.6		-3.0	-6.8		-2.4	
I _{OL}	Output sink current												
		G. H types	0/5	0.4		5	0.64		0.51	1		0.36	
			0/10	0.5		10	1.6		1.3	2.6		0.9	
			0/15	1.5		15	4.2		3.4	6.8		2.4	
		E. F types	0/5	0.4		5	0.52		0.44	1		0.36	
			0/10	0.5		10	1.3		1.1	2.6		0.9	
			0/15	1.5		15	3.6		3.0	6.8		2.4	
I _{IK} , I _{IL}	Input leakage current												
		G. H types	0/18	Any input		18		± 0.1		$\pm 10^5$	± 0.1	± 1	
		E. F types	0/15			15		± 0.3		$\pm 10^5$	± 0.3	± 1	
C _i	Input capacitance												
			Any input							5	75		pf

* T_{LOW} 55°C for G. H devices, 40°C for E. F devices

* T_{HIGH} +125°C for G. H devices, +85°C for E. F devices

The Noise Margin for both "1" and "0" level is:

- 1 V min. with V_{DD} = 5 V
- 2 V min. with V_{DD} = 10 V
- 2.5 V min. with V_{DD} = 15 V

DYNAMIC ELECTRICAL CHARACTERISTICS

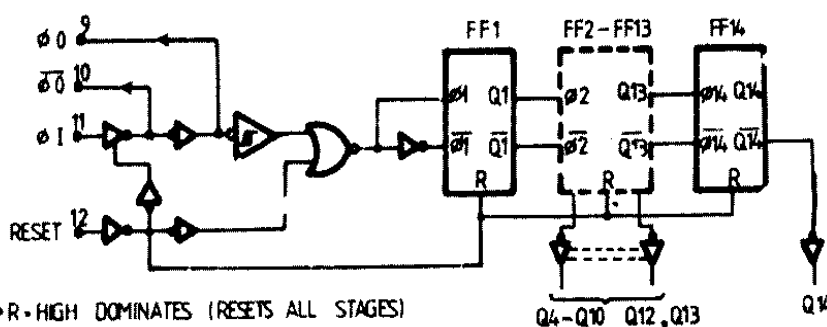
($T_A = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, $R_L = 200\text{ kohm}$, typical temperature coefficient for all $V_{DD} = 0.3\%/^\circ\text{C}$ values, all input rise and fall time = 20 ns)

PARAMETER	TEST CONDITIONS	VALUES			UNIT	
		V_{DD} (V)	Min.	Typ.		Max.
Input-pulse operation						
t_{PLH} t_{PHL} Propagation delay time (\emptyset to Q4 Out)		5		370	740	ns
		10		150	300	
		15		100	200	
t_{PLH} t_{PHL} Propagation delay time (Qn to Q _{n+1})		5		100	200	ns
		10		50	100	
		15		40	80	
t_{TLH} t_{THL} Transition time		5		100	200	ns
		10		50	100	
		15		40	80	
t_W Input pulse width	$f = 100\text{ kHz}$	5		50	100	ns
		10		20	40	
		15		15	30	
t_r t_f Input rise and fall time		5	Unlimited			μs
		10				
		15				
f_{max} Maximum clock input frequency		5	3.5	7		MHz
		10	8	16		
		15	12	24		
Reset operation						
t_{PLH} Propagation delay time		5		180	360	ns
		10		80	160	
		15		50	100	
t_W Reset pulse width		5		60	120	ns
		10		30	60	
		15		20	40	
RC operation						
Variation of frequency (Unit-to-Unit)	$C_x = 200\text{ pF}$	5	18	21.5	25	kHz
	$R_S = 560\text{ k}\Omega$	10	20	23	26	
	$R_x = 50\text{ k}\Omega$	15	21.1	24	27	
Variation of frequency with voltage (Same Unit)	$C_x = 200\text{ pF}$ $R_S = 560\text{ k}\Omega$ $R_x = 50\text{ k}\Omega$	5V to 10 V	—	—	2	kHz
		10 V to 15 V	—	—	1	
R_x max	$C_x = 10\text{ }\mu\text{F}$	5	—	—	20	M Ω
	$= 50\text{ }\mu\text{F}$	10	—	—	20	
	$= 10\text{ }\mu\text{F}$	15	—	—	10	

PARAMETER	TEST CONDITIONS	VALUES			UNIT	
		V _{DD} (V)	Min.	Typ.		Max.
D _x max	R _x = 500 kΩ	5	—	—	1000	pF
	= 300 kΩ	10	—	—	50	
	= 300 kΩ	15	—	—	50	
Maximum Oscillator Frequency*	R _x = 5 kΩ	10	530	650	810	kHz
	C _x = 15 pF	15	690	800	940	

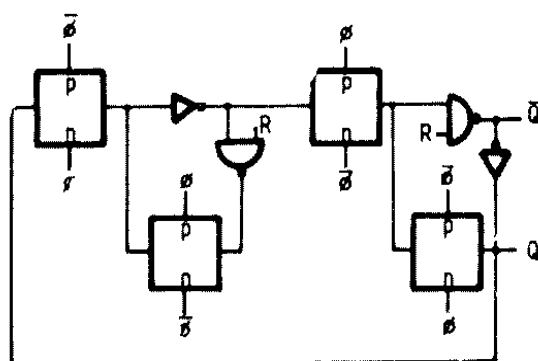
* RC oscillator applications are not recommended at supply voltages below 7 V for R_x = 50 kΩ

LOGIC DIAGRAM



- R-HIGH DOMINATES (RESETS ALL STAGES)
- ▲ COUNTER ADVANCES ONE BINARY COUNT ON EACH NEGATIVE-GOING TRANSITION OF φ 1 (AND φ 0)

Detail of typical flip-flop stage



APPLICATIONS

