



MMC 4051 MMC 4052 MMC 4053

ANALOG MULTIPLEXERS-DEMULTIPLEXERS:

4051 SINGLE 8-CHANNEL 4052 DIFFERENTIAL 4-CHANNEL 4053 TRIPLE 2-CHANNEL GENERAL DESCRIPTION

The MMC 4051, MMC 4052 and MMC 4053 are monolithic integrated circuits, available in 16-lead dual-in-line plastic or ceramic package. MMC 4051, MMC 4052 and MMC 4053 analog multiplexers/demultiplexers are digitally controlled analog switches having low ON impedance and very low OFF leakage current. These multiplexer circuits dissipate extremely low quiescent power over the full $V_{DD}-V_{SS}$ and $V_{DD}-V_{EE}$ supply-voltage ranges, independent of the logic state of the control signals. When a logic "1" is present at the inhibit input terminal all channel are off. The MMC 4051 is a single 8-channel multiplexer having three binary control inputs, A, B and C, and an inhibit input. The three binary signals select 1 of 8 channels to be turned on, and connect one of the 8 inputs to the output. The MMC 4052 is a differential 4-channel multiplexer having two binary control inputs, A and B, and an inhibit input. The two binary input signals select 1 of 4 pairs of channels to be turned on and connect the analog inputs to the outputs.

The MMC 4053 is a triple 2-channel multiplexer having three separate digital control inputs, A, B, and C and an inhibit input. Each control input selects one of a pair of channels which are connected in a singlepole double-throw configuration.

FEATURES

- Low „ON“ resistance: 125 ohm (typ.) over 15 Vp.p. signal-input range for $V_{DD}-V_{EE} = 15$ V
- High „OFF“ resistance: channel leakage ± 100 pA (typ.) $V_{DD}-V_{EE} = 18$ V
- Binary address decoding on chip
- Very low quiescent power dissipation under all digital control input and supply conditions: 0.2 μ W (typ.), $V_{DD}-V_{SS} = V_{DD}-V_{EE} = 10$ V
- Matched switch characteristics: $R_{ON} = 5$ ohm (typ.) for $V_{DD}-V_{EE} = 15$ V
- Wide range of digital and analog signal levels: digital 3 to 20 V, analog to 20 Vp.p.

ABSOLUTE MAXIMUM RATINGS

V_{DD}^*	Supply voltage: G and H types	-0.5 to	20	V
	E and F types	-0.5 to	18	V
V_i	Input voltage	-0.5 to	$V_{DD}+0.5$	V
I_i	DC input current (any one input)		± 10	mA
P_{tot}	Total power dissipation (per package)		200	mW
	Dissipation per output transistor for $T_A =$ full package-temperature range		100	mW
T_A	Operating temperature: G and H types	-55 to	125	°C
	E and F types	-40 to	85	°C
T_{stg}	Storage temperature	-65 to	150	°C

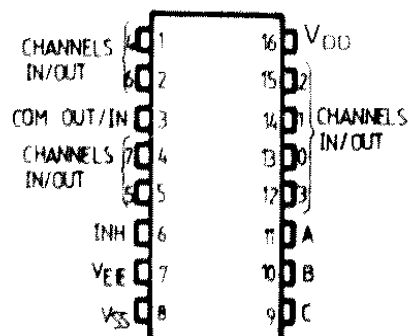
* All voltage values are referred to V_{SS} pin voltage

RECOMMENDED OPERATING CONDITIONS

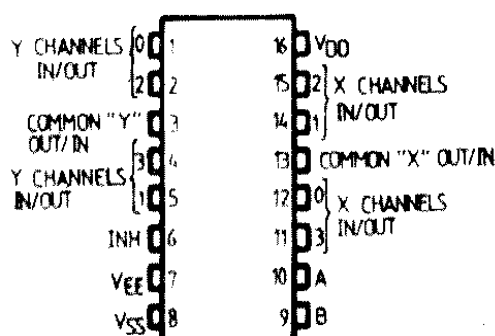
V_{DD}^*	Supply voltage: G and H types	3 to	18	V
	E and F types	3 to	15	V
V_i	Input voltage	0 to	V_{DD}	V
T_A	Operating temperature: G and H types	-55 to	125	°C
	E and F types	-40 to	85	°C

CONNECTION DIAGRAMS

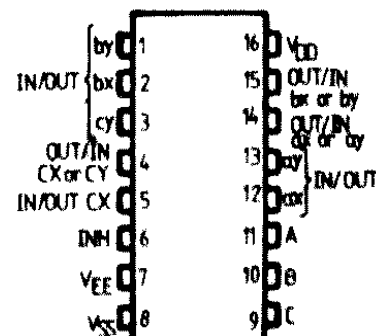
MMC 4051



MMC 4052



MMC 4053



MMC 4051 MMC 4052 MMC 4053

STATIC ELECTRICAL CHARACTERISTICS

(over recommended operating conditions)

PARAMETER			TEST CONDITIONS				VALUES						UNIT	
			V _{IS} - (V)	V _{EE} (V)	V _{SS} (V)	V _{DD} (V)	T _{LOW}		25°C			T _{HIGH}		
							min.	max.	min.	typ.	max.	min.		max.
I _L quiescent device current	G, H types				5		5		0.04	5		150	μA	
					10		10		0.04	10		300		
					15		20		0.04	20		600		
					20		100		0.08	100		3000		
	E, F types				5		20		0.04	20		150		
					10		40		0.04	40		300		
				15		80		0.04	80		600			

Switch

ON-resistance	G, H types	$0 \leq V_I \leq V_{DD}$	0	0	5		880		470	1050		1200	Ω
					10		310		180	400		580	
					15		220		125	280		400	
	E, F types	$0 \leq V_I \leq V_{DD}$	0	0	5		880		470	1050		1200	Ω
					10		330		180	400		520	
					15		230		125	280		360	
Δ ON-resistance (between any 2 channels)			0	0	5				10				Ω
					10				10				
					15				5				
OFF (●) Any channel OFF	G, H types		0	0	18		100		± 0.1	100		1000	nA
leakage current	All channels OFF (common OUT/IN)	G, H types	0	0	18		100		± 0.1	100		1000	nA
	Any channel OFF	E, F types	0	0	15		300		± 0.1	300		1000	nA
	All channels OFF (common OUT/IN)	E, F types	0	0	15		300		± 0.1	300		1000	nA
C-capacitance	Input								5				pF
	Output 4051								30				
	Output 4052		-5	-5	5				18				
	Output 4053								9				
	Feedthrough								0.2				

Control (Address or Inhibit)

V_{IL} Input low voltage	$= V_{DD}$ thru 1K Ω	$V_{EE} = V_{SS}$ $R_I = 1K\Omega$ to V_{SS}	5	1.5		1.5		1.5		1.5	V
			10	.3		3		3		3	
			15	4		4		4		4	
V_{IH} Input high voltage		$I_{IS} > 2\mu A$ (on all OFF channels)	5	3.5		3.5				3.5	V
			10	7		7				7	
			15	11		11				11	

MMC 4051 MMC 4052 MMC 4053**STATIC ELECTRICAL CHARACTERISTICS**

(over recommended operating conditions)

PARAMETER		TEST CONDITIONS				VALUES						UNIT	
		V _{IS} (V)	V _{EE} (V)	V _{SS} (V)	V _{DD} (V)	T _{LOW}		25°C			T _{HIGH}		
						min.	max.	min.	typ.	max.	min.		max.
I _{IH} , I _{IL} Input leakage current	G, H types	V _I = 0/18 V			18		±0.1		±10 ⁻³	±0.1		±1	μA
	E, F types	V _I = 0/15 V			15		±0.3		±10 ⁻³	±0.3		±1	
C _I Input capacitance		Any address or inhibit input							5	7.5			pF

(a) Determined by minimum feasible leakage measurement for automatic testing

(*) $T_{LOW} = -55^\circ\text{C}$ for G, H device; -40°C for E, F device. $T_{HIGH} = +125^\circ\text{C}$ for G, H device; $+85^\circ\text{C}$ for E, F device.**DYNAMIC ELECTRICAL CHARACTERISTICS** $(T_A = 25^\circ\text{C}, C_L = 50\text{ pF, all input square wave rise and fall time} = 20\text{ ns})$

PARAMETER	TEST CONDITIONS						VALUES		UNIT		
	V _{EE} (V)	R _L (KΩ)	f _i (KHz)	V _{IS} (V)	V _{SS} (V)	V _{DD} (V)	typ.	max.			
Switch											
t _{pd} Propagation delay time (Signal Input to output)		200		10 V 		5 10 15			30 15 11	30 60 20	ns
Frequency response channel „ON“ (Sine wave Input) at $20 \text{ Log } \frac{V_0}{V_i} = -3 \text{ dB}$	= V _{SS}	1		5(*)		10	V _O at common OUT/IN	4053 4052 4051	30 25 20		MHz
							V _O at any channel		60		MHz
Feedthrough (all channels OFF) at $20 \text{ Log } \frac{V_0}{V_i} = -40 \text{ dB}$	= V _{SS}	1		5(*)		10	V _O at common OUT/IN	4053 4052 4051	8 10 12		MHz
							V _O at any channel		8		MHz
Frequency signal crosstalk at $20 \text{ Log } \frac{V_0}{V_i} = -40 \text{ dB}$	= V _{SS}	1		5(*)		10	Between any 2 channels		3		MHz
							Between sections 4052 only	Measured on common	6		
								Measured on any channel	10		
							Between any 2 sections 4053 only	In pin 2 out pin 14	2.5		
							In pin 15 out pin 14	6			
Sine wave distortion: f _s = 1 KHz sine wave	= V _{SS}	10 10 10	1 1 1	2(*) 3(*) 5(*)		5 10 15			0.3 0.2 0.12		%

MMC 4051 MMC 4052 MMC 4053

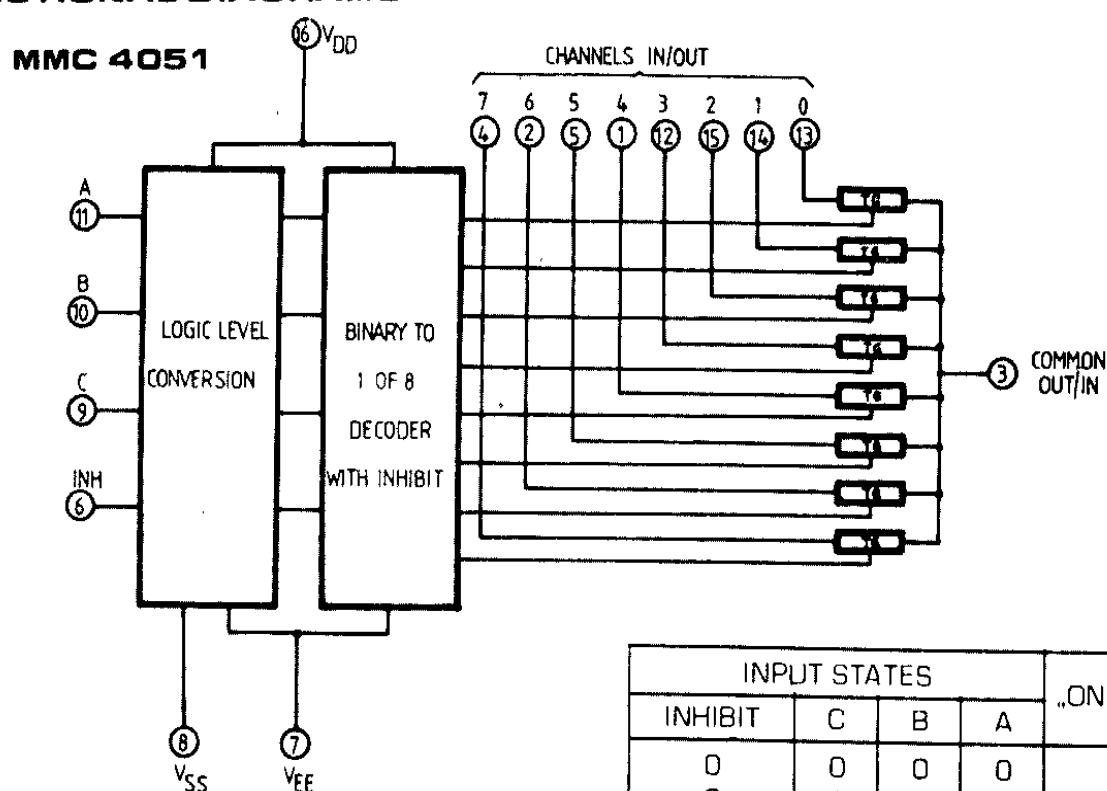
PARAMETER	TEST CONDITIONS						VALUES		UNIT
	V _{EE} (V)	R _L (K)	f _i (KHz)	V _{IS} (V)	V _{SS} (V)	V _{DD} (V)	typ.	max.	

Control (address or inhibit)

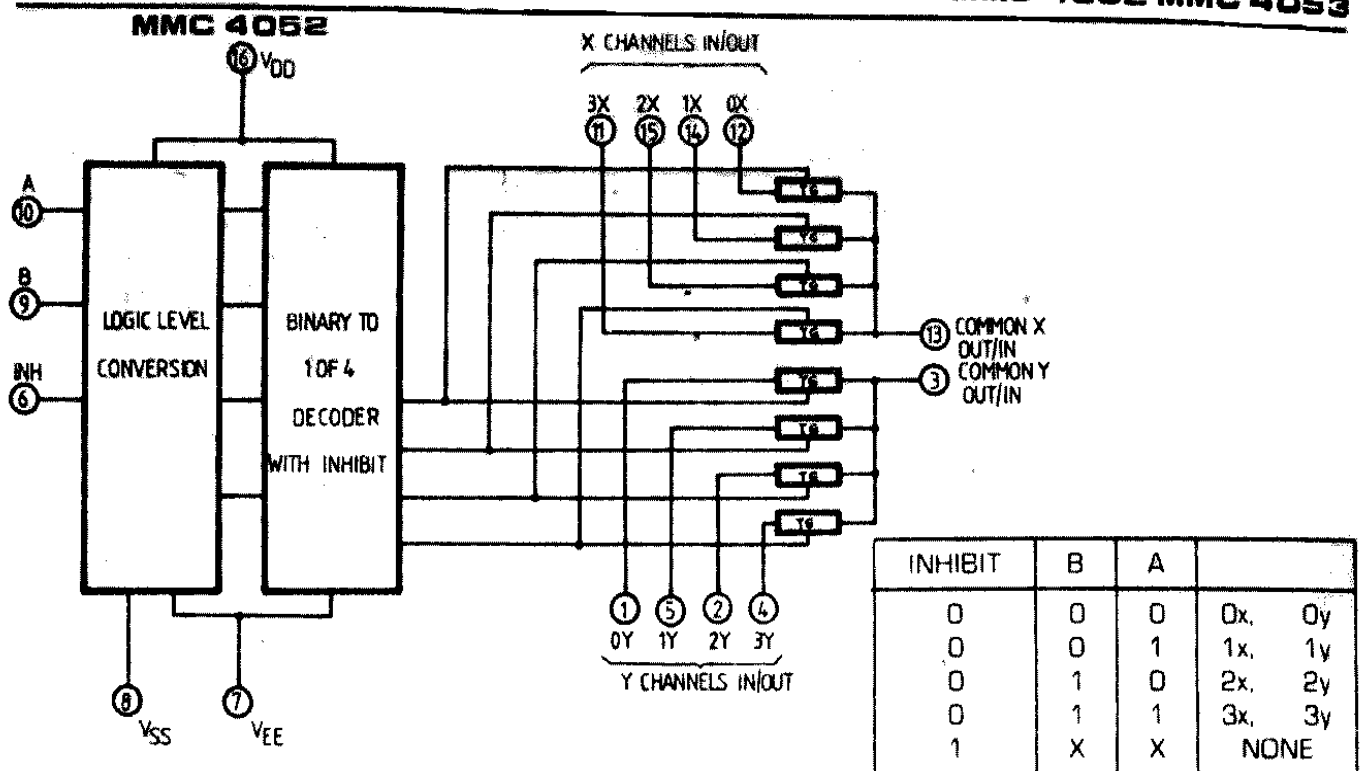
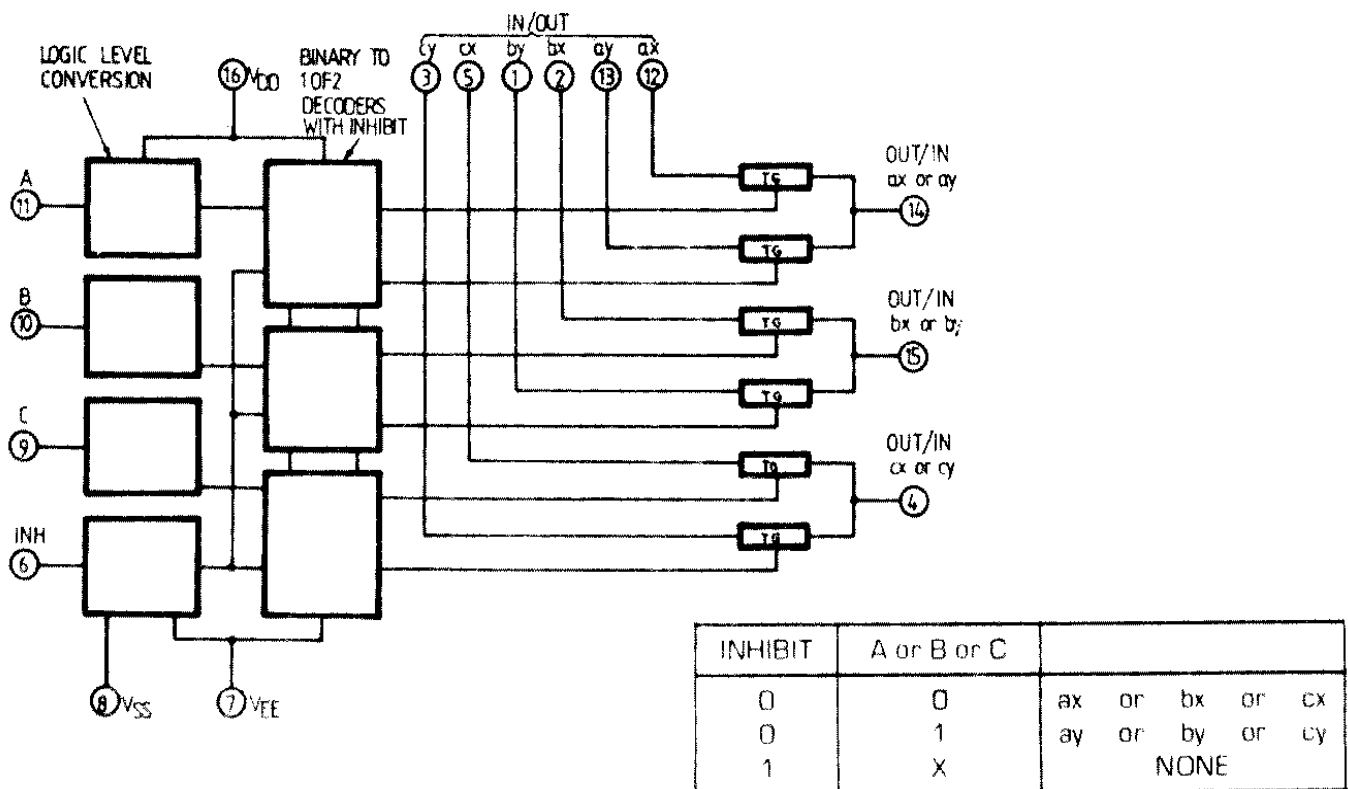
Propagation delay time: Address-to signal OUT channels ON or OFF	0 0 0 - 5				0 0 0 0	5 10 15 5		360 160 120 225	720 320 240 450	ns
Propagation delay time: Inhibit to signal OUT (channel turning ON)	0 0 0 - 10	10			0 0 0 0	5 10 15 5		360 160 120 200	720 320 240 400	ns
Propagation delay time: Inhibit to signal OUT (channel turning OFF)	0 0 0 - 10	0.3				5 10 15 5		200 90 70 130	450 210 160 300	ns
Address or inhibit to signal crosstalk	0	10%			0	10	V _C = V _{DD} - V _{SS} (Square wave)	65		mV peak

(●) Peak to peak voltage symmetrical about $\frac{V_{DD} - V_{EE}}{2}$

(%) Both ends of channel.

FUNCTIONAL DIAGRAMS AND TRUTH TABLES

INPUT STATES				„ON“ CHANNEL(S)
INHIBIT	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	NONE

MMC 4051 MMC 4052 MMC 4053**MMC 4053****SPECIAL CONSIDERATIONS**

Control of analog signals up to 20 V peak-to-peak can be achieved by digital signal amplitudes of 4.5 to 20 V (if $V_{DD} - V_{SS} = 3$ V, a $V_{DD} - V_{EE}$ of up to 13 V can be controlled, for $V_{DD} - V_{EE}$ level differences above 13 V, a $V_{DD} - V_{SS}$ of at least 4.5V is required). For example, if $V_{DD} = +5$ V, $V_{SS} = 0$, and $V_{EE} = -13.5$ V, analog signals from -13.5 V to $+4.5$ V can be controlled by digital inputs of 0 to 4.5V. In certain applications, the external load-resistor current may include both V_{DD} and signal-line components. To avoid drawing V_{DD} current when switch current flows into the transmission gate inputs, the voltage drop across the bidirectional switch must not exceed 0.8 volt. No V_{DD} current will flow through R_L if the switch current flows into lead 3 on the MMC 4051; leads 3 and 13 on the MMC 4052; leads 4, 14, 15 on the MMC 4053.