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/uW (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

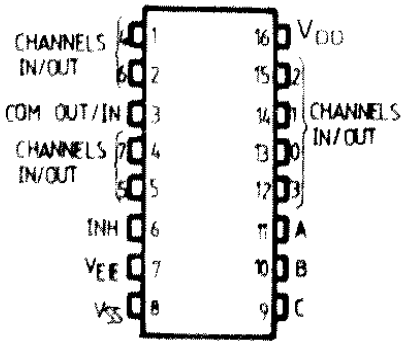
* All voltage values are referred to V_{SS} pin voltage

RECOMMENDED OPERATING CONDITIONS

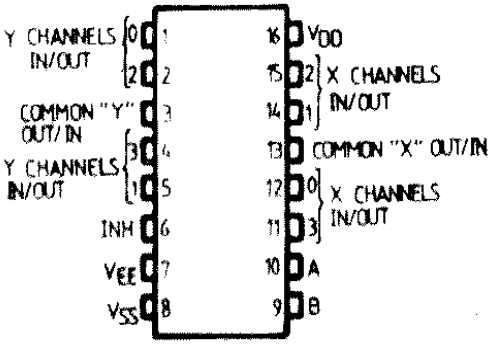
V_{DD}*	Supply voltage: G and H types	3 to	18	V
	E and F types	3 to	15	V
V_i	Input voltage	0 to	V_{DD}	V
T_A	Operating temperature: G and H types	-55 to	125	°C
	E and F types	-40 to	85	°C

CONNECTION DIAGRAMS

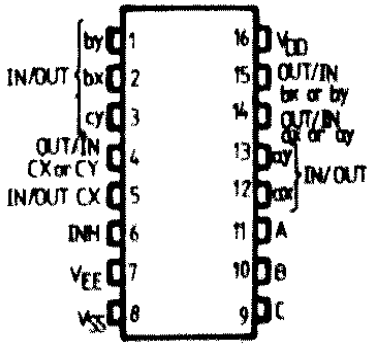
MMC 4051



MMC 4052



MMC 4053



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} min.	T^*_{LOW} max.	25°C min.	25°C typ.	25°C max.	T^*_{HIGH} min.	T^*_{HIGH} max.	
I_L quiescent device current	G, H types					5		5		0.04	5		150	
						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	µA
						10		40		0.04	40		300	
						15		80		0.04	80		600	
Switch														
ON-resistance	G, H types	$0 \le V_I \le V_{DD}$	0	0		5		880		470	1050		1200	
						10		310		180	400		580	
						15		220		125	280		400	
	E, F types	$0 \le V_I \le V_{DD}$	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				
						10				10				Ω
						15				5				
OFF (•) channel leakage current	Any channel OFF	G, H types	0	0		18		100		±0.1	100		1000	nA
	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				
	Output 4051									30				
	Output 4052			−5	−5	5				18				pF
	Output 4053									9				
	Feedthrough									0.2				
Control (Address or Inhibit)														
V_{IL} Input low voltage		= V_{DD} thru 1KΩ	$V_{EE} = V_{SS}$ R_I = 1KΩ to V_{SS}			5		1.5			1.5		1.5	
						10		3			3		3	V
						15		4			4		4	
V_{IH} Input high voltage			$I_{IS} > 2\mu A$ (on all OFF channels)			5	3.5		3.5			3.5		
						10	7		7			7		V
						15	11		11			11		

STATIC ELECTRICAL CHARACTERISTICS

(over recommended operating conditions)

PARAMETER		TEST CONDITIONS V_{IS} (V)	V_{EE} (V)	V_{SS} (V)	V_{DD} (V)	VALUES T^*_{LOW} min.	T^*_{LOW} max.	25°C min.	25°C typ.	25°C max.	T^*_{HIGH} min.	T^*_{HIGH} max.	UNIT
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

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

(*) T_{Low} = −55° C for G, H device; −40°C for E, F device.
T_{High} = +125° C for G, H device; +85°C for E, F device.

DYNAMIC ELECTRICAL CHARACTERISTICS

(T_A = 25°C, C_L = 50 pF, all input square wave rise and fall time = 20 ns)

PARAMETER	TEST CONDITIONS V_{EE} (V)	R_L (KΩ)	f_i (KHz)	V_{IS} (V)	V_{SS} (V)	V_{DD} (V)			VALUES typ.	VALUES max.	UNIT
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 $20 \log \frac{V_O}{V_I} = -3$ 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 $20 \log \frac{V_O}{V_I}$ = −40 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 $20 \log \frac{V_O}{V_I} = -40$ 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_{IS} = 1 KHz sine wave	= V_{SS}	10 10 10	1 1 1	2(•) 3(•) 5(•)		5 10 15			0.3 0.2 0.12		%

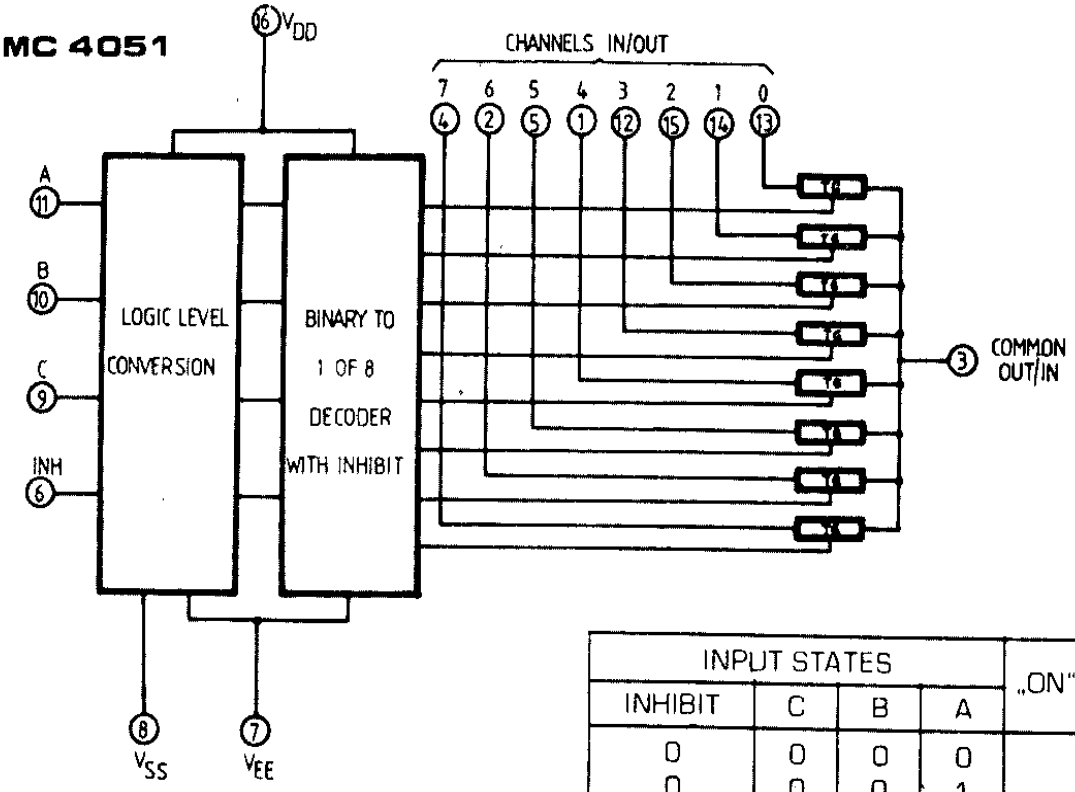
PARAMETER	TEST CONDITIONS V_{EE} (V)	R_L (K)	f_i (KHz)	V_{IS} (V)	V_{SS} (V)	V_{DD} (V)		VALUES typ.	VALUES max.	UNIT
Control (address or inhibit)										
Propagation delay time: Address-to signal OUT channels ON or OFF	0 0 0 – 5				0 0 0 0	5 10 15 5		360 160 120 225	720 320 240 450	ns
Propagation 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 symetrical about $\frac{V_{DD} - V_{EE}}{2}$

(✲) Both ends of channel.

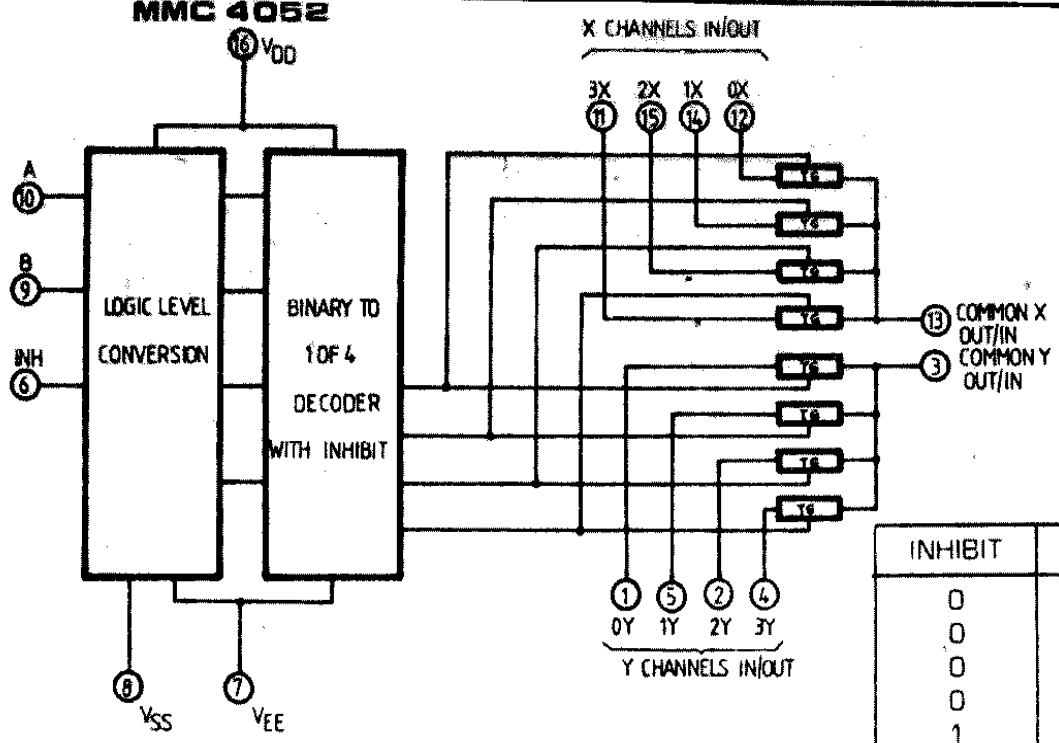
FUNCTIONAL DIAGRAMS AND TRUTH TABLES

MMC 4051



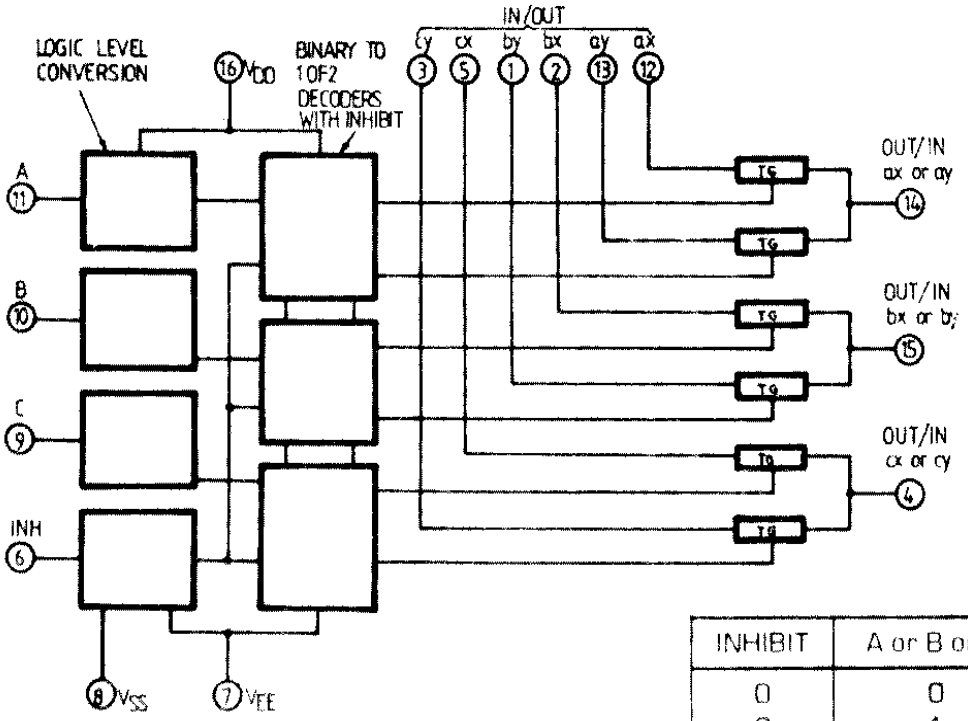
INPUT STATES INHIBIT	C	B	A	„ON" CHANNEL(S)
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	NONE

MMC 4052



INHIBIT	B	A	
0	0	0	0x, 0y
0	0	1	1x, 1y
0	1	0	2x, 2y
0	1	1	3x, 3y
1	X	X	NONE

MMC 4053



INHIBIT	A or B or C	
0	0	ax or bx or cx
0	1	ay or by or cy
1	X	NONE

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} = + 5V, V_{SS} = 0, and V_{EE} = −13.5V, analog signals from −13.5V to + 4.5V 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.