ANALOG MULTIPLEXERS/DEMULTIPLEXERS: MMC 4067: SINGLE 16-CHANNEL MMC 4097: DIFFERENTIAL 8-CHANNEL

GENERAL DESCRIPTION

The MMC 4067, MMC 4097 are monolithic integrated circuits, available in 24-lead dual-in-line plastic package.
The MMC 4067, MMC 4097 analog multiplexers/demultiplexers are digitally controlled analog switches having low ON impedance, low OFF leakage current, and internal address decoding. In addition, the ON resistance is relatively constant over the full input-signal range.
The MMC 4067 is a 16-channel multiplexer with four binary control inputs A, B, C, D, and an inhibit input, arranged so that any combination of the inputs selects one switch.

The MMC 4097 is a differential 8-channel multiplexer having three binary control inputs A, B, C, and an inhibit input. The inputs permit selection of one of eight pairs of switches. A logic „1" present at the inhibit input turns all channels off.

FEATURES

- Low on resistance: 125Ω (typ.) over 15 V_{p-p} signal-input range for V_{DD}-V_{SS} = 15 V
- High off resistance: channel leakage of +/−10 pA (typ.) for V_{DD}-V_{SS} = 15 V
- Matched switch characteristics: ΔR_{on} = 5Ω (typ.) for V_{DD}-V_{SS} = 15 V
- Very low quiescent power dissipation under all digital-control input and supply conditions: 0.2 μW (typ.) for V_{DD}-V_{SS} = 10 V
- Binary address decoding on chip

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

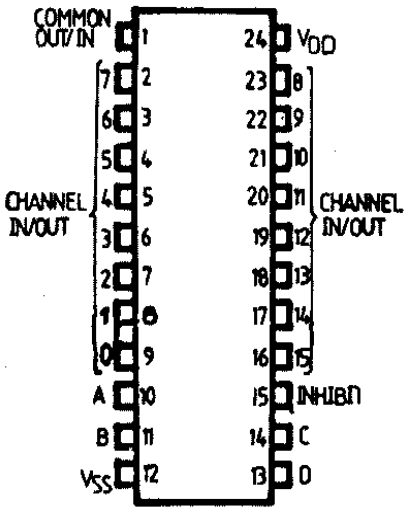
* All voltage values are referred to V_{SS} pin voltage

RECOMMENDED OPERATING CONDITIONS

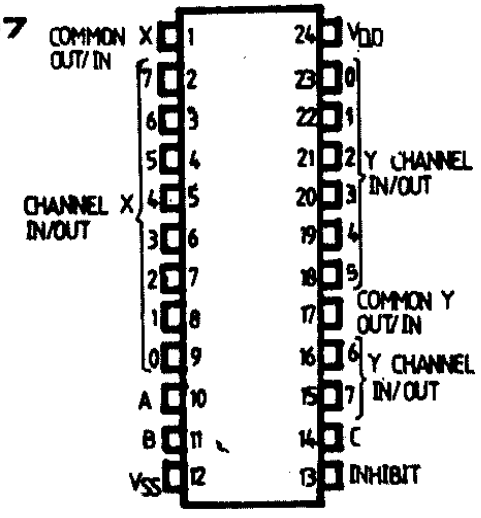
V_{DD}*	Supply voltage: G and H types	3 to	18	V
	E and F types	3 to	15	V
V_I	Input voltage	0 to	V_{DD}	V
T_A	Operating temperature: G and H types	-55 to	125	°C
	E and F types	-40 to	85	°C

CONNECTION DIAGRAM

MMC 4067



MMC 4097



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 and 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 and F types				5		20		0.04	20		150	
					10		40		0.04	40		300	
					15		80		0.04	80		600	
Switch													
RON Resistance	G and H types	$0 \le V_I \le V_{DD}$	0	0	5		800		470	1050		1300	Ω
					10		310		180	400		580	
					15		200		125	240		320	
	E and F types	$0 \le V_I \le V_{DD}$	0	0	5		850		470	1050		1200	
					10		330		180	400		520	
					15		210		125	240		300	
ΔRON Resistance (Between any 2 channels)			0	0	5				10				Ω
					10				10				
					15				5				
OFF(●) leakage current · Any channel OFF	G and H types		0	0	18		100		+/-0.1	100		1000	nA
All channels OFF (common OUT/IN)	G and H types		0	0	18		100		+/-0.1	100		1000	nA
Any channel OFF	E and F types		0	0	15		300		+/-0.1	300		1000	nA
All channels OFF (common OUT/IN)	E and F types		0	0	15		300		+/-0.1	300		1000	nA
C Capacitance	Input								5				pF
	Output 4067								55				
	Output 4097								35				
	Feedthrough			-5	5				0.2				
Control (Address or Inhibit)													
V_{IL} Input low voltage		V_{DD} thru 1 kΩ	V_{EE} = V_{SS} R_L 1K to V_{SS} $I_{IS} \le 2\mu A$ (on all OFF channels)		5		1.5			1.5		1.5	V
					10		3			3		3	
					15		4			4		4	
V_{IH} Input high voltage					5	3.5		3.5			3.5		
					10	7		7			7		
					15	11		11			11		
I_{IH} I_{IL} Input leakage current	G and H types	V_I = 0/18			18		±0.1		±10⁻³	±0.1		±1	µA
	E and F types	V_I = 0/15			15		±0.3		±10⁻³	±0.3		±1	µA

PARAMETER	TEST CONDITIONS				VALUES							UNIT
	V_I (V)	V_O (V)	$\|I_O\|$ (μA)	V_{DD} (V)	T^*_{LOW}		25°C			T^*_{HIGH}		
					min.	max.	min.	typ	max.	min.	max.	
CI Input capacitance	Any address or inhibit input							5	7.5			pF

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

✲ T_{LOW} = −55°C for G and H types; −40°C for E and F types
T_{high} = +125°C for G and H types; +85°C for E and F types

DYNAMIC ELECTRICAL CHARACTERISTICS

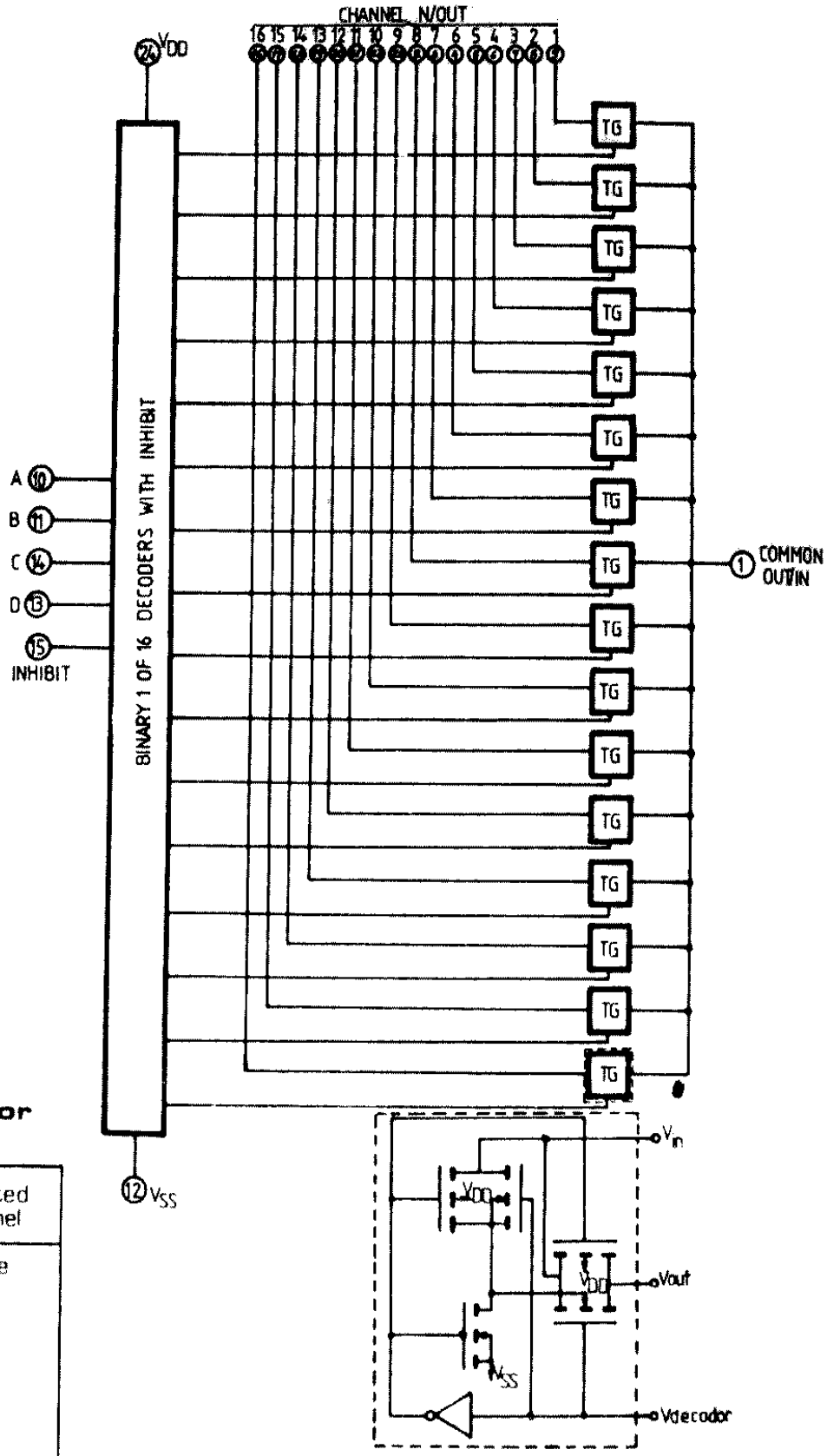
(T_{amb} = 25°C, C_L = 50 pF, all input square wave rise and fall times = 20 ns)

PARAMETER	TEST CONDITIONS							VALUES		UNIT
	V_C (V)	R_L (kΩ)	f_i (kHz)	V_i (V)	V_{SS} (V)	V_{DD} (V)		TYP.	MAX.	
Switch										
t_{pd} Propagation delay time (Signal input to output)	= V_{DD}	200		V_{DD}	0	5 10 15		30 15 11	60 30 20	ns
Frequency response channel „ON" (Sine wave input) at 20 Log(V_O/V_I) = −3dB	= V_{DD}	1		5(●)	0	10	V_O at common OUT/IN 4067	14		MHz
							4097	20		MHz
							V_O at any channel	60		MHz
Feedthrough (all channels OFF) at 20 Log(V_O/V_I) = −40dB	= V_{SS}	1		5(●)	0	10	V_O at common OUT/IN 4067	20		MHz
							4097	12		
							V_O at any channel	8		
Frequency signal crosstalk at 20 Log(V_O(B)/V_I(A)) = −40 dB	$V_{C(A)}$ = V_{DD} $V_{C(B)}$ = V_{SS}	1		5(●)	0	10	Between any (A and B) channels	1		MHz
							Between sections (A and B) 4097 only — Measured on common	10		
							Measured on any channel	18		
Sine wave distortion f_{is} = 1 kHz sine wave	5 10 15	10 10 10	1 1 1	2(●) 3(●) 5(●)	0 0 0	5 10 15		0.3 0.2 0.12		%
Control (Address or inhibit)										
Propagation delay time: address or inhibit to signal OUT (channel turning ON)	V_{DD}	10			0 0 0	5 10 15		325 135 95	650 270 190	ns
Propagation delay time: address or inhibit to signal OUT (channel turning OFF)	V_{DD}	0.3			0 0 0	5 10 15		220 90 65	440 180 130	ns
Address or inhibit to signal crosstalk	V_{DD}	10✲			0	10		75		mV peak

✲ Both ends of channel

(○) peak to peak voltage symmetrical about (V_{DD}−V_{SS})/2

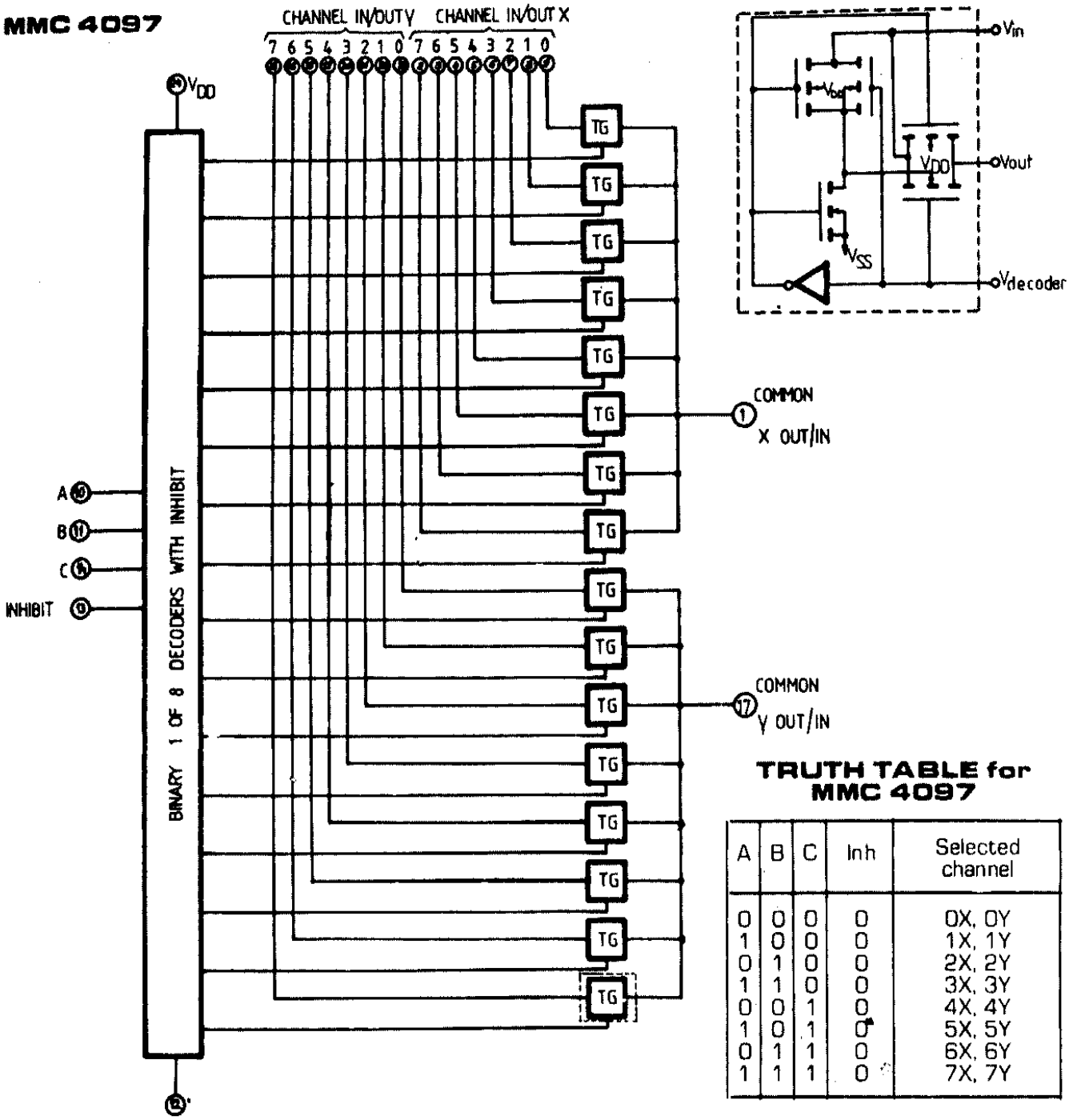
LOGIC DIAGRAM
MMC 4067



TRUTH TABLE for MMC 4067

A	B	C	D	Inh	Selected channel
X	X	X	X	1	None
0	0	0	0	0	0
1	0	0	0	0	1
0	1	0	0	0	2
1	1	0	0	0	3
0	0	1	0	0	4
1	0	1	0	0	5
0	1	1	0	0	6
1	1	1	0	0	7
0	0	0	1	0	8
1	0	0	1	0	9
0	1	0	1	0	10
1	1	1	1	0	11
0	0	1	1	0	12
1	0	1	1	0	13
0	1	1	1	0	14
1	1	1	1	0	15

MMC 4097



TRUTH TABLE for MMC 4097

A	B	C	Inh	Selected channel
0	0	0	0	0X, 0Y
1	0	0	0	1X, 1Y
0	1	0	0	2X, 2Y
1	1	0	0	3X, 3Y
0	0	1	0	4X, 4Y
1	0	1	0	5X, 5Y
0	1	1	0	6X, 6Y
1	1	1	0	7X, 7Y

APPLICATIONS INFORMATION

In applications where separate power sources are used to drive V_{DD} and the signal inputs, the V_{DD} current capability should exceed V_{DD}/R_L (R_L = effective external load). This provision avoids permanent current flow or clamp action on the V_{DD} supply when power is applied or removed from the MMC 4067 or MMC 4097.

When switching from one address to another, some of the ON periods of the channels of the multiplexers will overlap momentarily, which may be objectionable in certain applications. Also when a channel is turned on or off by an address input, there is a momentary conductive path from the channel to V_{SS}, which will dump some charge from any capacitor connected to the input or output of the channel. The inhibit input turning on a channel will similarly dump some charge to V_{SS}. The amount of charge dumped is mostly a function of the signal level above V_{SS}. Typically, at V_{DD}-V_{SS} = 10V, a 100 pF capacitor connected to the input or output of the channel will lose3-4% of its voltage at the moment the channel turns on or off. This loss of voltage is essentially independent of the address or inhibit signal transition time, if the transition time is less than1-2 μs. When the inhibit signal turns a channel off, there is no charge dumping to V_{SS}. Rather, there is a slight rise in the channel voltage level (65 mV typ.) due to capacitive coupling from inhibit input to channel input or output. Address inputs also couple some voltage steps onto the channel signal levels.

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