

M74HC4051

Single 8-channel analog multiplexer/demultiplexer

Features

- Low power dissipation:
 - $I_{CC} = 4 \ \mu A(max)$ at $T_A = 25 \ ^{\circ}C$
- Logic level translation to enable 5 V logic signal to communicate with ±5 V analog signal
- Low ON resistance: 70 Ω typ (V_{CC} - V_{EE} = 4.5 V) 50 Ω typ (V_{CC} - V_{EE} = 9 V)
- Wide analog input voltage range : ±6 V
- Fast switching: t_{pd} = 15 ns (typ) at T_A = 25 °C
- Low crosstalk between switches
- High ON/OFF output voltage ratio
- Wide operating supply voltage range (V_{CC} - V_{EE}) = 2 to 12 V
- Low sine wave distortion: 0.02% at V_{CC} - V_{EE} = 9 V
- High noise immunity:
 V_{NIH} = V_{NIL} = 28 % V_{CC} (min)
- Pin and function compatible with 74 series 4051



Description

The M74HC4051 is a single 8-channel analog multiplexer/demultiplexer fabricated with silicon gate C^2MOS technology, pin-to-pin compatible with the equivalent metal gate CMOS4000B series. It contains 8 bidirectional and digitally controlled analog switches.

A built-in level shifting is included to allow an input range up to ± 6 V (peak) for an analog signal with digital control signal of 0 to 6 V.

The V_{EE} supply pin is provided for analog input signals. It has an inhibit (INH) input terminal to disable all the switches when is at high level. For operation as a digital multiplexer/demultiplexer, V_{EE} is connected to GND.

A, B and C control inputs select one channel out of eight. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

Table 1. Device summary

Order code	Package	Packaging
M74HC4051RM13TR	SOP-16	Tape and reel
M74HC4051TTR	TSSOP-16	Tape and reel

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1 Pin connection and IEC logic symbols





Figure 2. IEC logic symbols



1.1 Pin description

Table 2.Pin description

Pin number	Symbol	Name and function
3	COM OUT/IN	Common output/input
6	INH	Inhibit input
7	V _{EE}	Negative supply voltage
11, 10, 9	A, B, C	Select inputs
13, 14, 15, 12, 1, 5, 2, 4	0 to 7	Independent input/outputs
8	GND	Ground (0 V)
16	V _{CC}	Positive supply voltage





Figure 4. I/O equivalent circuit



	Input	state		
INH	С	В	Α	ON channel
L	L	L	L	0
L	L	L	Н	1
L	L	Н	L	2
L	L	Н	Н	3
L	Н	L	L	4
L	Н	L	Н	5
L	Н	Н	L	6
L	Н	Н	Н	7
Н	Х	Х	Х	NONE

x: Don't care









2 Maximum ratings

Stressing the device above the rating listed in the "absolute maximum ratings" table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

Symbol	Parameter	Value	Unit	
V _{CC}	Supply voltage		-0.5 to +7	V
V_{CC} , V_{EE}	Supply voltage		-0.5 to +13	V
VI	Control input voltage		-0.5 to V _{CC} + 0.5	V
V _{I/O}	Switch I/O voltage		V _{EE} -0.5 to V _{CC} + 0.5	V
I _{CK}	Control input diode current		±20	mA
I _{IOK}	I/O diode current		±20	mA
Ι _Τ	Switch through current		±25	mA
$I_{\rm CC}$ or $I_{\rm GND}$	DC V_{CC} or ground current		±50	mA
		DIP-16	500 ⁽¹⁾	mW
P _D	Power dissipation	SOP-16 and TSSOP-16	180	mW
T _{stg}	Storage temperature		-65 to +150	°C
TL	Lead temperature (10 sec)		300	°C

Table 4. Absolute maximum ratings

1. 500 mW at 65 °C; derate to 300 mW by 10 mW/xC from 65 °C to 85 °C

Table 5. Recommended operating conditions

Symbol	Parameter		Value	Unit
V _{CC}	Supply voltage		2 to 6	V
V_{EE}	Supply voltage		-6 to 0	V
V_{CC} - V_{EE}	Supply voltage		2 to 12	V
VI	Input voltage		0 to V _{CC}	V
V _{I/O}	I/O voltage		V _{EE} to V _{CC}	V
T _{op}	Operating temperature		-55 to 125	°C
		$V_{CC} = 2.0 V$	0 to 1000	
t _r , t _f	Input rise and fall time	$V_{CC} = 4.5 V$	0 to 500	ns
		V _{CC} = 6.0 V	0 to 400	



			Tes	t condition	Value							
Symbo I	Parameter	V _{CC}	V _{EE}		T,	_A = 25	°C	-40 85) to °C	-55 125	i to i °C	Unit
		(v)	(v)		Min	Тур	Мах	Min	Max	Min	Max	
		2.0			1.5			1.5		1.5		
V _{IHC}	High level input voltage	4.5			3.15			3.15		3.15		V
	g -	6.0			4.2			4.2		4.2		
		2.0					0.5		0.5		0.5	
V _{ILC}	Low level input voltage	4.5					1.35		1.35		1.35	V
	g -	6.0					1.8		1.8		1.8	
		4.5	GND	$V_{1} = V_{110} \circ r V_{110}$		85	180		225		270	
		4.5	-4.5	$V_{I/O} = V_{CC}$ to V_{EE} $I_{I/O} \leq 2mA$		55	120		150		180	W
		6.0	-6.0			50	100		125		150	
R _{ON}	ON resistance	2.0	GND			150						
		4.5	GND	$V_{I} = V_{IHC} \text{ or } V_{ILC}$		70	150		190		230	
		4.5	-4.5	$V_{I/O} = V_{CC} \text{ or } V_{EE}$ $I_{I/O} \leq 2 \text{ mA}$		50	100		125		150	
		6.0	-6.0			45	80		100		120	
	Difference of ON	4.5	GND	$V_{\rm H} = V_{\rm HIO} {\rm or} V_{\rm HIO}$		10	30		35		45	
ΔR_{ON}	resistance between	4.5	-4.5	$V_{I/O} = V_{CC} \text{ or } V_{EE}$		5	12		15		18	W
	switches	6.0	-6.0	l _{I/O} ≤2 mA		5	10		12		15	
	Input/output	6.0	GND	$V_{OS} = V_{CC}$ or GND			±0.06		±0.6		±1.2	
I _{OFF}	leakage current (switch off)	6.0	-6.0	$V_{IS} = GND \text{ or } V_{CC}$ $V_I = V_{ILC} \text{ or } V_{IHC}$			±0.1		±1		±2	μA
	Switch input	6.0	GND				±0.06		±0.6		±1.2	
Ι _{ΙΖ}	leakage current (switch on, output open)	6.0	-6.0	$V_{OS} = V_{CC}$ or GND $V_{I} = V_{IHC}$ or V_{ILC}			±0.1		±1		±2	μA
lı	Input leakage current	6.0	GND	$V_{I} = V_{CC}$ or GND			±0.1		±0.1		±1	μA
	Quiescent supply	6.0	GND				4		40		80	
'CC	current	6.0	-6.0	$v_{\rm I} = v_{\rm CC}$ of GND			8		80		160	μΑ

Table 6. DC electrical specifications



			Test co	ondition				Value				
Symbol	Parameter	V _{CC}	V _{EE}		т	_A = 25°	°C	-40 to	₀ 85°C	-55 12	5 to 5°C	Unit
		(v)	(V)		Min.	Тур	Max	Min	Max	Min	Max	
		2.0	GND			25	60		75		90	
<u>т</u>	Phase difference	4.5	GND			6	12		15		18	
Ч/О	and output	6.0	GND			5	10		13		15	115
		4.5	-4.5			4						1
		2.0	GND			64	225		280		340	
t _{P7I}	Output enable	4.5	GND			18	45		56		68	
t _{PZH}	time	6.0	GND	$H_{L} = 1 K\Omega$		15	38		48		58	ns
		4.5	-4.5			18						1
		2.0	GND			100	250		315		375	
t _{PLZ}	Output disable	4.5	GND			33	50		63		70	
t _{PHZ}	time	6.0	GND			28	43		54		64	
		4.5	-4.5			29						1

Table 7.AC electrical characteristics ($C_L = 50 \text{ pF}$, Input $t_r = t_f = 6 \text{ns}$)

Table 8. Capacitive characteristics

		Test condition			Value							
Symbol Parameter		V _{CC}	V _{EE}		T _A = 25 °C			-40 to 85 °C		-55 to 125 °C		Unit
		(v)	(v)		Min	Тур	Max	Min	Max	Min	Max	
C _{IN}	Input capacitance	5.0				5	10		10		10	pF
C _{I/O}	Common terminal capacitance	5.0	-5.0			36	70		70		70	pF
C _{I/O}	Switch terminal capacitance	5.0	-5.0			7	15		15		15	pF
C _{IOS}	Feed through capacitance	5.0	-5.0			0.95	2		2		2	pF
C _{PD}	Power dissipation capacitance (1)	5.0	GND			70						pF

1. C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$.



Symbo			Test condition		Value	Unit	
l	Parameter	V _{CC} (V)	V _{EE} (V)	V _{IN} (V _{p-p})		Тур	
		2.25	-2.25	4		0.025	
	Sine wave distortion	4.5	-4.5	8	f_{IN} = 1 KHz R _L = 10 K Ω C _L = 50 pF	0.020	%
		6.0	-6.0	11		0.018	
	Frequency	2.25	-2.25	Adiust	Adjust f_{IN} voltage to obtain 0 dBm at V _{OS} . Increase f_{IN} Frequency until dB meter reads -3dB $R_L = 50 \ \Omega$, $C_L = 10 \ pF$, $f_{IN} = 1 \ KHz$ sine wave		
f _{MAX}	response	4.5	-4.5	Increas			MHz
	(Switch on)(")	6.0	-6.0	$R_L = 50$			
Frequency		2.25	-2.25	Adiust	Adjust $f_{\rm IN}$ voltage to obtain 0 dBm at V _{OS} .		
f _{MAX} response (switch on) ⁽²⁾	response	4.5	-4.5	Increase f _{IN} Frequency until dB meter reads -3dB		70	MHz
	(switch on) ⁽²⁾	6.0	-6.0	$R_L = 50$	$\Omega\Omega_{\rm C}$ C _L = 10 pF, $t_{\rm IN}$ = 1KHz sine wave	85	
	Feed through	2.25	-2.25	V _{IN} is c	centered at (V _{CC} - V _{FF})/2	-50	
	attenuation	4.5	-4.5	Adjust	input for 0 dBm	-50	dB
	(switch off)	6.0	-6.0	$R_L = 60$	00 Ω, C _L = 50 pF, f_{IN} = 1 KHz sine wave	-50	
	Crosstalk	2.25	-2.25			60	
	(control input to	4.5	-4.5	Adjust R ₁ = 6	R _L at set up so that I _S = 0A. 20 Ω C _L = 50 pE f _{IN} = 1 KHz square wave	140	mV
	signal output)	6.0	-6.0			200	
	Crosstalk	2.25	-2.25			-50	
	(between any	4.5	-4.5	Adjust	V_{IN} to obtain 0d Bm at input 20 $\Omega C_{I} = 50 \text{ pF}$, $f_{INI} = 1 \text{ KHz}$ sine wave	-50	dB
	wo switches)	6.0	-6.0		$c_{\rm L} = c_{\rm L} = c_{\rm IN} = 1$ KHz sine wave		

Table 9.	Analog switch characteristic	s (GND = 0 V; $T_A = 25^{\circ}C$)
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1. Input common terminal, and measured at switch terminal.

2. Input switch terminal, and measured at common terminal.

These characteristics are determined by the design of the device.



2.1 Switching characteristics test circuit





Figure 8. Bandwidth and feedthrough attenuation







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Figure 10. Common terminal capacitance (C_{I-O}, C_{I/O)}







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3 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK[®] packages. These packages have a Lead-free second level interconnect . The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.





Figure 14. Plastic DIP-16 (0.25) package information



		SO-16 M	ECHANICA	L DATA				
DIM		mm.		inch				
DIM.	MIN.	ТҮР	MAX.	MIN.	TYP.	MAX.		
А			1.75			0.068		
a1	0.1		0.25	0.004		0.010		
a2			1.64			0.063		
b	0.35		0.46	0.013		0.018		
b1	0.19		0.25	0.007		0.010		
С		0.5			0.019			
c1		•	45°	(typ.)	•	•		
D	9.8		10	0.385		0.393		
E	5.8		6.2	0.228		0.244		
е		1.27			0.050			
e3		8.89			0.350			
F	3.8		4.0	0.149		0.157		
G	4.6		5.3	0.181		0.208		
L	0.5		1.27	0.019		0.050		
М			0.62			0.024		

Figure 15. SO-16 package information







Figure 16. TSSOP16 package information





4 Revision history

Table 10. Document revision history

Date	Revision	Changes
01-Jul-2001	1	Initial release.
21-June-2004	2	Document internal migration, no content change.
10-Mar-2008	3	Document restructured and converted to new ST template, updated <i>Table 4 on page 5</i> , removed tube packing info.
21-Apr-2008	4	Replaced M74HC4051M13TR with M74HC4051RM13TR in <i>Table 1</i> on page 1.



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