



## 4051

## CMOS IC

### 8-CHANNEL ANALOG MULTIPLEXERS/DEMULTIPLEXERS

#### DESCRIPTION

UTC **4051** is single 8-channel analog multiplexers/demultiplexers for application as digitally-controlled analog switches.

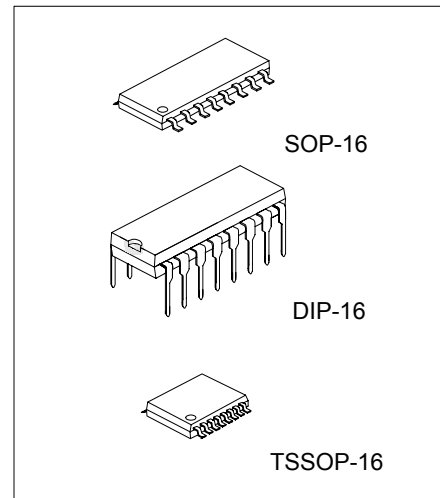
The device has three binary control inputs and an inhibit input. It feature low ON impedance and very low OFF leakage current. Control of analog signals up to the complete supply voltage range can be achieved.

#### FEATURES

- \* Wide analog voltage range:  $V_{DD}-V_{EE} = 3V\sim 18V$ . (Note:  $V_{EE}$  must be  $V_{SS}$ )
- \* Break-Before-Make switching eliminates channel overlap.
- \* Linearized transfer characteristics
- \* Implement an SP8T solid state switch effectively.
- \* Pin-to-Pin Replacement for CD4051

#### ORDERING INFORMATION

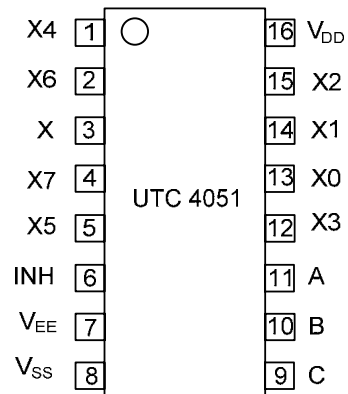
Ordering Number		Package	Packing
Normal	Lead Free Plating		
4051-D16-T	4051L-D16-T	DIP-16	Tube
4051-P16-R	4051L-P16-R	TSSOP-16	Tape Reel
4051-P16-T	4051L-P16-T	TSSOP-16	Tube
4051-S16-R	4051L-S16-R	SOP-16	Tape Reel
4051-S16-T	4051L-S16-T	SOP-16	Tube



\*Pb-free plating product number: 4051L

<p>4051L-D16-T</p> <p>(1)Packing Type (2)Package Type (3)Lead Plating</p>	<p>(1) R: Tape Reel, T: Tube (2) D16: DIP-16, P16: TSSOP-16, S16: SOP-16 (3) L: Lead Free Plating, Blank: Pb/Sn</p>
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### ■ PIN CONFIGURATION



### ■ PIN DESCRIPTION

PIN No.	SYMBOL	I/O	FUNCTIONS
3	X	I/O	Common input/output
6	INH	I	Inhibit inputs
7	$V_{EE}$		Supply voltage
8	$V_{SS}$		Ground
11,10,9	A,B,C	I	Binary control inputs
13,14,15,12,1,5,2,4	X0~X7	I/O	Independent inputs/outputs
16	$V_{DD}$		Positive supply voltage

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
DC Supply Voltage (Referenced to $V_{EE}$ , $V_{SS}$ , $V_{EE}$ )	$V_{DD}$	-0.5 ~ +18	V
Input or Output Voltage (DC or Transient) (Referenced to $V_{SS}$ for Control Inputs and $V_{EE}$ for Switch I/O)	$V_{IN}$ , $V_{OUT}$	-0.5 ~ $V_{DD} + 0.5$	V
Input Current (DC or Transient), Per Control Pin	$I_{IN}$	±10	mA
Switch Through Current	$I_{SW}$	±25	mA
Power Dissipation	$P_D$	500	mW
Derating above 65		7	mW/
Junction Temperature	$T_J$	+125	
Operating Temperature	$T_{OPR}$	-40 ~ +125	
Storage Temperature	$T_{STG}$	-40 ~ +150	

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ ELECTRICAL CHARACTERISTICS ( $T_a=25$  , unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>SUPPLY REQUIREMENTS (Voltages Referenced to <math>V_{EE}</math>)</b>						
Power Supply Voltage Range	$V_{DD}$	$V_{DD} - 3.0$ $V_{SS}$ $V_{EE}$	3		18	V
Quiescent Current Per Package	$I_Q$	Control Inputs: $V_{IN} = V_{SS}$ or $V_{DD}$ Switch I/O: $V_{EE}$ $V_{I/O}$ $V_{DD}$ , and $\Delta V_{sw}$ 500mV (Note 2)		0.005 0.010 0.015	5 10 20	$\mu$ A
Total Supply Current (Dynamic Plus Quiescent, Per Package)	$I_{D(AV)}$	$T_a=25$ only (The channel component, $(V_{IN}-V_{OUT})/R_{ON}$ , is not included.)		(0.07 $\mu$ A/kHz) f + $I_Q$ (0.20 $\mu$ A/kHz) f + $I_Q$ (0.36 $\mu$ A/kHz) f + $I_Q$		$\mu$ A
<b>SWITCHES IN/OUT AND COMMONS OUT/IN -- X, Y, Z (Voltages Referenced to <math>V_{EE}</math>)</b>						
Recommended Peak-to-Peak Voltage Into or Out of the Switch	$V_{I/O}$	Channel On or Off	0		$V_{DD}$	$V_{PP}$
Recommended Static or Dynamic Voltage Across the Switch	$\Delta V_{sw}$	Channel On	0		600	mV
Output Offset Voltage	$V_{O(OFF)}$	$V_{IN} = 0V$ , No Load		10		$\mu$ V
ON Resistance	$R_{ON}$	$\Delta V_{sw}$ 500mV $V_{IN} = V_{IL}$ or $V_{IH}$ (Control), and $V_{IN} = 0$ to $V_{DD}$ (Switch)		250 120 80	1050 500 280	$\Omega$
ON Resistance Between Any Two Channels in the Same Package	$\Delta R_{ON}$			25 10 10	70 50 45	$\Omega$
Off-Channel Leakage Current	$I_{OFF}$	$V_{IN} = V_{IL}$ or $V_{IH}$ (Control) Channel to Channel or Any One Channel, $V_{DD}=15V$		±0.05	±100	nA
Capacitance, Switch I/O	$C_{I/O}$	Inhibit = $V_{DD}$		10		pF
Capacitance, Common O/I	$C_{O/I}$	Inhibit = $V_{DD}$		17		pF
Capacitance, Feedthrough (Channel Off)	$C_{I/O}$	Pins Not Adjacent Pins Adjacent		0.15 0.47		pF

### ■ ELECTRICAL CHARACTERISTICS(Cont.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
<b>CONTROL INPUTS – INHIBIT A, B, C (Voltages Referenced to V<sub>SS</sub>)</b>							
Low Level Input Voltage	V <sub>DD</sub> =5V	V <sub>IL</sub>	R <sub>ON</sub> = per spec, I <sub>OFF</sub> = per spec		2.25	1.5	V
	V <sub>DD</sub> =10V				4.50	3.0	
	V <sub>DD</sub> =15V			6.75	4.0		
High Level Input Voltage	V <sub>DD</sub> =5V	V <sub>IH</sub>	R <sub>ON</sub> = per spec, I <sub>OFF</sub> = per spec		3.5	2.75	V
	V <sub>DD</sub> =10V				7	5.5	
	V <sub>DD</sub> =15V				11	8.25	
Input Leakage Current	I <sub>LEAK</sub>	V <sub>IN</sub> = 0 or V <sub>DD</sub> , V <sub>DD</sub> =15V		±0.00001	±0.1	μA	
Input Capacitance	C <sub>IN</sub>			5.0	7.5	pF	

### ■ DYNAMIC ELECTRICAL CHARACTERISTICS

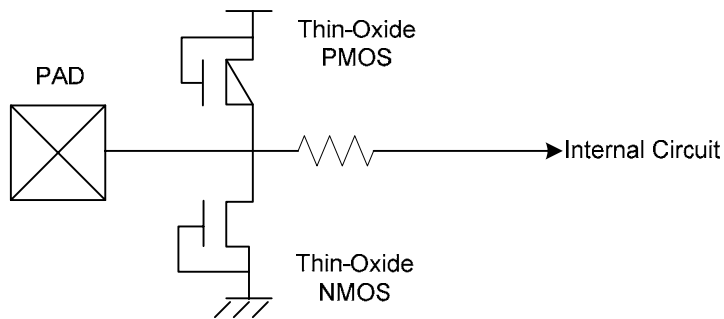
(C<sub>L</sub> = 50pF, T<sub>a</sub>=25 °C, V<sub>EE</sub> = V<sub>SS</sub>, unless otherwise specified)

PARAMETER	SYMBOL	V <sub>DD</sub> -V <sub>EE</sub> V <sub>dC</sub>	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Propagation Delay Times Switch Input to Switch Output (R <sub>L</sub> = 10 kΩ)	t <sub>PLH</sub> , t <sub>PHL</sub>	5	t <sub>PLH</sub> , t <sub>PHL</sub> = (0.17 ns/pF)C <sub>L</sub> + 26.5ns		35	90	ns
		10	t <sub>PLH</sub> , t <sub>PHL</sub> = (0.08 ns/pF)C <sub>L</sub> + 11ns		15	40	
		15	t <sub>PLH</sub> , t <sub>PHL</sub> = (0.06 ns/pF)C <sub>L</sub> + 9ns		12	30	
Inhibit to Output	t <sub>PHZ</sub> , t <sub>PLZ</sub> t <sub>PZH</sub> , t <sub>PZL</sub>	5	(R <sub>L</sub> =10kΩ, V <sub>EE</sub> =V <sub>SS</sub> )		350	700	ns
		10	Output "1" or "0" to High Impedance, or High Impedance to "1" or "0" Level		170	340	
		15			140	280	
Control Input to Output	t <sub>PLH</sub> , t <sub>PHL</sub>	5	R <sub>L</sub> = 10 kΩ, V <sub>EE</sub> = V <sub>SS</sub>		360	720	ns
		10			160	320	
		15			120	240	
Total Harmonic Distortion	THD	10	R <sub>L</sub> = 10KΩ, f = 1 kHz, V <sub>in</sub> = 5 V <sub>PP</sub>		0.07		%
Bandwidth	BW	10	R <sub>L</sub> = 1kΩ, V <sub>IN</sub> = 1/2 (V <sub>DD</sub> -V <sub>EE</sub> ) p-p, C <sub>L</sub> = 50pF, 20 Log (V <sub>OUT</sub> /V <sub>IN</sub> ) = -3dB		17		MHz
Off Channel Feedthrough Attenuation		10	R <sub>L</sub> =1KΩ, V <sub>IN</sub> = 1/2 (V <sub>DD</sub> -V <sub>EE</sub> ) p-p f <sub>IN</sub> = 4.5 MHz		-50		dB
Channel Separation		10	R <sub>L</sub> = 1kΩ, V <sub>IN</sub> = 1/2 (V <sub>DD</sub> -V <sub>EE</sub> ) p-p f <sub>IN</sub> = 3MHz		-50		dB
Crosstalk, Control Input to Common O/I		10	R <sub>1</sub> = 1kΩ, R <sub>L</sub> = 10kΩ Control t <sub>TLH</sub> = t <sub>THL</sub> = 20ns, Inhibit = V <sub>SS</sub>		75		mV

Note 1. Data of "TYP" is intended as an indication of the IC's potential performance.

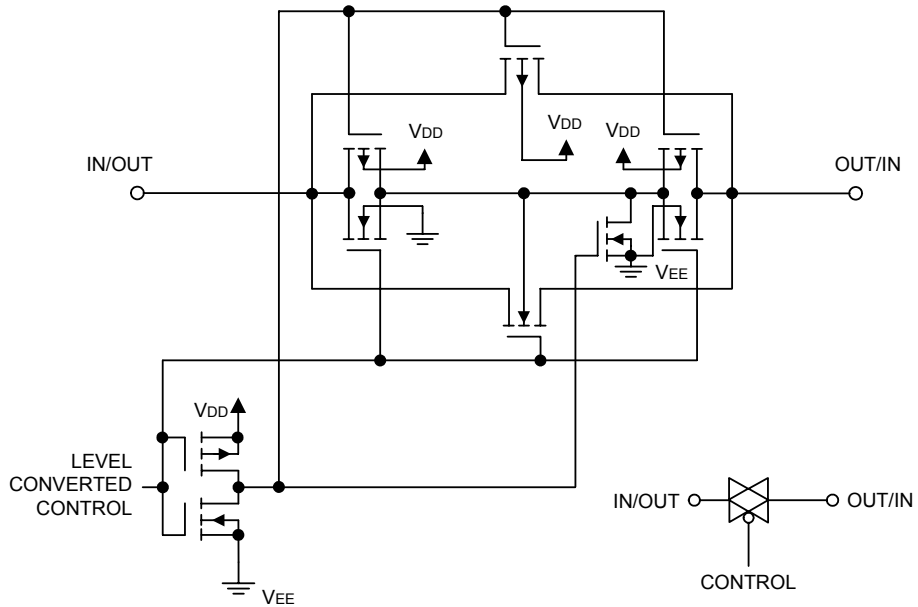
2. For voltage drops across the switch(ΔV<sub>sw</sub>)>600mV (>300mV at high temperature), excessive V<sub>DD</sub> current may be drawn, i.e. the current out of the switch may contain both V<sub>DD</sub> and switch input components. The reliability of the device will be unaffected unless the Maximum Ratings are exceeded.

## ■ ESD PROTECTION CIRCUIT



Standard ESD protection circuit at all input pads.

SWITCH CIRCUIT SCHEMATIC

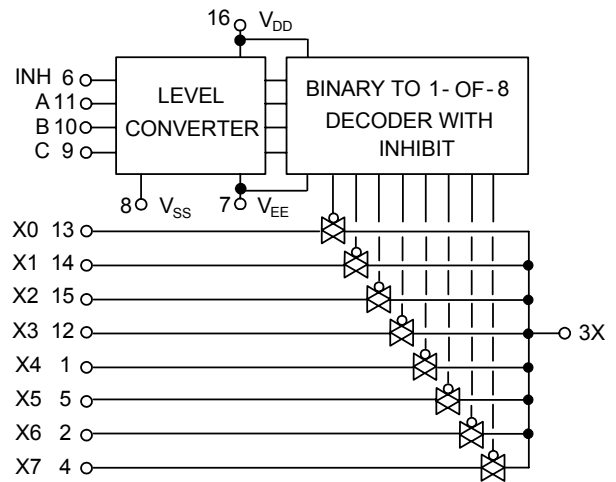


TRUTH TABLE

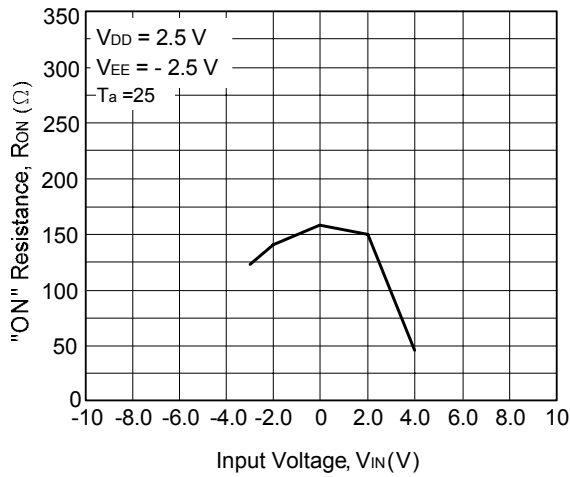
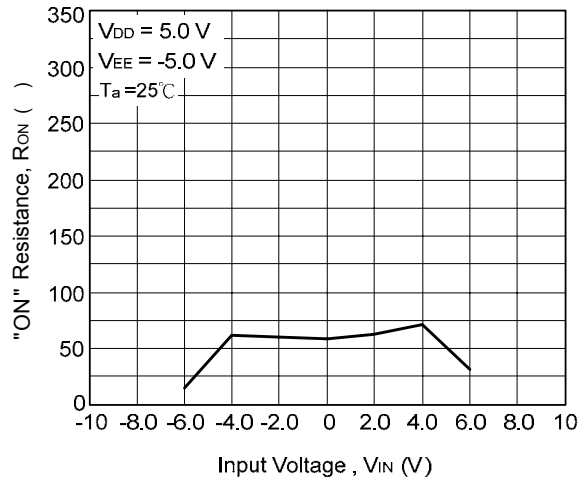
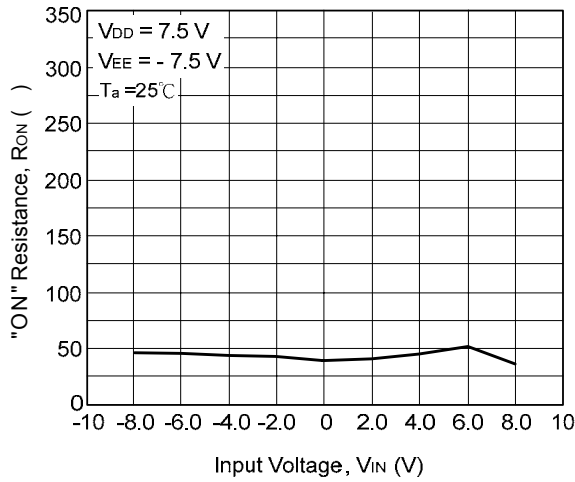
Control Inputs				ON Switches
INHIBIT	C	B	A	
0	0	0	0	X0
0	0	0	1	X1
0	0	1	0	X2
0	0	1	1	X3
0	1	0	0	X4
0	1	0	1	X5
0	1	1	0	X6
0	1	1	1	X7
1	x	x	x	None

x = Don't Care

FUNCTIONAL DIAGRAM



■ TYPICAL CHARACTERISTICS



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