



## 4051

## CMOS IC

### 8-CHANNEL ANALOG MULTIPLEXERS/DEMULTIPLEXERS

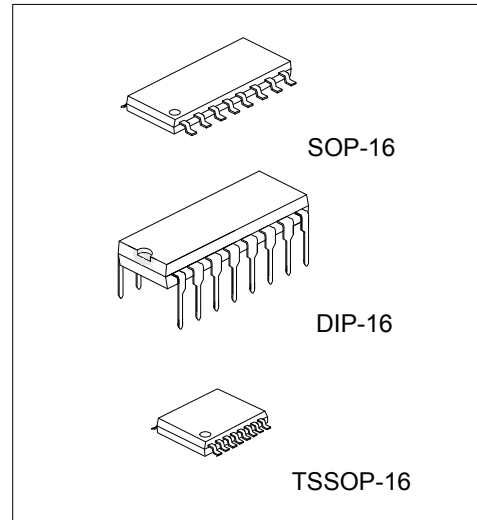
#### DESCRIPTION

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  $\leq V_{SS}$ )
- \* Break-Before-Make Switching Eliminates Channel Overlap.
- \* Linearized Transfer Characteristics
- \* Implement an SP8T solid state switch effectively.
- \* Pin-to-Pin Replacement for CD4051

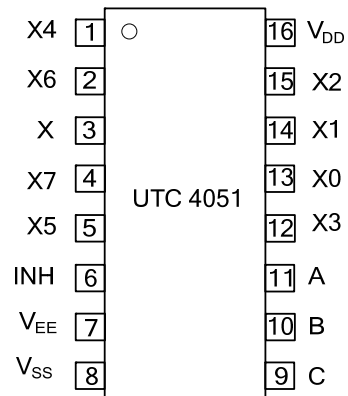


#### ORDERING INFORMATION

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

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



### ■ PIN DESCRIPTION

PIN No.	SYMBAL	I/O	NAME AND FUNCTION
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 RATING

PARAMETER	SYMBOL	RATINGS	UNIT
DC Supply Voltage (Referenced to $V_{EE}$ , $V_{SS} \geq V_{EE}$ )	$V_{DD}$	-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	$I_{IN}$	$\pm 10$	mA
Switch Through Current	$I_{SW}$	$\pm 25$	mA
Power Dissipation	$P_D$	500	mW
Derating above 65°C		7	mW/°C
Junction Temperature	$T_J$	125	°C
Operating Temperature	$T_{OPR}$	-40 ~ +125	°C
Storage Temperature	$T_{STG}$	-40 ~ +150	°C

Note: 1. 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 ( $T_A=25^\circ\text{C}$ , 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	$V_{DD}$	$V_{DD} - 3.0 \geq V_{SS} \geq V_{EE}$	3		18	V
Quiescent Current per Package	$V_{DD}=5\text{V}$	Control Inputs: $V_{IN} = V_{SS}$ or $V_{DD}$ Switch I/O: $V_{EE} \leq V_{IO} \leq V_{DD}$ , $\Delta V_{SW} \leq 500\text{mV}$ (Note 2)		0.005	5	$\mu\text{A}$
	$V_{DD}=10\text{V}$			0.010	10	
	$V_{DD}=15\text{V}$			0.015	20	
Total Supply Current (Dynamic Plus Quiescent, Per Package)	$V_{DD}=5\text{V}$	$T_A=25^\circ\text{C}$ only (The channel component, $(V_{IN}-V_{OUT})/R_{on}$ , is not included.)	$(0.07 \mu\text{A/kHz}) f + I_Q$		$\mu\text{A}$	
	$V_{DD}=10\text{V}$		$(0.20 \mu\text{A/kHz}) f + I_Q$			
	$V_{DD}=15\text{V}$		$(0.36 \mu\text{A/kHz}) f + I_Q$			
<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	$V_{IO}$	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	$V_{O(OFF)}$	$V_{IN} = 0\text{V}$ , No Load		10		$\mu\text{V}$
ON Resistance	$V_{DD}=5\text{V}$	$\Delta V_{SW} \leq 500\text{mV}$ $V_{IN} = V_{IL}$ or $V_{IH}$ (Control), $V_{IN} = 0$ to $V_{DD}$ (Switch)		250	1050	$\Omega$
	$V_{DD}=10\text{V}$			120	500	
	$V_{DD}=15\text{V}$			80	280	
$\Delta$ ON Resistance Between Any Two Channels in the Same Package	$V_{DD}=5\text{V}$	$\Delta R_{ON}$		25	70	$\Omega$
	$V_{DD}=10\text{V}$			10	50	
	$V_{DD}=15\text{V}$			10	45	
Off-Channel Leakage Current	$I_{OFF}$	$V_{IN} = V_{IL}$ or $V_{IH}$ (Control) Channel to Channel or Any One Channel, $V_{DD}=15\text{V}$		$\pm 0.05$	$\pm 100$	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		0.15		pF
		Pins Adjacent		0.47		

■ 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

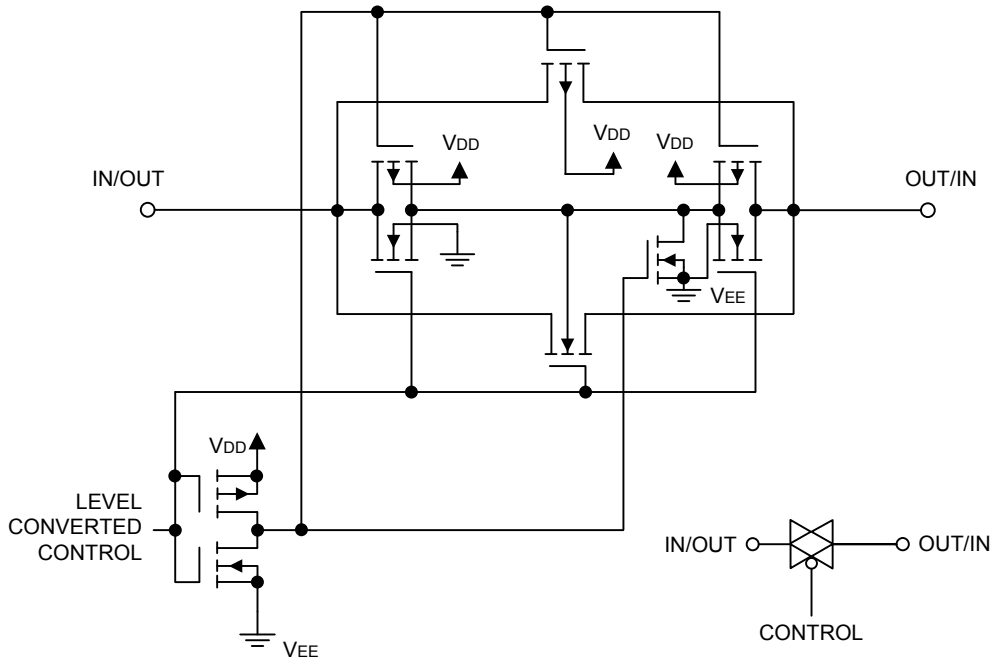
(C<sub>L</sub> = 50pF, T<sub>A</sub>=25°C, V<sub>EE</sub> ≤ V<sub>SS</sub>, unless otherwise specified)

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> = 10kΩ)	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> = 10kΩ, 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.

■ TEST CIRCUIT

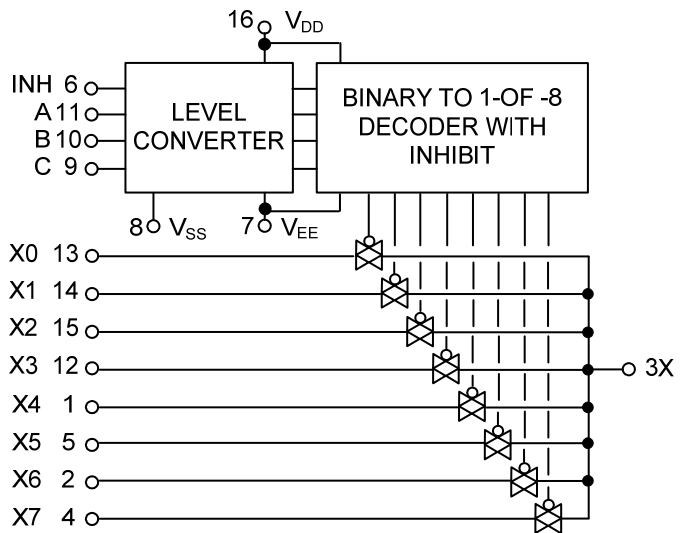


Switch Circuit Schematic

■ TRUTH TABLE

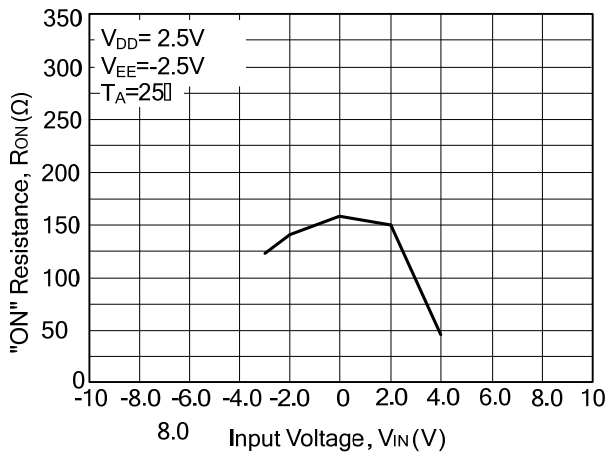
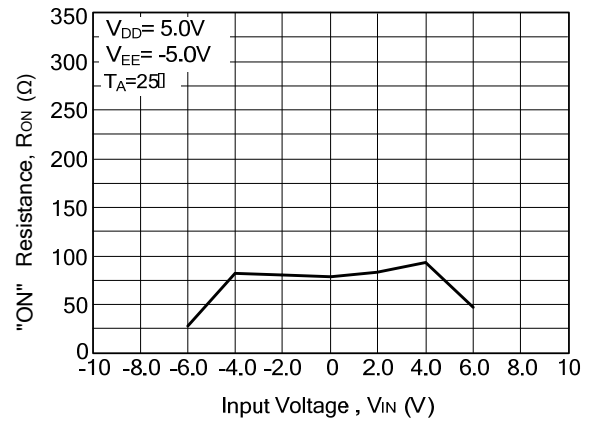
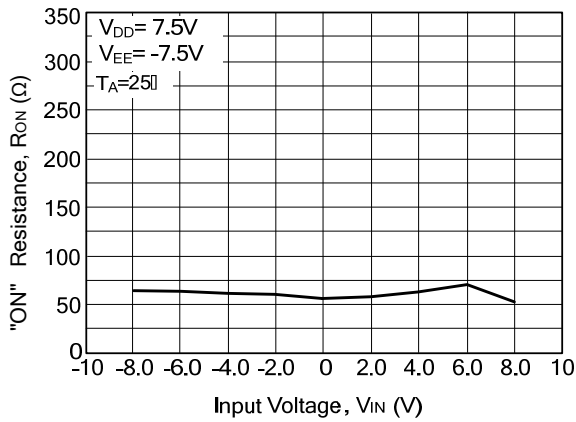
Control Inputs				ON Switches
INHIBIT	C	B	A	
0	0	0	0	X0
0	0	0	1	X1
0	0	1	0	X2
0	0	1	1	X3
0	1	0	0	X4
0	1	0	1	X5
0	1	1	0	X6
0	1	1	1	X7
1	x	x	x	None

x = Don't Care



UTC 4051 Functional Diagram

■ TYPICAL CHARACTERISTICS



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