



## 4053

CMOS IC

### TRIPLE 2-CHANNEL ANALOG MULTIPLEXERS/DEMULTIPLEXERS

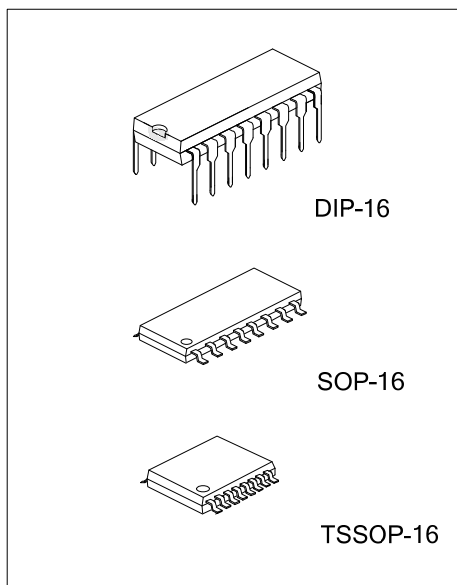
#### DESCRIPTION

UTC **4053** is triple 2-channel analog multiplexers/demultiplexers for application as digitally-controlled analog switches.

The device has three separate digital 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 SPDT Switch Effectively.
- \* Pin to Pin Replacement for CD4053



#### ORDERING INFORMATION

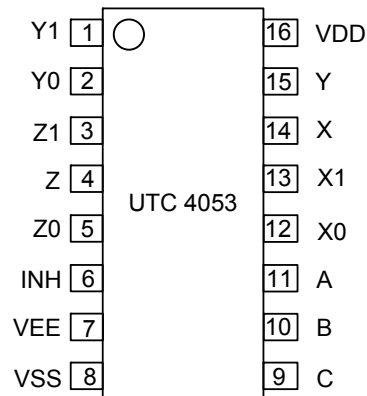
Ordering Number		Package	Packing
Lead Free	Halogen Free		
4053L-D16-T	4053G-D16-T	DIP-16	Tube
-	4053G-S16-R	SOP-16	Tape Reel
-	4053G-P16-R	TSSOP-16	Tape Reel

<p>4053L-D16-T</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p>	<p>(1) T: Tube, R: Tape Reel (2) D16: DIP-16, S16: SOP-16, P16: TSSOP-16 (3) L: Lead Free, G: Halogen Free and Lead Free</p>
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#### MARKING

DIP-16	SOP-16 / TSSOP-16
<p>16 15 14 13 12 11 10 9 UTC □□□□ 4053 □ □ □ 1 2 3 4 5 6 7 8</p> <p>Date Code L: Lead Free G: Halogen Free Lot Code</p>	<p>16 15 14 13 12 11 10 9 UTC □□□□ 4053G □ □ 1 2 3 4 5 6 7 8</p> <p>Date Code Lot Code</p>

### ■ PIN CONFIGURATION



### ■ PIN DESCRIPTION

PIN No.	SYMBOL	NAME AND FUNCTION
14,15,4	X,Y,Z	Commons Input/Output
6	INH	Inhibit Input
7	V <sub>EE</sub>	Supply Voltage
8	V <sub>SS</sub>	Ground
11,10,9	A,B,C	Digital Control Inputs
12,13	X0,X1	A-X Switches Inputs/Outputs
2,1	Y0,Y1	B-Y Switches Inputs/Outputs
5,3	Z0,Z1	C-Z Switches Inputs/Outputs
16	V <sub>DD</sub>	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	$I_{IN}$	±10	mA
Switch Through Current	$I_{SW}$	±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: 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	$V_{DD}$	$V_{DD} - 3 \geq V_{SS} \geq V_{EE}$	3		18	V	
Quiescent Current per Package	$V_{DD}=5\text{V}$	Control Inputs: $V_{IN} = V_{SS}$ or $V_{DD}$ Switch I/O: $V_{EE} \leq V_{I/O} \leq V_{DD}$ , $\Delta V_{SW} \leq 500\text{mV}$ (Note 2)		0.005	5	$\mu\text{A}$	
	$V_{DD}=10\text{V}$			0.010	10	$\mu\text{A}$	
	$V_{DD}=15\text{V}$			0.015	20	$\mu\text{A}$	
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 excluded)		$(0.07 \mu\text{A}/\text{kHz}) f + I_Q$		$\mu\text{A}$	
	$V_{DD}=10\text{V}$			$(0.20 \mu\text{A}/\text{kHz}) f + I_Q$	$\mu\text{A}$		
	$V_{DD}=15\text{V}$			$(0.36 \mu\text{A}/\text{kHz}) f + I_Q$	$\mu\text{A}$		
<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 (Note2)	$\Delta V_{SW}$	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), and $V_{IN} = 0$ to $V_{DD}$ (Switch)		250	1050	$\Omega$	
	$V_{DD}=10\text{V}$			120	500	$\Omega$	
	$V_{DD}=15\text{V}$			80	280	$\Omega$	
$\Delta$ 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	$\Omega$	
	$V_{DD}=15\text{V}$			10	45	$\Omega$	
Off-Channel Leakage Current	$I_{OFF}$	$V_{IN} = V_{IL}$ or $V_{IH}$ (Control) Channel to Channel or Any One Channel, $V_{DD}=15\text{V}$		±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		0.15		pF	
		Pins Adjacent		0.47		Pf	
<b>CONTROL INPUTS – INHIBIT A, B, C (Voltages Referenced to <math>V_{SS}</math>)</b>							
Low Level Input Voltage	$V_{DD}=5\text{V}$	$V_{IL}$	$R_{ON} = \text{per spec}$ , $I_{OFF} = \text{per spec}$		2.25	1.5	V
	$V_{DD}=10\text{V}$				4.50	3.0	V
	$V_{DD}=15\text{V}$				6.75	4.0	V
High Level Input Voltage	$V_{DD}=5\text{V}$	$V_{IH}$	$R_{ON} = \text{per spec}$ , $I_{OFF} = \text{per spec}$		3.5	2.75	V
	$V_{DD}=10\text{V}$				7.0	5.50	V
	$V_{DD}=15\text{V}$				11	8.25	V
Input Leakage Current	$I_{LEAK}$	$V_{IN} = 0$ or $V_{DD}$ , $V_{DD}=15\text{V}$		±0.00001	±0.1	$\mu\text{A}$	
Input Capacitance	$C_{IN}$			5.0	7.5	pF	

### ■ DYNAMIC ELECTRICAL CHARACTERISTICS

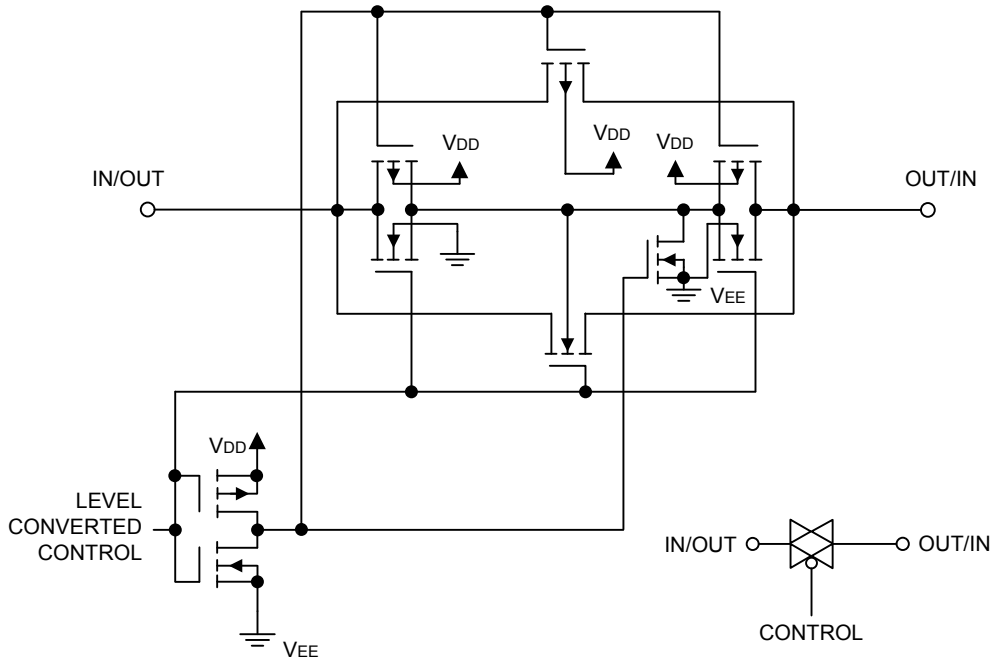
( $C_L = 50\text{pF}$ ,  $T_A = 25^\circ\text{C}$ ,  $V_{EE} \leq V_{SS}$ , unless otherwise specified)

PARAMETER	SYMBOL	$V_{DD}-V_{EE}$ $V_{DC}$	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Propagation Delay Times Switch Input to Switch Output ( $R_L = 10\text{ k}\Omega$ )	$t_{PLH}$ , $t_{PHL}$	5	$t_{PLH}$ , $t_{PHL} = (0.17\text{ ns/pF})C_L + 16.5\text{ns}$		25	65	ns
		10	$t_{PLH}$ , $t_{PHL} = (0.08\text{ ns/pF})C_L + 4.0\text{ns}$		8.0	20	ns
		15	$t_{PLH}$ , $t_{PHL} = (0.06\text{ ns/pF})C_L + 3.0\text{ns}$		6.0	15	ns
Inhibit to Output	$t_{PHZ}$ , $t_{PLZ}$ $t_{PZH}$ , $t_{PZL}$	5	$(R_L = 10\text{k}\Omega, V_{EE} = V_{SS})$ , Output "1" or "0" to High Impedance, or High Impedance to "1" or "0" Level		275	550	ns
		10			140	280	ns
		15			110	220	ns
Control Input to Output	$t_{PLH}$ , $t_{PHL}$	5	$R_L = 10\text{k}\Omega, V_{EE} = V_{SS}$		300	600	ns
		10			120	240	ns
		15			80	160	ns
Total Harmonic Distortion	THD	10	$R_L = 10\text{k}\Omega, f = 1\text{ kHz}, V_{IN} = 5\text{ V}_{PP}$		0.07		%
Bandwidth	BW	10	$R_L = 1\text{k}\Omega, V_{IN} = 1/2(V_{DD}-V_{EE})\text{ p-p}$ , $C_L = 50\text{pF}, 20\text{ Log}(V_{OUT}/V_{IN}) = -3\text{dB}$		17		MHz
Off Channel Feedthrough Attenuation		10	$R_L = 1\text{k}\Omega, V_{IN} = 1/2(V_{DD}-V_{EE})\text{ p-p}$ $f_{IN} = 55\text{MHz}$		-50		dB
Channel Separation		10	$R_L = 1\text{k}\Omega, V_{IN} = 1/2(V_{DD}-V_{EE})\text{ p-p}$ $f_{IN} = 3\text{MHz}$		-50		dB
Crosstalk, Control Input to Common O/I		10	$R_1 = 1\text{k}\Omega, R_L = 10\text{k}\Omega$ Control $t_{TLH} = t_{THL} = 20\text{ns}, \text{Inhibit} = V_{SS}$		75		mV

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

2. For voltage drops across the switch ( $\Delta V_{SW}$ ) > 600mV (> 300mV at high temperature), excessive  $V_{DD}$  current may be drawn, i.e. the current out of the switch may contain both  $V_{DD}$  and switch input components. The reliability of the device will be unaffected unless the Maximum Ratings are exceeded.

■ TEST CIRCUIT

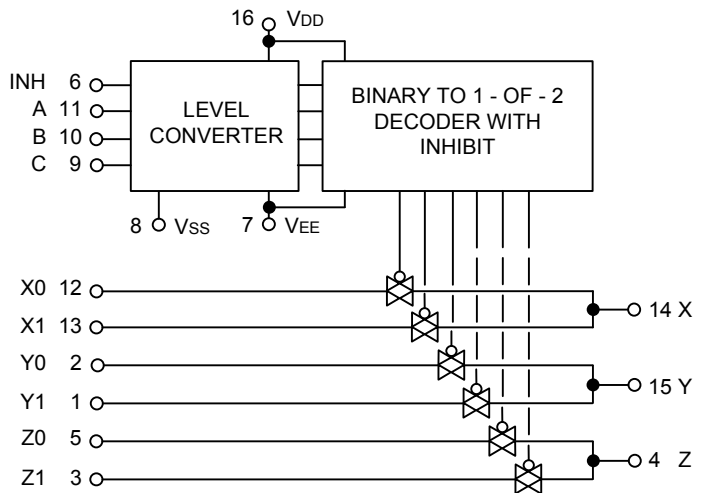


Switch Circuit Schematic

■ TRUTH TABLE

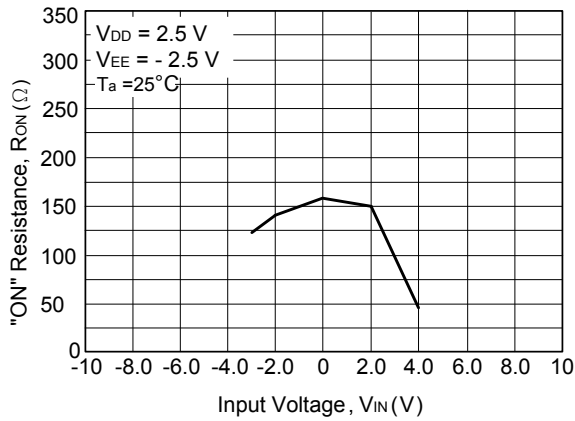
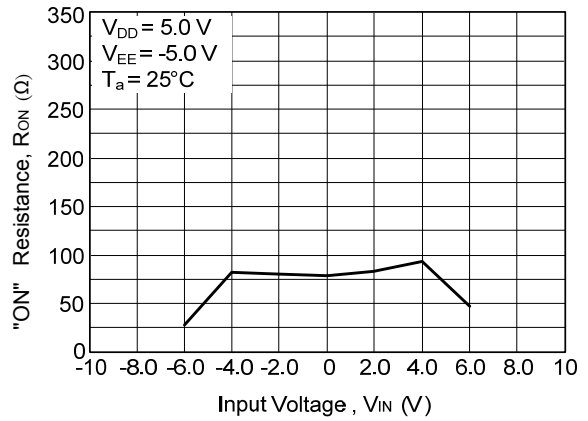
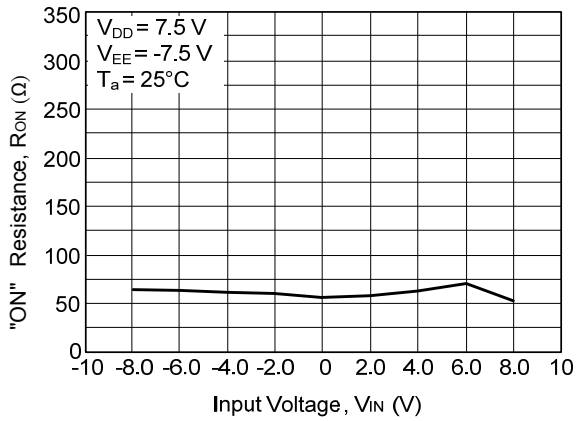
Control Inputs				ON Switches		
INHIBIT	Select			UTC 4053		
	C	B	A	Z0	Y0	X0
0	0	0	0	Z0	Y0	X0
0	0	0	1	Z0	Y0	X1
0	0	1	0	Z0	Y1	X0
0	0	1	1	Z0	Y1	X1
0	1	0	0	Z1	Y0	X0
0	1	0	1	Z1	Y0	X1
0	1	1	0	Z1	Y1	X0
0	1	1	1	Z1	Y1	X1
1	x	x	x	None		

x = Don't Care



UTC 4053 Functional Diagram

■ TYPICAL CHARACTERISTICS



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