



## 4052

CMOS IC

### DIFFERENTIAL 4-CHANNEL ANALOG MULTIPLEXERS/ DEMULTIPLEXERS

#### DESCRIPTION

The UTC **4052** is differential 4-channel analog multiplexers/demultiplexers for application as digitally-controlled analog switches.

The device has two 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.

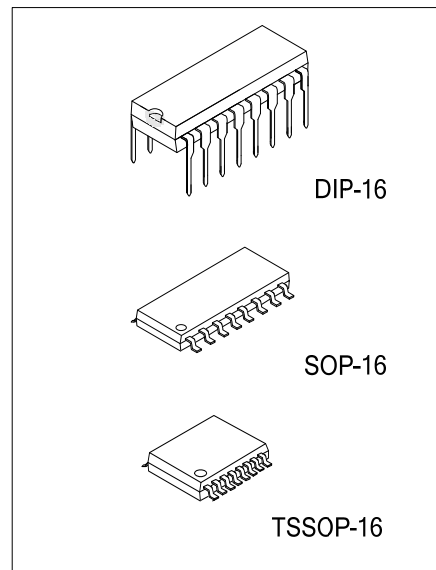
#### FEATURES

- \* 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 DP4T Switch Effectively.
- \* Pin to Pin Replacement for CD4052

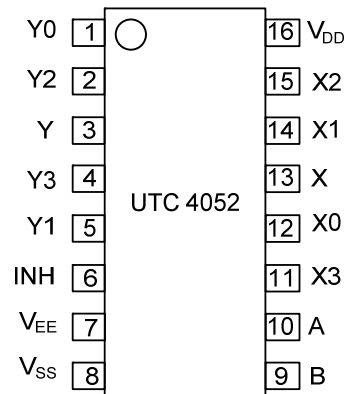
#### ORDERING INFORMATION

Ordering Number			Package	Packing
Normal	Lead Free Plating	Halogen Free		
4052-D16-T	4052L-D16-T	4052G-D16-T	DIP-16	Tube
4052-P16-R	4052L-P16-R	4052G-P16-R	TSSOP-16	Tape Reel
4052-S16-T	4052L-S16-T	4052G-S16-T	SOP-16	Tube
4052-S16-R	4052L-S16-R	4052G-S16-R	SOP-16	Tape Reel

<p>4052L-D16-R</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Lead Plating</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, Blank: Pb/Sn</p>
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### ■ PIN CONFIGURATION



### ■ PIN DESCRIPTION

PIN No.	SYMBOL	NAME AND FUNCTION
13, 3	X, Y	Commons Input/Output
6	INH	Inhibit Input
7	$V_{EE}$	Supply Voltage
8	$V_{SS}$	Ground
10, 9	A, B	Binary Control Inputs
12, 14, 15, 11	X0~X3	X Channel Inputs/Outputs
1, 5, 2, 4	Y0~Y3	Y Channel Inputs/Outputs
16	$V_{DD}$	Positive Supply Voltage

Note: Control Inputs referenced to  $V_{SS}$ . Analog Inputs and Outputs reference to  $V_{EE}$ .  $V_{EE}$  must be  $< V_{SS}$ .

■ 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	$P_D$	700	mW
Derating above 65°C		7	mW/°C
Junction Temperature	$T_J$	125	°C
Operating Temperature Range	$T_{OPR}$	-40 ~ +125	°C
Storage Temperature Range	$T_{STG}$	-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: $V_{EE} \leq V_{I/O} \leq V_{DD}$ , and $\Delta V_{sw} \leq 500\text{mV}$ (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	$V_{DD}=5\text{V}$	$\Delta V_{sw} \leq 500\text{mV}$ (Note2) $V_{IN} = V_{IL}$ 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, $V_{DD}=15\text{V}$		$\pm 0.05$	$\pm 100$	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		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 $V_{DD}$ , $V_{DD}=15\text{V}$		$\pm 0.00001$	$\pm 0.1$	$\mu\text{A}$	
Input Capacitance	$C_{IN}$			5.0	7.5	pF	

### ■ DYNAMIC ELECTRICAL CHARACTERISTICS

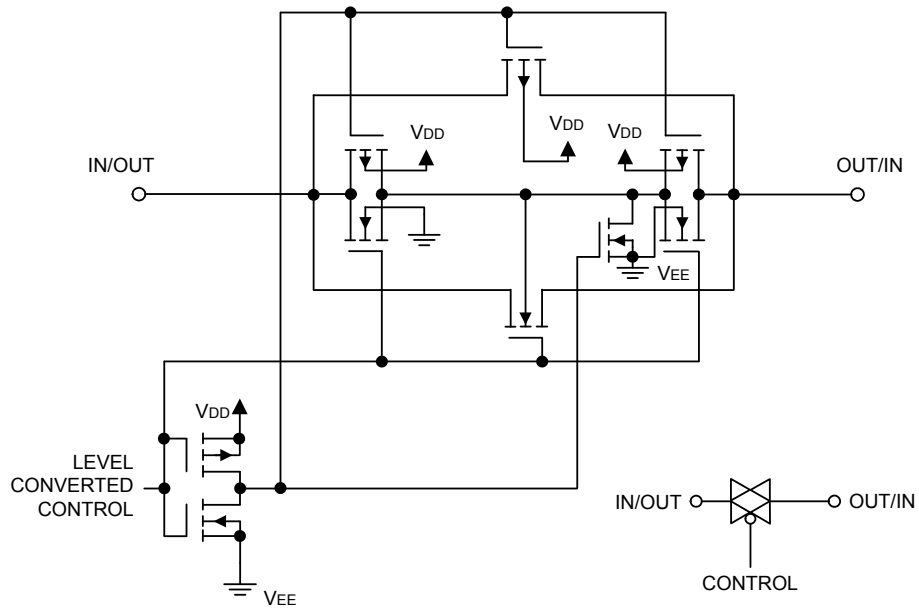
( $C_L = 50\text{pF}$ ,  $T_a = 25^\circ\text{C}$ ,  $V_{EE} \leq V_{SS}$ , unless otherwise specified)

PARAMETER	SYMBOL	$V_{DD}-V_{EE}$ Vdc	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	$t_{PLH}$ , $t_{PHL} = (0.17\text{ ns/pF})C_L + 21.5\text{ns}$		30	75	ns
		10	$t_{PLH}$ , $t_{PHL} = (0.08\text{ ns/pF})C_L + 8.0\text{ns}$		12	30	ns
		15	$t_{PLH}$ , $t_{PHL} = (0.06\text{ ns/pF})C_L + 7.0\text{ns}$		10	25	ns
Inhibit to Output	$t_{PHZ}$ , $t_{PLZ}$ $t_{PZH}$ , $t_{PZL}$	5	( $R_L = 10\text{k}\Omega$ , $V_{EE} = V_{SS}$ )		300	600	ns
		10	Output "1" or "0" to High Impedance, or High Impedance to "1" or "0" Level		155	310	ns
		15			125	250	ns
Control Input to Output	$t_{PLH}$ , $t_{PHL}$	5	$R_L = 10\text{ k}\Omega$ , $V_{EE} = V_{SS}$		325	650	ns
		10			130	260	ns
		15			90	180	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	$R_L = 1\text{k}\Omega$ , $V_{IN} = 1/2 (V_{DD}-V_{EE})$ p-p, $C_L = 50\text{pF}$ , $20\text{ Log}(V_{OUT}/V_{IN}) = -3\text{dB}$		17		MHz
Off Channel Feedthrough Attenuation		10	$R_L = 1\text{k}\Omega$ , $V_{IN} = 1/2 (V_{DD}-V_{EE})$ p-p $f_{IN} = 30\text{MHz}$		-50		dB
Channel Separation		10	$R_L = 1\text{k}\Omega$ , $V_{IN} = 1/2 (V_{DD}-V_{EE})$ 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 $t_{TLH} = t_{THL} = 20\text{ns}$ , Inhibit = $V_{SS}$		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 ( $\Delta V_{sw}$ ) > 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



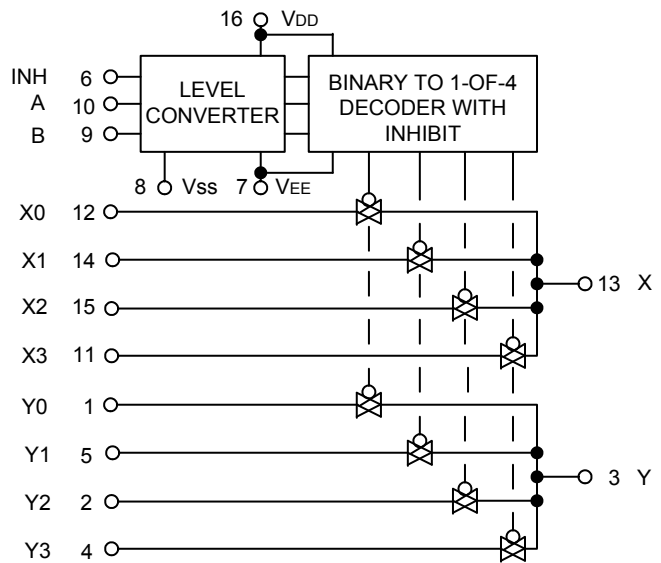
Switch Circuit Schematic

■ TRUTH TABLE

TRUTH TABLE

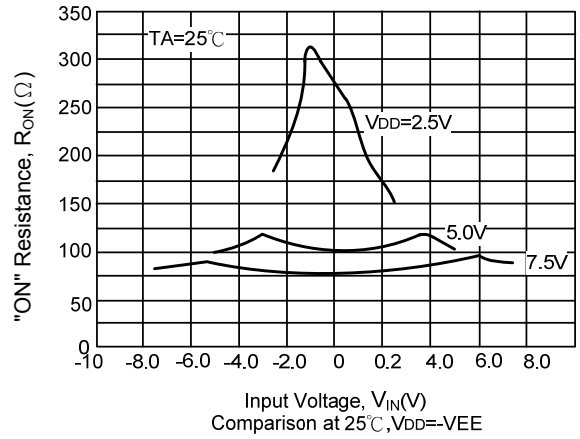
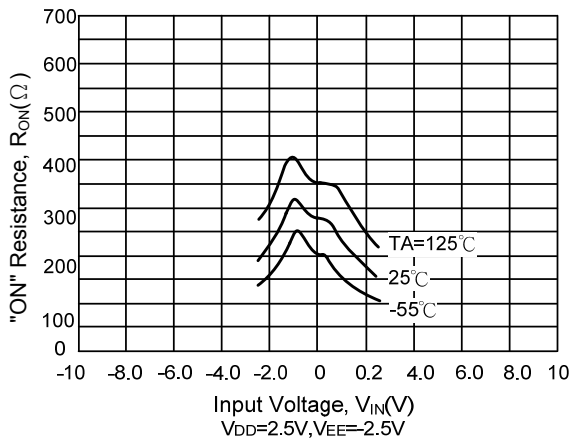
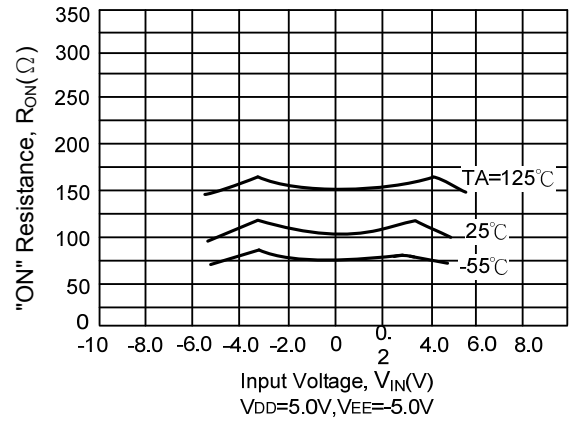
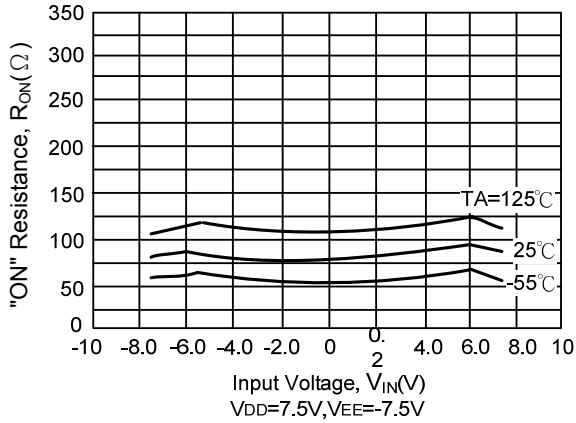
Control Inputs			ON Switches	
Inhibit	Select			
	B	A	Y0	X0
0	0	0	Y1	X1
0	0	1	Y2	X2
0	1	0	Y3	X3
0	1	1		
1	X	X	None	

\* X=Don't Care



UTC 4052 Functional Diagram

■ TYPICAL CHARACTERISTICS



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