



ELECTRONICS, INC.
 44 FARRAND STREET
 BLOOMFIELD, NJ 07003
 (973) 748-5089
<http://www.nteinc.com>

NTE74HC4053 Integrated Circuit TTL – High Speed CMOS, Triple 2–Channel Analog Multiplexer/Demultiplexer

Description:

The NTE74HC4053 is a digitally controlled analog switch in a 16–Lead DIP type package that utilizes silicon gate CMOS technology to achieve operating speeds similar to LS–TTL with the low power consumption of standard CMOS integrated circuits.

The NTE74HC4053 analog multiplexer/demultiplexer controls analog voltages that may vary across the voltage supply range (i.e. V_{CC} to V_{EE}). They are bidirectional switch thus allowing any analog input to be used as an output and visa-versa. The switches have low “on” resistance and low “off” leakages, in addition to having an enable control which, when high, disables all switches to their “of” state.

Features:

- Wide Power Supply Range: 2V to 6V
- Switch Voltage: 0V to 10V
- High Noise Immunity: $N_{IL} = 30\%$, $N_{IH} = 30\%$ of V_{CC} at $V_{CC} = 5V$
- Wide Analog Input Voltage Range: $\pm 5V$ Max
- Low “ON” Resistance:
 - 70 Ω Typical ($V_{CC} - V_{EE} = 4.5V$)
 - 40 Ω Typical ($V_{CC} - V_{EE} = 9V$)
- Low Crosstalk between Switches
- Fast Switching and Propagation Speeds
- “Break–Before–Make” Switching

Absolute Maximum Ratings: (Note 1, Note 2)

DC Supply Voltage, $V_{CC} - V_{EE}$	-0.5 to +10.5V
DC Supply Voltage, V_{CC}	-0.5 to +7.0V
DC Supply Voltage, V_{EE}	+0.5 to -7.0V
DC Input Diode Current, I_{IK}	$\pm 20mA$
DC Switch Diode Current, I_{OK}	$\pm 20mA$
DC Switch Current, I_{OUT}	$\pm 25mA$
DC V_{CC} or GND Current, I_{CC}	$\pm 50mA$
DC V_{EE} Current, I_{EE}	-20mA
Maximum Junction Temperature, T_J	+150°C
Storage Temperature Range, T_{stg}	-65°C to +150°C
Typical Thermal Resistance, Junction–to–Ambient, R_{thJA}	90°C/W
Lead Temperature (During Soldering, 10sec), T_L	+300°C

Note 1. Absolute Maximum Ratings are those values beyond which damage to the device may occur.
 Note 2. Unless otherwise specified, all voltages are referenced to GND.

Recommended Operating Conditions:

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage (Note 3)	V_{CC}	2.0	–	6.0	V
Supply Voltage	$V_{CC} - V_{EE}$	2.0	–	10.0	V
Supply Voltage (Note 3)	V_{EE}	0	–	–6.0	V
DC Input Control Voltage	V_I	GND	–	V_{CC}	V
Analog Switch I/O Voltage	V_{IS}	V_{EE}	–	V_{CC}	V
Operating Temperature Range	T_A	–40	–	+85	°C
Input Rise or Fall Times $V_{CC} = 2.0V$	t_r, t_f	–	–	1000	ns
$V_{CC} = 4.5V$		–	–	500	ns
$V_{CC} = 6.0V$		–	–	400	ns

Note 3. In certain applications, the external load resistor current may include both V_{CC} and signal line components. To avoid drawing V_{CC} current when switch current flows into the transmission gate inputs, the voltage drop across the bidirectional switch must not exceed 0.6V (calculated from r_{ON} values shown in “Electrical Characteristics” table). No V_{CC} current will flow through R_L if the switch current flows into Pin4, Pin14, and Pin15.

DC Electrical Characteristics:

Parameter	Symbol	Test Conditions				$T_A = +25^\circ C$		$T_A = -40^\circ$ to $+85^\circ C$		Unit
		V_{IS}	V_I	V_{EE}	V_{CC}	Typ	Guaranteed Limits			
Minimum High Level Input Voltage	V_{IH}				2.0	–	1.5	1.5	V	
					4.5	–	3.15	3.15	V	
					6.0	–	4.2	4.2	V	
Maximum Low Level Input Voltage	V_{IL}				2.0	–	0.5	0.5	V	
					4.5	–	1.35	1.35	V	
					6.0	–	1.8	1.8	V	
On Resistance ($I_O = 1mA$)	r_{ON}	V_{CC} or V_{EE}	V_{IL} or V_{IH}	0	4.5	70	160	200	Ω	
				0	6.0	60	140	175	Ω	
				–4.5	4.5	40	120	150	Ω	
		0		4.5	90	180	225	Ω		
		0		6.0	80	160	200	Ω		
		–4.5		4.5	45	130	162	Ω		
Maximum On Resistance between any Two Channels	Δr_{ON}			0	4.5	10	–	–	Ω	
				0	6.0	8.5	–	–	Ω	
				–4.5	4.5	5.0	–	–	Ω	
Switch On/Off Leakage Current 1 and 2 Channel	I_{IZ}	For Switch Off: When $V_{IS} = V_{CC}$, $V_{OS} = V_{EE}$; When $V_{IS} = V_{EE}$, $V_{OS} = V_{CC}$ For Switch On: All Applicable Combinations of V_{IS} and V_{OS} Voltage Levels	0	6.0	–	± 0.1	± 1.0	μA		
			–5.0	5.0	–	± 0.1	± 1.0	μA		

DC Electrical Characteristics (Cont'd):

Parameter	Symbol	Test Conditions				T _A = +25°C		T _A = -40° to +85°C		Unit
		V _{IS}	V _I	V _{EE}	V _{CC}	Typ	Guaranteed Limits			
Control Input Leakage Current	I _{IL}		V _{CC} or GND	0	6.0	-	±0.1	±1.0	μA	
Quiescent Device Current (I _O = 0)	I _{CC}	When V _{IS} = V _{EE} , V _{OS} = V _{CC}	V _{CC} or GND	0	6.0	-	8	80	μA	
		When V _{IS} = V _{CC} , V _{OS} = V _{EE}		-5.0	5.0	-	16	160	μA	

Switching Specifications: (V_{CC} = 5V, T_A = +25°C, t_r = t_f = 6ns unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Propagation Delay Switch IN to OUT	t _{PHL} , t _{PLH}	C _L = 15pF	-	4	-	ns
Switch Turn-off (S or \bar{E})	t _{PHZ} , t _{PLZ}	C _L = 15pF	-	18	-	ns
Switch Turn-Off (S or \bar{E})	t _{PZH} , t _{PZL}	C _L = 15pF	-	18	-	ns
Power Dissipation Capacitance	C _{PD}	Note 4	-	38	-	ns

Note 4. C_{PD} is used to determine the dynamic power consumption, per package.

$$P_D = C_{PD} V_{CC}^2 f_i + \sum (C_L + C_S) V_{CC}^2 f_o \text{ where } f_o = \text{Output Frequency, } f_i = \text{Input Frequency, } C_L = \text{Output Load Capacitance, } C_S = \text{Switch Capacitance, } V_{CC} = \text{Supply Voltage.}$$

Switching Specifications: (C_L = 50pF, t_r = t_f = 6ns unless otherwise specified)

Parameter	Symbol	Test Conditions			T _A = +25°C		T _A = -40° to +85°C		Unit
			V _{EE}	V _{CC}	Typ	Guaranteed Limits			
Propagation Delay (Switch In to Out)	t _{PLH} , t _{PHL}		0	2.0	-	60	75	ns	
			0	4.5	-	12	15	ns	
			0	6.0	-	10	13	ns	
			-4.5	4.5	-	8	10	ns	
Maximum Switch Turn "Off" Delay from S or \bar{E} to Switch Output	t _{PHZ} , t _{PLZ}		0	2.0	-	210	265	ns	
			0	4.5	-	42	53	ns	
			0	6.0	-	36	45	ns	
			-4.5	4.5	-	29	36	ns	
Maximum Switch Turn "On" Delay from S or \bar{E} to Switch Output	t _{PZL} , t _{PZH}		0	2.0	-	220	275	ns	
			0	4.5	-	44	55	ns	
			0	6.0	-	37	47	ns	
			-4.5	4.5	-	31	39	ns	
Input (Control) Capacitance	C _{IN}		-	-	-	10	10	pF	

Analog Channel Specifications: (T_A = +25°C unless otherwise specified)

Parameter	Symbol	Test Conditions			Min	Typ	Max	Unit
			V _{EE}	V _{CC}				
Common Output Capacitance	C _{COM}		-	-	-	8	-	pF
Minimum Switch Frequency Response at -3db	f _{MAX}	Note 5, Note 6	-2.25	-2.25	-	200	-	MHz
			-4.5	4.5	-	200	-	MHz

Note 5. Adjust input voltage to obtain 0dbm at V_{OS} for f_{IN} = 1Mhz.

Note 6. V_{IS} is centered at (V_{CC} - V_{EE})/2.

Analog Channel Specifications (Cont'd): ($T_A = +25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Test Conditions			Min	Typ	Max	Unit
			V_{EE}	V_{CC}				
Crosstalk Between any Two Switches	-	Note 6, Note 7	-2.25	-2.25	-	(TBE)	-	MHz
			-4.5	4.5	-	(TBE)	-	MHz
Sinewave Distortion	-		-2.25	-2.25	-	0.035	-	%
			-4.5	4.5	-	0.018	-	%
\bar{E} or S to Switch Feedthrough Noise	-	Note 6, Note 7	-2.25	-2.25	-	(TBE)	-	mV
			-4.5	4.5	-	(TBE)	-	mV
Switch "OFF" Signal Feedthrough	-	Note 6, Note 7	-2.25	-2.25	-	-64	-	dB
			-4.5	4.5	-	-66	-	dB

Note 5. Adjust input voltage to obtain 0dbm at V_{OS} for $f_{IN} = 1\text{MHz}$.

Note 6. V_{IS} is centered at $(V_{CC} - V_{EE})/2$.

Note 7. Adjust input for 0dbm.

Truth Table:

Input States				"ON" Channels
Enable	S_0	S_1	S_2	
L	L	L	L	C0, B0, A0
L	H	L	L	C0, B0, A1
L	L	H	L	C0, B1, A0
L	H	H	L	C0, B1, A1
L	L	L	H	C1, B0, A0
L	H	L	H	C1, B0, A1
L	L	H	H	C1, B1, A0
L	H	H	H	C1, B1, A1
H	X	X	X	None

H = HIGH Voltage Level

L = LOW Voltage Level

X = Don't Care

Pin Connection Diagram

