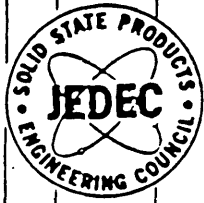


AUGUST 1986



JEDEC STANDARD NO. 7-A

STANDARD FOR DESCRIPTION OF
54/74HCXXXX AND 54/74HCTXXXX
HIGH SPEED CMOS DEVICES

JEDEC
Solid State Products Engineering Council



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HIGH SPEED CMOS DEVICES

(From JEDEC Council Letter Ballot JCB-86-5, formulated
under the cognizance of EIA/JEDEC JC40.2 Committee on CMOS
Logic Devices.)

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54/74HCXXXX STANDARD

1. PURPOSE AND SCOPE

1.1 Purpose:

To develop a standard of "54/74HCXXXX" series specification to provide for uniformity, multiplicity of sources, elimination of confusion, and ease of device specification and design by users.

1.2 Scope:

This Standard covers standard specifications for description of "54/74HCXXXX" Series High-Speed Silicon Gate CMOS devices.

2. DEFINITIONS

2.1 "54/74HCXXXX" series includes buffered devices whose input logic levels are defined herein for V_{IH} and V_{IL} .

2.2 A buffered device has two or more active logic stages between inputs and outputs.

2.3 "54" indicates that the devices are specified over the temperature range -55 to 125°C.

2.4 "74" indicates that the devices are specified over the temperature range -40 to 85°C.

3. STANDARD SPECIFICATIONS

All voltages listed are referenced to ground except where noted.

3.1 ABSOLUTE MAXIMUM RATINGS(NOTE 1):

Supply Voltage	V_{CC}	-0.5 to 7.0	V
DC Input Diode Current	I_{IK}	$V_I < 0$	-20 mA
<u>OR</u>		$V_I > V_{CC}$	20 mA
DC Input Voltage	V_I	-0.5 to $V_{CC} + 0.5$	V
DC Output Diode Current	I_{OK}	$V_O < 0$	-20 mA
<u>OR</u>		$V_O > V_{CC}$	20 mA
DC Output Voltage	V_O	-0.5 to $V_{CC} + 0.5$	V
DC Output Source or	I_O	± 25 (STD)	mA
Sink Current, Per Output Pin		± 35 (Bus Driver)	mA
DC V_{CC} or Ground Current	I_{CC} or I_{GND}	± 50 (STD)	mA
		± 70 (Bus Driver)	mA
Storage Temperature	T_{stg}	-65 to 150	°C

3.2 Recommended Operation Conditions:

Supply Voltage (NOTE 2)	V_{CC}	2.0 to 6.0	V
Input Voltage	V_I	0 to V_{CC}	V
Output Voltage	V_O	0 to V_{CC}	V
Operating Temperature	T_A		
<u>74HC</u>		-40 to 85	°C
<u>54HC</u>		-55 to 125	°C
Input Rise and Fall Time	t_r, t_f	at 2.0V	0 to 1000 ns
(Except for Schmitt Inputs)		at 4.5V	0 to 500 ns
		at 6.0V	0 to 400 ns

NOTE 1: Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

NOTE 2: Unless otherwise specified.

3.3 DC SPECIFICATIONS

(TABLE 1)

54/74HC FAMILY SPECIFICATIONS

SYMB	PARAMETER	V _{CC}	Temperature °C						UNIT	TEST CONDITIONS			
			54HC/74HC		74HC		54HC						
			25		-40 TO 85		-55 TO 125						
		V	MIN	MAX	MIN	MAX	MIN	MAX	T				
V _{IH}	HIGH LEVEL	2.0	1.50		1.50		1.50		V				
	INPUT	4.5	3.15		3.15		3.15		V				
	VOLTAGE	6.0	4.20		4.20		4.20		V				
V _{IL}	LOW LEVEL	2.0		0.30		0.30		0.30	V				
	INPUT	4.5		0.90		0.90		0.90	V				
	VOLTAGE	6.0		1.20		1.20		1.20	V				
V _{OH}	HIGH LEVEL OUTPUT VOLTAGE	2.0	1.90		1.90		1.90		V	NOTE 4 I _O V _I STD BUS UNIT V _{IH} -20.0 -20.0 uA -20.0 -20.0 uA OR -20.0 -20.0 uA - 4.0 - 6.0 mA V _{IL} - 5.2 - 7.8 mA			
		4.5	4.40		4.40		4.40		V				
		6.0	5.90		5.90		5.90		V				
		4.5	3.98		3.84		3.70		V				
		6.0	5.48		5.34		5.20		V				
		V _{OL}	LOW LEVEL OUTPUT VOLTAGE	2.0		0.10		0.10			0.10	V	V _{IH} 20.0 20.0 uA 20.0 20.0 uA OR 20.0 20.0 uA 4.0 6.0 mA V _{IL} 5.2 7.8 mA
				4.5		0.10		0.10			0.10	V	
6.0				0.10		0.10		0.10	V				
4.5				0.26		0.33		0.40	V				
6.0				0.26		0.33		0.40	V				
I _I	INPUT LEAKAGE CURRENT	6.0		±0.1		±1.0		±1.0	uA	V _{CC} OR GND			
		NOTE 2											
I _{OZ}	3-STATE OUTPUT OFF-STATE CURRENT	6.0		±0.5		±5.0		±10.0	uA	V _{IH} OR V _{IL} V _O = V _{CC} OR GND			
		NOTE 3											
I _{CC}	QUIESCENT SUPPLY CURRENT									V _{CC} OR GND I _O = 0			
	SSI CATEGORY	6.0		2.0		20.0		40.0	uA				
	FF CATEGORY	6.0		4.0		40.0		80.0	uA				
	MSI CATEGORY	6.0		8.0		80.0		160.0	uA				
NOTE 4													

- NOTES: (1) NOT APPLICABLE TO OPEN DRAIN OUTPUTS
(2) FOR DIGITAL I/O PINS USE I_{OZ} LIMITS
(3) ALSO APPLICABLE FOR OPEN DRAIN OUTPUTS
(4) SEE APPENDIX B

54/74HCTXXXX STANDARD

1. PURPOSE AND SCOPE

1.1 Purpose:

To develop a standard of "54/74HCTXXX" series specifications to provide for uniformity, multiplicity of sources, elimination of confusion, and ease of device specification and design by users.

1.2 Scope:

This Standard covers standard specifications for description of "54/74HCTXXXX" series High-Speed Silicon Gate CMOS devices which are functionally and parametrically similar to "54/74LSXXX" devices.

2. DEFINITIONS

2.1 "54/74HCTXXXX" series includes devices whose input logic levels are TTL input levels.

2.2 "54" indicates that the devices are specified over the temperature range -55 to 125°C.

2.3 "74" indicates that the devices are specified over the temperature range -40 to 85°C.

3. STANDARD SPECIFICATIONS

All voltages listed are referenced to ground except where noted.

3.1 ABSOLUTE MAXIMUM RATINGS (NOTE 1):

Supply Voltage	V_{CC}	-0.5 to 7.0	V
DC Input Diode Current	I_{IK}	$V_I < 0$	-20 mA
<u>OR</u>		$V_I > V_{CC}$	20 mA
DC Input Voltage	V_I	-0.5 to $V_{CC} + 0.5$	V
DC Output Diode Current	I_{OK}	$V_O < 0$	-20 mA
<u>OR</u>		$V_O > V_{CC}$	20 mA
DC Output Voltage	V_O	-0.5 to $V_{CC} + 0.5$	V
DC Output Source or	I_O	± 25 (STD)	mA
Sink Current, Per Output Pin		± 35 (Bus Driver)	mA
DC V_{CC} or Ground Current	I_{CC} or I_{GND}	± 50 (STD)	mA
		± 70 (Bus Driver)	mA
Storage Temperature	T_{stg}	-65 to 150	°C

3.2 Recommended Operation Conditions:

Supply Voltage (NOTE 2)	V_{CC}	4.5 to 5.5	V
Input Voltage	V_I	0 to V_{CC}	V
Output Voltage	V_O	0 to V_{CC}	V
Operating Temperature	T_A		
<u>74HCT</u>		-40 to 85	°C
<u>54HCT</u>		-55 to 125	°C
Input Rise and Fall Time	t_r, t_f	0 to 500	ns
(Except for Schmitt Inputs)			

NOTE 1: Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

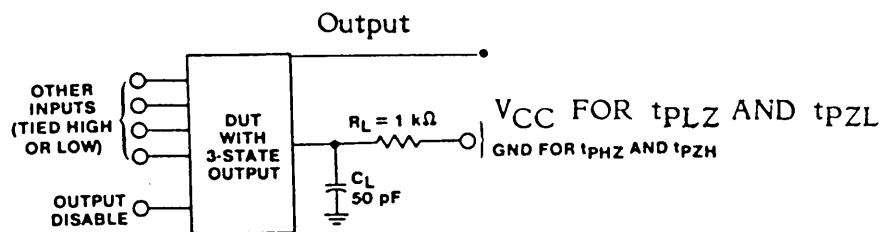
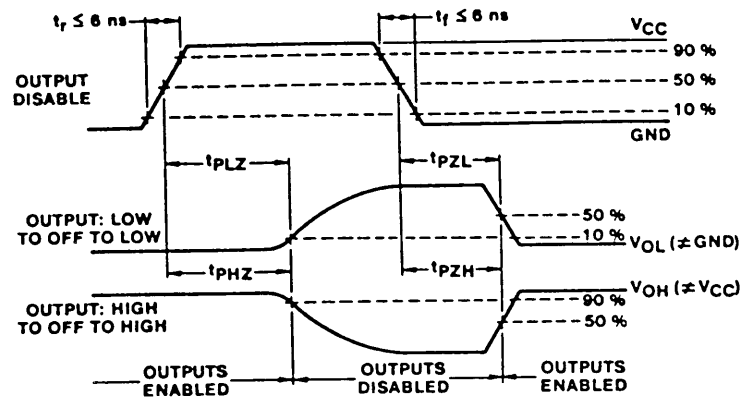
NOTE 2: Unless otherwise specified.

3.3 DC SPECIFICATIONS (TABLE 2)
54/74HCT FAMILY SPECIFICATIONS

SYMB	PARAMETER	V _{CC} V	Temperature °C						U N I T	TEST CONDITIONS			
			54HCT/74HCT		74 HCT		54 HCT						
			25		-40 TO 85		-55 TO 125						
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.					
V _{IH}	HIGH LEVEL INPUT VOLTAGE	4.5 TO 5.5	2.0		2.0		2.0		V				
V _{IL}	LOW LEVEL INPUT VOLTAGE	4.5 TO 5.5		0.8		0.8		0.8	V				
V _{OH} NOTE 1	HIGH LEVEL OUTPUT VOLTAGE									NOTE 4			U
										I _O			N
										V _I	STD	BUS DRV.	I T
		4.5	4.40		4.40		4.40		V	V _{IH} OR V _{IL}	-20.0	-20.0	uA
		4.5	3.98		3.84		3.70		V		- 4.0	- 6.0	mA
V _{OL}	LOW LEVEL OUTPUT VOLTAGE	4.5 4.5		0.10 0.26		0.10 0.33		0.10 0.40	V V	V _{IH} OR V _{IL}	20.0 4.0	20.0 6.0	uA mA
I _I NOTE 2	INPUT LEAKAGE CURRENT	5.5		±0.1		±1.0		±1.0	uA	V _{CC} OR GND			
I _{OZ} NOTE 3	3-STATE OUTPUT OFF-STATE CURRENT	5.5		±0.5		±5.0		±10.0	uA	V _{IH} OR V _{IL}	V _O = V _{CC} OR GND		
I _{CC} NOTE 4	QUIESCENT SUPPLY CURRENT									V _{CC} OR GND	I _O = 0		
	SSI CATEGORY	5.5		2.0		20.0		40.0	uA				
	FF CATEGORY	5.5		4.0		40.0		80.0	uA				
	MSI CATEGORY	5.5		8.0		80.0		160.0	uA				
ΔI _{CC}	ADDITIONAL WORST CASE SUPPLY CURRENT NOTE 5	5.5		2.7		2.9		3.0	mA	PER INPUT-PIN: V _I = 2.4V OTHER INPUTS: AT V _{CC} OR GND I _O = 0			

- NOTES: (1) NOT APPLICABLE TO OPEN DRAIN OUTPUTS
(2) FOR DIGITAL I/O USE I_{OZ}
(3) ALSO APPLICABLE TO OPEN DRAIN OUTPUTS
(4) SEE APPENDIX B
(5) TOTAL SUPPLY CURRENT = I_{CC} + ΣΔI_{CC}

54/74 HCXXXX THREE-STATE WAVEFORMS

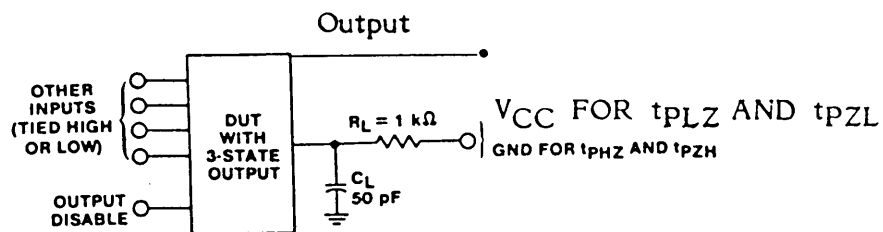
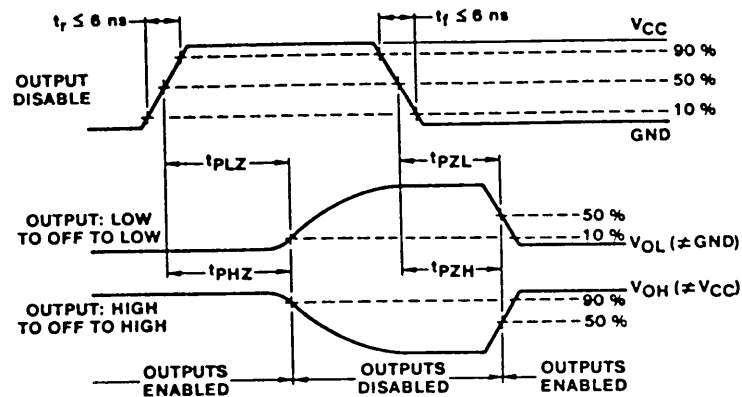


Three-state propagation delay waveforms and test circuit

OPEN DRAIN WAVEFORMS

Output $R_L = \text{k}\Omega$ to V_{CC} , $C_L = 50 \text{ pF}$
 t_{PLZ} ; t_{PZL} waveforms same as three-state

54/74 HCXXXX THREE-STATE WAVEFORMS



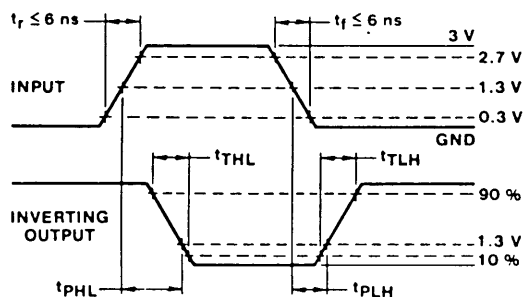
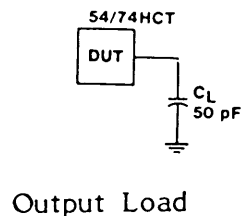
Three-state propagation delay waveforms and test circuit

OPEN DRAIN WAVEFORMS

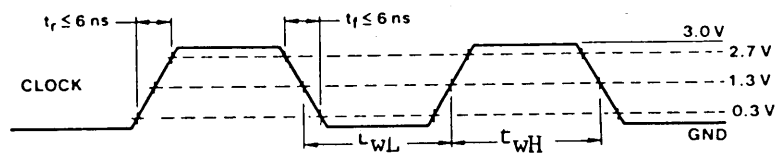
Output $R_L = \text{k}\Omega$ to V_{CC} , $C_L = 50 \text{ pF}$
 t_{PLZ} ; t_{PZL} waveforms same as three-state

APPENDIX A (continued)

2.0 Switching Waveforms for 54/74HCTXXX



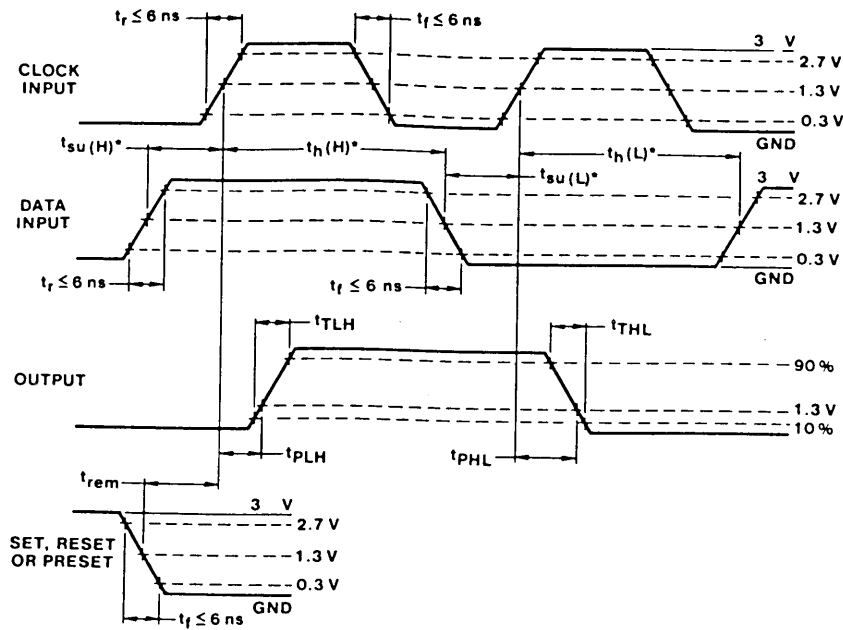
Transition times and propagation delay times, combinational logic.



Outputs should be switching from 10% to 90% in accordance with device truth table. For $f_{\max}$ input duty cycle = 50%.

Clock-pulse rise and fall times and pulse width.

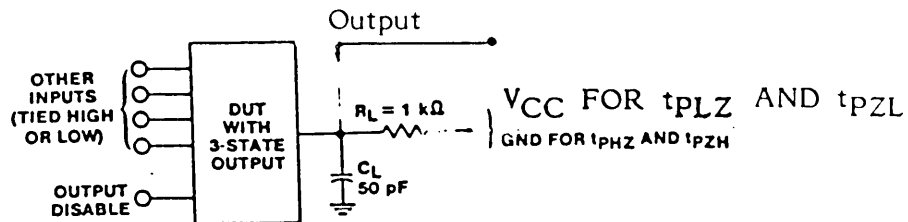
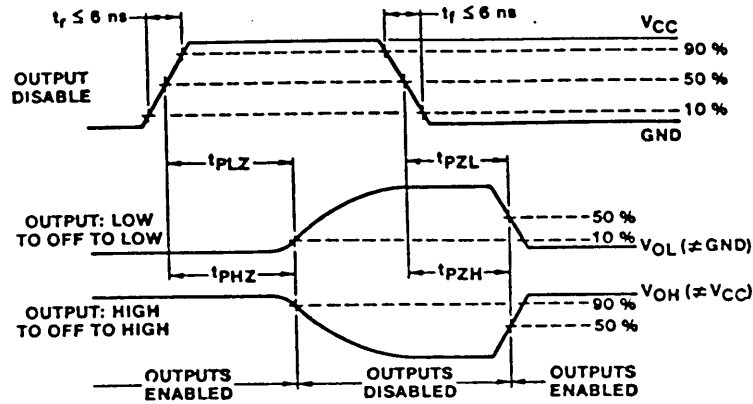
HCTXXX CLOCK, DATA, SET, PRESET, ETC., WAVEFORMS



Setup times, hold times, removal time, and propagation delay times for edge triggered sequential logic circuits.

*Use of (H) or (L) is optional terminology.

54/74 HCTXXX THREE-STATE WAVEFORMS



Three-state propagation delay waveforms and test circuit

OPEN DRAIN WAVEFORMS

Output $R_L = \text{k}\Omega$ to V_{CC} , $C_L = 50 \text{ pF}$
 t_{PLZ} ; t_{PZL} waveforms same as three-state

APPENDIX BI_{CC} and output drive categories for HCXXX and HCTXXX devices

I _{CC} Limits		FF		MSI		SPECIAL	
SSI						I _{CC} @	
2.0 μ A		4.0 μ A		8.0 μ A			
00	9014@	73	42	192	381	658*	4060@
01	9015@	74	83	193	382	659*	4061@
02	9034	75	85	194	390	664*	4067
03	9035	76	91	195	393	665*	4094
04	9114@	77	93	219*	423	668*	40102
U04@	9115@	78	95	221	423A	669*	40103
05	9134	107	123	221A	442*	670	40104*
07	9135	108	123A	237	443*	670B*	40105
08		109	125*	238	444*	671*#	4316@
09		112	126*	239	490	672*#	4351
10		113	131	240*	521	673*#	4352
11		114	137	241*	533*	674*	4353
14@		279	138	242*	534*	677	4510
20		375	139	243*	540*	678	4511@
21		7074	147	244*	541*	679	4514
27		7075	148	245*	543*	680	4515
30		7076	149	251	544*	684	4516
32			151	251B*	550*	686	4518
34			151B*	253	551*	688	4520
36			152	253B*	563*	690*#	4543@
51			152B*	257*	564*	691*#	4560
58			153	258*	573*	692*#	4724
86			154	259	574*	693*#	7022
132@			155	273	583*	696*#	7030
133			157	280	589*	697*#	7181
266			157B*	283	590*#	698*#	7292
386			158	292	592	699*#	7294
4002			158B*	294	592B*	793*	7340*
4016@			160	297	593*#	804*	7344*
4049@			161	298	594*#	805*	7373*
4049B*@			162	299*#	595*#	808*	7533*
4050@			163	322*#	597	832*	7563*
4050B*@			164	323*#	597B*	873*	7573*
4066@			165	352*	598*#	881	7597*
4072			166	353*	604*	882	7793*
4075			168	354*	620*	4015	7873*
4078			169	356*	623*	4017	7881
7001@			173*	365*	630*#	4020	9000@
7002@			174	366*	632*#	4022	9373*
7003@			175	367*	640*	4024	9533*
7006			180	368*	643*	4028	9563*
7007			181	373*	645*	4040	9573*
7008			182	374*	646*	4051@	9616*#
7032@			189*	377	648*	4052@	
7078			190	378	651*	4053@	
7266			191	379	652*	4059	

FOOTNOTE REFERENCE

- @ = Non-standard characteristics apply - Refer to Appendix C
 * = Bus driver outputs I_{OL}/I_{OH} = ± 6 mA (For standard outputs I_{OL}/I_{OH} = ± 4 mA)
 # = Outputs other than three-state bus drivers may have the standard V_{OL}/V_{OH} outputs specifications

APPENDIX C

NON-STANDARD DEVICE SPECIFICATIONS

This appendix describes individual device specifications that are either not covered by the main standard or are special exceptions to this standard due to device functional, design, or application considerations.

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Paragraph	Device Description
1.0	HC/HCT4543 Output Drive and Transition Time Specifications
2.0	HC/HCT4511 Output Drive Specifications
3.0	HC4049/50 Input and I_{CC} Specifications
4.0	Parts with On-Chip Oscillators
5.0	Schmitt-trigger Input Specifications
6.0	Monostable Multivibrator I_{CC} and Pulse Width Specifications.
7.0	Quad Analog Switch Specifications
8.0	Specifications for Analog Multiplexers, and Switches with Level Translators
9.0	Phase Lock Loop Specifications
10.0	HCU04 DC Specification
11.0	Definition of -1, -2 Part Number Suffixes
12.0	HC682 Input Leakage and I_{CC} Specifications

1.0 HC/HCT4543 BCD to Seven-Segment Latch/Decoder/Driver for LCD's

1.1 Special V_{OL} and V_{OH} DC Electrical Characteristics

SYMB	PARAMETER	V _{CC} V	Temperature °C						UNIT	TEST CONDITIONS
			54/74HC/T		74HC/T		54HC/T			
			25		-40 to 85		-55 to 125			
			MIN	MAX	MIN	MAX	MIN	MAX		
V _{OH}	High Level Output Voltage	4.5	3.98		3.84		3.70		V	I _O =-0.40 mA I _O =-0.52 mA V _I =V _{IH} or V _{IL}
		6.0	5.48		5.34		5.20		V	
V _{OL}	Low Level Output Voltage	4.5		0.26		0.33		0.40	V	I _O =0.40 mA I _O =0.52 mA V _I =V _{IH} or V _{IL}
		6.0		0.26		0.33		0.40	V	

Note: For HCT, only the 4.5 V values apply.

1.2 Special t_{THL} and t_{TLH} Characteristics

Transition time limits are 10X the standard values quoted in Appendix D.

2.0 HC/HCT4511 BCD to Seven-Segment Latch/Decoder/Driver for LED's

2.1 Special DC Electrical Characteristics

SYMB	PARAMETER	V _{CC} V	Temperature °C						U N I T	TEST CONDITIONS
			54/74HC/T		74HC/T		54HC/T			
			25		-40 to 85		-55 to 125			
			MIN	MAX	MIN	MAX	MIN	MAX		
V _{OH}	High Level Output Voltage	4.5	3.98		3.84		3.70		V	I _O = -6.0 mA I _O = -7.8 mA V _I =V _{IH} or V _{IL}
		6.0	5.48		5.34		5.20		V	
V _{OL}	Low Level Output Voltage	4.5		0.26		0.33		0.40	V	I _O =4.0 mA I _O =5.2 mA V _I =V _{IH} or V _{IL}
		6.0		0.26		0.33		0.40	V	

Note: For HCT, only the 4.5 V values apply.

5.0 Schmitt-trigger Input Specifications

HC/HCT14	Hex Schmitt-trigger
HC/HCT132	Quad NAND Schmitt-trigger
HC7001	Quad AND Schmitt-trigger
HC7002	Quad NOR Schmitt-trigger
HC7003	Quad NAND Schmitt-trigger with open-drain outputs
HC7032	Quad OR Schmitt-trigger
HC9014	Nine wide inverting Schmitt-trigger
HC9015	Nine wide non-inverting Schmitt-trigger
HC9114	Nine wide inverting Schmitt-trigger with open-drain outputs
HC9115	Nine wide non-inverting Schmitt-trigger with open-drain outputs

5.1 Additional DC Characteristics HC Series Devices

SYMB	PARAMETER	V _{CC} V	Temperature °C						U N I T
			54HC/74HC		74HC		54HC		
			25		-40 to 85		-55 to 125		
			MIN	MAX	MIN	MAX	MIN	MAX	
V _{T+}	Positive Going Threshold Voltage	2.0	0.70	1.50	0.70	1.50	0.70	1.50	V
		4.5	1.55	3.15	1.55	3.15	1.55	3.15	V
		6.0	2.10	4.20	2.10	4.20	2.10	4.20	V
V _{T-}	Negative Going Threshold Voltage	2.0	0.30	1.00	0.30	1.00	0.30	1.00	V
		4.5	0.90	2.45	0.90	2.45	0.90	2.45	V
		6.0	1.20	3.20	1.20	3.20	1.20	3.20	V
V _H	Hysteresis Voltage	2.0	0.20	1.20	0.20	1.20	0.20	1.20	V
		4.5	0.40	2.10	0.40	2.10	0.40	2.10	V
		6.0	0.50	2.50	0.50	2.50	0.50	2.50	V

For HC Devices V_{T+} max is same as V_{IH} min
and V_{T-} min is same as V_{IL} max

5.0 Schmitt-trigger Input Specifications

HC/HCT14	Hex Schmitt-trigger
HC/HCT132	Quad NAND Schmitt-trigger
HC7001	Quad AND Schmitt-trigger
HC7002	Quad NOR Schmitt-trigger
HC7003	Quad NAND Schmitt-trigger with open-drain outputs
HC7032	Quad OR Schmitt-trigger
HC9014	Nine wide inverting Schmitt-trigger
HC9015	Nine wide non-inverting Schmitt-trigger
HC9114	Nine wide inverting Schmitt-trigger with open-drain outputs
HC9115	Nine wide non-inverting Schmitt-trigger with open-drain outputs

5.1 Additional DC Characteristics HC Series Devices

SYMB	PARAMETER	V _{CC} V	Temperature °C						U N I T
			54HC/74HC		74HC		54HC		
			25		-40 to 85		-55 to 125		
			MIN	MAX	MIN	MAX	MIN	MAX	
V _{T+}	Positive Going Threshold Voltage	2.0	0.70	1.50	0.70	1.50	0.70	1.50	V
		4.5	1.55	3.15	1.55	3.15	1.55	3.15	V
		6.0	2.10	4.20	2.10	4.20	2.10	4.20	V
V _{T-}	Negative Going Threshold Voltage	2.0	0.30	1.00	0.30	1.00	0.30	1.00	V
		4.5	0.90	2.45	0.90	2.45	0.90	2.45	V
		6.0	1.20	3.20	1.20	3.20	1.20	3.20	V
V _H	Hysteresis Voltage	2.0	0.20	1.20	0.20	1.20	0.20	1.20	V
		4.5	0.40	2.10	0.40	2.10	0.40	2.10	V
		6.0	0.50	2.50	0.50	2.50	0.50	2.50	V

For HC Devices V_{T+} max is same as V_{IH} min
and V_{T-} min is same as V_{IL} max

5.2 Additional DC Characteristics HCT Series Devices

SYMB	PARAMETER	V _{CC} V	Temperature °C						U N I T
			54/74HCT		74HCT		54HCT		
			25		-40 to 85		-55 to 125		
			MIN	MAX	MIN	MAX	MIN	MAX	
V _{T+}	Positive Going Threshold Voltage	4.5	1.20	1.90	1.20	1.90	1.20	1.90	V
		5.5	1.40	2.10	1.40	2.10	1.40	2.10	V
V _{T-}	Negative Going Threshold Voltage	4.5	0.50	1.20	0.50	1.20	0.50	1.20	V
		5.5	0.60	1.40	0.60	1.40	0.60	1.40	V
V _H	Hysteresis Voltage	4.5	0.40	1.40	0.40	1.40	0.40	1.40	V
		5.5	0.40	1.50	0.40	1.50	0.40	1.50	V

For HCT devices, V_{IH} and V_{IL} parameters of Table 2 (p. 6) do not apply.

6.0 Monostable Multivibrator I_{CC} and Pulse Width Specifications

HC/HCT123	Retriggerable Monostable Multivibrator
HC123A	Retriggerable Monostable Multivibrator
HC/HCT423	Retriggerable Monostable Multivibrator
HC423A	Retriggerable Monostable Multivibrator
HC/HCT4538	Retriggerable Monostable Multivibrator
HC/HCT221	Monostable Multivibrator
HC221A	Monostable Multivibrator

6.1 Additional DC Electrical Characteristics

HC123A, HC221A, HC423A

SYMB	PARAMETER	V _{CC} V	Temperature °C						UNIT	TEST CONDITIONS
			54HC/74HC		74HC		54HC			
			25		-40 to 85		-55 to 125			
			MIN	MAX	MIN	MAX	MIN	MAX		
I _{CC}	Active Supply Current	6.0		2.0		2.6		3.2	mA	V _I =V _{CC} or GND Pins 7 & 15 e V _I =0.5V _{CC} Q1=Q2=HIGH

Note: For Quiescent I_{CC} , standard limits apply (ref: Appendix B)

HC/HCT4538

SYMB	PARAMETER	V _{CC} V	Temperature °C						U N I T	TEST CONDITIONS.
			54/74HC/T		74HC/T		54HC/T			
			25		-40 to 85		-55 to 125			
			MIN	MAX	MIN	MAX	MIN	MAX		
I _{CC}	Quiescent Supply Current	V _{CC} max		150		250		400	µA	V _I =V _{CC} or GND I _O =0 µA
I _{CC}	Active Supply Current (See Note 1)	V _{CC}		0.60		0.80		1.00	mA	V _I =V _{CC} or GND Q1=Q2=HIGH I _O =0 µA RC common pins at V _I =0.25V _{CC} , or V _I =0.5V _{CC}

Note 1: V_I of RC common pins is equal to either $0.25V_{CC}$ or $0.5V_{CC}$ per individual manufacturer's specifications.

7.0 HC/HCT4016, HC/HCT4066 Quad Analog Switches.

These parts have the following extended specifications. Standard V_{OH} and V_{OL} specifications under loaded conditions may not apply.

7.1 Extended Absolute Maximum Ratings

Supply Voltage (V_{CC}) HC -0.5 V to 11.0 V
HCT -0.5 V to 7.0 V

7.2 Extended Recommended Operating Conditions

Supply Voltage (V_{CC}) HC 2.0 V to 10.0 V
HCT 4.5 V to 5.5 V

DC Input Voltage 0 V to V_{CC}
(Control or Switch)

Control Input Rise and Fall Time 0 to 250 ns at $V_{CC}=10$ V

Refer to individual manufacturer's data sheets for limitations on DC voltage drop across each switch and current through the switch.

7.3 Additional DC Electrical Characteristics

SYMB	PARAMETER		V _{CC} V	Temperature °C						U N I T	TEST CONDITIONS
				54/74HC/T		74HC/T		54HC/T			
				25		-40 to 85		-55 to 125			
				MIN	MAX	MIN	MAX	MIN	MAX		
V _{IH}	High Level Input Voltage		9.0	6.30		6.30		6.30		V	
V _{IL}	Low Level Input Voltage		9.0		1.80		1.80		1.80	V	
R _{ON}	ON Resistance (4016)		4.5 9.0		180 135		225 170		270 205	Ω Ω	V _{IS} =GND or V _{CC} I _S ≤2.0 mA, V _I =V _{IH}
R _{ON}	Peak ON Resistance (4016)		4.5 9.0		320 170		400 215		480 255	Ω Ω	V _{IS} =GND to V _{CC} I _S ≤2.0 mA, V _I =V _{IH}
R _{ON}	ON Resistance (4066)		4.5 9.0		85 63		106 78		130 95	Ω Ω	V _{IS} =GND or V _{CC} I _S ≤2.0 mA, V _I =V _{IH}
R _{ON}	Peak ON Resistance (4066)		4.5 9.0		170 85		215 106		255 130	Ω Ω	V _{IS} =GND to V _{CC} I _S ≤2.0 mA, V _I =V _{IH}
I _{CC}	Quiescent Supply Current	HCT	5.5		2.0		20		40	μA	V _I =GND or V _{CC}
		HC	6.0		2.0		20		40	μA	
		HC	10.0		16.0		160		320	μA	
I _{IZ}	Switch ON/OFF Leakage	HCT	5.5		±0.1		±5.0		±10	μA	V _{IS} =GND or V _{CC} V _{OS} =V _{CC} or GND V _I =V _{IL} or V _{IH}
		HC	6.0		±0.1		±5.0		±10	μA	
		HC	10.0		±0.1		±5.0		±10	μA	

Note: 9 V and 10 V Ratings apply to HC types only.

7.0 HC/HCT4016, HC/HCT4066 Quad Analog Switches.

These parts have the following extended specifications. Standard V_{OH} and V_{OL} specifications under loaded conditions may not apply.

7.1 Extended Absolute Maximum Ratings

Supply Voltage (V_{CC}) HC -0.5 V to 11.0 V
HCT -0.5 V to 7.0 V

7.2 Extended Recommended Operating Conditions

Supply Voltage (V_{CC}) HC 2.0 V to 10.0 V
HCT 4.5 V to 5.5 V

DC Input Voltage 0 V to V_{CC}
(Control or Switch)

Control Input Rise and Fall Time 0 to 250 ns at $V_{CC}=10$ V

Refer to individual manufacturer's data sheets for limitations on DC voltage drop across each switch and current through the switch.

7.3 Additional DC Electrical Characteristics

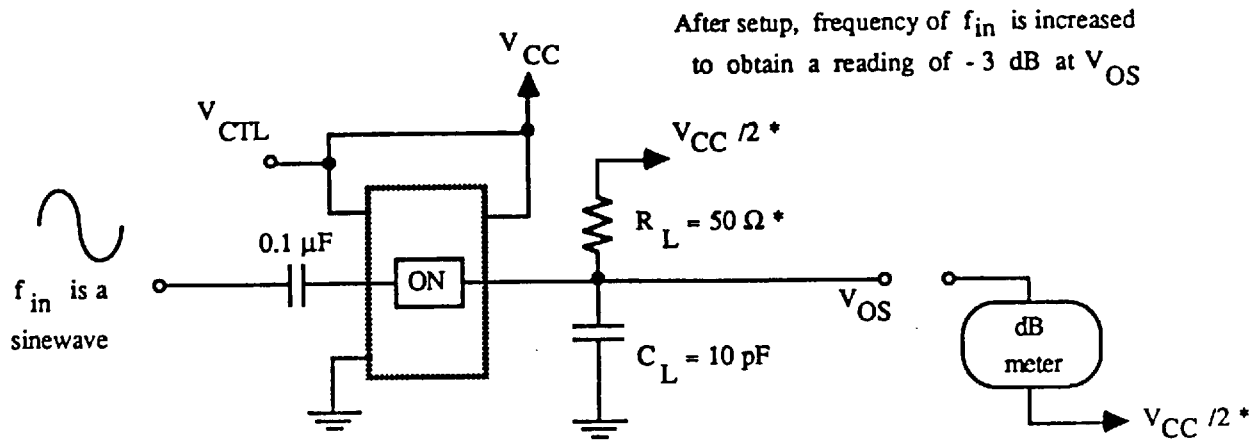
SYMB	PARAMETER		V _{CC} V	Temperature °C						U N I T	TEST CONDITIONS
				54/74HC/T		74HC/T		54HC/T			
				25		-40 to 85		-55 to 125			
				MIN	MAX	MIN	MAX	MIN	MAX		
V _{IH}	High Level Input Voltage		9.0	6.30		6.30		6.30		V	
V _{IL}	Low Level Input Voltage		9.0		1.80		1.80		1.80	V	
R _{ON}	ON Resistance (4016)		4.5 9.0		180 135		225 170		270 205	Ω Ω	V _{IS} =GND or V _{CC} I _S ≤2.0 mA, V _I =V _{IH}
R _{ON}	Peak ON Resistance (4016)		4.5 9.0		320 170		400 215		480 255	Ω Ω	V _{IS} =GND to V _{CC} I _S ≤2.0 mA, V _I =V _{IH}
R _{ON}	ON Resistance (4066)		4.5 9.0		85 63		106 78		130 95	Ω Ω	V _{IS} =GND or V _{CC} I _S ≤2.0 mA, V _I =V _{IH}
R _{ON}	Peak ON Resistance (4066)		4.5 9.0		170 85		215 106		255 130	Ω Ω	V _{IS} =GND to V _{CC} I _S ≤2.0 mA, V _I =V _{IH}
I _{CC}	Quiescent Supply Current	HCT	5.5		2.0		20		40	μA	V _I =GND or V _{CC}
		HC	6.0		2.0		20		40	μA	
		HC	10.0		16.0		160		320	μA	
I _{IZ}	Switch ON/OFF Leakage	HCT	5.5		±0.1		±5.0		±10	μA	V _{IS} =GND or V _{CC} V _{OS} =V _{CC} or GND V _I =V _{IL} or V _{IH}
		HC	6.0		±0.1		±5.0		±10	μA	
		HC	10.0		±0.1		±5.0		±10	μA	

Note: 9 V and 10 V Ratings apply to HC types only.

7.4 Recommended Conditions for Additional Characterization Parameters

PARAMETER	V _{CC} V	U N I T	TEST CONDITIONS
Minimum Frequency Response(-3dB)	4.5 9.0	MHz MHz	Figure 7.4.1
Crosstalk Between Any Two Switches	4.5 9.0	dB dB	Figure 7.4.2
Control to Switch Feedthrough Noise (Peak to Peak)	4.5 9.0	mV mV	Figure 7.4.3
Switch OFF Signal Feedthrough Isolation	4.5 9.0	dB dB	Figure 7.4.4
Total Harmonic Distortion	4.5 9.0	% %	Figure 7.4.5

Appendix C



Adjust input voltage to obtain 0 dBm at V_{OS} when $f_{in} = 1$ MHz

* **Note 1** : To eliminate separate $V_{CC}/2$ power supply, an equivalent load with two 100 Ω resistors tied one each to V_{CC} and GND can be used.

Figure 7.4.1 Characterization Circuit for Minimum Frequency Response

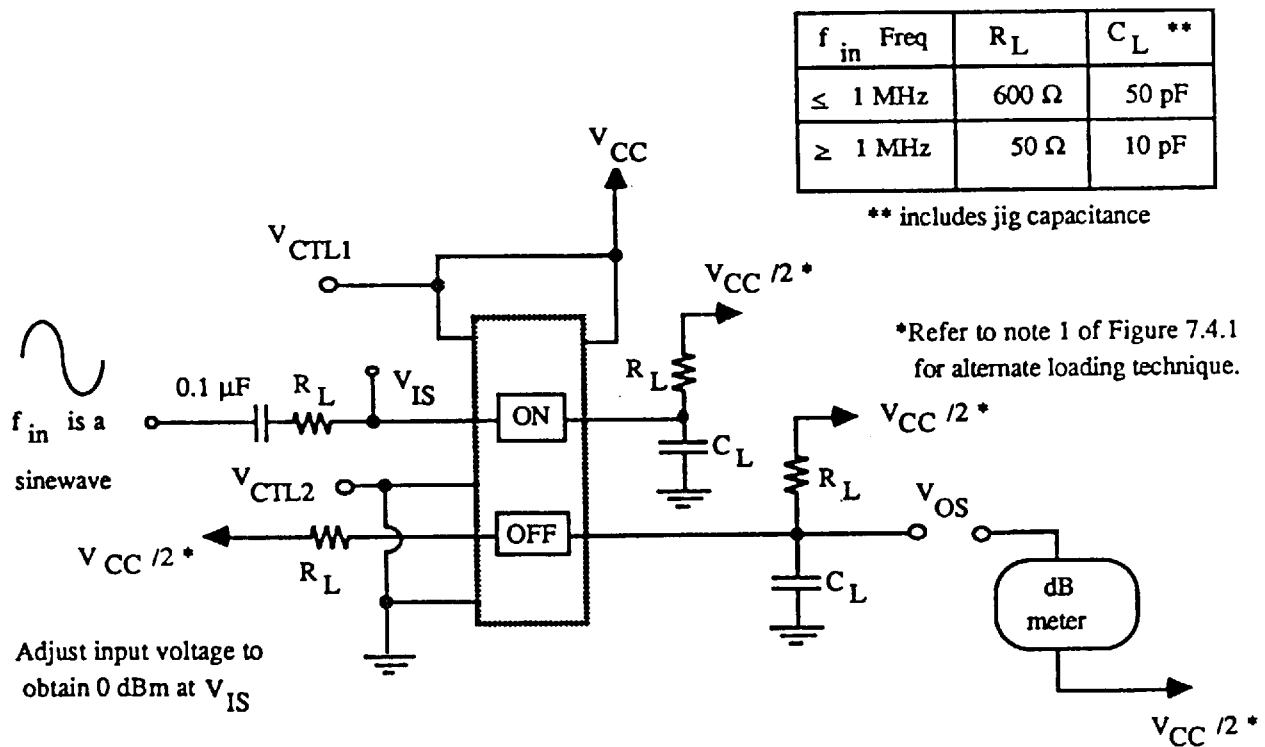
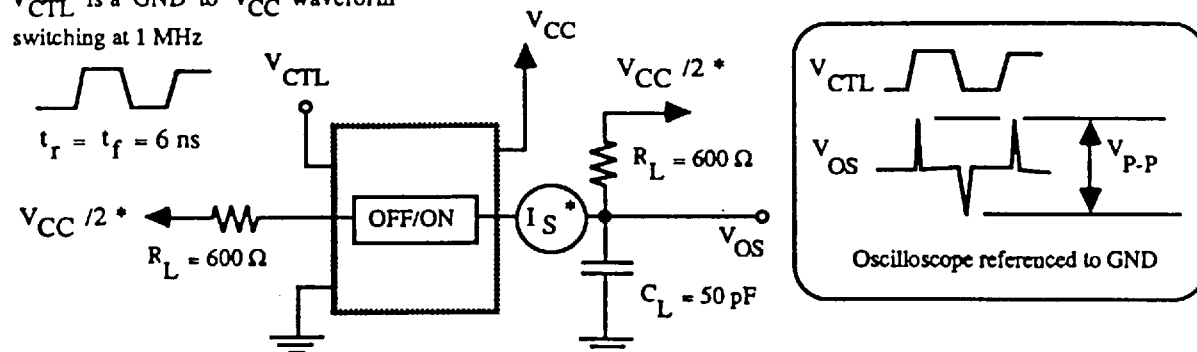


Figure 7.4.2 Characterization Circuit for Crosstalk Between Any Two Switches

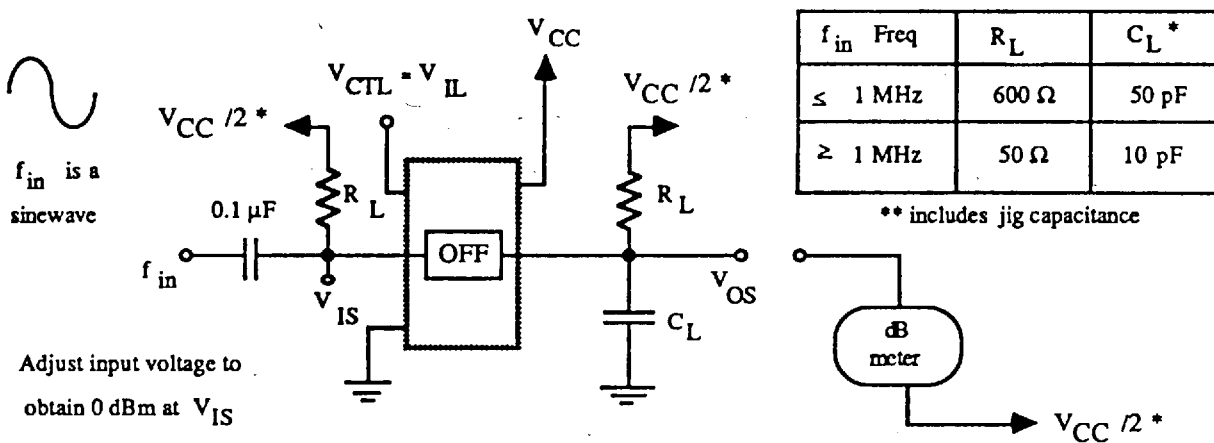
Appendix C

V_{CTL} is a GND to V_{CC} waveform switching at 1 MHz



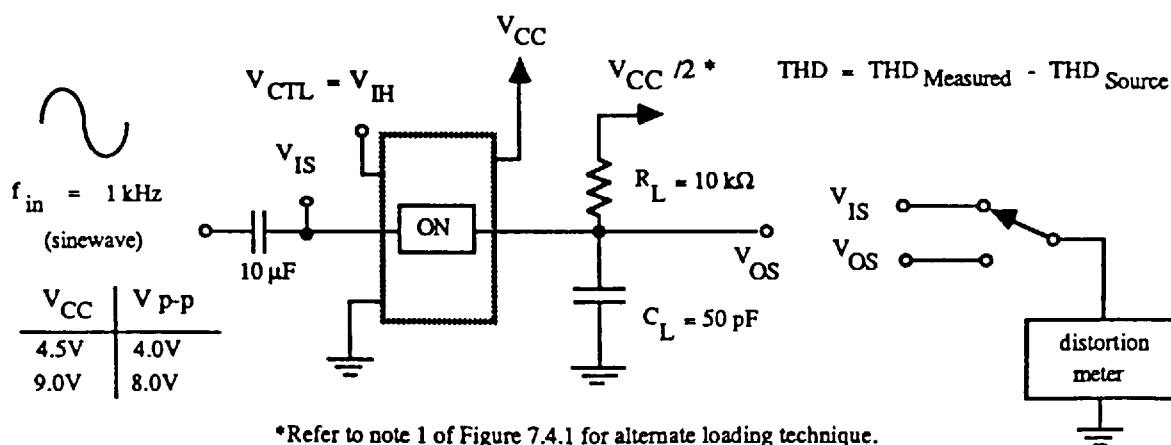
* Adjust load at setup such that switch current is zero. Use same supply for $V_{CC}/2$
Refer to note 1 of Figure 7.4.1 for alternate loading technique.

Figure 7.4.3 Characterization Circuit for Control to Switch Feedthrough Noise



*Refer to note 1 of Figure 7.4.1 for alternate loading technique.

Figure 7.4.4 Characterization Circuit for Switch OFF Feedthrough Isolation



*Refer to note 1 of Figure 7.4.1 for alternate loading technique.

Figure 7.4.5 Characterization Circuit for Total Harmonic Distortion

8.0 Specifications for Analog Multiplexers, and Switches with Level Translators

HC/HCT4051, HC/HCT4052, HC/HCT4053: Analog Multiplexers
 HC/HCT4351, HC/HCT4352, HC/HCT4353: Latched Analog Multiplexers
 HC/HCT4316: Quad Analog Switch with Level Translation

These analog switches/multiplexers have the following extended specifications. Standard V_{OH} and V_{OL} specifications under loaded conditions may not be applicable to these devices.

8.1 Extended Absolute Maximum Ratings

Supply Voltage (V_{CC})	-0.5 V to +7.0 V
Supply Voltage ($V_{CC}-V_{EE}$)	-0.5 V to +11.0 V
Supply Voltage (V_{EE})	+0.5 V to -7.0 V

8.2 Extended Recommended Operating Conditions

Supply Voltage (V_{CC})	HC	2.0 V to 6.0 V
	HCT	4.5 V to 5.5 V
Supply Voltage (V_{EE})		0.0 V to -6.0 V
Supply Voltage ($V_{CC}-V_{EE}$)		2.0 V to 10.0 V
(see Figure 8.2.1)		
DC Input Voltage (V_I)		0.0 V to V_{CC}
(digital inputs)		
DC Input Voltage (V_{IS})		V_{EE} to V_{CC}
(analog inputs)		

Refer to individual manufacturer's data sheets for limitations on DC voltage drop across each switch and current through the switch.

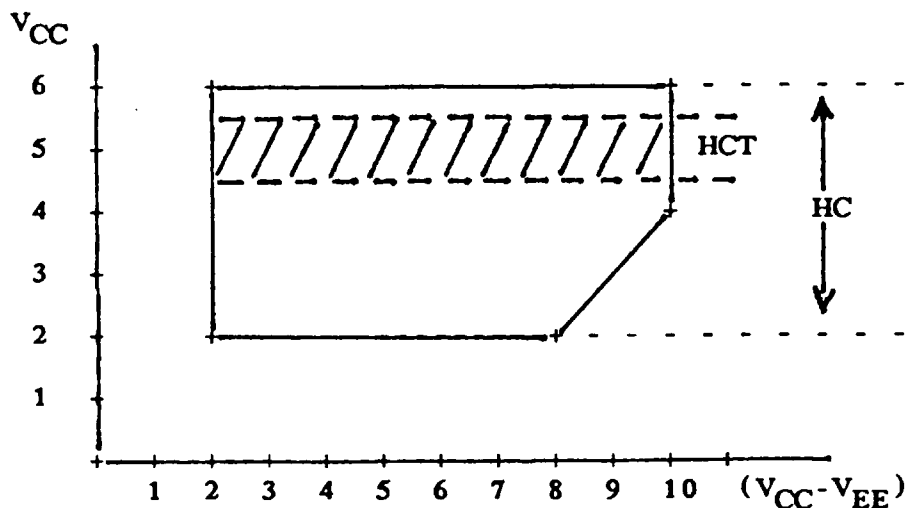


Figure 8.2.1 Recommended Power Supply Range

8.3 Additional DC Electrical Characteristics

8.3.1 On-Resistance Characteristics

$$V_{CC} = 4.5 \text{ V}$$

SYM	PARAMETER	V_{EE} V	Temperature °C						U N I T	TEST CONDITIONS
			54/74HC/T		74HC/T		54HC/T			
			25		-40 to 85		-55 to 125			
			MIN	MAX	MIN	MAX	MIN	MAX		
R_{ON}	ON Resistance ('51,52,53)	0.0 -4.5		160 120		200 150		240 180	Ω Ω	$V_{IS}=V_{EE}$ or V_{CC} $I_S \leq 2.0 \text{ mA}$ $V_I=V_{IH}$ or V_{IL}
R_{ON}	Peak ON Resis- tance ('51,52,53)	0.0 -4.5		200 130		250 165		300 195	Ω Ω	$V_{IS}=V_{EE}$ to V_{CC} $I_S \leq 2.0 \text{ mA}$ $V_I=V_{IH}$ or V_{IL}
R_{ON}	ON Resistance ('4316)	0.0 -4.5		180 135		225 170		270 205	Ω Ω	$V_{IS}=V_{EE}$ or V_{CC} $I_S \leq 2.0 \text{ mA}$ $V_I=V_{IH}$ or V_{IL}
R_{ON}	Peak ON Resis- tance ('4316)	0.0 -4.5		320 170		400 215		480 255	Ω Ω	$V_{IS}=V_{EE}$ to V_{CC} $I_S \leq 2.0 \text{ mA}$ $V_I=V_{IH}$ or V_{IL}

8.3.2 Leakage Characteristics

SYM	PARAMETER	V _{CC} V	Temperature °C						U N I T	No. of Chnls	TEST CONDITIONS
			54/74HC/T		74HC/T		54HC/T				
			25		-40 to 85		-55 to 125				
			MIN	MAX	MIN	MAX	MIN	MAX			
I _{IZ}	Switch ON/OFF Leakage Current (HC Series) V _{EE} = 0.0 V	6.0		±0.1		±1.0		± 2.0	µA	1&2	V _I =V _{IH} or V _{IL} V _{IS} =GND or V _{CC} V _{OS} =V _{CC} or V _{EE}
		6.0		±0.1		±2.5		± 5.0	µA	4	
		6.0		±0.2		±5.0		±10.0	µA	8	
I _{IZ}	Switch ON/OFF Leakage Current (HCT Series) V _{EE} = 0.0 V	5.5		±0.1		±1.0		± 2.0	µA	1&2	V _I =V _{IH} or V _{IL} V _{IS} =GND or V _{CC} V _{OS} =V _{CC} or V _{EE}
		5.5		±0.1		±2.5		± 5.0	µA	4	
		5.5		±0.2		±5.0		±10.0	µA	8	
I _{IZ}	Switch ON/OFF Leakage Current HC/HCT Series V _{EE} = -5.0 V	5.0		±0.1		±1.0		± 1.0	µA	1&2	V _I =V _{IH} or V _{IL}
		5.0		±0.2		±2.5		± 5.0	µA	4	
		5.0		±0.4		±5.0		±10.0	µA	8	

8.3.3 Supply Current Characteristics

SYM	PARAMETER		V _{EE} V	V _{CC} V	Temperature °C						UNIT	TEST CONDITIONS
					54/74HC/T		74HC/T		54HC/T			
					25		-40 to 85		-55 to 125			
					MIN	MAX	MIN	MAX	MIN	MAX		
I _{CC}	Quiescent	HCT	0.0	5.5		8.0		80		160	μA	V _I =GND or V _{CC}
	Supply	HC	0.0	6.0		8.0		80		160	μA	
	Current	HC/T	-5.0	5.0		16.0		160		320	μA	

8.4 Recommended Conditions for Additional Characterization Parameters

PARAMETER	V _{CC}	V _{EE}	U N I T	TEST CONDITIONS
Minimum Frequency Response (-3dB)	2.25 4.50	-2.25 -4.50	MHz MHz	Figure 8.4.1
Crosstalk Between any Two Switches	2.25 4.50	-2.25 -4.50	dB dB	Figure 8.4.2
Control to Switch Feedthrough Noise (Peak to Peak)	2.25 4.50	-2.25 -4.50	mV mV	Figure 8.4.3
Switch OFF Signal Feedthrough Isolation	2.25 4.50	-2.25 -4.50	dB dB	Figure 8.4.4
Total Harmonic Distortion	2.25 4.50	-2.25 -4.50	% %	Figure 8.4.5