



Data sheet acquired from Harris Semiconductor
SCHS213C

September 1998 - Revised July 2003

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

High-Speed CMOS Logic Analog Multiplexers/Demultiplexers with Latch

Features

- Wide Analog Input Voltage Range $\pm 5V$ (Max)
- Low "On" Resistance
 - $V_{CC} - V_{EE} = 4.5V$ 70Ω (Typ)
 - $V_{CC} - V_{EE} = 9V$ 40Ω (Typ)
- Low Crosstalk Between Switches
- Fast Switching and Propagation Speeds
- "Break-Before-Make" Switching
- Wide Operating Temperature Range . . . $-55^{\circ}C$ to $125^{\circ}C$
- HC Types
 - 2V to 6V Operation, Control; 0V to 10V Switch
 - High Noise Immunity: $N_{IL} = 30\%$, $N_{IH} = 30\%$ of V_{CC} at $V_{CC} = 5V$
- HCT Types
 - 4.5V to 5.5V Operation, Control; 0V to 10V Switch
 - Direct LSTTL Input Logic Compatibility, $V_{IL} = 0.8V$ (Max), $V_{IH} = 2V$ (Min)
 - CMOS Input Compatibility, $I_I \leq 1\mu A$ at V_{OL} , V_{OH}

CMOS technology to achieve operating speeds similar to LSTTL with the low power consumption of standard CMOS integrated circuits.

These analog multiplexers/demultiplexers are, in essence, the HC/HCT4015 and HC4052 preceded by address latches that are controlled by an active low Latch Enable input (LE). Two Enable inputs, one active low ($\bar{E}1$), and the other active high (E2) are provided allowing enabling with either input voltage level.

Ordering Information

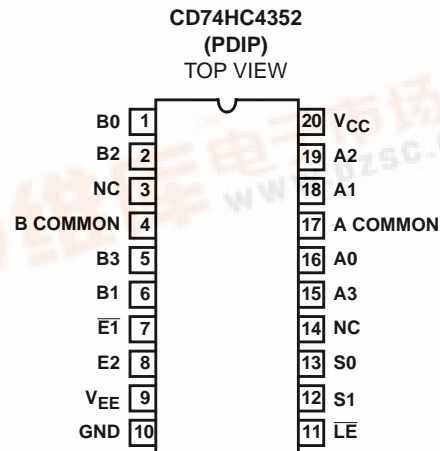
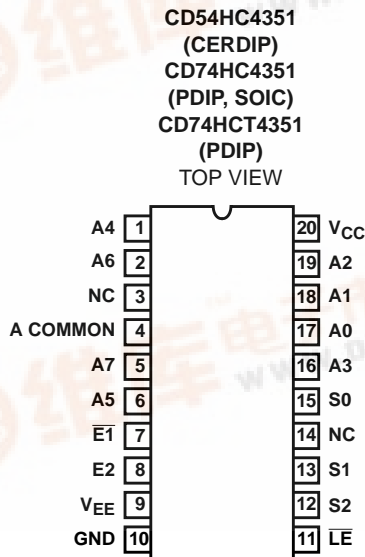
PART NUMBER	TEMP. RANGE (°C)	PACKAGE
CD54HC4351F3A	-55 to 125	20 Ld CERDIP
CD74HC4351E	-55 to 125	20 Ld PDIP
CD74HC4351M	-55 to 125	20 Ld SOIC
CD74HC4351M96	-55 to 125	20 Ld SOIC
CD74HCT4351E	-55 to 125	20 Ld PDIP
CD74HC4352E	-55 to 125	20 Ld PDIP

NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel.

Description

The 'HC4351, CD74HCT4351, and CD74HC4352 are digitally controlled analog switches which utilize silicon-gate

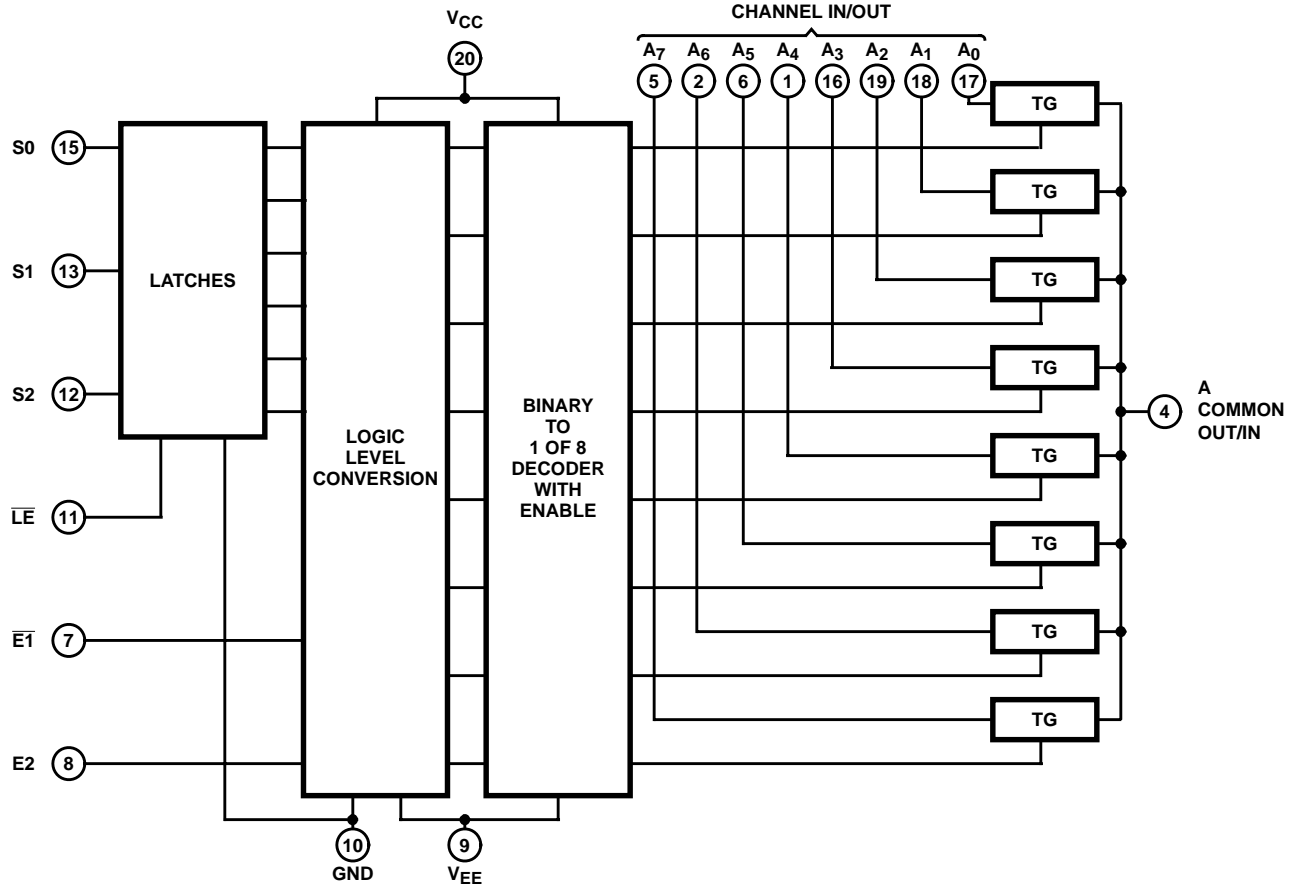
Pinouts



CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Functional Diagram

'HC4351, CD74HCT4351



TRUTH TABLE
'HC4351, CD74HCT4351

INPUT STATES					(NOTE 1) "ON" SWITCHES LE = H
$\overline{E1}$	E2	S2	S1	S0	
L	H	L	L	L	A ₀
L	H	L	L	H	A ₁
L	H	L	H	L	A ₂
L	H	L	H	H	A ₃
L	H	H	L	L	A ₄
L	H	H	L	H	A ₅
L	H	H	H	L	A ₆
L	H	H	H	H	A ₇
H	L	X	X	X	None

H = High Voltage Level, L = Low Voltage Level, X = Don't Care

NOTE:

1. When \overline{LE} is low S0-S2 data are latched and switches cannot change state.

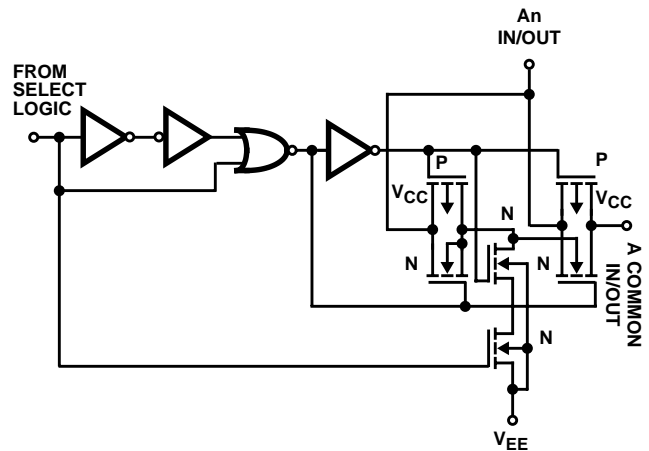
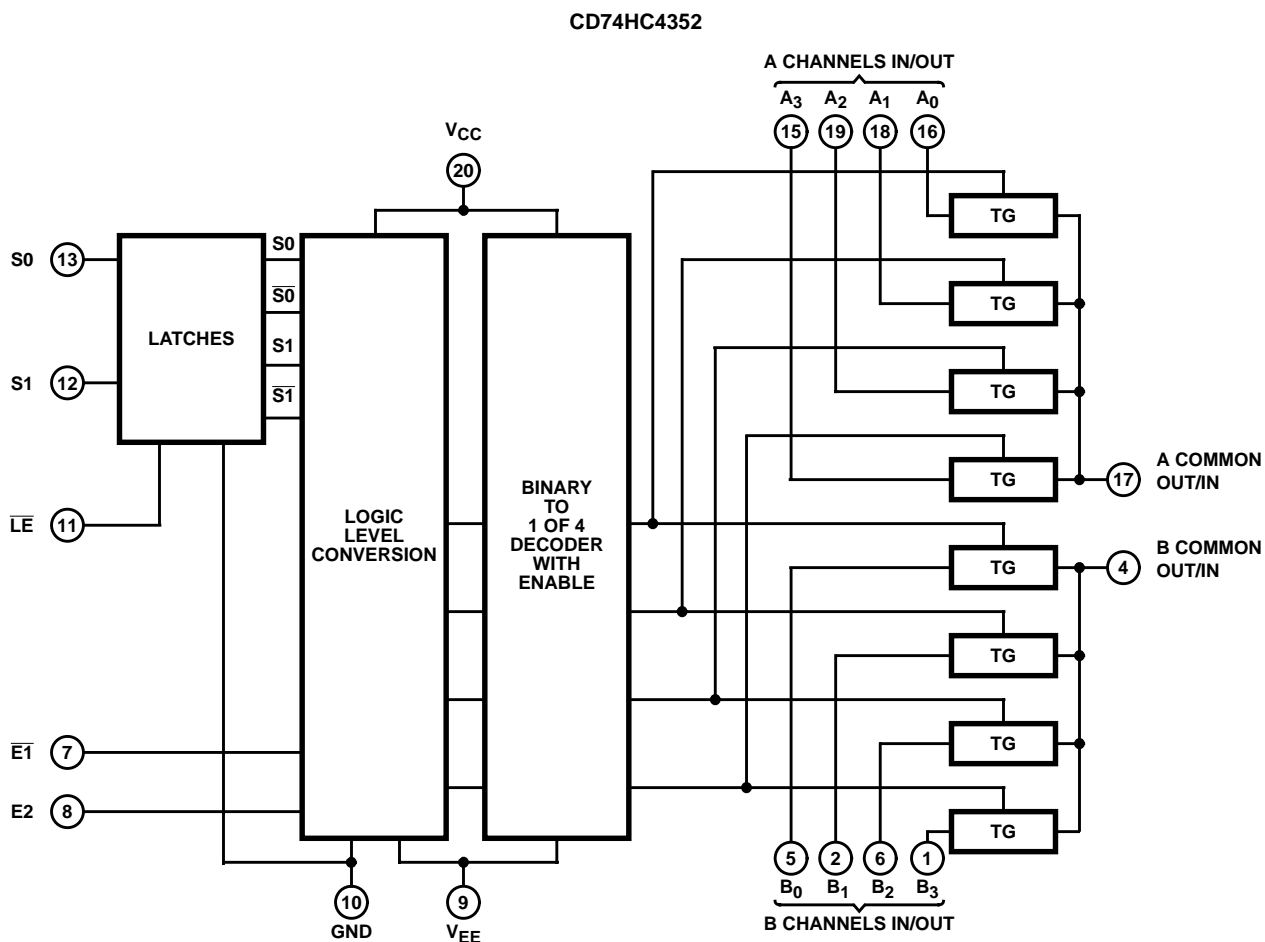


FIGURE 1. DETAIL OF ONE HC/HCT4351 SWITCH

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Functional Diagram



TRUTH TABLE
CD74HC4352

INPUT STATES				(NOTE 2) "ON" SWITCHES LE = H
E1	E2	S1	S0	
L	H	L	L	A ₀ , B ₀
L	H	L	H	A ₁ , B ₁
L	H	H	L	A ₂ , B ₂
L	H	H	H	A ₃ , B ₃
H	L	X	X	None

H = High Voltage Level, L = Low Voltage Level, X = Don't Care

NOTE:

- When Latch Enable is "Low" channel-select data is latched and switches cannot change state.

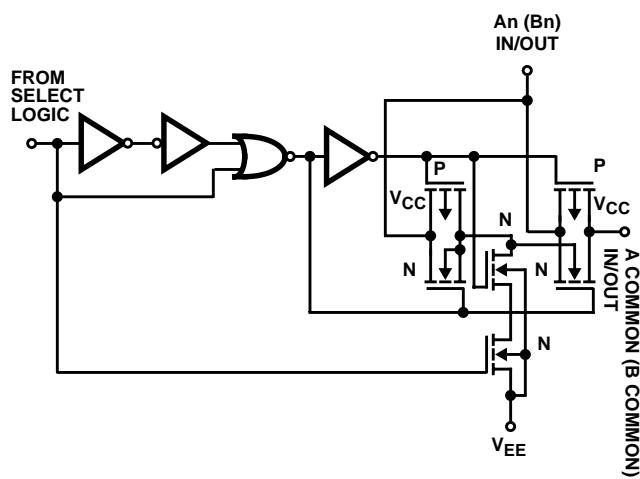


FIGURE 2. DETAIL OF ONE CD74HC4352 SWITCH

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Absolute Maximum Ratings

DC Supply Voltage, V_{CC}	-0.5V to 7V
DC Supply Voltage, $V_{CC} - V_{EE}$	-0.5V to 10.5V
DC Supply Voltage, V_{EE}	0.5V to -7V
DC Input Diode Current, I_{IK}	
For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$	$\pm 20mA$
DC Switch Diode Current, I_{OK}	
For $V_I < V_{EE} - 0.5V$ or $V_I < V_{CC} + 0.5V$	$\pm 25mA$
DC Switch Current, I_{OK} (Note 3)	
For $V_I > V_{EE} - 0.5V$ or $V_I < V_{CC} + 0.5V$	$\pm 20mA$
DC Output Diode Current, I_{OK}	
For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$	$\pm 20mA$
DC Output Source or Sink Current per Output Pin, I_O	
For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$	$\pm 25mA$
DC V_{CC} or Ground Current, I_{CC}	$\pm 50mA$

Operating Conditions

Temperature Range, T_A	-55°C to 125°C
Supply Voltage Range, V_{CC}	
HC Types2V to 6V
HCT Types4.5V to 5.5V
Supply Voltage Range, $V_{CC} - V_{EE}$	
HC, HCT Types (Figure 3)2V to 10V
Supply Voltage Range, V_{EE}	
HC, HCT Types (Figure 4)0V to -6V
DC Input or Output Voltage, V_I	GND to V_{CC}
Analog Switch I/O Voltage, V_{IS}	V_{EE} (Min)
.....	V_{CC} (Max)
Input Rise and Fall Time, t_r, t_f	
2V	1000ns (Max)
4.5V	500ns (Max)
6V	400ns (Max)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

- 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 the DC Electrical Specifications table). No V_{CC} current will flow through R_L if the switch current flows into terminal 3 on the 'HC4351 and CD74HCT4351; terminals 3 and 13 on the CD74HC4352.
- The package thermal impedance is calculated in accordance with JESD 51-7.

Thermal Information

Thermal Resistance (Typical, Note 4)	θ_{JA} (°C/W)
E (PDIP) Package	69
M (SOIC) Package	58
Maximum Junction Temperature	150°C
Maximum Storage Temperature Range	-65°C to 150°C
Maximum Lead Temperature (Soldering 10s)	300°C
(SOIC - Lead Tips Only)	

Recommended Operating Area as a Function of Supply Voltage

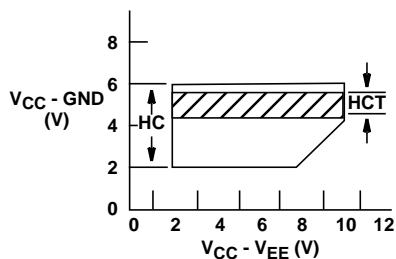


FIGURE 3.

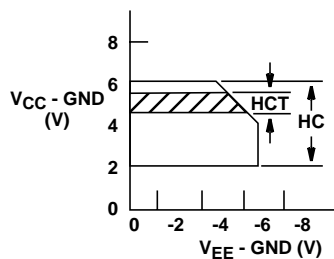


FIGURE 4.

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

DC Electrical Specifications (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS				25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V _I (V)	V _{IS} (V)	V _{EE} (V)	V _{CC} (V)	MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HCT TYPES													
High Level Input Voltage	V _{IH}	-	-	-	4.5 to 5.5	2	-	-	2	-	2	-	V
Low Level Input Voltage	V _{IL}	-	-	-	4.5 to 5.5	-	-	0.8	-	0.8	-	0.8	V
“ON” Resistance I _O = 1mA Figure 9	R _{ON}	V _{IH} or V _{IL}	V _{CC} or V _{EE}	0	4.5	-	70	160	-	200	-	240	Ω
				-4.5	4.5	-	40	120	-	150	-	180	Ω
		V _{CC} to V _{EE}	0	4.5	-	90	180	-	225	-	270	Ω	
			-4.5	4.5	-	45	130	-	162	-	195	Ω	
Maximum “ON” Resistance Between Any Two Channels	ΔR _{ON}	-	-	0	4.5	-	10	-	-	-	-	-	Ω
				-4.5	4.5	-	5	-	-	-	-	-	-
Switch On/Off Leakage Current 4 Channels (4352)	I _{IZ}	V _{IH} or V _{IL}	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	-	-	±0.1	-	±1	-	±1	μA
-5				5	-	-	±0.2	-	±2	-	±2	μA	
0				6	-	-	±0.2	-	±2	-	±2	μA	
-5				5	-	-	±0.4	-	±4	-	±4	μA	
Switch On/Off Leakage Current 8 Channels (4351)													
Control Input Leakage Current	I _I	V _{CC} or GND	-	0	5.5	-	-	±0.1	-	±1	-	±1	μA
Quiescent Device Current I _O = 0	I _{CC}	Any Voltage Between V _{CC} and GND	When V _{IS} = V _{EE} , V _{OS} = V _{CC} ; When V _{IS} = V _{CC} , V _{OS} = V _{EE}	0	5.5	-	-	8	-	80	-	160	μA
				-4.5	5.5	-	-	16	-	160	-	320	μA
Additional Quiescent Device Current Per Input Pin: 1 Unit Load	ΔI _{CC} (Note 5)	V _{CC} -2.1	-	-	4.5 to 5.5	-	100	360	-	450	-	490	μA

NOTE:

5. For dual-supply systems theoretical worst case (V_I = 2.4V, V_{CC} = 5.5V) specification is 1.8mA.

HCT Input Loading Table

TYPE	INPUT	UNIT LOADS
All	$\overline{E}1, E2, Sn$	0.5
(4351, 4352)	\overline{LE}	1.5

NOTE: Unit Load is ΔI_{CC} limit specified in DC Electrical Table, e.g., 360μA max at 25°C.

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Switching Specifications Input $t_r, t_f = 6\text{ns}$

PARAMETER	SYMBOL	TEST CONDITIONS	V _{EE} (V)	V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES												
Propagation Delay, Switch In to Switch Out	t _{PLH} , t _{PHL}	C _L = 50pF	0	2	-	-	35	-	45	-	55	ns
			0	4.5	-	-	7	-	9	-	11	ns
			0	6	-	-	6	-	8	-	9	ns
			-4.5	4.5	-	-	5	-	7	-	8	ns
Maximum Switch Turn "ON" Delay 4351 E1, E2, LE to V _{OS}	t _{PZH} , t _{PZL}	C _L = 50pF	0	2	-	-	300	-	375	-	450	ns
			0	4.5	-	-	60	-	75	-	90	ns
			0	6	-	-	51	-	64	-	77	ns
			-4.5	4.5	-	-	55	-	69	-	83	ns
		C _L = 15pF	-	5	-	27	-	-	-	-	-	ns
Maximum Switch Turn "ON" Delay 4352 E1, E2, LE to V _{OS}	t _{PZH} , t _{PZL}	C _L = 50pF	0	2	-	-	350	-	440	-	525	ns
			0	4.5	-	-	70	-	88	-	105	ns
			0	6	-	-	60	-	75	-	90	ns
			-4.5	4.5	-	-	60	-	75	-	90	ns
		C _L = 15pF	-	5	-	35	-	-	-	-	-	ns
Maximum Switch Turn "ON" Delay 4351 Sn to V _{OS}	t _{PZH} , t _{PZL}	C _L = 50pF	0	2	-	-	300	-	375	-	450	ns
			0	4.5	-	-	60	-	75	-	90	ns
			0	6	-	-	51	-	64	-	77	ns
			-4.5	4.5	-	-	50	-	63	-	75	ns
		C _L = 15pF	-	5	-	27	-	-	-	-	-	ns
Maximum Switch Turn "ON" Delay 4352 Sn to V _{OS}	t _{PZH} , t _{PZL}	C _L = 50pF	0	2	-	-	375	-	470	-	565	ns
			0	4.5	-	-	75	-	94	-	113	ns
			0	6	-	-	64	-	80	-	96	ns
			-4.5	4.5	-	-	55	-	69	-	83	ns
		C _L = 15pF	-	5	-	35	-	-	-	-	-	ns
Maximum Switch Turn "OFF" Delay 4351 E1 to V _{OS}	t _{PHZ} , t _{PLZ}	C _L = 50pF	0	2	-	-	250	-	315	-	375	ns
			0	4.5	-	-	50	-	63	-	75	ns
			0	6	-	-	43	-	54	-	64	ns
			-4.5	4.5	-	-	40	-	50	-	60	ns
		C _L = 15pF	-	5	-	21	-	-	-	-	-	ns

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Switching Specifications Input $t_r, t_f = 6\text{ns}$ (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	V _{EE} (V)	V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Maximum Switch Turn "OFF" Delay 4351 E2 to V _{OS}	t_{PHZ}, t_{PLZ}	C _L = 50pF	0	2	-	-	250	-	315	-	375	ns
			0	4.5	-	-	50	-	63	-	75	ns
			0	6	-	-	43	-	54	-	64	ns
			-4.5	4.5	-	-	40	-	50	-	60	ns
		C _L = 15pF	-	5	-	21	-	-	-	-	-	ns
Maximum Switch Turn "OFF" Delay 4351 \overline{LE} to V _{OS}	t_{PHZ}, t_{PLZ}	C _L = 50pF	0	2	-	-	275	-	345	-	415	ns
			0	4.5	-	-	55	-	69	-	83	ns
			0	6	-	-	47	-	59	-	71	ns
			-4.5	4.5	-	-	45	-	56	-	68	ns
Maximum Switch Turn "OFF" Delay 4351 Sn to V _{OS}	t_{PHZ}, t_{PLZ}	C _L = 50pF	0	2	-	-	275	-	345	-	415	ns
			0	4.5	-	-	55	-	69	-	83	ns
			0	6	-	-	47	-	59	-	71	ns
			-4.5	4.5	-	-	48	-	60	-	71	ns
Maximum Switch Turn "OFF" Delay 4352 $\overline{E1}, E2, \overline{LE}$ to V _{OS}	t_{PHZ}, t_{PLZ}	C _L = 50pF	0	2	-	-	275	-	345	-	415	ns
			0	4.5	-	-	55	-	69	-	83	ns
			0	6	-	-	47	-	59	-	71	ns
			-4.5	4.5	-	-	50	-	63	-	75	ns
		C _L = 15pF	-	5	-	21	-	-	-	-	-	ns
Setup Time 4351 Sn to LE	t _{SU}	C _L = 50pF	0	2	-	-	60	-	75	-	90	ns
			0	4.5	-	-	12	-	15	-	18	ns
			0	6	-	-	10	-	13	-	15	ns
			-4.5	4.5	-	-	18	-	23	-	27	ns
Hold Time 4351 and 4352 Sn to LE	t _H	C _L = 50pF	0	2	5	-	-	5	-	5	-	ns
			0	4.5	5	-	-	5	-	5	-	ns
			0	6	5	-	-	5	-	5	-	ns
			-4.5	4.5	5	-	-	5	-	5	-	ns
Pulse Width 4351 and 4352 LE	t _W	C _L = 50pF	0	2	100	-	-	125	-	150	-	ns
			0	4.5	20	-	-	25	-	30	-	ns
			0	6	17	-	-	21	-	26	-	ns
			-4.5	4.5	25	-	-	31	-	38	-	ns
Input (Control) Capacitance	C _I	-	-	-	-	10	-	10	-	10	pF	
Power Dissipation Capacitance (Notes 6, 7) 4351	C _{PD}	-	-	5	-	50	-	-	-	-	pF	

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Switching Specifications Input $t_r, t_f = 6\text{ns}$ (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	V _{EE} (V)	V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
					MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Power Dissipation Capacitance (Notes 6, 7) 4352	C _{PD}	-	-	5	-	74	-	-	-	-	-	pF
HCT TYPES												
Propagation Delay, Switch In to Switch Out	t _{PLH} , t _{PHL}	C _L = 50pF	0	4.5	-	-	7	-	9	-	11	ns
			-4.5	4.5	-	-	5	-	7	-	8	ns
Maximum Switch Turn "ON" Delay 4351 E1, E2, LE to V _{OS}	t _{PZH} , t _{PZL}	C _L = 50pF	0	4.5	-	-	75	-	94	-	113	ns
			-4.5	4.5	-	-	60	-	75	-	90	ns
		C _L = 15pF	-	5	-	35	-	-	-	-	-	ns
Maximum Switch Turn "ON" Delay 4351 Sn to V _{OS}	t _{PZH} , t _{PZL}	C _L = 50pF	0	4.5	-	-	75	-	94	-	113	ns
			-4.5	4.5	-	-	60	-	75	-	90	ns
		C _L = 15pF	-	5	-	35	-	-	-	-	-	ns
Maximum Switch Turn "OFF" Delay 4351 E1 to V _{OS}	t _{PHZ} , t _{PLZ}	C _L = 50pF	0	4.5	-	-	55	-	69	-	83	ns
			-4.5	4.5	-	-	40	-	50	-	60	ns
		C _L = 15pF	-	5	-	23	-	-	-	-	-	ns
Maximum Switch Turn "OFF" Delay 4351 E2 to V _{OS}	t _{PHZ} , t _{PLZ}	C _L = 50pF	0	4.5	-	-	60	-	75	-	90	ns
			-4.5	4.5	-	-	50	-	63	-	75	ns
		C _L = 15pF	-	5	-	23	-	-	-	-	-	ns
Maximum Switch Turn "OFF" Delay 4351 LE to V _{OS}	t _{PHZ} , t _{PLZ}	C _L = 50pF	0	4.5	-	-	60	-	75	-	90	ns
			-4.5	4.5	-	-	55	-	69	-	83	ns
Maximum Switch Turn "OFF" Delay 4351 Sn to V _{OS}	t _{PHZ} , t _{PLZ}	C _L = 50pF	0	4.5	-	-	65	-	81	-	98	ns
			-4.5	4.5	-	-	55	-	69	-	83	ns
		C _L = 15pF	-	5	-	23	-	-	-	-	-	ns
Setup Time 4351 Sn to LE		C _L = 50pF	0	4.5	-	-	12	-	15	-	18	ns
			-4.5	4.5	-	-	14	-	18	-	21	ns
Hold Time 4351 and 4352 Sn to LE		C _L = 50pF	0	4.5	5	-	-	5	-	5	-	ns
			-4.5	4.5	5	-	-	5	-	5	-	ns
Pulse Width 4351 LE	t _W	C _L = 50pF	0	4.5	25	-	-	31	-	28	-	ns
			-4.5	4.5	25	-	-	31	-	38	-	ns
Input (Control) Capacitance	C _I	-	-	-	-	-	10	-	10	-	10	pF
Power Dissipation Capacitance (Notes 6, 7) 4351	C _{PD}	-	-	5	-	52	-	-	-	-	-	pF

NOTES:

- C_{PD} is used to determine the dynamic power consumption, per package.
- $P_D = C_{PD} V_{CC}^2 f_i + \sum (C_L + C_S) V_{CC}^2 f_o$ where f_i = input frequency, f_o = output frequency, C_L = output load capacitance, C_S = switch capacitance, V_{CC} = supply voltage.

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Analog Channel Specifications $T_A = 25^\circ\text{C}$

PARAMETER	SYMBOL	TEST CONDITIONS	TYPE	V_{EE} (V)	V_{CC} (V)	HC/HCT	UNITS
Switch Input Capacitance	C_I		All	-	-	5	pF
Common Capacitance	C_{COM}		4351	-	-	25	pF
			4352	-	-	12	pF
Minimum Switch Frequency Response at -3dB (Figure 6, 8)	f_{MAX}	See Figure 11 (Notes 8, 9)	4351	-	-	145	MHz
			4352	-2.25	2.25	165	MHz
			4351	-	-	180	MHz
			4352	-4.5	4.5	185	MHz
Crosstalk Between Any Two Switches (Note 11)		See Figure 10 (Notes 9, 10)	4351	-	-	N/A	dB
			4352	-2.25	2.25	(TBE)	dB
			4351	-	-	N/A	dB
			4352	-4.5	4.5	(TBE)	dB
Sine-Wave Distortion		See Figure 12	All	-2.25	2.25	0.035	%
			All	-4.5	4.5	0.018	%
\bar{E} or S to Switch Feedthrough Noise		See Figure 13 (Notes 9, 10)	4351	-	-	-	mV
			4352	-2.25	2.25	(TBE)	mV
			4351	-	-	-	mV
			4352	-4.5	4.5	(TBE)	mV
Switch "OFF" Signal Feedthrough (Figure 6, 8)		See Figure 14 (Notes 9, 10)	4351	-	-	-73	dB
			4352	-2.25	2.25	-65	dB
			4351	-	-	-75	dB
			4352	-4.5	4.5	-67	dB

NOTES:

8. Adjust input voltage to obtain 0dBm at V_{OS} for, $f_{in} = 1\text{MHz}$.
9. V_{IS} is centered at $(V_{CC} - V_{EE})/2$.
10. Adjust input for 0dBm.
11. Not applicable for 'HC4351 and CD74HCT4351.

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Typical Performance Curves

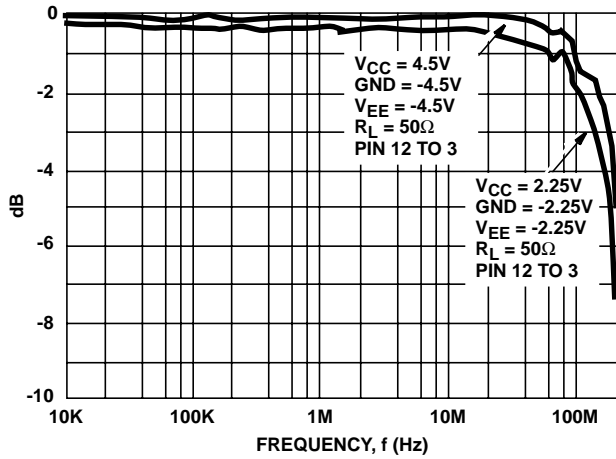


FIGURE 5. CHANNEL ON BANDWIDTH ('HC4351, CD74HCT4351)

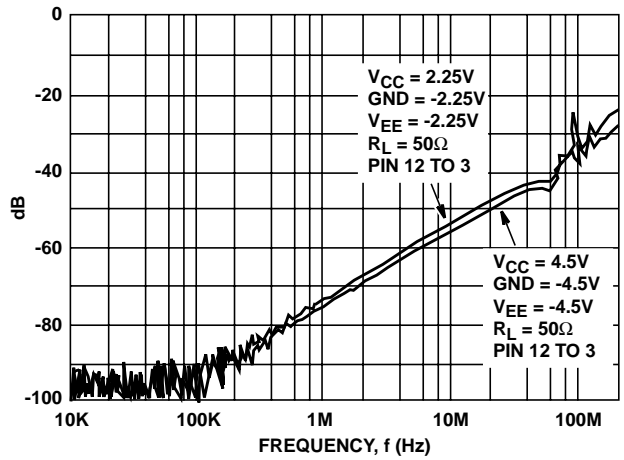


FIGURE 6. CHANNEL OFF FEEDTHROUGH ('HC4351, CD74HCT4351)

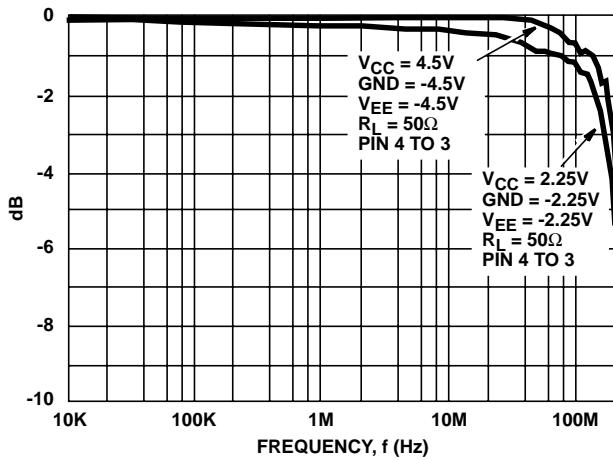


FIGURE 7. CHANNEL ON BANDWIDTH (CD74HC4352)

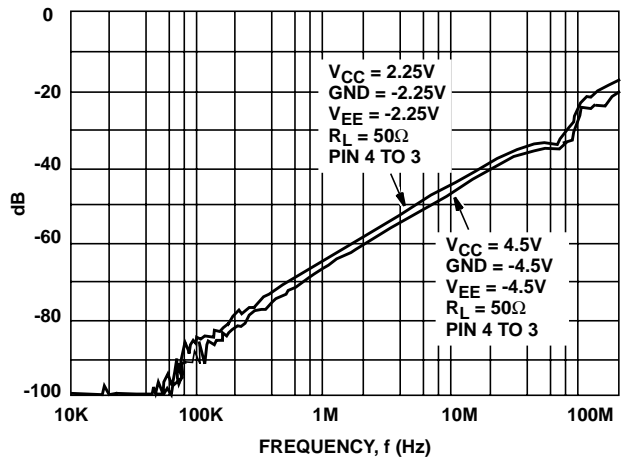


FIGURE 8. CHANNEL OFF FEEDTHROUGH (CD74HC4352)

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Typical Performance Curves (Continued)

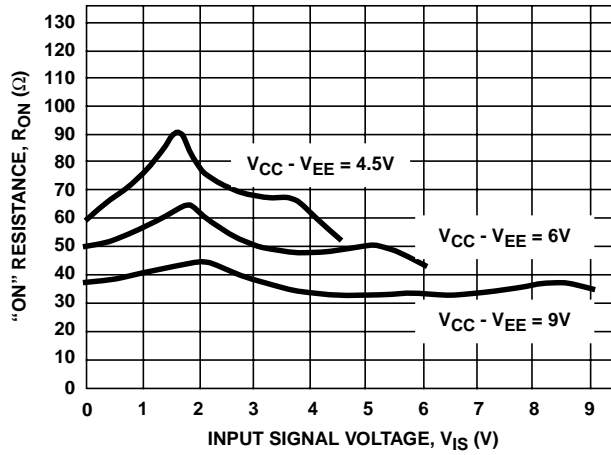


FIGURE 9. TYPICAL ON RESISTANCE vs INPUT SIGNAL VOLTAGE

Analog Test Circuits

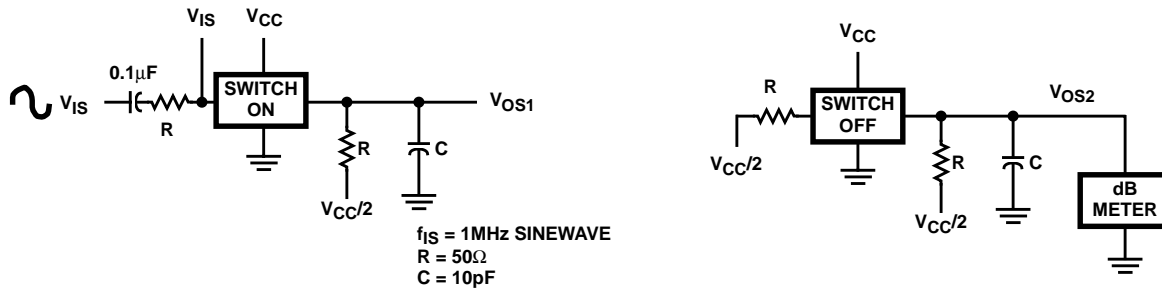


FIGURE 10. CROSSTALK BETWEEN TWO SWITCHES TEST CIRCUIT

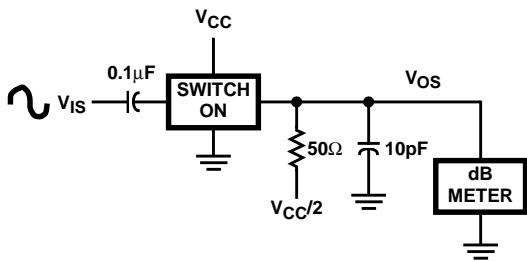


FIGURE 11. FREQUENCY RESPONSE TEST CIRCUIT

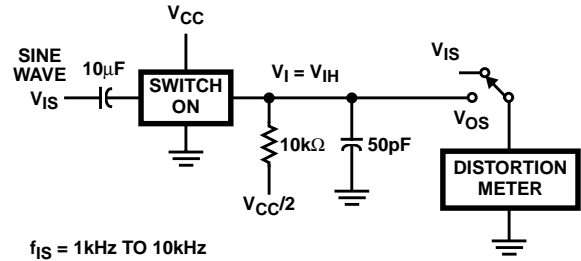


FIGURE 12. TOTAL HARMONIC DISTORTION TEST CIRCUIT

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Analog Test Circuits (Continued)

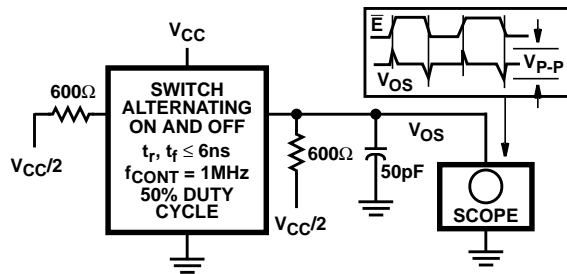


FIGURE 13. CONTROL-TO-SWITCH FEEDTHROUGH NOISE TEST CIRCUIT

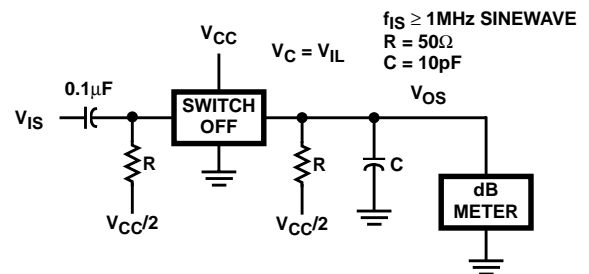
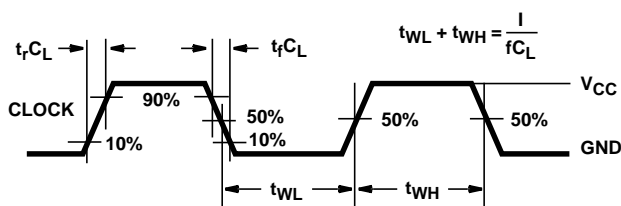


FIGURE 14. SWITCH OFF SIGNAL FEEDTHROUGH

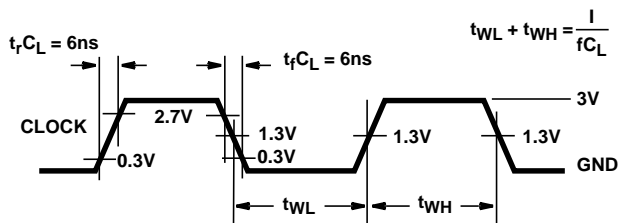
CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Test Circuits and Waveforms



NOTE: Outputs should be switching from 10% V_{CC} to 90% V_{CC} in accordance with device truth table. For f_{MAX} , input duty cycle = 50%.

FIGURE 15. HC CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH



NOTE: Outputs should be switching from 10% V_{CC} to 90% V_{CC} in accordance with device truth table. For f_{MAX} , input duty cycle = 50%.

FIGURE 16. HCT CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH

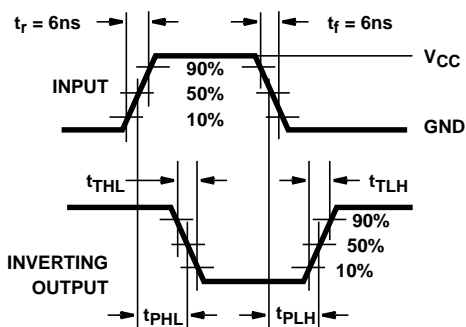


FIGURE 17. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

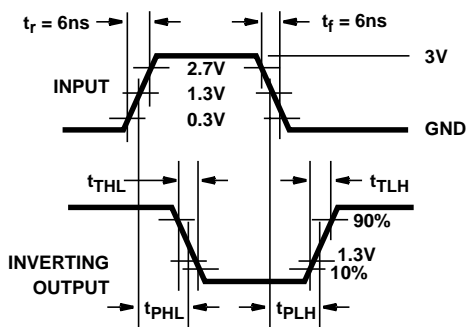


FIGURE 18. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

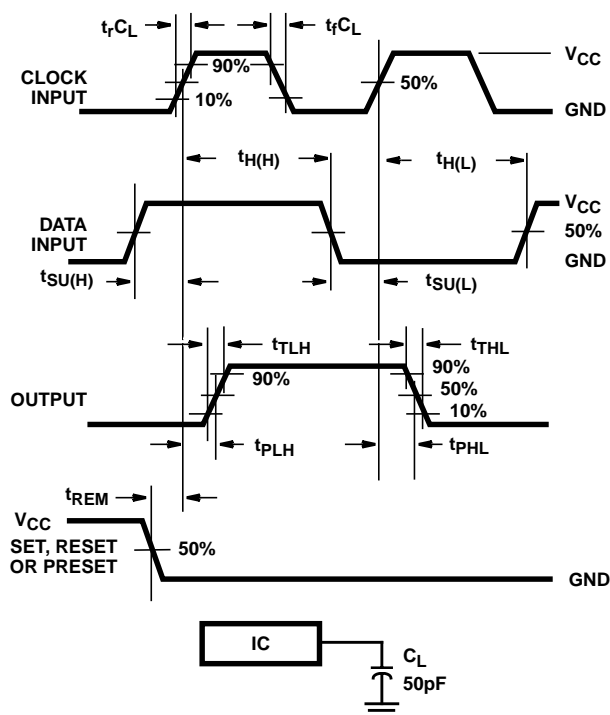


FIGURE 19. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

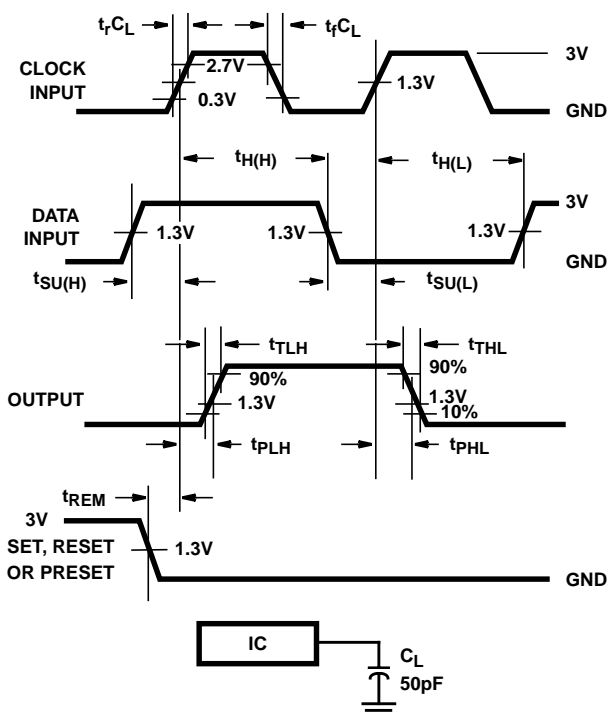


FIGURE 20. HCT SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

Test Circuits and Waveforms (Continued)

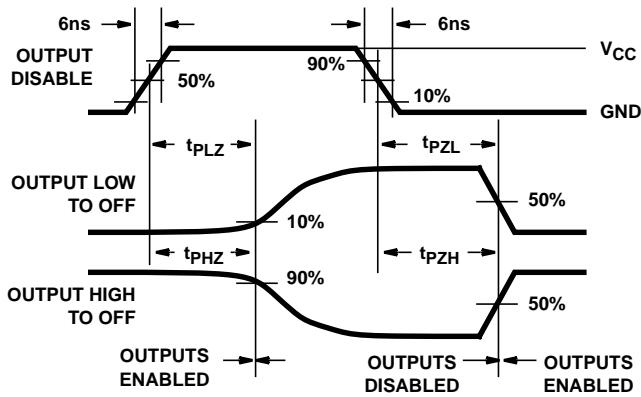


FIGURE 21. HC THREE-STATE PROPAGATION DELAY WAVEFORM

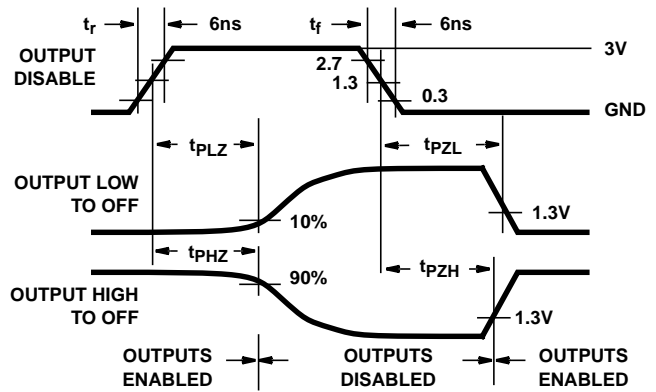
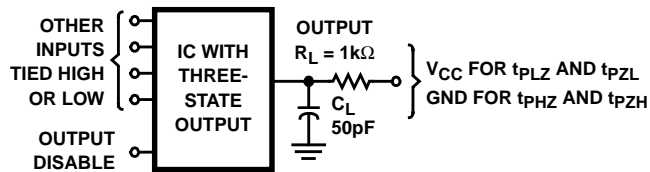


FIGURE 22. HCT THREE-STATE PROPAGATION DELAY WAVEFORM



NOTE: Open drain waveforms t_{pLZ} and t_{pZL} are the same as those for three-state shown on the left. The test circuit is Output $R_L = 1k\Omega$ to V_{CC} , $C_L = 50pF$.

FIGURE 23. HC AND HCT THREE-STATE PROPAGATION DELAY TEST CIRCUIT

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
CD54HC4351F3A	ACTIVE	CDIP	J	20	1	TBD	Call TI	Level-NC-NC-NC
CD74HC4351E	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HC4351EE4	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HC4351M	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC4351M96	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC4351M96E4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC4351ME4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC4352E	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HC4352EE4	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HCT4351E	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HCT4351EE4	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

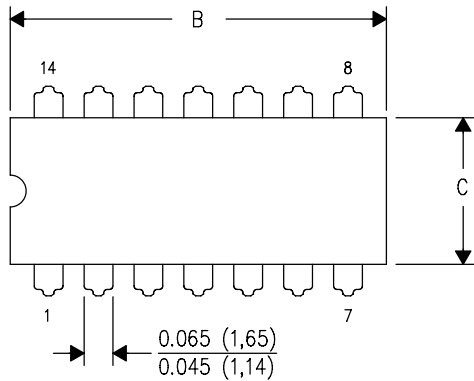
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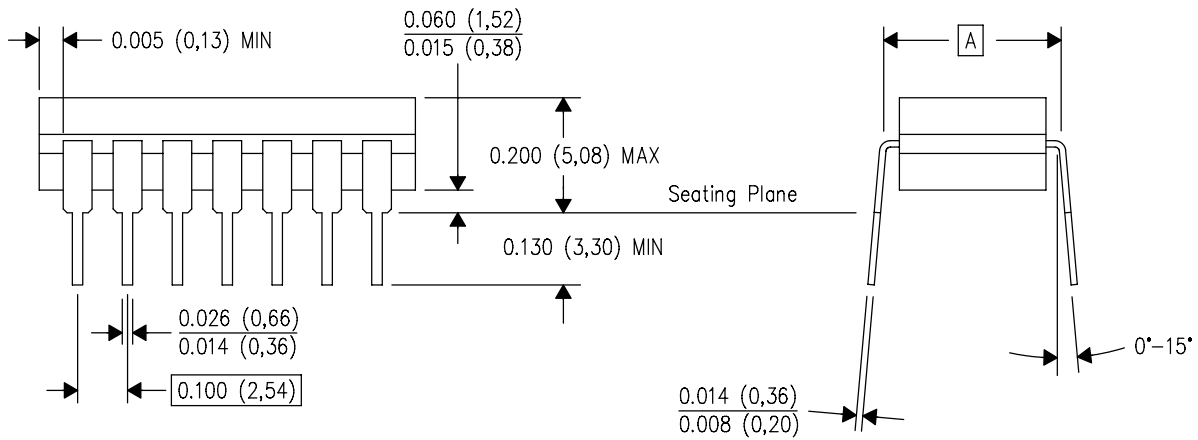
J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



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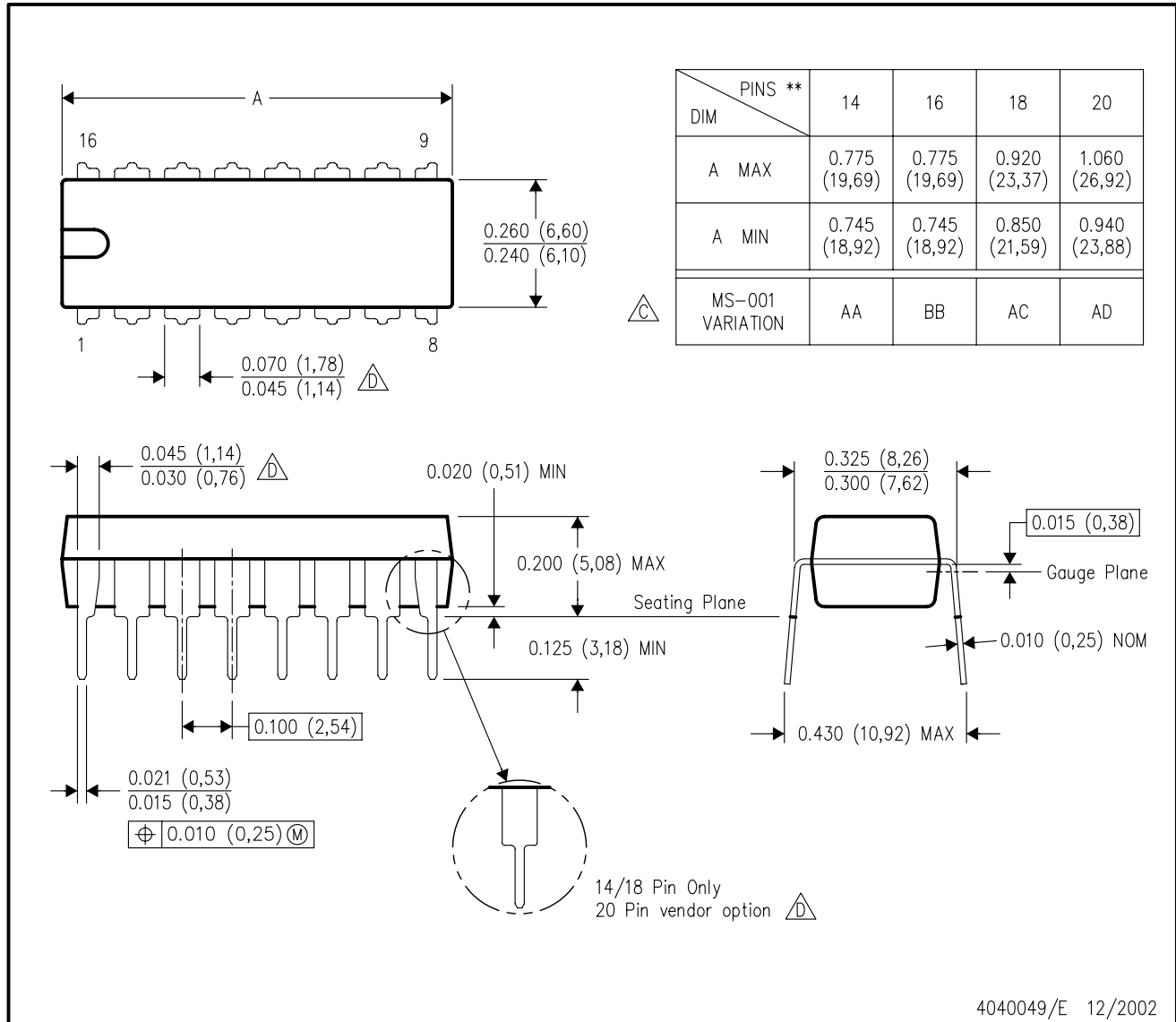
- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

MECHANICAL DATA

N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE

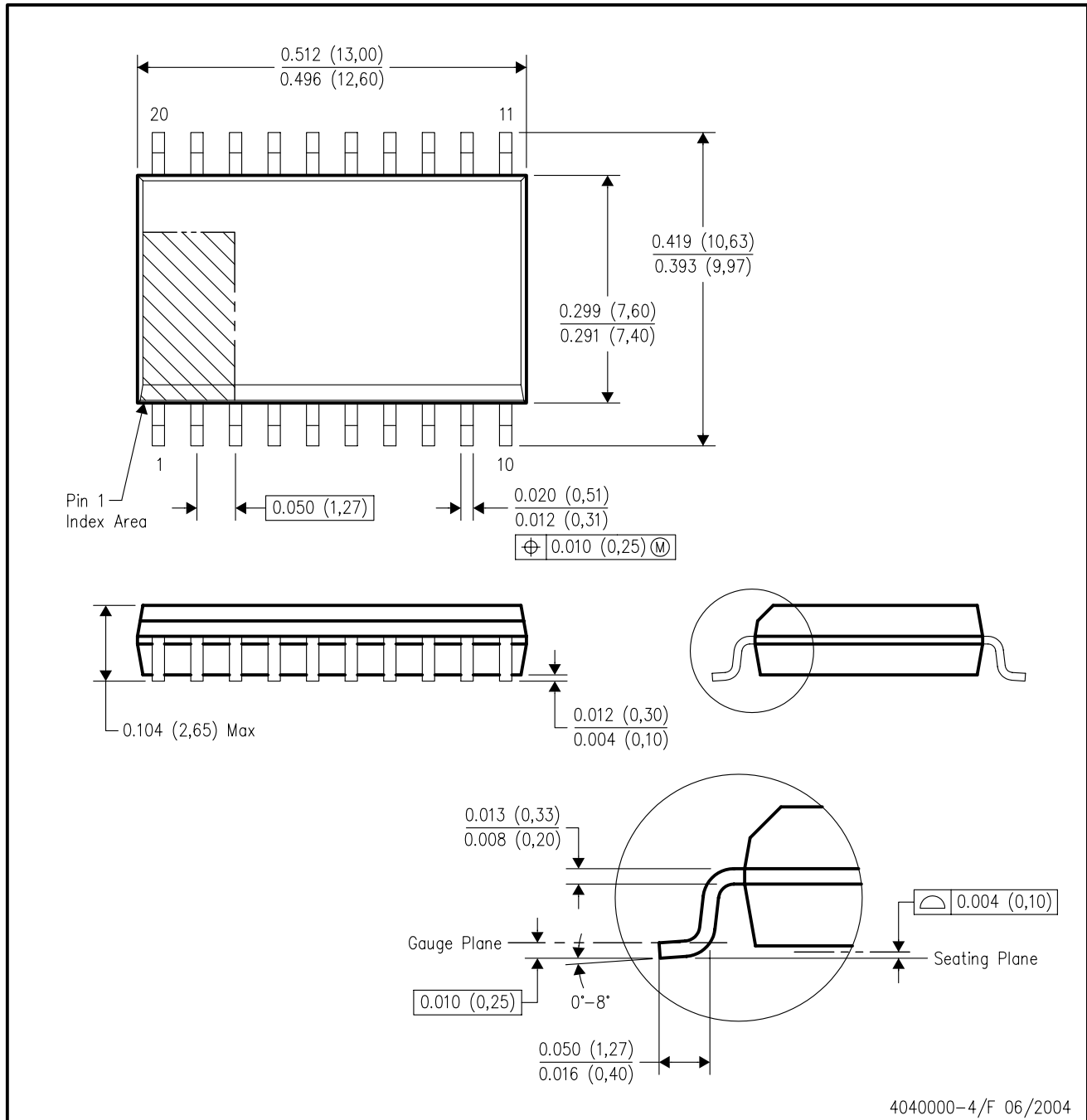


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

MECHANICAL DATA

DW (R-PDSO-G20)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MS-013 variation AC.

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