

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}

Description

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

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

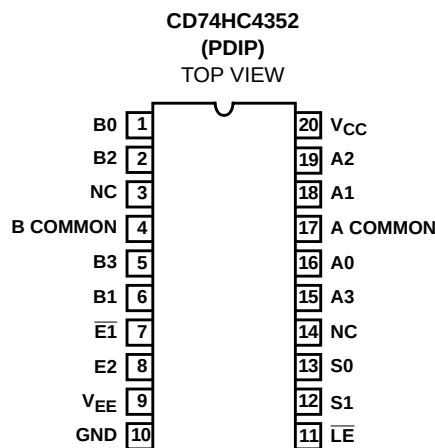
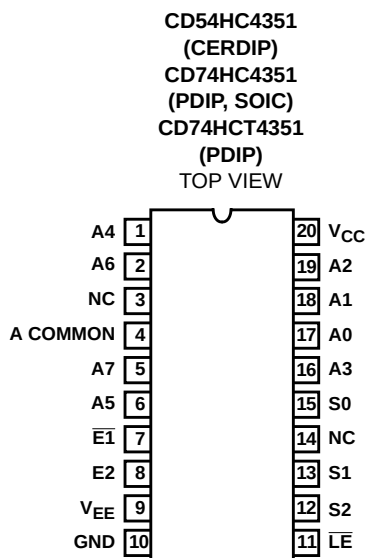
These analog multiplexers/demultiplexers are, in essence, the HC/HCT4015 and HC4052 preceded by address latches that are controlled by an active low Latch Enable input ($\overline{LE}$). Two Enable inputs, one active low ($\overline{E1}$), and the other active high (E2) are provided allowing enabling with either input voltage level.

Ordering Information

PART NUMBER	TEMP. RANGE ($^{\circ}C$)	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

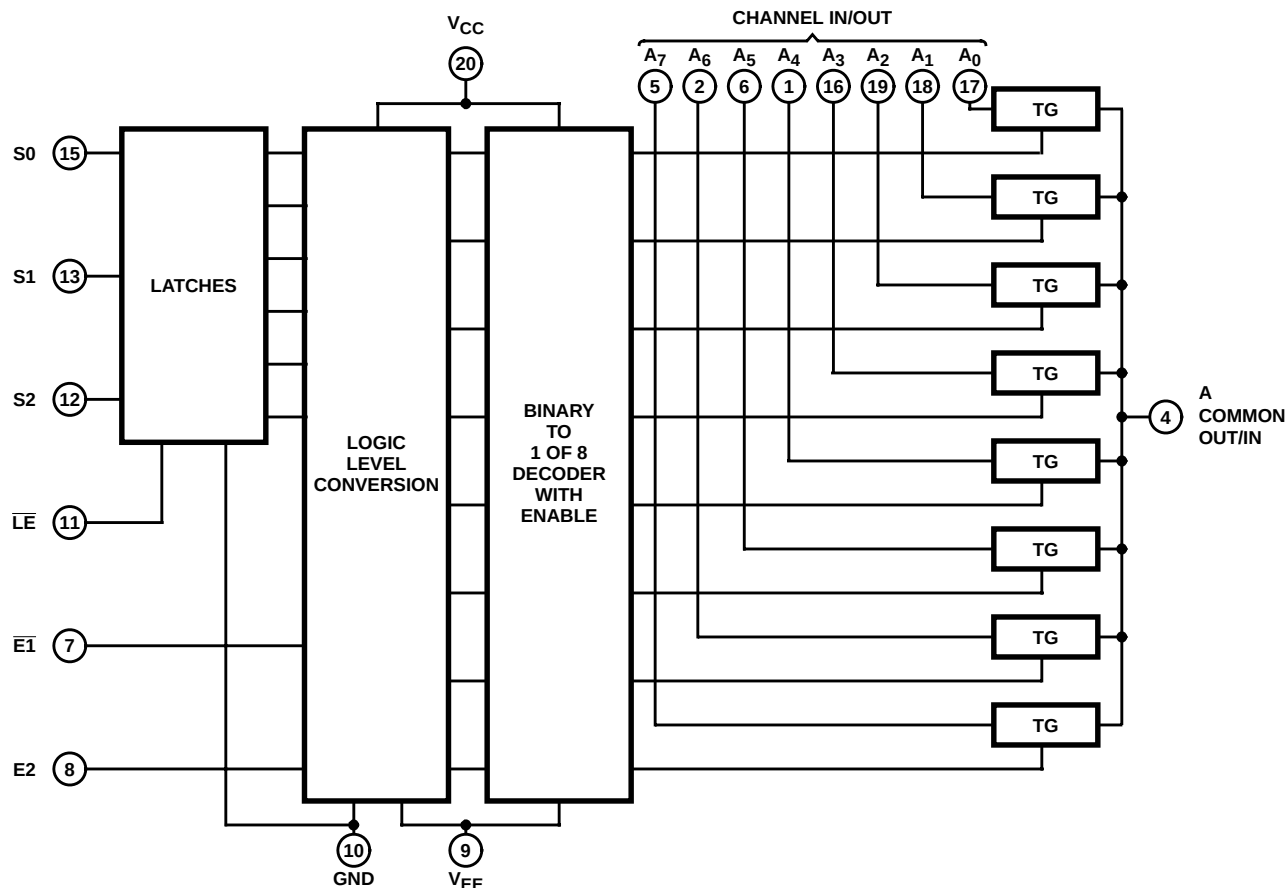
NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel.

Pinouts



Functional Diagram

'HC4351, CD74HCT4351



TRUTH TABLE
'HC4351, CD74HCT4351

INPUT STATES					(NOTE 1) "ON" SWITCHES $\overline{LE} = H$
$\overline{E1}$	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.

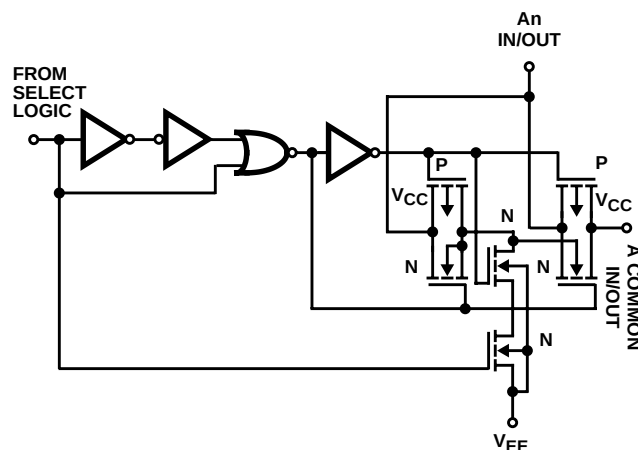
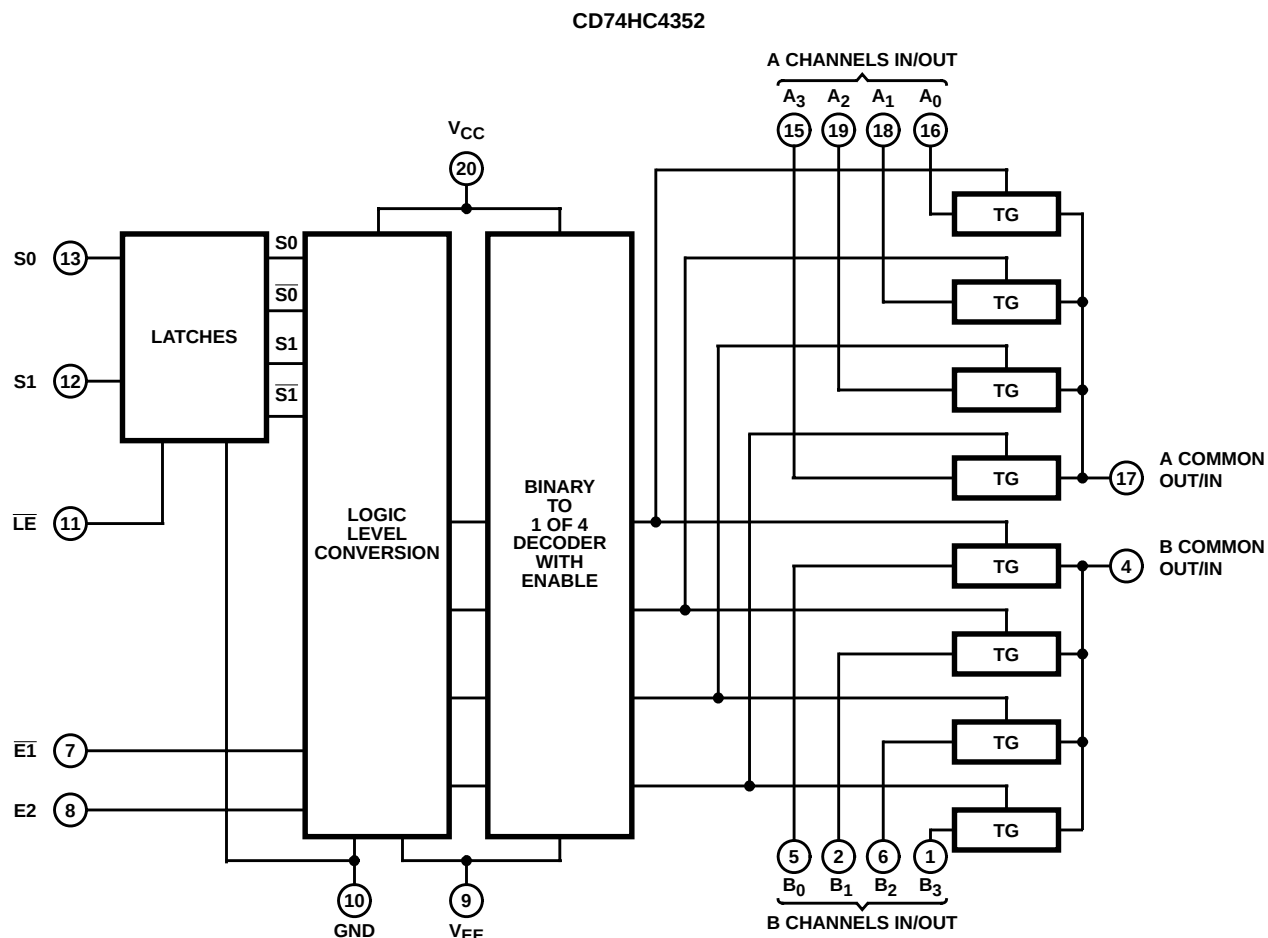


FIGURE 1. DETAIL OF ONE HC/HCT4351 SWITCH

Functional Diagram



TRUTH TABLE
CD74HC4352

INPUT STATES				(NOTE 2) "ON" SWITCHES $\overline{LE} = H$
$\overline{E1}$	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.

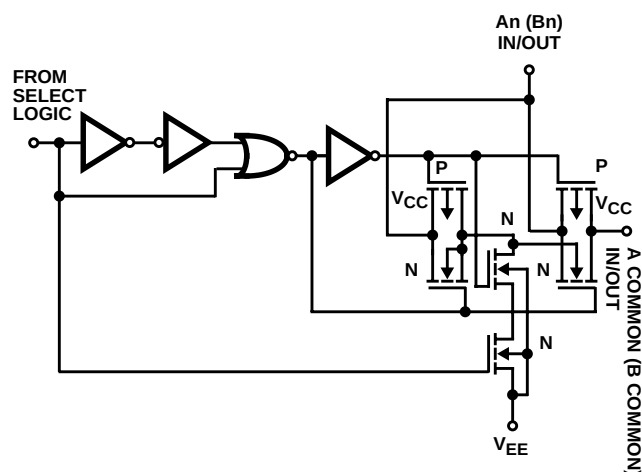


FIGURE 2. DETAIL OF ONE CD74HC4352 SWITCH

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 Types	.2V to 6V
HCT Types	.4.5V 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

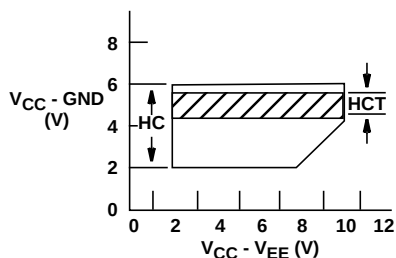


FIGURE 3.

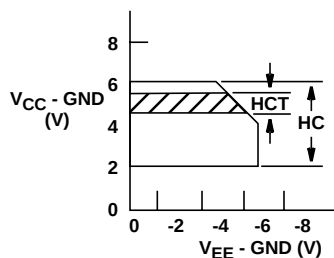


FIGURE 4.

CD54HC4351, CD74HC4351, CD74HCT4351, CD74HC4352

DC Electrical Specifications

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	
HC TYPES													
High Level Input Voltage	V _{IH}	-	-	-	2	1.5	-	-	1.5	-	1.5	-	V
					4.5	3.15	-	-	3.15	-	3.15	-	V
					6	4.2	-	-	4.2	-	4.2	-	V
Low Level Input Voltage	V _{IL}	-	-	-	2	-	-	0.5	-	0.5	-	0.5	V
					4.5	-	-	1.35	-	1.35	-	1.35	V
					6	-	-	1.8	-	1.8	-	1.8	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
				0	6	-	60	140	-	175	-	210	Ω
				-4.5	4.5	-	40	120	-	150	-	180	Ω
			V _{CC} to V _{EE}	0	4.5	-	90	180	-	225	-	270	Ω
				0	6	-	80	160	-	200	-	240	Ω
				-4.5	4.5	-	45	130	-	162	-	195	Ω
Maximum “ON” Resistance Between Any Two Channels	ΔR _{ON}	-	-	0	4.5	-	10	-	-	-	-	-	Ω
				0	6	-	8.5	-	-	-	-	-	Ω
				-4.5	4.5	-	5	-	-	-	-	-	Ω
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 Combina- tions of V _{IS} and V _{OS} Voltage Levels	0	6	-	-	±0.1	-	±1	-	±1	μA
				-5	5	-	-	±0.2	-	±2	-	±2	μA
Switch On/Off Leakage Current 8 Channels (4351)				0	6	-	-	±0.2	-	±2	-	±2	μA
				-5	5	-	-	±0.4	-	±4	-	±4	μA
Control Input Leakage Current	I _{IL}	V _{CC} or GND	-	0	6	-	-	±0.1	-	±1	-	±1	μA
Quiescent Device Current I _O = 0	I _{CC}	V _{CC} or GND	When V _{IS} = V _{EE} , V _{OS} = V _{CC} , When V _{IS} = V _{CC} , V _{OS} = V _{EE}	0	6	-	-	8	-	80	-	160	μA
				-5	5	-	-	16	-	160	-	320	μA

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	-	-	-	-	Ω	
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	
Switch On/Off Leakage Current 8 Channels (4351)				0	6	-	-	±0.2	-	±2	-	±2	μA
				-5	5	-	-	±0.4	-	±4	-	±4	μA
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	$\overline{E}1, E2, S_n$	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 = 6ns

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 E ₁ , E2, L _E 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 E ₁ , E2, L _E 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 S _n 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 S _n 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 E ₁ 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}	$C_L = 50\text{pF}$	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
		$C_L = 15\text{pF}$	-	5	-	21	-	-	-	-	-	ns
Maximum Switch Turn "OFF" Delay 4351 LE to V_{OS}	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	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}	$C_L = 50\text{pF}$	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 E1, E2, LE to V_{OS}	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	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
Setup Time 4351 Sn to $\overline{LE}$	t_{SU}	$C_L = 50\text{pF}$	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 $\overline{LE}$	t_H	$C_L = 50\text{pF}$	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 $\overline{LE}$	t_W	$C_L = 50\text{pF}$	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}	$C_L = 50\text{pF}$	0	4.5	-	-	7	-	9	-	11	ns
			-4.5	4.5	-	-	5	-	7	-	8	ns
Maximum Switch Turn "ON" Delay 4351 $\overline{E1}, E2, \overline{LE}$ to V_{OS}	t_{PZH}, t_{PZL}	$C_L = 50\text{pF}$	0	4.5	-	-	75	-	94	-	113	ns
			-4.5	4.5	-	-	60	-	75	-	90	ns
		$C_L = 15\text{pF}$	-	5	-	35	-	-	-	-	-	ns
Maximum Switch Turn "ON" Delay 4351 S_n to V_{OS}	t_{PZH}, t_{PZL}	$C_L = 50\text{pF}$	0	4.5	-	-	75	-	94	-	113	ns
			-4.5	4.5	-	-	60	-	75	-	90	ns
		$C_L = 15\text{pF}$	-	5	-	35	-	-	-	-	-	ns
Maximum Switch Turn "OFF" Delay 4351 $\overline{E1}$ to V_{OS}	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	0	4.5	-	-	55	-	69	-	83	ns
			-4.5	4.5	-	-	40	-	50	-	60	ns
		$C_L = 15\text{pF}$	-	5	-	23	-	-	-	-	-	ns
Maximum Switch Turn "OFF" Delay 4351 $E2$ to V_{OS}	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	0	4.5	-	-	60	-	75	-	90	ns
			-4.5	4.5	-	-	50	-	63	-	75	ns
		$C_L = 15\text{pF}$	-	5	-	23	-	-	-	-	-	ns
Maximum Switch Turn "OFF" Delay 4351 $\overline{LE}$ to V_{OS}	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	0	4.5	-	-	60	-	75	-	90	ns
			-4.5	4.5	-	-	55	-	69	-	83	ns
Maximum Switch Turn "OFF" Delay 4351 S_n to V_{OS}	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	0	4.5	-	-	65	-	81	-	98	ns
			-4.5	4.5	-	-	55	-	69	-	83	ns
		$C_L = 15\text{pF}$	-	5	-	23	-	-	-	-	-	ns
Setup Time 4351 S_n to $\overline{LE}$		$C_L = 50\text{pF}$	0	4.5	-	-	12	-	15	-	18	ns
			-4.5	4.5	-	-	14	-	18	-	21	ns
Hold Time 4351 and 4352 S_n to $\overline{LE}$		$C_L = 50\text{pF}$	0	4.5	5	-	-	5	-	5	-	ns
			-4.5	4.5	5	-	-	5	-	5	-	ns
Pulse Width 4351 $\overline{LE}$	t_W	$C_L = 50\text{pF}$	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:

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

7. $P_D = C_{PD} V_{CC}^2 f_i + \sum (C_L + C_S) V_{CC}^2 f_o$ 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.

Typical Performance Curves

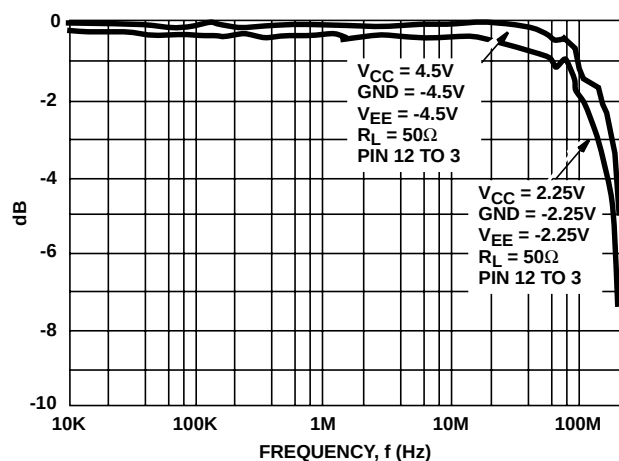


FIGURE 5. CHANNEL ON BANDWIDTH ('HC4351, CD74HCT4351)

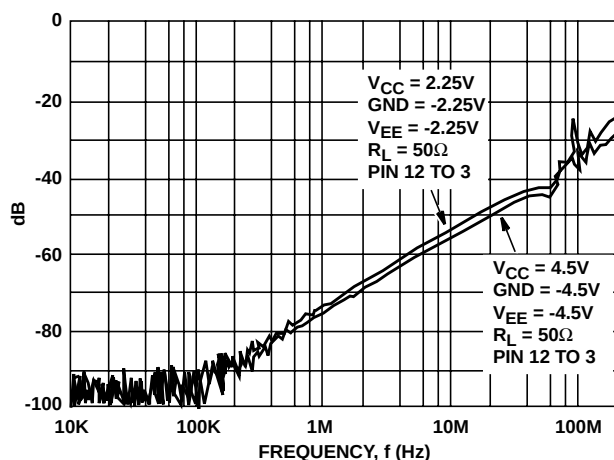


FIGURE 6. CHANNEL OFF FEEDTHROUGH ('HC4351, CD74HCT4351)

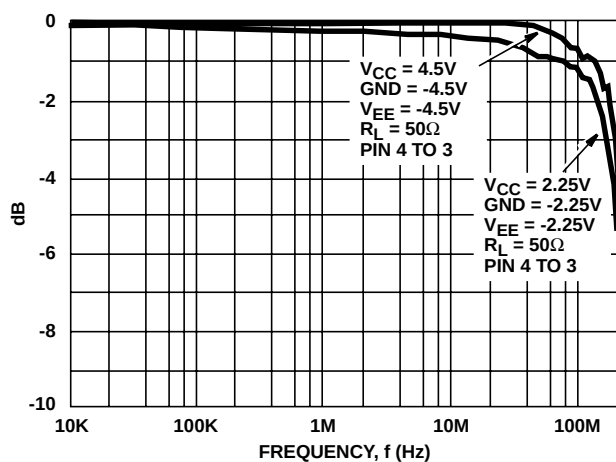


FIGURE 7. CHANNEL ON BANDWIDTH (CD74HC4352)

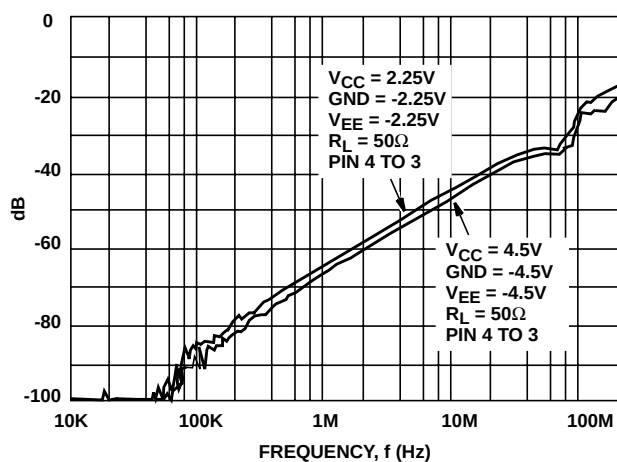


FIGURE 8. CHANNEL OFF FEEDTHROUGH (CD74HC4352)

Typical Performance Curves (Continued)

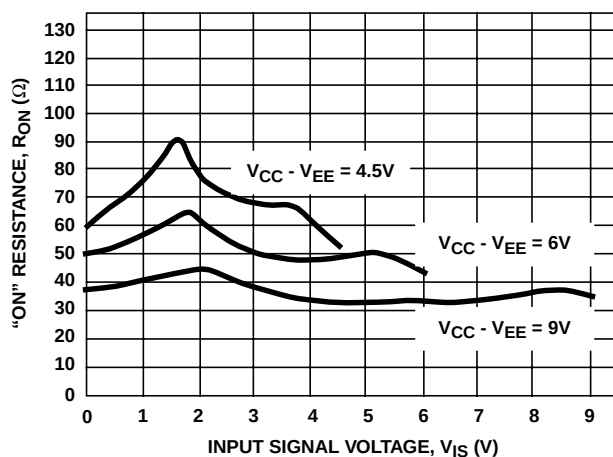


FIGURE 9. TYPICAL ON RESISTANCE vs INPUT SIGNAL VOLTAGE

Analog Test Circuits

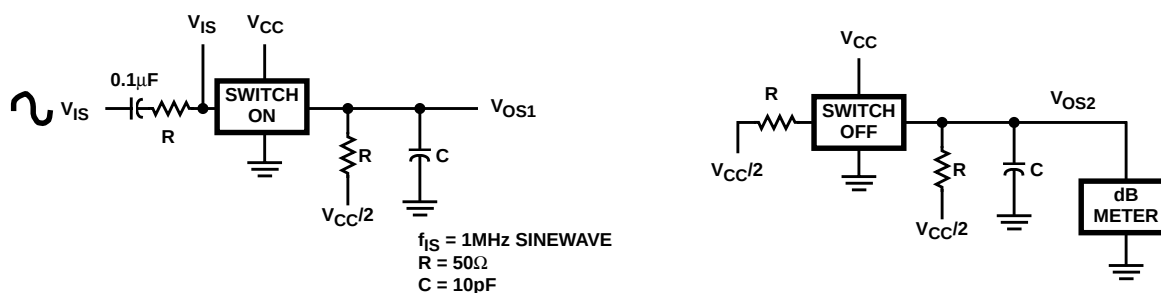


FIGURE 10. CROSSTALK BETWEEN TWO SWITCHES TEST CIRCUIT

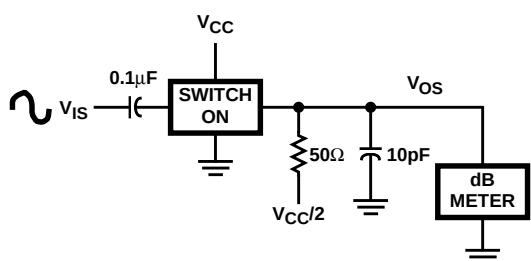


FIGURE 11. FREQUENCY RESPONSE TEST CIRCUIT

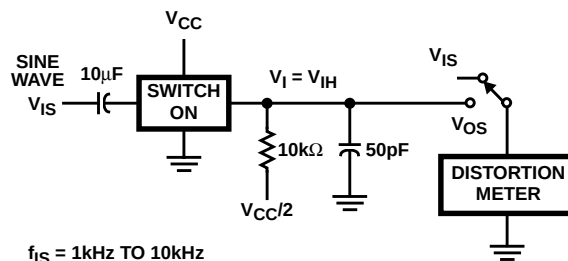


FIGURE 12. TOTAL HARMONIC DISTORTION TEST CIRCUIT

Analog Test Circuits (Continued)

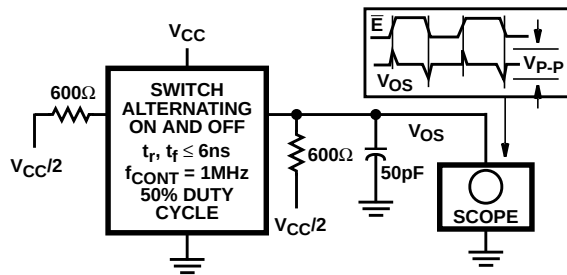


FIGURE 13. CONTROL-TO-SWITCH FEEDTHROUGH NOISE TEST CIRCUIT

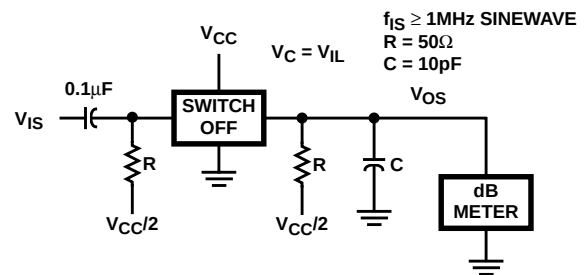
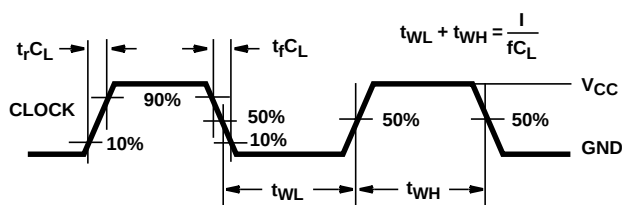


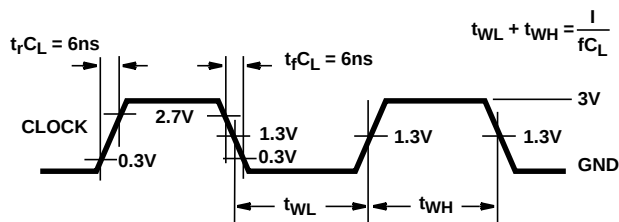
FIGURE 14. SWITCH OFF SIGNAL FEEDTHROUGH

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

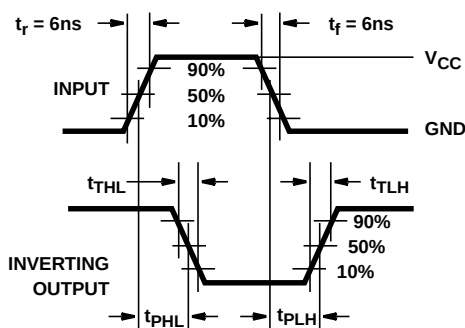


FIGURE 17. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

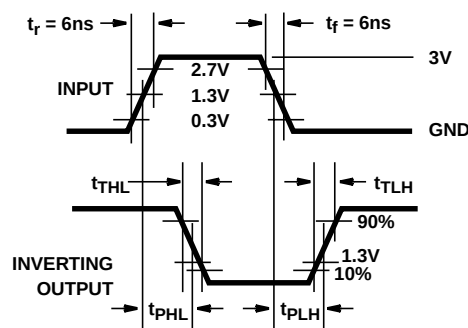


FIGURE 18. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

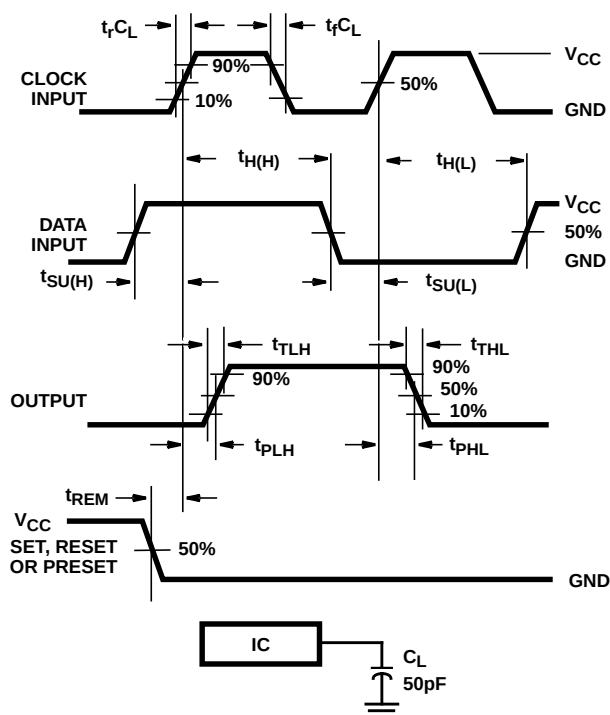


FIGURE 19. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

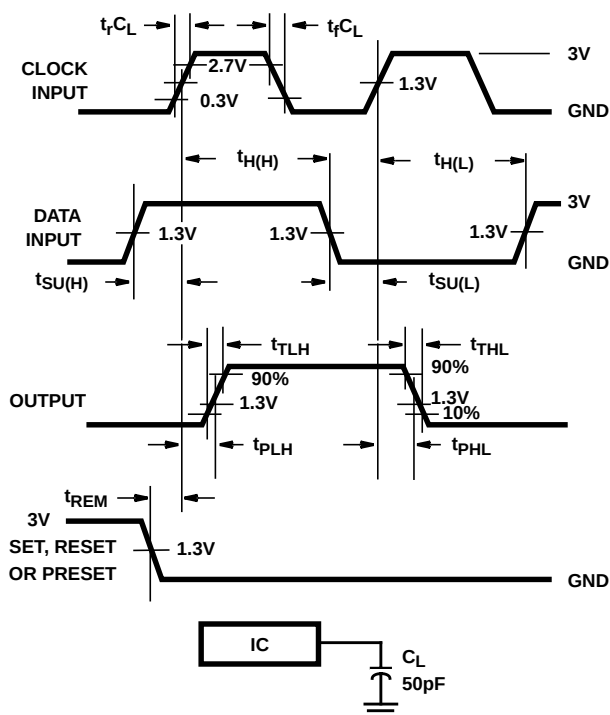


FIGURE 20. HCT SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

Test Circuits and Waveforms (Continued)

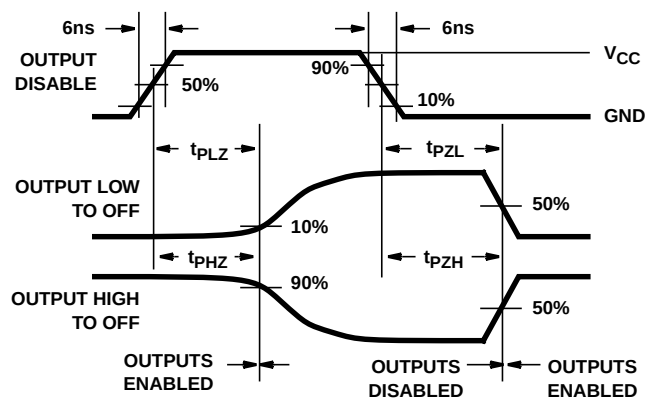


FIGURE 21. HC THREE-STATE PROPAGATION DELAY WAVEFORM

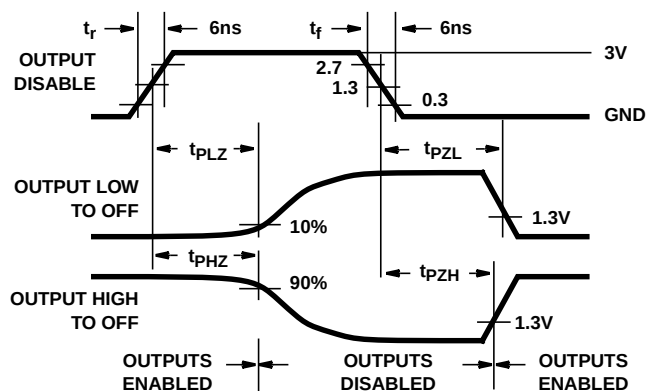
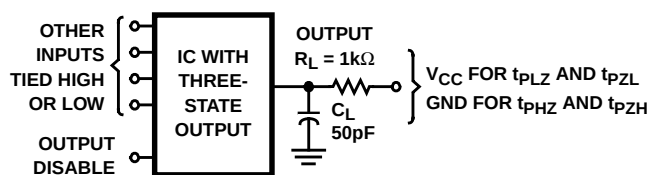


FIGURE 22. HCT THREE-STATE PROPAGATION DELAY WAVEFORM



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 part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
CD54HC4351F3A	Active	Production	CDIP (J) 20	20 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD54HC4351F3A
CD54HC4351F3A.A	Active	Production	CDIP (J) 20	20 TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	CD54HC4351F3A
CD74HC4351E	NRND	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC4351E
CD74HC4351E.A	NRND	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC4351E
CD74HC4351M	NRND	Production	SOIC (DW) 20	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4351M
CD74HC4351M.A	NRND	Production	SOIC (DW) 20	25 TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4351M
CD74HC4351M96	NRND	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4351M
CD74HC4351M96.A	NRND	Production	SOIC (DW) 20	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4351M
CD74HC4352E	Active	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC4352E
CD74HC4352E.A	Active	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HC4352E
CD74HCT4351E	NRND	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HCT4351E
CD74HCT4351E.A	NRND	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HCT4351E

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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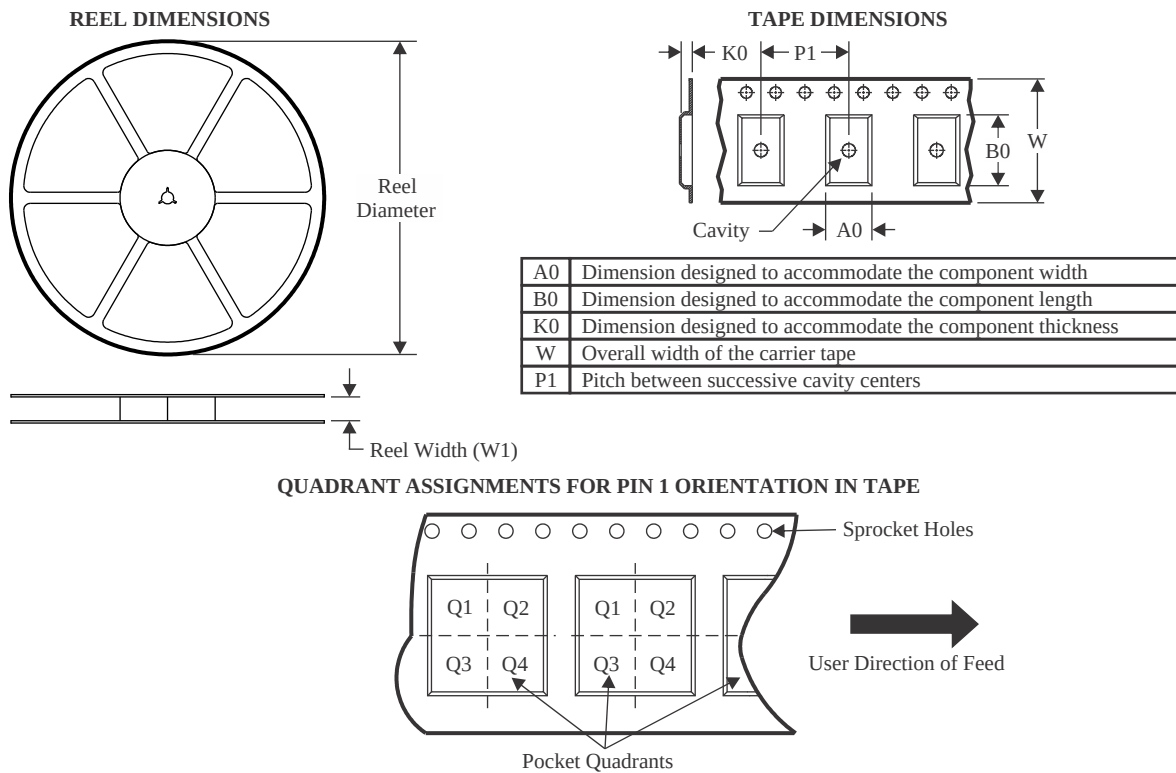
OTHER QUALIFIED VERSIONS OF CD54HC4351, CD74HC4351 :

- Catalog : [CD74HC4351](#)
- Military : [CD54HC4351](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

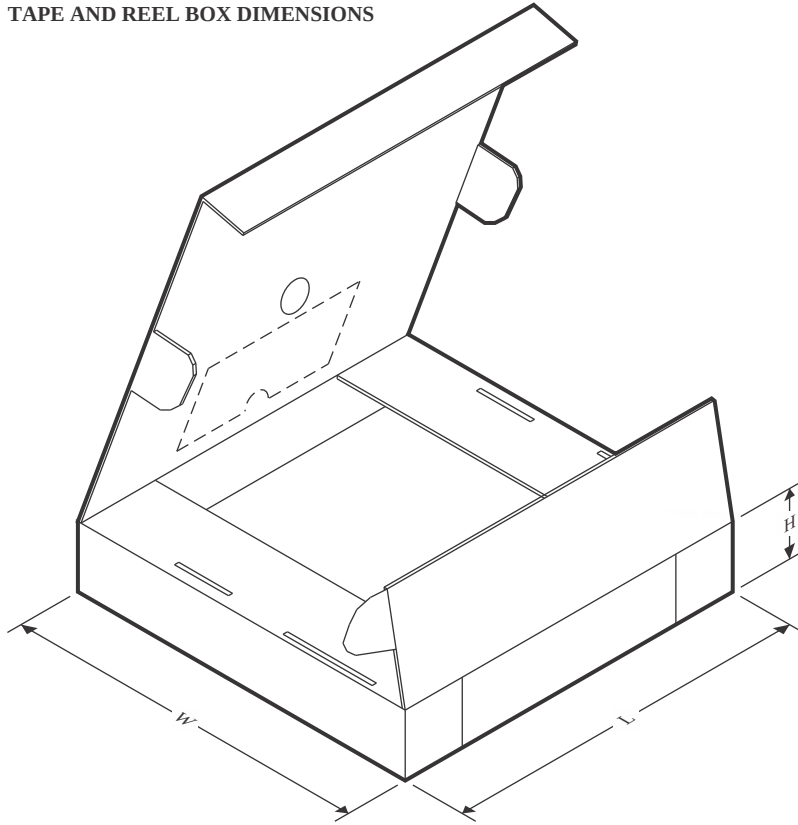
TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD74HC4351M96	SOIC	DW	20	2000	330.0	24.4	10.8	13.3	2.7	12.0	24.0	Q1

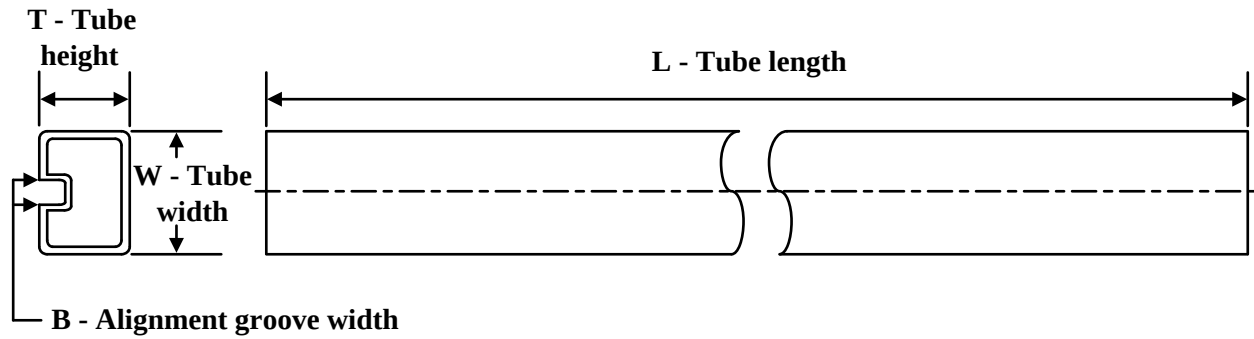
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74HC4351M96	SOIC	DW	20	2000	356.0	356.0	45.0

TUBE



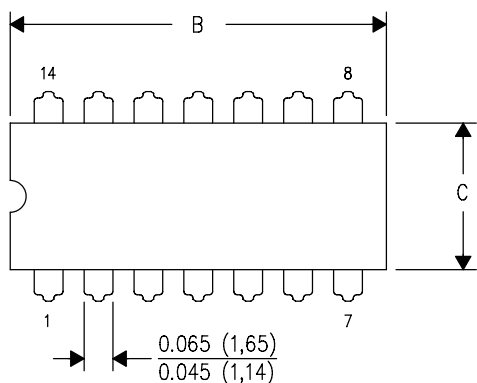
*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
CD74HC4351E	N	PDIP	20	20	506	13.97	11230	4.32
CD74HC4351E.A	N	PDIP	20	20	506	13.97	11230	4.32
CD74HC4351M	DW	SOIC	20	25	507	12.83	5080	6.6
CD74HC4351M.A	DW	SOIC	20	25	507	12.83	5080	6.6
CD74HC4352E	N	PDIP	20	20	506	13.97	11230	4.32
CD74HC4352E.A	N	PDIP	20	20	506	13.97	11230	4.32
CD74HCT4351E	N	PDIP	20	20	506	13.97	11230	4.32
CD74HCT4351E.A	N	PDIP	20	20	506	13.97	11230	4.32

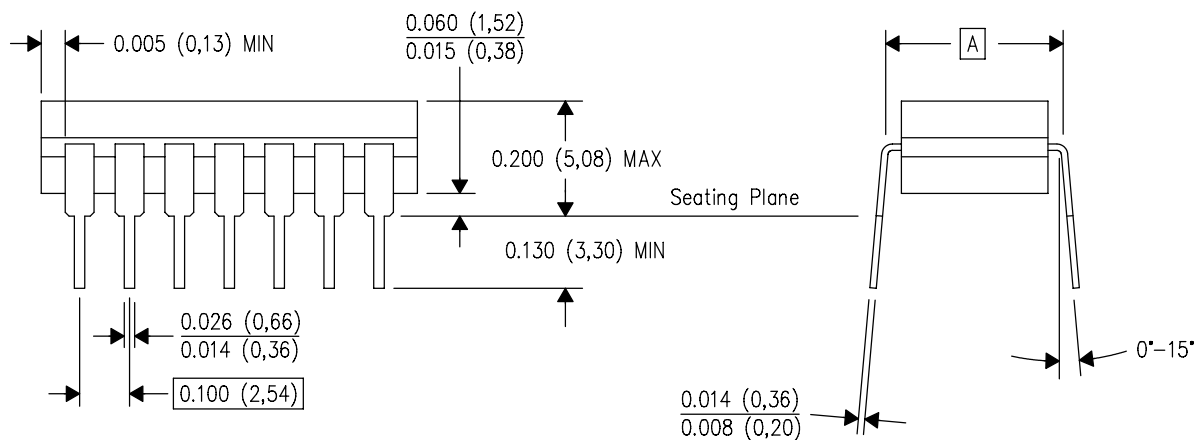
J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	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)



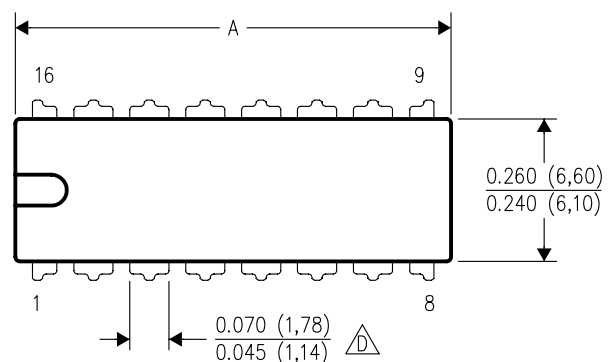
4040083/F 03/03

- 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.

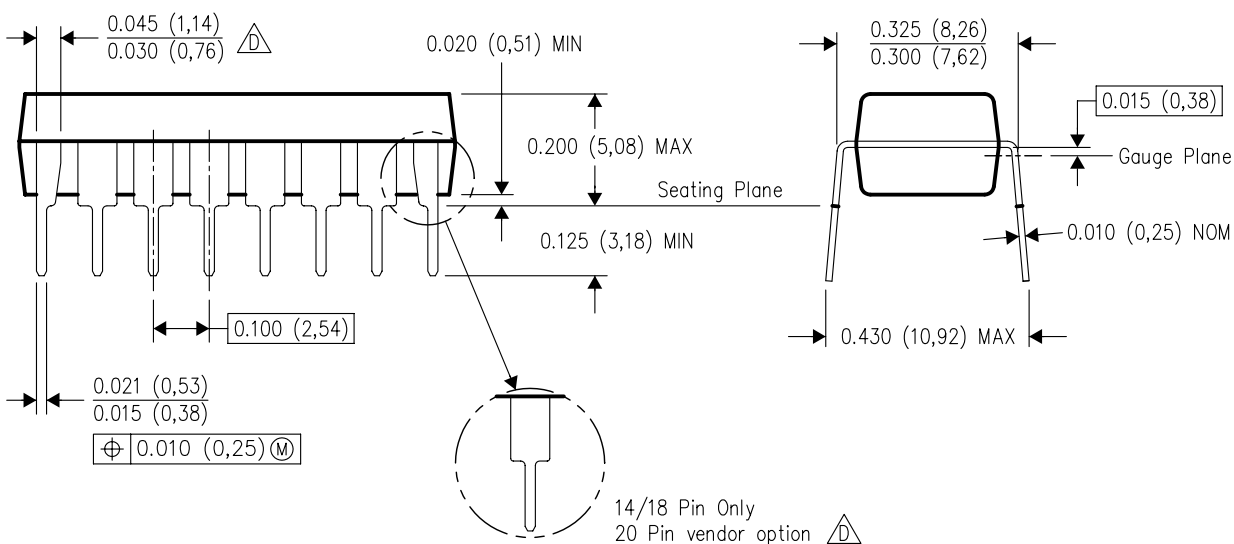
N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



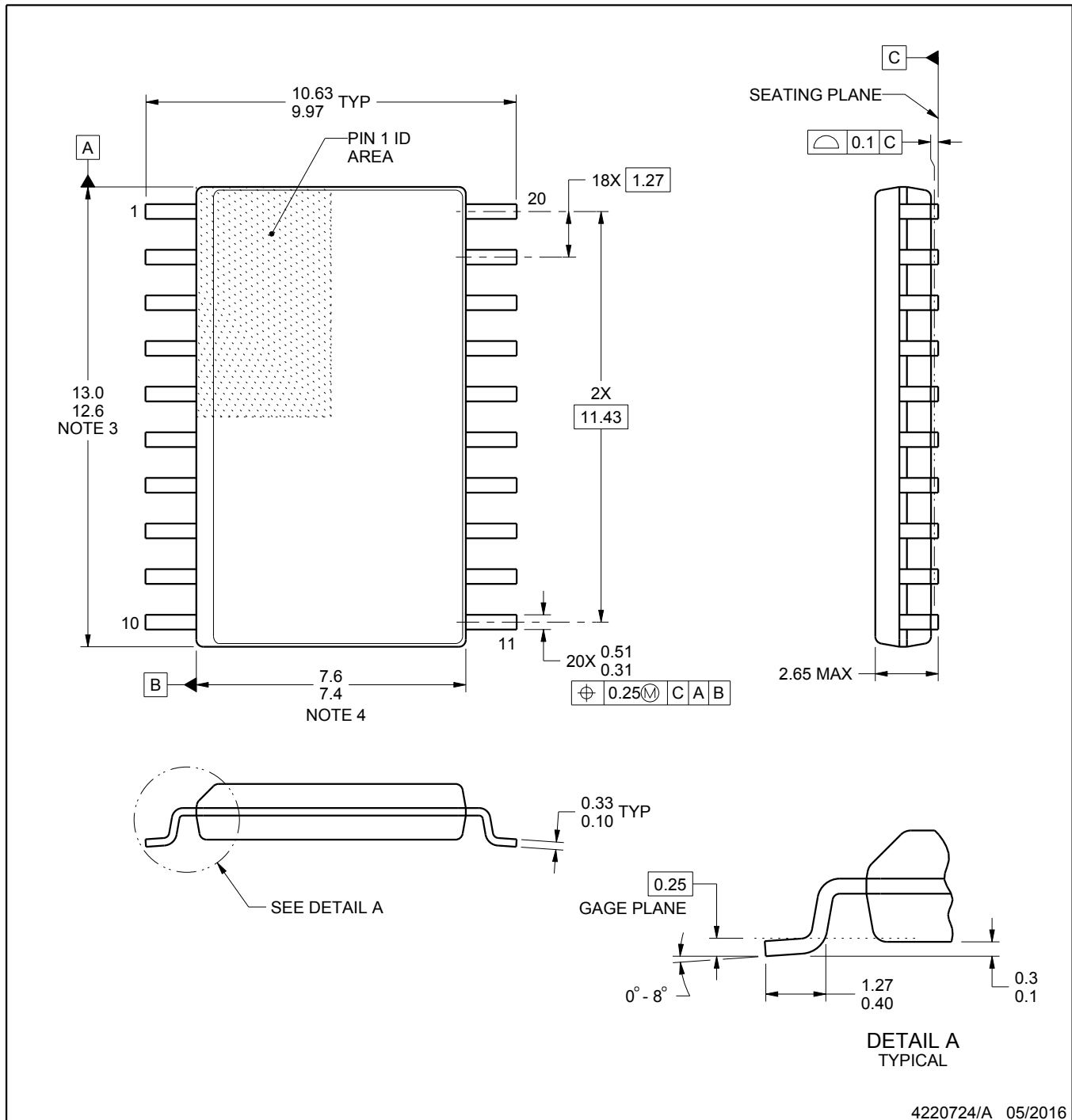
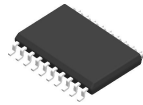
PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



4040049/E 12/2002

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.



4220724/A 05/2016

NOTES:

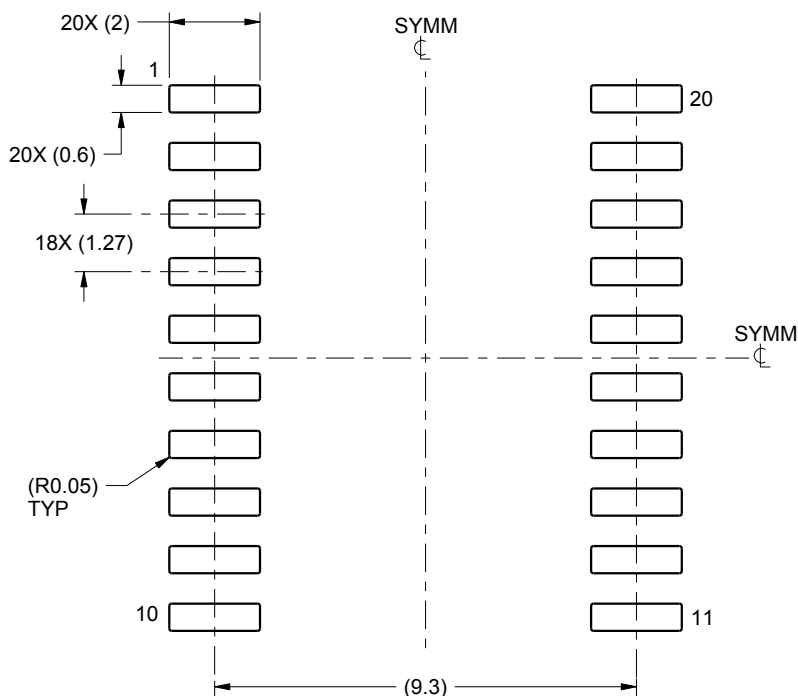
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.

EXAMPLE BOARD LAYOUT

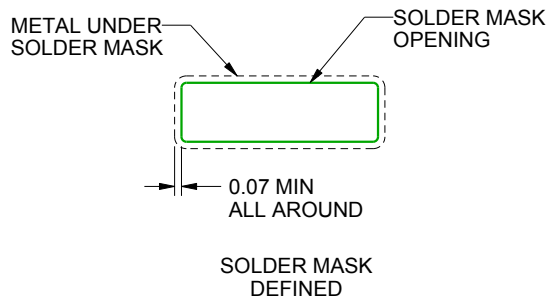
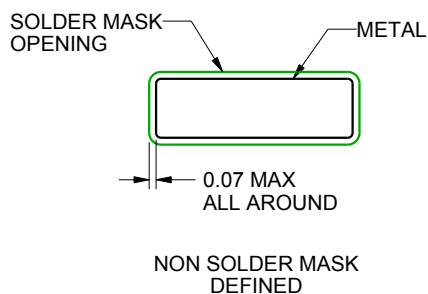
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

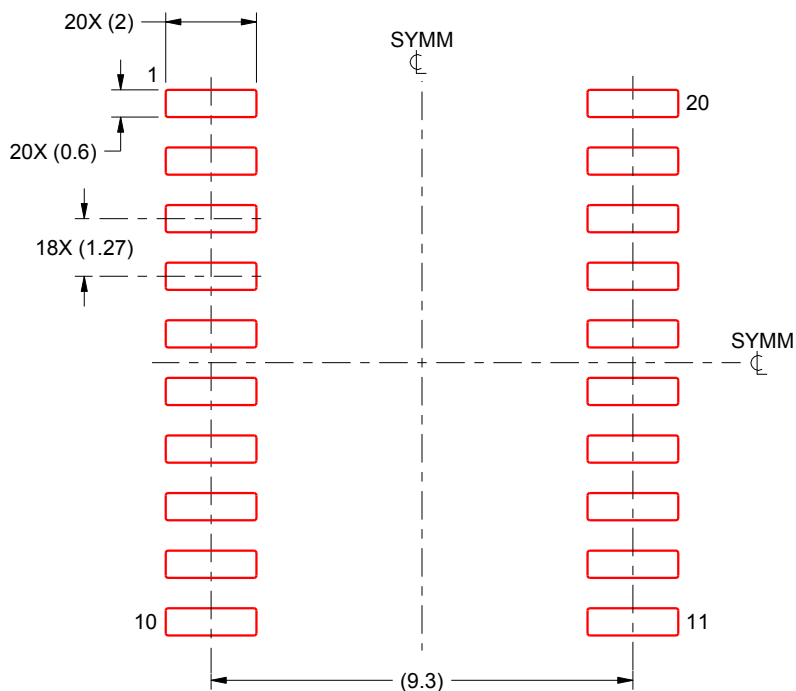
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

4220724/A 05/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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