CD54HC251, CD74HC251, CD54HCT251, CD74HCT251

Data sheet acquired from Harris Semiconductor
SCHS169C

High-Speed CMOS Logic 8-Input Multiplexer, Three-State

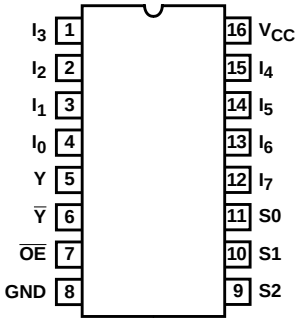
November 1997 - Revised October 2003

Features

- **Selects One of Eight Binary Data Inputs**
- **Three-State Output Capability**
- **True and Complement Outputs**
- **Typical (Data to Output) Propagation Delay of 14ns at V_{CC} = 5V, C_L = 15pF, T_A = 25^oC**
- **Fanout (Over Temperature Range)**
  - **Standard Outputs . . . . . 10 LSTTL Loads**
  - **Bus Driver Outputs . . . . . 15 LSTTL Loads**
- **Wide Operating Temperature Range . . . -55^oC to 125^oC**
- **Balanced Propagation Delay and Transition Times**
- **Significant Power Reduction Compared to LSTTL Logic ICs**
- **Alternate Source is Philips**
- **HC Types**
  - **2V to 6V Operation**
  - **High Noise Immunity: N_{IL} = 30%, N_{IH} = 30% of V_{CC} at V_{CC} = 5V**
- **HCT Types**
  - **4.5V to 5.5V Operation**
  - **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}**

Pinout

CD54HC251, CD54HCT251
(CERDIP)
CD74HC251, CD74HCT251
(PDIP, SOIC)
TOP VIEW



Description

The ’HC251 and ’HCT251 are 8-channel digital multiplexers with three-state outputs, fabricated with high-speed silicon-gate CMOS technology. Together with the low power consumption of standard CMOS integrated circuits, they possess the ability to drive 10 LSTTL loads. The three-state feature makes them ideally suited for interfacing with bus lines in a bus-oriented system.

This multiplexer features both true (Y) and complement ($\overline{Y}$) outputs as well as an output enable ($\overline{OE}$) input. The $\overline{OE}$ must be at a low logic level to enable this device. When the $\overline{OE}$ input is high, both outputs are in the high-impedance state. When enabled, address information on the data select inputs determines which data input is routed to the Y and $\overline{Y}$ outputs. The ’HCT251 logic family is speed, function, and pin-compatible with the standard ’LS251.

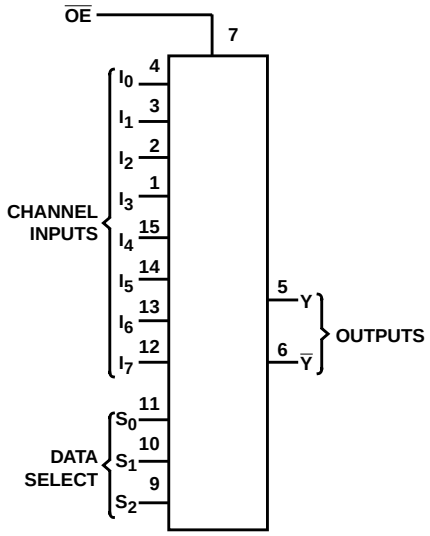
Ordering Information

PART NUMBER	TEMP. RANGE (^oC)	PACKAGE
CD54HC251F3A	-55 to 125	16 Ld CERDIP
CD54HCT251F3A	-55 to 125	16 Ld CERDIP
CD74HC251E	-55 to 125	16 Ld PDIP
CD74HC251M	-55 to 125	16 Ld SOIC
CD74HC251MT	-55 to 125	16 Ld SOIC
CD74HC251M96	-55 to 125	16 Ld SOIC
CD74HCT251E	-55 to 125	16 Ld PDIP
CD74HCT251M	-55 to 125	16 Ld SOIC
CD74HCT251MT	-55 to 125	16 Ld SOIC
CD74HCT251M96	-55 to 125	16 Ld SOIC

NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel. The suffix T denotes a small-quantity reel of 250.

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper IC Handling Procedures.

Functional Diagram



TRUTH TABLE

INPUTS				OUTPUT	
SELECT			OUTPUT CONTROL $\overline{OE}$	Y	$\overline{Y}$
S2	S1	S0			
X	X	X	H	Z	Z
L	L	L	L	I_0	$\overline{I}_0$
L	L	H	L	I_1	$\overline{I}_1$
L	H	L	L	I_2	$\overline{I}_2$
L	H	H	L	I_3	$\overline{I}_3$
H	L	L	L	I_4	$\overline{I}_4$
H	L	H	L	I_5	$\overline{I}_5$
H	H	L	L	I_6	$\overline{I}_6$
H	H	H	L	I_7	$\overline{I}_7$

H = High Voltage Level, L = Low Voltage Level, X = Don't Care, Z = High Impedance (Off), I_0, I_1...I_7 = the level of the respective input.

Absolute Maximum Ratings

DC Supply Voltage, V_{CC} . . . . . -0.5V to 7V
DC Input Diode Current, I_{IK}
For V_I < -0.5V or V_I > V_{CC} + 0.5V . . . . . ±20mA
DC Output Diode Current, I_{OK}
For V_O < -0.5V or V_O > V_{CC} + 0.5V . . . . . ±20mA
DC Drain Current, per Output, I_O
For -0.5V < V_O < V_{CC} +0.5V . . . . . ±25mA
DC Output Source or Sink Current per Output Pin, I_O
For V_O > -0.5V or V_O < V_{CC} + 0.5V . . . . . ±25mA
DC V_{CC} or Ground Current, I_{CC} . . . . . ±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
DC Input or Output Voltage, V_I, V_O . . . . . 0V to V_{CC}
Input Rise and Fall Time
2V . . . . . 1000ns (Max)
4.5V. . . . . 500ns (Max)
6V . . . . . 400ns (Max)

Thermal Information

Thermal Resistance (Typical, Note 1)	θ_{JA} (°C/W)
E (PDIP) Package	67
M (SOIC) Package	73

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)

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.
NOTE:

1. The package thermal impedance is calculated in accordance with JESD 51-7.

DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V_I (V)	I_O (mA)		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
High Level Output Voltage CMOS Loads	V_{OH}	V_{IH} or V_{IL}	-0.02	2	1.9	-	-	1.9	-	1.9	-	V
			-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
			-0.02	6	5.9	-	-	5.9	-	5.9	-	V
High Level Output Voltage TTL Loads			-	-	-	-	-	-	-	-	-	V
			-4	4.5	3.98	-	-	3.84	-	3.7	-	V
			-5.2	6	5.48	-	-	5.34	-	5.2	-	V
Low Level Output Voltage CMOS Loads	V_{OL}	V_{IH} or V_{IL}	0.02	2	-	-	0.1	-	0.1	-	0.1	V
			0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
			0.02	6	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads			-	-	-	-	-	-	-	-	-	V
			4	4.5	-	-	0.26	-	0.33	-	0.4	V
			5.2	6	-	-	0.26	-	0.33	-	0.4	V

DC Electrical Specifications (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS		V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V_I (V)	I_O (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Input Leakage Current	I_I	V_{CC} or GND	-	6	-	-	±0.1	-	±1	-	±1	µA
Quiescent Device Current	I_{CC}	V_{CC} or GND	0	6	-	-	8	-	80	-	160	µA
Three-State Leakage Current	-	V_{IL} or V_{IH}	V_O = V_{CC} or GND	6	-	-	±0.5	-	±5.0	-	±10	µA
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
High Level Output Voltage CMOS Loads	V_{OH}	V_{IH} or V_{IL}	-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
High Level Output Voltage TTL Loads			-4	4.5	3.98	-	-	3.84	-	3.7	-	V
Low Level Output Voltage CMOS Loads	V_{OL}	V_{IH} or V_{IL}	0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads			4	4.5	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I_I	V_{CC} and GND	0	5.5	-		±0.1	-	±1	-	±1	µA
Quiescent Device Current	I_{CC}	V_{CC} or GND	0	5.5	-	-	8	-	80	-	160	µA
Three-State Leakage Current	-	V_{IL} or V_{IH}	V_O = V_{CC} or GND	6	-	-	±0.5	-	±5.0	-	±10	µA
Additional Quiescent Device Current Per Input Pin: 1 Unit Load	ΔI_{CC} (Note 2)	V_{CC} -2.1	-	4.5 to 5.5	-	100	360	-	450	-	490	µA

NOTE:

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

HCT Input Loading Table

INPUT	UNIT LOADS
S0, S1, S2	0.55
I0 - I7	0.5
$\overline{OE}$	2.65

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

Switching Specifications Input t_r, t_f = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	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	t_{PLH}, t_{PHL}	C_L = 50pF	2	-	-	245	-	305	-	370	ns
Select to Outputs			4.5	-	-	49	-	61	-	74	ns
		C_L =15pF	5	-	21	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	42	-	52	-	63	ns
Data to Outputs	t_{PLH}, t_{PHL}	C_L = 50pF	2	-	-	175	-	220	-	265	ns
			4.5	-	-	35	-	44	-	53	ns
		C_L =15pF	5	-	12	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	30	-	37	-	45	ns
Enable to High Z and Enable from High Z	t_{PLH}, t_{PHL}	C_L = 50pF	2	-	-	140	-	175	-	210	ns
			4.5	-	-	28	-	35	-	42	ns
		C_L =15pF	5	-	11	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	24	-	30	-	36	ns
Output Transition Time	t_{TLH}, t_{THL}	C_L = 50pF	2	-	-	75	-	95	-	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
Input Capacitance	C_{IN}	-	-	-	-	10	-	10	-	10	pF
Three-State Output Capacitance	CO	-	-	-	-	15	-	15	-	15	pF
Power Dissipation Capacitance (Notes 3, 4)	C_{PD}	-	5	-	60	-	-	-	-	-	pF
HCT TYPES											
Propagation Delay	t_{PLH}, t_{PHL}										
Select to Outputs		C_L = 50pF	4.5	-	-	42	-	53	-	63	ns
		C_L =15pF	5	-	18	-	-		-	-	ns
Data to Outputs	t_{PLH}, t_{PHL}	C_L = 50pF	4.5	-	-	35	-	44	-	53	ns
		C_L =15pF	5	-	12	-	-	-	-	-	ns
Enable to High Z and Enable from High Z	t_{PLH}, t_{PHL}	C_L = 50pF	4.5	-		30	-	38	-	45	ns
		C_L =15pF	5	-	12	-	-	-	-	-	ns
Output Transition Time	t_{TLH}, t_{THL}	C_L = 50pF	4.5	-	-	15	-	19	-	22	ns
Input Capacitance	C_{IN}	-	-	-	-	10	-	10	-	10	pF
Power Dissipation Capacitance (Notes 3, 4)	C_{PD}	-	5		60	-	-	-	-	-	pF

NOTES:

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

Test Circuits and Waveforms

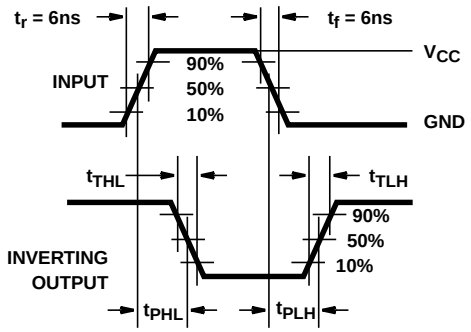


FIGURE 1. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

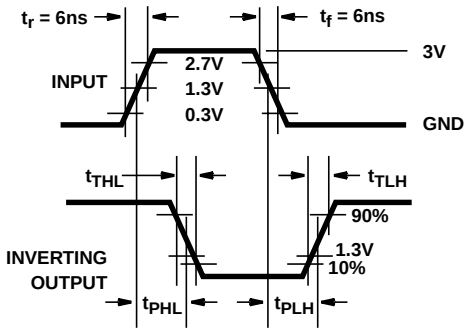


FIGURE 2. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

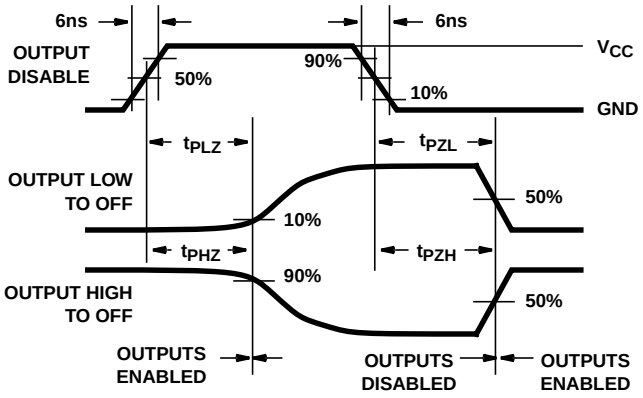


FIGURE 3. HC THREE-STATE PROPAGATION DELAY WAVEFORM

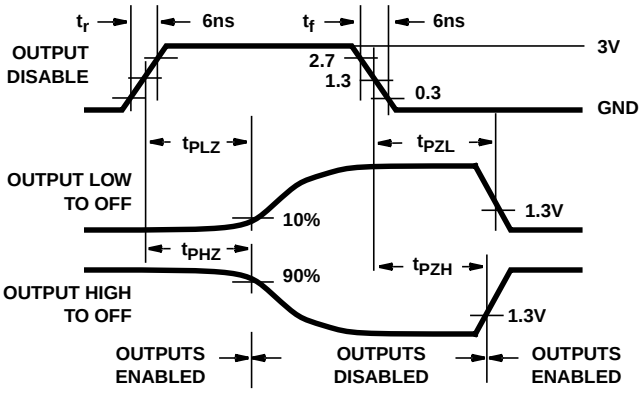
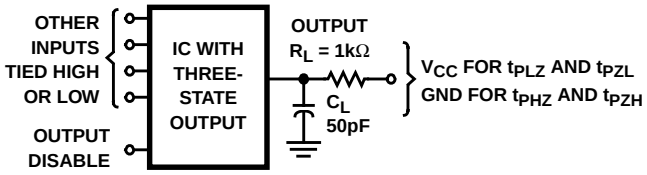


FIGURE 4. HCT THREE-STATE PROPAGATION DELAY WAVEFORM



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 = 1kΩ to V_{CC}, C_L = 50pF.

FIGURE 5. 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)
5962-9052401MEA	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
CD54HC251F	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
CD54HC251F3A	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
CD54HCT251F3A	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
CD74HC251E	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HC251EE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HC251M	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC251M96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC251M96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC251M96G4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC251ME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC251MG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC251MT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC251MTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HC251MTG4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT251E	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HCT251EE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD74HCT251M	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT251M96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT251M96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT251M96G4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT251ME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT251MG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT251MT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT251MTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD74HCT251MTG4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

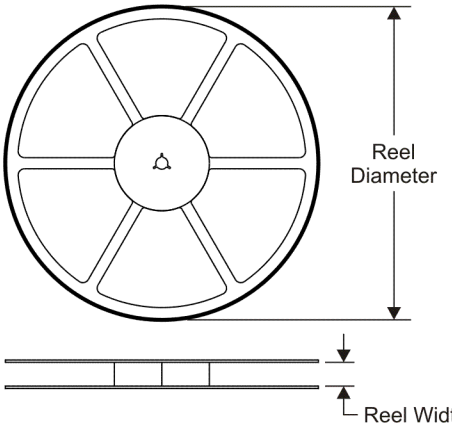
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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), Pb-Free (RoHS Exempt), 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.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
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)

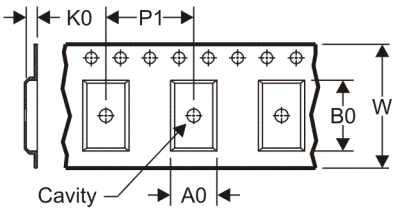
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

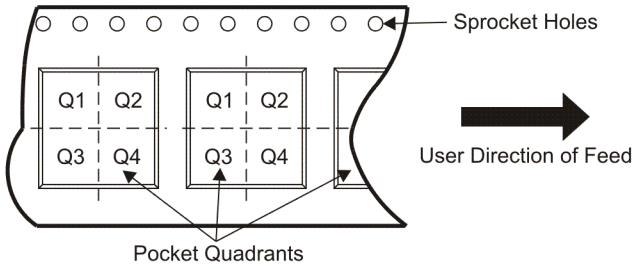


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

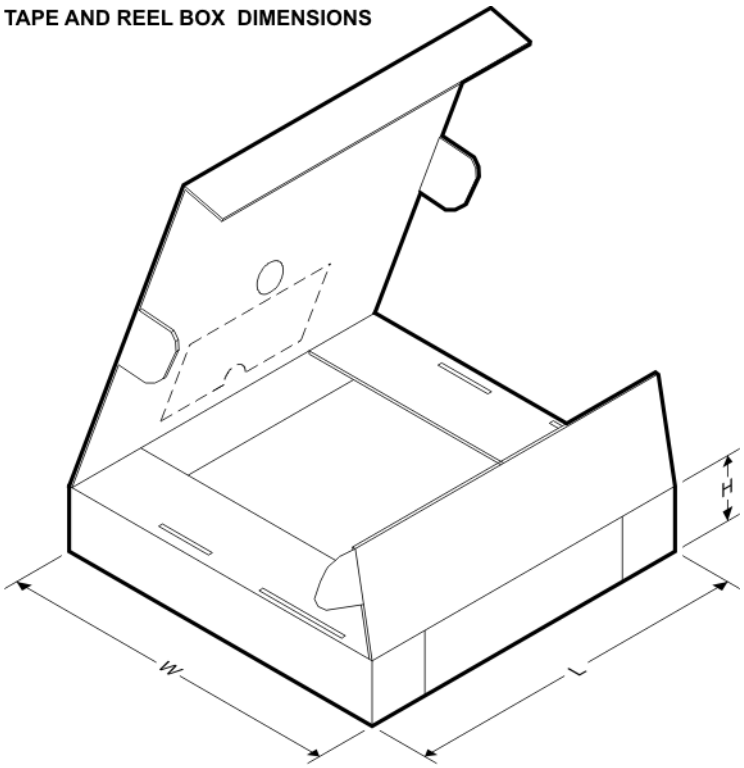
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CD74HC251M96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD74HCT251M96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



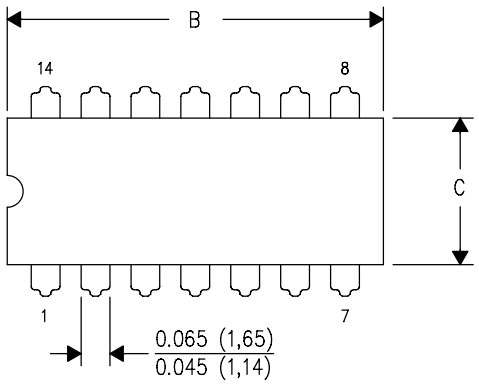
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74HC251M96	SOIC	D	16	2500	333.2	345.9	28.6
CD74HCT251M96	SOIC	D	16	2500	333.2	345.9	28.6

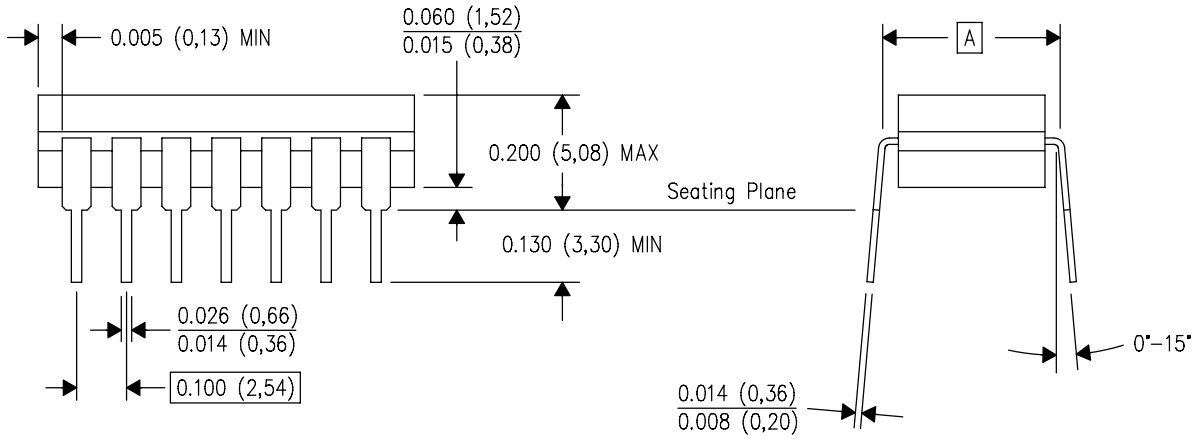
J (R–GDIP–T**)

14 LEADS SHOWN

CERAMIC DUAL IN–LINE PACKAGE



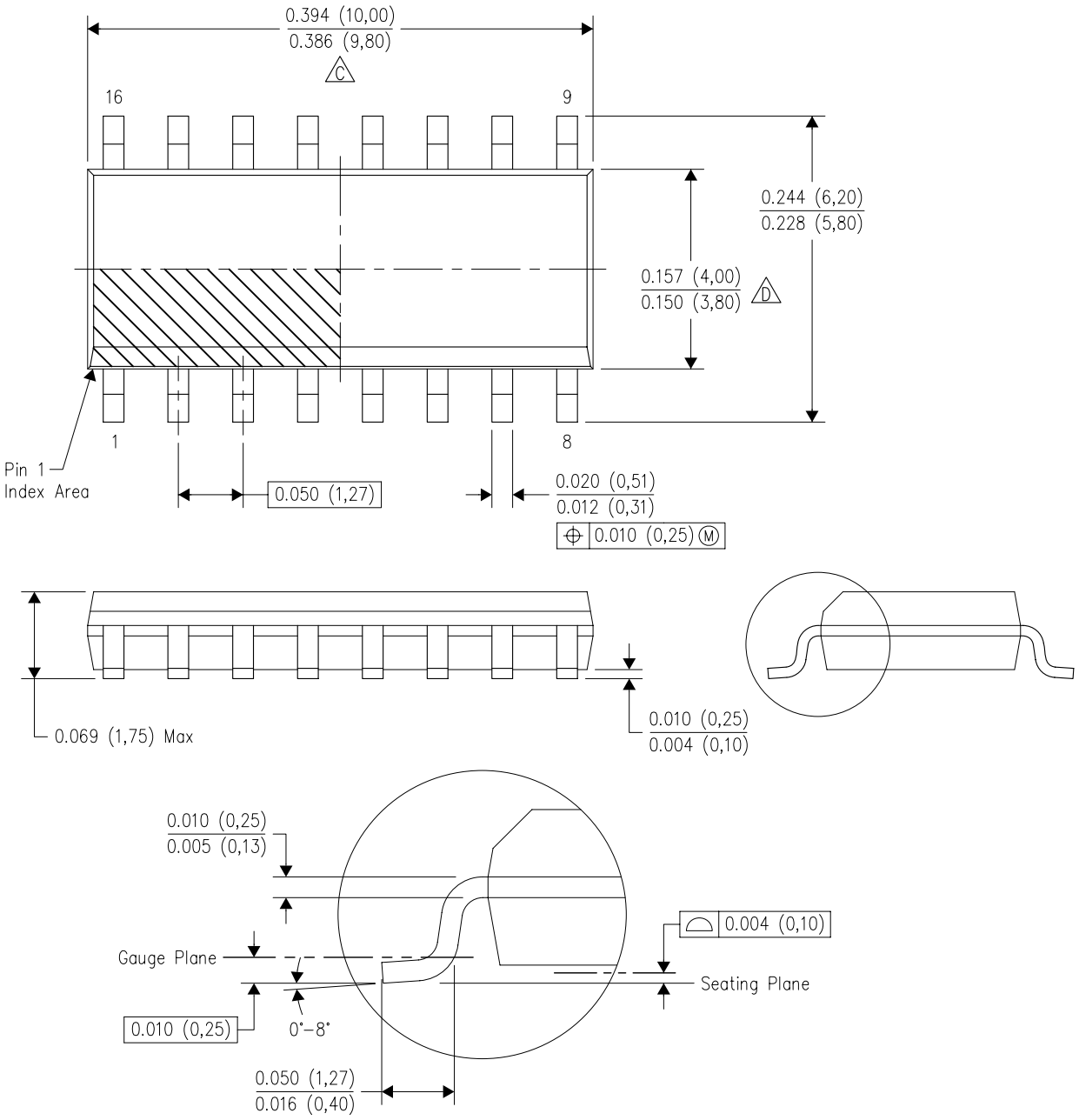
DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

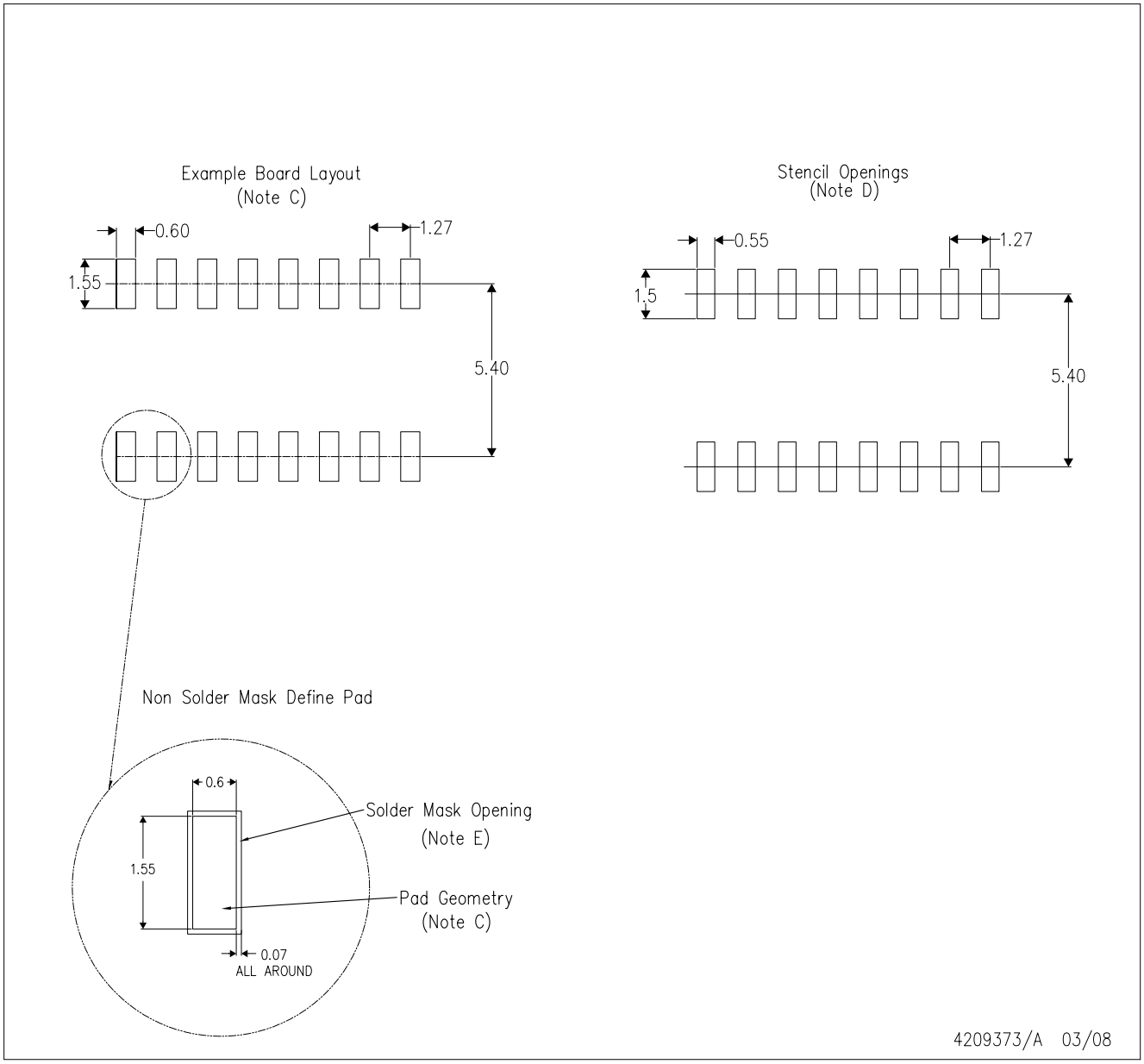
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls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

D (R–PDSO–G16) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
E. Reference JEDEC MS–012 variation AC.

D(R–PDSO–G16)

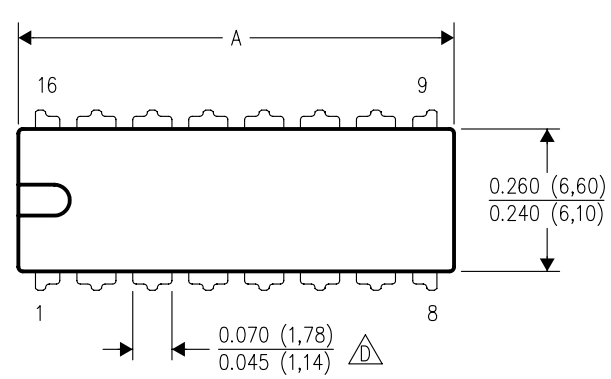


NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Refer to IPC7351 for alternate board design.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

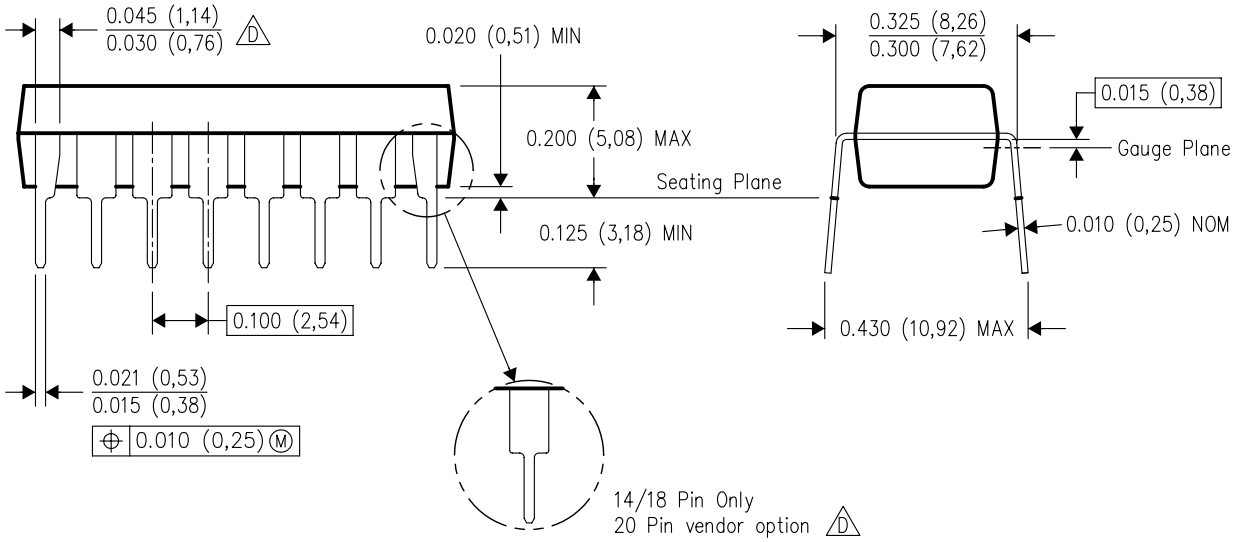
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



DIM \ PINS **	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 (C)	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.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

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