

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

SCLS459A - June 2001 - Revised May 2003

Features

- Edge-Triggered Data Flip-Flops
 - Transparent Select Latches
- Buffered Inputs
- 3-State Complementary Outputs
- Bus Line Driving Capability
- Typical Propagation Delay: $V_{CC} = 5V$, $C_L = 15pF$, $T_A = 25^{o}C$
 - Clock to Output = 22ns
- Fanout (Over Temperature Range)
 - Standard Outputs......10 LSTTL Loads
 - Bus Driver Outputs 15 LSTTL Loads
- Wide Operating Temperature Range ... -55°C to 125°C
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- 4.5V to 5.5V Operation
- Direct LSTTL Input Logic Compatibility, V_{IL}= 0.8V (Max), V_{IH} = 2V (Min)
- CMOS Input Compatibility, $I_I \le 1\mu A$ at V_{OL} , V_{OH}

Description

The CD74HCT356 consists of data selectors/multiplexers that select one of eight sources. The data select bits (S0, S1, and S2) are stored in transparent latches that are enabled by a low latch enable input ($\overline{\text{LE}}$).

The data is stored in edge-triggered flip-flops that are triggered by a low-to-high clock transition.

In both types the 3-state outputs are controlled by three output-enable inputs (OE1, OE2, and OE3).

Ordering Information

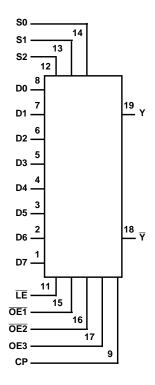
PART NUMBER	TEMP. RANGE (°C)	PACKAGE
CD74HCT356E	-55 to 125	20 Ld PDIP
CD74HCT356M96	-55 to 125	20 Ld SOIC

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

Pinout

CD74HCT356 (PDIP or SOIC) **TOP VIEW** D7 1 20 V_{CC} D6 2 Υ 19 18 Y D5 3 17 OE3 D4 4 16 OE2 D3 5 D2 6 15 OE1 D1 7 14 S0 13 S1 D0 8 CP 9 12 S2 11 LE GND 10

Functional Diagram



TRUTH TABLE

			INPUTS					
SE	LECT (NOTE	1)	СГОСК	ou	TPUT ENABL	_ES	оиті	PUTS
S2	S1	S0	СР	OE1 OE2 OE3		OE3	Ÿ	Y
Х	Х	Х	Х	Н	Х	Х	Z	Z
Х	Х	Х	Х	Х	Н	Х	Z	Z
Х	Х	Х	Х	Х	Х	L	Z	Z
L	L	L	1	L	L	Н	D0	D0
L	L	L	H or L	L	L	Н	_{D0} _n	D0 _n
L	L	Н	1	L	L	Н	D1	D1
L	L	Н	H or L	L	L	Н	□1 _n	D1 _n
L	Н	L	1	L	L	Н	D2	D2
L	Н	L	H or L	L	L	Н	Ū2 _n	D2 _n
L	Н	Н	1	L	L	Н	D3	D3
L	Н	Н	H or L	L	L	Н	Ū3 _n	D3 _n
Н	L	L	1	L	L	Н	D4	D4
Н	L	L	H or L	L	L	Н	D4 _n	D4 _n
Н	L	Н	1	L	L	Н	D5	D5
Н	L	Н	H or L	L	L	Н	D5 _n	D5 _n
Н	Н	L	1	L	L	Н	D6	D6
Н	Н	L	H or L	L	L	Н	D6 _n	D6 _n

CD74HCT356

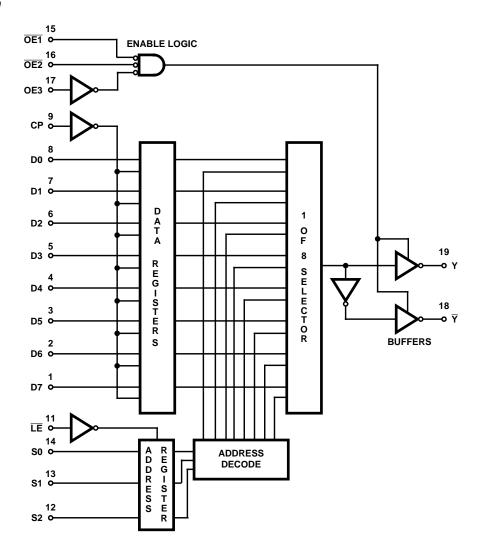
TRUTH TABLE (Continued)

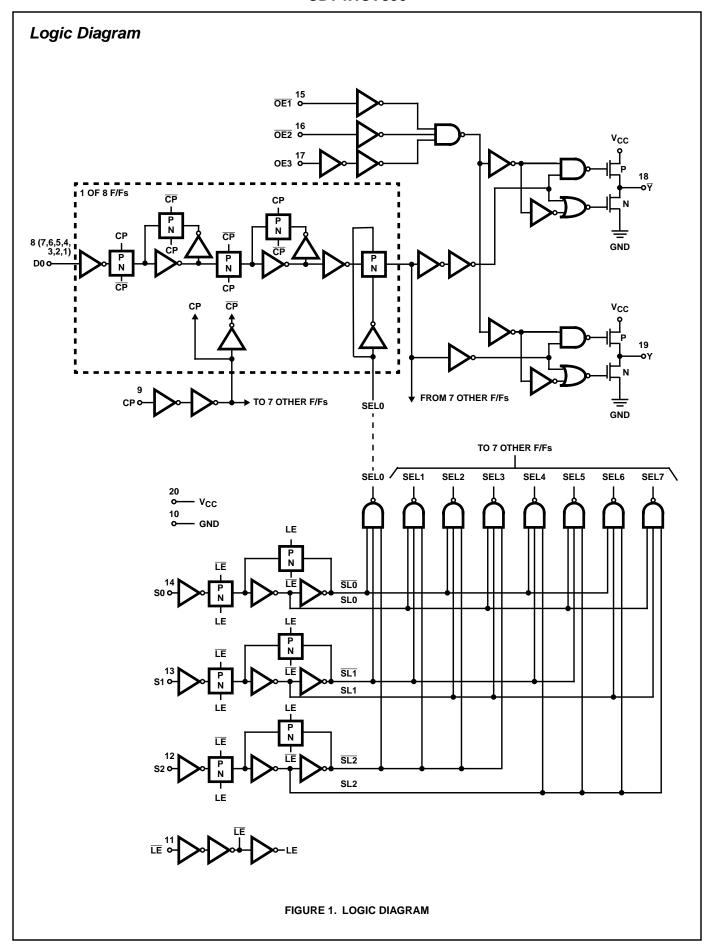
SE	LECT (NOTE	1)	CLOCK	OU	TPUT ENABL	OUTPUTS		
S2	S1	S0	СР	OE1	OE2	Ÿ	Y	
Н	Н	Н	1	L	L	D7	D7	
Н	Н	Н	H or L	L	L	Н	Ū7 _n	D7 _n

 $H = High\ \mbox{Voltage Level (Steady State)}; \ L = Low\ \mbox{Voltage Level (Steady State)}; \ \Upsilon = Transition\ from\ Low\ to\ High\ Level; \\ X = Don't\ Care; \ Z = High-Impedance\ State\ (Off\ State); \ D0_n...D7_n = the\ level\ of\ steady-state\ inputs\ D0\ through\ D7,\ respectively, before\ the\ most\ recent\ low-to-high\ transition\ of\ data\ control. \\ NOTE:$

1. This column shows the input address setup with $\overline{\text{LE}}$ low.

Block Diagram





CD74HCT356

Absolute Maximum Ratings

DC Supply Voltage, V _{CC} 0.5V to 7V
DC Input Diode Current, I _{IK}
For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$
DC Output Diode Current, I _{OK}
For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$
DC Drain Current, per Output, IO
For $-0.5V < V_O < V_{CC} + 0.5V$
DC Output Source or Sink Current per Output Pin, IO
For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$
DC V _{CC} or Ground Current, I _{CC}

Thermal Information

Thermal Resistance (Typical, Note 2)	θ_{JA} (oC/W)
E (PDIP) Package	69
M (SOIC) Package	58
Maximum Junction Temperature	150 ⁰ C
Maximum Storage Temperature Range	65°C to 150°C
Maximum Lead Temperature (Soldering 10s)	300 ^o C
(SOIC - Lead Tips Only)	

Operating Conditions

Temperature Range, T _A	55°C to 125°C
Supply Voltage Range, V _{CC}	
DC Input or Output Voltage, $V_I, V_O \dots$	0V to $V_{\mbox{\footnotesize CC}}$
Input Rise and Fall Time	
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.

NOTE:

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

DC Electrical Specifications

		1	ST ITIONS			25°C	25°C -40°C TO 85°C		O 85°C	-55°C T	O 125°C	
PARAMETER	SYMBOL	V _I (V)	I _O (mA)	V _{CC} (V)	MIN	TYP	MAX	MIN	MAX	MIN	MAX	UNITS
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	Voн	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	lį	V _{CC} to GND	0	5.5	-	-	±0.1	-	±1	-	±1	μА
Quiescent Device Current	Icc	V _{CC} or GND	0	5.5	-	-	8	-	80	-	160	μА
Additional Quiescent Device Current Per Input Pin: 1 Unit Load	ΔI _{CC} (Note 3)	V _{CC} -2.1	-	4.5 to 5.5	-	100	360	-	450	-	490	μА
3-State Leakage Current	l _{OZ}	V _{IL} or V _{IH}	V _O = V _{CC} or GND	5.5	-	-	±0.5	-	±5	-	±10	μА

NOTE:

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

CD74HCT356

Input Loading Table

INPUT	UNIT LOADS
D0-D7	0.50
S0, S1, S3	0.70
OE1, OE2	0.80
OE3	0.25
LE	0.25
СР	0.60

NOTE: Unit Load is ΔI_{CC} limit specified in DC Electrical Specifications table, e.g., 360 μ A max at 25 o C.

Prerequisite For Switching Specifications

		TEST V _{CC}		25°C		-40°C TO 85°C		-55°C TO 125°C			
PARAMETER	SYMBOL	CONDITIONS			TYP	MAX	MIN	MAX	MIN	MAX	UNITS
CP Pulse Width	t _{PLH} , t _{PHL}	-	4.5	16	20	-	25	-	30	-	ns
LE Pulse Width	t _{PLH} , t _{PHL}	-	4.5	16	20	-	25	-	30	-	ns
Setup Times $\operatorname{Dn} \to \overline{\operatorname{E}}$	t _{SU}	-	4.5	5	7	-	9	-	11	-	ns
Setup Times Sn $\rightarrow \overline{\text{LE}}$	tsu	-	4.5	5	7	-	9	-	11	-	ns
$Hold\ Times\ Dn \to \overline{E}$	t _H	-	4.5	9	9	-	11	-	14	-	ns
Hold Times Sn $\rightarrow \overline{\text{LE}}$	t _H	-	4.5	12	12	-	15	-	18	-	ns

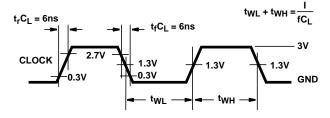
Switching Specifications Input t_r , $t_f = 6ns$

		TEST		25	°C	-40°C TO 85°C	-55°C TO 125°C		
PARAMETER	SYMBOL	CONDITIONS	V _{CC} (V)	TYP	MAX	MAX	MAX	UNITS	
Propagation Delay,	t _{PLH} , t _{PHL}	C _L = 50pF	4.5	-	51	64	77	ns	
$CP \rightarrow Y, \overline{Y}$		C _L = 15pF	5	22	-	-	-	ns	
Propagation Delay,	t _{PLH} , t _{PHL}	C _L = 50pF	4.5	-	59	74	89	ns	
$Sn \rightarrow Y, \overline{Y}$		C _L = 15pF	5	25	-	-	-	ns	
Propagation Delay, $\overline{\text{LE}} \to Y, \overline{Y}$	t _{PLH} , t _{PHL}	C _L = 50pF	4.5	-	63	79	94	ns	
		C _L = 15pF	5	25	-	-	=	ns	
Output Disabling Time	t _{PLZ} , t _{PHZ}	C _L = 50pF	4.5	-	33	41	50	ns	
	t _{PLZ}	C _L = 15pF	5	13	-	-	-	ns	
	t _{PHZ}	C _L = 15pF	5	15	-	-	=	ns	
Output Enabling Time	t _{PLZ} , t _{PHZ}	C _L = 50pF	4.5	-	34	43	51	ns	
		C _L = 15pF	5	14	-	-	-	ns	
Output Transition Time	t _{TLH} , t _{THL}	C _L = 50pF	4.5	-	12	15	18	ns	
Input Capacitance	C _{IN}	-	-	-	10	10	10	pF	
3-State Capacitance	co	-	-	-	20	20	20	pF	
Power Dissipation Capacitance (Notes 4, 5)	C _{PD}	-	5	52	-	-	-	pF	

NOTES:

- 4. $C_{\mbox{\scriptsize PD}}$ is used to determine the dynamic power consumption, per device.
- 5. $P_D = V_{CC}^2 (C_{PD} + C_L)$ where f_i = Input Frequency, C_L = Output Load Capacitance, V_{CC} = Supply Voltage.

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 2. CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH

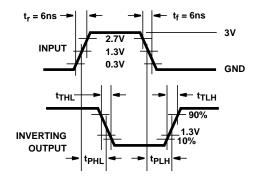
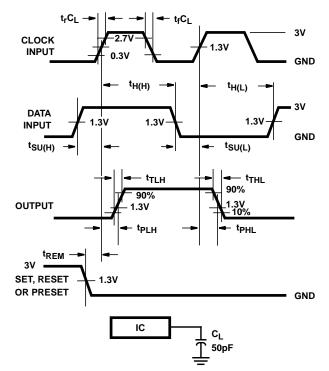


FIGURE 3. TRANSITION TIMES AND PROPAGATION-DELAY TIMES, COMBINATION LOGIC

Test Circuits and Waveforms (Continued)



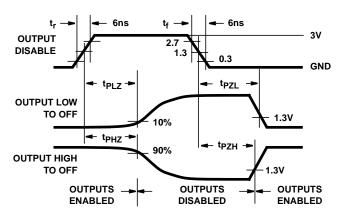
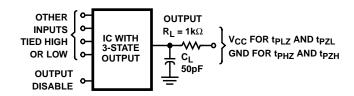


FIGURE 5. 3-STATE PROPAGATION-DELAY WAVEFORM

FIGURE 4. SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION-DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS



NOTE: Open-drain waveforms t_{PLZ} and t_{PZL} are the same as those for 3-state shown on the left. The test circuit is Output $R_L = 1k\Omega$ to V_{CC} , $C_L = 50pF$.

FIGURE 6. 3-STATE PROPAGATION-DELAY TEST CIRCUIT

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PACKAGING INFORMATION

Orderable part number	Status	Material type	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material	MSL rating/ Peak reflow	Op temp (°C)	Part marking (6)
CD74HCT356E	Active	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HCT356E
CD74HCT356E.A	Active	Production	PDIP (N) 20	20 TUBE	Yes	NIPDAU	N/A for Pkg Type	-55 to 125	CD74HCT356E

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

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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⁽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.

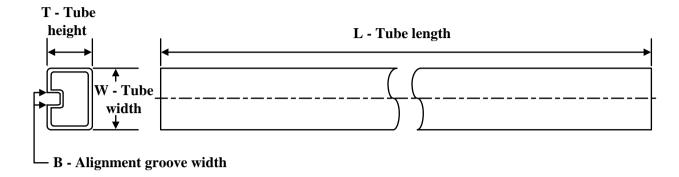
⁽⁵⁾ MSL rating/Peak reflow: The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be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

PACKAGE MATERIALS INFORMATION

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TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
CD74HCT356E	N	PDIP	20	20	506	13.97	11230	4.32
CD74HCT356E.A	N	PDIP	20	20	506	13.97	11230	4.32

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



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.



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