

October 1996

Fast CMOS 16-Bit Registered Transceiver

Features

- Advanced 0.6 micron CMOS Technology
- These Devices Are High-speed, Low Power Devices with High Current Drive
- $V_{CC} = 5V \pm 10\%$
- Hysteresis on All Inputs
- CD74FCT16952T
 - High Output Drive: $I_{OH} = -32mA$; $I_{OL} = 64mA$
 - Power Off Disable Outputs Permit "Live Insertion"
 - Typical V_{OLP} (Output Ground Bounce) $< 1.0V$ at $V_{CC} = 5V$, $T_A = 25^\circ C$
- CD74FCT162952T
 - Balanced Output Drivers: $\pm 24mA$
 - Reduced System Switching Noise
 - Typical V_{OLP} (Output Ground Bounce) $< 0.6V$ at $V_{CC} = 5V$, $T_A = 25^\circ C$
- CD74FCT162H952T
 - Bus Hold Retains Last Active Bus State During Three-State
 - Eliminates the Need for External Pull-Up Resistors

Description

These devices are 16-bit registered transceivers organized with two sets of eight D-type latches with separate input and output controls for each set. For data flow from A-to-B, for example, the A-to-B Enable ($\overline{x_{CEAB}}$) input must be LOW in order to enter data from x_{Ax} . The data present on the A port will be clocked on the B register when x_{CLKAB} toggles from LOW-to-HIGH. The $\overline{x_{OEAB}}$ control performs the output enable function on the B port. Control of data from B-to-A is similar, but uses the $\overline{x_{CEBA}}$, x_{CLKBA} , and $\overline{x_{OEBA}}$ inputs. By connecting the control pins of the two independent transceivers together, a full 16-bit operation can be achieved. The output buffers are designed with a Power-Off disable allowing "live insertion" of boards when used as backplane drivers.

The CD74FCT16952T output buffers are designed with a Power-Off disable allowing "live insertion" of boards when used as backplane drivers.

The CD74FCT162952T has $\pm 24mA$ balanced output drivers. It is designed with current limiting resistors at its outputs to control the output edge rate resulting in lower ground bounce and undershoot. This eliminates the need for external terminating resistors for most interface applications.

The CD74FCT162H952T has "Bus Hold" which retains the input's last state whenever the input goes to high-impedance preventing "floating" inputs and eliminating the need for pull-up/down resistors.

Ordering Information

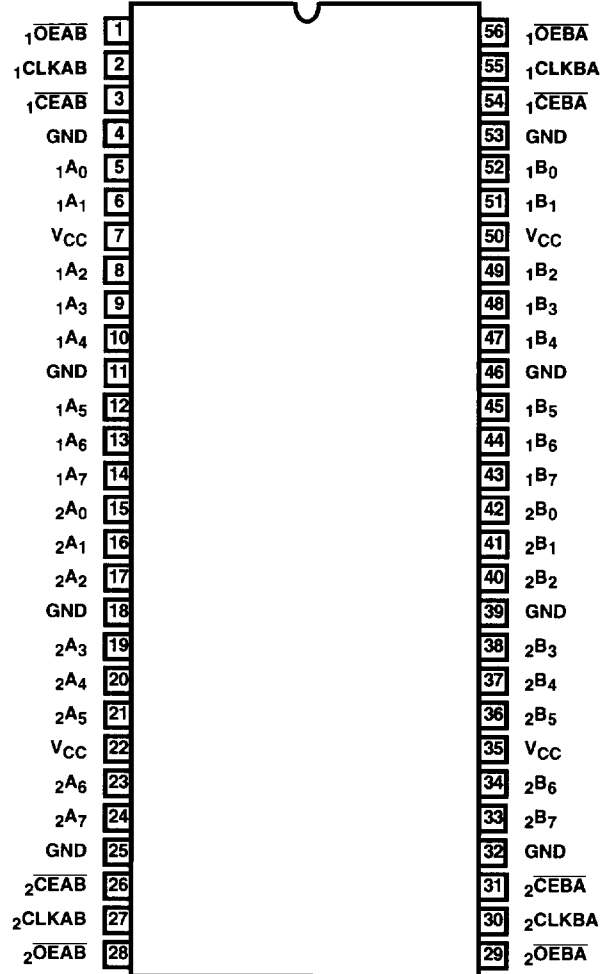
PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CD74FCT16952ATMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT16952ATSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT16952BTMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT16952BTSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT16952CTMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT16952CTSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT16952DTMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT16952DTSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT16952ETMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT16952ETSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162952ATMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162952ATSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162952BTMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162952BTSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162952CTMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162952CTSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162952DTMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162952DTSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162952ETMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162952ETSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162H952ATMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162H952ATSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162H952BTMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162H952BTSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162H952CTMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162H952CTSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162H952DTMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162H952DTSM	-40 to 85	56 Ld SSOP	M56.300-P
CD74FCT162H952ETMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162H952ETSM	-40 to 85	56 Ld SSOP	M56.300-P

HARRIS 120

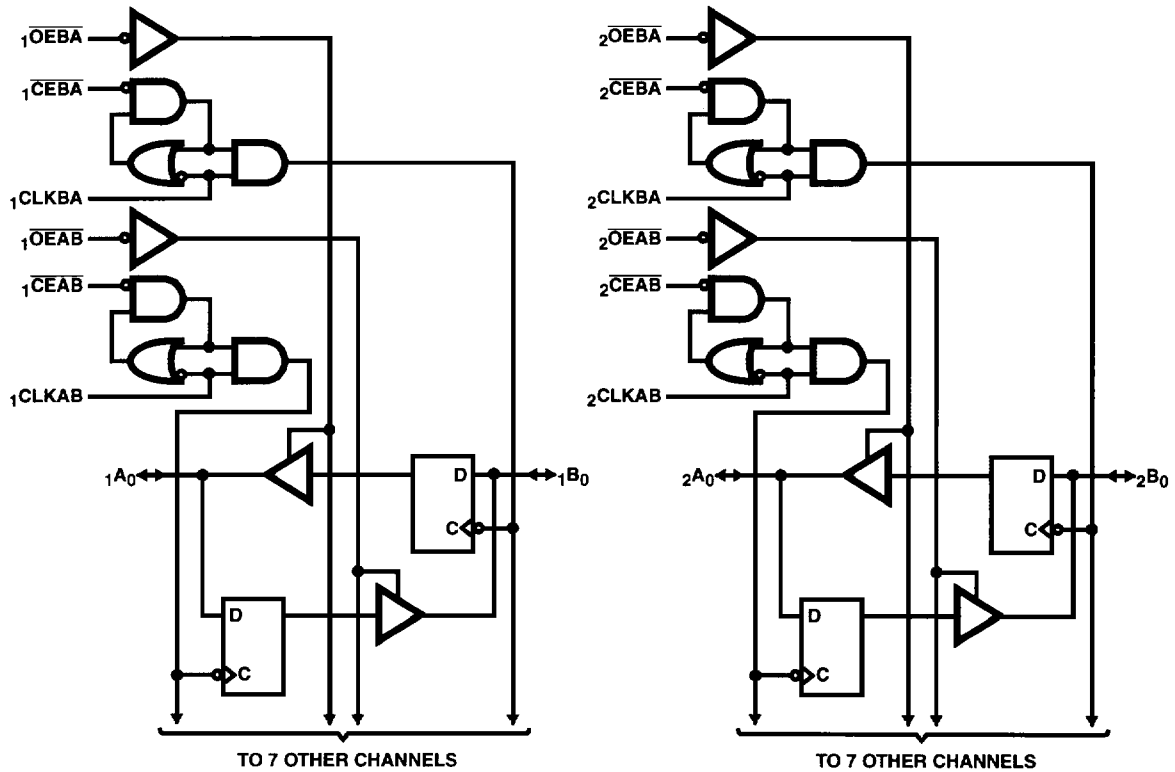
CD74FCT16952T, CD74FCT162952T, CD74FCT162H952T

Pinout

CD74FCT16952T, CD74FCT162952T, CD74FCT162H952T
(SSOP, TSSOP)
TOP VIEW



Functional Block Diagram



TRUTH TABLE (NOTES 1, 2)

INPUTS				OUTPUTS
$\overline{x}CEAB$	$\overline{x}CLKAB$	$\overline{x}OEAB$	xAx	xBx
H	X	L	X	B (Note 3)
X	L	L	X	B (Note 3)
L	↑	L	L	L
L	↑	L	H	H
X	X	H	X	High Z

NOTES:

1. H = High Voltage Level
L = Low Voltage Level
X = Don't Care or Irrelevant
↑ = LOW-to-HIGH Transition
Z = High Impedance
2. A-to-B data flow shown. B-to-A flow control is the same, except using $\overline{x}CEBA$, $\overline{x}CLKBA$, and $\overline{x}OEBA$.
3. Level of B before the indicated steady-state input conditions were established.

Pin Descriptions

PIN NAME	DESCRIPTION
$\overline{\text{XOEAB}}$	A-to-B Output Enable Input (Active LOW)
$\overline{\text{XOEBA}}$	B-to-A Output Enable Input (Active LOW)
$\overline{\text{XCEAB}}$	A-to-B Clock Enable Input (Active LOW)
$\overline{\text{XCEBA}}$	B-to-A Clock Enable Input (Active LOW)
XCLKAB	A-to-B Clock Input
XCLKBA	B-to-A Clock Input
XA_x	A-to-B Data Inputs or B-to-A Three-State Outputs (Note 4)
XB_x	B-to-A Data Inputs or A-to-B Three-State Outputs (Note 4)
GND	Ground
V _{CC}	Power

NOTE:

- For the CD74FCT162H952T, these pins have "Bus Hold". All other pins are standard, outputs, or I/Os.

CD74FCT16952T, CD74FCT162952T, CD74FCT162H952T

Absolute Maximum Ratings

DC Input Voltage -0.5V to 7.0V
 DC Output Current 120mA

Operating Conditions

Operating Temperature Range -40°C to 85°C
 Supply Voltage to Ground Potential
 Inputs and V_{CC} Only -0.5V to 7.0V
 Supply Voltage to Ground Potential
 Outputs and D/O Only -0.5V to 7.0V

Thermal Information

Thermal Resistance (Typical, Note 5) θ_{JA} (°C/W)
 TSSOP Package 85
 SSOP Package 70
 Maximum Junction Temperature 150°C
 Maximum Storage Temperature Range -65°C to 150°C
 Maximum Lead Temperature (Soldering 10s) 300°C
 (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.

NOTES:

5. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications

PARAMETERS	SYMBOL	(NOTE 6) TEST CONDITIONS	MIN	(NOTE 7) TYP	MAX	UNITS
DC ELECTRICAL SPECIFICATIONS Over the Operating Range, T _A = -40°C to 85°C, V _{CC} = 5.0V ±10%						
Input HIGH Voltage	V _{IH}	Guaranteed Logic HIGH Level	2.0	-	-	V
Input LOW Voltage	V _{IL}	Guaranteed Logic LOW Level	-	-	0.8	V
Input HIGH Current	I _{IH}	Standard Input, V _{CC} = Max V _{IN} = V _{CC}	-	-	1	μA
Input HIGH Current	I _{IH}	Standard I/O, V _{CC} = Max V _{IN} = V _{CC}	-	-	1	μA
Input HIGH Current	I _{IH}	Bus Hold Input (Note 9) V _{CC} = Max V _{IN} = V _{CC}	-	-	±100	μA
Input HIGH Current	I _{IH}	Bus Hold I/O (Note 9) V _{CC} = Max V _{IN} = V _{CC}	-	-	±100	μA
Input LOW Current	I _{IL}	Standard Input, V _{CC} = Min V _{IN} = GND	-	-	-1	μA
Input LOW Current	I _{IL}	Standard I/O, V _{CC} = Min V _{IN} = GND	-	-	-1	μA
Input LOW Current	I _{IL}	Bus Hold Input (Note 9) V _{CC} = Min V _{IN} = GND	-	-	±100	μA
Input LOW Current	I _{IL}	Bus Hold I/O (Note 9) V _{CC} = Min V _{IN} = GND	-	-	±100	μA
Bus Hold Sustain Current	I _{BHH}	Bus Hold Input (Note 9) V _{CC} = Min V _{IN} = 2.0V	-50	-	-	μA
	I _{BHL}		50	-	-	μA
High Impedance Output Current (Three-State) (Note 10)	I _{OZH}	V _{CC} = Max V _{OUT} = 2.7V	-	-	1	μA
	I _{OZL}	V _{CC} = Max V _{OUT} = 0.5V	-	-	-1	μA
Clamp Diode Voltage	V _{IK}	V _{CC} = Min, I _{IN} = -18mA	-	-0.7	-1.2	V
Short Circuit Current	I _{OS}	V _{CC} = Max (Note 8), V _{OUT} = GND	-80	-140	-200	mA
Output Drive Current	I _O	V _{CC} = Max (Note 8), V _{OUT} = 2.5V	-50	-	-180	mA
Input Hysteresis	V _H		-	100	-	mV

CD74FCT16952T, CD74FCT162952T, CD74FCT162H952T

Electrical Specifications (Continued)

PARAMETERS	SYMBOL	(NOTE 6) TEST CONDITIONS	MIN	(NOTE 7) TYP	MAX	UNITS	
CD74FCT16952T OUTPUT DRIVE SPECIFICATIONS Over the Operating Range							
Output HIGH Voltage	V _{OH}	V _{CC} = Min, V _{IN} = V _{IH} or V _{IL}	I _{OH} = -3.0mA	2.5	3.5	-	V
			I _{OH} = -15.0mA	2.4	3.5	-	V
			I _{OH} = -32.0mA	2.0	3.0	-	V
Output LOW Voltage	V _{OL}	V _{CC} = Min, V _{IN} = V _{IH} or V _{IL}	I _{OL} = 64mA	-	0.2	0.55	V
Power Down Disable	I _{OFF}	V _{CC} = 0V, V _{IN} or V _{OUT} ≤ 4.5V	-	-	±100	μA	
CD74FCT162952T, CD74FCT162H952T OUTPUT DRIVE SPECIFICATIONS Over the Operating Range							
Output HIGH Voltage	V _{OH}	V _{CC} = Min, V _{IN} = V _{IH} or V _{IL}	I _{OH} = -24.0mA	2.4	3.3	-	V
Output LOW Voltage	V _{OL}	V _{CC} = Min, V _{IN} = V _{IH} or V _{IL}	I _{OL} = 24mA	-	0.3	0.55	V
Output LOW Current	I _{ODL}	V _{CC} = 5V, V _{IN} = V _{IH} or V _{IL} , V _{OUT} = 1.5V (Note 8)	-	60	115	150	mA
Output HIGH Current	I _{ODH}	V _{CC} = 5V, V _{IN} = V _{IH} or V _{IL} , V _{OUT} = 1.5V (Note 8)	-60	-115	-150	mA	
CAPACITANCE T _A = 25°C, f = 1MHz							
Input Capacitance (Note 11)	C _{IN}	V _{IN} = 0V	-	4.5	6	pF	
Output Capacitance (Note 11)	C _{OUT}	V _{OUT} = 0V	-	5.5	8	pF	
POWER SUPPLY SPECIFICATIONS							
Quiescent Power Supply Current	I _{CC}	V _{CC} = Max	V _{IN} = GND or V _{CC}	-	0.1	500	μA
Supply Current per Input at TTL HIGH	ΔI _{CC}	V _{CC} = Max	V _{IN} = 3.4V (Note 12)	-	0.5	1.5	mA
Supply Current per Input per MHz (Note 13)	I _{CCD}	V _{CC} = Max, Outputs Open x _{OEAB} or x _{OEBA} = GND One Input Toggling 50% Duty Cycle	V _{IN} = V _{CC} V _{IN} = GND	-	75	120	μA/ MHz
Total Power Supply Current (Note 15)	I _C	V _{CC} = Max, Outputs Open f _{CP} = 10MHz (xCLKAB) 50% Duty Cycle x _{OEAB} = x _{CEAB} = GND x _{CEBA} = V _{CC} One Bit Toggling, f _l = 5MHz	V _{IN} = V _{CC} V _{IN} = GND	-	0.8	1.7 (Note 14)	mA
			V _{IN} = 3.4V V _{IN} = GND	-	1.3	3.2 (Note 14)	mA
			V _{IN} = V _{CC} V _{IN} = GND	-	3.8	6.5 (Note 14)	mA
			V _{IN} = 3.4V V _{IN} = GND	-	8.3	20.5 (Note 14)	mA

CD74FCT16952T, CD74FCT162952T, CD74FCT162H952T

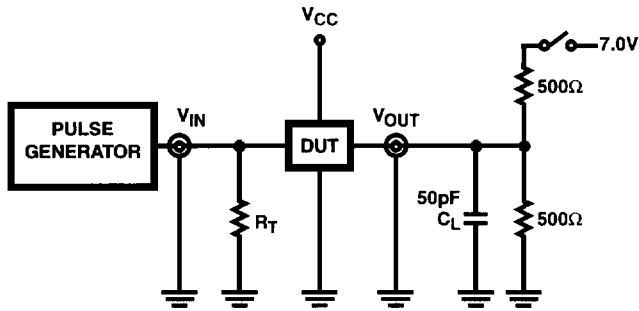
Switching Specifications Over Operating Range

PARAMETER	SYMBOL	(NOTE 16) TEST CONDITIONS	AT		BT		CT		DT		ET		UNITS
			(NOTE 17) MIN	MAX	(NOTE 17) MIN	MAX	(NOTE 17) MIN	MAX	(NOTE 17) MIN	MAX	(NOTE 17) MIN	MAX	
Propagation Delay $\overline{x}CLKAB, \overline{x}CLKBA$ to xBx, xAx	$t_{PLH},$ t_{PHL}	$C_L = 50pF$ $R_L = 500\Omega$	2.0	10.0	2.0	7.5	2.0	6.3	2.0	4.4	1.5	3.7	ns
Output Enable Time $\overline{x}OEBA, \overline{x}OEAB$ to xAx, xBx	$t_{PZH},$ t_{PZL}		1.5	10.5	1.5	8.0	1.5	7.0	1.5	4.8	1.5	4.4	ns
Output Disable Time (Note 18) $\overline{x}OEBA, \overline{x}OEAB$ to xAx, xBx	$t_{PHZ},$ t_{PLZ}		1.5	10.0	1.5	7.5	1.5	6.5	1.5	4.0	1.5	4.0	ns
Setup Time HIGH or LOW, xAx, xBx to $\overline{x}CLKAB, \overline{x}CLKBA$	t_{SU}		2.5	-	2.5	-	2.5	-	2.0	-	1.5	-	ns
Hold Time HIGH or LOW, xAx, xBx to $\overline{x}CLKAB, \overline{x}CLKBA$	t_H		2.0	-	2.0	-	1.5	-	1.0	-	0.0	-	ns
Setup Time HIGH or LOW, $\overline{x}CEAB, \overline{x}CEBA$ to $\overline{x}CLKAB, \overline{x}CLKBA$	t_{SU}		3.0	-	3.0	-	3.0	-	2.0	-	2.0	-	ns
Hold Time HIGH or LOW, $\overline{x}CEAB, \overline{x}CEBA$ to $\overline{x}CLKAB, \overline{x}CLKBA$	t_H		2.0	-	2.0	-	2.0	-	1.5	-	0.0	-	ns
Pulse Width HIGH (Note 18) or LOW, $\overline{x}CLKAB$ or $\overline{x}CLKBA$	t_W		3.0	-	3.0	-	3.0	-	3.0	-	3.0	-	ns
Output Skew (Note 19)	$t_{SK(O)}$		-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	ns

NOTES:

6. For conditions shown as Max or Min, use appropriate value specified under Electrical Characteristics for the applicable device type.
7. Typical values are at $V_{CC} = 5.0V$, $25^\circ C$ ambient and maximum loading, except as noted.
8. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
9. Pins with Bus Hold are identified in the pin description.
10. This specification does not apply to bi-directional functionalities with Bus Hold.
11. This parameter is determined by device characterization but is not production tested.
12. Per TTL driven input ($V_{IN} = 3.4V$); all other inputs at V_{CC} or GND.
13. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
14. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
15. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_I N_I)$
 I_{CC} = Quiescent Current
 ΔI_{CC} = Power Supply Current for a TTL High Input ($V_{IN} = 3.4V$)
 D_H = Duty Cycle for TTL Inputs High
 N_T = Number of TTL Inputs at D_H
 I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)
 f_{CP} = Clock Frequency for Register Devices (Zero for Non-Register Devices)
 f_I = Input Frequency
 N_I = Number of Inputs at f_I
 All currents are in milliamps and all frequencies are in megahertz.
16. See test circuit and wave forms.
17. Minimum limits are guaranteed but not tested on Propagation Delays.
18. This parameter is guaranteed but not production tested.
19. Skew between any two outputs, of the same package, switching in the same direction. This parameter is guaranteed by design.

Test Circuits and Waveforms



SWITCH POSITION	
TEST	SWITCH
t_{PLZ} , t_{PZL}	Closed
t_{PHZ} , t_{PZH} , t_{PLH} , t_{PHL}	Open

DEFINITIONS:

C_L = Load capacitance, includes jig and probe capacitance.
 R_T = Termination resistance, should be equal to Z_{OUT} of the Pulse Generator.

NOTE:

1. Pulse Generator for All Pulses: Rate $\leq 1.0\text{MHz}$; $Z_{OUT} \leq 50\Omega$; $t_f, t_r \leq 2.5\text{ns}$.

FIGURE 1. TEST CIRCUIT

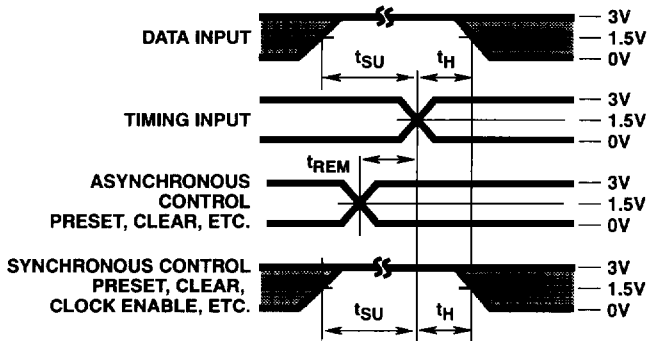


FIGURE 2. SETUP, HOLD, AND RELEASE TIMING

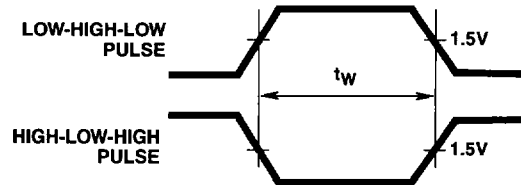


FIGURE 3. PULSE WIDTH

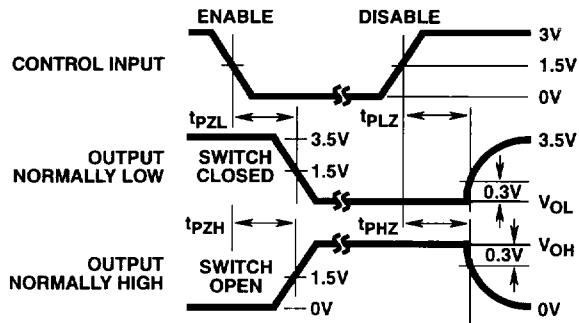


FIGURE 4. ENABLE AND DISABLE TIMING

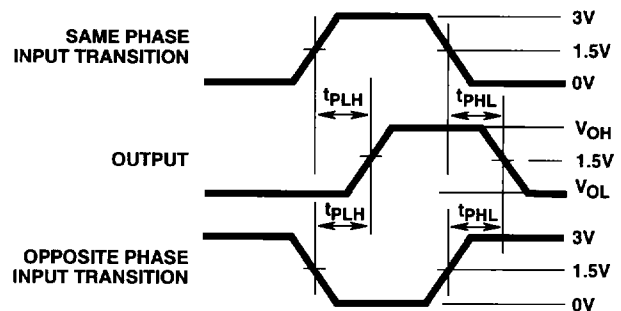
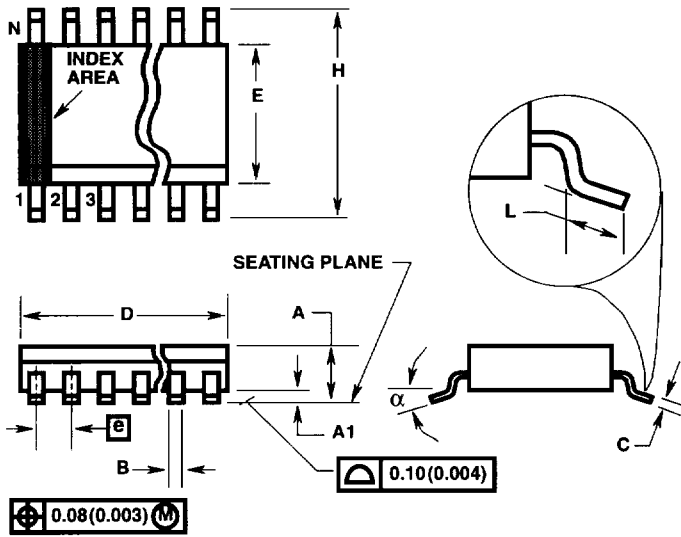


FIGURE 5. PROPAGATION DELAY

CD74FCT16952T, CD74FCT162952T, CD74FCT162H952T

Thin Shrink Small Outline Plastic Packages (TSSOP)



M56.240-P

56 LEAD THIN SHRINK SMALL OUTLINE PLASTIC PACKAGE

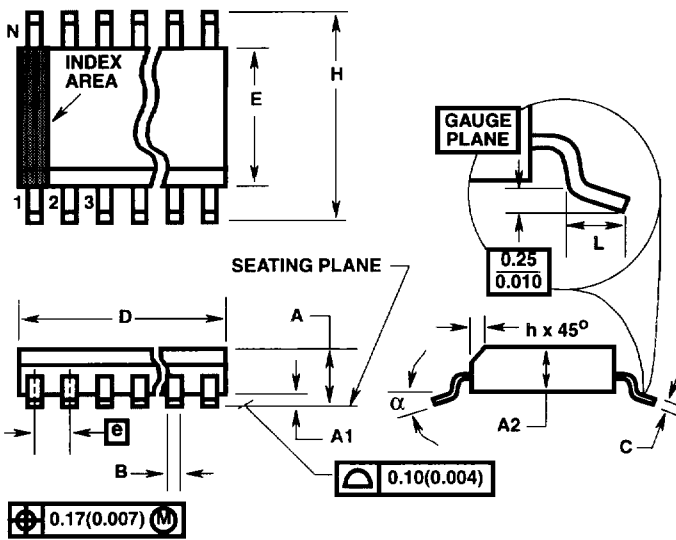
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.041	0.047	1.05	1.20	-
A1	0.002	0.006	0.05	0.15	-
B	0.007	0.010	0.178	0.254	-
C	0.004	0.008	0.102	0.203	-
D	0.547	0.555	13.90	14.09	1
E	0.236	0.244	6.00	6.19	2
e	0.0197 BSC		0.50 BSC		-
H	0.307	0.330	7.80	8.38	-
L	0.020	0.030	0.51	0.76	3
N	56		56		4
alpha	0°	8°	0°	8°	-

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NOTES:

1. Dimension "D" does not include mold flash, protrusions or gate burrs.
2. Dimension "E" does not include interlead flash or protrusions.
3. "L" is the length of terminal for soldering to a substrate.
4. "N" is the number of terminal positions.
5. Terminal numbers are shown for reference only.
6. Controlling dimension: INCHES. Converted millimeter dimensions are not necessarily exact.

Shrink Small Outline Plastic Packages (SSOP)



M56.300-P
56 LEAD SHRINK SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.096	0.108	2.44	2.74	-
A1	0.008	0.016	0.20	0.41	-
A2	0.088	0.092	2.24	2.34	-
B	0.008	0.0135	0.20	0.34	-
C	0.005	0.010	0.13	0.25	-
D	0.720	0.730	18.29	18.54	2
E	0.291	0.299	7.39	7.59	3
e	0.025 BSC		0.635 BSC		-
H	0.395	0.415	10.03	10.54	-
h	0.015	0.025	0.381	0.635	-
L	0.020	0.040	0.51	1.01	4
N	56		56		5
α	0°	8°	0°	8°	-

Rev. 0 5/96

NOTES:

1. These package dimensions are within allowable dimensions of JEDEC MO-118-AB, Issue B.
2. Dimension "D" does not include mold flash, protrusions or gate burrs.
3. Dimension "E" does not include interlead flash or protrusions.
4. "L" is the length of terminal for soldering to a substrate.
5. "N" is the number of terminal positions.
6. Terminal numbers are shown for reference only.
7. Controlling dimension: INCHES. Converted millimeter dimensions are not necessarily exact.

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