HARRIS SEMICONDUCTOR

CD74FCT16952T, CD74FCT162952T

December 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 ±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°C**
- **CD74FCT162952T**
  - **Balanced Output Drivers: ±24mA**
  - **Reduced System Switching Noise**
  - **Typical V_{OLP} (Output Ground Bounce) < 0.6V at V_{CC} = 5V, T_A = 25°C**

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 ($_X\overline{CEAB}$) input must be LOW in order to enter data from $_XA_X$. The data present on the A port will be clocked on the B register when $_X$CLKAB toggles from LOW-to-HIGH. The $_X\overline{OEAB}$ control performs the output enable function on the B port. Control of data from B-to-A is similar, but uses the $_X\overline{CEBA}$, xCLKBA, and $_X\overline{OEBA}$ 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 ±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.

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
CD74FCT16952TMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT16952TSM	-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
CD74FCT162952TMT	-40 to 85	56 Ld TSSOP	M56.240-P
CD74FCT162952TSM	-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

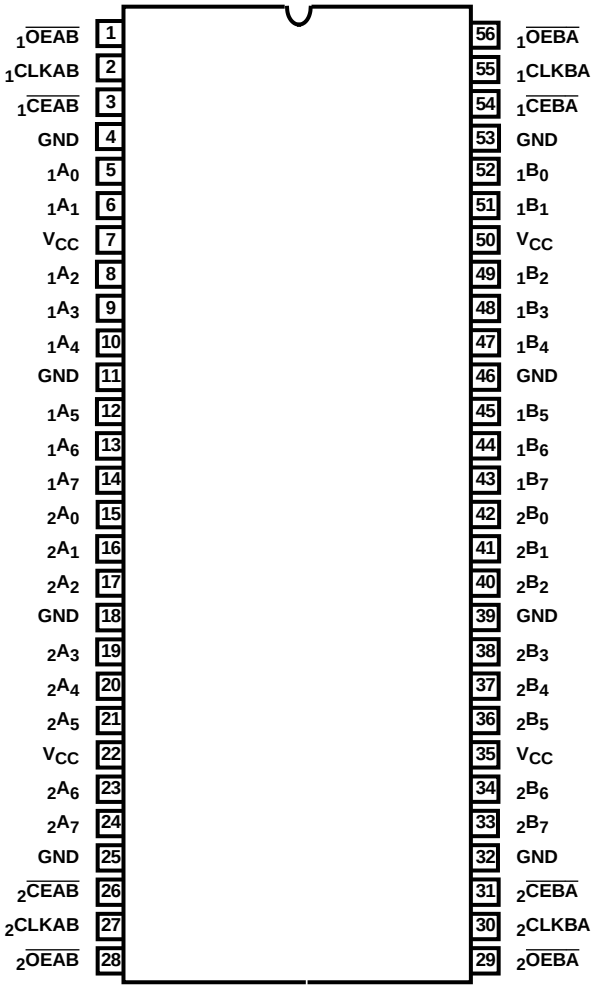
NOTE: When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.

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

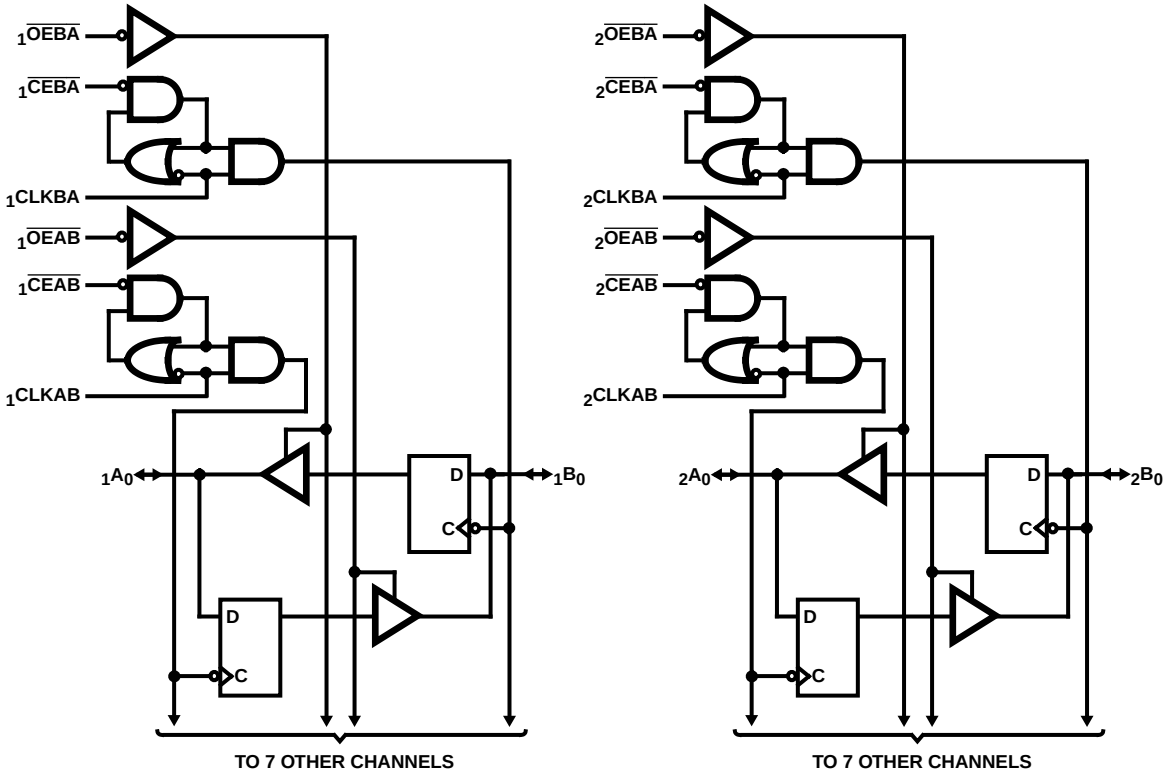
File Number **4191.1**

Pinout

CD74FCT16952T, CD74FCT162952T
(SSOP, TSSOP)
TOP VIEW



Functional Block Diagram



TRUTH TABLE (NOTES 1, 2)

INPUTS				OUTPUTS
$_X\overline{CEAB}$	$_X$CLKAB	$X\overline{OEAB}$	$_XA_X$	$_XB_X$
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 $_X\overline{CEBA}$, $_X$CLKBA, and $_X\overline{OEBA}$.
3. Level of B before the indicated steady-state input conditions were established.

Pin Descriptions

PIN NAME	DESCRIPTION
$_X\overline{OEAB}$	A-to-B Output Enable Input (Active LOW)
$_X\overline{OEBA}$	B-to-A Output Enable Input (Active LOW)
$_X\overline{CEAB}$	A-to-B Clock Enable Input (Active LOW)
$_X\overline{CEBA}$	B-to-A Clock Enable Input (Active LOW)
$_X$CLKAB	A-to-B Clock Input
$_X$CLKBA	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

Absolute Maximum Ratings

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

Operating Conditions

Operating Temperature Range . . . . . -40^oC to 85^oC
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 4)	θ_{JA} ($^oC/W$)
TSSOP Package	85
SSOP Package	70

Maximum Junction Temperature . . . . . 150^oC
Maximum Storage Temperature Range . . . . . -65^oC to 150^oC
Maximum Lead Temperature (Soldering 10s) . . . . . 300^oC
(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:

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

Electrical Specifications

PARAMETERS	SYMBOL	(NOTE 5) TEST CONDITIONS		MIN	(NOTE 6) TYP	MAX	UNITS
DC ELECTRICAL SPECIFICATIONS Over the Operating Range, $T_A = -40^oC$ to 85^oC, $V_{CC} = 5.0V \pm 10\%$							
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 8) V_{CC} = Max	$V_{IN} = V_{CC}$	-	-	±100	µA
Input HIGH Current	I_{IH}	Bus Hold I/O (Note 8) 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 8) V_{CC} = Min	V_{IN} = GND	-	-	±100	µA
Input LOW Current	I_{IL}	Bus Hold I/O (Note 8) V_{CC} = Min	V_{IN} = GND	-	-	±100	µA
Bus Hold Sustain Current	I_{BHH}	Bus Hold Input (Note 8) V_{CC} = Min	V_{IN} = 2.0V	-50	-	-	µA
	I_{BHL}		V_{IN} = 0.8V	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 7), V_{OUT} = GND		-80	-140	-200	mA
Output Drive Current	I_O	V_{CC} = Max (Note 7), V_{OUT} = 2.5V		-50	-	-180	mA
Input Hysteresis	V_H			-	100	-	mV

Electrical Specifications (Continued)

PARAMETERS	SYMBOL	(NOTE 5) TEST CONDITIONS		MIN	(NOTE 6) 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 $V_{OUT} \leq$ 4.5V		-	-	±100	µA
CD74FCT162952T 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 7)		60	115	150	mA
Output HIGH Current	I_{ODH}	V_{CC} = 5V, V_{IN} = V_{IH} or V_{IL}, V_{OUT} = 1.5V (Note 7)		-60	-115	-150	mA
CAPACITANCE $T_A = 25^oC$, f = 1MHz							
Input Capacitance (Note 10)	C_{IN}	V_{IN} = 0V		-	4.5	6	pF
Output Capacitance (Note 10)	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 11)	-	0.5	1.5	mA
Supply Current per Input per MHz (Note 12)	I_{CCD}	V_{CC} = Max, Outputs Open $_X\overline{OEAB}$ or $_X\overline{OEBA}$ = GND One Input Toggling 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	-	75	120	µA/ MHz
Total Power Supply Current (Note 14)	I_C	V_{CC} = Max, Outputs Open f_{CP} = 10MHz ($_X$CLKAB) 50% Duty Cycle $_X\overline{OEAB}$ = $_X\overline{CEAB}$ = GND $_X\overline{CEBA}$ = V_{CC} One Bit Toggling, f_I = 5MHz	V_{IN} = V_{CC} V_{IN} = GND	-	0.8	1.7 (Note 13)	mA
			V_{IN} = 3.4V V_{IN} = GND	-	1.3	3.2 (Note 13)	mA
		V_{CC} = Max, Outputs Open f_{CP} = 10MHz ($_X$CLKAB) 50% Duty Cycle $_X\overline{OEAB}$ = $_X\overline{CEAB}$ = GND $_X\overline{CEBA}$ = V_{CC} 16 Bits Toggling, f_I = 2.5MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	-	3.8	6.5 (Note 13)	mA
			V_{IN} = 3.4V V_{IN} = GND	-	8.3	20.5 (Note 13)	mA

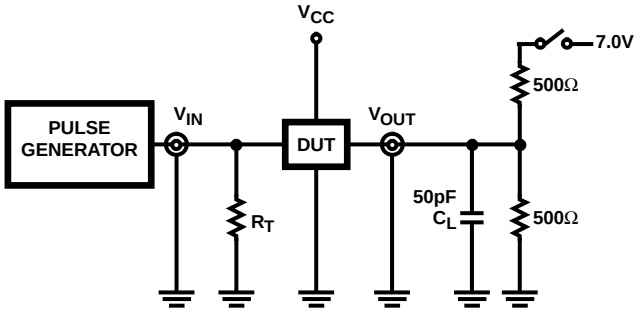
Switching Specifications Over Operating Range

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

NOTES:

5. For conditions shown as Max or Min, use appropriate value specified under Electrical Characteristics for the applicable device type.
6. Typical values are at V_{CC} = 5.0V, 25^{o}C ambient and maximum loading, except as noted.
7. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
8. Pins with Bus Hold are identified in the pin description.
9. This specification does not apply to bi-directional functionalities with Bus Hold.
10. This parameter is determined by device characterization but is not production tested.
11. Per TTL driven input (V_{IN} = 3.4V); all other inputs at V_{CC} or GND.
12. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
13. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
14. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
    $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_I N_I)$
    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.
15. See test circuit and wave forms.
16. Minimum limits are guaranteed but not tested on Propagation Delays.
17. This parameter is guaranteed but not production tested.
18. 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 ≤ 1.0MHz; Z_{OUT} ≤ 50Ω; t_f, t_r ≤ 2.5ns.

FIGURE 1. TEST CIRCUIT

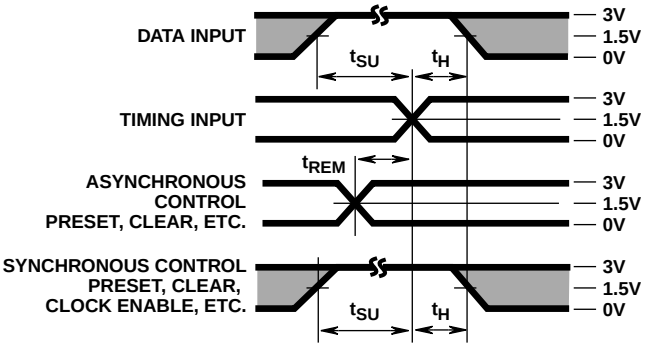


FIGURE 2. SETUP, HOLD, AND RELEASE TIMING

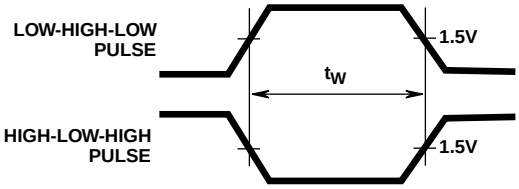


FIGURE 3. PULSE WIDTH

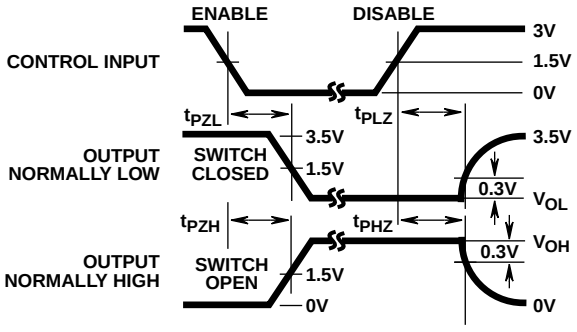


FIGURE 4. ENABLE AND DISABLE TIMING

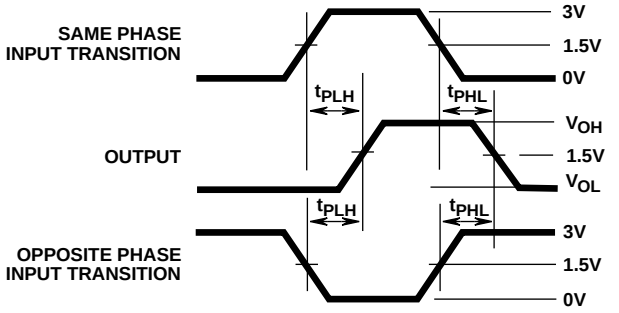
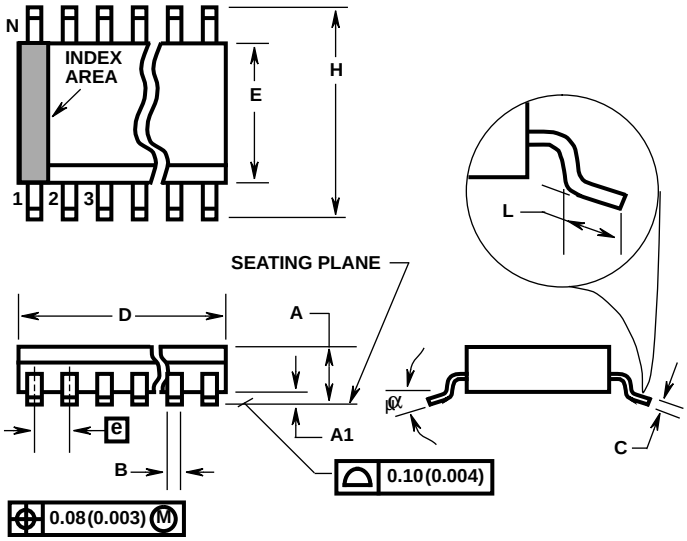


FIGURE 5. PROPAGATION DELAY

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
α	0^o	8^o	0^o	8^o	-

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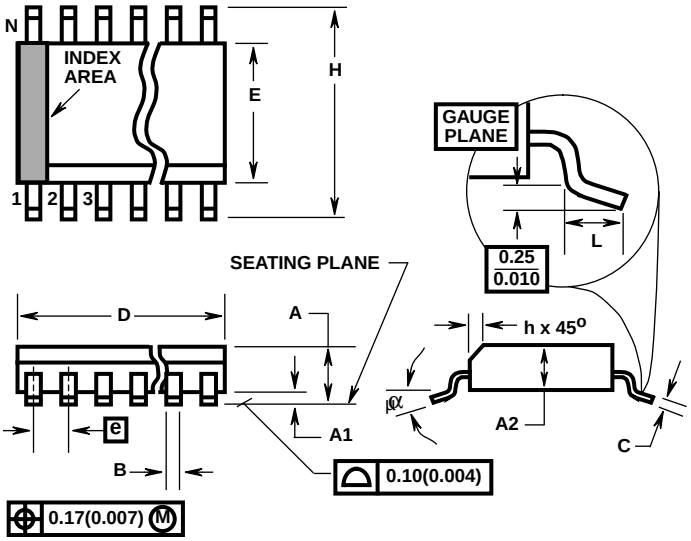
NOTES:

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^o	8^o	0^o	8^o	-

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NOTES:

1. These package dimensions are within allowable dimensions of JECEC 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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