HARRIS SEMICONDUCTOR CD74FCT162Q245T

PRELIMINARY

December 1996

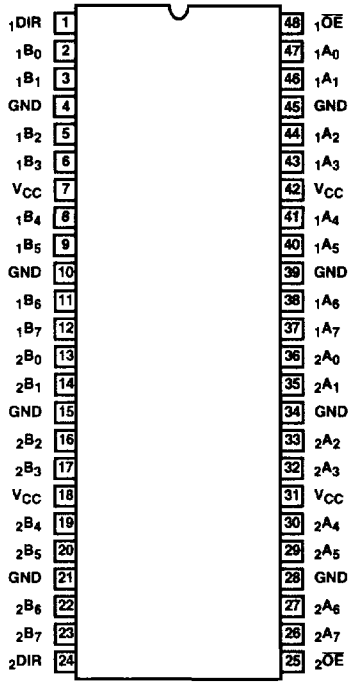
Fast CMOS 16-Bit Bidirectional Transceiver

Features

- **Advanced 0.6 micron CMOS Technology**
- **Balanced Output Drivers: ±12mA**
- **Output Impedance 35Ω (Typical)**
- **Typical V_{OLP} (Output Ground Bounce) < 0.5V at V_{CC} = 5V, T_A = 25°C**
- **Bus Hold Retains Last Active Bus State During Three-State**
- **Hysteresis on All Inputs**

Pinout

CD74FCT162Q245T
(SSOP, TSSOP)
TOP VIEW



Description

The CD74FCT162Q245T is a 16-bit bidirectional transceiver designed for asynchronous two-way communication between data buses. The direction control input pin ($_X$DIR) determines the direction of data flow through the bidirectional transceiver. The Direction and Output Enable controls are designed to operate these devices as either two independent 8-bit transceivers or one 16-bit transceiver. The output enable ($\overline{OE}$) input, when HIGH, disables both A and B ports by placing them in HIGH Z condition.

The CD74FCT162Q245T is designed with current limiting resistors at its outputs to control the output edge rate resulting in lower ground bounce and undershoot. This device features a typical output impedance of 35Ω, eliminating the need for external terminating resistors for most bus interface applications. This noise suppression benefit is designated by the letter "Q" (for quiet) in the part number.

The CD74FCT162Q245T also features "Bus Hold" which retains the input's last state whenever the input goes to high-impedance preventing "floating" inputs and eliminating the need for pullup/down resistors.

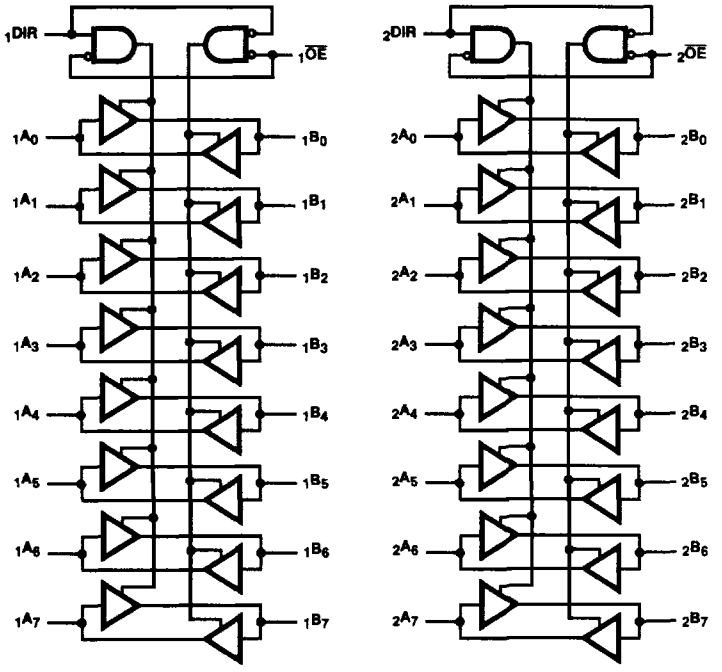
Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CD74FCT162Q245TMT	-40 to 85	48 Ld TSSOP	M48.240-P
CD74FCT162Q245ATMT	-40 to 85	48 Ld TSSOP	M48.240-P
CD74FCT162Q245CTMT	-40 to 85	48 Ld TSSOP	M48.240-P
CD74FCT162Q245DTMT	-40 to 85	48 Ld TSSOP	M48.240-P
CD74FCT162Q245ETMT	-40 to 85	48 Ld TSSOP	M48.240-P
CD74FCT162Q245TSM	-40 to 85	48 Ld SSOP	M48.300-P
CD74FCT162Q245ATSM	-40 to 85	48 Ld SSOP	M48.300-P
CD74FCT162Q245CTSM	-40 to 85	48 Ld SSOP	M48.300-P
CD74FCT162Q245DTSM	-40 to 85	48 Ld SSOP	M48.300-P
CD74FCT162Q245ETSM	-40 to 85	48 Ld SSOP	M48.300-P

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

File Number **4277**

Functional Block Diagram



TRUTH TABLE (NOTE 1)

INPUTS		OUTPUTS
$_X\overline{OE}$	$_X$DIR	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	High Z State

NOTE:

1. H = High Voltage Level
   L = Low Voltage Level
   X = Don't Care
   Z = High Impedance

Pin Descriptions

PIN NAME	DESCRIPTION
$_X\overline{OE}$	Three-State Output Enable Inputs (Active LOW)
$_X$DIR	Direction Control Input
$_XA_X$	Side A Inputs or Three-State Outputs (Note 2)
$_XB_X$	Side B Inputs or Three-State Outputs (Note 2)
GND	Ground
V_{CC}	Power

NOTE:

2. For the CD74FCT162Q245T, these pins have "Bus Hold". All other pins are standard, outputs, or I/Os.

Absolute Maximum Ratings

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

Operating Conditions

Operating Temperature Range . . . . . $-40^{o}C$ to $85^{o}C$
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 3)	θ_{JA} ($^{o}C/W$)
TSSOP Package	94
SSOP Package	76

Maximum Junction Temperature . . . . . $150^{o}C$
Maximum Storage Temperature Range . . . . . $-65^{o}C$ to $150^{o}C$
Maximum Lead Temperature (Soldering 10s) . . . . . $300^{o}C$
(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.

NOTE:

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

Electrical Specifications

PARAMETER	SYMBOL	(NOTE 4) TEST CONDITIONS		MIN	(NOTE 5) TYP	MAX	UNITS
DC ELECTRICAL SPECIFICATIONS Over the Operating Range, $T_A = -40^{o}C$ to $85^{o}C$, $V_{CC} = 5.0V \pm 10\%$							
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}	Bus Hold Input (Note 7) 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}	Bus Hold Input (Note 7) V_{CC} = Min	V_{IN} = GND	-	-	±100	µA
Bus Hold Sustain Current	I_{BHH}	Bus Hold Input (Note 7) V_{CC} = Min	V_{IN} = 2.0V	-50	-	-	µA
	I_{BHL}		V_{IN} = 0.8V	50	-	-	µA
High Impedance Output Current (Three-State) (Note 9)	I_{OZH}	V_{CC} = Max	$V_{OUT} = V_{CC}$	-	-	1	µA
	I_{OZL}	V_{CC} = Max	V_{OUT} = GND	-	-	-1	µA
Clamp Diode Voltage	V_{IK}	V_{CC} = Min, I_{IN} = -18mA		-	-0.7	-1.2	V
Output Drive Current	I_O	V_{CC} = Max (Note 6), V_{OUT} = 2.5V		-50	-	-180	mA
Input Hysteresis	V_H			-	100	-	mV
OUTPUT DRIVE SPECIFICATIONS Over the Operating Range							
Output LOW Current	I_{ODL}	V_{CC} = 5V, $V_{IN} = V_{IH}$ or V_{IL}, V_{OUT} = 1.5V (Note 6)		36	-	-	mA
Output HIGH Current	I_{ODH}	V_{CC} = 5V, $V_{IN} = V_{IH}$ or V_{IL}, V_{OUT} = 1.5V (Note 6)		-100	-166	-200	mA
Output HIGH Voltage	V_{OH}	V_{CC} = Min, $V_{IN} = V_{IH}$ or V_{IL}	I_{OH} = -12.0mA	2.4	3.3	-	V
Output LOW Voltage	V_{OL}	V_{CC} = Min, $V_{IN} = V_{IH}$ or V_{IL}	I_{OL} = 12mA	-	0.4	0.55	V

Electrical Specifications (Continued)

PARAMETER	SYMBOL	(NOTE 4) TEST CONDITIONS		MIN	(NOTE 5) TYP	MAX	UNITS
CAPACITANCE $T_A = 25^oC$, f = 1MHz							
Input Capacitance (Note 9)	C_{IN}	$V_{IN} = 0V$		-	4.5	6	pF
Output Capacitance (Note 9)	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 10)	-	0.5	1.5	mA
Supply Current per Input per MHz (Note 11)	I_{CCD}	V_{CC} = Max, Outputs Open $_x\overline{OE}$ = $_x$DIR = GND One Bit Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ V_{IN} = GND	-	60	100	µA/ MHz
Total Power Supply Current (Note 13)	I_C	V_{CC} = Max, Outputs Open f_i = 10MHz, 50% Duty Cycle $_x\overline{OE}$ = $_x$DIR = GND One Bit Toggling	$V_{IN} = V_{CC}$ V_{IN} = GND	-	0.6	1.5 (Note 12)	mA
			V_{IN} = 3.4V V_{IN} = GND	-	0.9	2.3 (Note 12)	mA
		V_{CC} = Max, Outputs Open f_i = 2.5MHz 50% Duty Cycle $_x\overline{OE}$ = $_x$DIR = GND 16 Bits Toggling	$V_{IN} = V_{CC}$ V_{IN} = GND	-	2.4	4.5 (Note 12)	mA
			V_{IN} = 3.4V V_{IN} = GND	-	6.4	16.5 (Note 12)	mA

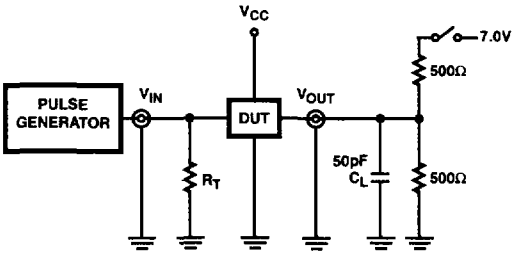
Switching Specifications Over Operating Range

PARAMETER	SYMBOL	(NOTE 14) TEST CONDITIONS	T		AT		CT		DT		ET		UNITS
			(NOTE 15) MIN	MAX	(NOTE 15) MIN	MAX	(NOTE 15) MIN	MAX	(NOTE 16) MIN	MAX	(NOTE 15) MIN	MAX	
Propagation Delay A to B, B to A	t_{PLH}, t_{PHL}	C_L = 50pF R_L = 500Ω	1.5	7.0	1.5	4.6	1.5	4.1	1.5	3.8	1.5	3.2	ns
Output Enable Time $x\overline{OE}$ to A or B	t_{PZH}, t_{PZL}		1.5	9.5	1.5	6.2	1.5	5.8	1.5	5.0	1.5	4.4	ns
Output Disable Time (Note 17) $x\overline{OE}$ to A or B	t_{PHZ}, t_{PLZ}		1.5	7.5	1.5	5.0	1.5	4.8	1.5	4.3	1.5	4.0	ns
Output Enable Time xDIR to A or B (Note 16)	t_{PZH}, t_{PZL}		1.5	9.5	1.5	6.2	1.5	5.8	1.5	5.0	1.5	4.8	ns
Output Disable Time xDIR to A or B (Note 16)	t_{PHZ}, t_{PLZ}		1.5	7.5	1.5	5.0	1.5	4.8	1.5	4.3	1.5	4.0	ns
Output Skew(17)	$t_{SK(O)}$		-	0.5	-	0.5	-	0.5	-	0.5	-	0.5	ns

NOTES:

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

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

FIGURE 1. TEST CIRCUIT

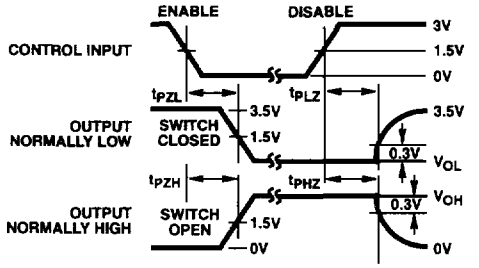


FIGURE 2. ENABLE AND DISABLE TIMING

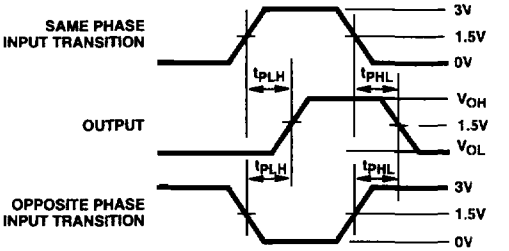


FIGURE 3. PROPAGATION DELAY