HARRIS SEMICONDUCTOR

# CD74FCT16541T, CD74FCT162541T, CD74FCT162H541T

October 1997

## Fast CMOS 16-Bit Octal Buffer/Line Drivers

### 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
- Output Skew: ≤ 0.5ns
- CD74FCT16541T
  - 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
- CD74FCT162541T
  - Balanced Output Drivers: ±24mA
  - Reduced System Switching Noise
  - Typical $V_{OLP}$ (Output Ground Bounce) < 0.6V at $V_{CC}$ = 5V, $T_A$ = 25°C
- CD74FCT162H541T
  - Bus Hold Retains Last Active Bus State During Three-State
  - Eliminates the Need for External Pull-up Resistors

### Description

These devices are non-inverting 16-bit buffer/line drivers designed for applications driving high capacitance loads and low impedance backplanes. These high-speed, low power devices offer bus/backplane interface capability and a flow-through organization for ease of board layout. These devices are designed with three-state controls to operate in a Dual-Byte, or a single 16-bit word mode.

The CD74FCT16541T output buffers are designed with a Power-Off disable allowing "live insertion" of boards when used as backplane drivers.

The CD74FCT162541T 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.

The CD74FCT162H541T 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. |
|---|---|---|---|
| CD74FCT16541ATMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT16541ATSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT16541CTMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT16541CTSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT16541DTMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT16541DTSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT16541ETMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT16541ETSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT16541TMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT16541TSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT162541ATMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162541ATSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT162541CTMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162541CTSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT162541DTMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162541DTSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT162541ETMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162541ETSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT162541TMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162541TSM | -40 to 85 | 48 Ld SSOP | M48.300-P |
| CD74FCT162H541ATMT | -40 to 85 | 48 Ld SSOP | M48-300-P |
| CD74FCT162H541ATSM | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162H541CTMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162H541CTSM | -40 to 85 | 48 Ld SSOP | M48-300-P |
| CD74FCT162H541DTMT | -40 to 85 | 48 Ld SSOP | M48-300-P |
| CD74FCT162H541DTSM | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162H541ETMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162H541ETSM | -40 to 85 | 48 Ld SSOP | M48-300-P |
| CD74FCT162H541TMT | -40 to 85 | 48 Ld TSSOP | M48.240-P |
| CD74FCT162H541TSM | -40 to 85 | 48 Ld SSOP | M48-300-P |

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

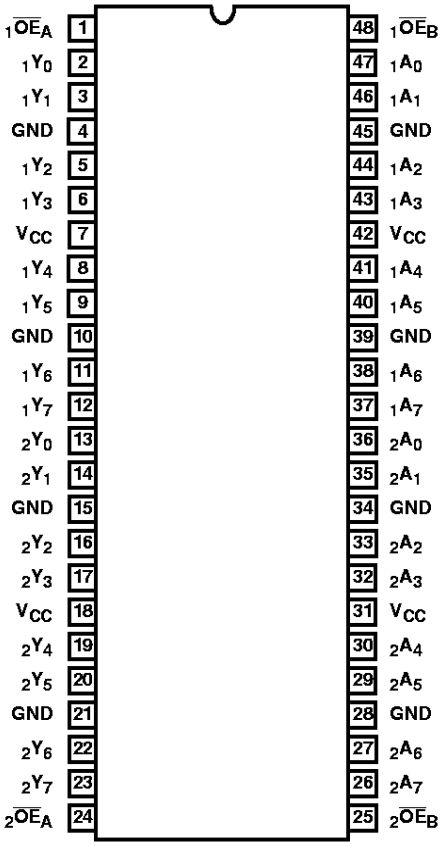
CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper IC Handling Procedures.



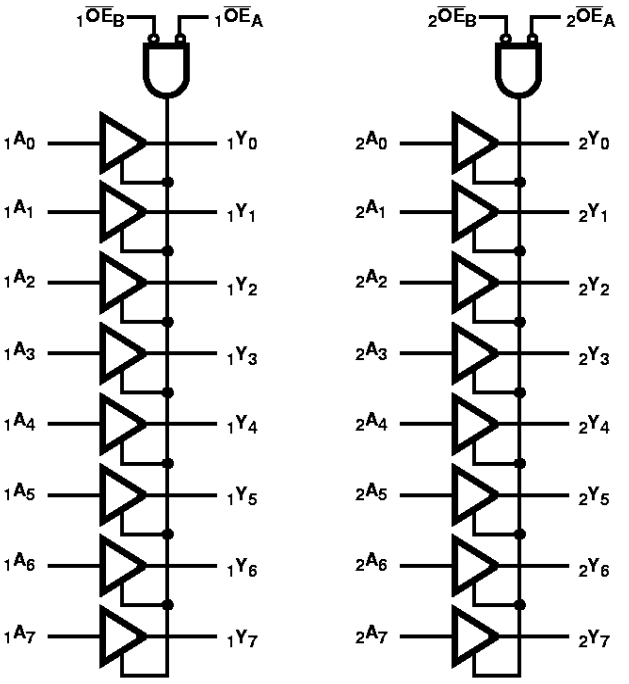
File Number **4186.2**

## Pinout

CD74FCT16541T, CD74FCT162541T, CD74FCT162H541T
(SSOP, TSSOP)
TOP VIEW



## Functional Block Diagram




**TRUTH TABLE** (NOTE 1)

| INPUTS | | OUTPUTS |
|---|---|---|
| $_x\overline{OE}$ | $_xA_x$ | $_xY_x$ |
| L | L | H |
| L | H | L |
| H | X | Z |

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) |
| $_xA_x$ | Inputs (Note 2) |
| $_xY_x$ | Three-State Outputs |
| GND | Ground |
| $V_{CC}$ | Power |

NOTE:

2. For the CD74FCT162H541T, 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°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 3) | $\theta_{JA}$ (°C/W) |
|---|---|
| TSSOP Package | 94 |
| SSOP Package | 76 |

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.*

NOTE:

3. $\theta_{JA}$ 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°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 7) $V_{CC}$ = Max | $V_{IN} = V_{CC}$ | - | - | ±100 | µA |
| Input HIGH Current | $I_{IH}$ | Bus Hold I/O (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 | $I_{IL}$ | Standard I/O, $V_{CC}$ = Min | $V_{IN}$ = GND | - | - | -1 | µA |
| Input LOW Current | $I_{IL}$ | Bus Hold Input (Note 7) $V_{CC}$ = Min | $V_{IN}$ = GND | - | - | ±100 | µA |
| Input LOW Current | $I_{IL}$ | Bus Hold I/O (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 8) | $I_{OZH}$ | $V_{CC}$ = 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 6), $V_{OUT}$ = GND | | -80 | -140 | -200 | mA |
| Output Drive Current | $I_O$ | $V_{CC}$ = Max (Note 6), $V_{OUT}$ = 2.5V | | -50 | - | -180 | mA |
| Input Hysteresis | $V_H$ | | | - | 100 | - | mV |

## Electrical Specifications (Continued)

| PARAMETER | SYMBOL | (NOTE 4) TEST CONDITIONS | | MIN | (NOTE 5) TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **CD74FCT16541T 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 |
| **CD74FCT162541T, CD74FCT162H541T 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 6) | | 60 | 115 | 150 | mA |
| Output HIGH Current | $I_{ODH}$ | $V_{CC}$ = 5V, $V_{IN}$ = $V_{IH}$ or $V_{IL}$, $V_{OUT}$ = 1.5V (Note 6) | | -60 | -115 | -150 | mA |
| **CAPACITANCE** $T_A$ = 25°C, 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 | $\Delta I_{CC}$ | $V_{CC}$ = 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<br>$_X\overline{OE}$ = GND<br>One Bit Toggling<br>50% Duty Cycle | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | - | 60 | 100 | µA/ MHz |
| Total Power Supply Current (Note 13) | $I_C$ | $V_{CC}$ = Max, Outputs Open<br>$f_I$ = 10MHz, 50% Duty Cycle<br>$_X\overline{OE}$ = GND<br>One Bit Toggling | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | - | 0.6 | 1.5 (Note 12) | mA |
| | | | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND | - | 0.9 | 2.3 (Note 12) | mA |
| | | $V_{CC}$ = Max, Outputs Open<br>$f_I$ = 2.5MHz<br>50% Duty Cycle<br>$_X\overline{OE}$ = GND<br>16 Bits Toggling | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | - | 2.4 | 4.5 (Note 12) | mA |
| | | | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND | - | 6.4 | 16.5 (Note 12) | mA |

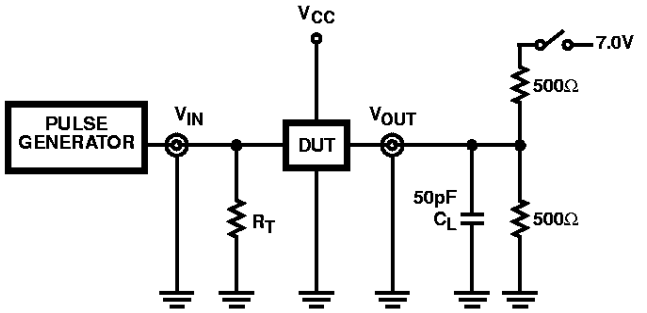
## Switching Specifications Over Operating Range

| PARAMETER | SYMBOL | (NOTE 14) TEST CONDITIONS | T (NOTE 15) MIN | T MAX | AT (NOTE 15) MIN | AT MAX | CT (NOTE 15) MIN | CT MAX | DT (NOTE 15) MIN | DT MAX | ET (NOTE 15) MIN | ET MAX | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CD74FCT16541T, CD74FCT162541T, CD74FCT162H541T** | | | | | | | | | | | | | |
| Propagation Delay $_XA_X$ to $_XY_X$ | $t_{PLH}$, $t_{PHL}$ | $C_L$ = 50pF, $R_L$ = 500Ω | 1.5 | 8.0 | 1.5 | 4.8 | 1.5 | 4.3 | 1.5 | 3.6 | 1.5 | 3.2 | ns |
| Output Enable Time $_X\overline{OE}$ to $_XA_X$ or $_XY_X$ | $t_{PZH}$, $t_{PZL}$ | | 1.5 | 10.0 | 1.5 | 6.2 | 1.5 | 5.8 | 1.5 | 4.8 | 1.5 | 4.4 | ns |
| Output Disable Time (Note 16) $_X\overline{OE}$ to $_XA_X$ or $_XY_X$ | $t_{PHZ}$, $t_{PLZ}$ | FCT16541T, FCT162541T | 1.5 | 9.5 | 1.5 | 5.6 | 1.5 | 5.2 | 1.5 | 4.0 | 1.5 | 3.6 | ns |
| | | FCT162H541T | 1.5 | 9.5 | 1.5 | 5.6 | 1.5 | 5.2 | 1.5 | 4.0 | 1.5 | 4.0 | ns |
| Output Skew (Note 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, except as noted.
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
    $\Delta I_{CC}$ = 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; $Z_{OUT}$ ≤ 50Ω; $t_f$, $t_r$ ≤ 2.5ns.

FIGURE 1. TEST CIRCUIT

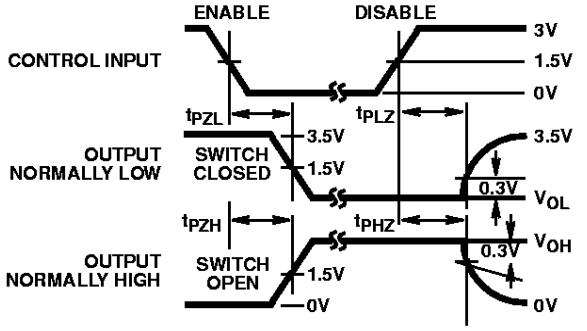



FIGURE 2. ENABLE AND DISABLE TIMING

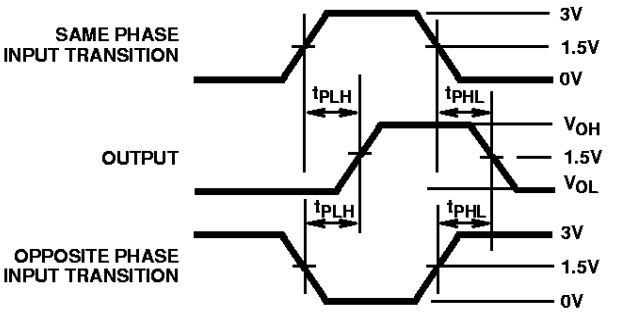



FIGURE 3. PROPAGATION DELAY

All Harris Semiconductor products are manufactured, assembled and tested under **ISO9000** quality systems certification.



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