# FAST CMOS 16-BIT BUFFER/LINE DRIVER

## IDT54/74FCT162240AT/CT/ET

## FEATURES:

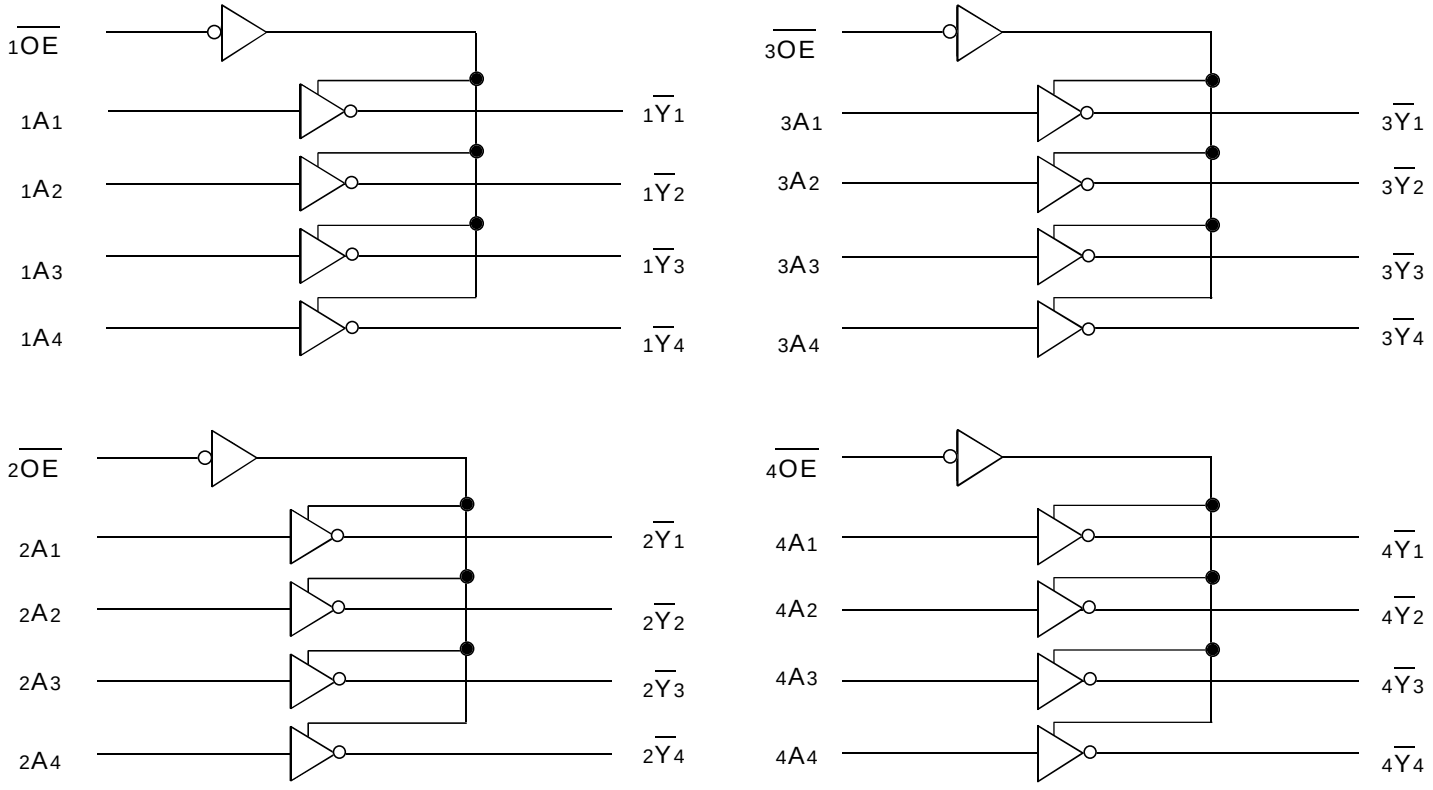
- 0.5 MICRON CMOS Technology
- High-speed, low-power CMOS replacement for ABT functions
- Typical $t_{SK}(o)$ (Output Skew) < 250ps
- Low input and output leakage ≤1µA (max.)
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 25 mil pitch SSOP, 19.6 mil pitch TSSOP, 15.7 mil pitch TVSOP and 25 mil pitch CERPACK packages
- Extended commercial range of -40°C to +85°C
- $V_{CC}$ = 5V ±10%
- Balanced Output Drivers:
  - ±24mA (commercial)
  - ±16mA (military)
- Reduced system switching noise
- Typical $V_{OLP}$ (Output Ground Bounce) < 0.6V at $V_{CC}$ = 5V, $T_A$ = 25°C

## DESCRIPTION:

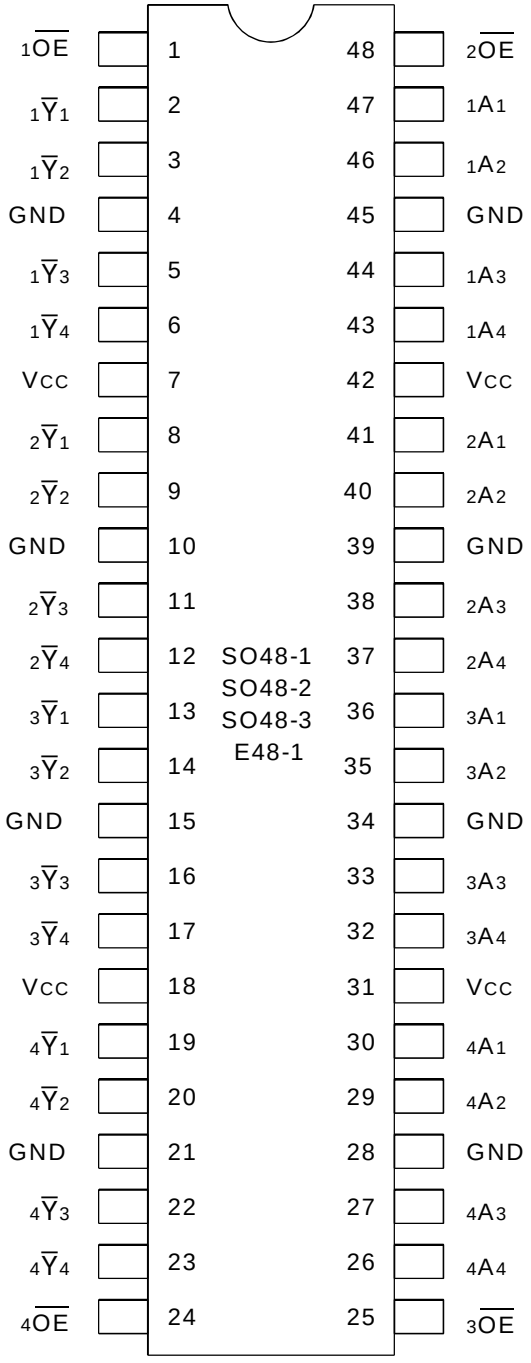
The FCT162240T/AT/CT/ET 16-bit buffer/line driver is built using advanced dual metal CMOS technology. These high-speed, low-power devices offer bus/backplane interface capability with improved packing density. The flow-through organization of signal pins simplifies layout. The three-state controls are designed to operate these devices in a Quad-Nibble, Dual-Byte or single 16-bit word mode. All inputs are designed with hysteresis for improved noise margin.

The FCT162240T/AT/CT/ET have balanced output drive with current limiting resistors. This offers low ground bounce, minimal undershoot, and controlled output fall times– reducing the need for external series terminating resistors. The FCT162240T/AT/CT/ET are plug-in replacements for FCT16240T/AT/CT/ET and 54/74ABT16240 for on-board interface applications.

## FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION




**SSOP/ TSSOP/ TVSOP/ CERPACK**
**TOP VIEW**

## ABSOLUTE MAXIMUM RATINGS(1)

| Symbol | Description | Max | Unit |
|---|---|---|---|
| $V_{TERM}$(2) | Terminal Voltage with Respect to GND | –0.5 to +7 | V |
| $V_{TERM}$(3) | Terminal Voltage with Respect to GND | –0.5 to $V_{CC}$+0.5 | V |
| $T_{STG}$ | Storage Temperature | –65 to +150 | °C |
| $I_{OUT}$ | DC Output Current | –60 to +120 | mA |

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**NOTES:**
1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. All device terminals except FCT162XXXT Output and I/O terminals.
3. Output and I/O terminals for FCT162XXXT.

## CAPACITANCE ($T_A$ = +25°C, f = 1.0MHz)

| Symbol | Parameter(1) | Conditions | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $C_{IN}$ | Input Capacitance | $V_{IN}$ = 0V | 3.5 | 6 | pF |
| $C_{OUT}$ | Output Capacitance | $V_{OUT}$ = 0V | 3.5 | 8 | pF |

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**NOTE:**
1. This parameter is measured at characterization but not tested.

## PIN DESCRIPTION

| Pin Names | Description |
|---|---|
| x$\overline{OE}$ | 3–State Output Enable Inputs (Active LOW) |
| xAx | Data Inputs |
| x$\overline{Y}$x | 3-State Outputs |

## FUNCTION TABLE(1)

| Inputs | | Outputs |
|---|---|---|
| x$\overline{OE}$ | xAx | x$\overline{Y}$x |
| L | L | H |
| L | H | L |
| H | X | Z |

**NOTE:**
1. H = HIGH Voltage Level
   X = Don't Care
   L = LOW Voltage Level
   Z = High-Impedance

# DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

**Following Conditions Apply Unless Otherwise Specified:**
**Commercial: $T_A$ = -40°C to +85°C, $V_{CC}$ = 5.0V ±10%; Military: $T_A$ = -55°C to +125°C, $V_{CC}$ = 5.0V ±10%**

| Symbol | Parameter | Test Conditions[1] | | Min. | Typ.[2] | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{IH}$ | Input HIGH Level | Guaranteed Logic HIGH Level | | 2 | — | — | V |
| $V_{IL}$ | Input LOW Level | Guaranteed Logic LOW Level | | — | — | 0.8 | V |
| $I_{IH}$ | Input HIGH Current (Input pins)[5] | $V_{CC}$ = Max. | $V_I$ = $V_{CC}$ | — | — | ±1 | µA |
| | Input HIGH Current (I/O pins)[5] | | | — | — | ±1 | |
| $I_{IL}$ | Input LOW Current (Input pins)[5] | | $V_I$ = GND | — | — | ±1 | |
| | Input LOW Current (I/O pins)[5] | | | — | — | ±1 | |
| $I_{OZH}$ | High Impedance Output Current | $V_{CC}$ = Max. | $V_O$ = 2.7V | — | — | ±1 | µA |
| $I_{OZL}$ | (3-State Output pins)[5] | | $V_O$ = 0.5V | — | — | ±1 | |
| $V_{IK}$ | Clamp Diode Voltage | $V_{CC}$ = Min., $I_{IN}$ = –18mA | | — | –0.7 | –1.2 | V |
| $I_{OS}$ | Short Circuit Current | $V_{CC}$ = Max., $V_O$ = GND[3] | | –80 | –140 | –250 | mA |
| $V_H$ | Input Hysteresis | — | | — | 100 | — | mV |
| $I_{CCL}$<br>$I_{CCH}$<br>$I_{CCZ}$ | Quiescent Power Supply Current | $V_{CC}$ = Max.<br>$V_{IN}$ = GND or $V_{CC}$ | | — | 5 | 500 | µA |

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# OUTPUT DRIVE CHARACTERISTICS

| Symbol | Parameter | Test Conditions[1] | | Min. | Typ.[2] | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $I_{ODL}$ | Output LOW Current | $V_{CC}$ = 5V, $V_{IN}$ = $V_{IH}$ or $V_{IL}$, $V_O$ = 1.5V[3] | | 60 | 115 | 200 | mA |
| $I_{ODH}$ | Output HIGH Current | $V_{CC}$ = 5V, $V_{IN}$ = $V_{IH}$ or $V_{IL}$, $V_O$ = 1.5V[3] | | –60 | –115 | –200 | mA |
| $V_{OH}$ | Output HIGH Voltage | $V_{CC}$ = Min.<br>$V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = –16mA MIL<br>$I_{OH}$ = –24mA COM'L | 2.4 | 3.3 | — | V |
| $V_{OL}$ | Output LOW Voltage | $V_{CC}$ = Min.<br>$V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 16mA MIL<br>$I_{OL}$ = 24mA COM'L | — | 0.3 | 0.55 | V |

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**NOTES:**
1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at $V_{CC}$ = 5.0V, +25°C ambient.
3. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
4. Duration of the condition can not exceed one second.
5. The test limit for this parameter is ±5µA at $T_A$ = -55°C.

# POWER SUPPLY

| Symbol | Parameter | Test Conditions[1] | | Min. | Typ.[2] | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $\Delta I_{CC}$ | Quiescent Power Supply Current<br>TTL Inputs HIGH | $V_{CC}$ = Max.<br>$V_{IN}$ = 3.4V[3] | | — | 0.5 | 1.5 | mA |
| $I_{CCD}$ | Dynamic Power Supply Current[4] | $V_{CC}$ = Max.<br>Outputs Open<br>x$\overline{OE}$ = GND<br>One Input Toggling<br>50% Duty Cycle | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | — | 60 | 100 | µA/<br>MHz |
| $I_C$ | Total Power Supply Current[6] | $V_{CC}$ = Max.<br>Outputs Open<br>fi = 10MHz<br>50% Duty Cycle<br>x$\overline{OE}$ = GND<br>One Bit Toggling | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | — | 0.6 | 1.5 | mA |
| | | | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND | — | 0.9 | 2.3 | |
| | | $V_{CC}$ = Max.<br>Outputs Open<br>fi = 2.5MHz<br>50% Duty Cycle<br>x$\overline{OE}$ = GND<br>Sixteen Bits Toggling | $V_{IN}$ = $V_{CC}$<br>$V_{IN}$ = GND | — | 2.4 | 4.5[5] | |
| | | | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND | — | 6.4 | 16.5[5] | |

**NOTES:**

1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at $V_{CC}$ = 5.0V, +25°C ambient.
3. Per TTL driven input ($V_{IN}$ = 3.4V). All other inputs at $V_{CC}$ or GND.
4. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
5. Values for these conditions are examples of the $I_{CC}$ formula. These limits are guaranteed but not tested.
6. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP}/2 + f_i N_i)$
   $I_{CC}$ = Quiescent Current ($I_{CCL}$, $I_{CCH}$ and $I_{CCZ}$)
   $\Delta I_{CC}$ = 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)
   $N_{CP}$ = Number of Clock Inputs at $f_{CP}$
   $f_i$ = Input Frequency
   $N_i$ = Number of Inputs at $f_i$

# SWITCHING CHARACTERISTICS OVER OPERATING RANGE

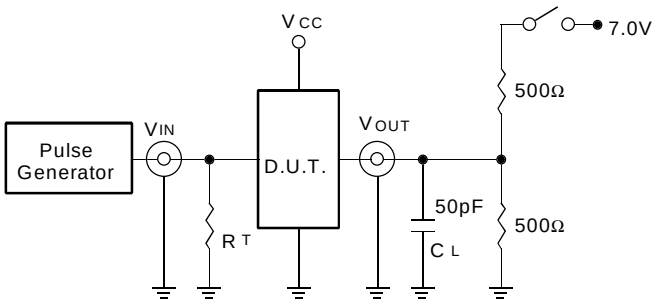
| | | | FCT162240T | | | | FCT162240AT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Com'l. | | Mil. | | Com'l. | | Mil. | | |
| Symbol | Parameter | Condition[1] | Min.[2] | Max. | Min.[2] | Max. | Min.[2] | Max. | Min.[2] | Max. | Unit |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>xAx to x$\overline{Y}$x | $C_L$ = 50pF<br>$R_L$ = 500Ω | 1.5 | 8 | 1.5 | 9 | 1.5 | 4.8 | 1.5 | 5.1 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time | | 1.5 | 10 | 1.5 | 10.5 | 1.5 | 6.2 | 1.5 | 6.5 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output Disable Time | | 1.5 | 9.5 | 1.5 | 10 | 1.5 | 5.6 | 1.5 | 5.9 | ns |
| $t_{SK(o)}$ | Output Skew[3] | | — | 0.5 | — | 0.5 | — | 0.5 | — | 0.5 | ns |

| | | | FCT162240CT | | | | FCT162240ET | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Com'l. | | Mil. | | Com'l. | | Mil. | | |
| Symbol | Parameter | Condition[1] | Min.[2] | Max. | Min.[2] | Max. | Min.[2] | Max. | Min.[2] | Max. | Unit |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>xAx to x$\overline{Y}$x | $C_L$ = 50pF<br>$R_L$ = 500Ω | 1.5 | 4.3 | 1.5 | 4.7 | 1.5 | 3.2 | — | — | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time | | 1.5 | 5.8 | 1.5 | 6.5 | 1.5 | 4.4 | — | — | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output Disable Time | | 1.5 | 5.2 | 1.5 | 5.7 | 1.5 | 3.6 | — | — | ns |
| $t_{SK(o)}$ | Output Skew[3] | | — | 0.5 | — | 0.5 | — | 0.5 | — | — | ns |

**NOTES:**
1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

# TEST CIRCUITS AND WAVEFORMS

## TEST CIRCUITS FOR ALL OUTPUTS




## SWITCH POSITION

| Test | Switch |
|---|---|
| Open Drain<br>Disable Low<br>Enable Low | Closed |
| All Other Tests | Open |

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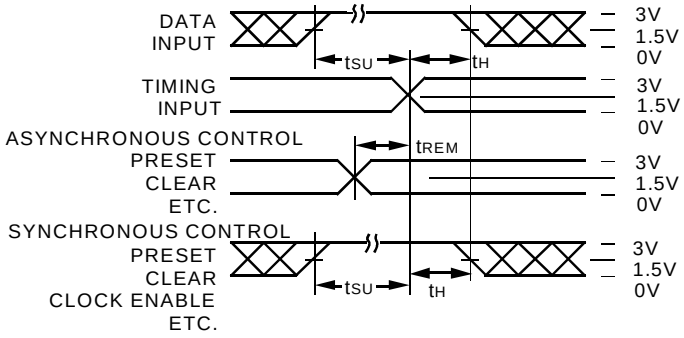
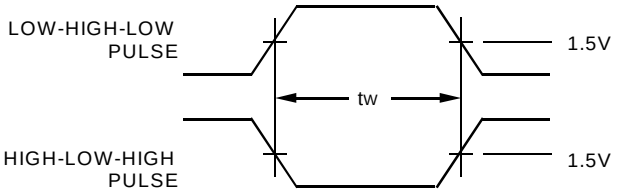
**DEFINITIONS:**

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

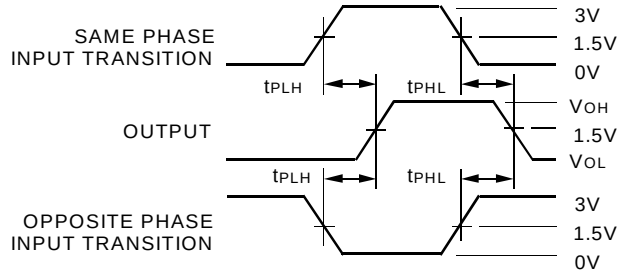
## SET-UP, HOLD, AND RELEASE TIMES



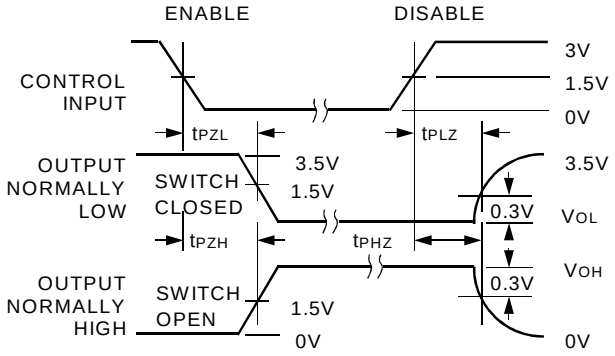

## PULSE WIDTH




## PROPAGATION DELAY



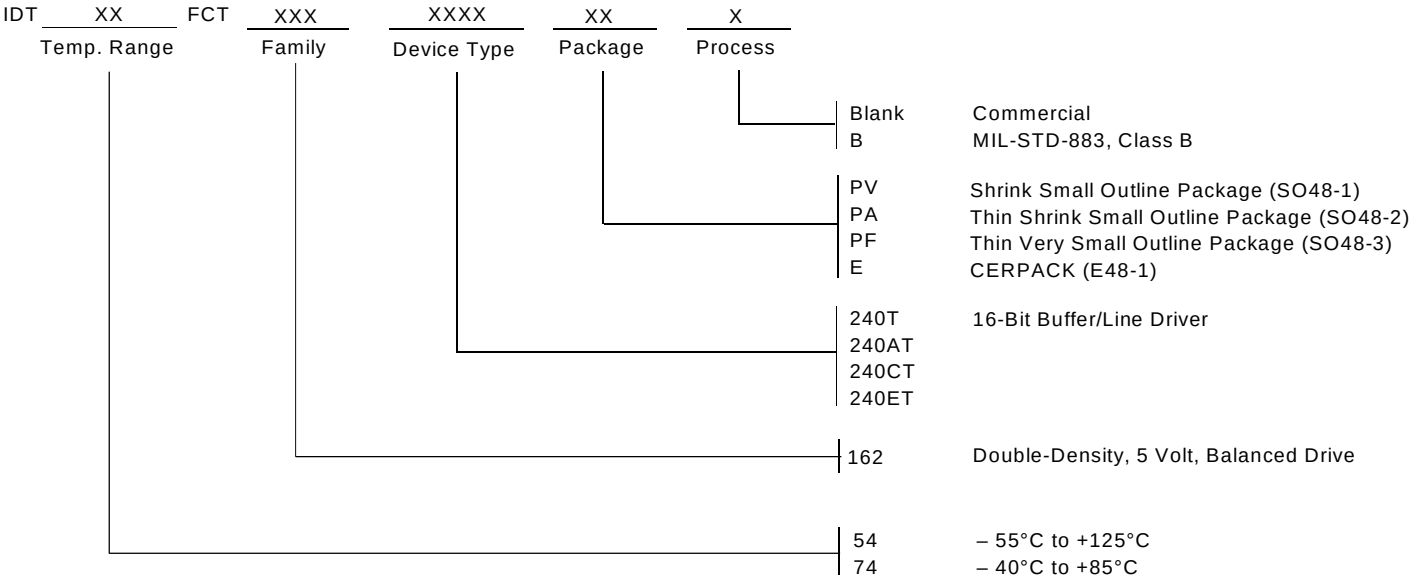

## ENABLE AND DISABLE TIMES




**NOTES:**

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; $t_F$ ≤ 2.5ns; $t_R$ ≤ 2.5ns.

# ORDERING INFORMATION

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