Integrated Device Technology, Inc.

# FAST CMOS OCTAL BUFFER/LINE DRIVER

**IDT54/74FCT240/A/C**
**IDT54/74FCT241/A/C**
**IDT54/74FCT244/A/C**
**IDT54/74FCT540/A/C**
**IDT54/74FCT541/A/C**

## FEATURES:

- IDT54/74FCT240/241/244/540/541 equivalent to FAST™ speed and drive
- **IDT54/74FCT240A/241A/244A/540A/541A 25% faster than FAST**
- **IDT54/74FCT240C/241C/244C/540C/541C up to 55% faster than FAST**
- $I_{OL}$ = 64mA (commercial) and 48mA (military)
- CMOS power levels (1mW typ. static)
- Product available in Radiation Tolerant and Radiation Enhanced versions
- Military product compliant to MIL-STD-883, Class B
- Meets or exceeds JEDEC Standard 18 specifications

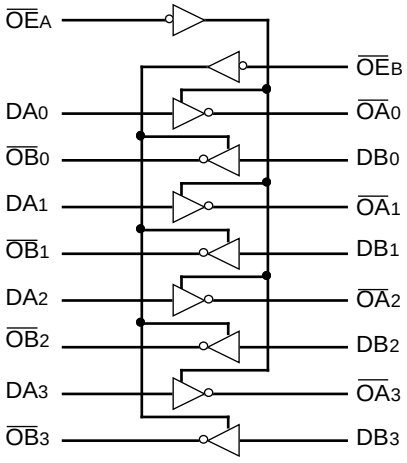
## DESCRIPTION:

The IDT octal buffer/line drivers are built using an advanced dual metal CMOS technology. The IDT54/74FCT240/A/C, IDT54/74FCT241/A/C and IDT54/74FCT244/A/C are designed to be employed as memory and address drivers, clock drivers and bus-oriented transmitter/receivers which provide improved board density.

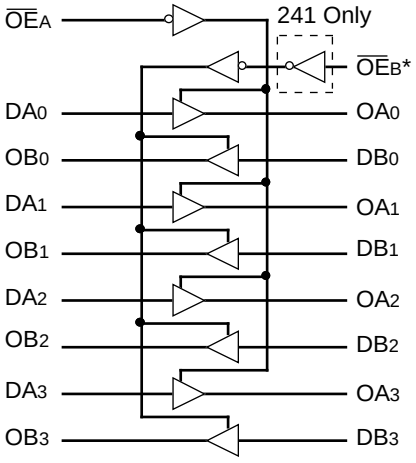
The IDT54/74FCT540/A/C and IDT54/74FCT541/A/C are similar in function to the IDT54/74FCT240/A/C and IDT54/74FCT244/A/C, respectively, except that the inputs and outputs are on opposite sides of the package. This pinout arrangement makes these devices especially useful as output ports for microprocessors and as backplane drivers, allowing ease of layout and greater board density.

## FUNCTIONAL BLOCK DIAGRAMS

### 2529 cnv* 01–03

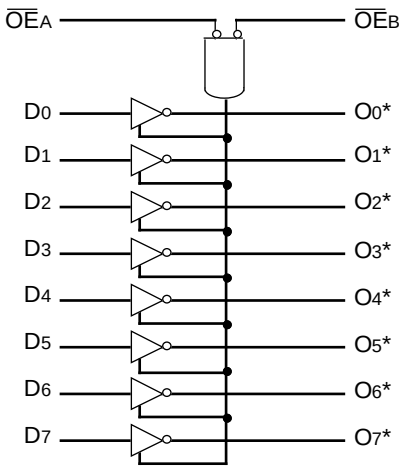



**IDT54/74FCT240**




**IDT54/74FCT241/244**

*$OE_B$ for 241, $\overline{OE}_B$ for 244




**IDT54/74FCT540/541**

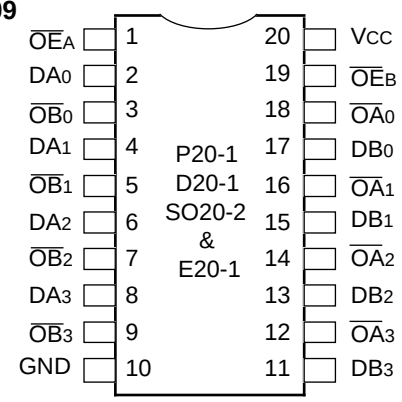
*Logic diagram shown for 'FCT540. 'FCT541 is the non-inverting option.

2606 dwg 01–03

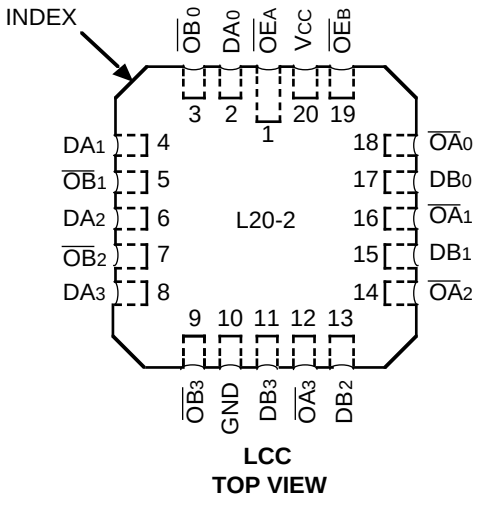
## PIN CONFIGURATIONS

### IDT54/74FCT240

**2529 cnv* 04–09**

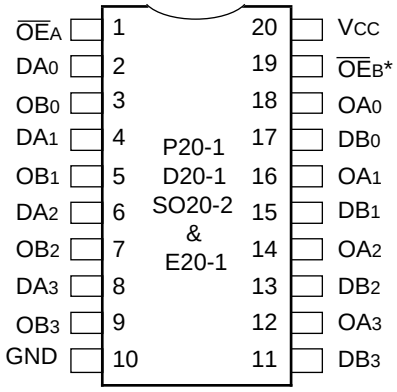



**DIP/SOIC/CERPACK**
**TOP VIEW**

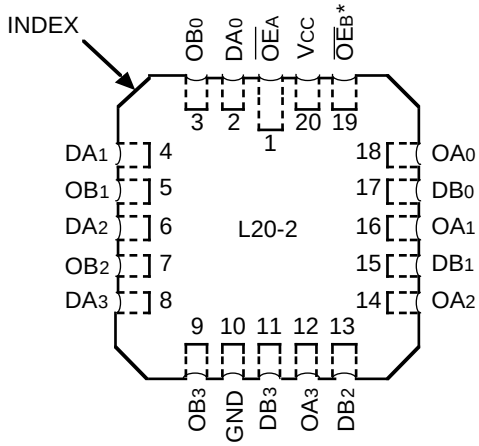



**LCC**
**TOP VIEW**

### IDT54/74FCT241/244



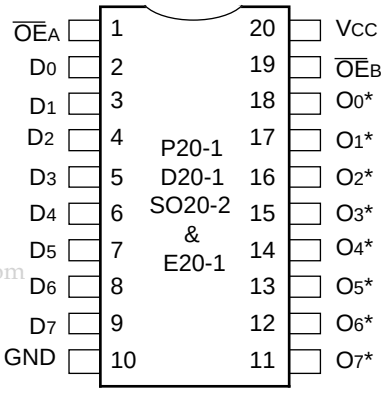

**DIP/SOIC/CERPACK**
**TOP VIEW**




**LCC**
**TOP VIEW**

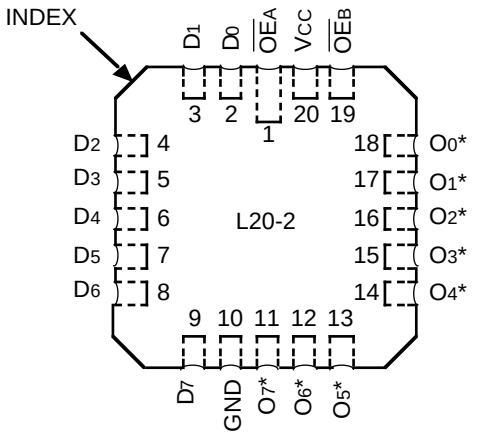
*OEB for 241, $\overline{OE}_B$ for 244

### IDT54/74FCT540/541






**DIP/SOIC/CERPACK**
**TOP VIEW**




**LCC**
**TOP VIEW**

*$\overline{O}_X$ for 540, $O_X$ for 541

2606 cnv* 04–09

## PIN DESCRIPTION

| Pin Names | Description |
|---|---|
| $\overline{OE}$ A, $\overline{OE}$ B | 3–State Output Enable Inputs (Active LOW) |
| $OE_B$[1] | 3–State Output Enable Input (Active HIGH) |
| Dxx | Inputs |
| Oxx | Outputs |

2606 tbl 04

**NOTE:**
1. $OE_B$ for 241 only.

## FUNCTION TABLE

| Inputs[1] | | | | Outputs[1] | | | | |
|---|---|---|---|---|---|---|---|---|
| $\overline{OE}$ A | $\overline{OE}$ B | $OE_B$[2] | D | 240 | 241 | 244 | 540 | 541 |
| L | L | H | L | H | L | L | H | L |
| L | L | H | H | L | H | H | L | H |
| H | H | L | X | Z | Z | Z | Z | Z |

2606 tbl 05

**NOTES:**
1. H = High Voltage Level
   X = Don't Care
   L = Low Voltage Level
   Z = High Impedance
2. $OE_B$ for 241 only.

## ABSOLUTE MAXIMUM RATINGS[1]

| Symbol | Rating | Commercial | Military | Unit |
|---|---|---|---|---|
| $V_{TERM}$[2] | Terminal Voltage with Respect to GND | –0.5 to +7.0 | –0.5 to +7.0 | V |
| $V_{TERM}$[3] | Terminal Voltage with Respect to GND | –0.5 to $V_{CC}$ | –0.5 to $V_{CC}$ | V |
| $T_A$ | Operating Temperature | 0 to +70 | –55 to +125 | °C |
| $T_{BIAS}$ | Temperature Under Bias | –55 to +125 | –65 to +135 | °C |
| $T_{STG}$ | Storage Temperature | –55 to +125 | –65 to +150 | °C |
| $P_T$ | Power Dissipation | 0.5 | 0.5 | W |
| $I_{OUT}$ | DC Output Current | 120 | 120 | mA |

2606 tbl 01

**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. No terminal voltage may exceed $V_{CC}$ by +0.5V unless otherwise noted.
2. Input and $V_{CC}$ terminals only.
3. Outputs and I/O terminals only.

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

| Symbol | Parameter (1) | Conditions | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $C_{IN}$ | Input Capacitance | $V_{IN}$ = 0V | 6 | 10 | pF |
| $C_{OUT}$ | Output Capacitance | $V_{OUT}$ = 0V | 8 | 12 | pF |

2606 tbl 02

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

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified: $V_{LC}$ = 0.2V; $V_{HC}$ = $V_{CC}$ – 0.2V
Commercial: $T_A$ = 0°C to +70°C, $V_{CC}$ = 5.0V ± 5%; 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 | | 2.0 | — | — | V |
| $V_{IL}$ | Input LOW Level | Guaranteed Logic LOW Level | | — | — | 0.8 | V |
| $I_{IH}$ | Input HIGH Current | $V_{CC}$ = Max. | $V_I$ = $V_{CC}$ | — | — | 5 | µA |
| | | | $V_I$ = 2.7V | — | — | 5[4] | |
| $I_{IL}$ | Input LOW Current | | $V_I$ = 0.5V | — | — | –5[4] | |
| | | | $V_I$ = GND | — | — | –5 | |
| $I_{OZH}$ | Off State (High Impedance) Output Current | $V_{CC}$ = Max. | $V_O$ = $V_{CC}$ | — | — | 10 | µA |
| | | | $V_O$ = 2.7V | — | — | 10[4] | |
| $I_{OZL}$ | | | $V_O$ = 0.5V | — | — | –10[4] | |
| | | | $V_O$ = GND | — | — | –10 | |
| $V_{IK}$ | Clamp Diode Voltage | $V_{CC}$ = Min., $I_N$ = –18mA | | — | –0.7 | –1.2 | V |
| $I_{OS}$ | Short Circuit Current | $V_{CC}$ = Max.[3], $V_O$ = GND | | –60 | –120 | — | mA |
| $V_{OH}$ | Output HIGH Voltage | $V_{CC}$ = 3V, $V_{IN}$ = $V_{LC}$ or $V_{HC}$, $I_{OH}$ = –32µA | | $V_{HC}$ | $V_{CC}$ | — | V |
| | | $V_{CC}$ = Min. $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = –300µA | $V_{HC}$ | $V_{CC}$ | — | |
| | | | $I_{OH}$ = –12mA MIL. | 2.4 | 4.3 | — | |
| | | | $I_{OH}$ = –15mA COM'L. | 2.4 | 4.3 | — | |
| $V_{OL}$ | Output LOW Voltage | $V_{CC}$ = 3V, $V_{IN}$ = $V_{LC}$ or $V_{HC}$, $I_{OL}$ = 300µA | | — | GND | $V_{LC}$ | V |
| | | $V_{CC}$ = Min. $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 300µA | — | GND | $V_{LC}$[4] | |
| | | | $I_{OL}$ = 48mA MIL. | — | 0.3 | 0.55 | |
| | | | $I_{OL}$ = 64mA COM'L. | — | 0.3 | 0.55 | |

2606 tbl 03

**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 and maximum loading.
3. Not more than one output should be shorted at one time. Duration of the short circuit test should not exceed one second.
4. This parameter is guaranteed but not tested.

## POWER SUPPLY CHARACTERISTICS

$V_{LC}$ = 0.2V; $V_{HC}$ = $V_{CC}$ – 0.2V

| Symbol | Parameter | Test Conditions[1] | | Min. | Typ.[2] | Max. | Unit |
|---|---|---|---|---|---|---|---|
| $I_{CC}$ | Quiescent Power Supply Current | $V_{CC}$ = Max.<br>$V_{IN} \geq V_{HC}$; $V_{IN} \leq V_{LC}$ | | — | 0.2 | 1.5 | mA |
| $\Delta I_{CC}$ | Quiescent Power Supply Current<br>TTL Inputs HIGH | $V_{CC}$ = Max.<br>$V_{IN}$ = 3.4V[3] | | — | 0.5 | 2.0 | mA |
| $I_{CCD}$ | Dynamic Power Supply Current[4] | $V_{CC}$ = Max.<br>Outputs Open<br>$\overline{OE}_A$ = $\overline{OE}_B$ = GND or<br>$\overline{OE}_A$ = GND,<br>$OE_B$ = $V_{CC}$<br>One Input Toggling<br>50% Duty Cycle | $V_{IN} \geq V_{HC}$<br>$V_{IN} \leq V_{LC}$ | — | 0.15 | 0.25 | mA/<br>MHz |
| $I_C$ | Total Power Supply Current [6] | $V_{CC}$ = Max.<br>Outputs Open<br>fi = 10MHz<br>50% Duty Cycle | $V_{IN} \geq V_{HC}$<br>$V_{IN} \leq V_{LC}$<br>(FCT) | — | 1.7 | 4.0 | mA |
| | | $\overline{OE}_A$ = $\overline{OE}_B$ = GND or<br>$\overline{OE}_A$ = GND,<br>$OE_B$ = $V_{CC}$<br>One Bit Toggling | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND | — | 2.0 | 5.0 | |
| | | $V_{CC}$ = Max.<br>Outputs Open<br>fi = 5MHz<br>50% Duty Cycle | $V_{IN} \geq V_{HC}$<br>$V_{IN} \leq V_{LC}$<br>(FCT) | — | 3.2 | 6.5[5] | |
| | | $\overline{OE}_A$ = $\overline{OE}_B$ = GND or<br>$\overline{OE}_A$ = GND,<br>$OE_B$ = $V_{CC}$<br>Eight Bits Toggling | $V_{IN}$ = 3.4V<br>$V_{IN}$ = GND | — | 5.2 | 14.5[5] | |

2606 tbl 06

**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. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$
   $I_{CC}$ = 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.

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE FOR FCT240(1,2)

| | | | 54/74FCT240 | | | | 54/74FCT240A | | | | 54/74FCT240C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Com'l. | | Mil. | | Com'l. | | Mil. | | Com'l. | | Mil. | | |
| Symbol | Parameter | Condition | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Unit |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$D_N$ to $\overline{O}_N$ | $C_L$ = 50pF<br>$R_L$ = 500Ω | 1.5 | 8.0 | 1.5 | 9.0 | 1.5 | 4.8 | 1.5 | 5.1 | 1.5 | 4.3 | 1.5 | 4.7 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time | | 1.5 | 10.0 | 1.5 | 10.5 | 1.5 | 6.2 | 1.5 | 6.5 | 1.5 | 5.8 | 1.5 | 6.5 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output Disable Time | | 1.5 | 9.5 | 1.5 | 10.0 | 1.5 | 5.6 | 1.5 | 5.9 | 1.5 | 5.2 | 1.5 | 5.7 | ns |

2606 tbl 07

SWITCHING CHARACTERISTICS OVER OPERATING RANGE FOR FCT241 AND FCT244(1,2)

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE FOR FCT241 AND FCT244(1,2)

| | | | 54/74FCT241/244 | | | | 54/74FCT241A/244A | | | | 54/74FCT241C/244C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Com'l. | | Mil. | | Com'l. | | Mil. | | Com'l. | | Mil. | | |
| Symbol | Parameter | Condition | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Unit |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$D_N$ to $O_N$ | $C_L$ = 50pF<br>$R_L$ = 500Ω | 1.5 | 6.5 | 1.5 | 7.0 | 1.5 | 4.8 | 1.5 | 5.1 | 1.5 | 4.1 | 1.5 | 4.6 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time | | 1.5 | 8.0 | 1.5 | 8.5 | 1.5 | 6.2 | 1.5 | 6.5 | 1.5 | 5.8 | 1.5 | 6.5 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output Disable Time | | 1.5 | 7.0 | 1.5 | 7.5 | 1.5 | 5.6 | 1.5 | 5.9 | 1.5 | 5.2 | 1.5 | 5.7 | ns |

2606 tbl 08

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE FOR FCT540 AND FCT541(1,2)

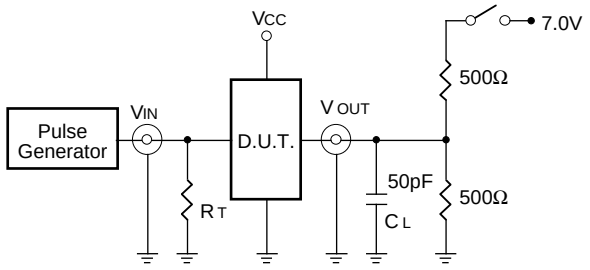
| | | | 54/74FCT540/541 | | | | 54/74FCT540A/541A | | | | 54/74FCT540C/541C | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Com'l. | | Mil. | | Com'l. | | Mil. | | Com'l. | | Mil. | | |
| Symbol | Parameter | Condition | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Unit |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$D_N$ to $\overline{O}_N$<br>IDT54/74FCT540 | $C_L$ = 50pF<br>$R_L$ = 500Ω | 1.5 | 8.5 | 1.5 | 9.5 | 1.5 | 4.8 | 1.5 | 5.1 | 1.5 | 4.3 | 1.5 | 4.7 | ns |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$D_N$ to $O_N$<br>IDT54/74FCT541 | | 1.5 | 8.0 | 1.5 | 9.0 | 1.5 | 4.8 | 1.5 | 5.1 | 1.5 | 4.1 | 1.5 | 4.6 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time | | 1.5 | 10.0 | 1.5 | 10.5 | 1.5 | 6.2 | 1.5 | 6.5 | 1.5 | 5.8 | 1.5 | 6.5 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output Disable Time | | 1.5 | 9.5 | 1.5 | 10.0 | 1.5 | 5.6 | 1.5 | 5.9 | 1.5 | 5.2 | 1.5 | 5.7 | ns |

**NOTES:**
1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.

2606 tbl 09

# 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 |

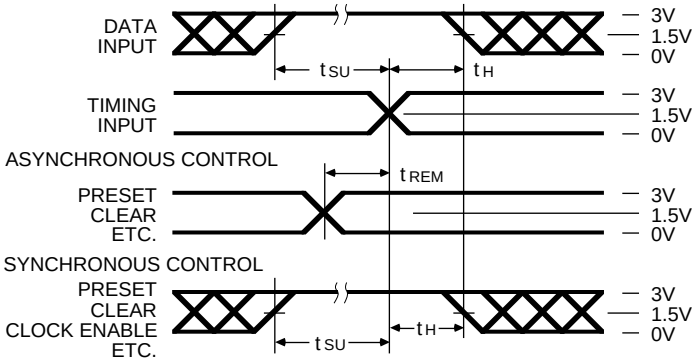
2606 tbl 10

**DEFINITIONS:**

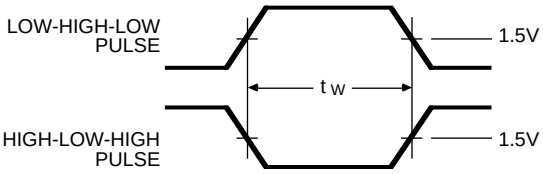
$C_L$ = Load capacitance: includes jig and probe capacitance.

$R_T$ = Termination resistance: should be equal to $Z_{OUT}$ of the Pulse Generator.

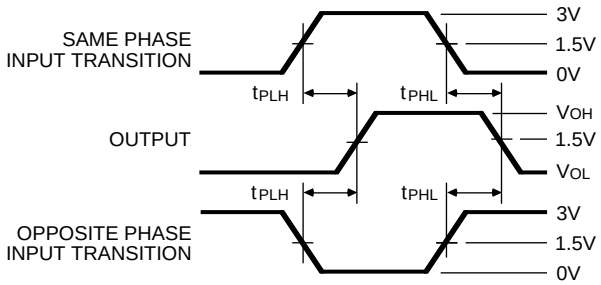
## SET-UP, HOLD AND RELEASE TIMES



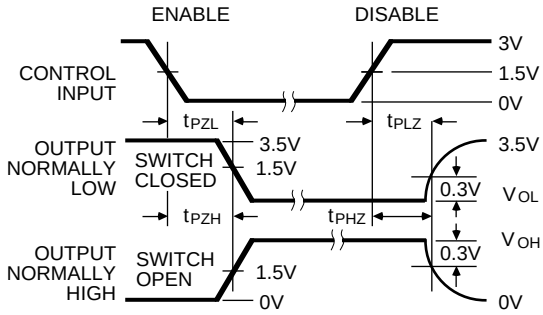

## PULSE WIDTH




## PROPAGATION DELAY




## ENABLE AND DISABLE TIMES

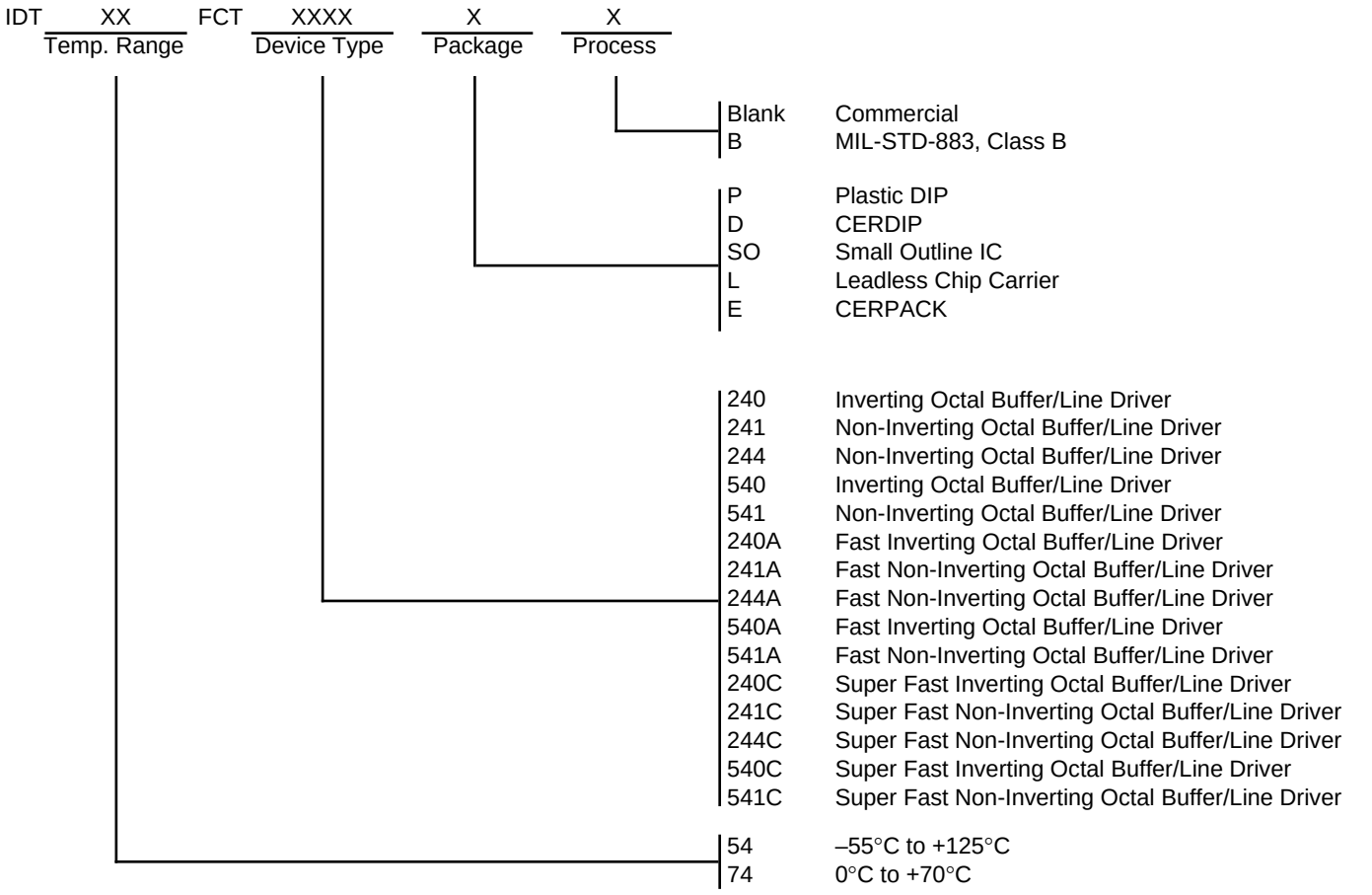



2606 drw 10

**NOTES**

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.
2. Pulse Generator for All Pulses: Rate ≤ 1.0 MHz; $Z_O$ ≤ 50Ω; $t_F$ ≤ 2.5ns; $t_R$ ≤ 2.5ns.

## ORDERING INFORMATION




2606 cnv* 15