



Integrated Device Technology, Inc.

# FAST CMOS OCTAL D REGISTERS (3-STATE)

IDT54/74FCT374T/AT/CT/DT - 2374T/AT/CT

IDT54/74FCT534T/AT/CT

IDT54/74FCT574T/AT/CT/DT - 2574T/AT/CT

## FEATURES:

- **Common features:**
  - Low input and output leakage  $\leq 1\mu\text{A}$  (max.)
  - CMOS power levels
  - True TTL input and output compatibility
    - $V_{OH} = 3.3\text{V}$  (typ.)
    - $V_{OL} = 0.3\text{V}$  (typ.)
  - Meets or exceeds JEDEC standard 18 specifications
  - Product available in Radiation Tolerant and Radiation Enhanced versions
  - Military product compliant to MIL-STD-883, Class B and DESC listed (dual marked)
  - Available in DIP, SOIC, SSOP, QSOP, CERPACK and LCC packages
- **Features for FCT374T/FCT534T/FCT574T:**
  - Std., A, C and D speed grades
  - High drive outputs (-15mA IOH, 48mA IOL)
- **Features for FCT2374T/FCT2574T:**
  - Std., A, and C speed grades
  - Resistor outputs (-15mA IOH, 12mA IOL Com.) (-12mA IOH, 12mA IOL Mil.)
  - Reduced system switching noise

## DESCRIPTION

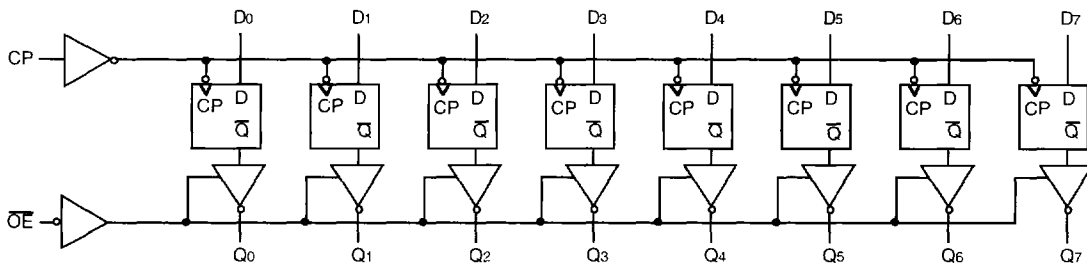
The FCT374T/FCT2374T, FCT534T and FCT574T/FCT2574T are 8-bit registers built using an advanced dual metal CMOS technology. These registers consist of eight D-type flip-flops with a buffered common clock and buffered 3-state output control. When the output enable ( $\overline{OE}$ ) input is LOW, the eight outputs are enabled. When the  $\overline{OE}$  input is HIGH, the outputs are in the high-impedance state.

Input data meeting the set-up and hold time requirements of the D inputs is transferred to the Q outputs on the LOW-to-HIGH transition of the clock input.

The FCT2374T and FCT2574T 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. FCT2xxxT parts are plug-in replacements for FCTxxxT parts.

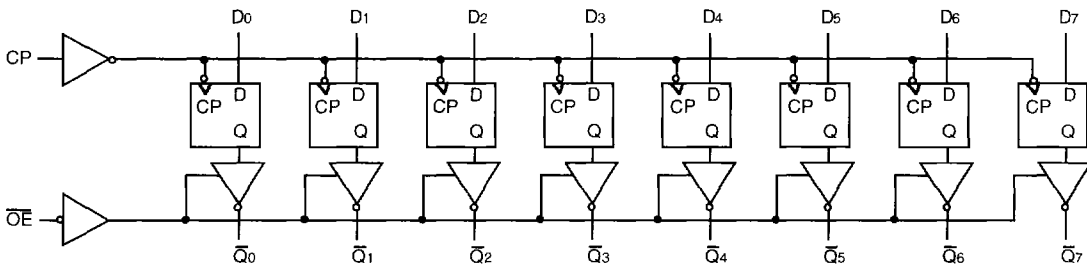
## FUNCTIONAL BLOCK DIAGRAM FCT374/FCT2374T AND FCT574/FCT2574T

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## FUNCTIONAL BLOCK DIAGRAM FCT534T



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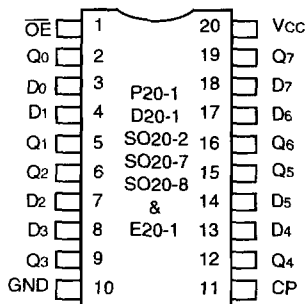
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MILITARY AND COMMERCIAL TEMPERATURE RANGES

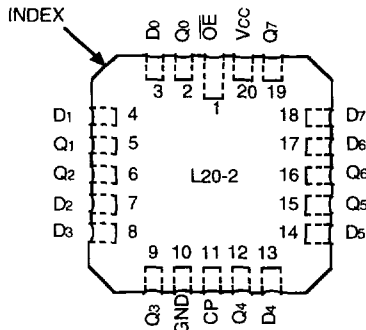
JUNE 1996

**PIN CONFIGURATIONS**

**IDT54/74FCT374T**



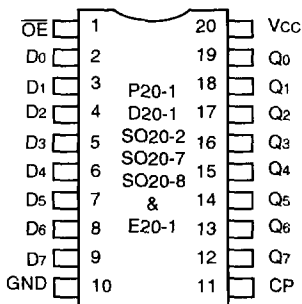
**DIP/SSOP/SSOP/QSOP/CERPACK  
TOP VIEW**



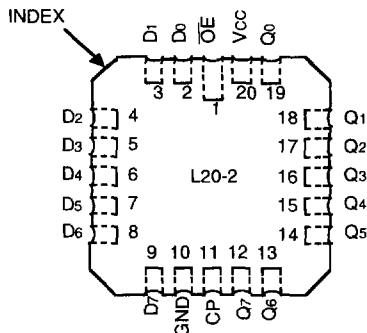
**LCC  
TOP VIEW**

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**IDT54/74FCT574T**



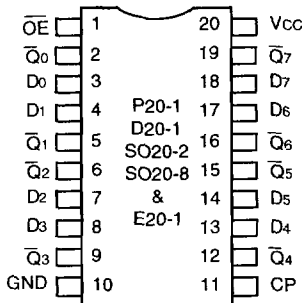
**DIP/SSOP/SSOP/QSOP/CERPACK  
TOP VIEW**



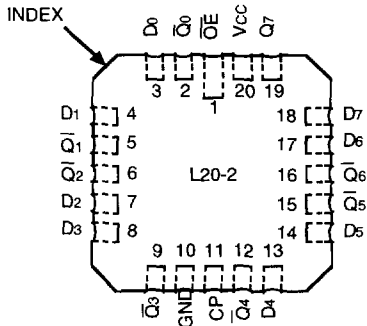
**LCC  
TOP VIEW**

2569 drw 04

**IDT54/74FCT534T**



**DIP/SSOP/SSOP/QSOP/CERPACK  
TOP VIEW**



**LCC  
TOP VIEW**

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**PIN DESCRIPTION**

Pin Names	Description
DN	D flip-flop data inputs
CP	Clock Pulse for the register. Enters data on LOW-to-HIGH transition.
QN	3-state outputs, (true)
$\bar{Q}N$	3-state outputs, (inverted)
$\bar{O}E$	Active LOW 3-state Output Enable input

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**FUNCTION TABLE<sup>(1)</sup>**

Function	Inputs			534		374/574	
	$\bar{O}E$	CP	DN	Outputs	Internal	Outputs	Internal
				QN	QN	QN	QN
HI-Z	H	L	X	Z	NC	Z	NC
	H	H	X	Z	NC	Z	NC
LOAD REGISTER	L	↑	L	H	L	L	H
	L	↑	H	L	H	H	L
	H	↑	L	Z	L	Z	H
	H	↑	H	Z	H	Z	L

**NOTE:**

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- H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Don't Care  
 Z = High Impedance  
 NC = No Change  
 ↑ = LOW-to-HIGH transition



**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

Symbol	Rating	Commercial	Military	Unit
VTERM <sup>(2)</sup>	Terminal Voltage with Respect to GND	-0.5 to +7.0	-0.5 to +7.0	V
VTERM <sup>(3)</sup>	Terminal Voltage with Respect to GND	-0.5 to Vcc +0.5	-0.5 to Vcc +0.5	V
TA	Operating Temperature	0 to +70	-55 to +125	°C
TBIAS	Temperature Under Bias	-55 to +125	-65 to +135	°C
TSTG	Storage Temperature	-55 to +125	-65 to +150	°C
PT	Power Dissipation	0.5	0.5	W
IOUT	DC Output Current	-60 to +120	-60 to +120	mA

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**NOTES:**

- 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 Vcc by +0.5V unless otherwise noted.
- Input and Vcc terminals only.
- Outputs and I/O terminals only.

**CAPACITANCE** (TA = +25°C, f = 1.0MHz)

Symbol	Parameter <sup>(1)</sup>	Conditions	Typ.	Max.	Unit
CIN	Input Capacitance	VIN = 0V	6	10	pF
COU	Output Capacitance	VOUT = 0V	8	12	pF

**NOTE:**

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- This parameter is measured at characterization but not tested.

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial:  $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 5\%$ ; Military:  $T_A = -55^\circ\text{C}$  to  $+125^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 10\%$

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	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 <sup>(4)</sup>	$V_{CC} = \text{Max.}$	$V_I = 2.7\text{V}$	—	—	$\pm 1$	$\mu\text{A}$
$I_{IL}$	Input LOW Current <sup>(4)</sup>		$V_I = 0.5\text{V}$	—	—	$\pm 1$	
$I_{OZH}$	High Impedance Output Current (3-State Output pins) <sup>(4)</sup>	$V_{CC} = \text{Max.}$	$V_O = 2.7\text{V}$	—	—	$\pm 1$	$\mu\text{A}$
$I_{OZL}$			$V_O = 0.5\text{V}$	—	—	$\pm 1$	
$I_I$	Input HIGH Current <sup>(4)</sup>	$V_{CC} = \text{Max.}, V_I = V_{CC}(\text{Max.})$		—	—	$\pm 1$	$\mu\text{A}$
$V_{IK}$	Clamp Diode Voltage	$V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$		—	-0.7	-1.2	V
$V_H$	Input Hysteresis	—		—	200	—	mV
$I_{CC}$	Quiescent Power Supply Current	$V_{CC} = \text{Max.}, V_{IN} = \text{GND or } V_{CC}$		—	0.01	1	mA

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## OUTPUT DRIVE CHARACTERISTICS FOR FCT374T/534T/574T

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -6\text{mA MIL.}$	2.4	3.3	—	V
			$I_{OH} = -8\text{mA COM'L.}$	—	—	—	V
			$I_{OH} = -12\text{mA MIL.}$ $I_{OH} = -15\text{mA COM'L.}$	2.0	3.0	—	V
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 32\text{mA MIL.}$ $I_{OL} = 48\text{mA COM'L.}$	—	0.3	0.5	V
$I_{OS}$	Short Circuit Current	$V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$		-60	-120	-225	mA

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## OUTPUT DRIVE CHARACTERISTICS FOR FCT2374T/2574T

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
$I_{ODL}$	Output LOW Current	$V_{CC} = 5\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_{OUT} = 1.5\text{V}^{(3)}$		16	48	—	mA
$I_{ODH}$	Output HIGH Current	$V_{CC} = 5\text{V}, V_{IN} = V_{IH} \text{ or } V_{IL}, V_{OUT} = 1.5\text{V}^{(3)}$		-16	-48	—	mA
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -12\text{mA MIL.}$	2.4	3.3	—	V
			$I_{OH} = -15\text{mA COM'L.}$	—	—	—	V
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 12\text{mA}$	—	0.3	0.50	V

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### NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 5.0\text{V}$ ,  $+25^\circ\text{C}$  ambient.
- Not more than one output should be shorted at one time. Duration of the short circuit test should not exceed one second.
- The test limit for this parameter is  $\pm 5\mu\text{A}$  at  $T_A = -55^\circ\text{C}$ .

**POWER SUPPLY CHARACTERISTICS**

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit	
$\Delta I_{CC}$	Quiescent Power Supply Current TTL Inputs HIGH	VCC = Max. VIN = 3.4V <sup>(3)</sup>		—	0.5	2.0	mA	
I <sub>CCD</sub>	Dynamic Power Supply Current <sup>(4)</sup>	VCC = Max. Outputs Open $\overline{OE}$ = GND One Input Toggling 50% Duty Cycle	VIN = VCC VIN = GND	FCTxxxT	—	0.15	0.25	mV/ MHz
				FCT2xxxT	—	0.06	0.12	
I <sub>C</sub>	Total Power Supply Current <sup>(6)</sup>	VCC = Max. Outputs Open f <sub>CP</sub> = 10MHz 50% Duty Cycle $\overline{OE}$ = GND fi = 5MHz 50% Duty Cycle One Bit Toggling	VIN = VCC VIN = GND	FCTxxxT	—	1.5	3.5	mA
				FCT2xxxT	—	0.6	2.2	
		VIN = 3.4 VIN = GND	FCTxxxT	—	2.0	5.5		
			FCT2xxxT	—	1.1	4.2		
		VIN = VCC VIN = GND	FCTxxxT	—	3.8	7.3 <sup>(5)</sup>		
			FCT2xxxT	—	1.5	4.0 <sup>(5)</sup>		
	VIN = 3.4 VIN = GND	FCTxxxT	—	6.0	16.3 <sup>(5)</sup>			
	VIN = 3.4 VIN = GND	FCT2xxxT	—	3.8	13.0 <sup>(5)</sup>			

**NOTES:**

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- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at VCC = 5.0V, +25°C ambient.
- Per TTL driven input (VIN = 3.4V). All other inputs at VCC or GND.
- This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
- Values for these conditions are examples of the I<sub>CC</sub> formula. These limits are guaranteed but not tested.
- I<sub>C</sub> = I<sub>QUIESCENT</sub> + I<sub>INPUTS</sub> + I<sub>DYNAMIC</sub>  
 I<sub>C</sub> = I<sub>CC</sub> +  $\Delta I_{CC}$  DHNT + I<sub>CCD</sub> (f<sub>CP</sub>/2 + fiNi)  
 I<sub>CC</sub> = Quiescent Current  
 $\Delta I_{CC}$  = Power Supply Current for a TTL High Input (VIN = 3.4V)  
 DH = Duty Cycle for TTL Inputs High  
 NT = Number of TTL Inputs at DH  
 I<sub>CCD</sub> = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)  
 f<sub>CP</sub> = Clock Frequency for Register Devices (Zero for Non-Register Devices)  
 fi = Input Frequency  
 Ni = Number of Inputs at fi  
 All currents are in milliamps and all frequencies are in megahertz.



**SWITCHING CHARACTERISTICS OVER OPERATING RANGE**

Symbol	Parameter	Conditions <sup>(1)</sup>	FCT374T/534T/574T FCT2374T/2574T				FCT374AT/534AT/574AT FCT2374AT/2574AT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	
tPLH	Propagation Delay CP to QN <sup>(3)</sup>	CL = 50pF RL = 500Ω	2.0	10.0	2.0	11.0	2.0	6.5	2.0	7.2	ns
tPZH	Output Enable Time		1.5	12.5	1.5	14.0	1.5	6.5	1.5	7.5	ns
tPZL											
tPHZ	Output Disable Time		1.5	8.0	1.5	8.0	1.5	5.5	1.5	6.5	ns
tPLZ											
tsu	Set-up Time HIGH or LOW, DN to CP		2.0	—	2.0	—	2.0	—	2.0	—	ns
th	Hold Time HIGH or LOW, DN to CP		1.5	—	1.5	—	1.5	—	1.5	—	ns
tw	CP Pulse Width HIGH or LOW	7.0	—	7.0	—	5.0	—	6.0	—	ns	

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Symbol	Parameter	Conditions <sup>(1)</sup>	FCT374CT/534CT/574CT FCT2374CT/2574CT				FCT374DT/574DT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	
tPLH	Propagation Delay CP to QN <sup>(3)</sup>	CL = 50pF RL = 500Ω	2.0	5.2	2.0	6.2	2.0	4.2	—	—	ns
tPHL											
tPZH	Output Enable Time		1.5	5.5	1.5	6.2	1.5	4.8	—	—	ns
tPZL											
tPHZ	Output Disable Time		1.5	5.0	1.5	5.7	1.5	4.0	—	—	ns
tPLZ											
tsu	Set-up Time HIGH or LOW, DN to CP		2.0	—	2.0	—	2.0	—	—	—	ns
th	Hold Time HIGH or LOW, DN to CP	1.5	—	1.5	—	1.0	—	—	—	ns	
tw	CP Pulse Width HIGH or LOW <sup>(4)</sup>	5.0	—	6.0	—	3.0	—	—	—	ns	

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**NOTES:**

1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. On for FCT374/2374T and FCT574/2574T, On for FCT534T.
4. This parameter is guaranteed but not tested.



Integrated Device Technology, Inc.

# FAST CMOS OCTAL D FLIP-FLOP WITH CLOCK ENABLE

IDT54/74FCT377T/AT/CT/DT

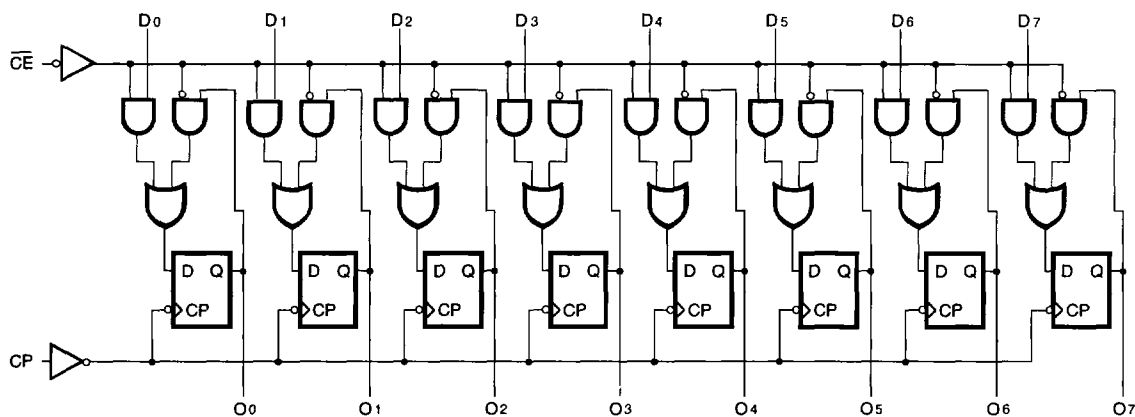
## FEATURES:

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- Low input and output leakage  $\leq 1\mu\text{A}$  (max.)
- CMOS power levels
- True TTL input and output compatibility
  - $V_{OH} = 3.3\text{V}$  (typ.)
  - $V_{OL} = 0.3\text{V}$  (typ.)
- High drive outputs (-15mA  $I_{OH}$ , 48mA  $I_{OL}$ )
- Power off disable outputs permit "live insertion"
- Meets or exceeds JEDEC standard 18 specifications
- Product available in Radiation Tolerant and Radiation Enhanced versions
- Military product compliant to MIL-STD-883, Class B and DESC listed (dual marked)
- Available in DIP, SOIC, QSOP, CERPACK and LCC packages

## DESCRIPTION:

The IDT54/74FCT377T/AT/CT/DT are octal D flip-flops built using an advanced dual metal CMOS technology. The IDT54/74FCT377T/AT/CT/DT have eight edge-triggered, D-type flip-flops with individual D inputs and O outputs. The common buffered Clock (CP) input loads all flip-flops simultaneously when the Clock Enable ( $\overline{CE}$ ) is LOW. The register is fully edge-triggered. The state of each D input, one set-up time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's O output. The  $\overline{CE}$  input must be stable only one set-up time prior to the LOW-to-HIGH transition for predictable operation.

## FUNCTIONAL BLOCK DIAGRAM



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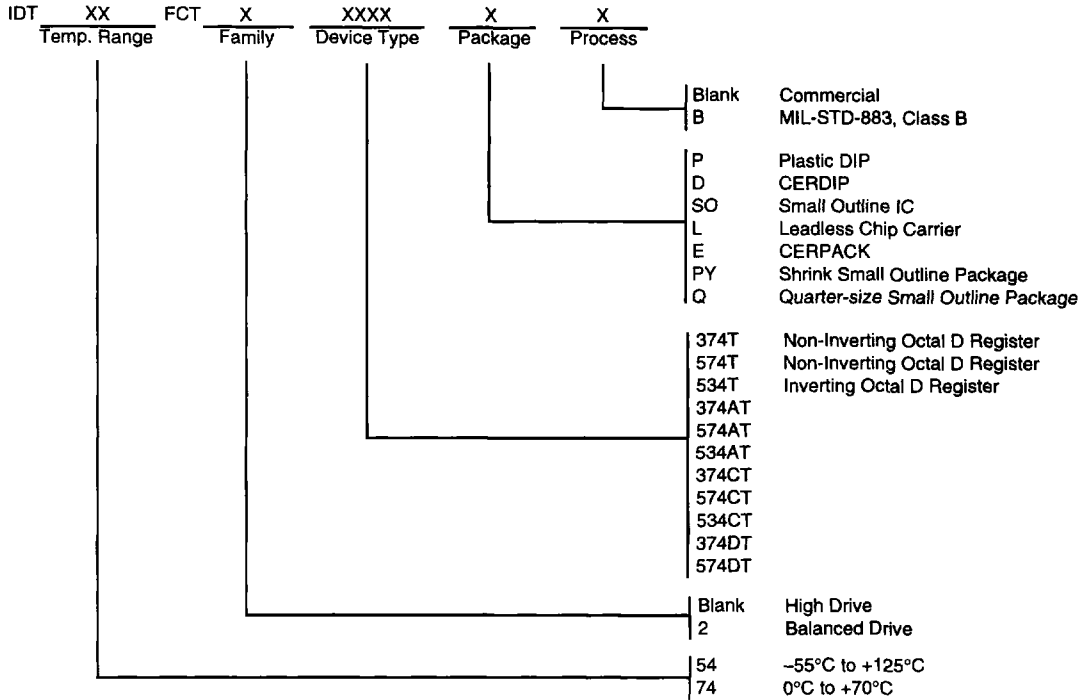
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**ORDERING INFORMATION**



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