Integrated Device Technology, Inc.

FAST CMOS OCTAL REGISTERED TRANSCEIVERS

IDT29FCT52AT/BT/CT/DT
IDT29FCT2052AT/BT/CT

FEATURES:

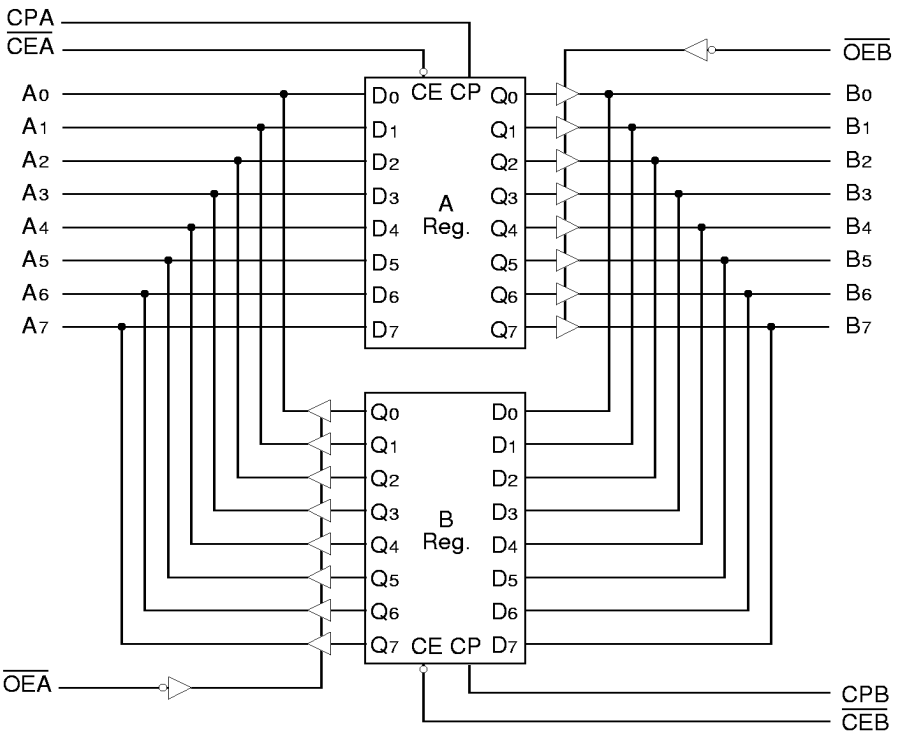
- **Common features:**
  - Low input and output leakage ≤1μA (max.)
  - Extended commercial range of –40°C to +85°C
  - CMOS power levels
  - True TTL input and output compatibility
    - V_{OH} = 3.3V (typ.)
    - V_{OL} = 0.3V (typ.)
  - Meets or exceeds JEDEC standard 18 specifications
  - Product 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, TSSOP, CERPACK and LCC packages
- **Features for FCT29FCT52T:**
  - A, B, C and D speed grades
  - High drive outputs (-15mA I_{OH}, 64mA I_{OL})
  - Power off disable outputs permit “live insertion”
- **Features for FCT29FCT2052T:**
  - A, B and C speed grades
  - Resistor outputs (-15mA I_{OH}, 12mA I_{OL} Com.)
    (-12mA I_{OH}, 12mA I_{OL} Mil.)
  - Reduced system switching noise

DESCRIPTION:

The IDT29FCT52AT/BT/CT/DT is an 8-bit registered transceiver built using an advanced dual metal CMOS technology. Two 8-bit back-to-back registers store data flowing in both directions between two bidirectional buses. Separate clock, clock enable and 3-state output enable signals are provided for each register. Both A outputs and B outputs are guaranteed to sink 64mA.

The IDT29FCT2052AT/BT/CT has balanced drive outputs 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 IDT29FCT2052T part is a plug-in replacement for the IDT29FCT52T part.

FUNCTIONAL BLOCK DIAGRAM

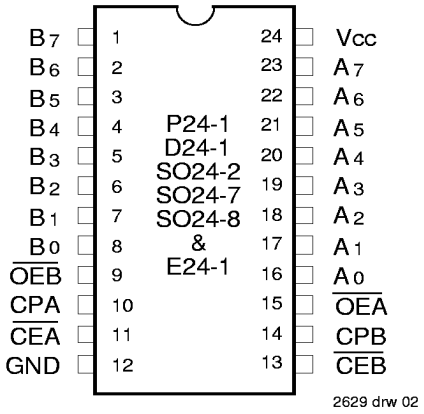


2629 drw 01

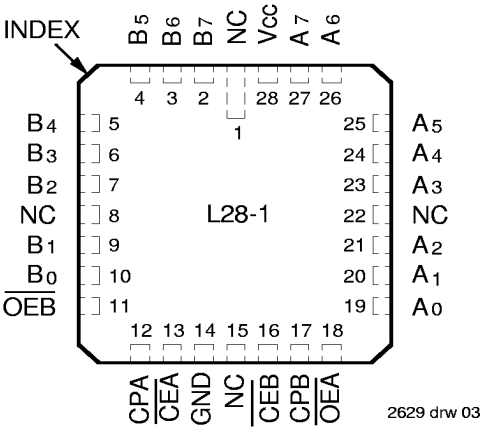
DSC-2629/8

For the latest information regarding this part, please contact IDT's web site at http://www.idt.com or fax-on-demand service at (US)1-800-9-IDT-FAX / (International) 408-492-8391.

PIN CONFIGURATIONS



DIP/SOIC/SSOP/QSOP/CERPACK
TOP VIEW



LCC
TOP VIEW

PIN DESCRIPTION

Name	I/O	Description
A_{0-7}	I/O	Eight bidirectional lines carrying the A Register inputs or B Register outputs.
B_{0-7}	I/O	Eight bidirectional lines carrying the B Register inputs or A Register outputs.
CPA	I	Clock for the A Register. When $\overline{CEA}$ is LOW, data is entered into the A Register on the LOW-to-HIGH transition of the CPA signal.
$\overline{CEA}$	I	Clock Enable for the A Register. When $\overline{CEA}$ is LOW, data is entered into the A Register on the LOW-to-HIGH transition of the CPA signal. When $\overline{CEA}$ is HIGH, the A Register holds its contents, regardless of CPA signal transitions.
$\overline{OEB}$	I	Output Enable for the A Register. When $\overline{OEB}$ is LOW, the A Register outputs are enabled onto the B_{0-7} lines. When $\overline{OEB}$ is HIGH, the B_{0-7} outputs are in the high-impedance state.
CPB	I	Clock for the B Register. When $\overline{CEB}$ is LOW, data is entered into the B Register on the LOW-to-HIGH transition of the CPB signal.
$\overline{CEB}$	I	Clock Enable for the B Register. When $\overline{CEB}$ is LOW, data is entered into the B Register on the LOW-to-HIGH transition of the CPB signal. When $\overline{CEB}$ is HIGH, the B Register holds its contents, regardless of CPB signal transitions.
$\overline{OEA}$	I	Output Enable for the B Register. When $\overline{OEA}$ is LOW, the B Register outputs are enabled onto the A_{0-7} lines. When $\overline{OEA}$ is HIGH, the A_{0-7} outputs are in the high-impedance state.

2629 tbl 01

REGISTER FUNCTION TABLE[1]
(Applies to A or B Register)

Inputs			Internal	
D	CP	$\overline{CE}$	Q	Function
X	X	H	NC	Hold Data
L	↑	L	L	Load Data
H	↑	L	H	

2629 tbl 02

NOTE:
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   NC = No Change
   ↑ = LOW-to-HIGH Transition

OUTPUT CONTROL[1]

	Internal		
$\overline{OE}$	Q	Y-Outputs	Function
H	X	Z	Disable Outputs
L	L	L	Enable Outputs
L	H	H	

2629 tbl 03

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

ABSOLUTE MAXIMUM RATINGS[1]

Symbol	Description	Max.	Unit
V_{TERM}[2]	Terminal Voltage with Respect to GND	–0.5 to +7.0	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

2529 lnk 04

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 29FCT2052T Output and I/O terminals.
3. Outputs and I/O terminals for 29FCT2052T.

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

2640 lnk 05

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

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Commercial: T_A = –40°C to +85°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[4]	V_{CC} = Max.	V_I = 2.7V	—	—	±1	µA
I_{IL}	Input LOW Current[4]		V_I = 0.5V	—	—	±1	
I_{OZH}	High Impedance Output Current	V_{CC} = Max.	V_O = 2.7V	—	—	±1	µA
I_{OZL}	(3-State Output pins)[4]		V_O = 0.5V	—	—	±1	
I_I	Input HIGH Current[4]	V_{CC} = Max., V_I = V_{CC} (Max.)		—	—	±1	µA
V_{IK}	Clamp Diode Voltage	V_{CC} = Min., I_{IN} = –18mA		—	–0.7	–1.2	V
V_H	Input Hysteresis	—		—	200	—	mV
I_{CC}	Quiescent Power Supply Current	V_{CC} = Max., V_{IN} = GND or V_{CC}		—	0.01	1	mA

2629 tbl 06

OUTPUT DRIVE CHARACTERISTICS FOR 29FCT52T

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OH} = –6mA MIL. I_{OH} = –8mA COM'L.	2.4	3.3	—	V
			I_{OH} = –12mA MIL. I_{OH} = –15mA COM'L.	2.0	3.0	—	V
V_{OL}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 48mA MIL. I_{OL} = 64mA COM'L.	—	0.3	0.55	V
I_{OS}	Short Circuit Current	V_{CC} = Max., V_O = GND[3]		–60	–120	–225	mA
I_{OFF}	Input/Output Power Off Leakage[5]	V_{CC} = 0V, V_{IN} or V_O ≤ 4.5V		—	—	±1	µA

2629 tbl 07

OUTPUT DRIVE CHARACTERISTICS FOR 29FCT2052T

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_{OUT} = 1.5V[3]		16	48	—	mA
I_{ODH}	Output HIGH Current	V_{CC} = 5V, V_{IN} = V_{IH} or V_{IL}, V_{OUT} = 1.5V[3]		–16	–48	—	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OH} = –12mA MIL. I_{OH} = –15mA COM'L.	2.4	3.3	—	V
V_{OL}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 12mA	—	0.3	0.50	V

2629 tbl 08

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 Vcc = 5.0V, +25°C ambient.
3. Not more than one output should be shorted at one time. Duration of the short circuit test should not exceed one second.
4. The test limit for this parameter is ±5µA at T_A = –55°C.
5. This parameter is guaranteed but not tested.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]			Min.	Typ.[2]	Max.	Unit
ΔI_{CC}	Quiescent Power Supply Current TTL Inputs HIGH	V_{CC} = Max. V_{IN} = 3.4V[3]			—	0.5	2.0	mA
I_{CCD}	Dynamic Power Supply Current[4]	V_{CC} = Max. Outputs Open $\overline{OE}_A$ or $\overline{OE}_B$ = GND One Input Toggling 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	FCTxxxT	—	0.15	0.25	mA/ MHz
				FCT2xxxT	—	0.06	0.12	
I_C	Total Power Supply Current[6]	V_{CC} = Max. Outputs Open f_{CP} = 10MHz 50% Duty Cycle $\overline{OE}_A$ or $\overline{OE}_B$ = GND One Bit Toggling at fi = 5MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	FCTxxxT	—	1.5	3.5	mA
				FCT2xxxT	—	0.6	2.2	
			V_{IN} = 3.4V V_{IN} = GND	FCTxxxT	—	2.0	5.5	
				FCT2xxxT		1.1	4.2	
		V_{CC} = Max. Outputs Open f_{CP} = 10MHz 50% Duty Cycle $\overline{OE}_A$ or $\overline{OE}_B$ = GND Eight Bits Toggling at fi = 2.5MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	FCTxxxT	—	3.8	7.3[5]	
				FCT2xxxT	—	1.5	4.0[5]	
			V_{IN} = 3.4V V_{IN} = GND	FCTxxxT	—	6.0	16.3[5]	
				FCT2xxxT	—	3.8	13.0[5]	

2629 tbl 09

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
   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.

SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter	Condition[1]	29FCT52AT 29FCT2052AT				29FCT52BT 29FCT2052BT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	
t_{PLH} t_{PHL}	Propagation Delay CPA, CPB to An, Bn	C_L = 50pF R_L = 500Ω	2.0	10.0	2.0	11.0	2.0	7.5	2.0	8.0	ns
t_{PZH} t_{PZL}	Output Enable Time $\overline{OEA}$ or $\overline{OEB}$ to An, Bn		1.5	10.5	1.5	13.0	1.5	8.0	1.5	8.5	ns
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{OEA}$ or $\overline{OEB}$ to An, Bn		1.5	10.0	1.5	10.0	1.5	7.5	1.5	8.0	ns
t_{SU}	Set-up Time, HIGH or LOW An, Bn to CPA, CPB		2.5	—	2.5	—	2.5	—	2.5	—	ns
t_H	Hold Time, HIGH or LOW An, Bn to CPA, CPB		2.0	—	2.0	—	1.5	—	1.5	—	ns
t_{SU}	Set-up Time, HIGH or LOW $\overline{CEA}$, $\overline{CEB}$ to CPA, CPB		3.0	—	3.0	—	3.0	—	3.0	—	ns
t_H	Hold Time, HIGH or LOW $\overline{CEA}$, $\overline{CEB}$ to CPA, CPB		2.0	—	2.0	—	2.0	—	2.0	—	ns
t_W	Clock Pulse Width HIGH or LOW[3]		3.0	—	3.0	—	3.0	—	3.0	—	ns

2629 tbl 10

Symbol	Parameter	Condition[1]	29FCT52CT 29FCT2052CT				29FCT52DT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	
t_{PLH} t_{PHL}	Propagation Delay CPA, CPB to An, Bn	C_L = 50pF R_L = 500Ω	2.0	6.3	2.0	7.3	2.0	4.5	—	—	ns
t_{PZH} t_{PZL}	Output Enable Time $\overline{OEA}$ or $\overline{OEB}$ to An, Bn		1.5	7.0	1.5	8.0	1.5	5.6	—	—	ns
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{OEA}$ or $\overline{OEB}$ to An, Bn		1.5	6.5	1.5	7.5	1.5	4.3	—	—	ns
t_{SU}	Set-up Time, HIGH or LOW An, Bn to CPA, CPB		2.5	—	2.5	—	1.5	—	—	—	ns
t_H	Hold Time, HIGH or LOW An, Bn to CPA, CPB		1.5	—	1.5	—	1.0	—	—	—	ns
t_{SU}	Set-up Time, HIGH or LOW $\overline{CEA}$, $\overline{CEB}$ to CPA, CPB		3.0	—	3.0	—	2.0	—	—	—	ns
t_H	Hold Time, HIGH or LOW $\overline{CEA}$, $\overline{CEB}$ to CPA, CPB		2.0	—	2.0	—	1.0	—	—	—	ns
t_W	Clock Pulse Width HIGH or LOW[3]		3.0	—	3.0	—	3.0	—	—	—	ns

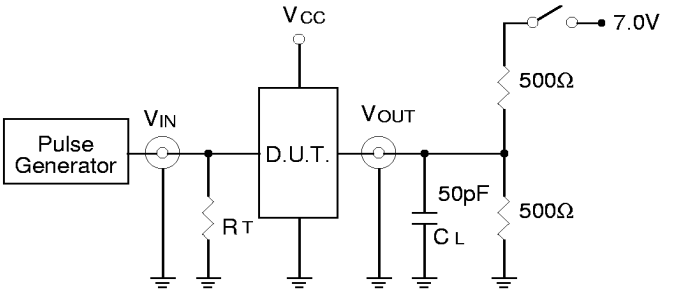
NOTES:

2629 tbl 11

1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. This parameter is guaranteed but not tested.

TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



2629 drw 03

SWITCH POSITION

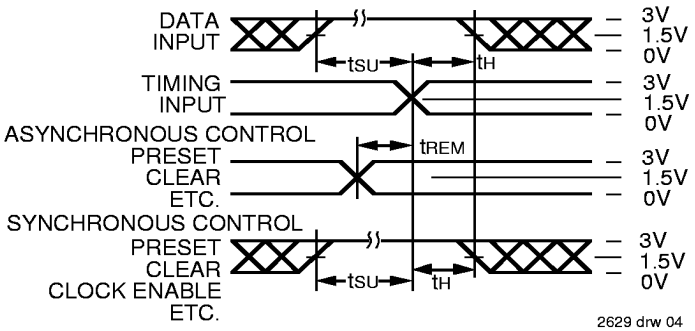
Test	Switch
Open Drain Disable Low Enable Low	Closed
All Other Tests	Open

2629 lnk 12

DEFINITIONS:

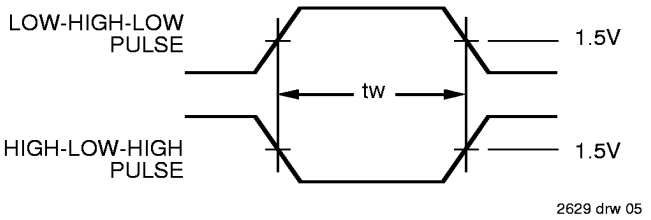
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

SET-UP, HOLD AND RELEASE TIMES



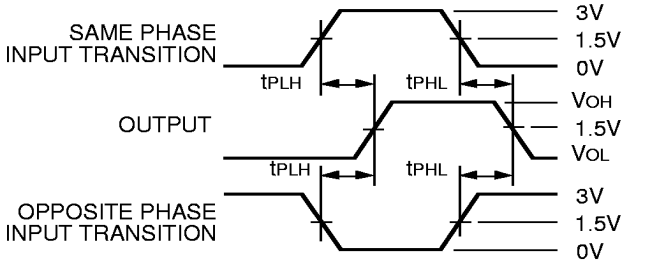
2629 drw 04

PULSE WIDTH

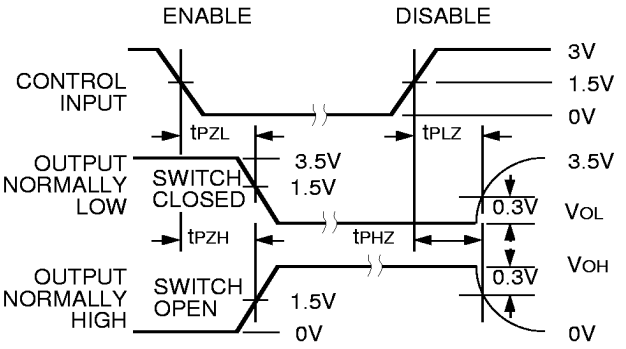


2629 drw 05

PROPAGATION DELAY



2629 drw 06

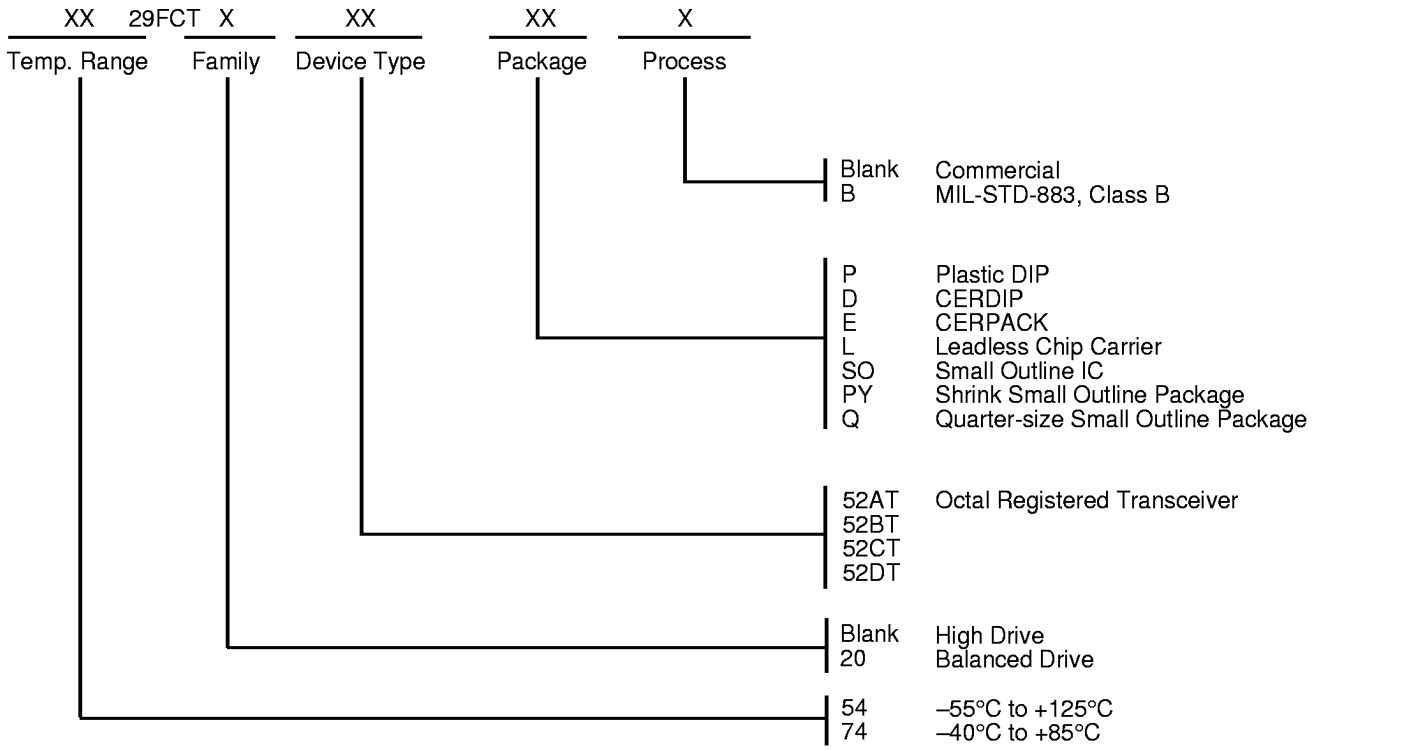


2629 drw 07

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



2629 drw 08