Integrated Device Technology, Inc.

3.3V CMOS 16-BIT REGISTERED TRANSCEIVER

IDT54/74FCT163952/A/C
PRODUCT PREVIEW

FEATURES:

- 0.5 MICRON CMOS Technology
- **Typical $t_{SK(o)}$ (Output Skew) < 250ps**
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 25 mil Center SSOP and Cerpack Packages and 19.6 mil pitch TSSOP Package
- Extended commercial range of -40°C to +85°C
- Vcc = 3.3V ±0.3V, Normal Range or Vcc = 2.7 to 3.6V, Extended Range
- CMOS power levels (10µW typ. static)
- Rail-to-Rail output swing for increased noise margin
- Military product compliant to MIL-STD-883, Class B
- Low Ground Bounce (0.3V typ.)
- Inputs (except I/O) can be driven by 3.3V or 5V components

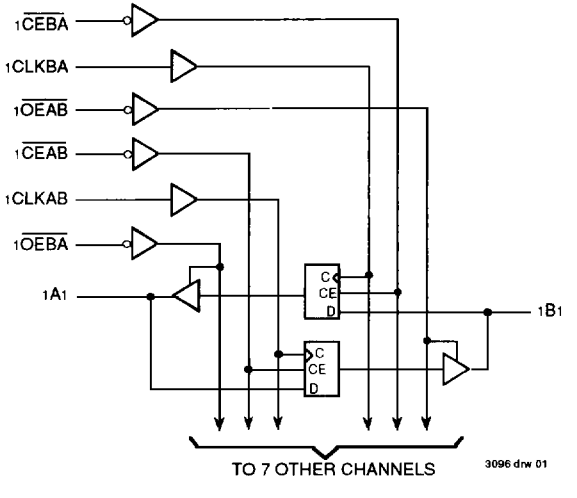
DESCRIPTION:

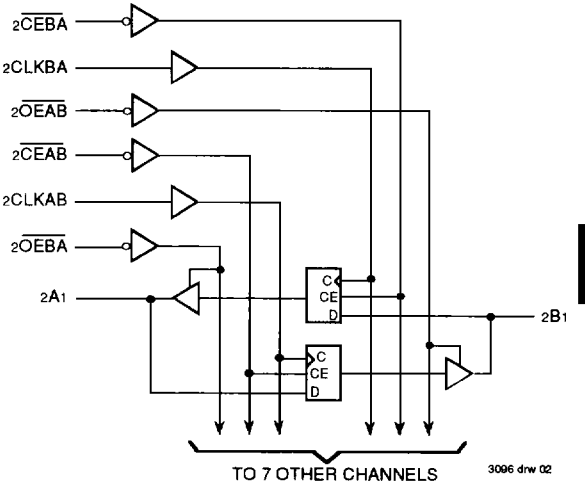
The IDT54/74FCT163952/A/C 16-bit registered transceivers are built using advanced dual metal CMOS technology.

These high-speed, low-power devices are organized as two independent 8-bit D-type registered transceivers with separate input and output control for independent control of data flow in either direction. For example, the A-to-B Enable ($xCEAB$) must be LOW to enter data from the A port. xCLKAB controls the clocking function. When xCLKAB toggles from LOW-to-HIGH, the data present on the A port will be clocked into the register. $xOEAB$ performs the output enable function on the B port. Data flow from the B port to A port is similar but requires using $xCEBA$, xCLKBA, and $xOEBA$ inputs. Full 16-bit operation is achieved by tying the control pins of the independent transceivers together.

The IDT54/74FCT163952/A/C have series current limiting resistors. These offer low ground bounce, minimal undershoot, and controlled output fall times–reducing the need for external series terminating resistors.

FUNCTIONAL BLOCK DIAGRAM





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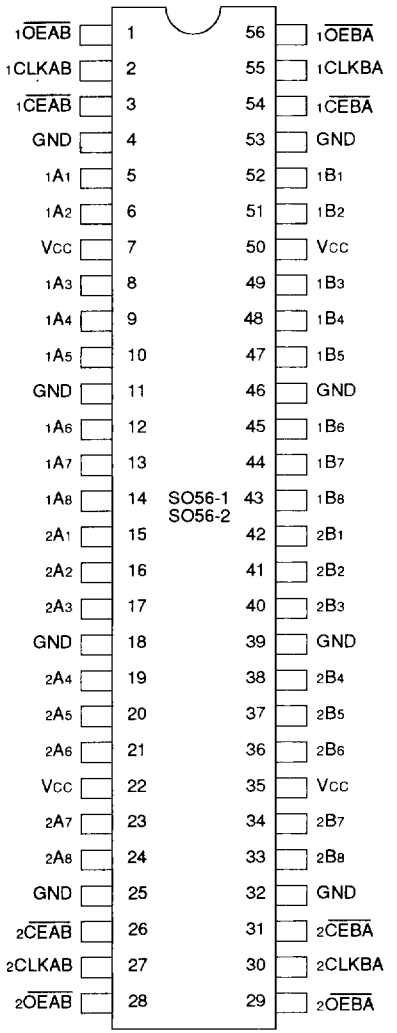
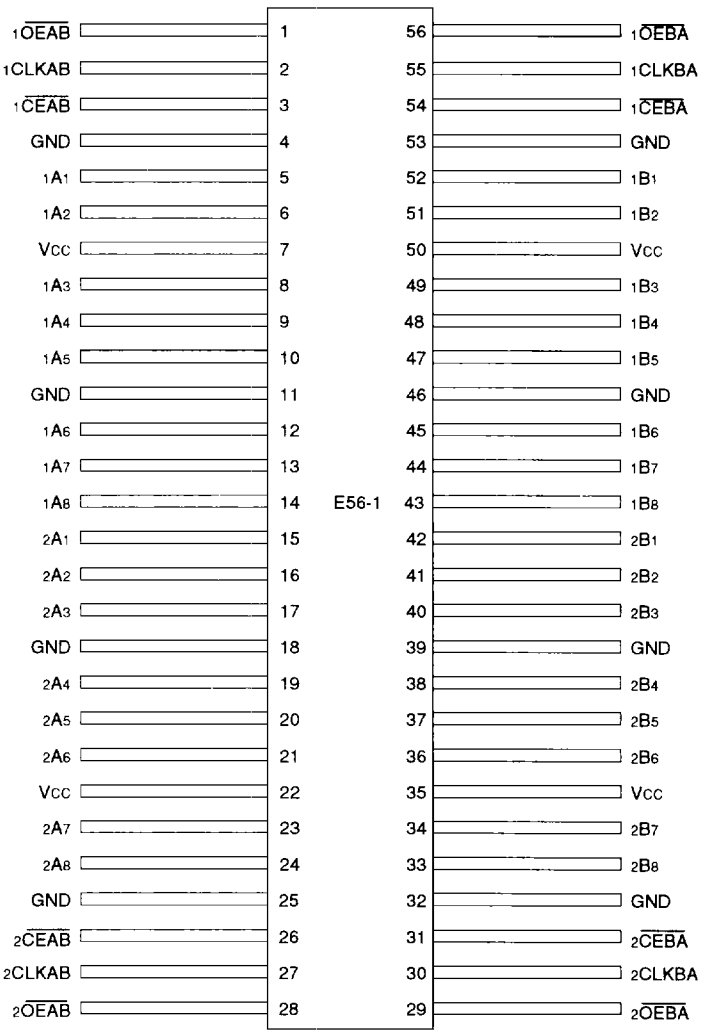
PIN CONFIGURATIONS



SSOP
TSSOP
TOP VIEW

3096 drw 03



CERPACK
TOP VIEW

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PIN DESCRIPTION

Pin Names	Description
$x\overline{OEAB}$	A-to-B Output Enable Input (Active LOW)
$x\overline{OEBA}$	B-to-A Output Enable Input (Active LOW)
$x\overline{CEAB}$	A-to-B Clock Enable Input (Active LOW)
$x\overline{CEBA}$	B-to-A Clock Enable Input (Active LOW)
xCLKAB	A-to-B Clock Input
xCLKBA	B-to-A Clock Input
xAx	A-to-B Data Inputs or B-to-A 3-State Outputs
xBx	B-to-A Data Inputs or A-to-B 3-State Outputs

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FUNCTION TABLE[1,3]

Inputs				Outputs
$x\overline{CEAB}$	xCLKAB	$x\overline{OEAB}$	xAx	xBx
H	X	L	X	B[2]
X	L	L	X	B[2]
L	↑	L	L	L
L	↑	L	H	H
X	X	H	X	Z

NOTES: 3096 tbl 02

1. A-to-B data flow is shown: B-to-A data flow is similar but uses, $x\overline{CEBA}$, xCLKBA, and $x\overline{OEBA}$.
2. Level of B before the indicated steady-state input conditions were established.
3. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   ↑ = LOW-to-HIGH Transition
   Z = High-impedance

ABSOLUTE MAXIMUM RATINGS[1]

Symbol	Rating	Commercial	Military	Unit
V_{TERM}[2]	Terminal Voltage with Respect to GND	–0.5 to +4.6	–0.5 to +4.6	V
V_{TERM}[3]	Terminal Voltage with Respect to GND	–0.5 to +7.0	–0.5 to +7.0	V
V_{TERM}[4]	Terminal Voltage with Respect to GND	–0.5 to V_{CC} + 0.5	–0.5 to V_{CC} + 0.5	V
T_A	Operating Temperature	–40 to +85	–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	1.0	1.0	W
I_{OUT}	DC Output Current	–60 to +60	–60 to +60	mA

NOTES: 3096 lnk 03

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. V_{CC} terminals.
3. Input terminals.
4. Output and I/O terminals.

CAPACITANCE (T_A = +25°C, f = 1.0MHz)

Symbol	Parameter[1]	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	3.5	6.0	pF
$C_{I/O}$	I/O Capacitance	V_{OUT} = 0V	3.5	8.0	pF

NOTE: 3096 lnk 04

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

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DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Commercial: T_A = –40°C to +85°C, V_{CC} = 2.7V to 3.6V; Military: T_A = –55°C to +125°C, V_{CC} = 2.7V to 3.6V

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
V_{IH}	Input HIGH Level (Input pins)	Guaranteed Logic HIGH Level		2.0	—	5.5	V
	Input HIGH Level (I/O pins)			2.0	—	V_{CC}+0.5	
V_{IL}	Input LOW Level (Input and I/O pins)	Guaranteed Logic LOW Level		–0.5	—	0.8	V
I_{IH}	Input HIGH Current (Input pins)[6]	V_{CC} = Max.	V_I = 5.5V	—	—	±1	µA
	Input HIGH Current (I/O pins)[6]		V_I = V_{CC}	—	—	±1	
I_{IL}	Input LOW Current (Input pins)[6]		V_I = GND	—	—	±1	
	Input LOW Current (I/O pins)[6]		V_I = GND	—	—	±1	
I_{OZH}	High Impedance Output Current	V_{CC} = Max.	V_O = V_{CC}	—	—	±1	µA
I_{OZL}	(3-State Output pins)[6]		V_O = GND	—	—	±1	
V_{IK}	Clamp Diode Voltage	V_{CC} = Min., I_{IN} = –18mA		—	–0.7	–1.2	V
I_{ODH}	Output HIGH Current	V_{CC} = 3.3V, V_{IN} = V_{IH} or V_{IL}, V_O = 1.5V[3]		–36	–60	–110	mA
I_{ODL}	Output LOW Current	V_{CC} = 3.3V, V_{IN} = V_{IH} or V_{IL}, V_O = 1.5V[3]		50	90	200	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min.	I_{OH} = –0.1mA	V_{CC}–0.2	—	—	V
		V_{IN} = V_{IH} or V_{IL}	I_{OH} = –3mA	2.4	3.0	—	
		V_{CC} = 3.0V V_{IN} = V_{IH} or V_{IL}	I_{OH} = –6mA MIL. I_{OH} = –8mA COM'L.	2.4[5]	3.0	—	
V_{OL}	Output LOW Voltage	V_{CC} = Min.	I_{OL} = 0.1mA	—	—	0.2	V
		V_{IN} = V_{IH} or V_{IL}	I_{OL} = 16mA	—	0.2	0.4	
			I_{OL} = 24mA	—	0.3	0.5	
I_{OS}	Short Circuit Current[4]	V_{CC} = Max., V_O = GND[3]		–60	–135	–240	mA
V_H	Input Hysteresis	—		—	150	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CC} = Max., V_{IN} = GND or V_{CC}	COM'L.	—	0.1	10	µA
			MIL.	—	0.1	100	

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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 Vcc = 3.3V, +25°C ambient.
3. Not more than one output should be tested at one time. Duration of the test should not exceed one second.
4. This parameter is guaranteed but not tested.
5. V_{OH} = V_{CC} –0.6V at rated current.
6. The test limit for this parameter is ±5µA at T_A = –55°C.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
ΔI_{CC}	Quiescent Power Supply	V_{CC} = Max.	V_{IN} = V_{CC} –0.6V[3]	—			mA
I_{CCD}	Dynamic Power Supply Current[4]	V_{CC} = Max., Outputs Open x$\overline{OEAB}$ or x$\overline{OEBA}$ = GND One Input Toggling 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—			µA/ MHz
I_C	Total Power Supply Current[6]	V_{CC} = Max., Outputs Open f_{CP} = 10MHz (xCLKAB) 50% Duty Cycle x$\overline{OEAB}$ = x$\overline{CEAB}$ = GND x$\overline{OEBA}$ = V_{CC} One Bit Toggling f_i = 5MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—			mA
			V_{IN} = V_{CC} –0.6V V_{IN} = GND	—			
		V_{CC} = Max., Outputs Open f_{CP}= 10MHz (xCLKAB) 50% Duty Cycle x$\overline{OEAB}$ = x$\overline{CEAB}$ = GND x$\overline{OEBA}$ = V_{CC} Sixteen Bits Toggling f_i = 2.5MHz 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—			
			V_{IN} = V_{CC} –0.6V V_{IN} = GND	—			

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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} = 3.3V, +25°C ambient.
3. Per TTL driven input; 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})
   ΔI_{CC} = Power Supply Current for a TTL High Input
   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

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SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter	Condition[1]	FCT163952				FCT163952A				FCT163952C				Unit
			Com'l.		Mil.		Com'l.		Mil.		Com'l.		Mil.		
			Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	
t_{PLH} t_{PHL}	Propagation Delay xCLKAB, xCLKBA to xBx, xAx	C_L = 50pF R_L = 500Ω					2.0	10.0	2.0	11.0	2.0	6.3	2.0	7.3	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OEBA}$, x$\overline{OEAB}$ to xAx, xBx						1.5	10.5	1.5	13.0	1.5	7.0	1.5	8.0	ns
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OEBA}$, x$\overline{OEAB}$ to xAx, xBx						1.5	10.0	1.5	10.0	1.5	6.5	1.5	7.5	ns
t_{SU}	Set-up Time HIGH or LOW xAx, xBx to xCLKAB, xCLKBA						2.5	—	2.5	—	2.5	—	2.5	—	ns
t_H	Hold Time HIGH or LOW xAx, xBx to xCLKAB, xCLKBA						2.0	—	2.0	—	1.5	—	1.5	—	ns
t_{SU}	Set-up Time HIGH or LOW x$\overline{CEAB}$, x$\overline{CEBA}$ to xCLKAB, xCLKBA						3.0	—	3.0	—	3.0	—	3.0	—	ns
t_H	Hold Time HIGH or LOW x$\overline{CEAB}$, x$\overline{CEBA}$ to xCLKAB, xCLKBA						2.0	—	2.0	—	2.0	—	2.0	—	ns
t_W	Pulse Width HIGH or LOW xCLKAB or xCLKBA[4]						3.0	—	3.0	—	3.0	—	3.0	—	ns
$t_{SK(o)}$	Output Skew[3]						—	0.5	—	0.5	—	0.5	—	0.5	ns

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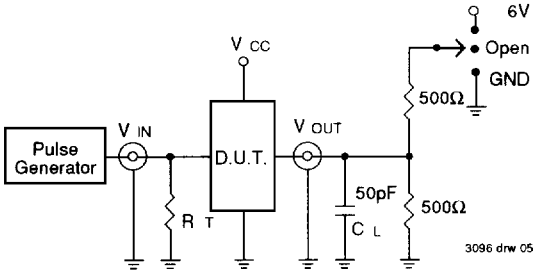
NOTES:
1. See test circuits and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.
4. This parameter is guaranteed but not tested.

TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	6V
Disable High Enable High	GND
All Other tests	Open

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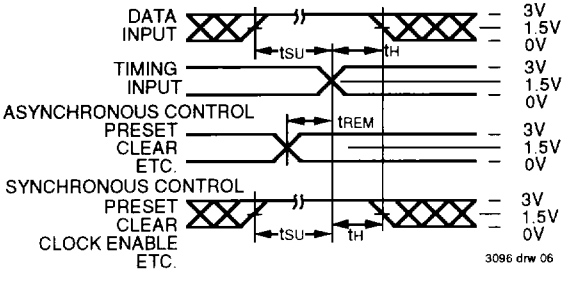
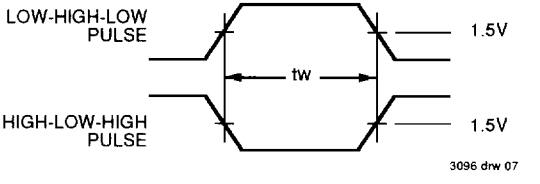
DEFINITIONS:

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



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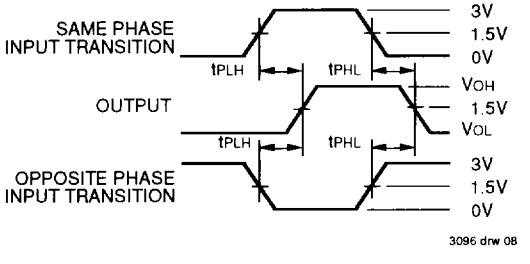
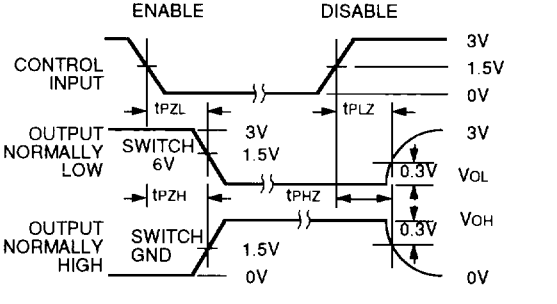


ENABLE AND DISABLE TIMES



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.
3. If V_{CC} is below 3V, input voltage swings should be adjusted not to exceed V_{CC}.

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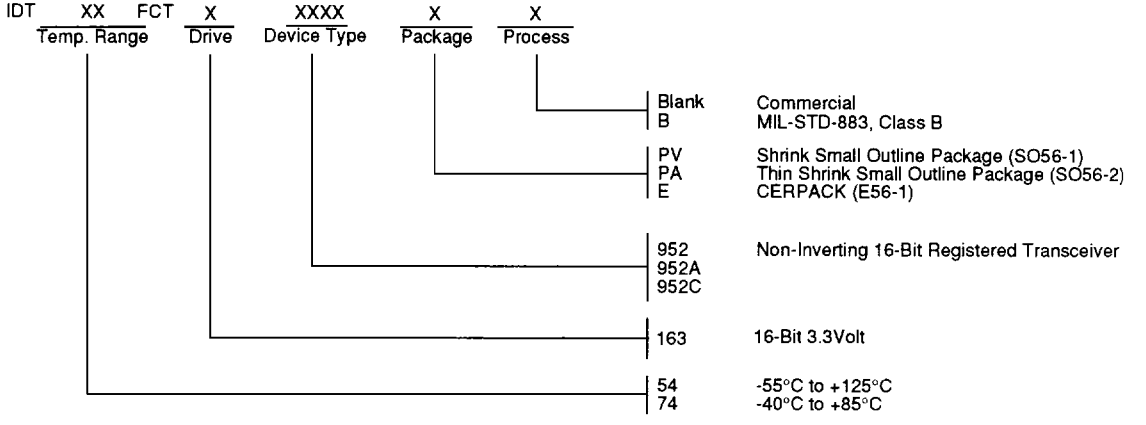
ORDERING INFORMATION



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