

FEATURES:

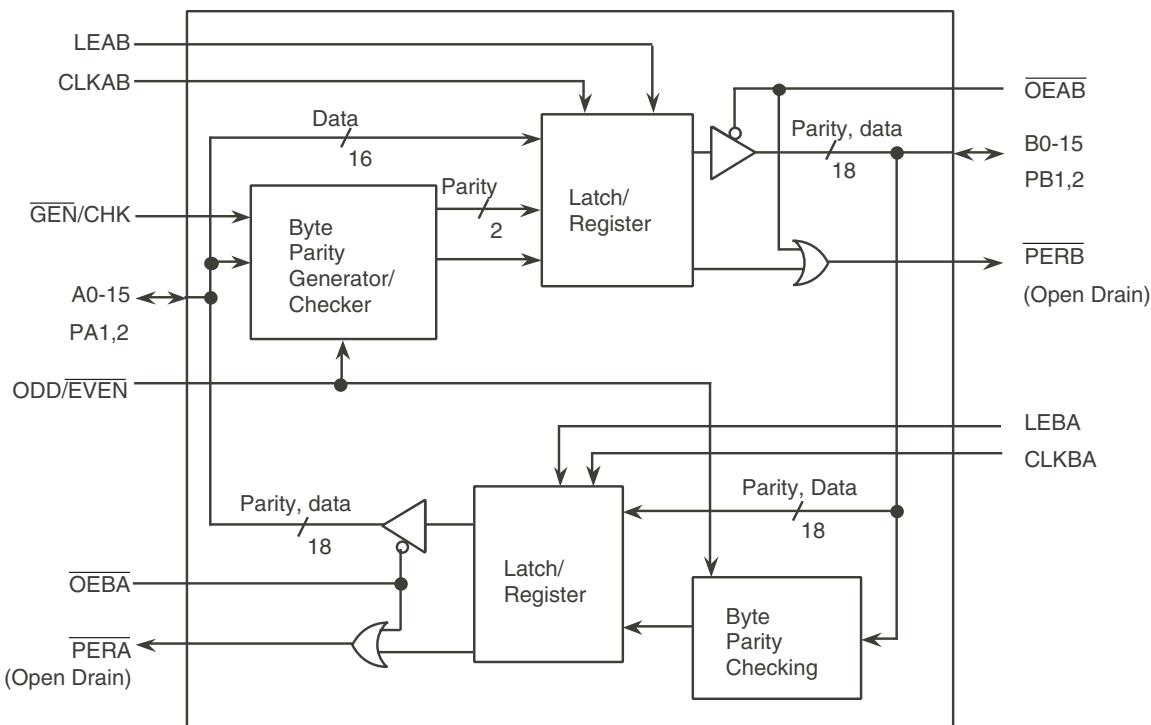
- 0.5 MICRON CMOS Technology
- Typical $t_{sk(o)}$ (Output Skew) < 250ps, clocked mode
- Low input and output leakage $\leq 1\mu A$ (max)
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model ($C = 200pF$, $R = 0$)
- $V_{CC} = 5V \pm 10\%$
- **Balanced Output Drivers:**
 - $\pm 24mA$ (industrial)
 - $\pm 16mA$ (military)
- **Series current limiting resistors**
- **Generate/Check, Check/Check modes**
- Open drain parity error allows wire-OR
- Available in the following packages:
 - Industrial: SSOP, TSSOP
 - Military: CERPACK

DESCRIPTION:

The FCT162511T 16-bit registered/latched transceiver with parity is built using advanced dual metal CMOS technology. This high-speed, low-power transceiver combines D-type latches and D-type flip-flops to allow data flow in transparent, latched, or clocked modes. The device has a parity generator/checker in the A-to-B direction and a parity checker in the B-to-A direction. Error checking is done at the byte level with separate parity bits for each byte. Separate error flags exits for each direction with a single error flag indicating an error for either byte in the A-to-B direction and a second error flag indicating an error for either byte in the B-to-A direction. The parity error flags are open drain outputs which can be tied together and/or tied with flags from other devices to form a single error flag or interrupt. The parity error flags are enabled by the OE_{xx} control pins allowing the designer to disable the error flag during combinational transitions.

The control pins LE_{AB} , CLK_{AB} , and \overline{OE}_{AB} control operation in the A-to-B direction while LE_{BA} , CLK_{BA} , and \overline{OE}_{BA} control the B-to-A direction. GEN/CHK is only for the selection of A-to-B operation. The B-to-A direction is always in checking mode. The $ODD/EVEN$ select is common between the two directions. Except for the $ODD/EVEN$ control, independent operation can be achieved between the two directions by using the corresponding control lines.

FUNCTIONAL BLOCK DIAGRAM

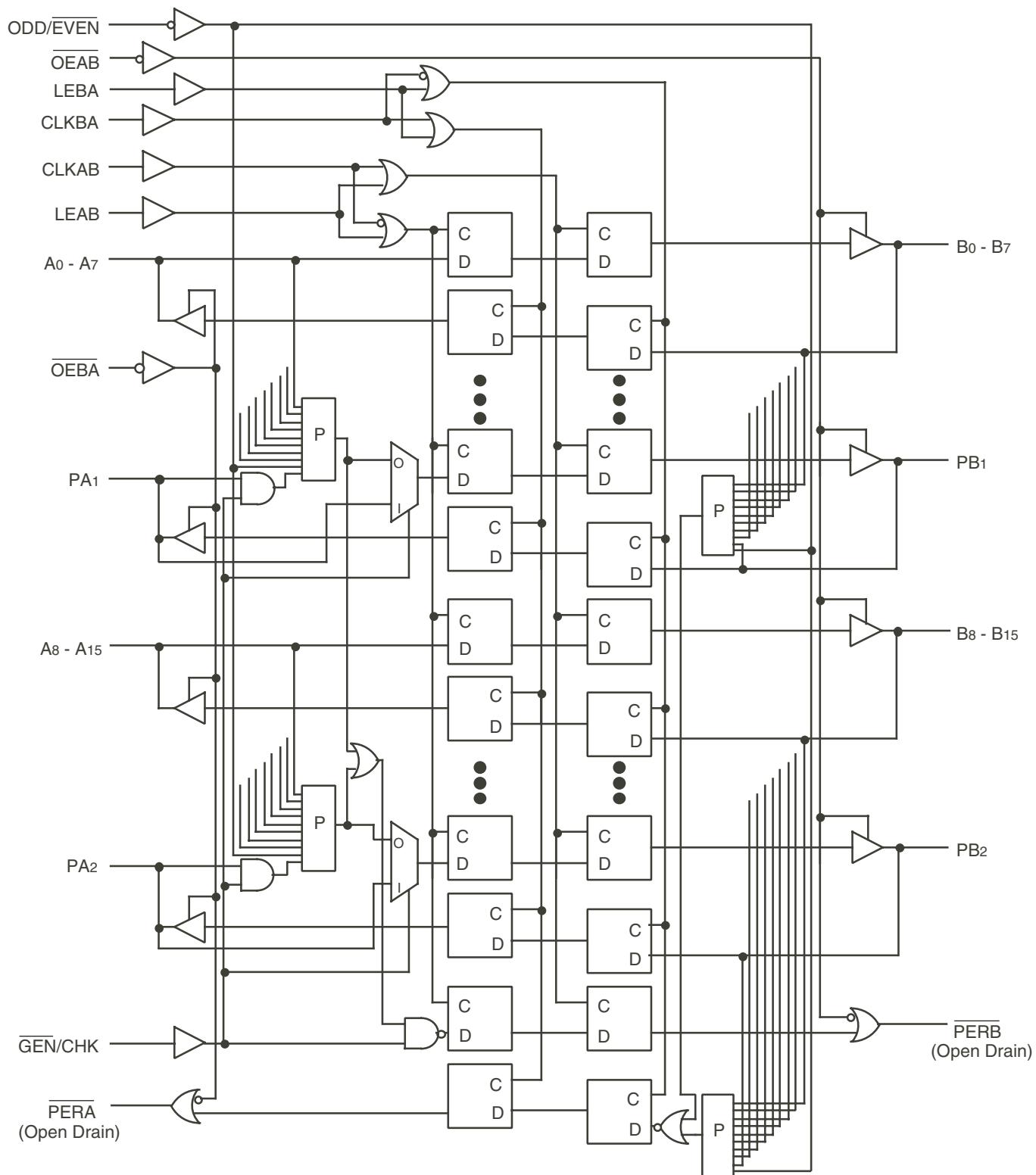


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MILITARY AND INDUSTRIAL TEMPERATURE RANGES

SEPTEMBER 2009

BLOCK DIAGRAM



PIN CONFIGURATION

OEAB	1	56	GEN/CHK
LEAB	2	55	CLKAB
PA1	3	54	PB1
GND	4	53	GND
A0	5	52	B0
A1	6	51	B1
Vcc	7	50	Vcc
A2	8	49	B2
A3	9	48	B3
A4	10	47	B4
A5	11	46	B5
A6	12	45	B6
A7	13	44	B7
GND	14	43	PERB
PERA	15	42	GND
A8	16	41	B8
A9	17	40	B9
A10	18	39	B10
A11	19	38	B11
A12	20	37	B12
A13	21	36	B13
VCC	22	35	VCC
A14	23	34	B14
A15	24	33	B15
GND	25	32	GND
PA2	26	31	PB2
OEBA	27	30	CLKBA
LEBA	28	29	ODD/EVEN

SSOP/ TSSOP/ CERPACK
TOP VIEW**ABSOLUTE MAXIMUM RATINGS(1)**

Symbol	Description	Max	Unit
VTERM ⁽²⁾	Terminal Voltage with Respect to GND	-0.5 to 7	V
VTERM ⁽³⁾	Terminal Voltage with Respect to GND	-0.5 to Vcc+0.5	V
TSTG	Storage Temperature	-65 to +150	°C
IOUT	DC Output Current	-60 to +120	mA

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.
- All device terminals except FCT162XXX Output and I/O terminals.
- Output and I/O terminals for FCT162XXX.

CAPACITANCE ($T_A = +25^\circ\text{C}$, $F = 1.0\text{MHz}$)

Symbol	Parameter ⁽¹⁾	Conditions	Typ.	Max.	Unit
C _{IN}	Input Capacitance	V _{IN} = 0V	3.5	6	pF
C _{I/O}	I/O Capacitance	V _{OUT} = 0V	3.5	8	pF
C _O	Open Drain Capacitance	V _{OUT} = 0V	3.5	6	pF

PIN DESCRIPTION

Pin Names	Description
OEAB	A-to-B Output Enable Input (Active LOW)
OEBA	B-to-A Output Enable Input (Active LOW)
LEAB	A-to-B Latch Enable Input
LEBA	B-to-A Latch Enable Input
CLKAB	A-to-B Clock Input
CLKBA	B-to-A Clock Input
Ax	A-to-B Data Inputs or B-to-A 3-State Outputs
Bx	B-to-A Data Inputs or A-to-B 3-State Outputs
PERA	Parity Error (Open Drain) on A Outputs
PERB	Parity Error (Open Drain) on B Outputs
PAx ⁽¹⁾	A-to-B Parity Input, B-to-A Parity Output
PBx	B-to-A Parity Input, A-to-B Parity Output
ODD/EVEN	Parity Mode Selection Input
GEN/CHK	A to B Port Generate or Check Mode Input

NOTE:

- The PAx pin input is internally disabled during parity generation. This means that when generating parity in the A to B direction there is no need to add a pull up resistor to guarantee state. The pin will still function properly as the parity output for the B to A direction.

FUNCTION TABLE(1, 4)

Inputs			Outputs	
\overline{OEAB}	LEAB	CLKAB	Ax	Bx
H	X	X	X	Z
L	H	X	L	L
L	H	X	H	H
L	L	↑	L	L
L	L	↑	H	H
L	L	L	X	$B^{(2)}$
L	L	H	X	$B^{(3)}$

NOTES:

1. A-to-B data flow is shown. B-to-A data flow is similar but uses \overline{OEBA} , LEBA, and CLKBA.
2. Output level before the indicated steady-state input conditions were established.
3. Output level before the indicated steady-state input conditions were established, provided that CLKAB was HIGH before LEAB went LOW.
4. H = HIGH Voltage Level
- L = LOW Voltage Level
- X = Don't Care
- Z = High-impedance
- ↑ = LOW-to-HIGH Transition

FUNCTION TABLE (PARITY CHECKING) (1, 2, 3, 4)

$A_0 - A_7$ and $PA_1^{(5)}$ Number of inputs that are high	ODD/EVEN	\overline{PERB}
1, 3, 5, 7 or 9	L	L
1, 3, 5, 7 or 9	H	$H^{(6)}$
0, 2, 4, 6 or 8	L	$H^{(6)}$
0, 2, 4, 6 or 8	H	L

NOTES:

1. Conditions shown are for $\overline{GEN/CHK} = H$, $\overline{OEAB} = L$, $\overline{OEBA} = H$.
2. A-to-B parity checking is shown. B-to-A parity checking is similar but uses $\overline{OEBA} = L$, $\overline{OEAB} = H$ and errors will be indicated on \overline{PERA} .
3. In parity checking mode the parity bits will be transmitted unchanged along with the corresponding data regardless of parity errors ($PB_1 = PA_1$).
4. The response shown is for LEAB = H. If LEAB = L then CLKAB will control as an edge triggered clock.
5. Conditions shown are for the byte $A_0 - A_7$ and PA_1 . The byte $A_8 - A_{15}$ and PA_2 is similar.
6. The parity error flag \overline{PERB} is a combined flag for both bytes $A_0 - A_7$ and $A_8 - A_{15}$. If a parity error occurs on either byte \overline{PERB} will go low. \overline{PERB} is an open drain output which must be externally pulled up to achieve a logic HIGH.

FUNCTION TABLE (PARITY GENERATION) (1, 2, 3, 4, 5)

$A_0 - A_7$ Number of inputs that are high	ODD/EVEN	PB_1
1, 3, 5 or 7	L	H
1, 3, 5 or 7	H	L
0, 2, 4, 6 or 8	L	L
0, 2, 4, 6 or 8	H	H

NOTES:

1. Conditions shown are for $\overline{GEN/CHK} = L$, $\overline{OEAB} = L$, $\overline{OEBA} = H$.
2. A-to-B parity checking is shown. B-to-A is capable of parity checking while A-to-B is performing generation. B-to-A will not generate parity.
3. The response shown is for LEAB = H. If LEAB = L then CLKAB will control as an edge triggered clock.
4. Conditions shown are for the byte $A_0 - A_7$. The byte $A_8 - A_{15}$ is similar but will output the parity on PB_2 .
5. The error flag \overline{PERB} will remain in a high state during parity generation.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Industrial: TA = -40°C to +85°C, Vcc = 5.0V ±10%; Military: TA = -55°C to +125°C, Vcc = 5.0V ±10%

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
VIH	Input HIGH Level	Guaranteed Logic HIGH Level		2	—	—	V
VIL	Input LOW Level	Guaranteed Logic LOW Level		—	—	0.8	V
I _{IH}	Input HIGH Current (Input pins) ⁽⁵⁾	Vcc = Max.	Vi = Vcc	—	—	±1	µA
	Input HIGH Current (I/O pins) ⁽⁵⁾			—	—	±1	
I _{IL}	Input LOW Current (Input pins) ⁽⁵⁾		Vi = GND	—	—	±1	
	Input LOW Current (I/O pins) ⁽⁵⁾			—	—	±1	
I _{OZH}	High Impedance Output Current	Vcc = Max.	VO = 2.7V	—	—	±1	µA
I _{OZL}	(3-State Output pins) ⁽⁵⁾		VO = 0.5V	—	—	±1	
V _{IK}	Clamp Diode Voltage	Vcc = Min., I _{IN} = -18mA		—	-0.7	-1.2	V
I _{OS}	Short Circuit Current	Vcc = Max., VO = GND ⁽³⁾		-80	-140	-250	mA
V _H	Input Hysteresis	—		—	100	—	mV
I _{CCL} I _{CCH} I _{CCZ}	Quiescent Power Supply Current	Vcc = Max. VIN = GND or Vcc		—	5	500	µA

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit	
I _{ODL}	Output LOW Current (I/O pins)	Vcc = 5V, VIN = VIH or VIL, VO = 1.5V ⁽³⁾		60	115	200	mA	
				—	250	—	mA	
I _{ODH}	Output HIGH Current		Vcc = 5V, VIN = VIH or VIL, VO = 1.5V ⁽³⁾		-60	-115	-200	mA
I _{OFF}	Output Power Off Leakage Current (Open Drain) ⁽⁵⁾		Vcc = 0, VO ≤ 5.5V		—	—	±1	µA
V _{OH}	Output HIGH Voltage (I/O pins)		Vcc = Min. VIN = VIH or VIL	I _{OH} = -16mA MIL I _{OH} = -24mA IND	2.4	3.3	—	V
V _{OL}	Output LOW Voltage (I/O pins)	Vcc = Min. VIN = VIH or VIL		I _{OL} = 16mA MIL I _{OL} = 24mA IND	—	0.3	0.55	V
				I _{OL} = 48mA MIL I _{OL} = 64mA IND	—	0.3	0.55	V

NOTES:

1. For conditions shown as Min. or Max., 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 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 TA = -55°C.

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⁾		All other Input Pins	—	0.5	1.5
				Parity Input Pins (P _{Ax} , P _{Bx})	—	1	2.5
I _{CCD}	Dynamic Power Supply Current ⁽⁴⁾	V _{CC} = Max. Outputs Open $\overline{OEAB} = GND$, $\overline{OEBA} = V_{CC}$ One Input Toggling 50% Duty Cycle		V _{IN} = V _{CC} V _{IN} = GND	—	75	120
I _C	Total Power Supply Current ⁽⁶⁾	V _{CC} = Max. Outputs Open f _{CP} = 10MHz (CLKAB) 50% Duty Cycle $\overline{OEAB} = GND$, $\overline{OEBA} = V_{CC}$		V _{IN} = V _{CC} V _{IN} = GND	—	0.8	1.7
		LEAB = GND One Bit Toggling f _i = 5MHz 50% Duty Cycle		V _{IN} = 3.4V V _{IN} = GND	—	1.3	3.2
		V _{CC} = Max. Outputs Open f _{CP} = 10MHz (CLKAB) 50% Duty Cycle $\overline{OEAB} = GND$, $\overline{OEBA} = V_{CC}$		V _{IN} = V _{CC} V _{IN} = GND	—	3.8	6.5 ⁽⁵⁾
		LEAB = GND Eighteen Bits Toggling f _i = 2.5MHz 50% Duty Cycle		V _{IN} = 3.4V V _{IN} = GND	—	9	21.8 ⁽⁵⁾

NOTES:

1. For conditions shown as Min. or Max., 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. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$

$$I_C = I_{CC} + \Delta I_{CC} D_{HNT} + I_{CCD} (f_{CP} N_{CP}/2 + f_i N_i)$$

I_{CC} = Quiescent Current (I_{CCL}, I_{CH} and I_{CCZ})

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)

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 (PROPAGATION DELAYS)

Symbol	Parameter	Condition ⁽¹⁾	FCT162511AT				FCT162511CT				Unit	
			Ind.		Mil.		Ind.		Mil.			
			Min. ⁽²⁾	Max.								
t_{PLH}	Propagation Delay, PAx to PBx Ax to Bx or Bx to Ax, PBx to PAx	$CL = 50pF$ $RL = 500\Omega$	1.5	5	1.5	5.3	1.5	4.2	1.5	4.5	ns	
t_{PHL}	Propagation Delay Ax to PBx		1.5	7.5	1.5	8	1.5	6.5	1.5	6.8	ns	
$t_{PLH}^{(3)}$	Propagation Delay Ax to PERB, PAx to PERB		1.5	9	1.5	9	1.5	7.5	1.5	7.8	ns	
$t_{PHL}^{(3)}$	Propagation Delay Bx to PERA, PBx to PERA		1.5	8	1.5	8	1.5	6.5	1.5	6.8	ns	
t_{PLH}	Propagation Delay LEBA to Ax and PAx LEAB to Bx and PBx		1.5	9	1.5	9	1.5	7.5	1.5	7.8	ns	
t_{PHL}	Propagation Delay LEBA to PERA, LEAB to PERB		1.5	8	1.5	8	1.5	6.5	1.5	6.8	ns	
t_{PLH}	Propagation Delay CLKBA to Ax and PAx CLKAB to Bx and PBx		1.5	5.6	1.5	6	1.5	5.3	1.5	5.5	ns	
$t_{PHL}^{(3)}$	Propagation Delay CLKBA to PERA CLKAB to PERB		1.5	7	1.5	7	1.5	6	1.5	6.3	ns	
t_{PLZ}	Output Enable Time OEBA to Ax and PAx OEAB to Bx and PBx		1.5	6	1.5	6	1.5	5	1.5	5.3	ns	
t_{PHZ}	Output Disable Time OEBA to Ax and PAx OEAB to Bx and PBx		1.5	5.6	1.5	6	1.5	5.3	1.5	5.5	ns	
$t_{PLZ}^{(3)}$	Parity ERROR Enable OEBA to PERA, OEAB to PERB		1.5	6	1.5	6.3	1.5	6	1.5	6.3	ns	
t_{PZL}	ODD/EVEN to PERx		1.5	6	1.5	6.3	1.5	6	1.5	6.3	ns	
t_{PLH}	ODD/EVEN to PBx		1.5	10	1.5	10	1.5	10	1.5	10	ns	
t_{PHL}	ODD/EVEN to PBx		1.5	10	1.5	10	1.5	10	1.5	10	ns	

NOTES:

1. See test circuits and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. On Open Drain Outputs t_{PLH} is measured at $V_{OUT} = V_{OL} + 0.3V$.

SWITCHING CHARACTERISTICS OVER OPERATING RANGE (SET UP TIMES)

Symbol	Parameter	Test Conditions ^(1, 3)				FCT162511AT		FCT162511CT		Unit			
						Ind.		Mil.					
						Min.	Max.	Min.	Max.				
tsu	Set-up Time HIGH or LOW Ax to CLKAB	GEN/CHK LOW	PBx valid	CL = 50pF RL = 500Ω	4	—	4	—	3	—	3.5	—	ns
			PBx not valid		3	—	3	—	3	—	3	—	ns
		GEN/CHK HIGH	PERB valid		4	—	4	—	3	—	3	—	ns
			PERB not valid		3	—	3	—	3	—	3	—	ns
	Set-up Time PAx to CLKAB	GEN/CHK HIGH	PERB valid	CL = 50pF RL = 500Ω	4	—	4	—	3	—	3	—	ns
			PERB not valid		3	—	3	—	3	—	3	—	ns
	Set-up Time Bx to CLKBA, PBx to CLKBA		PERA valid		4	—	4	—	3	—	3	—	ns
			PERA not valid		3	—	4	—	3	—	3	—	ns
tsu	Set-up Time Ax to LEAB	CLKAB LOW	PBx valid	CL = 50pF RL = 500Ω	3.5	—	3.5	—	3	—	3	—	ns
			PBx not valid		3	—	3	—	3	—	3	—	ns
		CLKAB LOW	PERB valid		3.5	—	3.5	—	3	—	3	—	ns
			PERB not valid		3	—	3	—	3	—	3	—	ns
		CLKAB HIGH	PBx valid		3.5	—	3.5	—	3	—	3	—	ns
			PBx not valid		3	—	3	—	3	—	3	—	ns
		CLKAB HIGH	PERB valid		3.5	—	3.5	—	3	—	3	—	ns
			PERB not valid		3	—	3	—	3	—	3	—	ns
	Set-up Time PAx to LEAB	CLKAB LOW	PERB valid		3.5	—	3.5	—	3	—	3	—	ns
			PERB not valid		3	—	3	—	3	—	3	—	ns
		CLKAB HIGH	PERB valid		3.5	—	3.5	—	3	—	3	—	ns
			PERB not valid		3	—	3	—	3	—	3	—	ns
tsu	Set-up Time Bx to LEBA PBx to LEBA	CLKBA LOW	PERA valid	CL = 50pF RL = 500Ω	3.5	—	3.5	—	3	—	3	—	ns
			PERA not valid		3	—	3	—	3	—	3	—	ns
		CLKBA HIGH	PERA valid		3.5	—	3.5	—	3	—	3	—	ns
			PERA not valid		3	—	3	—	3	—	3	—	ns
	tsk(0)	Output Skew ⁽⁴⁾				—	0.5	—	0.5	—	0.5	—	0.5

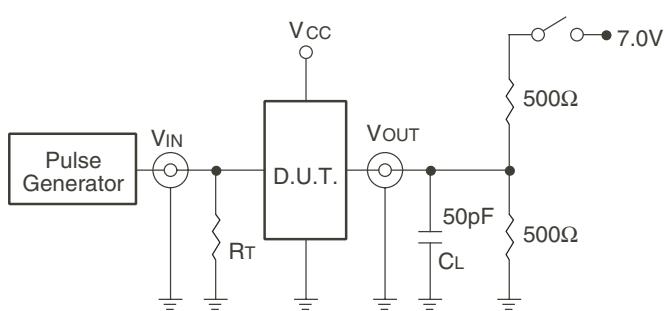
SWITCHING CHARACTERISTICS OVER OPERATING RANGE (HOLD TIMES)

Symbol	Parameter	Condition ⁽¹⁾	FCT162511AT		FCT162511CT		Unit		
			Ind.		Mil.				
			Min.	Max.	Min.	Max.			
tH	Hold Time HIGH or LOW Ax to LEAB, Bx to LEBA	CL = 50pF RL = 500Ω	1	—	1	—	1	—	ns
	Hold Time HIGH or LOW PAx to LEAB		1	—	1	—	1	—	ns
	Hold Time HIGH or LOW PBx to LEBA		1	—	1	—	1	—	ns
	Hold Time Ax to CLKAB, PAx to CLKAB		1	—	1	—	0	—	ns
	Hold Time Bx to CLKBA, PBx to CLKBA		1	—	1	—	0	—	ns
	LEAB or LEBA Pulse Width HIGH ⁽²⁾		3	—	3	—	3	—	ns
	CLKAB or CLKBA Pulse Width HIGH or LOW ⁽²⁾		3	—	3	—	3	—	ns

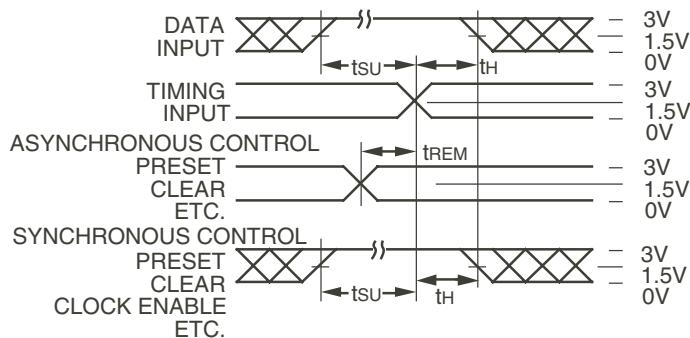
NOTES:

- See test circuits and waveforms.
- This parameter is guaranteed but not tested.
- "Not valid" means the set-up time indicated is not sufficient to assure proper functioning of this output; however, the set-up time indicated will assure proper functioning of the A to B or B to A port respective to the indicated direction.
- Skew between any two outputs of the same package, switching in the same direction, excluding PERRx in clocked mode, and Pxx (parity bits) and PERRx in transparent/latched mode. This parameter is guaranteed by design.

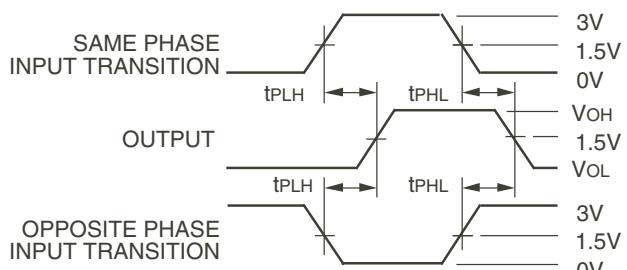
TEST CIRCUITS AND WAVEFORMS



Test Circuits for All Outputs



Set-up, Hold, and Release Times



Propagation Delay

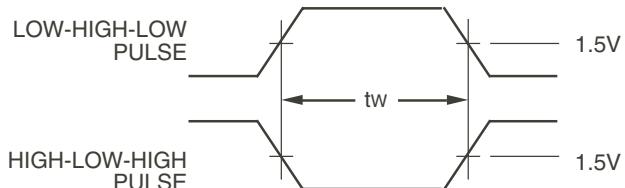
SWITCH POSITION

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

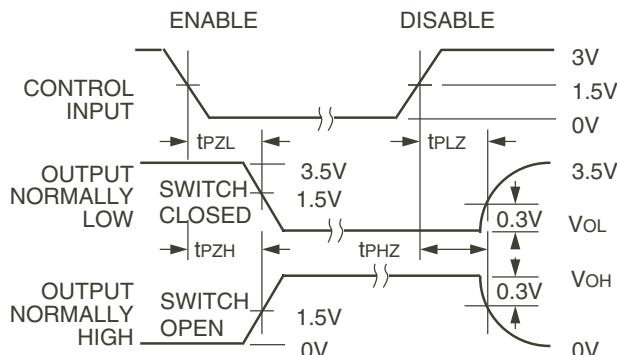
DEFINITIONS:

CL = Load capacitance: includes jig and probe capacitance.

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



Pulse Width

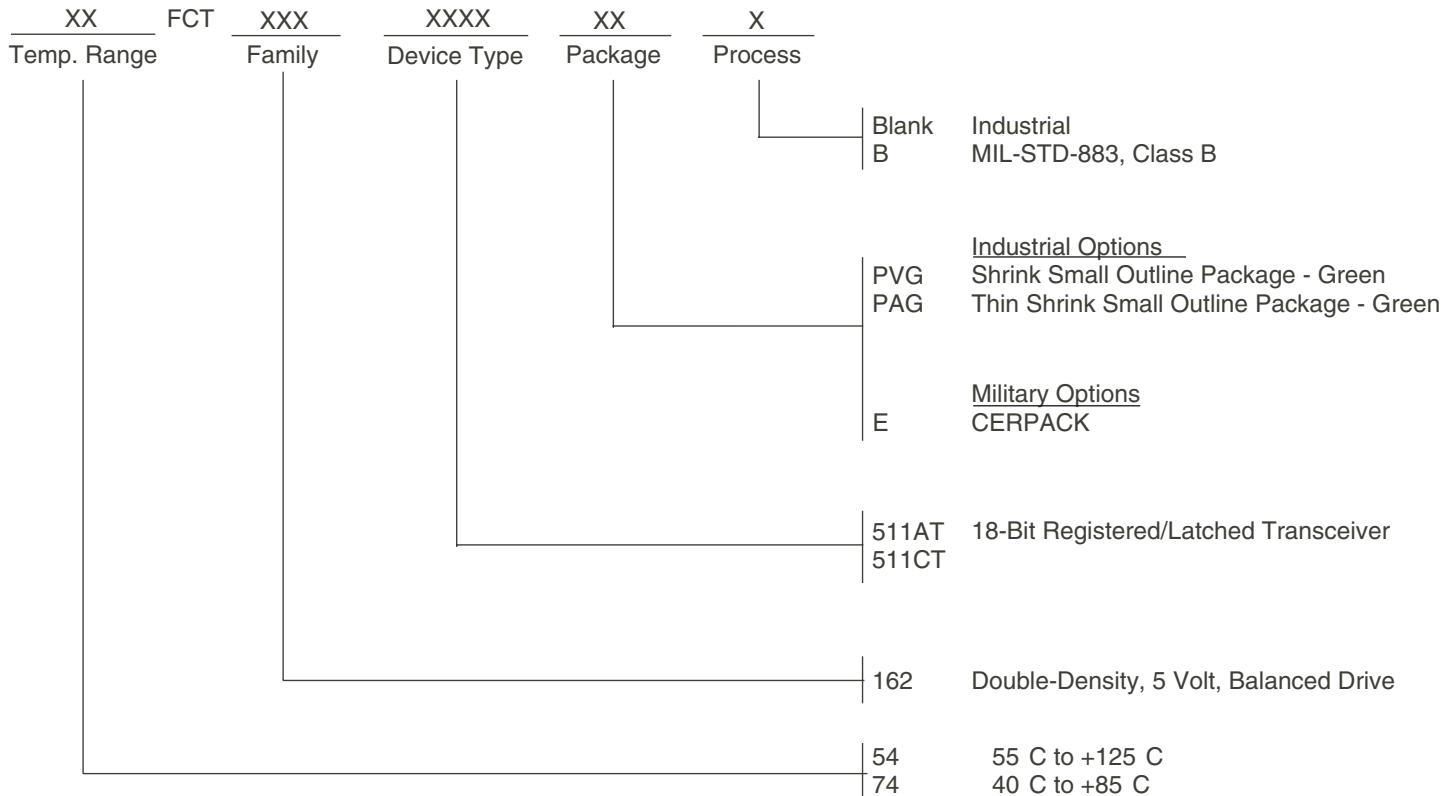


Enable and Disable Times

NOTES:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.
2. Pulse Generator for All Pulses: Rate \leq 1.0MHz; t_f \leq 2.5ns; t_r \leq 2.5ns.

ORDERING INFORMATION



Datasheet Document History

09/06/09 Pg.6

Updated the ordering information by removing the "IDT" notation and non RoHS part.



CORPORATE HEADQUARTERS
 6024 Silver Creek Valley Road
 San Jose, CA 95138

for SALES:
 800-345-7015 or 408-284-8200
 fax: 408-284-2775
www.idt.com

for Tech Support:
logichelp@idt.com