

QS74FCT163952
High Speed CMOS 3.3V
16-Bit Bus Register
Transceiver

FEATURES/BENEFITS

- Pin and function compatible with T.I. Widebus™ and IDT Double-Density™ families
- CMOS power levels: <math><1\mu\text{W}</math> typical standby
- SSOP (PV) and TSSOP (PA) packages
- Low output skew: 0.5ns $t_{SK(O)}$
- Flow-through pinout for easy layout
- Extended commercial temperature: -40°C to $+85^{\circ}\text{C}$
- Extended 3.3V supply range 2.7V to 3.6V
- JEDEC compatible LVTTTL output levels for 3.3V
- Input hysteresis for noise immunity
- Multiple power and ground pins for low noise
- A and C speed grades: 6.3ns t_{PD} for C
- 5V tolerant inputs for 5V to 3.3V translation

DESCRIPTION

The FCT163952 is a 16-bit bus register transceiver with three-state outputs that is ideal for driving address and data buses. Two independent 8-bit registered transceivers are used to permit independent control of data flow in either direction. Easy board layout is facilitated by the use of flow-through pinouts and byte enable controls provide architectural flexibility for systems designers. All outputs have ground bounce suppression circuitry (See QSI Application Note AN-01). Multiple power and ground pins result in low ground and V_{CC} bounce. This JEDEC LVTTTL compliant 3.3V device is useful for 5V to 3.3V applications since all inputs will support 5V signals.

Figure 1. Functional Block Diagram

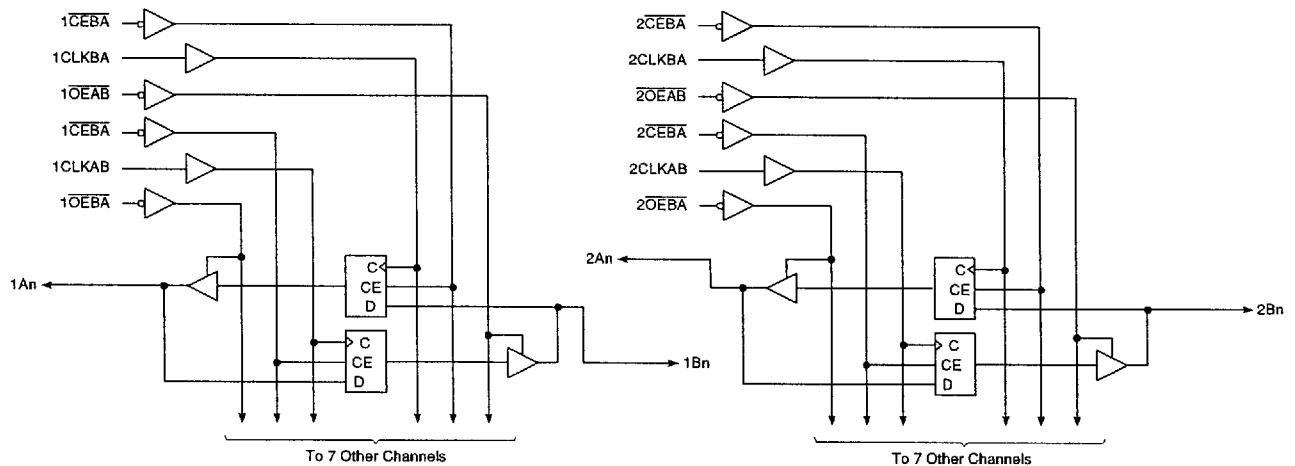


Figure 2. Pin Configuration
(All Pins Top View)

SSOP, TSSOP			
$\overline{1OEAB}$	1	56	$\overline{1OEBA}$
$\overline{1CLKAB}$	2	55	$\overline{1CLKBA}$
$\overline{1CEAB}$	3	54	$\overline{1CEBA}$
GND	4	53	GND
1A1	5	52	1B1
1A2	6	51	1B2
V _{CC}	7	50	V _{CC}
1A3	8	49	1B3
1A4	9	48	1B4
1A5	10	47	1B5
GND	11	46	GND
1A6	12	45	1B6
1A7	13	44	1B7
1A8	14	43	1B8
2A1	15	42	2B1
2A2	16	41	2B2
2A3	17	40	2B3
GND	18	39	GND
2A4	19	38	2B4
2A5	20	37	2B5
2A6	21	36	2B6
V _{CC}	22	35	V _{CC}
2A7	23	34	2B7
2A8	24	33	2B8
GND	25	32	GND
$\overline{2CEAB}$	26	31	$\overline{2CEBA}$
$\overline{2CLKAB}$	27	30	$\overline{2CLKBA}$
$\overline{2OEAB}$	28	29	$\overline{2OEBA}$

Table 1. Pin Description

Name	Description
\overline{xOEAB}	A to B Output Enable Inputs (Active LOW)
\overline{xOEBA}	B to A Output Enable Inputs (Active LOW)
\overline{xCEAB}	A to B Enable Inputs (Active LOW)
\overline{xCEBA}	B to A Enable Inputs (Active LOW)
xCLKAB	A to B Clock Inputs
xCLKBA	B to A Clock Inputs
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

Table 2. Function Table (1, 2)

\overline{xCEAB}	Inputs			xAx	xBx
	xCLKAB	\overline{xOEAB}			
H	X	L	X	B ⁽³⁾	
X	L	L	X	B ⁽³⁾	
L	↑	L	L	L	
L	↑	L	H	H	
X	X	H	X	Z	

Notes:

- ↑ = LOW-to-HIGH Transition
H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care
- A-to-B data flow shown: B-to-A flow control is the same, except using \overline{xCEBA} , xCLKBA, and \overline{xOEBA} .
- Level of B before the indicated steady-state input conditions were established.

Table 3. Capacitance

$T_A = 25^\circ\text{C}$, $f = 1\text{MHz}$, $V_{IN} = 0\text{V}$, $V_{OUT} = 0\text{V}$

Symbol	Parameter	Typ	Unit
C_{IN}	Input Capacitance	7.0	pF
C_{OUT}	Output Capacitance	8.0	pF

Note: Capacitance is characterized but not production tested.

Table 4. Absolute Maximum Ratings

Supply Voltage to Ground	-0.5V to +4.6V
DC Output Voltage V_{OUT}	-0.5V to $V_{CC} + 0.5\text{V}$
DC Input Voltage V_{IN}	-0.5V to +7.0V
AC Input Voltage (for a pulse width $\leq 20\text{ns}$)	-3.0V
DC Input Diode Current with $V_{IN} < 0$	-20mA
DC Output Diode Current with $V_{OUT} < 0$	-50mA
DC Output Current Max. Sink Current/Pin	120mA
T_{STG} Storage Temperature	-65° to +150°C

Note: Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to this device resulting in functional or reliability type failures.

Table 5. Recommended Operating Conditions

Symbol		Min	Max	Unit
V_{CC}	Supply Voltage	2.7	3.6	V
V_{IN}	Input Voltage	-0.5	5.5	V
V_{OUT}	Voltage Applied to Output or I/O	0	V_{CC}	V
$\Delta t/\Delta v$	Input Transition Slew Rate	—	10	ns/V
T_A	Operating Free Air Temperature	-40	+85	°C

Table 6. DC Electrical Characteristics Over Operating Range

Recommended Operating Ranges apply unless otherwise noted.

Symbol	Parameter	Test Conditions ⁽¹⁾	Min	Typ ⁽²⁾	Max	Unit	
V_{IH}	Input HIGH Voltage	Logic HIGH for All Inputs	2.0	—	5.5	V	
V_{IL}	Input LOW Voltage	Logic LOW for All Inputs	-0.5	—	0.8	V	
ΔV_T	Input Hysteresis ⁽⁴⁾	$V_{TLH} - V_{THL}$ for All Inputs	—	150	—	mV	
$ I_{IH} $	Input HIGH Current (Input pins)	$V_{CC} = \text{Max.}$ $V_I = 5.5V$	—	—	1	μA	
	Input HIGH Current (I/O pins)		$V_I = V_{CC}$	—	—		1
$ I_{IL} $	Input LOW Current (Input pins)	$V_{CC} = \text{Max.}$ $V_I = \text{GND}$	—	—	1	μA	
	Input LOW Current (I/O pins)		$V_I = \text{GND}$	—	—		1
$ I_{OZ} $	Off-State Output Current (Hi-Z)	$V_{CC} = \text{Max.}, V_{OUT} = 0V,$ $V_{OUT} = V_{CC}$	—	—	1	μA	
I_{OS}	Short Circuit Current ^(3,4)	$V_{CC} = \text{Max.}, V_{OUT} = \text{GND}$	-60	-140	-240	mA	
V_{OH}	Output HIGH Voltage	$V_{CC} = 2.7V$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -0.1mA$ $I_{OH} = -3.0mA$	$V_{CC} - 0.2$ 2.4	—	—	V
		$V_{CC} = 3.0V$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -8mA$	2.4	—	—	V
V_{OL}	Output LOW Voltage	$V_{CC} = 2.7V$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 0.1mA$ $I_{OL} = 16mA$ $I_{OL} = 24mA$	—	—	0.2 0.4 0.55	V
		$V_{CC} = 3.0V$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 24mA$	—	—	0.5	V
V_{IK}	Input Clamp Voltage ⁽⁴⁾	$V_{CC} = \text{Min.}, I_{IN} = -18mA$	—	-0.7	-1.2	V	

Notes:

1. For conditions shown as Max or Min use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values indicate $V_{CC} = 3.3V$ and $T_A = 25^\circ C$.
3. Not more than one output should be shorted at one time. Duration of test should not exceed one second.
4. These parameters are guaranteed by design but not production tested.

Table 7. Power Supply Characteristics

Symbol	Parameter	Test Conditions ⁽¹⁾	Typ ⁽¹⁾	Max	Unit	
I_{CC}	Quiescent Power Supply Current	$V_{CC} = 3.6V$, Freq = 0, $V_{IN} = GND$ or V_{CC}	0.1	10	μA	
ΔI_{CC}	Supply Current per Input @ TTL HIGH	$V_{CC} = 3.6V$, $V_{IN} = V_{CC} - 0.6V$	2.0	30	μA	
I_{CCD}	Supply Current per Input per MHz ⁽⁴⁾	$V_{CC} = 3.6V$, Outputs Open One Bit Toggling @ 50% Duty Cycling $\overline{xOE} = GND$	$V_{IN} = V_{CC}$ $V_{IN} = GND$	65	100	$\mu A / MHz$
I_C	Total Power Supply Current ⁽⁶⁾	$V_{CC} = 3.6V$, Outputs Open One Bit Toggling @ 50% Duty Cycle $f = 5MHz$, $f_{CP} = 10MHz$ (xCLKAB) $\overline{xOEAB} = \overline{xCEAB} = GND$ $\overline{xOEBA} = V_{CC}$	$V_{IN} = V_{CC} - 0.6V$ $V_{IN} = GND$	0.4 ⁽⁵⁾	0.6 ⁽⁵⁾	mA
		$V_{CC} = 3.6V$, Outputs Open Sixteen Bits Toggling @ 50% Duty Cycling $f = 2.5MHz$, $f_{CP} = 10MHz$ (xCLKAB) $\overline{xOEAB} = \overline{xCEAB} = GND$ $\overline{xOEBA} = V_{CC}$	$V_{IN} = V_{CC} - 0.6V$ $V_{IN} = GND$	2.1 ⁽⁵⁾	3.4 ⁽⁵⁾	mA

Notes:

- For conditions shown as Min. or Max. use the appropriate value specified under Recommended Operating Conditions for the applicable device type.
- Typical values are at $V_{CC} = 3.3V$, +25°C ambient.
- Per TTL driven input. All other inputs at V_{CC} 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_{CC} formula. These limits are guaranteed by design but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
 $I_C = I_{CCQ} + \Delta I_{CC} D_H N_T + I_{CCD} f N_O$
 I_{CCQ} = Quiescent Current (I_{CCL} , I_{CCH} , and I_{CCZ}).
 ΔI_{CC} = Power Supply Current for a TTL-High Input ($V_{IN} = V_{CC} - 0.6V$).
 D_H = Duty Cycle for TTL High Inputs.
 N_T = Number of TTL High Inputs.
 I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL).
 f = Average Switching Frequency per Output.
 N_O = Number of Outputs Switching.

Note: 1. Characterized but not production tested.

Table 8. Switching Characteristics Over Operating Range

Recommended operating ranges apply unless otherwise noted.

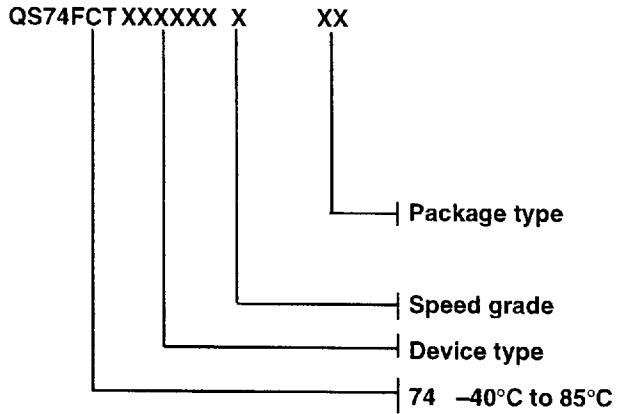
$C_{LOAD} = 50pF$, $R_{LOAD} = 500\Omega$ unless otherwise noted.

Symbol	Description ⁽¹⁾	FCT163952A		FCT163952C		Unit
		Min	Max	Min	Max	
t_{PHL} t_{PLH}	Propagation Delay xCLKAB, xCLKBA to xAx, xBx	2.0	10.0	2.0	6.3	ns
t_{PZH} t_{PZL}	Output Enable Time xOEBA, xOEAB to xAx, xBx	1.5	10.5	1.5	7.0	ns
t_{PHZ} t_{PLZ}	Output Disable Time ⁽²⁾ xOEBA, xOEAB to xAx, xBx	1.5	10.0	1.5	6.5	ns
t_{SU}	Setup Time HIGH or LOW xAx, xBx to xCKLAB, xCKLBA	2.5	—	2.5	—	ns
t_H	Hold Time HIGH or LOW xAx, xBx to xCLKAB, xCLKBA	2.0	—	1.5	—	ns
t_{SU}	Setup Time HIGH or LOW xCEBA, xCEAB to xCLKAB, xCLKBA	3.0	—	3.0	—	ns
t_H	Setup Time HIGH or LOW xCEBA, xCEAB to xCLKAB, xCLKBA	2.0	—	2.0	—	ns
t_W	Pulse Width LOW xCLKAB to xCLKBA ⁽²⁾	3.0	—	3.0	—	ns
$t_{SK(O)}$	Output Skew ⁽³⁾	—	0.5	—	0.5	ns

Notes:

1. Minimums guaranteed but not tested on propagation delays. See Test Circuit and Waveforms.
2. Switching characteristics are with $V_{CC} = 3.3V \pm 0.3V$. For 2.7V V_{CC} operation, parameters should be degraded by 20%.
3. Guaranteed by design, but not production tested.
4. Skew between any two outputs of the same package switching in the same direction.
This parameter is guaranteed by characterization but not production tested.

ORDERING INFORMATION



Device Type:
163952

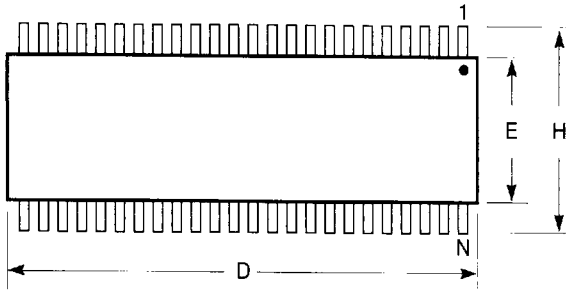
Speed Grades:
A
C

Package Type:
PV – SSOP, 300 mil
PA – TSSOP, 240 mil

PACKAGING INFORMATION

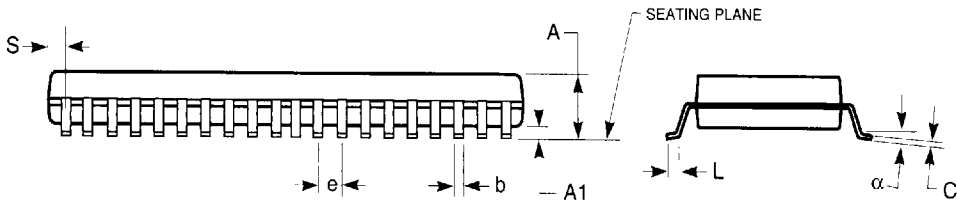
300-MIL SSOP - Package Code PV

Shrink Small Outline Package
Plastic Small Outline Gull-Wing



Notes:

1. Refer to applicable symbol list.
2. All dimensions are in inches.
3. N is the number of lead positions.
4. Dimensions D and E are to be measured at maximum material condition but do not include mold flash. Allowable mold flash is 0.006 in. per side.
5. Lead coplanarity is 0.004 in. maximum.



JEDEC#	MO-118AA			MO-118AB		
DWG#	PSS-48B			PSS-56B		
Symbol	Min	Nom	Max	Min	Nom	Max
A	0.095	0.102	0.110	0.095	0.102	0.110
A1	0.008	0.012	0.016	0.008	0.012	0.016
b	0.008	0.010	0.0135	0.008	0.010	0.0135
C	0.005	0.008	0.010	0.005	0.008	0.010
D	0.620	0.625	0.630	0.720	0.725	0.730
E	0.291	0.295	0.299	0.291	0.295	0.299
e	0.025 BSC			0.025 BSC		
H	0.395	0.410	0.420	0.395	0.410	0.420
L	0.020	0.030	0.040	0.020	0.030	0.040
N	48			56		
α	0°	5°	8°	0°	5°	8°
S	0.022	0.025	0.028	0.022	0.025	0.028

■ 7466803 0003418 594 ■