QUALITY SEMICONDUCTOR, INC.

High-Speed CMOS 16-Bit Bus Register Transceiver (3-State)

QS74FCT16952T
QS74FCT162952T

FEATURES/BENEFITS

- Pin and function compatible with T.I. Widebus™ and IDT Double-Density™ families
- CMOS power levels: <1μW typical standby
- SSOP (PV) and TSSOP (PA) packages
- Low output skew: 0.5ns $t_{SK(O)}$
- Flow-through pinout for easy layout
- Power off disable allows hot plugging
- Industrial temperature: –40°C to +85°C
- Input hysteresis for noise immunity
- Multiple power and ground pins for low noise

FCT16952T

- High drive standard FCT-T outputs: I_{OL} = +64mA, I_{OH} = –32mA
- Incident switching for driving buses and large loads

FCT162952T

- Balanced output drivers: ±24mA
- Reduced switching noise for point to point signals

DESCRIPTION

The FCT16952 family of products are 16-bit bus register transceivers with three-state outputs that are ideal for driving address and data buses. Two independent 8-bit registered transeivers 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) and many power and ground pins provide low ground bounce. To accommodate hot-plug or live insertion applications, both versions of this product were designed not to load an active bus when V_{CC} is removed. In applications where bus signals are point-to-point or driving light capacitance loads, the balanced drive FCT162952 is recommended.

Figure 1. Functional Block Diagram

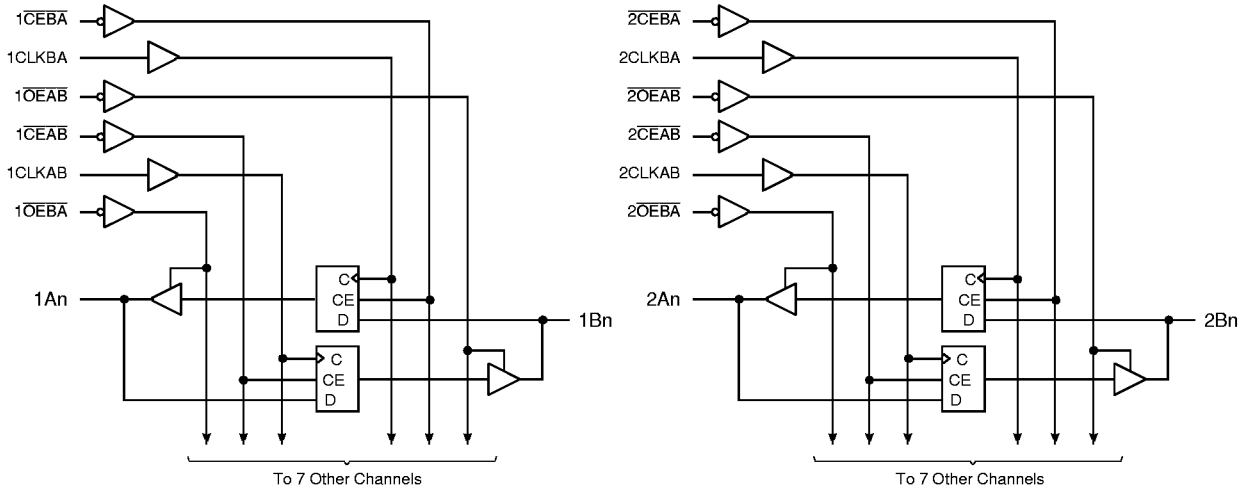

Figure 2. Pin Configuration (All Pins Top View)

SSOP, TSSOP

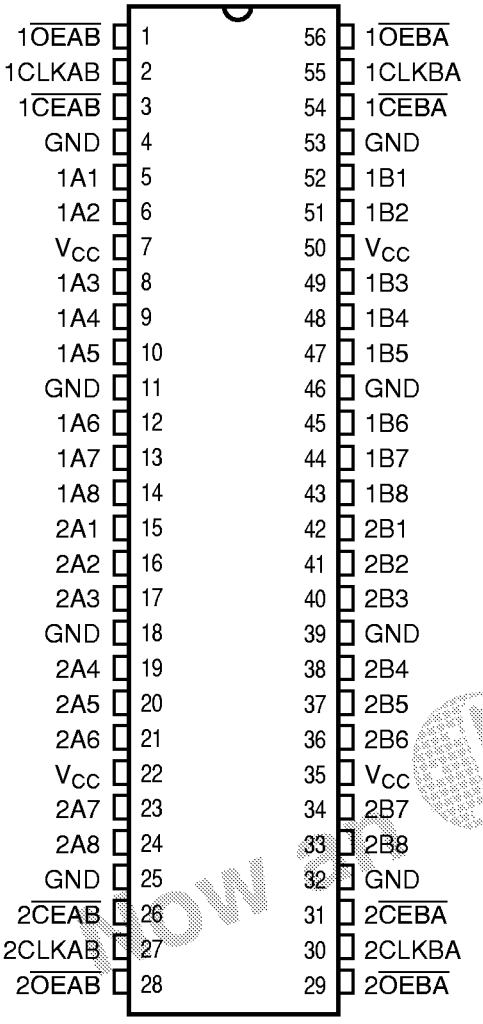

Table 1. Pin Description

Name	Description
x$\overline{\text{OEAB}}$	A to B Output Enable Inputs (Active LOW)
x$\overline{\text{OEBA}}$	B to A Output Enable Inputs (Active LOW)
x$\overline{\text{CEAB}}$	A to B Enable Inputs (Active LOW)
x$\overline{\text{CEBA}}$	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]

Inputs				Outputs
x$\overline{\text{CEAB}}$	xCLKAB	x$\overline{\text{OEAB}}$	xAx	xBx
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:
1. ↑ = LOW-to-HIGH Transition
   H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
2. A-to-B data flow shown: B-to-A flow control is the same, except using x$\overline{\text{CEBA}}$, xCLKBA, and x$\overline{\text{OEBA}}$.
3. Level of B before the indicated steady-state input conditions were established.

Table 3. Absolute Maximum Ratings

Supply Voltage to Ground	–0.5V to +7.0V
DC Output Voltage V_{OUT}	–0.5V to +7.0V
DC Input Voltage V_{IN}	–0.5V to +7.0V
AC Input Voltage (for a pulse width ≤ 20ns)	–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
Maximum Power Dissipation	1.0 watts
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 4. Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply Voltage	4.5	5.5	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 5. DC Electrical Characteristics Over Operating Range

Recommended Operating Conditions 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	—	—	V
V_{IL}	Input LOW Voltage	Logic LOW for All Inputs	—	—	0.8	V
ΔV_T	Input Hysteresis	$V_{TLH} - V_{THL}$ for All Inputs[4]	—	100	—	mV
$\lvert I_{IH} \rvert$ $\lvert I_{IL} \rvert$	Input Current Input HIGH or LOW	V_{CC} = Max., $0 \le V_{IN} < V_{CC}$	—	—	1	µA
$\lvert I_{OZ} \rvert$	Off-State Output Current (Hi-Z)	V_{CC} = Max., $0 \le V_{OUT} \le V_{CC}$	—	—	1	µA
$\lvert I_{OFF} \rvert$	Power off leakage	V_{CC} = 0V, $V_{IN/OUT} \le 4.5V$[5]	—	—	1	µA
I_{OS}	Short Circuit Current	V_{CC} = Max., V_{OUT} = GND[3,4]	–80	–140	–225	mA
V_{IK}	Input Clamp Voltage	V_{CC} = Min., I_{IN} = –18mA	–	–0.7	–1.2	V

Notes:
1. For conditions shown as Min. or Max. use appropriate value specified under Recommended Operating Conditions for the applicable device type.
2. Typical values indicate V_{CC} = 5.0V and T_A = 25°C.
3. Not more than one output should be tested at one time. Duration of test should not exceed one second.
4. These parameters are guaranteed by design but not tested.
5. The test limit for this parameter is ± 5µA at T_A = –55°C

Table 6. Capacitance

T_A = 25°C, f = 1MHz, V_{IN} = 0V, V_{OUT} = 0V

Pins	Typ	Max	Unit
All	6.0	9.0	pF

Table 7. Output Drive Characteristics for FCT16952T

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} = –3mA	2.5	3.4	—	V
			I_{OH} = –15mA	2.4	3.2	—	V
			I_{OH} = –32mA[4]	2.0	3.0	—	V
V_{OL}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 64mA	—	0.3	0.55	V

Table 8. Output Drive Characteristics for FCT162952T

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]		60	115	200	mA
I_{ODH}	Output HIGH Current	V_{CC} = 5V, V_{IN} = V_{IH} or V_{IL} V_{OUT} = 1.5V[3]		–60	–115	–200	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OH} = –24mA	2.4	3.1	—	V
V_{OL}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 24mA	—	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 indicate V_{CC} = 5.0V and T_A = 25°C.
3. Not more than one output should be shorted and the duration is ≤1 second.
4. Duration of the condition should not exceed one second.

Table 9. Power Supply Characteristics

Symbol	Parameter	Test Conditions[1]		Typ[2]	Max	Unit
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CC} = Max., V_{IN} = GND or V_{CC}		5	500	µA
ΔI_{CC}	Supply Current per Input @ TTL HIGH	V_{CC} = Max., V_{IN} = 3.4V[3]		0.5	1.5	mA
Q_{CCD}	Supply Current per Input per MHz[4]	V_{CC} = Max., Outputs Open One Bit Toggling @ 50% Duty Cycle $x\overline{OEAB}$ = $x\overline{CEAB}$ = GND	V_{IN} = V_{CC} V_{IN} = GND	75	120	µA/ MHz
I_C	Total Power Supply Current[6]	V_{CC} = Max., Outputs Open One Bit Toggling @ 50% Duty Cycle f_i = 5MHz, f_{CP} = 10MHz (xCLKAB) $x\overline{OEAB}$ = $x\overline{CEAB}$ = GND $x\overline{OEBA}$ = V_{CC}	V_{IN} = V_{CC} V_{IN} = GND	0.8	1.7[5]	mA
			V_{IN} = 3.4V V_{IN} = GND	1.3	3.2[5]	mA
		V_{CC} = Max., Outputs Open Sixteen Bits Toggling @ 50% Duty Cycle f_i = 2.5MHz, f_{CP} = 10MHz (xCLKAB) $x\overline{OEAB}$ = $x\overline{CEAB}$ = GND $x\overline{OEBA}$ = V_{CC}	V_{IN} = V_{CC} V_{IN} = GND	3.8	6.5[5]	mA
			V_{IN} = 3.4 V V_{IN} = GND	8.3	20[5]	mA

Notes:

1. For conditions shown as Min. or Max., use the appropriate values specified under Recommended Operating Conditions for 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 by design but not tested.
6. $I_C = I_{QUIESCENT} + I_{INPUTS} = I_{DYNAMIC}$.
   $I_C = I_{CCQ} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP}/2 + f_i N_i)$.
   I_{CCQ} = Quiescent Current (I_{CCL}, I_{CCH}, and I_{CCZ}).
   ΔI_{CC} = Power Supply Current for a TTL-High Input (V_{IN} = 3.4V).
   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_{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.

Table 10. Switching Characteristics Over Operating Range

Recommended Operating Ranges apply unless otherwise specified.
C_{LOAD} = 50pF, R_{LOAD} = 500Ω unless otherwise noted.

Symbol	Description[1]	FCT16952AT FCT162952AT		FCT16952BT FCT162952BT		FCT16952CT FCT162952CT		Unit
		Min	Max	Min	Max	Min	Max	
t_{PHL} t_{PLH}	Propagation Delay xCLKAB, xCLKBA to xAx, xBx	2.0	10.0	2.0	7.5	2.0	6.3	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OEBA}$, x$\overline{OEAB}$ to xAx, xBx	1.5	10.5	1.5	8.0	1.5	7.0	ns
t_{PHZ} t_{PLZ}	Output Disable Time[2] x$\overline{OEBA}$, x$\overline{OEAB}$ to xAx, xBx	1.5	10.0	1.5	7.5	1.5	6.5	ns
t_{SU}	Setup Time HIGH or LOW xAx, xBx to xCLKAB, xCLKBA	2.5	—	2.5	—	2.5	—	ns
t_H	Hold Time HIGH or LOW xAx, xBx to xCLKAB, xCLKBA	2.0	—	1.5	—	1.5	—	ns
t_{SU}	Setup Time HIGH or LOW x$\overline{CEBA}$, x$\overline{CEAB}$ to xCLKAB, xCLKBA	3.0	—	3.0	—	3.0	—	ns
t_H	Hold Time HIGH or LOW x$\overline{CEBA}$, x$\overline{CEAB}$ to xCLKAB, xCLKBA	2.0	—	2.0	—	2.0	—	ns
t_W	Pulse Width LOW xCLKAB or XCLKBA[2]	3.0	—	3.0	—	3.0	—	ns
$t_{SK(O)}$	Output Skew[3]	—	0.5	—	0.5	—	0.5	ns

Notes:
1. Minimums guaranteed but not tested. See Test Circuit and Waveforms.
2. This parameter is guaranteed but not production tested.
3. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design but not tested.