P54/74PCT651/651A
P54/74PCT652/652A
OCTAL TRANSCEIVERS/REGISTER

T-52-31

FEATURES

- Full CMOS Implementation
- Low Power Operation
- Independent Register for A and B Buses
- Choice of Non-Inverting and Inverting Data Transfer
- Multiplexed Real-Time and Stored Data Transfer
- Bidirectional Bus Transceiver and Registers
- Fully TTL Compatible Input and Output Levels
- 3-State Output
- Produced with PACE Technology™
- Compact Pinout
  - 24-Pin 300 mil DIP, SOIC
  - 28-Pad 450 mil sq. LCC

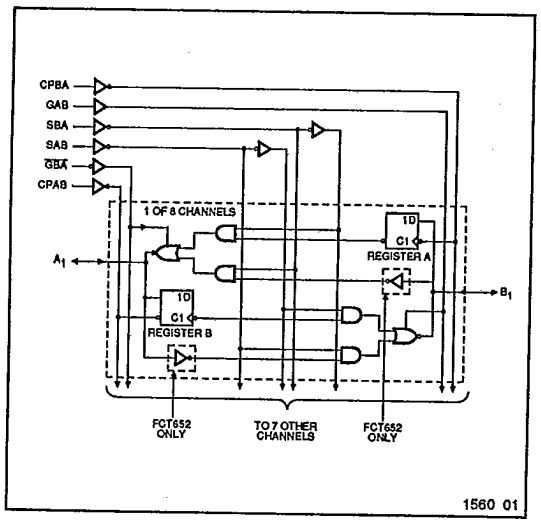
4

DESCRIPTION

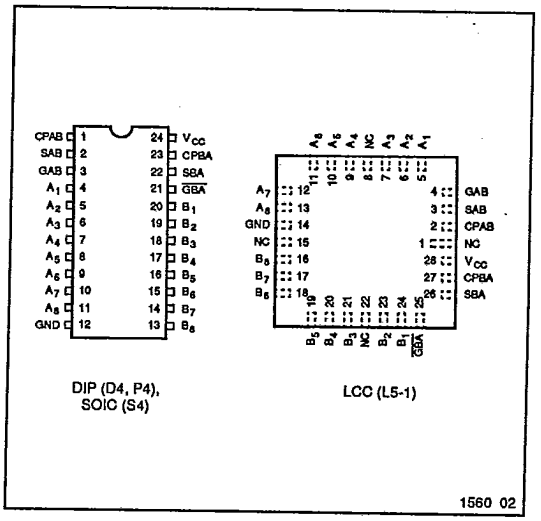
THE P54/74PCT651/A and P54/74PCT652/A consist of bus tranciever circuits, D-type flip-flops and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal storage registers. GAB and $\overline{GBA}$ control pins are provided to control the transceiver functions. SAB and SBA control pins are provided to select either real-time or stored data transfer. The circuitry used for select control will eliminate the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. A low input level selects real-time data and a high selects stored data.

Data on the A or B data bus, or both, can be stored in the internal D flip-flops by low-to-high transitions at the appropriate clock pins (CPAB or CPBA), regardless of the select or enable control pins. When SAB and SBA are in the real-time transfer mode, it is also possible to store data without using the internal D-type flip-flops by simultaneously enabling GAB and $\overline{GBA}$. In this configuration, each output reinforces its input. Thus, when all other data sources to the two sets of bus lines are at high impedance, each set of bus lines will remain at its last state.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATIONS



ABSOLUTE MAXIMUM RATINGS[1,2]

Symbol	Parameter	Value	Unit
T_{STG}	Storage Temperature	–65 to +150	°C
T_A	Ambient Temperature Under Bias	–55 to +125	°C
V_{CC}	V_{CC} Potential to Ground	–0.5 to +7.0	V
I_{IN}	Input Current	–30 to +5.0	mA
I_{OUTPUT}	Current Applied to Output	100	mA
V_{IN}	Input Voltage	–0.5 to V_{CC} + 0.5	V
V_{OUT}	Voltage Applied to Output	–0.5 to V_{CC} + 0.5	V

1560 Tbl 01

1560 Tbl 02

Notes:
1. Operation beyond the limits set forth in the above table may impair the useful life of the device. Unless otherwise noted, these limits are over the operating free-air temperature range.
2. Unused inputs must always be connected to an appropriate logic voltage level, preferably either V_{CC} or ground.

RECOMMENDED OPERATING CONDITIONS

Free Air Ambient Temperature	Min	Max
Military	–55°C	+125°C
Commercial	0°C	+70°C

1560 Tbl 03

Supply Voltage (V_{CC})	Min	Max
Military	+4.5V	+5.5V
Commercial	+4.75V	+5.25V

1560 Tbl 04

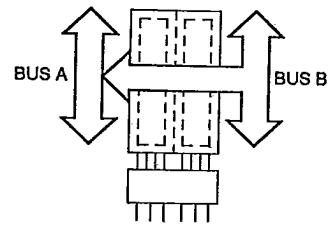
DC ELECTRICAL CHARACTERISTICS (Over recommended operating conditions)

Symbol	Parameter		Min	Typ[1]	Max	Units	V_{CC}	Conditions
V_{IH}	Input HIGH Voltage		2.0		V_{CC} + 0.5	V		
V_{IL}	Input LOW Voltage		–0.5		0.8	V		
V_H	Hysteresis			.35		V		All inputs
V_{CD}	Input Clamp Diode Voltage				–1.2	V	MIN	I_{IN} = –18mA
V_{OH}	Output HIGH Voltage	V_{CC} = 3V, V_{IN} = 0.2V, or V_{CC} – 0.2V	V_{CC} – 0.2			V		I_{OH} = –32µA
		Military/Commercial (CMOS)	V_{CC} – 0.2			V	MIN	I_{OH} = –300µA
		Military (TTL)	2.4			V	MIN	I_{OH} = –12mA
		Commercial (TTL)	2.7			V	MIN	I_{OH} = –15mA
V_{OL}	Output LOW Voltage	V_{CC} = 3V, V_{IN} = 0.2V, or V_{CC} – 0.2V			0.2	V		I_{OL} = 300µA
		Military/Commercial (CMOS)			0.2	V	MIN	I_{OL} = 300µA
		Military (TTL)			0.55	V	MIN	I_{OL} = 48mA
		Commercial (TTL)			0.55	V	MIN	I_{OL} = 64mA
I_{IH}	Input HIGH Current				5	µA	MAX	V_{IN} = V_{CC}
I_{IL}	Input LOW Current				–5	µA	MAX	V_{IN} = GND
I_{IH}	Input HIGH Current[3]				5	µA	MAX	V_{IN} = 2.7V
I_{IL}	Input LOW Current[3]				–5	µA	MAX	V_{IN} = 0.5V
I_{IH}	Input HIGH Current (I/O Pins only)				15	µA	MAX	V_{IN} = V_{CC}
I_{IL}	Input LOW Current (I/O Pins only)				–15	µA	MAX	V_{IN} = GND
I_{IH}	Input HIGH Current[3] (I/O Pins only)				15	µA	MAX	V_{IN} = 2.7V
I_{IL}	Input LOW Current[3] (I/O Pins only)				–15	µA	MAX	V_{IN} = 0.5V
I_{OS}	Output Short Circuit Current[2]		–60			mA	MAX	V_{OUT} = 0.0V
C_{IN}	Input Capacitance[3]			5	10	pF		All inputs
C_{OUT}	Output Capacitance[3]			9	12	pF		All outputs

1560 Tbl 05

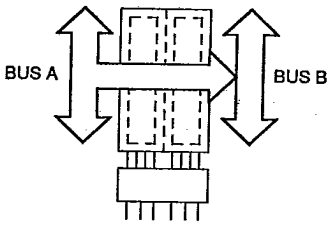
Notes:
1. Typical limits are at V_{CC} = 5.0V, T_A = +25°C ambient.
2. Not more than one output should be shorted at a time. Duration of short should not exceed one second. The use of high speed test apparatus and/or sample and hold techniques are preferable in order to minimize internal chip heating and more accurately reflect operational values. Otherwise prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests, I_{os} tests should be performed last.
3. This parameter is guaranteed but not tested.

T-52-31



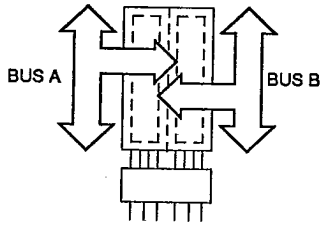
GAB	$\overline{GBA}$	CPAB	CPBA	SAB	SBA
L	L	X	X	X	L

REAL-TIME TRANSFER
BUS B TO BUS A



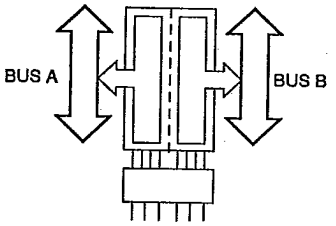
GAB	$\overline{GBA}$	CPAB	CPBA	SAB	SBA
H	H	X	X	L	X

REAL-TIME TRANSFER
BUS A TO BUS B



GAB	$\overline{GBA}$	CPAB	CPBA	SAB	SBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

STORAGE FROM
A AND/OR B



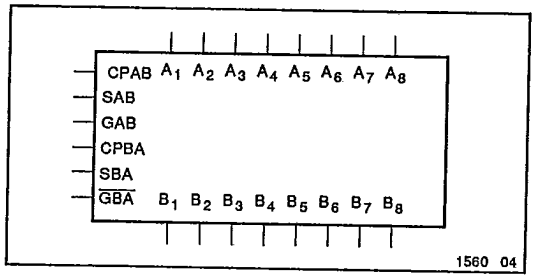
GAB	$\overline{GBA}$	CPAB	CPBA	SAB	SBA
H	L	H or L	H or L	H	H

TRANSFER
STORED DATA
TO A AND/OR B

1560 03

4

LOGIC SYMBOL



1560 04

PIN DESCRIPTION

Pin Names	Description
A_1–A_8	Data Register Inputs Data Register A Outputs
B_1–B_8	Data Register B Inputs Data Register B Outputs
CPAB, CPBA	Clock Pulse Inputs
SAB, SBA	Transmit/Receive Inputs
GAB, $\overline{GBA}$	Output Enable Inputs

1560 Tbl 08

T-52-31

FUNCTION TABLES

Inputs						Data I/O		Operation or Function	
GAB	$\overline{GBA}$	CPAB	CPBA	SAB	SBA	A_1 thru A_8	B_1 thru B_8	FCT651/A	FCT652/A
L L	H H	H or L ↑	H or L ↑	X X	X X	Input	Input	Isolation Store A and B Data	Isolation Store A and B Data
X H	H H	↑ ↑	H or L ↑	X X[2]	X X	Input Input	Unspecified[1] Output	Store A, Hold B Store A in both registers	Store A, Hold B Store A in both registers
L L	X L	H or L ↑	↑ ↑	X X	X X[2]	Unspecified[1] Output	Input Input	Hold A, Store B Store B in both registers	Hold A, Store B Store B in both registers
L L	L L	X X	X H or L	X X	L H	Output	Input	Real-Time $\overline{B}$ Data to A Bus Stored $\overline{B}$ Data to A Bus	Real-Time B Data to A Bus Stored B Data to A Bus
H H	H H	X H or L	X X	L H	X X	Input	Output	Real-Time $\overline{A}$ Data to B Bus Stored $\overline{A}$ Data to B Bus	Real-Time A Data to B Bus Stored A Data to B Bus
H	L	H or L	H or L	H	H	Output	Output	Stored $\overline{A}$ Data to B Bus and Stored $\overline{B}$ Data to A Bus	Stored A Data to B Bus and Stored B Data to A Bus

1560 Tbl 07

Notes:
1. The data output functions may be enabled or disabled by various signals at the GAB or $\overline{GBA}$ inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs.
2. Select control = L: clocks can occur simultaneously.
   Select control = H: clocks must be staggered in order to load both registers.

H = HIGH, L = LOW, X = Don't Care, ↑ LOW-to-HIGH Transition

DC CHARACTERISTICS (Over recommended operating conditions unless otherwise specified.)

Symbol	Parameter	Typ[1]	Max	Units	Conditions
I_{CCQC}	Quiescent Power Supply Current (CMOS inputs) Com'l / Mil	.003 / .003	0.3 / 0.5	mA / mA	V_{CC} = MAX, $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$, f = 0, Outputs Open
I_{CCQT}	Quiescent Power Supply Current (TTL inputs)		2.0	mA	V_{CC} = MAX, V_{IN} = 3.4V[2], f = 0, Outputs Open
I_{CCD}	Dynamic Power Supply Current[3]		0.25	mA/ MHz	V_{CC} = MAX, One Input Toggling, 50% Duty Cycle, GAB = GND, $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$, Outputs Open, $\overline{GBA}$ = GND, SAB = CPAB = GND, and SBA = V_{CC}
I_{CC}	Total Power Supply Current[5]		4.0	mA	V_{CC} = MAX, f_0 = 10MHz, 50% Duty Cycle, Outputs Open, One Bit Toggling at f_1 = 5MHz, GAB = GND, $\overline{GBA}$ = GND, $V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$, SAB = CPAB = GND, and SBA = V_{CC}
			6.0	mA	V_{CC} = MAX, f_0 = 10MHz, 50% Duty Cycle, Outputs Open, One Bit Toggling at f_1 = 5MHz, GAB = GND, $\overline{GBA}$ = GND, V_{IN} = 3.4V or V_{IN} = GND, SAB = CPAB = GND, and SBA = V_{CC}
			7.8[4]	mA	V_{CC} = MAX, f_0 = 10MHz, 50% Duty Cycle, Outputs Open, Eight Bits Toggling at f_1 = 2.5MHz, GAB = GND, $\overline{GBA}$ = GND, $V_{IN} = 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$, SAB = CPAB = GND, and SBA = V_{CC}
			16.8[4]	mA	V_{CC} = MAX, f_0 = 10MHz, 50% Duty Cycle, Outputs Open, Eight Bits Toggling at f_1 = 2.5MHz, GAB = GND, $\overline{GBA}$ = GND, V_{IN} = 3.4V or V_{IN} = GND, SAB = CPAB = GND, and SBA = V_{CC}

1560 Tbl 08

Notes:

1. Typical values are at V_{CC} = 5.0V, +25°C ambient and maximum loading.
2. Per TTL driven input (V_{IN} = 3.4V); all other inputs at V_{CC} or GND.
3. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
4. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
5. $I_{CC} = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   $I_{CC} = I_{CCQC} + I_{CCQT} \cdot D_H N_T + I_{CCD}(f_0/2 + f_1 N_1)$
   I_{CCQC} = Quiescent Current with CMOS input levels
   I_{CCQT} = 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_0 = Clock Frequency for Register Devices (Zero for Non-Register Devices)
   f_1 = Input Frequency
   N_1 = Number of Inputs at f_1
   All currents are in milliamps and all frequencies are in megahertz.

4

AC CHARACTERISTICS

Sym.	Parameter	P54/74PCT651/652					P54/74PCT651A/652A					Units	Fig. No.
		T_A=+25°C V_{CC}=+5.0V	MIL		COM'L		T_A=+25°C V_{CC}=+5.0V	MIL		COM'L			
		Typ.	Min.[1]	Max.	Min.[1]	Max.	Typ.	Min.[1]	Max.	Min.[1]	Max.		
t_{PLH} t_{PHL}	Propagation Delay Bus to Bus	8.0 8.0	2.0 2.0	10.0 10.0	2.0 2.0	9.0 9.0						ns ns	1 5
t_{PLH} t_{PHL}	Propagation Delay Clock to Bus	8.0 8.0	2.0 2.0	11.0 11.0	2.0 2.0	9.0 9.0						ns ns	1 5
t_{PLH} t_{PHL}	Propagation Delay SBA or SAB to A or B	10.0 10.0	2.0 2.0	12.0 12.0	2.0 2.0	11.0 11.0						ns ns	1 5
t_{PZH} t_{PZL}	Output Enable Time Enable to Bus	9.0 9.0	2.0 2.0	12.0 12.0	2.0 2.0	10.0 10.0						ns ns	1, 7, 8
t_{PHZ} t_{PLZ}	Output Disable Time Enable to Bus	9.0 9.0	2.0 2.0	12.0 12.0	2.0 2.0	10.0 10.0						ns ns	1, 7, 8

Note: AC Characteristics guaranteed with C_L = 50pF as shown in Figure 1.

1560 Tbl 09

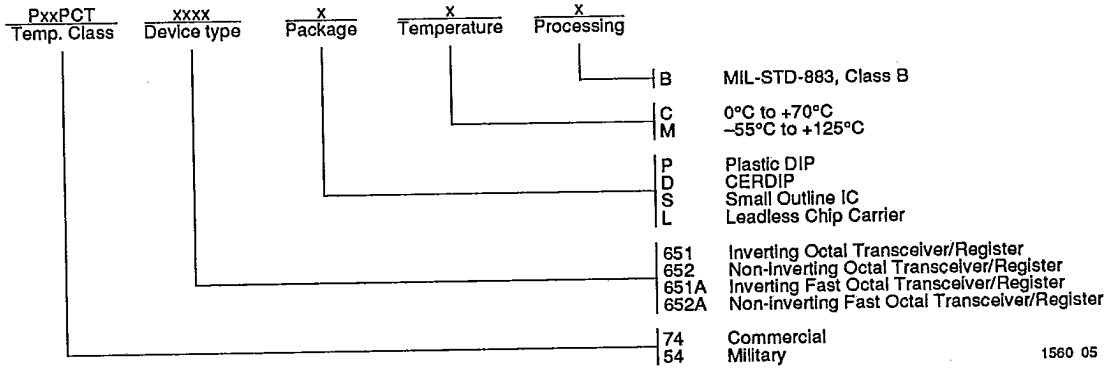
AC OPERATING REQUIREMENTS

Sym.	Parameter	P54/74PCT651/652					P54/74PCT651A/652A					Units	Fig. No.
		T_A=+25°C V_{CC}=+5.0V	MIL		COM'L		T_A=+25°C V_{CC}=+5.0V	MIL		COM'L			
		Typ.	Min.	Max.	Min.	Max.	Typ.	Min.	Max.	Min.	Max.		
t_s(H) t_s(L)	Setup Time, HIGH or LOW Bus to Clock	3.0 3.0	4.5 4.5	–	4.0 4.0							ns	1 4
t_h(H) t_h(L)	Hold Time, HIGH or LOW Bus to Clock	1.0 1.0	2.0 2.0	–	2.0 2.0							ns	1 4
t_w(H) t_w(L)	Pulse Width, HIGH or LOW	4.0 4.0	6.0 6.0	–	6.0 6.0							ns	1 5

1560 Tbl 10

Notes:
1. Minimum limits are guaranteed but not tested on Propagation Delays.
2. With one data channel toggling, $t_w(L) = t_w(H) = 2.0$ns and $t_r = t_f = 1.0$ns.

ORDERING INFORMATION



1560 05

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