

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC74HC646AP

## OCTAL BUS TRANSCEIVER / REGISTER (3-STATE)

The TC74HC646A is high speed CMOS OCTAL BUS TRANSCEIVER / REGISTERS fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

This device is bus transceiver with 3-state outputs, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the internal registers.

When the direction input (DIR) is held high, the A1 thru A8 become inputs and the B1 thru B8 become outputs. When the DIR input is held low, the A1 thru A8 become output and the B1 thru B8 become inputs.

The enable input  $\bar{G}$  is held high, both the A Bus and B Bus become high impedance

The select inputs (SAB, SBA) can multiplex stored and real-time (transparent mode) data.

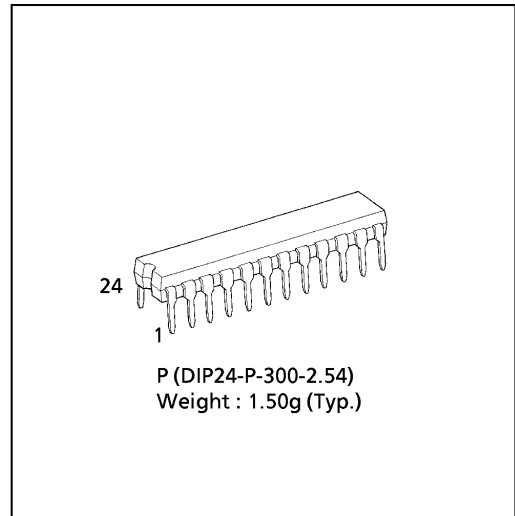
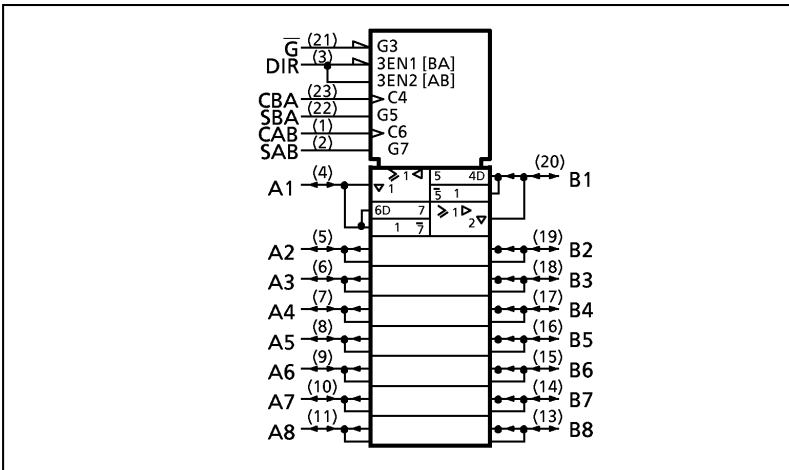
Data on the A Bus or B Bus can be clocked into the registers on the positive going transition of either CAB or CBA clock inputs, respectively.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

### FEATURES :

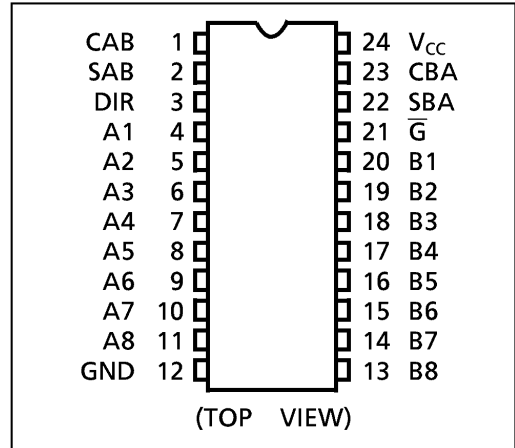
- High Speed.....  $f_{MAX} = 73\text{MHz}$  (typ.)  
at  $V_{CC} = 5\text{V}$
- Low Power Dissipation.....  $I_{CC} = 4\mu\text{A}$  (Max.) at  $T_a = 25^\circ\text{C}$
- High Noise Immunity.....  $V_{NIH} = V_{NIL} = 28\%V_{CC}$  (Min.)
- Output Drive Capability..... 15 LSTTL Loads
- Symmetrical Output Impedance...  $|I_{OH}| = |I_{OL}| = 6\text{mA}$  (Min.)
- Balanced Propagation Delays.....  $t_{PLH} \approx t_{PHL}$
- Wide Operating Voltage Range...  $V_{CC}$  (opr.) =  $2\text{V} \sim 6\text{V}$
- Pin and Function Compatible with 74LS646

### IEC LOGIC SYMBOL



P (DIP24-P-300-2.54)  
Weight : 1.50g (Typ.)

### PIN ASSIGNMENT









### APPLICATION NOTES

- 1) Do not apply a signal to any bus terminal when it is in the out put mode. Damage may result.
- 2) All floating (high impedance) bus terminals must have their input levels fixed by means of pull up or pull down resistors.

980508EBA2

● TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.

TRUTH TABLE

$\bar{G}$	DIR	CAB	CBA	SAB	SBA	A	B	Function
H	X	X	X	X	X	INPUTS Z	INPUTS Z	The output functions of A and B Busses are disabled.
				X	X	X	X	The data on the A and B Busses are used as inputs to the internal flip-flops. Data on the Bus will be stored on the rising edge of the Clock.
L	H	X	X*	L	X	INPUTS L H	OUTPUTS L H	The data on the A bus are displayed on the B bus.
			X*	L	X	L H	L H	The data on the A Bus are displayed on the B Bus, and are stored into the A storage flip-flops on the rising edge of CAB.
		X	X*	H	X	X	Qn	The data in the A storage flip-flops are displayed on the B Bus.
			X*	H	X	L H	L H	The data on the A Bus are stored into the A storage flip-flops on the rising edge of CAB, and the stored data propagate directly onto the B Bus.
L	L	X*	X	X	L	OUTPUTS L H	INPUTS L H	The data on the B bus are displayed on the A bus.
		X*		X	L	L H	L H	The data on the B Bus are displayed on the A Bus, and are stored into the B storage flip-flops on the rising edge of CBA.
		X*	X	X	H	Qn	X	The data in the B storage flip-flops are displayed on the A Bus.
		X*		X	H	L H	L H	The data on the B Bus are stored into the B storage flip-flops on the rising edge of CBA, and the stored data propagate directly onto the A Bus.

Notes : X : Don't Care

Qn : The data stored into the internal flip-flops by most recent low to high transition of the clock inputs.

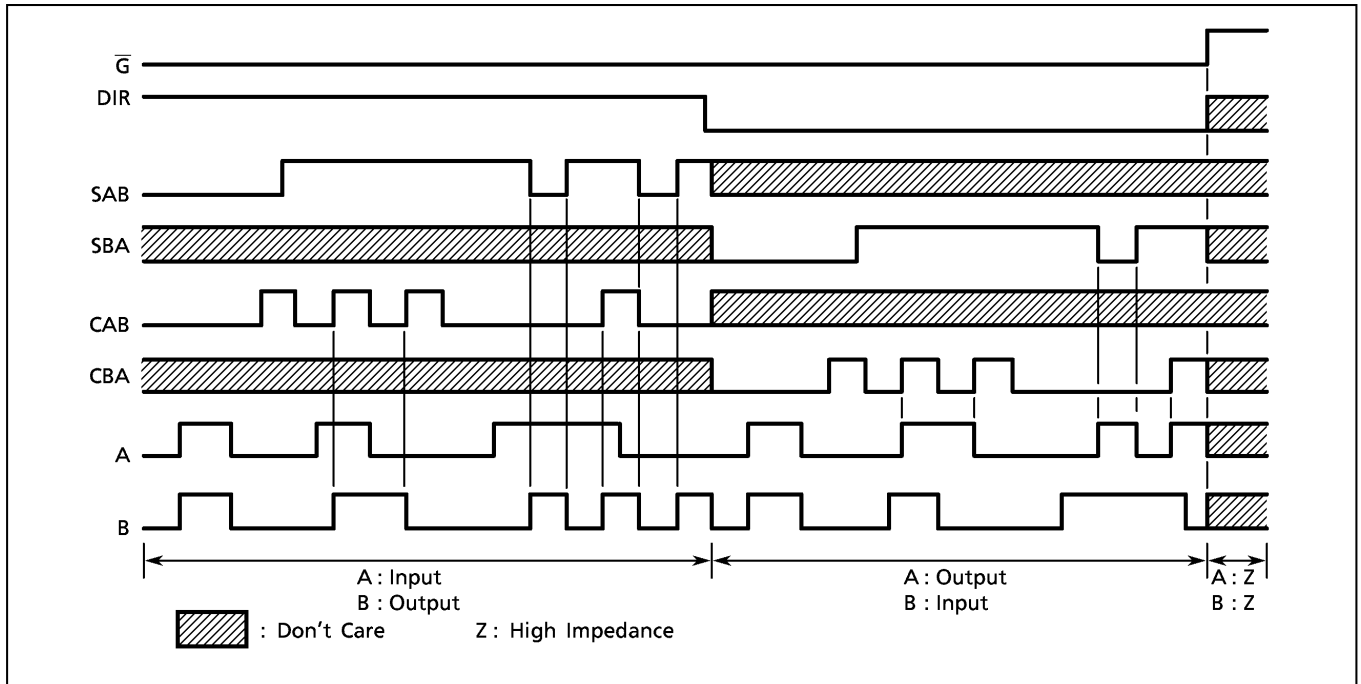
Z : High Impedance

\* The clocks are not internally gated with either  $\bar{G}$  or DIR. Therefore, data on the A and/or B Busses may be clocked into the storage flip-flops at any time.

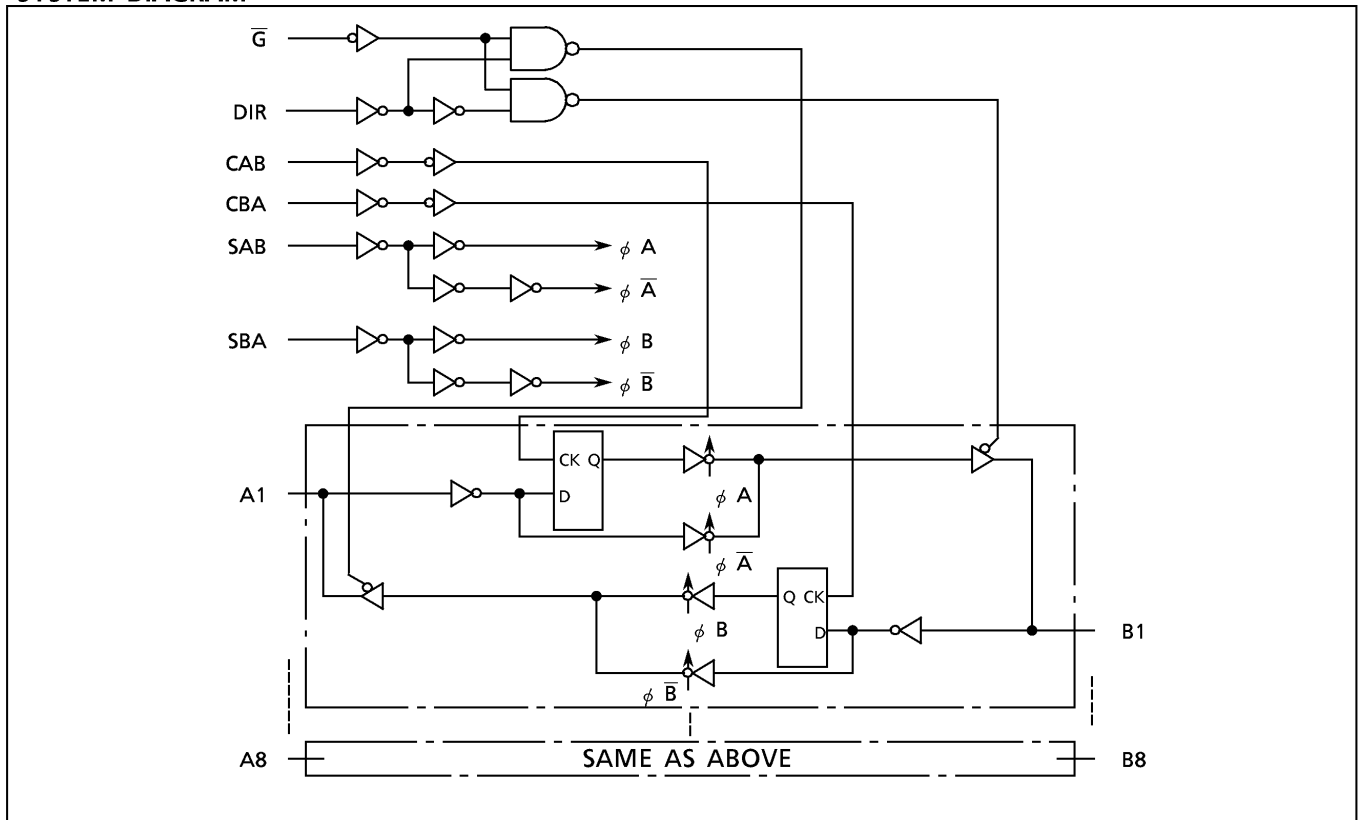
980508EBA2'

- The products described in this document are subject to foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

TIMING CHART



SYSTEM DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	$V_{CC}$	-0.5~7	V
DC Input Voltage	$V_{IN}$	-0.5~ $V_{CC} + 0.5$	V
DC Output Voltage	$V_{OUT}$	-0.5~ $V_{CC} + 0.5$	V
Input Diode Current	$I_{IK}$	±20	mA
Output Diode Current	$I_{OK}$	±20	mA
DC Output Current	$I_{OUT}$	±35	mA
DC $V_{CC}$ /Ground Current	$I_{CC}$	±75	mA
Power Dissipation	$P_D$	500*	mW
Storage Temperature	$T_{stg}$	-65~150	°C

\*500mW in the range of  $T_a = -40^{\circ}\text{C} \sim 65^{\circ}\text{C}$ . From  $T_a = 65^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  a derating factor of  $-10\text{mW}/^{\circ}\text{C}$  shall be applied until 300mW.

## RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	$V_{CC}$	2~6	V
Input Voltage	$V_{IN}$	0~ $V_{CC}$	V
Output Voltage	$V_{OUT}$	0~ $V_{CC}$	V
Operating Temperature	$T_{opr}$	-40~85	°C
Input Rise and Fall Time	$t_r, t_f$	0~1000 ( $V_{CC} = 2.0\text{V}$ ) 0~500 ( $V_{CC} = 4.5\text{V}$ ) 0~400 ( $V_{CC} = 6.0\text{V}$ )	ns

## DC ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC}$ (V)	$T_a = 25^{\circ}\text{C}$			$T_a = -40 \sim 85^{\circ}\text{C}$		UNIT	
				MIN.	TYP.	MAX.	MIN.	MAX.		
High - Level Input Voltage	$V_{IH}$		2.0	1.50	—	—	1.50	—	V	
			4.5	3.15	—	—	3.15	—		
			6.0	4.20	—	—	4.20	—		
Low - Level Input Voltage	$V_{IL}$		2.0	—	—	0.50	—	0.50	V	
			4.5	—	—	1.35	—	1.35		
			6.0	—	—	1.80	—	1.80		
High - Level Output Voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20\mu\text{A}$	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	
			$I_{OH} = -6\text{mA}$ $I_{OH} = -7.8\text{mA}$	4.5	4.18	4.31	—	4.13	—	
				6.0	5.68	5.80	—	5.63	—	
Low - Level Output Voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20\mu\text{A}$	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	
			$I_{OL} = 6\text{mA}$ $I_{OL} = 7.8\text{mA}$	4.5	—	0.17	0.26	—	0.33	
				6.0	—	0.18	0.26	—	0.33	
3 - State Output Off - State Current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT} = V_{CC}$ or GND	6.0	—	—	±0.5	—	±5.0	$\mu\text{A}$	
Input Leakage Current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	±0.1	—	±1.0		
Quiescent Supply Current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	4.0	—	40.0		

TIMING REQUIREMENTS (Input  $t_r = t_f = 6\text{ns}$ )

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC}$ (V)	Ta = 25°C		Ta = -40~85°C	UNIT
				TYP.	LIMIT	LIMIT	
Minimum Pulse Width (CK)	$t_{W(H)}$ $t_{W(L)}$		2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum Set-up Time	$t_s$		2.0	—	50	65	
			4.5	—	10	13	
			6.0	—	9	11	
Minimum Hold Time	$t_h$		2.0	—	5	5	
			4.5	—	5	5	
			6.0	—	5	5	
Clock Frequency	f		2.0	—	6	5	MHz
			4.5	—	31	25	
			6.0	—	36	29	

AC ELECTRICAL CHARACTERISTICS (Input  $t_r = t_f = 6\text{ns}$ )

PARAMETER	SYMBOL	TEST CONDITION	CL (pF)	$V_{CC}$ (V)	Ta = 25°C			Ta = -40~85°C		UNIT
					MIN.	TYP.	MAX.	MIN.	MAX.	
Output Transition Time	$t_{TLH}$ $t_{THL}$		50	2.0	—	25	60	—	75	ns
				4.5	—	7	12	—	15	
				6.0	—	6	10	—	13	
Propagation Delay Time (BUS-BUS)	$t_{PLH}$ $t_{PHL}$		50	2.0	—	74	150	—	190	
				4.5	—	21	30	—	38	
				6.0	—	18	26	—	32	
			150	2.0	—	91	190	—	240	
				4.5	—	26	38	—	48	
				6.0	—	22	32	—	41	
Propagation Delay Time (CAB, CBA-BUS)	$t_{PLH}$ $t_{PHL}$		50	2.0	—	98	210	—	265	
				4.5	—	28	42	—	53	
				6.0	—	24	36	—	45	
			150	2.0	—	116	250	—	315	
				4.5	—	33	50	—	63	
				6.0	—	28	43	—	54	
Propagation Delay Time (SAB, SBA-BUS)	$t_{PLH}$ $t_{PHL}$		50	2.0	—	81	170	—	215	
				4.5	—	23	34	—	43	
				6.0	—	20	29	—	37	
			150	2.0	—	98	210	—	265	
				4.5	—	28	42	—	53	
				6.0	—	24	36	—	45	
Output Enable Time ( $\bar{G}$ , DIR-BUS)	$t_{pZL}$ $t_{pZH}$	RL = 1k $\Omega$	50	2.0	—	84	175	—	220	
				4.5	—	24	35	—	44	
				6.0	—	20	30	—	37	
			150	2.0	—	102	215	—	270	
				4.5	—	29	43	—	54	
				6.0	—	25	37	—	46	
Output Disable Time ( $\bar{G}$ , DIR-BUS)	$t_{pLZ}$ $t_{pHZ}$	RL = 1k $\Omega$	50	2.0	—	60	175	—	220	
				4.5	—	23	35	—	44	
				6.0	—	20	30	—	37	

AC ELECTRICAL CHARACTERISTICS ( Input  $t_r = t_f = 6\text{ns}$  ) (Con'd)

PARAMETER	SYMBOL	TEST CONDITION	CL (pF)	V <sub>CC</sub> (V)	Ta = 25°C			Ta = -40~85°C		UNIT
					MIN.	TYP.	MAX.	MIN.	MAX.	
Maximum Clock Frequency	f <sub>MAX</sub>		50	2.0 4.5 6.0	6 31 36	19 67 79	— — —	5 25 29	— — —	MHz
Input Capacitance	C <sub>IN</sub>				—	5	10	—	10	pF
Output Capacitance	C <sub>I/O</sub>				—	13	—	—	—	
Power Dissipation Capacitance	C <sub>PD</sub> (1)				—	39	—	—	—	

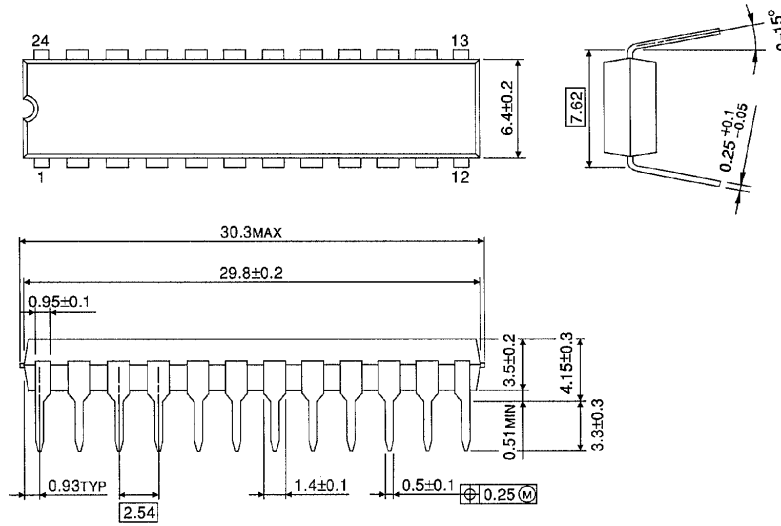
Note (1) C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 8 \text{ (per bit)}$$

DIP 24PIN OUTLINE DRAWING (DIP24-P-300-2.54)

Unit in mm



Weight : 1.50g (Typ.)