

# MM54HC646/MM74HC646 Non-Inverting Octal Bus Transceiver/Registers

## MM54HC648/MM74HC648 Inverting Octal Bus Transceiver/Registers

### General Description

These transceivers utilize advanced silicon-gate CMOS technology, and contain two sets of TRI-STATE® outputs, two sets of D-type flip-flops, and control circuitry designed for high speed multiplexed transmission of data.

Six control inputs enable this device to be used as a latched transceiver, unlatched transceiver, or a combination of both. As a latched transceiver, data from one bus is stored for later retrieval by the other bus. Alternately real time bus data (unlatched) may be directly transferred from one bus to another.

Circuit operation is determined by the G, DIR, CAB, CBA, SAB, SBA control inputs. The enable input, G, controls whether any bus outputs are enabled. The direction control, DIR, determines which bus is enabled, and hence the direction data flows: The SAB, SBA inputs control whether the latched data (stored in D type flip flops), or the bus data (from other bus input pins) is transferred. Each set of flip-

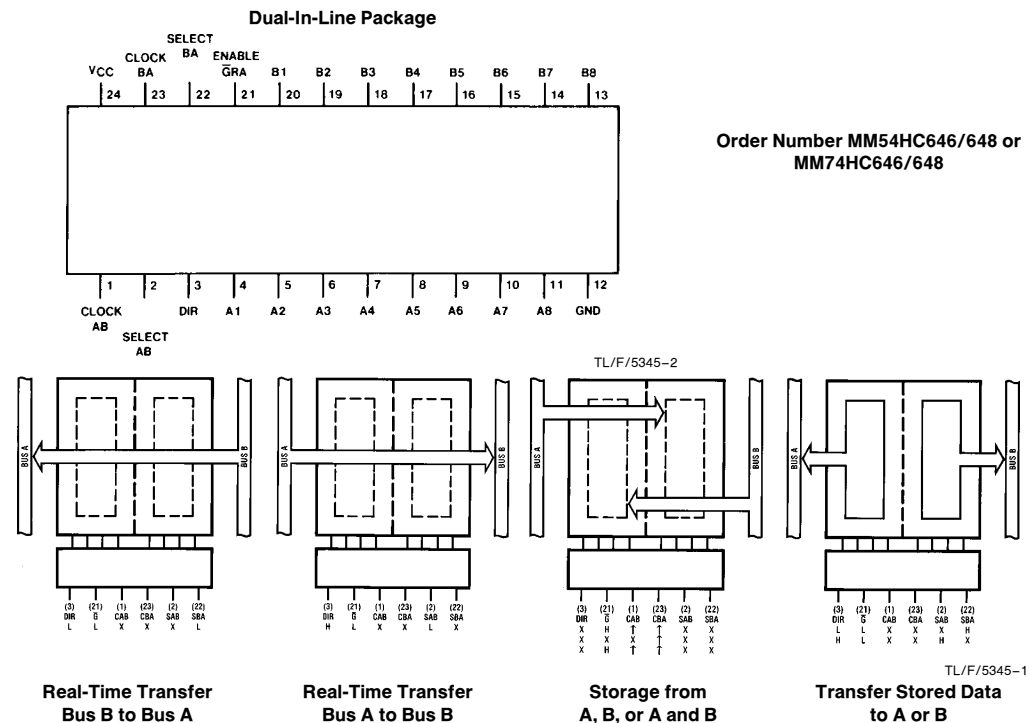
flops has its own clock CAB, and CBA, for storing data. Data is latched on the rising edge of the clock.

Each output can drive up to 15 low power Schottky TTL loads. These devices are functionally and pin compatible to their LS-TTL counterparts. All inputs are protected from damage due to static discharge by diodes to V<sub>CC</sub> and ground.

### Features

- Typical propagation delay: 14 ns
- TRI-STATE outputs
- Bidirectional communication
- Wide power supply range: 2–6V
- Low quiescent supply current: 160  $\mu$ A maximum (74HC)
- High output current: 6 mA (74HC)

### Connection Diagram



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## Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage ( $V_{CC}$ )	-0.5 to +7.0V
DC Input Voltage ( $V_{IN}$ )	-1.5 to $V_{CC} + 1.5V$
DC Output Voltage ( $V_{OUT}$ )	-0.5 to $V_{CC} + 0.5V$
Clamp Diode Current ( $I_{IK}, I_{OK}$ )	$\pm 20$ mA
DC Output Current, per pin ( $I_{OUT}$ )	$\pm 35$ mA
DC $V_{CC}$ or GND Current, per pin ( $I_{CC}$ )	$\pm 70$ mA
Storage Temperature Range ( $T_{STG}$ )	-65°C to +150°C
Power Dissipation ( $P_D$ ) (Note 3)	600 mW
S.O. Package only	500 mW
Lead Temp. ( $T_L$ ) (Soldering 10 seconds)	260°C

## Operating Conditions

	Min	Max	Units
Supply Voltage ( $V_{CC}$ )	2	6	V
DC Input or Output Voltage ( $V_{IN}, V_{OUT}$ )	0	$V_{CC}$	V
Operating Temp. Range ( $T_A$ )			
MM74HC	-40	+85	°C
MM54HC	-55	+125	°C
Input Rise or Fall Times ( $t_r, t_f$ )			
$V_{CC} = 2.0V$		1000	ns
$V_{CC} = 4.5V$		500	ns
$V_{CC} = 6.0V$		400	ns

## DC Electrical Characteristics (Note 4)

Symbol	Parameter	Conditions	$V_{CC}$	$T_A = 25^\circ C$			Units	
				Typ	74HC $T_A = -40$ to $85^\circ C$	54HC $T_A = -55$ to $125^\circ C$		
$V_{IH}$	Minimum High Level Input Voltage		2.0V	1.5	1.5	1.5	V	
			4.5V	3.15	3.15	3.15	V	
			6.0V	4.2	4.2	4.2	V	
$V_{IL}$	Maximum Low Level Input Voltage**		2.0V	0.5	0.5	0.5	V	
			4.5V	1.35	1.35	1.35	V	
			6.0V	1.8	1.8	1.8	V	
$V_{OH}$	Minimum High Level Output Voltage	$V_{IN} = V_{IH}$ or $V_{IL}$ $ I_{OUT}  \leq 20 \mu A$	2.0V	2.0	1.9	1.9	V	
			4.5V	4.5	4.4	4.4	V	
			6.0V	6.0	5.9	5.9	V	
		$V_{IN} = V_{IH}$ or $V_{IL}$ $ I_{OUT}  \leq 6.0$ mA $ I_{OUT}  \leq 7.8$ mA	4.5V	4.2	3.96	3.84	3.7	V
			6.0V	5.7	5.46	5.34	5.2	V
$V_{OL}$	Maximum Low Level Output Voltage	$V_{IN} = V_{IH}$ or $V_{IL}$ $ I_{OUT}  \leq 20 \mu A$	2.0V	0	0.1	0.1	V	
			4.5V	0	0.1	0.1	V	
			6.0V	0	0.1	0.1	V	
		$V_{IN} = V_{IH}$ or $V_{IL}$ $ I_{OUT}  \leq 6.0$ mA $ I_{OUT}  \leq 7.8$ mA	4.5V	0.2	0.26	0.33	0.4	V
			6.0V	0.2	0.26	0.33	0.4	V
$I_{IN}$	Maximum Input Current	$V_{IN} = V_{CC}$ or GND	6.0V		$\pm 0.1$	$\pm 1.0$	$\pm 1.0$	$\mu A$
$I_{OZ}$	Maximum TRI-STATE Output Leakage	$V_{OUT} = V_{CC}$ or GND $\bar{G} = V_{IH}$	6.0V		$\pm 0.5$	$\pm 5.0$	$\pm 10$	$\mu A$
$I_{CC}$	Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND $I_{OUT} = 0 \mu A$	6.0V		8.0	80	160	$\mu A$

**Note 1:** Absolute Maximum Ratings are those values beyond which damage to the device may occur.

**Note 2:** Unless otherwise specified all voltages are referenced to ground.

**Note 3:** Power Dissipation temperature derating — plastic "N" package: -12 mW/°C from 65°C to 85°C; ceramic "J" package: -12 mW/°C from 100°C to 125°C.

**Note 4:** For a power supply of 5V  $\pm 10\%$  the worst case output voltages ( $V_{OH}$ , and  $V_{OL}$ ) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case  $V_{IH}$  and  $V_{IL}$  occur at  $V_{CC} = 5.5V$  and 4.5V respectively. (The  $V_{IH}$  value at 5.5V is 3.85V.) The worst case leakage current ( $I_{IN}$ ,  $I_{CC}$ , and  $I_{OZ}$ ) occur for CMOS at the higher voltage and so the 6.0V values should be used.

\*\*  $V_{IL}$  limits are currently tested at 20% of  $V_{CC}$ . The above  $V_{IL}$  specification (30% of  $V_{CC}$ ) will be implemented no later than Q1, CY'89.

## Truth Table

Inputs						Data I/O		Operation or Function	
$\bar{G}$	DIR	CAB	CBA	SAB	SBA	A1 Thru A8	B1 Thru B8	'ALS646, 'ALS647 'AS646	'ALS648, 'ALS649 'AS648
X	X	$\uparrow$	X	X	X	Input	Not Specified	Store A, B Unspecified	Store A, B Unspecified
X	X	X	$\uparrow$	X	X	Not Specified	Input	Store B, A Unspecified	Store B, A Unspecified
H	X	$\uparrow$	$\uparrow$	X	X	Input	Input	Store A and B Data Isolation, hold storage	Store A and B Data Isolation, hold storage
H	X	H or L	H or L	X	X				

## Truth Table (Continued)

Inputs						Data I/O		Operation or Function	
$\bar{G}$	DIR	CAB	CBA	SAB	SBA	A1 Thru A8	B1 Thru B8	'ALS646, 'ALS647 'AS646	'ALS648, 'ALS649 'AS648
L	L	X	X	X	L	Output	Input	Real-Time B Data to A Bus Stored B Data to A Bus	Real-Time $\bar{B}$ Data to A Bus Stored $\bar{B}$ Data to A Bus
L	L	X	X	X	H				
L	H	X	X	L	X	Input	Output	Real-Time A Data to B Bus Stored A Data to B Bus	Real-Time $\bar{A}$ Data to B Bus Stored $\bar{A}$ Data to B Bus
L	H	X	X	H	X				

H = High Level L = Low Level X = Irrelevant  $\uparrow$  = low-to-high level transition

The data output functions i.e., data at the bus pins may be enabled or disabled by various signals at the  $\bar{G}$  and DIR inputs. Data input functions are always enabled.  
The data output functions i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs.

## AC Electrical Characteristics MM54HC646/MM74HC646, MM54HC648/MM74HC648

$V_{CC}=5V$ ,  $T_A=25^\circ C$ ,  $t_r=t_f=6$  ns

Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
$f_{MAX}$	Maximum Operating Frequency		45	30	MHz
$t_{PHL}$ , $t_{PLH}$	Maximum Propagation Delay, A or B Input to B or A Output	$C_L = 45$ pF	14	25	ns
$t_{PHL}$ , $t_{PLH}$	Maximum Propagation Delay, CBA or CAB Input to A or B Output	$C_L = 45$ pF	31	40	ns
$t_{PHL}$ , $t_{PLH}$	Maximum Propagation Delay, SBA or SAB Input to A or B Output, with A or B high	$C_L = 45$ pF	35	50	ns
$t_{PHL}$ , $t_{PLH}$	Maximum Propagation Delay, SBA or SAB Input to A or B Output, with A or B low	$C_L = 45$ pF	35	50	ns
$t_{PZH}$ , $t_{PZL}$	Maximum Enable Time $\bar{G}$ or DIR Input to A or B Output	$R_L = 1$ k $\Omega$ $C_L = 45$ pF	18	33	ns
$t_{PHZ}$ , $t_{PLZ}$	Maximum Disable Time, $\bar{G}$ or DIR Input to A or B Output	$R_L = 1$ k $\Omega$ $C_L = 5$ pF	17	30	ns

## AC Electrical Characteristics MM54HC646/MM74HC646, MM54HC648/MM74HC648

$V_{CC}=2.0-6.0V$ ,  $C_L=50$  pF,  $t_r=t_f=6$  ns (unless otherwise specified)

Symbol	Parameter	Conditions	$V_{CC}$	$T_A=25^\circ C$		74HC	54HC	Units
				Typ	Guaranteed Limits		$T_A=-40$ to $85^\circ C$	
$f_{MAX}$	Maximum Operating Frequency	$C_L=50$ pF	2.0V	5	4	3	MHz	
			4.5V	27	21	18	MHz	
			6.0V	31	24	20	MHz	
$t_{PHL}$ , $t_{PLH}$	Maximum Propagation Delay, A or B Input to B or A Output	$C_L=50$ pF	2.0V	60	180	189	225	ns
			2.0V	80	200	250	300	ns
		$C_L=50$ pF	4.5V	21	30	37	45	ns
			4.5V	30	40	50	60	ns
		$C_L=50$ pF	6.0V	18	26	31	39	ns
			6.0V	22	35	44	53	ns
$t_{PHL}$ , $t_{PLH}$	Maximum Propagation Delay, CBA or CAB Input to A or B Output	$C_L=50$ pF	2.0V	110	220	275	330	ns
			2.0V	150	270	338	405	ns
		$C_L=50$ pF	4.5V	31	44	55	66	ns
			4.5V	40	54	68	81	ns
		$C_L=50$ pF	6.0V	28	38	47	57	ns
			6.0V	34	47	59	71	ns

## AC Electrical Characteristics MM54HC646/MM74HC646, MM54HC648/MM74HC648 (Continued)

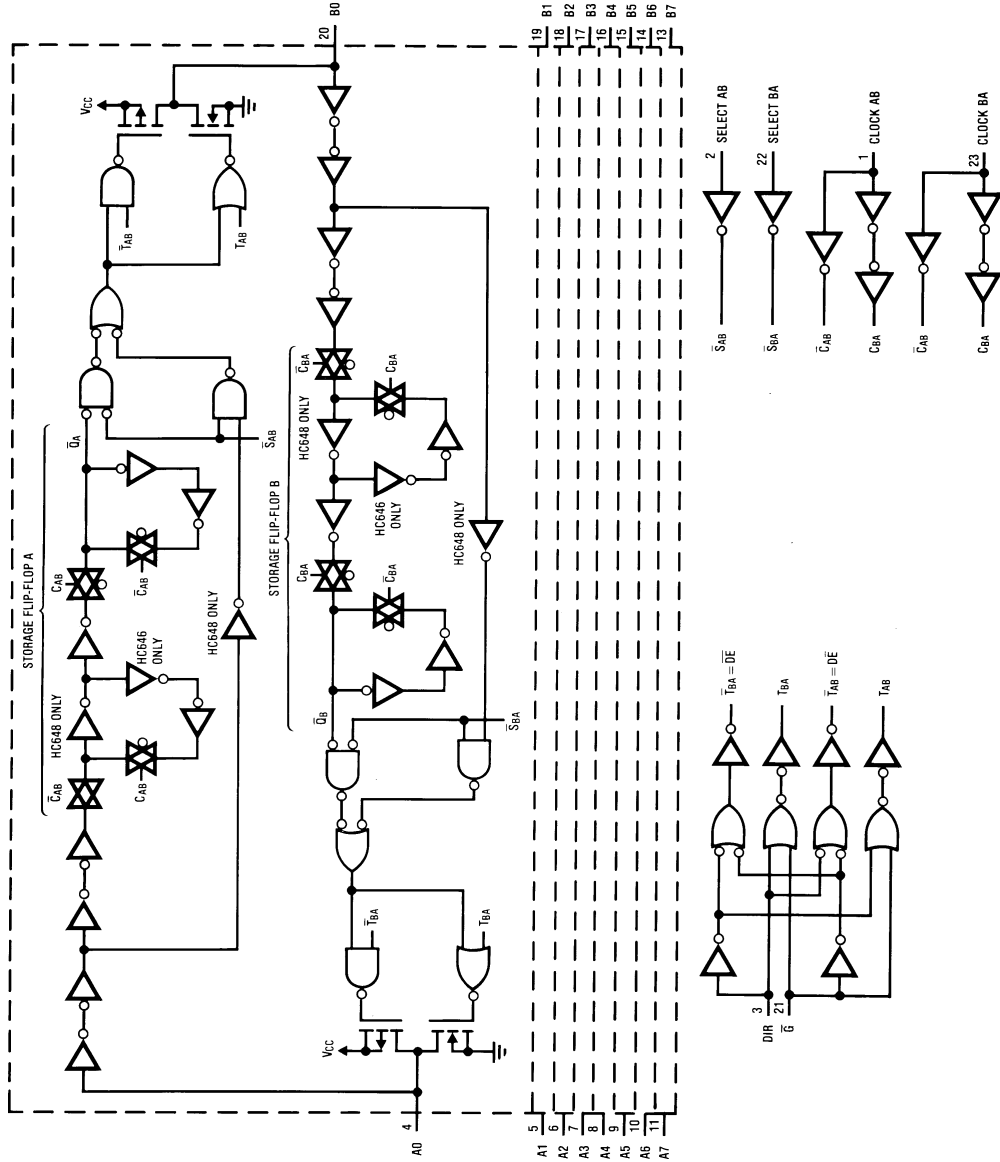
$V_{CC} = 2.0 - 6.0V$ ,  $C_L = 50$  pF,  $t_r = t_f = 6$  ns (unless otherwise specified)

Symbol	Parameter	Conditions	$V_{CC}$	$T_A = 25^\circ C$		74HC	54HC	Units	
						$T_A = -40$ to $85^\circ C$	$T_A = -55$ to $125^\circ C$		
				Typ	Guaranteed Limits				
$t_{PHL}$ , $t_{PLH}$	Maximum Propagation Delay, SBA or SAB Input to A or B Output	$C_L = 50$ pF	2.0V	85	170	214	253	ns	
			2.0V	110	220	277	328	ns	
		$C_L = 150$ pF	4.5V	17	34	43	51	ns	
			4.5V	22	44	55	66	ns	
		$C_L = 50$ pF	6.0V	14	29	36	43	ns	
			6.0V	19	37	47	56	ns	
$t_{PZL}$ , $t_{PZL}$	Maximum Output Enable Time, $\bar{G}$ Input or DIR to A or B Output	$R_L = 1$ k $\Omega$							
			$C_L = 50$ pF	2.0V	80	175	219	263	ns
				2.0V	120	225	281	338	ns
			$C_L = 150$ pF	4.5V	23	35	44	53	ns
4.5V	31	45		56	68	ns			
		$C_L = 50$ pF	6.0V	21	30	37	45	ns	
			6.0V	27	38	48	57	ns	
$t_{PHZ}$ , $t_{PLZ}$	Maximum Output Disable Time, $\bar{G}$ Input to A or B Output	$R_L = 1$ k $\Omega$	2.0V	85	175	219	263	ns	
			4.5V	23	35	44	53	ns	
			6.0V	21	30	37	45	ns	
$t_{THL}$ , $t_{TLH}$	Maximum Output Rise and Fall Time	$C_L = 50$ pF	2.0V		60	75	90	ns	
			4.5V		12	15	18	ns	
			6.0V		10	13	15	ns	
$t_S$	Minimum Set Up Time		2.0V		100	125	150	ns	
			4.5V		20	25	30	ns	
			6.0V		17	21	25	ns	
$t_H$	Minimum Hold Time		2.0V		0	0	0	ns	
			4.5V		0	0	0	ns	
			6.0V		0	0	0	ns	
$t_W$	Minimum Pulse Width of Clock		2.0V		80	100	120	ns	
			4.5V		16	20	24	ns	
			6.0V		14	18	21	ns	
$t_r$ , $t_f$	Maximum Input Rise and Fall Time		2.0V		1000	1000	1000	ns	
			4.5V		500	500	500	ns	
			6.0V		400	400	400	ns	
$C_{PD}$	Power Dissipation Capacitance (Note 5)			90				pF	
$C_{IN}$	Maximum Input Capacitance			5	10	10	10	pF	
$C_{OUT}$	Maximum Output Capacitance			15	20	20	20	pF	

**Note 5:**  $C_{PD}$  determines the no load dynamic power consumption,  $P_D = C_{PD} V_{CC}^2 f + I_{CC}$ , and the no load dynamic current consumption,  $I_S = C_{PD} V_{CC} f + I_{CC}$ .

**Note 6:** Refer to back of this section for Typical MM54/74HC AC Switching Waveforms and Test Circuits.

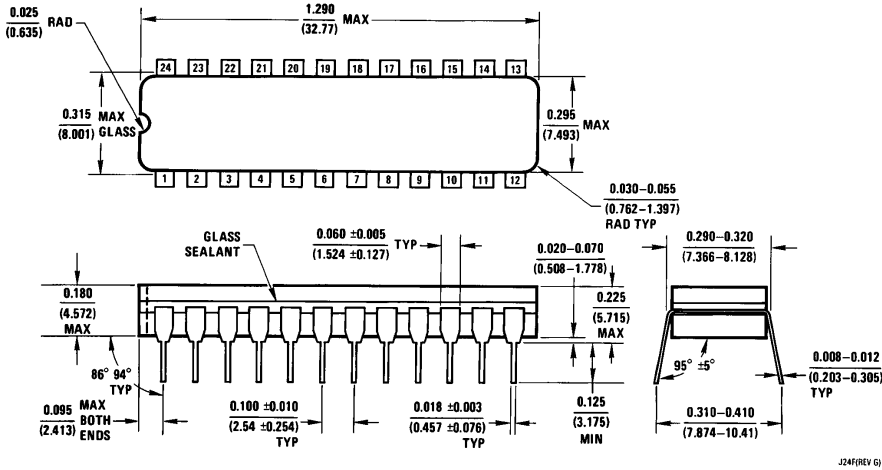
# Logic Diagram



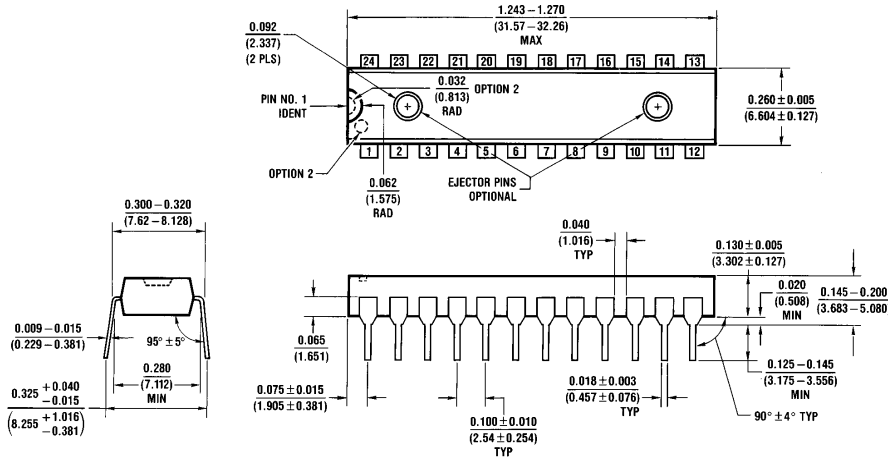
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**MM54HC646/MM74HC646 Non-Inverting Octal Bus Transceiver/Registers  
MM54HC648/MM74HC648 Inverting Octal Bus Transceiver/Registers**

**Physical Dimensions** inches, (millimeters)



**Order Number MM54HC646J, MM54HC648J, MM74HC646J, or MM74HC648J  
NS Package J24F**



**Order Number MM74HC646N, MM74HC648N  
NS Package N24C**

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