

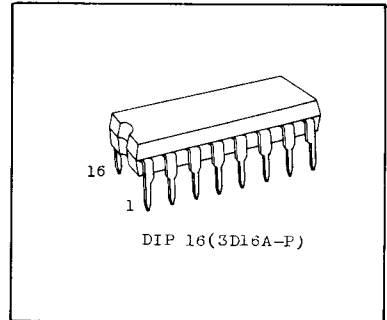
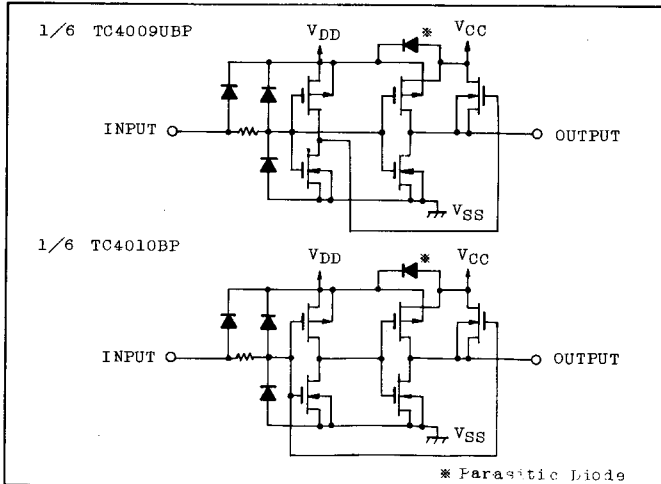
TC4009UBP HEX BUFFER/CONVERTER (INVERTING TYPE)  
TC4010BP HEX BUFFER/CONVERTER (NON-INVERTING TYPE)

TC4009UBP and TC4010BP contain six circuits of buffers with the level shift function. TC4009UBP provides inverted outputs and TC4010BP provides non-inverted outputs. Large output current enables to directly drive one TTL/MDTL input. Furthermore, since the logical amplitude of  $V_{DD}$ - $V_{SS}$  can be converted to the logical amplitude of  $V_{CC}$ - $V_{SS}$  by supplying two separate power supplies with the condition of ( $V_{DD} > V_{CC}$ ), these are suitable for the interface from C<sup>2</sup>MOS system operating with the power supply voltage of 5 volts or higher to TTL/MDTL system.

### MAXIMUM RATINGS

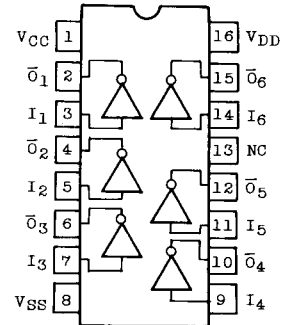
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Supply Voltage	$V_{DD}$	$V_{SS}-0.5 \sim V_{SS}+20$	V
	$V_{CC}$	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
Input Voltage	$V_{IN}$	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
Output Voltage	$V_{OUT}$	$V_{SS}-0.5 \sim V_{CC}+0.5$	V
DC Input Current	$I_{IN}$	$\pm 10$	mA
Power Dissipation	$P_D$	300	mW
Operating Ambient Temperature Range	$T_A$	$-40 \sim 85$	$^{\circ}\text{C}$
Storage Temperature Range	$T_{stg}$	$-65 \sim 150$	$^{\circ}\text{C}$
Lead Temp./Time	$T_{sol}$	$260^{\circ}\text{C} \cdot 10\text{sec}$	

### CIRCUIT DIAGRAM

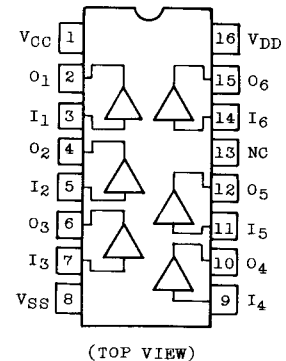


### PIN ASSIGNMENT

TC4009UBP



TC4010BP



# TC4009UBP, TC4010BP

## RECOMMENDED OPERATING CONDITIONS (V<sub>SS</sub>=0V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
DC Supply Voltage	V <sub>DD</sub>		3	-	18	V
	V <sub>CC</sub>		3	-	V <sub>DD</sub>	V
Input Voltage	V <sub>IN</sub>		0	-	V <sub>DD</sub>	V

## STATIC ELECTRICAL CHARACTERISTICS (V<sub>SS</sub>=0V, V<sub>DD</sub>=V<sub>CC</sub>)

CHARACTERISTIC	SYM-BOL	TEST CONDITION	V <sub>DD</sub> (V)	-40°C		25°C			85°C		UNIT
				MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.	
High-Level Output Voltage	V <sub>OH</sub>	I <sub>OUT</sub>   < 1μA V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>	5	4.95	-	4.95	5.00	-	4.95	-	V
			10	9.95	-	9.95	10.00	-	9.95	-	
			15	14.95	-	14.95	15.00	-	14.95	-	
Low-Level Output Voltage	V <sub>OL</sub>	I <sub>OUT</sub>   < 1μA V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>	5	-	0.05	-	0.00	0.05	-	0.05	V
			10	-	0.05	-	0.00	0.05	-	0.05	
			15	-	0.05	-	0.00	0.05	-	0.05	
Output High Current	I <sub>OH</sub>	V <sub>OH</sub> =4.6V	5	-0.73	-	-0.65	-1.2	-	-0.58	-	mA
		V <sub>OH</sub> =2.5V	5	-2.4	-	-2.1	-4.5	-	-1.9	-	
		V <sub>OH</sub> =9.5V	10	-1.8	-	-1.65	-2.8	-	-1.35	-	
		V <sub>OH</sub> =13.5V	15	-4.8	-	-4.3	-11	-	-3.5	-	
		V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>									
Output Low Current	I <sub>OL</sub>	V <sub>OL</sub> =0.4V	5	3.8	-	3.2	7	-	2.9	-	mA
		V <sub>OL</sub> =0.5V	10	9.6	-	8.0	13	-	6.6	-	
		V <sub>OL</sub> =1.5V	15	25.0	-	24.0	47	-	20.0	-	
		V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>									
Input High Voltage (TC4009UBP)	V <sub>IH</sub>	V <sub>OUT</sub> =0.5V	5	4.0	-	4.0	2.5	-	4.0	-	V
		V <sub>OUT</sub> =1.0V	10	8.0	-	8.0	5.0	-	8.0	-	
		V <sub>OUT</sub> =1.5V	15	12.0	-	12.0	7.5	-	12.0	-	
		I <sub>OUT</sub>   < 1μA									
Input Low Voltage (TC4009UBP)	V <sub>IL</sub>	V <sub>OUT</sub> =4.5V	5	-	1.0	-	1.7	1.0	-	1.0	V
		V <sub>OUT</sub> =9.0V	10	-	1.5	-	2.3	1.5	-	1.5	
		V <sub>OUT</sub> =13.5V	15	-	1.5	-	2.5	1.5	-	1.5	
		I <sub>OUT</sub>   < 1μA									
Input High Voltage (TC4010BP)	V <sub>IH</sub>	V <sub>OUT</sub> =4.5V	5	3.5	-	3.5	2.75	-	3.5	-	V
		V <sub>OUT</sub> =9.0V	10	7.0	-	7.0	5.5	-	7.0	-	
		V <sub>OUT</sub> =13.5V	15	11.0	-	11.0	8.25	-	11.0	-	
		I <sub>OUT</sub>   < 1μA									

## STATIC ELECTRICAL CHARACTERISTICS (V<sub>SS</sub>=0V, V<sub>DD</sub>=V<sub>CC</sub>)

CHARACTERISTIC		SYM-BOL	TEST CONDITION	V <sub>DD</sub> (V)	-40°C		25°C			85°C		UNIT
					MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.	
Input Low Voltage (TC4010BP)		V <sub>IL</sub>	V <sub>OUT</sub> =0.5V	5	-	1.5	-	2.25	1.5	-	1.5	V
			V <sub>OUT</sub> =1.0V	10	-	3.0	-	4.5	3.0	-	3.0	
			V <sub>OUT</sub> =1.5V	15	-	4.0	-	6.75	4.0	-	4.0	
			I <sub>OUT</sub>   < 1μA									
Input Current	"H" Level	I <sub>IH</sub>	V <sub>IH</sub> =18V	18	-	0.1	-	10 <sup>-5</sup>	0.1	-	1.0	μA
	"L" Level	I <sub>IL</sub>	V <sub>IL</sub> =0V	18	-	-0.1	-	-10 <sup>-5</sup>	-0.1	-	-1.0	
Quiescent Device Current		I <sub>DD</sub>	**	5	-	1.0	-	0.002	1.0	-	30	μA
			V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>	10	-	2.0	-	0.004	2.0	-	60	
			*	15	-	4.0	-	0.008	4.0	-	120	

\* All valid input combination.      \*\* Include I<sub>CC</sub>.

## DYNAMIC ELECTRICAL CHARACTERISTICS (T<sub>a</sub>=25°C, V<sub>SS</sub>=0V, C<sub>L</sub>=50pF, V<sub>DD</sub>=V<sub>CC</sub>)

CHARACTERISTIC		SYMBOL	TEST CONDITION	V <sub>DD</sub> (V)	MIN.	TYP.	MAX.	UNIT	
Output Transition Time (Low to High)		t <sub>TLH</sub>		5	-	75	350	ns	
				10	-	30	150		
				15	-	20	110		
Output Transition Time (High to Low)		t <sub>THL</sub>		5	-	25	70	ns	
				10	-	15	40		
				15	-	12	30		
TC4009UBP	Propagation Delay Time (Low to High)		t <sub>pLH</sub>		5	-	40	140	ns
					10	-	25	80	
					15	-	15	60	
	Propagation Delay Time (High to Low)		t <sub>pHL</sub>		5	-	25	60	
					10	-	15	40	
					15	-	15	30	
TC4010BP	Propagation Delay Time (Low to High)		t <sub>pLH</sub>		5	-	45	200	ns
					10	-	25	100	
					15	-	15	70	
	Propagation Delay Time (High to Low)		t <sub>pHL</sub>		5	-	50	130	
					10	-	25	70	
					15	-	15	50	
Input Capacitance		C <sub>IN</sub>	TC4009UBP		-	15	22.5	pF	
			TC4010BP		-	5	7.5		

# TC4009UBP, TC4010BP

## WAVEFORM FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

