

SYNCHRONOUS PROGRAMMABLE 4-BIT COUNTER

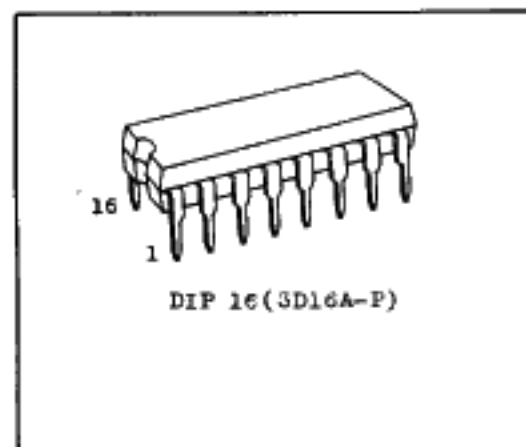
TC40160BP DECADE WITH ASYNCHRONOUS CLEAR

TC40161BP BINARY WITH ASYNCHRONOUS CLEAR

TC40162BP DECADE WITH SYNCHRONOUS CLEAR

TC40163BP BINARY WITH SYNCHRONOUS CLEAR

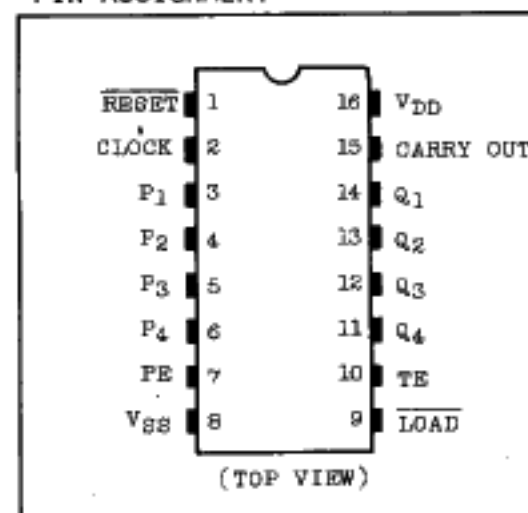
The TC40160BP, TC40161BP, TC40162BP, and TC40163BP are synchronously programmable 4-bit counters. The TC40160BP and TC40161BP are decimal counter and 4-bit binary counter respectively having asynchronous clear function which directly clears all the flip-flop outputs. The TC40162BP and TC40163BP are decimal counter and 4-bit binary counter respectively which are synchronous at the rising edges of clocks. CLEAR and LOAD of these counters are active at the "L" level. Further, these counters are functionally compatible with the 74160, 74161, 74162, and 74163 of TTL.



MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Supply Voltage	V <sub>DD</sub>	V <sub>SS</sub> -0.5 ~ V <sub>SS</sub> +20	V
Input Voltage	V <sub>IN</sub>	V <sub>SS</sub> -0.5 ~ V <sub>DD</sub> +0.5	V
Output Voltage	V <sub>OUT</sub>	V <sub>SS</sub> -0.5 ~ V <sub>DD</sub> +0.5	V
DC Input Current	I <sub>IN</sub>	±10	mA
Power Dissipation	P <sub>D</sub>	300	mW
Operating Temperature Range	T <sub>A</sub>	-40 ~ 85	°C
Storage Temperature Range	T <sub>stg</sub>	-65 ~ 150	°C
Lead Temp./Time	T <sub>sol</sub>	260°C · 10 sec	

PIN ASSIGNMENT

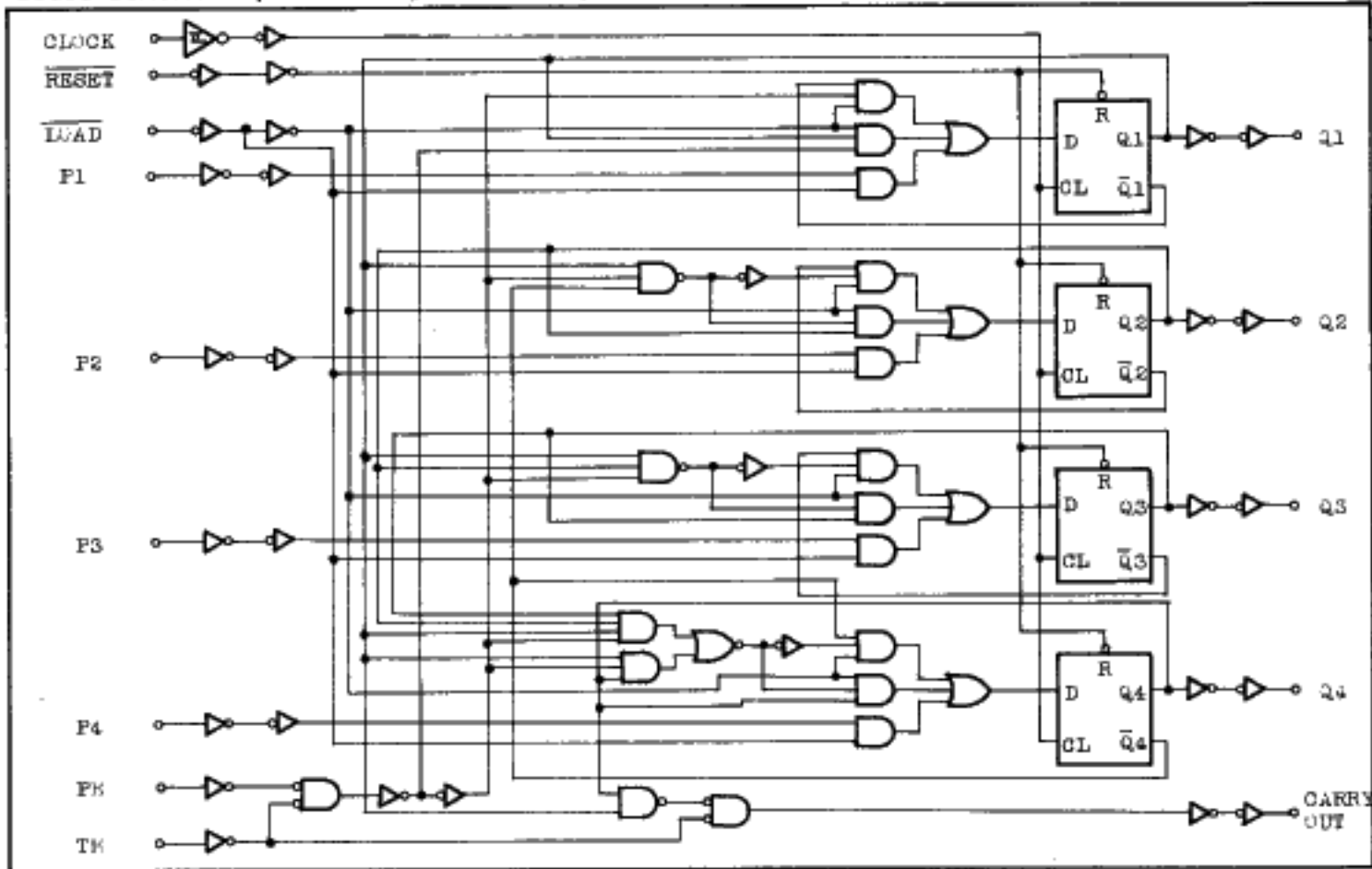


TRUTH TABLE

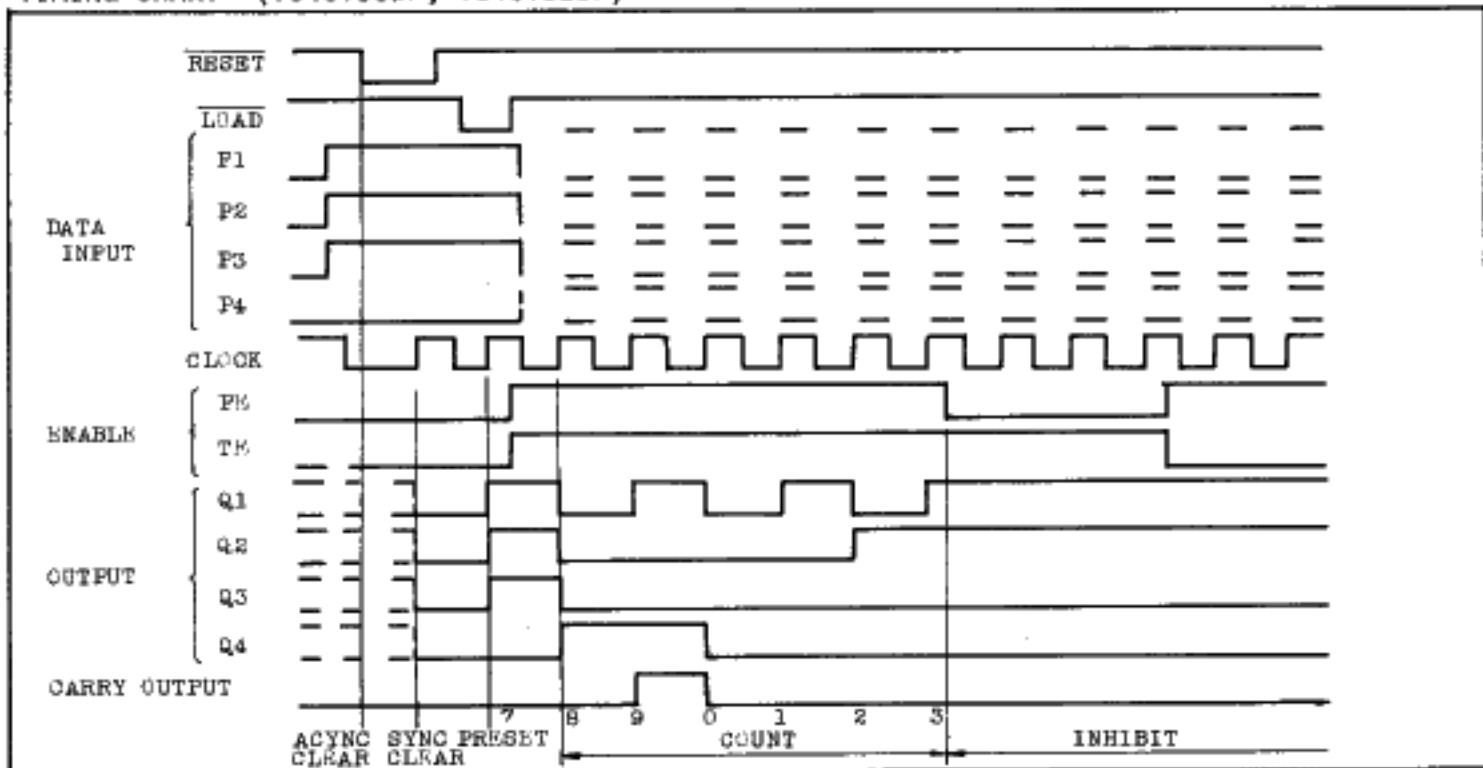
CLOCK	INPUT								OUTPUT				* : Don't care △ : Level change · : No change D : Data "H" or "L" ☆ : Don't care (TC40160, TC40161) Rise edge (TC40162, TC40163)
	RESET	LOAD	PE	TE	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub>	
☆	L	*	*	*	*	*	*	*	L	L	L	L	
△ ↓	H	L	*	*	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	
△ ↓	H	H	L	L	*	*	*	*	·	·	·	·	
△ ↓	H	H	L	H	*	*	*	*	·	·	·	·	
△ ↓	H	H	H	L	*	*	*	*	·	·	·	·	
△ ↓	H	H	H	H	*	*	*	*	COUNT				
△ ↓	H	*	*	*	*	*	*	*	·	·	·	·	

# TC40160BP, TC40161BP, TC40162BP, TC40163BP

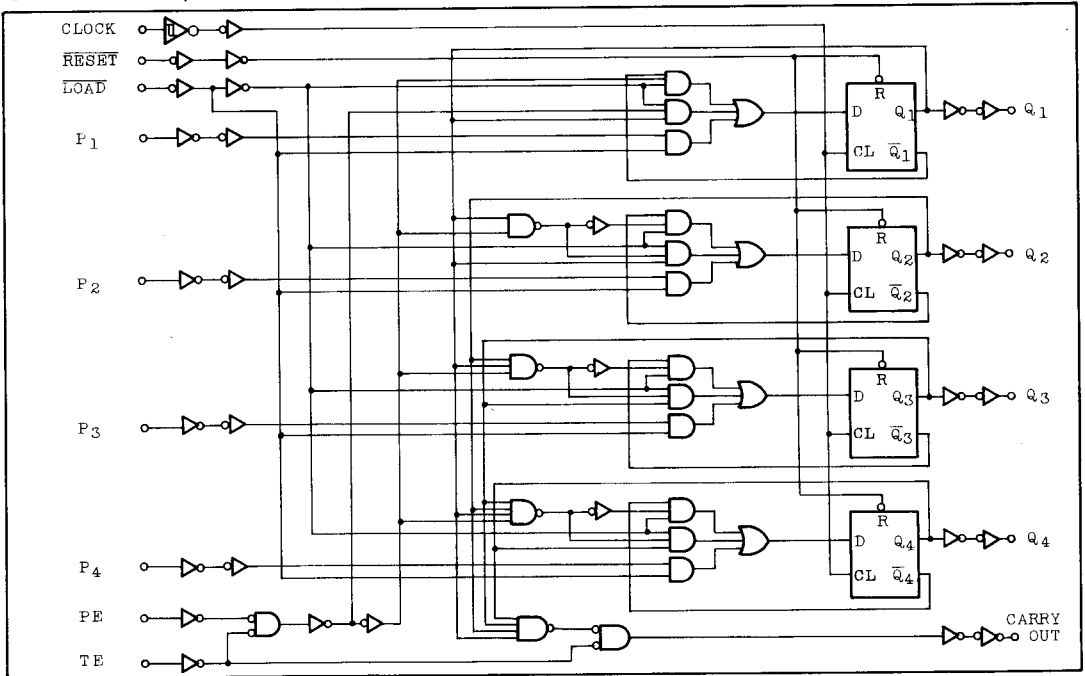
LIGIC DIAGRAM (TC40160BP, TC40162BP)



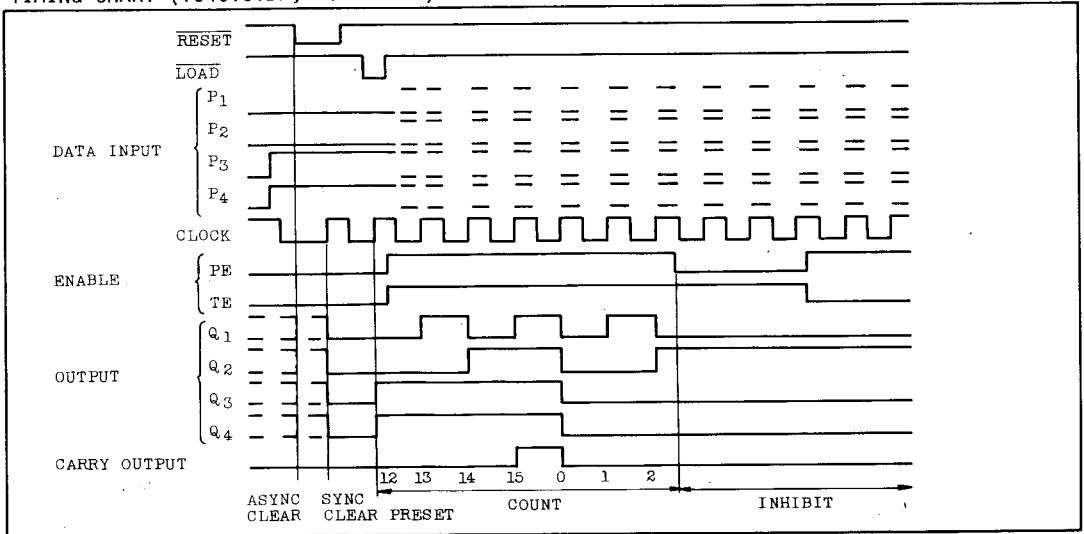
TIMING CHART (TC40160BP, TC40162BP)



LOGIC DIAGRAM (TC40161BP, TC40163BP)



TIMING CHART (TC40161BP, TC40163BP)



# TC40160BP, TC40161BP, TC40162BP, TC40163BP

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

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

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

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 V <sub>OH</sub> =2.5V V <sub>OH</sub> =9.5V V <sub>OH</sub> =13.5V V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>	5	-0.61	-	-0.51	-1.0	-	-0.42	-	mA	
			5	-2.5	-	-2.1	-4.0	-	-1.7	-		
			10	-1.5	-	-1.3	-2.2	-	-1.1	-		
			15	-4.0	-	-3.4	-9.0	-	-2.8	-		
Output Low Current	I <sub>OL</sub>	V <sub>OL</sub> =0.4V V <sub>OL</sub> =0.5V V <sub>OL</sub> =1.5V V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub>	5	0.61	-	0.51	1.5	-	0.42	-	mA	
			10	1.5	-	1.3	3.8	-	1.1	-		
			15	4.0	-	3.4	15.0	-	2.8	-		
Input High Voltage	V <sub>IH</sub>	V <sub>OUT</sub> =0.5V, 4.5V V <sub>OUT</sub> =1.0V, 9.0V V <sub>OUT</sub> =1.5V, 13.5V  I <sub>OUT</sub>   < 1μA	5	3.5	-	3.5	2.75	+	3.5	-	V	
			10	7.0	-	7.0	5.5	-	7.0	-		
			15	11.0	-	11.0	8.25	-	11.0	-		
Input Low Voltage	V <sub>IL</sub>	V <sub>OUT</sub> =0.5V, 4.5V V <sub>OUT</sub> =1.0V, 9.0V V <sub>OUT</sub> =1.5V, 13.5V  I <sub>OUT</sub>   < 1μA	5	-	1.5	-	2.25	1.5	-	1.5	V	
			10	-	3.0	-	4.5	3.0	-	3.0		
			15	-	4.0	-	6.75	4.0	-	4.0		
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	

STATIC ELECTRICAL CHARACTERISTICS (V<sub>SS</sub>=0V)

CHARACTERISTIC	SYM-BOL	TEST CONDITION	V <sub>DD</sub> (V)	-40°C		25°C			85°C		UNIT
				MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.	
Quiescent Device Current	I <sub>DD</sub>	V <sub>IN</sub> =V <sub>SS</sub> , V <sub>DD</sub> *	5	-	5	-	0.005	5	-	150	μA
			10	-	10	-	0.010	10	-	300	
			15	-	20	-	0.015	20	-	600	

\* All Valid input combinations.

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

CHARACTERISTIC	SYMBOL	TEST CONDITION	V <sub>DD</sub> (V)	MIN.	TYP.	MAX.	UNIT
Output Transition Time (Low to High)	t <sub>TLH</sub>		5	-	80	200	ns
			10	-	50	100	
			15	-	40	80	
Output Transition Time (High to Low)	t <sub>THL</sub>		5	-	80	200	ns
			10	-	50	100	
			15	-	40	80	
Propagation Delay Time (CLOCK - Q)	t <sub>pLH</sub> t <sub>pHL</sub>		5	-	250	500	ns
			10	-	100	200	
			15	-	70	140	
Propagation Delay Time (CLOCK-CARRY OUT)	t <sub>pLH</sub> t <sub>pHL</sub>		5	-	300	600	ns
			10	-	120	240	
			15	-	80	160	
Propagation Delay Time (TE-CARRY OUT)	t <sub>pLH</sub> t <sub>pHL</sub>		5	-	170	340	ns
			10	-	65	130	
			15	-	45	90	
Propagation Delay Time (RESET - Q) 40160, 40161 Only	t <sub>pHL</sub>		5	-	180	500	ns
			10	-	75	220	
			15	-	55	160	
Min. Clock Pulse Width	t <sub>w</sub>		5	-	130	250	ns
			10	-	45	90	
			15	-	30	60	
Min. Pulse Width (RESET) 40160, 40161 Only	t <sub>wL</sub>		5	-	140	280	ns
			10	-	55	110	
			15	-	35	70	

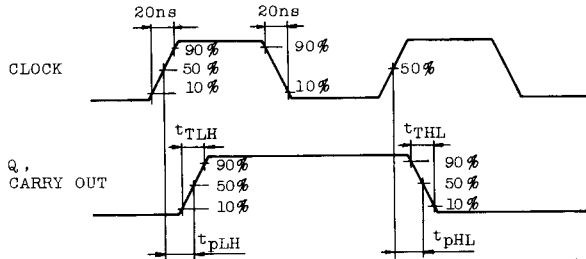
# TC40160BP, TC40161BP, TC40162BP, TC40163BP

DYNAMIC ELECTRICAL CHARACTERISTICS (Ta=25°C, VSS=0V, CL=50pF)

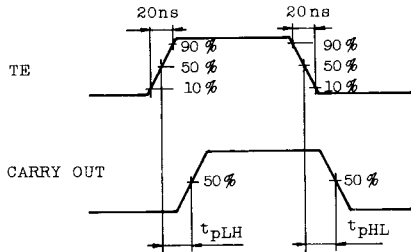
CHARACTERISTIC	SYMBOL	TEST CONDITION	VDD(V)	MIN.	TYP.	MAX.	UNIT	
Max. Clock Frequency	fCL		5	2	4	-	MHz	
			10	5.5	11	-		
			15	8	16	-		
Max. Clock Input Rise Time. Max. Clock Input Fall Time.	trCL tfCL		5	No Limit			μs	
			10					
			15					
Min. Set-up Time (Pn - CLOCK)	tSU		5	-	55	240	ns	
			10	-	20	90		
			15	-	15	60		
Min. Set-up Time (LOAD - CLOCK)	tSU		5	-	75	240		
			10	-	30	90		
			15	-	20	60		
Min. Set-up Time (PE, TE - CLOCK)	tSU		5	-	190	380		
			10	-	70	140		
			15	-	50	100		
Min. Set-up Time (RESET - CLOCK) 40162, 40163 Only	tSU		5	-	50	310		
			10	-	20	110		
			15	-	15	70		
Min. Hold Time (Pn, LOAD, PE, TE- CLOCK)	tH		5	-	-	0	ns	
			10	-	-	0		
			15	-	-	5		
Min. Hold Time (RESET - CLOCK) 40162, 40163 Only	tH		5	-	-30	0		
			10	-	-10	0		
			15	-	-5	0		
Min. Removal Time (RESET - COLCK) 40160, 40161 Only	trem		5	-	80	200		ns
			10	-	25	100		
			15	-	15	70		
Input Capacitance	CIN			-	5	7.5	pF	

WAVEFORM FOR MEASUREMENT OF DYNAMIC CHARACTERISTICS

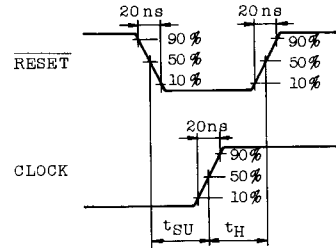
WAVEFORM 1



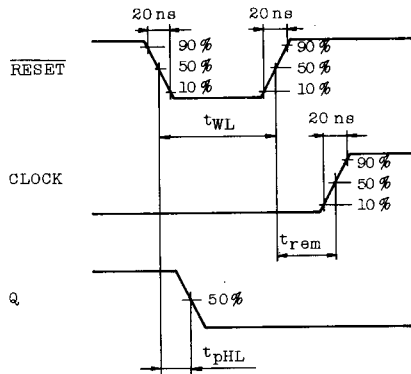
WAVEFORM 2



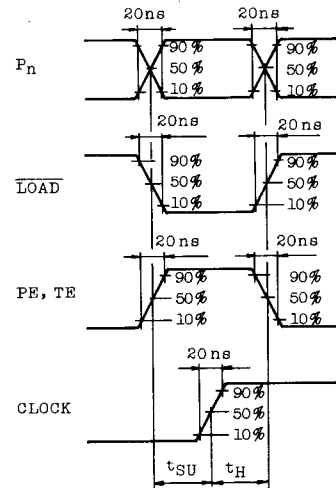
WAVEFORM 3 (40162, 40163)



WAVEFORM 4 (40160, 40161)



WAVEFORM 5



APPLICATION CIRCUIT

1. Cascaded counter packages in the parallel-clocked mode.

