

C²MOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC40H192P/F TC40H193P/F

TC40H192 SYNCHRONOUS BCD UP/DOWN COUNTER
(DUAL CLOCK WITH CLEAR)

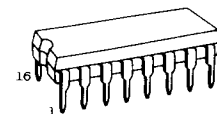
TC40H193 SYNCHRONOUS 4-BIT BINARY UP/DOWN COUNTER
(DUAL CLOCK WITH CLEAR)

The TC40H192 and the TC40H193 are synchronous type 4-bit up/down counters.

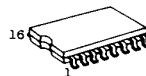
CLEAR input is active at "H" level, and PRE-SET input at "L" level, respectively. Both of them perform asynchronous operation.

The UP COUNT input and DOWN COUNT input of CLOCK are independent, and perform COUNT operation at the rising edge of pulse, respectively.

The TC40H192 and the TC40H193 are compatible in function and pin assignment with the TTL74192/74193.



DIP16 (3D16A-P)

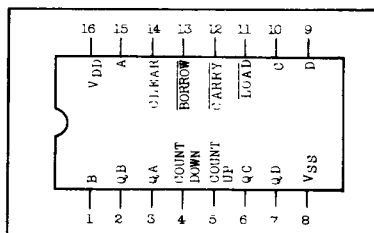


MFP16 (F16GC-P)

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V _{DD}	V _{SS} -0.5 ~ V _{SS} +10	V
Input Voltage	V _{IN}	V _{SS} -0.5 ~ V _{DD} +0.5	V
Output Voltage	V _{OUT}	V _{SS} -0.5 ~ V _{DD} +0.5	V
Input Current	I _{IN}	±10	mA
Power Dissipation	P _d	300(DIP)/180(MFP)	mW
Storage Temperature	T _{stg}	-65 ~ 150	°C
Lead Temp./Time	T _{sol}	260°C • 10 sec	

PIN CONNECTION



TRUTH TABLE

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COUNT UP	COUNT DOWN	LOAD	CLEAR	ACTION
	H	H	L	COUNT UP
	H	H	L	NO COUNT
H		H	L	COUNT DOWN
H		H	L	NO COUNT
*	*	L	L	PRESET
*	*	*	H	RESET

* Don't care

TC40H192

COUNT	Q _A	Q _B	Q _C	Q _D
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H

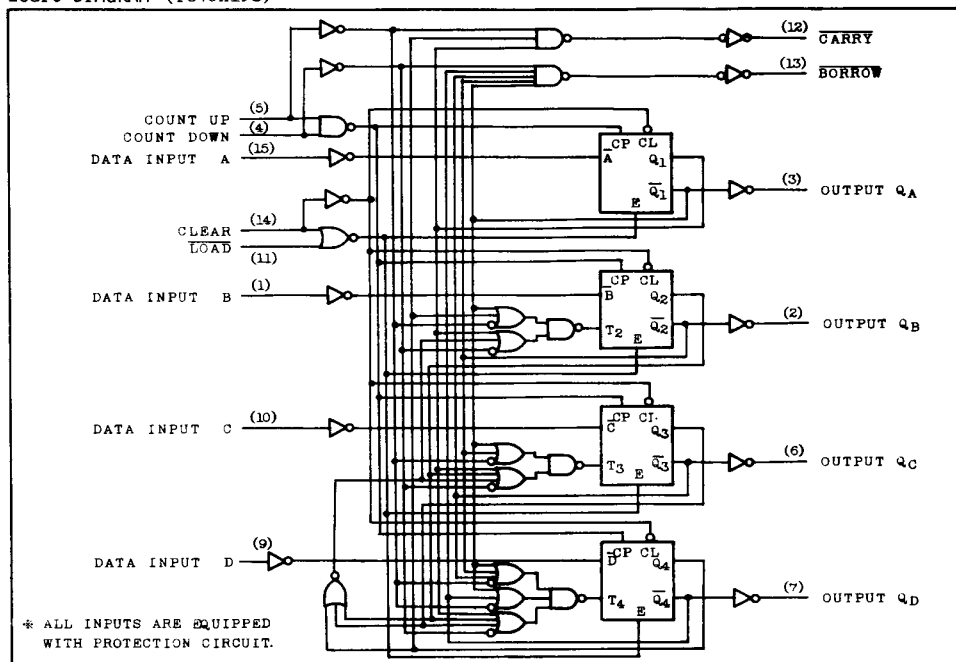
TC40H193

COUNT	Q _A	Q _B	Q _C	Q _D
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H
A	L	H	L	H
B	H	H	L	H
C	L	L	H	H
D	H	L	H	H
E	L	H	H	H
F	H	H	H	H

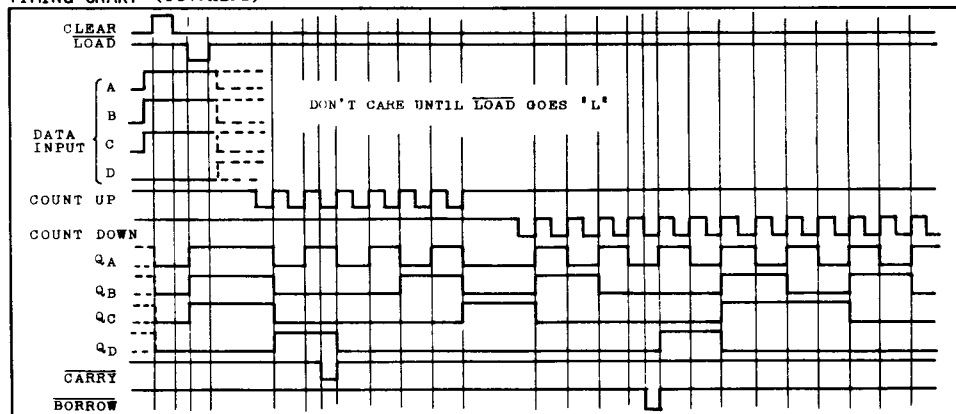
TC40H192P/F

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LOGIC DIAGRAM (TC40H192)



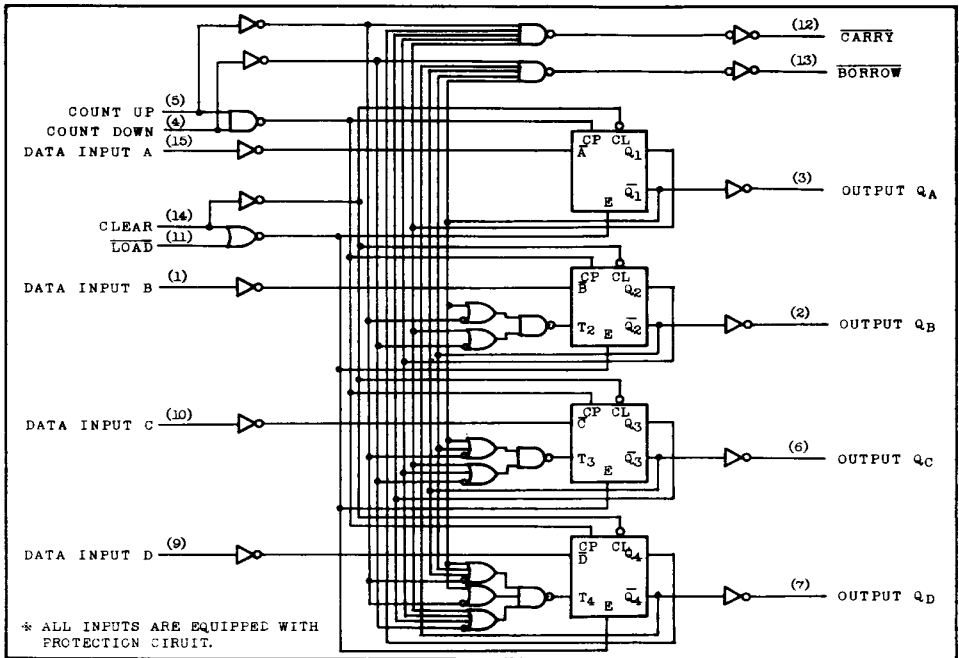
TIMING CHART (TC40H192)



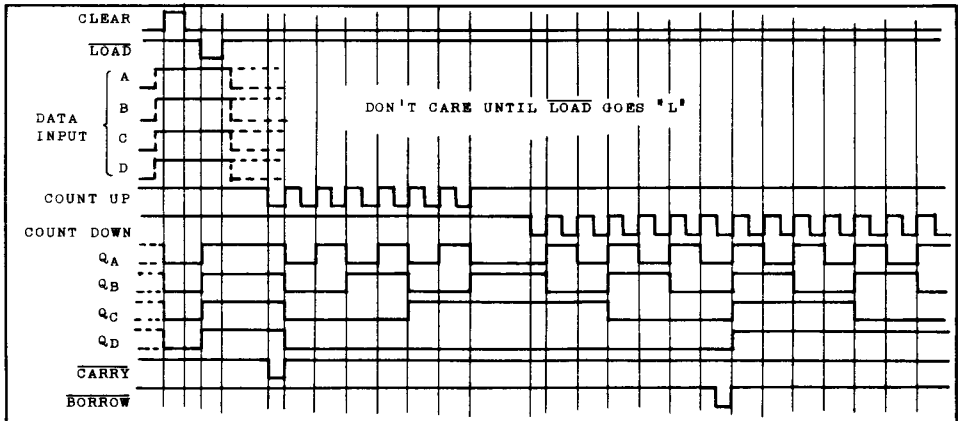
TC40H192P/F

TC40H193P/F

LOGIC DIAGRAM (TC40H193)



TIMING CHART (TC40H193)



TC40H192P/F

TC40H193P/F

RECOMMENDED OPERATING CONDITIONS ($V_{SS}=0V$)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{DD}	-	2	-	8	V
Input Voltage	V_{IN}	-	0	-	V_{DD}	V
Operating Temperature	T_{opr}	-	-40	-	85	°C

ELECTRICAL CHARACTERISTICS ($V_{SS}=0V$)

CHARACTERISTIC	SYMBOL	TEST CONDITION	V_{DD} (V)	-40°C		25°C			85°C		UNIT
				MIN.	TYP.	MIN.	TYP.	MAX.	MIN.	MAX.	
High Level Output Voltage	V_{OH}	$ I_{OUT} < 1\mu A$ $V_{IN}=V_{SS}, V_{DD}$	5	4.95	-	4.95	5.0	-	4.95	-	V
Low Level Output Voltage	V_{OL}	$ I_{OUT} < 1\mu A$ $V_{IN}=V_{SS}, V_{DD}$	5	-	0.05	-	0.0	0.05	-	0.05	
High Level Output Current	I_{OH}	$V_{OH}=4.6V$ $V_{IN}=V_{SS}, V_{DD}$	5	-0.52	-	-0.44	-	-	-0.36	-	mA
Low Level Output Current	I_{OL}	$V_{OL}=0.4V$ $V_{IN}=V_{SS}, V_{DD}$	5	1.4	-	1.1	-	-	0.8	-	
Input Voltage	"H" Level V_{IH}	$ I_{OUT} < 1\mu A$ $V_{OUT}=0.5V$	5	4.0	-	4.0	-	-	4.0	-	V
	"L" Level V_{IL}	$V_{OUT}=4.5V$	5	-	1.0	-	-	1.0	-	1.0	
Input Current	"H" Level I_{IH}	$V_{IH}=8.0V$	8	-	0.3	-	10^{-5}	0.3	-	1.0	μA
	"L" Level I_{IL}	$V_{IL}=0.0V$	8	-	-0.3	-	-10^{-5}	-0.3	-	-1.0	
Quiescent Supply Current	I_{DD}	$*V_{IN}=V_{SS}, V_{DD}$	5	-	12.5	-	0.005	12.5	-	75	μA

* All valid input combinations.

SWITCHING CHARACTERISTICS ($T_a=25^\circ C$, $V_{SS}=0.0V$, $V_{DD}=5.0V$, $C_L=15pF$)

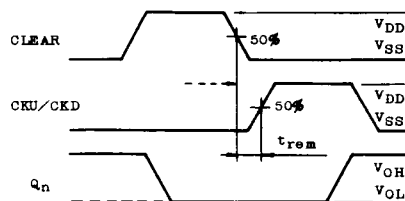
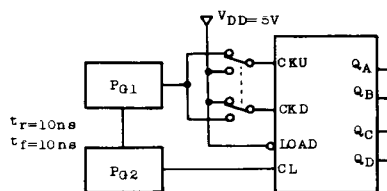
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Rise Time	t_{or}	-	-	22	40	ns
Output Fall Time	t_{of}		-	16	30	
Propagation Delay Time	t_{pLH}	CLOCK - Q	-	80	135	ns
	t_{pHL}		-	55	90	
Propagation Delay Time	t_{pLH}, t_{pHL}	CLOCK - CARRY BORROW	-	45	83	ns
	t_{pLH}, t_{pHL}	LOAD - CARRY BORROW	-	90	150	
	t_{pLH}, t_{pHL}	LOAD - Q	-	75	135	
	t_{pHL}	CLEAR - Q	-	70	105	
	t_{pLH}, t_{pHL}	CLEAR - CARRY BORROW	-	90	150	
Data Hold Time	t_{hold}	LOAD - DATA	-	0	10	ns
Data Setup Time	t_{setup}	LOAD - DATA	-	8	20	ns
Min. Clear Removal Time	t_{rem}	CLEAR - CLOCK	-	33	50	ns
Min. Load Removal Time	t_{rem}	LOAD - CLOCK	-	53	80	ns

TC40H192P/F

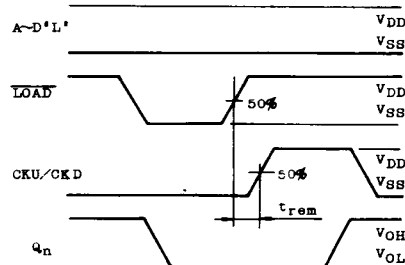
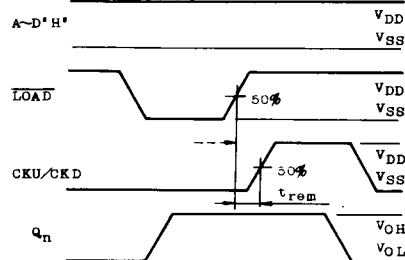
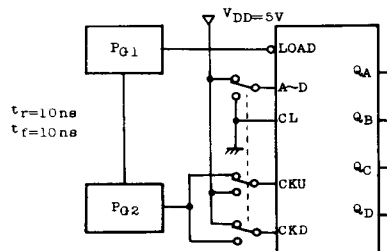
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SWITCHING TIME TEST CIRCUIT & WAVEFORM

Minimum Clear Removal Time Test Circuit



Minimum Load Removal Time Test Circuit



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TC40H193P/F

