National Semiconductor

MICROCIRCUIT DATA SHEET

CN54F193-X REV 0A0

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UP/DOWN BINARY COUNTER WITH SEPARATE UP/DOWN CLOCKS

General Description

The F193 is an up/down modulo-16 binary counter. Separate Count Up and Count Down Clocks are used, and in either counting mode the circuits operate synchronously. The outputs change state synchronously with the LOW-to-HIGH transitions on the clock inputs. Separate Terminal Count Up and Terminal Count Down outputs are provided that are used as the clocks for subsequent stages without extra logic, thus simplifying multi-stage counter designs.

Individual preset inputs allow the circuit to be used as a programmable counter. Both the Parallel Load ($\overline{PL}$) and the Master Reset (MR) inputs asynchronously override the clocks.

Industry Part Number

54F193

NS Part Numbers

54F193DC

Prime Die

M193

Processing

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Quality Conformance Inspection

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Subgrp	Description	Temp (^{o}C)
1	Static tests at	+25
2	Static tests at	+70
3	Static tests at	0
4	Dynamic tests at	+25
5	Dynamic tests at	+70
6	Dynamic tests at	0
7	Functional tests at	+25
8A	Functional tests at	+70
8B	Functional tests at	0
9	Switching tests at	+25
10	Switching tests at	+70
11	Switching tests at	0

(Absolute Maximum Ratings)

(Note 1)

Storage Temperature	-65 C to +150 C
Ambient Temperature under Bias	-55 C to +125 C
Junction Temperature under Bias	-55 C to +175 C
Vcc Pin Potential to Ground Pin	-0.5V to +7.0V
Input Voltage (Note 2)	-0.5V to +7.0V
Input Current (Note 2)	-30 mA to +5.0mA
Voltage Applied to Output in HIGH State (with Vcc=0V)	
Standard Output	-0.5V to Vcc
TRI-STATE Output	-0.5V to +5.5V
Current Applied to Output in LOW State (Max)	twice the rated Iol(mA)

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.
Note 2: Either voltage limit or current limit is sufficient to protect inputs.

Recommended Operating Conditions

Free Air Ambient Temperature	0 C to +70 C
Supply Voltage	+4.5V to +5.5V

Electrical Characteristics

DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: VCC 4.5V to 5.5V, Temp range: 0C to +70C

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
IIH	Input High Current	VCC=5.5V, VM=2.7V, VINH=5.5V	1, 2	INPUTS		5.0	uA	1, 2, 3
IBVI	Input High Current	VCC=5.5V, VM=7.0V, VINH=5.5V	1, 2	INPUTS		7.0	uA	1, 2, 3
IIL	Input LOW Current	VCC=5.5V, VM=0.5V, VINL=0.0V, VINH=5.5V	1, 2	INPUTS		-0.6	mA	1, 2, 3
IIL3	Input LOW Current	VCC=5.5V, VM=0.5V, VINH=5.5V	1, 2	CPD, CPU		-1.8	mA	1, 2, 3
VOL	Output LOW Voltage	VCC=4.5V, VIL=0.8V, VIH=2.0V, IOL=20mA, VINH=5.5V, VINL=0.0V	1, 2	OUTPUTS		0.5	V	1, 2, 3
VOH	Output HIGH Voltage	VCC=4.75V, VIL=0.8V, VINH=5.5V, VIH=2.0V, IOH=-1.0mA, VINL=0.0V	1, 2	OUTPUTS	2.7		V	1, 2, 3
		VCC=4.5V, VIL=0.8V, VINH=5.5V, VIH=2.0V, IOH=-1.0mA, VINL=0.0V	1, 2	OUTPUTS	2.5		V	1, 2, 3
IOS	Short-Circuit Current	VCC=5.5V, VINH=5.5V, VINL=0.0V, VM=0.0V	1, 2	OUTPUTS	-60	-150	mA	1, 2, 3
VCD	Input Clamp Diode Voltage	VCC=4.5V, IM=-18mA, VINH=5.5V, VINL=0.0V	1, 2	INPUTS		-1.2	V	1, 2, 3
ICC	Supply Current	VCC=5.5V, VINL=0.0V, VINH=5.5V	1, 2	VCC		55	mA	1, 2, 3
ICEX	Output HIGH Leakage Current	VCC=5.5V, VINL=0.0V, VINH=5.5V, VM=5.5V	1, 2	OUTPUTS		100	uA	1, 2, 3
VID	Input Leakage Test	VCC=0V, IID=1.9uA, all other pins grounded.	1, 2	INPUTS	4.75		V	1, 2, 3
IOD	Output Leakage Circuit Current	VCC=0V, VIOD=150mV, all other pins grounded.	1, 2	OUTPUTS		4.75	uA	1, 2, 3
VIL	Input LOW Voltage	Recognized as a LOW Signal	3	INPUTS		0.8	V	1, 2, 3
VIH	Input HIGH Voltage	Recognized as a HIGH Signal	3	INPUTS	2.0		V	1, 2, 3

AC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CP=50pf, RL=500 OHMS, TR=2.5ns, TF=2.5ns

tpLH(1)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	CPU or CPD to Qn	4.0	8.5	ns	9
			1, 2	CPU or CPD to Qn	4.0	9.5	ns	10, 11

Electrical Characteristics

AC PARAMETERS(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CP=50pf, RL=500 OHMS, TR=2.5ns, TF=2.5ns

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpHL(1)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	CPU or CPD to Qn	5.5	12.5	ns	9
			1, 2	CPU or CPD to Qn	5.5	13.5	ns	10, 11
tpLH(2)	Propagation Delay CPU or CPD to TCU or $\overline{TCD}$	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2		4.0	9.0	ns	9
tpLH(2)	Propagation Delay CPU or CPD to TCU or $\overline{TCD}$	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2		4.0	10.0	ns	10, 11
tpHL(2)	Propagation Delay CPU or CPD to TCU or $\overline{TCD}$	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2		3.5	8.0	ns	9
tpHL(2)	Propagation Delay CPU or CPD to TCU or $\overline{TCD}$	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2		3.5	9.0	ns	10, 11
tpLH(3)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	Pn to Qn	3.0	7.0	ns	9
			1, 2	Pn to Qn	3.0	8.0	ns	10, 11
tpHL(3)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	Pn to Qn	6.0	14.5	ns	9
			1, 2	Pn to Qn	6.0	15.5	ns	10, 11
tpLH(4)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	$\overline{PL}$ to Qn	5.0	11.0	ns	9
			1, 2	$\overline{PL}$ to Qn	5.0	12.0	ns	10, 11
tpHL(4)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	$\overline{PL}$ to Qn	5.5	13.0	ns	9
			1, 2	$\overline{PL}$ to Qn	5.5	14.0	ns	10, 11
tpLH(5)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	MR to $\overline{TCU}$	6.0	13.5	ns	9
			1, 2	MR to $\overline{TCU}$	6.0	14.5	ns	10, 11
tpHL(5)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	MR to $\overline{TCD}$	6.0	14.5	ns	9
			1, 2	MR to $\overline{TCD}$	6.0	15.5	ns	10, 11

Electrical Characteristics

AC PARAMETERS(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CP=50pf, RL=500 OHMS, TR=2.5ns, TF=2.5ns

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpHL(6)	Propagation Delay	VCC= 5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	Mr to Qn	5.5	14.5	ns	9
			1, 2	Mr to Qn	5.5	15.5	ns	10, 11
tpLH(7)	Propagation Delay $\overline{PL}$ to $\overline{TCU}$ or $\overline{TCD}$	VCC= 5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2		7.0	15.5	ns	9
tpLH(7)	Propagation Delay $\overline{PL}$ to $\overline{TCU}$ or $\overline{TCD}$	VCC= 5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2		7.0	16.5	ns	10, 11
tpHL(7)	Propagation Delay $\overline{PL}$ to $\overline{TCU}$ or $\overline{TCD}$	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2		7.0	14.5	ns	9
tpHL(7)	Propagation Delay $\overline{PL}$ to $\overline{TCU}$ or $\overline{TCD}$	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2		7.0	15.5	ns	10, 11
tpLH(8)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	Pn to $\overline{TCU/TCD}$	7.0	14.5	ns	9
			1, 2	Pn to $\overline{TCU/TCD}$	7.0	15.5	ns	10, 11
tpHL(8)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	1, 2	Pn to $\overline{TCU/TCD}$	6.5	14.0	ns	9
			1, 2	Pn to $\overline{TCU/TCD}$	5.5	15.0	ns	10, 11
ts(H/L)	Setup Time (High or Low)	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	4	Pn to $\overline{PL}$	4.5		ns	9
			4	Pn to $\overline{PL}$	5.0		ns	10, 11
th(H/L)	Hold Time (High or Low)	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	4	Pn to $\overline{PL}$	2.0		ns	9, 10, 11
tw(H)	Pulse Width (High)	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	4	MR	6.0		ns	9, 10, 11
tw(L)	Pulse Width (Low)	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C TR=1.0ns, TF=1.0ns	4	CPU or CPD	5.0		ns	9, 10, 11
tw (L)	Pulse Width (Low)	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	4	$\overline{PL}$	6.0		ns	9, 10, 11
		VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C, TR=1.0ns, TF=1.0ns	4	CPn(chg-dir)	10.0		ns	9, 10, 11
tREC	Recovery Time	VCC=5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	4	MR to CPU or CPD	4.0		ns	9, 10, 11
		VCC= 5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C	4	$\overline{PL}$ to CPU or CPD	6.0		ns	9, 10, 11

Electrical Characteristics

AC PARAMETERS(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CP=50pf, RL=500 OHMS, TR=2.5ns, TF=2.5ns

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
fMAX	Maximum Clock Frequency	VCC= 5.0V @25C, VCC=4.5V & 5.5V @ 0C/+70C, TR=1.0ns, TF=1.0ns	4		100		MHZ	9
			4		90		MHZ	10, 11

Note 1: Screen tested 100% on each device at +75C temperature only, subgroups A2, 8A & 10.
Note 2: Sample tested (Method 5005, Table 1) on each MFG. lot at +75C temperature only, subgroups A2, 8A & 10.
Note 3: Guaranteed by applying specific input condition and testing VOL & VOH.
Note 4: Guaranteed but not tested. (DESIGN CHARACTERIZATION DATA)

Revision History

Rev	ECN #	Rel Date	Originator	Changes
0A0	M0002773	03/23/98	Donald B. Miller	Initial MDS Release, revision 0A0.