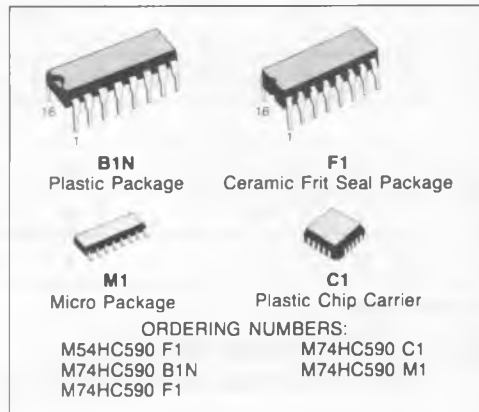


8-BIT BINARY COUNTER REGISTER (3-STATE)

- **LOW POWER DISSIPATION**
 $I_{CC} = 4 \mu A$ (MAX.) at $T_A = 25^\circ C$
- **HIGH NOISE IMMUNITY**
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (MIN.)
- **OUTPUT DRIVE CAPABILITY**
 10 LSTTL LOADS (For RCO)
 15 LSTTL LOADS (For QA ~ QH)
- **SYMMETRICAL OUTPUT IMPEDANCE**
 $|I_{OH}| = I_{OL} = 6 \text{ mA}$ (MIN.) For QA ~ QH Output
 $|I_{OH}| = I_{OL} = 4 \text{ mA}$ (MIN) For RCO Output
- **BALANCED PROPAGATION DELAYS**
 $t_{PLH} = t_{PHL}$
- **WIDE OPERATING VOLTAGE RANGE**
 V_{CC} (OPR) = 2V to 6V
- **PIN AND FUNCTION COMPATIBLE**
 WITH 54/74LS590

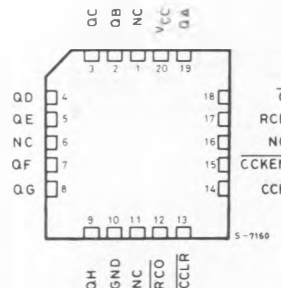
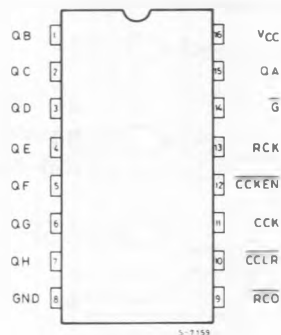


DESCRIPTION

The M54/74HC590 is a high speed CMOS 8-BIT BINARY COUNTER REGISTER (3-STATE) fabricated in silicon gate CMOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption.

These devices each contain an 8-bit binary counter that feeds an 8-bit storage register. The storage register has parallel outputs. Separate clocks are provided for both the binary counter and storage register. The binary counter features a direct clear input CCLR and a count enable input CCKEN. For cascading, a ripple carry output RCO is provided. Expansion is easily accomplished by tying RCO of the first stage to CCKEN of the second stage, etc. Both the counter and register clocks are positive-edge triggered. If the user wishes to connect both clocks together, the counter state will always be one count ahead of the register. Internal circuitry prevents clocking from the clock enable. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION (top view)



NC =
No Internal
Connection

TRUTH TABLE

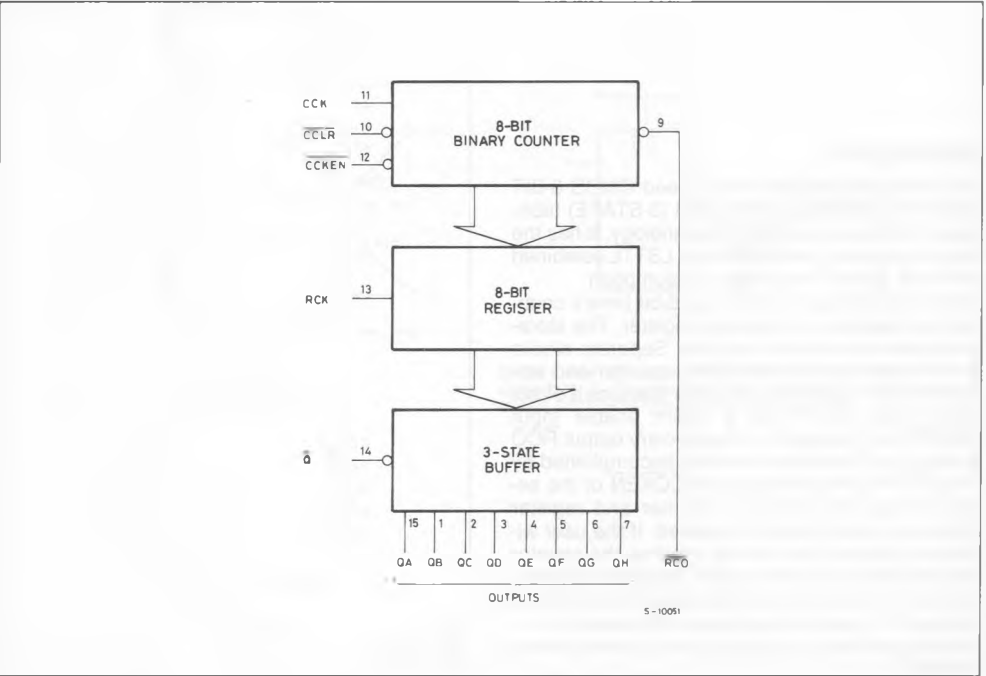
INPUTS					FUNCTION
$\overline{G}$	RCK	$\overline{CCLR}$	$\overline{CCKEN}$	CCK	
H	X	X	X	X	Q OUTPUTS DISABLE
L	X	X	X	X	Q OUTPUTS ENABLE
X		X	X	X	COUNTER DATA IS STORED INTO REGISTER.
X		X	X	X	REGISTER STATE IS NOT CHANGED.
X	X	L	X	X	COUNTER CLEAR
X	X	H	L		ADVANCE ONE COUNT
X	X	H	L		NO COUNT
X	X	H	H	X	NO COUNT

X: DON'T CARE

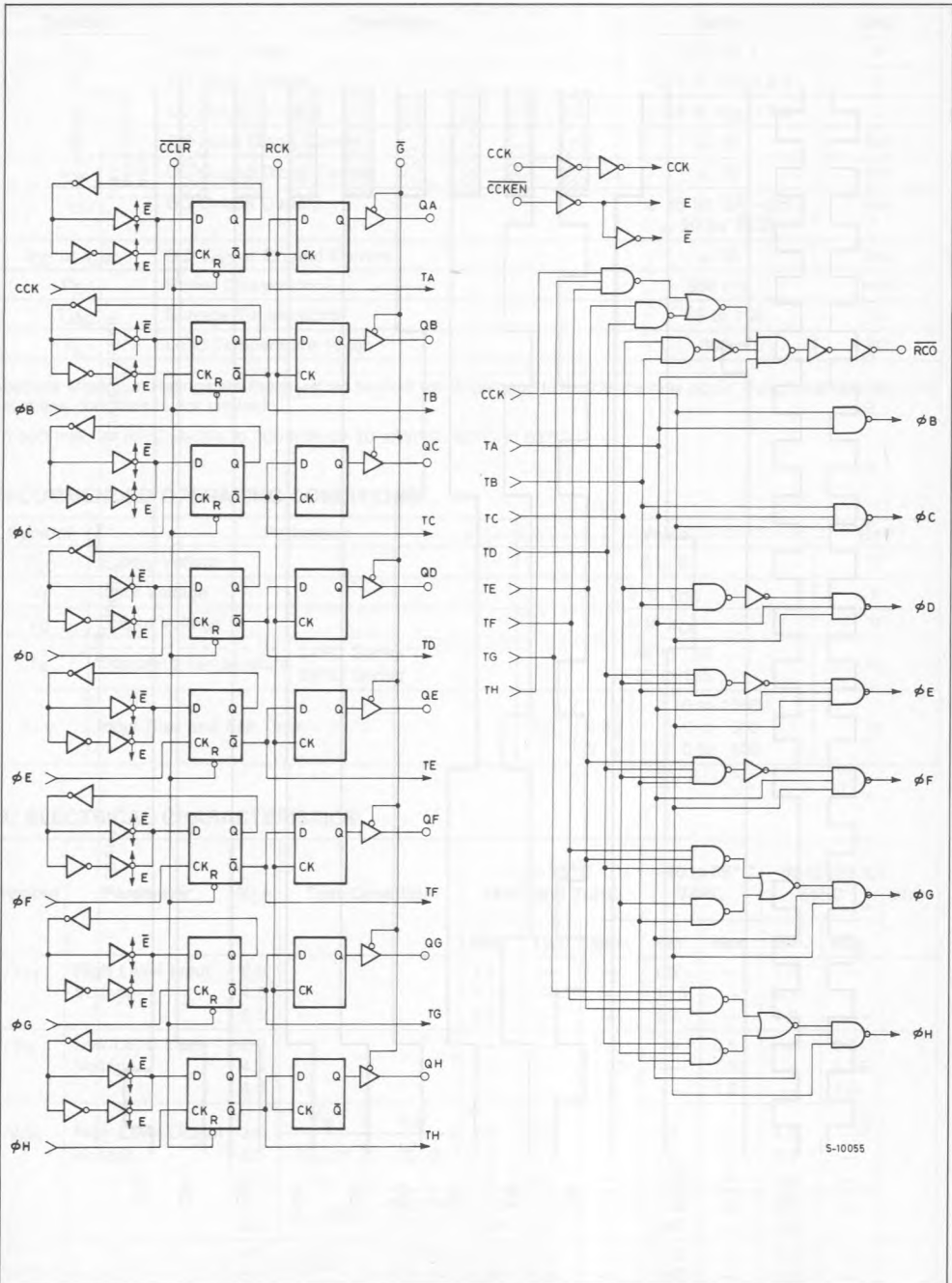
$$RCO = QA' \cdot QB' \cdot QC' \cdot QD' \cdot QE' \cdot QF' \cdot QG' \cdot QH'$$

(QA' ~ QH': INTERNAL OUTPUTS OF THE COUNTER)

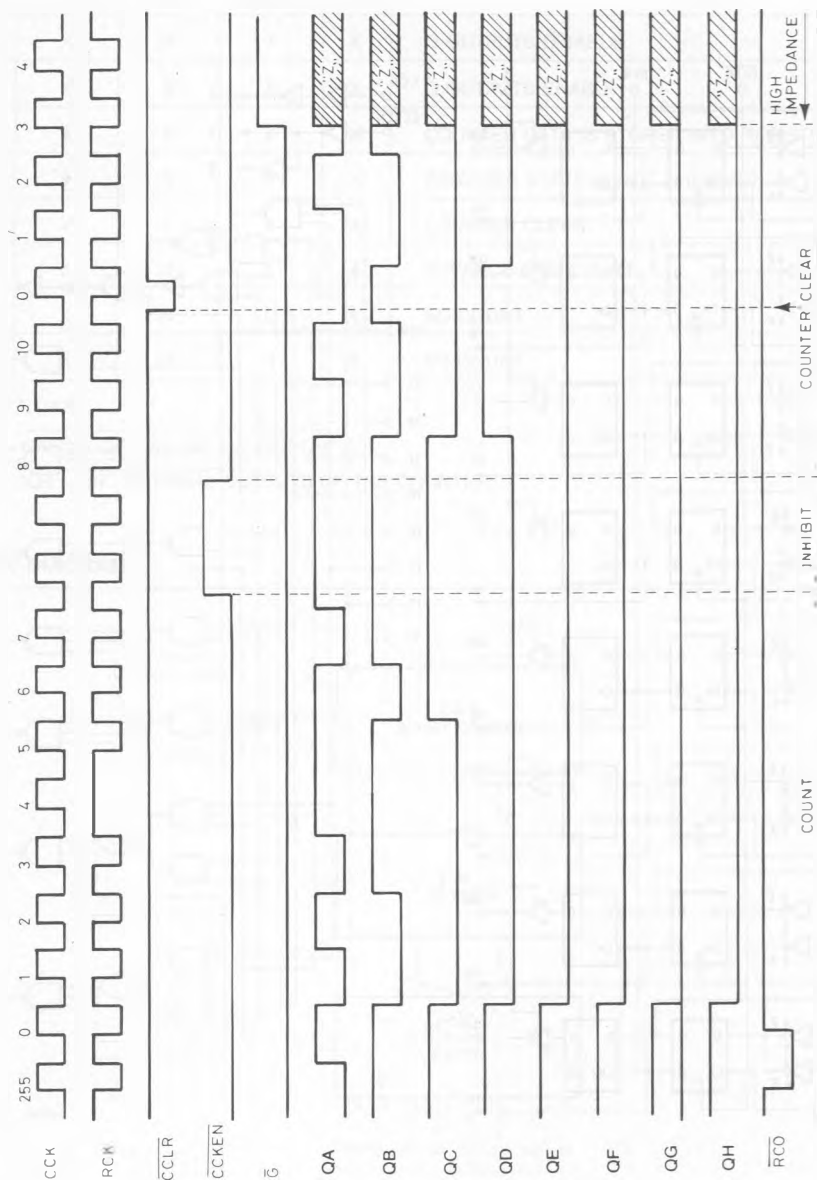
BLOCK DIAGRAM



LOGIC DIAGRAM



TIMING CHART



S-10056

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to 7	V
V_I	DC Input Voltage	-0.5 to $V_{CC} + 0.5$	V
V_O	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	V
I_{IK}	DC Input Diode Current	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Current	± 35 for QA ~ QH ± 20 for RCO	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 70	mA
P_D	Power Dissipation	500 (*)	mW
T_{stg}	Storage Temperature	-65 to 150	°C
T_L	Lead Temperature 10sec	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

(*) 500 mW: $\cong$ 65°C derate to 300 mW by 10 mW/°C: 65°C to 85°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	2 to 6	V
V_I	Input Voltage	0 to V_{CC}	V
V_O	Output Voltage	0 to V_{CC}	V
T_A	Operating Temperature 74HC Series 54HC Series	-40 to 85 -55 to 125	°C
t_r, t_f	Input Rise and Fall Time	$V_{CC} \begin{cases} 2 \text{ V} & 0 \text{ to } 1000 \\ 4.5 \text{ V} & 0 \text{ to } 500 \\ 6 \text{ V} & 0 \text{ to } 400 \end{cases}$	ns

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V_{CC}	Test Condition	$T_A = 25^\circ\text{C}$ 54HC and 74HC			-40 to 85°C 74HC		-55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage	2.0 4.5 6.0		1.5 3.15 4.2	— — —	— — —	1.5 3.15 4.2	— — —	1.5 3.15 4.2	— — —	V
V_{IL}	Low Level Input Voltage	2.0 4.5 6.0		— — —	— — —	0.5 1.35 1.8	— 1.35 1.8	0.5 1.35 1.8	— 1.35 1.8	0.5 1.35 1.8	V
V_{OH}	High Level Output Voltage	2.0	V_{IN}	I_{OH}	1.9	2.0	—	1.9	—	1.9	V
		4.5	V_{IH} or V_{IL}	-20 μA	4.4	4.5	—	4.4	—	4.4	
		6.0		—	5.9	6.0	—	5.9	—	5.9	
		4.5		-6.0 mA	4.18	4.31	—	4.13	—	4.10	
		6.0	QA ~ QH	-7.8 mA	5.68	5.8	—	5.63	—	5.60	
		4.5	RCO	-4.0 mA	4.18	4.31	—	4.13	—	4.10	
		6.0		-5.2 mA	5.68	5.8	—	5.63	—	5.60	

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V _{CC}	Test Condition		T _A = 25°C 54HC and 74HC			- 40 to 85°C 74HC		- 55 to 125°C 54HC		Unit
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V _{OL}	Low Level Output Voltage	2.0	V _I	I _O	—	0.0	0.1	—	0.1	—	0.1	V
		4.5	V _{IH} or V _{IL}	20 µA	—	0.0	0.1	—	0.1	—	0.1	
		6.0			—	0.0	0.1	—	0.1	—	0.1	
		4.5 6.0	Q _A ~ Q _H	6.0 mA 7.8 mA	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	— —	0.40 0.40	
		4.5 6.0	RCO	4.0 mA 5.2 mA		0.17 0.18	0.26 0.26	— —	0.33 0.33	— —	0.40 0.40	— —
I _{OZ}	3-State Output Off-State Current	6.0	V _{OUT} = V _{CC} or GND		—	—	± 0.5	—	± 5.0	—	± 10	µA
I _{IN}	Input Leakage Current	6.0	V _{IN} = V _{CC} or GND		—	—	± 0.1	—	± 1.0	—	± 1.0	µA
I _{CC}	Quiescent Supply Current	6.0	V _{IN} = V _{CC} or GND		—	—	4	—	40	—	80	µA

AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input t_r = t_f = 6ns)

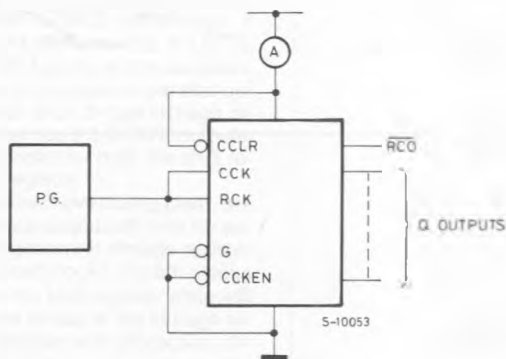
Symbol	Parameter	V _{CC}	Test Condition	T _A = 25°C 54HC and 74HC			- 40 to 85°C 74HC		- 55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t _{TLH} t _{THL}	Output Transition Time (Q Outputs)	2.0 4.5 6.0		— — —	25 7 6	60 12 10	— — —	75 15 13		90 18 15	ns
t _{TLH} t _{THL}	Output Transition Time (RCO)	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16		110 22 19	
t _{PLH} t _{PHL}	Propagation Delay Time (CCK - RCO)	2.0 4.5 6.0		— — —	124 31 26	240 48 41	— — —	300 60 51		360 72 61	
t _{PLH}	Propagation Delay Time (CCLR-RCO)	2.0 4.5 6.0		— — —	104 26 22	200 40 34	— — —	250 50 43		300 60 51	
t _{PLH} t _{PHL}	Propagation Delay Time (RCK-Q)	2.0 4.5 6.0		— — —	92 23 20	180 36 31	— — —	225 45 38		270 54 46	
f _{MAX}	Maximum Clock Frequency	2.0 4.5 6.0		4 20 24	8 32 38	— — —	3 16 19	— — —	2.6 13 15	— — —	MHz
t _{W(H)} t _{W(L)}	Minimum Pulse Width (CCK, RCK)	2.0 4.5 6.0		— — —	48 12 10	125 25 21	— — —	155 31 26		190 38 32	ns
t _{W(L)}	Minimum Pulse Width (CCLR)	2.0 4.5 6.0		— — —	92 23 20	200 40 34	— — —	250 50 43		300 60 51	ns

AC ELECTRICAL CHARACTERISTICS (Continued)

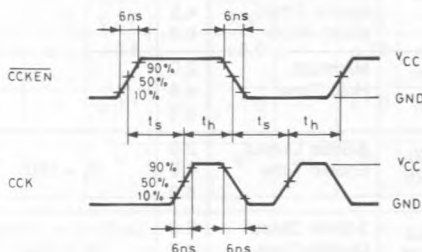
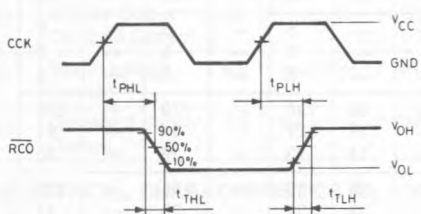
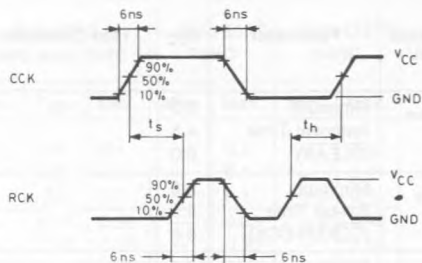
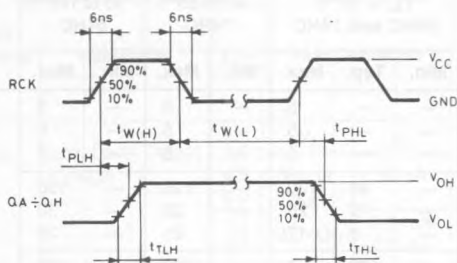
Symbol	Parameter	V _{CC}	Test Condition	T _A = 25°C 54HC and 74HC			- 40 to 85°C 74HC		- 55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t _{rem}	Minimum Removal Time (CLEAR)	2.0		—	—	5	—	5	—	5	ns
		4.5		—	—	5	—	5	—	5	
		6.0		—	—	5	—	5	—	5	
t _s	Minimum Set-up Time (CCKEN-CCK)	2.0		—	40	100	—	125	—	150	
		4.5		—	10	20	—	25	—	30	
		6.0		—	9	17	—	21	—	26	
t _s	Minimum Set-up Time (CCK, RCK)	2.0		—	128	245	—	305	—	370	
		4.5		—	32	49	—	61	—	74	
		6.0		—	27	42	—	52	—	63	
t _h	Minimum Hold Time	2.0		—	—	5	—	5	—	5	
		4.5		—	—	5	—	5	—	5	
		6.0		—	—	5	—	5	—	5	
t _{PZL} t _{PZH}	3-State Output Enable Time	2.0	R _L = 1KΩ	—	68	135	—	170	—	205	
		4.5		—	17	27	—	34	—	41	
		6.0		—	14	23	—	29	—	35	
t _{PLZ} t _{PHZ}	3-State Output Disable Time	2.0	R _L = 1KΩ	—	88	155	—	195	—	235	
		4.5		—	22	31	—	39	—	47	
		6.0		—	19	26	—	33	—	40	
C _{IN}	Input Capacitance			—	5	10	—	10	—	10	pF
C _{PD(1)}	Power Dissipation Capacitance			—	95	—	—	—	—	—	

Note (1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit)

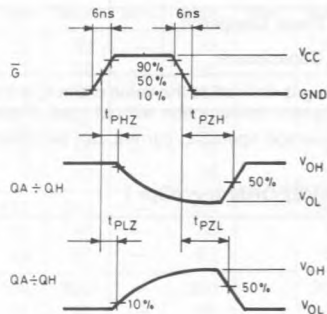
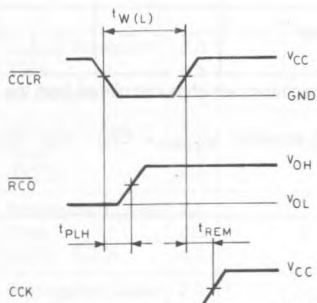
Average operating current can be obtained by the following equation: $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

TEST WAVEFORM I_{CC} (Opr.)

SWITCHING CHARACTERISTICS TEST WAVEFORM



S-10054



S-10052