TC5053P, TC5054P

TC5053P 4-DIGIT UP/DOWN DECADE COUNTER
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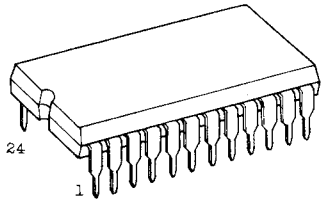
TC5053P/TC5054P is a 4-digit decimal up/down counter containing 7-segment decoder/driver.
The counter consists internally of a 4-digit latch, multiplexer, scan oscillating circuit, and decoder/driver capable of directly driving LED.
The clock input is independently equipped with an up-clock and a down-clock. Each input has the function of a Schmitt trigger.
This type of up/down counter can be widely applied to counters, panelmeters, etc.

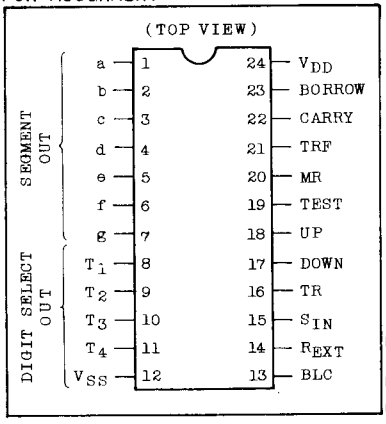


DIP 24 (6D24A-P)

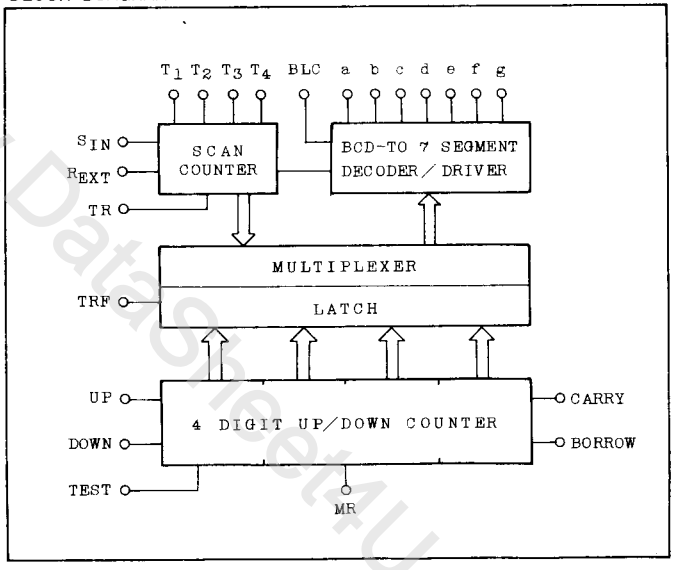
ABSOLUTE MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
DC 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
DC Input Current	I_{IN}	±10	mA
Power Dissipation	P_D	300	mW
Storage Temperature Range	T_{stg}	-55~125	°C
Lead Temp./Time	T_{sol}	260°C · 10sec	

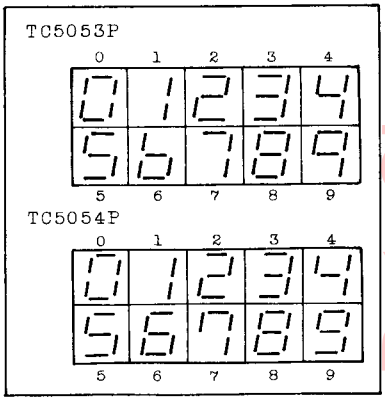
PIN ASSGNMENT



BLOCK DIAGRAM



SEGMENT OUTPUTS MODE



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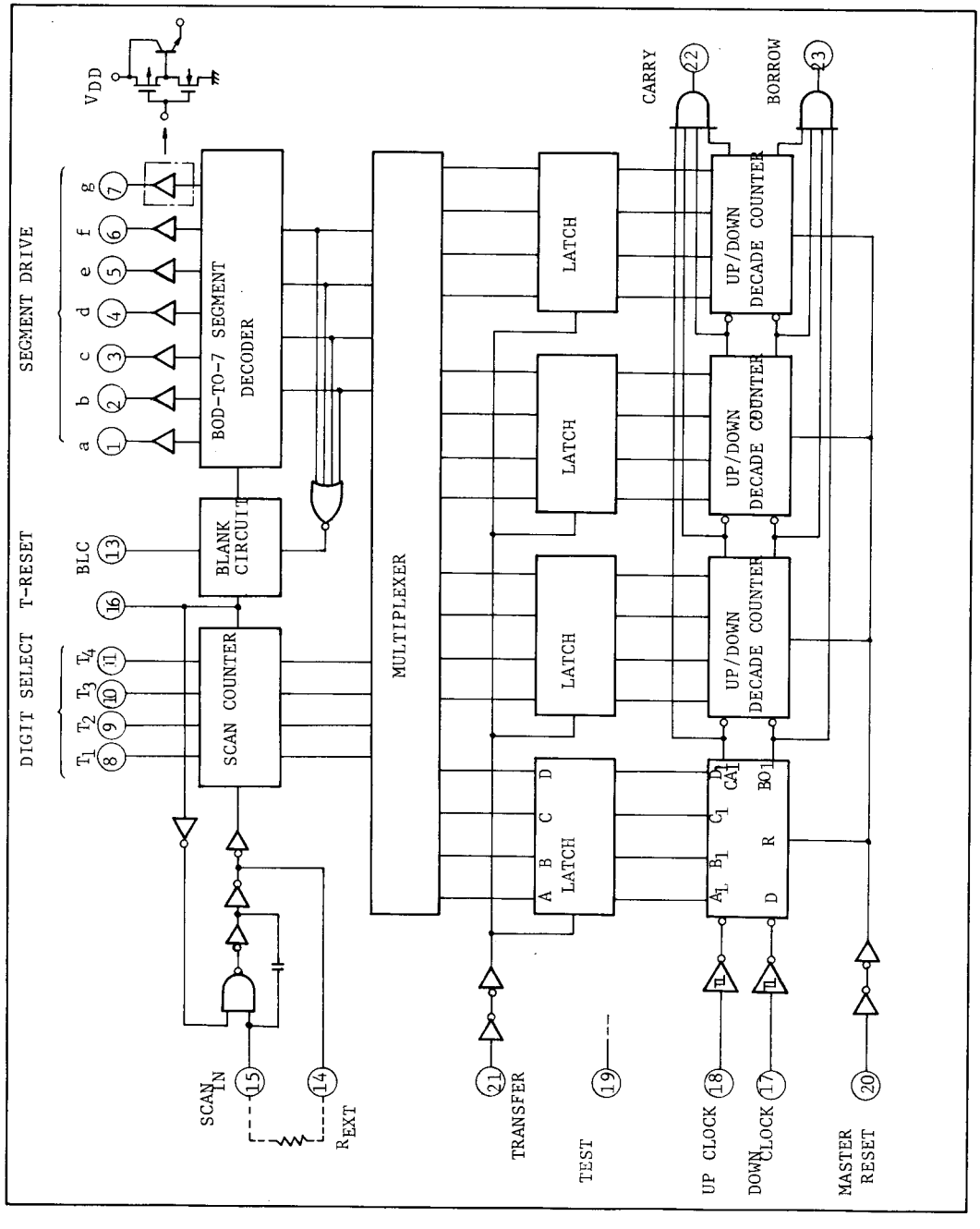
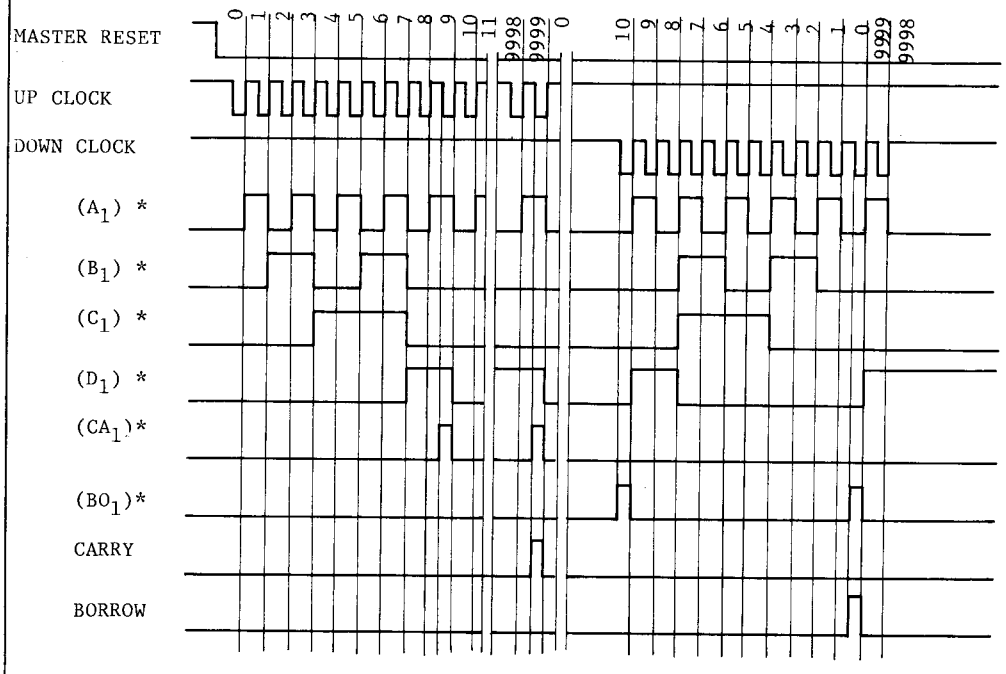


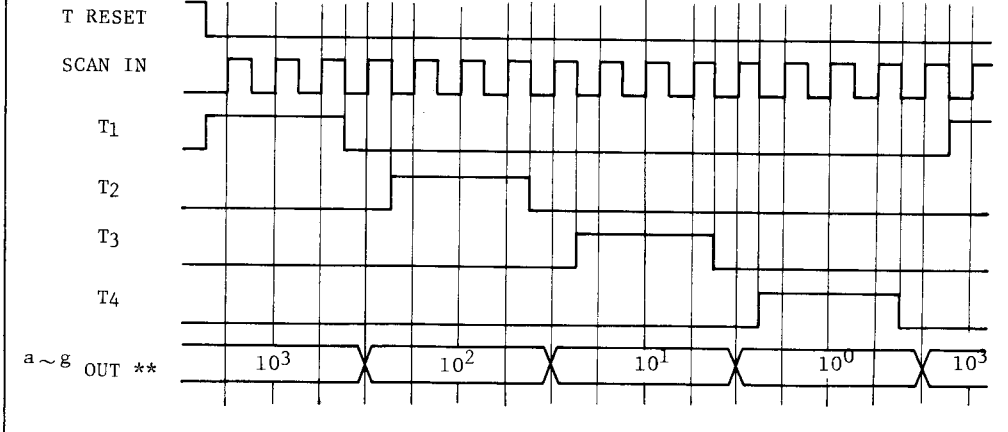
TIMING CHART

COUNT SEQUENCE



* Internal

SCAN SEQUENCE



** Required pull down Register

DESCRIPTION OF PIN FUNCTION

PIN NO.	SYMBOL	NAME	FUNCTION
1	a	SEGMENT a	The segments a ∿ g are the outputs that have convereted the decimal up/down counter BCD outputs into 7-segment display element driving codes. These segment signals are synchronous with SCAN inputs and are dynamically output from the higher order digit. Since they are designed so that I_{OH} is large, they can directly drive a cathod common type LED.
2	b	" b	
3	c	" c	
4	d	" d	
5	e	" e	
6	f	" f	
7	g	" g	
8	T_1	DIGIT SELECT 1	These are the outputs indicating the digits of the outputs a ∿ g and correspond to the higher-order positions from T_1 upward. These outputs are automatically switched in order of T_1 - T_2 - T_3 - T_4 - T_1 by giving clock to SCAN input.
9	T_2	" 2	
10	T_3	" 3	
11	T_4	" 4	
12	V_{SS}	V_{SS}	(GND)
13	BLC	BLANKING CONTROL	"H": No 0 suppression "L": Leading zero suppression of All digits The leading 0 suppression of the digits of more than the higher-order(N-1) can be made by connecting this terminal to Tn.
14	R_{EXT}	REGISTER EXTERNAL	SCAN clock is produced by connecting a resistor between R_{EXT} and S_{IN}. In case S_{IN} is externally provided, R_{EXT} should be opened.
15	S_{IN}	SCAN IN	This is a clock input of digit selection counter. If a resistor is connected between S_{IN} and R_{EXT} , SCAN Counter can make self-osillation. (Pulse may be externally applied)
16	TR	T-COUNTER RESET	Operation of SCAN counter can be stopped by "H" level. Whenever TR is fallen, SCAN counter starts scanning from T_1.
17	DOWN	DOWN COUNT	The internal counter makes document at the rising edge of a pulse if the pulse is provided to the in a state where UP input is kept at "H" level.
18	UP	UP COUNT	The internal counter makes up count at the rising edge of a pulse if the pulse is provided to the in a state where DOWN input is kept at "H" level.
19	TEST	TEST	This set to "L" level. (When it is set to "H" level, counting varies with the rising or falling edge.)
20	MR	MASTER RESET	A state of count is cleared to "0000" at the 'H" level.
21	TRF	TRANSFER	In case of "H" level input, the counter contents are always being output through a multiplexer. In case of "L" level input, however, the counter contents before the change to "L" level are not changed by the change in counter contents because the previous contents remain kept in the latch circuit.
22	CARRY	CARRY	In UP COUNT, when the COUNTER contents reaches "9999", "H" level is output as long as UP COUNTER input holds "L" level.
23	BORROW	BORROW	In DOWN COUNT, when the COUNTER contents reaches "0000", "H" level is output as long as DOWN COUNTER input holds "L" level.
24	V_{DD}	V_{DD}	(V_{DD})

RECOMMENDED OPERATING CONDITION (V_{SS}=0V)

ITEM	SYMBOL		MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{DD}		3	-	8	V
Input Voltage	V_{IN}		0	-	V_{DD}	V
Operating Temperature	T_{opr}		-30	-	85	°C
R_{EXT} EXTERNAL REGISTANCE	R_{EXT}		5K	-	1M	Ω

ELECTRICAL CHARACTERISTICS (V_{SS}=0V)

ITEM		SYMBOL	TEST CONDITION	V_{DD} (V)	-30°C		25°C			85°C		UNIT
					MIN	MAX	MIN	TYP	MAX	MIN	MAX	
High Level Output Voltage	T_1~T_4, Carry, Borrow	V_{OH}	$\|I_{OUT}\|$<1μA V_{IN}=VSS, V_{DD}	5	4.95	-	4.95	-	-	4.95	-	V
	a ~ g				4.0	-	4.0	4.5	-	4.0	-	
	R_{EXT}				4.95	-	4.95	-	-	4.95	-	
Low Level Output Voltage	T_1~T_4, Carry, Borrow	V_{OL}	$\|I_{OUT}\|$<1μA V_{IN}=VSS, V_{DD}	5	-	0.05	-	-	0.05	-	0.05	V
	R_{EXT}				-	0.05	-	-	0.05	-	0.05	
High Level Output Current	T_1~T_4, Carry, Borrow	I_{OH}	V_{OH}=4.6V	5	-0.2	-	-0.16	-	-	-0.12	-	mA
	a ~ g		V_{OH}=3.5V		-2.0	-	-2.0	-	-	-1.5	-	
	R_{EXT}		V_{OH}=4.6V		-0.02	-	-0.02	-	-	-0.01	-	
Low Level Output Current	T_1~T_4, Carry, Borrow	I_{OL}	V_{OL}=0.4V	5	0.52	-	0.44	-	-	0.36	-	mA
	R_{EXT}				0.02	-	0.02	-	-	0.01	-	
Disable Current (a~g)		I_{DL}	V_{OL}=0V	8	-	-3.0	-	-10^{-4}	-	-	-3.0	μA
High Level Input Voltage	UP/DOWN CLOCK	V_{IH}		5	3.5	-	3.5	-	-	3.5	-	V
	OTHER				3.5	-	3.5	2.75	-	3.5	-	
Low Level Input Voltage	UP/DOWN CLOCK	V_{IL}		5	-	1.5	-	-	1.5	-	1.5	V
	OTHER				-	1.5	-	2.25	1.5	-	1.5	
High Level Input Current		I_{IH}	V_{IH}=8V	8	-	0.15	-	10^{-5}	0.15	-	1.0	μA
Low Level Input Current		I_{IL}	V_{IL}=0V	8	-	-0.15	-	-10^{-5}	-0.15	-	1.0	
Quiescent Current Consumption		I_{DD}	V_{IN}=V_{SS}, V_{DD} OUTPUT OPEN	8	-		-	-		-		μA

SWITCHING CHARACTERISTICS (Ta=25°C, V_{SS}=0V, C_L=50pF)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Rise Time	t_{TLH}	T_1~T_4, Carry, Borrow	-	70	180	ns
		a~g (R_L=1kΩ)	-	40	100	
Output Fall Time	t_{THL}	T_1~T_4, Carry, Borrow	-	50	130	
Propagation Delay Time	t_{pLH} t_{pHL}	CLOCK-a~g (R_L=1kΩ, T_1=H)	-	5000	12000	ns
		CLOCK-Carry, Borrow	-	700	1500	
		SCAN-T_1~T_4	-	450	1000	
		SCAN-a~g (R_L=1kΩ)	-	750	1700	
Max. Frequency	f_{CL}-1*	CLOCK	2.0	4.0	-	MHz
	f_{CL}-2*		0.7	1.4	-	
	f_{CL}-1**	SCAN	2.0	4.0	-	
	f_{CL}-2**		0.7	1.1	-	

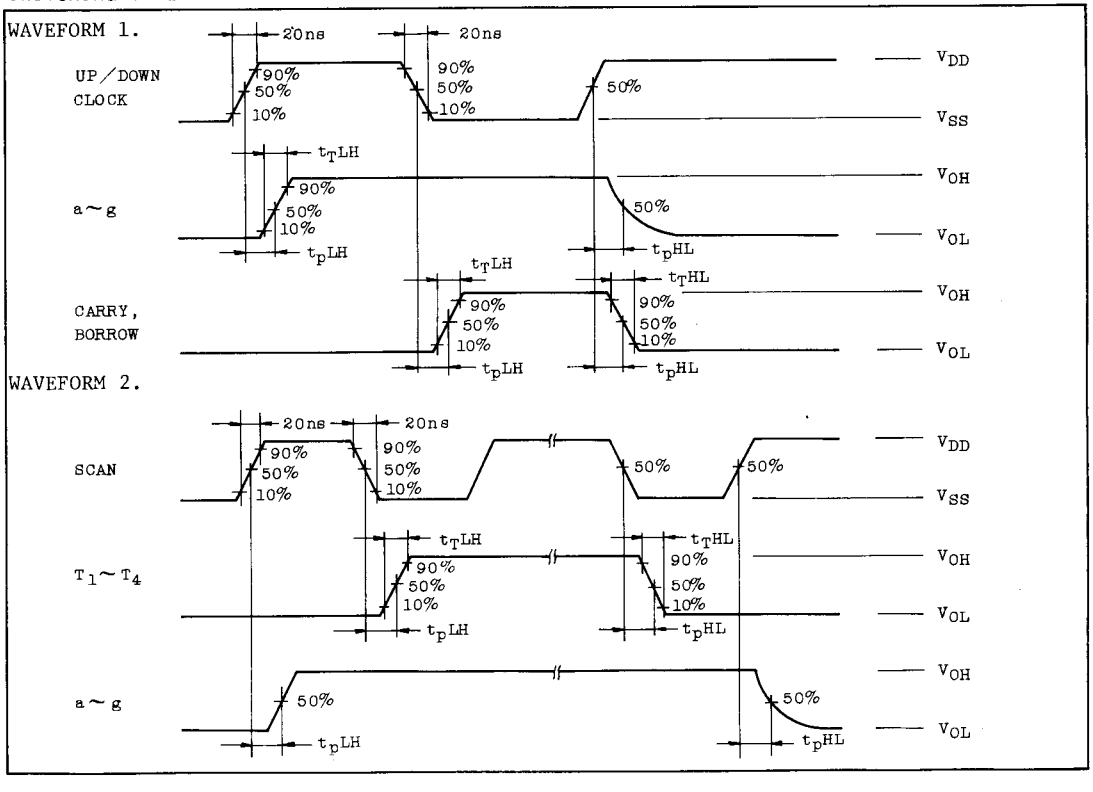
SWITCHING CHARACTERISTICS (Ta=25°C, V_{SS}=0V, C_L=50pF) (Continued)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Min. Pulse Width	t_w(MR)	MASTER RESET	-	150	450	ns
	t_w(TR)	T-COUNTER RESET	-	100	300	
	t_w(TRF)	TRANSFER	-	50	200	
Minimum Removal Time	t_{rem}	MR-CLOCK	-	-100	250	ns
		TR-SCAN	-	250	750	
		TRF-CLOCK	-	100	400	
Max. Clock Rise Time Max. Clock Fall Time	t_{rCL} t_{fCL}	UP/DOWN CLOCK	No Limit			μs
Input Capacitance	C_{IN}	except SCAN	-	5	7.5	pF

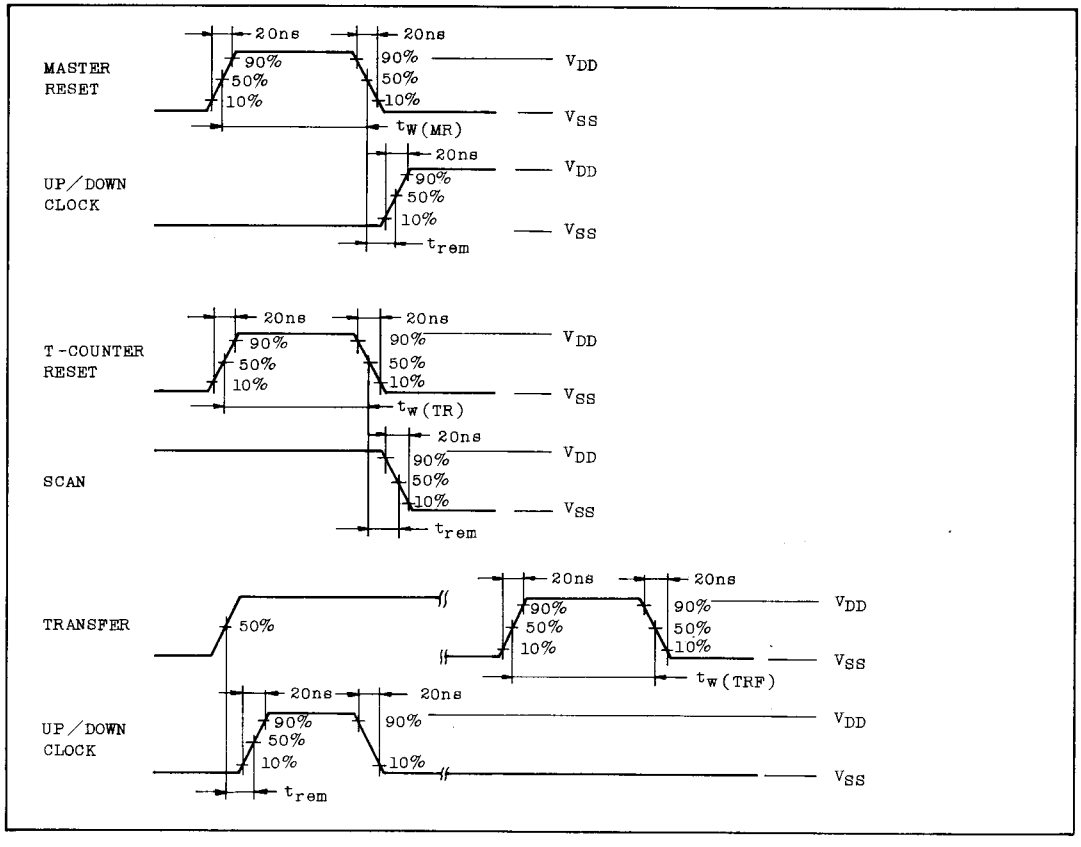
* Counter operation : f_{CL-1}, CARRY, BORROW operation : f_{CL-2}

** Leading zero suppression : f_{CL-2}, No zero suppression : f_{CL-1}

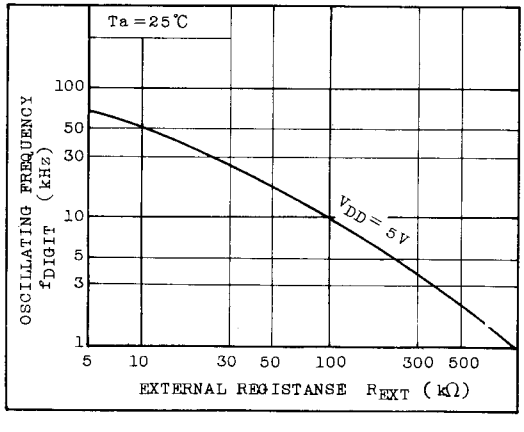
SWITCHING TIME TEST WAVEFORMS



SWITCHING TIME TEST WAVEFORMS (Continued)



f_{DIGIT} - R_{EXT} (TYP.)



I_{DDopr} - f_{IN} (TYP.)