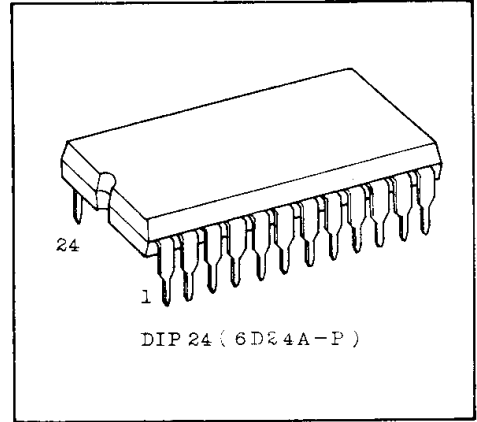


TC5053P 4-DIGIT UP/DOWN DECADE COUNTER
TC5054P 4-DIGIT UP/DOWN DECADE COUNTER

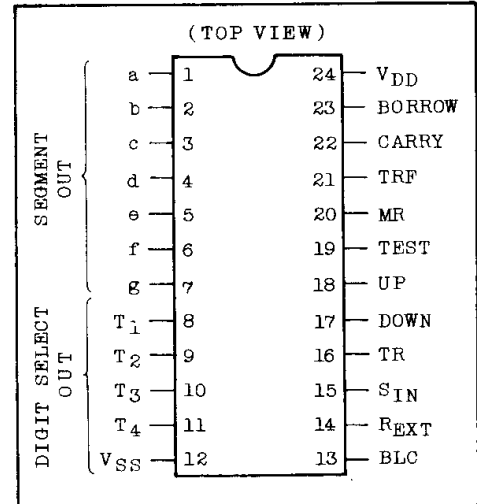
TC5053P/TC5054P is a 4-digit decimal up/down counter containing 7-segment decoder/driver.
The counter consists internally of a 4-digit latch, multiplexer, scan oscillating circuit, and decoder/driver capable of directly driving LED.
The clock input is independently equipped with an up-clock and a down-clock.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



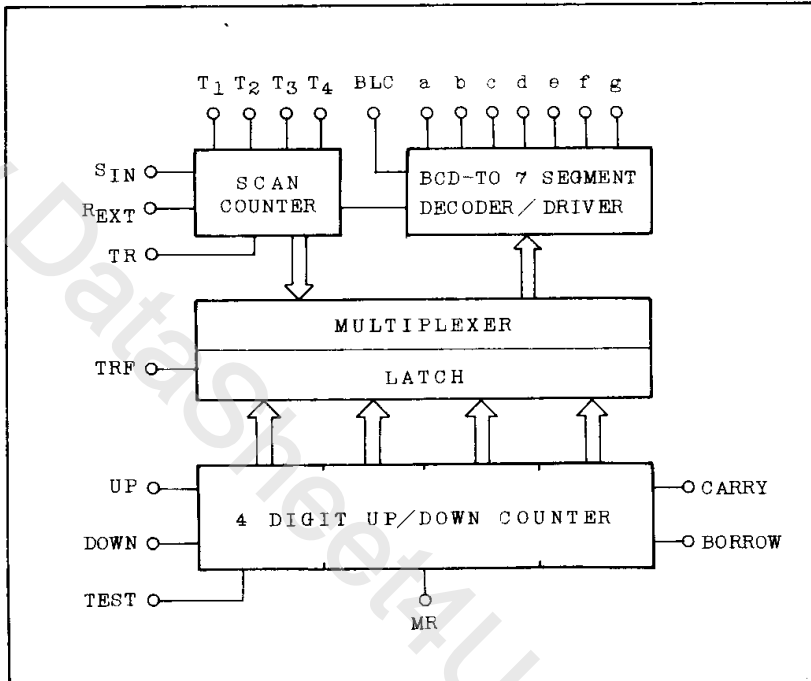
ABSOLUTE MAXIMUM RATINGS

| 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 | |

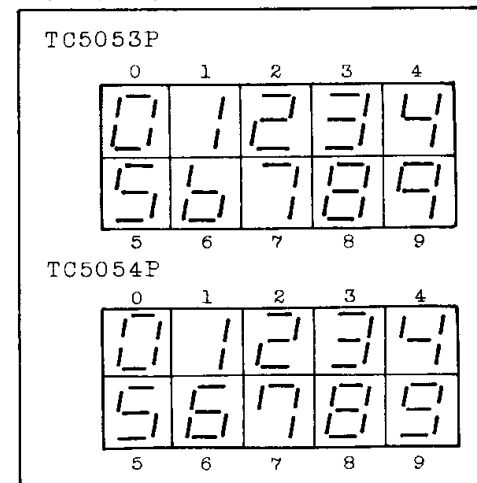
PIN ASSIGNMENT



BLOCK DIAGRAM

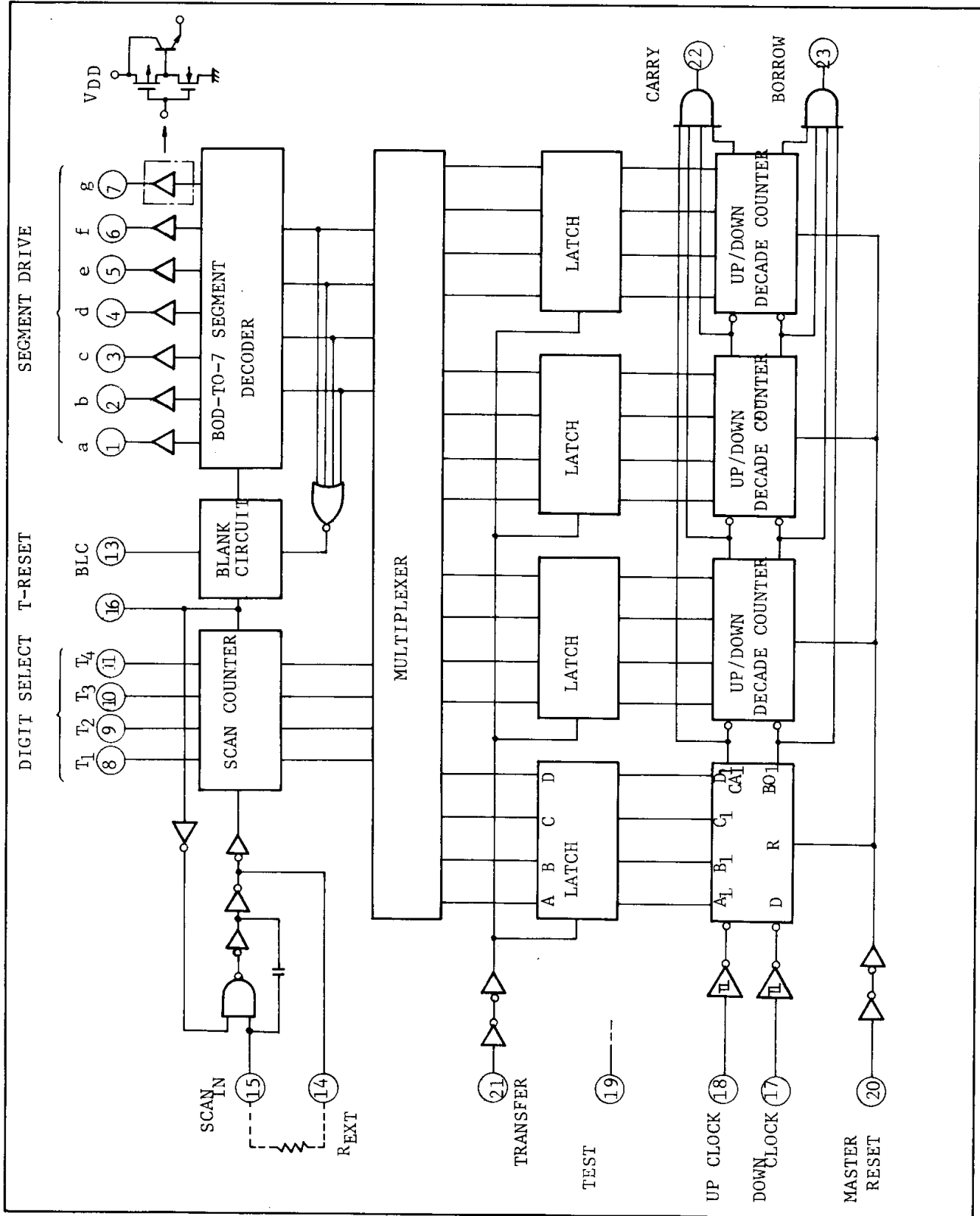


SEGMENT OUTPUTS MODE

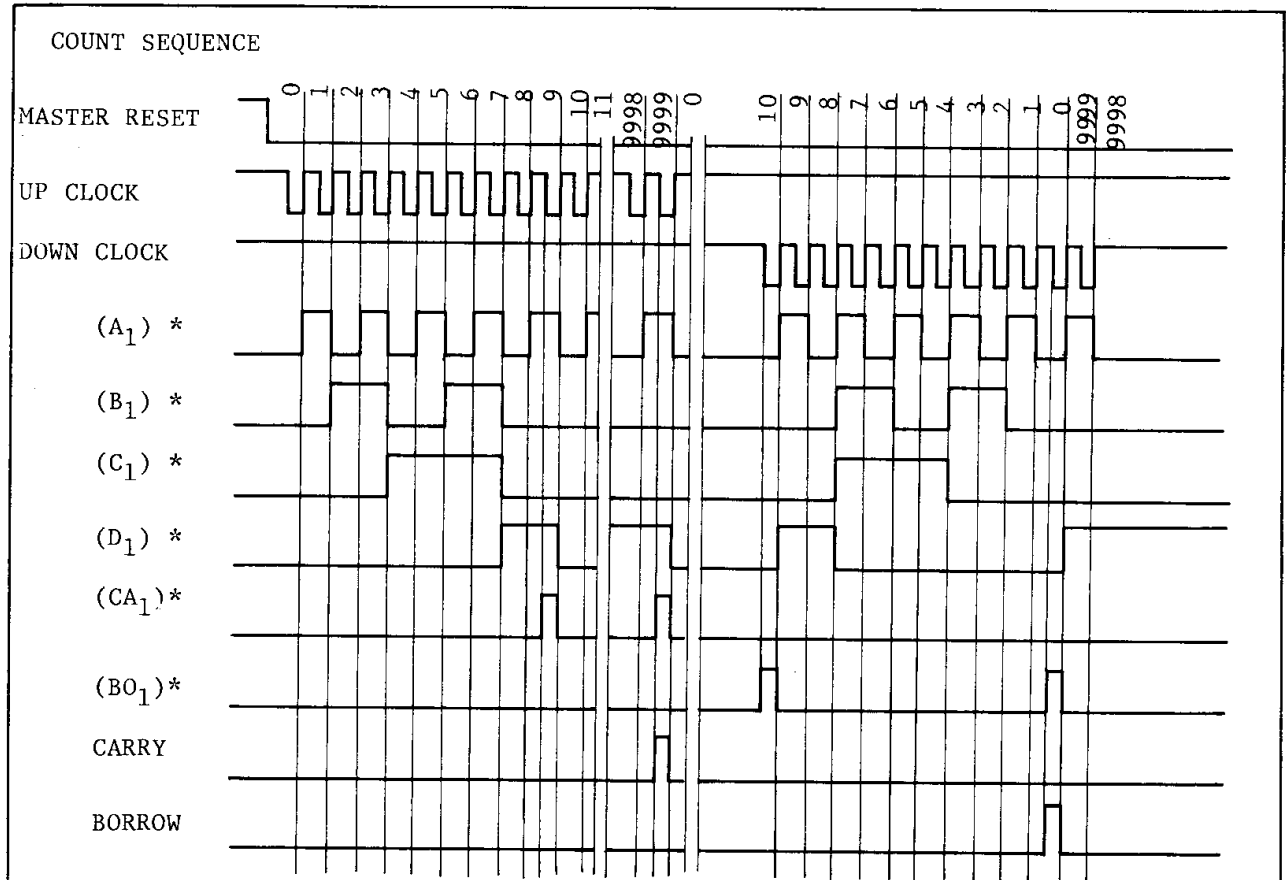


TC5053P, TC5054P

BLOCK DIAGRAM

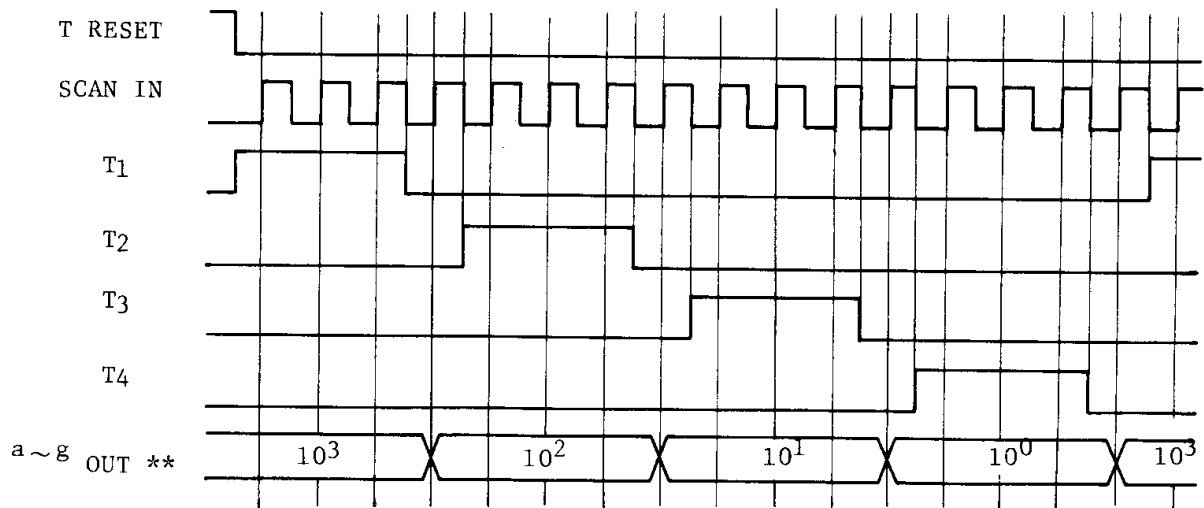


TIMING CHART



* Internal

SCAN SEQUENCE



** Required pull down Register

TC5053P, TC5054P

DESCRIPTION OF PIN FUNCTION

| PIN NO. | SYMBOL | NAME | FUNCTION | |
|---------|------------------|-------------------|---|--|
| 1 | a | SEGMENT a | The segments a ~ g are the outputs that have converted 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 | The leading 0 suppression of the digits of more than the higher-order(N-1) can be made by connecting this terminal to T _n . |
| | | | "L" Leading zero suppression of All digits | |
| 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-oscillation. (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 down count 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 | I _{OUT} < 1μA V _{IN} =V _{SS} , 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 | I _{OUT} < 1μA V _{IN} =V _{SS} , 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 | V _{OH} =4.6V | 5 | -0.2 | - | -0.16 | - | - | -0.12 | - | mA |
| | a~g | | | -0.2 | - | -0.2 | - | - | -0.15 | - | |
| | R _{EXT} | | | -0.02 | - | -0.02 | - | - | -0.01 | - | |
| Low Level Output Current | T ₁ ~T ₄ , Carry, Borrow | 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 | μA |
| Quiescent Current Consumption | I _{DD} | V _{IN} =V _{SS} , V _{DD} OUTPUT OPEN | 8 | - | - | - | - | - | - | - | μA |

SWITCHING CHARACTERISTICS (T_a=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 | ns |
| 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 | - | |

TC5053P, TC5054P

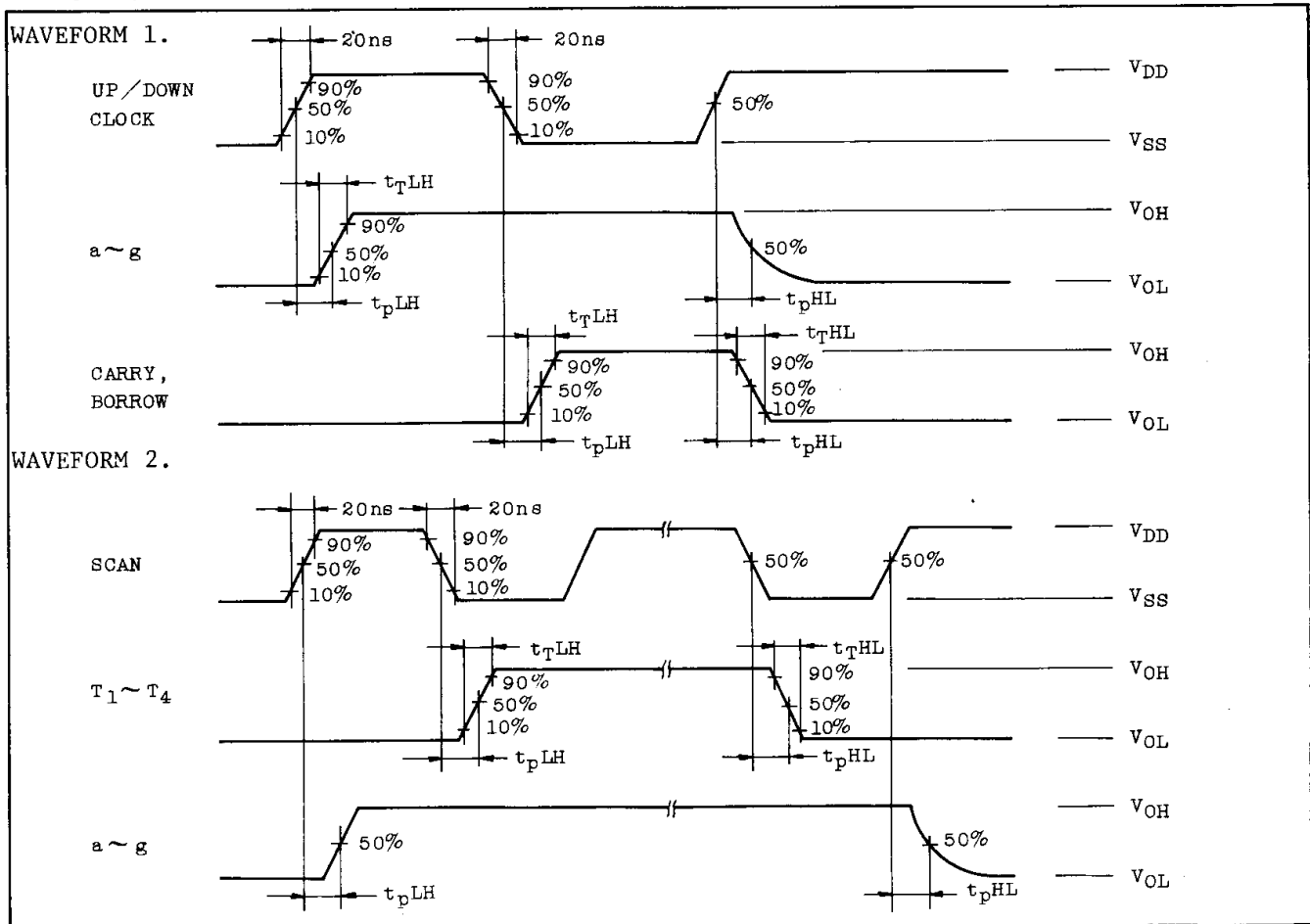
SWITCHING CHARACTERISTICS ($T_a=25^\circ\text{C}$, $V_{SS}=0\text{V}$, $C_L=50\text{pF}$) (Continued)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--|--------------------------------------|-----------------|----------|------|------|---------------|
| Min. Pulse Width | $t_w(\text{MR})$ | MASTER RESET | - | 150 | 450 | ns |
| | $t_w(\text{TR})$ | T-COUNTER RESET | - | 100 | 300 | |
| | $t_w(\text{TRF})$ | 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 |

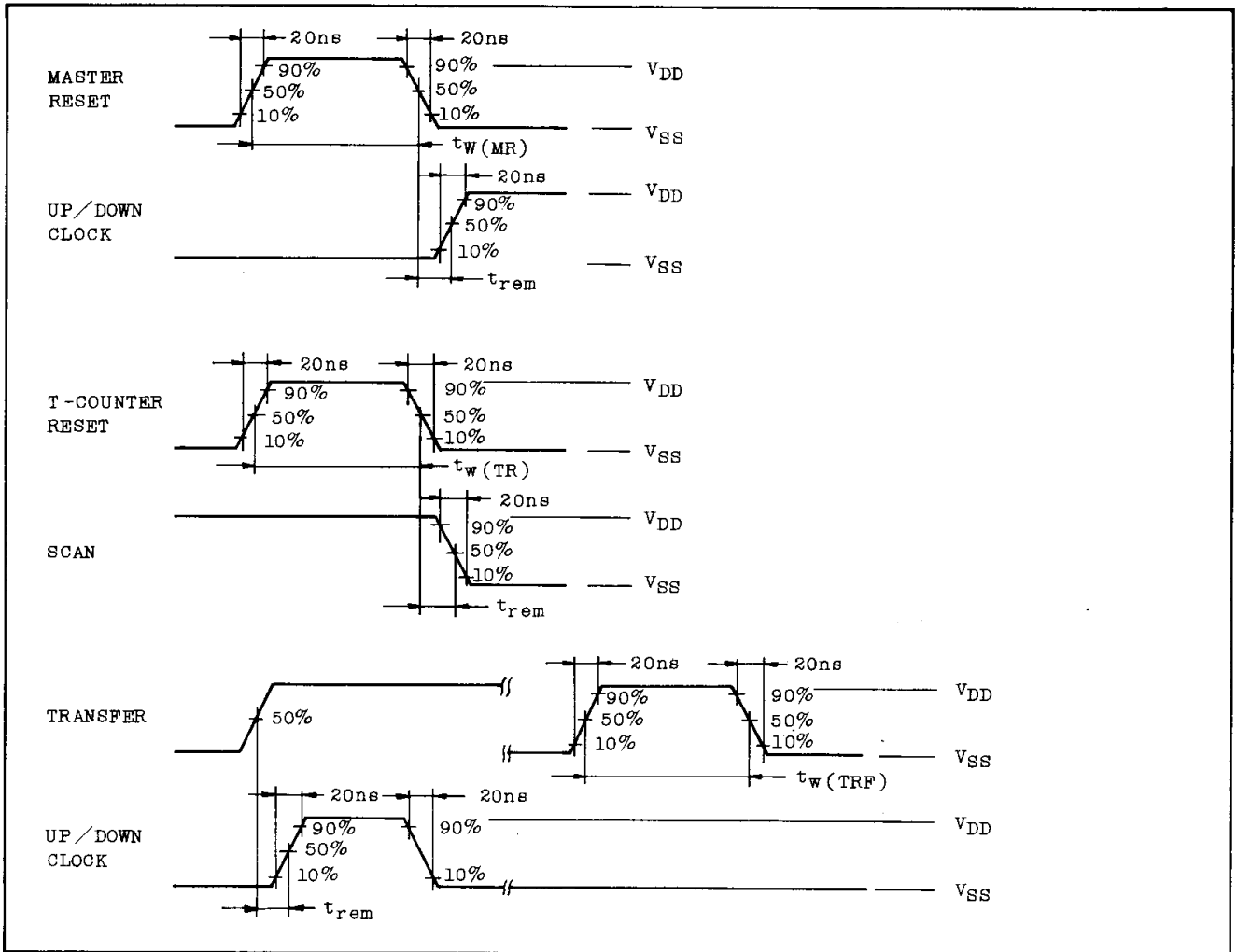
* Counter operation : $f_{\text{CL-1}}$, CARRY, BORROW operation : $f_{\text{CL-2}}$

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

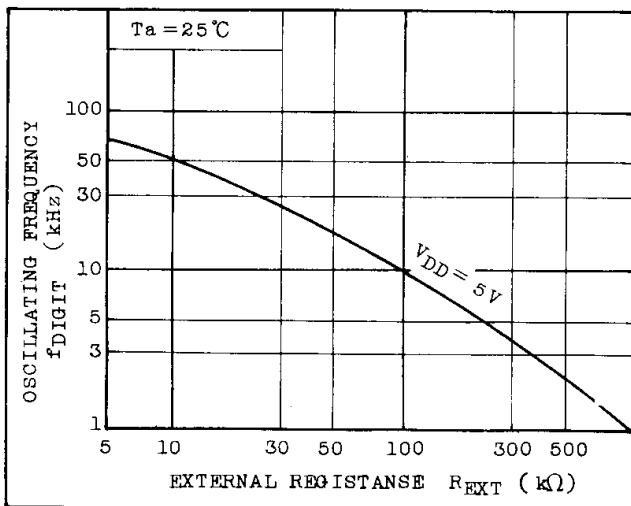
SWITCHING TIME TEST WAVEFORMS



SWITCHING TIME TEST WAVEFORMS (Continued)



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



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

