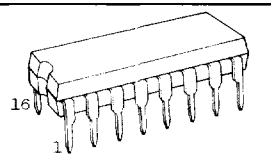
# TC74HC4094P/F

TC74HC4094P/F 8-BIT SHIFT AND STORE REGISTER (3-STATE)

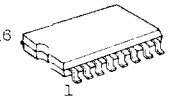
The TC74HC4094 is a high speed CMOS 8-STAGE SHIFT-AND-STORE REGISTER fabricated with silicon gate $C^2MOS$ technology. It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation. This device consists of an 8-bit shift register and a 8-bit latch with 3-state output buffer. Data is shifted serially through the shift register on the positive going transition of the clock input signal. The output of the last stage (Qs) can be used to cascade several devices. Data on the Qs output is transferred to a second output (Qs') on the following negative transition of the clock input signal. The data of each stage of the shift register is provided to a latch, which latches data on the negative going transition of the STROBE input signal. When STROBE input is held high, data propagates through the latch to a 3-state output buffer. This buffer is enabled when OUTPUT ENABLE input is taken high. All inputs are equipped with protection circuits against static discharge or transient excess voltage.

FEATURES

- High Speed ..... $f_{MAX}$=42MHz(Typ.) at $V_{CC}$=5V
- Low Power Dissipation ..... $I_{CC}$=4μA(Max.) at Ta=25°C
- High Noise Immunity ..... $V_{NIH}=V_{NIL}$=28% $V_{CC}$(Min.)
- Output Drive Capability ..... 10 LSTTL Loads
- Symmetrical Output Impedance ..... $|I_{OH}|=I_{OL}$=4mA
- Balanced Propagation Delays ..... $t_{pLH} \fallingdotseq t_{pHL}$
- Wide Oerating Voltage Range ..... $V_{CC(opr.)}$=2V ∿ 6V
- Pin and Function Compatible with 4094B




DIP16(3D16A-P)



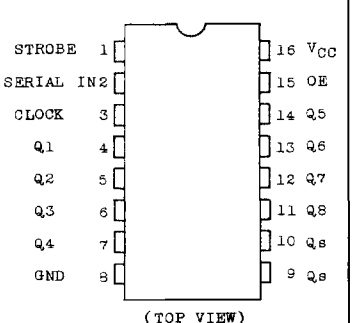

MFP16(F16GC-P)

ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | VALUE | UNIT |
|---|---|---|---|
| Supply Voltage Range | $V_{CC}$ | -0.5 ∿ 7 | V |
| DC Input Voltage | $V_{IN}$ | -0.5 ∿ $V_{CC}$+0.5 | V |
| DC Output Voltage | $V_{OUT}$ | -0.5 ∿ $V_{CC}$+0.5 | V |
| Input Diode Current | $I_{IK}$ | ±20 | mA |
| Output Diode Current | $I_{OK}$ | ±20 | mA |
| DC Output Current | $I_{OUT}$ | ±25 | mA |
| DC $V_{CC}$/Ground Current | $I_{CC}$ | ±50 | mA |
| Power Dissipation | $P_D$ | 500(DIP)*<br>180(MFP) | mW |
| Storage Temperature | $T_{stg}$ | -65 ∿ 150 | °C |
| Lead Temperature 10sec | $T_L$ | 300 | °C |

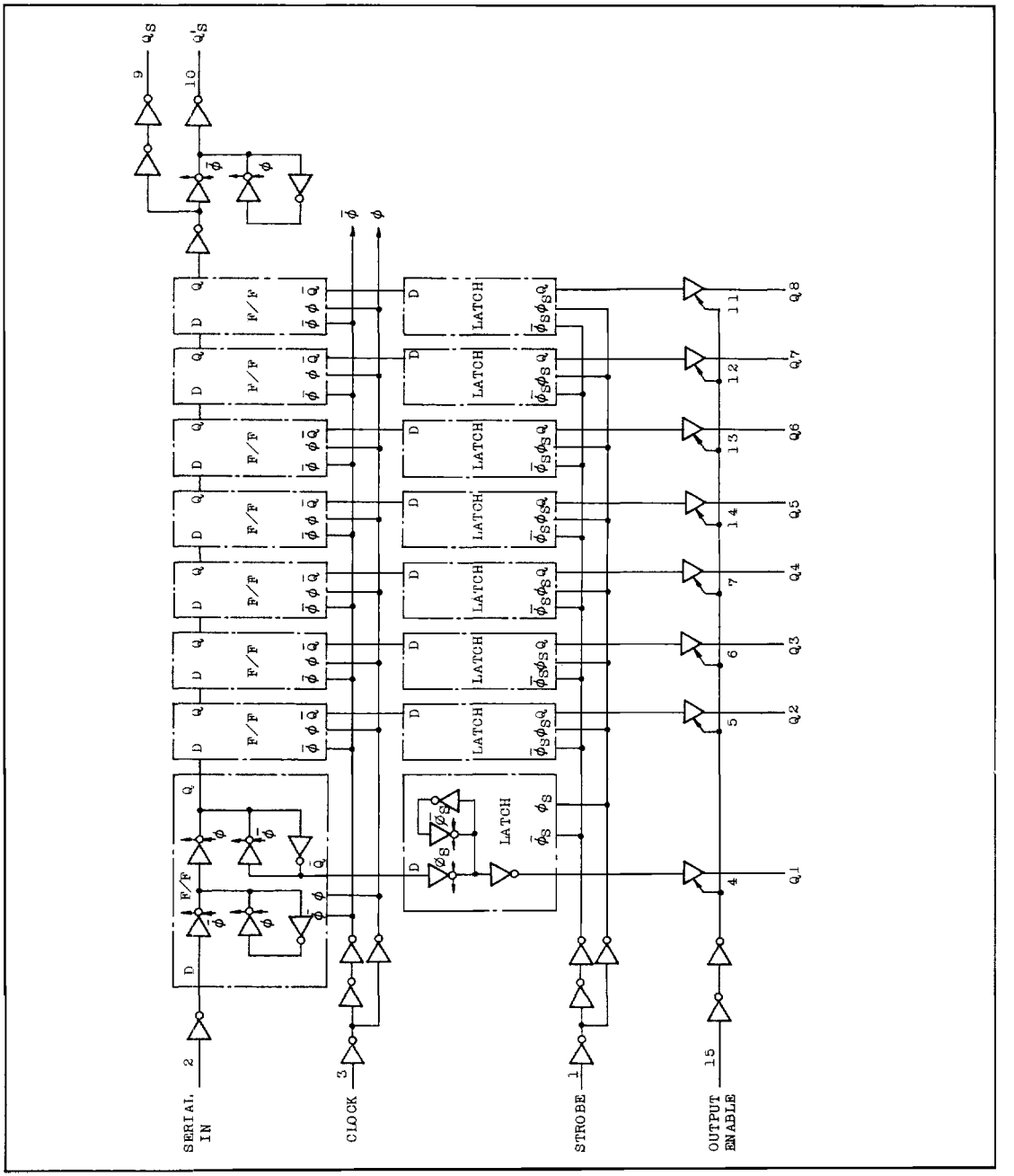
* 500mW in the range of Ta=-40° ∿ 65°C and from Ta=65°C up to 85°C derating factor of -10mW/°C shall be applied until 300mW.

PIN ASSIGNMENT

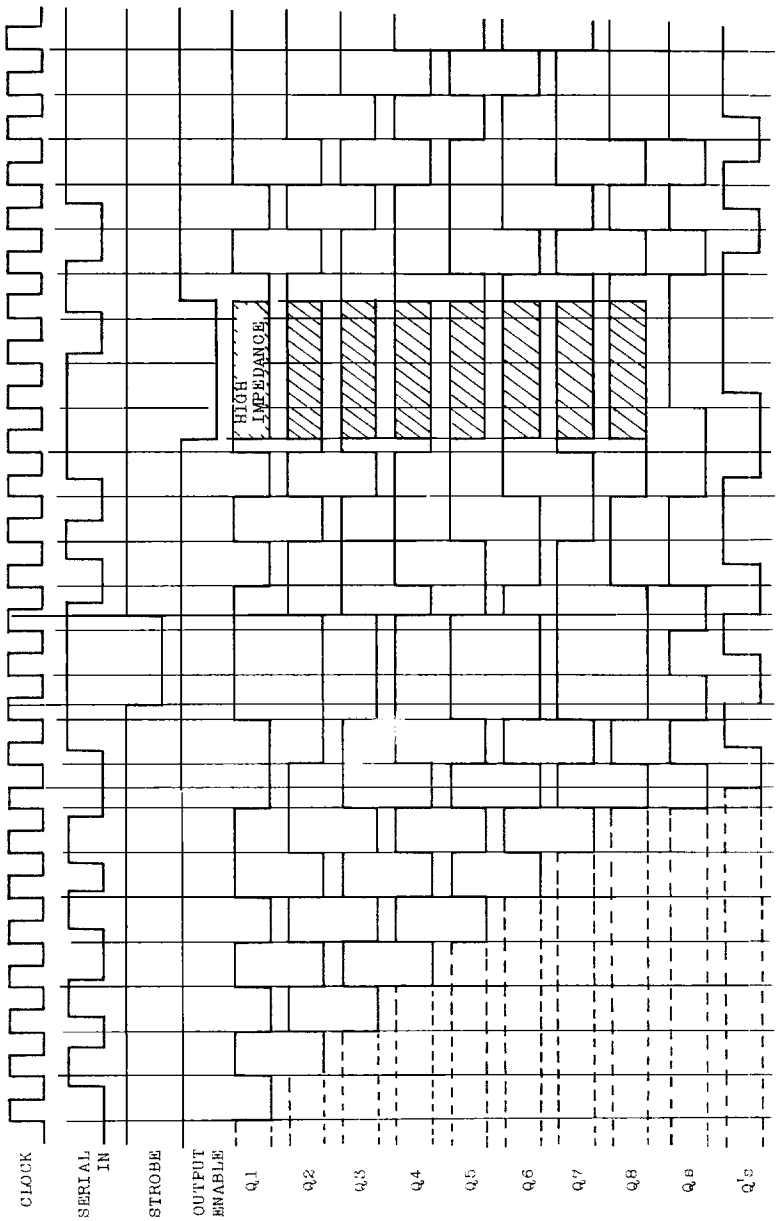



(TOP VIEW)

LOGIC DIAGRAM



TIMING CHART



TRUTH TABLE

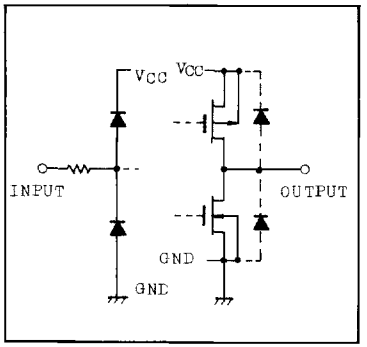
| CK | OE | ST | SI | PARA.OUT | | SERI.OUT | |
|---|---|---|---|---|---|---|---|
| | | | | $Q_1$ | $Q_n$ | $Q_s$ | $Q'_s$ |
| ↑ | H | H | L | L | Qn-1 | Q7 | NC |
| ↑ | H | H | H | H | Qn-1 | Q7 | NC |
| ↑ | H | L | X | NC | NC | Q7 | NC |
| ↑ | L | X | X | Z | Z | Q7 | NC |
| ↓ | H | X | X | NC | NC | NC | Qs |
| ↓ | L | X | X | Z | Z | NC | Qs |

X : DON'T CARE
NC: NO CHANGE
Z : HIGH IMPEDANCE

RECOMMENDED OPERATING CONDITIONS

| PARAMETER | SYMBOL | LIMIT | UNIT |
|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 2 ∿ 6 | V |
| Input Voltage | $V_{IN}$ | 0 ∿ $V_{CC}$ | V |
| Cutput Voltage | $V_{OUT}$ | 0 ∿ $V_{CC}$ | V |
| Operating Temperature | $T_{opr}$ | -40 ∿ 85 | °C |
| Input Rise and Fall Time | $t_r$, $t_f$ | 0 ∿ 1000 ($V_{CC}$=2.0V)<br>0 ∿ 500 ($V_{CC}$=4.5V)<br>0 ∿ 400 ($V_{CC}$=6.0V) | ns |

INPUT and OUTPUT
EQUIVALENT CIRCUIT




DC ELECTRICAL CHARACTERISTICS

| PARAMETER | SYMBOL | TEST CONDITION | | $V_{CC}$ | Ta=25°C MIN. | Ta=25°C TYP. | Ta=25°C MAX. | Ta=-40∿85°C MIN. | Ta=-40∿85°C MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| High-Level Input Voltage | $V_{IH}$ | | | 2.0 | 1.5 | - | - | 1.5 | - | V |
| | | | | 4.5 | 3.15 | - | - | 3.15 | - | |
| | | | | 6.0 | 4.2 | - | - | 4.2 | - | |
| Low-Level Input Voltage | $V_{IL}$ | | | 2.0 | - | - | 0.5 | - | 0.5 | V |
| | | | | 4.5 | - | - | 1.35 | - | 1.35 | |
| | | | | 6.0 | - | - | 1.8 | - | 1.8 | |
| High-Level Output Voltage | $V_{OH}$ | $V_{IN}$=$V_{IH}$ or $V_{IL}$ | $I_{OH}$=-20μA | 2.0 | 1.9 | 2.0 | - | 1.9 | - | V |
| | | | | 4.5 | 4.4 | 4.5 | - | 4.4 | - | |
| | | | | 6.0 | 5.9 | 6.0 | - | 5.9 | - | |
| | | | $I_{OH}$=-4mA | 4.5 | 4.18 | 4.31 | - | 4.13 | - | |
| | | | $I_{OH}$=-5.2mA | 6.0 | 5.68 | 5.80 | - | 5.63 | - | |

DC ELECTRICAL CHARACTERISTICS (Continued)

| PARAMETER | SYMBOL | TEST CONDITION | | $V_{CC}$ | Ta=25°C MIN. | Ta=25°C TYP. | Ta=25°C MAX. | Ta=-40~85°C MIN. | Ta=-40~85°C MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| Low-Level Output Voltage | $V_{OL}$ | $V_{IN}$= $V_{IH}$ or $V_{IL}$ | $I_{OL}$=20μA | 2.0 | - | 0.0 | 0.1 | - | 0.1 | V |
| | | | | 4.5 | - | 0.0 | 0.1 | - | 0.1 | |
| | | | | 6.0 | - | 0.0 | 0.1 | - | 0.1 | |
| | | | $I_{OL}$=4mA | 4.5 | - | 0.17 | 0.26 | - | 0.33 | |
| | | | $I_{OL}$=5.2mA | 6.0 | - | 0.18 | 0.26 | - | 0.33 | |
| 3-State Output Off-State Current | $I_{OZ}$ | $V_{IN}$=$V_{IH}$ or $V_{IL}$<br>$V_{OUT}$=$V_{CC}$ or GND | | 6.0 | - | - | ±0.5 | - | ±5.0 | μA |
| Input Leakage Current | $I_{IN}$ | $V_{IN}$=$V_{CC}$ or GND | | 6.0 | - | - | ±0.1 | - | ±1.0 | μA |
| Quiescent Supply Current | $I_{CC}$ | $V_{IN}$=$V_{CC}$ or GND | | 6.0 | - | - | 4.0 | - | 40.0 | |

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

| PARAMETER | SYMBOL | TEST CONDITION | $V_{CC}$ | 25°C MIN. | 25°C TYP. | 25°C MAX. | -40 ~ 85°C MIN. | -40 ~ 85°C MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Transition Time | $t_{TLH}$ | | 2.0 | - | 30 | 75 | - | 95 | ns |
| | | | 4.5 | - | 8 | 15 | - | 19 | |
| | $t_{THL}$ | | 6.0 | - | 7 | 13 | - | 16 | |
| Propagation Delay Time (CLOCK - Qn) | $t_{PLH}$ | | 2.0 | - | 140 | 270 | - | 340 | |
| | | | 4.5 | - | 35 | 54 | - | 68 | |
| | $t_{PHL}$ | | 6.0 | - | 30 | 46 | - | 58 | |
| Propagation Delay Time (CLOCK - Qs, Qs') | $t_{PLH}$ | | 2.0 | - | 104 | 200 | - | 250 | |
| | | | 4.5 | - | 26 | 40 | - | 50 | |
| | $t_{PHL}$ | | 6.0 | - | 22 | 34 | - | 43 | |
| Propagation Delay Time (STROBE - Qn) | $t_{PLH}$ | | 2.0 | - | 135 | 210 | - | 265 | |
| | | | 4.5 | - | 27 | 42 | - | 53 | |
| | $t_{PHL}$ | | 6.0 | - | 23 | 36 | - | 45 | |
| Maximum Clock Frequency | $f_{MAX}$ | | 2.0 | 4 | 10 | - | 3 | - | MHz |
| | | | 4.5 | 20 | 38 | - | 16 | - | |
| | | | 6.0 | 24 | 45 | - | 19 | - | |
| Minimum Clock Pulse Width | $t_{w(H)}$ | | 2.0 | - | 35 | 100 | - | 125 | ns |
| | | | 4.5 | - | 9 | 20 | - | 25 | |
| | $t_{w(L)}$ | | 6.0 | - | 8 | 17 | - | 21 | |
| Minimum Strobe Pulse Width | $t_{w(H)}$ | | 2.0 | - | 35 | 100 | - | 125 | |
| | | | 4.5 | - | 9 | 20 | - | 25 | |
| | | | 6.0 | - | 8 | 17 | - | 21 | |

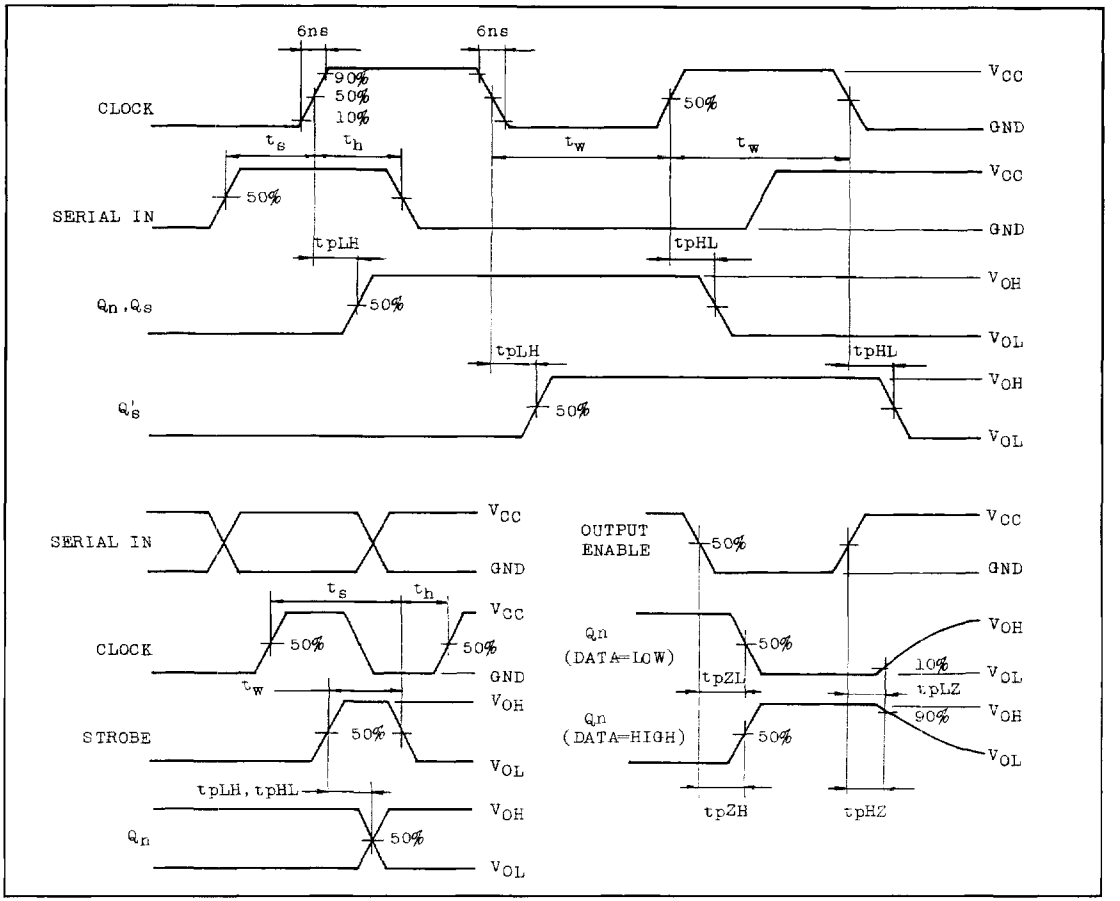
AC ELECTRICAL CHARACTERISTICS (Continued)

| PARAMETER | SYMBOL | TEST CONDITION | $V_{CC}$ | 25°C MIN. | 25°C TYP. | 25°C MAX. | -40 ~ 85°C MIN. | -40 ~ 85°C MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Minimum Serial In Set-up Time | $t_s$ | | 2.0 | - | 25 | 75 | - | 95 | ns |
| | | | 4.5 | - | 6 | 15 | - | 19 | |
| | | | 6.0 | - | 5 | 13 | - | 16 | |
| Minimum Strobe Set-up Time | $t_s$ | | 2.0 | - | 50 | 150 | - | 190 | |
| | | | 4.5 | - | 13 | 30 | - | 38 | |
| | | | 6.0 | - | 11 | 26 | - | 33 | |
| Minimum Serial In Hold Time | $t_h$ | | 2.0 | - | - | 0 | - | 0 | |
| | | | 4.5 | - | - | 0 | - | 0 | |
| | | | 6.0 | - | - | 0 | - | 0 | |
| Minimum Strobe Hold Time | $t_h$ | | 2.0 | - | - | 0 | - | 0 | |
| | | | 4.5 | - | - | 0 | - | 0 | |
| | | | 6.0 | - | - | 0 | - | 0 | |
| 3-State Output Enable Time | $t_{PZL}$ $t_{PZH}$ | $R_L$=1kΩ | 2.0 | - | 76 | 150 | - | 190 | |
| | | | 4.5 | - | 19 | 30 | - | 38 | |
| | | | 6.0 | - | 16 | 26 | - | 33 | |
| 3-State Output Disable Time | $t_{PLZ}$ $t_{PHZ}$ | $R_L$=1kΩ | 2.0 | - | 84 | 150 | - | 190 | |
| | | | 4.5 | - | 21 | 30 | - | 38 | |
| | | | 6.0 | - | 18 | 26 | - | 33 | |
| Input Capacitance | $C_{IN}$ | | | - | 5 | 10 | - | 10 | pF |
| Power Dissipation Capacitance | $C_{PD}$ (1) | | | - | 167 | - | - | - | |

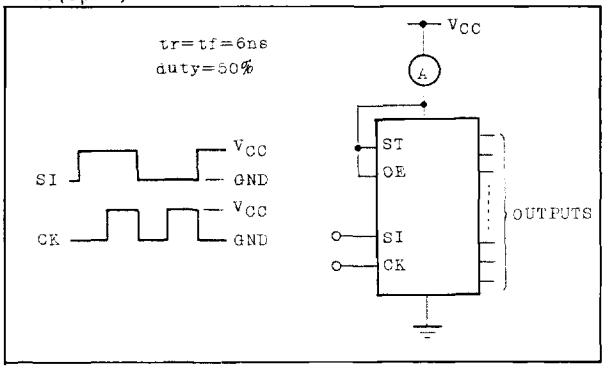
Note (1) $C_{PD}$ is defined as the value of internal equivalent capacitance of IC which is calculated from the operating current consumption without load (refer to Test Circuit). Average operating current can be obtained by the equation hereunder.

$$I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

## SWITCHING CHARACTERISTICS TEST WAVEFORM




## $I_{CC(opr.)}$ TEST WAVEFORM




## $C_{PD}$ CALCULATION

$C_{PD}$ is to be calculated with the formula hereunder by using the measured value of $I_{CC(opr)}$ in the test circuit drawn left side.

$$C_{PD} = \frac{I_{CC(opr)}}{f_{IN} \cdot V_{CC}}$$

At determining the typical value of $C_{PD}$, a relatively high frequency 1MHz was applied for $f_{IN}$, in order to eliminate the error from the quiescent supply current.