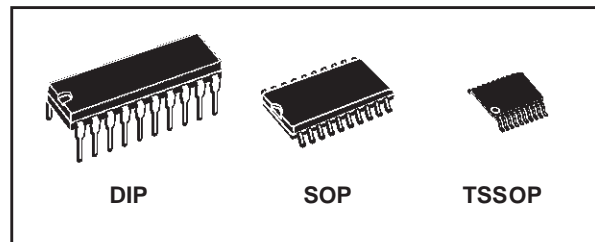




M74HC690

DECADE COUNTER/REGISTER (3-STATE)

- HIGH SPEED:
 $f_{MAX} = 53 \text{ MHz (TYP.) at } V_{CC} = 6\text{V}$
- LOW POWER DISSIPATION:
 $I_{CC} = 4\mu\text{A (MAX.) at } T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)}$
- SYMMETRICAL OUTPUT IMPEDANCE:
 $|I_{OH}| = I_{OL} = 6\text{mA (MIN) for } Q_A \text{ to } Q_D \text{ OUTPUT}$
 $|I_{OH}| = I_{OL} = 4\text{mA (MIN) for RCO OUTPUT}$
- BALANCED PROPAGATION DELAYS:
 $t_{PLH} \approx t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:
 $V_{CC} \text{ (OPR)} = 2\text{V to } 6\text{V}$
- PIN AND FUNCTION COMPATIBLE WITH
 74 SERIES 690



ORDER CODES

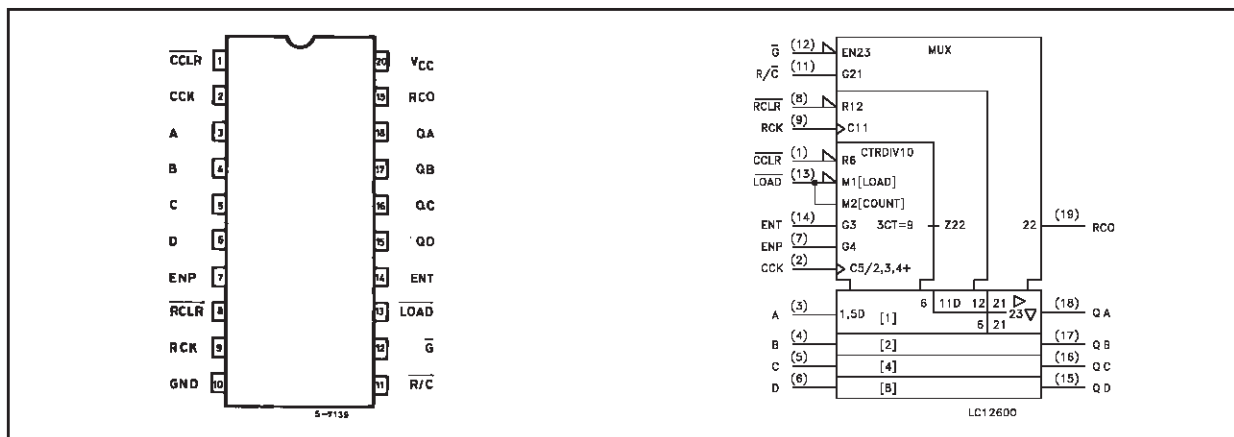
| PACKAGE | TUBE | T & R |
|---------|-------------|----------------|
| DIP | M74HC690B1R | |
| SOP | M74HC690M1R | M74HC690RM13TR |
| TSSOP | | M74HC690TTR |

DESCRIPTION

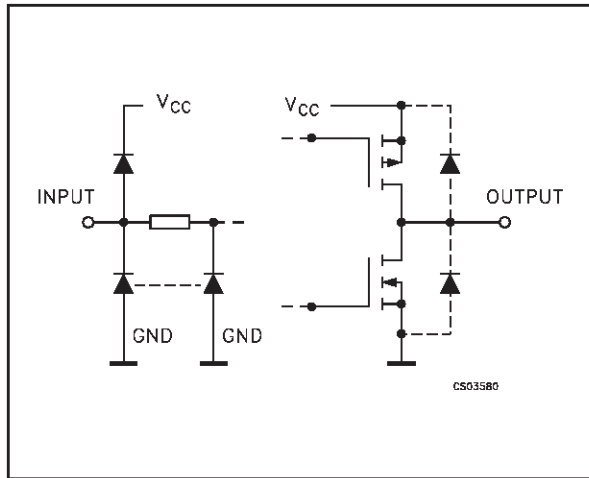
The M74HC690 is an high speed CMOS DECADE/COUNTER REGISTER (3 STATE) fabricated with silicon gate C²MOS technology. The internal circuit is composed of 3 stages including buffer output, which offers high noise immunity and stable output. This device incorporates a synchronous counter, four bit D-type register, and quadruple two-line to one-line multiplexers with three-state outputs in a single 20 pin package. The counter can be programmed from the data inputs and have enable P and enable T inputs and a ripple carry output for easy expansion. The register/counter select input, R/C, selects the counter when low or the register when high for the three state-outputs, QA, QB, QC, and

QD. If the LOAD input ($\overline{\text{LOAD}}$) is held "L" DATA input (A - D) are loaded into the internal counter at positive edge of counter clock input (CCK). In the counter mode, internal counter counts up at the positive edge of the counter clock. If the counter clear inputs ($\overline{\text{CCLR}}$) is held "L", the internal counter is cleared asynchronously to the counter clock. The internal counter's outputs are stored in the output register at the positive edge of the register clock (RCK). If the register clear input ($\overline{\text{RCLR}}$) is held "L" the register is cleared asynchronously to register clock. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION AND IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

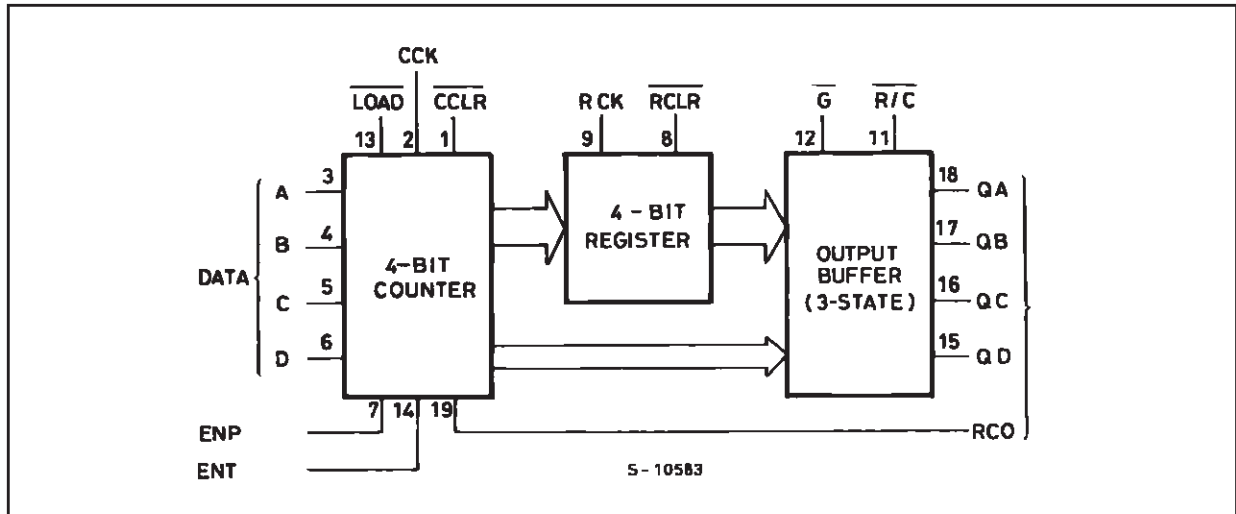
| PIN No | SYMBOL | NAME AND FUNCTION |
|----------|-----------------|-----------------------------|
| 3 to 6 | A to D | Data Inputs |
| 7, 14 | ENP, ENT | Enable Inputs |
| 15 to 18 | QA to QD | Data Outputs |
| 1 | CCLR | Counter Clear (Active LOW) |
| 2 | CCK | Counter Clock |
| 11 | R/C | Counter/Register Select |
| 8 | RCLR | Register Clear (Active LOW) |
| 9 | RCK | Register Clock |
| 19 | RCO | Ripple Counter Output |
| 10 | GND | Ground (0V) |
| 20 | V _{CC} | Positive Supply Voltage |

TRUTH TABLE

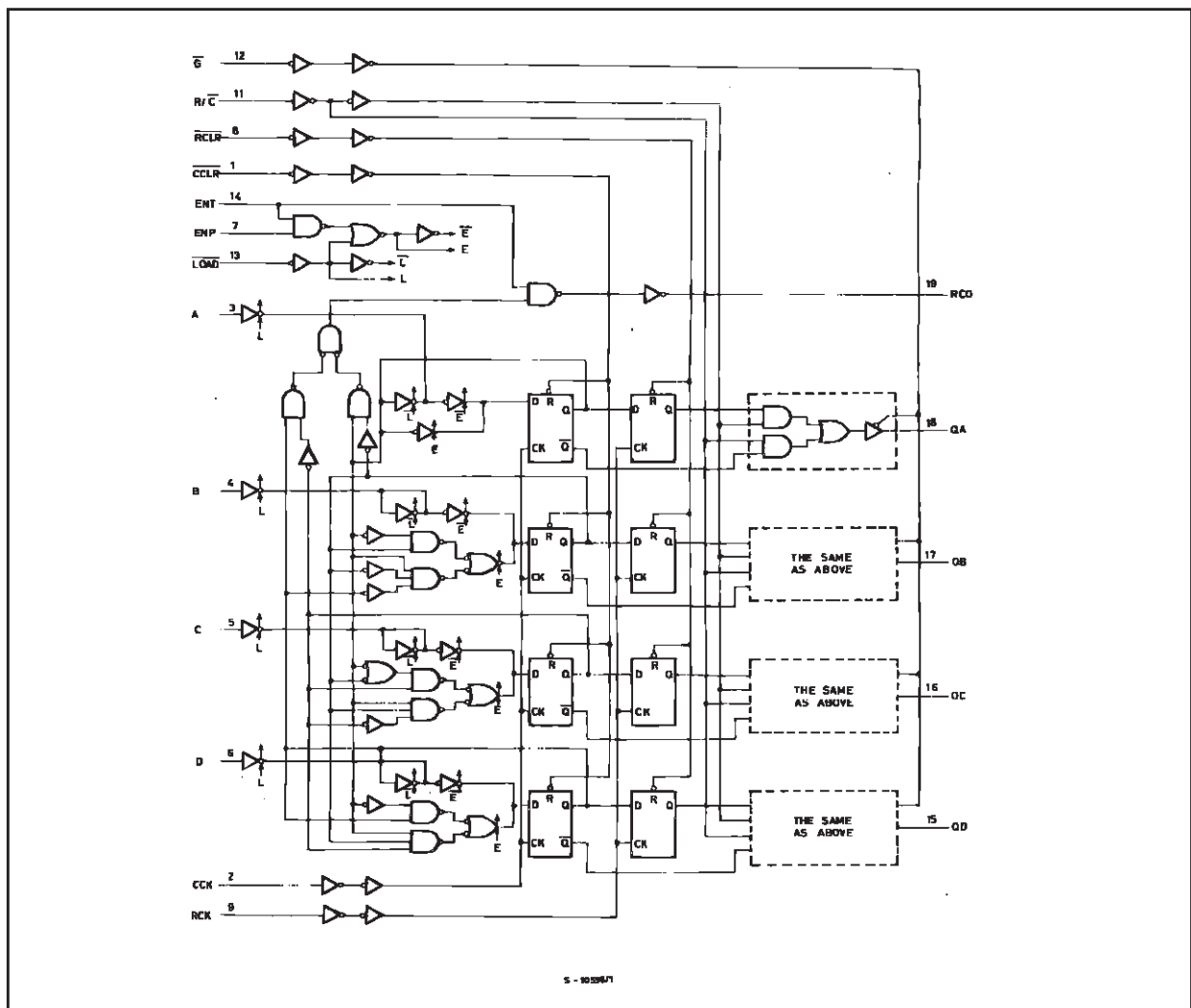
| INPUTS | | | | | | | | | OUTPUTS | | | | FUNCTION |
|--------|------|-----|-----|-----|------|-----|-----|----|-----------|----|----|----|----------------|
| CCLR | LOAD | ENP | ENT | CCK | RCLR | RCK | R/C | Ḡ | QA | QB | QC | QD | |
| X | X | X | X | X | X | X | X | X | Z | Z | Z | Z | HIGH IMPEDANCE |
| L | X | X | X | X | X | X | L | L | L | L | L | L | CLEAR COUNTER |
| H | L | X | X | ⎓ | X | X | L | L | a | b | c | d | LOAD COUNTER |
| H | H | L | X | ⎓ | X | X | L | L | NO CHANGE | | | | NO COUNT |
| H | H | X | L | ⎓ | X | X | L | L | NO CHANGE | | | | NO COUNT |
| H | H | H | H | ⎓ | X | X | L | L | COUNT UP | | | | COUNT UP |
| H | X | X | X | ⎓ | X | X | L | L | NO CHANGE | | | | NO COUNT |
| X | X | X | X | X | L | X | H | L | L | L | L | L | CLEAR REGISTER |
| X | X | X | X | X | H | ⎓ | H | L | a' | b' | c' | d' | LOAD REGISTER |
| X | X | X | X | X | H | ⎓ | H | L | NO CHANGE | | | | NO LOAD |

X : Don't Care
 Z : High Impedance
 a-d : The level of steady state inputs at inputs A through D respectively.
 a'-d' : The level of steady state outputs at internal counter outputs a' through qd' respectively
 RCO = QA · QD · ENT

BLOCK DIAGRAM



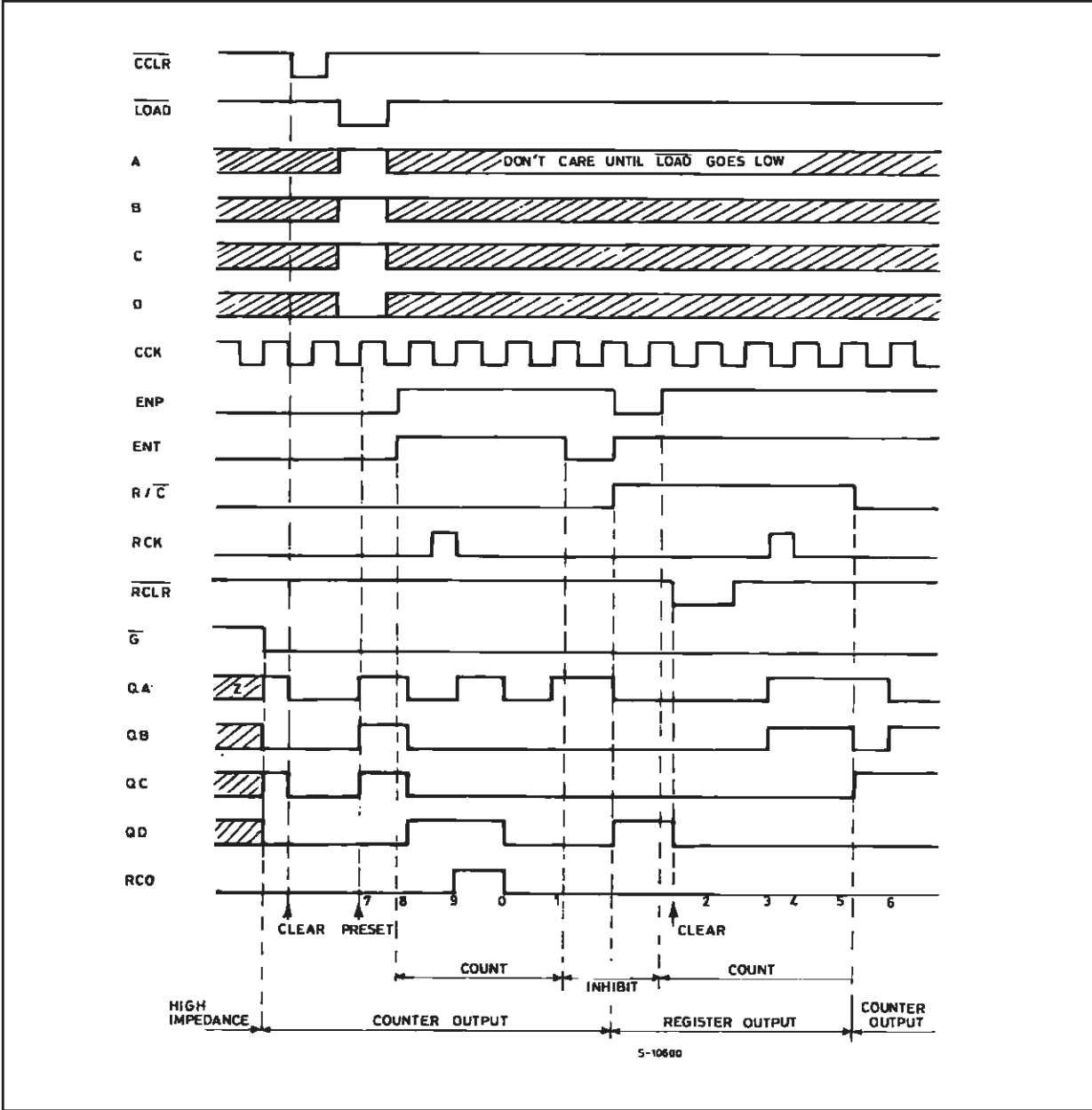
LOGIC DIAGRAM



This logic diagram has not been used to estimate propagation delays



TIMING CHART



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 Source Sink Current per Output PIN (RCO) (QA to QD) | ± 25 ± 35 | 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 (10 sec) | 300 | °C |

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

(*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 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_{op} | Operating Temperature | -55 to 125 | °C | |
| t_r, t_f | Input Rise and Fall Time | $V_{CC} = 2.0V$ | 0 to 1000 | ns |
| | | $V_{CC} = 4.5V$ | 0 to 500 | ns |
| | | $V_{CC} = 6.0V$ | 0 to 400 | ns |

DC SPECIFICATIONS

| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | |
|-----------------|---------------------------------------|------------------------|--|-----------------------|------|-------|-------------|------|--------------|------|------|
| | | V _{CC} (V) | | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| V _{IH} | High Level Input Voltage | 2.0 | | 1.5 | | | 1.5 | | 1.5 | | V |
| | | 4.5 | | 3.15 | | | 3.15 | | 3.15 | | |
| | | 6.0 | | 4.2 | | | 4.2 | | 4.2 | | |
| V _{IL} | Low Level Input Voltage | 2.0 | | | | 0.5 | | 0.5 | | 0.5 | V |
| | | 4.5 | | | | 1.35 | | 1.35 | | 1.35 | |
| | | 6.0 | | | | 1.8 | | 1.8 | | 1.8 | |
| V _{OH} | High Level Output Voltage (QA - QD) | 2.0 | I _O =-20 μA | 1.9 | 2.0 | | 1.9 | | 1.9 | | V |
| | | 4.5 | I _O =-20 μA | 4.4 | 4.5 | | 4.4 | | 4.4 | | |
| | | 6.0 | I _O =-20 μA | 5.9 | 6.0 | | 5.9 | | 5.9 | | |
| | | 4.5 | I _O =-6.0 mA | 4.18 | 4.31 | | 4.13 | | 4.10 | | |
| | | 6.0 | I _O =-7.8 mA | 5.68 | 5.8 | | 5.63 | | 5.60 | | |
| V _{OH} | High Level Output Voltage (RCO) | 2.0 | I _O =-20 μA | 1.9 | 2.0 | | 1.9 | | 1.9 | | V |
| | | 4.5 | I _O =-20 μA | 4.4 | 4.5 | | 4.4 | | 4.4 | | |
| | | 6.0 | I _O =-20 μA | 5.9 | 6.0 | | 5.9 | | 5.9 | | |
| | | 4.5 | I _O =-4.0 mA | 4.18 | 4.31 | | 4.13 | | 4.10 | | |
| | | 6.0 | I _O =-5.2 mA | 5.68 | 5.8 | | 5.63 | | 5.60 | | |
| V _{OL} | Low Level Output Voltage (QA - QD) | 2.0 | I _O =20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | I _O =20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 6.0 | I _O =20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 | I _O =6.0 mA | | 0.17 | 0.26 | | 0.37 | | 0.40 | |
| | | 6.0 | I _O =7.8 mA | | 0.18 | 0.26 | | 0.37 | | 0.40 | |
| V _{OL} | Low Level Output Voltage (RCO) | 2.0 | I _O =20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | I _O =20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 6.0 | I _O =20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 | I _O =4.0 mA | | 0.17 | 0.26 | | 0.37 | | 0.40 | |
| | | 6.0 | I _O =5.2 mA | | 0.18 | 0.26 | | 0.37 | | 0.40 | |
| I _I | Input Leakage Current | 6.0 | V _I = V _{CC} or GND | | | ± 0.1 | | ± 1 | | ± 1 | μA |
| I _{OZ} | High Impedance Output Leakage Current | 6.0 | V _I = V _{IH} or V _{IL} V _O = V _{CC} or GND | | | ± 0.5 | | ± 5 | | ± 10 | μA |
| I _{CC} | Quiescent Supply Current | 6.0 | V _I = V _{CC} or GND | | | 4 | | 40 | | 80 | μA |

AC ELECTRICAL CHARACTERISTICS ($C_L = 50 \text{ pF}$, Input $t_r = t_f = 6 \text{ ns}$)

| Symbol | Parameter | Test Condition | | | Value | | | | | | Unit | |
|---------------------|-------------------------------------|-----------------|---------------|--|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|
| | | V_{CC} (V) | C_L (pF) | | $T_A = 25^\circ\text{C}$ | | | $-40 \text{ to } 85^\circ\text{C}$ | | $-55 \text{ to } 125^\circ\text{C}$ | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| t_{TLH} t_{THL} | Output Transition Time (Q) | 2.0 | 50 | | | 25 | 60 | | 75 | | 90 | ns |
| | | 4.5 | | | 7 | 12 | | 15 | | 19 | | |
| | | 6.0 | | | 6 | 10 | | 13 | | 15 | | |
| t_{TLH} t_{THL} | Output Transition Time (RCO) | 2.0 | 50 | | | 30 | 75 | | 95 | | 115 | ns |
| | | 4.5 | | | 8 | 15 | | 19 | | 23 | | |
| | | 6.0 | | | 7 | 13 | | 16 | | 20 | | |
| t_{PLH} t_{PHL} | Propagation Delay Time (CCK - Q) | 2.0 | 50 | | | 82 | 205 | | 255 | | 310 | ns |
| | | 4.5 | | | 26 | 41 | | 51 | | 62 | | |
| | | 6.0 | | | 22 | 35 | | 43 | | 53 | | |
| | | 2.0 | 150 | | | 95 | 235 | | 295 | | 255 | |
| | | 4.5 | | | 30 | 47 | | 59 | | 71 | | |
| 6.0 | | 26 | 40 | | 50 | | 60 | | | | | |
| t_{PLH} t_{PHL} | Propagation Delay Time (RCK - Q) | 2.0 | 50 | | | 86 | 210 | | 265 | | 315 | ns |
| | | 4.5 | | | 27 | 42 | | 53 | | 63 | | |
| | | 6.0 | | | 23 | 36 | | 45 | | 54 | | |
| | | 2.0 | 150 | | | 99 | 240 | | 300 | | 360 | |
| | | 4.5 | | | 31 | 48 | | 60 | | 72 | | |
| 6.0 | | 26 | 41 | | 51 | | 61 | | | | | |
| t_{PLH} t_{PHL} | Propagation Delay Time (CCK - RCO) | 2.0 | 50 | | | 65 | 165 | | 205 | | 250 | ns |
| | | 4.5 | | | 21 | 33 | | 41 | | 50 | | |
| | | 6.0 | | | 18 | 28 | | 35 | | 43 | | |
| t_{PLH} t_{PHL} | Propagation Delay Time (R/C - Q) | 2.0 | 50 | | | 59 | 145 | | 180 | | 220 | ns |
| | | 4.5 | | | 18 | 29 | | 36 | | 44 | | |
| | | 6.0 | | | 15 | 25 | | 31 | | 37 | | |
| | | 2.0 | 150 | | | 72 | 175 | | 220 | | 265 | |
| | | 4.5 | | | 22 | 35 | | 44 | | 53 | | |
| 6.0 | | 19 | 30 | | 37 | | 45 | | | | | |
| t_{PLH} t_{PHL} | Propagation Delay Time (ENT - RCO) | 2.0 | 50 | | | 36 | 100 | | 125 | | 150 | ns |
| | | 4.5 | | | 12 | 20 | | 25 | | 30 | | |
| | | 6.0 | | | 10 | 17 | | 21 | | 26 | | |
| t_{PHL} | Propagation Delay Time (CCLR - Q) | 2.0 | 50 | | | 91 | 225 | | 280 | | 340 | ns |
| | | 4.5 | | | 29 | 45 | | 56 | | 68 | | |
| | | 6.0 | | | 25 | 38 | | 48 | | 58 | | |
| | | 2.0 | 150 | | | 104 | 255 | | 320 | | 385 | |
| | | 4.5 | | | 33 | 51 | | 64 | | 77 | | |
| 6.0 | | 28 | 43 | | 54 | | 65 | | | | | |
| t_{PHL} | Propagation Delay Time (RCLR - Q) | 2.0 | 50 | | | 86 | 210 | | 265 | | 315 | ns |
| | | 4.5 | | | 27 | 42 | | 53 | | 63 | | |
| | | 6.0 | | | 23 | 36 | | 45 | | 54 | | |
| | | 2.0 | 150 | | | 100 | 240 | | 300 | | 360 | |
| | | 4.5 | | | 31 | 48 | | 60 | | 72 | | |
| 6.0 | | 26 | 41 | | 51 | | 61 | | | | | |
| t_{PHL} | Propagation Delay Time (CCLR - RCO) | 2.0 | 50 | | | 70 | 175 | | 220 | | 265 | ns |
| | | 4.5 | | | 22 | 35 | | 44 | | 53 | | |
| | | 6.0 | | | 19 | 30 | | 37 | | 45 | | |

M74HC690

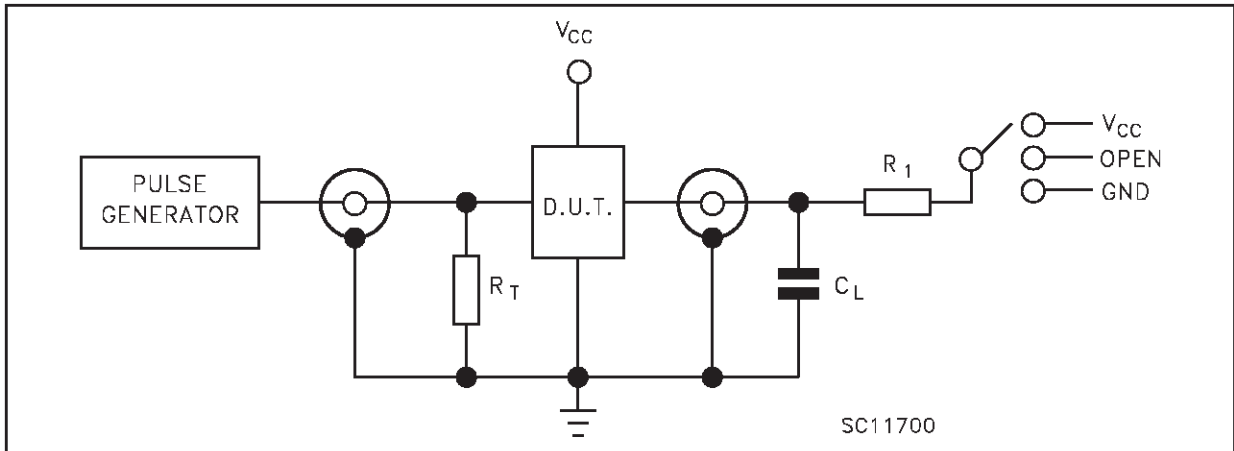
| Symbol | Parameter | Test Condition | | | Value | | | | | | Unit | |
|--|--------------------------------------|------------------------|------------------------|-----------------------|-----------------------|------|------|-------------|------|--------------|------|------|
| | | V _{CC} (V) | C _L (pF) | | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| f _{MAX} | Maximum Clock Frequency | 2.0 | 50 | | 4.4 | 12 | | 3.6 | | 3 | | MHz |
| | | 4.5 | | 22 | 45 | | 18 | | 15 | | | |
| | | 6.0 | | 26 | 53 | | 21 | | 18 | | | |
| t _{PZL} t _{PZH} | High Impedance Output Enable Time | 2.0 | 50 | R _L = 1 KΩ | | 48 | 120 | | 150 | | 180 | ns |
| | | 4.5 | | | 15 | 24 | | 30 | | 36 | | |
| | | 6.0 | | | 13 | 20 | | 26 | | 31 | | |
| | | 2.0 | 150 | R _L = 1 KΩ | | 61 | 150 | | 190 | | 225 | ns |
| | | 4.5 | | | 19 | 30 | | 38 | | 45 | | |
| | | 6.0 | | | 17 | 26 | | 32 | | 38 | | |
| t _{PLZ} t _{PHZ} | High Impedance Output Disable Time | 2.0 | 50 | R _L = 1 KΩ | | 32 | 145 | | 180 | | 220 | ns |
| | | 4.5 | | | 15 | 29 | | 36 | | 44 | | |
| | | 6.0 | | | 13 | 25 | | 31 | | 37 | | |
| t _{W(L)} t _{W(H)} | Minimum Pulse Width (CCK, RCK) | 2.0 | 50 | | | 28 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | 7 | 15 | | 19 | | 22 | | | |
| | | 6.0 | | 6 | 13 | | 16 | | 19 | | | |
| t _{W(L)} | Minimum Pulse Width (CCLR - RCLR) | 2.0 | 50 | | | 40 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | 8 | 15 | | 19 | | 22 | | | |
| | | 6.0 | | 7 | 13 | | 16 | | 19 | | | |
| t _s | Minimum Set-up Time (LOAD, ENT, ENP) | 2.0 | 50 | | | 68 | 150 | | 190 | | 220 | ns |
| | | 4.5 | | 17 | 30 | | 38 | | 44 | | | |
| | | 6.0 | | 14 | 26 | | 32 | | 37 | | | |
| t _s | Minimum Set-up Time (A, B, C, D) | 2.0 | 50 | | | 44 | 100 | | 125 | | 145 | ns |
| | | 4.5 | | 11 | 20 | | 25 | | 29 | | | |
| | | 6.0 | | 9 | 17 | | 21 | | 25 | | | |
| t _s | Minimum Set-up Time (CCK - RCK) | 2.0 | 50 | | | 48 | 125 | | 155 | | 180 | ns |
| | | 4.5 | | 12 | 25 | | 31 | | 36 | | | |
| | | 6.0 | | 10 | 21 | | 26 | | 31 | | | |
| t _h | Minimum Hold Time | 2.0 | 50 | | | | 0 | | 0 | | 0 | ns |
| | | 4.5 | | | | | 0 | | 0 | | | |
| | | 6.0 | | | | | 0 | | 0 | | | |
| t _{REM} | Minimum Removal Time | 2.0 | 50 | | | | 25 | | 30 | | 40 | ns |
| | | 4.5 | | | | | 5 | | 6 | | 8 | |
| | | 6.0 | | | | | 5 | | 5 | | 7 | |

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Test Condition | | | Value | | | | | | Unit | |
|-----------------|--|------------------------|--|--|-----------------------|------|------|-------------|------|--------------|------|------|
| | | V _{CC} (V) | | | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| C _{IN} | Input Capacitance | | | | | 5 | 10 | | 10 | | 10 | pF |
| C _{PD} | Power Dissipation Capacitance (note 1) | | | | | 70 | | | | | | pF |

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

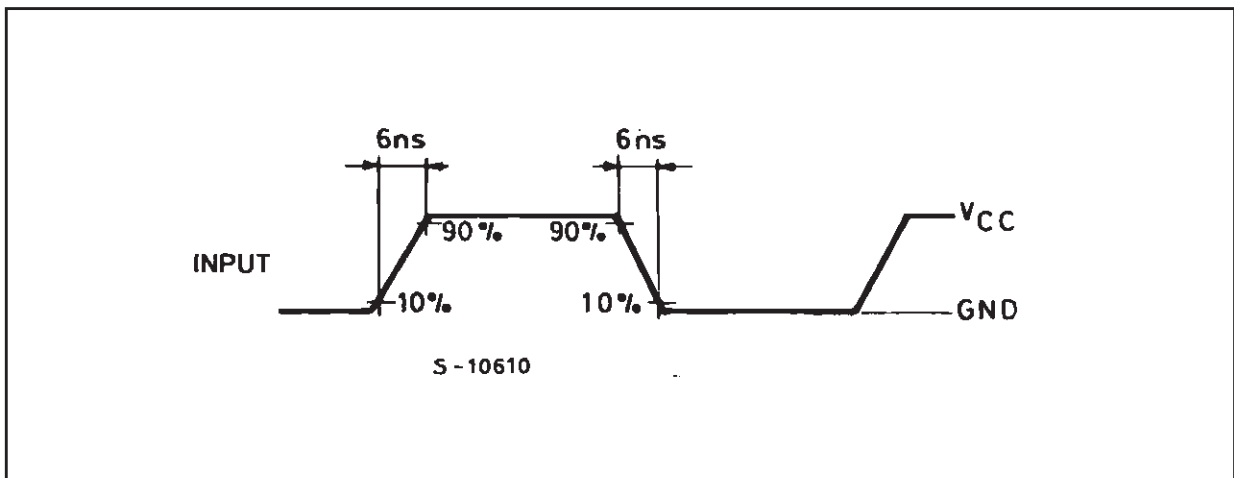
TEST CIRCUIT



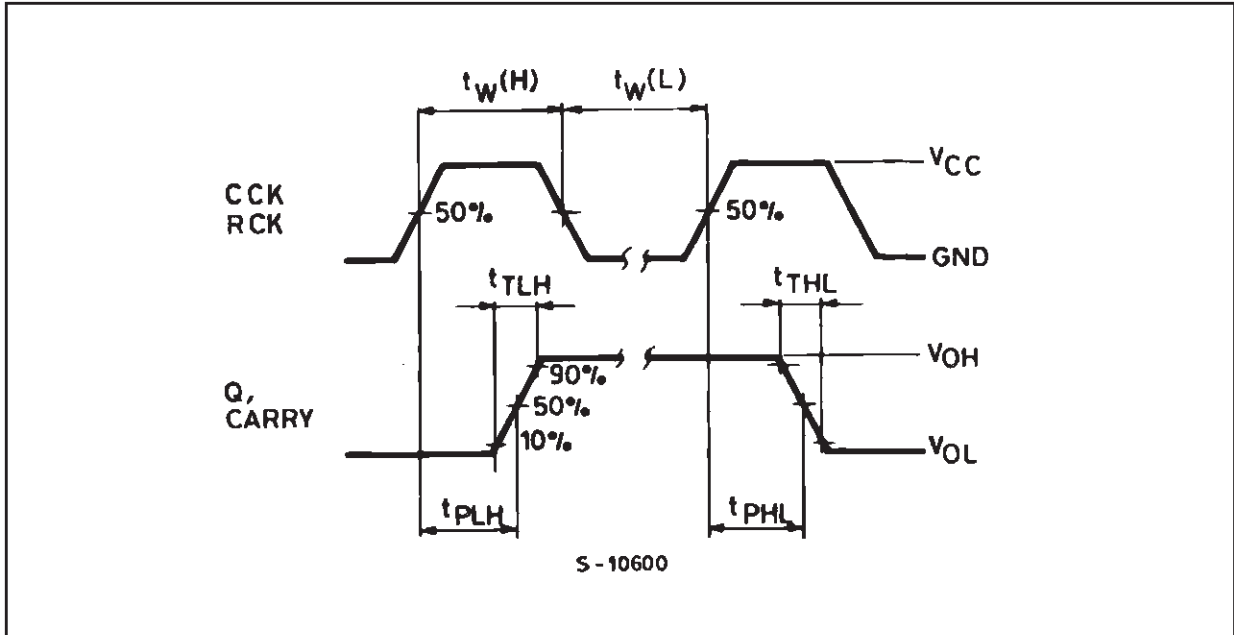
| TEST | SWITCH |
|-----------------------|----------|
| t_{PLH} , t_{PHL} | Open |
| t_{PZL} , t_{PLZ} | V_{CC} |
| t_{PZH} , t_{PHZ} | GND |

C_L = 50pF/150pF or equivalent (includes jig and probe capacitance)
 R_1 = 1K Ω or equivalent
 R_T = Z_{OUT} of pulse generator (typically 50 Ω)

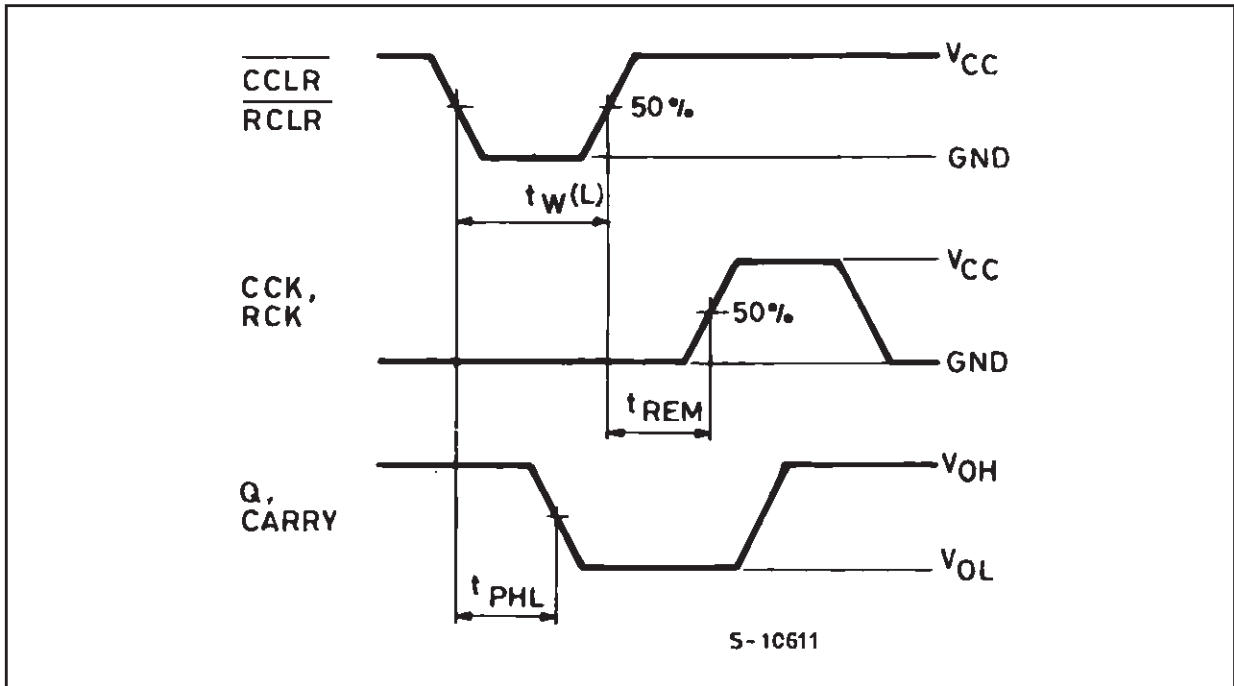
WAVEFORM 1: INPUT WAVEFORM (f=1MHz; 50% duty cycle)

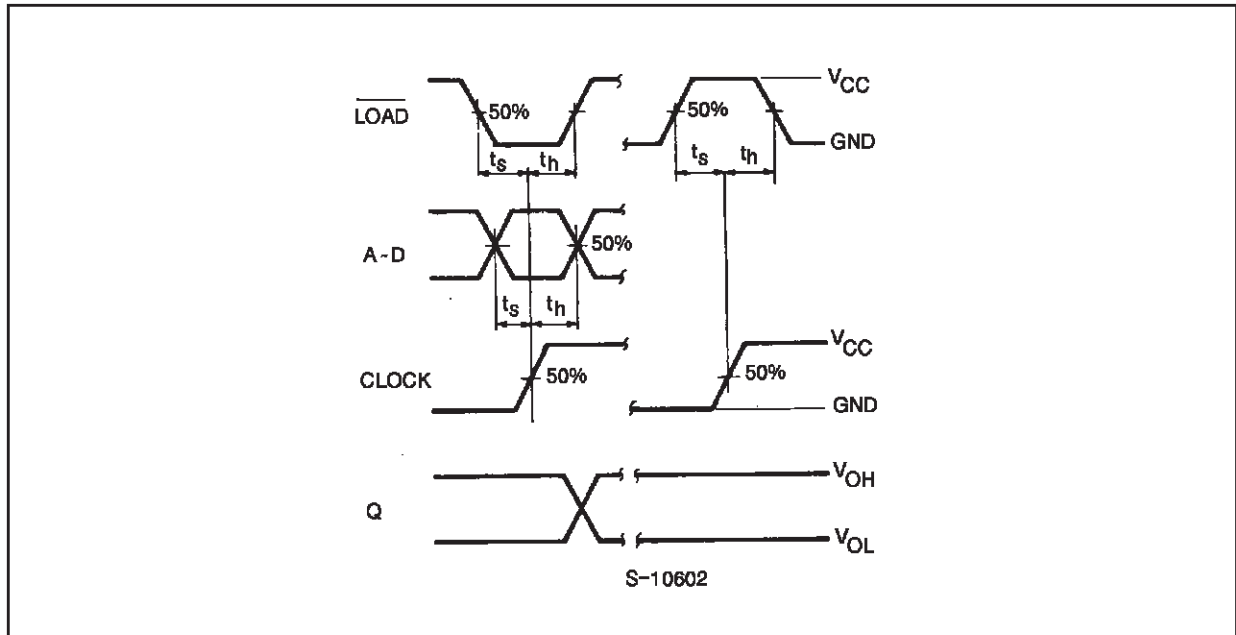
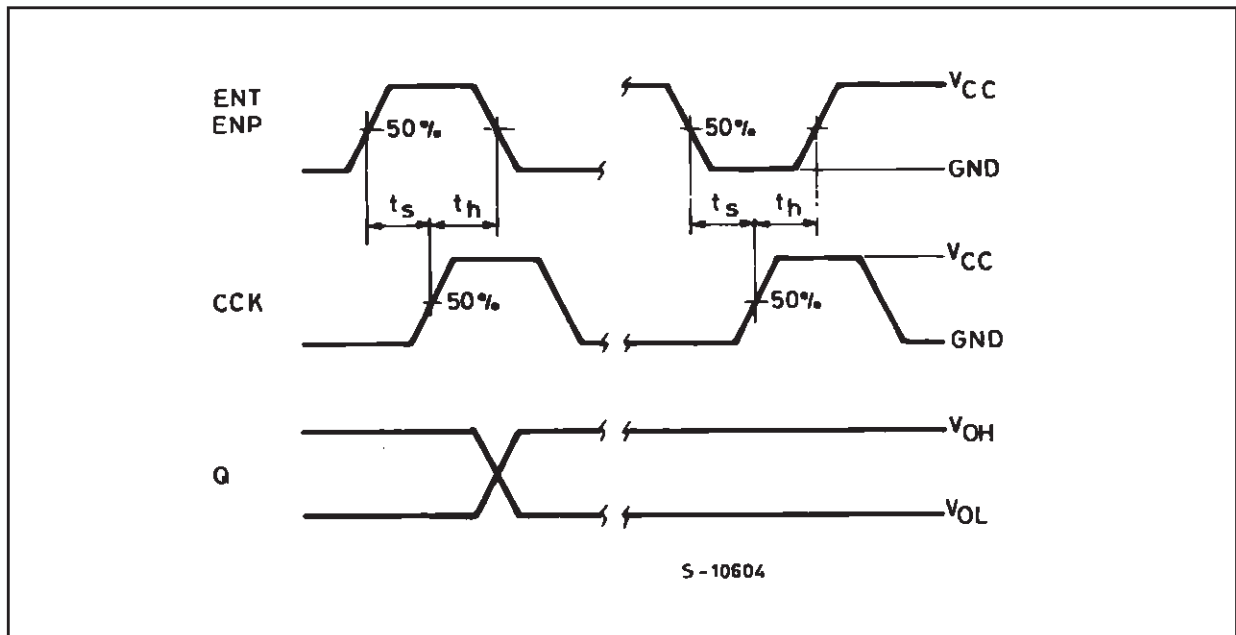


WAVEFORM 2 : PROPAGATION DELAY TIME, MINIMUM PULSE WIDTH (f=1MHz; 50% duty cycle)

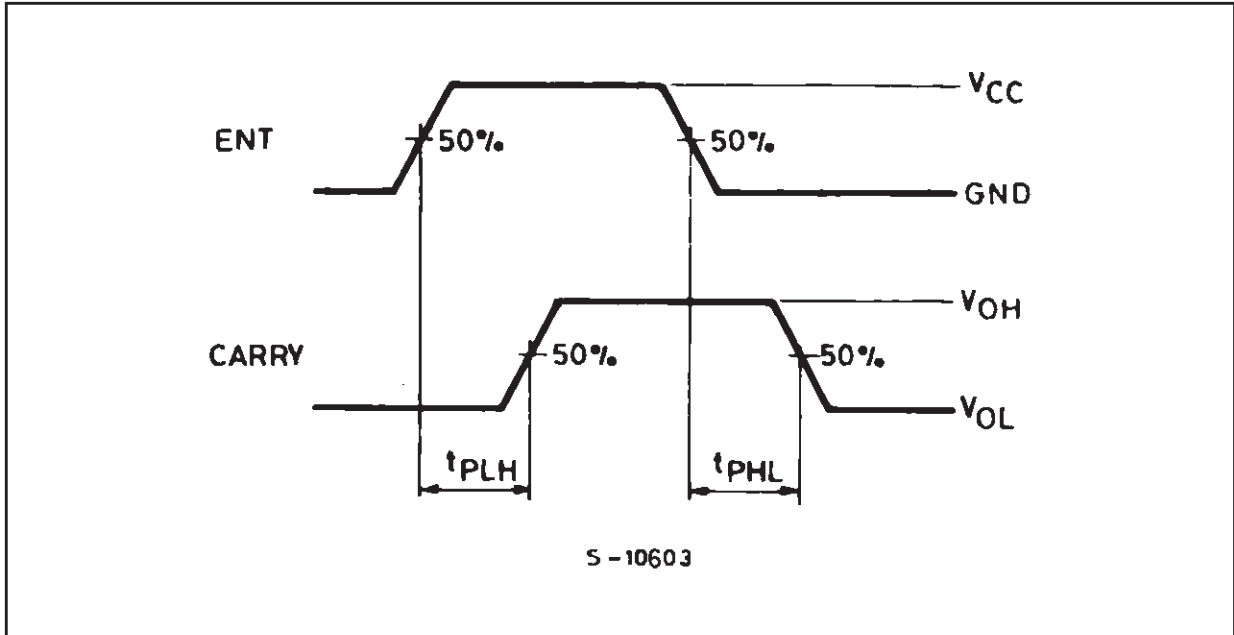


WAVEFORM 3 : MINIMUM PULSE WIDTH AND REMOVAL TIME (f=1MHz; 50% duty cycle)

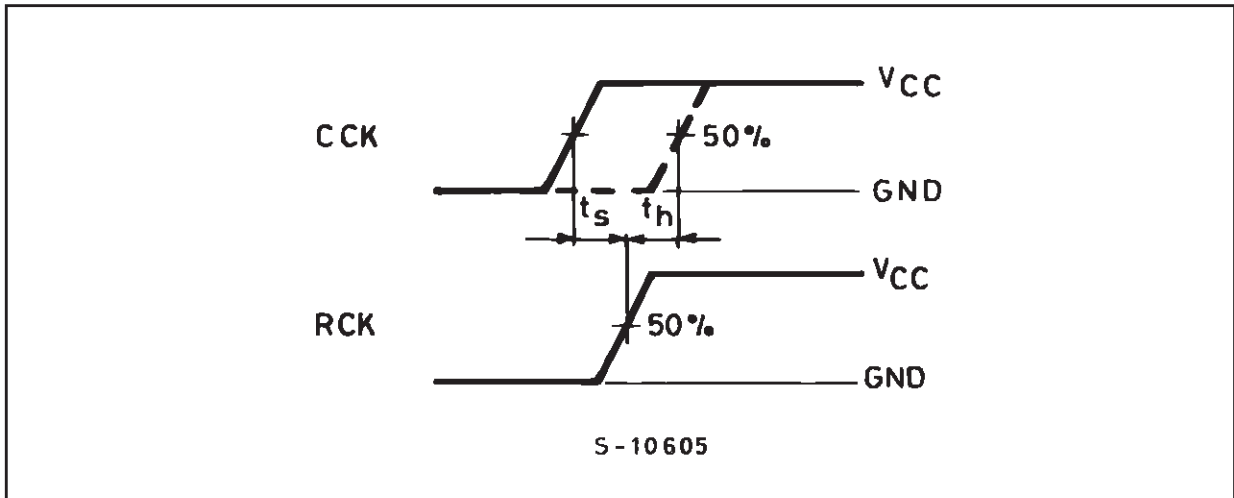


WAVEFORM 4 : MINIMUM SETUP AND HOLD TIME ($f=1\text{MHz}$; 50% duty cycle)WAVEFORM 5 : MINIMUM SETUP AND HOLD TIME ($f=1\text{MHz}$; 50% duty cycle)

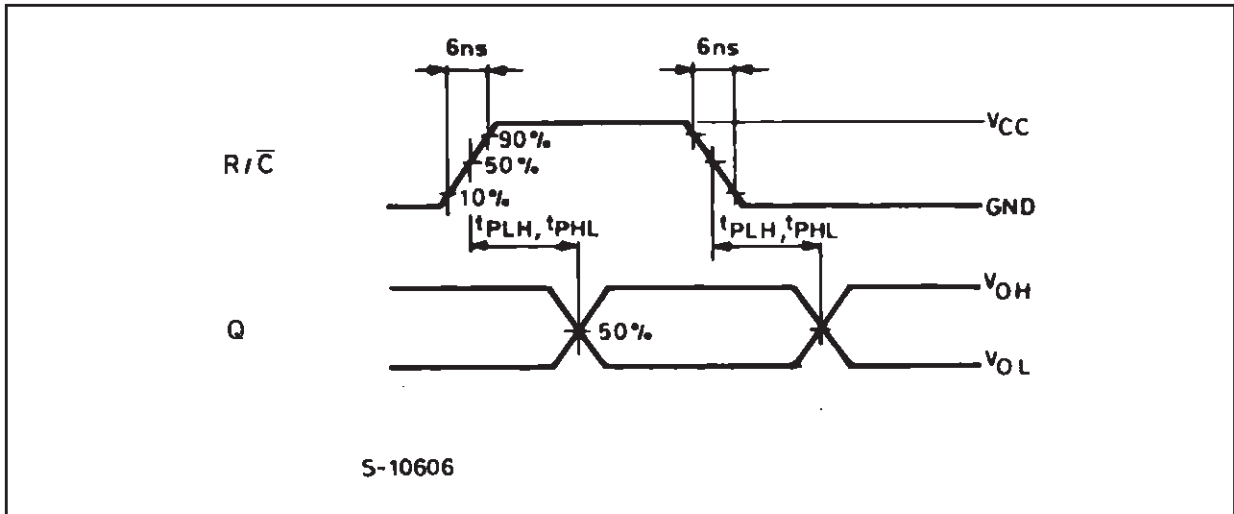
WAVEFORM 6 : PROPAGATION DELAY TIME (f=1MHz; 50% duty cycle)



WAVEFORM 7 : MINIMUM SETUP AND HOLD TIME (f=1MHz; 50% duty cycle)



WAVEFORM 8 : PROPAGATION DELAY TIME (f=1MHz; 50% duty cycle)



t_{PLZ}, t_{PZL}

The 1KΩ load resistors should be connected between outputs and V_{CC} line and the 50pF load capacitor should be connected between outputs and GND line.

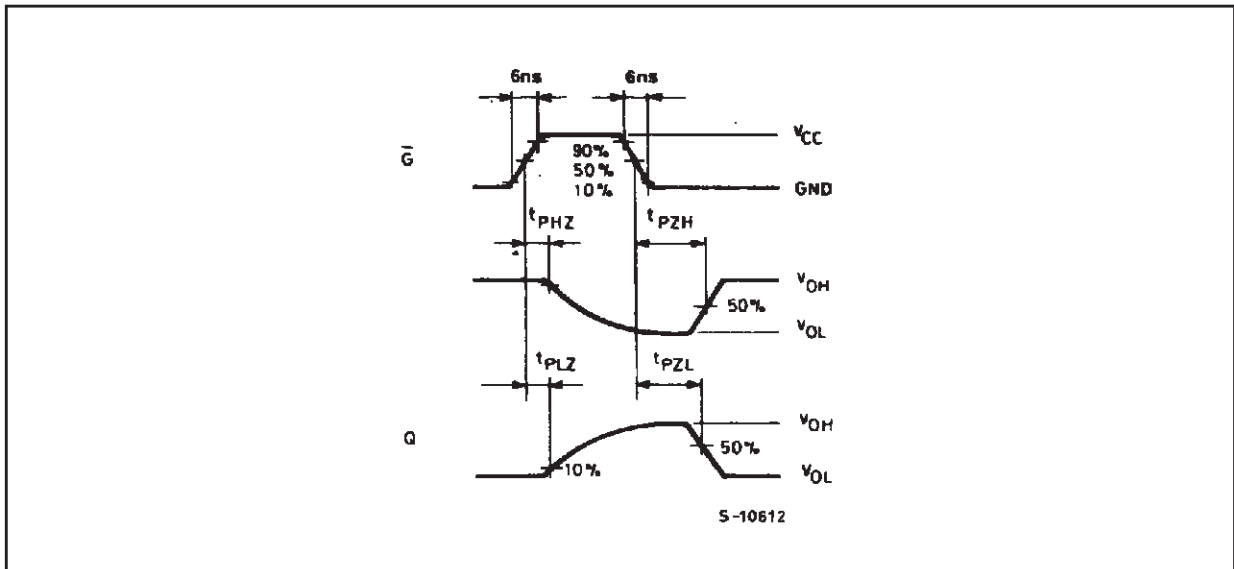
All inputs except \bar{G} input should be connected to V_{CC} or GND line such that outputs will be in low logic level while \bar{G} input is held low.

t_{PHZ}, t_{PZH}

The 1KΩ load resistors and the 50pF load capacitors should be connected between each output and GND line.

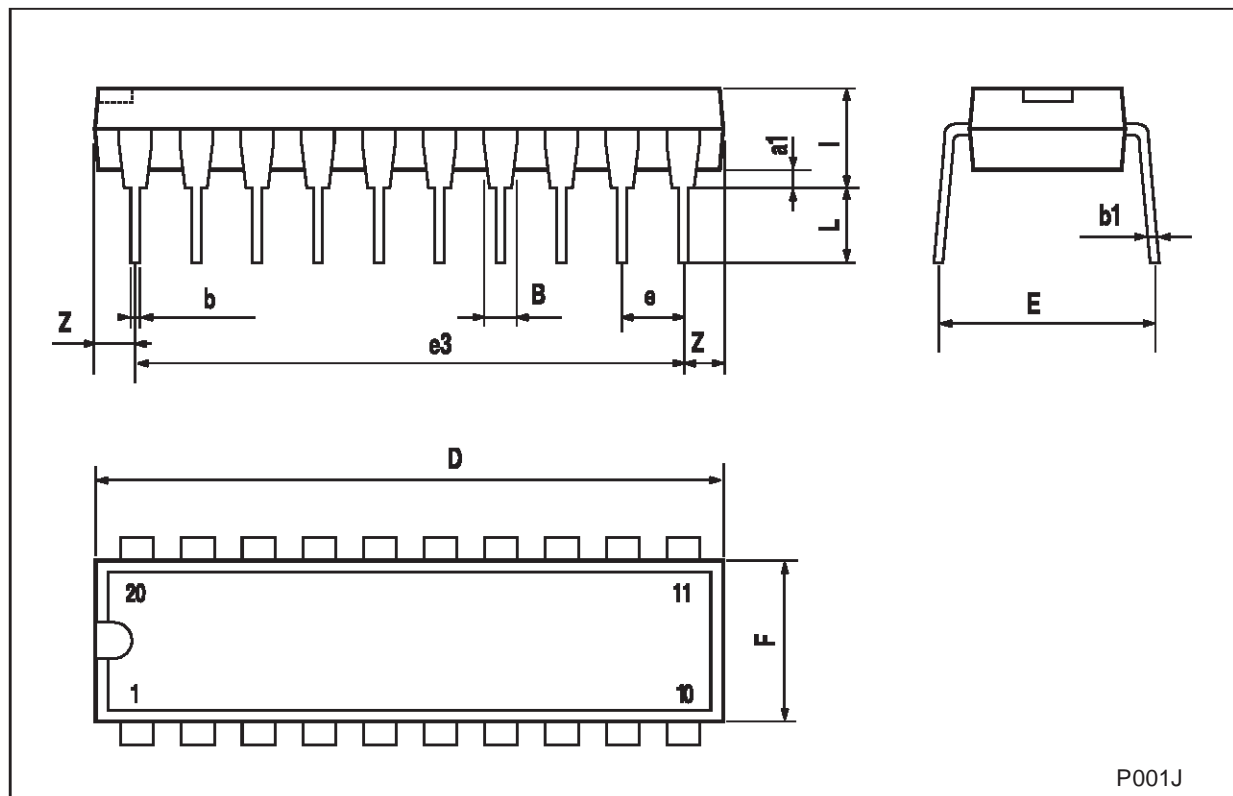
All inputs except \bar{G} input should be connected to V_{CC} or GND line such that outputs will be in low logic level while \bar{G} input is held low.

WAVEFORM 9 : OUTPUT ENABLE AND DISABLE TIME (f=1MHz; 50% duty cycle)



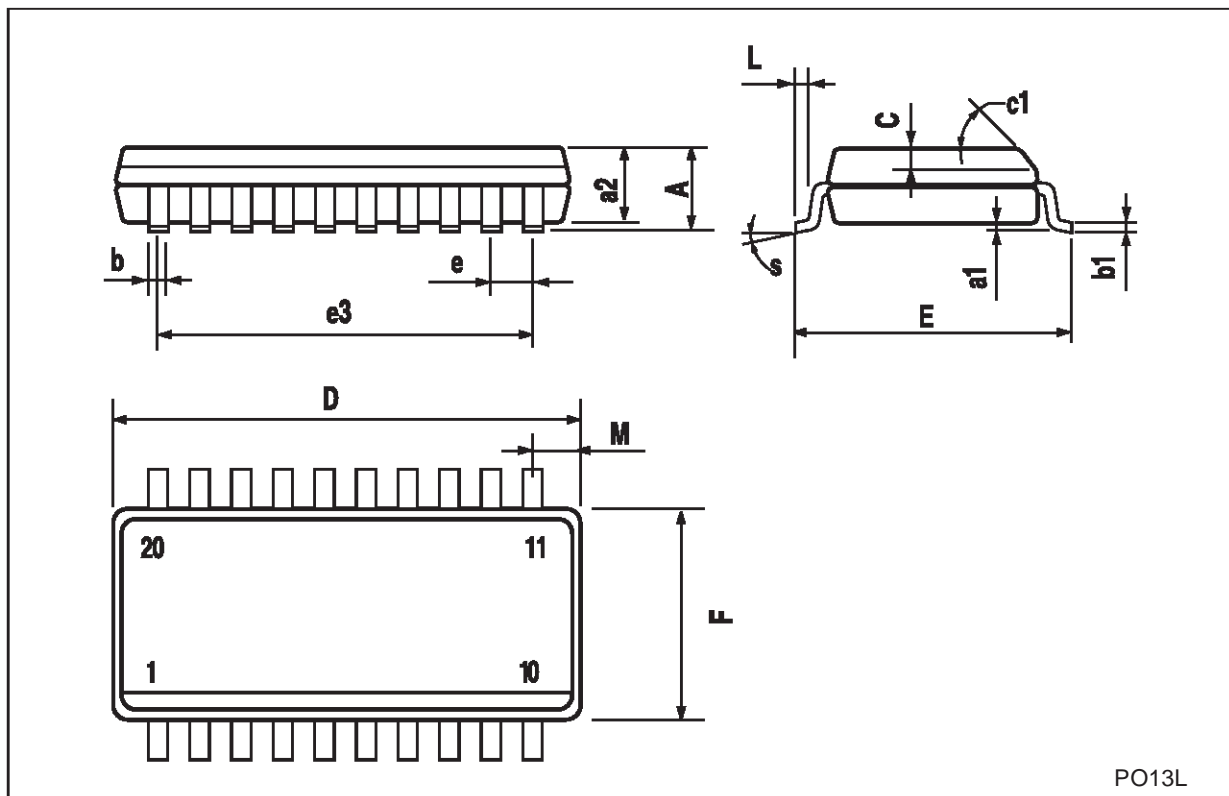
Plastic DIP-20 (0.25) MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.254 | | | 0.010 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.45 | | | 0.018 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 25.4 | | | 1.000 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 22.86 | | | 0.900 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 3.93 | | | 0.155 |
| L | | 3.3 | | | 0.130 | |
| Z | | | 1.34 | | | 0.053 |



SO-20 MECHANICAL DATA

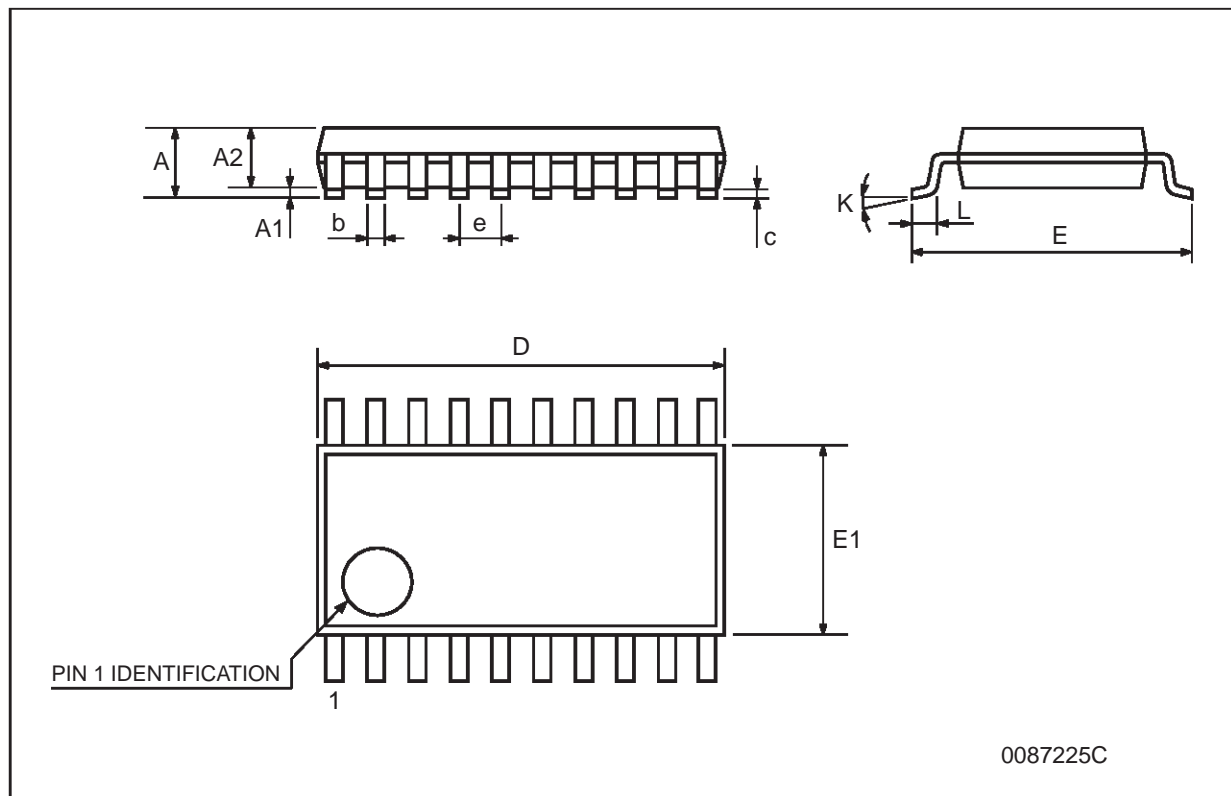
| DIM. | mm. | | | inch | | |
|------|------------|-------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 2.65 | | | 0.104 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.008 |
| a2 | | | 2.45 | | | 0.096 |
| b | 0.35 | | 0.49 | 0.014 | | 0.019 |
| b1 | 0.23 | | 0.32 | 0.009 | | 0.012 |
| C | | 0.5 | | | 0.020 | |
| c1 | 45° (typ.) | | | | | |
| D | 12.60 | | 13.00 | 0.496 | | 0.512 |
| E | 10.00 | | 10.65 | 0.393 | | 0.419 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 11.43 | | | 0.450 | |
| F | 7.40 | | 7.60 | 0.291 | | 0.300 |
| L | 0.50 | | 1.27 | 0.020 | | 0.050 |
| M | | | 0.75 | | | 0.029 |
| S | 8° (max.) | | | | | |



PO13L

TSSOP20 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------|----------|------|-------|------------|--------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.2 | | | 0.047 |
| A1 | 0.05 | | 0.15 | 0.002 | 0.004 | 0.006 |
| A2 | 0.8 | 1 | 1.05 | 0.031 | 0.039 | 0.041 |
| b | 0.19 | | 0.30 | 0.007 | | 0.012 |
| c | 0.09 | | 0.20 | 0.004 | | 0.0089 |
| D | 6.4 | 6.5 | 6.6 | 0.252 | 0.256 | 0.260 |
| E | 6.2 | 6.4 | 6.6 | 0.244 | 0.252 | 0.260 |
| E1 | 4.3 | 4.4 | 4.48 | 0.169 | 0.173 | 0.176 |
| e | | 0.65 BSC | | | 0.0256 BSC | |
| K | 0° | | 8° | 0° | | 8° |
| L | 0.45 | 0.60 | 0.75 | 0.018 | 0.024 | 0.030 |



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