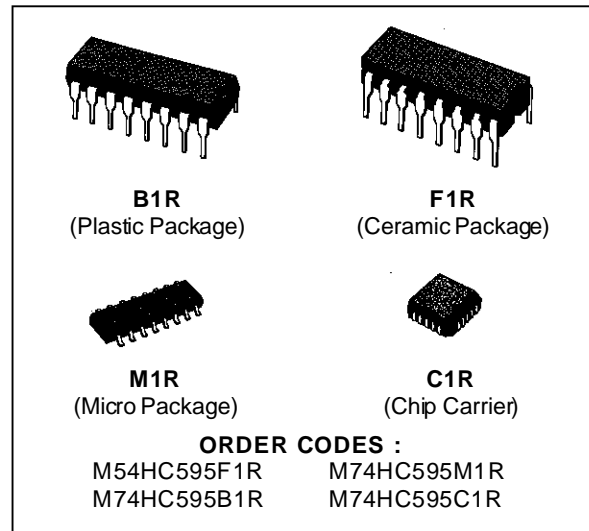


8 BIT SHIFT REGISTER WITH OUTPUT LATCHES (3 STATE)

- HIGH SPEED
 $f_{MAX} = 55 \text{ MHz (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION
 $I_{CC} = 4 \mu\text{A (MAX.) AT } T_A = 25 \text{ }^\circ\text{C}$
- HIGH NOISE IMMUNITY
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- OUTPUT DRIVE CAPABILITY
 15 LSTTL LOADS FOR QA TO QH
 10 LSTTL LOADS FOR QH'
- SYMMETRICAL OUTPUT IMPEDANCE
 $|I_{OH}| = I_{OL} = 6 \text{ mA (MIN.) FOR QA TO QH}$
 $|I_{OH}| = I_{OL} = 4 \text{ mA (MIN.) FOR QH'}$
- BALANCED PROPAGATION DELAYS
 $t_{PLH} = t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE
 $V_{CC} \text{ (OPR)} = 2 \text{ V TO } 6 \text{ V}$
- PIN AND FUNCTION COMPATIBLE
 WITH LSTTL 54/74LS595



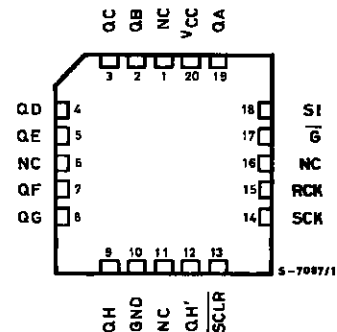
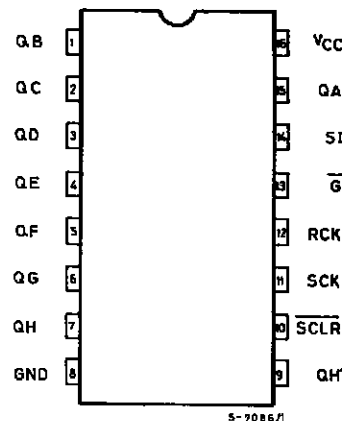
DESCRIPTION

The M54/74HC595 is a high speed CMOS 8-BIT SHIFT REGISTERS/OUTPUT LATCHES (3-STATE) fabricated in silicon C²MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. This device contains an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has 8 3-STATE outputs. Separate clocks are provided for both the shift register and the storage register.

The shift register has a direct-overriding clear, serial input, and serial output (standard) pins for cascading. Both the shift register and storage register use positive-edge triggered clocks. If both clocks are connected together, the shift register state will always be one clock pulse ahead of the storage register.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTIONS (top view)



NC =
No Internal
Connection

INPUT AND OUTPUT EQUIVALENT CIRCUIT

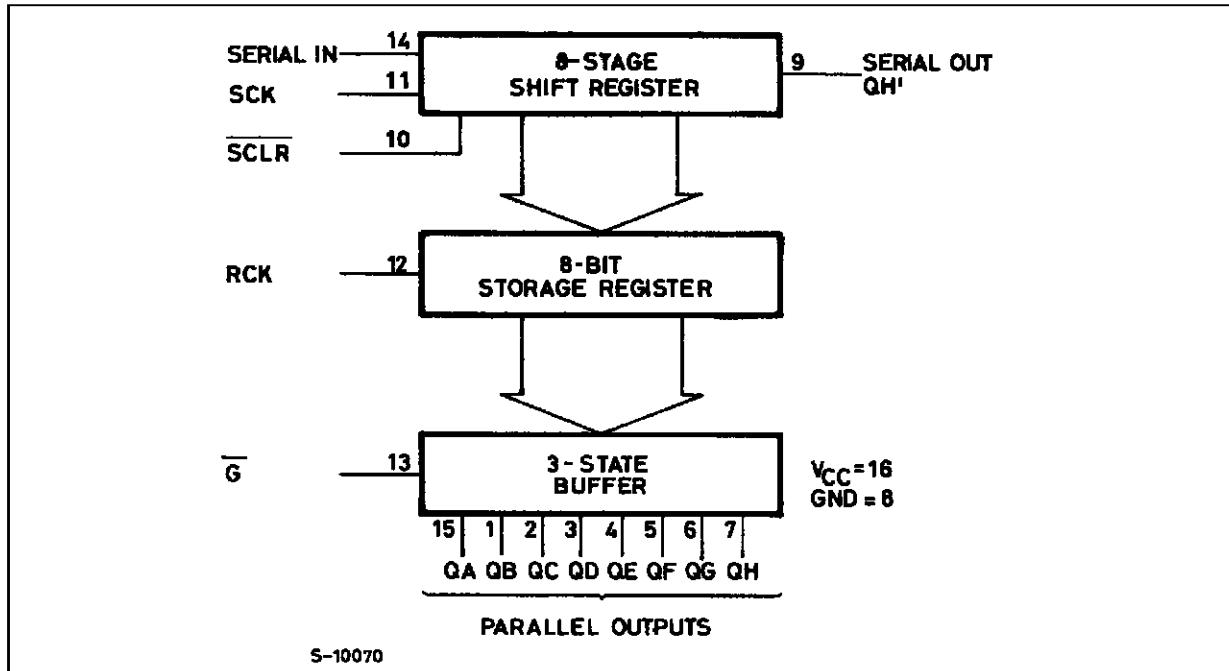


TRUTH TABLE

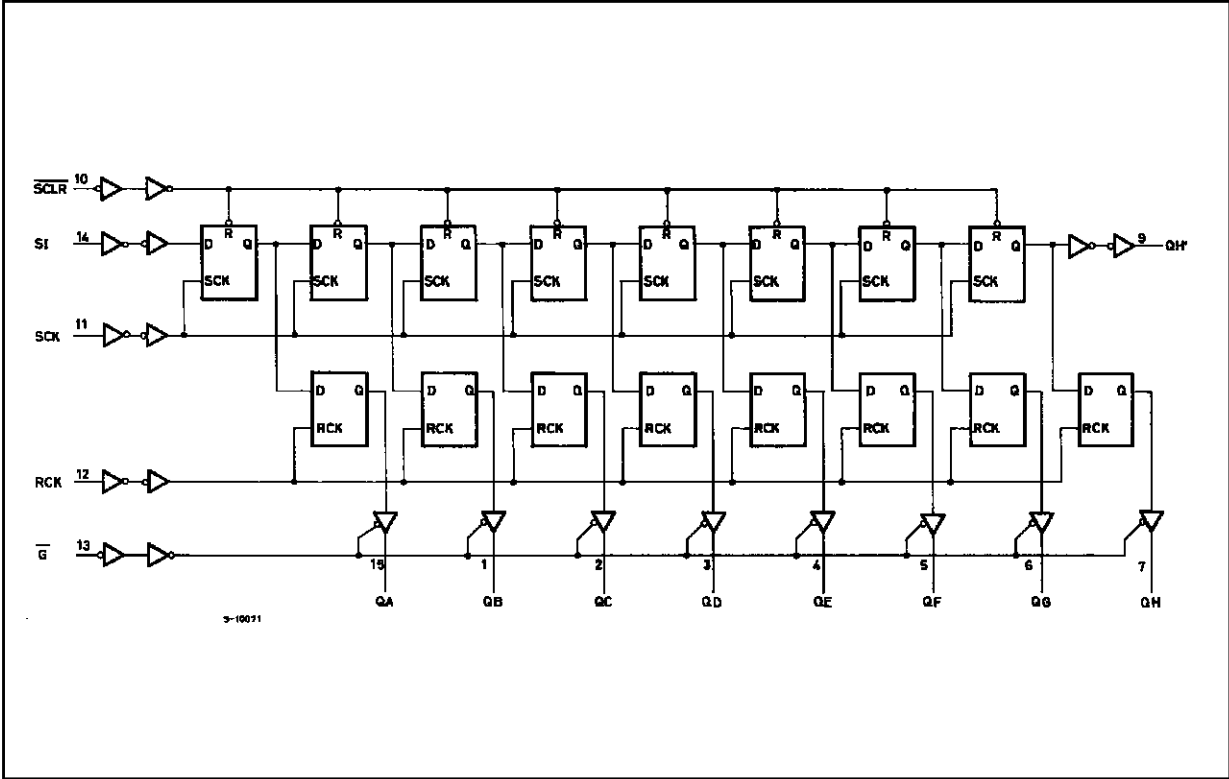
| INPUTS | | | | | OUTPUT |
|--------|-----|------|-----|----------------|---|
| SI | SCK | SCLR | RCK | \overline{G} | |
| X | X | X | X | H | QA THRU QH OUTPUTS DISABLE |
| X | X | X | X | L | QA THRU QH OUTPUTS ENABLE |
| X | X | L | X | X | SHIFT REGISTER IS CLEARED |
| L | | H | X | X | FIRST STAGE OF S.R. BECOMES "L" OTHER STAGES STORE THE DATA OF PREVIOUS STAGE, RESPECTIVELY |
| H | | H | X | X | FIRST STAGE OF S.R. BECOMES "H" OTHER STAGES STORE THE DATA OF PREVIOUS STAGE, RESPECTIVELY |
| X | | H | X | X | STATE OF S.R IS NOT CHANGED |
| X | X | X | | X | S.R. DATA IS STORED INTO STORAGE REGISTER |
| X | X | X | | X | STORAGE REGISTER STATE IS NOT CHANGED |

X: DONT CARE

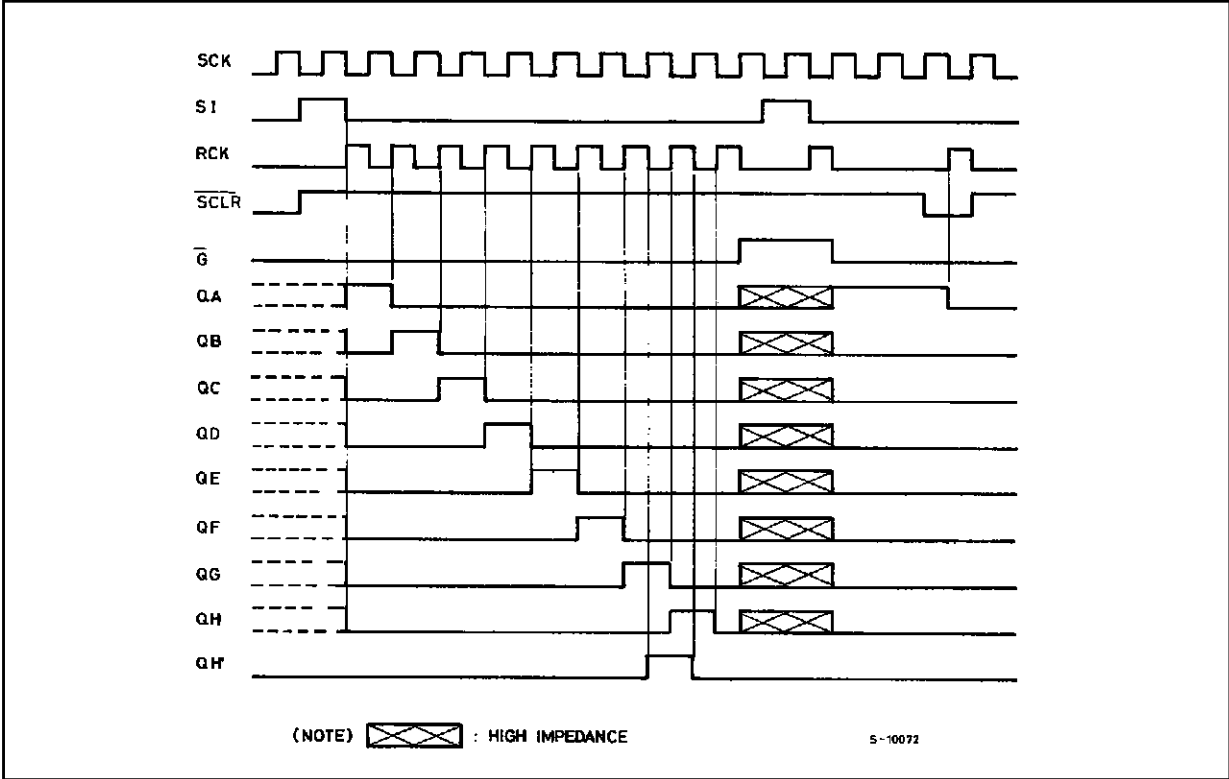
LOGIC DIAGRAM



LOGIC DIAGRAM



TIMING CHART

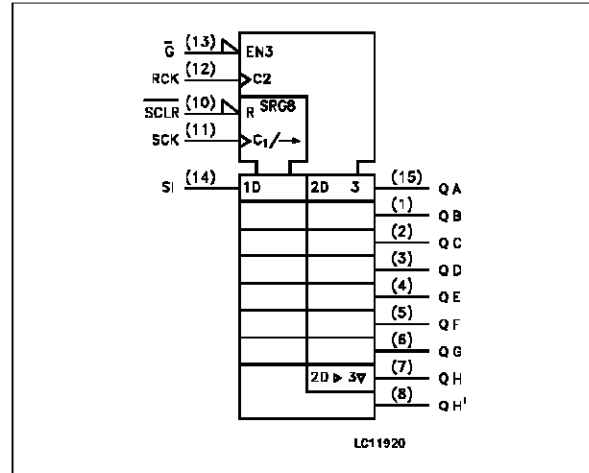


M54/M74HC595

PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|-------------------------|-----------------|------------------------------|
| 1, 2, 3, 4, 5, 6, 7, 15 | QA to QH | Data Outputs |
| 9 | QH' | Serial Data Outputs |
| 10 | SCLR | Shift Register Clear Input |
| 11 | SCK | Shift Register Clock Input |
| 13 | \bar{G} | Output Enable Input |
| 14 | SI | Serial Data Input |
| 12 | RCK | Storage Register Clock Input |
| 8 | GND | Ground (0V) |
| 16 | V _{CC} | Positive Supply Voltage |

IEC LOGIC SYMBOL



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 Per Output Pin QA-QH | ± 35 | mA |
| I _O | DC Output Current Per Output Pin QH' | ± 25 | 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 condition is not implied.
 (*) 500 mW: ± 65 °C derate to 300 mW by 10mW/°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 _{op} | Operating Temperature: M54HC Series M74HC Series | -55 to +125 -40 to +85 | °C °C | |
| t _r , t _f | Input Rise and Fall Time | V _{CC} = 2 V V _{CC} = 4.5 V V _{CC} = 6 V | 0 to 1000 0 to 500 0 to 400 | ns |

DC SPECIFICATIONS

| Symbol | Parameter | Test Conditions | | Value | | | | | | Unit | | |
|-----------------|---|------------------------|--|---|------|------|----------------------|------|-----------------------|------|------|---|
| | | V _{CC} (V) | | T _A = 25 °C 54HC and 74HC | | | -40 to 85 °C 74HC | | -55 to 125 °C 54HC | | | |
| | | | | 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 (for QH' output) | 2.0 | V _I = V _{IH} or V _{IL} | I _O = -20 μA | 1.9 | 2.0 | | 1.9 | | 1.9 | V | |
| | | 4.5 | | | 4.4 | 4.5 | | 4.4 | | 4.4 | | |
| | | 6.0 | | | 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 _{OH} | High Level Output Voltage (for QA to QH outputs) | 2.0 | V _I = V _{IH} or V _{IL} | I _O = -20 μA | 1.9 | 2.0 | | 1.9 | | 1.9 | V | |
| | | 4.5 | | | 4.4 | 4.5 | | 4.4 | | 4.4 | | |
| | | 6.0 | | | 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 _{OL} | Low Level Output Voltage (for QH' output) | 2.0 | V _I = V _{IH} or V _{IL} | I _O = 20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | | | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 6.0 | | | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 | | I _O = 4.0 mA | | 0.17 | 0.26 | | 0.33 | | 0.40 | |
| | | 6.0 | | I _O = 5.2 mA | | 0.18 | 0.26 | | 0.33 | | 0.40 | |
| V _{OL} | Low Level Output Voltage (for QA to QH outputs) | 2.0 | V _I = V _{IH} or V _{IL} | I _O = 20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | | | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 6.0 | | | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 | | I _O = 6.0 mA | | 0.17 | 0.26 | | 0.33 | | 0.40 | |
| | | 6.0 | | I _O = 7.8 mA | | 0.18 | 0.26 | | 0.33 | | 0.40 | |
| I _I | Input Leakage Current | 6.0 | V _I = V _{CC} or GND | | | ±0.1 | | ±1 | | ±1 | μA | |
| I _{OZ} | 3 State Output Off State 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 | |

M54/M74HC595

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

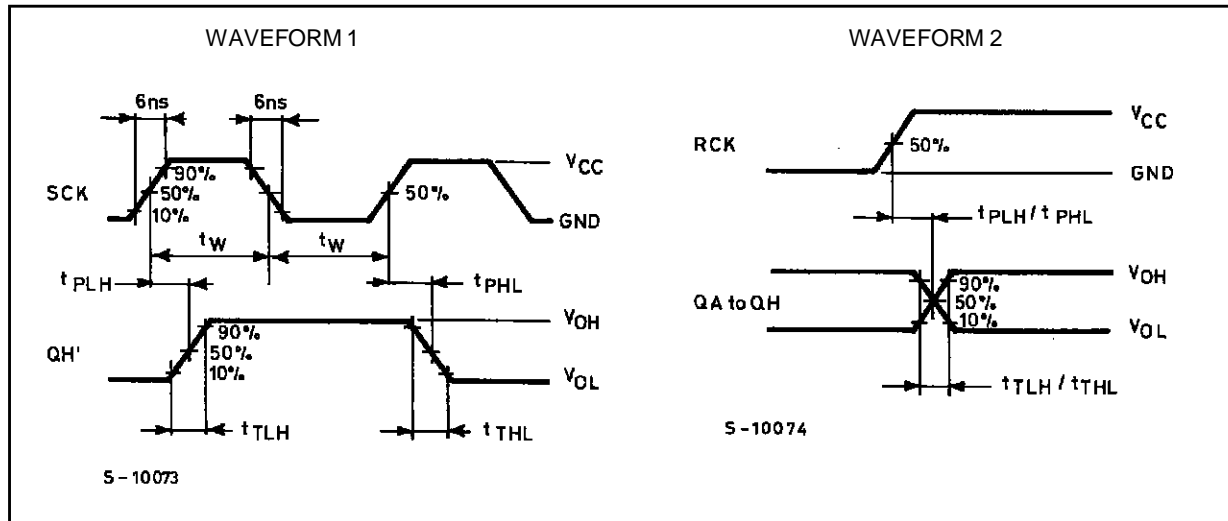
| Symbol | Parameter | Test Conditions | | | Value | | | | | | Unit | |
|--------------------------------------|-------------------------------------|------------------------|------------------------|-----------------------|---|------|------|----------------------|------|-----------------------|------|------|
| | | V _{CC} (V) | C _L (pF) | | T _A = 25 °C 54HC and 74HC | | | -40 to 85 °C 74HC | | -55 to 125 °C 54HC | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| t _{TLH} t _{THL} | Output Transition Time (Qn) | 2.0 | 50 | | 25 | 60 | | 75 | | 90 | ns | |
| | | 4.5 | | 7 | 12 | | 15 | | 18 | | | |
| | | 6.0 | | 6 | 10 | | 13 | | 15 | | | |
| t _{TLH} t _{THL} | Output Transition Time (QH') | 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 (SCK - QH') | 2.0 | 50 | | 45 | 125 | | 155 | | 190 | ns | |
| | | 4.5 | | 15 | 25 | | 31 | | 38 | | | |
| | | 6.0 | | 13 | 21 | | 26 | | 32 | | | |
| t _{PLH} t _{PHL} | Propagation Delay Time (SCLR - QH') | 2.0 | 50 | | 60 | 175 | | 220 | | 265 | ns | |
| | | 4.5 | | 18 | 35 | | 44 | | 53 | | | |
| | | 6.0 | | 15 | 30 | | 37 | | 45 | | | |
| t _{PLH} t _{PHL} | Propagation Delay Time (RCK - Qn) | 2.0 | 50 | | 60 | 150 | | 190 | | 225 | ns | |
| | | 4.5 | | 20 | 30 | | 38 | | 45 | | | |
| | | 6.0 | | 17 | 26 | | 32 | | 38 | | | |
| | | 2.0 | 150 | | 75 | 190 | | 240 | | 285 | ns | |
| | | 4.5 | | 25 | 38 | | 48 | | 57 | | | |
| | | 6.0 | | 22 | 32 | | 41 | | 48 | | | |
| t _{PZL} t _{PZH} | 3 State Output Enable Time | 2.0 | 50 | R _L = 1 KΩ | 45 | 135 | | 170 | | 205 | ns | |
| | | 4.5 | | | 15 | 27 | | 34 | | 41 | | |
| | | 6.0 | | | 13 | 23 | | 29 | | 35 | | |
| | | 2.0 | 150 | R _L = 1 KΩ | 60 | 175 | | 220 | | 265 | ns | |
| | | 4.5 | | | 20 | 35 | | 44 | | 53 | | |
| | | 6.0 | | | 17 | 30 | | 37 | | 45 | | |
| t _{PLZ} t _{PHZ} | 3 State Output Disable Time | 2.0 | 50 | R _L = 1 KΩ | 30 | 150 | | 190 | | 225 | ns | |
| | | 4.5 | | | 15 | 30 | | 38 | | 45 | | |
| | | 6.0 | | | 14 | 26 | | 32 | | 38 | | |
| f _{MAX} | Maximum Clock Frequency | 2.0 | 50 | | 6.0 | 17 | | 4.8 | | 4 | ns | |
| | | 4.5 | | 30 | 50 | | 24 | | 20 | | | |
| | | 6.0 | | 35 | 59 | | 28 | | 24 | | | |
| | | 2.0 | 150 | | 5.2 | 14 | | 4.2 | | 3.4 | ns | |
| | | 4.5 | | 26 | 40 | | 21 | | 17 | | | |
| | | 6.0 | | 31 | 45 | | 25 | | 20 | | | |
| t _{w(H)} | Minimum Pulse Width (SCK, RCK) | 2.0 | 50 | | 17 | 75 | | 95 | | 110 | ns | |
| | | 4.5 | | 6 | 15 | | 19 | | 22 | | | |
| | | 6.0 | | 6 | 13 | | 16 | | 19 | | | |
| t _{w(L)} | Minimum Pulse Width (SCLR) | 2.0 | 50 | | 20 | 75 | | 95 | | 110 | ns | |
| | | 4.5 | | 6 | 15 | | 19 | | 22 | | | |
| | | 6.0 | | 6 | 13 | | 16 | | 19 | | | |
| t _s | Minimum Set-up Time (SI - CCK) | 2.0 | 50 | | 25 | 50 | | 65 | | 75 | ns | |
| | | 4.5 | | 5 | 10 | | 13 | | 15 | | | |
| | | 6.0 | | 4 | 9 | | 11 | | 13 | | | |

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

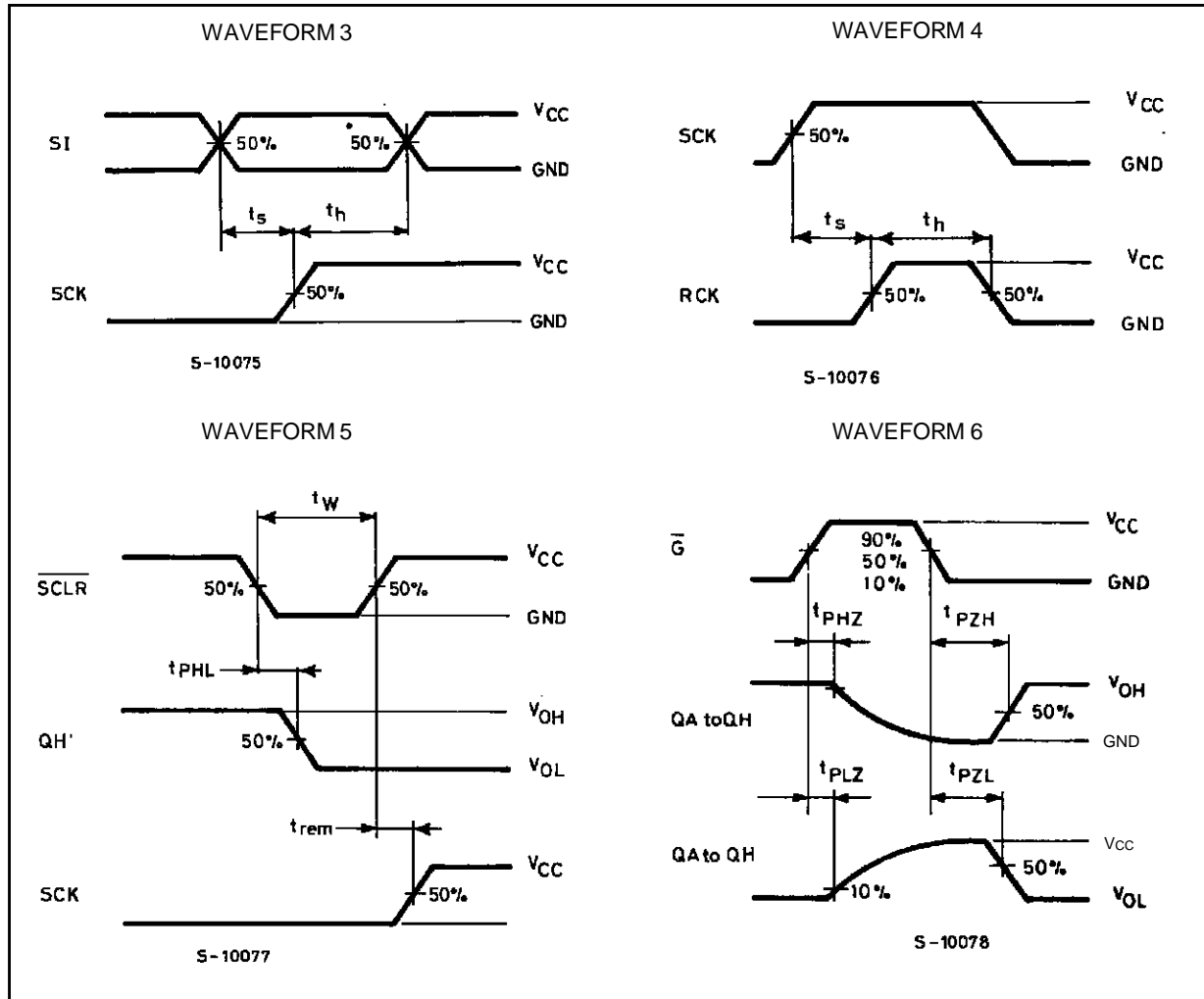
| Symbol | Parameter | Test Conditions | | | Value | | | | | | Unit | | |
|--------------|-------------------------------------|-------------------|---------------|--|-------|--------------|---|-----------------|--|-----------------|----------------|-----------------|----|
| | | V_{CC} (V) | C_L (pF) | $T_A = 25 \text{ }^\circ\text{C}$ 54HC and 74HC | | | $-40 \text{ to } 85 \text{ }^\circ\text{C}$ 74HC | | $-55 \text{ to } 125 \text{ }^\circ\text{C}$ 54HC | | | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | | | |
| t_s | Minimum Set-up Time (SCK - RCK) | 2.0 4.5 6.0 | 50 | | | 35 8 6 | 75 15 13 | | 95 19 16 | 110 22 19 | ns | | |
| t_s | Minimum Set-up Time (SCRL - RCK) | 2.0 4.5 6.0 | | 50 | | | 40 10 7 | 100 20 17 | | 125 25 21 | | 145 29 25 | ns |
| t_h | Minimum Hold Time | 2.0 4.5 6.0 | | | 50 | | | | 0 0 0 | | | 0 0 0 | |
| t_{REM} | Minimum Clear Removal Time | 2.0 4.5 6.0 | 50 | | | | | 15 3 3 | 50 10 9 | | 65 13 11 | 75 15 13 | |
| C_{IN} | Input Capacitance | | | | | | | 5 | 10 | | 10 | 10 | pF |
| $C_{PD} (*)$ | Power Dissipation Capacitance | | | | | | 184 | | | | | pF | |

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

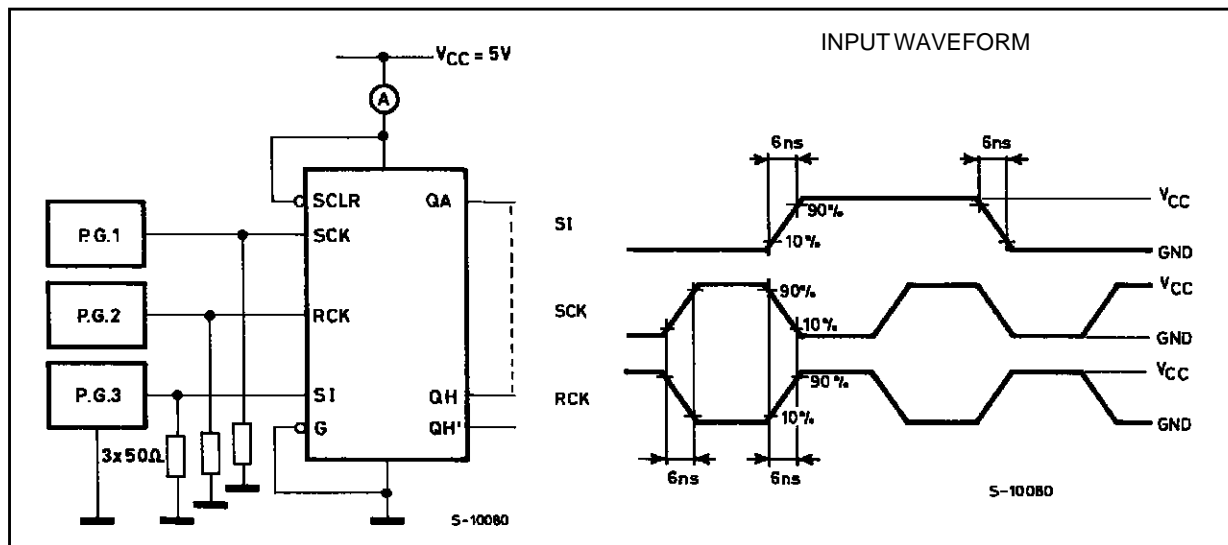
SWITCHING CHARACTERISTICS TEST WAVEFORM



SWITCHING CHARACTERISTICS TEST WAVEFORM (continued)



TEST CIRCUIT I_{CC} (Opr.)



Plastic DIP16 (0.25) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 17.78 | | | 0.700 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | | | 1.27 | | | 0.050 |



Ceramic DIP16/1 MECHANICAL DATA

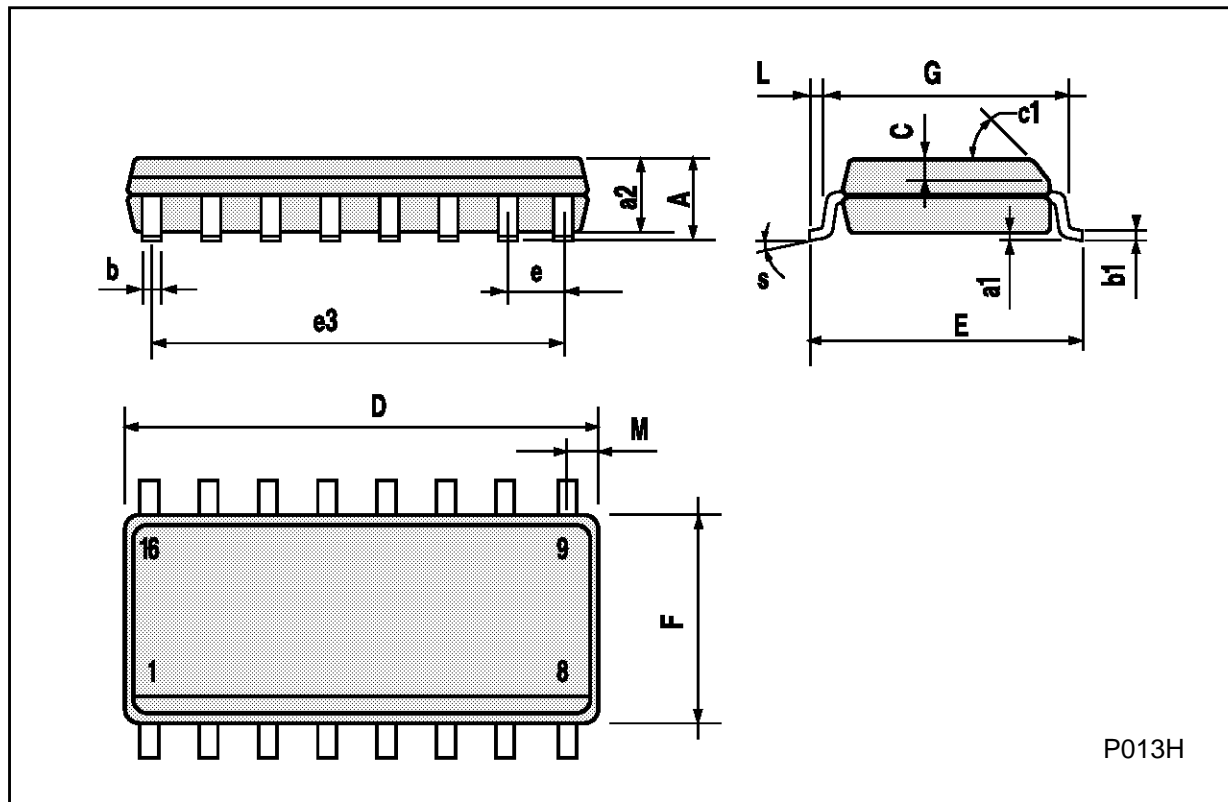
| DIM. | mm | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 20 | | | 0.787 |
| B | | | 7 | | | 0.276 |
| D | | 3.3 | | | 0.130 | |
| E | 0.38 | | | 0.015 | | |
| e3 | | 17.78 | | | 0.700 | |
| F | 2.29 | | 2.79 | 0.090 | | 0.110 |
| G | 0.4 | | 0.55 | 0.016 | | 0.022 |
| H | 1.17 | | 1.52 | 0.046 | | 0.060 |
| L | 0.22 | | 0.31 | 0.009 | | 0.012 |
| M | 0.51 | | 1.27 | 0.020 | | 0.050 |
| N | | | 10.3 | | | 0.406 |
| P | 7.8 | | 8.05 | 0.307 | | 0.317 |
| Q | | | 5.08 | | | 0.200 |



P053D

SO16 (Narrow) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 0.5 | | | 0.019 | |
| c1 | 45° (typ.) | | | | | |
| D | 9.8 | | 10 | 0.385 | | 0.393 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 8.89 | | | 0.350 | |
| F | 3.8 | | 4.0 | 0.149 | | 0.157 |
| G | 4.6 | | 5.3 | 0.181 | | 0.208 |
| L | 0.5 | | 1.27 | 0.019 | | 0.050 |
| M | | | 0.62 | | | 0.024 |
| S | 8° (max.) | | | | | |



P013H

PLCC20 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 9.78 | | 10.03 | 0.385 | | 0.395 |
| B | 8.89 | | 9.04 | 0.350 | | 0.356 |
| D | 4.2 | | 4.57 | 0.165 | | 0.180 |
| d1 | | 2.54 | | | 0.100 | |
| d2 | | 0.56 | | | 0.022 | |
| E | 7.37 | | 8.38 | 0.290 | | 0.330 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 5.08 | | | 0.200 | |
| F | | 0.38 | | | 0.015 | |
| G | | | 0.101 | | | 0.004 |
| M | | 1.27 | | | 0.050 | |
| M1 | | 1.14 | | | 0.045 | |



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