



M54/74HC299

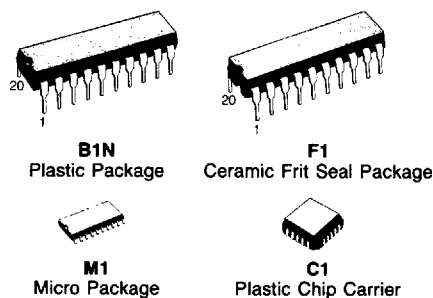
M74/74HC323

HC299 8-BIT PIPO SHIFT REGISTER WITH ASYNCHRONOUS CLEAR

HC323 8-BIT PIPO SHIFT REGISTER WITH SYNCHRONOUS CLEAR

S G S-THOMSON

- LOW POWER DISSIPATION
 $I_{CC} = 4 \mu A$ (MAX.) at $T_A = 25^\circ C$
- HIGH NOISE IMMUNITY
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (Min.)
- OUTPUT DRIVE CAPABILITY
 10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE
 $|I_{OH}| = I_{OL} = 6 \text{ mA}$ (MIN.) for Q_A , to Q_H ,
 $|I_{OH}| = I_{OL} = 4 \text{ mA}$ (MIN.) for Q_A , to Q_H
- BALANCED PROPAGATION DELAYS
 $t_{PLH} = t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE
 V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE
 WITH 54/74LS299



ORDERING NUMBERS:
 M54HCTXXX F1 M74HCTXXX C1
 M74HCTXXX B1N M74HCTXXX M1

DESCRIPTION

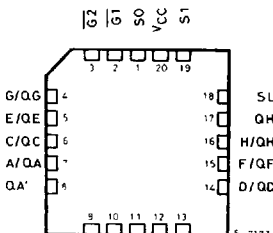
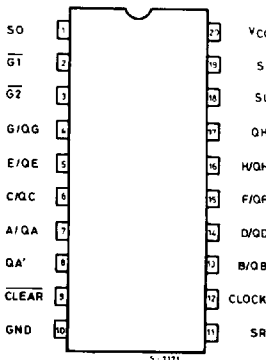
The M54/74HC299/323 are high speed CMOS 8-BIT PIPO SHIFT REGISTERS (3-STATE) fabricated with silicon gate C²MOS technology. They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power consumption.

These devices have four modes (HOLD, SHIFT LEFT, SHIFT RIGHT and LOAD DATA). Each mode is chosen by two function select inputs (S0, S1). When one or both enable inputs, (G1, G2) are high, the eight input/output terminals are in the high-impedance state; however sequential operation or clearing of the register is not affected.

Clear function on the HC299 is asynchronous to CLOCK, while the HC323 is cleared synchronous to clock.

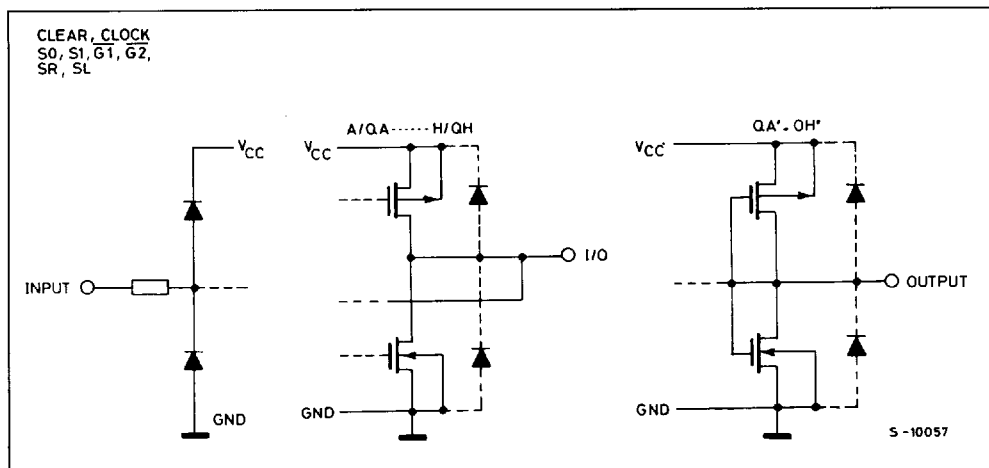
All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTIONS (top view)



NC =
No Internal
Connection

INPUT AND OUTPUT EQUIVALENT CIRCUIT



TRUTH TABLE

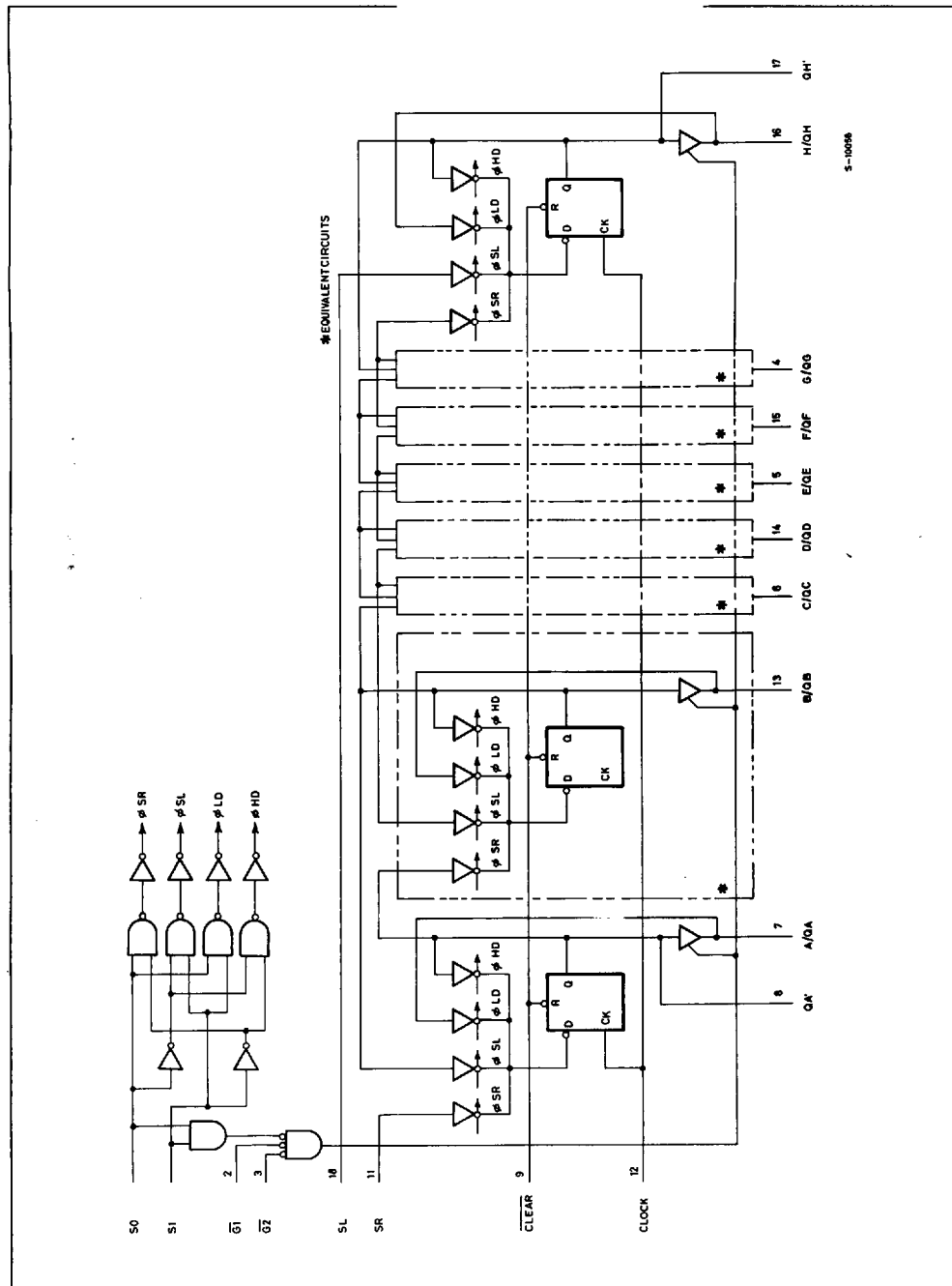
| MODE | INPUTS | | | | | | INPUTS/OUTPUTS | | | | OUTPUTS | | |
|-------------|--------|-----------------|----|----------------|-----|-------|----------------|--------|----|------|---------|-----|-----|
| | CLEAR | FUNCTION SELECT | | OUTPUT CONTROL | | CLOCK | | SERIAL | | A/QA | H/QH | QA' | QH' |
| | | S1 | S0 | G1* | G2* | (299) | (323) | SL | SR | | | | |
| Z | L | H | H | X | X | X | | X | X | Z | Z | L | L |
| CLEAR | L | L | X | L | L | X | ↓ | X | X | L | L | L | L |
| | L | X | L | L | L | X | ↑ | X | X | L | L | L | L |
| HOLD | H | L | L | L | L | X | | X | X | QA0 | QH0 | QA0 | QH0 |
| SHIFT RIGHT | H | L | H | L | L | ↓ | | X | H | H | QGn | H | QGn |
| | H | L | H | L | L | ↑ | | X | L | L | QGn | L | QGn |
| SHIFT LEFT | H | H | L | L | L | ↓ | | H | X | QBn | H | QBn | H |
| | H | H | L | L | L | ↑ | | L | X | QBn | L | QBn | L |
| LOAD | H | H | H | X | X | ↓ | | X | X | a | h | a | h |

* When one or both output controls are high, the eight, input/output terminals are in the high-impedance state; however sequential operation or clearing of the register is not affected.

- Z : HIGH IMPEDANCE
- Qno : THE LEVEL OF An BEFORE THE INDICATED,STEADY-STATE INPUT CONDITIONS WERE ESTABLISHED.
- Qnn : THE LEVEL OF Qn BEFORE THE MOST RECENT ACTIVE TRANSITION INDICATED BY ↓ OR ↑
- a,h : THE LEVEL OF THE STEADY-STATE INPUTS A, H, RESPECTIVELY.
- X : DON'T CARE

LOGIC DIAGRAM (HC299)

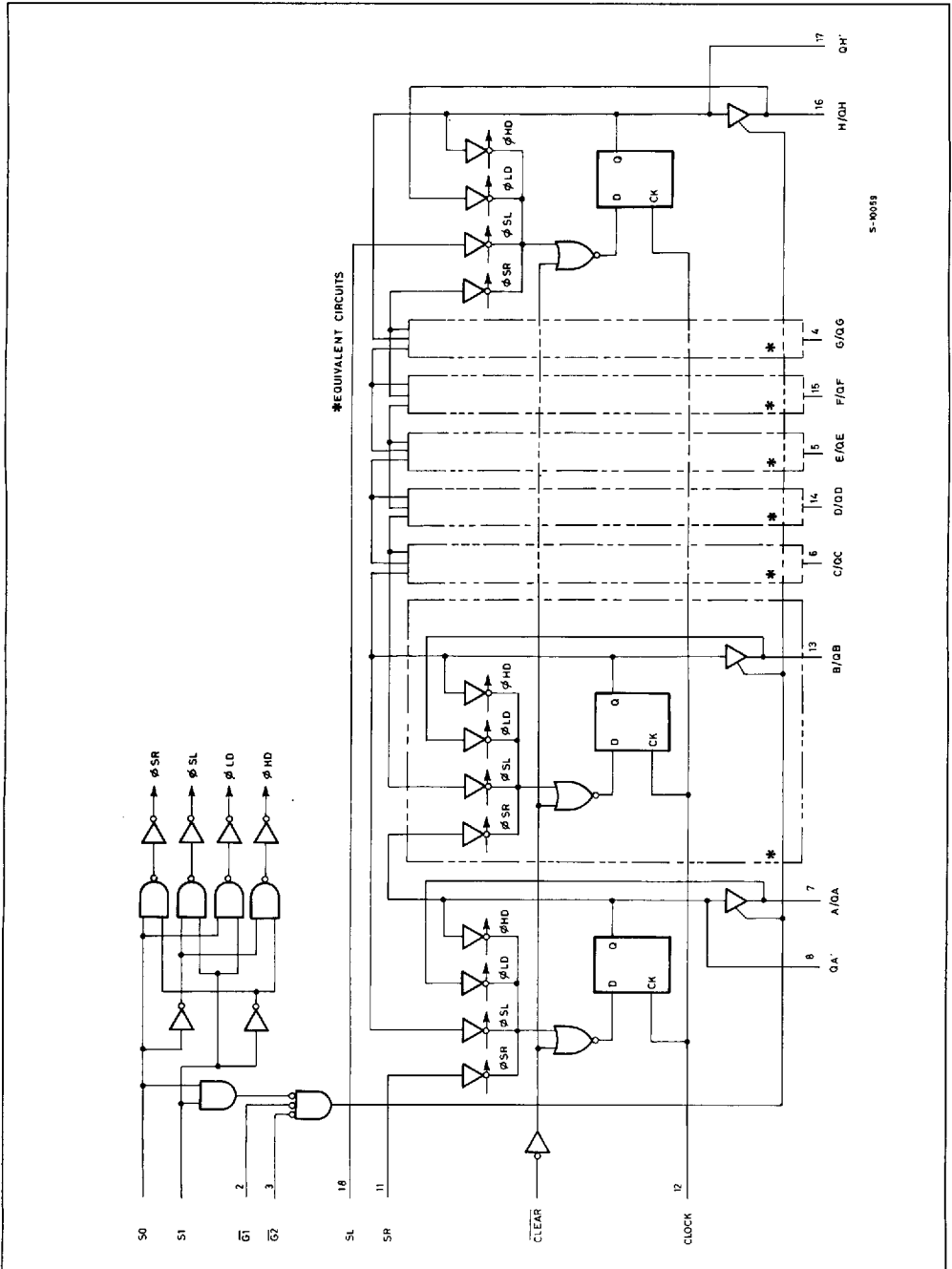
S G S-THOMSON



5-10096

S G S-THOMSON

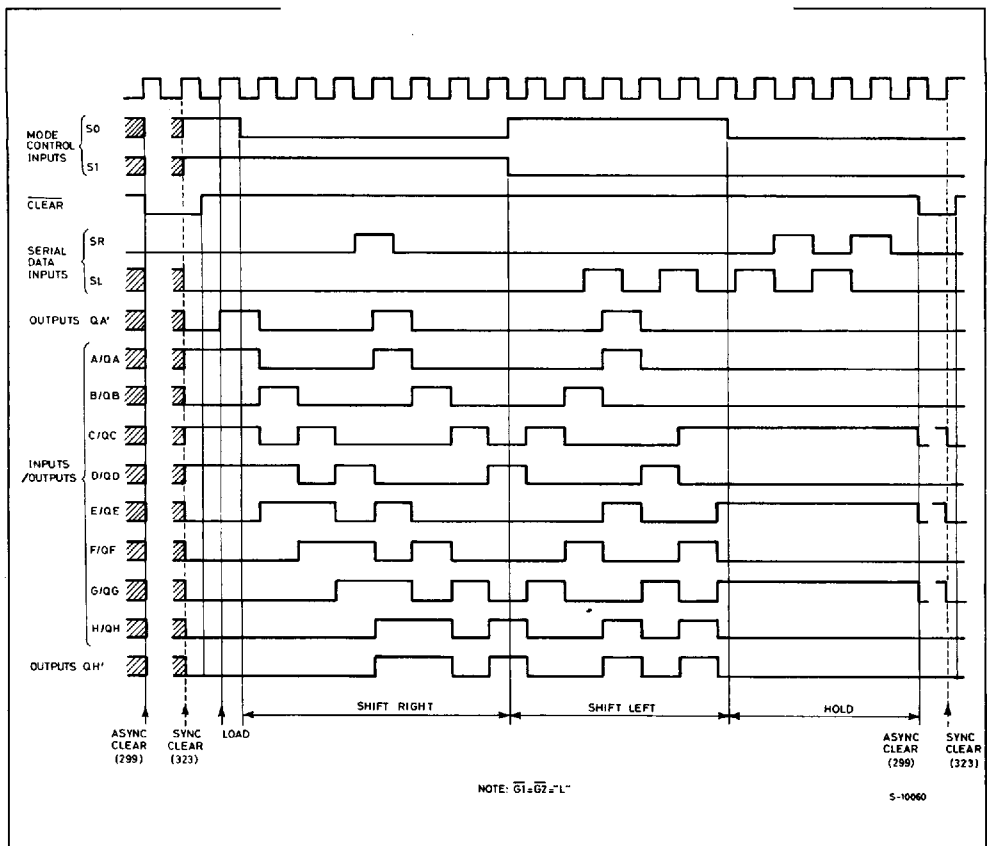
LOGIC DIAGRAM (HC323)



S-00058

TIMING CHART

S G S-THOMSON



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 | ± 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 | $^{\circ}C$ |

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

(*) 500 mW: $\cong 65^{\circ}C$ derate to 300 mW by 10 mW/ $^{\circ}C$: $65^{\circ}C$ to $85^{\circ}C$

S G S-THOMSON

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_A | Operating Temperature 74HC Series 54HC Series | - 40 to 85 - 55 to 125 | °C |
| t_r, t_f | Input Rise and Fall Time | V_{CC} $\begin{cases} 2 \text{ V} & 0 \text{ to } 1000 \\ 4.5 \text{ V} & 0 \text{ to } 500 \\ 6 \text{ V} & 0 \text{ to } 400 \end{cases}$ | ns |

DC SPECIFICATIONS

| Symbol | Parameter | V_{CC} | Test Condition | $T_A = 25^\circ\text{C}$ 54HC and 74HC | | | - 40 to 85°C 74HC | | - 55 to 125°C 54HC | | Unit | |
|----------|----------------------------------|----------|--|---|------|-----------|----------------------|-----------|-----------------------|-----------|---------------|---|
| | | | | 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 | 2.0 | V_{IN} | I_{OH} | 1.9 | 2.0 | — | 1.9 | — | 1.9 | — | V |
| | | 4.5 | V_{IH} | - 20 μA | 4.4 | 4.5 | — | 4.4 | — | 4.4 | — | |
| | | 6.0 | or V_{IL} | | 5.9 | 6.0 | — | 5.9 | — | 5.9 | — | |
| | | 4.5 | Q_A to Q_H | - 6.0 mA | 4.18 | 4.31 | — | 4.13 | — | 4.10 | — | |
| | | 6.0 | | - 7.8 mA | 5.68 | 5.8 | — | 5.63 | — | 5.60 | — | |
| 4.5 | Q_A', Q_H' | - 4.0 mA | 4.18 | 4.31 | — | 4.13 | — | 4.10 | — | | | |
| 6.0 | | - 5.2 mA | 5.68 | 5.8 | — | 5.63 | — | 5.60 | — | | | |
| V_{OL} | Low Level Output Voltage | 2.0 | V_{IN} | I_{OH} | — | 0 | 0.1 | — | 0.1 | — | 0.1 | V |
| | | 4.5 | V_{IH} | 20 μA | — | 0 | 0.1 | — | 0.1 | — | 0.1 | |
| | | 6.0 | or V_{IL} | | — | 0 | 0.1 | — | 0.1 | — | 0.1 | |
| | | 4.5 | Q_A to Q_H | 6.0 mA | — | 0.17 | 0.26 | — | 0.33 | — | 0.40 | |
| | | 6.0 | | 7.8 mA | — | 0.18 | 0.26 | — | 0.33 | — | 0.40 | |
| 4.5 | Q_A', Q_H' | 4.0 mA | — | 0.17 | 0.26 | — | 0.33 | — | 0.40 | | | |
| 6.0 | | 5.2 mA | — | 0.18 | 0.26 | — | 0.33 | — | 0.40 | | | |
| I_{OZ} | 3-State Output Off-State Current | 6.0 | $V_{IN} = V_{IL}$ or V_{IH} $V_{OUT} = V_{CC}$ or GND | — | — | ± 0.5 | — | ± 5.0 | — | ± 10 | μA | |
| I_{IN} | Input Leakage Current | 6.0 | $V_{IN} = V_{CC}$ or GND | — | — | ± 0.1 | — | ± 1.0 | — | ± 1.0 | | |
| I_{CC} | Quiescent Supply Current | 6.0 | $V_{IN} = V_{CC}$ or GND | — | — | 4 | — | 40 | — | 80 | | |

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

| Symbol | Parameter | V_{CC} | Test Condition | $T_A = 25^\circ\text{C}$ 54HC and 74HC | | | -40 to 85°C 74HC | | -55 to 125°C 54HC | | Unit |
|--------------------------|---|----------|----------------|---|------|------|-------------------------------------|------|--------------------------------------|------|------|
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| t_{TLH} t_{THL} | Output Transition Time (QA to QH) | 2.0 | | — | 25 | 60 | — | 75 | — | 90 | ns |
| | | 4.5 | | — | 7 | 12 | — | 15 | — | 18 | |
| | | 6.0 | | — | 6 | 10 | — | 13 | — | 15 | |
| t_{TLH} t_{THL} | Output Transition Time (QA', QH') | 2.0 | | — | 30 | 75 | — | 95 | — | 110 | ns |
| | | 4.5 | | — | 8 | 15 | — | 19 | — | 22 | |
| | | 6.0 | | — | 7 | 13 | — | 16 | — | 19 | |
| t_{PLH} t_{PHL} | Propagation Delay Time (CLOCK-QA to QH) | 2.0 | | — | 120 | 235 | — | 295 | — | 355 | ns |
| | | 4.5 | | — | 30 | 47 | — | 59 | — | 71 | |
| | | 6.0 | | — | 26 | 40 | — | 50 | — | 60 | |
| t_{PLH} t_{PHL} | Propagation Delay Time (CLOCK-QA', QH') | 2.0 | | — | 120 | 235 | — | 295 | — | 345 | ns |
| | | 4.5 | | — | 30 | 47 | — | 59 | — | 71 | |
| | | 6.0 | | — | 26 | 40 | — | 50 | — | 60 | |
| t_{PHL} | Propagation Delay Time ($\overline{\text{CLEAR}}$ -QA to QH) ⁽¹⁾ | 2.0 | | — | 116 | 230 | — | 290 | — | 345 | ns |
| | | 4.5 | | — | 29 | 46 | — | 58 | — | 69 | |
| | | 6.0 | | — | 25 | 39 | — | 49 | — | 59 | |
| t_{PHL} | Propagation Delay Time ($\overline{\text{CLEAR}}$ -QA', QH') ⁽¹⁾ | 2.0 | | — | 116 | 230 | — | 290 | — | 345 | ns |
| | | 4.5 | | — | 29 | 46 | — | 58 | — | 69 | |
| | | 6.0 | | — | 25 | 39 | — | 49 | — | 59 | |
| f_{MAX} | Maximum Clock Frequency | 2.0 | | 4 | 8 | — | 3 | — | 3 | — | MHz |
| | | 4.5 | | 20 | 33 | — | 16 | — | 13 | — | |
| | | 6.0 | | 24 | 39 | — | 19 | — | 15 | — | |
| $t_{W(H)}$ $t_{W(L)}$ | Minimum Pulse Width (CLOCK) | 2.0 | | — | 30 | 75 | — | 95 | — | 110 | ns |
| | | 4.5 | | — | 8 | 15 | — | 19 | — | 22 | |
| | | 6.0 | | — | 7 | 13 | — | 16 | — | 19 | |
| $t_{W(L)}$ | Minimum Pulse Width CLEAR | 2.0 | | — | 50 | 100 | — | 125 | — | 150 | ns |
| | | 4.5 | | — | 12 | 20 | — | 25 | — | 30 | |
| | | 6.0 | | — | 10 | 17 | — | 21 | — | 26 | |
| t_s | Minimum Set-up Time (SL, SR, A to H) | 2.0 | | — | 25 | 75 | — | 95 | — | 110 | ns |
| | | 4.5 | | — | 6 | 15 | — | 19 | — | 22 | |
| | | 6.0 | | — | 5 | 13 | — | 16 | — | 19 | |
| t_s | Minimum Set-up Time (S0, S1) | 2.0 | | — | 50 | 125 | — | 155 | — | 190 | ns |
| | | 4.5 | | — | 13 | 25 | — | 31 | — | 38 | |
| | | 6.0 | | — | 11 | 21 | — | 26 | — | 32 | |
| t_s | Minimum Set-up Time (CLEAR) ⁽²⁾ | 2.0 | | — | 32 | 75 | — | 95 | — | 110 | ns |
| | | 4.5 | | — | 8 | 15 | — | 19 | — | 22 | |
| | | 6.0 | | — | 7 | 13 | — | 16 | — | 19 | |
| t_h | Minimum Hold Time (SL, SR, A to H) | 2.0 | | — | — | 0 | — | 0 | — | 0 | ns |
| | | 4.5 | | — | — | 0 | — | 0 | — | 0 | |
| | | 6.0 | | — | — | 0 | — | 0 | — | 0 | |
| t_h | Minimum Hold Time (S0, S1) | 2.0 | | — | — | 0 | — | 0 | — | 0 | ns |
| | | 4.5 | | — | — | 0 | — | 0 | — | 0 | |
| | | 6.0 | | — | — | 0 | — | 0 | — | 0 | |

(1) Apply to M54/74HC299

(2) Apply to M54/74HC323

AC ELECTRICAL CHARACTERISTICS (Continued)

| Symbol | Parameter | V _{CC} | Test Condition | T _A = 25°C 54HC and 74HC | | | -40 to 85°C 74HC | | -55 to 125°C 54HC | | Unit |
|--------------------------------------|-------------------------------------|-----------------|----------------------|--|------|------|---------------------|------|----------------------|------|------|
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| t _H | Minimum Hold Time (CLEAR) (2) | 2.0 | | — | — | 0 | — | 0 | — | 0 | ns |
| | | 4.5 | | — | — | 0 | — | 0 | — | 0 | |
| | | 6.0 | | — | — | 0 | — | 0 | — | 0 | |
| t _{REM} | Minimum Removal Time (CLEAR) (1) | 2.0 | | — | — | 25 | — | 30 | — | 40 | ns |
| | | 4.5 | | — | — | 5 | — | 6 | — | 8 | |
| | | 6.0 | | — | — | 5 | — | 6 | — | 7 | |
| t _{PZL} t _{PZH} | 3-State Output Enable Time | 2.0 | R _L = 1kΩ | — | 100 | 195 | — | 245 | — | 295 | ns |
| | | 4.5 | | — | 25 | 39 | — | 49 | — | 59 | |
| | | 6.0 | | — | 21 | 33 | — | 42 | — | 50 | |
| t _{PLZ} t _{PHZ} | 3-State Output Disable Time | 2.0 | R _L = 1kΩ | — | 112 | 200 | — | 250 | — | 300 | ns |
| | | 4.5 | | — | 28 | 40 | — | 50 | — | 60 | |
| | | 6.0 | | — | 24 | 34 | — | 43 | — | 51 | |
| C _{IN} | Input Capacitance | | | — | 5 | 10 | — | 10 | — | 10 | pF |
| C _{OUT} | Output Capacitance (QA to QH) | | | — | 13 | — | — | — | — | — | pF |
| C _{PD} (*) | Power Dissipation Capacitance | | | — | 221 | — | — | — | — | — | pF |

Note (*) 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).

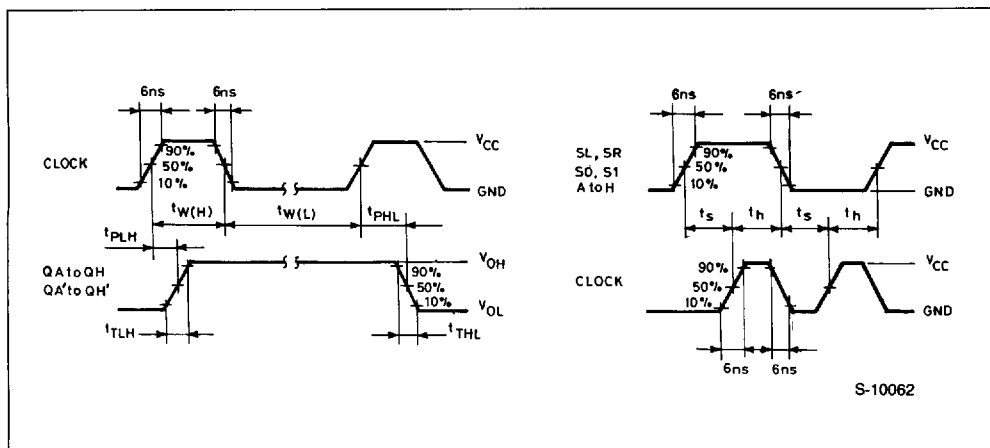
Average operating current can be obtained from the equation:

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

(1) Apply to M54/74HC299

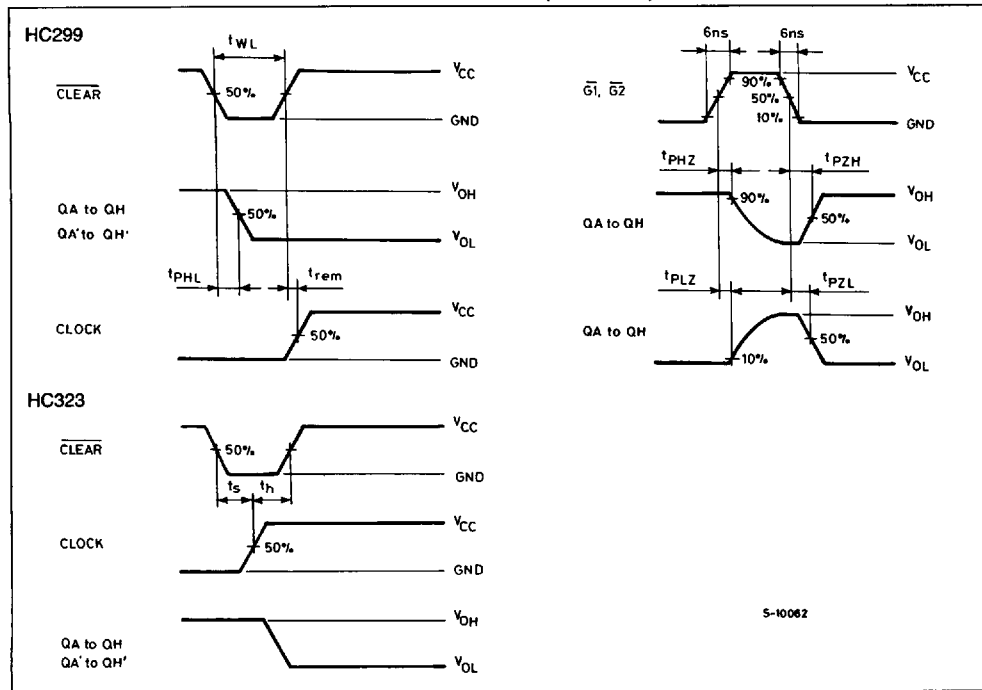
(2) Apply to M54/74HC323

SWITCHING CHARACTERISTICS TEST WAVEFORM



S-10062

SWITCHING CHARACTERISTICS TEST WAVEFORM (Continued)



TEST CIRCUIT I_{CC} (Opr.)

