

DUAL J-K FLIP FLOP WITH PRESET AND CLEAR

- HIGH SPEED
 $f_{MAX} = 63 \text{ MHz (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION
 $I_{CC} = 2 \mu\text{A (MAX.) AT } T_A = 25 \text{ }^\circ\text{C}$
- HIGH NOISE IMMUNITY
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- OUTPUT DRIVE CAPABILITY
10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE
 $|I_{OH}| = I_{OL} = 4 \text{ mA (MIN.)}$
- 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 54/74LS109

DESCRIPTION

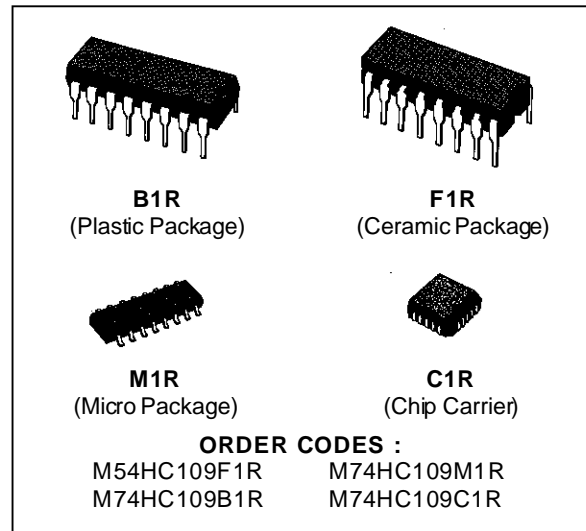
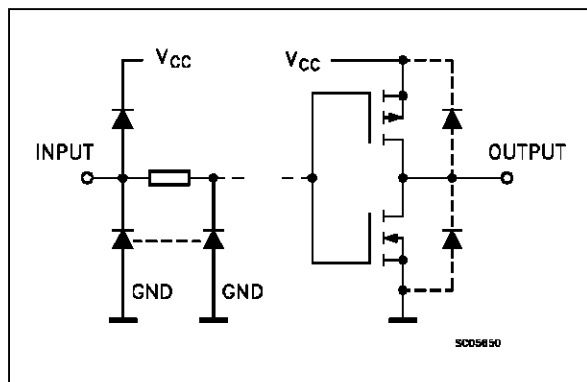
The M54/74HC109 is a high speed CMOS DUAL J-K FLIP-FLOP WITH PRESET AND CLEAR fabricated in silicon gate C²MOS technology.

It has the same high speed performance of LSTTL combined with true CMOS low power consumption.

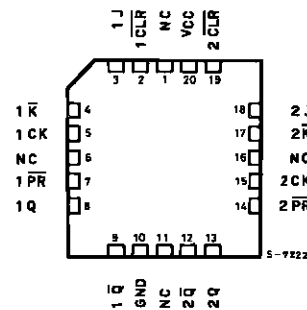
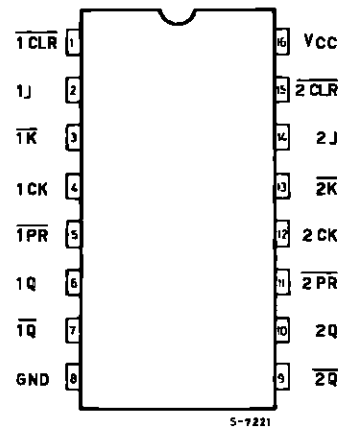
In accordance with the logic level on the J and \bar{K} input is device changes state on positive going transitions of the clock pulse. CLEAR and PRESET are independent of the clock and accomplished by a low logic level on the corresponding input.

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

INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN CONNECTIONS (top view)



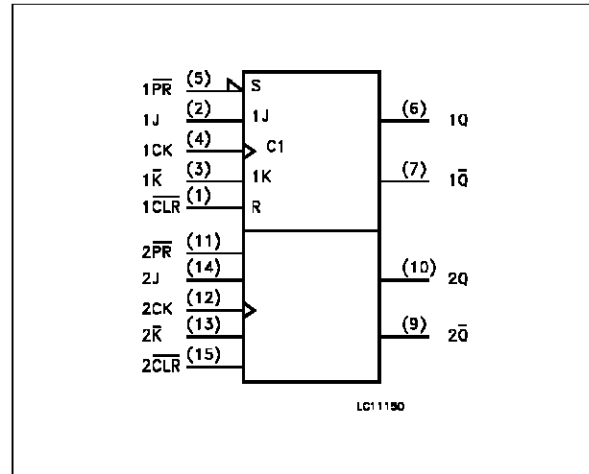
NC =
No Internal
Connection

M54/M74HC109

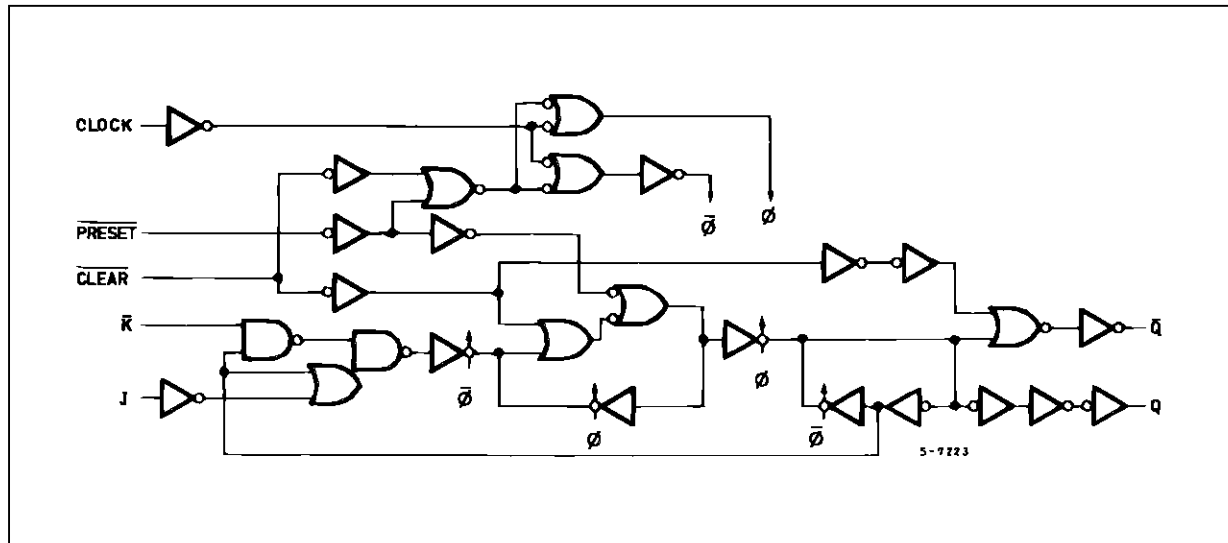
PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|-------------|----------------|--|
| 1, 15 | 1CLR, 2CLR | Asynchronous Reset Direct Input |
| 2, 4, 3, 13 | 1J, 2J, 1K, 2K | Synchronous Inputs; Flip-flops 1 and 2 |
| 4, 12 | 1CK, 2CK | Clock Input |
| 5, 11 | 1PR, 2PR | Asynchronous Set Direct Input (Active LOW) |
| 6, 10 | 1Q, 2Q | True Flip-flop Outputs |
| 7, 9 | 1Q, 2Q | Complement Flip-flop Outputs |
| 8 | GND | Ground (0V) |
| 16 | Vcc | Positive Supply Voltage |

IEC LOGIC SYMBOL



LOGIC CIRCUIT



TRUTH TABLE

| INPUTS | | | | | OUTPUTS | | FUNCTION |
|--------|----|---|---|----|----------------|----------------|-----------|
| CLR | PR | J | K | CK | Q | Q | |
| L | H | X | X | X | L | H | CLEAR |
| H | L | X | X | X | H | L | PRESET |
| L | L | X | X | X | H | H | |
| H | H | L | H | ⌋ | Q _n | Q _n | NO CHANGE |
| H | H | L | L | ⌋ | L | H | |
| H | H | H | H | ⌋ | H | L | |
| H | H | H | L | ⌋ | Q _n | Q _n | TOGGLE |
| H | H | X | X | ⌋ | Q _n | Q _n | NO CHANGE |

X = DONT CARE

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 | ± 25 | mA |
| I _{CC} or I _{GND} | DC V _{CC} or Ground Current | ± 50 | 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

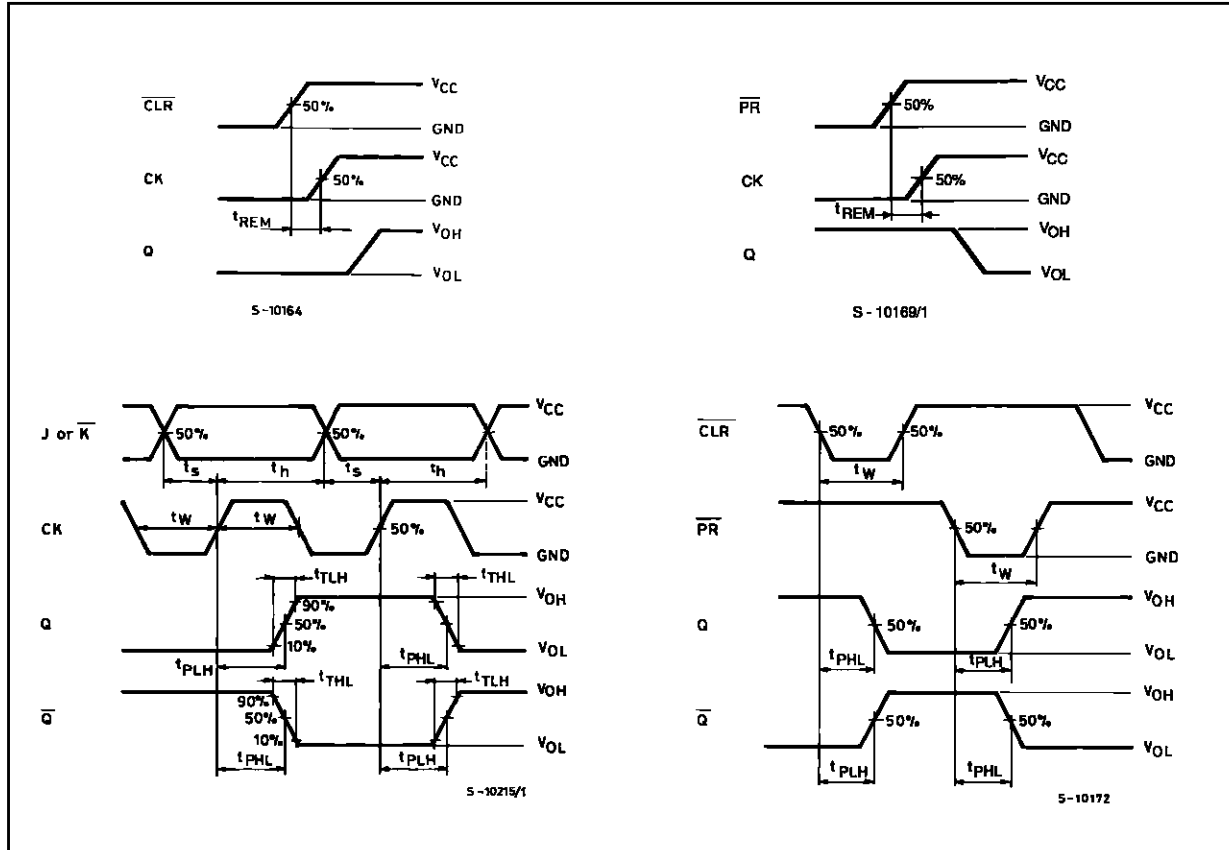
| Symbol | Parameter | Test Conditions | | Value | | | | | | Unit | | |
|-----------------|---------------------------|------------------------|--|---|-------------------------|------|----------------------|------|-----------------------|------|------|---|
| | | V _{CC} (V) | | T _A = 25 °C 54HC and 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 | 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 _{OL} | Low Level Output Voltage | 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 | |
| I _I | Input Leakage Current | 6.0 | V _I = V _{CC} or GND | | | ±0.1 | | ±1 | | ±1 | μA | |
| I _{CC} | Quiescent Supply Current | 6.0 | V _I = V _{CC} or GND | | | 2 | | 20 | | 40 | μA | |

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

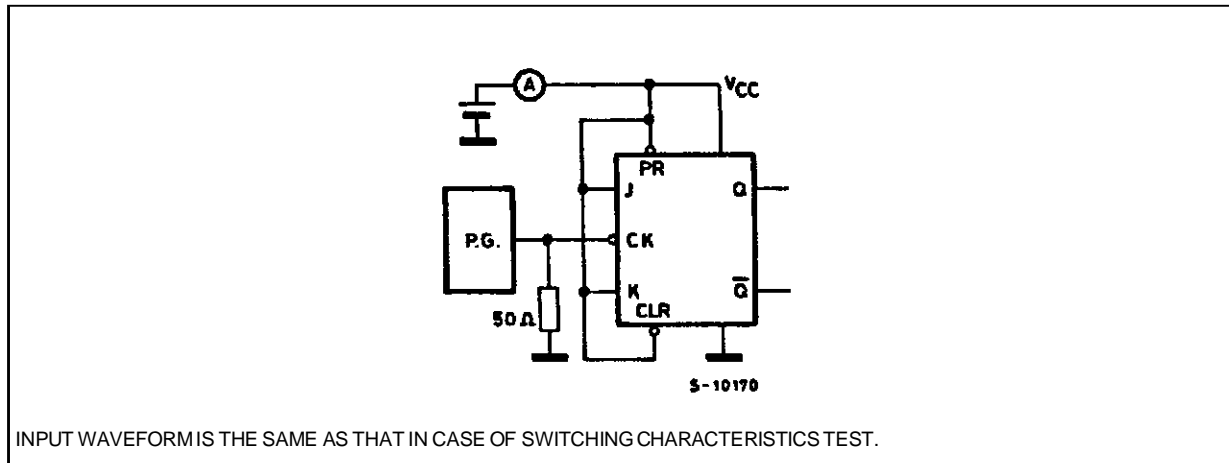
| Symbol | Parameter | Test Conditions | | Value | | | | | | Unit | |
|--|--|------------------------|--|---|------|------|----------------------|------|-----------------------|------|------|
| | | V _{CC} (V) | | T _A = 25 °C 54HC and 74HC | | | -40 to 85 °C 74HC | | -55 to 125 °C 54HC | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| t _{TLH} t _{THL} | Output Transition Time | 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 (CK-Q, \bar{Q}) | 2.0 | | | 50 | 150 | | 190 | | 225 | ns |
| | | 4.5 | | | 16 | 30 | | 38 | | 45 | |
| | | 6.0 | | | 13 | 26 | | 32 | | 38 | |
| t _{PLH} t _{PHL} | Propagation Delay Time (CLR, PR-Q, \bar{Q}) | 2.0 | | | 50 | 150 | | 190 | | 225 | ns |
| | | 4.5 | | | 16 | 30 | | 38 | | 45 | |
| | | 6.0 | | | 13 | 26 | | 32 | | 38 | |
| f _{MAX} | Maximum Clock Frequency | 2.0 | | 6.2 | 17 | | 5 | | 4.2 | | MHz |
| | | 4.5 | | 31 | 59 | | 25 | | 21 | | |
| | | 6.0 | | 37 | 67 | | 30 | | 25 | | |
| t _{W(H)} t _{W(L)} | Minimum Pulse Width (CLOCK) | 2.0 | | | 15 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 6 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 6 | 13 | | 16 | | 19 | |
| t _{W(L)} | Minimum Pulse Width (CLR, PR) | 2.0 | | | 15 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 6 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 6 | 13 | | 16 | | 19 | |
| t _s | Minimum Set-up Time | 2.0 | | | 17 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 5 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 4 | 13 | | 16 | | 19 | |
| t _h | Minimum Hold Time | 2.0 | | | | 0 | | 0 | | 0 | ns |
| | | 4.5 | | | | 0 | | 0 | | 0 | |
| | | 6.0 | | | | | 0 | | 0 | 0 | |
| t _{REM} | Minimum Removal Time (CLR, PR) | 2.0 | | | 13 | 50 | | 65 | | 75 | ns |
| | | 4.5 | | | 4 | 10 | | 13 | | 15 | |
| | | 6.0 | | | 3 | 9 | | 11 | | 13 | |
| C _{IN} | Input Capacitance | | | | 5 | 10 | | 10 | | 10 | pF |
| C _{PD} (*) | Power Dissipation Capacitance | | | | 41 | | | | | | 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. $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$ (per Flip-flop)

SWITCHING CHARACTERISTICS TEST WAVEFORM



TEST CIRCUIT I_{cc} (Opr.)



INPUT WAVEFORM IS THE SAME AS THAT IN CASE OF SWITCHING CHARACTERISTICS TEST.

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 |



P001C

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 |



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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