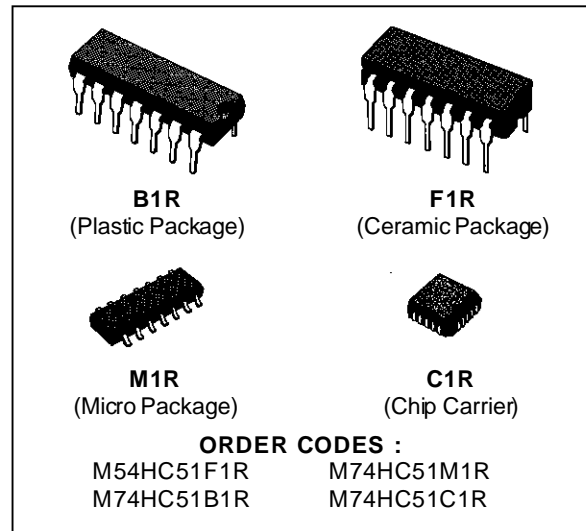


## DUAL 2 WIDE 2 INPUT AND/OR INVERT GATE

- HIGH SPEED  
 $t_{PD} = 10 \text{ ns (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION  
 $I_{CC} = 1 \mu\text{A (MAX.) AT } T_A = 25 \text{ }^\circ\text{C}$
- 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 54/74LS51

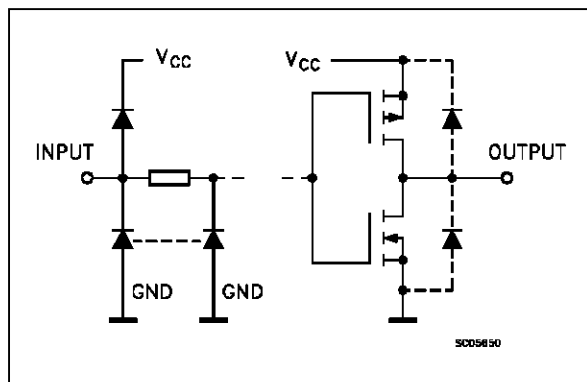


### DESCRIPTION

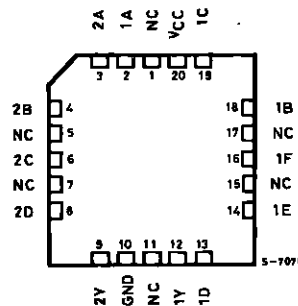
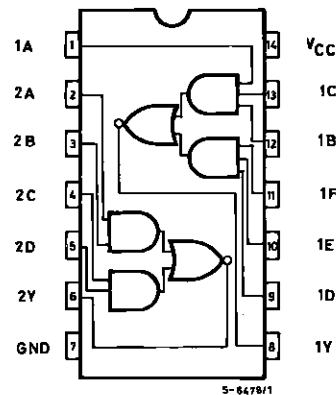
The M54/74HC51 is a high speed CMOS DUAL 2 WIDE-2 INPUT AND/OR INVERT GATE fabricated in silicon gate C<sup>2</sup>MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. It contains a 2-WIDE 2-INPUT AND-OR-INVERT GATE and a 2-WIDE 3-INPUT AND-OR-INVERT GATE.

The internal circuit is composed of 3 stages (2-INPUT) or 5 stages (3-INPUT) including buffered output, which gives high noise immunity and a stable output. 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/M74HC51

## PIN DESCRIPTION

| PIN No               | SYMBOL          | NAME AND FUNCTION       |
|----------------------|-----------------|-------------------------|
| 1, 12, 13, 9, 10, 11 | 1A to 1F        | Data Inputs             |
| 2, 3, 4, 5           | 2A to 2D        | Data Inputs             |
| 8, 6                 | 1Y, 2Y          | Data Outputs            |
| 7                    | GND             | Ground (0V)             |
| 14                   | V <sub>CC</sub> | Positive Supply Voltage |

## TRUTH TABLE

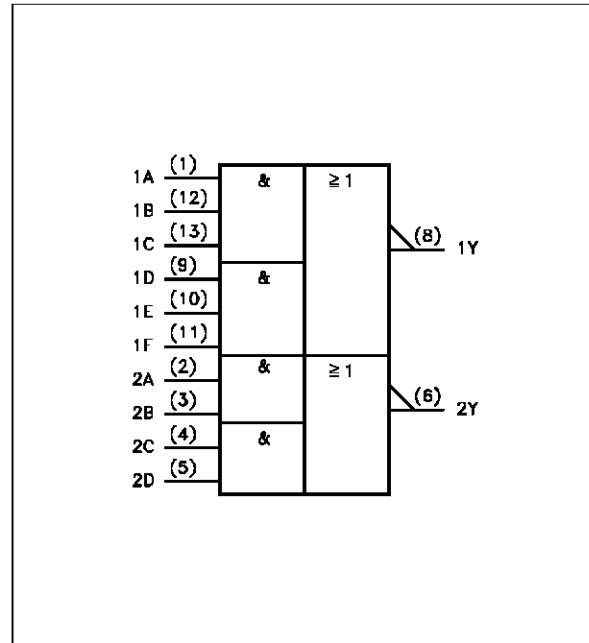
| 1A                     | 1B | 1C | 1D | 1E | 1F | 1Y |
|------------------------|----|----|----|----|----|----|
| H                      | H  | H  | X  | X  | X  | L  |
| X                      | X  | X  | H  | H  | H  | L  |
| ALL OTHER COMBINATIONS |    |    |    |    |    | H  |

## TRUTH TABLE

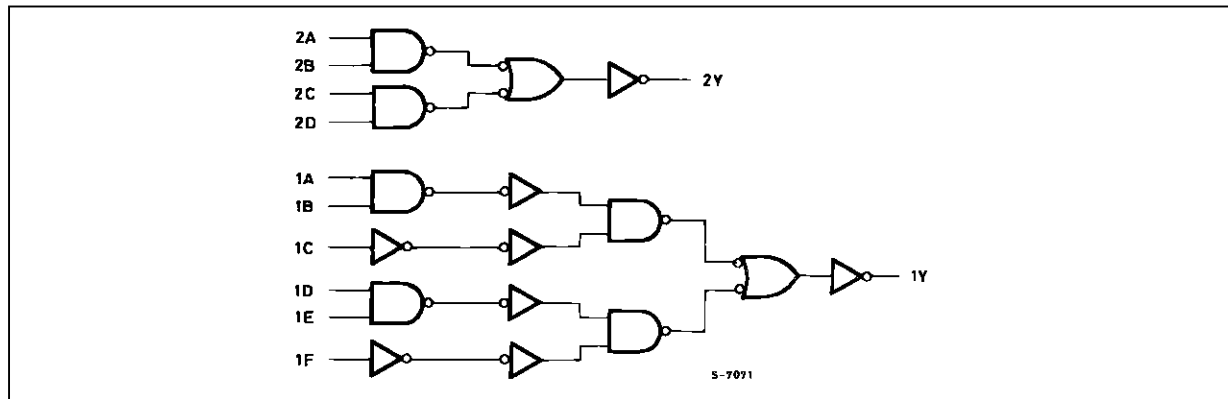
| 2A                     | 2B | 2C | 2D | 2Y |
|------------------------|----|----|----|----|
| H                      | H  | X  | X  | L  |
| X                      | X  | H  | H  | L  |
| ALL OTHER COMBINATIONS |    |    |    | H  |

X = DON'T CARE

## IEC LOGIC SYMBOL



## LOGIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol                              | Parameter                                    | Value                         | Unit |
|-------------------------------------|--|-------------------------------|------|
| V <sub>CC</sub>                     | Supply Voltage                               | -0.5 to +7                    | V    |
| V <sub>I</sub>                      | DC Input Voltage                             | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| V <sub>O</sub>                      | DC Output Voltage                            | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| I <sub>IK</sub>                     | DC Input Diode Current                       | ± 20                          | mA   |
| I <sub>OK</sub>                     | DC Output Diode Current                      | ± 20                          | mA   |
| I <sub>O</sub>                      | DC Output Source Sink Current Per Output Pin | ± 25                          | mA   |
| I <sub>CC</sub> or I <sub>GND</sub> | DC V <sub>CC</sub> or Ground Current         | ± 50                          | mA   |
| P <sub>D</sub>                      | Power Dissipation                            | 500 (*)                       | mW   |
| T <sub>stg</sub>                    | Storage Temperature                          | -65 to +150                   | °C   |
| T <sub>L</sub>                      | 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: <b>M54HC Series</b><br><b>M74HC Series</b> | -55 to +125<br>-40 to +85 | $^{\circ}\text{C}$<br>$^{\circ}\text{C}$ |    |
| $t_r, t_f$ | Input Rise and Fall Time  | $V_{CC} = 2\text{ V}$     | 0 to 1000                                | ns |
|            |   | $V_{CC} = 4.5\text{ V}$   | 0 to 500                                 |    |
|            |   | $V_{CC} = 6\text{ V}$     | 0 to 400                                 |    |

## DC SPECIFICATIONS

| Symbol   | Parameter                 | Test Conditions |                                  | Value   |                       |           |  |         |   | Unit    |               |   |
|----------|---------------------------|-----------------|----------------------------------|---|-----------------------|-----------|--|---------|---|---------|---------------|---|
|          |                           |                 |                                  | $T_A = 25\text{ }^{\circ}\text{C}$<br>54HC and 74HC |                       |           | $-40\text{ to }85\text{ }^{\circ}\text{C}$<br>74HC |         | $-55\text{ to }125\text{ }^{\circ}\text{C}$<br>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   |         | V             |   |
|          |                           | 4.5             |                                  |   |                       |           | 1.35   |         | 1.35  |         |               |   |
|          |                           | 6.0             |                                  |   |                       |           | 1.8  |         | 1.8   |         |               |   |
| $V_{OH}$ | High Level Output Voltage | 2.0             | $V_I = V_{IH}$<br>or<br>$V_{IL}$ | $I_O = -20\text{ }\mu\text{A}$                      | 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             |                                  | $I_O = -4.0\text{ mA}$                              | 4.18                  | 4.31      |  | 4.13    |   | 4.10    |               |   |
|          |                           | 6.0             |                                  | $I_O = -5.2\text{ mA}$                              | 5.68                  | 5.8       |  | 5.63    |   | 5.60    |               |   |
| $V_{OL}$ | Low Level Output Voltage  | 2.0             | $V_I = V_{IH}$<br>or<br>$V_{IL}$ | $I_O = 20\text{ }\mu\text{A}$                       |                       | 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             |                                  |   | $I_O = 4.0\text{ mA}$ | 0.17      | 0.26   |         | 0.33  |         | 0.40          |   |
|          |                           | 6.0             |                                  |   | $I_O = 5.2\text{ mA}$ | 0.18      | 0.26   |         | 0.33  |         | 0.40          |   |
| $I_I$    | Input Leakage Current     | 6.0             | $V_I = V_{CC}$ or GND            |   |                       | $\pm 0.1$ |  | $\pm 1$ |   | $\pm 1$ | $\mu\text{A}$ |   |
| $I_{CC}$ | Quiescent Supply Current  | 6.0             | $V_I = V_{CC}$ or GND            |   |                       | 1         |  | 10      |   | 20      | $\mu\text{A}$ |   |

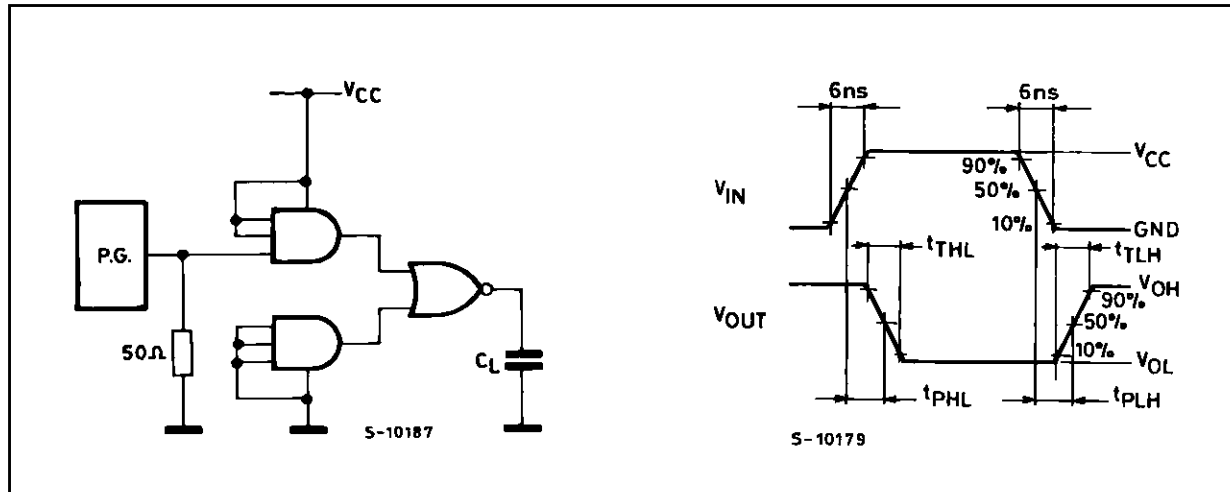
# M54/M74HC51

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

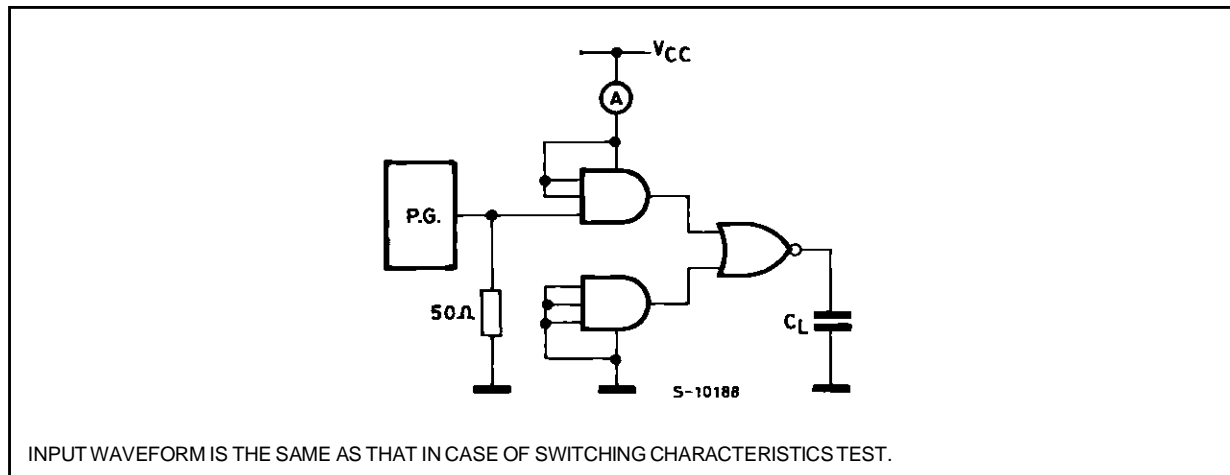
| Symbol                 | Parameter                     | Test Conditions |  | Value  |      |      |   |      |  | Unit |      |
|------------------------|-------------------------------|-----------------|--|--|------|------|---|------|--|------|------|
|                        |                               | $V_{CC}$<br>(V) |  | $T_A = 25 \text{ }^\circ\text{C}$<br>54HC and 74HC |      |      | $-40 \text{ to } 85 \text{ }^\circ\text{C}$<br>74HC |      | $-55 \text{ to } 125 \text{ }^\circ\text{C}$<br>54HC |      |      |
|                        |                               |                 |  | Min.   | Typ. | Max. | Min.  | Max. | Min.   |      | Max. |
| $t_{TLH}$<br>$t_{THL}$ | Output Transition Time        | 2.0             |  |  | 30   | 75   |   | 95   |  | 110  | ns   |
|                        |                               | 4.5             |  |  | 8    | 15   |   | 19   |  | 22   |      |
|                        |                               | 6.0             |  |  | 7    | 13   |   | 16   |  | 19   |      |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time        | 2.0             |  |  | 39   | 100  |   | 125  |  | 150  | ns   |
|                        |                               | 4.5             |  |  | 13   | 20   |   | 25   |  | 30   |      |
|                        |                               | 6.0             |  |  | 11   | 17   |   | 21   |  | 26   |      |
| $C_{IN}$               | Input Capacitance             |                 |  |  | 5    | 10   |   | 10   |  | 10   | pF   |
| $C_{PD} (*)$           | Power Dissipation Capacitance |                 |  |  | 32   |      |   |      |  |      | 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 CIRCUIT



## TEST CIRCUIT $I_{CC}$ (Opr.)



## Plastic DIP14 MECHANICAL DATA

| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 1.39 |       | 1.65 | 0.055 |       | 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   |      | 15.24 |      |       | 0.600 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    | 1.27 |       | 2.54 | 0.050 |       | 0.100 |



**Ceramic DIP14/1 MECHANICAL DATA**

| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7.0  |       |       | 0.276 |
| D    |      | 3.3   |      |       | 0.130 |       |
| E    | 0.38 |       |      | 0.015 |       |       |
| e3   |      | 15.24 |      |       | 0.600 |       |
| 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    | 1.52 |       | 2.54 | 0.060 |       | 0.100 |
| N    |      |       | 10.3 |       |       | 0.406 |
| P    | 7.8  |       | 8.05 | 0.307 |       | 0.317 |
| Q    |      |       | 5.08 |       |       | 0.200 |



P053C

## SO14 MECHANICAL DATA

| DIM. | mm         |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.003 |       | 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    | 8.55       |      | 8.75 | 0.336 |       | 0.344 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 7.62 |      |       | 0.300 |       |
| 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    |            |      | 0.68 |       |       | 0.026 |
| S    | 8° (max.)  |      |      |       |       |       |



**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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