

8-Bit Equality Comparator

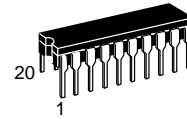
High-Performance Silicon-Gate CMOS

The MC54/74HC688 is identical in pinout to the LS688. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

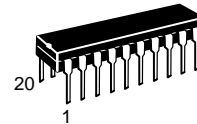
The HC688 compares two 8-bit binary or BCD words and indicates whether or not they are equal. By using the Cascade Input, two or more of the devices may be cascaded to compare words of more than 8 bits.

- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2 to 6 V
- Low Input Current: 1 μ A
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 116 FETs or 29 Equivalent Gates

MC54/74HC688



J SUFFIX
CERAMIC PACKAGE
CASE 732-03



N SUFFIX
PLASTIC PACKAGE
CASE 738-03

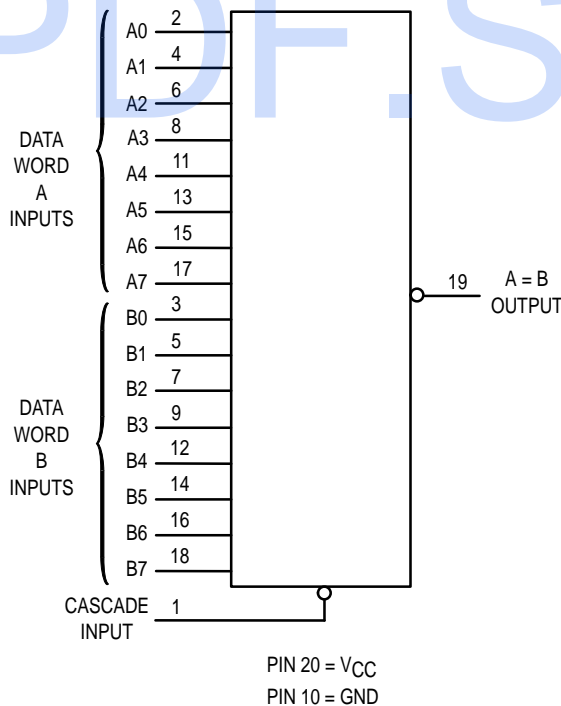


DW SUFFIX
SOIC PACKAGE
CASE 751D-04

ORDERING INFORMATION

MC54HCXXXJ Ceramic
MC74HCXXXN Plastic
MC74HCXXXDW SOIC

LOGIC DIAGRAM



PIN ASSIGNMENT

| | | | |
|---------------|----|----|-----------------|
| CASCADE INPUT | 1 | 20 | V _{CC} |
| A0 | 2 | 19 | A = B |
| B0 | 3 | 18 | |
| A1 | 4 | 17 | A7 |
| B1 | 5 | 16 | B6 |
| A2 | 6 | 15 | A6 |
| B2 | 7 | 14 | B5 |
| A3 | 8 | 13 | A5 |
| B3 | 9 | 12 | B4 |
| GND | 10 | 11 | |

FUNCTION TABLE

| Inputs | | Output |
|------------|---------|--------|
| Data Words | Cascade | A = B |
| A = B | L | L |
| A > B | L | H |
| A < B | L | H |
| X | H | H |



MAXIMUM RATINGS*

| Symbol | Parameter | Value | Unit |
|-----------|---|-------------------------|------|
| V_{CC} | DC Supply Voltage (Referenced to GND) | - 0.5 to + 7.0 | V |
| V_{in} | DC Input Voltage (Referenced to GND) | - 1.5 to $V_{CC} + 1.5$ | V |
| V_{out} | DC Output Voltage (Referenced to GND) | - 0.5 to $V_{CC} + 0.5$ | V |
| I_{in} | DC Input Current, per Pin | ± 20 | mA |
| I_{out} | DC Output Current, per Pin | ± 25 | mA |
| I_{CC} | DC Supply Current, V_{CC} and GND Pins | ± 50 | mA |
| P_D | Power Dissipation in Still Air, Plastic or Ceramic DIP† SOIC Package† | 750 500 | mW |
| T_{stg} | Storage Temperature | - 65 to + 150 | °C |
| T_L | Lead Temperature, 1 mm from Case for 10 Seconds (Plastic DIP or SOIC Package) (Ceramic DIP) | 260 300 | °C |

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

† Derating — Plastic DIP: - 10 mW/°C from 65° to 125°C
Ceramic DIP: - 10 mW/°C from 100° to 125°C
SOIC Package: - 7 mW/°C from 65° to 125°C

For high frequency or heavy load considerations, see Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit | |
|-------------------|--|--|-------------|--------------------|----|
| V_{CC} | DC Supply Voltage (Referenced to GND) | 2.0 | 6.0 | V | |
| V_{in}, V_{out} | DC Input Voltage, Output Voltage (Referenced to GND) | 0 | V_{CC} | V | |
| T_A | Operating Temperature, All Package Types | - 55 | + 125 | °C | |
| t_r, t_f | Input Rise and Fall Time (Figure 2) | $V_{CC} = 2.0 \text{ V}$ $V_{CC} = 4.5 \text{ V}$ $V_{CC} = 6.0 \text{ V}$ | 0 0 0 | 1000 500 400 | ns |

DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

| Symbol | Parameter | Test Conditions | V_{CC} V | Guaranteed Limit | | | Unit |
|----------|--|---|--|------------------|-------------------------|--------------------------|---------------|
| | | | | - 55 to 25°C | $\leq 85^\circ\text{C}$ | $\leq 125^\circ\text{C}$ | |
| V_{IH} | Minimum High-Level Input Voltage | $V_{out} = 0.1 \text{ V or } V_{CC} - 0.1 \text{ V}$ $ I_{out} \leq 20 \mu\text{A}$ | 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} | Maximum Low-Level Input Voltage | $V_{out} = 0.1 \text{ V or } V_{CC} - 0.1 \text{ V}$ $ I_{out} \leq 20 \mu\text{A}$ | 2.0 | 0.3 | 0.3 | 0.3 | V |
| | | | 4.5 | 0.9 | 0.9 | 0.9 | |
| | | | 6.0 | 1.2 | 1.2 | 1.2 | |
| V_{OH} | Minimum High-Level Output Voltage | $V_{in} = V_{IH} \text{ or } V_{IL}$ $ I_{out} \leq 20 \mu\text{A}$ | 2.0 | 1.9 | 1.9 | 1.9 | V |
| | | | 4.5 | 4.4 | 4.4 | 4.4 | |
| | | | 6.0 | 5.9 | 5.9 | 5.9 | |
| | | | $V_{in} = V_{IH} \text{ or } V_{IL}$ $ I_{out} \leq 4.0 \text{ mA}$ $ I_{out} \leq 5.2 \text{ mA}$ | 4.5 | 3.98 | 3.84 | |
| V_{OL} | Maximum Low-Level Output Voltage | $V_{in} = V_{IH} \text{ or } V_{IL}$ $ I_{out} \leq 20 \mu\text{A}$ | 2.0 | 0.1 | 0.1 | 0.1 | V |
| | | | 4.5 | 0.1 | 0.1 | 0.1 | |
| | | | 6.0 | 0.1 | 0.1 | 0.1 | |
| | | | $V_{in} = V_{IH} \text{ or } V_{IL}$ $ I_{out} \leq 4.0 \text{ mA}$ $ I_{out} \leq 5.2 \text{ mA}$ | 4.5 | 0.26 | 0.33 | |
| I_{in} | Maximum Input Leakage Current | $V_{in} = V_{CC} \text{ or } GND$ | 6.0 | ± 0.1 | ± 1.0 | ± 1.0 | μA |
| I_{CC} | Maximum Quiescent Supply Current (per Package) | $V_{in} = V_{CC} \text{ or } GND$ $I_{out} = 0 \mu\text{A}$ | 6.0 | 8 | 80 | 160 | μA |

NOTE: Information on typical parametric values can be found in Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

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

| Symbol | Parameter | VCC V | Guaranteed Limit | | | Unit |
|--|---|----------|------------------|--------|---------|------|
| | | | - 55 to 25°C | ≤ 85°C | ≤ 125°C | |
| t _{PLH} , t _{PHL} | Maximum Propagation Delay, Input A or B to Output A = B (Figures 1 and 3) | 2.0 | 210 | 265 | 315 | ns |
| | | 4.5 | 42 | 53 | 63 | |
| | | 6.0 | 36 | 45 | 54 | |
| t _{PLH} , t _{PHL} | Maximum Propagation Delay, Cascade Input to Output A = B (Figures 2 and 3) | 2.0 | 120 | 150 | 180 | ns |
| | | 4.5 | 24 | 30 | 36 | |
| | | 6.0 | 20 | 26 | 31 | |
| t _{TLH} , t _{THL} | Maximum Output Transition Time, Any Output (Figures 2 and 3) | 2.0 | 75 | 95 | 110 | ns |
| | | 4.5 | 15 | 19 | 22 | |
| | | 6.0 | 13 | 16 | 19 | |
| C _{in} | Maximum Input Capacitance | — | 10 | 10 | 10 | pF |

NOTES:

1. For propagation delays with loads other than 50 pF, see Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).
2. Information on typical parametric values can be found in Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

| C _{PD} | Power Dissipation Capacitance (Per Package)* | Typical @ 25°C, VCC = 5.0 V | pF |
|-----------------|--|-----------------------------|----|
| | | 30 | |

* Used to determine the no-load dynamic power consumption: $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$. For load considerations, see Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

SWITCHING WAVEFORMS

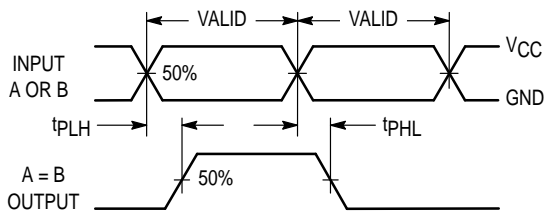


Figure 1.

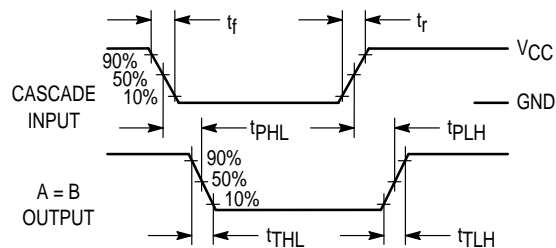
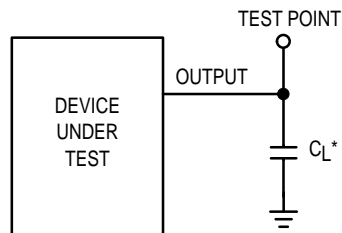


Figure 2.

TEST CIRCUITS

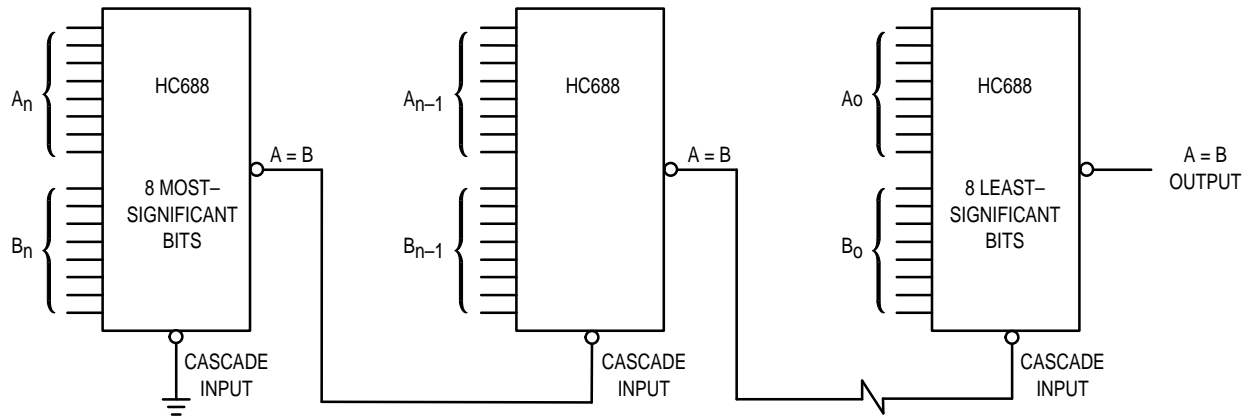


* Includes all probe and jig capacitance

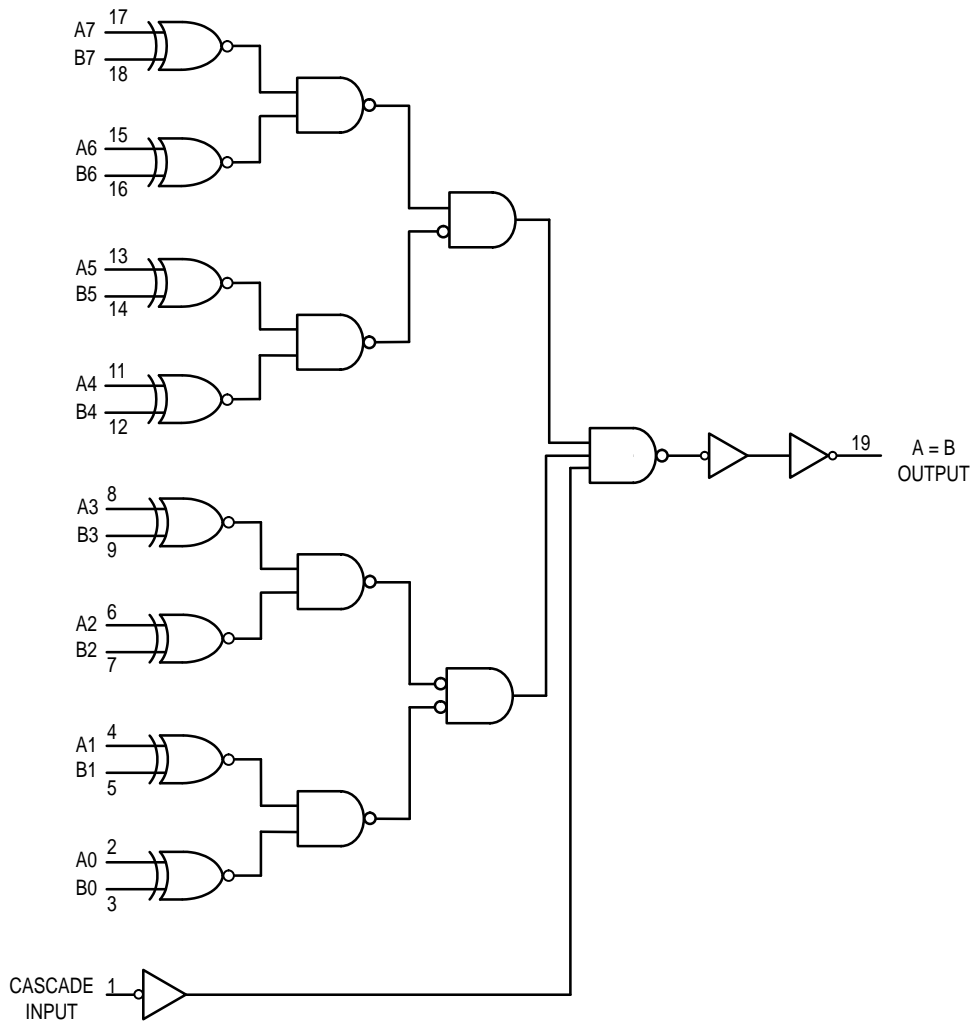
Figure 3.

TYPICAL APPLICATION

Two or more HC688 8-bit Equality Comparators may be cascaded to compare binary or BCD numbers having more than 8 bits. One method of accomplishing this is shown here.



EXPANDED LOGIC DIAGRAM



OUTLINE DIMENSIONS

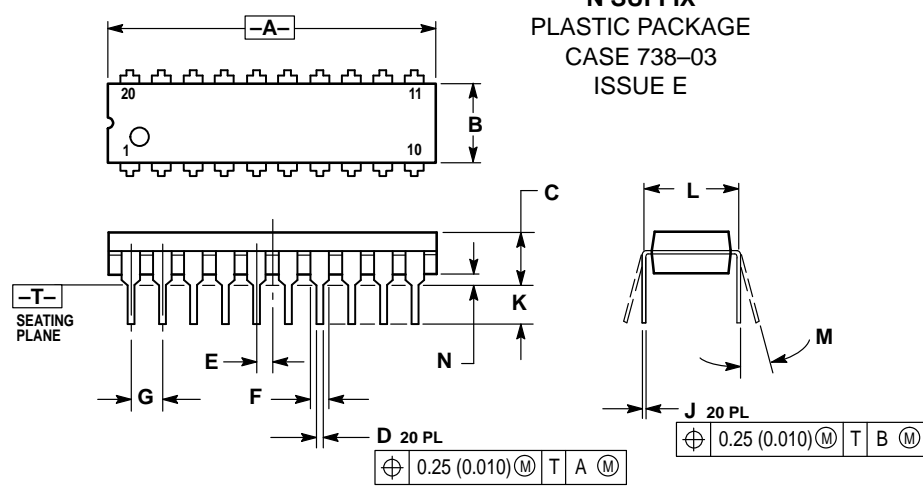
J SUFFIX
CERAMIC PACKAGE
 CASE 732-03
 ISSUE E



- NOTES:
- LEADS WITHIN 0.25 (0.010) DIAMETER, TRUE POSITION AT SEATING PLANE, AT MAXIMUM MATERIAL CONDITION.
 - DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
 - DIMENSIONS A AND B INCLUDE MENISCUS.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 23.88 | 25.15 | 0.940 | 0.990 |
| B | 6.60 | 7.49 | 0.260 | 0.295 |
| C | 3.81 | 5.08 | 0.150 | 0.200 |
| D | 0.38 | 0.56 | 0.015 | 0.022 |
| F | 1.40 | 1.65 | 0.055 | 0.065 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 0.51 | 1.27 | 0.020 | 0.050 |
| J | 0.20 | 0.30 | 0.008 | 0.012 |
| K | 3.18 | 4.06 | 0.125 | 0.160 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | 0° | 15° | 0° | 15° |
| N | 0.25 | 1.02 | 0.010 | 0.040 |

N SUFFIX
PLASTIC PACKAGE
 CASE 738-03
 ISSUE E

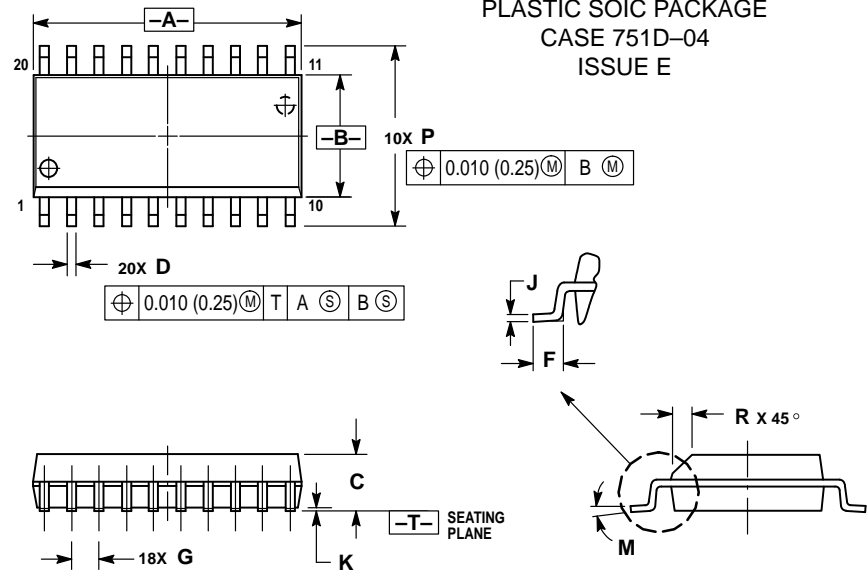


- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 - CONTROLLING DIMENSION: INCH.
 - DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
 - DIMENSION B DOES NOT INCLUDE MOLD FLASH.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 1.010 | 1.070 | 25.66 | 27.17 |
| B | 0.240 | 0.260 | 6.10 | 6.60 |
| C | 0.150 | 0.180 | 3.81 | 4.57 |
| D | 0.015 | 0.022 | 0.39 | 0.55 |
| E | 0.050 BSC | | 1.27 BSC | |
| F | 0.050 | 0.070 | 1.27 | 1.77 |
| G | 0.100 BSC | | 2.54 BSC | |
| J | 0.008 | 0.015 | 0.21 | 0.38 |
| K | 0.110 | 0.140 | 2.80 | 3.55 |
| L | 0.300 BSC | | 7.62 BSC | |
| M | 0° | 15° | 0° | 15° |
| N | 0.020 | 0.040 | 0.51 | 1.01 |

| | | | |
|-----------------------------------|---|---|---------------|
| $\oplus 0.25 (0.010) \text{ (M)}$ | T | A | (M) |
| $\oplus 0.25 (0.010) \text{ (M)}$ | T | B | (M) |

DW SUFFIX
PLASTIC SOIC PACKAGE
 CASE 751D-04
 ISSUE E



- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 - CONTROLLING DIMENSION: MILLIMETER.
 - DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
 - MAXIMUM MOLD PROTRUSION 0.150 (0.006) PER SIDE.
 - DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 12.65 | 12.95 | 0.499 | 0.510 |
| B | 7.40 | 7.60 | 0.292 | 0.299 |
| C | 2.35 | 2.65 | 0.093 | 0.104 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.50 | 0.90 | 0.020 | 0.035 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.25 | 0.32 | 0.010 | 0.012 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 10.05 | 10.55 | 0.395 | 0.415 |
| R | 0.25 | 0.75 | 0.010 | 0.029 |

| | | | | | |
|-----------------------------------|---|---|---------------|---|---------------|
| $\oplus 0.010 (0.25) \text{ (M)}$ | T | A | (S) | B | (S) |
|-----------------------------------|---|---|---------------|---|---------------|

| | | | | | |
|-----------------------------------|---|---|---------------|---|---------------|
| $\oplus 0.010 (0.25) \text{ (M)}$ | T | A | (S) | B | (S) |
|-----------------------------------|---|---|---------------|---|---------------|

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