# MC74LCX16245

# Low-Voltage CMOS 16-Bit Transceiver

## With 5 V−Tolerant Inputs and Outputs (3−State, Non−Inverting)

The MC74LCX16245 is a high performance, non−inverting 16−bit transceiver operating from a 2.3 to 3.6 V supply. The device is byte controlled. Each byte has separate Output Enable inputs which can be tied together for full 16−bit operation. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A $V_I$ specification of 5.5 V allows MC74LCX16245 inputs to be safely driven from 5.0 V devices. The MC74LCX16245 is suitable for memory address driving and all TTL level bus oriented transceiver applications.

The 4.5 ns maximum propagation delays support high performance applications. Current drive capability is 24 mA at both A and B ports. The Transmit/Receive (T/$\overline{R}$n) inputs determine the direction of data flow through the bidirectional transceiver. Transmit (active−HIGH) enables data from A ports to B ports; Receive (active−LOW) enables data from B to A ports. The Output Enable inputs ($\overline{OE}$n), when HIGH, disable both A and B ports by placing them in a HIGH Z condition.

### Features

- Designed for 2.3 to 3.6 V $V_{CC}$ Operation
- 4.5 ns Maximum $t_{pd}$
- 5.0 V Tolerant − Interface Capability With 5.0 V TTL Logic
- Supports Live Insertion and Withdrawal
- $I_{OFF}$ Specification Guarantees High Impedance When $V_{CC}$ = 0 V
- LVTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current in All Three Logic States (20 μA) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance: Human Body Model >2000 V; Machine Model >200 V
- These are Pb−Free Devices*

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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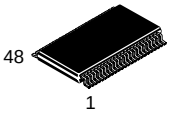
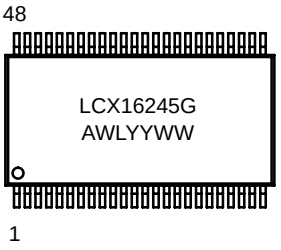



**TSSOP−48**
**DT SUFFIX**
**CASE 1201**

**MARKING DIAGRAM**




| | |
|---|---|
| A | = Assembly Location |
| WL | = Wafer Lot |
| YY | = Year |
| WW | = Work Week |
| G | = Pb−Free Package |

**ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

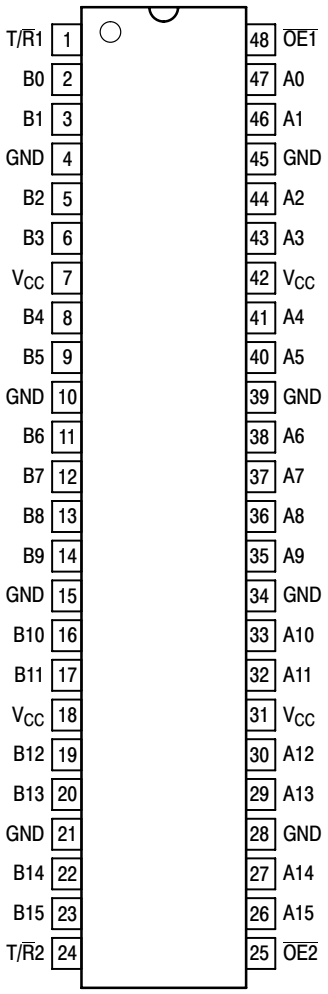



**Figure 1. Pinout: 48−Lead** (Top View)

**Table 1. PIN NAMES**

| Pins | Function |
|---|---|
| $\overline{OEn}$ | Output Enable Inputs |
| T/$\overline{Rn}$ | Transmit/Receive Inputs |
| A0 − A15 | Side A Inputs or 3−State Outputs |
| B0 − B15 | Side B Inputs or 3−State Outputs |

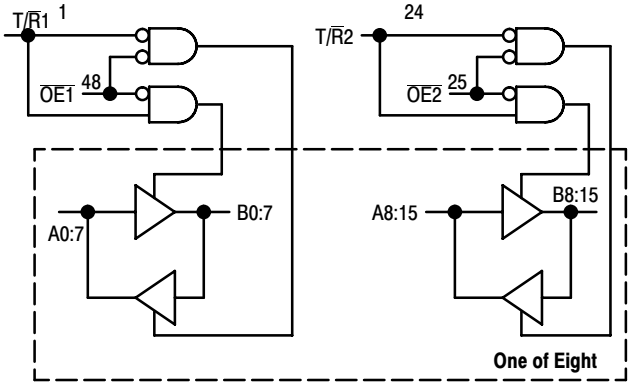



**Figure 2. Logic Diagram**

**TRUTH TABLE**

| Inputs | | | Inputs | | |
|---|---|---|---|---|---|
| **OE1** | **T/$\overline{R}$1** | **Outputs** | **OE2** | **T/$\overline{R}$2** | **Outputs** |
| L | L | Bus B0:7 Data to Bus A0:7 | L | L | Bus B8:15 Data to Bus A8:15 |
| L | H | Bus A0:7 Data to Bus B0:7 | L | H | Bus A8:15 Data to Bus B8:15 |
| H | X | High Z State on A0:7, B0:7 | H | X | High Z State on A8:15, B8:15 |

H = High Voltage Level
L = Low Voltage Level
Z = High Impedance State
X = High or Low Voltage Level and Transitions Are Acceptable; for $I_{CC}$ reasons, DO NOT FLOAT Inputs

## ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| MC74LCX16245DT | TSSOP−48* | 39 Units / Rail |
| MC74LCX16245DTG | TSSOP−48* | 39 Units / Rail |
| MC74LCX16245DTR2 | TSSOP−48* | 2500 / Tape & Reel |
| M74LCX16245DTR2G | TSSOP−48* | 2500 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
*This package is inherently Pb−Free.

## MAXIMUM RATINGS

| Symbol | Parameter | Value | Condition | Unit |
|---|---|---|---|---|
| $V_{CC}$ | DC Supply Voltage | −0.5 to +7.0 | | V |
| $V_I$ | DC Input Voltage | $-0.5 \le V_I \le +7.0$ | | V |
| $V_O$ | DC Output Voltage | $-0.5 \le V_O \le +7.0$ | Output in 3−State | V |
| | | $-0.5 \le V_O \le V_{CC} + 0.5$ | Output in HIGH or LOW State. (Note 1) | V |
| $I_{IK}$ | DC Input Diode Current | −50 | $V_I$ < GND | mA |
| $I_{OK}$ | DC Output Diode Current | −50 | $V_O$ < GND | mA |
| | | +50 | $V_O > V_{CC}$ | mA |
| $I_O$ | DC Output Source/Sink Current | ±50 | | mA |
| $I_{CC}$ | DC Supply Current Per Supply Pin | ±100 | | mA |
| $I_{GND}$ | DC Ground Current Per Ground Pin | ±100 | | mA |
| $T_{STG}$ | Storage Temperature Range | −65 to +150 | | °C |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.
1. $I_O$ absolute maximum rating must be observed.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | Operating<br>Data Retention Only | 2.0<br>1.5 | 2.5, 3.3<br>2.5, 3.3 | 3.6<br>3.6 | V |
| $V_I$ | Input Voltage | | 0 | | 5.5 | V |
| $V_O$ | Output Voltage | (HIGH or LOW State)<br>(3−State) | 0<br>0 | | $V_{CC}$<br>5.5 | V |
| $I_{OH}$ | HIGH Level Output Current | $V_{CC}$ = 3.0 V − 3.6 V<br>$V_{CC}$ = 2.7 V − 3.0 V<br>$V_{CC}$ = 2.3 V − 2.7 V | | | − 24<br>− 12<br>− 8 | mA |
| $I_{OL}$ | LOW Level Output Current | $V_{CC}$ = 3.0 V − 3.6 V<br>$V_{CC}$ = 2.7 V − 3.0 V<br>$V_{CC}$ = 2.3 V − 2.7 V | | | + 24<br>+ 12<br>+ 8 | mA |
| $T_A$ | Operating Free−Air Temperature | | −40 | | +85 | °C |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate, $V_{IN}$ from 0.8 V to 2.0 V, $V_{CC}$ = 3.0 V | | 0 | | 10 | ns/V |

## DC ELECTRICAL CHARACTERISTICS

| Symbol | Characteristic | Condition | $T_A$ = −40°C to +85°C | | Unit |
|---|---|---|---|---|---|
| | | | Min | Max | |
| $V_{IH}$ | HIGH Level Input Voltage (Note 2) | 2.3 V ≤ $V_{CC}$ ≤ 2.7 V | 1.7 | | V |
| | | 2.7 V ≤ $V_{CC}$ ≤ 3.6 V | 2.0 | | |
| $V_{IL}$ | LOW Level Input Voltage (Note 2) | 2.3 V ≤ $V_{CC}$ ≤ 2.7 V | | 0.7 | V |
| | | 2.7 V ≤ $V_{CC}$ ≤ 3.6 V | | 0.8 | |
| $V_{OH}$ | HIGH Level Output Voltage | 2.3 V ≤ $V_{CC}$ ≤ 3.6 V; $I_{OL}$ = 100 μA | $V_{CC}$ − 0.2 | | V |
| | | $V_{CC}$ = 2.3 V; $I_{OH}$ = −8 mA | 1.8 | | |
| | | $V_{CC}$ = 2.7 V; $I_{OH}$ = −12 mA | 2.2 | | |
| | | $V_{CC}$ = 3.0 V; $I_{OH}$ = −18 mA | 2.4 | | |
| | | $V_{CC}$ = 3.0 V; $I_{OH}$ = −24 mA | 2.2 | | |
| $V_{OL}$ | LOW Level Output Voltage | 2.3 V ≤ $V_{CC}$ ≤ 3.6 V; $I_{OL}$ = 100 μA | | 0.2 | V |
| | | $V_{CC}$ = 2.3 V; $I_{OL}$= 8 mA | | 0.6 | |
| | | $V_{CC}$ = 2.7 V; $I_{OL}$= 12 mA | | 0.4 | |
| | | $V_{CC}$ = 3.0 V; $I_{OL}$ = 16 mA | | 0.4 | |
| | | $V_{CC}$ = 3.0 V; $I_{OL}$ = 24 mA | | 0.55 | |
| $I_I$ | Input Leakage Current | 2.3 V ≤ $V_{CC}$ ≤ 3.6 V; 0 V ≤ $V_I$ ≤ 5.5 V | | ±5.0 | μA |
| $I_{OZ}$ | 3−State Output Current | 2.3 ≤ $V_{CC}$ ≤ 3.6 V; 0V ≤ $V_O$ ≤ 5.5 V; $V_I$ = $V_{IH}$ or $V_{IL}$ | | ±5.0 | μA |
| $I_{OFF}$ | Power−Off Leakage Current | $V_{CC}$ = 0 V; $V_I$ or $V_O$ = 5.5 V | | 10 | μA |
| $I_{CC}$ | Quiescent Supply Current | 2.3 ≤ $V_{CC}$ ≤ 3.6 V; $V_I$ = GND or $V_{CC}$ | | 20 | μA |
| | | 2.3 ≤ $V_{CC}$ ≤ 3.6 V; 3.6 ≤ $V_I$ or $V_O$ ≤ 5.5 V | | ±20 | μA |
| $\Delta I_{CC}$ | Increase in $I_{CC}$ per Input | 2.3 ≤ $V_{CC}$ ≤ 3.6 V; $V_{IH}$ = $V_{CC}$ − 0.6 V | | 500 | μA |

2. These values of $V_I$ are used to test DC electrical characteristics only.

## AC CHARACTERISTICS $t_R = t_F$ = 2.5 ns; $R_L$ = 500 Ω

| Symbol | Parameter | Waveform | $T_A$ = −40°C to +85°C | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ = 3.3 V ± 0.3 V, $C_L$ = 50 pF | | $V_{CC}$ = 2.7 V, $C_L$ = 50 pF | | $V_{CC}$ = 2.5 V ± 0.2 V, $C_L$ = 30 pF | | |
| | | | Min | Max | Min | Max | Min | Max | |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>Input to Output | 1 | 1.5<br>1.5 | 4.5<br>4.5 | 1.5<br>1.5 | 5.2<br>5.2 | 1.5<br>1.5 | 5.4<br>5.4 | ns |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time to<br>High and Low Level | 2 | 1.5<br>1.5 | 6.5<br>6.5 | 1.5<br>1.5 | 7.2<br>7.2 | 1.5<br>1.5 | 8.5<br>8.5 | ns |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output Disable Time From<br>High and Low Level | 2 | 1.5<br>1.5 | 6.4<br>6.4 | 1.5<br>1.5 | 6.9<br>6.9 | 1.5<br>1.5 | 7.7<br>7.7 | ns |
| $t_{OSHL}$<br>$t_{OSLH}$ | Output−to−Output Skew<br>(Note 3) | | | 1.0<br>1.0 | | | | | ns |

3. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH−to−LOW ($t_{OSHL}$) or LOW−to−HIGH ($t_{OSLH}$); parameter guaranteed by design.

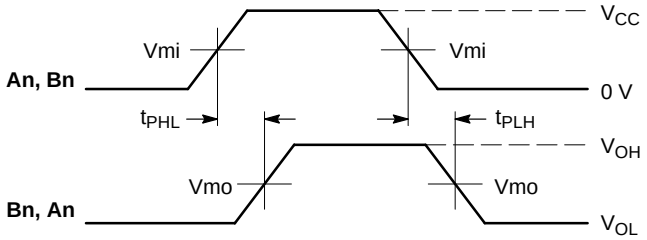
## DYNAMIC SWITCHING CHARACTERISTICS

| Symbol | Characteristic | Condition | $T_A$ = +25°C | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $V_{OLP}$ | Dynamic LOW Peak Voltage (Note 4) | $V_{CC}$ = 3.3 V, $C_L$ = 50 pF, $V_{IH}$ = 3.3 V, $V_{IL}$ = 0 V<br>$V_{CC}$ = 2.5 V, $C_L$ = 30 pF, $V_{IH}$ = 2.5 V, $V_{IL}$ = 0 V | | 0.8<br>0.6 | | V<br>V |
| $V_{OLV}$ | Dynamic LOW Valley Voltage (Note 4) | $V_{CC}$ = 3.3 V, $C_L$ = 50 pF, $V_{IH}$ = 3.3 V, $V_{IL}$ = 0 V<br>$V_{CC}$ = 2.5 V, $C_L$ = 30 pF, $V_{IH}$ = 2.5 V, $V_{IL}$ = 0 V | | −0.8<br>−0.6 | | V<br>V |

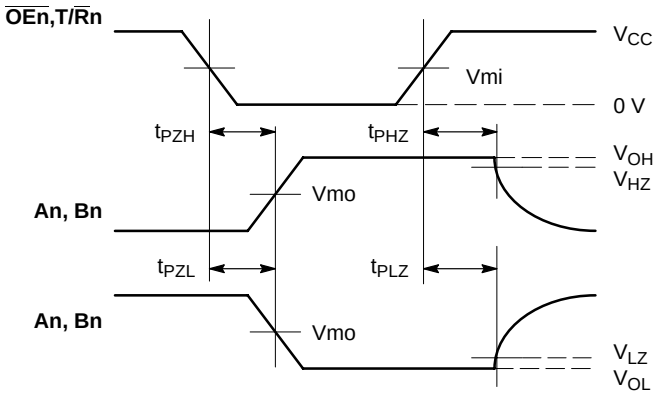
4. Number of outputs defined as “n”. Measured with “n−1” outputs switching from HIGH−to−LOW or LOW−to−HIGH. The remaining output is measured in the LOW state.

## CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Condition | Typical | Unit |
|---|---|---|---|---|
| $C_{IN}$ | Input Capacitance | $V_{CC}$ = 3.3 V, $V_I$ = 0 V or $V_{CC}$ | 7 | pF |
| $C_{I/O}$ | Input/Output Capacitance | $V_{CC}$ = 3.3 V, $V_I$ = 0 V or $V_{CC}$ | 8 | pF |
| $C_{PD}$ | Power Dissipation Capacitance | 10 MHz, $V_{CC}$ = 3.3 V, $V_I$ = 0 V or $V_{CC}$ | 20 | pF |




**WAVEFORM 1 − PROPAGATION DELAYS**
$t_R = t_F$ = 2.5 ns, 10% to 90%; f = 1 MHz; $t_W$ = 500 ns




**WAVEFORM 2 − OUTPUT ENABLE AND DISABLE TIMES**
$t_R = t_F$ = 2.5 ns, 10% to 90%; f = 1 MHz; $t_W$ = 500 ns

**Figure 3. AC Waveforms**

**Table 2. AC WAVEFORMS**

| Symbol | $V_{CC}$ | | |
|---|---|---|---|
| | **3.3 V ± 0.3 V** | **2.7 V** | **2.5 V ± 0.2 V** |
| Vmi | 1.5 V | 1.5 V | $V_{CC}$ / 2 |
| Vmo | 1.5 V | 1.5 V | $V_{CC}$ / 2 |
| $V_{HZ}$ | $V_{OL}$ + 0.3 V | $V_{OL}$ + 0.3 V | $V_{OL}$ + 0.15 V |
| $V_{LZ}$ | $V_{OH}$ − 0.3 V | $V_{OH}$ − 0.3 V | $V_{OH}$ − 0.15 V |

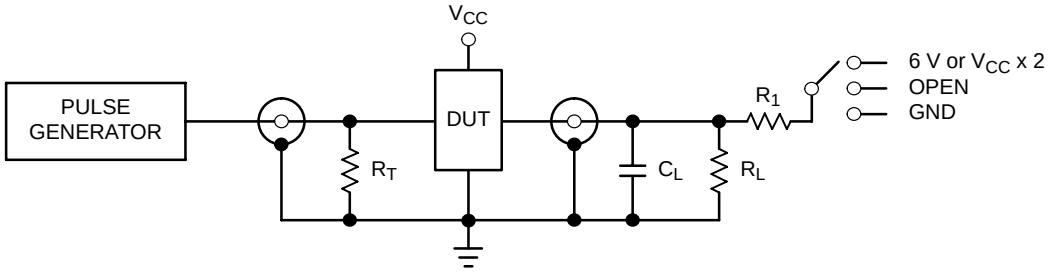



**Figure 4. Test Circuit**

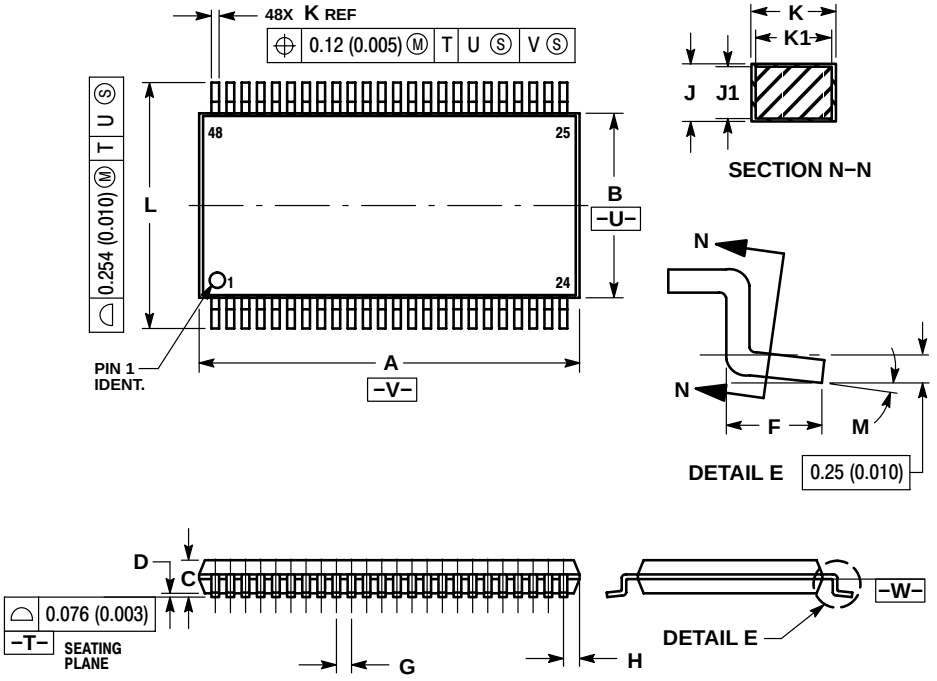
**Table 3. TEST CIRCUIT**

| TEST | SWITCH |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | Open |
| $t_{PZL}$, $t_{PLZ}$ | 6 V at $V_{CC}$ = 3.3 ± 0.3 V<br>6 V at $V_{CC}$ = 2.5 ± 0.2 V |
| Open Collector/Drain $t_{PLH}$ and $t_{PHL}$ | 6 V |
| $t_{PZH}$, $t_{PHZ}$ | GND |

$C_L$ = 50 pF at $V_{CC}$ = 3.3 ± 0.3 V or equivalent (includes jig and probe capacitance)
$C_L$ = 30 pF at $V_{CC}$ = 2.5 ± 0.2 V or equivalent (includes jig and probe capacitance)
$R_L$ = $R_1$ = 500 Ω or equivalent
$R_T$ = $Z_{OUT}$ of pulse generator (typically 50 Ω)

## PACKAGE DIMENSIONS

**TSSOP−48**
**DT SUFFIX**
CASE 1201−01
ISSUE A




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 12.40 | 12.60 | 0.488 | 0.496 |
| B | 6.00 | 6.20 | 0.236 | 0.244 |
| C | --- | 1.10 | --- | 0.043 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.50 | 0.75 | 0.020 | 0.030 |
| G | 0.50 BSC | | 0.0197 BSC | |
| H | 0.37 | --- | 0.015 | --- |
| J | 0.09 | 0.20 | 0.004 | 0.008 |
| J1 | 0.09 | 0.16 | 0.004 | 0.006 |
| K | 0.17 | 0.27 | 0.007 | 0.011 |
| K1 | 0.17 | 0.23 | 0.007 | 0.009 |
| L | 7.95 | 8.25 | 0.313 | 0.325 |
| M | 0 ° | 8 ° | 0 ° | 8 ° |

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