



## Unidirectional and Bidirectional Transient Voltage Suppressor (TVS) Device

Screening in  
reference to  
MIL-PRF-19500  
available

### DESCRIPTION

These MRT100KP40A – MRT100KP400CA high reliability devices protect against dangerous high-voltage, short term transients such as those caused by the secondary effects of lightning per IEC61000-4-5 (see protection classes below) and RTCA/DO-160. They also protect against voltage spikes caused by inductive load switching, induced RFI, and ESD or EFT per IEC61000-4-2 and IEC61000-4-4. Clamping time is nearly instantaneous at < 5ns.

**Important:** For the latest information, visit our website <http://www.microsemi.com>.

### FEATURES

- Available in both unidirectional and bidirectional configurations
- Suppresses transients up to 100 kW @ 6.4/69  $\mu$ s
- Fast response with less than 5 ns turn-on time
- Preferred 100 kW TVS for aircraft power bus protection
- 3 $\sigma$  lot norm screening performed on standby current  $I_D$
- 100% surge tested devices
- Multiple screening levels in reference to MIL-PRF-19500 are available. Refer to [Hirel Non-Hermetic Product Portfolio](#) for more details on the screening options. (See [part nomenclature](#) for all options.)
- High reliability controlled devices have wafer fabrication and assembly lot traceability
- Moisture classification is level 1 with no dry pack required per IPC/JEDEC J-STD-020B
- RoHS compliant versions are available

### APPLICATIONS / BENEFITS

- Economical TVS series for thru-hole mounting
- Protection from high power switching transients, induced RF, and lightning threats with comparatively small package size (0.25 inch diameter)
- Protection from ESD and EFT per IEC61000-4-2 and IEC61000-4-4
- Pin injection protection per RTCA/DO-160 up to Level 4 for Waveform 4 (6.4/69  $\mu$ s) on all devices
- Pin injection protection per RTCA/DO-160 up to Level 5 for Waveform 4 (6.4/69  $\mu$ s) on device types MRT100KP33A or CA up to MRT100KP260A or CA
- Pin injection protection per RTCA/DO-160 up to Level 3 for Waveform 5A (40/120  $\mu$ s) on all devices
- Pin injection protection per RTCA/DO-160 up to Level 4 for Waveform 5A (40/120  $\mu$ s) on device types MRT100KP33A or CA up to MRT100KP64A or CA
- Consult Factory for other voltages with similar Peak Pulse Power ( $P_{PP}$ ) capabilities



**Case 5A  
(DO-204AR)  
Package**

#### **MSC – Lawrence**

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1-800-446-1158 or  
(978) 620-2600  
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[www.microsemi.com](http://www.microsemi.com)

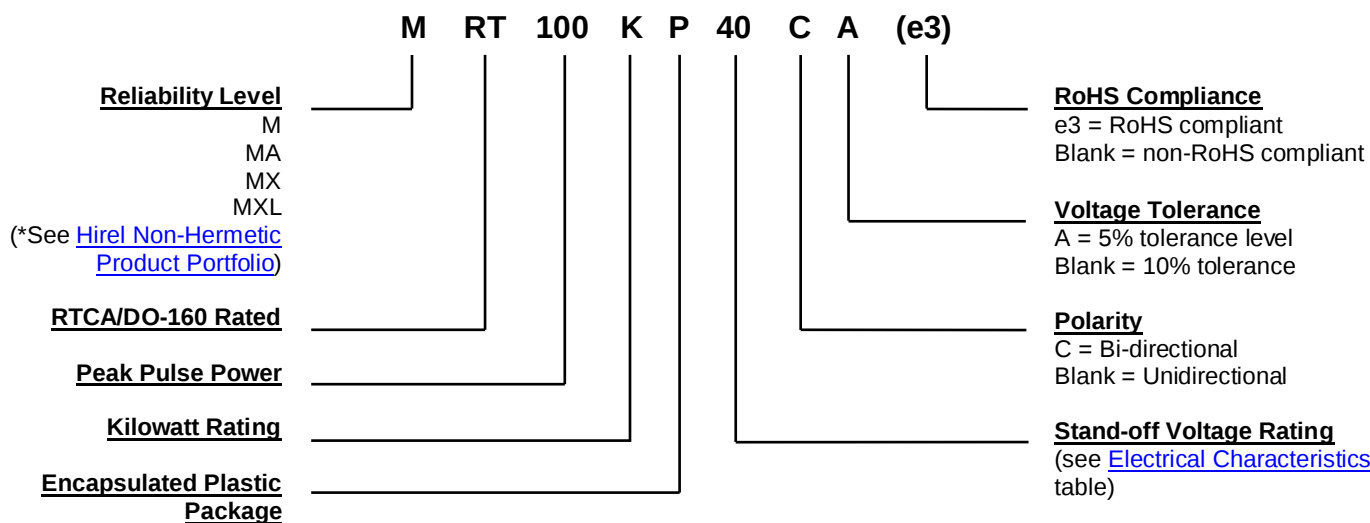
**MAXIMUM RATINGS @ 25 °C unless otherwise noted**

| Parameters/Test Conditions                                                    | Symbol              | Value                    | Unit |
|-------------------------------------------------------------------------------|---------------------|--------------------------|------|
| Junction and Storage Temperature                                              | $T_J$ and $T_{STG}$ | -65 to +150              | °C   |
| Thermal Resistance, Junction to Lead @ 3/8 inch (10 mm) lead length from body | $R_{\theta JL}$     | 17.5                     | °C/W |
| Thermal Resistance, Junction to Ambient <sup>(1)</sup>                        | $R_{\theta JA}$     | 77.5                     | °C/W |
| Peak Pulse Power Dissipation <sup>(2)</sup> 6.4/69 $\mu$ s                    | $P_{PP}$            | 100                      | kW   |
| Steady-State Power Dissipation @ $T_A = 25$ °C                                | $P_D$               | 7<br>1.61 <sup>(1)</sup> | W    |
| $T_{clamping}$ (0 volts to $V_{(BR)}$ min, theoretical) Unidirectional        |                     | < 100                    | ps   |
| Bidirectional                                                                 |                     | < 5                      | ns   |
| Surge Peak Forward Current <sup>(2)</sup>                                     | $I_{FSM}$           | 250                      | A    |
| Solder Temperature @ 10 s                                                     |                     | 260                      | °C   |

**Notes:** 1. When mounted on FR4 PC board with 4 mm<sup>2</sup> copper pads (1 oz) and track width 1 mm, length 25 mm.  
2. At 8.3 ms half-sine wave (unidirectional only).

**MECHANICAL and PACKAGING**

- CASE: Void-free transfer molded thermosetting epoxy body meeting UL94V-0.
- TERMINALS: Tin-lead or RoHS compliant annealed matte-tin plating. Solderable per MIL-STD-750, method 2026.
- MARKING: Part number
- POLARITY: Cathode indicated by band. No cathode band on bidirectional devices.
- TAPE & REEL option: Standard per EIA-296 (add "TR" suffix to part number). Consult factory for quantities.
- WEIGHT: Approximately 1.7 grams
- See [Package Dimensions](#) on last page.

**PART NOMENCLATURE**


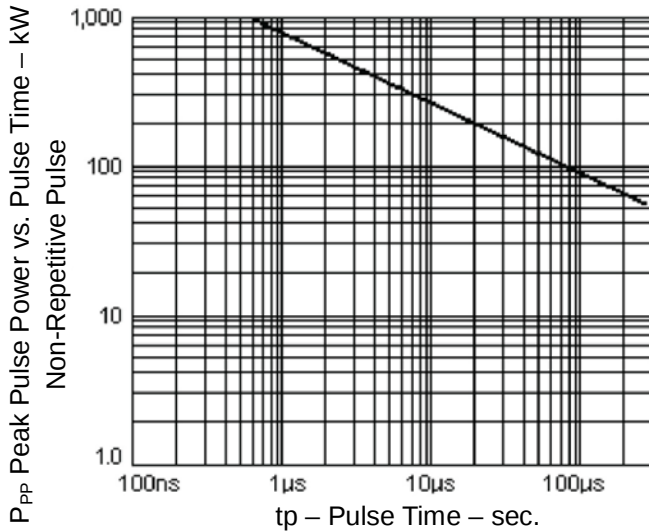
| SYMBOLS & DEFINITIONS |                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Symbol                | Definition                                                                                                                                                                                                                                                                                                                                            |
| $\alpha_{V(BR)}$      | Temperature Coefficient of Breakdown Voltage: The change in breakdown voltage divided by the change in temperature that caused it expressed in $\%/^{\circ}\text{C}$ or $\text{mV}/^{\circ}\text{C}$ .                                                                                                                                                |
| $V_{WM}$              | Working Standoff Voltage: The maximum-rated value of dc or repetitive peak positive cathode-to-anode voltage that may be continuously applied over the standard operating temperature.                                                                                                                                                                |
| $P_{PP}$              | Peak Pulse Power. The rated random recurring peak impulse power or rated nonrepetitive peak impulse power. The impulse power is the maximum-rated value of the product of $I_{PP}$ and $V_C$ .                                                                                                                                                        |
| $V_{(BR)}$            | Breakdown Voltage: The voltage across the device at a specified current $I_{(BR)}$ in the breakdown region.                                                                                                                                                                                                                                           |
| $I_D$                 | Standby Current: The current through the device at rated stand-off voltage.                                                                                                                                                                                                                                                                           |
| $I_{PP}$              | Peak Impulse Current: The maximum rated random recurring peak impulse current or nonrepetitive peak impulse current that may be applied to a device. A random recurring or nonrepetitive transient current is usually due to an external cause, and it is assumed that its effect will have completely disappeared before the next transient arrives. |
| $V_C$                 | Clamping Voltage: The voltage across the device in a region of low differential resistance during the application of an impulse current ( $I_{PP}$ ) for a specified waveform.                                                                                                                                                                        |
| $I_{(BR)}$            | Breakdown Current: The current used for measuring Breakdown Voltage $V_{(BR)}$                                                                                                                                                                                                                                                                        |

**ELECTRICAL CHARACTERISTICS @ 25 °C**

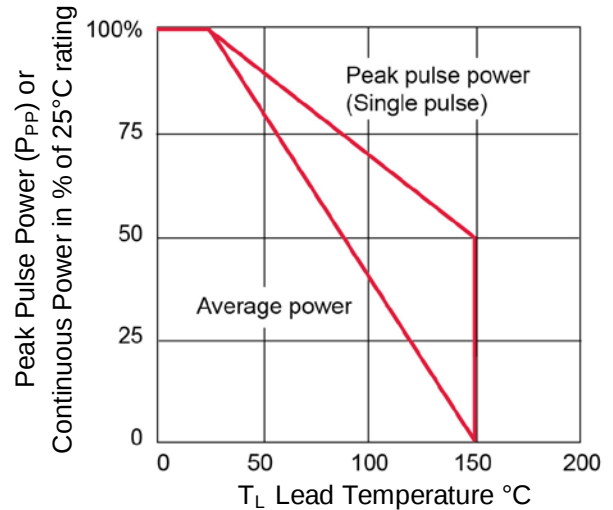
| Part Number  | Rated Stand-off Voltage | Breakdown Voltage<br>$V_{(BR)}$ Volts<br>@ $I_{(BR)}$ |            | Maximum Clamping<br>@ $I_{PP}^{(1)}$ | Maximum Reverse Leakage<br>@ $V_{WM}$<br>$I_D$ | Maximum Peak Pulse Current <sup>(2)</sup><br>@ 6.4/69 $\mu s$<br>$I_{PP}$ | Maximum $V_{(BR)}$ Temperature Coefficient<br>$\alpha_{V(BR)}$ |
|--------------|-------------------------|-------------------------------------------------------|------------|--------------------------------------|------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------|
|              | $V_{WM}$                | $V_{(BR)}$                                            | $I_{(BR)}$ | $V_C$                                |                                                |                                                                           |                                                                |
|              | Volts                   | Volts                                                 | mA         | Volts                                | $\mu Amps$                                     | Amps                                                                      | mV/°C                                                          |
| MRT100KP40A  | 40                      | 44.4-49.1                                             | 20         | 78.6                                 | 1500                                           | 1273 *                                                                    | 46                                                             |
| MRT100KP43A  | 43                      | 47.8-52.8                                             | 10         | 84.5                                 | 500                                            | 1184 *                                                                    | 50                                                             |
| MRT100KP45A  | 45                      | 50.0-55.3                                             | 5          | 88.5                                 | 150                                            | 1130 *                                                                    | 52                                                             |
| MRT100KP48A  | 48                      | 53.3-58.9                                             | 5          | 94.3                                 | 150                                            | 1061 *                                                                    | 56                                                             |
| MRT100KP51A  | 51                      | 56.7-62.7                                             | 5          | 101                                  | 50                                             | 990 *                                                                     | 60                                                             |
| MRT100KP54A  | 54                      | 60.0-66.3                                             | 5          | 106                                  | 25                                             | 943 *                                                                     | 63                                                             |
| MRT100KP58A  | 58                      | 64.4-71.2                                             | 5          | 114                                  | 15                                             | 878                                                                       | 68                                                             |
| MRT100KP60A  | 60                      | 66.7-73.7                                             | 5          | 118                                  | 15                                             | 848                                                                       | 71                                                             |
| MRT100KP64A  | 64                      | 71.1-78.6                                             | 5          | 126                                  | 10                                             | 795                                                                       | 76                                                             |
| MRT100KP70A  | 70                      | 77.8-86.0                                             | 5          | 138                                  | 10                                             | 725                                                                       | 83                                                             |
| MRT100KP75A  | 75                      | 83.3-92.1                                             | 5          | 147                                  | 10                                             | 680                                                                       | 89                                                             |
| MRT100KP78A  | 78                      | 86.7-95.8                                             | 5          | 153                                  | 10                                             | 655                                                                       | 93                                                             |
| MRT100KP85A  | 85                      | 94.4-104                                              | 5          | 166                                  | 10                                             | 602                                                                       | 102                                                            |
| MRT100KP90A  | 90                      | 100-111                                               | 5          | 178                                  | 10                                             | 563                                                                       | 109                                                            |
| MRT100KP100A | 100                     | 111-123                                               | 5          | 197                                  | 10                                             | 508                                                                       | 121                                                            |
| MRT100KP110A | 110                     | 122-135                                               | 5          | 216                                  | 10                                             | 463                                                                       | 133                                                            |
| MRT100KP120A | 120                     | 133-147                                               | 5          | 235                                  | 10                                             | 426                                                                       | 145                                                            |
| MRT100KP130A | 130                     | 144-159                                               | 5          | 254                                  | 10                                             | 394                                                                       | 157                                                            |
| MRT100KP150A | 150                     | 167-185                                               | 5          | 296                                  | 10                                             | 338                                                                       | 183                                                            |
| MRT100KP160A | 160                     | 178-197                                               | 5          | 315                                  | 10                                             | 318                                                                       | 195                                                            |
| MRT100KP170A | 170                     | 189-209                                               | 5          | 334                                  | 10                                             | 300                                                                       | 207                                                            |
| MRT100KP180A | 180                     | 200-221                                               | 5          | 354                                  | 10                                             | 283                                                                       | 219                                                            |
| MRT100KP200A | 200                     | 222-245                                               | 5          | 392                                  | 10                                             | 256                                                                       | 243                                                            |
| MRT100KP220A | 220                     | 245-271                                               | 5          | 434                                  | 10                                             | 231                                                                       | 269                                                            |
| MRT100KP250A | 250                     | 278-308                                               | 5          | 493                                  | 10                                             | 203                                                                       | 306                                                            |
| MRT100KP260A | 260                     | 289-320                                               | 5          | 512                                  | 10                                             | 196                                                                       | 318                                                            |
| MRT100KP280A | 280                     | 311-345                                               | 5          | 552                                  | 10                                             | 181                                                                       | 344                                                            |
| MRT100KP300A | 300                     | 333-369                                               | 5          | 590                                  | 10                                             | 170                                                                       | 368                                                            |
| MRT100KP350A | 350                     | 389-431                                               | 5          | 690                                  | 10                                             | 145                                                                       | 430                                                            |
| MRT100KP400A | 400                     | 444-492                                               | 5          | 787                                  | 10                                             | 127                                                                       | 490                                                            |

**NOTES:**

1. Clamping voltage does not include any variable parasitic lead inductance effects observed during the 6.4  $\mu s$  rise time due to lead length.
2. The maximum peak pulse current ( $I_{PP}$ ) shown represents the performance capabilities by design.  
\*Surge test screening is only performed up to 900 Amps (test equipment limitations).

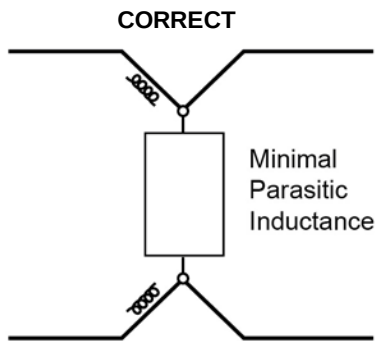
**GRAPHS**


**FIGURE 1**  
Peak Pulse Power vs. Pulse Time  
To 50% of Exponentially Decaying Pulse

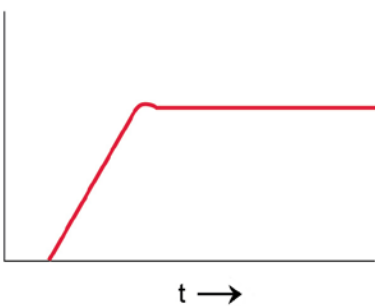


**FIGURE 2**  
Power Derating

**NOTE:** This  $P_{PP}$  versus time graph allows the designer to use these parts over a broad power spectrum using the guidelines illustrated in [MicroNote 104](#) on [www.microsemi.com](http://www.microsemi.com). Aircraft transients are described with exponentially decaying waveforms. For suppression of square-wave impulses, derate power and current to 66% of that for the exponential decay shown in Figure 1.



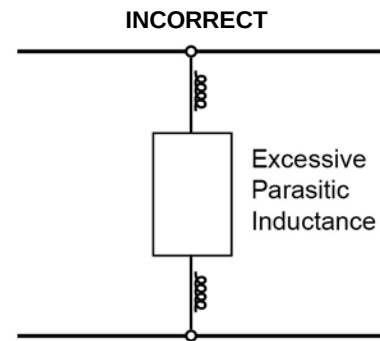
**FIGURE 3**



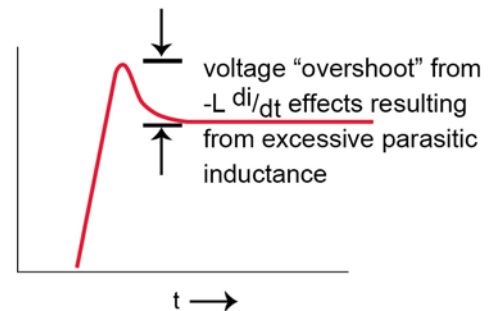
**FIGURE 4**

**INSTALLATION**

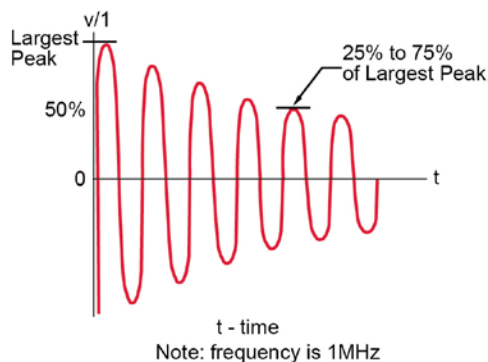
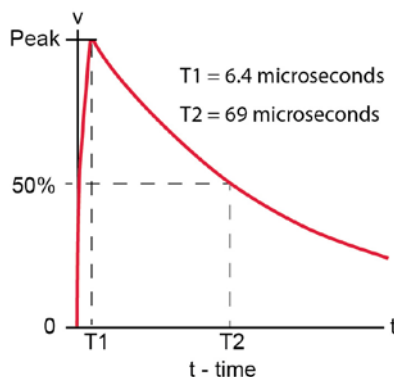
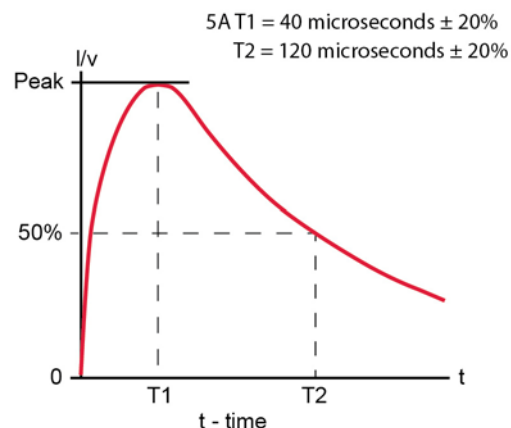
TVS devices used across power lines are subject to relatively high magnitude surge currents and are more prone to adverse parasitic inductance effects in the mounting leads. Minimizing the shunt path of the lead inductance and their  $V = -L di/dt$  effects will optimize the TVS effectiveness. Examples of optimum installation and poor installation are illustrated in Figures 3 to 6. Figure 3 illustrates minimal parasitic inductance with attachment at end of device. Inductive voltage drop is across the input leads. Virtually no "overshoot" voltage results as illustrated with Figure 4. The loss of effectiveness in protection caused by excessive parasitic inductance is illustrated in Figures 5 and 6. Also see [MicroNote 111](#) for further information on "Parasitic Lead Inductance in TVS".



**FIGURE 5**



**FIGURE 6**

**GRAPHS (continued)**

**FIGURE 7 – Waveform 3**

**FIGURES 8 – Waveform 4**

**FIGURE 9 – Waveform 5A**

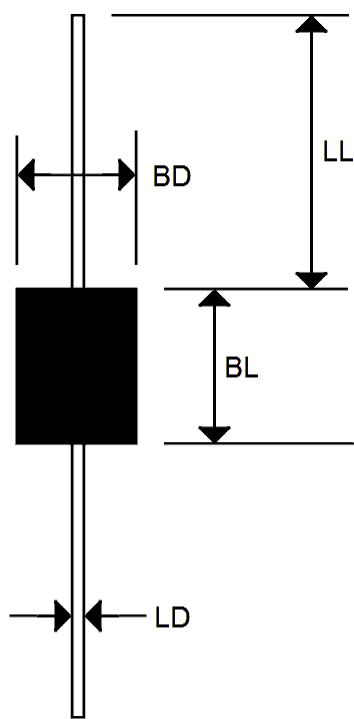
**NOTE:** The 1 MHz damped oscillatory waveform (3) has an effective pulse width of 4  $\mu$ s. Equivalent peak pulse power at each of the pulse widths represented in RTCA/DO-160 for waveforms 3, 4 and 5A (above) have been determined referencing Figure 1 herein as well as MicroNotes [104](#) and [120](#) (found on [www.microsemi.com](http://www.microsemi.com)) and are listed below.

| WAVEFORM<br>NUMBER | PULSE<br>WIDTH | PEAK PULSE<br>POWER | Peak Pulse Current Conversion Factor<br>* from Rated $I_{PP}$ at 6.4/69 $\mu$ s |
|--------------------|----------------|---------------------|---------------------------------------------------------------------------------|
|                    | $\mu$ s        | kW                  |                                                                                 |
| <b>3</b>           | 4              | 340                 | 3.40x                                                                           |
| <b>4</b>           | 6.4/69         | 100                 | 1.00x                                                                           |
| <b>5A</b>          | 40/120         | 70                  | 0.70x                                                                           |

\* Multiply by the conversion factor shown with reference to the maximum rated  $I_{PP}$  in the Electrical Characteristics Table on page 2.

**NOTE 1:** High current fast rise-time transients of 250 ns or less can more than triple the  $V_C$  from parasitic inductance effects ( $V = -Ldi/dt$ ) compared to the clamping voltage shown in the initial [Electrical Characteristics](#) table as also described in Figures 5 and 6 herein.

**NOTE 2:** Also see MicroNotes [127](#), [130](#), and [132](#) on [www.microsemi.com](http://www.microsemi.com) for further information on transient voltage suppressors with reference to aircraft industry specification RTCA/DO-160.

**PACKAGE DIMENSIONS**


| Dim       | Dimensions |       |             |       |
|-----------|------------|-------|-------------|-------|
|           | Inch       |       | Millimeters |       |
|           | Min        | Max   | Min         | Max   |
| <b>LL</b> | 0.750      | -     | 19.05       | -     |
| <b>BL</b> | 0.365      | 0.385 | 9.27        | 9.78  |
| <b>BD</b> | 0.235      | 0.255 | 5.97        | 6.48  |
| <b>LD</b> | 0.047      | 0.053 | 1.194       | 1.346 |