



# STB4NC50

N-CHANNEL 500V - 2.2Ω - 4A D2PAK

PowerMesh™II MOSFET

| TYPE     | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|----------|------------------|---------------------|----------------|
| STB4NC50 | 500V             | < 2.7Ω              | 4 A            |

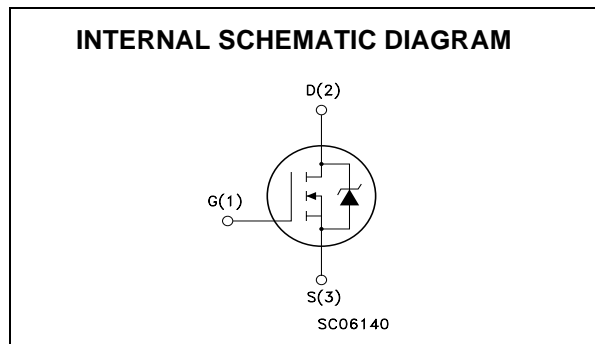
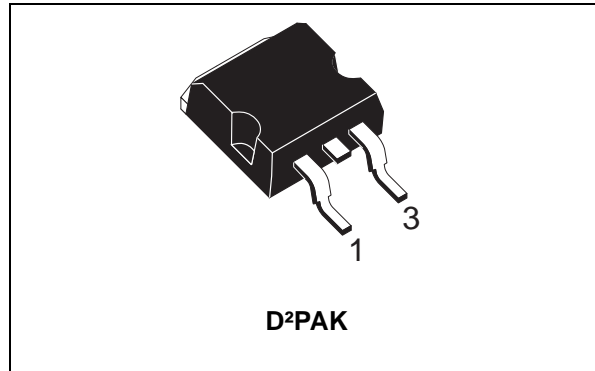
- TYPICAL R<sub>DS(on)</sub> = 2.2 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- NEW HIGH VOLTAGE BENCHMARK
- GATE CHARGE MINIMIZED

### DESCRIPTION

The PowerMESH™II is the evolution of the first generation of MESH OVERLAY™. The layout refinements introduced greatly improve the Ron\*area figure of merit while keeping the device at the leading edge for what concerns switching speed, gate charge and ruggedness.

### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVERS



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter  | Value      | Unit |
|---------------------|--|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)           | 500        | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 500        | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                 | ±30        | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C  | 4          | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 2.5        | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                               | 12         | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 80         | W    |
|                     | Derating Factor                                      | 0.64       | W/°C |
| dv/dt(1)            | Peak Diode Recovery voltage slope                    | 3.5        | V/ns |
| T <sub>stg</sub>    | Storage Temperature                                  | -65 to 150 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                  | 150        | °C   |

(●)Pulse width limited by safe operating area

(1)I<sub>SD</sub> ≤ 4A, di/dt ≤ 300A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

## STB4NC50

### THERMAL DATA

|                |  |      |      |
|----------------|--|------|------|
| Rthj-case      | Thermal Resistance Junction-case Max           | 1.56 | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient Max        | 62.5 | °C/W |
| Rthc-sink      | Thermal Resistance Case-sink Typ               | 0.5  | °C/W |
| T <sub>l</sub> | Maximum Lead Temperature For Soldering Purpose | 300  | °C   |

### AVALANCHE CHARACTERISTICS

| Symbol          | Parameter  | Max Value | Unit |
|-----------------|--|-----------|------|
| I <sub>AR</sub> | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)                                | 10        | A    |
| E <sub>AS</sub> | Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V) | 110       | mJ   |

### ELECTRICAL CHARACTERISTICS (TCASE = 25 °C UNLESS OTHERWISE SPECIFIED) OFF

| Symbol               | Parameter   | Test Conditions   | Min. | Typ. | Max.    | Unit     |
|----------------------|---|---|------|------|---------|----------|
| V <sub>(BR)DSS</sub> | Drain-source Breakdown Voltage                        | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0  | 500  |      |         | V        |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0) | V <sub>DS</sub> = Max Rating<br>V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C |      |      | 1<br>50 | μA<br>μA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ±30V  |      |      | ±100    | nA       |

### ON (1)

| Symbol              | Parameter                         | Test Conditions  | Min. | Typ. | Max. | Unit |
|---------------------|-----------------------------------|--|------|------|------|------|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                               | 2    | 3    | 4    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V, I <sub>D</sub> = 1.5 A  |      | 2.2  | 2.7  | Ω    |
| I <sub>D(on)</sub>  | On State Drain Current            | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> ,<br>V <sub>GS</sub> = 10V | 4    |      |      | A    |

### DYNAMIC

| Symbol              | Parameter                    | Test Conditions  | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|--|------|------|------|------|
| g <sub>fs</sub> (1) | Forward Transconductance     | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> ,<br>I <sub>D</sub> = 2A |      | 3    |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0                                  |      | 315  |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |  |      | 52   |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |  |      | 7.7  |      | pF   |

**ELECTRICAL CHARACTERISTICS (CONTINUED)**

**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions  | Min. | Typ. | Max. | Unit |
|-------------|--------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 300V, I_D = 2A$<br>$R_G = 4.7\Omega, V_{GS} = 10V$ |      | 10   |      | ns   |
| $t_r$       | Rise Time          | (see test circuit, Figure 3)                                 |      | 13   |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 400V, I_D = 4.2A,$<br>$V_{GS} = 10V$               |      | 12.5 | 17   | nC   |
| $Q_{gs}$    | Gate-Source Charge |  |      | 2.7  |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |  |      | 6.1  |      | nC   |

**SWITCHING OFF**

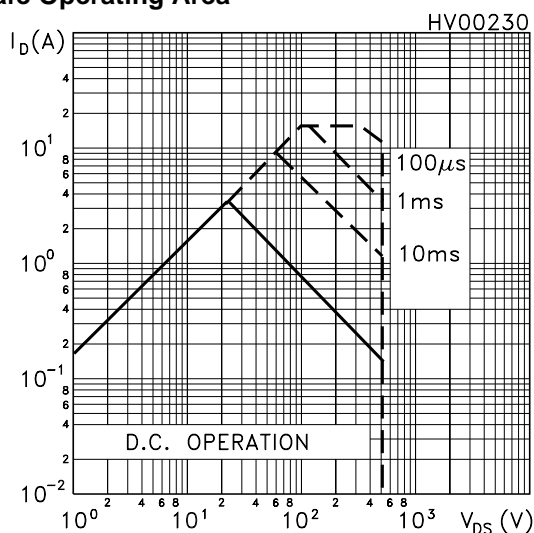
| Symbol        | Parameter             | Test Conditions   | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|---|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 400V, I_D = 4A,$<br>$R_G = 4.7\Omega, V_{GS} = 10V$ |      | 15   |      | ns   |
| $t_f$         | Fall Time             | (see test circuit, Figure 5)                                  |      | 13   |      | ns   |
| $t_c$         | Cross-over Time       |   |      | 20   |      | ns   |

**SOURCE DRAIN DIODE**

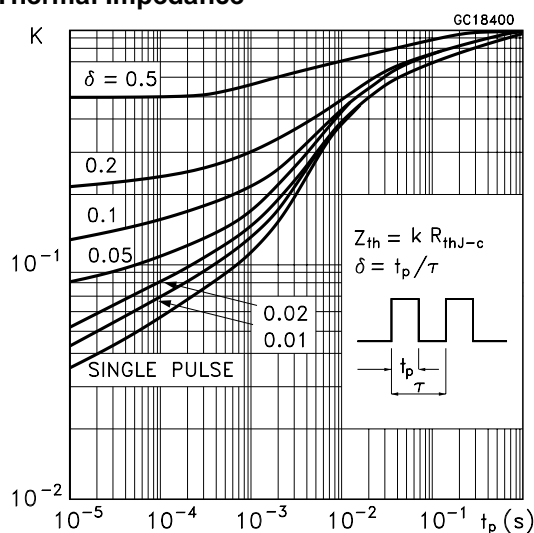
| Symbol       | Parameter                     | Test Conditions   | Min. | Typ. | Max. | Unit    |
|--------------|-------------------------------|---|------|------|------|---------|
| $I_{SD}$     | Source-drain Current          |   |      |      | 4    | A       |
| $I_{SDM(2)}$ | Source-drain Current (pulsed) |   |      |      | 16   | A       |
| $V_{SD(1)}$  | Forward On Voltage            | $I_{SD} = 4A, V_{GS} = 0$   |      |      | 1.6  | V       |
| $t_{rr}$     | Reverse Recovery Time         | $I_{SD} = 4A, di/dt = 100A/\mu s, V_{DD} = 100V, T_j = 150^\circ C$<br>(see test circuit, Figure 5) |      | 400  |      | ns      |
| $Q_{rr}$     | Reverse Recovery Charge       |   |      | 1.64 |      | $\mu C$ |
| $I_{RRM}$    | Reverse Recovery Current      |   |      | 8.2  |      | A       |

Note: 1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %.  
2. Pulse width limited by safe operating area.

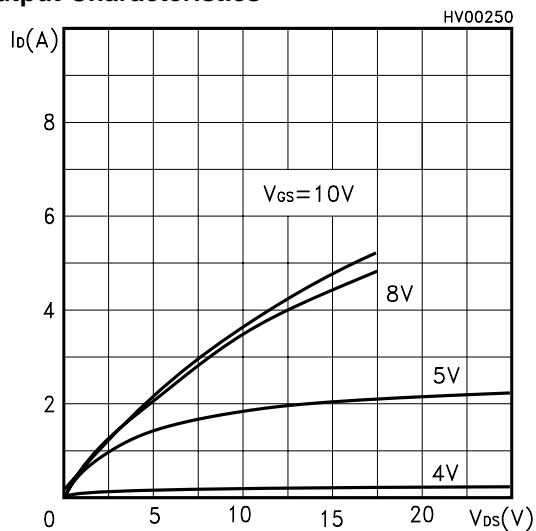
**Safe Operating Area**



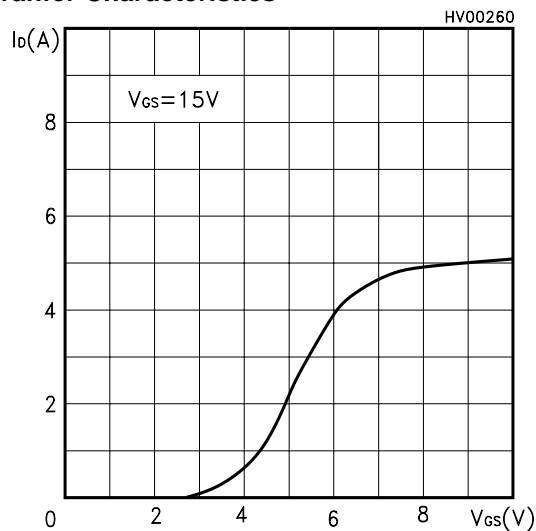
**Thermal Impedance**



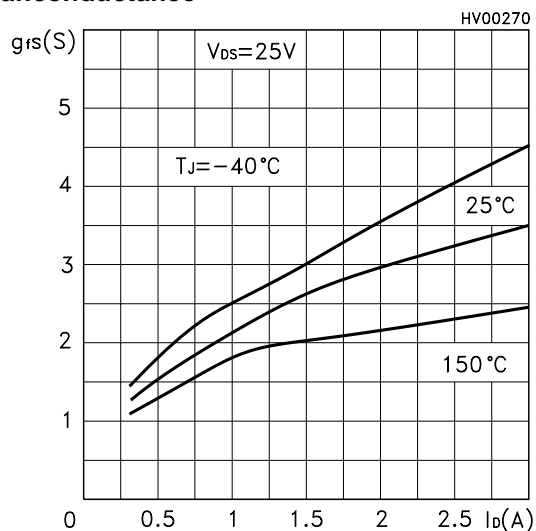
Output Characteristics



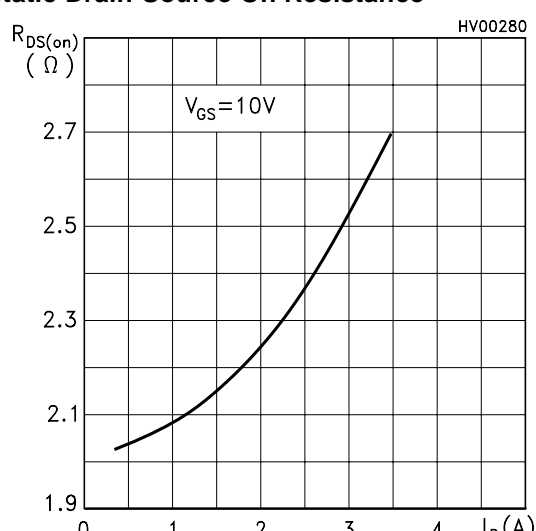
Transfer Characteristics



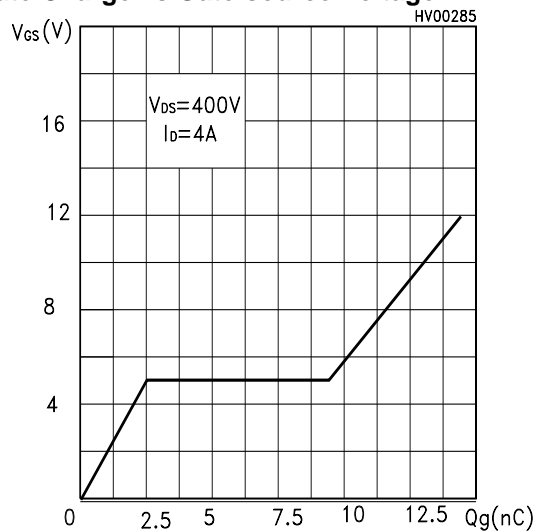
Transconductance



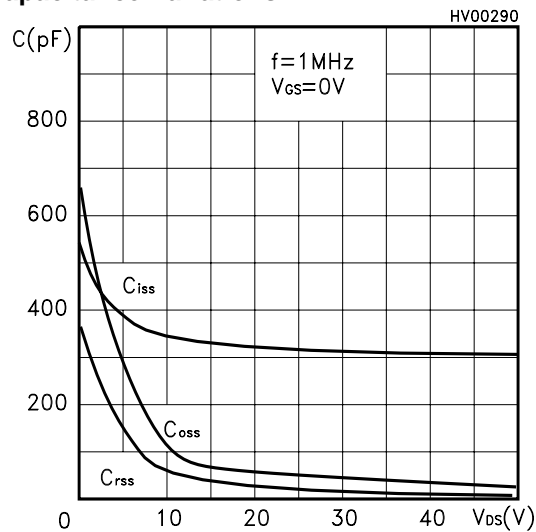
Static Drain-Source On Resistance



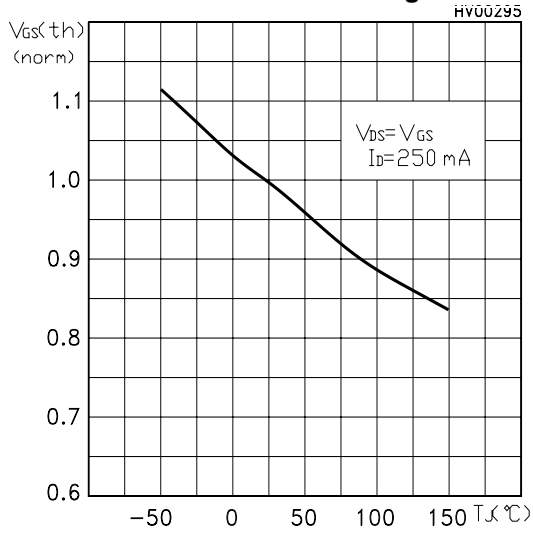
Gate Charge vs Gate-source Voltage



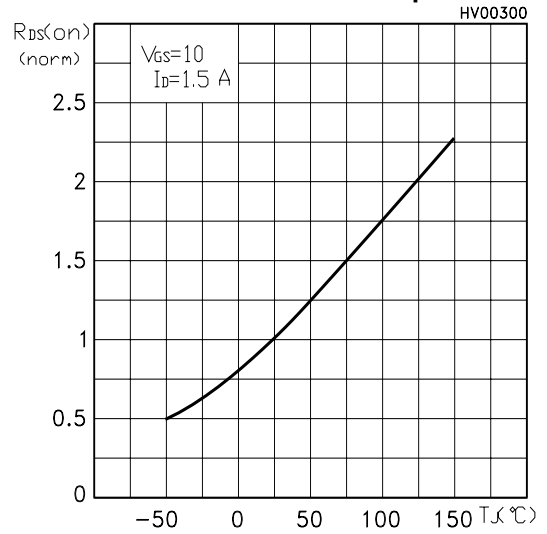
Capacitance Variations



**Normalized Gate Threshold Voltage vs Temp.**



**Normalized On Resistance vs Temperature**



**Source-drain Diode Forward Characteristics**

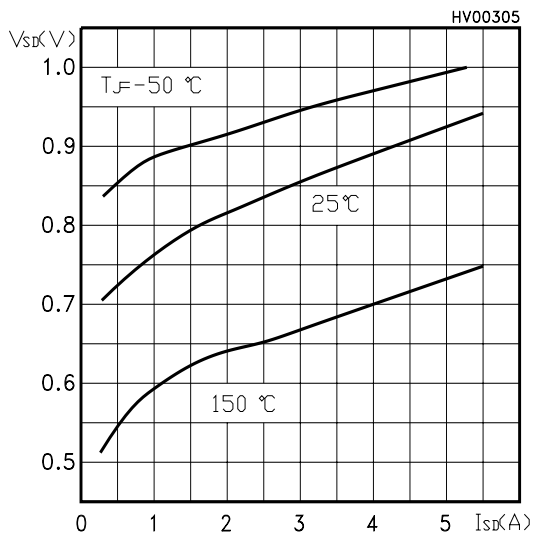


Fig. 1: Unclamped Inductive Load Test Circuit



Fig. 2: Unclamped Inductive Waveform



Fig. 3: Switching Times Test Circuits For Resistive Load



Fig. 4: Gate Charge test Circuit

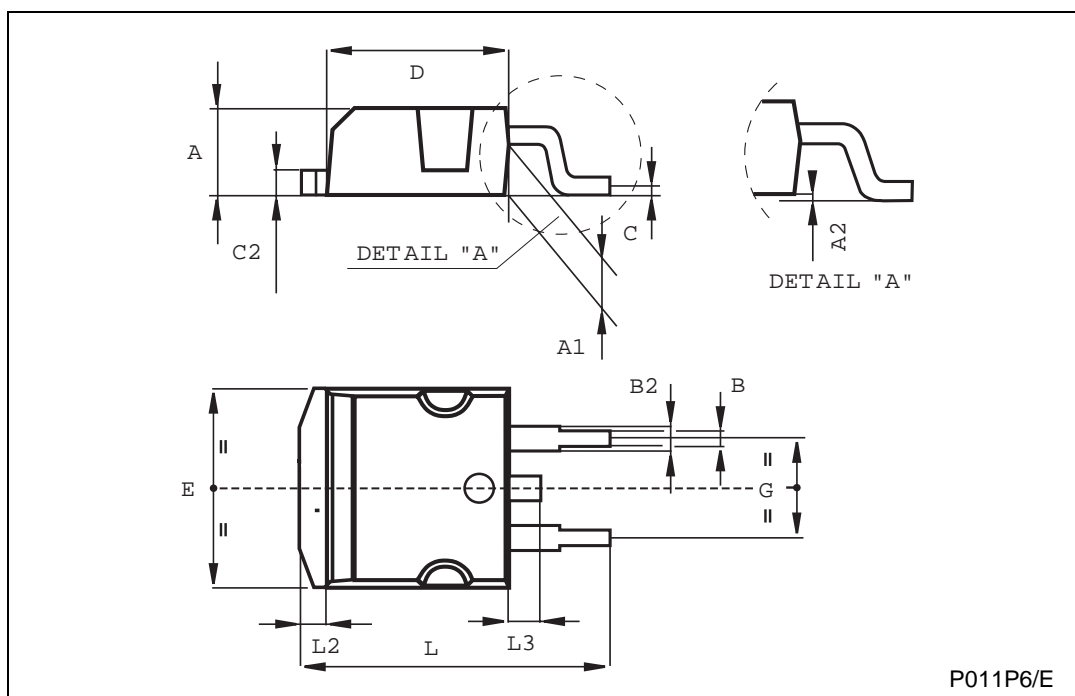


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



TO-263 (D<sup>2</sup>PAK) MECHANICAL DATA

| DIM. | mm   |      |       | inch  |      |       |
|------|------|------|-------|-------|------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP. | MAX.  |
| A    | 4.4  |      | 4.6   | 0.173 |      | 0.181 |
| A1   | 2.49 |      | 2.69  | 0.098 |      | 0.106 |
| B    | 0.7  |      | 0.93  | 0.027 |      | 0.036 |
| B2   | 1.14 |      | 1.7   | 0.044 |      | 0.067 |
| C    | 0.45 |      | 0.6   | 0.017 |      | 0.023 |
| C2   | 1.21 |      | 1.36  | 0.047 |      | 0.053 |
| D    | 8.95 |      | 9.35  | 0.352 |      | 0.368 |
| E    | 10   |      | 10.4  | 0.393 |      | 0.409 |
| G    | 4.88 |      | 5.28  | 0.192 |      | 0.208 |
| L    | 15   |      | 15.85 | 0.590 |      | 0.624 |
| L2   | 1.27 |      | 1.4   | 0.050 |      | 0.055 |
| L3   | 1.4  |      | 1.75  | 0.055 |      | 0.068 |



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