



| Features | <i>Bvdss</i>                                                                                               | <i>Rdson</i> | <i>ID</i> |
|----------|------------------------------------------------------------------------------------------------------------|--------------|-----------|
|          | 650V                                                                                                       | 2.2Ω         | 4A        |
|          | <b>Application</b><br><div>➤ PWM applications</div> <div>➤ Load Switch</div> <div>➤ Power management</div> |              |           |

➤ Planar Mosfets

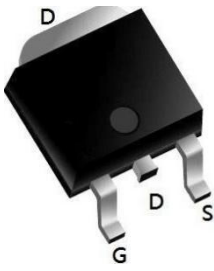
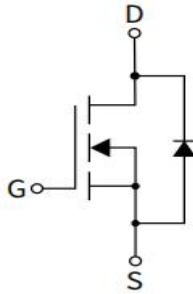
➤ Excellent  $R_{DS(ON)}$

➤ Low Gate Charge

➤ High current Capability

➤ Green product RoHS compliant, lead free

RoHS

| Package                                                                                                         |                                                                                                        |                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <br>Marking and pin assignment | <br>TO252-3L top view | <br>Schematic diagram |

## Package Marking and Ordering Information

| Device Marking | Device  | Device Package | Quantity |
|----------------|---------|----------------|----------|
| 4N65           | HL4N65R | TO252-3L       | 2500     |

## Absolute Maximum Ratings ( $T_C=25^{\circ}\text{C}$ unless otherwise specified)

| Parameter                                                  |                       | Symbol           | Value     | Unit |
|------------------------------------------------------------|-----------------------|------------------|-----------|------|
| Drain-Source Voltage                                       |                       | V <sub>DS</sub>  | 650       | V    |
| Gate-Source Voltage                                        |                       | V <sub>GS</sub>  | ± 30      | V    |
| Continuous Drain Current <sup>1</sup>                      | T <sub>C</sub> = 25℃  | I <sub>D</sub>   | 4         | A    |
|                                                            | T <sub>C</sub> = 100℃ |                  | 2.5       | A    |
| Pulsed Drain Current <sup>2</sup>                          |                       | I <sub>DM</sub>  | 16        | A    |
| Single Pulse Avalanche Energy <sup>3</sup>                 |                       | E <sub>AS</sub>  | 84        | mJ   |
| Avalanche Current <sup>3</sup>                             |                       | I <sub>AS</sub>  | 4.6       | A    |
| Total Power Dissipation <sup>4</sup> @T <sub>C</sub> =25℃  |                       | P <sub>D</sub>   | 69        | W    |
| Total Power Dissipation <sup>4</sup> @T <sub>C</sub> =100℃ |                       |                  | 28        |      |
| Storage Temperature Range                                  |                       | T <sub>STG</sub> | -55 ~ 150 | ℃    |
| Operating Junction Temperature Range                       |                       | T <sub>J</sub>   | -55 ~ 150 | ℃    |



## Thermal Resistance Ratings

| Parameter                                        | Symbol          | Typ. | Max. | Unit |
|--------------------------------------------------|-----------------|------|------|------|
| Thermal Resistance Junction-Ambient <sup>1</sup> | $R_{\theta JA}$ | 50   | 55   | °C/W |
| Thermal Resistance Junction-Case <sup>1</sup>    | $R_{\theta JC}$ | 1.8  | 0.7  | °C/W |

## Ordering Information

| Ordering Number | Package  | Pin Assignment |   |   | Packing   |
|-----------------|----------|----------------|---|---|-----------|
| Halogen Free    |          | G              | D | S |           |
| HL4N65R         | TO252-3L | 1              | 2 | 3 | Tape Reel |

Electrical Characteristics ( $T_J=25^{\circ}\text{C}$  unless otherwise noted)

| Parameter                         | Symbol       | Test Condition                                   | Min. | Typ. | Max.      | Unit     |
|-----------------------------------|--------------|--------------------------------------------------|------|------|-----------|----------|
| Drain-source breakdown voltage    | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                        | 650  | -    | -         | V        |
| Drain-Source Leakage Current      | $I_{DSS}$    | $V_{DS}=650V, V_{GS}=0V, T_J=25^{\circ}\text{C}$ | -    | -    | 1         | $\mu A$  |
|                                   |              | $V_{DS}=650V, V_{GS}=0V, T_J=55^{\circ}\text{C}$ | -    | -    | 5         |          |
| Gate-Source Leakage Current       | $I_{GSS}$    | $V_{GS}=\pm 30V, V_{DS}=0V$                      | -    | -    | $\pm 100$ | nA       |
| Gate threshold voltage            | $V_{GS(th)}$ | $V_{GS}=V_{DS}, I_D=250\mu A$                    | 2.5  | 3.5  | 4.5       | V        |
| Static Drain-Source On-Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=2A$                             | -    | 2.2  | 2.6       | $\Omega$ |
| Forward Transconductance          | $g_{fs}$     | -                                                | -    | -    | -         | S        |
| Gate Resistance                   | $R_g$        | $V_{DS}=0V, V_{GS}=0V, f=1\text{MHz}$            | -    | 1.2  | -         | $\Omega$ |
| Input Capacitance                 | $C_{iss}$    | $V_{DS}=25V, V_{GS}=0V, f=1\text{MHz}$           | -    | 518  | -         | pF       |
| Output Capacitance                | $C_{oss}$    |                                                  | -    | 52   | -         |          |
| Reverse Transfer Capacitance      | $C_{rss}$    |                                                  | -    | 4.9  | -         |          |
| Total Gate Charge                 | $Q_g$        | $V_{DS}=520V, V_{GS}=10V, I_D=4A$                | -    | 18   | -         | nC       |
| Gate-Source Charge                | $Q_{gs}$     |                                                  | -    | 3.4  | -         |          |
| Gate-Drain Charge                 | $Q_{gd}$     |                                                  | -    | 13   | -         |          |
| Turn-On Delay Time                | $t_{d(on)}$  | $V_{DS}=325V,$<br>$R_G=25\Omega, I_D=4A$         | -    | 13   | -         | ns       |
| Rise Time                         | $t_r$        |                                                  | -    | 23   | -         |          |
| Turn-Off Delay Time               | $t_{d(off)}$ |                                                  | -    | 29   | -         |          |
| Fall Time                         | $t_f$        |                                                  | -    | 17   | -         |          |
| Reverse Recovery Time             | $t_{rr}$     | $I_F=4A, di/dt=100A/\mu s,$                      | -    | 209  | -         | ns       |



|                         |          |            |   |     |   |         |
|-------------------------|----------|------------|---|-----|---|---------|
| Reverse Recovery Charge | $Q_{rr}$ | $V_R=400V$ | - | 1.3 | - | $\mu C$ |
|-------------------------|----------|------------|---|-----|---|---------|

Note:

1. Computed continuous current assumes the condition of  $T_{J\_Max}$  while the actual continuous depends on the thermal & electromechanical application board design.
2. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
3. This single-pulse measurement was taken under the following condition [ $L=10mH$ ,  $V_{GS}=10V$ ,  $V_{DS}=50V$ ] while its value is limited by  $T_{J\_Max}=150^{\circ}C$ .
4. The power dissipation PD is based on  $T_{J\_Max}=150^{\circ}C$ .
5. This value is guaranteed by design hence it is not included in the production test.

## Typical Performance Characteristics

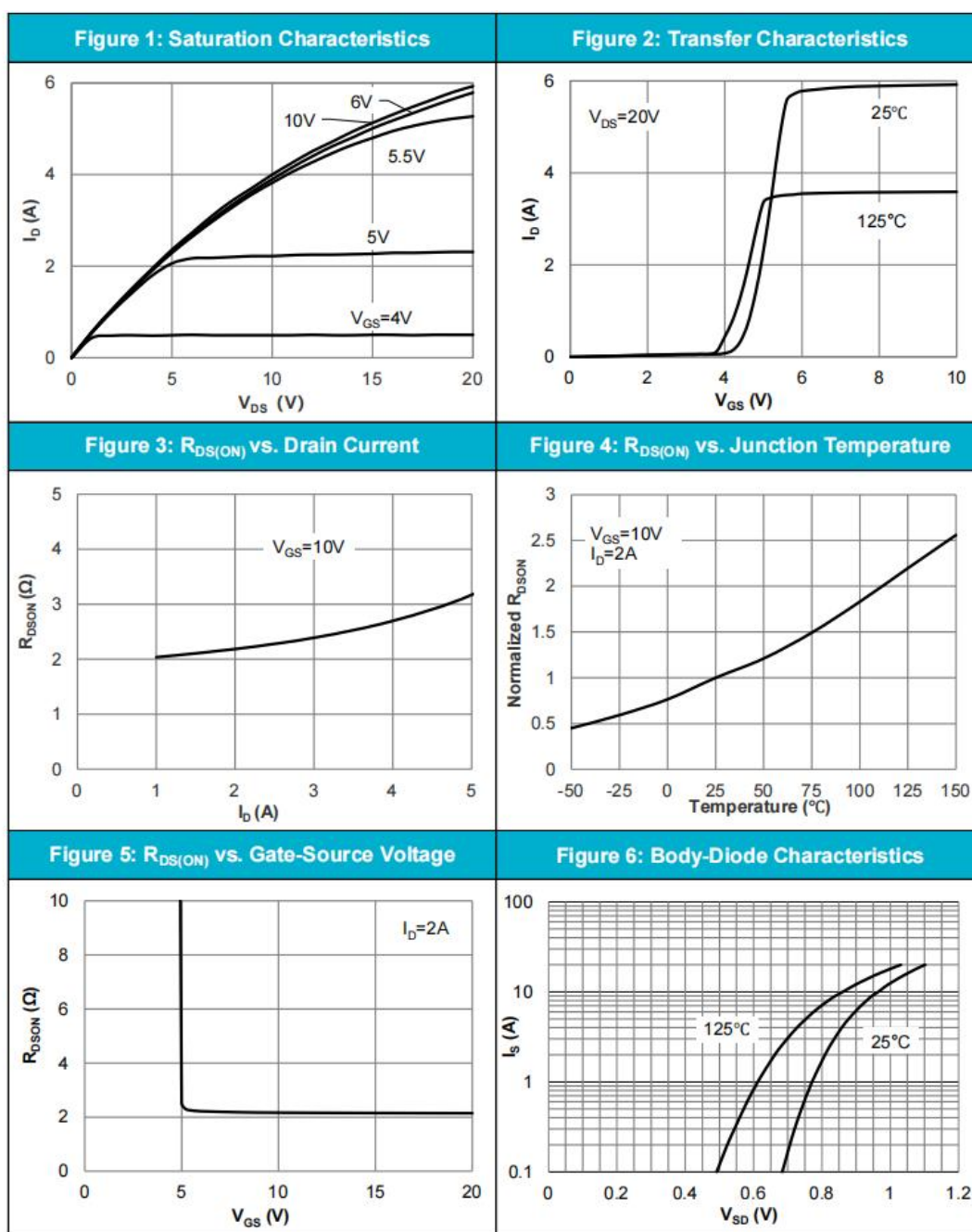




Figure 7: Gate-Charge characteristics

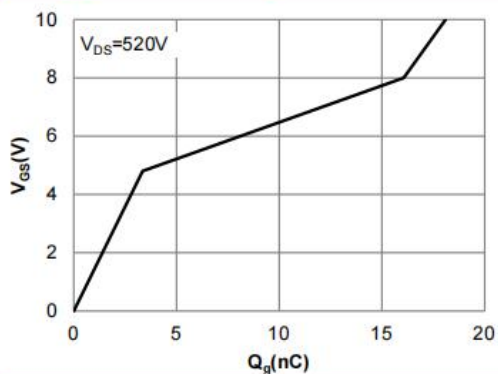


Figure 8: Capacitance characteristics

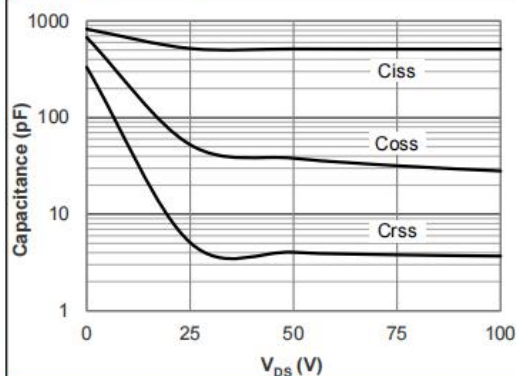


Figure 9: Current De-rating

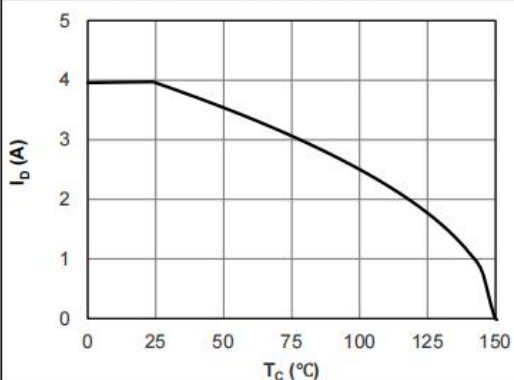


Figure 10: Power De-rating

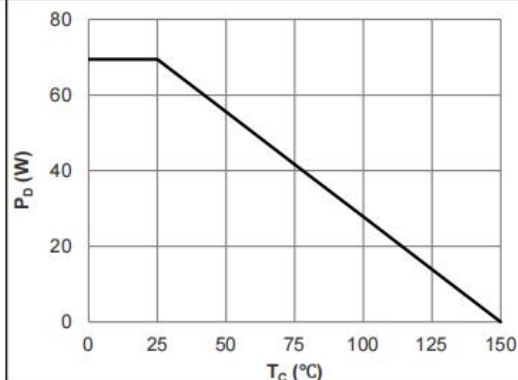


Figure 11: Maximum Safe Operating Area

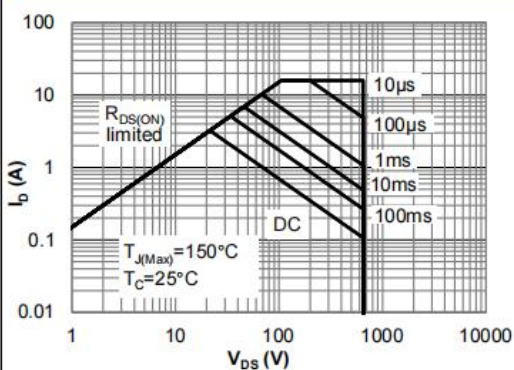


Figure 12: Peak Current Capacity

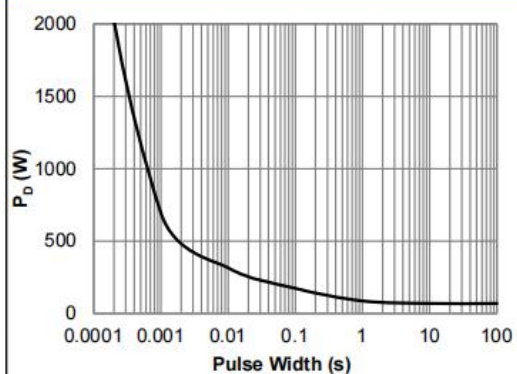
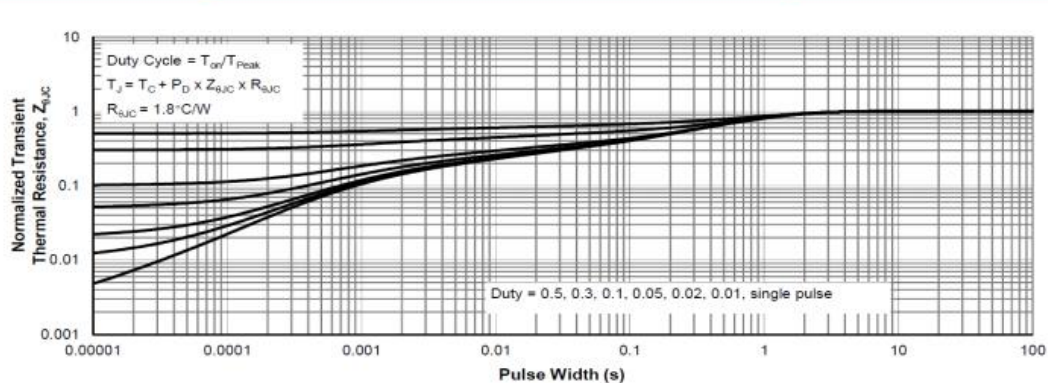


Figure 13: Normalized Maximum Transient Thermal Impedance





Test Circuit & Waveform

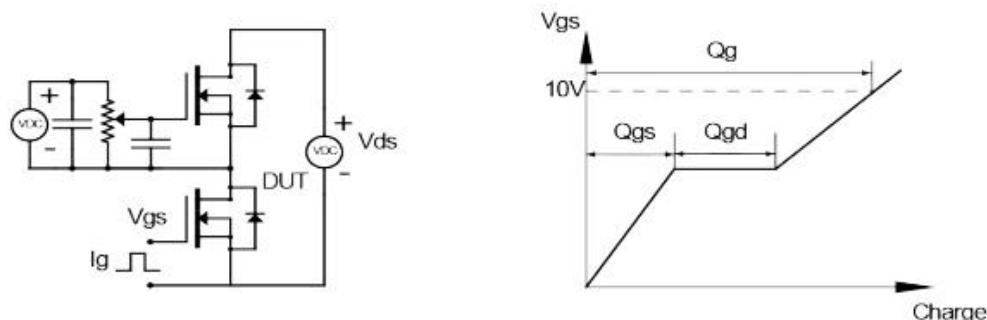


Figure1: Gate Charge Test Circuit & Waveforms

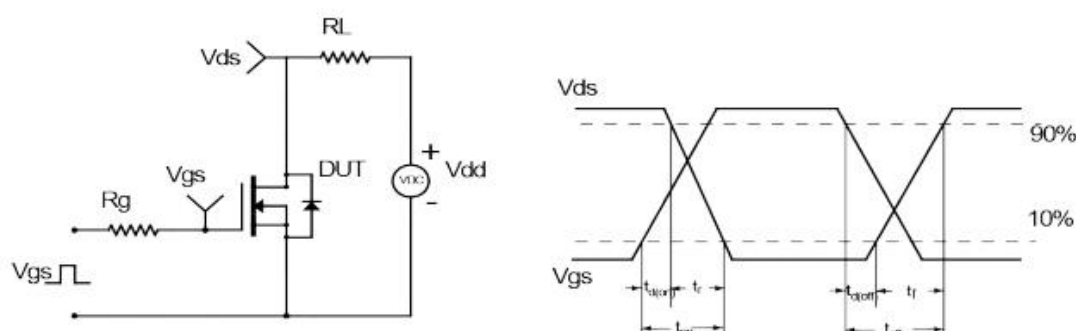


Figure2: Resistive Switching Test Circuit & Waveforms

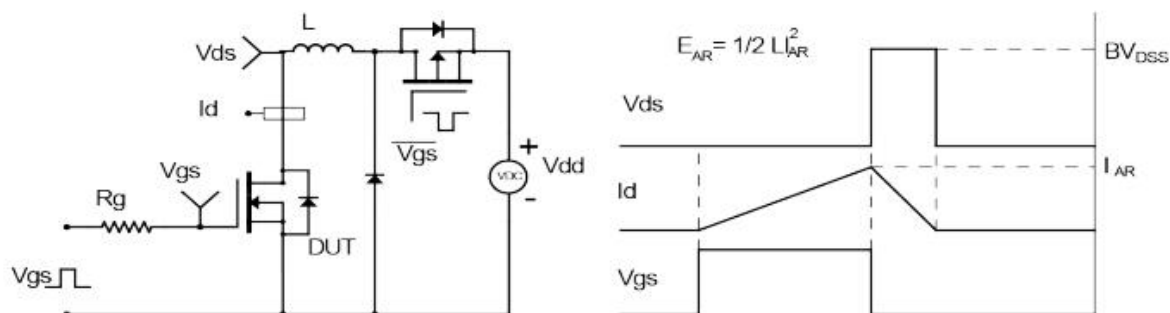


Figure3: Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

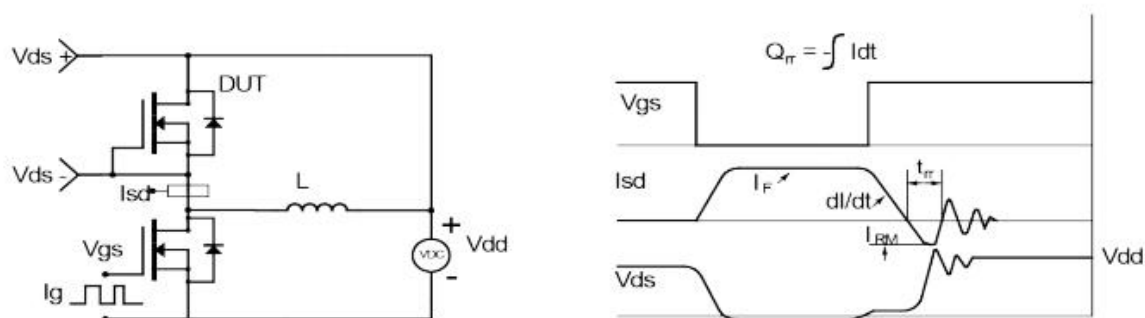
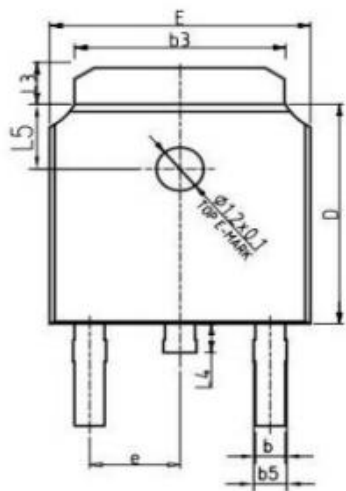


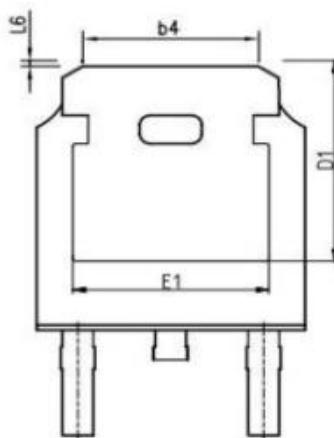
Figure4: Diode Recovery Test Circuit & Waveforms



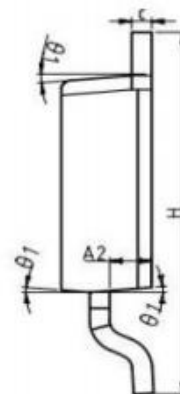
## Package Dimensions TO252-3L



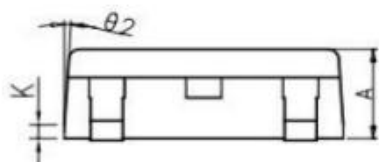
TOP VIEW



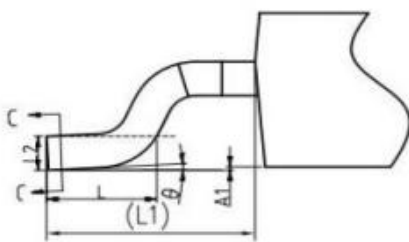
BOTTOM VIEW



SIDE VIEW



SIDE VIEW



| SYMBOL | MILLIMETER |       |       |
|--------|------------|-------|-------|
|        | MIN        | TYP.  | MAX   |
| A      | 2.20       | 2.30  | 2.38  |
| A1     | 0.00       | -     | 0.10  |
| A2     | 0.97       | 1.07  | 1.17  |
| b      | 0.72       | 0.78  | 0.85  |
| b3     | 5.23       | 5.33  | 5.46  |
| b4     | 4.27       | 4.32  | 4.37  |
| b5     | 0.72       | 0.88  | 0.93  |
| c      | 0.47       | 0.53  | 0.58  |
| c1     | 0.46       | 0.51  | 0.56  |
| D      | 6.00       | 6.10  | 6.20  |
| E      | 6.50       | 6.60  | 6.70  |
| E1     | 4.70       | 4.83  | 4.92  |
| e      | 2.286 BSC  |       |       |
| H      | 9.90       | 10.10 | 10.30 |
| L      | 1.40       | 1.50  | 1.70  |
| L3     | 0.90       | -     | 1.25  |
| L4     | 0.60       | 0.80  | 1.00  |
| L5     | 1.70       | 1.80  | 1.90  |



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