



**THE DATASHEET OF  
IPB200N15N3GATMA1**



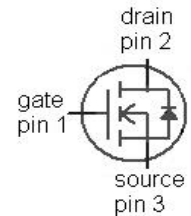
## OptiMOS™ 3 Power-Transistor

### Features

- N-channel, normal level
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target application
- Ideal for high-frequency switching and synchronous rectification
- Halogen-free according to IEC61249-2-21

### Product Summary

|                  |     |    |
|------------------|-----|----|
| $V_{DS}$         | 150 | V  |
| $R_{DS(on),max}$ | 20  | mΩ |
| $I_D$            | 50  | A  |



| Type    | IPB200N15N3 G | IPD200N15N3 G | IPI200N15N3 G | IPP200N15N3 G |
|---------|---------------|---------------|---------------|---------------|
|         |               |               |               |               |
| Package | PG-TO263-3    | PG-TO252-3    | PG-TO262-3    | PG-TO220-3    |
| Marking | 200N15N       | 200N15N       | 200N15N       | 200N15N       |

Maximum ratings, at  $T_j=25\text{ °C}$ , unless otherwise specified

| Parameter                           | Symbol            | Conditions  | Value       | Unit  |
|-------------------------------------|-------------------|---|-------------|-------|
| Continuous drain current            | $I_D$             | $T_C=25\text{ °C}$  | 50          | A     |
|                                     |                   | $T_C=100\text{ °C}$   | 40          |       |
| Pulsed drain current <sup>2)</sup>  | $I_{D,pulse}$     | $T_C=25\text{ °C}$  | 200         |       |
| Avalanche energy, single pulse      | $E_{AS}$          | $I_D=50\text{ A}$ , $R_{GS}=25\text{ Ω}$  | 170         | mJ    |
| Reverse diode $dv/dt$               | $dv/dt$           | $I_D=50\text{ A}$ , $V_{DS}=120\text{ V}$ ,<br>$di/dt=100\text{ A/μs}$ ,<br>$T_{j,max}=175\text{ °C}$ | 6           | kV/μs |
| Gate source voltage                 | $V_{GS}$          |   | ±20         | V     |
| Power dissipation                   | $P_{tot}$         | $T_C=25\text{ °C}$  | 150         | W     |
| Operating and storage temperature   | $T_j$ , $T_{stg}$ |   | -55 ... 175 | °C    |
| IEC climatic category; DIN IEC 68-1 |                   |   | 55/175/56   |       |

<sup>1)</sup>J-STD20 and JESD22

<sup>2)</sup> See figure 3

| Parameter | Symbol | Conditions | Values |      |      | Unit |
|-----------|--------|------------|--------|------|------|------|
|           |        |            | min.   | typ. | max. |      |

**Thermal characteristics**

|  |            |  |   |   |    |     |
|--|------------|--|---|---|----|-----|
| Thermal resistance, junction - case    | $R_{thJC}$ |  | - | - | 1  | K/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | minimal footprint                            | - | - | 75 |     |
|  |            | 6 cm <sup>2</sup> cooling area <sup>3)</sup> | - | - | 50 |     |

**Electrical characteristics**, at  $T_j=25\text{ °C}$ , unless otherwise specified

**Static characteristics**

|                                  |               |   |     |     |     |               |
|----------------------------------|---------------|---|-----|-----|-----|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$                        | 150 | -   | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=90\text{ }\mu\text{A}$                  | 2   | 3   | 4   |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=120\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$  | -   | 0.1 | 1   | $\mu\text{A}$ |
|                                  |               | $V_{DS}=120\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | -   | 10  | 100 |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$                     | -   | 1   | 100 | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=10\text{ V}, I_D=50\text{ A}$                       | -   | 16  | 20  | m $\Omega$    |
|                                  |               | $V_{GS}=8\text{ V}, I_D=25\text{ A}$                        | -   | 16  | 20  |               |
| Gate resistance                  | $R_G$         |   | -   | 2.4 | -   | $\Omega$      |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}, I_D=50\text{ A}$             | 29  | 57  | -   | S             |

<sup>3)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70  $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical in still air.

| Parameter | Symbol | Conditions | Values |      |      | Unit |
|-----------|--------|------------|--------|------|------|------|
|           |        |            | min.   | typ. | max. |      |

**Dynamic characteristics**

|                              |              |   |   |      |    |    |
|------------------------------|--------------|---|---|------|----|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=75\text{ V},$<br>$f=1\text{ MHz}$                          | - | 1820 | -  | pF |
| Output capacitance           | $C_{oss}$    |   | - | 214  | -  |    |
| Reverse transfer capacitance | $C_{rss}$    |   | - | 5    | -  |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=75\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=50\text{ A}, R_{G,ext}=1.6\ \Omega$ | - | 14   | 21 | ns |
| Rise time                    | $t_r$        |   | - | 11   | 17 |    |
| Turn-off delay time          | $t_{d(off)}$ |   | - | 23   | 35 |    |
| Fall time                    | $t_f$        |   | - | 6    | 9  |    |

**Gate Charge Characteristics<sup>4)</sup>**

|                       |               |  |   |     |    |    |
|-----------------------|---------------|--|---|-----|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=75\text{ V}, I_D=50\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 10  | 14 | nC |
| Gate to drain charge  | $Q_{gd}$      |  | - | 4   | 6  |    |
| Switching charge      | $Q_{sw}$      |  | - | 9   | 13 |    |
| Gate charge total     | $Q_g$         |  | - | 23  | 31 |    |
| Gate plateau voltage  | $V_{plateau}$ |  | - | 5.7 | -  |    |
| Output charge         | $Q_{oss}$     | $V_{DD}=75\text{ V}, V_{GS}=0\text{ V}$                                    | - | 60  | 79 | nC |

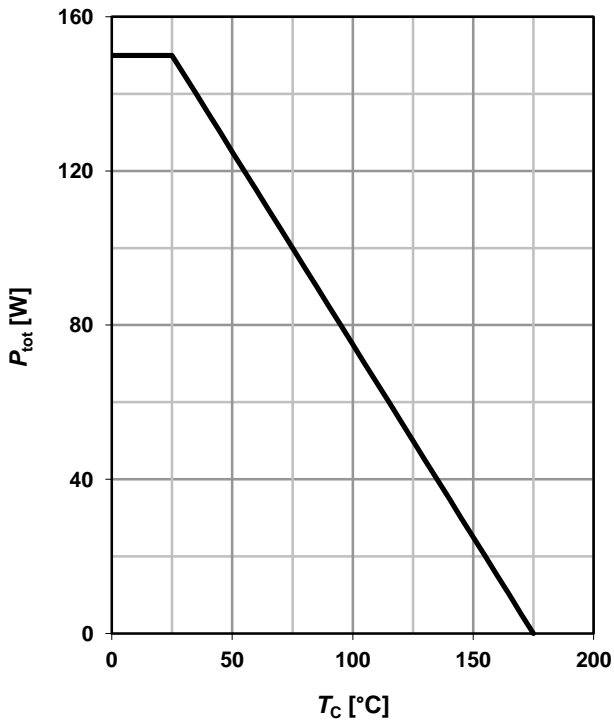
**Reverse Diode**

|                                  |               |   |   |     |     |    |
|----------------------------------|---------------|---|---|-----|-----|----|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^\circ\text{C}$  | - | -   | 50  | A  |
| Diode pulse current              | $I_{S,pulse}$ |   | - | -   | 220 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=50\text{ A},$<br>$T_j=25\text{ }^\circ\text{C}$ | - | 1   | 1.2 | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=75\text{ V}, I_F=I_S,$<br>$di_F/dt=100\text{ A}/\mu\text{s}$       | - | 106 | -   | ns |
| Reverse recovery charge          | $Q_{rr}$      |   | - | 332 | -   | nC |

<sup>4)</sup> See figure 16 for gate charge parameter definition

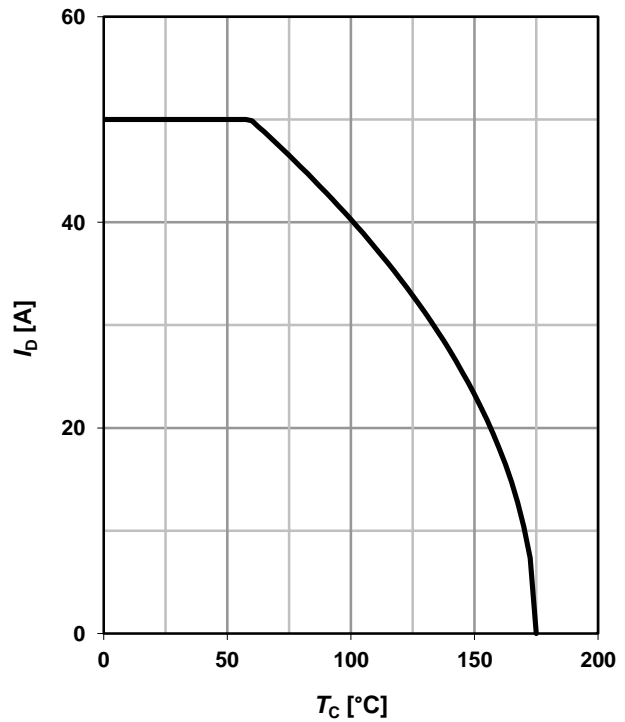
### 1 Power dissipation

$$P_{tot}=f(T_C)$$



### 2 Drain current

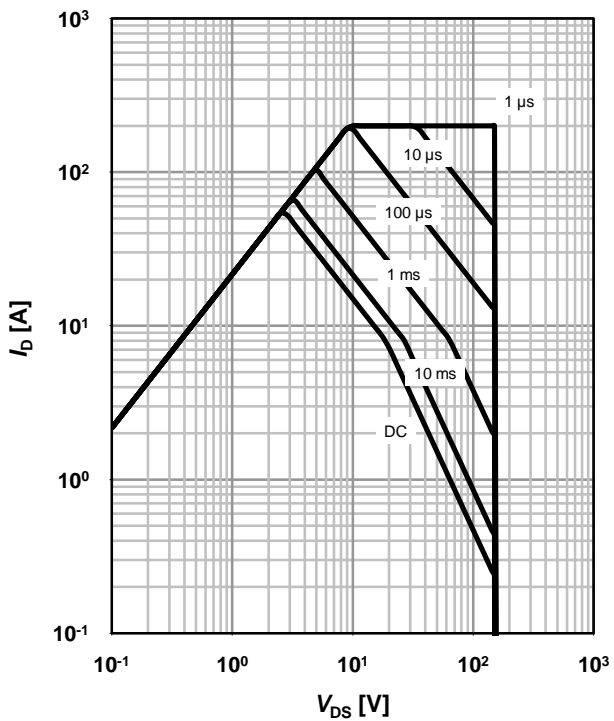
$$I_D=f(T_C); V_{GS} \geq 10 \text{ V}$$



### 3 Safe operating area

$$I_D=f(V_{DS}); T_C=25 \text{ °C}; D=0$$

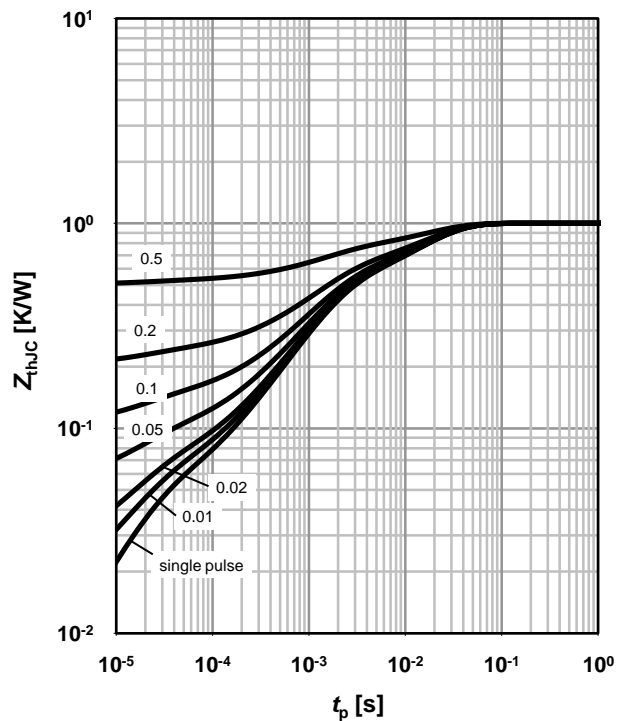
parameter:  $t_p$



### 4 Max. transient thermal impedance

$$Z_{thJC}=f(t_p)$$

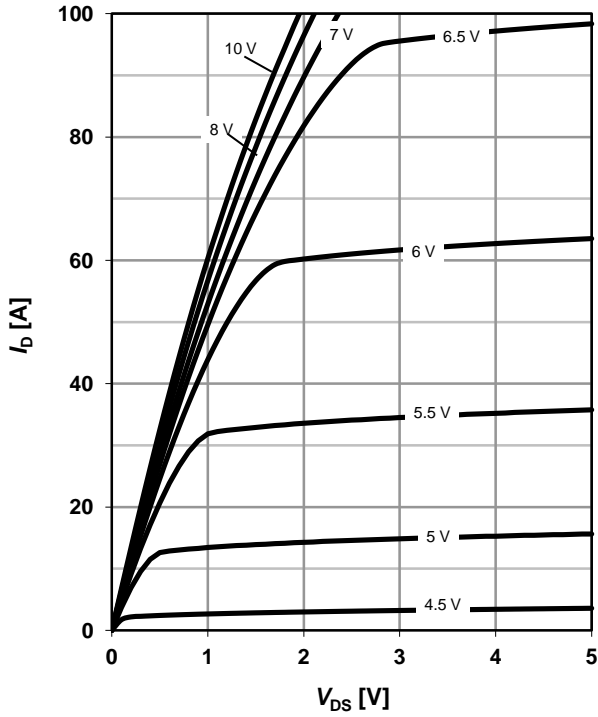
parameter:  $D=t_p/T$



**5 Typ. output characteristics**

$I_D = f(V_{DS}); T_j = 25\text{ }^\circ\text{C}$

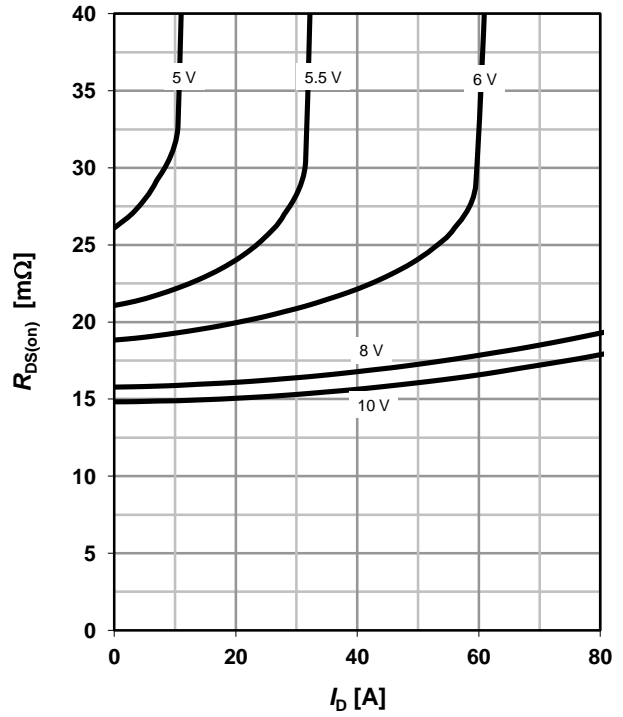
parameter:  $V_{GS}$



**6 Typ. drain-source on resistance**

$R_{DS(on)} = f(I_D); T_j = 25\text{ }^\circ\text{C}$

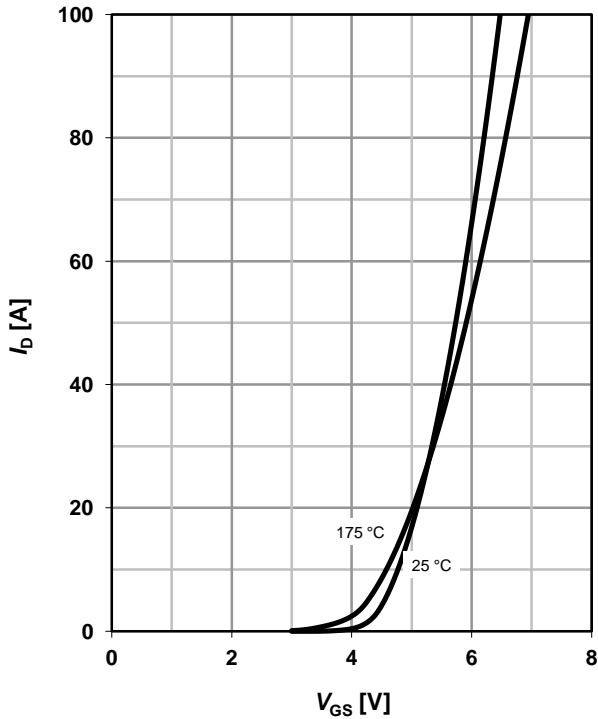
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

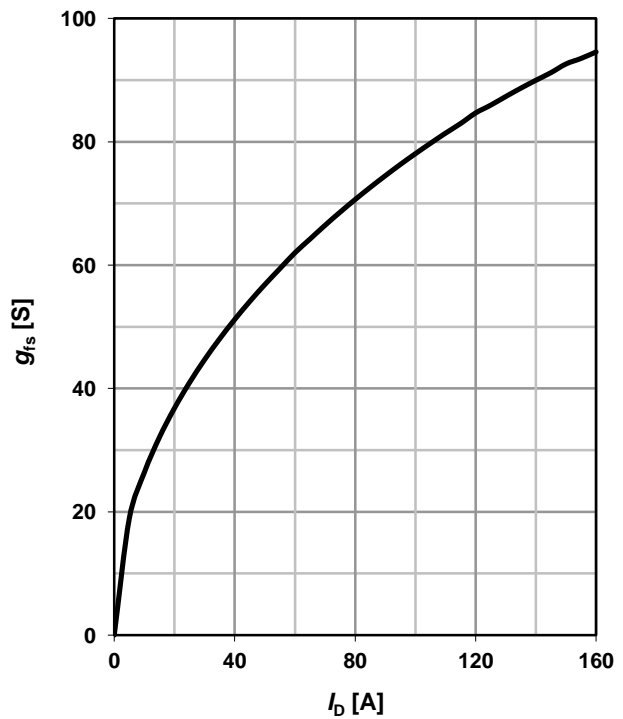
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter:  $T_j$



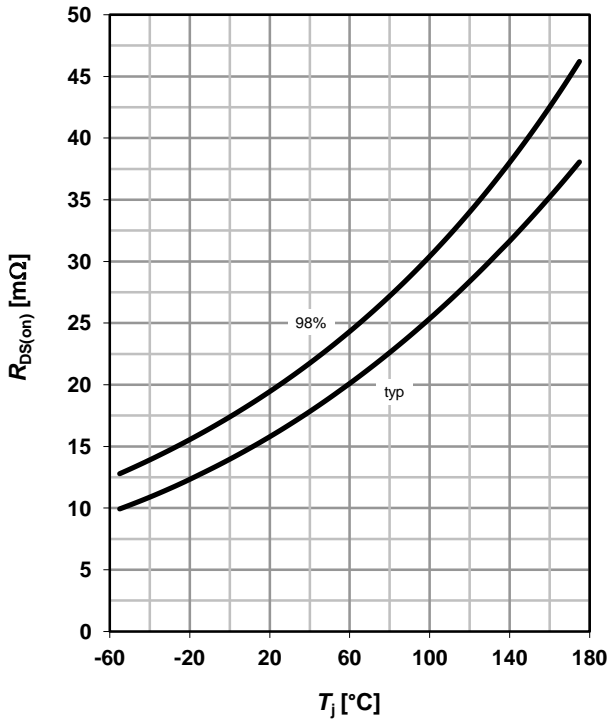
**8 Typ. forward transconductance**

$g_{fs} = f(I_D); T_j = 25\text{ }^\circ\text{C}$



**9 Drain-source on-state resistance**

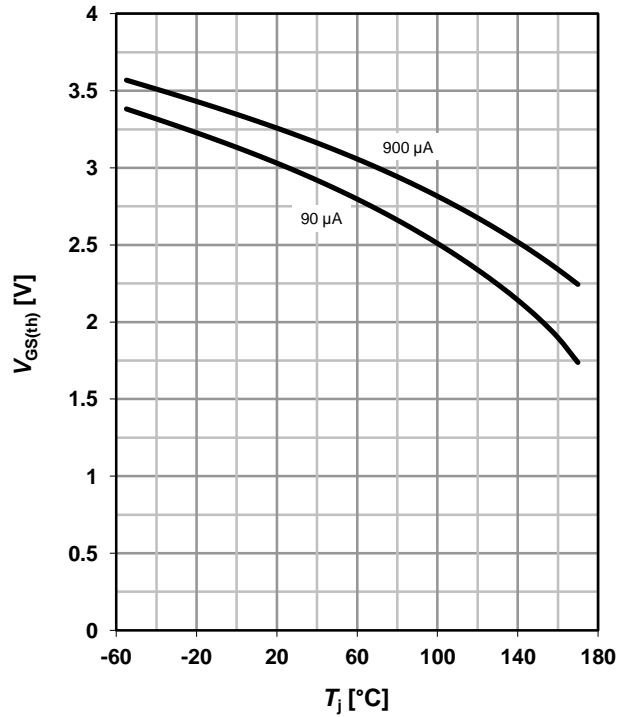
$R_{DS(on)}=f(T_j); I_D=50\text{ A}; V_{GS}=10\text{ V}$



**10 Typ. gate threshold voltage**

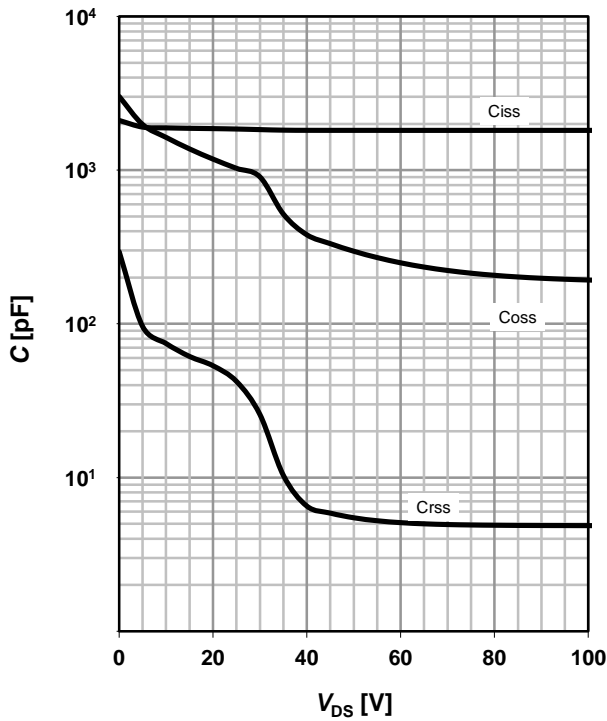
$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}$

parameter:  $I_D$



**11 Typ. capacitances**

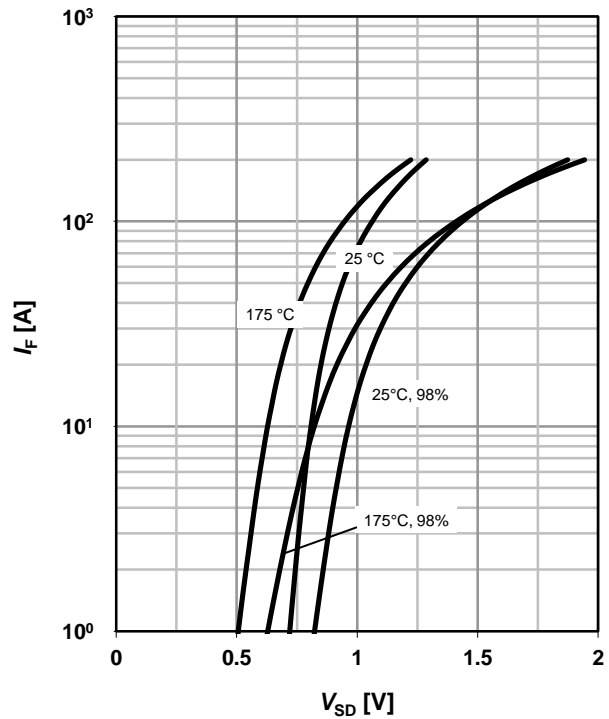
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$



**12 Forward characteristics of reverse diode**

$I_F=f(V_{SD})$

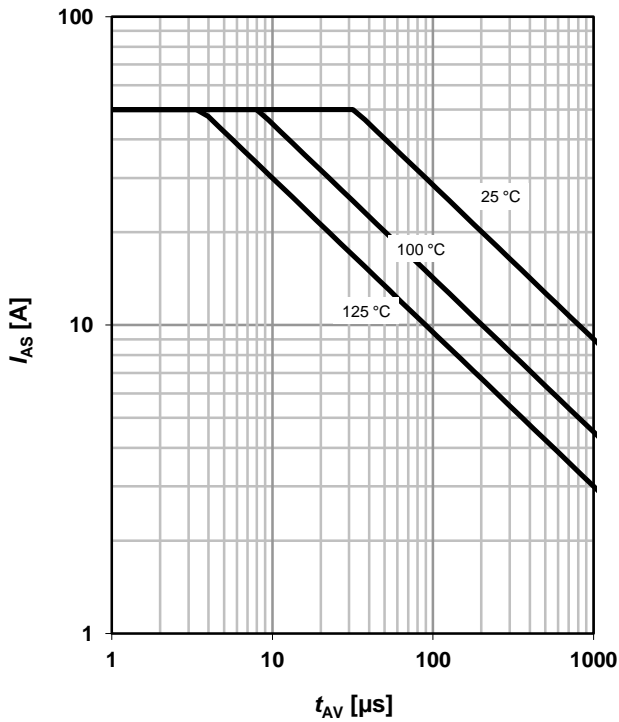
parameter:  $T_j$



### 13 Avalanche characteristics

$$I_{AS} = f(t_{AV}); R_{GS} = 25 \Omega$$

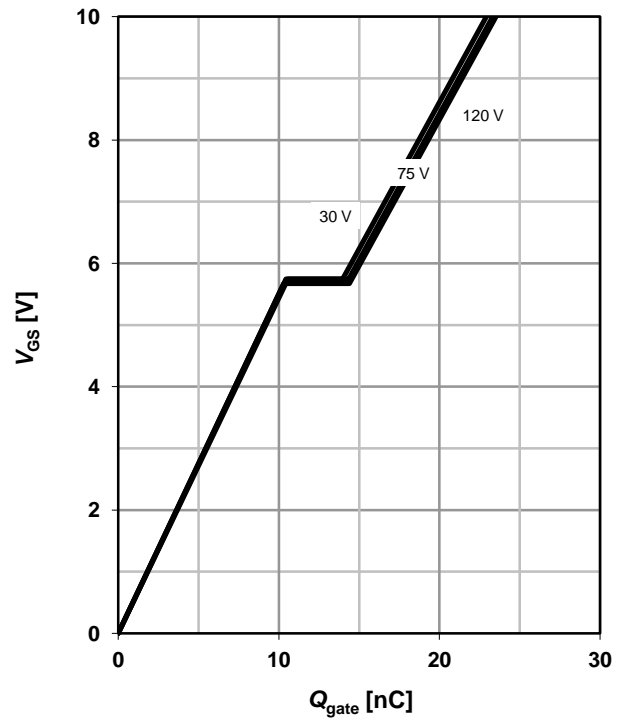
parameter:  $T_{j(\text{start})}$



### 14 Typ. gate charge

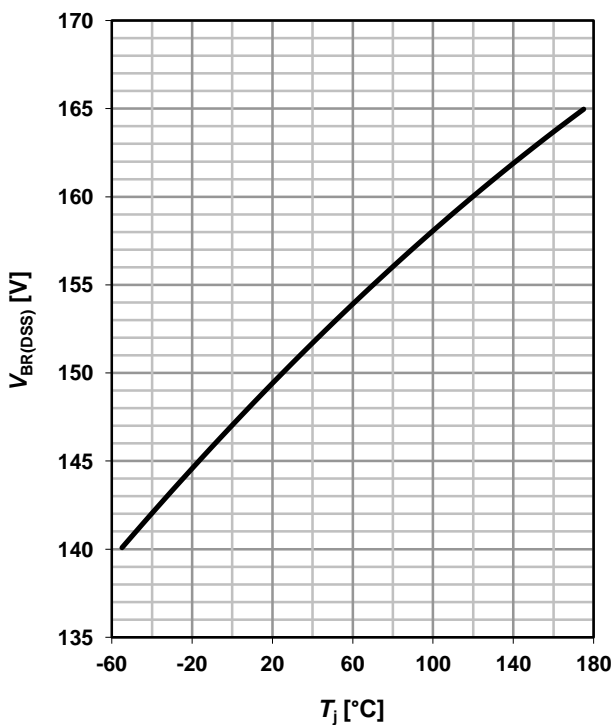
$$V_{GS} = f(Q_{\text{gate}}); I_D = 50 \text{ A pulsed}$$

parameter:  $V_{DD}$

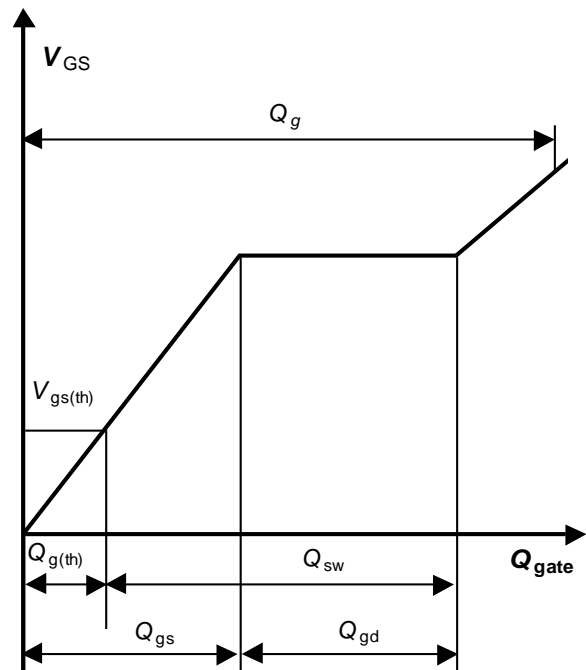


### 15 Drain-source breakdown voltage

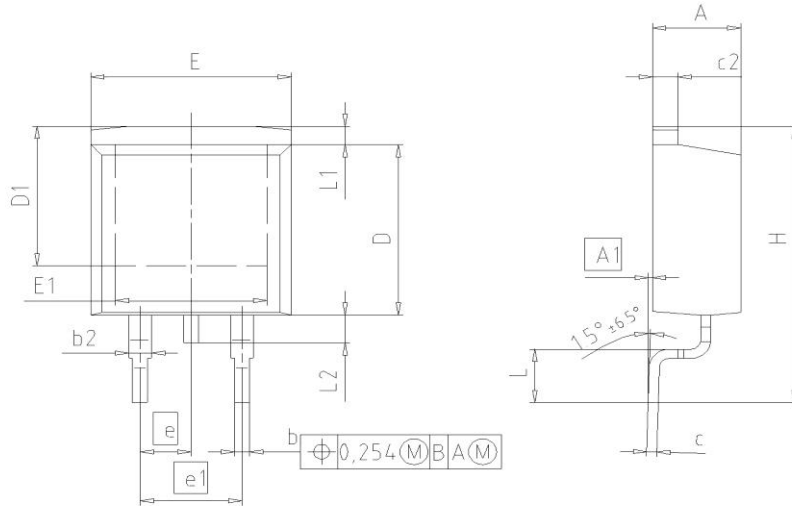
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



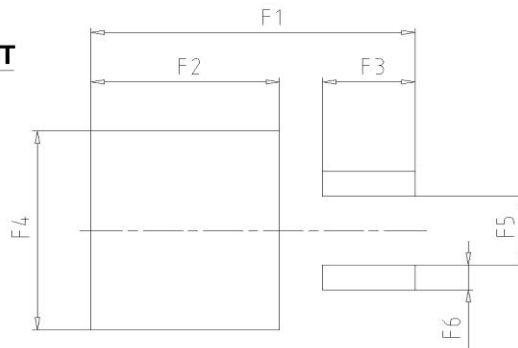
### 16 Gate charge waveforms



PG-TO263-3 Outline



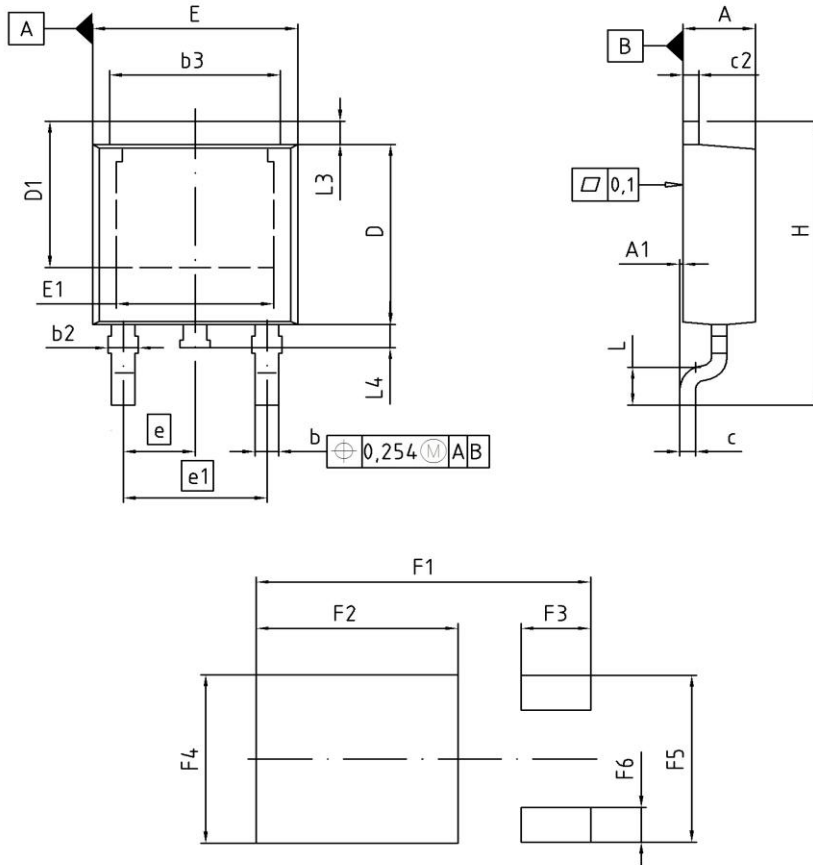
**FOOTPRINT**



| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 4.30        | 4.57  | 0.169  | 0.180 |
| A1  | 0.00        | 0.25  | 0.000  | 0.010 |
| b   | 0.65        | 0.85  | 0.026  | 0.033 |
| b2  | 0.95        | 1.15  | 0.037  | 0.045 |
| c   | 0.33        | 0.65  | 0.013  | 0.026 |
| c2  | 1.17        | 1.40  | 0.046  | 0.055 |
| D   | 8.51        | 9.45  | 0.335  | 0.372 |
| D1  | 7.10        | 7.90  | 0.280  | 0.311 |
| E   | 9.80        | 10.31 | 0.386  | 0.406 |
| E1  | 6.50        | 8.60  | 0.256  | 0.339 |
| e   | 2.54        |       | 0.100  |       |
| e1  | 5.08        |       | 0.200  |       |
| H   | 14.61       | 15.88 | 0.575  | 0.625 |
| L   | 2.29        | 3.00  | 0.090  | 0.118 |
| L1  | 0.70        | 1.60  | 0.028  | 0.063 |
| L2  | 1.00        | 1.78  | 0.039  | 0.070 |
| F1  | 16.05       | 16.25 | 0.632  | 0.640 |
| F2  | 9.30        | 9.50  | 0.366  | 0.374 |
| F3  | 4.50        | 4.70  | 0.177  | 0.185 |
| F4  | 10.70       | 10.90 | 0.421  | 0.429 |
| F5  | 3.65        | 3.85  | 0.144  | 0.152 |
| F6  | 1.25        | 1.45  | 0.049  | 0.057 |

|                                    |
|------------------------------------|
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| <b>ISSUE DATE</b><br>30-08-2007    |
| <b>REVISION</b><br>01              |

PG-TO252-3 Outline



| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 2.16        | 2.41  | 0.085  | 0.095 |
| A1  | 0.00        | 0.15  | 0.000  | 0.006 |
| b   | 0.64        | 0.89  | 0.025  | 0.035 |
| b2  | 0.65        | 1.15  | 0.026  | 0.045 |
| b3  | 5.00        | 5.50  | 0.197  | 0.217 |
| c   | 0.46        | 0.60  | 0.018  | 0.024 |
| c2  | 0.46        | 0.98  | 0.018  | 0.039 |
| D   | 5.97        | 6.22  | 0.235  | 0.245 |
| D1  | 5.02        | 5.84  | 0.198  | 0.230 |
| E   | 6.40        | 6.73  | 0.252  | 0.265 |
| E1  | 4.70        | 5.21  | 0.185  | 0.205 |
| e   | 2.29        |       | 0.090  |       |
| e1  | 4.57        |       | 0.180  |       |
| H   | 9.40        | 10.48 | 0.370  | 0.413 |
| L   | 1.18        | 1.70  | 0.046  | 0.067 |
| L3  | 0.90        | 1.25  | 0.035  | 0.049 |
| L4  | 0.51        | 1.00  | 0.020  | 0.039 |
| F1  | 10.50       | 10.70 | 0.413  | 0.421 |
| F2  | 6.30        | 6.50  | 0.248  | 0.256 |
| F3  | 2.10        | 2.30  | 0.083  | 0.091 |
| F4  | 5.70        | 5.90  | 0.224  | 0.232 |
| F5  | 5.66        | 5.86  | 0.223  | 0.231 |
| F6  | 1.10        | 1.30  | 0.043  | 0.051 |

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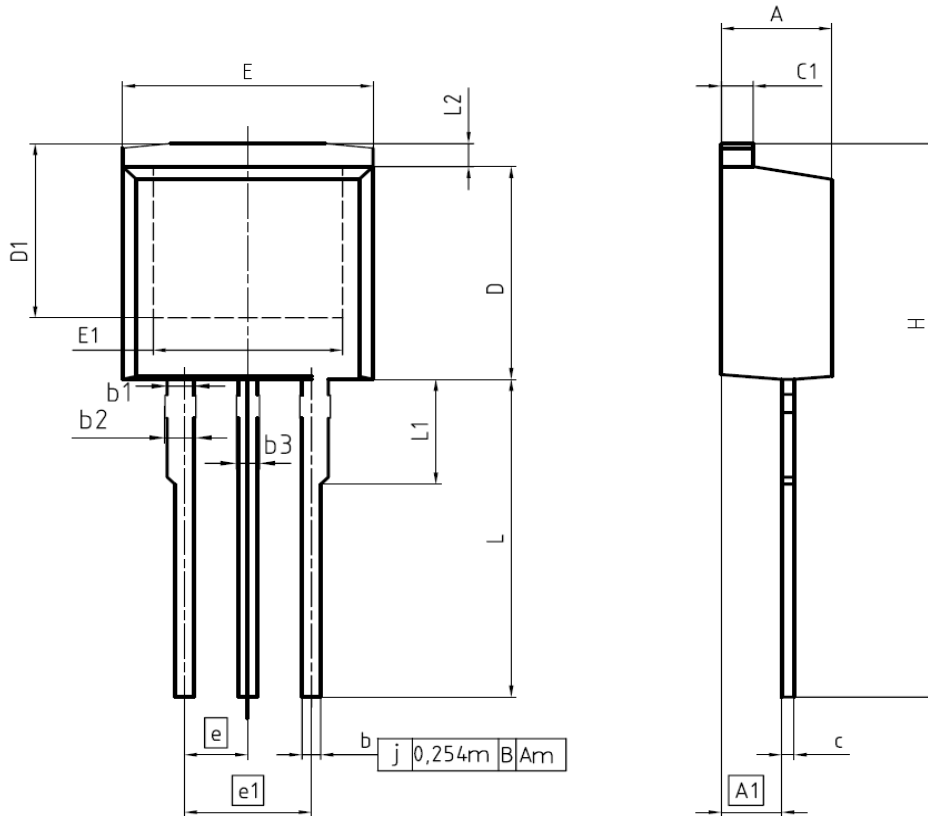
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ISSUE DATE  
19-10-2007

REVISION  
03

PG-TO262-3 Outline



| DIM | MILLIMETERS |        | INCHES |       |
|-----|-------------|--------|--------|-------|
|     | MIN         | MAX    | MIN    | MAX   |
| A   | 4.300       | 4.572  | 0.169  | 0.180 |
| A1  | 2.150       | 2.718  | 0.085  | 0.107 |
| b   | 0.650       | 0.864  | 0.026  | 0.034 |
| b1  | 0.950       | 1.093  | 0.037  | 0.043 |
| b2  | 0.950       | 1.400  | 0.037  | 0.055 |
| b3  | 0.650       | 1.118  | 0.026  | 0.044 |
| c   | 0.330       | 0.600  | 0.013  | 0.024 |
| c1  | 1.170       | 1.400  | 0.046  | 0.055 |
| D   | 8.509       | 9.450  | 0.335  | 0.372 |
| D1  | 6.900       | -      | 0.272  | -     |
| E   | 9.700       | 10.363 | 0.382  | 0.408 |
| E1  | 6.500       | 8.600  | 0.256  | 0.339 |
| e   | 2.540       |        | 0.100  |       |
| e1  | 5.080       |        | 0.200  |       |
| L   | 13.000      | 14.000 | 0.512  | 0.551 |
| L1  | -           | 4.800  | -      | 0.189 |
| L2  | -           | 1.727  | -      | 0.068 |

REFERENCE  
JEDEC TO262

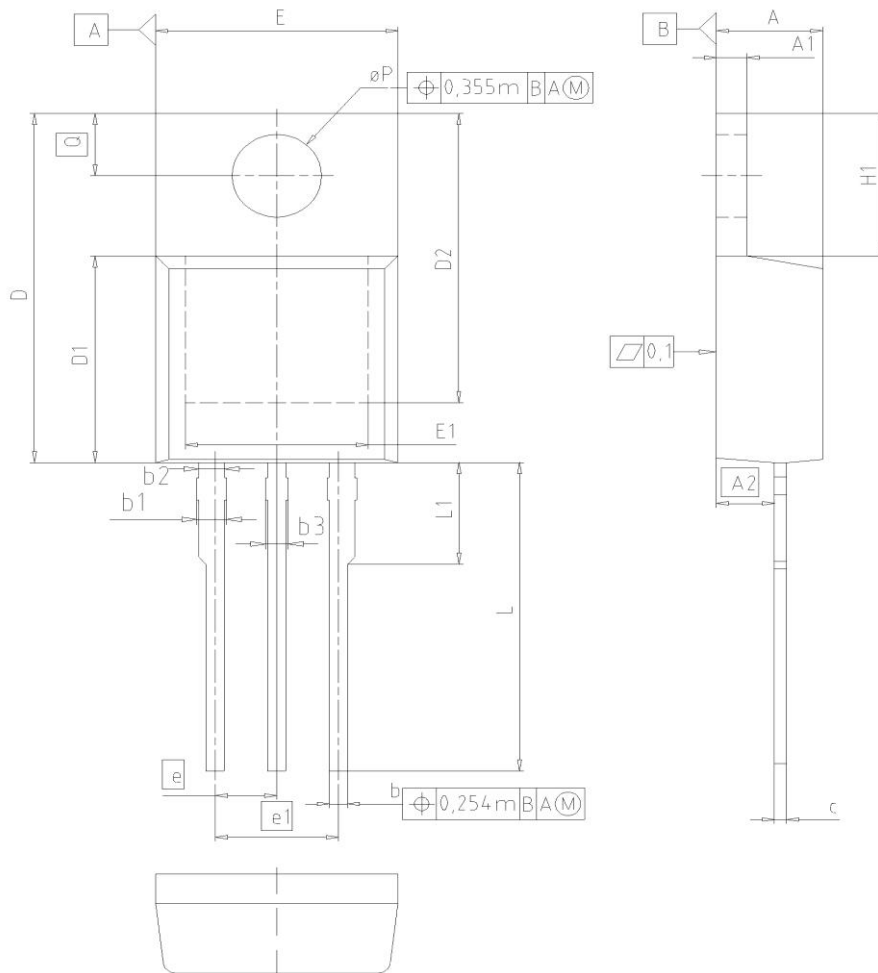
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FILE  
TO262\_1

PG-TO220-3 Outline



| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 4.30        | 4.57  | 0.169  | 0.180 |
| A1  | 1.17        | 1.40  | 0.046  | 0.055 |
| A2  | 2.15        | 2.72  | 0.085  | 0.107 |
| b   | 0.65        | 0.86  | 0.026  | 0.034 |
| b1  | 0.95        | 1.40  | 0.037  | 0.055 |
| b2  | 0.95        | 1.15  | 0.037  | 0.045 |
| b3  | 0.65        | 1.15  | 0.026  | 0.045 |
| c   | 0.33        | 0.60  | 0.013  | 0.024 |
| D   | 14.81       | 15.95 | 0.583  | 0.628 |
| D1  | 8.51        | 9.45  | 0.335  | 0.372 |
| D2  | 12.19       | 13.10 | 0.480  | 0.516 |
| E   | 9.70        | 10.36 | 0.382  | 0.408 |
| E1  | 6.50        | 8.60  | 0.256  | 0.339 |
| e   | 2.54        |       | 0.100  |       |
| e1  | 5.08        |       | 0.200  |       |
| H1  | 5.90        | 6.90  | 0.232  | 0.272 |
| L   | 13.00       | 14.00 | 0.512  | 0.551 |
| L1  | -           | 4.80  | -      | 0.189 |
| øP  | 3.60        | 3.89  | 0.142  | 0.153 |
| Q   | 2.60        | 3.00  | 0.102  | 0.118 |

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