



**THE DATASHEET OF
IPD33CN10NGATMA1**



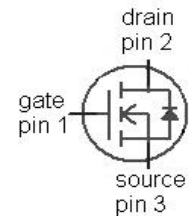
OptiMOS™ 2 Power-Transistor

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 JEDEC¹⁾ for target application
- Ideal for high-frequency switching and synchronous rectification
- Halogen-free according to IEC61249-2-21

Product Summary

| | | |
|--------------------------|-----|----|
| V_{DS} | 100 | V |
| $R_{DS(on),max}$ (TO252) | 33 | mΩ |
| I_D | 27 | A |



| Type | IPB34CN10N G | IPD33CN10N G | IPI35CN10N G | IPP35CN10N G |
|---------|--------------|--------------|--------------|--------------|
| | | | | |
| Package | PG-TO263-3 | PG-TO252-3 | PG-TO262-3 | PG-TO220-3 |
| Marking | 34CN10N | 33CN10N | 35CN10N | 35CN10N |

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

| Parameter | Symbol | Conditions | Value | Unit |
|-------------------------------------|-------------------|--|-------------|------|
| Continuous drain current | I_D | $T_C=25\text{ °C}$ | 27 | A |
| | | $T_C=100\text{ °C}$ | 20 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | 108 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=27\text{ A}$, $R_{GS}=25\text{ Ω}$ | 47 | mJ |
| Gate source voltage ³⁾ | V_{GS} | | ±20 | V |
| Power dissipation | P_{tot} | $T_C=25\text{ °C}$ | 58 | W |
| Operating and storage temperature | T_j , T_{stg} | | -55 ... 175 | °C |
| IEC climatic category; DIN IEC 68-1 | | | 55/175/56 | |

¹⁾ J-STD20 and JESD22

²⁾ see figure 3

³⁾ $T_{jmax}=150\text{ °C}$ and duty cycle $D=0.01$ for $V_{GS}<-5\text{ V}$

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

Thermal characteristics

| | | | | | | |
|--|------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | R_{thJC} | | - | - | 2.6 | K/W |
| Thermal resistance, junction - ambient (TO220, TO262, TO263) | R_{thJA} | minimal footprint | - | - | 62 | |
| | | 6 cm ² cooling area ⁴⁾ | - | - | 40 | |
| Thermal resistance, junction - ambient (TO251, TO252) | | minimal footprint | - | - | 75 | |
| | | 6 cm ² cooling area ⁴⁾ | - | - | 50 | |

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

Static characteristics

| | | | | | | |
|----------------------------------|---------------|--|-----|-----|-----|---------------|
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$ | 100 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=29\text{ }\mu\text{A}$ | 2 | 3 | 4 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=80\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$ | - | 0.1 | 1 | μA |
| | | $V_{DS}=80\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ °C}$ | - | 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 | $R_{DS(on)}$ | $V_{GS}=10\text{ V}, I_D=27\text{ A},$ (TO252) | - | 25 | 33 | m Ω |
| | | $V_{GS}=10\text{ V}, I_D=27\text{ A},$ (TO251) | - | 25 | 33 | |
| | | $V_{GS}=10\text{ V}, I_D=27\text{ A},$ (TO263) | - | 25 | 34 | |
| | | $V_{GS}=10\text{ V}, I_D=27\text{ A},$ (TO220, TO262) | - | 26 | 35 | |
| Gate resistance | R_G | | - | 1 | - | Ω |
| Transconductance | g_{fs} | $ V_{DS} >2 I_D R_{DS(on)max},$ $I_D=27\text{ A}$ | 15 | 30 | - | S |

⁴⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μm 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} | $V_{GS}=0\text{ V}, V_{DS}=50\text{ V},$ $f=1\text{ MHz}$ | - | 1180 | 1570 | pF |
| Output capacitance | C_{oss} | | - | 175 | 233 | |
| Reverse transfer capacitance | C_{rss} | | - | 13 | 20 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=50\text{ V}, V_{GS}=10\text{ V},$ $I_D=27\text{ A}, R_{G,ext}=1.6\ \Omega$ | - | 11 | 17 | ns |
| Rise time | t_r | | - | 21 | 31 | |
| Turn-off delay time | $t_{d(off)}$ | | - | 17 | 25 | |
| Fall time | t_f | | - | 4 | 6 | |

Gate Charge Characteristics⁵⁾

| | | | | | | |
|-----------------------|---------------|--|---|-----|----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=50\text{ V}, I_D=27\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$ | - | 7 | 9 | nC |
| Gate to drain charge | Q_{gd} | | - | 4 | 6 | |
| Switching charge | Q_{sw} | | - | 7 | 11 | |
| Gate charge total | Q_g | | - | 18 | 24 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 5.6 | - | V |
| Output charge | Q_{oss} | $V_{DD}=50\text{ V}, V_{GS}=0\text{ V}$ | - | 18 | 24 | nC |

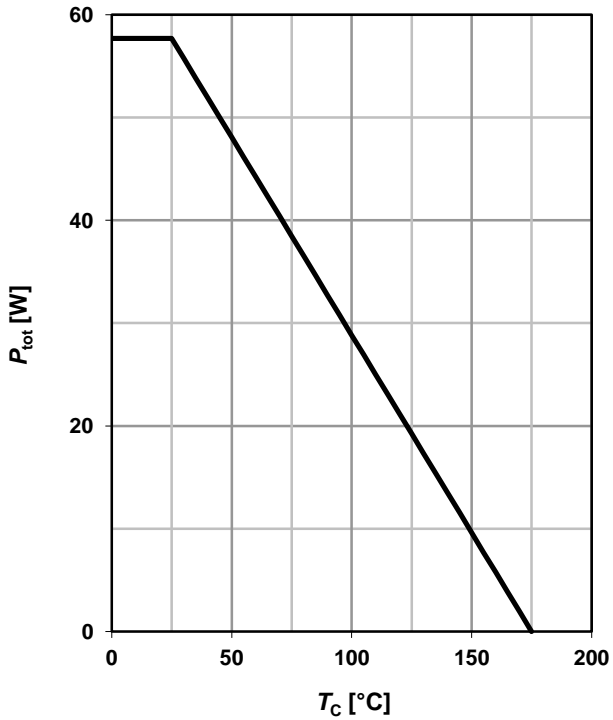
Reverse Diode

| | | | | | | |
|----------------------------------|---------------|---|---|-----|-----|----|
| Diode continuous forward current | I_S | $T_C=25\text{ }^\circ\text{C}$ | - | - | 27 | A |
| Diode pulse current | $I_{S,pulse}$ | | - | - | 108 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0\text{ V}, I_F=27\text{ A},$ $T_j=25\text{ }^\circ\text{C}$ | - | 1 | 1.2 | V |
| Reverse recovery time | t_{rr} | $V_R=50\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$ | - | 77 | | ns |
| Reverse recovery charge | Q_{rr} | | - | 154 | - | nC |

⁵⁾ See figure 16 for gate charge parameter definition

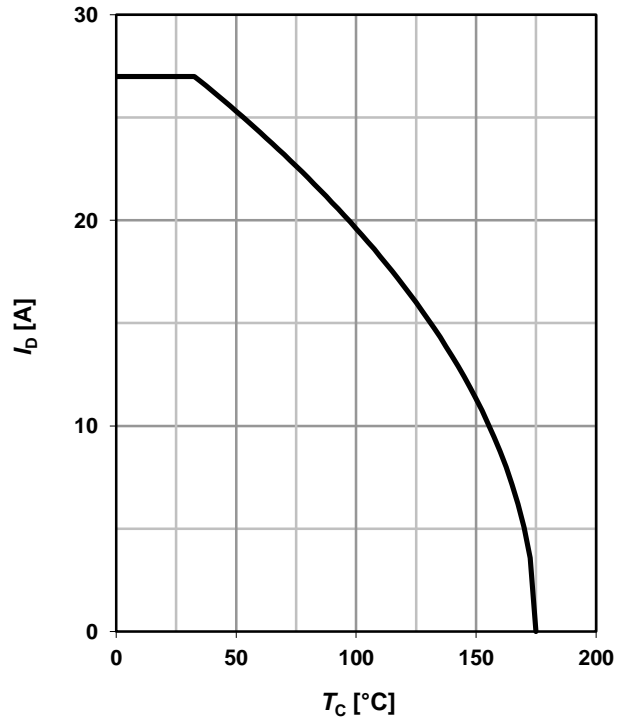
1 Power dissipation

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



2 Drain current

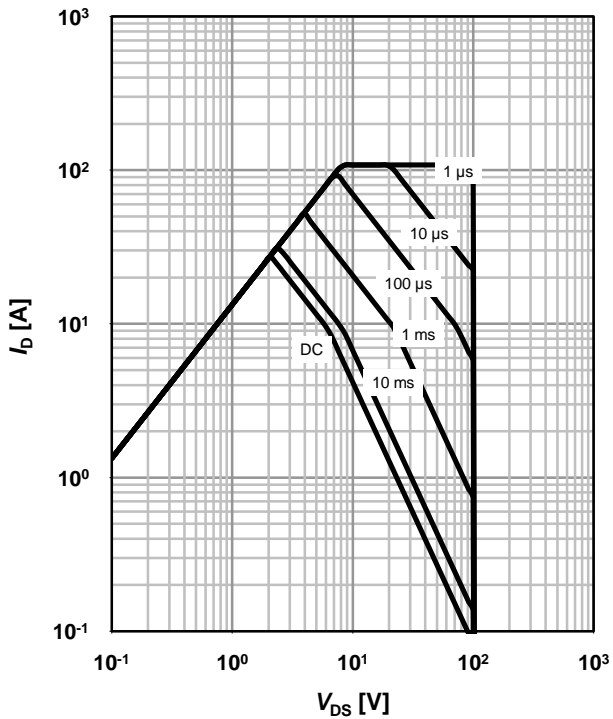
$$I_D = f(T_C); V_{GS} \geq 10 \text{ V}$$



3 Safe operating area

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

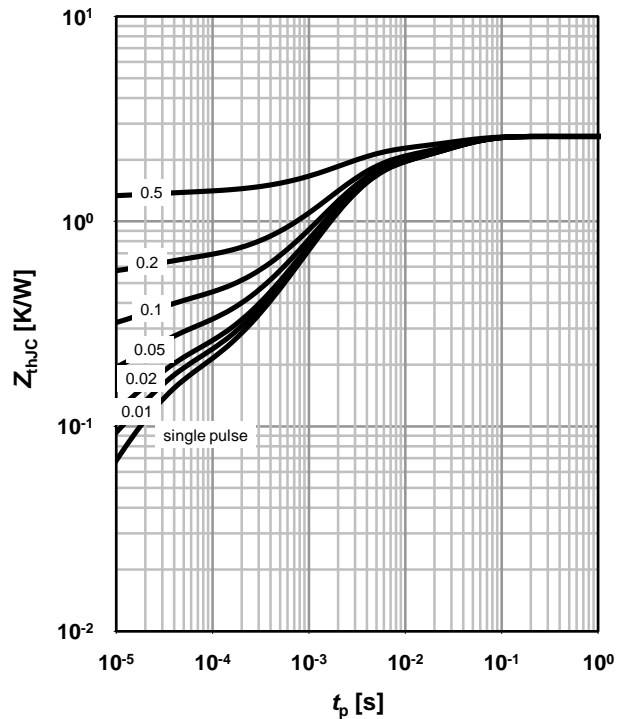
parameter: t_p



4 Max. transient thermal impedance

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

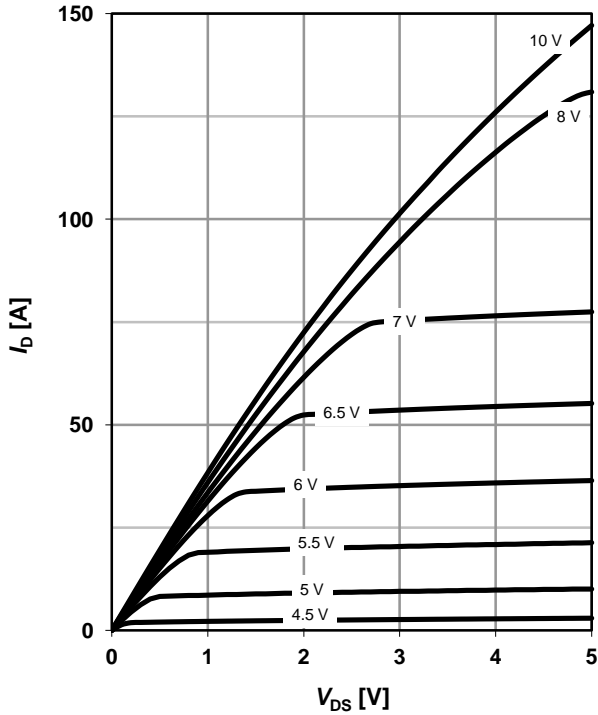
parameter: $D = t_p/T$



5 Typ. output characteristics

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

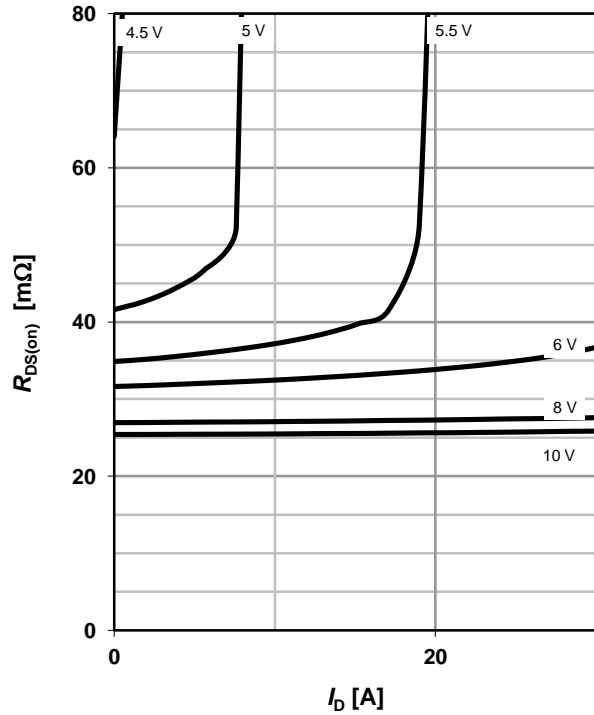
parameter: V_{GS}



6 Typ. drain-source on resistance

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

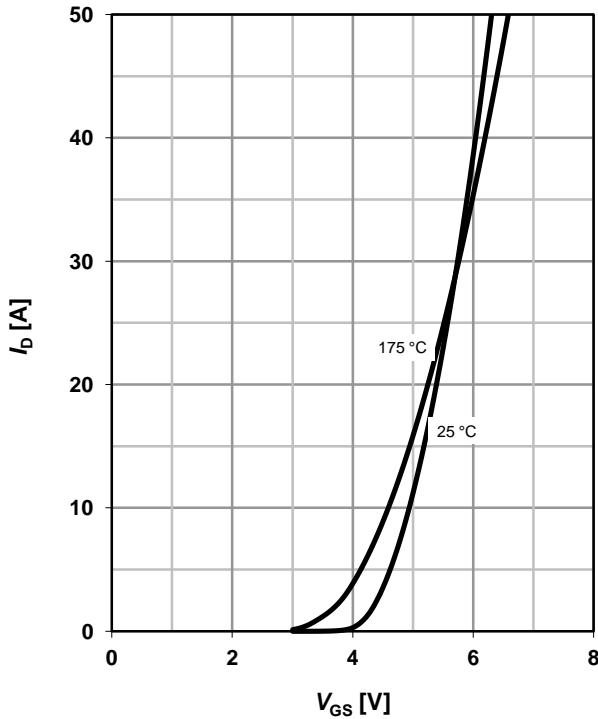
parameter: V_{GS}



7 Typ. transfer characteristics

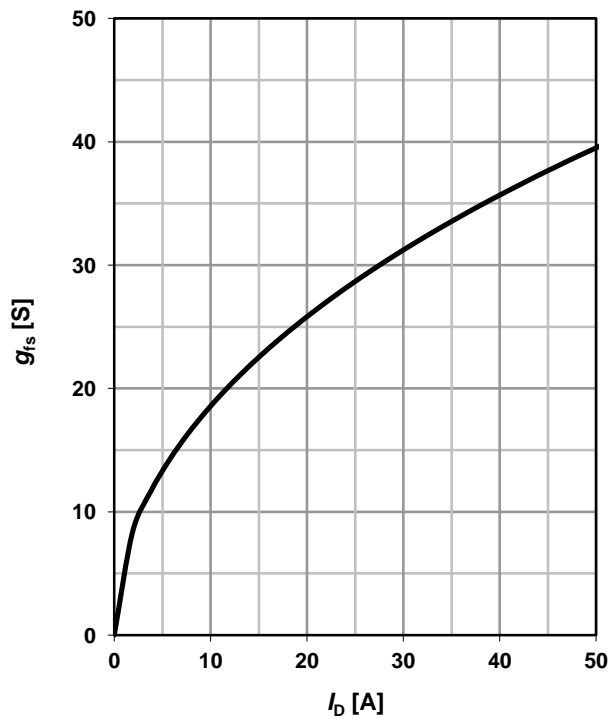
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

parameter: T_j



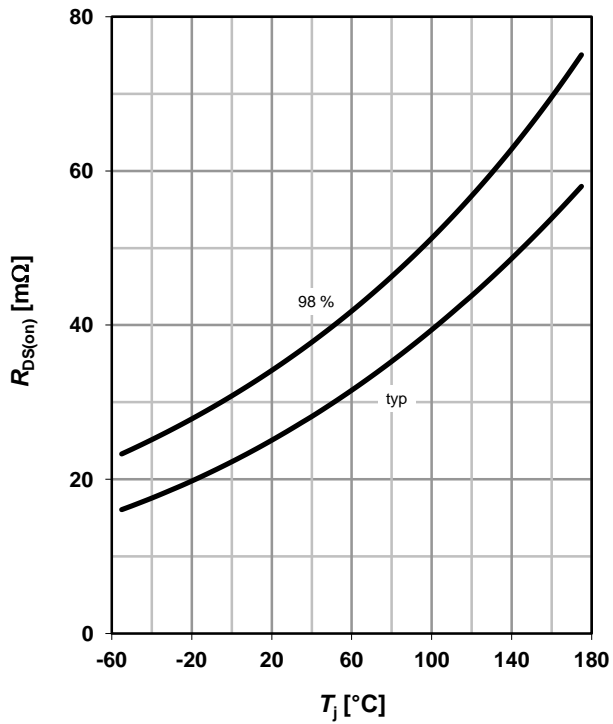
8 Typ. forward transconductance

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



9 Drain-source on-state resistance

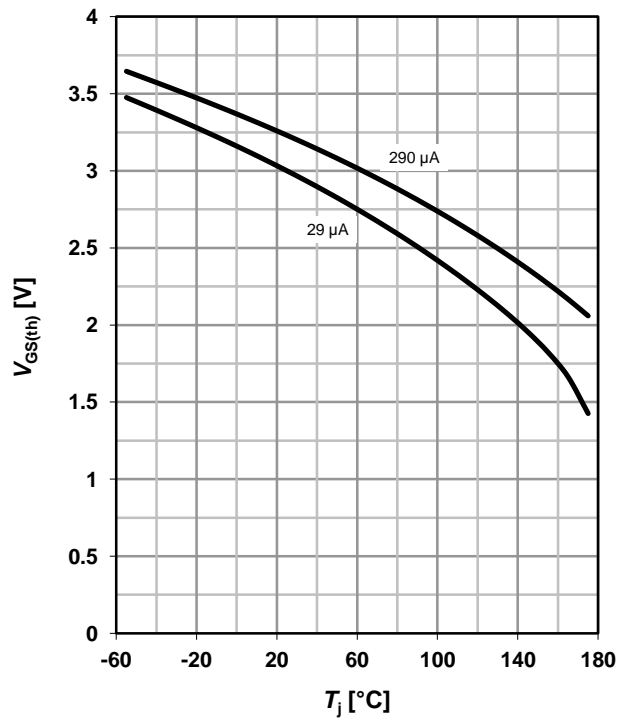
$$R_{DS(on)} = f(T_j); I_D = 27 \text{ A}; V_{GS} = 10 \text{ V}$$



10 Typ. gate threshold voltage

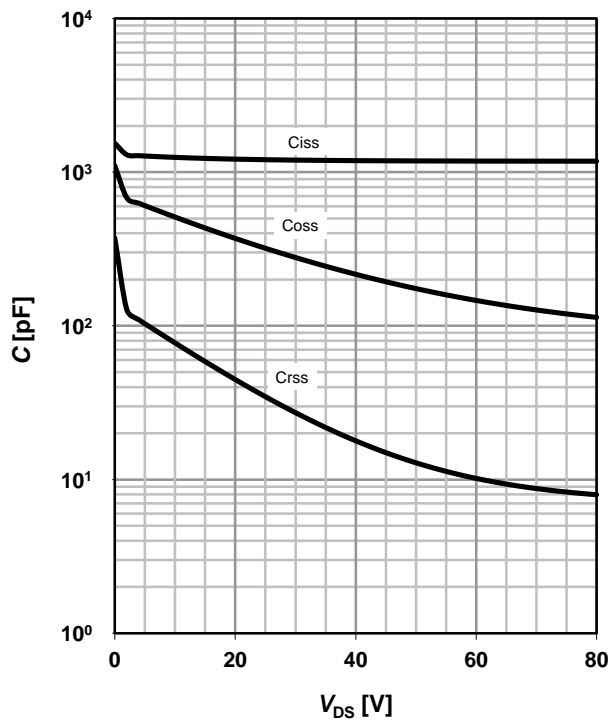
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter: I_D



11 Typ. capacitances

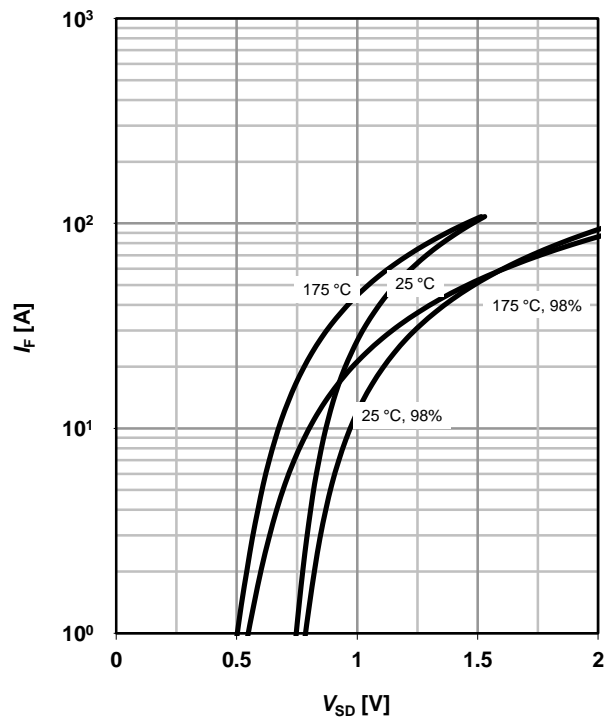
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



12 Forward characteristics of reverse diode

$$I_F = f(V_{SD})$$

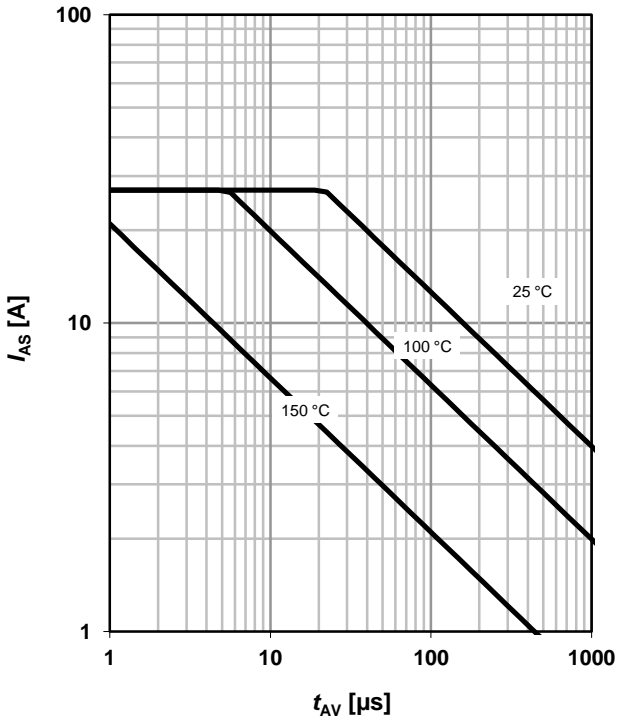
parameter: T_j



13 Avalanche characteristics

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

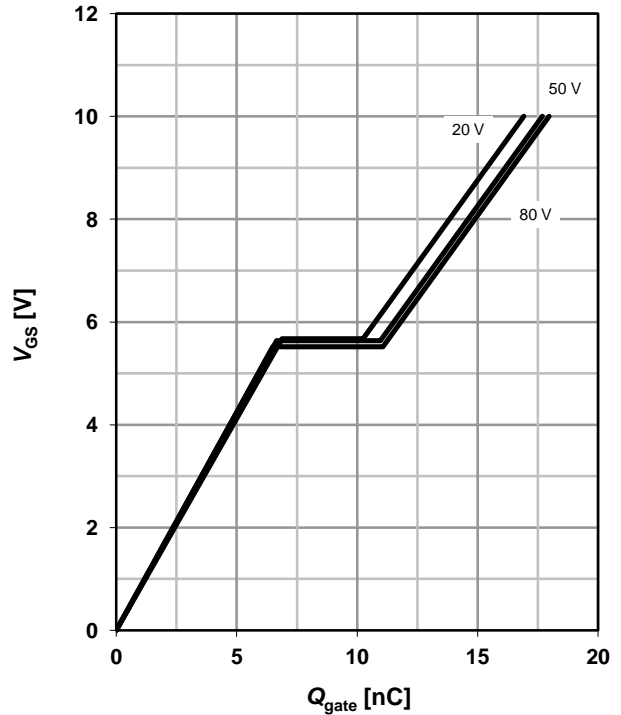
parameter: $T_{j(\text{start})}$



14 Typ. gate charge

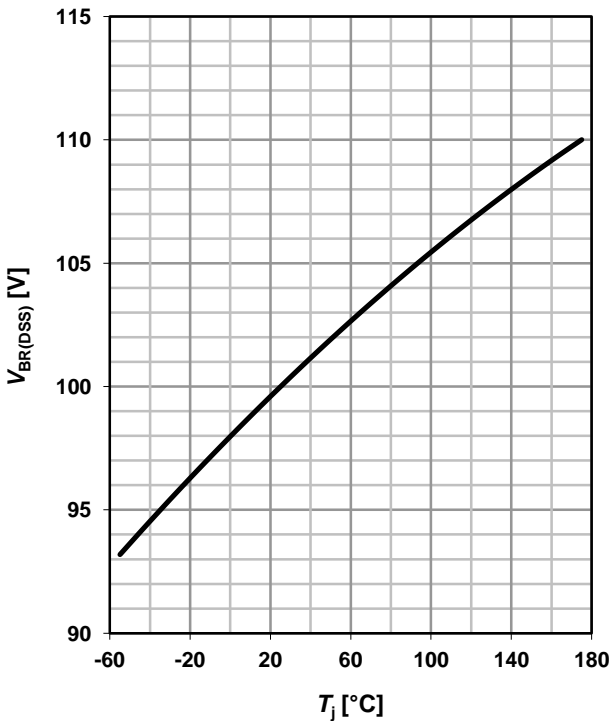
$V_{GS}=f(Q_{\text{gate}}); I_D=27 \text{ A pulsed}$

parameter: V_{DD}

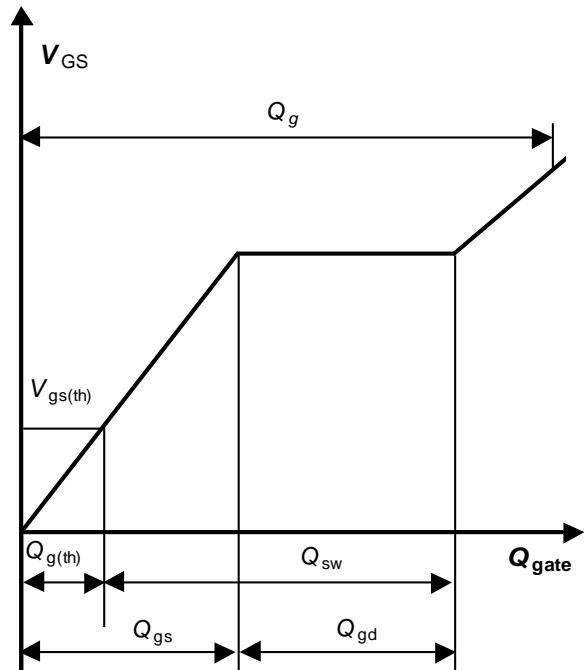


15 Drain-source breakdown voltage

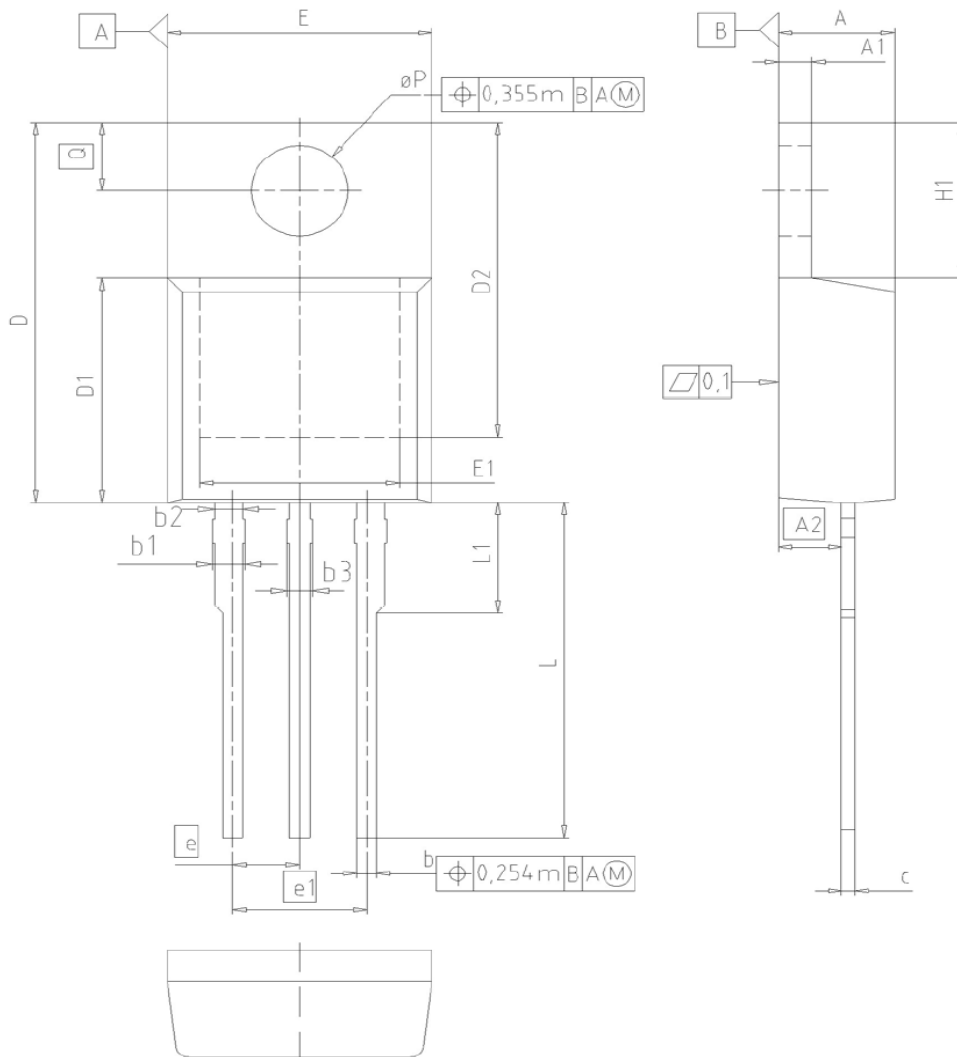
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$



16 Gate charge waveforms



PG-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 | |
| N | 3 | | 3 | |
| H1 | 5.90 | 6.90 | 0.232 | 0.272 |
| L | 13.00 | 14.00 | 0.512 | 0.551 |
| L1 | - | 4.80 | - | 0.189 |
| ϕP | 3.60 | 3.89 | 0.142 | 0.153 |
| Q | 2.60 | 3.00 | 0.102 | 0.118 |

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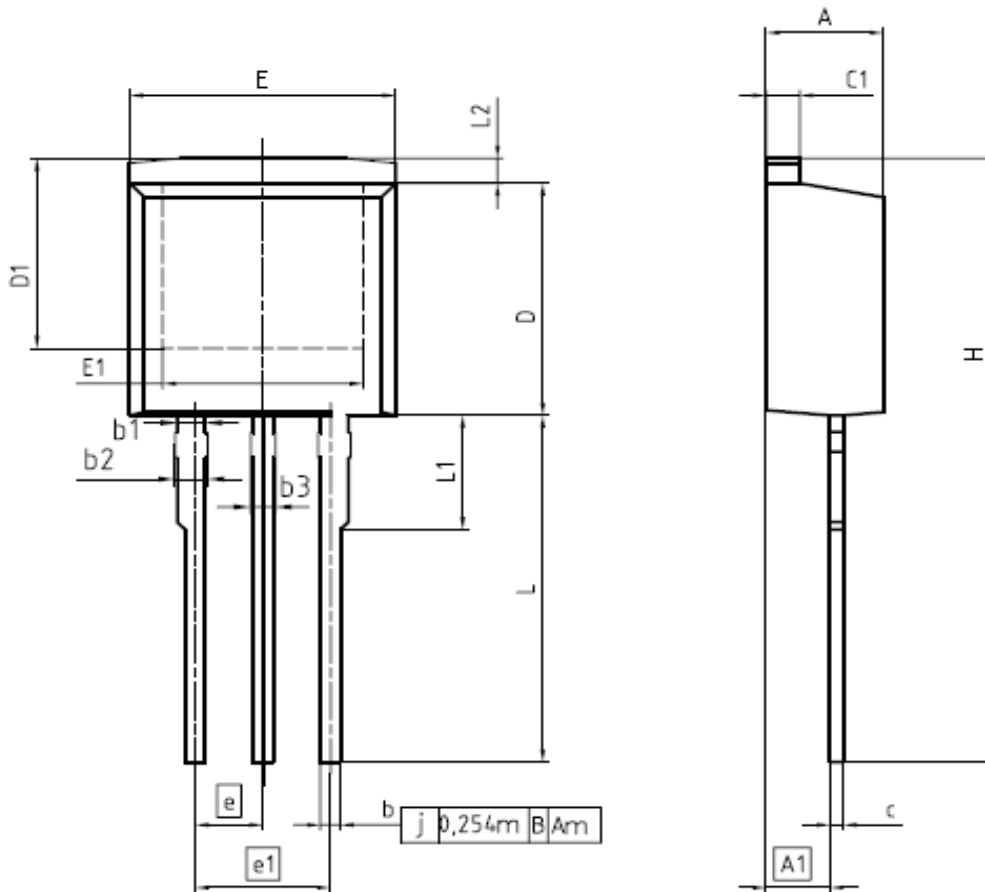
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EUROPEAN PROJECTION

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REVISION
05

PG-TO262-3-1 (I²PAK)



| 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 |
| e1 | 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 | |
| N | 3 | | 3 | |
| L | 13,000 | 14,000 | 0,512 | 0,551 |
| L1 | - | 4,600 | - | 0,189 |
| L2 | - | 1,727 | - | 0,068 |

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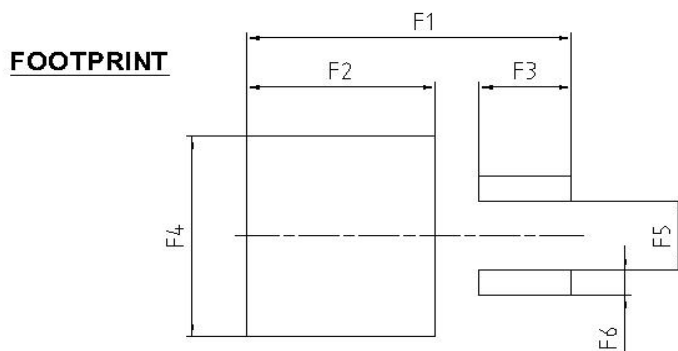
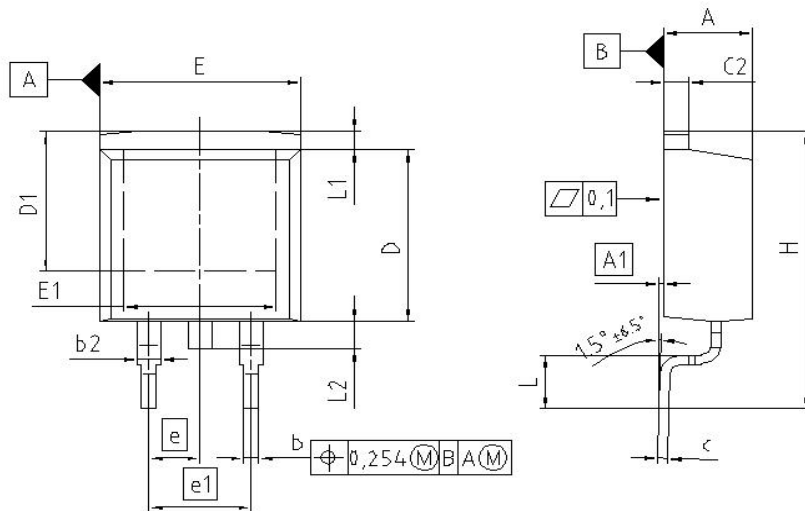
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FILE
TO262_1

PG-TO-263 (D²-Pak)



| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|--------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.300 | 4.572 | 0.169 | 0.180 |
| A1 | 0.000 | 0.254 | 0.000 | 0.010 |
| b | 0.650 | 0.850 | 0.026 | 0.033 |
| b2 | 0.950 | 1.321 | 0.037 | 0.052 |
| c | 0.330 | 0.650 | 0.013 | 0.026 |
| c2 | 0.170 | 1.400 | 0.046 | 0.055 |
| D | 8.509 | 9.450 | 0.335 | 0.372 |
| D1 | 7.100 | - | 0.280 | - |
| E | 9.800 | 10.312 | 0.386 | 0.406 |
| E1 | 6.500 | - | 0.256 | - |
| e | 2.540 | | 0.100 | |
| e1 | 5.080 | | 0.200 | |
| N | 2 | | 2 | |
| H | 14.605 | 15.875 | 0.575 | 0.625 |
| L | 2.200 | 3.000 | 0.087 | 0.118 |
| L1 | - | 1.600 | - | 0.063 |
| L2 | 1.000 | 1.778 | 0.039 | 0.070 |
| F1 | 16.050 | 16.250 | 0.632 | 0.640 |
| F2 | 9.300 | 9.500 | 0.366 | 0.374 |
| F3 | 4.500 | 4.700 | 0.177 | 0.185 |
| F4 | 10.700 | 10.900 | 0.421 | 0.429 |
| F5 | 3.630 | 3.830 | 0.143 | 0.151 |
| F6 | 1.100 | 1.300 | 0.043 | 0.051 |

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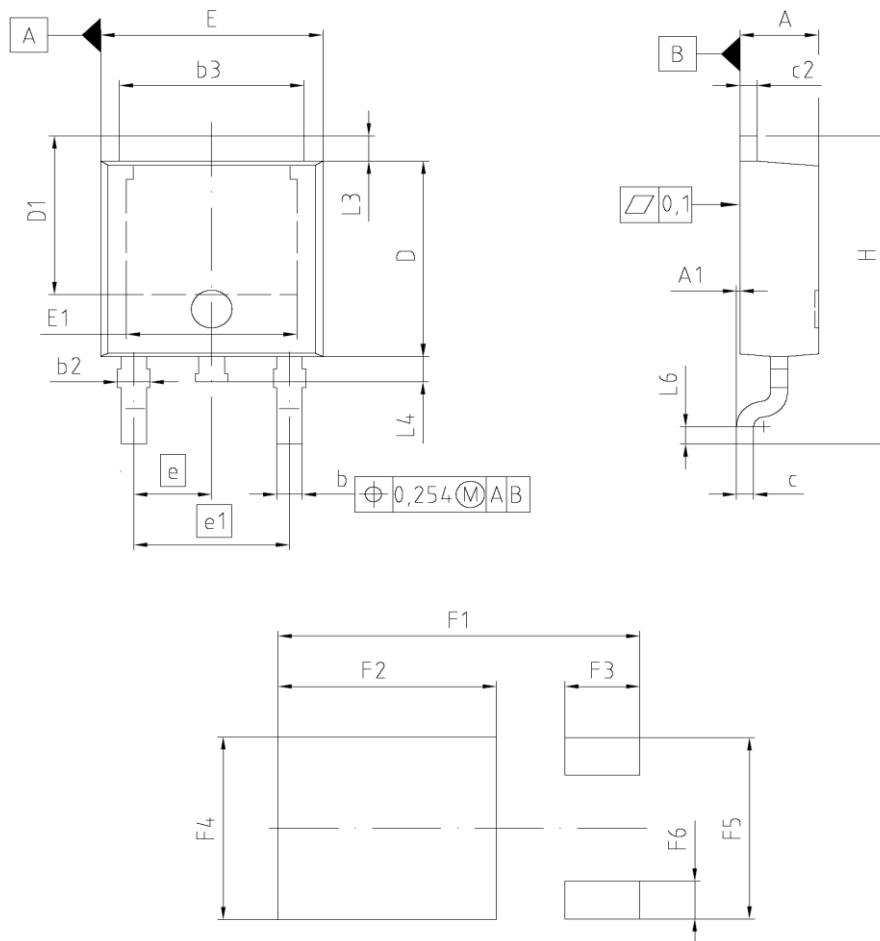
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FILE
TO263_2

PG-TO252-3: Outline



| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|--------|--------|-------|
| | MIN | MAX | MIN | MAX |
| A | 2.159 | 2.413 | 0.085 | 0.095 |
| A1 | 0.000 | 0.150 | 0.000 | 0.006 |
| b | 0.635 | 0.889 | 0.025 | 0.035 |
| b2 | 0.650 | 1.150 | 0.026 | 0.045 |
| b3 | 5.004 | 5.500 | 0.197 | 0.217 |
| c | 0.457 | 0.580 | 0.018 | 0.023 |
| c2 | 0.460 | 0.980 | 0.018 | 0.039 |
| D | 5.969 | 6.223 | 0.235 | 0.245 |
| D1 | 5.020 | 5.842 | 0.198 | 0.230 |
| E | 6.400 | 6.731 | 0.252 | 0.265 |
| E1 | 4.850 | 5.207 | 0.191 | 0.205 |
| e | 2.286 | | 0.090 | |
| e1 | 4.572 | | 0.180 | |
| N | 3 | | 3 | |
| H | 9.400 | 10.480 | 0.370 | 0.413 |
| L3 | 0.900 | 1.143 | 0.035 | 0.045 |
| L4 | 0.584 | 0.950 | 0.023 | 0.037 |
| L6 | 0.510 | 0.686 | 0.020 | 0.027 |
| F1 | 10.500 | 10.700 | 0.413 | 0.421 |
| F2 | 6.300 | 6.500 | 0.248 | 0.256 |
| F3 | 2.100 | 2.300 | 0.083 | 0.091 |
| F4 | 5.700 | 5.900 | 0.224 | 0.232 |
| F5 | 5.660 | 5.860 | 0.222 | 0.231 |
| F6 | 1.100 | 1.300 | 0.043 | 0.051 |

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