

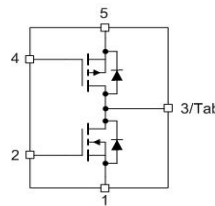
OptiMOS[®]-T PN Half Bridge

Features

- Dual p- and n-channel MOSFET
- Automotive AEC Q101 qualified
- Green package (RoHS compliant)
- Ultra low $R_{DS(on)}$
- 150 °C operating temperature

Product Summary

| | P | N | |
|-----------------------|----------|----------|------------|
| V_{DS} | -30 | 55 | V |
| $R_{DS(on),max}^{5)}$ | 12.7 | 11.7 | m Ω |
| I_D | -40 | 40 | A |

PG-TO263-5-1


| Type | Package | Marking |
|-------------|----------------|----------------|
| BTS7904B | PG-TO263-5-1 | 7904B |

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

| Parameter | Symbol | Conditions | Value | | Unit |
|--|----------------|-----------------------|--------------|-------------------------|-------------|
| | | | P | N | |
| Continuous drain current ¹⁾ | I_D | $T_C=25\text{ °C}$ | -40 | 40 | A |
| | | $T_C=100\text{ °C}$ | -40 | 40 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25\text{ °C}$ | -160 | 160 | |
| Avalanche energy, single pulse ²⁾ | E_{AS} | $I_D=\pm 20\text{ A}$ | 350 | 200 | mJ |
| Avalanche current, single pulse | I_{AS} | | -40 | 40 | A |
| Gate source voltage | V_{GS} | | -16 / +5 | +16 / -16 ³⁾ | V |
| Power dissipation ²⁾ | P_{tot} | $T_C=25\text{ °C}$ | 96 | 69 | W |
| Operating and storage temperature | T_j, T_{stg} | | -55 ... 150 | | °C |
| IEC climatic category; DIN IEC 68-1 | | | 55/150/56 | | |

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

Thermal characteristics

| | | | | | | | |
|-------------------------------------|---|------------|--|---|---|-----|-----|
| Thermal resistance, junction - case | P | R_{thJC} | | - | - | 1.3 | K/W |
| | N | | | - | - | 1.8 | |
| SMD version, device on PCB | | R_{thJA} | minimal footprint | - | - | 62 | |
| | | | 6 cm ² cooling area ⁴⁾ | - | - | 45 | |

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

| | | | | | | | |
|--|---|--|---|------|-------|------|---------------|
| Drain-source breakdown voltage | P | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=-1\text{ mA}$ | -30 | - | - | V |
| | N | | $V_{GS}=0\text{ V}, I_D=1\text{ mA}$ | 55 | - | - | |
| Gate threshold voltage | P | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=-70\text{ }\mu\text{A}$ | -1 | -1.5 | -2.1 | |
| | N | | $V_{DS}=V_{GS}, I_D=40\text{ }\mu\text{A}$ | 1.2 | 1.7 | 2.2 | |
| Zero gate voltage drain current | P | I_{DSS} | $V_{DS}=-18\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$ | - | -0.01 | -1 | μA |
| | | | $V_{DS}=-18\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ }^\circ\text{C}$ | - | -1 | -100 | |
| | N | $V_{DS}=18\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$ | - | 0.01 | 1 | | |
| | | $V_{DS}=18\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ }^\circ\text{C}$ | - | 1 | 100 | | |
| Gate-source leakage current | P | I_{GSS} | $V_{GS}=-16\text{ V}, V_{DS}=0\text{ V}$ | - | -10 | -100 | nA |
| | N | | $V_{GS}=16\text{ V}, V_{DS}=0\text{ V}$ | - | 1 | 100 | |
| Drain-source on-state resistance ⁵⁾ | P | $R_{DS(on)}$ | $V_{GS}=-10\text{ V}, I_D=-20\text{ A}$ | - | 6.9 | 12.7 | m Ω |
| | N | | $V_{GS}=10\text{ V}, I_D=20\text{ A}$ | - | 9.4 | 11.7 | |
| | P | | $V_{GS}=-4.5\text{ V}, I_D=-12.5\text{ A}$ | - | 17.2 | 20.7 | |
| | N | | $V_{GS}=4.5\text{ V}, I_D=20\text{ A}$ | - | 16.5 | 20.2 | |

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

Dynamic characteristics

| | | | | | | | |
|------------------------------|---|--------------|---|---|------|------|----|
| Input capacitance | P | C_{iss} | $V_{GS}=0\text{ V}, V_{DS}=\pm 25\text{ V}, f=1\text{ MHz}$ | - | 3900 | 5200 | pF |
| | N | | | - | 4600 | 6100 | |
| Output capacitance | P | C_{oss} | | - | 1000 | 1300 | |
| | N | | | - | 570 | 760 | |
| Reverse transfer capacitance | P | C_{rss} | | - | 850 | 1300 | |
| | N | | | - | 550 | 820 | |
| Turn-on delay time | P | $t_{d(on)}$ | $V_{DD}=15\text{ V}, V_{GS}=10\text{ V}$ N: $I_D=30\text{ A}, R_G=2\ \Omega$ P: $I_D=-30\text{ A}, R_G=2\ \Omega$ | - | 22 | - | ns |
| | N | | | - | 15 | - | |
| Rise time | P | t_r | | - | 94 | - | |
| | N | | | - | 77 | - | |
| Turn-off delay time | P | $t_{d(off)}$ | | - | 104 | - | |
| | N | | | - | 31 | - | |
| Fall time | P | t_f | | - | 150 | - | |
| | N | | | - | 8 | - | |

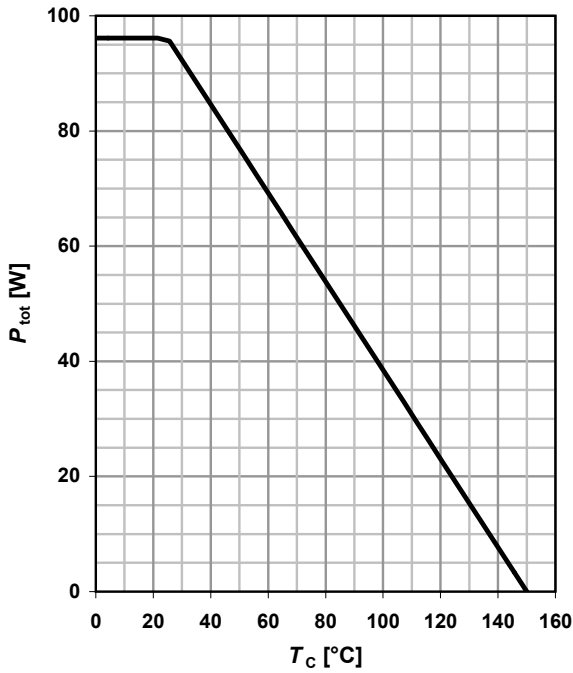
Gate Charge Characteristics²⁾

| | | | | | | | |
|-----------------------|---|---------------|--|---|------|------|----|
| Gate to source charge | P | Q_{gs} | $V_{DD}=-24\text{ V}, I_D=-40\text{ A}, V_{GS}=0\text{ to }-10\text{ V}$ | - | -12 | -16 | nC |
| Gate to drain charge | | Q_{gd} | | - | -30 | -45 | |
| Switching charge | | Q_g | | - | -80 | -121 | |
| Gate plateau voltage | | $V_{plateau}$ | | - | -3.0 | - | |
| Gate to source charge | N | Q_{gs} | $V_{DD}=44\text{ V}, I_D=40\text{ A}, V_{GS}=0\text{ to }10\text{ V}$ | - | 20 | 27 | |
| Gate to drain charge | | Q_{gd} | | - | 32 | 48 | |
| Gate charge | | Q_g | | - | 82 | 123 | |
| Gate plateau voltage | | $V_{plateau}$ | | | 4.2 | | |

| Parameter | Symbol | Conditions | Values | | | Unit | |
|--|--------|---------------|--|------|-------|------|----|
| | | | min. | typ. | max. | | |
| Reverse Diode | | | | | | | |
| Diode continuous forward current ²⁾ | P | I_S | $T_C=25\text{ °C}$ | - | - | -40 | A |
| | N | | | | | 40 | |
| Diode pulse current | P | $I_{S,pulse}$ | | - | - | -160 | |
| | N | | | | | 160 | |
| Diode forward voltage | P | V_{SD} | $V_{GS}=0\text{ V}, I_F=-40\text{ A}, T_j=25\text{ °C}$ | - | -1.00 | -1.2 | V |
| | N | | $V_{GS}=0\text{ V}, I_F=40\text{ A}, T_j=25\text{ °C}$ | - | 0.90 | 1.2 | |
| Reverse recovery time ²⁾ | P | t_{rr} | $V_R=15\text{ V}, I_F=I_S, di_F/dt=400\text{ A}/\mu\text{s}$ | - | 41 | - | ns |
| | N | | | - | 47 | - | |
| Reverse recovery charge ²⁾ | P | Q_{rr} | | - | -40 | - | nC |
| | N | | | - | 50 | - | |

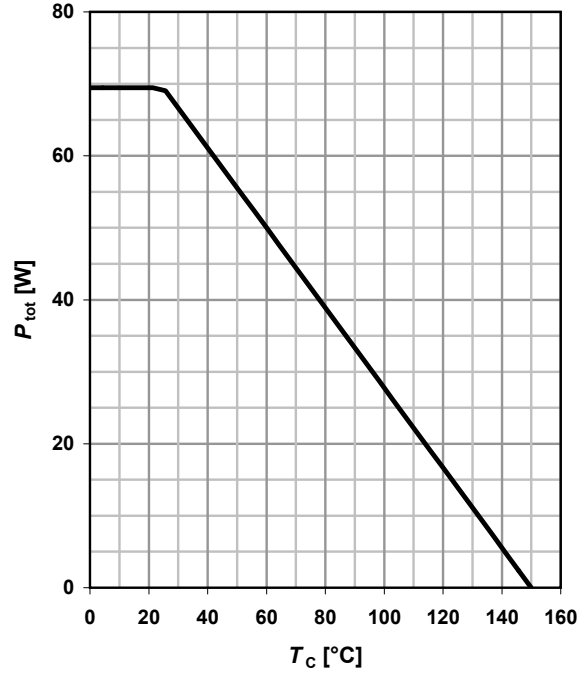
1 Power dissipation (P)

$P_{tot}=f(T_C), V_{GS} \geq 6\text{ V}$



2 Power dissipation (N)

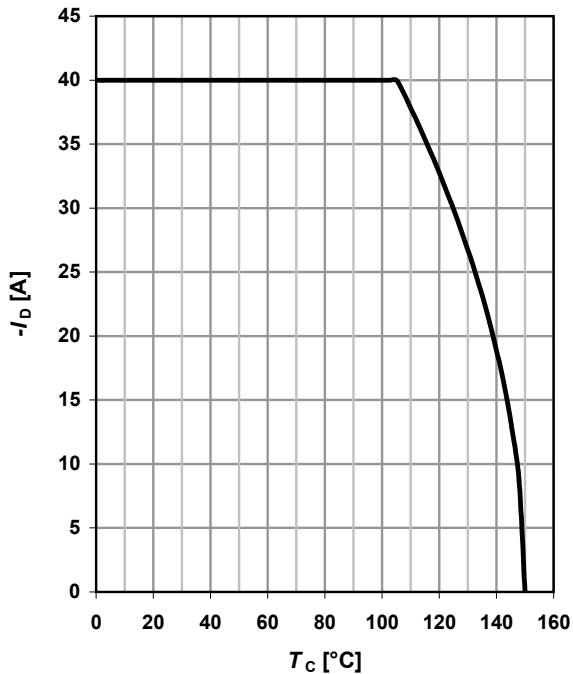
$P_{tot}=f(T_C), V_{GS} \geq 6\text{ V}$



3 Drain current (P)

$I_D=f(T_C)$

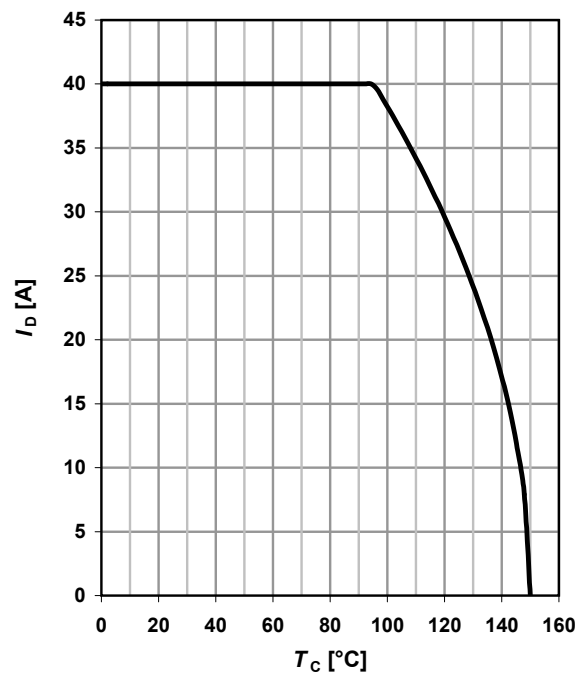
parameter: $V_{GS} \geq 6\text{ V}$



4 Drain current (N)

$I_D=f(T_C)$

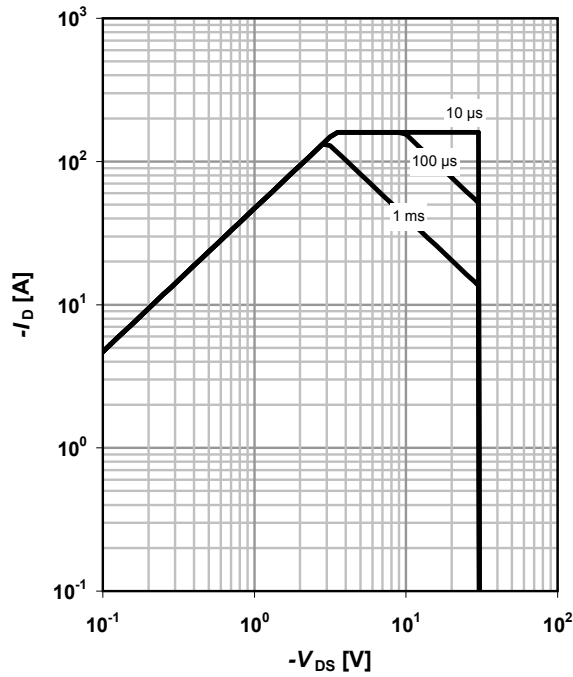
parameter: $V_{GS} \geq 6\text{ V}$



5 Safe operating area (P)

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

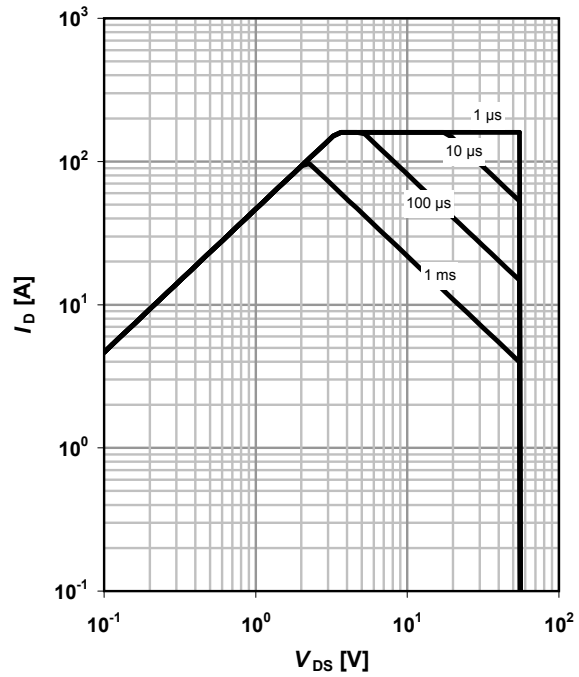
parameter: t_p



6 Safe operating area (N)

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

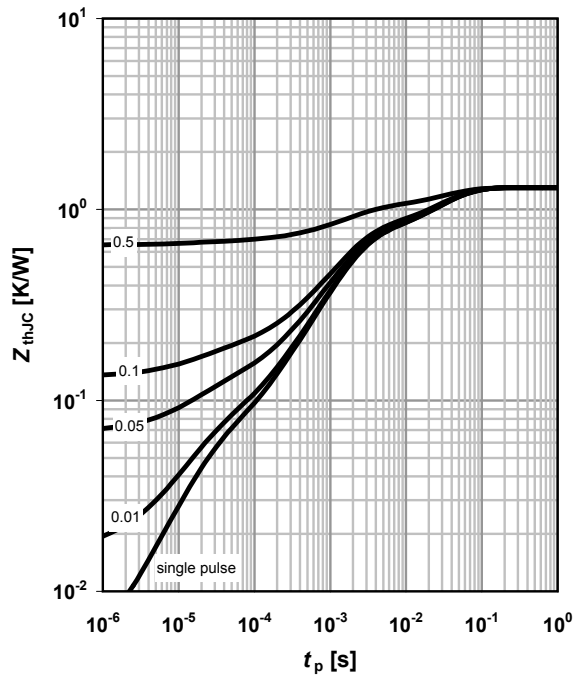
parameter: t_p



7 Max. transient thermal impedance (P)

$Z_{thJC} = f(t_p)$

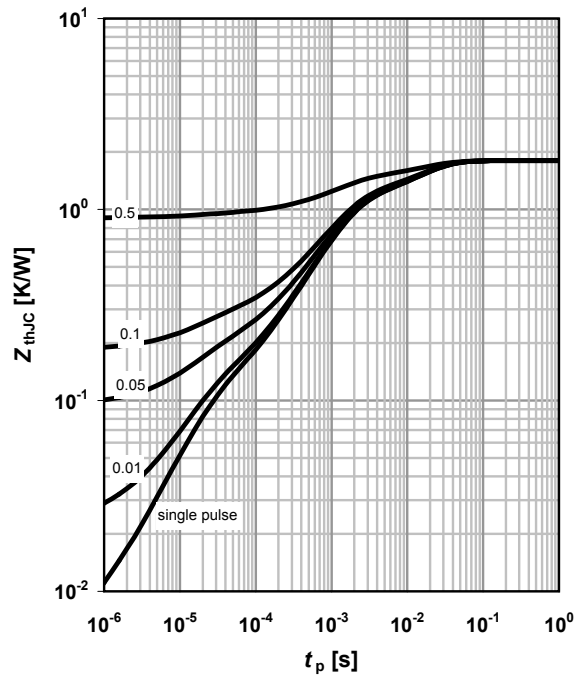
parameter: $D = t_p/T$



8 Max. transient thermal impedance (N)

$Z_{thJC} = f(t_p)$

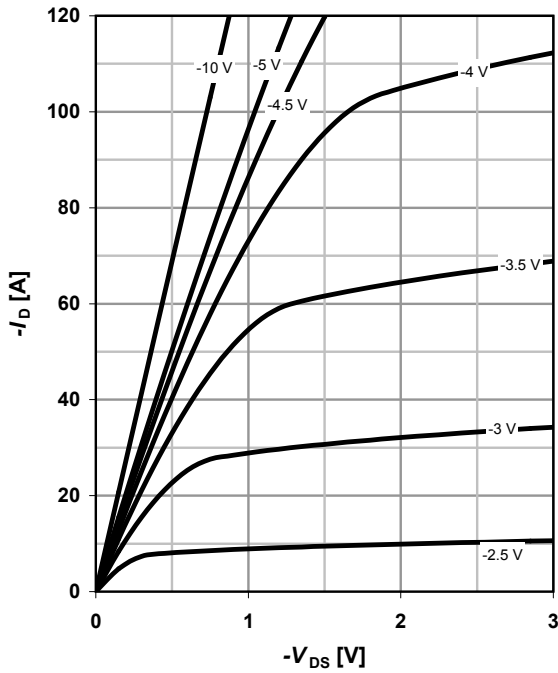
parameter: $D = t_p/T$



9 Typ. output characteristics (P)

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

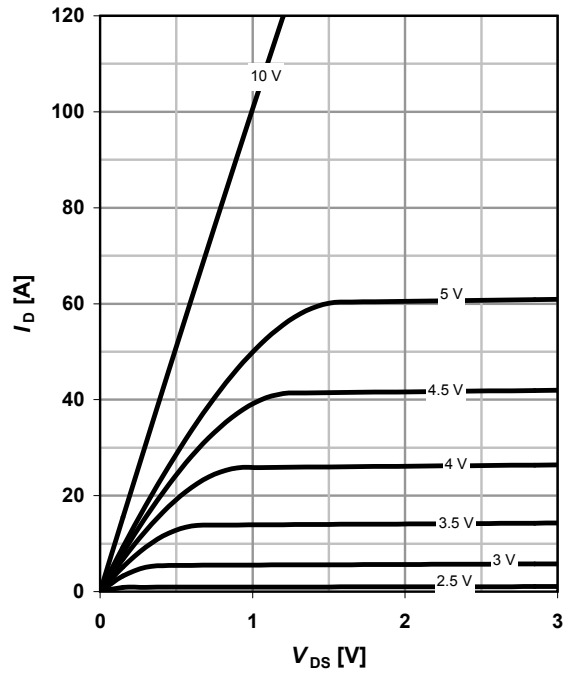
parameter: V_{GS}



10 Typ. output characteristics (N)

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

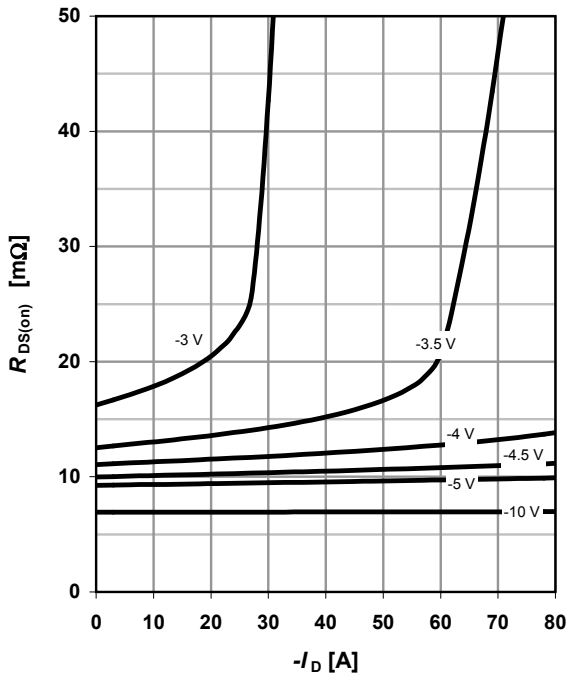
parameter: V_{GS}



11 Typ. drain-source on resistance (P)⁵⁾

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

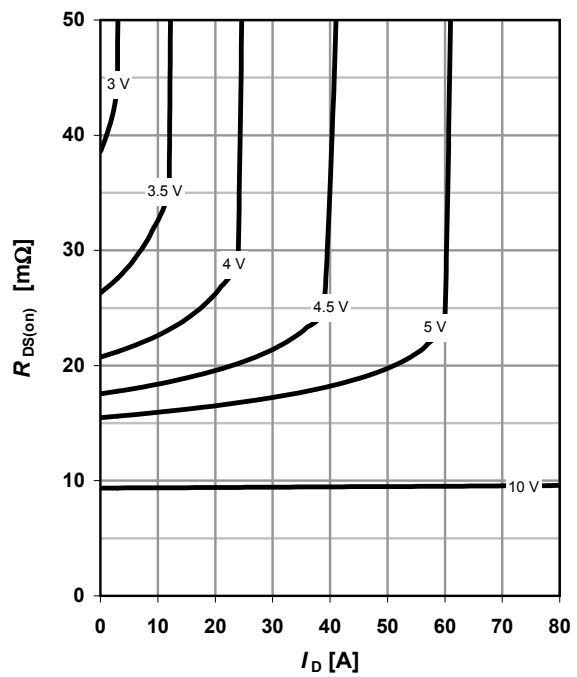
parameter: V_{GS}



12 Typ. drain-source on resistance (N)⁵⁾

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

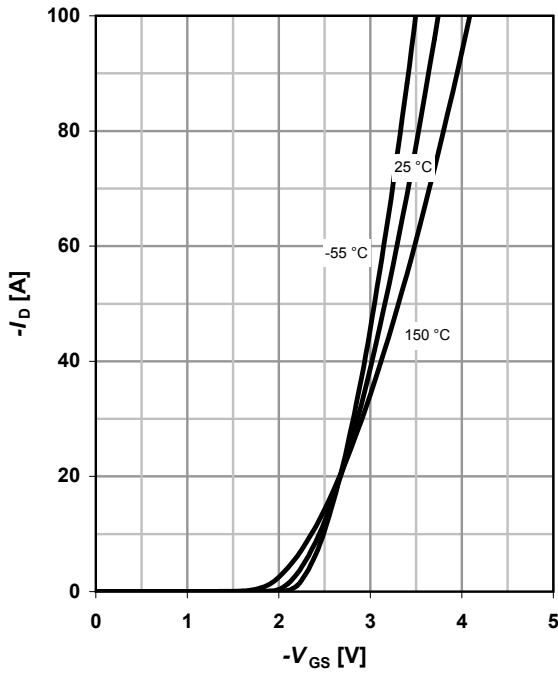
parameter: V_{GS}



13 Typ. transfer characteristics (P)

$$I_D = f(V_{GS}); V_{DS} = -6 \text{ V}$$

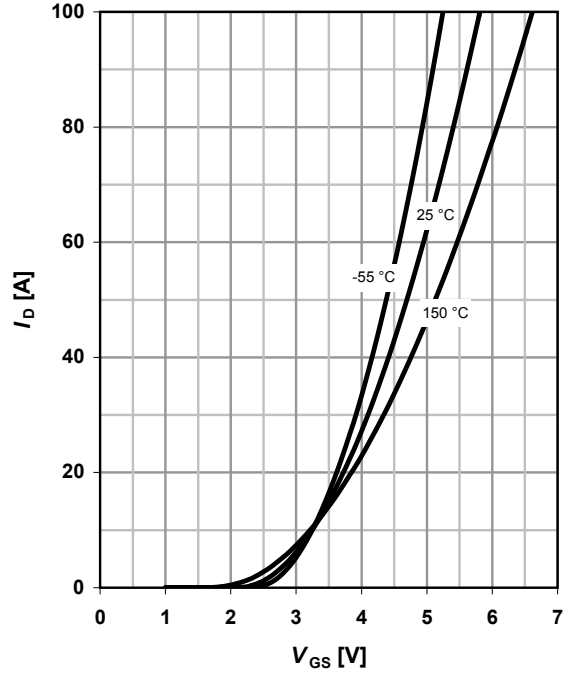
parameter: T_j



14 Typ. transfer characteristics (N)

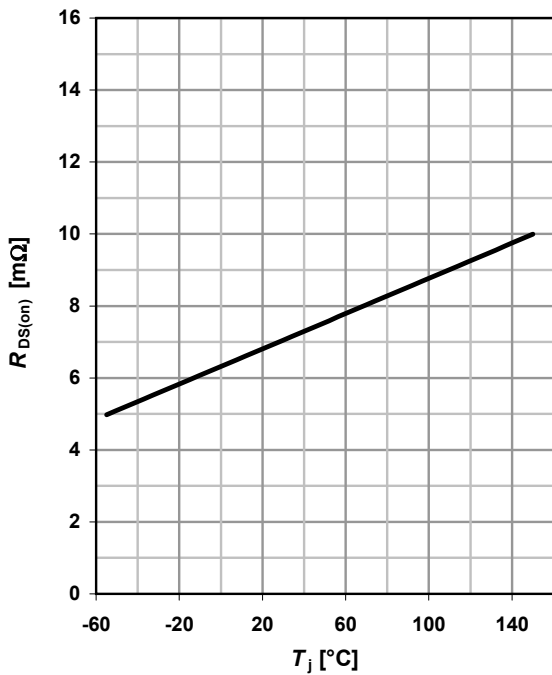
$$I_D = f(V_{GS}); V_{DS} = 6 \text{ V}$$

parameter: T_j



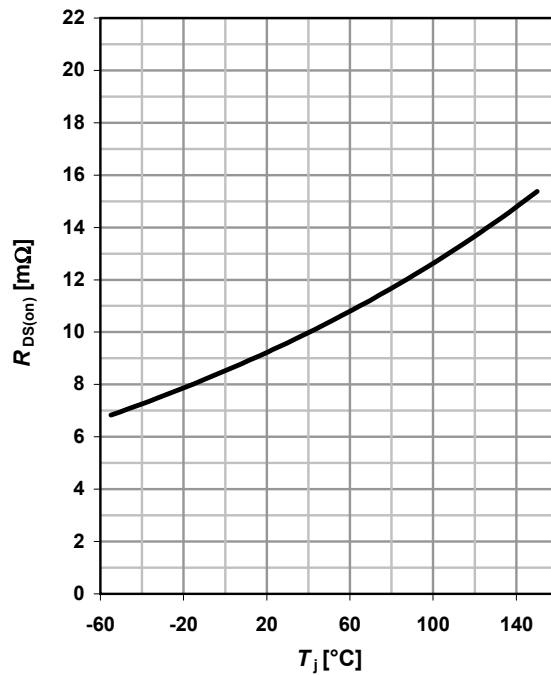
15 Drain-source on-state resistance (P)⁵⁾

$$R_{DS(on)} = f(T_j); I_D = -20 \text{ A}; V_{GS} = -10 \text{ V}$$



16 Drain-source on-state resistance (N)⁵⁾

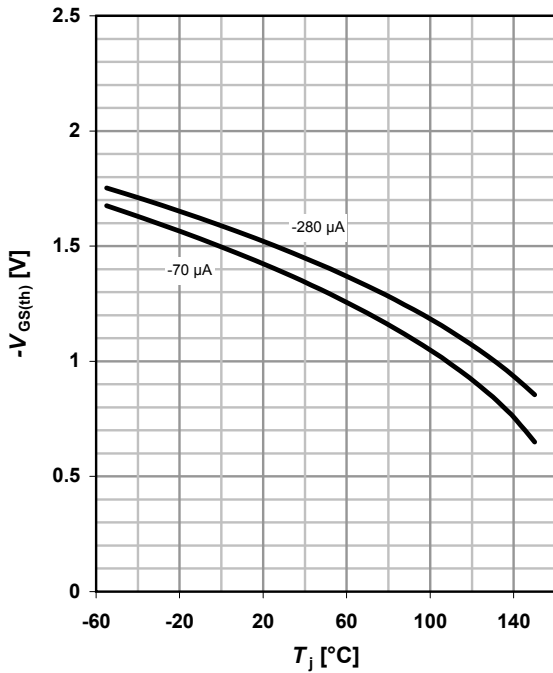
$$R_{DS(on)} = f(T_j); I_D = 20 \text{ A}; V_{GS} = 10 \text{ V}$$



17 Typ. gate threshold voltage (P)

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

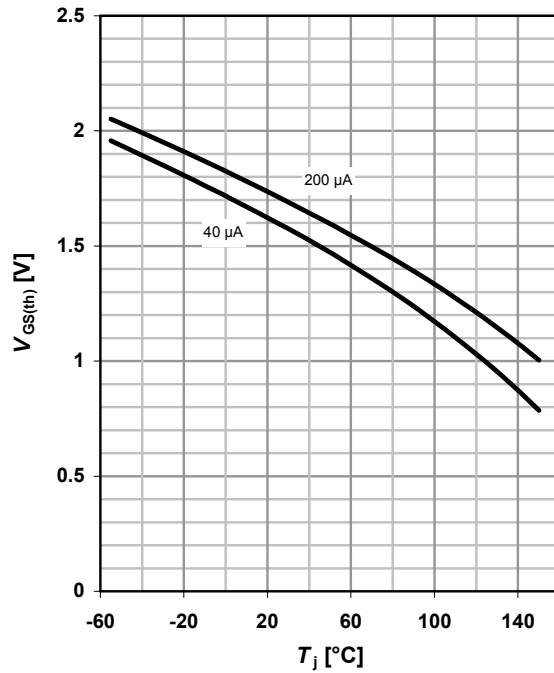
parameter: I_D



18 Typ. gate threshold voltage (N)

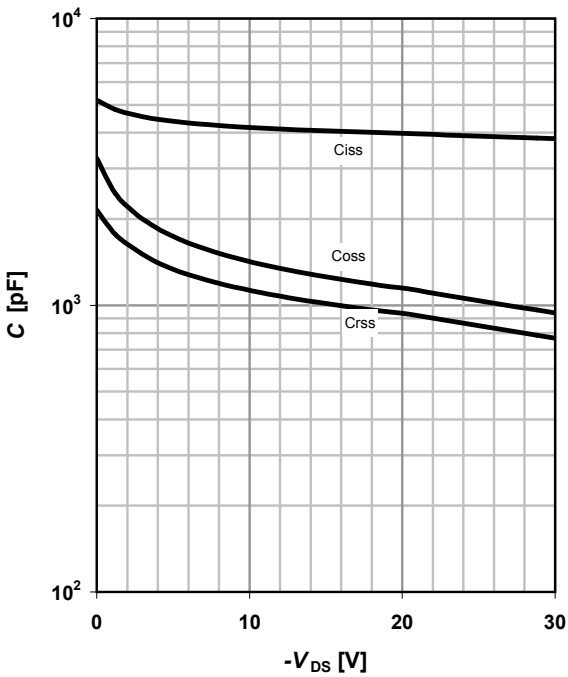
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter: I_D



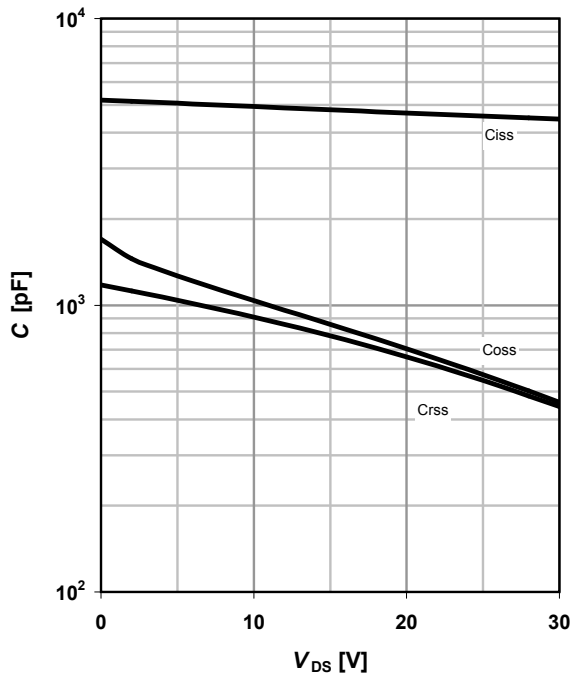
19 Typ. capacitances (P)

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



20 Typ. capacitances (N)

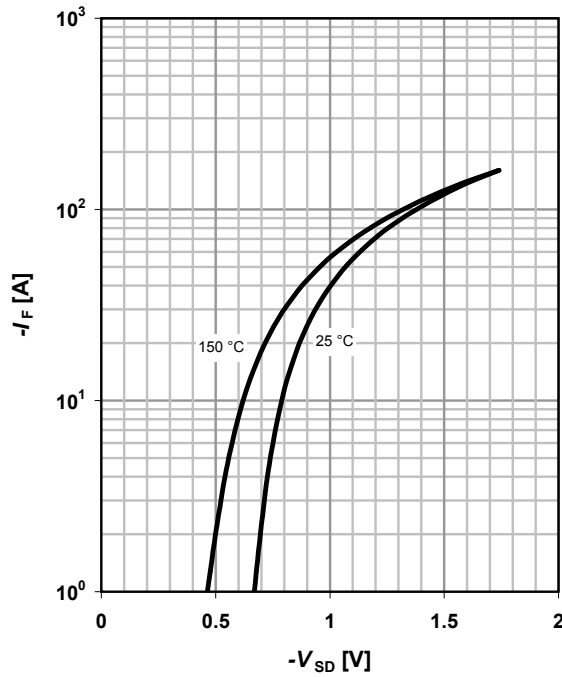
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



21 Forward characteristics of reverse diode (P)

$I_F = f(V_{SD})$

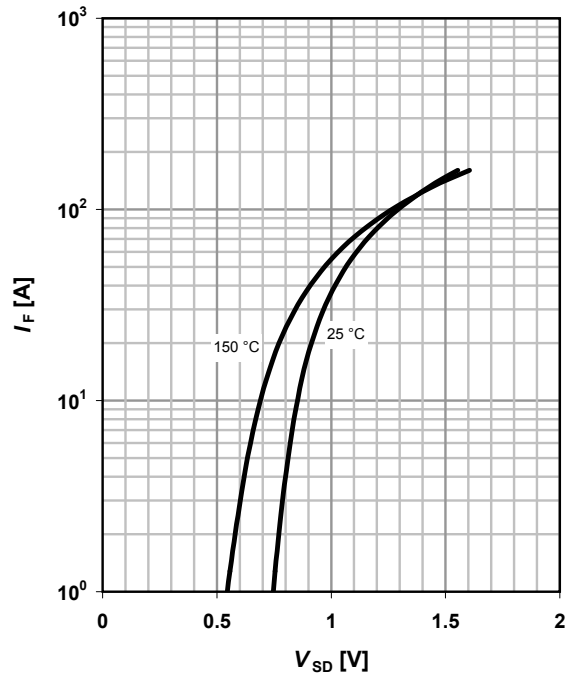
parameter: T_j



22 Forward characteristics of reverse diode (N)

$I_F = f(V_{SD})$

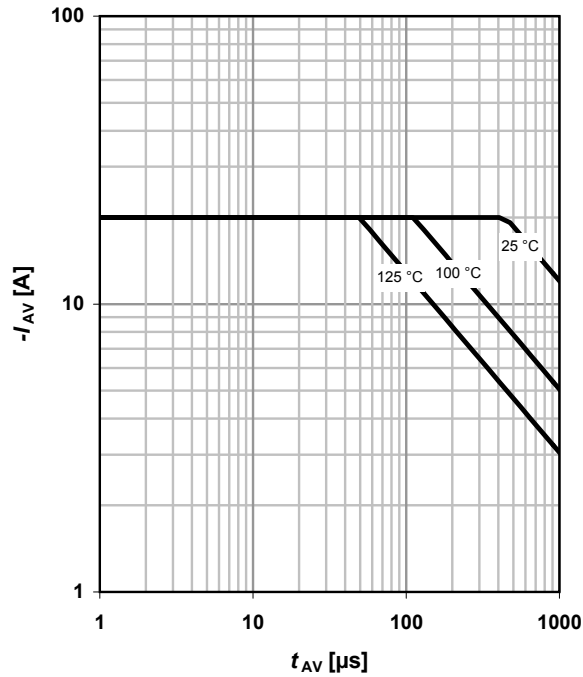
parameter: T_j



23 Avalanche characteristics (P)

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

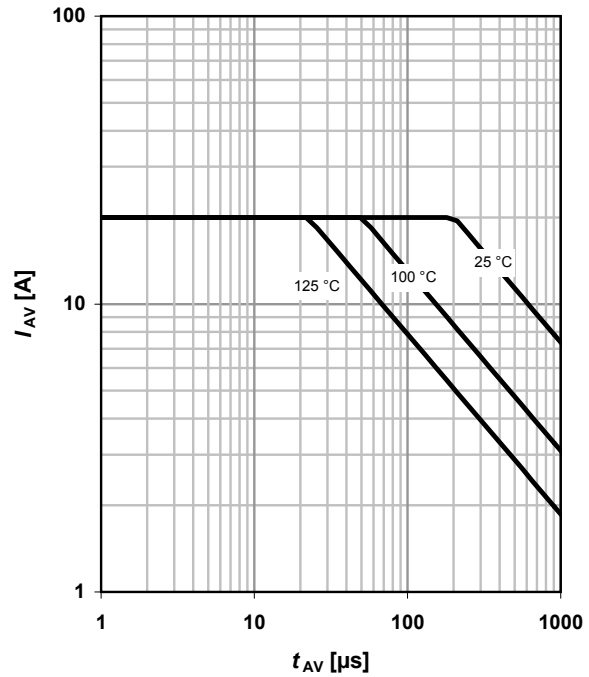
parameter: $T_{j(start)}$



24 Avalanche characteristics (N)

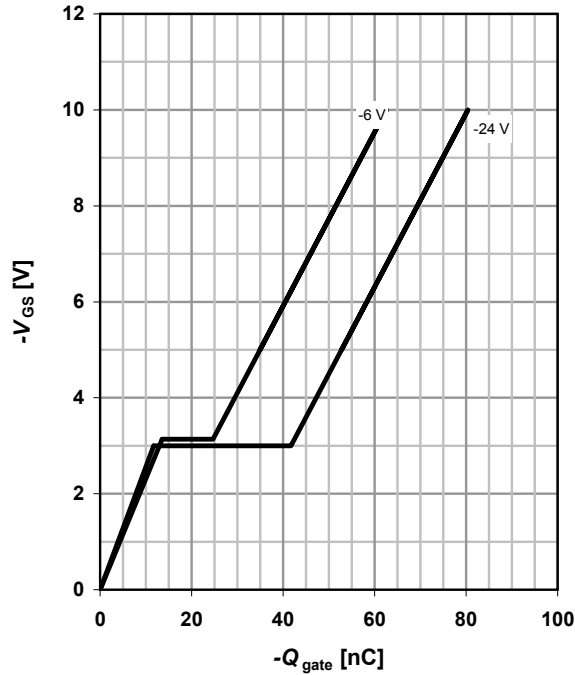
$I_{AS} = f(t_{AV}); R_{GS} = 25 \Omega$

parameter: $T_{j(start)}$



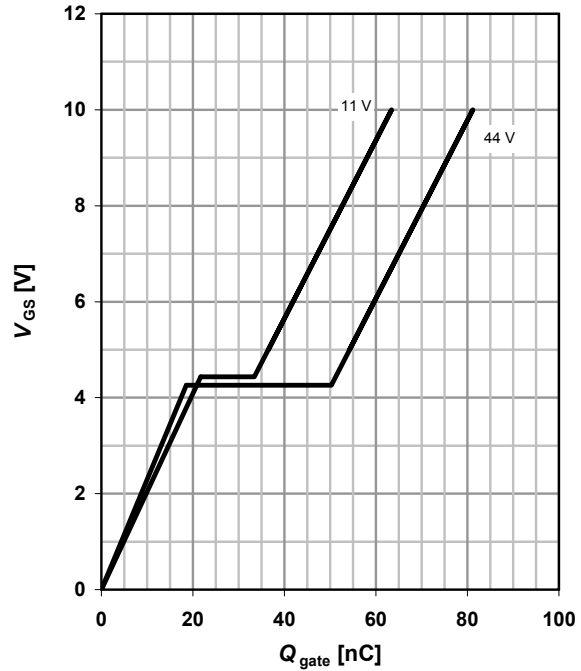
25 Typ. gate charge (P)

$V_{GS}=f(Q_{gate}); I_D=-40$ A pulsed
parameter: V_{DD}



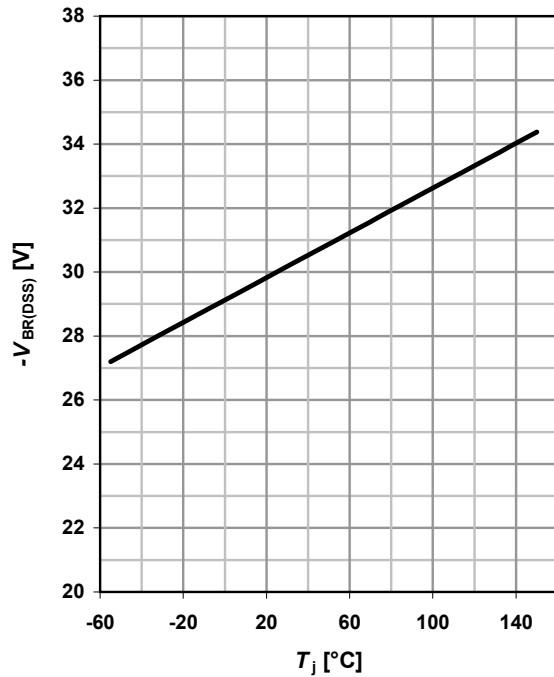
26 Typ. gate charge (N)

$V_{GS}=f(Q_{gate}); I_D=40$ A pulsed
parameter: V_{DD}



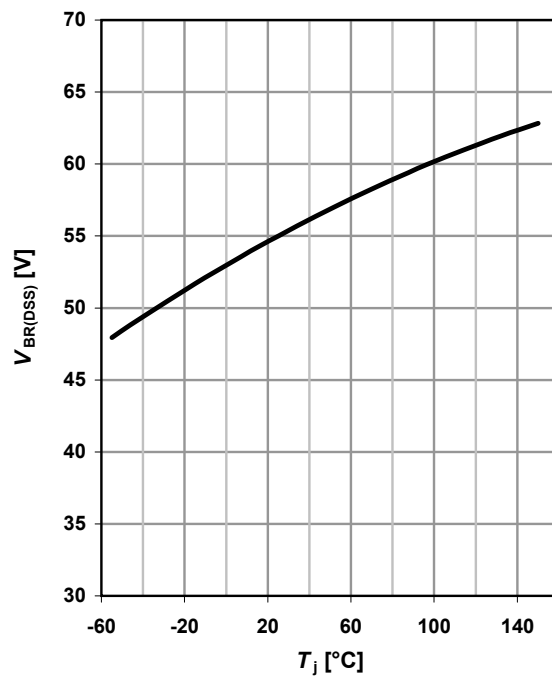
27 Drain-source breakdown voltage (P)

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



28 Drain-source breakdown voltage (N)

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



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