



**THE DATASHEET OF
IPB70P04P4-09**



OptiMOS[®] -P2 Power-Transistor

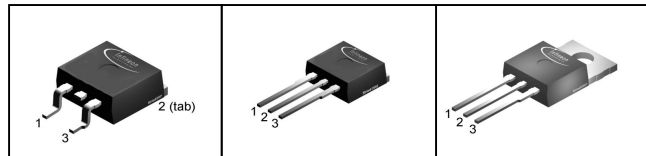
Features

- P-channel - Normal Level - Enhancement mode
- AEC qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green package (RoHS compliant)
- 100% Avalanche tested

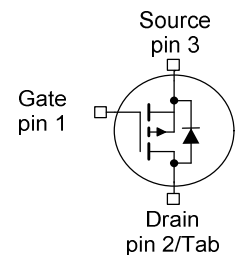
Product Summary

| | | |
|----------------------------|-----|------------|
| V_{DS} | -40 | V |
| $R_{DS(on)}$ (SMD Version) | 9.1 | m Ω |
| I_D | -70 | A |

PG-TO263-3-2 PG-TO262-3-1 PG-TO220-3-1



| Type | Package | Marking |
|---------------|--------------|---------|
| IPB70P04P4-09 | PG-TO263-3-2 | 4P0409 |
| IPI70P04P4-09 | PG-TO262-3-1 | 4P0409 |
| IPP70P04P4-09 | PG-TO220-3-1 | 4P0409 |


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

| Parameter | Symbol | Conditions | Value | Unit |
|--|----------------|---|--------------|------------------|
| Continuous drain current ¹⁾ | I_D | $T_C=25^\circ\text{C}$, $V_{GS}=-10\text{V}$ | -72 | A |
| | | $T_C=100^\circ\text{C}$, $V_{GS}=-10\text{V}$ | -50 | |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | $T_C=25^\circ\text{C}$ | -288 | |
| Avalanche energy, single pulse | E_{AS} | $I_D=-36\text{A}$ | 24 | mJ |
| Avalanche current, single pulse | I_{AS} | - | -72 | A |
| Gate source voltage | V_{GS} | - | ± 20 | V |
| Power dissipation | P_{tot} | $T_C=25\text{ }^\circ\text{C}$ | 75 | W |
| Operating and storage temperature | T_j, T_{stg} | - | -55 ... +175 | $^\circ\text{C}$ |
| IEC climatic category; DIN IEC 68-1 | - | - | 55/175/56 | |

| Parameter | Symbol | Conditions | Values | | | Unit |
|--|------------|--|--------|------|------|------|
| | | | min. | typ. | max. | |
| Thermal characteristics²⁾ | | | | | | |
| Thermal resistance, junction - case | R_{thJC} | - | - | - | 2 | K/W |
| Thermal resistance, junction - ambient, leaded | R_{thJA} | - | - | - | 62 | |
| SMD version, device on PCB | R_{thJA} | minimal footprint | - | - | 62 | |
| | | 6 cm ² cooling area ²⁾ | - | - | 40 | |

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

Static characteristics

| | | | | | | |
|----------------------------------|---------------|--|------|-------|------|------------|
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=-1mA$ | -40 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=-120\mu A$ | -2.0 | -3.0 | -4.0 | |
| Zero gate voltage drain current | I_{DSS} | $V_{DS}=-32V, V_{GS}=0V, T_j=25^\circ C$ | - | -0.05 | -1 | μA |
| | | $V_{DS}=-32V, V_{GS}=0V, T_j=125^\circ C^{2)}$ | - | -20 | -200 | |
| Gate-source leakage current | I_{GSS} | $V_{GS}=-20V, V_{DS}=0V$ | - | - | -100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}=-10V, I_D=-70A$ | - | 6.9 | 9.4 | m Ω |
| | | $V_{GS}=-10V, I_D=-70A, \text{SMD version}$ | - | 6.6 | 9.1 | |

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

Dynamic characteristics²⁾

| | | | | | | |
|------------------------------|--------------|---|---|------|------|----|
| Input capacitance | C_{iss} | $V_{GS}=0V, V_{DS}=-25V,$ $f=1MHz$ | - | 3700 | 4810 | pF |
| Output capacitance | C_{oss} | | - | 1400 | 1820 | |
| Reverse transfer capacitance | C_{rss} | | - | 40 | 80 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}=-20V,$ $V_{GS}=-10V, I_D=-70A,$ $R_G=3.5\Omega$ | - | 19 | - | ns |
| Rise time | t_r | | - | 15 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 24 | - | |
| Fall time | t_f | | - | 31 | - | |

Gate Charge Characteristics²⁾

| | | | | | | |
|-----------------------|---------------|--|---|------|----|----|
| Gate to source charge | Q_{gs} | $V_{DD}=-32V, I_D=-70A,$ $V_{GS}=0$ to $-10V$ | - | 20 | 26 | nC |
| Gate to drain charge | Q_{gd} | | - | 10 | 20 | |
| Gate charge total | Q_g | | - | 54 | 70 | |
| Gate plateau voltage | $V_{plateau}$ | | - | -5.4 | - | V |

Reverse Diode

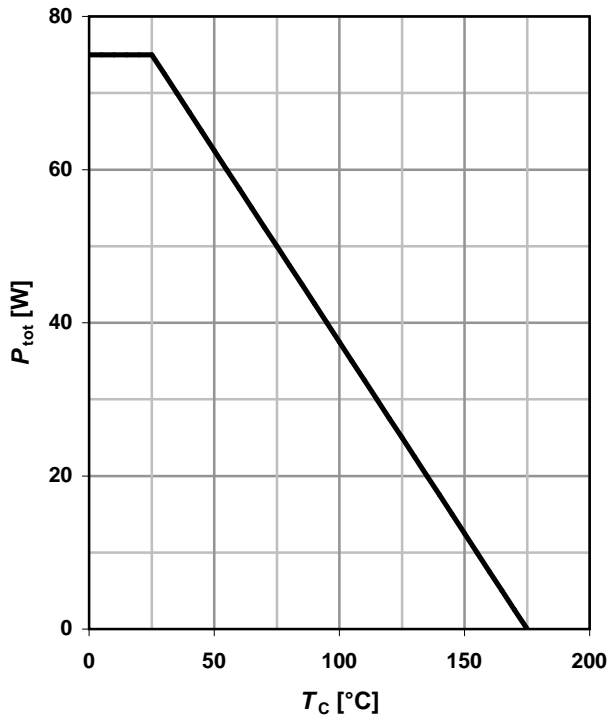
| | | | | | | |
|--|---------------|--|---|------|------|----|
| Diode continuous forward current ²⁾ | I_S | $T_C=25^\circ C$ | - | - | -72 | A |
| Diode pulse current ²⁾ | $I_{S,pulse}$ | | - | - | -288 | |
| Diode forward voltage | V_{SD} | $V_{GS}=0V, I_F=-70A,$ $T_j=25^\circ C$ | - | -1.0 | -1.3 | V |
| Reverse recovery time ²⁾ | t_{rr} | $V_R=-20V, I_F=-50A,$ $di_F/dt=-100A/\mu s$ | - | 50 | - | ns |
| Reverse recovery charge ²⁾ | Q_{rr} | | - | 50 | - | nC |

¹⁾ Defined by design. Not subject to production test.

²⁾ 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.

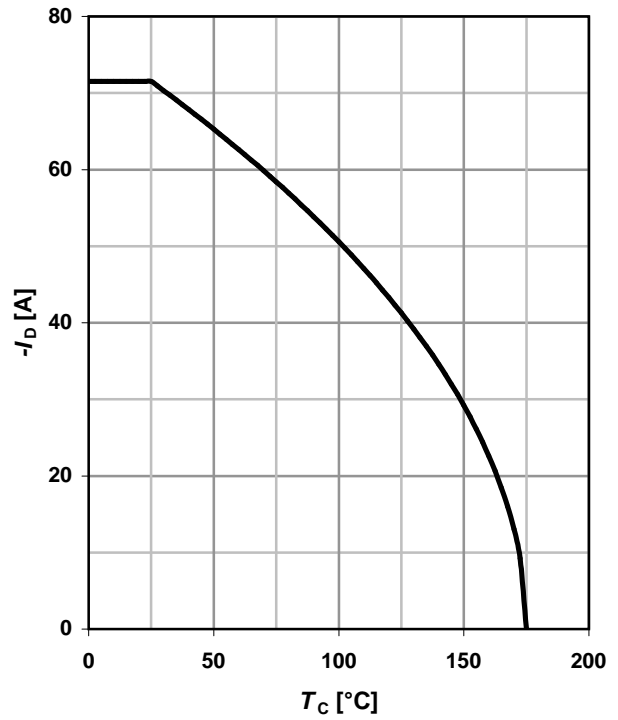
1 Power dissipation

$P_{tot} = f(T_C); V_{GS} \leq -6V$



2 Drain current

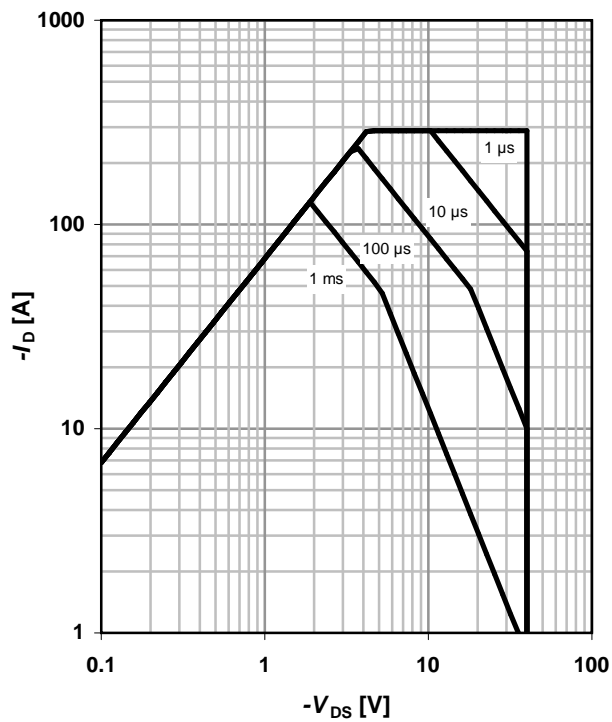
$I_D = f(T_C); V_{GS} \leq -6V; SMD$



3 Safe operating area

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

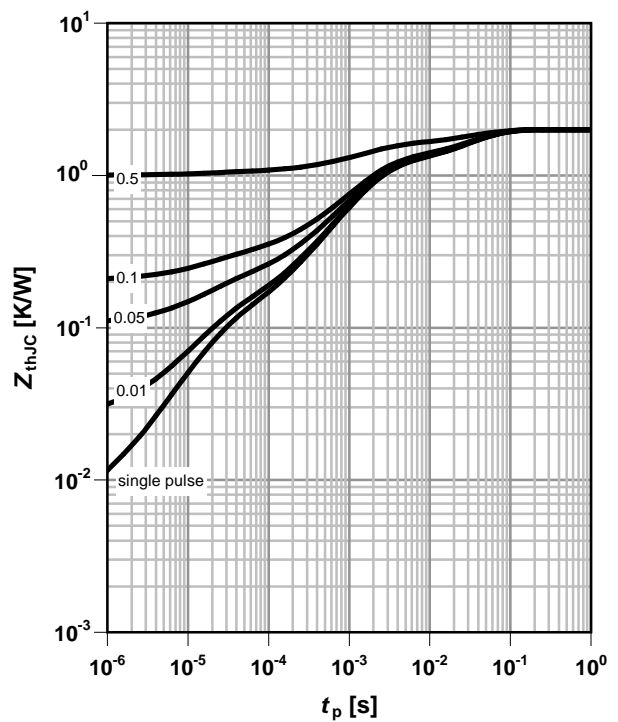
parameter: t_p



4 Max. transient thermal impedance

$Z_{thJC} = f(t_p)$

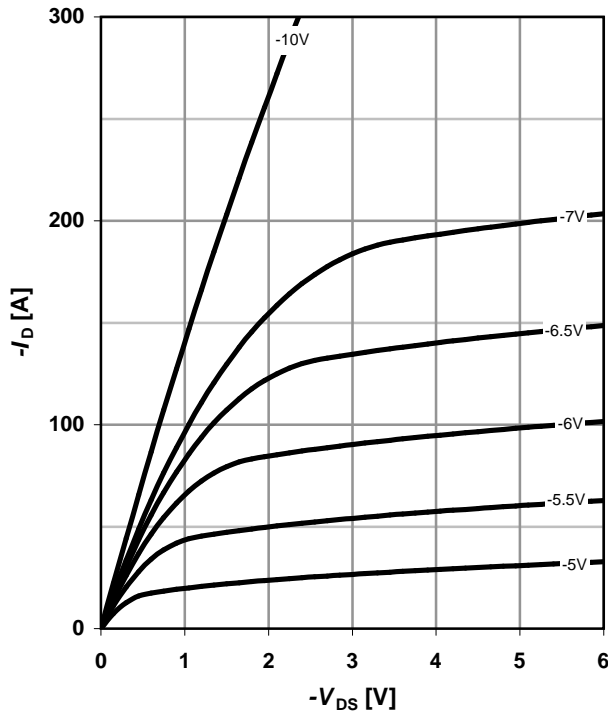
parameter: $D = t_p/T$



5 Typ. output characteristics

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

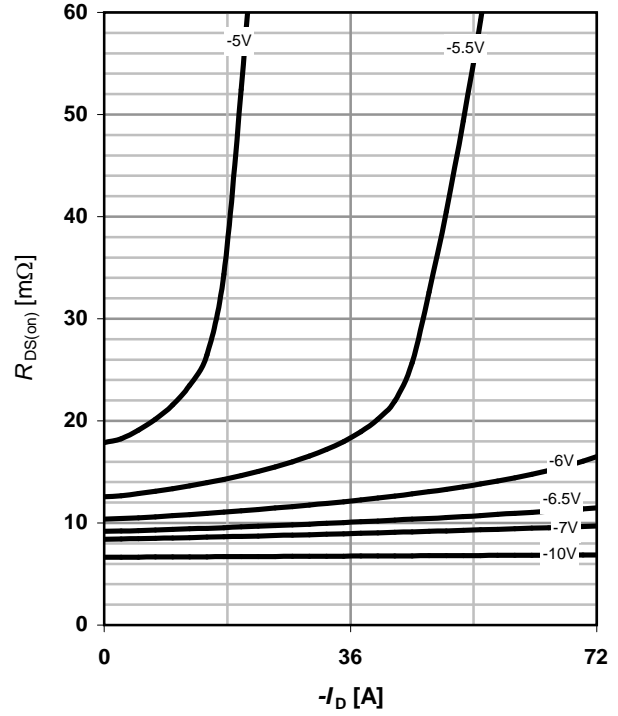
parameter: V_{GS}



6 Typ. drain-source on-state resistance

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

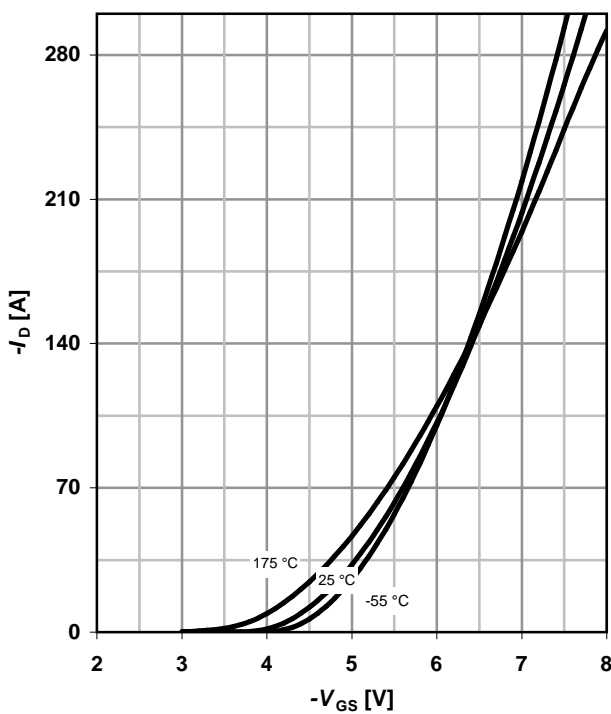
parameter: V_{GS}



7 Typ. transfer characteristics

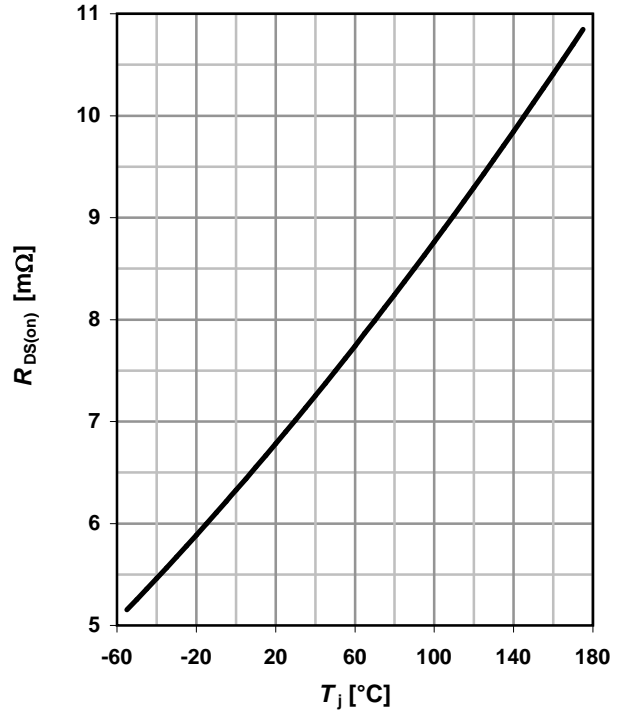
$I_D = f(V_{GS}); V_{DS} = -6V$

parameter: T_j



8 Typ. drain-source on-state resistance

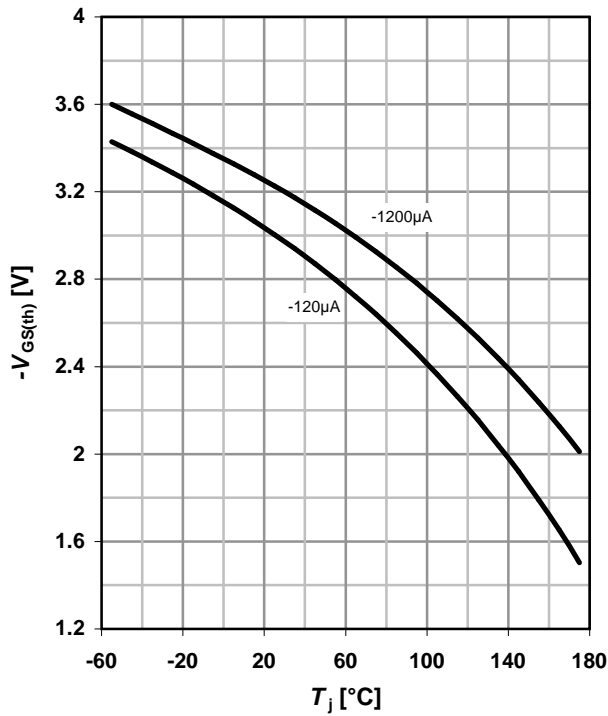
$R_{DS(on)} = f(T_j); I_D = -70\text{ A}; V_{GS} = -10\text{ V}; \text{SMD}$



9 Typ. gate threshold voltage

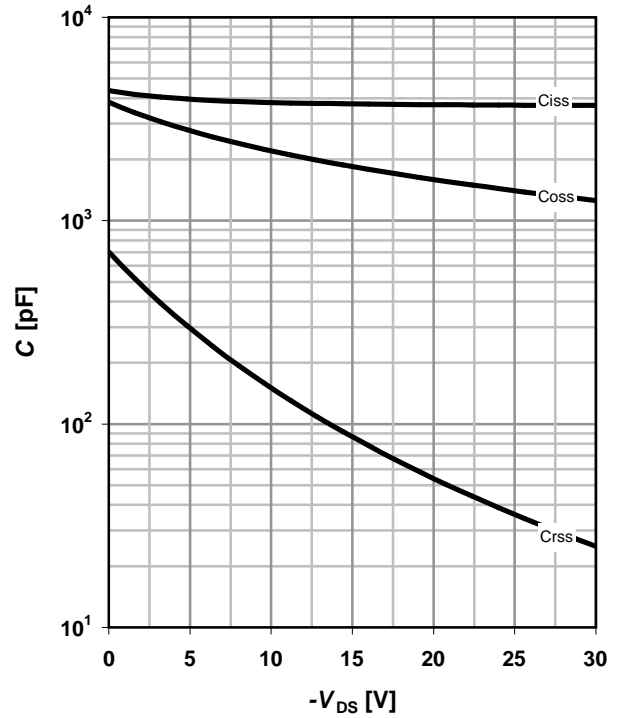
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter: I_D



10 Typ. capacitances

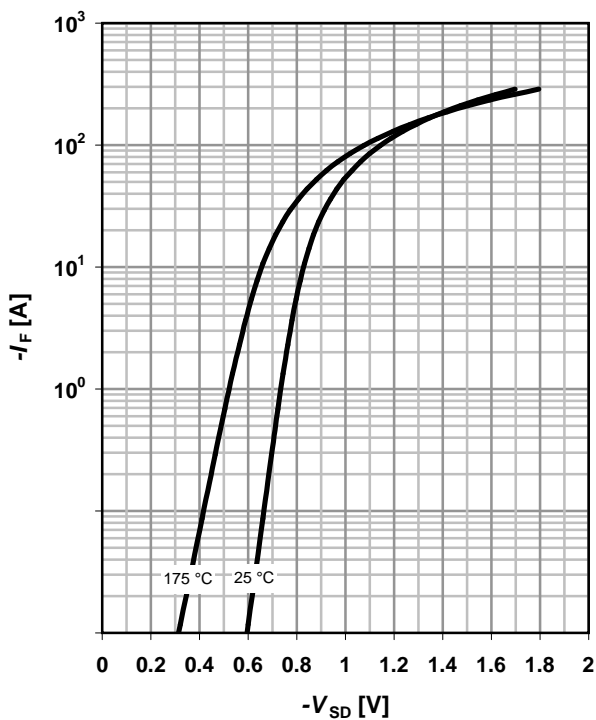
$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$



11 Typical forward diode characteristics

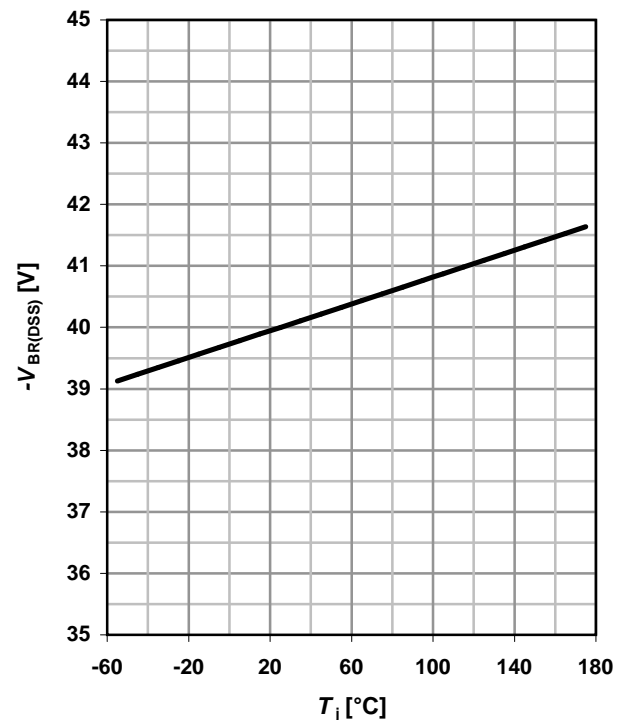
$I_F = f(V_{SD})$

parameter: T_j



12 Drain-source breakdown voltage

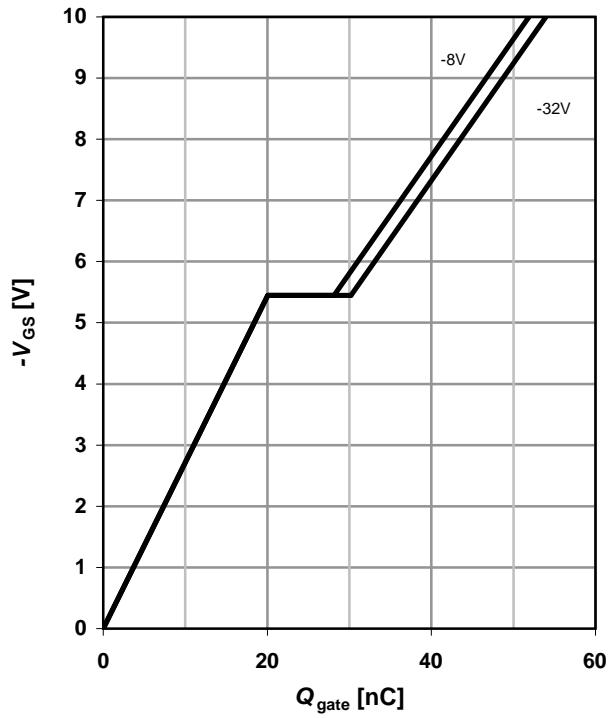
$V_{BR(DSS)} = f(T_j); I_D = -1 mA$



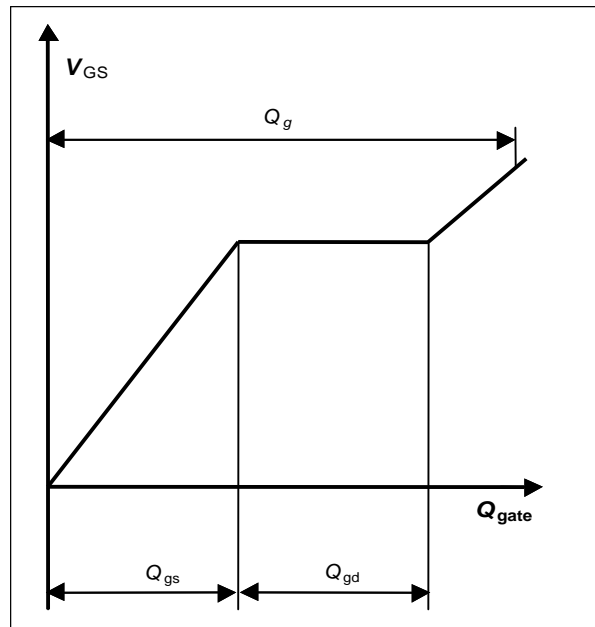
13 Typ. gate charge

$V_{GS} = f(Q_{gate}); I_D = -70$ A pulsed

parameter: V_{DD}



14 Gate charge waveforms



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Revision History

| Version | Date | Changes |
|---------|------------|---------------------------------------|
| 1.1 | 02.09.2009 | $V_{GS(th)}$: I_D changed to 116uA |
| 1.2 | 07.10.2009 | $V_{GS(th)}$: I_D changed to 120uA |
| 1.2 | 07.10.2009 | $R_{DS(on)}$: I_D changed to 70A |
| 1.2 | 07.10.2009 | V_{SD} : I_D changed to 70A |
| 1.2 | 07.10.2009 | I_{GSS} : V_{GS} changed to 20V |
| 1.3 | 04.02.2011 | Final Data Sheet |
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