

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ CE

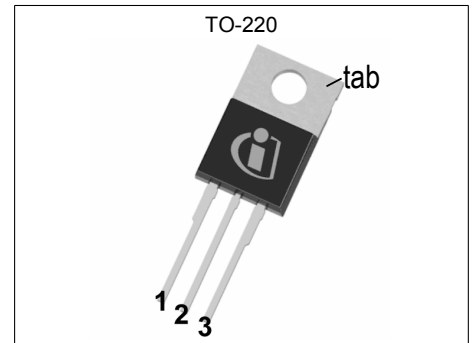
500V CoolMOS™ CE Power Transistor
IPx50R380CE

Data Sheet

Rev. 2.1
Final

1 Description

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ CE series combines the experience of the leading SJ MOSFET supplier with high class innovation while representing a cost appealing alternative compared to standard MOSFETs in target applications. The resulting devices provide all benefits of a fast switching SJ MOSFET while not sacrificing ease of use. Extremely low switching and conduction losses make switching applications even more efficient, more compact, lighter and cooler.



Features

- Extremely low losses due to very low FOM $R_{DS(on)} \cdot Q_g$ and E_{oss}
- Very high commutation ruggedness
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)

Applications

PFC stages, hard switching PWM stages and resonant switching PWM stages for e.g. PC Silverbox, LCD & PDP TV and Lighting.

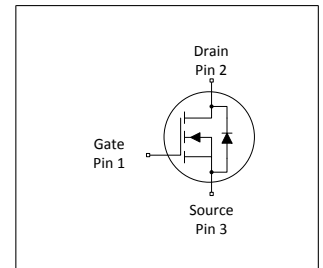


Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|----------------------|-------|------------|
| $V_{DS} @ T_{j,max}$ | 550 | V |
| $R_{DS(on),max}$ | 0.38 | Ω |
| $Q_{g,typ}$ | 24.8 | nC |
| $I_{D,pulse}$ | 32.4 | A |
| $E_{oss@400V}$ | 2.54 | μJ |
| Body diode di/dt | 500 | A/ μs |

| Type / Ordering Code | Package | Marking | Related Links |
|----------------------|-----------|---------|----------------|
| IPP50R380CE | PG-TO 220 | 5R380CE | see Appendix A |

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2 Maximum ratings

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

Table 2 Maximum ratings

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|----------------|------------|------|------------|------------------|--|
| | | Min. | Typ. | Max. | | |
| Continuous drain current ¹⁾ | I_D | - | - | 9.9 6.3 | A | $T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$ |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | - | - | 32.4 | A | $T_C = 25^\circ\text{C}$ |
| Avalanche energy, single pulse | E_{AS} | - | - | 173 | mJ | $I_D = 4\text{A}$; $V_{DD} = 50\text{V}$ |
| Avalanche energy, repetitive | E_{AR} | - | - | 0.26 | mJ | $I_D = 4\text{A}$; $V_{DD} = 50\text{V}$ |
| Avalanche current, repetitive | I_{AR} | - | - | 4.0 | A | - |
| MOSFET dv/dt ruggedness | dv/dt | - | - | 50 | V/ns | $V_{DS} = 0 \dots 400\text{V}$ |
| Gate source voltage | V_{GS} | -20 -30 | - | 20 30 | V | static; AC ($f > 1\text{ Hz}$) |
| Power dissipation (non FullPAK) TO-220 | P_{tot} | - | - | 73 | W | $T_C = 25^\circ\text{C}$ |
| Operating and storage temperature | T_j, T_{stg} | -55 | - | 150 | $^\circ\text{C}$ | - |
| Mounting torque (non FullPAK) TO-220 | - | - | - | 60 | Ncm | M3 and M3.5 screws |
| Continuous diode forward current | I_S | - | - | 8.6 | A | $T_C = 25^\circ\text{C}$ |
| Diode pulse current ²⁾ | $I_{S,pulse}$ | - | - | 32.4 | A | $T_C = 25^\circ\text{C}$ |
| Reverse diode dv/dt ³⁾ | dv/dt | - | - | 15 | V/ns | $V_{DS} = 0 \dots 400\text{V}$, $I_{SD} \leq I_S$, $T_j = 25^\circ\text{C}$, $t_{cond} < 2\mu\text{s}$ |
| Maximum diode commutation speed ³⁾ | di/dt | - | - | 500 | A/ μs | $V_{DS} = 0 \dots 400\text{V}$, $I_{SD} \leq I_S$, $T_j = 25^\circ\text{C}$, $t_{cond} < 2\mu\text{s}$ |

3 Thermal characteristics

Table 3 Thermal characteristics (non FullPAK) TO-220

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|------------|--------|------|------|--------------------|-------------------------------------|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | R_{thJC} | - | - | 1.71 | $^\circ\text{C/W}$ | - |
| Thermal resistance, junction - ambient | R_{thJA} | - | - | 62 | $^\circ\text{C/W}$ | leaded |
| Soldering temperature, wavesoldering only allowed at leads | T_{sold} | - | - | 260 | $^\circ\text{C}$ | 1.6mm (0.063 in.) from case for 10s |

¹⁾ Limited by $T_{j,max}$. Maximum duty cycle $D = 0.75$

²⁾ Pulse width t_p limited by $T_{j,max}$

³⁾ $V_{DClink} = 400\text{V}$; $V_{DS,peak} < V_{(BR)DSS}$; identical low side and high side switch with identical R_G

4 Electrical characteristics

Table 4 Static characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|----------------------------------|---------------|--------|------|------|----------|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 500 | - | - | V | $V_{GS}=0V, I_D=1mA$ |
| Gate threshold voltage | $V_{(GS)th}$ | 2.50 | 3 | 3.50 | V | $V_{DS}=V_{GS}, I_D=0.26mA$ |
| Zero gate voltage drain current | I_{DSS} | - | - | 1 | μA | $V_{DS}=500V, V_{GS}=0V, T_j=25^\circ C$ $V_{DS}=500V, V_{GS}=0V, T_j=150^\circ C$ |
| Gate-source leakage current | I_{GSS} | - | - | 100 | nA | $V_{GS}=20V, V_{DS}=0V$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 0.35 | 0.38 | Ω | $V_{GS}=13V, I_D=3.2A, T_j=25^\circ C$ $V_{GS}=13V, I_D=3.2A, T_j=150^\circ C$ |
| Gate resistance | R_G | - | 3 | - | Ω | $f=1\text{ MHz}, \text{open drain}$ |

Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|--|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | C_{iss} | - | 584 | - | pF | $V_{GS}=0V, V_{DS}=100V, f=1MHz$ |
| Output capacitance | C_{oss} | - | 40 | - | pF | $V_{GS}=0V, V_{DS}=100V, f=1MHz$ |
| Effective output capacitance, energy related ¹⁾ | $C_{o(er)}$ | - | 32 | - | pF | $V_{GS}=0V, V_{DS}=0...400V$ |
| Effective output capacitance, time related ²⁾ | $C_{o(tr)}$ | - | 133 | - | pF | $I_D=\text{constant}, V_{GS}=0V, V_{DS}=0...400V$ |
| Turn-on delay time | $t_{d(on)}$ | - | 7.2 | - | ns | $V_{DD}=400V, V_{GS}=13V, I_D=3.9A,$ $R_G=3.4\Omega$ |
| Rise time | t_r | - | 5.6 | - | ns | $V_{DD}=400V, V_{GS}=13V, I_D=3.9A,$ $R_G=3.4\Omega$ |
| Turn-off delay time | $t_{d(off)}$ | - | 35 | - | ns | $V_{DD}=400V, V_{GS}=13V, I_D=3.9A,$ $R_G=3.4\Omega$ |
| Fall time | t_f | - | 8.6 | - | ns | $V_{DD}=400V, V_{GS}=13V, I_D=3.9A,$ $R_G=3.4\Omega$ |

Table 6 Gate charge characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-----------------------|---------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | Q_{gs} | - | 3.1 | - | nC | $V_{DD}=400V, I_D=3.9A, V_{GS}=0\text{ to }10V$ |
| Gate to drain charge | Q_{gd} | - | 13.1 | - | nC | $V_{DD}=400V, I_D=3.9A, V_{GS}=0\text{ to }10V$ |
| Gate charge total | Q_g | - | 24.8 | - | nC | $V_{DD}=400V, I_D=3.9A, V_{GS}=0\text{ to }10V$ |
| Gate plateau voltage | $V_{plateau}$ | - | 5.3 | - | V | $V_{DD}=400V, I_D=3.9A, V_{GS}=0\text{ to }10V$ |

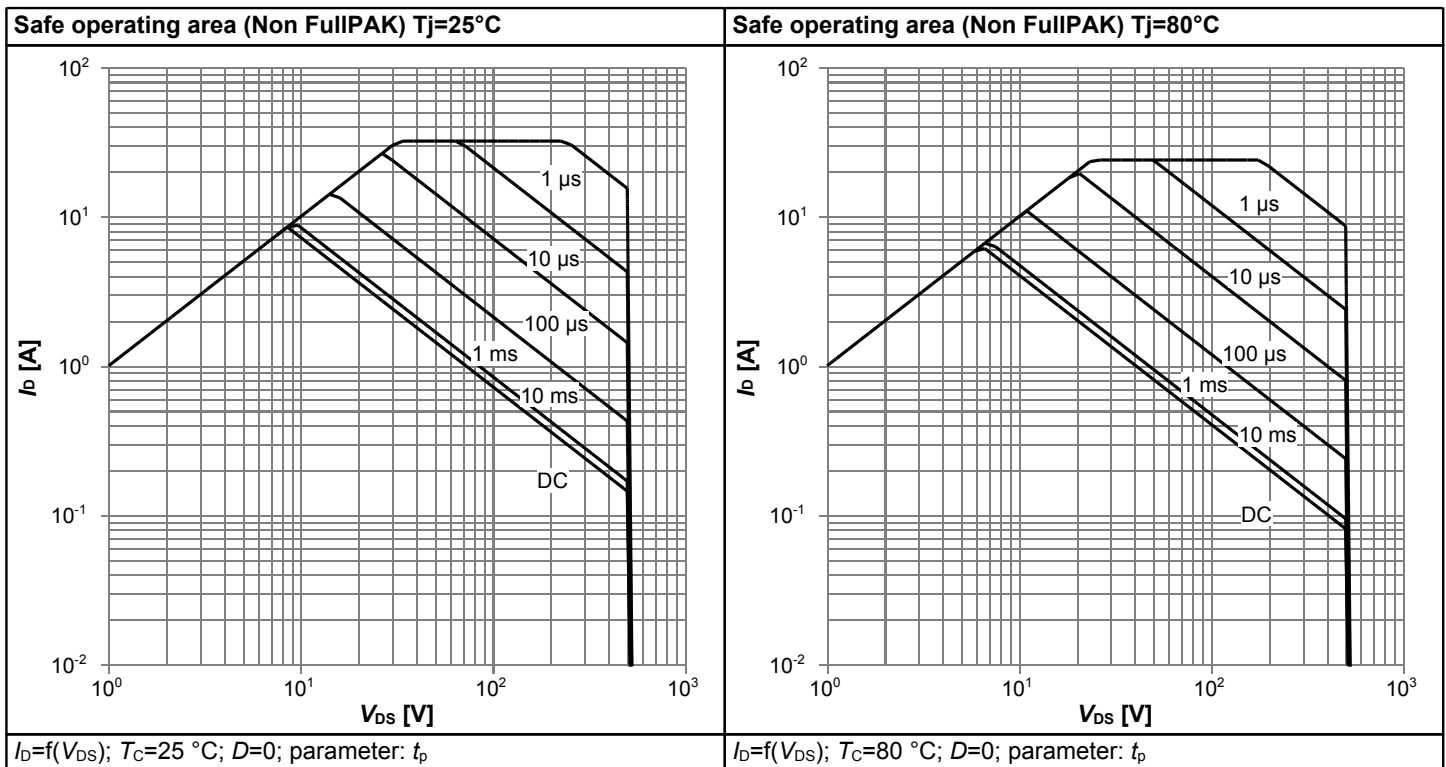
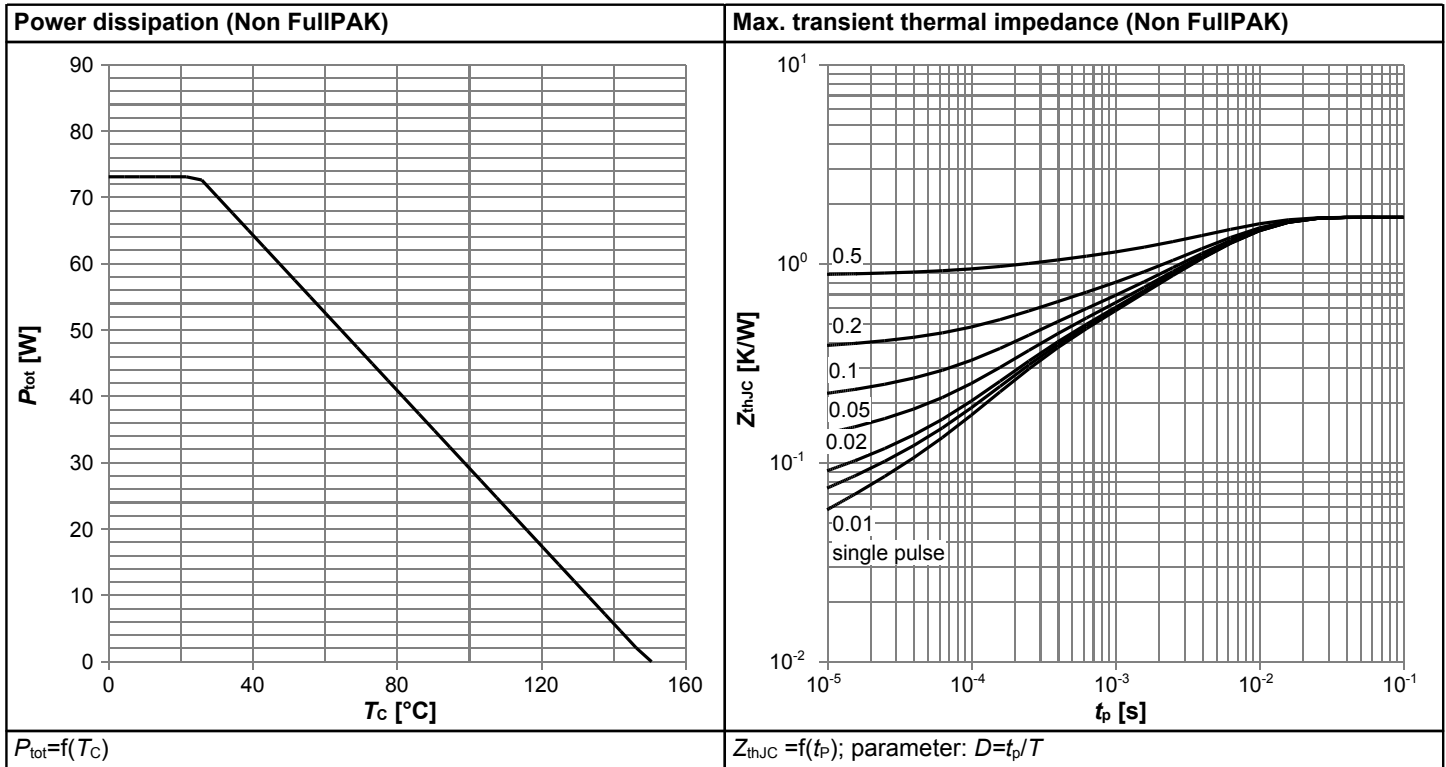
¹⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

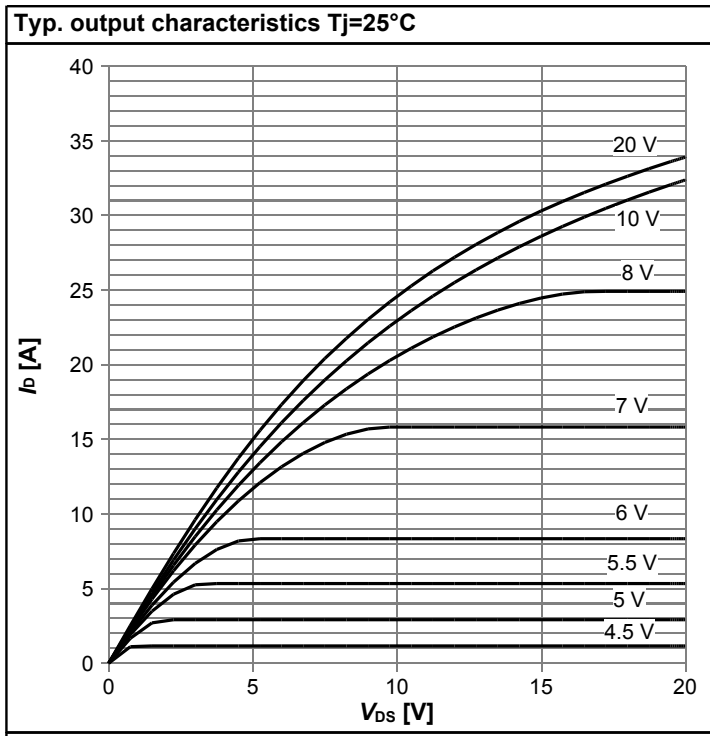
²⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

Table 7 Reverse diode characteristics

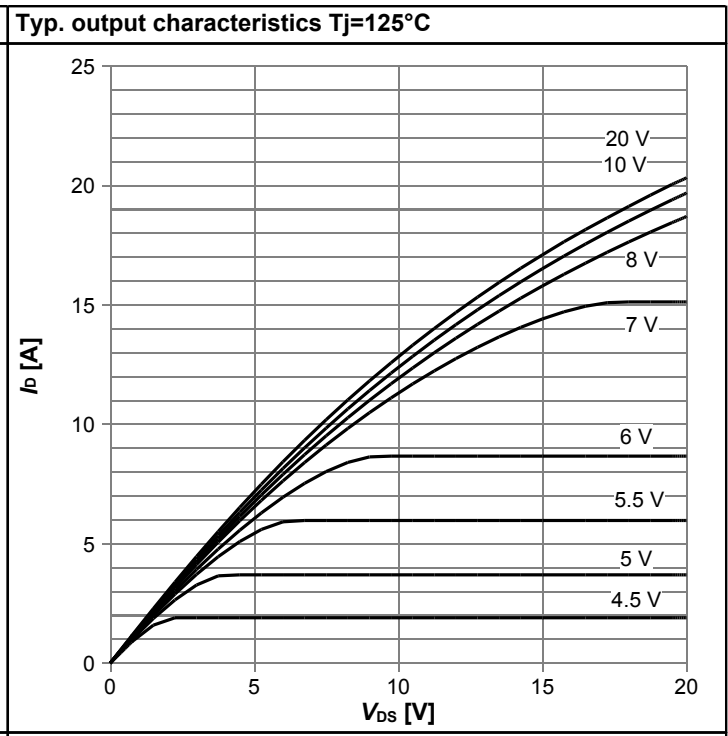
| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-------------------------------|-----------|--------|------|------|---------|--|
| | | Min. | Typ. | Max. | | |
| Diode forward voltage | V_{SD} | - | 0.85 | - | V | $V_{GS}=0V, I_F=3.9A, T_i=25^{\circ}C$ |
| Reverse recovery time | t_{rr} | - | 207 | - | ns | $V_R=400V, I_F=3.9A, di_F/dt=100A/\mu s$ |
| Reverse recovery charge | Q_{rr} | - | 1.7 | - | μC | $V_R=400V, I_F=3.9A, di_F/dt=100A/\mu s$ |
| Peak reverse recovery current | I_{rrm} | - | 15.5 | - | A | $V_R=400V, I_F=3.9A, di_F/dt=100A/\mu s$ |

5 Electrical characteristics diagrams

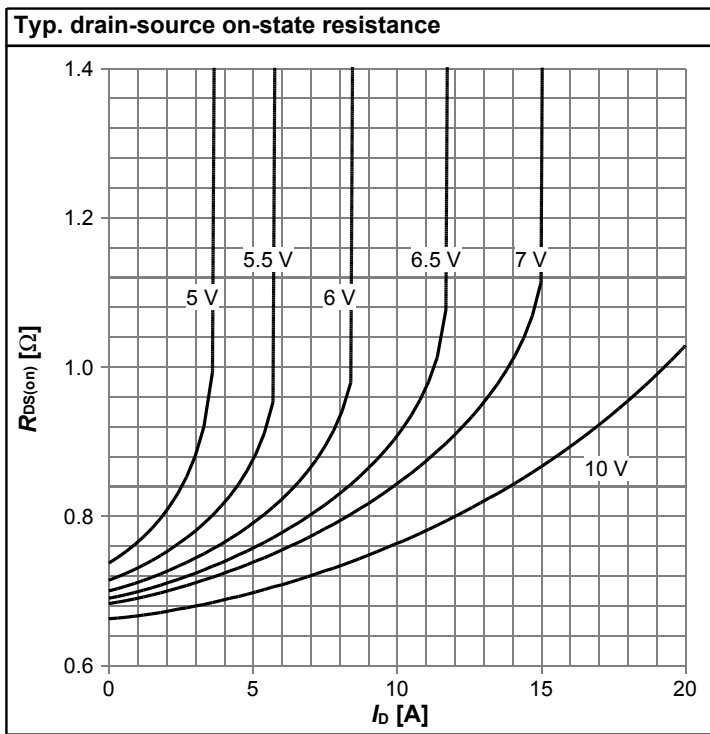




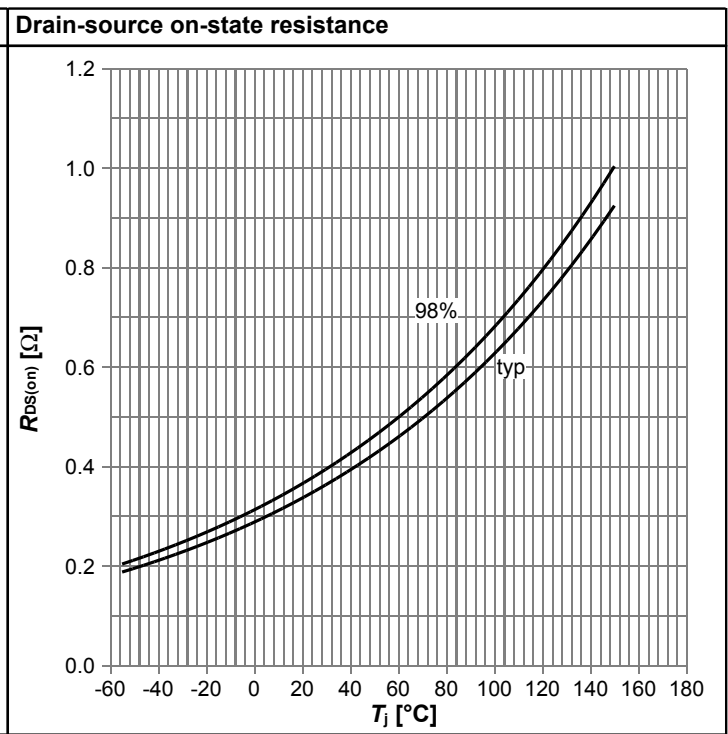
$I_D=f(V_{DS}); T_j=25^\circ\text{C};$ parameter: V_{GS}



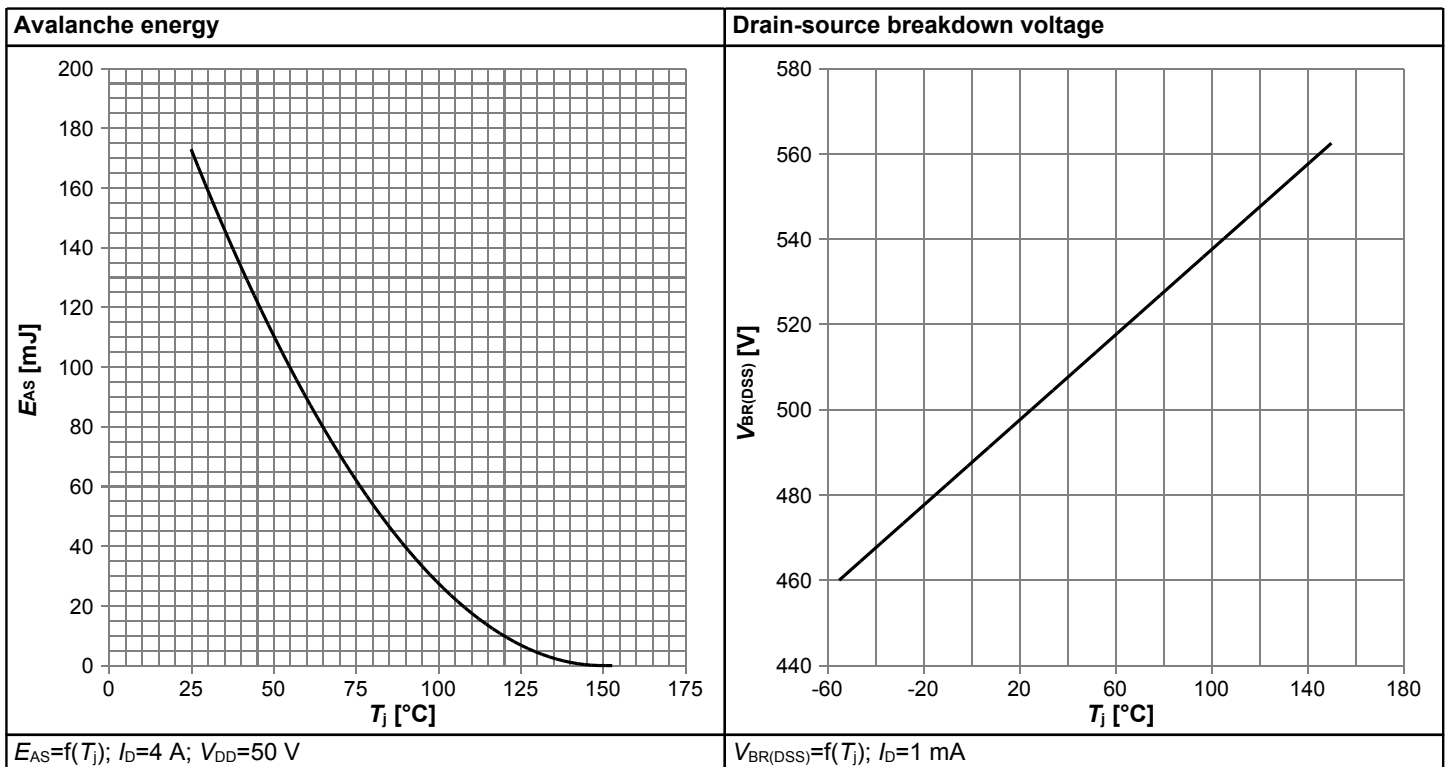
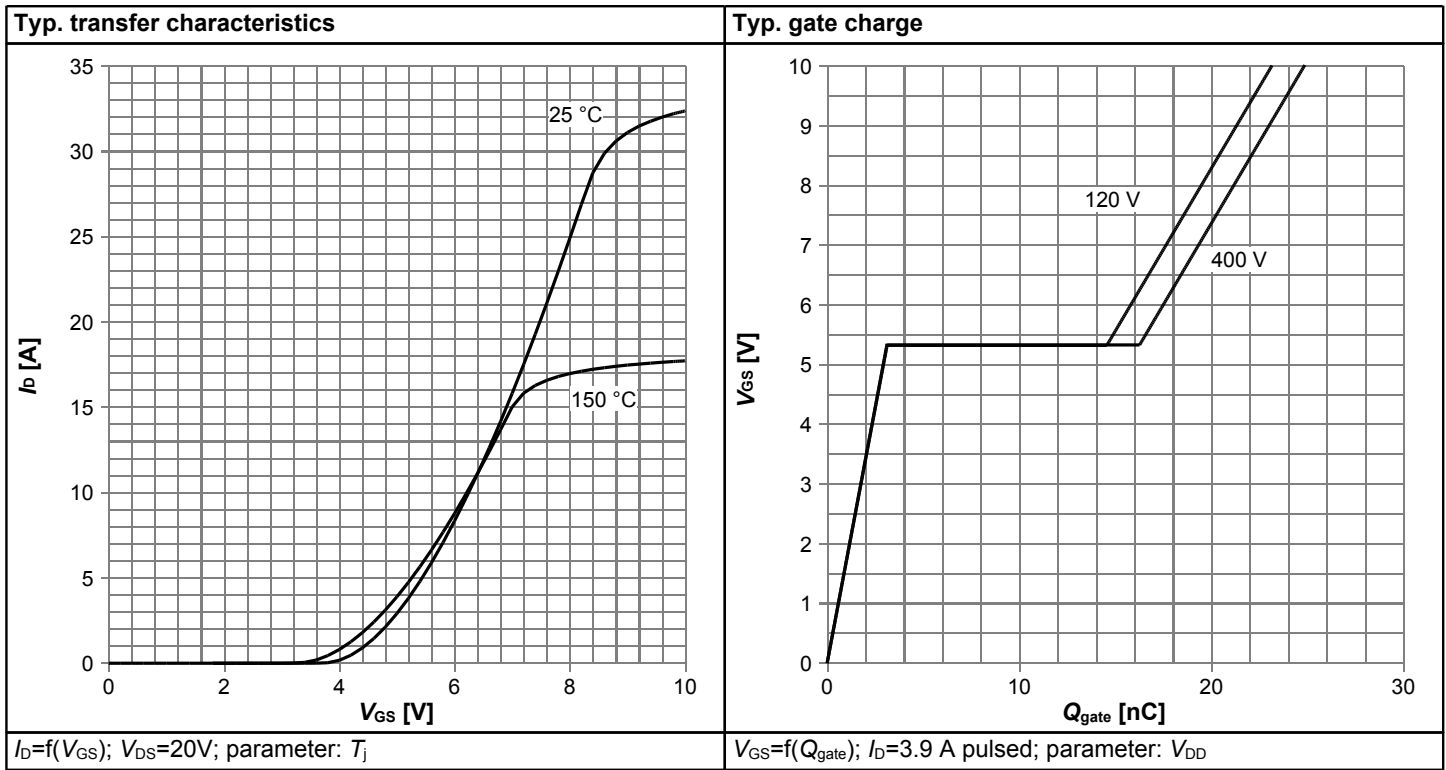
$I_D=f(V_{DS}); T_j=125^\circ\text{C};$ parameter: V_{GS}

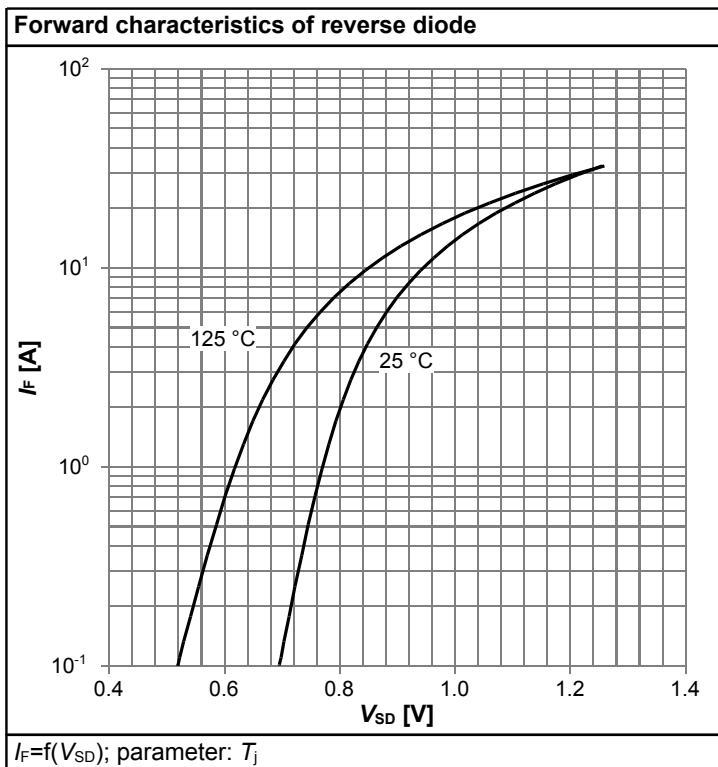
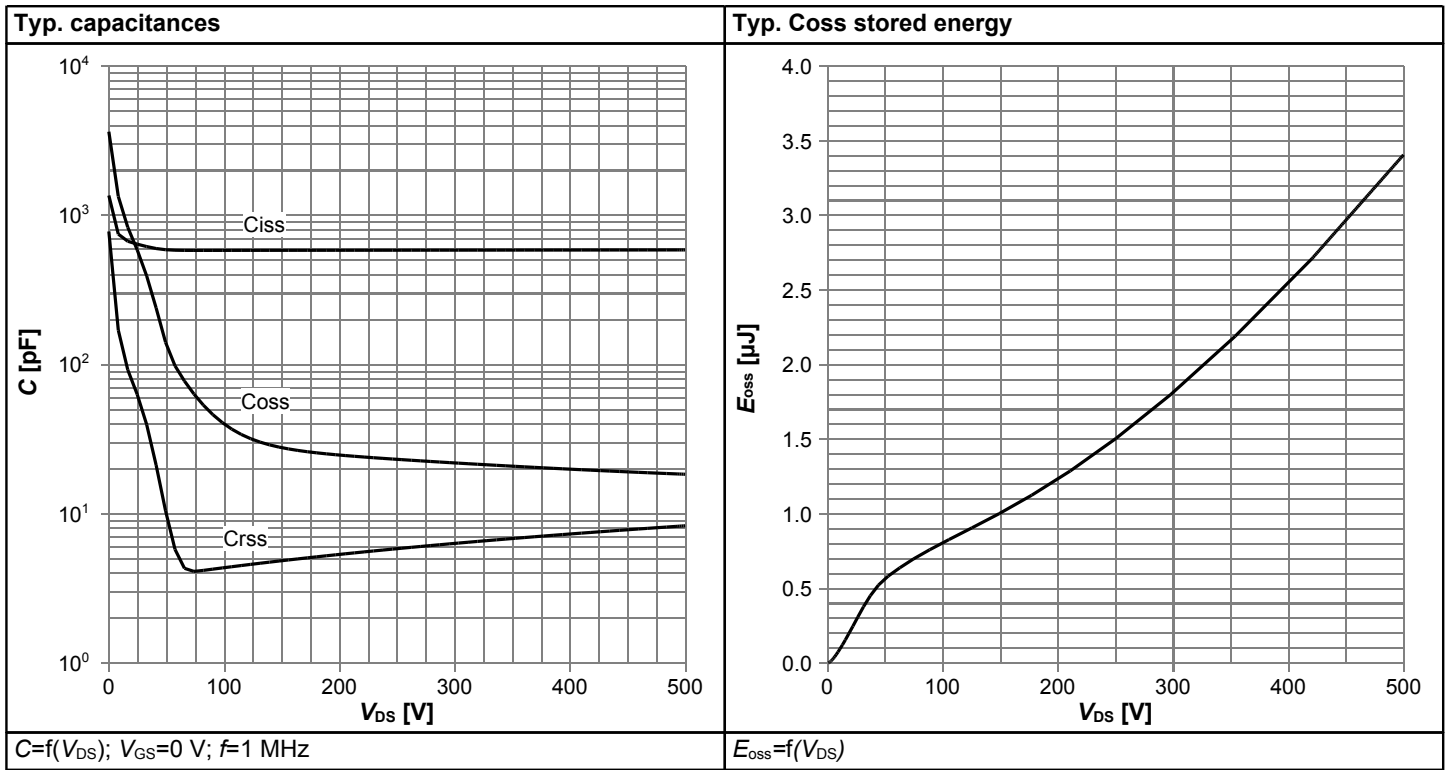


$R_{DS(on)}=f(I_D); T_j=125^\circ\text{C};$ parameter: V_{GS}

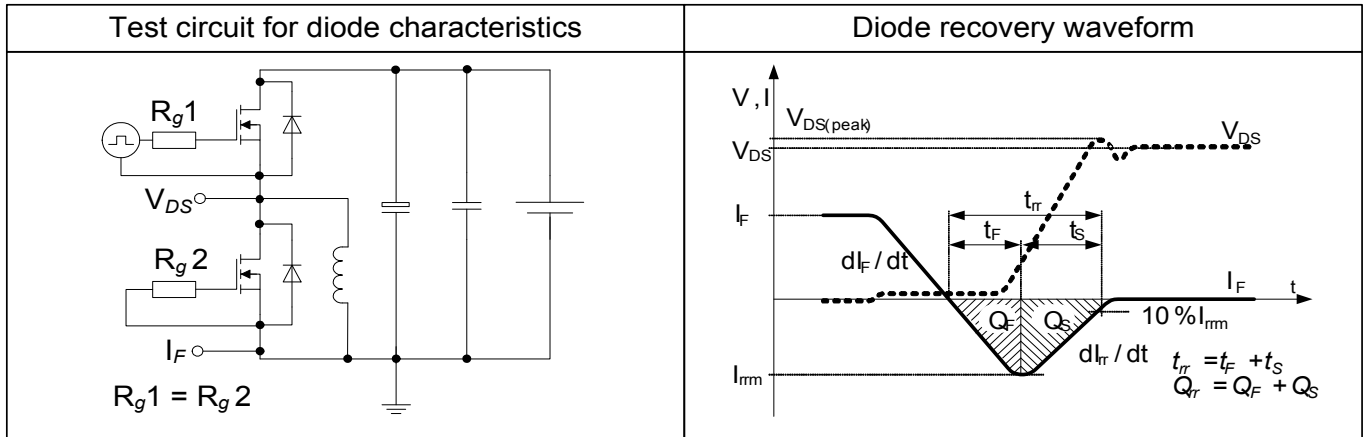
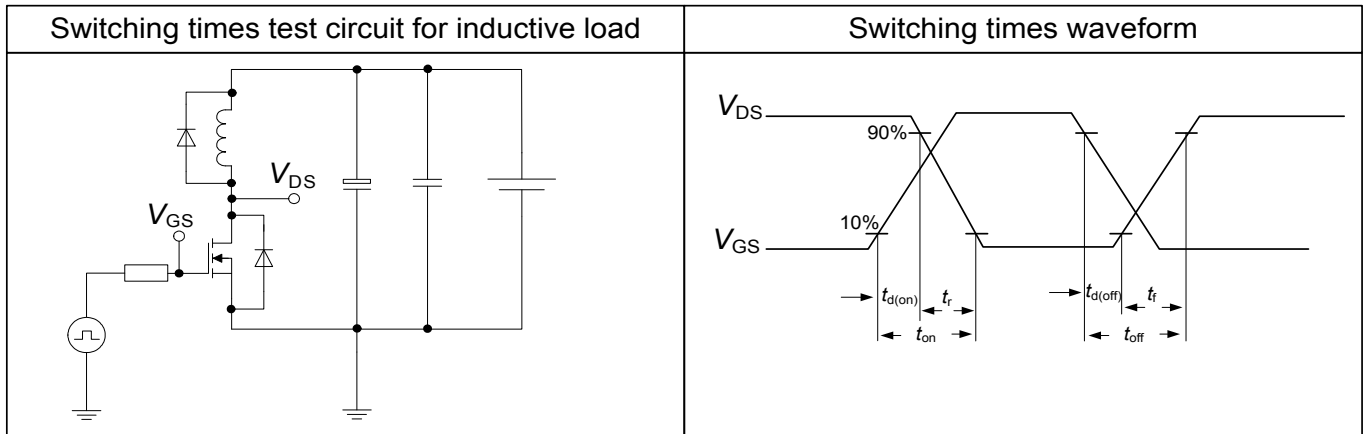
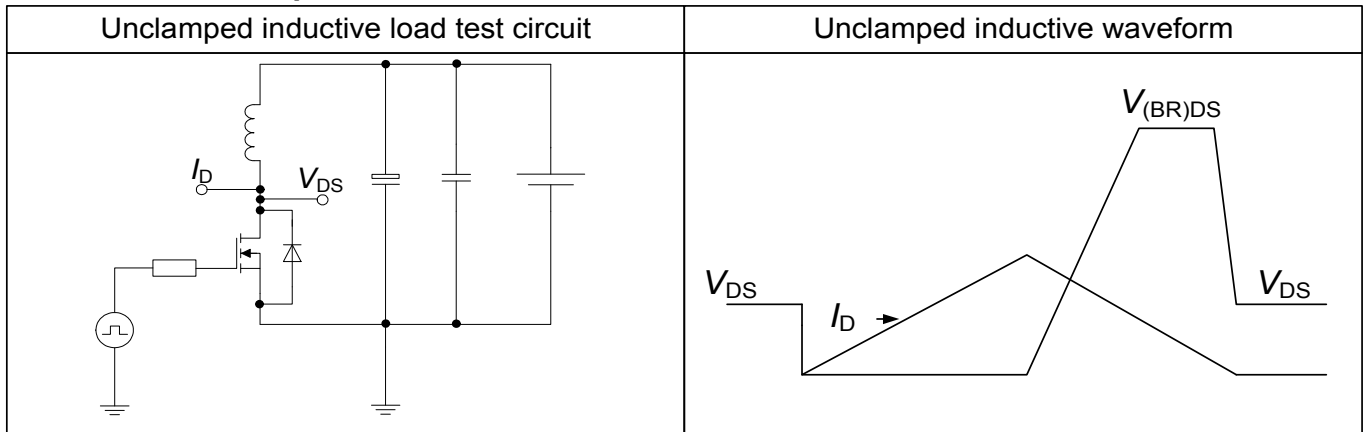


$R_{DS(on)}=f(T_j); I_D=3.2\text{ A}; V_{GS}=13\text{ V}$





6 Test Circuits

Table 8 Diode characteristics

Table 9 Switching times

Table 10 Unclamped inductive load


8 Appendix A

Table 11 Related Links

- IFX CoolMOS Webpage: www.infineon.com
- IFX Design tools: www.infineon.com

Revision History

IPP50R380CE

Revision: 2014-06-06, Rev. 2.1

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0 | 2012-08-24 | Release of final version |
| 2.1 | 2014-06-06 | Removal of TO-220FP |

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