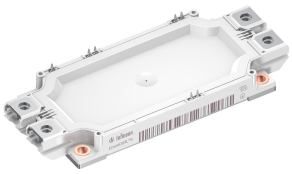
## Final datasheet

## EconoDUAL™3 module with CoolSiC™ Trench MOSFET and PressFIT / NTC



### Features

- Electrical features
  - $V_{DSS}$ = 1200 V
  - $I_{DN}$ = 500 A / $I_{DRM}$ = 1000 A
  - Integrated temperature sensor
  - Suitable Infineon gate drivers can be found under https://www.infineon.com/gdfinder
- Mechanical features
  - Standard housing
  - PressFIT contact technology
  - Isolated base plate
  - High power density

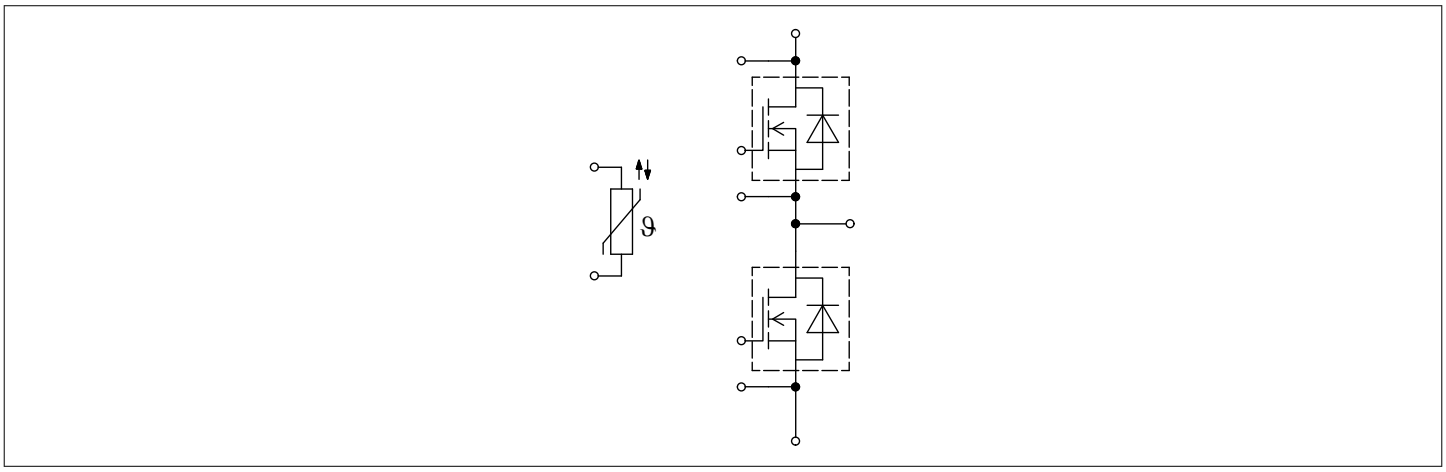
### Potential applications

- Construction, commercial, and agriculture vehicles
- Wind turbines
- Motor drives
- UPS systems
- Solar applications

### Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

### Description



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# 1 Package

**Table 1 Insulation coordination**

| Parameter | Symbol | Note or test condition | Values | Unit |
|---|---|---|---|---|
| Isolation test voltage | $V_{ISOL}$ | RMS, f = 50 Hz, *t* = 1 min | 3.4 | kV |
| Isolation test voltage NTC | $V_{ISOL(NTC)}$ | RMS, f = 50 Hz, *t* = 1 min | 3.4 | kV |
| Material of module baseplate | | | Cu | |
| Internal isolation | | basic insulation (class 1, IEC 61140) | $Al_2O_3$ | |
| Creepage distance | $d_{Creep\ nom}$ | terminal to baseplate, nom., (PD2, IEC 60664-1, Ed. 3.0) | > 15 | mm |
| Creepage distance | $d_{Creep\ min}$ | terminal to baseplate, min., (PD2, IEC 60664-1, Ed. 3.0) | 14.7 | mm |
| Creepage distance | $d_{Creep\ nom}$ | terminal to terminal, nom., (PD2, IEC 60664-1, Ed. 3.0) | 12.1 | mm |
| Creepage distance | $d_{Creep\ min}$ | terminal to terminal, min., (PD2, IEC 60664-1, Ed. 3.0) | 11.5 | mm |
| Clearance | $d_{Clear\ nom}$ | terminal to baseplate, nom. | > 12.5 | mm |
| Clearance | $d_{Clear\ min}$ | terminal to baseplate, min. | 12.5 | mm |
| Clearance | $d_{Clear\ nom}$ | terminal to terminal, nom. | 10.0 | mm |
| Clearance | $d_{Clear\ min}$ | terminal to terminal, min. | 9.6 | mm |
| Comparative tracking index | *CTI* | | > 200 | |
| Relative thermal index (electrical) | *RTI* | housing | 140 | °C |

**Table 2 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Stray inductance module | $L_{sCE}$ | | | | 20 | | nH |
| Module lead resistance, terminals - chip | $R_{CC'+EE'}$ | $T_C$ = 25 °C, per switch | | | 0.8 | | mΩ |
| Storage temperature | $T_{stg}$ | | | -40 | | 125 | °C |
| Mounting torque for module mounting | *M* | - Mounting according to valid application note | M5, Screw | 3 | | 6 | Nm |
| Terminal connection torque | *M* | - Mounting according to valid application note | M6, Screw | 3 | | 6 | Nm |
| Weight | *G* | | | | 345 | | g |

# 2 MOSFET, T1 / T2

**Table 3 Maximum rated values**

| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| Drain-source voltage | $V_{DSS}$ | | $T_{vj}$ = 25 °C | 1200 | V |
| Implemented drain current | $I_{DN}$ | | | 500 | A |
| Continuous DC drain current | $I_{DDC}$ | $T_{vj}$ = 175 °C, $V_{GS}$ = 18 V | $T_C$ = 115 °C | 420 | A |
| Repetitive peak drain current | $I_{DRM}$ | verified by design, $t_p$ limited by $T_{vjmax}$ | | 1000 | A |
| Gate-source voltage, max. transient voltage | $V_{GS}$ | $D$ < 0.01 | | -10/23 | V |
| Gate-source voltage, max. static voltage | $V_{GS}$ | | | -7/20 | V |

**Table 4 Recommended values**

| Parameter | Symbol | Note or test condition | Values | Unit |
|---|---|---|---|---|
| On-state gate voltage | $V_{GS(on)}$ | | 15...18 | V |
| Off-state gate voltage | $V_{GS(off)}$ | | -5...0 | V |

**Table 5 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Drain-source on-resistance | $R_{DS(on)}$ | $I_D$ = 500 A | $V_{GS}$ = 15 V, $T_{vj}$ = 25 °C | | 1.75 | | mΩ |
| | | | $V_{GS}$ = 18 V, $T_{vj}$ = 25 °C | | 1.46 | 1.91 | |
| | | | $V_{GS}$ = 18 V, $T_{vj}$ = 125 °C | | 2.36 | | |
| | | | $V_{GS}$ = 18 V, $T_{vj}$ = 175 °C | | 3.13 | | |
| Gate threshold voltage | $V_{GS(th)}$ | $I_D$ = 224 mA, $V_{DS}$ = $V_{GS}$, $T_{vj}$ = 25 °C, (tested after 1ms pulse at $V_{GS}$ = +20 V) | | 3.45 | 4.3 | 5.15 | V |
| Total gate charge | $Q_G$ | $V_{DD}$ = 800 V, $V_{GS}$ = -3/18 V, $T_{vj}$ = 25 °C | | | 1.6 | | µC |
| Internal gate resistor | $R_{Gint}$ | $T_{vj}$ = 25 °C | | | 0.9 | | Ω |
| Input capacitance | $C_{ISS}$ | $f$ = 100 kHz, $V_{DS}$ = 800 V, $V_{GS}$ = 0 V | $T_{vj}$ = 25 °C | | 48.4 | | nF |
| Output capacitance | $C_{OSS}$ | $f$ = 100 kHz, $V_{DS}$ = 800 V, $V_{GS}$ = 0 V | $T_{vj}$ = 25 °C | | 2.4 | | nF |
| Reverse transfer capacitance | $C_{rss}$ | $f$ = 100 kHz, $V_{DS}$ = 800 V, $V_{GS}$ = 0 V | $T_{vj}$ = 25 °C | | 0.158 | | nF |

**(table continues...)**

**Table 5 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| $C_{OSS}$ stored energy | $E_{OSS}$ | $V_{DS}$ = 800 V, $V_{GS}$ = -3/18 V, $T_{vj}$ = 25 °C | | | 945 | | µJ |
| Drain-source leakage current | $I_{DSS}$ | $V_{DS}$ = 1200 V, $V_{GS}$ = -3 V | $T_{vj}$ = 25 °C | | 0.32 | 660 | µA |
| Gate-source leakage current | $I_{GSS}$ | $V_{DS}$ = 0 V, $T_{vj}$ = 25 °C | $V_{GS}$ = 20 V | | | 400 | nA |
| Turn-on delay time (inductive load) | $t_{d\,on}$ | $I_D$ = 500 A, $R_{Gon}$ = 6.8 Ω, $V_{DD}$ = 600 V, $V_{GS}$ = -3/18 V, $t_{dead}$ = 1000 ns | $T_{vj}$ = 25 °C | | 156 | | ns |
| | | | $T_{vj}$ = 125 °C | | 172 | | |
| | | | $T_{vj}$ = 175 °C | | 182 | | |
| Rise time (inductive load) | $t_r$ | $I_D$ = 500 A, $R_{Gon}$ = 6.8 Ω, $V_{DD}$ = 600 V, $V_{GS}$ = -3/18 V, $t_{dead}$ = 1000 ns | $T_{vj}$ = 25 °C | | 261 | | ns |
| | | | $T_{vj}$ = 125 °C | | 243 | | |
| | | | $T_{vj}$ = 175 °C | | 238 | | |
| Turn-off delay time (inductive load) | $t_{d\,off}$ | $I_D$ = 500 A, $R_{Goff}$ = 3.9 Ω, $V_{DD}$ = 600 V, $V_{GS}$ = -3/18 V | $T_{vj}$ = 25 °C | | 276 | | ns |
| | | | $T_{vj}$ = 125 °C | | 305 | | |
| | | | $T_{vj}$ = 175 °C | | 319 | | |
| Fall time (inductive load) | $t_f$ | $I_D$ = 500 A, $R_{Goff}$ = 3.9 Ω, $V_{DD}$ = 600 V, $V_{GS}$ = -3/18 V | $T_{vj}$ = 25 °C | | 74 | | ns |
| | | | $T_{vj}$ = 125 °C | | 76 | | |
| | | | $T_{vj}$ = 175 °C | | 77 | | |
| Turn-on energy loss per pulse | $E_{on}$ | $I_D$ = 500 A, $V_{DD}$ = 600 V, $L_\sigma$ = 8 nH, $V_{GS}$ = -3/18 V, $R_{Gon}$ = 6.8 Ω, di/dt = 4.7 kA/µs ($T_{vj}$ = 175 °C), $t_{dead}$ = 1000 ns | $T_{vj}$ = 25 °C | | 40.2 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 38.3 | | |
| | | | $T_{vj}$ = 175 °C | | 39 | | |
| Turn-on energy loss per pulse, optimized | $E_{on,o}$ | $I_D$ = 500 A, $V_{DD}$ = 600 V, $L_\sigma$ = 8 nH, $V_{GS}$ = -3/18 V, $R_{Gon,o}$ = 2.4 Ω, di/dt = 9.3 kA/µs ($T_{vj}$ = 175 °C), $t_{dead}$ = 200 ns | $T_{vj}$ = 25 °C | | 16.8 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 17.1 | | |
| | | | $T_{vj}$ = 175 °C | | 18.1 | | |
| Turn-off energy loss per pulse | $E_{off}$ | $I_D$ = 500 A, $V_{DD}$ = 600 V, $L_\sigma$ = 8 nH, $V_{GS}$ = -3/18 V, $R_{Goff}$ = 3.9 Ω, dv/dt = 6.2 kV/µs ($T_{vj}$ = 175 °C) | $T_{vj}$ = 25 °C | | 20.4 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 21.6 | | |
| | | | $T_{vj}$ = 175 °C | | 22.2 | | |
| Thermal resistance, junction to case | $R_{thJC}$ | per MOSFET | | | | 0.0820 | K/W |
| Thermal resistance, case to heat sink | $R_{thCH}$ | per MOSFET, $\lambda_{grease}$= 1 W /(m*K) | | | 0.0300 | | K/W |
| Temperature under switching conditions | $T_{vj\,op}$ | | | -40 | | 175 | °C |

***Note**: The selection of positive and negative gate-source voltages impacts losses and the long-term behavior of the MOSFET and body diode. The design guidelines described in Application Notes AN 2018-09 and AN 2021-13 must be considered to ensure sound operation of the device over the planned lifetime.*

*Tvj op > 150°C is allowed for operation at overload conditions for MOSFET and body diode. For detailed specifications, please refer to AN 2021-13.*

# 3 Body diode (MOSFET, T1 / T2)

**Table 6 Maximum rated values**

| Parameter | Symbol | Note or test condition | | Values | Unit |
|---|---|---|---|---|---|
| DC body diode forward current | $I_{SD}$ | $T_{vj}$ = 175 °C, $V_{GS}$ = -3 V | $T_C$ = 115 °C | 200 | A |

**Table 7 Characteristic values**

| Parameter | Symbol | Note or test condition | | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| Forward voltage | $V_{SD}$ | $I_{SD}$ = 500 A, $V_{GS}$ = -3 V | $T_{vj}$ = 25 °C | | 4.14 | 5.2 | V |
| | | | $T_{vj}$ = 125 °C | | 3.88 | | |
| | | | $T_{vj}$ = 175 °C | | 3.78 | | |
| Peak reverse recovery current | $I_{rrm}$ | $I_{SD}$ = 500 A, $di_s/dt$ = 4.7 kA/µs, $V_{DD}$ = 600 V, $V_{GS}$=-3 V, $t_{dead}$ = 1000 ns | $T_{vj}$ = 25 °C | | 76 | | A |
| | | | $T_{vj}$ = 125 °C | | 114 | | |
| | | | $T_{vj}$ = 175 °C | | 148 | | |
| Recovered charge | $Q_{rr}$ | $I_{SD}$ = 500 A, $di_s/dt$ = 4.7 kA/µs, $V_{DD}$ = 600 V, $V_{GS}$=-3 V, $t_{dead}$ = 1000 ns | $T_{vj}$ = 25 °C | | 3.7 | | µC |
| | | | $T_{vj}$ = 125 °C | | 4.9 | | |
| | | | $T_{vj}$ = 175 °C | | 7 | | |
| Reverse recovery energy | $E_{rec}$ | $I_{SD}$ = 500 A, $di_s/dt$ = 4.7 kA/µs ($T_{vj}$ = 175 °C), $V_{DD}$ = 600 V, $V_{GS}$=-3 V, $t_{dead}$ = 1000 ns | $T_{vj}$ = 25 °C | | 0.12 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 0.37 | | |
| | | | $T_{vj}$ = 175 °C | | 0.67 | | |
| Reverse recovery energy, optimized | $E_{rec,o}$ | $I_{SD}$ = 500 A, $di_s/dt$ = 9.3 kA/µs ($T_{vj}$ = 175 °C), $V_{DD}$ = 600 V, $V_{GS}$ = -3 V, $t_{dead}$ = 200 ns | $T_{vj}$ = 25 °C | | 1.3 | | mJ |
| | | | $T_{vj}$ = 125 °C | | 3.8 | | |
| | | | $T_{vj}$ = 175 °C | | 5.3 | | |

# 4 NTC-Thermistor

**Table 8 Characteristic values**

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Rated resistance | $R_{25}$ | $T_{NTC}$ = 25 °C | | 5 | | kΩ |
| Deviation of $R_{100}$ | $\Delta R/R$ | $T_{NTC}$ = 100 °C, $R_{100}$ = 493 Ω | -5 | | 5 | % |

**(table continues...)**

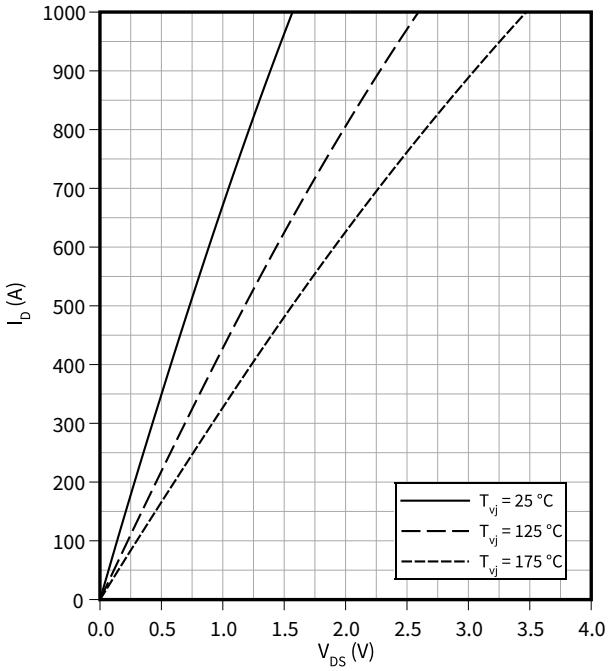
**Table 8 (continued) Characteristic values**

| Parameter | Symbol | Note or test condition | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Power dissipation | $P_{25}$ | $T_{NTC}$ = 25 °C | | | 20 | mW |
| B-value | $B_{25/50}$ | $R_2 = R_{25} \exp[B_{25/50}(1/T_2\text{-}1/(298{,}15\ K))]$ | | 3375 | | K |
| B-value | $B_{25/80}$ | $R_2 = R_{25} \exp[B_{25/80}(1/T_2\text{-}1/(298{,}15\ K))]$ | | 3411 | | K |
| B-value | $B_{25/100}$ | $R_2 = R_{25} \exp[B_{25/100}(1/T_2\text{-}1/(298{,}15\ K))]$ | | 3433 | | K |

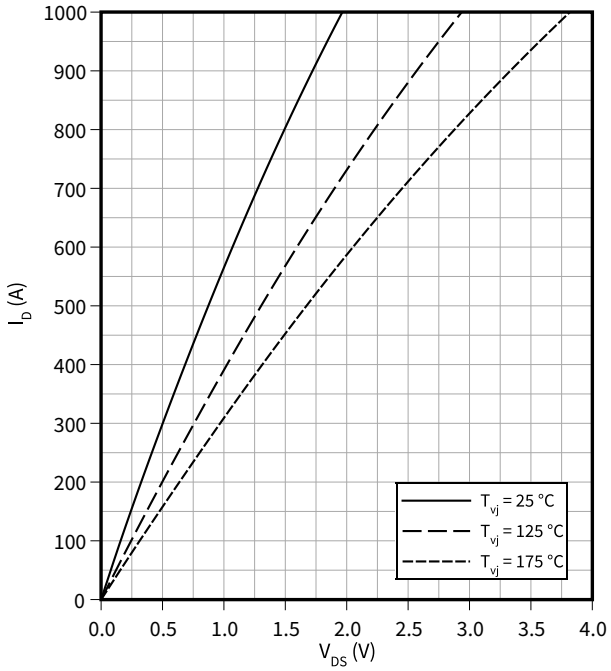
***Note**: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.*

# 5 Characteristics diagrams

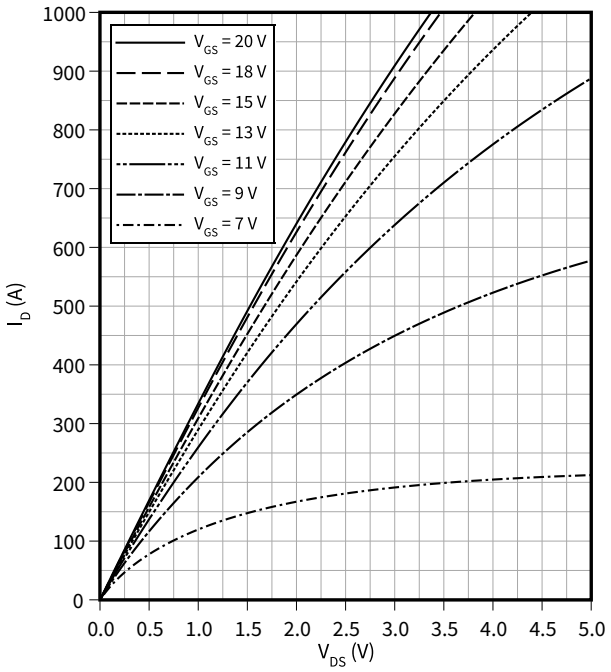
**Output characteristic (typical), MOSFET, T1 / T2**
$I_D = f(V_{DS})$
$V_{GS}$ = 18 V



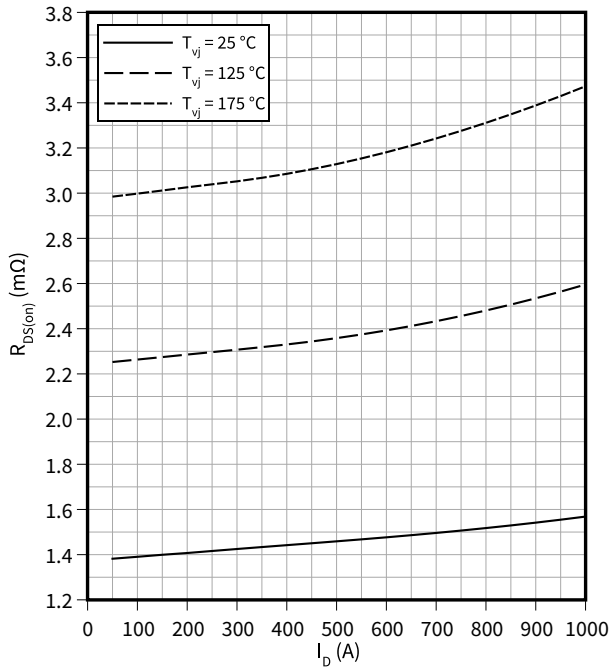

**Output characteristic (typical), MOSFET, T1 / T2**
$I_D = f(V_{DS})$
$V_{GS}$ = 15 V




**Output characteristic field (typical), MOSFET, T1 / T2**
$I_D = f(V_{DS})$
$T_{vj}$ = 175 °C

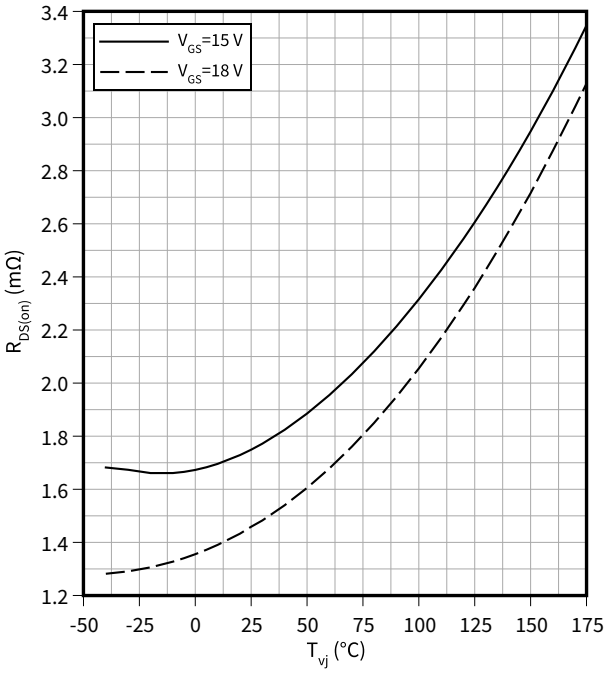



**Drain source on-resistance (typical), MOSFET, T1 / T2**
$R_{DS(on)} = f(I_D)$
$V_{GS}$ = 18 V



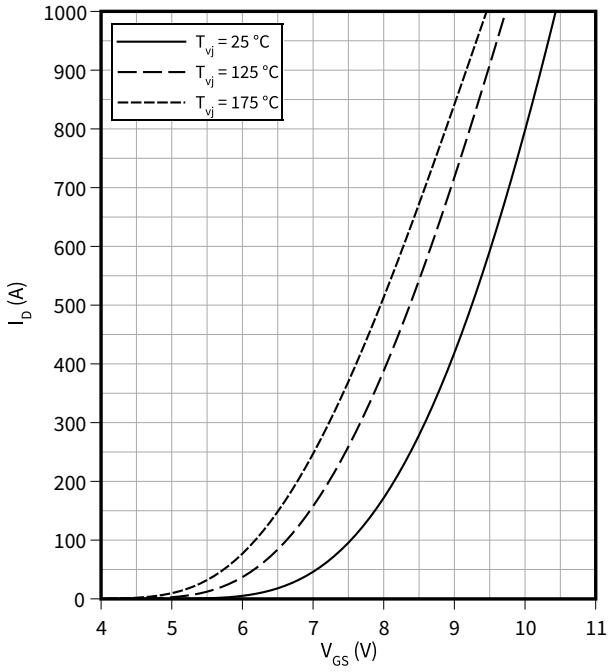
### Drain source on-resistance (typical), MOSFET, T1 / T2

$R_{DS(on)} = f(T_{vj})$
$I_D = 500$ A



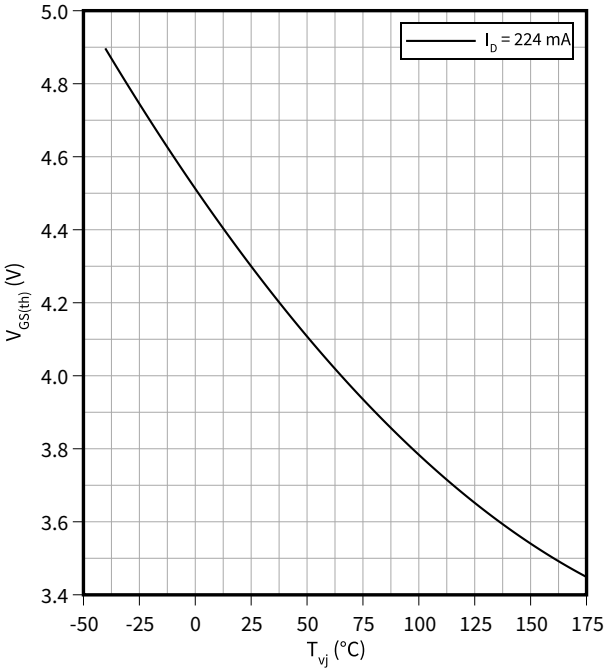

### Transfer characteristic (typical), MOSFET, T1 / T2

$I_D = f(V_{GS})$
$V_{DS} = 20$ V



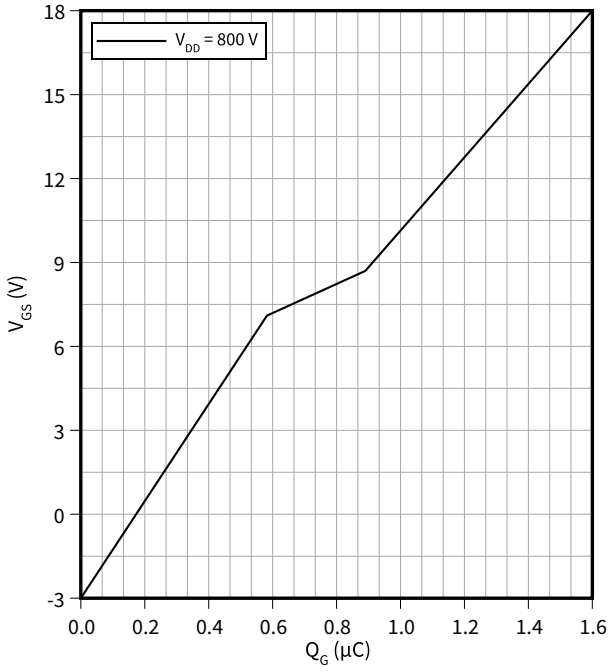

### Gate-source threshold voltage (typical), MOSFET, T1 / T2

$V_{GS(th)} = f(T_{vj})$
$V_{GS} = V_{DS}$




### Gate charge characteristic (typical), MOSFET, T1 / T2

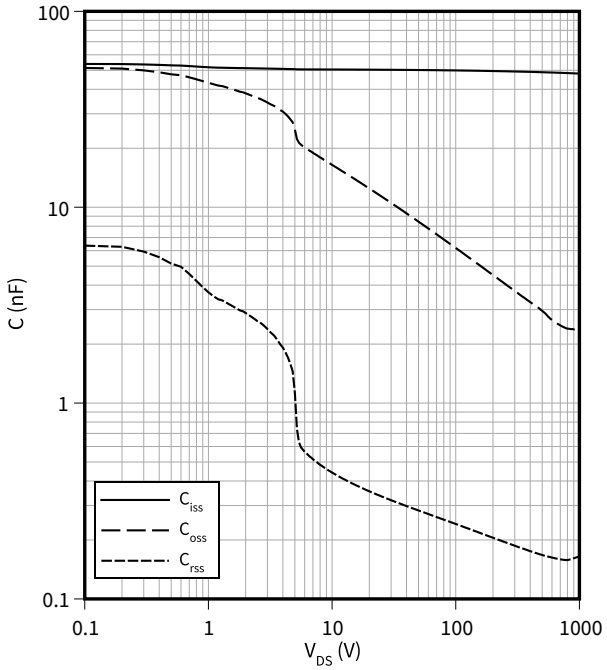
$V_{GS} = f(Q_G)$
$I_D = 500$ A, $T_{vj} = 25$ °C



### Capacity characteristic (typical), MOSFET, T1 / T2

$C = f(V_{DS})$

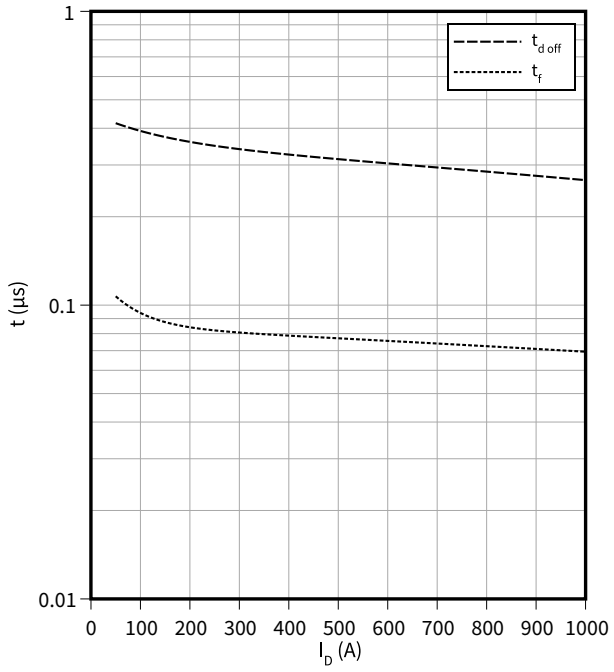
$V_{GS}$ = 0 V, f = 100 kHz, $T_{vj}$ = 25 °C




### Switching times (typical), MOSFET, T1 / T2

$t = f(I_D)$

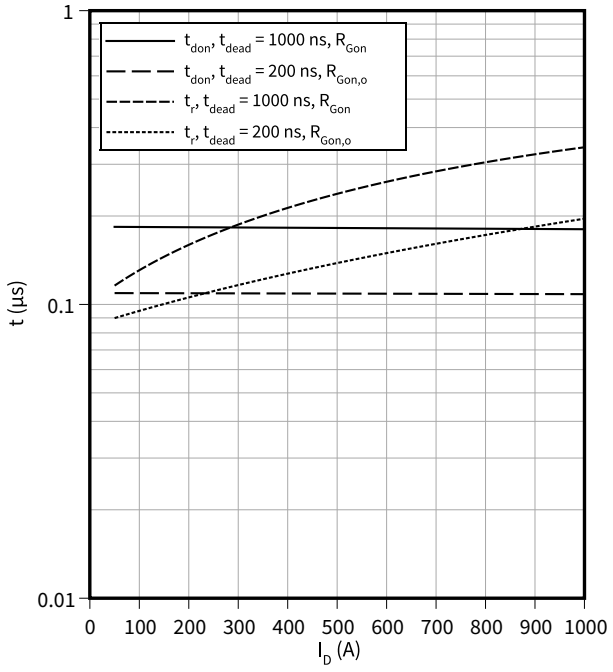
$R_{Goff}$ = 3.9 Ω, $V_{DD}$ = 600 V, $T_{vj}$ = 175 °C, $V_{GS}$ = -3/18 V




### Switching times (typical), MOSFET, T1 / T2

$t = f(I_D)$

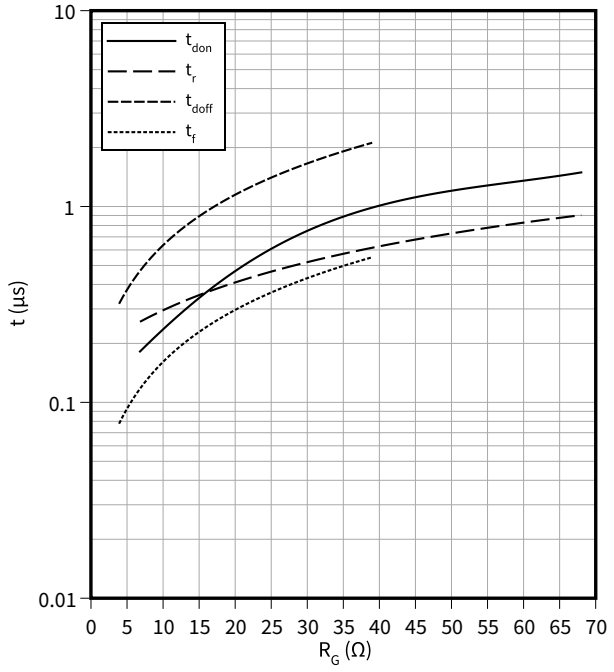
$V_{DD}$ = 600 V, $R_{Gon}$ = 6.8 Ω, $R_{Gon,o}$ = 2.4 Ω, $T_{vj}$ = 175 °C, $V_{GS}$ = -3/18 V




### Switching times (typical), MOSFET, T1 / T2

$t = f(R_G)$

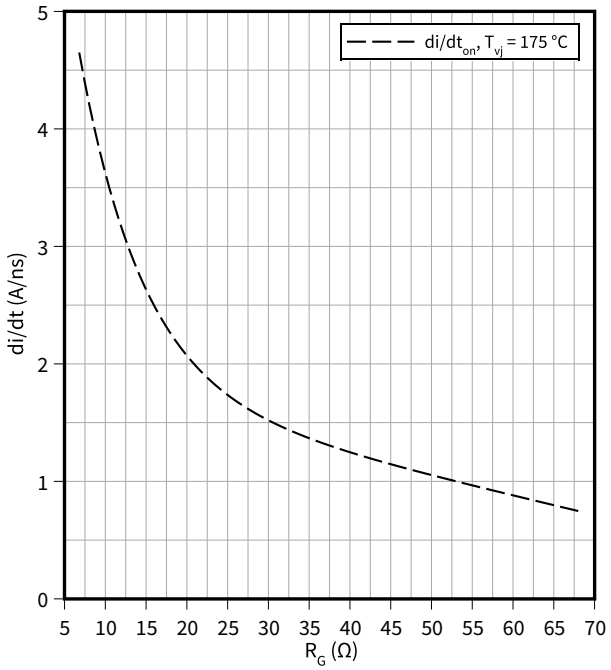
$V_{DD}$ = 600 V, $t_{dead}$ = 1000 ns, $I_D$ = 500 A, $T_{vj}$ = 175 °C, $V_{GS}$ = -3/18 V



### Current slope (typical), MOSFET, T1 / T2

di/dt = f($R_G$)

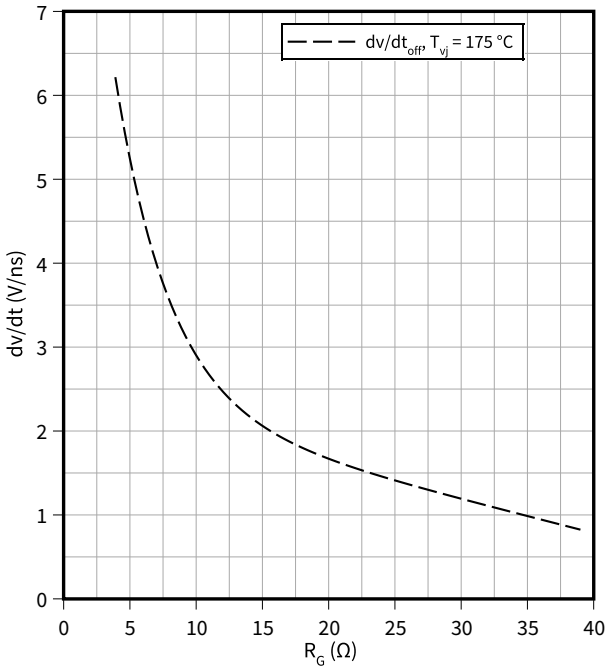
$V_{DD}$ = 600 V, $I_D$ = 500 A, $V_{GS}$ = -3/18 V




### Voltage slope (typical), MOSFET, T1 / T2

dv/dt = f($R_G$)

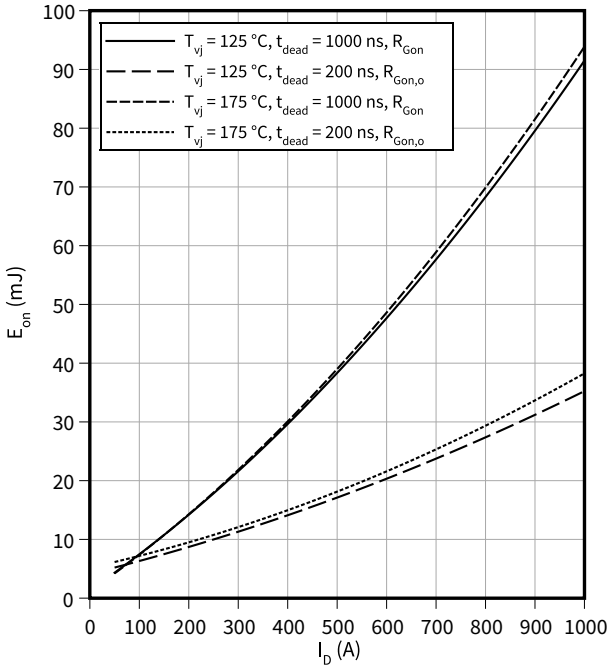
$V_{DD}$ = 600 V, $I_D$ = 500 A, $V_{GS}$ = -3/18 V




### Switching losses (typical), MOSFET, T1 / T2

$E_{on}$ = f($I_D$)

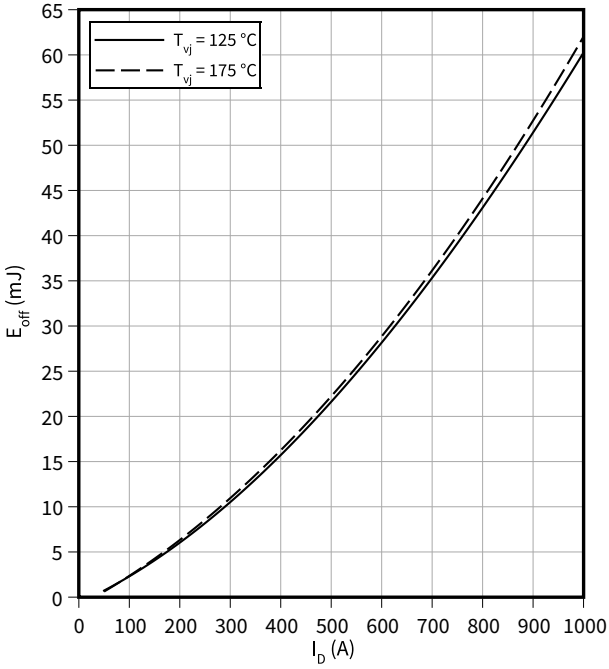
$V_{DD}$ = 600 V, $R_{Gon}$ = 6.8 Ω, $R_{Gon,o}$ = 2.4 Ω, $V_{GS}$ = -3/18 V




### Switching losses (typical), MOSFET, T1 / T2

$E_{off}$ = f($I_D$)

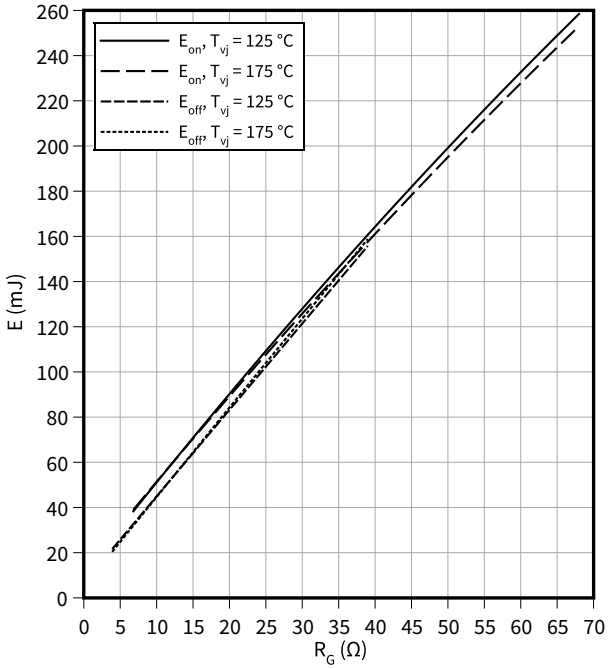
$R_{Goff}$ = 3.9 Ω, $V_{DD}$ = 600 V, $V_{GS}$ = -3/18 V



### Switching losses (typical), MOSFET, T1 / T2

$E = f(R_G)$

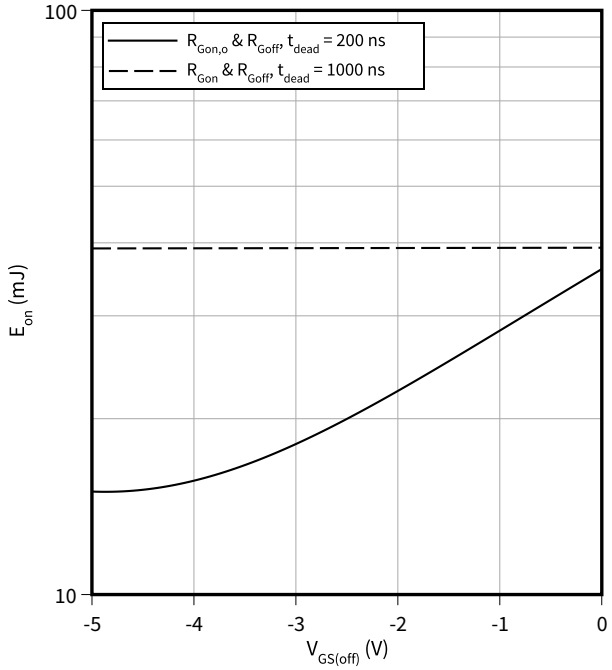
$V_{DD}$ = 600 V, $t_{dead}$ = 1000 ns, $I_D$ = 500 A, $V_{GS}$ = -3/18 V




### Switching losses (typical), MOSFET, T1 / T2

$E_{on} = f(V_{GS(off)})$

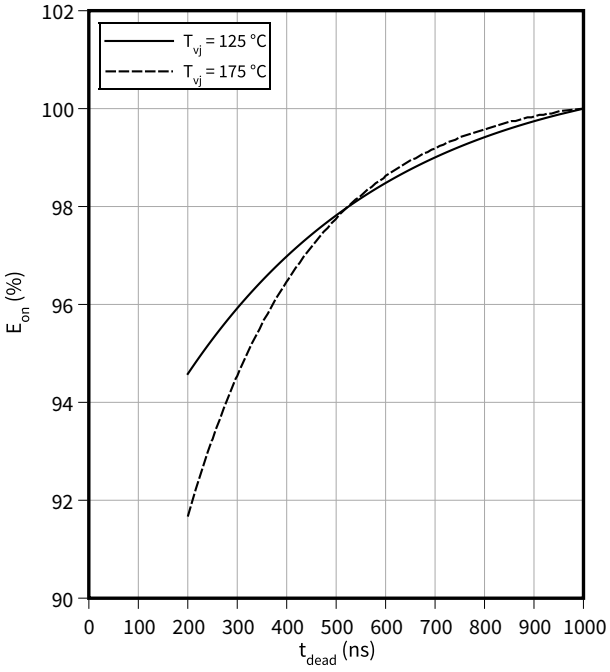
$R_{Goff}$ = 3.9 Ω, $V_{DD}$ = 600 V, $R_{Gon}$ = 6.8 Ω, $V_{GS(on)}$ = 18 V, $I_D$ = 500 A, $R_{Gon,o}$ = 2.4 Ω, $T_{vj}$ = 175 °C




### Switching losses (typical), MOSFET, T1 / T2

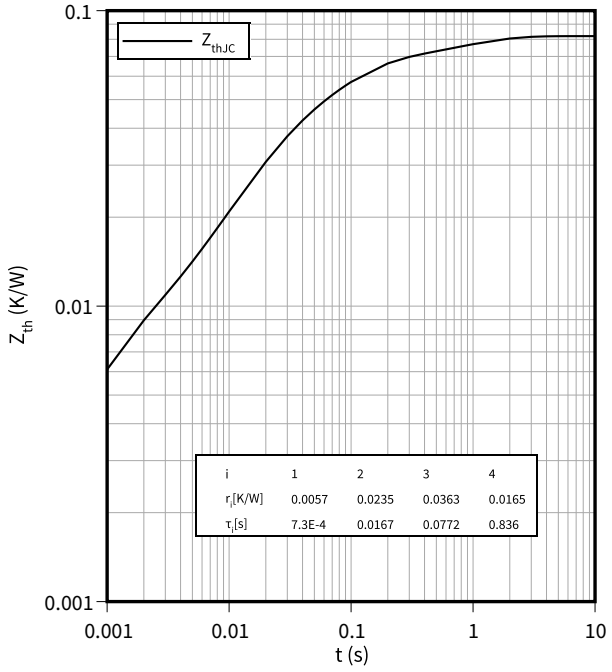
$E_{on} = f(t_{dead})$

$R_{Gon}$ = 6.8 Ω, $I_D$ = 500 A, $V_{DD}$ = 600 V, $V_{GS}$ = -3/18 V



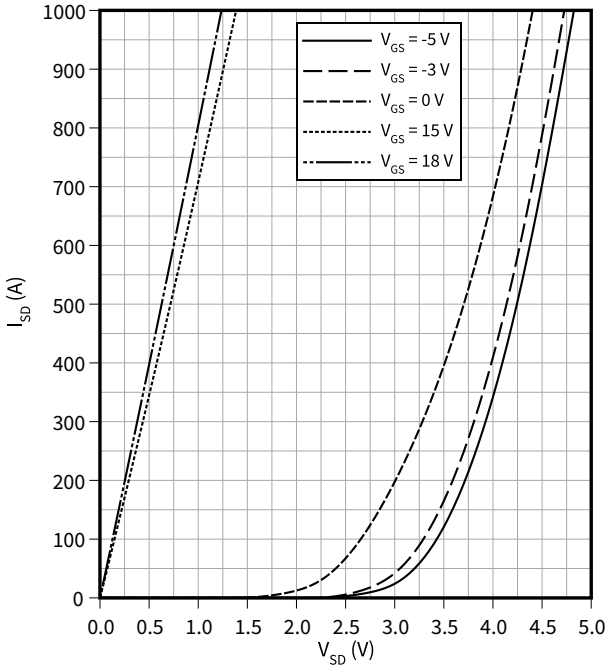

### Transient thermal impedance, MOSFET, T1 / T2

$Z_{th} = f(t)$



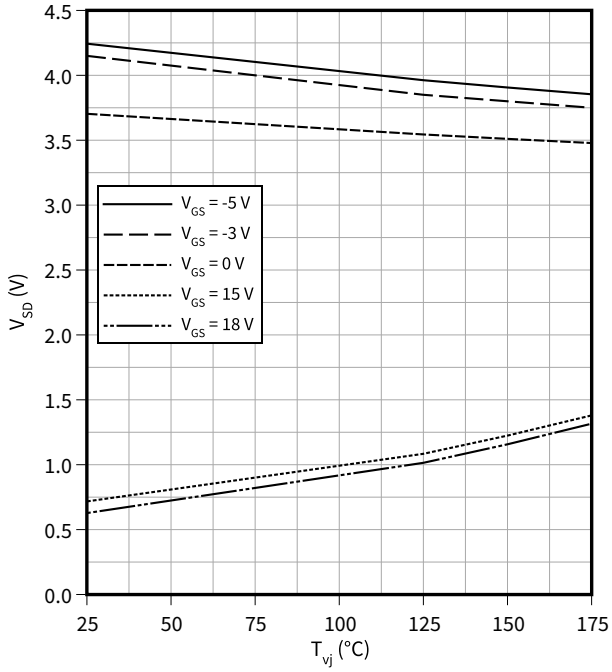
### Forward characteristic body diode (typical), MOSFET, T1 / T2

$I_{SD} = f(V_{SD})$
$T_{vj} = 25\ °C$



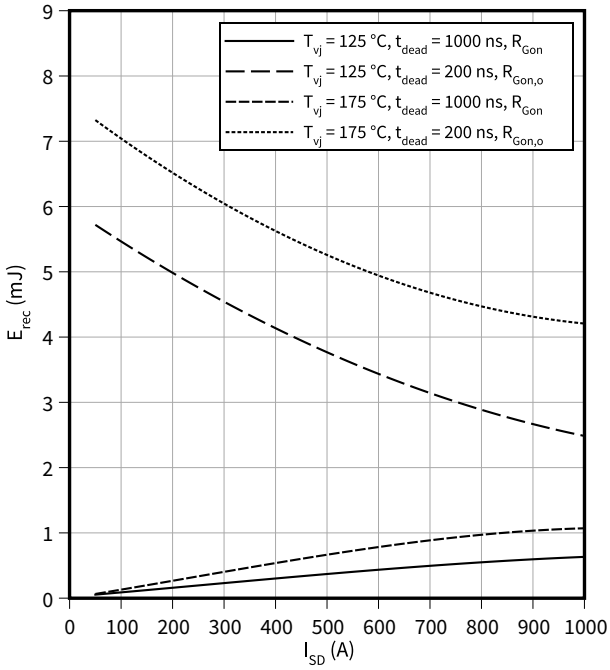

### Forward voltage of body diode (typical), MOSFET, T1 / T2

$V_{SD} = f(T_{vj})$
$I_{SD} = 500\ A$



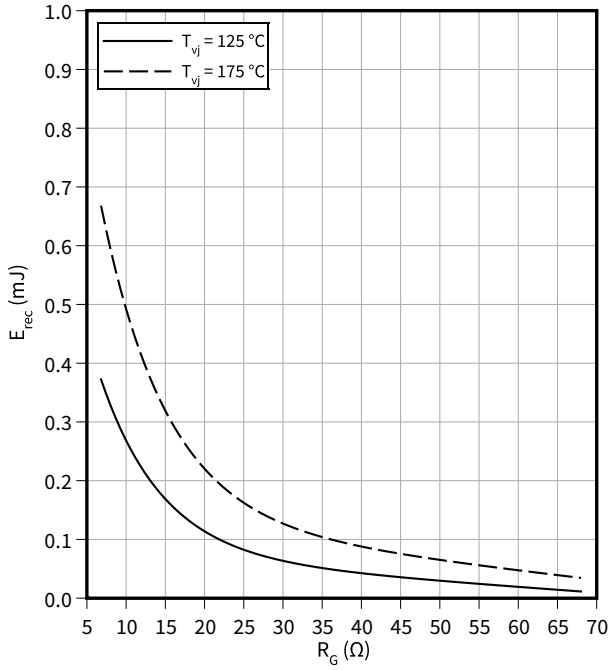

### Switching losses body diode (typical), MOSFET, T1 / T2

$E_{rec} = f(I_{SD})$
$R_{Gon} = 6.8\ \Omega$, $R_{Gon,o} = 2.4\ \Omega$, $V_{DD} = 600\ V$




### Switching losses body diode (typical), MOSFET, T1 / T2

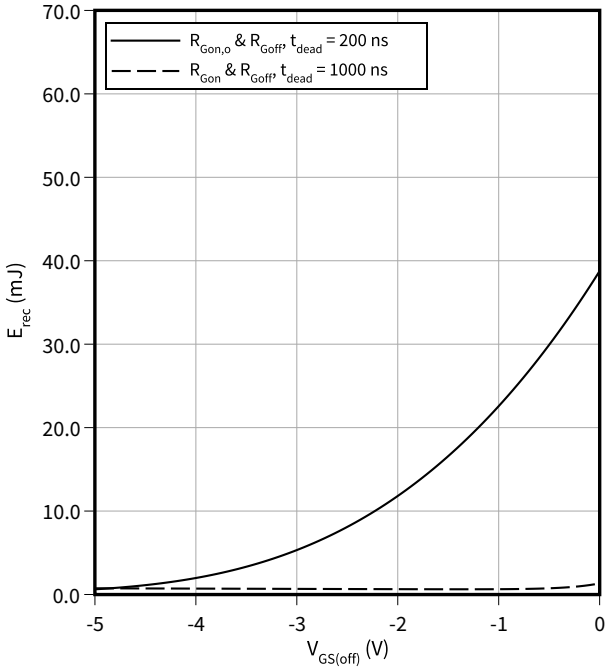
$E_{rec} = f(R_G)$
$t_{dead} = 1000\ ns$, $I_{SD} = 500\ A$, $V_{DD} = 600\ V$



### Switching losses body diode (typical), MOSFET, T1 / T2

$E_{rec} = f(V_{GS(off)})$

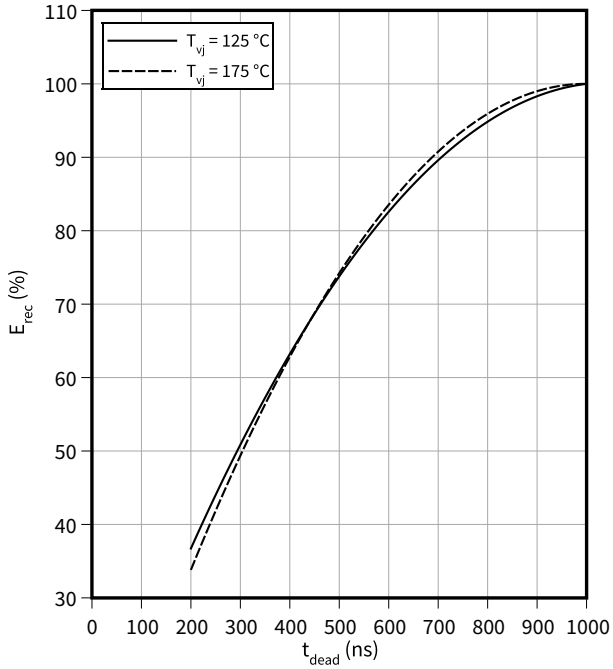
$R_{Goff}$ = 3.9 Ω, $R_{Gon}$ = 6.8 Ω, $V_{GS(on)}$ = 18 V, $I_{SD}$ = 500 A, $R_{Gon,o}$ = 2.4 Ω, $V_{DD}$ = 600 V, $T_{vj}$ = 175 °C




### Switching losses body diode (typical), MOSFET, T1 / T2

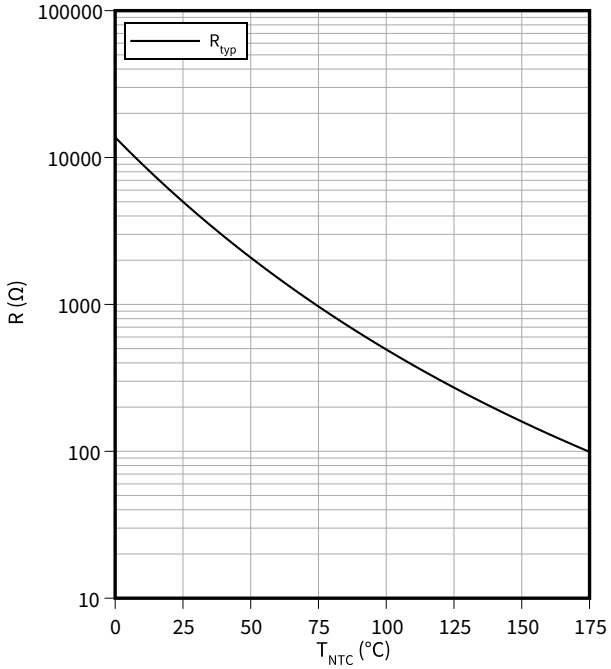
$E_{rec} = f(t_{dead})$

$R_{Gon}$ = 6.8 Ω, $I_D$ = 500 A, $V_{DD}$ = 600 V, $V_{GS}$ = -3/18 V




### Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



# 6 Circuit diagram

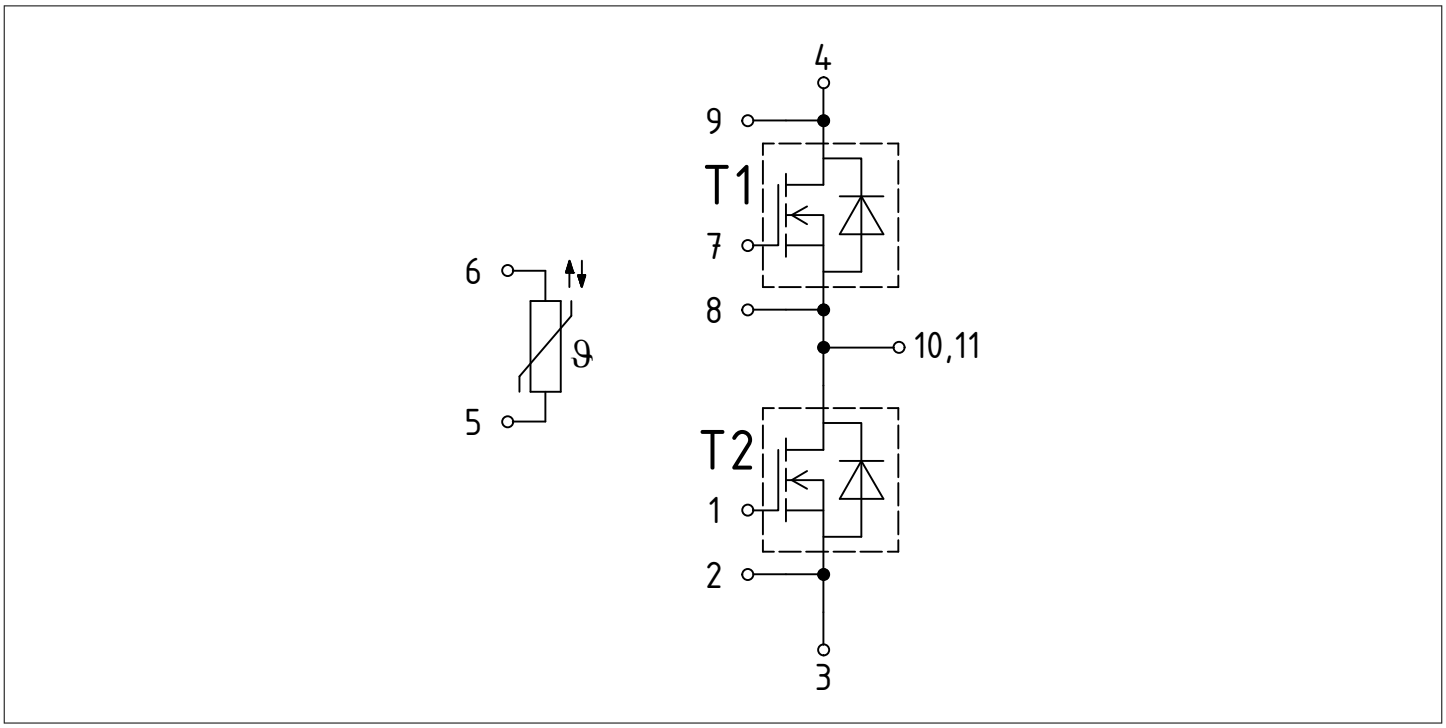
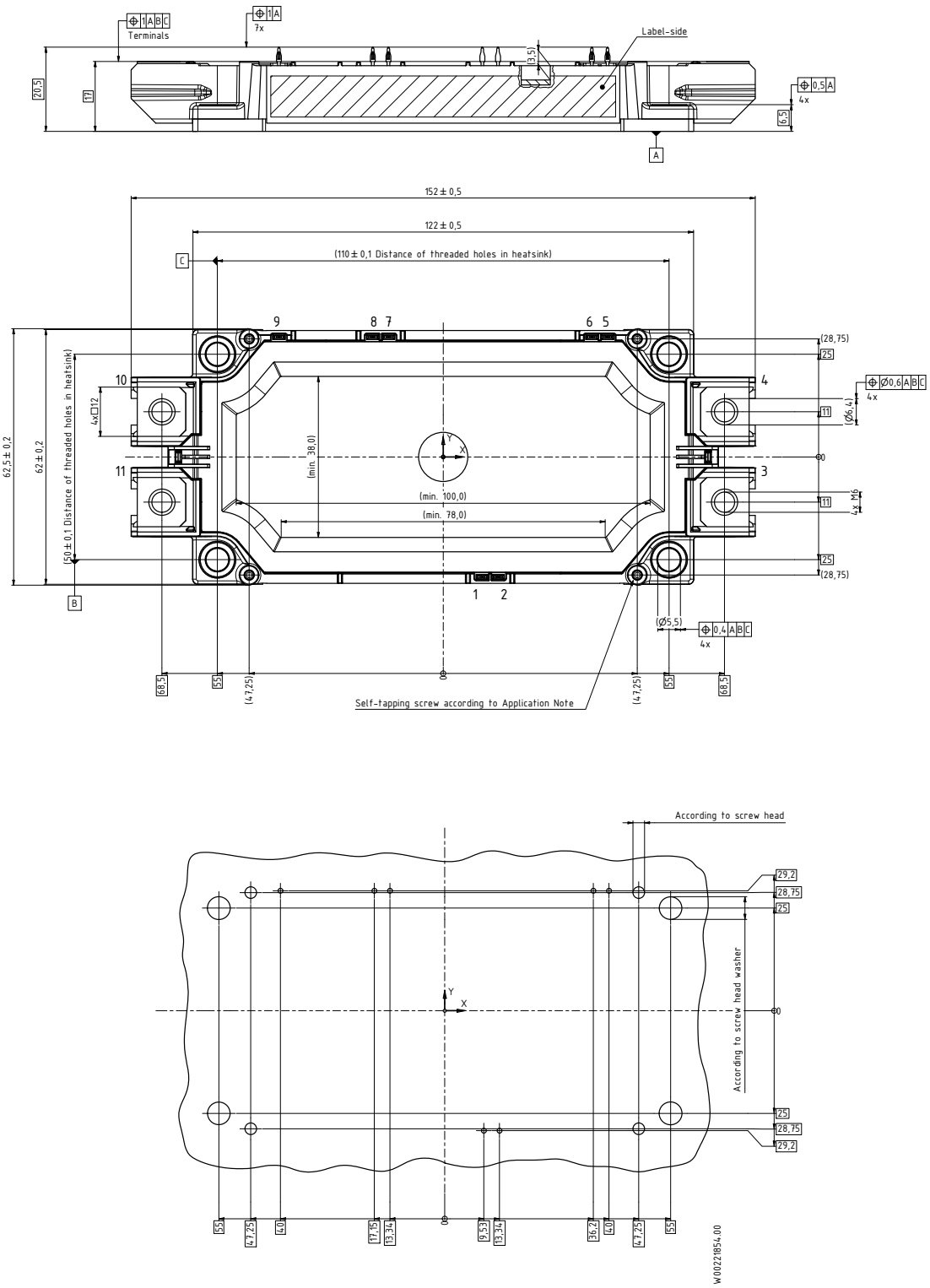



**Figure 1**

# 7 Package outlines




Tolerance of PCB hole pattern Ø 0,05

For PressFIT pin and solder pin: Details about hole specification for contacts refer to AN2006-05

*Dimensions according to ISO 14405 (GG) (Method of least squares (LSQ)).*
*Reference D and E defined with (GG)*
*ISO 8015 – Independency principle*

**Figure 2**

# 8 Module label code

| Module label code | | | |
|---|---|---|---|
| Code format | Data Matrix | | Barcode Code128 |
| Encoding | ASCII text | | Code Set A |
| Symbol size | 16x16 | | 23 digits |
| Standard | IEC24720 and IEC16022 | | IEC8859-1 |
| Code content | *Content*<br>Module serial number<br>Module material number<br>Production order number<br>Date code (production year)<br>Date code (production week) | *Digit*<br>1 – 5<br>6 - 11<br>12 - 19<br>20 – 21<br>22 – 23 | *Example*<br>71549<br>142846<br>55054991<br>15<br>30 |
| Example | 7154914284655054991530 | | 7154914284655054991530 |

**Figure 3**

## Revision history

| Document revision | Date of release | Description of changes |
|---|---|---|
| 0.10 | 2024-03-20 | Initial version |
| 0.20 | 2024-08-28 | Target datasheet |
| 1.00 | 2024-11-11 | Final datasheet |
| 1.01 | 2024-12-10 | General update |

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