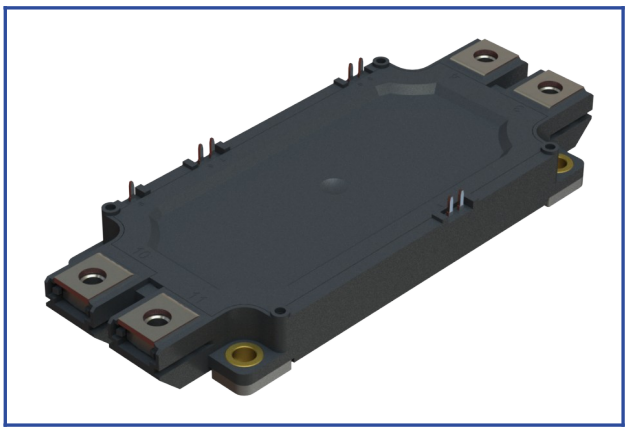
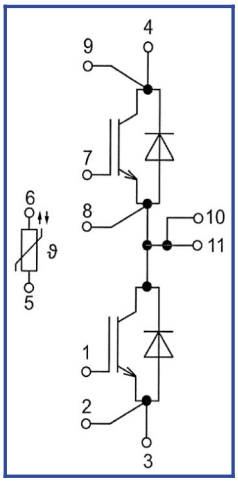
## Low Inductance IGBT Module with 17 mm Height Housing — 1700 V 750 A






### Chip features

- IGBT chip
  - low $V_{CE(sat)}$ and $E_{off}$ value
  - 10 µs short circuit duration at 150°C
  - square RBSOA of 2x$I_C$
- FRD chip
  - fast and soft reverse recovery
  - low voltage drop

### Design features

- copper baseplate
- $Si_3N_4$ DBC substrate
- ultrasonic welded power terminals
- improved thermal cycling
- RoHS compliant
- low inductance

### Typical application

- AC motor drives
- solar inverters
- air conditioning
- high power converters and UPS
- Inverters for wind energy converters

## Maximum rated values

| Definition | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| **IGBT** | | | | |
| Collector-Emitter voltage | $V_{CES}$ | $V_{GE}$ = 0. | 1700 | V |
| Maximum allowable collector current (continuous) | $I_{C\ 25}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 25°C. | 981 | A |
| | $I_{C\ 80}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 80°C. | 750 | A |
| Repetitive peak collector current*1 | $I_{CRM}$ | $I_{CRM}$ = 3 x $I_{C\ nom}$; $t_p$ = 1 ms. | 2250 | A |
| Short-circuit duration | $t_{psc}$ | $T_{vj}$ = 25°C; $V_{GE}$ = ±15 V; $V_{CE}$ = 720 V; $R_{G\ on}$ = $R_{G\ off}$ = 1.5 Ω. | 10 | µs |
| | | $T_{vj}$ = 150°C; $V_{GE}$ = ±15 V; $V_{CE}$ = 720 V; $R_{G\ on}$ = $R_{G\ off}$ = 1.5 Ω. | 10 | |
| Gate-Emitter voltage | $V_{GES}$ | | ±20 | V |
| Junction operating temperature | $T_{vj\ (op)}$ | | -40…+150 | °C |
| **Inverse diode** | | | | |
| Repetitive peak reverse voltage | $V_{RRM}$ | $V_{GE}$ = 0 V. | 1700 | V |
| Maximum allowable forward current (continuous) | $I_{F\ 25}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 25°C. | 698 | A |
| | $I_{F\ 80}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 80°C. | 523 | A |
| Repetitive peak forward current*1 | $I_{FRM}$ | $I_{FRM}$ = 3 x $I_{F\ nom}$; $t_p$ = 1 ms. | 2250 | A |
| Junction operating temperature | $T_{vj\ (op)}$ | | -40…+150 | °C |
| **Module** | | | | |
| Storage temperature | $T_{stg}$ | | -40…+50 | °C |
| Isolation voltage | $V_{isol}$ | AC sin 50 Hz; t = 1 min. | 4000 | V |

*1 Pulse width and repetition rate should be such that device junction temperature does not exceed maximum $T_{vj}$ rating

## Characteristics

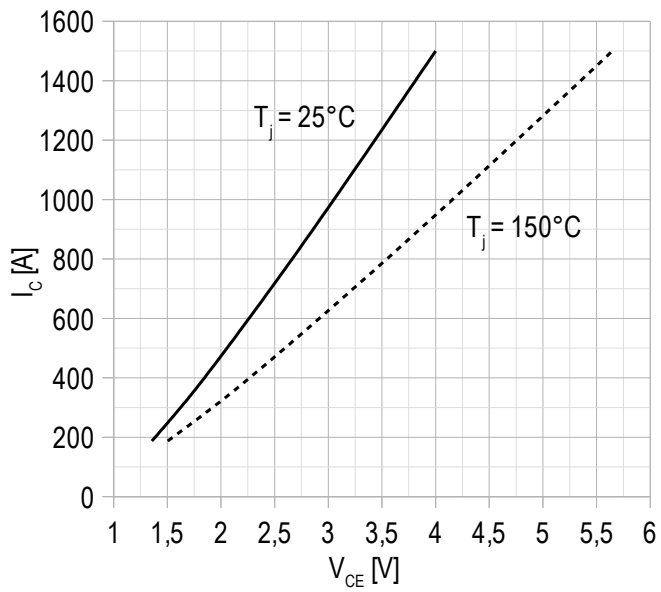
| Definition | Symbol | Conditions | | Value min. | Value typ. | Value max. | Unit. |
|---|---|---|---|---|---|---|---|
| **IGBT** | | | | | | | |
| Collector-Emitter saturation voltage | $V_{CEsat}$ | $V_{GE}$ = +15 V; $I_C$ = 750 A; $t_u$ = 1000 µs. | $T_{vj}$ = 25°C | 1.75 | 2.55 | 3.35 | V |
| | | | $T_{vj}$ = 150°C | 2.75 | 3.40 | 4.05 | V |
| Gate-Emitter threshold voltage | $V_{GE(th)}$ | $I_C$ = 30 mA; $V_{CE}$ = $V_{GE}$; $T_{vj}$ = 25°C; $t_u$ = 2 ms. | | 4.15 | 6.10 | 8.10 | V |
| Collector-Emitter cut-off current | $I_{CES}$ | $V_{CE}$ = 1700 V; $t_u$ = 50 ms; $V_{GE}$ = 0. | $T_{vj}$ = 25°C | - | 11.00 | 300 | µA |
| | | | $T_{vj}$ = 150°C | - | 2.00 | 6.00 | mA |
| Gate-Emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0; $V_{GE}$ = ±20 V; $T_{vj}$ = 25°C; $t_u$ = 30 ms. | | - | 14.00 | 200 | nA |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 25 V; $V_{GE}$ = 0 V; f = 1 MHz; $T_{vj}$ = 25°C. | | - | - | - | nF |
| Reverse transfer capacitance | $C_{res}$ | | | - | - | - | nF |
| Total gate charge | $Q_G$ | $I_C$ = 600 A; $V_{CE}$ = 920 V; $V_{GE}$ = -8...+15 V. | | - | 3200 | 3400 | nC |
| Internal gate resistance | $R_{Gint}$ | $T_{vj}$ = 25°C. | | - | 1.20 | - | Ω |
| Turn-on delay time | $t_{d(on)}$ | $V_{CE}$ = 920 V; $V_{GE}$ = ±15 V; $I_{C\,max}$ = 750 A; $R_G$ = 1.5 Ω; $L_s$ = 56 nH. | $T_{vj}$ = 25°C | 172 | 229 | 286 | ns |
| | | | $T_{vj}$ = 150°C | 206 | 265 | 324 | ns |
| Rise time | $t_{ri}$ | | $T_{vj}$ = 25°C | 70 | 82 | 94 | ns |
| | | | $T_{vj}$ = 150°C | 80 | 99 | 118 | ns |
| Turn-on energy | $E_{on}$ | | $T_{vj}$ = 25°C | 48.5 | 91.0 | 133.5 | mJ |
| | | | $T_{vj}$ = 150°C | 129.0 | 195.0 | 261.0 | mJ |
| Turn-off delay time | $t_{d(off)}$ | | $T_{vj}$ = 25°C | 462 | 539 | 616 | ns |
| | | | $T_{vj}$ = 150°C | 529 | 609 | 689 | ns |
| Fall time | $t_{fi}$ | | $T_{vj}$ = 25°C | 209 | 285 | 361 | ns |
| | | | $T_{vj}$ = 150°C | 345 | 455 | 565 | ns |
| Turn-off energy | $E_{off}$ | | $T_{vj}$ = 25°C | 141.0 | 169.0 | 197.0 | mJ |
| | | | $T_{vj}$ = 150°C | 191.5 | 229.5 | 267.5 | mJ |
| Collector-emitter threshold voltage | $V_{CE0}$ | $V_{GE}$ = +15 V; $T_{vj}$ = 150°C; $I_{CE1}$ = 187 A; $I_{CE2}$ = 750 A; $t_u$ = 1000 µs. | | 0.86 | 0.88 | 0.89 | V |
| On-State slope resistance (IGBT) | $r_{CE0}$ | | | 1.67 | 2.28 | 2.89 | mΩ |
| Thermal resistance junction to case | $R_{th(j-c)}$ | DC; $I_{test}$ = 1.5 A; $V_{GE}$ = +15 V. | | - | 0.033 | 0.041 | K/W |
| **Inverse diode** | | | | | | | |
| Forward voltage drop | $V_F$ | $I_F$ = 750 A; $V_{GE}$ = 0; $t_u$ = 1000 µs. | $T_{vj}$ = 25°C | 2.40 | 2.90 | 3.40 | V |
| | | | $T_{vj}$ = 150°C | 3.00 | 3.60 | 4.20 | V |
| Reverse recovery time | $t_{rr}$ | $V_{CE}$ = 920 V; $V_{GE}$ = ±15 V; $I_{C\,max}$ = 750 A; $R_G$ = 1.5 Ω; $L_s$ = 56 nH. | $T_{vj}$ = 25°C | 348 | 414 | 480 | ns |
| | | | $T_{vj}$ = 150°C | 527 | 669 | 811 | ns |
| Peak reverse current | $I_{RM}$ | | $T_{vj}$ = 25°C | 365 | 540 | 715 | A |
| | | | $T_{vj}$ = 150°C | 310 | 455 | 600 | A |
| Recovered charge | $Q_r$ | | $T_{vj}$ = 25°C | 92.0 | 125.5 | 159.0 | µC |
| | | | $T_{vj}$ = 150°C | 120.0 | 160.5 | 201.0 | µC |
| Reverse recovery energy | $E_{rec}$ | | $T_{vj}$ = 25°C | 61.0 | 84.5 | 108.0 | mJ |
| | | | $T_{vj}$ = 150°C | 74 | 104 | 134.0 | mJ |
| Threshold voltage | $V_{(T0)}$ | $T_{vj}$ = 150°C; $V_{GE}$ = 0; $I_{F1}$ = 187 A; $I_{F2}$ = 750 A; $t_u$ = 1000 µs | | 1.12 | 1.14 | 1.16 | V |
| Forward slope resistance | $r_T$ | | | 1.65 | 2.19 | 2.73 | mΩ |
| Thermal resistance junction to case | $R_{th(JC-D)}$ | DC; $I_{test}$ = 1.5 A; $V_{GE}$ = +15 V. | | - | 0.060 | 0.070 | K/W |

| Module | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pin resistance | $R_{Pxy}$ | $T_{vj}$ = 25°C. | $R_{P10/11-3}$ | - | 0.92 | 1.00 | mΩ |
| | | | $R_{P10/11-4}$ | - | 0.59 | 1.00 | |
| Parasitic inductance between terminals | $L_{Pce}$ | | | - | 26 | - | nH |
| Thermistor resistance | $R_t$ | $T_{vj}$ = 25°C | | 4850 | - | 6225 | Ω |
| | | $T_{vj}$ = 150°C | | 160 | - | 195 | |
| Coefficient of temperature sensitivity | $B_{25/50}$ | $R_2 = R_{25} \exp [B_{25/50} (1/T_2 - 1/T_1)]$, $T_1$ = 298.15 K | | - | 3375 | - | K |
| Thermal resistance case to heatsink | $R_{thCH}$ | per module | | - | 0.009 | 0.014 | K/W |
| Mounting torque for screws to heatsink | $M_s$ | to heatsink M5 | | 3 | - | 6 | N*m |
| Mounting torque for terminal screws | $M_t$ | to terminals M6 | | 3 | - | 6 | N*m |
| Weight | W | | | - | 360 | - | g |

## Notes:

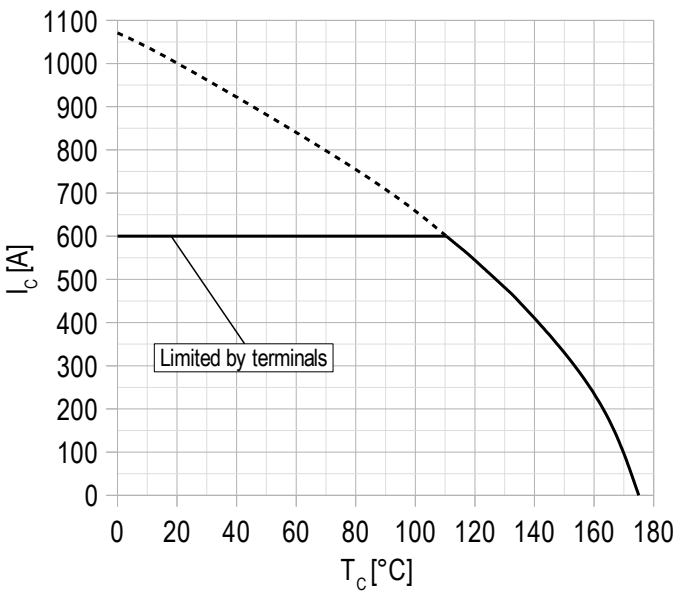
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature $T_{vj\ op}$ = -40...+150°C.

### Chart 1 – typ. output characteristic, IGBT.



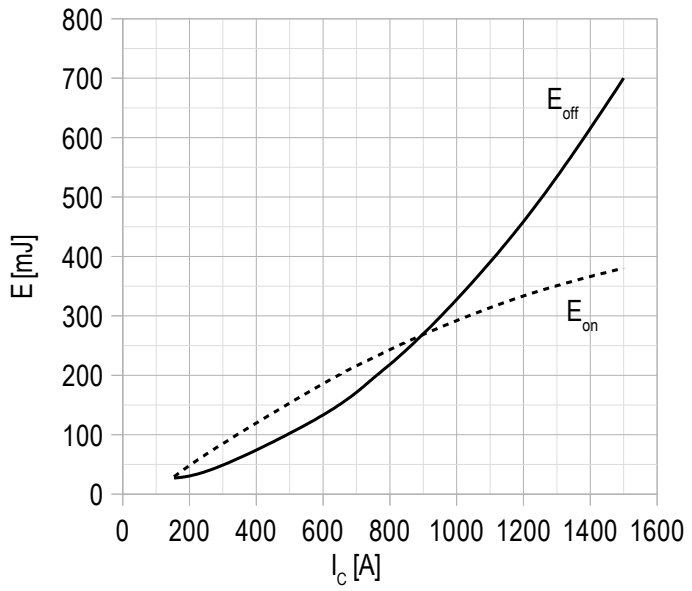

$V_{GE}$ = +15 V.

### Chart 2 – max. rated current (continuous) vs temperature.



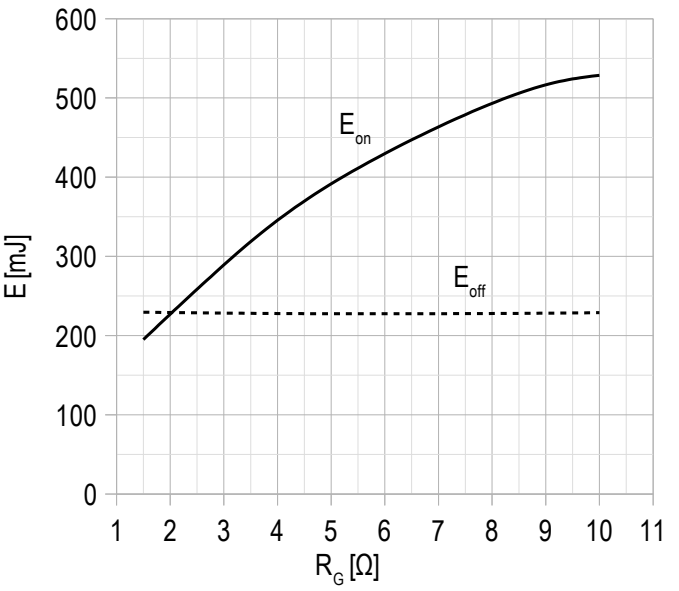

DC;
$V_{GE}$ = +15 V;
$T_{vj\ (max)}$ = 150°C.

### Chart 3 – typ. turn-on/-off energy vs rated current, IGBT.



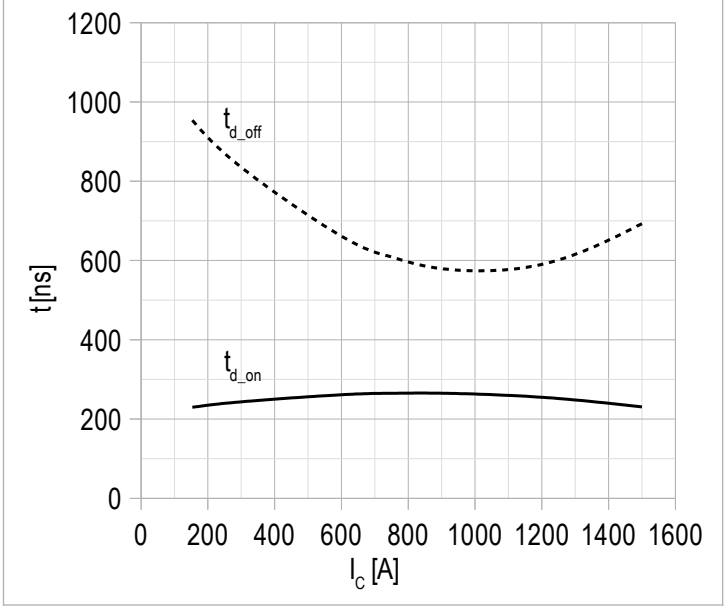

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$R_G$ = 1.5 Ω;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

### Chart 4 – typ. turn-on/-off energy vs gate resistance, IGBT.



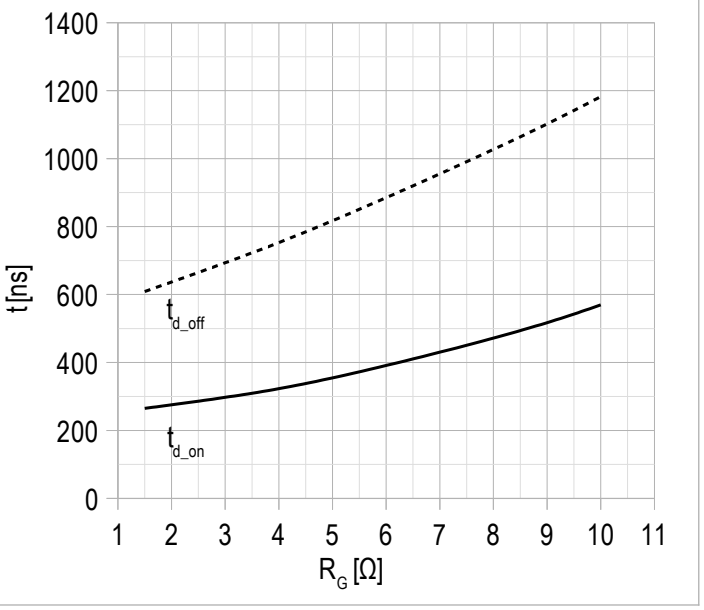

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 750 A;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

### Chart 5 – typ. switching times vs rated current, IGBT.



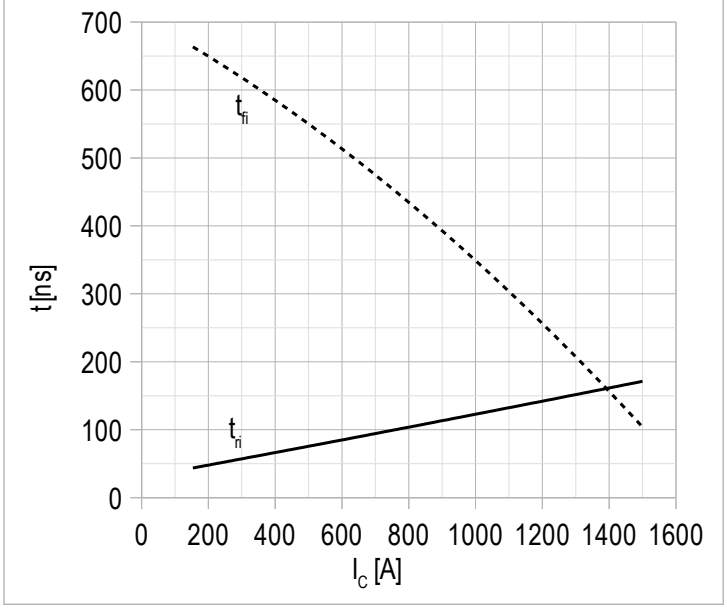

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$R_G$ = 1.5 Ω;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

### Chart 6 – typ. switching times vs gate resistance, IGBT.



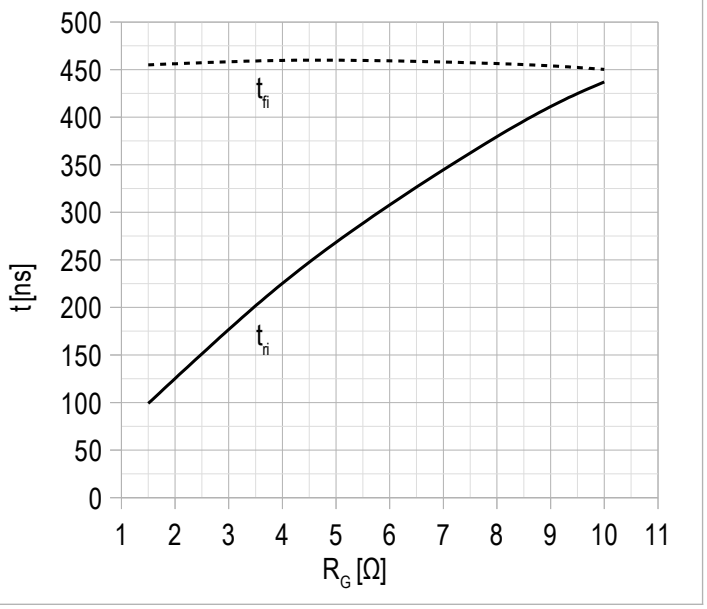

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 750 A;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

### Chart 7 – typ. switching times vs rated current, IGBT.



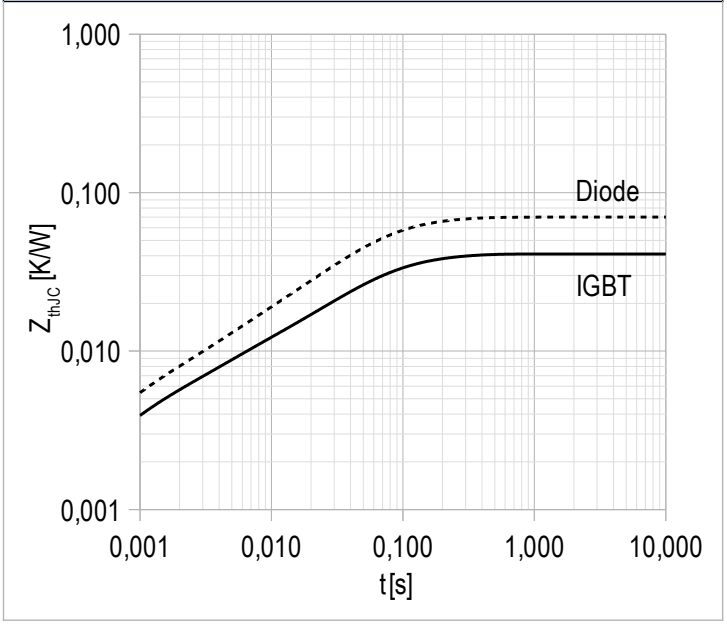

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$R_G$ = 1.5 Ω;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

### Chart 8 – typ. switching times vs gate resistance, IGBT.



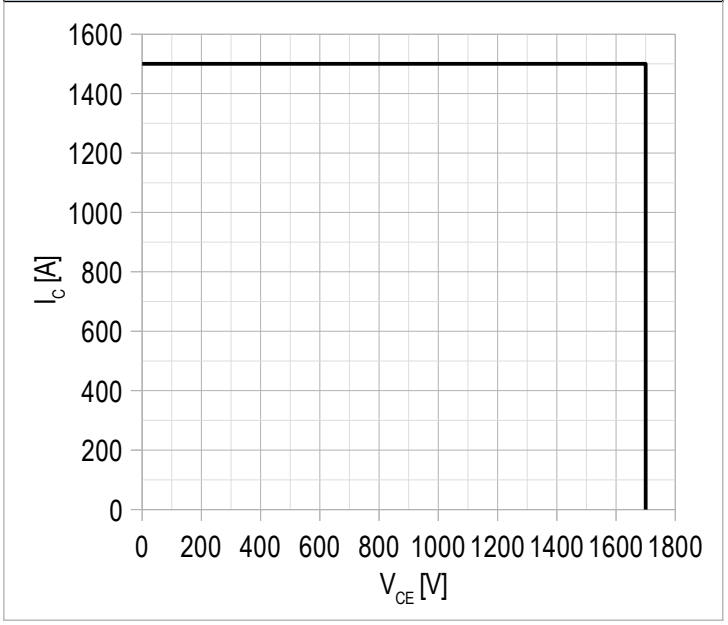

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 750 A;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

### Chart 9 – max. transient thermal impedance.



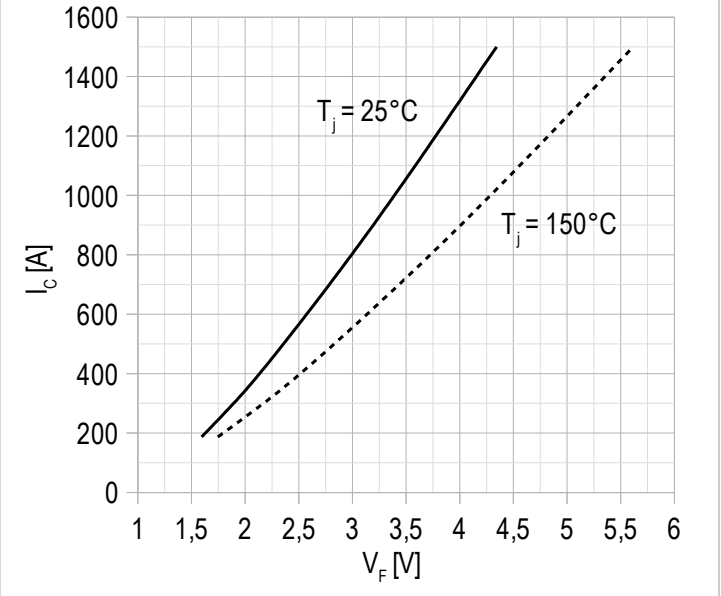

Single pulse;
$V_{GE}$ = +15 V.

### Chart 10 – RBSOA.



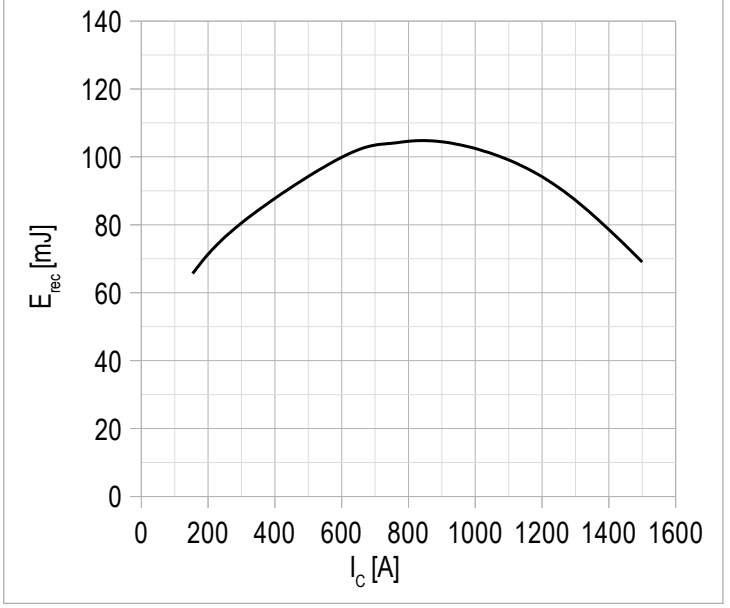

$V_{CE\ max}$ = 1700 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 2*$I_{C\ nom}$;
$R_G$ = 1.5 Ω;
$L_s$ = 56 nH.

### Chart 11 – typ. output characteristic, FRD.



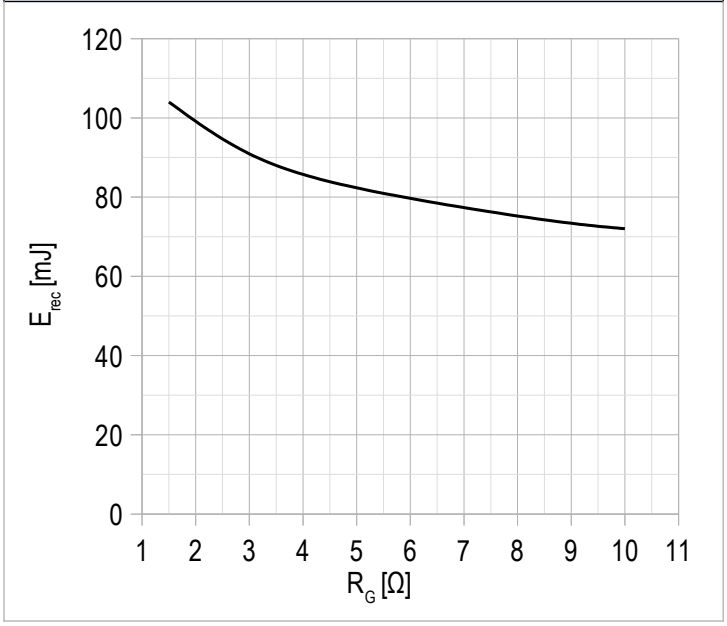

$V_{GE}$ = 0 V.

### Chart 12 – typ. switching losses vs rated current, FRD.



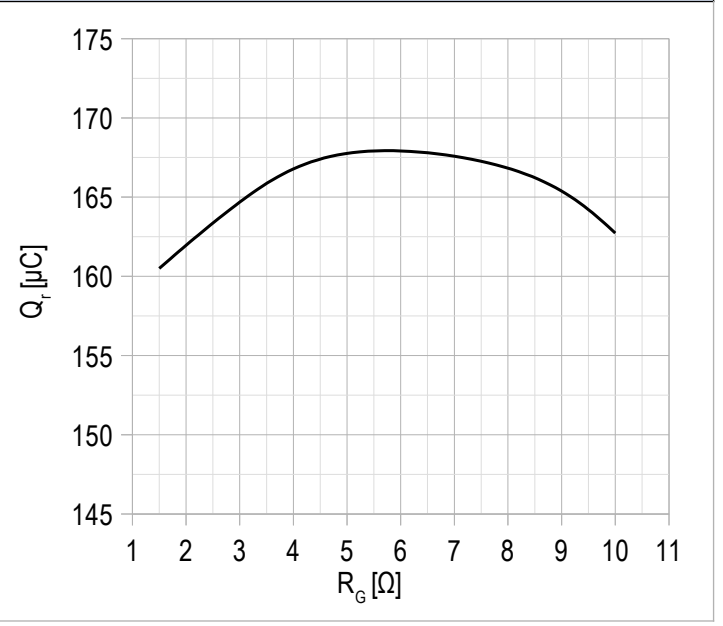

$V_{GE}$ = ±15 V;
$V_{CE}$ = 920 V;
$L_s$ = 56 nH;
$R_{G\ on}$ = 1.5 Ω;
$T_{vj\ (max)}$ = 150°C.

**Chart 13 – typ. switching losses vs gate resistance, FRD.**



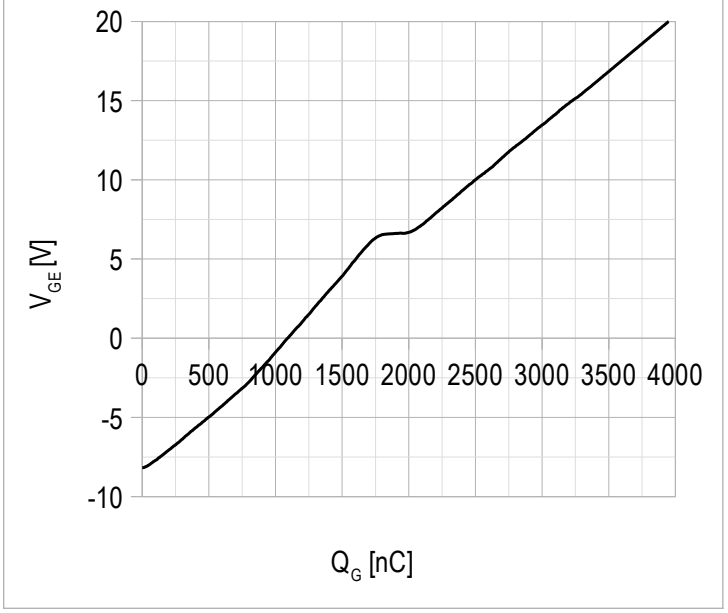

$V_{GE}$ = ±15 V;
$V_{CE}$ = 920 V;
$I_{C\ max}$ = 750 A;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

**Chart 14 – typ. reverse recovered charge vs gate resistance, FRD.**



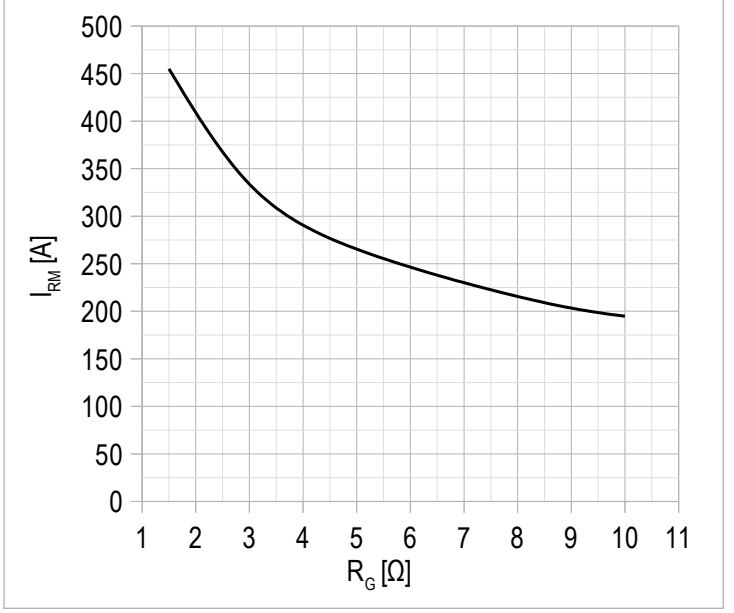

$V_{GE}$ = ±15 V;
$V_{CE}$ = 920 V;
$I_{C\ max}$ = 750 A;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

**Chart 15 – typ. gate charge characteristic.**



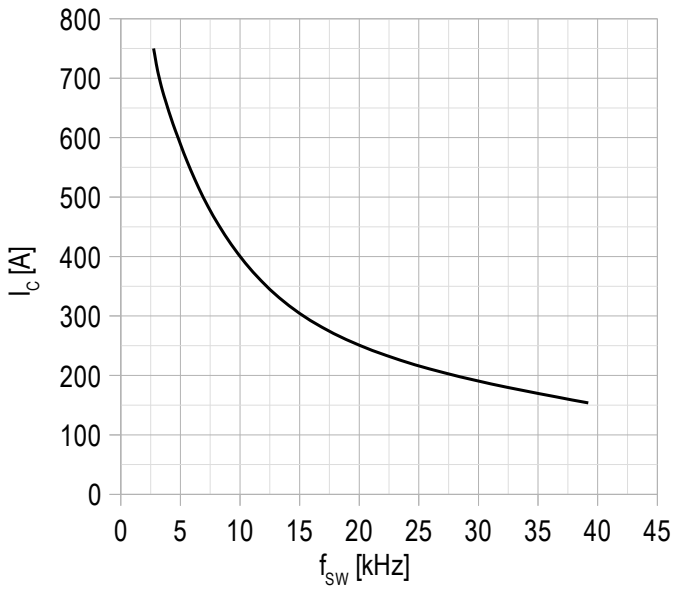

$I_C$ = 600 A;
$V_{CE}$ = 920 V;
$V_{GE}$ = -8...+15 V.

**Chart 16 – typ. reverse recovery current vs gate resistance FRD.**



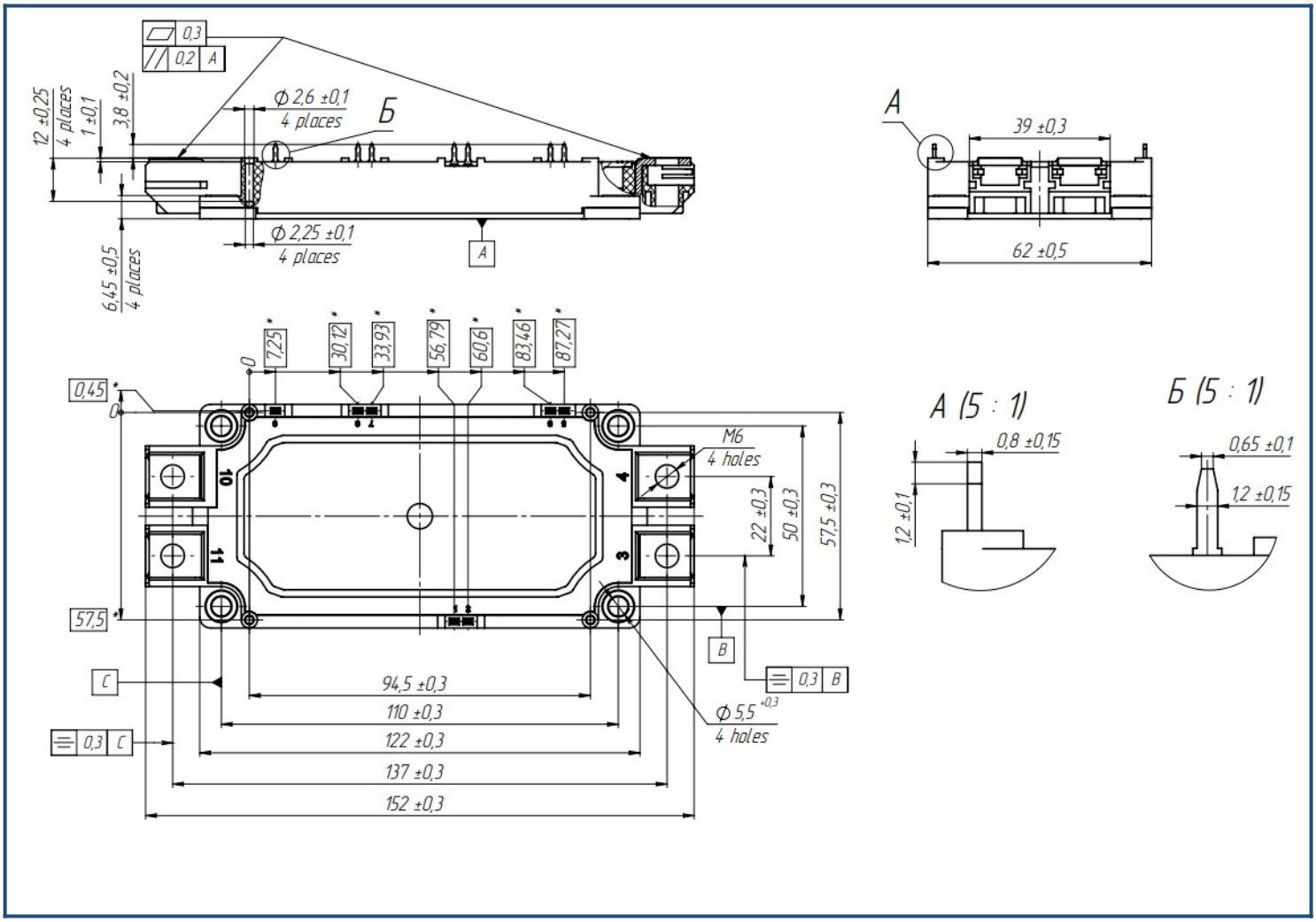

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

**Chart 17 – max. rated current vs frequency.**




Duty cycle 50%;
$V_{CE}$ = 920 V;
$T_c$ = 80 °C;
$T_{vj\ (max)}$ = 175 °C.

## Overall dimensions: Package type – D2




## Part numbering guide

| MID2 | - | HB | 17 | SG | - | 750 | N | - | S | |
|---|---|---|---|---|---|---|---|---|---|---|
| MID2 | | | | | | | | | | IGBT module package type: D2 |
| | | HB | | | | | | | | 2 switches as Half-Bridge |
| | | | 17 | | | | | | | Voltage rating ($V_{CES}$/100) |
| | | | | SG | | | | | | IGBT+FRD chipset modification |
| | | | | | | 750 | | | | Current Rating |
| | | | | | | | N | | | Climatic version: normal climate |
| | | | | | | | | | S | $Si_3N_4$ DBC substrate |

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