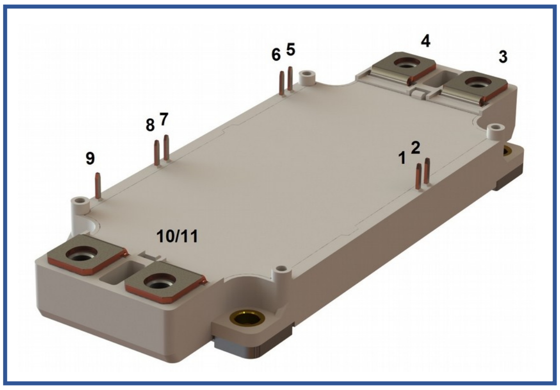
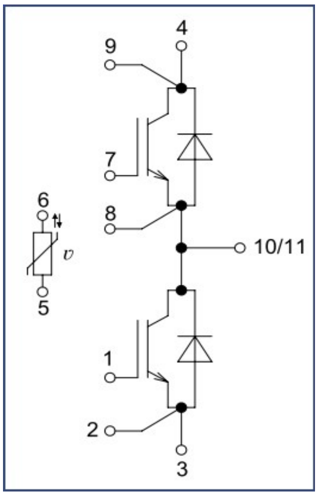
## Low Inductance IGBT Module with 17 mm Height Housing 1700 V 450 A




### Chip features

- IGBT chip
  - Trench FS — V-Series IGBT ( 6 th gen)
  - low $V_{CE(sat)}$ value
  - 10 µs short circuit duration at 150°C
  - square RBSOA of 2x$I_C$
  - low EMI
- FRD chip
  - fast and soft reverse recovery
  - low voltage drop

### Design features

- copper baseplate
- $Al_2O_3$ DBC substrate
- ultrasonic welded power terminals
- improved thermal cycling
- RoHS compliant

### 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 |
| Collector current (nominal) | $I_{C\ nom}$ | | 450 | A |
| Collector current (maximum continuous) | $I_{C\ 25}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 25°C. | 591 | A |
| | $I_{C\ 80}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 80°C. | 450 | A |
| Repetitive peak collector current[*1] | $I_{CRM}$ | $I_{CRM}$ = 3 x $I_{C\ nom}$; $t_p$ = 1 ms. | 1350 | A |
| Short-circuit duration | $t_{psc}$ | $T_{vj}$ = 25°C; $V_{GE}$ = ±15 V; $V_{CE}$ = 1000 V; $R_{G\ on}$ = $R_{G\ off}$ = 3 Ω. | 10 | µs |
| | | $T_{vj}$ = 150°C; $V_{GE}$= ±15 V; $V_{CE}$= 1000 V; $R_{G\ on}$ = $R_{G\ off}$ = 3 Ω. | 10 | |
| Gate-Emitter voltage | $V_{GES}$ | | ±20 | V |
| Junction operating temperature | $T_{vj\ (op)}$ | | -40…+150 | ºC |
| **Inverse diode** | | | | |
| Repetitive peak reverse voltage | $V_{RRM}$ | $V_{GE}$ = 0 V. | 1700 | V |
| Forward current (nominal) | $I_{F\ nom}$ | | 450 | A |
| Forward current (maximum continuous) | $I_{F\ 25}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 25°C. | 494 | A |
| | $I_{F\ 80}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 80°C. | 450 | A |
| Repetitive peak forward current[*1] | $I_{FRM}$ | $I_{FRM}$ = 3 x $I_{F\ nom}$; $t_p$ = 1 ms. | 1350 | A |
| Junction operating temperature | $T_{vj\ (op)}$ | | -40…+150 | °C |
| **Module** | | | | |
| Storage temperature | $T_{stg}$ | | -55…+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

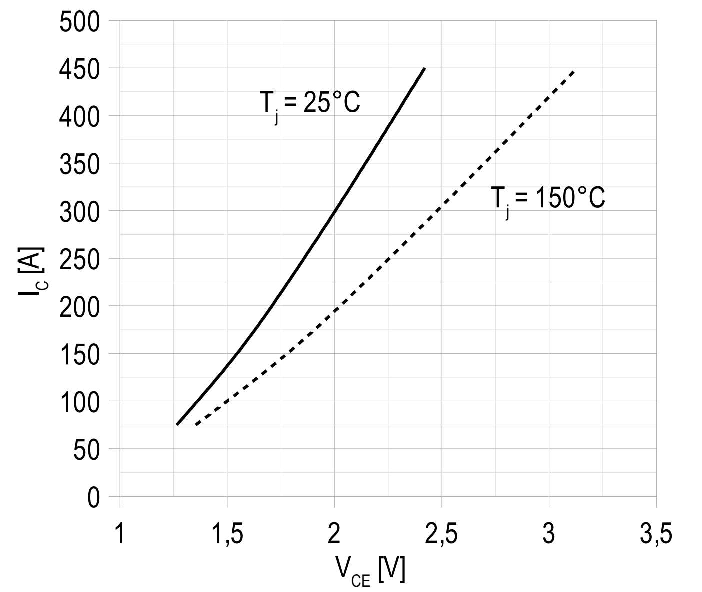
| Definition | Symbol | Conditions | | Value min. | Value typ. | Value max. | Unit. |
|---|---|---|---|---|---|---|---|
| **IGBT** | | | | | | | |
| Collector-Emitter saturation voltage | $V_{CEsat}$ | $V_{GE}$ = +15 V; $I_C$ = 450 A; $t_u$ = 1000 µs. | $T_{vj}$ = 25°C | 2.29 | 2.33 | 2.50 | V |
| | | | $T_{vj}$ = 150°C | 2.94 | 3.03 | 3.25 | V |
| Gate-Emitter threshold voltage | $V_{GE(th)}$ | $I_C$ = 18 mA; $V_{CE}$ = $V_{GE}$; $T_{vj}$ = 25°C; $t_u$ = 2 ms. | | 5.25 | 5.60 | 6.10 | V |
| Collector-Emitter cut-off current | $I_{CES}$ | $V_{CE}$ = 1700 V; $t_u$ = 50 ms; $V_{GE}$ = 0. | $T_{vj}$ = 25°C | 2.94 | 3.69 | 150 | µA |
| | | | $T_{vj}$ = 150°C | 1.17 | 1.40 | 3.00 | mA |
| Gate-Emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0; $V_{GE}$ = ±20 V; $T_{vj}$ = 25°C; $t_u$ = 30 ms. | | 9.9 | 14.9 | 200 | nA |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 10 V; $V_{GE}$ = 0 V; f = 1 MHz; $T_{vj}$ = 25°C. | | - | 40.80 | - | nF |
| Output capacitance | $C_{oes}$ | | | - | 2.10 | - | nF |
| Reverse transfer capacitance | $C_{res}$ | | | - | 4.20 | - | nF |
| Total gate charge | $Q_G$ | $I_C$ = 450 A; $V_{CE}$ = 920 V; $V_{GE}$ = - 8÷15 V. | | - | 4930 | 5100 | nC |
| Internal gate resistance | $R_{Gint}$ | $T_{vj}$ = 25°C. | | - | 1.70 | - | Ω |
| Turn-on delay time | $t_{d(on)}$ | $V_{CE}$ = 920 V; $V_{GE}$ = ±15 V; $I_{C\,max}$ = 450 A; $R_G$ = 3.0 Ω; L = 100 µH. | $T_{vj}$ = 25°C | 340 | 356 | 420 | ns |
| | | | $T_{vj}$ = 150°C | 440 | 456 | 520 | |
| Rise time | $t_{ri}$ | | $T_{vj}$ = 25°C | 80 | 83 | 98 | ns |
| | | | $T_{vj}$ = 150°C | 84 | 86 | 100 | |
| Turn-on energy | $E_{on}$ | | $T_{vj}$ = 25°C | 65 | 74 | 92 | mJ |
| | | | $T_{vj}$ = 150°C | 109 | 120 | 150 | |
| Turn-off delay time | $t_{d(off)}$ | | $T_{vj}$ = 25°C | 920 | 950 | 1100 | ns |
| | | | $T_{vj}$ = 150°C | 1060 | 1090 | 1250 | |
| Fall time | $t_{fi}$ | | $T_{vj}$ = 25°C | 420 | 436 | 500 | ns |
| | | | $T_{vj}$ = 150°C | 620 | 644 | 750 | |
| Turn-off energy | $E_{off}$ | | $T_{vj}$ = 25°C | 103 | 107 | 130 | mJ |
| | | | $T_{vj}$ = 150°C | 143 | 150 | 175 | |
| Collector-emitter threshold voltage | $V_{CE0}$ | $V_{GE}$ = +15 V; $T_{vj}$ = 150°C; $I_{CE1}$ = 125 A; $I_{CE2}$ = 450 A; $t_u$ = 1000 µs. | | 1.041 | 1.055 | 1.10 | V |
| On-State slope resistance (IGBT) | $r_{CE0}$ | | | 4.22 | 4.39 | 4.69 | mΩ |
| Thermal resistance junction to case | $R_{th(j-c)}$ | DC; $I_{CE}$ = 300±50 A; $I_{test}$ = 1.5 A; $V_{GE}$ = +15 V. | | - | 0.0627 | 0.0675 | K/W |
| **Inverse diode** | | | | | | | |
| Forward voltage drop | $V_F$ | $I_F$ = 450 A; $V_{GE}$ = 0; $t_u$ = 1000 µs. | $T_{vj}$ = 25°C | 2.08 | 2.13 | 2.34 | V |
| | | | $T_{vj}$ = 150°C | 2.37 | 2.45 | 2.72 | V |
| Reverse recovery time | $t_{rr}$ | $V_{CE}$ = 920 V; $V_{GE}$ = ±15 V; $I_{C\,max}$ = 450 A; $R_G$ = 3.0 Ω; L = 100 µH. | $T_{vj}$ = 25°C | 195 | 206 | 240 | ns |
| | | | $T_{vj}$ = 150°C | 327 | 425 | 650 | ns |
| Repetitive peak reverse current | $I_{RRM}$ | | $T_{vj}$ = 25°C | 358 | 373 | 430 | A |
| | | | $T_{vj}$ = 150°C | 440 | 453 | 510 | A |
| Reverse recovered charge | $Q_{rr}$ | | $T_{vj}$ = 25°C | 42 | 44 | 55 | µC |
| | | | $T_{vj}$ = 150°C | 79 | 91 | 125 | µC |
| Reverse recovery energy | $E_{rec}$ | | $T_{vj}$ = 25°C | 61 | 64 | 76 | mJ |
| | | | $T_{vj}$ = 150°C | 118 | 123 | 145 | mJ |
| Threshold voltage | $V_{(T0)}$ | $T_{vj}$ = 150°C; $V_{GE}$ = 0; $I_{CE1}$ = 125 A; $I_{CE2}$ = 450 A; $t_u$ = 1000 µs | | 0.944 | 0.957 | 1.000 | V |
| Forward slope resistance | $r_T$ | | | 3.170 | 3.310 | 3.580 | mΩ |
| Thermal resistance junction to case | $R_{th(JC-D)}$ | DC; $I_{CE}$ = 300±50 A; $I_{test}$ = 1.5 A; $V_{GE}$ = +15 V. | | - | 0.105 | 0.115 | 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 | $L_{Pce}$ | | | - | 22 | - | nH |
| Thermistor resistance | $R_{t25}$ | $T_{vj}$ = 25°C | | - | 5000 | - | Ω |
| | | $T_{vj}$ = 100°C | | - | 495 | - | |
| 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 M6 | | 3 | - | 6 | N*m |
| Mounting torque for terminal screws | $M_t$ | to terminals M5 | | 3 | - | 6 | N*m |
| Weight | W | | | - | 360 | - | g |

## Notes:

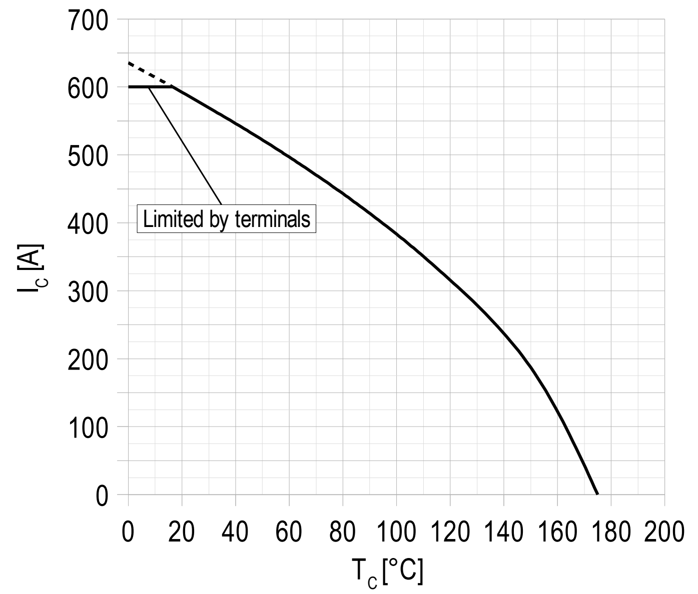
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature $T_{vj\ op}$ = - 40 ÷ +150°C;
- The information given in the datasheet is preliminary.

Chart 1 – typ. output characteristic, IGBT.



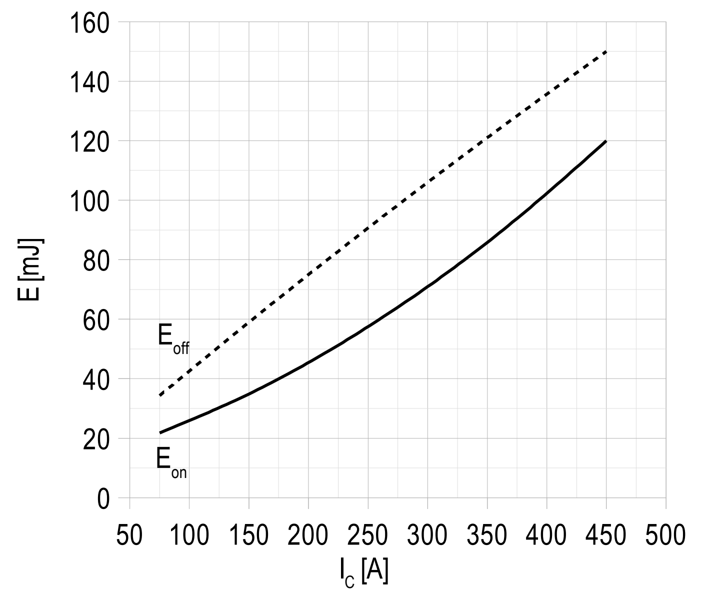

$V_{GE}$ = +15 V.

Chart 2 – max. rated current vs temperature.



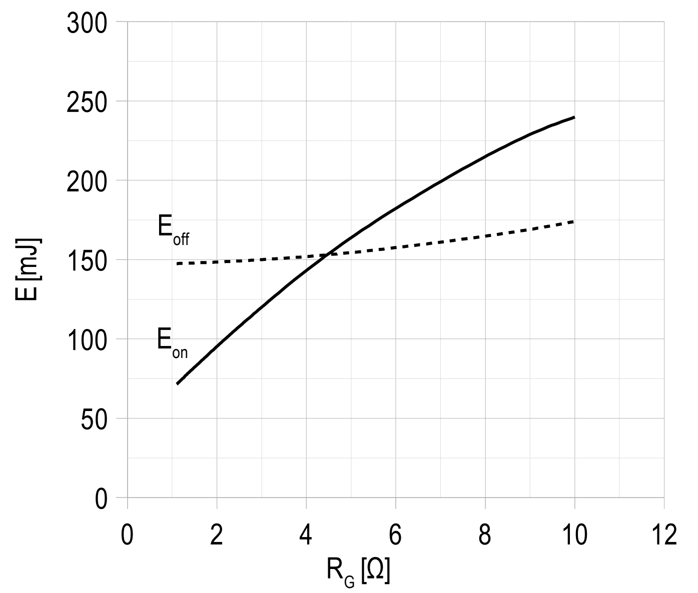

DC;
$V_{GE}$ = +15 V;
$T_{vj\,(max)}$ = 150°C.

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



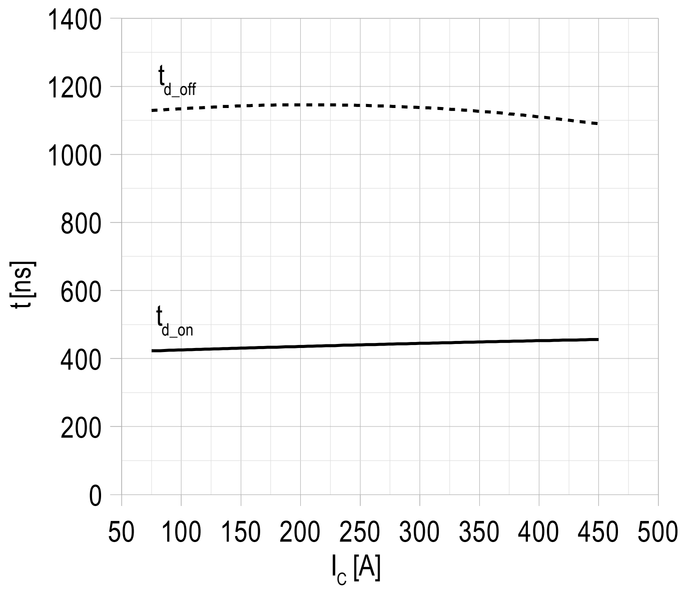

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$R_G$ = 3 Ω;
L = 100 μH;
$T_{vj\,(max)}$ = 150°C.

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



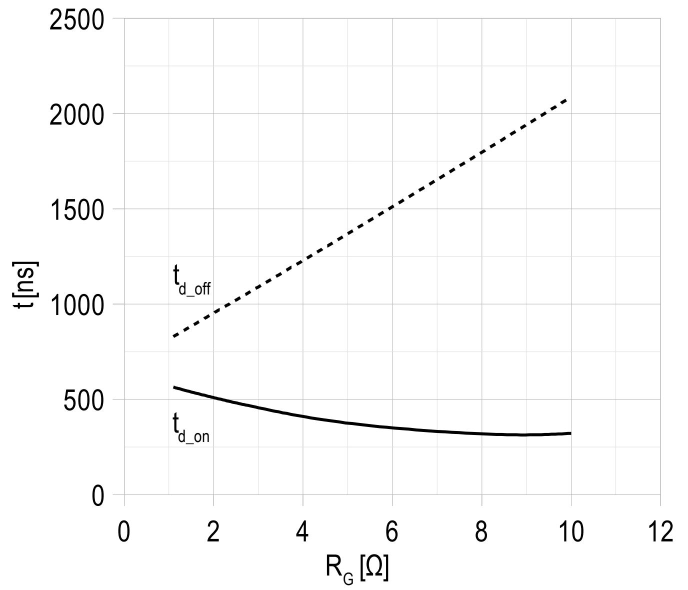

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$I_{C\,max}$ = 450 A;
L = 100 μH;
$T_{vj\,(max)}$ = 150°C.

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



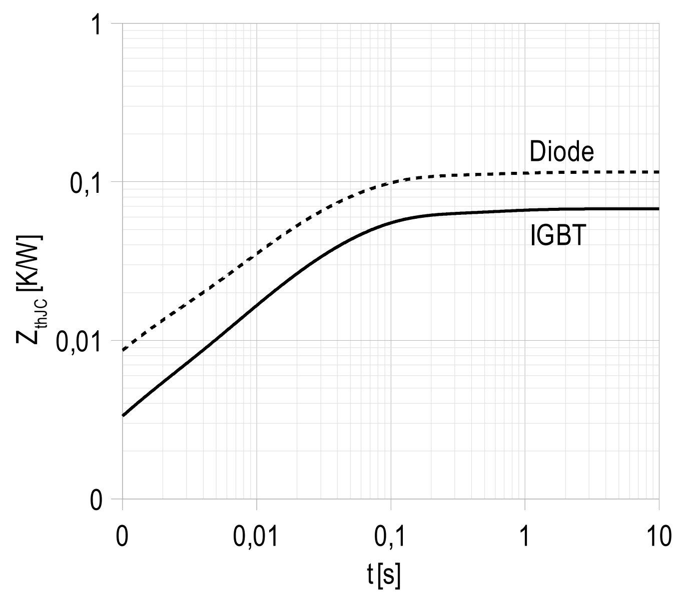

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$R_G$ = 3 Ω;
L = 100 μH;
$T_{vj\ (max)}$ = 150°C.

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



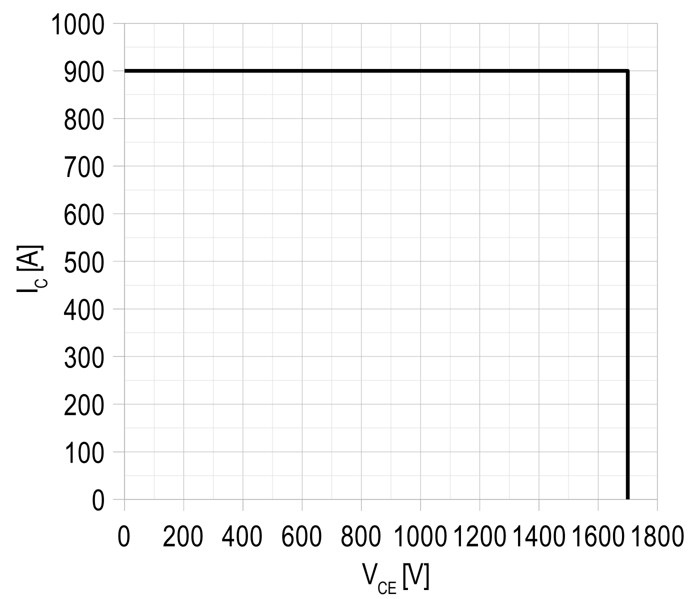

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 450 A;
L = 100 μH;
$T_{vj\ (max)}$ = 150°C.

**Chart 7 – max. transient thermal impedance.**



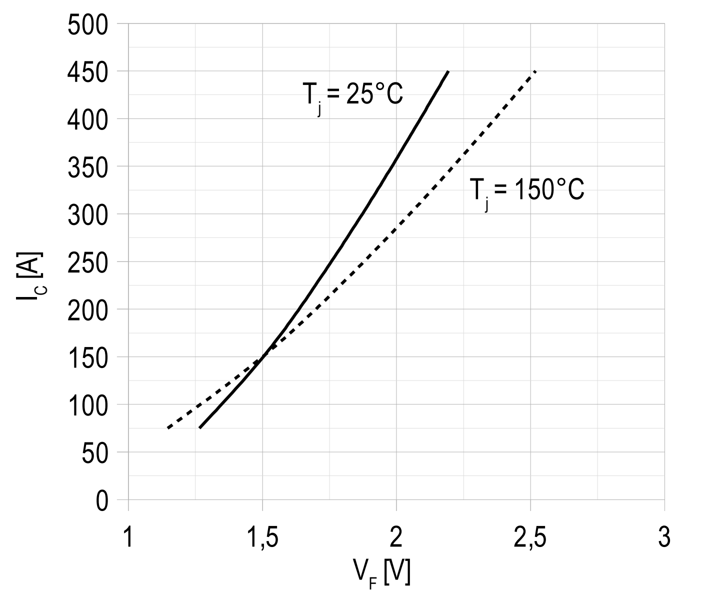

Single pulse;
$V_{GE}$ = +15 V.

**Chart 8 – RBSOA.**



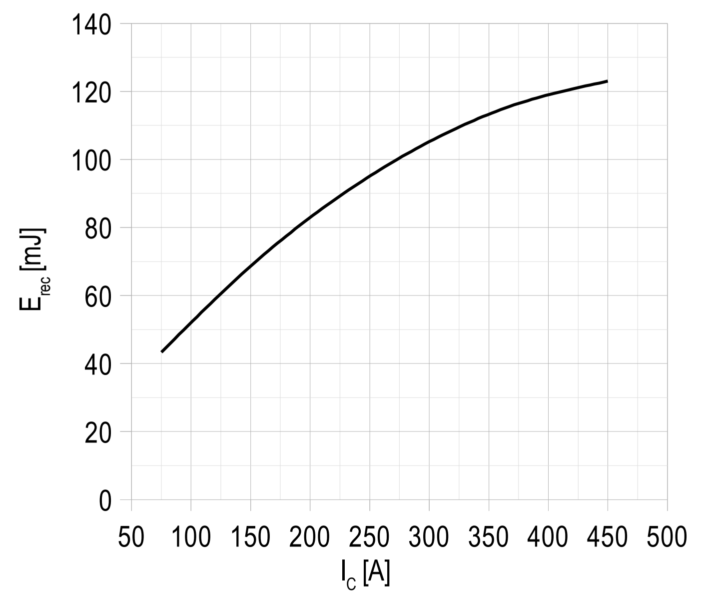

$V_{CE\ max}$ = 1700 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 2*$I_{C\ nom}$;
$R_G$ = 3 Ω;
L = 30 μH.

### Chart 9 – typ. output characteristic, FRD.



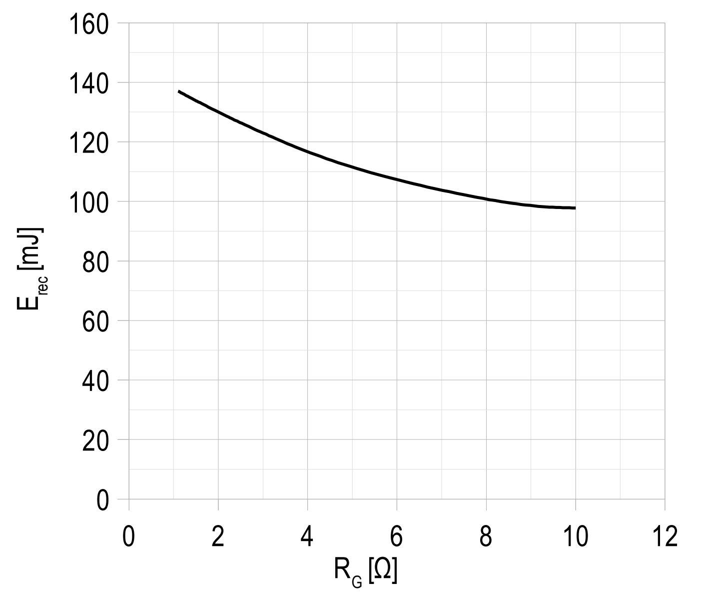

$V_{GE}$ = +15 V.

### Chart 10 – typ. switching losses vs rated current, FRD.



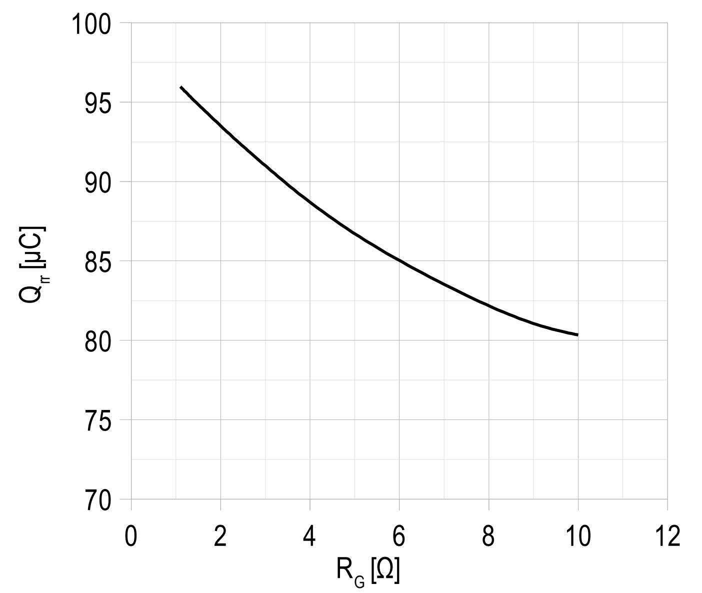

$V_{GE}$ = ±15 V;
$V_{CE}$ = 920 V;
L = 100 µH;
$R_{G\ on}$ = 3 Ω;
$T_{vj\ (max)}$ = 150°C.

### Chart 11 – typ. switching losses vs gate resistance, FRD.



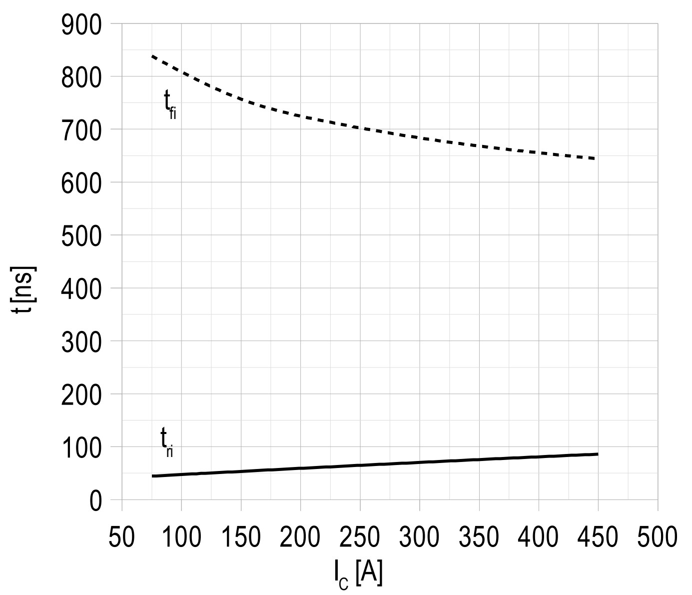

$V_{GE}$ = ±15 V;
$V_{CE}$ = 920 V;
$I_{C\ max}$ = 450 A;
L = 100 µH;
$T_{vj\ (max)}$ = 150°C.

### Chart 12 – typ. reverse recovered charge vs gate resistance, FRD.



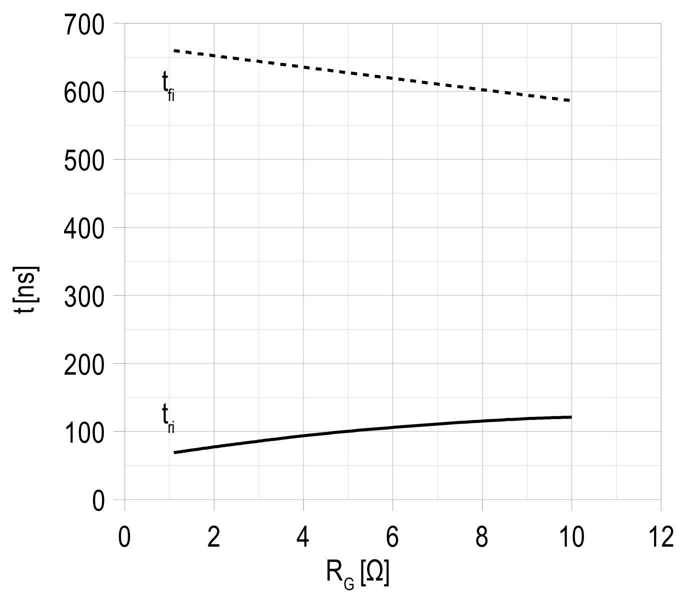

$V_{GE}$ = ±15 V;
$V_{CE}$ = 920 V;
$I_{C\ max}$ = 450 A;
L = 100 µH;
$T_{vj\ (max)}$ = 150°C.

**Chart 13 – typ. switching times vs rated current, FRD.**



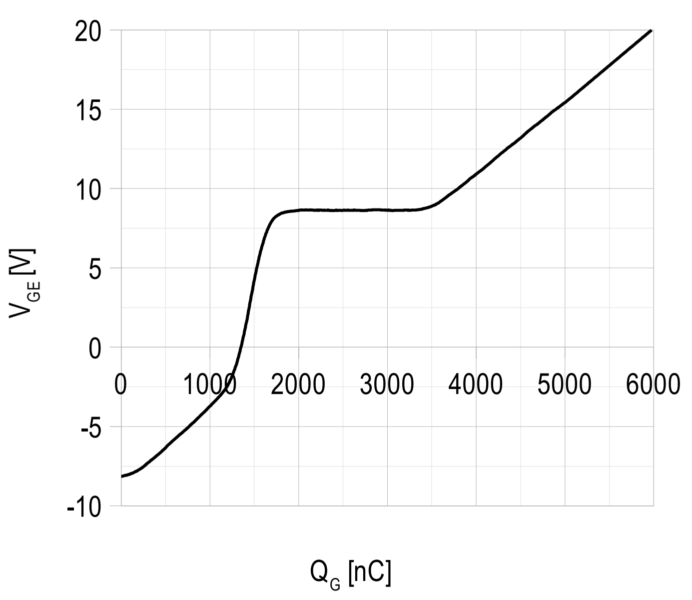

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$R_G$ = 3 Ω;
L = 100 μH.
$T_{vj\,(max)}$ = 150°C.

**Chart 14 – typ. switching times vs gate resistance, FRD.**



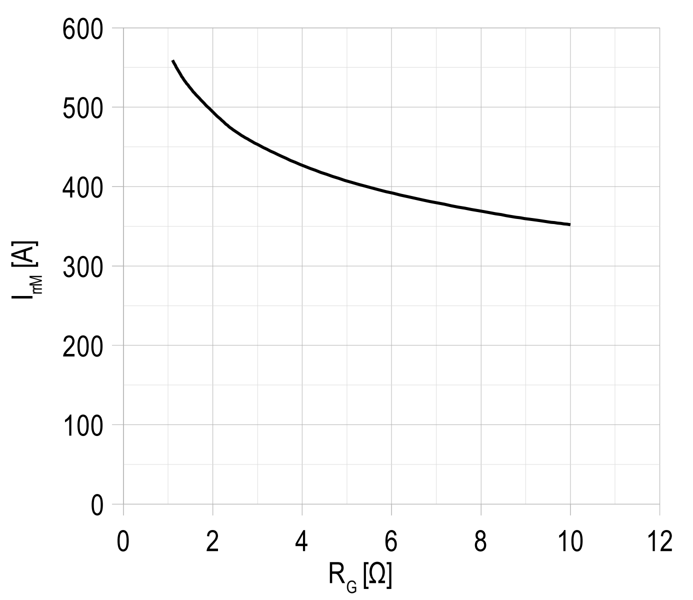

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$I_{C\,max}$ = 450 A;
L = 100 μH.
$T_{vj\,(max)}$ = 150°C.

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



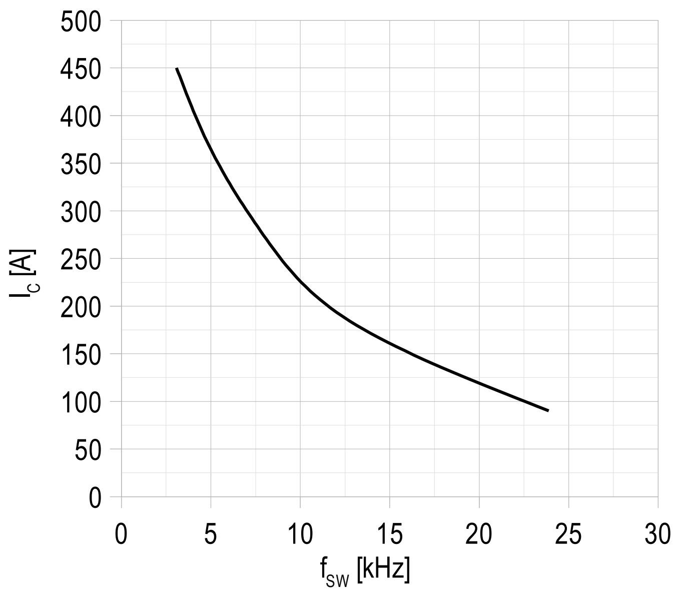

$I_C$ = 450 A;
$V_{CE}$ = 920 V;
$V_{GE}$ = - 8÷15 V.

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



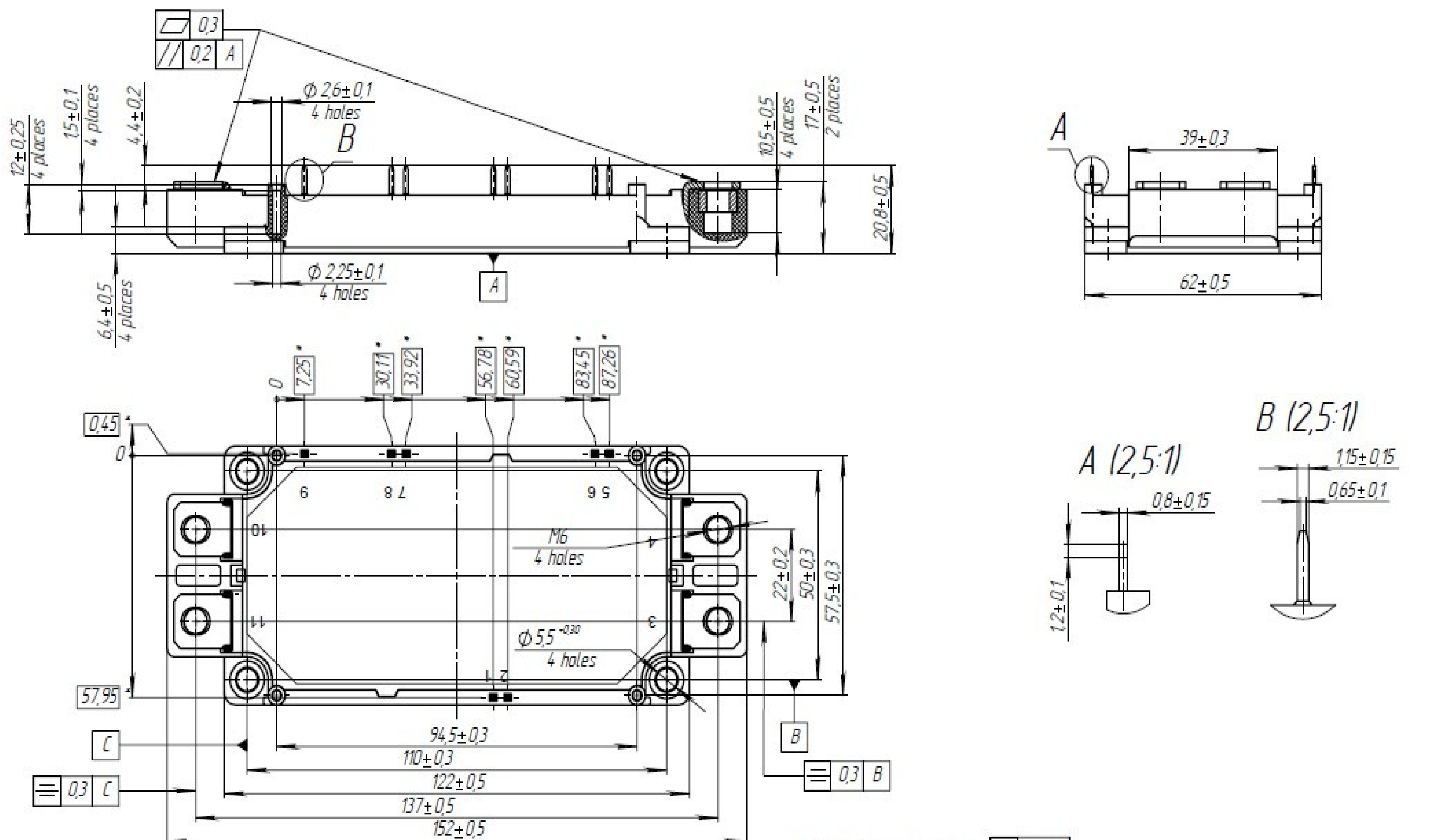

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
L = 100 μH.
$T_{vj\,(max)}$ = 150°C.

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




Duty cycle 50%

## Overall dimensions: Package type – DA




## Part numbering guide

| MIDA | - | HB | 17 | FA | - | 450 | N | |
|---|---|---|---|---|---|---|---|---|
| MIDA | | | | | | | | IGBT module package type: DA |
| | | HB | | | | | | 2 switches as Half-Bridge |
| | | | 17 | | | | | Voltage rating ($V_{CES}$/100) |
| | | | | FA | | | | IGBT+FRD chipset modification |
| | | | | | | 450 | | Current Rating |
| | | | | | | | N | Climatic version: normal climate |