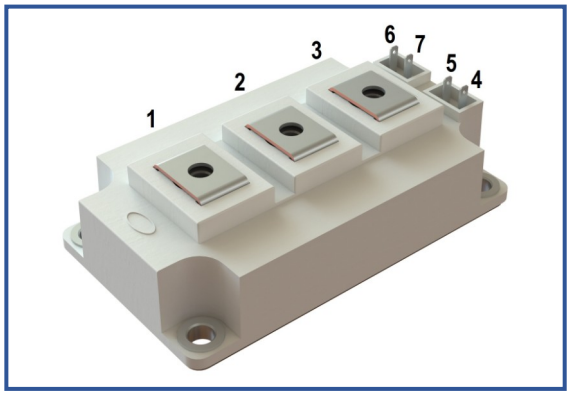
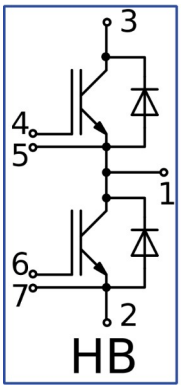
# MIAA-HB17SA-300N

IGBT module datasheet

## Industry standard 62mm IGBT module

**1700 V 300 A**




### Chip features

- IGBT chip
  - Trench FS
  - low $V_{CE(sat)}$ value
  - 10 µs short circuit of 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
- ultrasonically welded power terminals
- Improved thermal cycling
- RoHS compliant

### Typical application

- AC motor drives
- solar inverter
- air conditioning
- high power converters and UPS

## 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. | 494 | A |
| | $I_{C\ 80}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 80°C. | 300 | A |
| Repetitive peak collector current*1 | $I_{CRM}$ | $I_{CRM}$ = 2 x $I_{C\ nom}$; $t_p$ = 1 ms. | 600 | A |
| Short-circuit duration | $t_{psc}$ | $T_{vj}$ = 25°C; $V_{GE}$ = ±15 V; $V_{CE}$ = 700 V; $R_{G\ on}$ = $R_{G\ off}$ = 2.2 Ω; $I_{Cmax}$ < 1700 A. | 10 | µs |
| | | $T_{vj}$ = 150°C; $V_{GE}$= ±15 V; $V_{CE}$= 700 V; $R_{G\ on}$ = $R_{G\ off}$ = 2.2 Ω; $I_{Cmax}$ < 1400 A. | 10 | |
| Gate-Emitter voltage | $V_{GES}$ | | ±20 | V |
| Junction operating temperature | $T_{vj\ (op)}$ | | -40…+150 | °C |
| **Inverse diode \ Freewheeling 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. | 294 | A |
| | $I_{F\ 80}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 80°C. | 218 | A |
| Repetitive peak forward current*1 | $I_{FRM}$ | $I_{FRM}$ = 2 x $I_{F\ nom}$; $t_p$ = 1 ms. | 600 | A |
| Junction operating temperature | $T_{vj\ (op)}$ | | -40…+150 | °C |
| **Module** | | | | |
| Storage temperature | $T_{stg}$ | | -40…+50 | °C |
| Isolation voltage | $U_{isol}$ | 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

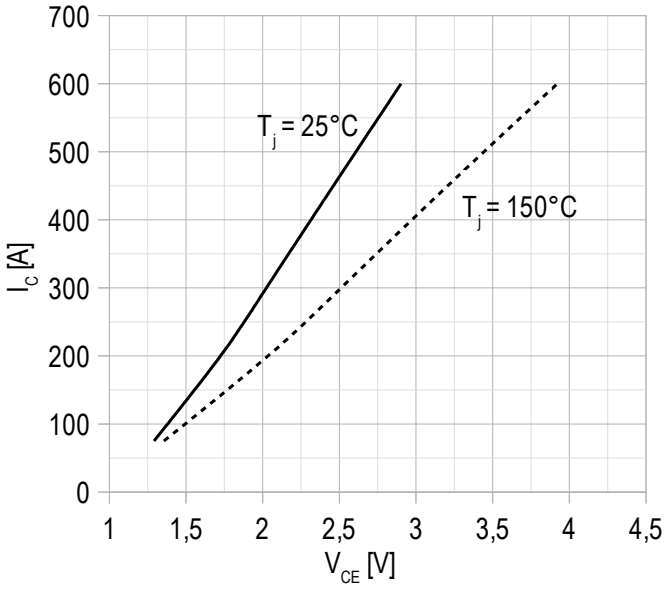
| Definition | Symbol | Conditions | | Value min. | Value typ. | Value max. | Unit. |
|---|---|---|---|---|---|---|---|
| **IGBT** | | | | | | | |
| Collector-Emitter saturation voltage | $V_{CEsat}$ | $V_{GE}$ = +15 V; $I_C$ = 300 A; $t_u$ = 1000 мкс. | $T_{vj}$ = 25°C | 1.70 | 2.00 | 2.30 | V |
| | | | $T_{vj}$ = 150°C | 2.10 | 2.50 | 2.90 | V |
| Gate-Emitter threshold voltage | $V_{GE(th)}$ | $I_C$ = 12 mA; $V_{CE}$ = $V_{GE}$; $T_{vj}$ = 25°C; $t_u$ = 2 ms. | | 4.90 | 5.50 | 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 | - | 18 | 100 | μA |
| | | | $T_{vj}$ = 150°C | - | 12 | 20 | mA |
| Gate-Emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0; $V_{GE}$ = ±20 V; $T_{vj}$ = 25°C; $t_u$ = 30 ms. | | - | 15 | 100 | nA |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 10 V; $V_{GE}$ = 0 V; f = 1 MHz; $T_{vj}$ = 25°C. | | - | 21.30 | - | nF |
| Reverse transfer capacitance | $C_{res}$ | | | - | 0.86 | - | nF |
| Total gate charge | $Q_G$ | $I_C$ = 300 A; $V_{CE}$ = 920 V; $V_{GE}$ = -15...+15 V. | | - | 1700 | 1850 | nC |
| Internal gate resistance | $R_{Gint}$ | $T_{vj}$ = 25°C. | | - | 2.50 | - | Ω |
| Turn-on delay time | $t_{d(on)}$ | $V_{CE}$ = 920 V; $V_{GE}$ = ±15 V; $I_{C\,max}$ = 300 A; $R_G$ = 2.2 Ω; $L_s$ = 56 nH. | $T_{vj}$ = 25°C | 178 | 224 | 270 | ns |
| | | | $T_{vj}$ = 150°C | 208 | 256 | 304 | |
| Rise time | $t_{ri}$ | | $T_{vj}$ = 25°C | 52 | 61 | 70 | ns |
| | | | $T_{vj}$ = 150°C | 59 | 68 | 77 | |
| Turn-on energy | $E_{on}$ | | $T_{vj}$ = 25°C | 24.5 | 43.5 | 62.5 | mJ |
| | | | $T_{vj}$ = 150°C | 46.5 | 74.0 | 101.5 | |
| Turn-off delay time | $t_{d(off)}$ | | $T_{vj}$ = 25°C | 378 | 466 | 554 | ns |
| | | | $T_{vj}$ = 150°C | 514 | 602 | 690 | |
| Fall time | $t_{fi}$ | | $T_{vj}$ = 25°C | 354 | 428 | 502 | ns |
| | | | $T_{vj}$ = 150°C | 494 | 609 | 724 | |
| Turn-off energy | $E_{off}$ | | $T_{vj}$ = 25°C | 58.0 | 67.0 | 76.0 | mJ |
| | | | $T_{vj}$ = 150°C | 82.0 | 96.0 | 110.0 | |
| Collector-emitter threshold voltage | $V_{CE0}$ | $V_{GE}$ = +15 V; $T_{vj}$ = 150°C; $I_{CE1}$ = 75 A; $I_{CE2}$ = 300 A; $t_u$ = 1000 μs. | | 0.91 | 0.97 | 1.03 | V |
| On-State slope resistance (IGBT) | $r_{CE0}$ | | | 4.77 | 5.14 | 5.51 | mΩ |
| Thermal resistance junction to case | $R_{th(j-c)}$ | DC; $I_{CE}$ = 220±10 A; $I_{test}$ = 1.0 A; $V_{GE}$ = +15 V. | | - | 0.068 | 0.081 | K/W |
| **Inverse diode \ Freewheeling diode** | | | | | | | |
| Forward voltage drop | $V_F$ | $I_F$ = 300 A; $V_{GE}$ = 0; $t_u$ = 1000 μs. | $T_{vj}$ = 25°C | 1.75 | 2.05 | 2.35 | V |
| | | | $T_{vj}$ = 150°C | 1.85 | 2.20 | 2.55 | V |
| Reverse recovery time | $t_{rr}$ | $V_{CE}$ = 920 V; $V_{GE}$ = ±15 V; $I_{C\,max}$ = 300 A; $R_{G\,on}$ = 2.2 Ω; $L_s$ = 56 nH. | $T_{vj}$ = 25°C | 239 | 350 | 461 | ns |
| | | | $T_{vj}$ = 150°C | 450 | 666 | 882 | ns |
| Peak reverse current | $I_{RM}$ | | $T_{vj}$ = 25°C | 145 | 225 | 305 | A |
| | | | $T_{vj}$ = 150°C | 165 | 260 | 355 | A |
| Recovered charge | $Q_r$ | | $T_{vj}$ = 25°C | 25.5 | 35.0 | 44.5 | μC |
| | | | $T_{vj}$ = 150°C | 53.5 | 74.0 | 94.5 | μC |
| Reverse recovery energy | $E_{rec}$ | | $T_{vj}$ = 25°C | 18.5 | 29.0 | 39.5 | mJ |
| | | | $T_{vj}$ = 150°C | 37.0 | 54.5 | 72.0 | mJ |
| Threshold voltage | $V_{(T0)}$ | $T_{vj}$ = 150°C; $V_{GE}$ = 0; $I_{CE1}$ = 75 A; $I_{CE2}$ = 300 A; $t_u$ = 1000 μs | | 0.90 | 0.94 | 0.98 | V |
| Forward slope resistance | $r_T$ | | | 3.92 | 4.20 | 4.48 | mΩ |
| Thermal resistance junction to case | $R_{th(JC-D)}$ | DC; $I_{CE}$ = 200±10 A; $I_{test}$ = 1.0 A; $V_{GE}$ = +15 V. | | - | 0.193 | 0.222 | K/W |

| Module | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pin resistance | $R_{Pxy}$ | $T_{vj}$ = 25°C. | $R_{P12}$ | - | 0.28 | 0.50 | mΩ |
| | | | $R_{P13}$ | - | 0.38 | 0.50 | |
| Parasitic inductance between terminals | $L_{Pce}$ | | | - | 22 | - | nH |
| Thermal resistance case to heatsink | $R_{thCH}$ | per module | | - | 0.02 | 0.04 | K/W |
| Mounting torque for screws to heatsink | $M_s$ | to heatsink M6 | | 3 | - | 5 | N*m |
| Mounting torque for terminal screws | $M_t$ | to terminals M6 | | 2.25 | 2.50 | 2.75 | N*m |
| Weight | W | | | - | 318 | 340 | g |

## Notes:

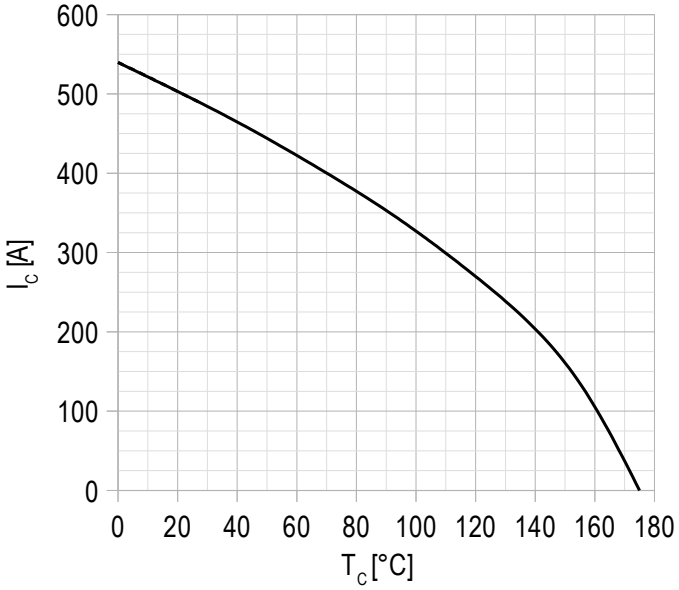
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature $T_{vj\ op}$ = -40...+150°C.

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



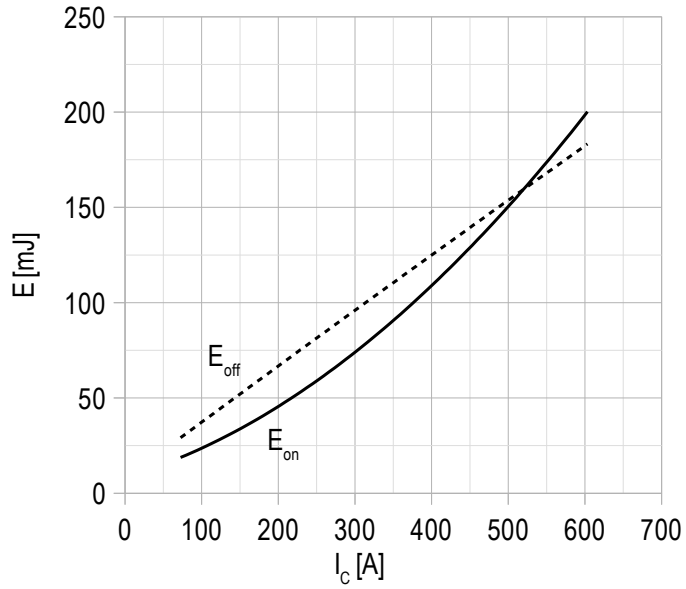

$V_{GE}$ = +15 V.

## Chart 2 – max. rated current vs temperature.



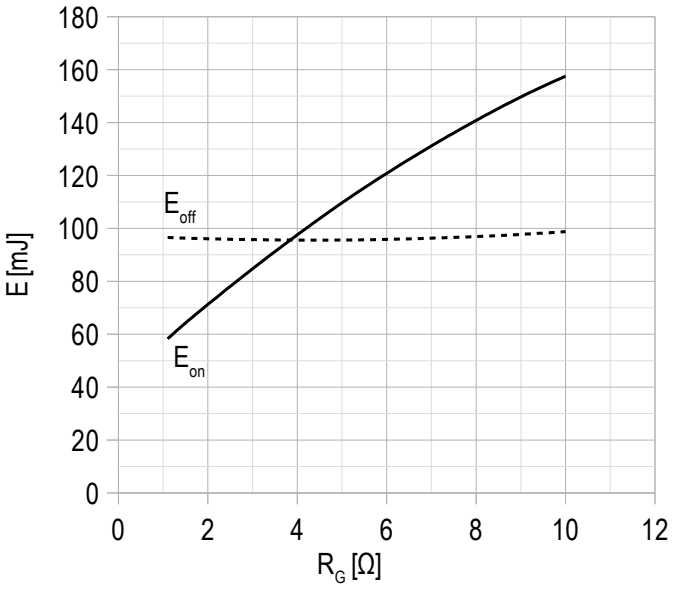

DC;
$V_{GE}$ = +15 V;
$T_{vj\ (max)}$ = 175°C.

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



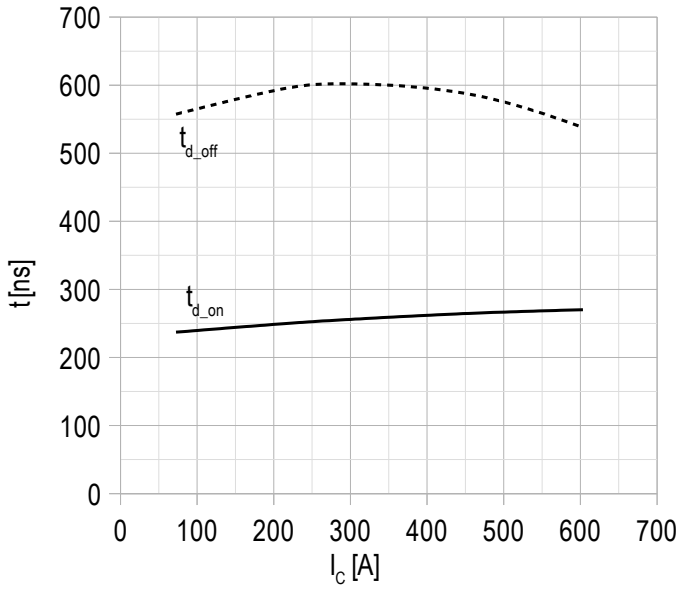

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$R_G$ = 2.2 Ω;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



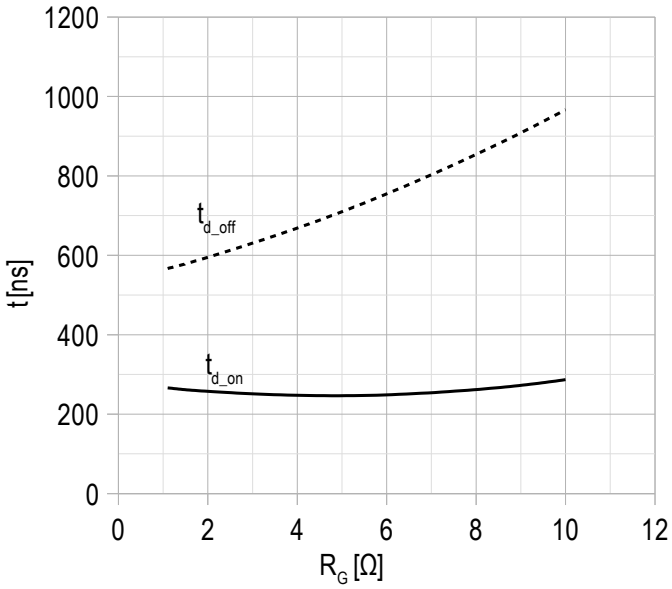

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$I_{Cmax}$ = 300 A;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



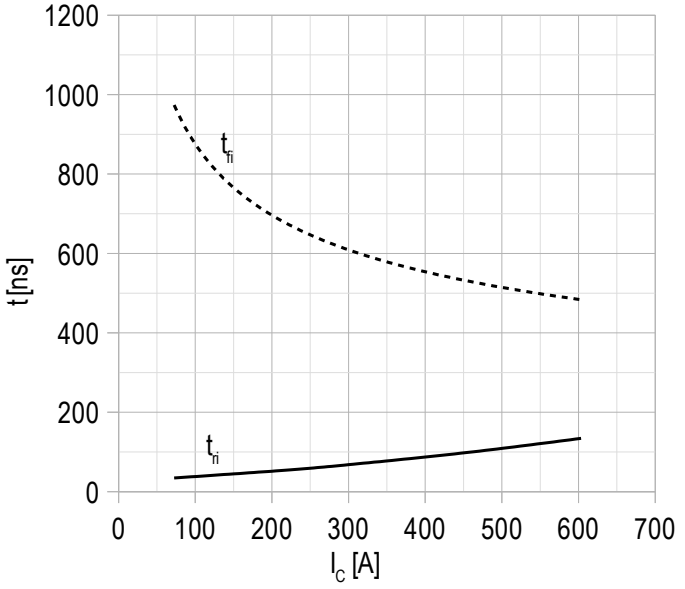

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$R_G$ = 2.2 Ω;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



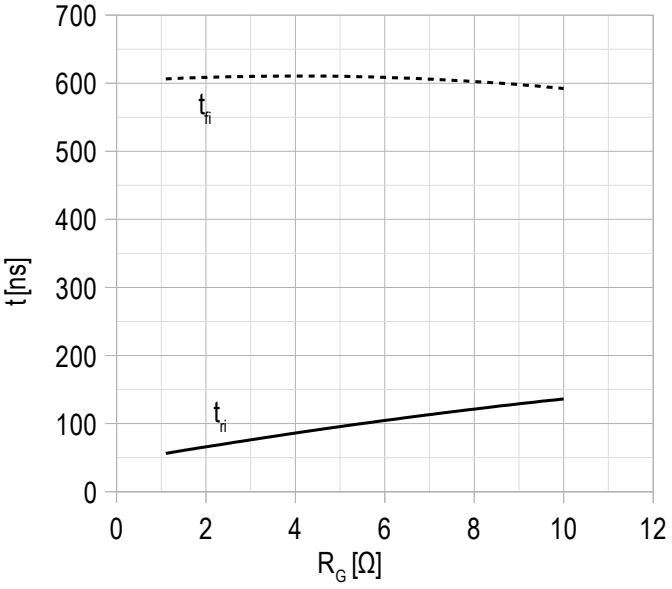

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 300 A;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



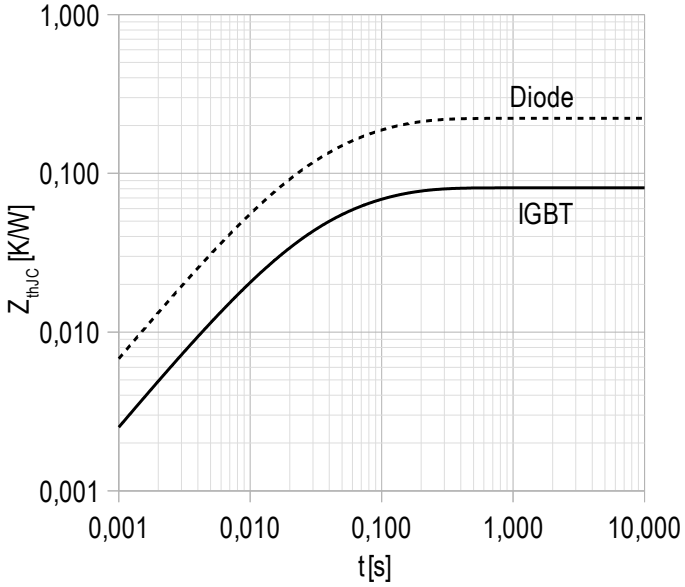

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$R_G$ = 2.2 Ω;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



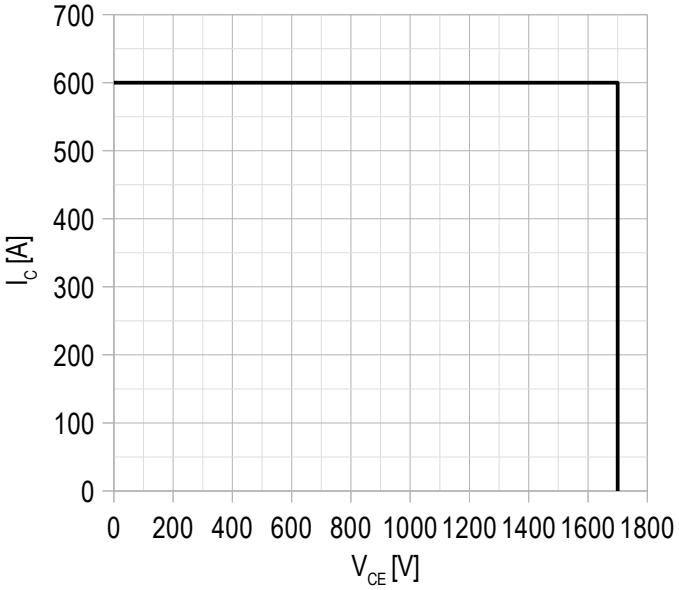

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 300 A;
$L_s$ = 56 nH.
$T_{vj\ (max)}$ = 150°C.

## Chart 9 – max. transient thermal impedance .



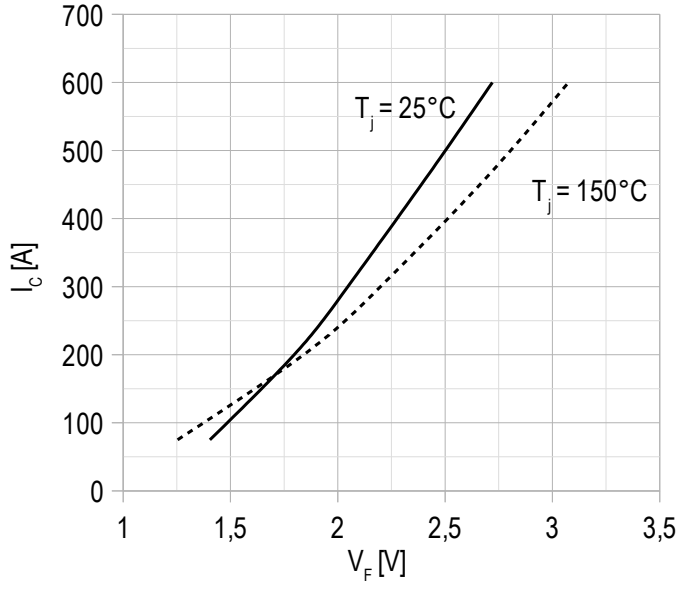

Single pulse;
$V_{GE}$ = +15 V.

## Chart 10 – RBSOA.



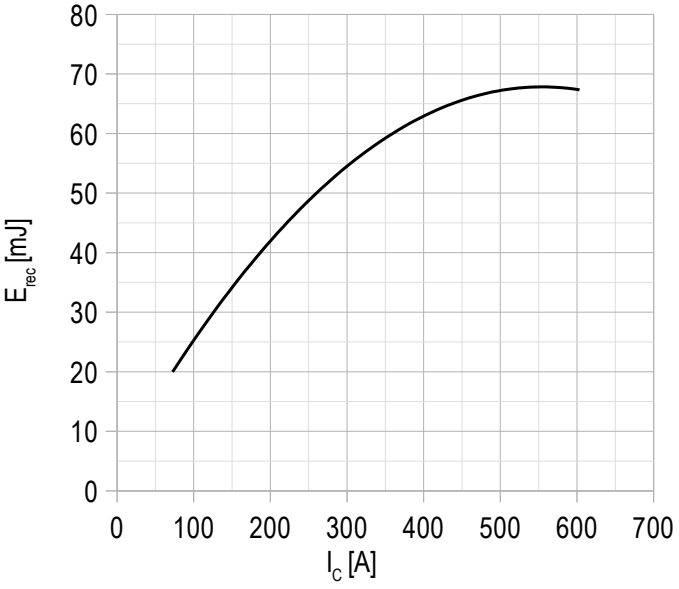

$V_{CE\ max}$ = 1700 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 2*$I_{C\ nom}$;
$R_G$ = 2.2 Ω;
$L_s$ = 56 nH.

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



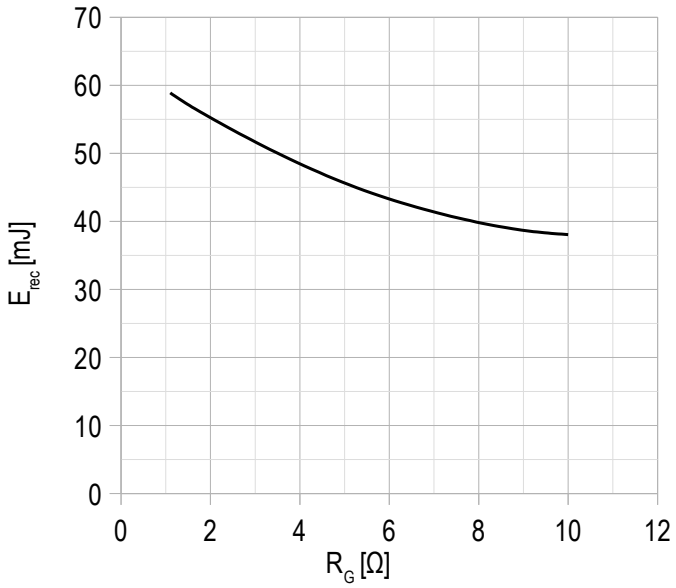

$V_{GE}$ = 0 V.

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



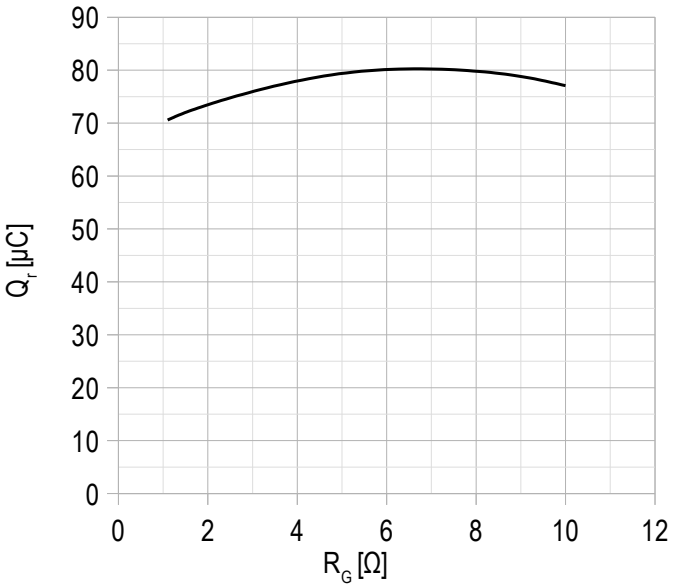

$V_{GE}$ = ±15 V;
$V_{CE}$ = 920 V;
$L_s$ = 56 nH;
$R_{G\ on}$ = 2.2 Ω;
$T_{vj\ (max)}$ = 150°C.

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



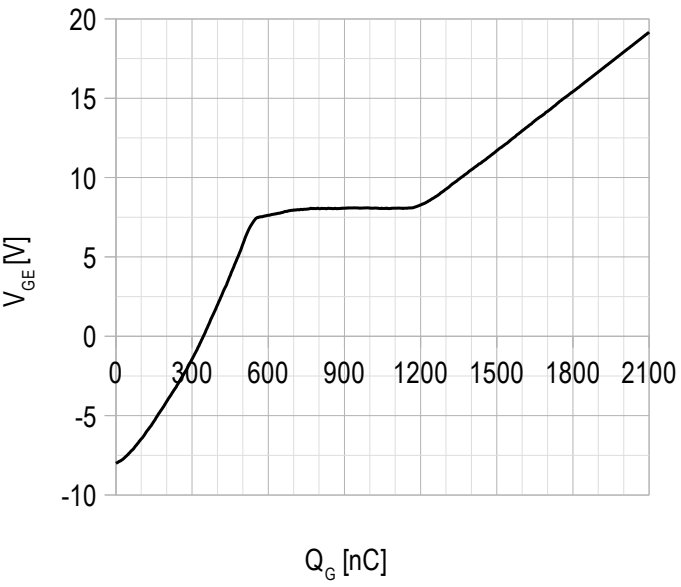

$V_{GE}$ = ±15 V;
$V_{CE}$ = 920 V;
$I_{C\ max}$ = 300 A;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

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



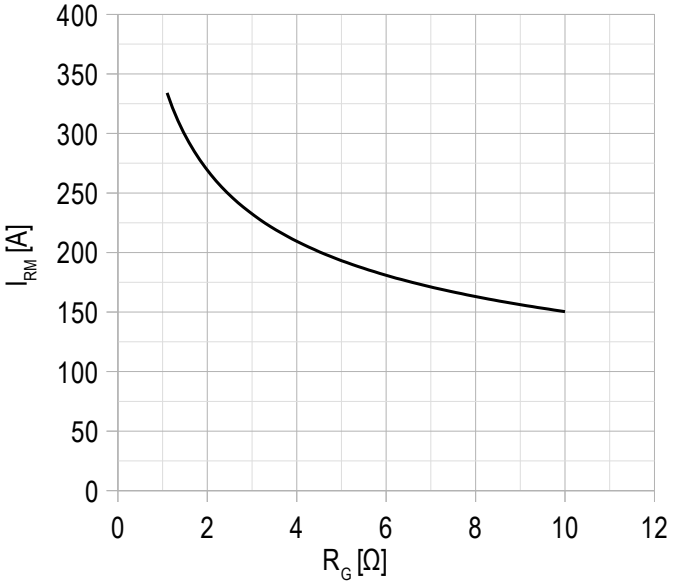

$V_{GE}$ = ±15 V;
$V_{CE}$ = 920 V;
$I_{C\ max}$ = 300 A;
$L_s$ = 56 nH;
$T_{vj\ (max)}$ = 150°C.

## Chart 15 – typ. gate charge characteristic.



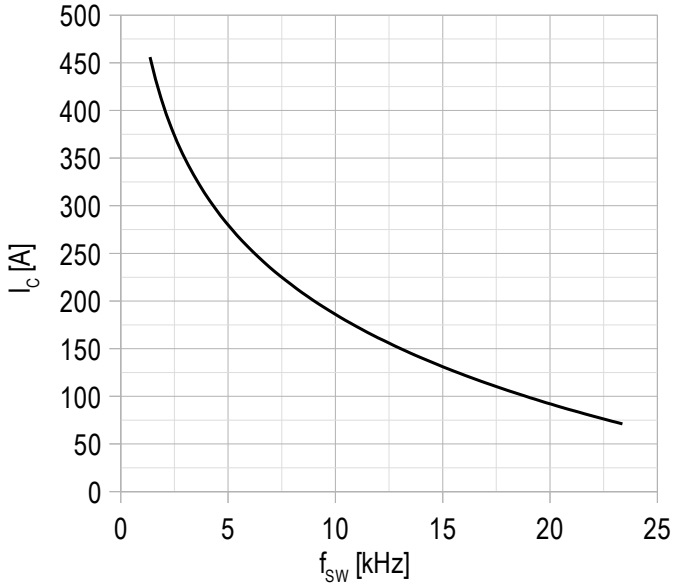

$I_C$ = 300 A;
$V_{CE}$ = 920 V;
$V_{GE}$ = - 8÷15 V.

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



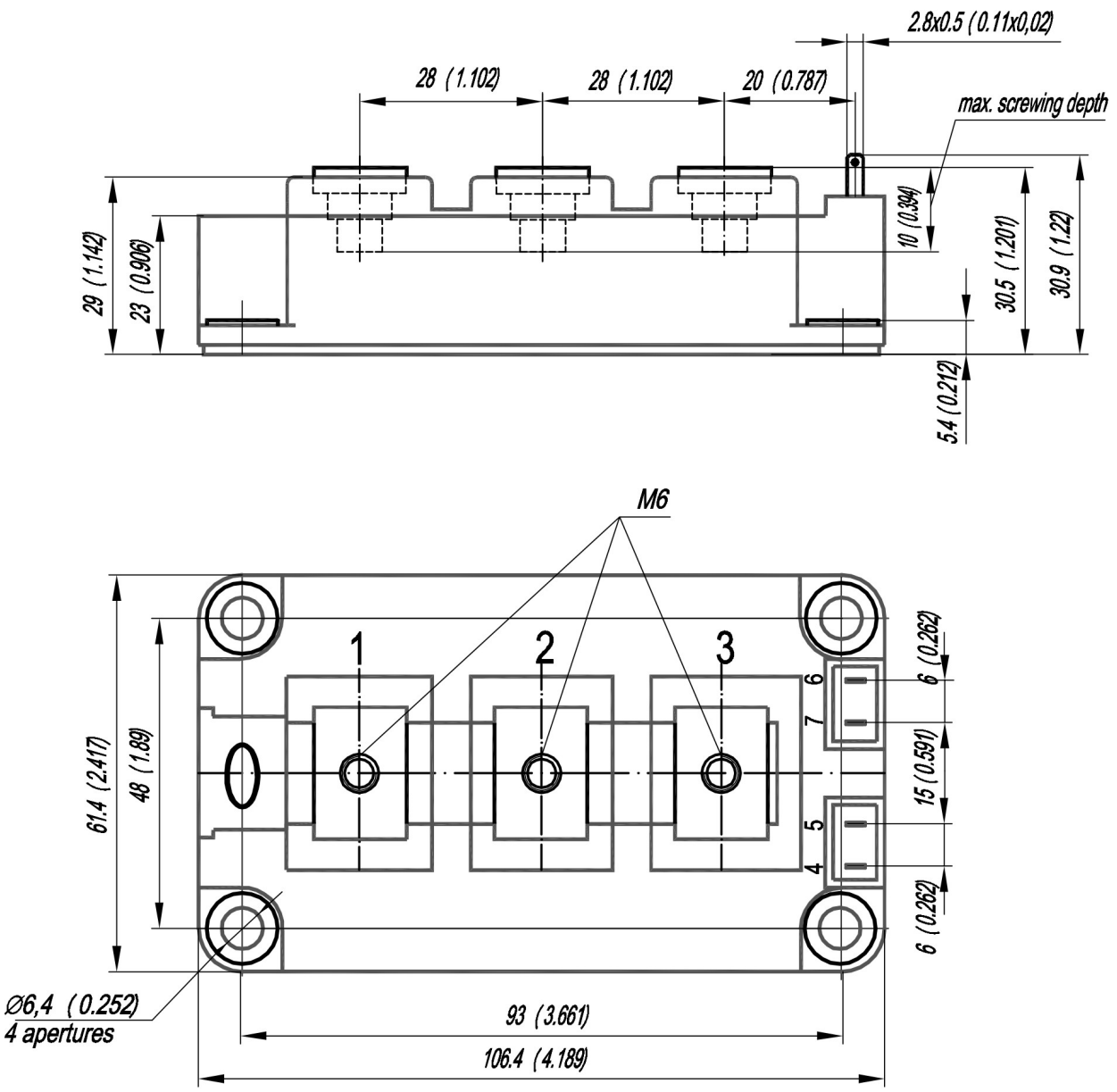

$V_{CE}$ = 920 V;
$V_{GE}$ = ±15 V;
$L_s$ = 56 nH.
$T_{vj\ (max)}$ = 150°C.

**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 – AA




## Part numbering guide

| MIAA | - | HB | 17 | SA | - | 300 | N | |
|---|---|---|---|---|---|---|---|---|
| MIAA | | | | | | | | IGBT module package type: AA |
| | | HB | | | | | | 2 switches as Half-Bridge |
| | | | 17 | | | | | Voltage rating ($V_{CES}$/100) |
| | | | | SA | | | | IGBT+FRD chipset modification |
| | | | | | | 300 | | Current Rating |
| | | | | | | | N | Climatic version: normal climate |