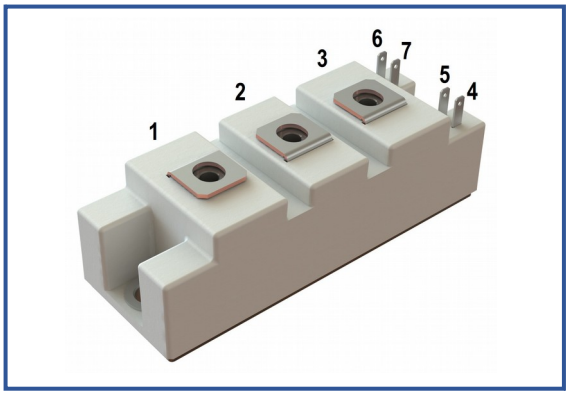
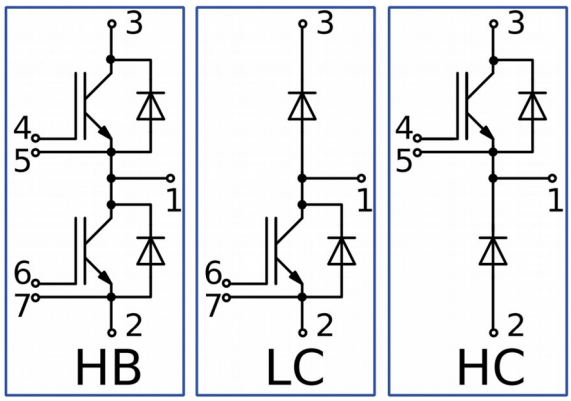
# MIFA-HB12FA-150N

IGBT module datasheet

## Industry standard 34mm IGBT module

**1200 V 150 A**




### Chip features

- IGBT chip
  - Trench FS — V-Series IGBT (6 th gen)
  - 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 termal cycling
- RoHS compliant
- UL certified file-No. E255404

### 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. | 1200 | V |
| Collector current (nominal) | $I_{C\ nom}$ | | 150 | A |
| Collector current (maximum continuous) | $I_{C\ 25}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 25°C. | 233 | A |
| | $I_{C\ 80}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 80°C. | 150 | A |
| Repetitive peak collector current*1 | $I_{CRM}$ | $I_{CRM}$ = 3 x $I_{C\ nom}$; $t_p$ = 1 ms. | 450 | 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; $I_{C\ max}$ < 1100 A. | 10 | µs |
| | | $T_{vj}$ = 150°C; $V_{GE}$ = ±15 V; $V_{CE}$ = 700 V; $R_{G\ on}$ = $R_{G\ off}$ = 2.2 Ω; $I_{C\ max}$ < 1100 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. | 1200 | V |
| Forward current (nominal) | $I_{F\ nom}$ | | 150 | A |
| Forward current (maximum continuous) | $I_{F\ 25}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 25°C. | 193 | A |
| | $I_{F\ 80}$ | $T_{vj\ (max)}$ = 175°C; $T_c$ = 80°C. | 146 | A |
| Repetitive peak forward current*1 | $I_{FRM}$ | $I_{FRM}$ = 3 x $I_{F\ nom}$; $t_p$ = 1 ms. | 450 | 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

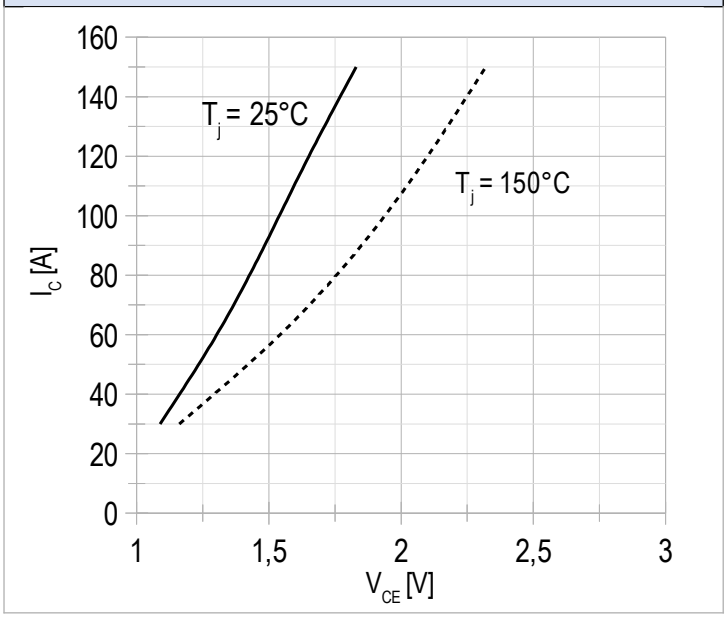
| Definition | Symbol | Conditions | | Value min. | Value typ. | Value max. | Unit |
|---|---|---|---|---|---|---|---|
| **IGBT** | | | | | | | |
| Collector-Emitter saturation voltage | $V_{CEsat}$ | $V_{GE}$ = +15 V; $I_C$ = 150 A; $t_u$ = 1000 µs. | $T_{vj}$ = 25°C | 1.79 | 1.83 | 1.90 | V |
| | | | $T_{vj}$ = 150°C | 2.26 | 2.32 | 2.50 | V |
| Gate-Emitter threshold voltage | $V_{GE(th)}$ | $I_C$ = 1.6 mA; $V_{CE}$ = $V_{GE}$; $T_{vj}$ = 25°C; $t_u$ = 2 ms. | | 5.66 | 6.04 | 6.47 | V |
| Collector-Emitter cut-off current | $I_{CES}$ | $V_{CE}$ = 1200 V; $t_u$ = 10 ms; $V_{GE}$ = 0. | $T_{vj}$ = 25°C | 2.67 | 3.02 | 300 | µA |
| | | | $T_{vj}$ = 150°C | 0.77 | 0.98 | 3.00 | mA |
| Gate-Emitter leakage current | $I_{GES}$ | $V_{CE}$ = 0; $V_{GE}$ = ±20 V; $T_{vj}$ = 25°C; $t_u$ = 30 ms. | | 12.4 | 15.6 | 125 | nA |
| Input capacitance | $C_{ies}$ | $V_{CE}$ = 10 V; $V_{GE}$ = 0 V; f = 1 MHz; $T_{vj}$ = 25°C. | | - | 13.8 | - | nF |
| Output capacitance | $C_{oes}$ | | | - | 1.00 | - | nF |
| Reverse transfer capacitance | $C_{res}$ | | | - | 1.20 | - | nF |
| Total gate charge | $Q_G$ | $I_C$ = 150 A; $V_{CE}$ = 600 V; $V_{GE}$ = - 8÷15 V. | | - | 1565 | 1676 | нС |
| Internal gate resistance | $R_{Gint}$ | $T_{vj}$ = 25°C. | | - | 5.00 | - | Ω |
| Turn-on delay time | $t_{d(on)}$ | $V_{CE}$ = 600 V; $V_{GE}$ = ±15 V; $I_{C\,max}$ = 150 A; $R_G$ = 2.2 Ω; L = 300 µH. | $T_{vj}$ = 25°C | 336 | 346 | 410 | ns |
| | | | $T_{vj}$ = 150°C | 378 | 391 | 450 | ns |
| Rise time | $t_{ri}$ | | $T_{vj}$ = 25°C | 46.0 | 49.0 | 58.0 | ns |
| | | | $T_{vj}$ = 150°C | 51.0 | 54.0 | 66.0 | ns |
| Turn-on energy | $E_{on}$ | | $T_{vj}$ = 25°C | 5.23 | 6.17 | 9.0 | mJ |
| | | | $T_{vj}$ = 150°C | 9.95 | 11.2 | 16.0 | mJ |
| Turn-off delay time | $t_{d(off)}$ | | $T_{vj}$ = 25°C | 409 | 419 | 470 | ns |
| | | | $T_{vj}$ = 150°C | 472 | 488 | 580 | ns |
| Fall time | $t_{fi}$ | | $T_{vj}$ = 25°C | 184 | 231 | 320 | ns |
| | | | $T_{vj}$ = 150°C | 327 | 357 | 490 | ns |
| Turn-off energy | $E_{off}$ | | $T_{vj}$ = 25°C | 11.5 | 12.4 | 18.0 | mJ |
| | | | $T_{vj}$ = 150°C | 15.8 | 16.7 | 23.0 | mJ |
| Collector-emitter threshold voltage | $V_{CE0}$ | $V_{GE}$ = +15 V; $T_{vj}$ = 150°C; $I_{CE1}$ = 38 A; $I_{CE2}$ = 150 A; $t_u$ = 1000 µs. | | 0.84 | 0.85 | 0.90 | V |
| On-State slope resistance (IGBT) | $r_{CE0}$ | | | 9.46 | 9.76 | 10.7 | mΩ |
| Thermal resistance junction to case | $R_{th(j-c)}$ | DC; $I_{CE}$ = 150 A; $I_{test}$ = 0.5 A; $V_{GE}$ = +15 V. | | - | 0.146 | 0.230 | K/W |
| **Inverse diode \ Freewheeling diode** | | | | | | | |
| Forward voltage drop | $V_F$ | $I_F$ = 150 A; $V_{GE}$ = 0; $t_u$ = 1000 µs. | $T_{vj}$ = 25°C | 1.82 | 1.86 | 1.96 | V |
| | | | $T_{vj}$ = 150°C | 1.91 | 1.95 | 2.10 | V |
| Reverse recovery time | $t_{rr}$ | $V_{GE}$ = ±15 V; $V_{CE}$ = 600 V; $I_{C\,max}$ = 150 A; L = 300 µH; $R_{G\,on}$ = 2.2 Ω. | $T_{vj}$ = 25°C | 119 | 123 | 140 | ns |
| | | | $T_{vj}$ = 150°C | 169 | 179 | 210 | ns |
| Peak reverse recovery current | $I_{rrM}$ | | $T_{vj}$ = 25°C | 135 | 141 | 170 | A |
| | | | $T_{vj}$ = 150°C | 166 | 175 | 220 | A |
| Reverse recovered charge | $Q_{rr}$ | | $T_{vj}$ = 25°C | 10.0 | 10.0 | 12.0 | µC |
| | | | $T_{vj}$ = 150°C | 17.0 | 18.0 | 21.0 | µC |
| Reverse recovery energy | $E_{rec}$ | | $T_{vj}$ = 25°C | 5.00 | 5.00 | 7.00 | mJ |
| | | | $T_{vj}$ = 150°C | 13.0 | 14.0 | 18.0 | mJ |
| Threshold voltage | $V_{(T0)}$ | $T_{vj}$ = 150°C; $V_{GE}$ = 0; $I_{CE1}$ = 38 A; $I_{CE2}$ = 150 A; $t_u$ = 1000 µs | | 0.82 | 0.83 | 0.84 | V |
| Forward slope resistance | $r_T$ | | | 7.23 | 7.53 | 8.15 | mΩ |
| Thermal resistance junction to case | $R_{th(JC-D)}$ | DC; $I_{CE}$ = 120 A; $I_{test}$ = 0.5 A; $V_{GE}$ = +15 V. | | - | 0.260 | 0.340 | K/W |

| Module | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pin resistance | $R_{Pxy}$ | $T_{vj}$ = 25°C. | $R_{P12}$ | - | 0.47 | 0.50 | mΩ |
| | | | $R_{P13}$ | - | 0.66 | 0.66 | |
| Parasitic inductance between terminals | $L_{Pxy}$ | $T_{vj}$ = 25°C; f = 1 MHz. | $L_{P12}$ | - | 34.5 | 35.0 | nH |
| | | | $L_{P13}$ | - | 52.3 | 60.0 | |
| 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 | | 3.00 | - | 5.00 | Nm |
| Mounting torque for terminal screws | $M_t$ | to terminals M5 | | 1.80 | 2.00 | 2.20 | Nm |
| Weight | W | | | - | 150 | 170 | g |

## Notes:

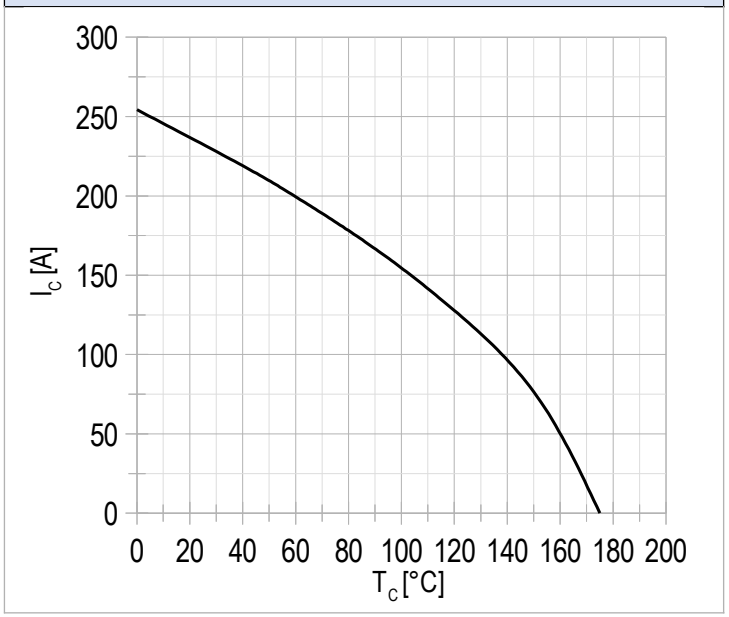
- Insulating material operating temperature 125°C max;
- Case temperature 125°C max;
- The recommended operating junction temperature $T_{vj\ op}$ = - 40 ÷ +150°C.

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



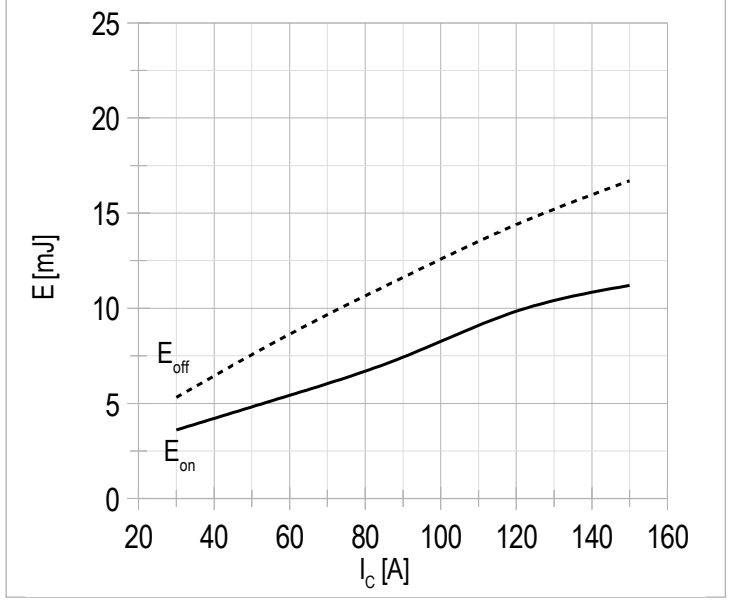

$V_{GE}$ = +15 V.

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



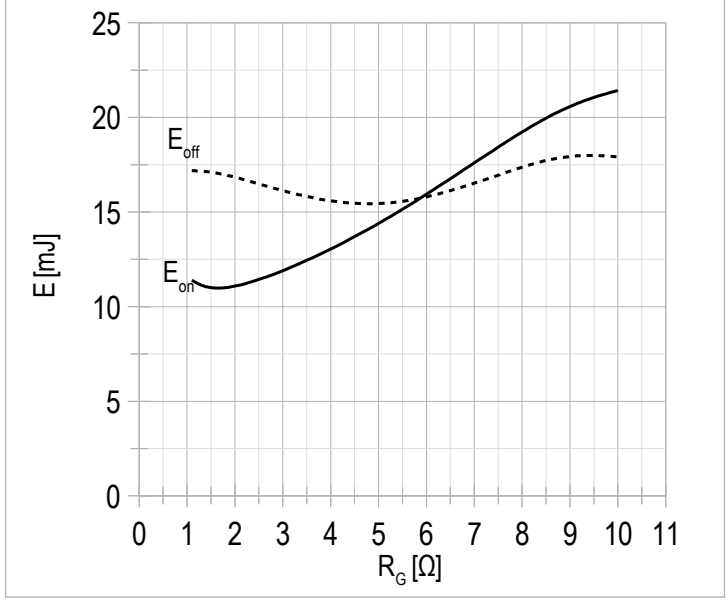

DC;
$V_{GE}$ = +15 V;
$T_{vj\ (max)}$ = 150°C.

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



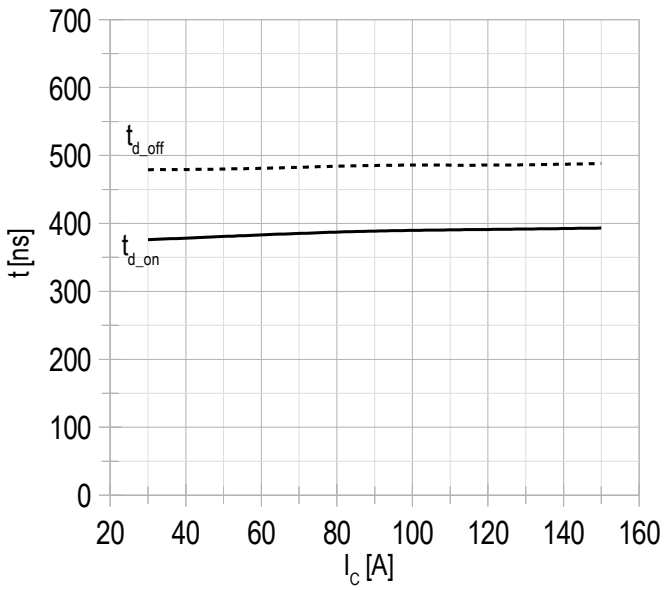

$V_{CE}$ = 600 V;
$V_{GE}$ = ±15 V;
$R_G$ = 2.2 Ω;
L = 300 µH;
$T_{vj\ (max)}$ = 150°C.

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



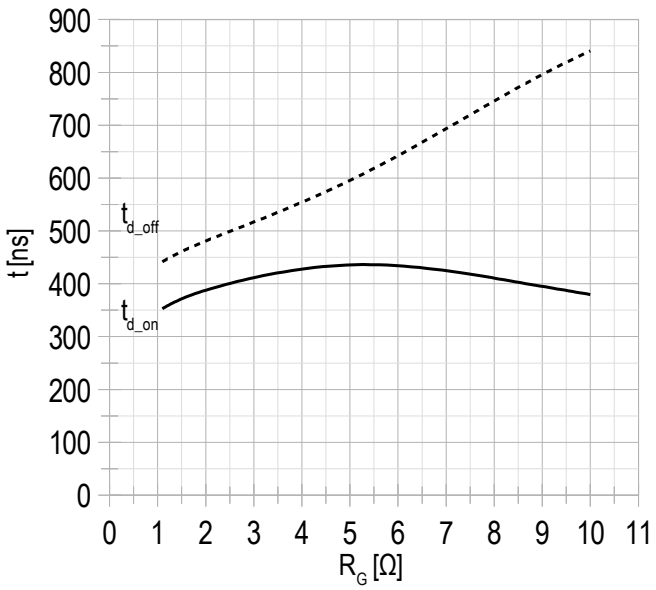

$V_{CE}$ = 600 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 150 A;
L = 300 µH;
$T_{vj\ (max)}$ = 150°C.

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



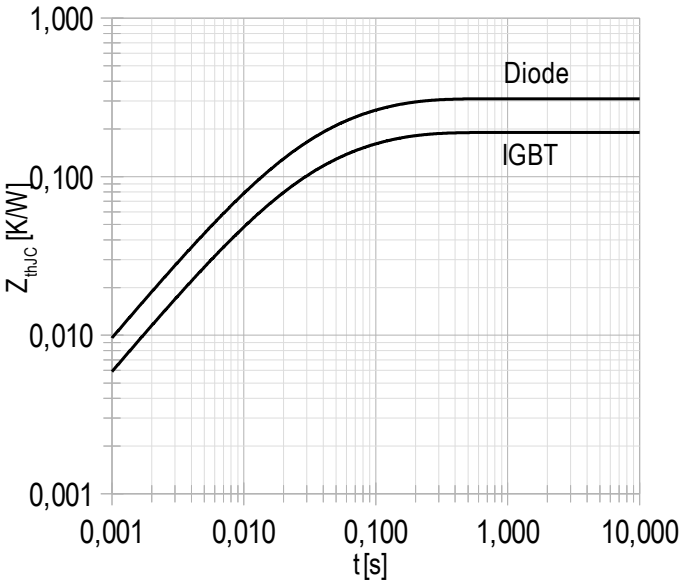

$V_{CE}$ = 600 V;
$V_{GE}$ = ±15 V;
$R_G$ = 2.2 Ω;
L = 300 µH;
$T_{vj\ (max)}$ = 150°C.

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



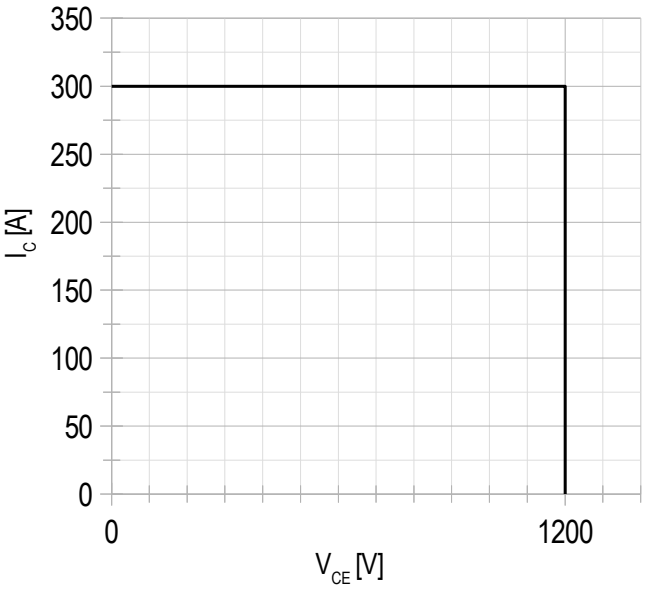

$V_{CE}$ = 600 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 150 A;
L = 300 µH;
$T_{vj\ (max)}$ = 150°C.

## Chart 7 – max. transient thermal impedance.



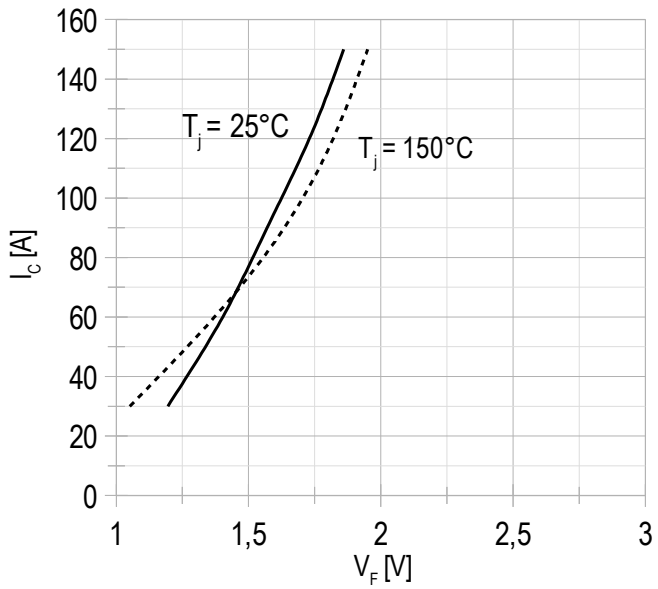

Single pulse;
$V_{GE}$ = +15 V.

## Chart 8 – RBSOA.



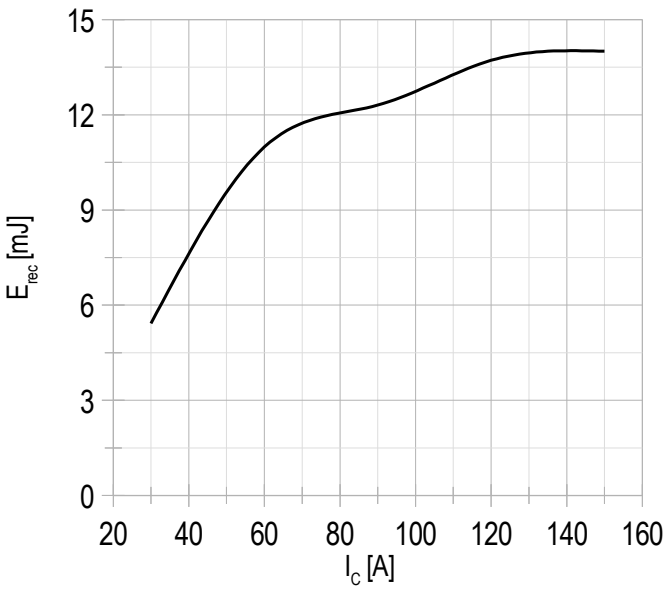

$V_{CE\ max}$ = 1200 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 2*$I_{C\ nom}$;
L = 300 µH.

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



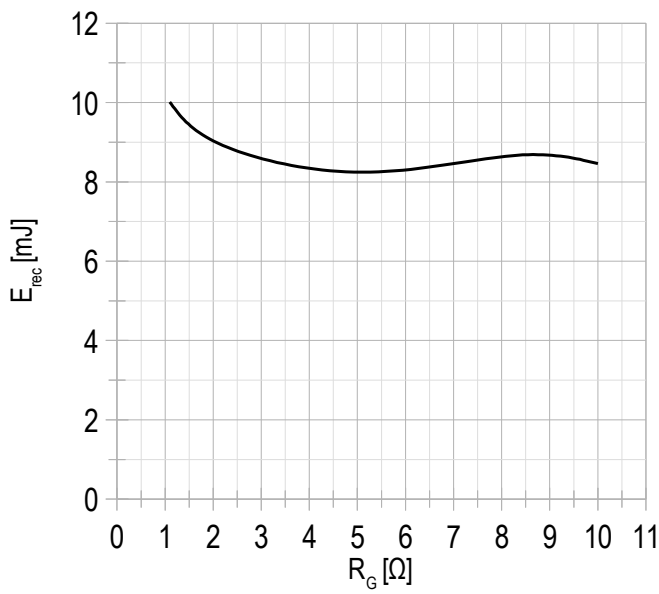

$V_{GE}$ = +15 V.

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



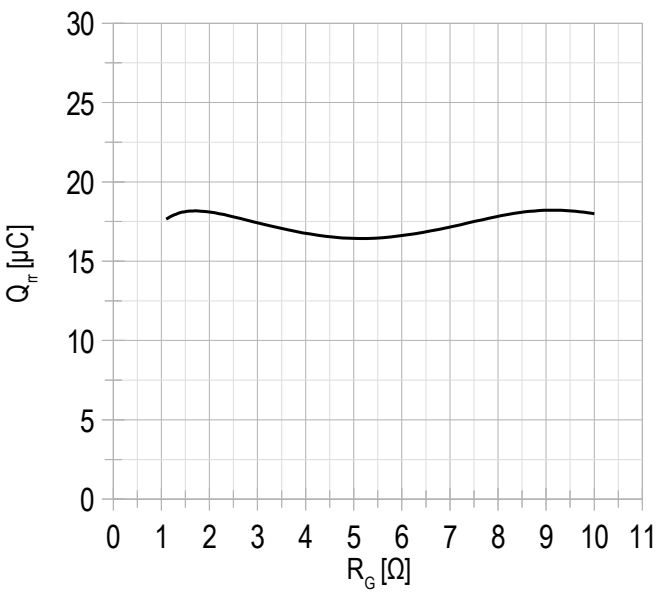

$V_{GE}$ = ±15 V;
$V_{CE}$ = 600 V;
L = 300 µH;
$R_G$ = 2.2 Ω;
$T_{vj\ (max)}$ = 150°C.

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



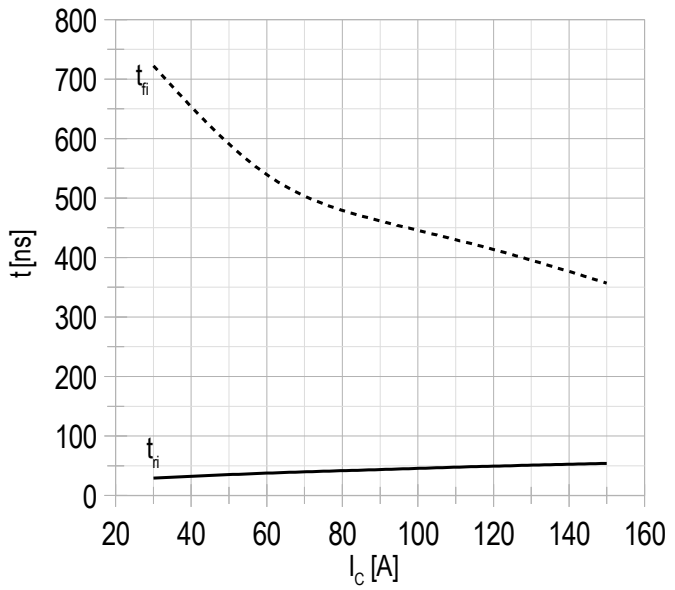

$V_{GE}$ = ±15 V;
$V_{CE}$ = 600 V;
$I_{C\ max}$ = 150 A;
L = 300 µH;
$T_{vj\ (max)}$ = 150°C.

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



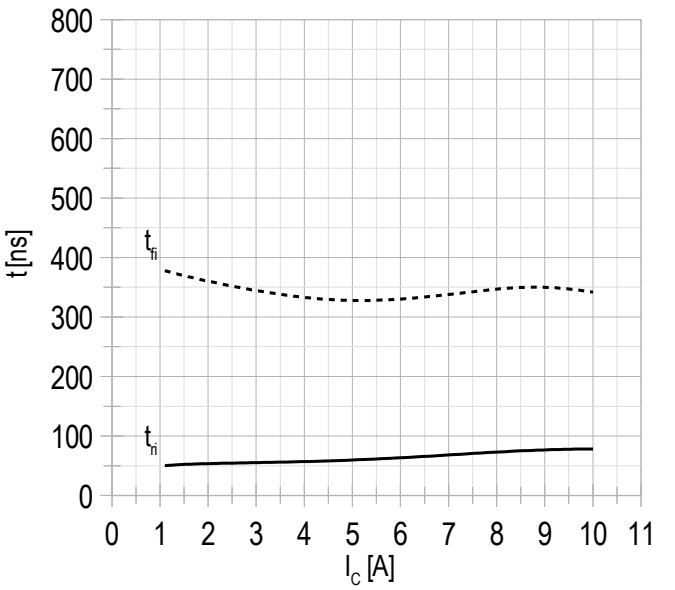

$V_{GE}$ = ±15 V;
$V_{CE}$ = 600 V;
$I_{C\ max}$ = 150 A;
L = 300 µH;
$T_{vj\ (max)}$ = 150°C.

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



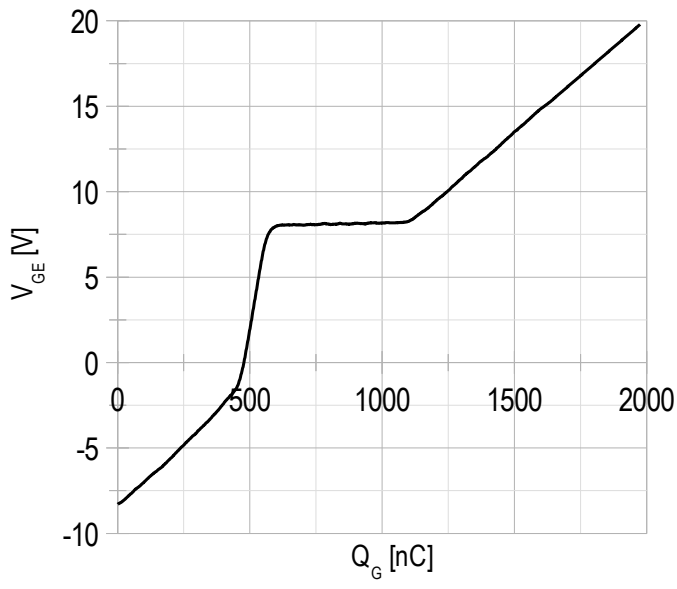

$V_{CE}$ = 600 V;
$V_{GE}$ = ±15 V;
$R_G$ = 2.2 Ω;
L = 300 µH.
$T_{vj\ (max)}$ = 150°C.

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



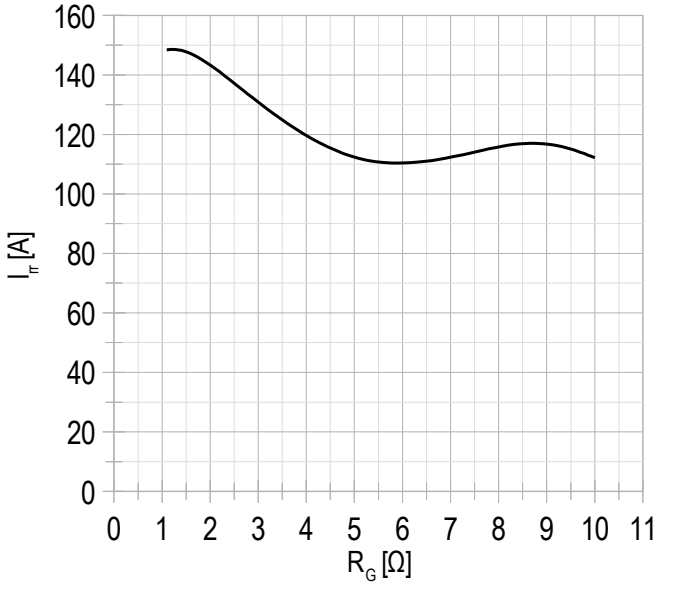

$V_{CE}$ = 600 V;
$V_{GE}$ = ±15 V;
$I_{C\ max}$ = 150 A;
L = 300 µH.
$T_{vj\ (max)}$ = 150°C.

## Chart 15 – typ. gate charge characteristic.



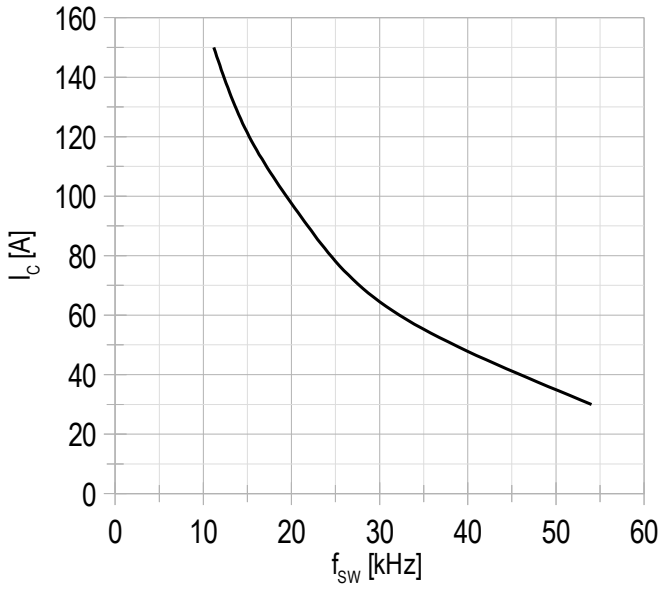

$I_C$ = 150 A;
$V_{CE}$ = 600 V;
$V_{GE}$ = - 8÷15 V.

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



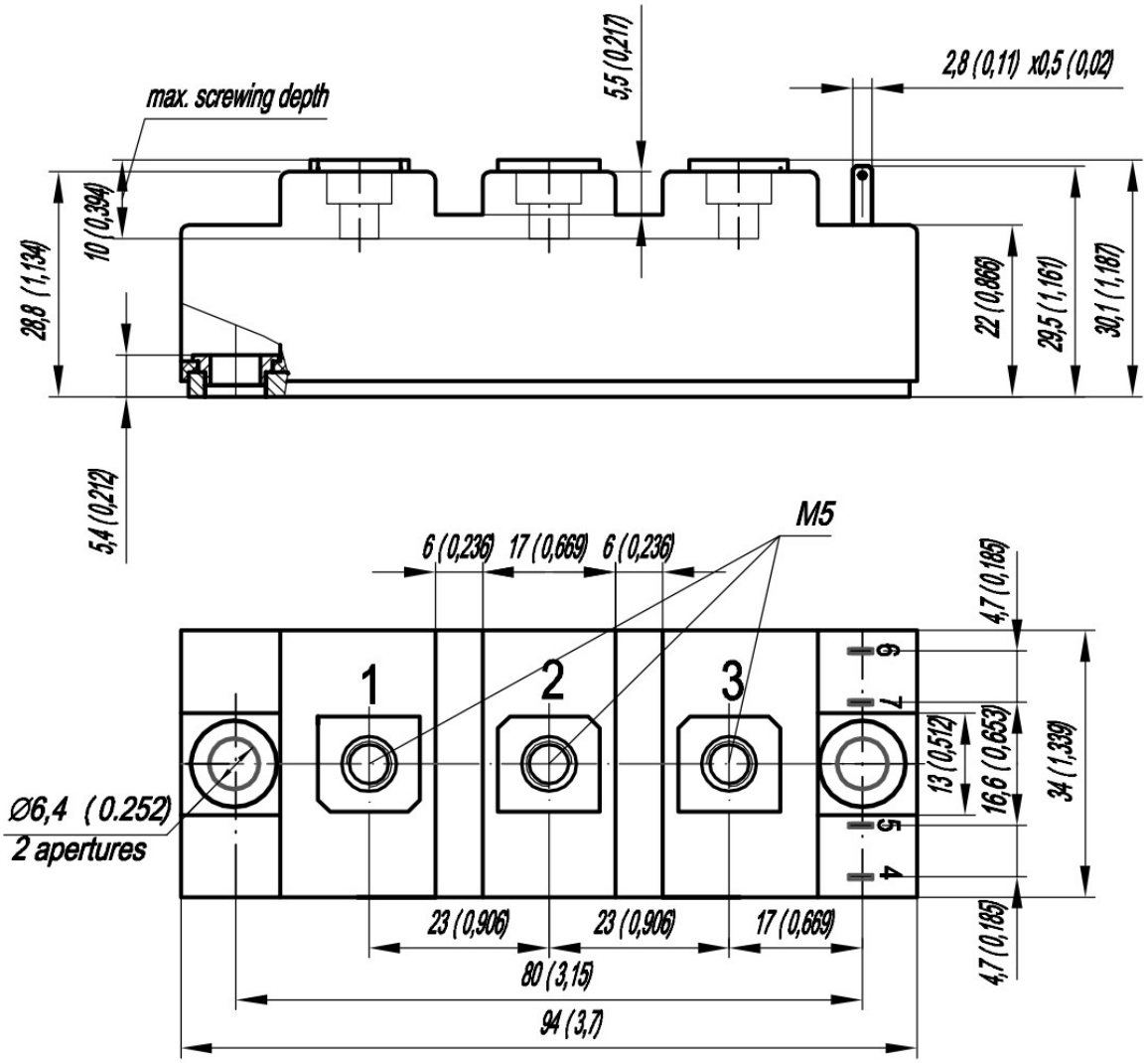

$V_{CE}$ = 600 V;
$V_{GE}$ = ±15 V;
L = 300 µH.
$T_{vj\ (max)}$ = 150°C.

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




Duty cycle 50%

## **Overall dimensions**: Package type – FA




## Part numbering guide

| MIFA | - | HB | 12 | FA | - | 150 | N | |
|---|---|---|---|---|---|---|---|---|
| MIFA | | | | | | | | IGBT module package type: FA |
| | | HB | | | | | | 2 switches as Half-Bridge |
| | | HC | | | | | | 1 switch as High-Side chopper |
| | | LC | | | | | | 1 switch as Low-Side chopper |
| | | | 12 | | | | | Voltage rating ($V_{CES}$/100) |
| | | | | FA | | | | IGBT+FRD chipset modification |
| | | | | | | 150 | | Current Rating |
| | | | | | | | N | Climatic version: normal climate |