# 2MBI600XDE120-50

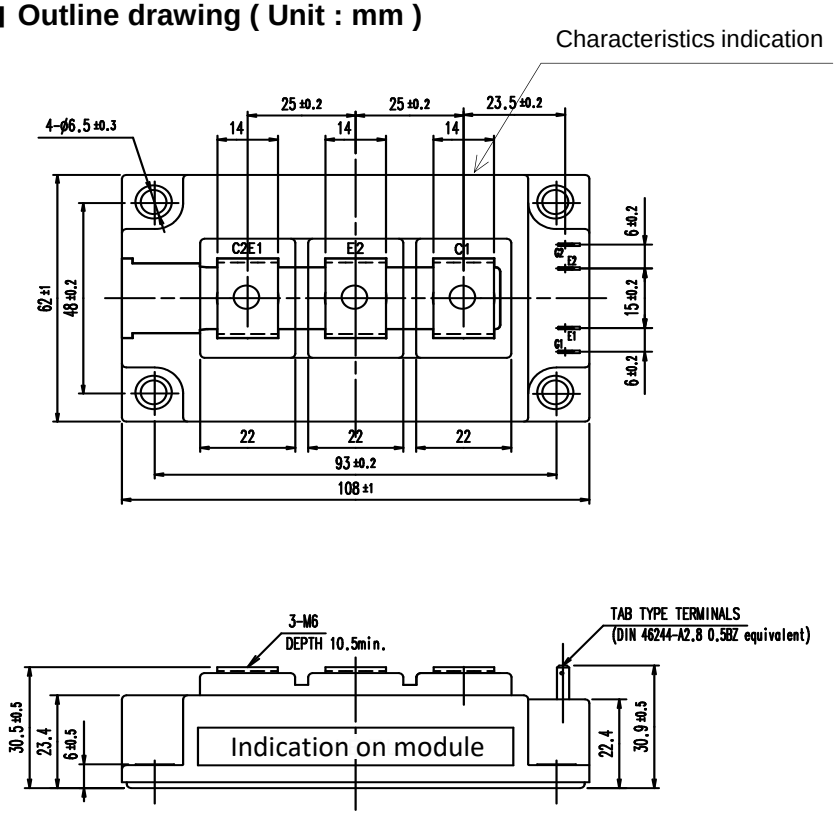
**IGBT Modules**

## Power Module (X series)
## 1200V / 600A / 2-in-1 package

### ■ Features
Low $V_{CE(sat)}$
High speed switching
Low Inductance Module structure

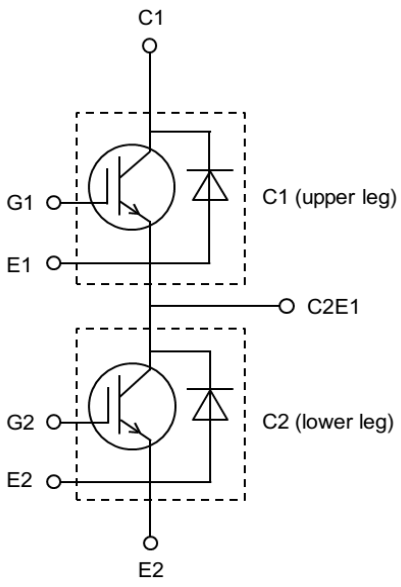
### ■ Applications
Inverter for Motor Drives, AC and DC Servo Drives
Uniterruptible Power Supply Systems,
Industrial machines,such as Welding machines

### ■ Outline drawing ( Unit : mm )




Weight: 370g(typ.)

### ■ Equivalent Circuit






FM5F9212
2018/07

# 2MBI600XDE120-50



## ■ Absolute Maximum Ratings (at $T_C$= 25°C unless otherwise specified)

| Items | | Symbols | Conditions | Maximum Ratings | Units |
|---|---|---|---|---|---|
| Collector-Emitter voltage,Gate-Emitter short-circuited | | $V_{CES}$ | | 1200 | V |
| Gate-Emitter voltage,Collector-Emitter short-circuited | | $V_{GES}$ | | ±20 | V |
| Collector current | | $I_C$ | Continuous $T_C$=100°C | 600 | A |
| Repetitive peak collector current | | $I_{CRM}$ | 1ms | 1200 | |
| Forward current | | $I_F$ | | 600 | |
| Repetitive peak forward current | | $I_{FRM}$ | 1ms | 1200 | |
| Total power dissipation | | $P_{tot}$ | 1 device | 3655 | W |
| Virtual Junction temperature | | $T_{vj}$ | | 175 | °C |
| Operating virtual junction temperature | | $T_{vjop}$ | | 175 | |
| Case temperature | | $T_c$ | | 125 | |
| Storage temperature | | $T_{stg}$ | | -40 ~ 125 | |
| Isolation voltage | between terminal and copper base (*1) | $V_{isol}$ | AC: 1min. | 4000 | Vrms |
| Mounting torque of screws to heat sink(*2) | | $M_s$ | M5 or M6 | 6.0 | N m |
| Mounting torque of screws to terminals(*2) | | $M_t$ | M6 | 5.0 | |

(*1) All terminals should be connected together during the test.
(*2) Recommendable Value: Mounting 3.0 ~ 6.0N·m (M5 or M6)
Recommendable Value: Terminals 2.5 ~ 5.0 N·m (M6)

## ■ Electrical characteristics (at $T_{vj}$= 25°C unless otherwise specified)

| Items | Symbols | Conditions | | Characteristics min. | Characteristics typ. | Characteristics max. | Units |
|---|---|---|---|---|---|---|---|
| Collector-Emitter cut -off current,Gate-Emitter short - circuited | $I_{CES}$ | $V_{GE}$= 0V<br>$V_{CE}$= 1200V | | - | - | 200 | μA |
| Gate leakage current,Collector-Emitter short-circuited | $I_{GES}$ | $V_{CE}$=0V, $V_{GE}$=±20V | | - | - | 400 | nA |
| Gate-Emitter threshold voltage | $V_{GE(th)}$ | $V_{CE}$= 20V<br>$I_C$= 600mA | | 6.0 | 6.5 | 7.0 | V |
| Collector-Emitter saturation voltage | $V_{CE(sat)}$ (terminal) | $V_{GE}$ = 15V<br>$I_C$= 600A | $T_{vj}$=25°C | - | 1.70 | 2.15 | V |
| | $V_{CE(sat)}$ (chip) | | $T_{vj}$=25°C | - | 1.45 | 1.90 | |
| | | | $T_{vj}$=125°C | - | 1.85 | - | |
| | | | $T_{vj}$=150°C | - | 1.90 | - | |
| | | | $T_{vj}$=175°C | - | 2.00 | - | |
| Internal gate resistance | $r_g$ | - | | - | 1.63 | - | Ω |
| Input capacitance | $C_{ies}$ | $V_{CE}$=10V, $V_{GE}$=0V, f=1MHz | | - | 63 | - | nF |
| Output capacitance | $C_{oes}$ | | | - | 2.1 | - | |
| Reverse transfer capacitance | $C_{res}$ | | | - | 0.56 | - | |
| Gate charge | $Q_G$ | $V_{CC}$= 600V, $I_C$= 600A<br>$V_{GE}$= -15 → +15V | | - | 4.0 | - | μC |
| Forward voltage | $V_F$ (terminal) | $V_{GE}$ = 0V<br>$I_F$= 600A | $T_{vj}$=25°C | - | 1.85 | 2.30 | V |
| | $V_F$ (chip) | | $T_{vj}$= 25°C | - | 1.60 | 2.05 | |
| | | | $T_{vj}$=125°C | - | 1.70 | - | |
| | | | $T_{vj}$=150°C | - | 1.65 | - | |
| | | | $T_{vj}$=175°C | - | 1.60 | - | |
| Turn-on delay time (*1) | $t_{d(on)}$ | $V_{CC}$= 600V<br>$I_C$, $I_F$= 600A<br>$V_{GE}$= +15/ -15V<br>$R_G$= 0.56 Ω<br>$L_S$= 30 nH | $T_{vj}$= 25°C | - | 0.30 | - | μs |
| | | | $T_{vj}$=125°C | - | 0.33 | - | |
| | | | $T_{vj}$=150°C | - | 0.34 | - | |
| | | | $T_{vj}$=175°C | - | 0.35 | - | |
| Rise time (*1) | $t_r$ | | $T_{vj}$= 25°C | - | 0.07 | - | |
| | | | $T_{vj}$=125°C | - | 0.08 | - | |
| | | | $T_{vj}$=150°C | - | 0.08 | - | |
| | | | $T_{vj}$=175°C | - | 0.09 | - | |
| Turn-off delay time (*1) | $t_{d(off)}$ | | $T_{vj}$= 25°C | - | 0.39 | - | |
| | | | $T_{vj}$=125°C | - | 0.43 | - | |
| | | | $T_{vj}$=150°C | - | 0.45 | - | |
| | | | $T_{vj}$=175°C | - | 0.45 | - | |
| Fall time (*1) | $t_f$ | | $T_{vj}$= 25°C | - | 0.12 | - | |
| | | | $T_{vj}$=125°C | - | 0.16 | - | |
| | | | $T_{vj}$=150°C | - | 0.17 | - | |
| | | | $T_{vj}$=175°C | - | 0.18 | - | |
| Reverse recovery time | $t_{rr}$ | | $T_{vj}$= 25°C | - | 0.15 | - | |
| | | | $T_{vj}$=125°C | - | 0.26 | - | |
| | | | $T_{vj}$=150°C | - | 0.28 | - | |
| | | | $T_{vj}$=175°C | - | 0.31 | - | |

(*1) Turn on time ($t_{on}$) = $t_{d(on)}$+ $t_r$ , Turn off time ($t_{off}$) = $t_{d(off)}$ + $t_f$

## ■ Electrical characteristics (at $T_{vj}$= 25°C unless otherwise specified)

| Items | Symbols | Conditions | | Characteristics min. | Characteristics typ. | Characteristics max. | Units |
|---|---|---|---|---|---|---|---|
| Turn-on energy | $E_{on}$ | $V_{CC}$ = 600V<br>$I_C$, $I_F$ = 600A<br>$V_{GE}$ = +15/ -15V<br>$R_G$ = 0.56 Ω<br>$L_S$ = 30 nH | $T_{vj}$= 25°C | - | 13.6 | - | mJ |
| | | | $T_{vj}$=125°C | - | 23.1 | - | |
| | | | $T_{vj}$=150°C | - | 25.4 | - | |
| | | | $T_{vj}$=175°C | - | 27.8 | - | |
| Turn-off energy | $E_{off}$ | | $T_{vj}$= 25°C | - | 58.2 | - | |
| | | | $T_{vj}$=125°C | - | 68.4 | - | |
| | | | $T_{vj}$=150°C | - | 71.0 | - | |
| | | | $T_{vj}$=175°C | - | 73.6 | - | |
| Reverse recovery energy | $E_{rr}$ | | $T_{vj}$= 25°C | - | 30.1 | - | |
| | | | $T_{vj}$=125°C | - | 46.0 | - | |
| | | | $T_{vj}$=150°C | - | 50.0 | - | |
| | | | $T_{vj}$=175°C | - | 54.0 | - | |

NOTICE:
The external gate resistance ($R_G$) shown above is one of our recommended value for the purpose of minimum switching loss. However the optimum $R_G$ depends on circuit configuration and/or environment. We recommend that the $R_G$ has to be carefully chosen based on consideration if IGBT module matches design criteria, for example, switching loss, EMC/EMI, spike voltage, surge current and no unexpected oscillation and so on.

## ■Thermal resistance characteristics

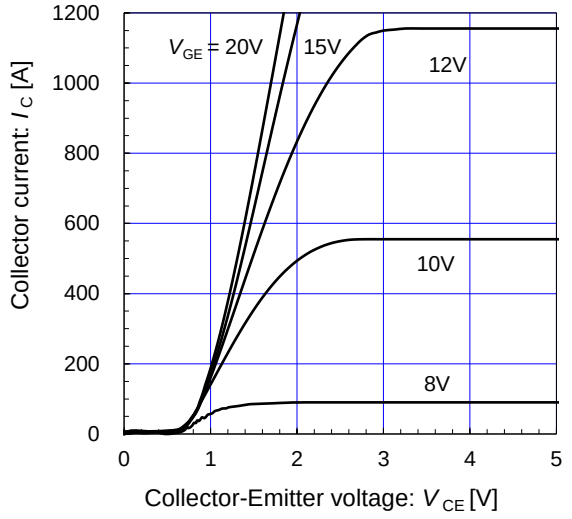
| | Symbols | Conditions | Characteristics min. | Characteristics typ. | Characteristics max. | Units |
|---|---|---|---|---|---|---|
| Thermal resistance (1device) | $R_{th(j-c)}$ | Inverter IGBT | - | - | 0.041 | K/W |
| | | Inverter FWD | - | - | 0.056 | |
| Thermal resistance case to heat sink (1IGBT + 1FWD) (*1) | $R_{th(c-s)}$ | with 1 W/(m·K) thermal grease | - | 0.0125 | - | |

(*1) This is the value which is defined mounting on the additional heat sink with thermal grease.

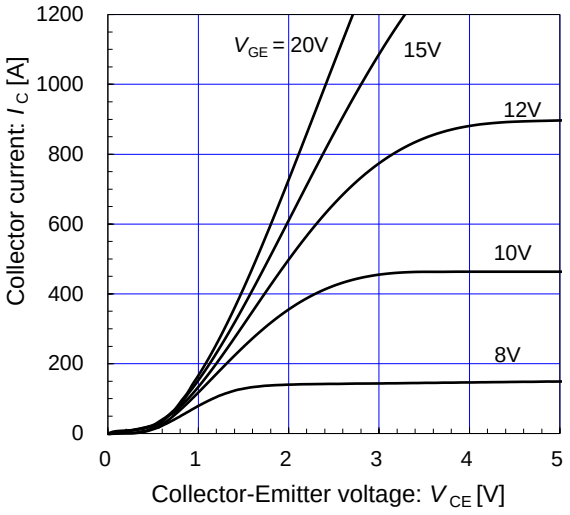
# 2MBI600XDE120-50

**IGBT Modules**

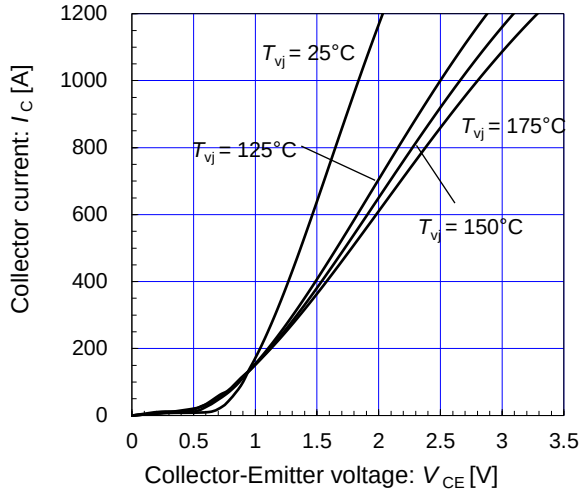
[Inverter]
Collector current vs. Collector-Emitter voltage
$T_{vj}$ = 25°C / chip



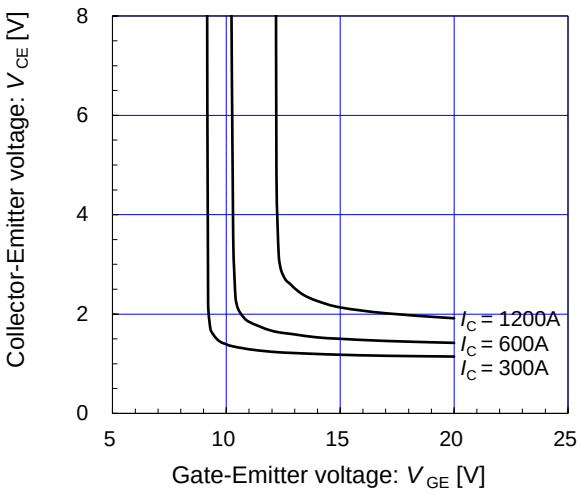

[Inverter]
Collector current vs. Collector-Emitter voltage (typ.)
$T_{vj}$ = 175°C / chip



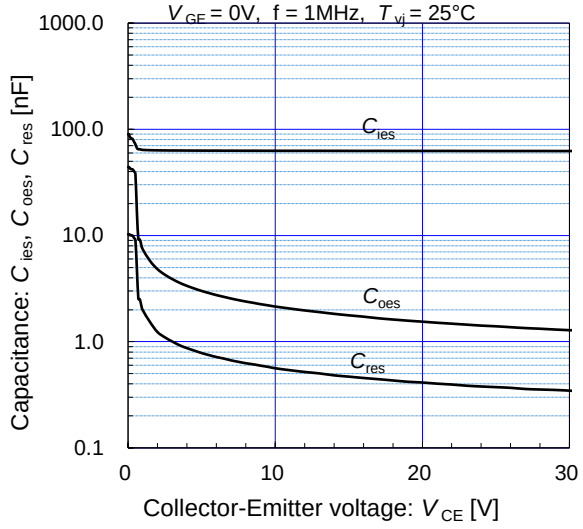

[Inverter]
Collector current vs. Collector-Emitter voltage
$V_{GE}$ = 15V / chip



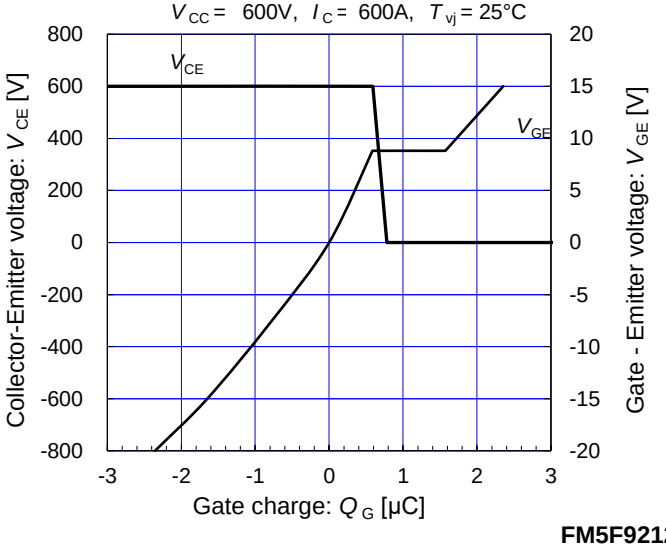

[Inverter]
Collector-Emitter voltage vs. Gate-Emitter voltage
$T_{vj}$ = 25°C / chip




[Inverter]
Capacitance vs. Collector-Emitter Voltage
$V_{GE}$ = 0V, f = 1MHz, $T_{vj}$ = 25°C



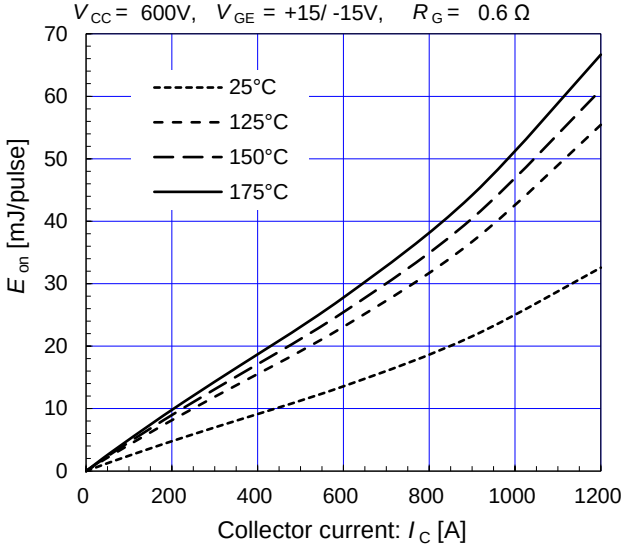

[Inverter]
Dynamic Gate Charge (typ.)
$V_{CC}$ = 600V, $I_C$ = 600A, $T_{vj}$ = 25°C



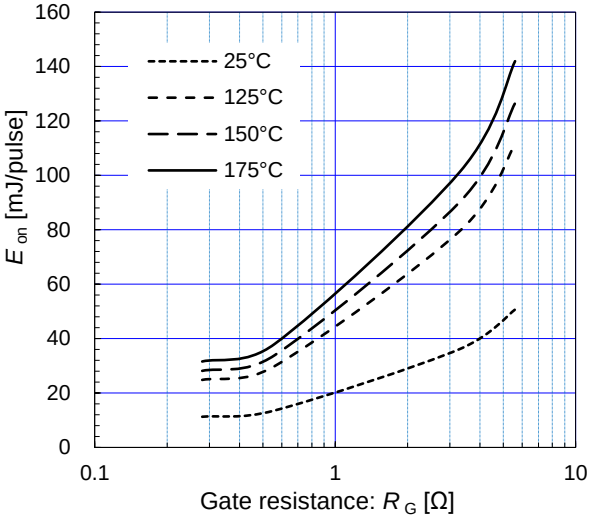
# 2MBI600XDE120-50



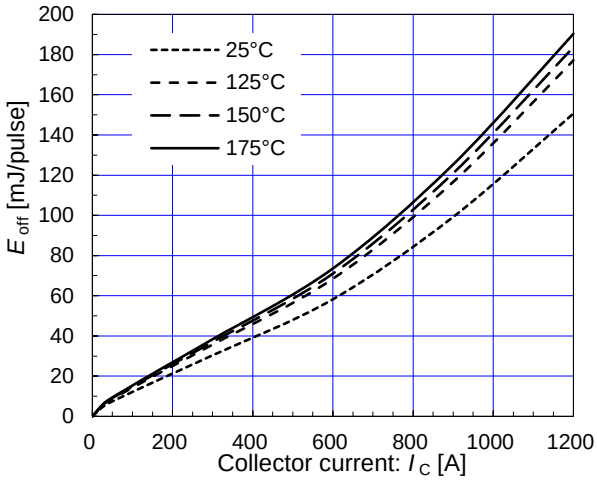
[Inverter]
$E_{on}$ vs. Collector current (typ.)
$V_{CC}$ = 600V, $V_{GE}$ = +15/ -15V, $R_G$ = 0.6 Ω



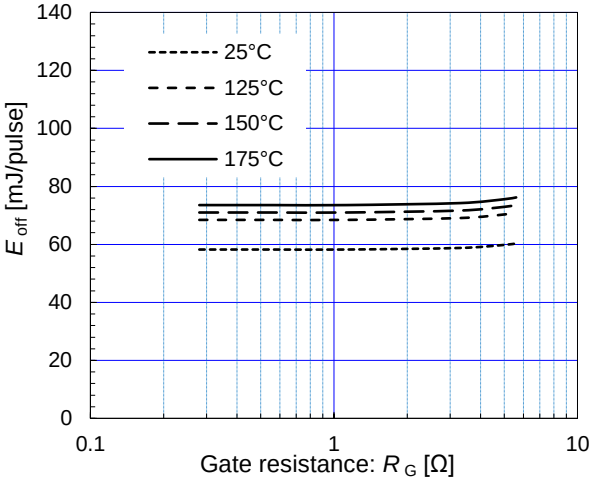

[Inverter]
$E_{on}$ vs. Gate resistance (typ.)
$V_{CC}$ = 600V, $V_{GE}$ = +15/ -15V, $I_C$ = 600A



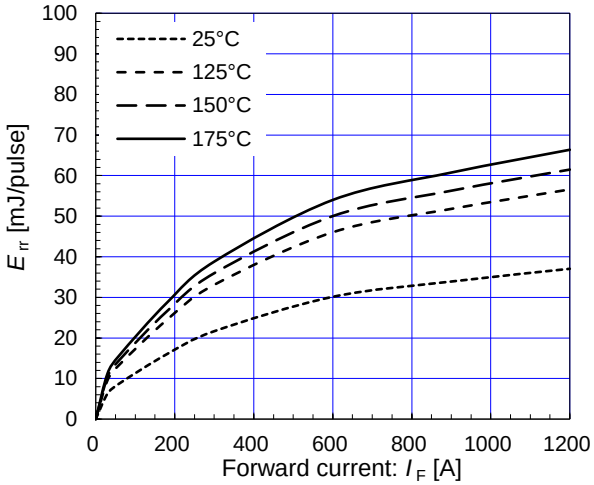

[Inverter]
$E_{off}$ vs. Collector current (typ.)
$V_{CC}$ = 600V, $V_{GE}$ = +15/ -15V, $R_G$ = 0.6 Ω



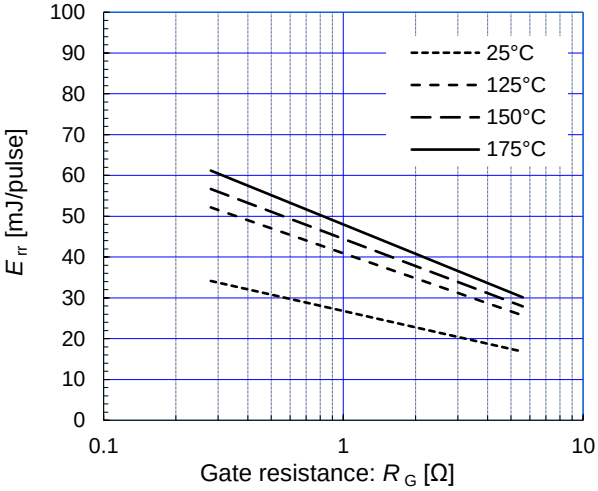

[Inverter]
$E_{off}$ vs. Gate resistance (typ.)
$V_{CC}$ = 600V, $V_{GE}$ = +15/ -15V, $I_C$ = 600A




[Inverter]
$E_{rr}$ vs. Forward current (typ.)
$V_{CC}$ = 600V, $V_{GE}$ = +15/ -15V, $R_G$ = 0.6 Ω



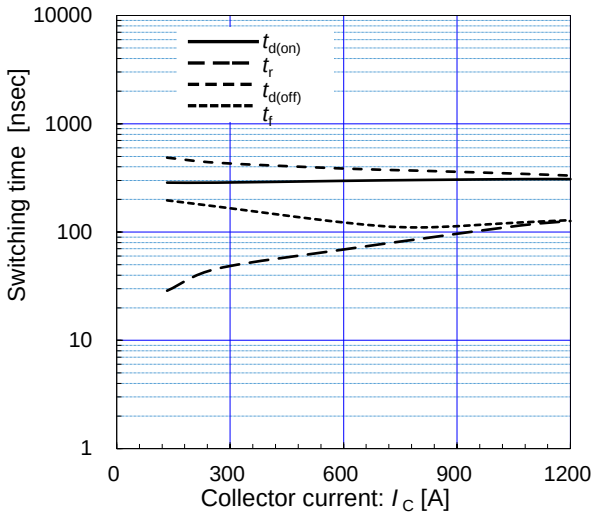

[Inverter]
$E_{rr}$ vs. Gate resistance (typ.)
$V_{CC}$ = 600V, $V_{GE}$ = +15/ -15V, $I_F$ = 600A



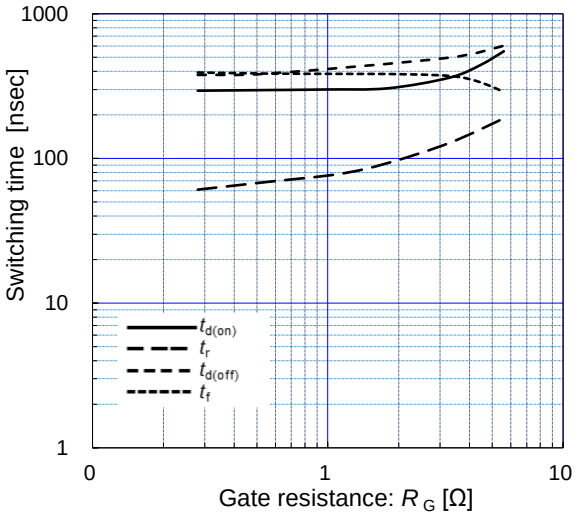
# 2MBI600XDE120-50



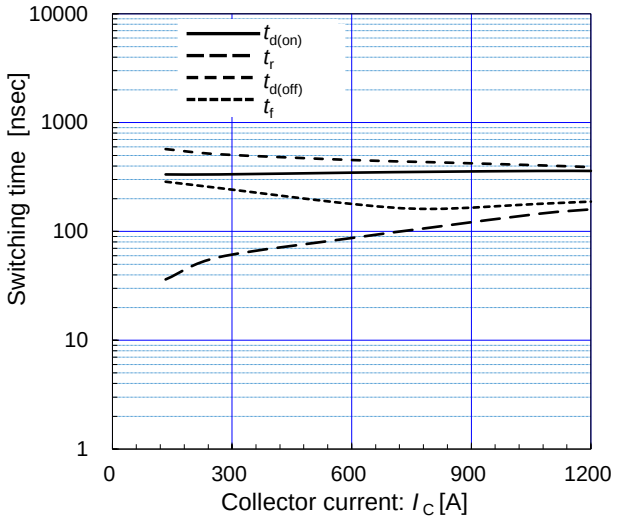
[Inverter]
Switching time vs. Collector current (typ.)
$V_{CC}$ = 600V, $R_G$ = 0.56 Ω $V_{GE}$ = +15/ -15V, $T_{vj}$ = 25°C



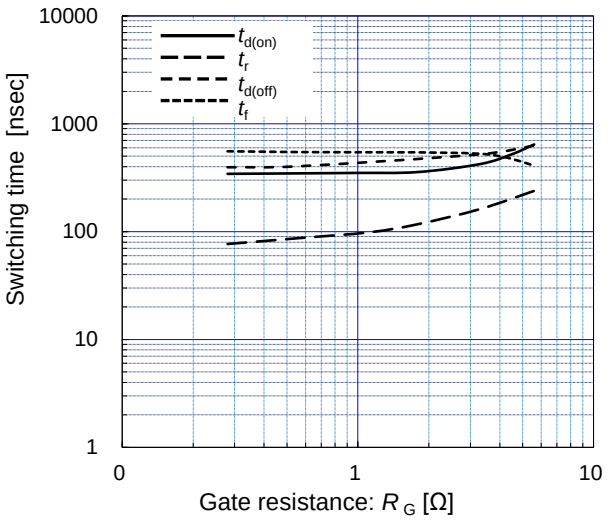

[Inverter]
Switching time vs. Gate resistance (typ.)
$V_{CC}$ = 600V, $I_C$ = 600A, $V_{GE}$ = +15/ -15V, $T_{vj}$ = 25°C



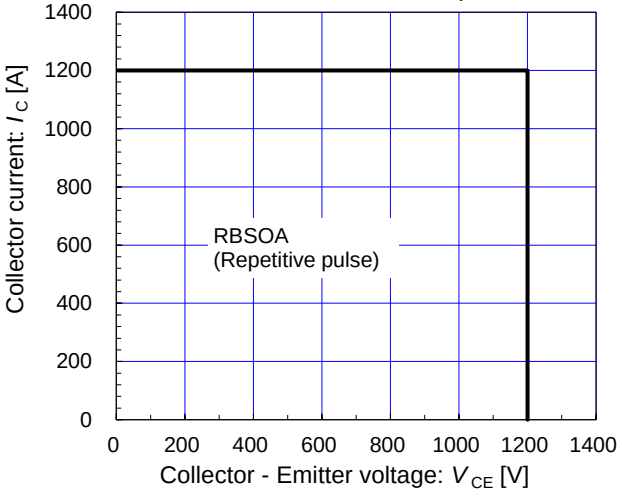

[Inverter]
Switching time vs. Collector current (typ.)
$V_{CC}$ = 600V, $R_G$ = 0.56Ω, $V_{GE}$ = +15/ -15V, $T_{vj}$ = 175°C




[Inverter]
Switching time vs. Gate resistance (typ.)
$V_{CC}$ = 600V, $I_C$ = 600A, $V_{GE}$ = +15/ -15V, $T_{vj}$ = 175°C




[Inverter]
Reverse bias safe operating area (max.)
$V_{GE}$ = +15/ -15V $R_G$ = 0.56Ω, $T_{vj}$ = 175°C



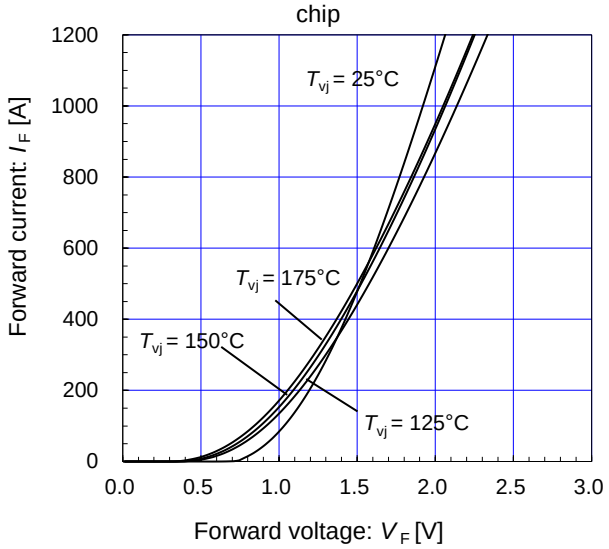



FM5F9212
2018/07

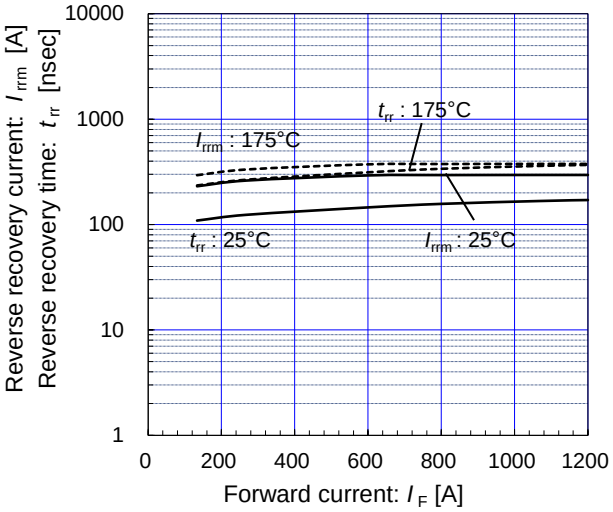
# 2MBI600XDE120-50



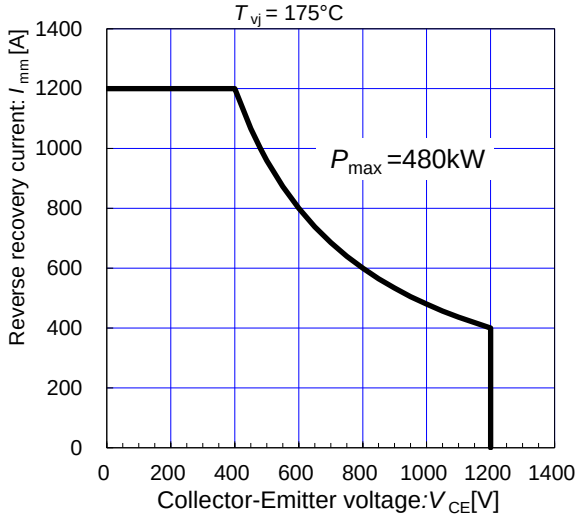
[Inverter]
Forward current vs. Forward voltage (typ.)
chip



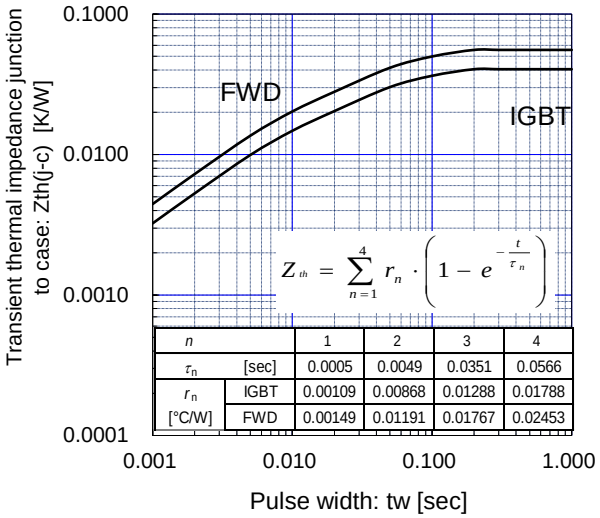

[Inverter]
Reverse recovery characteristics (typ.)
$V_{CC}$ = 600V, $V_{GE}$ = +15/ -15V, $R_G$ = 0.56Ω




[Inverter]
FWD safe operation area (max)
$T_{vj}$ = 175°C




[Inverter]
Transient thermal resistance(max.)




| n | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $\tau_n$ | [sec] | 0.0005 | 0.0049 | 0.0351 | 0.0566 |
| $r_n$ | IGBT | 0.00109 | 0.00868 | 0.01288 | 0.01788 |
| [°C/W] | FWD | 0.00149 | 0.01191 | 0.01767 | 0.02453 |

# Warnings

1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of 7/2018. The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Catalog, be sure to obtain the latest specifications.

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4. The products introduced in this Catalog are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
・Computers ・OA equipment ・Communications equipment (terminal devices) ・Measurement equipment
・Machine tools ・Audiovisual equipment ・Electrical home appliances ・Personal equipment ・Industrial robots etc.

5. If you need to use a product in this Catalog for equipment requiring higher reliability than normal, such as for the equipment listed below, it is imperative to contact Fuji Electric Co., Ltd. to obtain prior approval. When using these products for such equipment, take adequate measures such as a backup system to prevent the equipment from malfunctioning even if a Fuji's product incorporated in the equipment becomes faulty.
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・Traffic-signal control equipment ・Gas leakage detectors with an auto-shut-off feature
・Emergency equipment for responding to disasters and anti-burglary devices ・Safety devices ・Medical equipment

6. Do not use products in this Catalog for the equipment requiring strict reliability such as the following and equivalents to strategic equipment (without limitation).
・Space equipment ・Aeronautic equipment ・Nuclear control equipment ・Submarine repeater equipment

7. 

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富士電機 Innovating Energy Technology

# Technical Information

IGBT Modules

- Please refer to URLs below for futher information about products, application manuals and design support.
- 关于本规格书中没有记载的产品信息，应用手册，技术信息等，请参考以下链接。
- 本データシートに記載されていない製品情報，アプリケーションマニュアル，デザインサポートは以下のURLをご参照下さい。

## FUJI ELECTRIC Power Semiconductor WEB site

| | |
|---|---|
| 日本 | www.fujielectric.co.jp/products/semiconductor/ |
| Global | www.fujielectric.com/products/semiconductor/ |
| 中国 | www.fujielectric.com.cn/products/semiconductor/ |
| Europe | www.fujielectric-europe.com/en/power_semiconductor/ |
| North America | www.americas.fujielectric.com/products/semiconductors/ |

## Information

### 日本

| | |
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| 1 半導体総合カタログ | www.fujielectric.co.jp/products/semiconductor/catalog/ |
| 2 製品情報 | www.fujielectric.co.jp/products/semiconductor/model/ |
| 3 アプリケーションマニュアル | www.fujielectric.co.jp/products/semiconductor/model/igbt/application/ |
| 4 デザインサポート | www.fujielectric.co.jp/products/semiconductor/model/igbt/technical/ |
| 5 マウンティングインストラクション | www.fujielectric.co.jp/products/semiconductor/model/igbt/mounting/ |
| 6 IGBT 損失シミュレーションソフト | www.fujielectric.co.jp/products/semiconductor/model/igbt/simulation/ |
| 7 富士電機技報 | www.fujielectric.co.jp/products/semiconductor/journal/ |
| 8 製品のお問い合わせ | www.fujielectric.co.jp/products/semiconductor/contact/ |
| 9 改廃のお知らせ | www.fujielectric.co.jp/products/semiconductor/discontinued/ |

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| 2 Product Information | www.fujielectric.com/products/semiconductor/model/ |
| 3 Application Manuals | www.fujielectric.com/products/semiconductor/model/igbt/application/ |
| 4 Design Support | www.fujielectric.com/products/semiconductor/model/igbt/technical/ |
| 5 Mounting Instructions | www.fujielectric.com/products/semiconductor/model/igbt/mounting/ |
| 6 IGBT Loss Simulation Software | www.fujielectric.com/products/semiconductor/model/igbt/simulation/ |
| 7 Fuji Electric Journal | www.fujielectric.com/products/semiconductor/journal/ |
| 8 Contact | www.fujielectric.com/contact/ |
| 9 Revised and discontinued product information | www.fujielectric.com/products/semiconductor/discontinued/ |

### 中国

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| 1 半导体综合目录 | www.fujielectric.com.cn/products/semiconductor/catalog/ |
| 2 产品信息 | www.fujielectric.com.cn/products/semiconductor/model/ |
| 3 应用手册 | www.fujielectric.com.cn/products/semiconductor/model/igbt/application/ |
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