

# 6MBI200XXA120-50

IGBT Modules

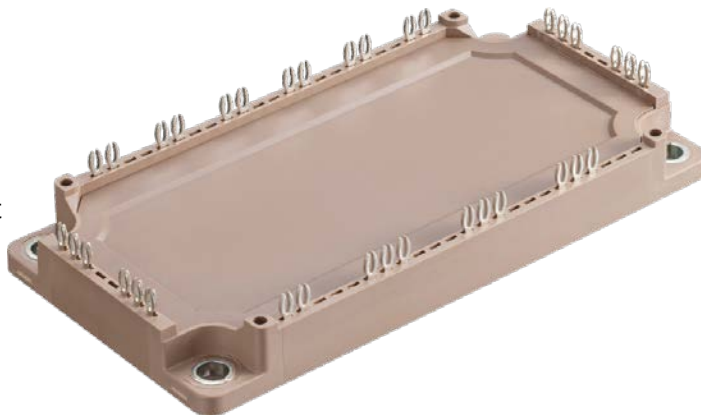
**Power Module (X series)**  
1200V / 200A / 6-in-1 package

## ■ Features

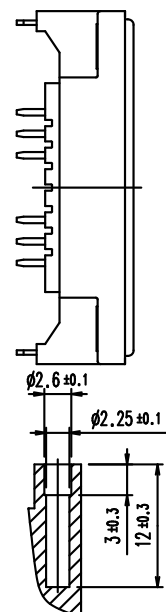
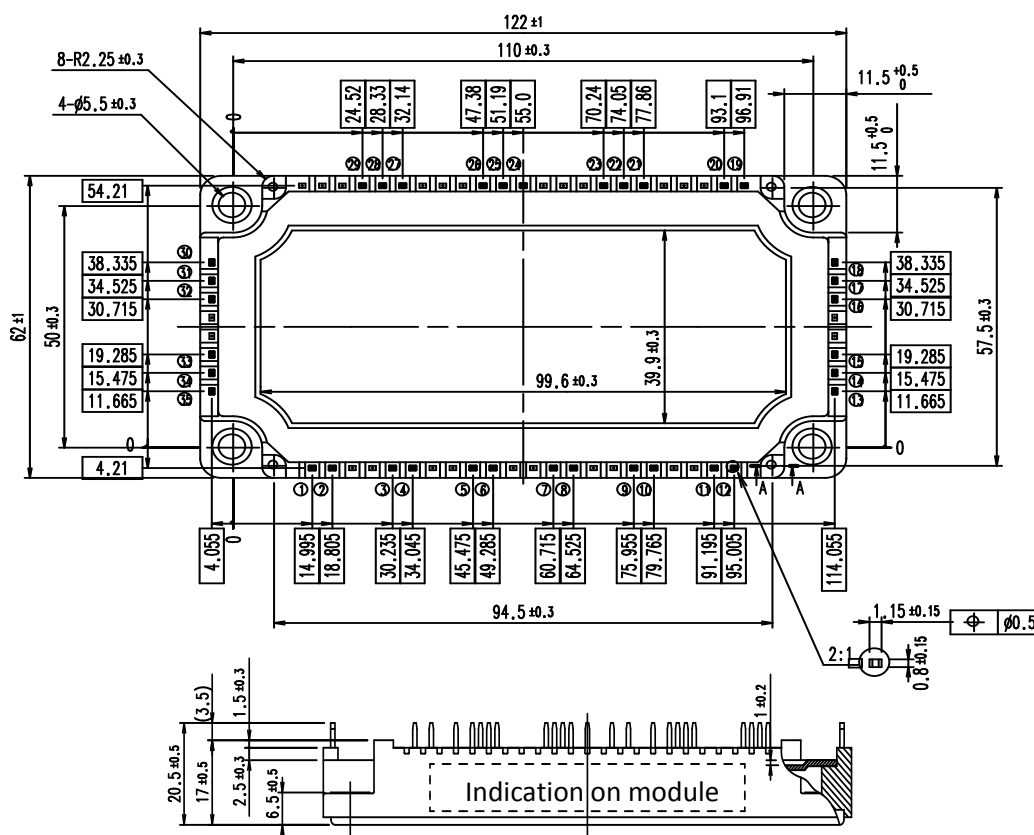
- Low  $V_{CE(sat)}$
- Compact Package
- P.C.Board Mount Module
- Converter Diode Bridge Dynamic Brake Circuit
- RoHS compliant Product

## ■ Applications

- Inverter for Motor Drives,
- AC and DC Servo Drive Amplifier
- Uninterruptible Power Supply



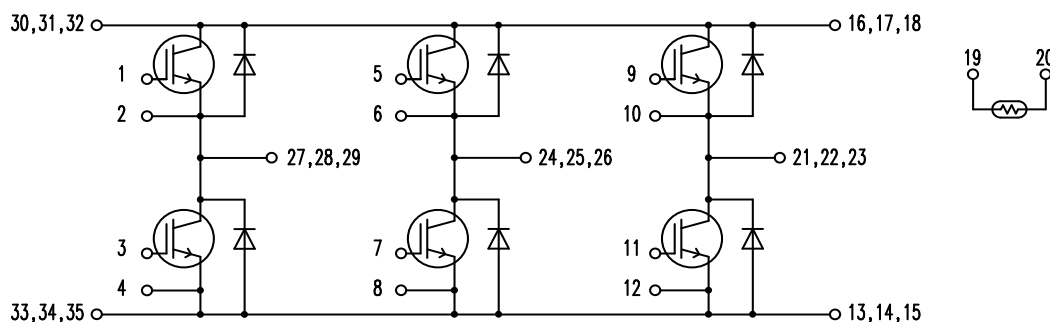
## ■ Outline drawing ( Unit : mm )



Section A-A

Weight: 310 g(typ.)

## ■ Equivalent Circuit



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## ■ Absolute Maximum Ratings (at $T_c = 25^\circ\text{C}$ 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 |                                       | $V_{GES}$  |                                     | $\pm 20$        | V                |
| Collector current                                       |                                       | $I_C$      | Continuous $T_c = 80^\circ\text{C}$ | 200             | A                |
| Repetitive peak collector current                       |                                       | $I_{CRM}$  | 1ms                                 | 400             |                  |
| Forward current                                         |                                       | $I_F$      | Continuous                          | 200             |                  |
| Repetitive peak forward current                         |                                       | $I_{FRM}$  | 1ms                                 | 400             |                  |
| Total power dissipation                                 |                                       | $P_{tot}$  | 1 device                            | 750             | W                |
| Virtual junction temperature                            |                                       | $T_{vj}$   |                                     | 175             | $^\circ\text{C}$ |
| 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             |
|                                                         | between thermistor and others (*2)    |            |                                     |                 |                  |
| Mounting torque of screws to heatsink (*3)              |                                       | $M_s$      | M5                                  | 6.0             | N·m              |

(\*1) All terminals should be connected together during the test.

(\*2) Two thermistor terminals should be connected together, other terminals should be connected together and shorted to base plate during the test.

(\*3) Recommendable value : Mounting 2.5 ~ 6.0 N·m (M5)

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**IGBT Modules**

■ Electrical characteristics (at  $T_{vj} = 25^{\circ}\text{C}$  unless otherwise specified)

| Items                    |                                                                 | Symbols                  | Conditions                                                                                          |                       | Characteristics |        |      | Units    |
|--------------------------|-----------------------------------------------------------------|--------------------------|-----------------------------------------------------------------------------------------------------|-----------------------|-----------------|--------|------|----------|
|                          |                                                                 |                          |                                                                                                     |                       | min.            | typ.   | max. |          |
| Inverter                 | Collector-emitter cut-off current, gate-emitter short-circuited | $I_{CES}$                | $V_{GE} = 0V$<br>$V_{CE} = 1200V$                                                                   |                       | -               | -      | 50   | $\mu A$  |
|                          | Gate leakage current , collector-emitter short-circuited        | $I_{GES}$                | $V_{CE}=0V, V_{GE}=\pm 20V$                                                                         |                       | -               | -      | 100  | nA       |
|                          | Gate-Emitter threshold voltage                                  | $V_{GE(th)}$             | $V_{CE} = 20V$<br>$I_C = 200mA$                                                                     |                       | 6.0             | 6.5    | 7.0  | V        |
|                          | Collector-Emitter saturation voltage                            | $V_{CE(sat)}$ (terminal) | $V_{GE} = 15V$<br>$I_C = 200A$                                                                      | $T_{vj}=25^{\circ}C$  | -               | 2.20   | 2.75 | V        |
|                          |                                                                 | $V_{CE(sat)}$ (chip)     |                                                                                                     | $T_{vj}=25^{\circ}C$  | -               | 1.45   | 1.90 |          |
|                          |                                                                 |                          |                                                                                                     | $T_{vj}=125^{\circ}C$ | -               | 1.80   | -    |          |
|                          |                                                                 |                          |                                                                                                     | $T_{vj}=150^{\circ}C$ | -               | 1.90   | -    |          |
|                          |                                                                 |                          |                                                                                                     | $T_{vj}=175^{\circ}C$ | -               | 1.95   | -    |          |
|                          | Internal Gate resistance                                        | $r_g$                    | -                                                                                                   |                       | -               | 5.00   | -    | $\Omega$ |
|                          | Input capacitance                                               | $C_{ies}$                | $V_{CE}=10V, V_{GE}=0V, f=1MHz$                                                                     |                       | -               | 21.3   | -    | nF       |
|                          | Output capacitance                                              | $C_{oes}$                |                                                                                                     |                       | -               | 0.7    | -    |          |
|                          | Reverse transfer capacitance                                    | $C_{res}$                |                                                                                                     |                       | -               | 0.19   | -    |          |
|                          | Gate charge                                                     | $Q_G$                    | $V_{CC} = 600V, I_C = 200A$<br>$V_{GE} = -15 \rightarrow +15V$                                      |                       | -               | 1400.0 | -    | $\mu C$  |
|                          | Forward on voltage                                              | $V_F$ (terminal)         | $V_{GE} = 0V$<br>$I_F = 200A$                                                                       | $T_{vj}=25^{\circ}C$  | -               | 2.55   | 3.10 | V        |
|                          |                                                                 | $V_F$ (chip)             |                                                                                                     | $T_{vj}= 25^{\circ}C$ | -               | 1.80   | 2.25 |          |
|                          |                                                                 |                          |                                                                                                     | $T_{vj}=125^{\circ}C$ | -               | 1.85   | -    |          |
|                          |                                                                 |                          |                                                                                                     | $T_{vj}=150^{\circ}C$ | -               | 1.80   | -    |          |
|                          |                                                                 |                          |                                                                                                     | $T_{vj}=175^{\circ}C$ | -               | 1.75   | -    |          |
|                          | Turn-on delay time (*1)                                         | $t_{d(on)}$              | $V_{CC} = 600V$<br>$I_C, I_F = 200A$<br>$V_{GE} = +15/-15 V$<br>$R_G = 1.8 \Omega$<br>$L_S = 30 nH$ | $T_{vj}= 25^{\circ}C$ | -               | 0.27   | -    | $\mu s$  |
|                          |                                                                 |                          |                                                                                                     | $T_{vj}=125^{\circ}C$ | -               | 0.30   | -    |          |
|                          | $T_{vj}=150^{\circ}C$                                           | -                        |                                                                                                     | 0.31                  | -               |        |      |          |
|                          | $T_{vj}=175^{\circ}C$                                           | -                        |                                                                                                     | 0.32                  | -               |        |      |          |
|                          | Rise time (*1)                                                  | $T_{vj}= 25^{\circ}C$    |                                                                                                     | -                     | 0.08            | -      |      |          |
|                          |                                                                 | $T_{vj}=125^{\circ}C$    |                                                                                                     | -                     | 0.09            | -      |      |          |
|                          |                                                                 | $T_{vj}=150^{\circ}C$    |                                                                                                     | -                     | 0.09            | -      |      |          |
|                          |                                                                 | $T_{vj}=175^{\circ}C$    |                                                                                                     | -                     | 0.10            | -      |      |          |
| Turn-off delay time (*1) | $t_{d(off)}$                                                    | $T_{vj}= 25^{\circ}C$    |                                                                                                     | -                     | 0.34            | -      |      |          |
|                          |                                                                 | $T_{vj}=125^{\circ}C$    |                                                                                                     | -                     | 0.39            | -      |      |          |
|                          |                                                                 | $T_{vj}=150^{\circ}C$    |                                                                                                     | -                     | 0.40            | -      |      |          |
|                          |                                                                 | $T_{vj}=175^{\circ}C$    |                                                                                                     | -                     | 0.41            | -      |      |          |
| Fall time (*1)           | $t_f$                                                           | $T_{vj}= 25^{\circ}C$    |                                                                                                     | -                     | 0.12            | -      |      |          |
|                          |                                                                 | $T_{vj}=125^{\circ}C$    |                                                                                                     | -                     | 0.13            | -      |      |          |
|                          |                                                                 | $T_{vj}=150^{\circ}C$    |                                                                                                     | -                     | 0.19            | -      |      |          |
|                          |                                                                 | $T_{vj}=175^{\circ}C$    |                                                                                                     | -                     | 0.10            | -      |      |          |
| Reverse recovery time    | $t_{rr}$                                                        | $T_{vj}= 25^{\circ}C$    | -                                                                                                   | 0.18                  | -               |        |      |          |
|                          |                                                                 | $T_{vj}=125^{\circ}C$    | -                                                                                                   | 0.23                  | -               |        |      |          |
|                          |                                                                 | $T_{vj}=150^{\circ}C$    | -                                                                                                   | 0.26                  | -               |        |      |          |
|                          |                                                                 | $T_{vj}=175^{\circ}C$    | -                                                                                                   | 0.28                  | -               |        |      |          |

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

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■ Electrical characteristics (at  $T_{vj}=25^{\circ}\text{C}$  unless otherwise specified)

| Items      |                               | Symbols   | Conditions            |                       | Characteristics |       |          | Units |
|------------|-------------------------------|-----------|-----------------------|-----------------------|-----------------|-------|----------|-------|
|            |                               |           |                       |                       | min.            | typ.  | max.     |       |
| Inverter   | Switching loss<br>(per pulse) | $E_{on}$  | $V_{CC} = 600V$       | $T_{vj}=25^{\circ}C$  | -               | 16.48 | -        | mJ    |
|            |                               |           | $I_C, I_F = 200A$     | $T_{vj}=125^{\circ}C$ | -               | 23.94 | -        |       |
|            |                               |           | $V_{GE} = +15/-15 V$  | $T_{vj}=150^{\circ}C$ | -               | 26.79 | -        |       |
|            |                               |           | $R_G = 1.8 \Omega$    | $T_{vj}=175^{\circ}C$ | -               | 29.69 | -        |       |
|            |                               | $E_{off}$ | $L_S = 30 nH$         | $T_{vj}=25^{\circ}C$  | -               | 14.91 | -        |       |
|            |                               |           | $T_{vj}=125^{\circ}C$ | -                     | 19.28           | -     |          |       |
|            |                               |           | $T_{vj}=150^{\circ}C$ | -                     | 20.51           | -     |          |       |
|            |                               |           | $T_{vj}=175^{\circ}C$ | -                     | 21.46           | -     |          |       |
|            |                               | $E_{rr}$  | $T_{vj}=25^{\circ}C$  | -                     | 5.80            | -     |          |       |
|            |                               |           | $T_{vj}=125^{\circ}C$ | -                     | 9.83            | -     |          |       |
|            |                               |           | $T_{vj}=150^{\circ}C$ | -                     | 10.60           | -     |          |       |
|            |                               |           | $T_{vj}=175^{\circ}C$ | -                     | 12.09           | -     |          |       |
| Thermistor | Resistance                    | $R$       | $T = 25^{\circ}C$     | -                     | 5000            | -     | $\Omega$ |       |
|            |                               |           | $T = 100^{\circ}C$    | 465                   | 495             | 520   |          |       |
|            | B value                       | $B$       | $T = 25/ 50^{\circ}C$ | 3305                  | 3375            | 3450  | K        |       |

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.

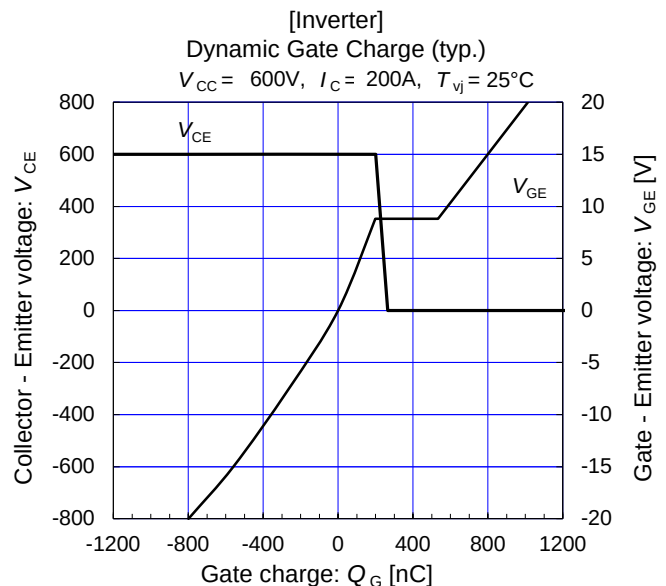
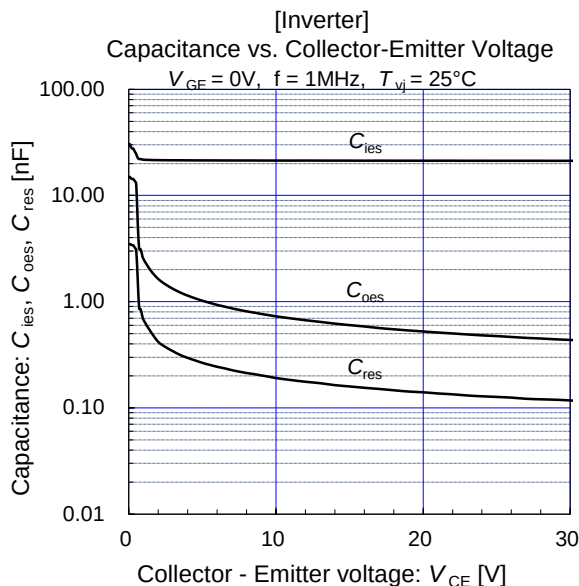
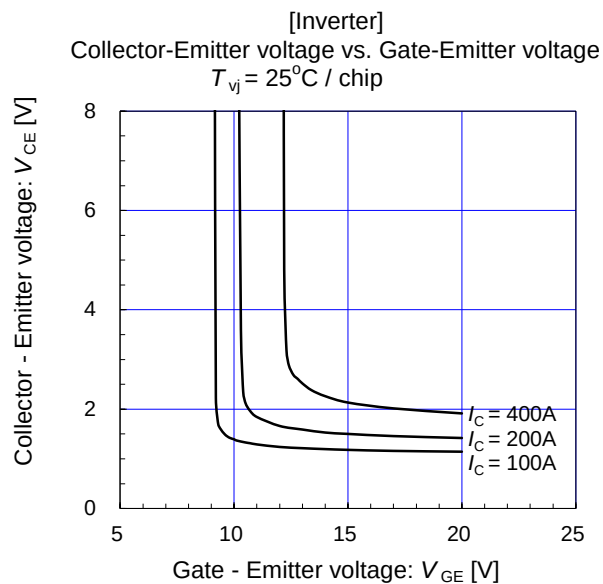
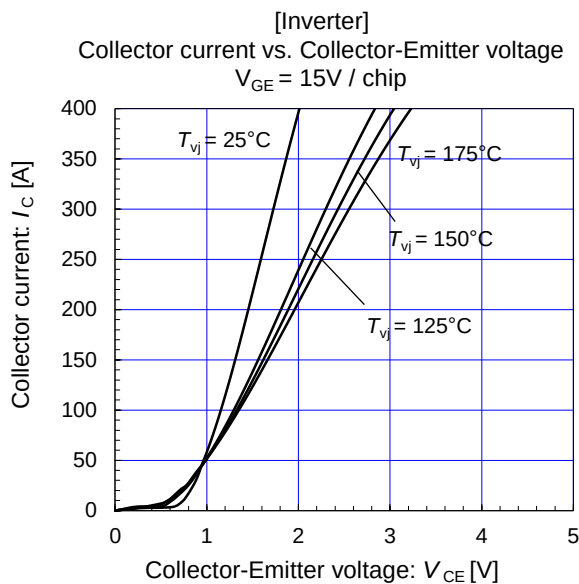
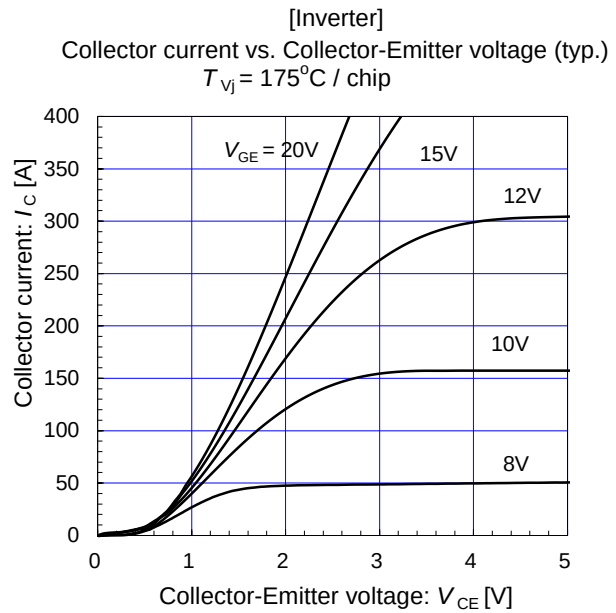
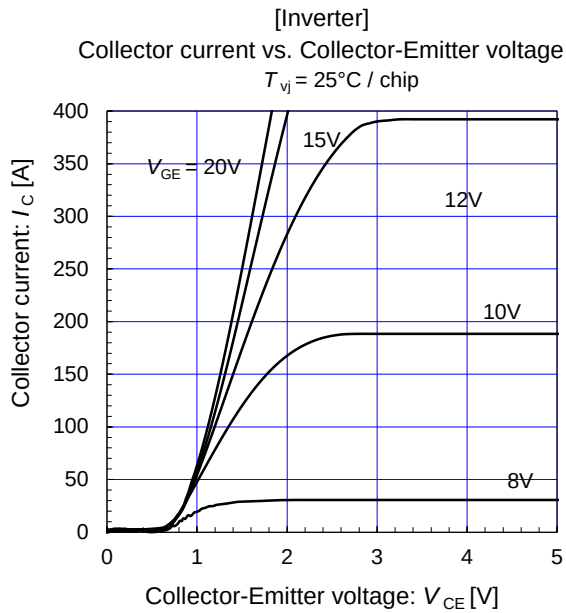
■ Thermal resistance characteristics

| Items                                                     | Symbols       | Conditions                    | Characteristics |      |      | Units                |
|-----------------------------------------------------------|---------------|-------------------------------|-----------------|------|------|----------------------|
|                                                           |               |                               | min.            | typ. | max. |                      |
| Thermal resistance junction to case (1 device)            | $R_{th(j-c)}$ | Inverter IGBT                 | -               | -    | 0.20 | $^{\circ}\text{C/W}$ |
|                                                           |               | Inverter FWD                  | -               | -    | 0.26 |                      |
| Thermal resistance case to heatsink (1 IGBT + 1 FWD) (*1) | $R_{th(c-s)}$ | with 1 W/(m·K) thermal grease | -               | 0.05 | -    |                      |

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

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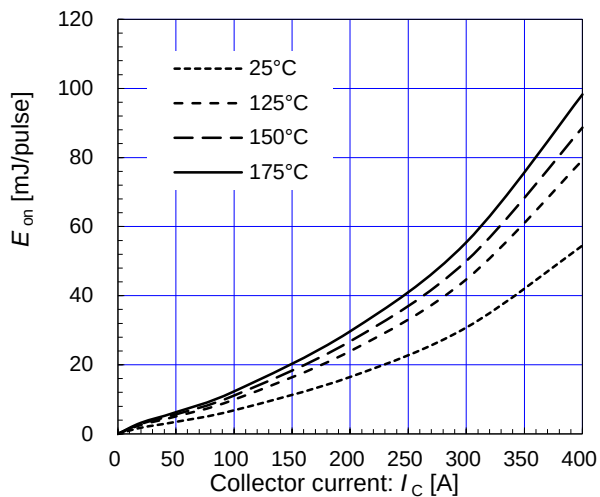
# 6MBI200XXA120-50

IGBT Modules

[Inverter]

$E_{on}$  vs. Collector current (typ.)

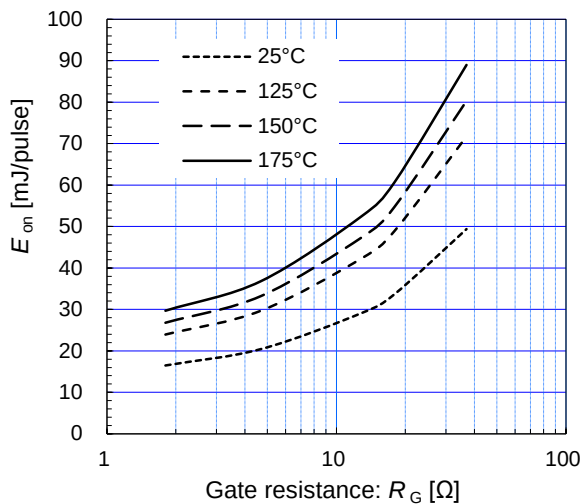
$V_{CC} = 600V$ ,  $V_{GE} = +15/-15V$ ,  $R_G = 1.8\ \Omega$



[Inverter]

$E_{on}$  vs. Gate resistance (typ.)

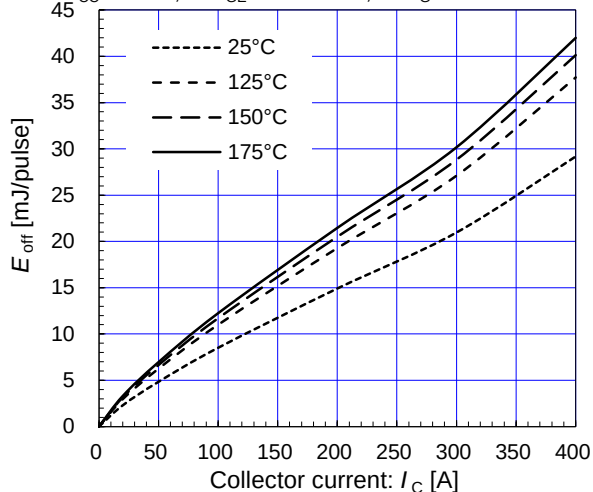
$V_{CC} = 600V$ ,  $V_{GE} = +15/-15V$ ,  $I_C = 200A$



[Inverter]

$E_{off}$  vs. Collector current (typ.)

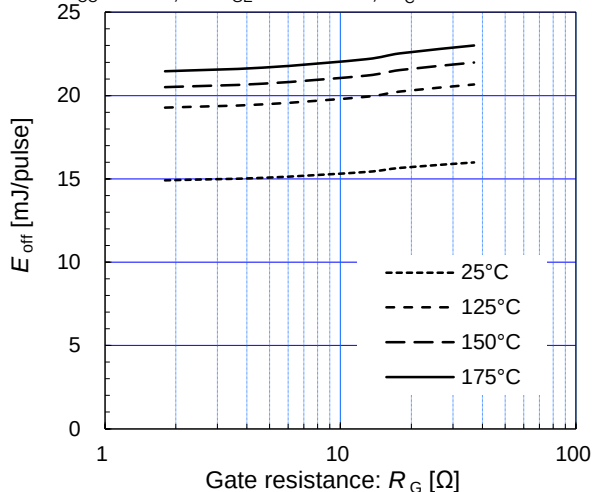
$V_{CC} = 600V$ ,  $V_{GE} = +15/-15V$ ,  $R_G = 1.8\ \Omega$



[Inverter]

$E_{off}$  vs. Gate resistance (typ.)

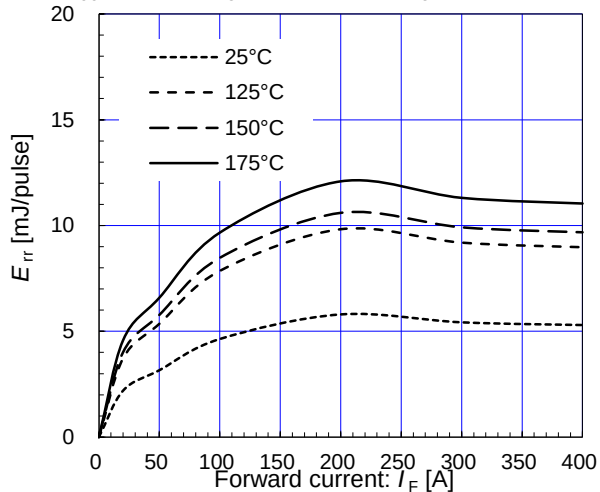
$V_{CC} = 600V$ ,  $V_{GE} = +15/-15V$ ,  $I_C = 200A$



[Inverter]

$E_{rr}$  vs. Forward current (typ.)

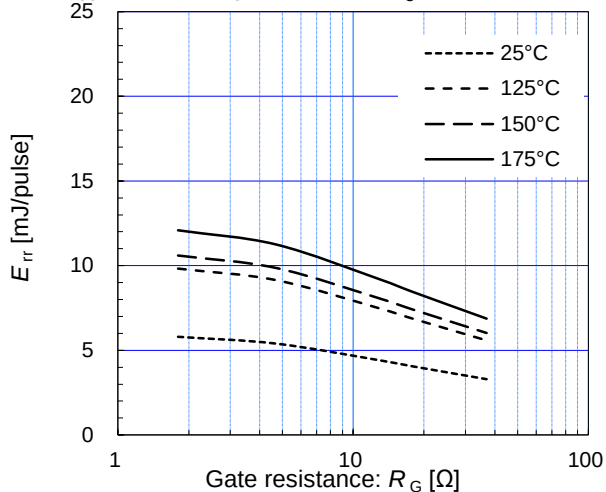
$V_{CC} = 600V$ ,  $V_{GE} = +15/-15V$ ,  $R_G = 1.8\ \Omega$



[Inverter]

$E_{rr}$  vs. Gate resistance (typ.)

$V_{CC} = 600V$ ,  $V_{GE} = +15/-15V$ ,  $I_C = 200A$



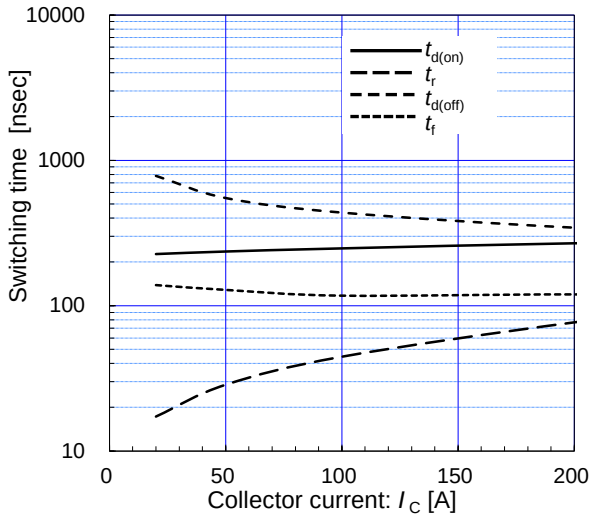
# 6MBI200XXA120-50

IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

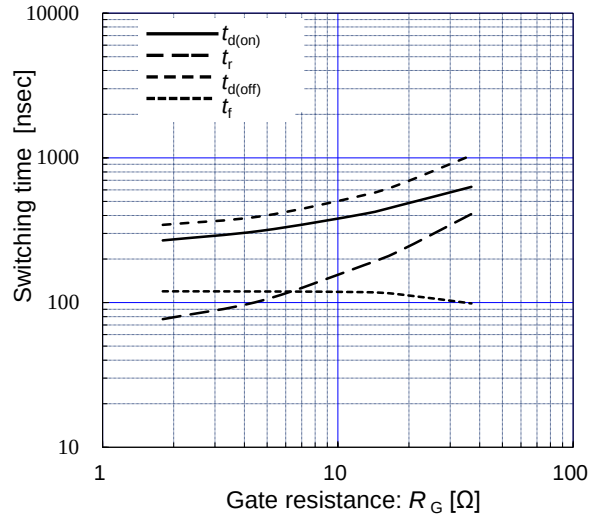
$V_{CC} = 600V$ ,  $R_G = 1.8 \Omega$ ,  $V_{GE} = +15/-15 V$ ,  $T_{vj} = 25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

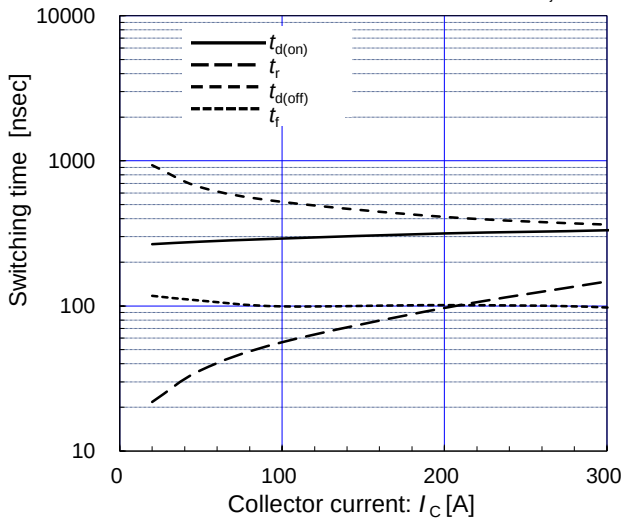
$V_{CC} = 600V$ ,  $I_C = 200A$ ,  $V_{GE} = +15/-15 V$ ,  $T_{vj} = 25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

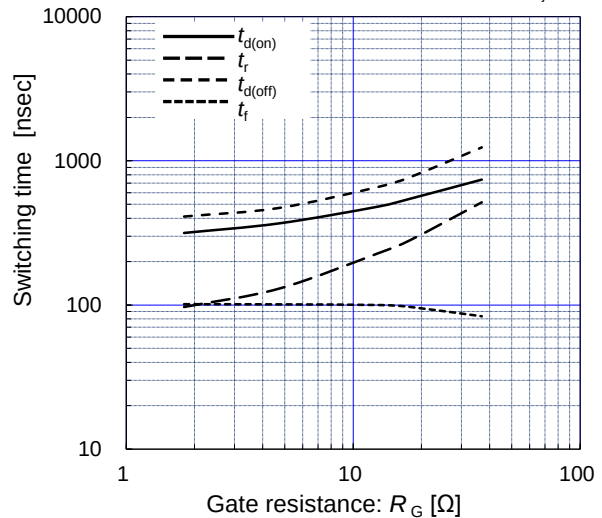
$V_{CC} = 600V$ ,  $R_G = 1.8 \Omega$ ,  $V_{GE} = +15/-15 V$ ,  $T_{vj} = 175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

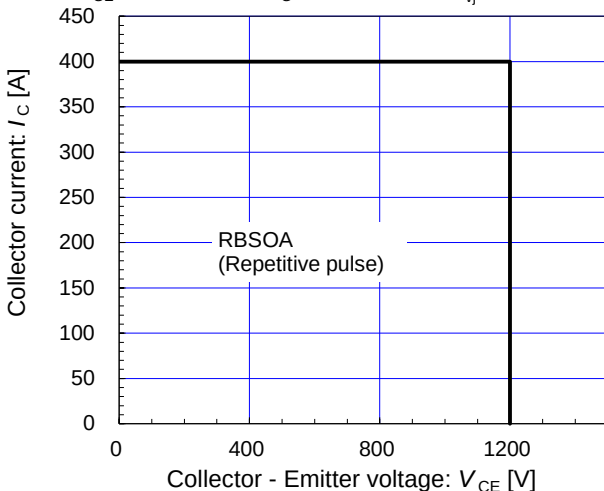
$V_{CC} = 600V$ ,  $I_C = 200A$ ,  $V_{GE} = +15/-15 V$ ,  $T_{vj} = 175^\circ C$



[Inverter]

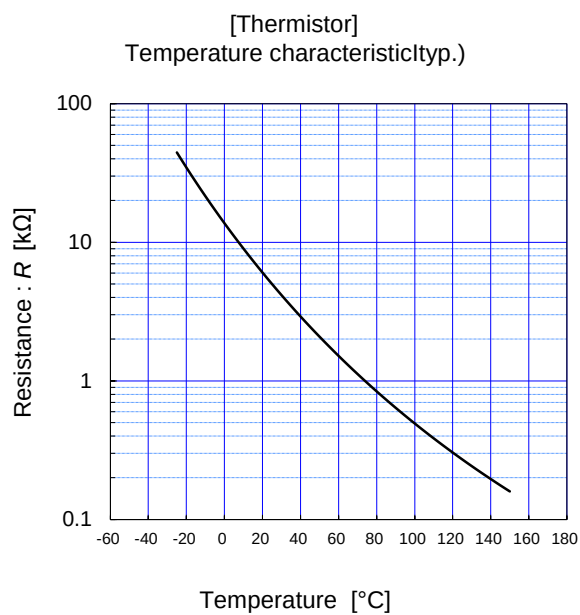
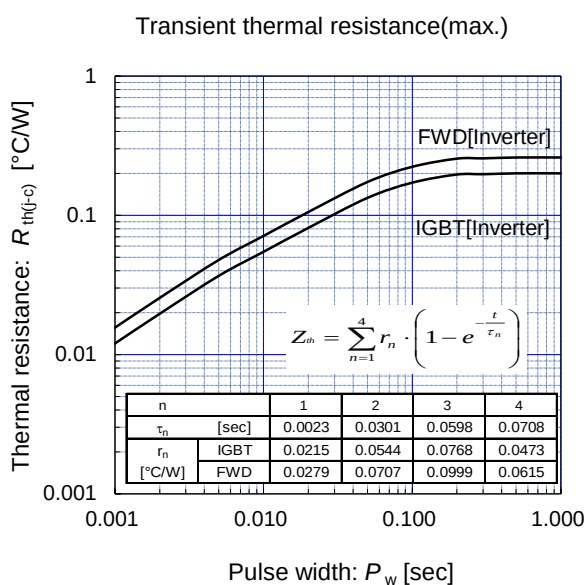
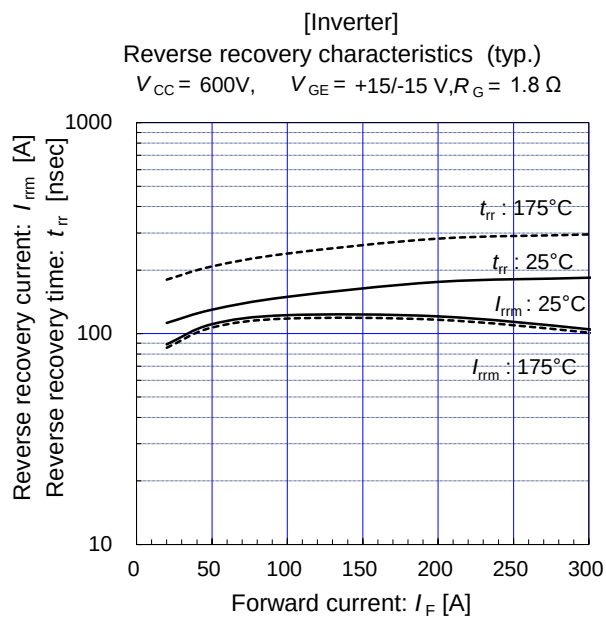
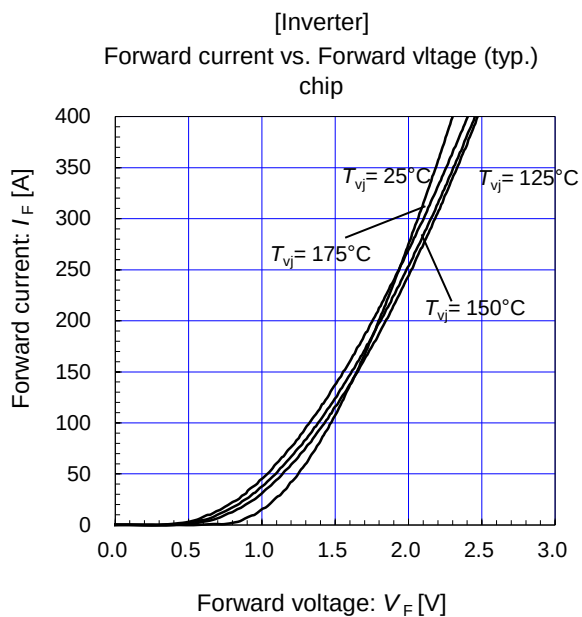
Reverse bias safe operating area (max.)

$V_{GE} = +15/-15 V$ ,  $R_G = 1.8 \Omega$ ,  $T_{vj} = 175^\circ C$



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IGBT Modules





## Warnings

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## IGBT Modules

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

#### Global

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| 1 Semiconductors General Catalog               | <a href="http://www.fujielectric.com/products/semiconductor/catalog/">www.fujielectric.com/products/semiconductor/catalog/</a>                               |
| 2 Product Information                          | <a href="http://www.fujielectric.com/products/semiconductor/model/">www.fujielectric.com/products/semiconductor/model/</a>                                   |
| 3 Application Manuals                          | <a href="http://www.fujielectric.com/products/semiconductor/model/igbt/application/">www.fujielectric.com/products/semiconductor/model/igbt/application/</a> |
| 4 Design Support                               | <a href="http://www.fujielectric.com/products/semiconductor/model/igbt/technical/">www.fujielectric.com/products/semiconductor/model/igbt/technical/</a>     |
| 5 Mounting Instructions                        | <a href="http://www.fujielectric.com/products/semiconductor/model/igbt/mounting/">www.fujielectric.com/products/semiconductor/model/igbt/mounting/</a>       |
| 6 IGBT Loss Simulation Software                | <a href="http://www.fujielectric.com/products/semiconductor/model/igbt/simulation/">www.fujielectric.com/products/semiconductor/model/igbt/simulation/</a>   |
| 7 Fuji Electric Journal                        | <a href="http://www.fujielectric.com/products/semiconductor/journal/">www.fujielectric.com/products/semiconductor/journal/</a>                               |
| 8 Contact                                      | <a href="http://www.fujielectric.com/contact/">www.fujielectric.com/contact/</a>                                                                             |
| 9 Revised and discontinued product information | <a href="http://www.fujielectric.com/products/semiconductor/discontinued/">www.fujielectric.com/products/semiconductor/discontinued/</a>                     |

#### 中国

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| 1 半导体综合目录     | <a href="http://www.fujielectric.com.cn/products/semiconductor/catalog/">www.fujielectric.com.cn/products/semiconductor/catalog/</a>                               |
| 2 产品信息        | <a href="http://www.fujielectric.com.cn/products/semiconductor/model/">www.fujielectric.com.cn/products/semiconductor/model/</a>                                   |
| 3 应用手册        | <a href="http://www.fujielectric.com.cn/products/semiconductor/model/igbt/application/">www.fujielectric.com.cn/products/semiconductor/model/igbt/application/</a> |
| 4 技术信息        | <a href="http://www.fujielectric.com.cn/products/semiconductor/model/igbt/technical/">www.fujielectric.com.cn/products/semiconductor/model/igbt/technical/</a>     |
| 5 安装说明书       | <a href="http://www.fujielectric.com.cn/products/semiconductor/model/igbt/mounting/">www.fujielectric.com.cn/products/semiconductor/model/igbt/mounting/</a>       |
| 6 IGBT 损耗模拟软件 | <a href="http://www.fujielectric.com.cn/products/semiconductor/model/igbt/simulation/">www.fujielectric.com.cn/products/semiconductor/model/igbt/simulation/</a>   |
| 7 富士电机技报      | <a href="http://www.fujielectric.com.cn/products/semiconductor/journal/">www.fujielectric.com.cn/products/semiconductor/journal/</a>                               |
| 8 产品咨询        | <a href="http://www.fujielectric.com/contact/">www.fujielectric.com/contact/</a>                                                                                   |
| 9 产品更改和停产信息   | <a href="http://www.fujielectric.com.cn/products/semiconductor/discontinued/">www.fujielectric.com.cn/products/semiconductor/discontinued/</a>                     |