

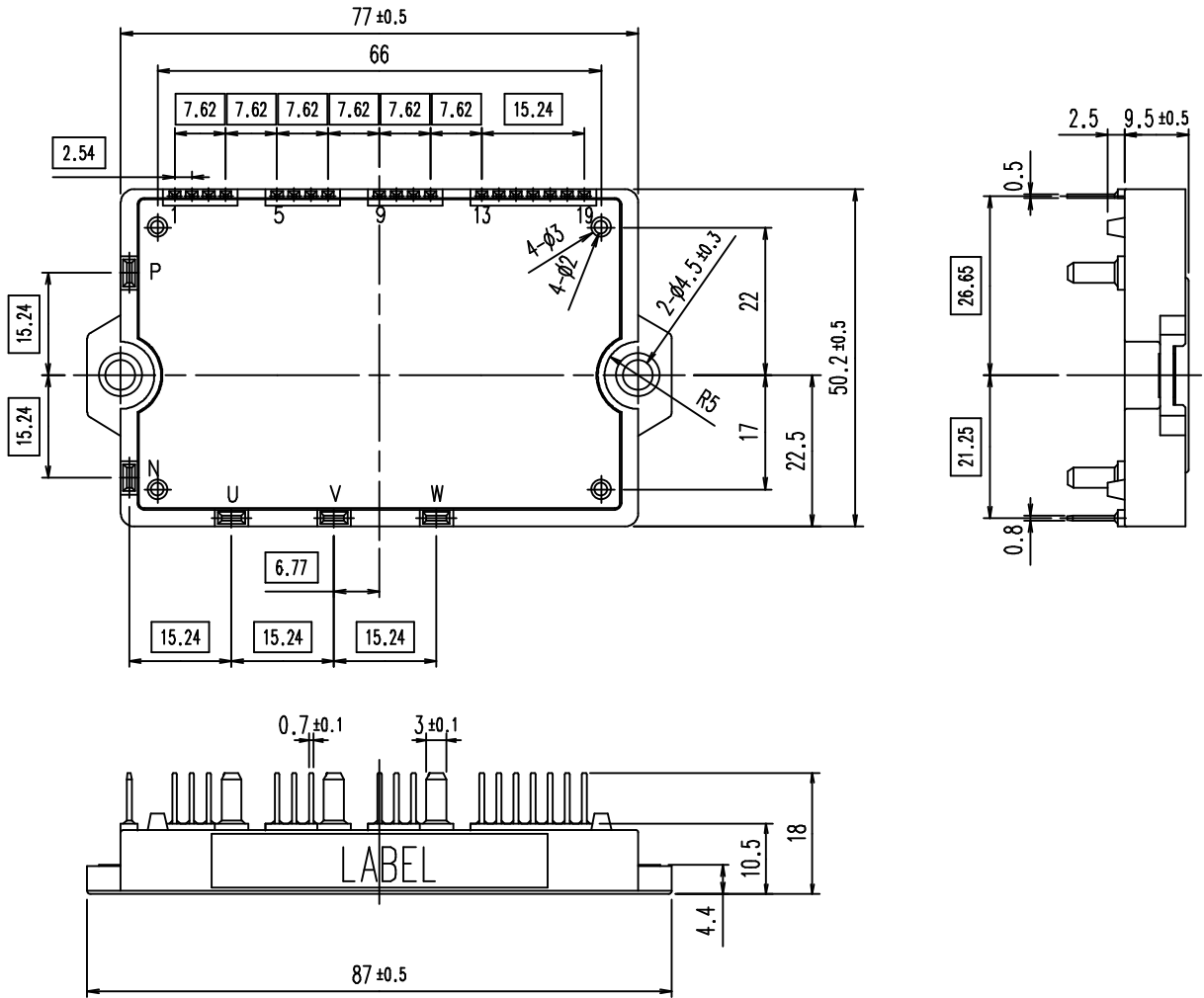




# 1. Package Outline Drawings

(Tc=25 )

Package type : P626



注)

Note

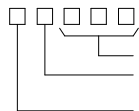
1. は理論寸法を示す。  
" " shows theoretical dimension.
2. 端子ピッチは根元寸法とする。  
The dimensions of the terminals are defined at the bottom.
3. 端子 : Sn-Cuめっき  
Terminal : SnCu plating

## Indication on module (モジュール表示)

Display on module label

- Logo of production
- Type name : 6MBP50VBA120-50
- Ic, VCES rating 50A 1200V
- Lot No. (5digits)
- Place of manufacturing (code)
- Data matrix

Indication of Lot No.



Odered No. in monthly  
Manufactured month  
(Jan. ~ Sep. : 1 ~ 9, Oct:O, Nov.:N, Dec.:D)  
Last digit of manufactured year

[Dimensions in mm]

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DWG.NO.

MS6M1398

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a

## 2. Pin Descriptions

### 2.1 Main circuit

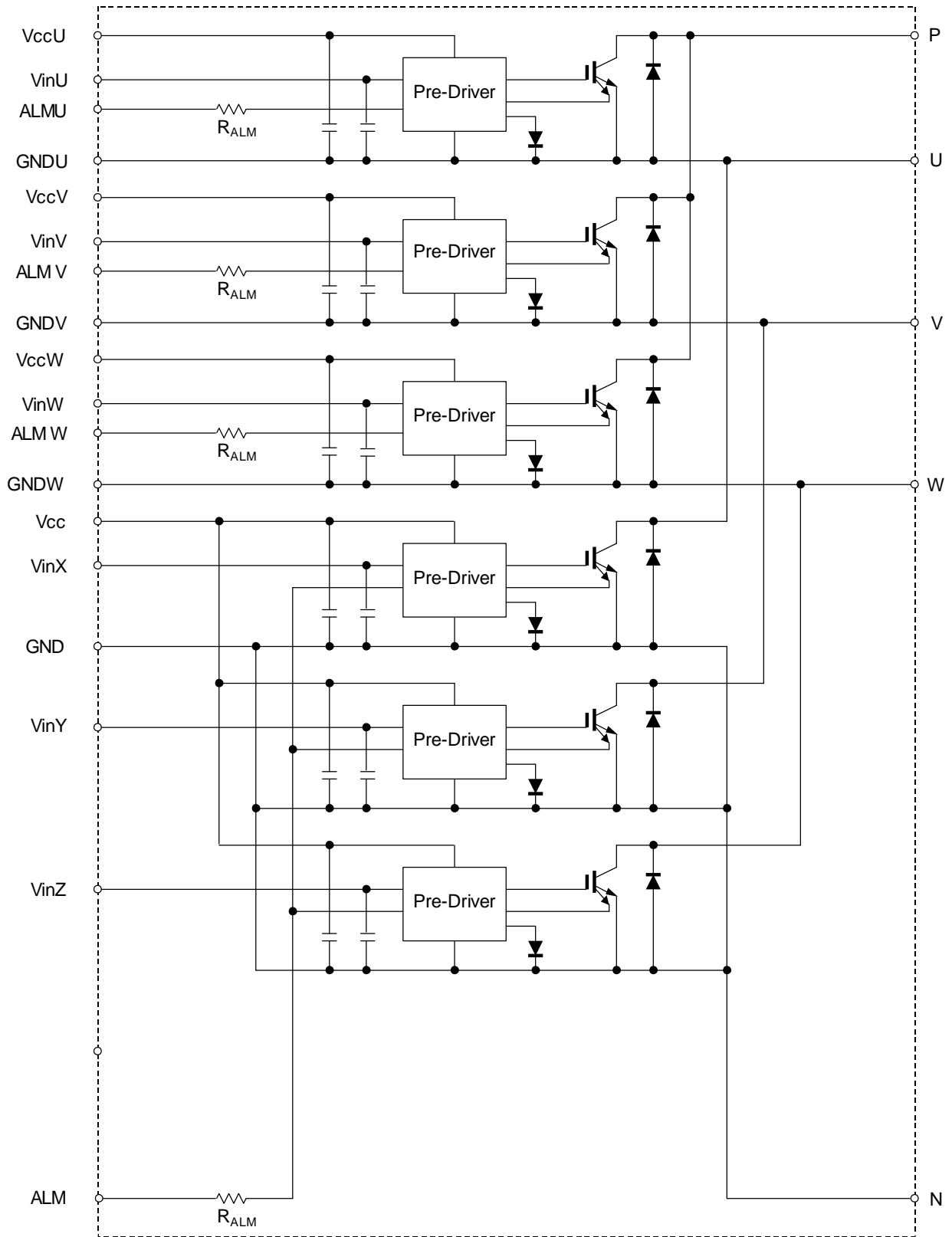
| Symbol | Description                    |
|--------|--------------------------------|
| P      | Positive input supply voltage. |
| U      | Output (U).                    |
| V      | Output (V).                    |
| W      | Output (W).                    |
| N      | Negative input supply voltage. |

### 2.1 Control circuit

| No. | Symbol | Description                          |
|-----|--------|--------------------------------------|
|     | GNDU   | High side ground (U).                |
|     | ALMU   | Alarm signal output (U).             |
|     | VinU   | Logic input for IGBT gate drive (U). |
|     | VccU   | High side supply voltage (U).        |
|     |        |                                      |
|     | GNDV   | High side ground (V).                |
|     | ALMV   | Alarm signal output (V).             |
|     | VinV   | Logic input for IGBT gate drive (V). |
|     | VccV   | High side supply voltage (V).        |
|     |        |                                      |
|     | GNDW   | High side ground (W).                |
|     | ALMW   | Alarm signal output (W).             |
|     | VinW   | Logic input for IGBT gate drive (W). |
|     | VccW   | High side supply voltage (W).        |
|     |        |                                      |
|     | GND    | Low side ground.                     |
|     | VCC    | Low side supply voltage.             |
|     | -      | no contact.                          |
|     | VinX   | Logic input for IGBT gate drive (X). |
|     | VinY   | Logic input for IGBT gate drive (Y). |
|     | VinZ   | Logic input for IGBT gate drive (Z). |
|     | ALM    | Low side alarm signal output.        |

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### 3. Block Diagram



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Pre-drivers include following functions

1. Amplifier for driver
2. Short circuit protection
3. Under voltage lockout circuit
4. Over current protection
5. IGBT chip over heating protection

#### 4. Absolute Maximum Ratings

Tc = 25 , Vcc = 15V unless otherwise specified.

| Items                           | Symbol           | Min.            | Max.                 | Units            |    |
|---------------------------------|------------------|-----------------|----------------------|------------------|----|
| Collector-Emitter Voltage *1    | V <sub>CES</sub> | 0               | 1200                 | V                |    |
| Short Circuit Voltage           | V <sub>SC</sub>  | 400             | 800                  | V                |    |
| Collector Current               | DC               | I <sub>C</sub>  | -                    | 50               | A  |
|                                 | 1ms              | I <sub>CP</sub> | -                    | 100              | A  |
|                                 | Duty=100% *2     | -I <sub>C</sub> | -                    | 50               | A  |
| Collector Power Dissipation     | 1 device *3      | P <sub>C</sub>  | -                    | 255              | W  |
| Supply Voltage of Pre-Driver *4 | V <sub>CC</sub>  | -0.5            | 20                   | V                |    |
| Input Signal Voltage *5         | V <sub>in</sub>  | -0.5            | V <sub>CC</sub> +0.5 | V                |    |
| Alarm Signal Voltage *6         | V <sub>ALM</sub> | -0.5            | V <sub>CC</sub>      | V                |    |
| Alarm Signal Current *7         | I <sub>ALM</sub> | -               | 20                   | mA               |    |
| Junction Temperature            | T <sub>j</sub>   | -               | 150                  |                  |    |
| Operating Case Temperature      | T <sub>opr</sub> | -20             | 110                  |                  |    |
| Storage Temperature             | T <sub>stg</sub> | -40             | 125                  |                  |    |
| Solder Temperature *8           | T <sub>sol</sub> | -               | 260                  |                  |    |
| Isolating Voltage *9            | V <sub>iso</sub> | -               | AC2500               | V <sub>rms</sub> |    |
| Screw Torque                    | Mounting (M4)    | -               | -                    | 1.7              | Nm |

#### Notes

\*1: V<sub>CES</sub> shall be applied to the input voltage between terminal P-(U,V, W) and (U,V, W)-N.

\*2: Duty=125 /R<sub>th(j-c)</sub>D/(I<sub>F</sub>×V<sub>F</sub> Max.)×100

\*3: P<sub>C</sub>=125 /R<sub>th(j-c)</sub>Q

\*4: V<sub>CC</sub> shall be applied to the input voltage between terminal No.4 and 1, 8 and 5, 12 and 9, 14 and 13.

\*5: V<sub>in</sub> shall be applied to the input voltage between terminal No.3 and 1, 7 and 5, 11 and 9, 16~18 and 13.

\*6: V<sub>ALM</sub> shall be applied to the voltage between terminal No.2 and 1, 6 and 5, 10 and 9, 19 and 13.

\*7: I<sub>ALM</sub> shall be applied to the input current to terminal No.2,6,10 and 19.

\*8: Immersion time 10±1sec. 1time

\*9: Terminal to base, 50/60Hz sine wave 1min. All terminals should be connected together during the test.

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## 5. Electrical Characteristics

$T_j = 25$  ,  $V_{CC} = 15V$  unless otherwise specified.

### 5.1 Main circuit

| Item           |  | Symbol   | Conditions                      | Min.     | Typ. | Max. | Units   |   |
|----------------|--|----------|---------------------------------|----------|------|------|---------|---|
| Inverter       | Collector Current<br>at off signal input | ICES     | $V_{CE}=1200V$                  | -        | -    | 1.0  | mA      |   |
|                | Collector-Emitter<br>saturation voltage  | VCE(sat) | IC=50A<br>Fig.4                 | Terminal | -    | -    | 2.30    | V |
|                |  |          |                                 | Chip     | -    | 1.70 | -       | V |
|                | Forward voltage of FWD                   | VF       | IF=50A<br>Fig.5                 | Terminal | -    | -    | 2.60    | V |
| Chip           |  |          |                                 | -        | 2.10 | -    | V       |   |
| Switching time |  | ton      | $V_{DC}=600V, T_j=125$          | 1.1      | -    | -    | $\mu s$ |   |
|                |  | toff     | IC=50A Fig.1,6                  | -        | -    | 2.1  | $\mu s$ |   |
|                |  | trr      | $V_{DC}=600V$<br>IF=50A Fig.1,6 | -        | -    | 0.3  | $\mu s$ |   |

### 5.2 Control circuit

| Item  |                        | Symbol  | Conditions                       | Min. | Typ. | Max. | Units |
|---|------------------------|---------|----------------------------------|------|------|------|-------|
| Supply current of P-side<br>pre-driver (per one unit) |                        | Iccp    | Switching Frequency<br>= 0-15kHz | -    | -    | 15   | mA    |
| Supply current of N-side<br>pre-driver                |                        | Iccn    | $T_c=-20 \sim 110$<br>Fig.7      | -    | -    | 47   | mA    |
| Input signal threshold voltage                        | V <sub>inth(on)</sub>  | Vin-GND | ON                               | 1.2  | 1.4  | 1.6  | V     |
|   | V <sub>inth(off)</sub> |         | OFF                              | 1.5  | 1.7  | 1.9  | V     |

### 5.3 Protection Circuit

| Item  |                                   | Symbol             | Conditions               | Min. | Typ. | Max. | Units    |
|---|-----------------------------------|--------------------|--------------------------|------|------|------|----------|
| Over Current Protection Level                           |                                   | IOC                | $T_j=125$                | 75   | -    | -    | A        |
| Over Current Protection Delay time                      |                                   | t <sub>dOC</sub>   | $T_j=125$ , Fig.3        | -    | 5    | -    | $\mu s$  |
| Short Circuit Protection Delay time                     |                                   | t <sub>SC</sub>    | $T_j=125$ , Fig.8        | -    | 2    | 3    | $\mu s$  |
| IGBT Chips Over Heating<br>Protection Temperature Level |                                   | T <sub>jOH</sub>   | Surface of<br>IGBT Chips | 150  | -    | -    |          |
| Over Heating Protection Hysteresis                      |                                   | T <sub>jH</sub>    |                          | -    | 20   | -    |          |
| Under Voltage Protection Level                          |                                   | VUV                |                          | 11.0 | -    | 12.5 | V        |
| Under Voltage Protection Hysteresis                     |                                   | VH                 |                          | 0.2  | 0.5  | -    | V        |
| Alarm Signal Hold Time                                  | t <sub>ALM(OC)</sub>              | ALM-GND            |                          | 1.0  | 2.0  | 2.4  | ms       |
|   | t <sub>ALM(UV)</sub>              | $T_c=-20 \sim 110$ | V <sub>CC</sub> 10V      | 2.5  | 4.0  | 4.9  | ms       |
|   | t <sub>ALM(T<sub>jOH</sub>)</sub> | Fig.2              |                          | 5.0  | 8.0  | 11.0 | ms       |
| Resistance for current limit                            |                                   | RALM               |                          | 960  | 1265 | 1570 | $\Omega$ |

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## 6. Thermal Characteristics (Tc = 25 )

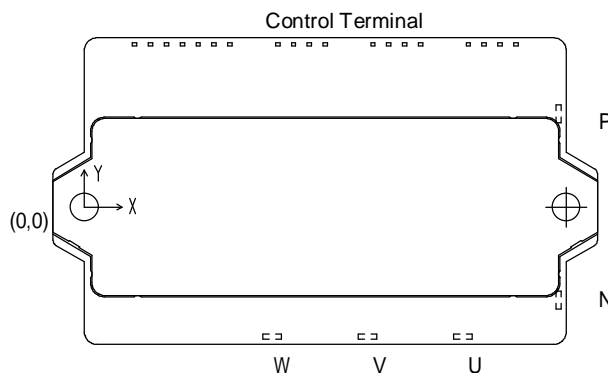
| Item   |          | Symbol   | Min.      | Typ. | Max. | Units |    |
|--|----------|----------|-----------|------|------|-------|----|
| Junction to Case<br>Thermal Resistance*10    | Inverter | IGBT     | Rth(j-c)Q | -    | -    | 0.49  | /W |
|  |          | FWD      | Rth(j-c)D | -    | -    | 0.75  | /W |
| Case to Fin Thermal Resistance with Compound |          | Rth(c-f) | -         | 0.05 | -    | /W    |    |

\*10: For 1device , the measurement point of the case is just under the chip.

### Chip layout drawing

Package : P626

Type name : 6MBP50VBA120-50



Location of measurement of Tc (chip center right under)

| Element<br>Axis | U    |      | V    |      | W    |      | X    |      | Y    |      | Z    |      |
|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|
|                 | IGBT | FWD  | IGBT | FWD  | IGBT | FWD  | IGBT | FWD  | IGBT | FWD  | IGBT | FWD  |
| X               | 61.5 | 53.8 | 46.1 | 38.4 | 30.7 | 23.0 | 56.9 | 64.8 | 40.4 | 48.3 | 23.9 | 31.8 |
| Y               | 6.5  | 6.5  | 6.5  | 6.5  | 6.5  | 6.5  | -6.0 | -4.7 | -6.0 | -4.7 | -6.0 | -4.7 |

(Unit : mm)

## 7.Noise Immunity (VDC=600V, VCC=15V, Test Circuit Figure 9.)

| Item                             | Conditions   | Min. | Typ. | Max. | Units |
|----------------------------------|--|------|------|------|-------|
| Common mode<br>rectangular noise | Pulse width 1μs,polarity ±,10 min.<br>Judge : no over-current, no miss operating | ±2.0 | -    | -    | kV    |

## 8.Recommended Operating Conditions

| Item   | Symbol | Min. | Typ. | Max. | Units |
|--|--------|------|------|------|-------|
| DC Bus Voltage   | VDC    | -    | -    | 800  | V     |
| Power Supply Voltage of Pre-Driver                     | VCC    | 13.5 | 15.0 | 16.5 | V     |
| Switching frequency of IPM                             | fsw    | -    | -    | 20   | kHz   |
| Arm shoot through blocking time for IPM's input signal | tdead  | 1.0  | -    | -    | μs    |
| Screw Torque (M4)                                      | -      | 1.3  | -    | 1.7  | Nm    |

## 9.Weight

| Item   | Symbol | Min. | Typ. | Max. | Units |
|--------|--------|------|------|------|-------|
| Weight | Wt     | -    | 100  | -    | g     |

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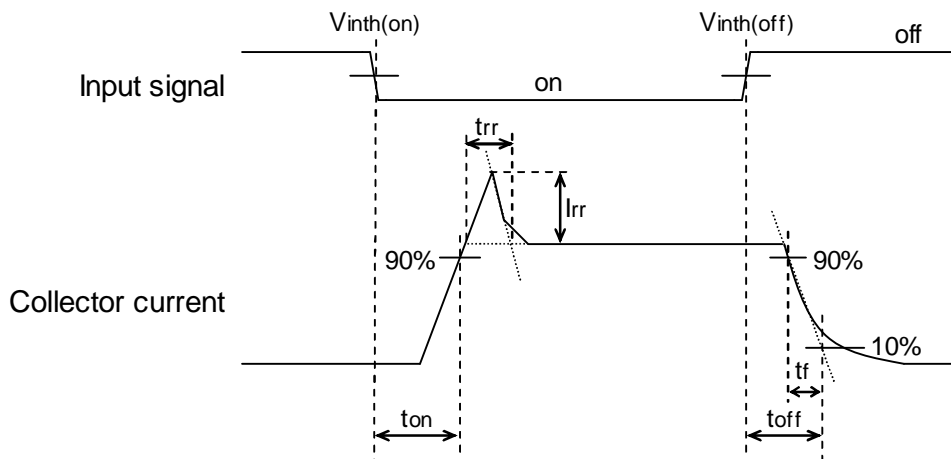


Figure1. Switching Time Waveform Definitions.

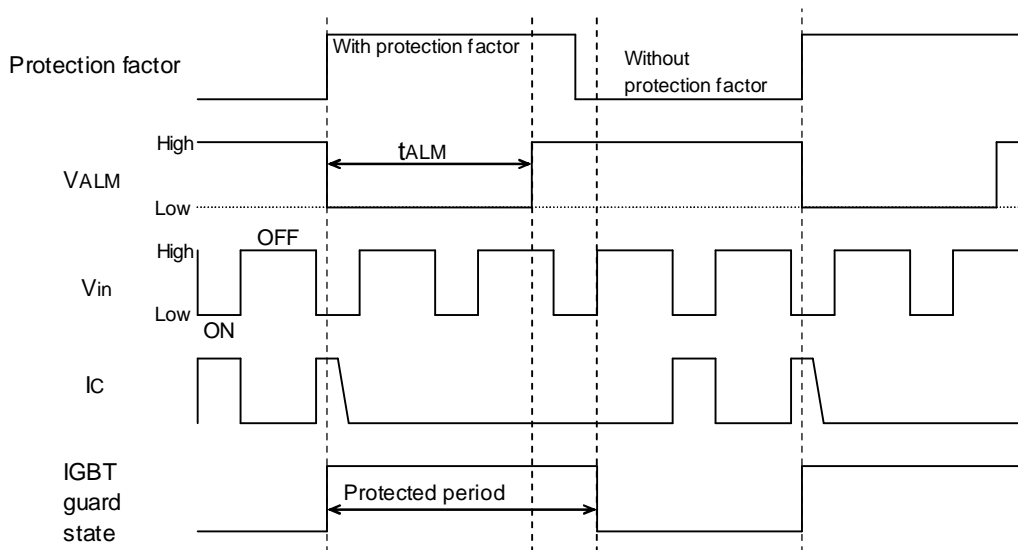


Figure2. Input/output Timing Diagram.

〔Alarm output〕〔アラーム出力〕

Set condition ( ) : The alarm is output only once(High Low) according to timing when the protection factor occurs.

セット条件 ( ) : 保護要因の発生したタイミングで、保護動作した相より1回のみアラーム出力(High Low)されます。

Reset condition : After it continues at the hold time of each alarm factor( $t_{ALM}$ ), it is released regardless of the presence of the alarm factor.

リセット条件 ( ) : 要因毎の保持時間( $t_{ALM}$ )継続後に 要因の有無に関係なく解除されます。

〔Protection operation (Switching stop of IGBT)〕〔保護動作(IGBTのスイッチング停止)〕

Set condition ( ) : The protection function operates when the protection factor occurs.

セット条件 ( ) : 保護要因の発生とともに動作します。

Reset condition ( ) : When the condition of protection factor cancellation,  $t_{ALM}$  passage, and input signal OFF becomes complete, the protection operation is released.

リセット条件 ( ) : 保護要因解消,  $t_{ALM}$ 経過, 入力信号OFFの条件が揃った時に解除されます。

〔Condition that alarm is output again〕〔アラームが再出力される条件〕

The protection factor occurs again after the protection operation is reset, the protection function operates at the same time when the alarm is output. ( )

保護動作がリセットされた後に再度保護要因が発生すれば、アラームが再出力されると同時に保護動作します ( )。

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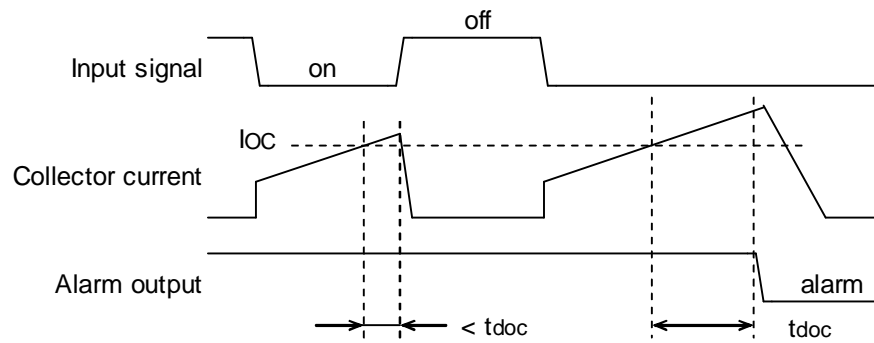


Figure3. Over Current Protection Timing Diagram.

Period : When a collector current over the OC level flows and the OFF command is input within a period less than the trip delay time  $t_{doc}$ , the current is hard-interrupted and no alarm is output.

期間 : OCレベルを超えたコレクタ電流が流れ、遮断遅れ時間 $t_{doc}$ より短い時間内で、オフ指令が入力された場合は、電流をハード遮断しアラームは出力しません。

Period : When a collector current over the OC level flows for a period more than the trip delay time  $t_{doc}$ , the current is soft-interrupted and the alarm signals are outputted.

期間 : OCレベルを超えたコレクタ電流が、遮断遅れ時間 $t_{doc}$ を超えた時間以上が流れ続けると電流をソフト遮断しアラームを出力します。

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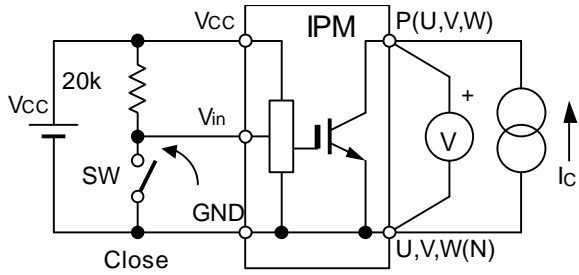


Figure4. VCE(sat) Test Circuit(Terminal)

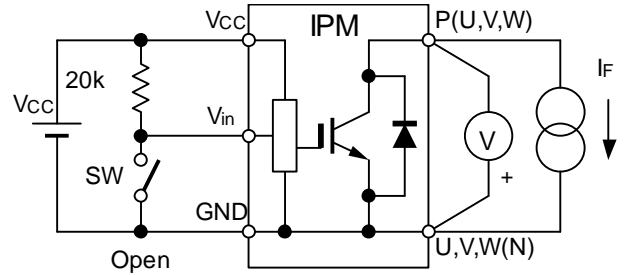


Figure5. VF Test Circuit(Terminal)

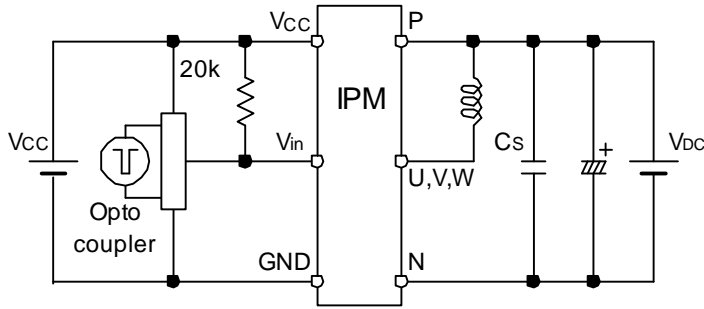


Figure6. Switching Characteristics Test Circuit

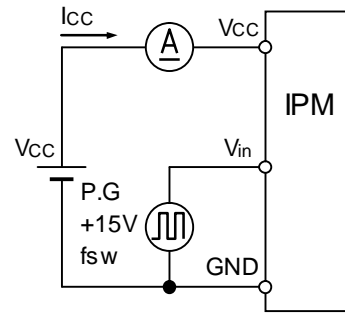


Figure7. Icc Test Circuit

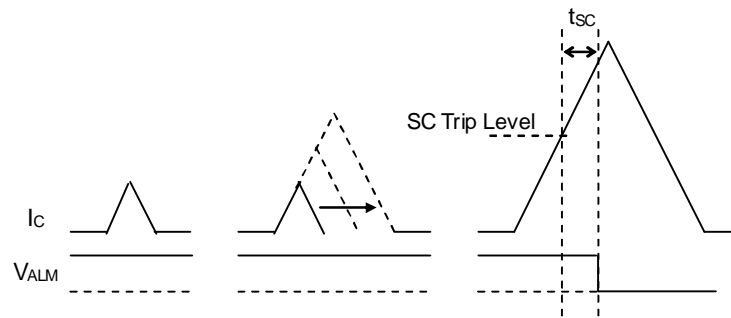


Figure8. Definition of tsc

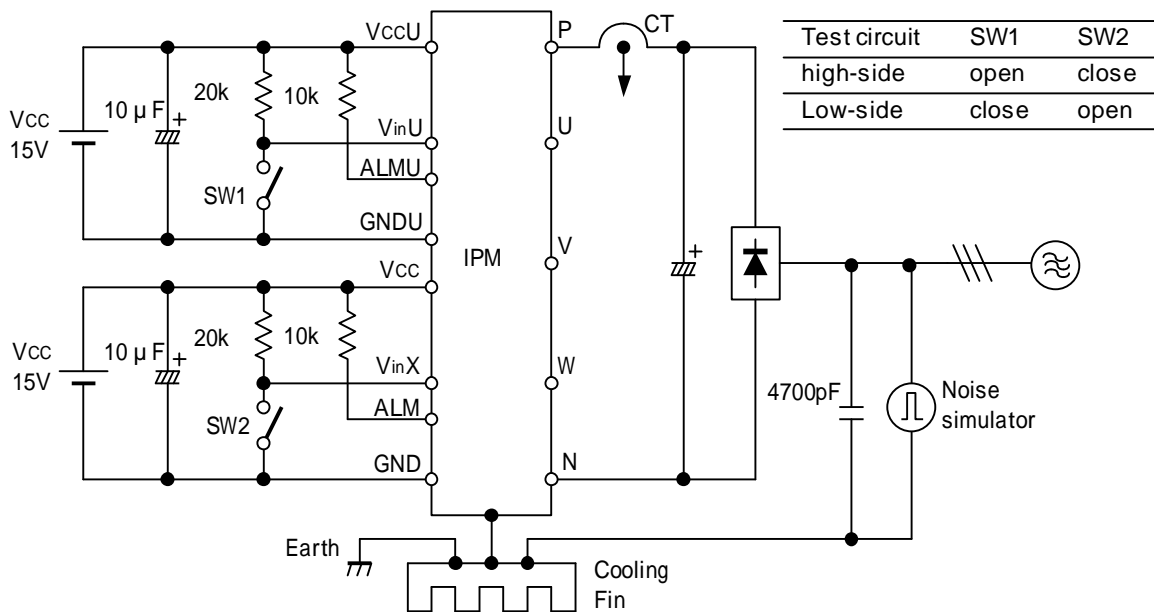


Figure9. Noise Test Circuit

## 10. Truth table

### 10.1 IGBT Control

The following table shows the IGBT ON/OFF status with respect to the input signal  $V_{in}$ .

The IGBT can be turned on when  $V_{in}$  is at "Low" level without the operation of IPM's protection.

入力信号 $V_{in}$ に対するIGBTのON / OFF状態を下表に示します。

保護要因が無い状態において、 $V_{in}$ が "Low" レベルで、IGBTはONします。

| Input signal | IPM's Protection status | Output (IGBT) |
|--------------|-------------------------|---------------|
| Low          | No operation            | On            |
| Low          | Operation               | Off           |
| High         | -                       | Off           |

### 10.2 Fault Detection

- (1) When a fault is detected at the high side, only the detected arm stops its output.

At that time the detected arm outputs an alarm.

上アームで異常を検出した場合、検出したアームのみ出力を停止します。

この場合、検出したアームはアラームを出力します。

- (2) When a fault is detected at the low side, all the lower arms stop their outputs and the alarm signals are outputted from lower arms.

下アーム回路で異常が発生した場合、

下アーム全ての出力を停止し、下アームからアラームを出力します。

- (3) An alarm is output only once. The output period is dependent on cause of fault.

アラームは1回のみ出力されます。また、出力期間 ( $t_{ALM}$ ) は異常内容によって異なります。

|                      | Cause of fault | Operation of IGBT |         |         |          | Alarm Output |      |      |     |
|----------------------|----------------|-------------------|---------|---------|----------|--------------|------|------|-----|
|                      |                | U-phase           | V-phase | W-phase | Low side | ALMU         | ALMV | ALMW | ALM |
| High side<br>U-phase | OC             | OFF               | *       | *       | *        | L            | H    | H    | H   |
|                      | UV             | OFF               | *       | *       | *        | L            | H    | H    | H   |
|                      | TjOH           | OFF               | *       | *       | *        | L            | H    | H    | H   |
| High side<br>V-phase | OC             | *                 | OFF     | *       | *        | H            | L    | H    | H   |
|                      | UV             | *                 | OFF     | *       | *        | H            | L    | H    | H   |
|                      | TjOH           | *                 | OFF     | *       | *        | H            | L    | H    | H   |
| High side<br>W-phase | OC             | *                 | *       | OFF     | *        | H            | H    | L    | H   |
|                      | UV             | *                 | *       | OFF     | *        | H            | H    | L    | H   |
|                      | TjOH           | *                 | *       | OFF     | *        | H            | H    | L    | H   |
| Low side             | OC             | *                 | *       | *       | OFF      | H            | H    | H    | L   |
|                      | UV             | *                 | *       | *       | OFF      | H            | H    | H    | L   |
|                      | TjOH           | *                 | *       | *       | OFF      | H            | H    | H    | L   |

\*: Depend on input logic.

H:High , L:Low

## 11. Recommendation for design and application

- (1) For the control power supply, secure the enough current capacity.  
 制御電源は、十分な電流容量を確保してください。
- (2) For the control power VCC, use four power supplies isolated each.  
 Connect the aluminum electrolytic capacitors (about 50V/10 $\mu$ F for upper arm and 50V/47 $\mu$ F for lower arm) as close as possible to the control power terminal VCC. These aluminum electrolytic capacitors are used not for smoothing the control power supply but for reducing the impedance of the external wiring.  
 Using single power supply such as bootstrap may occur the fluctuation of control power supply, so, it is necessary to design the systems considering these phenomenon in advance.  
 制御電源Vccは、絶縁された4電源を使用してください。  
 アルミ電解コンデンサ(上アーム:50V/10 $\mu$ F、下アーム:50V/47 $\mu$ F 程度)を、IPMの制御電源端子Vccに出来るだけ近接して実装してください。尚、本コンデンサは制御電源を平滑化する為のものではなく、IPMまでの配線インピーダンス補正用です。  
 ブートストラップ等の単電源での使用は、制御電圧変動等が予測される為、十分な検討、検証が必要です。
- (3) Don't apply noise current to the IPM's control GND line. It causes the malfunction.  
 IPMの制御GNDラインにノイズ電流を流さないでください。誤動作の原因となります。
- (4) At the external circuit, connections of GNDU to the main terminal U-phase, GNDV to V-phase, GNDW to W-phase, and GND to N-phase are prohibited. It causes the malfunction.  
 制御端子GNDUと主端子U、制御端子GNDVと主端子V、制御端子GNDWと主端子W、制御端子GNDと主端子Nを外部回路で接続しないで下さい。誤動作の原因になります。
- (5) In case of existence of disuse phase (ex. single phase use or disuse of DB phase), pull up the logic input and alarm signal output terminals of these disuse phase to VCC.  
 IPMを単相にて使用する場合は、ブレーキ内蔵タイプにてブレーキを使用しない場合は、使用しない相も制御電源を供給し、入力端子(Vin)、アラーム出力端子(ALM)共にVccへプルアップしてください。入力端子(Vin)オープン状態で制御電源を立ち上げた場合、アラーム出力状態となります。
- (6) In designing, make sure that the capacity of primary side current of optocoupler is enough, considering the CTR of optocoupler.  
 In case of the input forward current is not sufficient, input signals of IPM become instability and IPM may occur miss operation.  
 フォトカプラの一次側電流は、お使いのフォトカプラのCTRを考慮し十分に余裕をもった設計にして下さい。  
 一次電流が不足している場合、IPM入力信号が不安定となり、誤動作の原因となります。
- (7) To suppress the surge voltage, reduce the inductance at the DC bus of P-N circuit and connect some capacitors between the P and N terminals. Use capacitors with good high frequency characteristics.  
 P-N間の直流母線は出来るだけ低インダクタンス化し、P-N端子間にコンデンサを接続するなどしてサージ電圧を低減して下さい。  
 スナバコンデンサには高周波数特性の良いものを選んでください。
- (8) To estimate the chip temperature accurately, measure the case temperature just under the power chips and sum up the calculated  $\Delta T_{j-c}$  to the case temperature.  
 チップ温度推定には、必ずチップ直下のケース温度を測定し、これに計算より求めた  $T_{j-c}$ を加えて行って下さい。
- (9) In case of mounting this product on cooling fin, use thermal compound to secure thermal conductivity. If the thermal compound amount was not enough or its applying method was not suitable, its spreading will not be enough, then, thermal conductivity will be worse and thermal run away destruction may occur. The recommended thickness of thermal compound is 100 $\mu$ m. In the applying, confirm the spreading state of thermal compound.  
 (Spreading state of the thermal compound can be confirmed by removing this product after mounting.)  
 素子を冷却フィンに取り付ける際には、熱伝導を確保するためのコンパウンド等をご使用ください。又、塗布量が不足したり、塗布方法が不適切な場合、コンパウンドが十分に素子全体に広がらず、放熱悪化による熱破壊に繋がる事があります。コンパウンドの塗布厚は100 $\mu$ mを推奨しますが、塗布する際には製品全面にコンパウンドが広がっている事を確認してください。  
 (実装した後に素子を取りはずすとコンパウンドの広がり具合を確認する事が出来ます。)

(10) The assurance of solderability in main and control terminals is within once. Soldering in more than twice is out of quality assurance.

本製品の主端子・制御端子部分のハンダ付け性保証回数は1回です。付け直し等による2回以上の回数のハンダ付け性は保証の対象外です。

(11) This product is designed on the assumption that it applies to an inverter use. Sufficient examination is required at applying to a converter use. Please contact Fuji Electric Co.,Ltd if you would like to apply to converter use.

本製品は、インバータ用途への適用を前提に設計されております。コンバータ用途へ適用される場合は、十分な検討が必要です。もし、コンバータへ適用される場合は御連絡ください。

(12) Design the circuit pattern with shorter wiring from optocoupler to input signal terminals to reduce stray capacity in primary and secondary sides of optocoupler

フォトカプラとIPMの入力端子間の配線は極力短くし、フォトカプラの一次側と二次側の浮遊容量を小さくしたパターンレイアウトにしてください。

(13) A ceramic capacitor(about 0.1μF) should be connected from pin VCC to GND to stabilize the operation of high speed optocoupler. The total lead length between capacitor and optocoupler is recommended within 1cm.

フォトカプラの安定動作のため、Vcc-GND間に0.1μF程度のセラミックコンデンサを接続してください。コンデンサとフォトカプラのループ配線長は、出来るだけ1cmを超えないようにしてください。

(14) For the high-speed optocoupler, use high-CMR type with tpHL, tpLH 0.8μs.

高速フォトカプラは、tpHL, tpLH 0.8μs、高CMRタイプをご使用ください。

(15) For the alarm output circuit, use low-speed type optocoupler with CTR 100%.

アラーム出力回路は、低速フォトカプラCTR 100%のタイプをご使用ください。

(16) Design the control board considering the external noise

制御基板は、外来ノイズの影響を考慮した設計にしてください。

(17) As connecting the capacitor between the input terminal and GND, the response time of secondary side of optocoupler will be delayed compared with the primary side input. So in designing, consider these points.

入力端子-GND間にコンデンサを接続すると、フォトカブラ一次側入力信号に対する応答時間が長くなりますのでご注意ください。

(18) To prevent noise intrusion from the AC lines, connect a capacitor of about 4700pF between the each three-phase lines and the ground.

ACラインからのノイズ侵入を防ぐために、3相各線 - アース間に4700pF程度のコンデンサを接続してください。

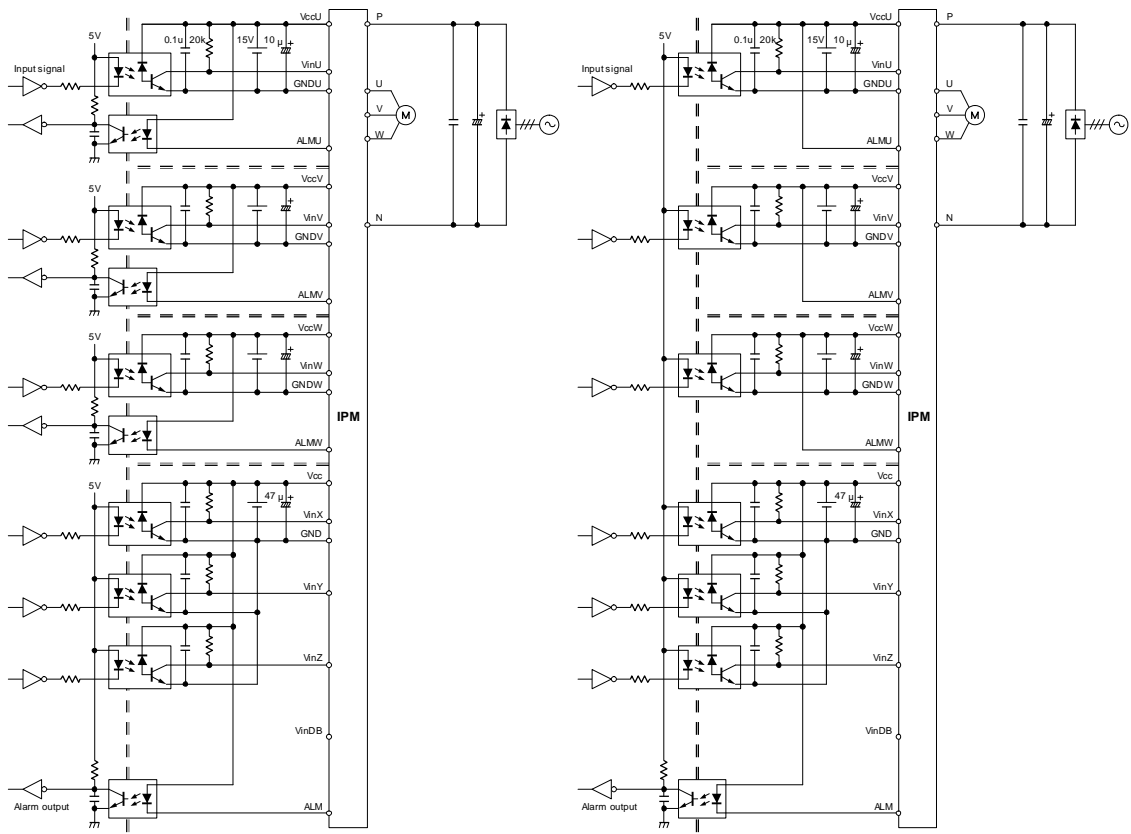
(19) Use this product with keeping the cooling fin's flatness between screw holes within 50μm per 100mm and the roughness within 10μm. Also keep the tightening torque within the limits of this specification. Too large convex of cooling fin may cause isolation breakdown and this may lead to a critical accident. On the other hand, too large concave of cooling fin makes gap between this product and the fin wider, then, thermal conductivity will be worse and over heat destruction may occur.

冷却フィンにはネジ取り付け位置間で平坦度を100mmで50μm以下、表面の粗さは10μm以下を推奨します。過大な凸反りは本製品の絶縁破壊を起こし、重大事故に発展する場合があります。また、過大な凹反りやゆがみ等は、本製品と冷却フィン間に空隙が生じて放熱が悪くなり、熱破壊に繋がる場合があります。

(20) Please see the 『IGBT-IPM APPLICATION MANUAL』 and 『IGBT MODULES APPLICATION MANUAL』.

『IGBT-IPM アプリケーションマニュアル』及び『IGBTモジュール アプリケーションマニュアル』を御参照ください。

## 12.Example of applied circuit



(a) In case of use of high-side alarm

(b) In case of no use of high-side alarm

## 13. Packing and Label

Please see the packing specification of IPM (Technical Rep. No. : MT6M8302).

IPM 梱包仕様書MT6M8302を御参照ください。

## 14. Cautions for storage and transportation

- Store the IPM at a standard temperature and humidity. (5 to 35 , 45 to 75%)  
Be careful to solderability of the terminals if the IPM has passed over one year from manufacturing date, under the above storage condition.  
常温・常湿保存が望ましい。(5 ~ 35 , 45 ~ 75%)  
本保存条件下で、製造から1年以上経過した場合は、端子はんだ付け性に十分注意する事。
- Avoid a sudden change in ambient temperature to prevent condensation on the module surfaces.  
モジュールの表面が結露しないよう、急激な温度変化を避けて下さい。
- Avoid places where corrosive gas generates or much dust exists.  
腐食性ガスの発生場所、粉塵の多い場所は避けて下さい。
- Store the module terminals under unprocessed conditions  
モジュールの端子は未加工の状態での保管すること。
- Avoid physical shock or falls during the transportation.  
運搬時に衝撃を与えたり落下させないで下さい。

## 15. Scope of application

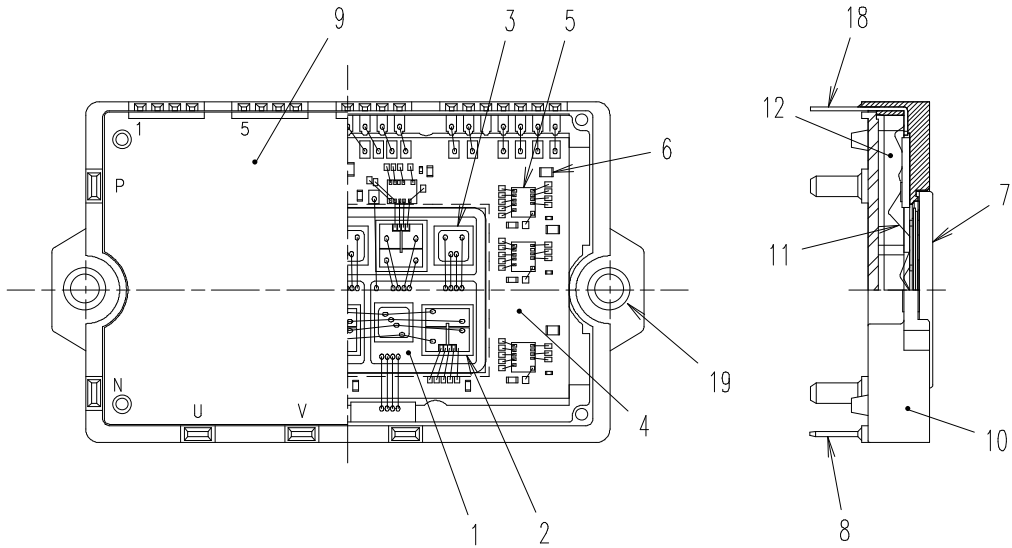
This specification is applied to the IGBT-IPM (type: 6MBP50VBA120-50)

本仕様書は、IGBT-IPM (型式:6MBP50VBA120-50)に適用する。

## 16. Based safety standards

UL1557

## 17. List of materials



This figure doesn't show the chip size and chip layout exactly. For only explanation of materials.  
 本図は、材料説明のための図であり、正確なチップサイズやレイアウトを表記したものではありません。

(Total weight of soldering material (typ.) : 3.1g)

| No. | Parts                                 | Material (main)                     | Ref.   |
|-----|---------------------------------------|-------------------------------------|--|
| 1   | Isolation substrate                   | Al <sub>2</sub> O <sub>3</sub> + Cu |  |
| 2   | IGBT chip                             | Silicon                             |  |
| 3   | FWD chip                              | Silicon                             |  |
| 4   | Printed Circuit Board                 | Glass reinforced Epoxy resin        | Halogen Free   |
| 5   | IC Chip                               | Silicon                             |  |
| 6   | Capacitor chip                        | Ceramics                            | Ni-Sn plating (External electrode)<br>PbO (Internal electrode) |
| 7   | Base Plate                            | Cu                                  | Ni plating (External)  |
| 8   | Main Terminal                         | Cu                                  | Sn-Cu plating on Ni plating                                    |
| 9   | Lid                                   | PPS resin                           | UL 94V-0   |
| 10  | Case                                  | PPS resin                           | UL 94V-0   |
| 11  | Wiring                                | Aluminum                            |  |
| 12  | Silicone Gel                          | Silicone gel                        |  |
| 13  | Adhesive(Lid, Case)                   | Silicone resin                      | (Not drawn in above)   |
| 14  | Adhesive(PCB)                         | Epoxy resin                         | (Not drawn in above)   |
| 15  | Solder (Under chip)                   | Sn/Ag base (Pb Free)                | (Not drawn in above)   |
| 16  | Solder<br>(Under Isolation substrate) | Sn/Ag base (Pb Free)                | (Not drawn in above)   |
| 17  | Solder<br>(Under electronic parts)    | Sn/Ag base (Pb Free)                | (Not drawn in above)   |
| 18  | Control Terminal                      | Brass                               | Sn-Cu plating on Ni plating                                    |
| 19  | Ring                                  | SUS                                 |  |
| 20  | Label                                 | PET                                 | (Not drawn in above)   |

PbO is excluded from RoHS directive.

## 18. RoHS Directive Compliance List of materials

The document (MS5F6209) about RoHS that Fuji Electric issued is applied to this Intelligent Power Module.  
 The Japanese Edition (MS5F6212) is made into a reference grade.

本IPMは富士電機が発行しているRoHSに関する資料MS5F6209を適用する。  
 日本語版 (MS5F6212) は参考資料とする。

Fuji Electric Co.,Ltd.

DWG.NO.

MS6M1398

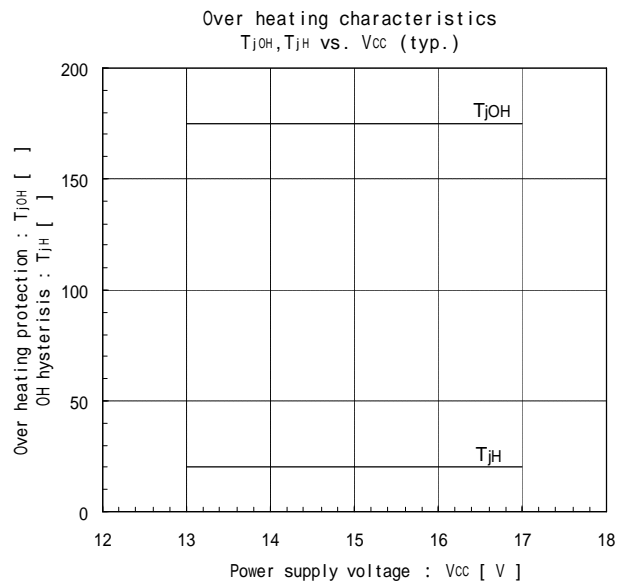
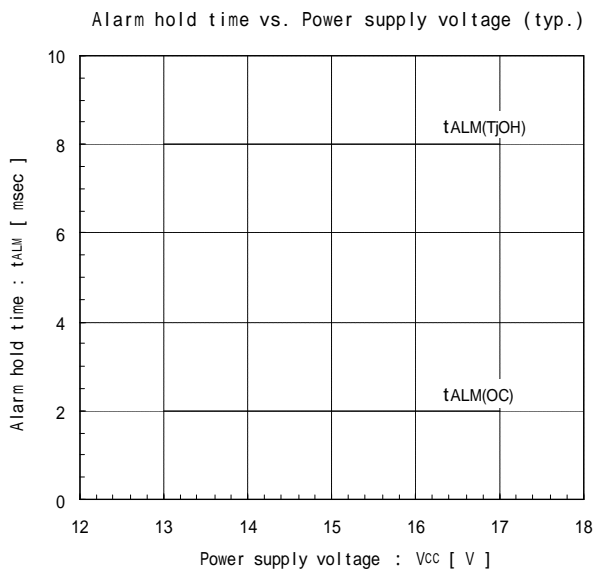
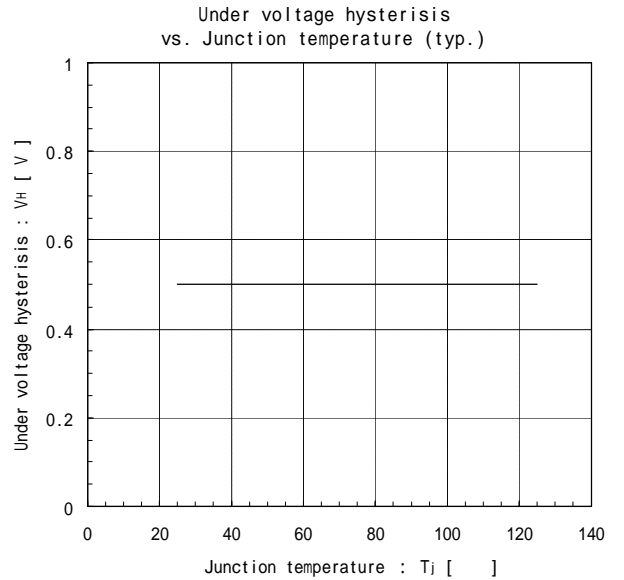
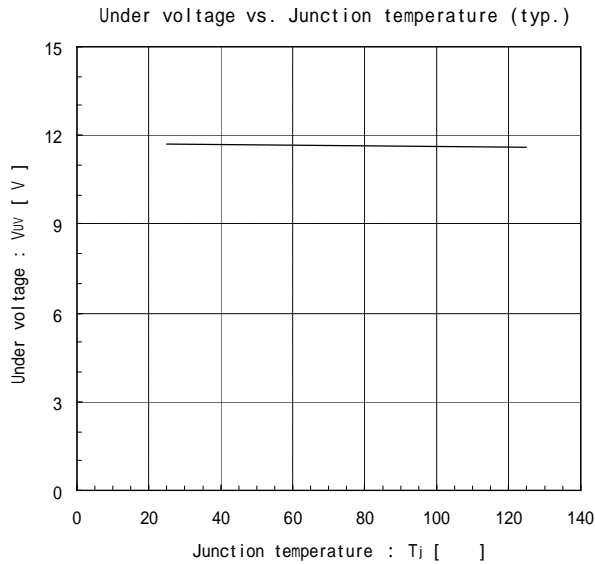
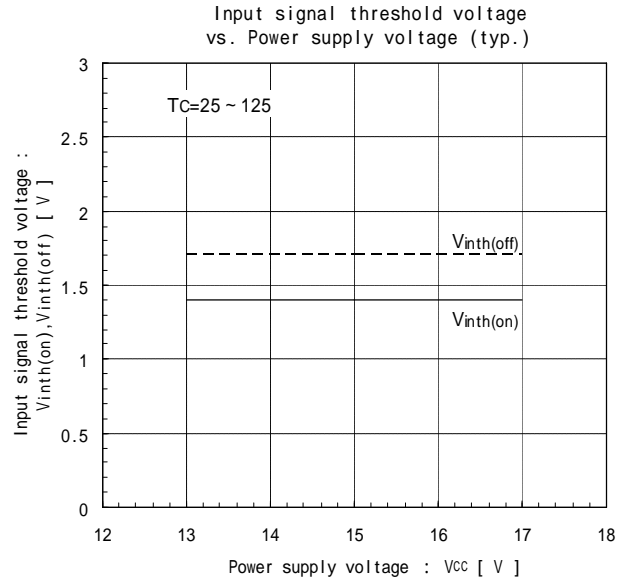
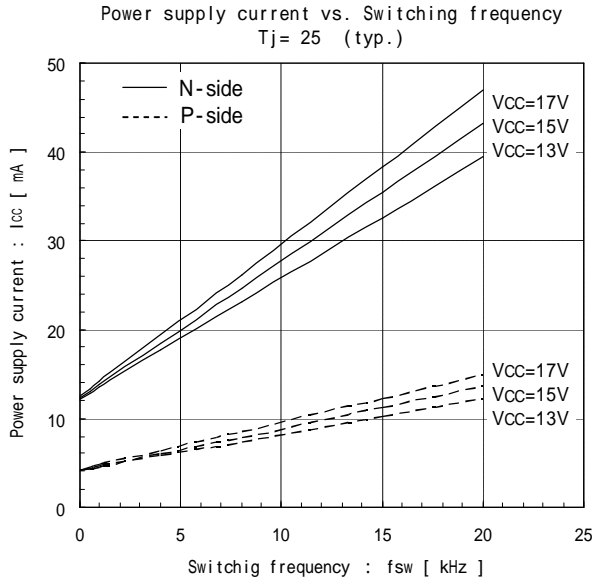
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a



# 19. Characteristics (Representative)

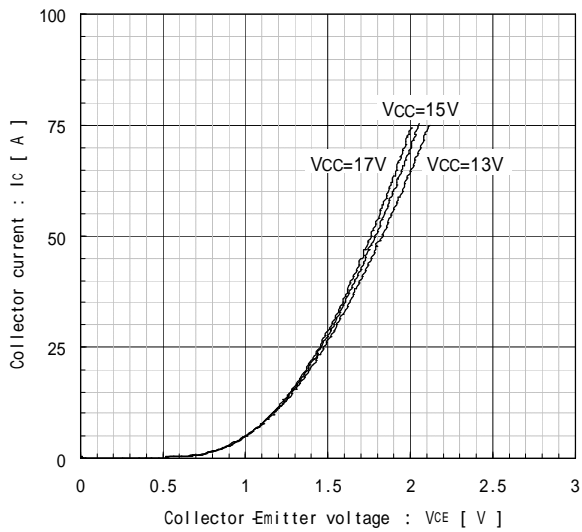
## 19-1. Control Circuit



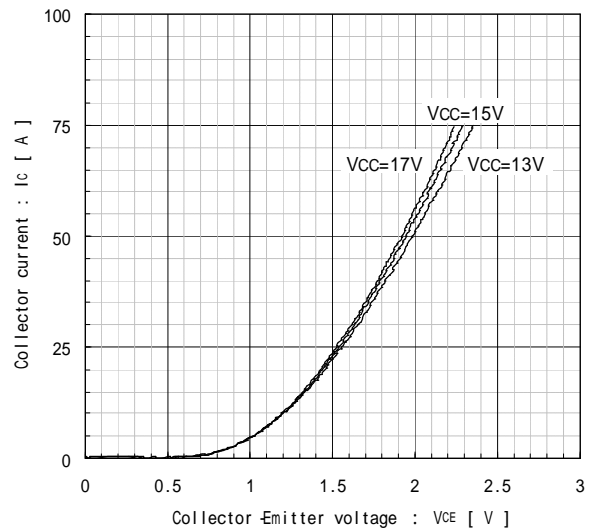
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## 19-2. Inverter

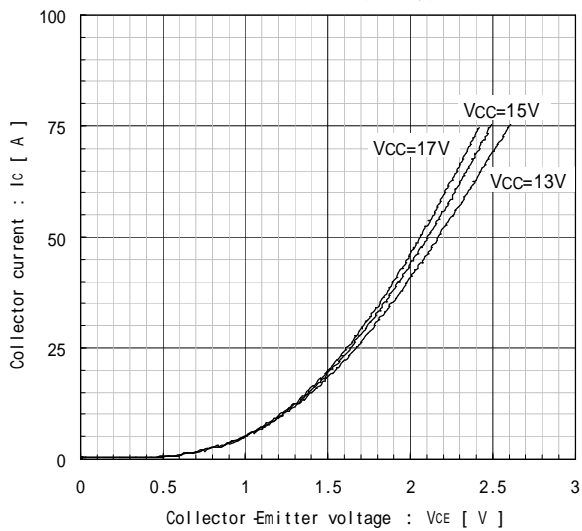
Collector current vs. Collector-Emmitter voltage  
T<sub>j</sub>=25 [Chip] (typ.)



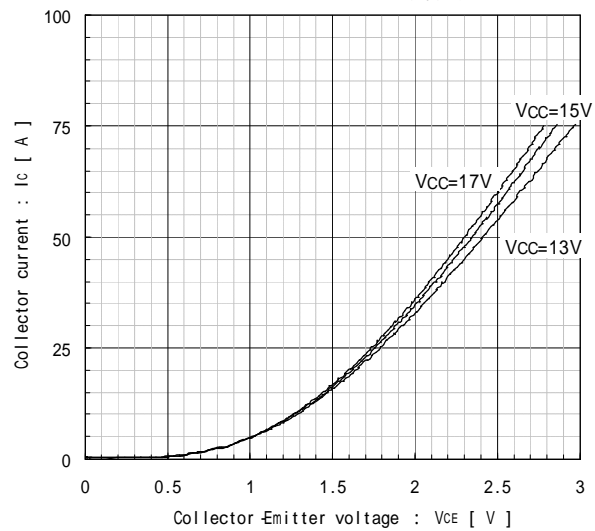
Collector current vs. Collector-Emmitter voltage  
T<sub>j</sub>=25 [Terminal] (typ.)



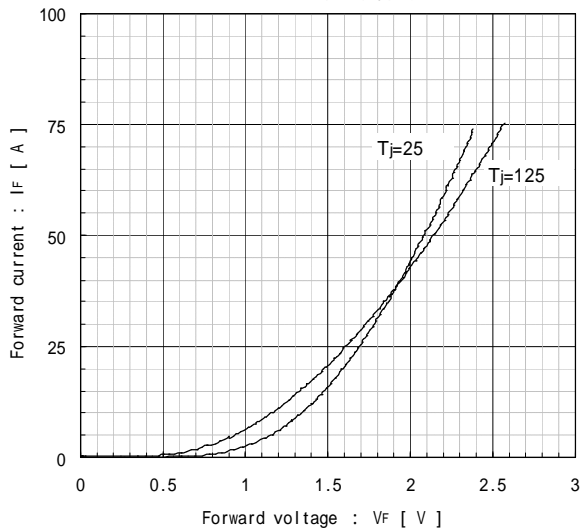
Collector current vs. Collector-Emmitter voltage  
T<sub>j</sub>=125 [Chip] (typ.)



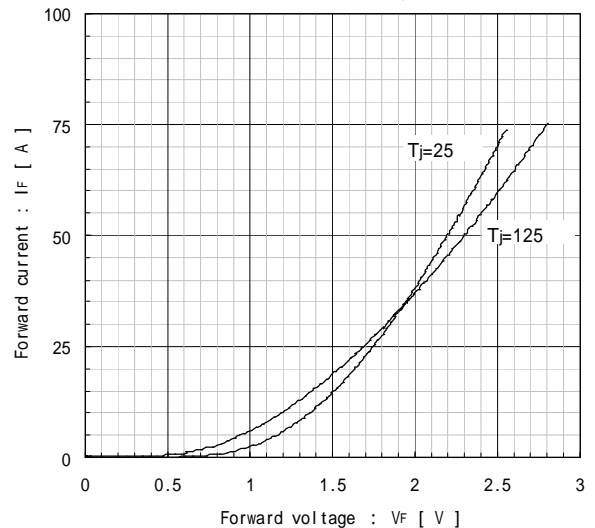
Collector current vs. Collector-Emmitter voltage  
T<sub>j</sub>=125 [Terminal] (typ.)



Forward current vs. Forward voltage  
[Chip] (typ.)

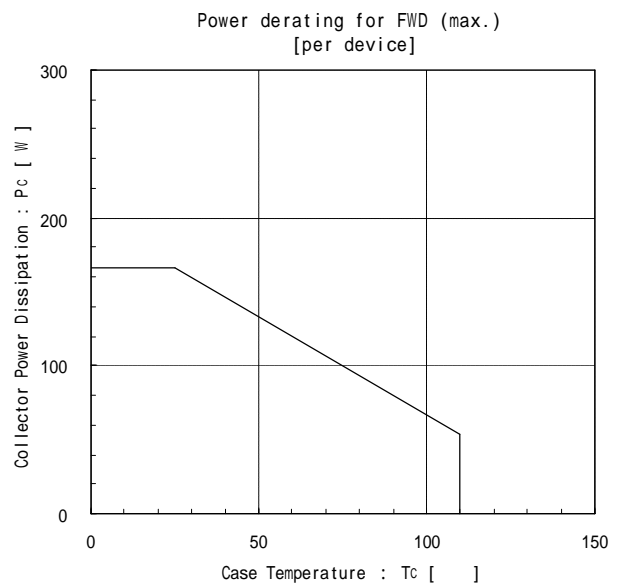
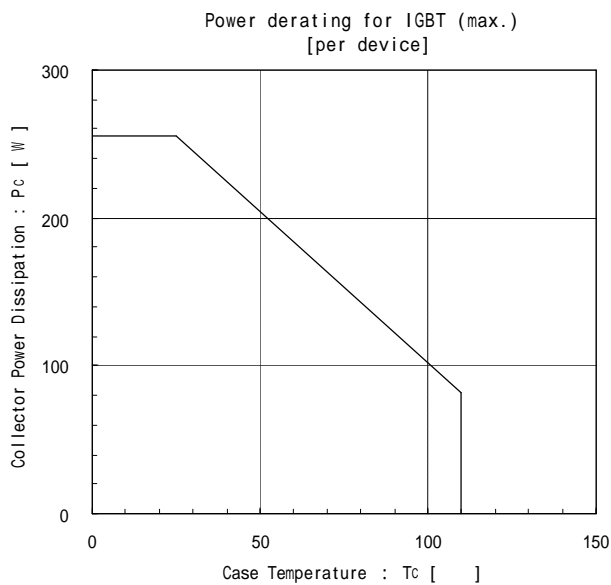
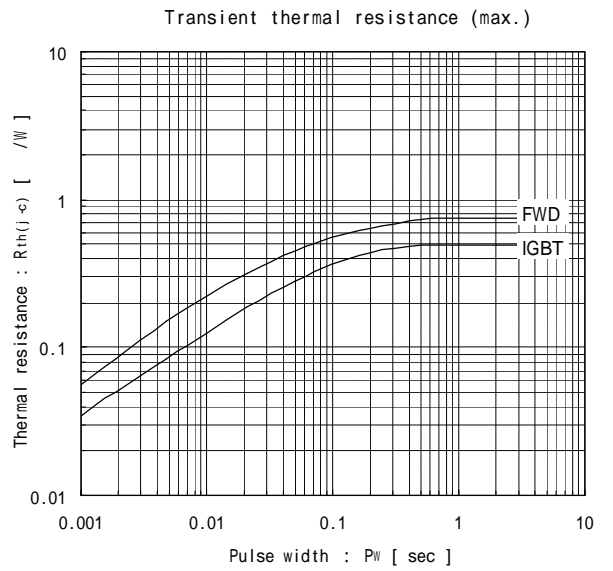
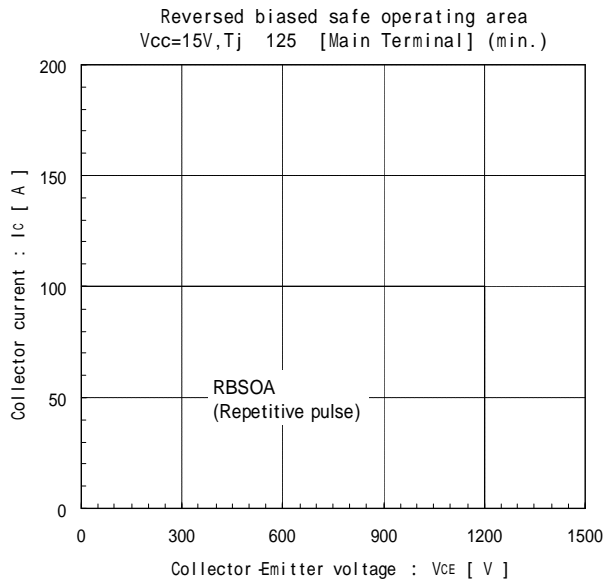
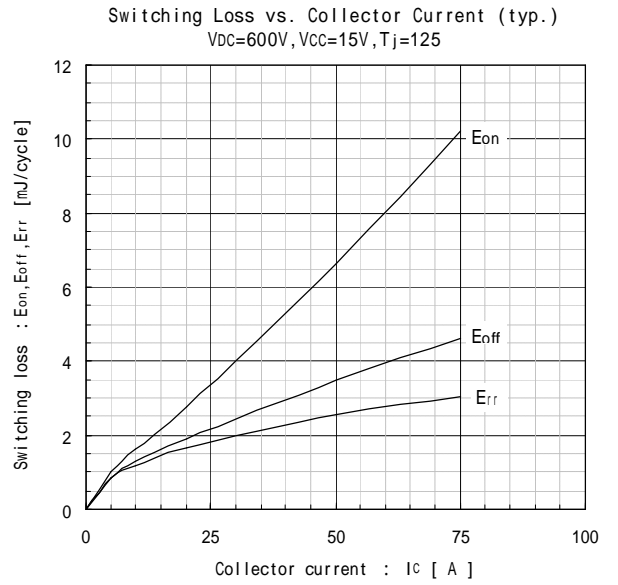
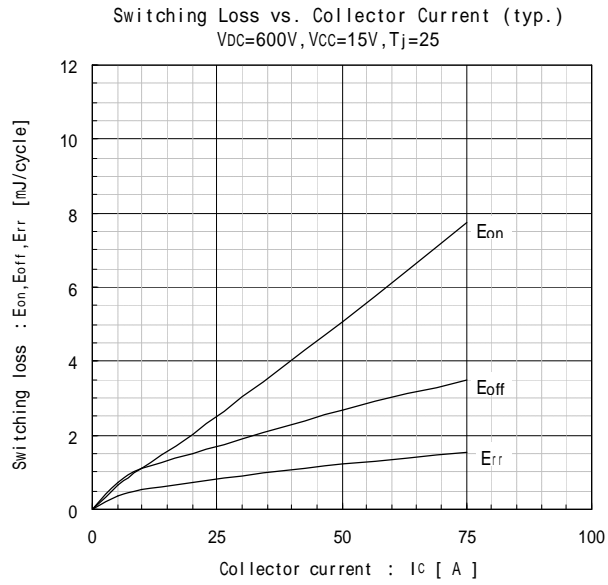


Forward current vs. Forward voltage  
[Terminal] (typ.)



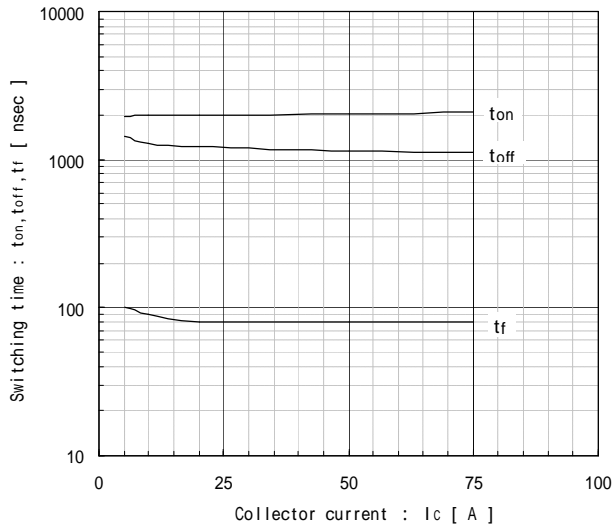
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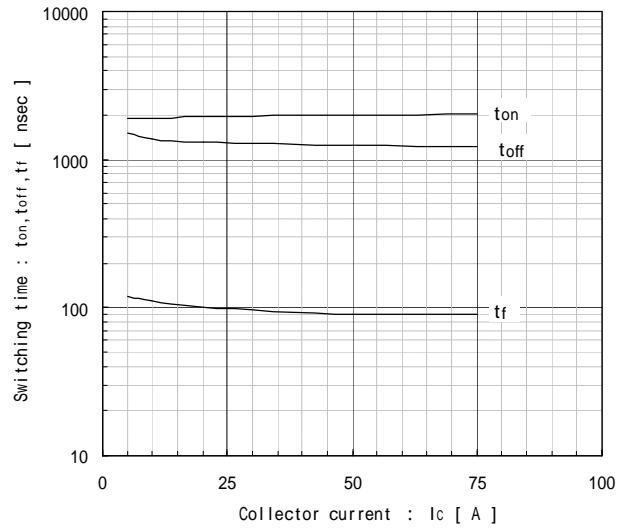


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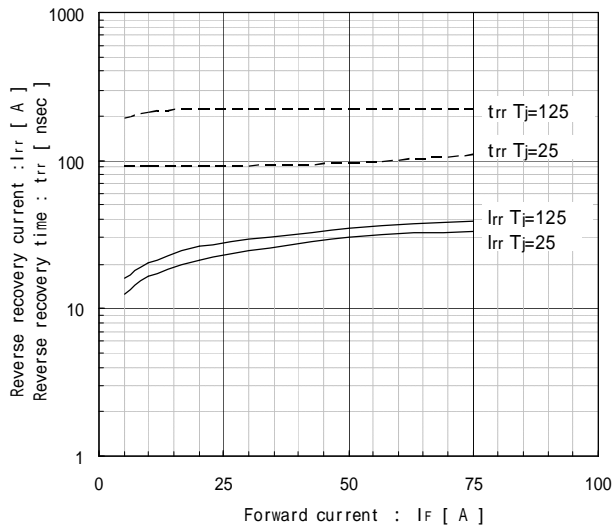
Switching time vs. Collector current (typ.)  
 $V_{DC}=600V, V_{CC}=15V, T_j=25$



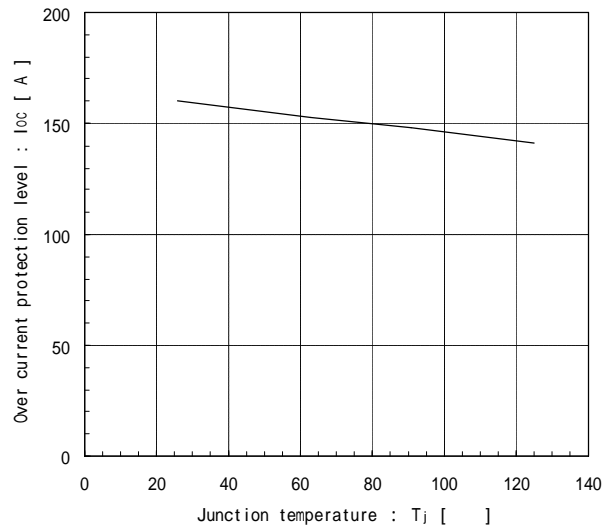
Switching time vs. Collector current (typ.)  
 $V_{DC}=600V, V_{CC}=15V, T_j=125$



Reverse recovery characteristics (typ.)  
 $t_{rr}, I_{rr}$  vs.  $I_f$



Over current protection vs. Junction temperature (typ.)  $V_{CC}=15V$



## 20. Reliability Test

### Test conditions and results

| Test categories           | No. | Test items                               | Test methods and conditions  | Reference norms<br>EIAJ<br>ED-4701            | Number of sample | Acceptance number | Number of failure |
|---------------------------|-----|--|--|---|------------------|-------------------|-------------------|
| Mechanical Tests<br>機械的試験 | 1   | Terminal strength<br>端子強度<br>(Pull test) | Pull force : 40 N (main terminal)<br>10 N (control terminal)<br>Test time : 10 ±1 sec.   | Test Method 401<br>Method                     | 5                | (1 : 0)           | 0                 |
|                           | 2   | Mounting Strength<br>締付け強度               | Screw torque : 1.3 ~ 1.7 N·m (M4)<br>Test time : 10 ±1 sec.  | Test Method 402<br>method                     | 5                | (1 : 0)           | 0                 |
|                           | 3   | Vibration<br>振動                          | Range of frequency : 10 ~ 500 Hz<br>Sweeping time : 15 min.<br>Acceleration : 100 m/s <sup>2</sup><br>Sweeping direction : Each X,Y,Z axis<br>Test time : 6 hr. (2hr./direction)   | Test Method 403<br>Condition code B           | 5                | (1 : 0)           | 0                 |
|                           | 4   | Shock<br>衝撃                              | Maximum acceleration : 5000 m/s <sup>2</sup><br>Pulse width : 1.0 ms<br>Direction : Each X,Y,Z axis<br>Test time : 3 times/direction   | Test Method 404<br>Condition code B           | 5                | (1 : 0)           | 0                 |
|                           | 5   | Solderability<br>はんだ付け性                  | Solder temp. : 245 ±5<br>Immersion duration : 5.0 ±0.5 sec.<br>Test time : 1 time<br>Solder Alloy : Sn-Ag-Cu<br>Each terminal should be Immersed in solder within 1~1.5mm from the body.   | Test Method 303                               | 5                | (1 : 0)           | 0                 |
|                           | 6   | Resistance to soldering heat<br>はんだ耐熱性   | Solder temp. : 260 ±5<br>Immersion time : 10 ±1sec.<br>Test time : 1 time<br>Each terminal should be Immersed in solder within 1~1.5mm from the body.  | Test Method 302<br>Condition code A           | 5                | (1 : 0)           | 0                 |
| Environment Tests<br>環境試験 | 1   | High temperature storage<br>高温保存         | Storage temp. : 125 ±5<br>Test duration : 1000 hr.   | Test Method 201                               | 5                | (1 : 0)           | 0                 |
|                           | 2   | Low temperature storage<br>低温保存          | Storage temp. : -40 ±5<br>Test duration : 1000 hr.   | Test Method 202                               | 5                | (1 : 0)           | 0                 |
|                           | 3   | Temperature humidity storage<br>高温高湿保存   | Storage temp. : 85 ±2<br>Relative humidity : 85 ±5%<br>Test duration : 1000hr.   | Test Method 103<br>Test code C                | 5                | (1 : 0)           | 0                 |
|                           | 4   | Unsaturated Pressurized Vapor<br>不飽和蒸気加圧 | Test temp. : 120 ±2<br>Test humidity : 85 ±5%<br>Test duration : 96 hr.  | Test Method 103<br>Test code E                | 5                | (1 : 0)           | 0                 |
|                           | 5   | Temperature cycle<br>温度サイクル              | Test temp. : Minimum storage temp. -40 ±5<br>Maximum storage temp. 125 ±5<br>Normal temp. 5 ~ 35<br>Dwell time : T <sub>min</sub> ~ T <sub>N</sub> ~ T <sub>max</sub> ~ T <sub>N</sub><br>1hr. 0.5hr. 1hr. 0.5hr.<br>Number of cycles : 100 cycles         | Test Method 105                               | 5                | (1 : 0)           | 0                 |
|                           | 6   | Thermal shock<br>熱衝撃                     | Test temp. : High temp. side 100 <sup>+0</sup> <sub>-5</sub><br>Low temp. side 0 <sup>+5</sup> <sub>-0</sub><br>Fluid used : Pure water (running water)<br>Dipping time : 5 min. par each temp.<br>Transfer time : 10 sec.<br>Number of cycles : 10 cycles | Test Method 307<br>method<br>Condition code A | 5                | (1 : 0)           | 0                 |

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Test conditions and results

| Test categories          | No. | Test items   | Test methods and conditions   | Reference norms<br>EIAJ<br>ED-4701  | Number of sample | Acceptance number | Number of failure |
|--------------------------|-----|--|---|-------------------------------------|------------------|-------------------|-------------------|
| Endurance Tests<br>耐久性試験 | 1   | High temperature reverse bias<br>高温逆バイアス                     | Test temp. : Ta = 125 ±5<br>(Tj 150 )<br>Bias Voltage : VC = 0.8xVCES<br>Bias Method : Applied DC voltage to C-E<br>Vcc = 15V<br>Test duration : 1000 hr.             | Test Method 101                     | 5                | ( 1 : 0 )         | 0                 |
|                          | 2   | Temperature humidity bias<br>高温高湿バイアス                        | Test temp. : 85 ±2<br>Relative humidity : 85 ±5 %<br>Bias Voltage : VC = 0.8xVCES<br>Vcc = 15V<br>Bias Method : Applied DC voltage to C-E<br>Test duration : 1000 hr. | Test Method 102<br>Condition code C | 5                | ( 1 : 0 )         | 0                 |
|                          | 3   | Intermitted operating life<br>(Delta-Tj Power cycle)<br>断続動作 | ON time : 2 sec.<br>OFF time : 18 sec.<br>Test temp. : D Tj=100 ±5deg<br>Tj 150 , Ta=25 ±5<br>Number of cycles : 15000 cycles   | Test Method 106                     | 5                | ( 1 : 0 )         | 0                 |

### Failure Criteria

| Item                      | Characteristic  | Symbol   | Failure criteria  |             | Unit    |    |
|---------------------------|---|----------|-------------------|-------------|---------|----|
|                           |   |          | Lower limit       | Upper limit |         |    |
| Electrical characteristic | Leakage current   | ICES     | -                 | USLx2.0     | mA      |    |
|                           | Saturation voltage  | VCE(sat) | -                 | USLx1.2     | V       |    |
|                           | Forward voltage   | VF       | -                 | USLx1.2     | V       |    |
|                           | Thermal resistance  | IGBT     | Rth(j-c)Q         | -           | USLx1.2 | /W |
|                           |   | FWD      | Rth(j-c)D         | -           | USLx1.2 | /W |
|                           | Over Current Protection                                   | IOC      | LSLx0.8           | USLx1.2     | A       |    |
|                           | Alarm signal hold time                                    | tALM     | LSLx0.8           | USLx1.2     | ms      |    |
| Visual inspection         | Isolation voltage   | Viso     | Broken insulation |             | -       |    |
|                           | Visual inspection<br>Peeling<br>Plating<br>and the others | -        | The visual sample |             | -       |    |

LSL : Lower specified limit.

USL : Upper specified limit.

Note :

Each parameter measurement read-outs shall be made after stabilizing the components at room ambient for 2 hours minimum, 24 hours maximum after removal from the tests. And in case of the wetting tests, for example, moisture resistance tests, each component shall be made wipe or dry completely before the measurement.

信頼性試験後の電気的特性検査及び外観検査は、試験終了後2時間以上、24時間以内室温に放置後行う。又、耐湿性試験や熱衝撃試験のように水分の付着または、内部浸入の可能性のある項目については表面を拭き、エアブローで表面の水分を除去し、十分に水分が除去された状態で測定する。

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# Warnings

- This product shall be used within its absolute maximum rating (voltage, current, and temperature). This product may be broken in case of using beyond the ratings.  
製品の絶対最大定格(電圧, 電流, 温度等)の範囲内で御使用下さい。  
絶対最大定格を超えて使用すると、素子が破壊する場合があります。
- Connect adequate fuse or protector of circuit between three-phase line and this product to prevent the equipment from causing secondary destruction.  
万一の不慮の事故で素子が破壊した場合を考慮し、商用電源と本製品の間に適切な容量のヒューズ又はブレーカーを必ず付けて2次破壊を防いでください。
- When studying the device at a normal turn-off action, make sure that working paths of the turn-off voltage and current are within the RBSOA specification.  
通常のターンオフ動作における素子責務の検討の際には、ターンオフ電圧・電流の動作軌跡がRBSOA仕様内にあることを確認して下さい。
- Use this product after realizing enough working on environment and considering of product's reliability life. This product may be broken before target life of the system in case of using beyond the product's reliability life.  
製品の使用環境を十分に把握し、製品の信頼性寿命が満足できるか検討の上、本製品を適用して下さい。  
製品の信頼性寿命を超えて使用した場合、装置の目標寿命より前に素子が破壊する場合があります。
- If the product had been used in the environment with acid, organic matter, and corrosive gas (For example : hydrogen sulfide, sulfurous acid gas), the product's performance and appearance can not be ensured easily.  
酸・有機物・腐食性ガス(硫化水素, 亜硫酸ガス等)を含む環境下で使用された場合、製品機能・外観などの保証は致しかねます。
- Use this product within the delta-Tj power cycle curve (Technical Rep.No. : MT5Z02525) and the delta-Tc power cycle curve (Technical Rep.No. : MT5Z02509)  
Power cycle capability is classified to delta-Tj mode which is stated as above and delta-Tc mode. Delta-Tc mode is due to rise and down of case temperature (Tc), and depends on cooling design of equipment which use this product. In application which has such frequent rise and down of Tc, well consideration of product life time is necessary.  
本製品は、Tjパワーサイクル寿命カーブ(技術資料No.: MT5Z02525)と Tcパワーサイクル寿命カーブ(技術資料No.: MT5Z02509)の範囲内で使って下さい。  
パワーサイクル耐量にはこの Tjによる場合の他に、Tcによる場合があります。これはケース温度(Tc)の上昇下降による熱ストレスであり、本製品をご使用する際の放熱設計に依存します。ケース温度の上昇下降が頻繁に起こる場合は、製品寿命に十分留意してご使用下さい。
- Never add mechanical stress to deform the main or control terminal.  
The deformed terminal may cause poor contact problem.  
主端子及び制御端子に応力を与えて変形させないで下さい。  
端子の変形により、接触不良などを引き起こす場合があります。

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## Warnings

- If excessive static electricity is applied to the control terminals, the devices can be broken.  
Implement some countermeasures against static electricity.  
制御端子に過大な静電気が印加された場合、素子が破壊する場合があります。  
取り扱い時は静電気対策を実施して下さい。
- Use the latest version Specification and Application Manual every time in case of designing the new equipment.  
新規装置設計の際は、常に最新の仕様書及びアプリケーションマニュアルを適用してください。

## Cautions

- Fuji Electric is constantly making every endeavor to improve the product quality and reliability. However, semiconductor products may rarely happen to fail or malfunction. To prevent accidents causing injury or death, damage to property like by fire, and other social damage resulted from a failure or malfunction of the Fuji Electric semiconductor products, take some measures to keep safety such as redundant design, spread-fire-preventive design, and malfunction-protective design.  
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- The product described in this specification is not designed nor made for being applied to the equipment or systems used under life-threatening situations. When you consider applying the product of this specification to particular used, such as vehicle-mounted units, shipboard equipment, aerospace equipment, medical devices, atomic control systems and submarine relaying equipment or systems, please apply after confirmation of this product to be satisfied about system construction and required reliability.  
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If there is any unclear matter in this specification, please contact Fuji Electric Co., Ltd.