

6th Gen. new MPD IGBT MODULES

APPLICATION NOTE

1. Index

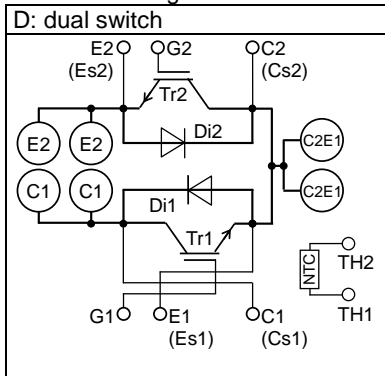
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The company name and product names herein are the trademarks and registered trademarks of the respective companies.

2. Product line-up

CM2500DY-24S CM1800DY-34S

Connection Diagram: without mark on Label



Peripheral Device (ISAHAYA ELECTRONICS CORPORATION SELECTION GUIDE for Power Electronics 2013, pp4)

·IGBT gate drive unit

for CM2500DY-24S
VLA553-01R, VLA555-01R

for CM1800DY-34S
VLA553-02R, VLA555-02R

Image photo



·IGBT gate driver

VLA552-01R

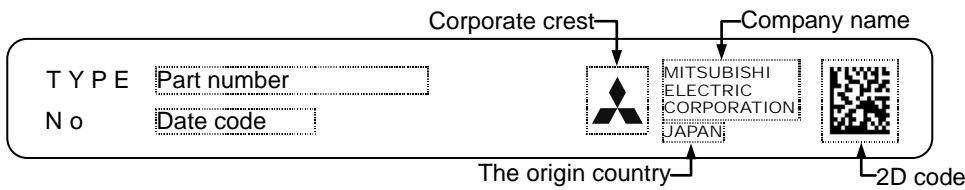
Please contact to the following company to inquire about these products.

ISAHAYA ELECTRONICS CORPORATION

URL: <http://www.idc-com.co.jp/>

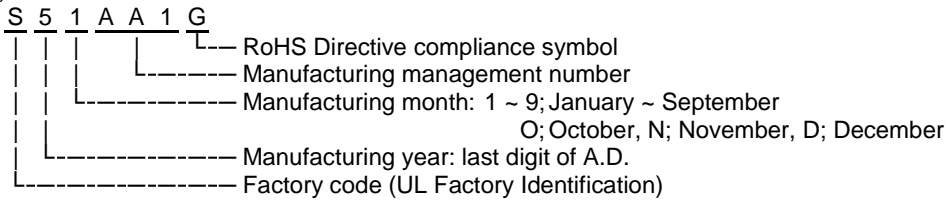
3. Label marking

(a) A marking example with 2D code



Note: Some parametric are optional.

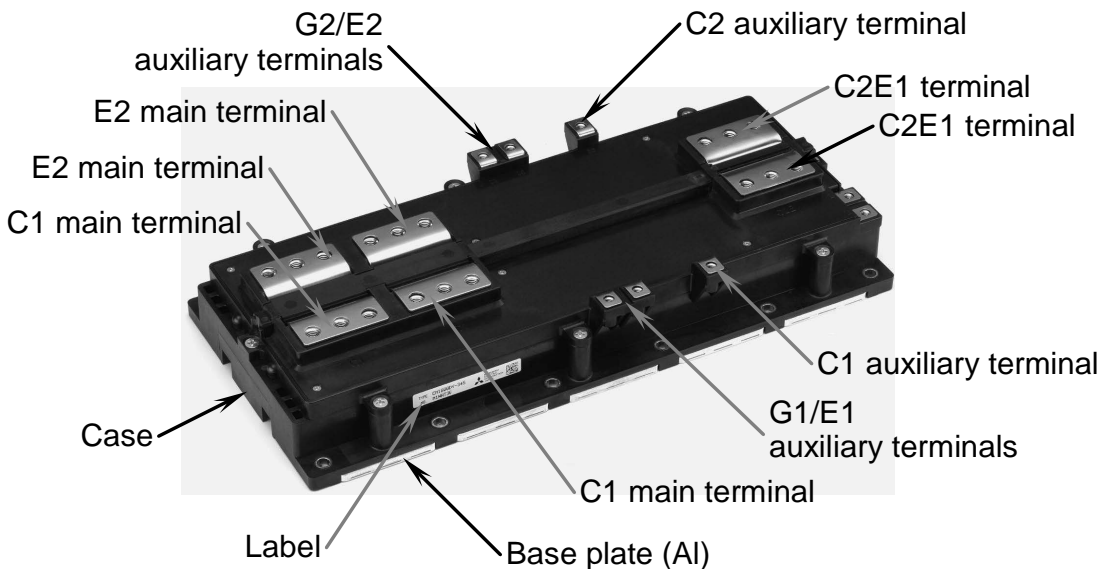
(b) Date code formation



(c) 2D code specifications

Item	Specification
Symbology	Data Matrix (ECC200)
Data type	alphanumeric (ASCII) characters
Error correction ability	20 ~ 35 %
Symbol size	6.0 mm × 6.0 mm
Code size	24 cell × 24 cell
Cell size	0.25 mm
Data size	32 letters

(d) Label position and parts name



4. 2D code specifications

Data item	Letter size
Part number	20
Space	2
Date code	8
Space	2
Total	32

Data contents example ("SP" means space , equivalent to ASCII code number 32)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
C	M	2	5	0	0	D	Y	-	2	4	S	SP	SP	SP	SP	SP	SP	SP	SP	SP	SP	M	1	2	H	A	1	G	SP	SP	SP
20																				2		8								2	

5. Safety Standard (UL)

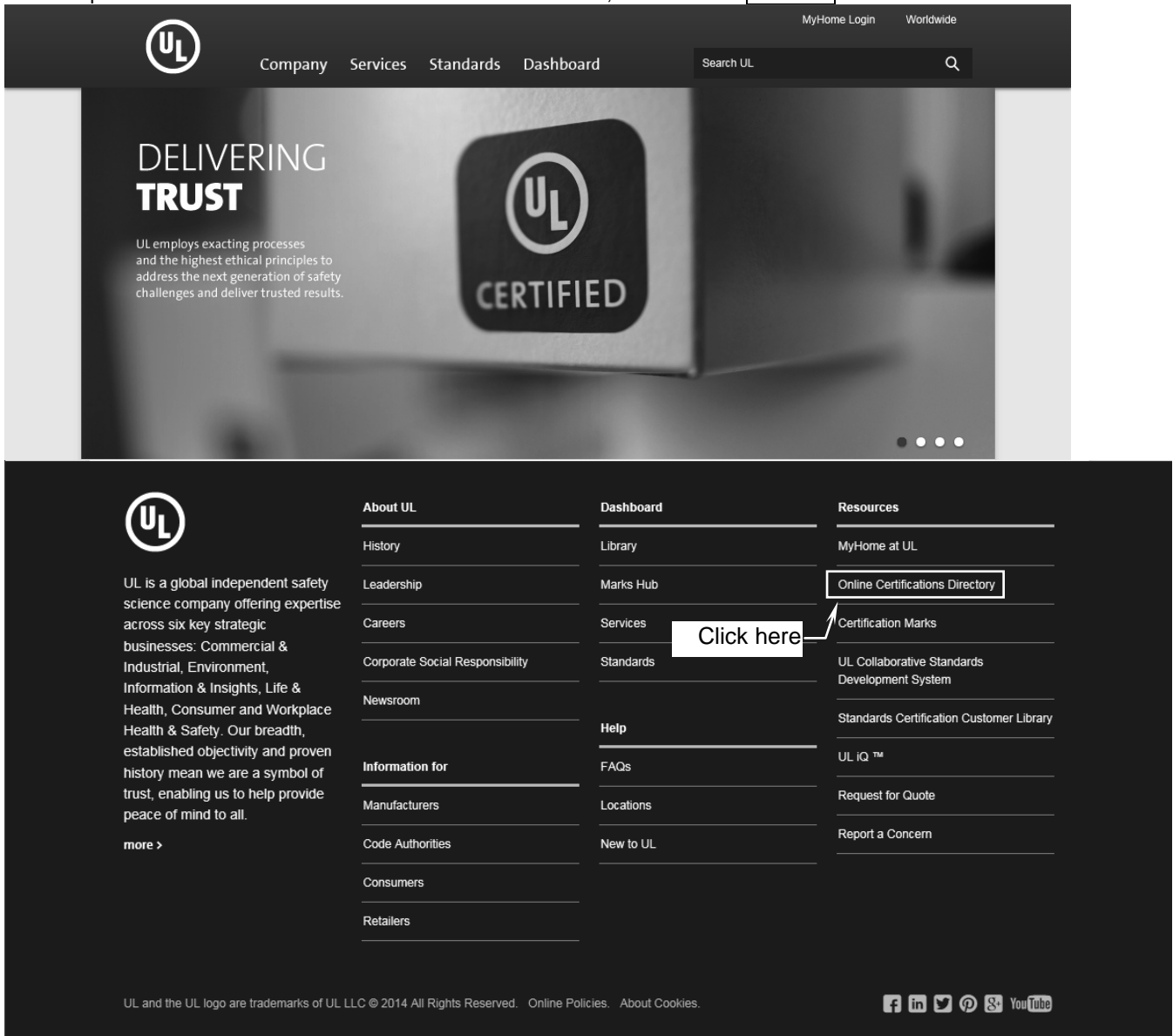
Compliance with international standard UL1557 has already been certified (File No. E323585).

Please refer the certified modules to UL website.

We do not apply the certification, the authorization about other security standards (TUV, VDE, and CSA).

(And do not do a design in consideration of correspondence to the reinforcement insulation of the CE marking.)

(a) Certified modules can be searched through the following website (2014/9/23), click the [Online Certifications Directory](#), and input the file number E323585 in frame of UL File number, then click the [SEARCH](#) button.



Or directly input the following URL into address bar of IE
"http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/gfilenbr.html"

(b) In the search results page as in the below figure, click *QQX2.E323585* shown in cell of Link to File, then the certified module table will be displayed (refer to the next page).

Company Name	Category Name	Link to File
MITSUBISHI ELECTRIC CORP	Electrically-isolated Semiconductor Devices - Component	QQX2.E323585

(c) Certified Modules (Search results example)



ONLINE CERTIFICATIONS DIRECTORY

Home Quick Guide Contact Us UL.com

QQQX2.E323585

Electrically Isolated Semiconductor Devices - Component

Page Bottom

Electrically Isolated Semiconductor Devices - Component

See General Information for Electrically Isolated Semiconductor Devices - Component

MITSUBISHI ELECTRIC CORP

E323585

POWER DEVICE WORKS

1-1-1 IMAJUKUHIGASHI, NISHI-KU

FUKUOKA-SHI, FUKUOKA 819-0192 JAPAN

Power switching semi-conductors, TSB series, Models MG400V1US51, MIG50J4CSB1W, MIG50J7CSB1W, MIG50J6CSB1W, MIG75J7CSB1W, MIG75J6CSB1W, MIG100J7CSB1W, MIG100J6CSB1W, MIG150J7CSB1W, MIG150J6CSB1W, MIG150J7CSB2W, MIG50Q6CSB1X, MIG50Q7CSB1X, MIG75Q7CSB1X, MIG600J2CMB1W, MIG300Q2CMB1X, MIG400Q2CMB1X, MG400J2YS60A, MG600J2YS60A, MG400J2YS61A, MG200Q2YS60A, MG600J2YS61A, MG300Q2YS60A, MG400Q2YS60A, MG400Q2YS70A, MG150J7KS61, MIG300J2CSB1W, MIG400J2CSB1W, MIG200Q2CSB1X, MIG100Q6CMB1X, MIG150Q6CMB1X, MIG200J6CMB1W, MIG200J6CMB2W, MG800J2YS50A, MG600Q2YS60A, MG200J6ES61, MG25Q1BS11, MG50Q1BS11, MG75Q1BS11, MG25J1BS11, MG50J1BS11, MG75J1BS11, MG100J1BS11, MG150J1BS11, MG50Q2YS50, MG75Q1ZS50, MG100Q2YS51, MG200Q2YS50, MG200Q2YS65H, MG300Q1US51, MG400Q1US51, MG400Q1US65H, MG300Q2YS50, MG50J2YS91, MG300J1US51, MG300J2YS40, MG300J2YS50, MG75Q2YS40, MG150Q2YS40, MG200Q2YS40, MG300Q1US11, MG300Q1US41, MG400Q1US11, MG400Q1US41, MG500Q1US1, MG500Q1US11, MG600Q1US51, MG25J2YS40, MG50J2YS40, MG50J2YS45, MG75J2YS40, MG100J2YS40, MG100Q2YS65H, MG150Q2YS65H, MG75J6ES50, MG50J2YS50, MG75J2YS50, MG100J2YS50, MG150J1ZS50, MG150J2YS40, MG150J2YS50, MG200J2YS40, MG200J2YS50, MG300Q2YS61, MG600Q1US61, MG25Q6ES43.

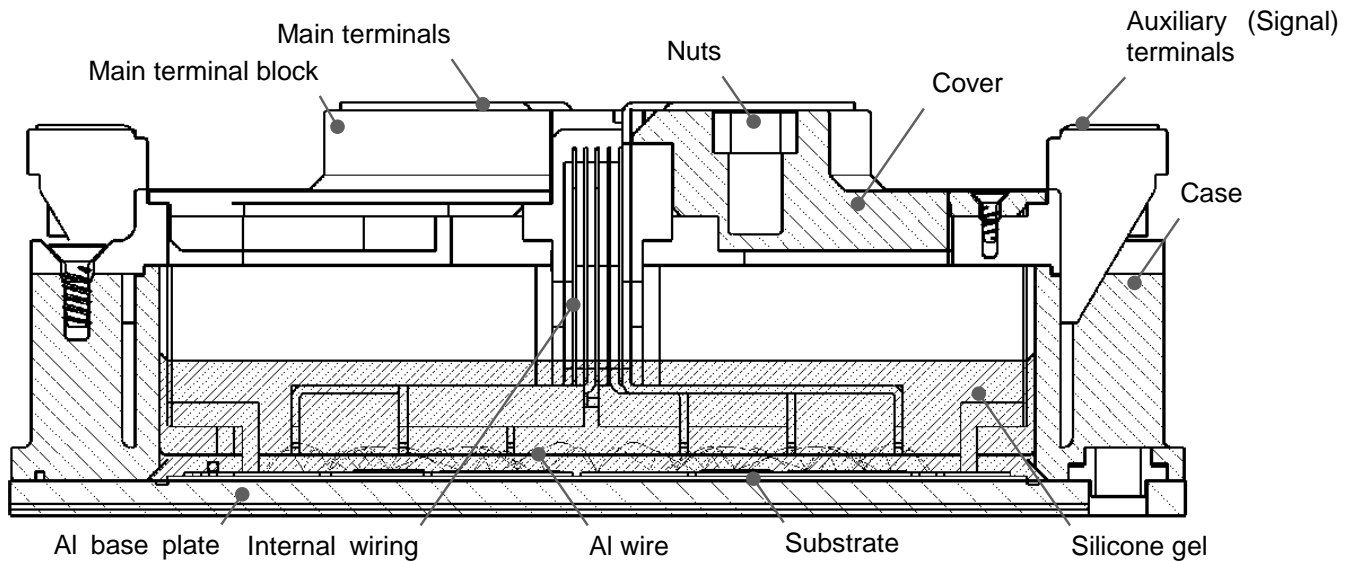
CM-U series, Models CM100DU-12H, CM100DU-24H, CM100E3U-12H, CM100E3U-24H, CM150DU-12H, CM150DU-24H, CM150E3U-12H, CM200DU-12H, CM200DU-24H, CM200E3U-12H, CM300DU-12H, CM400DU-12H, CM400DU-24H, CM50DU-24H, CM50E3U-24H, CM75DU-12H, CM75DU-24H, CM75E3U-12H, CM75E3U-24H, CM800DU-12H, CM100BU-12H, CM100TU-12H, CM300DU-24H, CM300E3U-24H, CM50BU-24H, CM50TU-24H, CM600DU-12H, CM600HU-24H, CM75BU-12H, CM75BU-24H, CM75TU-12H, CM800HUS-12H, CM400HU-24H, CM600HU-12H, CM100TU-24H, CM150TU-12H, CM150TU-24H, CM200TU-12H, CM75TU-24H, CM150E3U-24H, CM200E3U-24H, CM300E3U-12H, CM300EC2U-12H, CM300EC3U-12H, CM400E3U-12H.

CM-F series, Models CM800E2UA-24F, CM800E3UA-24F, CM100TJ-12F, CM100TJ-24F, CM100TJA-24F, CM100TJA-24FA, CM150TJ-12F, CM150TJA-12F, CM50TJ-24F, CM50TJA-34KA, CM75TJ-24F, CM75TJA-24F, CM75TJA-24FA, CM450HA-5F, CM600HA-5F, CM600HN-5F, CM800DU-5F, CM100DU-12F, CM100DU-24F, CM100DUS-12F, CM100E3U-12F, CM100E3U-24F, CM150DU-12F, CM150DU-24F, CM150DU-24FA, CM150DUM-12F, CM150DUS-12F, CM150E3U-12F, CM200DU-12F, CM200DU-24F, CM300DU-12F, CM400DU-12F, CM400DU-24F, CM400DU-24FA, CM400DU-5F, CM50DU-24F, CM75DU-12F, CM75DU-24F, CM75DUM-12F, CM75E3U-24F, CM800E2U-24F, CM800E3U-24F, CM100TU-12F, CM150BUM6-12F, CM200DUR-24F, CM300DU-24F, CM300DU-24FA, CM50B3U-24F, CM50TU-24F, CM600DU-24F, CM600DU-24FA, CM600DU-5F, CM600HU-24F, CM75B3U-12F, CM75BUM6-12F, CM75TU-12F, CM400HU-24F, CM600HU-12F, CM100TU-24F, CM150TU-24F, CM200TU-12F, CM200TU-5F, CM350DU-5F, CM75TU-24F, CM150E3U-24F, CM200E3U-24F, CM300E2U-12F, CM400E2U-12F, CM400E4U-24F.

CM-NF series, Models CM300TJ-24NF, CM450TJ-24NF, CM1000E2UA-24A, CM1000E2UA-24D, CM1000E3UA-24A, CM1000E3UA-24D, CM400HA-24A, CM500HA-34A, CM600HA-24A, CM600HB-24A, CM150BL6-12NFH, CM100HA1-12NF, CM150HA1-12NF, CM50HA1-24NF, CM75HA1-12NF, CM100DC1-24NFM, CM150DC1-24NFM, CM200DC1-24NFM, CM300DC1-24NFM, CM100DU-24NFH, CM100DY-24A, CM100DY-24NF, CM100DY-34A, CM100E3Y-24NF, CM150DU-24NFH, CM150DY-12NF, CM150DY-12NFA, CM150DY-24A, CM150DY-24NF, CM150DY-34A, CM150E3Y2-24NF, CM150E3Y-24NF, CM200CU-12NFH, CM200DU-12NFH, CM200DU-24FA, CM200DU-24NFH, CM200DY-12NF, CM200DY-12NFA, CM200DY-24A, CM200DY-24NF, CM200DY-34A, CM200DY6-12NF, CM200E3Y-12NF, CM300DU-12NFH, CM300DU-24NFH, CM300DY1-24NF, CM300DY-12NF, CM300DY-12NFA, CM300DY-12NFB, CM300DY-24A, CM300DY-24NFH, CM400DU-12NFH, CM400DY-12NF, CM400DY-12NFA, CM400DY-12NFB, CM400E3Y-12NF, CM600DY2-12NFB, CM75DY-24NF, CM75DY-34A, CM600DU-24NF, CM600HU-24NF, CM600HUA-24NFH, CM75BU-24NFH, CM75BU-24NFM, CM900HU-24NF, CM400DY-34A, CM300DY-24NF, CM300DY-34A, CM400DU-24NFH, CM400DU-24NFJ, CM400DY-24A, CM400DY-24NF, CM600DU-12NFH, CM600DU-24NFH, CM600DY-12NF, CM600DY-12NFB, CM600DY-24A, CM600E3U-12NFH, CM100DC-24NFM, CM150DC-24NFM, CM150DC6-24NFM, CM200DC-24NFM, CM300DC-24NFM, CM400HC-24NFM, CM400HC6-24NFM, CM600HC-24NFM, CM150RL-24NF, CM150TL-24NF, CM200RL-12NF, CM200RL-24NF, CM200TL-12NF, CM200TL-24NF, CM100RL-12NF, CM100RL-24NF, CM100TL-12NF, CM100TL-24NF, CM100TL6-12NF, CM150RL-12NF, CM150RL-24NF, CM150TL-12NF, CM150TL6-12NF, CM200RL-12NF, CM50FL6-12NFH, CM50RL-24NF, CM50TL-24NF, CM75RL-12NF, CM75RL-24NF, CM75TL-12NF, CM75TL-24NF, CM1000DU-34NF, CM1000DU-34NF, CM1000DUC-34NF, CM1000E3U-34NF, CM1400DU-24NF, CM1400DUC-24NF, CM1400E3U-24NF, CM900DU-24NF, CM900DUC-24NF, CM300E3Y6-24NFH, CM400E3Y6-24NFH, CM400C1Y-24S, CM450DY-24S, CM800DY-24S, CM1000DUC-34SA, CM1400DUC-24S, CM300DY-24S, CM600DY-24S, CM1800DY-34S, CM2500DY-24S, CM400E4Y-24A.

- * There is a case of the omission of the update delay and the authorization article according to the convenience of the update of Homepage.
- * When a corresponding article isn't found out, please contact us.
- * At present, Mitsubishi Electric Corporation don't supply yellow card "E323585".

6. Internal structure



About the flammable

The PPS (Poly Phenylene Sulfide Resin) in IGBT module complies with standard of UL 94V-0, but the silicone gel is combustible and does not comply with 94V-0, but it has the dielectric breakdown strength of above 10 kV/mm after the hardening at the flash point temperature of 340 °C and at the ignition point temperature 450 °C.

Because there is not self extinguish-ability, too, in case of the fire, a fire must be extinguished using the dry chemicals, the carbon dioxide extinguishing agent and the bubble extinguishing agent and so on.

Because PPS has self extinguish-ability, if a burning source is cut off, there is not live danger.

There is not a fireproof standard of UL which corresponds to the other silicon chip, the copper base board and so on.

Others

Insulation distances of Mitsubishi Electric's modules are in accordance with UL standards. In general, the electric strength to the same space distance falls due to the decrease of atmospheric pressure at high altitude.


Moreover, the amount of cosmic rays increases rapidly when the altitude goes up. It has been known that cosmic rays can raise the possibility of faults in semiconductors. There is no data concerning the probability.

How to use power module Properly and Safely


7. How to use Power Module properly and safely

Unsuitable operation (such as electrical, mechanical stress and so on) may lead to damage of power modules.

Please pay attention to the following descriptions and use Mitsubishi Electric's IGBT modules according to the guidance.

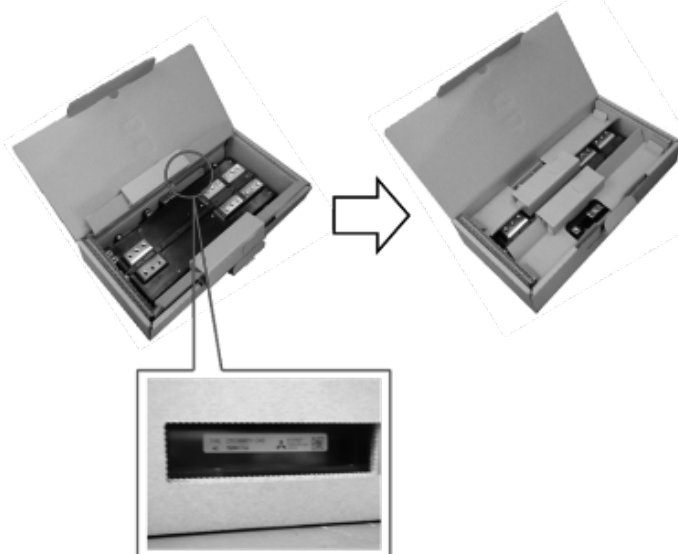
 Cautions	
During Transit	<ul style="list-style-type: none"> • Keep shipping cartons right side up. If stress is applied by either placing a carton upside down or by leaning a box against something, terminals can be bent and/or resin packages can be damaged. • Tossing or dropping of a carton may damage devices inside. • If a device gets wet with water, malfunctioning and failure may result. Special care should be taken during rain or snow to prevent the devices from getting wet.
Storage	<ul style="list-style-type: none"> • The temperature and humidity of the storage place should be 5 ~ 35 °C and 45 ~ 75 % respectively. The performance and reliability of devices may be jeopardized if devices are stored in an environment far above or below the range indicated above.
Prolonged Storage	<ul style="list-style-type: none"> • When storing devices more than one year, dehumidifying measures should be provided for the storage place. When using devices after a long period of storage, make sure to check the exterior of the devices is free from scratches, dirt, rust, and so on.
Operating Environment	<ul style="list-style-type: none"> • Devices should not be exposed to water, organic solvents, corrosive gases, explosive gases, fine particles, or corrosive agents, since any of those can lead to a serious accident.
Flame Resistance	<ul style="list-style-type: none"> • Although the epoxy resin and case materials are in conformity with UL94 V-0 standards, it should be noted that those are not non-flammable.
Electrostatic Discharge	<ul style="list-style-type: none"> • Following precautions should be taken for MOS-gated devices such as IGBT modules (CM*** series), to prevent electrostatic build up which could damage the devices. (1) Precautions against the device rupture caused by static electrostatic electricity of human bodies and cartons and/or excessive voltage applied across the gate to emitter may damage and rupture devices. The basis of anti-electro static build-up and quick dissipation of the charged electricity. <ul style="list-style-type: none"> * Containers that are susceptible to static electricity should not be used for transit or for storage. * Gate to emitter should be always shorted with a carbon cloth or the like until right before a module is used. Never touch the gate terminals with bare hands. * Always ground the equipment and your body during installation (after removing a carbon cloth or the like. It is advisable to cover the workstation and its surrounding floor with conductive mats and ground them. * It should be noted that the static electricity charged to a printed circuit board might damage devices if the gate to emitter of the circuit board is open.

How to use power module Properly and Safely

 Cautions

Anti-electrostatic Measures

- (2) Precautions when the gate to emitter is open
- * Voltage should not be applied across the collector to emitter when the gate to emitter is open.
 - * The gate to emitter should be shorted before removing a device from a unit.
- (3) Packing example
- * During an installation process (after taking out a module from a packing box to the installation to an apparatus), please take enough static electricity measures such as the use of ground band on the worker and/or using static-eliminator.
 - * If storage with the containers excepts the interior cardboard box, take any electrostatic measures such as the use of a conductive container.
 - * The modules are not fixed in the interior cardboard box.
- Please be careful about the handling enough not to drop a module at the time of takeoff and unpacking the interior cardboard box and unpacking the interior cardboard box.




Electrically-charged measure

- When applying the voltage to gate-emitter test for acceptance as saturated voltage test, after the test and before collecting the modules to the storage (conductivity) container or a packing box, let it discharge electricity by high resistance (extent of 10 kΩ)

Wiring method

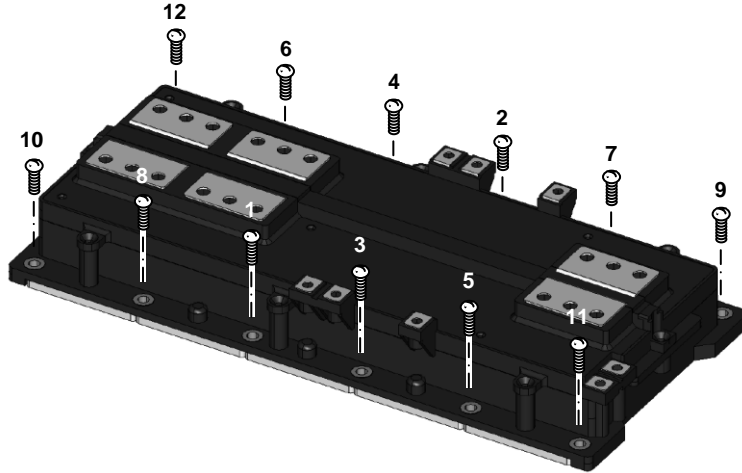
- Do not add the over stress to the screw terminals or terminal structure when mounting modules. It might cause the damage to terminal structure or jointing part between case and terminals.
- Do not add the over stress to the pin terminals when use the printed circuit board for wiring. It might cause the bent (or snap) of pin terminals.
- Be careful about the size of the screw and the mounting process when fixing the printed circuit board to the module case.
The case of the module may be damaged when using the wrong size screw and/or the wrong mounting process.

How to use power module Properly and Safely

 **Cautions**

Mounting

- When mounting a module on a heat sink, a device could get damage if a sudden torque ("one side tightening ") is applied at only one mounting terminal, since stress is applied on a ceramic plate and silicon chips inside the module.
Shown in Fig.1 is the recommended torquing order for mounting screws.

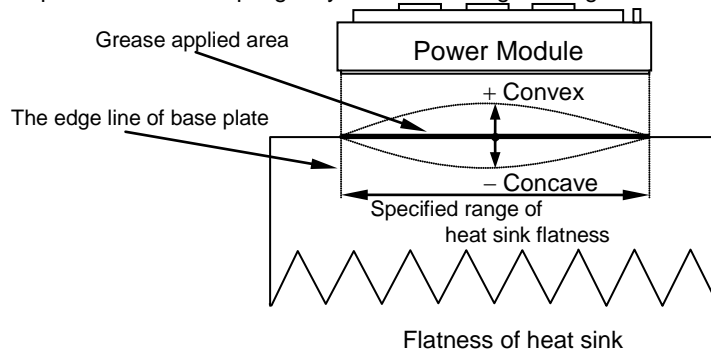


12-point mounting type
 Temporary tightening 1→2→3→4→5→6→7→8→9→10→11→12
 Final tightening 1→2→3→4→5→6→7→8→9→10→11→12

Fig.1 Recommended torquing order for mounting screws

* Temporary tightening torque should be set at 20 ~ 30 % of maximum rating.

- Also, care must be taken to achieve maximum contact (i.e. minimum contact thermal resistance) for the best heat dissipation. The flatness of heat sink (e_s) where a module is mounted should be as follows.
 $\pm 0 \mu\text{m} \sim +100 \mu\text{m}$ on a length of 100 mm
 Also, the surface finish should be as follows.
 Less than $10 \mu\text{m}$ of roughness on a length of 100 mm
 Apply good thermal conductivity grease (termed hereinafter called grease) for heat radiation to the contact surface of the module and heat sink evenly as follows.
 $+50 \mu\text{m} \sim +100 \mu\text{m}$
 Grease on the contact surface prevents the corrosion of the contact surface.
 However, use the kind of grease that has a stable characteristic over the whole operating temperature range and does not change its properties for several years.
 A torque wrench shall be used in tightening mounting screws and tighten screws to the specified torque. Excessive torquing may result in damage or degradation of a device.



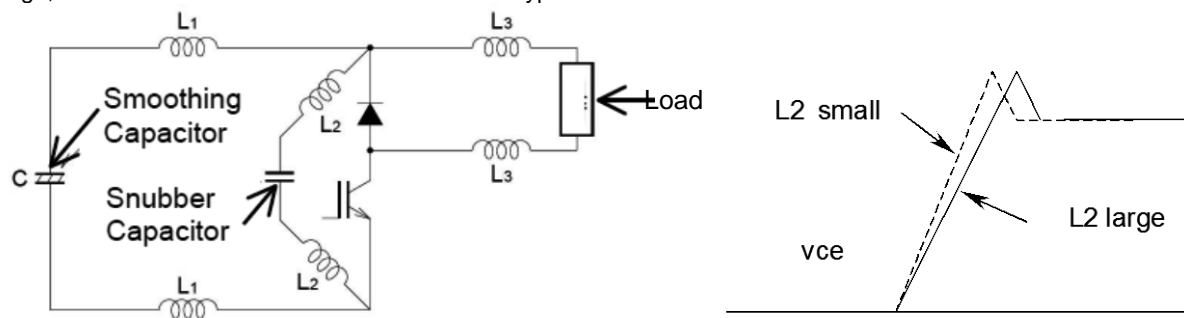
8. Installation of Power Module

8.1 Installing Capacitor

During switching, voltage is induced in power circuit stray inductance by the high di/dt of the main current when the stray inductance is too large. This voltage can appear on the IGBT module and cause damage. In order to avoid this problem, guidelines that should be followed in designing the circuit layout are:

- ① Locate the smoothing capacitor as close as possible to the IGBT module
- ② Use bypass capacitor (ceramic capacitor or film capacitor) near the IGBT module to bypass high frequency current
- ③ Adopt low impedance electrolytic capacitor as smoothing capacitor
- ④ Use snubber circuit to absorb surge voltage
- ⑤ Decrease switching speed in order to lower di/dt .

② and ⑤ are the most effective to reduce surge voltage. The stray inductance of snubber circuit generally is not considered to avoid complicating the circuit. In addition, combination of ②, ④, ⑤ is needed since there is a limit to shorten the length of wiring. The bypass capacitor of approach ② should be replaced with snubber circuit (RC, RCD) when oscillation. Because wiring inductance becomes large, we recommend that we connect collective bypass condenser or collective snubber circuit between C1-E2.



L1: Stray inductance between the smoothing (electrolytic) capacitor and the IGBT module.

L2: Stray inductance between the bypass (or snubber) capacitor and the IGBT module.

L3: Stray inductance between the load and the power circuit's output stage.

8.2 Mounting instructions

When mounting IGBT modules on a heat sink, uneven mounting can cause the module ceramic isolation destroy.

To achieve the best thermal radiation effect, the larger the contact area is, the smaller the thermal resistance is. Heat sink should have a surface finish in range of a surface roughness within 10 μm , warpage within 100 μm .

Uniform coating of grease between the module and heat sink can prevent corrosion of contact parts. Select a compound, which has stable characteristics over the whole operating temperature range and does not change its properties over the life of the equipment. Use a uniform coating of thermal interface compound.

The thickness of grease should be in the range +50 μm ~+100 μm according to the surface finish.

Mounting screws should be tightened by using a torque wrench until the prescribed torque. As mentioned before, over torque terminal or mounting screws may result in damage of IGBT modules. When an electric screwdriver is used, grease with low viscosity is recommended and extra grease shall be extruded before final tightening screws.

* For the recommended torque order for mounting screws, refer to "Mounting" in the section of "How to Use Power Module Properly and Safely."

Note) Maximum torque specifications are provided in device data sheets. The type and quantity of grease having an effect on the thermal resistance are determined by consideration of both grease and heat sink. Typical value given in datasheet is measured by using grease manufactured by Shin-Etsu Chemical Co., Ltd. {Thermal conductivity grease of $\lambda=0.9 \text{ W}/(\text{m}\cdot\text{K})$ }.

Formerly the mounting screws were prepared for users as accessories with module.

But for some reasons, this service was stopped since NF series products.

8.3 Coating method of thermal conductive grease

The coating method of thermal conductive grease is introduced in this section. The thermal conductive grease is called as grease in the following.

- ① Preparations: power module, grease, screen, squeegee, electronic mass meter and gloves
- ② Relationship between the coating amount and thickness is,

$$\text{Thickness of grease} = \frac{\text{amount of grease [g]}}{\text{base area of module [cm}^2\text{]} \times \text{density of grease [g/cm}^3\text{]}}$$

The recommended thickness of grease is 50 - 100 μm

The amount of grease can be obtained as the following example.

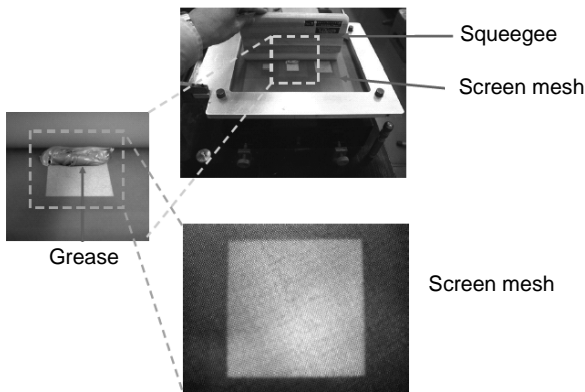
For example: For case with size of 124×54 (refer to the figure of page 14), the amount of Shin-Etsu Chemical Co.,Ltd. grease G-747 can be calculated through the equation below.

$$50 - 100 \mu\text{m} = \frac{\text{amount of grease [g]}}{66.96[\text{cm}^2] \times 2.65[\text{g/cm}^3]}$$

∴ The amount needed is ≒ 0.9 - 1.8 [g]

- ③ Measure the mass of module
- ④ Measure the grease with the same amount as calculated
- ⑤ Coating the module base uniformly by using squeegee

There are the using screen mesh printing methods in others. Example photo is shown as following.



Finally it is fulfilled to uniformly cover thermal grease on the module base with specified thickness.

Table 1 Thermal conductive grease (example)

Manufacturer	Type	Note
Shin-Etsu Chemical Co., Ltd.	G-747, G-776, etc.	for insulated type module
	G-751	for non-insulated type module

For more information of characteristics and caution of use, please contact to each manufacturers.

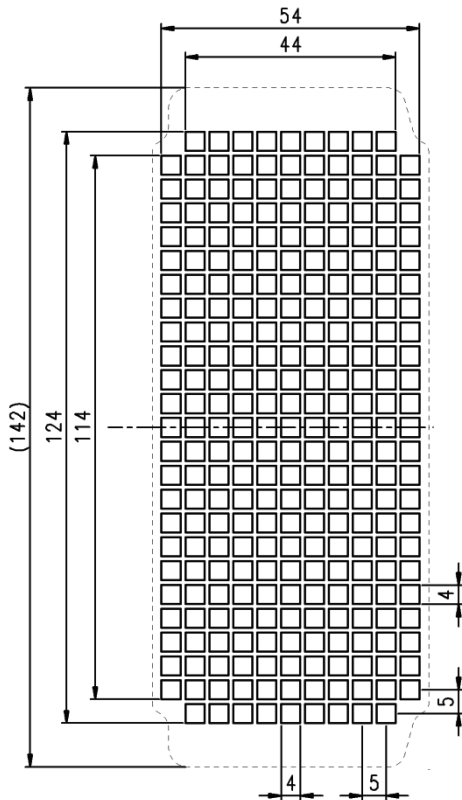
ALCAN UNIVERSAL JOINTING-COMPOUND is grease for the aluminum conductor connection. The purpose of grease is an electric contact resistance decline by the contact-ability improvement and the corrosion control of the aluminum surface.

It seems that there is long-range use experience but because we are not the one of the purpose to improve a heat conduction at the contacted part, the contact thermal resistance reductional effect cannot look forward to it too much.

When employing these, because information enough for thermal management becomes necessary, please contact to each manufacture.

The company name and product names herein are the trademarks and registered trademarks of the respective companies.

8.4 Screen print template (example)



Generally, the thickness can be set as 0.17mm. Because different kind of grease will lead different result even using same screen print template, adjust the thickness of screen print template when it is necessary.

8.5 Explanation of Thermal resistance

The junction to case thermal resistance $R_{th(j-c)}$ and the case to heat sink thermal resistance $R_{th(c-s)}$ are given in datasheet.

The case temperature (T_C) is defined on the surface of base plate just under the chip.

The case temperature measurement point of the products is shown in page 14.

- * With the thickness of the heat sink to use, the thermal resistance $R_{th(s-a)}$ of the heat sink sometimes changes. The smaller the size of is in the heat sink is the thinner the thickness of it becomes, the larger the thermal resistance becomes under the same metal material.
- * If the amount of coating of grease, contact thermal resistance $R_{th(c-s)}$ sometimes changes.
- * Because the packages of the: general industrial power modules are not hermetically sealed structure, it is possible for liquid to infiltrate easily inside the module.
- * Because we design the general industrial power modules on the assumption that the package materials and the semiconductor chips do not have long-range contact with anything except the silicone gel to be used, after pulling the modules in the silicone oil and so on, the characteristics and the reliability is not guaranteed.

8.6 The method of measuring case temperature

The junction to case thermal resistance $R_{th(j-c)}$ and case to heat sink resistance $R_{th(c-s)}$ are defined at just under the chip in datasheet. Hence, the case temperature should be measured at just under the chip. We recommend the temperature measuring method meets your purpose, e.g. enough accuracy and response speed. Thermocouple is one of the methods for measuring case temperature in Mitsubishi Electric. Two of the many kinds of measurement method will be introduced on this report.

(1) Method of processing base plate

The trench of width 1.5-2 mm and 0.7 mm in depth is processed on the base plate of the module. Of course, it is necessary not to damage thermo-couple and heat sink. The burr should be removed from processed area on the base plate. [Refer to Fig.1]

The thermo-couple is trailed through the trench. The trench fills a filler, e.g. Ag (silver paste), In (Indium), etc., for holding and protecting the wire from damage. The point of thermocouple is not kept position if much power appears to it. So, thermocouple is better to hold at side of module by glue or tape. [Refer to Fig.2]

(2) Method of processing heat sink

Another method is processed at heat sink. The trench of width 1.5-2 mm and 1 mm in depth is processed on surface of heat sink. You ready the rubber block which can be used over measurement temperature. The rubber is put into the trench at the measurement point. The thermo-couple is trailed through the trench. The trench fills a filler, e.g. Ag (silver paste), In (Indium), etc., for holding and protecting the wire from damage. [Refer to Fig.3] Copper plate can be used between module and heat sink if you difficult to process the base plate such as water cooling heat sink.

After each of (1) or (2), the module is mounted on the heat sink with grease, based on the method on application note. It is confirmed that the display of the measuring equipment, e.g. multi meter, data logger, etc., is steady after connected. After then, case temperature will be measured.

(3) Note

The measurement point of thermo couple is at edge of contact materials. Hence, Invalid area could be cut for measuring correct place.

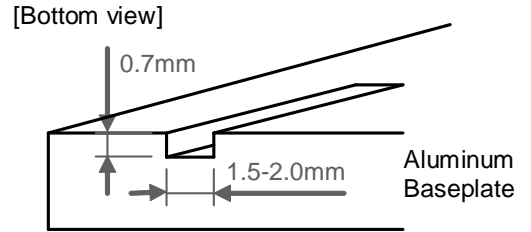


Fig.1 trench on the base plate

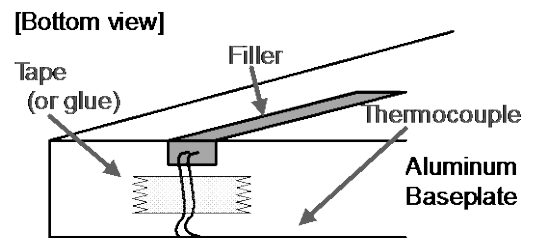


Fig.2 Fill the filler

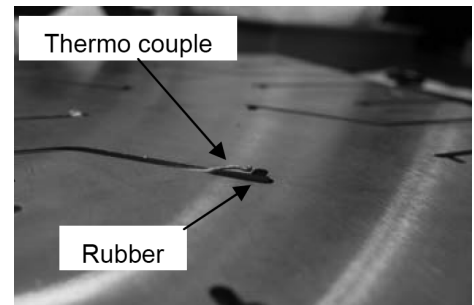


Fig.3 TC with rubber on the heat sink

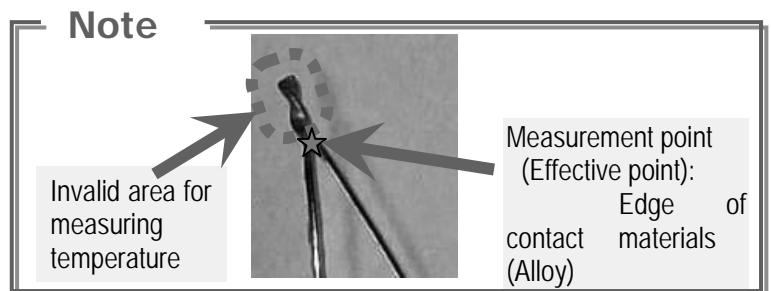
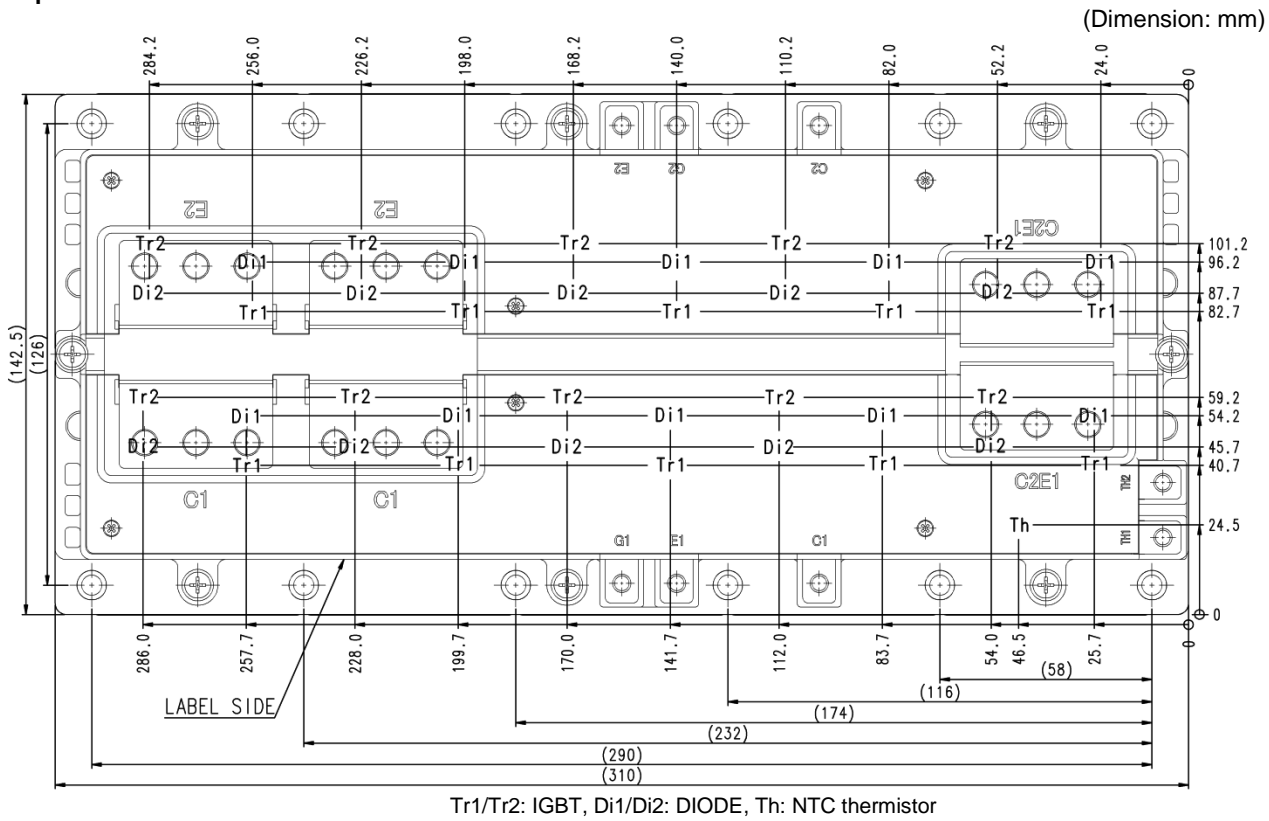


Fig.4 The tip of thermocouple

8.7 Chip location



9. Switching energy

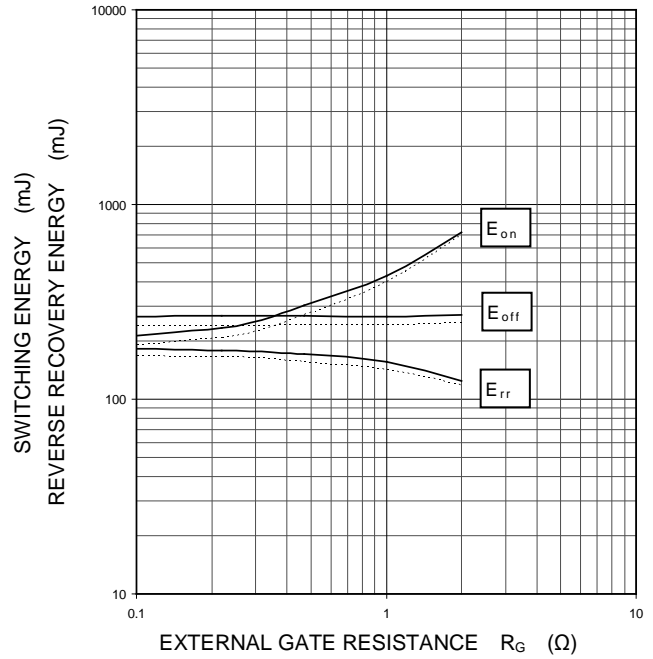
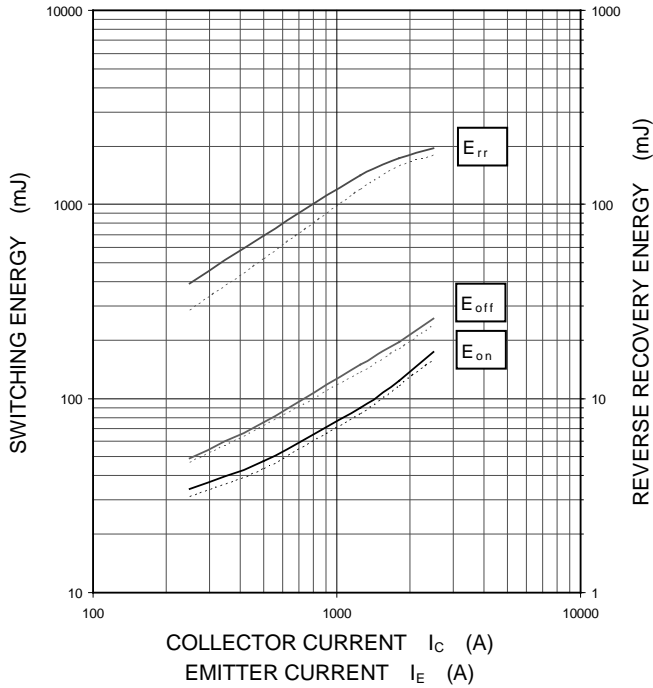
When half (full) bridge inductive load switching is performed at a high temperature and enough small wiring inductance, the switching energy becomes maximum.

We show typical examples of switching energy under the conditions described below.

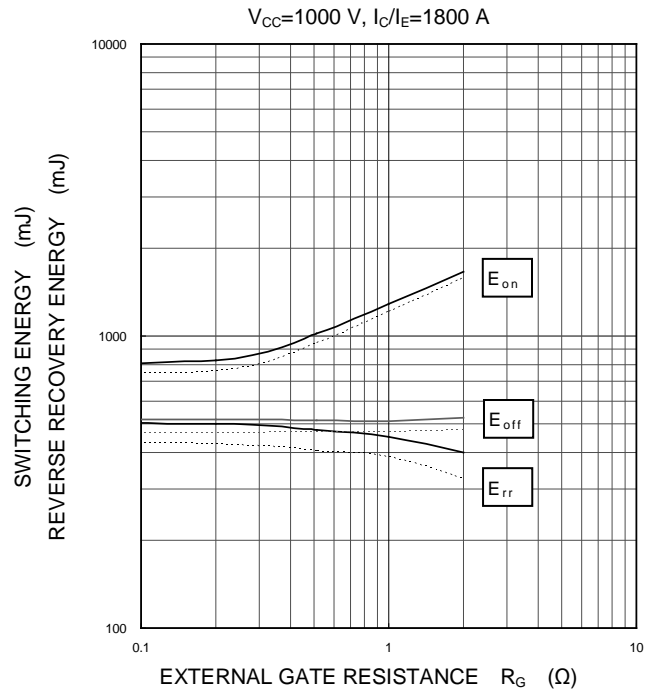
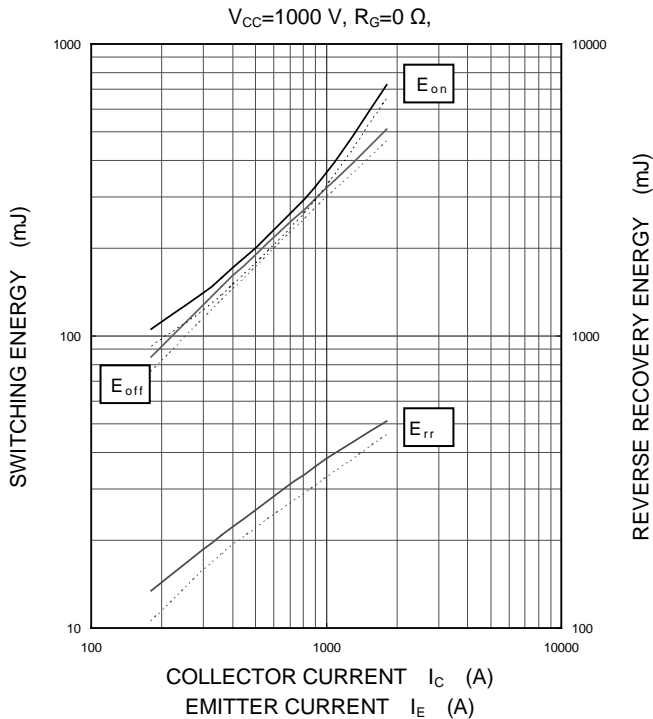
Conditions; $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD, PER PULSE, -----: $T_j=150\text{ }^\circ\text{C}$, - - - - -: $T_j=125\text{ }^\circ\text{C}$

$V_{CC}=600\text{ V}$, $R_G=0\ \Omega$,

$V_{CC}=600\text{ V}$, $I_C/I_E=2500\text{ A}$



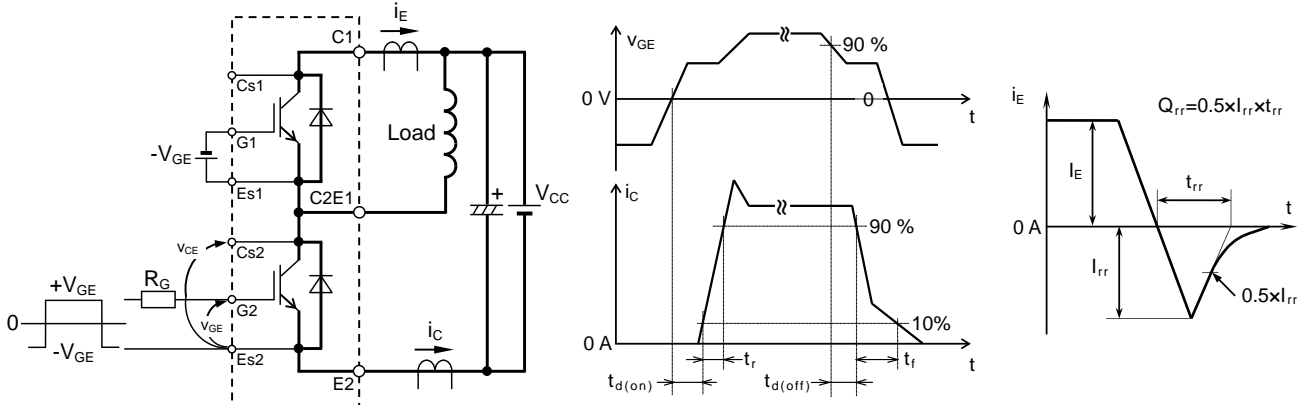
Half bridge switching energy of CM2500DY-24S



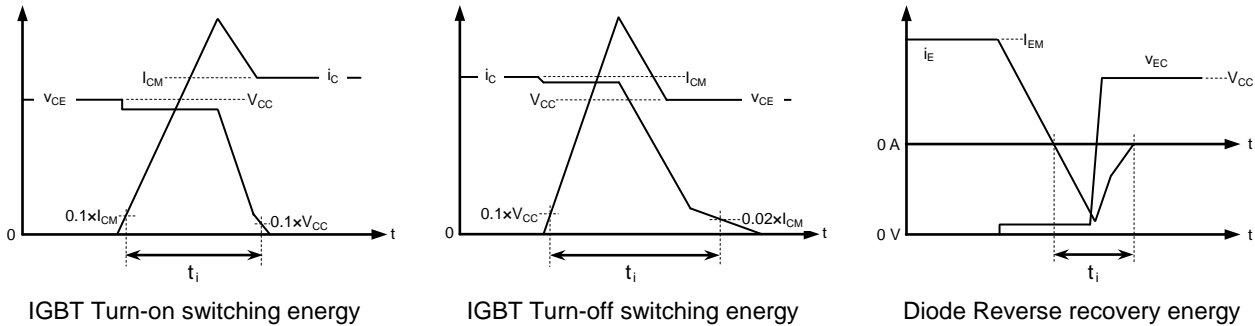
Half bridge switching energy of CM1800DY-34S

10 Test circuit and waveforms

Half-bridge switching test circuit and waveforms



Half-bridge switching test circuit and waveforms



IGBT turn-on/turn-off switching energy and Diode reverse recovery test wave forms.
(Integral time instruction drawing)

100% of parameter to fix each 10% and 2% doesn't include the current which is caused by Diode reverse recovery or the stray capacitance of load and a surge voltage and a voltage drop which is caused by the stray inductance.

100% of V_{CE} is V_{CC} .

An influence over the switching loss by the corrugated change, which is caused by these, is reflected in the switching loss just as it is.

Also, for the reactive-power, we included it in the integration value because it is impossible to separate.

Strictly, 0% of the I_C is not $I_C=0$ A and it is I_{ces} . 0% of V_{CE} is not $V_{CE}=0$ V and it is V_{CEsat} .

When it isn't possible to sufficiently remove the vibration, which is caused by the wiring inductance, a range is fixed based on the line, which estimated the center line of the vibration.

But, when the same estimation above is difficult, we sometimes suppose that the range is fixed based on the time which the waveform reaches the criterion first.

11 Loss calculation

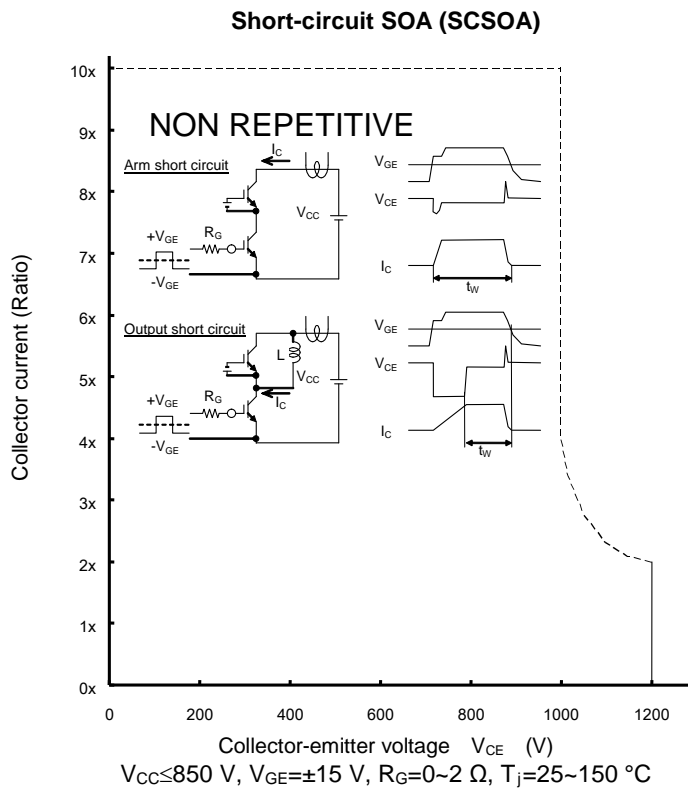
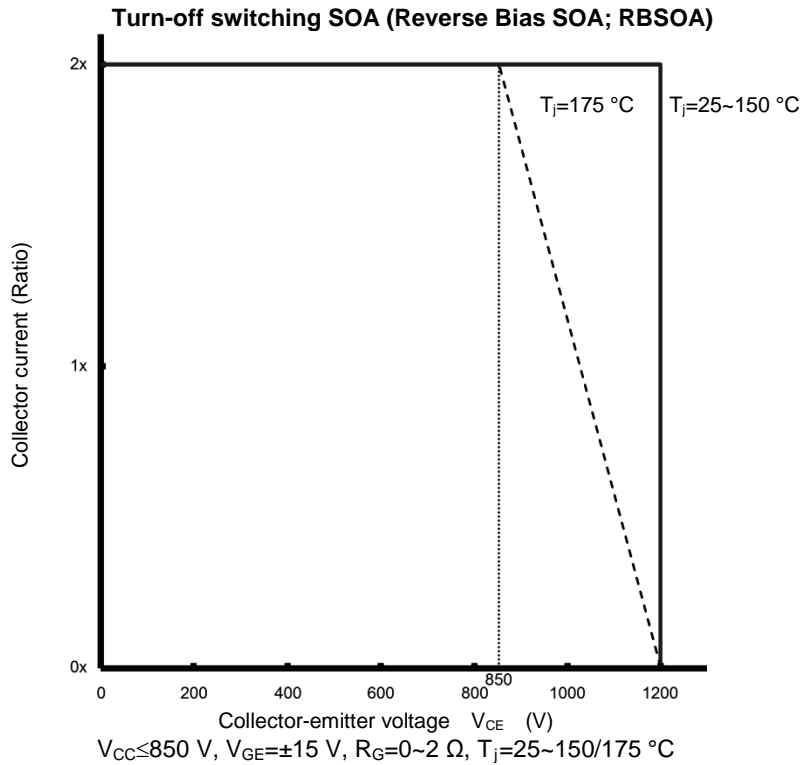
Simulation software designed for the power loss calculation with Mitsubishi Electric power modules under customers specific application conditions (2-level¹ and 3-level² inverter circuit) and for junction temperature rises as a consequence of power loss.

You need to register yourself to our web site and download the data in order to access the loss simulator.

<http://www.mitsubishielectric.com/semiconductors/simulator/index.html>

12. Safe operating area (SOA)

CM2500DY-24S (300G)



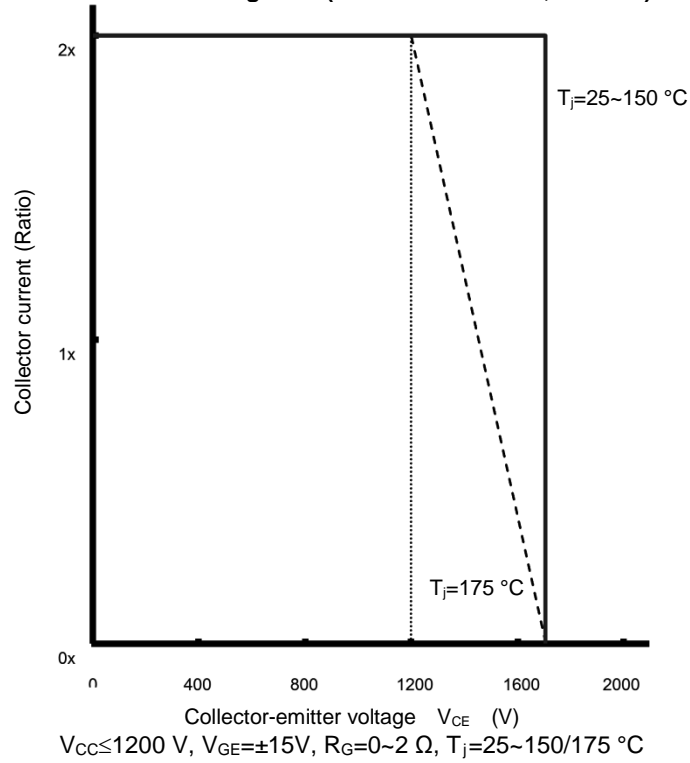
Note:

1. For suppressing V_{CE} at short-circuit turn-off below this SCSOA curve, we recommend to use a soft turn-off technique for $-di/dt$ (off) decreasing control.
2. SOA is 99% guarantee by extremal probability.
3. Collector-Emitter voltage defines the voltage between auxiliary collector and auxiliary emitter terminal.
4. In case of output short circuit, output inductance (L) should be more than 10 μ H.
5. $t_w \leq 10 \mu$ s, from V_{CE} reached 50 V.

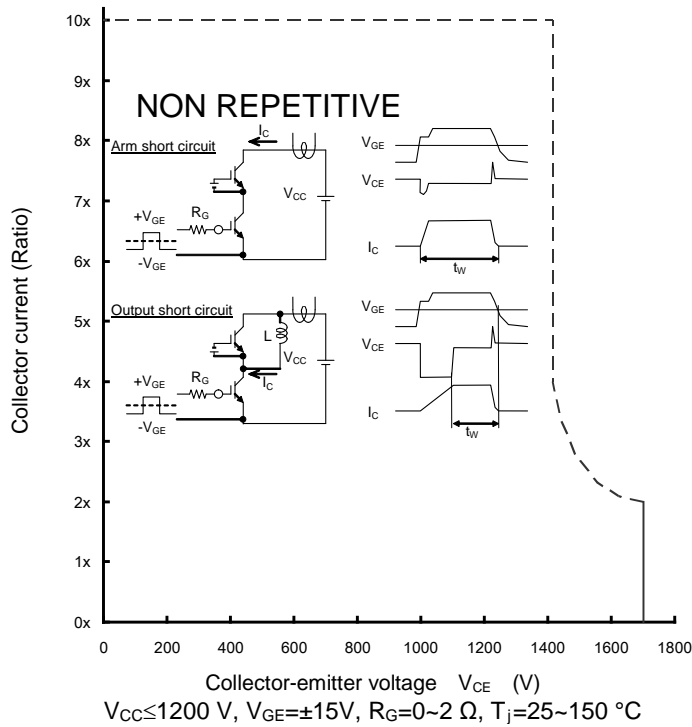
12. Safe operating area (SOA)

CM1800DY-34S (302G)

Turn-off switching SOA (Reverse Bias SOA; RBSOA)



Short-circuit SOA (SCSOA)



Note;

1. For suppressing V_{CE} at short-circuit turn-off below this SCSOA curve, we recommend to use a soft turn-off technique for $-di/dt$ (off) decreasing control.
2. SOA is 99% guarantee by extremal probability.
3. Collector-Emitter voltage defines the voltage between auxiliary collector and auxiliary emitter terminal.
4. In case of output short circuit, output inductance (L) should be more than 5 μH .
5. $t_w \leq 10$ μs , from V_{CE} reached 50 V.

Keep safety first in your circuit designs!

Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

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