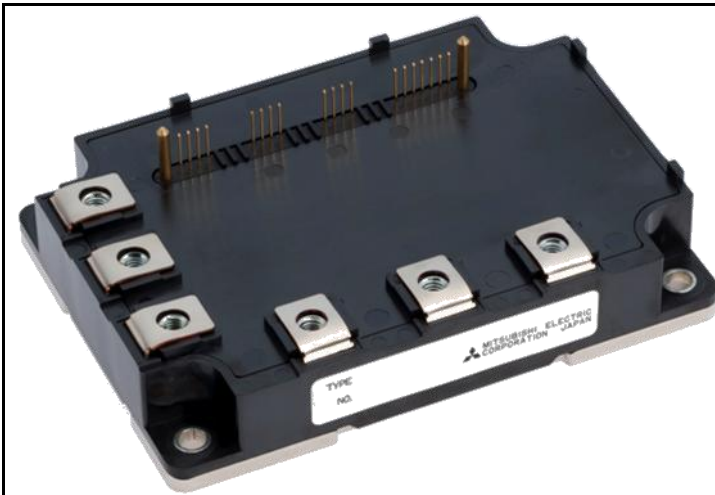


<Intelligent Power Modules>

PM450CGC060

FLAT-BASE TYPE
INSULATED PACKAGE

Prepared by	A	H.Murakami, M.Joko, R.Yoneyama
		T.Marumo, T.Ogawa, T.Shimizu
Approved by (Date)		H. Takemoto
		8 th -Oct. 2015



FEATURE

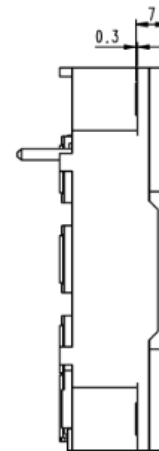
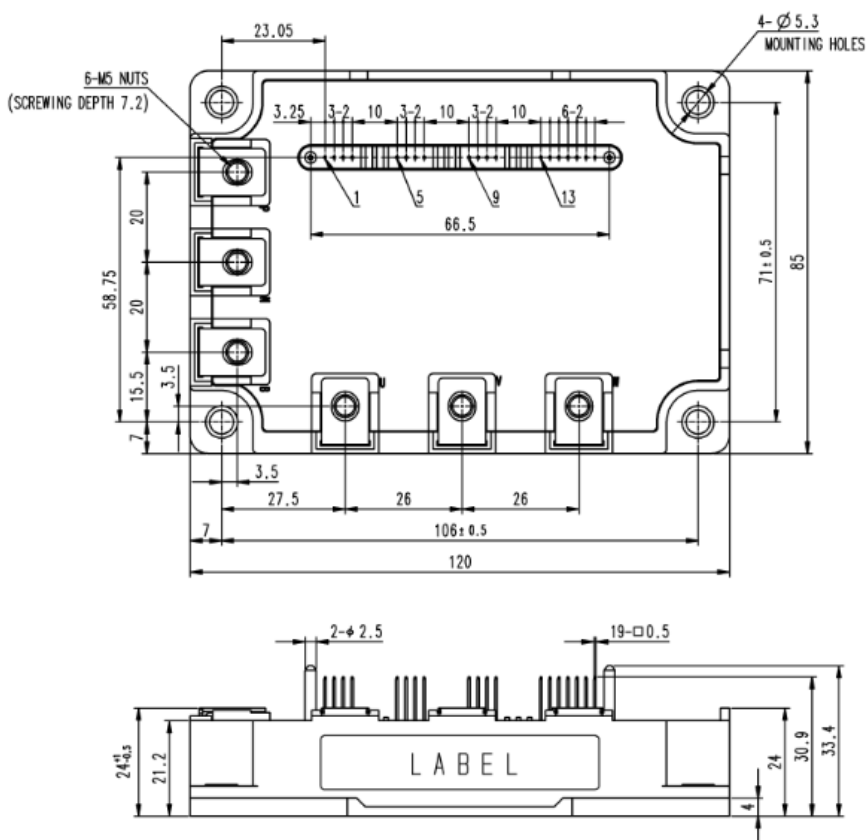
- a) Adopting Full-Gate CSTBT™ chip.
- b) The over-temperature protection which detects the chip surface temperature of CSTBT™ is adopted.
- c) Error output signal is possible from all each protection upper and lower arm of IPM.

APPLICATION

General purpose inverter, servo drives and other motor controls

PACKAGE OUTLINES

Dimensions in mm



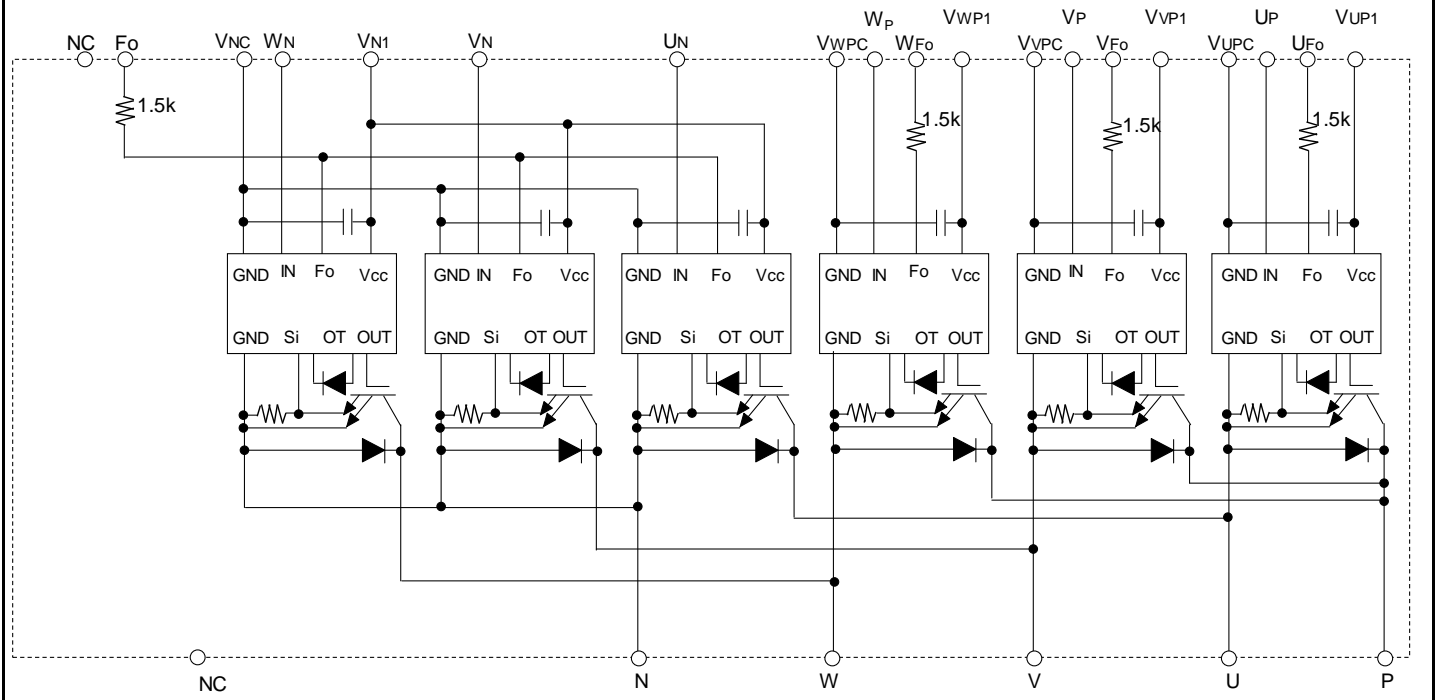
1. VUPC
2. UFO
3. UP
4. VUP1
5. VVPC
6. VFO
7. VP
8. VVP1
9. VWPC
10. WFO
11. WP
12. VWP1
13. VNC
14. VN1
15. NC
16. UN
17. VN
18. WN
19. Fo

PM450CGC060

HIGH POWER SWITCHING USE
INSULATED TYPE

TENTATIVE
Notice: This is not a final specification.
Some parametric limits are subject to change

INTERNAL FUNCTIONS BLOCK DIAGRAM



MAXIMUM RATINGS ($T_j = 25^\circ\text{C}$, unless otherwise noted)

INVERTER PART

Symbol	Parameter	Conditions	Ratings	Unit
V_{CES}	Collector-Emitter Voltage	$V_D=15\text{ V}$, $V_{CIN}=15\text{ V}$	600	V
I_C	Collector Current	$T_C=25^\circ\text{C}$	450	A
I_{CRM}		Pulse	900	
P_{tot}	Total Power Dissipation	$T_C=25^\circ\text{C}$	1041	W
I_E	Emitter Current	$T_C=25^\circ\text{C}$	450	A
I_{ERM}	(Free-wheeling Diode Forward current)	Pulse	900	
T_j	Junction Temperature		-20 ~ +150	$^\circ\text{C}$

*: T_c measurement point is just under the chip.

CONTROL PART

Symbol	Parameter	Conditions	Ratings	Unit
V_D	Supply Voltage	Applied between: $V_{UP1}-V_{UPC}$, $V_{VP1}-V_{VPC}$, $V_{WP1}-V_{WPC}$, $V_{N1}-V_{NC}$	20	V
V_{CIN}	Input Voltage	Applied between: U_P-V_{UPC} , V_P-V_{VPC} , W_P-V_{WPC} , U_N , V_N , W_N-V_{NC}	20	V
V_{FO}	Fault Output Supply Voltage	Applied between: $U_{FO}-V_{UPC}$, $V_{FO}-V_{VPC}$, $W_{FO}-V_{WPC}$, F_O-V_{NC}	20	V
I_{FO}	Fault Output Current	Sink current at U_{FO} , V_{FO} , W_{FO} , F_O terminals	20	mA

TOTAL SYSTEM

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC(Prot)}$	Supply Voltage Protected by SC	$V_D = 13.5\text{ V} \sim 16.5\text{ V}$, Inverter Part, $T_j = +125^\circ\text{C}$ start	400	V
$V_{CC(surge)}$	Supply Voltage (Surge)	Applied between: P-N, Surge value	500	V
T_{stg}	Storage Temperature	-	-40 ~ +125	$^\circ\text{C}$
V_{isol}	Isolation Voltage	60Hz, Sinusoidal, Charged part to Base plate, AC 1min, RMS	2500	V

*: T_c measurement point is just under the chip.

PM450CGC060

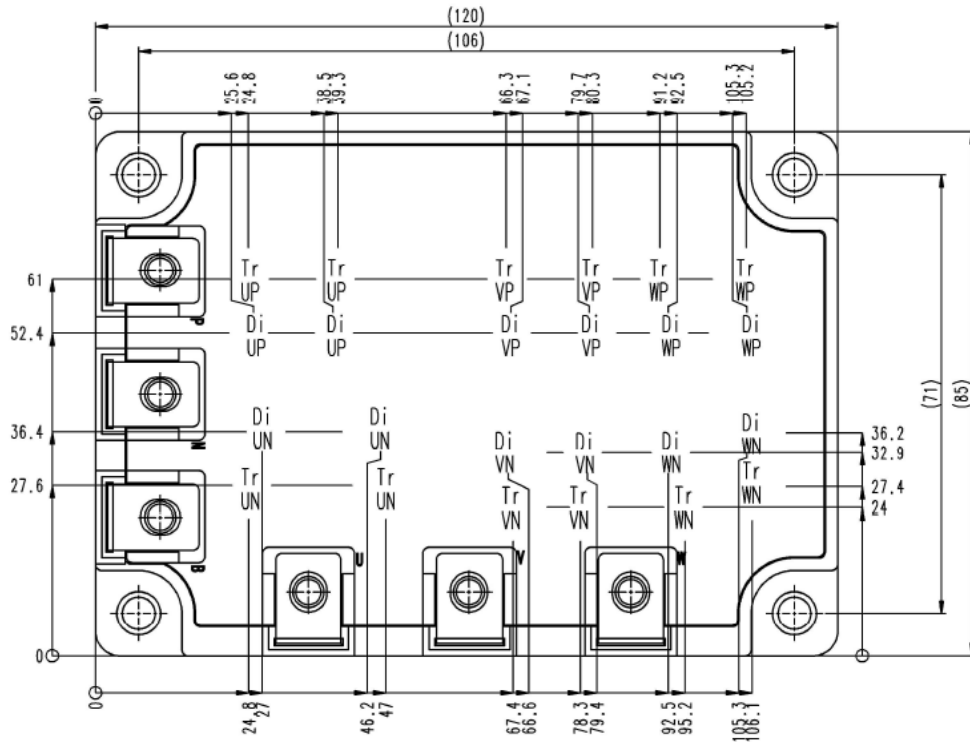
HIGH POWER SWITCHING USE
INSULATED TYPE

TENTATIVE
Notice: This is not a final specification.
Some parametric limits are subject to change

THERMAL RESISTANCE

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal Resistance	Junction to case, IGBT, per 1 element (Note1)	-	-	0.12	K/W
$R_{th(j-c)D}$		Junction to case, FWD, per 1 element (Note1)	-	-	0.16	
$R_{th(c-s)}$	Contact Thermal Resistance	Case to heat sink, per 1 module, Thermal grease applied (Note.1)	-	0.015	-	

Note1. If you use this value, $R_{th(s-a)}$ should be measured just under the chips.



ELECTRICAL CHARACTERISTICS ($T_j = 25^\circ\text{C}$, unless otherwise noted)

INVERTER PART

Symbol	Parameter	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
V_{CEsat}	Collector-Emitter Saturation Voltage	$V_D=15\text{ V}$, $I_C=450\text{ A}$	-	2.00	2.60	V	
		$V_{CIN}=0\text{ V}$, Pulsed, Terminal (Fig.1)	-	2.00	2.60		
V_{EC}	Emitter-Collector Voltage	$I_E=450\text{ A}$, $V_D=15\text{ V}$, $V_{CIN}=15\text{ V}$, Terminal (Fig.2)	-	1.60	2.70	V	
t_{on}	Switching Time	$V_D=15\text{ V}$, $V_{CIN}=0\text{ V} \leftrightarrow 15\text{ V}$, $V_{CC}=300\text{ V}$, $I_C=450\text{ A}$, $T_j=125^\circ\text{C}$, Inductive Load (Fig.3, 4)	-	0.9	-	μs	
t_{rr}			-	0.2	-		
$t_{c(on)}$			-	0.3	-		
t_{off}			-	1.2	-		
$t_{c(off)}$			-	0.3	-		
I_{CES}	Collector-Emitter Cut-off Current	$V_{CE}=V_{CES}$, $V_D=15\text{ V}$, $V_{CIN}=15\text{ V}$ (Fig.5)	$T_j=25^\circ\text{C}$	-	-	1	mA
			$T_j=125^\circ\text{C}$	-	-	10	

PM450CGC060

HIGH POWER SWITCHING USE
INSULATED TYPE

TENTATIVE
Notice: This is not a final specification.
Some parametric limits are subject to change

ELECTRICAL CHARACTERISTICS (cont.; T_j= 25°C, unless otherwise noted)

CONTROL PART

Symbol	Parameter	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I _D	Circuit Current	V _D =15 V, V _{CIN} =15 V	V _{P1} -V _{PC}	-	2	4	mA
			V _{N1} -V _{NC}	-	6	12	
V _{th(ON)}	Input ON Threshold Voltage	Applied between:	1.2	1.5	1.8	V	
V _{th(OFF)}	Input OFF Threshold Voltage	U _P -V _{UPC} , V _P -V _{VPC} , W _P -V _{WPC} , U _N , V _N , W _N -V _{NC}	1.7	2.0	2.3		
SC	Short Circuit Trip Level	-20≤T _j ≤125 °C, V _D =15 V (Fig.3, 6)	675	-	-	A	
t _{off(SC)}	Short Circuit Current Delay Time	V _D =15 V (Fig.3, 6)	-	0.2	-	μs	
OT	Over Temperature Protection	Detect Temperature of IGBT chip	Trip level	150	-	-	°C
OT _(hys)			Hysteresis	-	20	-	
UV _t	Supply Circuit	-20≤T _j ≤125 °C	Trip level	11.5	12.0	12.5	V
UV _r	Under-Voltage Protection		Reset level	-	12.5	-	
I _{FO(H)}	Fault Output Current	V _D =15 V, V _{FO} =15 V (Note2)	-	-	0.01	mA	
I _{FO(L)}			-	10	15		
t _{FO}	Fault Output Pulse Width	V _D =15 V (Note2)	1.0	1.8	-	ms	

Note2. Fault output is given only when the internal SC, OT & UV protections schemes of either upper or lower arm device operate to protect it.

MECHANICAL RATINGS AND CHARACTERISTICS

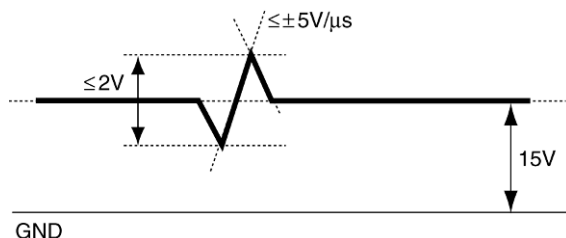
Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M _s	Mounting Torque	Mounting part screw : M5	2.5	3.0	3.5	N•m
M _t	Mounting Torque	Main terminal part screw : M5	2.5	3.0	3.5	N•m
m	mass	-	-	575	-	g

RECOMMENDED CONDITIONS FOR USE

Symbol	Parameter	Conditions	Recommended value	Unit
V _{CC}	Supply Voltage	Applied across P-N terminals	≤ 400	V
V _D	Control Supply Voltage	Applied between : V _{UP1} -V _{UPC} , V _{VP1} -V _{VPC} , V _{WP1} -V _{WPC} , V _{N1} -V _{NC} (Note3)	15.0±1.5	V
V _{CIN(ON)}	Input ON Voltage	Applied between :	≤ 0.8	V
V _{CIN(OFF)}	Input OFF Voltage	U _P -V _{UPC} , V _P -V _{VPC} , W _P -V _{WPC} , U _N , V _N , W _N -V _{NC}	≥ 9.0	
f _{PWM}	PWM Input Frequency	Using Application Circuit of Fig. 8	≤ 20	kHz
t _{dead}	Arm Shoot-through Blocking Time	For IPM's each input signals (Fig.7)	≥ 2.0	μs

This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU.

Note3. With ripple satisfying the following conditions: dv/dt swing ≤ ±5 V/μs, Variation ≤ 2 V peak to peak



PRECAUTIONS FOR TESTING

1. Before applying any control supply voltage (V_D), the input terminals should be pulled up by resistors, etc. to their corresponding supply voltage and each input signal should be kept off state.
After this, the specified ON and OFF level setting for each input signal should be done.
2. When performing "SC" tests, the turn-off surge voltage spike at the corresponding protection operation should not be allowed to rise above V_{CES} rating of the device.
(These test should not be done by using a curve tracer or its equivalent.)

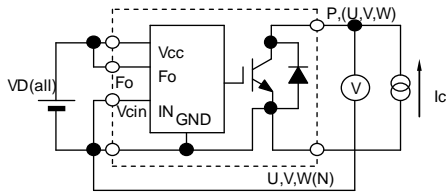


Fig.1 V_{CESat} Test

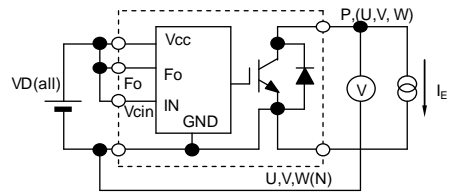


Fig.2 V_{EC} Test

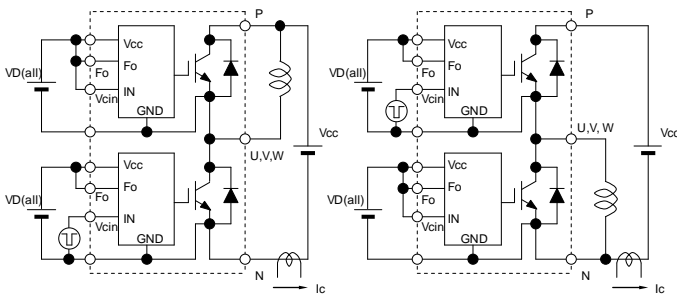


Fig.3 Switching time and SC test circuit

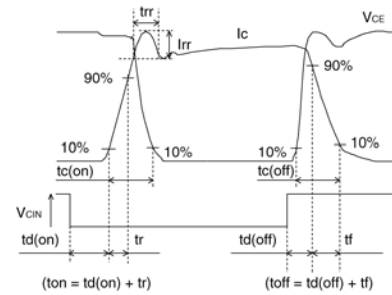


Fig.4 Switching time test waveform

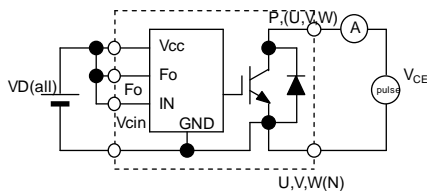


Fig.5 I_{CES} Test

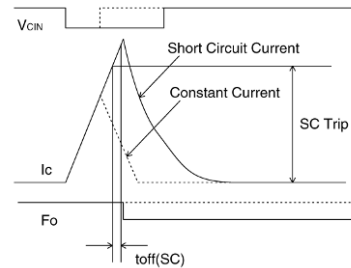
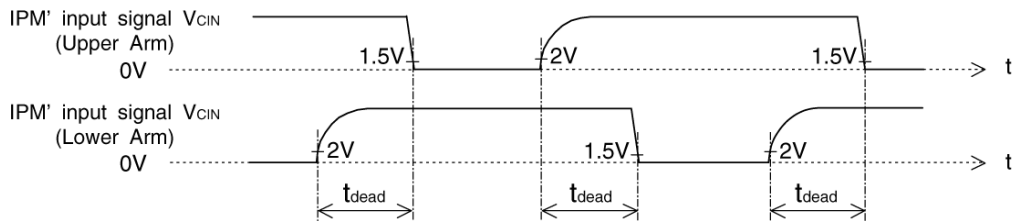


Fig.6 SC test waveform



1.5V: Input on threshold voltage $V_{th(on)}$ typical value, 2V: Input off threshold voltage $V_{th(off)}$ typical value

Fig. 7 Dead time measurement point example

PM450CGC060

HIGH POWER SWITCHING USE
INSULATED TYPE

TENTATIVE
Notice: This is not a final specification.
Some parametric limits are subject to change

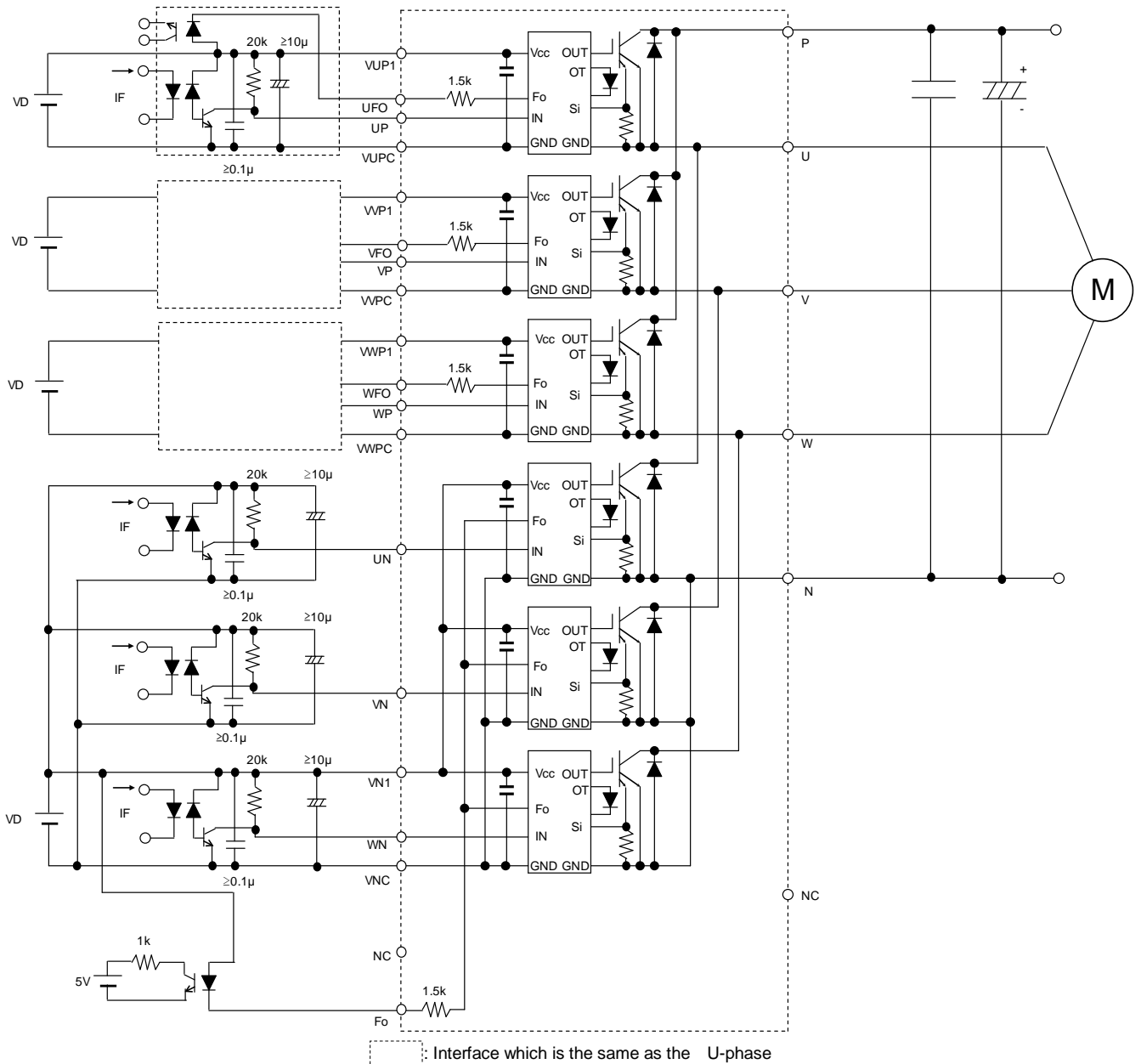


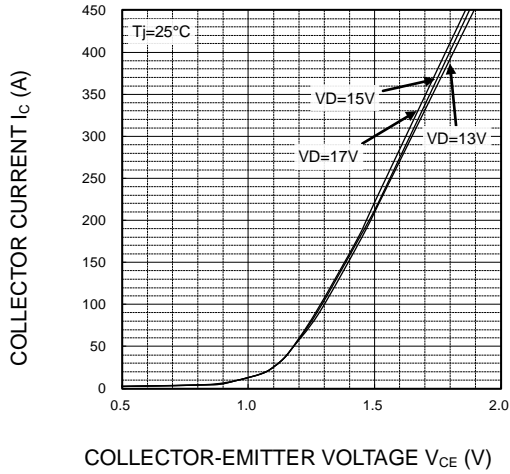
Fig. 8 Application Example Circuit

NOTES FOR STABLE AND SAFE OPERATION ;

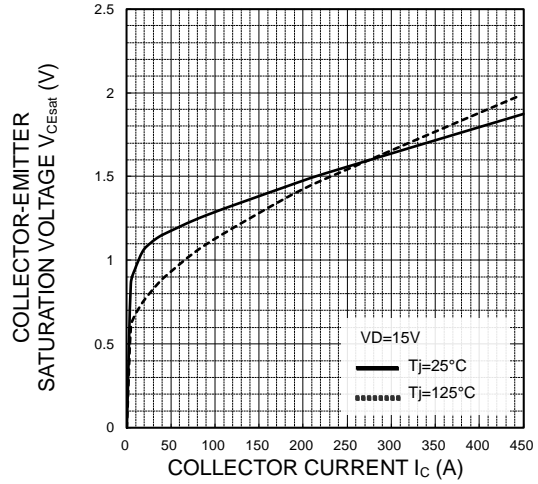
- Design the PCB pattern to minimize wiring length between opto-coupler and IPM's input terminal, and also to minimize the stray capacity between the input and output wirings of opto-coupler.
- Connect low impedance capacitor between the Vcc and GND terminal of each fast switching opto-coupler.
- Fast switching opto-couplers: $t_{PLH}, t_{PHL} \leq 0.8\mu s$, Use High CMR type.
- Slow switching opto-coupler: CTR > 100%
- Use 4 isolated control power supplies (V_D). Also, care should be taken to minimize the instantaneous voltage charge of the power supply.
- Make inductance of DC bus line as small as possible, and minimize surge voltage using snubber capacitor between P and N terminal.

PERFORMANCE CURVES

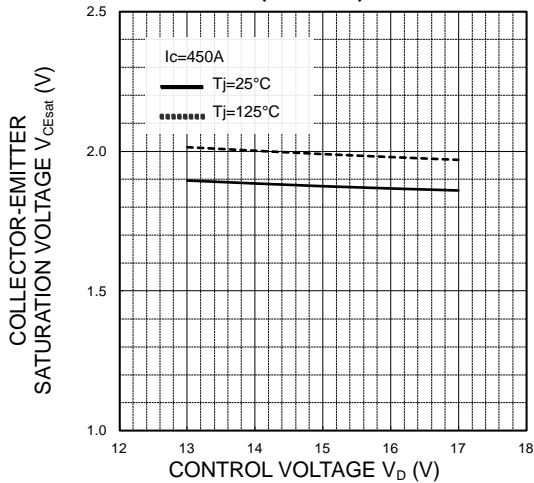
OUTPUT CHARACTERISTICS (TYPICAL)



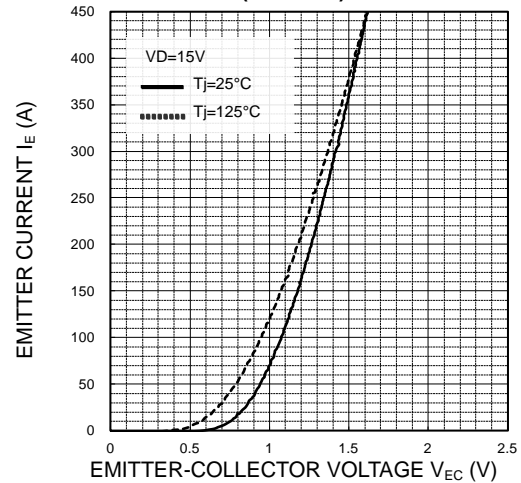
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. I_c) CHARACTERISTICS (TYPICAL)



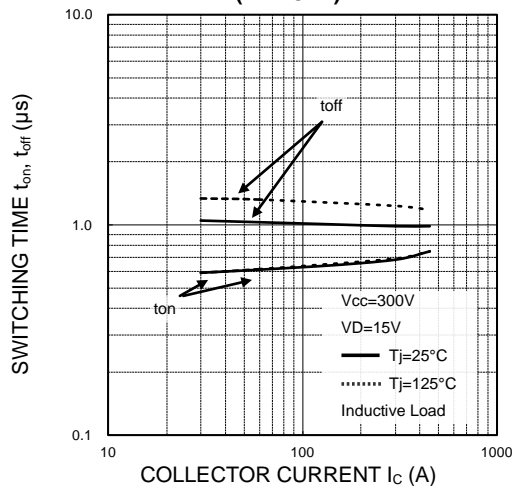
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. V_D) CHARACTERISTICS (TYPICAL)



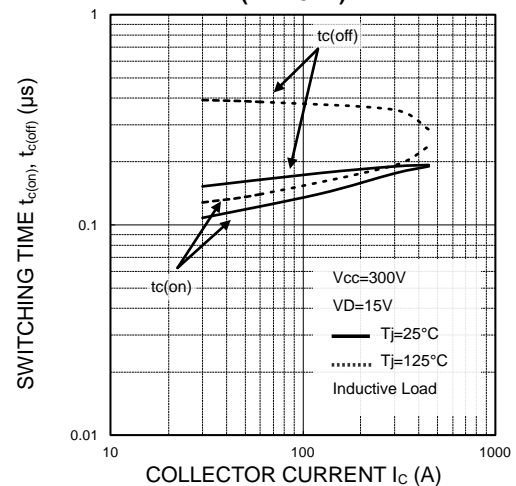
FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



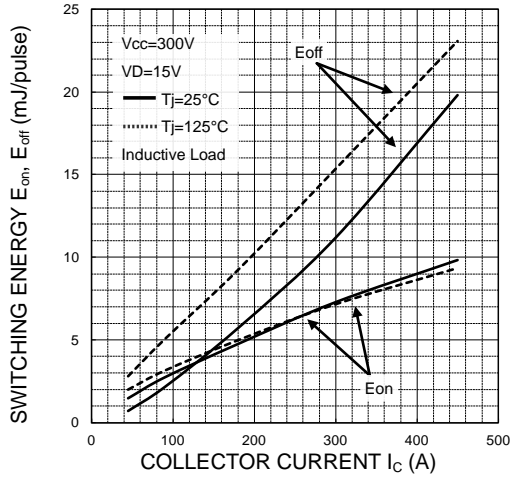
SWITCHING TIME (t_{on} , t_{off}) CHARACTERISTICS (TYPICAL)



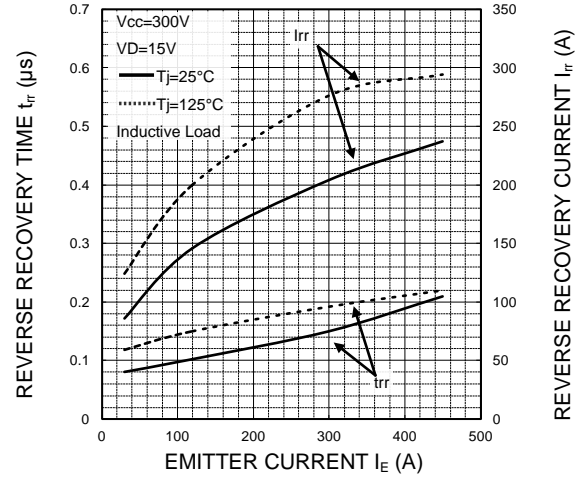
SWITCHING TIME ($t_{c(on)}$, $t_{c(off)}$) CHARACTERISTICS (TYPICAL)



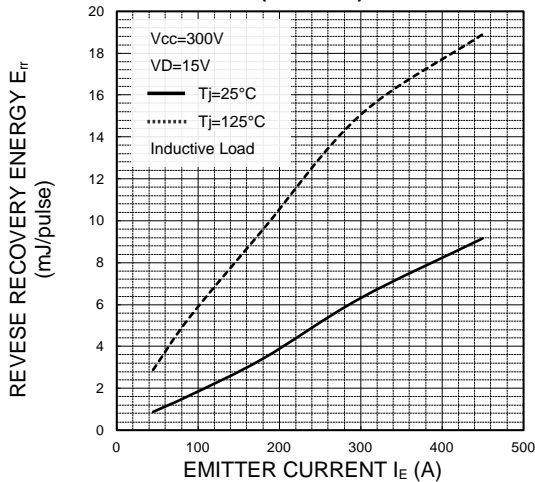
SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



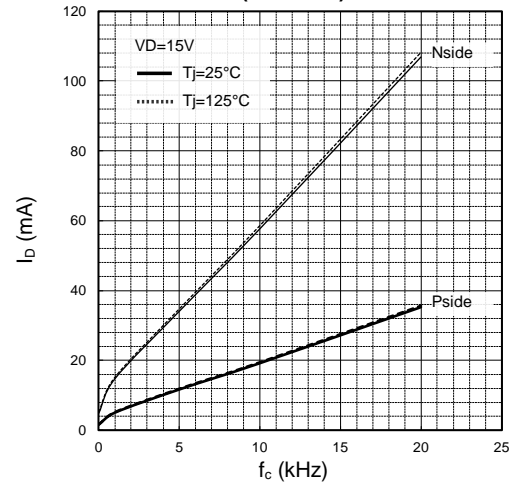
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



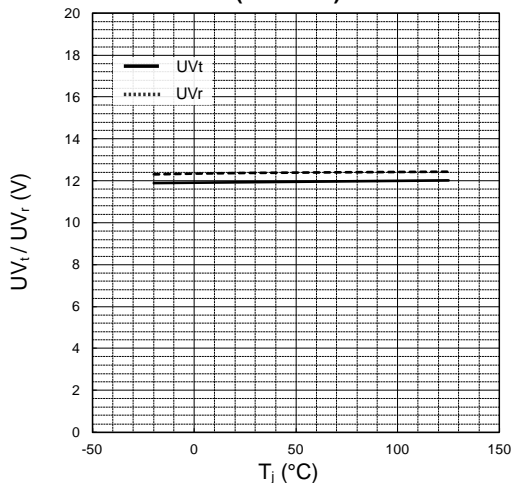
FREE WHEELING DIODE REVERSE RECOVERY ENERGY CHARACTERISTICS (TYPICAL)



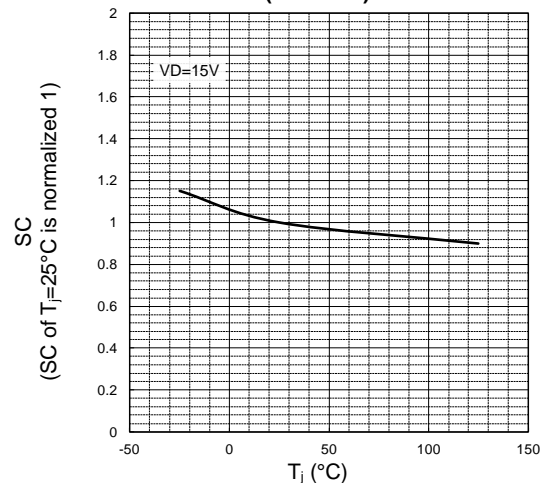
I_D VS. f_c CHARACTERISTICS (TYPICAL)



UV TRIP LEVEL VS. T_j CHARACTERISTICS (TYPICAL)



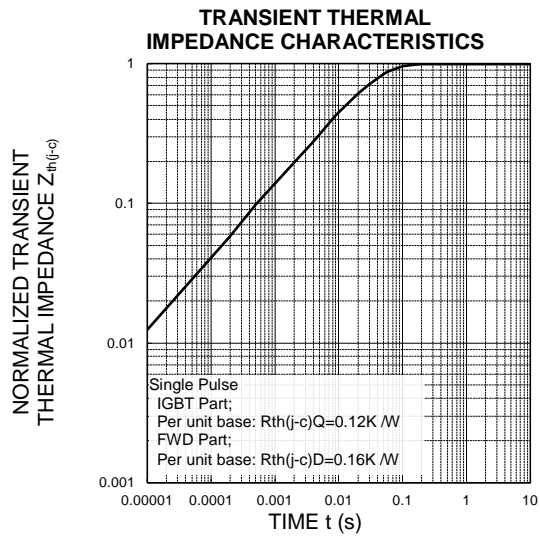
SC TRIP LEVEL VS. T_j CHARACTERISTICS (TYPICAL)



PM450CGC060

HIGH POWER SWITCHING USE
INSULATED TYPE

TENTATIVE
Notice: This is not a final specification.
Some parametric limits are subject to change



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.

Notes regarding these materials

- These materials are intended as a reference to assist our customers in the selection of the Mitsubishi semiconductor product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Mitsubishi Electric Corporation or a third party.
- Mitsubishi Electric Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
- All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Mitsubishi Electric Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Mitsubishi Electric Corporation by various means, including the Mitsubishi Semiconductor home page (www.MitsubishiElectric.com/semiconductors/).
- When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
- Mitsubishi Electric Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
- The prior written approval of Mitsubishi Electric Corporation is necessary to reprint or reproduce in whole or in part these materials.
- If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
- Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for further details on these materials or the products contained therein.