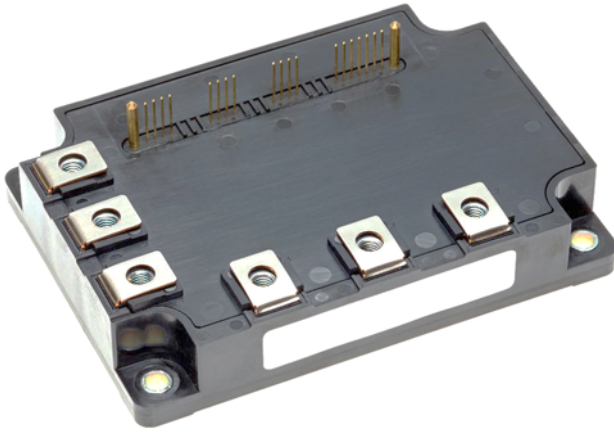


<Intelligent Power Modules>

PM100RG1C120

FLAT-BASE TYPE
INSULATED PACKAGE



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 available from each protection upper and lower arm of IPM.
- d) Outputting an error signal corresponding to the abnormal state (error mode identification)

UL Recognized under UL1557, File No. E323585

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

APPLICATION

General purpose inverter, servo drives and other motor controls

PACKAGE OUTLINES

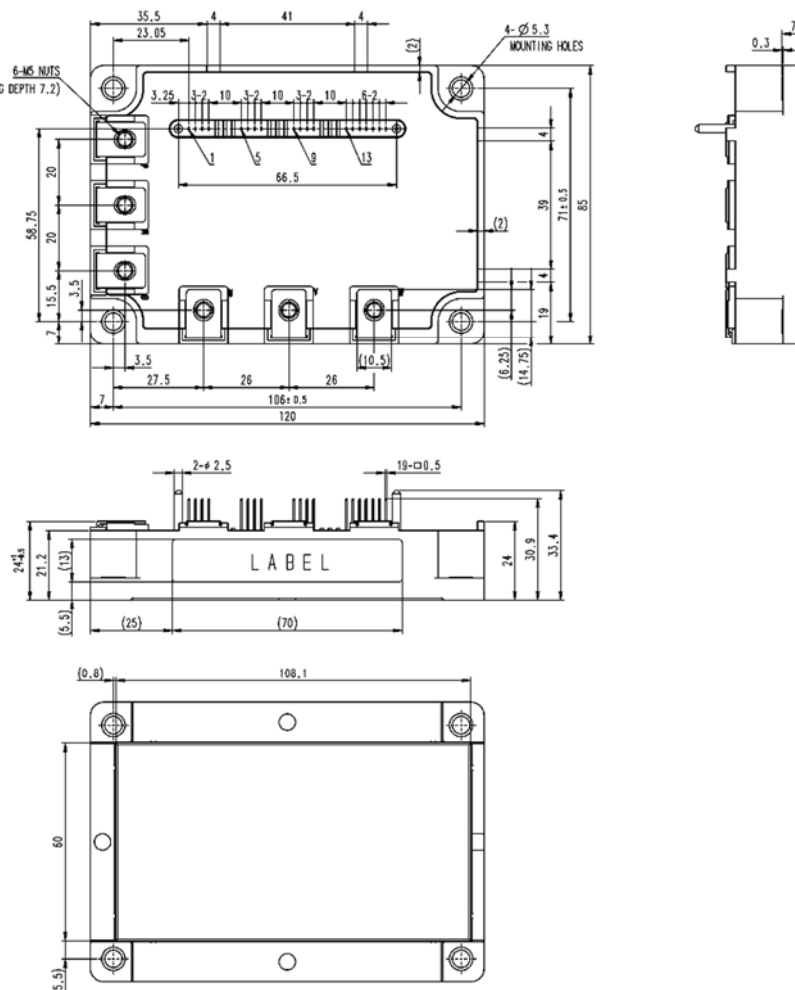
Dimensions in mm

Tolerance otherwise specified

Division of Dimension		Tolerance
0.5	to 3	±0.2
over 3	to 6	±0.3
over 6	to 30	±0.5
over 30	to 120	±0.8
over 120	to 400	±1.2

TERMINAL CODE

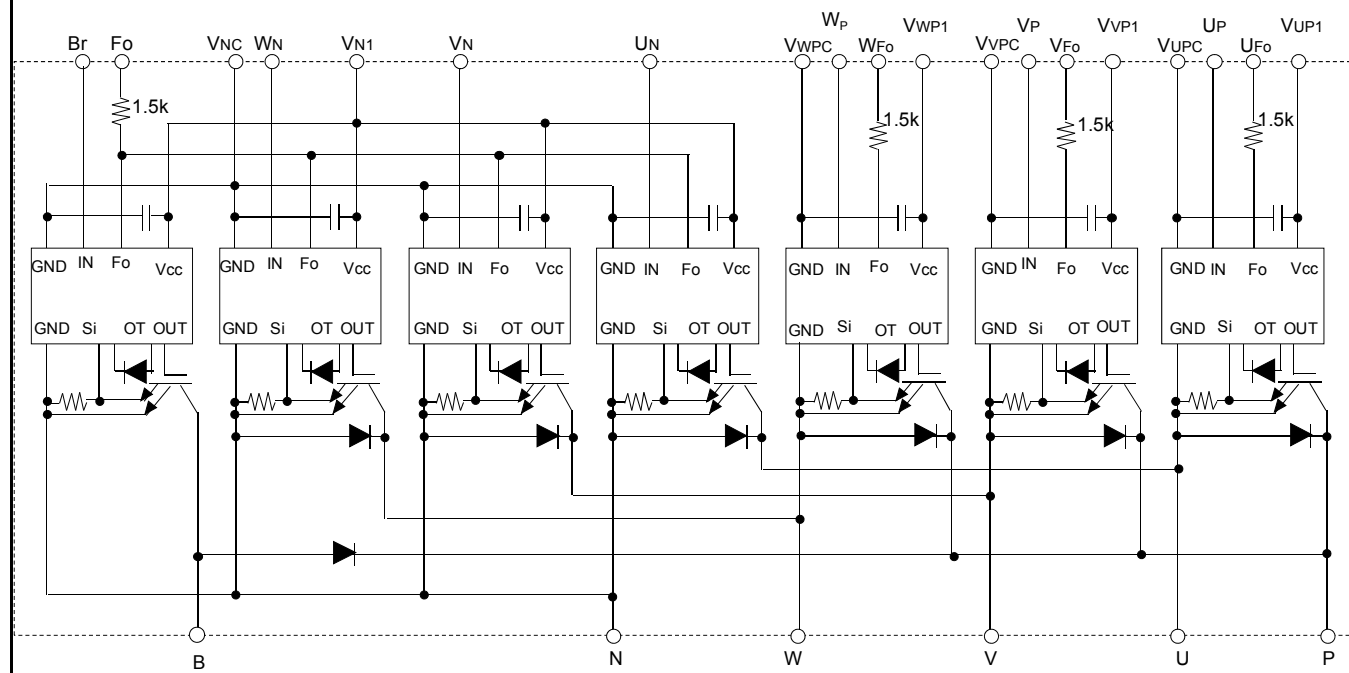
- 1. V_{UPC}
- 2. U_{FO}
- 3. U_P
- 4. V_{UP1}
- 5. V_{VPC}
- 6. V_{FO}
- 7. V_P
- 8. V_{VP1}
- 9. V_{WPC}
- 10. W_{FO}
- 11. W_P
- 12. V_{WP1}
- 13. V_{NC}
- 14. V_{N1}
- 15. BR
- 16. U_N
- 17. V_N
- 18. W_N
- 19. F_O



PM100RG1C120

HIGH POWER SWITCHING USE

INSULATED TYPE

INTERNAL FUNCTIONS BLOCK DIAGRAM**MAXIMUM RATINGS** (Tvj = 25°C, unless otherwise noted)**INVERTER PART**

Symbol	Parameter	Conditions	Ratings	Unit
V_{CES}	Collector-Emitter Voltage	$V_D=15\text{ V}$, $V_{CIN}=15\text{ V}$	1200	V
I_C	Collector Current	$T_C=25\text{ }^\circ\text{C}$	100	A
I_{CRM}		Pulse	200	
P_{tot}	Total Power Dissipation	$T_C=25\text{ }^\circ\text{C}$	735	W
I_E	Emitter Current	$T_C=25\text{ }^\circ\text{C}$	100	A
I_{ERM}	(Free-wheeling Diode Forward current)	Pulse	200	
T_{vj}	Junction Temperature		-20 ~ +150	°C

*: Tc measurement point is just under the chip.

BRAKE PART

Symbol	Parameter	Conditions	Ratings	Unit
V_{CES}	Collector-Emitter Voltage	$V_D=15\text{ V}$, $V_{CIN}=15\text{ V}$	1200	V
I_C	Collector Current	$T_C=25\text{ }^\circ\text{C}$	50	A
I_{CRM}		Pulse	100	
P_{tot}	Total Power Dissipation	$T_C=25\text{ }^\circ\text{C}$	480	W
$V_{R(DC)}$	Diode Rated Reverse DC Voltage	$T_C=25\text{ }^\circ\text{C}$	1200	V
I_F	Diode Forward Current	$T_C=25\text{ }^\circ\text{C}$	50	A
T_j	Junction Temperature		-20 ~ +150	°C

*: Tc measurement point is just under the chip.

CONTROL PART

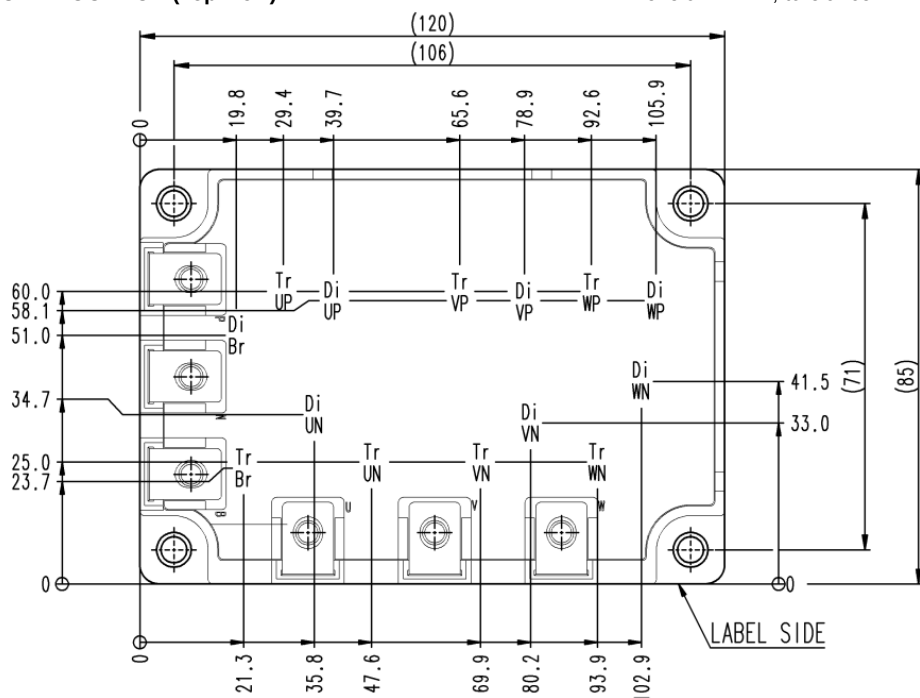
Symbol	Parameter	Conditions	Ratings	Unit
V_D	Supply Voltage	Applied between: $V_{UP1}-V_{UPC}$, $V_{VP1}-V_{VPC}$, $V_{WP1}-V_{WPC}$, $V_{N1}-V_{NC}$	20	V
V_{CIN}	Input Voltage	Applied between: U_P-V_{UPC} , V_P-V_{VPC} , W_P-V_{WPC} , U_N , V_N , W_N , $Br-V_{NC}$	20	V
V_{FO}	Fault Output Supply Voltage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

PM100RG1C120HIGH POWER SWITCHING USE
INSULATED TYPE**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, $T_{vj} = +125^\circ\text{C}$ start	800	V
T_{stg}	Storage Temperature	-	$-40 \sim +125$	$^\circ\text{C}$
T_C	Operating Case Temperature	-	$-20 \sim +125$	$^\circ\text{C}$
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.**THERMAL RESISTANCE**

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal Resistance	Inverter, Junction to case, IGBT, per 1 element (Note1)	-	-	0.17	K/W
$R_{th(j-c)D}$		Inverter, Junction to case, FWD, per 1 element (Note1)	-	-	0.25	
$R_{th(j-c)Q}$		Brake, Junction to case, IGBT, per 1 element (Note1)	-	-	0.26	
$R_{th(j-c)D}$		Brake, Junction to case, FWD, per 1 element (Note1)	-	-	0.41	
$R_{th(c-s)}$	Contact Thermal Resistance	Case to heat sink, per 1 module, Thermal grease applied (Note.1, 2)	-	8.4	-	K/kW

Note1. If you use this value, $R_{th(s-a)}$ should be measured just under the chips.Note2. Typical value is measured by using thermally conductive grease of $\lambda = 0.9 \text{ W}/(\text{m} \cdot \text{K})$, $D_{(c-s)} = 50 \text{ } \mu\text{m}$.**CHIP LOCATION (Top view)**Dimension in mm, tolerance: $\pm 1 \text{ mm}$ 

Tr** : IGBT
Di** : FWD

PM100RG1C120HIGH POWER SWITCHING USE
INSULATED TYPE**ELECTRICAL CHARACTERISTICS** (Tvj= 25°C, unless otherwise noted)**INVERTER PART**

Symbol	Parameter	Conditions			Limits			Unit
					Min.	Typ.	Max.	
V _{CEsat}	Collector-Emitter Saturation Voltage	V _D =15 V, I _C =100 A	Tvj=25 °C	Terminal	-	-	1.85	V
				Chip	-	1.3	-	
		V _{CIN} =0 V, Pulsed, (Fig.1)	Tvj=125 °C	Terminal	-	-	2.1	
				Chip	-	1.5	-	
V _{EC}	Emitter-Collector Voltage	V _D =15 V, I _E =100 A,	Tvj=25 °C	Terminal	-	-	2.4	V
				Chip	-	1.75	-	
		V _{CIN} = 15 V, pulsed, (Fig.2)	Tvj=125 °C	Terminal	-	-	2.65	
				Chip	-	1.95	-	
t _{on}	Switching Time	V _D =15 V, V _{CIN} =0 V↔15 V, V _{CC} =600 V, I _C =100A, Tvj=125 °C, Inductive Load (Fig.3, 4)			0.3	0.8	1.2	μs
t _{rr}					-	0.2	0.4	
t _{c(on)}					-	0.2	0.4	
t _{off}					-	1.2	2.8	
t _{c(off)}					-	0.4	1.2	
I _{CES}	Collector-Emitter Cut-off Current	V _{CE} =V _{CES} , V _D =15 V, V _{CIN} =15 V (Fig.5)		Tvj=25 °C	-	-	1	mA
				Tvj=125 °C	-	-	10	

BRAKE PART

Symbol	Parameter	Conditions			Limits			Unit
					Min.	Typ.	Max.	
V _{CEsat}	Collector-Emitter Saturation Voltage	V _D =15 V, I _C =50A	Tvj=25 °C	Terminal	-	-	1.75	V
				Chip	-	1.3	-	
		V _{CIN} =0 V, Pulsed, (Fig.1)	Tvj=125 °C	Terminal	-	-	2.0	
				Chip	-	1.5	-	
V _{FM}	Diode Forward Voltage	I _F =50A	Tvj=25 °C	Terminal	-	-	2.35	V
				Chip	-	1.75	-	
			Tvj=125 °C	Terminal	-	-	2.6	
				Chip	-	1.95	-	
I _{CES}	Collector-Emitter Cut-off Current	V _{CE} =V _{CES} , V _D =15 V, V _{CIN} =15 V (Fig.5)		Tvj=25 °C	-	-	1	mA
				Tvj=125 °C	-	-	10	

PM100RG1C120HIGH POWER SWITCHING USE
INSULATED TYPE**ELECTRICAL CHARACTERISTICS** (Tvj = 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	-	4	6	mA
				16	24	
		V _D =15 V, V _{CIN} =0 V ↔ 15 V, V _{CC} =800 V I _C =0A, Tvj=125 °C, f _C ≤20kHz	-	29	35	
				103	120	
V _{th(ON)}	Input ON Threshold Voltage	Applied between: U _P -V _{UPC} , V _P -V _{VPC} , W _P -V _{WPC} , U _N , V _N , W _N , Br-V _{NC}	1.2	1.5	1.8	V
V _{th(OFF)}	Input OFF Threshold Voltage		1.7	2.0	2.3	
SC	Short Circuit Trip Level	-20≤Tvj≤125 °C, V _D =15 V (Fig.3, 6)	Inverter	200	-	A
			Brake	100	-	
t _{d(SC)}	Short Circuit Current Delay Time	V _D =15 V, Tvj=125 °C (Fig.3, 6)	-	2.0	-	μs
OT	Over Temperature Protection	Detect temperature of IGBT chip surface	Trip level	150	-	°C
OT _(hys)			Hysteresis	-	20	
UV _t	Supply Circuit	-	Trip level	11.0	12.0	V
UV _r	Under-Voltage Protection		Reset level	-	12.5	
I _{FO(H)}	Fault Output Current	V _D =15 V, V _{FO} =15 V (Note3)	-	-	0.01	mA
I _{FO(L)}			-	10	15	
t _{FO}	Fault Output Pulse Width	V _D =15 V (Note3)	OT	-	8.0	ms
			UV	-	4.0	
			SC	-	2.0	

Note3. 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

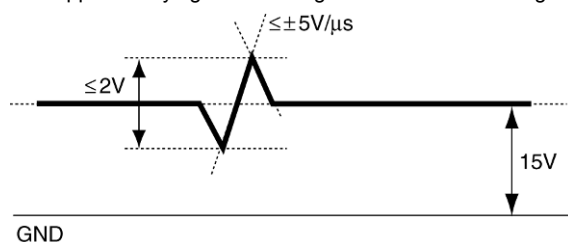
Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M _s	Mounting Torque	Mounting part screw : M5	2.5	3.0	3.5	N•m
M _t	Mounting Torque	Main terminal part screw : M5	2.5	3.0	3.5	
m	mass	-	-	425	-	g

RECOMMENDED CONDITIONS FOR USE

Symbol	Parameter	Conditions	Recommended value	Unit
V _{CC}	Supply Voltage	Applied across P-N terminals	≤ 800	V
V _D	Control Supply Voltage	Applied between : V _{UP1} -V _{UPC} , V _{VP1} -V _{VPC} , V _{WP1} -V _{WPC} , V _{N1} -V _{NC} (Note4)	15.0±1.5	V
V _{CIN(ON)}	Input ON Voltage	Applied between : U _P -V _{UPC} , V _P -V _{VPC} , W _P -V _{WPC} , U _N , V _N , W _N , Br-V _{NC}	≤ 0.8	V
V _{CIN(OFF)}	Input OFF Voltage		≥ 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)	≥ 2.5	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.

Note4. With ripple satisfying the following conditions: dv/dt swing ≤ ±5 V/μs, Variation ≤ 2 V peak to peak



PM100RG1C120

HIGH POWER SWITCHING USE

INSULATED TYPE

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.)

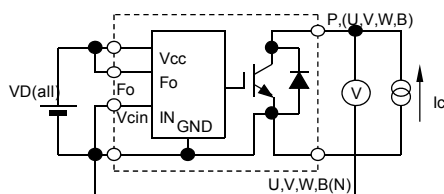
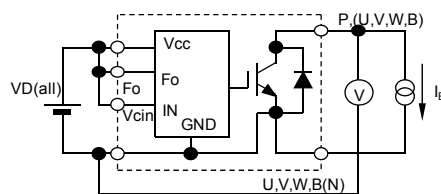
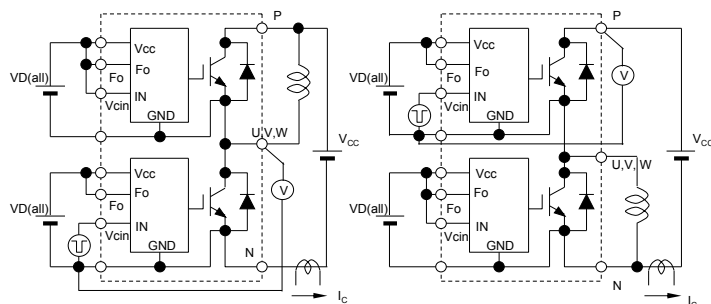
Fig.1 V_{CESat} TestFig.2 V_{EC} Test

Fig.3 Switching time and SC test circuit

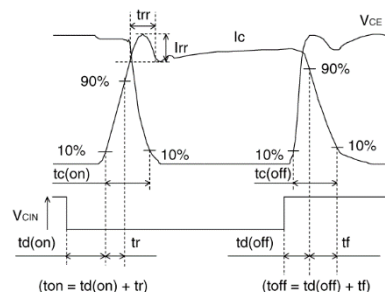


Fig.4 Switching time test waveform

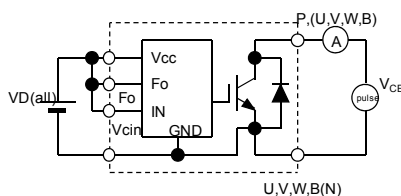
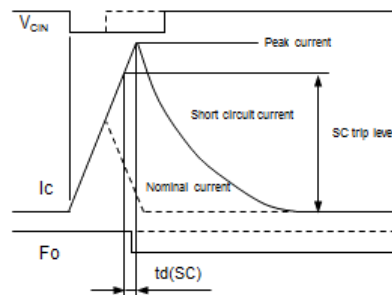
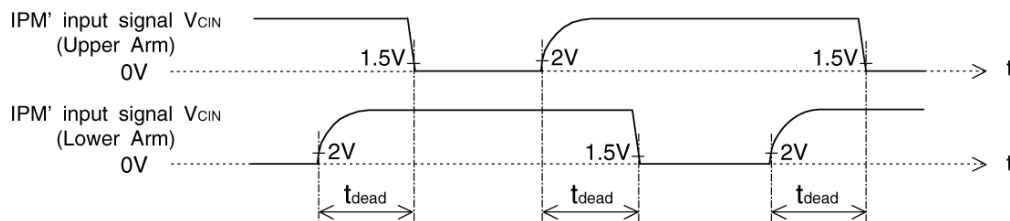
Fig.5 I_{CES} Test

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

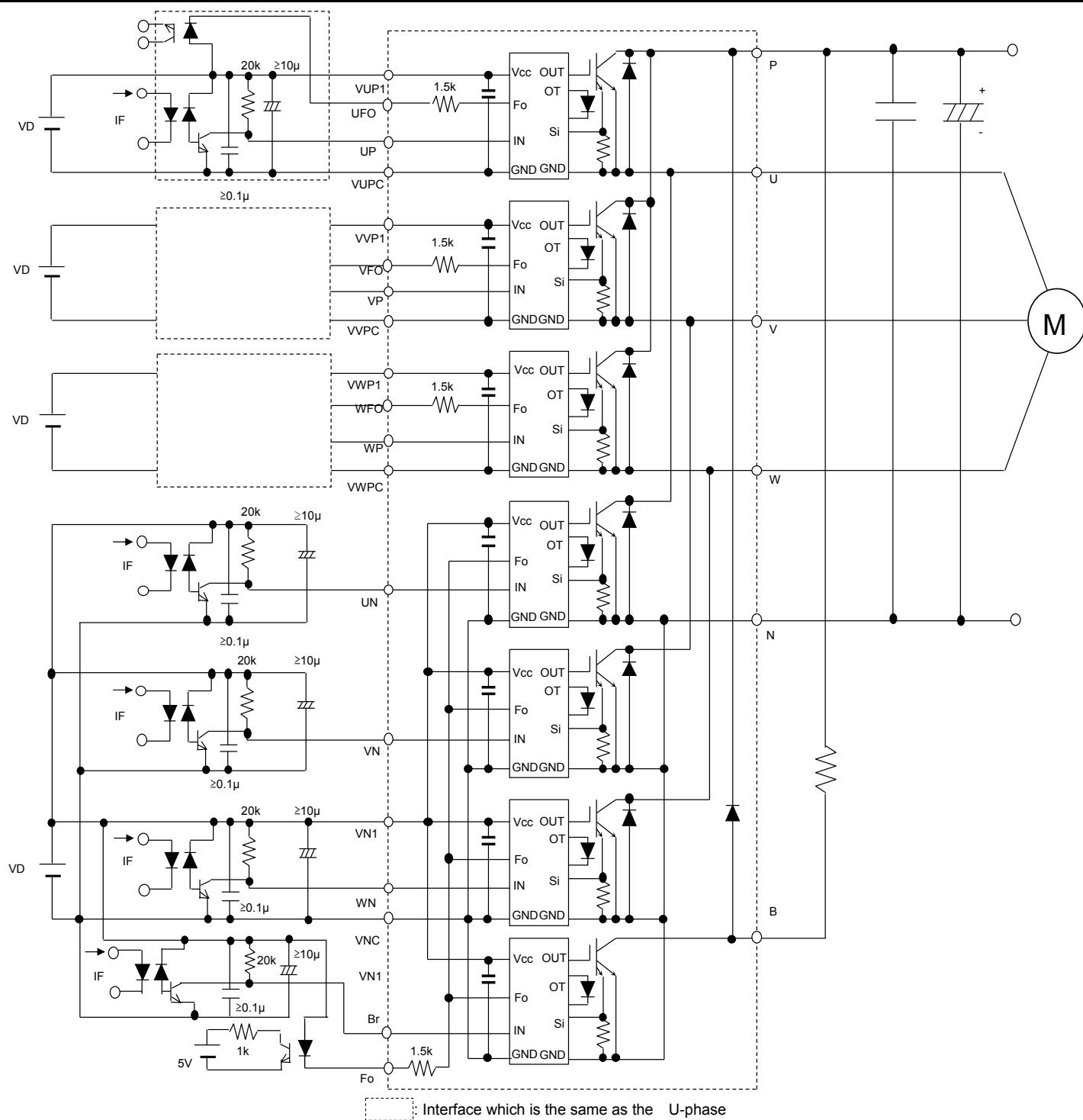
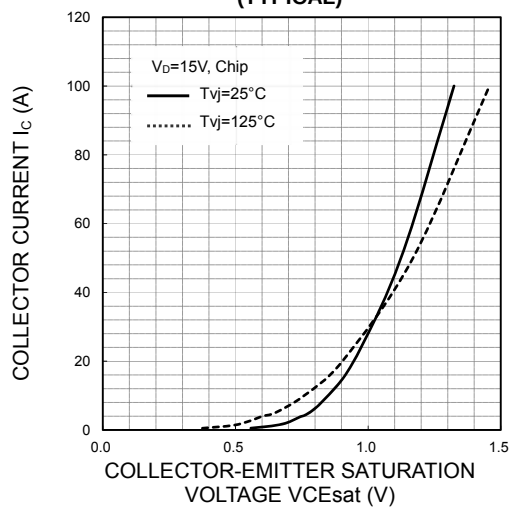
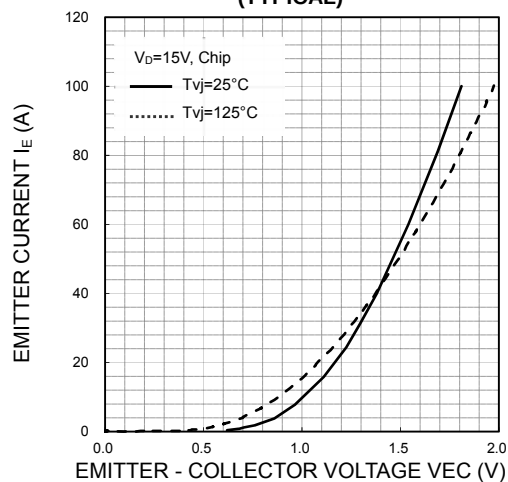
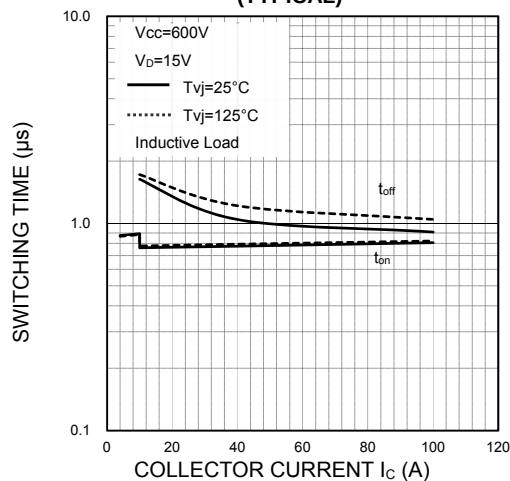
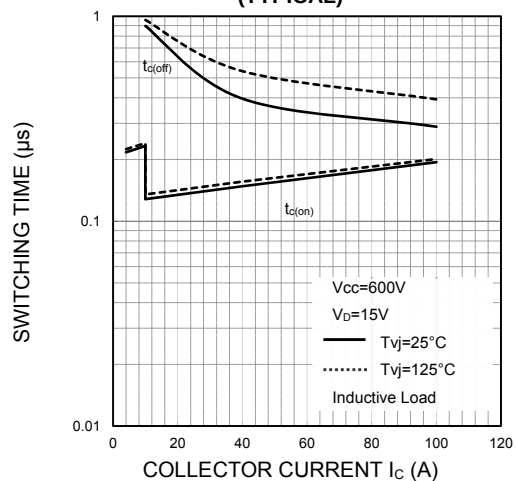
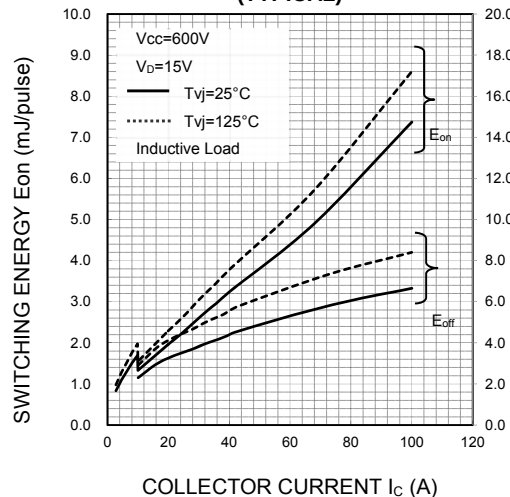
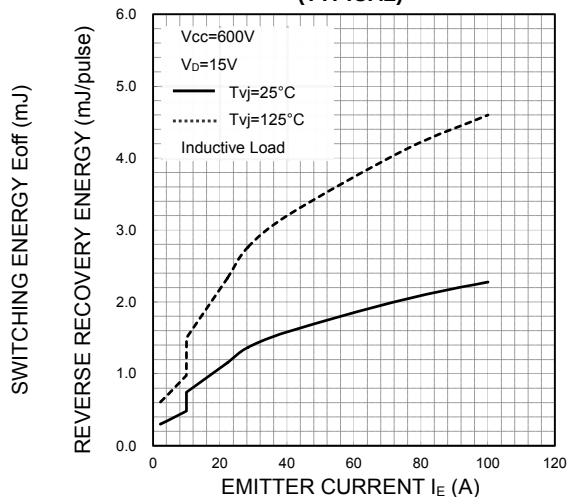
PM100RG1C120HIGH POWER SWITCHING USE
INSULATED TYPE

Fig. 8 Application Example Circuit

NOTES FOR STABLE AND SAFE OPERATION ;

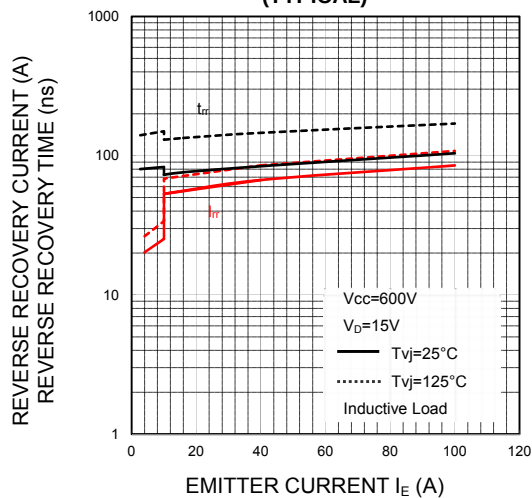
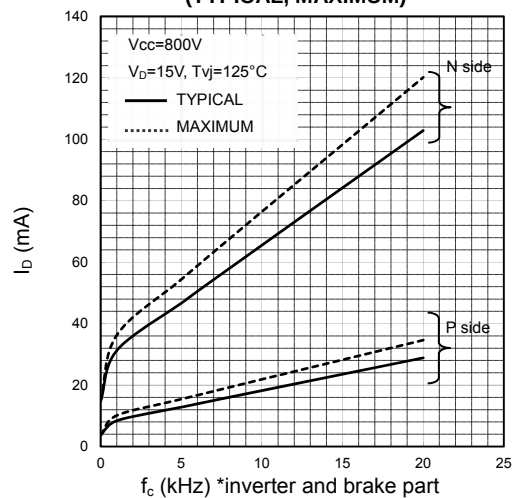
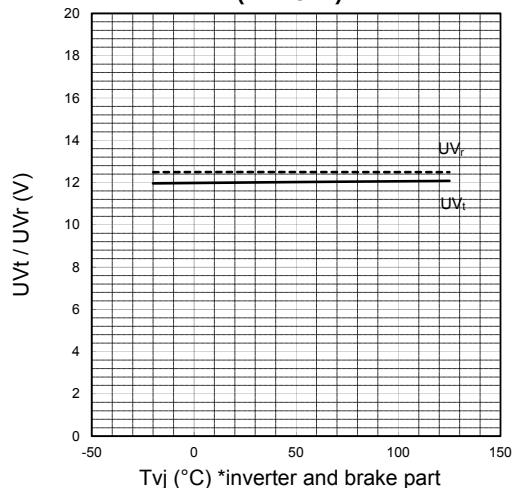
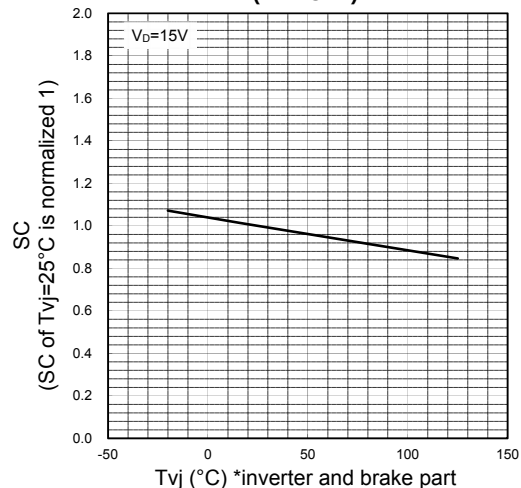
- Design the PCB pattern to minimize wiring length between opto-coupler and IPM's input terminal, and also to minimize the stray capacity between the input and output wirings of opto-coupler.
- Connect low impedance capacitor between the Vcc and GND terminal of each fast switching opto-coupler.
- Fast switching opto-couplers: t_{PLH} , $t_{PHL} \leq 0.8\mu s$, Use High CMR type.
- Slow switching opto-coupler: CTR > 100% (*can be applied to Brake part input signal, in this case, resistor should be selected properly).
- 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**Inverter part****COLLECTOR-EMITTER SATURATION VOLTAGE (VS. I_C) 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 ENERGY CHARACTERISTICS (TYPICAL)**

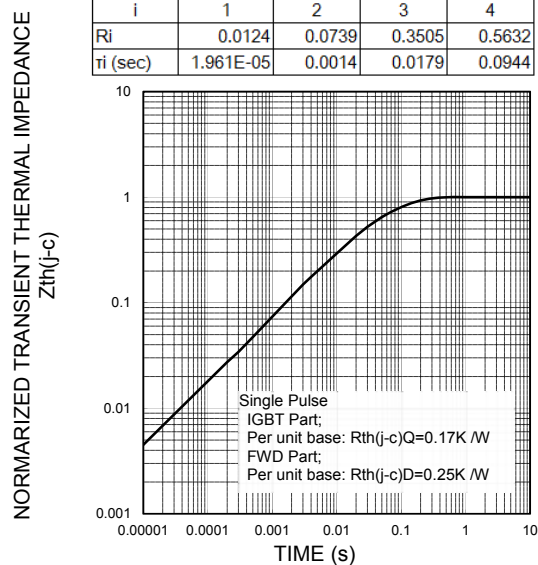
PM100RG1C120

HIGH POWER SWITCHING USE

INSULATED TYPE

FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL) **I_D VS. f_c CHARACTERISTICS (TYPICAL, MAXIMUM)****UV TRIP LEVEL VS. T_{vj} CHARACTERISTICS (TYPICAL)****SC TRIP LEVEL VS. T_{vj} CHARACTERISTICS (TYPICAL)****TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (TYPICAL)**

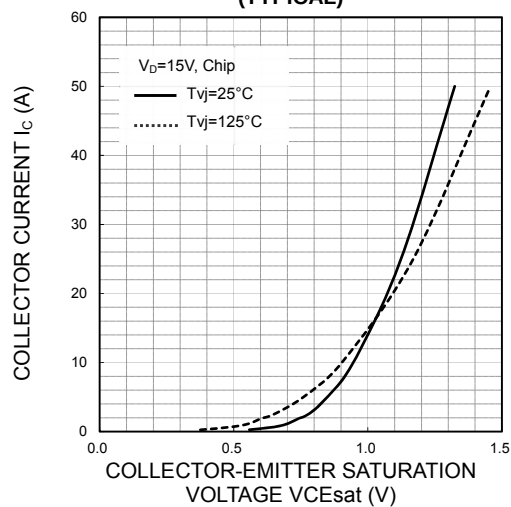
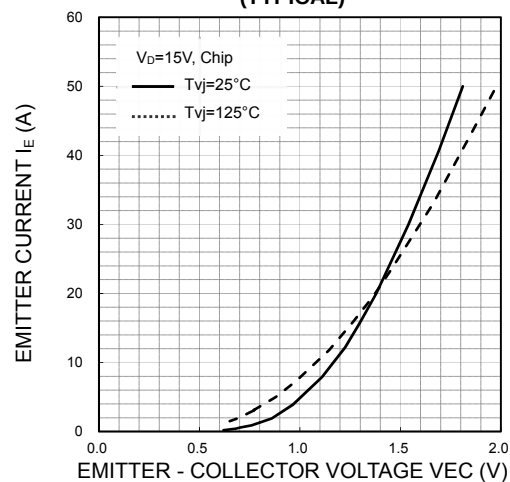
i	1	2	3	4
R_i	0.0124	0.0739	0.3505	0.5632
t_i (sec)	1.961E-05	0.0014	0.0179	0.0944



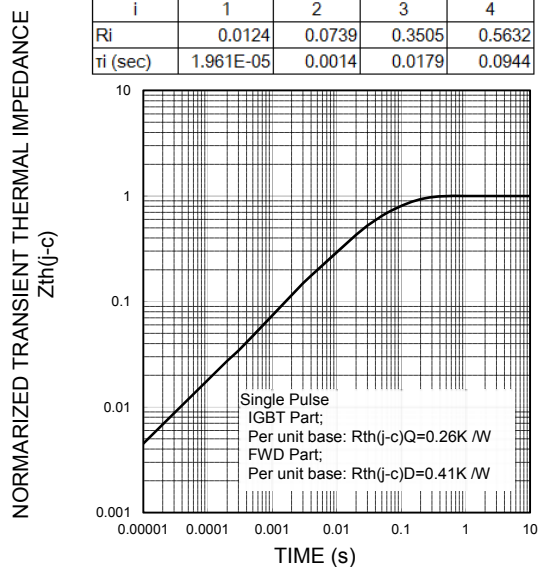
PM100RG1C120

HIGH POWER SWITCHING USE

INSULATED TYPE

PERFORMANCE CURVES**Brake part****COLLECTOR-EMITTER SATURATION
VOLTAGE (VS. I_c) CHARACTERISTICS
(TYPICAL)****FREE WHEELING DIODE FORWARD
CHARACTERISTICS
(TYPICAL)****TRANSIENT THERMAL IMPEDANCE
CHARACTERISTICS
(TYPICAL)**

i	1	2	3	4
R_i	0.0124	0.0739	0.3505	0.5632
t_i (sec)	1.961E-05	0.0014	0.0179	0.0944



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