PM50B5L1C060

FLAT-BASE TYPE
INSULATED PACKAGE

PM50B5L1C060

FEATURE

a) Adopting new 5th generation Full-Gate CSTBT™ chip

b) Error output signal is possible from all each protection upper and lower IGBT.

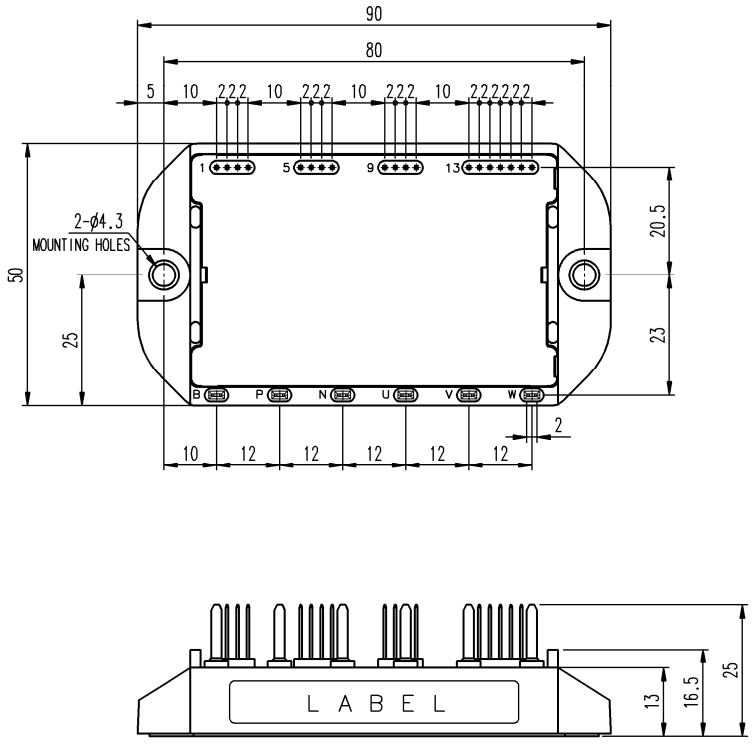
c) The mounting surface is 90mm×50mm about 30% less than B5LA type

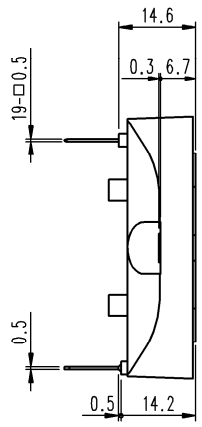
- Monolithic gate drive & protection logic
- Detection, protection & status indication circuits for, short-circuit, over-temperature & under-voltage.

APPLICATION

Photo voltaic power conditioner

PACKAGE OUTLINES **Dimensions in mm**

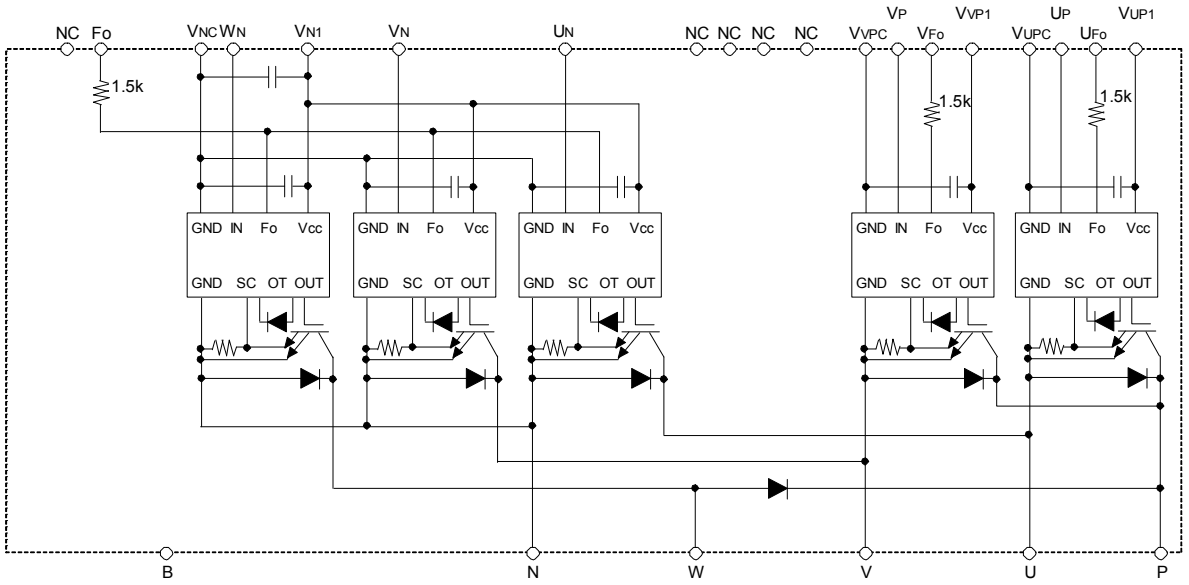




Terminal code

1. V_{UPC}	8. V_{VP1}	15. NC
2. U_{Fo}	9. NC	16. U_N
3. U_P	10. NC	17. V_N
4. V_{UP1}	11. NC	18. W_N
5. V_{VPC}	12. NC	19. Fo
6. V_{Fo}	13. V_{NC}	
7. V_P	14. V_{N1}	

INTERNAL FUNCTIONS BLOCK DIAGRAM



MAXIMUM RATINGS (T_j = 25°C, unless otherwise noted)

INVERTER PART

Symbol	Parameter	Conditions	Ratings	Unit
V_{CES}	Collector-Emitter Voltage	V_D=15V, V_{CIN}=15V	600	V
I_C	Collector Current	T_C=25°C	50	A
I_{CRM}		Pulse	100	
P_{tot}	Total Power Dissipation	T_C=25°C	168	W
I_E	Emitter Current	T_C=25°C	50	A
I_{ERM}	(Free wheeling Diode Forward current)	Pulse	100	
T_j	Junction Temperature		-20 ~ +150	°C

*: Tc measurement point is just under the chip.

CONVERTER PART

Symbol	Parameter	Conditions	Ratings	Unit
V_{CES}	Collector-Emitter Voltage	V_D=15V, V_{CIN}=15V	600	V
I_C	Collector Current	T_C=25°C	50	A
I_{CRM}		Pulse	100	
P_{tot}	Total Power Dissipation	T_C=25°C	168	W
I_E	Emitter Current	T_C=25°C	50	A
I_{ERM}	(Free wheeling Diode Forward current)	Pulse	100	
I_F	Di Forward Current	T_C=25°C	50	A
$V_{R(DC)}$	Di Rated DC Reverse Voltage	T_C=25°C	600	V
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_{N1}-V_{NC}	20	V
V_{CIN}	Input Voltage	Applied between : UP-V_{UPC}, VP-V_{VPC}, UN·VN·WN -V_{NC}	20	V
V_{FO}	Fault Output Supply Voltage	Applied between : UFo-V_{UPC}, VFo-V_{VPC}, Fo-V_{NC}	20	V
I_{FO}	Fault Output Current	Sink current at UFo, VFo, Fo terminals	20	mA

TOTAL SYSTEM

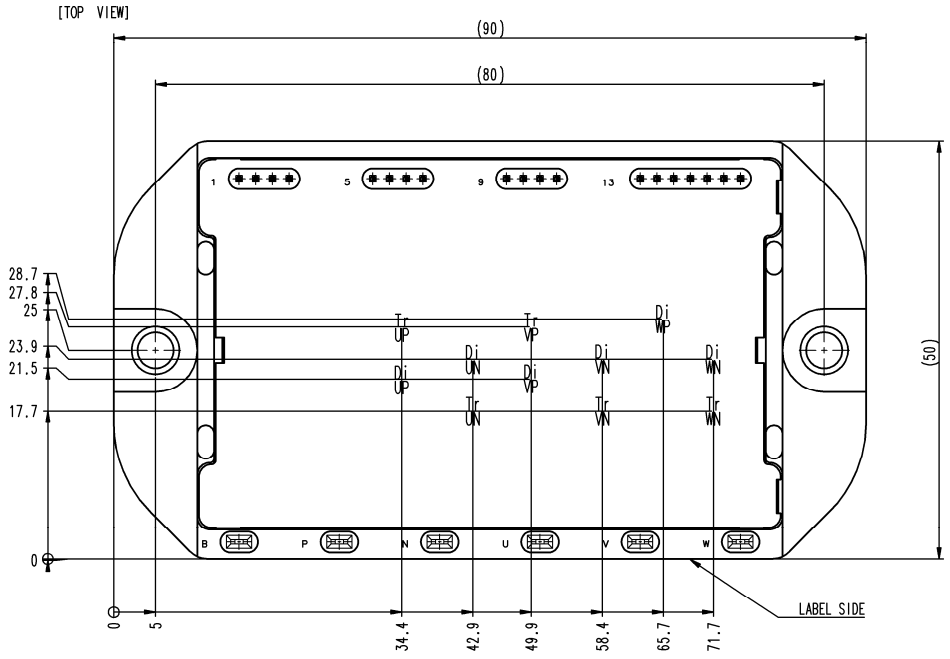
Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC(PROT)}$	Supply Voltage Protected by SC	V_D =13.5V ~ 16.5V Inverter Part, T_j =+125°C Start	450	V
$V_{CC(surge)}$	Supply Voltage (Surge)	Applied between : P-N, Surge value	500	V
T_{stg}	Storage Temperature		-40 ~ +125	°C
V_{isol}	Isolation Voltage	60Hz, 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, IGBT (per 1 element)	(Note.1)	-	-	0.74	K/W
$R_{th(j-c)D}$		Inverter, FWDi (per 1 element)	(Note.1)	-	-	1.28	
$R_{th(j-c)Q}$		Converter, IGBT (per 1 element)	(Note.1)	-	-	0.74	
$R_{th(j-c)D}$		Converter, FWDi (per 1 element)	(Note.1)	-	-	1.28	
$R_{th(j-c)D}$		Converter, Di (per 1 element)	(Note.1)	-	-	1.28	
$R_{th(c-s)}$	Contact Thermal Resistance	Case to heat sink, (per 1 module) Thermal grease applied	(Note.1)	-	0.06	-	

Note.1: If you use this value, $R_{th(s-a)}$ should be measured just under the chips.



ELECTRICAL CHARACTERISTICS (Tj = 25°C, unless otherwise noted)

INVERTER PART

Symbol	Parameter	Conditions		Limits			Unit
				Min.	Typ.	Max.	
V_{CEsat}	Collector-Emitter Saturation Voltage	V_D=15V, I_C=50A V_{CIN}=0V, Pulsed (Fig. 1)	T_j=25°C	-	2.2	2.7	V
			T_j=125°C	-	2.2	2.7	
V_{EC}	Emitter-Collector Voltage	I_E=50A, V_D=15V, V_{CIN}= 15V (Fig. 2)		-	2.4	3.3	V
t_{on}	Switching Time	V_D=15V, V_{CIN}=0V↔15V V_{CC}=300V, I_C=50A T_j=125°C Inductive Load (Fig. 3,4)		0.1	0.5	1.2	μs
t_{rr}				-	0.1	0.2	
$t_{c(on)}$				-	0.15	0.3	
t_{off}				-	1.1	2.0	
$t_{c(off)}$				-	0.2	0.4	
I_{CES}	Collector-Emitter Cut-off Current	V_{CE}=V_{CES}, V_D=15V , V_{CIN}=15V (Fig. 5)	T_j=25°C	-	-	1	mA
			T_j=125°C	-	-	10	

CONVERTER PART

Symbol	Parameter	Conditions		Limits			Unit
				Min.	Typ.	Max.	
V_{CEsat}	Collector-Emitter Saturation Voltage	V_D=15V, I_C=50A V_{CIN}=0V, Pulsed (Fig. 1)	T_j=25°C	-	2.2	2.7	V
			T_j=125°C	-	2.2	2.7	
V_{EC}	Emitter-Collector Voltage	I_E=50A, V_D=15V, V_{CIN}= 15V (Fig. 2)		-	2.4	3.3	V
V_{FM}	Di Forward Voltage	I_F=50A		-	2.4	3.3	V
t_{on}	Switching Time	V_D=15V, V_{CIN}=0V↔15V V_{CC}=300V, I_C=50A T_j=125°C Inductive Load (Fig. 3,4)		0.1	0.5	1.2	μs
t_{rr}				-	0.1	0.2	
$t_{c(on)}$				-	0.15	0.3	
t_{off}				-	1.1	2.0	
$t_{c(off)}$				-	0.2	0.4	
I_{CES}	Collector-Emitter Cut-off Current	V_{CE}=V_{CES}, V_D=15V , V_{CIN}=15V (Fig. 5)	T_j=25°C	-	-	1	mA
			T_j=125°C	-	-	10	

CONTROL PART

Symbol	Parameter	Conditions		Limits			Unit
				Min.	Typ.	Max.	
I_D	Circuit Current	V_D=15V, V_{CIN}=15V	V_{N1}-V_{NC}	-	6.5	12	mA
			$V_{•P1}$-$V_{•PC}$	-	1.6	4.0	
$V_{th(ON)}$	Input ON Threshold Voltage	Applied between : UP-V_{UPC}, VP-V_{VPC}, UN·VN·WN -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≤T_j≤125°C, V_D=15V (Fig. 3, 6)		75	-	-	A
$t_{off(SC)}$	Short Circuit Current Delay Time	V_D=15V (Fig. 3, 6)		-	0.2	-	μs
OT	Over Temperature Protection	Detect Temperature of IGBT chip	Trip level	135	-	-	°C
$OT_{(hys)}$			Hysteresis	-	20	-	
UV_t	Supply Circuit Under-Voltage Protection	-20≤Tj≤125°C	Trip level	11.5	12.0	12.5	V
UV_r			Reset level	-	12.5	-	
$I_{FO(H)}$	Fault Output Current	V_D=15V, V_{FO}=15V (Note.2)		-	-	0.01	mA
$I_{FO(L)}$				-	10	15	
t_{FO}	Fault Output Pulse Width	V_D=15V (Note.2)		1.0	1.8	-	ms

Note.2: Fault output is given only when the internal SC, OT & UV protections schemes of either upper or lower arm device operate to protect it.

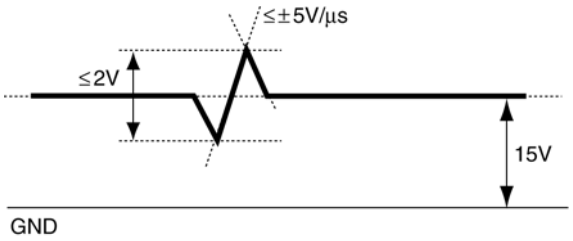
MECHANICAL RATINGS AND CHARACTERISTICS

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M_s	Mounting Torque	Mounting part screw : M4	1.4	1.65	1.9	N·m
m	Weight	-	-	135	-	g

RECOMMENDED CONDITIONS FOR USE

Symbol	Parameter	Conditions	Recommended value	Unit
V_{CC}	Supply Voltage	Applied across P-N terminals	≤ 450	V
V_D	Control Supply Voltage	Applied between : V_{UP1}-V_{UPC}, V_{VP1}-V_{VPC}, V_{N1}-V_{NC} (Note.3)	15.0±1.5	V
$V_{CIN(ON)}$	Input ON Voltage	Applied between : UP-V_{UPC}, VP-V_{VPC}, UN·VN·WN -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)	≥ 2.0	μs
I_O	Module Operating Current	RMS	≤ 20	A

Note.3: With ripple satisfying the following conditions: dv/dt swing ≤ ±5V/μs, Variation ≤ 2V 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.)

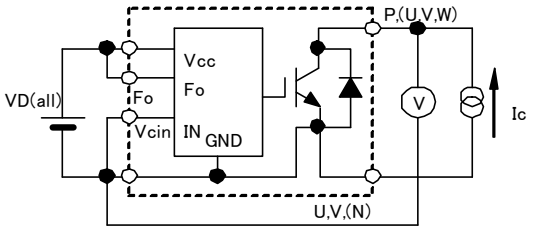


Fig. 1 V_{CEsat} Test

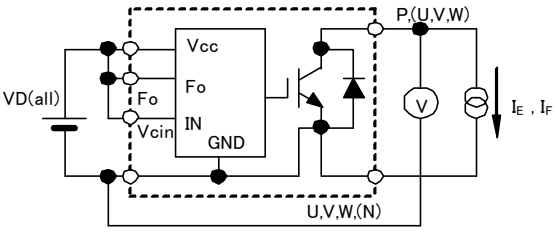


Fig. 2 V_{EC}, V_{FM} Test

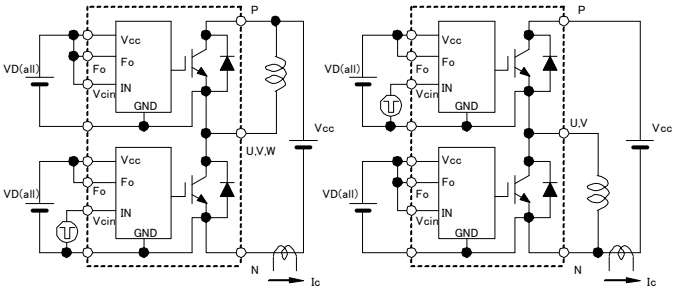


Fig. 3 Switching time and SC test circuit

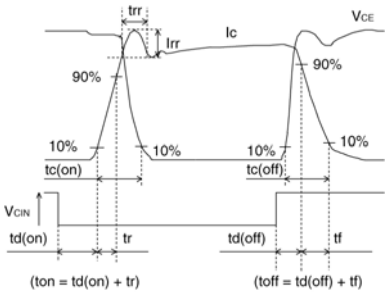


Fig. 4 Switching time test waveform

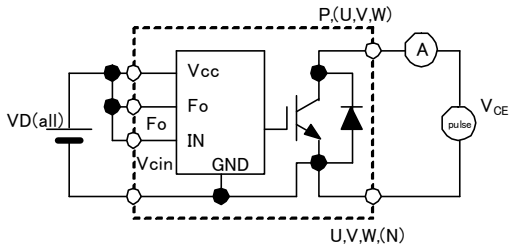


Fig. 5 I_{CES} Test

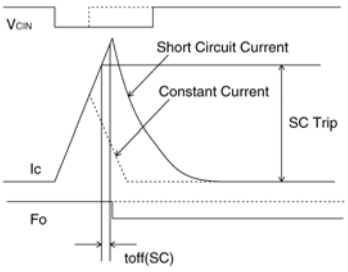
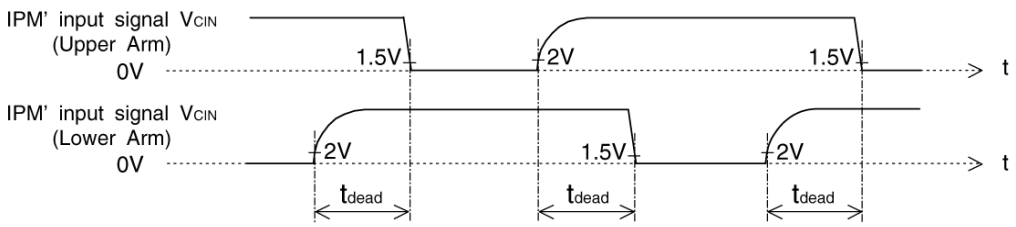


Fig. 6 SC test waveform



1.5V: Input on threshold voltage Vth(on) typical value, 2V: Input off threshold voltage Vth(off) typical value

Fig. 7 Dead time measurement point example

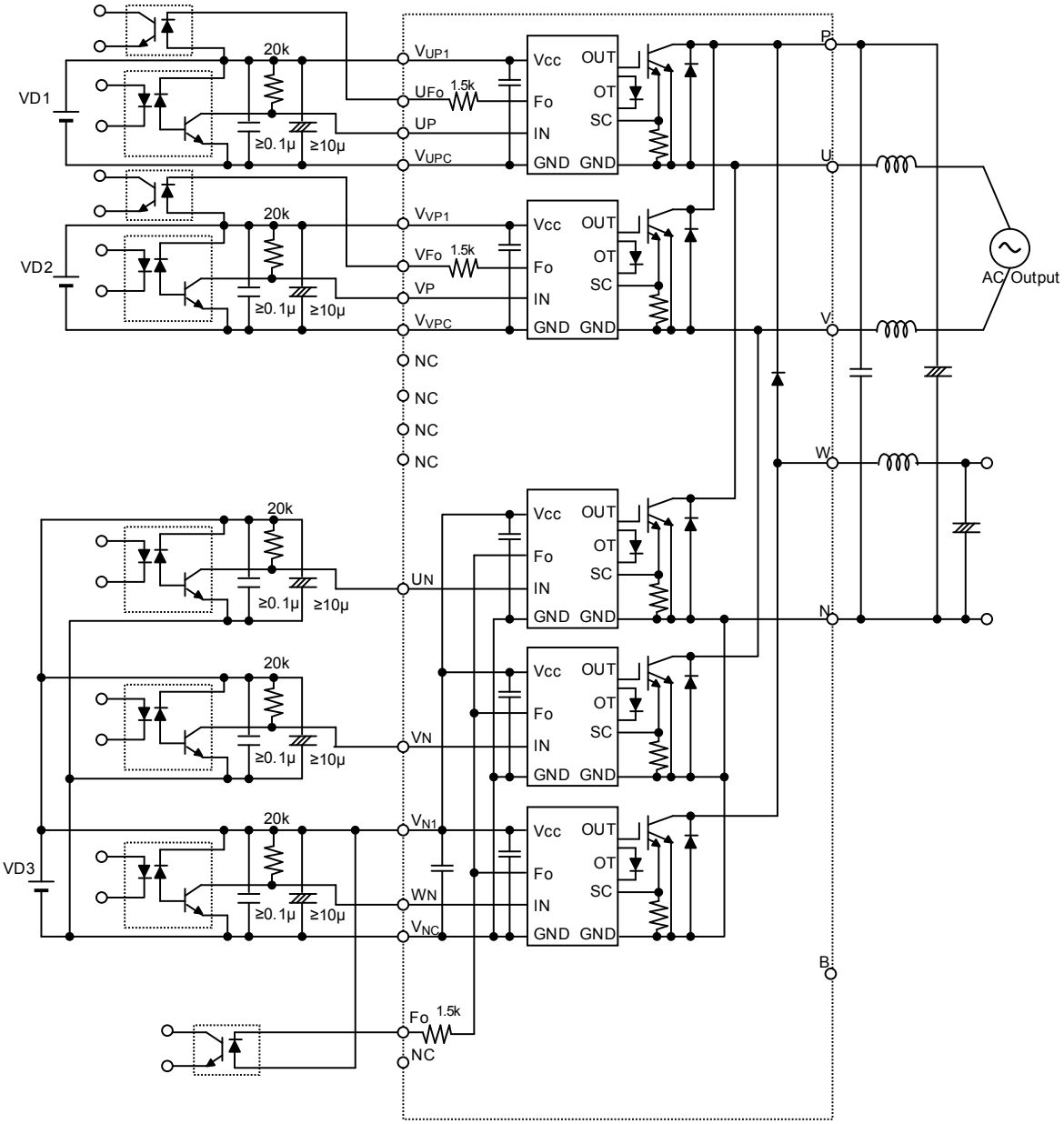


Fig. 8 Application Example Circuit

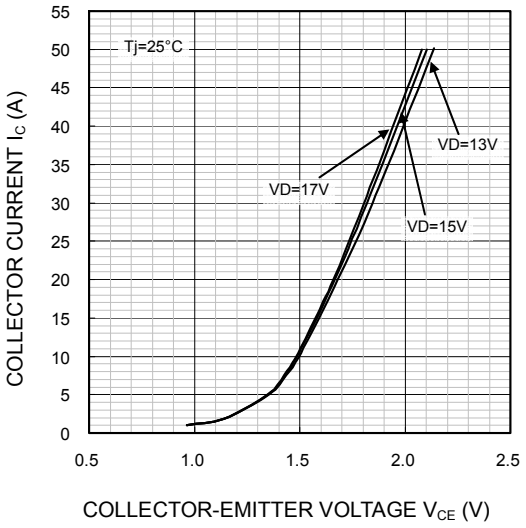
NOTES FOR STABLE AND SAFE OPERATION ;

- 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} ≤ 0.8μs, Use High CMR type.
- Slow switching opto-coupler: CTR > 100%
- Use 3 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.

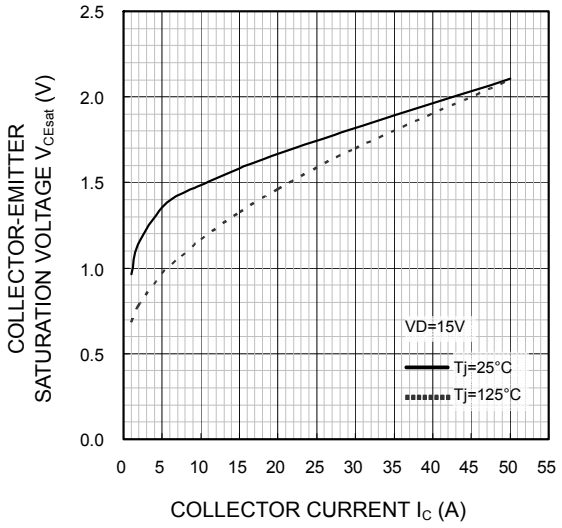
PERFORMANCE CURVES

OUTPUT CHARACTERISTICS

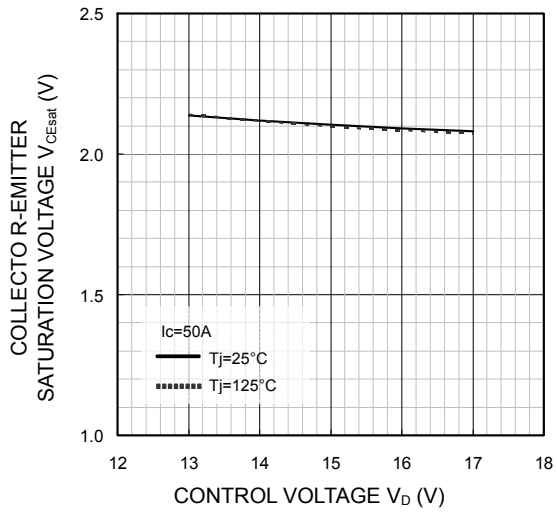
(TYPICAL)
INVERTER PART & CONVERTER PART



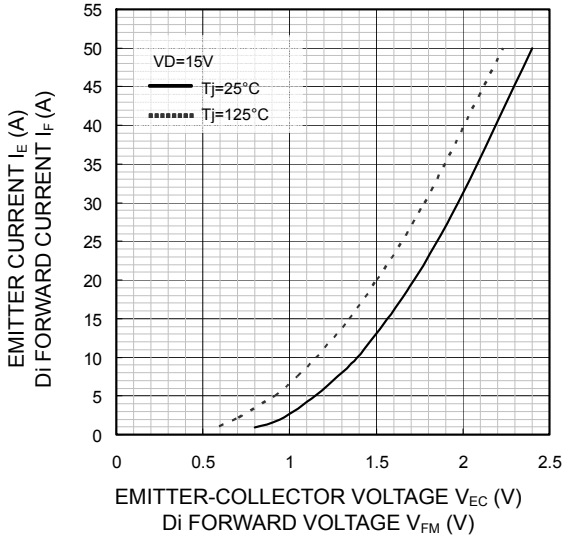
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. Ic) CHARACTERISTICS (TYPICAL) INVERTER PART & CONVERTER PART



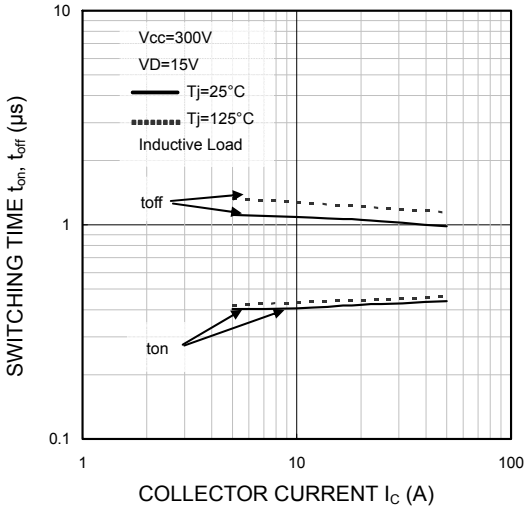
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. V_D) CHARACTERISTICS (TYPICAL) INVERTER PART & CONVERTER PART



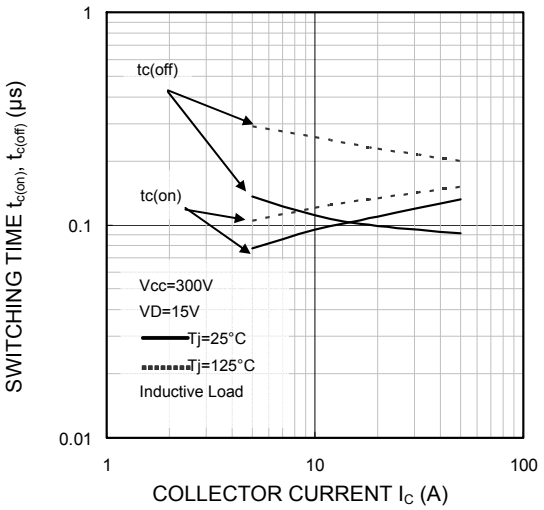
FREE WHEELING DIODE & DIODE FORWARD CHARACTERISTICS (TYPICAL) INVERTER PART & CONVERTER PART



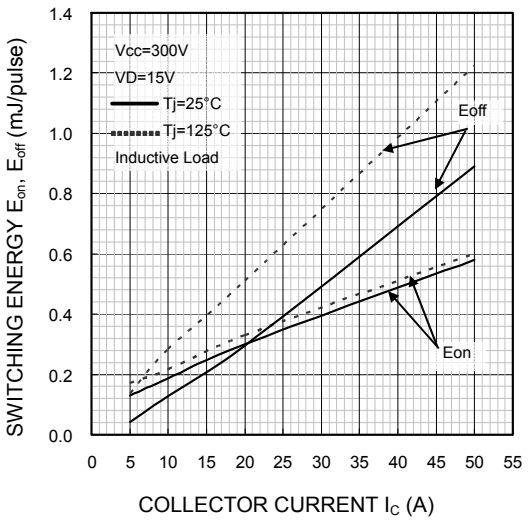
SWITCHING TIME (t_{on}, t_{off}) CHARACTERISTICS (TYPICAL) INVERTER PART & CONVERTER PART



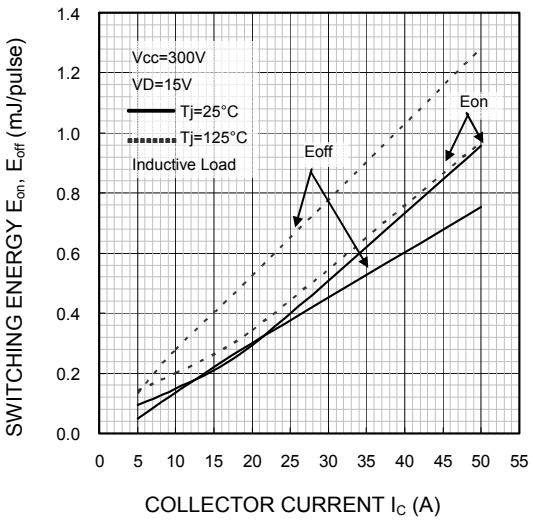
SWITCHING TIME ($t_{c(on)}$, $t_{c(off)}$) CHARACTERISTICS (TYPICAL) INVERTER PART & CONVERTER PART



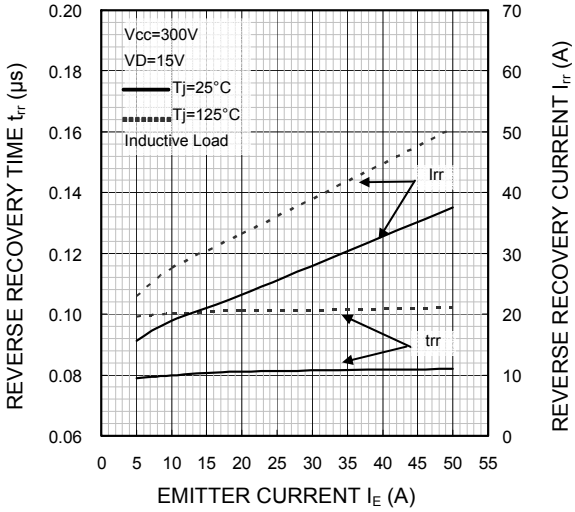
SWITCHING ENERGY CHARACTERISTICS (TYPICAL) INVERTER PART



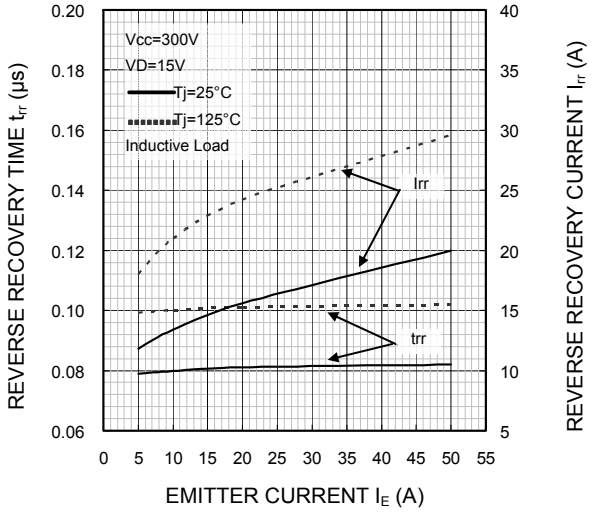
SWITCHING ENERGY CHARACTERISTICS (TYPICAL) CONVERTER PART



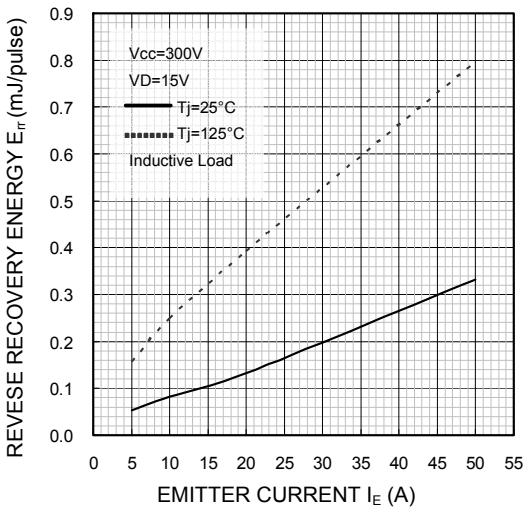
**FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)
INVERTER PART**



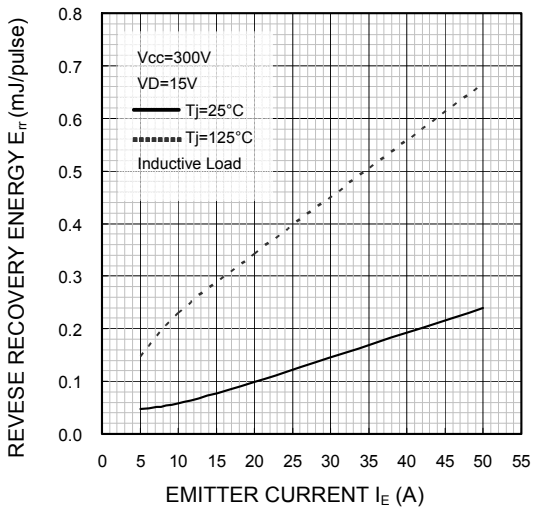
**FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)
CONVERTER PART**



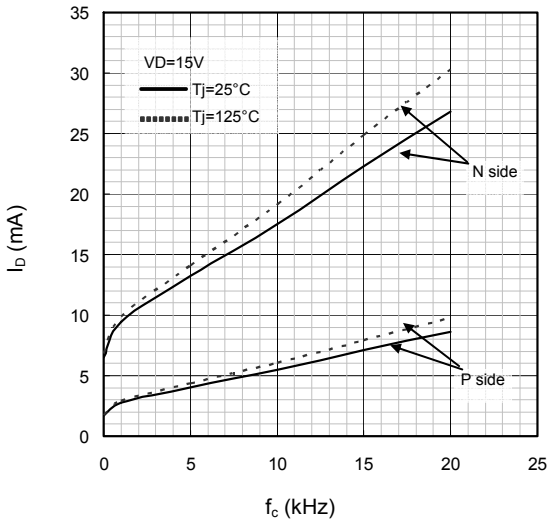
**FREE WHEELING DIODE
REVERSE RECOVERY ENERGY
CHARACTERISTICS
(TYPICAL)
INVERTER PART**



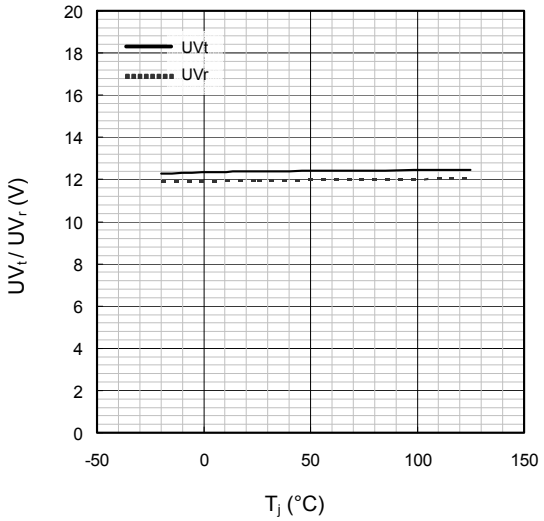
**FREE WHEELING DIODE
REVERSE RECOVERY ENERGY
CHARACTERISTICS
(TYPICAL)
CONVERTER PART**



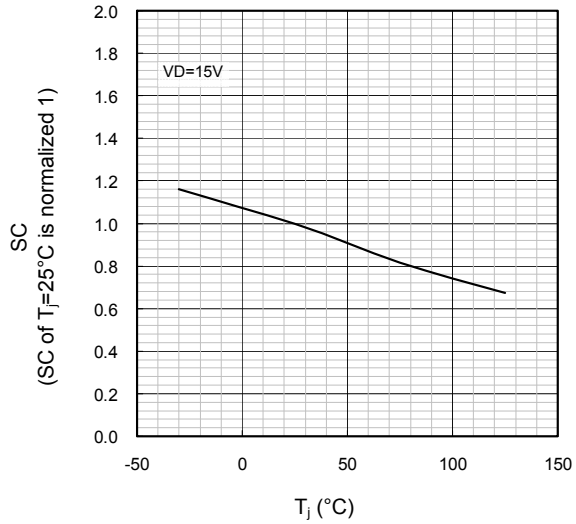
I_D VS. f_c CHARACTERISTICS (TYPICAL)



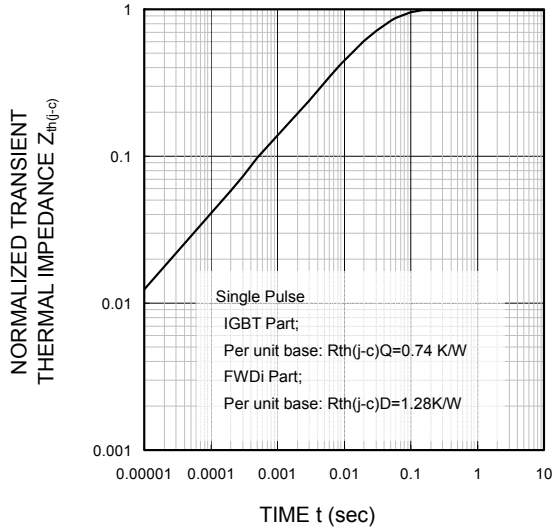
UV TRIP LEVEL VS. T_j CHARACTERISTICS (TYPICAL)



SC TRIP LEVEL VS. T_j CHARACTERISTICS (TYPICAL) INVERTER PART & CONVERTER PART



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS INVERTER PART



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS CONVERTER PART