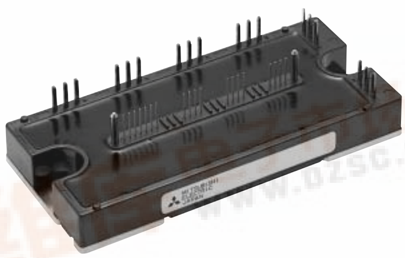
MITSUBISHI <INTELLIGENT POWER MODULES>

PM50B5LB060

FLAT-BASE TYPE
INSULATED PACKAGE

PM50B5LB060



FEATURE

a) Adopting new 5th generation IGBT (CSTBT™) chip, which performance is improved by 1μm fine rule process.
   For example, typical $V_{ce(sat)}$=1.55V @Tj=125°C
b) Over-temperature protection by detecting Tj of the CSTBT™ chips and error output is possible from all each conservation upper and lower arm of IPM.
c) New small package
   Reduce the package size by 10%, thickness by 22% from S-DASH series.

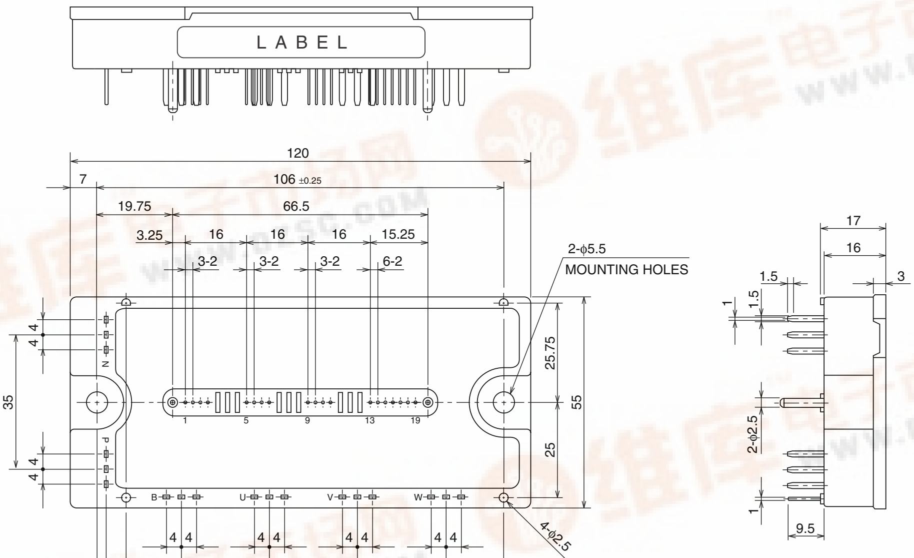
- 2φ 50A, 600V Current-sense IGBT type inverter
- 50A, 600V Current-sense Chopper IGBT
- Monolithic gate drive & protection logic
- Detection, protection & status indication circuits for, short-circuit, over-temperature & under-voltage (P-Fo available from upper arm devices)
- UL Recognized Yellow Card No.E80276(N)
  File No.E80271

APPLICATION

Photo voltaic power conditioner

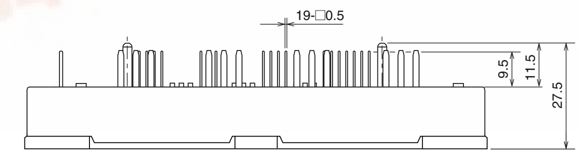
PACKAGE OUTLINES

Dimensions in mm

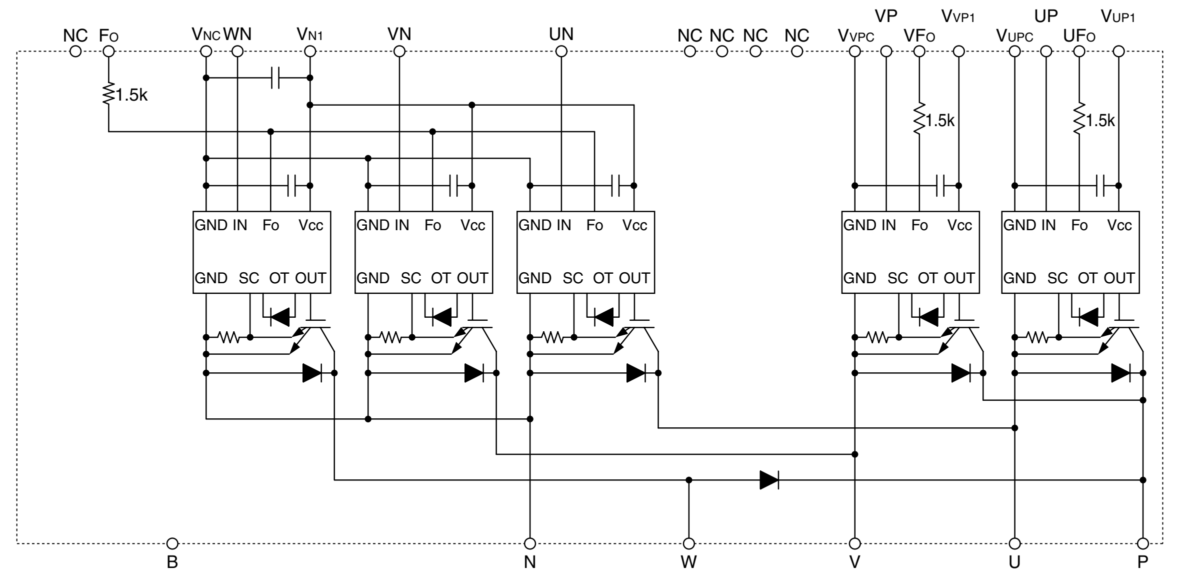


Terminal code

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



INTERNAL FUNCTIONS BLOCK DIAGRAM



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

INVERTER PART

Symbol	Parameter	Condition	Ratings	Unit
V_{CES}	Collector-Emitter Voltage	V_D = 15V, V_{CIN} = 15V	600	V
$\pm I_C$	Collector Current	T_C = 25°C	50	A
$\pm I_{CP}$	Collector Current (Peak)	T_C = 25°C	100	A
P_C	Collector Dissipation	T_C = 25°C	131	W
T_j	Junction Temperature		–20 ~ +150	°C

CONVERTER PART

Symbol	Parameter	Condition	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_{CP}	Collector Current (Peak)	T_C = 25°C	100	A
P_C	Collector Dissipation	T_C = 25°C (Note-1)	131	W
I_F	FWDi Forward Current	T_C = 25°C	50	A
$V_{R(DC)}$	FWDi Rated DC Reverse Voltage	T_C = 25°C	600	V
T_j	Junction Temperature		–20 ~ +150	°C

CONTROL PART

Symbol	Parameter	Condition	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 : U_P-V_{UPC}, V_P-V_{VPC} 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}, F_O-V_{NC}	20	V
I_{FO}	Fault Output Current	Sink current at U_{FO}, V_{FO}, F_O terminals	20	mA

PM50B5LB060

FLAT-BASE TYPE
INSULATED PACKAGE

TOTAL SYSTEM

Symbol	Parameter	Condition	Ratings	Unit
$V_{CC(PROT)}$	Supply Voltage Protected by SC	V_D = 13.5 ~ 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_{iso}	Isolation Voltage	60Hz, Sinusoidal, Charged part to Base, AC 1 min.	2500	V_{rms}

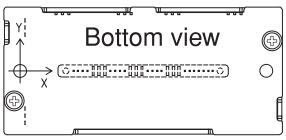
THERMAL RESISTANCES

Symbol	Parameter	Condition	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Junction to case Thermal Resistances	Inverter IGBT part (per 1/4 module) (Note-1)	—	—	0.95	°C/W
$R_{th(j-c)F}$		Inverter FWDi part (per 1/4 module) (Note-1)	—	—	1.61	
$R_{th(j-c)Q}$		Converter IGBT part (Note-1)	—	—	0.95	
$R_{th(j-c)F}$		Converter FWDi upper part (Note-1)	—	—	0.95	
$R_{th(j-c)F}$		Converter FWDi lower part (Note-1)	—	—	1.61	
$R_{th(c-f)}$	Contact Thermal Resistance	Case to fin, (per 1 module) Thermal grease applied (Note-1)	—	—	0.038	

(Note-1) Tc (under the chip) measurement point is below.

(unit : mm)

arm / axis	UP		VP		WP	UN		VN		WN	
	IGBT	FWDi	IGBT	FWDi	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi
X	32.7	32.2	62.8	63.3	82.9	38.8	39.3	53.0	52.5	75.6	75.1
Y	–10.0	–0.2	–8.8	–2.0	–8.4	8.0	0.8	3.8	–2.8	3.8	–2.8



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

Symbol	Parameter	Condition		Limits			Unit
				Min.	Typ.	Max.	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_D = 15V, I_C = 50A, V_{CIN} = 0V (Fig. 1)	T_j = 25°C	—	1.7	2.3	V
			T_j = 125°C	—	1.55	2.0	
V_{EC}	FWDi Forward Voltage	–I_C = 50A, V_D = 15V, V_{CIN} = 15V (Fig. 2)		—	2.2	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)		0.3	0.7	1.4	μs
t_{rr}				—	0.1	0.2	
$t_{c(on)}$				—	0.2	0.4	
t_{off}				—	0.9	1.8	
$t_{c(off)}$				—	0.2	0.4	
I_{CES}	Collector-Emitter Cutoff Current	V_{CE} = V_{CES}, V_{CIN} = 15V (Fig. 5)	T_j = 25°C	—	—	1	mA
			T_j = 125°C	—	—	10	

CONVERTER PART

Symbol	Parameter	Condition		Limits Min.	Limits Typ.	Limits Max.	Unit
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_D = 15V, I_C = 50A, V_{CIN} = 0V, Pulsed (Fig. 1)	T_j = 25°C	—	1.7	2.3	V
			T_j = 125°C	—	1.55	2.0	
V_{EC}	FWDi Forward Voltage	$-I_C$ = 50A, V_{CIN} = 15V, V_D = 15V (Fig. 2)		—	2.2	3.3	V
V_{FM}	Forward Voltage	I_F = 50A		—	1.9	3.0	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)		0.3	0.7	1.4	μs
t_{rr}				—	0.1	0.2	
$t_{c(on)}$				—	0.2	0.4	
t_{off}				—	0.9	1.8	
$t_{c(off)}$				—	0.2	0.4	
I_{CES}	Collector-Emitter Cutoff Current	V_{CE} = V_{CES}, V_D = 15V (Fig. 5)	T_j = 25°C	—	—	1	mA
			T_j = 125°C	—	—	10	

CONTROL PART

Symbol	Parameter	Condition		Limits Min.	Limits Typ.	Limits Max.	Unit
I_D	Circuit Current	V_D = 15V, V_{CIN} = 15V	V_{N1}-V_{NC}	—	15	25	mA
			V_{*P1}-V_{*PC}	—	5	10	
$V_{th(ON)}$	Input ON Threshold Voltage	Applied between : U_P-V_{UPC}, V_P-V_{VPC}, U_N • V_N • W_N-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	$-20 \le T_j \le 125$°C, V_D = 15V (Fig. 3,6)	Inverter part	100	—	—	A
			Converter part	100	—	—	
$t_{off(SC)}$	Short Circuit Current Delay Time	V_D = 15V (Fig. 3,6)		—	0.2	—	μs
OT	Over Temperature Protection	V_D = 15V, Detect T_j of IGBT chip	Trip level	135	145	—	°C
OT_r			Reset level	—	125	—	
UV	Supply Circuit Under-Voltage Protection	$-20 \le T_j \le 125$°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}	Minimum 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	Condition	Limits Min.	Limits Typ.	Limits Max.	Unit
—	Mounting torque	Mounting part screw : M5	2.5	3.0	3.5	N • m
—	Weight	—	—	340	—	g

RECOMMENDED CONDITIONS FOR USE

Symbol	Parameter	Condition	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 ± 1.5	V
$V_{CIN(ON)}$	Input ON Voltage	Applied between : U_P-V_{UPC}, V_P-V_{VPC}, U_N • V_N • W_N-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

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

PRECAUTIONS FOR TESTING

1. Before appling any control supply voltage (V_D), the input terminals should be pulled up by resistores, 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.)

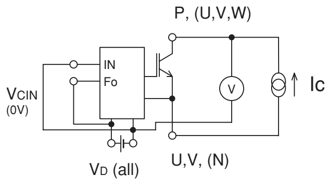


Fig. 1 $V_{CE(sat)}$ Test

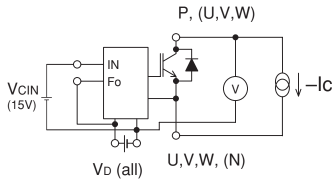


Fig. 2 V_{EC}, (V_{FM}) Test

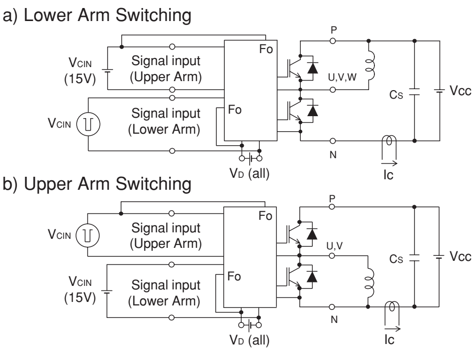


Fig. 3 Switching Time and SC Test Circuit

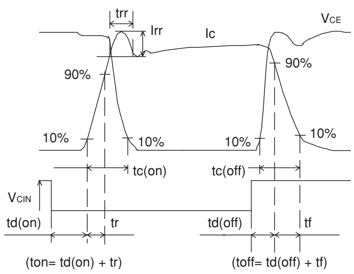


Fig. 4 Switching Time Test Waveform

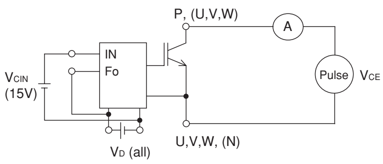


Fig. 5 I_{CES} Test

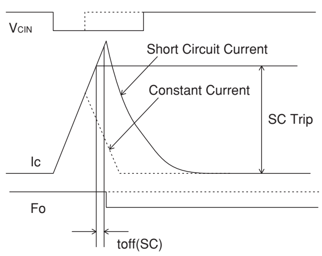
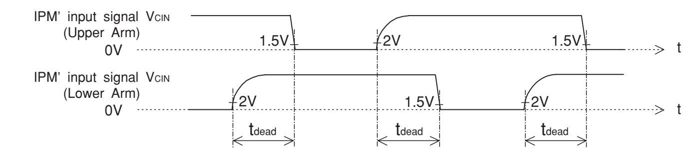


Fig. 6 SC Test Waveform



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

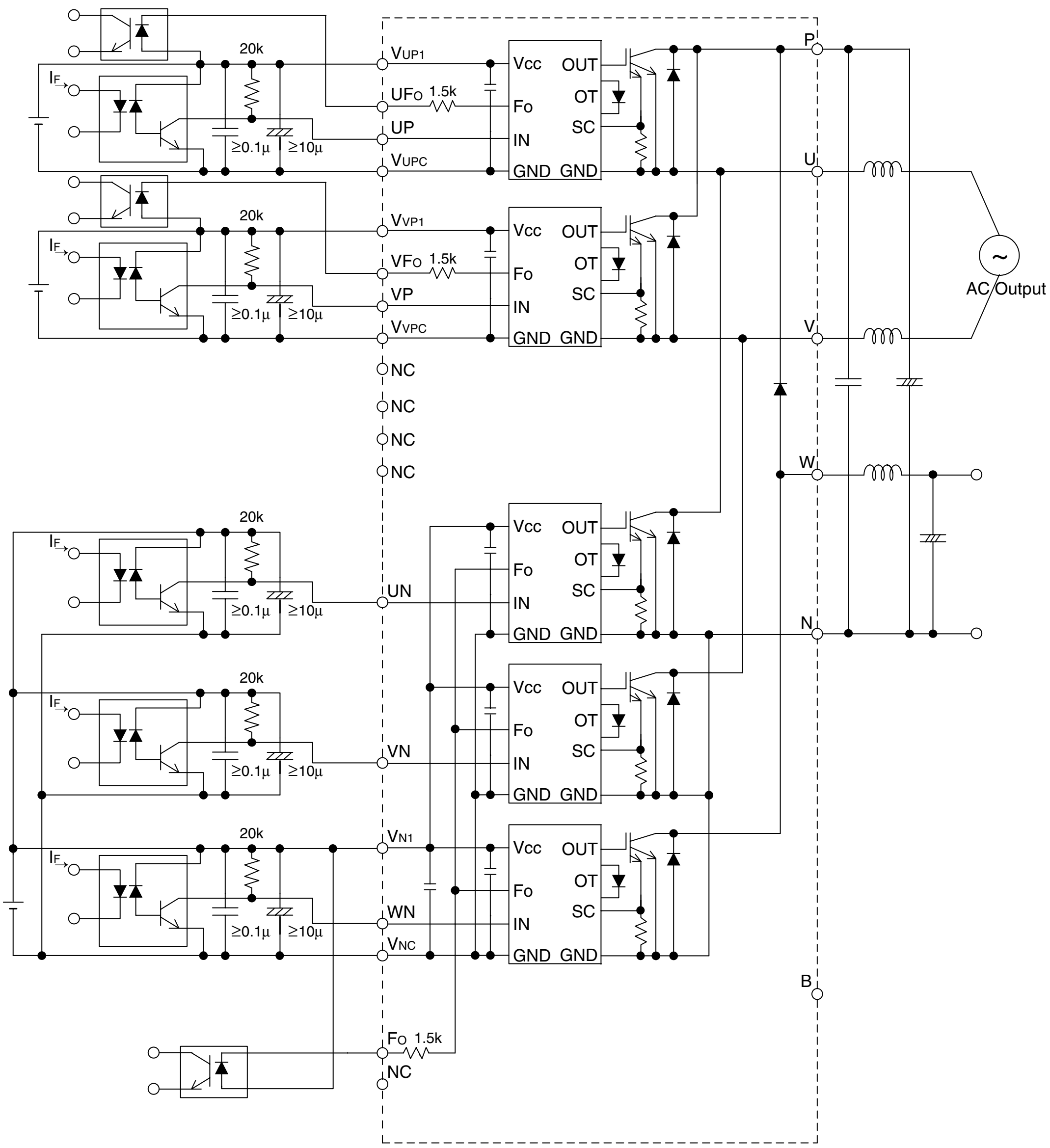


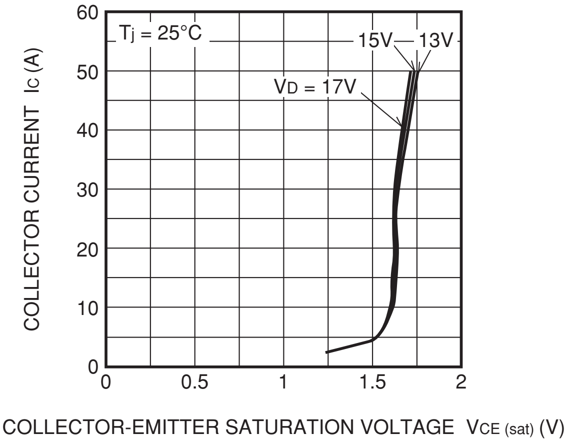
Fig. 8 Application Example Circuit

NOTES FOR STABLE AND SAFE OPERATION ;

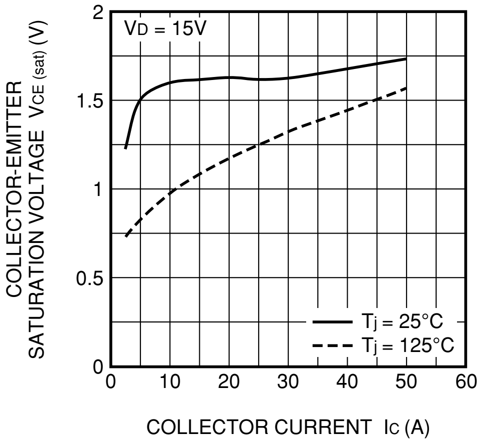
- Design the PCB pattern to minimize wiring length between opto-coupler and IPM's input terminal, and also to minimize the stray capacity between the input and output wirings of opto-coupler.
- Connect low impedance capacitor between the Vcc and GND terminal of each fast switching opto-coupler.
- Fast switching opto-couplers: t_{PLH}, $t_{PHL} \leq 0.8\mu s$, 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 (INVERTER PART)

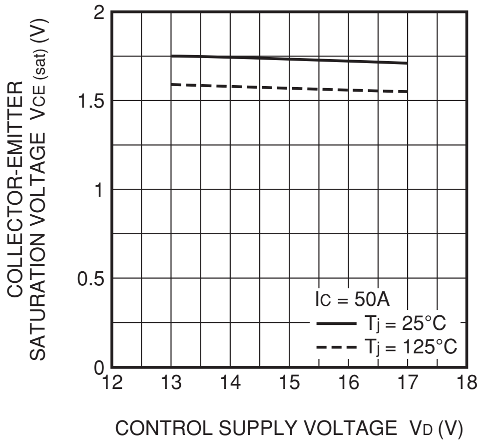
OUTPUT CHARACTERISTICS (TYPICAL)



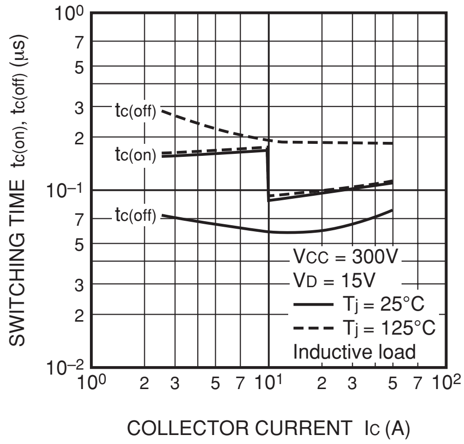
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. Ic) CHARACTERISTICS (TYPICAL)



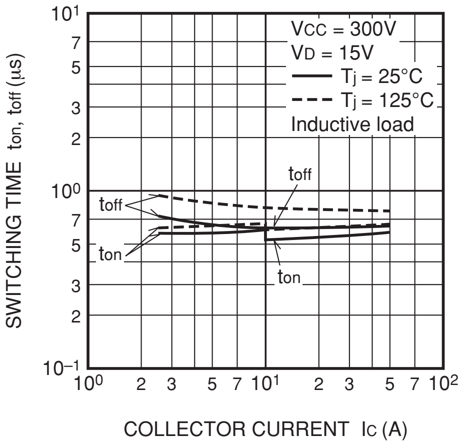
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. VD) CHARACTERISTICS (TYPICAL)



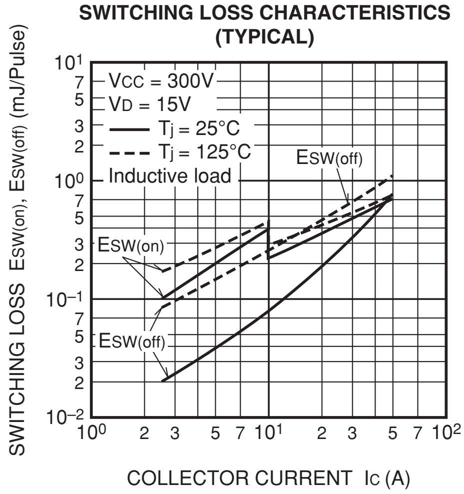
SWITCHING TIME CHARACTERISTICS (TYPICAL)



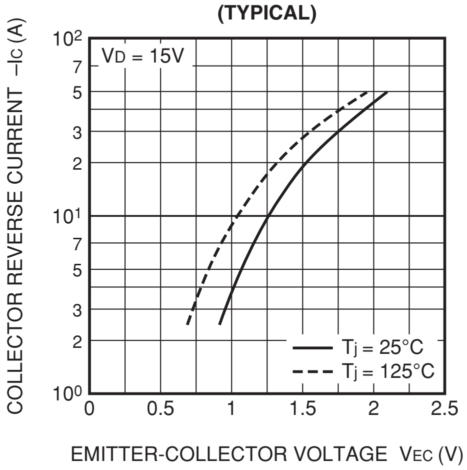
SWITCHING TIME CHARACTERISTICS (TYPICAL)



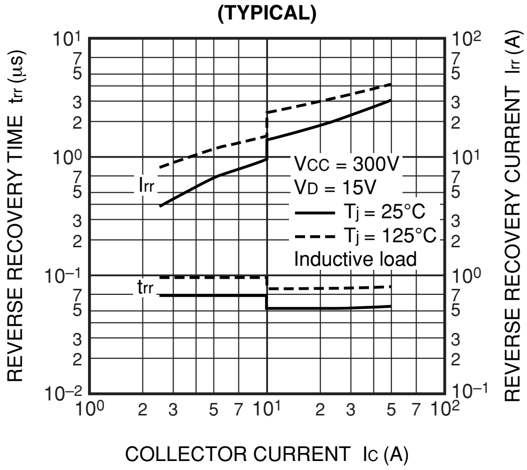
SWITCHING LOSS CHARACTERISTICS (TYPICAL)



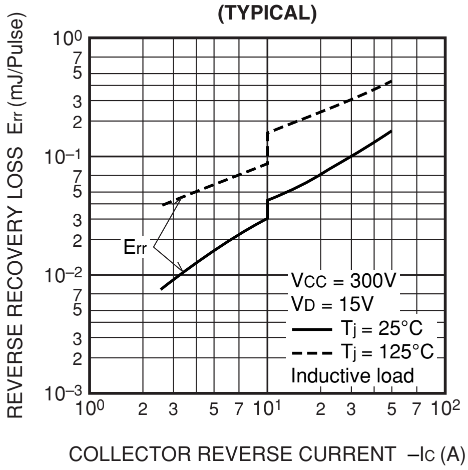
FWDi FORWARD VOLTAGE CHARACTERISTICS (TYPICAL)



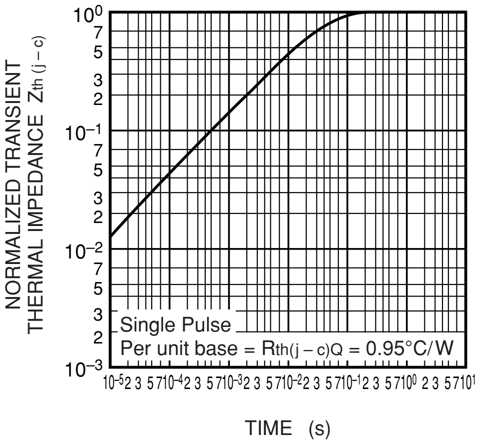
FWDi REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



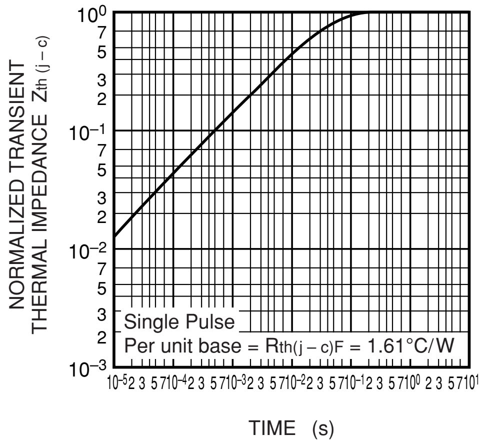
FWDi REVERSE RECOVERY LOSS CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT PART)

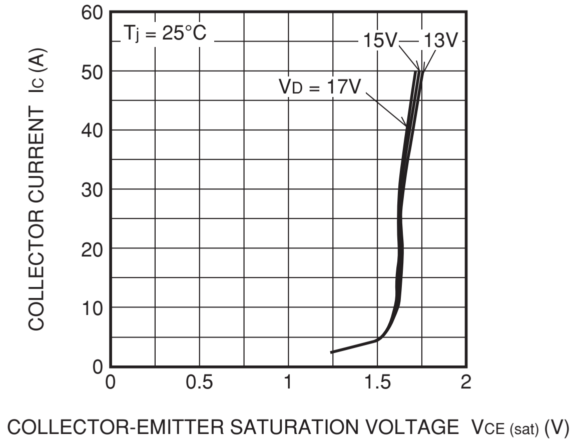


TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (FWDi PART)

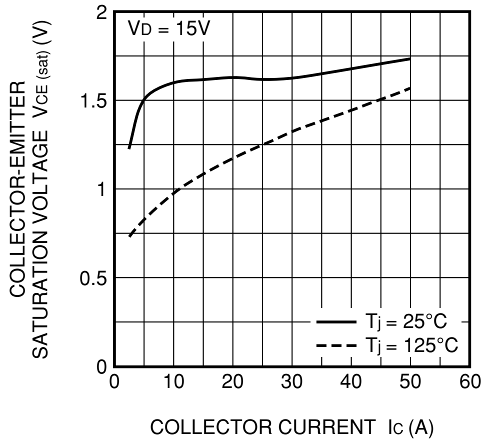


(CONVERTER PART)

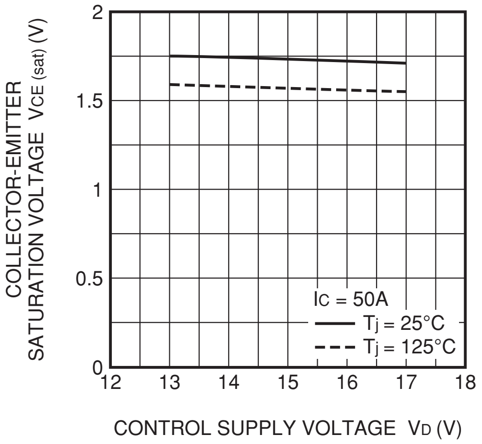
OUTPUT CHARACTERISTICS (TYPICAL)



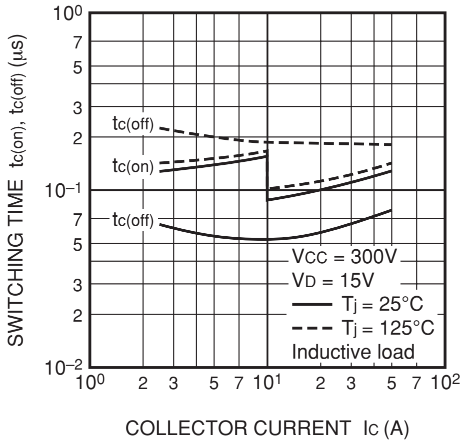
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. Ic) CHARACTERISTICS (TYPICAL)



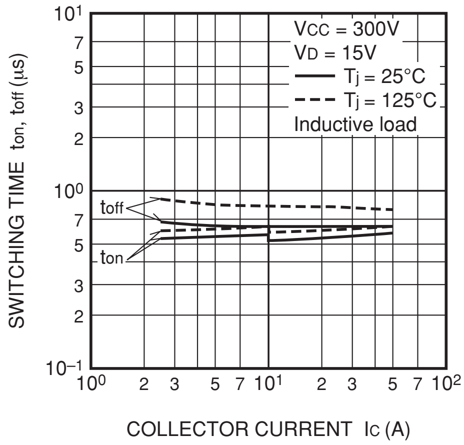
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. VD) CHARACTERISTICS (TYPICAL)



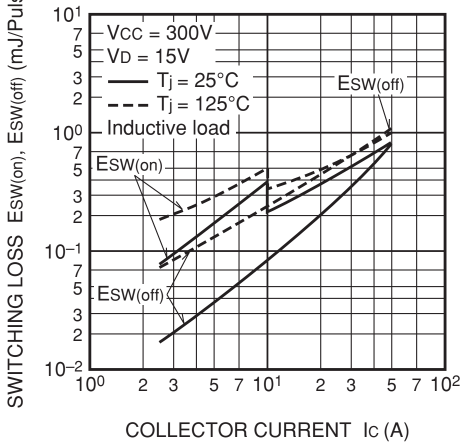
SWITCHING TIME CHARACTERISTICS (Lower Arm · TYPICAL)



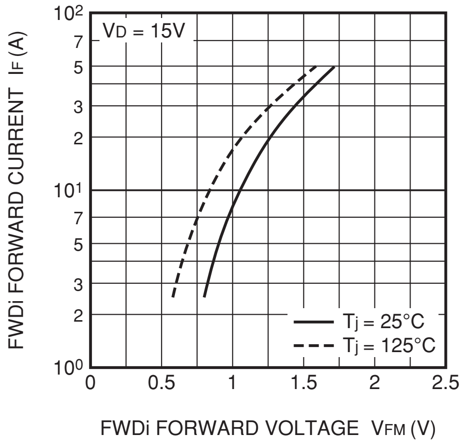
SWITCHING TIME CHARACTERISTICS (Lower Arm · TYPICAL)



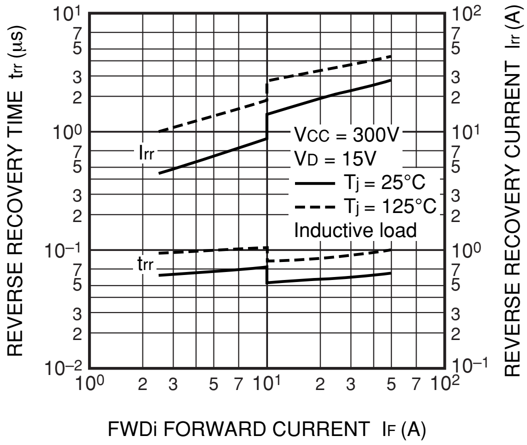
SWITCHING LOSS CHARACTERISTICS (Lower Arm · TYPICAL)



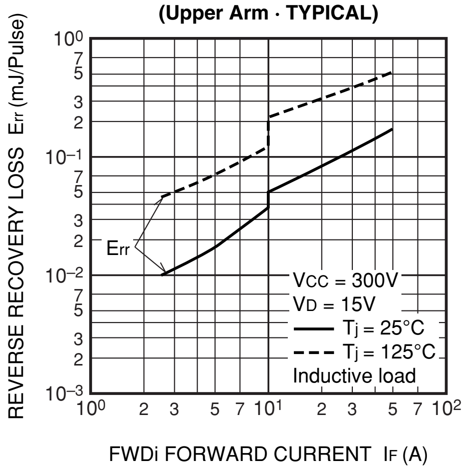
FWDi FORWARD VOLTAGE CHARACTERISTICS (Upper Arm · TYPICAL)



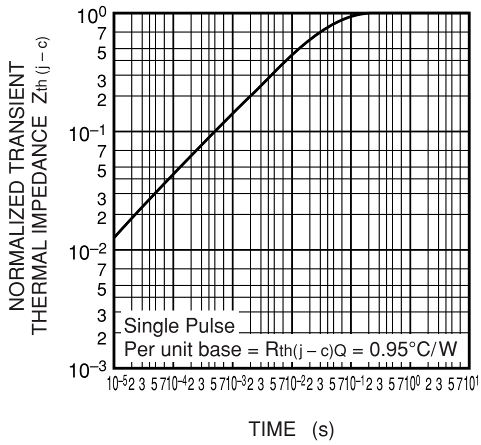
FWDi REVERSE RECOVERY CHARACTERISTICS (Upper Arm · TYPICAL)



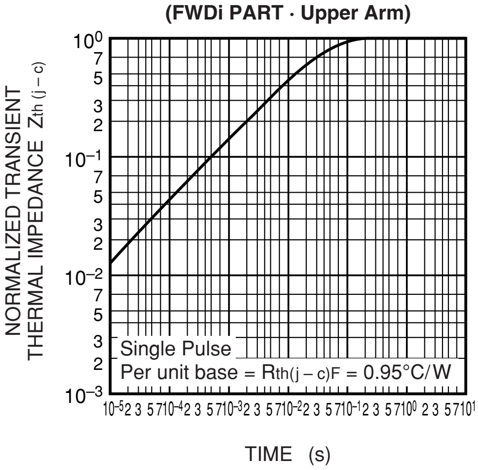
FWDi REVERSE RECOVERY LOSS CHARACTERISTICS (Upper Arm · TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT PART)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (FWDi PART · Upper Arm)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (FWDi PART · Lower Arm)