MITSUBISHI <INTELLIGENT POWER MODULES>

PM100CS1D120

FLAT-BASE TYPE
INSULATED PACKAGE

PM100CS1D120

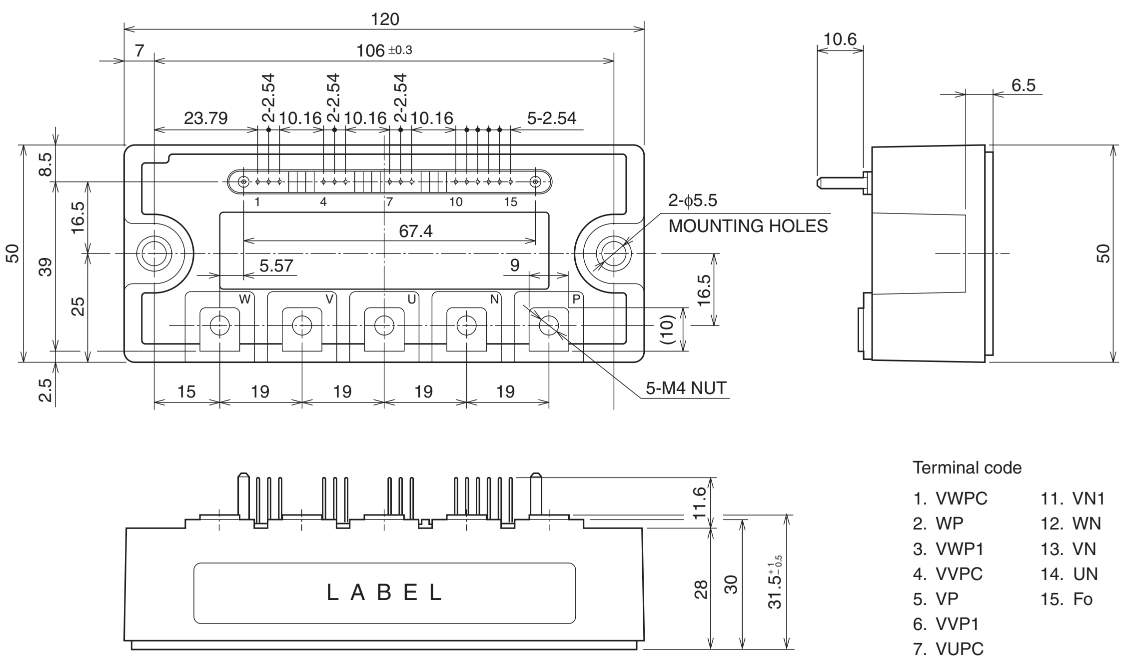
FEATURE
Inverter + Drive & Protection IC

- 3 phase 100A/1200V CSTBT^{TM}
  (The Current senser and the thermal senser with a build-in CSTBT^{TM}.)
- Monolithic gate drive & protection logic
- Detection, protection & status indication circuits for, short-circuit, over-temperature & under-voltage

APPLICATION

General purpose inverter, servo drives and other motor controls

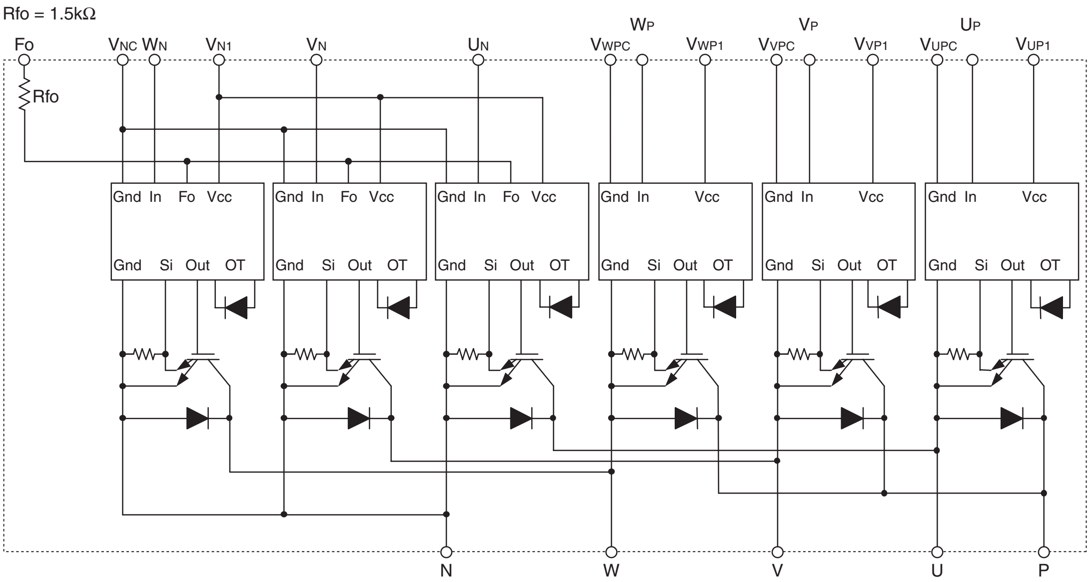
PACKAGE OUTLINES **Dimensions in mm**



Terminal code

1. VWPC	11. VN1
2. WP	12. WN
3. VWP1	13. VN
4. VVPC	14. UN
5. VP	15. Fo
6. VVP1	
7. VUPC	
8. UP	
9. VUP1	
10. VNC	

INTERNAL FUNCTIONS BLOCK DIAGRAM



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

INVERTER PART

Symbol	Parameter	Condition	Ratings	Unit
V_{CES}	Collector-Emitter Voltage	V_D = 15V, V_{CIN} = 15V	1200	V
$\pm I_C$	Collector Current	T_C = 25°C (Note-1)	100	A
$\pm I_{CP}$	Collector Current (Peak)	T_C = 25°C	200	A
P_C	Collector Dissipation	T_C = 25°C (Note-1)	694	W
T_j	Junction Temperature		–20 ~ +150	°C

*: Tc measurement point is just under the chip.

CONTROL PART

Symbol	Parameter	Condition	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 : F_O-V_{NC}	20	V
I_{FO}	Fault Output Current	Sink current at F_O terminals	20	mA

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	800	V
$V_{CC(surge)}$	Supply Voltage (Surge)	Applied between : P-N, Surge value	1000	V
T_{stg}	Storage Temperature		–40 ~ +125	°C
V_{iso}	Isolation Voltage	60Hz, Sinusoidal, Charged part to Base, AC 1 min.	2500	V_{rms}

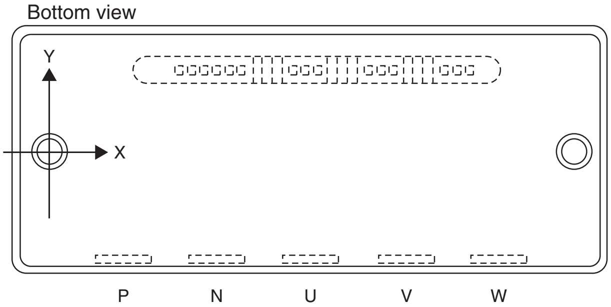
THERMAL RESISTANCES

Symbol	Parameter	Condition	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Junction to case Thermal Resistances	Inverter IGBT part (per 1 element) (Note-1)	—	—	0.18	°C/W
$R_{th(j-c)F}$		Inverter FWDi part (per 1 element) (Note-1)	—	—	0.27	
$R_{th(c-f)}$	Contact Thermal Resistance	Case to fin, (per 1 module) Thermal grease applied (Note-1)	—	—	0.046	

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

arm / axis	UP		VP		WP		UN		VN		WN	
	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi
X	21.4	21.4	65.0	65.0	90.0	90.0	36.0	36.0	51.0	51.0	76.0	76.0
Y	5.3	–4.6	5.3	–4.6	5.3	–4.6	–0.7	–10.6	–0.7	–10.6	–0.7	–10.6

Bottom view



ELECTRICAL CHARACTERISTICS (T_j = 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 = 100A V_{CIN} = 0V, Pulsed (Fig. 1)	T_j = 25°C	—	1.65	2.15	V
			T_j = 125°C	—	1.85	2.35	
V_{EC}	FWDi Forward Voltage	–I_C = 100A, V_D = 15V, V_{CIN} = 15V (Fig. 2)		—	2.50	3.50	V
t_{on}	Switching Time	V_D = 15V, V_{CIN} = 0V↔15V V_{CC} = 600V, I_C = 100A T_j = 125°C Inductive Load (Fig. 3,4)		0.3	0.65	2.0	μs
t_{rr}				—	0.20	0.8	
$t_{c(on)}$				—	0.35	1.0	
t_{off}				—	1.10	2.8	
$t_{c(off)}$				—	0.35	1.2	
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.	Typ.	Max.	Unit
I_D	Circuit Current	V_D = 15V, V_{CIN} = 15V	V_{N1}-V_{NC}	—	6	12	mA
			V_{*P1}-V_{*PC}	—	2	4	
$V_{th(ON)}$	Input ON Threshold Voltage	Applied between : U_P-V_{UPC}, V_P-V_{VPC}, W_P-V_{WPC}		1.2	1.5	1.8	V
$V_{th(OFF)}$	Input OFF Threshold Voltage	U_N • V_N • W_N-V_{NC}		1.7	2.0	2.3	
SC	Short Circuit Trip Level	$-20 \le T_j \le 125°C$, V_D = 15V (Fig. 3,6)		150	—	—	A
$t_{off(SC)}$	Short Circuit Current Delay Time	V_D = 15V (Fig. 3,6)		—	1.0	—	µs
OT	Over Temperature Protection	Detect Temperature of IGBT chip	Trip level	135	—	—	°C
$OT_{(hys)}$			Hysteresis	—	20	—	
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_{CIN} = 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 protection.
Fault output of SC, OT & UV protection operate by lower arms.
Fault output of SC protection given pulse.
Fault output of OT, UV protection given pulse while over trip level.

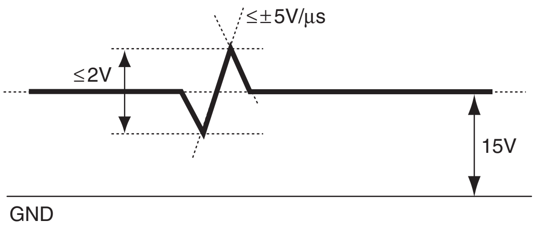
MECHANICAL RATINGS AND CHARACTERISTICS

Symbol	Parameter	Condition		Limits Min.	Typ.	Max.	Unit
—	Mounting torque	Mounting part	screw : M5	2.5	3.0	3.5	N • m
		Main terminal part	screw : M4	1.5	1.7	2.0	
—	Weight	—		—	400	—	g

RECOMMENDED CONDITIONS FOR USE

Symbol	Parameter	Condition	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} (Note-3)	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}	≤ 0.8	V
$V_{CIN(OFF)}$	Input OFF Voltage	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)	≥ 2.5	µs

(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.)

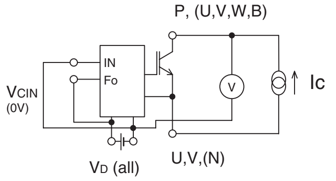


Fig. 1 $V_{CE(sat)}$ Test

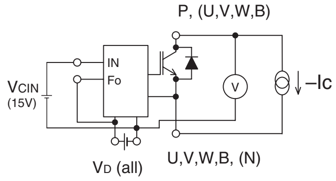


Fig. 2 V_{EC}, (V_{FM}) Test

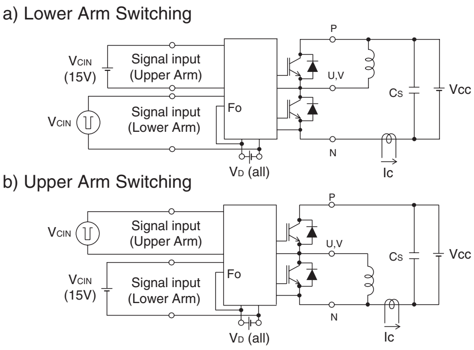


Fig. 3 Switching time and SC test circuit

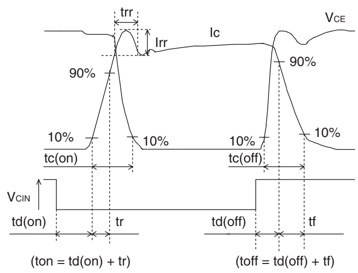


Fig. 4 Switching time test waveform

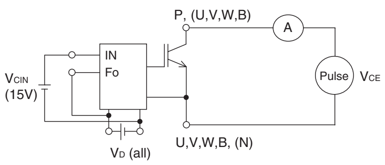


Fig. 5 I_{CES} Test

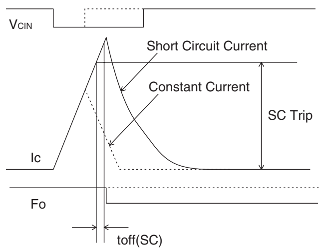
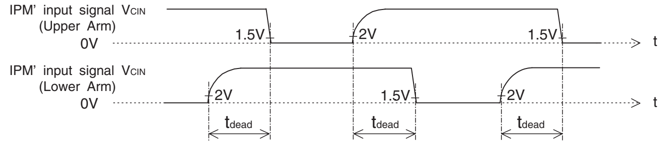
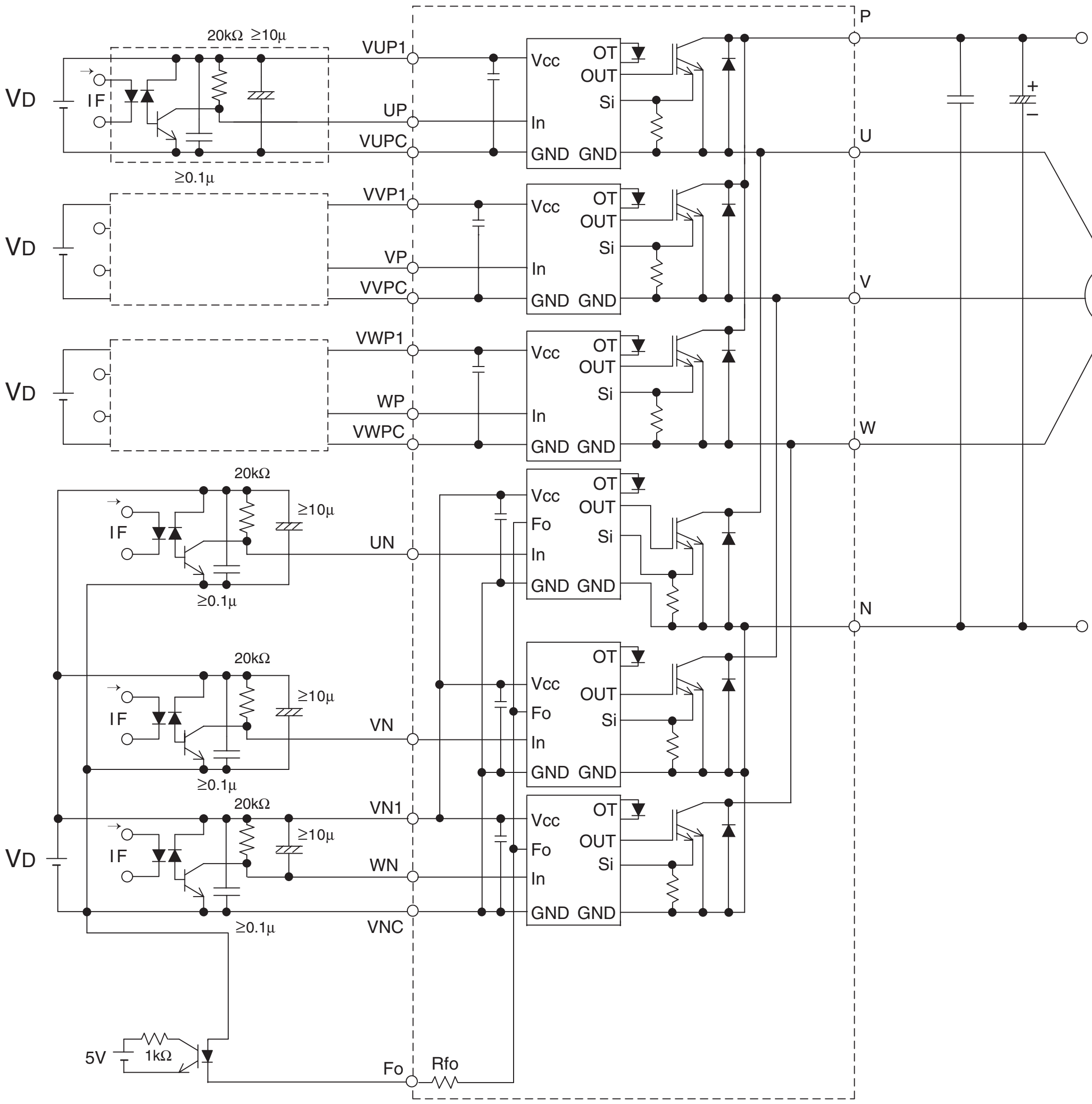


Fig. 6 SC test waveform



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



: Interface which is the same as U-phase

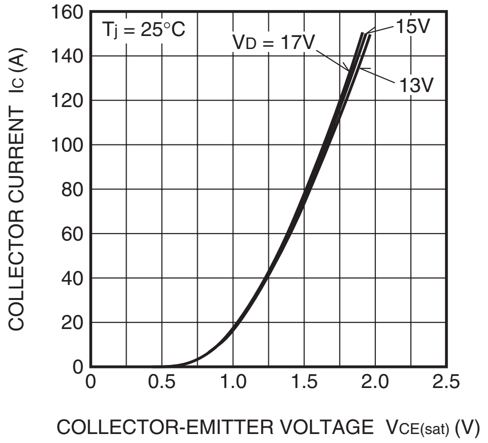
Fig. 8 Application Example Circuit

NOTES FOR STABLE AND SAFE OPERATION ;

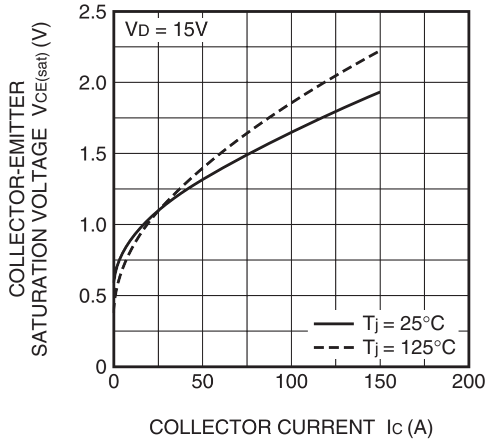
- Design the PCB pattern to minimize wiring length between opto-coupler and IPM's input terminal, and also to minimize the stray capacity between the input and output wirings of opto-coupler.
- Connect low impedance capacitor between the Vcc and GND terminal of each fast switching opto-coupler.
- Fast 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.
- Use line noise filter capacitor (ex. 4.7nF) between each input AC line and ground to reject common-mode noise from AC line and improve noise immunity of the system.

PERFORMANCE CURVES

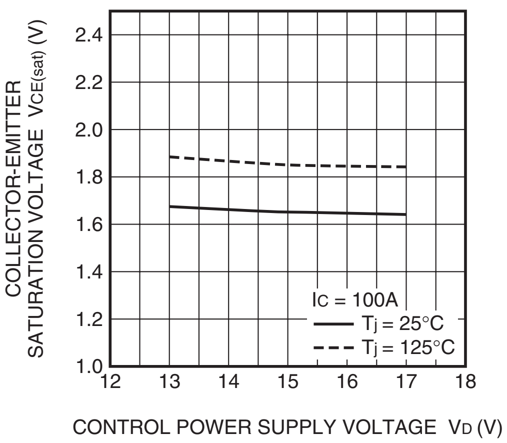
OUTPUT CHARACTERISTICS (TYPICAL)



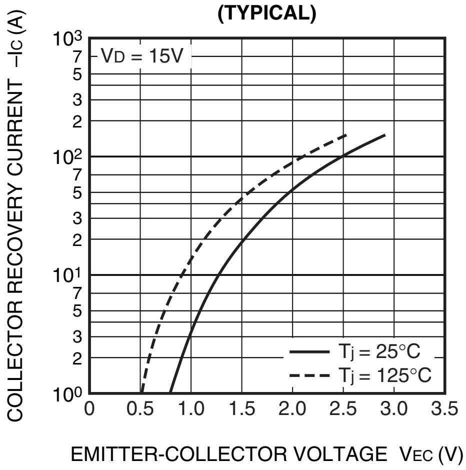
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. Ic) CHARACTERISTICS (TYPICAL)



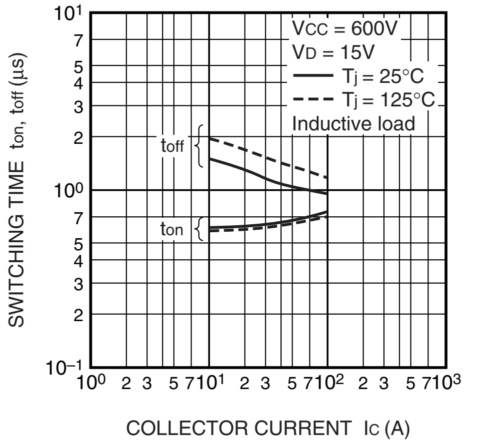
COLLECTOR-EMITTER SATURATION VOLTAGE (VS. VD) CHARACTERISTICS (TYPICAL)



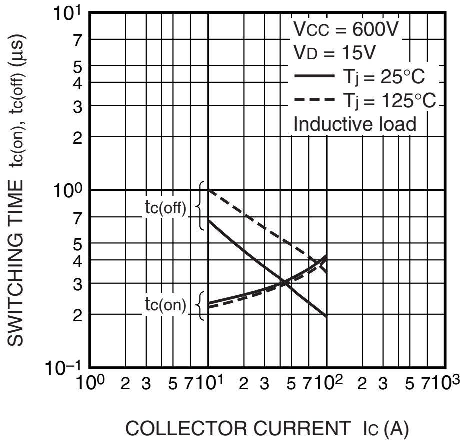
DIODE FORWARD CHARACTERISTICS (TYPICAL)



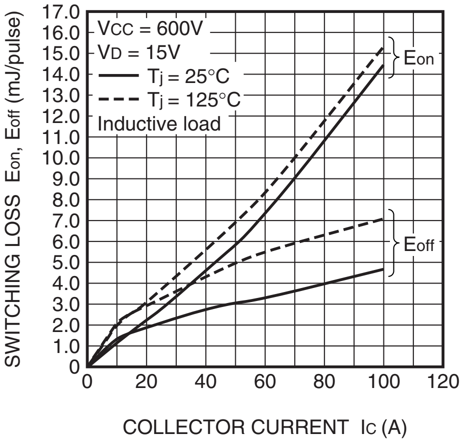
SWITCHING TIME (t_{on}, t_{off}) CHARACTERISTICS (TYPICAL)



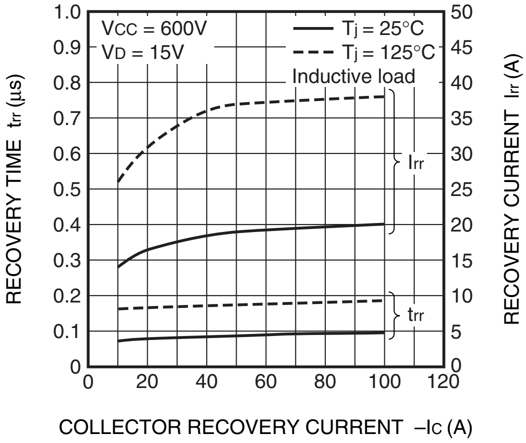
SWITCHING TIME ($t_{c(on)}$, $t_{c(off)}$) CHARACTERISTICS (TYPICAL)



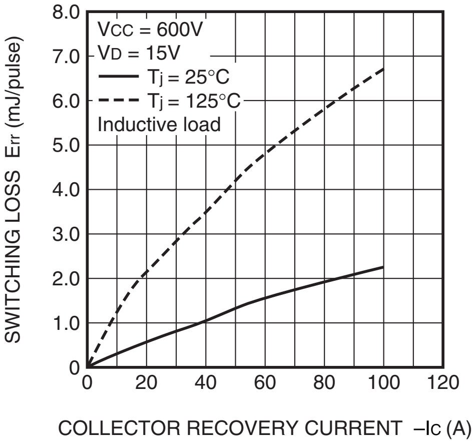
SWITCHING LOSS CHARACTERISTICS (TYPICAL)



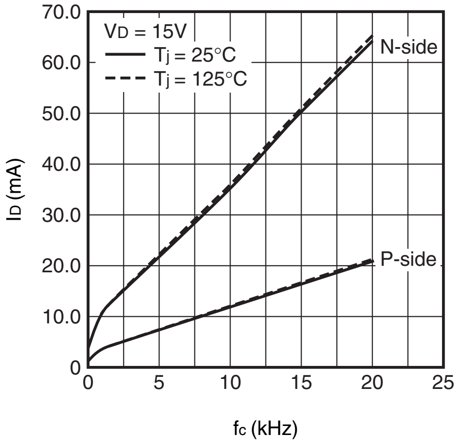
DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



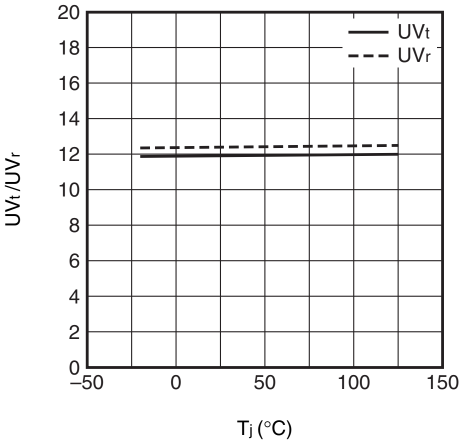
SWITCHING RECOVERY LOSS CHARACTERISTICS (TYPICAL)



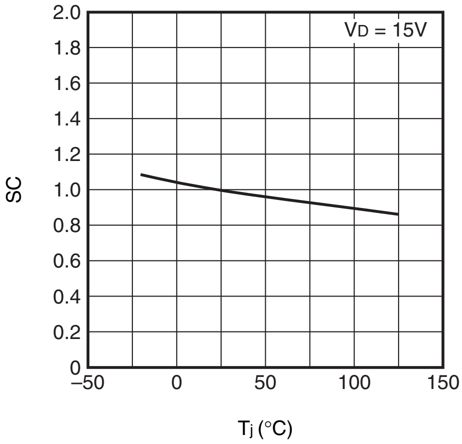
I_D VS. f_c CHARACTERISTICS (TYPICAL)



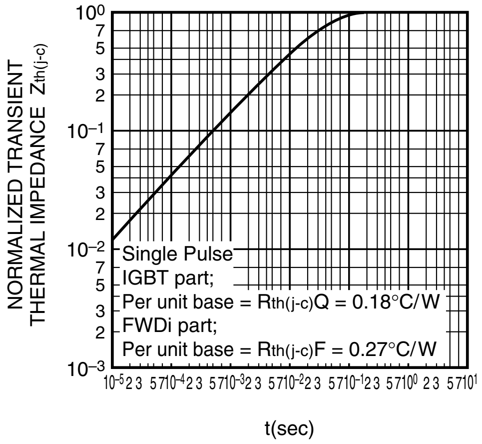
UV TRIP LEVEL VS. T_j CHARACTERISTICS (TYPICAL)



SC TRIP LEVEL VS. T_j CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (TYPICAL)



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