

# PM50RVA120

FLAT-BASE TYPE  
INSULATED PACKAGE

## PM50RVA120



### FEATURE

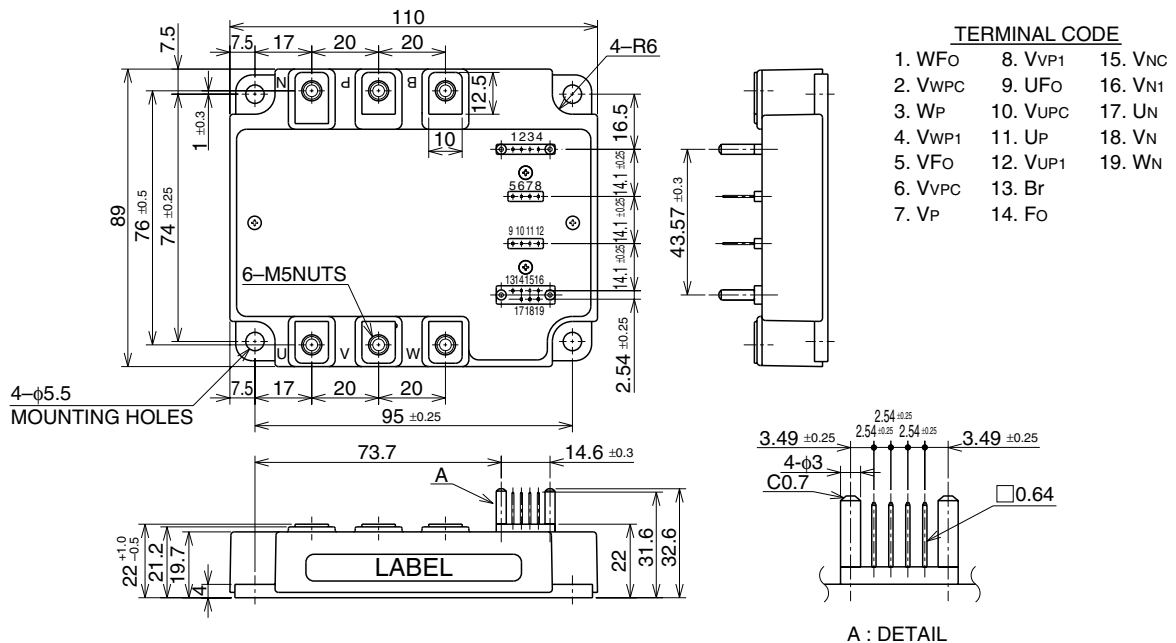
- 3φ 50A, 1200V Current-sense IGBT for 20kHz switching
- 15A, 1200V Current-sense regenerative brake IGBT
- Monolithic gate drive & protection logic
- Detection, protection & status indication circuits for over-current, short-circuit, over-temperature & under-voltage
- Acoustic noise-less 7.5kW class inverter application
- UL Recognized  
Yellow Card No. E80276(N)  
File No. E80271

## APPLICATION

General purpose inverter, servo drives and other motor controls

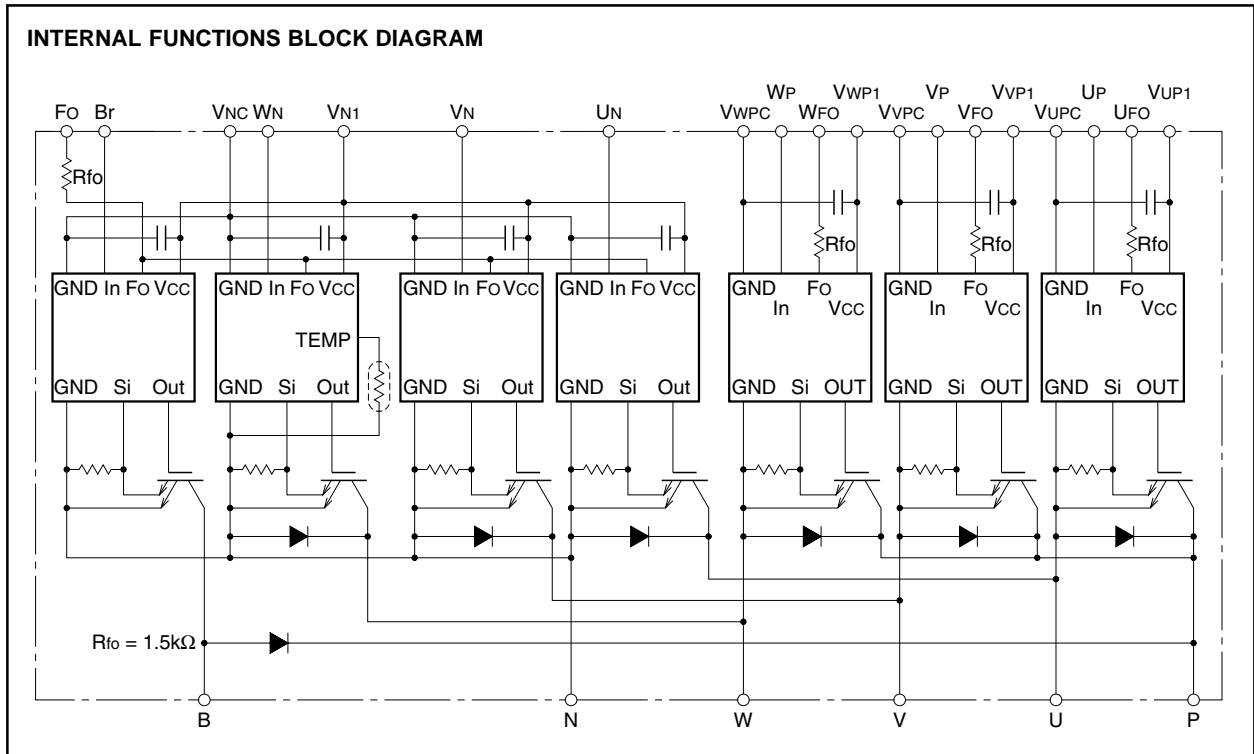
## PACKAGE OUTLINES

Dimensions in mm



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

**INVERTER PART**

Symbol	Parameter	Condition	Ratings	Unit
$V_{CES}$	Collector-Emitter Voltage	$V_D = 15\text{V}, V_{CIN} = 15\text{V}$	1200	V
$\pm I_C$	Collector Current	$T_c = 25^\circ\text{C}$	50	A
$\pm I_{CP}$	Collector Current (Peak)	$T_c = 25^\circ\text{C}$	100	A
$P_C$	Collector Dissipation	$T_c = 25^\circ\text{C}$	338	W
$T_j$	Junction Temperature		$-20 \sim +150$	$^\circ\text{C}$

**BRAKE PART**

Symbol	Parameter	Condition	Ratings	Unit
$V_{CES}$	Collector-Emitter Voltage	$V_D = 15\text{V}, V_{CIN} = 15\text{V}$	1200	V
$I_C$	Collector Current	$T_c = 25^\circ\text{C}$	15	A
$I_{CP}$	Collector Current (Peak)	$T_c = 25^\circ\text{C}$	30	A
$P_C$	Collector Dissipation	$T_c = 25^\circ\text{C}$	134	W
$V_{R(DC)}$	FWDi Rated DC Reverse Voltage	$T_c = 25^\circ\text{C}$	1200	V
$I_F$	FWDi Forward Current	$T_c = 25^\circ\text{C}$	15	A
$T_j$	Junction Temperature		$-20 \sim +150$	$^\circ\text{C}$

**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 : $U_P-V_{UPC}, V_P-V_{VPC}$ $W_P-V_{WPC}, U_N \cdot V_N \cdot W_N \cdot B_r-V_{NC}$	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 $U_{FO}, V_{FO}, W_{FO}$ and $F_O$ terminal	20	mA

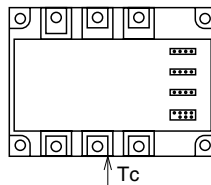
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## TOTAL SYSTEM

Symbol	Parameter	Condition	Ratings	Unit
V <sub>CC(Prot)</sub>	Supply Voltage Protected by SC	V <sub>D</sub> = 13.5 ~ 16.5V, Inverter Part, T <sub>j</sub> = 125°C Start	800	V
V <sub>CC(surge)</sub>	Supply Voltage (Surge)	Applied between : P-N, Surge value or without switching	1000	V
T <sub>c</sub>	Module Case Operating Temperature	(Note-1)	-20 ~ +100	°C
T <sub>stg</sub>	Storage Temperature		-40 ~ +125	°C
V <sub>iso</sub>	Isolation Voltage	60Hz, Sinusoidal, Charged part to Base, AC 1 min.	2500	V <sub>rms</sub>

(Note-1) T<sub>c</sub> measurement point is below. (3mm depth at the center of the side of base plate)



## ELECTRICAL CHARACTERISTICS (T<sub>j</sub> = 25°C, unless otherwise noted)

### INVERTER PART

Symbol	Parameter	Test Condition	Limits			Unit	
			Min.	Typ.	Max.		
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	V <sub>D</sub> = 15V, I <sub>C</sub> = 50A V <sub>CIN</sub> = 0V	T <sub>j</sub> = 25°C	—	2.65	3.30	V
			T <sub>j</sub> = 125°C	—	2.75	3.35	
V <sub>EC</sub>	FWDi Forward Voltage	-I <sub>C</sub> = 50A, V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V	—	2.5	3.5	V	
t <sub>on</sub>	Switching Time	V <sub>D</sub> = 15V, V <sub>CIN</sub> = 0V↔15V V <sub>CC</sub> = 600V, I <sub>C</sub> = 50A T <sub>j</sub> = 125°C Inductive Load (upper and lower arm)	—	0.4	0.9	2.3	μs
t <sub>tr</sub>			—	0.2	0.3		
t <sub>c(on)</sub>			—	0.4	1.0		
t <sub>off</sub>			—	2.4	3.4		
t <sub>c(off)</sub>			—	0.7	1.2		
I <sub>CES</sub>	Collector-Emitter Cutoff Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>CIN</sub> = 15V	T <sub>j</sub> = 25°C	—	—	1	mA
			T <sub>j</sub> = 125°C	—	—	10	

### BRAKE PART

Symbol	Parameter	Test Condition	Limits			Unit	
			Min.	Typ.	Max.		
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	V <sub>D</sub> = 15V, I <sub>C</sub> = 15A V <sub>CIN</sub> = 0V	T <sub>j</sub> = 25°C	—	2.50	3.30	V
			T <sub>j</sub> = 125°C	—	2.20	3.20	
V <sub>FM</sub>	FWDi Forward Voltage	I <sub>F</sub> = 15A	—	2.50	3.50	V	
I <sub>CES</sub>	Collector-Emitter Cutoff Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>CIN</sub> = 15V	T <sub>j</sub> = 25°C	—	—	1	mA
			T <sub>j</sub> = 125°C	—	—	10	

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## CONTROL PART

Symbol	Parameter	Test Condition	Limits			Unit	
			Min.	Typ.	Max.		
Id	Circuit Current	V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V	V <sub>N1</sub> -V <sub>Nc</sub>	—	44	60	mA
			V <sub>P1</sub> -V <sub>PC</sub>	—	13	18	
V <sub>th(ON)</sub>	Input ON Threshold Voltage	Applied between : UP-VUPC, VP-VVPC, WP-VWPC UN • VN • WN • Br-VNC		1.2	1.5	1.8	V
V <sub>th(OFF)</sub>	Input OFF Threshold Voltage			1.7	2.0	2.3	
OC	Over Current Trip Level	-20 ≤ T <sub>j</sub> ≤ 125°C, V <sub>D</sub> = 15V, Break part		22	—	—	A
SC	Short Circuit Trip Level	-20 ≤ T <sub>j</sub> ≤ 125°C, V <sub>D</sub> = 15V	Inverter part	59	—	—	A
			Brake part	—	52	—	
toff(OC)	Over Current Delay Time	V <sub>D</sub> = 15V, Break part		—	10	—	μs
toff(SC)	Short Circuit Current Delay Time	V <sub>D</sub> = 15V		—	10	—	μs
OT	Over Temperature Protection	Base-plate Temperature detection, V <sub>D</sub> = 15V	Trip level	111	118	125	°C
			Reset level	—	100	—	
UV	Supply Circuit Under-Voltage Protection	-20 ≤ T <sub>j</sub> ≤ 125°C	Trip level	11.5	12.0	12.5	V
			Reset level	—	12.5	—	
I <sub>FO(H)</sub>	Fault Output Current	V <sub>D</sub> = 15V, V <sub>FO</sub> = 15V (Note-2)		—	—	0.01	mA
I <sub>FO(L)</sub>				—	10	15	
t <sub>FO</sub>	Minimum Fault Output Pulse Width	V <sub>D</sub> = 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 OT protection operate by lower arm.  
Fault output of OT, UV protection given pulse while over level.

## THERMAL RESISTANCES

Symbol	Parameter	Test Condition	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(j-c)Q</sub>	Junction to case Thermal Resistances	Inverter IGBT part (per 1/6 module)	—	—	0.37	°C/W
R <sub>th(j-c)F</sub>		Inverter FWDi part (per 1/6 module)	—	—	0.70	
R <sub>th(j-c)Q</sub>		Brake IGBT part	—	—	0.93	
R <sub>th(j-c)F</sub>		Brake FWDi part	—	—	1.50	
R <sub>th(c-f)</sub>	Contact Thermal Resistance	Case to fin, Thermal grease applied (per 1 module)	—	—	0.027	

## MECHANICAL RATINGS AND CHARACTERISTICS

Symbol	Parameter	Test Condition	Limits			Unit
			Min.	Typ.	Max.	
—	Mounting torque	Mounting part screw : M5	2.5	3.0	3.5	N • m
—	Mounting torque	Main terminal screw : M5	2.5	3.0	3.5	N • m
—	Weight	—	—	560	—	g

## RECOMMENDED CONDITIONS FOR USE

Symbol	Parameter	Test Condition	Recommended value	Unit
V <sub>CC</sub>	Supply Voltage	Applied across P-N terminals	≤ 800	V
V <sub>D</sub>	Control Supply Voltage	Applied between : V <sub>UP1</sub> -V <sub>UPC</sub> , V <sub>VP1</sub> -V <sub>VPC</sub> V <sub>WP1</sub> -V <sub>WPC</sub> , V <sub>N1</sub> -V <sub>Nc</sub> (Note-3)	15 ± 1.5	V
V <sub>CIN(ON)</sub>	Input ON Voltage	Applied between : UP-VUPC, VP-VVPC, WP-VWPC UN • VN • WN • Br-VNC	≤ 0.8	V
V <sub>CIN(OFF)</sub>	Input OFF Voltage		≥ 4.0	
t <sub>dead</sub>	Arm Shoot-through Blocking Time	For IPM's each input signals	≥ 3.0	μs
f <sub>PWM</sub>	PWM Input Frequency	Using Application Circuit input signal of IPM, Sinusoidal PWM VVVF inverter	≤ 20	kHz

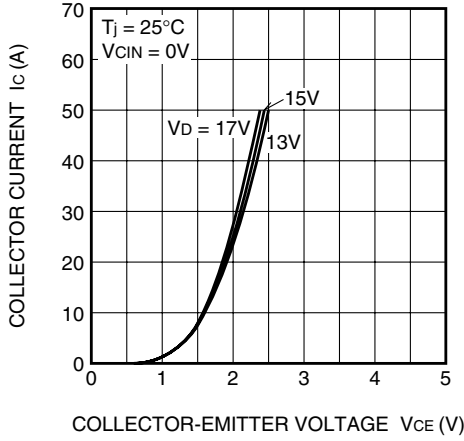
(Note-3) With ripple satisfying the following conditions dv/dt swing ≤ ±5V/μs, Variation ≤ 2V peak to peak

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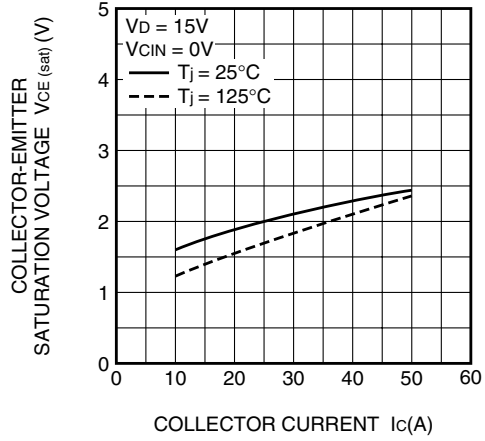
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## PERFORMANCE CURVES (Inverter Part)

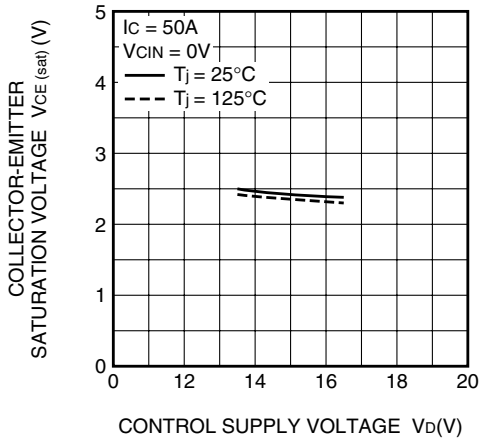
**OUTPUT CHARACTERISTICS (TYPICAL)**



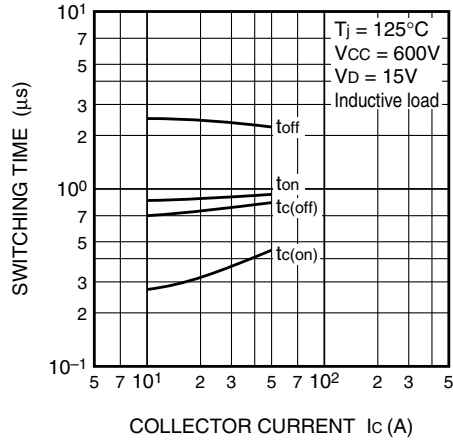
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



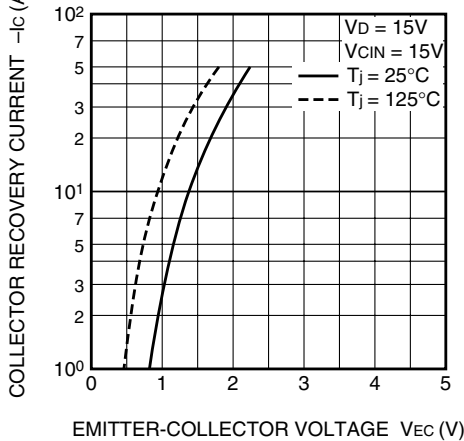
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



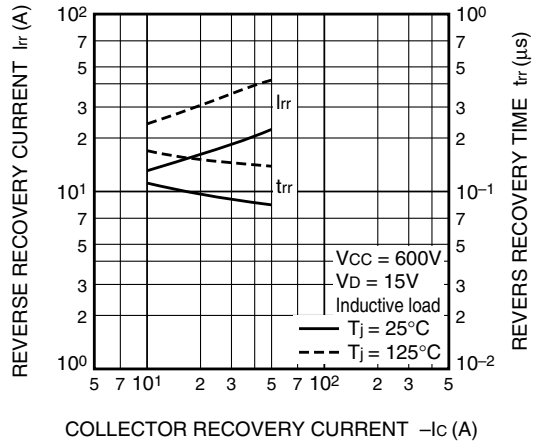
**SWITCHING CHARACTERISTICS (TYPICAL)**



**DIODE FORWARD CHARACTERISTICS (TYPICAL)**



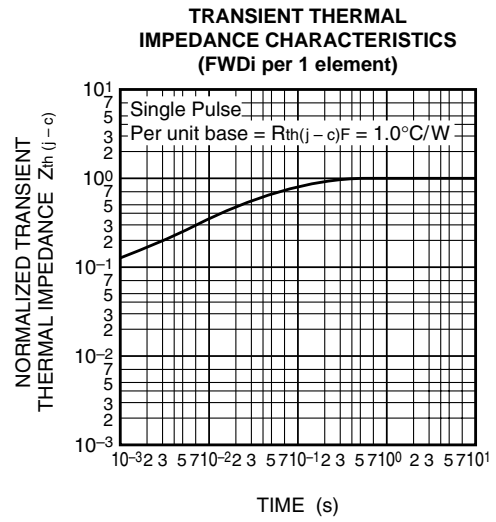
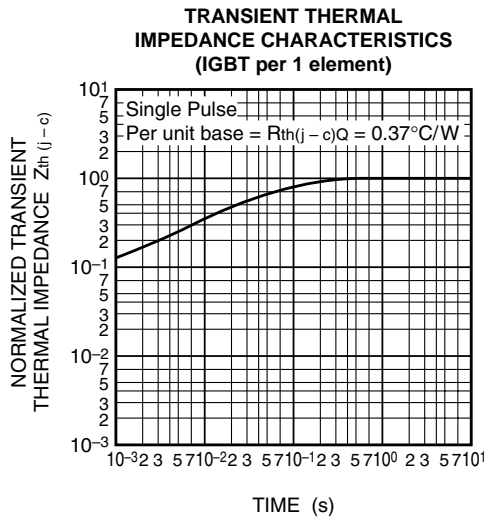
**DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



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## PERFORMANCE CURVES (Inverter Part)

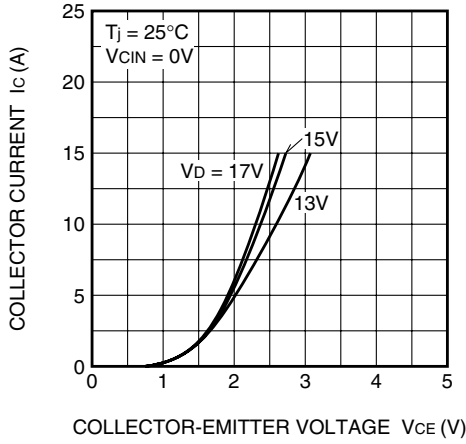


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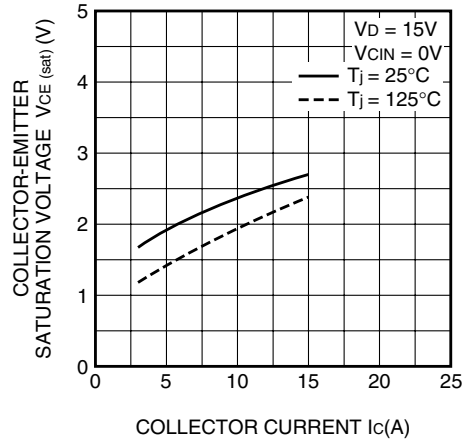
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## PERFORMANCE CURVES (Brake Part)

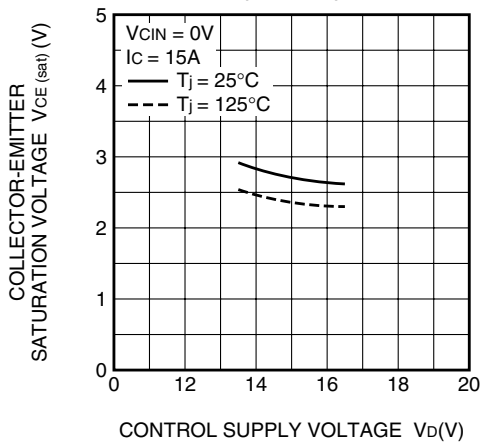
OUTPUT CHARACTERISTICS (TYPICAL)



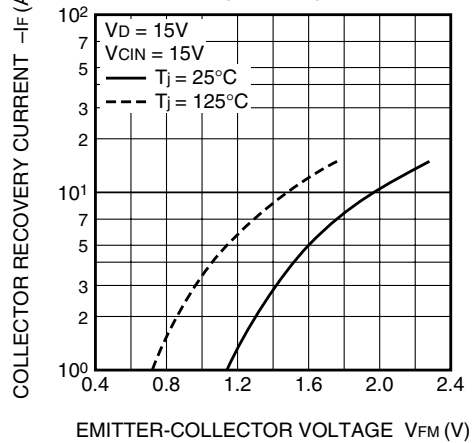
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



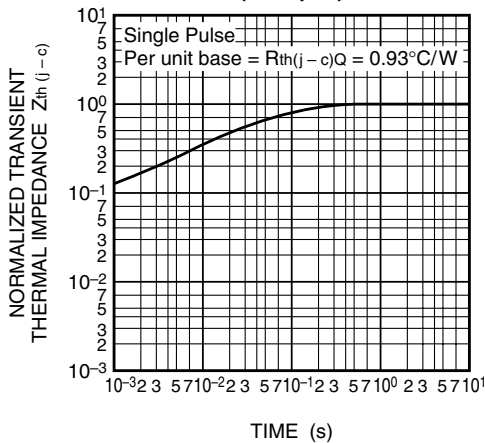
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



DIODE FORWARD CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT part)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (FWDi part)

