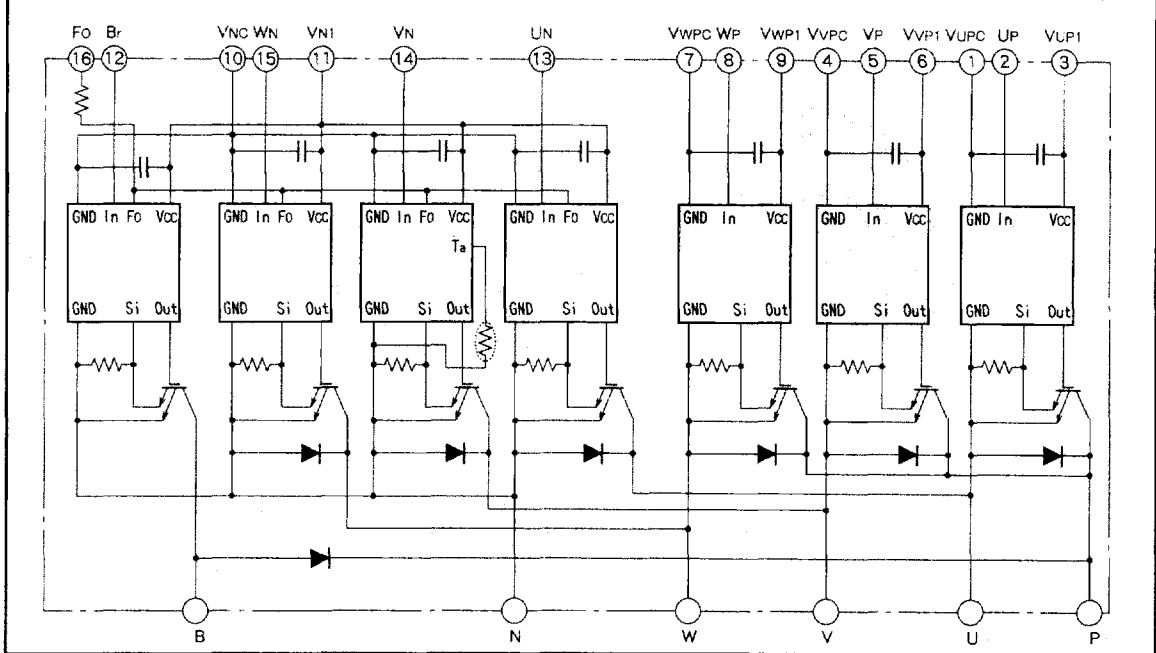


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FLAT-BASE TYPE
INSULATED PACKAGE

EQUIVALENT CIRCUIT DIAGRAM



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

INVERTER PART

Symbol	Parameter	Conditions	Ratings	Unit
V _{CC}	Supply voltage	Applied between : P-N	450	V
V _{CC(surge)}	Supply voltage (surge)	Applied between : P-N, surge value	500	V
V _{CES}	Collector-emitter voltage		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	138	W
T _j	Junction temperature		- 20 ~ + 150	°C

BRAKE PART

Symbol	Parameter	Conditions	Ratings	Unit
V _{CC}	Supply voltage	Applied between : P-N	450	V
V _{CC(surge)}	Supply voltage (surge)	Applied between : P-N, surge value	500	V
V _{CES}	Collector-emitter voltage		600	V
I _C	Collector current	T _C = 25 °C	15	A
I _{CP}	Collector current (peak)	T _C = 25 °C	30	A
I _F	FWDi Forward current	T _C = 25 °C	15	A
V _{R(DC)}	FWDi Rating DC reverse voltage	T _C = 25 °C	600	V
P _C	Collector dissipation	T _C = 25 °C	52	W
T _j	Junction temperature		- 20 ~ + 150	°C

CONTROL PART

Symbol	Parameter	Conditions	Ratings	Unit
V _D	Supply voltage	Applied between : V _{UP1} -V _{UPC} , V _{VP1} -V _{VP} , V _{WP1} -V _{WPC} , V _{N1} -V _N	20	V
V _{CIN}	Input voltage	Applied between : U _P -U _{PC} , V _P -V _{PC} , W _P -W _{PC} , U _N · V _N · W _N · B _F -V _N	20	V
V _{FO}	Fault output supply voltage	Applied between : F _O -V _N	20	V
I _{FO}	Fault output current	Sink current of F _O terminal	20	mA

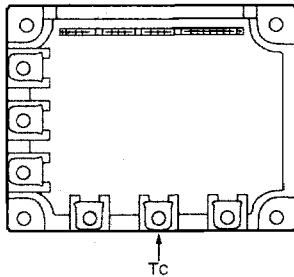
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FLAT-BASE TYPE
INSULATED PACKAGE

TOTAL SYSTEM

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC(Prot)}$	Supply voltage protected by OC & SC	$V_D = 13.5 \sim 16.5V$ Inverter part, $T_j = 125^\circ C$ start	400	V
T_C	Module case operating temperature	(Note 1)	$-20 \sim +100$	$^\circ C$
T_{stg}	Storage temperature	—	$-40 \sim +125$	$^\circ C$
V_{iso}	Isolation voltage	60Hz, Sinusoidal, AC, 1min	2500	V_{rms}

Note 1. T_C measuring point is as shown below



ELECTRICAL CHARACTERISTICS ($T_j = 25^\circ C$, unless otherwise noted)

INVERTER PART

Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_D = 15V, V_{CIN} = 0V$ Pulsed	$I_C = 50A, T_J = 25^\circ C$ $I_C = 50A, T_J = 125^\circ C$	—	2.7 2.5	3.5 3.4	V
V_{EC}	FWDi forward voltage	$-I_C = 50A, V_D = 15V, V_{CIN} = 15V$		—	1.7	2.5	V
t_{on}	Switching time	$V_D = 15V, V_{CIN} = 0V \leftrightarrow 15V$ $V_{CC} = 300V, I_C = 50A$ $T_J = 125^\circ C$ (Per 1 arm) Inductive load		0.3	0.6	1.5	μs
t_{rr}				—	0.25	0.4	μs
$t_{c(on)}$				—	0.4	1.2	μs
t_{off}				—	2.0	3.3	μs
$t_{c(off)}$				—	0.6	1.2	μs
I_{CES}	Collector-emitter cutoff current	$V_{CE} = V_{CES}$	$T_J = 25^\circ C$ $T_J = 125^\circ C$	— —	— —	1 10	mA

BRAKE PART

Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ	Max	
VCE(sat)	Collector-emitter saturation voltage	VD = 15V, VCIN = 0V Pulsed	IC = 15A, TJ = 25 °C	—	2.6	3.5	V
			IC = 15A, TJ = 125 °C	—	3.0	4.0	
VEC	FWDi forward voltage	- IC = 15A, VD = 15V, VCIN = 15V		—	1.7	2.2	V
ICES	Collector-emitter cutoff current	VCE = VCES	TJ = 25 °C	—	—	1	mA
			TJ = 125 °C	—	—	10	

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FLAT-BASE TYPE
INSULATED PACKAGE

CONTROL PART

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
V _D	Supply voltage	Applied between : V _{UP1} -V _{UPC} , V _{VP1} -V _{VPC} , V _{WP1} -V _{WPC} , V _{N1} -V _{NPC}	13.5	15	16.5	V
I _D	Circuit current	V _D = 15V, V _{CIN} = 15V V _{N1} -V _{NPC} V _{XP1} -V _{XPC}	—	80 25	120 35	mA
V _{CIN(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 -V _{NPC}	1.2	1.5	1.8	V
V _{CIN(OFF)}	Input off threshold voltage		1.7	2.0	2.3	V
f _{PWM}	PWM input frequency	3 φ sinusoidal	—	15	20	kHz
t _{dead}	Arm shoot-through blocking time	For each pulse input U _P -U _N , V _P -V _N , W _P -W _N Using application circuit Opto-coupler's input signal I _F = 12mA	3.0 5.0	— —	— —	μs
OC	Over current trip level	- 20°C ≤ T _J ≤ 125°C V _D = 15V	65 18	88 26	— —	A
		Inverter part Brake part				
SC	Short circuit trip level	- 20°C ≤ T _J ≤ 125°C V _D = 15V	— —	132 39	— —	A
		Inverter part Brake part				
t _{off(OC)}	Over current delay time	V _D = 15V	—	10	—	μs
OT	Over temperature	Trip level	111	118	125	°C
OT _r	protection	Reset level	—	100	—	°C
UV	Supply circuit under	Trip level	11.5	12.0	12.5	V
UV _r	voltage protection	Reset level	—	12.5	—	V
I _{FO(H)}	Fault output current (Note 2)	V _D = 15V, V _{FO} = 15V	—	—	0.01	mA
I _{FO(L)}			—	10	15	mA
t _{FO}	Minimum fault output pulse width (Note 2)	V _D = 15V	1.0	2.0	—	ms

Note 2. Fault output is given only when the internal OC, SC, OT & UV protections schemes of any lower arm device operate to protect the device. For each upper arm device, the internal OC, SC & UV protection schemes are provided to protect the device but, no fault output is given.

THERMAL RESISTANCES

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
R _{th(j-c)Q}	Junction-to-case thermal resistances	Inverter IGBT part, per 1/6 module	—	—	0.9	°C/W
R _{th(j-c)F}		Inverter FWDi part, per 1/6 module	—	—	2.5	°C/W
R _{th(j-c)Q}		Brake IGBT	—	—	2.4	°C/W
R _{th(j-c)F}		Brake FWDi	—	—	4.5	°C/W
R _{th(c-f)}	Contact thermal resistance	Thermal grease applied, per 1/6 module	—	—	0.19	°C/W

MECHANICAL RATINGS AND CHARACTERISTICS

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
—	Mounting torque	Mounting part screw : M5	1.47	1.67	1.96	N · m
			15	17	20	kg · cm
—	Mounting torque	Main terminals part screw : M5	1.47	1.67	1.96	N · m
			15	17	20	kg · cm
—	Weight	—	—	550	—	g

RECOMMENDED CONDITIONS FOR USE

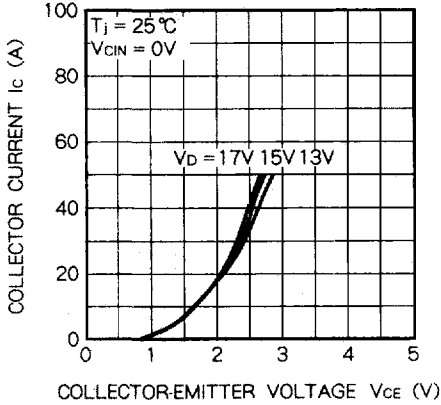
Symbol	Parameter	Test conditions	Value			Unit
			Min	Typ	Max	
V _{CC}	Supply voltage	Applied across P-N terminals	0	300	400	V
V _D		Applied between : V _{UP1} -V _{UPC} , V _{VP1} -V _{VPC} , V _{WP1} -V _{WPC} , V _{N1} -V _{NPC}	13.5	15	16.5	V
V _{CIN(ON)}	Input on voltage	Applied between : U _P , V _P , W _P , U _N , W _N , Br	0	—	0.8	V
V _{CIN(OFF)}	Input off voltage		4.0	—	15	V
f _{PWM}	PWM input frequency	Using application circuit	5	15	20	kHz
t _{dead}	Arm shoot-through blocking time	Using application circuit Opto-coupler's input signal	5.0	—	—	μs

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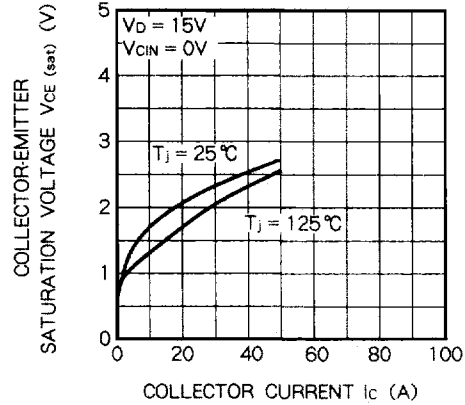
FLAT-BASE TYPE
INSULATED PACKAGE

PERFORMANCE CURVES (INVERTER PART)

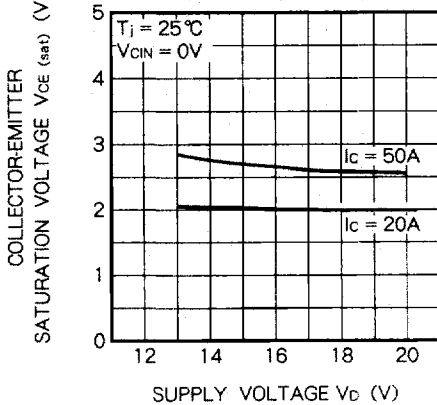
OUTPUT CHARACTERISTICS
(TYPICAL)



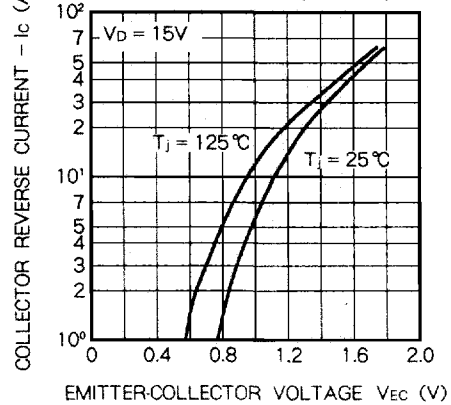
SATURATION VOLTAGE
CHARACTERISTICS (TYPICAL)



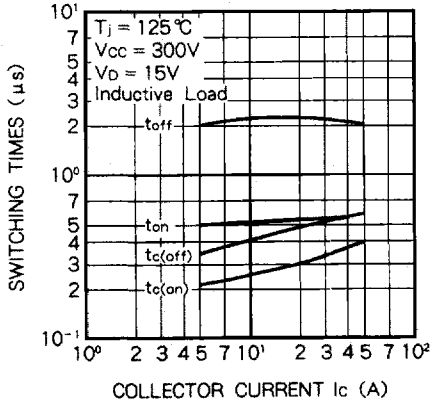
COLLECTOR-EMITTER SATURATION
VOLTAGE (TYPICAL)



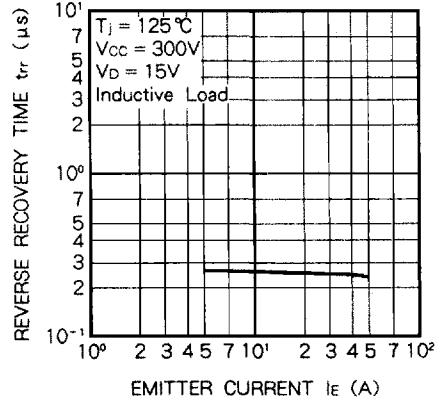
FREE-WHEEL DIODE FORWARD
CHARACTERISTICS (TYPICAL)



SWITCHING TIME VS.
COLLECTOR CURRENT (TYPICAL)



REVERSE RECOVERY CHARACTERISTICS
OF FREE-WHEEL DIODE (TYPICAL)

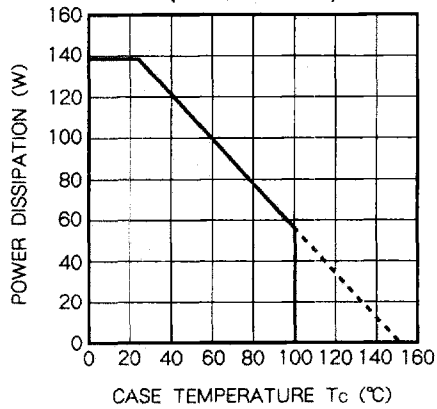


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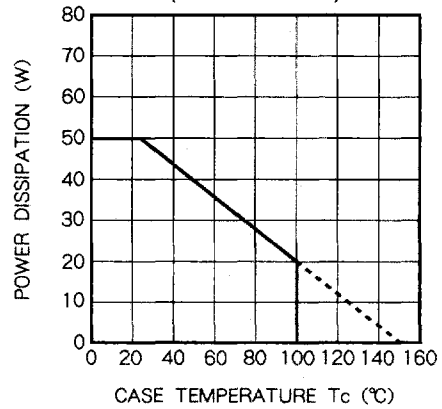
FLAT-BASE TYPE
INSULATED PACKAGE

(INVERTER PART)

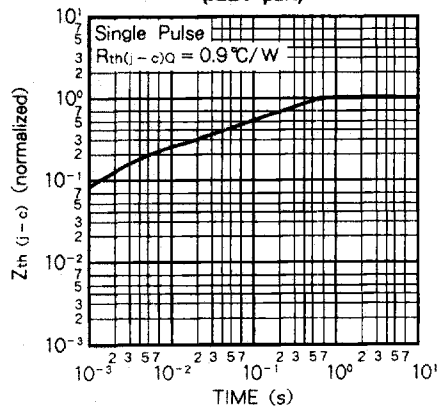
POWER DISSIPATION DERATING CURVE
(Per IGBT element)



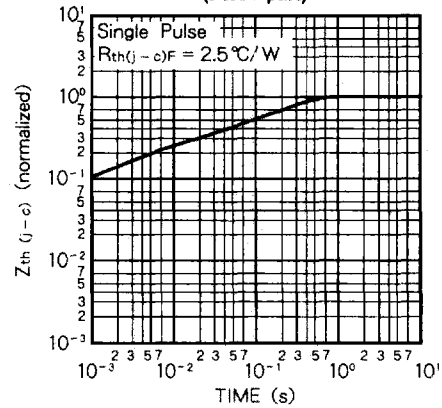
POWER DISSIPATION DERATING CURVE
(Per FWDi element)



TRANSIENT THERMAL
IMPEDANCE CHARACTERISTICS
(IGBT part)



TRANSIENT THERMAL
IMPEDANCE CHARACTERISTICS
(FWDi part)

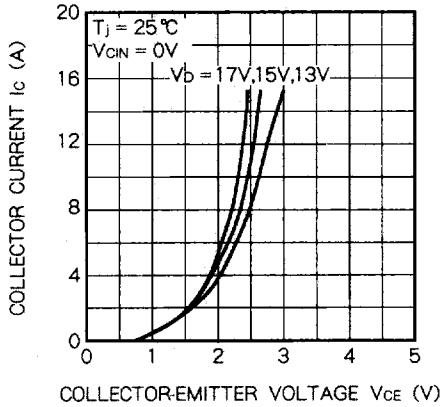


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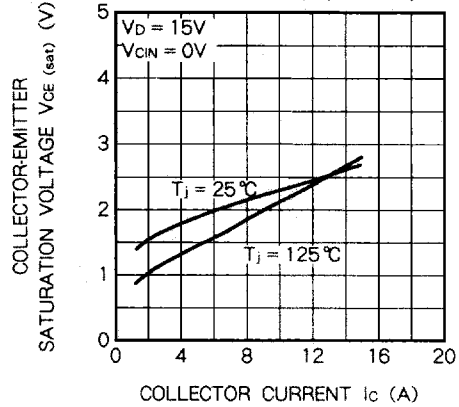
FLAT-BASE TYPE
INSULATED PACKAGE

PERFORMANCE CURVES (BRAKE PART)

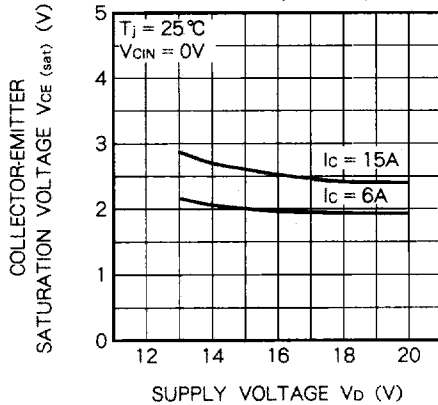
OUTPUT CHARACTERISTICS
(TYPICAL)



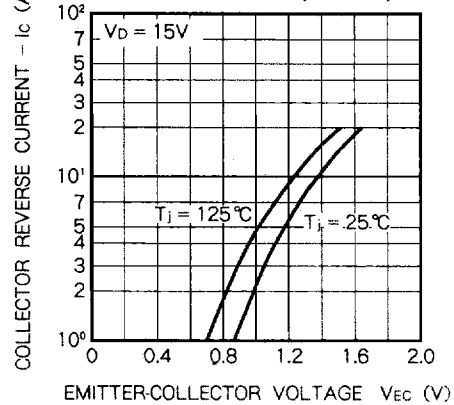
SATURATION VOLTAGE
CHARACTERISTICS (TYPICAL)



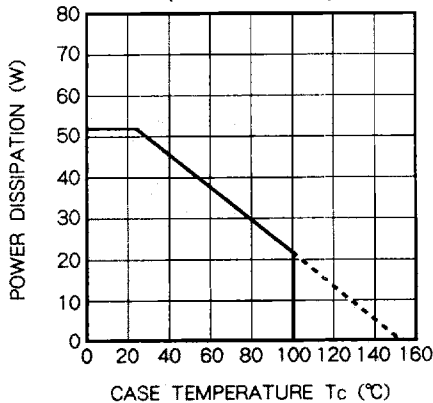
COLLECTOR-EMITTER SATURATION
VOLTAGE (TYPICAL)



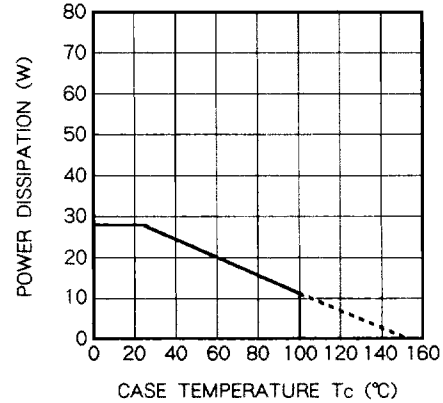
FREE-WHEEL DIODE FORWARD
CHARACTERISTICS (TYPICAL)



POWER DISSIPATION DERATING CURVE
(Per IGBT element)



POWER DISSIPATION DERATING CURVE
(Per FWDi element)

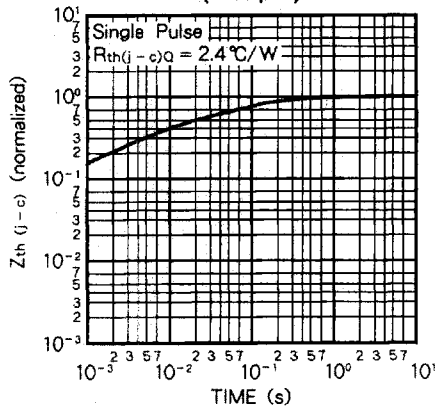


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FLAT-BASE TYPE
INSULATED PACKAGE

(BRAKE PART)

TRANSIENT THERMAL
IMPEDANCE CHARACTERISTICS
(IGBT part)



TRANSIENT THERMAL
IMPEDANCE CHARACTERISTICS
(FWDI part)

