Fuji Electric

Innovating Energy Technology

7MBR50XKD065-50

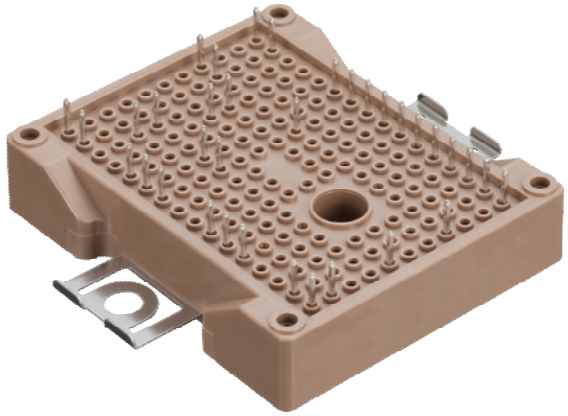
IGBT Modules

Power Module(X series)
650V / 50A / PIM

■ Feactures

Low $V_{CE(sat)}$
Compact Package
P.C.Board Mount Module
Converter Diode Bridge Dynamic Brake Circuit
RoHS compliant Product

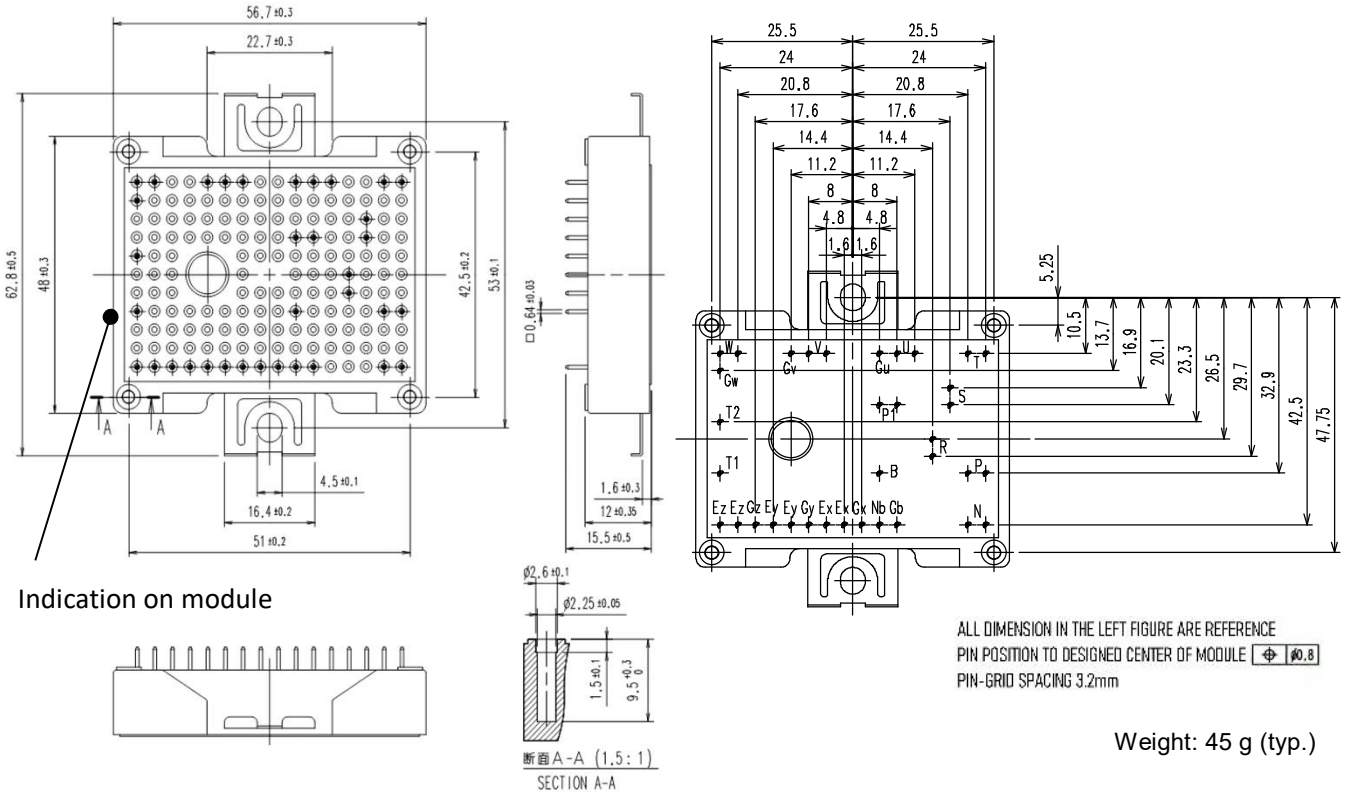
■ Typical appearance



■Applications

Inverter for Motor Drive
AC and DC Servo Drive Amplifier
Uniterruptible Power Supply

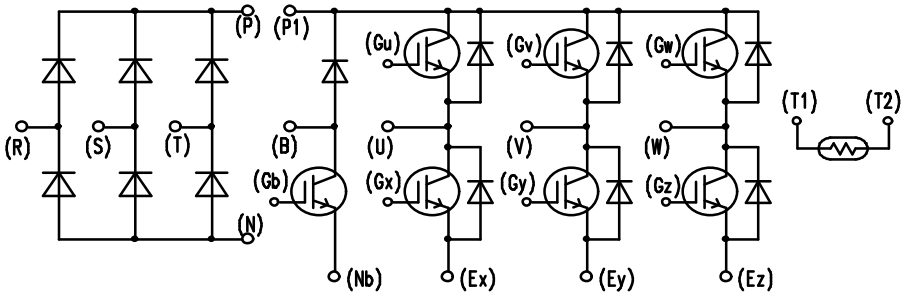
■ Outline drawing (Unit : mm)



Weight: 45 g (typ.)

■ Equivalent circuit

[Converter] [Brake] [Inverter] [Thermistor]



■ Maximum ratings (at T_c = 25°C unless otherwise specified)

	Items		Symbols	Conditions		Maximum ratings	Units
Inverter	Collector-Emitter voltage, Gate-Emitter short-circuited		V_{CES}			650	V
	Gate-Emitter voltage, Collecter-Emitter short-circuited		V_{GES}			±20	V
	Collector current		I_C	Continuous	T_c=100°C	50	A
	Repetitve peak collector current		I_{CRM}	1ms		100	
	Forward current		I_F	Continuous		50	
	Repetitive peak forward current		I_{FRM}	1ms		100	
	Total power dissipation		P_{tot}	1 device		270	W
Brake IGBT	Collector-Emitter voltage, Gate-Emitter short-circuited		V_{CES}			650	V
	Gate-Emitter voltage, Collector-Emitter short-circuited		V_{GES}			±20	V
	Collector current		I_C	Continuous	T_c=100°C	50	A
	Repetitive peak collector current		I_{CRM}	1ms		100	
	Total power dissipation		P_C	1 device		270	W
Brake FWD	Forward current		I_F	Continuous		20	A
	Repetitive peak forward current		I_{FRM}	1ms		40	
	Repetitive peak reverse voltage		V_{RRM}			650	V
Converter	Repetitive peak reverse voltage		V_{RRM}			800	V
	Average output current		I_O	Three-phase full wave rectified current	T_c=80°C	50	A
	Surge current (Non-Repetitive) (*1)		I_{FSM}	t=10ms, Half sine wave form	T_{vj}=25°C	535	A
					T_{vj}=150°C	470	
	I^2t (Non-Repetitive) (*1)		I^2t		T_{vj}=25°C	1445	A^2s
					T_{vj}=150°C	1115	
Virtual junction temperature			T_{vj}	Inverter, Brake		175	°C
				Converter		150	
Operating virtual junction temperature (under switching conditions)			T_{vjop}	Inverter, Brake		175	
				Converter		150	
Case temperature			T_c			125	
Storage temperature			T_{stg}			-40 ~ 125	
Isolation voltage	between terminals and copper base (*2)		V_{isol}	A.C. : 1min.		2500	Vrms
	between thermistor and others (*3)						
Screw torque	Mounting torque of screws to heat sink		M_s	M4		1.3～1.7	N·m

(*1) T_{vj} : Temperature at test start.

(*2) All terminals should be connected together during the test.

(*3) Two thermistor terminals should be connected together, other terminals should be connected together and shorted to base plate during the test.

■ Electrical characteristics (at T_{vj} = 25°C unless otherwise specified)

	Items	Symbols	Conditions		Characteristics min.	Characteristics typ.	Characteristics max.	Units
Inverter	Collector-Emitter cut-off current, Gate-Emitter short-circuited	I_{CES}	V_{GE} = 0V V_{CE} = 650V		-	-	50	μA
	Gate leakage current, Collector-Emitter short-circuited	I_{GES}	V_{CE} = 0V V_{GE} = +20/-20V		-	-	100	nA
	Gate-Emitter threshold voltage	$V_{GE(th)}$	V_{CE} = 20V I_C = 50mA		6.0	6.5	7.0	V
	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	V_{GE} = 15V I_C = 50A	T_{vj}=25°C	-	1.50	1.95	V
		$V_{CE(sat)}$ (chip)		T_{vj}=25°C	-	1.30	1.75	
				T_{vj}=125°C	-	1.45	-	
				T_{vj}=150°C	-	1.50	-	
				T_{vj}=175°C	-	1.55	-	
	Internal gate resistance	r_g	-		-	0	-	Ω
	Capacitance	C_{ies}	V_{CE} = 10V, V_{GE} =0V, f = 1MHz		-	5.7	-	nF
		C_{oes}			-	0.22	-	
		C_{res}			-	0.08	-	
	Gate charge	Q_G	V_{CC} = 300V V_{GE}=-15 → +15V I_C = 50A		-	410	-	nC
	Forward voltage	V_F (terminal)	I_F = 50A	T_{vj}=25°C	-	1.75	2.20	V
		V_F (chip)		T_{vj}=25°C	-	1.55	2.00	
				T_{vj}=125°C	-	1.50	-	
				T_{vj}=150°C	-	1.50	-	
				T_{vj}=175°C	-	1.45	-	
	Switching time (*1)	$t_{d(on)}$	V_{CC} = 300V I_C,I_F = 50A L_s = 30nH V_{GE} = +15/-15 V R_G = 8.2 Ω	T_{vj}=25°C	-	0.06	-	μs
				T_{vj}=125°C	-	0.06	-	
				T_{vj}=150°C	-	0.06	-	
				T_{vj}=175°C	-	0.06	-	
		t_r	V_{CC} = 300V I_C,I_F = 50A L_s = 30nH V_{GE} = +15/-15 V R_G = 8.2 Ω	T_{vj}=25°C	-	0.02	-	
				T_{vj}=125°C	-	0.02	-	
				T_{vj}=150°C	-	0.03	-	
				T_{vj}=175°C	-	0.03	-	
		$t_{d(off)}$	V_{CC} = 300V I_C,I_F = 50A L_s = 30nH V_{GE} = +15/-15 V R_G = 8.2 Ω	T_{vj}=25°C	-	0.17	-	
				T_{vj}=125°C	-	0.20	-	
				T_{vj}=150°C	-	0.20	-	
				T_{vj}=175°C	-	0.20	-	
		t_f	V_{CC} = 300V I_C,I_F = 50A L_s = 30nH V_{GE} = +15/-15 V	T_{vj}=25°C	-	0.04	-	
				T_{vj}=125°C	-	0.05	-	
				T_{vj}=150°C	-	0.05	-	
	Reverse recovery time	t_{rr}	V_{CC} = 300V I_C,I_F = 50A L_s = 30nH V_{GE} = +15/-15 V R_G = 8.2 Ω	T_{vj}=25°C	-	0.06	-	
				T_{vj}=125°C	-	0.10	-	
				T_{vj}=150°C	-	0.11	-	
				T_{vj}=175°C	-	0.13	-	

(*1) Turn on time (t_{on}) = $t_{d(on)}$ + t_r , Turn off time (t_{off}) = $t_{d(off)}$ + t_f

	Items	Symbols	Conditions		Characteristics min.	typ.	max.	Units
Inverter	Switching loss (per pulse)	E_{on}	V_{CC} = 300V, I_C,I_F = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 8.2 Ω	T_{vj}=25°C	-	0.58	-	mJ
				T_{vj}=125°C	-	0.91	-	
				T_{vj}=150°C	-	1.01	-	
				T_{vj}=175°C	-	1.12	-	
		E_{off}	V_{CC} = 300V, I_C,I_F = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 8.2 Ω	T_{vj}=25°C	-	1.52	-	
				T_{vj}=125°C	-	1.89	-	
				T_{vj}=150°C	-	2.00	-	
				T_{vj}=175°C	-	2.08	-	
		E_{rr}	V_{CC} = 300V, I_C,I_F = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 8.2 Ω	T_{vj}=25°C	-	0.47	-	
				T_{vj}=125°C	-	0.68	-	
				T_{vj}=150°C	-	0.79	-	
				T_{vj}=175°C	-	0.93	-	
Brake	Collector-Emitter cut-off current, Gate-Emitter short-circuited	I_{CES}	V_{GE} = 0V, V_{CE} = 650V		-	-	50	μA
	Gate leakage current, Collector-Emitter short-circuited	I_{GES}	V_{CE} = 0V, V_{GE} = +20/-20V		-	-	100	nA
	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	V_{GE} = 15V, I_C = 50A	T_{vj}=25°C	-	1.50	1.95	V
		$V_{CE(sat)}$ (chip)		T_{vj}=25°C	-	1.30	1.75	
				T_{vj}=125°C	-	1.45	-	
				T_{vj}=150°C	-	1.50	-	
				T_{vj}=175°C	-	1.55	-	
	Internal gate resistance	r_g	-		-	0	-	Ω
	Switching time (*1)	$t_{d(on)}$	V_{CC} = 300V, I_C = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 8.2 Ω	T_{vj}=25°C	-	0.06	-	μs
				T_{vj}=125°C	-	0.06	-	
				T_{vj}=150°C	-	0.06	-	
				T_{vj}=175°C	-	0.06	-	
		t_r	V_{CC} = 300V, I_C = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 8.2 Ω	T_{vj}=25°C	-	0.02	-	
				T_{vj}=125°C	-	0.02	-	
				T_{vj}=150°C	-	0.03	-	
				T_{vj}=175°C	-	0.03	-	
		$t_{d(off)}$	V_{CC} = 300V, I_C = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 8.2 Ω	T_{vj}=25°C	-	0.17	-	
				T_{vj}=125°C	-	0.20	-	
				T_{vj}=150°C	-	0.20	-	
				T_{vj}=175°C	-	0.20	-	
		t_f	V_{CC} = 300V, I_C = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 8.2 Ω	T_{vj}=25°C	-	0.04	-	
				T_{vj}=125°C	-	0.05	-	
				T_{vj}=150°C	-	0.05	-	
				T_{vj}=175°C	-	0.05	-	
	Forward voltage	V_F (terminal)	I_F = 20A	T_{vj}=25°C	-	1.80	2.25	V
		V_F (chip)	I_F = 20A	T_{vj}=25°C	-	1.60	2.05	
				T_{vj}=125°C	-	1.60	-	
				T_{vj}=150°C	-	1.60	-	
				T_{vj}=175°C	-	1.55	-	
Converter	Reverse current	I_{RRM}	V_R = 800V		-	-	50	μA
	Forward voltage	V_{FM}	I_F = 50A	terminal	-	1.30	1.75	V
				chip	-	1.10	1.55	
Thermistor	Resistance	R	T = 25°C		-	5000	-	Ω
			T = 100°C		465	495	520	
	B value	B	T = 25/ 50°C		3305	3375	3450	K

(*1) Turn on time (t_{on}) = $t_{d(on)}$ + t_r , Turn off time (t_{off}) = $t_{d(off)}$ + t_f

NOTICE:
The external gate resistance (R_G) shown above is one of our recommended value for the purpose of minimum switching loss. However the optimum R_G depends on circuit configuration and/or environment. We recommend that the R_G has to be carefully chosen based on consideration if IGBT module matches design criteria, for example, switching loss, EMC/EMI, spike voltage, surge current and no unexpected oscillation and so on.

■Thermal resistance characteristics

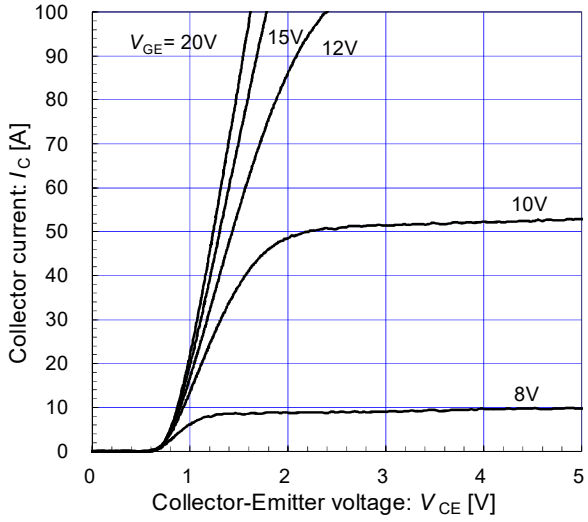
Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance junction to case (1 device)	$R_{th(j-c)}$	Inverter IGBT	-	-	0.55	K/W
		Inverter FWD	-	-	0.73	
		Brake IGBT	-	-	0.55	
		Brake FWD	-	-	1.50	
		Converter Diode	-	-	0.58	
Thermal resistance case to heat sink(*1) (1 device)	$R_{th(c-f)}$	Inverter IGBT	-	0.57	-	
		Inverter FWD	-	0.61	-	
		Brake IGBT	-	0.63	-	
		Brake FWD	-	0.71	-	
		Converter Diode	-	0.68	-	

(*1) This is the value which is defined mounting on the additional cooling fin with 1 W/(m・K) thermal grease.

[Inverter]

Collector current vs. Collector-Emitter voltage (typ.)

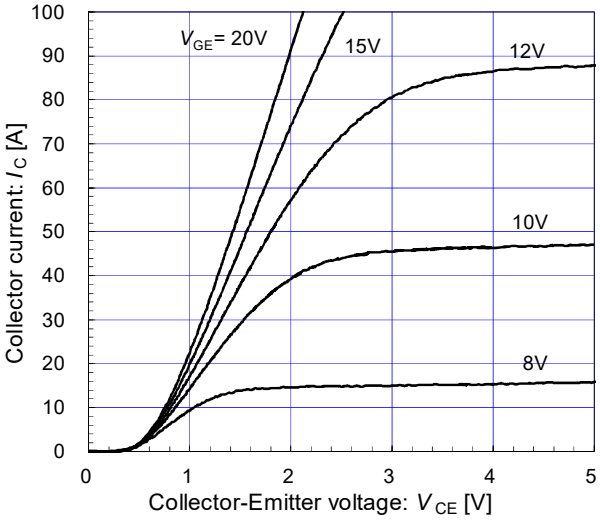
T_{vj}= 25°C / chip



[Inverter]

Collector current vs. Collector-Emitter voltage (typ.)

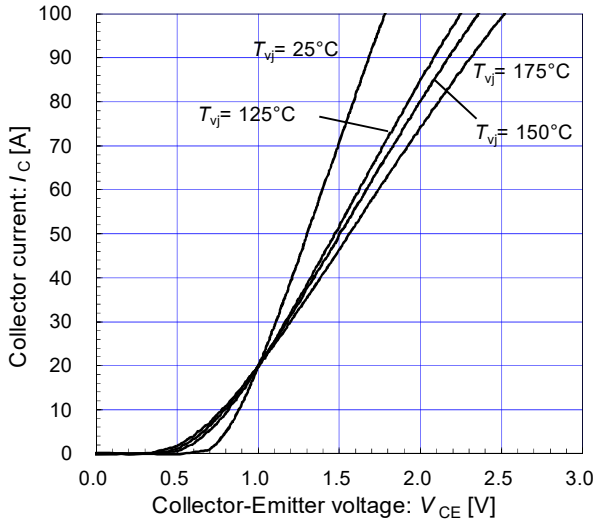
T_{vj}= 175°C / chip



[Inverter]

Collector current vs. Collector-Emitter voltage (typ.)

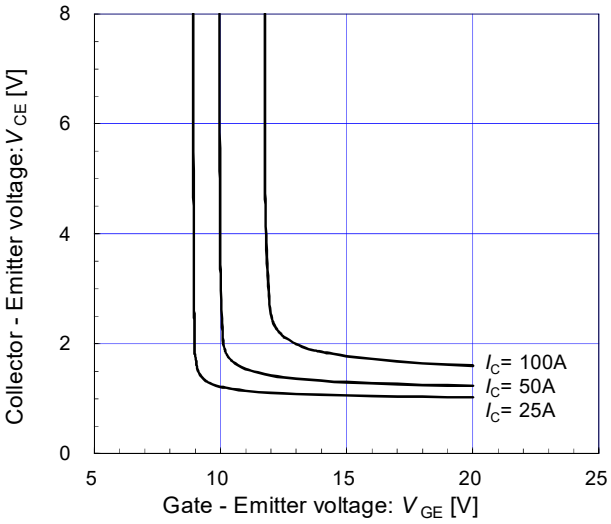
V_{GE}=15V / chip



[Inverter]

Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)

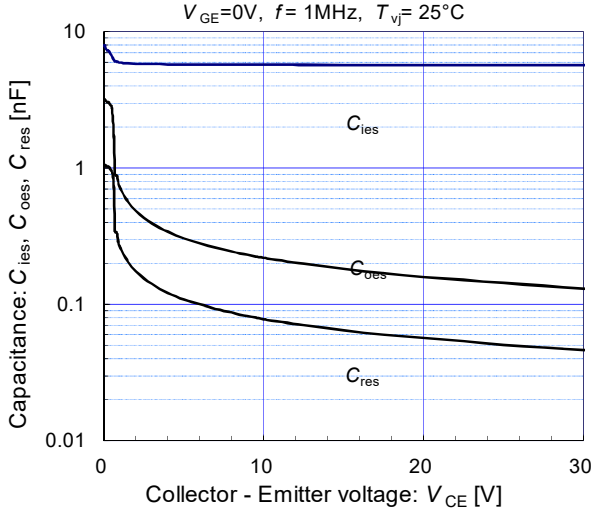
T_{vj}= 25°C / chip



[Inverter]

Capacitance vs. Collector-Emitter voltage (typ.)

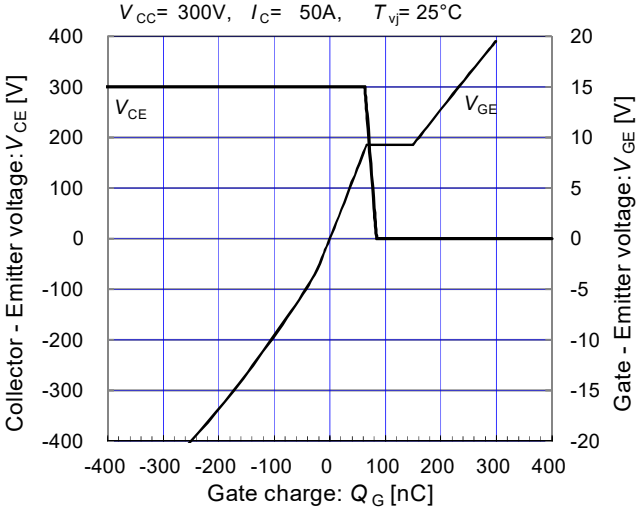
V_{GE}=0V, f= 1MHz, T_{vj}= 25°C



[Inverter]

Dynamic gate charge (typ.)

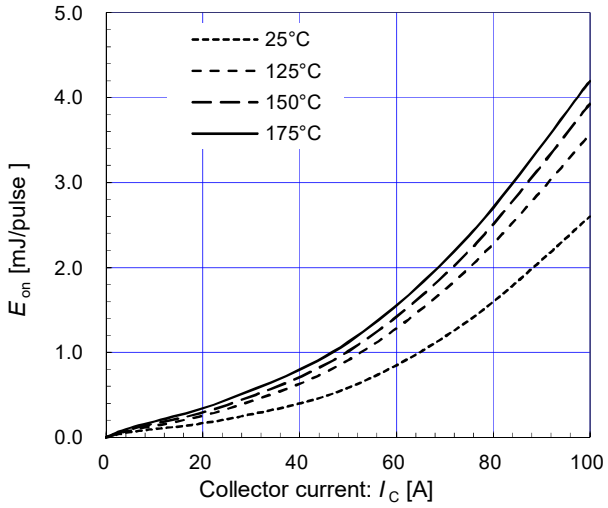
V_{CC}= 300V, I_C= 50A, T_{vj}= 25°C



[Inverter]

E_{on} vs. Collector current (typ.)

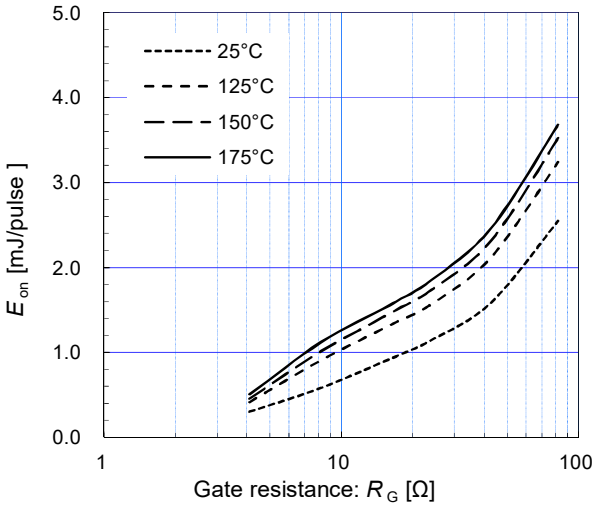
V_{CC}= 300V, V_{GE}= +15/-15 V R_G= 8.2 Ω



[Inverter]

E_{on} vs. Gate resistance (typ.)

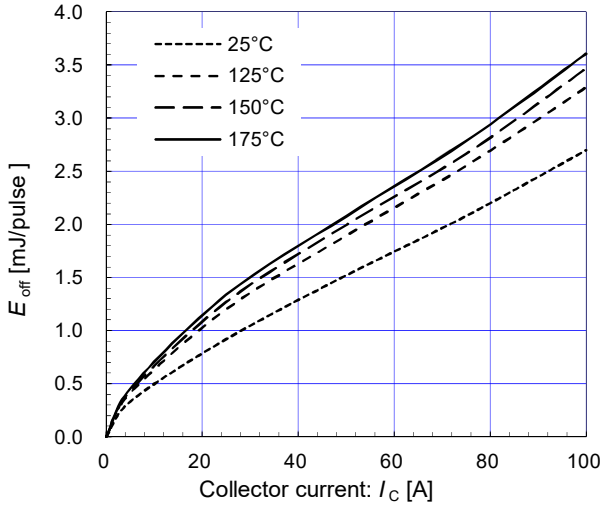
V_{CC}= 300V, V_{GE}= +15/-15 V I_C= 50A



[Inverter]

E_{off} vs. Collector current (typ.)

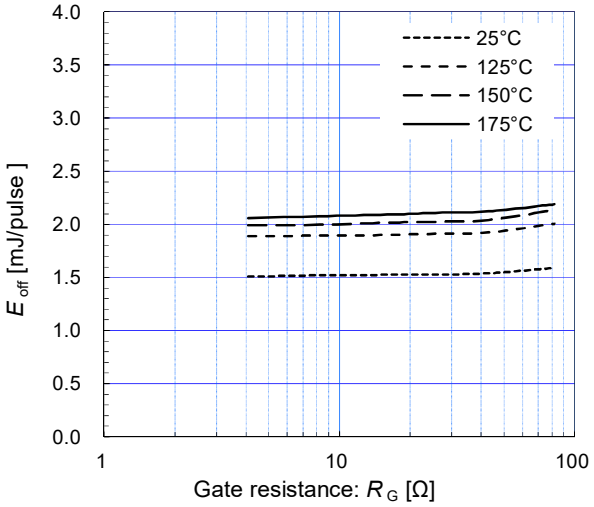
V_{CC}= 300V, V_{GE}= +15/-15 V R_G= 8.2 Ω



[Inverter]

E_{off} vs. Gate resistance (typ.)

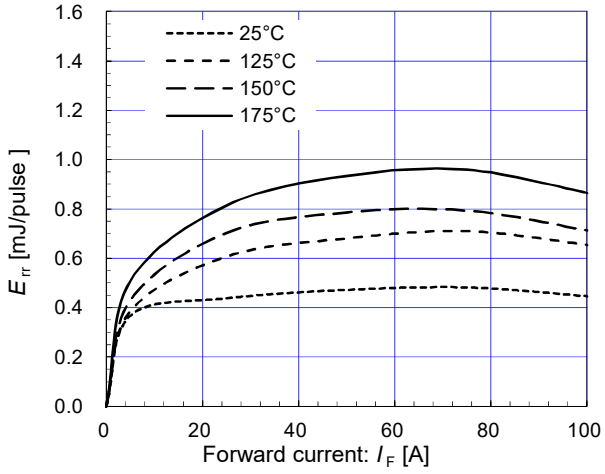
V_{CC}= 300V, V_{GE}= +15/-15 V I_C= 50A



[Inverter]

E_{rr} vs. Forward current (typ.)

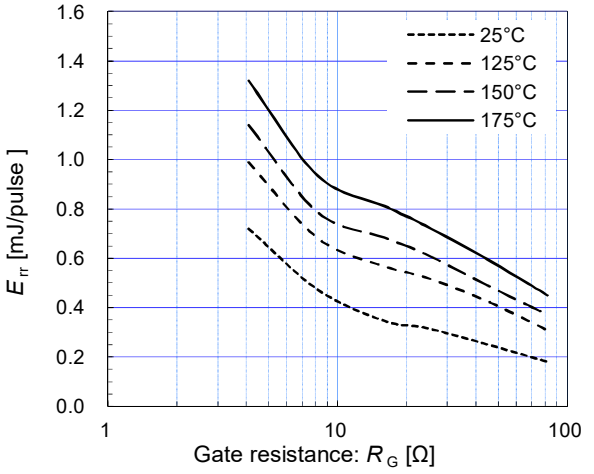
V_{CC}= 300V, V_{GE}= +15/-15 V R_G= 8.2 Ω



[Inverter]

E_{rr} vs. Gate resistance (typ.)

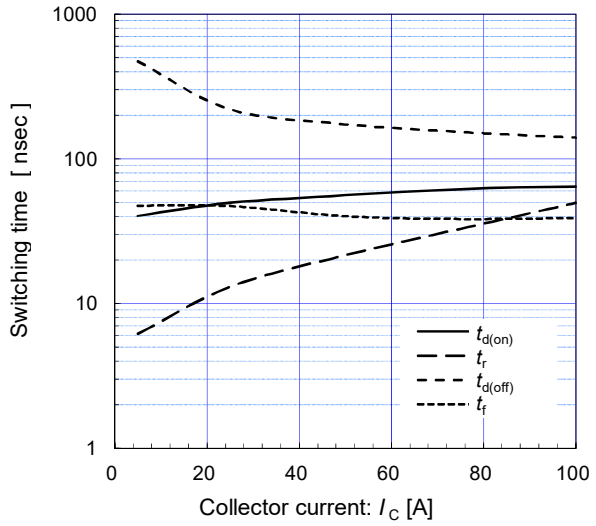
V_{CC}= 300V, V_{GE}= +15/-15 V I_C= 50A



[Inverter]

Switching time vs. Collector current (typ.)

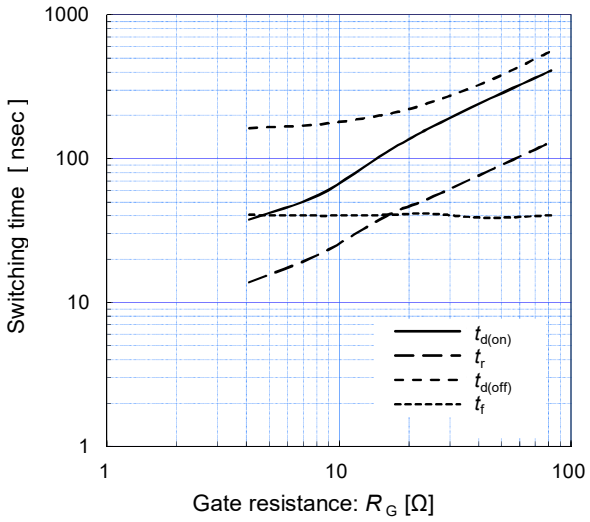
V_{CC}= 300V, R_G= 8.2Ω V_{GE}= +15/-15 V, T_{vj}= 25°C



[Inverter]

Switching time vs. Gate resistance (typ.)

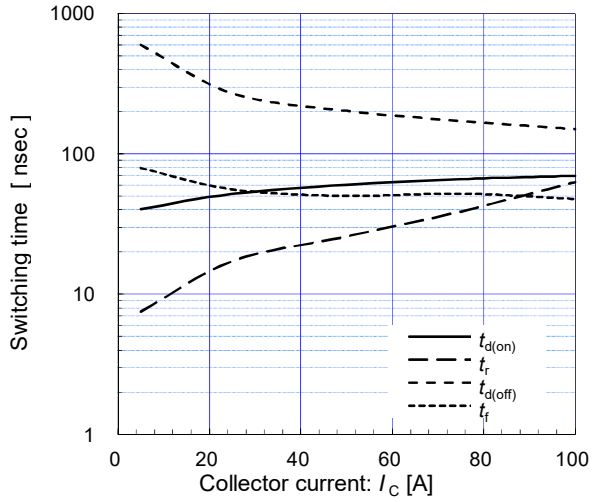
V_{CC}= 300V, I_C= 50A, V_{GE}= +15/-15 V, T_{vj}= 25°C



[Inverter]

Switching time vs. Collector current (typ.)

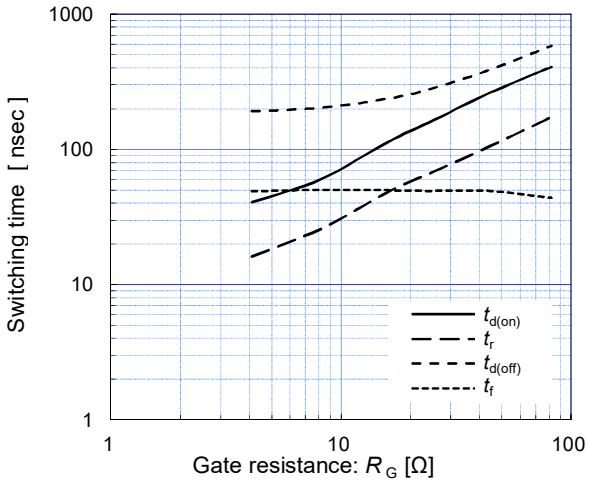
V_{CC}= 300V, R_G= 8.2Ω V_{GE}= +15/-15 V, T_{vj}= 175°C



[Inverter]

Switching time vs. Gate resistance (typ.)

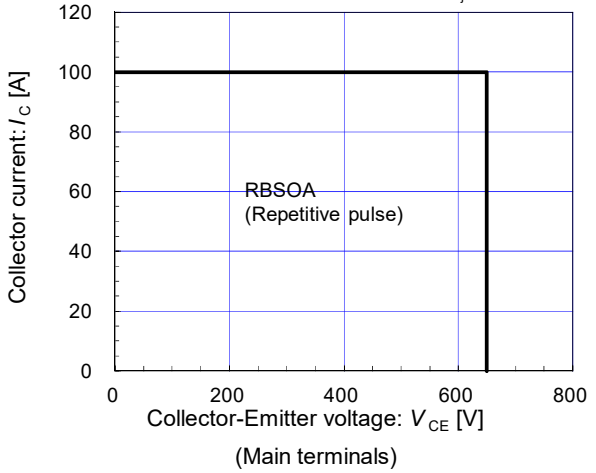
V_{CC}= 300V, I_C= 50A, V_{GE}= +15/-15 V, T_{vj}= 175°C



[Inverter]

Reverse bias safe operating area (max.)

V_{GE}= +15/-15 V, R_G>= 8.2Ω T_{vj}= 175°C

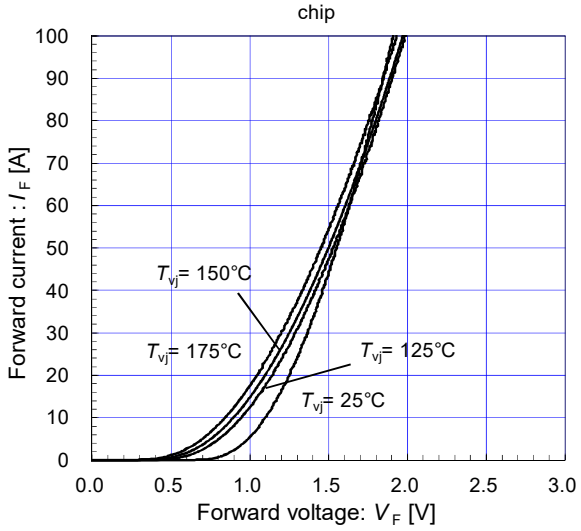


(Main terminals)

[Inverter]

Forward current vs. Forward voltage (typ.)

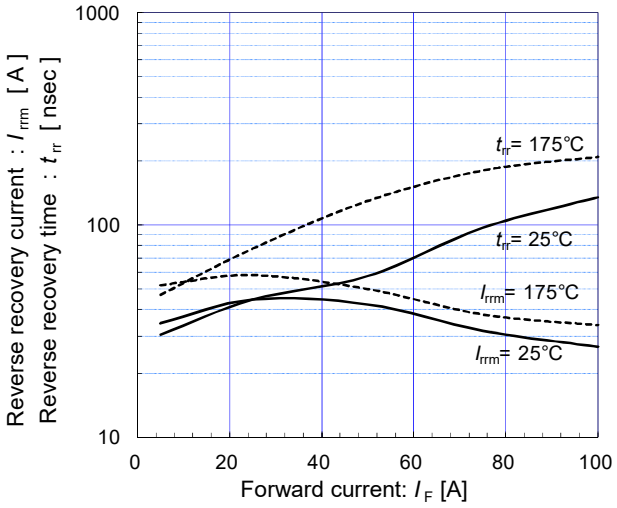
chip



[Inverter]

Reverse recovery characteristics (typ.)

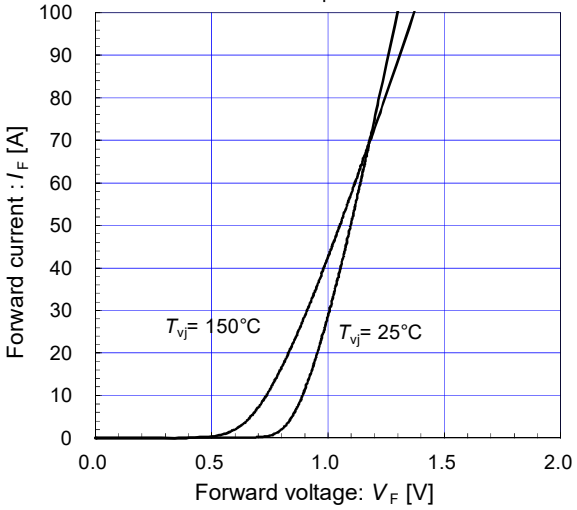
V_{CC}= 300V, V_{GE}= +15/-15 V, R_G= 8.2Ω



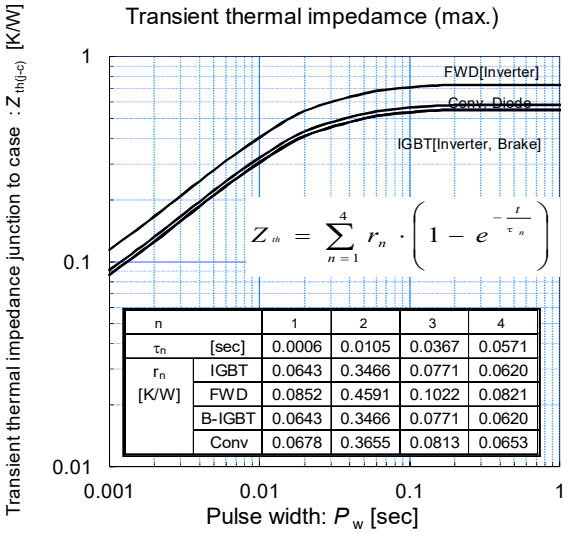
[Converter]

Forward current vs. Forward voltage (typ.)

chip



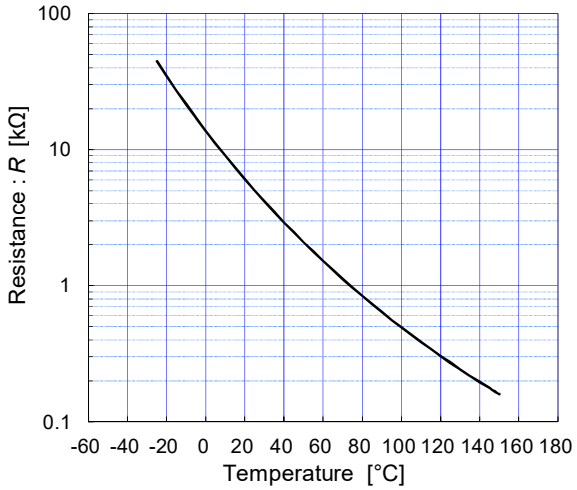
Transient thermal impedamce (max.)



n		1	2	3	4
τ_n	[sec]	0.0006	0.0105	0.0367	0.0571
r_n [K/W]	IGBT	0.0643	0.3466	0.0771	0.0620
	FWD	0.0852	0.4591	0.1022	0.0821
	B-IGBT	0.0643	0.3466	0.0771	0.0620
	Conv	0.0678	0.3655	0.0813	0.0653

[Thermistor]

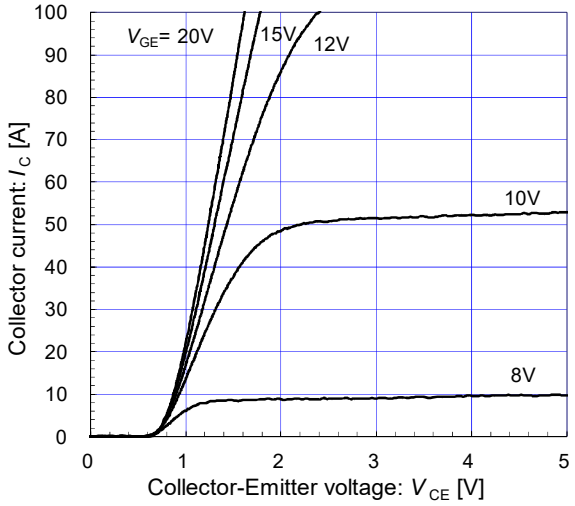
Temperature characteristic (typ.)



[Brake]

Collector current vs. Collector-Emitter voltage (typ.)

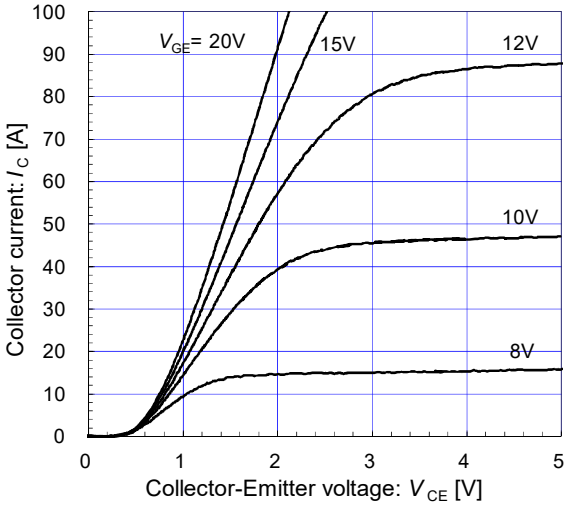
T_{vj}= 25°C / chip



[Brake]

Collector current vs. Collector-Emitter voltage (typ.)

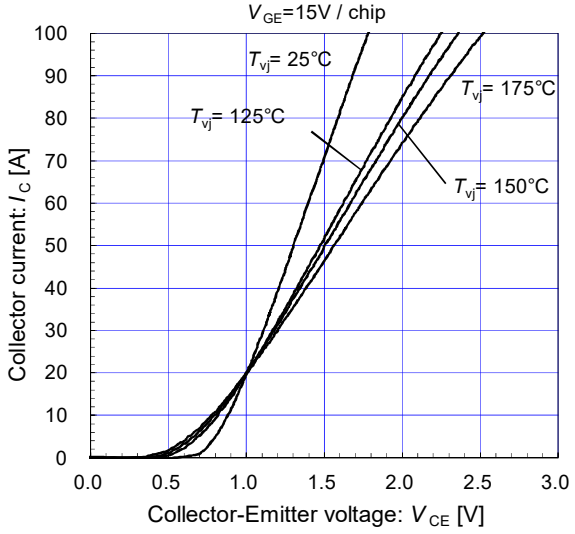
T_{vj}= 175°C / chip



[Brake]

Collector current vs. Collector-Emitter voltage (typ.)

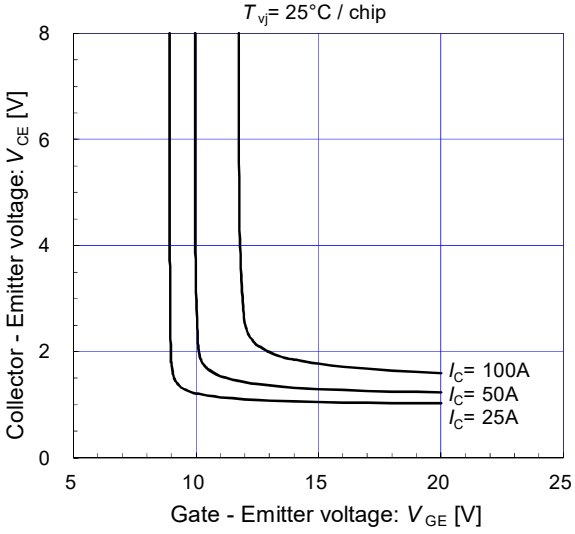
V_{GE}=15V / chip



[Brake]

Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)

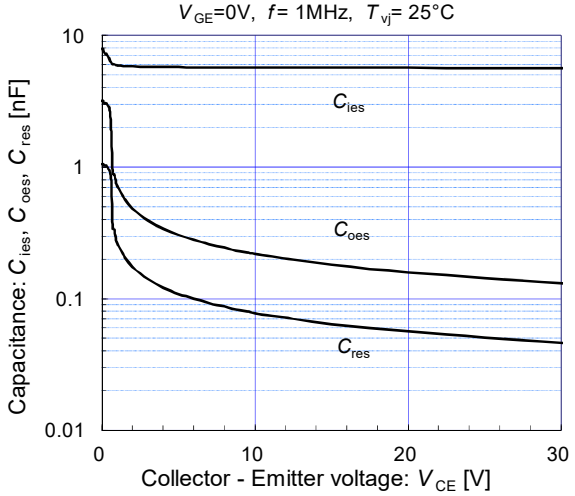
T_{vj}= 25°C / chip



[Brake]

Capacitance vs. Collector-Emitter voltage (typ.)

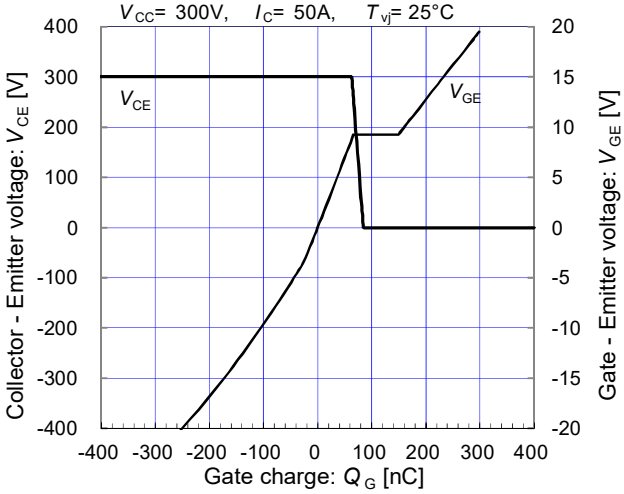
V_{GE}=0V, f= 1MHz, T_{vj}= 25°C



[Brake]

Dynamic gate charge (typ.)

V_{CC}= 300V, I_C= 50A, T_{vj}= 25°C



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1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of 3/2023. The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Catalog, be sure to obtain the latest specifications.

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・Machine tools ・Audiovisual equipment ・Electrical home appliances ・Personal equipment ・Industrial robots etc.

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7.

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