7MBR50XMA120-50

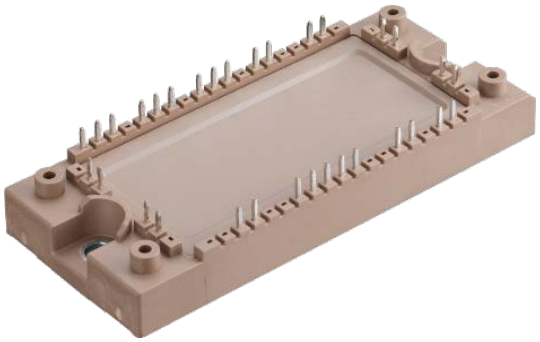
IGBT Modules

Power Module(X series)
1200V / 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

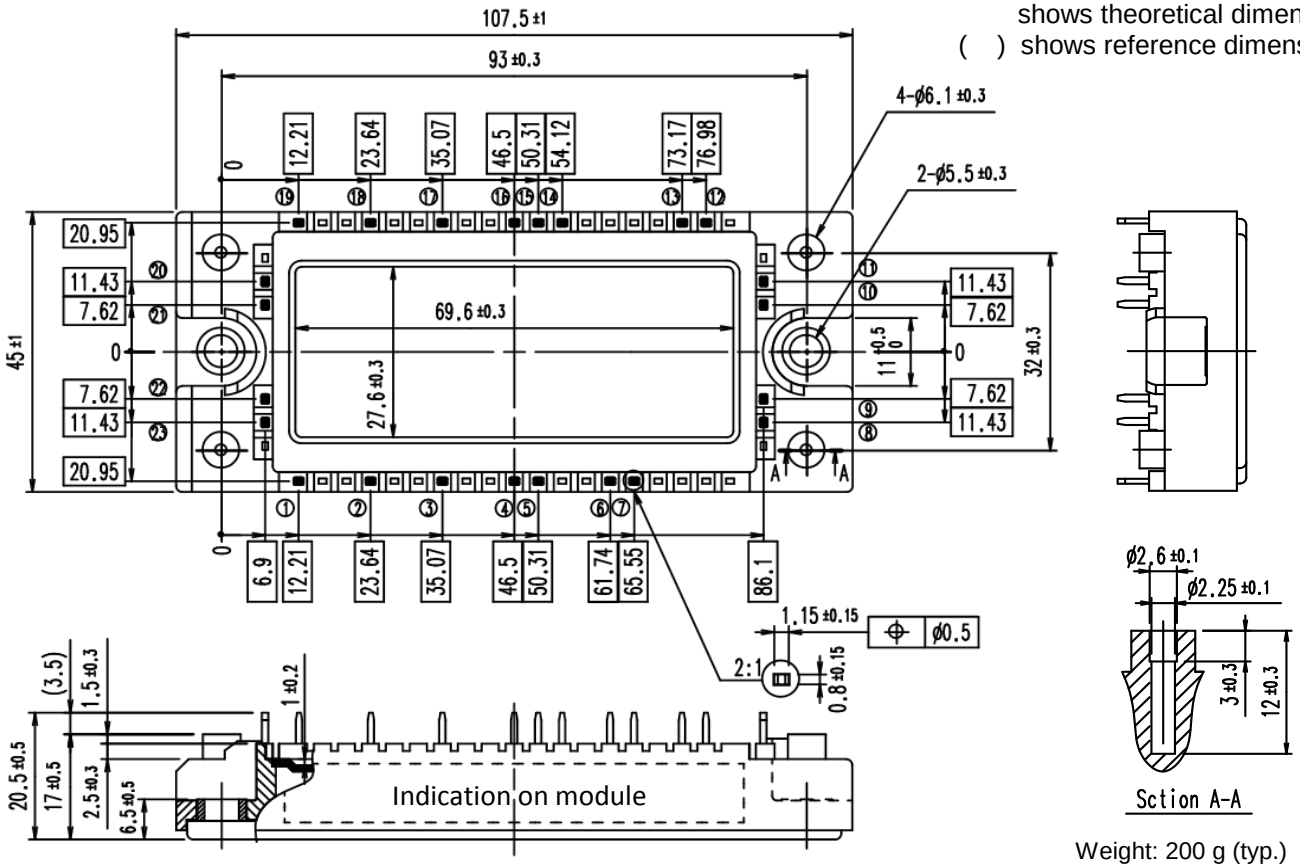


□Applications

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

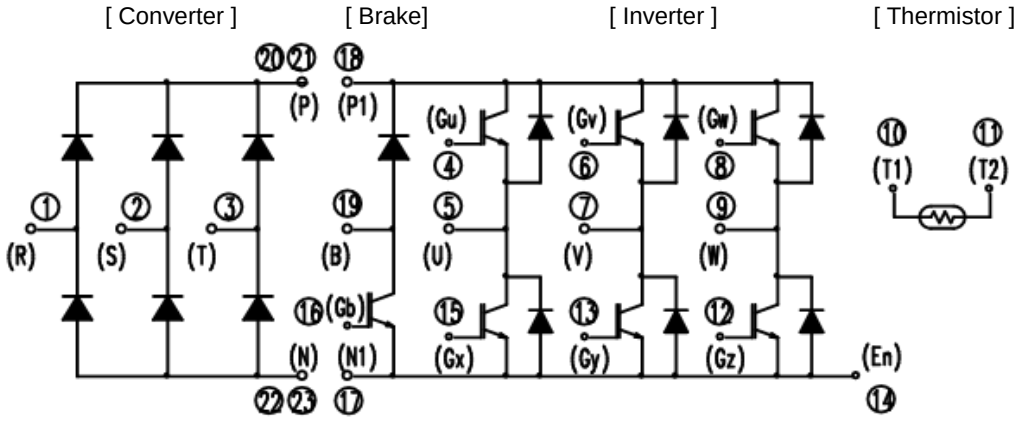
□ Outline drawing (Unit : mm)

shows theoretical dimensio
( ) shows reference dimensio



Weight: 200 g (typ.)

□ Equivalent circuit



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

	Items		Symbols	Conditions		Maximum ratings	Units
Inverter	Collector-Emitter voltage		V_{CES}			1200	V
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current		I_C	Continuous	T_c=100°C	50	A
			I_C pulse	1ms		100	
	Forward current		I_F	Continuous		50	
			I_F pulse	1ms		100	
	Collector power dissipation		P_C	1 device		250	W
Brake IGBT	Collector-Emitter voltage		V_{CES}			1200	V
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current		I_C	Continuous	T_c=100°C	35	A
			I_C pulse	1ms		70	
	Collector power dissipation		P_C	1 device		200	W
Brake FWD	Forward current		I_F	Continuous		15	A
			I_{FRM}	1ms		30	
	Repetitive peak reverse voltage		V_{RRM}			1200	V
Converter	Repetitive peak reverse voltage		V_{RRM}			1600	V
	Average output current		I_O	Three-phase full wave rectified	T_c=80°C	50	A
	Surge current (Non-Repetitive) (*1)		I_{FSM}	t=10ms, Half sine wave form	T_j=25°C	630	A
					T_j=150°C	520	
	I^2t (Non-Repetitive) (*1)		I^2t		T_j=25°C	2000	A^2s
					T_j=150°C	1350	
Junction temperature			T_j	Inverter, Brake		175	°C
				Converter		150	
Operating junction temperature (under switching conditions)			T_{jop}	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_{iso}	A.C. : 1min.		2500	Vrms
	between thermistor and others (*3)						
Screw torque (*4)	Mounting		-	M5		6.0	N·m

(*1) T_j : 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.

(*4) Recommendable value : Mounting 2.5 ~ 6.0 N·m (M5)

□ Electrical characteristics (at T_j = 25°C unless otherwise specified)

	Items	Symbols	Conditions		Characteristics min.	Characteristics typ.	Characteristics max.	Units
Inverter	Zero Gate voltage collector current	I_{CES}	V_{GE} = 0V V_{CE} = 1200V		-	-	50	μA
	Gate-Emitter leakage current	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_j=25°C	-	1.70	2.15	V
		$V_{CE(sat)}$ (chip)		T_j=25°C	-	1.50	1.95	
				T_j=125°C	-	1.85	-	
				T_j=150°C	-	1.95	-	
				T_j=175°C	-	2.00	-	
	Internal Gate resistance	r_g	-		-	0.0	-	Ω
	Capacitance	C_{ies}	V_{CE} = 10V, V_{GE} =0V, f = 1MHz		-	5.3	-	nF
		C_{oes}			-	0.18	-	
		C_{res}			-	0.05	-	
	Gate charge	Q_G	V_{CC} = 600V V_{GE}=-15 → +15V I_C = 50A		-	340	-	nC
	Forward voltage	V_F (terminal)	V_{GE} = 15V	T_j=25°C	-	2.00	2.45	V
		V_F (chip)	I_F = 50A	T_j=25°C	-	1.80	2.25	
				T_j=125°C	-	1.85	-	
				T_j=150°C	-	1.80	-	
				T_j=175°C	-	1.75	-	
	Switching time (*1)	$t_{d(on)}$	V_{CC} = 600V	T_j=25°C	-	0.09	-	μs
			I_C,I_F = 50A L_s = 30nH	T_j=125°C	-	0.09	-	
			V_{GE} = +15/-15 V	T_j=150°C	-	0.09	-	
			R_G = 18 Ω	T_j=175°C	-	0.10	-	
		t_r	V_{CC} = 600V	T_j=25°C	-	0.04	-	
			I_C,I_F = 50A L_s = 30nH	T_j=125°C	-	0.04	-	
			V_{GE} = +15/-15 V	T_j=150°C	-	0.04	-	
			R_G = 18 Ω	T_j=175°C	-	0.04	-	
		$t_{d(off)}$	V_{CC} = 600V	T_j=25°C	-	0.24	-	
			I_C,I_F = 50A L_s = 30nH	T_j=125°C	-	0.27	-	
			V_{GE} = +15/-15 V	T_j=150°C	-	0.27	-	
			R_G = 18 Ω	T_j=175°C	-	0.28	-	
		t_f	V_{CC} = 600V	T_j=25°C	-	0.11	-	
			I_C,I_F = 50A L_s = 30nH	T_j=125°C	-	0.17	-	
			V_{GE} = +15/-15 V	T_j=150°C	-	0.20	-	
			R_G = 18 Ω	T_j=175°C	-	0.21	-	
	Reverse recovery time	t_{rr}	V_{CC} = 600V	T_j=25°C	-	0.08	-	
			I_C,I_F = 50A L_s = 30nH	T_j=125°C	-	0.14	-	
			V_{GE} = +15/-15 V	T_j=150°C	-	0.17	-	
			R_G = 18 Ω	T_j=175°C	-	0.19	-	

(*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.	Characteristics typ.	Characteristics max.	Units
Inverter	Switching loss (per pulse)	E_{on}	V_{CC} = 600V, I_C,I_F = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 18 Ω	T_j=25°C	-	3.78	-	mJ
				T_j=125°C	-	4.90	-	
				T_j=150°C	-	5.46	-	
				T_j=175°C	-	5.83	-	
		E_{off}	V_{CC} = 600V, I_C,I_F = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 18 Ω	T_j=25°C	-	3.36	-	
				T_j=125°C	-	4.31	-	
				T_j=150°C	-	4.62	-	
				T_j=175°C	-	4.96	-	
		E_{rr}	V_{CC} = 600V, I_C,I_F = 50A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 18 Ω	T_j=25°C	-	1.43	-	
				T_j=125°C	-	2.52	-	
				T_j=150°C	-	3.27	-	
				T_j=175°C	-	3.72	-	
Brake	Zero Gate voltage collector current	I_{CES}	V_{GE} = 0V, V_{CE} = 1200V		-	-	50	μA
	Gate-Emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = +20/-20V		-	-	100	nA
	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	V_{GE} = 15V, I_C = 35A	T_j=25°C	-	1.65	2.10	V
		$V_{CE(sat)}$ (chip)		T_j=25°C	-	1.50	1.95	
				T_j=125°C	-	1.85	-	
				T_j=150°C	-	1.95	-	
				T_j=175°C	-	2.00	-	
	Internal Gate resistance	r_g	-		-	0	-	Ω
	Switching time (*1)	$t_{d(on)}$	V_{CC} = 600V, I_C = 35A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 30 Ω	T_j=25°C	-	0.10	-	μs
				T_j=125°C	-	0.10	-	
				T_j=150°C	-	0.11	-	
				T_j=175°C	-	0.11	-	
		t_r	V_{CC} = 600V, I_C = 35A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 30 Ω	T_j=25°C	-	0.04	-	
				T_j=125°C	-	0.05	-	
				T_j=150°C	-	0.05	-	
				T_j=175°C	-	0.05	-	
		$t_{d(off)}$	V_{CC} = 600V, I_C = 35A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 30 Ω	T_j=25°C	-	0.23	-	
				T_j=125°C	-	0.27	-	
				T_j=150°C	-	0.27	-	
				T_j=175°C	-	0.27	-	
		t_f	V_{CC} = 600V, I_C = 35A, L_s = 30nH, V_{GE} = +15/-15 V, R_G = 30 Ω	T_j=25°C	-	0.12	-	
				T_j=125°C	-	0.18	-	
				T_j=150°C	-	0.20	-	
				T_j=175°C	-	0.21	-	
	Reverse current	I_{RRM}	V_R = 1200V		-	-	50	μA
	Forward voltage	V_F (terminal)	I_F = 15A	T_j=25°C	-	1.95	2.40	V
		V_F (chip)	I_F = 15A	T_j=25°C	-	1.80	2.25	
				T_j=125°C	-	1.85	-	
				T_j=150°C	-	1.80	-	
				T_j=175°C	-	1.75	-	
Converter	Reverse current	I_{RRM}	V_R = 1600V		-	-	50	μA
	Forward voltage	V_{FM}	I_F = 50A	terminal	-	1.25	1.70	V
				chip	-	1.05	1.50	
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

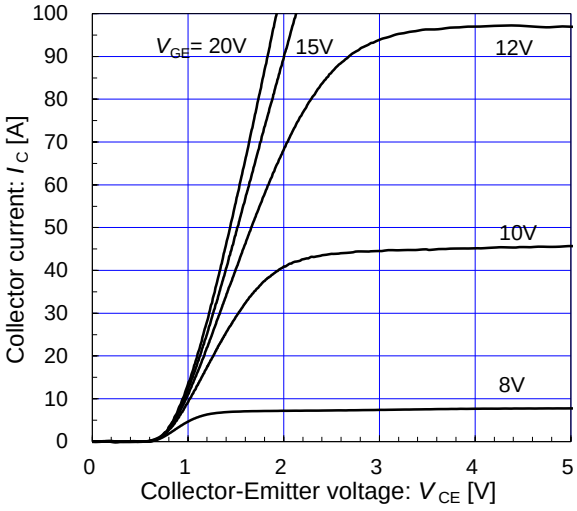
Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance (1device)	$R_{th(j-c)}$	Inverter IGBT	-	-	0.59	°C/W
		Inverter FWD	-	-	0.71	
		Brake IGBT	-	-	0.74	
		Brake FWD	-	-	1.85	
		Converter Diode	-	-	0.72	
Contact thermal resistance (1 IGBT+1 FWD) (*1)	$R_{th(c-f)}$	with 1 W/(m·K) thermal grease	-	0.05	-	

(*1) This is the value which is defined mounting on the additional cooling fin with thermal grease.

[Inverter]

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

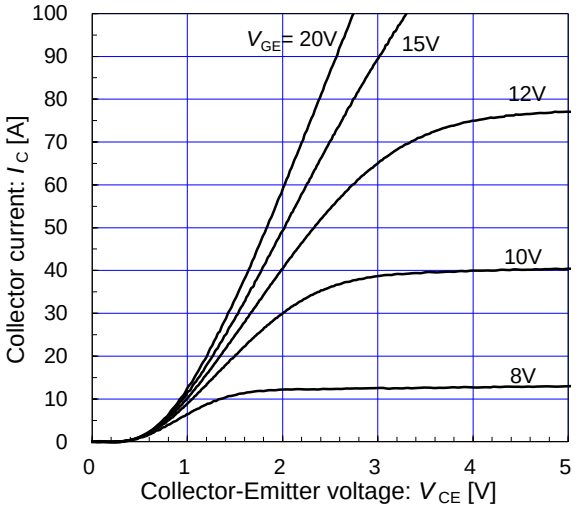
T_j= 25°C / chip



[Inverter]

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

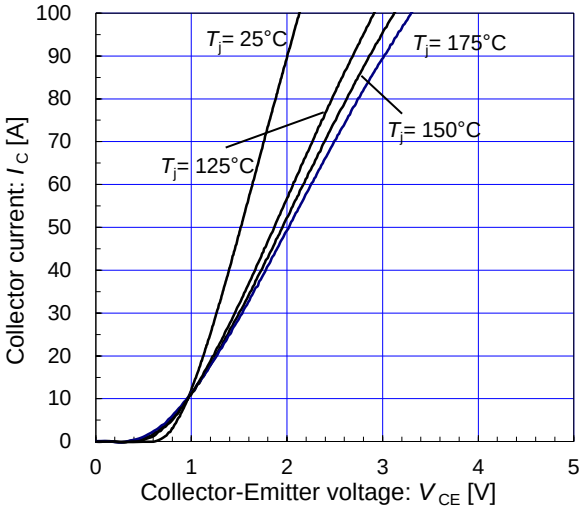
T_j= 175°C / chip



[Inverter]

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

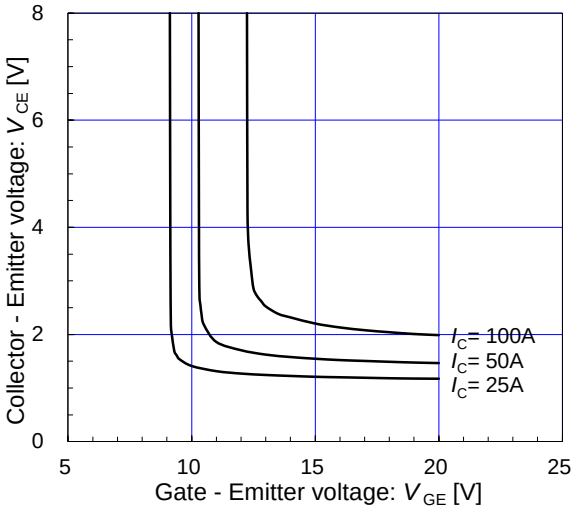
V_{GE}=15V / chip



[Inverter]

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

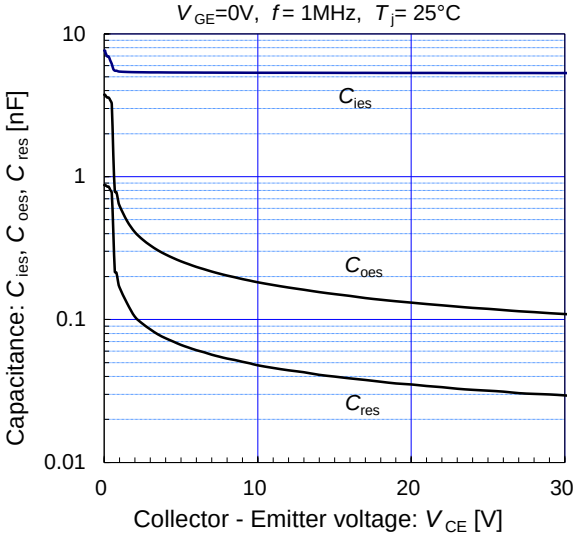
T_j= 25°C / chip



[Inverter]

Capacitance vs. Collector-Emitter voltage (typ.)

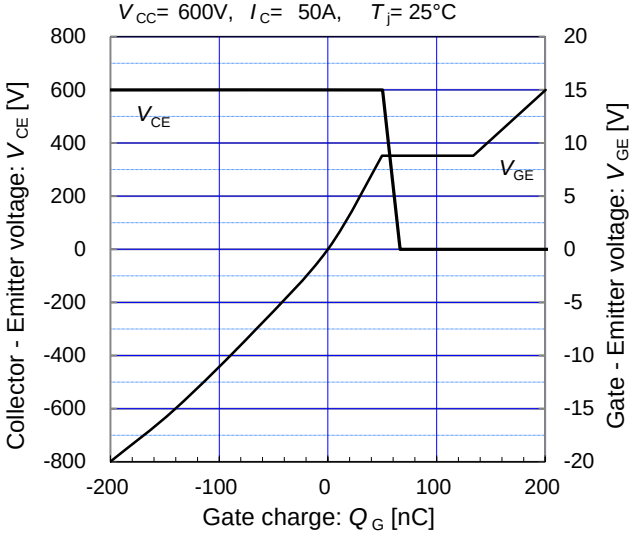
V_{GE}=0V, f= 1MHz, T_j= 25°C



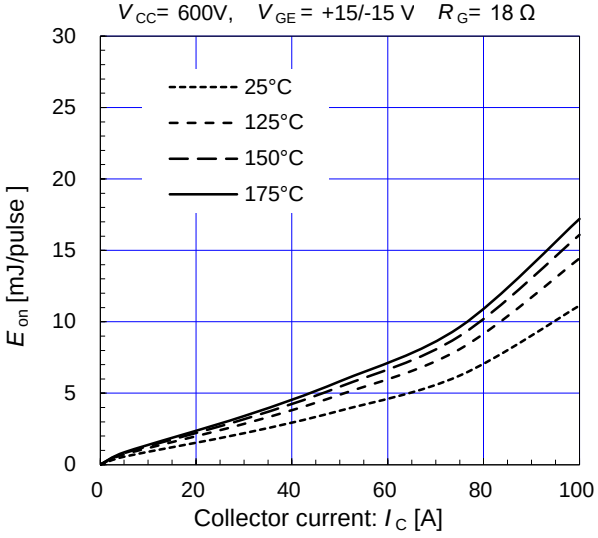
[Inverter]

Dynamic Gate charge (typ.)

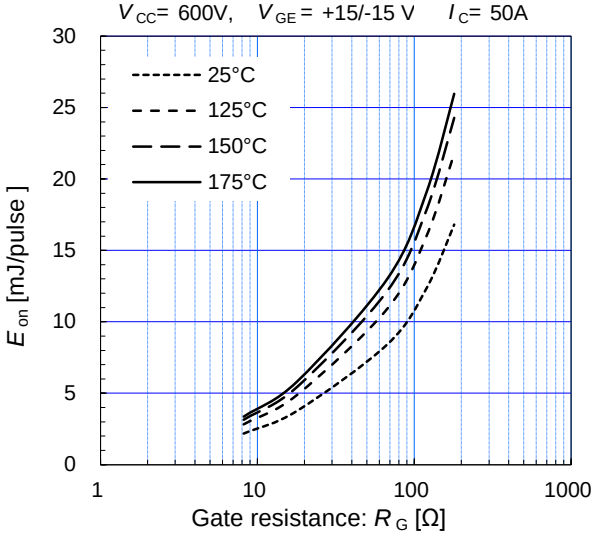
V_{CC}= 600V, I_C= 50A, T_j= 25°C



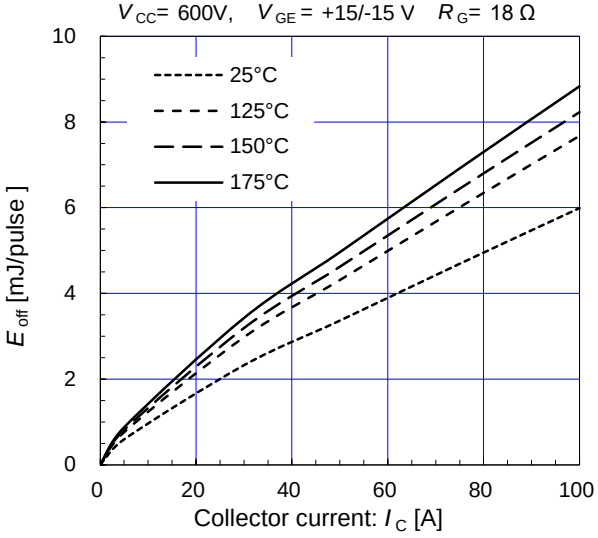
[Inverter]
E_{on} vs. Collector current (typ.)
V_{CC}= 600V, V_{GE} = +15/-15 V R_G= 18 Ω



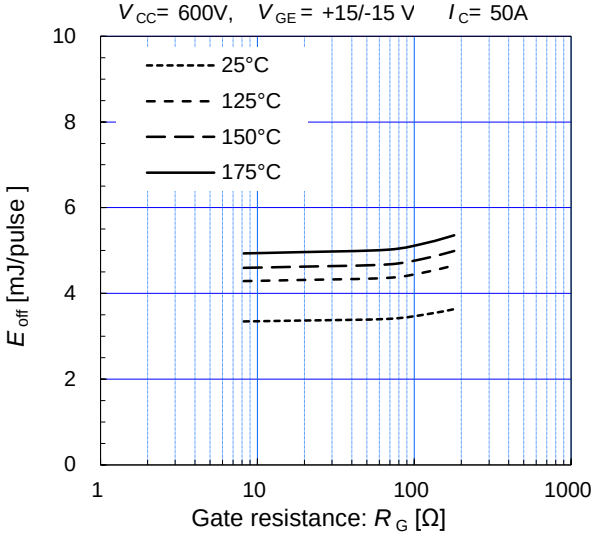
[Inverter]
E_{on} vs. Gate resistance (typ.)
V_{CC}= 600V, V_{GE} = +15/-15 V I_C= 50A



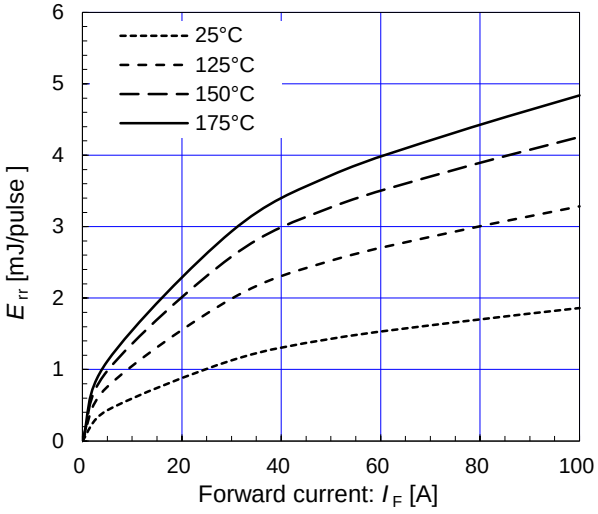
[Inverter]
E_{off} vs. Collector current (typ.)
V_{CC}= 600V, V_{GE} = +15/-15 V R_G= 18 Ω



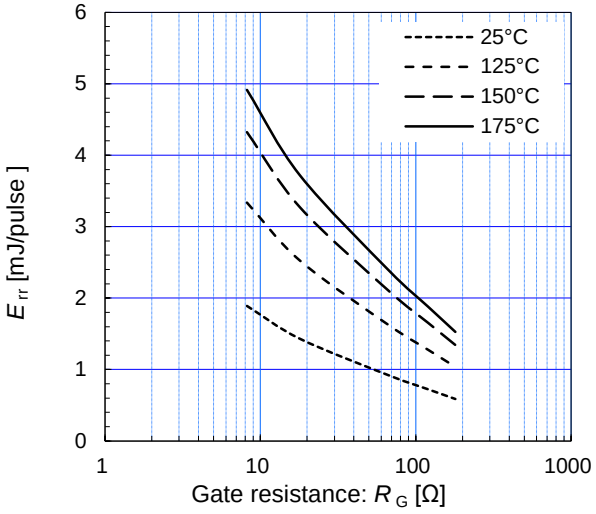
[Inverter]
E_{off} vs. Gate resistance (typ.)
V_{CC}= 600V, V_{GE} = +15/-15 V I_C= 50A



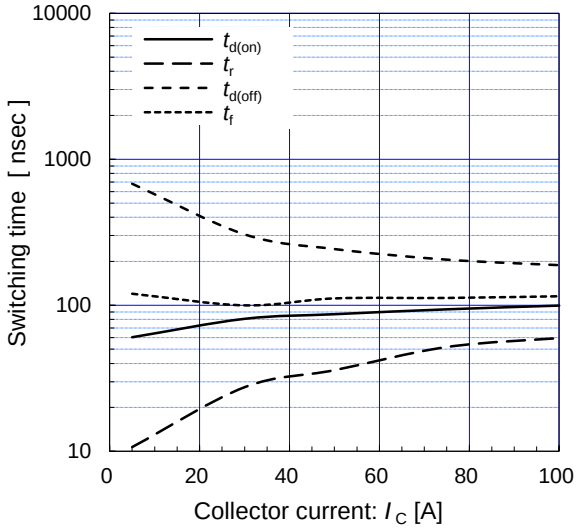
[Inverter]
E_{rr} vs. Forward current (typ.)
V_{CC}= 600V, V_{GE} = +15/-15 V R_G= 18 Ω



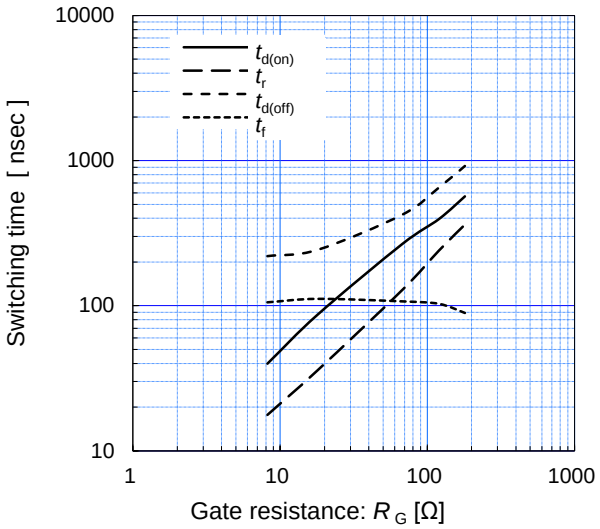
[Inverter]
E_{rr} vs. Gate resistance (typ.)
V_{CC}= 600V, V_{GE} = +15/-15 V I_C= 50A



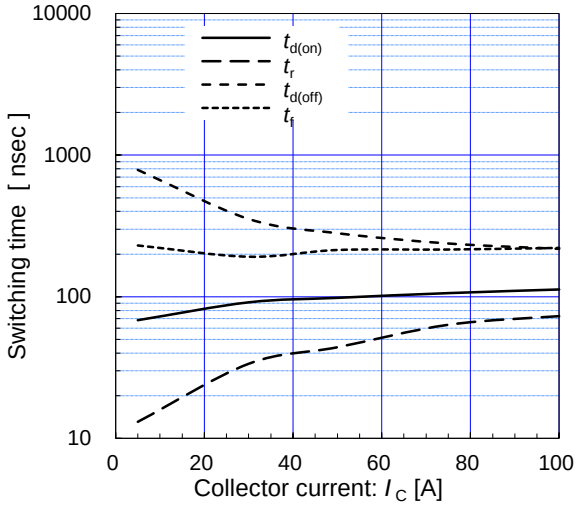
[Inverter]
Switching time vs. Collector current (typ.)
V_{CC}= 600V, R_G= 18Ω V_{GE}= +15/-15 V, T_j= 25°C



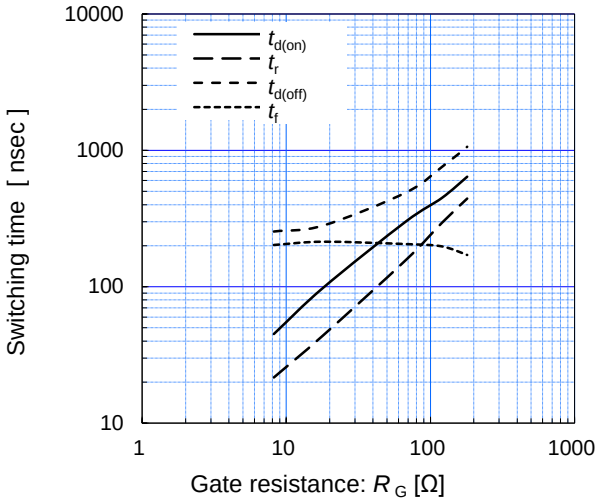
[Inverter]
Switching time vs. Gate resistance (typ.)
V_{CC}= 600V, I_C= 50A, V_{GE}= +15/-15 V, T_j= 25°C



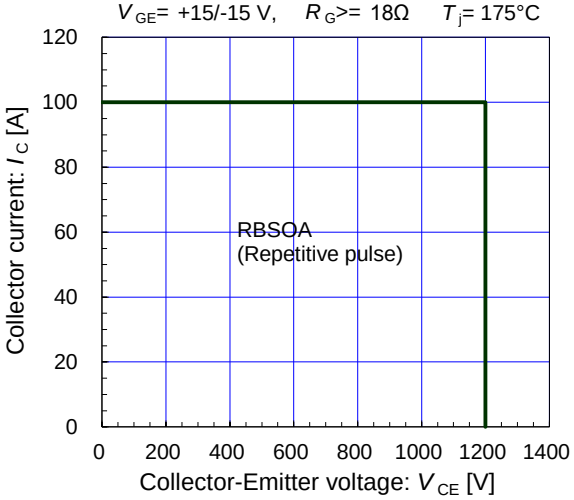
[Inverter]
Switching time vs. Collector current (typ.)
V_{CC}= 600V, R_G= 18Ω V_{GE}= +15/-15 V, T_j= 175°C



[Inverter]
Switching time vs. Gate resistance (typ.)
V_{CC}= 600V, I_C= 50A, V_{GE}= +15/-15 V, T_j= 175°C



[Inverter]
Reverse bias safe operating area (max.)
V_{GE}= +15/-15 V, R_G>= 18Ω T_j= 175°C

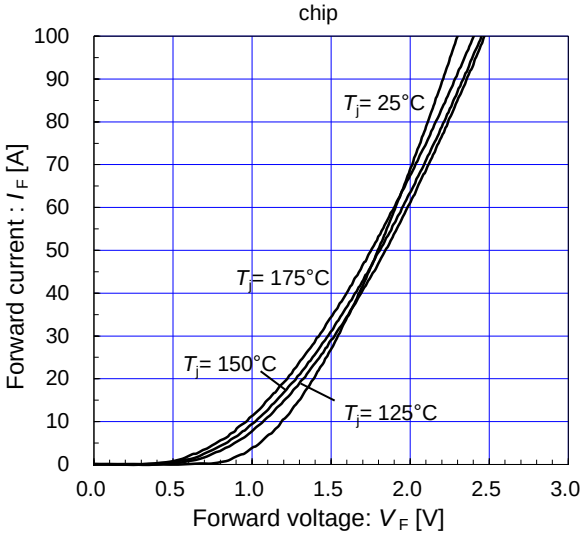


(Main terminals)

[Inverter]

Forward current vs. Forward voltage (typ.)

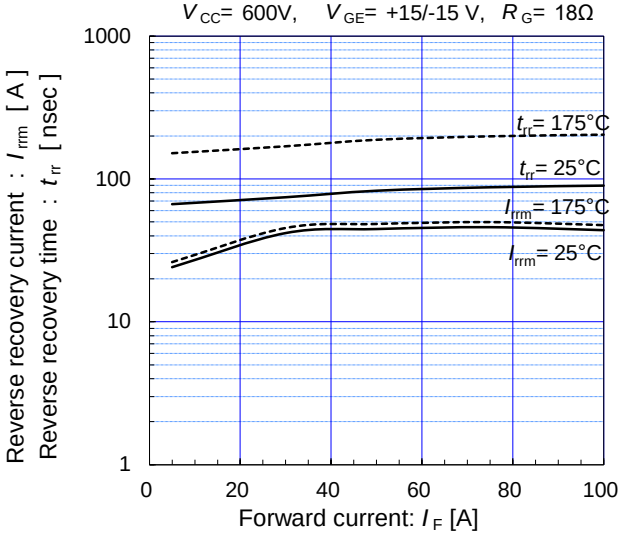
chip



[Inverter]

Reverse recovery characteristics (typ.)

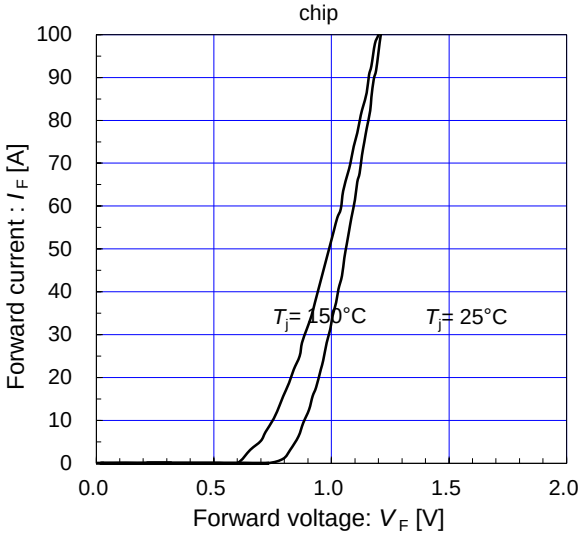
V_{CC}= 600V, V_{GE}= +15/-15 V, R_G= 18Ω



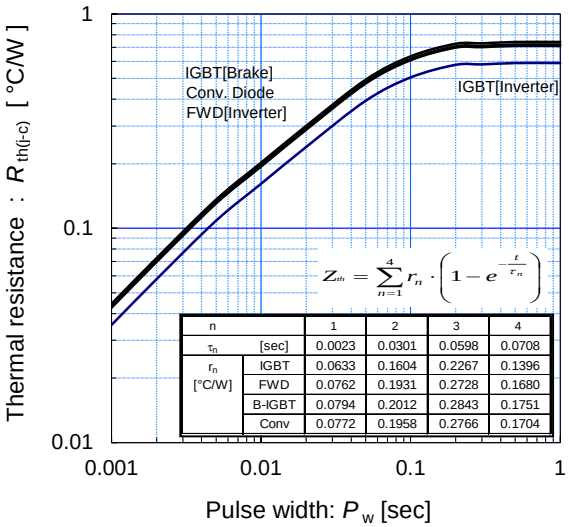
[Converter]

Forward current vs. Forward voltage (typ.)

chip



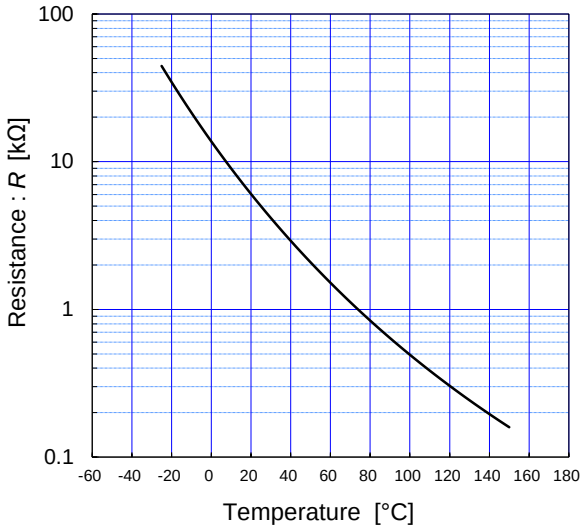
Transient thermal resistance (max.)



n		1	2	3	4
τ_n	[sec]	0.0023	0.0301	0.0598	0.0708
r_n [°C/W]	IGBT	0.0633	0.1604	0.2267	0.1396
	FWD	0.0762	0.1931	0.2728	0.1680
	B-IGBT	0.0794	0.2012	0.2843	0.1751
	Conv	0.0772	0.1958	0.2766	0.1704

[Thermistor]

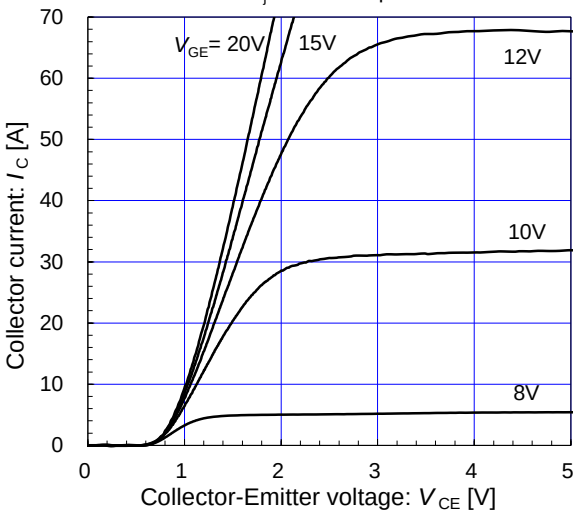
Temperature characteristic (typ.)



[Brake]

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

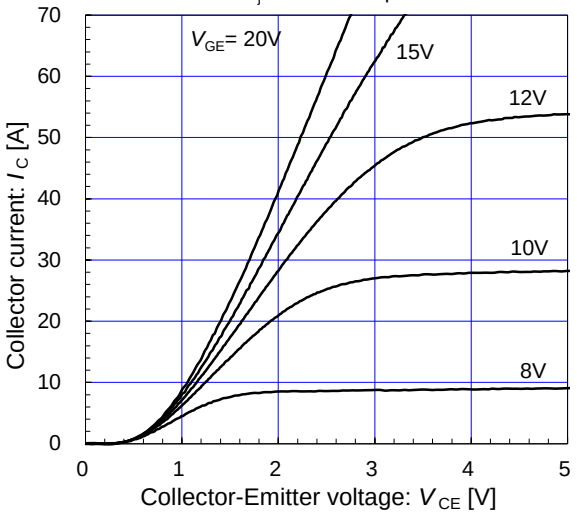
T_j= 25°C / chip



[Brake]

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

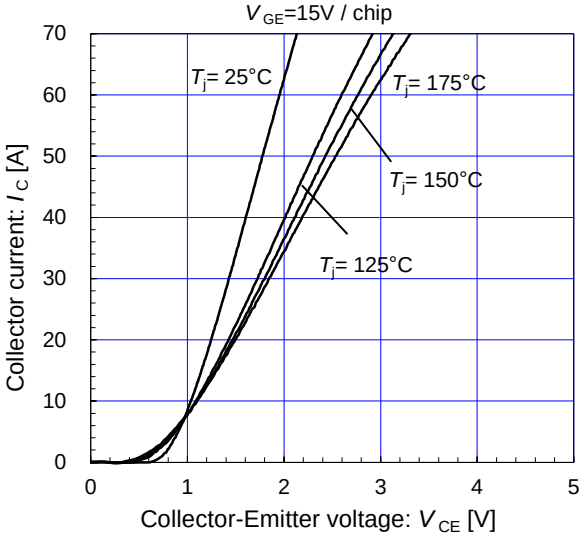
T_j= 175°C / chip



[Brake]

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

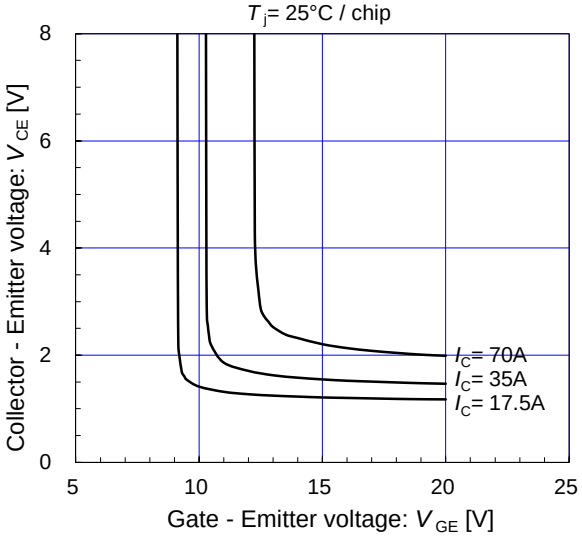
V_{GE}=15V / chip



[Brake]

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

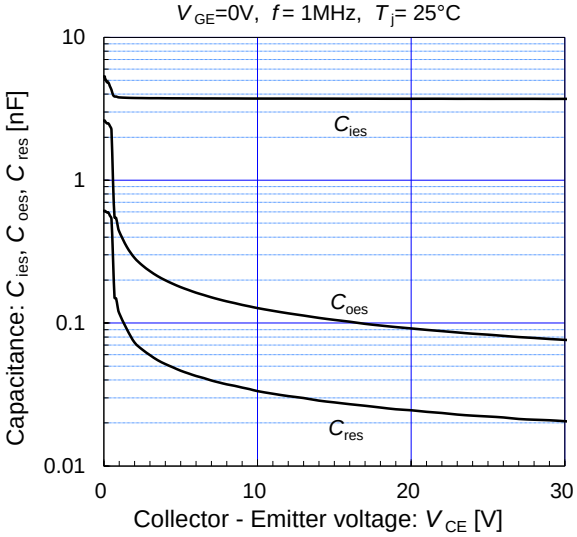
T_j= 25°C / chip



[Brake]

Capacitance vs. Collector-Emitter voltage (typ.)

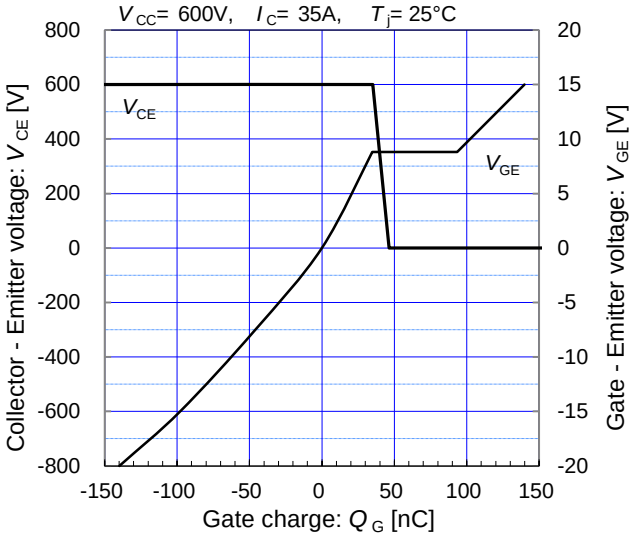
V_{GE}=0V, f= 1MHz, T_j= 25°C



[Brake]

Dynamic Gate charge (typ.)

V_{CC}= 600V, I_C= 35A, T_j= 25°C



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4. The products introduced in this Catalog are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
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・Emergency equipment for responding to disasters and anti-burglary devices ・Safety devices ・Medical equipment

6. Do not use products in this Catalog for the equipment requiring strict reliability such as the following and equivalents to strategic equipment (without limitation).
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7.

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