

# 7MBR50XRKD120-50

IGBT Modules

**Power Module(X series)**  
1200V / 50A / PIM

■ **Features**

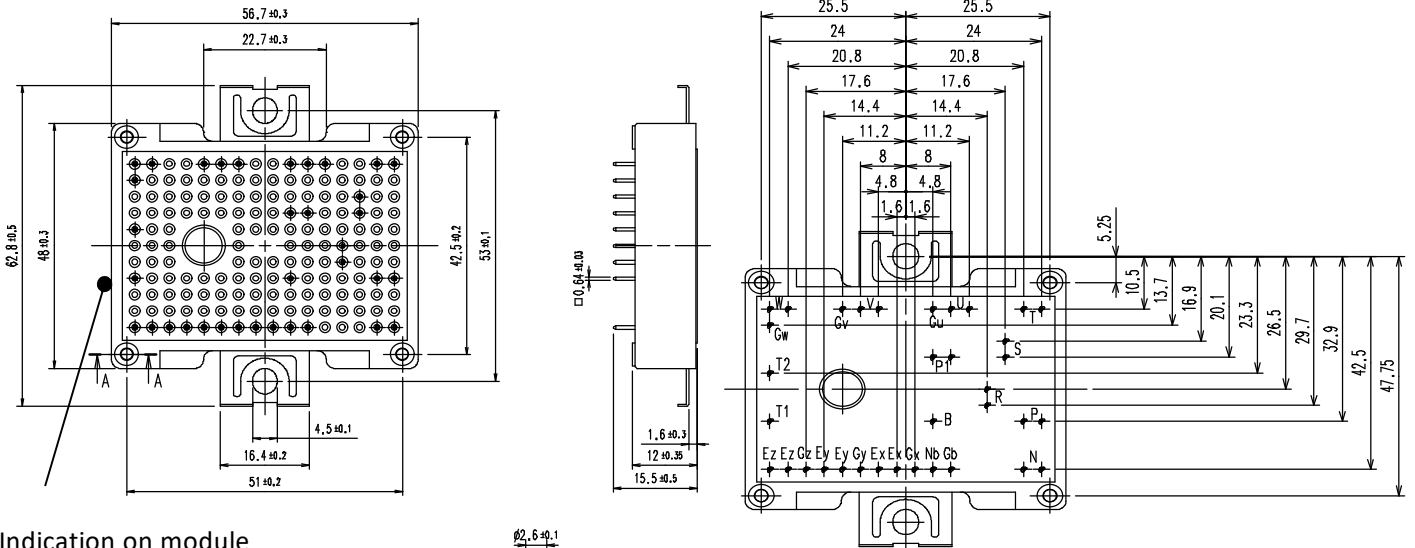
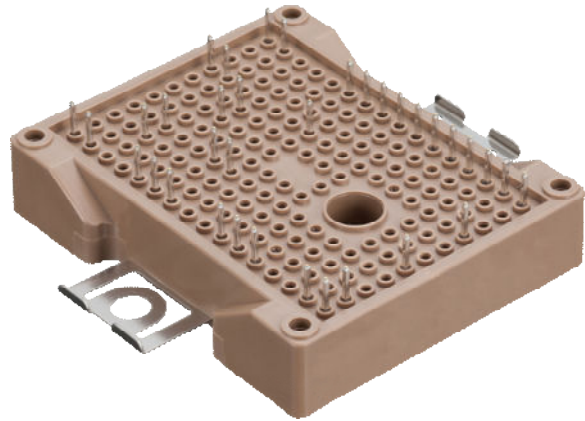
- Low  $V_{CE(sat)}$
- Compact Package
- P.C.Board Mount Module
- Converter Diode Bridge Dynamic Brake Circuit
- RoHS compliant Product

■ **Applications**

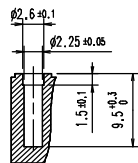
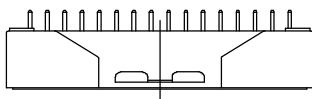
- Inverter for Motor Drive
- AC and DC Servo Drive Amplifier
- Uninterruptible Power Supply

■ **Outline drawing ( Unit : mm )**

■ **Typical appearance**



Indication on module

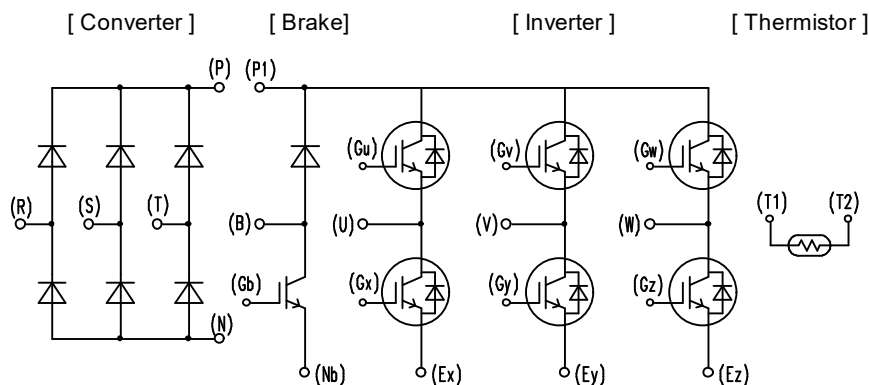


断面 A-A (1.5:1)  
SECTION A-A

ALL DIMENSION IN THE LEFT FIGURE ARE REFERENCE  
PIN POSITION TO DESIGNED CENTER OF MODULE  $\Phi \pm 0.8$   
PIN-GRID SPACING 3.2mm

Weight: 45 g (typ.)

■ **Equivalent circuit**



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**IGBT Modules**
**■ Maximum ratings ( at  $T_c = 25^\circ\text{C}$  unless otherwise specified )**

Items		Symbols	Conditions	Maximum ratings	Units	
Inverter	Collector-Emitter voltage, Gate-Emitter short-circuited	$V_{CES}$		1200	V	
	Gate-Emitter voltage, Collector-Emitter short-circuited	$V_{GES}$		$\pm 20$	V	
	Collector current	$I_C$	Continuous   $T_c=100^\circ\text{C}$	50	A	
	Repetitive peak collector current	$I_{CRM}$	1ms	100		
	Reverse-Conducting current	$I_{RC}$	Continuous	50		
	Repetitive peak reverse-conducting current	$I_{RCRM}$	1ms	100		
	Total power dissipation	$P_{tot}$	1 device	500	W	
Brake IGBT	Collector-Emitter voltage, Gate-Emitter short-circuited	$V_{CES}$		1200	V	
	Gate-Emitter voltage, Collector-Emitter short-circuited	$V_{GES}$		$\pm 20$	V	
	Collector current	$I_C$	Continuous   $T_c=100^\circ\text{C}$	35	A	
	Repetitive peak collector current	$I_{CRM}$	1ms	70		
	Total power dissipation	$P_{tot}$	1 device	255	W	
Brake FWD	Forward current	$I_F$	Continuous	10	A	
	Repetitive peak forward current	$I_{FRM}$	1ms	20		
	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 current   $T_c=80^\circ\text{C}$	50	A	
	Surge forward current (Non-Repetitive) (*1)	$I_{FSM}$	$t=10\text{ms}$ , Half sine wave form	$T_{vj}=25^\circ\text{C}$ $T_{vj}=150^\circ\text{C}$	470 385	A
	$I^2t$ (Non-Repetitive) (*1)	$I^2t$		$T_{vj}=25^\circ\text{C}$ $T_{vj}=150^\circ\text{C}$	1105 750	
	Virtual junction temperature	$T_{vj}$	Inverter, Brake Converter	175 150	$^\circ\text{C}$	
Operating virtual junction temperature (under switching conditions)	$T_{vjop}$	Inverter, Brake Converter	175 150			
Case temperature	$T_c$		125			
Storage temperature	$T_{stg}$		-40 ~ 125			
Isolation voltage	between terminals and copper base (*2) between thermistor and others (*3)	$V_{isol}$	A.C. : 1min.	2500		Vrms
Mounting torque for 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.

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**IGBT Modules**
**■ Electrical characteristics ( at  $T_{vj} = 25^{\circ}\text{C}$  unless otherwise specified)**

Items	Symbols	Conditions	Characteristics			Units	
			min.	typ.	max.		
Collector-Emitter cut-off current , Gate-Emitter short-circuited	$I_{CES}$	$V_{GE} = 0\text{V}$ $V_{CE} = 1200\text{V}$	-	-	50	$\mu\text{A}$	
Gate leakage current , Collector-Emitter short-circuited	$I_{GES}$	$V_{CE} = 0\text{V}$ $V_{GE} = +20/-20\text{V}$	-	-	100	nA	
Gate-Emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = 20\text{V}$ $I_C = 50\text{mA}$	6.0	6.5	7.0	V	
Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15\text{V}$ $I_C = 50\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	2.00	2.50	V
			$T_{vj}=25^{\circ}\text{C}$	-	1.80	2.25	
	$T_{vj}=125^{\circ}\text{C}$		-	2.25	-		
	$T_{vj}=150^{\circ}\text{C}$		-	2.30	-		
	$V_{CE(sat)}$ (chip)		$T_{vj}=175^{\circ}\text{C}$	-	2.45	-	
Internal gate resistance	$r_g$	-	-	0	-	$\Omega$	
Input capacitance	$C_{ies}$	$V_{CE} = 10\text{V}, V_{GE}=0\text{V}, f = 1\text{MHz}$	-	5.7	-	nF	
Output capacitance	$C_{oes}$		-	0.26	-		
Reverse transfer capacitance	$C_{res}$		-	0.06	-		
Gate charge	$Q_G$	$V_{CC} = 600\text{V}$ $V_{GE}=-15 \rightarrow +15\text{V}$ $I_C = 50\text{A}$	-	420	-	nC	
Reverse-conducting voltage	$V_{RC(terminal)}$	$I_{RC} = 50\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	2.05	2.55	V
			$T_{vj}=25^{\circ}\text{C}$	-	1.85	2.30	
	$T_{vj}=125^{\circ}\text{C}$		-	2.15	-		
	$T_{vj}=150^{\circ}\text{C}$		-	2.15	-		
	$V_{RC}$ (chip)		$T_{vj}=175^{\circ}\text{C}$	-	2.10	-	
Turn-on delay time(*1)	$t_{d(on)}$	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.07	-	$\mu\text{s}$
			$T_{vj}=125^{\circ}\text{C}$	-	0.07	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.07	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.07	-	
Rise time	$t_r$	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.03	-	$\mu\text{s}$
			$T_{vj}=125^{\circ}\text{C}$	-	0.04	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.04	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.04	-	
Turn-off delay time(*2)	$t_{d(off)}$	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.17	-	$\mu\text{s}$
			$T_{vj}=125^{\circ}\text{C}$	-	0.20	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.21	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.22	-	
Fall time	$t_f$	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.05	-	$\mu\text{s}$
			$T_{vj}=125^{\circ}\text{C}$	-	0.10	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.12	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.14	-	
Forward recovery time	$t_{fr}$	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.14	-	$\mu\text{s}$
			$T_{vj}=125^{\circ}\text{C}$	-	0.20	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.21	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.23	-	

 (\*1) Turn on time ( $t_{on}$ ) =  $t_{d(on)} + t_r$ 

 (\*2) Turn off time ( $t_{off}$ ) =  $t_{d(off)} + t_f$

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Items	Symbols	Conditions	Characteristics			Units	
			min.	typ.	max.		
Inverter	Turn-on energy (per puls)	$V_{CC} = 600V$ $I_C, I_{RC} = 50A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 10 \Omega$	$T_{vj}=25^\circ C$	-	4.29	-	mJ
			$T_{vj}=125^\circ C$	-	5.98	-	
			$T_{vj}=150^\circ C$	-	6.54	-	
			$T_{vj}=175^\circ C$	-	7.06	-	
	Turn-off energy (per puls)	$V_{CC} = 600V$ $I_C, I_{RC} = 50A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 10 \Omega$	$T_{vj}=25^\circ C$	-	1.91	-	
			$T_{vj}=125^\circ C$	-	2.70	-	
			$T_{vj}=150^\circ C$	-	2.95	-	
			$T_{vj}=175^\circ C$	-	3.20	-	
	Forward recovery energy (per puls)	$V_{CC} = 600V$ $I_C, I_{RC} = 50A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 10 \Omega$	$T_{vj}=25^\circ C$	-	1.66	-	
$T_{vj}=125^\circ C$			-	2.95	-		
$T_{vj}=150^\circ C$			-	3.24	-		
$T_{vj}=175^\circ C$			-	3.50	-		
Collector-Emitter cut-off current, Gate-Emitter short-circuited	$I_{CES}$	$V_{GE} = 0V$ $V_{CE} = 1200V$	-	-	50	$\mu A$	
Gate leakage current, Collector-Emitter short-circuited	$I_{GES}$	$V_{CE} = 0V, \quad V_{GE} = +20/-20V$	-	-	100	nA	
Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_C = 35A$	$T_{vj}=25^\circ C$	-	1.65	2.10	V
			$T_{vj}=125^\circ C$	-	1.50	1.95	
	$V_{CE(sat)}$ (chip)		$T_{vj}=150^\circ C$	-	1.85	-	
			$T_{vj}=175^\circ C$	-	1.95	-	
Internal gate resistance	$r_g$	-	-	0	-	$\Omega$	
Brake	Turn-on delay time(*1)	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	0.04	-	$\mu s$
			$T_{vj}=125^\circ C$	-	0.04	-	
			$T_{vj}=150^\circ C$	-	0.04	-	
			$T_{vj}=175^\circ C$	-	0.04	-	
	Rise time	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	0.02	-	
			$T_{vj}=125^\circ C$	-	0.02	-	
			$T_{vj}=150^\circ C$	-	0.02	-	
			$T_{vj}=175^\circ C$	-	0.02	-	
	Turn-off delay time(*2)	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	0.20	-	
			$T_{vj}=125^\circ C$	-	0.23	-	
			$T_{vj}=150^\circ C$	-	0.23	-	
			$T_{vj}=175^\circ C$	-	0.23	-	
Fall time	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	0.12	-		
		$T_{vj}=125^\circ C$	-	0.16	-		
		$T_{vj}=150^\circ C$	-	0.20	-		
		$T_{vj}=175^\circ C$	-	0.22	-		
Reverse current	$I_R$	$V_R = 1200V$	-	-	50	$\mu A$	
Forward voltage	$V_F$ (terminal)	$I_F = 10A$	$T_{vj}=25^\circ C$	-	2.05	2.50	V
			$T_{vj}=125^\circ C$	-	1.90	2.35	
	$V_F$ (chip)		$T_{vj}=150^\circ C$	-	1.95	-	
			$T_{vj}=175^\circ C$	-	1.90	-	
Converter	Reverse current	$I_R$	$V_R = 1600V$	-	-	50	$\mu A$
	Continuous(direct)forward voltage	$V_F$	$I_F = 50A$	terminal	-	1.30	1.80
chip				-	1.10	1.55	
Thermistor	Resistance	$R$	$T = 25^\circ C$	-	5000	-	$\Omega$
			$T = 100^\circ C$	465	495	520	
B value	$B$	$T = 25/ 50^\circ C$	3305	3375	3450	K	

 (\*1) Turn on time ( $t_{on}$ ) =  $t_{d(on)} + t_r$ 

 (\*2) Turn off time ( $t_{off}$ ) =  $t_{d(off)} + t_f$

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**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(1device)	$R_{th(j-c)}$	Inverter RC-IGBT	-	-	0.30	K/W
		Brake IGBT	-	-	0.58	
		Brake FWD	-	-	1.75	
		Converter Diode	-	-	0.73	
Thermal resistance case to heat sink(*1) (1device)	$R_{th(c-s)}$	Inverter RC-IGBT	-	0.55	-	
		Brake IGBT	-	0.61	-	
		Brake FWD	-	0.71	-	
		Converter Diode	-	0.68	-	

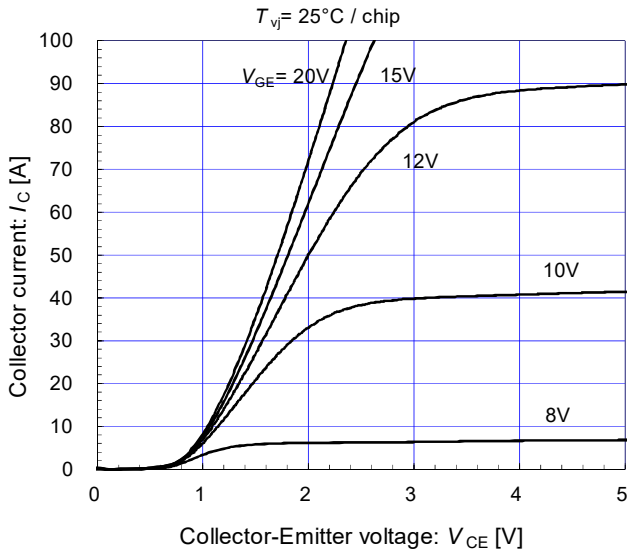
(\*1) This is the value which is defined mounting on the additional heat sink with 1w/(m·k) thermal grease.

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**IGBT Modules**

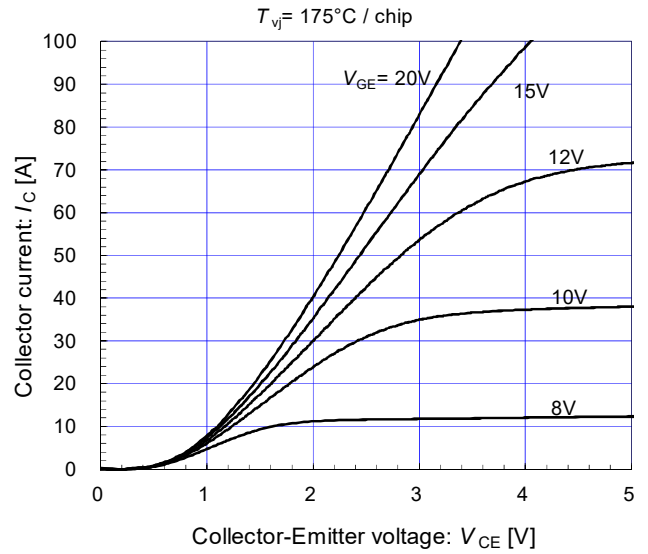
[ Inverter ]

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



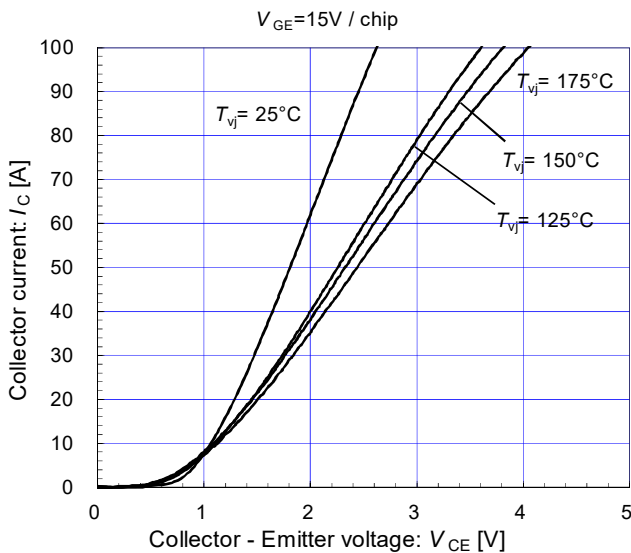
[ Inverter ]

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



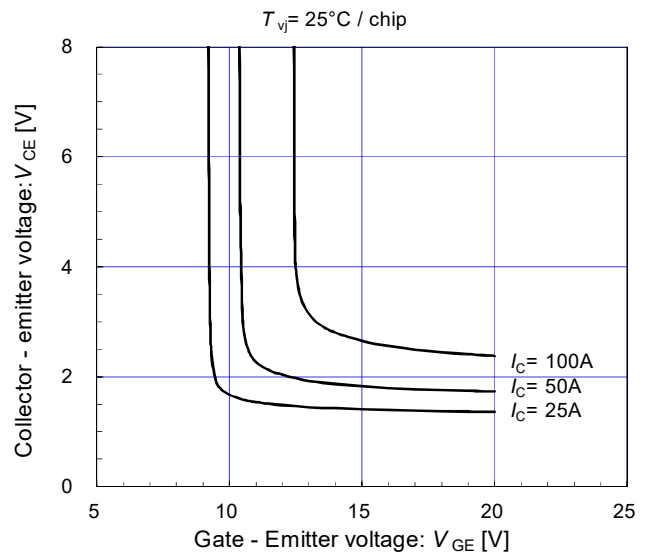
[ Inverter ]

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



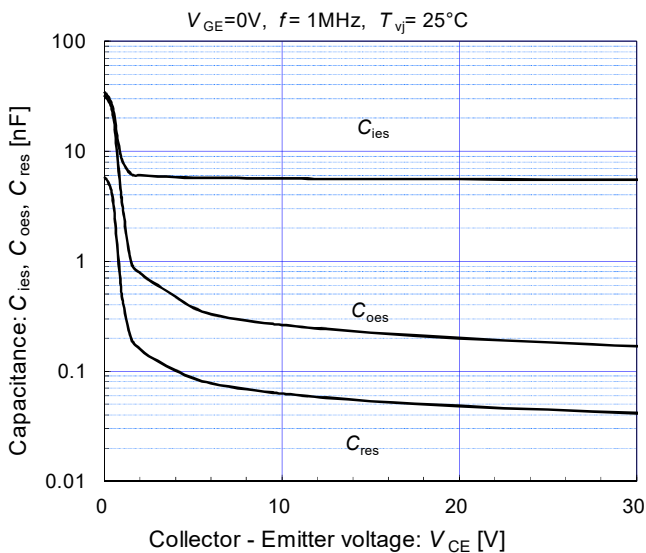
[ Inverter ]

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



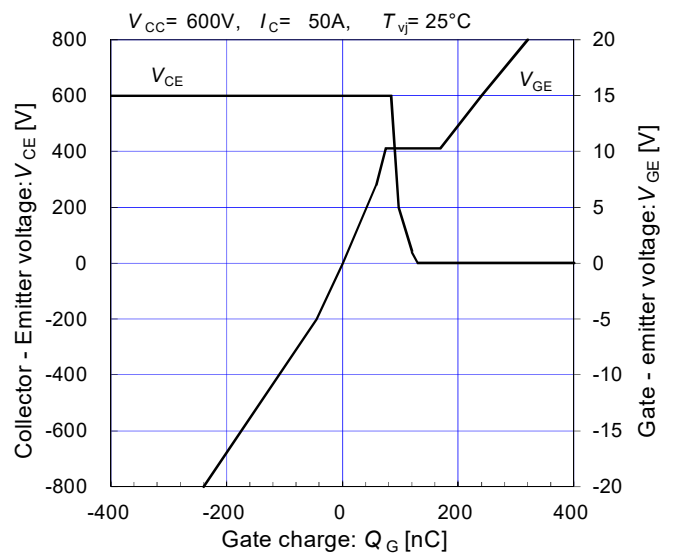
[ Inverter ]

Capacitance vs. Collector-Emmitter voltage (typ.)

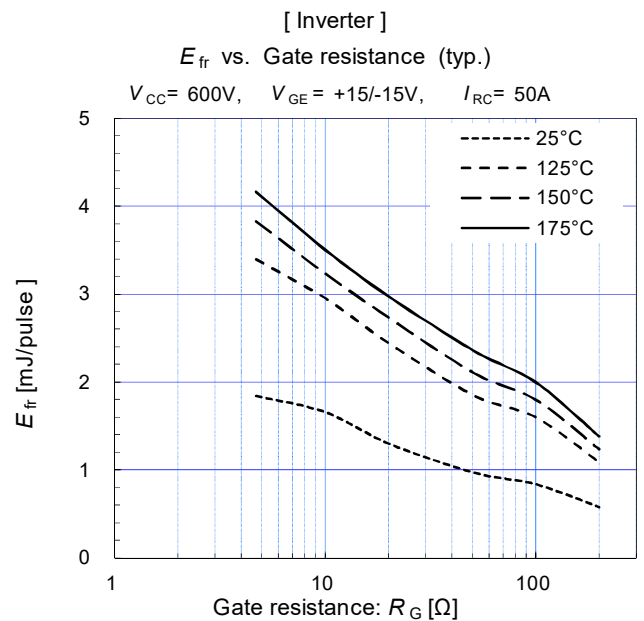
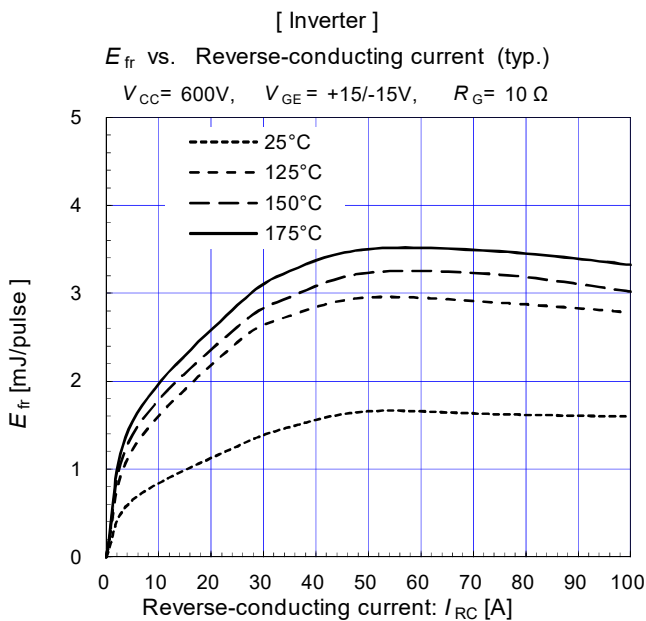
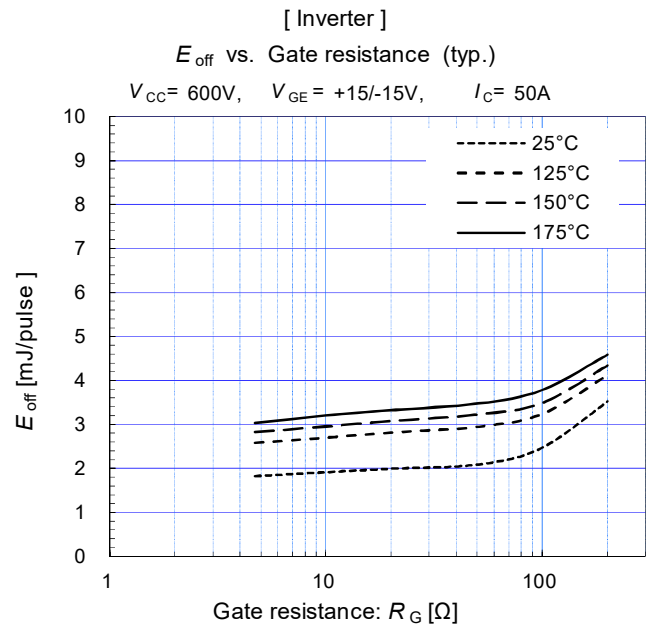
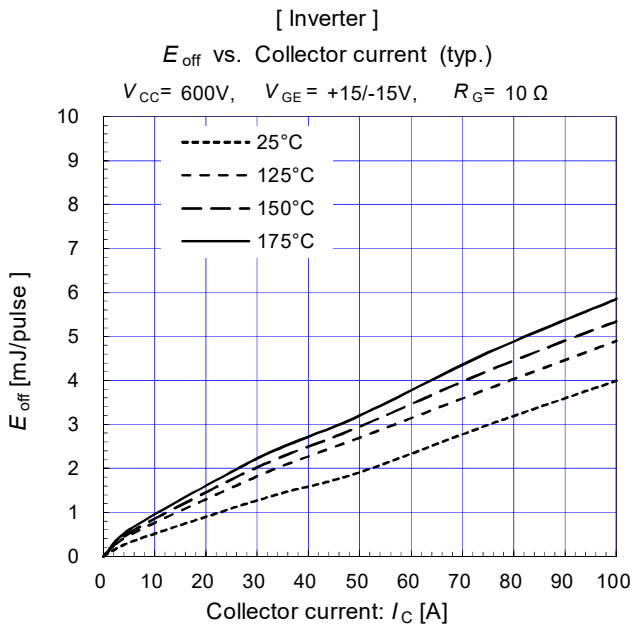
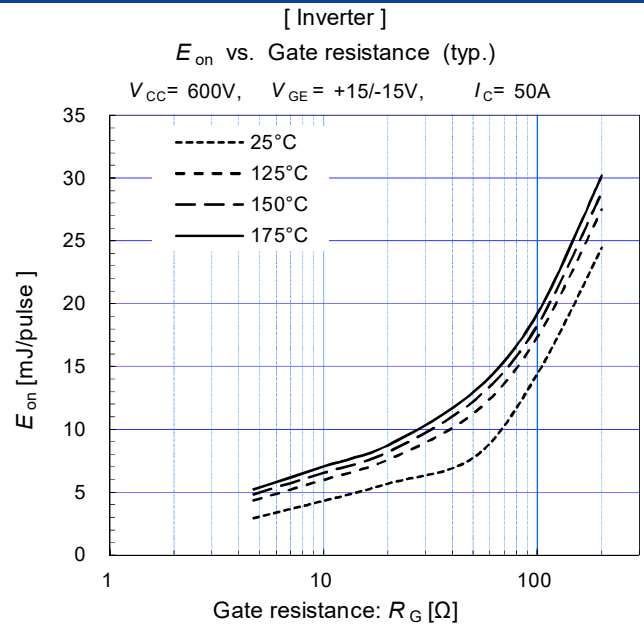
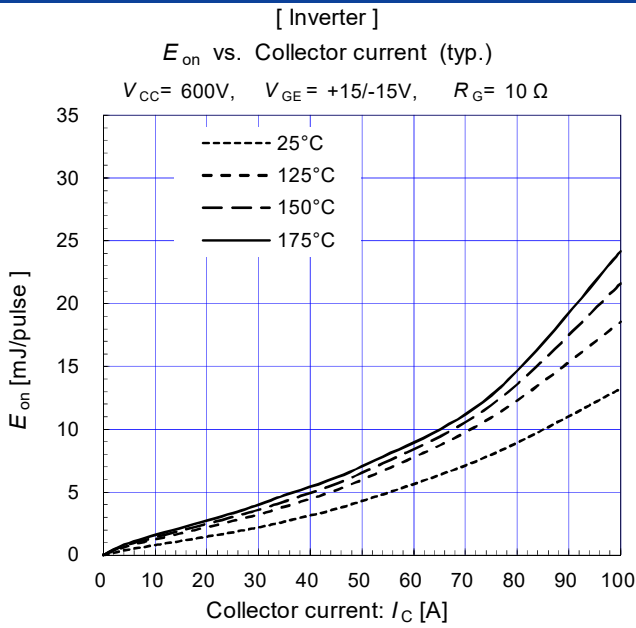


[ Inverter ]

Dynamic gate charge (typ.)



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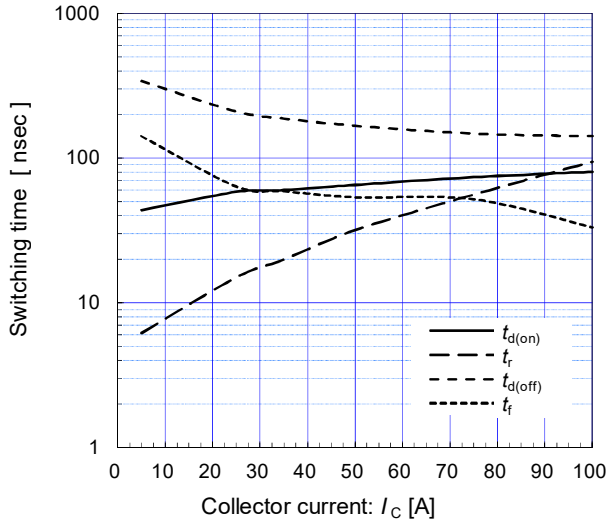
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IGBT Modules

[ Inverter ]

Switching time vs. Collector current (typ.)

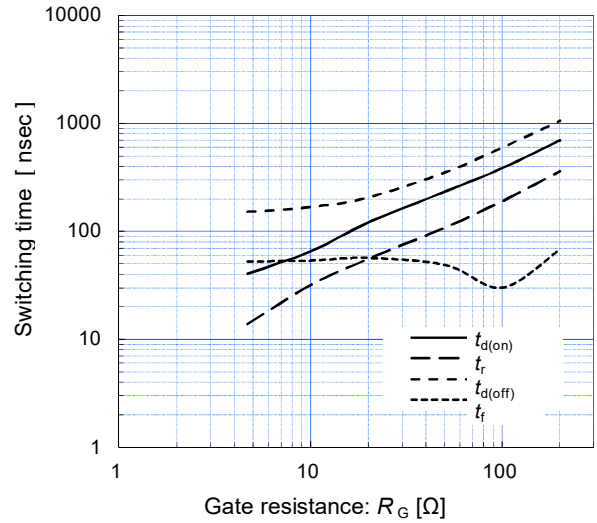
$V_{CC}=600V, R_G=10\Omega, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[ Inverter ]

Switching time vs. Gate resistance (typ.)

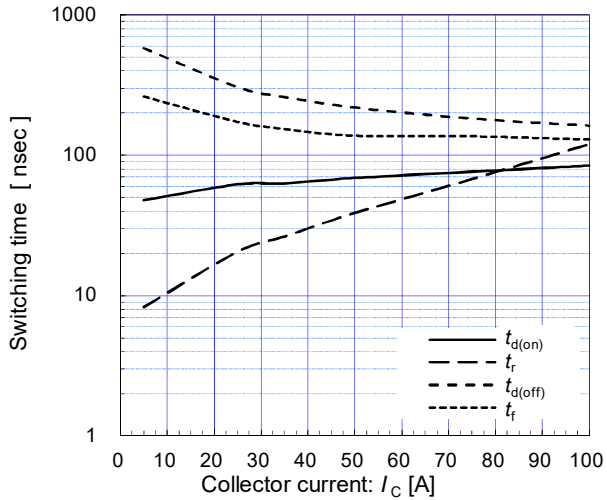
$V_{CC}=600V, I_C=50A, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[ Inverter ]

Switching time vs. Collector current (typ.)

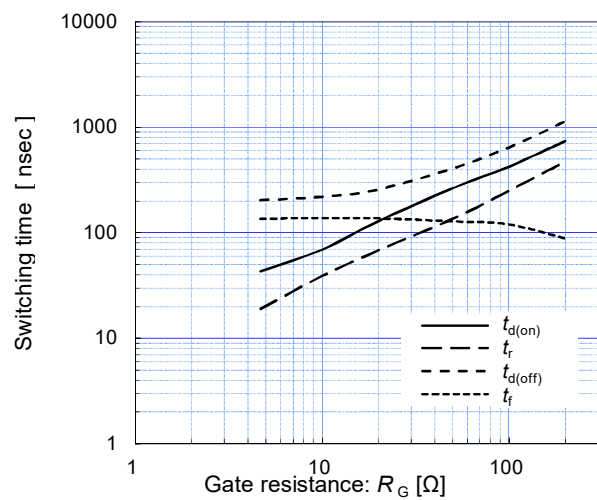
$V_{CC}=600V, R_G=10\Omega, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[ Inverter ]

Switching time vs. Gate resistance (typ.)

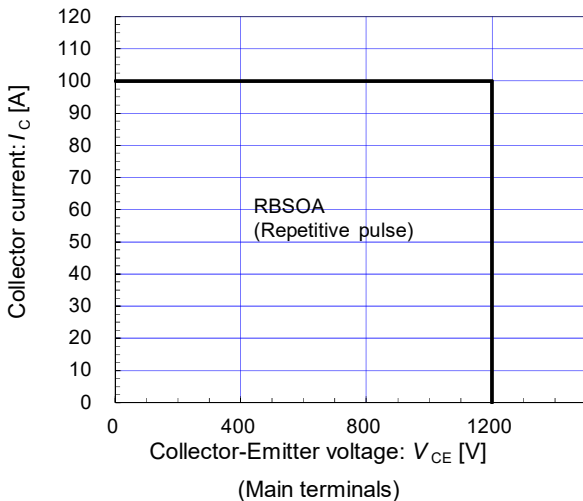
$V_{CC}=600V, I_C=50A, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[ Inverter ]

Reverse bias safe operating area (max.)

$V_{GE}=+15/-15V, R_G \geq 10\Omega, T_{vj}=175^\circ C$



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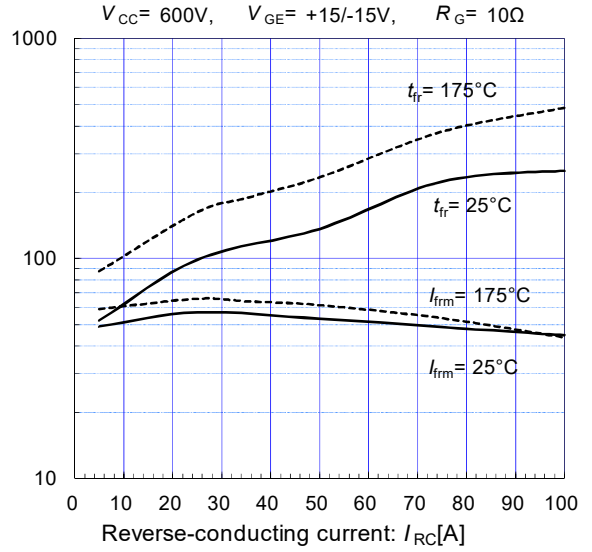
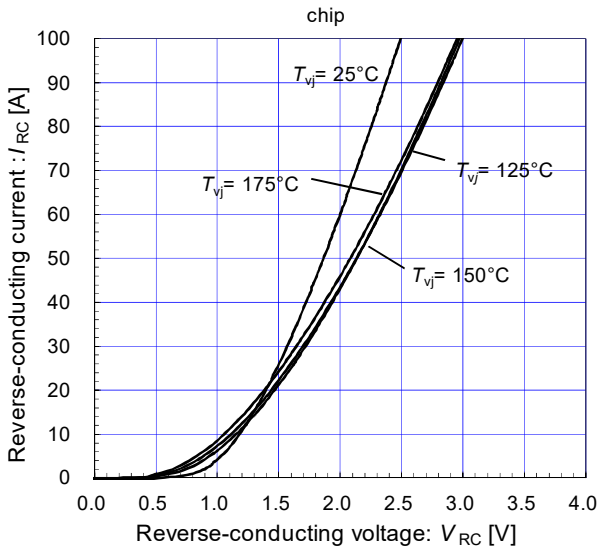
IGBT Modules

[ Inverter ]

[ Inverter ]

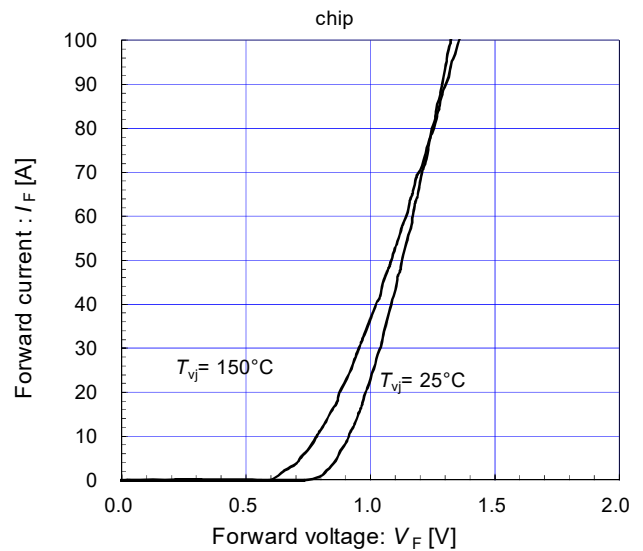
Reverse-conducting current vs. Reverse-conducting voltage (typ.)

Forward recovery characteristics (typ.)

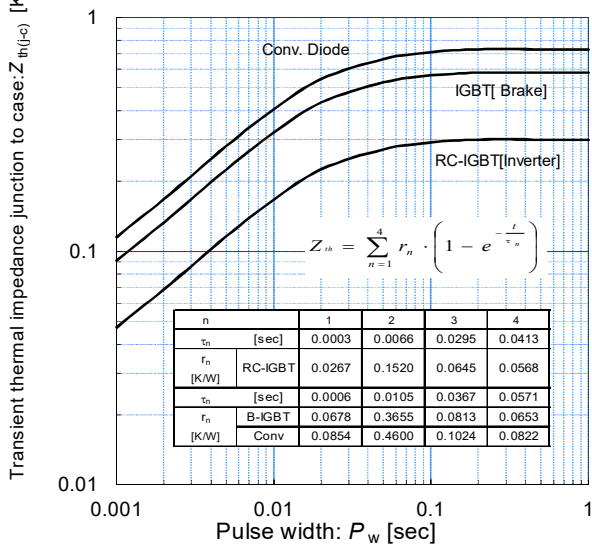


[ Converter ]

Forward current vs. Forward voltage (typ.)

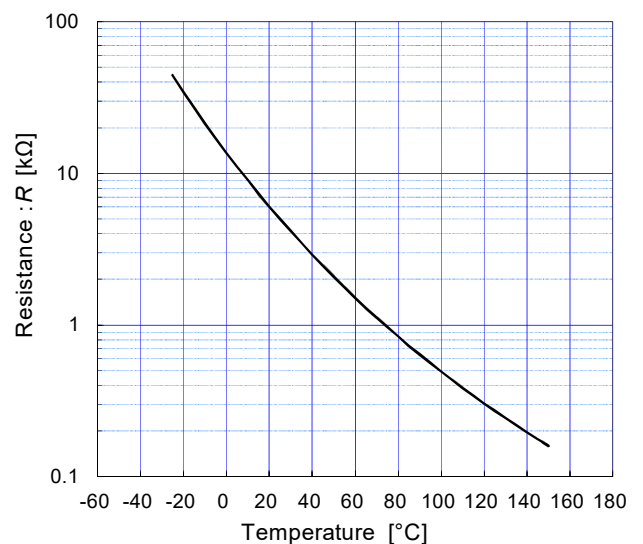


Transient thermal impedance (max.)



[ Thermistor ]

Temperature characteristic (typ.)

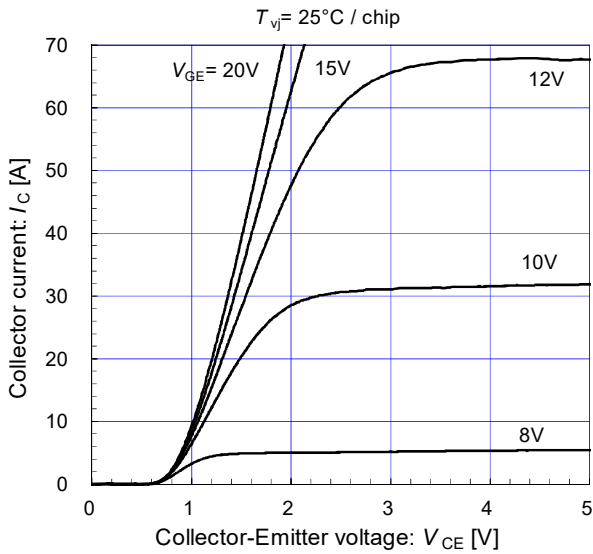


# 7MBR50XRKD120-50

**IGBT Modules**

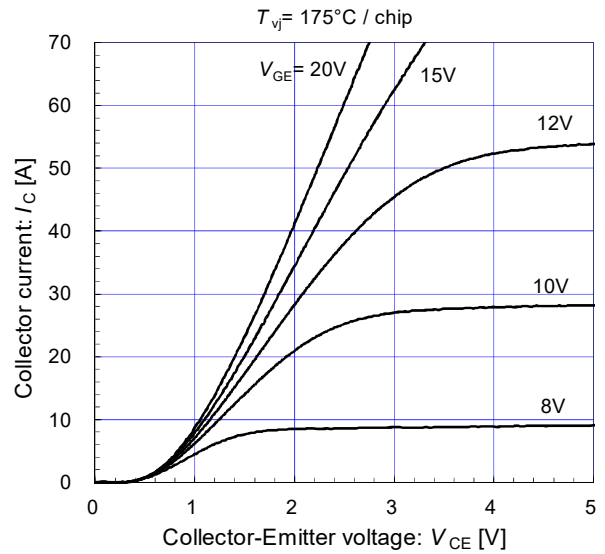
[ Brake ]

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



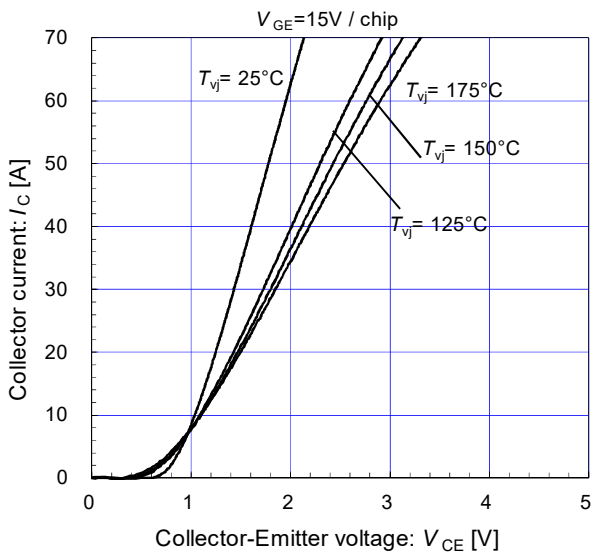
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Collector current vs. Collector-Emittor voltage (typ.)



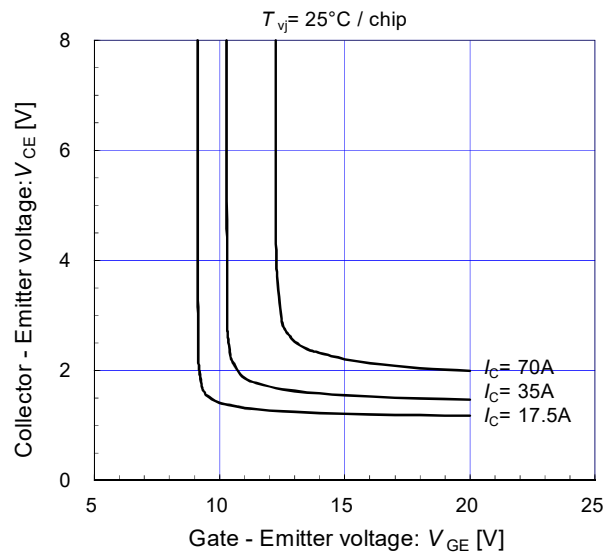
[ Brake ]

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



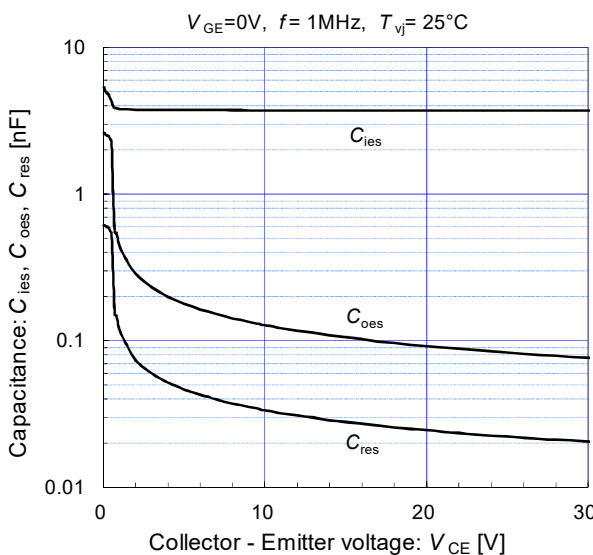
[ Brake ]

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



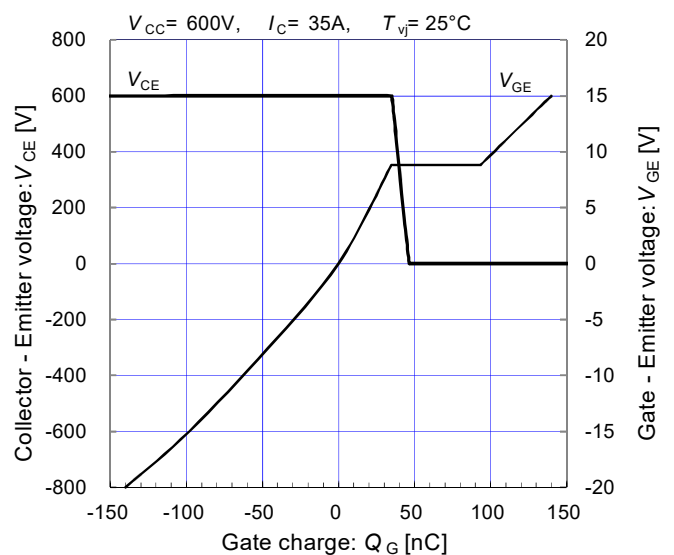
[ Brake ]

Capacitance vs. Collector-Emittor voltage (typ.)



[ Brake ]

Dynamic gate charge (typ.)



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# Technical Information

## IGBT Modules

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