

# 7MBR20XKC065-50

IGBT Modules

**Power Module(X series)**  
650V / 20A / PIM

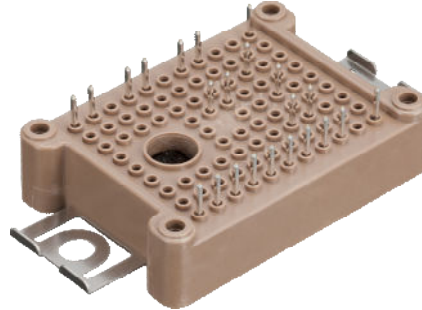
■ **Features**

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

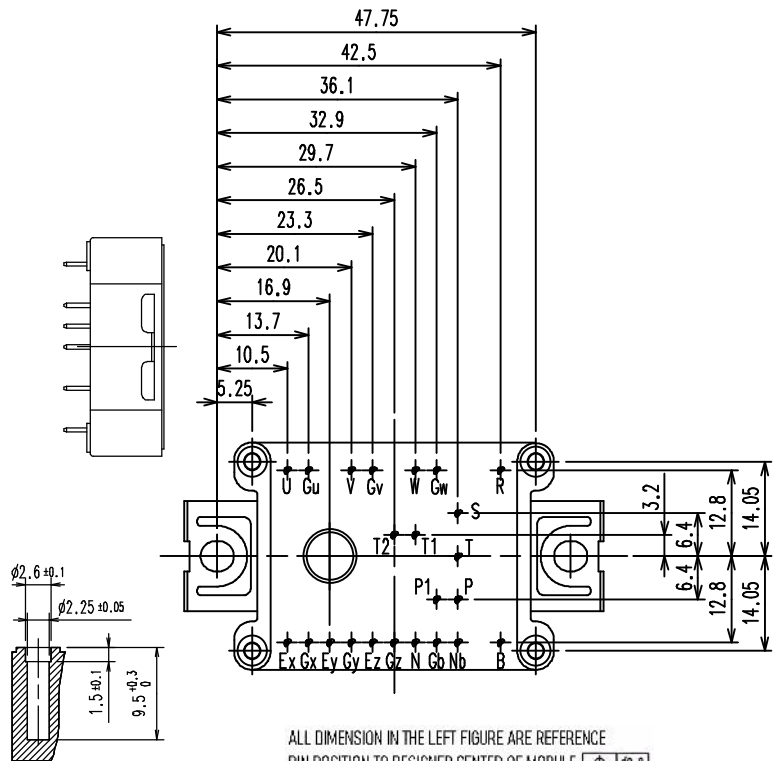
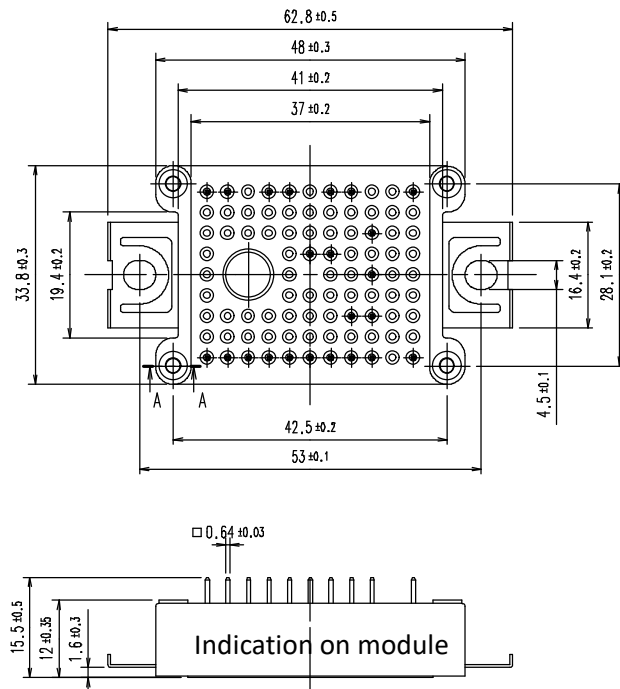
■ **Applications**

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

■ **Typical appearance**



■ **Outline drawing ( Unit : mm )**

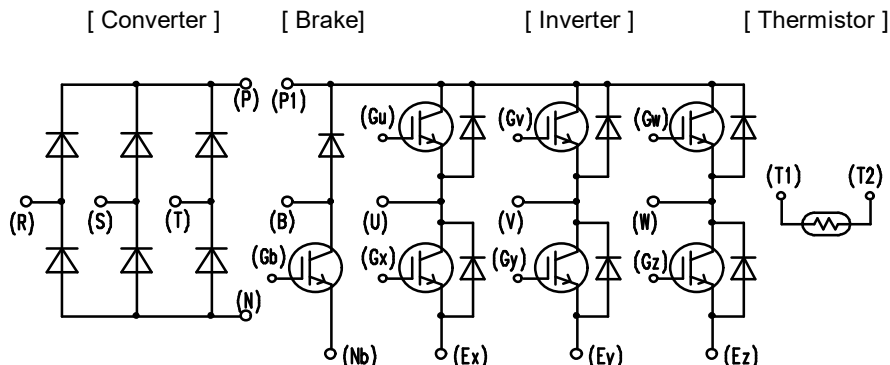


断面 A-A (1.5 : 1)  
SECTION A-A

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

Weight: 25 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	$V_{CES}$			650	V
	Gate-Emitter voltage, Collector-Emitter short-circuited	$V_{GES}$			$\pm 20$	V
	Collector current	$I_C$	Continuous	$T_c=100^\circ\text{C}$	20	A
	Repetitive peak collector current	$I_{CRM}$	1ms		40	
	Forward current	$I_F$	Continuous		20	
	Repetitive peak forward current	$I_{FRM}$	1ms		40	
	Total power dissipation	$P_{tot}$	1 device		135	W
Brake IGBT	Collector-Emitter voltage, Gate-Emitter short-circuited	$V_{CES}$			650	V
	Gate-Emitter voltage, Collector-Emitter short-circuited	$V_{GES}$			$\pm 20$	V
	Collector current	$I_C$	Continuous	$T_c=100^\circ\text{C}$	20	A
	Repetitive peak collector current	$I_{CRM}$	1ms		40	
	Total power dissipation	$P_{tot}$	1 device		135	W
Brake FWD	Forward current	$I_F$	Continuous		10	A
	Repetitive peak forward current	$I_{FRM}$	1ms		20	
	Repetitive peak reverse voltage	$V_{RRM}$			650	V
	Repetitive peak reverse voltage	$V_{RRM}$			800	V
Converter	Average output current	$I_O$	Three-phase full wave rectified current	$T_c=80^\circ\text{C}$	20	A
	Surge current (Non-Repetitive) (*1)	$I_{FSM}$	$t=10\text{ms}$ , Half sine wave form	$T_{vj}=25^\circ\text{C}$	390	A
				$T_{vj}=150^\circ\text{C}$	340	
	$I^2t$ (Non-Repetitive) (*1)	$I^2t$		$T_{vj}=25^\circ\text{C}$	760	A <sup>2</sup> s
			$T_{vj}=150^\circ\text{C}$	585		
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) Between thermistor and others (*3)	$V_{isol}$	A.C. : 1min.		2500	Vrms
Screw torque	Mounting torque of screws to heatsink	$M_S$	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	$I_{CES}$	$V_{GE} = 0\text{V}$ $V_{CE} = 650\text{V}$	-	-	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	$V_{GE(th)}$	$V_{CE} = 20\text{V}$ $I_C = 20\text{mA}$	6.0	6.5	7.0	V	
Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15\text{V}$ $I_C = 20\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	1.40	1.90	V
			$T_{vj}=25^{\circ}\text{C}$	-	1.30	1.75	
	$V_{CE(sat)}$ (chip)	$T_{vj}=125^{\circ}\text{C}$	-	1.45	-		
		$T_{vj}=150^{\circ}\text{C}$	-	1.50	-		
Internal gate resistance	$r_g$	-	-	0	-	$\Omega$	
			-	0	-	$\Omega$	
Capacitance	$C_{ies}$	$V_{CE} = 10\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	2.3	-	nF	
	$C_{oes}$		-	0.09	-		
	$C_{res}$		-	0.03	-		
Gate charge	$Q_G$	$V_{CC} = 300\text{V}$ $V_{GE} = -15 \rightarrow +15\text{V}$ $I_C = 20\text{A}$	-	160	-	nC	
Forward voltage	$V_F$ (terminal)	$I_F = 20\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	1.70	2.20	V
			$T_{vj}=25^{\circ}\text{C}$	-	1.60	2.05	
	$V_F$ (chip)	$T_{vj}=125^{\circ}\text{C}$	-	1.60	-		
		$T_{vj}=150^{\circ}\text{C}$	-	1.60	-		
		$T_{vj}=175^{\circ}\text{C}$	-	1.55	-		
Switching time (*1)	$t_{d(on)}$	$V_{CC} = 300\text{V}$ $I_C, I_F = 20\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 18\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.05	-	$\mu\text{s}$
			$T_{vj}=125^{\circ}\text{C}$	-	0.05	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.05	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.05	-	
	$t_r$	$V_{CC} = 300\text{V}$ $I_C, I_F = 20\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 18\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.02	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.02	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.02	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.02	-	
	$t_{d(off)}$	$V_{CC} = 300\text{V}$ $I_C, I_F = 20\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 18\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.15	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.17	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.18	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.18	-	
$t_f$	$V_{CC} = 300\text{V}$ $I_C, I_F = 20\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 18\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.04	-		
		$T_{vj}=125^{\circ}\text{C}$	-	0.04	-		
		$T_{vj}=150^{\circ}\text{C}$	-	0.04	-		
		$T_{vj}=175^{\circ}\text{C}$	-	0.04	-		
Reverse recovery time	$t_{rr}$	$V_{CC} = 300\text{V}$ $I_C, I_F = 20\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 18\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.06	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.10	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.11	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.13	-	

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

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**IGBT Modules**

Items	Symbols	Conditions	Characteristics			Units	
			min.	typ.	max.		
Inverter Switching loss (per pulse)	$E_{on}$	$V_{CC} = 300V$ $I_C, I_F = 20A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj}=25^\circ C$	-	0.31	-	mJ
			$T_{vj}=125^\circ C$	-	0.43	-	
			$T_{vj}=150^\circ C$	-	0.48	-	
			$T_{vj}=175^\circ C$	-	0.55	-	
	$E_{off}$	$V_{CC} = 300V$ $I_C, I_F = 20A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj}=25^\circ C$	-	0.58	-	
			$T_{vj}=125^\circ C$	-	0.75	-	
			$T_{vj}=150^\circ C$	-	0.79	-	
			$T_{vj}=175^\circ C$	-	0.83	-	
	$E_{rr}$	$V_{CC} = 300V$ $I_C, I_F = 20A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj}=25^\circ C$	-	0.18	-	
			$T_{vj}=125^\circ C$	-	0.28	-	
			$T_{vj}=150^\circ C$	-	0.34	-	
			$T_{vj}=175^\circ C$	-	0.39	-	
Collector-Emitter cut-off current, Gate-Emitter short-circuited	$I_{CES}$	$V_{GE} = 0V$ $V_{CE} = 650V$	-	-	50	$\mu A$	
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)	$V_{GE} = 15V$ $I_C = 20A$	$T_{vj}=25^\circ C$	-	1.40	1.90	V
			$T_{vj}=25^\circ C$	-	1.30	1.75	
	$V_{CE(sat)}$ (chip)		$T_{vj}=125^\circ C$	-	1.45	-	
			$T_{vj}=150^\circ C$	-	1.50	-	
Internal gate resistance	$r_g$	-	$T_{vj}=25^\circ C$	-	0	-	$\Omega$
			$T_{vj}=25^\circ C$	-	0	-	
			$T_{vj}=125^\circ C$	-	0	-	
			$T_{vj}=175^\circ C$	-	0	-	
Brake Switching time (*1)	$t_{d(on)}$	$V_{CC} = 300V$ $I_C = 20A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj}=25^\circ C$	-	0.05	-	$\mu s$
			$T_{vj}=125^\circ C$	-	0.05	-	
			$T_{vj}=150^\circ C$	-	0.05	-	
			$T_{vj}=175^\circ C$	-	0.05	-	
	$t_r$	$V_{CC} = 300V$ $I_C = 20A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj}=25^\circ C$	-	0.02	-	
			$T_{vj}=125^\circ C$	-	0.02	-	
			$T_{vj}=150^\circ C$	-	0.02	-	
			$T_{vj}=175^\circ C$	-	0.02	-	
	$t_{d(off)}$	$V_{CC} = 300V$ $I_C = 20A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj}=25^\circ C$	-	0.15	-	
			$T_{vj}=125^\circ C$	-	0.17	-	
			$T_{vj}=150^\circ C$	-	0.18	-	
			$T_{vj}=175^\circ C$	-	0.18	-	
	$t_f$	$V_{CC} = 300V$ $I_C = 20A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj}=25^\circ C$	-	0.04	-	
			$T_{vj}=125^\circ C$	-	0.04	-	
			$T_{vj}=150^\circ C$	-	0.04	-	
			$T_{vj}=175^\circ C$	-	0.04	-	
Reverse current	$I_{RRM}$	$V_R = 650V$	-	-	50	$\mu A$	
Forward voltage	$V_F$ (terminal)	$I_F = 10A$	$T_{vj}=25^\circ C$	-	1.65	2.15	V
			$T_{vj}=25^\circ C$	-	1.55	2.00	
	$V_F$ (chip)		$T_{vj}=125^\circ C$	-	1.50	-	
			$T_{vj}=150^\circ C$	-	1.50	-	
Converter	$I_{RRM}$	$V_R = 800V$	$T_{vj}=25^\circ C$	-	-	50	$\mu A$
			$T_{vj}=25^\circ C$	-	-	50	
			$T_{vj}=125^\circ C$	-	-	50	
			$T_{vj}=150^\circ C$	-	-	50	
Continuous (direct) forward voltage	$V_F$	$I_F = 20A$	terminal	-	1.10	1.60	V
			chip	-	1.00	1.45	
Thermistor	$R$	$T = 25^\circ C$	-	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 ( $t_{on}$ ) =  $t_{d(on)}$  +  $t_r$ , 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.

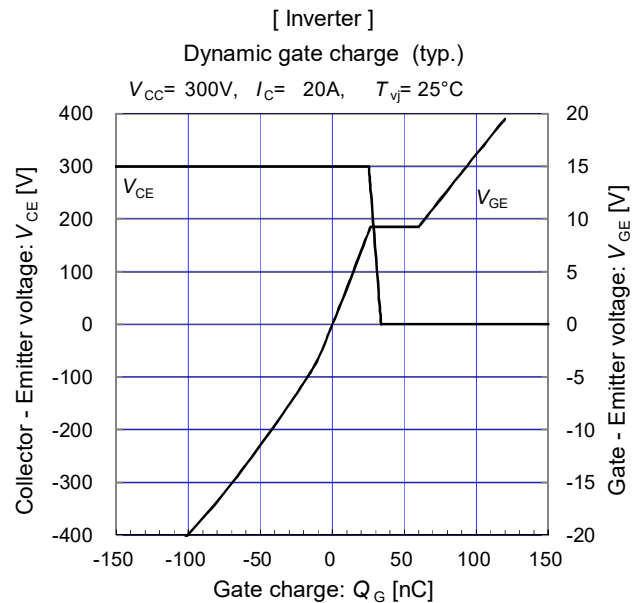
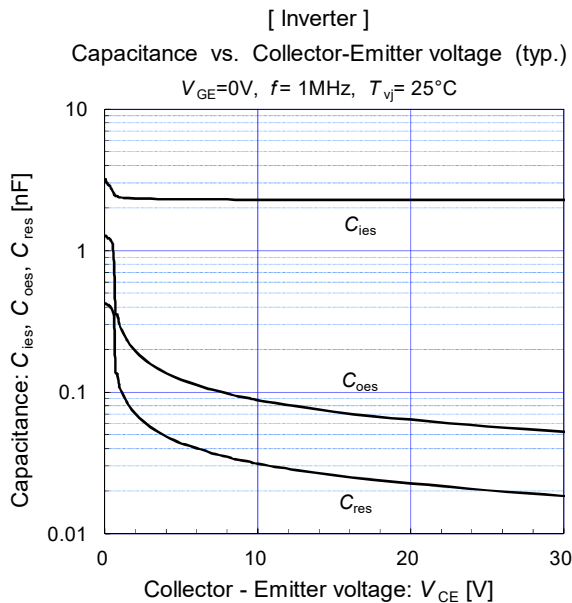
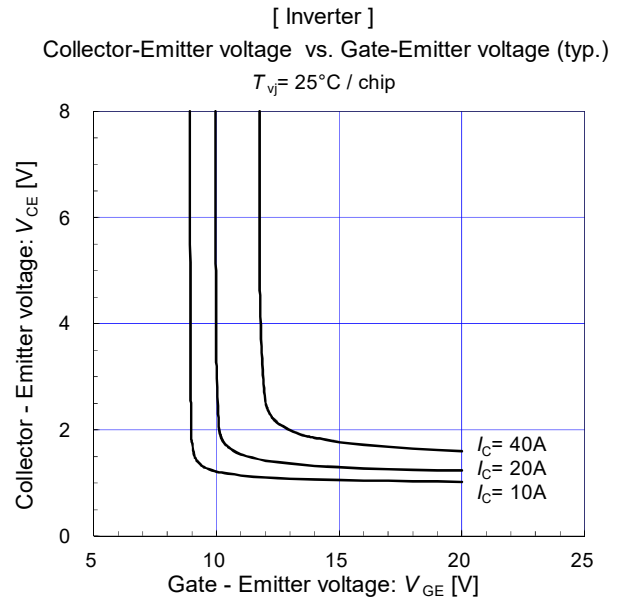
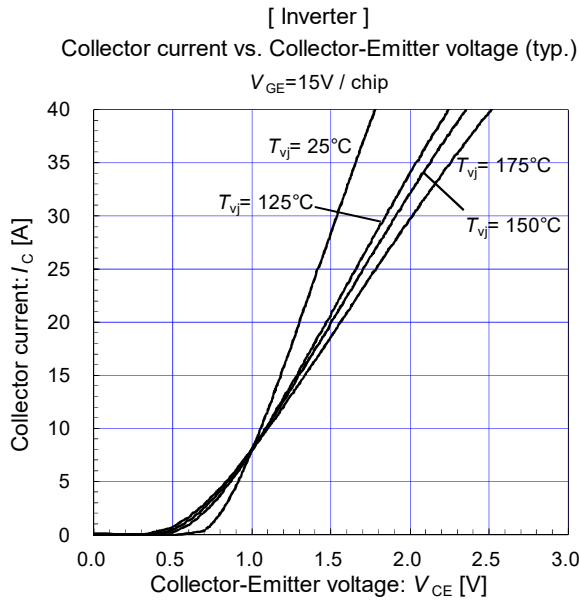
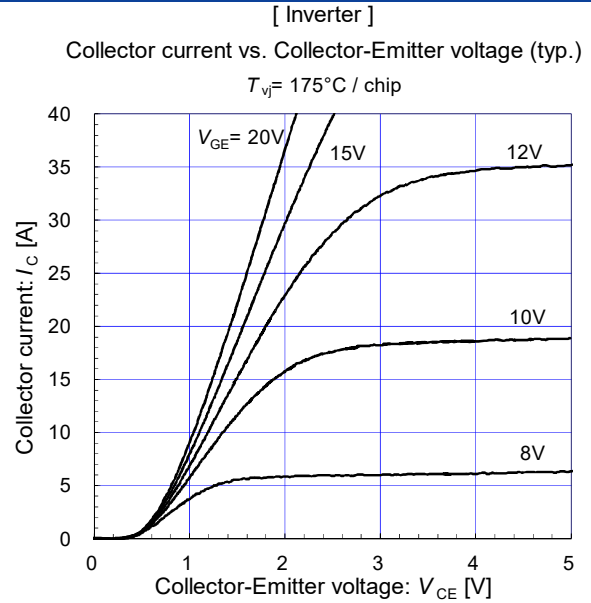
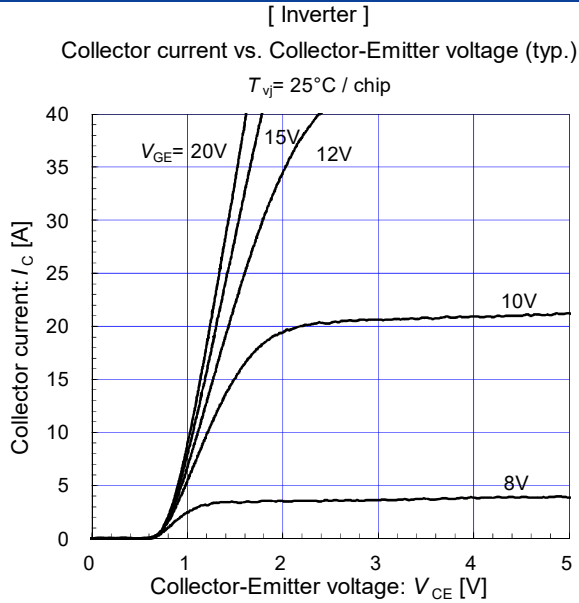
**■ Thermal resistance characteristics**

Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance junction to case (1 device)	$R_{th(j-c)}$	Inverter IGBT	-	-	1.09	KW
		Inverter FWD	-	-	1.50	
		Brake IGBT	-	-	1.09	
		Brake FWD	-	-	1.92	
		Converter Diode	-	-	0.75	
Thermal resistance case to heat sink(*1) (1 device)	$R_{th(c-f)}$	Inverter IGBT	-	0.78	-	
		Inverter FWD	-	0.92	-	
		Brake IGBT	-	0.82	-	
		Brake FWD	-	0.80	-	
		Converter Diode	-	0.79	-	

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

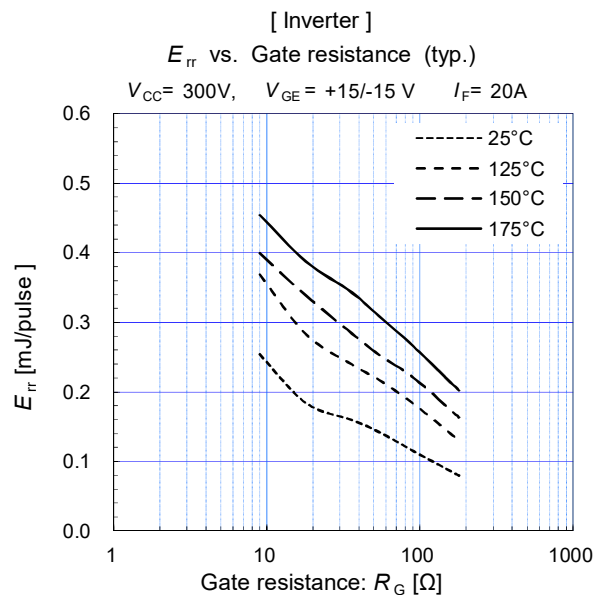
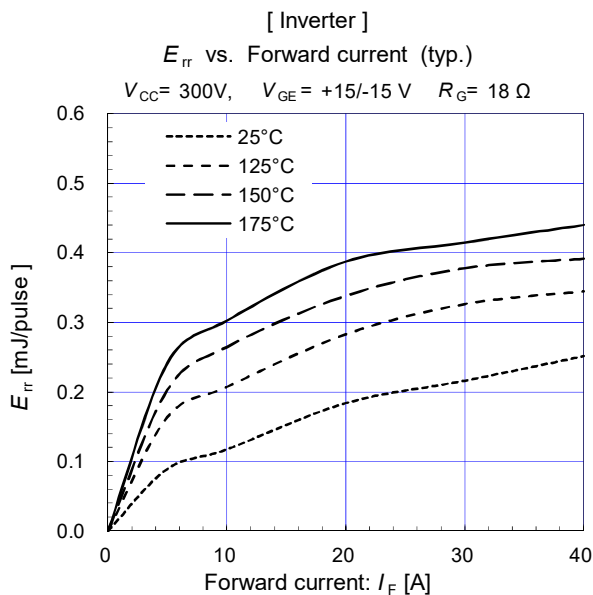
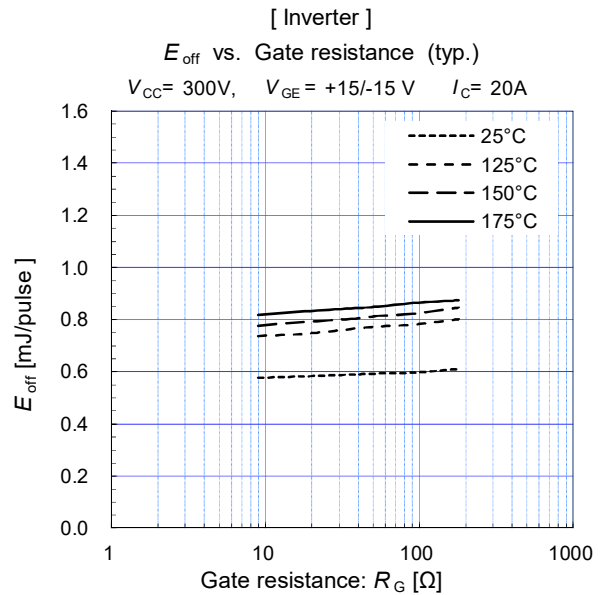
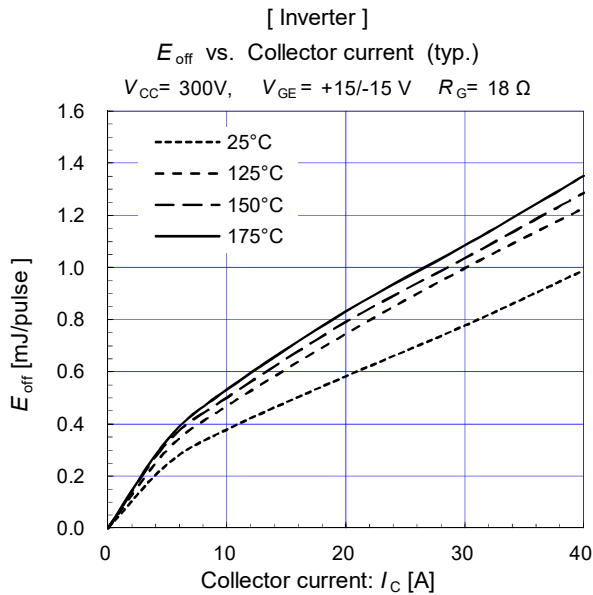
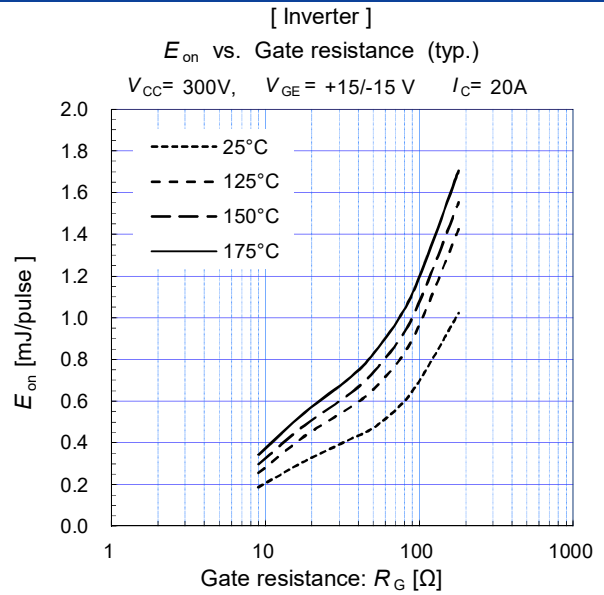
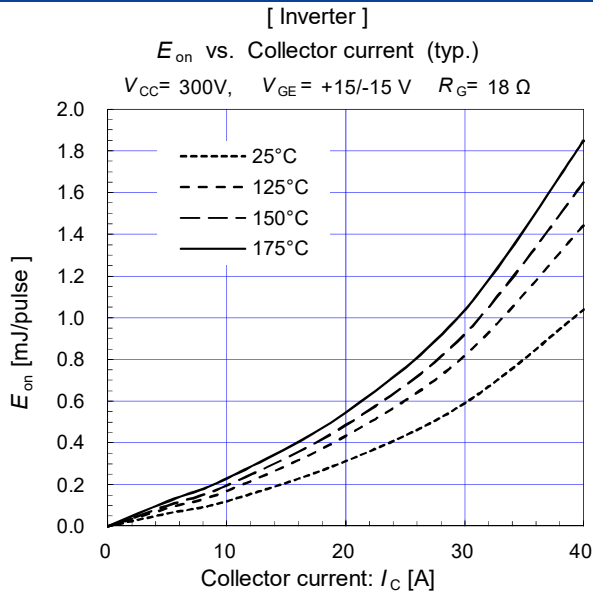
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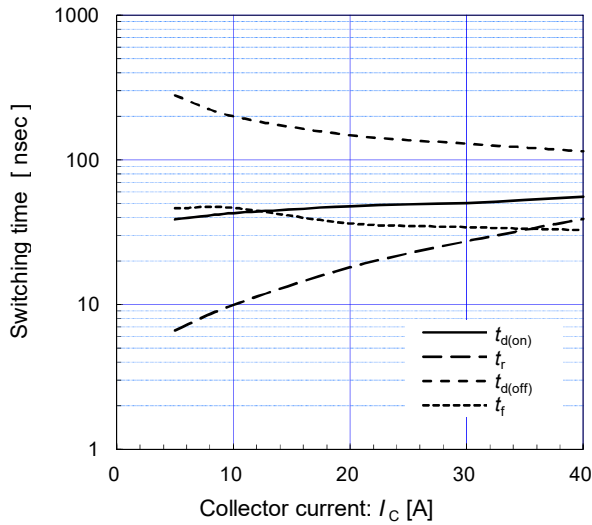
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IGBT Modules

[ Inverter ]

Switching time vs. Collector current (typ.)

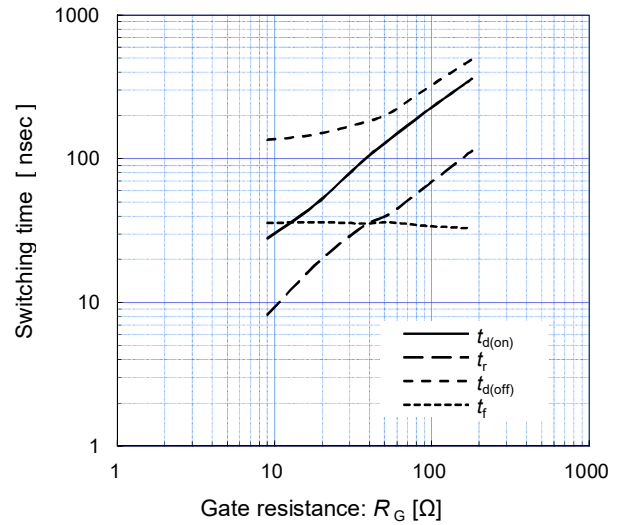
$V_{CC}=300V, R_G=18\Omega, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[ Inverter ]

Switching time vs. Gate resistance (typ.)

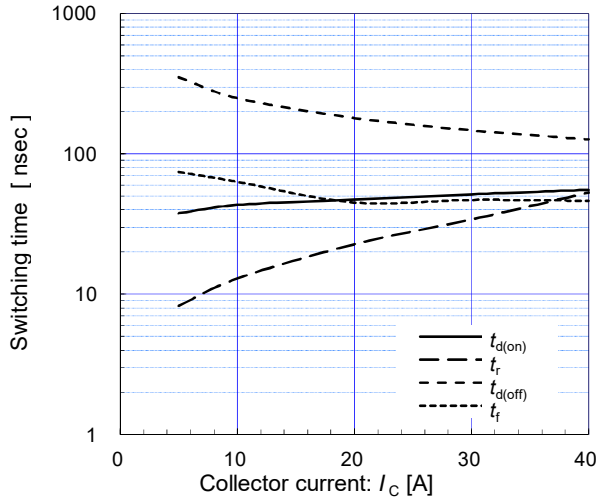
$V_{CC}=300V, I_C=20A, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[ Inverter ]

Switching time vs. Collector current (typ.)

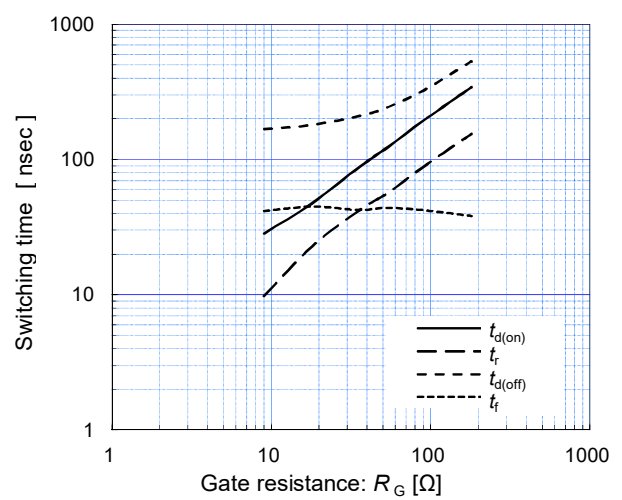
$V_{CC}=300V, R_G=18\Omega, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[ Inverter ]

Switching time vs. Gate resistance (typ.)

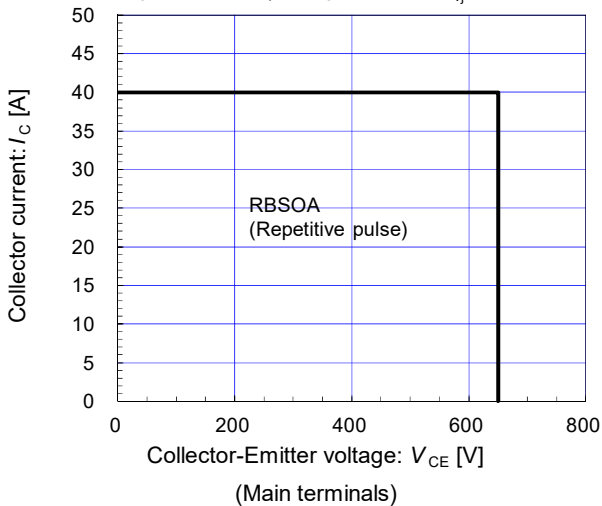
$V_{CC}=300V, I_C=20A, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[ Inverter ]

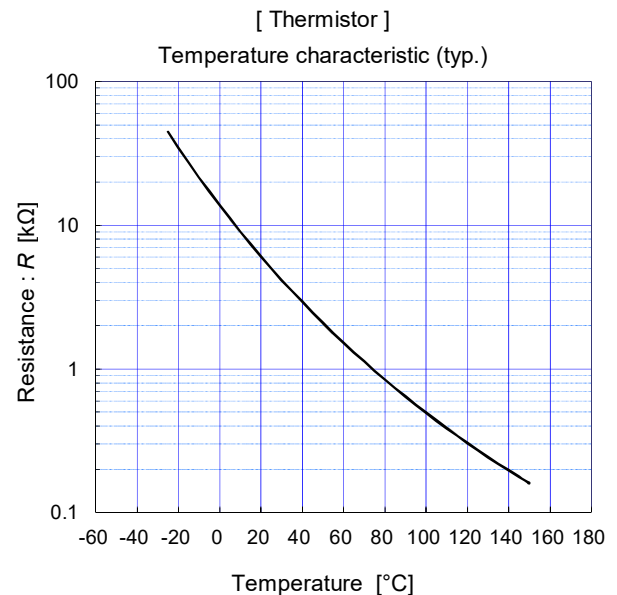
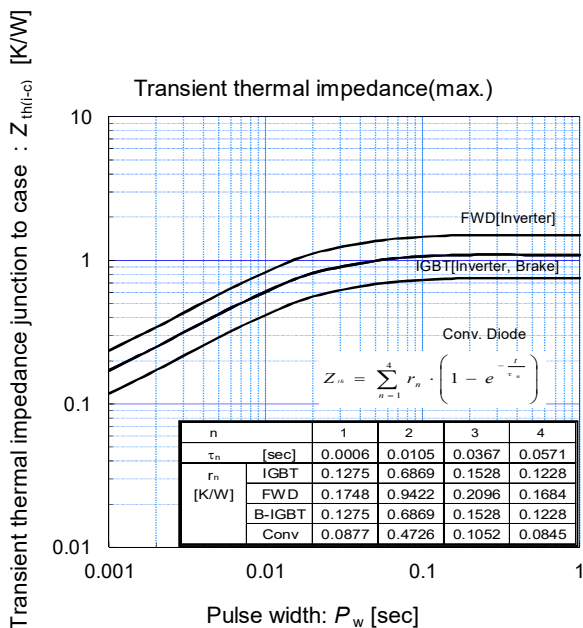
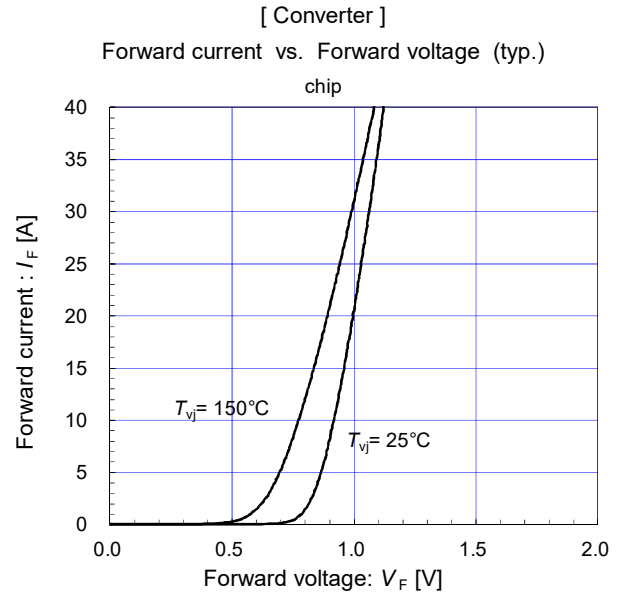
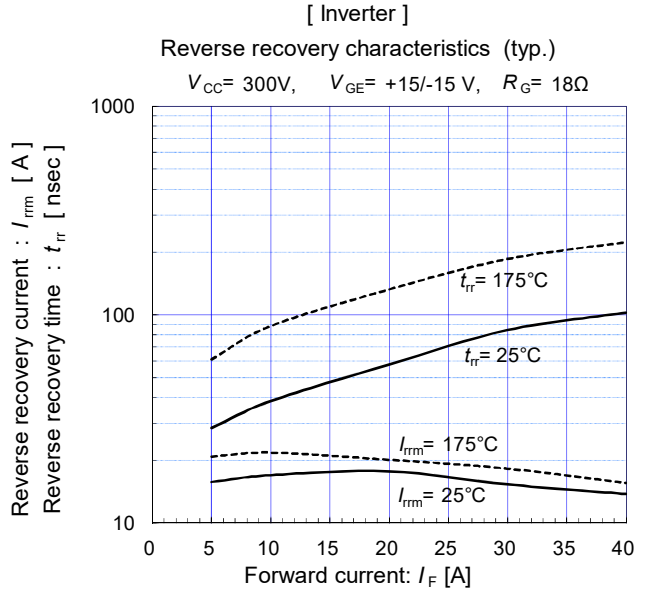
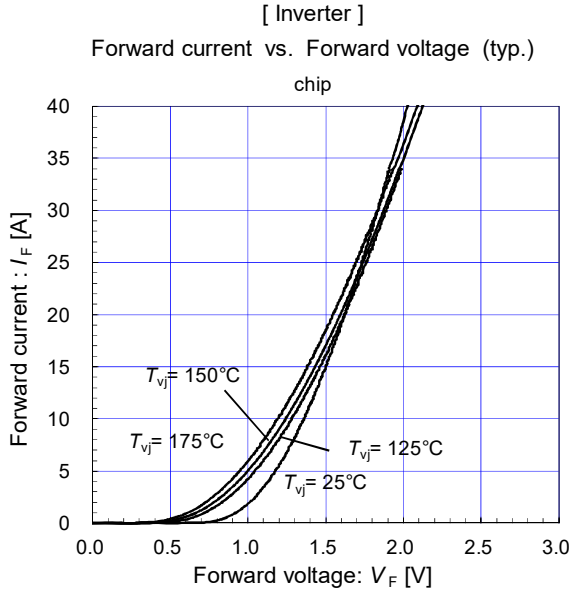
Reverse bias safe operating area (max.)

$V_{GE}=+15/-15V, R_G \geq 18\Omega, T_{vj}=175^\circ C$



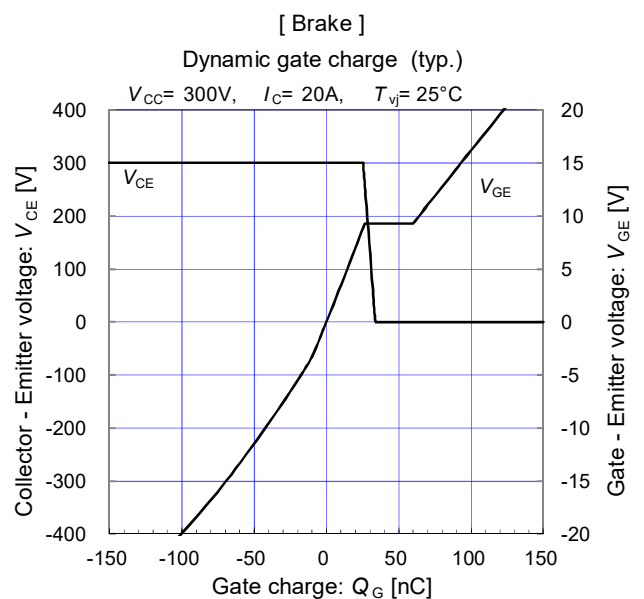
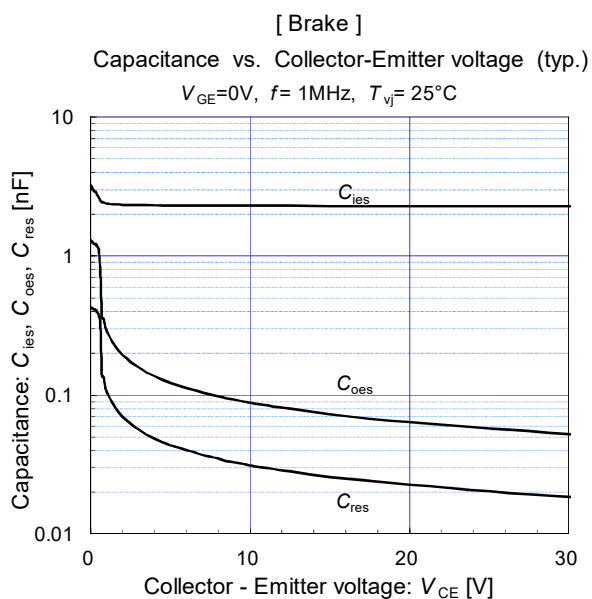
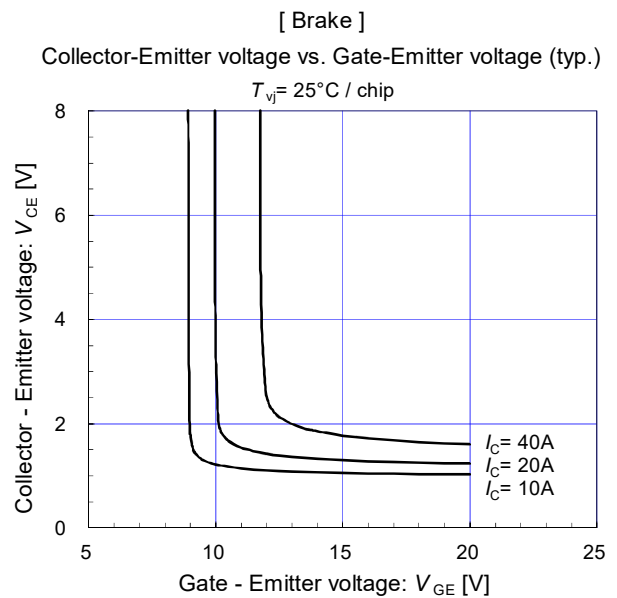
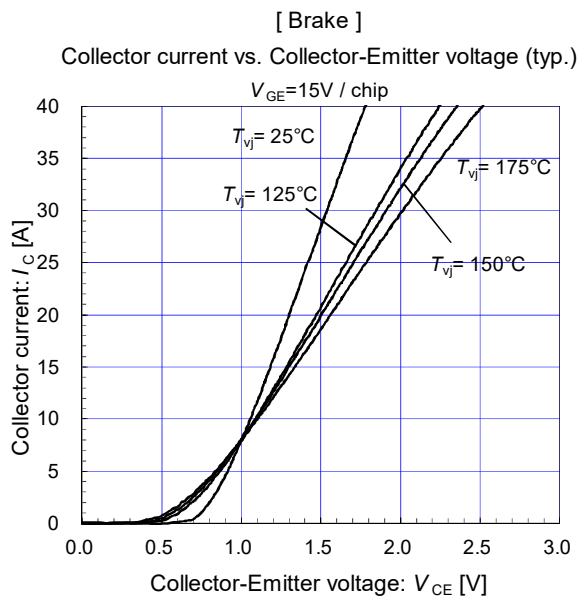
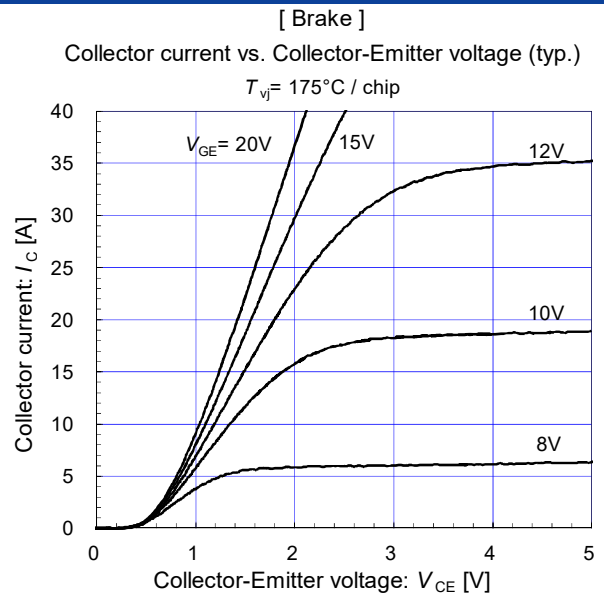
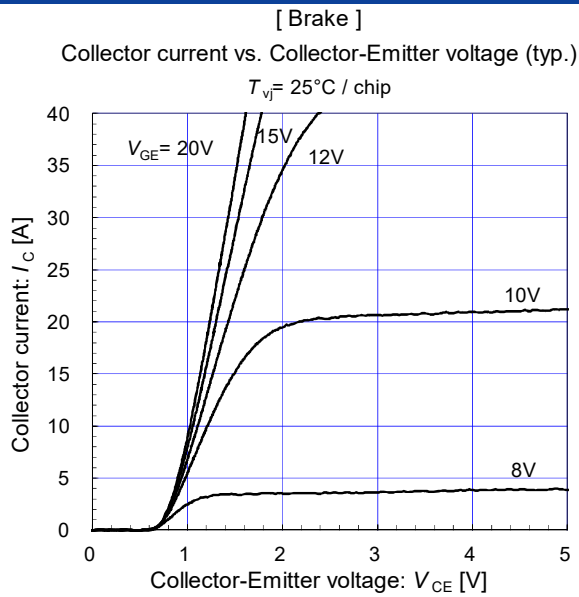
# 7MBR20XKC065-50

IGBT Modules



# 7MBR20XKC065-50

IGBT Modules



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**IGBT Modules**

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