

7MBR15XKD120-50

IGBT Modules

Power Module(X series)
1200V / 15A / PIM

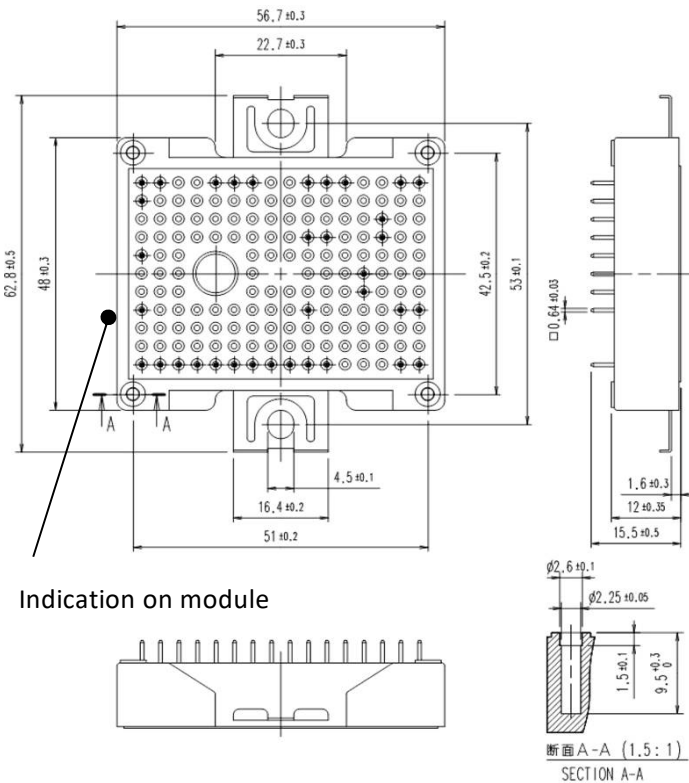
■ **Features**

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

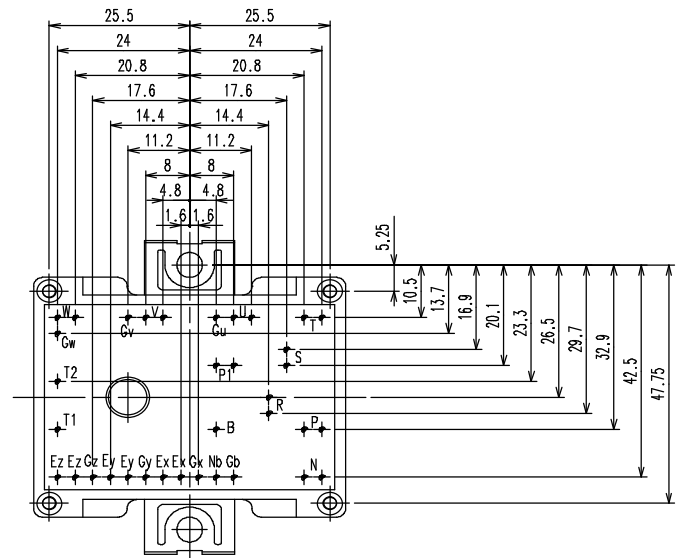
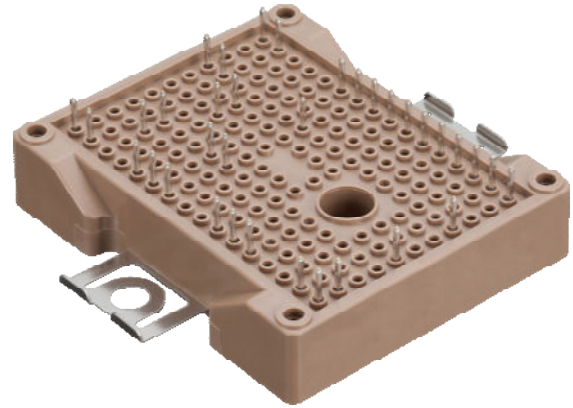
■ **Applications**

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

■ **Outline drawing (Unit : mm)**



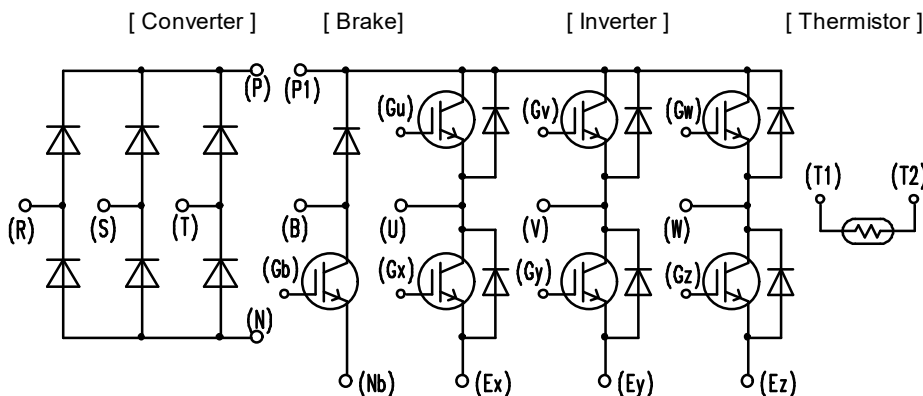
■ **Typical appearance**



ALL DIMENSION IN THE LEFT FIGURE ARE REFERENCE
PIN POSITION TO DESIGNED CENTER OF MODULE $\pm \phi 0.8$
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}			± 20	V
	Collector current	I_C	Continuous	$T_c=100^\circ\text{C}$	15	A
	Repetitive peak collector current	I_{CRM}	1ms		30	
	Forward current	I_F	Continuous		15	
	Repetitive peak forward current	I_{FRM}	1ms		30	
	Total power dissipation	P_{tot}	1 device		135	W
Brake IGBT	Collector-Emitter voltage, Gate-Emitter short-circuited	V_{CES}			1200	V
	Gate-Emitter voltage, Collector-Emitter short-circuited	V_{GES}			± 20	V
	Collector current	I_C	Continuous	$T_c=100^\circ\text{C}$	15	A
	Repetitive peak collector current	I_{CRM}	1ms		30	
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}			1200	V
Converter	Repetitive peak reverse voltage	V_{RRM}			1600	V
	Average output current	I_O	Three-phase full wave rectified current	$T_c=80^\circ\text{C}$	15	A
	Surge current (Non-Repetitive) (*1)	I_{FSM}	$t=10\text{ms}$, Half sine wave form	$T_{vj}=25^\circ\text{C}$	470	A
				$T_{vj}=150^\circ\text{C}$	385	
	I^2t (Non-Repetitive) (*1)	I^2t		$T_{vj}=25^\circ\text{C}$	1105	A^2s
			$T_{vj}=150^\circ\text{C}$	750		
Virtual junction temperature		T_{vj}	Inverter, Brake		175	$^\circ\text{C}$
			Converter		150	
Operating 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 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	μA	
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	$V_{GE(th)}$	$V_{CE} = 20\text{V}$ $I_C = 15\text{mA}$	6.0	6.5	7.0	V	
Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15\text{V}$ $I_C = 15\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	1.60	2.05	V
			$T_{vj}=25^{\circ}\text{C}$	-	1.50	1.95	
	$T_{vj}=125^{\circ}\text{C}$		-	1.85	-		
	$T_{vj}=150^{\circ}\text{C}$		-	1.95	-		
	$V_{CE(sat)}$ (chip)		$T_{vj}=175^{\circ}\text{C}$	-	2.00	-	
Internal gate resistance	r_g	-	-	0	-	Ω	
Capacitance	C_{ies}	$V_{CE} = 10\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	1.6	-	nF	
	C_{oes}		-	0.05	-		
	C_{res}		-	0.01	-		
Gate charge	Q_G	$V_{CC} = 600\text{V}$ $V_{GE} = -15 \rightarrow +15\text{V}$ $I_C = 15\text{A}$	-	100	-	nC	
Forward voltage	V_F (terminal)	$I_F = 15\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	1.90	2.35	V
	V_F (chip)		$T_{vj}=25^{\circ}\text{C}$	-	1.80	2.25	
			$T_{vj}=125^{\circ}\text{C}$	-	1.85	-	
			$T_{vj}=150^{\circ}\text{C}$	-	1.80	-	
			$T_{vj}=175^{\circ}\text{C}$	-	1.75	-	
Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600\text{V}$ $I_C, I_F = 15\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 39\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.05	-	μs
			$T_{vj}=125^{\circ}\text{C}$	-	0.06	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.06	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.06	-	
	t_r	$V_{CC} = 600\text{V}$ $I_C, I_F = 15\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 39\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.03	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.03	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.03	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.03	-	
	$t_{d(off)}$	$V_{CC} = 600\text{V}$ $I_C, I_F = 15\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 39\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.21	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.24	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.25	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.26	-	
t_f	$V_{CC} = 600\text{V}$ $I_C, I_F = 15\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 39\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.10	-		
		$T_{vj}=125^{\circ}\text{C}$	-	0.18	-		
		$T_{vj}=150^{\circ}\text{C}$	-	0.19	-		
		$T_{vj}=175^{\circ}\text{C}$	-	0.20	-		
Reverse recovery time	t_{rr}	$V_{CC} = 600\text{V}$ $I_C, I_F = 15\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 39\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.07	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.13	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.17	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.20	-	

 (*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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Items	Symbols	Conditions		Characteristics			Units
				min.	typ.	max.	
Inverter Switching loss (per pulse)	E_{on}	$V_{CC} = 600V$ $I_C, I_F = 15A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 39\Omega$	$T_{vj} = 25^\circ C$	-	1.18	-	mJ
			$T_{vj} = 125^\circ C$	-	1.57	-	
			$T_{vj} = 150^\circ C$	-	1.68	-	
			$T_{vj} = 175^\circ C$	-	1.79	-	
	E_{off}	$V_{CC} = 600V$ $I_C, I_F = 15A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 39\Omega$	$T_{vj} = 25^\circ C$	-	1.12	-	
			$T_{vj} = 125^\circ C$	-	1.41	-	
			$T_{vj} = 150^\circ C$	-	1.49	-	
			$T_{vj} = 175^\circ C$	-	1.56	-	
	E_{tr}	$V_{CC} = 600V$ $I_C, I_F = 15A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 39\Omega$	$T_{vj} = 25^\circ C$	-	0.72	-	
			$T_{vj} = 125^\circ C$	-	1.06	-	
			$T_{vj} = 150^\circ C$	-	1.26	-	
			$T_{vj} = 175^\circ C$	-	1.41	-	
Collector-Emitter cut-off current, Gate-Emitter short-circuited	I_{CES}	$V_{GE} = 0V$ $V_{CE} = 1200V$		-	-	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)	$V_{GE} = 15V$ $I_C = 15A$	$T_{vj} = 25^\circ C$	-	1.60	2.05	V
			$T_{vj} = 25^\circ C$	-	1.50	1.95	
	$V_{CE(sat)}$ (chip)		$T_{vj} = 125^\circ C$	-	1.85	-	
			$T_{vj} = 150^\circ C$	-	1.95	-	
Internal gate resistance	r_g		$T_{vj} = 175^\circ C$	-	2.00	-	Ω
				-	0	-	
Brake Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600V$ $I_C = 15A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 39\Omega$	$T_{vj} = 25^\circ C$	-	0.05	-	μs
			$T_{vj} = 125^\circ C$	-	0.06	-	
			$T_{vj} = 150^\circ C$	-	0.06	-	
			$T_{vj} = 175^\circ C$	-	0.06	-	
	t_r	$V_{CC} = 600V$ $I_C = 15A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 39\Omega$	$T_{vj} = 25^\circ C$	-	0.03	-	
			$T_{vj} = 125^\circ C$	-	0.03	-	
			$T_{vj} = 150^\circ C$	-	0.03	-	
			$T_{vj} = 175^\circ C$	-	0.03	-	
	$t_{d(off)}$	$V_{CC} = 600V$ $I_C = 15A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 39\Omega$	$T_{vj} = 25^\circ C$	-	0.21	-	
			$T_{vj} = 125^\circ C$	-	0.24	-	
			$T_{vj} = 150^\circ C$	-	0.25	-	
			$T_{vj} = 175^\circ C$	-	0.26	-	
	t_f	$V_{CC} = 600V$ $I_C = 15A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 39\Omega$	$T_{vj} = 25^\circ C$	-	0.10	-	
			$T_{vj} = 125^\circ C$	-	0.18	-	
			$T_{vj} = 150^\circ C$	-	0.19	-	
			$T_{vj} = 175^\circ C$	-	0.20	-	
Reverse current	I_{RRM}	$V_R = 1200V$		-	-	50	μA
Forward voltage	V_F (terminal)	$I_F = 10A$	$T_{vj} = 25^\circ C$	-	2.00	2.45	V
			$T_{vj} = 25^\circ C$	-	1.90	2.35	
	V_F (chip)		$T_{vj} = 125^\circ C$	-	1.95	-	
			$T_{vj} = 150^\circ C$	-	1.90	-	
Reverse current	I_{RRM}	$V_R = 1600V$	$T_{vj} = 175^\circ C$	-	1.85	-	μA
				-	-	50	
				-	-	50	
				-	-	50	
Forward voltage	V_{FM}	$I_F = 15A$	terminal	-	1.05	1.50	V
			chip	-	0.95	1.40	
Resistance	R	$T = 25^\circ C$		-	5000	-	Ω
				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	K/W
		Inverter FWD	-	-	1.30	
		Brake IGBT	-	-	1.09	
		Brake FWD	-	-	1.75	
		Converter Diode	-	-	0.73	
Thermal resistance case to heat sink(*1) (1 device)	$R_{th(c-f)}$	Inverter IGBT	-	0.64	-	
		Inverter FWD	-	0.69	-	
		Brake IGBT	-	0.70	-	
		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·t) thermal grease.

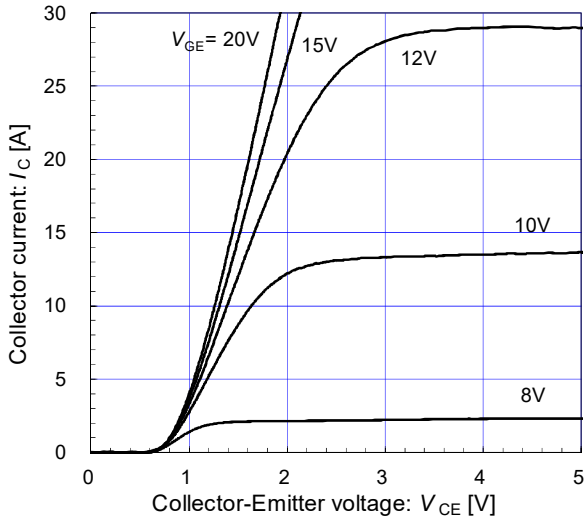
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IGBT Modules

[Inverter]

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

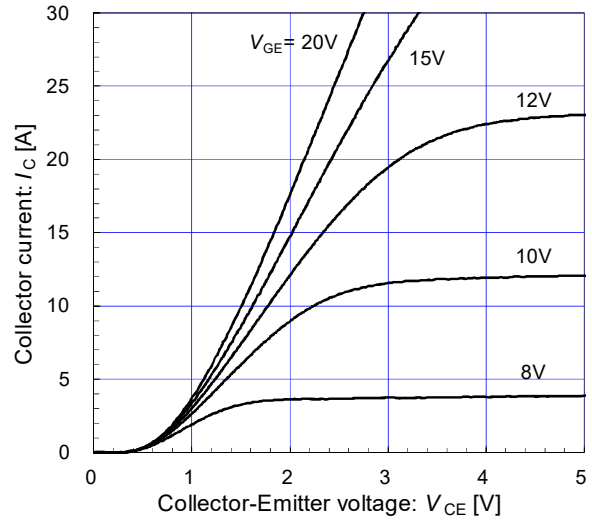
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[Inverter]

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

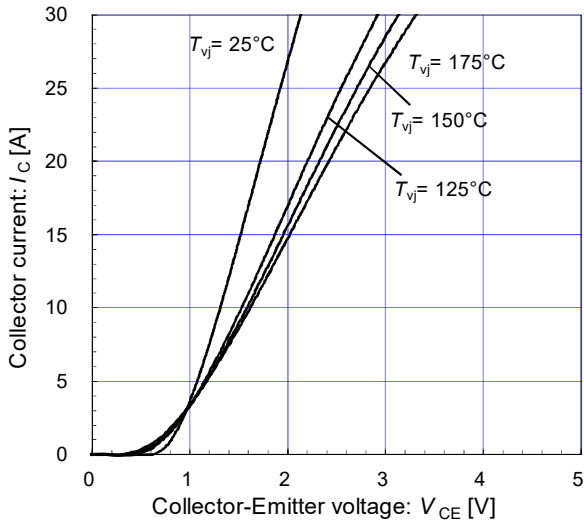
$T_{vj} = 175^{\circ}\text{C} / \text{chip}$



[Inverter]

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

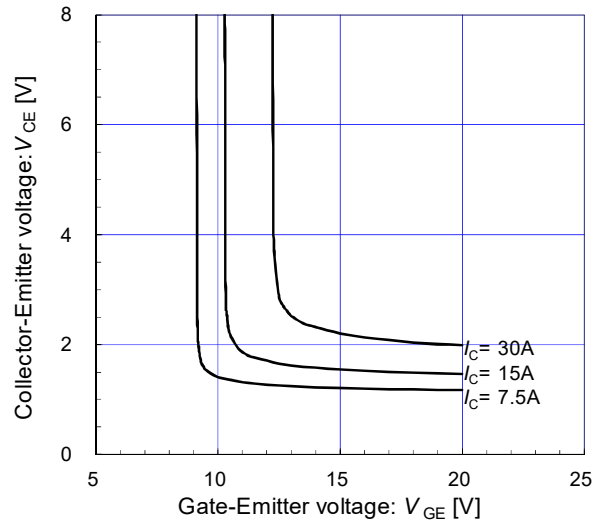
$V_{GE} = 15\text{V} / \text{chip}$



[Inverter]

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

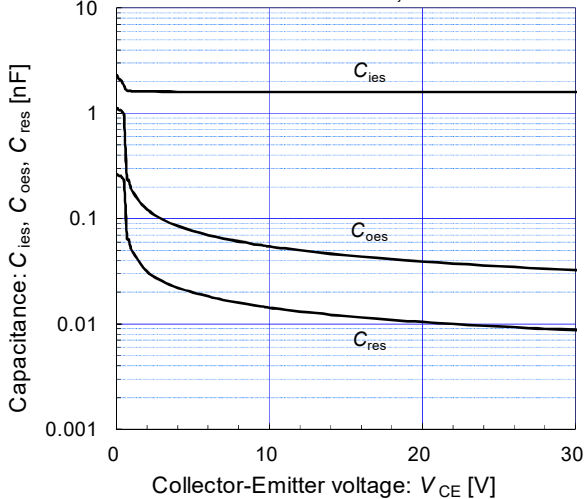
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[Inverter]

Capacitance vs. Collector-Emmitter voltage (typ.)

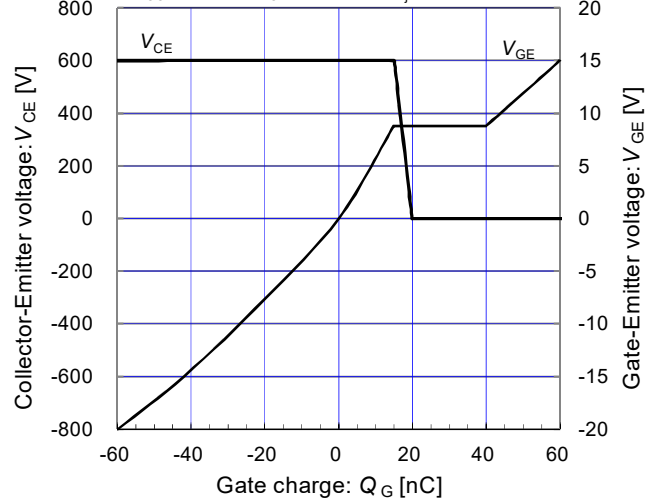
$V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}$



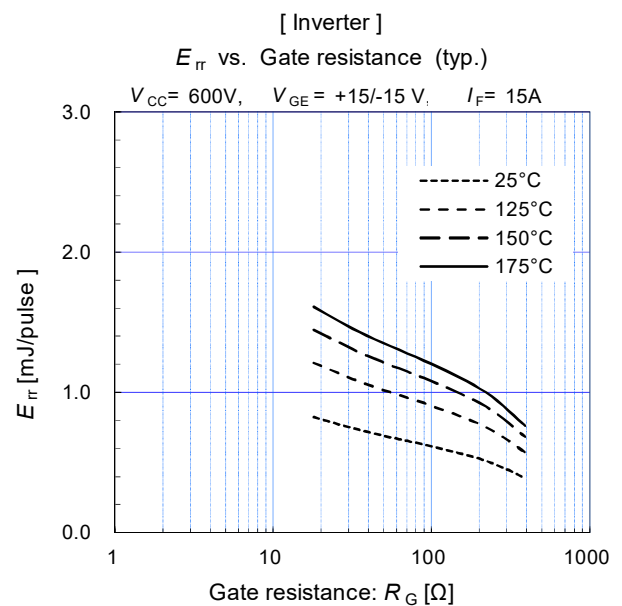
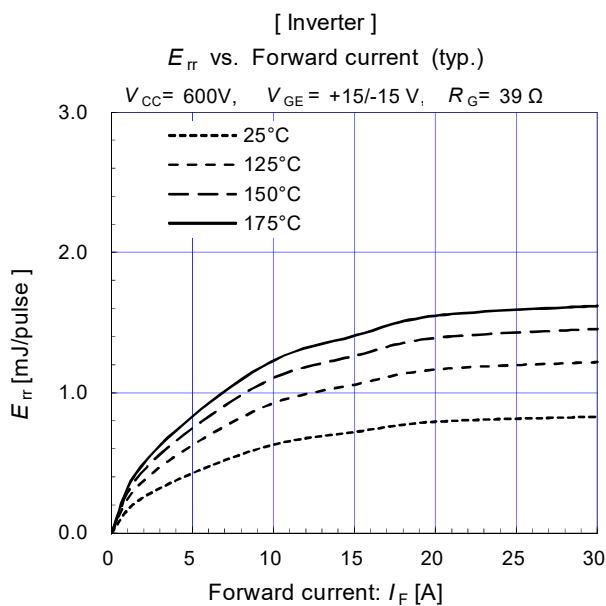
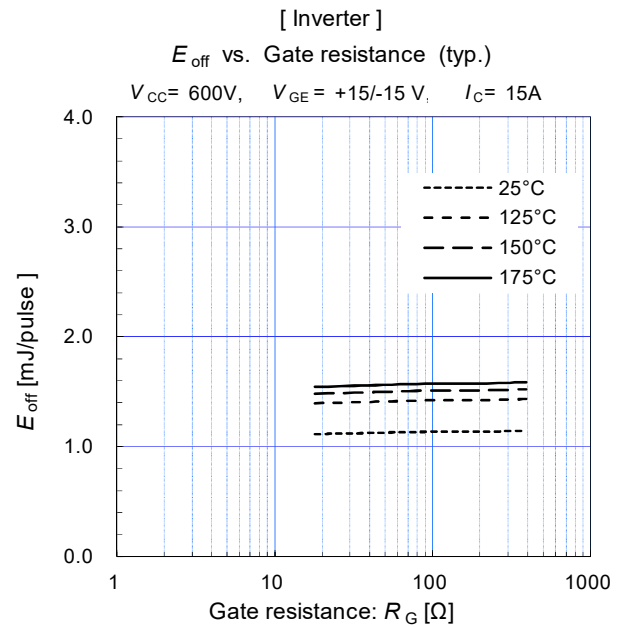
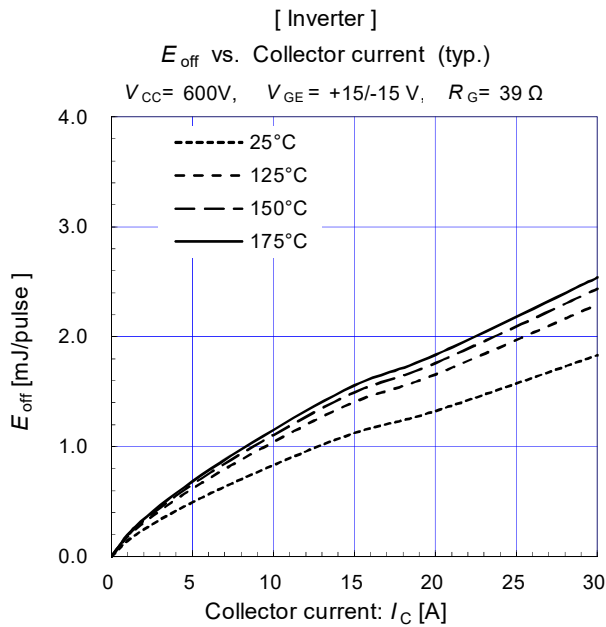
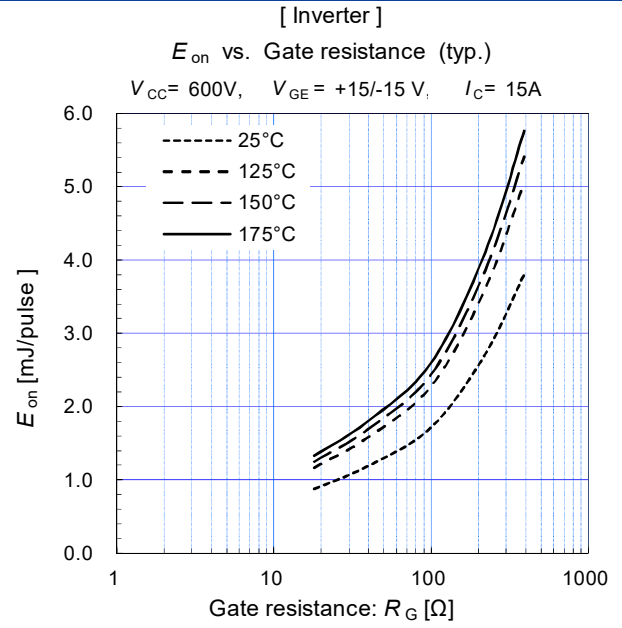
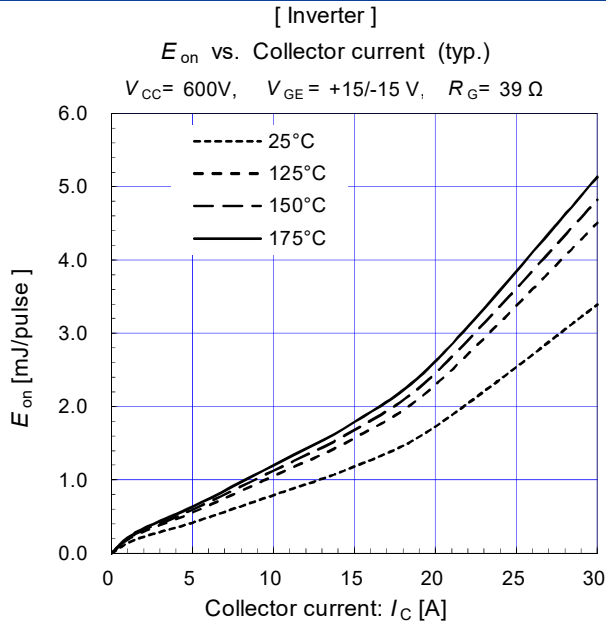
[Inverter]

Dynamic gate charge (typ.)

$V_{CC} = 600\text{V}, I_C = 15\text{A}, T_{vj} = 25^{\circ}\text{C}$



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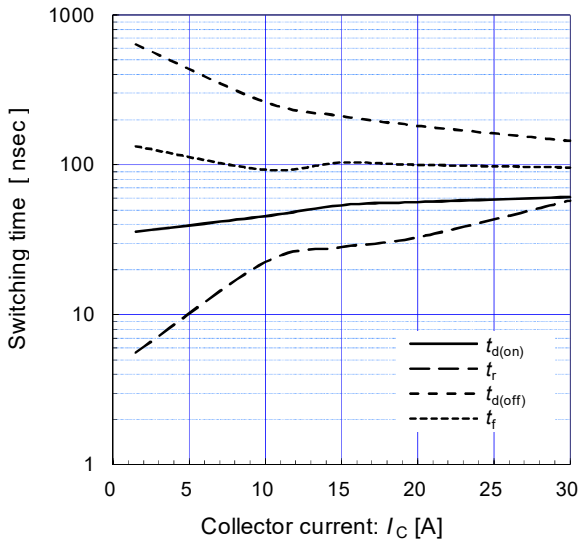
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IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

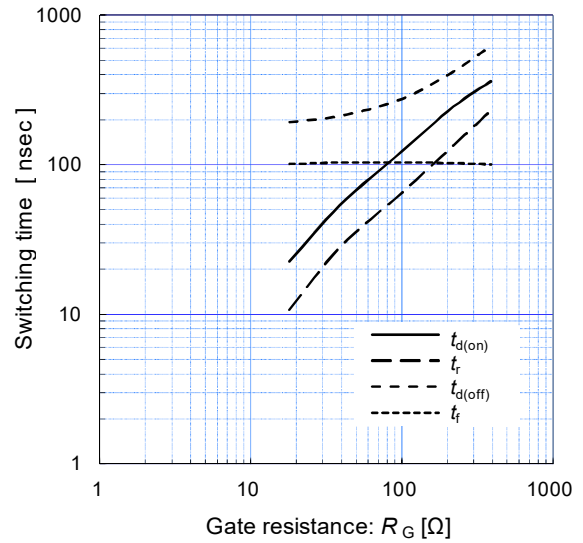
$V_{CC}=600V, R_G=39\Omega, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

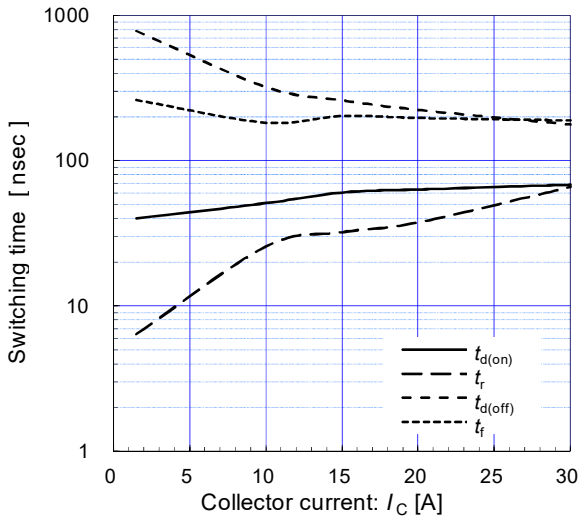
$V_{CC}=600V, I_C=15A, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

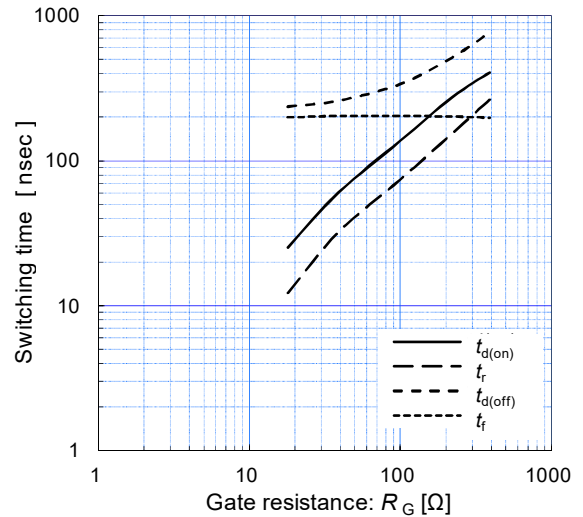
$V_{CC}=600V, R_G=39\Omega, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

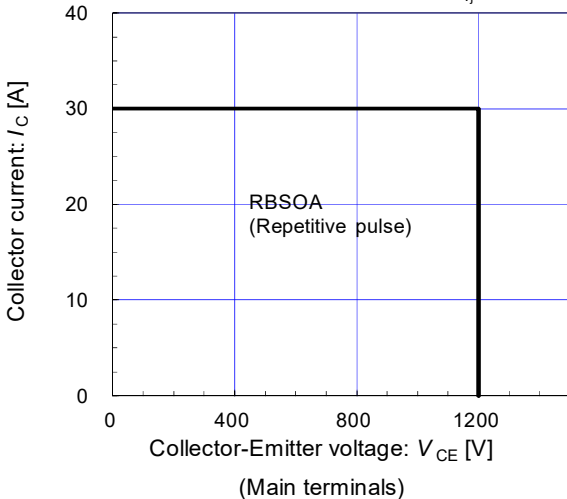
$V_{CC}=600V, I_C=15A, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[Inverter]

Reverse bias safe operating area (max.)

$V_{GE}=+15/-15V, R_G \geq 39\Omega, T_{vj}=175^\circ C$

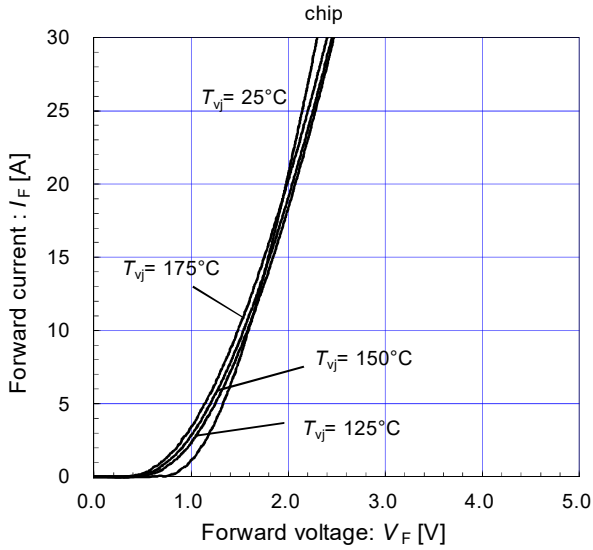


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IGBT Modules

[Inverter]

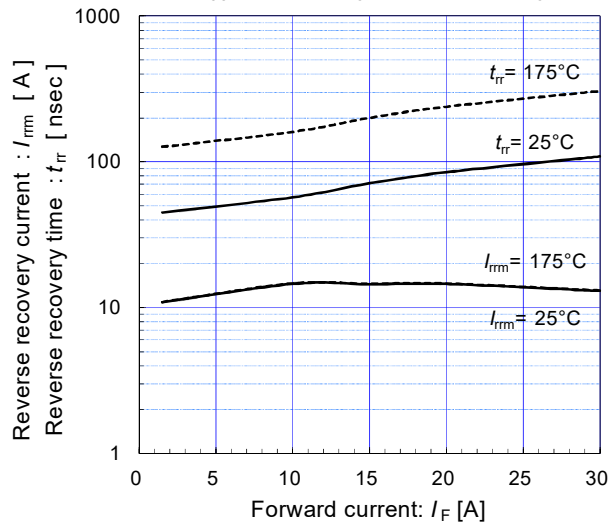
Forward current vs. Forward voltage (typ.)



[Inverter]

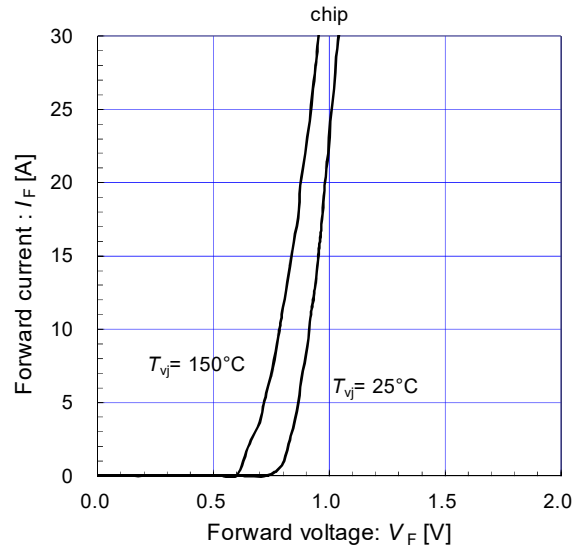
Reverse recovery characteristics (typ.)

$V_{CC} = 600V, V_{GE} = +15/-15V, R_G = 39\Omega$



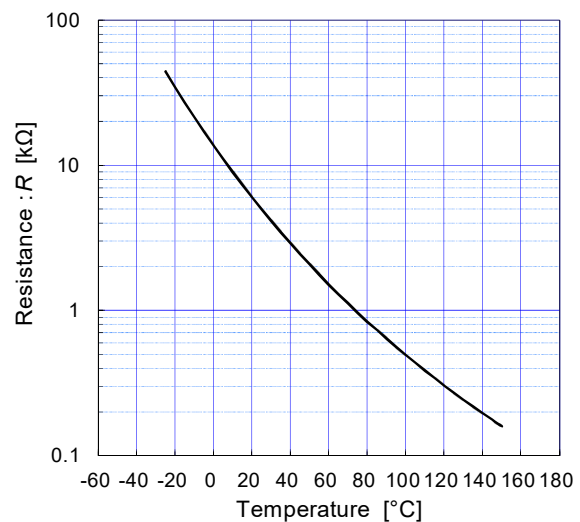
[Converter]

Forward current vs. Forward voltage (typ.)

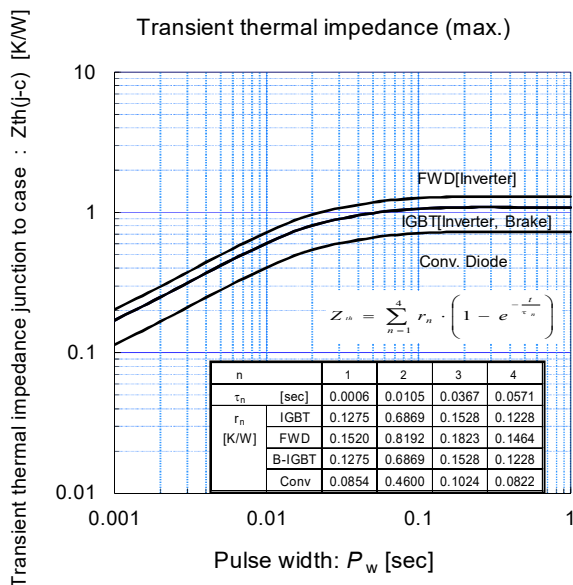


[Thermistor]

Temperature characteristic (typ.)



Transient thermal impedance (max.)



$$Z_{th} = \sum_{n=1}^4 r_n \cdot \left(1 - e^{-\frac{t}{\tau_n}} \right)$$

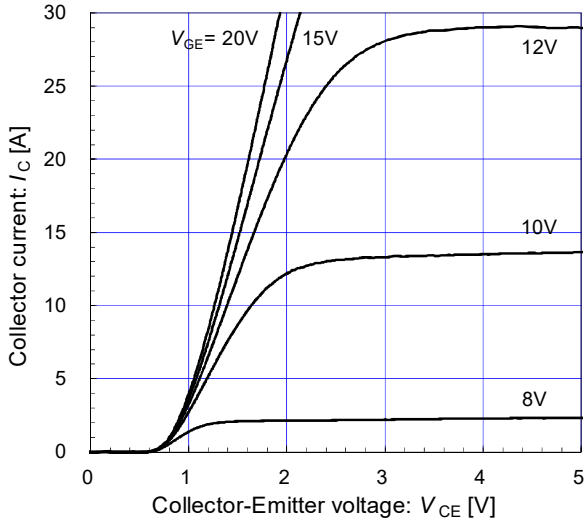
n		1	2	3	4
τ_n	[sec]	0.0006	0.0105	0.0367	0.0571
r_n	IGBT	0.1275	0.6869	0.1528	0.1228
	FWD	0.1520	0.8192	0.1823	0.1464
	B-IGBT	0.1275	0.6869	0.1528	0.1228
	Conv	0.0854	0.4600	0.1024	0.0822

7MBR15XKD120-50

[Brake]

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

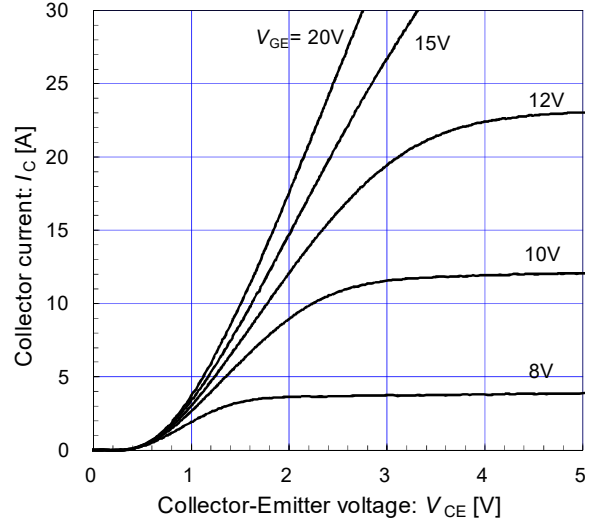
$T_{vj} = 25^\circ\text{C} / \text{chip}$



[Brake]

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

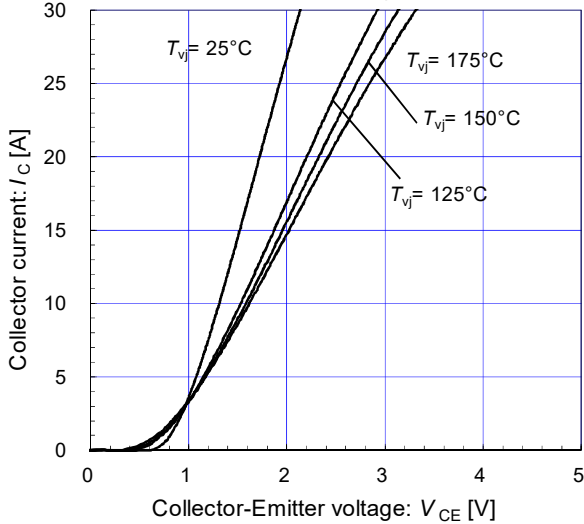
$T_{vj} = 175^\circ\text{C} / \text{chip}$



[Brake]

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

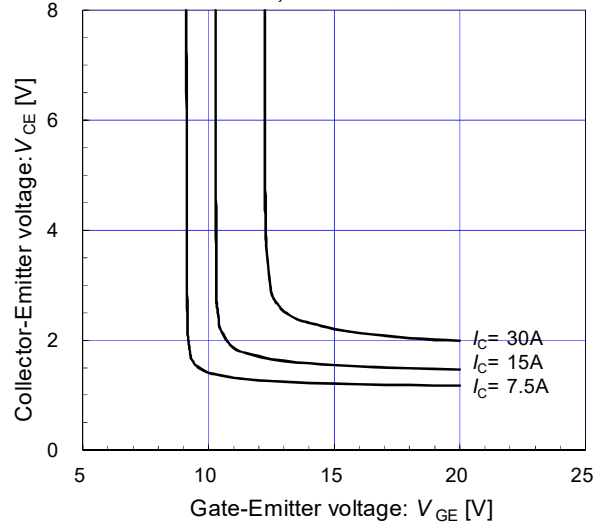
$V_{GE} = 15\text{V} / \text{chip}$



[Brake]

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

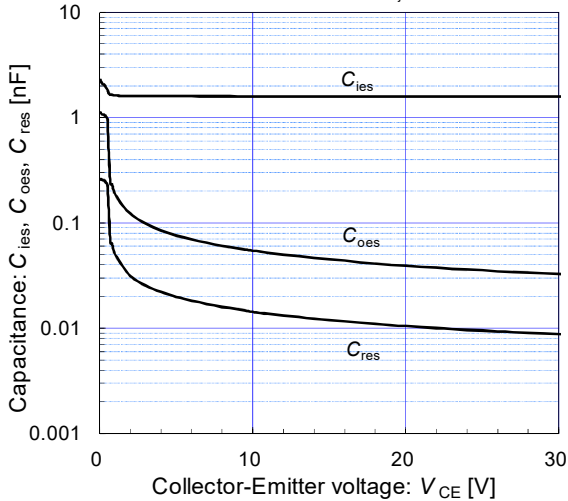
$T_{vj} = 25^\circ\text{C} / \text{chip}$



[Brake]

Capacitance vs. Collector-Emmitter voltage (typ.)

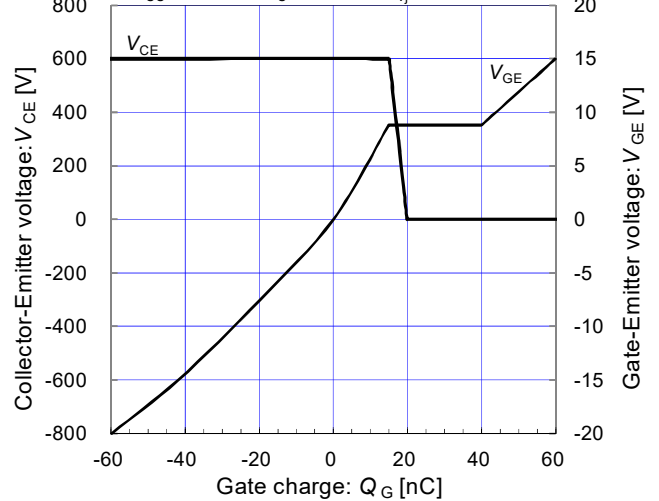
$V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^\circ\text{C}$



[Brake]

Dynamic gate charge (typ.)

$V_{CC} = 600\text{V}, I_C = 15\text{A}, T_{vj} = 25^\circ\text{C}$



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IGBT Modules

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