

7MBR50XMA065-50

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

Items		Symbols	Conditions		Maximum ratings	Units		
Inverter	Collector-Emitter voltage	V_{CES}			650	V		
	Gate-Emitter voltage	V_{GES}			±20	V		
	Collector current	I_C	Continuous	$T_c=100^{\circ}\text{C}$	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		210	W		
Brake IGBT	Collector-Emitter voltage	V_{CES}			650	V		
	Gate-Emitter voltage	V_{GES}			±20	V		
	Collector current	I_C	Continuous	$T_c=100^{\circ}\text{C}$	30	A		
		I_C pulse	1ms		60			
	Collector power dissipation		P_C	1 device		160	W	
Brake FWD	Forward current	I_F	Continuous		20	A		
		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	$T_c=80^{\circ}\text{C}$	50	A	
	Surge current (Non-Repetitive) (*1)	I_{FSM}	$t=10\text{ms}$, Half sine wave form	$T_{vj}=25^{\circ}\text{C}$	580	A		
				$T_{vj}=150^{\circ}\text{C}$	505			
	I^2t (Non-Repetitive) (*1)			$T_{vj}=25^{\circ}\text{C}$	1690	A^2s		
				$T_{vj}=150^{\circ}\text{C}$	1300			
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)	V_{isol}	A.C. : 1min.		2500	Vrms		
	between thermistor and others (*3)							
Screw torque	Mounting torque of screws to heat sink	M_5	M5		2.5~6.0	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.	
Inverter	Zero gate voltage collector current	I_{CES}	$V_{\text{GE}} = 0\text{V}$ $V_{\text{CE}} = 650\text{V}$		-	-	50	μA
	Gate-Emitter leakage current	I_{GES}	$V_{\text{CE}} = 0\text{V}$ $V_{\text{GE}} = +20/-20\text{V}$		-	-	100	nA
	Gate-Emitter threshold voltage	$V_{\text{GE(th)}}$	$V_{\text{CE}} = 20\text{V}$ $I_{\text{C}} = 50\text{mA}$		6.0	6.5	7.0	V
	Collector-Emitter saturation voltage	$V_{\text{CE(sat)}}$ (terminal)	$I_{\text{C}} = 50\text{A}$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	1.50	1.95	V
		$V_{\text{CE(sat)}}$ (chip)		$T_{\text{vj}}=25^{\circ}\text{C}$	-	1.30	1.75	
				$T_{\text{vj}}=125^{\circ}\text{C}$	-	1.45	-	
				$T_{\text{vj}}=150^{\circ}\text{C}$	-	1.50	-	
				$T_{\text{vj}}=175^{\circ}\text{C}$	-	1.55	-	
	Internal gate resistance	r_{g}	-		-	0	-	Ω
	Capacitance	C_{ies}	$V_{\text{CE}} = 10\text{V}, V_{\text{GE}}=0\text{V}, f = 1\text{MHz}$		-	5.7	-	nF
		C_{oes}			-	0.22	-	
		C_{res}			-	0.08	-	
	Gate charge	Q_{G}	$V_{\text{CC}} = 300\text{V}$ $V_{\text{GE}}=-15 \rightarrow +15\text{V}$ $I_{\text{C}} = 50\text{A}$		-	420	-	nC
	Forward voltage	V_{F} (terminal)	$I_{\text{F}} = 50\text{A}$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	1.75	2.20	V
		V_{F} (chip)		$T_{\text{vj}}=25^{\circ}\text{C}$	-	1.55	2.00	
				$T_{\text{vj}}=125^{\circ}\text{C}$	-	1.50	-	
				$T_{\text{vj}}=150^{\circ}\text{C}$	-	1.50	-	
$T_{\text{vj}}=175^{\circ}\text{C}$				-	1.45	-		
Switching time (*1)	$t_{\text{d(on)}}$	$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 68\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	0.35	-	μs	
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	0.36	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	0.36	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	0.35	-		
	t_{r}	$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 68\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	0.10	-		
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	0.13	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	0.14	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	0.14	-		
	$t_{\text{d(off)}}$	$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 68\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	0.52	-		
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	0.50	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	0.55	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	0.56	-		
	t_{f}	$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 68\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	0.04	-		
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	0.04	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	0.04	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	0.04	-		
Reverse recovery time	t_{rr}	$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 68\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	0.08	-		
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	0.25	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	0.27	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	0.28	-		

(*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}	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	2.28	-	mJ
			$I_C, I_F = 50A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	3.18	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	3.53	-	
			$R_G = 68 \Omega$	$T_{vj}=175^{\circ}C$	-	3.84	-	
		E_{off}	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	1.47	-	
			$I_C, I_F = 50A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	1.94	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	2.02	-	
			$R_G = 68 \Omega$	$T_{vj}=175^{\circ}C$	-	2.11	-	
		E_{rr}	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.18	-	
			$I_C, I_F = 50A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.30	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.37	-	
			$R_G = 68 \Omega$	$T_{vj}=175^{\circ}C$	-	0.42	-	
Zero gate voltage collector current	I_{CES}	$V_{GE} = 0V$ $V_{CE} = 650V$		-	-	50	μA	
Gate-Emitter leakage current	I_{GES}	$V_{CE} = 0V, \quad V_{GE} = +20/-20V$		-	-	100	nA	
Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_C = 30A$	$T_{vj}=25^{\circ}C$	-	1.40	1.85	V	
	$V_{CE(sat)}$ (chip)		$T_{vj}=25^{\circ}C$	-	1.30	1.75		
			$T_{vj}=125^{\circ}C$	-	1.45	-		
			$T_{vj}=150^{\circ}C$	-	1.50	-		
			$T_{vj}=175^{\circ}C$	-	1.55	-		
Internal gate resistance	r_g	-			-	0	-	Ω
Brake	Switching time (*1)	$t_{d(on)}$	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.36	-	μs
			$I_C = 30A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.37	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.36	-	
			$R_G = 120 \Omega$	$T_{vj}=175^{\circ}C$	-	0.35	-	
		t_r	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.12	-	
			$I_C = 30A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.15	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.15	-	
			$R_G = 120 \Omega$	$T_{vj}=175^{\circ}C$	-	0.16	-	
		$t_{d(off)}$	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.49	-	
			$I_C = 30A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.52	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.53	-	
			$R_G = 120 \Omega$	$T_{vj}=175^{\circ}C$	-	0.54	-	
		t_f	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.03	-	
			$I_C = 30A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.03	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.03	-	
			$R_G = 120 \Omega$	$T_{vj}=175^{\circ}C$	-	0.03	-	
Reverse current	I_{RRM}	$V_R = 650V$		-	-	50	μA	
Forward voltage	V_F (terminal)	$I_F = 20A$	$T_{vj}=25^{\circ}C$	-	1.65	2.10	V	
	V_F (chip)	$I_F = 20A$	$T_{vj}=25^{\circ}C$	-	1.55	2.00		
			$T_{vj}=125^{\circ}C$	-	1.50	-		
			$T_{vj}=150^{\circ}C$	-	1.50	-		
			$T_{vj}=175^{\circ}C$	-	1.45	-		
Reverse current	I_{RRM}	$V_R = 800V$		-	-	50	μA	
Forward voltage	V_{FM}	$I_F = 50A$	terminal	-	1.25	1.70	V	
			chip	-	1.05	1.50		
Thermistor	Resistance	R	$T = 25^{\circ}C$		-	5000	-	Ω
			$T = 100^{\circ}C$		465	495	520	
	B value	B	$T = 25/ 50^{\circ}C$			3305	3375	3450

(*1) Turn on time (t_{on}) = $t_{d(on)} + t_r$, Turn off time (t_{off}) = $t_{d(off)} + t_f$
FM6M01770b
2023/3

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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 (1device)	$R_{th(j-c)}$	Inverter IGBT	-	-	0.71	°C/W
		Inverter FWD	-	-	0.86	
		Brake IGBT	-	-	0.93	
		Brake FWD	-	-	1.60	
		Converter Diode	-	-	0.67	
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.

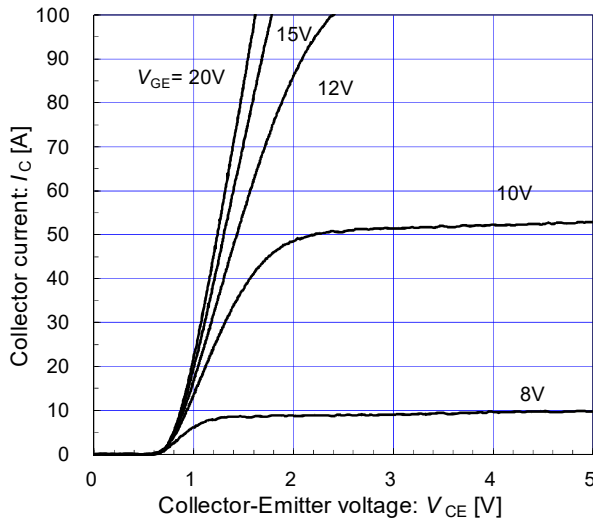
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IGBT Modules

[Inverter]

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

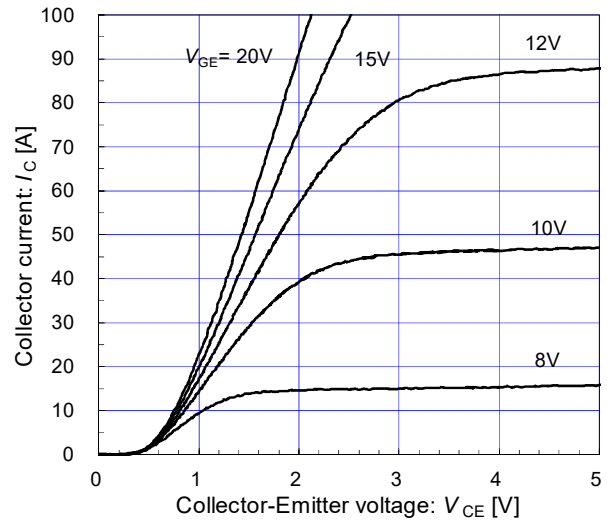
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Inverter]

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

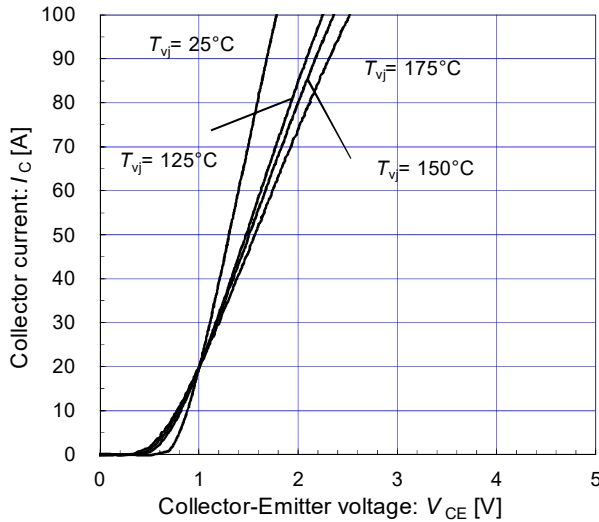
$T_{vj} = 175^{\circ}\text{C}$ / chip



[Inverter]

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

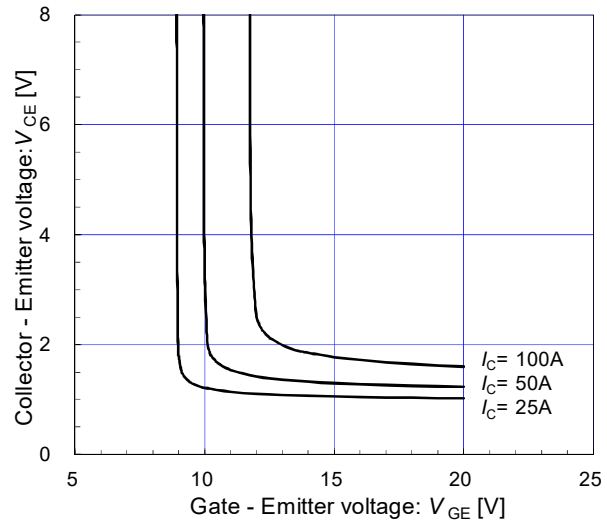
$V_{GE} = 15\text{V}$ / chip



[Inverter]

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

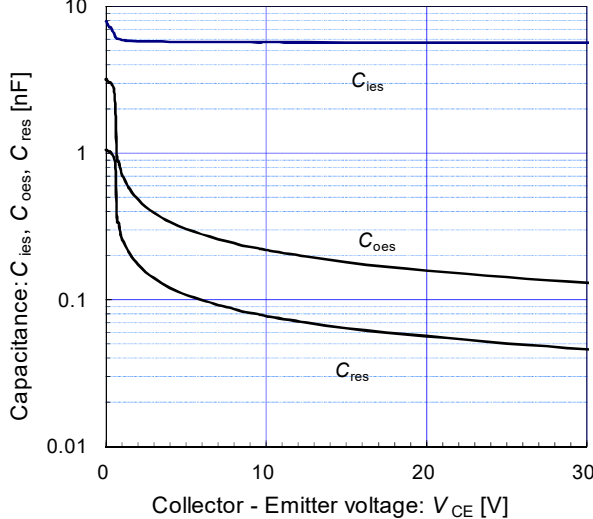
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Inverter]

Capacitance vs. Collector-Emitter voltage (typ.)

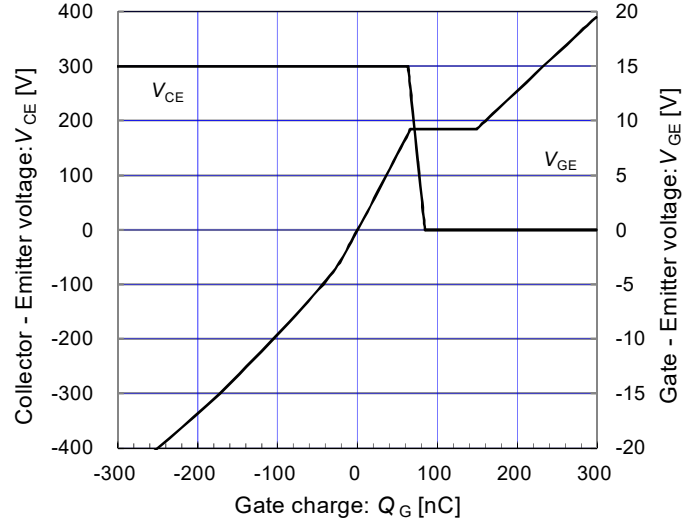
$V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$



[Inverter]

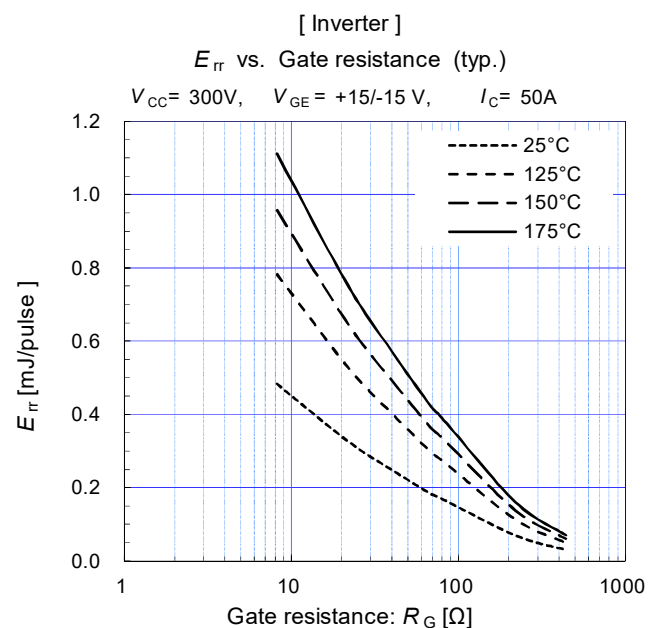
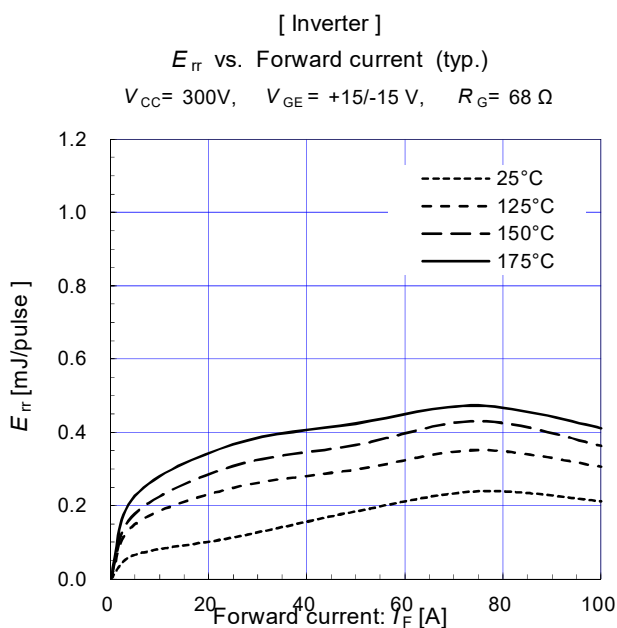
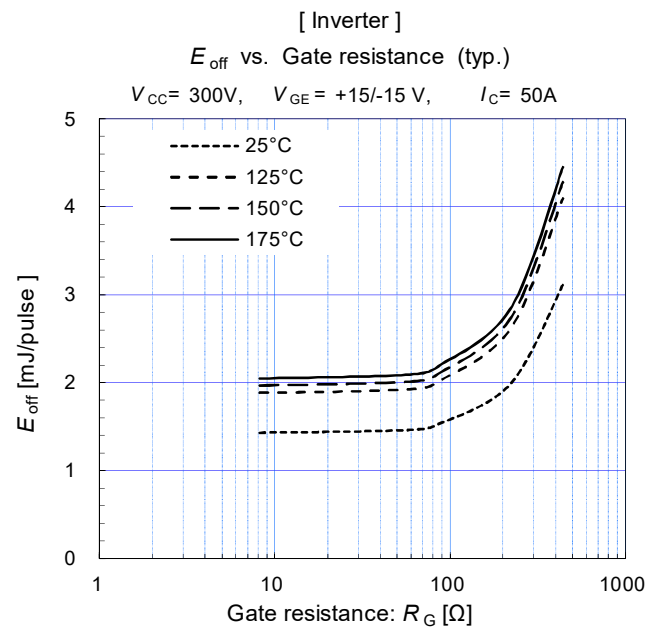
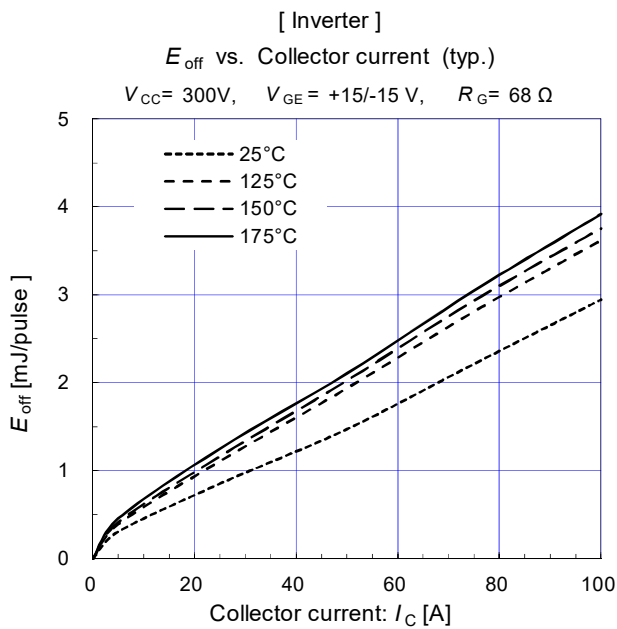
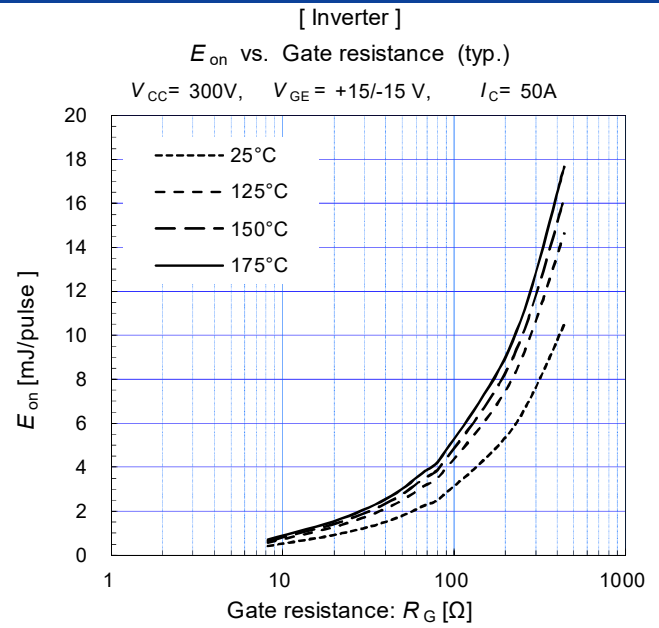
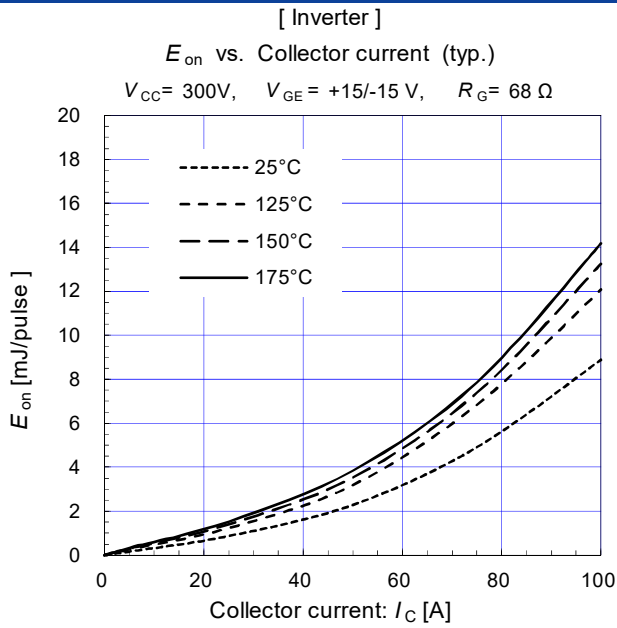
Dynamic gate charge (typ.)

$V_{CC} = 300\text{V}$, $I_C = 50\text{A}$, $T_{vj} = 25^{\circ}\text{C}$



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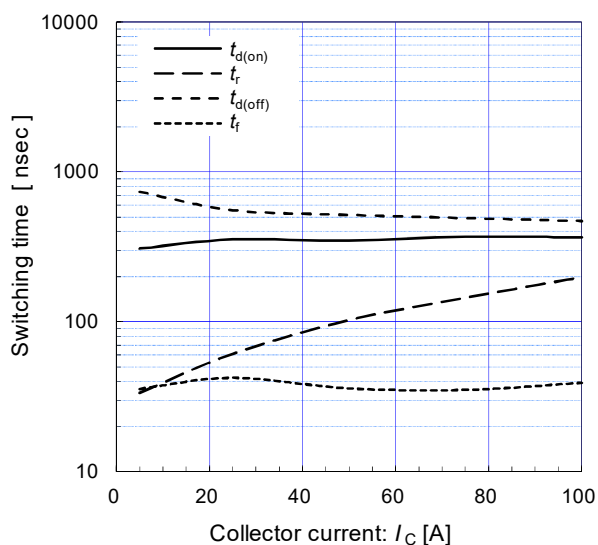
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IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

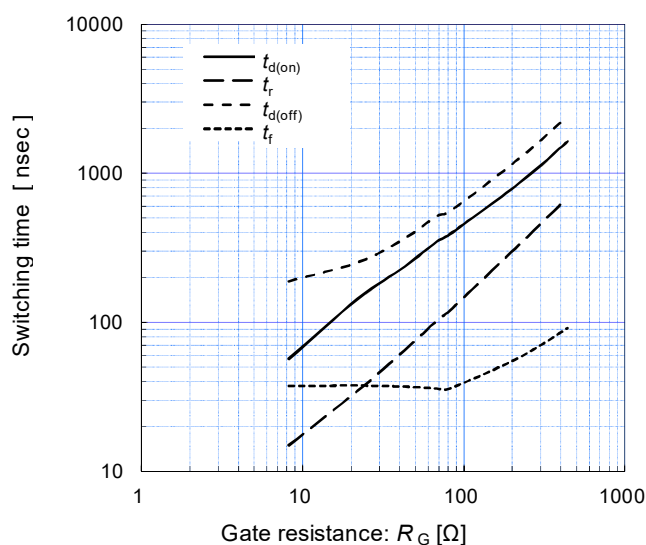
$V_{CC}=300V$, $R_G=68\Omega$ $V_{GE}=+15/-15V$, $T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

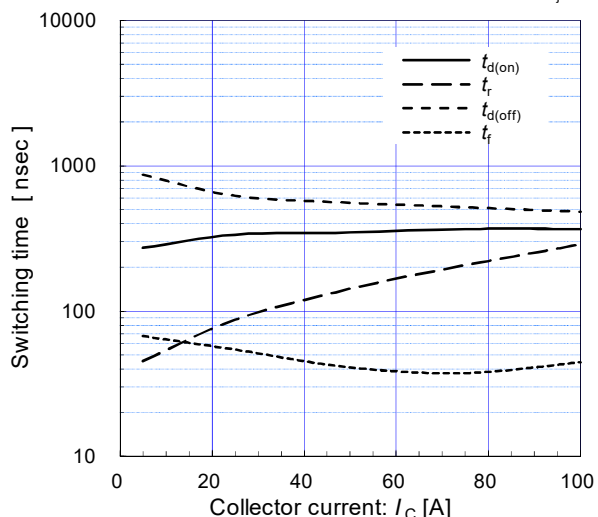
$V_{CC}=300V$, $I_C=50A$, $V_{GE}=+15/-15V$, $T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

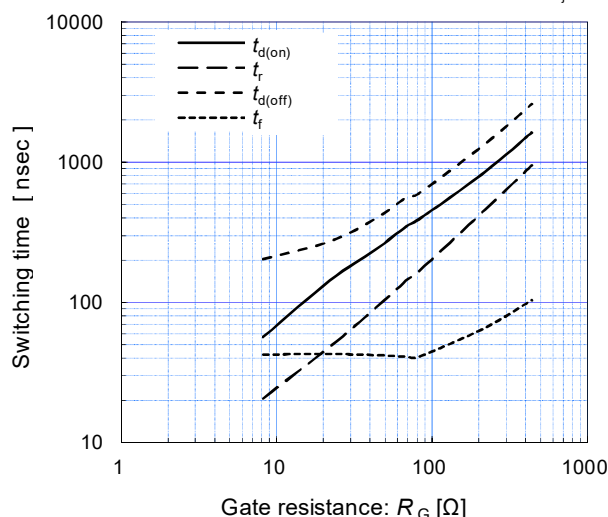
$V_{CC}=300V$, $R_G=68\Omega$ $V_{GE}=+15/-15V$, $T_{vj}=175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

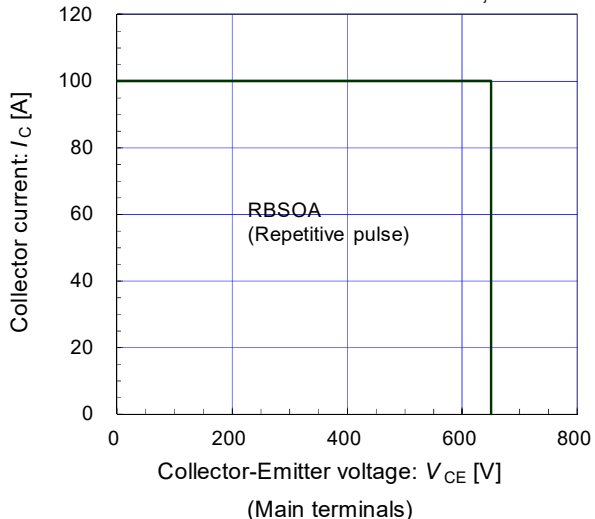
$V_{CC}=300V$, $I_C=50A$, $V_{GE}=+15/-15V$, $T_{vj}=175^\circ C$



[Inverter]

Reverse bias safe operating area (max.)

$V_{GE}=+15/-15V$, $R_G \geq 68\Omega$ $T_{vj}=175^\circ C$

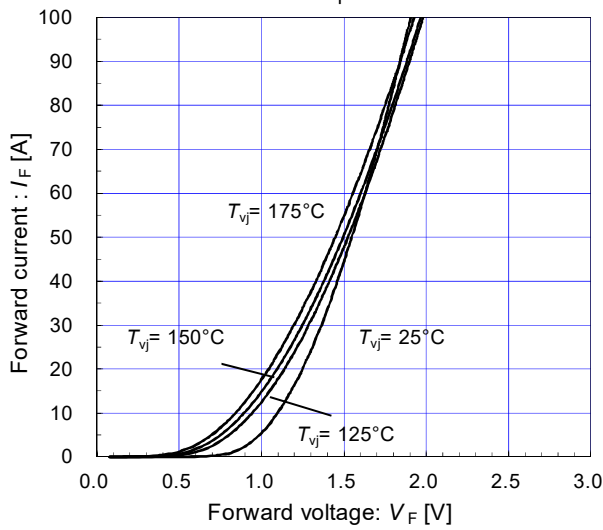


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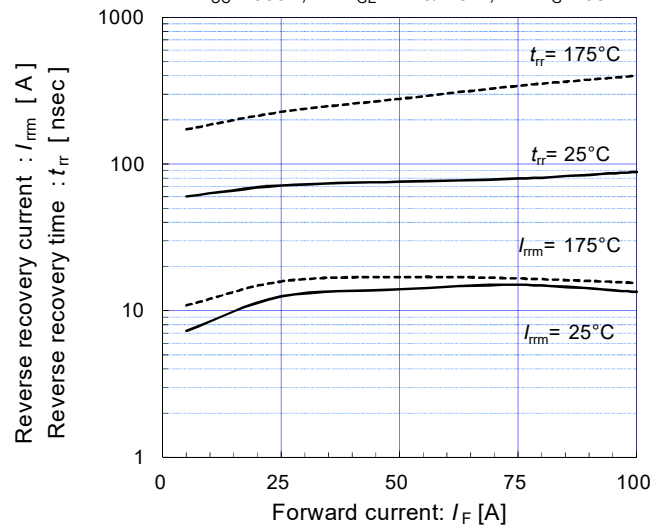
[Inverter]

Forward current vs. Forward voltage (typ.)
chip



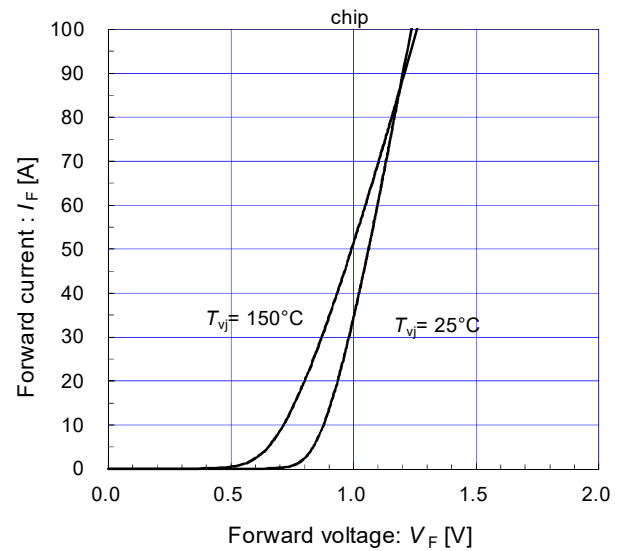
[Inverter]

Reverse recovery characteristics (typ.)
 $V_{CC} = 300V$, $V_{GE} = +15/-15V$, $R_G = 68\Omega$

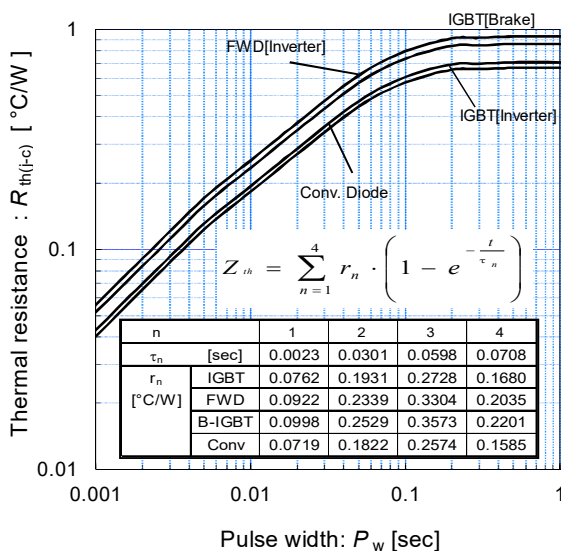


[Converter]

Forward current vs. Forward voltage (typ.)

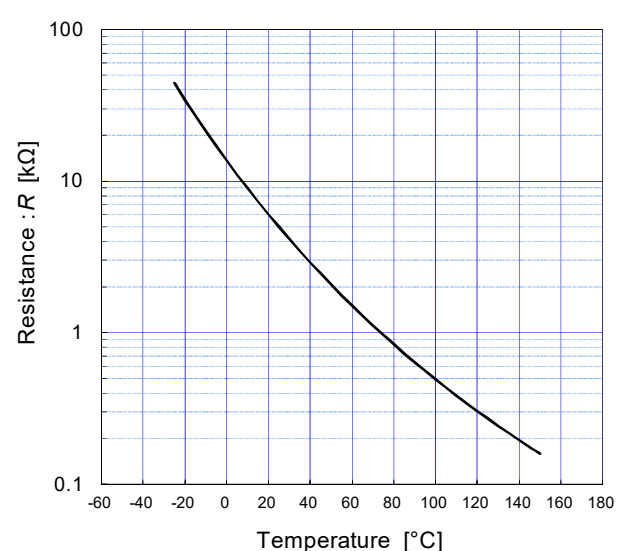


Transient thermal resistance (max.)



[Thermistor]

Temperature characteristic (typ.)



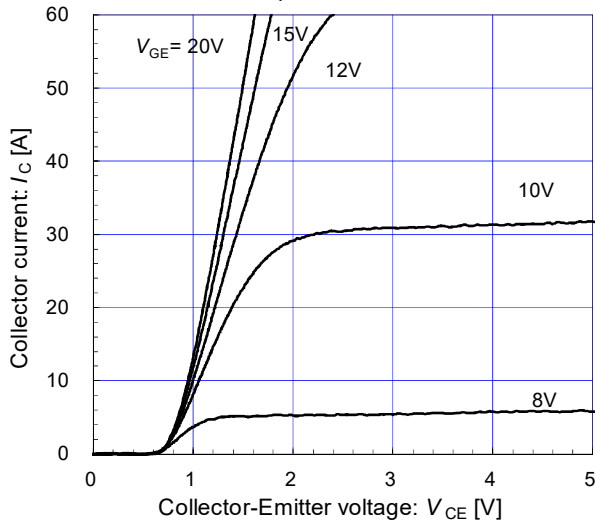
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[Brake]

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

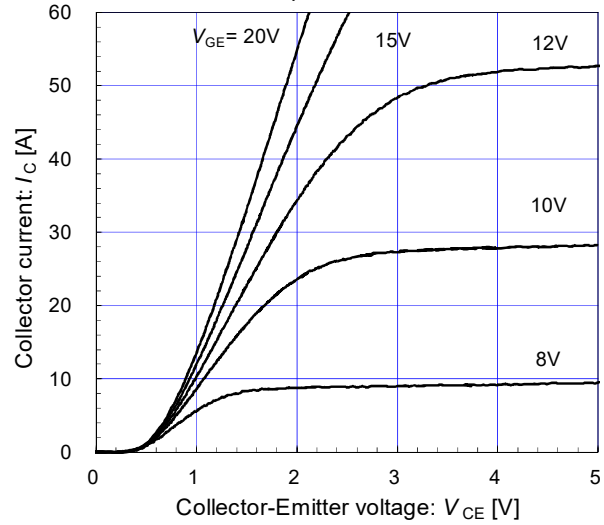
$T_{vj} = 25^\circ\text{C} / \text{chip}$



[Brake]

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

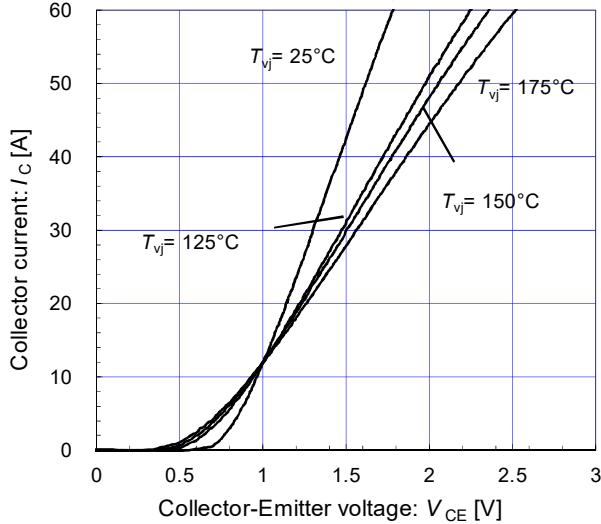
$T_{vj} = 175^\circ\text{C} / \text{chip}$



[Brake]

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

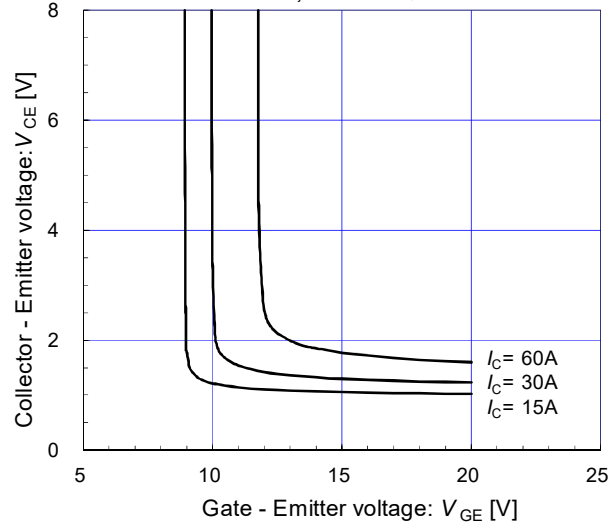
$V_{GE} = 15\text{V} / \text{chip}$



[Brake]

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

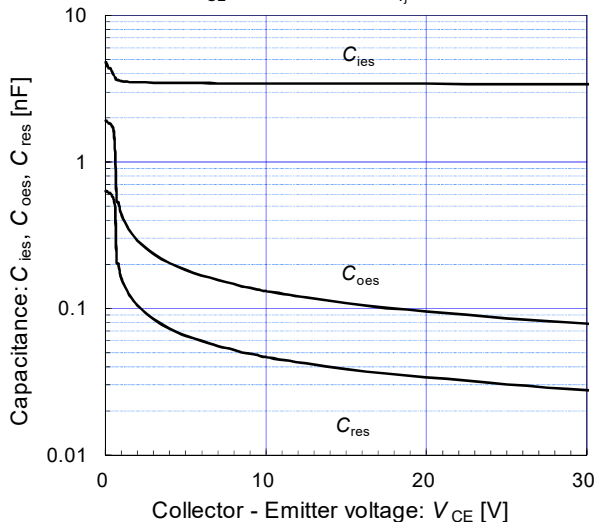
$T_{vj} = 25^\circ\text{C} / \text{chip}$



[Brake]

Capacitance vs. Collector-Emitter voltage (typ.)

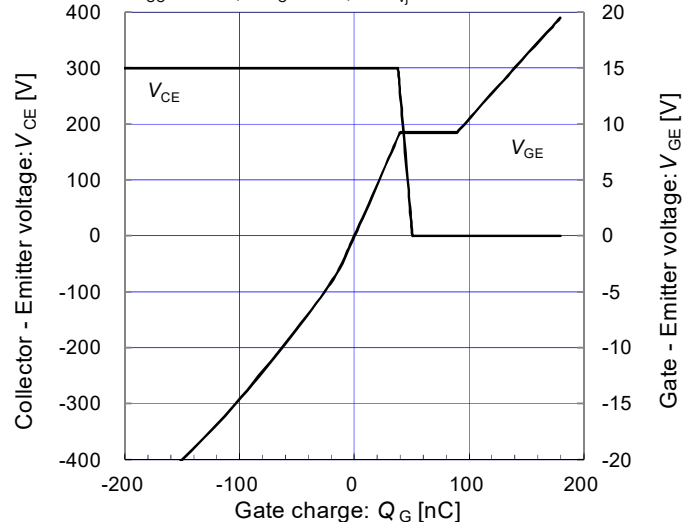
$V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^\circ\text{C}$



[Brake]

Dynamic gate charge (typ.)

$V_{CC} = 300\text{V}, I_C = 30\text{A}, T_{vj} = 25^\circ\text{C}$



FM6M01770b

2023/3

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