

7MBR15XKC065-50

IGBT Modules

Power Module(X series)
650V / 15A / PIM

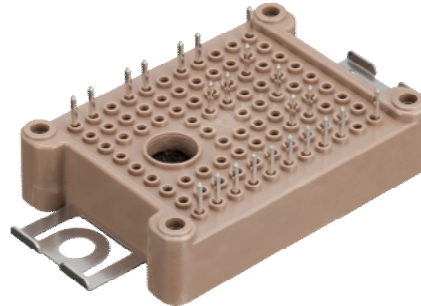
■ Features

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

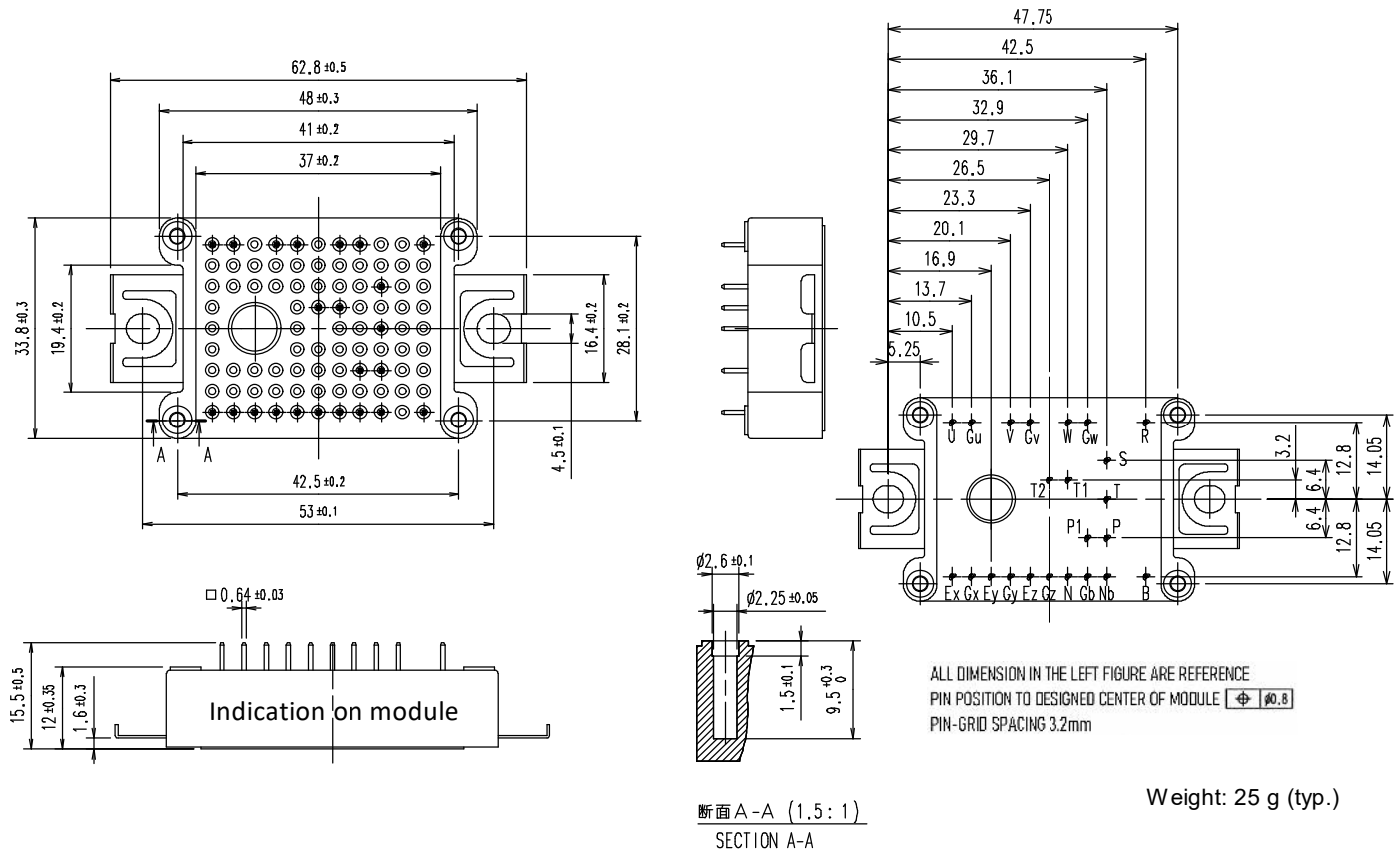
■ Applications

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

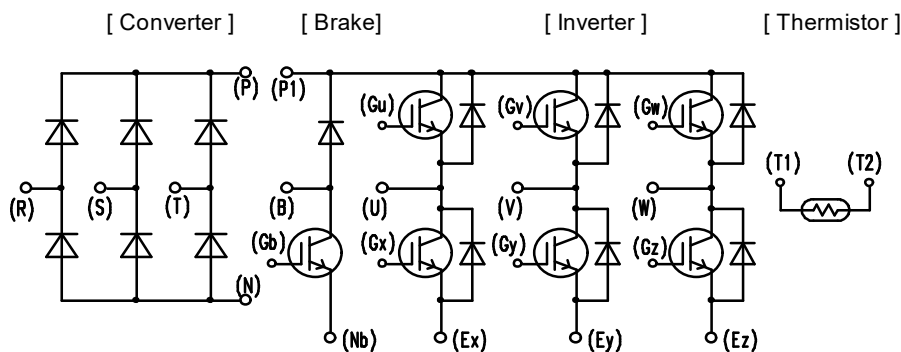
■ Typical appearance



■ Outline drawing (Unit : mm)



■ 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}			± 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		110	W
Brake IGBT	Collector-Emitter voltage, Gate-Emitter short-circuited	V_{CES}			650	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		110	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
Converter	Repetitive peak reverse voltage	V_{RRM}			800	V
	Average output current	I_O	Three-phase full wave rectified current	$T_c = 80^\circ\text{C}$	15	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^2s
				$T_{vj} = 150^\circ\text{C}$	585	
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.	
Inverter	Collector-Emitter cut-off current, Gate-Emitter short-circuited	I_{CES}	$V_{GE} = 0V$ $V_{CE} = 650V$		-	-	50	μA
	Gate leakage current, Collector-Emitter short-circuited	I_{GES}	$V_{CE} = 0V \quad V_{GE} = +20/-20V$		-	-	100	nA
	Gate-Emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = 20V$ $I_C = 15mA$		6.0	6.5	7.0	V
	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_C = 15A$	$T_{vj}=25^{\circ}C$	-	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
	Capacitance	C_{ies}	$V_{CE} = 10V, V_{GE} = 0V, f = 1MHz$		-	1.7	-	nF
		C_{oes}			-	0.07	-	
		C_{res}			-	0.02	-	
	Gate charge	Q_G	$V_{CC} = 300V \quad V_{GE} = -15 \rightarrow +15V$ $I_C = 15A$		-	120	-	nC
	Forward voltage	V_F (terminal)	$I_F = 15A$	$T_{vj}=25^{\circ}C$	-	1.60	2.05	V
		V_F (chip)		$T_{vj}=25^{\circ}C$	-	1.50	1.95	
				$T_{vj}=125^{\circ}C$	-	1.45	-	
				$T_{vj}=150^{\circ}C$	-	1.45	-	
				$T_{vj}=175^{\circ}C$	-	1.40	-	
	Switching time (*1)	$t_{d(on)}$	$V_{CC} = 300V$ $I_C, I_F = 15A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 24\Omega$	$T_{vj}=25^{\circ}C$	-	0.05	-	μs
$T_{vj}=125^{\circ}C$				-	0.05	-		
$T_{vj}=150^{\circ}C$				-	0.05	-		
$T_{vj}=175^{\circ}C$				-	0.05	-		
t_r		$V_{CC} = 300V$ $I_C, I_F = 15A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 24\Omega$	$T_{vj}=25^{\circ}C$	-	0.02	-		
			$T_{vj}=125^{\circ}C$	-	0.02	-		
			$T_{vj}=150^{\circ}C$	-	0.02	-		
			$T_{vj}=175^{\circ}C$	-	0.02	-		
$t_{d(off)}$		$V_{CC} = 300V$ $I_C, I_F = 15A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 24\Omega$	$T_{vj}=25^{\circ}C$	-	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		$V_{CC} = 300V$ $I_C, I_F = 15A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 24\Omega$	$T_{vj}=25^{\circ}C$	-	0.03	-		
			$T_{vj}=125^{\circ}C$	-	0.04	-		
			$T_{vj}=150^{\circ}C$	-	0.05	-		
			$T_{vj}=175^{\circ}C$	-	0.05	-		
Reverse recovery time	t_{rr}	$V_{CC} = 300V$ $I_C, I_F = 15A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 24\Omega$	$T_{vj}=25^{\circ}C$	-	0.06	-		
			$T_{vj}=125^{\circ}C$	-	0.10	-		
			$T_{vj}=150^{\circ}C$	-	0.12	-		
			$T_{vj}=175^{\circ}C$	-	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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Items		Symbols	Conditions		Characteristics			Units	
					min.	typ.	max.		
Inverter	Switching loss (per pulse)	E_{on}	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.12	-	mJ	
			$I_C, I_F = 15A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.17	-		
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.20	-		
			$R_G = 24 \Omega$	$T_{vj}=175^{\circ}C$	-	0.23	-		
			$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.38	-		
		E_{off}	$I_C, I_F = 15A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.47	-		
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.50	-		
			$R_G = 24 \Omega$	$T_{vj}=175^{\circ}C$	-	0.53	-		
			E_{rr}	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.12		-
				$I_C, I_F = 15A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.21		-
		$V_{GE} = +15/-15 V$		$T_{vj}=150^{\circ}C$	-	0.26	-		
		$R_G = 24 \Omega$		$T_{vj}=175^{\circ}C$	-	0.30	-		
Collector-Emitter cut-off current, Gate-Emitter short-circuited	I_{CES}	$V_{GE} = 0V$ $V_{CE} = 650V$		-	-	50	μA		
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)	$V_{GE} = 15V$ $I_C = 15A$	$T_{vj}=25^{\circ}C$	-	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)	$t_{d(on)}$	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.05	-	μs	
			$I_C = 15A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.05	-		
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.05	-		
			$R_G = 24 \Omega$	$T_{vj}=175^{\circ}C$	-	0.05	-		
		t_r	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.02	-		
			$I_C = 15A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.02	-		
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.02	-		
			$R_G = 24 \Omega$	$T_{vj}=175^{\circ}C$	-	0.02	-		
		$t_{d(off)}$	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.15	-		
			$I_C = 15A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.17	-		
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.18	-		
			$R_G = 24 \Omega$	$T_{vj}=175^{\circ}C$	-	0.18	-		
		t_f	$V_{CC} = 300V$	$T_{vj}=25^{\circ}C$	-	0.03	-		
			$I_C = 15A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.04	-		
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.05	-		
			$R_G = 24 \Omega$	$T_{vj}=175^{\circ}C$	-	0.05	-		
		Reverse current	I_{RRM}	$V_D = 650V$		-	-		50
Forward voltage	V_F (terminal)	$I_F = 10A$	$T_j=25^{\circ}C$	-	1.65	2.10	V		
	V_F (chip)	$I_F = 10A$	$T_{vj}=25^{\circ}C$	-	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}	$I_F = 15A$	terminal	-	1.05	1.50	V		
			chip	-	0.95	1.40			
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	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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IGBT Modules
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	-	-	1.31	K/W
		Inverter FWD	-	-	1.50	
		Brake IGBT	-	-	1.31	
		Brake FWD	-	-	1.92	
		Converter Diode	-	-	0.75	
Thermal resistance case to heat sink(*1) (1 device)	$R_{th(c-f)}$	Inverter IGBT	-	0.81	-	
		Inverter FWD	-	0.92	-	
		Brake IGBT	-	0.84	-	
		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.

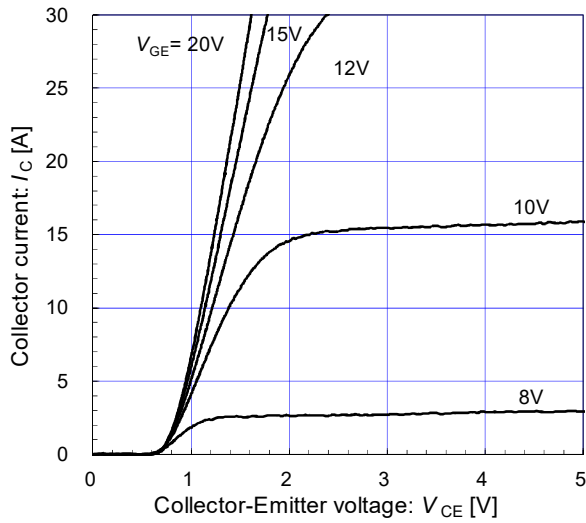
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IGBT Modules

[Inverter]

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

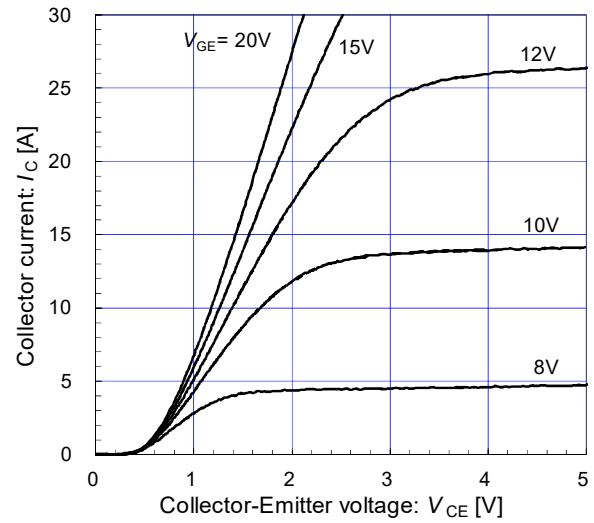
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Inverter]

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

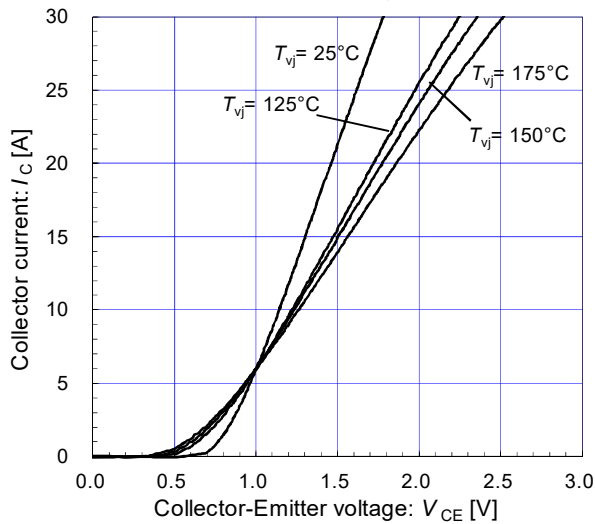
$T_{vj} = 175^{\circ}\text{C}$ / chip



[Inverter]

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

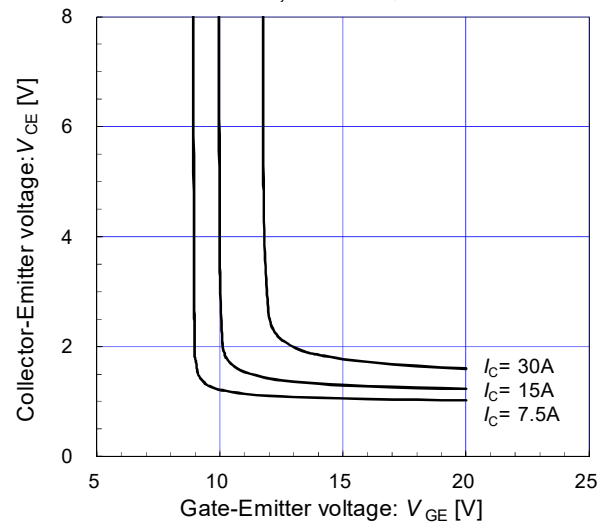
$V_{GE} = 15\text{V}$ / chip



[Inverter]

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

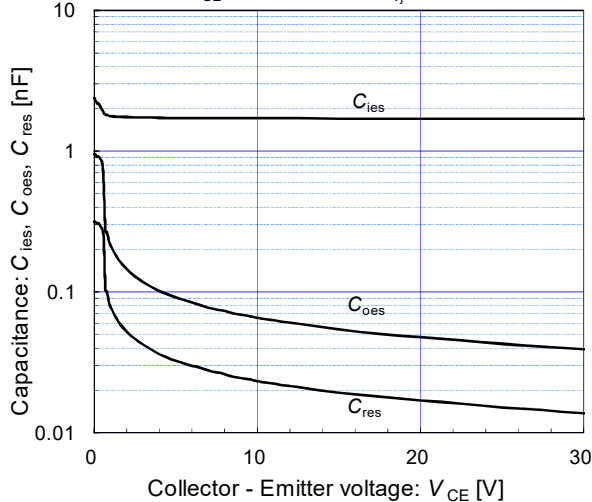
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Inverter]

Capacitance vs. Collector-Emittor voltage (typ.)

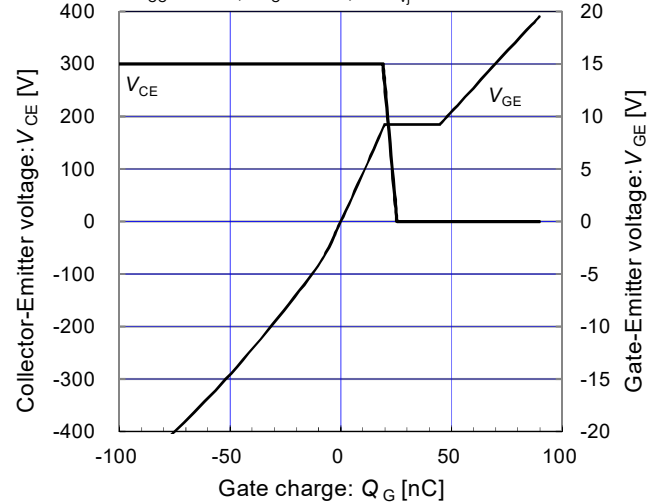
$V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$



[Inverter]

Dynamic gate charge (typ.)

$V_{CC} = 300\text{V}$, $I_C = 15\text{A}$, $T_{vj} = 25^{\circ}\text{C}$



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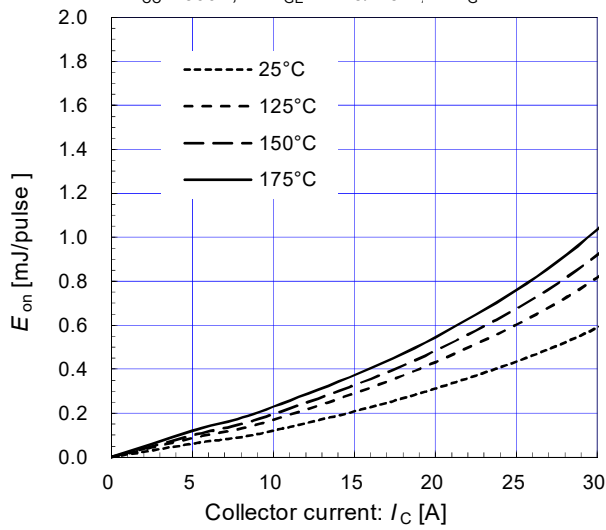
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IGBT Modules

[Inverter]

E_{on} vs. Collector current (typ.)

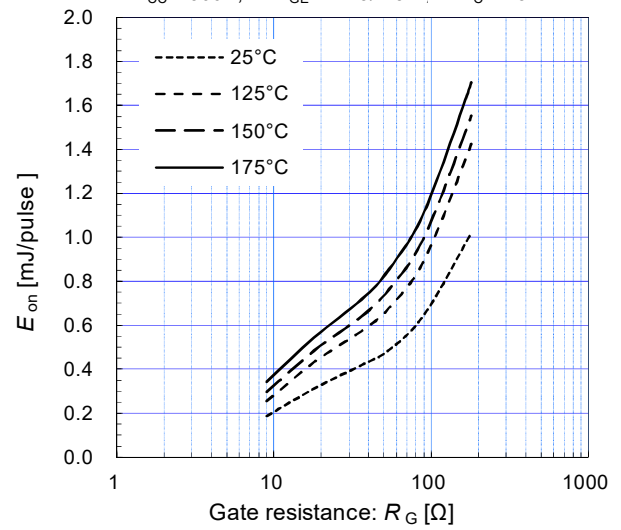
$V_{CC} = 300V$, $V_{GE} = +15/-15V$, $R_G = 24\Omega$



[Inverter]

E_{on} vs. Gate resistance (typ.)

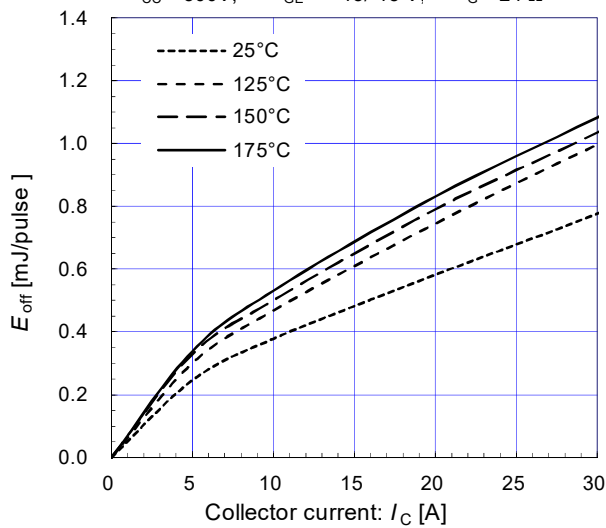
$V_{CC} = 300V$, $V_{GE} = +15/-15V$, $I_C = 15A$



[Inverter]

E_{off} vs. Collector current (typ.)

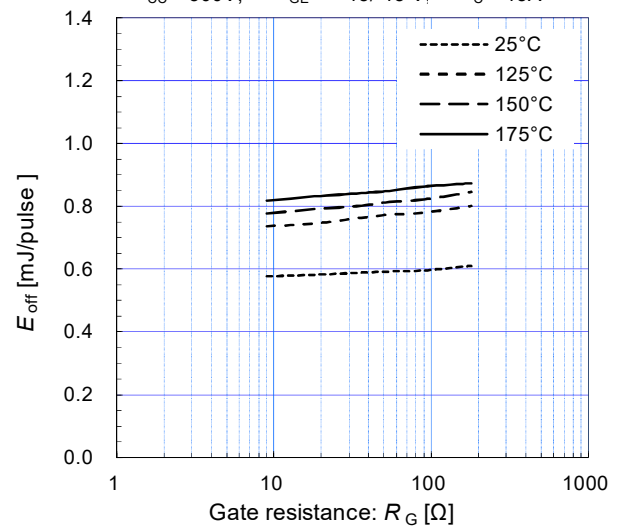
$V_{CC} = 300V$, $V_{GE} = +15/-15V$, $R_G = 24\Omega$



[Inverter]

E_{off} vs. Gate resistance (typ.)

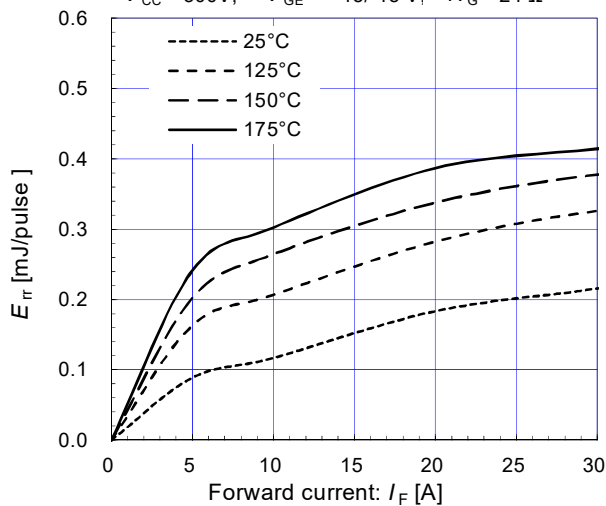
$V_{CC} = 300V$, $V_{GE} = +15/-15V$, $I_C = 15A$



[Inverter]

E_{rr} vs. Forward current (typ.)

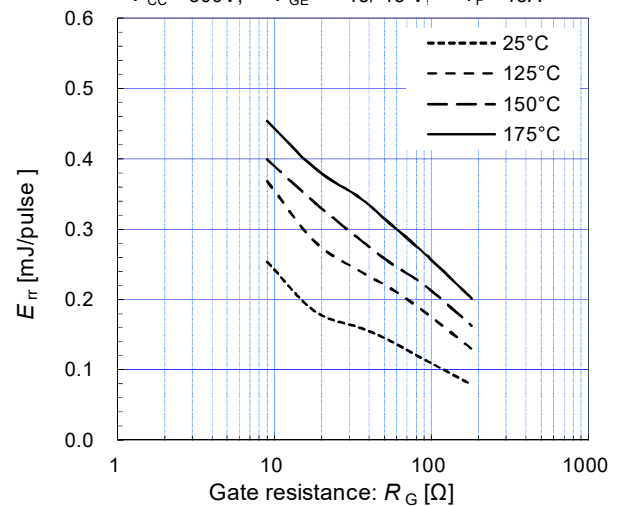
$V_{CC} = 300V$, $V_{GE} = +15/-15V$, $R_G = 24\Omega$



[Inverter]

E_{rr} vs. Gate resistance (typ.)

$V_{CC} = 300V$, $V_{GE} = +15/-15V$, $I_F = 15A$



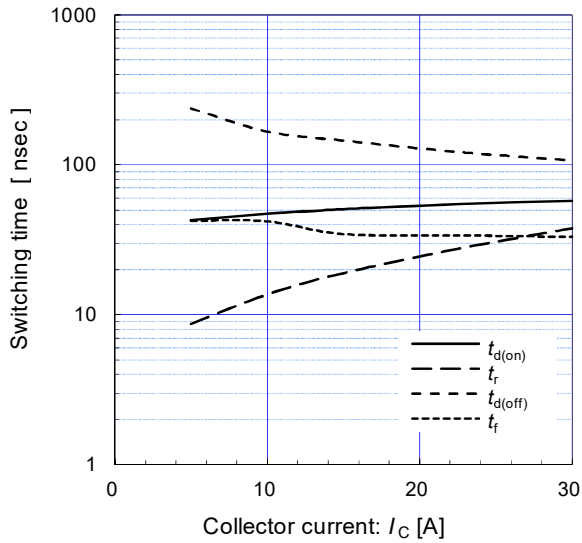
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IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

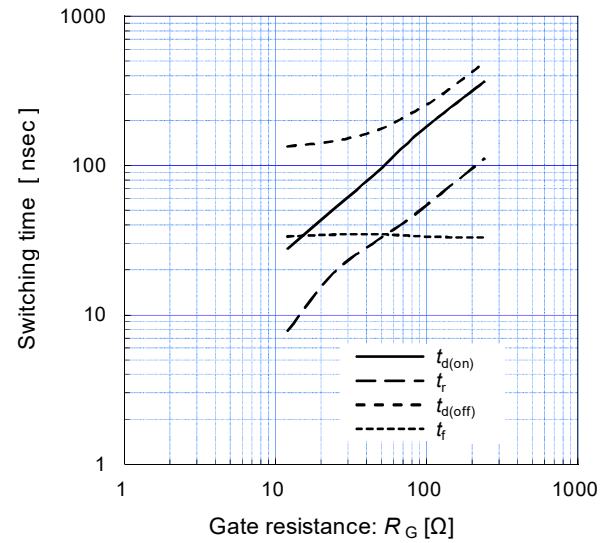
$V_{CC} = 300V$, $R_G = 24\Omega$ $V_{GE} = +15/-15V$, $T_{vj} = 25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

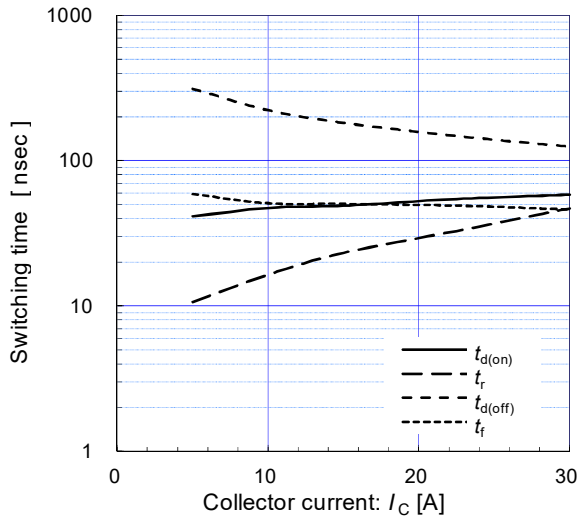
$V_{CC} = 300V$, $I_C = 15A$, $V_{GE} = +15/-15V$, $T_{vj} = 25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

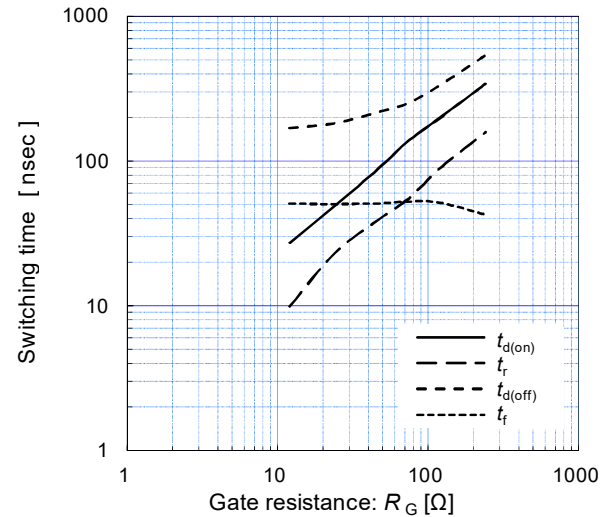
$V_{CC} = 300V$, $R_G = 24\Omega$ $V_{GE} = +15/-15V$, $T_{vj} = 175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

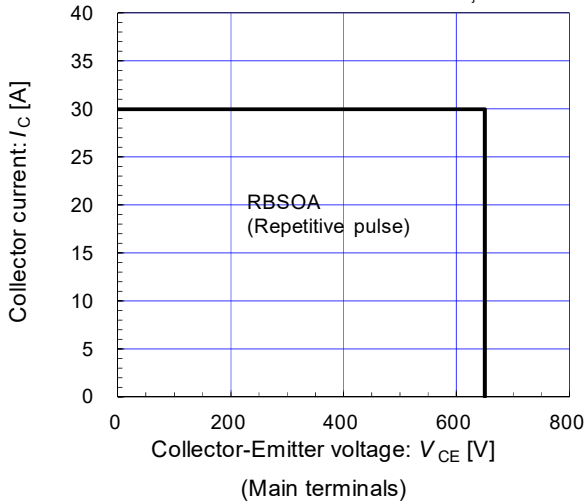
$V_{CC} = 300V$, $I_C = 15A$, $V_{GE} = +15/-15V$, $T_{vj} = 175^\circ C$



[Inverter]

Reverse bias safe operating area (max.)

$V_{GE} = +15/-15V$, $R_G \geq 24\Omega$, $T_{vj} = 175^\circ C$

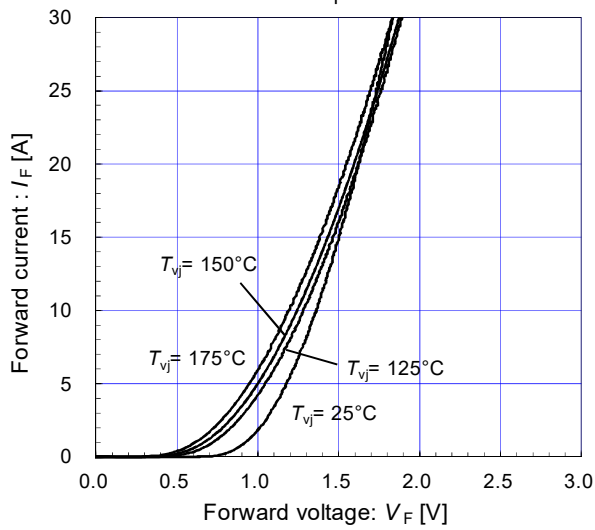


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IGBT Modules

[Inverter]

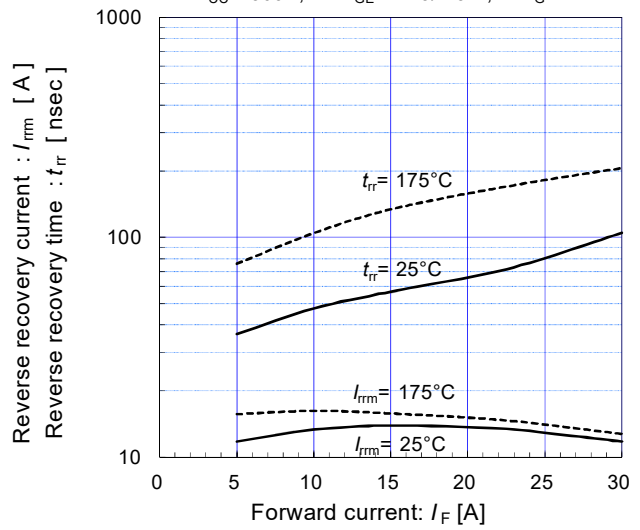
Forward current vs. Forward voltage (typ.)
chip



[Inverter]

Reverse recovery characteristics (typ.)

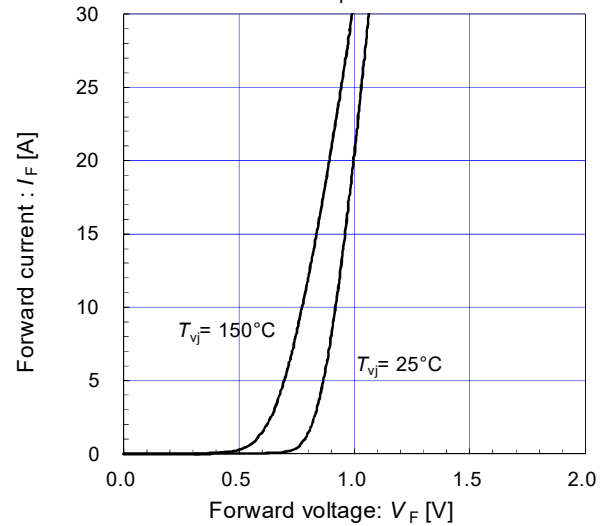
$V_{CC} = 300V$, $V_{GE} = +15/-15V$, $R_G = 24\Omega$



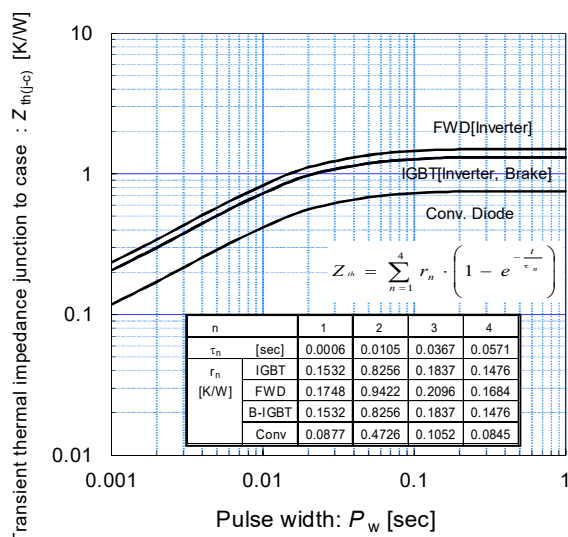
[Converter]

Forward current vs. Forward voltage (typ.)

chip

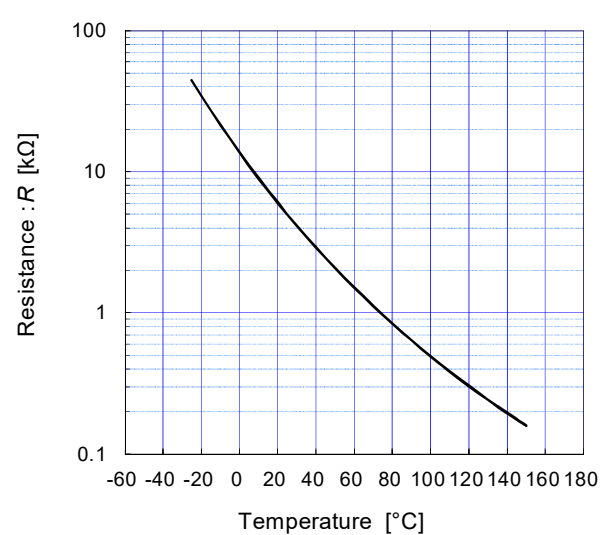


Transient thermal impedance (max.)



[Thermistor]

Temperature characteristic (typ.)



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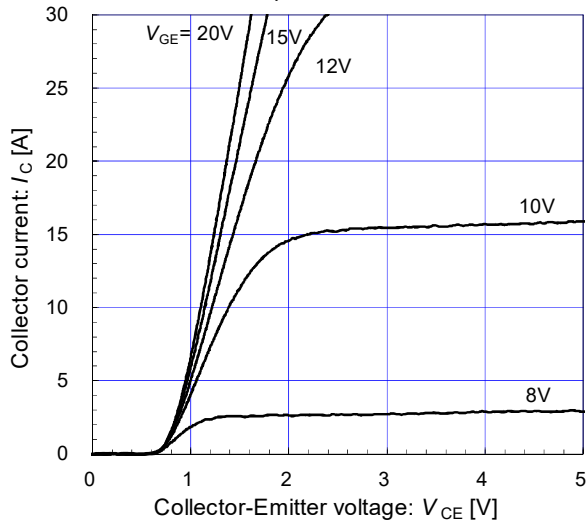
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IGBT Modules

[Brake]

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

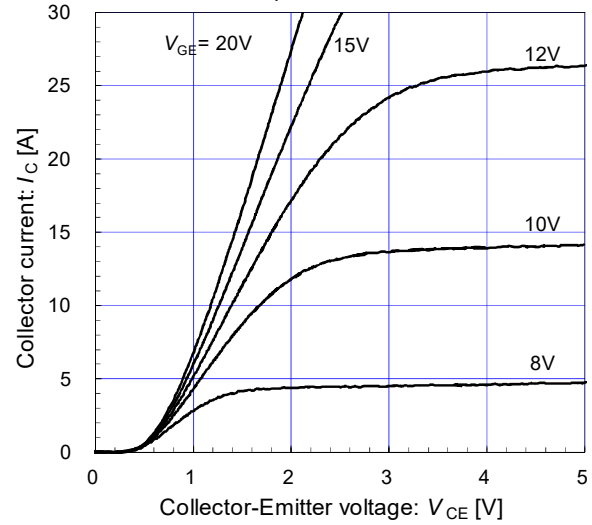
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Brake]

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

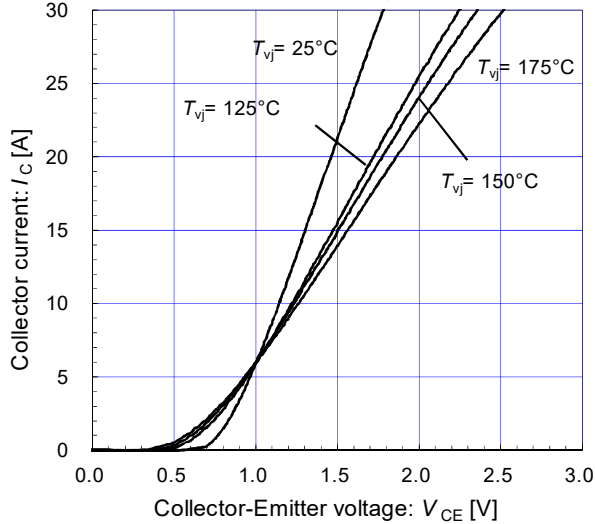
$T_{vj} = 175^{\circ}\text{C}$ / chip



[Brake]

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

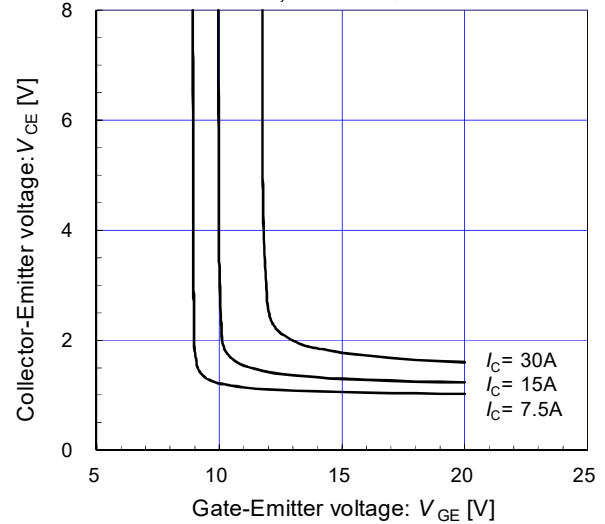
$V_{GE} = 15\text{V}$ / chip



[Brake]

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

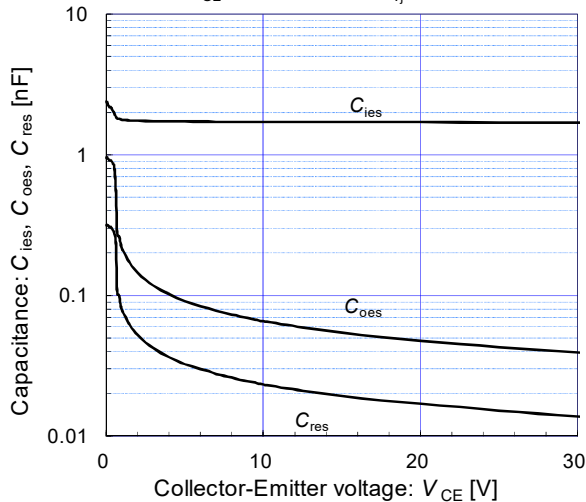
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Brake]

Capacitance vs. Collector-Emitter voltage (typ.)

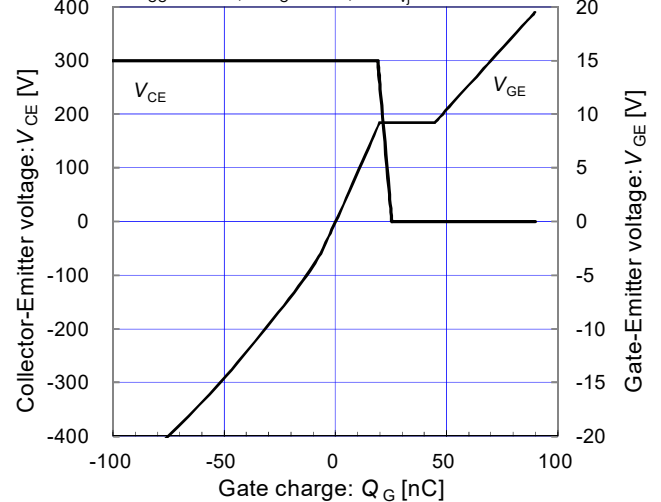
$V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$



[Brake]

Dynamic gate charge (typ.)

$V_{CC} = 300\text{V}$, $I_C = 15\text{A}$, $T_{vj} = 25^{\circ}\text{C}$



FM6M01746d

2023/3

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