

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

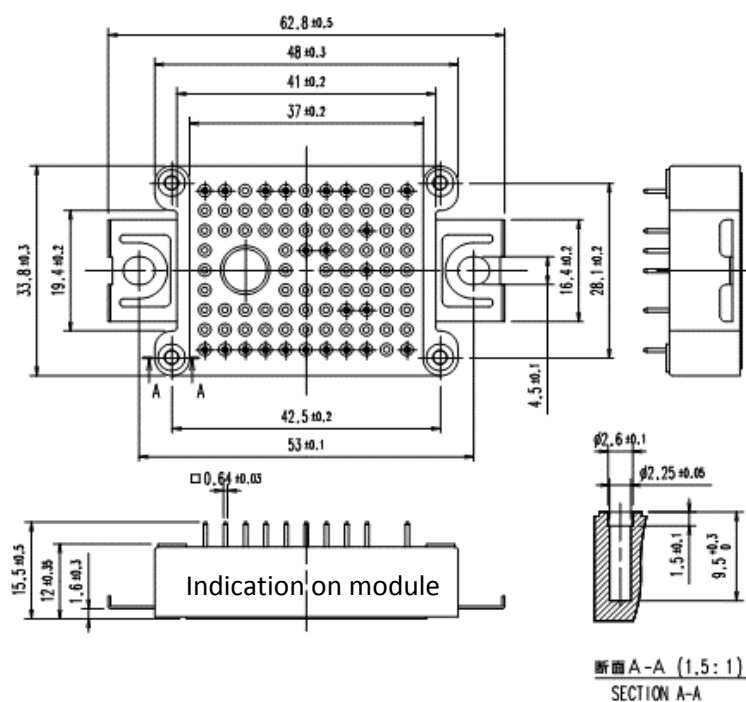
□ Applications

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

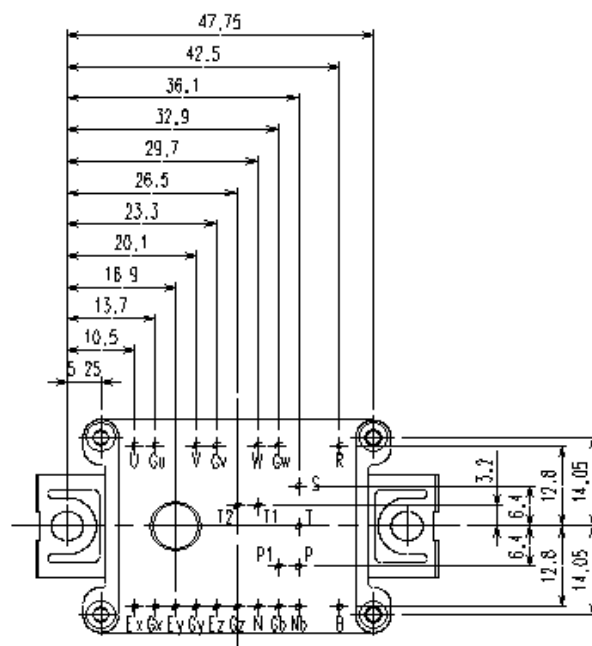
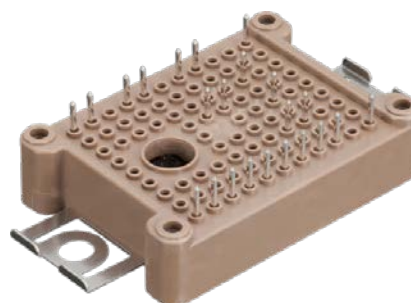
□ Outline drawing (Unit : mm)

shows theoretical dimension.

() shows reference dimension.



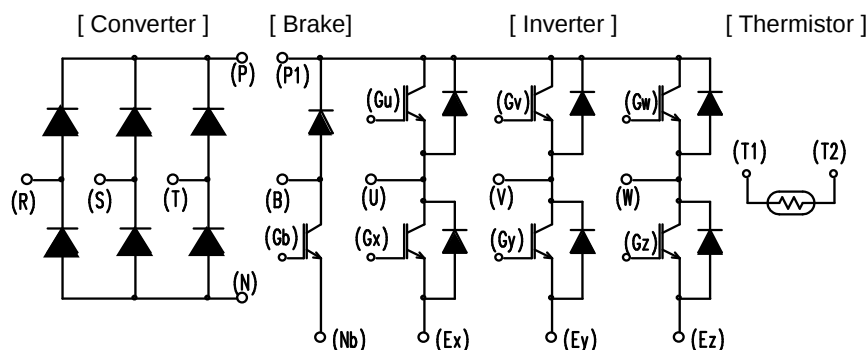
□ Typical appearance



Weight: 25 g (typ.)

PIN POSITIONS WITH TOLERANCE ± 0.4

□ Equivalent circuit



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□ 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	$T_c=100^{\circ}\text{C}$	20	A
		I_C pulse	1ms		40	
	Forward current	I_F	Continuous		20	
		I_F pulse	1ms		40	
Collector power dissipation	P_C	1 device		135	W	
Brake IGBT	Collector-Emitter voltage	V_{CES}			650	V
	Gate-Emitter voltage	V_{GES}			±20	V
	Collector current	I_C	Continuous	$T_c=100^{\circ}\text{C}$	20	A
		I_C pulse	1ms		40	
	Collector power dissipation	P_C	1 device		135	W
Brake FWD	Forward current	I_F	Continuous		10	A
		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	$T_c=80^{\circ}\text{C}$	20	A
	Surge current (Non-Repetitive) (*1)	I_{FSM}	$t=10\text{ms}$, Half sine wave form	$T_j=25^{\circ}\text{C}$	390	A
	I^2t (Non-Repetitive) (*1)	I^2t		$T_j=150^{\circ}\text{C}$	340	
$T_j=25^{\circ}\text{C}$			760	A ² s		
$T_j=150^{\circ}\text{C}$	585					
Junction temperature		T_j	Inverter, Brake		175	°C
			Converter		150	
Operating junction temperature (under switching conditions)		T_{jop}	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_{iso}	A.C. : 1min.		2500	Vrms
	between thermistor and others (*3)					
Screw torque (*4)	Mounting	-	M4		1.7	N·m

(*1) T_j : 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.

(*4) Recommendable value : Mounting 1.3 ~ 1.7 N·m (M4)

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□ Electrical characteristics (at $T_j = 25^\circ\text{C}$ 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	$V_{\text{GE(th)}}$	$V_{\text{CE}} = 20\text{V}$ $I_{\text{C}} = 20\text{mA}$		6.0	6.5	7.0	V
	Collector-Emitter saturation voltage	$V_{\text{CE(sat)}}$ (terminal)	$V_{\text{GE}} = 15\text{V}$ $I_{\text{C}} = 20\text{A}$	$T_{\text{j}}=25^{\circ}\text{C}$	-	1.40	1.90	V
		$V_{\text{CE(sat)}}$ (chip)		$T_{\text{j}}=25^{\circ}\text{C}$	-	1.30	1.75	
				$T_{\text{j}}=125^{\circ}\text{C}$	-	1.45	-	
				$T_{\text{j}}=150^{\circ}\text{C}$	-	1.50	-	
				$T_{\text{j}}=175^{\circ}\text{C}$	-	1.55	-	
	Internal Gate resistance	r_{g}	-		-	0	-	Ω
	Capacitance	C_{ies}	$V_{\text{CE}} = 10\text{V}, V_{\text{GE}} = 0\text{V}, f = 1\text{MHz}$		-	2.3	-	nF
		C_{oes}			-	0.09	-	
		C_{res}			-	0.03	-	
	Gate charge	Q_{G}	$V_{\text{CC}} = 300\text{V}$ $V_{\text{GE}} = -15 \rightarrow +15\text{V}$ $I_{\text{C}} = 20\text{A}$		-	160	-	nC
	Forward voltage	V_{F} (terminal)	$V_{\text{GE}} = 15\text{V}$ $I_{\text{F}} = 20\text{A}$	$T_{\text{j}}=25^{\circ}\text{C}$	-	1.70	2.20	V
		V_{F} (chip)		$T_{\text{j}}=25^{\circ}\text{C}$	-	1.60	2.05	
				$T_{\text{j}}=125^{\circ}\text{C}$	-	1.60	-	
				$T_{\text{j}}=150^{\circ}\text{C}$	-	1.60	-	
				$T_{\text{j}}=175^{\circ}\text{C}$	-	1.55	-	
	Switching time (*1)	$t_{\text{d(on)}}$	$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 20\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{j}}=25^{\circ}\text{C}$	-	0.05	-	μs
$T_{\text{j}}=125^{\circ}\text{C}$				-	0.05	-		
$T_{\text{j}}=150^{\circ}\text{C}$				-	0.05	-		
$T_{\text{j}}=175^{\circ}\text{C}$				-	0.05	-		
t_{r}		$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 20\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{j}}=25^{\circ}\text{C}$	-	0.02	-		
			$T_{\text{j}}=125^{\circ}\text{C}$	-	0.02	-		
			$T_{\text{j}}=150^{\circ}\text{C}$	-	0.02	-		
			$T_{\text{j}}=175^{\circ}\text{C}$	-	0.02	-		
$t_{\text{d(off)}}$		$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 20\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{j}}=25^{\circ}\text{C}$	-	0.15	-		
			$T_{\text{j}}=125^{\circ}\text{C}$	-	0.17	-		
			$T_{\text{j}}=150^{\circ}\text{C}$	-	0.18	-		
			$T_{\text{j}}=175^{\circ}\text{C}$	-	0.18	-		
t_{f}		$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 20\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{j}}=25^{\circ}\text{C}$	-	0.04	-		
			$T_{\text{j}}=125^{\circ}\text{C}$	-	0.04	-		
			$T_{\text{j}}=150^{\circ}\text{C}$	-	0.04	-		
			$T_{\text{j}}=175^{\circ}\text{C}$	-	0.04	-		
Reverse recovery time	t_{rr}	$V_{\text{CC}} = 300\text{V}$ $I_{\text{C}}, I_{\text{F}} = 20\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{j}}=25^{\circ}\text{C}$	-	0.06	-		
			$T_{\text{j}}=125^{\circ}\text{C}$	-	0.10	-		
			$T_{\text{j}}=150^{\circ}\text{C}$	-	0.11	-		
			$T_{\text{j}}=175^{\circ}\text{C}$	-	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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Items		Symbols	Conditions		Characteristics			Units
					min.	typ.	max.	
Inverter	Switching loss (per pulse)	E_{on}	$V_{CC} = 300V$	$T_J=25^{\circ}C$	-	0.31	-	mJ
			$I_C, I_F = 20A \quad L_S = 30nH$	$T_J=125^{\circ}C$	-	0.43	-	
			$V_{GE} = +15/-15 V$	$T_J=150^{\circ}C$	-	0.48	-	
			$R_G = 18 \Omega$	$T_J=175^{\circ}C$	-	0.55	-	
		E_{off}	$V_{CC} = 300V$	$T_J=25^{\circ}C$	-	0.58	-	
			$I_C, I_F = 20A \quad L_S = 30nH$	$T_J=125^{\circ}C$	-	0.75	-	
			$V_{GE} = +15/-15 V$	$T_J=150^{\circ}C$	-	0.79	-	
			$R_G = 18 \Omega$	$T_J=175^{\circ}C$	-	0.83	-	
		E_{rr}	$V_{CC} = 300V$	$T_J=25^{\circ}C$	-	0.18	-	
			$I_C, I_F = 20A \quad L_S = 30nH$	$T_J=125^{\circ}C$	-	0.28	-	
			$V_{GE} = +15/-15 V$	$T_J=150^{\circ}C$	-	0.34	-	
			$R_G = 18 \Omega$	$T_J=175^{\circ}C$	-	0.39	-	
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	
Brake	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_C = 20A$	$T_J=25^{\circ}C$	-	1.40	1.90	V
		$V_{CE(sat)}$ (chip)	$T_J=25^{\circ}C$	-	1.30	1.75		
			$T_J=125^{\circ}C$	-	1.45	-		
			$T_J=150^{\circ}C$	-	1.50	-		
			$T_J=175^{\circ}C$	-	1.55	-		
	Internal Gate resistance	r_g	-		-	0	-	Ω
	Switching time (*1)	$t_{d(on)}$	$V_{CC} = 300V$	$T_J=25^{\circ}C$	-	0.05	-	μs
			$I_C = 20A \quad L_S = 30nH$	$T_J=125^{\circ}C$	-	0.05	-	
			$V_{GE} = +15/-15 V$	$T_J=150^{\circ}C$	-	0.05	-	
			$R_G = 18 \Omega$	$T_J=175^{\circ}C$	-	0.05	-	
		t_r	$V_{CC} = 300V$	$T_J=25^{\circ}C$	-	0.02	-	
			$I_C = 20A \quad L_S = 30nH$	$T_J=125^{\circ}C$	-	0.02	-	
$V_{GE} = +15/-15 V$			$T_J=150^{\circ}C$	-	0.02	-		
$R_G = 18 \Omega$			$T_J=175^{\circ}C$	-	0.02	-		
$t_{d(off)}$		$V_{CC} = 300V$	$T_J=25^{\circ}C$	-	0.15	-		
		$I_C = 20A \quad L_S = 30nH$	$T_J=125^{\circ}C$	-	0.17	-		
		$V_{GE} = +15/-15 V$	$T_J=150^{\circ}C$	-	0.18	-		
		$R_G = 18 \Omega$	$T_J=175^{\circ}C$	-	0.18	-		
t_f		$V_{CC} = 300V$	$T_J=25^{\circ}C$	-	0.04	-		
	$I_C = 20A \quad L_S = 30nH$	$T_J=125^{\circ}C$	-	0.04	-			
	$V_{GE} = +15/-15 V$	$T_J=150^{\circ}C$	-	0.04	-			
	$R_G = 18 \Omega$	$T_J=175^{\circ}C$	-	0.04	-			
Reverse current	I_{RRM}	$V_R = 650V$		-	-	50	μA	
Forward voltage	V_F (terminal)	$I_F = 10A$	$T_J=25^{\circ}C$	-	1.65	2.15	V	
	V_F (chip)	$I_F = 10A$	$T_J=25^{\circ}C$	-	1.55	2.00		
		$T_J=125^{\circ}C$	-	1.50	-			
		$T_J=150^{\circ}C$	-	1.50	-			
		$T_J=175^{\circ}C$	-	1.45	-			
Converter	Reverse current	I_{RRM}	$V_R = 800V$		-	-	50	μA
Forward voltage	V_{FM}	$I_F = 20A$	terminal	-	1.10	1.60	V	
			chip	-	1.00	1.45		
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}) = $t_{d(off)} + t_f$
FM6M01747

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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 (1device)	$R_{th(j-c)}$	Inverter IGBT	-	-	1.09	°C/W
		Inverter FWD	-	-	1.50	
		Brake IGBT	-	-	1.09	
		Brake FWD	-	-	1.92	
		Converter Diode	-	-	0.75	
Contact thermal resistance(*1) (1device)	$R_{th(c-f)}$	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.

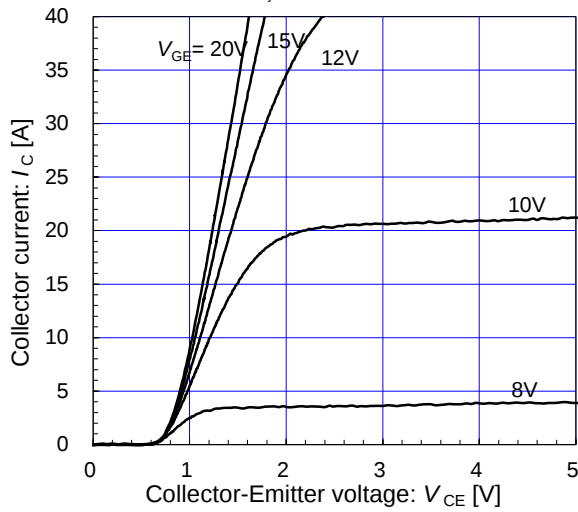
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IGBT Modules

[Inverter]

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

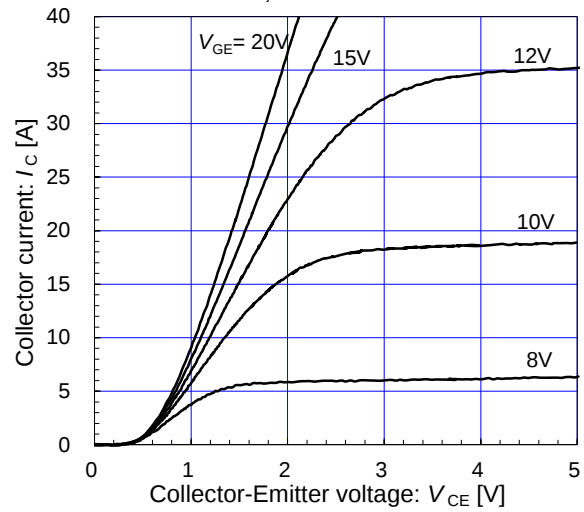
$T_j = 25^\circ\text{C}$ / chip



[Inverter]

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

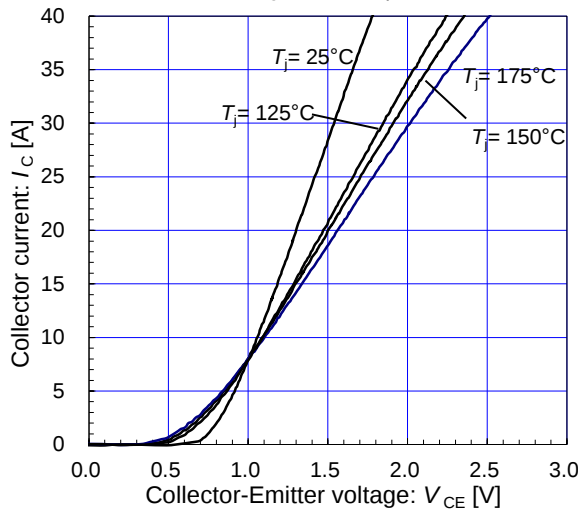
$T_j = 175^\circ\text{C}$ / chip



[Inverter]

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

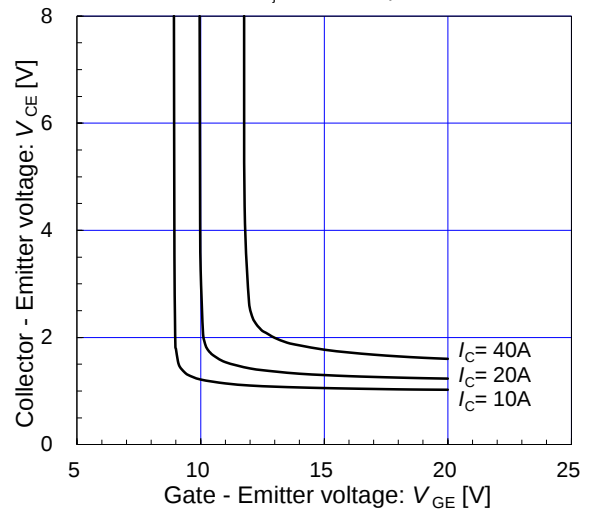
$V_{GE} = 15\text{V}$ / chip



[Inverter]

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

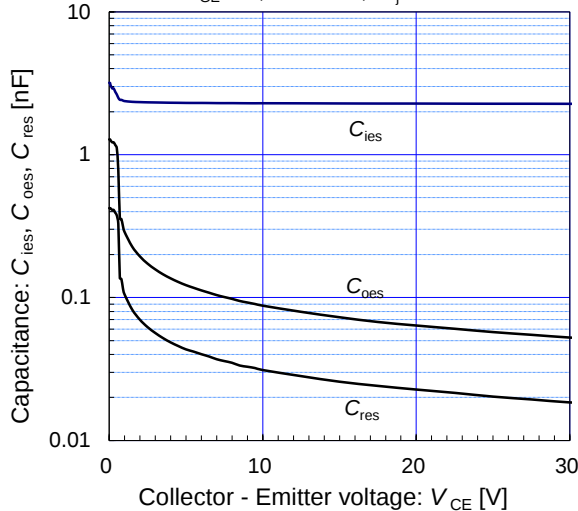
$T_j = 25^\circ\text{C}$ / chip



[Inverter]

Capacitance vs. Collector-Emittor voltage (typ.)

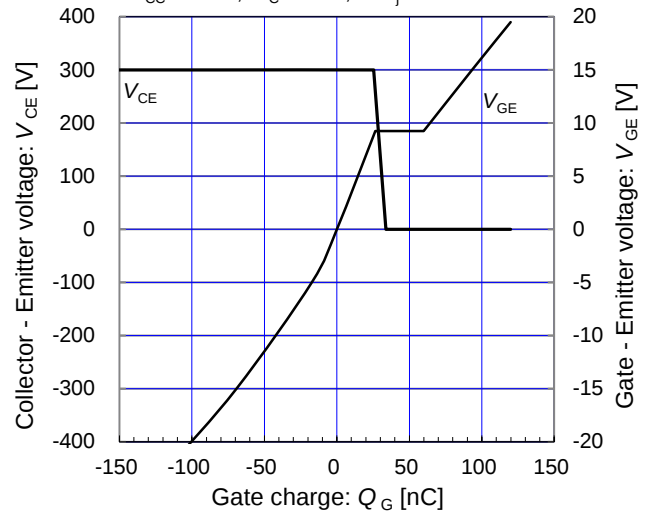
$V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_j = 25^\circ\text{C}$



[Inverter]

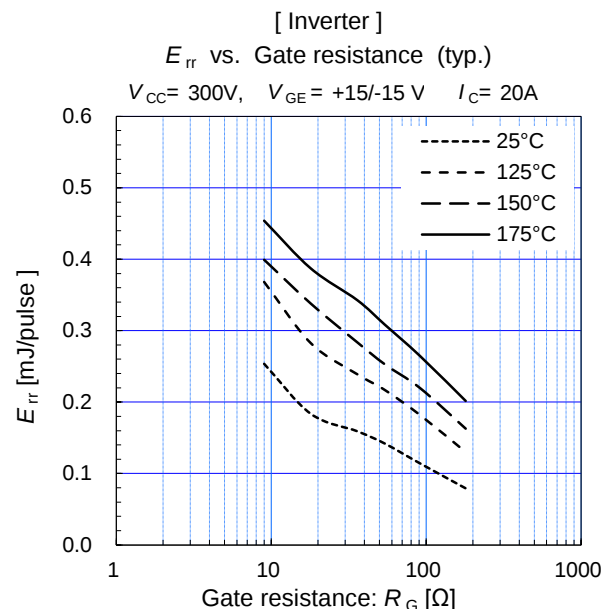
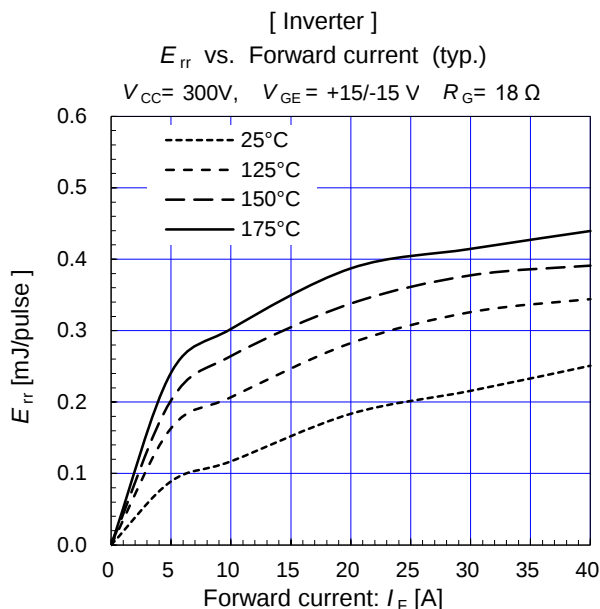
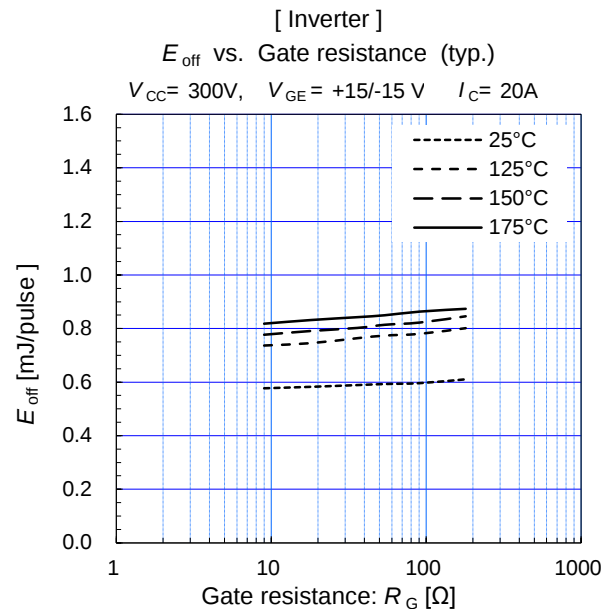
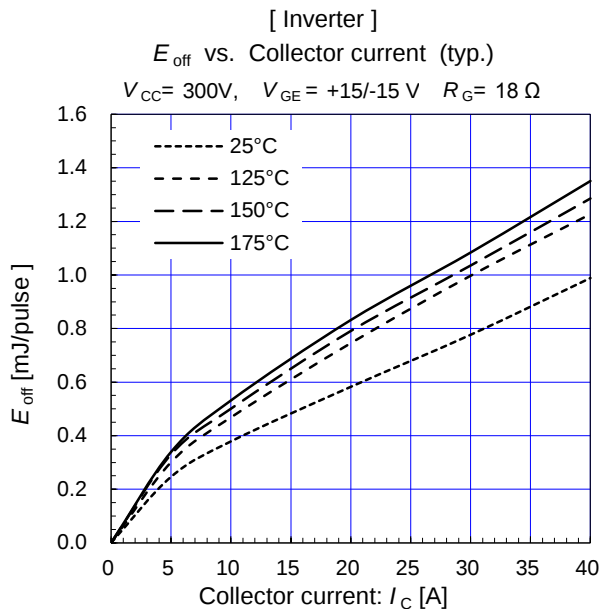
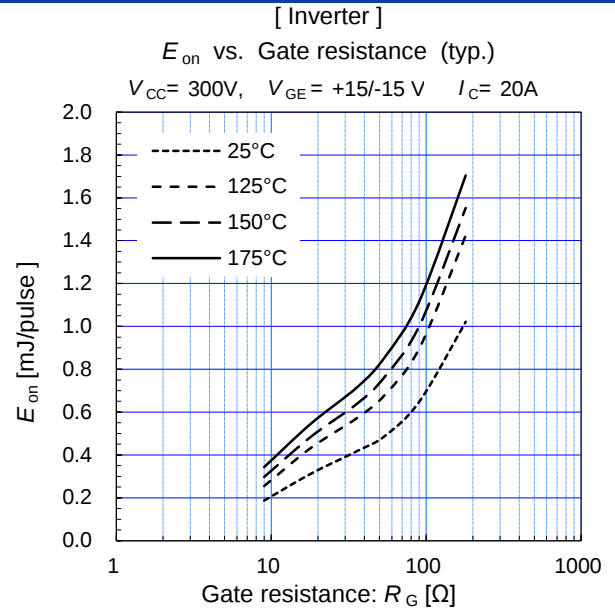
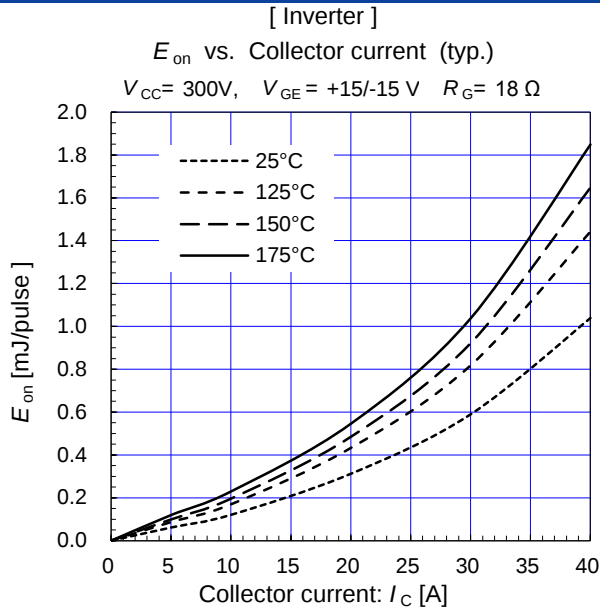
Dynamic Gate charge (typ.)

$V_{CC} = 300\text{V}$, $I_C = 20\text{A}$, $T_j = 25^\circ\text{C}$



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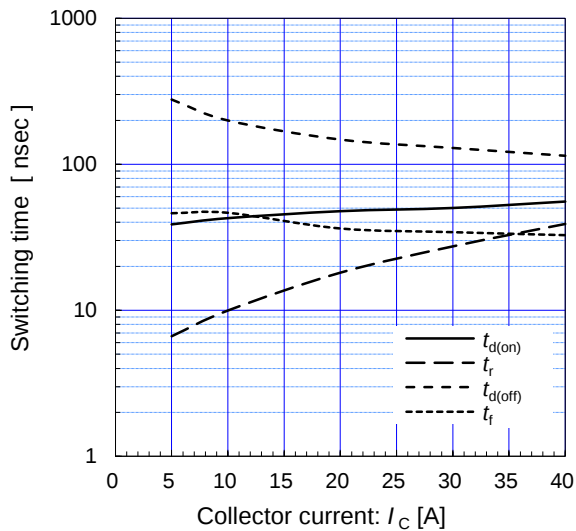
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IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

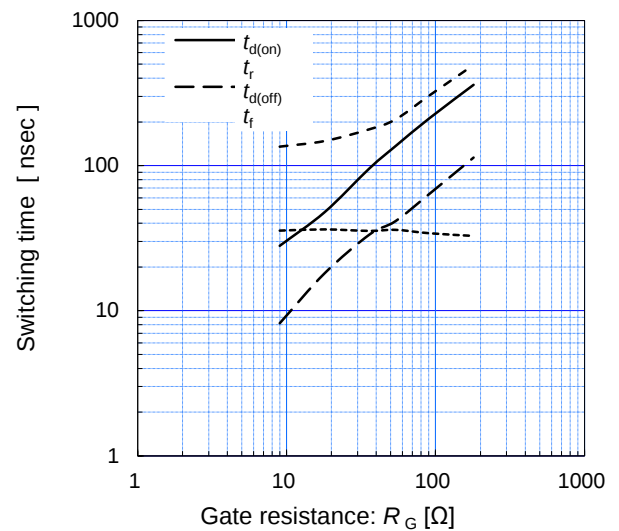
$V_{CC} = 300V$, $R_G = 18\Omega$ $V_{GE} = +15/-15V$, $T_J = 25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

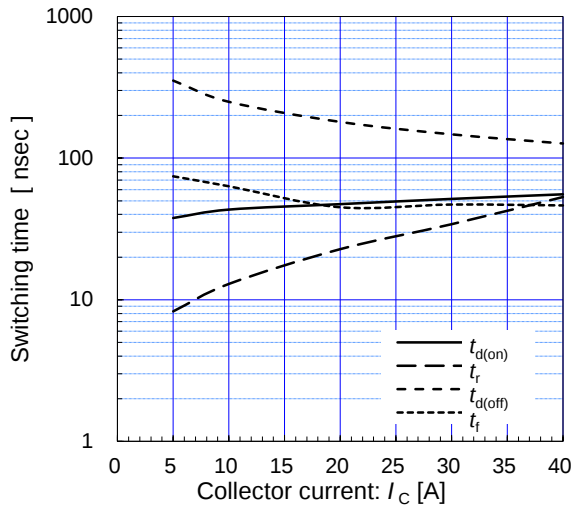
$V_{CC} = 300V$, $I_C = 20A$, $V_{GE} = +15/-15V$, $T_J = 25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

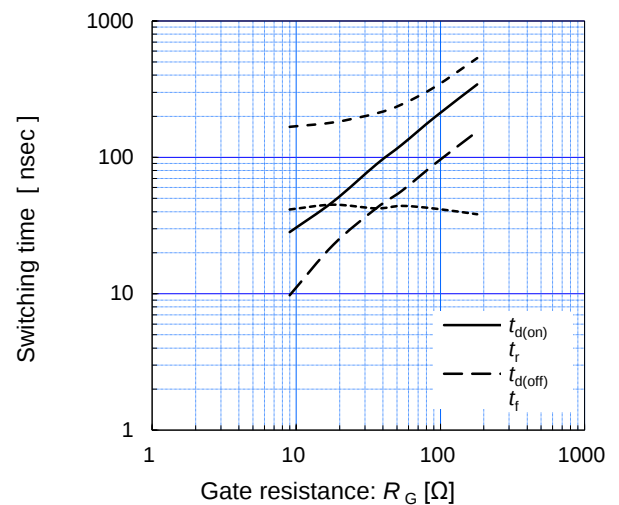
$V_{CC} = 300V$, $R_G = 18\Omega$ $V_{GE} = +15/-15V$, $T_J = 175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

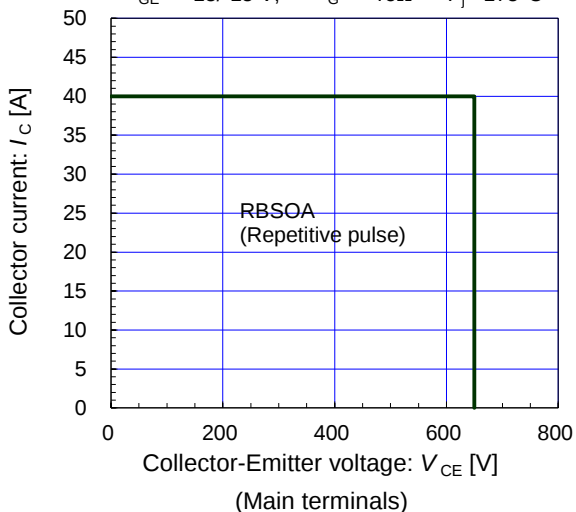
$V_{CC} = 300V$, $I_C = 20A$, $V_{GE} = +15/-15V$, $T_J = 175^\circ C$



[Inverter]

Reverse bias safe operating area (max.)

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

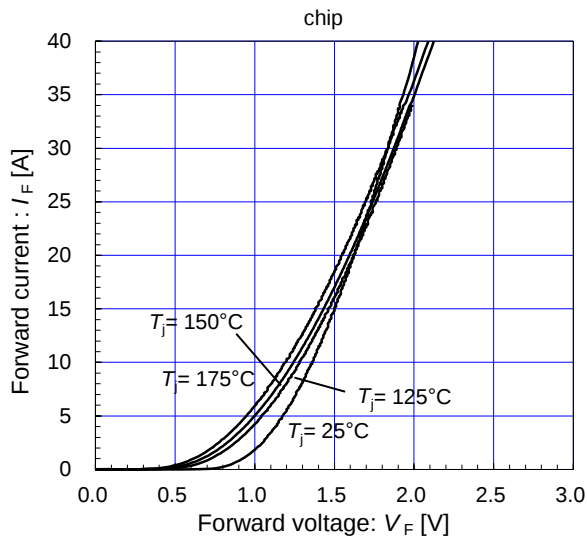


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IGBT Modules

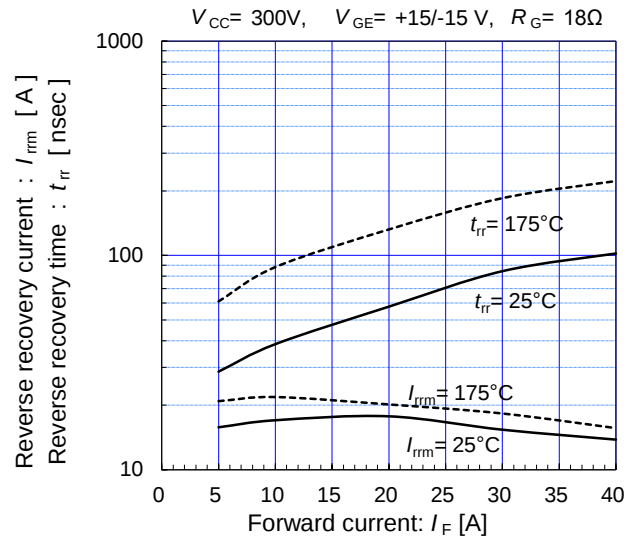
[Inverter]

Forward current vs. Forward voltage (typ.)



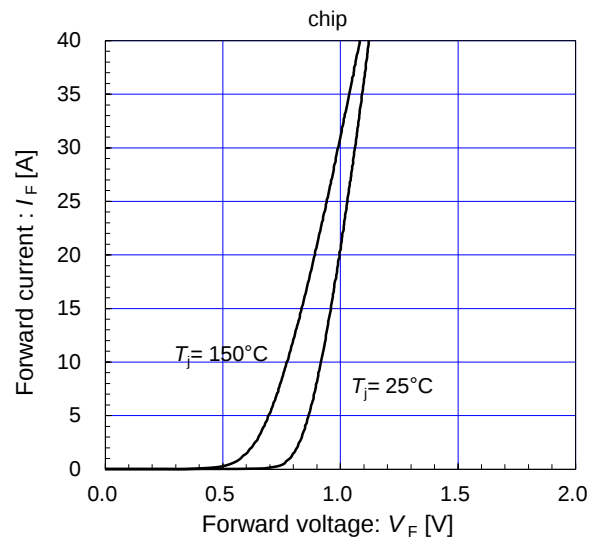
[Inverter]

Reverse recovery characteristics (typ.)

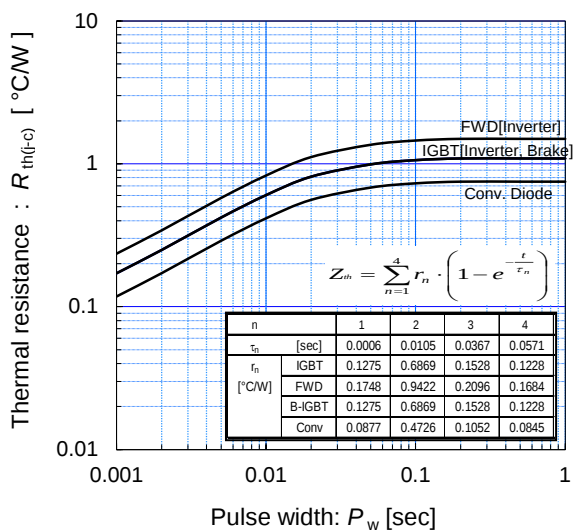


[Converter]

Forward current vs. Forward voltage (typ.)

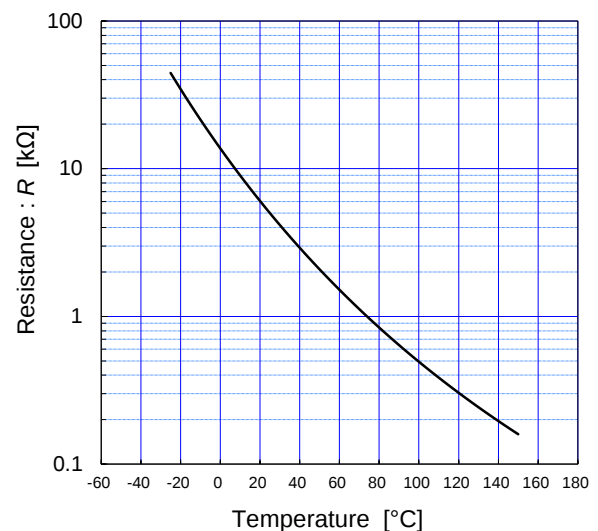


Transient thermal resistance (max.)



[Thermistor]

Temperature characteristic (typ.)



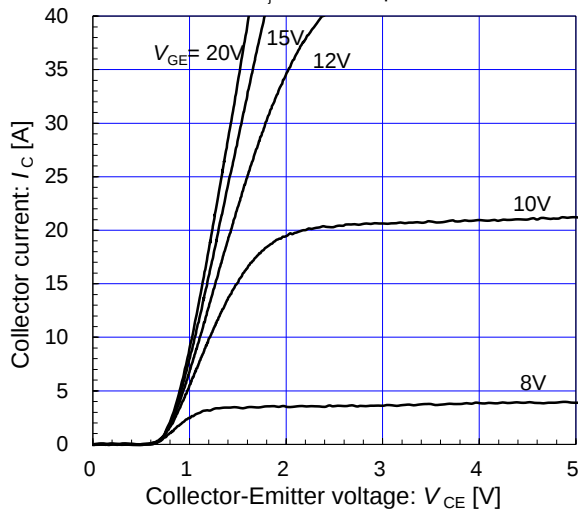
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IGBT Modules

[Brake]

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

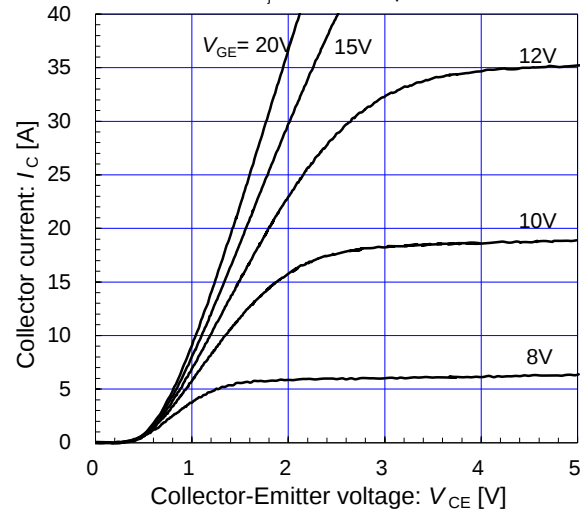
$T_j = 25^\circ\text{C}$ / chip



[Brake]

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

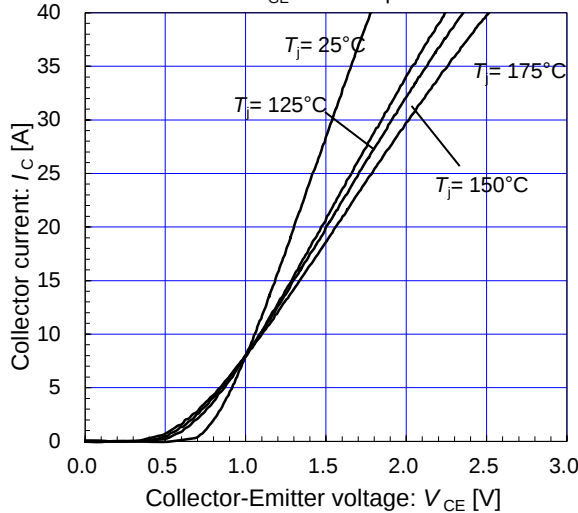
$T_j = 175^\circ\text{C}$ / chip



[Brake]

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

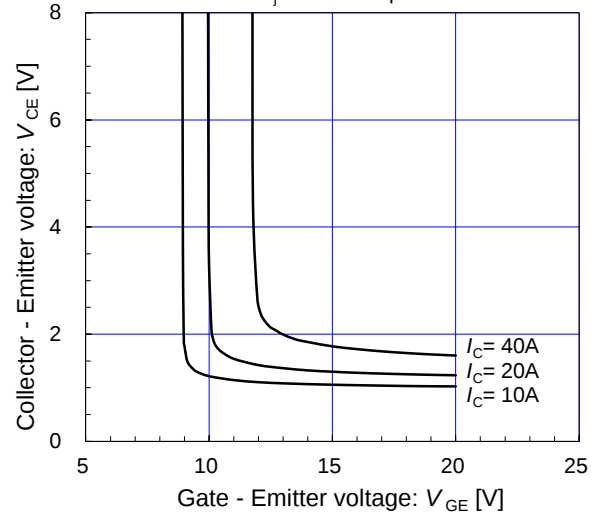
$V_{GE} = 15\text{V}$ / chip



[Brake]

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

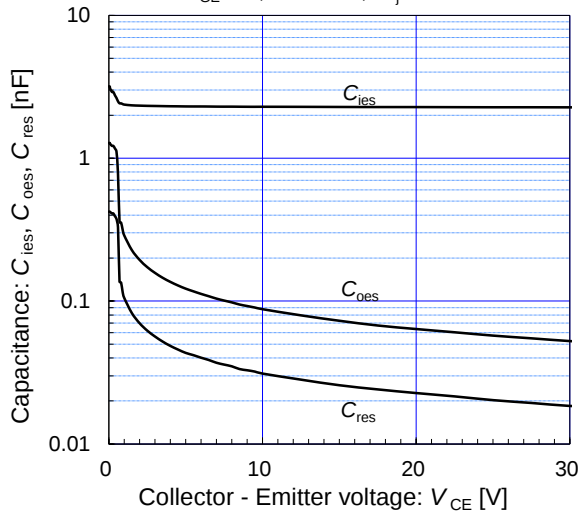
$T_j = 25^\circ\text{C}$ / chip



[Brake]

Capacitance vs. Collector-Emmitter voltage (typ.)

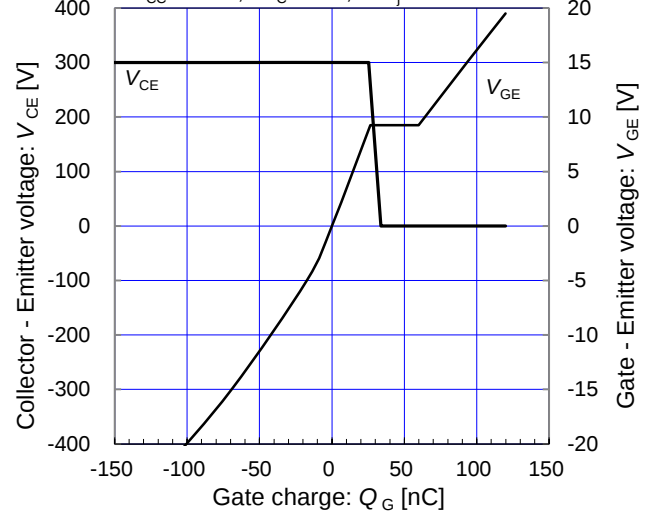
$V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_j = 25^\circ\text{C}$



[Brake]

Dynamic Gate charge (typ.)

$V_{CC} = 300\text{V}$, $I_C = 20\text{A}$, $T_j = 25^\circ\text{C}$



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