

7MBR50XPE120-50

IGBT Modules

Power Module(X series)
1200V / 50A / PIM

■ Features

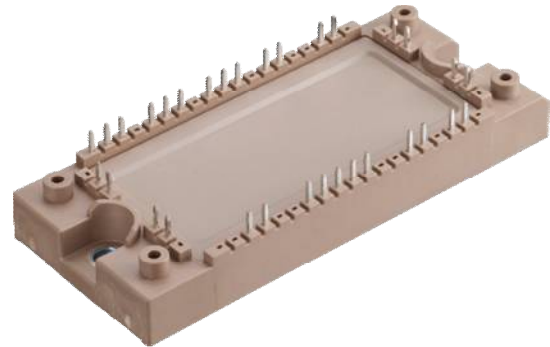
- Low $V_{CE(sat)}$
- Compact Package
- P.C.Board Mount Module
- Converter Diode Bridge Dynamic Brake Circuit
- RoHS compliant Product

■ Applications

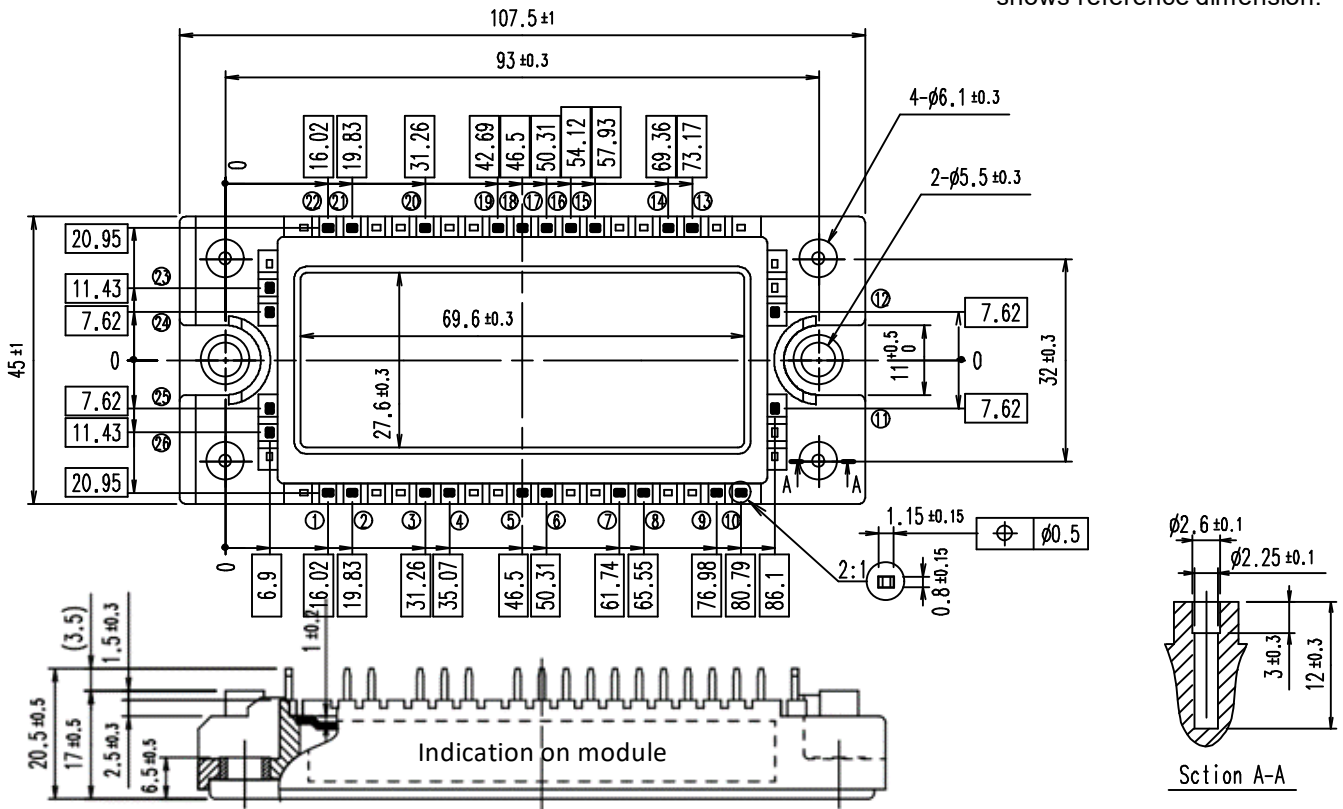
- Inverter for Motor Drive
- AC and DC Servo Drive Amplifier
- Uninterrupted Power Supply

■ Outline drawing (Unit : mm)

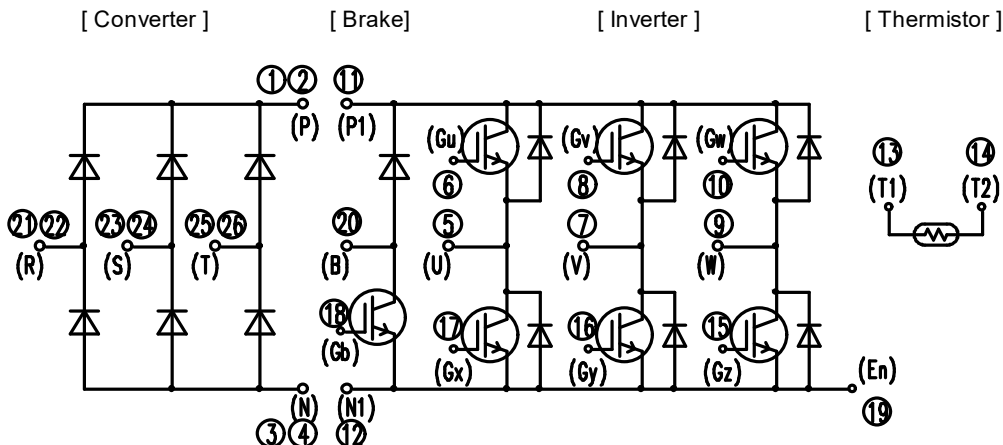
■ Typical appearance



□ shows theoretical dimension.
▭ shows reference dimension.



■ Equivalent circuit



7MBR50XPE120-50

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

Items		Symbols	Conditions		Maximum ratings	Units
Inverter	Collector-Emitter voltage, Gate-Emitter short-circuited	V_{CES}			1200	V
	Gate-Emitter voltage, Collector-Emitter short-circuited	V_{GES}			± 20	V
	Collector current	I_C	Continuous	$T_c = 100^\circ\text{C}$	50	A
	Repetitive peak forward current	I_{CRM}	1ms		100	
	Forward current	I_F	Continuous		50	
	Repetitive peak forward current	I_{FRM}	1ms		100	
	Total power dissipation	P_{tot}	1 device		340	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	$T_c = 100^\circ\text{C}$	35	A
	Repetitive peak forward current	I_{CRM}	1ms		70	
	Total power dissipation	P_{tot}	1 device		200	W
Brake FWD	Forward current	I_F	Continuous		15	A
	Repetitive peak forward current	I_{FRM}	1ms		30	
	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	$T_c = 80^\circ\text{C}$	50	A
	Surge(non-repetitive)forward current(*1)	I_{FSM}	$t = 10\text{ms}$, Half sine wave form	$T_{vj} = 25^\circ\text{C}$	630	A
				$T_{vj} = 150^\circ\text{C}$	520	
	I^2t (Non-Repetitive) (*1)	I^2t		$T_{vj} = 25^\circ\text{C}$	2000	A^2s
			$T_{vj} = 150^\circ\text{C}$	1350		
Virtual junction temperature		T_{vj}	Inverter, Brake		175	$^\circ\text{C}$
			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)	V_{isol}	A.C. : 1min.		2500	Vrms
	between thermistor and others (*3)					
Screw torque	Mounting torque of screws to heat sink	M_s	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.		
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	$V_{GE(th)}$	$V_{CE} = 20\text{V}$ $I_C = 50\text{mA}$	6.0	6.5	7.0	V	
Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15\text{V}$ $I_C = 50\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	1.70	2.20	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	-		
	$T_{vj}=175^{\circ}\text{C}$		-	2.00	-		
Internal gate resistance	r_g	-	-	0	-	Ω	
			-	-	-	-	
Capacitance	C_{ies}	$V_{CE} = 10\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	5.3	-	nF	
	C_{oes}		-	0.18	-		
	C_{res}		-	0.05	-		
Gate charge	Q_G	$V_{CC} = 600\text{V}$ $V_{GE} = -15 \rightarrow +15\text{V}$ $I_C = 50\text{A}$	-	340	-	nC	
Forward voltage	V_F (terminal)	$I_F = 50\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	2.00	2.50	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)	$t_{d(on)}$	$V_{CC} = 600\text{V}$ $I_C, I_F = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 18\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.09	-	μs
			$T_{vj}=125^{\circ}\text{C}$	-	0.09	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.09	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.10	-	
	t_r		$T_{vj}=25^{\circ}\text{C}$	-	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	-	
	$t_{d(off)}$		$T_{vj}=25^{\circ}\text{C}$	-	0.24	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.27	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.27	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.28	-	
t_f	$T_{vj}=25^{\circ}\text{C}$	-	0.11	-			
	$T_{vj}=125^{\circ}\text{C}$	-	0.17	-			
	$T_{vj}=150^{\circ}\text{C}$	-	0.20	-			
	$T_{vj}=175^{\circ}\text{C}$	-	0.21	-			
Reverse recovery time	t_{rr}	$T_{vj}=25^{\circ}\text{C}$	-	0.08	-		
		$T_{vj}=125^{\circ}\text{C}$	-	0.14	-		
		$T_{vj}=150^{\circ}\text{C}$	-	0.17	-		
		$T_{vj}=175^{\circ}\text{C}$	-	0.19	-		

(*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}	$V_{CC} = 600V$ $I_C, I_F = 50A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj} = 25^\circ C$	-	3.78	-	mJ
			$T_{vj} = 125^\circ C$	-	4.90	-	
			$T_{vj} = 150^\circ C$	-	5.46	-	
			$T_{vj} = 175^\circ C$	-	5.83	-	
	E_{off}	$V_{CC} = 600V$ $I_C, I_F = 50A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj} = 25^\circ C$	-	3.36	-	
			$T_{vj} = 125^\circ C$	-	4.31	-	
			$T_{vj} = 150^\circ C$	-	4.62	-	
			$T_{vj} = 175^\circ C$	-	4.96	-	
	E_{rr}	$V_{CC} = 600V$ $I_C, I_F = 50A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 18\Omega$	$T_{vj} = 25^\circ C$	-	1.43	-	
			$T_{vj} = 125^\circ C$	-	2.52	-	
			$T_{vj} = 150^\circ C$	-	3.27	-	
			$T_{vj} = 175^\circ C$	-	3.72	-	
Zero gate voltage collector current	I_{CES}	$V_{GE} = 0V$ $V_{CE} = 1200V$		-	-	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)	$V_{GE} = 15V$ $I_C = 35A$	$T_{vj} = 25^\circ C$	-	1.65	2.10	V
			$T_{vj} = 25^\circ C$	-	1.50	1.95	
	$T_{vj} = 125^\circ C$		-	1.85	-		
	$T_{vj} = 150^\circ C$		-	1.95	-		
	$V_{CE(sat)}$ (chip)	$V_{GE} = 15V$ $I_C = 35A$	$T_{vj} = 175^\circ C$	-	2.00	-	
			$T_{vj} = 25^\circ C$	-	0	-	
			$T_{vj} = 125^\circ C$	-	0	-	
			$T_{vj} = 150^\circ C$	-	0	-	
Internal gate resistance	r_g	-		-	0	-	Ω
Brake Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 30\Omega$	$T_{vj} = 25^\circ C$	-	0.10	-	μs
			$T_{vj} = 125^\circ C$	-	0.10	-	
			$T_{vj} = 150^\circ C$	-	0.11	-	
			$T_{vj} = 175^\circ C$	-	0.11	-	
	t_r	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 30\Omega$	$T_{vj} = 25^\circ C$	-	0.04	-	
			$T_{vj} = 125^\circ C$	-	0.05	-	
			$T_{vj} = 150^\circ C$	-	0.05	-	
			$T_{vj} = 175^\circ C$	-	0.05	-	
	$t_{d(off)}$	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 30\Omega$	$T_{vj} = 25^\circ C$	-	0.23	-	
			$T_{vj} = 125^\circ C$	-	0.27	-	
			$T_{vj} = 150^\circ C$	-	0.27	-	
			$T_{vj} = 175^\circ C$	-	0.27	-	
	t_f	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 30\Omega$	$T_{vj} = 25^\circ C$	-	0.12	-	
			$T_{vj} = 125^\circ C$	-	0.18	-	
			$T_{vj} = 150^\circ C$	-	0.20	-	
			$T_{vj} = 175^\circ C$	-	0.21	-	
Reverse current	I_{RRM}	$V_R = 1200V$		-	-	50	μA
Forward voltage	V_F (terminal)	$I_F = 15A$	$T_{vj} = 25^\circ C$	-	1.95	2.40	V
			$T_{vj} = 25^\circ C$	-	1.80	2.25	
	V_F (chip)		$T_{vj} = 125^\circ C$	-	1.85	-	
			$T_{vj} = 150^\circ C$	-	1.80	-	
			$T_{vj} = 175^\circ C$	-	1.75	-	
			$T_{vj} = 25^\circ C$	-	-	50	
			terminal	-	1.25	1.75	
			chip	-	1.05	1.50	
Thermistor	Resistance	$T = 25^\circ C$		-	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}) = $t_{d(off)} + t_f$

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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(1device)	$R_{th(j-c)}$	Inverter IGBT	-	-	0.44	K/W
		Inverter FWD	-	-	0.55	
		Brake IGBT	-	-	0.74	
		Brake FWD	-	-	1.85	
		Converter Diode	-	-	0.72	
Thermal resistance case to heat sink(*1) (1 IGBT+1 FWD) (*1)	$R_{th(c-s)}$	with 1 W/(m·K) thermal grease	-	0.05	-	

(*1) This is the value which is defined mounting on the additional heat sink with 1W(m·K) thermal grease.

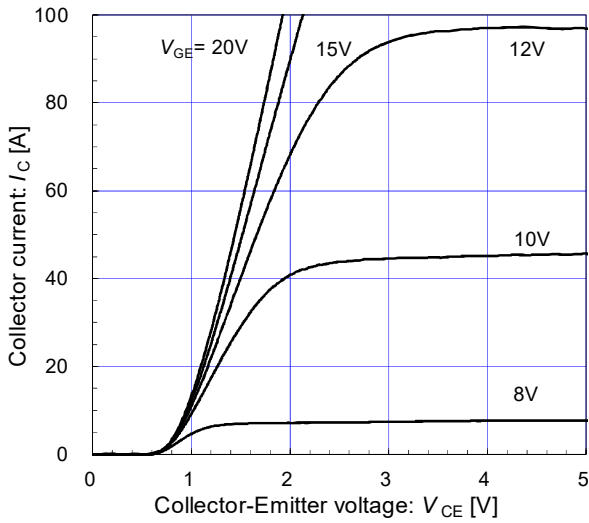
7MBR50XPE120-50

IGBT Modules

[Inverter]

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

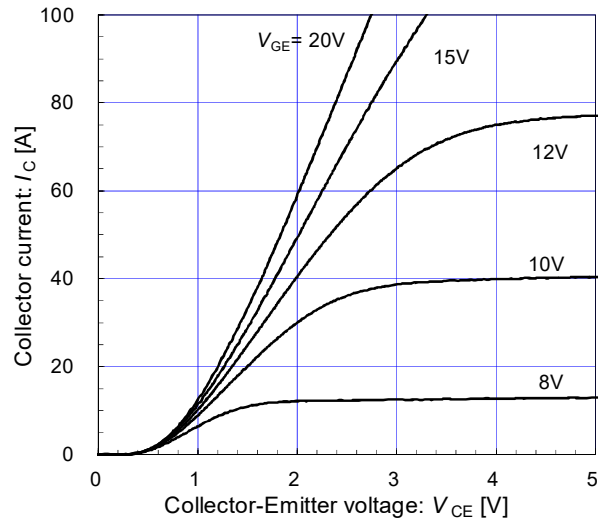
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Inverter]

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

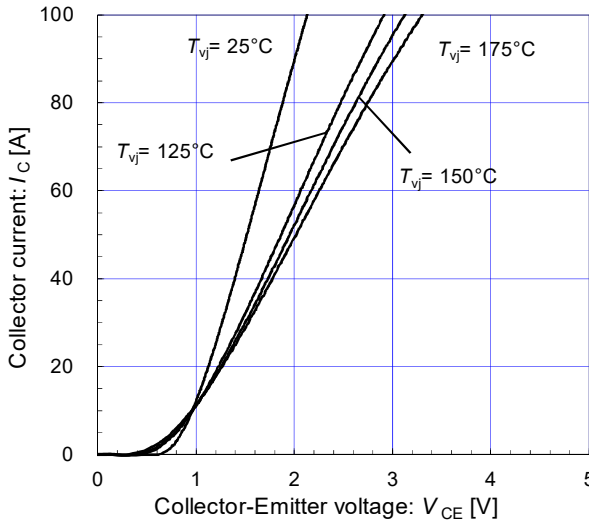
$T_{vj} = 175^{\circ}\text{C}$ / chip



[Inverter]

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

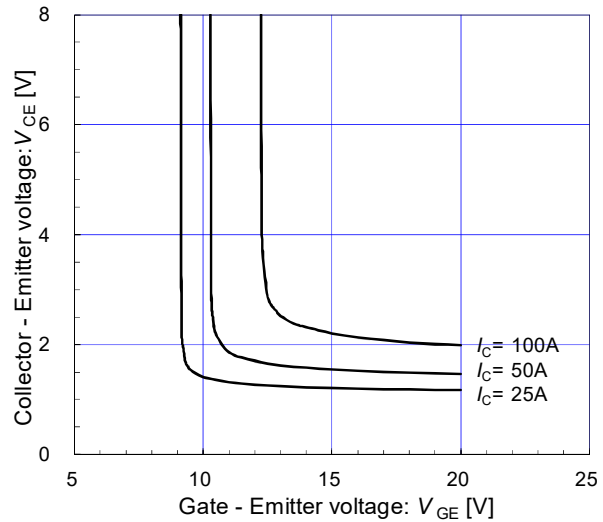
$V_{GE} = 15\text{V}$ / chip



[Inverter]

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

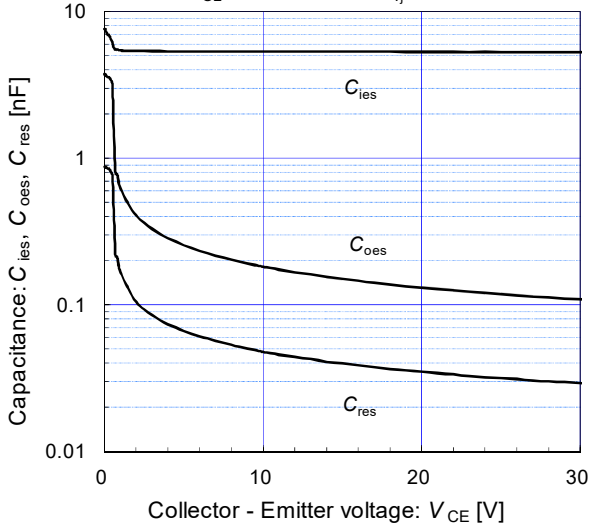
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Inverter]

Capacitance vs. Collector-Emmitter voltage (typ.)

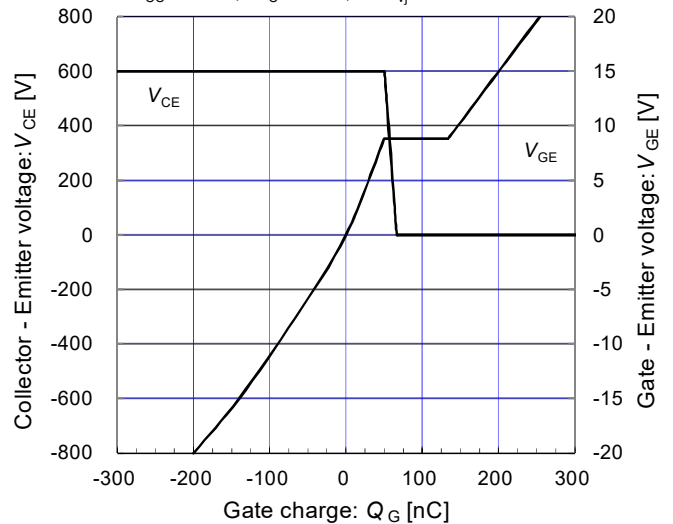
$V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$



[Inverter]

Dynamic gate charge (typ.)

$V_{CC} = 600\text{V}$, $I_c = 50\text{A}$, $T_{vj} = 25^{\circ}\text{C}$



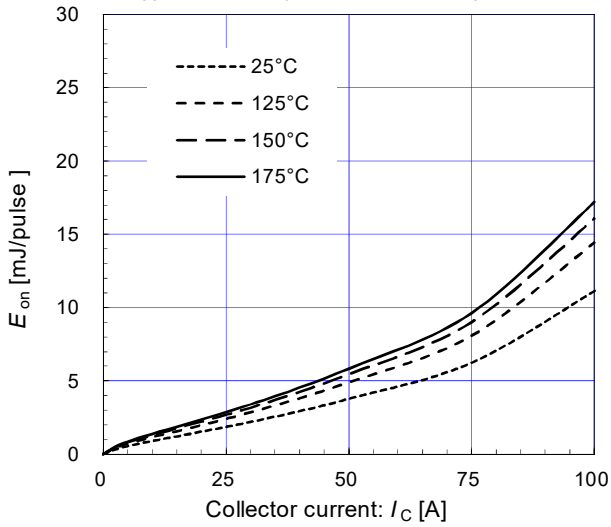
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IGBT Modules

[Inverter]

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

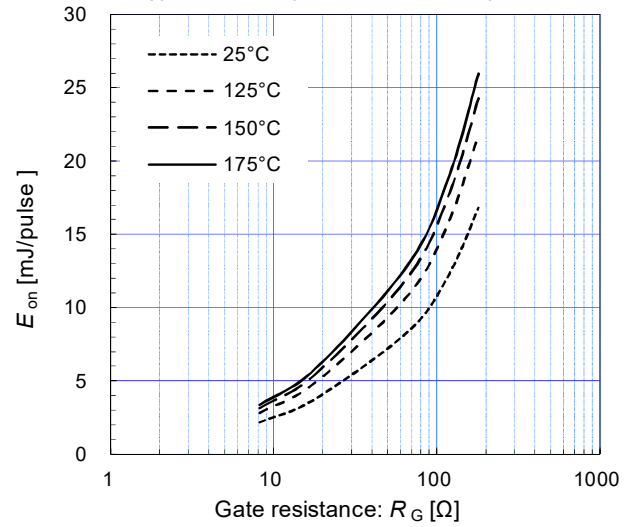
$V_{CC}=600V, V_{GE}=+15/-15V, R_G=18\Omega$



[Inverter]

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

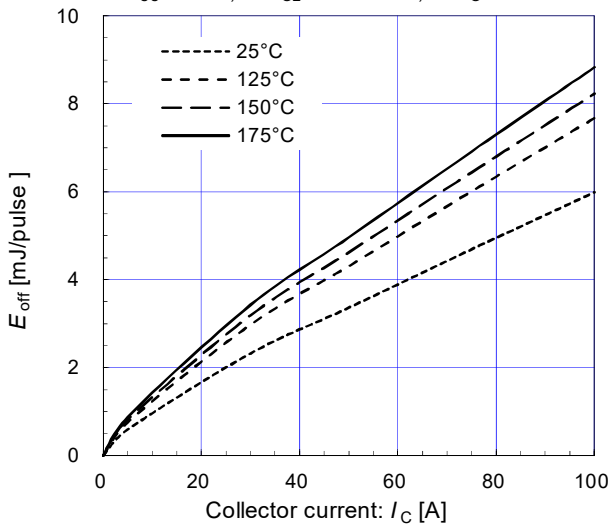
$V_{CC}=600V, V_{GE}=+15/-15V, I_C=50A$



[Inverter]

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

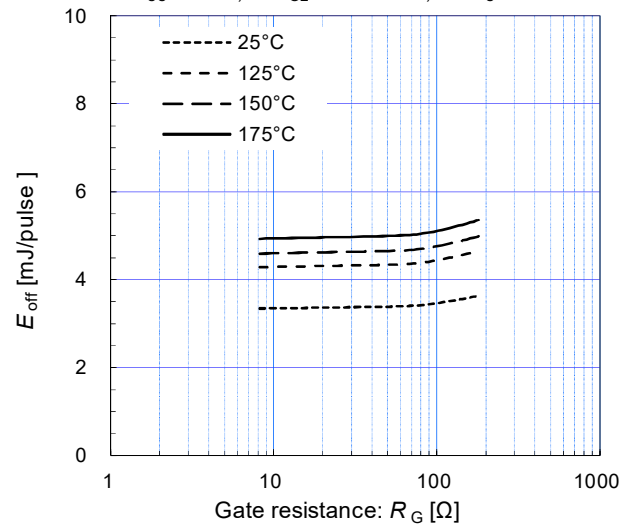
$V_{CC}=600V, V_{GE}=+15/-15V, R_G=18\Omega$



[Inverter]

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

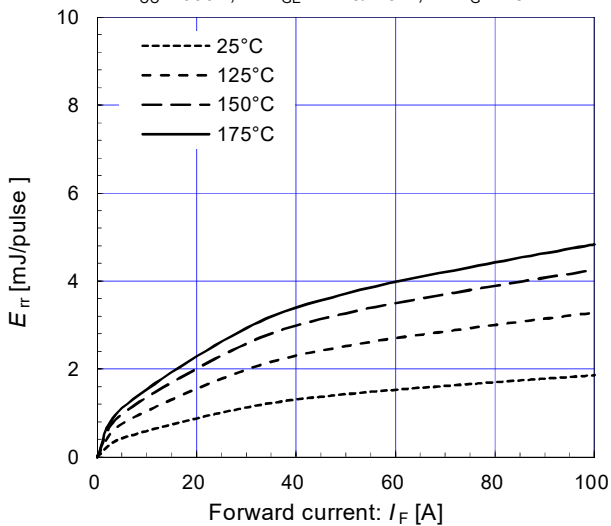
$V_{CC}=600V, V_{GE}=+15/-15V, I_C=50A$



[Inverter]

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

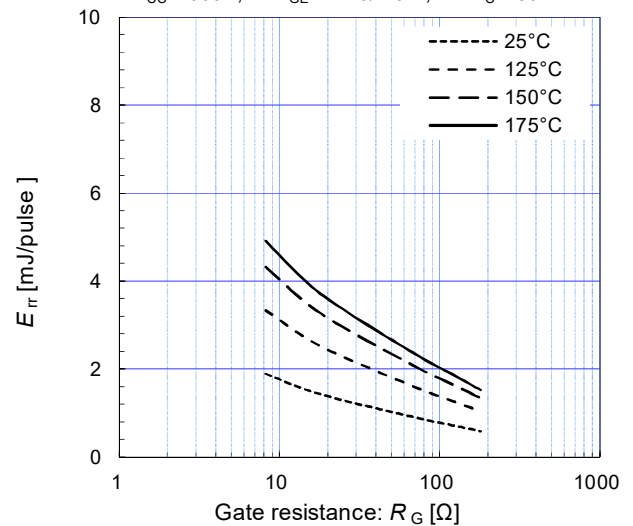
$V_{CC}=600V, V_{GE}=+15/-15V, R_G=18\Omega$



[Inverter]

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

$V_{CC}=600V, V_{GE}=+15/-15V, I_C=50A$



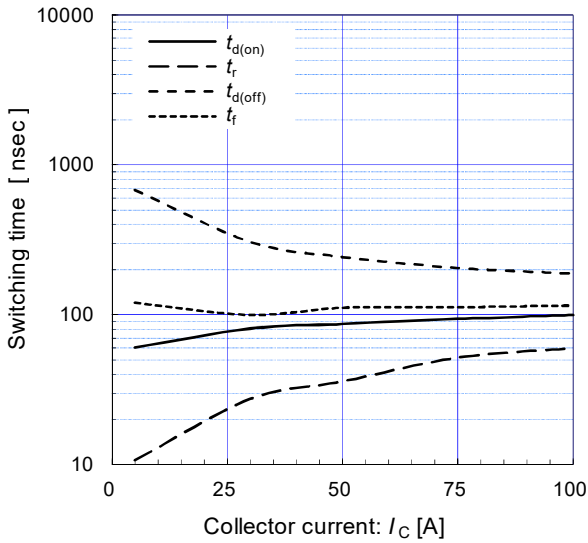
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IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

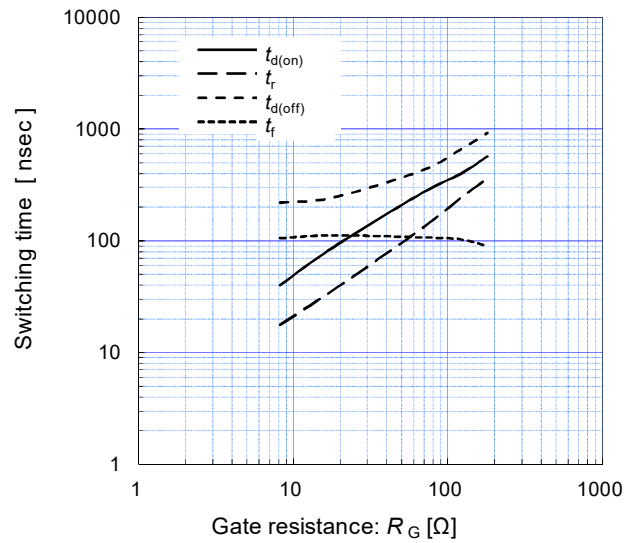
$V_{CC}=600V, R_G=18\Omega, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

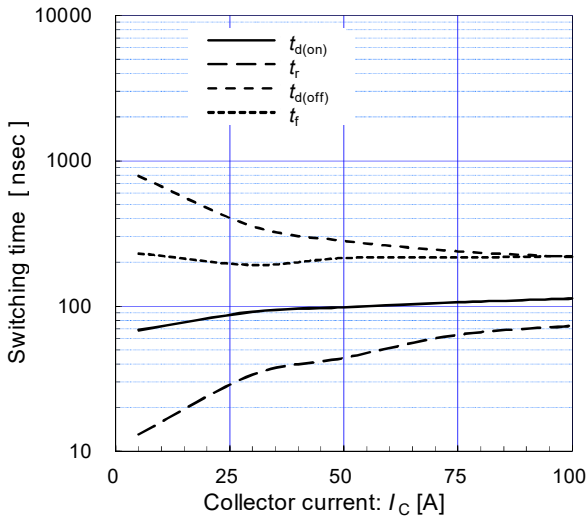
$V_{CC}=600V, I_C=50A, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

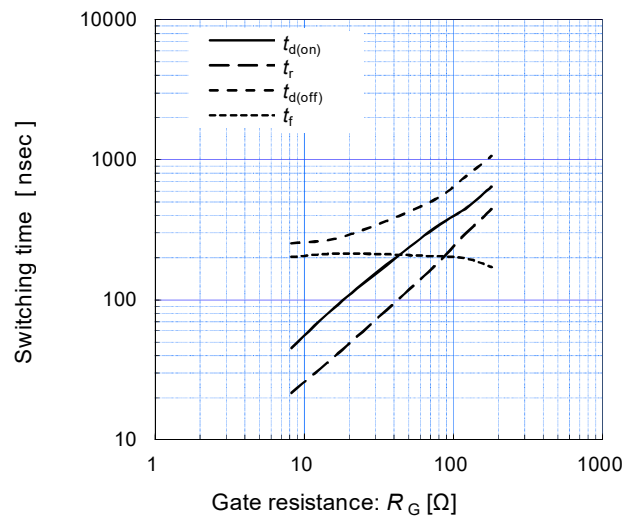
$V_{CC}=600V, R_G=18\Omega, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

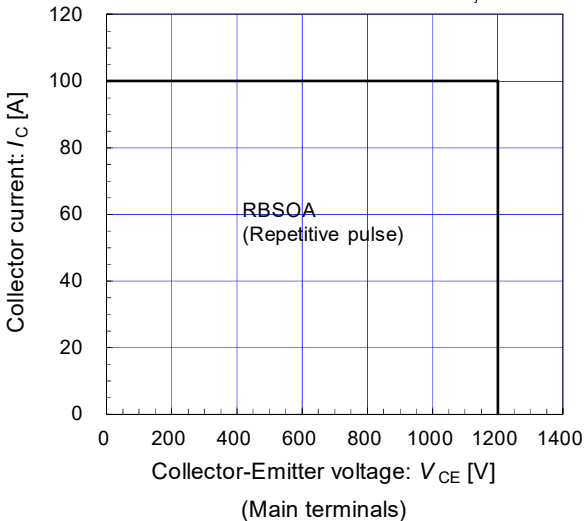
$V_{CC}=600V, I_C=50A, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[Inverter]

Reverse bias safe operating area (max.)

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

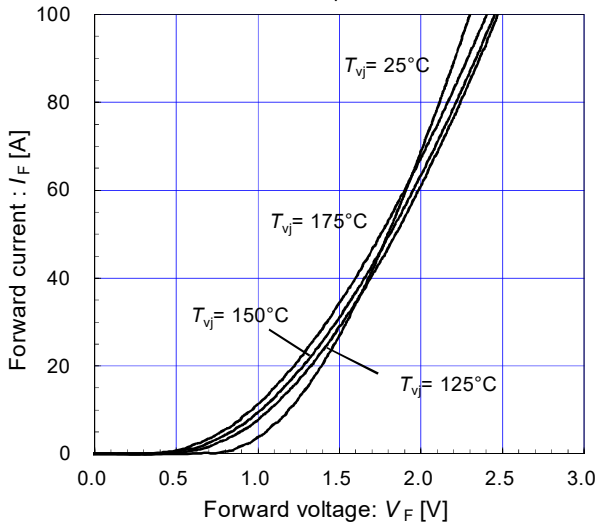


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[Inverter]

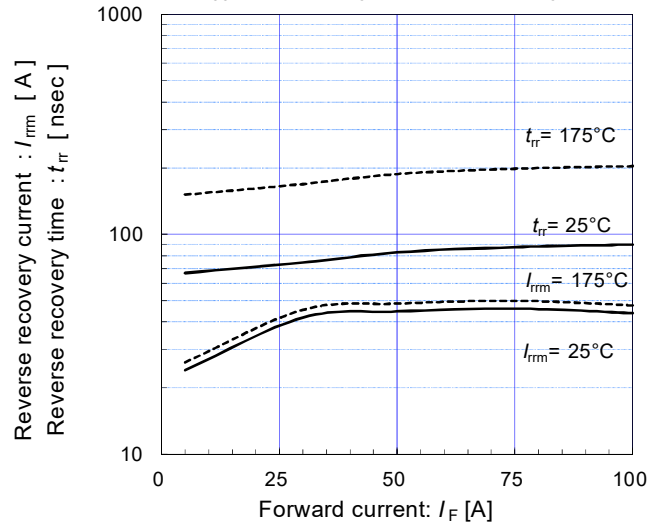
Forward current vs. Forward voltage (typ.)
chip



[Inverter]

Reverse recovery characteristics (typ.)

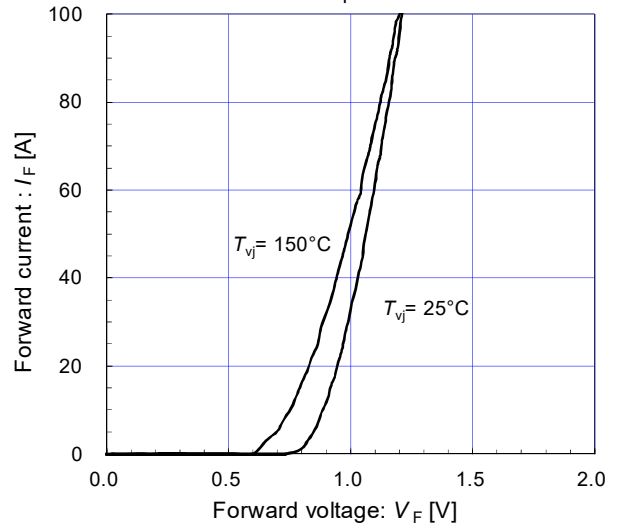
$V_{CC} = 600V, V_{GE} = +15/-15V, R_G = 18\Omega$



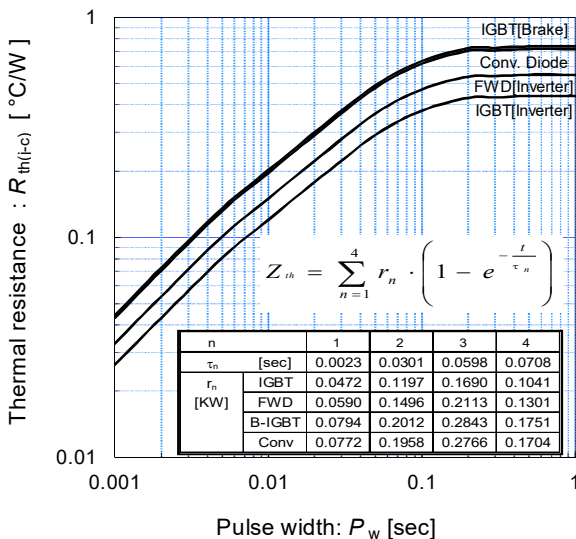
[Converter]

Forward current vs. Forward voltage (typ.)

chip

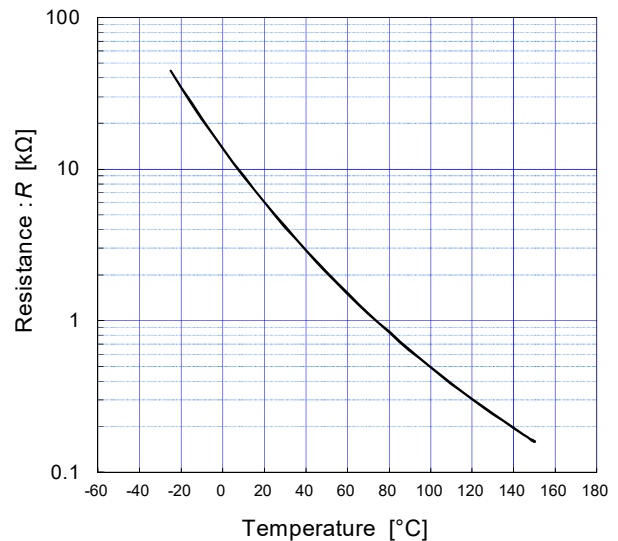


Transient thermal resistance (max.)



[Thermistor]

Temperature characteristic (typ.)



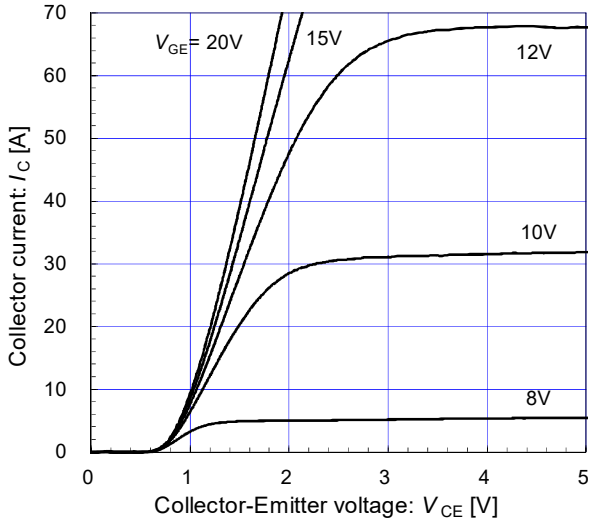
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[Brake]

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

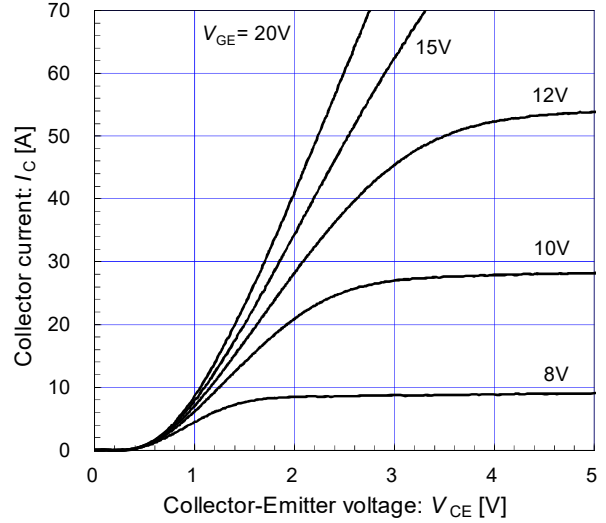
$T_{vj} = 25^\circ\text{C} / \text{chip}$



[Brake]

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

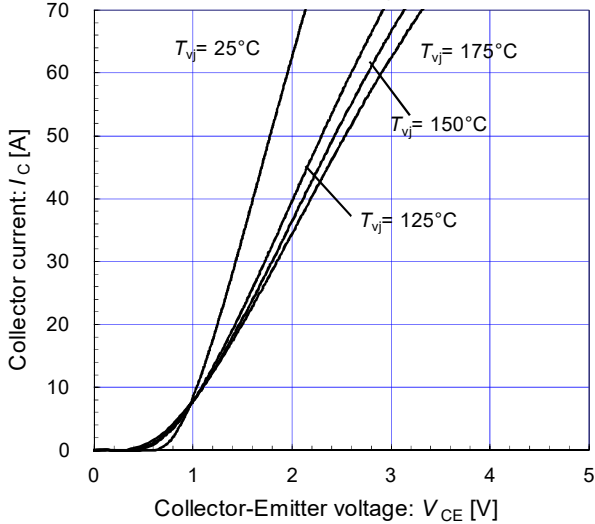
$T_{vj} = 175^\circ\text{C} / \text{chip}$



[Brake]

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

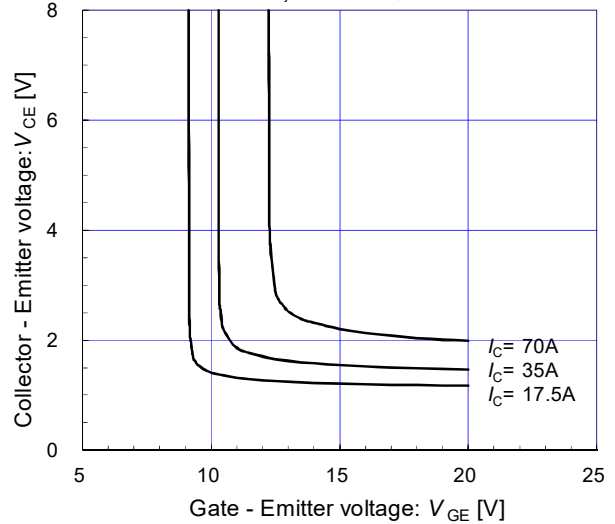
$V_{GE} = 15\text{V} / \text{chip}$



[Brake]

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

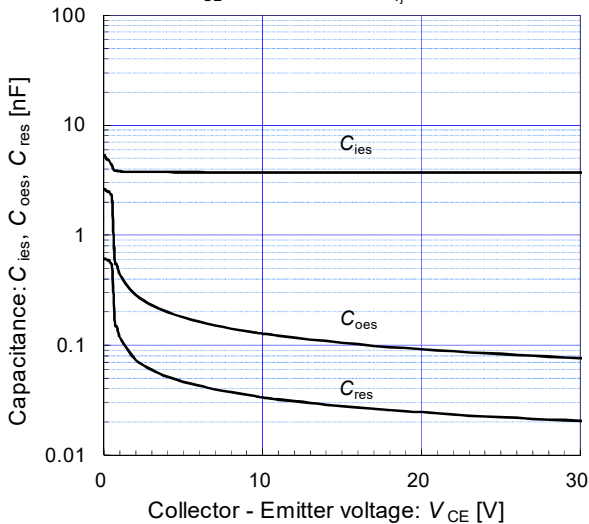
$T_{vj} = 25^\circ\text{C} / \text{chip}$



[Brake]

Capacitance vs. Collector-Emmitter voltage (typ.)

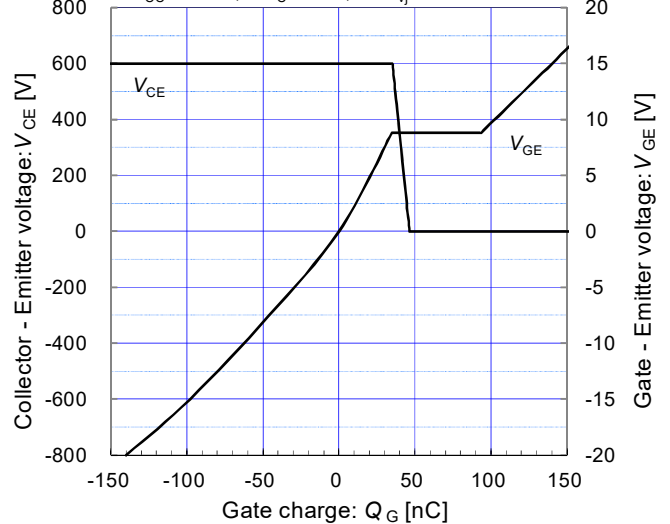
$V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^\circ\text{C}$



[Brake]

Dynamic gate charge (typ.)

$V_{CC} = 600\text{V}, I_c = 35\text{A}, T_{vj} = 25^\circ\text{C}$



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