

7MBR35XKB120-50

IGBT Modules

Power Module(X series)
1200V / 35A / PIM

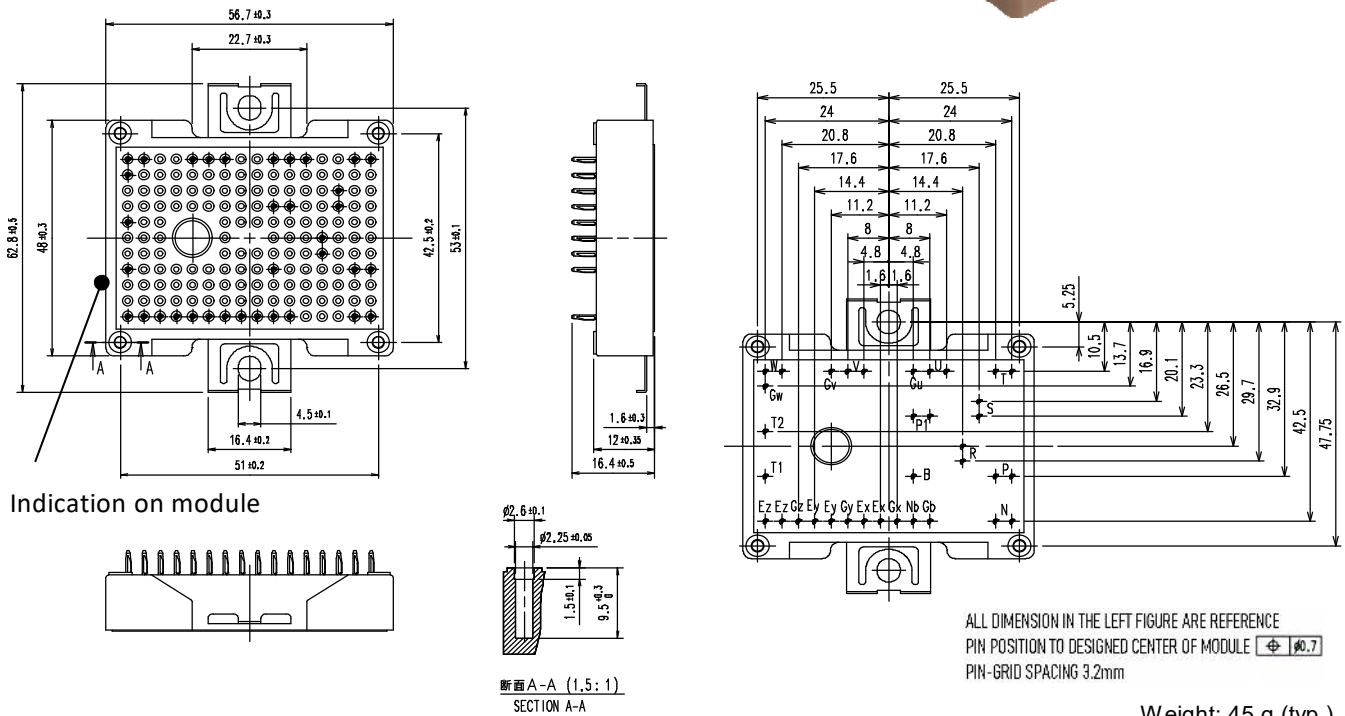
■ **Features**

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

■ **Applications**

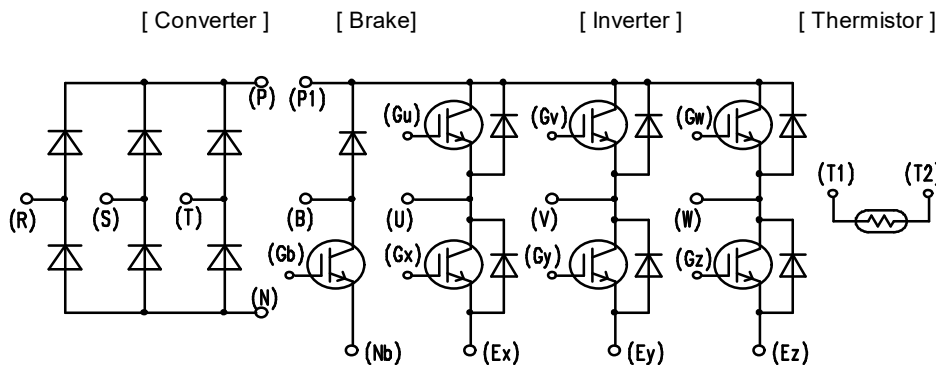
- Inverter for Motor Drive
- AC and DC Servo Drive Amplifier
- Uninterruptible Power Supply

■ **Outline drawing (Unit : mm)**



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	$T_c=100^\circ\text{C}$	35	A
	Repetitive peak collector current	I_{CRM}	1ms		70	
	Forward current	I_F	Continuous		35	
	Repetitive peak forward current	I_{FRM}	1ms		70	
	Total power dissipation	P_{tot}	1 device		255	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 collector current	I_{CRM}	1ms		70	
Total power dissipation	P_{tot}	1 device		255	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	$T_c=80^\circ\text{C}$	35	A
	Surge forward 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 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) 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	$V_{GE(th)}$	$V_{CE} = 20\text{V}$ $I_C = 35\text{mA}$	6.0	6.5	7.0	V			
Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15\text{V}$ $I_C = 35\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	1.75	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}	$V_{CE} = 10\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	3.7	-	nF
						C_{oes}	-	0.13	
C_{res}	-	0.03				-			
Gate charge	Q_G	$V_{CC} = 600\text{V}$ $V_{GE} = -15 \rightarrow +15\text{V}$ $I_C = 35\text{A}$	-	240	-	nC			
Forward voltage	V_F (terminal)	$I_F = 35\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	2.10	2.55	V		
			$T_{vj}=25^{\circ}\text{C}$	-	1.85	2.30			
	$T_{vj}=125^{\circ}\text{C}$		-	1.95	-				
	$T_{vj}=150^{\circ}\text{C}$		-	1.90	-				
	$T_{vj}=175^{\circ}\text{C}$		-	1.85	-				
Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 12\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.06	-	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	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 12\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.02	-			
			$T_{vj}=125^{\circ}\text{C}$	-	0.02	-			
			$T_{vj}=150^{\circ}\text{C}$	-	0.02	-			
			$T_{vj}=175^{\circ}\text{C}$	-	0.02	-			
	$t_{d(off)}$	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 12\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.20	-			
			$T_{vj}=125^{\circ}\text{C}$	-	0.23	-			
			$T_{vj}=150^{\circ}\text{C}$	-	0.23	-			
			$T_{vj}=175^{\circ}\text{C}$	-	0.23	-			
t_f	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 12\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.12	-				
		$T_{vj}=125^{\circ}\text{C}$	-	0.19	-				
		$T_{vj}=150^{\circ}\text{C}$	-	0.20	-				
		$T_{vj}=175^{\circ}\text{C}$	-	0.22	-				
Reverse recovery time	t_{rr}	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 12\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.07	-			
			$T_{vj}=125^{\circ}\text{C}$	-	0.14	-			
			$T_{vj}=150^{\circ}\text{C}$	-	0.15	-			
			$T_{vj}=175^{\circ}\text{C}$	-	0.16	-			

(*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}	$V_{CC} = 600V$ $I_C, I_F = 35A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12\Omega$	$T_{vj} = 25^\circ C$	-	1.86	-	mJ
			$T_{vj} = 125^\circ C$	-	2.75	-	
			$T_{vj} = 150^\circ C$	-	2.98	-	
			$T_{vj} = 175^\circ C$	-	3.26	-	
	E_{off}	$V_{CC} = 600V$ $I_C, I_F = 35A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12\Omega$	$T_{vj} = 25^\circ C$	-	2.54	-	
			$T_{vj} = 125^\circ C$	-	3.07	-	
			$T_{vj} = 150^\circ C$	-	3.25	-	
			$T_{vj} = 175^\circ C$	-	3.44	-	
	E_{rr}	$V_{CC} = 600V$ $I_C, I_F = 35A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12\Omega$	$T_{vj} = 25^\circ C$	-	1.39	-	
			$T_{vj} = 125^\circ C$	-	2.05	-	
			$T_{vj} = 150^\circ C$	-	2.41	-	
			$T_{vj} = 175^\circ C$	-	2.72	-	
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)	$V_{GE} = 15V$ $I_C = 35A$	$T_{vj} = 25^\circ C$	-	1.75	2.20	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	-		-	0	-	Ω
Brake Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600V$ $I_C = 35A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12\Omega$	$T_{vj} = 25^\circ C$	-	0.04	-	μs
			$T_{vj} = 125^\circ C$	-	0.04	-	
			$T_{vj} = 150^\circ C$	-	0.04	-	
			$T_{vj} = 175^\circ C$	-	0.04	-	
	t_r	$V_{CC} = 600V$ $I_C = 35A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12\Omega$	$T_{vj} = 25^\circ C$	-	0.02	-	
			$T_{vj} = 125^\circ C$	-	0.02	-	
			$T_{vj} = 150^\circ C$	-	0.02	-	
			$T_{vj} = 175^\circ C$	-	0.02	-	
	$t_{d(off)}$	$V_{CC} = 600V$ $I_C = 35A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12\Omega$	$T_{vj} = 25^\circ C$	-	0.20	-	
			$T_{vj} = 125^\circ C$	-	0.23	-	
			$T_{vj} = 150^\circ C$	-	0.23	-	
			$T_{vj} = 175^\circ C$	-	0.23	-	
	t_f	$V_{CC} = 600V$ $I_C = 35A$ $L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12\Omega$	$T_{vj} = 25^\circ C$	-	0.12	-	
			$T_{vj} = 125^\circ C$	-	0.16	-	
			$T_{vj} = 150^\circ C$	-	0.20	-	
			$T_{vj} = 175^\circ C$	-	0.22	-	
Reverse current	I_{RRM}	$V_R = 1200V$		-	-	50	μA
Forward voltage	V_F (terminal)	$I_F = 10A$	$T_{vj} = 25^\circ C$	-	2.15	2.60	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	-	
			$T_{vj} = 175^\circ C$	-	1.85	-	
Reverse current	I_{RRM}	$V_R = 1600V$		-	-	50	μA
Continuous (direct) forward voltage	V_F	$I_F = 35A$	terminal	-	1.30	1.75	V
			chip	-	1.05	1.50	
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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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	-	-	0.58	K/W
		Inverter FWD	-	-	0.79	
		Brake IGBT	-	-	0.58	
		Brake FWD	-	-	1.75	
		Converter Diode	-	-	0.73	
Thermal resistance case to heat sink(*1) (1 device)	$R_{th(c-s)}$	Inverter IGBT	-	0.55	-	
		Inverter FWD	-	0.60	-	
		Brake IGBT	-	0.61	-	
		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·K) thermal grease.

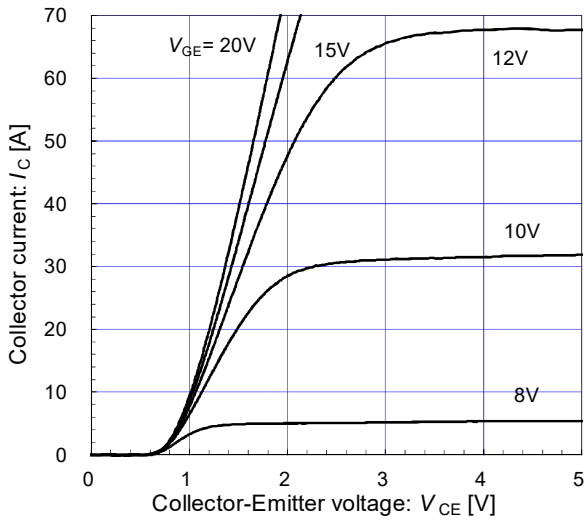
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IGBT Modules

[Inverter]

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

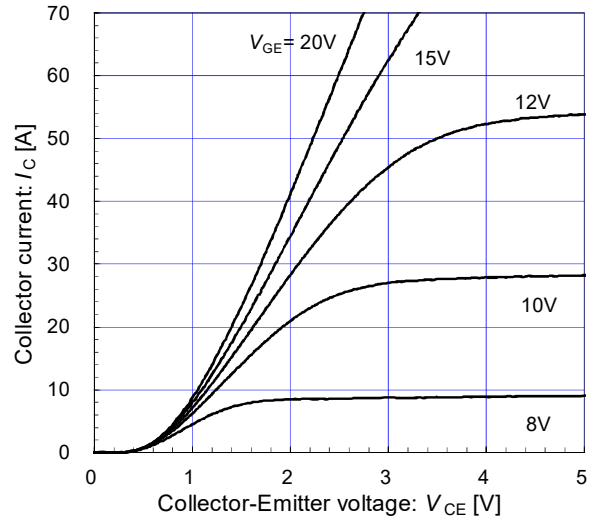
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[Inverter]

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

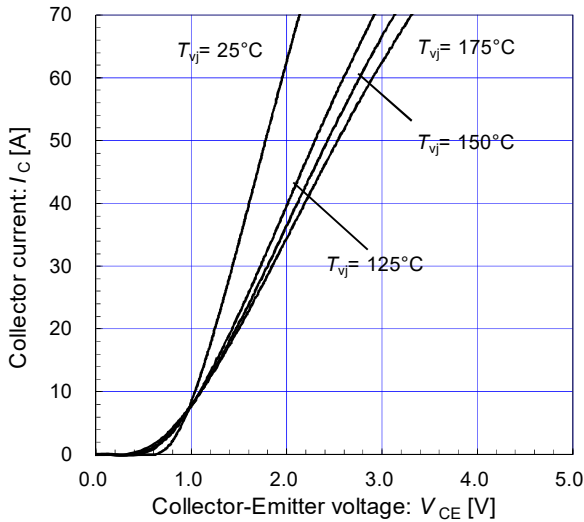
$T_{vj} = 175^{\circ}\text{C} / \text{chip}$



[Inverter]

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

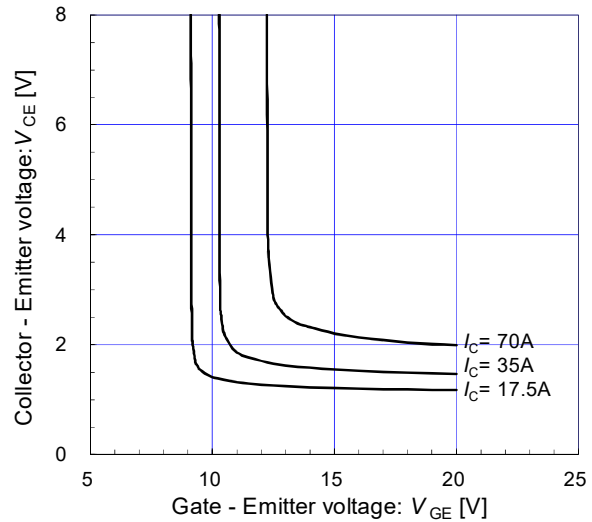
$V_{GE} = 15\text{V} / \text{chip}$



[Inverter]

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

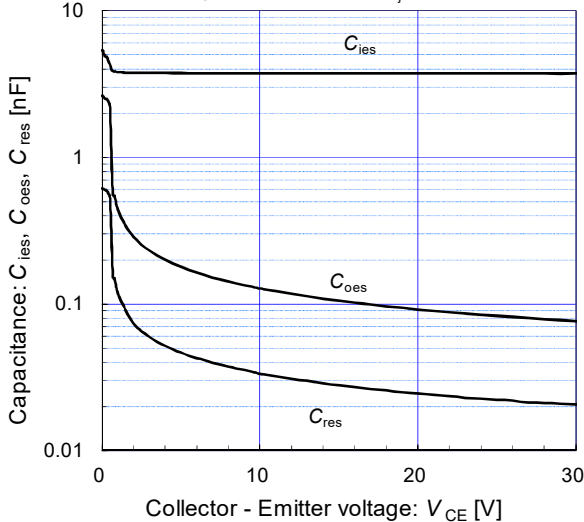
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[Inverter]

Capacitance vs. Collector-Emittor voltage (typ.)

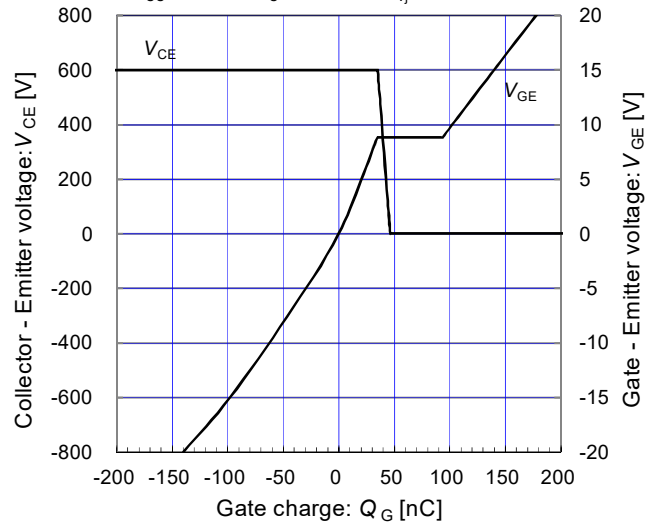
$V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}$



[Inverter]

Dynamic gate charge (typ.)

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

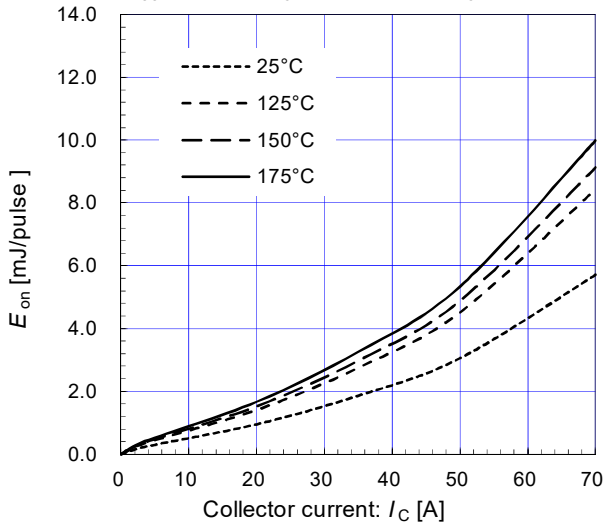


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[Inverter]

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

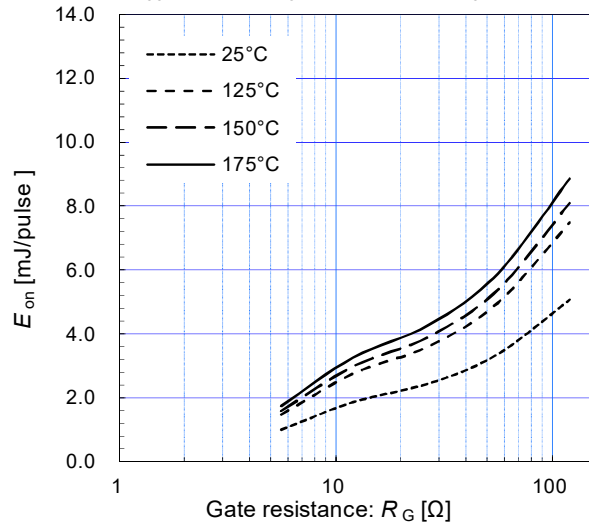
$V_{CC}= 600V, V_{GE}= +15/-15V, R_G= 12\ \Omega$



[Inverter]

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

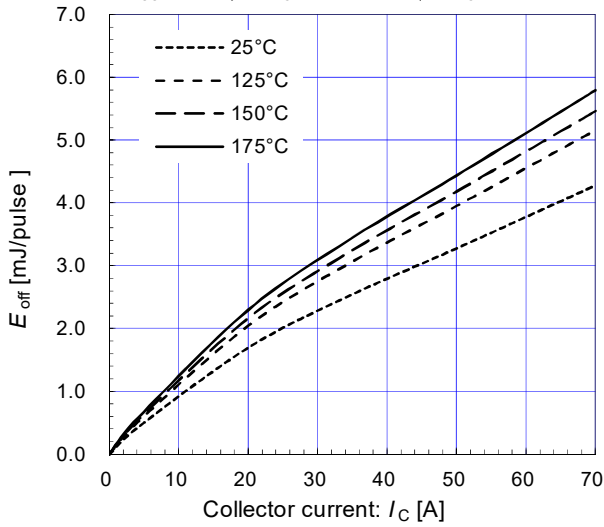
$V_{CC}= 600V, V_{GE}= +15/-15V, I_C= 35A$



[Inverter]

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

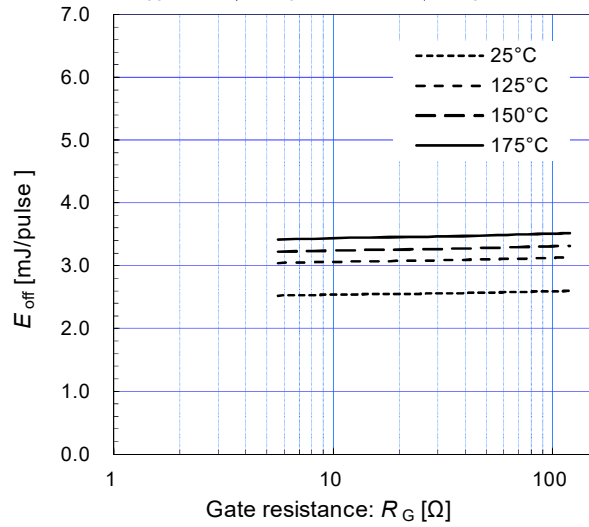
$V_{CC}= 600V, V_{GE}= +15/-15V, R_G= 12\ \Omega$



[Inverter]

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

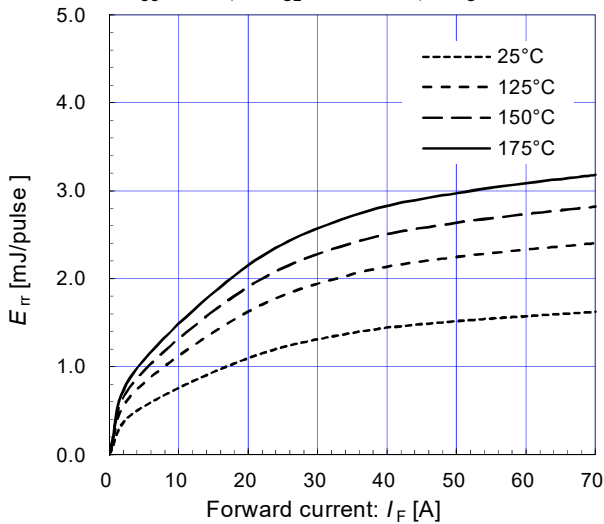
$V_{CC}= 600V, V_{GE}= +15/-15V, I_C= 35A$



[Inverter]

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

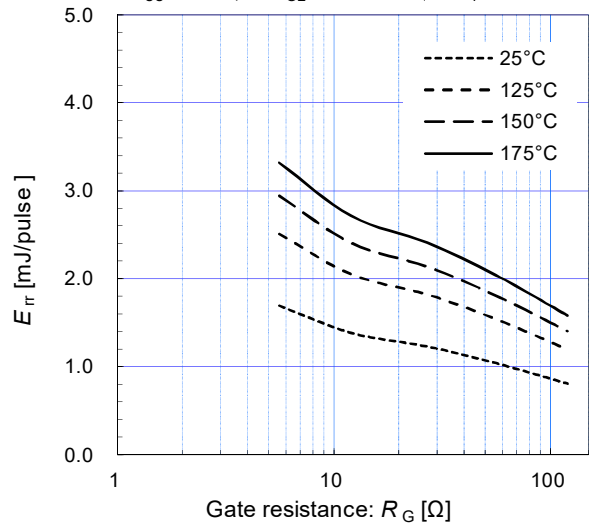
$V_{CC}= 600V, V_{GE}= +15/-15V, R_G= 12\ \Omega$



[Inverter]

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

$V_{CC}= 600V, V_{GE}= +15/-15V, I_F= 35A$



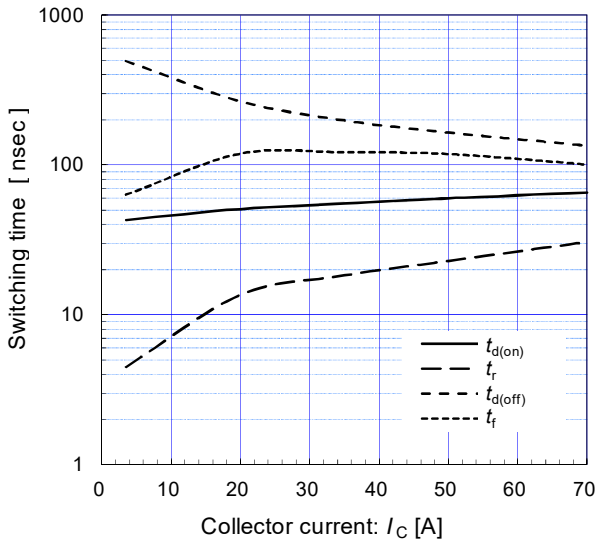
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IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

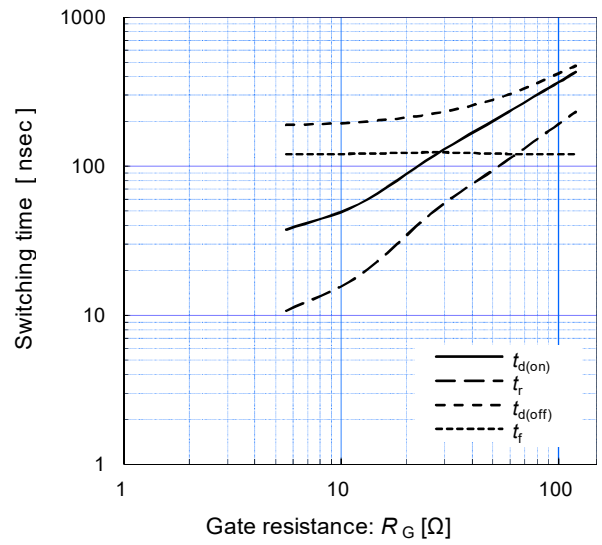
$V_{CC}=600V, R_G=12\Omega, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

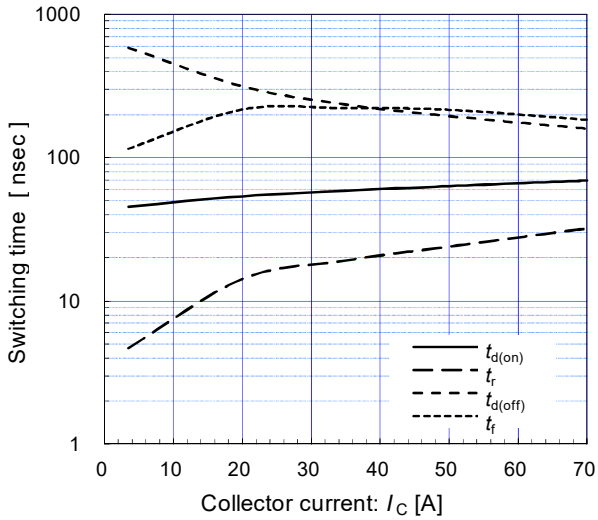
$V_{CC}=600V, I_C=35A, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

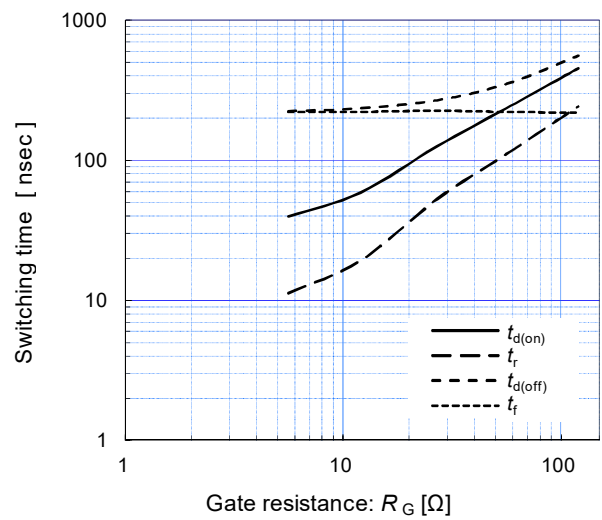
$V_{CC}=600V, R_G=12\Omega, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

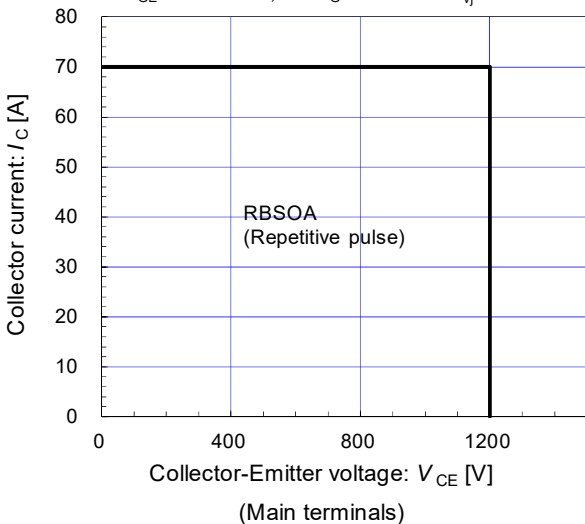
$V_{CC}=600V, I_C=35A, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[Inverter]

Reverse bias safe operating area (max.)

$V_{GE}=+15/-15V, R_G \geq 12\Omega, T_{vj}=175^\circ C$

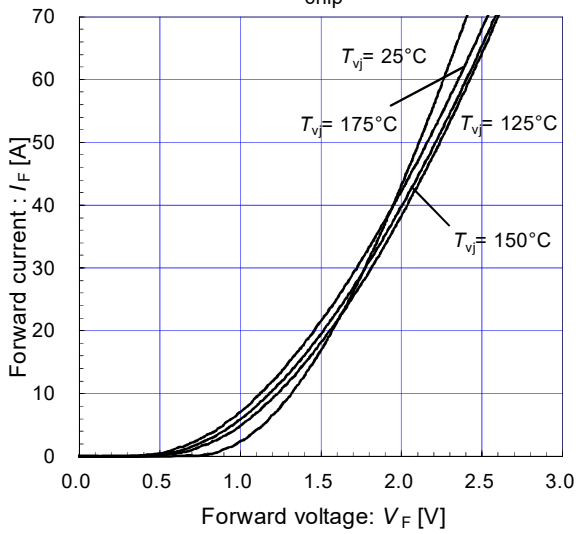


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IGBT Modules

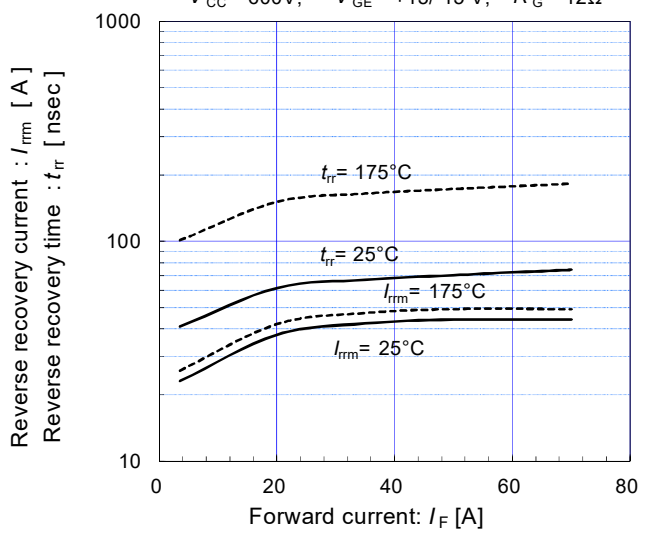
[Inverter]

Forward current vs. Forward voltage (typ.)
chip



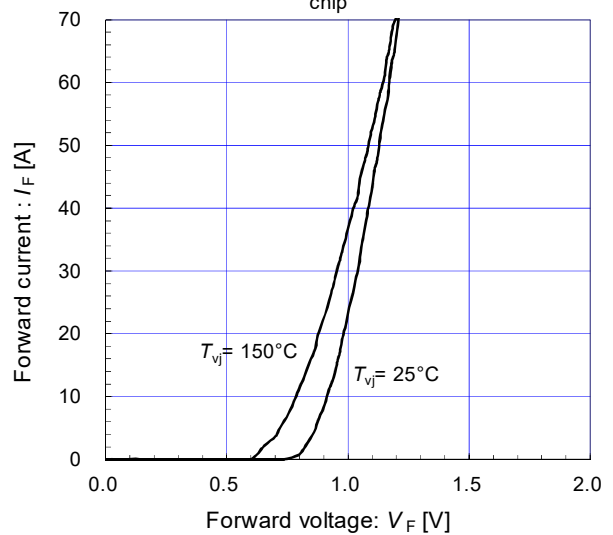
[Inverter]

Reverse recovery characteristics (typ.)
 $V_{CC} = 600V, V_{GE} = +15/-15V, R_G = 12\Omega$

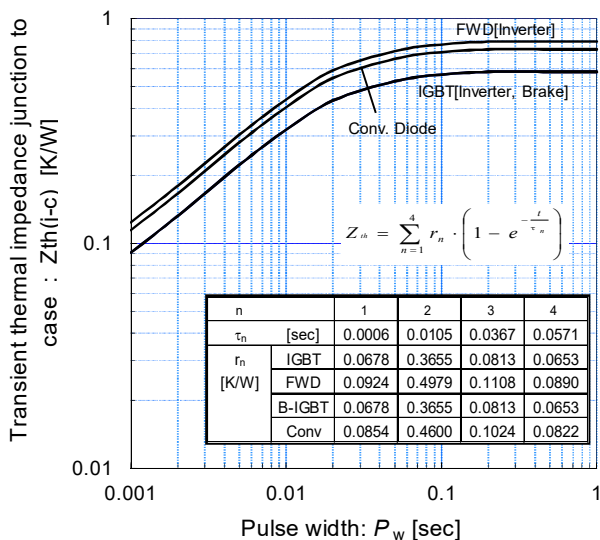


[Converter]

Forward current vs. Forward voltage (typ.)
chip

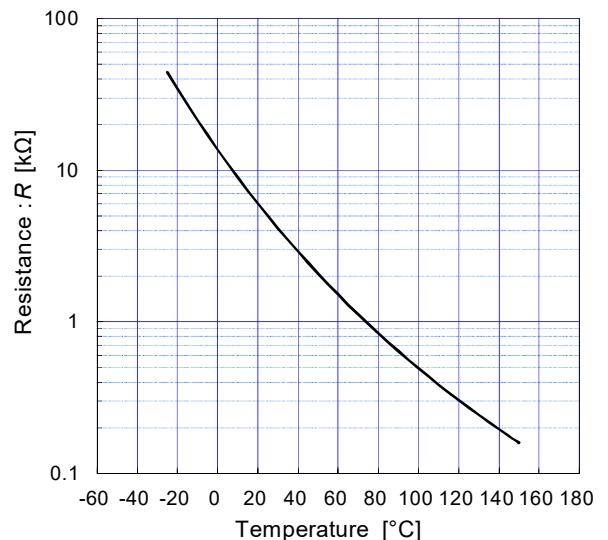


Transient thermal impedance (max.)



[Thermistor]

Temperature characteristic (typ.)

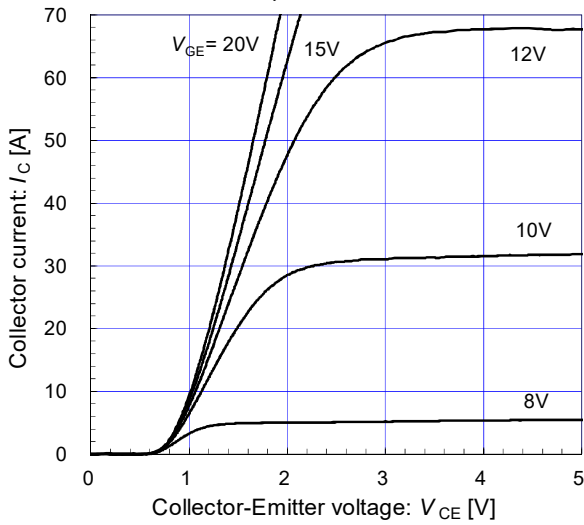


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[Brake]

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

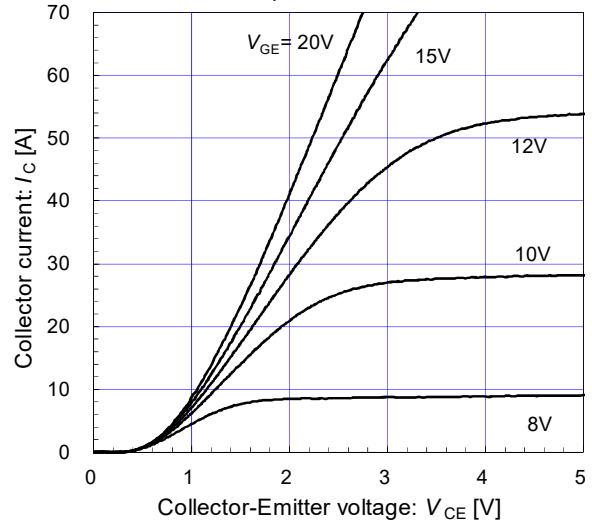
$T_{vj} = 25^\circ\text{C} / \text{chip}$



[Brake]

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

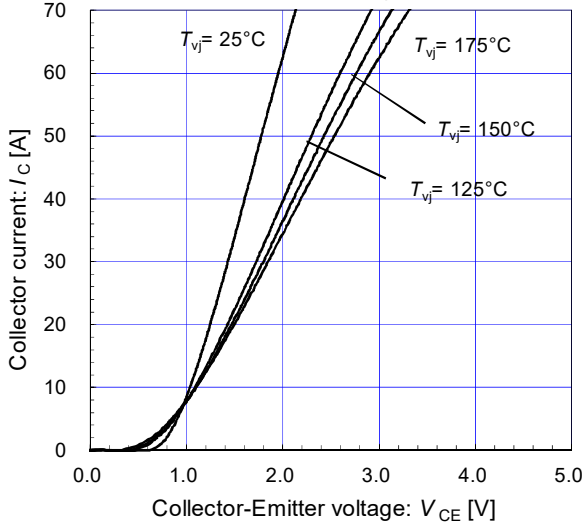
$T_{vj} = 175^\circ\text{C} / \text{chip}$



[Brake]

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

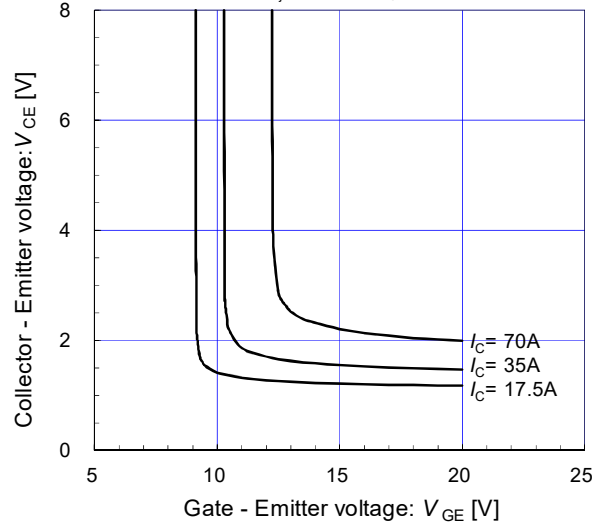
$V_{GE} = 15\text{V} / \text{chip}$



[Brake]

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

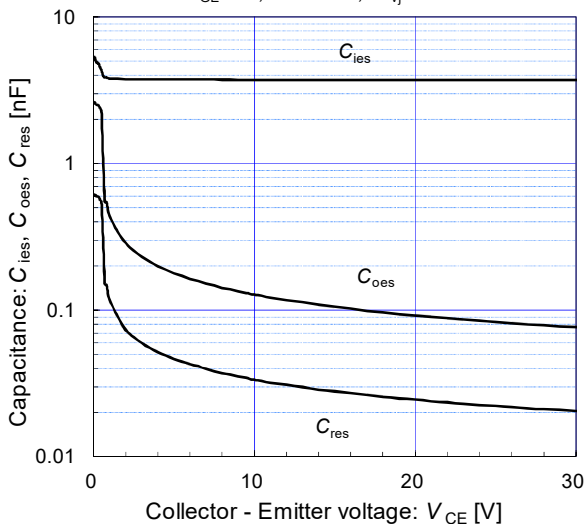
$T_{vj} = 25^\circ\text{C} / \text{chip}$



[Brake]

Capacitance vs. Collector-Emittter voltage (typ.)

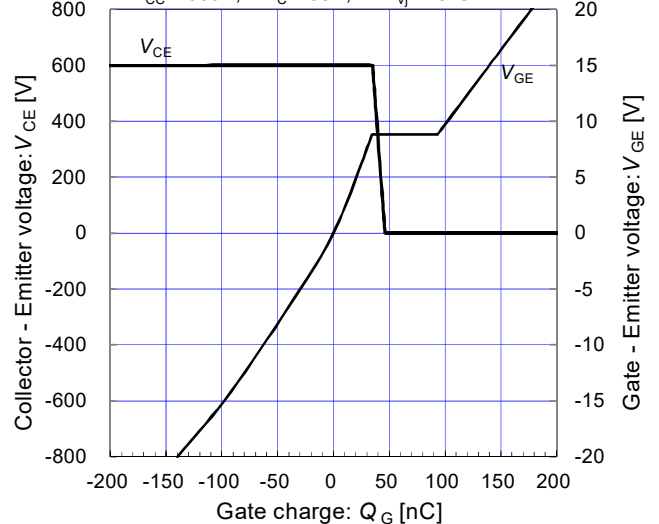
$V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^\circ\text{C}$



[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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