

7MBR35XKB120-50

IGBT Modules

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

■ Features

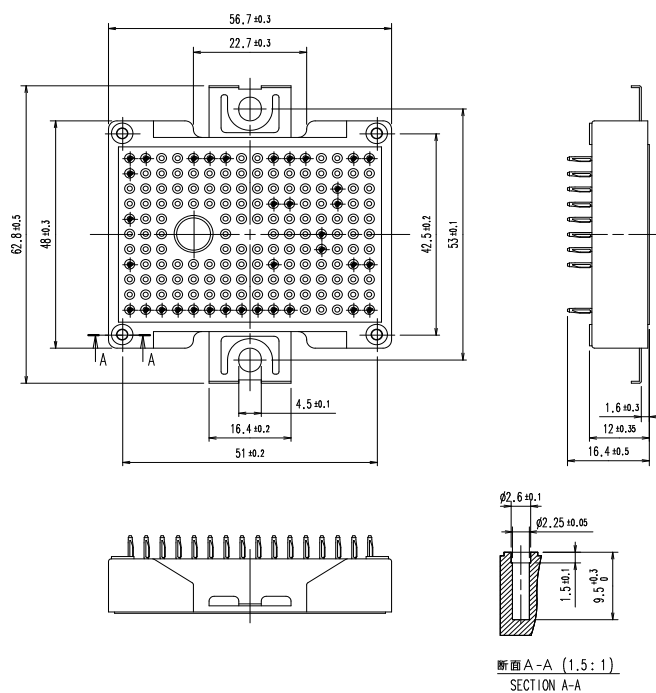
LOW $V_{CE(sat)}$
Compact Package
P.C.Board Mount Module
Converter Diode Bridge Dynamic Brake Circuit
RoHS compliant Product

■ Applications

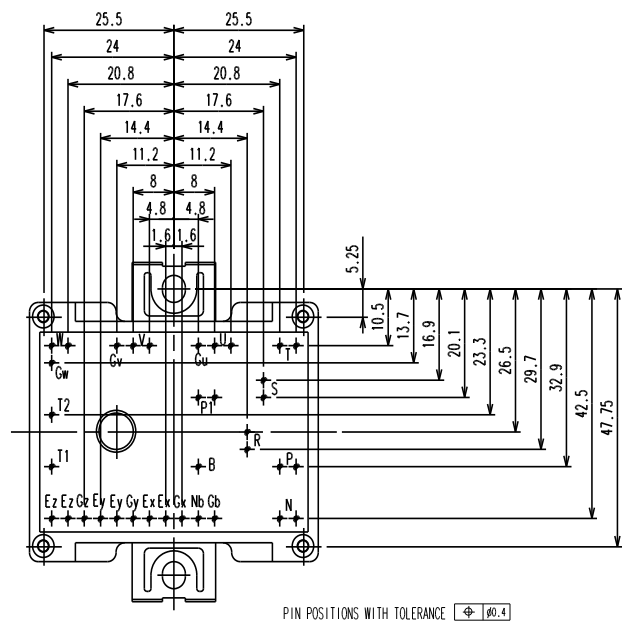
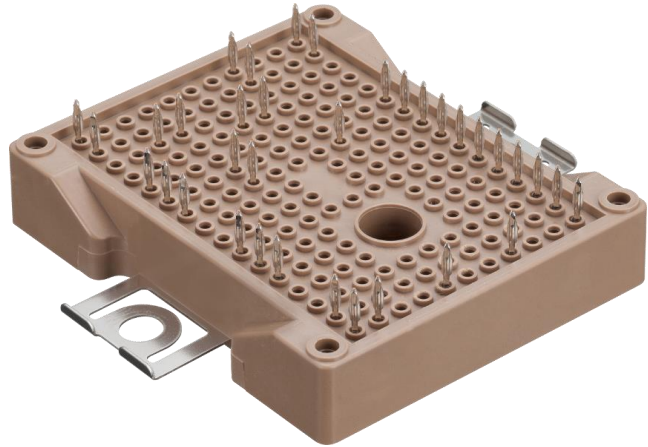
Inverter for Motor Drive
AC and DC Servo Drive Amplifier
Uninterruptible Power Supply

■ Outline drawing (Unit : mm)

shows theoretical dimension.
() shows reference dimension.

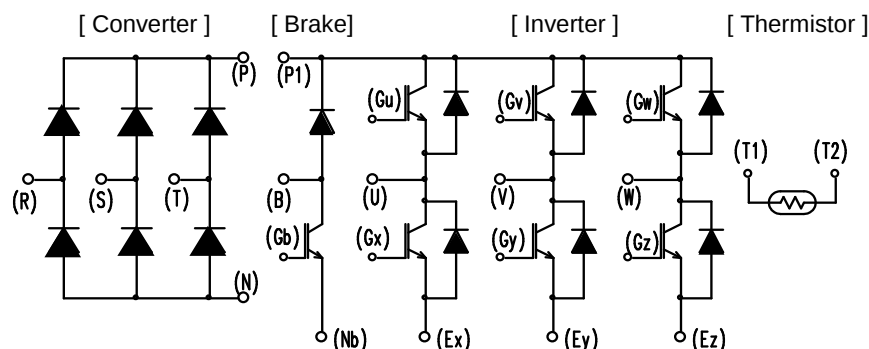


■ Typical appearance



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	$T_c = 80^\circ\text{C}$	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 (*4)	Mounting torque of screws to heat sink	M_s	M4		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.

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

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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}	$V_{GE} = 0V$ $V_{CE} = 1200V$		-	-	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	$V_{GE(th)}$	$V_{CE} = 20V$ $I_C = 35mA$		6.0	6.5	7.0	V	
	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_C = 35A$	$T_{vj}=25^{\circ}C$	-	1.75	2.20	V	
		$V_{CE(sat)}$ (chip)	$T_{vj}=25^{\circ}C$	-	1.50	1.95			
			$T_{vj}=125^{\circ}C$	-	1.85	-			
			$T_{vj}=150^{\circ}C$	-	1.95	-			
			$T_{vj}=175^{\circ}C$	-	2.00	-			
	Internal Gate resistance	r_g	-			-	0	-	Ω
	Capacitance	C_{ies}	$V_{CE} = 10V, V_{GE} = 0V, f = 1MHz$			-	3.7	-	nF
		C_{oes}				-	0.13	-	
		C_{res}				-	0.03	-	
	Gate charge	Q_G	$V_{CC} = 600V \quad V_{GE} = -15 \rightarrow +15V$ $I_C = 35A$			-	240	-	nC
	Forward voltage	V_F (terminal)	$I_F = 35A$	$T_{vj}=25^{\circ}C$	-	2.10	2.55	V	
		V_F (chip)	$T_{vj}=25^{\circ}C$	-	1.85	2.30			
			$T_{vj}=125^{\circ}C$	-	1.95	-			
			$T_{vj}=150^{\circ}C$	-	1.90	-			
$T_{vj}=175^{\circ}C$			-	1.85	-				
Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^{\circ}C$	-	0.06	-	μs		
			$T_{vj}=125^{\circ}C$	-	0.06	-			
			$T_{vj}=150^{\circ}C$	-	0.06	-			
			$T_{vj}=175^{\circ}C$	-	0.06	-			
	t_r	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^{\circ}C$	-	0.02	-			
			$T_{vj}=125^{\circ}C$	-	0.02	-			
			$T_{vj}=150^{\circ}C$	-	0.02	-			
			$T_{vj}=175^{\circ}C$	-	0.02	-			
	$t_{d(off)}$	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^{\circ}C$	-	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	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^{\circ}C$	-	0.12	-			
			$T_{vj}=125^{\circ}C$	-	0.19	-			
			$T_{vj}=150^{\circ}C$	-	0.20	-			
			$T_{vj}=175^{\circ}C$	-	0.22	-			
Reverse recovery time	t_{rr}	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^{\circ}C$	-	0.07	-			
			$T_{vj}=125^{\circ}C$	-	0.14	-			
			$T_{vj}=150^{\circ}C$	-	0.15	-			
			$T_{vj}=175^{\circ}C$	-	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}	$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	1.86	-	mJ
			$I_C, I_F = 35A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	2.75	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	2.98	-	
			$R_G = 12 \Omega$	$T_{vj}=175^{\circ}C$	-	3.26	-	
		E_{off}	$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	2.54	-	
			$I_C, I_F = 35A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	3.07	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	3.25	-	
			$R_G = 12 \Omega$	$T_{vj}=175^{\circ}C$	-	3.44	-	
		E_{rr}	$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	1.39	-	
			$I_C, I_F = 35A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	2.05	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	2.41	-	
			$R_G = 12 \Omega$	$T_{vj}=175^{\circ}C$	-	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}	$V_{CE} = 0V, \quad V_{GE} = +20/-20V$		-	-	100	nA	
Brake	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_C = 35A$	$T_{vj}=25^{\circ}C$	-	1.75	2.20	V
		$V_{CE(sat)}$ (chip)		$T_{vj}=25^{\circ}C$	-	1.50	1.95	
				$T_{vj}=125^{\circ}C$	-	1.85	-	
				$T_{vj}=150^{\circ}C$	-	1.95	-	
				$T_{vj}=175^{\circ}C$	-	2.00	-	
	Internal Gate resistance	r_g	-		-	0	-	Ω
	Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	0.04	-	μs
			$I_C = 35A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.04	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.04	-	
			$R_G = 12 \Omega$	$T_{vj}=175^{\circ}C$	-	0.04	-	
t_r		$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	0.02	-		
		$I_C = 35A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.02	-		
		$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.02	-		
		$R_G = 12 \Omega$	$T_{vj}=175^{\circ}C$	-	0.02	-		
$t_{d(off)}$		$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	0.20	-		
		$I_C = 35A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.23	-		
		$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.23	-		
		$R_G = 12 \Omega$	$T_{vj}=175^{\circ}C$	-	0.23	-		
t_f		$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	0.12	-		
	$I_C = 35A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	0.16	-			
	$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	0.20	-			
	$R_G = 12 \Omega$	$T_{vj}=175^{\circ}C$	-	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	
	V_F (chip)	$I_F = 10A$	$T_{vj}=25^{\circ}C$	-	1.90	2.35		
			$T_{vj}=125^{\circ}C$	-	1.95	-		
			$T_{vj}=150^{\circ}C$	-	1.90	-		
			$T_{vj}=175^{\circ}C$	-	1.85	-		
Converter	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		
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	-	-	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.

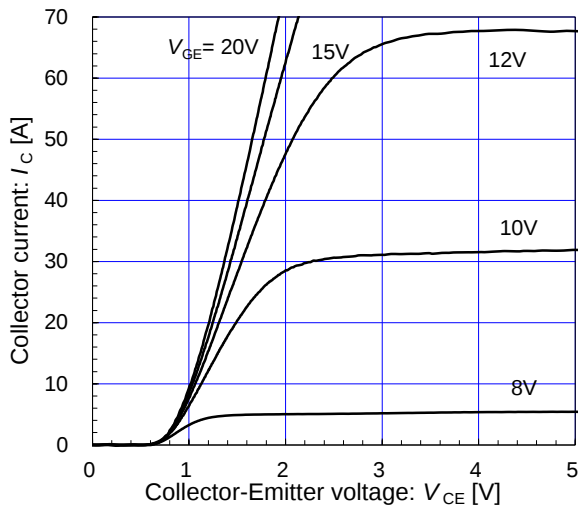
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IGBT Modules

[Inverter]

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

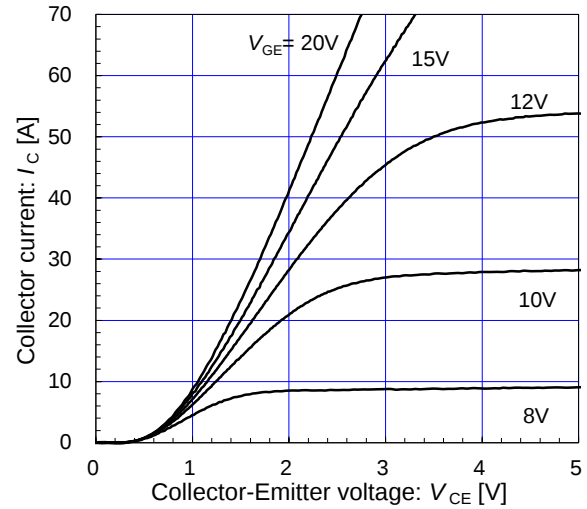
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[Inverter]

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

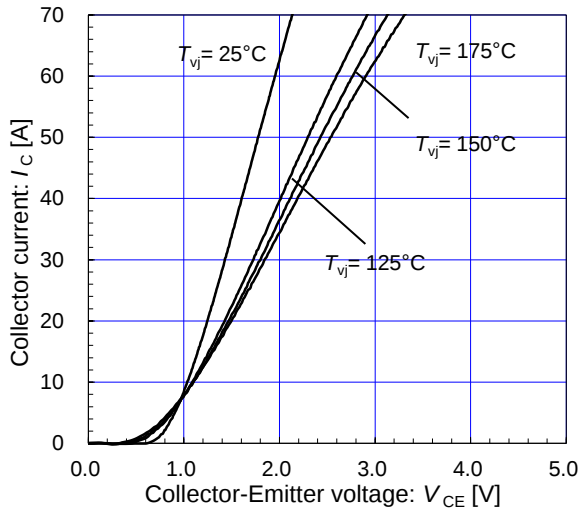
$T_{vj} = 175^{\circ}\text{C} / \text{chip}$



[Inverter]

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

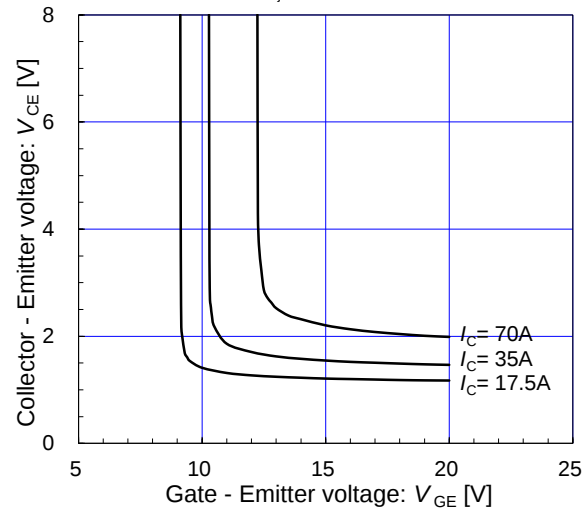
$V_{GE} = 15\text{V} / \text{chip}$



[Inverter]

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

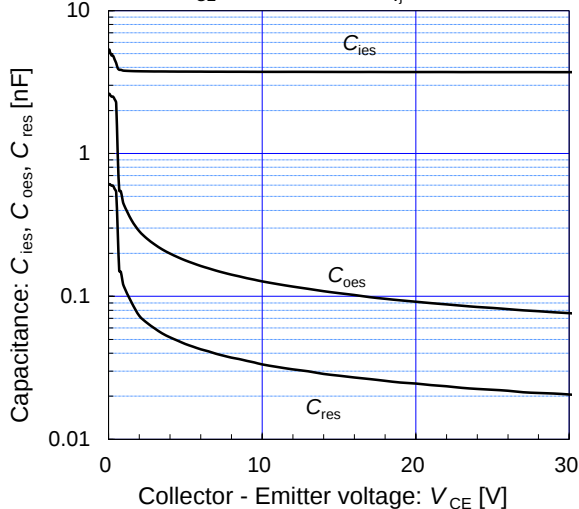
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[Inverter]

Capacitance vs. Collector-Emitter voltage (typ.)

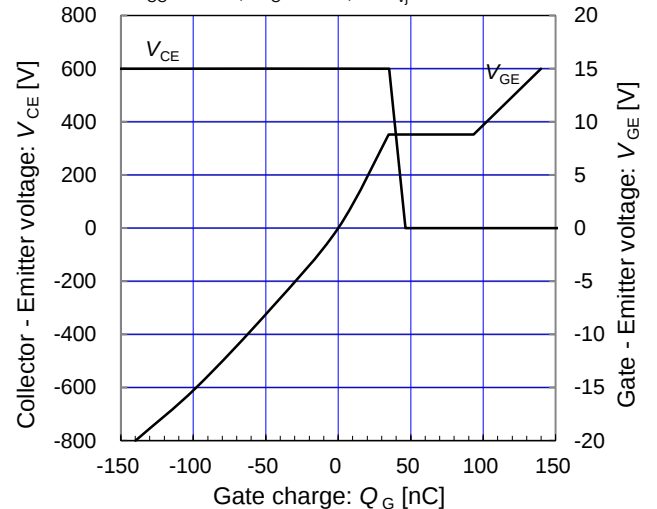
$V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}$



[Inverter]

Dynamic Gate charge (typ.)

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



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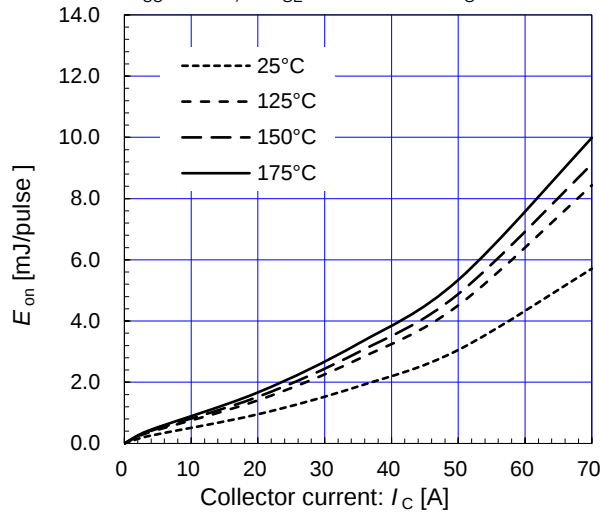
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IGBT Modules

[Inverter]

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

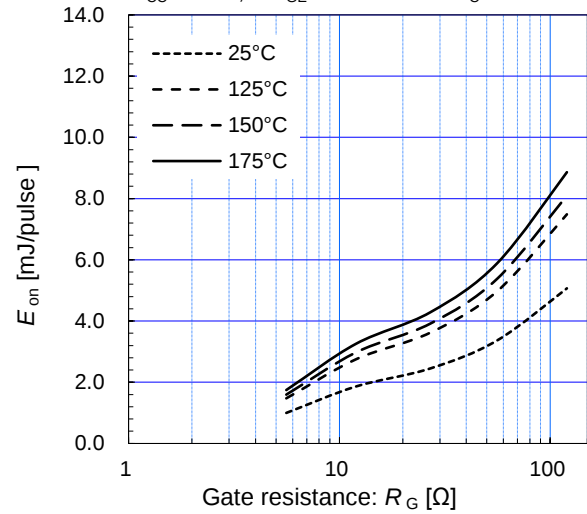
$V_{CC}=600V, V_{GE}=+15/-15V, R_G=12\Omega$



[Inverter]

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

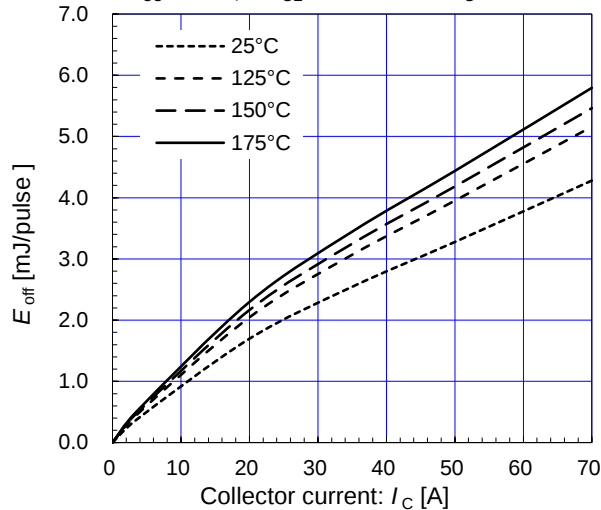
$V_{CC}=600V, V_{GE}=+15/-15V, I_C=35A$



[Inverter]

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

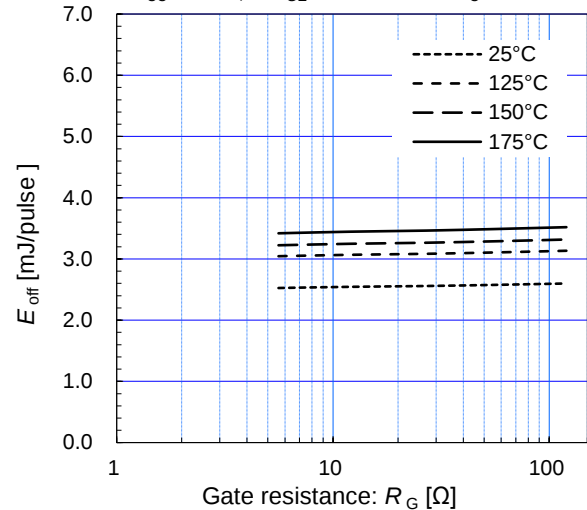
$V_{CC}=600V, V_{GE}=+15/-15V, R_G=12\Omega$



[Inverter]

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

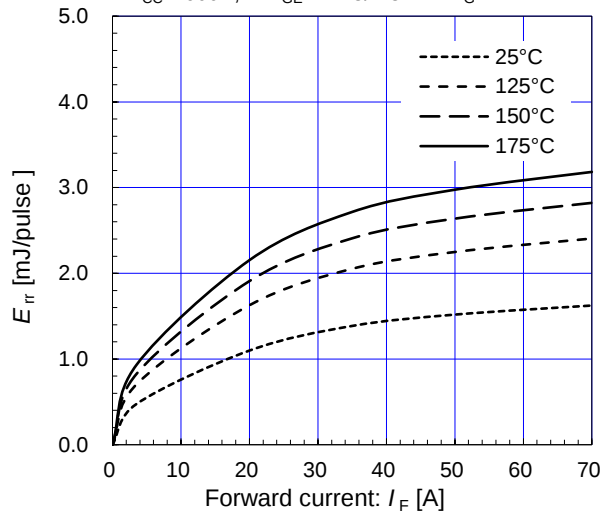
$V_{CC}=600V, V_{GE}=+15/-15V, I_C=35A$



[Inverter]

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

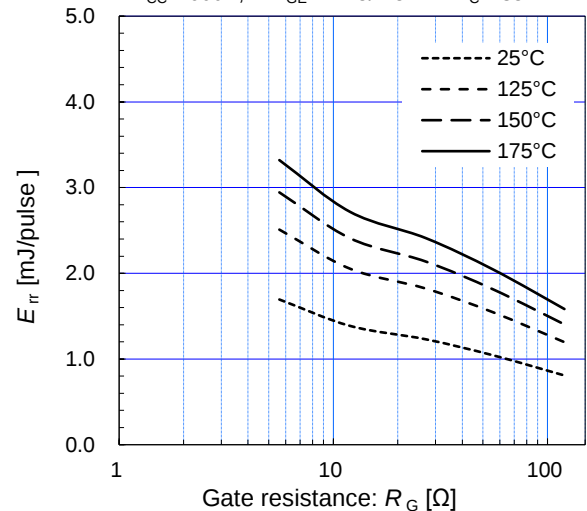
$V_{CC}=600V, V_{GE}=+15/-15V, R_G=12\Omega$



[Inverter]

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

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



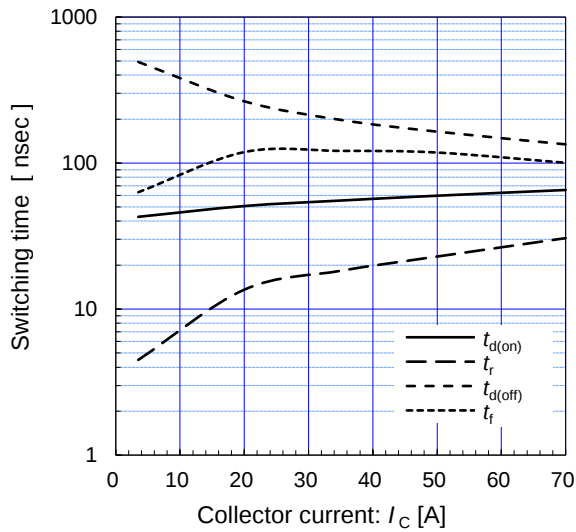
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IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

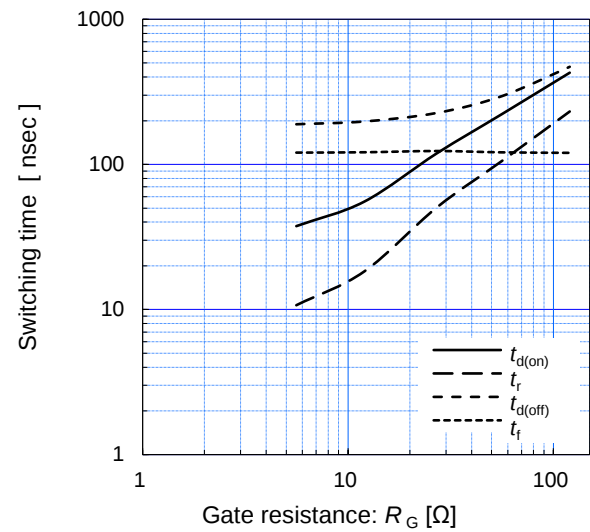
$V_{CC}=600V$, $R_G=12\Omega$ $V_{GE}=+15/-15V$, $T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

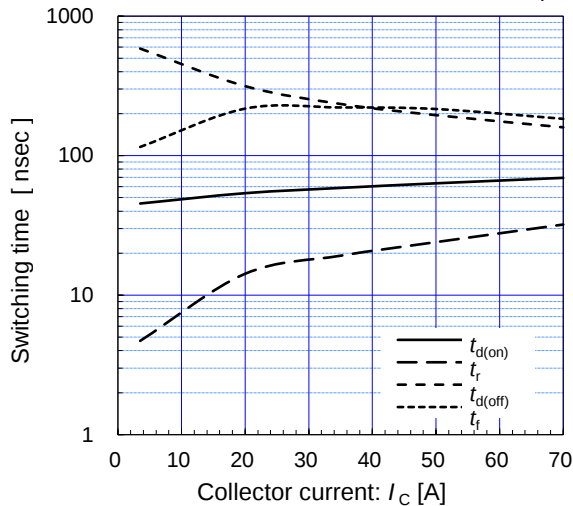
$V_{CC}=600V$, $I_C=35A$, $V_{GE}=+15/-15V$, $T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

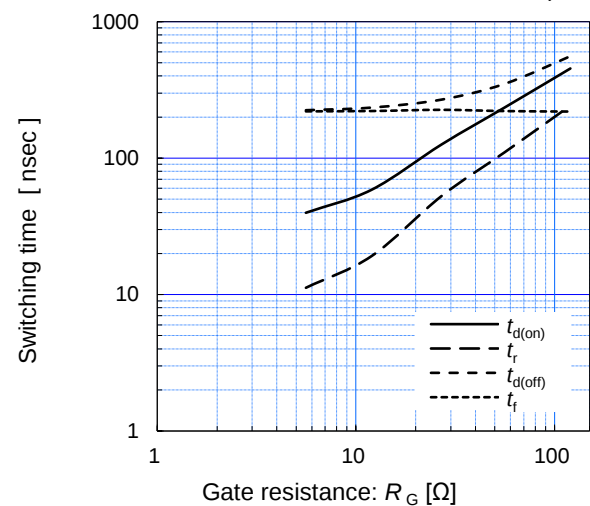
$V_{CC}=600V$, $R_G=12\Omega$ $V_{GE}=+15/-15V$, $T_{vj}=175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

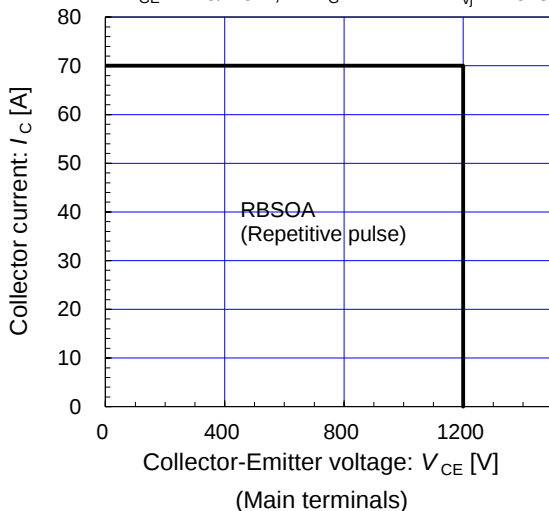
$V_{CC}=600V$, $I_C=35A$, $V_{GE}=+15/-15V$, $T_{vj}=175^\circ C$



[Inverter]

Reverse bias safe operating area (max.)

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

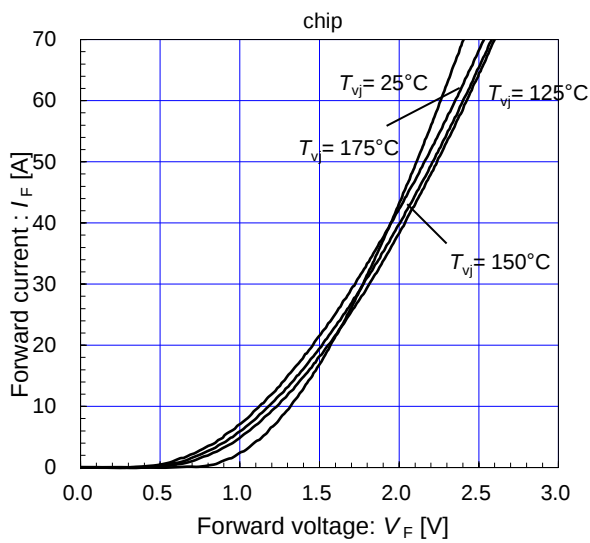


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IGBT Modules

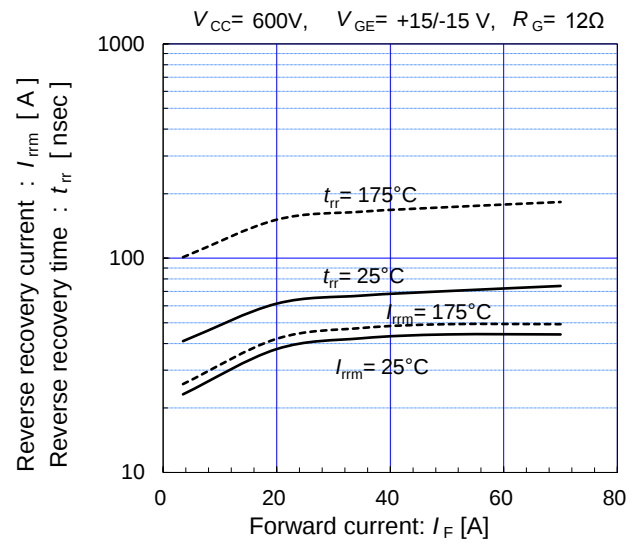
[Inverter]

Forward current vs. Forward voltage (typ.)



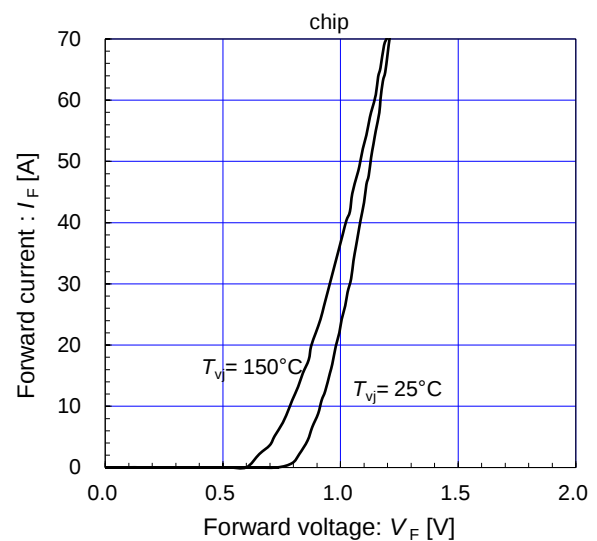
[Inverter]

Reverse recovery characteristics (typ.)

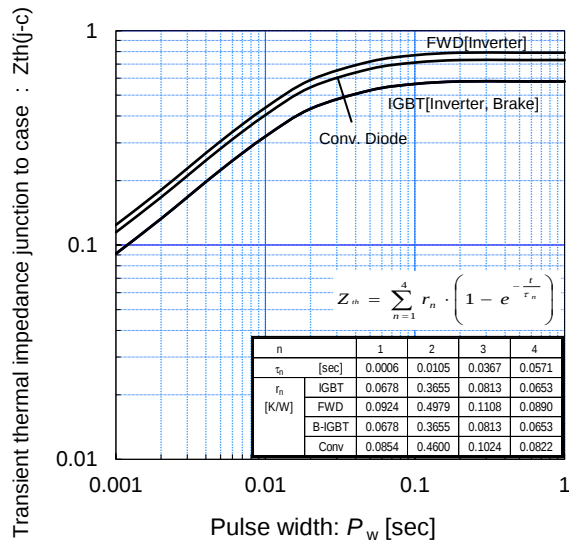


[Converter]

Forward current vs. Forward voltage (typ.)

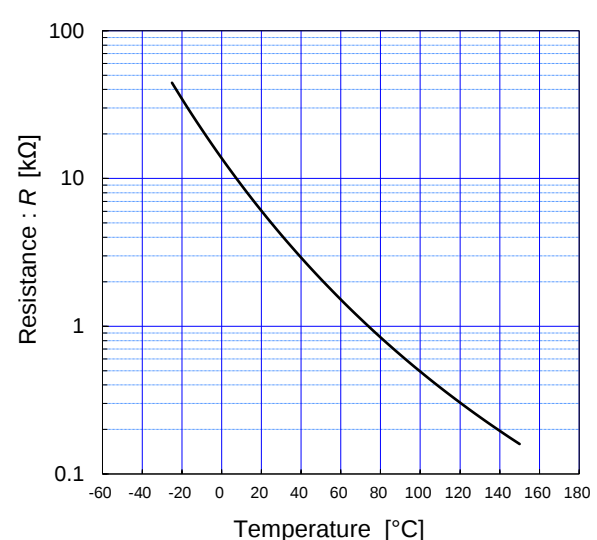


Transient thermal Impedance (max.)



[Thermistor]

Temperature characteristic (typ.)



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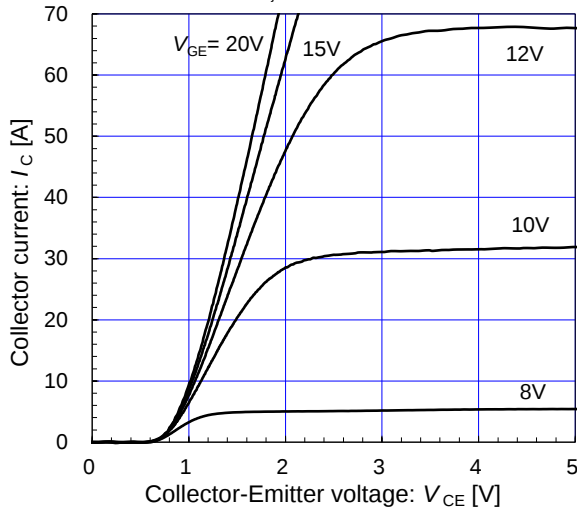
7MBR35XKB120-50

IGBT Modules

[Brake]

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

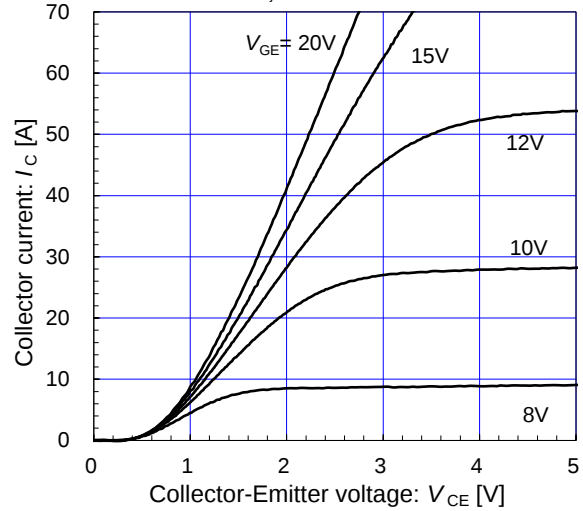
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Brake]

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

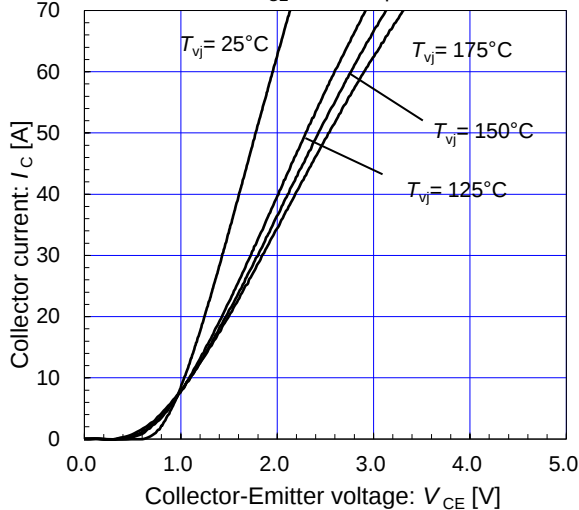
$T_{vj} = 175^{\circ}\text{C}$ / chip



[Brake]

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

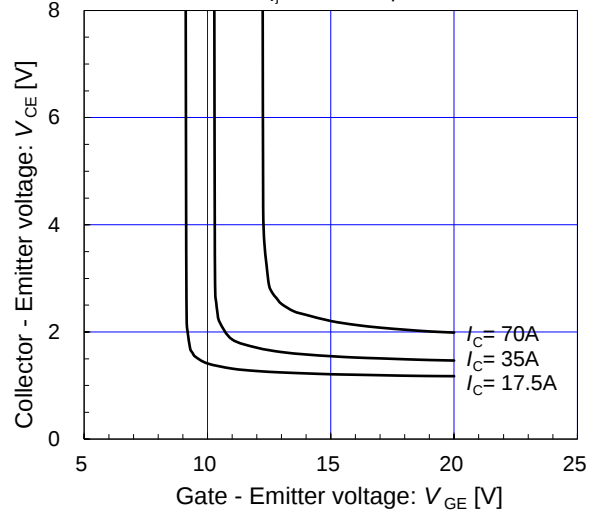
$V_{GE} = 15\text{V}$ / chip



[Brake]

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

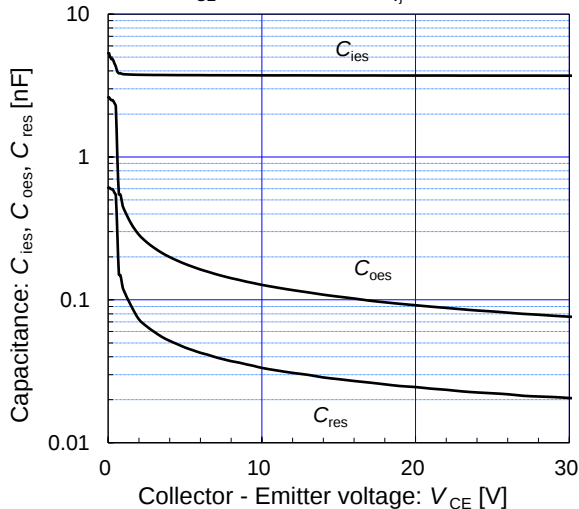
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Brake]

Capacitance vs. Collector-Emittor voltage (typ.)

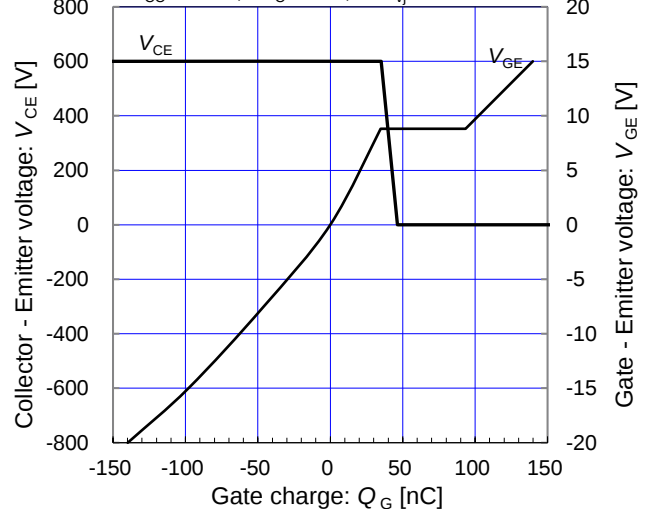
$V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$



[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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