

7MBR50XRKB120-50

IGBT Modules

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

■ Features

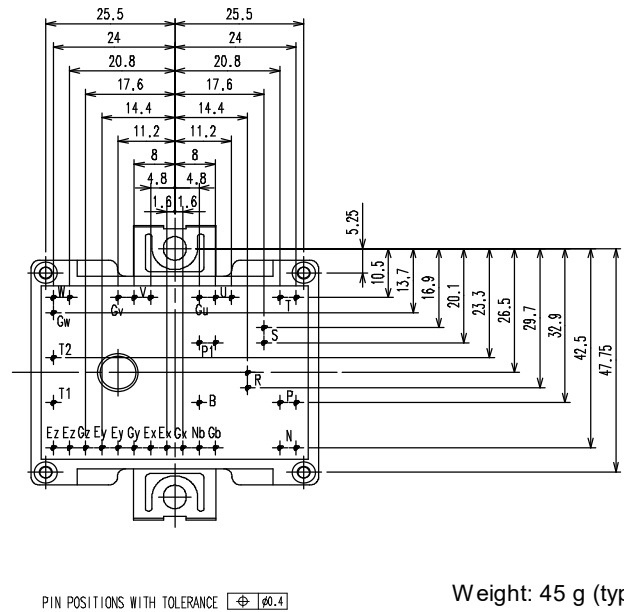
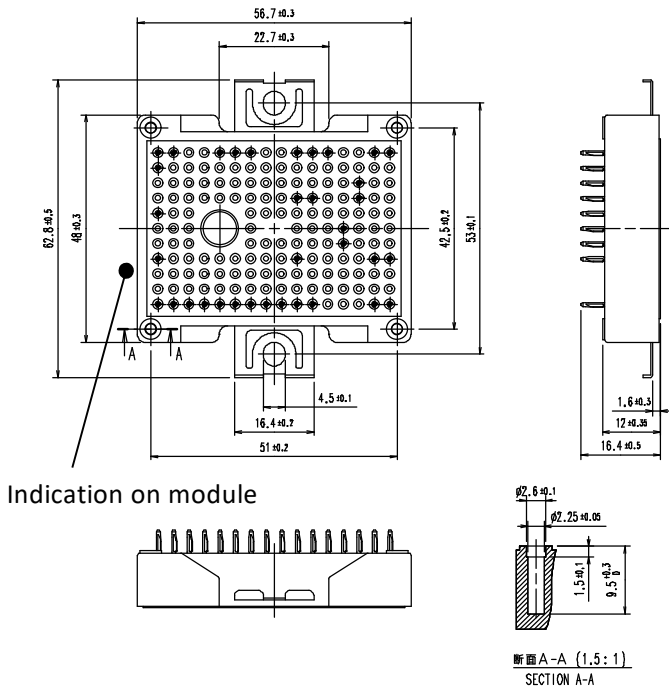
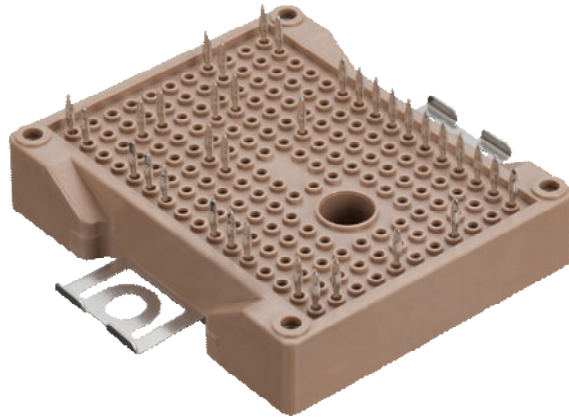
- Low $V_{CE(sat)}$
- Compact Package
- P.C.Board Mount Module
- Converter Diode Bridge Dynamic Brake Circuit
- RoHS compliant Product

■ Applications

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

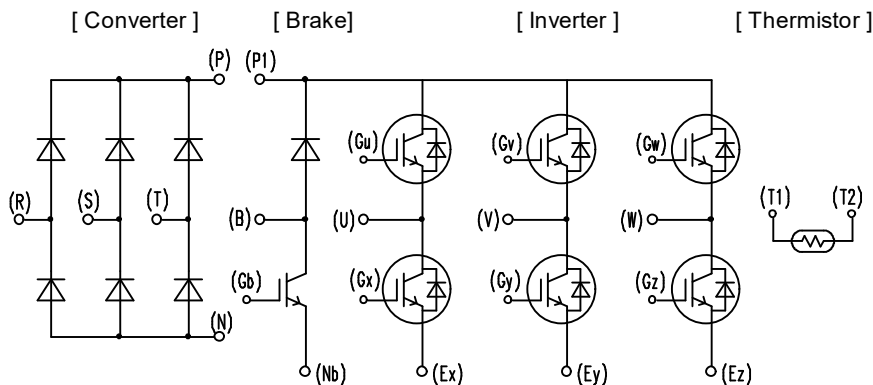
■ Outline drawing (Unit : mm)

■ Typical appearance



Weight: 45 g (typ.)

■ Equivalent circuit



7MBR50XRKB120-50

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 collector current	I_{CRM}	1ms	100		
	Reverse-conducting current	I_{RC}	Continuous	50		
	Repetitive peak reverse-conducting current	I_{RCRM}	1ms	100		
	Total power dissipation	P_{tot}	1 device	500	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		
Brake FWD	Total power dissipation	P_{tot}	1 device	255	W	
	Forward current	I_F	Continuous	10	A	
	Repetitive peak forward current	I_{FRM}	1ms	20		
Converter	Repetitive peak reverse voltage	V_{RRM}		1200	V	
	Repetitive peak reverse voltage	V_{RRM}		1600	V	
Converter	Average output current	I_O	Three-phase full wave rectified current $T_c=80^\circ\text{C}$	50	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)	V_{isol}	A.C. : 1min.	2500	Vrms	
	between thermistor and others (*3)					
Mounting torque for screws to heatsink		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.

7MBR50XRKB120-50

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)	$V_{GE} = 15\text{V}$ $I_C = 50\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	2.15	2.60	V
			$T_{vj}=25^{\circ}\text{C}$	-	1.80	2.25	
	$T_{vj}=125^{\circ}\text{C}$	-	2.25	-			
	$T_{vj}=150^{\circ}\text{C}$	-	2.30	-			
	$V_{CE(sat)}$ (chip)		$T_{vj}=175^{\circ}\text{C}$	-	2.45	-	
Internal gate resistance	r_g	-	-	0	-	Ω	
Input capacitance	C_{ies}	$V_{CE} = 10\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	5.7	-	nF	
Output capacitance	C_{oes}		-	0.26	-		
Reverse transfer capacitance	C_{res}		-	0.06	-		
Gate charge	Q_G		$V_{CC} = 600\text{V}$ $V_{GE} = -15 \rightarrow +15\text{V}$ $I_C = 50\text{A}$	-	420		-
Reverse-conducting voltage	$V_{RC(terminal)}$	$I_{RC} = 50\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	2.20	2.65	V
			$T_{vj}=25^{\circ}\text{C}$	-	1.85	2.30	
	V_{RC} (chip)		$T_{vj}=125^{\circ}\text{C}$	-	2.15	-	
			$T_{vj}=150^{\circ}\text{C}$	-	2.15	-	
			$T_{vj}=175^{\circ}\text{C}$	-	2.10	-	
Turn-on delay time(*1)	$t_{d(on)}$	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.07	-	μs
			$T_{vj}=125^{\circ}\text{C}$	-	0.07	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.07	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.07	-	
Rise time	t_r	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.03	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.04	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.04	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.04	-	
Turn-off delay time(*2)	$t_{d(off)}$	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.17	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.20	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.21	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.22	-	
Fall time	t_f	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.05	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.10	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.12	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.14	-	
Forward recovery time	t_{fr}	$V_{CC} = 600\text{V}$ $I_C, I_{RC} = 50\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 10\ \Omega$	$T_{vj}=25^{\circ}\text{C}$	-	0.14	-	
			$T_{vj}=125^{\circ}\text{C}$	-	0.20	-	
			$T_{vj}=150^{\circ}\text{C}$	-	0.21	-	
			$T_{vj}=175^{\circ}\text{C}$	-	0.23	-	

 (*1) Turn on time (t_{on}) = $t_{d(on)} + t_r$,

 (*2) Turn off time (t_{off}) = $t_{d(off)} + t_f$

7MBR50XRKB120-50

Items	Symbols	Conditions	Characteristics			Units		
			min.	typ.	max.			
Inverter	Turn-on energy (per pulse)	$V_{CC} = 600V$ $I_C, I_{RC} = 50A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 10 \Omega$	$T_{vj} = 25^\circ C$	-	4.29	-	mJ	
			$T_{vj} = 125^\circ C$	-	5.98	-		
			$T_{vj} = 150^\circ C$	-	6.54	-		
			$T_{vj} = 175^\circ C$	-	7.06	-		
	Turn-off energy (per pulse)	$V_{CC} = 600V$ $I_C, I_{RC} = 50A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 10 \Omega$	$T_{vj} = 25^\circ C$	-	1.91	-		
			$T_{vj} = 125^\circ C$	-	2.70	-		
			$T_{vj} = 150^\circ C$	-	2.95	-		
			$T_{vj} = 175^\circ C$	-	3.20	-		
	Forward recovery energy (per pulse)	$V_{CC} = 600V$ $I_C, I_{RC} = 50A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 10 \Omega$	$T_{vj} = 25^\circ C$	-	1.66	-		
			$T_{vj} = 125^\circ C$	-	2.95	-		
			$T_{vj} = 150^\circ C$	-	3.24	-		
			$T_{vj} = 175^\circ C$	-	3.50	-		
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		
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	
			-	-	0	-		
Brake	Turn-on delay time(*1)	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12 \Omega$	$T_{vj} = 25^\circ C$	-	0.04	-	μs	
			$T_{vj} = 125^\circ C$	-	0.04	-		
			$T_{vj} = 150^\circ C$	-	0.04	-		
			$T_{vj} = 175^\circ C$	-	0.04	-		
	Rise time	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12 \Omega$	$T_{vj} = 25^\circ C$	-	0.02	-		
			$T_{vj} = 125^\circ C$	-	0.02	-		
			$T_{vj} = 150^\circ C$	-	0.02	-		
			$T_{vj} = 175^\circ C$	-	0.02	-		
	Turn-off delay time(*2)	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12 \Omega$	$T_{vj} = 25^\circ C$	-	0.20	-		
			$T_{vj} = 125^\circ C$	-	0.23	-		
			$T_{vj} = 150^\circ C$	-	0.23	-		
			$T_{vj} = 175^\circ C$	-	0.23	-		
Fall time	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 12 \Omega$	$T_{vj} = 25^\circ C$	-	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_R	$V_R = 1200V$	-	-	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	-		
Converter	Reverse current	$V_R = 1600V$	-	-	50	μA		
			-	-	50	μA		
	Continuous(direct)forward voltage		V_F	terminal	-	1.45	1.90	V
				chip	-	1.10	1.55	
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}) = $t_{d(on)} + t_r$ (*2) Turn off time (t_{off}) = $t_{d(off)} + t_f$

7MBR50XRKB120-50

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 RC-IGBT	-	-	0.30	K/W
		Brake IGBT	-	-	0.58	
		Brake FWD	-	-	1.75	
		Converter Diode	-	-	0.73	
Thermal resistance case to heat sink(*1) (1device)	$R_{th(c-s)}$	Inverter RC-IGBT	-	0.55	-	
		Brake IGBT	-	0.61	-	
		Brake FWD	-	0.71	-	
		Converter Diode	-	0.68	-	

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

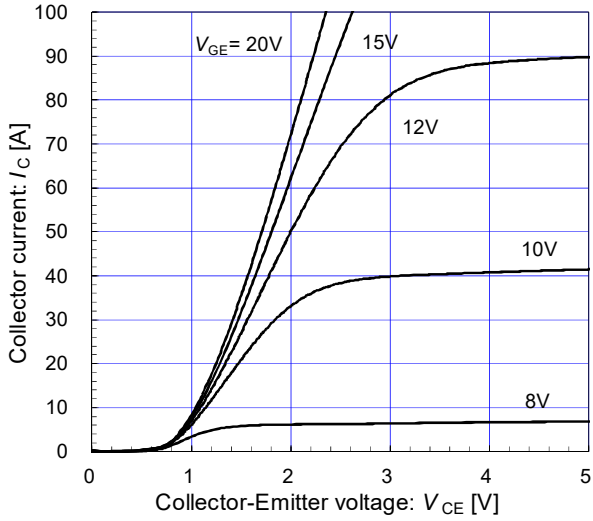
7MBR50XRKB120-50

IGBT Modules

[Inverter]

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

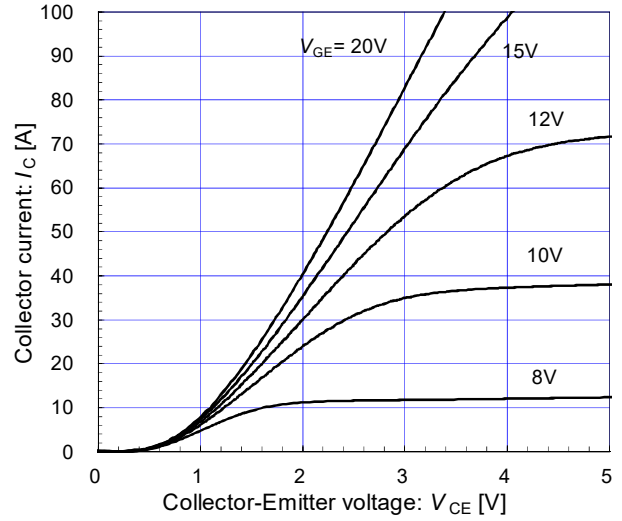
$T_{vj} = 25^\circ\text{C}$ / chip



[Inverter]

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

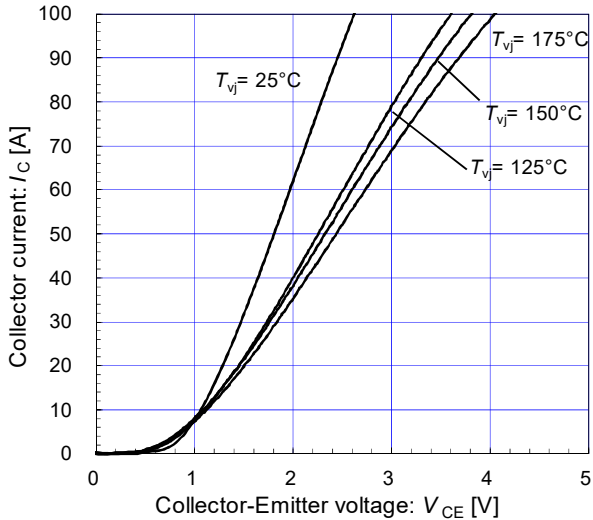
$T_{vj} = 175^\circ\text{C}$ / chip



[Inverter]

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

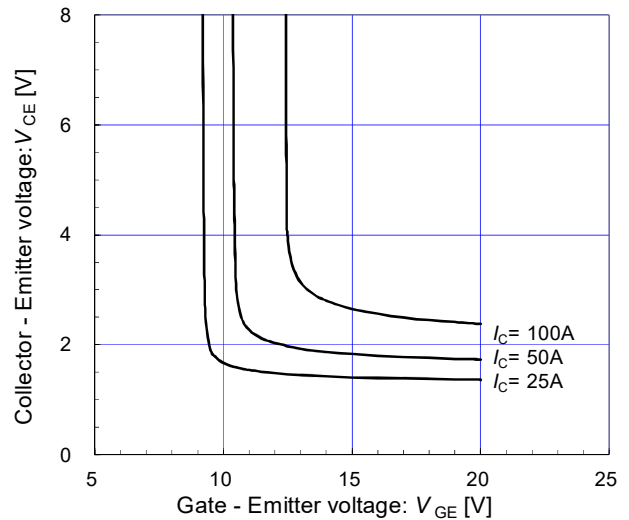
$V_{GE} = 15\text{V}$ / chip



[Inverter]

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

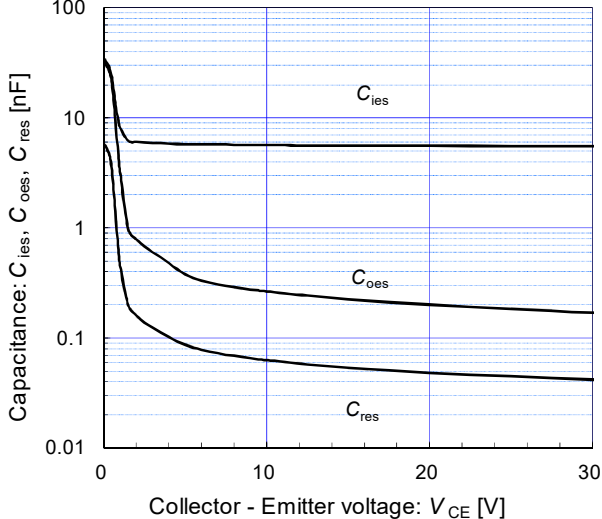
$T_{vj} = 25^\circ\text{C}$ / chip



[Inverter]

Capacitance vs. Collector-Emittor voltage (typ.)

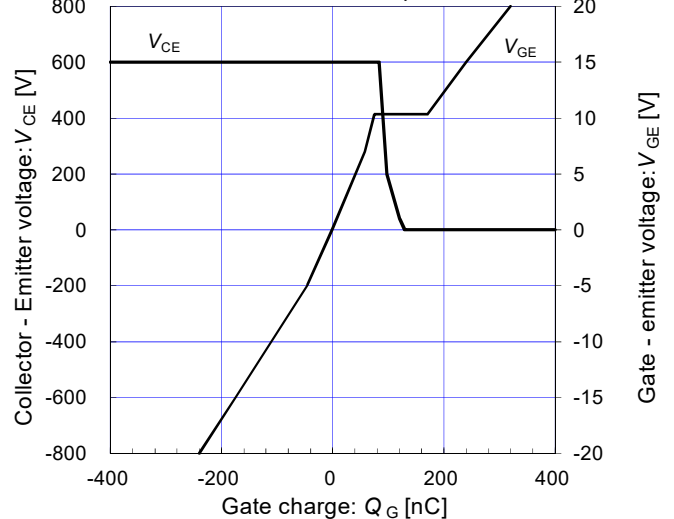
$V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_{vj} = 25^\circ\text{C}$



[Inverter]

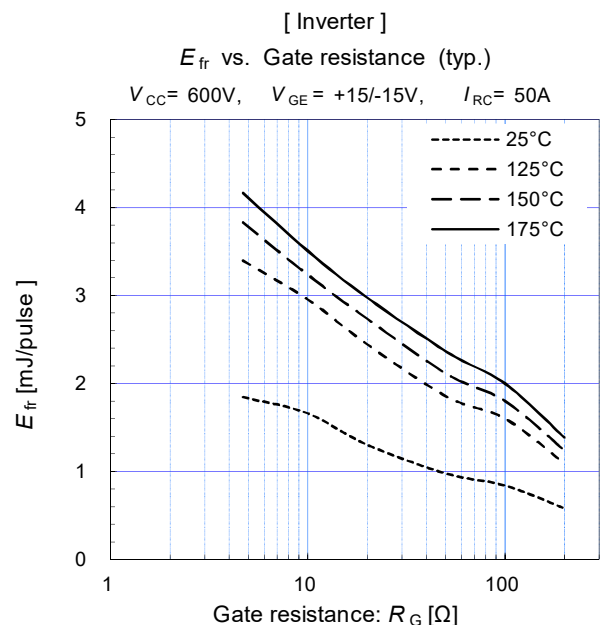
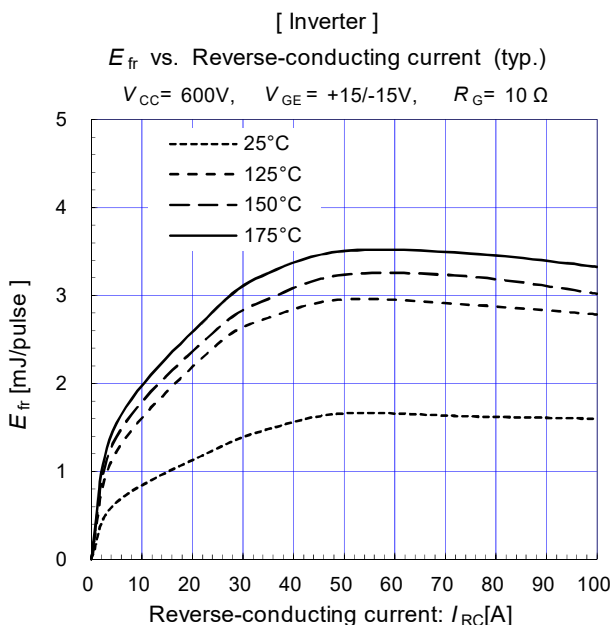
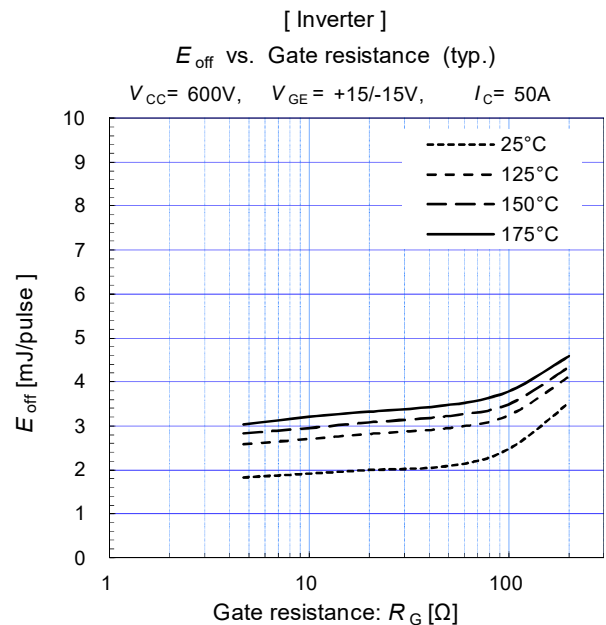
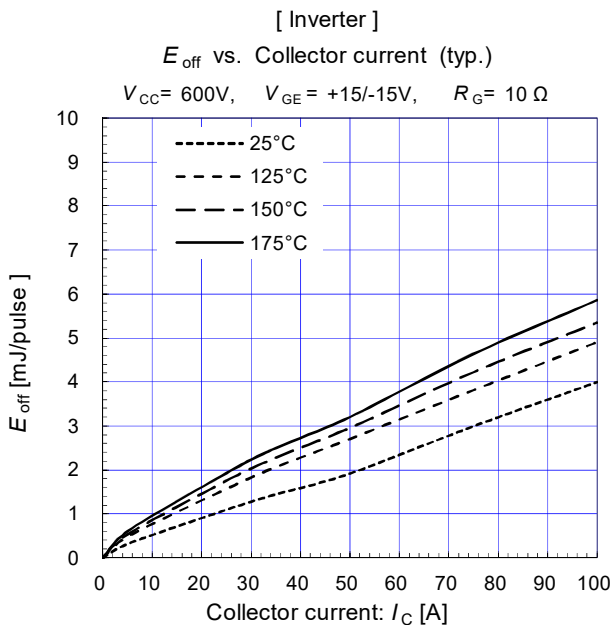
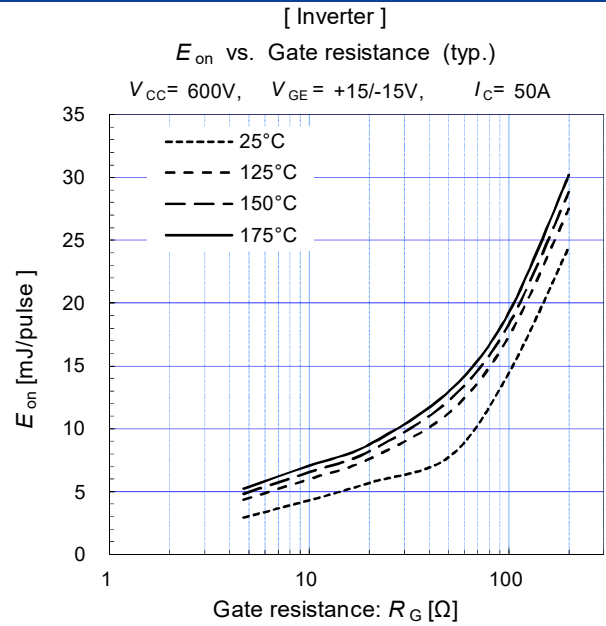
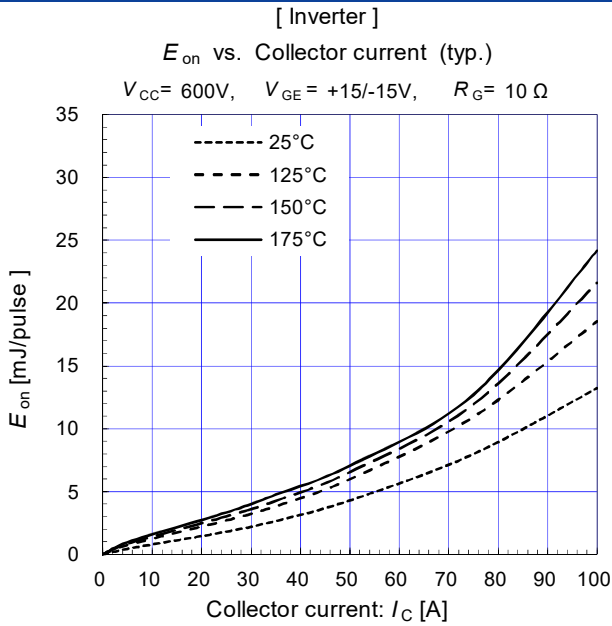
Dynamic gate charge (typ.)

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



7MBR50XRKB120-50

IGBT Modules



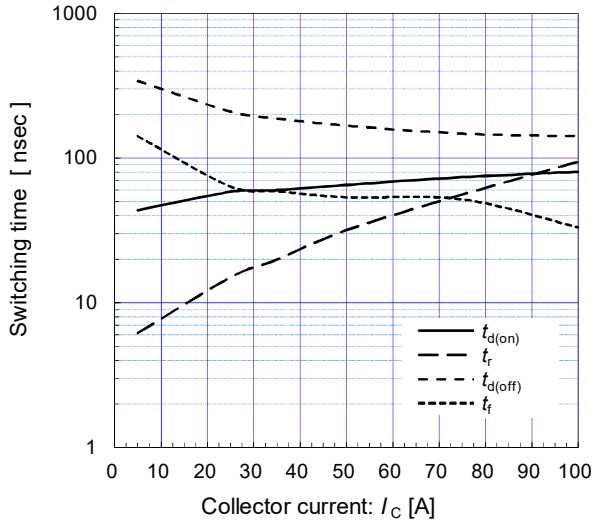
7MBR50XRKB120-50

IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

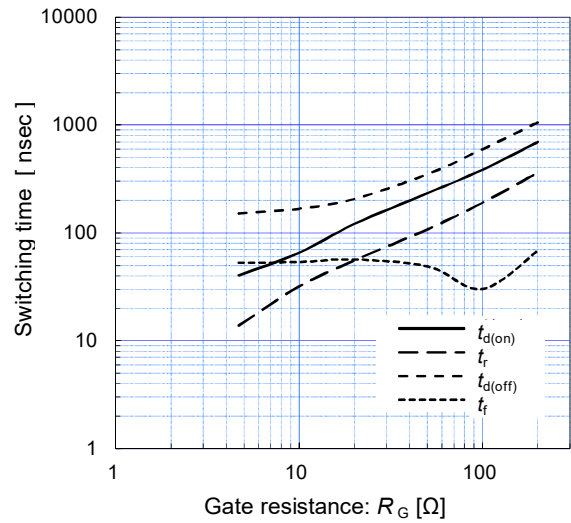
$V_{CC}=600V, R_G=10\Omega, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

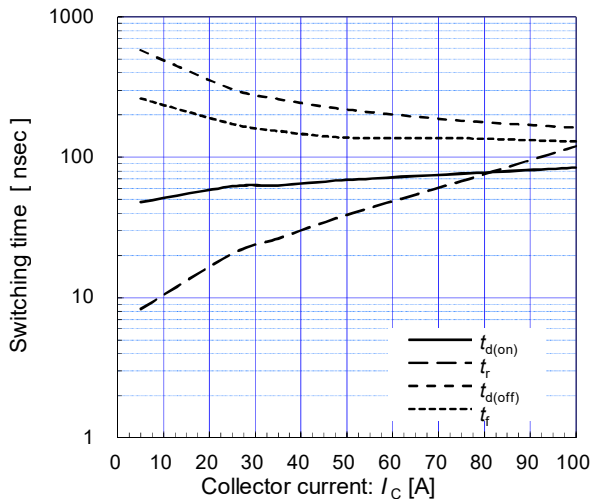
$V_{CC}=600V, I_C=50A, V_{GE}=+15/-15V, T_{vj}=25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

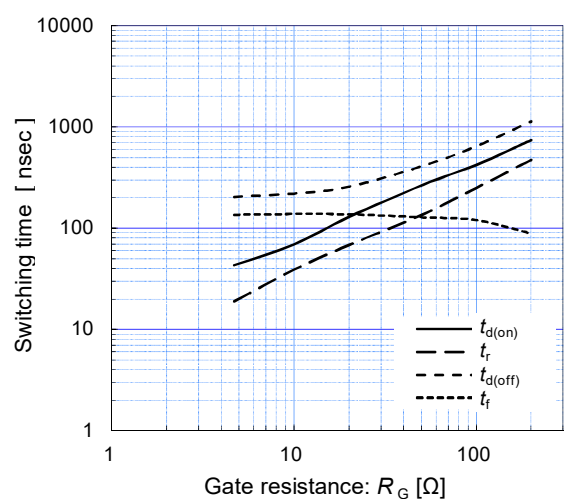
$V_{CC}=600V, R_G=10\Omega, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

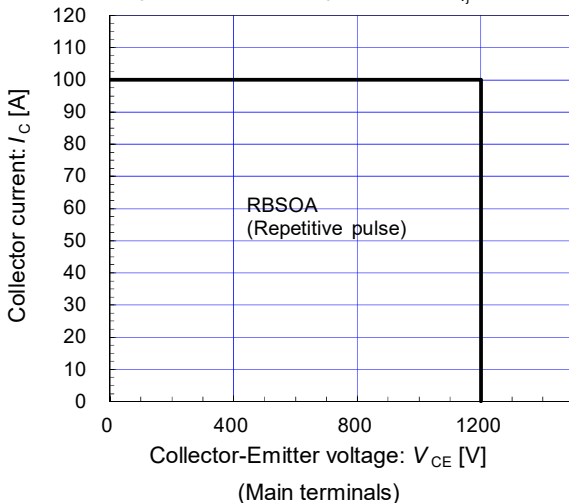
$V_{CC}=600V, I_C=50A, V_{GE}=+15/-15V, T_{vj}=175^\circ C$



[Inverter]

Reverse bias safe operating area (max.)

$V_{GE}=+15/-15V, R_G \geq 10\Omega, T_{vj}=175^\circ C$

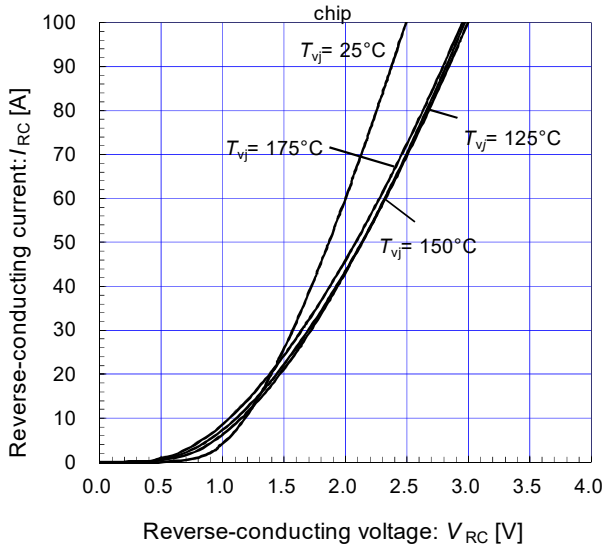


7MBR50XRKB120-50

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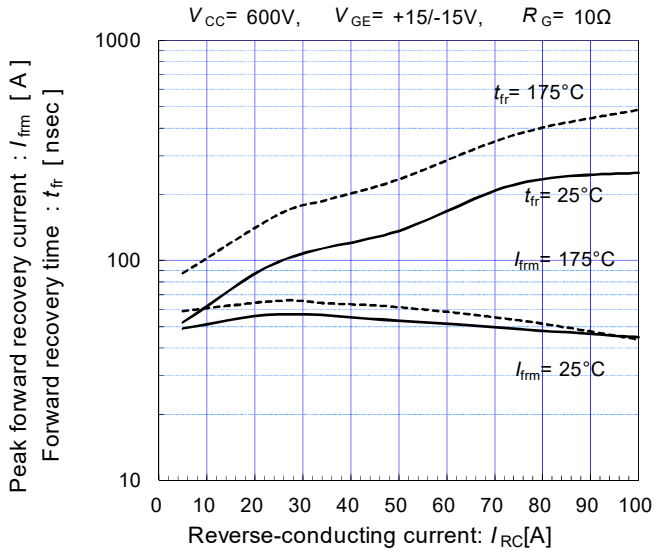
[Inverter]

Reverse-conducting current vs. Reverse-conducting voltage (typ.)



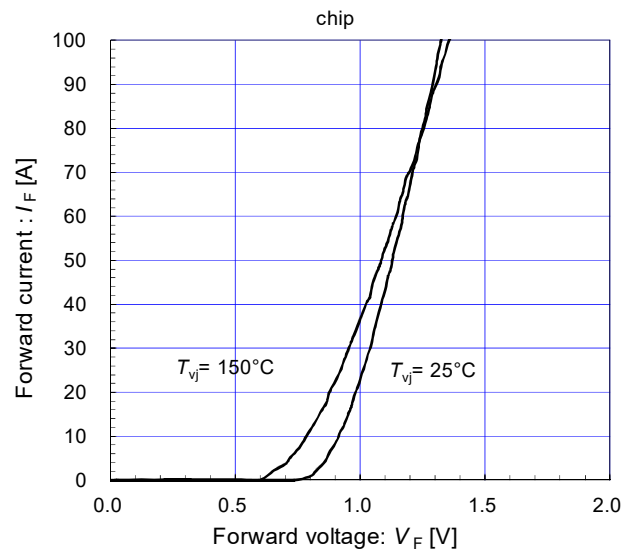
[Inverter]

Forward recovery characteristics (typ.)

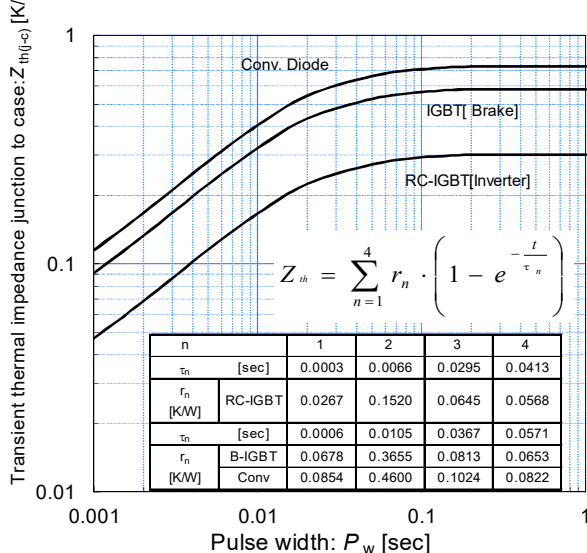


[Converter]

Forward current vs. Forward voltage (typ.)

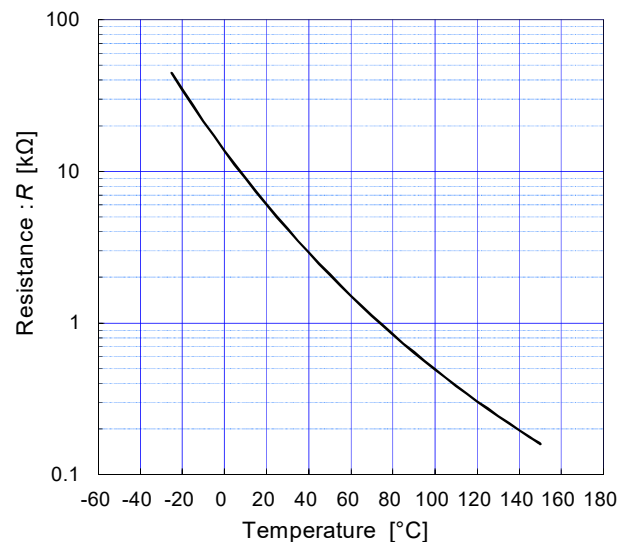


Transient thermal impedance (max.)



[Thermistor]

Temperature characteristic (typ.)

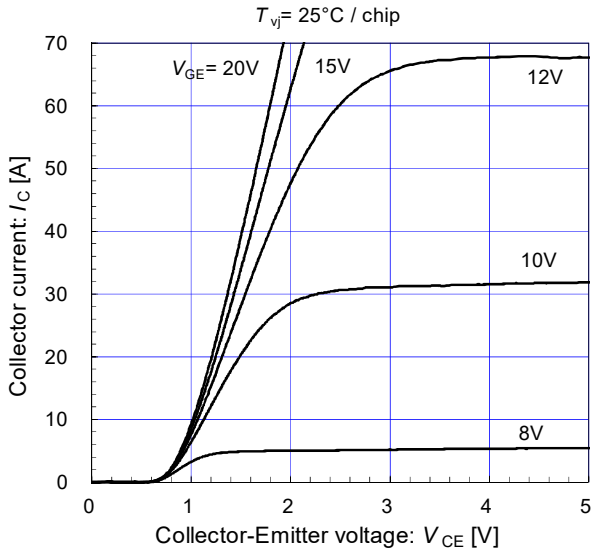


7MBR50XRKB120-50

IGBT Modules

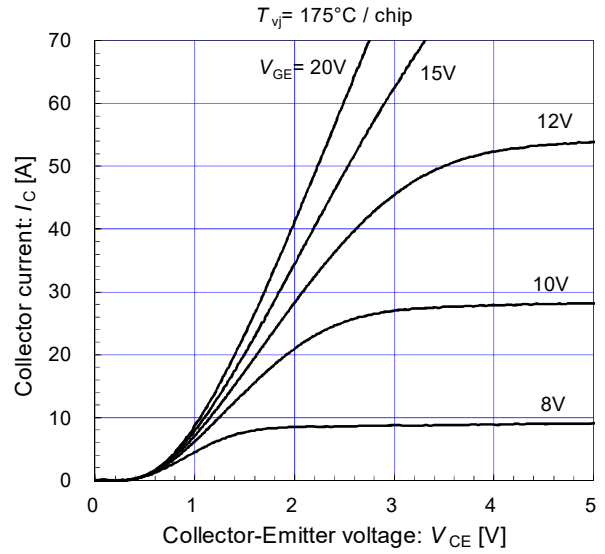
[Brake]

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



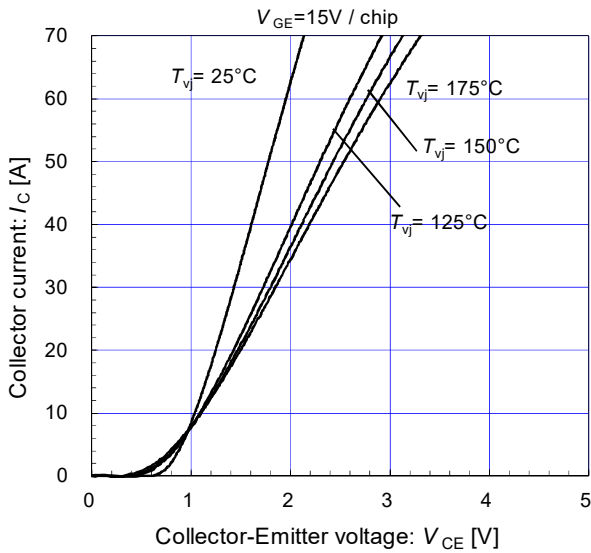
[Brake]

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



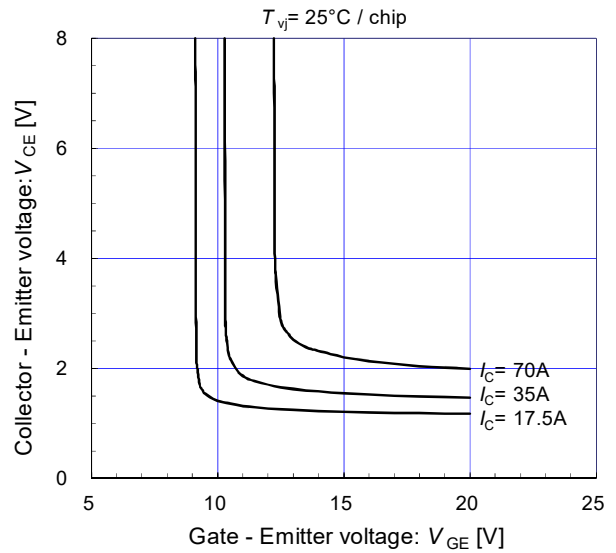
[Brake]

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



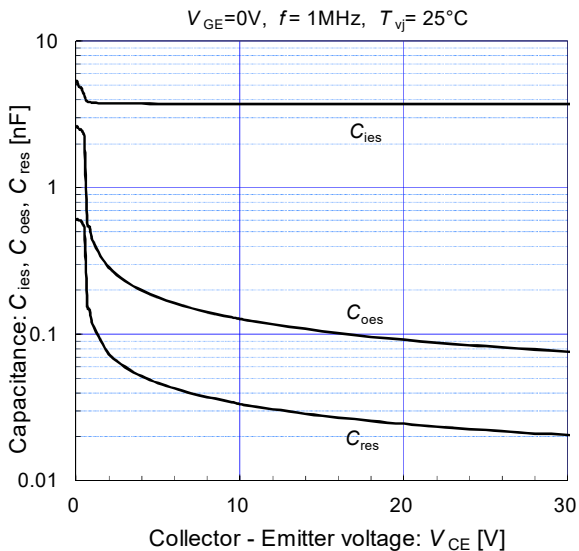
[Brake]

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



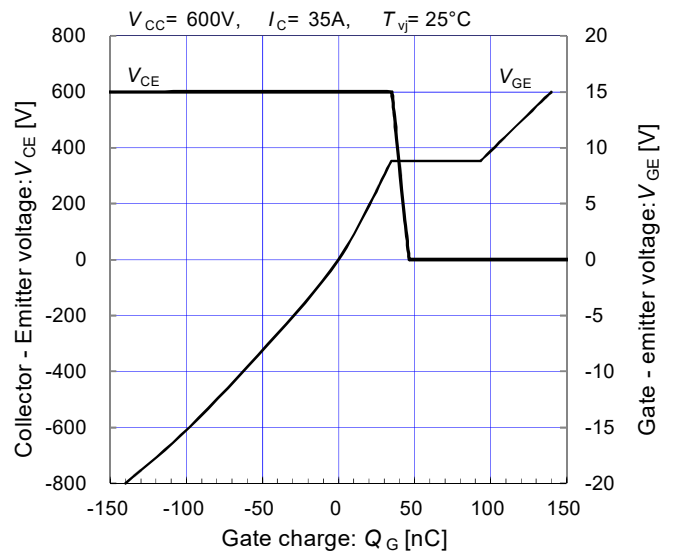
[Brake]

Capacitance vs. Collector-Emittor voltage (typ.)



[Brake]

Dynamic gate charge (typ.)



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