

7MBR50XPA120-50

IGBT Modules

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

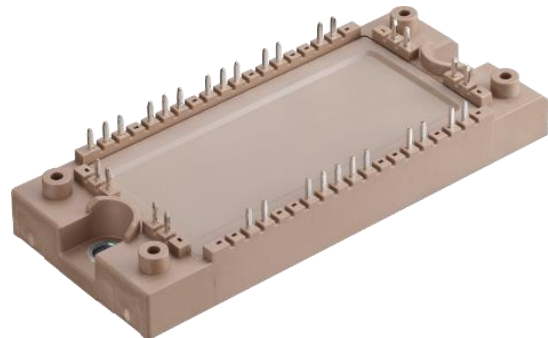
■ Features

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

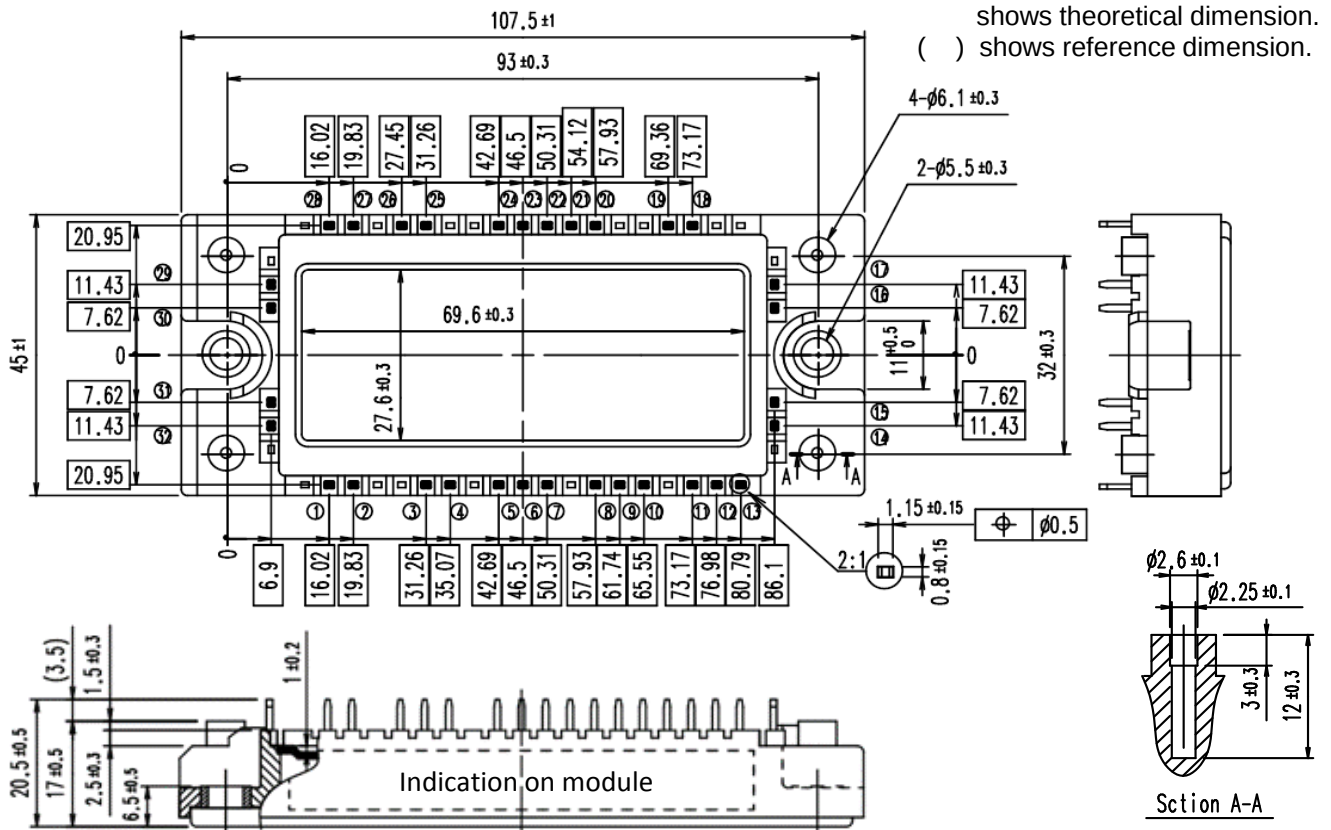
■ Applications

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

■ Typical appearance

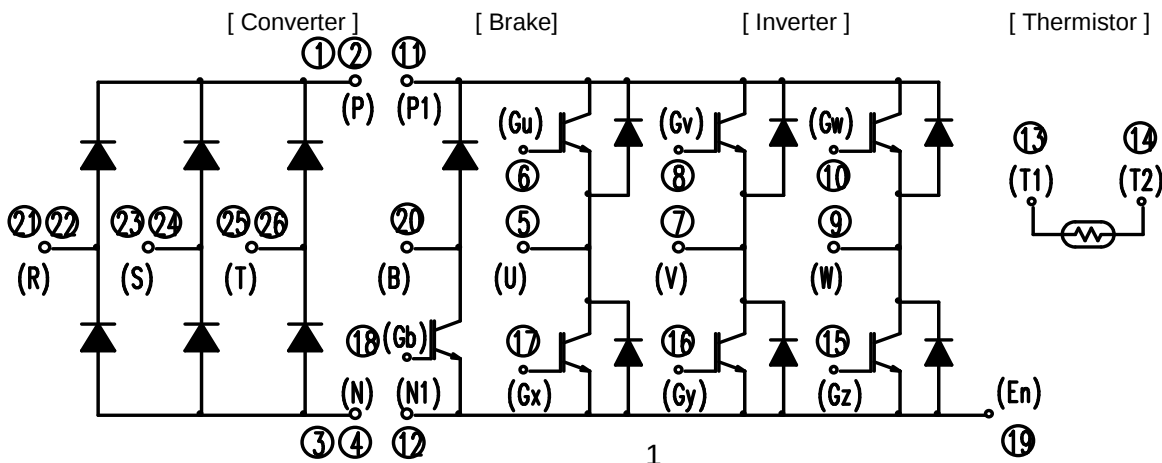


■ Outline drawing (Unit : mm)



Weight: 200 g (typ.)

■ Equivalent circuit



7MBR50XPA120-50

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

Items			Symbols	Conditions		Maximum ratings	Units
Inverter	Collector-Emitter voltage		V_{CES}			1200	V
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current		I_C	Continuous	$T_c=100^{\circ}\text{C}$	50	A
			I_C pulse	1ms		100	
	Forward current		I_F	Continuous		50	
			I_F pulse	1ms		100	
Collector power dissipation		P_C	1 device		250	W	
Brake IGBT	Collector-Emitter voltage		V_{CES}			1200	V
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current		I_C	Continuous	$T_c=100^{\circ}\text{C}$	35	A
			I_C pulse	1ms		70	
	Collector power dissipation		P_C	1 device		200	W
Brake FWD	Forward current		I_F	Continuous		15	A
			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 current (Non-Repetitive) (*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 ² s	
$T_{vj}=150^{\circ}\text{C}$			1350				
Junction temperature		T_{vj}	Inverter, Brake		175	°C	
			Converter		150		
Operating 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_{iso}	A.C. : 1min.		2500	Vrms	
	between thermistor and others (*3)						
Screw torque (*4)	Mounting	-	M5		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.

(*4) Recommendable value : Mounting 2.5 ~ 6.0 N·m (M5)

7MBR50XPA120-50

IGBT Modules
■ Electrical characteristics (at $T_{vj} = 25^{\circ}\text{C}$ unless otherwise specified)

Items		Symbols	Conditions		Characteristics			Units
					min.	typ.	max.	
Inverter	Zero Gate voltage collector current	I_{CES}	$V_{\text{GE}} = 0\text{V}$ $V_{\text{CE}} = 1200\text{V}$		-	-	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	$V_{\text{GE(th)}}$	$V_{\text{CE}} = 20\text{V}$ $I_{\text{C}} = 50\text{mA}$		6.0	6.5	7.0	V
	Collector-Emitter saturation voltage	$V_{\text{CE(sat)}}$ (terminal)	$V_{\text{GE}} = 15\text{V}$ $I_{\text{C}} = 50\text{A}$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	1.70	2.20	V
		$V_{\text{CE(sat)}}$ (chip)		$T_{\text{vj}}=25^{\circ}\text{C}$	-	1.50	1.95	
				$T_{\text{vj}}=125^{\circ}\text{C}$	-	1.85	-	
				$T_{\text{vj}}=150^{\circ}\text{C}$	-	1.95	-	
				$T_{\text{vj}}=175^{\circ}\text{C}$	-	2.00	-	
	Internal Gate resistance	r_{g}	-		-	0	-	Ω
	Capacitance	C_{ies}	$V_{\text{CE}} = 10\text{V}, V_{\text{GE}}=0\text{V}, f = 1\text{MHz}$		-	TBD	-	nF
		C_{oes}			-	TBD	-	
		C_{res}			-	TBD	-	
	Gate charge	Q_{G}	$V_{\text{CC}} = 600\text{V}$ $V_{\text{GE}}=-15 \rightarrow +15\text{V}$ $I_{\text{C}} = 50\text{A}$		-	340	-	nC
	Forward voltage	V_{F} (terminal)	$I_{\text{F}} = 50\text{A}$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	2.00	2.50	V
		V_{F} (chip)		$T_{\text{vj}}=25^{\circ}\text{C}$	-	1.80	2.25	
				$T_{\text{vj}}=125^{\circ}\text{C}$	-	1.85	-	
$T_{\text{vj}}=150^{\circ}\text{C}$				-	1.80	-		
$T_{\text{vj}}=175^{\circ}\text{C}$				-	1.75	-		
Switching time (*1)	$t_{\text{d(on)}}$	$V_{\text{CC}} = 600\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	TBD	-	μs	
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	TBD	-		
	t_{r}	$V_{\text{CC}} = 600\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	TBD	-		
	$t_{\text{d(off)}}$	$V_{\text{CC}} = 600\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	TBD	-		
	t_{f}	$V_{\text{CC}} = 600\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	TBD	-		
Reverse recovery time	t_{rr}	$V_{\text{CC}} = 600\text{V}$ $I_{\text{C}}, I_{\text{F}} = 50\text{A}$ $L_{\text{s}} = 30\text{nH}$ $V_{\text{GE}} = +15/-15\text{ V}$ $R_{\text{G}} = 18\ \Omega$	$T_{\text{vj}}=25^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=125^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=150^{\circ}\text{C}$	-	TBD	-		
			$T_{\text{vj}}=175^{\circ}\text{C}$	-	TBD	-		

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

7MBR50XPA120-50

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Items		Symbols	Conditions		Characteristics			Units
					min.	typ.	max.	
Inverter	Switching loss (per pulse)	E_{on}	$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	TBD	-	mJ
			$I_C,I_F = 50A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	TBD	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	TBD	-	
			$R_G = 18 \Omega$	$T_{vj}=175^{\circ}C$	-	TBD	-	
		E_{off}	$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	TBD	-	
			$I_C,I_F = 50A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	TBD	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	TBD	-	
			$R_G = 18 \Omega$	$T_{vj}=175^{\circ}C$	-	TBD	-	
		E_{rr}	$V_{CC} = 600V$	$T_{vj}=25^{\circ}C$	-	TBD	-	
			$I_C,I_F = 50A \quad L_s = 30nH$	$T_{vj}=125^{\circ}C$	-	TBD	-	
			$V_{GE} = +15/-15 V$	$T_{vj}=150^{\circ}C$	-	TBD	-	
			$R_G = 18 \Omega$	$T_{vj}=175^{\circ}C$	-	TBD	-	
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	
Brake	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_C = 35A$	$T_{vj}=25^{\circ}C$	-	1.65	2.10	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)	$t_{d(on)}$	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 30 \Omega$	$T_{vj}=25^{\circ}C$	-	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		$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 30 \Omega$	$T_{vj}=25^{\circ}C$	-	0.04	-		
			$T_{vj}=125^{\circ}C$	-	0.05	-		
			$T_{vj}=150^{\circ}C$	-	0.05	-		
			$T_{vj}=175^{\circ}C$	-	0.05	-		
$t_{d(off)}$		$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 30 \Omega$	$T_{vj}=25^{\circ}C$	-	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		$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 30 \Omega$	$T_{vj}=25^{\circ}C$	-	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	
	V_F (chip)	$I_F = 15A$	$T_{vj}=25^{\circ}C$	-	1.80	2.25		
			$T_{vj}=125^{\circ}C$	-	1.85	-		
			$T_{vj}=150^{\circ}C$	-	1.80	-		
			$T_{vj}=175^{\circ}C$	-	1.75	-		
Converter	Reverse current	I_{RRM}	$V_R = 1600V$		-	-	50	μA
Forward voltage	V_{FM}	$I_F = 50A$	terminal	-	1.25	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}) = $t_{d(off)} + t_f$
FM6M01718

7MBR50XPA120-50

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	-	-	0.59	°C/W
		Inverter FWD	-	-	0.71	
		Brake IGBT	-	-	0.74	
		Brake FWD	-	-	1.85	
		Converter Diode	-	-	0.72	
Contact thermal resistance (1 IGBT+1 FWD) (*1)	$R_{th(c-f)}$	with 1 W/(m·K) thermal grease	-	0.05	-	

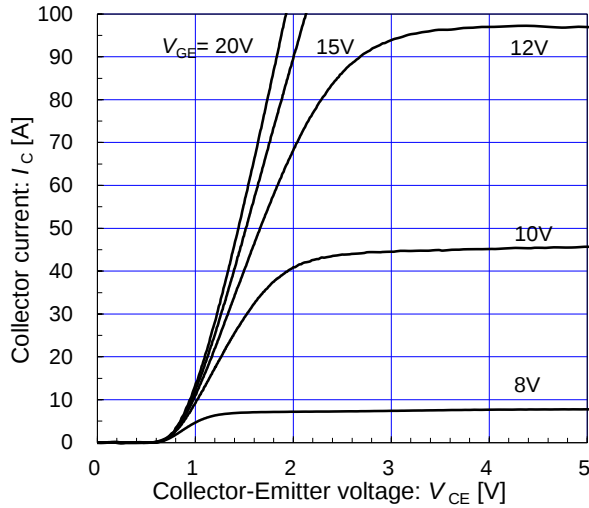
(*1) This is the value which is defined mounting on the additional cooling fin with thermal grease.

7MBR50XPA120-50

IGBT Modules

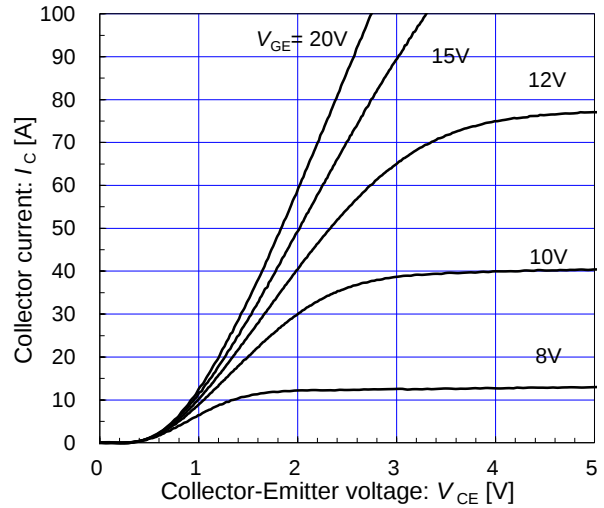
[Inverter]

Collector current vs. Collector-Emittor voltage (typ.)
 $T_{vj} = 25^{\circ}\text{C}$ / chip



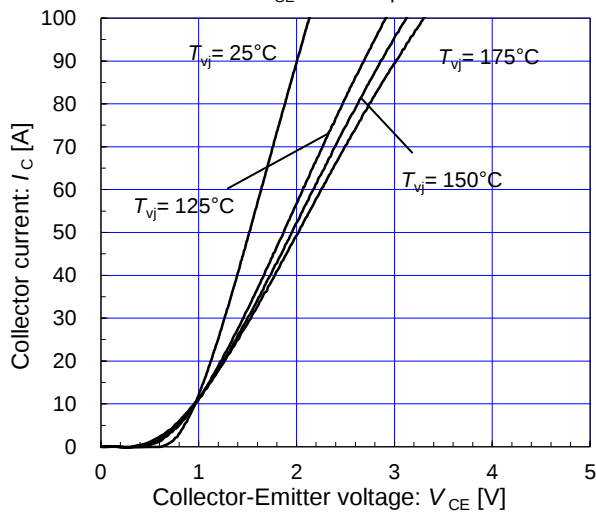
[Inverter]

Collector current vs. Collector-Emittor voltage (typ.)
 $T_{vj} = 175^{\circ}\text{C}$ / chip



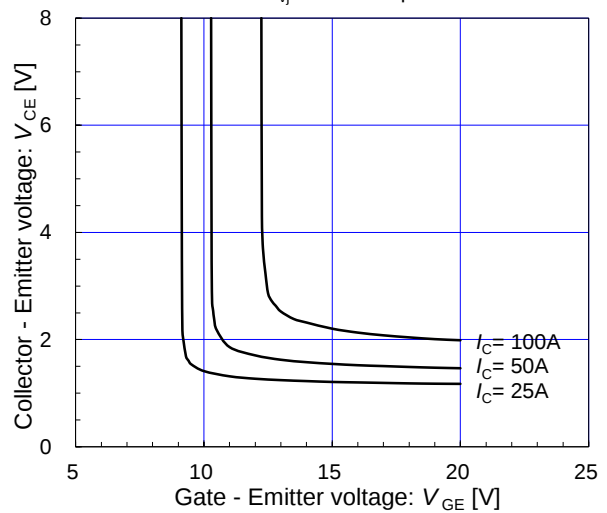
[Inverter]

Collector current vs. Collector-Emittor voltage (typ.)
 $V_{GE} = 15\text{V}$ / chip



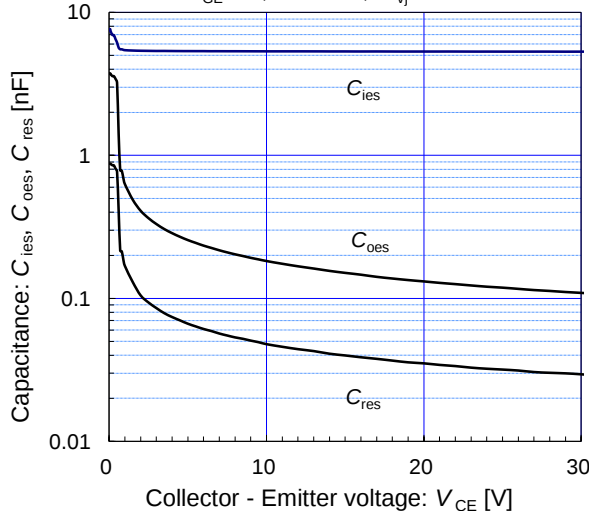
[Inverter]

Collector-Emittor voltage vs. Gate-Emittor voltage (typ.)
 $T_{vj} = 25^{\circ}\text{C}$ / chip



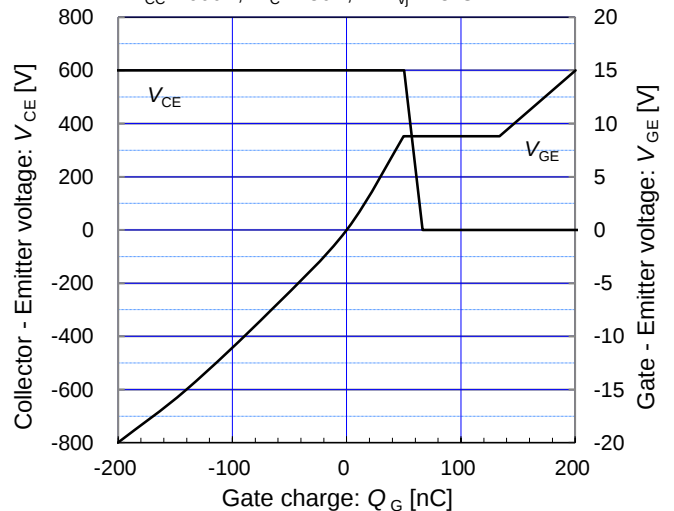
[Inverter]

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



FM6M01718

2017/6

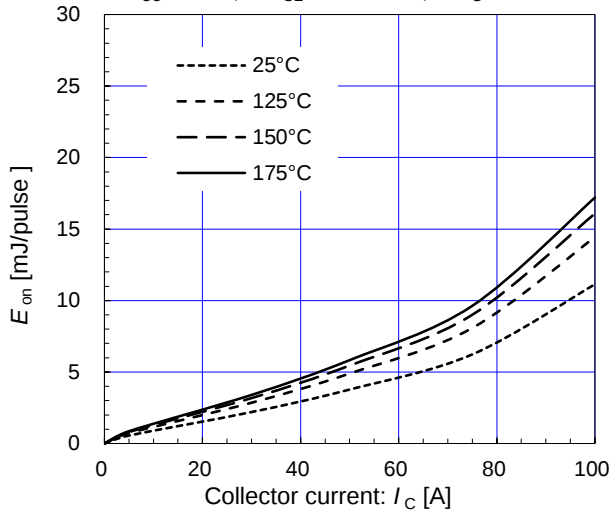
7MBR50XPA120-50

IGBT Modules

[Inverter]

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

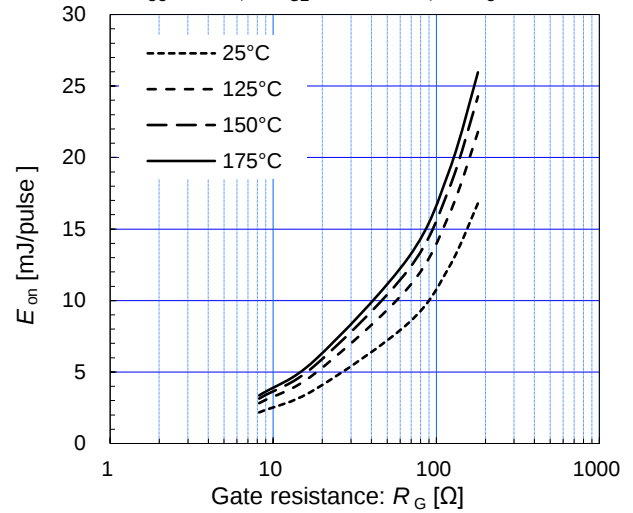
$V_{CC} = 600V$, $V_{GE} = +15/-15V$, $R_G = 18\Omega$



[Inverter]

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

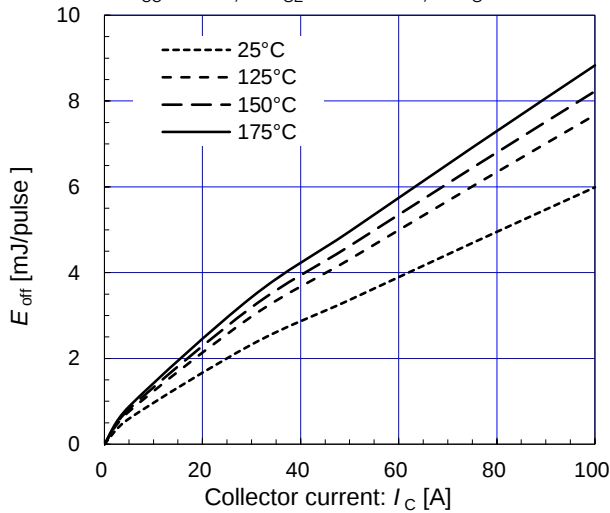
$V_{CC} = 600V$, $V_{GE} = +15/-15V$, $I_C = 50A$



[Inverter]

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

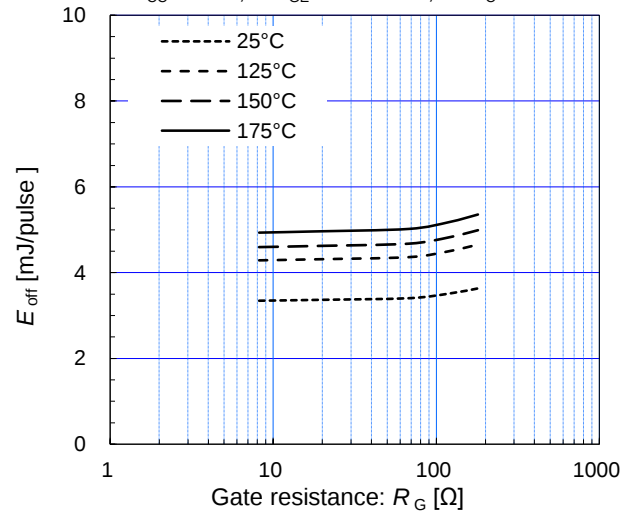
$V_{CC} = 600V$, $V_{GE} = +15/-15V$, $R_G = 18\Omega$



[Inverter]

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

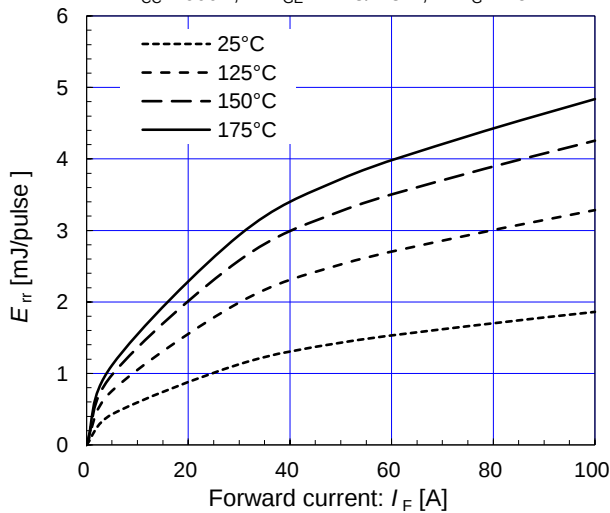
$V_{CC} = 600V$, $V_{GE} = +15/-15V$, $I_C = 50A$



[Inverter]

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

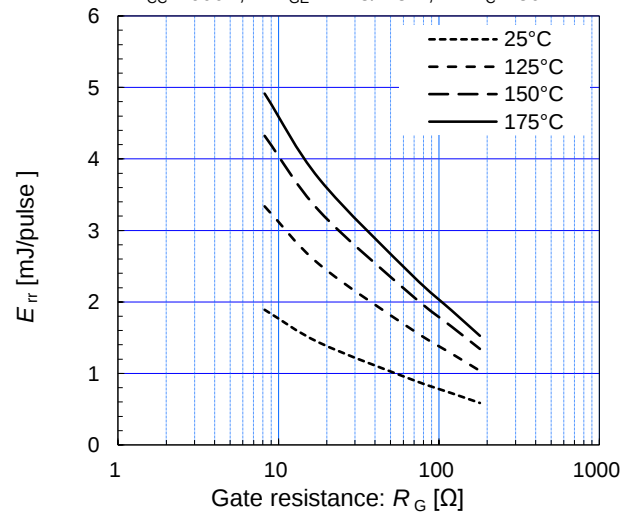
$V_{CC} = 600V$, $V_{GE} = +15/-15V$, $R_G = 18\Omega$



[Inverter]

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

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



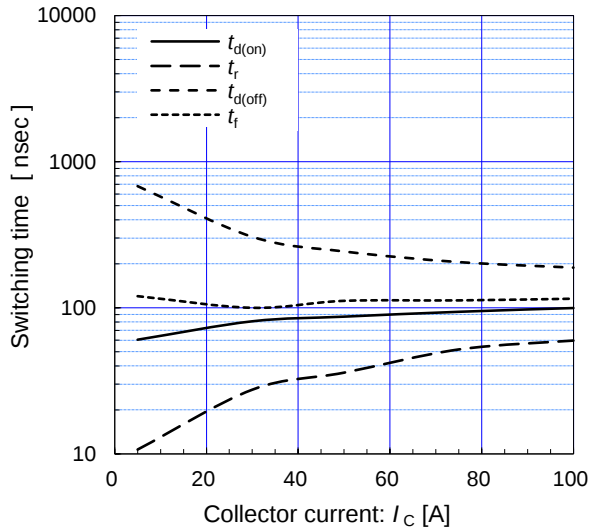
7MBR50XPA120-50

IGBT Modules

[Inverter]

Switching time vs. Collector current (typ.)

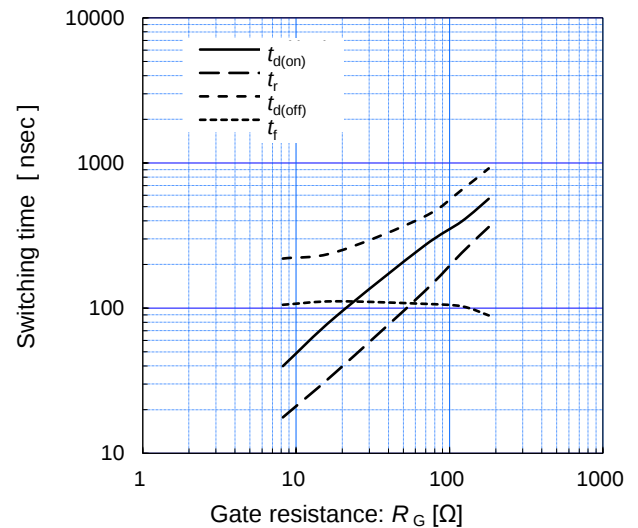
$V_{CC} = 600V$, $R_G = 18\Omega$ $V_{GE} = +15/-15V$, $T_{vj} = 25^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

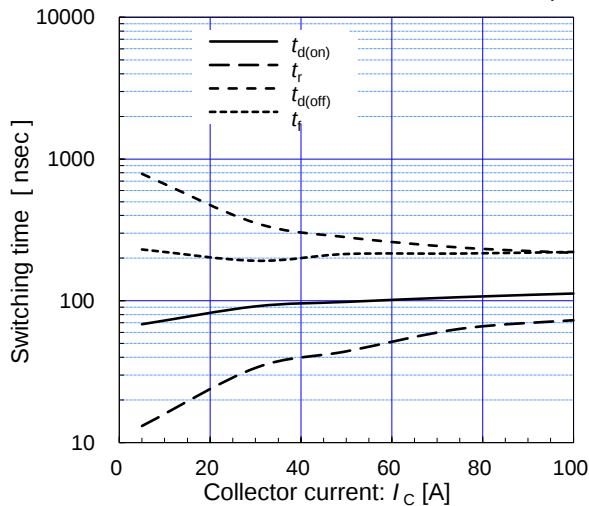
$V_{CC} = 600V$, $I_C = 50A$, $V_{GE} = +15/-15V$, $T_{vj} = 25^\circ C$



[Inverter]

Switching time vs. Collector current (typ.)

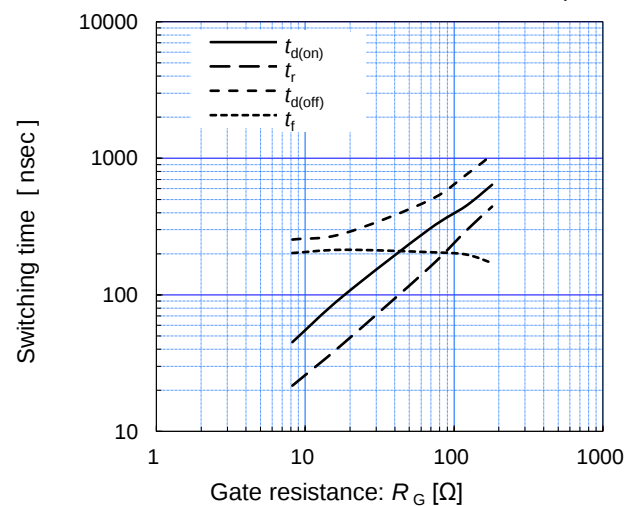
$V_{CC} = 600V$, $R_G = 18\Omega$ $V_{GE} = +15/-15V$, $T_{vj} = 175^\circ C$



[Inverter]

Switching time vs. Gate resistance (typ.)

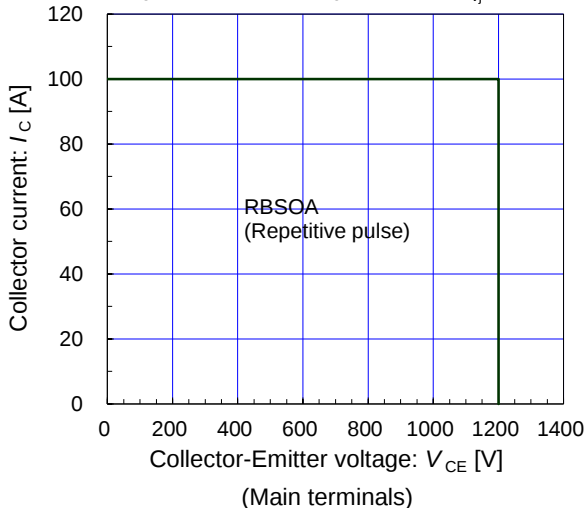
$V_{CC} = 600V$, $I_C = 50A$, $V_{GE} = +15/-15V$, $T_{vj} = 175^\circ C$



[Inverter]

Reverse bias safe operating area (max.)

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

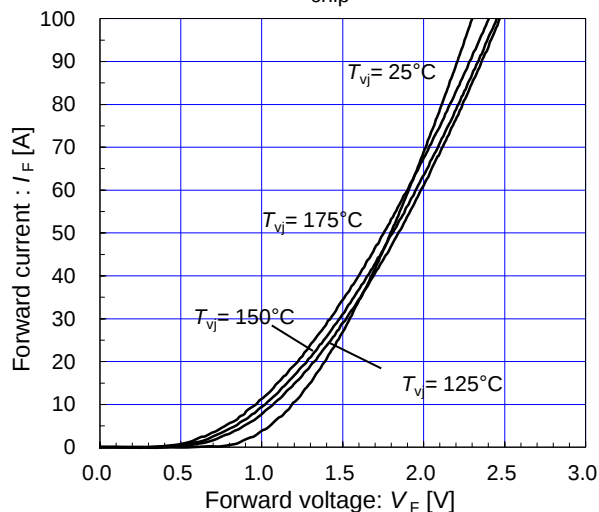


7MBR50XPA120-50

IGBT Modules

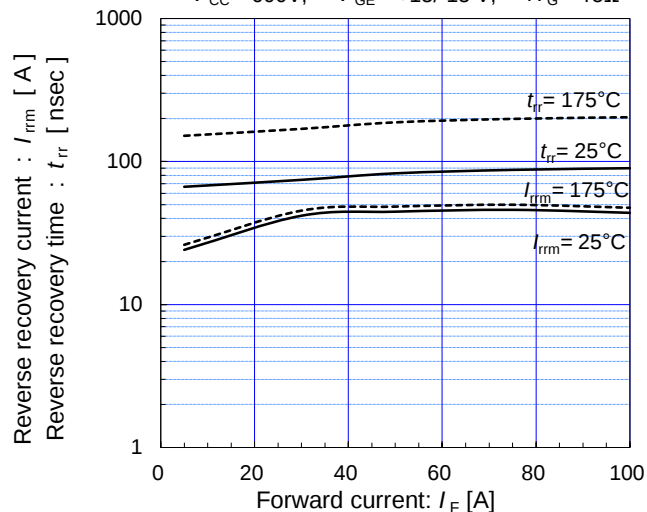
[Inverter]

Forward current vs. Forward voltage (typ.)
chip



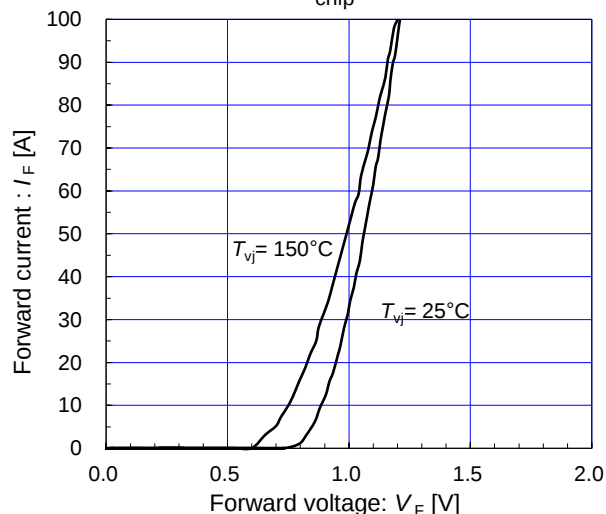
[Inverter]

Reverse recovery characteristics (typ.)
 $V_{CC} = 600V$, $V_{GE} = +15/-15V$, $R_G = 18\Omega$

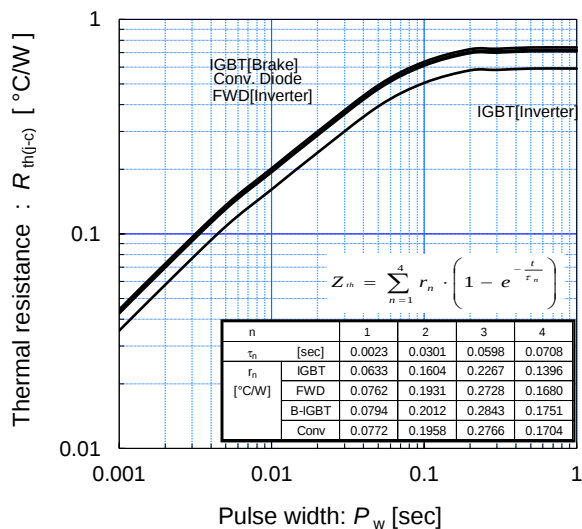


[Converter]

Forward current vs. Forward voltage (typ.)
chip

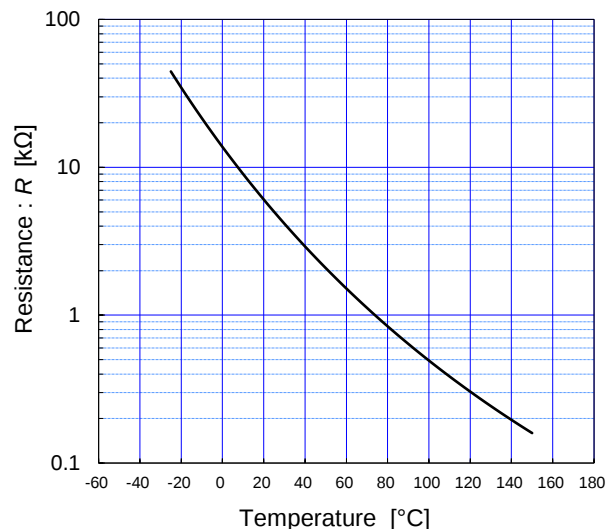


Transient thermal resistance (max.)



[Thermistor]

Temperature characteristic (typ.)



FM6M01718

2017/6

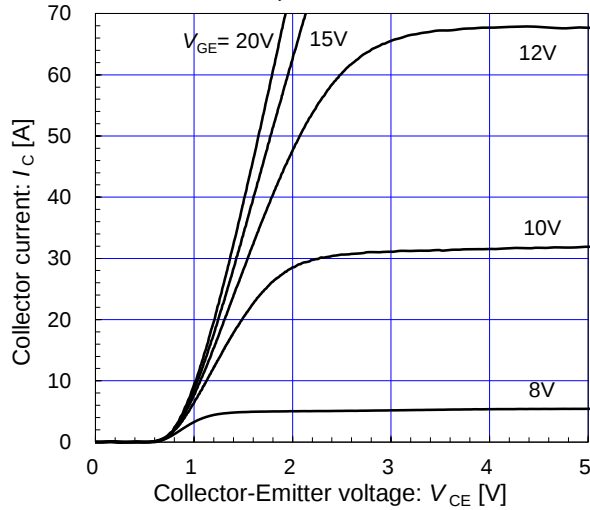
7MBR50XPA120-50

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[Brake]

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

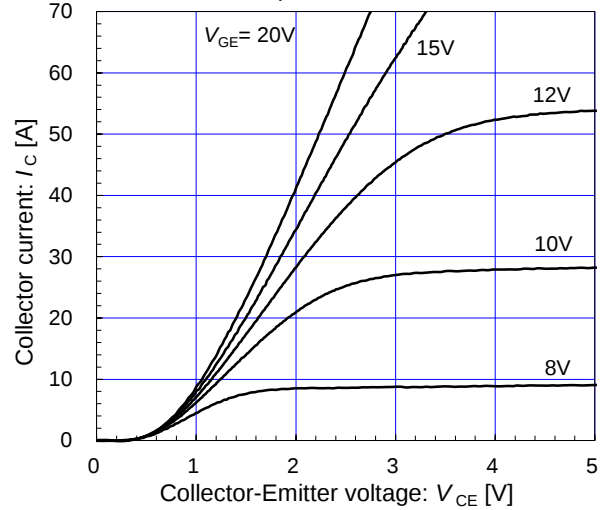
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Brake]

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

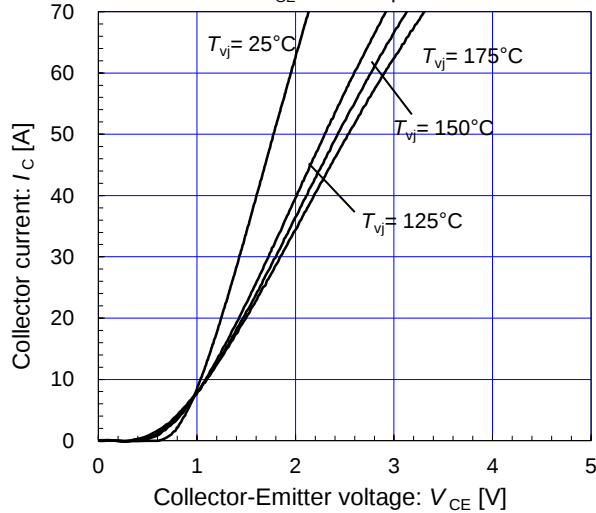
$T_{vj} = 175^{\circ}\text{C}$ / chip



[Brake]

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

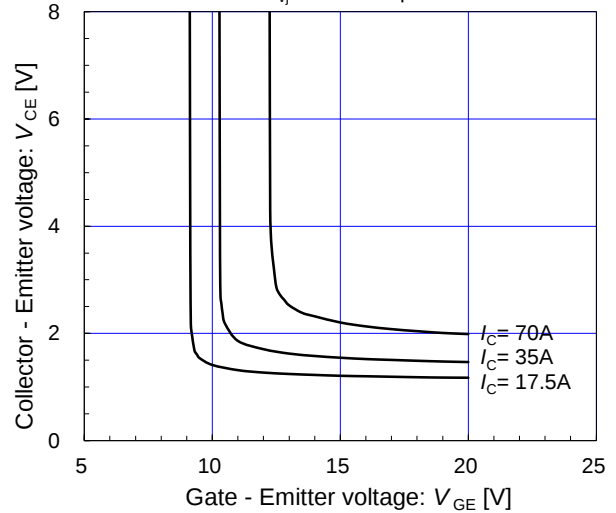
$V_{GE} = 15\text{V}$ / chip



[Brake]

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

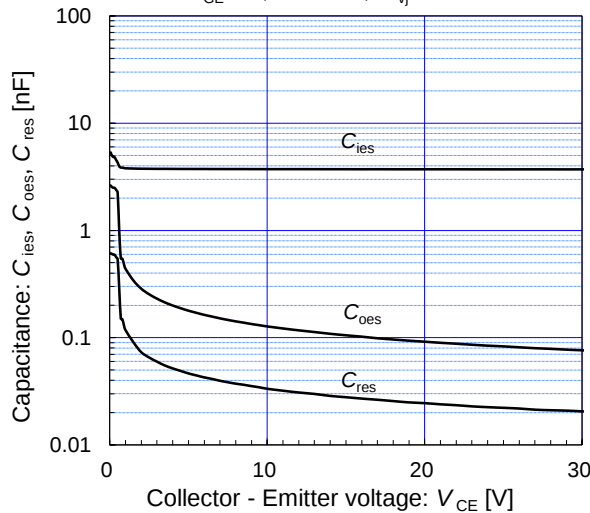
$T_{vj} = 25^{\circ}\text{C}$ / chip



[Brake]

Capacitance vs. Collector-Emittor voltage (typ.)

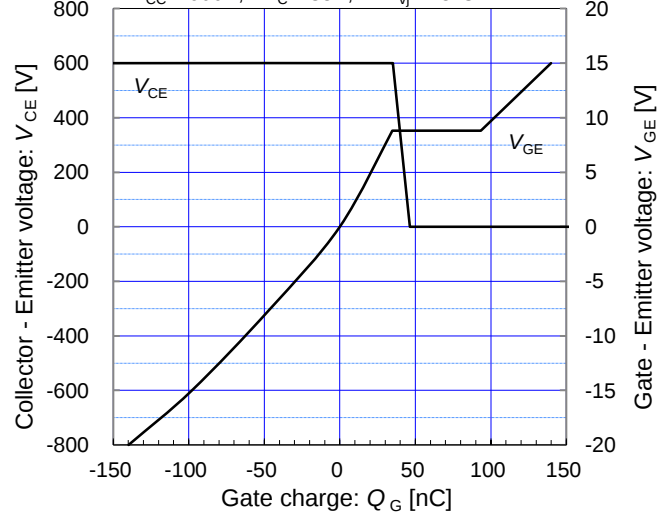
$V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_{vj} = 25^{\circ}\text{C}$



[Brake]

Dynamic Gate charge (typ.)

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



FM6M01718

2017/6

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