

# 7MBR35XMA120-50

IGBT Modules

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

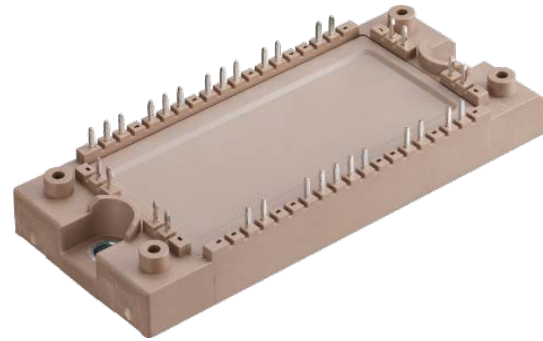
**Features**

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

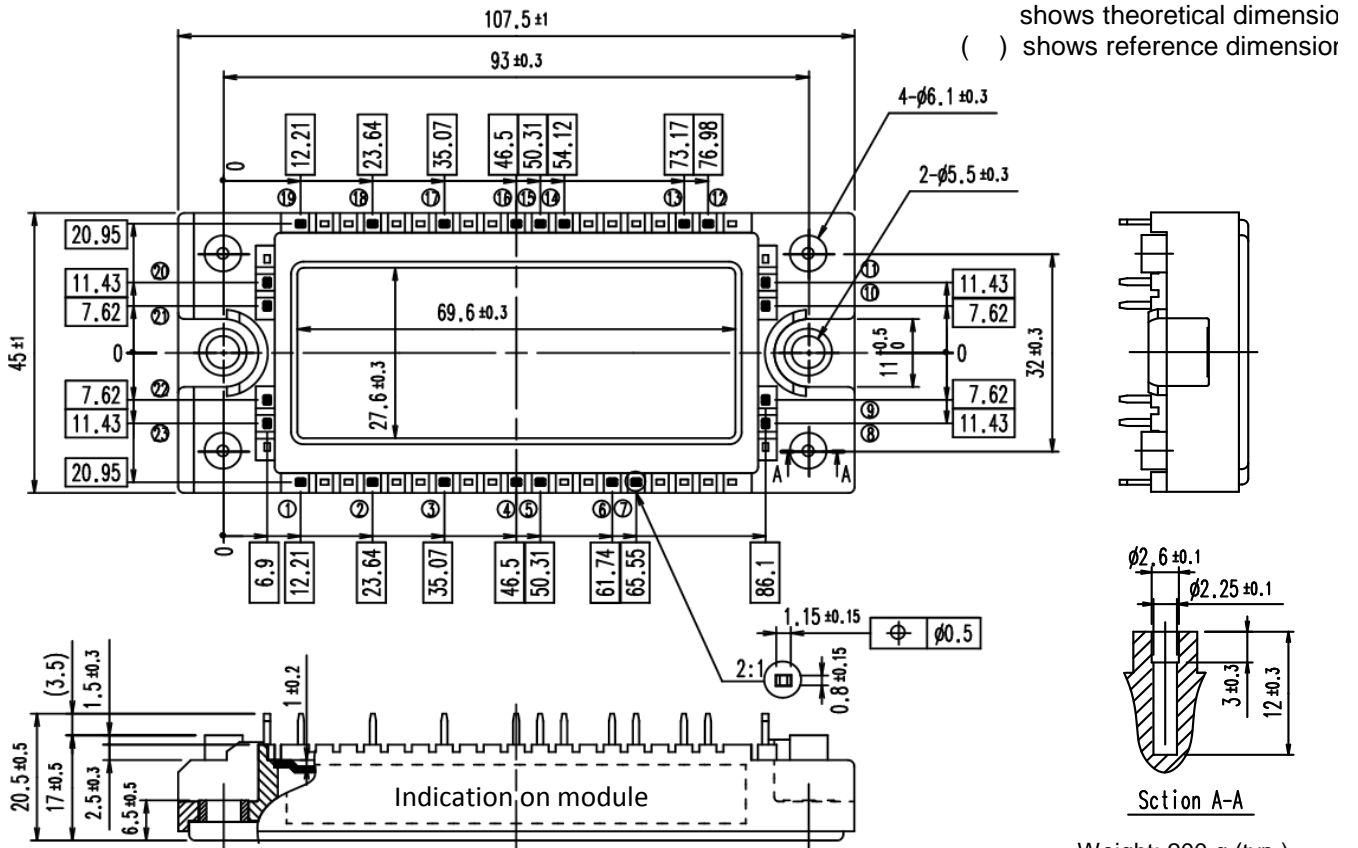
**Applications**

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

**Typical appearance**

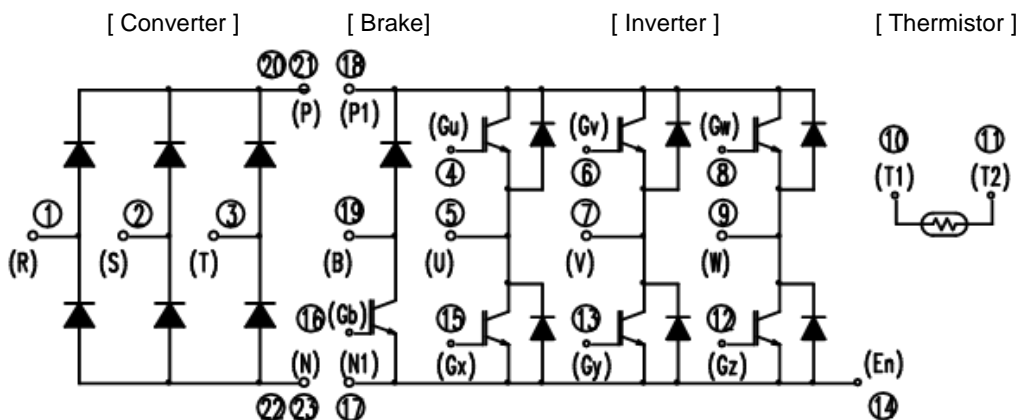


**Outline drawing ( Unit : mm )**



Weight: 200 g (typ.)

**Equivalent circuit**



# 7MBR35XMA120-50

□ 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	$V_{GES}$			$\pm 20$	V
	Collector current	$I_C$	Continuous	$T_c=100^\circ\text{C}$	35	A
		$I_C$ pulse	1ms		70	
	Forward current	$I_F$	Continuous		35	
		$I_F$ pulse	1ms		70	
Collector power dissipation	$P_C$	1 device		200	W	
Brake IGBT	Collector-Emitter voltage	$V_{CES}$			1200	V
	Gate-Emitter voltage	$V_{GES}$			$\pm 20$	V
	Collector current	$I_C$	Continuous	$T_c=100^\circ\text{C}$	25	A
		$I_C$ pulse	1ms		50	
Collector power dissipation	$P_C$	1 device		170	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	$T_c=80^\circ\text{C}$	35	A
	Surge current (Non-Repetitive) (*1)	$I_{FSM}$	$t=10\text{ms}$ , Half sine wave form	$T_j=25^\circ\text{C}$	470	A
				$T_j=150^\circ\text{C}$	385	
$I^2t$ (Non-Repetitive) (*1)	$I^2t$		$T_j=25^\circ\text{C}$	1105	A <sup>2</sup> s	
			$T_j=150^\circ\text{C}$	750		
Junction temperature	$T_j$	Inverter, Brake		175	°C	
		Converter		150		
Operating junction temperature (under switching conditions)	$T_{jop}$	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)  $T_j$  : 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)

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□ Electrical characteristics ( at  $T_j = 25^\circ\text{C}$  unless otherwise specified)

Items	Symbols	Conditions	Characteristics			Units	
			min.	typ.	max.		
Zero Gate voltage collector current	$I_{CES}$	$V_{GE} = 0\text{V}$ $V_{CE} = 1200\text{V}$	-	-	50	$\mu\text{A}$	
Gate-Emitter leakage current	$I_{GES}$	$V_{CE} = 0\text{V}$ $V_{GE} = +20/-20\text{V}$	-	-	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)	$V_{GE} = 15\text{V}$ $I_C = 35\text{A}$	$T_j = 25^\circ\text{C}$	-	1.65	2.10	V
	$V_{CE(sat)}$ (chip)		$T_j = 25^\circ\text{C}$	-	1.50	1.95	
			$T_j = 125^\circ\text{C}$	-	1.85	-	
			$T_j = 150^\circ\text{C}$	-	1.95	-	
			$T_j = 175^\circ\text{C}$	-	2.00	-	
Internal Gate resistance	$r_g$	-	-	0.0	-	$\Omega$	
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)	$V_{GE} = 15\text{V}$ $I_F = 35\text{A}$	$T_j = 25^\circ\text{C}$	-	1.95	2.40	V
	$V_F$ (chip)		$T_j = 25^\circ\text{C}$	-	1.80	2.25	
			$T_j = 125^\circ\text{C}$	-	1.85	-	
			$T_j = 150^\circ\text{C}$	-	1.80	-	
			$T_j = 175^\circ\text{C}$	-	1.75	-	
Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 30\ \Omega$	$T_j = 25^\circ\text{C}$	-	0.10	-	$\mu\text{s}$
			$T_j = 125^\circ\text{C}$	-	0.10	-	
			$T_j = 150^\circ\text{C}$	-	0.11	-	
			$T_j = 175^\circ\text{C}$	-	0.11	-	
	$t_r$	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 30\ \Omega$	$T_j = 25^\circ\text{C}$	-	0.04	-	
			$T_j = 125^\circ\text{C}$	-	0.05	-	
			$T_j = 150^\circ\text{C}$	-	0.05	-	
			$T_j = 175^\circ\text{C}$	-	0.05	-	
	$t_{d(off)}$	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 30\ \Omega$	$T_j = 25^\circ\text{C}$	-	0.23	-	
			$T_j = 125^\circ\text{C}$	-	0.27	-	
			$T_j = 150^\circ\text{C}$	-	0.27	-	
			$T_j = 175^\circ\text{C}$	-	0.27	-	
$t_f$	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 30\ \Omega$	$T_j = 25^\circ\text{C}$	-	0.12	-		
		$T_j = 125^\circ\text{C}$	-	0.18	-		
		$T_j = 150^\circ\text{C}$	-	0.20	-		
		$T_j = 175^\circ\text{C}$	-	0.21	-		
Reverse recovery time	$t_{rr}$	$V_{CC} = 600\text{V}$ $I_C, I_F = 35\text{A}$ $L_s = 30\text{nH}$ $V_{GE} = +15/-15\text{V}$ $R_G = 30\ \Omega$	$T_j = 25^\circ\text{C}$	-	0.10	-	
			$T_j = 125^\circ\text{C}$	-	0.17	-	
			$T_j = 150^\circ\text{C}$	-	0.22	-	
			$T_j = 175^\circ\text{C}$	-	0.27	-	

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

# 7MBR35XMA120-50

Items	Symbols	Conditions	Characteristics			Units	
			min.	typ.	max.		
Inverter Switching loss (per pulse)	$E_{on}$	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 30\Omega$	$T_j = 25^\circ C$	-	3.02	-	mJ
			$T_j = 125^\circ C$	-	4.16	-	
			$T_j = 150^\circ C$	-	4.48	-	
			$T_j = 175^\circ C$	-	4.77	-	
	$E_{off}$	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 30\Omega$	$T_j = 25^\circ C$	-	2.49	-	
			$T_j = 125^\circ C$	-	3.09	-	
			$T_j = 150^\circ C$	-	3.26	-	
			$T_j = 175^\circ C$	-	3.35	-	
	$E_{rr}$	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 30\Omega$	$T_j = 25^\circ C$	-	0.91	-	
			$T_j = 125^\circ C$	-	1.68	-	
			$T_j = 150^\circ C$	-	1.98	-	
			$T_j = 175^\circ C$	-	2.32	-	
Zero Gate voltage collector current	$I_{CES}$	$V_{GE} = 0V$ $V_{CE} = 1200V$	-	-	50	$\mu A$	
Gate-Emitter leakage current	$I_{GES}$	$V_{CE} = 0V, \quad V_{GE} = +20/-20V$	-	-	100	nA	
Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_C = 25A$	$T_j = 25^\circ C$	-	1.60	2.05	V
			$T_j = 25^\circ C$	-	1.50	1.95	
	$V_{CE(sat)}$ (chip)		$T_j = 125^\circ C$	-	1.85	-	
			$T_j = 150^\circ C$	-	1.95	-	
Internal Gate resistance	$r_g$	-	-	-	0	-	$\Omega$
			-	-	0	-	-
Brake Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600V$ $I_C = 25A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 36\Omega$	$T_j = 25^\circ C$	-	0.09	-	$\mu s$
			$T_j = 125^\circ C$	-	0.10	-	
			$T_j = 150^\circ C$	-	0.10	-	
			$T_j = 175^\circ C$	-	0.10	-	
	$t_r$	$V_{CC} = 600V$ $I_C = 25A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 36\Omega$	$T_j = 25^\circ C$	-	0.04	-	
			$T_j = 125^\circ C$	-	0.04	-	
			$T_j = 150^\circ C$	-	0.04	-	
			$T_j = 175^\circ C$	-	0.04	-	
	$t_{d(off)}$	$V_{CC} = 600V$ $I_C = 25A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 36\Omega$	$T_j = 25^\circ C$	-	0.23	-	
			$T_j = 125^\circ C$	-	0.26	-	
			$T_j = 150^\circ C$	-	0.27	-	
			$T_j = 175^\circ C$	-	0.27	-	
	$t_f$	$V_{CC} = 600V$ $I_C = 25A \quad L_s = 30nH$ $V_{GE} = +15/-15V$ $R_G = 36\Omega$	$T_j = 25^\circ C$	-	0.11	-	
			$T_j = 125^\circ C$	-	0.20	-	
			$T_j = 150^\circ C$	-	0.22	-	
			$T_j = 175^\circ C$	-	0.23	-	
Reverse current	$I_{RRM}$	$V_R = 1200V$	-	-	50	$\mu A$	
Forward voltage	$V_F$ (terminal)	$I_F = 15A$	$T_j = 25^\circ C$	-	1.90	2.35	V
			$T_j = 25^\circ C$	-	1.80	2.25	
	$V_F$ (chip)		$T_j = 125^\circ C$	-	1.85	-	
			$T_j = 150^\circ C$	-	1.80	-	
Reverse current	$I_{RRM}$	$V_R = 1600V$	-	-	50	$\mu A$	
			-	-	50	$\mu A$	
			-	-	50	$\mu A$	
			-	-	50	$\mu A$	
Forward voltage	$V_{FM}$	$I_F = 35A$	terminal	-	1.20	1.65	V
			chip	-	1.05	1.50	
Resistance	$R$	$T = 25^\circ C$	-	5000	-	$\Omega$	
		$T = 100^\circ C$	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 (1device)	$R_{th(j-c)}$	Inverter IGBT	-	-	0.74	°C/W
		Inverter FWD	-	-	0.86	
		Brake IGBT	-	-	0.88	
		Brake FWD	-	-	1.85	
		Converter Diode	-	-	0.87	
Contact thermal resistance (1 IGBT+1 FWD) (*1)	$R_{th(c-f)}$	with 1 W/(m·K) thermal grease	-	0.05	-	

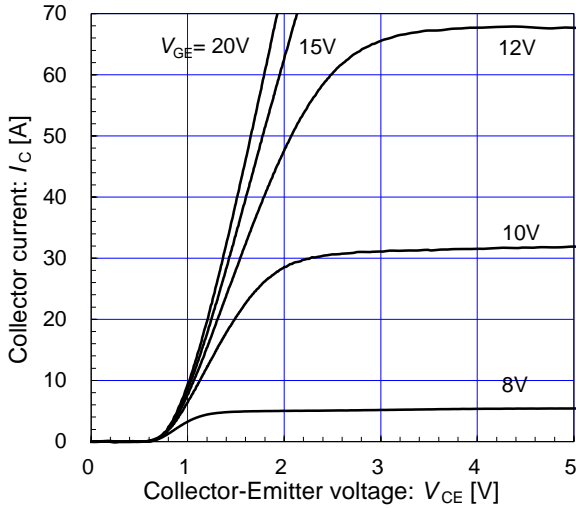
(\*1) This is the value which is defined mounting on the additional cooling fin with thermal grease.

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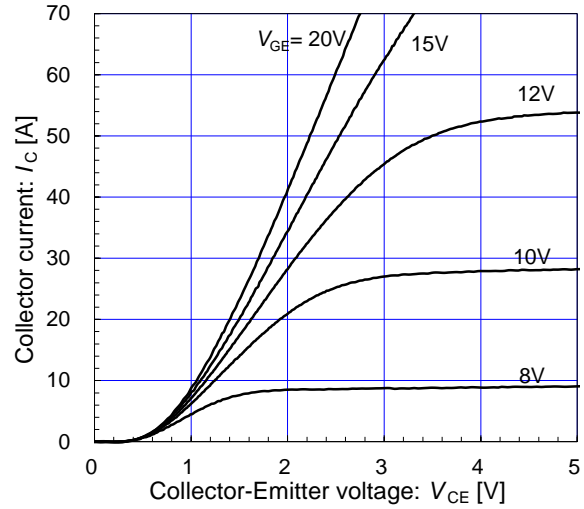
[ Inverter ]

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



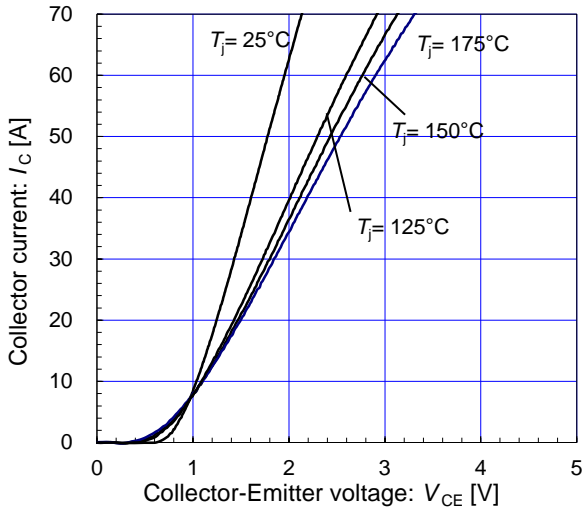
[ Inverter ]

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



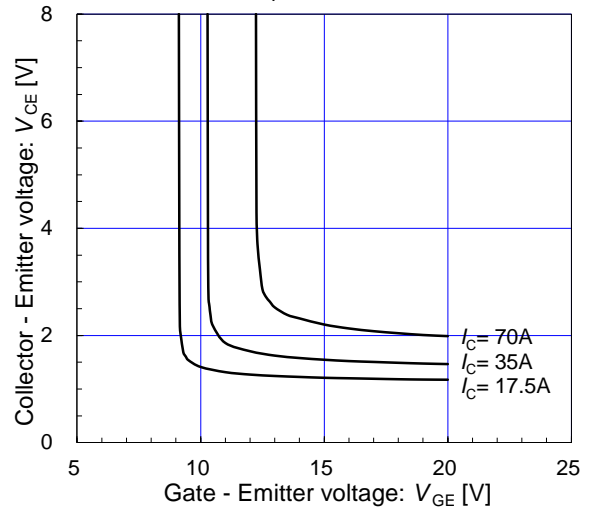
[ Inverter ]

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



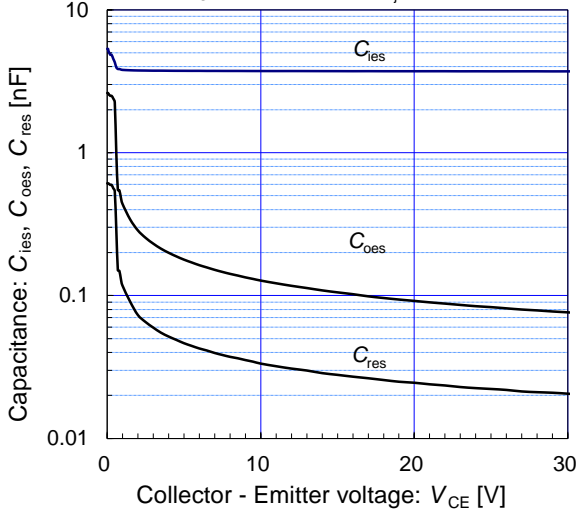
[ Inverter ]

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



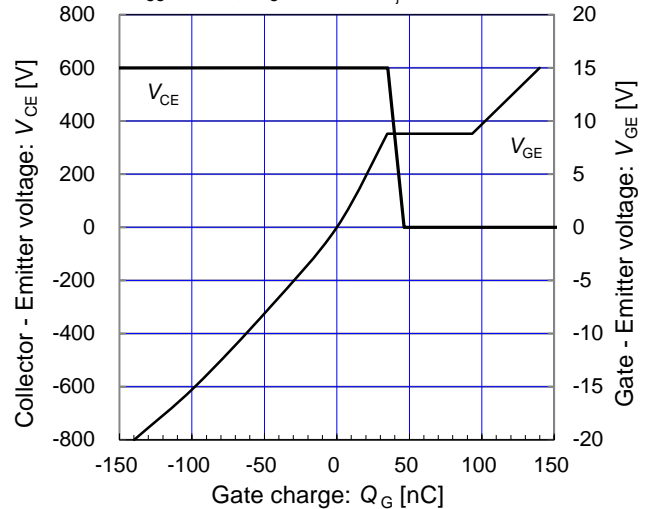
[ Inverter ]

Capacitance vs. Collector-Emittor voltage (typ.)  
 $V_{GE} = 0\text{V}, f = 1\text{MHz}, T_j = 25^\circ\text{C}$



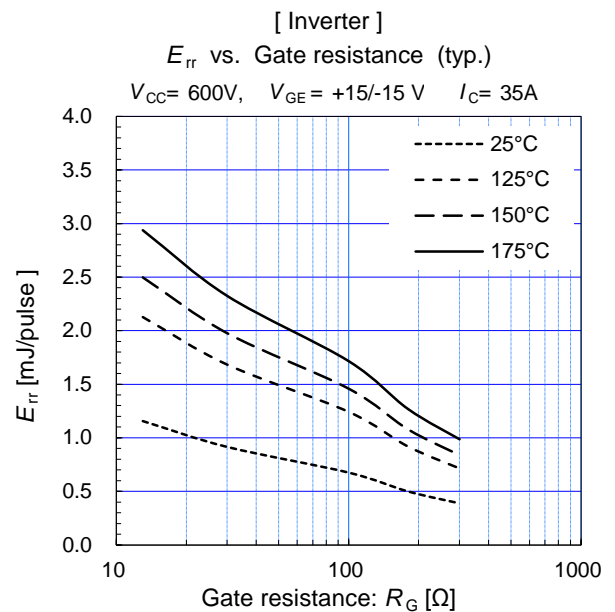
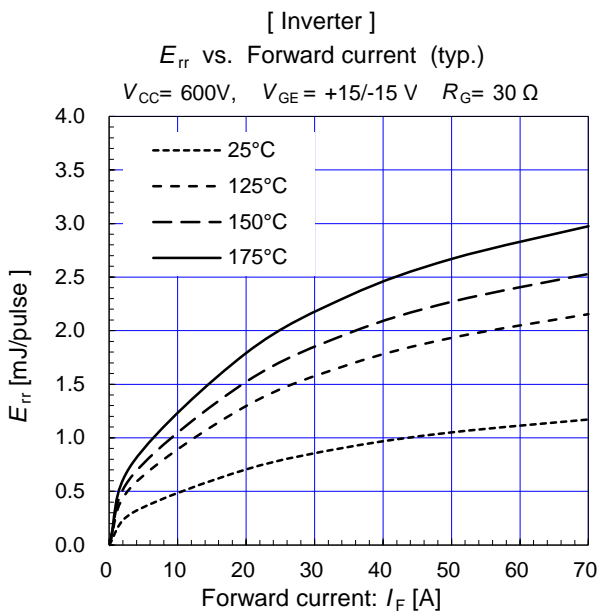
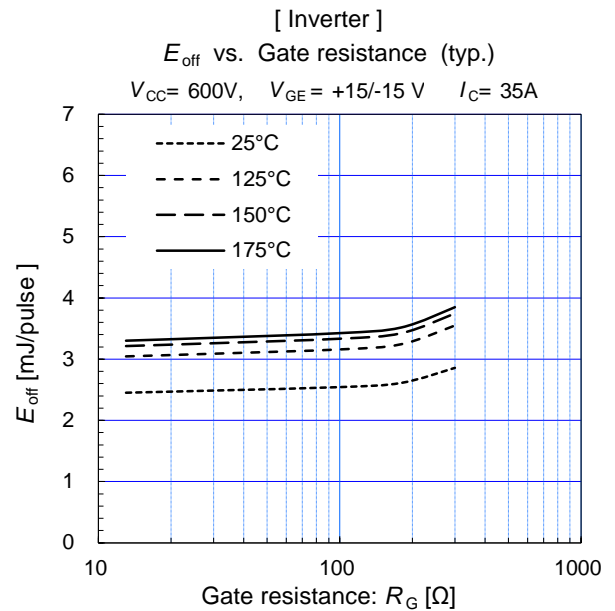
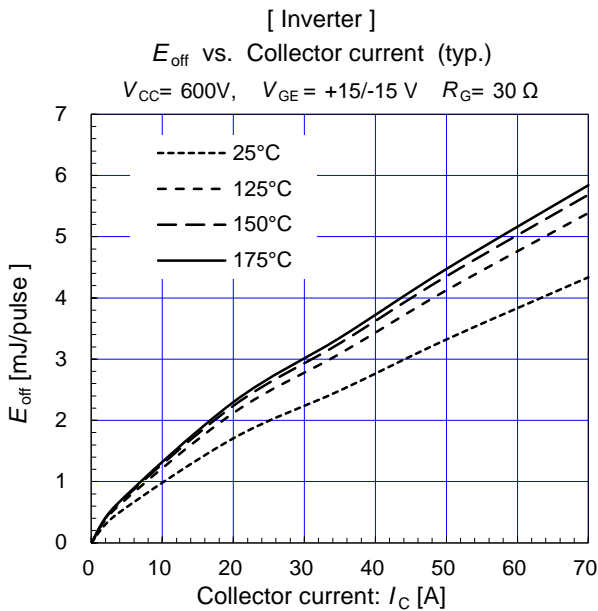
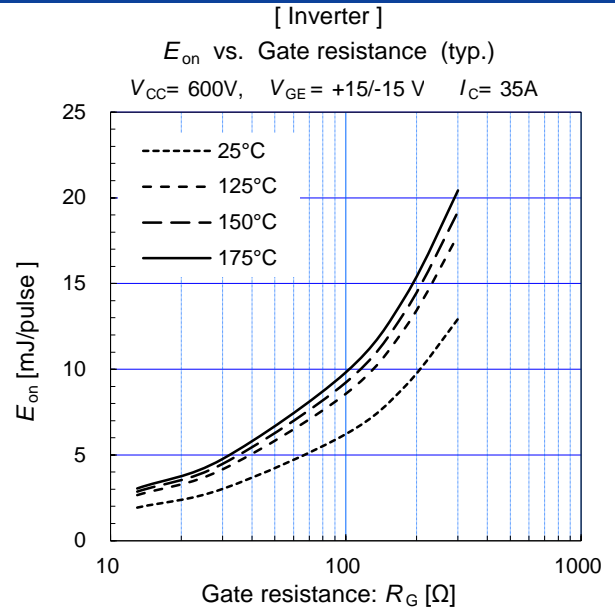
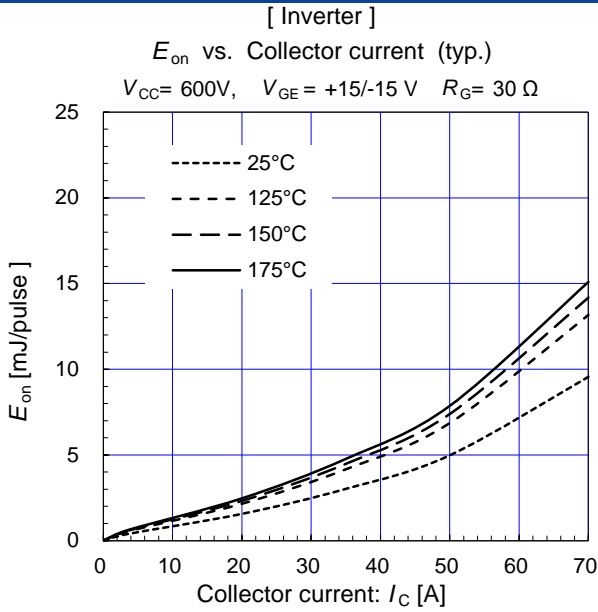
[ Inverter ]

Dynamic Gate charge (typ.)  
 $V_{CC} = 600\text{V}, I_C = 35\text{A}, T_j = 25^\circ\text{C}$



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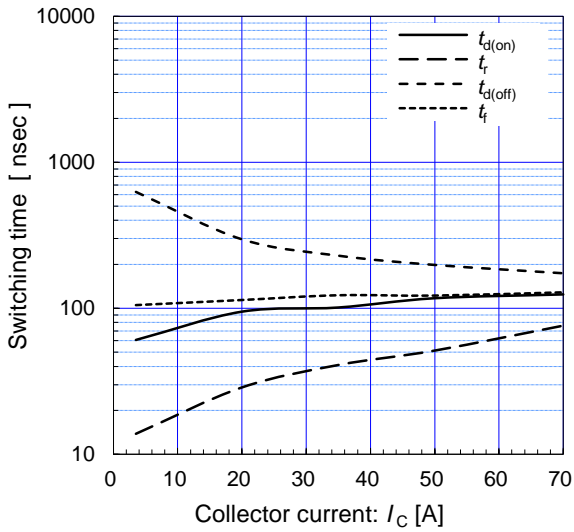
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IGBT Modules

[ Inverter ]

Switching time vs. Collector current (typ.)

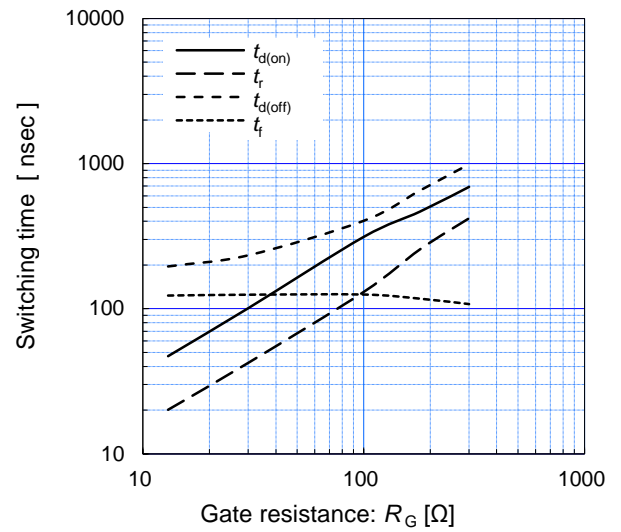
$V_{CC}=600V, R_G=30\Omega, V_{GE}=+15/-15V, T_j=25^\circ C$



[ Inverter ]

Switching time vs. Gate resistance (typ.)

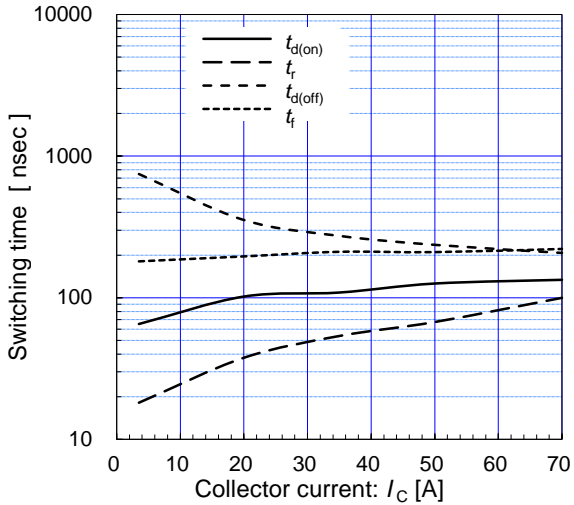
$V_{CC}=600V, I_C=35A, V_{GE}=+15/-15V, T_j=25^\circ C$



[ Inverter ]

Switching time vs. Collector current (typ.)

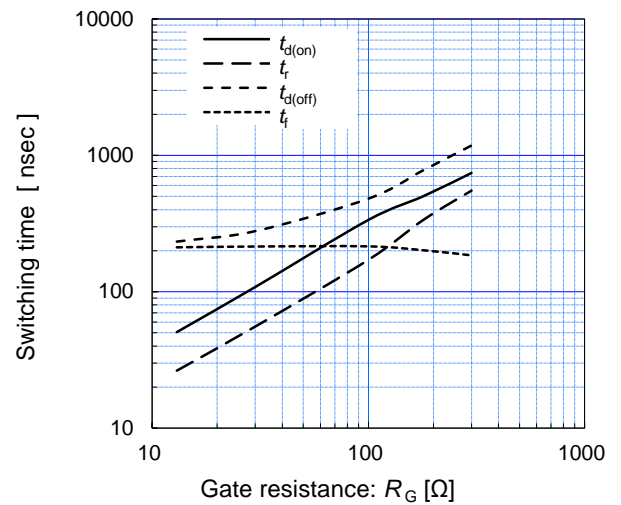
$V_{CC}=600V, R_G=30\Omega, V_{GE}=+15/-15V, T_j=175^\circ C$



[ Inverter ]

Switching time vs. Gate resistance (typ.)

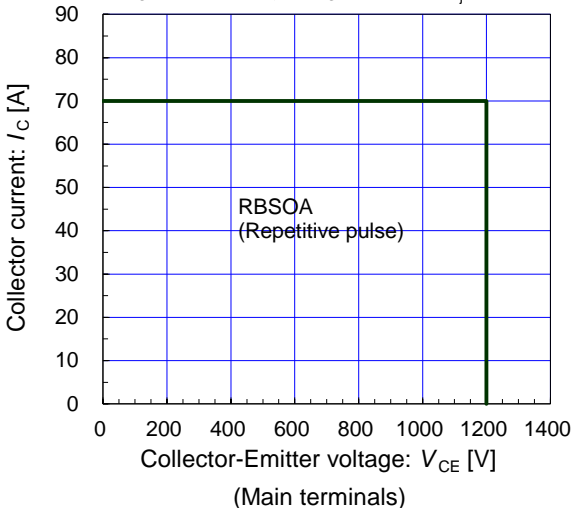
$V_{CC}=600V, I_C=35A, V_{GE}=+15/-15V, T_j=175^\circ C$



[ Inverter ]

Reverse bias safe operating area (max.)

$V_{GE}=+15/-15V, R_G \geq 30\Omega, T_j=175^\circ C$



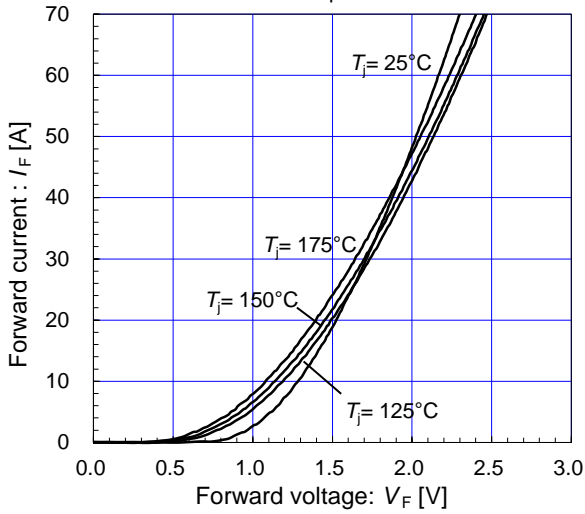


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IGBT Modules

[ Inverter ]

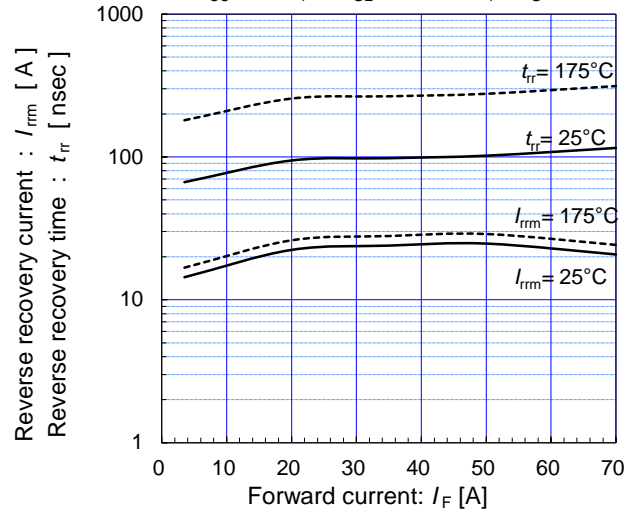
Forward current vs. Forward voltage (typ.)  
chip



[ Inverter ]

Reverse recovery characteristics (typ.)

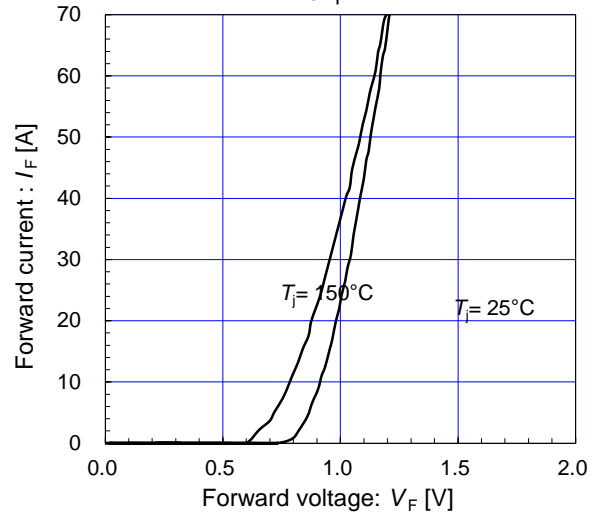
$V_{CC} = 600V, V_{GE} = +15/-15V, R_G = 30\Omega$



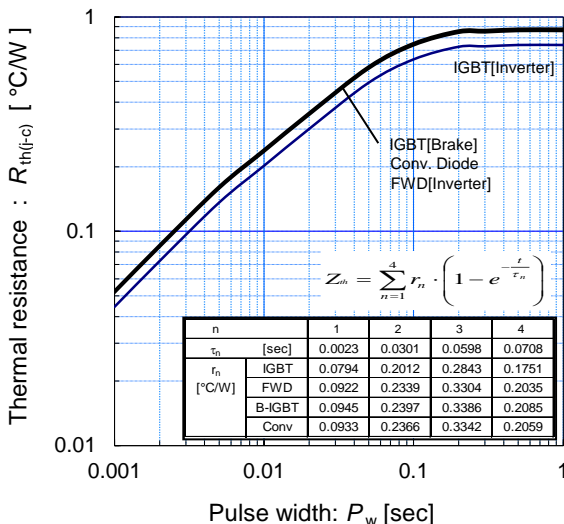
[ Converter ]

Forward current vs. Forward voltage (typ.)

chip

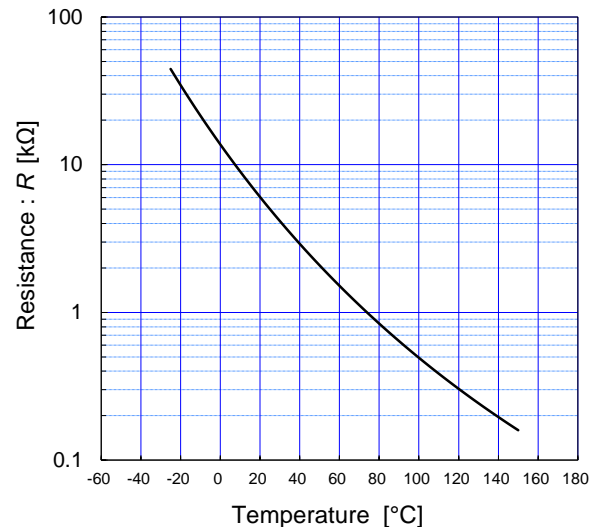


Transient thermal resistance (max.)

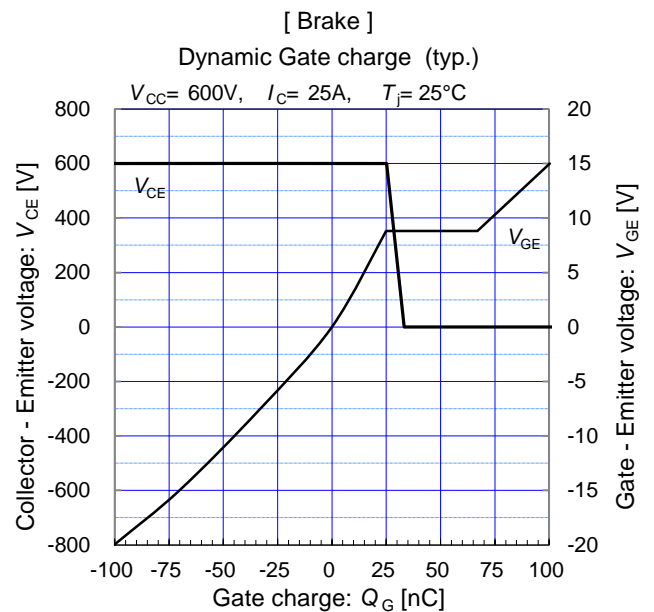
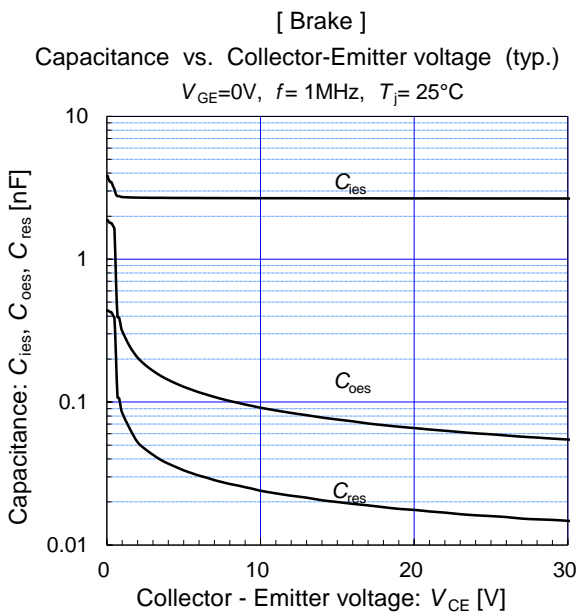
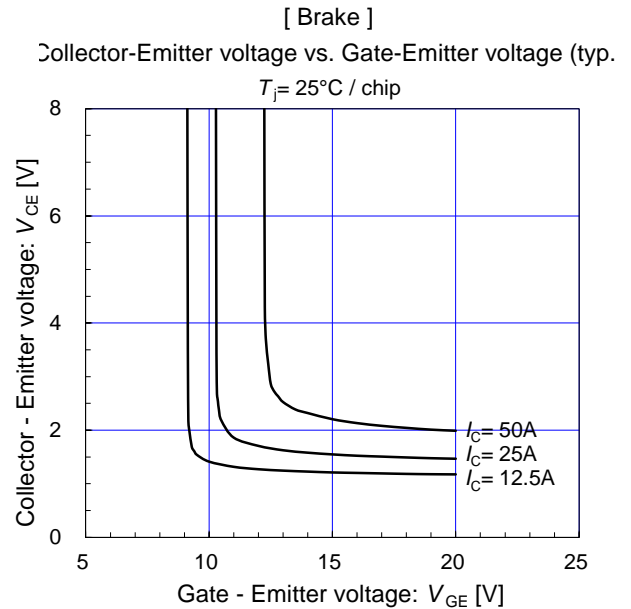
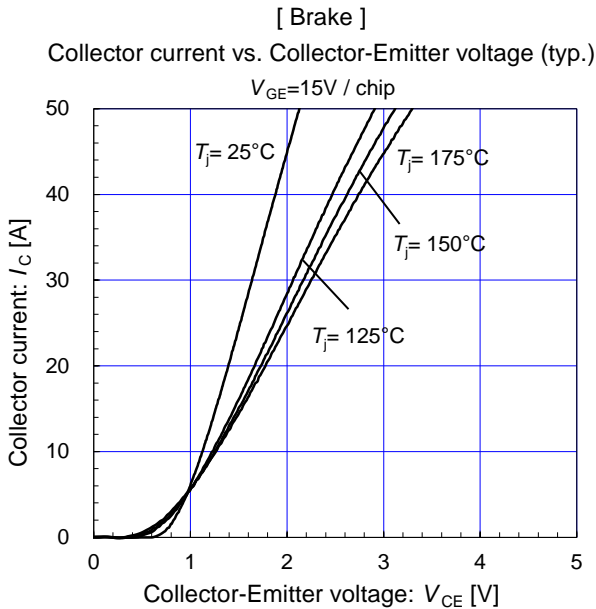
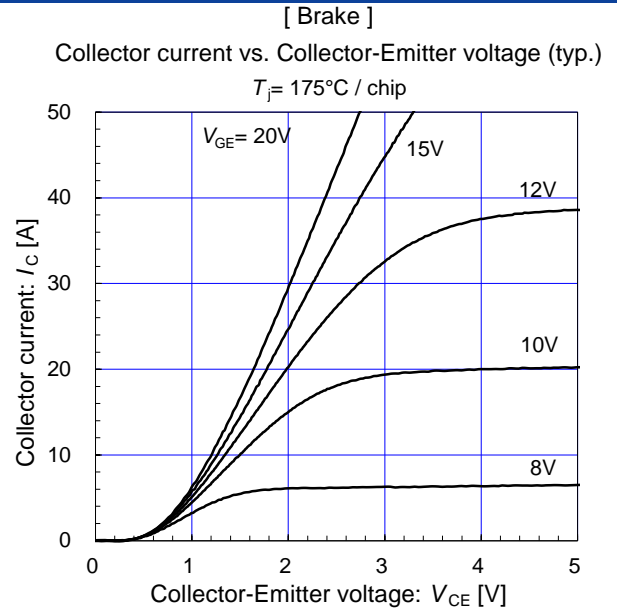
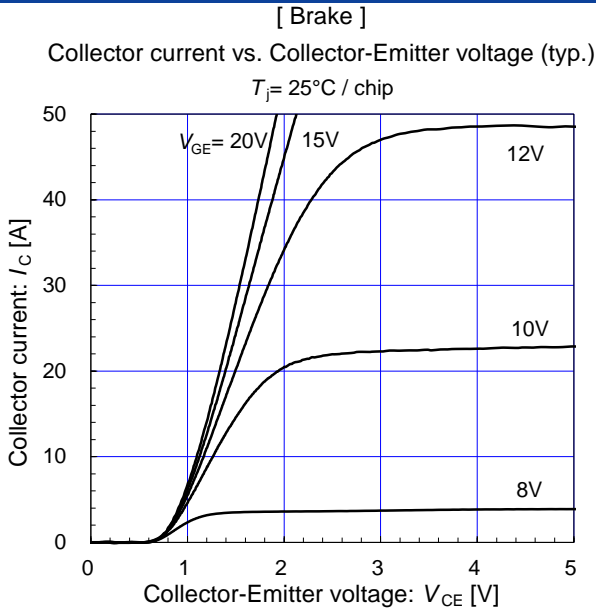


[ Thermistor ]

Temperature characteristic (typ.)



# 7MBR35XMA120-50



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