

# 7MBR35XKD120-50

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

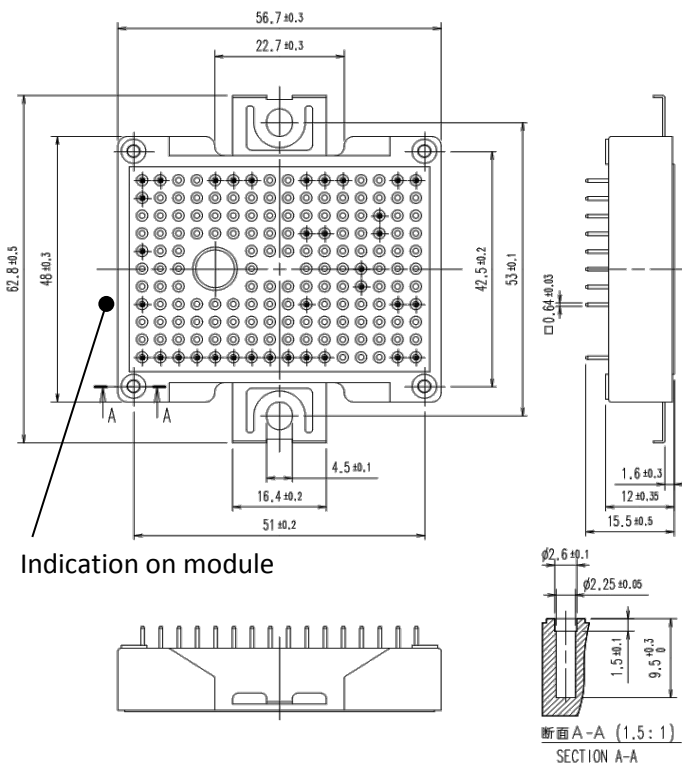
■ Applications

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

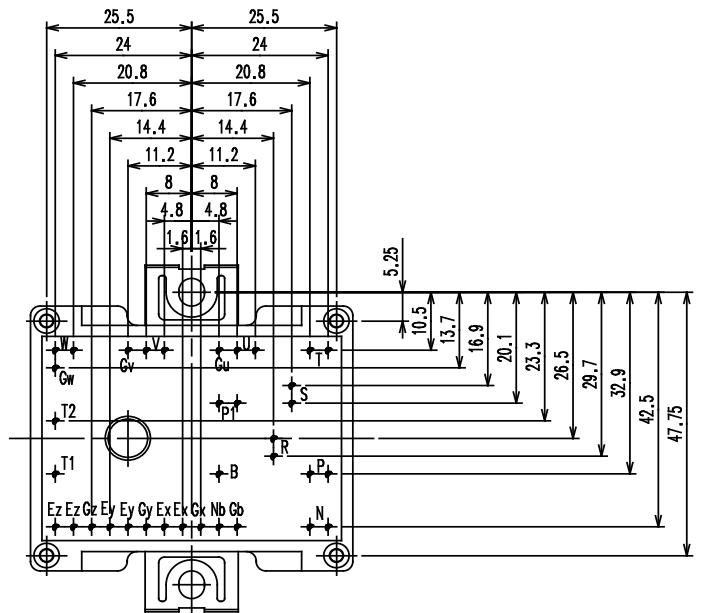
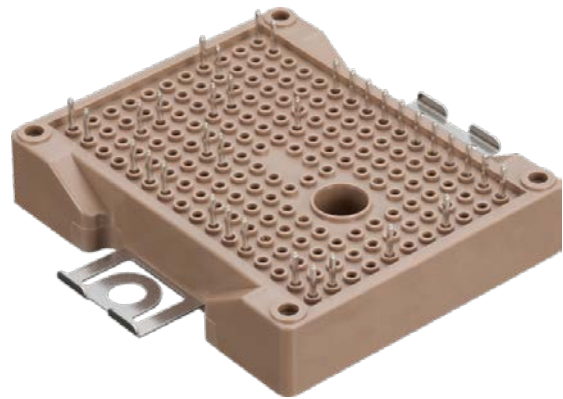
■ Outline drawing ( Unit : mm )

shows theoretical dimension.

( ) shows reference dimension.

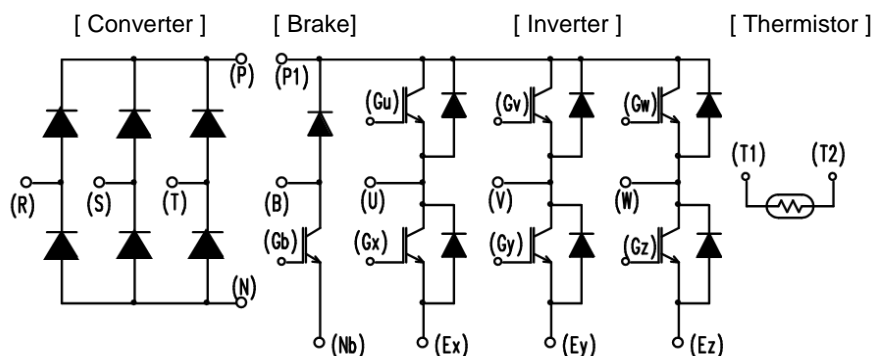


■ Typical appearance



Weight: 45 g (typ.)  
PIN POSITIONS WITH TOLERANCE  $\pm \phi 0.4$

□ Equivalent circuit



# 7MBR35XKD120-50

□ 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		255	W	
Brake IGBT	Collector-Emitter voltage	$V_{CES}$			1200	V
	Gate-Emitter voltage	$V_{GES}$			$\pm 20$	V
	Collector current	$I_C$	Continuous	$T_c=100^\circ\text{C}$	35	A
		$I_C$ pulse	1ms		70	
Collector power dissipation	$P_C$	1 device		255	W	
Brake FWD	Forward current	$I_F$	Continuous		10	A
		$I_{FRM}$	1ms		20	
	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	$T_c=80^\circ\text{C}$	35	A
	Surge current (Non-Repetitive) (*1)	$I_{FSM}$	t=10ms, Half sine wave form	$T_{vj}=25^\circ\text{C}$	470	A
				$T_{vj}=125^\circ\text{C}$	385	
	$I^2t$ (Non-Repetitive) (*1)	$I^2t$		$T_{vj}=150^\circ\text{C}$	1105	A <sup>2</sup> s
$T_{vj}=175^\circ\text{C}$				750		
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	-	M4	1.7	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 1.3 ~ 1.7 N·m (M4)

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**□ Electrical characteristics ( at  $T_{vj}= 25^{\circ}\text{C}$  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)	$V_{GE} = 15\text{V}$ $I_C = 35\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	1.65	2.10	V
	$V_{CE(sat)}$ (chip)		$T_{vj}=25^{\circ}\text{C}$	-	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	-	$\Omega$	
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)	$I_F = 35\text{A}$	$T_{vj}=25^{\circ}\text{C}$	-	2.00	2.45	V
	$V_F$ (chip)		$T_{vj}=25^{\circ}\text{C}$	-	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	-	$\mu\text{s}$
			$T_{vj}=125^{\circ}\text{C}$	-	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)	$E_{on}$	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	1.86	-	mJ
			$T_{vj}=125^\circ C$	-	2.75	-	
			$T_{vj}=150^\circ C$	-	2.98	-	
			$T_{vj}=175^\circ C$	-	3.26	-	
	$E_{off}$	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	2.54	-	
			$T_{vj}=125^\circ C$	-	3.07	-	
			$T_{vj}=150^\circ C$	-	3.25	-	
			$T_{vj}=175^\circ C$	-	3.44	-	
	$E_{rr}$	$V_{CC} = 600V$ $I_C, I_F = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	1.39	-	
			$T_{vj}=125^\circ C$	-	2.05	-	
			$T_{vj}=150^\circ C$	-	2.41	-	
			$T_{vj}=175^\circ C$	-	2.72	-	
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)	$V_{GE} = 15V$ $I_C = 35A$	$T_{vj}=25^\circ C$	-	1.65	2.10	V
			$T_{vj}=125^\circ C$	-	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	$r_g$	-	$T_{vj}=25^\circ C$	-	0	-	$\Omega$
			$T_{vj}=125^\circ C$	-	0	-	
			$T_{vj}=150^\circ C$	-	0	-	
			$T_{vj}=175^\circ C$	-	0	-	
Brake Switching time (*1)	$t_{d(on)}$	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	0.04	-	$\mu s$
			$T_{vj}=125^\circ C$	-	0.04	-	
			$T_{vj}=150^\circ C$	-	0.04	-	
			$T_{vj}=175^\circ C$	-	0.04	-	
	$t_r$	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	0.02	-	
			$T_{vj}=125^\circ C$	-	0.02	-	
			$T_{vj}=150^\circ C$	-	0.02	-	
			$T_{vj}=175^\circ C$	-	0.02	-	
	$t_{d(off)}$	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	0.20	-	
			$T_{vj}=125^\circ C$	-	0.23	-	
			$T_{vj}=150^\circ C$	-	0.23	-	
			$T_{vj}=175^\circ C$	-	0.23	-	
	$t_f$	$V_{CC} = 600V$ $I_C = 35A \quad L_s = 30nH$ $V_{GE} = +15/-15 V$ $R_G = 12 \Omega$	$T_{vj}=25^\circ C$	-	0.12	-	
			$T_{vj}=125^\circ C$	-	0.16	-	
			$T_{vj}=150^\circ C$	-	0.20	-	
			$T_{vj}=175^\circ C$	-	0.22	-	
Reverse current	$I_{RRM}$	$V_R = 1200V$	-	-	50	$\mu A$	
Forward voltage	$V_F$ (terminal)	$I_F = 10A$	$T_{vj}=25^\circ C$	-	2.05	2.50	V
			$T_{vj}=125^\circ C$	-	1.90	2.35	
	$V_F$ (chip)		$T_{vj}=125^\circ C$	-	1.95	-	
			$T_{vj}=150^\circ C$	-	1.90	-	
Reverse current	$I_{RRM}$	$V_R = 1600V$	$T_{vj}=25^\circ C$	-	-	50	$\mu A$
			$T_{vj}=125^\circ C$	-	-	50	
			$T_{vj}=150^\circ C$	-	-	50	
			$T_{vj}=175^\circ C$	-	-	50	
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	-	-	0.58	°C/W
		Inverter FWD	-	-	0.79	
		Brake IGBT	-	-	0.58	
		Brake FWD	-	-	1.75	
		Converter Diode	-	-	0.73	
Contact thermal resistance(*1) (1device)	$R_{th(c-f)}$	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.

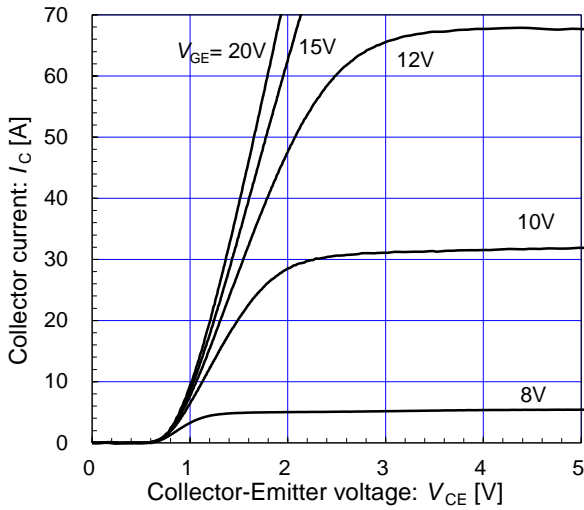
# 7MBR35XKD120-50

IGBT Modules

[ Inverter ]

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

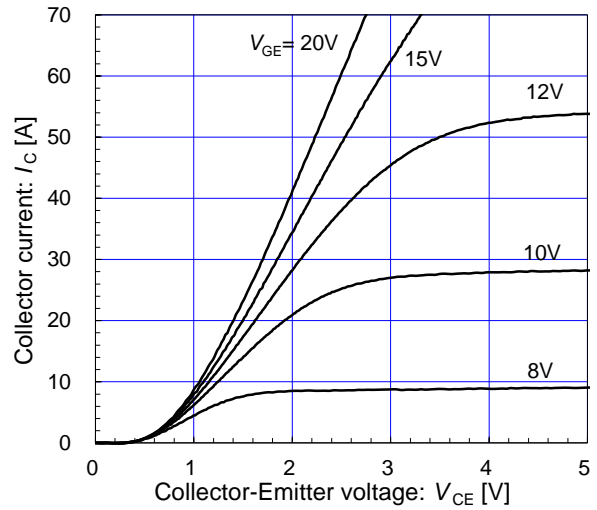
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[ Inverter ]

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

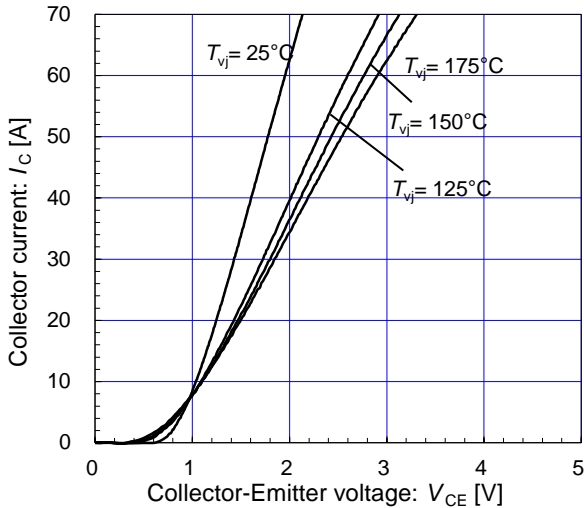
$T_{vj} = 175^{\circ}\text{C} / \text{chip}$



[ Inverter ]

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

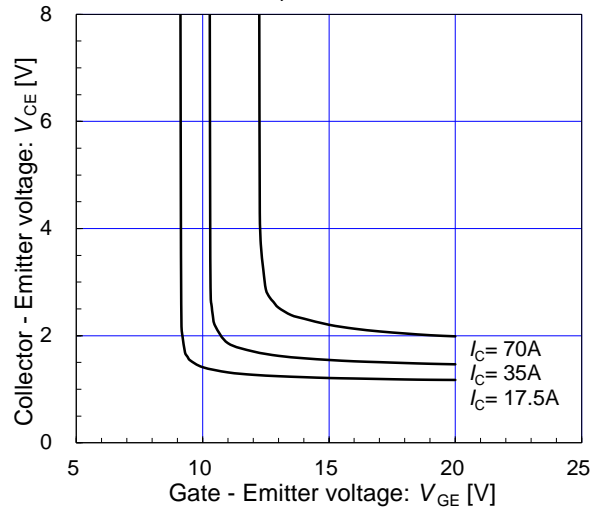
$V_{GE} = 15\text{V} / \text{chip}$



[ Inverter ]

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

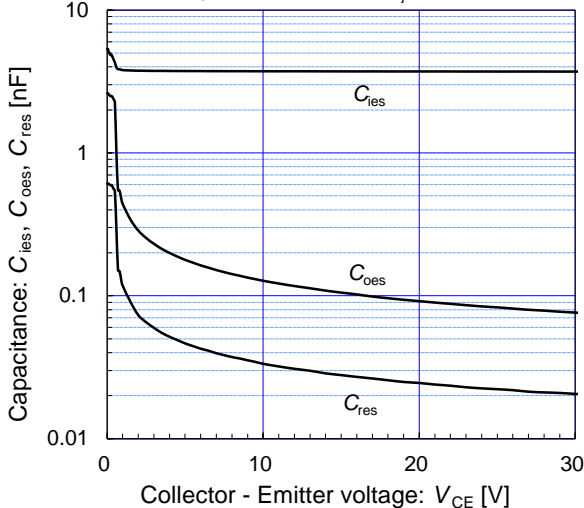
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[ Inverter ]

Capacitance vs. Collector-Emittor voltage (typ.)

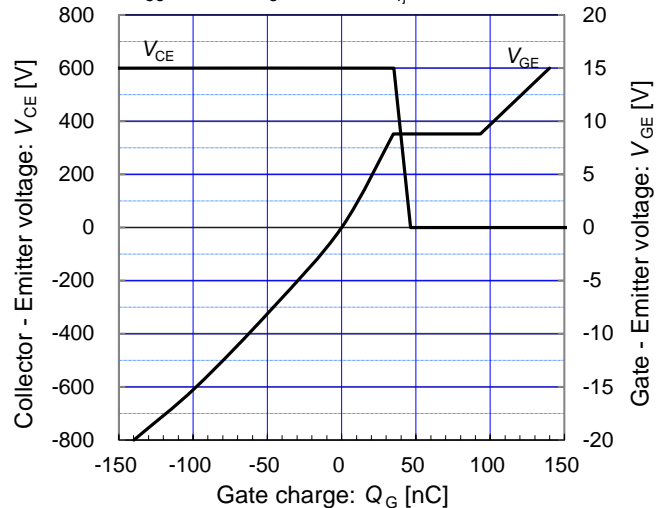
$V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}$



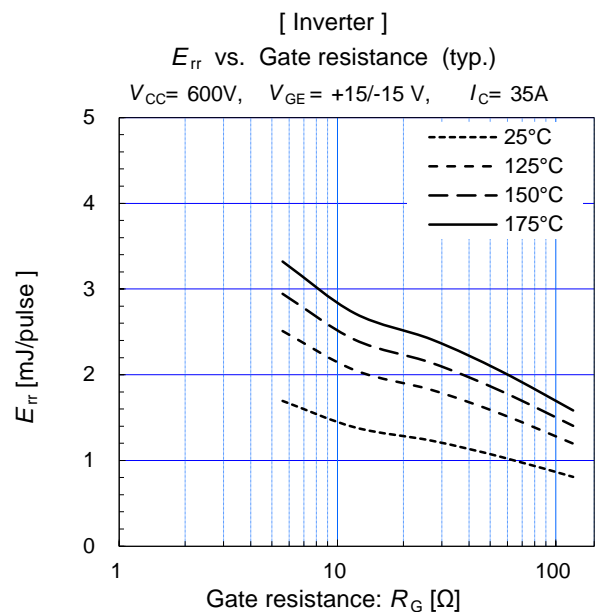
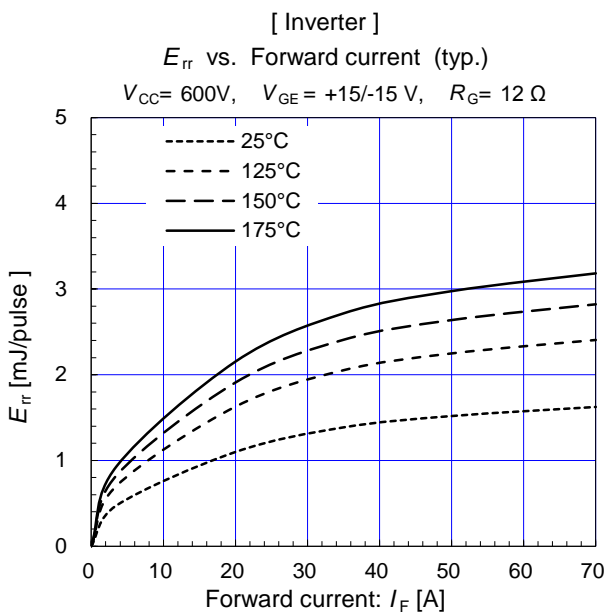
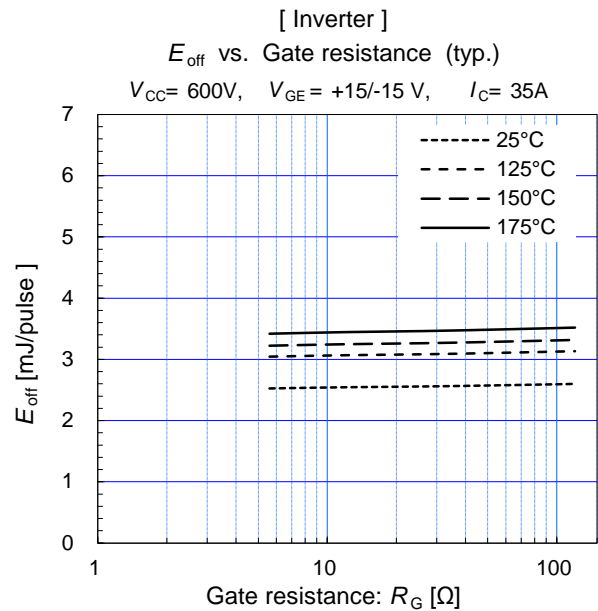
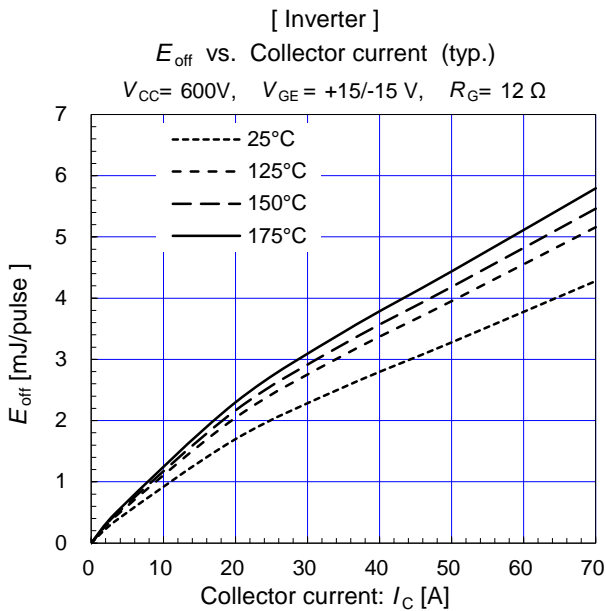
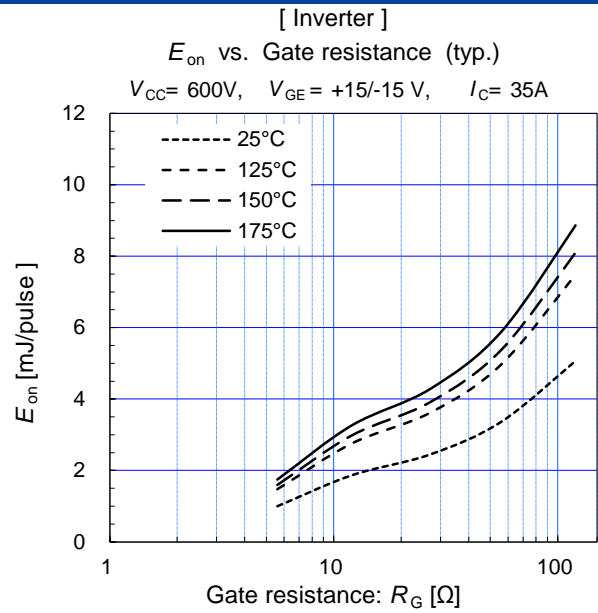
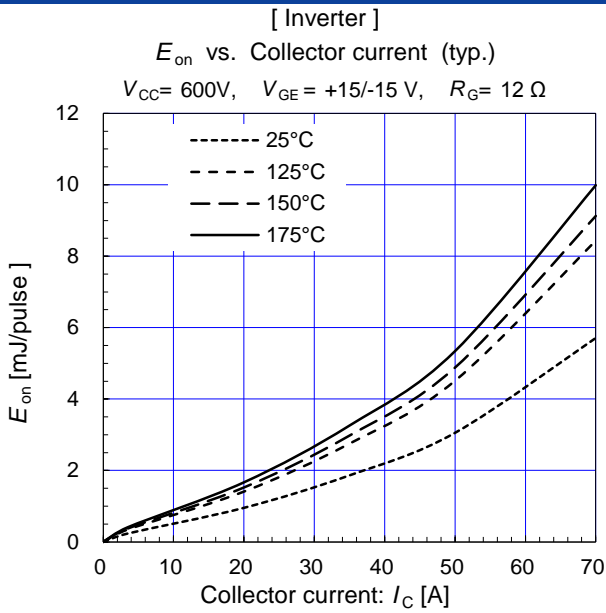
[ Inverter ]

Dynamic Gate charge (typ.)

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



# 7MBR35XKD120-50

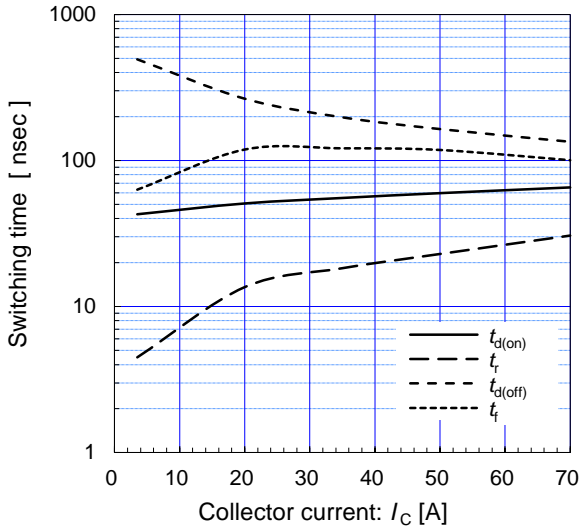


# 7MBR35XKD120-50

[ Inverter ]

Switching time vs. Collector current (typ.)

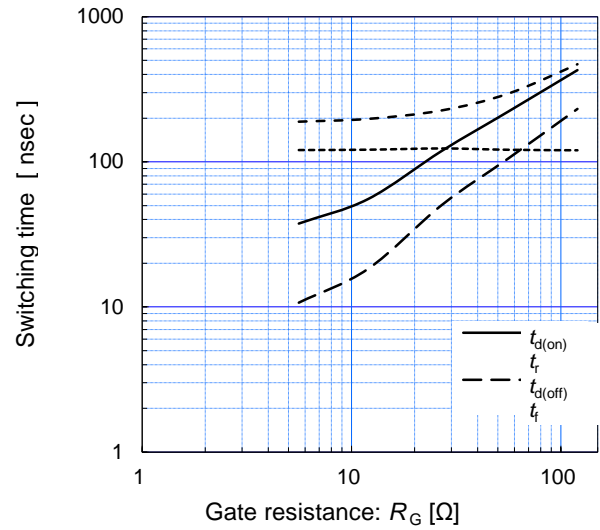
$V_{CC} = 600V, R_G = 12\Omega, V_{GE} = +15/-15V, T_{vj} = 25^\circ C$



[ Inverter ]

Switching time vs. Gate resistance (typ.)

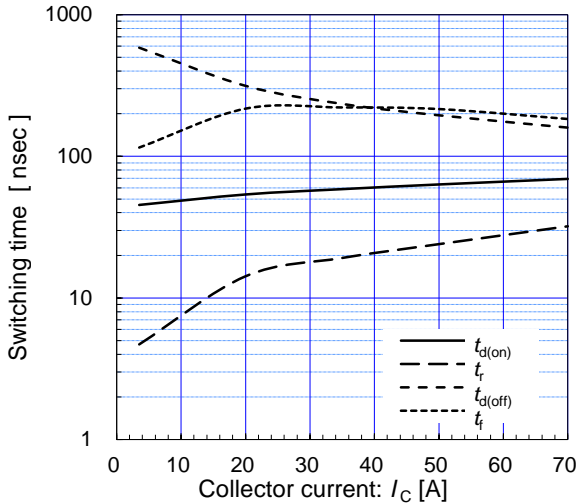
$V_{CC} = 600V, I_C = 35A, V_{GE} = +15/-15V, T_{vj} = 25^\circ C$



[ Inverter ]

Switching time vs. Collector current (typ.)

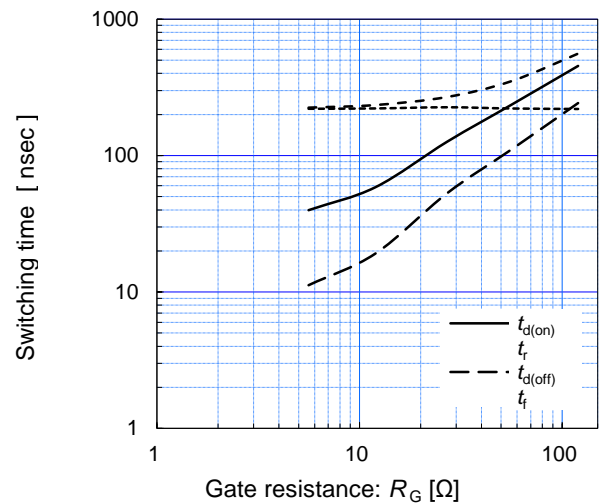
$V_{CC} = 600V, R_G = 12\Omega, V_{GE} = +15/-15V, T_{vj} = 175^\circ C$



[ Inverter ]

Switching time vs. Gate resistance (typ.)

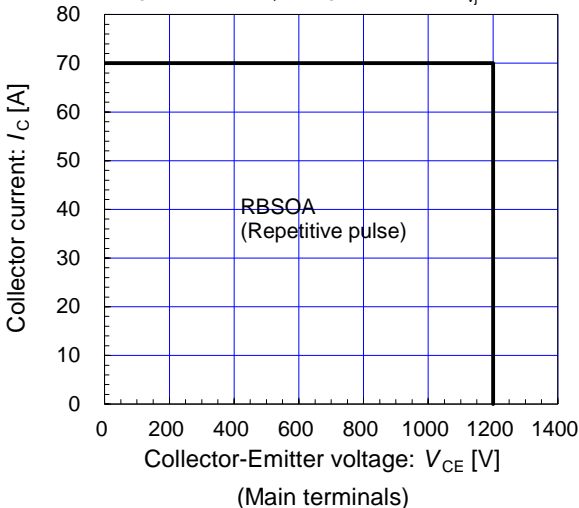
$V_{CC} = 600V, I_C = 35A, V_{GE} = +15/-15V, T_{vj} = 175^\circ C$



[ Inverter ]

Reverse bias safe operating area (max.)

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



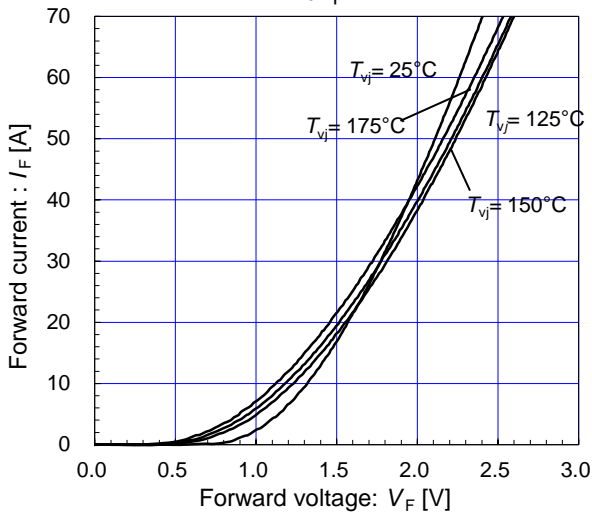


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IGBT Modules

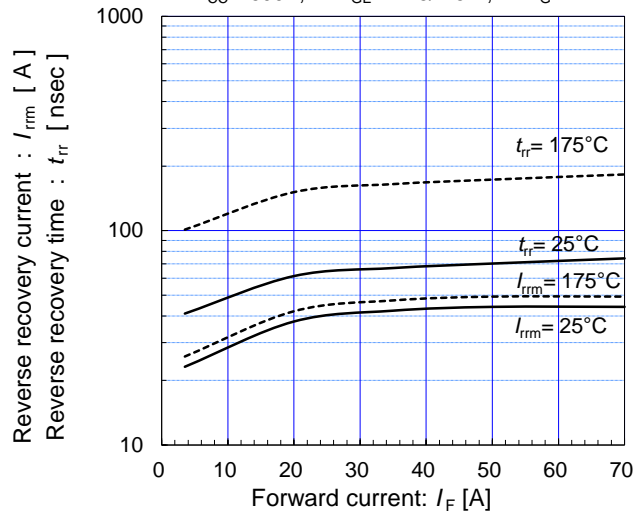
[ Inverter ]

Forward current vs. Forward voltage (typ.)  
chip



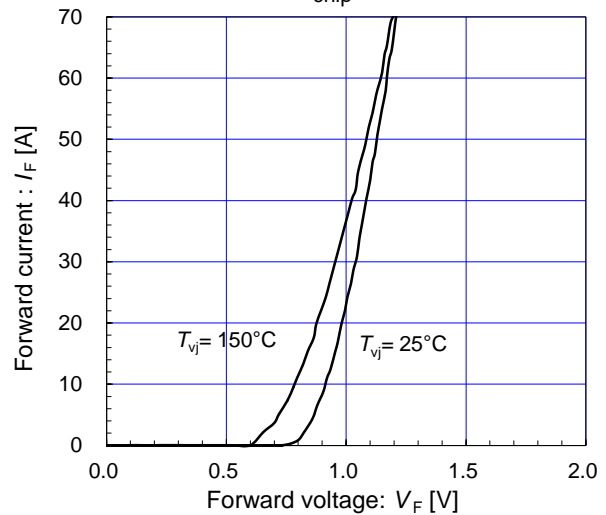
[ Inverter ]

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

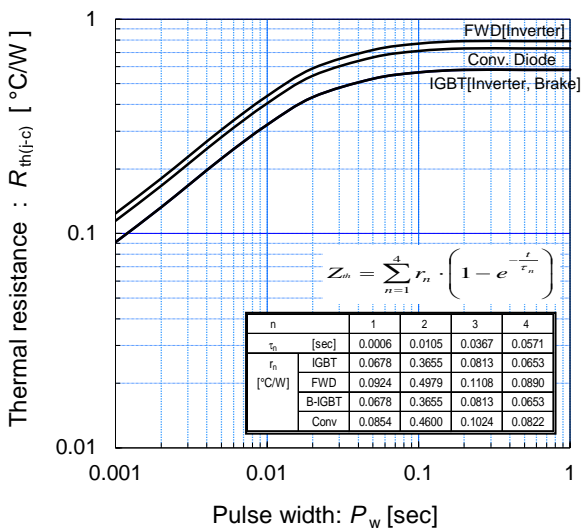


[ Converter ]

Forward current vs. Forward voltage (typ.)  
chip

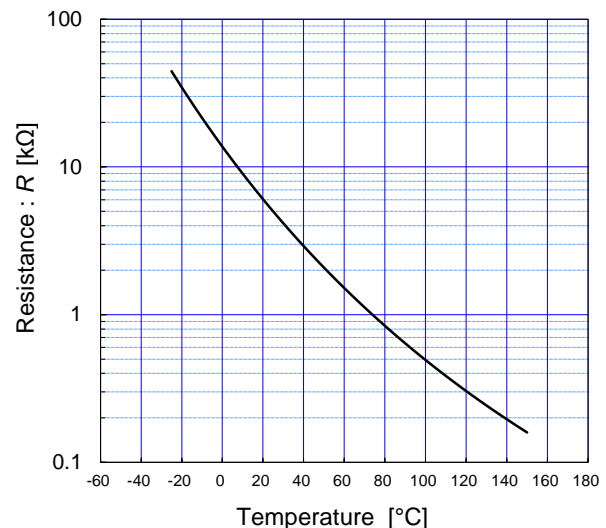


Transient thermal resistance (max.)



[ Thermistor ]

Temperature characteristic (typ.)



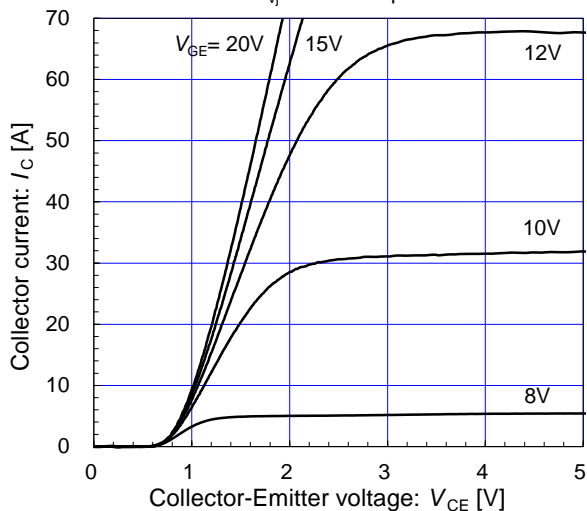
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IGBT Modules

[ Brake ]

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

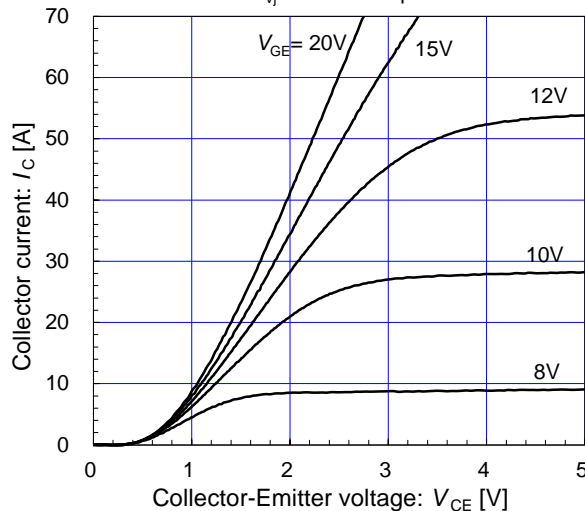
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[ Brake ]

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

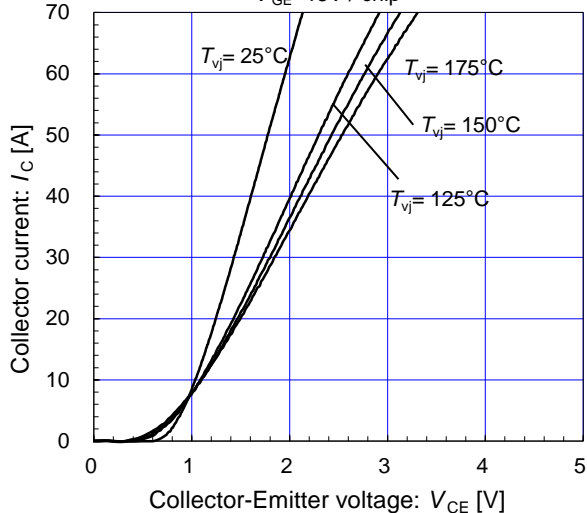
$T_{vj} = 175^{\circ}\text{C} / \text{chip}$



[ Brake ]

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

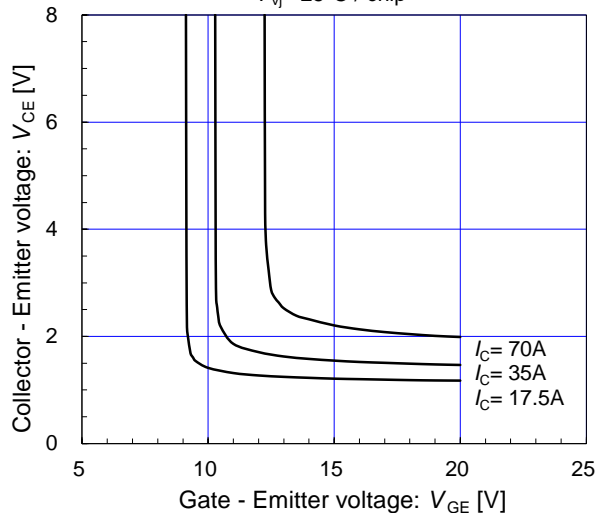
$V_{GE} = 15\text{V} / \text{chip}$



[ Brake ]

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

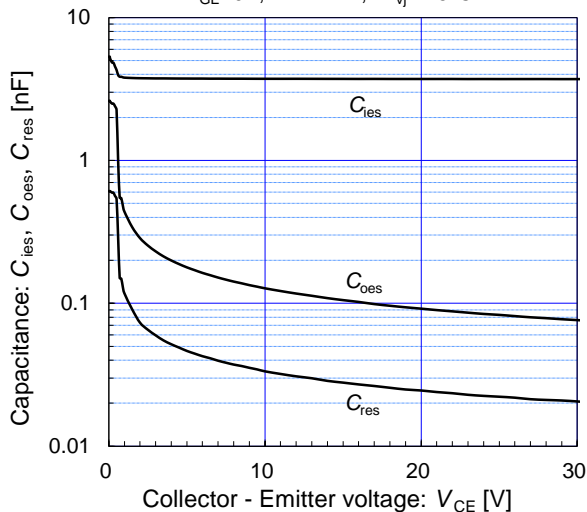
$T_{vj} = 25^{\circ}\text{C} / \text{chip}$



[ Brake ]

Capacitance vs. Collector-Emittor voltage (typ.)

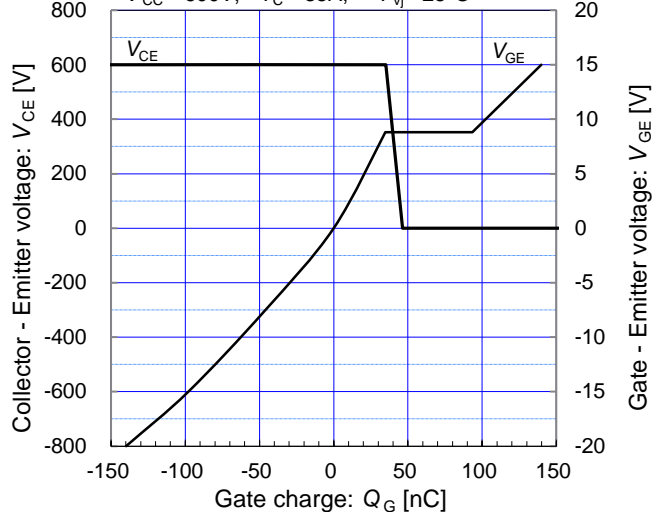
$V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}$



[ 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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