

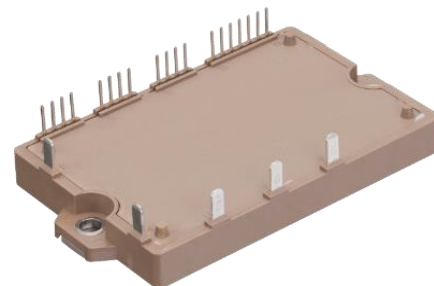
# 6MBP35XBA120-50

IGBT Modules

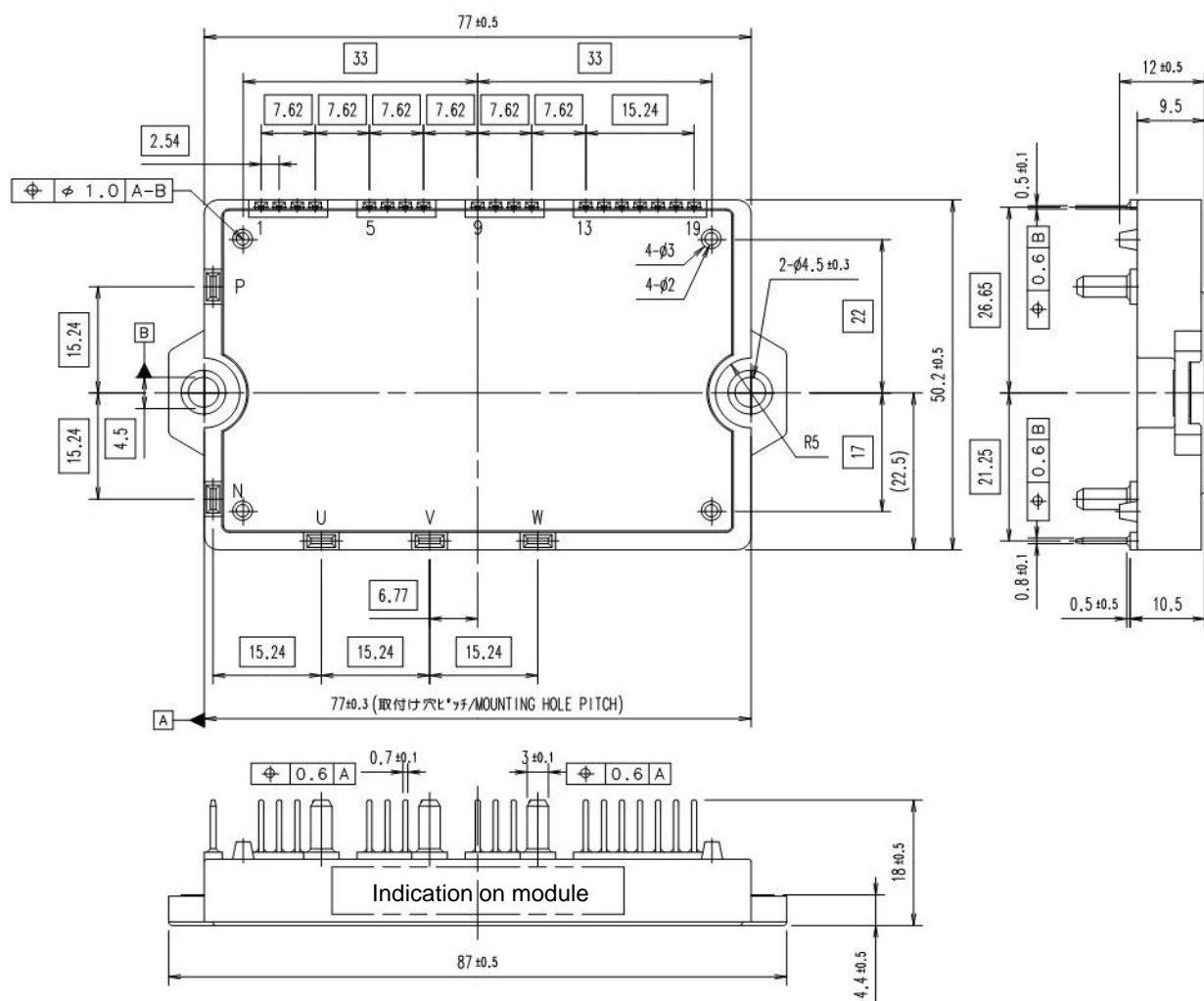
**IGBT Module (X series)**  
1200V / 35A / IPM

## ■ Features

- Temperature protection provided by directly detecting the junction temperature of the IGBTs
- Low power loss and soft switching
- High performance and high reliability IGBT with overheating protection
- Higher reliability because of a big decrease in number of parts in built-in control circuit



## ■ Outline drawing ( Unit : mm )



Weight:100g(typ.)

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IGBT Modules

## Absolute maximum ratings

 $T_C = 25^\circ\text{C}$ ,  $T_{vj} = 25^\circ\text{C}$ ,  $V_{CC} = 15\text{V}$  unless otherwise specified

Item		Symbol	Conditions	Min.	Max.	Units
Collector-Emitter voltage		$V_{CES}$	*1	-	1200	V
Short circuit voltage		$V_{SC}$	*2	400	800	V
Inverter	Collector current	$I_C$	DC	-	35	A
		$I_{CP}$	1ms	-	70	A
		$-I_C$	Duty=100% *3	-	35	A
	Total power dissipation	$P_{tot}$	IGBT 1 device *4	-	245	W
Brake	Collector current	$I_C$	DC	-	-	A
		$I_{CP}$	1ms	-	-	A
	Forward current of diode	$I_F$		-	-	A
	Total power dissipation	$P_{tot}$	IGBT 1 device *4	-	-	W
Supply voltage of pre-driver		$V_{CC}$	*5	-0.5	20	V
Input signal voltage		$V_{in}$	*6	-0.5	$V_{CC} + 0.5$	V
Alarm signal voltage		$V_{ALM}$	*7	-0.5	$V_{CC}$	V
Alarm signal current		$I_{ALM}$	*8	-	20	mA
$T_{vj}$ Warning signal voltage		$V_{WNG}$	*9	-0.5	$V_{CC}$	V
$T_{vj}$ Warning signal current		$I_{WNG}$	*10	-	20	mA
Virtual junction temperature		$T_{vj}$		-	175	$^\circ\text{C}$
Operating virtual junction temperature		$T_{vjop}$		-	150	$^\circ\text{C}$
Operating case temperature		$T_c$		-20	125	$^\circ\text{C}$
Storage temperature		$T_{stg}$		-40	125	$^\circ\text{C}$
Solder temperature		$T_{sol}$	*11	-	260	$^\circ\text{C}$
Isolating voltage		$V_{isol}$	*12	-	2500	Vrms
Mounting torque of screws to heat sink		$M_s$	Mounting(M4)	-	1.7	Nm
Mounting torque of screws to terminals		$M_t$	Main terminals(M4)	-	-	Nm

### Notes

- \*1:  $V_{CES}$  shall be applied to the input voltage between terminal P-(U,V, W) and (U,V, W)-N.  
 \*2: In the case of the load inductance to be over 1 $\mu\text{H}$ .  
 \*3: Duty=150 $^\circ\text{C}/R_{th(i-c)D}/(I_F \times V_F \text{ Max.}) \times 100$   
 \*4:  $P_{tot}=150^\circ\text{C}/R_{th(i-c)Q}$   
 \*5:  $V_{CC}$  shall be applied to the input voltage between terminal No.4 and 1, 8 and 5, 12 and 9, 14 and 13.  
 \*6:  $V_{in}$  shall be applied to the input voltage between terminal No.3 and 1, 7 and 5, 11 and 9, 16~18 and 13.  
 \*7:  $V_{ALM}$  shall be applied to the voltage between terminal No.2 and 1, 6 and 5, 10 and 9, 19 and 13.  
 \*8:  $I_{ALM}$  shall be applied to the input current to terminal No.2,6,10 and 19.  
 \*9:  $V_{WNG}$  shall be applied to the voltage between terminal No.15 and 13.  
 \*10:  $I_{WNG}$  shall be applied to the input current to terminal No.15.  
 \*11: Immersion time 10 $\pm$ 1sec. 1 time.  
 \*12: Terminal to base, 50/60Hz sine wave 1 min. All terminals should be connected together during the test.

## Electrical characteristics

### Main circuit

 $T_{vj} = 25^\circ\text{C}$ ,  $V_{CC} = 15\text{V}$  unless otherwise specified

Item		Symbol	Conditions	Min.	Typ.	Max.	Units
Inverter	Collector current at off signal input	$I_{CES}$	$V_{CE} = 1200\text{V}$	-	-	1.0	mA
	Collector-Emitter saturation voltage	$V_{CE(sat)}$	$I_C = 35\text{A}$	-	-	1.80	V
			Terminal	-	1.40	-	V
	Forward voltage of FWD	$V_F$	$I_F = 35\text{A}$	-	-	2.45	V
			Chip	-	2.00	-	V
Brake	Collector current at off signal input	$I_{CES}$		-	-	-	mA
	Collector-Emitter saturation voltage	$V_{CE(sat)}$	Terminal	-	-	-	V
			Chip	-	-	-	V
	Forward voltage of FWD	$V_F$	Terminal	-	-	-	V
			Chip	-	-	-	V
Switching time *13	$t_{on}$	$t_{d(on)}$	$I_C = 35\text{A}$ $T_{vj} = 150^\circ\text{C}$	0.5	-	-	$\mu\text{s}$
			$V_{DC} = 600\text{V}$	0.5	-	-	$\mu\text{s}$
				-	-	2.0	$\mu\text{s}$
				-	-	1.7	$\mu\text{s}$
	$t_{rr}$		$I_F = 35\text{A}$ $T_{vj} = 150^\circ\text{C}$	-	-	0.5	$\mu\text{s}$
			$V_{DC} = 600\text{V}$				

\*13: Turn on time ( $t_{on}$ ) =  $t_{d(on)} + t_r$ , Turn off time ( $t_{off}$ ) =  $t_{d(off)} + t_f$

# 6MBP35XBA120-50

**IGBT Modules**

## ● Control circuit

 $T_{vj}=25^{\circ}\text{C}$ ,  $V_{CC}=15\text{V}$  unless otherwise specified

Item	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply current of P-side pre-driver (per one unit)	$I_{ccp}$	Switching frequency ( $f_{sw}$ ) = 0~15kHz $T_C = -20\sim 125^{\circ}\text{C}$	-	-	10	mA
Supply current of N-side pre-driver	$I_{ccn}$		-	-	26	mA
Input signal threshold voltage	$V_{in(th)(on)}$	$V_{in}\text{-GND}$	1.2	1.4	1.6	V
	$V_{in(th)(off)}$					
		ON	1.2	1.4	1.6	V
		OFF	1.5	1.7	1.9	V

## ● Protection circuit

 $T_{vj}=25^{\circ}\text{C}$ ,  $V_{CC}=15\text{V}$  unless otherwise specified

Item	Symbol	Conditions	Min.	Typ.	Max.	Units
Over current protection level	$I_{OC}$	$T_{vj}=150^{\circ}\text{C}$	53	-	-	A
			-	-	-	A
Over current protection delay time	$t_{dOC}$	$T_{vj}=150^{\circ}\text{C}$	-	4.0	-	$\mu\text{s}$
Short circuit protection delay time	$t_{dSC}$	$T_{vj}=150^{\circ}\text{C}$	-	1.0	-	$\mu\text{s}$
IGBT chips over heating protection temperature level	$T_{jOH}$	Surface of IGBT chips	175	-	-	$^{\circ}\text{C}$
Over heating protection hysteresis	$T_{jH}$		-	20	-	$^{\circ}\text{C}$
IGBT chips warning temperature level	$T_{jW}$	Surface of IGBT chips (Y)	150	-	-	
Warning hysteresis	$T_{jWH}$		-	10	-	
Under voltage protection level	$V_{UV}$		11.0	-	12.5	V
Under voltage protection hysteresis	$V_H$		0.2	0.5	-	V
Alarm signal hold time	$t_{ALM(OC)}$	ALM-GND	1.0	2.0	2.4	ms
	$t_{ALM(UV)}$	$T_C=-20\sim 125^{\circ}\text{C}$	3.5	4.0	4.5	ms
	$t_{ALM(TjOH)}$	$V_{CC}\geq 10\text{V}$	7.0	8.0	9.0	ms
Warning signal hold time	$t_{WNG}$	WNG-GND $T_C=-20\sim 125^{\circ}\text{C}$	$T_{jw}$ operating ~ cancellation			ms
Alarm signal voltage	$V_{ALMH}$	ALM-GND, without protection	14.5	-	15.0	V
Warning signal voltage	$V_{WNGH}$	WNG-GND, without warning	14.5	-	15.0	V
Resistance for current limit	$R_{ALM}$		960	-	1570	$\Omega$
	$R_{WNG}$		960	-	1570	$\Omega$

## ■ Thermal resistance characteristics ( $T_C = 25^{\circ}\text{C}$ )

Item			Symbol	Min.	Typ.	Max.	Units
Thermal resistance junction to case *14	Inverter	IGBT	$R_{th(i-c)Q}$	-	-	0.61	K/W
		FWD	$R_{th(i-c)D}$	-	-	0.94	K/W
	Brake	IGBT	$R_{th(i-c)Q}$	-	-	-	K/W
		FWD	$R_{th(i-c)D}$	-	-	-	K/W
Thermal resistance case to heat sink *15			$R_{th(c-s)}$	-	0.05	-	K/W

\*14: For 1 device, the measurement point of the case is just under the chip.

\*15: This is the value which is defined mounting on the additional heat sink with 1 W/(m·K) thermal grease.

## ■ Noise immunity ( $V_{DC}=600\text{V}$ , $V_{CC}=15\text{V}$ )

Item	Conditions	Min.	Typ.	Max.	Units
Common mode rectangular noise	Pulse width 1 $\mu\text{s}$ , polarity $\pm$ , 10min. Judge: no over-current, no miss operating	$\pm 2.0$	-	-	kV

## ■ Recommended operating conditions

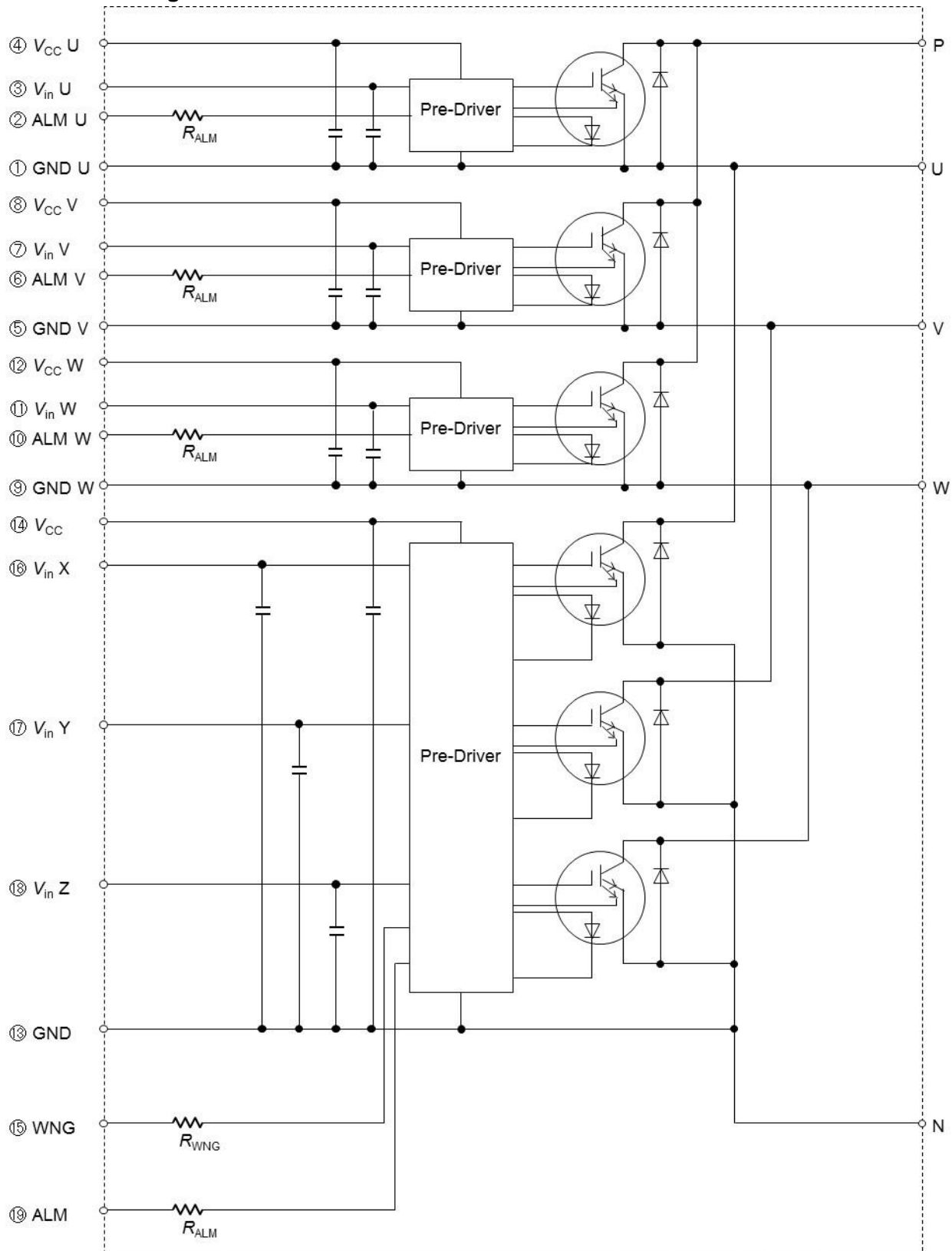
Item	Symbol	Min.	Typ.	Max.	Units
DC bus voltage	$V_{DC}$	-	-	800	V
Power supply voltage of pre-driver	$V_{CC}$	13.5	15.0	16.5	V
Switching frequency of IPM	$f_{sw}$	-	-	20.0	kHz
Arm shoot through blocking time for IPM's input signal *16	$t_{dead}$	1.5	-	-	$\mu\text{s}$
Screw torque (M4)	-	1.3	-	1.7	Nm

\*16:  $t_{dead} = t_{off} - t_{d(on)}$

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IGBT Modules

## ■ Block diagram



Pre-drivers include following functions

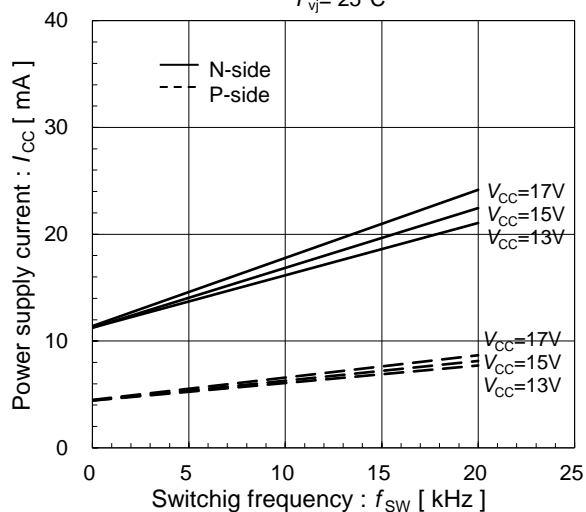
1. Amplifier for driver
2. Short circuit protection
3. Under voltage lockout circuit
4. Over current protection
5. IGBT chip over heating protection

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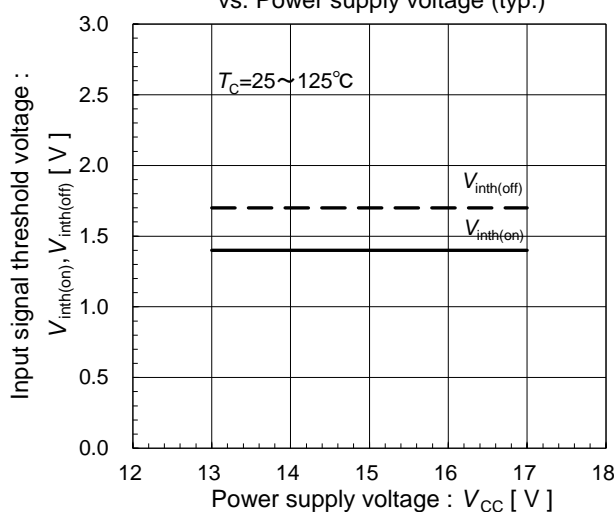
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■ Characteristics (representative)  
● Control circuit

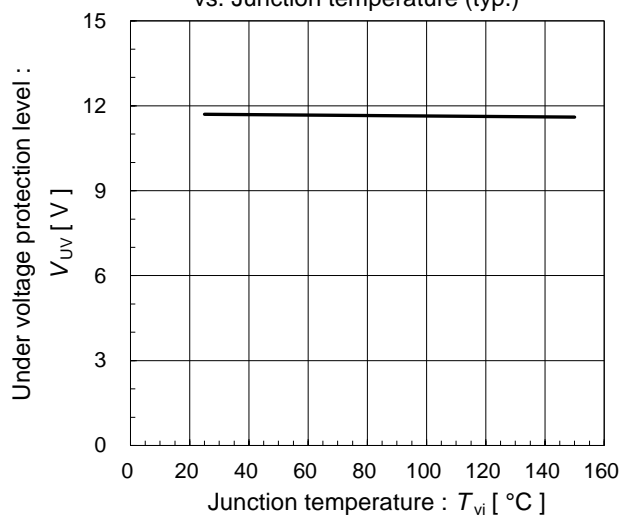
Power supply current vs. Switching frequency (typ.)  
 $T_{vj} = 25^{\circ}\text{C}$



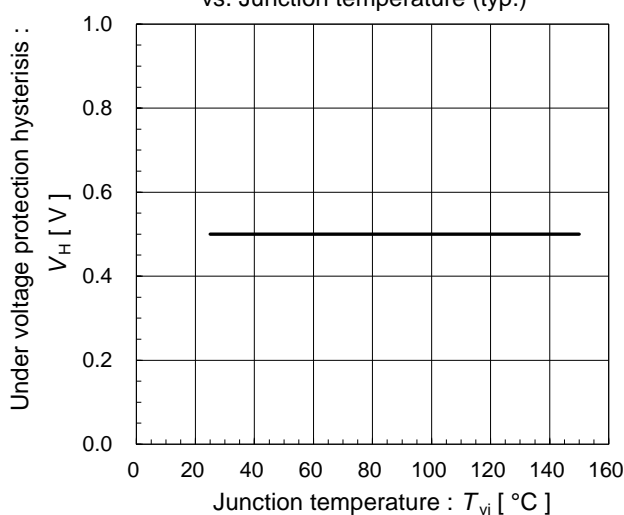
Input signal threshold voltage  
vs. Power supply voltage (typ.)



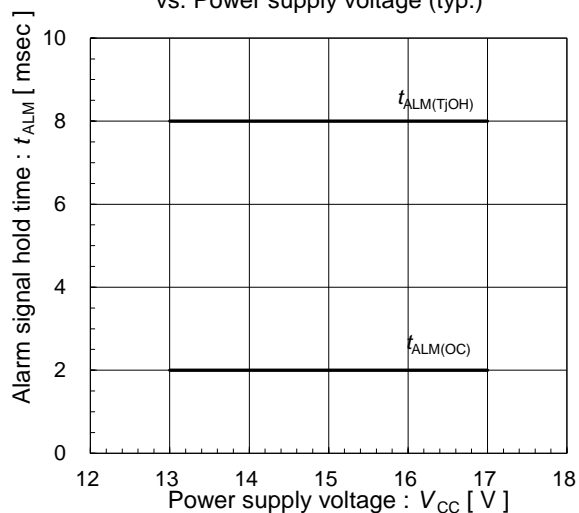
Under voltage protection level  
vs. Junction temperature (typ.)



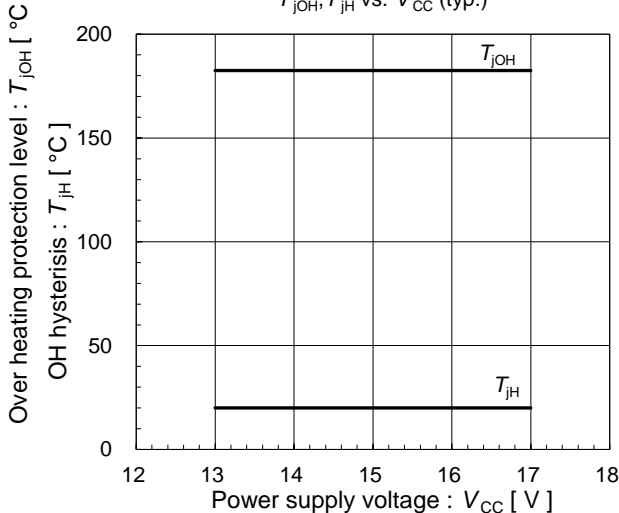
Under voltage protection hysteresis  
vs. Junction temperature (typ.)



Alarm signal hold time  
vs. Power supply voltage (typ.)



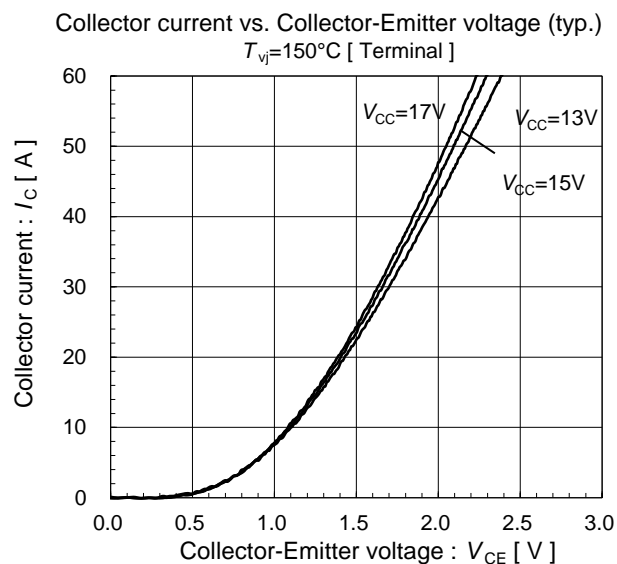
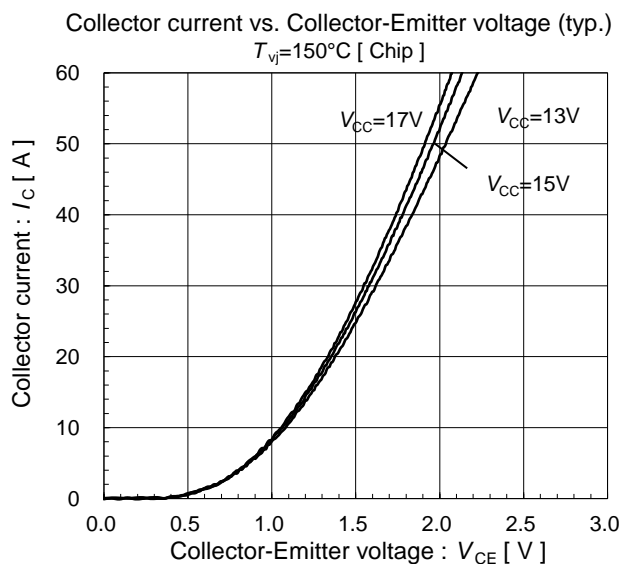
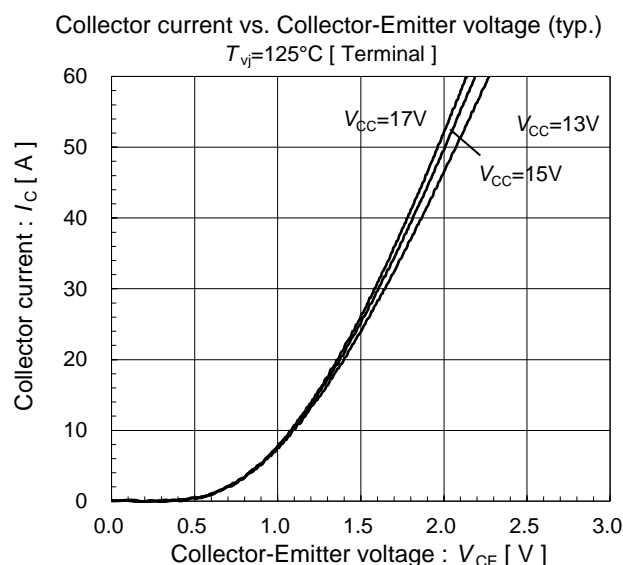
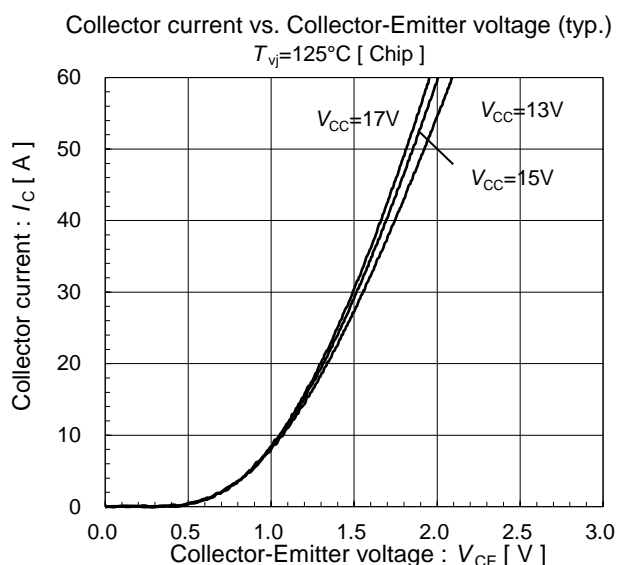
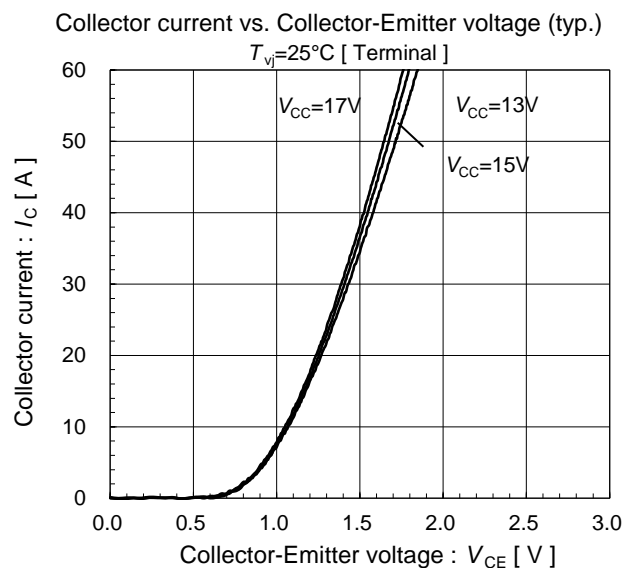
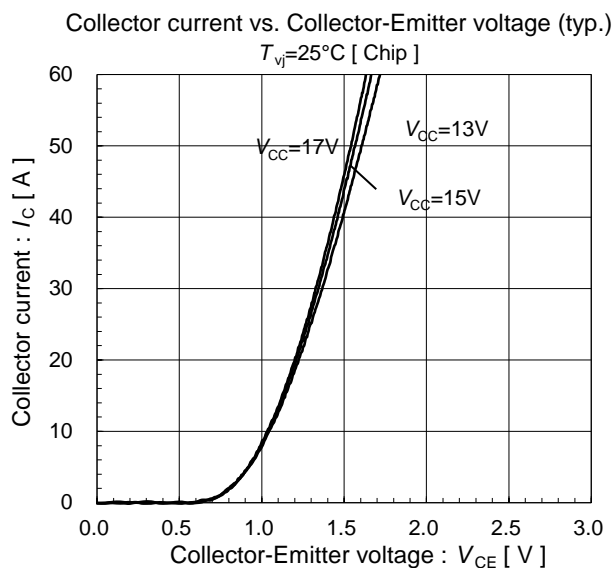
Over heating characteristics  
 $T_{JOH}, T_{JH}$  vs.  $V_{CC}$  (typ.)



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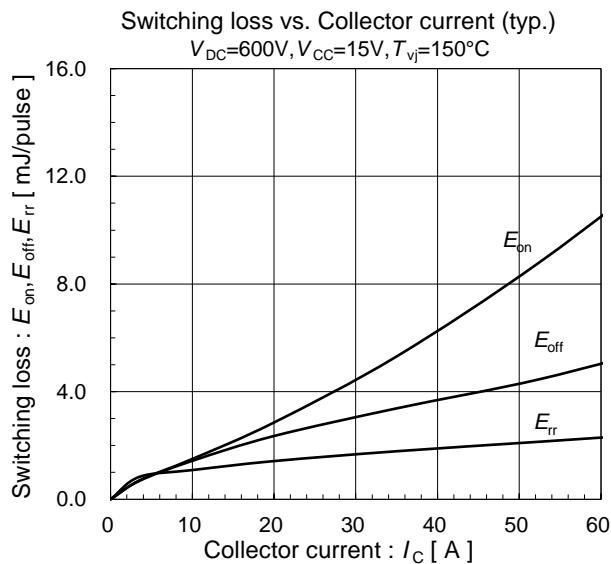
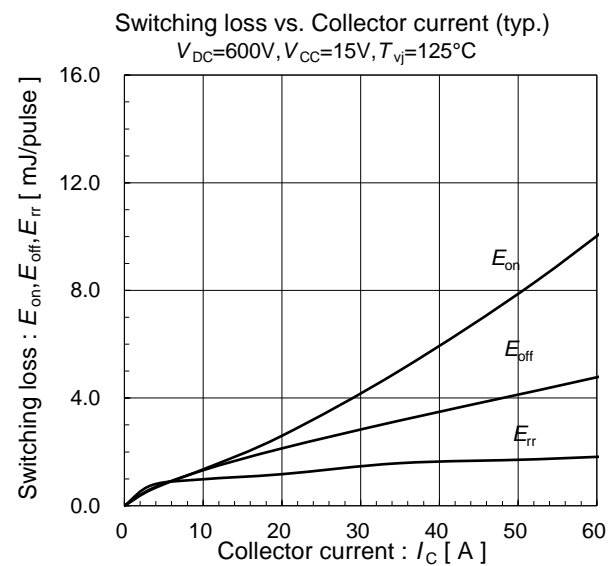
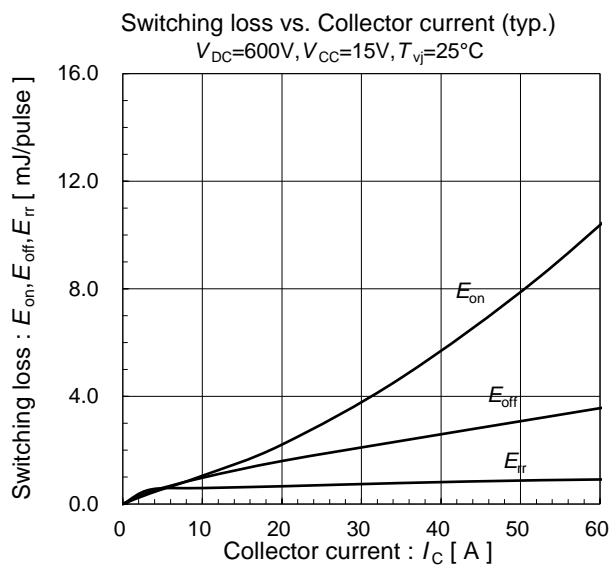
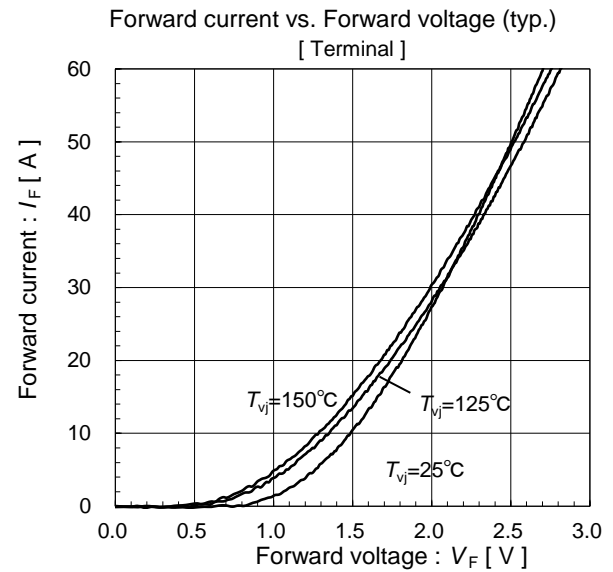
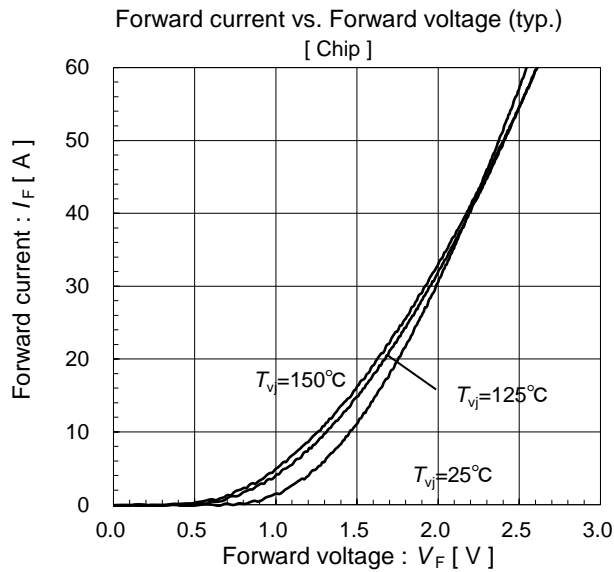
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## ● Inverter



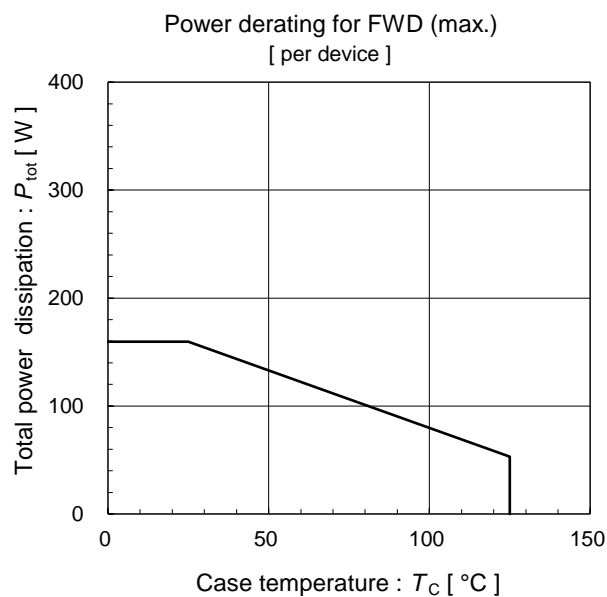
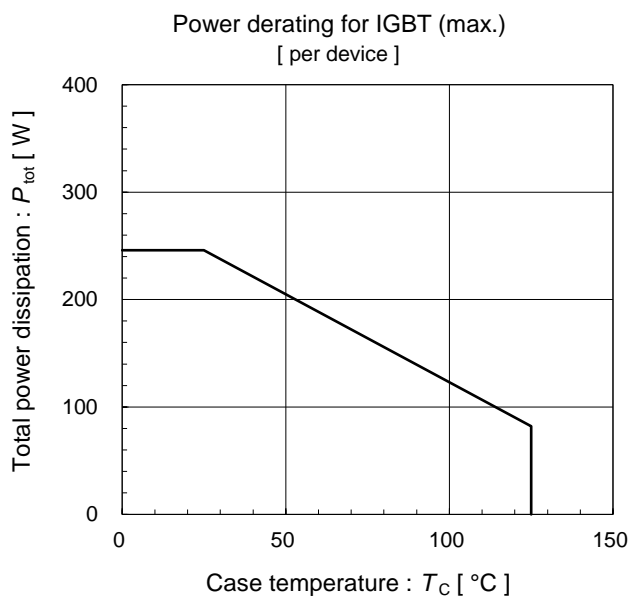
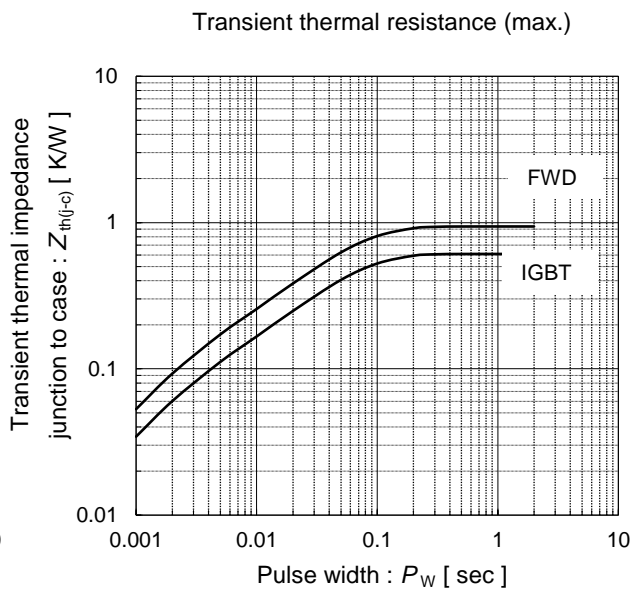
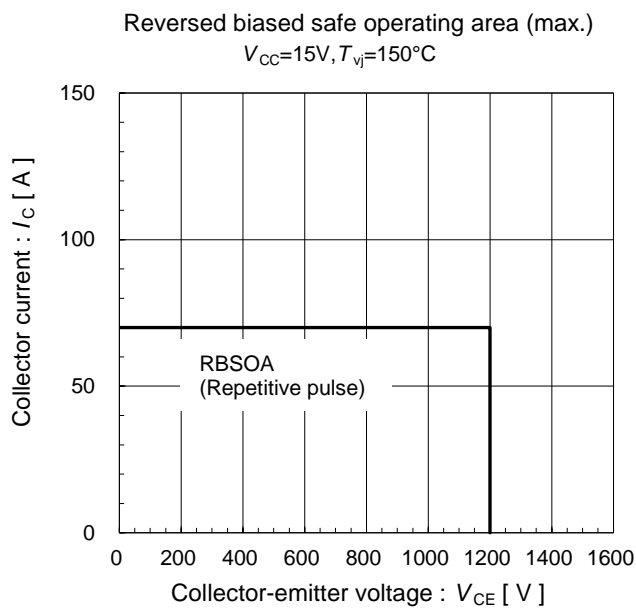
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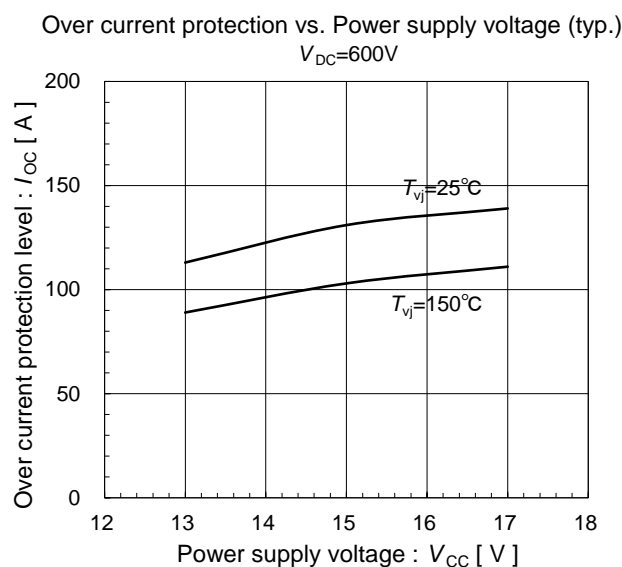
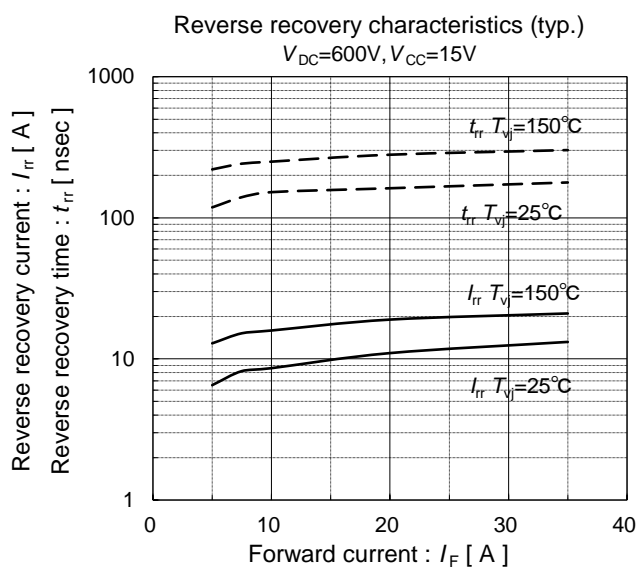
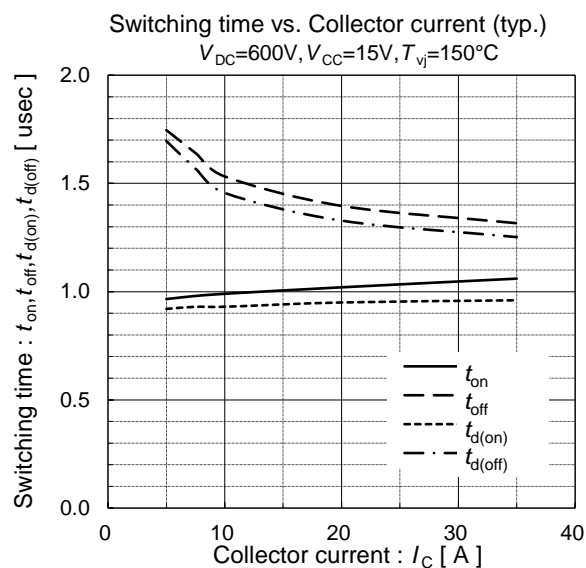
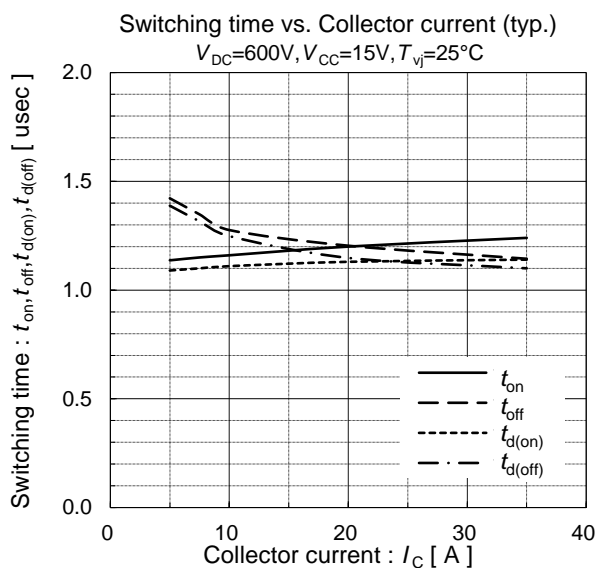
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