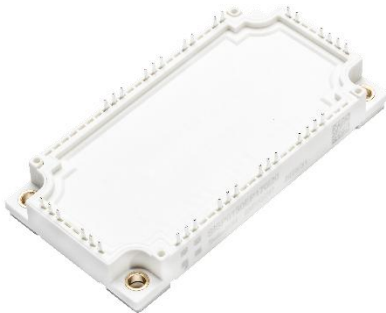


DATASHEET

SISP0150EP170i20

EP-Type H-bridge IGBT module with input rectifier



$V_{CE} = 1700 \text{ V}$

$I_C = 4 \times 150 \text{ A}$

- *i20* ultra-low loss fine pattern Trench IGBT chipset *i20IGBT*
- PIM with H-bridge and input rectifier
- Baseplate isolation with efficient Al_2O_3 ceramic Al_2O_3
- Cu baseplate for low thermal resistance
- Industry standard package

Maximum ratings¹

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNIT
Collector-emitter voltage	V_{CES} / V_{RRM}	$V_{GE} = 0 \text{ V}$, $T_{vj} = 25 \text{ °C}$		1700	V
DC collector current	I_C	$T_C = 125 \text{ °C}$, $T_{vj} = 175 \text{ °C}$		150	A
Peak collector current	I_{CM}	$t_p = 1 \text{ ms}$		300	A
Gate-emitter voltage	V_{GES}		-20	20	V
Total power dissipation	P_{tot}	$T_C = 25 \text{ °C}$, $T_{vj} = 175 \text{ °C}$, per IGBT		1040	W
DC forward current	I_F			150	A
Peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$		300	A
Surge current FWD	I_{FSM} I^2t	$V_R = 0 \text{ V}$, $T_{vj} = 150 \text{ °C}$, $t_p = 10 \text{ ms}$, half-sinewave		685 2360	A A ² s
Surge current Rectifier	I_{FSM} I^2t	$V_R = 0 \text{ V}$, $T_{vj} = 150 \text{ °C}$, $t_p = 10 \text{ ms}$, half-sinewave		1260 7940	A A ² s
Isolation voltage	V_{isol}	1 min, $f = 50 \text{ Hz}$		3400	V
Junction operating temperature	$T_{vj(op)}$		-40	175 ²	°C
Case temperature	T_C		-40	125	°C
Storage temperature	T_{stg}		-40	125	°C
Mounting torques ³	M_S	Base-heatsink, M5 screws	3	6	Nm

¹ Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747;

² $T_{vj(op)} > 150 \text{ °C}$ allowed for overload conditions, less than 20% of operation time

³ For details, please refer to the mounting instructions.

IGBT⁴

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Collector(-emitter) breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}$, $I_C = 1 \text{ mA}$, $T_{vj} = 25^\circ\text{C}$	1700			V
Collector-emitter saturation voltage ⁵	V_{CESat}	$I_C = 150 \text{ A}$, $V_{GE} = 15 \text{ V}$		1.65	2.0	V
		$T_{vj} = 125^\circ\text{C}$		1.85		V
		$T_{vj} = 175^\circ\text{C}$		2.05		V
Collector cut-off current	I_{CES}	$V_{CE} = 1700 \text{ V}$, $V_{GE} = 0 \text{ V}$			1	mA
		$T_{vj} = 125^\circ\text{C}$		0.3		mA
		$T_{vj} = 175^\circ\text{C}$		4.5		mA
Gate leakage current	I_{GES}	$V_{CE} = 0 \text{ V}$, $V_{GE} = \pm 20 \text{ V}$	-0.5		0.5	μA
Gate-emitter threshold voltage	$V_{GE(th)}$	$I_C = 7.5 \text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25^\circ\text{C}$	5	6.15	7.5	V
Gate charge	Q_G	$I_C = 150 \text{ A}$, $V_{CE} = 900 \text{ V}$, $V_{GE} = -15 \text{ V} \dots 15 \text{ V}$		1.12		μC
Input capacitance	C_{ies}	$V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$, $f = 100 \text{ kHz}$, $T_{vj} = 25^\circ\text{C}$		11.5		nF
Output capacitance	C_{oes}			0.46		nF
Reverse transfer capacitance	C_{res}			0.35		nF
Internal gate resistor	R_{Gint}	Per switch, $f = 1 \text{ MHz}$, $V_{GE} = 0 \text{ V}$, CE short		3.7		Ω
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 900 \text{ V}$, $I_C = 150 \text{ A}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 11 \Omega$ (A1 switch), $R_G = 6.5 \Omega$ (A2 switch), $L_S = 90 \text{ nH}$, inductive load	$T_{vj} = 25^\circ\text{C}$	180		ns
			$T_{vj} = 125^\circ\text{C}$	189		ns
			$T_{vj} = 175^\circ\text{C}$	195		ns
Rise time	t_r		$T_{vj} = 25^\circ\text{C}$	32		ns
			$T_{vj} = 125^\circ\text{C}$	36		ns
			$T_{vj} = 175^\circ\text{C}$	39		ns
Turn-off delay time	$t_{d(off)}$	$V_{CC} = 900 \text{ V}$, $I_C = 150 \text{ A}$, $R_G = 4.5 \Omega$, $V_{GE} = \pm 15 \text{ V}$, $L_S = 90 \text{ nH}$, inductive load	$T_{vj} = 25^\circ\text{C}$	494		ns
			$T_{vj} = 125^\circ\text{C}$	587		ns
			$T_{vj} = 175^\circ\text{C}$	626		ns
Fall time	t_f		$T_{vj} = 25^\circ\text{C}$	405		ns
			$T_{vj} = 125^\circ\text{C}$	604		ns
			$T_{vj} = 175^\circ\text{C}$	690		ns
Turn-on switching energy	E_{on}	$V_{CC} = 900 \text{ V}$, $I_C = 150 \text{ A}$, $R_G = 11 \Omega$ (A1 switch), $R_G = 6.5 \Omega$ (A2 switch), $L_S = 90 \text{ nH}$, inductive load	$T_{vj} = 25^\circ\text{C}$	46		mJ
			$T_{vj} = 125^\circ\text{C}$	58		mJ
			$T_{vj} = 175^\circ\text{C}$	66		mJ
Turn-off switching energy	E_{off}	$V_{CC} = 900 \text{ V}$, $I_C = 150 \text{ A}$, $R_G = 4.5 \Omega$, $V_{GE} = \pm 15 \text{ V}$, $L_S = 90 \text{ nH}$, inductive load	$T_{vj} = 25^\circ\text{C}$	30		mJ
			$T_{vj} = 125^\circ\text{C}$	42		mJ
			$T_{vj} = 175^\circ\text{C}$	47		mJ
Short circuit current	I_{SC}	$t_{pCS} \leq 10 \mu\text{s}$, $V_{GE} = 15 \text{ V}$, $T_{vj} = 175^\circ\text{C}$, $V_{CC} = 1200 \text{ V}$, $V_{CEM \text{ Chip}} \leq 1700 \text{ V}$		858		A

⁴ Characteristic values according to IEC 60747-9

⁵ Collector-emitter saturation voltage is given at chip-level

Diode FWD⁶

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Forward voltage ⁷	V_F	$I_F = 150 \text{ A}$	$T_{vj} = 25 \text{ °C}$	1.7	2.15	V
			$T_{vj} = 125 \text{ °C}$	1.85		V
			$T_{vj} = 175 \text{ °C}$	1.95		V
Peak reverse recovery current	I_{RM}	$V_R = 900 \text{ V}$, $I_F = 150 \text{ A}$, $R_G = 11 \text{ } \Omega$ (A1 switch), $R_G = 6.5 \text{ } \Omega$ (A2 switch), $L_s = 90 \text{ nH}$, inductive load	$T_{vj} = 25 \text{ °C}$	176		A
			$T_{vj} = 125 \text{ °C}$	184		A
			$T_{vj} = 175 \text{ °C}$	185		A
Recovery charge	Q_{rr}		$T_{vj} = 25 \text{ °C}$	35		μC
			$T_{vj} = 125 \text{ °C}$	55		μC
			$T_{vj} = 175 \text{ °C}$	66		μC
Reverse recovery time	t_{rr}		$T_{vj} = 25 \text{ °C}$	658		ns
			$T_{vj} = 125 \text{ °C}$	1054		ns
			$T_{vj} = 175 \text{ °C}$	1299		ns
Reverse recovery energy	E_{rec}		$T_{vj} = 25 \text{ °C}$	18		mJ
			$T_{vj} = 125 \text{ °C}$	30		mJ
			$T_{vj} = 175 \text{ °C}$	38		mJ

Diode Rectifier⁸

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Repetitive peak reverse voltage	V_{RRM}	$T_{vj}=25^\circ\text{C}$, $I_R = 1\text{mA}$	1700			V
Maximum RMS forward current	I_{FRMSM}	$T_C=95^\circ\text{C}$			150	A
Forward voltage ⁹	V_F	$I_F=150 \text{ A}$	$T_{vj} = 25 \text{ °C}$	1.08		V
			$T_{vj} = 125 \text{ °C}$	1.02		V
			$T_{vj} = 150 \text{ °C}$	1.0		V
Forward threshold voltage	$V_{(F0)}$	$T_{vj}=150^\circ\text{C}$, $I_F=50 - 150 \text{ A}$		0.7		V
Forward slope resistance	r_F	$T_{vj}=150^\circ\text{C}$, $I_F=50 - 150 \text{ A}$		2		m Ω
Junction operating temperature	$T_{vj(op)}$		-40		150	$^\circ\text{C}$

⁶ Characteristic values according to IEC 60747-2

⁷ Forward voltage is given at chip-level

⁸ Characteristic values according to IEC 60747-2

⁹ Forward voltage is given at chip-level



NTC Thermistor

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Rated resistance	R_{25}	$T_C = 25\text{ °C}$		5		k Ω
R100	R_{100}	$T_C = 100\text{ °C}$	468		518	Ω
B-value B	$B_{25/50}$	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15K))]$		3375		K
B-value B	$B_{25/100}$	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298.15K))]$		3433		K

Package properties ¹⁰

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$	Per switch				0.144	K/W
FWD thermal resistance junction to case	$R_{th(j-c)Diode}$					0.24	K/W
Rectifier thermal resistance junction to case	$R_{th(j-c)rectifier Diode}$					0.24	K/W
IGBT thermal resistance case to heatsink	$R_{th(c-h)IGBT}$				0.082		K/W
FWD thermal resistance case to heatsink	$R_{th(c-h)Diode}$				0.090		K/W
Rectifier thermal resistance case to heatsink	$R_{th(c-h)rectifier Diode}$				0.156		K/W
Comparative tracking index	CTI			400			
Module stray inductance	$L_s CE$	Per switch			35		nH
Resistance, terminal chip	$R_{CC'+EE'}$	Per switch	$T_{vj} = 25\text{ °C}$		2		m Ω
			$T_{vj} = 125\text{ °C}$		2.8		m Ω
			$T_{vj} = 175\text{ °C}$		3.1		m Ω

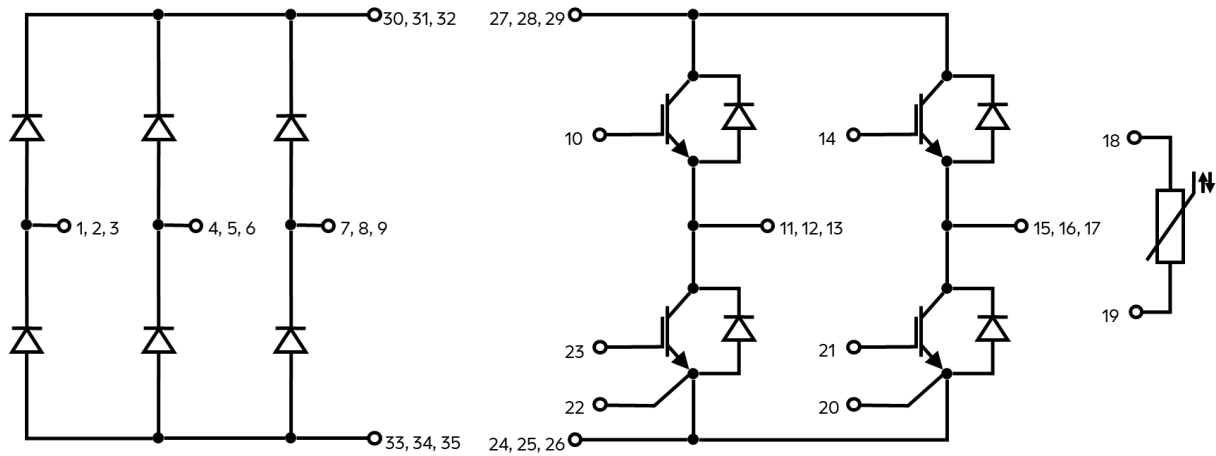
¹⁰ Package and mechanical properties according to IEC 60747-15



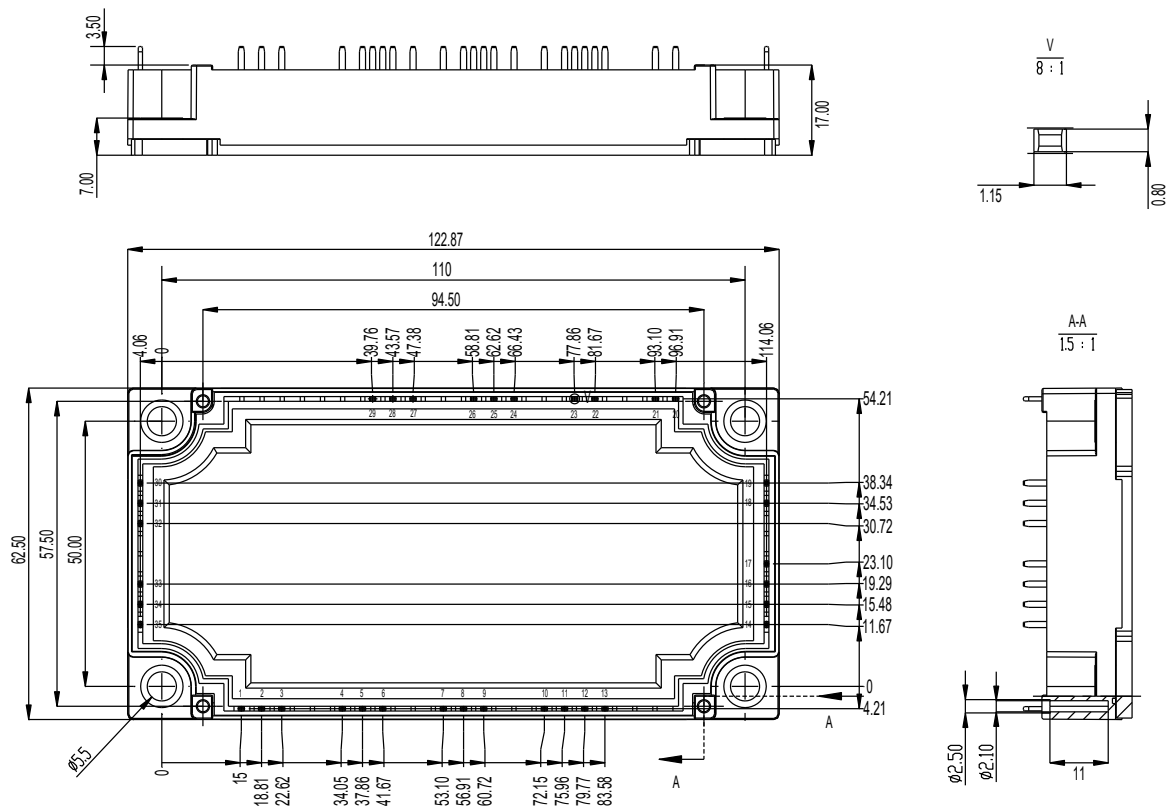
Mechanical properties

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Dimensions	L x W x H	Typical		122 x 62.5 x 17			mm ³
Clearance distance in air	d _a	According to IEC 60664-1 and EN 50124-1	Terminal to base:	10			mm
			Terminal to terminal:	10			mm
Surface creepage distance	d _s	According to IEC 60664-1 and EN 50124-1	Terminal to base:	7.5			mm
			Terminal to terminal:	10			mm
Mass	m				300		g

Electrical configuration



Outline drawing



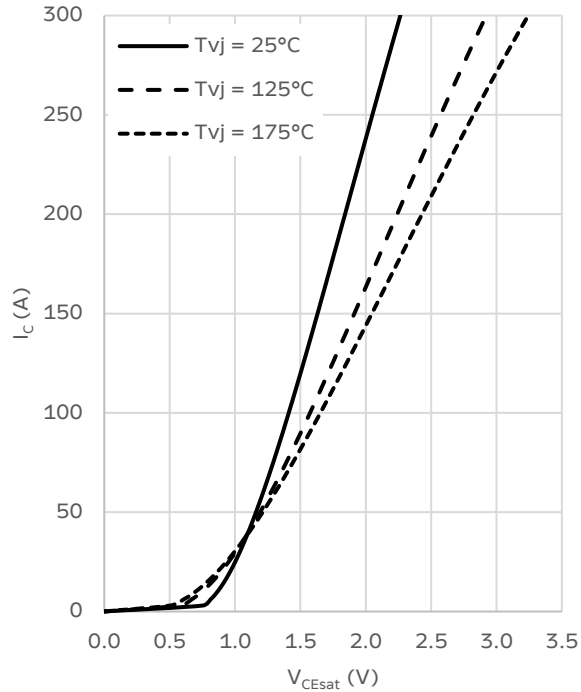
This is an electrostatic sensitive device.

This product has been designed and qualified for Industrial Level.

Characteristics

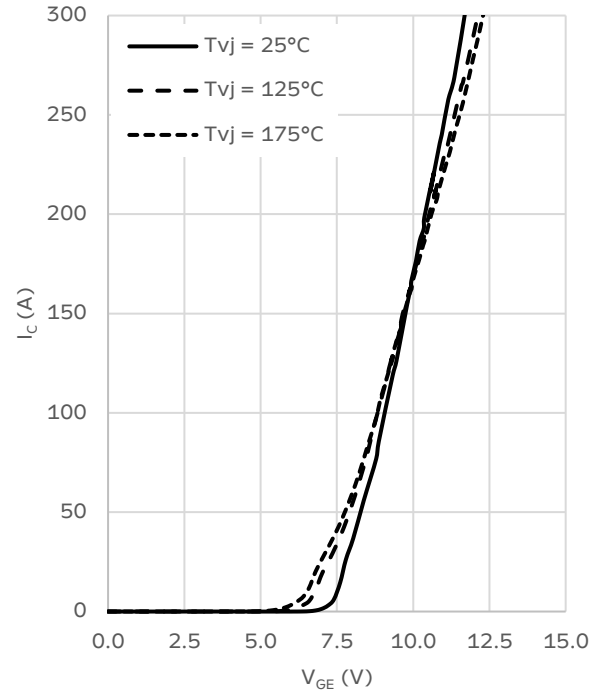
IGBT on-state characteristics (typical)

$I_C = f(V_{CE})$
 $V_{GE} = 15 \text{ V}$



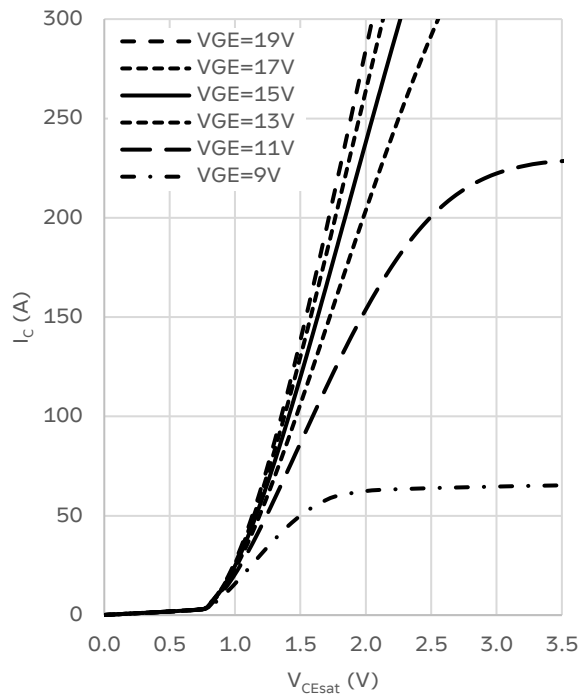
IGBT transfer characteristics (typical)

$I_C = f(V_{GE})$
 $V_{CE} = 20 \text{ V}$



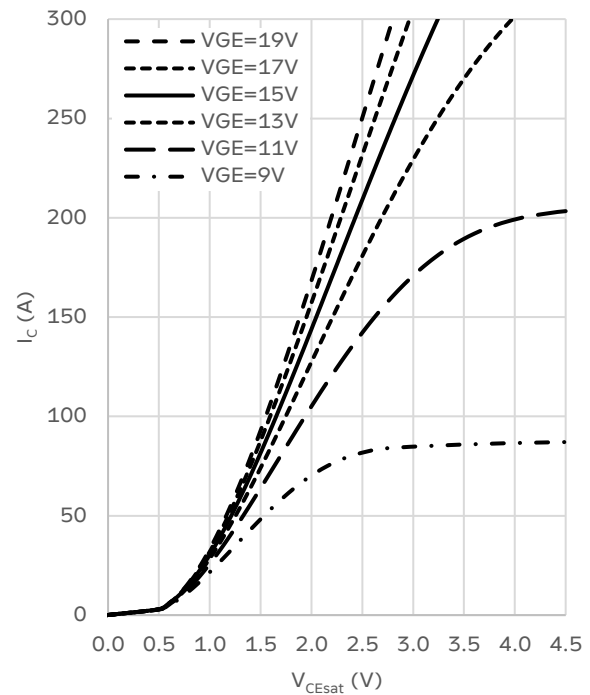
IGBT output characteristics (typical)

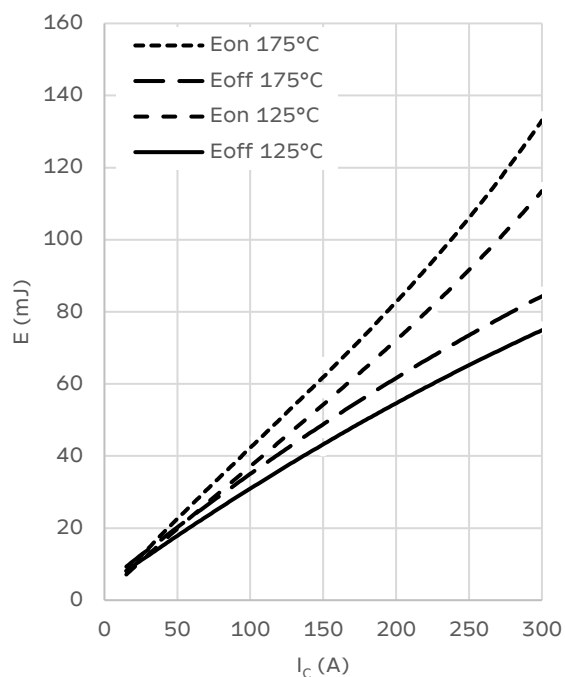
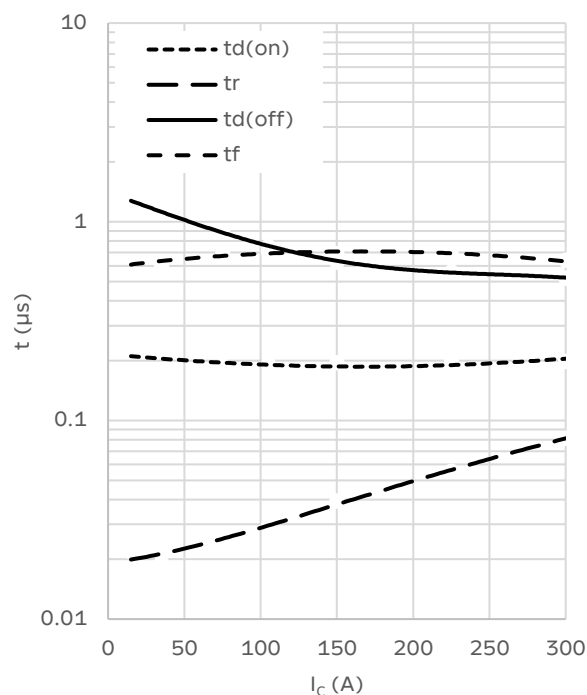
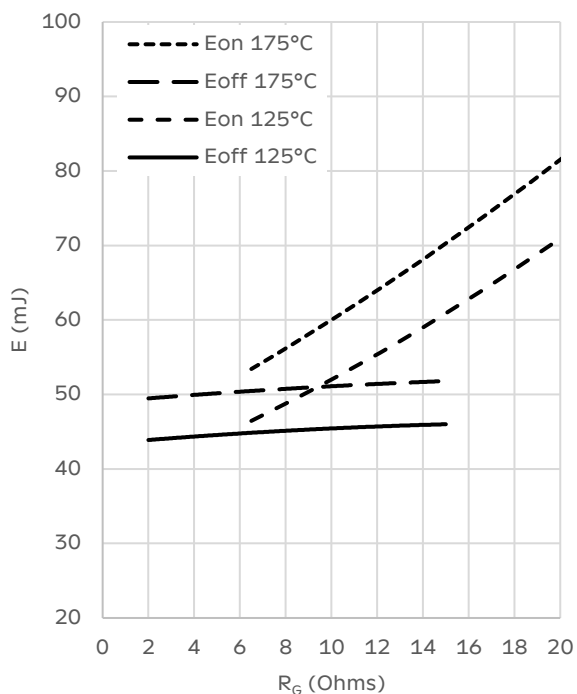
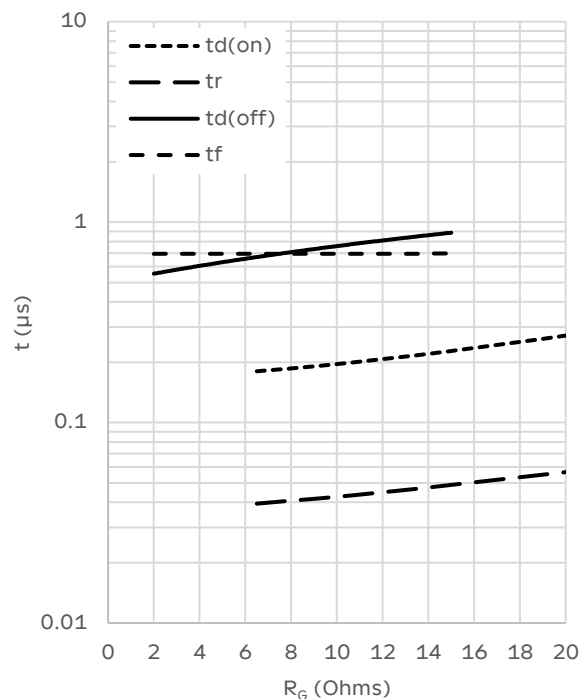
$I_C = f(V_{CE})$
 $T_{vj} = 25^\circ\text{C}$



IGBT output characteristics (typical)

$I_C = f(V_{CE})$
 $T_{vj} = 175^\circ\text{C}$



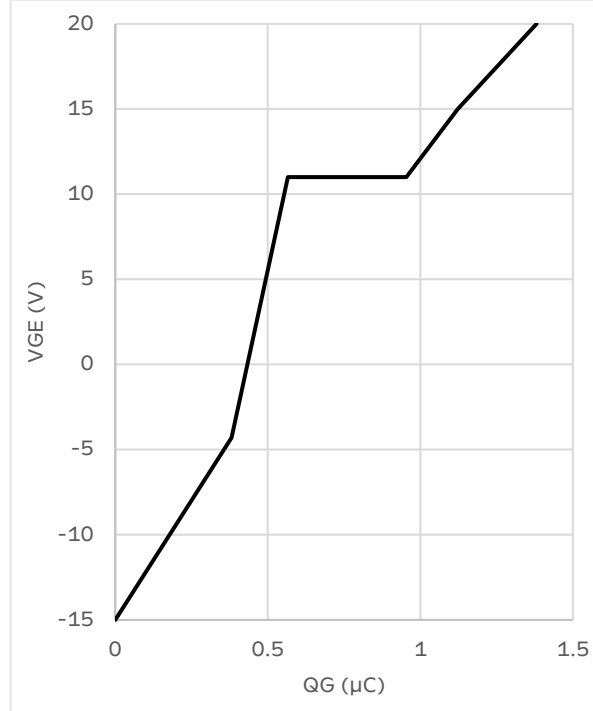
**IGBT switching losses (typical)** $E = f(I_{CE})$ $V_{CE} = 900\text{ V}$, $R_{Gon} = 11 / 6.5\ \Omega$, $R_{Goff} = 4.5\ \Omega$, $V_{GE} = -15/+15\text{ V}$ **IGBT switching times (typical)** $t = f(I_{CE})$, $T_{vj} = 175\text{ °C}$ $V_{CE} = 900\text{ V}$, $R_{Gon} = 11 / 6.5\ \Omega$, $R_{Goff} = 4.5\ \Omega$, $V_{GE} = -15/+15\text{ V}$ **IGBT switching losses (typical)** $E = f(R_G)$ $V_{CE} = 900\text{ V}$, $I_C = 150\text{ A}$, $V_{GE} = -15/+15\text{ V}$ **IGBT switching times (typical)** $t = f(R_G)$, $T_{vj} = 175\text{ °C}$ $V_{CE} = 900\text{ V}$, $I_C = 150\text{ A}$, $V_{GE} = -15/+15\text{ V}$ 



IGBT gate charge (typical)

$V_{GE} = f(Q_G)$, $T_{vj} = 25\text{ °C}$

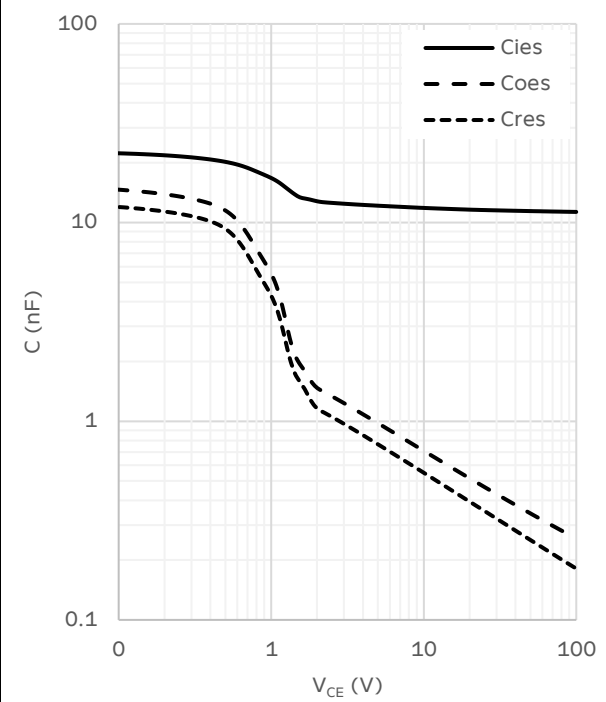
$V_{CE} = 900\text{ V}$, $I_C = 150\text{ A}$



Capacitance characteristics (typical)

$C = f(V_{CE})$, $T_{vj} = 25\text{ °C}$

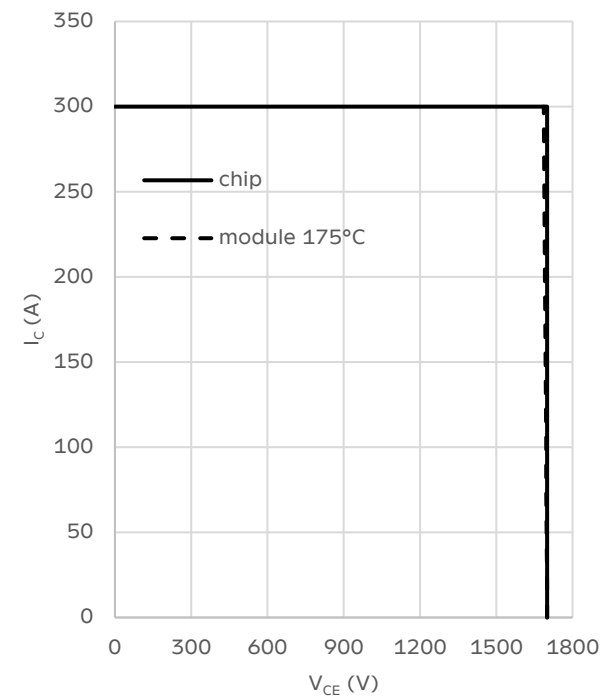
$f = 100\text{ kHz}$, $V_{GE} = 0\text{ V}$



IGBT RBSOA

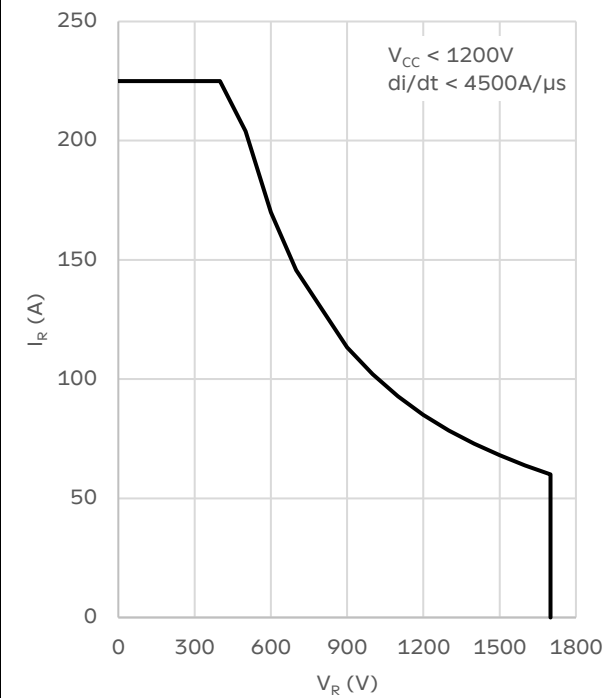
$I_C = f(V_{CEM})$

$R_{Goff} = 4.5\ \Omega$, $V_{GE} = \pm 15\text{ V}$



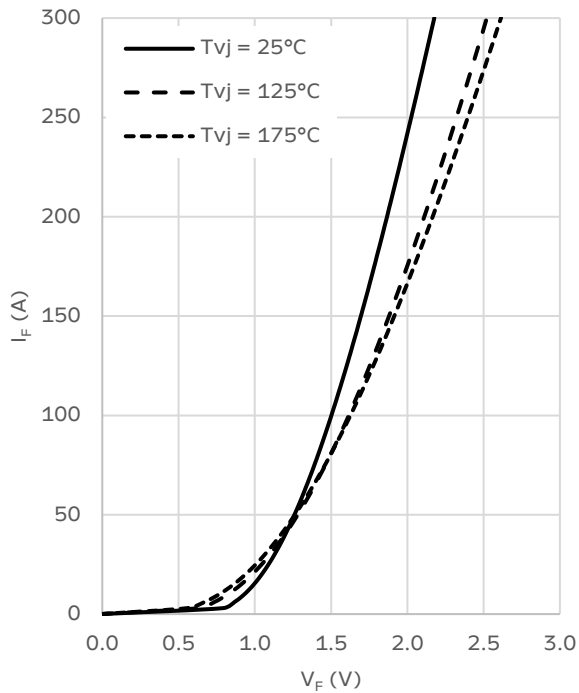
Diode SOA

$T_{vj} \leq 175\text{ °C}$



Diode forward characteristic (typical)

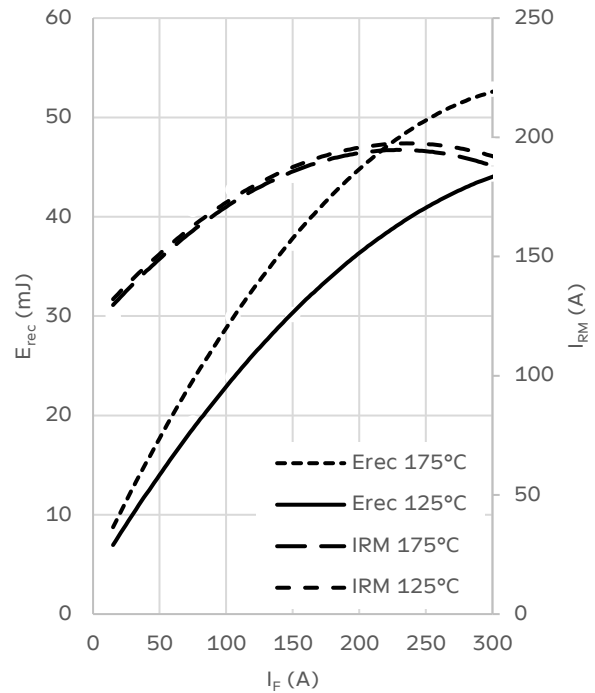
$$I_F = f(V_F)$$



Diode switching characteristics (typical)

$$E_{rec} = f(I_F), I_{RM} = f(I_F)$$

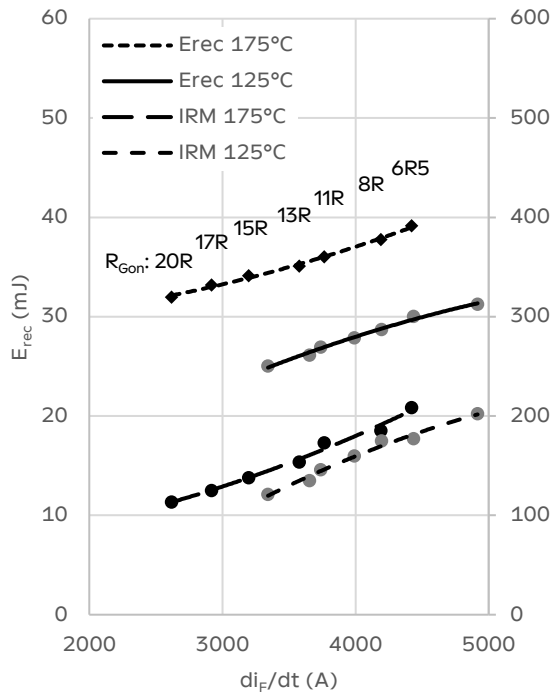
$V_{DC} = 900\text{ V}$, $R_{Gon} = 11 / 6.5\ \Omega$ (IGBT), $V_{GE} = -15/+15\text{ V}$ (IGBT)



Diode switching characteristics (typical)

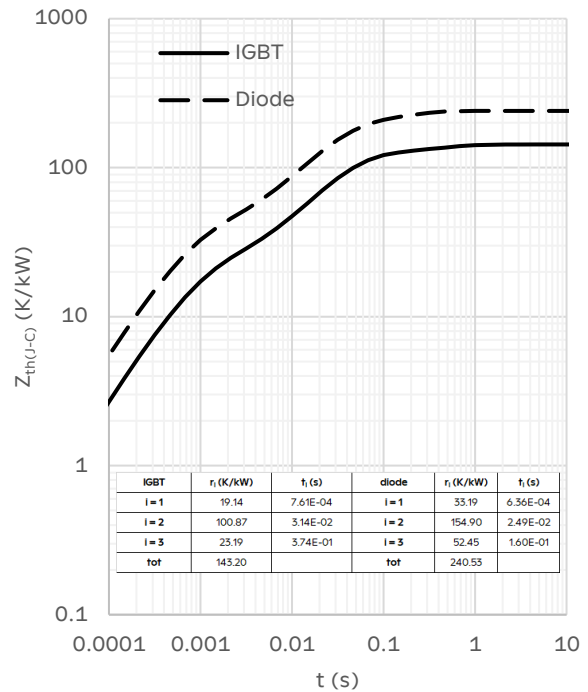
$$E_{rec} = f(di/dt), I_{RM} = f(di/dt)$$

$V_{DC} = 900\text{ V}$, $I_F = 150\text{ A}$, $V_{GE} = -15/+15\text{ V}$ (IGBT)



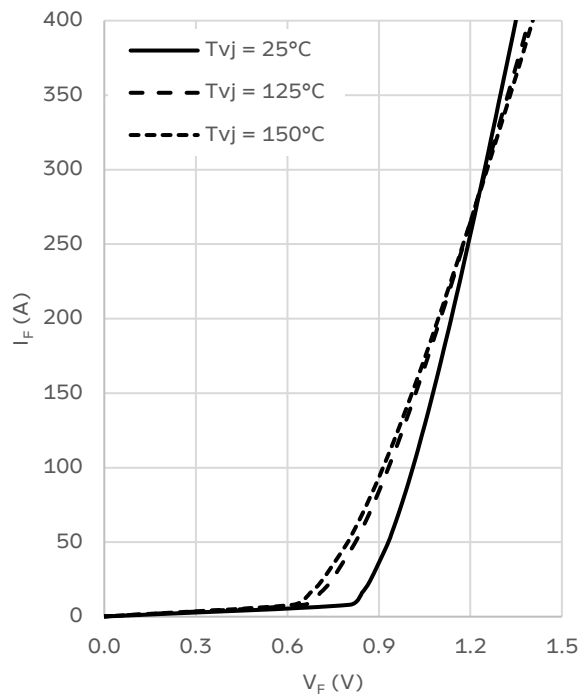
Thermal impedance Inverter

$$Z_{th(j-c)} = f(t)$$



Rectifier Diode forward characteristic (typical)

$I_F = f(V_F)$



Thermal impedance Rectifier

$Z_{th(j-c)} = f(t)$

