

DATASHEET

SISD0450ED170i20_A01

ED-Type phase leg IGBT module



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

$I_C = 2 \times 450 \text{ A}$

- *i*20 ultra-low loss fine pattern Trench IGBT chipset
- Baseplate isolation with reinforced Al_2O_3 ceramic
- Cu baseplate for low thermal resistance
- Improved Package with reduced internal impedance and terminal heating

Maximum ratings^{1 1}

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNIT
Collector-emitter voltage	V_{CES}	$V_{GE} = 0 \text{ V}$, $T_{vj} = 25 \text{ °C}$		1700	V
DC collector current	I_C	$T_C = 115 \text{ °C}$, $T_{vj} = 175 \text{ °C}$		450	A
Peak collector current	I_{CM}	$t_p = 1 \text{ ms}$		900	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 switch		2500	W
DC forward current	I_F			450	A
Peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$		900	A
Surge current	I_{FSM} I^2t	$V_R = 0 \text{ V}$, $T_{vj} = 150 \text{ °C}$, $t_p = 10 \text{ ms}$, half-sinewave		1830 16750	A A^2s
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 ³	°C
Storage temperature	T_{stg}		-40	125	°C
Mounting torques ⁴	M_S	Base-heatsink, M5 screws	3	6	Nm
	M_{t1}	Main terminals, M6 screws	3	6	Nm



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

² $T_{vj(op)} > 150\text{°C}$ allowed for overload conditions, in maximum for 60s and less than 20% of operation time

³ For UL1557 compliance T_{Cmax} must be limited to 125°C

⁴ For details, please refer to the mounting instructions.

**IGBT⁵**

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Collector(-emitter) breakdown voltage	V _{(BR)CES}	V _{GE} = 0 V, I _C = 1 mA, T _{vj} = 25°C		1700			V
Collector-emitter saturation voltage ⁶	V _{CEsat}	I _C = 450 A, V _{GE} = 15 V	T _{vj} = 25 °C		1.7	2.0	V _{CEsat}
			T _{vj} = 125 °C		2.0		V
			T _{vj} = 175 °C		2.16		V
Collector cut-off current	I _{CES}	V _{CE} = 1700 V, V _{GE} = 0 V	T _{vj} = 25 °C			1	I _{CES}
			T _{vj} = 125 °C		0.5		mA
			T _{vj} = 175 °C		9		mA
Gate leakage current	I _{GES}	V _{CE} = 0 V, V _{GE} = ±20 V		-0.5		0.5	µA
Gate-emitter threshold voltage	V _{GE(th)}	I _C = 25 mA, V _{CE} = V _{GE} , T _{vj} = 25°C		5	6.10	7.5	V
Gate charge	Q _G	I _C = 450 A, V _{CE} = 900 V, V _{GE} = -15 V ... 15 V			3		µC
Input capacitance	C _{ies}	V _{CE} = 25 V, V _{GE} = 0 V, f = 100 kHz, T _{vj} = 25 °C			30.6		nF
Output capacitance	C _{oes}				1.77		nF
Reverse tansfer capacitance	C _{res}				0.93		nF
Internal gate resistor	R _{Gint}	Per switch, f = 1 MHz, V _{GE} = 0V, CE short			2.1		Ω
Turn-on delay time	t _{d(on)}	V _{CC} = 900 V, I _C = 450 A, R _G = 2 Ω, V _{GE} = ± 15 V, L _S = 35 nH, inductive load	T _{vj} = 25 °C		142		t _{d(on)}
			T _{vj} = 125 °C		187		ns
			T _{vj} = 175 °C		211		ns
Rise time	t _r		T _{vj} = 25 °C		48		t _r
			T _{vj} = 125 °C		53		ns
			T _{vj} = 175 °C		56		ns
Turn-off delay time	t _{d(off)}	V _{CC} = 900 V, I _C = 450 A, R _G = 2 Ω, V _{GE} = ± 15 V, L _S = 35 nH, inductive load	T _{vj} = 25 °C		528		t _{d(off)}
			T _{vj} = 125 °C		644		ns
			T _{vj} = 175 °C		691		ns
Fall time	t _f		T _{vj} = 25 °C		380		t _f
			T _{vj} = 125 °C		557		ns
			T _{vj} = 175 °C		636		ns
Turn-on switching energy	E _{on}	V _{CC} = 900 V, I _C = 450 A, R _G = 2 Ω, V _{GE} = ± 15 V, L _S = 35 nH, inductive load	T _{vj} = 25 °C		111		E _{on}
			T _{vj} = 125 °C		151		mJ
			T _{vj} = 175 °C		177		mJ
Turn-off switching energy	E _{off}	V _{CC} = 900 V, I _C = 450 A, R _G = 2 Ω, V _{GE} = ± 15 V, L _S = 35 nH, inductive load	T _{vj} = 25 °C		95		E _{off}
			T _{vj} = 125 °C		134		mJ
			T _{vj} = 175 °C		150		mJ
Short circuit current	I _{SC}	t _{pcs} ≤ 10 µs, V _{GE} = 15 V, T _{vj} = 175 °C, V _{CC} = 1200V, V _{CEM Chip} ≤ 1700 V			1550		A

⁵ Characteristic values according to IEC 60747-9⁶ Collector-emitter saturation voltage is given at chip-level



Diode⁷

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Forward voltage ⁸	V _F	I _F = 450 A	T _{VJ} = 25 °C		1.75		V
			T _{VJ} = 125 °C		1.95		V
			T _{VJ} = 175 °C		2.0		V
Peak reverse recovery current	I _{RM}	V _R = 900 V, I _F = 450 A, di _F /dt = 8220 A/μs (175 °C), R _G =2 Ω, V _{GE} = ± 15 V, L _s = 35 nH, inductive load	T _{VJ} = 25 °C		408		A
			T _{VJ} = 125 °C		408		A
			T _{VJ} = 175 °C		409		A
Recovery charge	Q _{rr}		T _{VJ} = 25 °C		101		μC
			T _{VJ} = 125 °C		158		μC
			T _{VJ} = 175 °C		193		μC
Reverse recovery time	t _{rr}		T _{VJ} = 25 °C		848		Ns
			T _{VJ} = 125 °C		1316		Ns
			T _{VJ} = 175 °C		1598		Ns
Reverse recovery energy	E _{rec}		T _{VJ} = 25 °C		55		mJ
			T _{VJ} = 125 °C		91		mJ
			T _{VJ} = 175 °C		113		mJ

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	$B_{25/50}$	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15\text{K}))]$		3375		K
B-value B	$B_{25/100}$	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298.15\text{K}))]$		3433		K

⁷ Characteristic values according to IEC 60747-2

⁸ Forward voltage is given at chip-level



Package properties⁹

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
IGBT thermal resistance junction to case IGBT	$R_{th(j-c)IGBT}$	Per switch				0.060	K/W
Diode thermal resistance junction to case	$R_{th(j-c)Diode}$					0.106	K/W
IGBT thermal resistance case to heatsink IGBT	$R_{th(c-s)IGBT}$	IGBT per switch			0.032		K/W
Diode thermal resistance case to heatsink	$R_{th(c-s)Diode}$	diode per switch			0.039		K/W
Comparative tracking index	CTI			200			
Module stray inductance	$L_{s\ CE}$	Per switch			16		nH
Resistance, terminal chip	$R_{CC'+EE'}$	Per switch	$T_{vj} = 25\ ^\circ\text{C}$		0.75		m Ω
			$T_{vj} = 125\ ^\circ\text{C}$		1.05		m Ω
			$T_{vj} = 175\ ^\circ\text{C}$		1.15		m Ω
Maximum RMS DC-Terminal current	$I_{Term\ RMS}$		$T_{Terminal} = 90^\circ\text{C}$		580		A
			$T_{Terminal} = 105^\circ\text{C}$		565		A

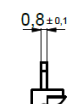
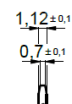
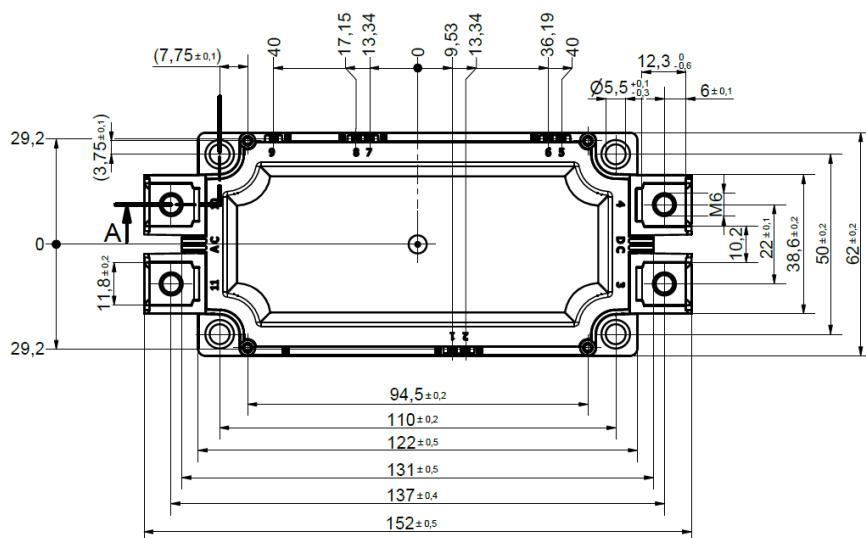
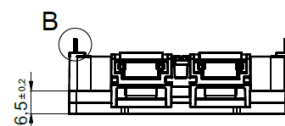
Mechanical properties

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Dimensions	L x W x H	Typical		152 x 62 x 17			mm ³
Clearance distance in air	d_a	According to IEC 60664-1 and EN 50124-1	Terminal to base:	12.5			mm
			Terminal to terminal:	10			mm
Surface creepage distance	d_s	According to IEC 60664-1 and EN 50124-1	Terminal to base:	15			mm
			Terminal to terminal:	13			mm
Mass	m				350		g

⁹ Package and mechanical properties according to IEC 60747-15

Technical drawing of a mechanical part, likely a shaft or axle, showing dimensions and a section line A-A. The drawing includes the following dimensions:

- Overall length: 113 ± 0.5
- Section line A-A: Indicated by a circle with the letter 'A' and a line pointing to the section.
- Distance from left end to section A: 1 ± 0.5
- Distance from section A to right end: 3.7 ± 0.5
- Overall diameter: 17 ± 0.5
- Reference dimension: (20.7)

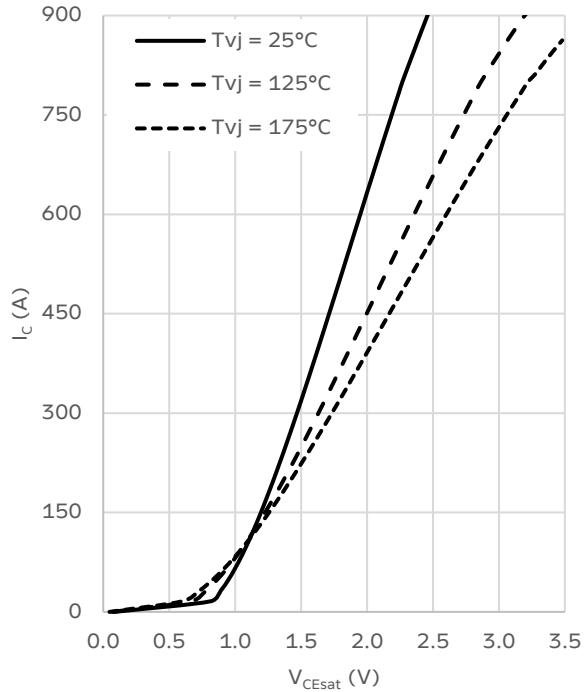


This product has been designed and qualified for Industrial Level.

Characteristics

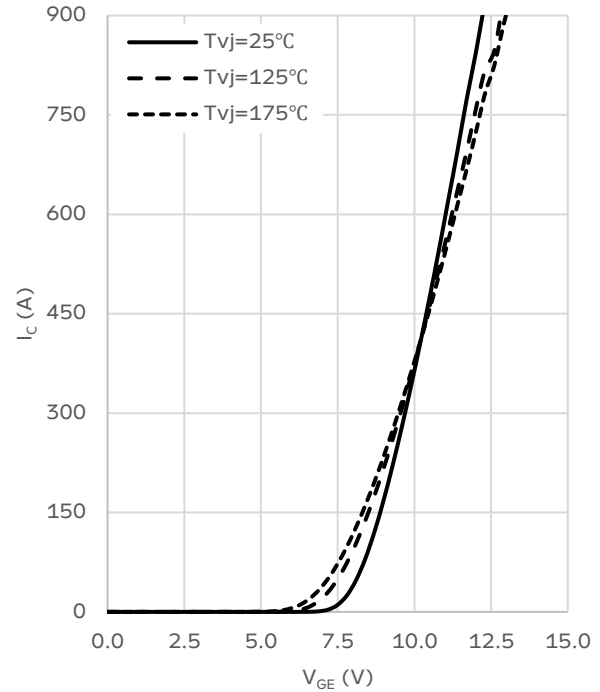
IGBT on-state characteristics (typical)

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



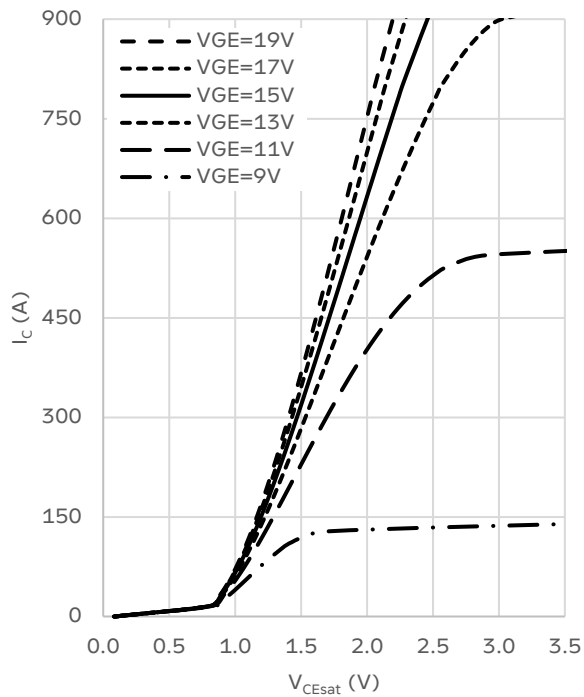
IGBT transfer characteristics (typical)

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



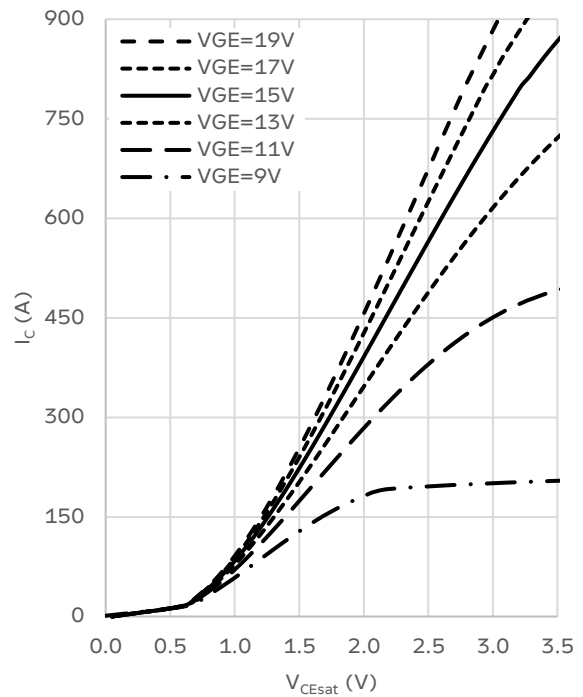
IGBT output characteristics (typical)

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



IGBT output characteristics (typical)

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

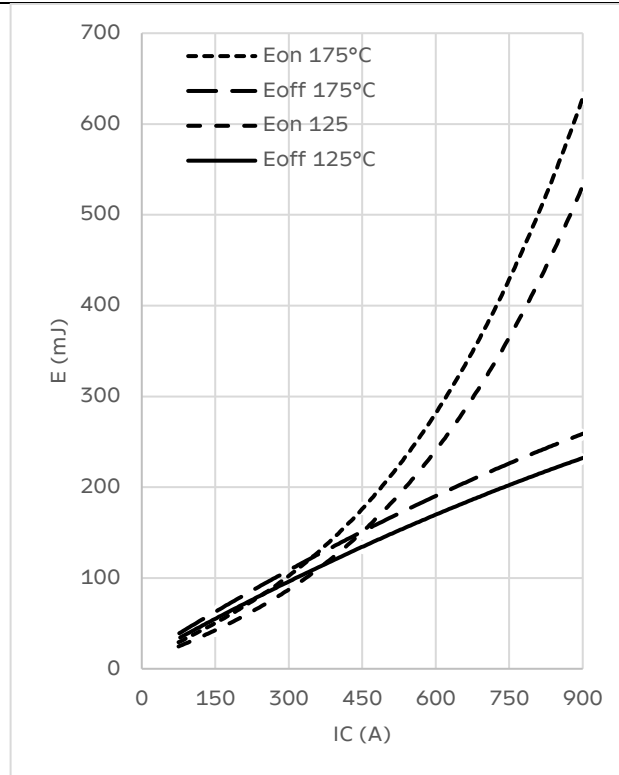




IGBT switching losses (typical)

$E = f(I_{CE})$

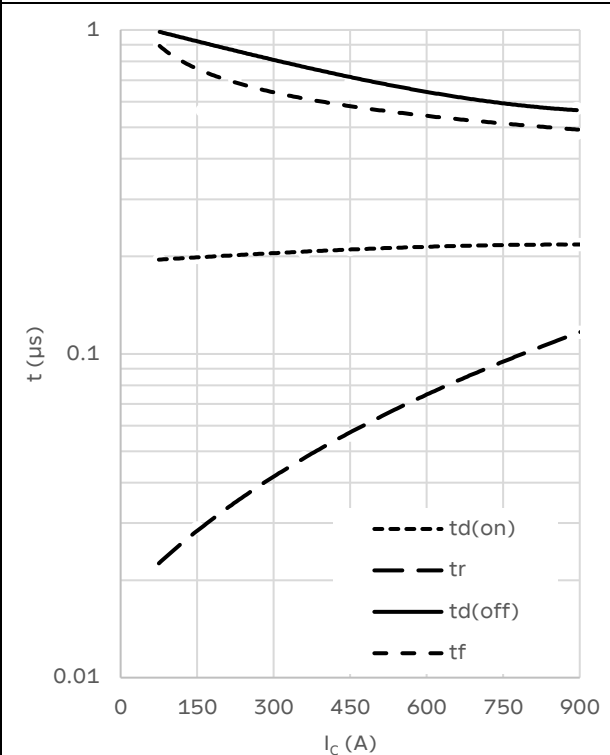
$V_{CE} = 900 \text{ V}$, $R_{Gon} = 2 \Omega$, $R_{Goff} = 2 \Omega$, $V_{GE} = -15/+15 \text{ V}$



IGBT switching times (typical)

$t = f(I_{CE})$, $T_{vj} = 175 \text{ °C}$

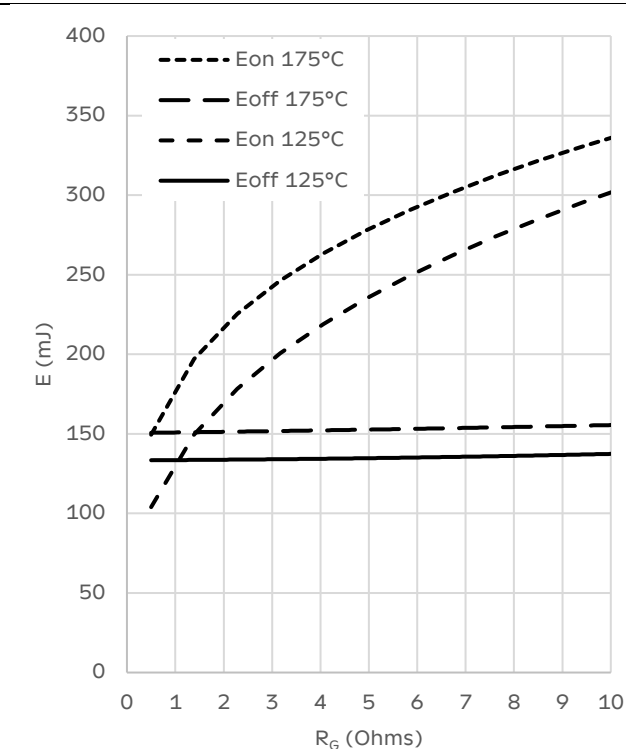
$V_{CE} = 900 \text{ V}$, $R_{Gon} = 2 \Omega$, $R_{Goff} = 2 \Omega$, $V_{GE} = -15/+15 \text{ V}$



IGBT switching losses (typical)

$E = f(R_G)$

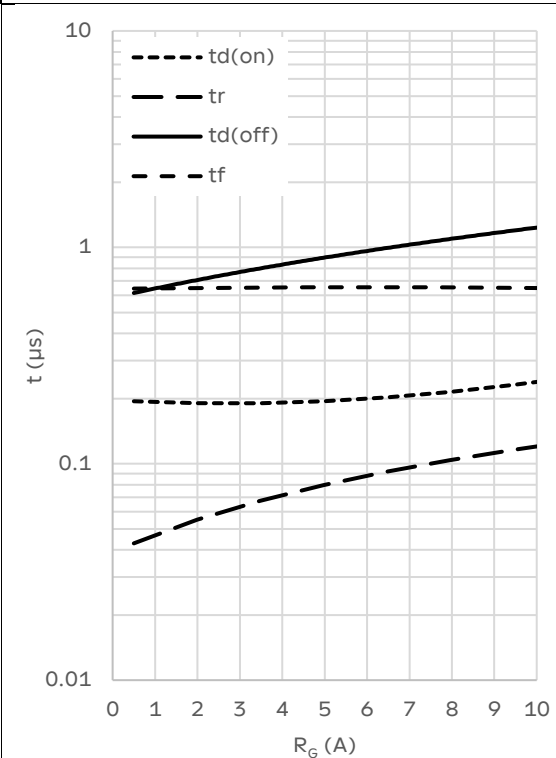
$V_{CE} = 900 \text{ V}$, $I_C = 450 \text{ A}$, $V_{GE} = -15/+15 \text{ V}$



IGBT switching times (typical)

$t = f(R_G)$, $T_{vj} = 175 \text{ °C}$

$V_{CE} = 900 \text{ V}$, $I_C = 450 \text{ A}$, $V_{GE} = -15/+15 \text{ V}$

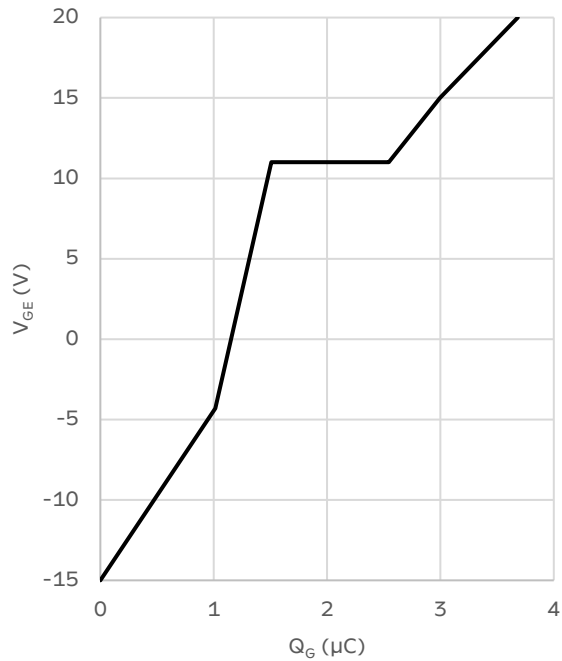




IGBT gate charge (typical)

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

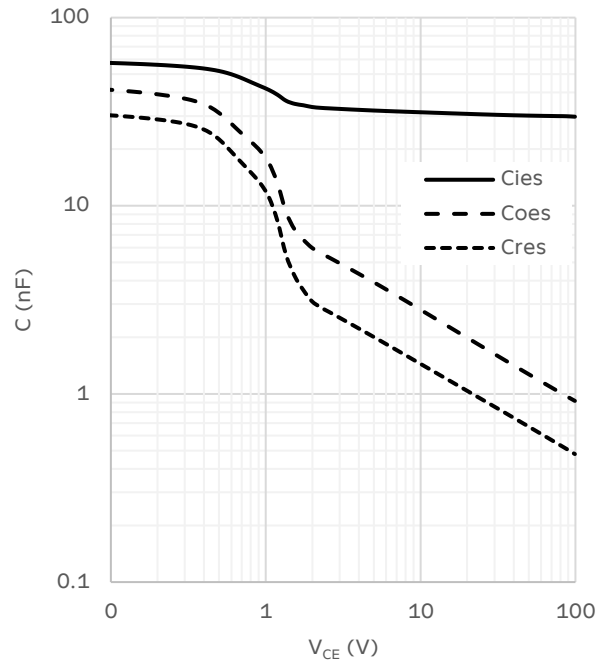
$V_{CE} = 900\text{ V}$, $I_C = 600\text{ A}$



Capacitance characteristics (typical)

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

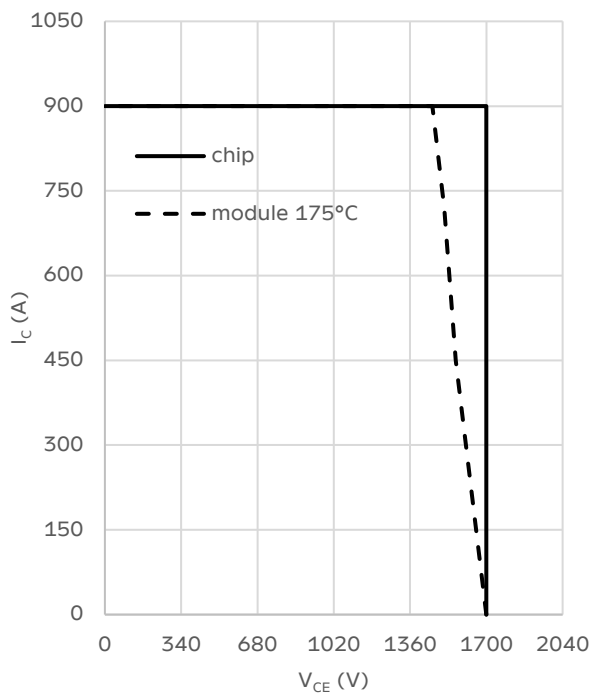
$f = 100\text{ kHz}$, $V_{GE} = 0\text{ V}$



IGBT RBSOA

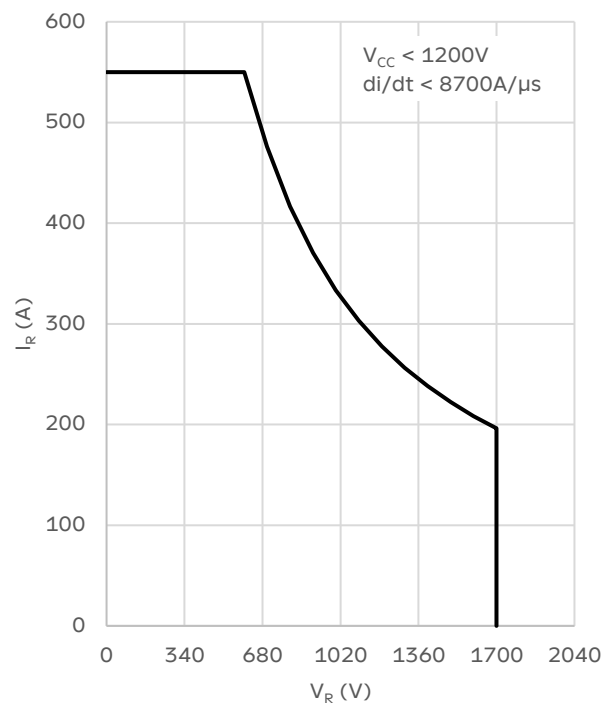
$I_C = f(V_{CEm})$

$R_{Goff} = 2\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$



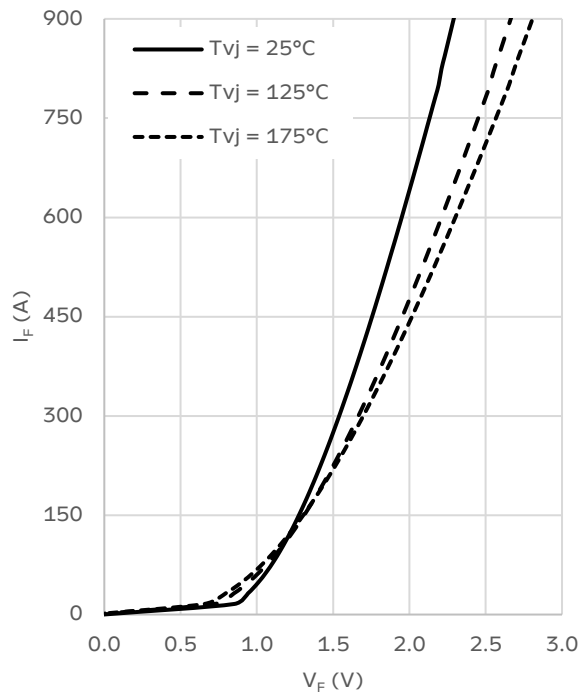
Diode SOA

$T_{vj} \leq 175\text{ °C}$



Diode forward characteristic (typical)

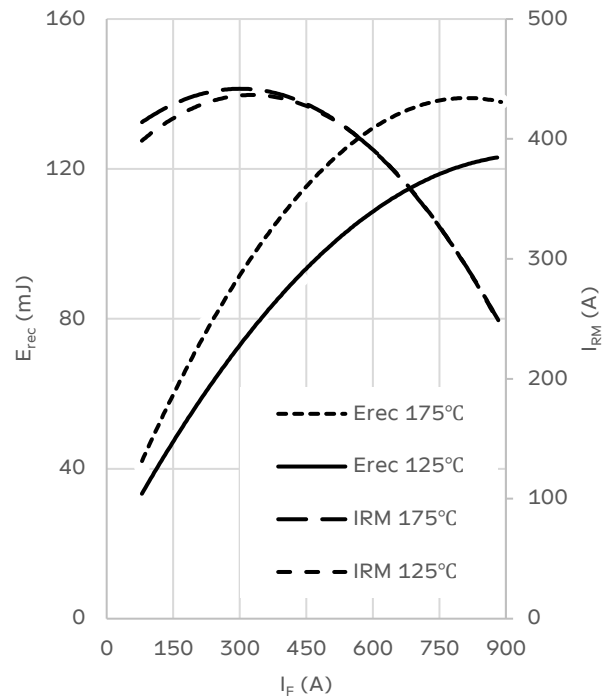
$$I_F = f(V_F)$$



Diode switching characteristics (typical)

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

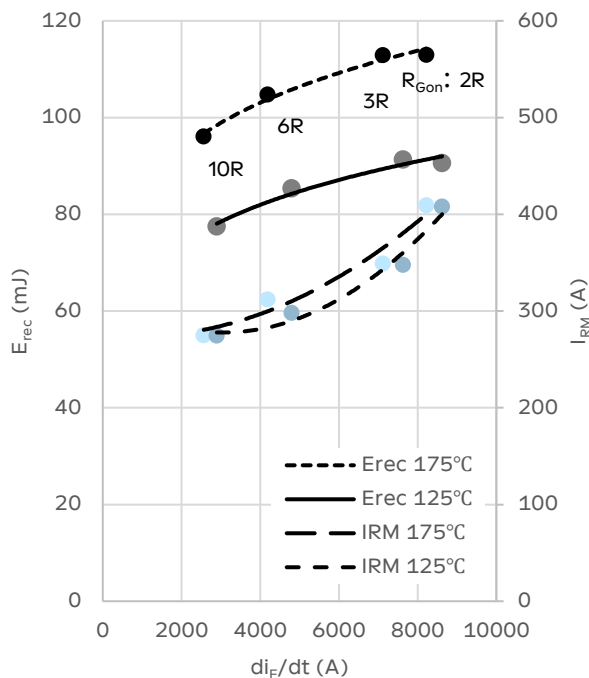
$$V_{DC} = 900 \text{ V}, R_{Gon} = 2 \Omega \text{ (IGBT)}, V_{GE} = -15/+15 \text{ V (IGBT)}$$



Diode switching characteristics (typical)

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

$$V_{DC} = 900 \text{ V}, I_F = 450 \text{ A}, V_{GE} = -15/+15 \text{ V (IGBT)}$$



Thermal impedance (typical)

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

