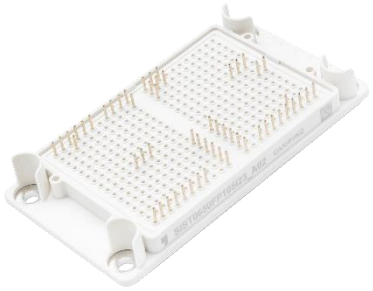
DATASHEET

SIST0650FP105i23_A02(_A03)

FP-Type three-level IGBT module



V_{CE} = 1050 V
I_C = 650 A

- *i23* ultra-low loss micro pattern Trench IGBT chipset
- Cu baseplate for low thermal resistance
- For solar power and Energy storage applications

- Industry standard package

Maximum ratings[1]

PARAMETER	SYMBOL	CONDITIONS	MIN	MAX	UNIT
Collector-emitter voltage	V_{CES}	V_{GE} = 0 V, T_{vj} = 25°C		1050	V
Implemented DC collector current T1-T4	I_{CN}			650	A
Collector current T1-T4	I_C	T_C = 110 °C, T_{vj} = 175°C		450	A
Peak collector current	I_{CM}	t_p = 1 ms		1300	A
Gate-emitter voltage	V_{GES}		-20	20	V
Peak Repetitive Reverse Voltage D1-D6	V_{RRM}			1200	V
Implemented DC forward current (D2, D3)	I_{FN}			400	A
Continuous forward current (D2, D3)	I_F			400	A
Peak forward current (D2, D3)	I_{FRM}	t_p = 1 ms		800	A
Continuous Forward Current (D1, D4)	I_F			280	A
Repetitive Peak Forward Current (D1, D4)	I_{FRM}	t_p = 10 ms		840	A
Continuous Forward Current (D5, D6)	I_F			210	A
Repetitive Peak Forward Current (D5, D6)	I_{FRM}	t_p = 10 ms		630	A
Isolation voltage	V_{isol}	1 min, f = 50 Hz		3200	V
Junction operating temperature	$T_{vj(op)}$		-40	175	°C
Case temperature	T_C		-40	125	°C
Storage temperature	T_{stg}		-40	125	°C
Mounting torques [2]	M_S	Base-heatsink, M5 screws	3	5	Nm

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IGBT[3] T1, T4

[1] Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747
[2] For details, please refer to the mounting instructions
[3] Characteristic values according to IEC 60747-9

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Collector(-emitter) breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 10 mA, T_{vj} = 25°C		1050			V
Collector-emitter saturation voltage [4]	V_{CEsat}	I_c = 600 A, V_{GE} = 15 V	T_{vj} = 25°C		1.65	2	V
			T_{vj} = 150°C		2.05		V
			T_{vj} = 175°C		2.15		V
Collector cut-off current	I_{CES}	V_{CE} = 1050 V, V_{GE} = 0 V	T_{vj} = 25°C			1	mA
			T_{vj} = 125°C		1		mA
			T_{vj} = 175°C		15		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 = 12 mA, V_{CE} = V_{GE}, T_{vj} = 25°C		3.5		6	V
Gate charge	Q_G	I_C = 450 A, V_{CE} = 650 V, V_{GE} = -15 V .. 15 V			3.1		µC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz, T_{vj} = 25°C			46		nF
Output capacitance	C_{oes}				1.12		nF
Reverse tansfer capacitance	C_{res}				0.46		nF
Internal gate resistor	R_{Gint}	Per switch			0.8		Ω
Turn-on delay time	$t_{d(on)}$	V_{CC} = 650 V, I_C = 200 A, R_G = 2.5 Ω, V_{GE} = -6/+15 V, c_{GE} = 10 nF, L_s = 17 nH, inductive load	T_{vj} = 25°C		106		ns
			T_{vj} = 150°C		114		ns
			T_{vj} = 175 °C		115		ns
Rise time	t_r		T_{vj} = 25°C		22		ns
			T_{vj} = 150 °C		24		ns
			T_{vj} = 175 °C		24		ns
Turn-off delay time	$t_{d(off)}$	V_{CC} = 650 V, I_C = 200 A, R_G = 8.2 Ω, V_{GE} = -6/+15 V, c_{GE} = 10 nF, L_s = 17 nH, inductive load	T_{vj} = 25°C		1050		ns
			T_{vj} = 150 °C		1210		ns
			T_{vj} = 175 °C		1250		ns
Fall time	t_f		T_{vj} = 25°C		52		ns
			T_{vj} = 150°C		109		ns
			T_{vj} = 175°C		110		ns
Turn-on switching energy	E_{on}	V_{CC} = 650 V, I_C = 200 A, R_G = 2.5 Ω, V_{GE} =-6/+15 V, c_{GE} = 10 nF, L_s = 17 nH, inductive load	T_{vj} = 25°C		3.5		mJ
			T_{vj} = 150°C		4.4		mJ
			T_{vj} = 175°C		4.55		mJ
Turn-off switching energy	E_{off}	V_{CC} = 650 V, I_C = 200 A, R_G = 2.5 Ω, V_{GE} = -6/+15 V, c_{GE} = 10 nF, L_s = 17 nH, inductive load	T_{vj} = 25°C		17.5		mJ
			T_{vj} = 150°C		21.6		mJ
			T_{vj} = 175°C		23		mJ

[4] Collector-emitter saturation voltage is given at chip-level

IGBT[5] T2, T3

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Collector(-emitter) breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 10 mA, T_{vj} = 25°C		1050			V
Collector-emitter saturation voltage [6]	V_{CEsat}	I_c = 600 A, V_{GE} = 15 V	T_{vj} = 25°C		1.65	2	V
			T_{vj} = 150°C		2.05		V
			T_{vj} = 175°C		2.15		V
Collector cut-off current	I_{CES}	V_{CE} = 1050 V, V_{GE} = 0 V	T_{vj} = 25°C			1	mA
			T_{vj} = 125°C		1		mA
			T_{vj} = 175°C		15		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 = 12 mA, V_{CE} = V_{GE}, T_{vj} = 25°C		3.5		6	V
Gate charge	Q_G	I_C = 450 A, V_{CE} = 650 V, V_{GE} = -15 V .. 15 V			3.1		µC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 100 kHz, T_{vj} = 25°C			46		nF
Output capacitance	C_{oes}				1.12		nF
Reverse tansfer capacitance	C_{res}				0.46		nF
Internal gate resistor	R_{Gint}	Per switch			0.8		Ω
Turn-on delay time	$t_{d(on)}$	V_{CC} = 650 V, I_C = 200 A, R_G = 2.5 Ω, V_{GE} =-6/+15 V, c_{GE} = 10 nF, L_s = 27 nH, inductive load	T_{vj} = 25°C		114		ns
			T_{vj} = 150°C		119		ns
			T_{vj} = 175°C		119		ns
Rise time	t_r		T_{vj} = 25°C		23		ns
			T_{vj} = 150°C		25		ns
			T_{vj} = 175°C		27		ns
Turn-off delay time	$t_{d(off)}$	V_{CC} = 650 V, I_C = 200 A, R_G = 10 Ω, V_{GE} =-6/+15 V, c_{GE} = 10 nF, L_s = 27 nH, inductive load	T_{vj} = 25°C		1240		ns
			T_{vj} = 150°C		1410		ns
			T_{vj} = 175°C		1450		ns
Fall time	t_f		T_{vj} = 25°C		40		ns
			T_{vj} = 150°C		72		ns
			T_{vj} = 175°C		83		ns
Turn-on switching energy	E_{on}	V_{CC} = 650 V, I_C = 200 A, R_G = 2.5 Ω, V_{GE} =-6/+15 V, c_{GE} = 10 nF, L_s = 27 nH, inductive load	T_{vj} = 25°C		5		mJ
			T_{vj} = 150°C		5.4		mJ
			T_{vj} = 175°C		5.7		mJ
Turn-off switching energy	E_{off}	V_{CC} = 650 V, I_C = 200 A, R_G = 10 Ω, V_{GE} =-6/+15 V, c_{GE} = 10 nF, L_s = 27 nH, inductive load	T_{vj} = 25°C		18.6		mJ
			T_{vj} = 150°C		23.5		mJ
			T_{vj} = 175°C		25.1		mJ

[5] Characteristic values according to IEC 60747-9
[6] Collector-emitter saturation voltage is given at chip-level

Diode[7] D2, D3

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Forward voltage[8]	V_F	I_F = 500 A	T_{vj} = 25°C		2.3		V
			T_{vj} = 150°C		2.4		V
			T_{vj} = 175°C		2.35		V

SiC inverse Diode[9] D1, D4

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Forward voltage[10]	V_F	I_F = 300 A	T_{vj} = 25°C		1.55		V
			T_{vj} = 150°C		2.15		V
			T_{vj} = 175°C		2.3		V
Peak reverse recovery current	I_{RM}	V_R = 650 V, I_F = 200 A, dI/dt = 5100 A/µs (175°C), R_G = 2.5 Ω, V_{GE} =-6/+15 V, c_{GE} = 10 nF, L_s = 27 nH, inductive load	T_{vj} = 25°C		60		A
			T_{vj} = 150°C		60		A
			T_{vj} = 175°C		60		A
Recovery charge	Q_{rr}		T_{vj} = 25°C		0.85		µC
			T_{vj} = 150°C		0.84		µC
			T_{vj} = 175°C		1.25		µC
Reverse recovery time	t_{rr}		T_{vj} = 25°C		23		ns
			T_{vj} = 150°C		24		ns
			T_{vj} = 175°C		26		ns
Reverse recovery energy	E_{rec}		T_{vj} = 25°C		0.34		mJ
			T_{vj} = 150°C		0.35		mJ
			T_{vj} = 175°C		0.37		mJ

[7] Characteristic values according to IEC 60747-2
[8] Forward voltage is given at chip-level

SiC neutral point Diode[9] D5, D6

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Forward voltage[10]	V_F	I_F = 200 A	T_{vj} = 25°C		1.5		V
			T_{vj} = 150°C		2.0		V
			T_{vj} = 175°C		2.15		V
Peak reverse recovery current	I_{RM}	V_R = 650 V, I_F = 200 A, dI/dt = 6200 A/µs (175°C), R_G = 2.5 Ω, V_{GE} = -6/+15 V, C_{GE} = 10 nF, L_s = 17 nH, inductive load	T_{vj} = 25°C		83		A
			T_{vj} = 150°C		75		A
			T_{vj} = 175°C		75		A
Recovery charge	Q_{rr}		T_{vj} = 25°C		0.74		µC
			T_{vj} = 150°C		0.58		µC
			T_{vj} = 175°C		0.59		µC
Reverse recovery time	t_{rr}		T_{vj} = 25°C		12		ns
			T_{vj} = 150°C		30		ns
			T_{vj} = 175°C		30		ns
Reverse recovery energy	E_{rec}		T_{vj} = 25°C		0.23		mJ
			T_{vj} = 150°C		0.34		mJ
			T_{vj} = 175°C		0.35		mJ

NTC Thermistor

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Rated resistance	R_{25}	T_C = 25°C		5		kΩ
R100	R_{100}	T_C = 100°C	468		518	Ω
B-value B	$B_{25/50}$	$R_2 = R_{25}$ exp [$B_{25/50}$(1/T2 – 1/(298.15K))]		3375		K
B-value B	$B_{25/100}$	$R_2 = R_{25}$ exp [$B_{25/100}$(1/T2 – 1/(298.15K))]		3433		K

Package properties [9]

PARAMETER	SYMBOL	CONDITIONS			MIN	TYP	MAX	UNIT
IGBT thermal resistance junction to case IGBT	$R_{th(j-c)IGBT}$	Per switch	T1, T4				0.074	K/W
			T2, T3				0.074	
Diode thermal resistance junction to case	$R_{th(j-c)Diode}$		D1, D4				0.145	K/W
			D2, D3				0.132	
			D5, D6				0.193	
IGBT thermal resistance case to heatsink IGBT	$R_{th(c-s)IGBT}$	IGBT per switch IGBT	T1, T4			0.030		K/W
			T2, T3			0.030		
Diode thermal resistance case to heatsink	$R_{th(c-s)Diode}$	diode per switch	D1, D4			0.045		K/W
			D2, D3			0.045		
			D5, D6			0.065		
Comparative tracking index	CTI				600			
Module stray inductance	$L_{s\ CIn}$	Inner commutation loop				7.7		nH
	$L_{s\ COut}$	Outer commutation loop				4.5		nH
Resistance, terminal chip	$R_{CC'+EE'}$, $R_{AA'+CC'}$	Per leg, T_C = 25°C		T1+T2			0.245	mΩ
				D5+T2			0.425	mΩ
				T3+D6			0.345	mΩ
				T3+T4			0.255	mΩ
				D1+D2			0.475	mΩ
				D3+D4			0.450	mΩ
Maximum RMS current per pin	$I_{Term\ RMS}$					50		A

[9] Package and mechanical properties according to IEC 60747-15

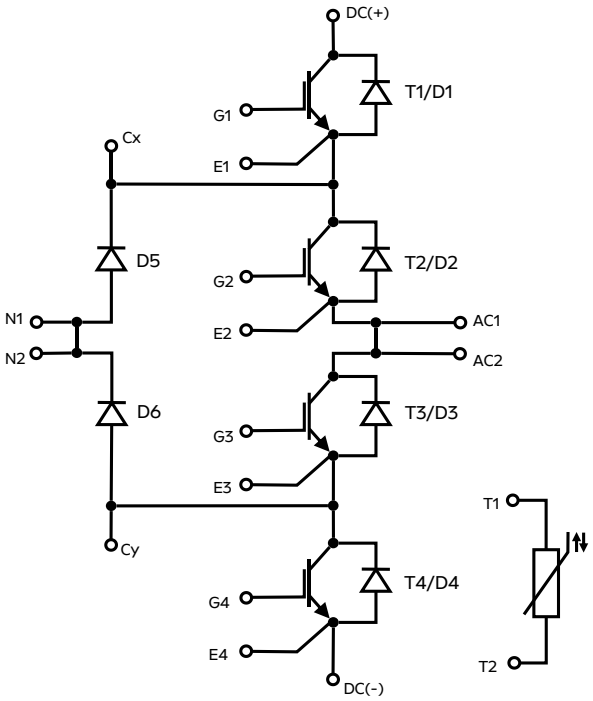
Mechanical properties

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT
Dimensions	L x W x H	Typical			113 x 62 x 17.3		mm^3
Clearance distance in air	d_a	According to IEC 60664-1 and EN 50124-1	Terminal to base:		15.7		mm
			Terminal to terminal:		5.4		mm
Surface creepage distance	d_s	According to IEC 60664-1 and EN 50124-1	Terminal to base:		17.5		mm
			Terminal to terminal:		5.4		mm
Mass	m				250		g

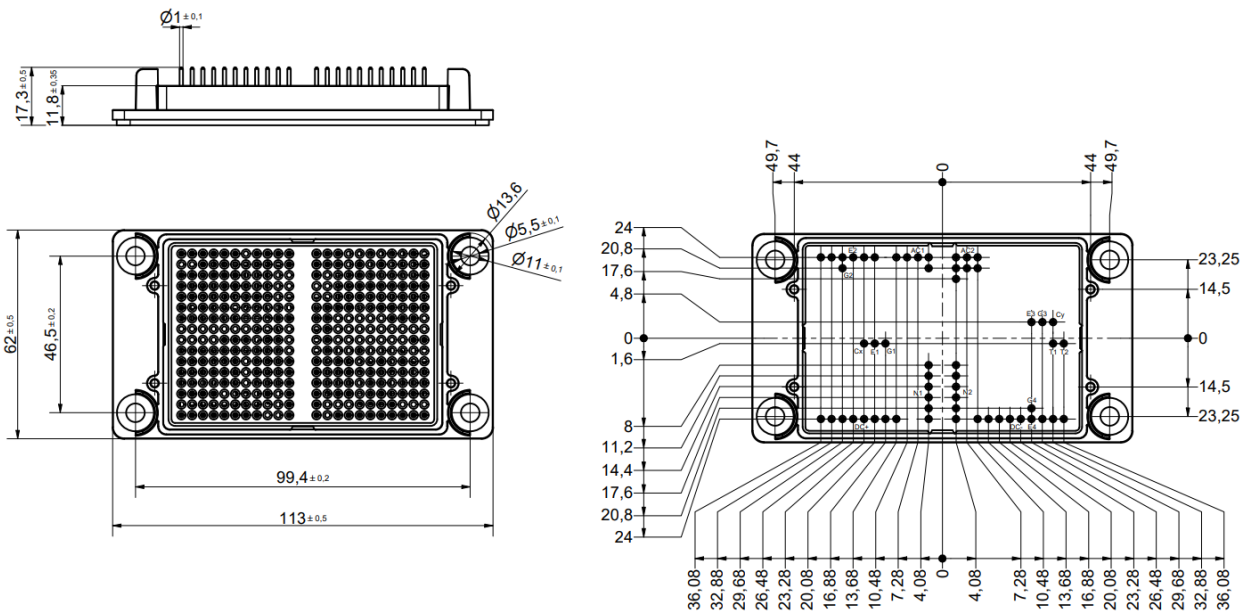
Ordering Information

OPTION	ARTICLE NUMBER
Welded straight pins	SIST0650FP105i23_A02
Soldered flexible pins	SIST0650FP105i23_A03

Electrical configuration



Outline drawing

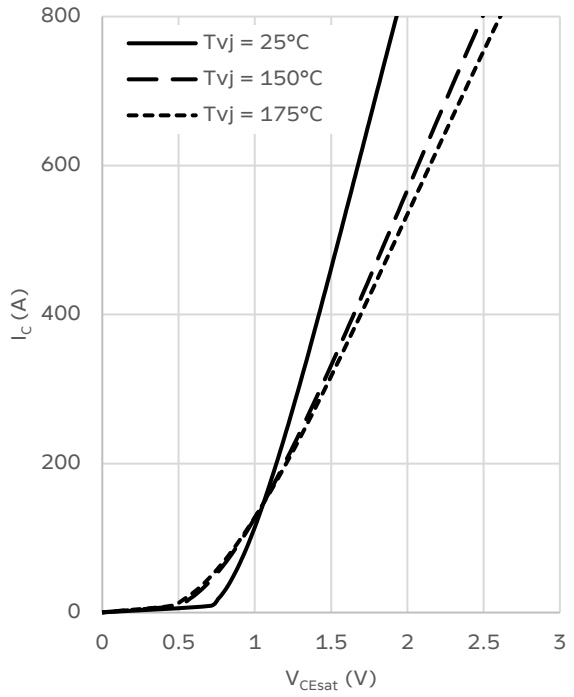


This is an electrostatic sensitive device.
This product has been designed and qualified for Industrial Level.

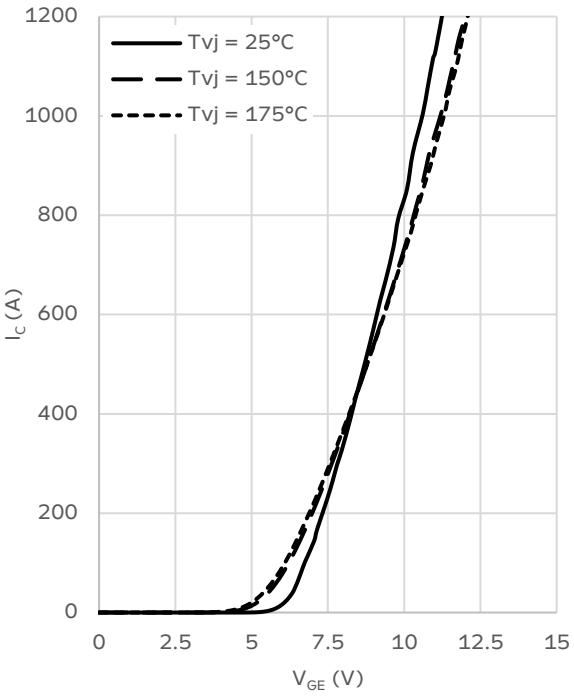
Characteristics

IGBT 1, 2, 3, 4

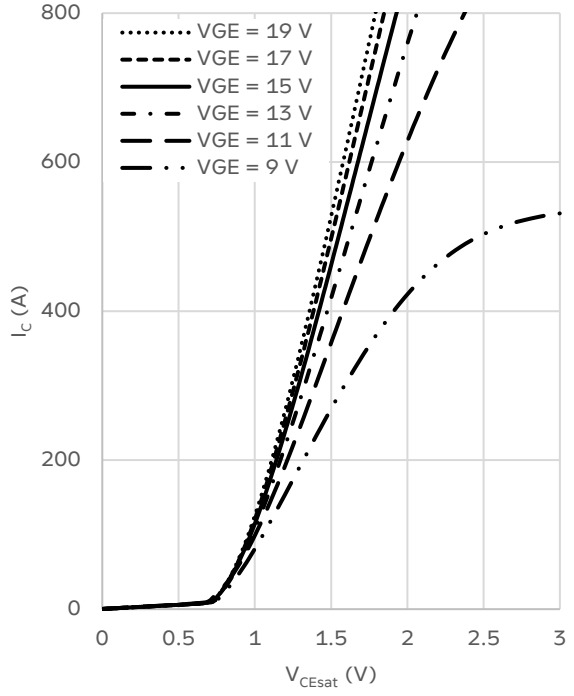
IGBT on-state characteristics T1 - T4 (typical)
$I_C = f(V_{CE})$
V_{GE} = 15 V



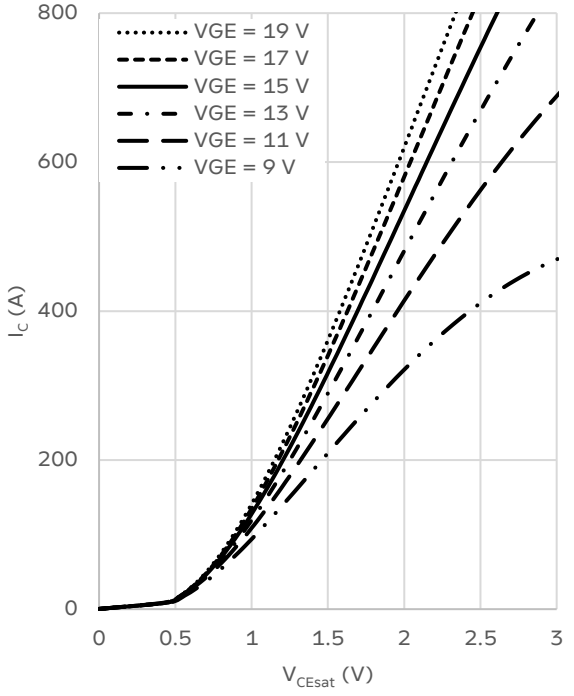
IGBT transfer characteristics T1 - T4 (typical)
$I_C = f(V_{GE})$
V_{CE} = 20V



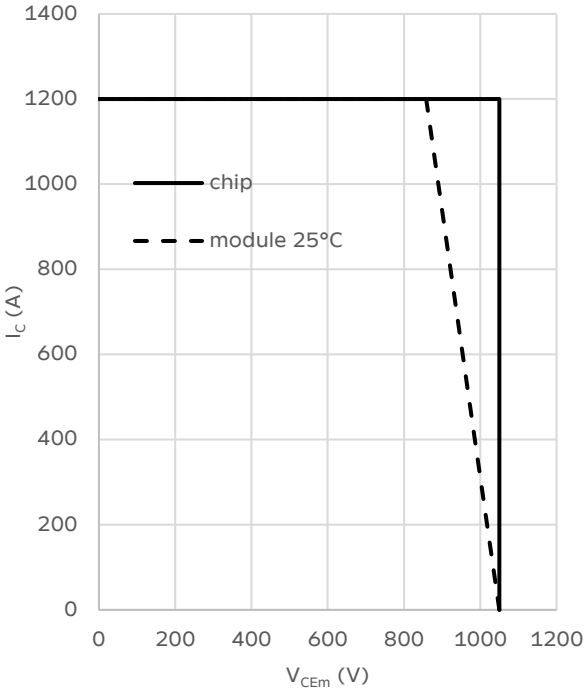
IGBT output characteristics T1 - T4 (typical)
$I_C = f(V_{CE})$
T_{vj} = 25 °C



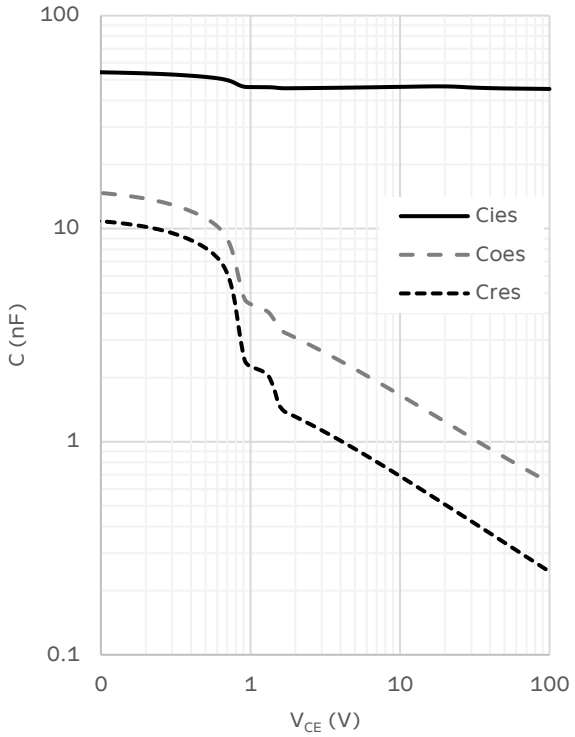
IGBT output characteristics T1 - T4 (typical)
$I_C = f(V_{CE})$
T_{vj} = 175 °C



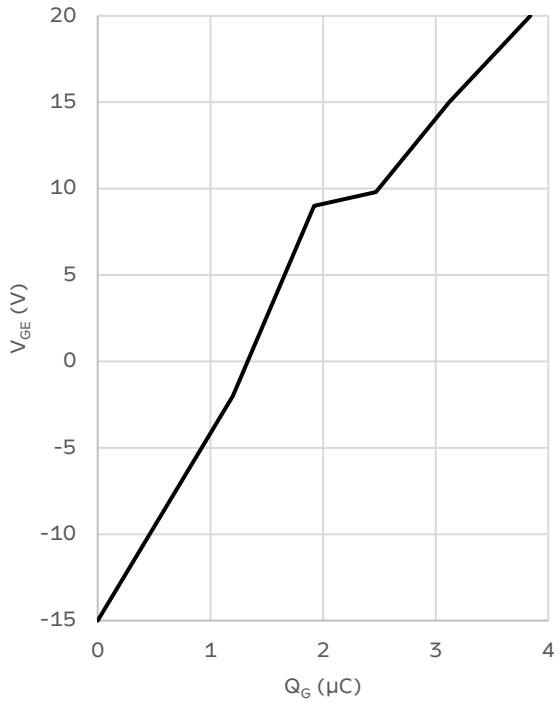
IGBT RBSOA
$I_C = f(V_{CEm})$
$R_{Goff} > 10\ \Omega$, $V_{GE} = -6/+15$ V



Capacitance characteristics (typical)
$C = f(V_{CE})$, $T_{vj} = 25$ °C
$f = 100$ kHz, $V_{GE} = 0$ V

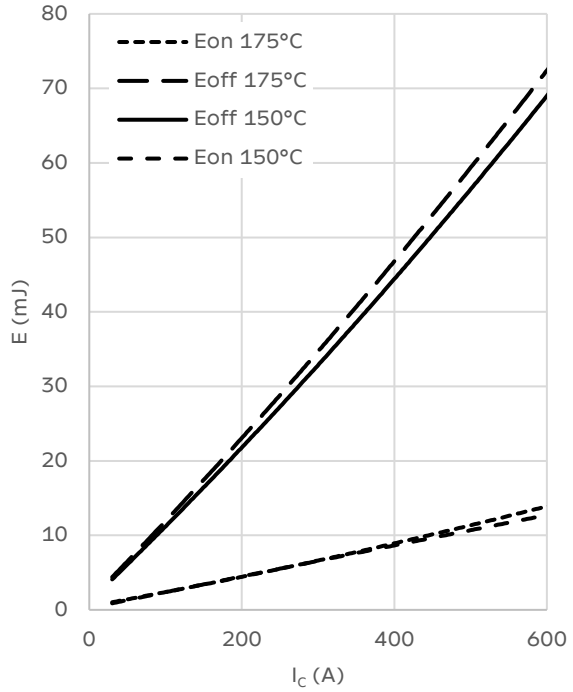


IGBT gate charge (typical)
$V_{GE} = f(Q_G)$, $T_{vj} = 25$°C
$V_{CE} = 650$ V, $I_C = 450$ A

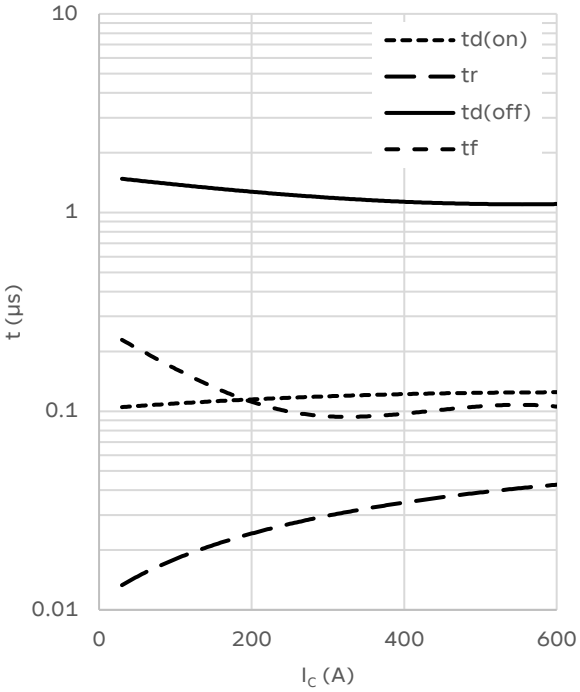


IGBT 1 / 4

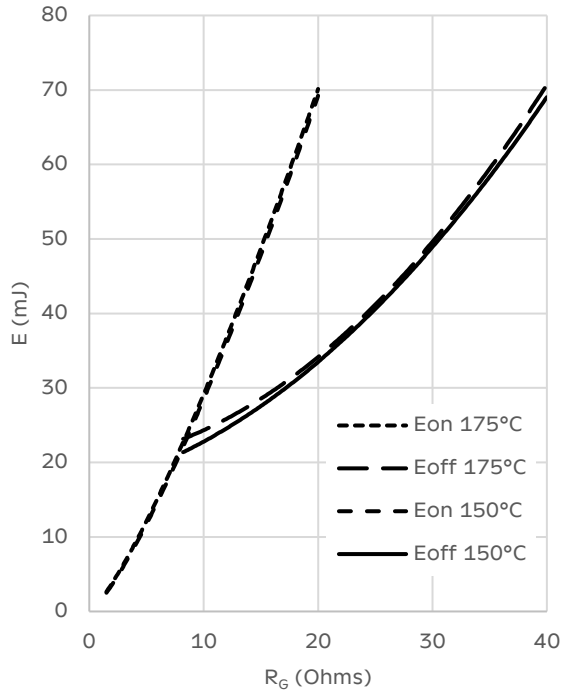
IGBT switching losses T1, T4 (typical)
E = f(I_{CE})
V_{CE} = 650 V, R_{Gon} = 2.5 Ω, R_{Goff} = 8.2 Ω, C_{GE} = 10 nF,
V_{GE} = -6/+15 V



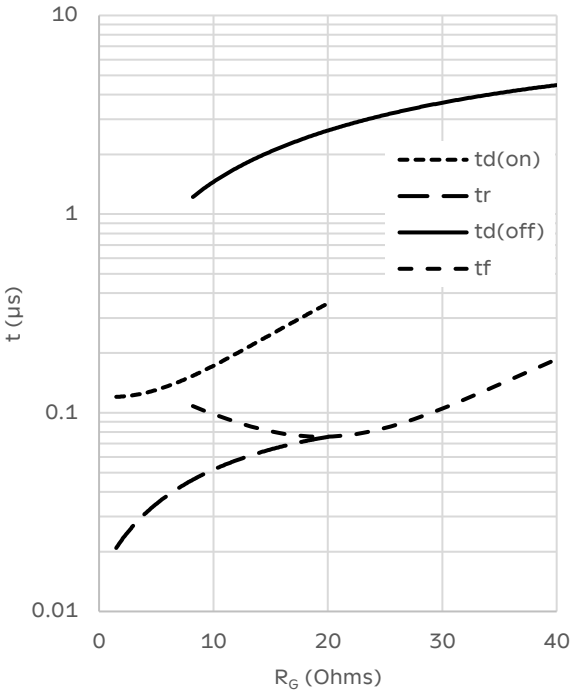
IGBT switching times T1, T4 (typical)
t = f(I_{CE}), T_{vj} = 175 °C
V_{CE} = 650 V, R_{Gon} = 2.5 Ω, R_{Goff} = 8.2 Ω, C_{GE} = 10 nF,
V_{GE} = -6/+15 V



IGBT switching losses T1, T4 (typical)
E = f(R_G)
V_{CE} = 650 V, I_C = 200 A, V_{GE} = -6/+15 V, C_{GE} = 10 nF

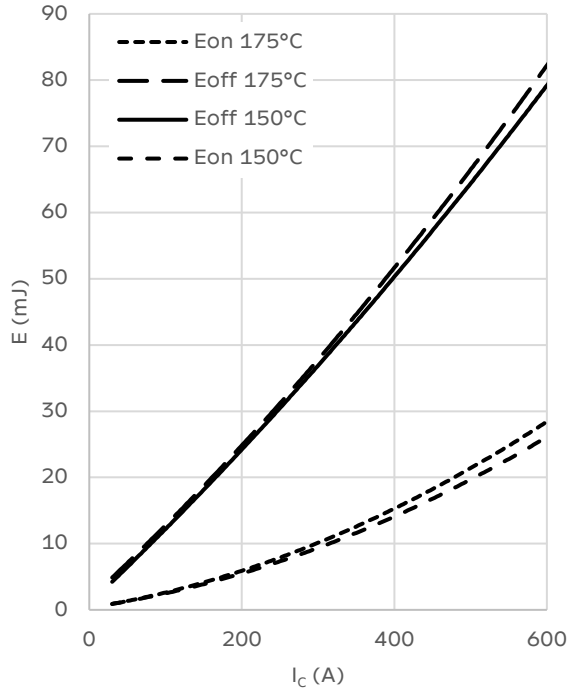


IGBT switching times T1, T4 (typical)
t = f(R_G), T_{vj} = 175 °C
V_{CE} = 650 V, I_C = 200 A, V_{GE} = -6/+15 V, C_{GE} = 10 nF

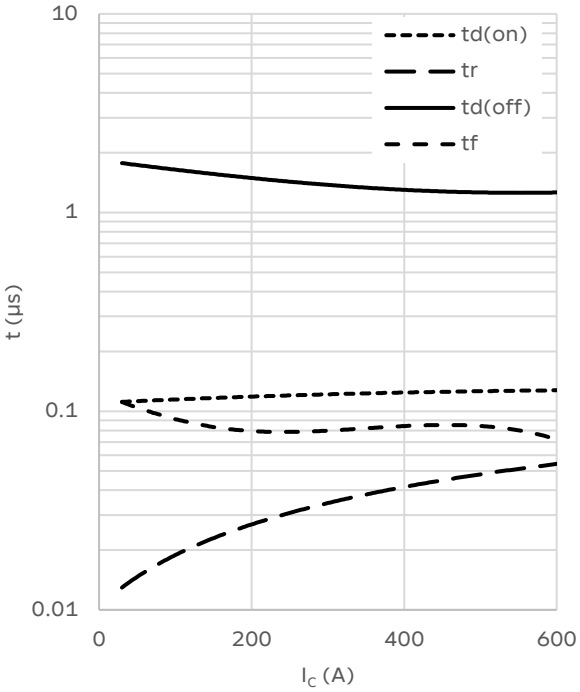


IGBT 2 / 3

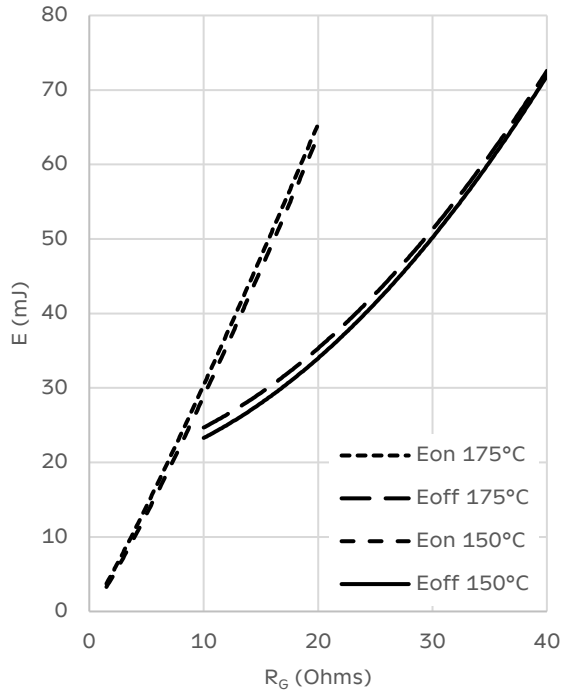
IGBT switching losses T2, T3 (typical)
E = f(I_{CE})
V_{CE} = 650 V, R_{Gon} = 2.5 Ω, R_{Goff} = 10 Ω, C_{GE} = 10 nF,
V_{GE} = -6/+15 V



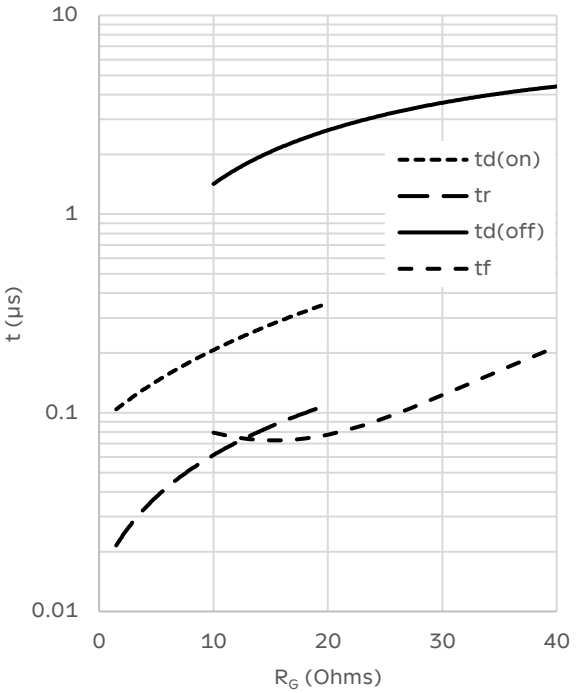
IGBT switching times T2, T3 (typical)
t = f(I_{CE}), T_{vj} = 175 °C
V_{CE} = 650 V, R_{Gon} = 2.5 Ω, R_{Goff} = 10 Ω, C_{GE} = 10 nF,
V_{GE} = -6/+15 V



IGBT switching losses T2, T3 (typical)
E = f(R_G)
V_{CE} = 650 V, I_C = 200 A, V_{GE} = -6/+15 V, C_{GE} = 10 nF

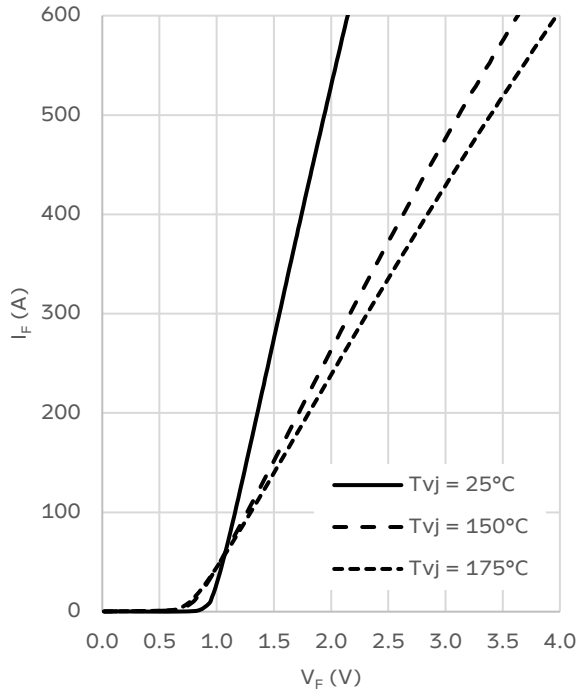


IGBT switching times T2, T3 (typical)
t = f(R_G), T_{vj} = 175 °C
V_{CE} = 650 V, I_C = 200 A, V_{GE} = -6/+15 V, C_{GE} = 10 nF

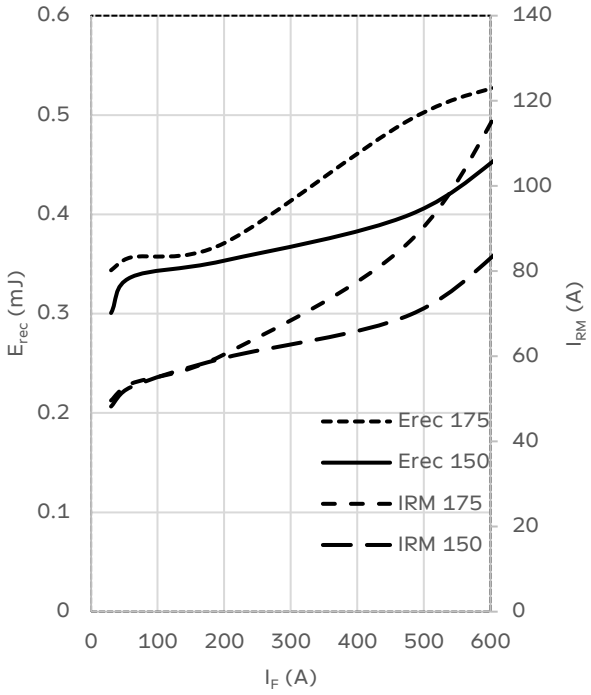


Diode 1 / 4

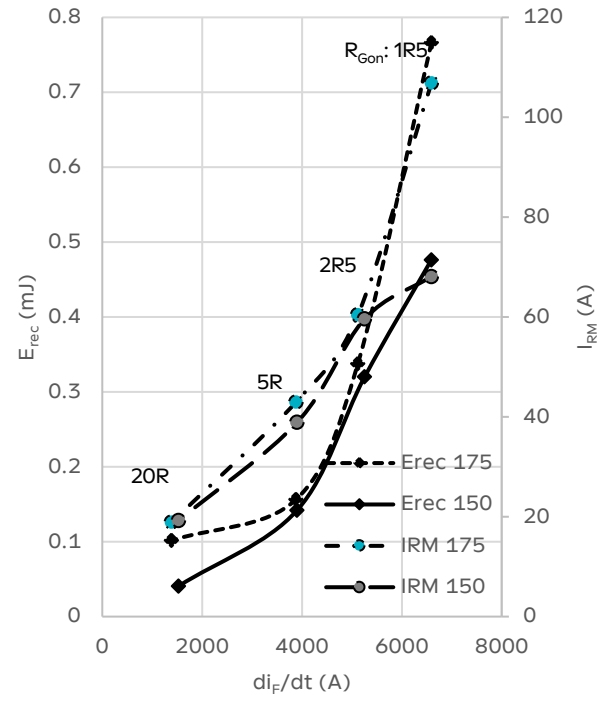
Diode forward characteristic D1, D4 (typical)
$I_F = f(V_F)$



Diode switching characteristics D1, D4 (typical)
$E_{rec} = f(I_F)$, $I_{RM} = f(I_F)$
V_{CE} = 650 V, R_{Gon} = 2.5 Ω, C_{GE} = 10 nF, V_{GE} = -6/+15 V

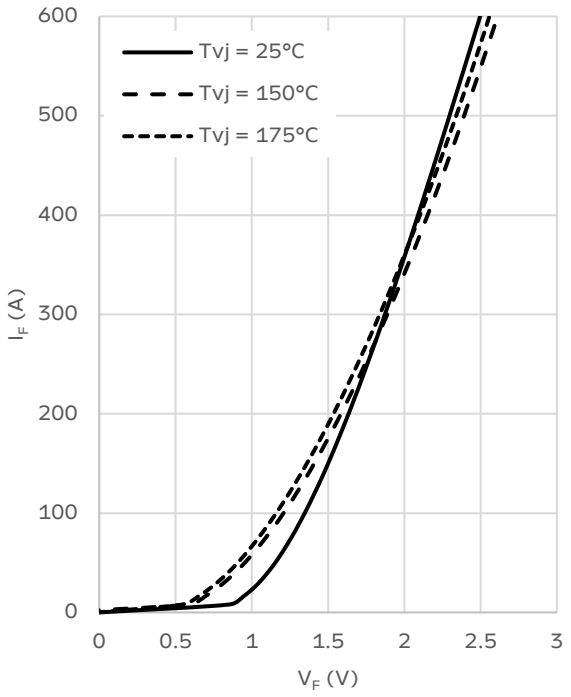


Diode switching characteristics D1, D4 (typical)
$E_{rec} = f(di/dt)$, $I_{RM} = f(di/dt)$
V_{CE} = 650 V, I_C = 200 A, V_{GE} = -6/+15 V, C_{GE} = 10 nF



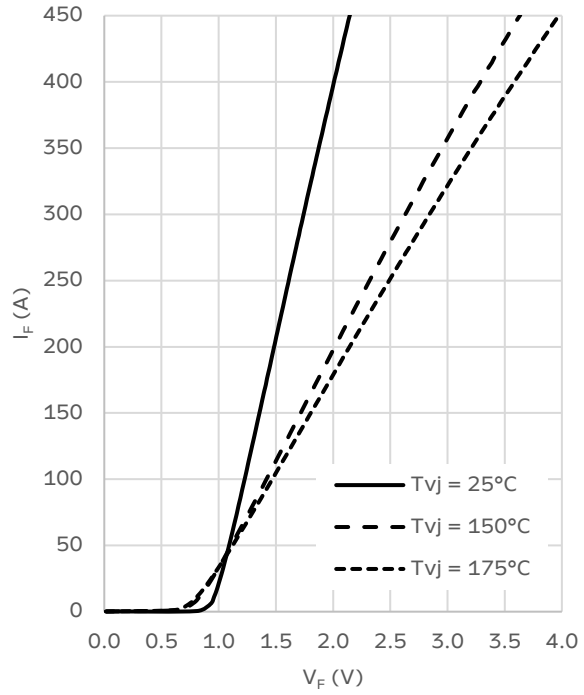
Diode 2 / 3

Diode forward characteristic D2, D3 (typical)
$I_F = f(V_F)$

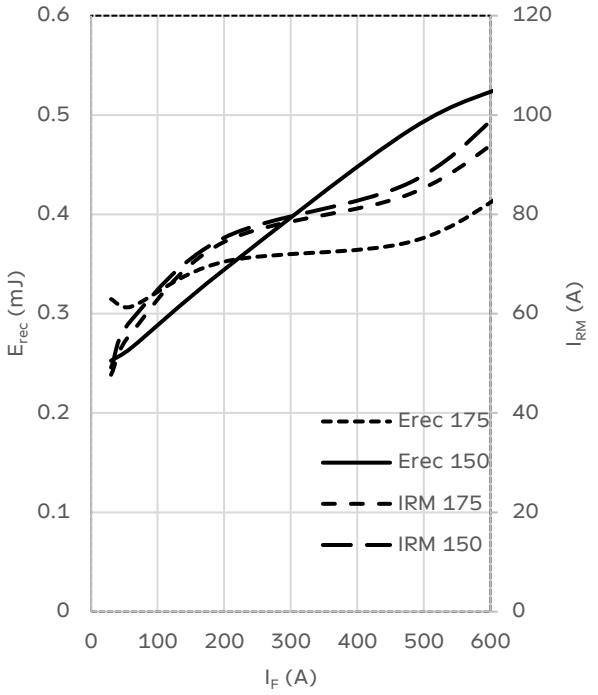


Diode 5 / 6

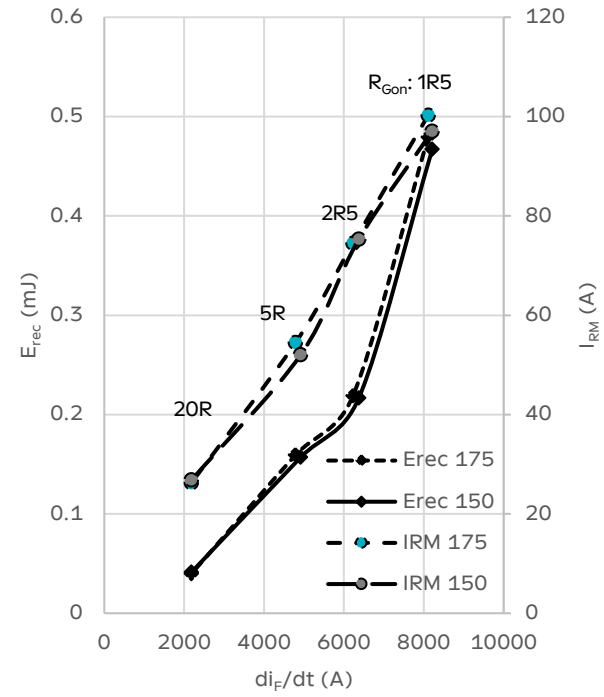
Diode forward characteristic D5, D6 (typical)
$I_F = f(V_F)$



Diode switching characteristics D5, D6 (typical)
$E_{rec} = f(I_F)$, $I_{RM} = f(I_F)$
V_{CE} = 650 V, R_{Gon} = 2.5 Ω, C_{GE} = 10 nF, V_{GE} = -6/+15 V



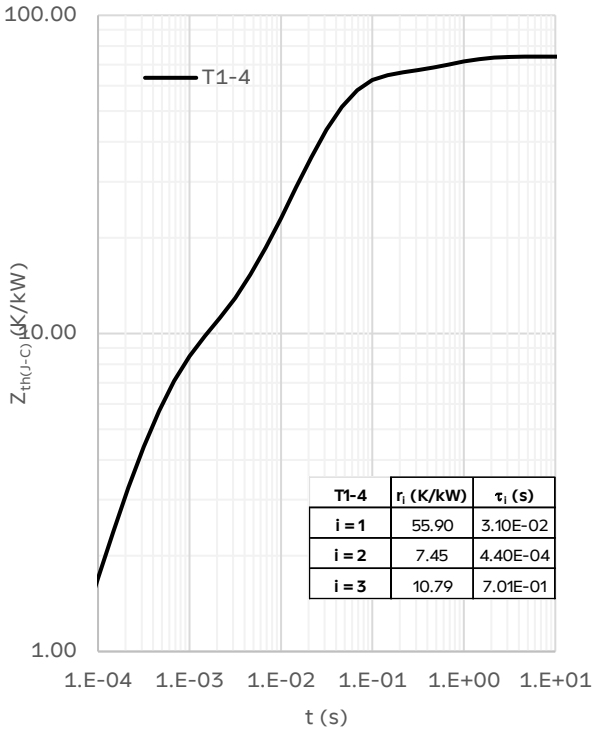
Diode switching characteristics D5, D6 (typical)
$E_{rec} = f(di/dt)$, $I_{RM} = f(di/dt)$
V_{CE} = 650 V, I_C = 200 A, V_{GE} = -6/+15 V, C_{GE} = 10 nF



Thermal Impedance

Thermal impedance IGBT 1-4

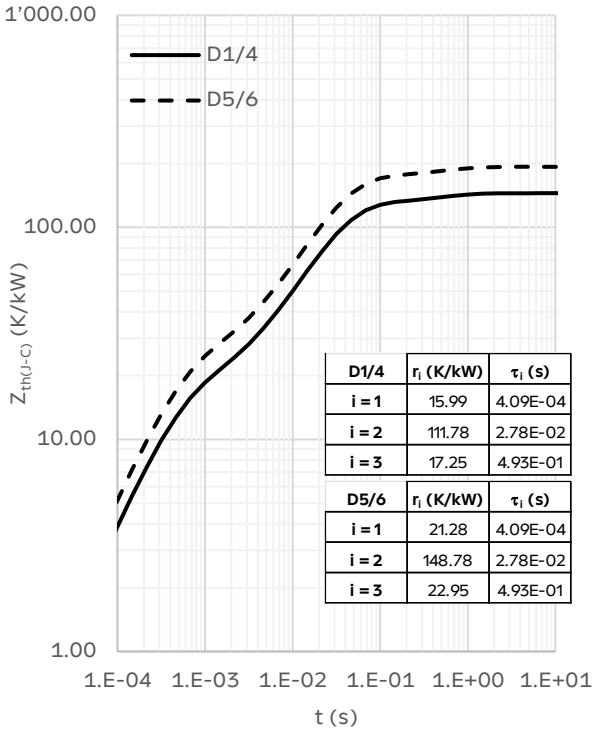
$Z_{th(j-c)} = f(t)$



T1-4	r_i (K/kW)	τ_i (s)
i = 1	55.90	3.10E-02
i = 2	7.45	4.40E-04
i = 3	10.79	7.01E-01

Thermal impedance SiC SBD D1/4 & D5/6

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

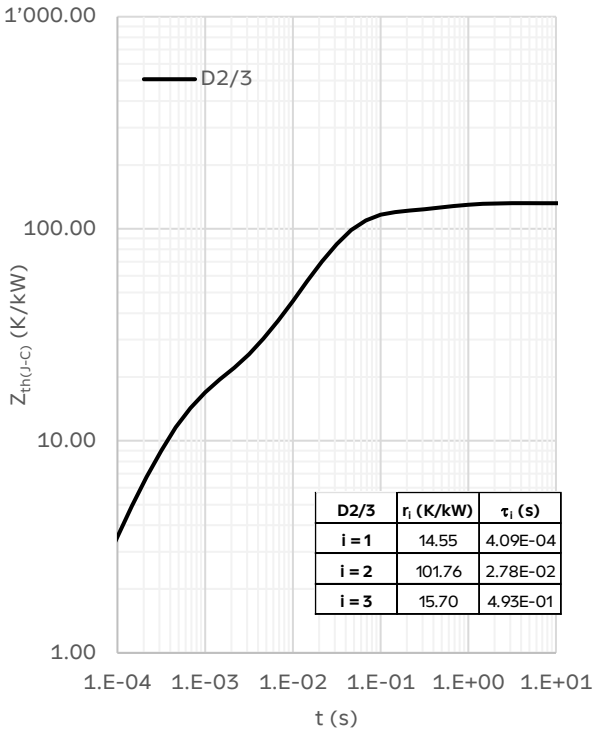


D1/4	r_i (K/kW)	τ_i (s)
i = 1	15.99	4.09E-04
i = 2	111.78	2.78E-02
i = 3	17.25	4.93E-01

D5/6	r_i (K/kW)	τ_i (s)
i = 1	21.28	4.09E-04
i = 2	148.78	2.78E-02
i = 3	22.95	4.93E-01

Thermal impedance Si Diode D2/3

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



D2/3	r_i (K/kW)	τ_i (s)
i = 1	14.55	4.09E-04
i = 2	101.76	2.78E-02
i = 3	15.70	4.93E-01

Revision History

Release	Version	Description
2026-07-30	v5.0	Final Datasheet
2026-09-01	V6.0	QG graph added