Datasheet 5SYA 1465-02, Nov. 2018

5SNA 1000G650300
HiPak IGBT module

- V_{CE} = 6500 V
- I_C = 1000 A
- Ultra-low-loss, rugged SPT^{++} chip-set
- Exceptional ruggedness and highest current rating
- High insulation package
- AlSiC base-plate and AlN substrate for low thermal resistance and high power cycling capability

Maximum rated values [1)]

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	V_{CES}	V_{GE} = 0 V, T_{vj} ≥ 25 °C		6500	V
DC collector current	I_C	T_C = 110 °C, T_{vj} = 150 °C		1000	A
Peak collector current	I_{CM}	t_p = 1 ms		2000	A
Gate-emitter voltage	V_{GES}		-20	20	V
DC forward current	I_F			1000	A
Peak forward current	I_{FRM}	t_p = 1 ms		2000	A
Surge current	I_{FSM}	V_R = 0 V, T_{vj} = 150 °C, t_p = 10 ms, half-sinewave		11000	A
IGBT short circuit SOA	t_{psc}	V_{CC} = 4500 V, $V_{CEM\ CHIP}$ ≤ 6500 V V_{GE} ≤ 15 V, T_{vj} ≤ 150 °C		10	µs
Isolation voltage	V_{isol}	1 min, f = 50 Hz		10200	V
Junction temperature	T_{vj}			175	°C
Junction operating temperature	$T_{vj(op)}$		-40	150	°C
Case temperature	T_C		-50	125	°C
Storage temperature	T_{stg}		-50	125	°C
Mounting torques	M_s	Base-heatsink, M6 screws	4	6	Nm
	M_{t1}	Main terminals, M8 screws	8	10	
	M_{t1}	Auxiliary terminals, M4 screws	2	3	

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

IGBT characteristic values [2)]

Parameter	Symbol	Conditions		min	typ.	max	Unit
Collector (-emitter) breakdown voltage	$V_{(BR)CES}$	VGE = 0 V, IC = 10 mA	Tvj = 150 °C	6500			V
			Tvj = 25 °C	6500			V
			Tvj = -40 °C	6000			V
Collector-emitter [3)] saturation voltage	$V_{CE\ sat}$	I_C = 1000 A, V_{GE} = 15 V	T_{vj} = 25 °C		3.1	3.6	V
			T_{vj} = 125 °C		4.1	4.7	V
			T_{vj} = 150 °C		4.4		V
Collector cut-off current	I_{CES}	V_{CE} = 6500 V, V_{GE} = 0 V	T_{vj} = 25 °C			1	mA
			T_{vj} = 125 °C		25	70	mA
			T_{vj} = 150 °C		95		mA
Gate leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = ± 20 V, T_{vj} = 150 °C		-500		500	nA
Gate-emitter threshold voltage	$V_{GE(TO)}$	I_C = 240 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.5		7.5	V
Gate charge	Q_{ge}	I_C = 1000 A, V_{CE} = 3600 V, V_{GE} = -15 V ... +15 V			8.3		µC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz, T_{vj} = 25 °C			101		nF
Internal gate resistance	R_{Gint}				0.74		
Turn-on delay time	$t_{d(on)}$	V_{CC} = 3600 V, I_C = 1000 A, R_G = 1.5 Ω, C_{GE} = 220 nF, V_{GE} = ±15 V, L_σ = 150 nH, inductive load	T_{vj} = 25 °C		520		ns
			T_{vj} = 125 °C		500		ns
			T_{vj} = 150 °C		500		ns
Rise time	t_r		T_{vj} = 25 °C		155		ns
			T_{vj} = 125 °C		160		ns
			T_{vj} = 150 °C		160		ns
Turn-off delay time	$t_{d(off)}$	V_{CC} = 3600 V, I_C = 1000 A, R_G = 15 Ω, C_{GE} = 220 nF, V_{GE} = ±15 V, L_σ = 150 nH, inductive load	T_{vj} = 25 °C		5000		ns
			T_{vj} = 125 °C		5650		ns
			T_{vj} = 150 °C		5900		ns
Fall time	t_f		T_{vj} = 25 °C		380		ns
			T_{vj} = 125 °C		460		ns
			T_{vj} = 150 °C		500		ns
Turn-on switching energy	E_{on}	V_{CC} = 3600 V, I_C = 1000 A, R_G = 1.5 Ω, C_{GE} = 220 nF, V_{GE} = ±15 V, L_σ = 150 nH, inductive load	T_{vj} = 25 °C		4100		mJ
			T_{vj} = 125 °C		5250		mJ
			T_{vj} = 150 °C		5800		mJ
Turn-off switching energy	E_{off}	V_{CC} = 3600 V, I_C = 1000 A, R_G = 15 Ω, C_{GE} = 220 nF, V_{GE} = ±15 V, L_σ = 150 nH, inductive load	T_{vj} = 25 °C		4200		mJ
			T_{vj} = 125 °C		5400		mJ
			T_{vj} = 150 °C		5650		mJ
Short circuit current	I_{SC}	t_{psc} ≤ 10 µs, V_{GE} = 15 V, V_{CC} = 4500 V, $V_{CEM\ CHIP}$ ≤ 6500 V	T_{vj} = 150 °C		4800		A

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[2)] Characteristic values according to IEC 60747 – 9

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

Diode characteristic values [4)]

Parameter	Symbol	Conditions		min	typ.	max	Unit
Forward voltage [5)]	V_F	I_F = 1000 A	T_{vj} = 25 °C		3.05	3.5	V
			T_{vj} = 125 °C		3.4	3.9	V
			T_{vj} = 150 °C		3.35		V
Reverse recovery current	I_{rr}	V_{CC} = 3600 V, I_F = 1000 A, V_{GE} = ±15 V, R_G = 1.5 Ω, C_{GE} = 220 nF, $L_σ$ = 150 nH inductive load	T_{vj} = 25 °C		1710		A
			T_{vj} = 125 °C		2230		A
			T_{vj} = 150 °C		2490		A
Recovered charge	Q_{rr}		T_{vj} = 25 °C		1210		µC
			T_{vj} = 125 °C		1950		µC
			T_{vj} = 150 °C		2260		µC
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		1400		ns
			T_{vj} = 125 °C		1400		ns
			T_{vj} = 150 °C		1380		ns
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		2300		mJ
			T_{vj} = 125 °C		4150		mJ
			T_{vj} = 150 °C		4900		mJ

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[4)] Characteristic values according to IEC 60747 – 2
[5)] Forward voltage is given at chip level

Package properties [6)]

Parameter	Symbol	Conditions		min	typ.	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$					0.0098	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$					0.016	K/W
IGBT thermal resistance [2)] case to heatsink	$R_{th(c-s)IGBT}$	IGBT per switch, λ grease = 1W/ m x K			0.008		K/W
Diode thermal resistance [2)] case to heatsink	$R_{th(c-s)DIODE}$	Diode per switch, λ grease = 1W/ m x K			0.011		K/W
Partial discharge voltage	V_e	f = 50 Hz, Q_{PD} ≤ 10pC (acc. to IEC 61287)		5100			V
Comparative tracking index	CTI			600			V
Module stray inductance	$L_{σ CE}$				18		nH
Resistance, terminal-chip	$R_{CC'+EE'}$		T_C = 25 °C		0.07		mΩ
			T_C = 125 °C		0.1		mΩ
			T_C = 150 °C		0.11		mΩ

Mechanical properties [6)]

Parameter	Symbol	Conditions		min	typ.	max	Unit
Dimensions	L x W x H	Typical			190 x 140 x 48		mm
Clearance distance in air	d_a	According to IEC 60664-1 and EN 50124-1	Term. to base:	40			mm
			Term. to term:	26			mm
Surface creepage distance	d_s	According to IEC 60664-1 and EN 50124-1	Term. to base:	64			mm
			Term. to term:	56			mm
Mass	m				1330		g

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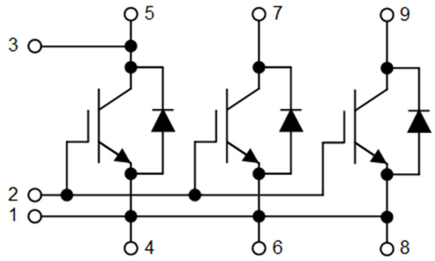
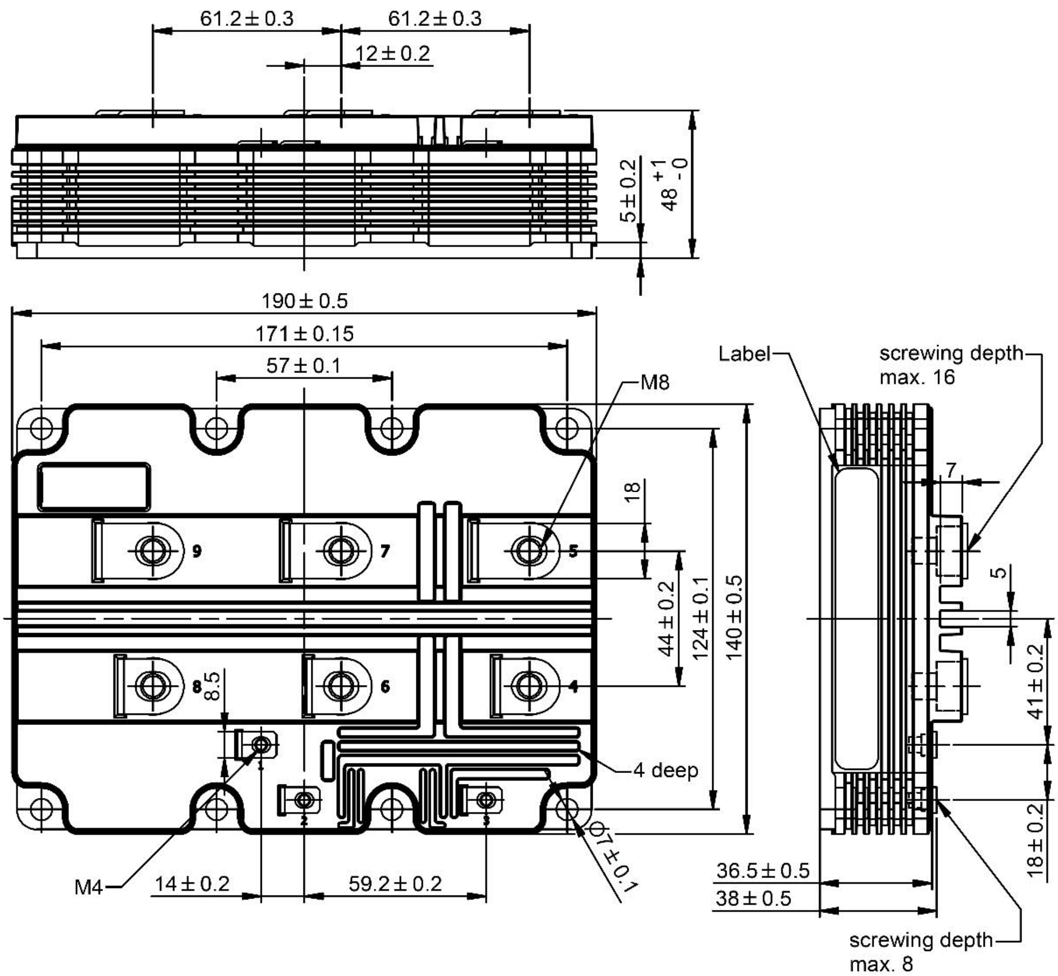
[6)] Package and mechanical properties according to IEC 60747 – 15

Electrical configuration



Outline drawing (mm)



Note: This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chapter VIII. This product has been designed and qualified for industrial level.

Fig. 1 Typical on-state characteristics, chip level

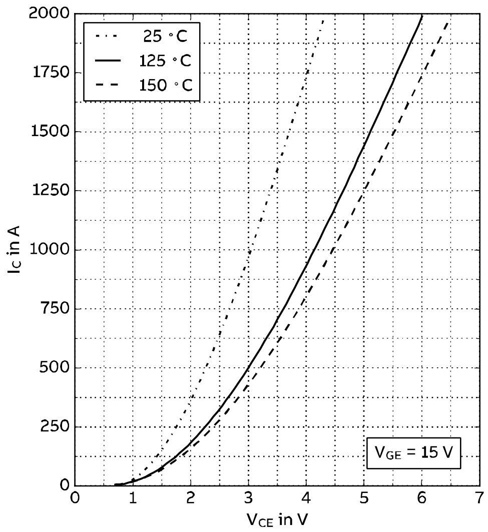


Fig. 2 Typical transfer characteristics, chip level

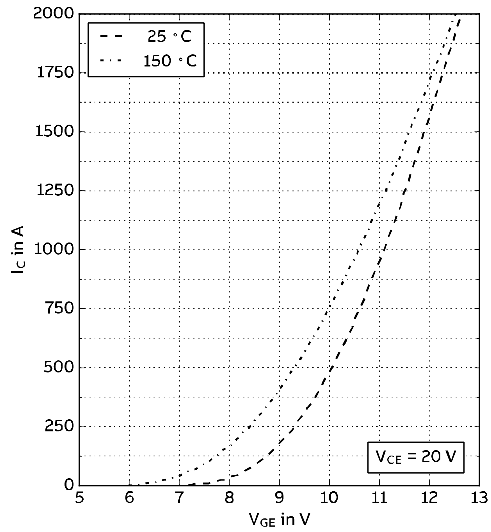


Fig. 3 Typical output characteristics, chip level

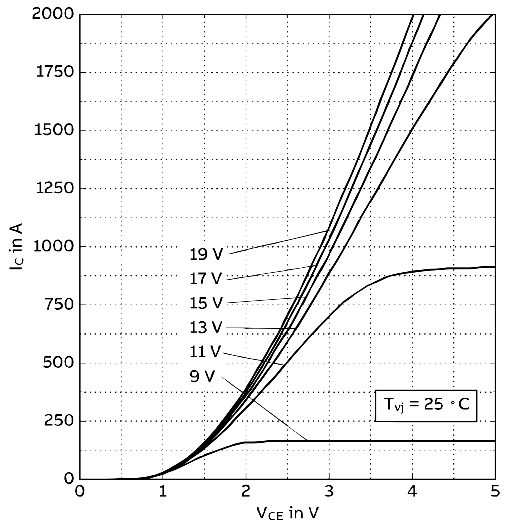


Fig. 4 Typical output characteristics, chip level

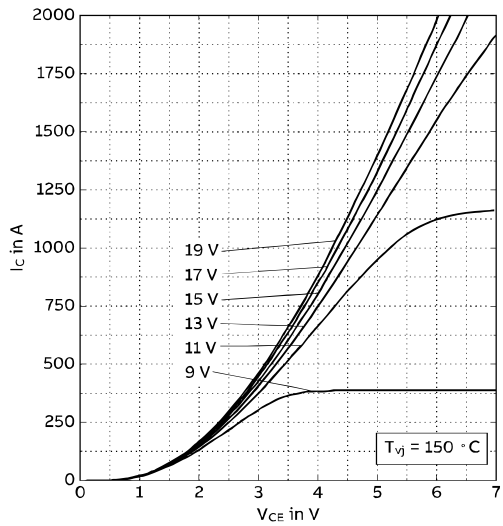


Fig. 5 Typical switching energies per pulse vs. collector current

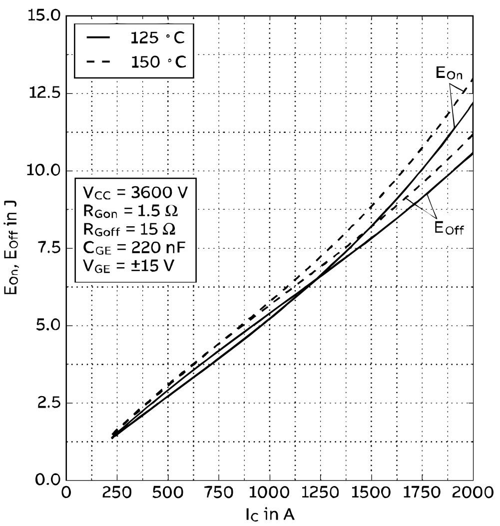


Fig. 6 Typical switching energies per pulse vs. gate resistor

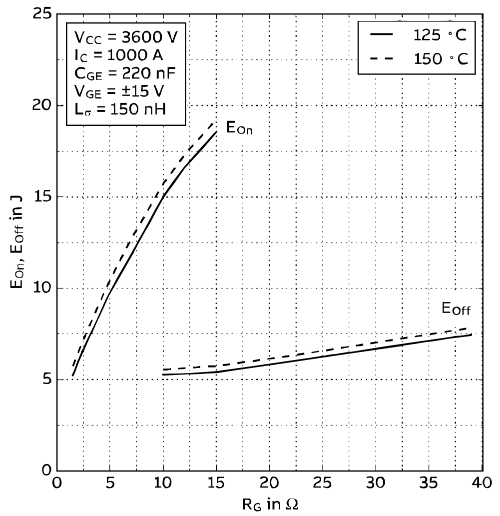


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Fig. 7 Typical switching times vs. collector current

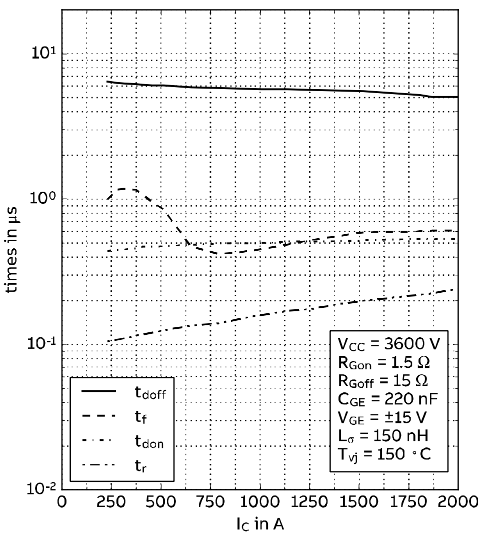

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Fig. 8 Typical switching times vs. gate resistor

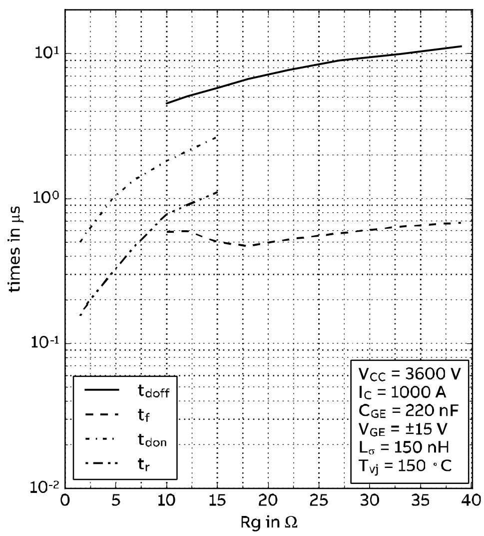

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Fig. 9 Typical gate charge characteristics

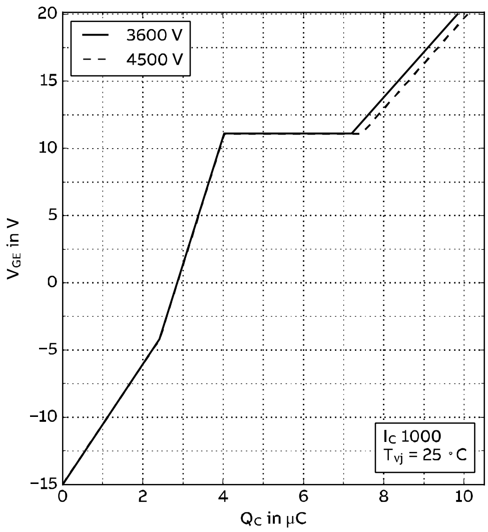

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Fig. 10 Turn-off safe operating area (RBSOA)

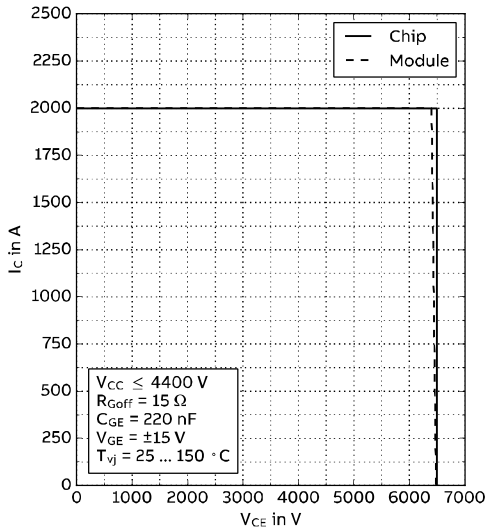

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Fig. 11 Typicial diode forward characteristics chip level

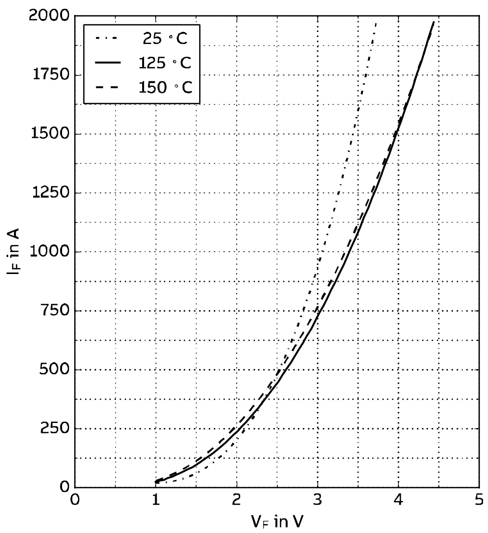

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Fig. 12 Typical reverse recovery characteristics vs. forward current

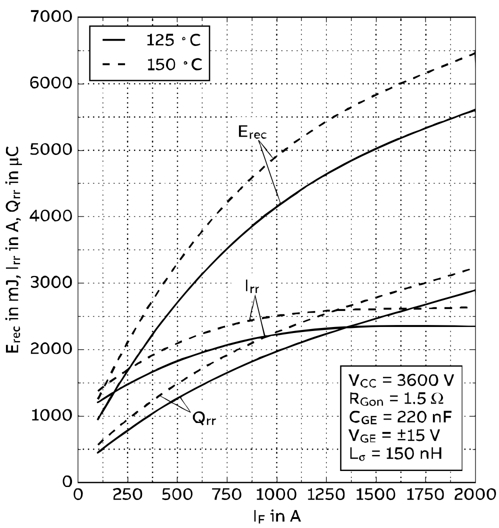


Fig. 13 Typical reverse recovery characteristics vs. di/dt

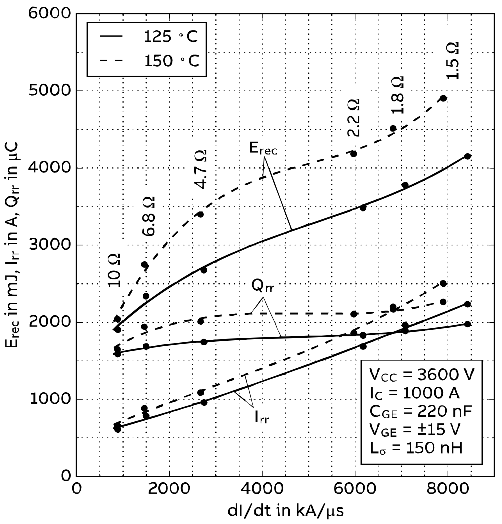


Fig. 14 Safe operating area diode (SOA)

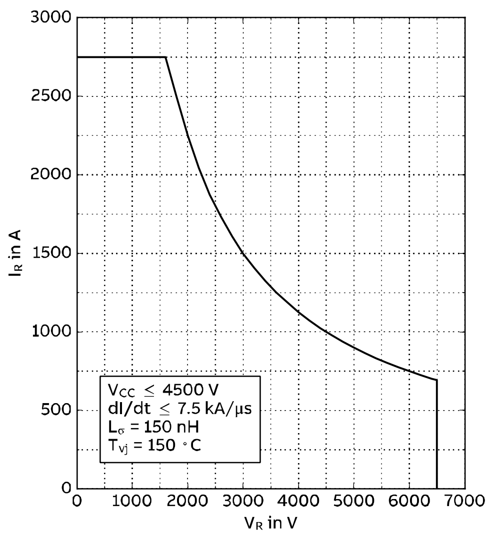
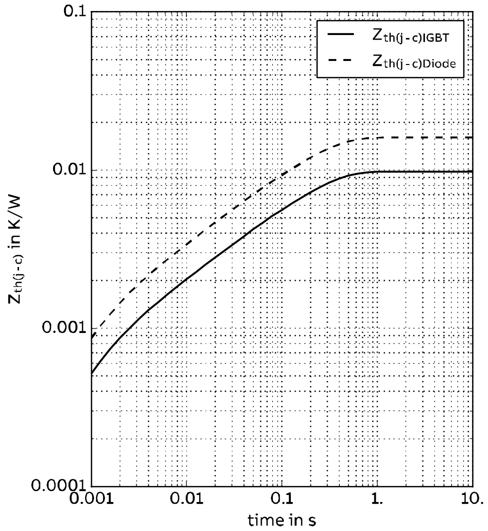


Fig. 15 Thermal impedance vs. time



Analytical function of the transient thermal resistance

$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i(1 - e^{-t/\tau_i})$$

	i	1	2	3	4	5
IGBT	R_i(K/kW)	0.9	2.35	4.84	1.68	
IGBT	τ_i(ms)	3609	364	51	3.7	
DIODE	R_i(K/kW)	1.95	6.11	5.9	2.06	
DIODE	τ_i(ms)	2283	160	32	2.7	

Related documents:

- 5SYA 2039 Mounting Instructions for HiPak modules
- 5SYA 2042 Failure rates of IGBT modules due to cosmic rays
- 5SYA 2043 Load – cycle capability of HiPaks
- 5SYA 2045 Thermal runaway during blocking
- 5SYA 2053 Applying IGBT
- 5SYA 2058 Surge currents for IGBT diodes
- 5SYA 2093 Thermal design of IGBT modules
- 5SYA 2098 Paralleling of IGBT modules
- 5SZK 9111 Specification of environmental class for HiPak Storage
- 5SZK 9112 Specification of environmental class for HiPak Transportation
- 5SZK 9113 Specification of environmental class for HiPak Operation (Industry)
- 5SZK 9120 Specification of environmental class for HiPak

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