Data Sheet, Doc. No. 5SYA 1470-01 10-2020

5SNA 1800E330400
HiPak IGBT module

- V_{CE} = 3300 V
- I_C = 1800 A
- Ultra-low loss TSPT+ technology
- Very soft switching FCE diode with increased diode area
- Exceptional ruggedness and highest current rating
- AlSiC base-plate for high power cycling capability
- AlN substrate for low thermal resistance
- Recognized under UL1557, File E196689

Maximum rated values [1)]

Parameter	Symbol	Conditions	min	max	Unit
Collector-emitter voltage	V_{CES}	V_{GE} = 0 V, T_{vj} ≥ 25 °C		3300	V
		V_{GE} = 0 V, T_{vj} = -40 °C		3000	
DC collector current	I_C	T_C = 98 °C, T_{vj} = 150 °C		1800	A
Peak collector current	I_{CM}	t_p = 1 ms		3600	A
Gate-emitter voltage	V_{GES}		-20	20	V
DC forward current	I_F			1800	A
Peak forward current	I_{FRM}	t_p = 1 ms		3600	A
Surge current	I_{FSM}	V_R = 0 V, $T_{vj\ start}$ = 150 °C, t_p = 10 ms, half-sinewave		14300	A
IGBT short circuit SOA	t_{psc}	V_{CC} = 2500 V, $V_{CEM\ CHIP}$ ≤ 3300 V V_{GE} ≤ 15 V, $T_{vj\ start}$ ≤ 150 °C		10	µs
Isolation voltage	V_{isol}	1 min, f = 50 Hz		6000	V
Junction temperature	T_{vj}			175	°C
Junction operating temperature	$T_{vj(op)}$		-40	150	°C
Case temperature	T_C		-40	125	°C
Storage temperature	T_{stg}		-50	125	°C
Mounting torques [2)]	M_s	Base-heatsink, M6 screws	4	6	Nm
	M_{t1}	Main terminals, M8 screws	8	10	
	M_{t2}	Auxiliary terminals, M4 screws	2	3	

[1)] Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747
[2)] For detailed mounting instructions refer to Document No. 5SYA 2039

IGBT characteristic values [3]

Parameter	Symbol	Conditions		min	typ	max	Unit
Collector (-emitter) breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 10 mA	T_{vj} = 150 °C	3300			V
			T_{vj} = 25 °C	3300			
			T_{vj} = -40 °C	3000			
Collector-emitter [4] saturation voltage	$V_{CE\,sat}$	I_C = 1800 A, V_{GE} = 15 V	T_{vj} = 25 °C		2.3	2.7	V
			T_{vj} = 125 °C		2.75	3.2	
			T_{vj} = 150 °C		2.9		
Collector cut-off current	I_{CES}	V_{CE} = 3300 V, V_{GE} = 0 V	T_{vj} = 25 °C			1	mA
			T_{vj} = 125 °C		22		
			T_{vj} = 150 °C		120		
Gate leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = ± 20 V, T_{vj} = 125 °C		-500		500	nA
Gate-emitter threshold voltage	$V_{GE(TO)}$	I_C = 240 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		6.7		8.7	V
Gate charge	Q_{ge}	I_C = 1800 A, V_{CE} = 1800 V, V_{GE} = -15 V ..15 V			18		µC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz, T_{vj} = 25 °C			239		nF
Internal gate resistance	R_{Gint}				0.83		Ω
Turn-on delay time	$t_{d(on)}$	V_{CC} = 1800 V, I_C = 1800 A, R_G = 1.2 Ω, C_{GE} = 330 nF, V_{GE} = ±15 V, L_σ = 100 nH, inductive load	T_{vj} = 25 °C		1120		ns
			T_{vj} = 150 °C		1120		
Rise time	t_r		T_{vj} = 25 °C		310		ns
			T_{vj} = 150 °C		320		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 1800 V, I_C = 1800 A, R_G = 4.7 Ω, C_{GE} = 330 nF, V_{GE} = ±15 V, L_σ = 100 nH, inductive load	T_{vj} = 25 °C		2890		ns
			T_{vj} = 150 °C		3470		
Fall time	t_f		T_{vj} = 25 °C		350		ns
			T_{vj} = 150 °C		420		
Turn-on switching energy	E_{on}	V_{CC} = 1800 V, I_C = 1800 A, R_G = 1.2 Ω, C_{GE} = 330 nF, V_{GE} = ±15 V, L_σ = 100 nH, inductive load	T_{vj} = 25 °C		3.50		J
			T_{vj} = 125 °C		4.30		
			T_{vj} = 150 °C		4.55		
Turn-off switching energy	E_{off}	V_{CC} = 1800 V, I_C = 1800 A, R_G = 4.7 Ω, C_{GE} = 330 nF, V_{GE} = ±15 V, L_σ = 100 nH, inductive load	T_{vj} = 25 °C		3.00		J
			T_{vj} = 125 °C		4.00		
			T_{vj} = 150 °C		4.25		
Short circuit current	I_{SC}	V_{CC} = 2500 V, V_{GE} = 15 V	$T_{vj\,start}$ = 150 °C		6600		A

[3] Characteristic values according to IEC 60747 – 9
[4] Collector-emitter saturation voltage is given at chip level

Diode characteristic values [5)]

Parameter	Symbol	Conditions		min	typ	max	Unit
Forward voltage [6)]	V_F	I_F = 1800 A	T_{vj} = 25 °C		2.0	2.45	V
			T_{vj} = 125 °C		2.2	2.65	
			T_{vj} = 150 °C		2.15		
Peak reverse recovery current	I_{RM}	V_{CC} = 1800 V, I_F = 1800 A, V_{GE} = ±15 V, R_G = 1.2 Ω, C_{GE} = 330 nF, di/dt = 6.7 kA/µs, L_σ = 100 nH, inductive load	T_{vj} = 25 °C		2340		A
			T_{vj} = 125 °C		2750		
			T_{vj} = 150 °C		3010		
Recovered charge	Q_{rr}		T_{vj} = 25 °C		1260		µC
			T_{vj} = 125 °C		2060		
			T_{vj} = 150 °C		2400		
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		850		ns
			T_{vj} = 125 °C		1080		
			T_{vj} = 150 °C		1220		
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		1.40		J
			T_{vj} = 125 °C		2.30		
			T_{vj} = 150 °C		2.60		

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

Package properties [7)]

Parameter	Symbol	Conditions		min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$					0.009	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$					0.014	K/W
IGBT thermal resistance [2)] case to heatsink	$R_{th(c-s)IGBT}$	IGBT per switch, λ grease = 1W/m x K			0.007		K/W
Diode thermal resistance [2)] case to heatsink	$R_{th(c-s)DIODE}$	Diode per switch, λ grease = 1W/m x K			0.010		K/W
Partial discharge extinction voltage	V_e	f = 50 Hz, Q_{PD} ≤ 10 pC (acc. To IEC 61287)		2600			V
Comparative tracking index	CTI			600			
Module stray inductance	$L_{\sigma CE}$				8		nH
Resistance, terminal-chip	$R_{CC'+EE'}$		T_C = 25 °C		0.055		mΩ
			T_C = 125 °C		0.075		
			T_C = 150 °C		0.080		

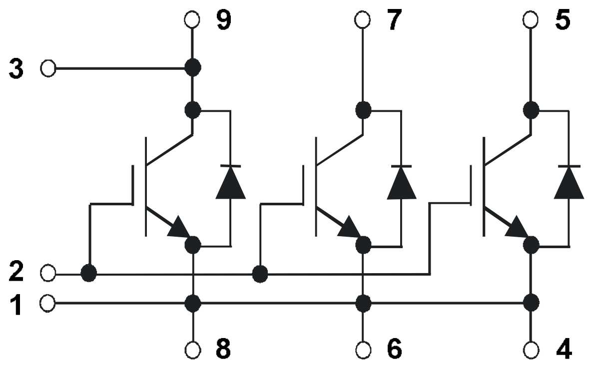
2) For detailed mounting instructions refer to Document No. 5SYA 2039

Mechanical properties [7)]

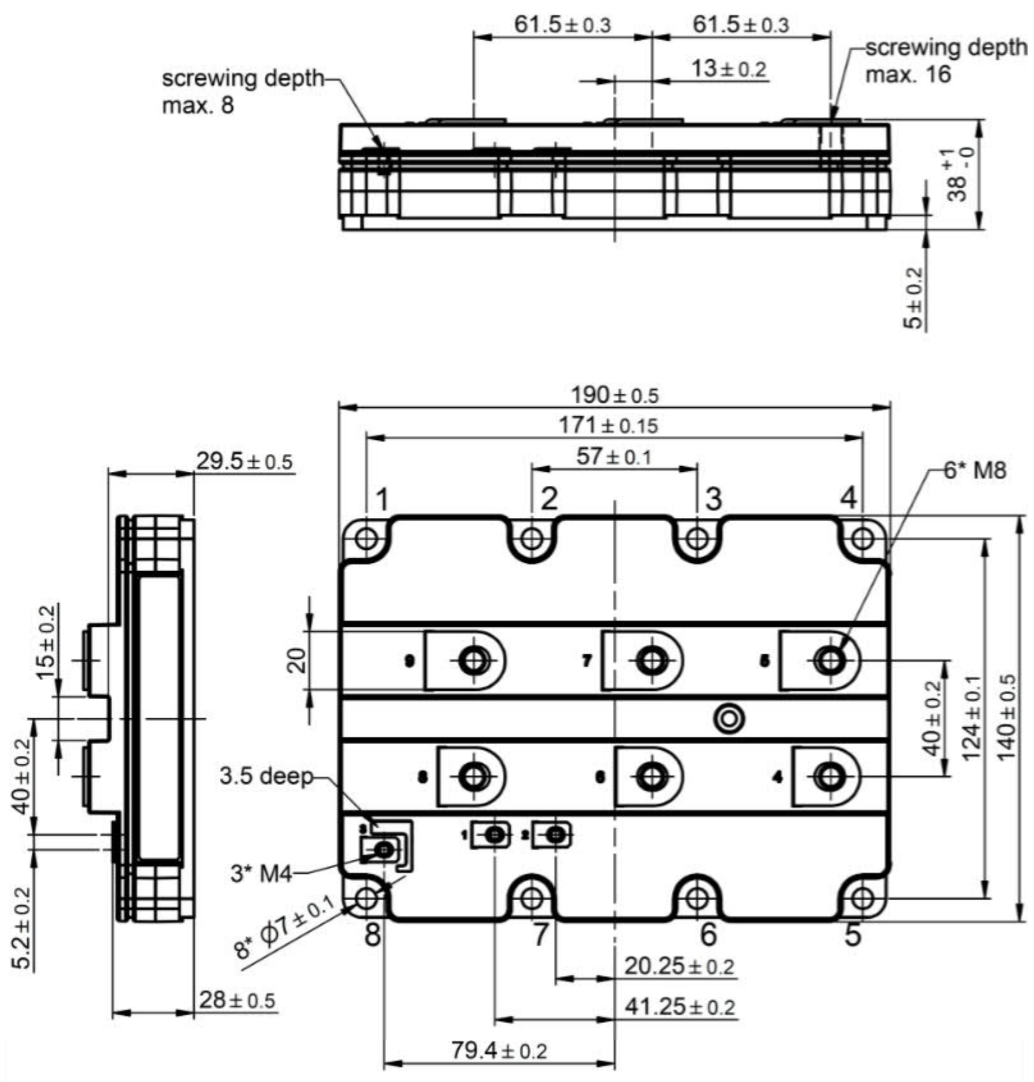
Parameter	Symbol	Conditions		min	typ	max	Unit
Dimensions	L x W x H	Typical			190 x 140 x 38		mm
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base:	23			mm
			Term. to term:	19			
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1	Term. to base:	28.2			mm
			Term. to term:	28.2			
Mass	m				1190		g

7) 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, chap. VIII. This product has been designed and qualified for Industrial Level.

Fig. 1 Typical on-state characteristics, chip level

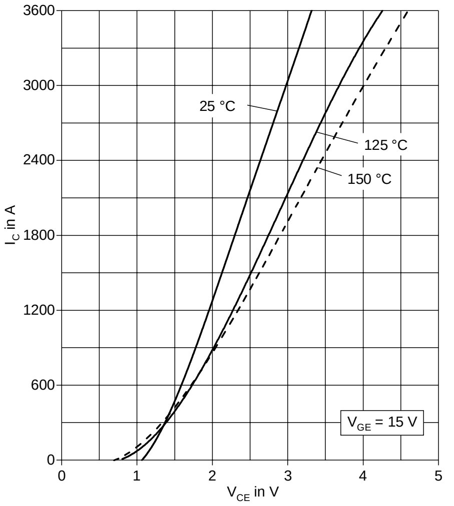


Fig. 2 Typical transfer characteristics, chip level

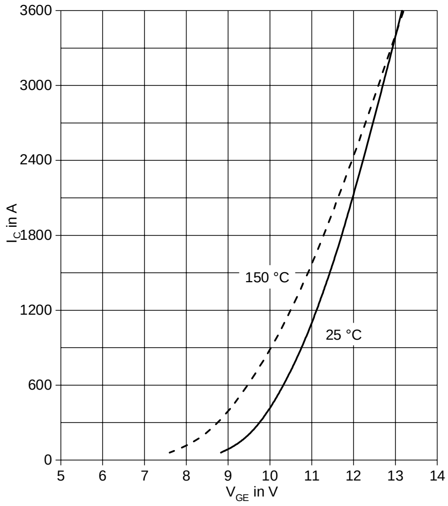


Fig. 3 Typical output characteristics, chip level

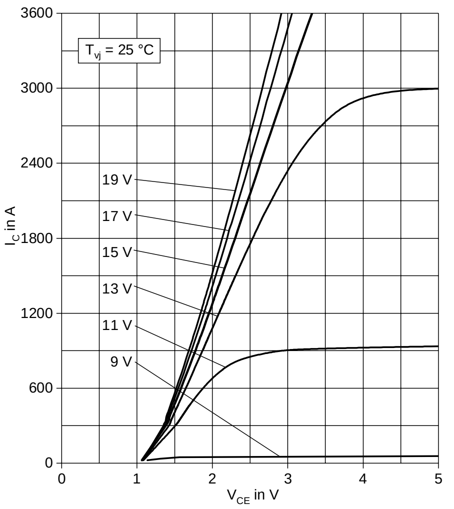


Fig. 4 Typical output characteristics, chip level

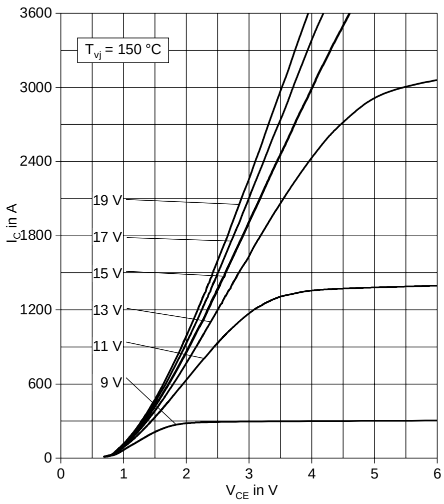


Fig. 5 Typical switching energies per pulse vs. collector current

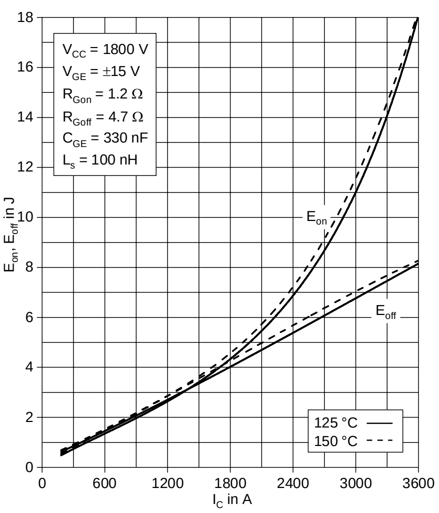


Fig. 6 Typical switching energies per pulse vs. gate resistor

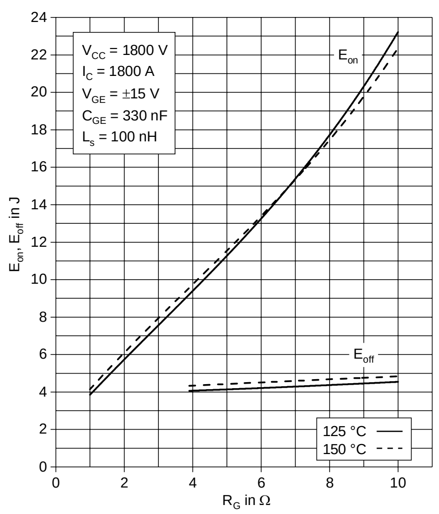


Fig. 7 Typical switching times vs. collector current

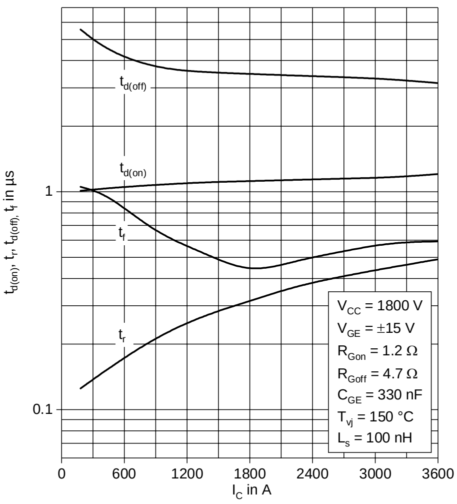


Fig. 8 Typical switching times vs. gate resistor

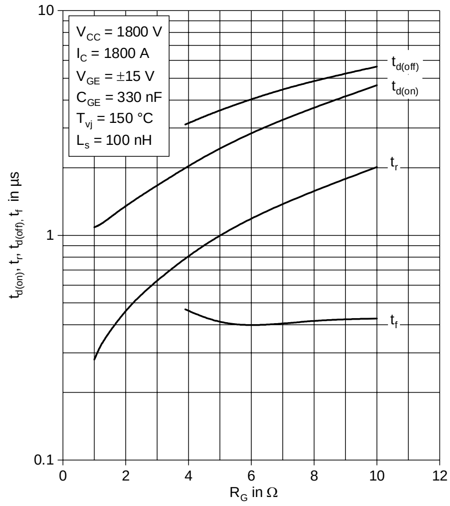


Fig. 9 Typical gate charge characteristics

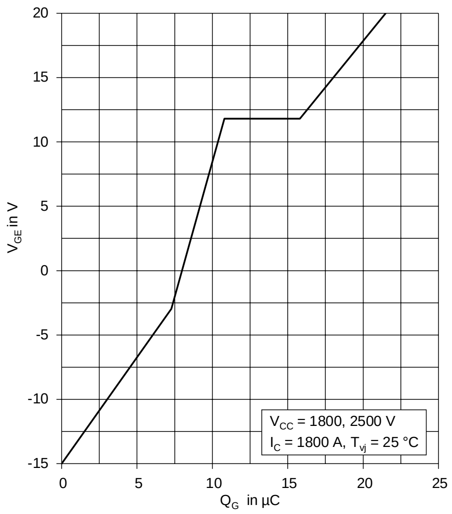


Fig. 10 Turn-off safe operating area (RBSOA)

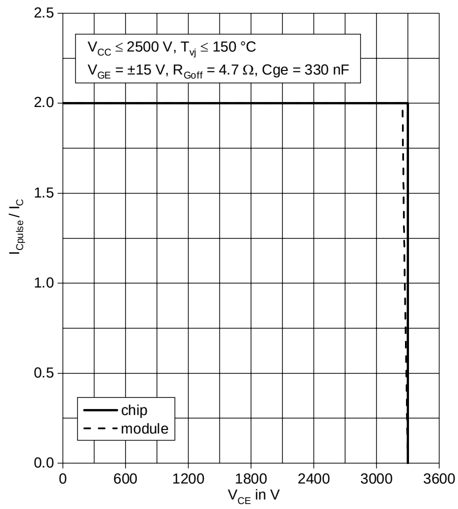


Fig. 11 Typical diode forward characteristics chip level

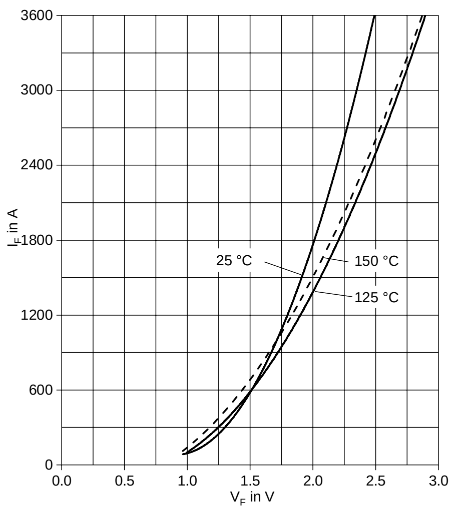


Fig. 12 Typical reverse recovery characteristics vs. forward current

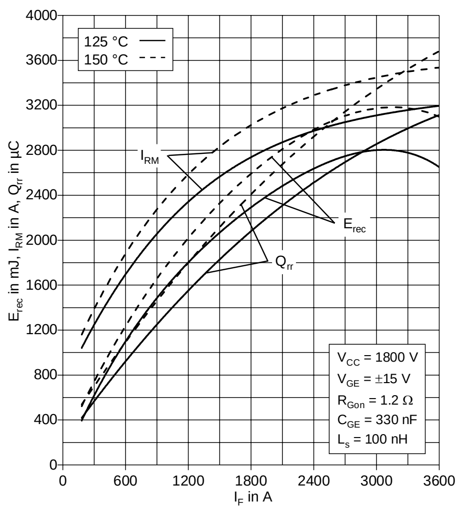


Fig. 13 Typical reverse recovery characteristics vs. di/dt

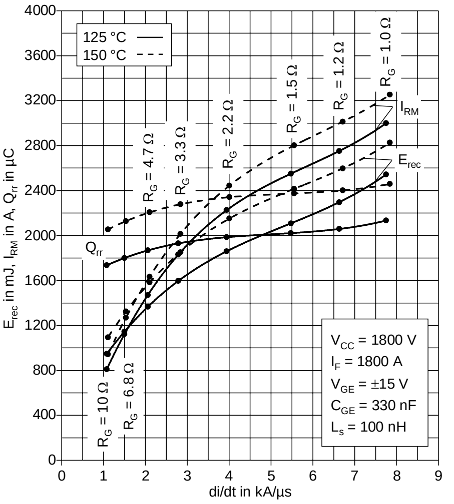


Fig. 14 Safe operating area diode (SOA)

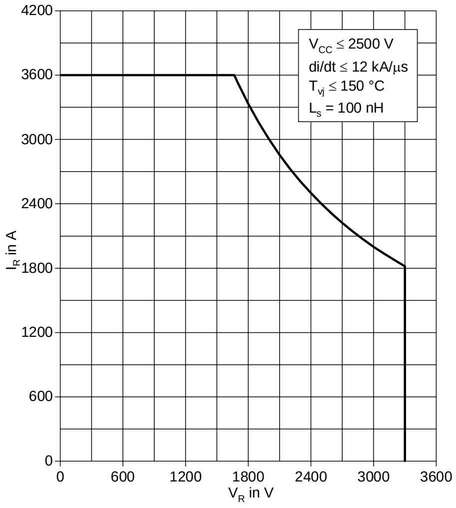
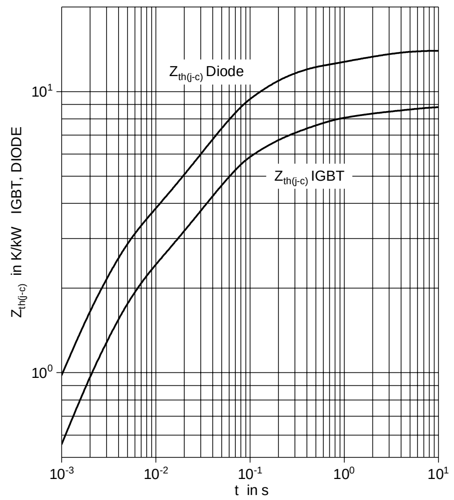


Fig. 15 Thermal impedance vs. time



Analytical function of the transient thermal resistance

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

	i	1	2	3	4	5
IGBT	Ri(K/kW)	1.631	4.286	2.089	0.855	
	τi(ms)	2.986	48.79	364.8	3593	
DIODE	Ri(K/kW)	2.441	4.23	5.055	2.253	
	τi(ms)	2.434	36.51	116.2	1641	

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 2057 IGBT diode safe operating area (SOA)
- 5SYA 2058 Surge currents for IGBT diodes
- 5SYA 2093 Thermal design of IGBT modules
- 5SYA 2098 Paralleling of IGBT modules

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