V_{RRM}	=	4500 V
$I_{F(AV)M}$	=	2070 A
I_{FSM}	=	$45 \cdot 10^3$ A
V_{F0}	=	1.56 V
r_F	=	0.80 mΩ
$V_{DC-Link}$	=	2800 V

Fast Recovery Diode

5SDF 20L4521
Preliminary

- **Industry standard housing**
- **Cosmic radiation withstand rating**
- **Optimized low switching losses**
- **Optimized for IGBT operation**
- **High RBSOA up to high di/dt**

Blocking
Maximum rated values [1]

Parameter	Symbol	Conditions		5SDF 20L4521	Unit
Repetitive peak reverse voltage	V_{RRM}	f = 50 Hz, t_p = 10 ms, T_{vj} = 140 °C		4500	V
Permanent DC voltage for 100 FIT failure rate	$V_{DC-link}$	Ambient cosmic radiation at sea level in open air.	100% Duty	2800	V
			5% Duty	3200	

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Reverse leakage current	I_{RRM}	V_{RRM}, T_{vj} = 140 °C			150	mA

Mechanical data
Maximum rated values [1]

Parameter	Symbol	Conditions	min	typ	max	Unit
Mounting force	F_M		36	40	70	kN
Acceleration	a	Device unclamped			50	m/s²
Acceleration	a	Device clamped			200	m/s²

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Weight	m				1.45	kg
Housing thickness	H	F_M = 40 kN, T_a = 25 °C	25.85		26.25	mm
Surface creepage distance	D_S		33			mm
Air strike distance	D_a		14			mm

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

On-state

Maximum rated values [1]

Parameter	Symbol	Conditions	min	typ	max	Unit
Average on-state current	$I_{F(AV)M}$	Half sine wave, Tc = 70 °C			2070	A
RMS on-state current	$I_{F(RMS)}$				3250	A
Peak non-repetitive surge current	I_{FSM}	t_p = 10 ms, T_{vj} = 140 °C, sine half wave,			$45 \cdot 10^3$	A
Limiting load integral	I^2t	V_R = 0 V, after surge			$10.1 \cdot 10^6$	A^2s

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
On-state voltage	V_F	I_F = 3300 A, T_{vj} = 140 °C		3.69	4.2	V
Threshold voltage	V_{F0}	I_F = 500...3500 A, T_{vj} = 140 °C			1.56	V
Slope resistance	r_F				0.80	mΩ

Turn-on

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Peak forward recovery voltage	V_{FRM}	dI_F/dt = 3000 A/µs, I_{FM} = 5500 A, T_{vj} = 140 °C		200		V

Turn-off

Maximum rated values [1]

Parameter	Symbol	Conditions	min	typ	max	Unit
Max. decay rate of on-state current	di/dt_{crit}				TBD	A/µs

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Reverse recovery charge	Q_{rr}	I_F = 3000 A, $V_{DC-Link}$ = 2800 V, di/dt = 5000 A/µs, L_σ = 200 nH, IGBT = 5SNA 2000K450300, T_{vj} = 140 °C, V_{GE} = ±15 V		5200	6400	µAs
Reverse recovery current	I_{RM}			3500	4300	A
Turn-off energy	E_{rr}			10.0	12.4	J

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Thermal

Maximum rated values [1])

Parameter	Symbol	Conditions	min	typ	max	Unit
Operating junction temperature range	T_{vj}				140	°C
Storage temperature range	T_{stg}		-40		125	°C

Characteristic values

Parameter	Symbol	Conditions	min	typ	max	Unit
Thermal resistance junction to case	$R_{th(j-c)}$	Double-side cooled F_m = 36... 70 kN			6	K/kW
	$R_{th(j-c)A}$	Anode-side cooled F_m = 36... 70 kN			11.2	K/kW
	$R_{th(j-c)C}$	Cathode-side cooled F_m = 36... 70 kN			12.9	K/kW
Thermal resistance case to heatsink	$R_{th(c-h)}$	Double-side cooled F_m = 36... 70 kN			3	K/kW
	$R_{th(c-h)}$	Single-side cooled F_m = 36... 70 kN			6	K/kW

Analytical function for transient thermal impedance:

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

i	1	2	3	4
R_i(K/kW)	3.708	1.426	0.686	0.176
τ_i(s)	0.5336	0.0670	0.0074	0.0011
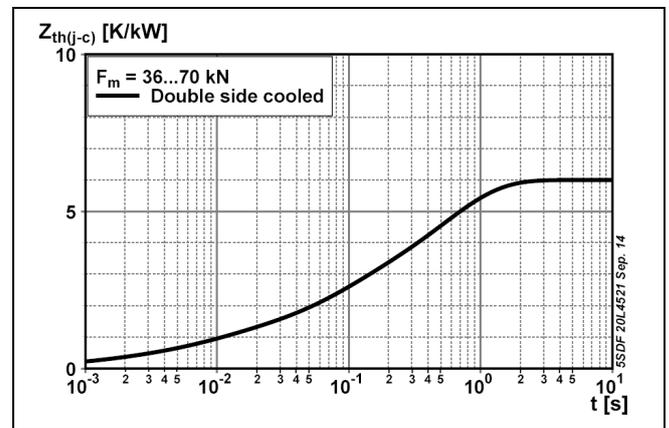
Fig. 1 Transient thermal impedance (junction-to-case) vs. time

Max. on-state characteristic model:			
$V_{F25} = A_{Tvj} + B_{Tvj} \cdot I_F + C_{Tvj} \cdot \ln(I_F + 1) + D_{Tvj} \cdot \sqrt{I_F}$			
Valid for I_F = 200 - 35000 A			
A_{25}	B_{25}	C_{25}	D_{25}
$-298.90 \cdot 10^{-3}$	$304.10 \cdot 10^{-6}$	$242.4 \cdot 10^{-3}$	$39.10 \cdot 10^{-3}$

Max. on-state characteristic model:			
$V_{F140} = A_{Tvj} + B_{Tvj} \cdot I_F + C_{Tvj} \cdot \ln(I_F + 1) + D_{Tvj} \cdot \sqrt{I_F}$			
Valid for I_F = 200 - 35000 A			
A_{140}	B_{140}	C_{140}	D_{140}
$-383.60 \cdot 10^{-3}$	$502.20 \cdot 10^{-6}$	$246.90 \cdot 10^{-3}$	$16.12 \cdot 10^{-3}$
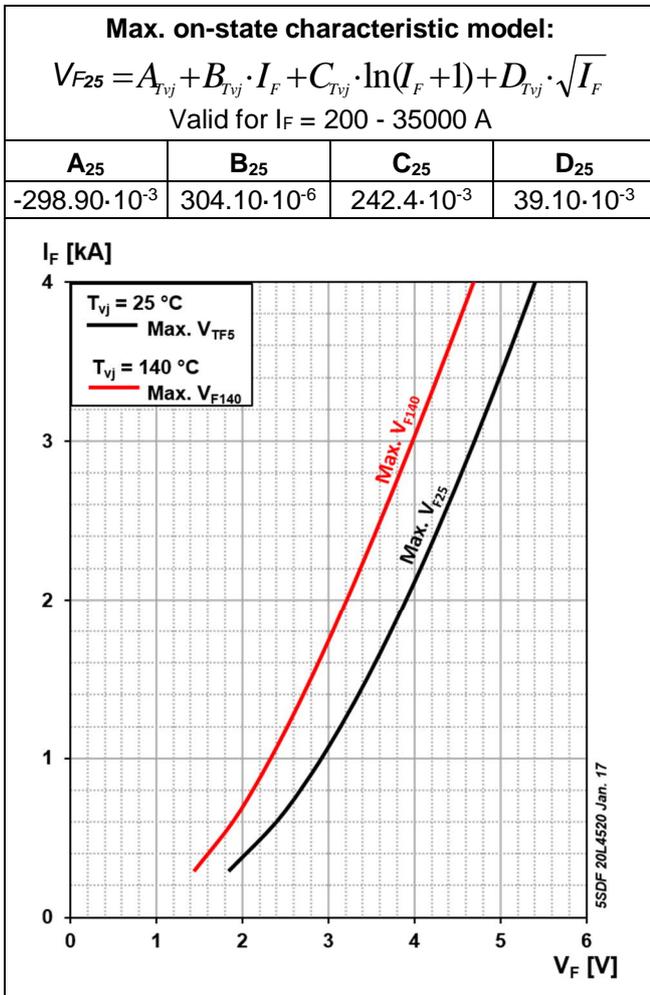
Fig. 2 On-state voltage characteristics
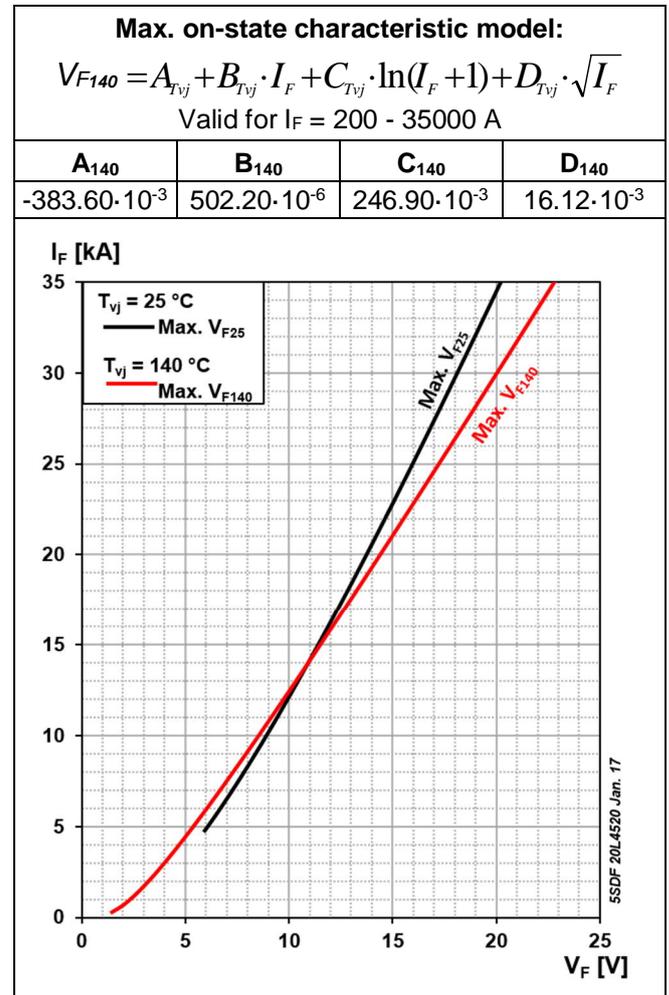
Fig. 3 On-state voltage characteristics
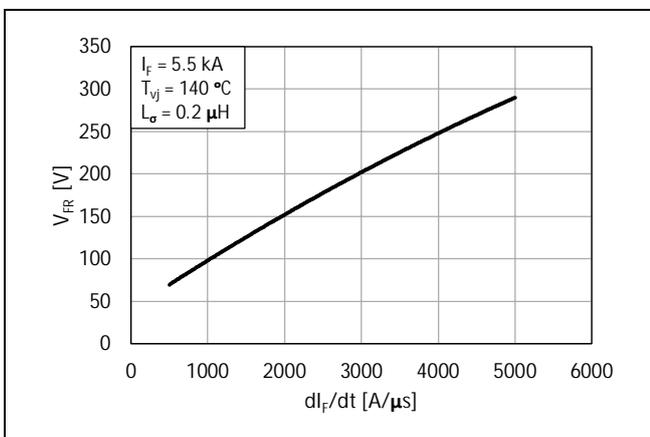
Fig. 4 Peak forward recovery voltage
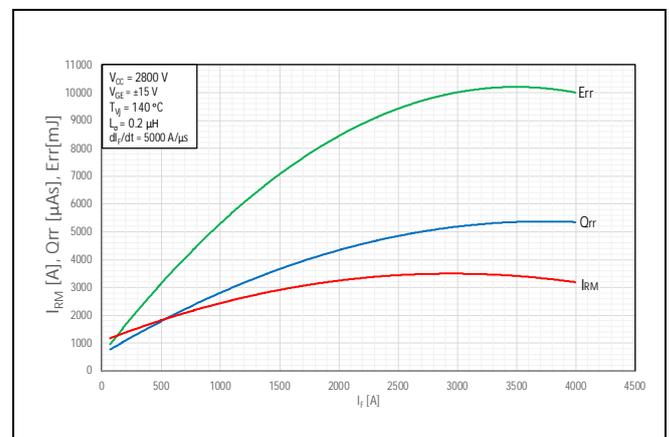
Fig. 5 Reverse recovery characteristics (typical values)

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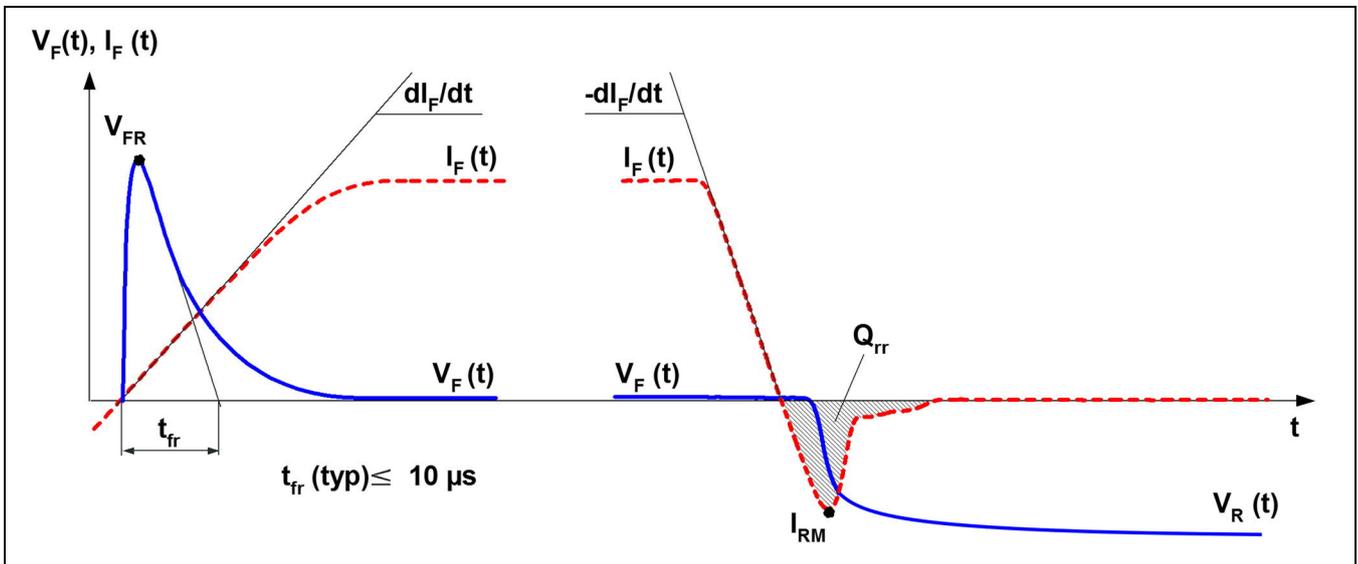
**Fig. 6** General current and voltage waveforms
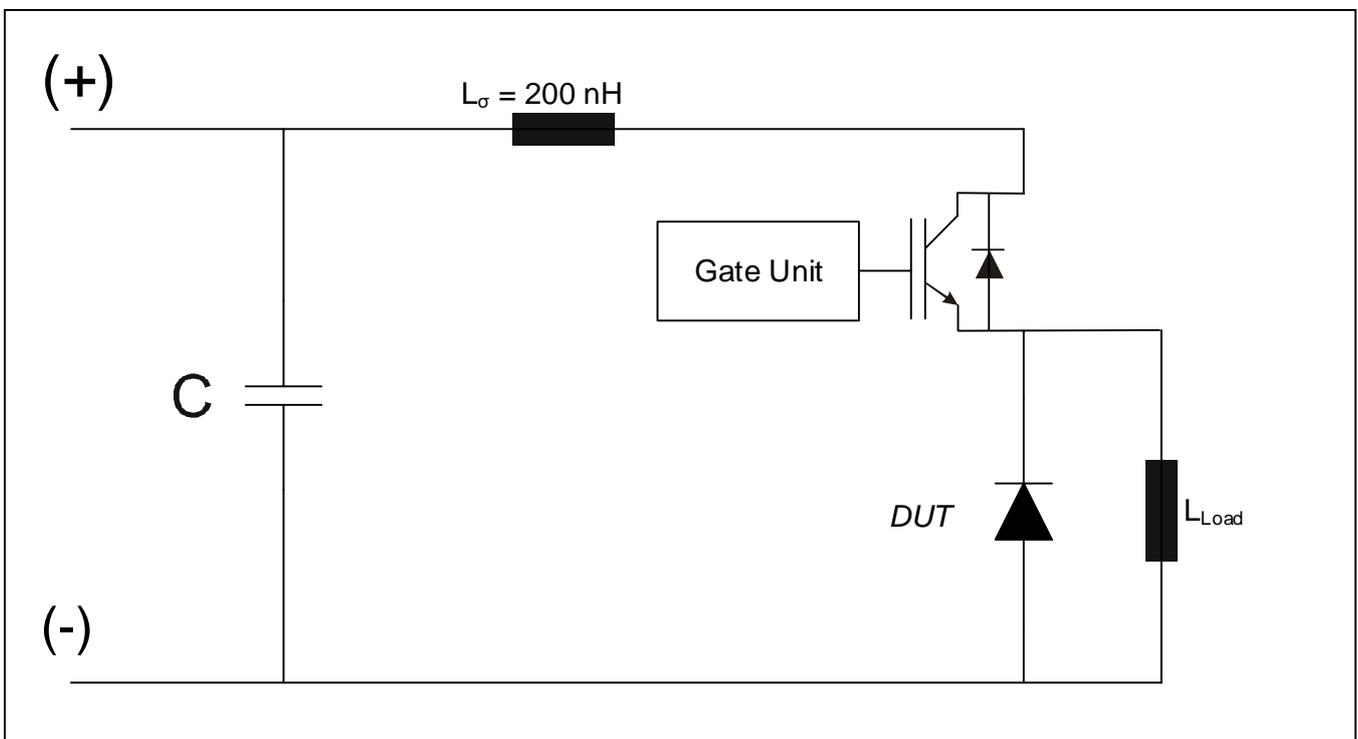
**Fig. 7** Reverse recovery test circuit. Fast Recovery Diode (DUT) in IGBT Application.
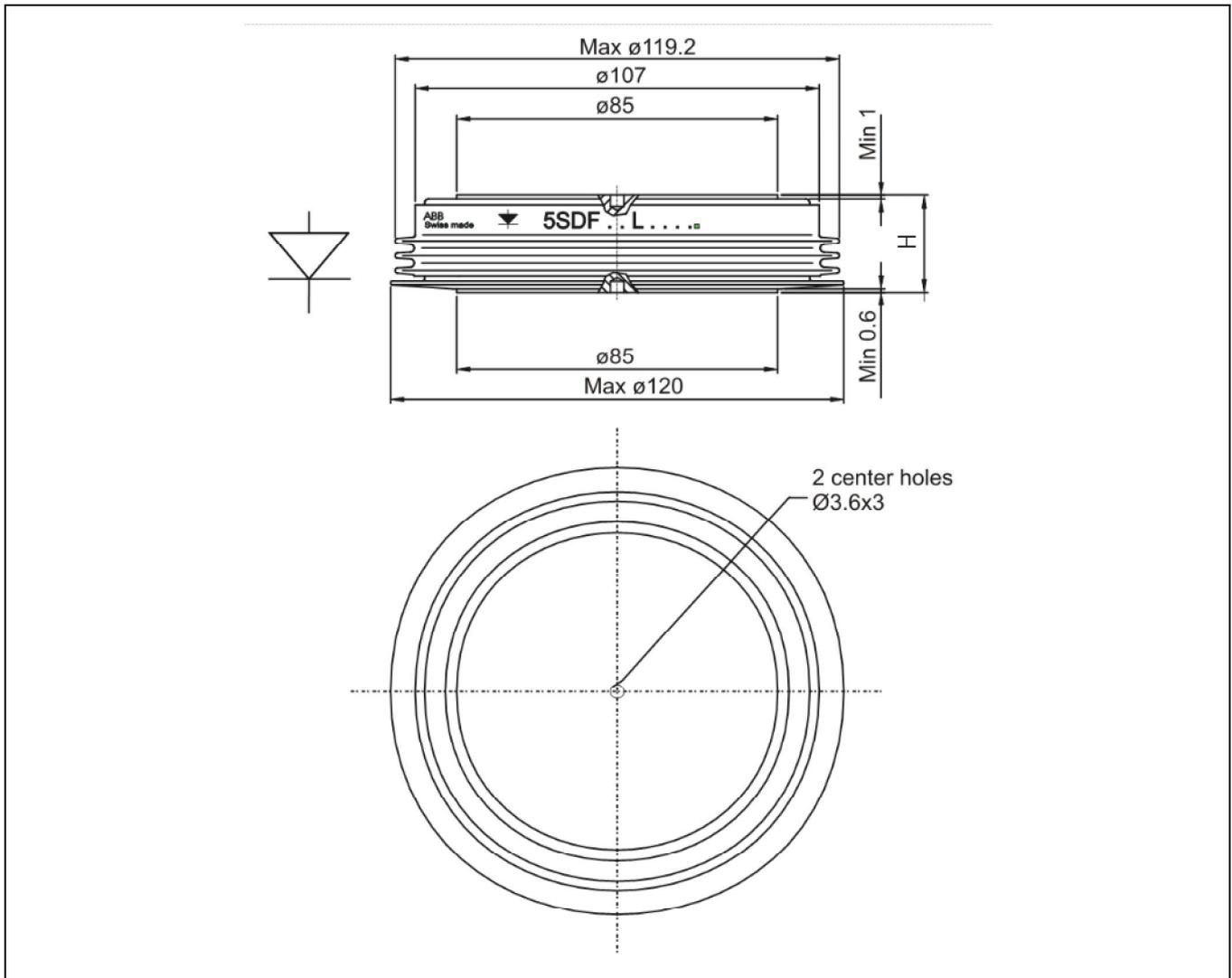
Fig. 8 Device Outline Drawing

Related documents:

Doc. Nr.	Title
5SYA 2036	Recommendations regarding mechanical clamping of Press Pack High Power Semiconductors
5SYA 2064	Applying Fast Recovery Diodes
5SZK 9104	Specification of environmental class for pressure contact diodes, PCTs and GTO, STORAGE
5SZK 9105	Specification of environmental class for pressure contact diodes, PCTs and GTO, TRANSPORTATION
5SZK 9115	Specification of environmental class for presspack Diodes, PCTs and GTOs, OPERATION (Industry)
5SZK 9116	Specification of environmental class for presspack Diodes, PCTs and GTOs, OPERATION (Traction)

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