

$V_{RRM} = 4500 \text{ V}$   
 $I_{F(AV)M} = 275 \text{ A}$   
 $I_{FSM} = 5.8 \cdot 10^3 \text{ A}$   
 $V_{F0} = 1.67 \text{ V}$   
 $r_F = 3.54 \text{ m}\Omega$   
 $V_{DC-Link} = 2800 \text{ V}$

## Fast Recovery Diode

# 5SDF 03D4502

Doc. No. 5SYA1117-03 Nov. 19

- Patented free-floating technology
- Industry standard housing
- Cosmic radiation withstand rating
- Low on-state and switching losses
- Optimized to use in snubberless operation

### Blocking

*Maximum rated values <sup>1)</sup>*

| Parameter                                     | Symbol        | Conditions  | 5SDF 03D4502 | Unit |
|---|---------------|---|--------------|------|
| Repetitive peak reverse voltage               | $V_{RRM}$     | $f = 50 \text{ Hz}$ , $t_p = 10 \text{ ms}$ , $T_{vj} = 115 \text{ }^\circ\text{C}$ | 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    |

*Characteristic values*

| Parameter               | Symbol    | Conditions  | min | typ | max | Unit |
|-------------------------|-----------|---|-----|-----|-----|------|
| Reverse leakage current | $I_{RRM}$ | $V_{RRM}$ , $T_{vj} = 115 \text{ }^\circ\text{C}$ |     |     | 8   | mA   |

### Mechanical data

*Maximum rated values <sup>1)</sup>*

| Parameter      | Symbol | Conditions       | min | typ | max | Unit           |
|----------------|--------|------------------|-----|-----|-----|----------------|
| Mounting force | $F_M$  |                  | 14  | 16  | 18  | kN             |
| Acceleration   | a      | Device unclamped |     |     | 50  | $\text{m/s}^2$ |
| Acceleration   | a      | Device clamped   |     |     | 200 | $\text{m/s}^2$ |

*Characteristic values*

| Parameter                 | Symbol | Conditions | min   | typ | max   | Unit |
|---------------------------|--------|------------|-------|-----|-------|------|
| Weight                    | m      |            |       |     | 0.25  | kg   |
| Housing thickness         | H      |            | 25.77 |     | 26.42 | mm   |
| Pole-piece diameter       | $D_P$  |            |       | 34  |       | mm   |
| Surface creepage distance | $D_S$  |            | 30    |     |       | mm   |
| Air strike distance       | $D_a$  |            | 20    |     |       | mm   |

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

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## On-state

### Maximum rated values <sup>1)</sup>

| Parameter                         | Symbol       | Conditions   | min | typ | max               | Unit   |
|-----------------------------------|--------------|--|-----|-----|-------------------|--------|
| Average on-state current          | $I_{F(AV)M}$ | Half sine wave, $T_c = 70\text{ °C}$   |     |     | 275               | A      |
| RMS on-state current              | $I_{F(RMS)}$ |  |     |     | 435               | A      |
| Peak non-repetitive surge current | $I_{FSM}$    | $t_p = 10\text{ ms}$ , $T_{vj} = 115\text{ °C}$ ,<br>sine half wave,<br>$V_R = 0\text{ V}$ , after surge |     |     | $5.8 \cdot 10^3$  | A      |
| Limiting load integral            | $I^2t$       |  |     |     | $1.68 \cdot 10^5$ | $A^2s$ |

### Characteristic values

| Parameter         | Symbol   | Conditions  | min | typ  | max  | Unit |
|-------------------|----------|---|-----|------|------|------|
| On-state voltage  | $V_F$    | $I_F = 630\text{ A}$ , $T_{vj} = 115\text{ °C}$           |     | 3.20 | 3.90 | V    |
| Threshold voltage | $V_{F0}$ | $I_F = 200 \dots 700\text{ A}$ , $T_{vj} = 115\text{ °C}$ |     | 1.45 | 1.67 | V    |
| Slope resistance  | $r_F$    |   |     |      | 2.78 | 3.54 |

## Turn-on

### Characteristic values

| Parameter                     | Symbol    | Conditions   | min | typ | max | Unit |
|-------------------------------|-----------|--|-----|-----|-----|------|
| Peak forward recovery voltage | $V_{FRM}$ | $di_F/dt = 1000\text{ A}/\mu s$ , $T_{vj} = 115\text{ °C}$ |     | 205 |     | V    |

## Turn-off

### Maximum rated values <sup>1)</sup>

| Parameter                           | Symbol         | Conditions   | min | typ | max | Unit      |
|-------------------------------------|----------------|--|-----|-----|-----|-----------|
| Max. decay rate of on-state current | $di/dt_{crit}$ | $I_F = 630\text{ A}$ , $T_{vj} = 115\text{ °C}$ ,<br>$V_{DC-Link} = 2800\text{ V}$ |     |     | 300 | $A/\mu s$ |

### Characteristic values

| Parameter                | Symbol   | Conditions  | min | typ | max | Unit     |   |
|--------------------------|----------|---|-----|-----|-----|----------|---|
| Reverse recovery charge  | $Q_{rr}$ | $I_F = 630\text{ A}$ , $V_{DC-Link} = 2700\text{ V}$ ,<br>$-di_F/dt = 250\text{ A}/\mu s$ , $L_{CL} = 300\text{ nH}$ ,<br>$C_{CL} = 3\text{ }\mu F$ , $R_S = 1.25\text{ }\Omega$ ,<br>$D_{CL} = 5SDF\ 08H6005$ , $T_{vj} = 115\text{ °C}$ |     | 755 | 930 | $\mu As$ |   |
| Reverse recovery current | $I_{RM}$ |   |     |     | 350 | 400      | A |
| Turn-off energy          | $E_{rr}$ |   |     |     |     | 1.8      | J |

## Thermal

### Maximum rated values<sup>1)</sup>

| Parameter                            | Symbol    | Conditions | min | typ | max | Unit |
|--------------------------------------|-----------|------------|-----|-----|-----|------|
| Operating junction temperature range | $T_{vj}$  |            | 0   |     | 115 | °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<br>$F_m = 14... 18$ kN  |     |     | 40  | K/kW |
|                                     | $R_{th(j-c)A}$ | Anode-side cooled<br>$F_m = 14... 18$ kN   |     |     | 80  | K/kW |
|                                     | $R_{th(j-c)C}$ | Cathode-side cooled<br>$F_m = 14... 18$ kN |     |     | 80  | K/kW |
| Thermal resistance case to heatsink | $R_{th(c-h)}$  | Double-side cooled<br>$F_m = 14... 18$ kN  |     |     | 8   | K/kW |
|                                     | $R_{th(c-h)}$  | Single-side cooled<br>$F_m = 14... 18$ kN  |     |     | 16  | K/kW |

Analytical function for transient thermal impedance:

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

| i            | 1      | 2      | 3      | 4      |
|--------------|--------|--------|--------|--------|
| $R_i$ (K/kW) | 25.613 | 9.407  | 3.385  | 1.595  |
| $\tau_i$ (s) | 0.3743 | 0.0454 | 0.0048 | 0.0013 |

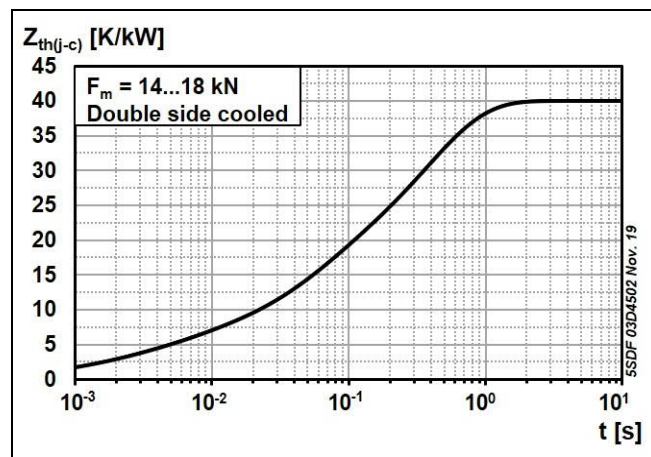


Fig. 1 Transient thermal impedance (junction-to-case) vs. time

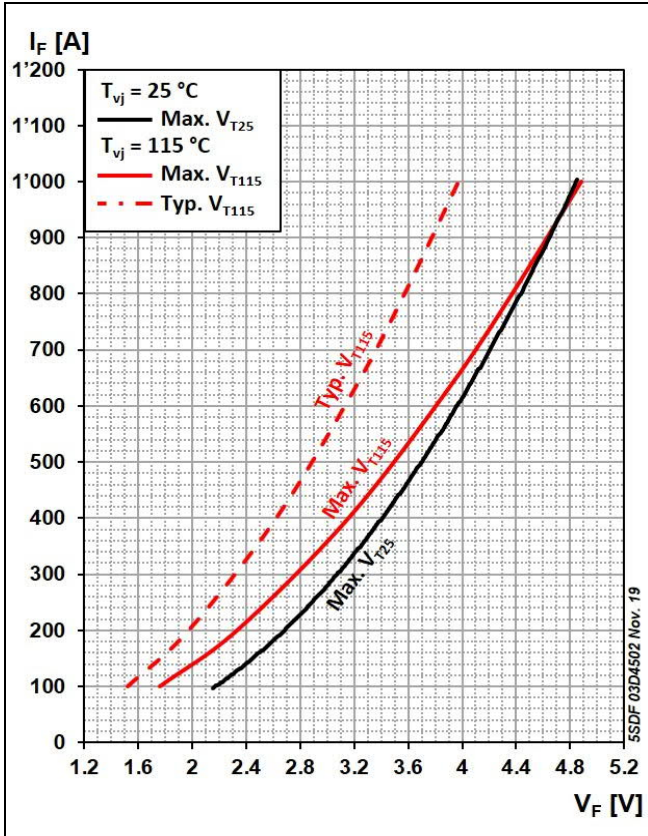


Fig. 2 Forward current vs. forward voltage

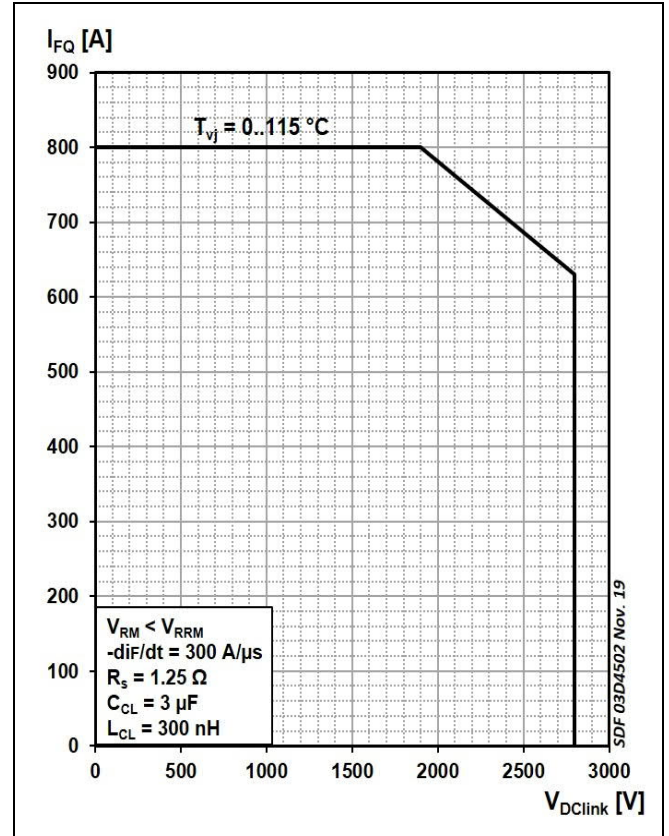


Fig. 3 Diode Safe Operating Area

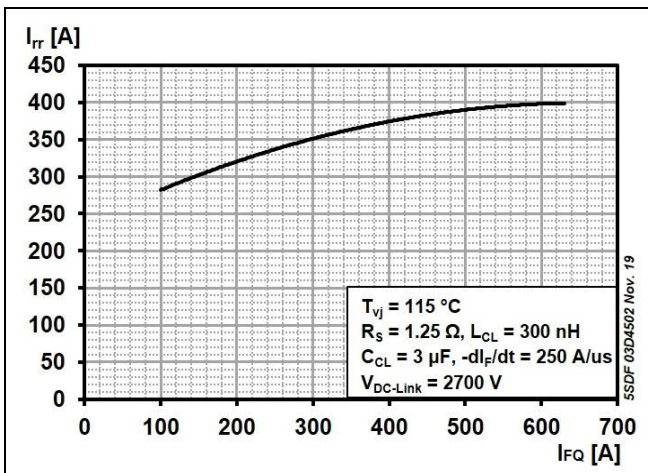


Fig. 4 Diode reverse recovery current vs. turn-off current

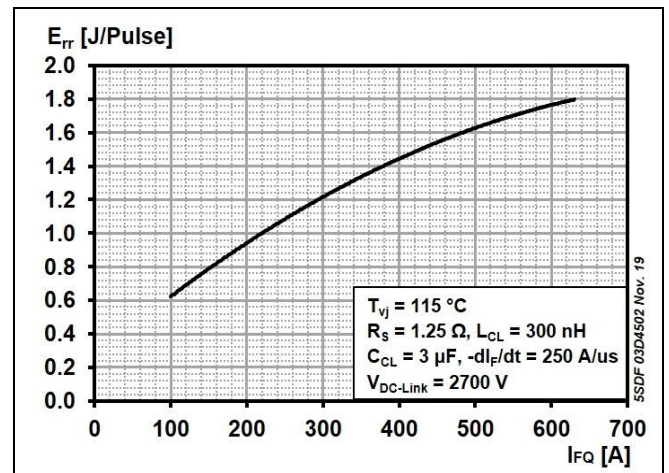
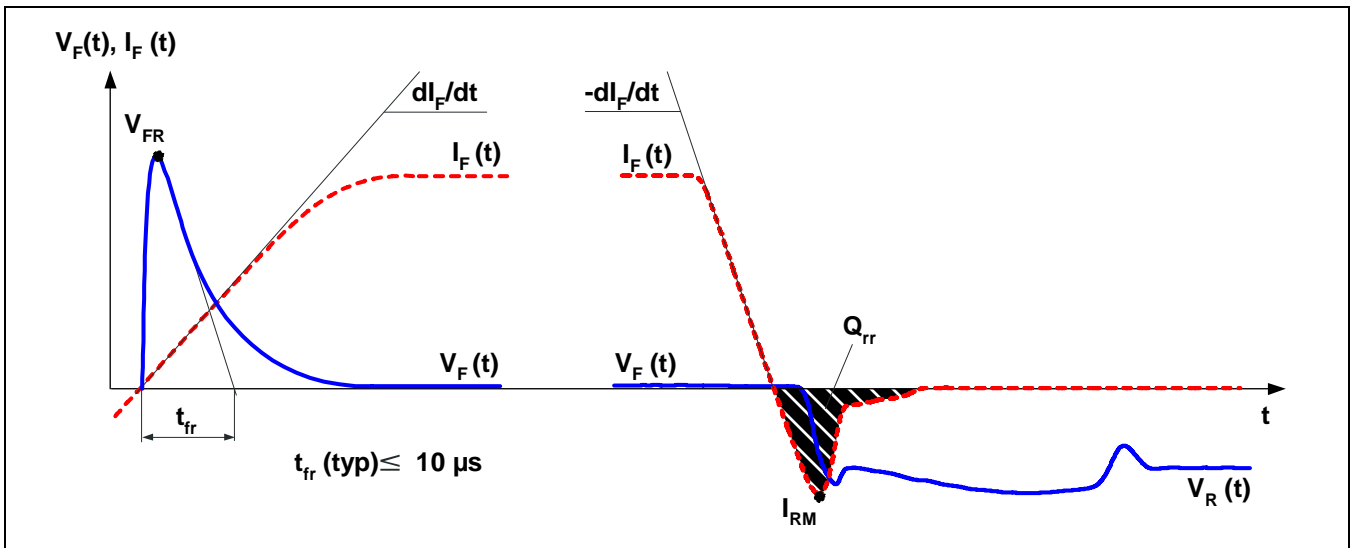
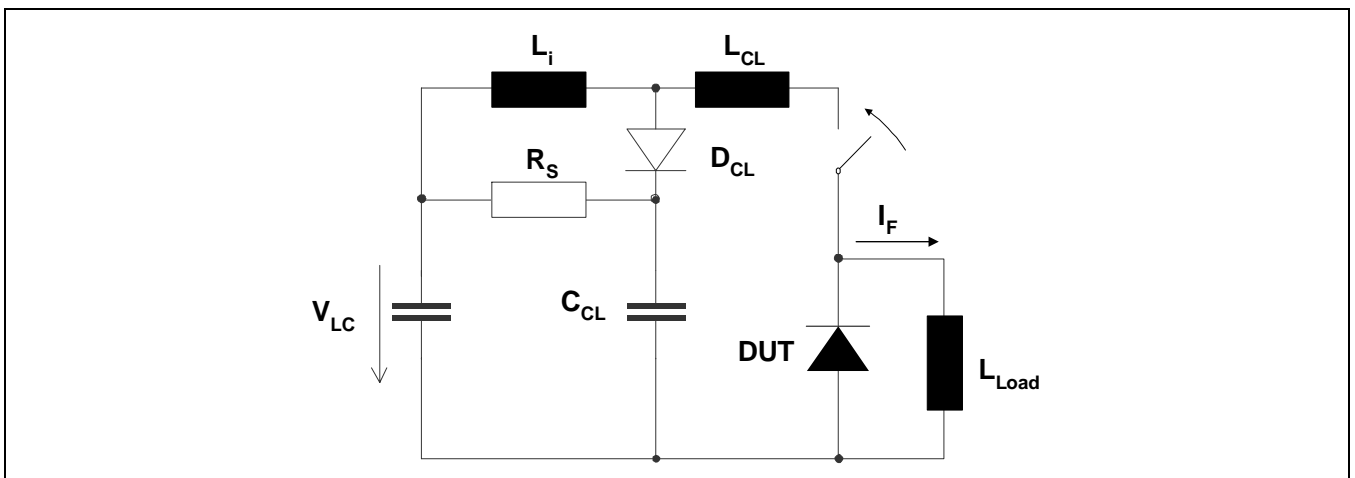


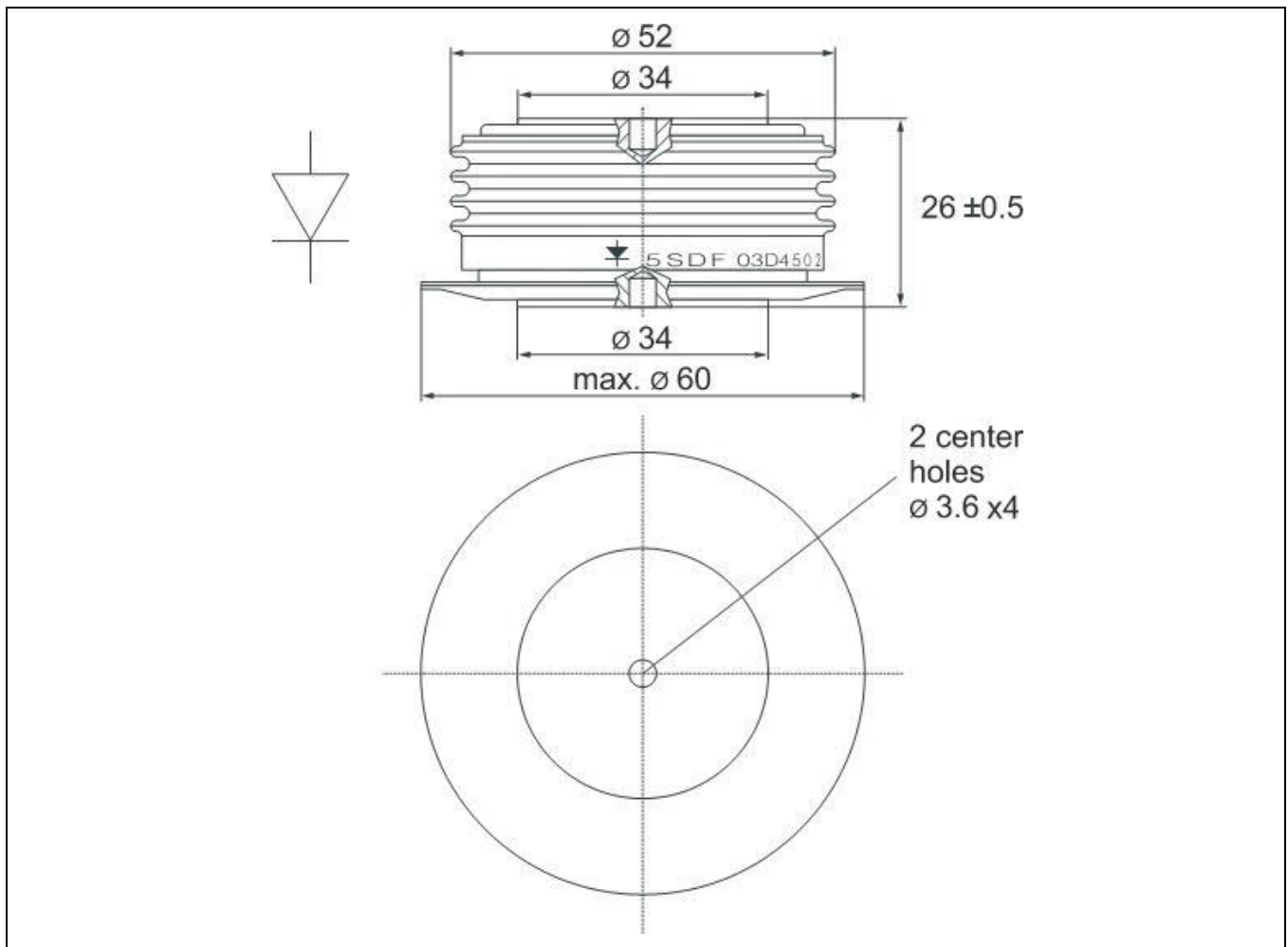
Fig. 5 Diode turn-off energy per pulse vs. turn-off current



**Fig. 6** General current and voltage waveforms



**Fig. 7** Test circuit.



**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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