

$V_{DSM} = 2800 \text{ V}$   
 $I_{TAVM} = 2625 \text{ A}$   
 $I_{TRMS} = 4120 \text{ A}$   
 $I_{TSM} = 43000 \text{ A}$   
 $V_{T0} = 0.85 \text{ V}$   
 $r_T = 0.160 \text{ m}\Omega$

# Phase Control Thyristor

## 5STP 24H2800

Doc. No. 5SYA1047-02 Sep. 01

- Patented free-floating silicon technology
- Low on-state and switching losses
- Designed for traction, energy and industrial applications
- Optimum power handling capability
- Interdigitated amplifying gate

### Blocking

| Part Number         | 5STP 24H2800          | 5STP 24H2600 | 5STP 24H2200 | Conditions                                                |
|---------------------|-----------------------|--------------|--------------|-----------------------------------------------------------|
| $V_{DRM}$ $V_{RRM}$ | 2800 V                | 2600 V       | 2200 V       | $f = 50 \text{ Hz}$ , $t_p = 10 \text{ ms}$               |
| $V_{RSM1}$          | 3000 V                | 2800 V       | 2400 V       | $t_p = 5 \text{ ms}$ , single pulse                       |
| $I_{DRM}$           | $\leq 300 \text{ mA}$ |              |              | $V_{DRM}$ $T_j = 125^\circ\text{C}$                       |
| $I_{RRM}$           | $\leq 300 \text{ mA}$ |              |              | $V_{RRM}$                                                 |
| $dV/dt_{crit}$      | 1000 V/ $\mu\text{s}$ |              |              | Exp. to $0.67 \times V_{DRM}$ , $T_j = 125^\circ\text{C}$ |

### Mechanical data

|       |                           |      |                      |
|-------|---------------------------|------|----------------------|
| $F_M$ | Mounting force            | nom. | 50 kN                |
|       |                           | min. | 45 kN                |
|       |                           | max. | 60 kN                |
| a     | Acceleration              |      |                      |
|       | Device unclamped          |      | 50 m/s <sup>2</sup>  |
|       | Device clamped            |      | 100 m/s <sup>2</sup> |
| m     | Weight                    |      | 0.9 kg               |
| $D_S$ | Surface creepage distance |      | 36 mm                |
| $D_a$ | Air strike distance       |      | 15 mm                |

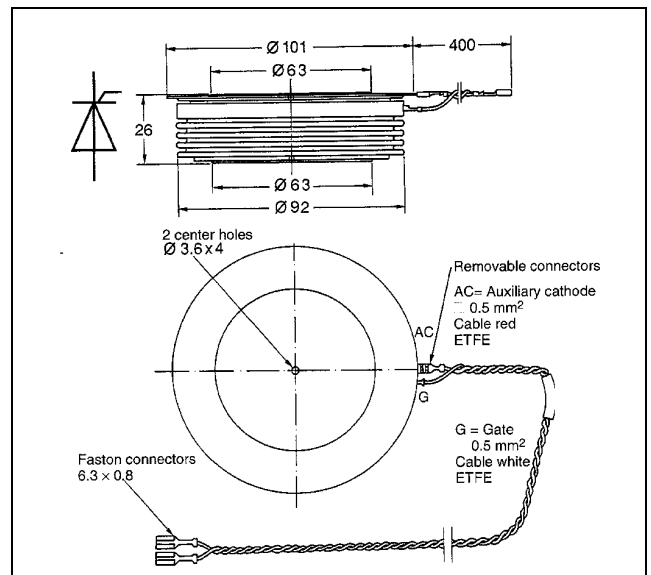


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## On-state

|                   |                               |                        |                                       |                                      |
|-------------------|-------------------------------|------------------------|---------------------------------------|--------------------------------------|
| I <sub>TAVM</sub> | Max. average on-state current | 2625 A                 | Half sine wave, T <sub>C</sub> = 70°C |                                      |
| I <sub>TRMS</sub> | Max. RMS on-state current     | 4120 A                 |                                       |                                      |
| I <sub>TSM</sub>  | Max. peak non-repetitive      | 43000 A                | tp = 10 ms                            | T <sub>j</sub> = 125°C               |
|                   | surge current                 | 46000 A                | tp = 8.3 ms                           | After surge:                         |
| I <sup>2</sup> t  | Limiting load integral        | 9245 kA <sup>2</sup> s | tp = 10 ms                            | V <sub>D</sub> = V <sub>R</sub> = 0V |
|                   |                               | 8781 kA <sup>2</sup> s | tp = 8.3 ms                           |                                      |
| V <sub>T</sub>    | On-state voltage              | 1.35 V                 | I <sub>T</sub> = 3000 A               | T <sub>j</sub> = 125°C               |
| V <sub>T0</sub>   | Threshold voltage             | 0.85 V                 | I <sub>T</sub> = 1500 - 4500 A        |                                      |
| r <sub>T</sub>    | Slope resistance              | 0.160 mΩ               |                                       |                                      |
| I <sub>H</sub>    | Holding current               | 25-75 mA               | T <sub>j</sub> = 25°C                 |                                      |
|                   |                               | 15-60 mA               | T <sub>j</sub> = 125°C                |                                      |
| I <sub>L</sub>    | Latching current              | 150- mA                | T <sub>j</sub> = 25°C                 |                                      |
|                   |                               | 50-200 mA              | T <sub>j</sub> = 125°C                |                                      |

## Switching

|                |                                           |                               |                                                                      |                                                                                                                                                  |
|----------------|-------------------------------------------|-------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| $di/dt_{crit}$ | Critical rate of rise of on-state current | 150 A/ $\mu\text{s}$          | Cont. $f = 50\text{ Hz}$                                             | $V_D \leq 0.67 \cdot V_{DRM}$ , $T_j = 125^\circ\text{C}$<br>$I_{TRM} = 3000\text{ A}$<br>$I_{FG} = 2\text{ A}$ , $t_r = 0.5\text{ }\mu\text{s}$ |
|                |                                           | 300 A/ $\mu\text{s}$          | 60 sec.<br>$f = 50\text{ Hz}$                                        |                                                                                                                                                  |
| $t_d$          | Delay time                                | $\leq 3.0\text{ }\mu\text{s}$ | $V_D = 0.4 \cdot V_{DRM}$                                            | $I_{FG} = 2\text{ A}$ , $t_r = 0.5\text{ }\mu\text{s}$                                                                                           |
| $t_q$          | Turn-off time                             | $\leq 400\text{ }\mu\text{s}$ | $V_D \leq 0.67 \cdot V_{DRM}$<br>$dv_D/dt = 20\text{ V}/\mu\text{s}$ | $I_{TRM} = 3000\text{ A}$ , $T_j = 125^\circ\text{C}$<br>$V_R > 200\text{ V}$ , $di_T/dt = -20\text{ A}/\mu\text{s}$                             |
| $Q_{rr}$       | Recovery charge                           | min                           | 4000 $\mu\text{As}$                                                  |                                                                                                                                                  |
|                |                                           | max                           | 7000 $\mu\text{As}$                                                  |                                                                                                                                                  |

## Triggering

|           |                           |        |                            |
|-----------|---------------------------|--------|----------------------------|
| $V_{GT}$  | Gate trigger voltage      | 2.6 V  | $T_j = 25^\circ$           |
| $I_{GT}$  | Gate trigger current      | 400 mA | $T_j = 25^\circ$           |
| $V_{GD}$  | Gate non-trigger voltage  | 0.3 V  | $V_D = 0.4 \times V_{DRM}$ |
| $I_{GD}$  | Gate non-trigger current  | 10 mA  | $V_D = 0.4 \times V_{DRM}$ |
| $V_{FGM}$ | Peak forward gate voltage | 12 V   |                            |
| $I_{FGM}$ | Peak forward gate current | 10 A   |                            |
| $V_{RGM}$ | Peak reverse gate voltage | 10 V   |                            |
| $P_G$     | Gate power loss           | 3 W    |                            |

## Thermal

|            |                                           |              |                     |
|------------|-------------------------------------------|--------------|---------------------|
| $T_{jmax}$ | Max. operating junction temperature range | 125 °C       |                     |
| $T_{stg}$  | Storage temperature range                 | -40...140 °C |                     |
| $R_{thJC}$ | Thermal resistance junction to case       | 20 K/kW      | Anode side cooled   |
|            |                                           | 20 K/kW      | Cathode side cooled |
|            |                                           | 10 K/kW      | Double side cooled  |
| $R_{thCH}$ | Thermal resistance case to heat sink      | 4 K/kW       | Single side cooled  |
|            |                                           | 2 K/kW       | Double side cooled  |

Analytical function for transient thermal impedance:

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

|             |        |        |        |        |
|-------------|--------|--------|--------|--------|
| i           | 1      | 2      | 3      | 4      |
| $R_i(K/kW)$ | 6.52   | 1.55   | 1.67   | 0.49   |
| $\tau_i(s)$ | 0.4562 | 0.0792 | 0.0088 | 0.0037 |

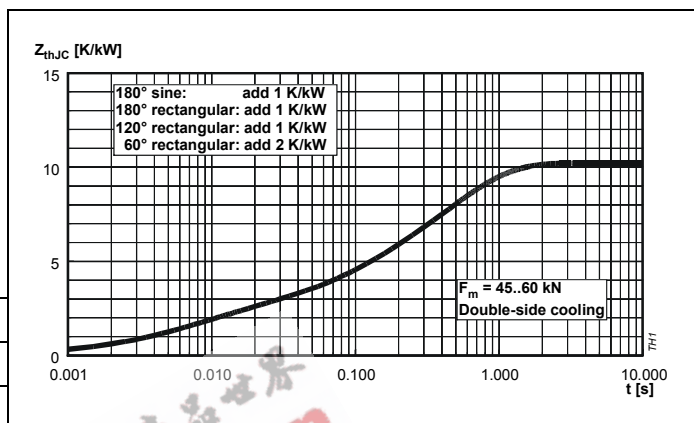


Fig. 1 Transient thermal impedance junction to case.

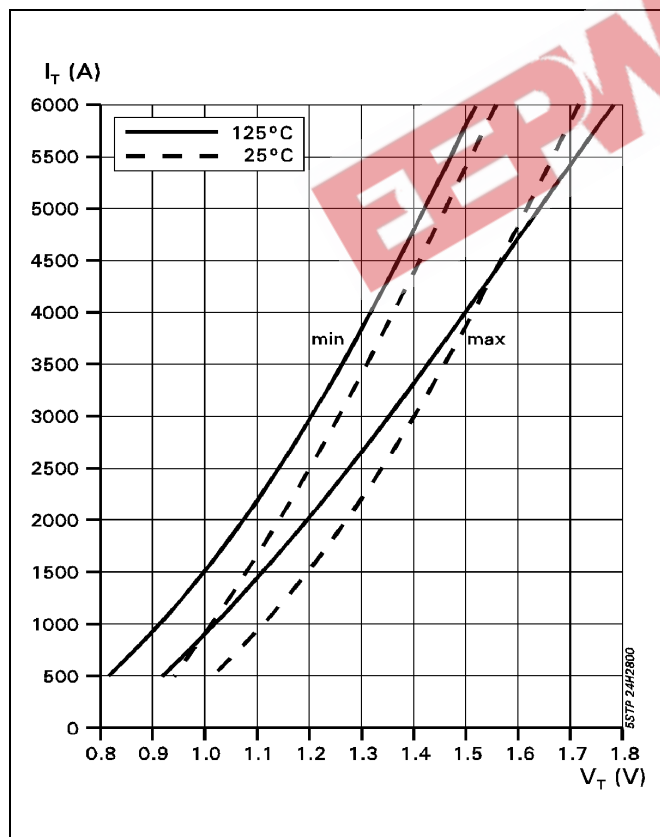


Fig. 2 On-state characteristics.

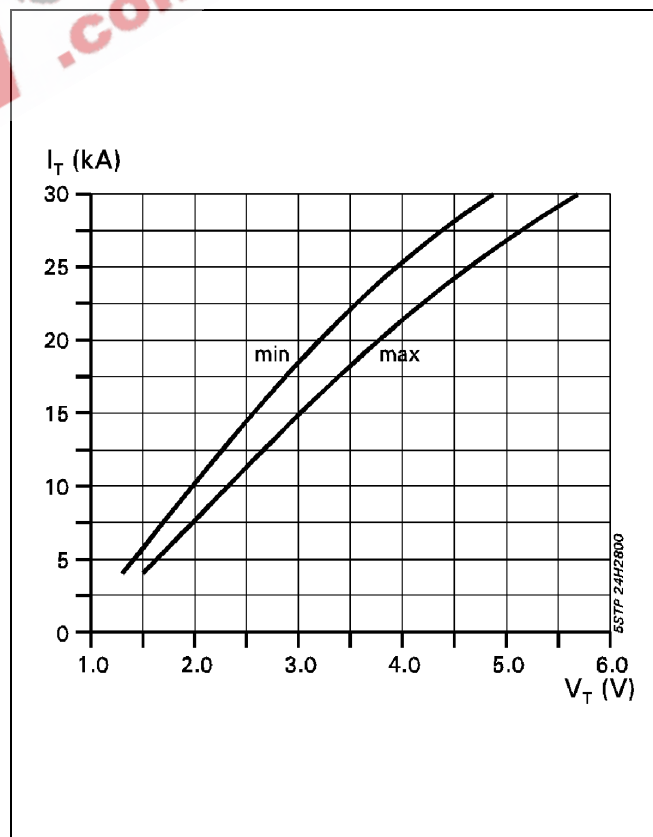


Fig. 3 On-state characteristics.  
 $T_j=125^\circ\text{C}$ , 10ms half sine

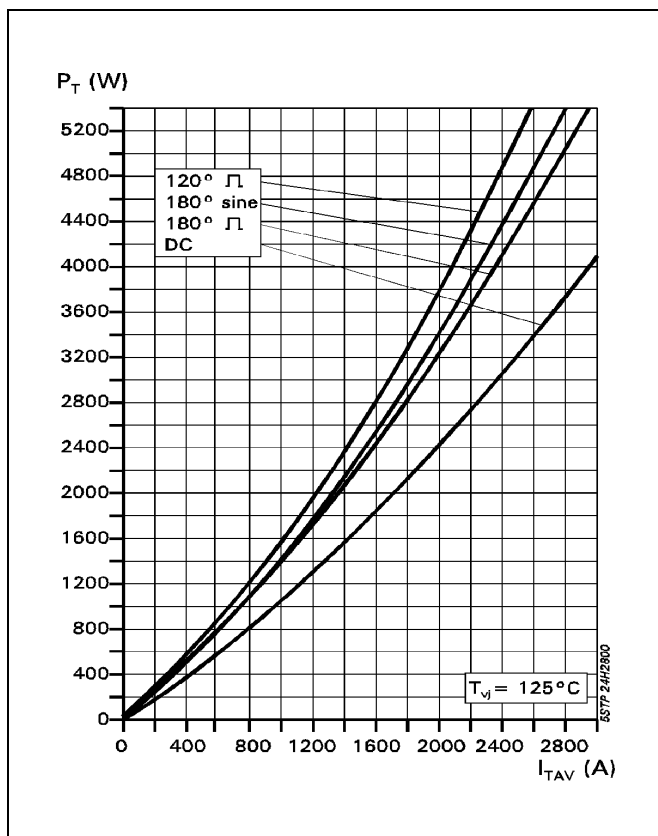


Fig. 4 On-state power dissipation vs. mean on-state current. Turn-on losses excluded.

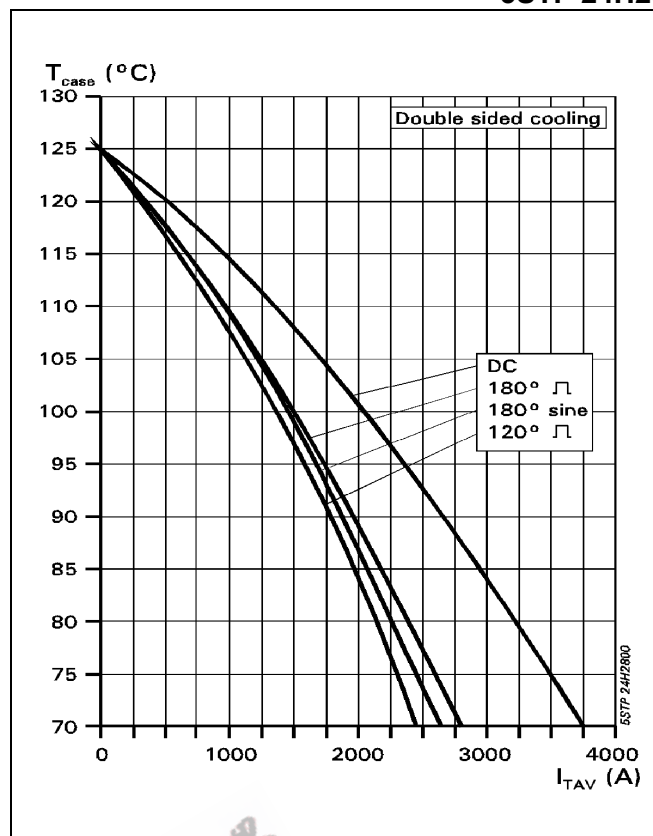


Fig. 5 Max. permissible case temperature vs. mean on-state current.

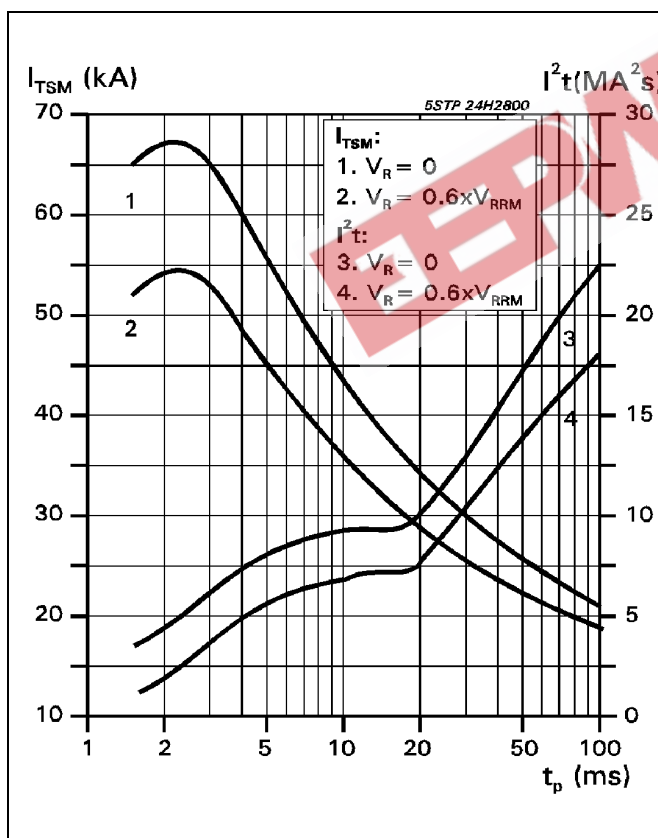


Fig. 6 Surge on-state current vs. pulse length. Half-sine wave.

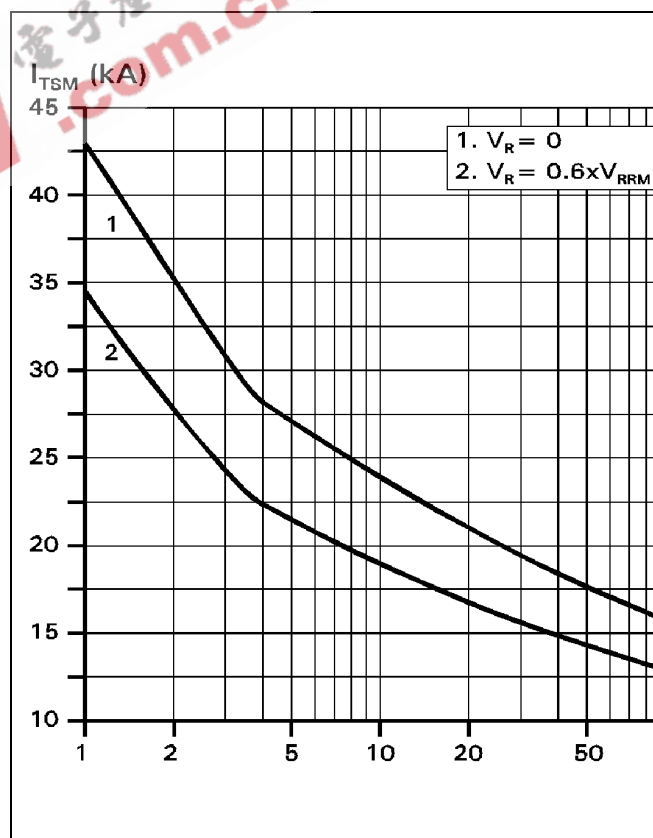


Fig. 7 Surge on-state current vs. number of pulses. Half-sine wave, 10 ms, 50Hz.

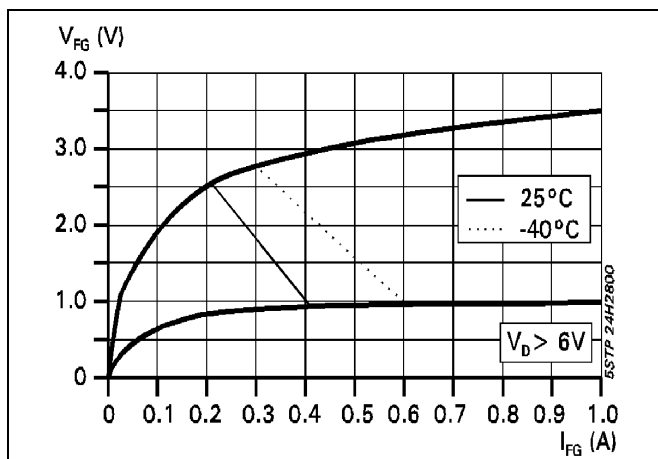


Fig. 8 Gate trigger characteristics.

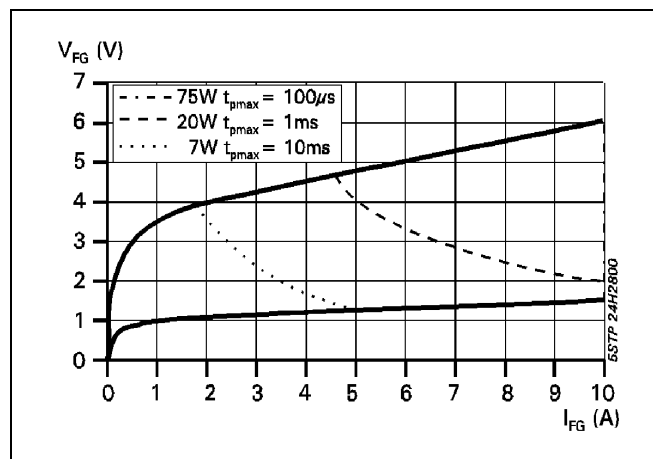


Fig. 9 Max. peak gate power loss.

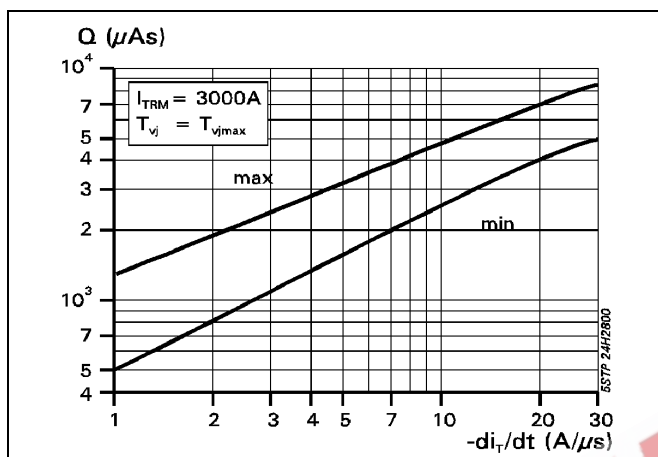


Fig. 10 Recovery charge vs. decay rate of on-state current.

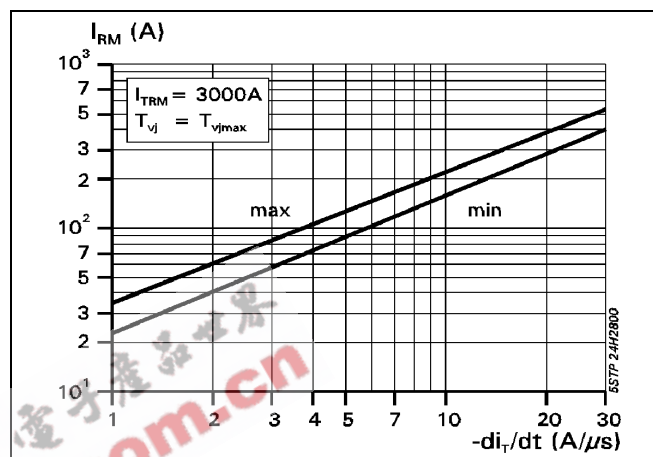


Fig. 11 Peak reverse recovery current vs. decay rate of on-state current.

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