

| | | |
|------------|---|----------|
| V_{DSM} | = | 6500 V |
| I_{TAVM} | = | 1800 A |
| I_{TRMS} | = | 2820 A |
| I_{TSM} | = | 32000 A |
| V_{T0} | = | 1.20 V |
| r_T | = | 0.430 mΩ |

Phase Control Thyristor

5STP 18M6500

Doc. No. 5SYA1010-03 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 | 5STP 18M6200 | 5STP 18M5800 | Conditions |
|---------------------|-----------------------|--------------|--------------|---|
| V_{DSM} V_{RSM} | 6500 V | 6200 V | 5800 V | $f = 5 \text{ Hz}$, $t_p = 10 \text{ ms}$ |
| V_{DRM} V_{RRM} | 5600 V | 5300 V | 4900 V | $f = 50 \text{ Hz}$, $t_p = 10 \text{ ms}$ |
| V_{RSM1} | 7000 V | 6700 V | 6300 V | $t_p = 5 \text{ ms}$, single pulse |
| I_{DSM} | $\leq 600 \text{ mA}$ | | | V_{DSM} $T_j = 125^\circ\text{C}$ |
| I_{RSM} | $\leq 600 \text{ mA}$ | | | |
| dV/dt_{crit} | 2000 V/ μs | | | Exp. to $0.67 \times V_{DRM}$, $T_j = 125^\circ\text{C}$ |

V_{DRM}/V_{RRM} are equal to V_{DSM}/V_{RSM} values up to $T_j = 110^\circ\text{C}$

Mechanical data

| | | | |
|-------|---------------------------|------|----------------------|
| F_M | Mounting force | nom. | 70 kN |
| | | min. | 63 kN |
| | | max. | 84 kN |
| a | Acceleration | | |
| | Device unclamped | | 50 m/s ² |
| | Device clamped | | 100 m/s ² |
| m | Weight | | 1.85 kg |
| D_S | Surface creepage distance | | 45 mm |
| D_a | Air strike distance | | 21 mm |

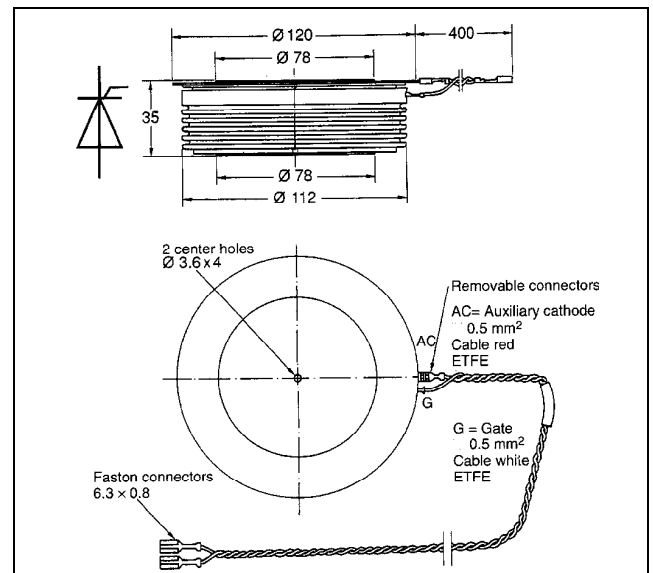


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On-state

| | | | | |
|------------|-------------------------------|----------------------------|--|---------------------------|
| I_{TAVM} | Max. average on-state current | 1800 A | Half sine wave, $T_C = 70^\circ\text{C}$ | |
| I_{TRMS} | Max. RMS on-state current | 2820 A | | |
| I_{TSM} | Max. peak non-repetitive | 32000 A | $t_p = 10\text{ ms}$ | $T_j = 125^\circ\text{C}$ |
| | surge current | 35000 A | $t_p = 8.3\text{ ms}$ | After surge: |
| I^2t | Limiting load integral | 5120 kA^2s | $t_p = 10\text{ ms}$ | $V_D = V_R = 0\text{V}$ |
| | | 5000 kA^2s | $t_p = 8.3\text{ ms}$ | |
| V_T | On-state voltage | 1.90 V | $I_T = 1600\text{ A}$ | $T_j = 125^\circ\text{C}$ |
| V_{T0} | Threshold voltage | 1.20 V | $I_T = 1000 - 3000\text{ A}$ | |
| r_T | Slope resistance | 0.430 $\text{m}\Omega$ | | |
| I_H | Holding current | 50-125 mA | $T_j = 25^\circ\text{C}$ | |
| | | 20-75 mA | $T_j = 125^\circ\text{C}$ | |
| I_L | Latching current | 100- mA | $T_j = 25^\circ\text{C}$ | |
| | | 75-250 mA | $T_j = 125^\circ\text{C}$ | |

Switching

| | | | | |
|----------------|---|-------------------------------|--|--|
| di/dt_{crit} | Critical rate of rise of on-state current | 250 A/ μs | Cont. $f = 50\text{ Hz}$ | $V_D \leq 0.67 \cdot V_{DRM}$, $T_j = 125^\circ\text{C}$ $I_{TRM} = 2000\text{ A}$ $I_{FG} = 2\text{ A}$, $t_r = 0.5\text{ }\mu\text{s}$ |
| | | 500 A/ μs | 60 sec. $f = 50\text{ Hz}$ | |
| 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 | $\leq 800\text{ }\mu\text{s}$ | $V_D \leq 0.67 \cdot V_{DRM}$ $dv_D/dt = 20\text{ V}/\mu\text{s}$ | $I_{TRM} = 2000\text{ A}$, $T_j = 125^\circ\text{C}$ $V_R > 200\text{ V}$, $di_T/dt = -1\text{ A}/\mu\text{s}$ |
| Q_{rr} | Recovery charge | min | 2000 μAs | |
| | | max | 3000 μAs | |

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 | 18 K/kW | Anode side cooled |
| | | 18 K/kW | Cathode side cooled |
| | | 9 K/kW | Double side cooled |
| R_{thCH} | Thermal resistance case to heat sink | 3 K/kW | Single side cooled |
| | | 1.5 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 |
| $R_i(K/kW)$ | 6.28 | 1.07 | 1.09 | 0.52 |
| $\tau_i(s)$ | 0.8956 | 0.1606 | 0.0256 | 0.0093 |

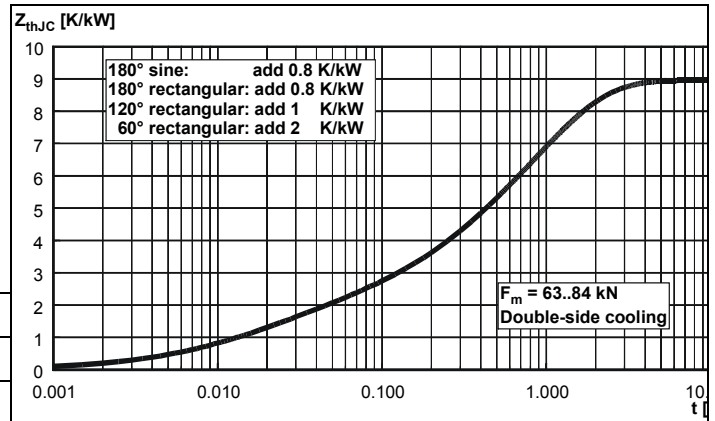


Fig. 1 Transient thermal impedance junction to case.

On-state characteristic model:

$$VT = A + B \cdot iT + C \cdot \ln(iT + 1) + D \cdot \sqrt{IT}$$

Valid for $i_T = 400 - 6000$ A

| | | | |
|----------|----------|-----------|----------|
| A | B | C | D |
| 0.871422 | 0.000093 | -0.020798 | 0.025657 |

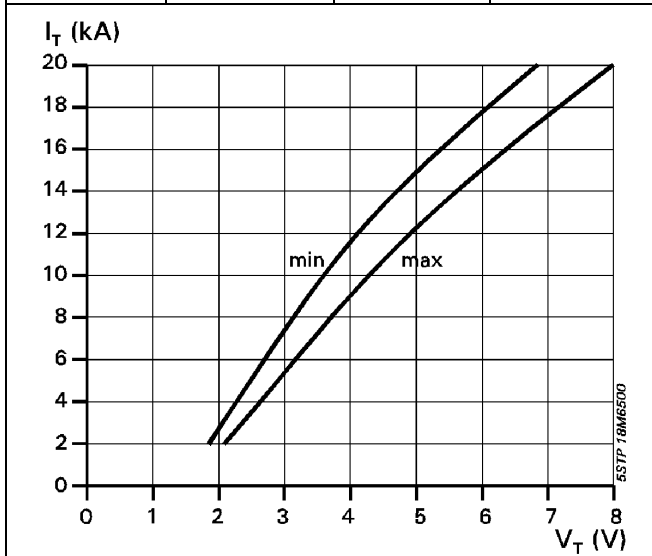


Fig. 2 On-state characteristics. $T_j=125^\circ\text{C}$, 10ms half sine

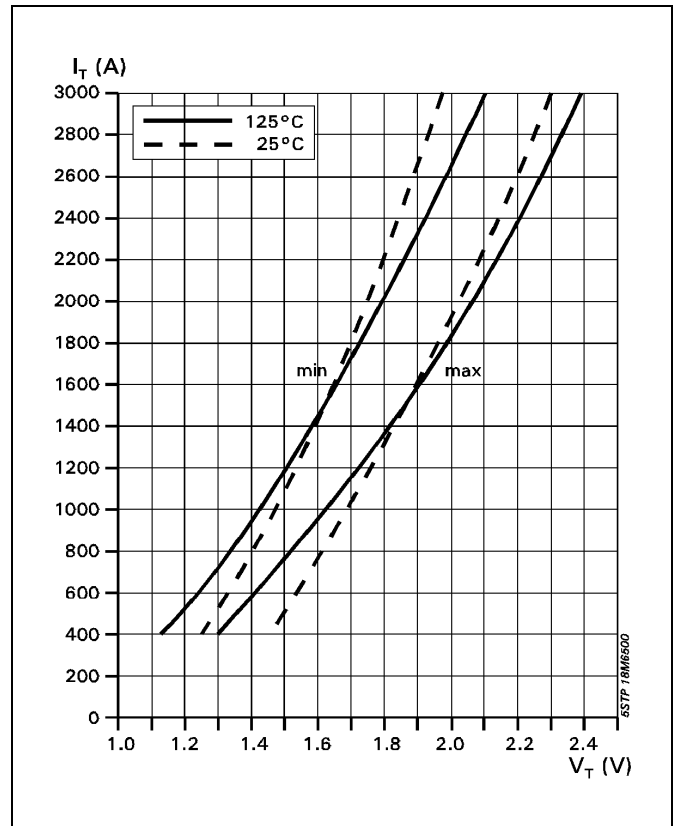


Fig. 3 On-state characteristics.

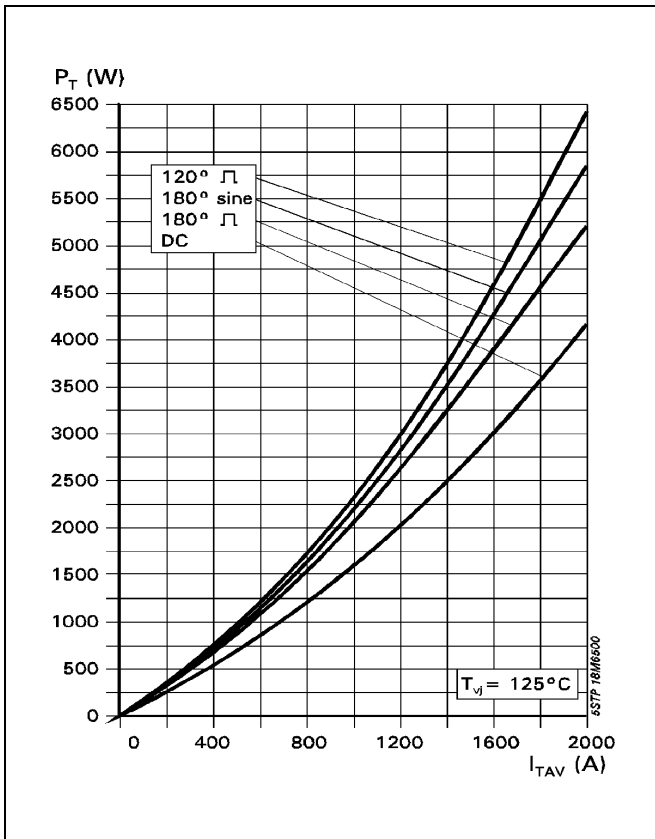


Fig. 4 On-state power dissipation vs. mean on-state current. Turn - on losses excluded.

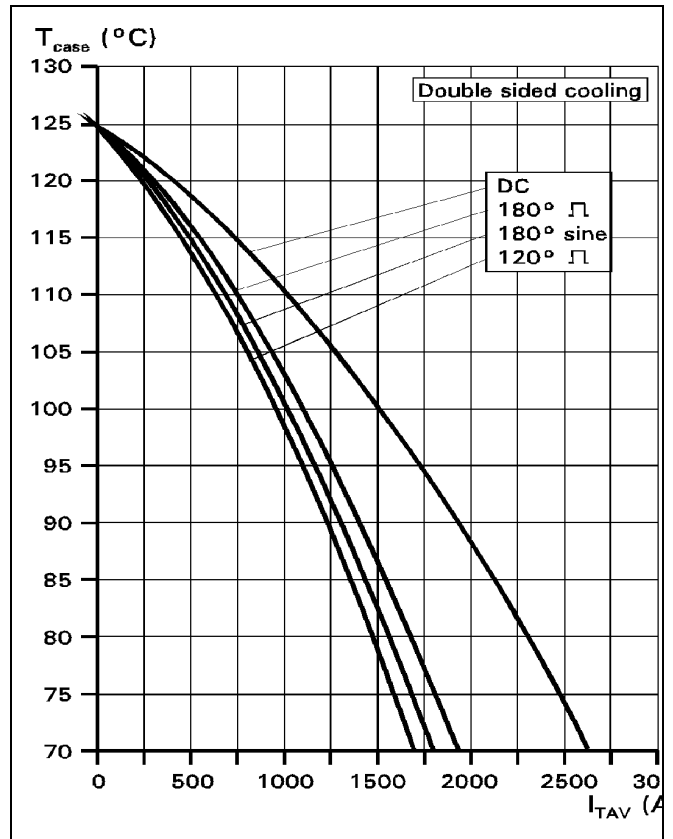


Fig. 5 Max. permissible case temperature vs. mean on-state current.

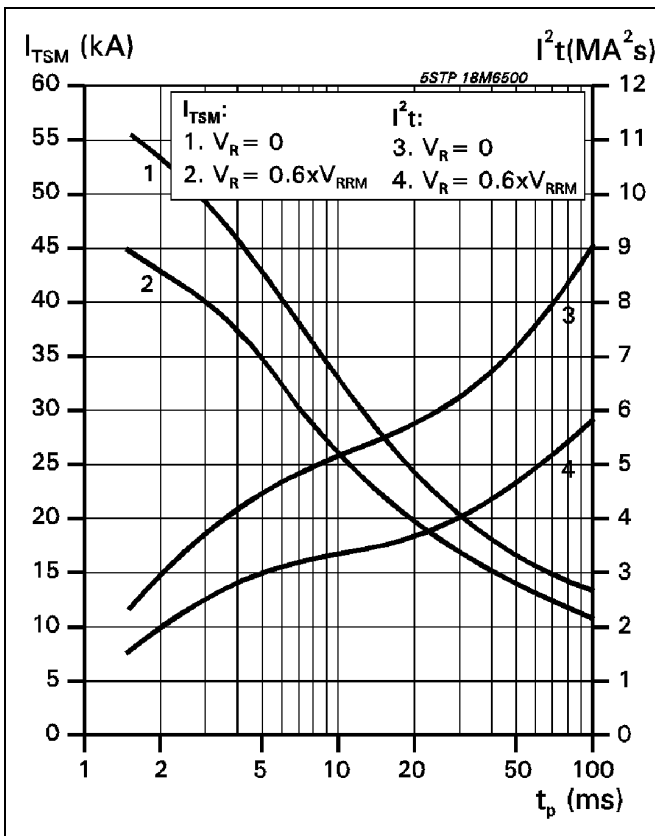


Fig. 6 Surge on-state current vs. pulse length. Half-sine wave.

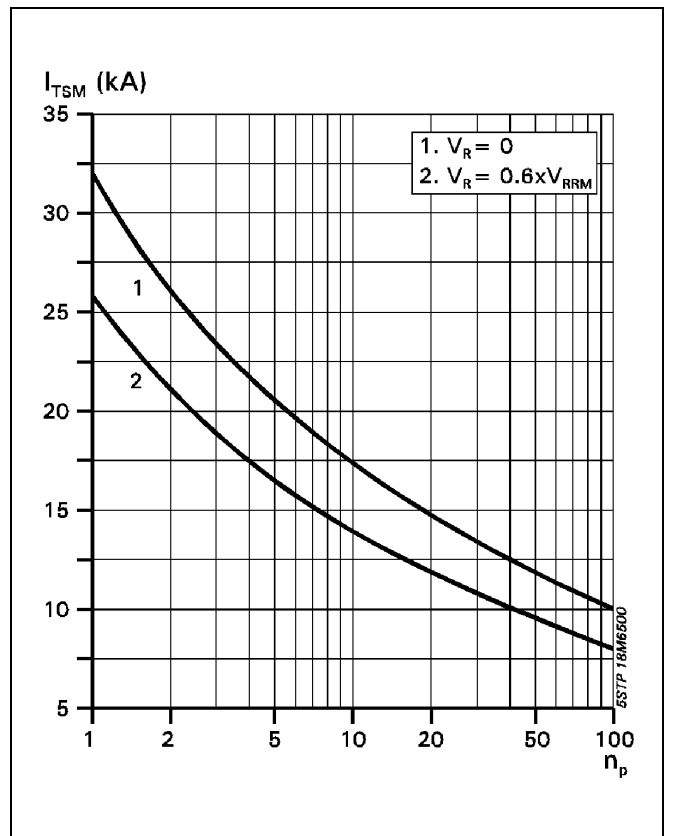


Fig. 7 Surge on-state current vs. number of pulses. Half-sine wave, 10 ms, 50Hz.

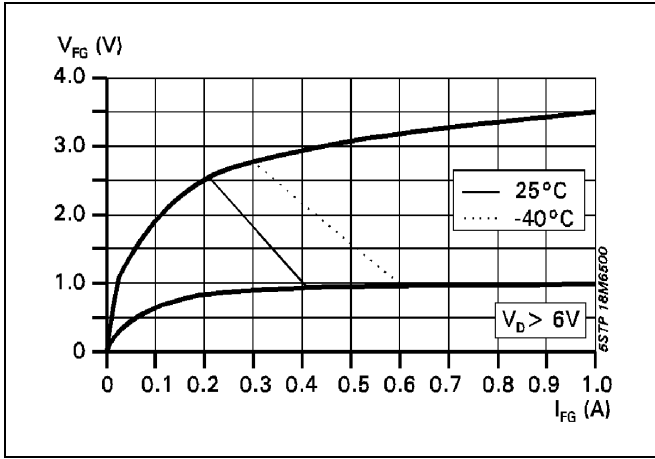


Fig. 8 Gate trigger characteristics.

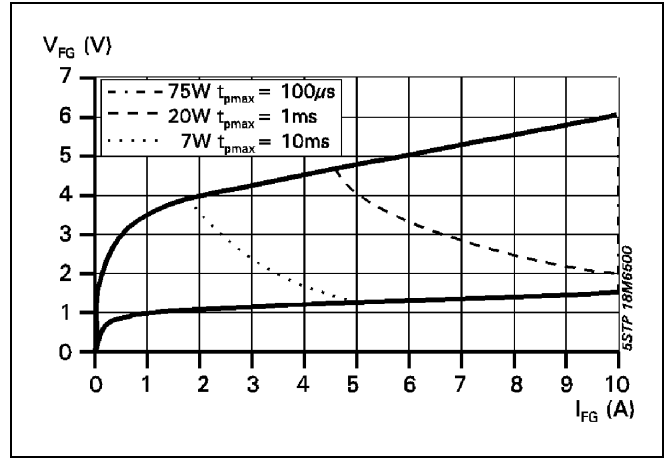


Fig. 9 Max. peak gate power loss.

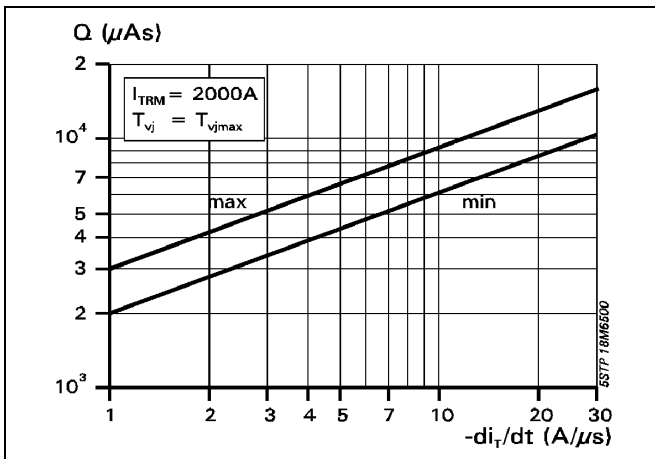


Fig. 10 Recovery charge vs. decay rate of on-state current.

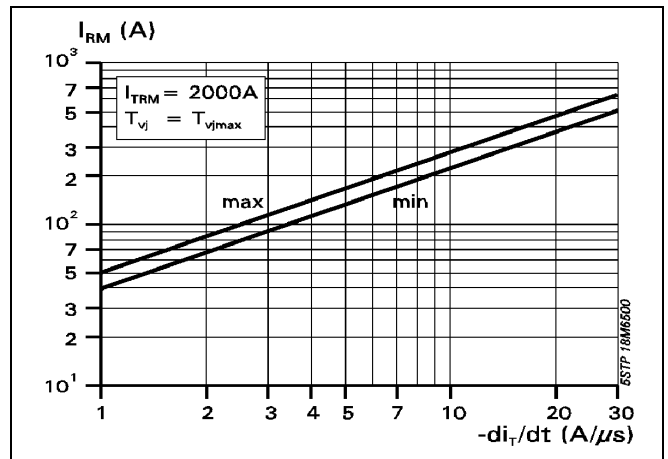


Fig. 11 Peak reverse recovery current vs. decay rate of on-state current.

Turn - off time, typical parameter relationship.

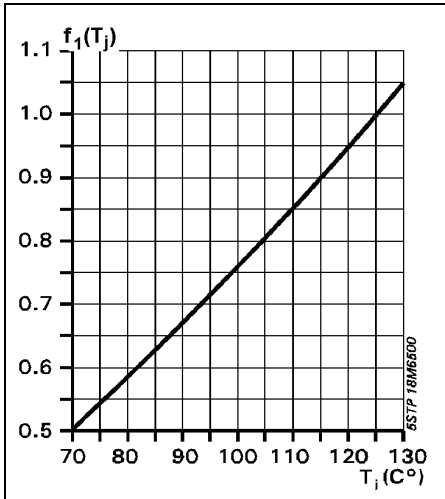


Fig. 12 $t_q/t_{q1} = f_1(T_j)$

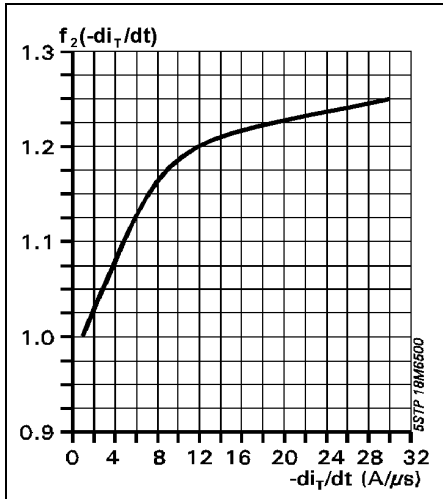


Fig. 13 $t_q/t_{q1} = f_2(-di_T/dt)$

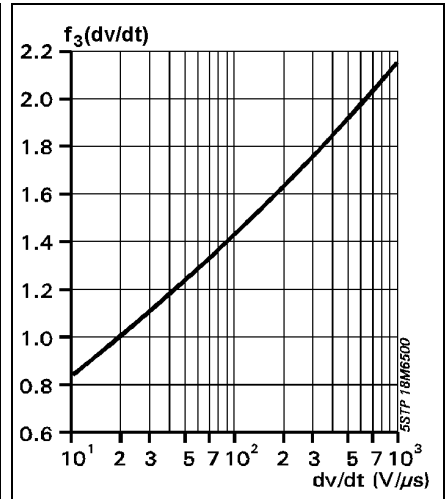


Fig. 14 $t_q/t_{q1} = f_3(dv/dt)$

$$t_q = t_{q1} \cdot f_1(T_j) \cdot f_2(-di_T/dt) \cdot f_3(dv/dt)$$

t_{q1} : at normalized values (see page 2)
 t_q : at varying conditions

Turn-on and Turn-off losses

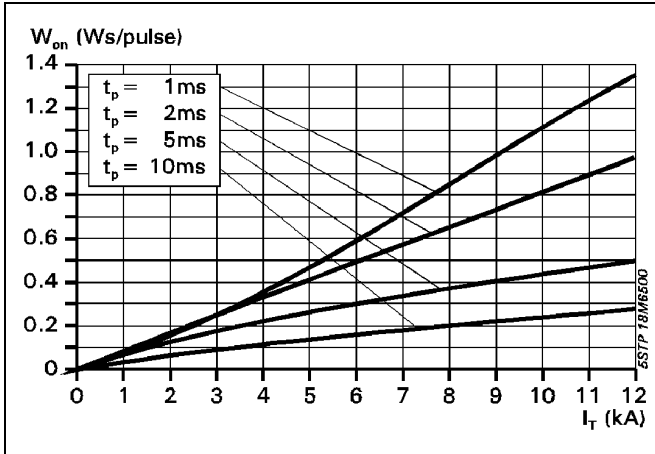


Fig. 15 $W_{on} = f(I_T, t_p)$, $T_j = 125^\circ\text{C}$.
Half sinusoidal waves.

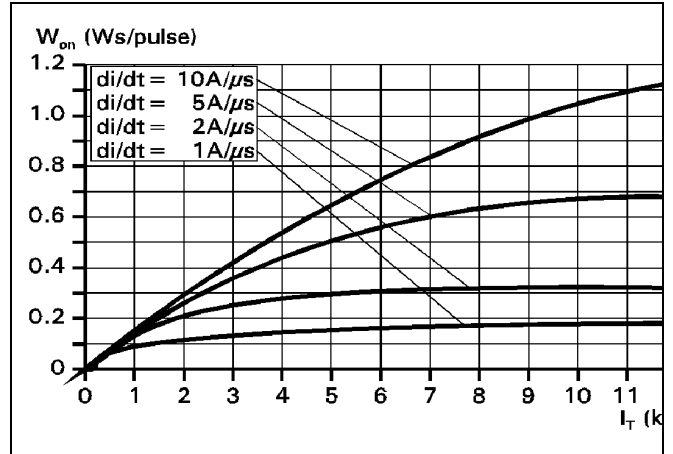


Fig. 16 $W_{on} = f(I_T, di/dt)$, $T_j = 125^\circ\text{C}$.
Rectangular waves.

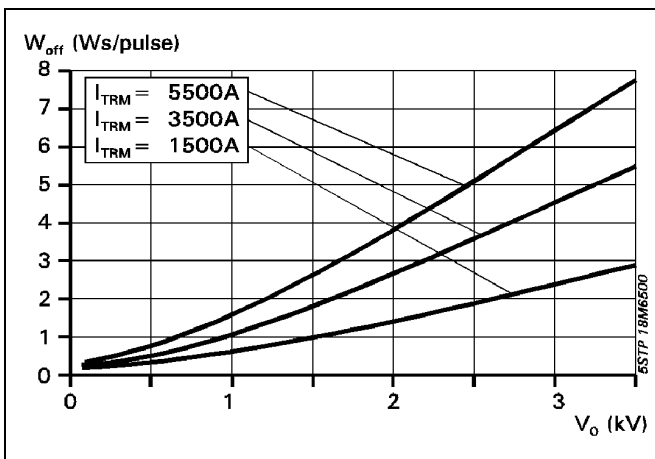


Fig. 17 $W_{off} = f(V_o, I_T)$, $T_j = 125^\circ\text{C}$.
Half sinusoidal waves. $t_p = 10$ ms.

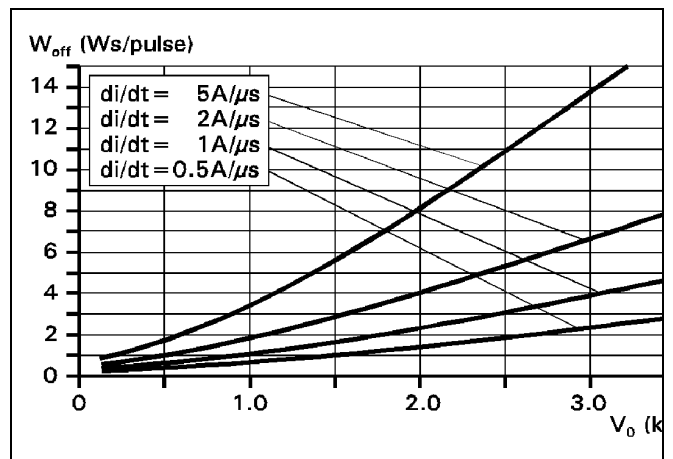


Fig. 18 $W_{off} = f(V_o, di/dt)$, $T_j = 125^\circ\text{C}$.
Rectangular waves.

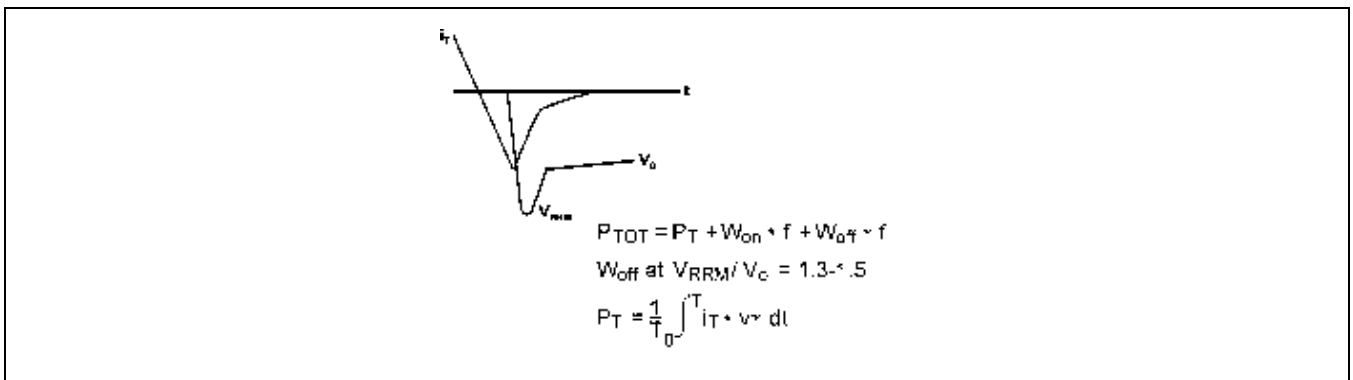


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