V_{DSM}	=	2800 V
I_{TAVM}	=	5490 A
I_{TRMS}	=	8625 A
I_{TSM}	=	75000 A
V_{T0}	=	0.86 V
r_T	=	0.070 mW

Phase Control Thyristor

5STP 45Q2800

Doc. No. 5SYA1050-01 Sep.00

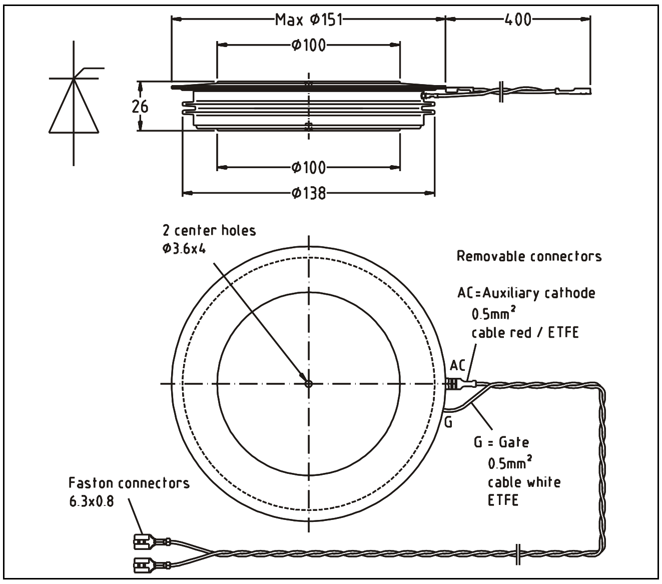
- **Patented free-floating silicon technology**
- **Low on-state and switching losses**
- **Designed for traction, energy and industrial applications**
- **Optimum power handling capability**
- **Interdigitated amplifying gate.**

Blocking

Part Number	**5STP 45Q2800**	**5STP 45Q2600**	**5STP 45Q2200**	Conditions	
V_{DRM} V_{RRM}	2800 V	2600 V	2200 V	f = 50 Hz, t_p = 10ms	
V_{RSM1}	3000 V	2800 V	2400 V	t_p = 5 ms, single pulse	
I_{DRM}	≤ 400 mA			V_{DRM}	T_j = 125°C
I_{RRM}	≤ 400 mA			V_{RRM}	
dV/dt_{crit}	1000 V/µs			@ Exp. to $0.67xV_{DRM}$	

Mechanical data

F_M	Mounting force	nom.	90	kN
		min.	81	kN
		max.	108	kN
a	Acceleration			
	Device unclamped		50	m/s^2
	Device clamped		100	m/s^2
m	Weight		2.1	kg
D_S	Surface creepage distance		36	mm
D_a	Air strike distance		15	mm



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On-state

I_{TAVM}	Max. average on-state current	5490 A	Half sine wave, T_C = 70°C	
I_{TRMS}	Max. RMS on-state current	8625 A		
I_{TSM}	Max. peak non-repetitive surge current	75000 A	tp = 10 ms	T_j = 125°C
		79000 A	tp = 8.3 ms	After surge:
I^2t	Limiting load integral	28125 kA^2s	tp = 10 ms	$V_D = V_R$ = 0V
		25900 kA^2s	tp = 8.3 ms	
V_T	On-state voltage	1.29 V	I_T = 6000 A	T_j = 125°C
V_{T0}	Threshold voltage	0.86 V	I_T = 3000 - 9000 A	
r_T	Slope resistance	0.070 mΩ		
I_H	Holding current	40-100 mA	T_j = 25°C	
		20-75 mA	T_j = 125°C	
I_L	Latching current	100-500 mA	T_j = 25°C	
		150-350 mA	T_j = 125°C	

Switching

di/dt_{crit}	Critical rate of rise of on-state current	250 A/µs	Cont.	$V_D \le 0.67 \cdot V_{DRM}$ T_j = 125°C
		500 A/µs	60 sec.	I_{TRM} = 3000 A f = 50 Hz
				I_{FG} = 2.0 A t_r = 0.5 µs
t_d	Delay time	≤ 3.0 µs	$V_D = 0.4 \cdot V_{DRM}$	I_{FG} = 2.0 A t_r = 0.5 µs
t_q	Turn-off time	≤ 400 µs	$V_D \le 0.67 \cdot V_{DRM}$	I_{TRM} = 3000 A T_j = 125°C
			dv_D/dt = 20V/µs	V_R > 200 V
Q_{rr}	Recovery charge min	4200 µAs		di_T/dt = -5 A/µs
	max	6500 µAs		

Triggering

V_{GT}	Gate trigger voltage	2.6 V	T_j = 25°C
I_{GT}	Gate trigger current	400 mA	T_j = 25°C
V_{GD}	Gate non-trigger voltage	0.3 V	$V_D = 0.4 \cdot V_{DRM}$
I_{GD}	Gate non-trigger current	10 mA	$V_D = 0.4 \cdot V_{DRM}$
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	Maximum gate power loss	3 W	

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Thermal

$T_{j\,max}$	Max. junction temperature	125°C	
$T_{j\,stg}$	Storage temperature range	-40...150°C	
R_{thJC}	Thermal resistance junction to case	10 K/kW	Anode side cooled
		10 K/kW	Cathode side cooled
		5 K/kW	Double side cooled
R_{thCH}	Thermal resistance case to heat sink	2 K/kW	Single side cooled
		1 K/kW	Double side cooled

Analytical function for transient thermal impedance:

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

i	1	2	3	4
R_i(K/kW)	3.27	0.736	0.661	0.312
τ_i(s)	0.5237	0.1082	0.02	0.0075

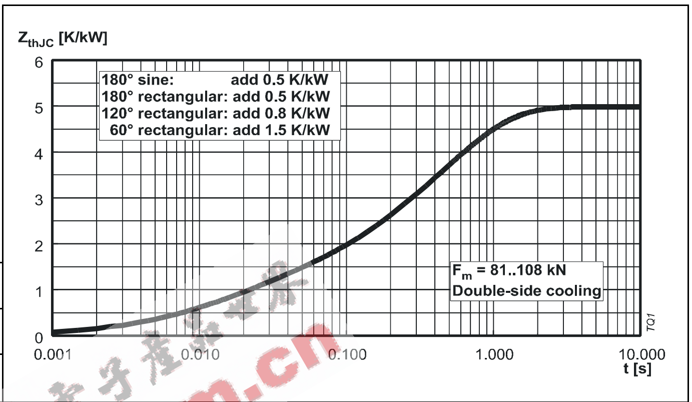


Fig. 1 Transient thermal impedance junction to case.

On-state characteristic model:

$$V_T = A + B \cdot i_T + C \cdot \ln(i_T + 1) + D \cdot \sqrt{i_T}$$

Valid for i_T = 500 – 15000 A

A	B	C	D
-0.096289	0.000051	0.135731	-0.001358

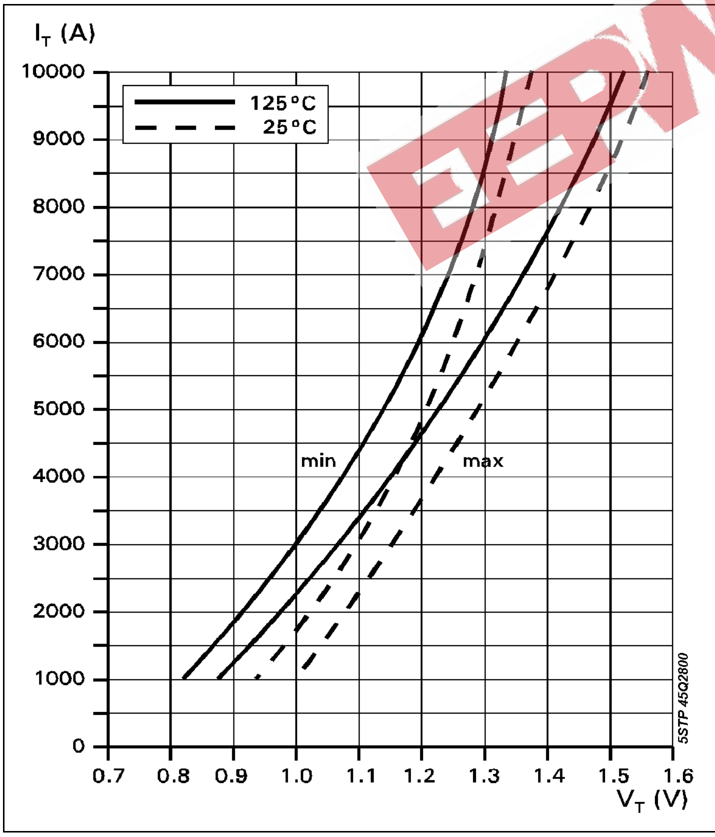


Fig 2. On-state characteristics.

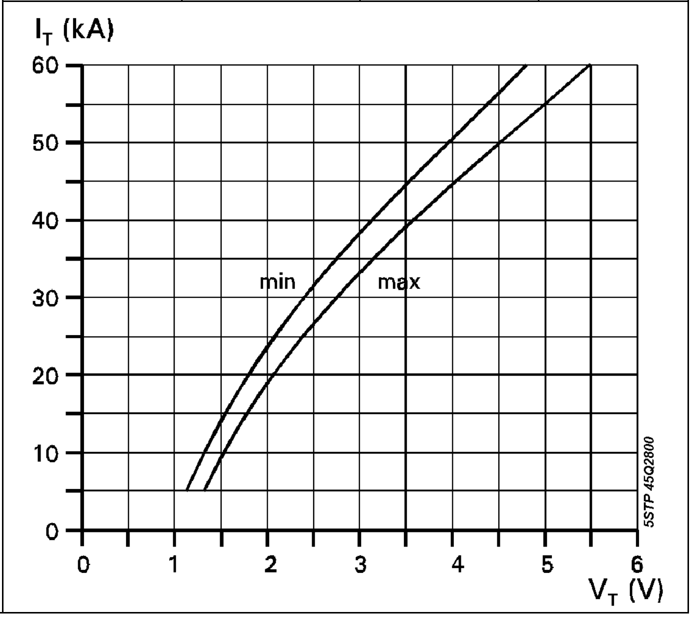


Fig. 3 On state characteristics.

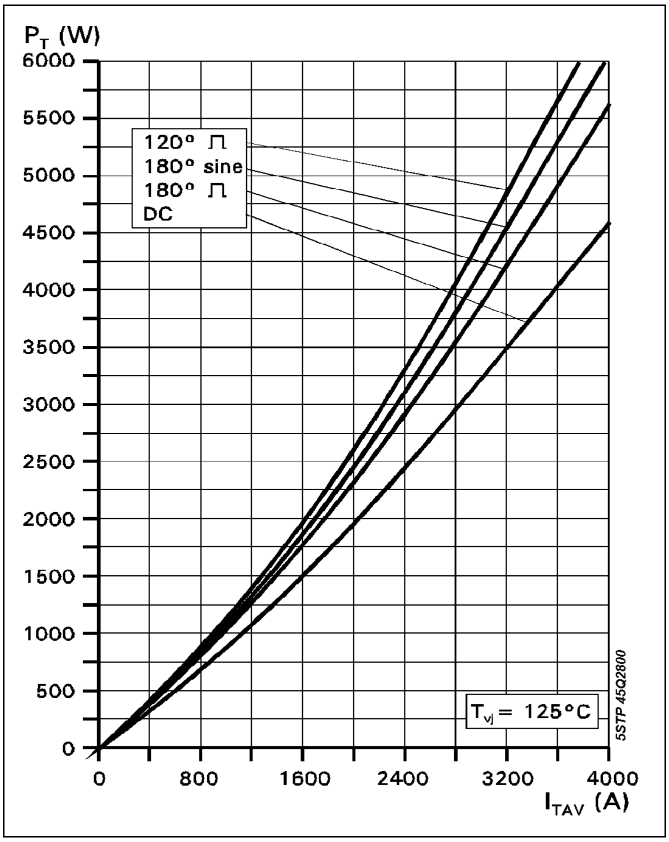


Fig. 4 On-state power dissipation vs. mean on-state current. Turn-on losses excluded.

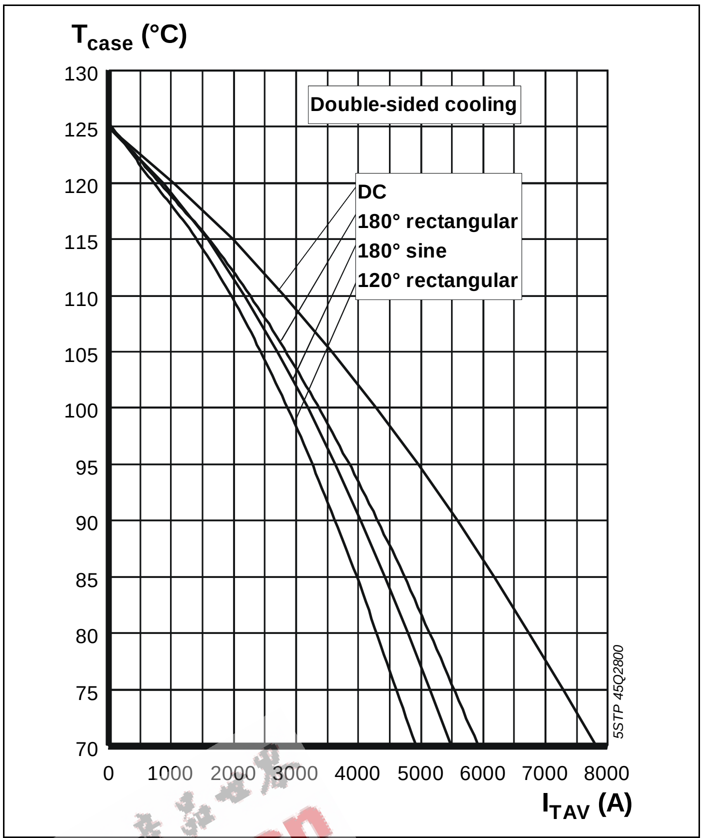


Fig. 5 Max. permissible case temperature vs. mean on-state current.

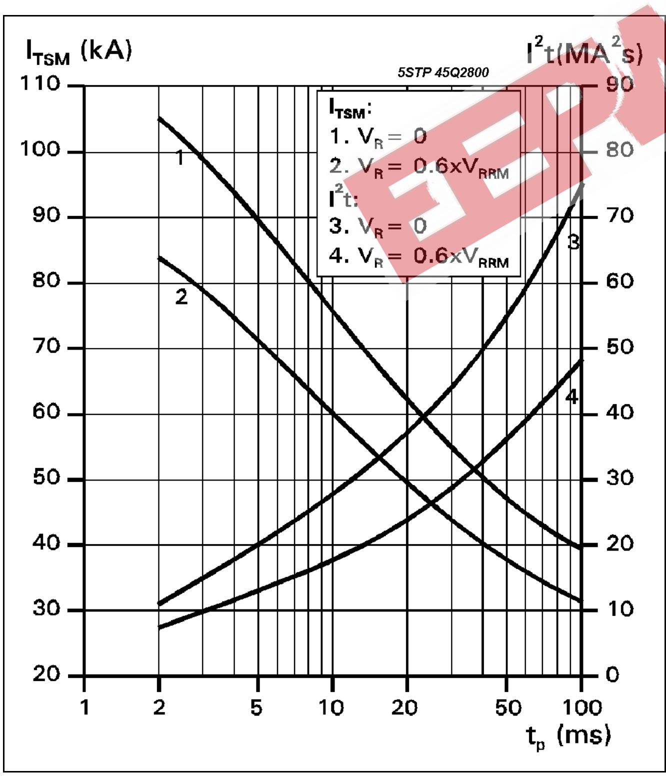


Fig. 6 Surge on-state current vs. pulse length. Half-sine wave.

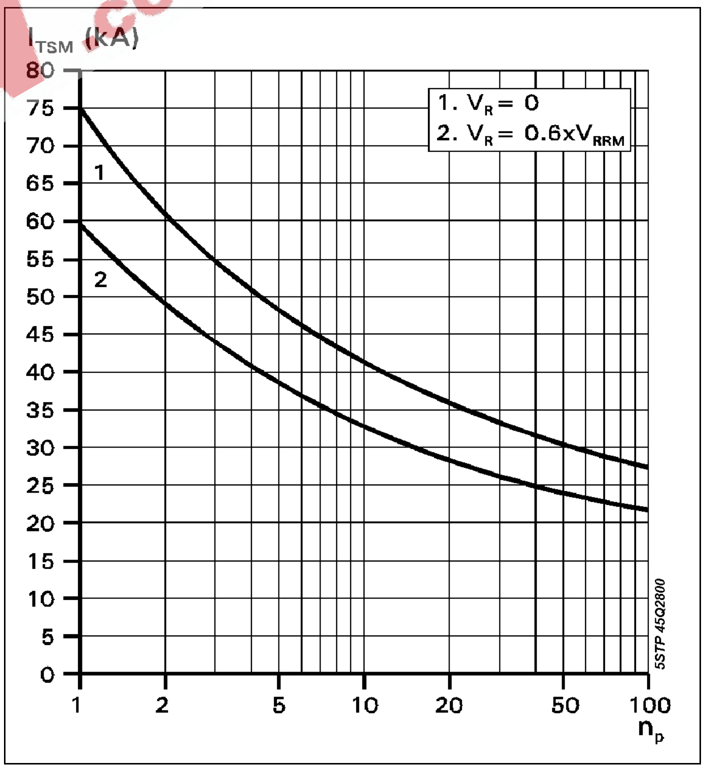


Fig. 7 Surge on-state current vs. number of pulses. Half-sine wave, 10 ms, 50Hz.

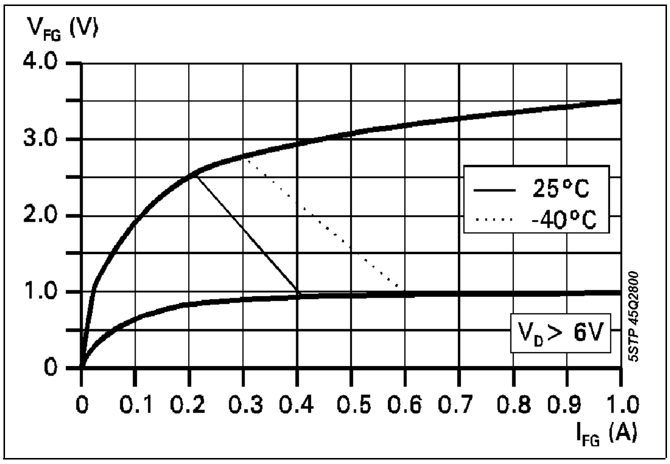


Fig. 8 Gate trigger characteristics.

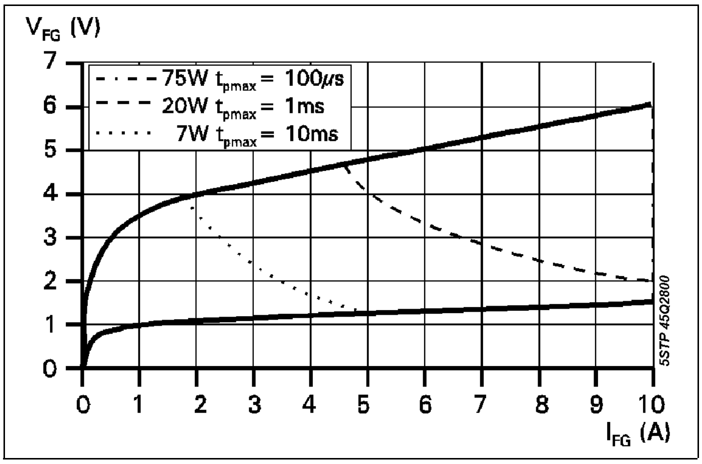


Fig. 9 Max. peak gate power loss.

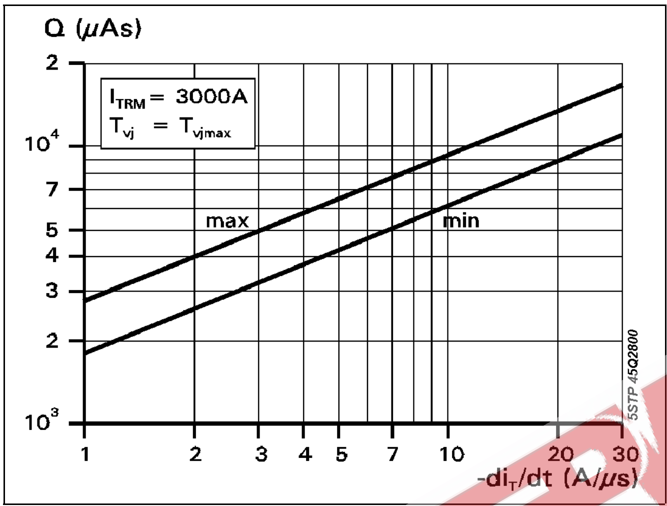


Fig. 10 Recovery charge vs. decay rate of on-state current.

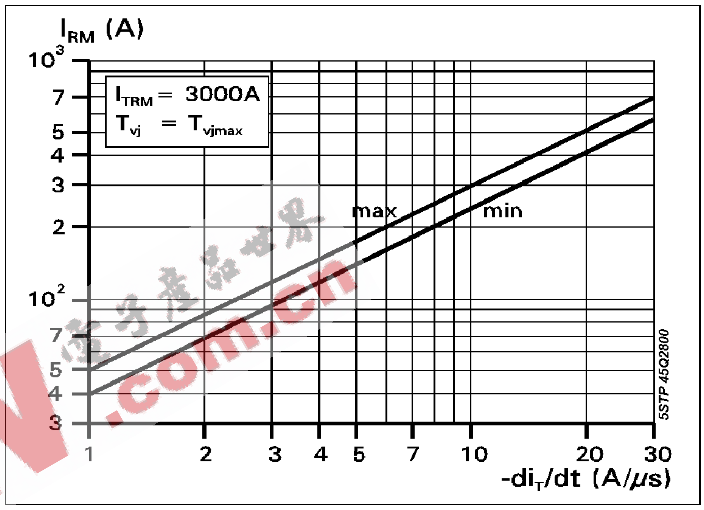


Fig. 11 Peak reverse recovery current vs. decay rate of on-state current.

Turn –off time, typical parameter relationship.

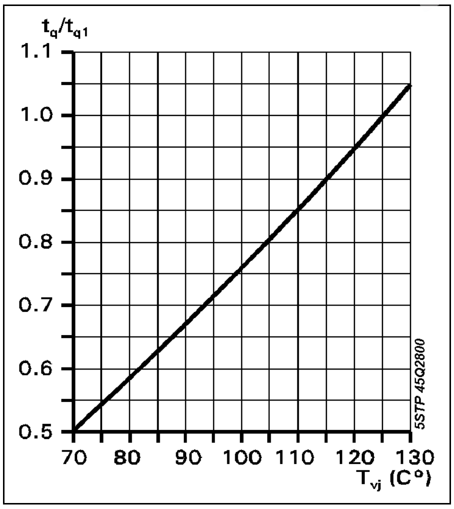


Fig. 12 $t_q/t_{q1} = f_1(T_j)$

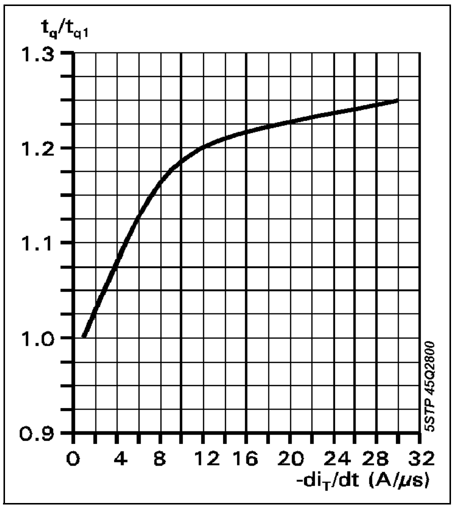


Fig. 13 $t_q/t_{q1} = f_2(\text{-di/dt})$

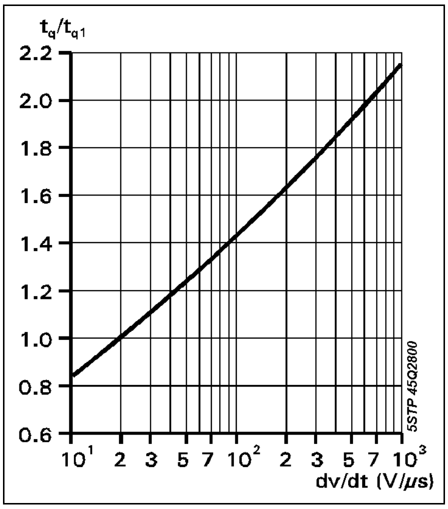


Fig. 14 $t_q/t_{q1} = f_3(dv/dt)$

$t_q = t_{q1} \bullet t_q/t_{q1}\ f_1(T_j) \bullet t_q/t_{q1}\ f_2(\text{-di/dt}) \bullet t_q/t_{q1}\ f_3(dv/dt)$

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

Turn-on and Turn-off losses

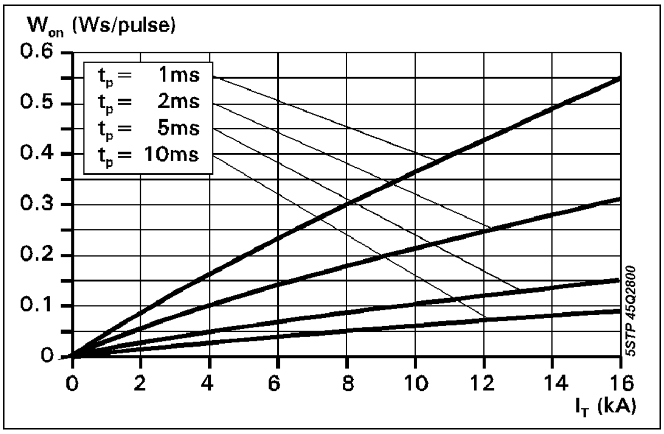


Fig. 15 $W_{on} = f(I_T, t_P)$, $T_j = 125°C$.
Half sinusoidal waves.

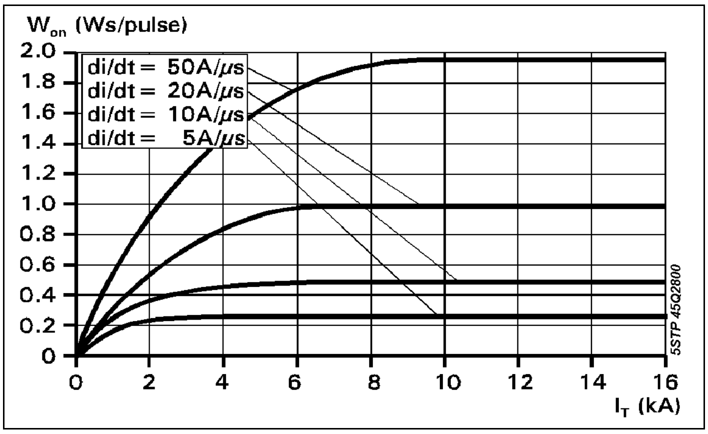


Fig. 16 $W_{on} = f(I_T, di/dt)$, $T_j = 125°C$.
Rectangular waves.

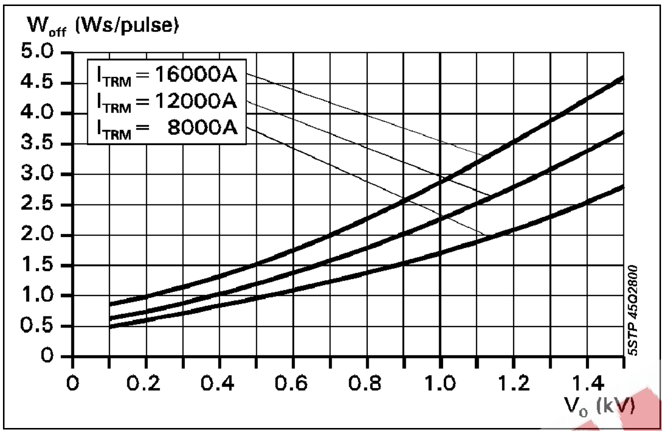


Fig. 17 $W_{off} = f(V_0, I_T)$, $T_j = 125°C$.
Half sinusoidal waves. $t_P = 10$ ms.

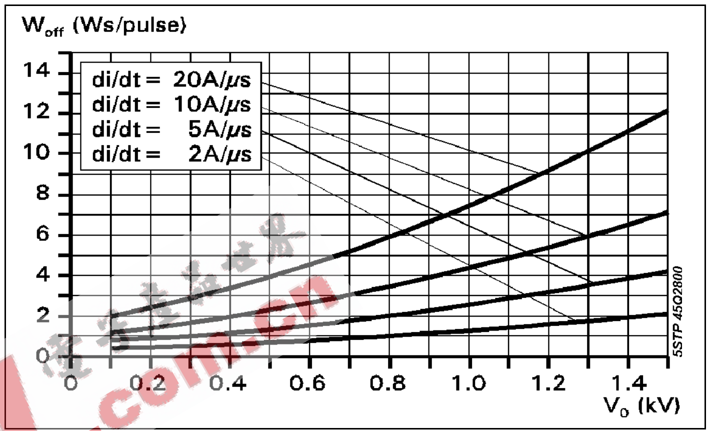
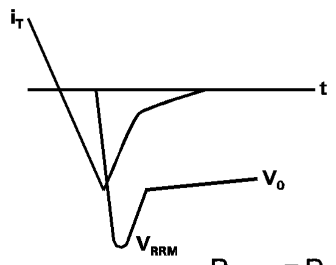


Fig. 18 $W_{off} = f(V_0, di/dt)$, $T_j = 125°C$.
Rectangular waves.



$$P_{TOT} = P_T + W_{on} * f + W_{off} * f$$

W_{off} at $V_{RRM} / V_o = 1.3\text{-}1.5$

$$P_T = \frac{1}{T} \int_0^T i_T * v_T \, dt$$

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