V_{DSM}	=	2800	V
I_{TAVM}	=	3740	A
I_{TRMS}	=	5880	A
I_{TSM}	=	60000	A
V_{T0}	=	0.95	V
r_T	=	0.100	mW

Phase Control Thyristor

5STP 33L2800

Doc. No. 5SYA1011-03 Aug.00

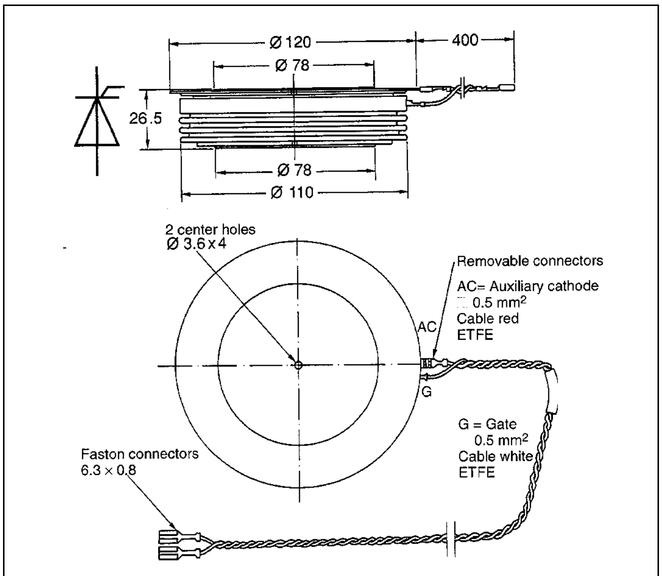
- **Patented free-floating silicon technology**
- **Low on-state and switching losses**
- **Designed for traction, energy and industrial applications**
- **Optimum power handling capability**
- **Interdigitated amplifying gate.**

Blocking

Part Number	5STP 33L2800	5STP 33L2600	5STP 33L2200	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.	70	kN
		min.	63	kN
		max.	84	kN
a	Acceleration Device unclamped Device clamped		 50 100	 m/s^2 m/s^2
m	Weight		1.45	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	3740 A	Half sine wave, T_C = 70°C	
I_{TRMS}	Max. RMS on-state current	5880 A		
I_{TSM}	Max. peak non-repetitive surge current	60000 A	tp = 10 ms	T_j = 125°C
		65000 A	tp = 8.3 ms	After surge:
I^2t	Limiting load integral	18000 kA^2s	tp = 10 ms	$V_D = V_R$ = 0V
		17500 kA^2s	tp = 8.3 ms	
V_T	On-state voltage	1.23 V	I_T = 3000 A	
V_{T0}	Threshold voltage	0.95 V	I_T = 2000 - 6000 A	T_j = 125°C
r_T	Slope resistance	0.100 mΩ		
I_H	Holding current	30-100 mA	T_j = 25°C	
		15-60 mA	T_j = 125°C	
I_L	Latching current	100-500 mA	T_j = 25°C	
		100-300 mA	T_j = 125°C	

Switching

di/dt_{crit}	Critical rate of rise of on-state current		250 A/µs	Cont.	$V_D \leq 0.67 \cdot V_{DRM}$ T_j = 125°C
			500 A/µs	60 sec.	I_{TRM} = 4500 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	$V_D \leq 0.67 \cdot V_{DRM}$ dv_D/dt = 20V/µs	I_{TRM} = 4500 A T_j = 125°C V_R > 200 V
Q_{rr}	Recovery charge	min	2000 µAs		di_T/dt = -5 A/µs
		max	4000 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	

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	14 K/kW	Anode side cooled
		14 K/kW	Cathode side cooled
		7 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:

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

i	1	2	3	4
R_i(K/kW)	4.7	0.853	1.07	0.49
τ_i(s)	0.4787	0.0824	0.0104	0.0041

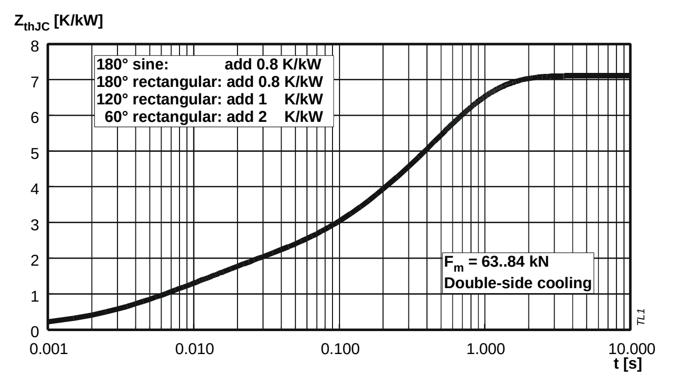


Fig. 1 Transient thermal impedance junction to case.

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 = 400 – 11000 A

A	B	C	D
0.731174	0.000079	0.017903	0.002314

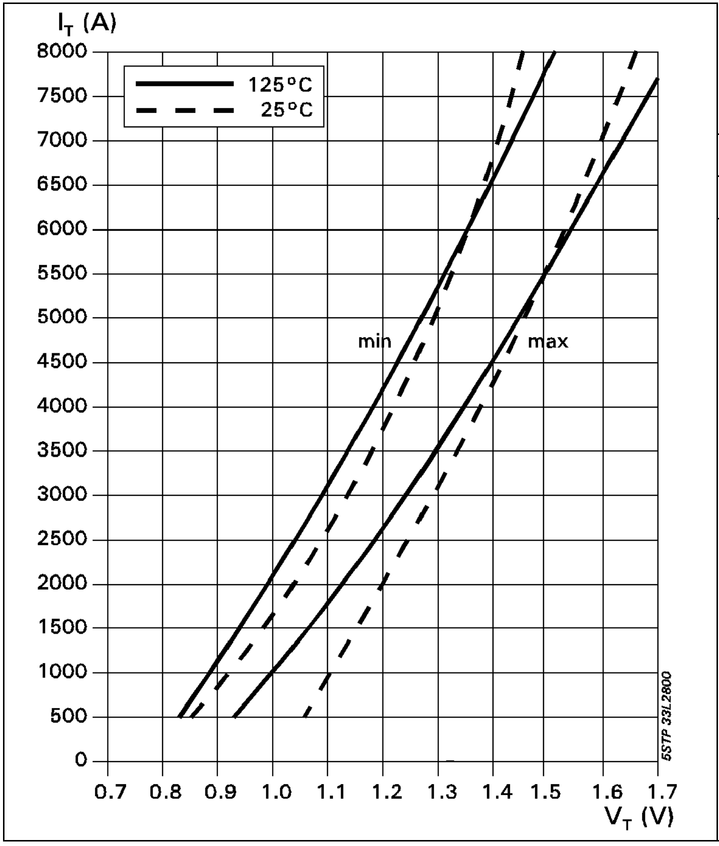


Fig 2. On-state characteristics.

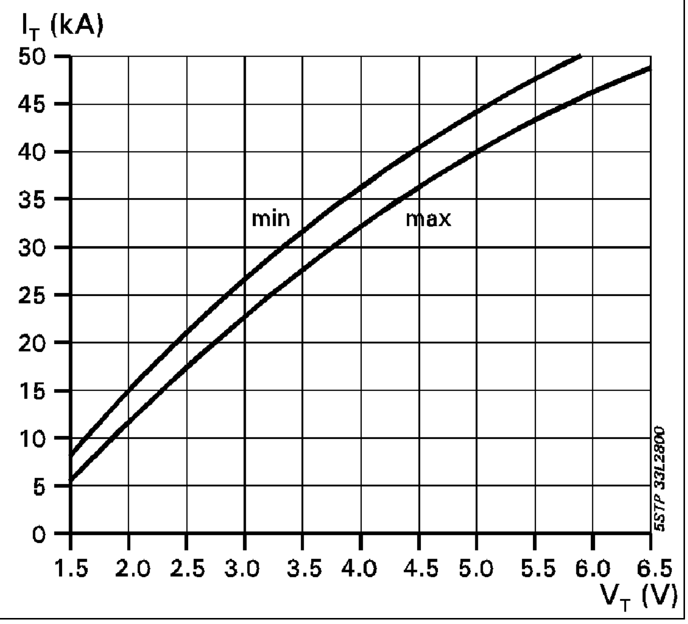


Fig. 3 On state characteristics.

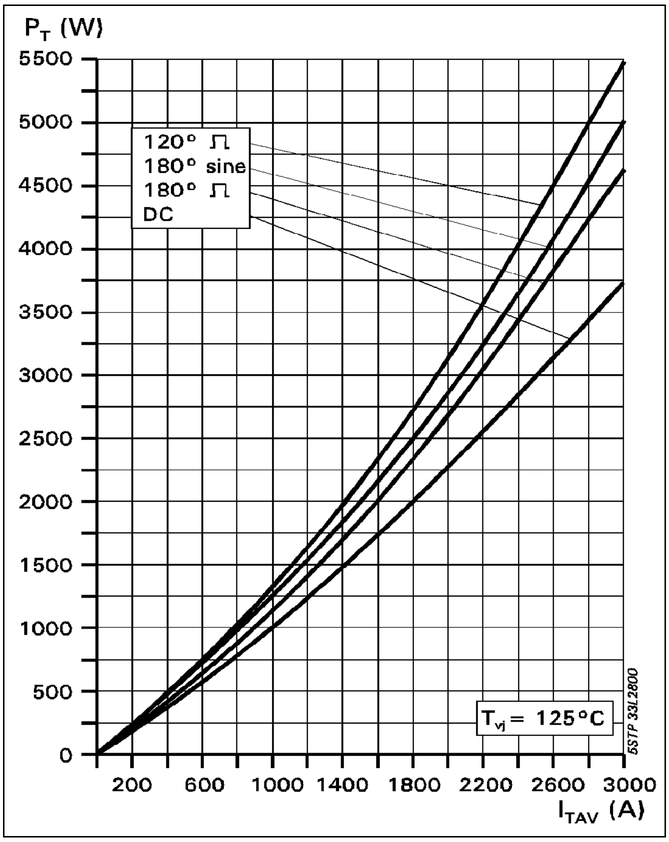


Fig. 4 On-state power dissipation vs. mean on-state current. Turn-on losses excluded.

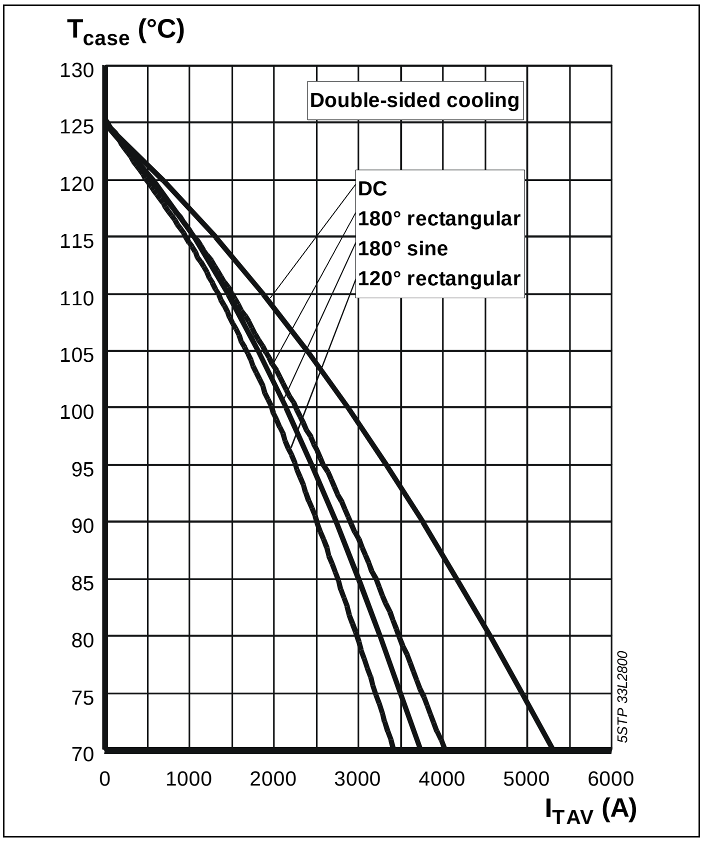


Fig. 5 Max. permissible case temperature vs. mean on-state current.

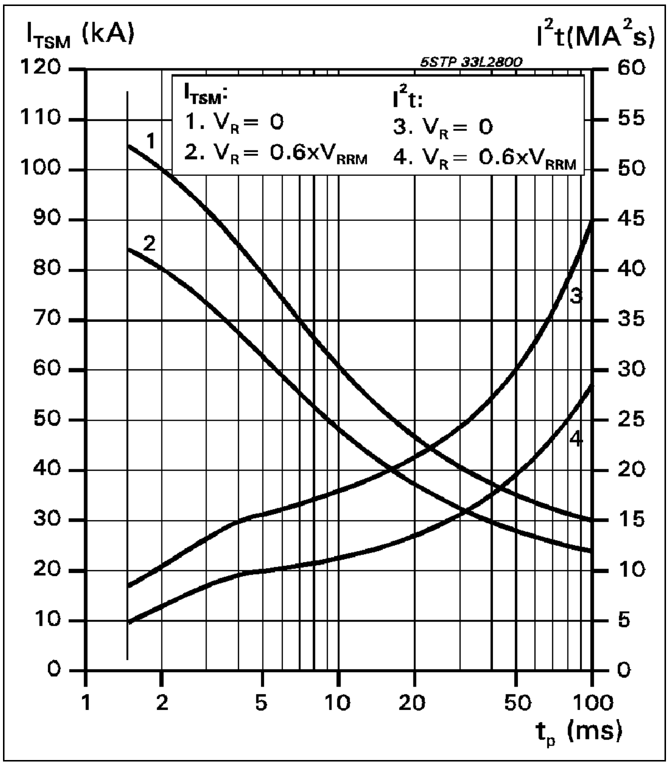


Fig. 6 Surge on-state current vs. pulse length. Half-sine wave.

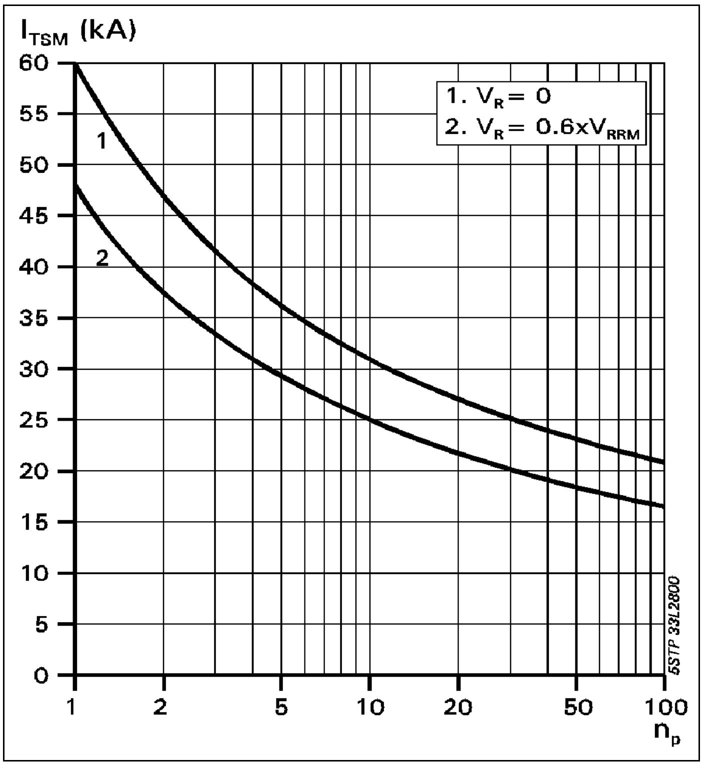


Fig. 7 Surge on-state current vs. number of pulses. Half-sine wave, 10 ms, 50Hz.

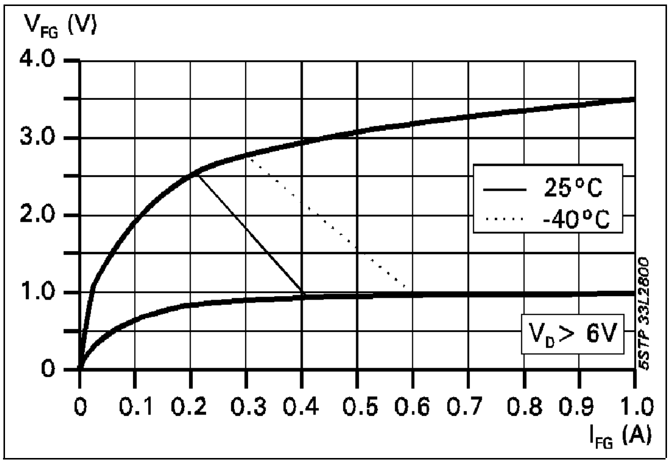


Fig. 8 Gate trigger characteristics.

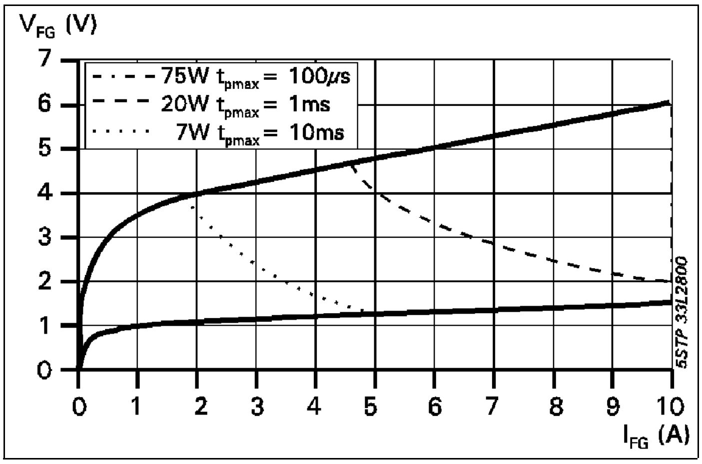


Fig. 9 Max. peak gate power loss.

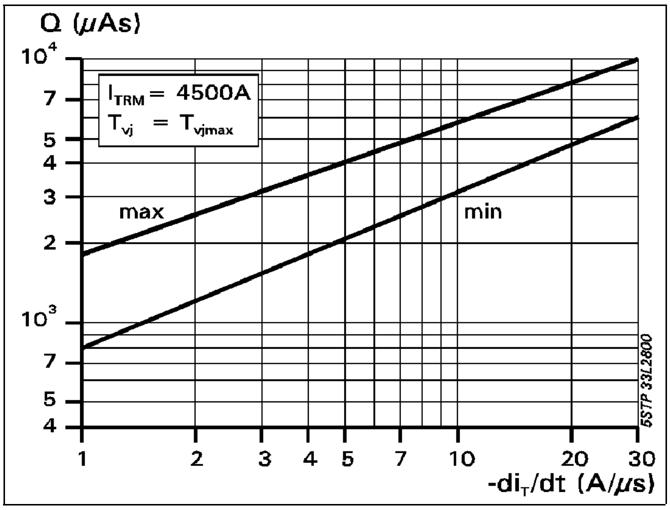


Fig. 10 Recovery charge vs. decay rate of on-state current.

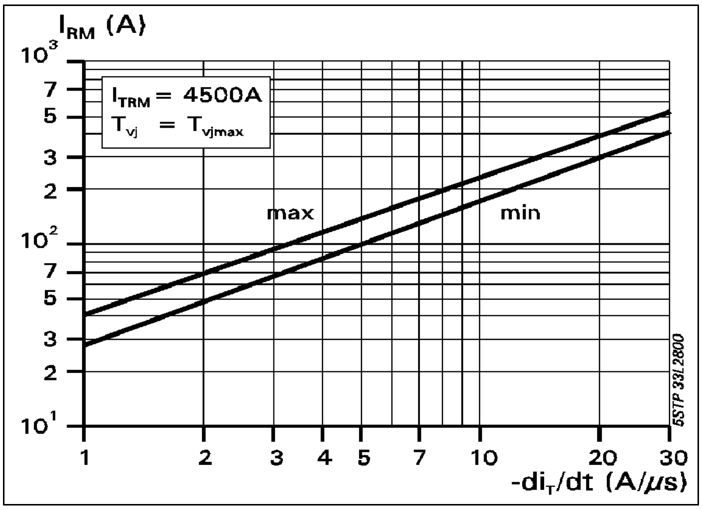


Fig. 11 Peak reverse recovery current vs. decay rate of on-state current.

Turn –off time, typical parameter relationship.

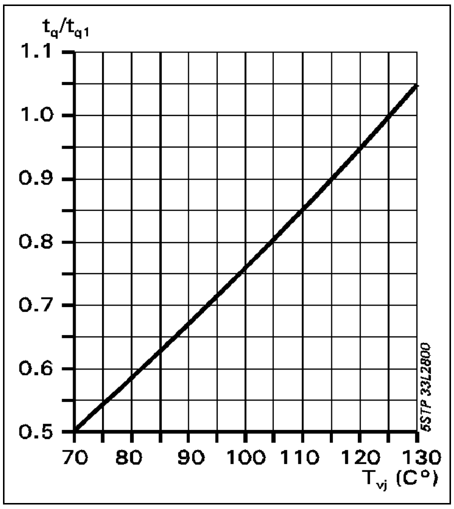


Fig. 12 $t_q/t_{q1} = f_1(T_j)$

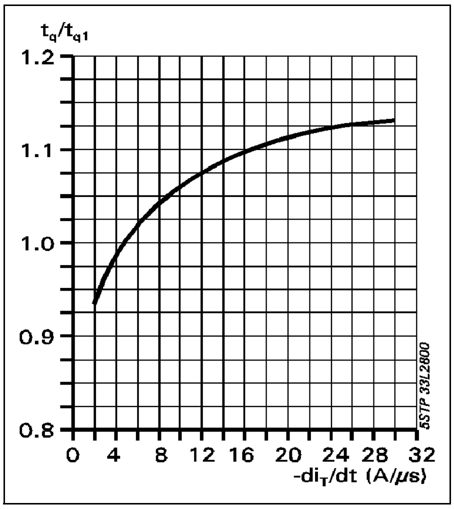


Fig. 13 $t_q/t_{q1} = f_2(\text{-di/dt})$

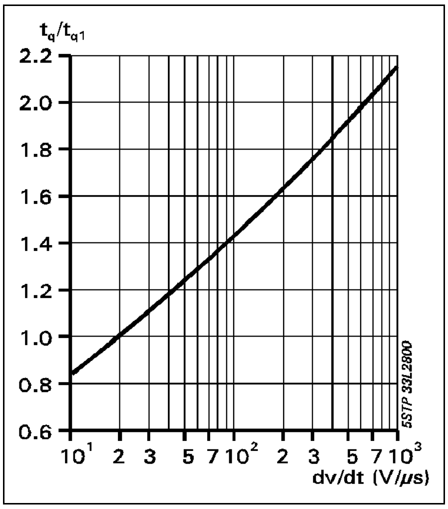


Fig. 14 $t_q/t_{q1} = f_3(\text{dv/dt})$

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

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

Turn-on and Turn-off losses

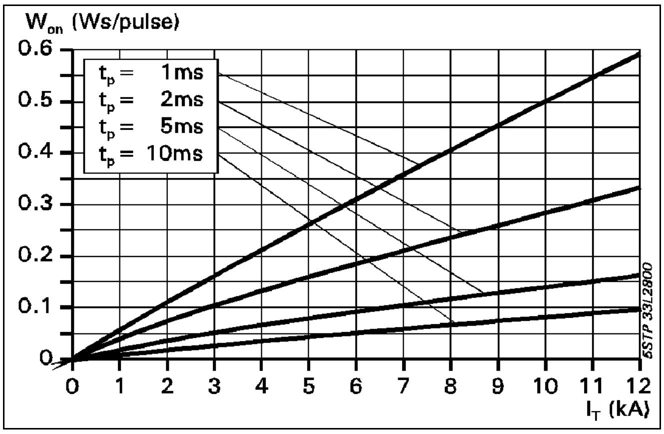


Fig. 15 $W_{on} = f(I_T, t_P)$, T_j = 125°C.
Half sinusoidal waves.

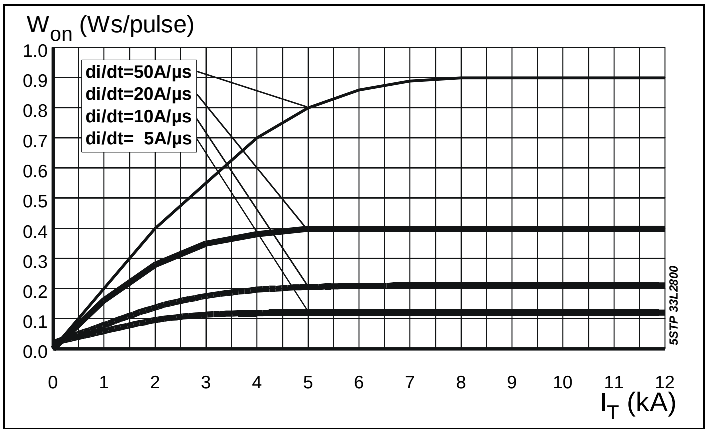


Fig. 16 $W_{on} = f(I_T, di/dt)$, T_j = 125°C.
Rectangular waves.

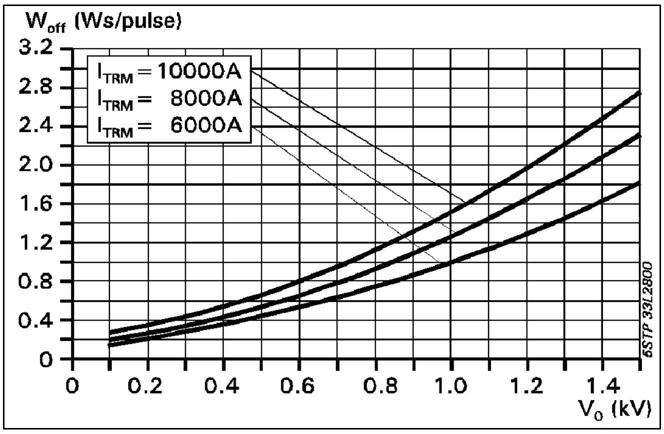


Fig. 17 $W_{off} = f(V_0, I_T)$, T_j = 125°C.
Half sinusoidal waves. t_P = 10 ms.

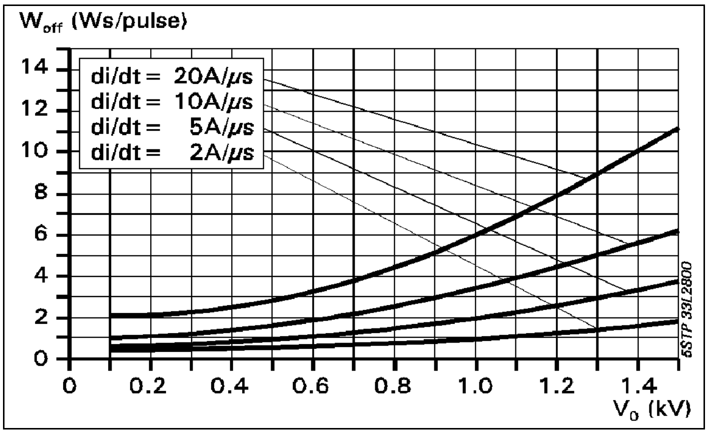
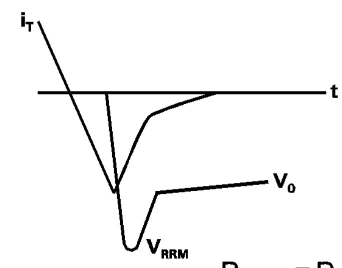


Fig. 18 $W_{off} = f(V_0, di/dt)$, T_j = 125°C.
Rectangular waves.



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

W_{off} at V_{RRM} / V_0 = 1.3-1.5

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

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