



Fast Thyristor
Type TFI833-250-30

Low switching losses
Low reverse recovery charge
Distributed amplified gate for high di_T/dt

Mean on-state current	I_{TAV}	250 A
Repetitive peak off-state voltage	V_{DRM}	3000 V
Repetitive peak reverse voltage	V_{RRM}	
Turn-off time	t_q	50.0; 63.0; 80.0; 100; 125 μs
V_{DRM}, V_{RRM}, V	3000	
Voltage code	30	
$T_j, ^\circ C$	- 60 ÷ 125	

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions
ON-STATE				
I_{TAV}	Mean on-state current	A	250 430	$T_c = 94^\circ C$; Double side cooled; $T_c = 55^\circ C$; Double side cooled; 180° half-sine wave; 50 Hz
I_{TRMS}	RMS on-state current	A	390	$T_c = 94^\circ C$; Double side cooled; 180° half-sine wave; 50 Hz
I_{TSM}	Surge on-state current	kA	5.7 6.6	$T_j = T_{jmax}$ $T_j = 25^\circ C$ 180° half-sine wave; 50 Hz ($t_p = 10$ ms); single pulse; $V_D = V_R = 0$ V; Gate pulse: $I_G = I_{FGM}$; $V_G = 20$ V; $t_{GP} = 50 \mu s$; $di_G/dt = 1$ A/ μs
			6.0 6.9	$T_j = T_{jmax}$ $T_j = 25^\circ C$ 180° half-sine wave; 60 Hz ($t_p = 8.3$ ms); single pulse; $V_D = V_R = 0$ V; Gate pulse: $I_G = I_{FGM}$; $V_G = 20$ V; $t_{GP} = 50 \mu s$; $di_G/dt = 1$ A/ μs
I^2t	Safety factor	$A^2s \cdot 10^3$	162 215	$T_j = T_{jmax}$ $T_j = 25^\circ C$ 180° half-sine wave; 50 Hz ($t_p = 10$ ms); single pulse; $V_D = V_R = 0$ V; Gate pulse: $I_G = I_{FGM}$; $V_G = 20$ V; $t_{GP} = 50 \mu s$; $di_G/dt = 1$ A/ μs
			149 197	$T_j = T_{jmax}$ $T_j = 25^\circ C$ 180° half-sine wave; 60 Hz ($t_p = 8.3$ ms); single pulse; $V_D = V_R = 0$ V; Gate pulse: $I_G = I_{FGM}$; $V_G = 20$ V; $t_{GP} = 50 \mu s$; $di_G/dt = 1$ A/ μs
BLOCKING				
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	3000	$T_{jmin} < T_j < T_{jmax}$; 180° half-sine wave; 50 Hz; Gate open
V_{DSM}, V_{RSM}	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	3100	$T_{jmin} < T_j < T_{jmax}$; 180° half-sine wave; 50 Hz; single pulse; Gate open
V_D, V_R	Direct off-state and Direct reverse voltages	V	$0.75 \cdot V_{DRM}$ $0.75 \cdot V_{RRM}$	$T_j = T_{jmax}$; Gate open

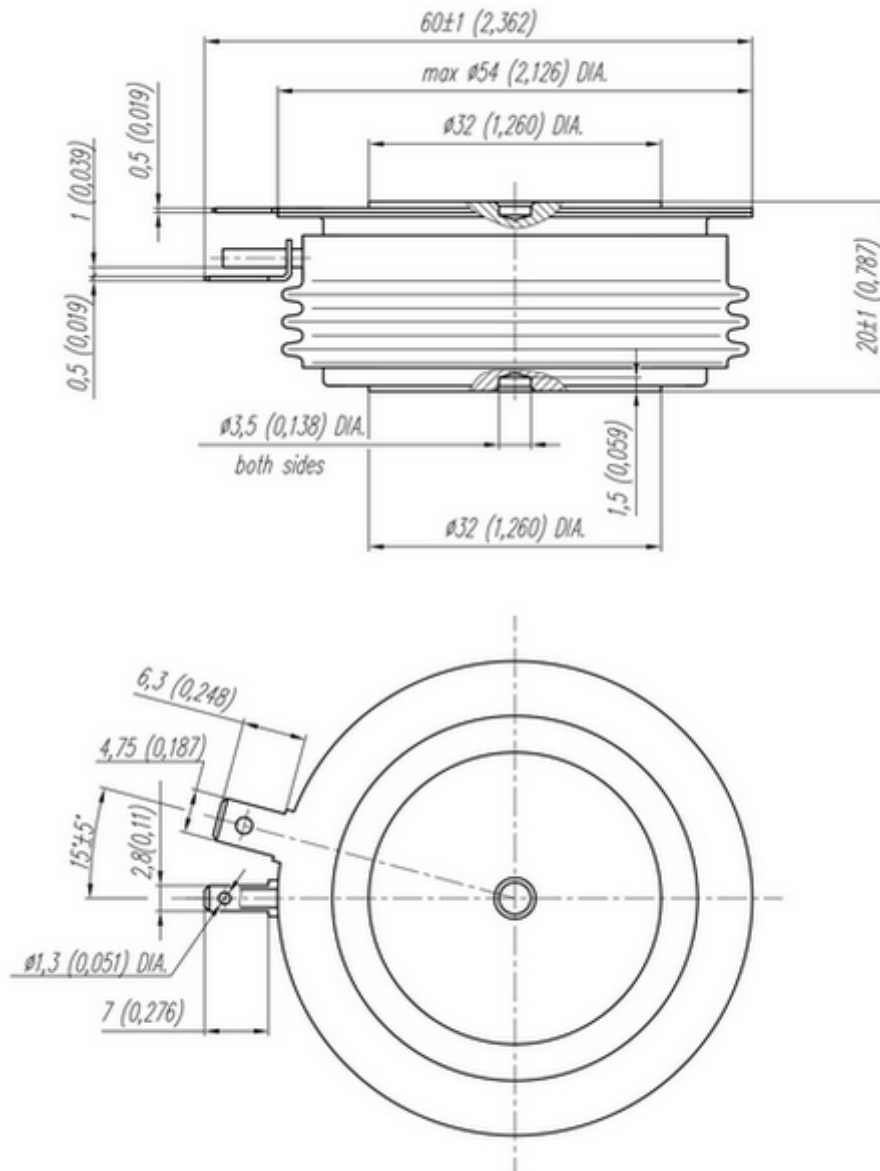
TRIGGERING				
I_{FGM}	Peak forward gate current	A	6	$T_j = T_{j\max}$
V_{RGM}	Peak reverse gate voltage	V	5	
P_G	Gate power dissipation	W	3	$T_j = T_{j\max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive (f=1 Hz)	A/ μ s	1000	$T_j = T_{j\max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 2 I_{TAV}$; Gate pulse: $I_G = I_{FGM}$; $V_G = 20$ V; $t_{GP} = 50$ μ s; $di_G/dt = 1$ A/ μ s
THERMAL				
T_{stg}	Storage temperature	$^{\circ}$ C	- 60 ÷ 125	
T_j	Operating junction temperature	$^{\circ}$ C	- 60 ÷ 125	
MECHANICAL				
F	Mounting force	kN	9.0 ÷ 11.0	
a	Acceleration	m/s ²	50 100	Device unclamped Device clamped

CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V_{TM}	Peak on-state voltage, max	V	3.00	$T_j = 25$ $^{\circ}$ C; $I_{TM} = 785$ A	
$V_{T(TO)}$	On-state threshold voltage, max	V	1.70	$T_j = T_{j\max}$;	
r_T	On-state slope resistance, max	m Ω	2.200	$0.5 \pi I_{TAV} < I_T < 1.5 \pi I_{TAV}$	
I_H	Holding current, max	mA	500	$T_j = 25$ $^{\circ}$ C; $V_D = 12$ V; Gate open	
BLOCKING					
I_{DRM}, I_{RRM}	Repetitive peak off-state and Repetitive peak reverse currents, max	mA	70	$T_j = T_{j\max}$; $V_D = V_{DRM}$; $V_R = V_{RRM}$	
$(dv_D/dt)_{crit}$	Critical rate of rise of off-state voltage ¹⁾ , min	V/ μ s	1000	$T_j = T_{j\max}$; $V_D = 0.67 \cdot V_{DRM}$; Gate open	
TRIGGERING					
V_{GT}	Gate trigger direct voltage, max	V	4.00 2.50 2.00	$T_j = T_{j\min}$ $T_j = 25$ $^{\circ}$ C $T_j = T_{j\max}$	$V_D = 12$ V; $I_D = 3$ A; Direct gate current
I_{GT}	Gate trigger direct current, max	mA	500 300 200	$T_j = T_{j\min}$ $T_j = 25$ $^{\circ}$ C $T_j = T_{j\max}$	
V_{GD}	Gate non-trigger direct voltage, min	V	0.25	$T_j = T_{j\max}$; $V_D = 0.67 \cdot V_{DRM}$;	
I_{GD}	Gate non-trigger direct current, min	mA	10.00	Direct gate current	
SWITCHING					
t_{gd}	Delay time	μ s	3.0	$T_j = 25$ $^{\circ}$ C; $V_D = 0.4 \cdot V_{DRM}$; $I_{TM} = I_{TAV}$; Gate pulse: $I_G = I_{FGM}$; $V_G = 20$ V; $t_{GP} = 50$ μ s; $di_G/dt = 1$ A/ μ s	
t_q	Turn-off time ²⁾ , max	μ s	50.0; 63.0; 80.0; 100; 125	$dv_D/dt = 50$ V/ μ s;	$T_j = T_{j\max}$; $I_{TM} = I_{TAV}$; $di_R/dt = -10$ A/ μ s; $V_R = 100$ V; $V_D = 0.67 \cdot V_{DRM}$
			63.0; 80.0; 100; 125; 160	$dv_D/dt = 200$ V/ μ s;	
Q_{rr}	Total recovered charge, max	μ C	500	$T_j = T_{j\max}$; $I_{TM} = I_{TAV}$;	
t_{rr}	Reverse recovery time, typ	μ s	5.0	$di_R/dt = -50$ A/ μ s;	
I_{rrM}	Peak reverse recovery current, max	A	200	$V_R = 100$ V	

THERMAL					
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.0400	Direct current	Double side cooled
R_{thjc-A}			0.0880		Anode side cooled
R_{thjc-K}			0.0720		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0060	Direct current	
MECHANICAL					
w	Weight, typ	g	180		
D_s	Surface creepage distance	mm (inch)	19.44 (0.765)		
D_a	Air strike distance	mm (inch)	12.10 (0.476)		

NOTES		PART NUMBERING GUIDE																																
¹⁾ Critical rate of rise of off-state voltage <table border="1"> <tr> <td>Symbol of group</td> <td colspan="5">A2</td> </tr> <tr> <td>$(dv_D/dt)_{crit}, V/\mu s$</td> <td colspan="5">1000</td> </tr> </table>		Symbol of group	A2					$(dv_D/dt)_{crit}, V/\mu s$	1000					<table border="1"> <tr> <td>TFI</td> <td>833</td> <td>250</td> <td>30</td> <td>A2</td> <td>E3</td> <td>N</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> </table>							TFI	833	250	30	A2	E3	N	1	2	3	4	5	6	7
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²⁾ Turn-off time ($dv_D/dt=50 V/\mu s$) <table border="1"> <tr> <td>Symbol of group</td> <td>E3</td> <td>C3</td> <td>B3</td> <td>A3</td> <td>X2</td> </tr> <tr> <td>$t_q, \mu s$</td> <td>50.0</td> <td>63.0</td> <td>80.0</td> <td>100</td> <td>125</td> </tr> </table>		Symbol of group	E3	C3	B3	A3	X2	$t_q, \mu s$	50.0	63.0	80.0	100	125	<ol style="list-style-type: none"> TFI — Fast Thyristor TFIS — Fast Thyristor with Distributed Amplified Gate Design version Mean on-state current, A Voltage code Critical rate of rise of off-state voltage Group of turn-off time ($dv_D/dt=50 V/\mu s$) Ambient conditions: N – normal; T – tropical 																				
Symbol of group	E3	C3	B3	A3	X2																													
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All dimensions in millimeters (inches)

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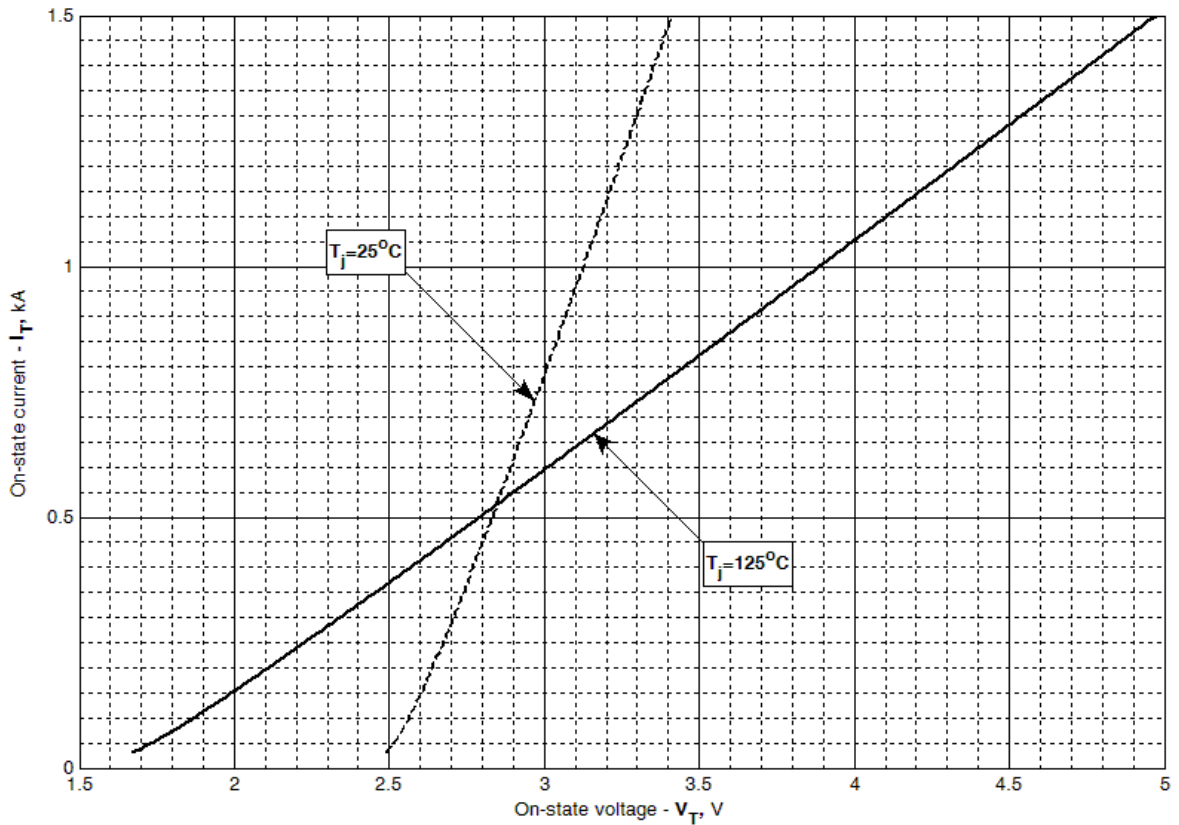


Fig 1 – On-state characteristics of Limit device

Analytical function for On-state characteristic:

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

	Coefficients for max curves	
	$T_j = 25^\circ\text{C}$	$T_j = T_{j,\text{max}}$
A	2.424973	1.543421
B	0.532501	2.119300
C	-0.250342	-0.334349
D	0.340838	0.455213

On-state characteristic model (see Fig. 1)

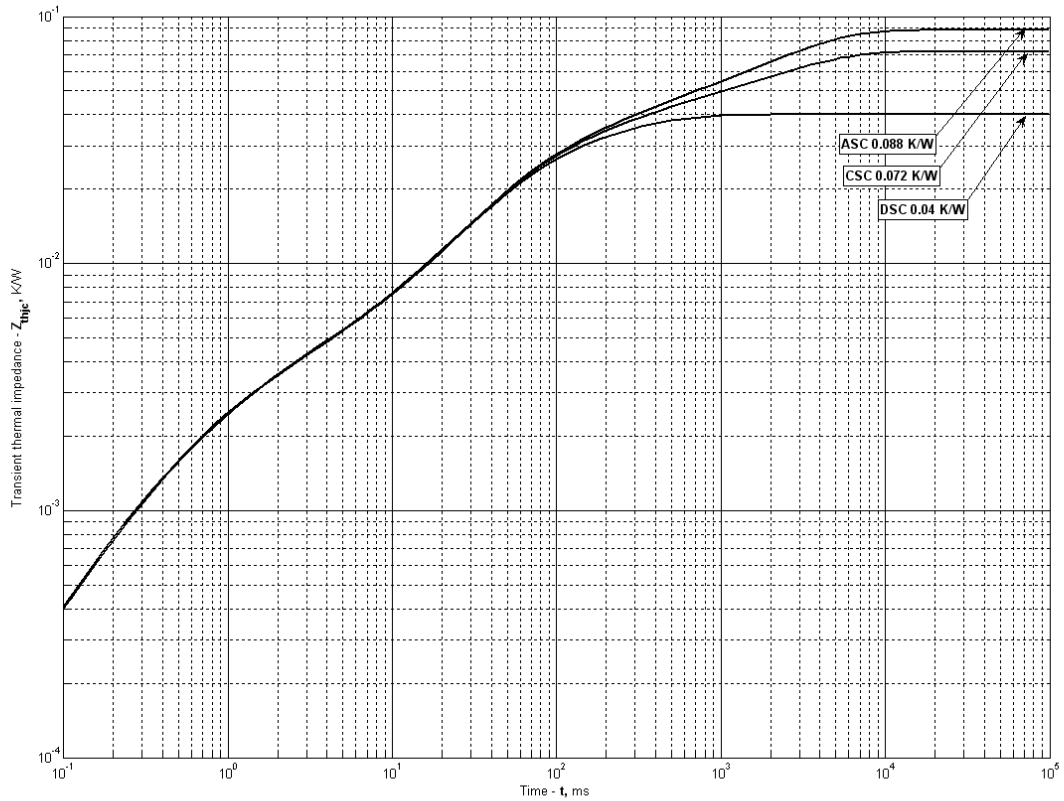


Fig 2 – Transient thermal impedance

Analytical function for Transient thermal impedance junction to case Z_{thjc} for DC:

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

Where $i = 1$ to n , n is the number of terms in the series.

t = Duration of heating pulse in seconds.

Z_{thjc} = Thermal resistance at time t .

R_i = Amplitude of p_{th} term.

τ_i = Time constant of r_{th} term.

DC Double side cooled

i	1	2	3	4	5	6
R_i , K/W	0.01423	0.01906	0.003576	0.002535	-4.666e-005	0.0006479
τ_i , S	0.265	0.05901	0.03499	0.001252	0.000001	0.0002488

DC Anode side cooled

i	1	2	3	4	5	6
R_i , K/W	0.04804	0.001789	0.01342	0.02147	0.001374	0.001945
τ_i , S	2.651	0.4195	0.2622	0.05451	0.002585	0.0005847

DC Cathode side cooled

i	1	2	3	4	5	6
R_i , K/W	0.03216	0.01306	0.002934	0.02064	0.001493	0.001786
τ_i , S	2.647	0.2831	0.1455	0.05284	0.002255	0.0005519

Transient thermal impedance junction to case Z_{thjc} model (see Fig. 2)

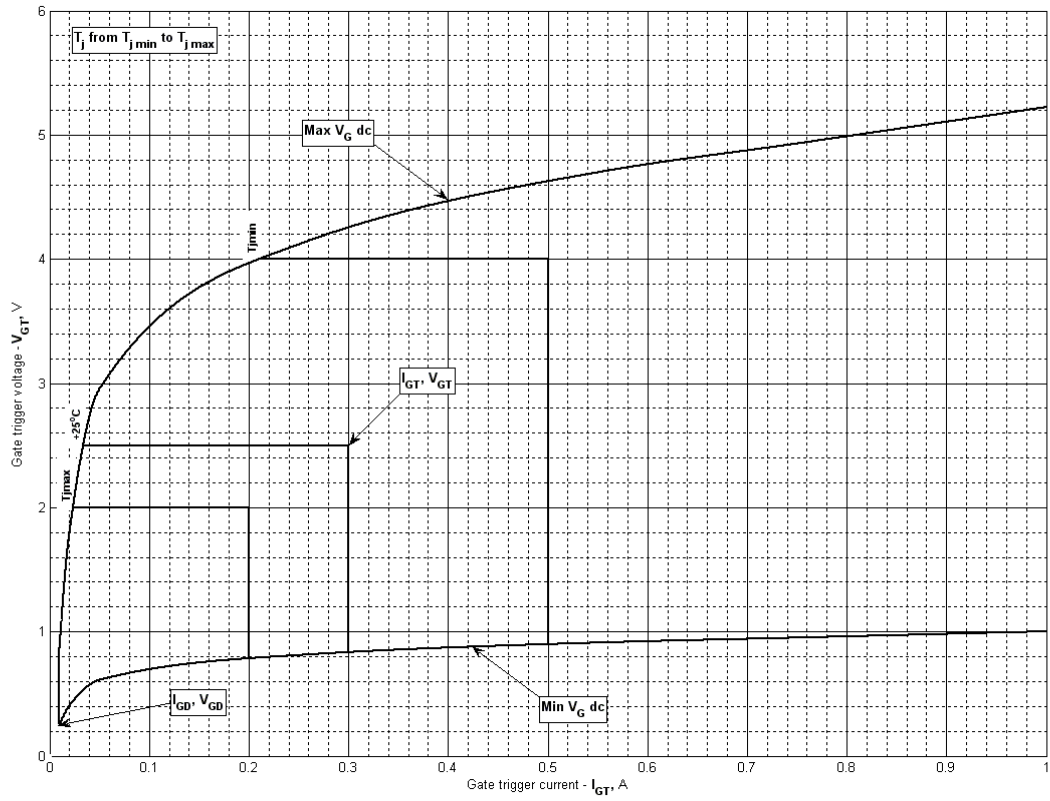


Fig 3 – Gate characteristics – Trigger limits

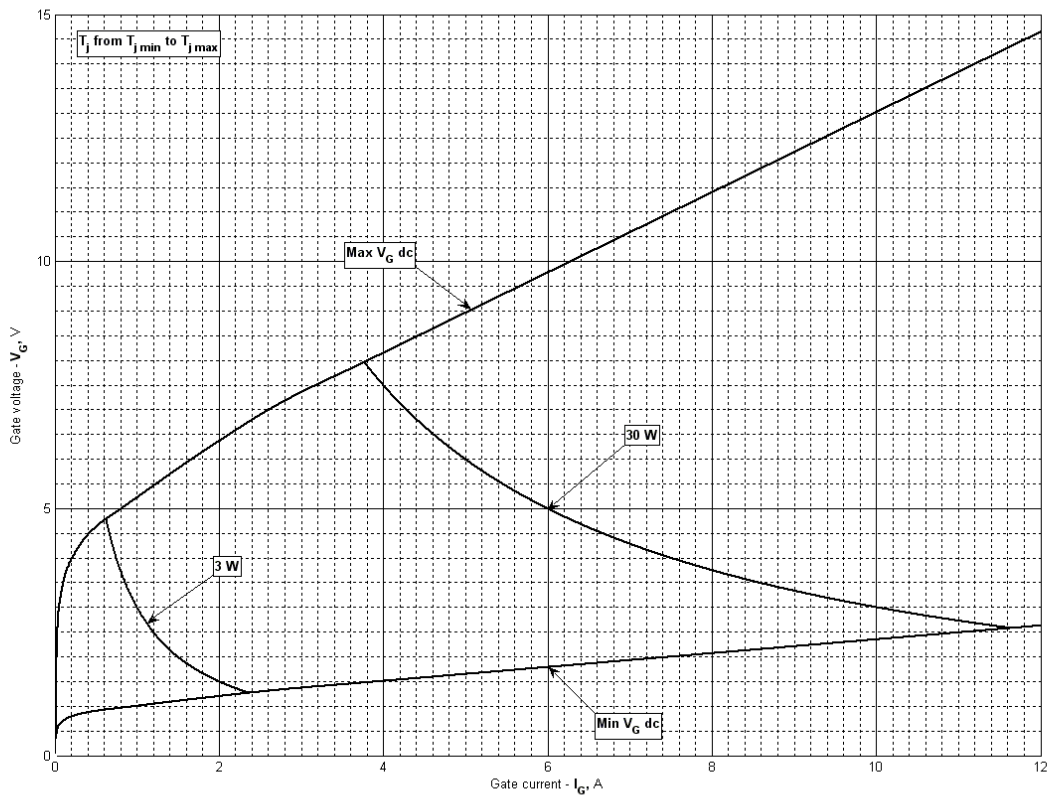


Fig 4 - Gate characteristics –Power curves

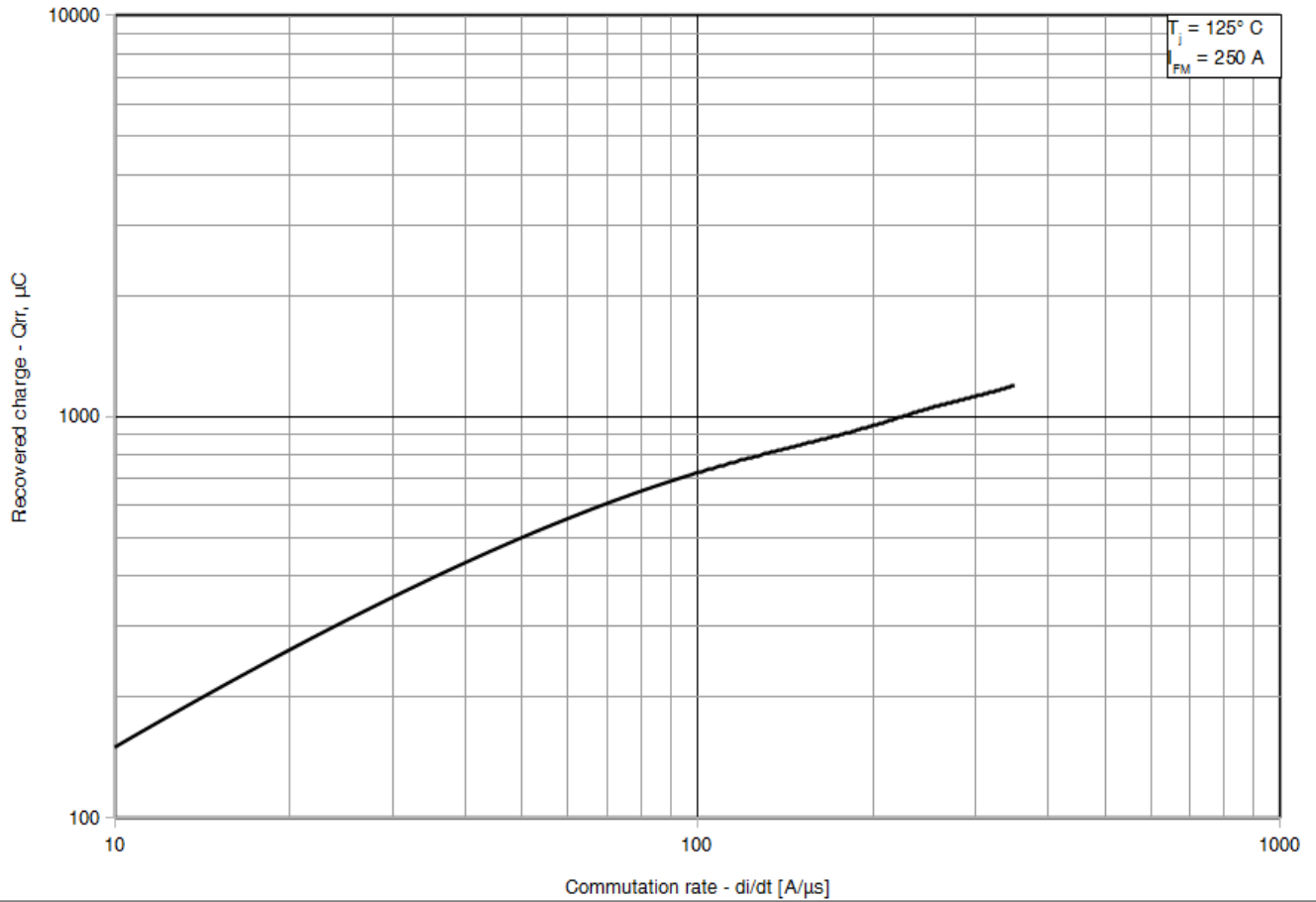


Fig 5 - Recovered charge, Q_{rr} (linear)

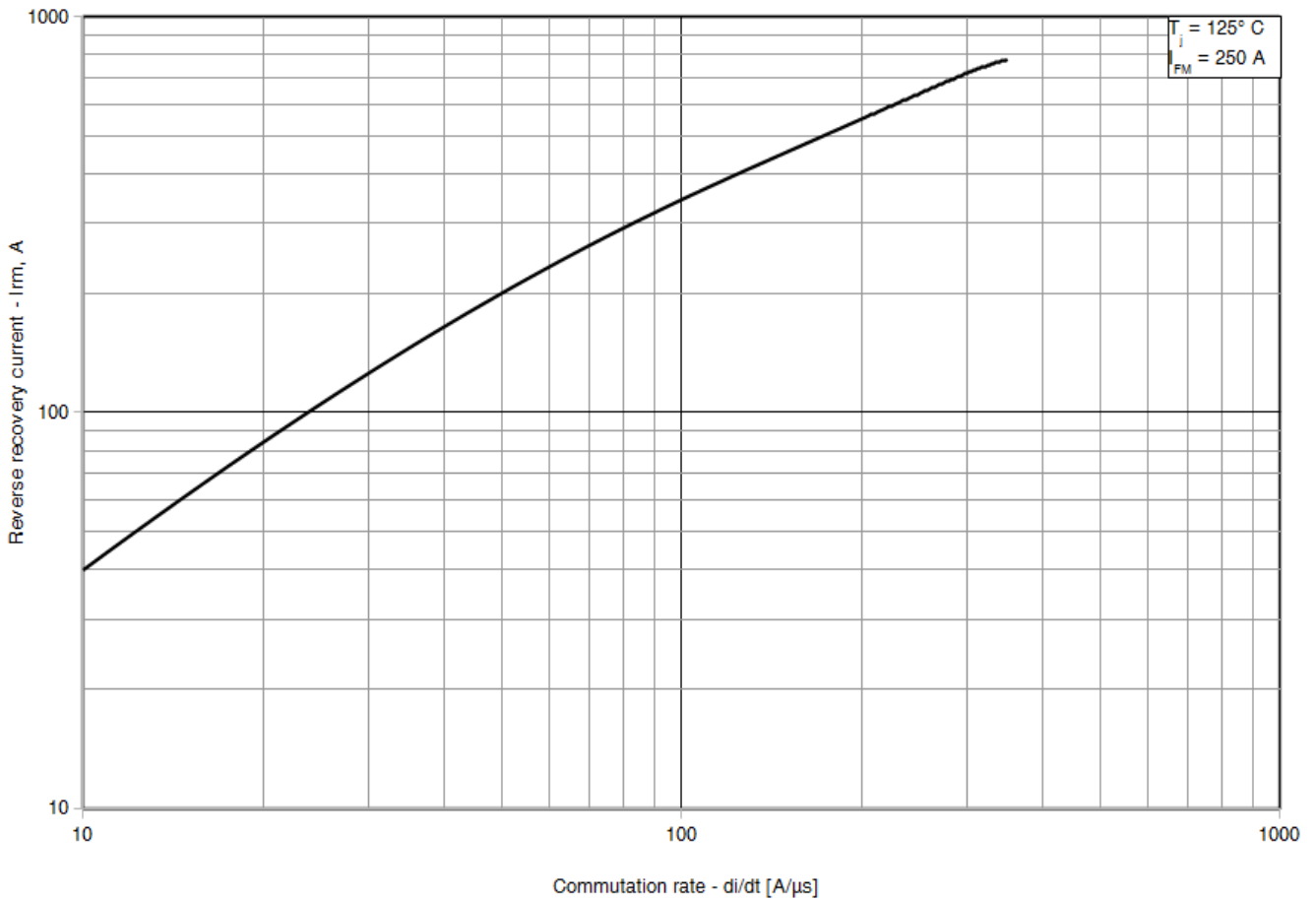


Fig 6 – Peak reverse recovery current, I_{rm}

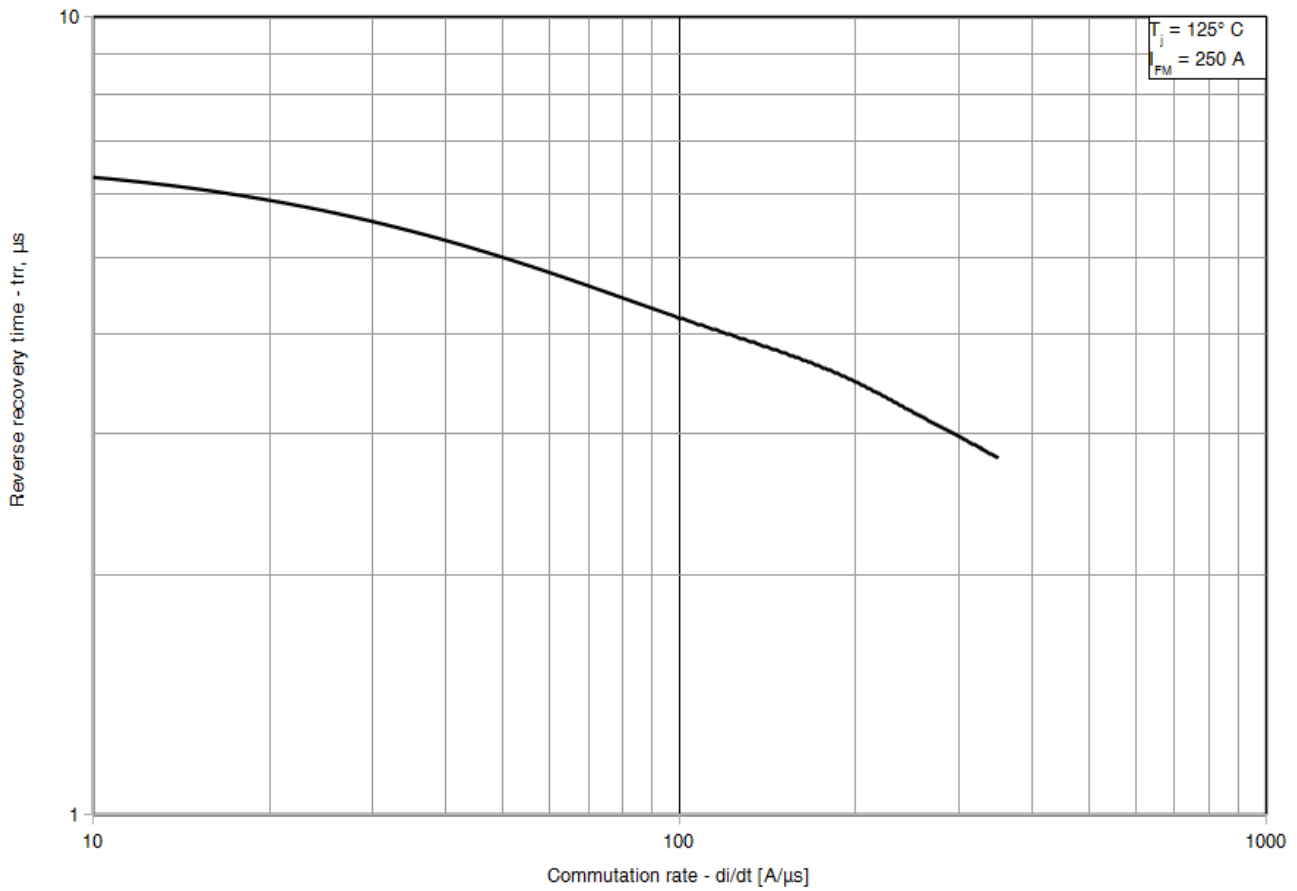


Fig 7 – Maximum recovery time, t_{rr} (linear)

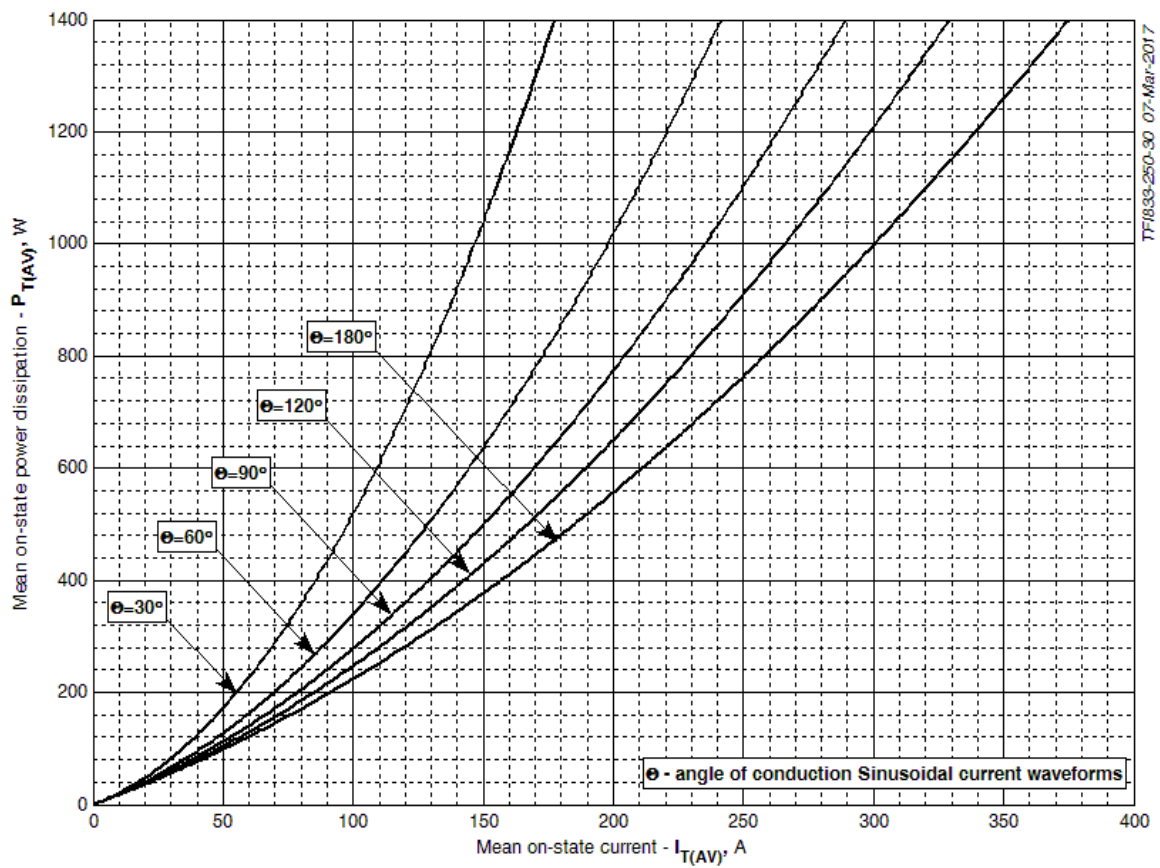
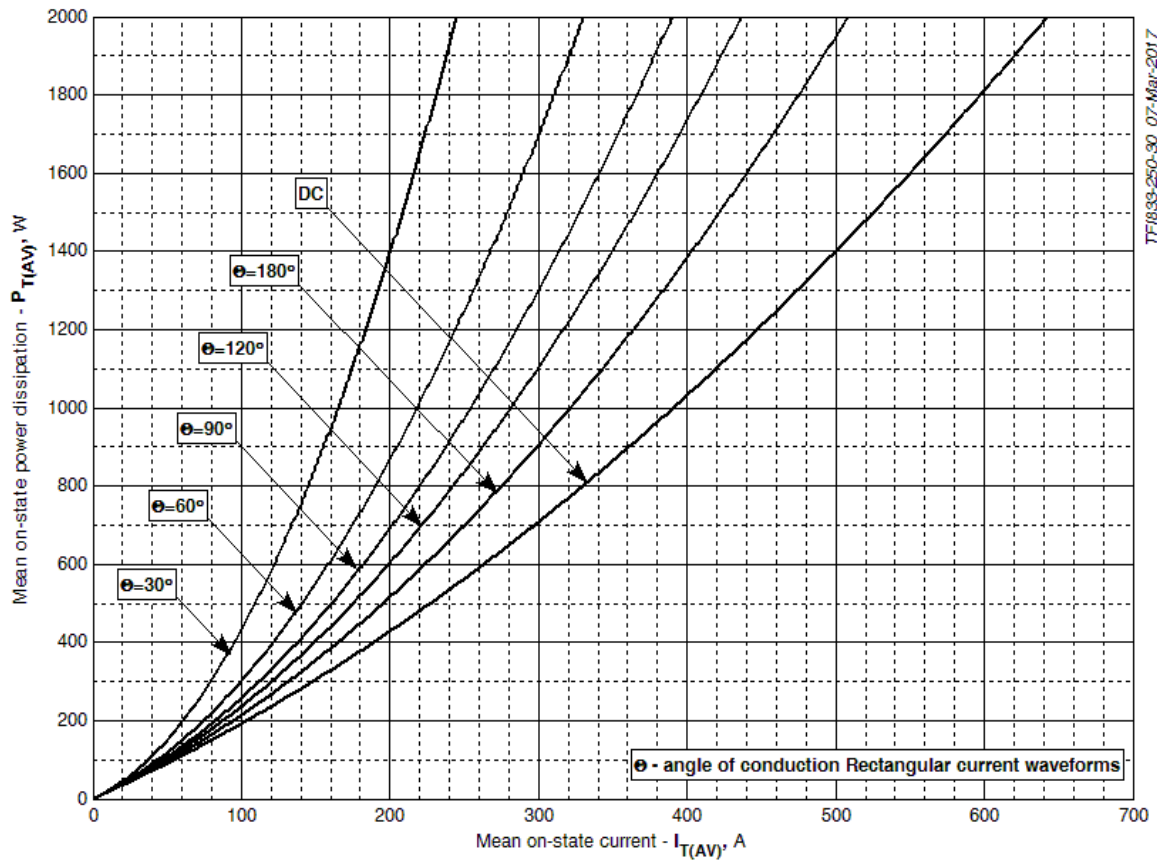
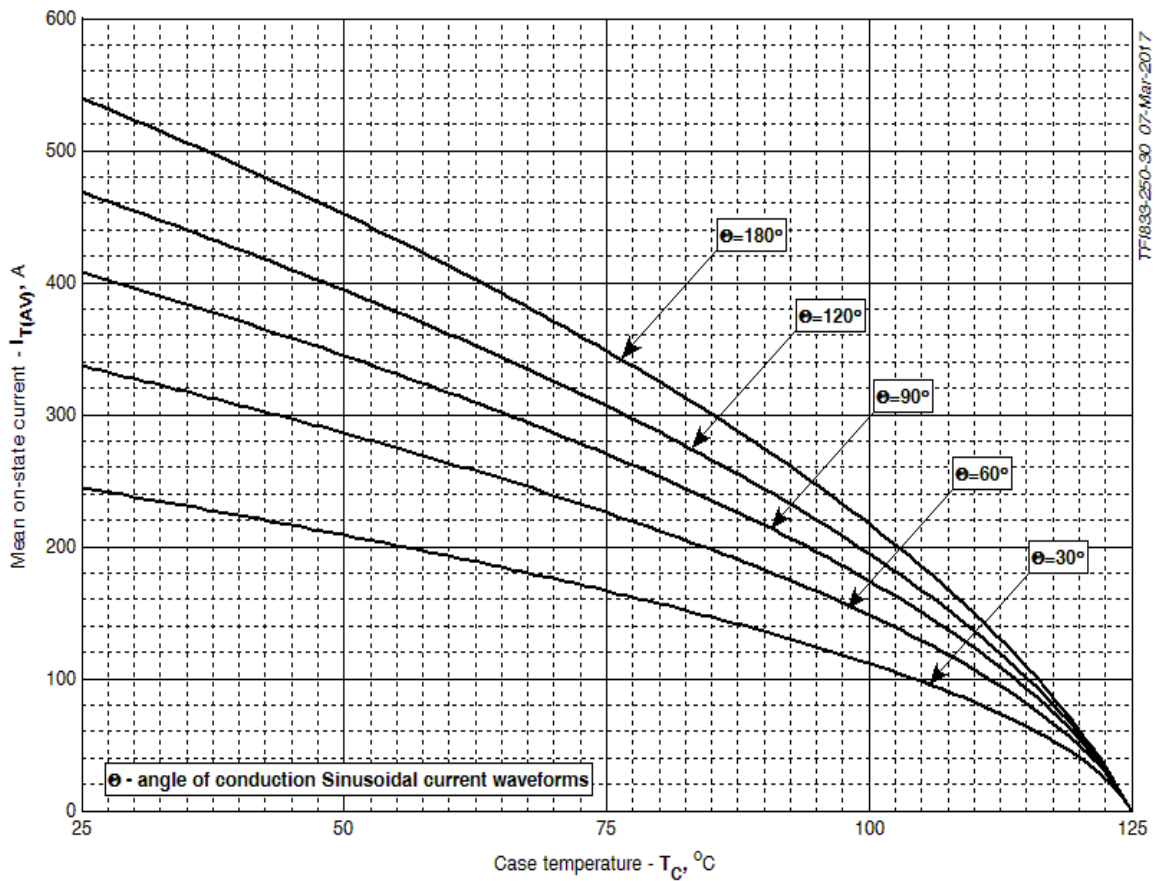


Fig 8 – On-state power loss (sinusoidal current waveforms)



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Fig 9 – On-state power loss (rectangular current waveforms)



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Fig 10 – Maximum case temperature DSC (sinusoidal current waveforms)

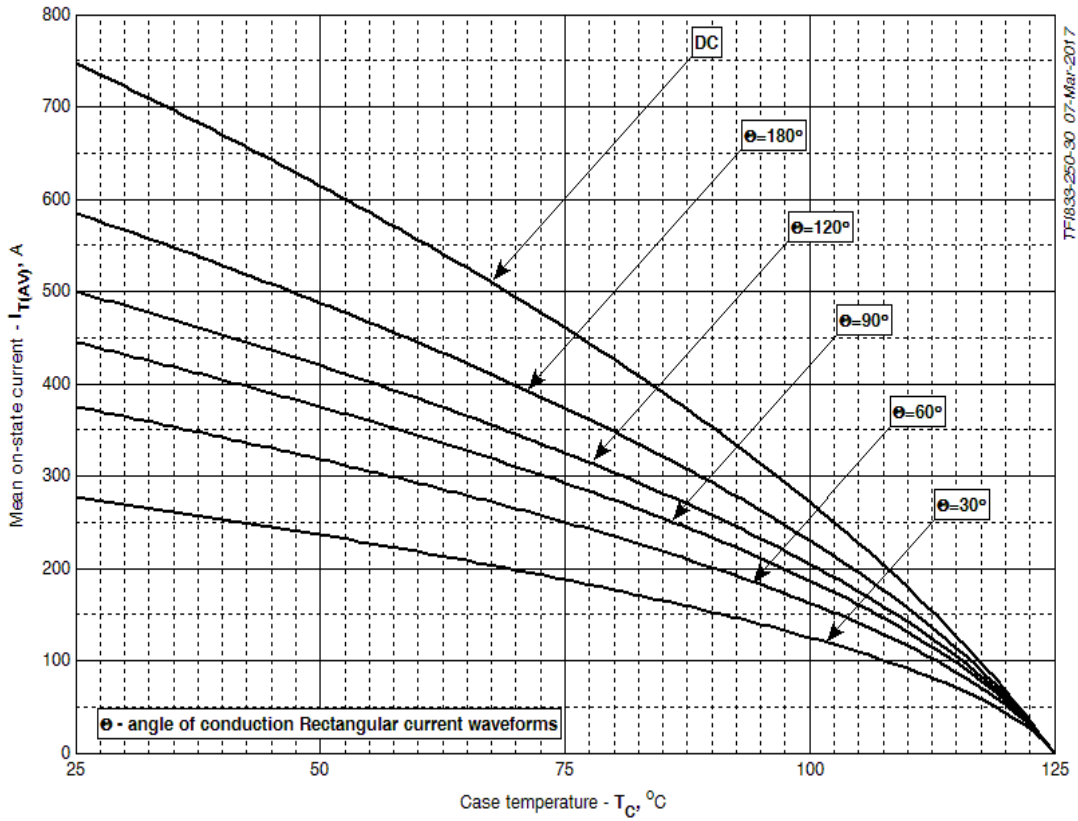


Fig 11 – Maximum case temperature DSC (rectangular current waveforms)

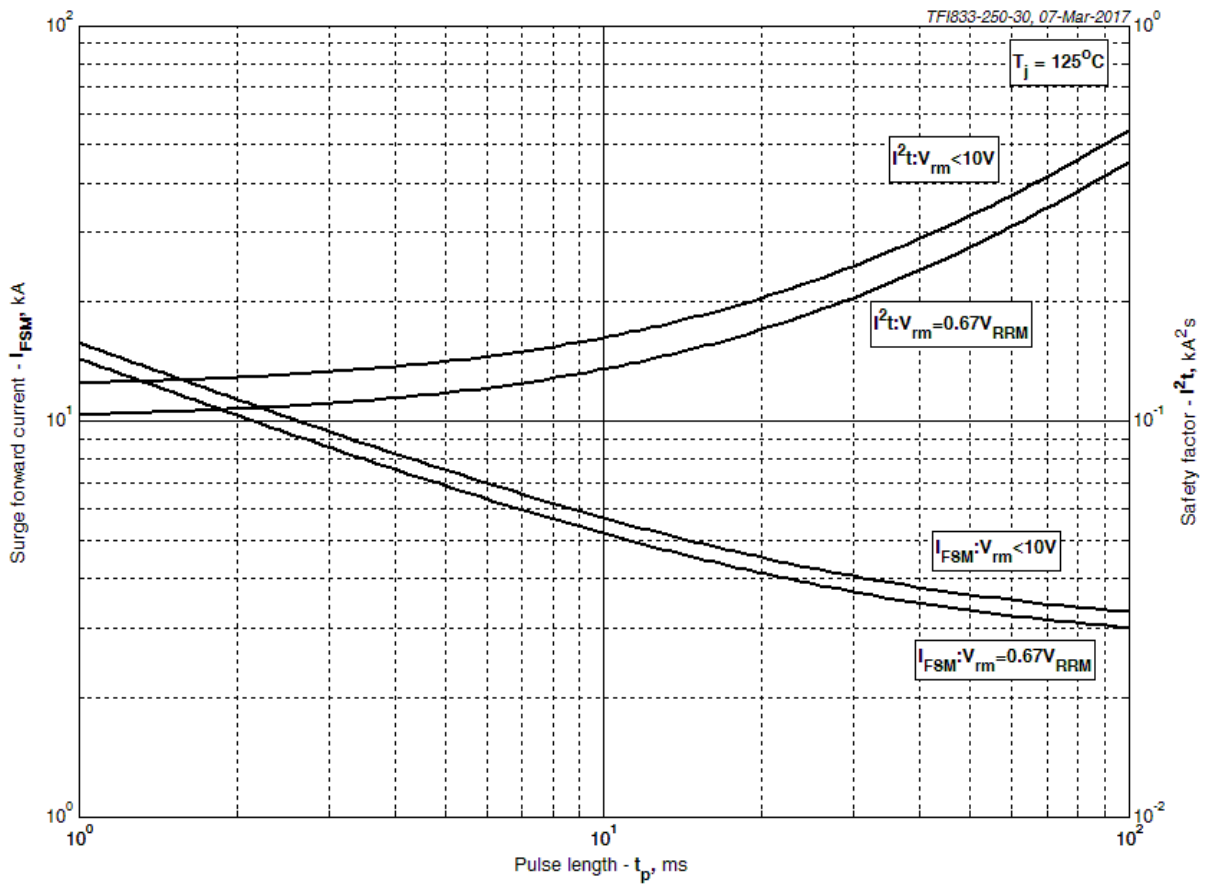
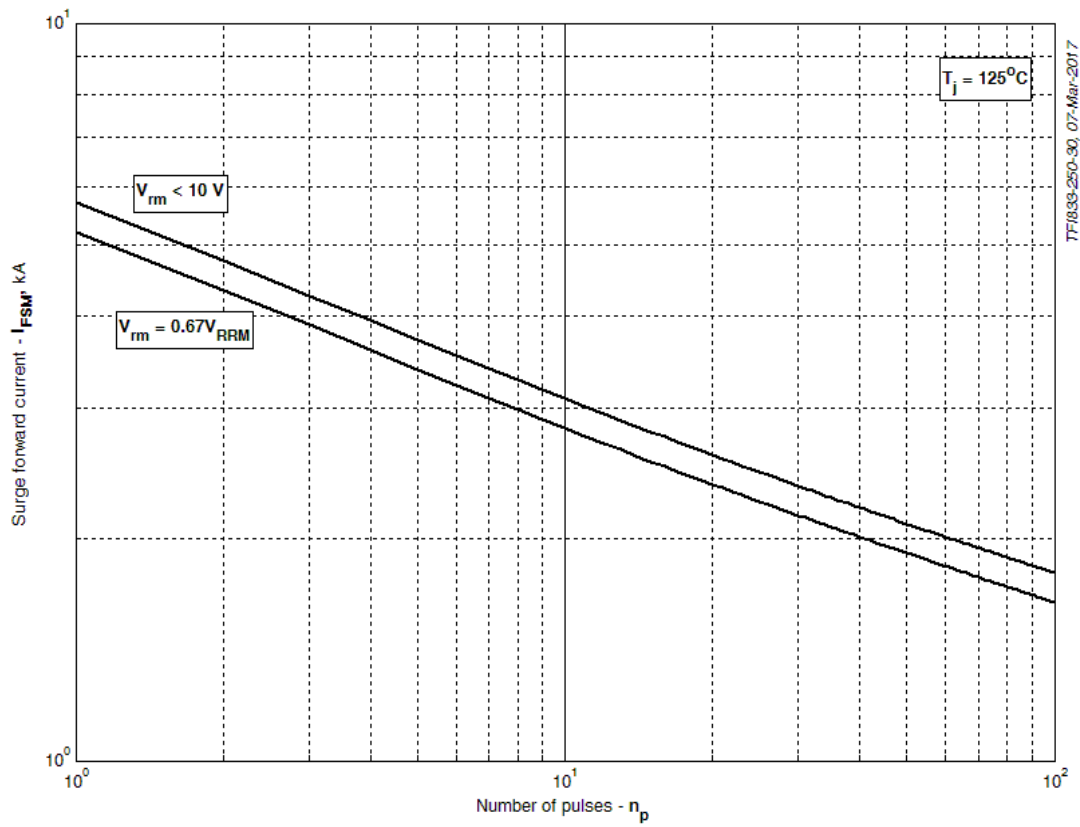


Fig 12 – Maximum surge and I^2t ratings



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Fig 13 – Maximum surge ratings