



PROTON-ELECTROTEX RUSSIA

Low switching losses
Low reverse recovery charge
High power cycling capability

Fast Recovery Diode Type DF133-500-12

Average forward current		I_{FAV}	500 A
Repetitive peak reverse voltage		V_{RRM}	1000...1200 V
Reverse recovery time		t_{rr}	2.50, 3.20, 4.00, 5.00 μ s
V_{RRM} , V	1000	1100	1200
Voltage code	10	11	12
T_j , °C	-60...+125		

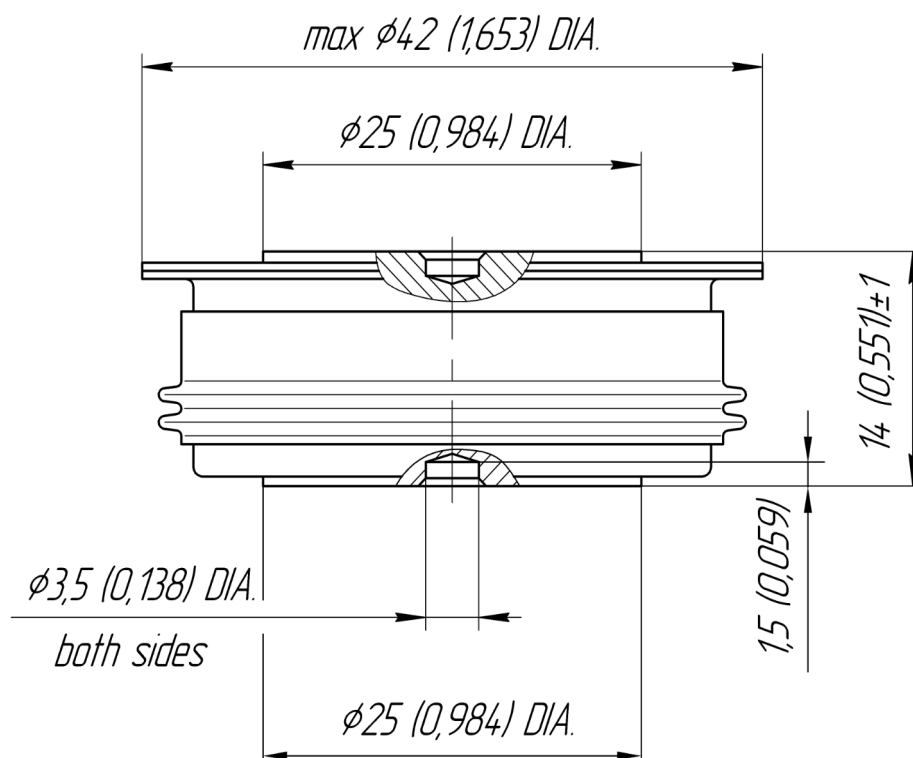
MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I _{FAV}	Maximum allowable average forward current	A	500 761	T _c =86 °C; Double side cooled; T _c =55 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I _{FRMS}	RMS forward current	A	785	T _c =86 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I _{FSM}	Surge forward current	kA	8.5 10.0	T _j =T _{j max} T _j =25 °C	180° half-sine wave; t _p =10 ms; single pulse; V _R =0 V;
			9.0 10.5	T _j =T _{j max} T _j =25 °C	180° half-sine wave; t _p =8.3 ms; single pulse; V _R =0 V;
I ² t	Safety factor	A ² s·10 ³	360 500	T _j =T _{j max} T _j =25 °C	180° half-sine wave; t _p =10 ms; single pulse; V _R =0 V;
			330 450	T _j =T _{j max} T _j =25 °C	180° half-sine wave; t _p =8.3 ms; single pulse; V _R =0 V;
BLOCKING					
V _{RRM}	Repetitive peak reverse voltages	V	1000...1200	T _{j min} < T _j < T _{j max} ; 180° half-sine wave; 50 Hz;	
V _{RSM}	Non-repetitive peak reverse voltages	V	1100...1300	T _{j min} < T _j < T _{j max} ; 180° half-sine wave; single pulse;	
V _R	Reverse continuous voltages	V	0.6·V _{RRM}	T _j =T _{j max} ;	
THERMAL					
T _{stg}	Storage temperature	°C	−60...+55		
T _j	Operating junction temperature	°C	−60...+125		
MECHANICAL					
F	Mounting force	kN	9.0...11.0		
a	Acceleration	m/s ²	50	Device clamped	

CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V _{FM}	Peak forward voltage, max	V	2.20	T _j =25 °C; I _{FM} =1570 A	
V _{F(TO)}	Forward threshold voltage, max	V	1.287	T _j =T _{j max} ;	
r _T	Forward slope resistance, max	mΩ	0.541	0.5 π I _{FAV} < I _T < 1.5 π I _{FAV}	
BLOCKING					
I _{RRM}	Repetitive peak reverse current, max	mA	50	T _j =T _{j max} ; V _R =V _{RRM}	
SWITCHING					
Q _r	Recovered charge, max	μC	190	T _j =T _{j max} ; I _{FM} = I _{FAV} ;	
t _{rr}	Reverse recovery time ¹⁾ , max	μs	2.50, 3.20, 4.00, 5.00	di _R /dt=-100 A/μs;	
I _{rr}	Reverse recovery current, max	A	150	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	0.0080	Direct current	
MECHANICAL					
m	Weight, max	g	95		
D _s	Surface creepage distance	mm (inch)	11.10 (0.437)		
D _a	Air strike distance	mm (inch)	11.60 (0.457)		

PART NUMBERING GUIDE						NOTES										
DF	133	500	12	M4	N	1) Reverse recovery time										
1	2	3	4	5	6											
1. Fast recovery diode 2. Design version 3. Average forward current, A 4. Voltage code 5. Group of reverse recovery time 6. Ambient conditions: N – normal; T – tropical																
						<table><tr><th>Symbol of group</th><th>M4</th><th>K4</th><th>H4</th><th>E4</th></tr><tr><td>t_{rr}, μs</td><td>2.50</td><td>3.20</td><td>4.00</td><td>5.00</td></tr></table>	Symbol of group	M4	K4	H4	E4	t _{rr} , μs	2.50	3.20	4.00	5.00
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All dimensions in millimeters (inches)

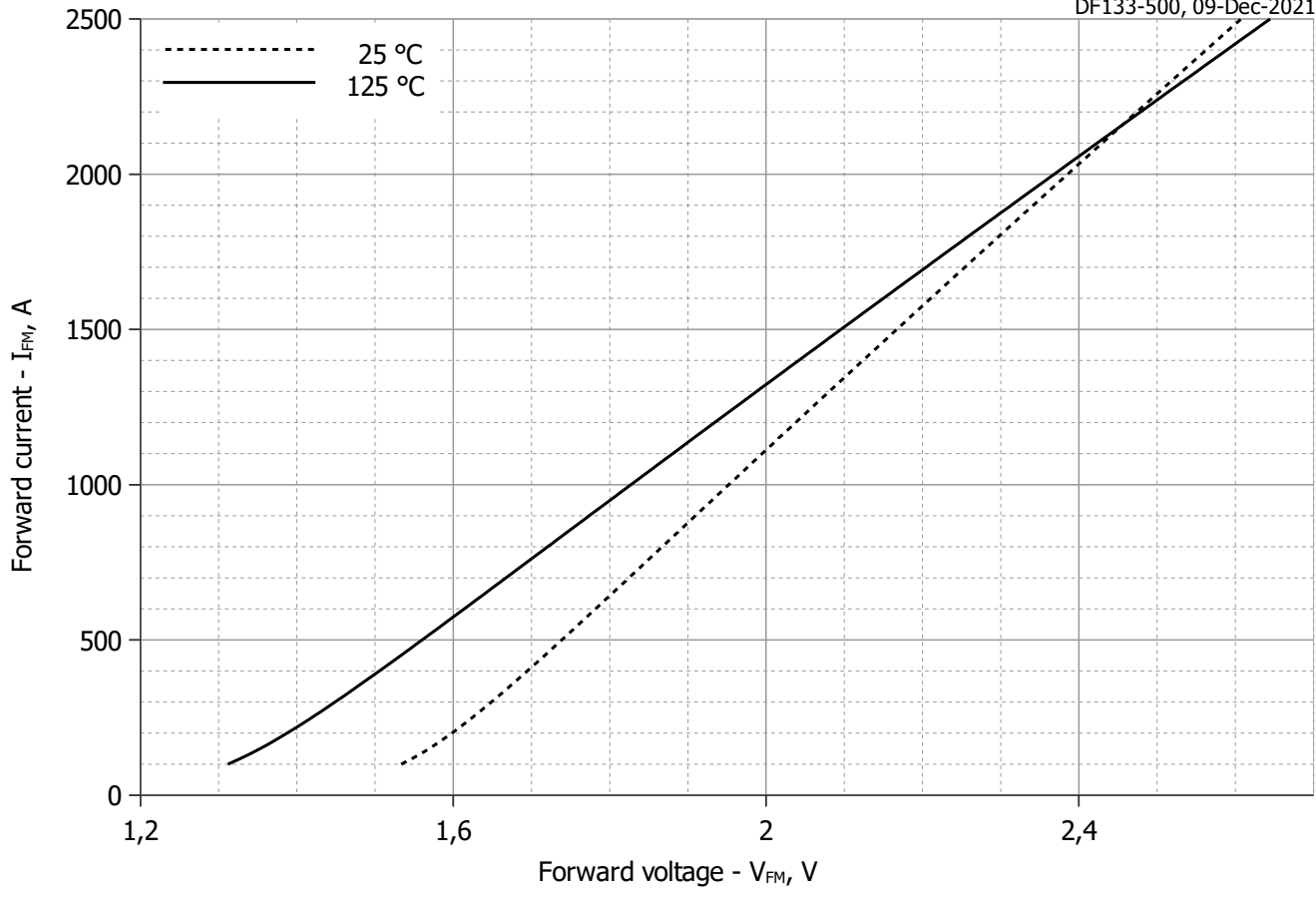


Fig 1 – Forward characteristics of Limit device

Analytical function for Forward characteristic:

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

	Coefficients for max curves	
	$T_j = 25^{\circ}\text{C}$	$T_j = T_{j\text{ max}}$
A	1.17073726	0.92943720
B	0.00054143	0.00065513
C	0.09569472	0.09880812
D	-0.01331508	-0.01391740

Forward characteristic model (see Fig. 1).

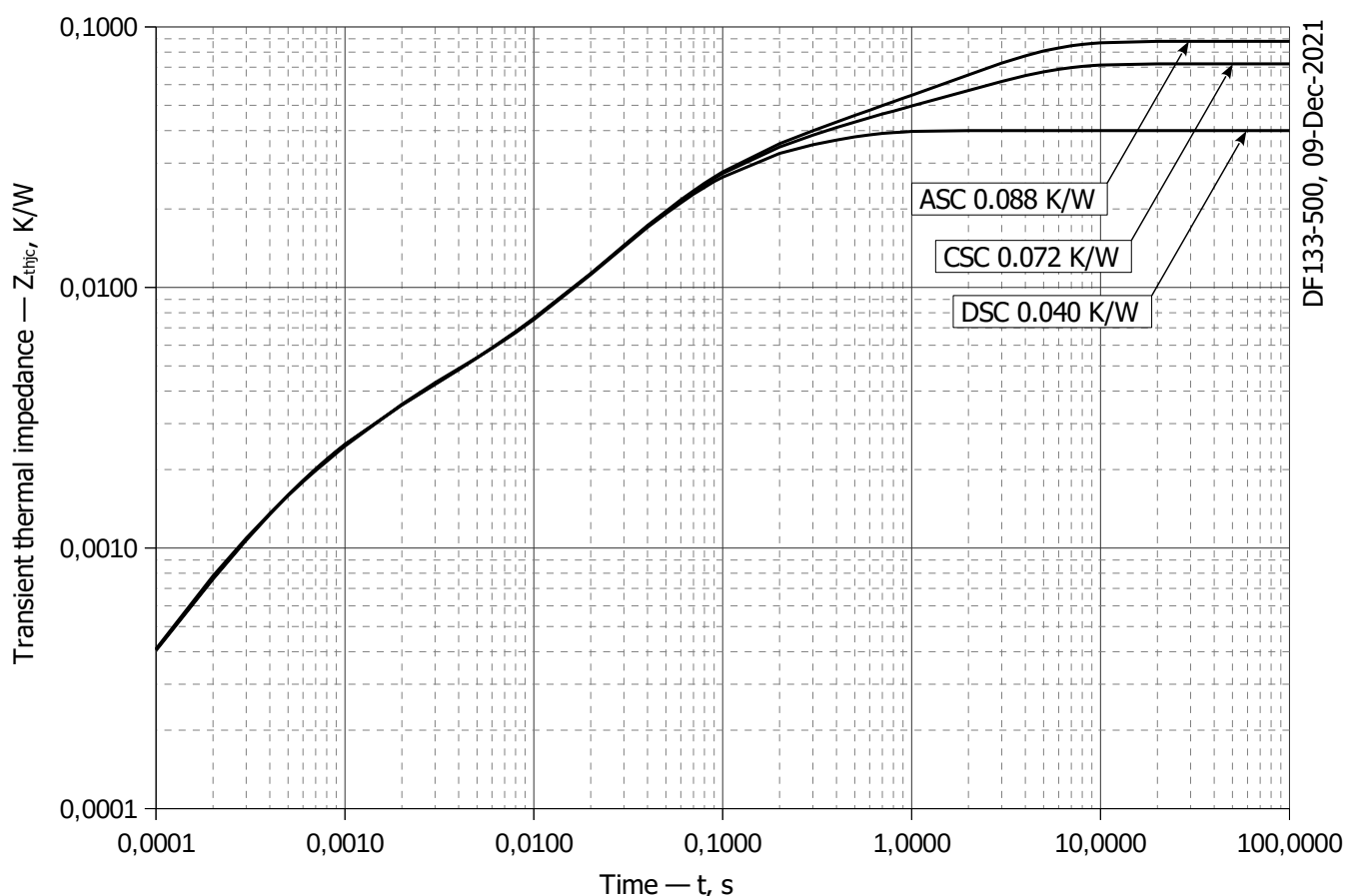


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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	-0.00004666	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)

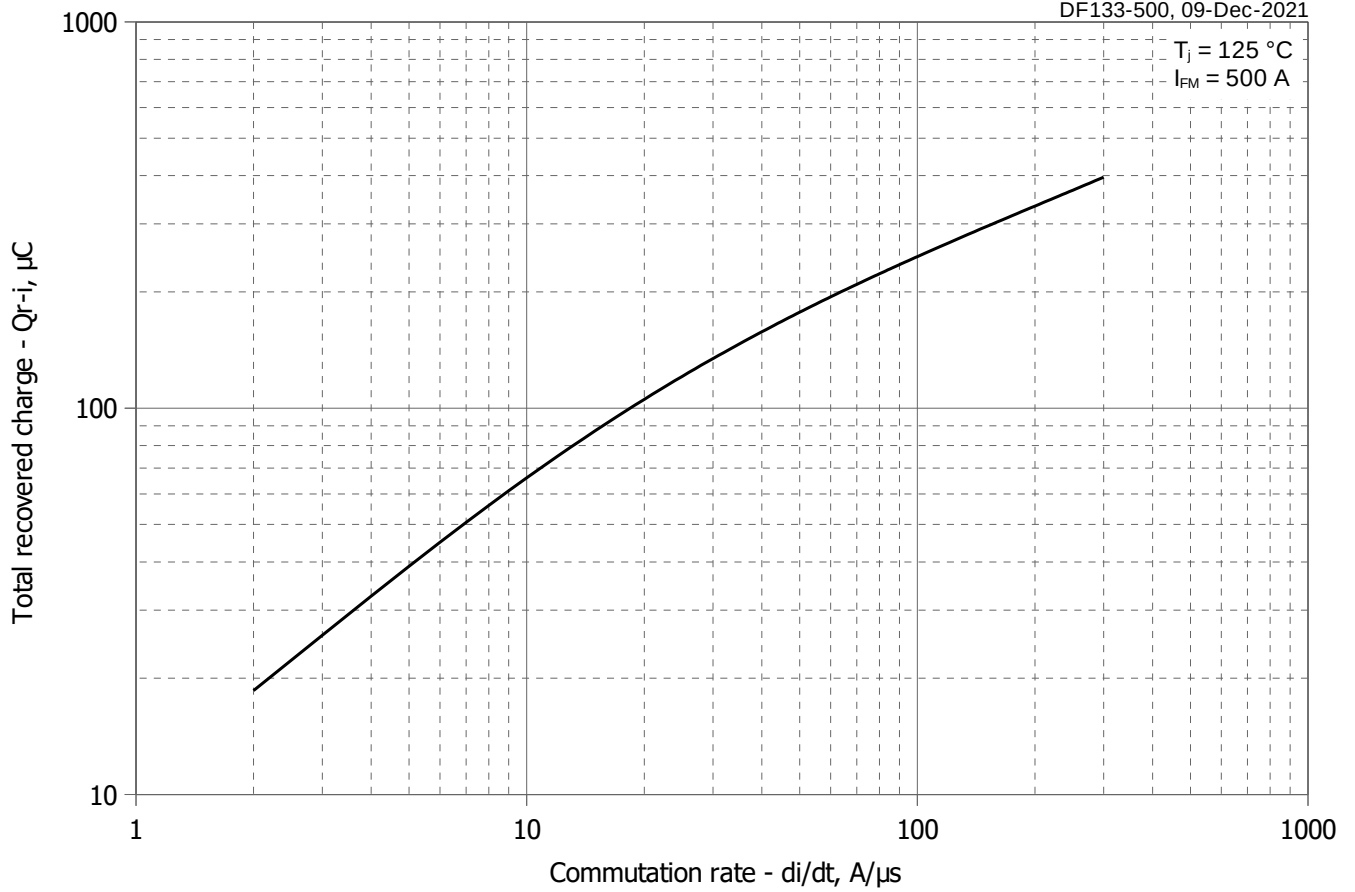


Fig 3 - Total recovered charge Q_{r-i} (integral) vs. commutation rate di_R/dt

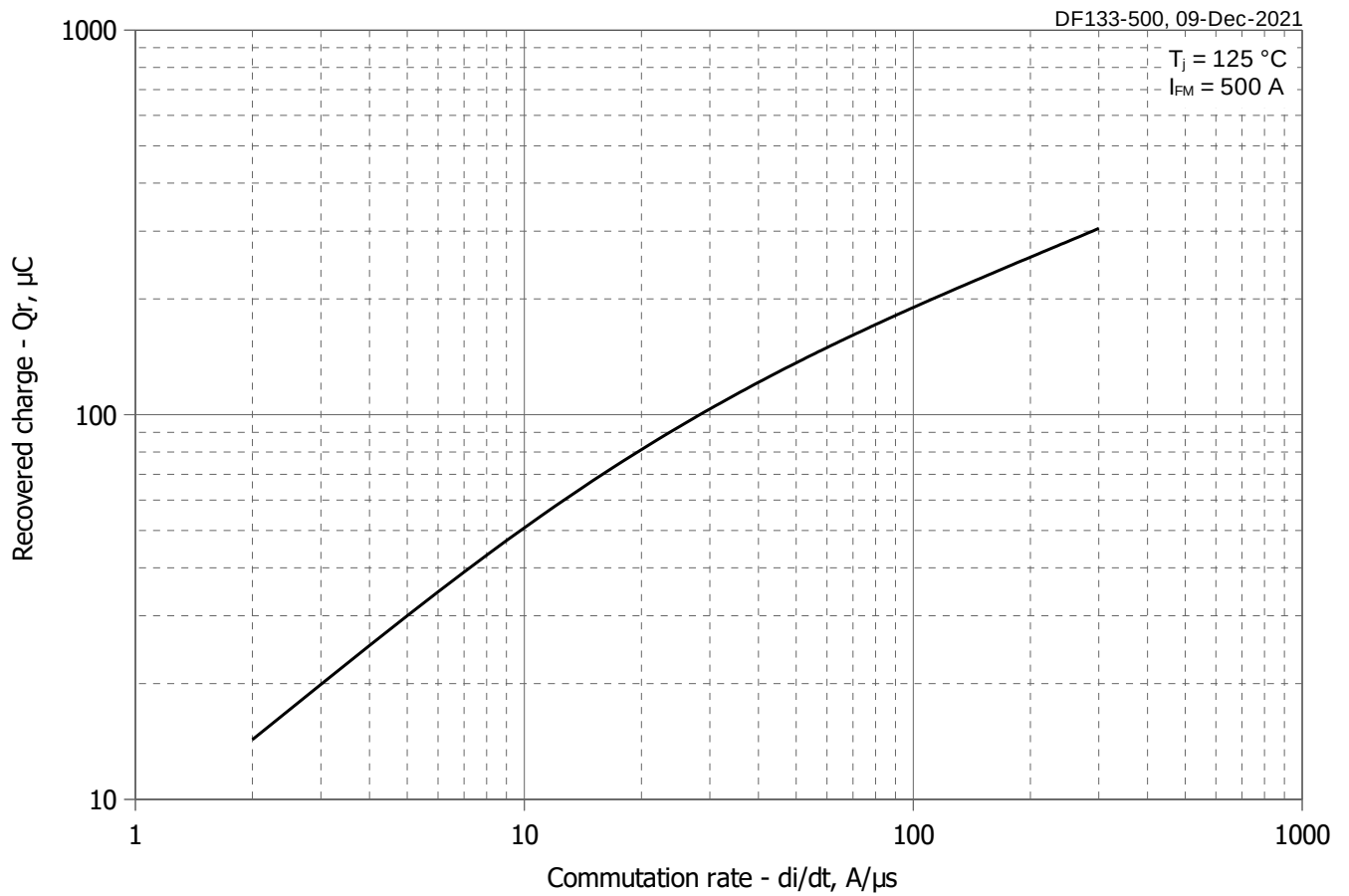


Fig 4 - Maximum recovered charge Q_r vs. commutation rate di_R/dt (50% chord)

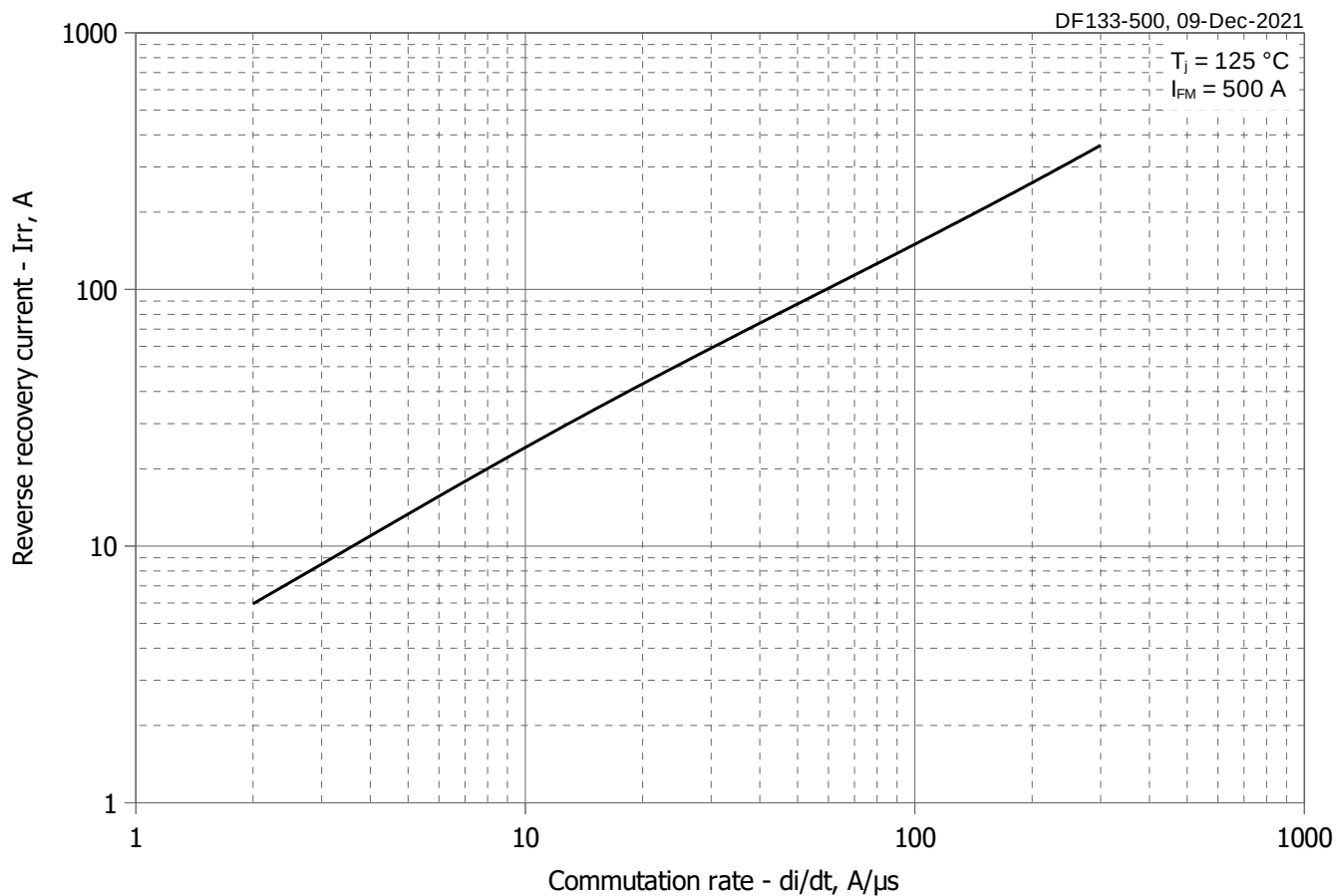


Fig 5 - Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

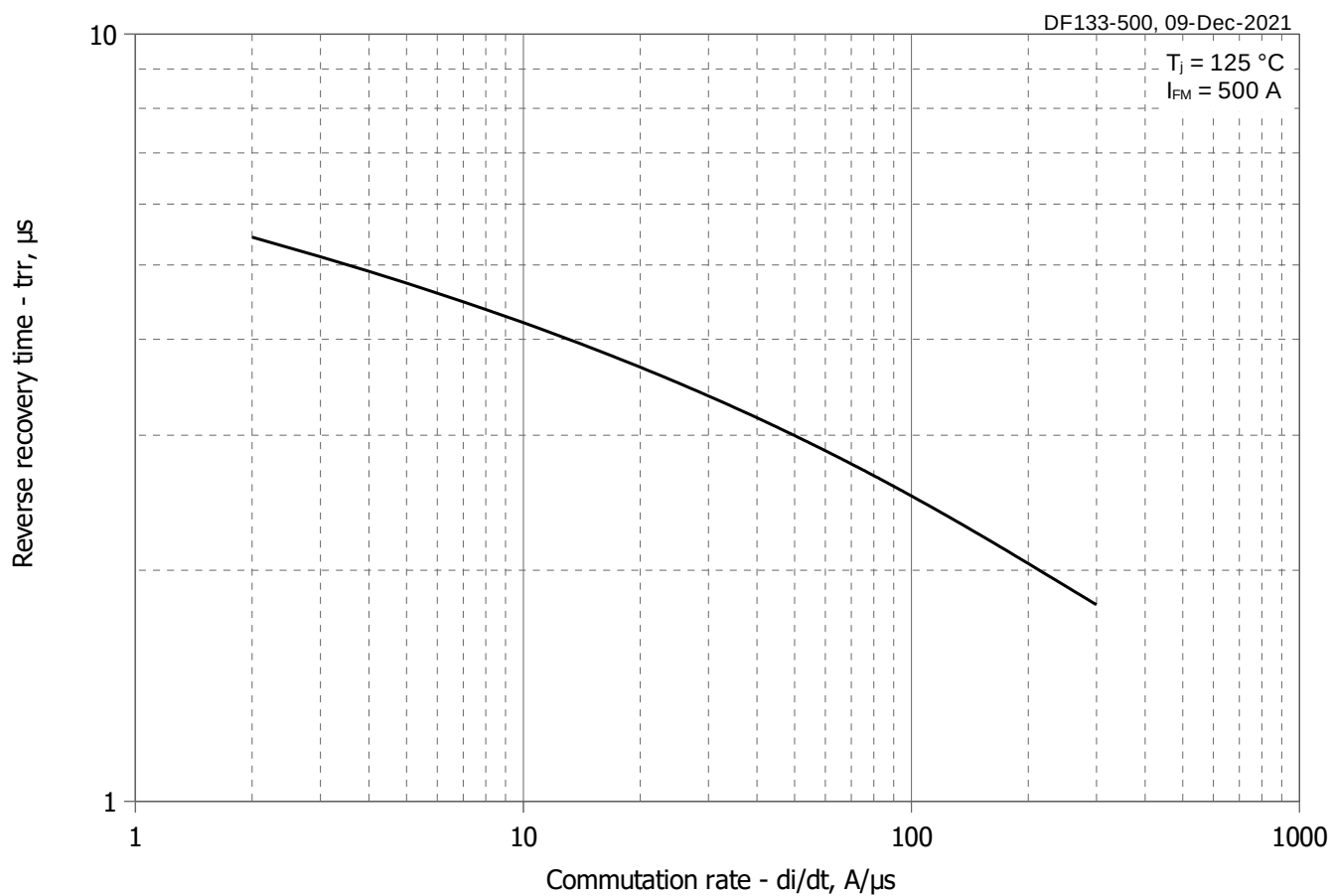


Fig 6 - Maximum recovery time t_{rr} vs. commutation rate di_R/dt (50% chord)

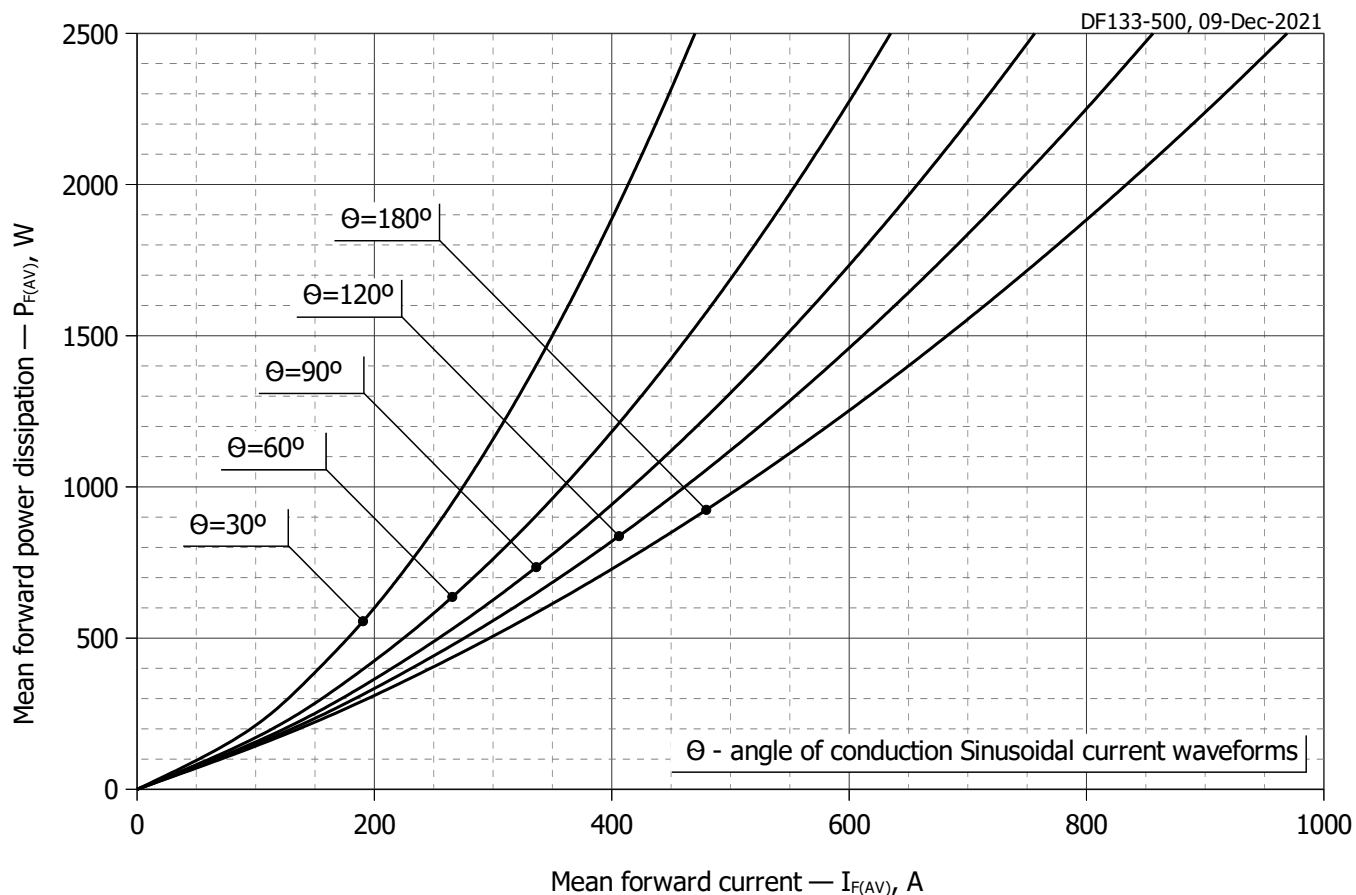


Fig. 7 - Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$, DSC)

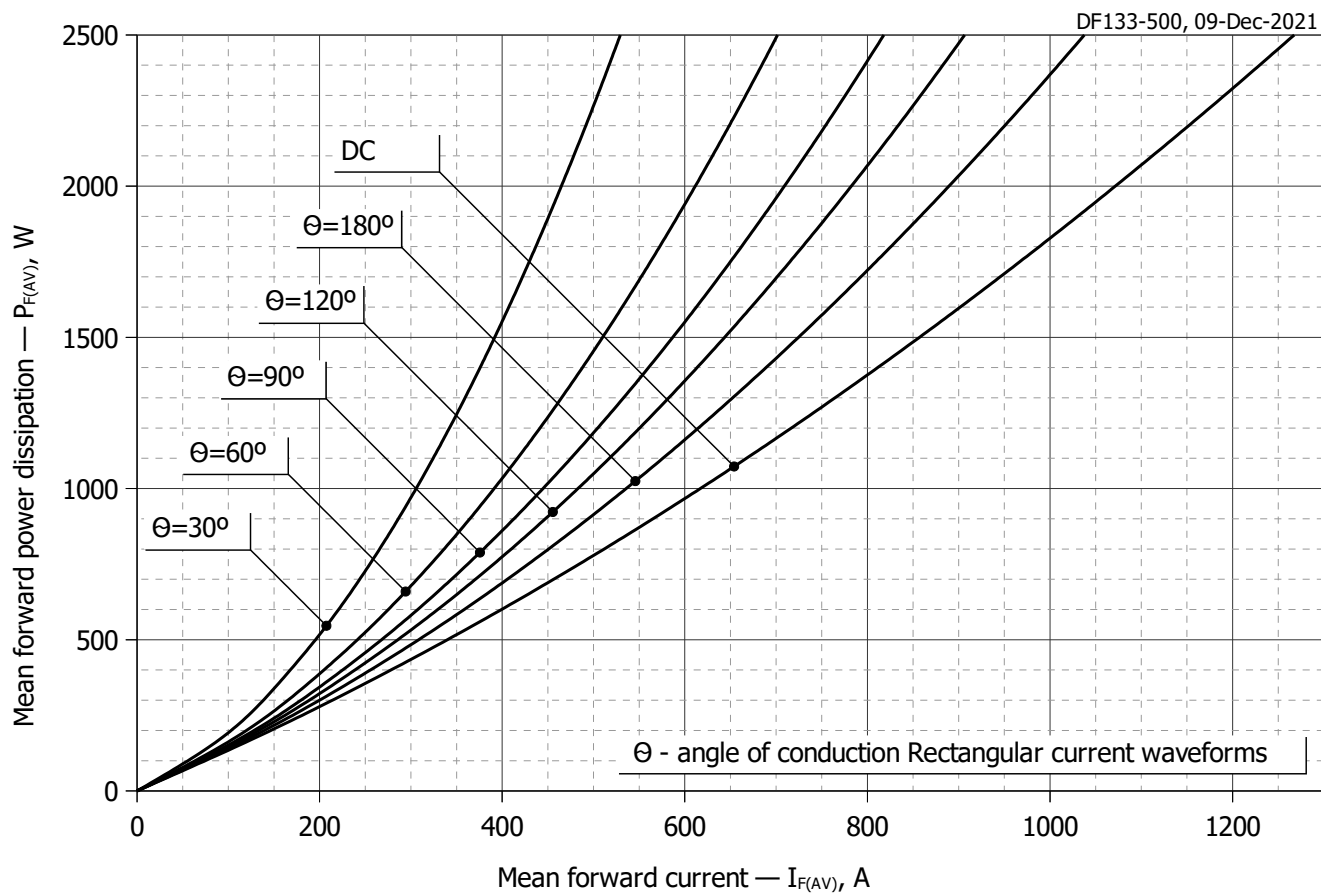


Fig. 8 – Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$, DSC)

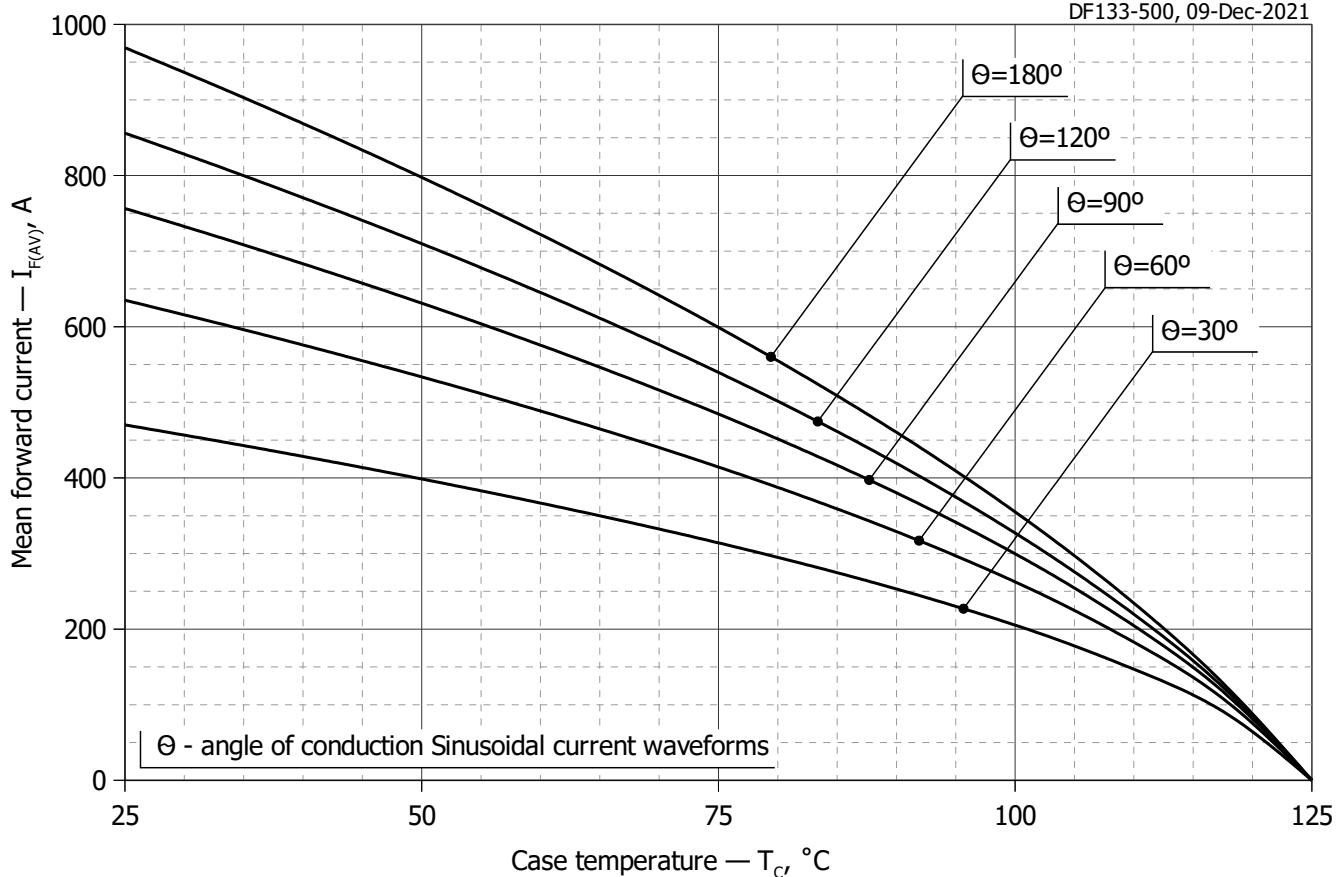


Fig. 9 – Mean forward current I_{FAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$, DSC)

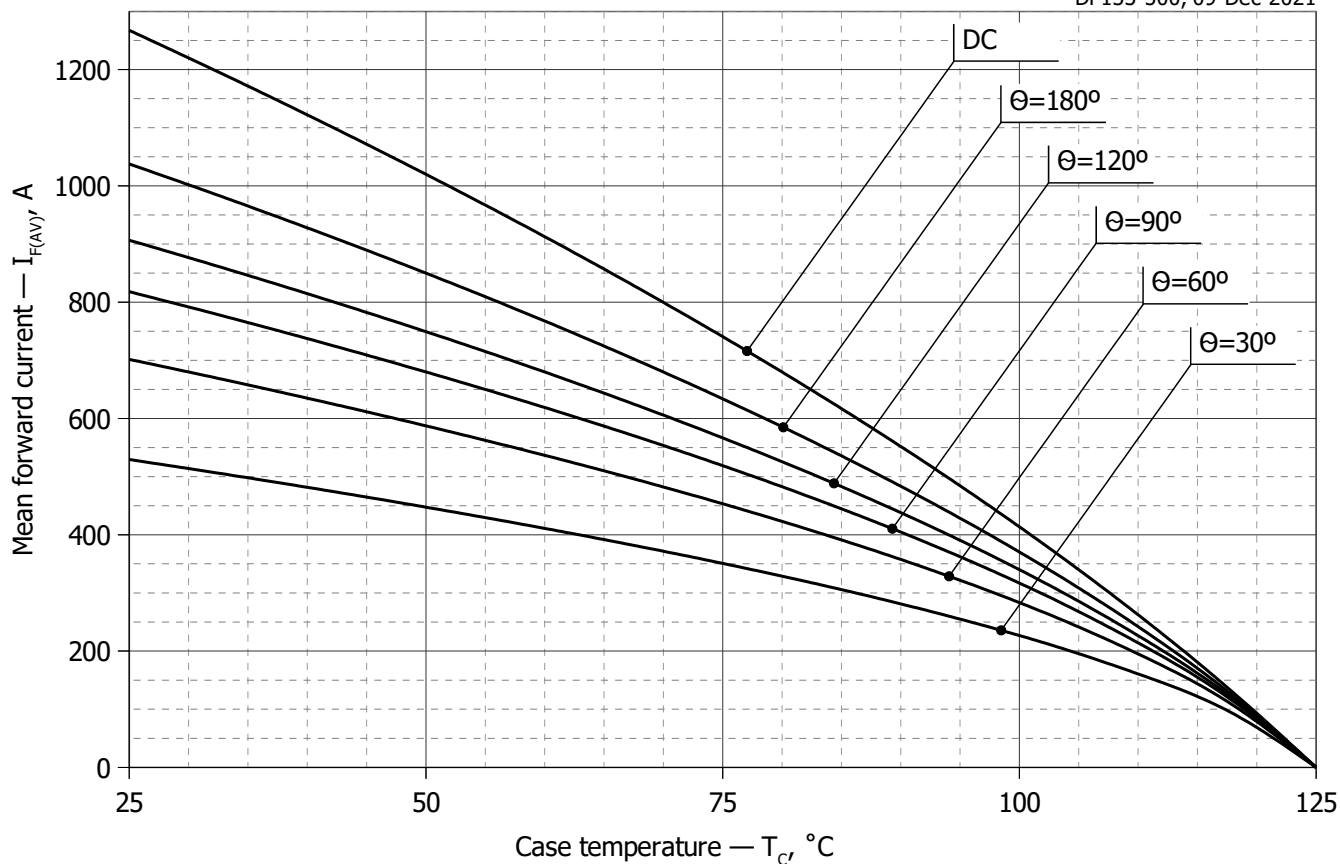


Fig. 10 - Mean forward current I_{FAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$, DSC)

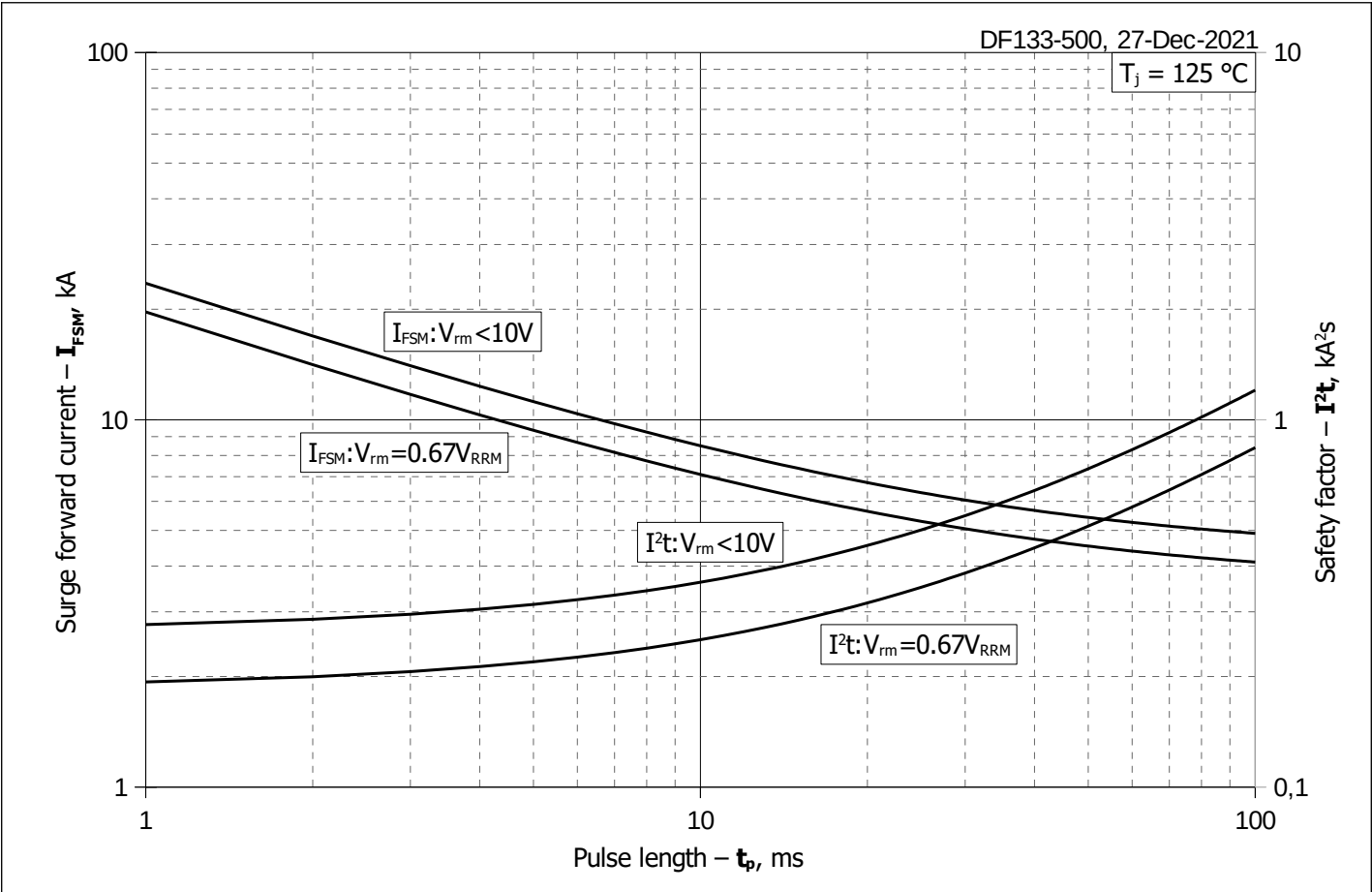


Fig. 11 – Maximum surge forward current I_{FSM} and safety factor I^2t vs. pulse length t_p

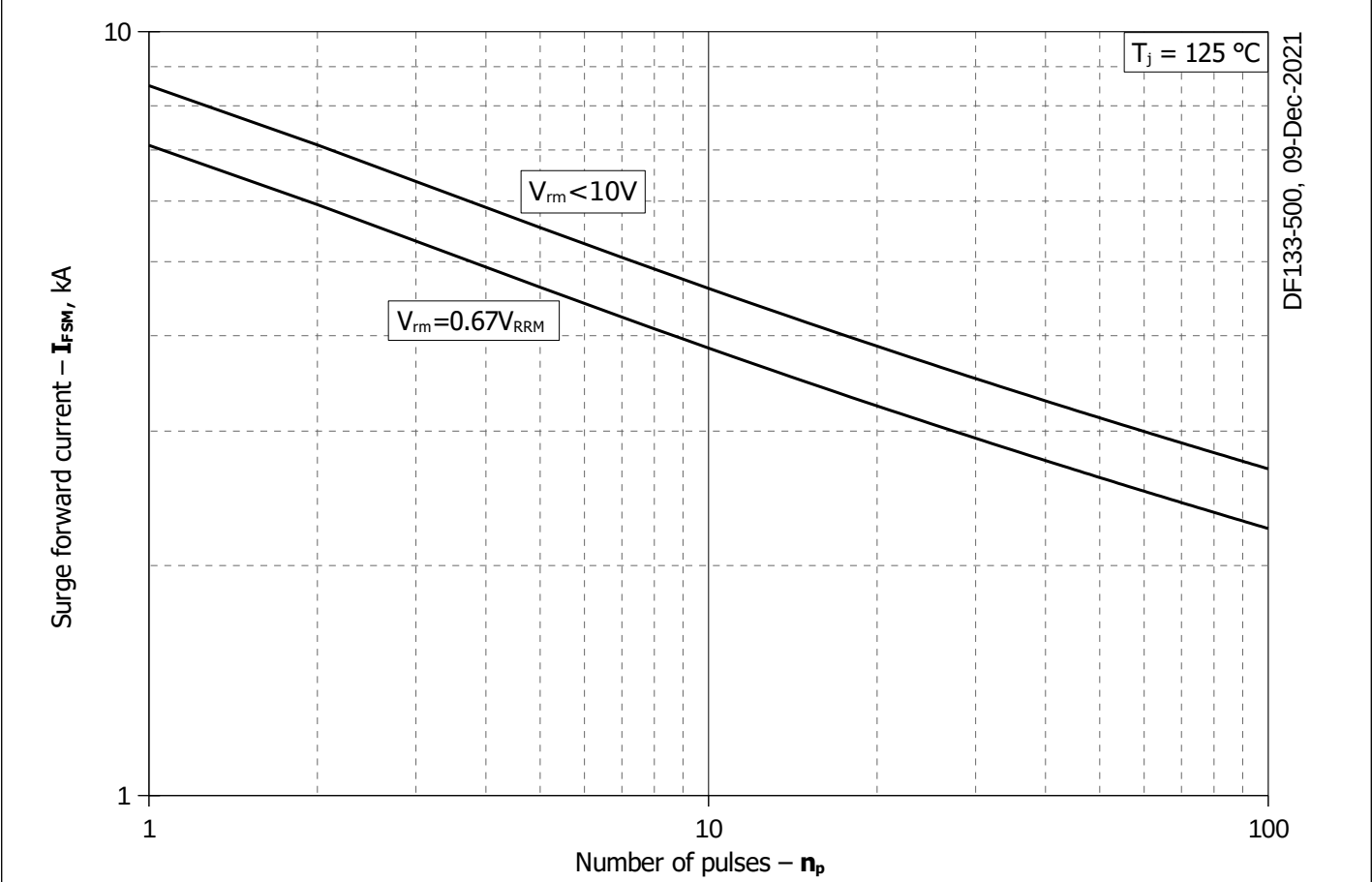


Fig. 12 - Maximum surge forward current I_{FSM} vs. number of pulses n_p