



PROTON-ELECTROTEX RUSSIA

High forward current capability
Low forward losses
Low thermal resistance
High load cycle capability

Rectifier Diode For Welding Type D156-9500-4

Average forward current	I_{FAV}	9500 A
Repetitive peak reverse voltage	V_{RRM}	200...400 V
V_{RRM} , V	200	400
Voltage code	2	4
T_j , °C	-45...+180	

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{FAV}	Average forward current	A	9500 11429 12905	$T_c=118\text{ }^{\circ}\text{C}$; Double side cooled; $T_c=100\text{ }^{\circ}\text{C}$; Double side cooled; $T_c=85\text{ }^{\circ}\text{C}$; Double side cooled; 180° half-sine wave; 50 Hz	
I_{FRMS}	RMS forward current	A	14915	$T_c=118\text{ }^{\circ}\text{C}$; Double side cooled; 180° half-sine wave; 50 Hz	
I_{FSM}	Surge forward current	kA	70.0 84.0	$T_j=T_{j\max}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_R=0\text{ V}$
			74.0 89.0	$T_j=T_{j\max}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_R=0\text{ V}$
I^2t	Safety factor	$A^2s\cdot10^3$	24500 35200	$T_j=T_{j\max}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_R=0\text{ V}$
			22700 32800	$T_j=T_{j\max}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_R=0\text{ V}$
BLOCKING					
V_{RRM}	Repetitive peak reverse voltages	V	200...400	$T_{j\min}<T_j<T_{j\max}$; 180° half-sine wave; 50 Hz	
V_{RSM}	Non-repetitive peak reverse voltages	V	300...500	$T_{j\min}<T_j<T_{j\max}$; 180° half-sine wave; single pulse	
V_R	Reverse continuous voltages	V	$0.6\cdot V_{RRM}$	$T_j=T_{j\max}$	
THERMAL					
T_{stg}	Storage temperature	$^{\circ}\text{C}$	-45...+40		
T_j	Operating junction temperature	$^{\circ}\text{C}$	-45...+180		
MECHANICAL					
F	Mounting force	kN	30.0...50.0		
a	Acceleration	m/s^2	50	Device clamped	

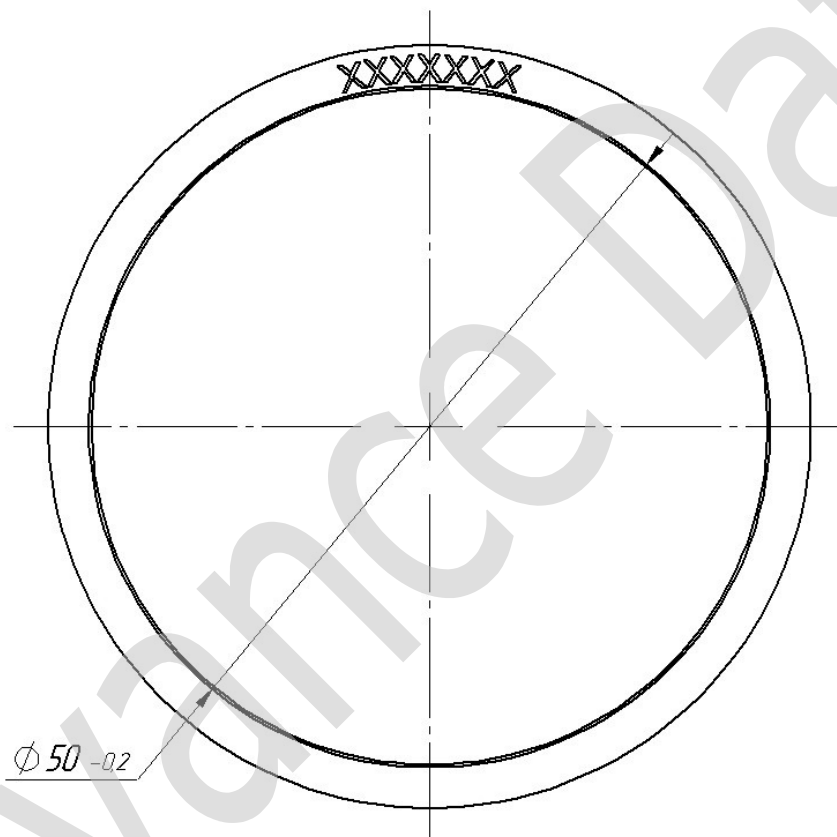
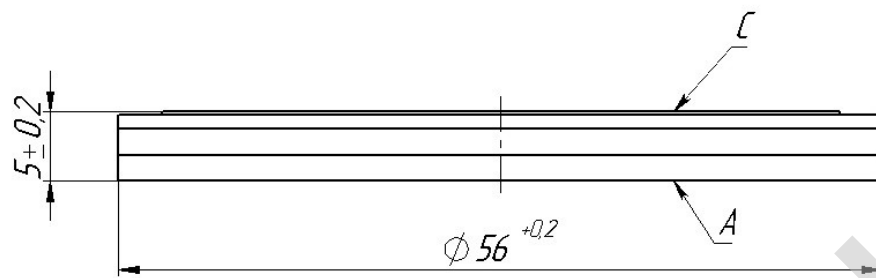
CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V _{FM}	Peak forward voltage, max	V	1.08 0.98	T _j =25 °C; I _{FM} = 6300 A T _j =T _{j max} ; I _{FM} = 8000 A	
V _{F(TO)}	Forward threshold voltage, max	V	0.84 0.80	T _j =T _{j max}	14900 A < I _T < 44700 A 10000 A < I _T < 30000 A
r _T	Forward slope resistance, max	mΩ	0.020 0.022		14900 A < I _T < 44700 A 10000 A < I _T < 30000 A
BLOCKING					
I _{RRM}	Repetitive peak reverse current, max	mA	50	T _j =T _{j max} ; V _R =V _{RRM}	
SWITCHING					
Q _{rr}	Total recovered charge, max	μC	1150 720	T _j =T _{j max} ; I _{FM} =1000 A; dI _{FM} /dt=-30 A/μS; T _j =T _{j max} ; I _{FM} =1000 A; dI _{FM} /dt=-10 A/μS;	
THERMAL					
R _{thjc}	Thermal resistance, junction to case, max	°C/W	0.0050	Direct Current	Double side cooled
R _{thjc-A}			0.0066		Anode side cooled
R _{thjc-K}			0.0200		Cathode side cooled
R _{thck}	Thermal resistance, case to heatsink, max		0.0035	Direct Current	
MECHANICAL					
m	Weight, max	g	110		
D _s	Surface creepage distance	mm (inch)	2.00 (0.079)		
D _a	Air strike distance	mm (inch)	2.00 (0.079)		

PART NUMBERING GUIDE

D	156	9500	4	N
1	2	3	4	

1. Design version
2. Average forward current, A
3. Voltage code
4. Ambient conditions: N – normal



All dimensions in millimeters

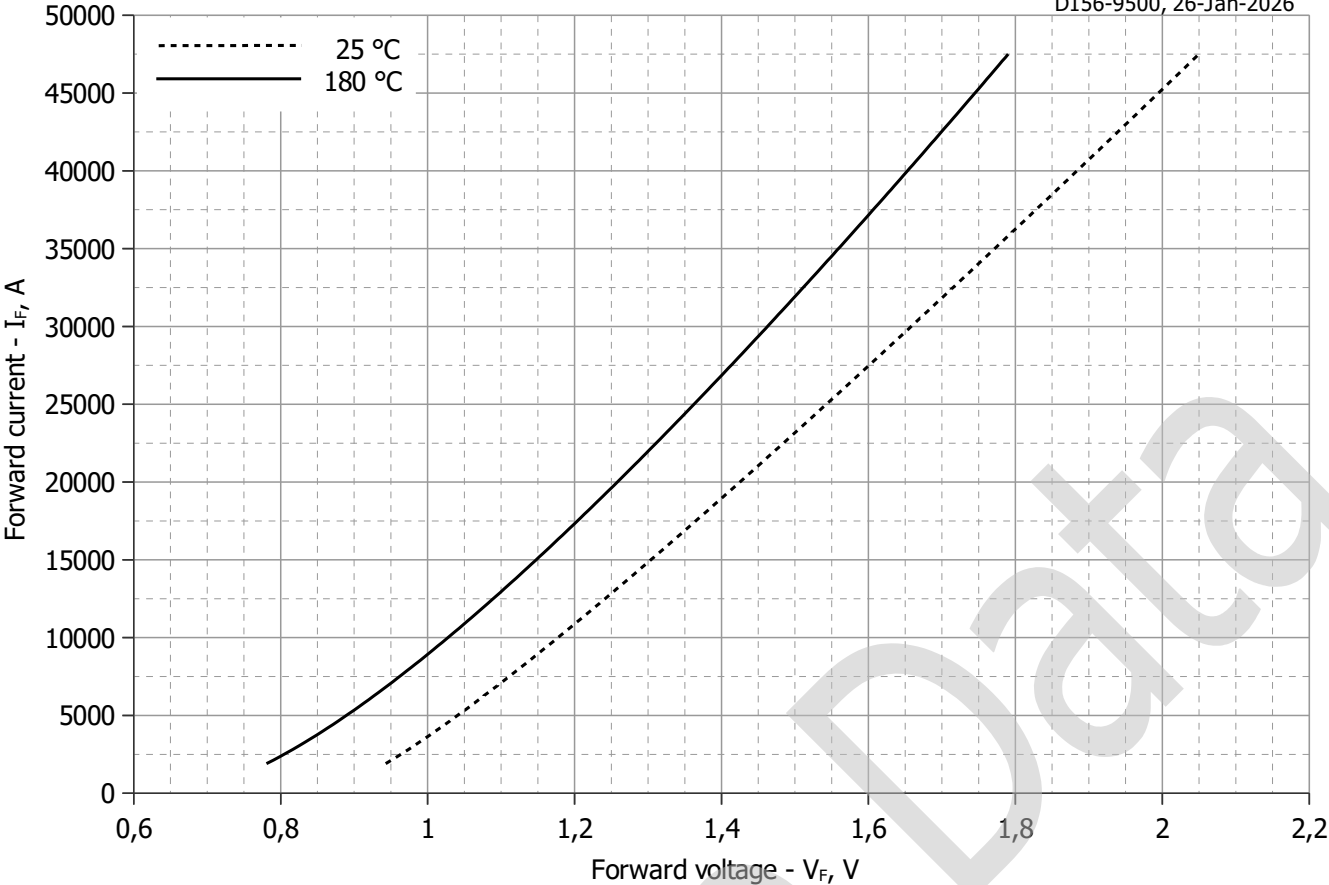


Fig 1 – Forward characteristics of Limit device

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	0.84946283	0.67131348
B	0.00001848	0.00001151
C	-0.00115320	-0.00499173
D	0.00153712	0.00287089

Forward characteristic model (see Fig. 1).

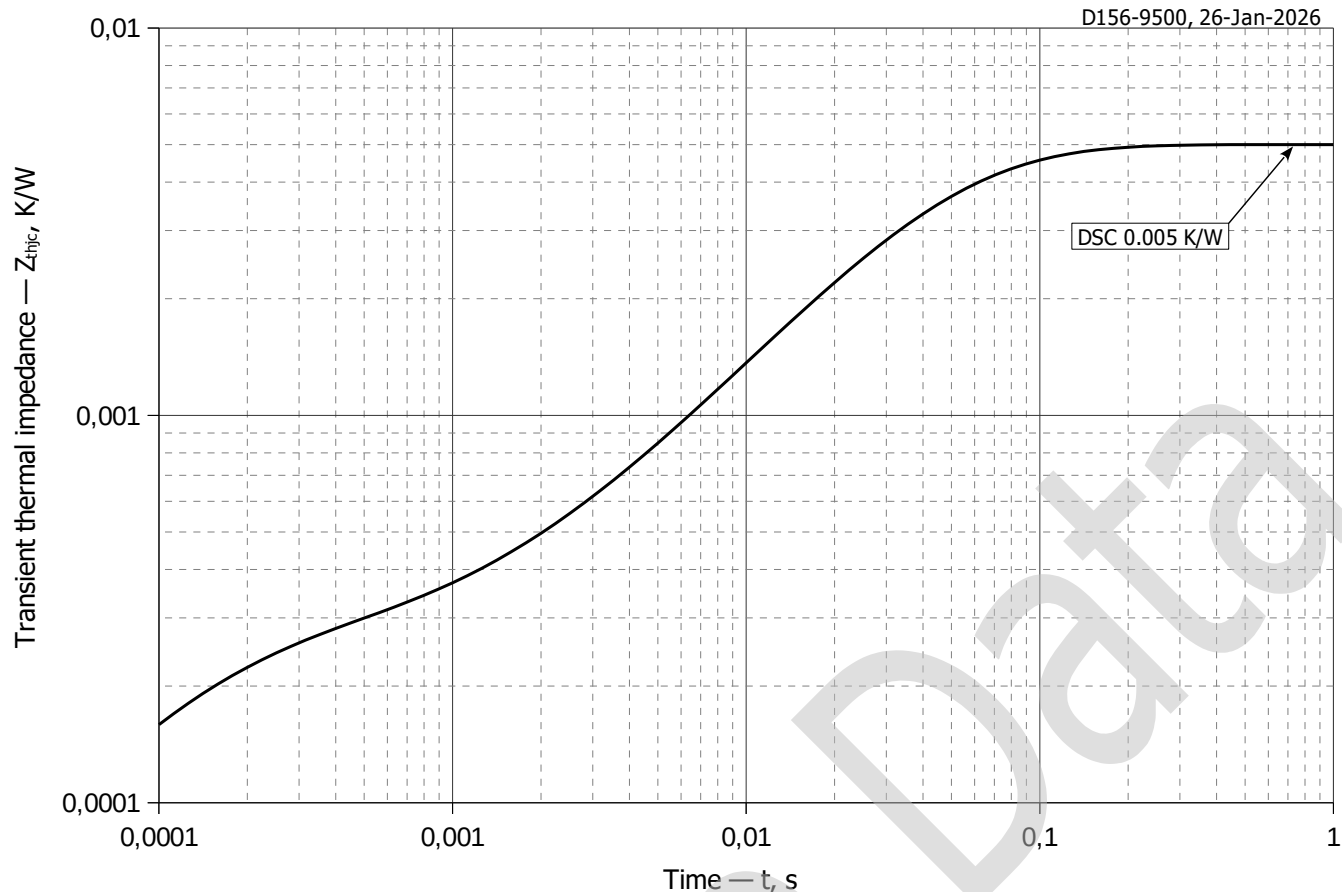


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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	0.0009858	0.003751	0.00001625	0.00001224	0.0001735	0.00006128
τ_i , s	0.07476	0.03287	0.007701	0.001065	0.0001313	0.00005139

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



Fig 3 - Maximum recovered charge Q_{rr} vs. commutation rate di_r/dt (25% chord)

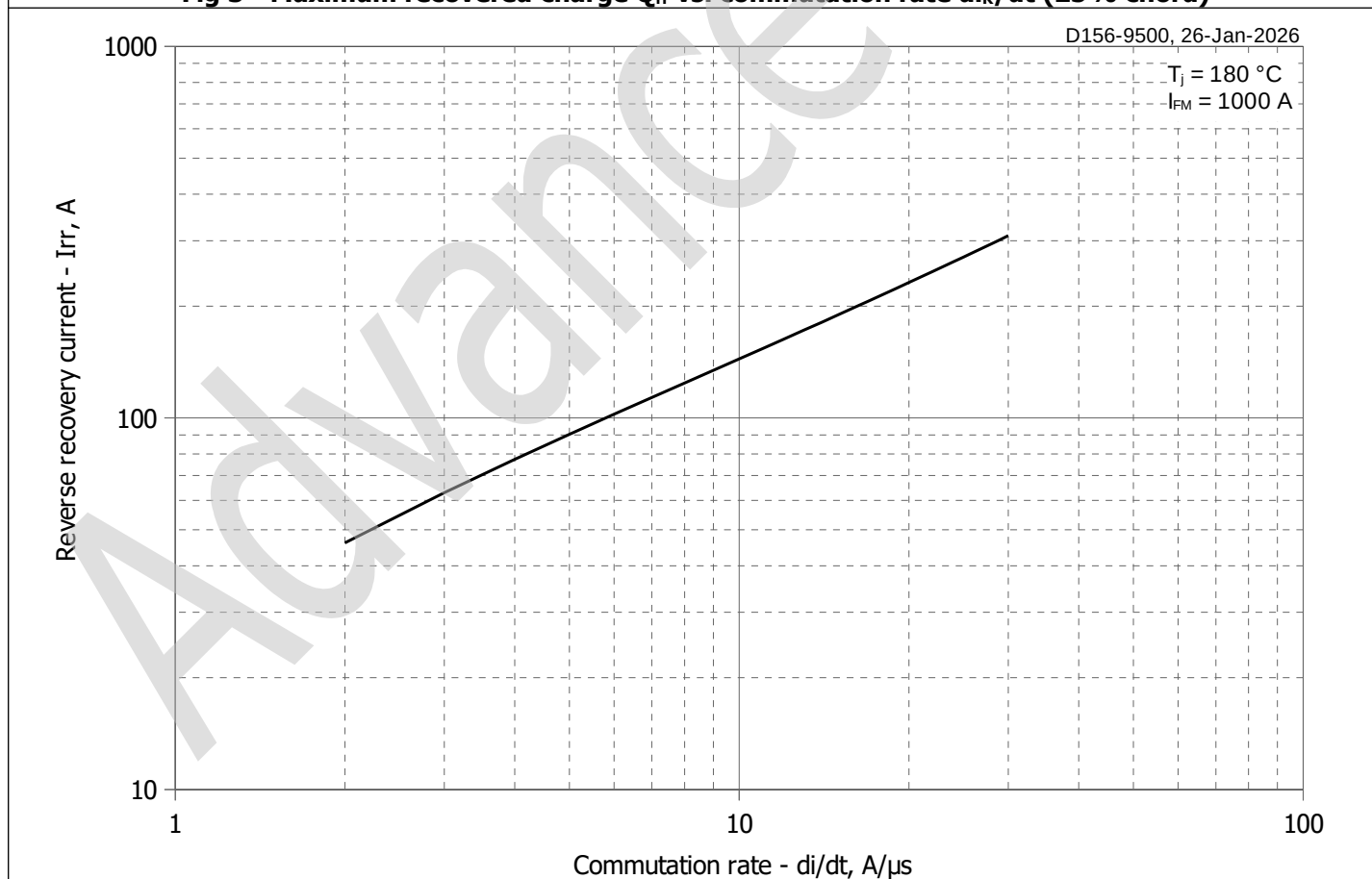


Fig 4 – Maximum reverse recovery current I_{rr} vs. commutation rate di_r/dt

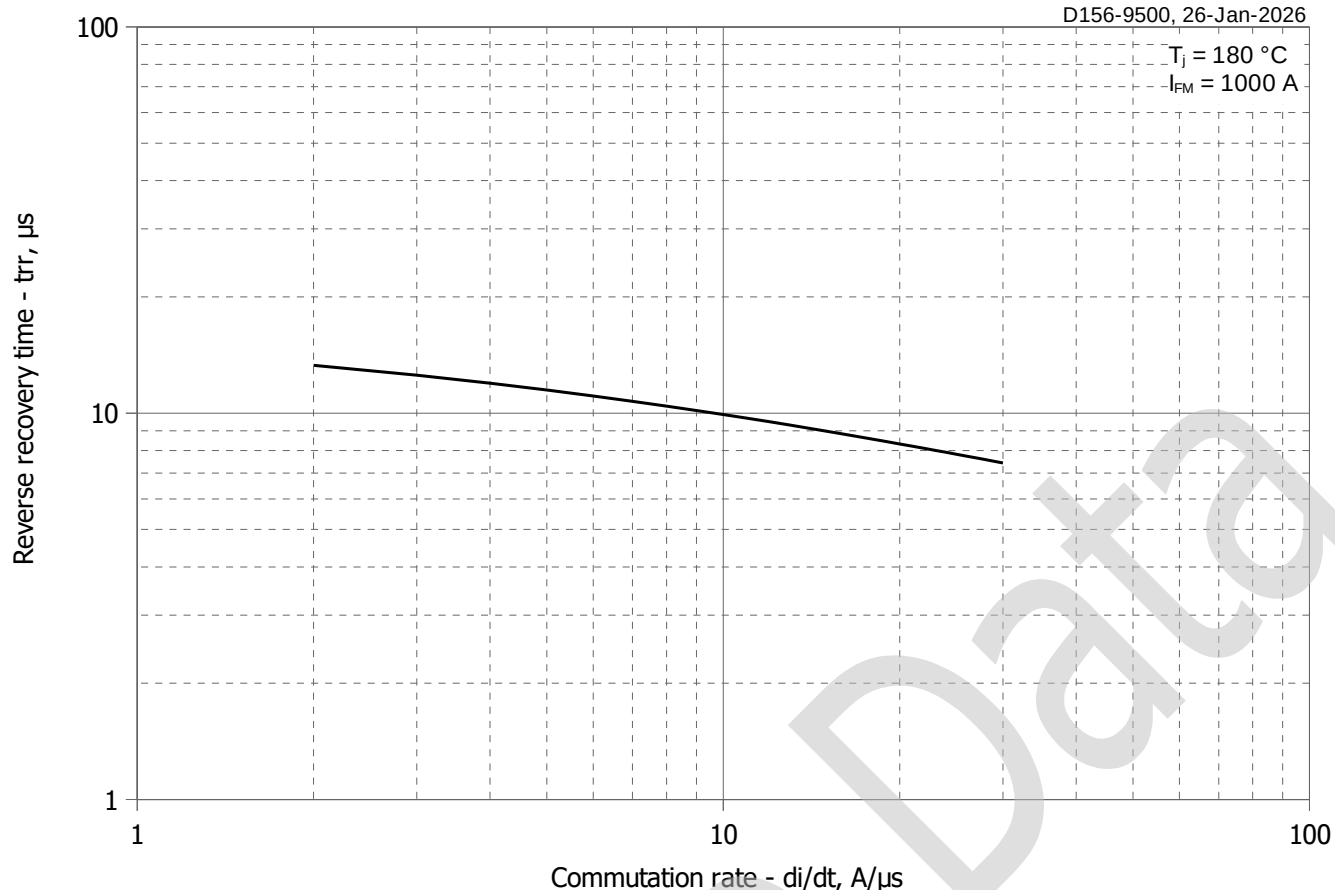
$T_j = 180\text{ }^{\circ}\text{C}$
 $I_{FM} = 1000\text{ A}$


Fig 5 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

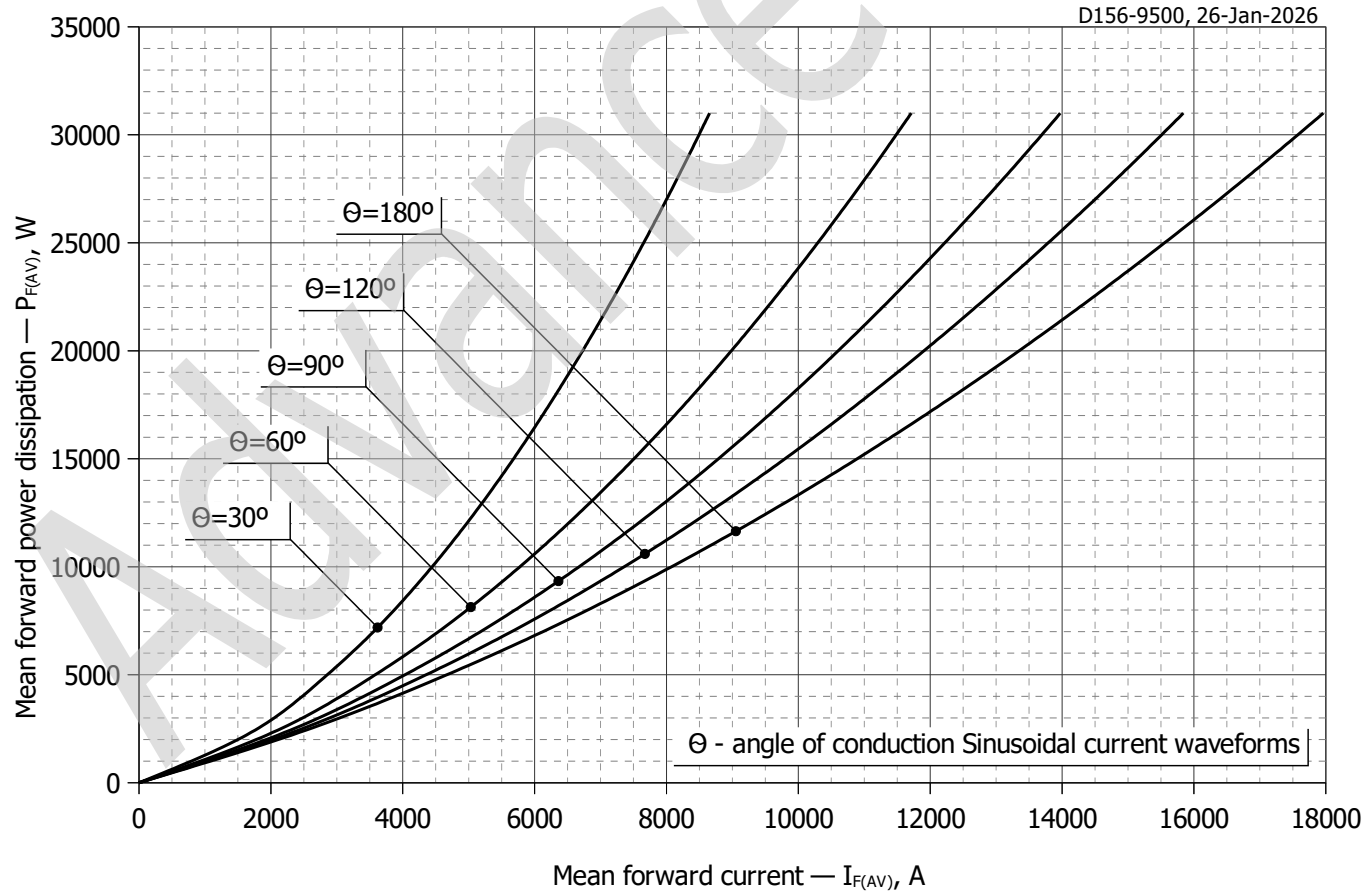


Fig 6 – Mean forward power dissipation P_{FAV} vs. Mean forward current I_{FAV} for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$, DSC)

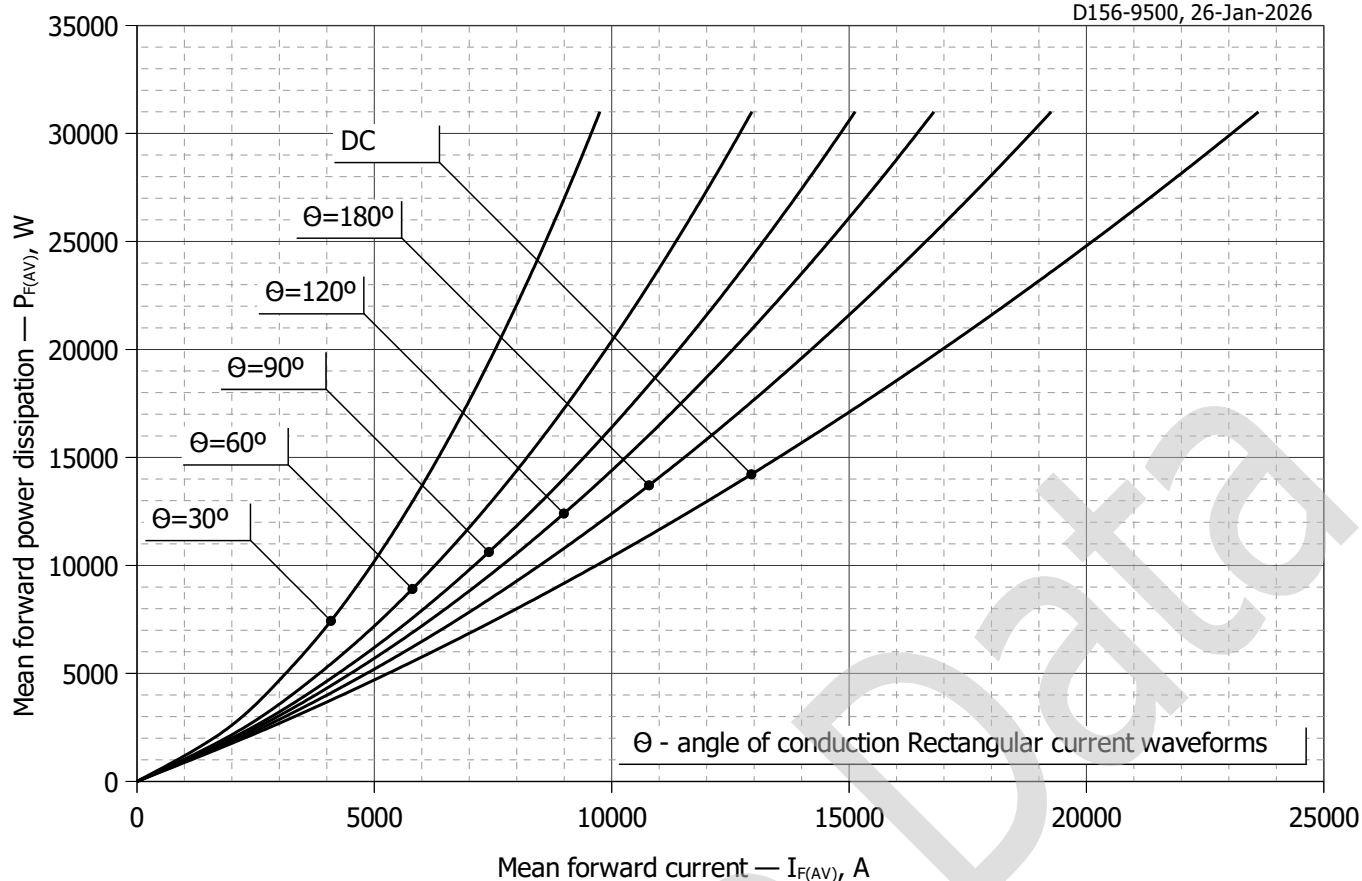


Fig 7 – Mean forward power dissipation P_{FAV} vs. Mean forward current I_{FAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

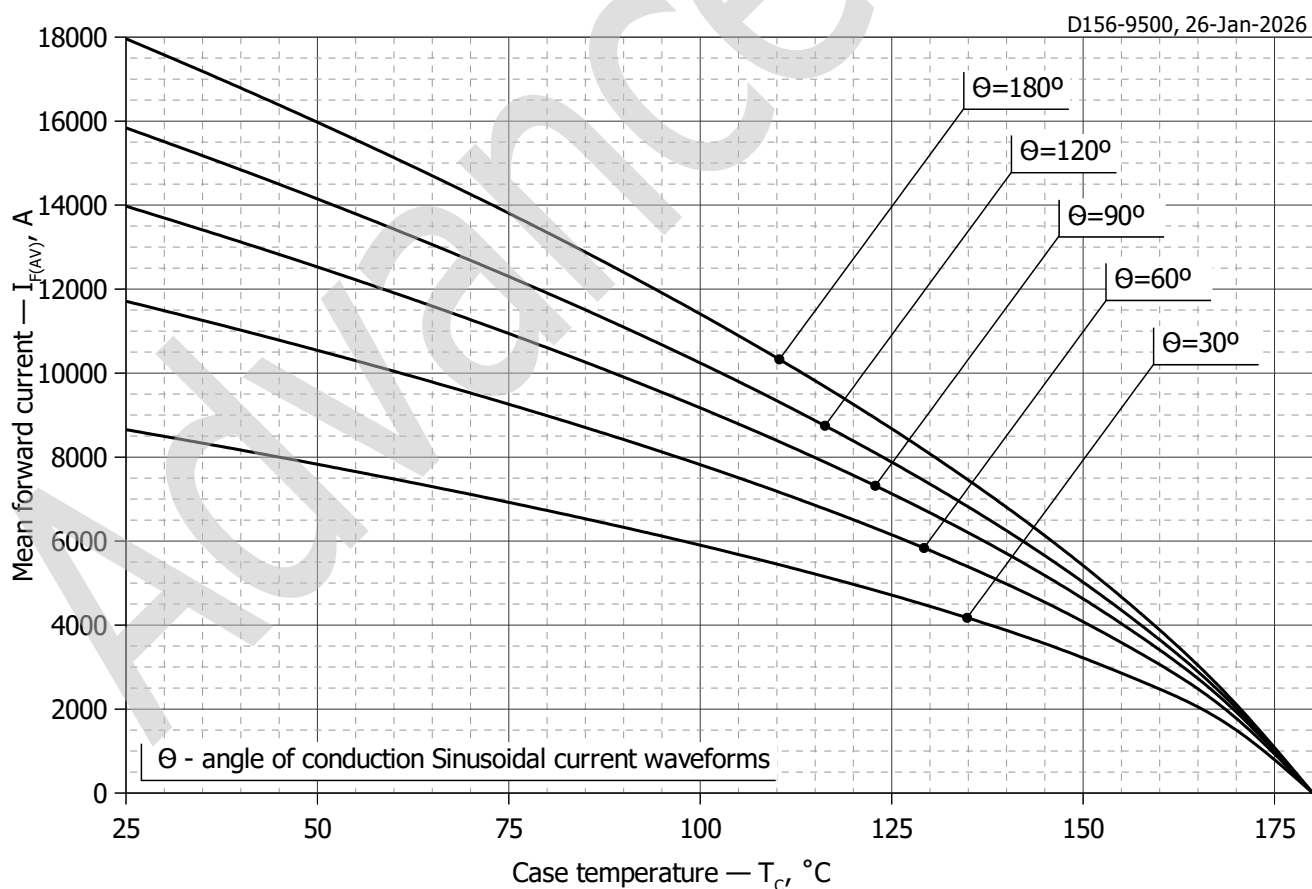


Fig 8 - Mean forward current I_{FAV} vs. Case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

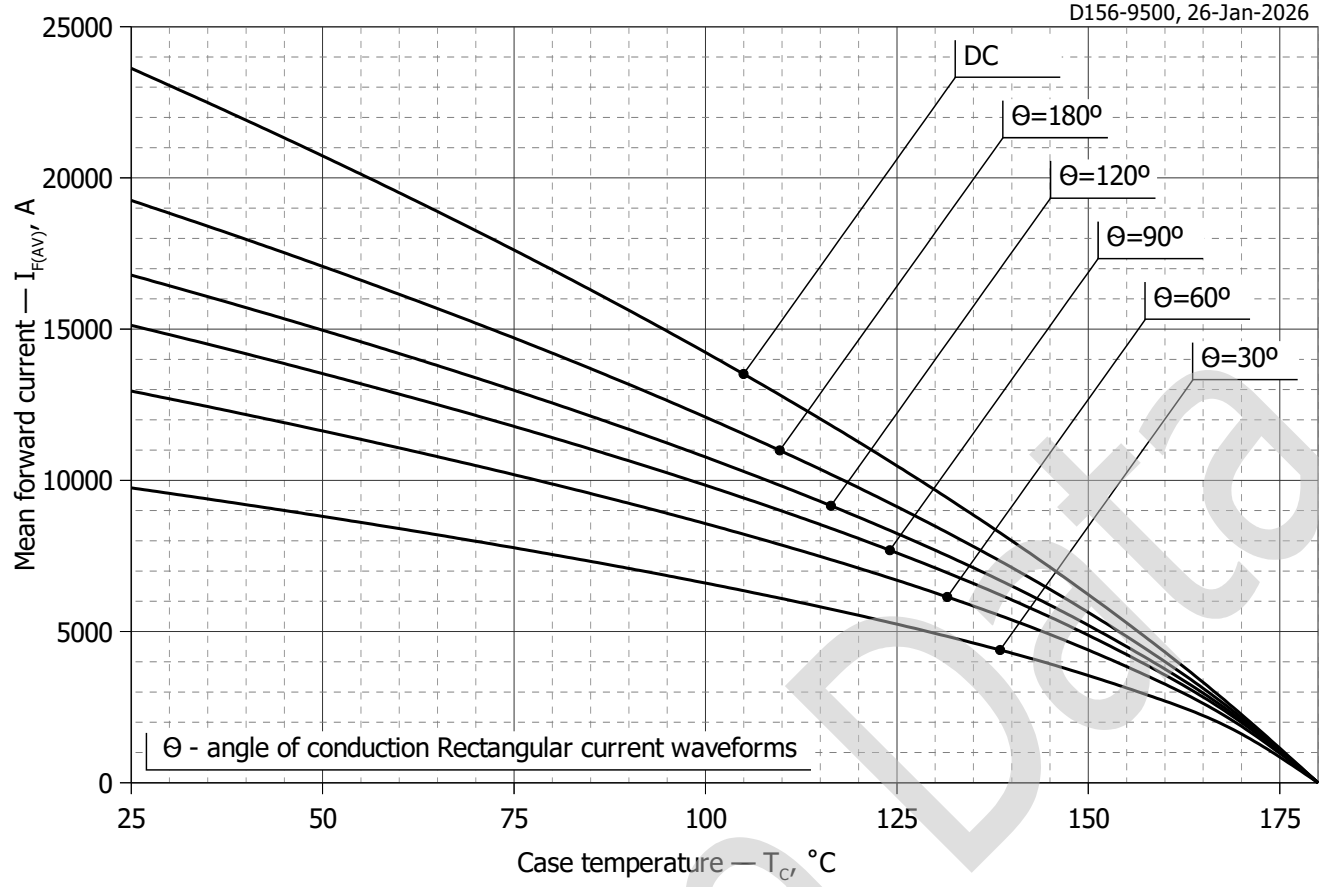


Fig 9 – Mean forward current I_{FAV} vs. Case temperature T_C for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$, DSC)

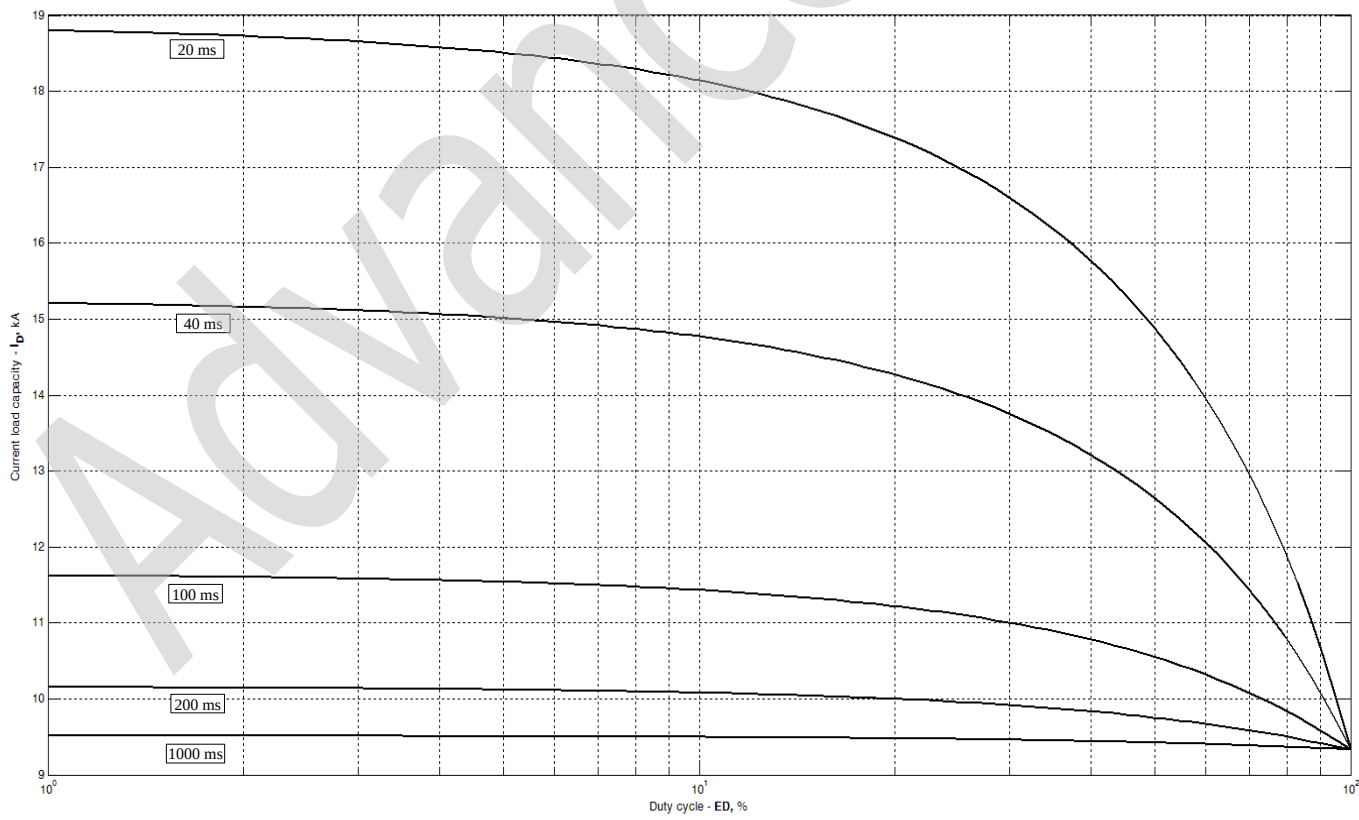


Fig 10 – Current load capability ($f=1000\text{ Hz}$, square wave, $\Delta T_j = 40\text{ °C}$)

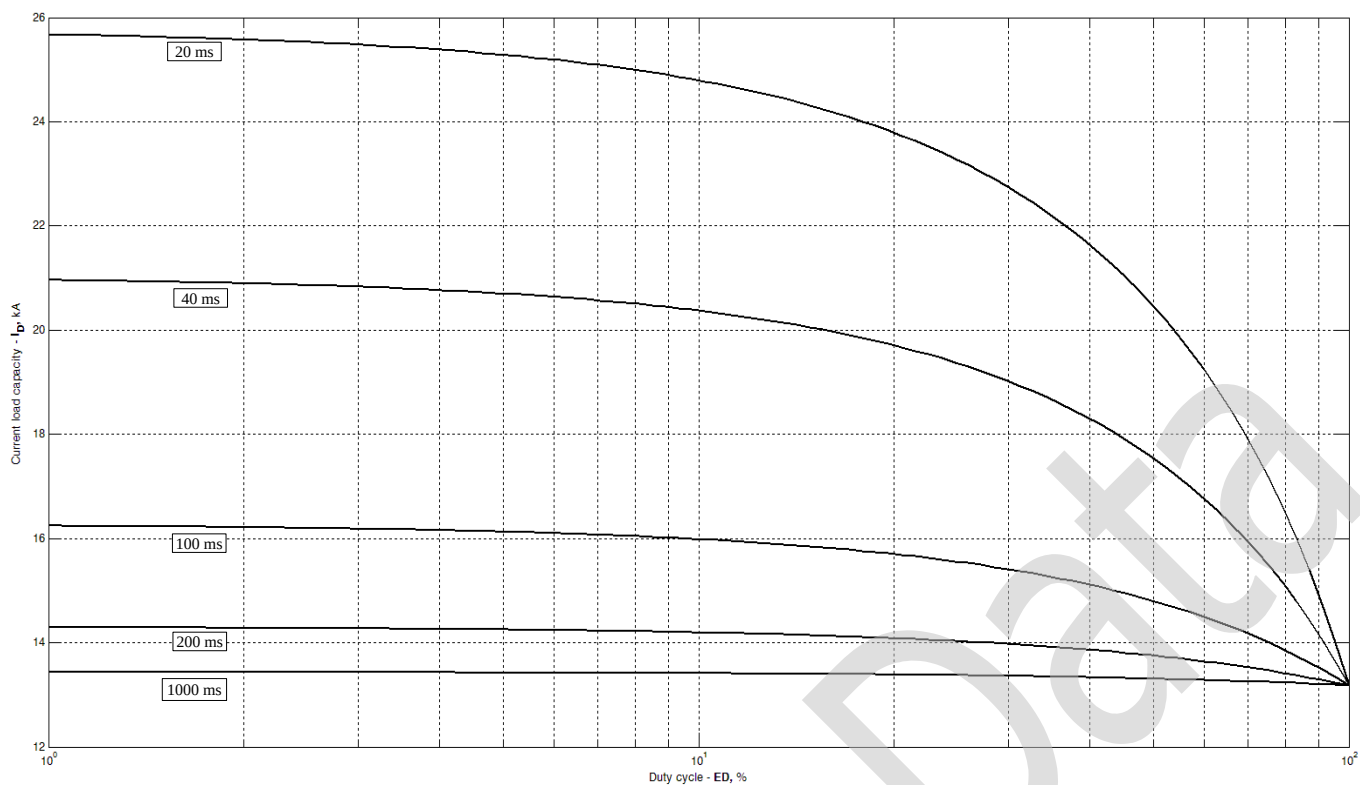


Fig 11 – Current load capability (f=1000 Hz, square wave, $\Delta T_j = 60^\circ\text{C}$)

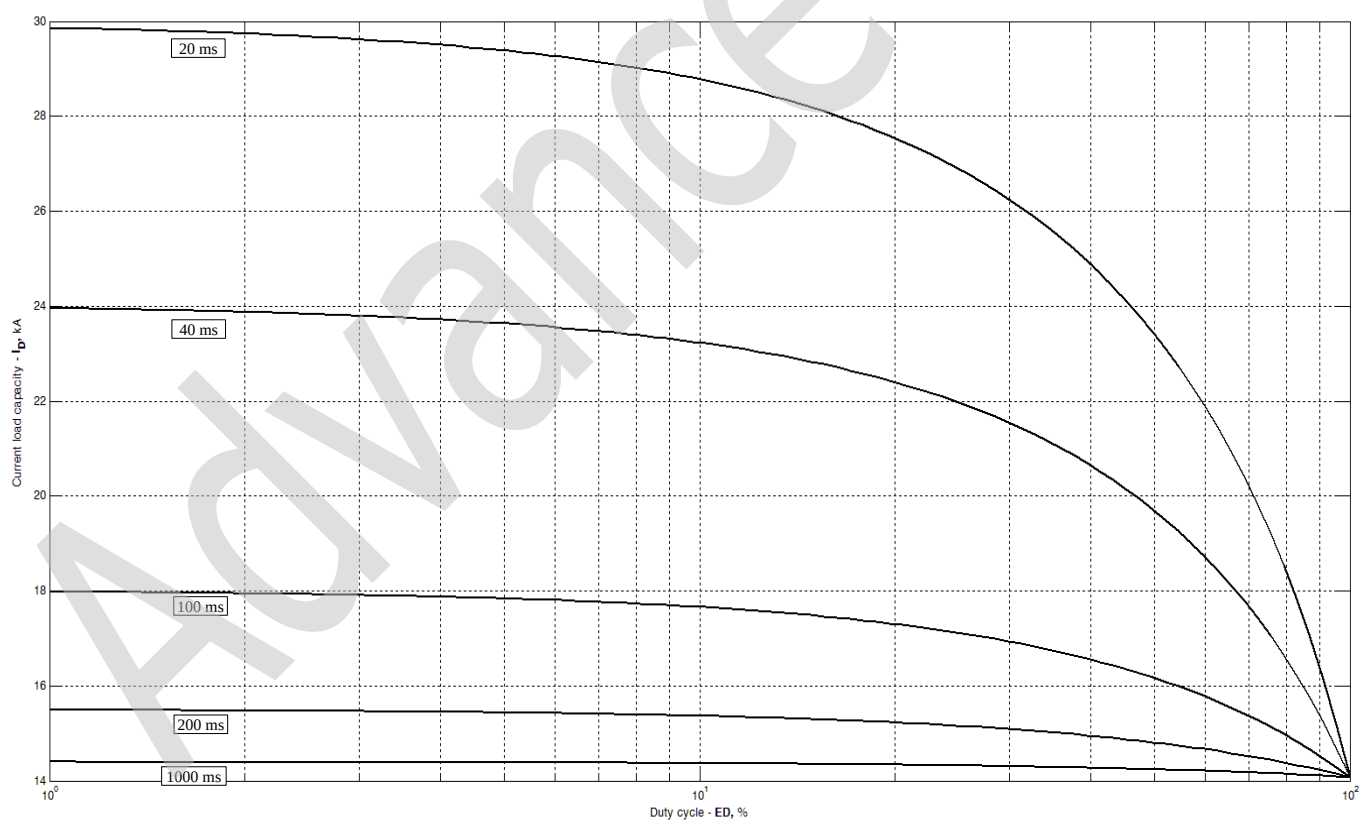


Fig 12 – Current load capability (f=1000 Hz, square wave, $\Delta T_j = 70^\circ\text{C}$)

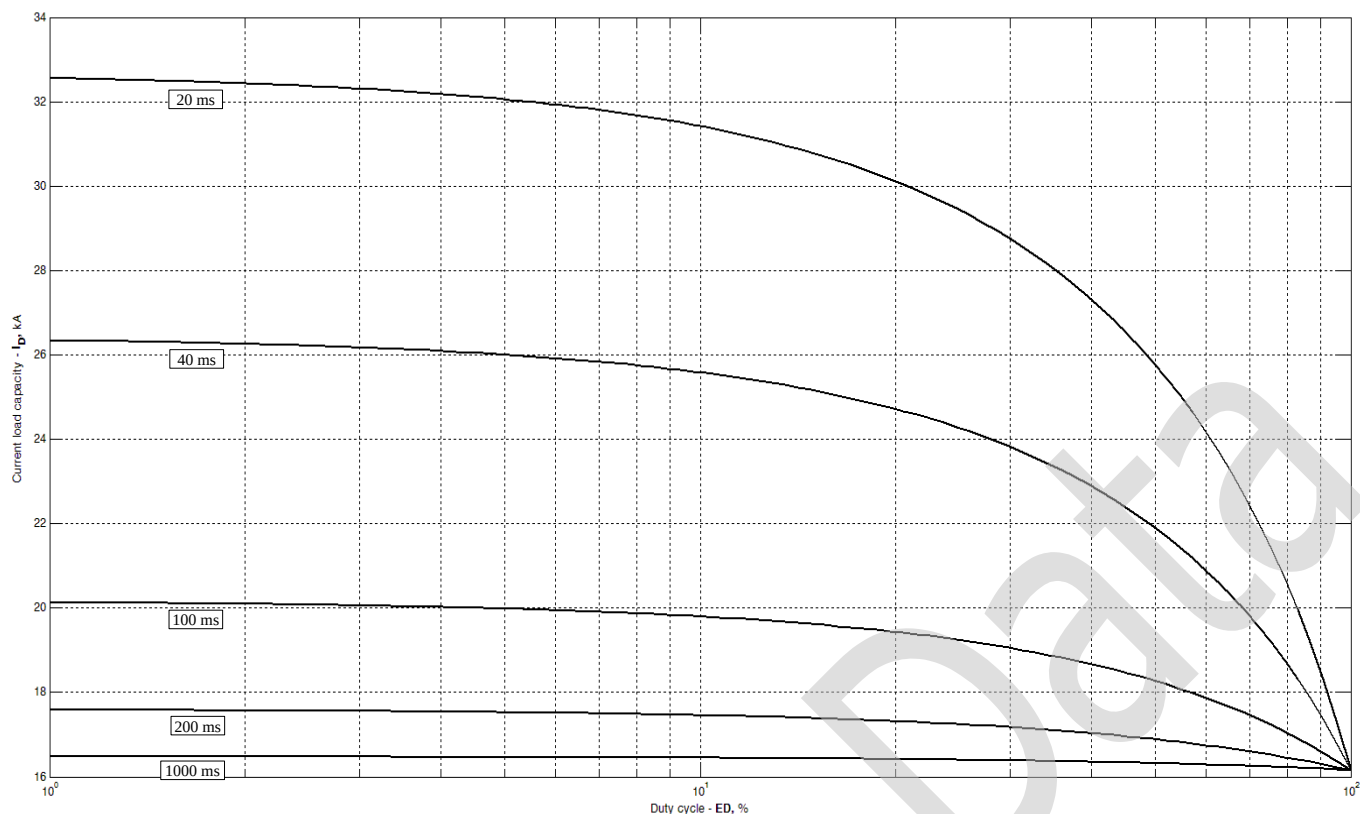


Fig 13 – Current load capability (f=1000 Hz, square wave, $\Delta T_j = 80\text{ °C}$)

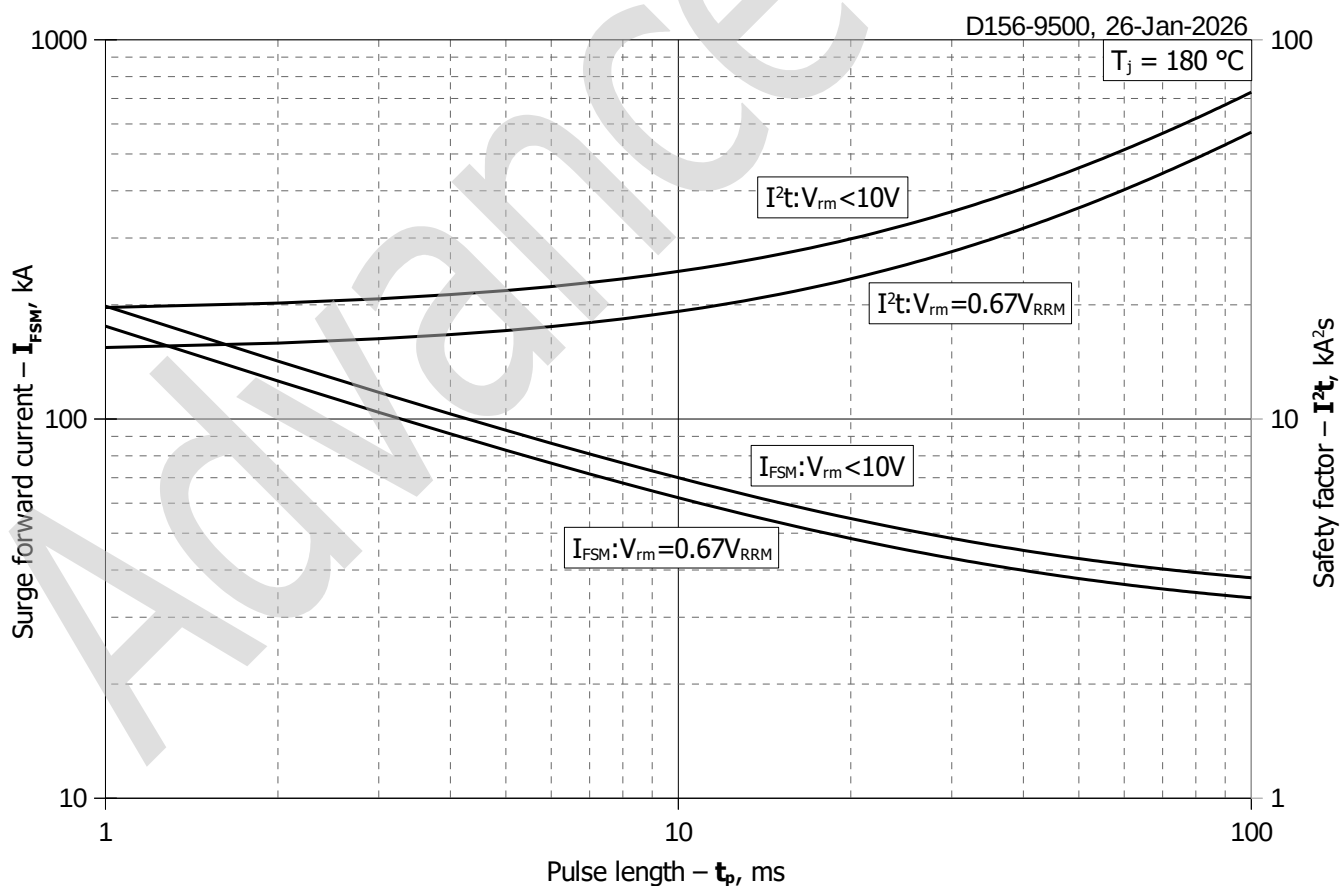


Fig 14 – Maximum surge and I^2t ratings

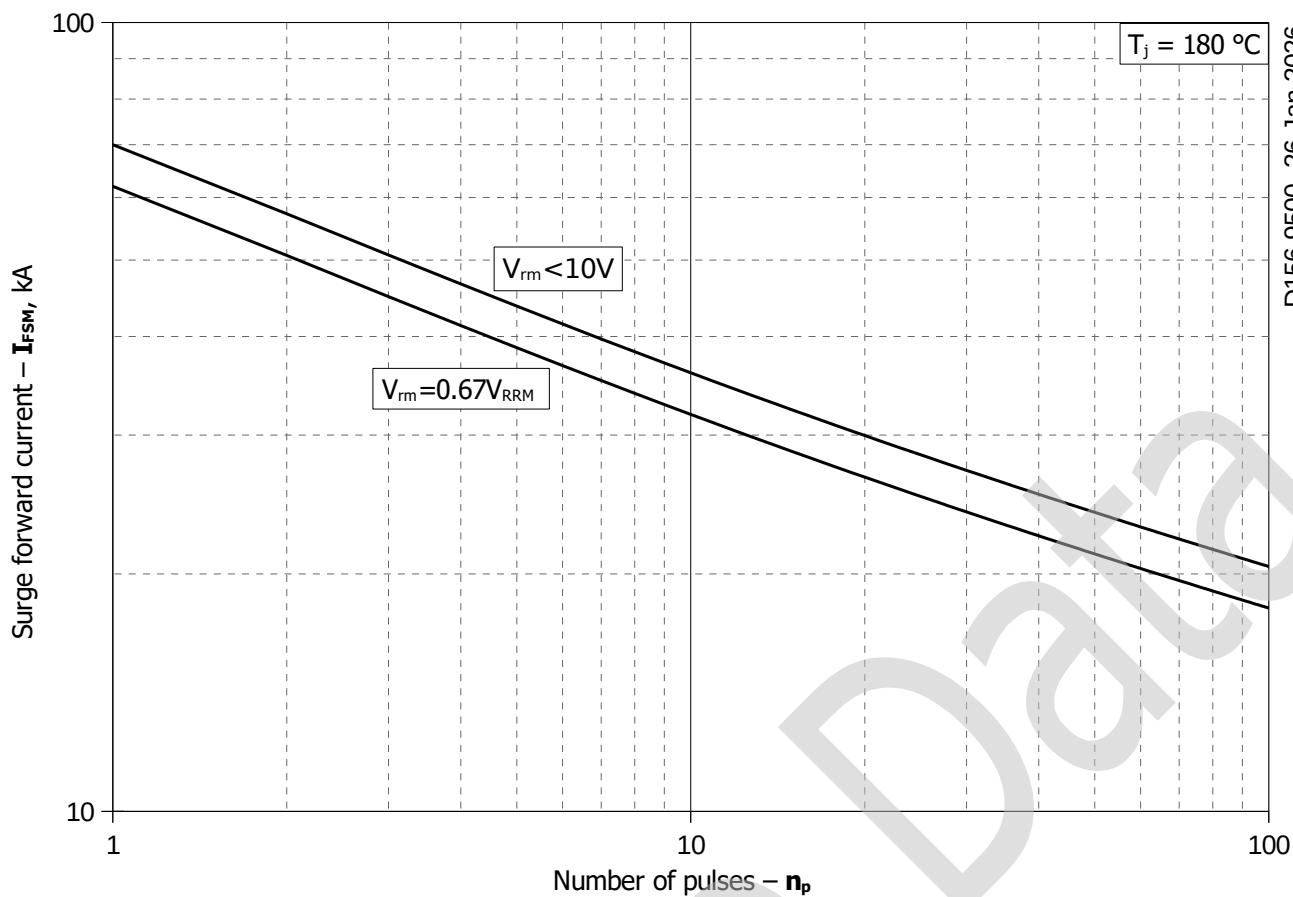


Fig 15 – Maximum surge ratings

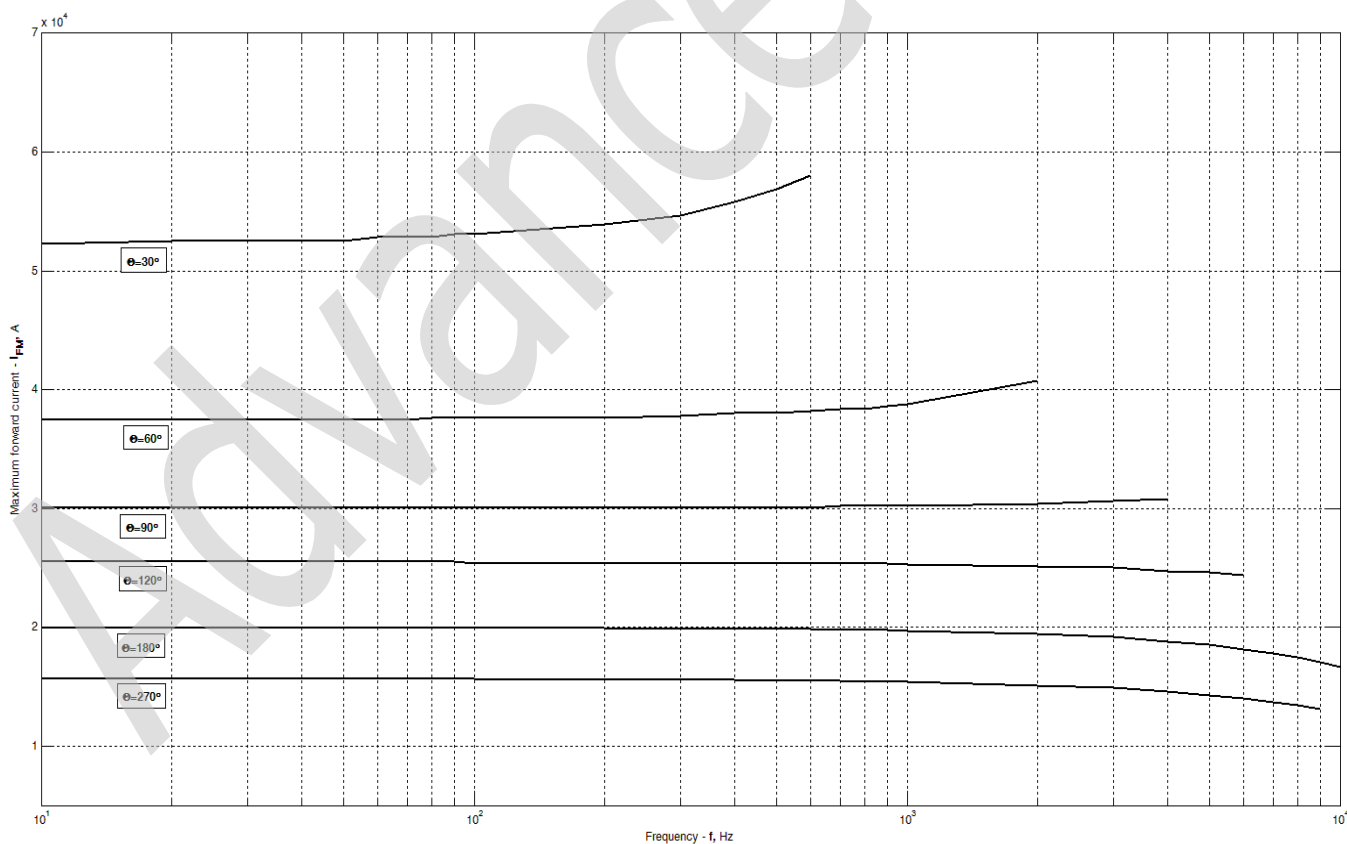


Fig 16 –Maximum forward current vs. frequency, trapezoid waveform,
 $T_c=85\text{ }^{\circ}\text{C}$, $di_F/dt=\pm 500\text{ A}/\mu\text{s}$, $V_R=100\text{ V}$

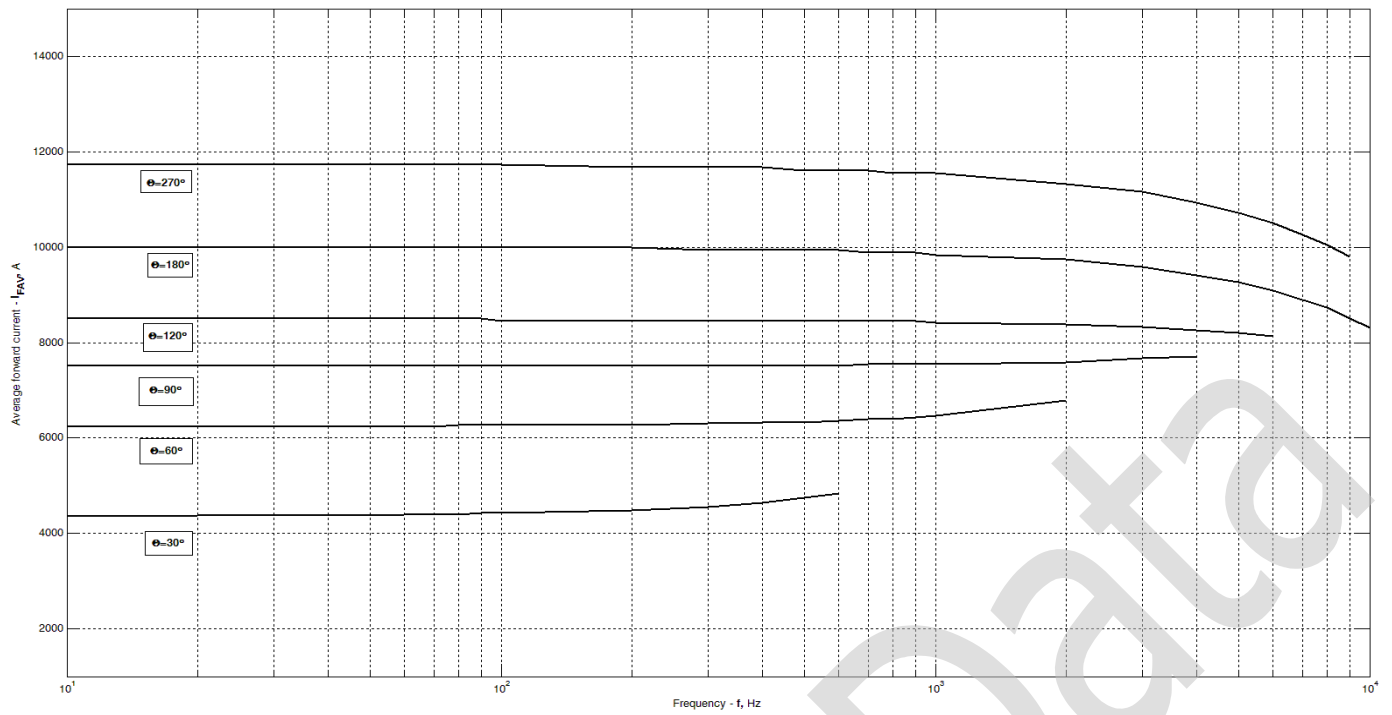


**Fig 17 –Average forward current vs. frequency, trapezoid waveform,
 $T_c=85\text{ }^\circ\text{C}$, $di_F/dt=\pm 500\text{ A}/\mu\text{s}$, $V_R=100\text{ V}$**