Welding Diode
D056-9500-4-N

AS ENERGI

Key Parameters

$I_{F(AV)M}$	=	9500	A
V_{RRM}	=	200-400	V
I_{FSM}	=	70.0	kA
I^2t	=	24500	kA^2s
V_{F0}	=	0.74	V
r_F	=	0.030	mΩ

Properties

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

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	– 60 ÷ 180		

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{FAV}	Average forward current	A	9500 10555 11814	T_c= 112 °C; Double side cooled; T_c= 100 °C; Double side cooled; T_c= 85 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{FRMS}	RMS forward current	A	14915	T_c= 112 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{FSM}	Surge forward current	kA	70.0 81.0	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; 50 Hz (t_p=10 ms); single pulse; V_R=0 V
			74.0 85.0	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; 60 Hz (t_p=8.3 ms); single pulse; V_R=0 V
I^2t	Safety factor	$A^2s{\cdot}10^3$	24500 32805	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; 50 Hz (t_p=10 ms); single pulse; V_R=0 V
			22725 29980	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; 60 Hz (t_p=8.3 ms); single pulse; V_R=0 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	250 ÷ 450	$T_{j\,min}$< T_j <$T_{j\,max}$; 180° half-sine wave; 50 Hz; single pulse;	
V_R	Reverse continuous voltages	V	0.75·V_{RRM}	T_j=$T_{j\,max}$;	
THERMAL					
T_{stg}	Storage temperature	°C	– 50 ÷ 40		
T_j	Operating junction temperature	°C	– 60 ÷ 180		
MECHANICAL					
F	Mounting force	kN	45.0 ÷ 50.0		
a	Acceleration	m/s^2	50 100	Device unclamped 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	0.74	T_j=$T_{j\,max}$; 5000 A < I_T < 14000 A	
r_T	Forward slope resistance, max	mW	0.030		
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	mC	1150	T_j=$T_{j\,max}$; I_{FM}=1000 A; dI_{FM}/dt=-30 A/ms;	
			720	T_j=$T_{j\,max}$; I_{FM}=1000 A; dI_{FM}/dt=-10 A/ms;	
THERMAL					
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.0050	Direct Current	Double side cooled
R_{thjc-A}			0.0070		Anode side cooled
R_{thjc-K}			0.0150		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max		0.0035	Direct Current	
MECHANICAL					
w	Weight, typ	g	110		
D_s	Surface creepage distance	mm (inch)	2.0 (0.079)		
D_a	Air strike distance	mm (inch)	2.0 (0.079)		

PART NUMBERING GUIDE

D	056	9500	4	N
1		2	3	4

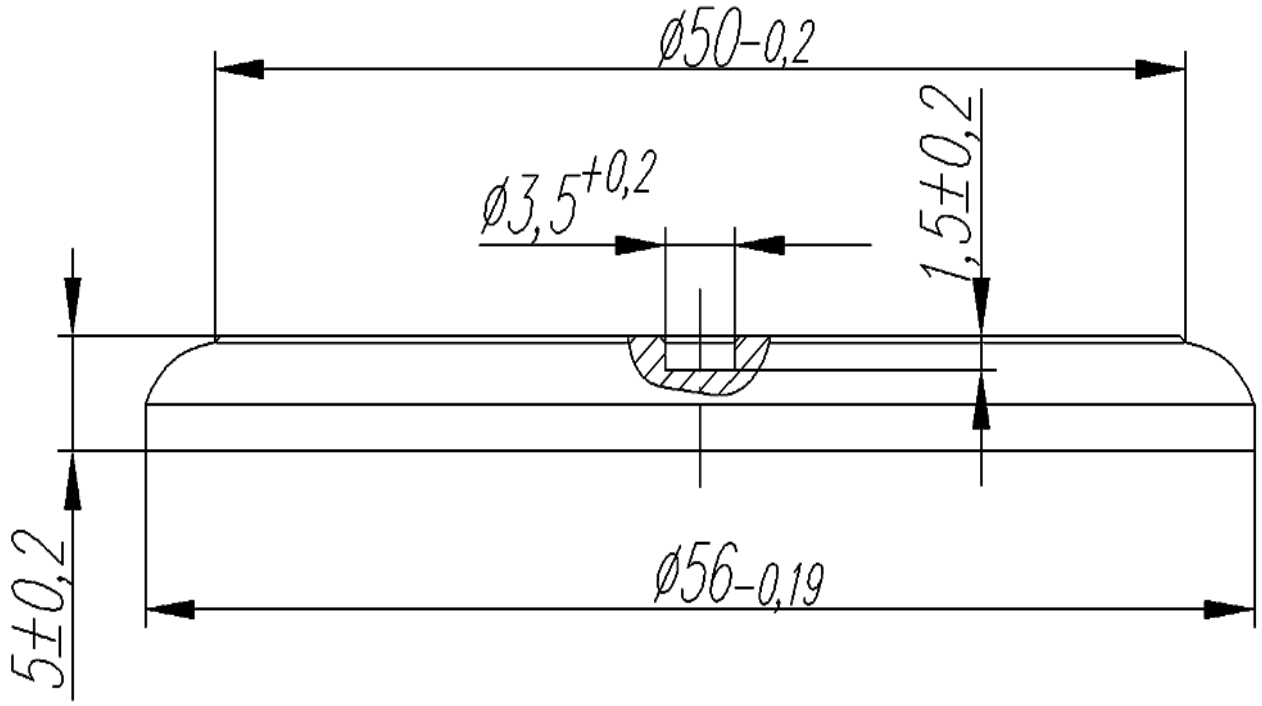
1. Design version
2. Average forward current, A
3. Voltage code
4. Ambient conditions: N – normal

De-raiting Main characteristics vs Mounting force

Symbols and parameters		Units	Values (F=30 kN)	Values (F=40 kN)	Conditions	
I_{FAV}	Average forward current	A	9495	10127	T_c= 100 °C; Double side cooled; 180° half-sine wave; 50 Hz	
V_{FM}	Peak forward voltage, max	V	1.10 1.00	1.09 0.99	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	0.76	0.75	T_j=$T_{j\,max}$; 5000 A < I_T < 14000 A	
r_T	Forward slope resistance, max	mW	0.032	0.031		
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.0056	0.0052	Direct current	Double side cooled
R_{thjc-A}			0.0080	0.0076		Anode side cooled
R_{thjc-K}			0.0165	0.0155		Cathode side cooled

DIMENSIONS

Package type:
HOUSINGLESS



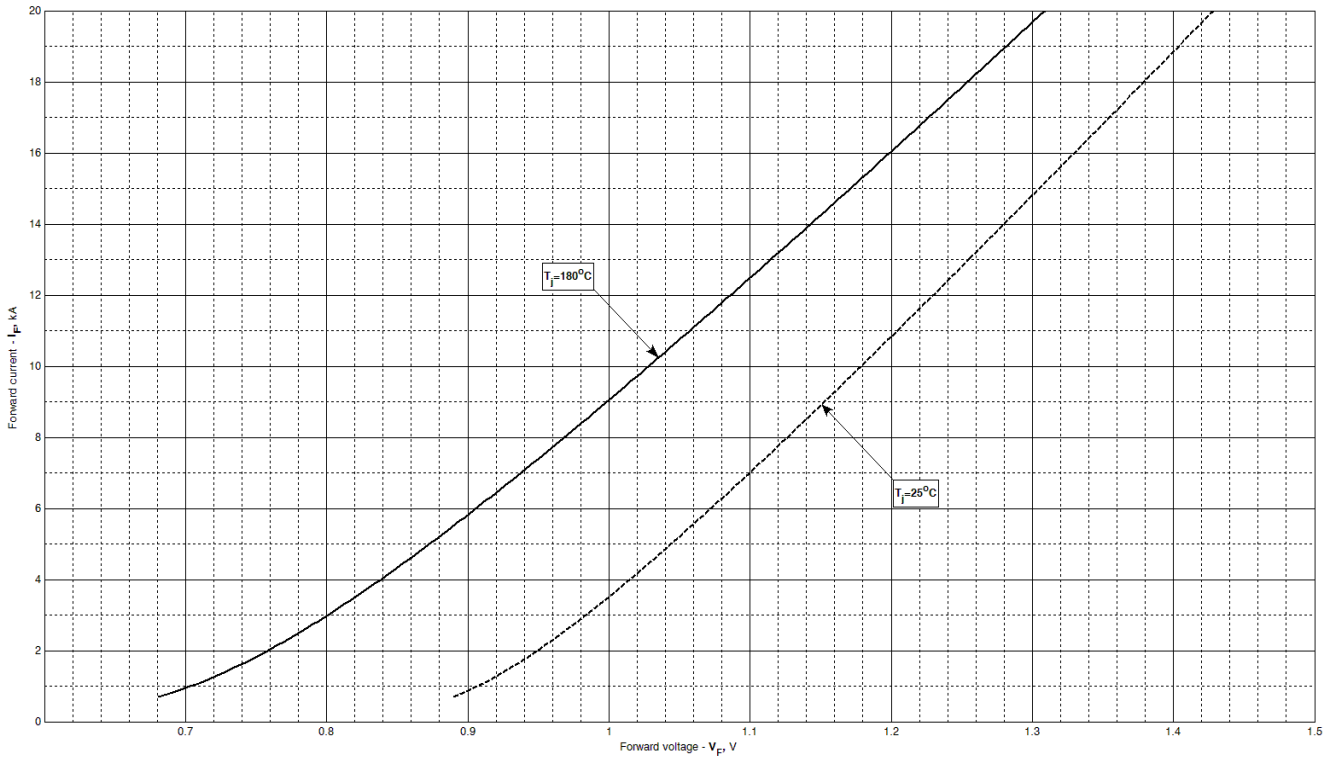


Fig 1 – Forward characteristics of Limit device

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°C	$T_j = T_{j\,max}$
A	0.907474	0.779908
B	0.019903	0.028250
C	0.069432	0.147664
D	-0.037894	-0.080592

Forward characteristic model (see Fig. 1)

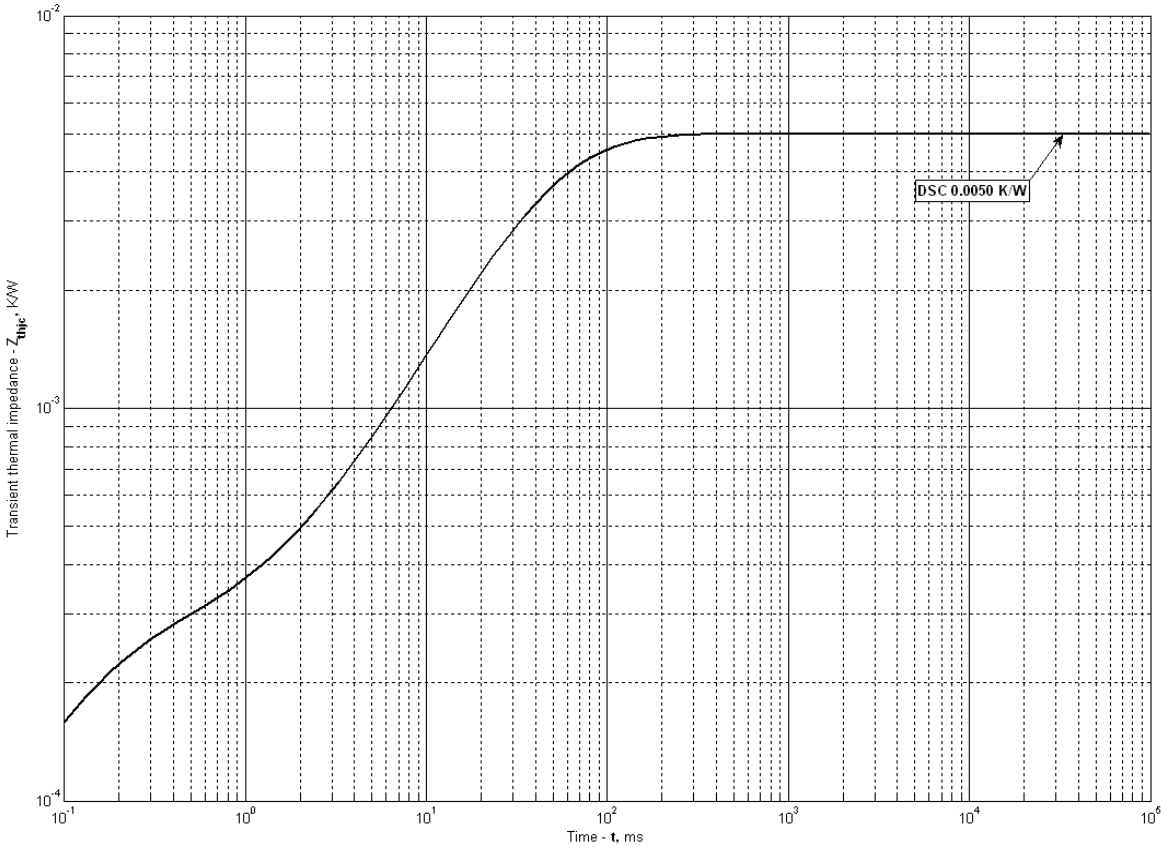


Fig 2 – Transient thermal impedance

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 constatnt 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)

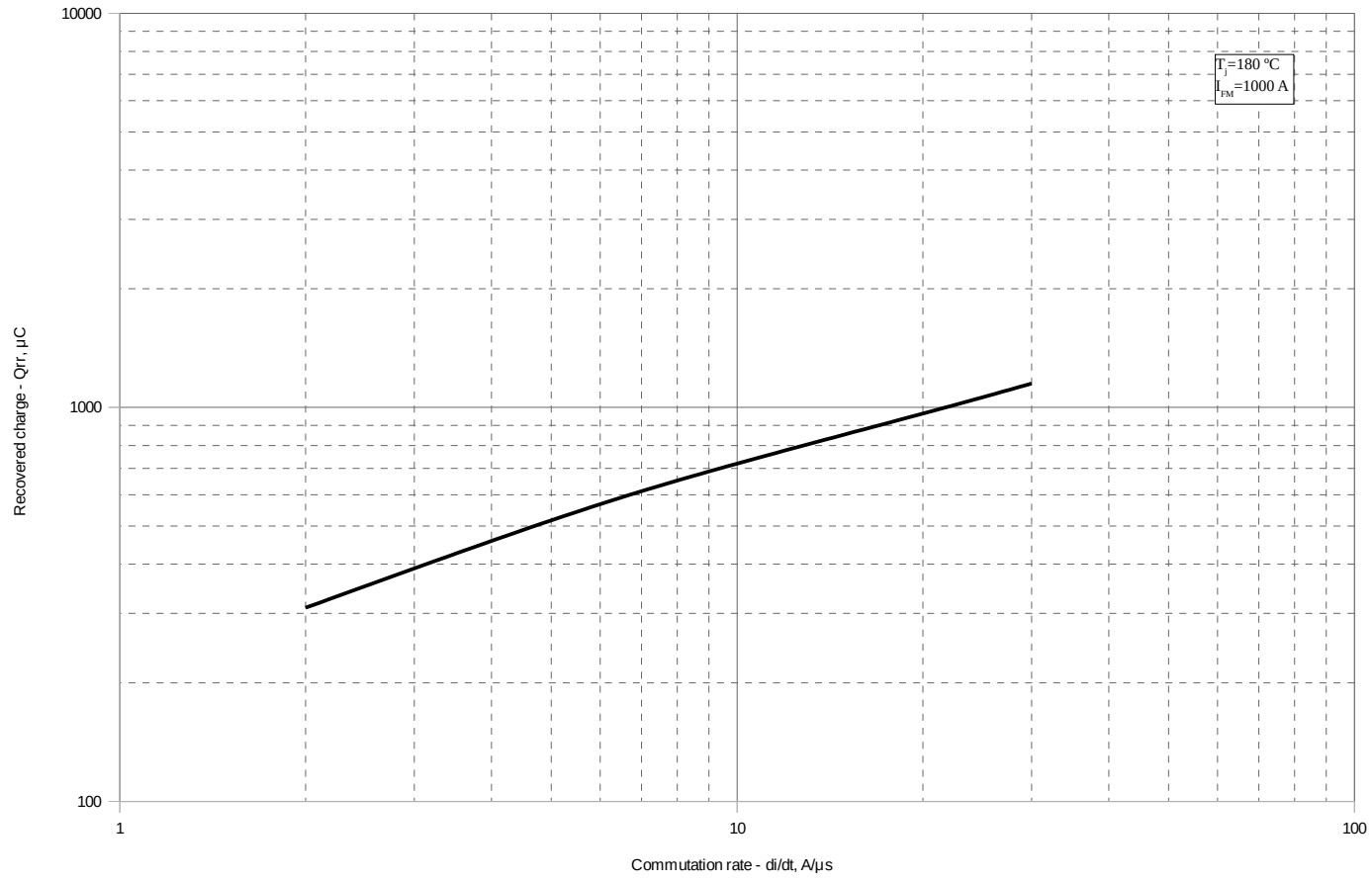


Fig 3 - Recovered charge, Q_{rr}

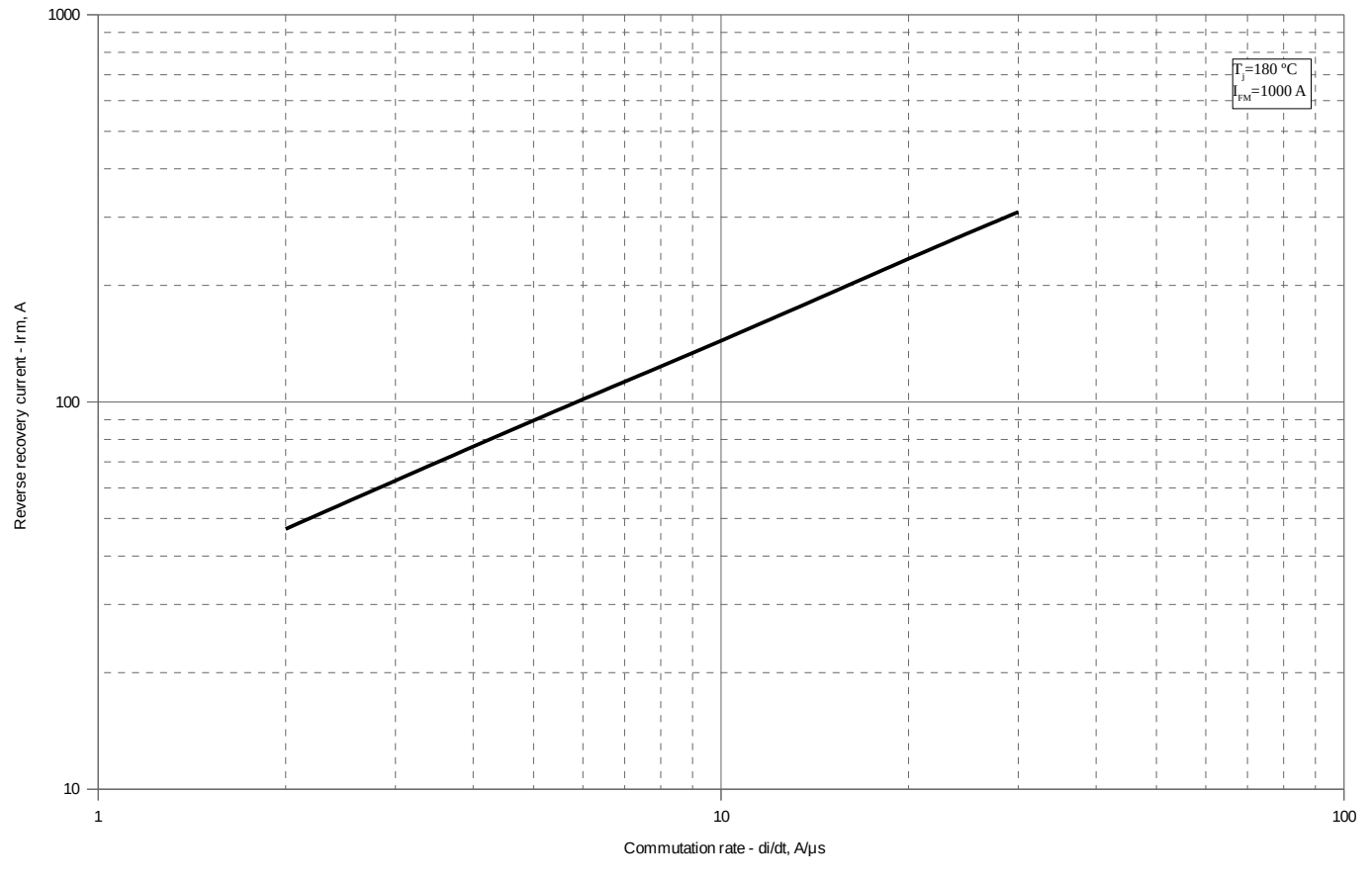


Fig 4 – Peak reverse recovery current, I_{rm}

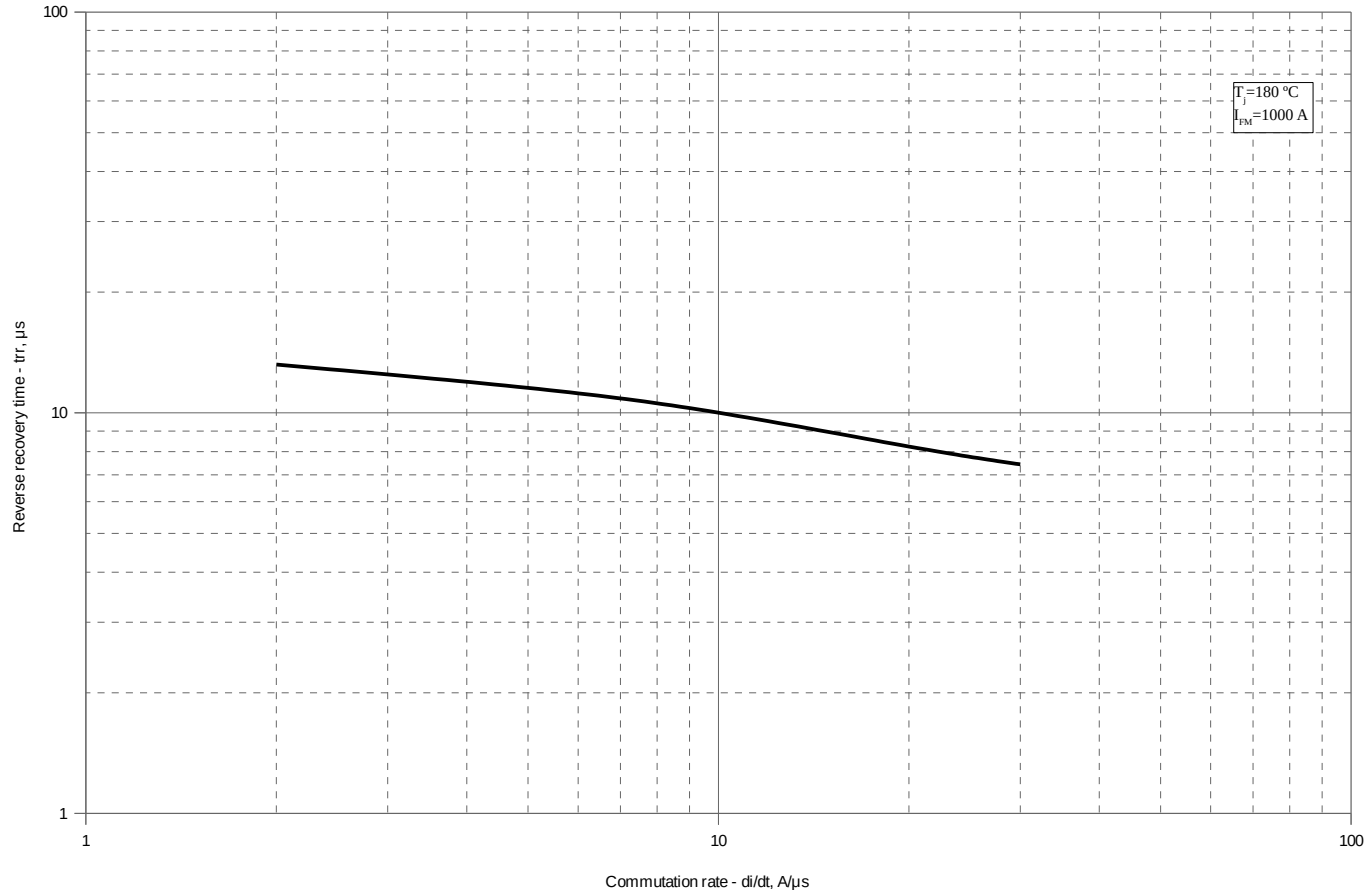


Fig 5 – Maximum recovery time, t_{rr} (linear)

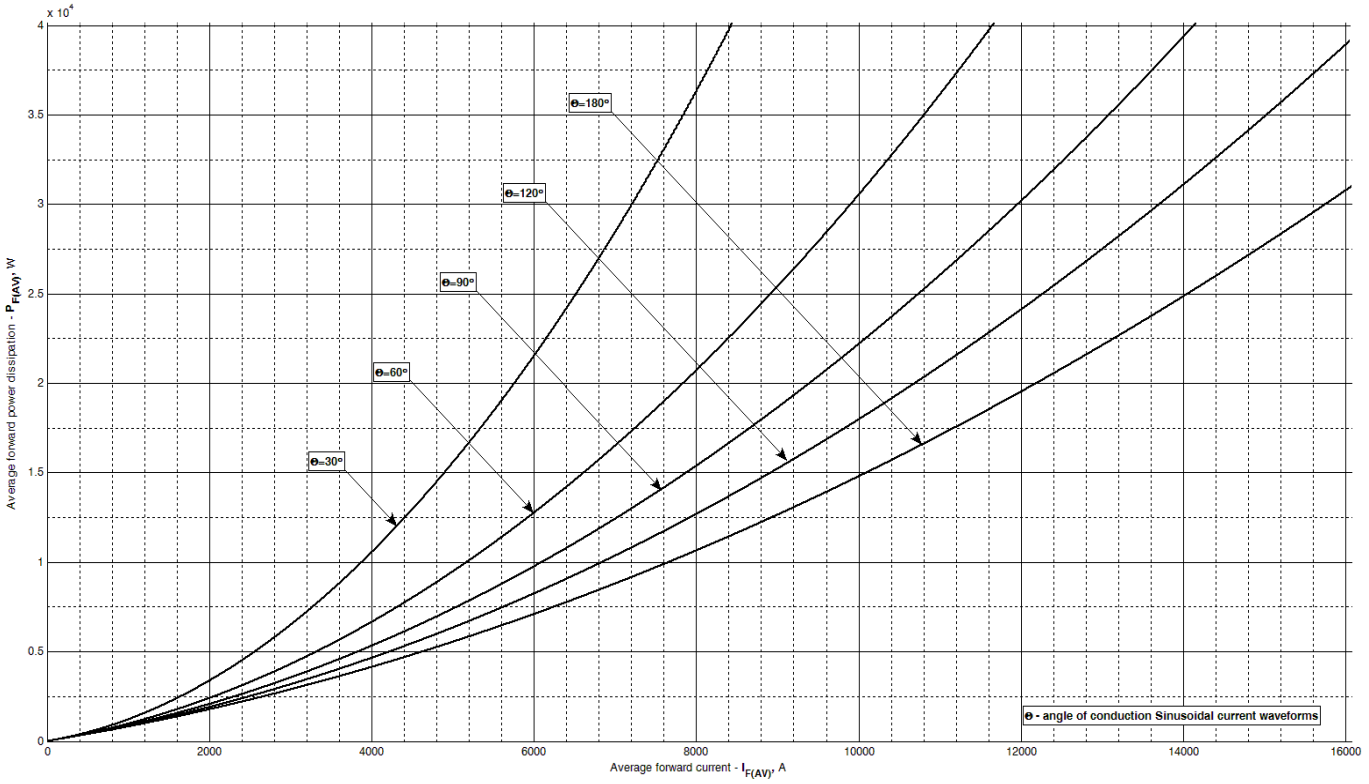


Fig 6 – Mean forward power dissipation P_{FAV} vs. Mean forward current I_{FAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

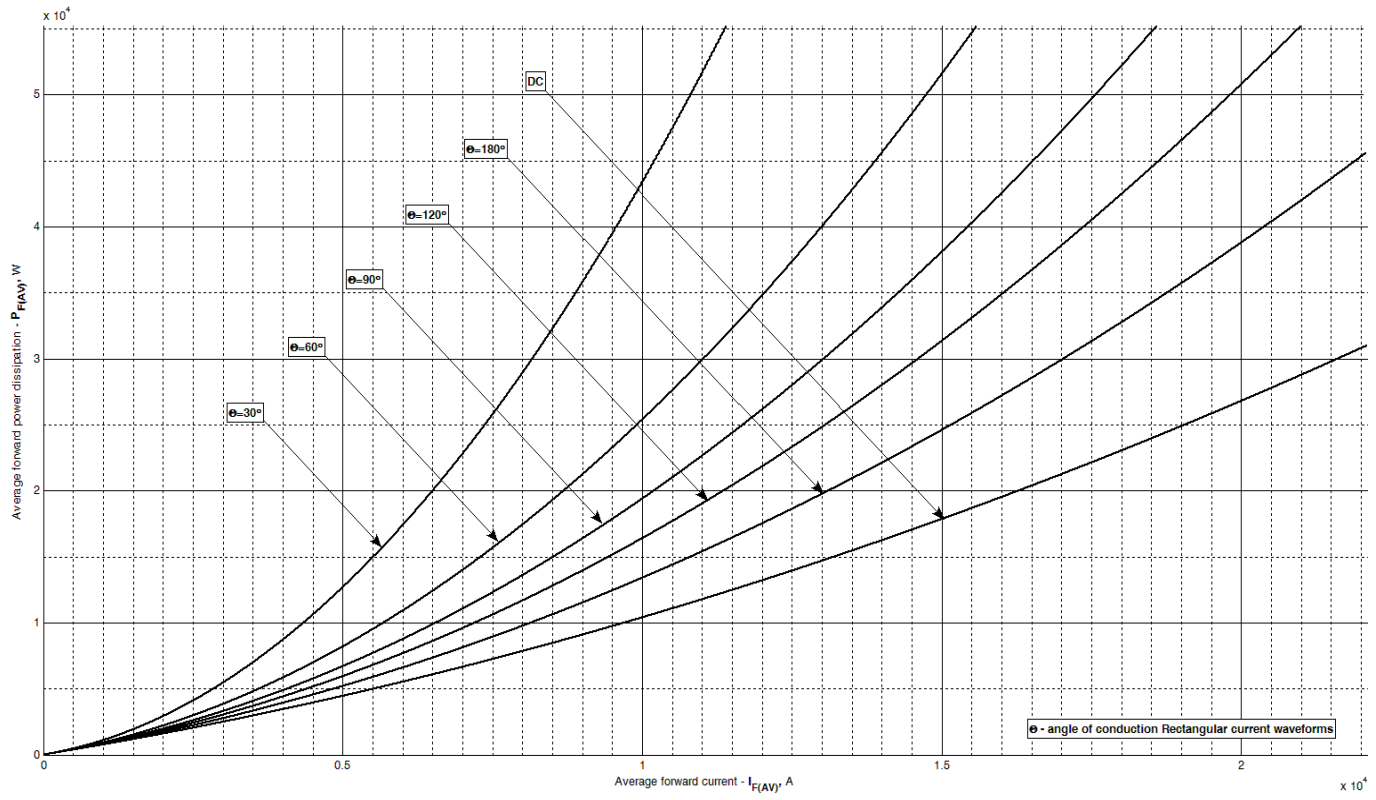


Fig 7 – Mean forward power dissipation P_{FAV} vs. Mean forward current I_{FAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

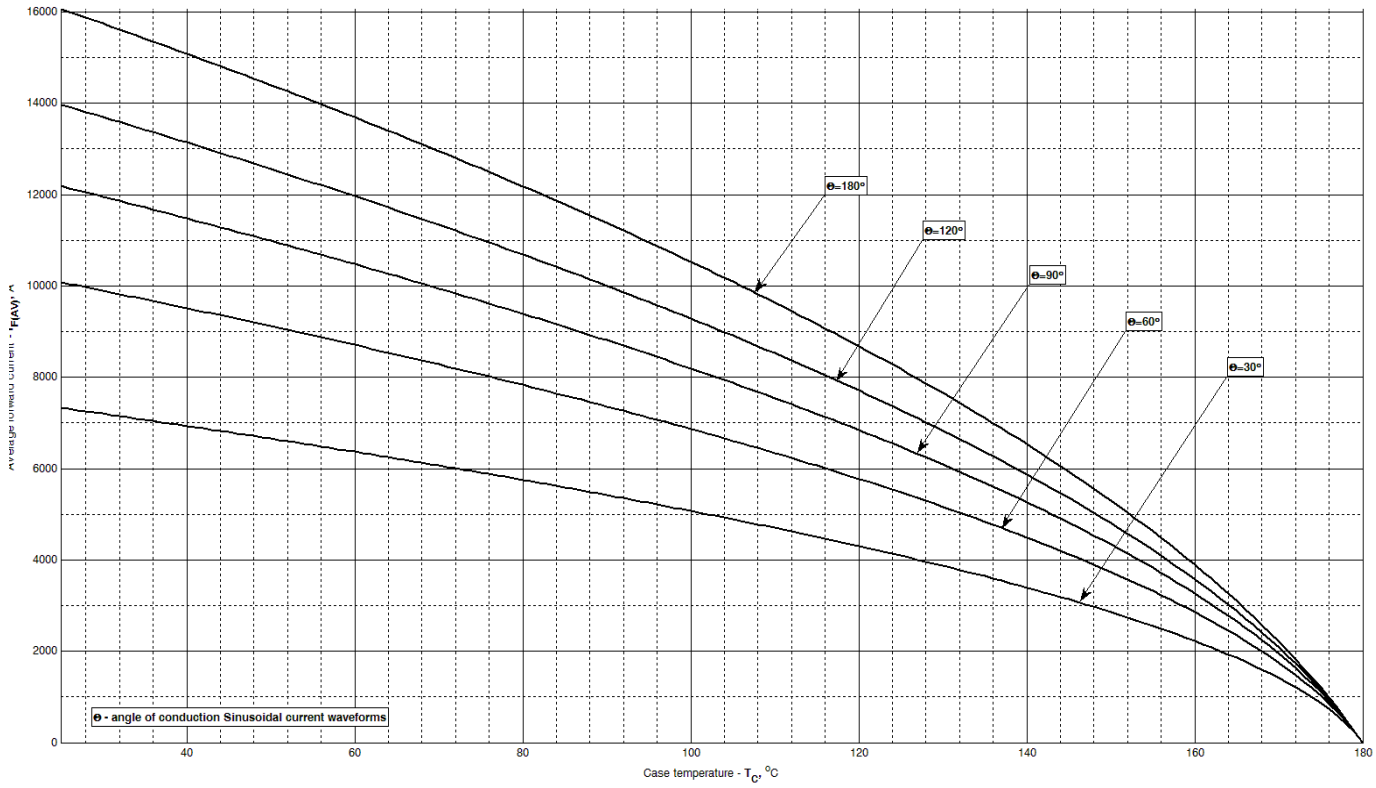


Fig 8 - Mean forward current I_{FAV} vs. Case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

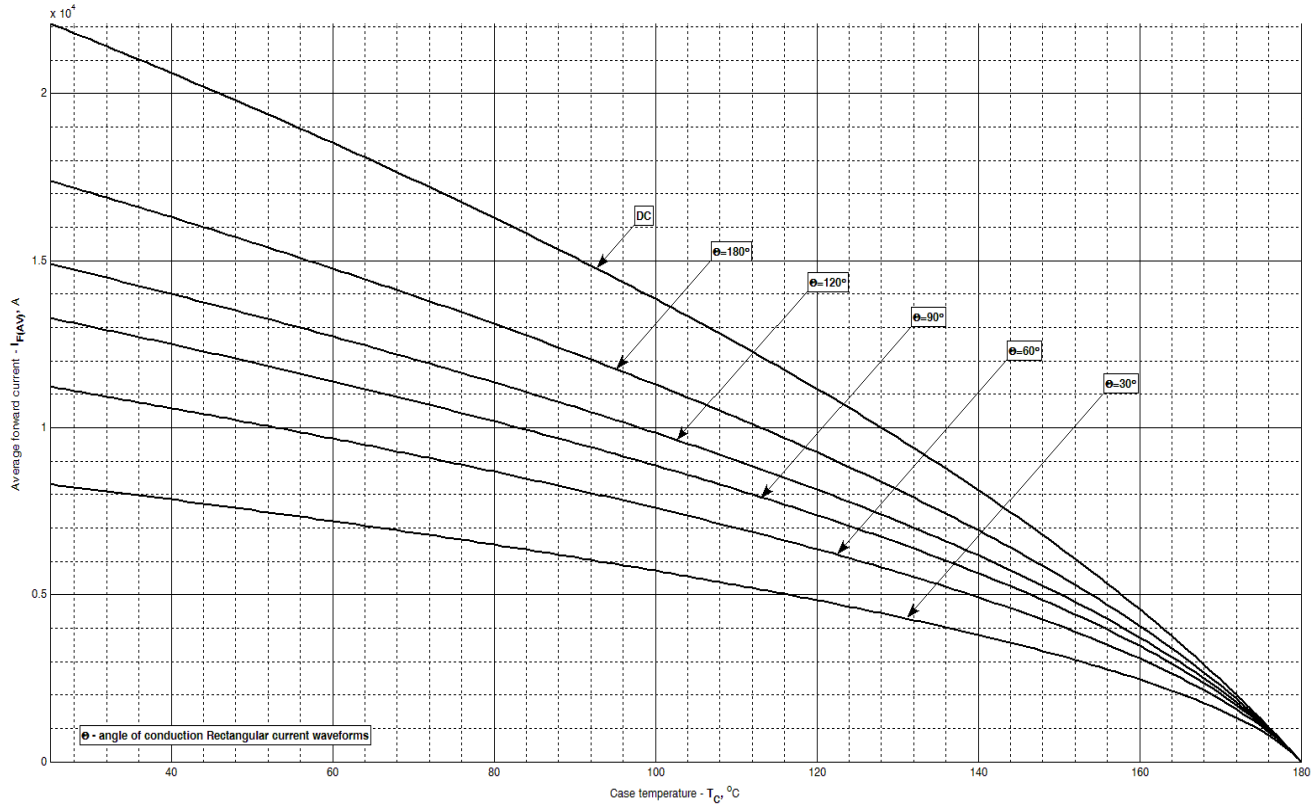


Fig 9 – Mean forward current I_{FAV} vs. Case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

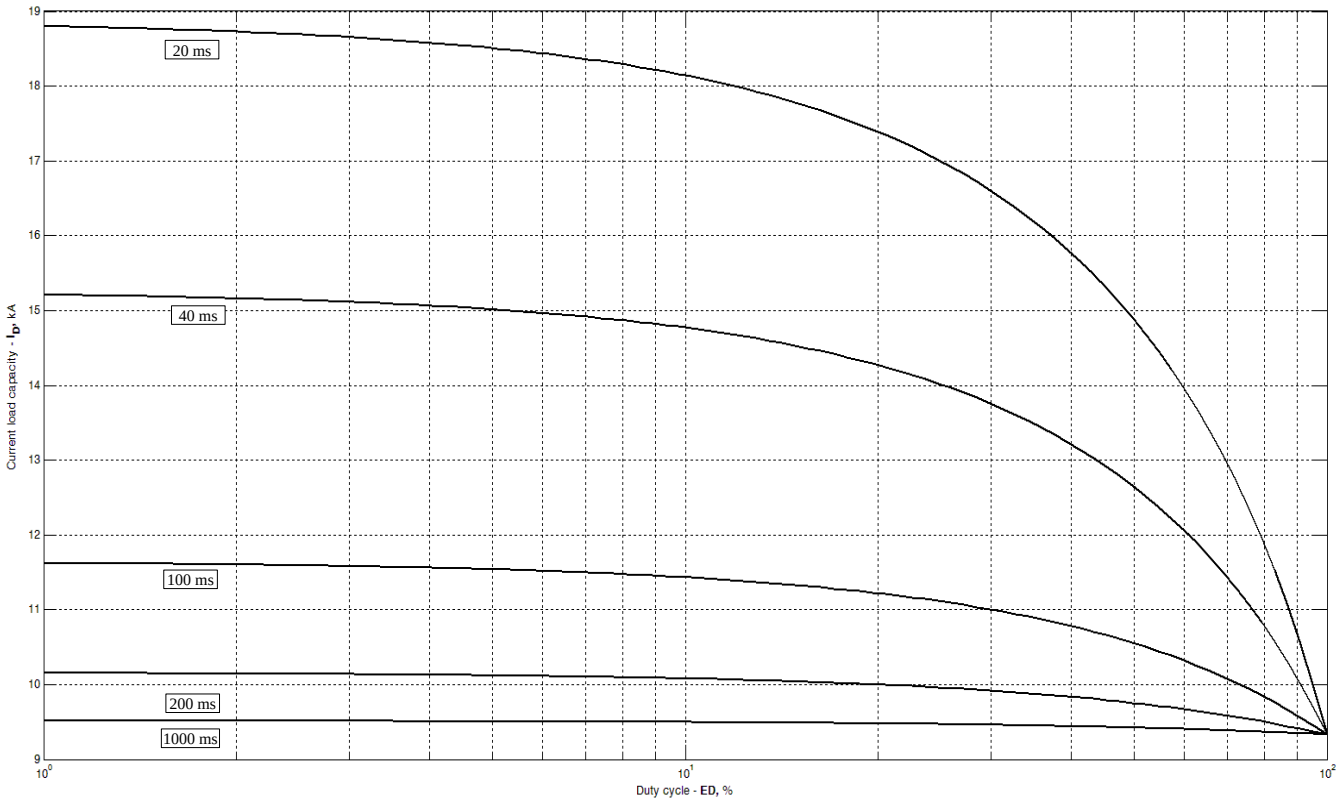


Fig 10 – Current load capability (f=1000 Hz, square wave, T_c = 40 °C)

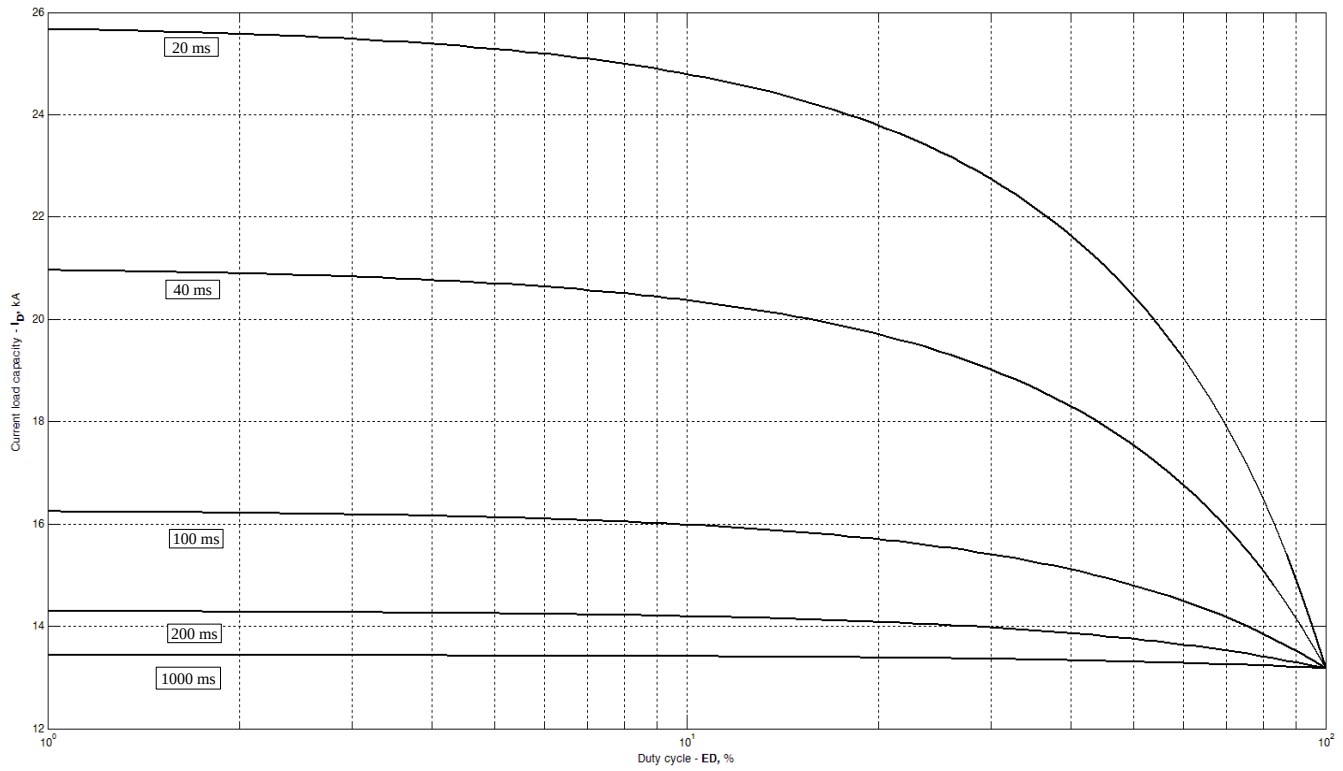


Fig 11 – Current load capability (f=1000 Hz, square wave, T_c = 60 °C)

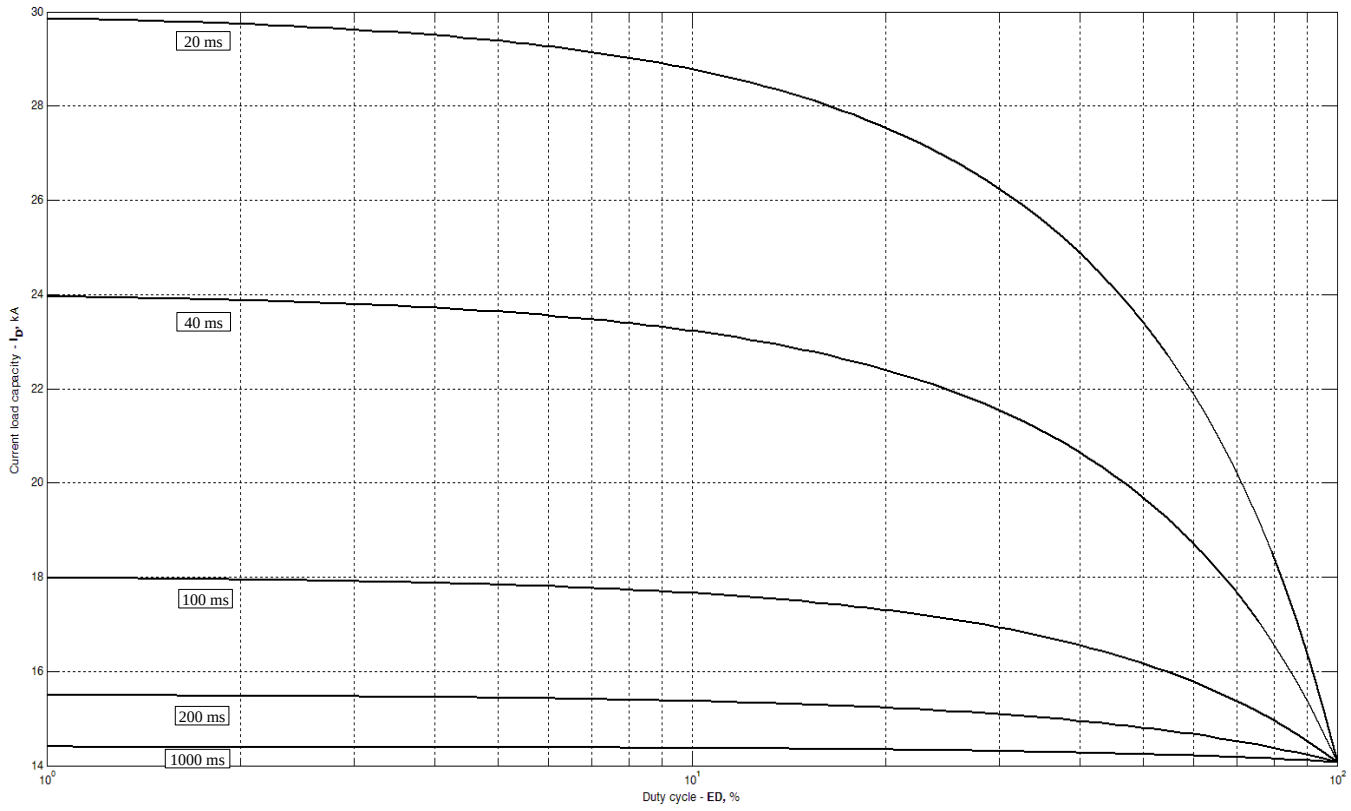


Fig 12 – Current load capability (f=1000 Hz, square wave, T_c = 70 °C)

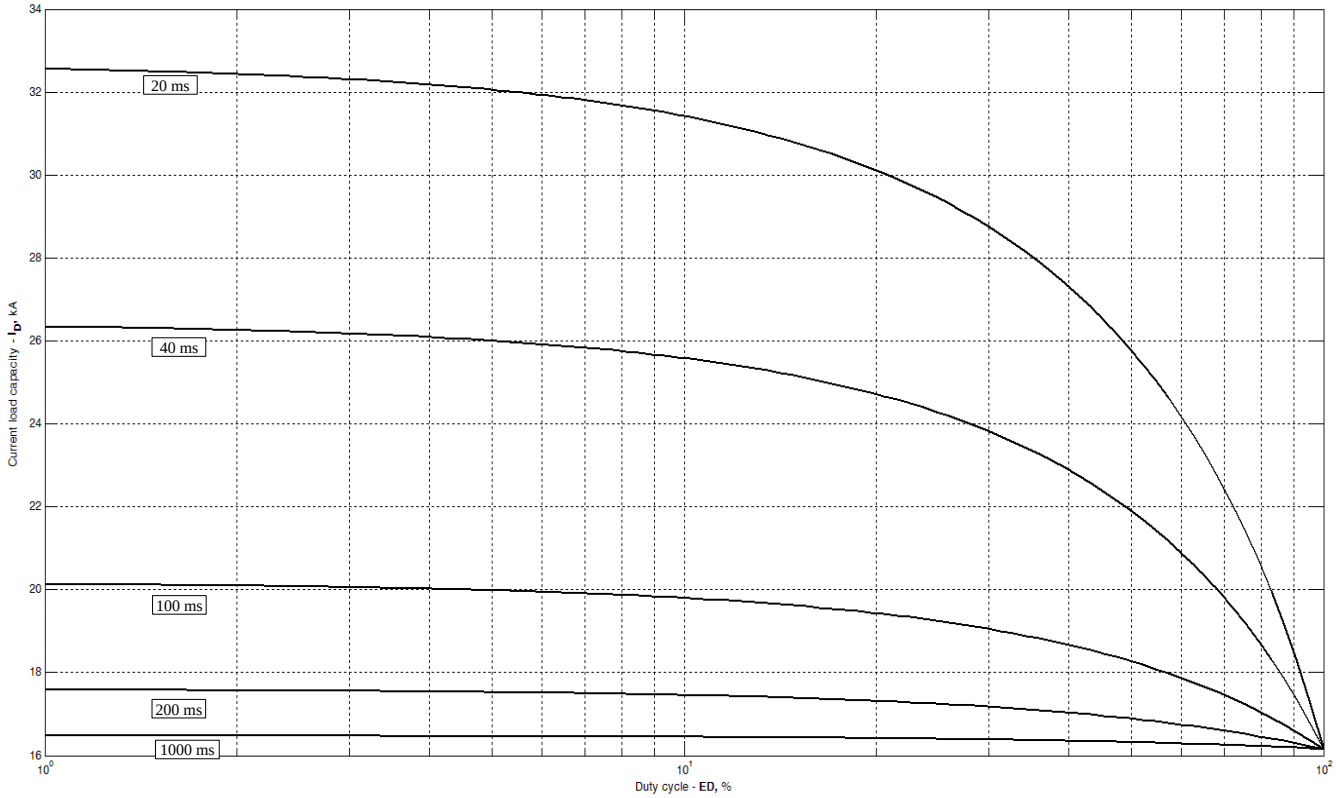


Fig 13 – Current load capability (f=1000 Hz, square wave, T_c = 80 °C)

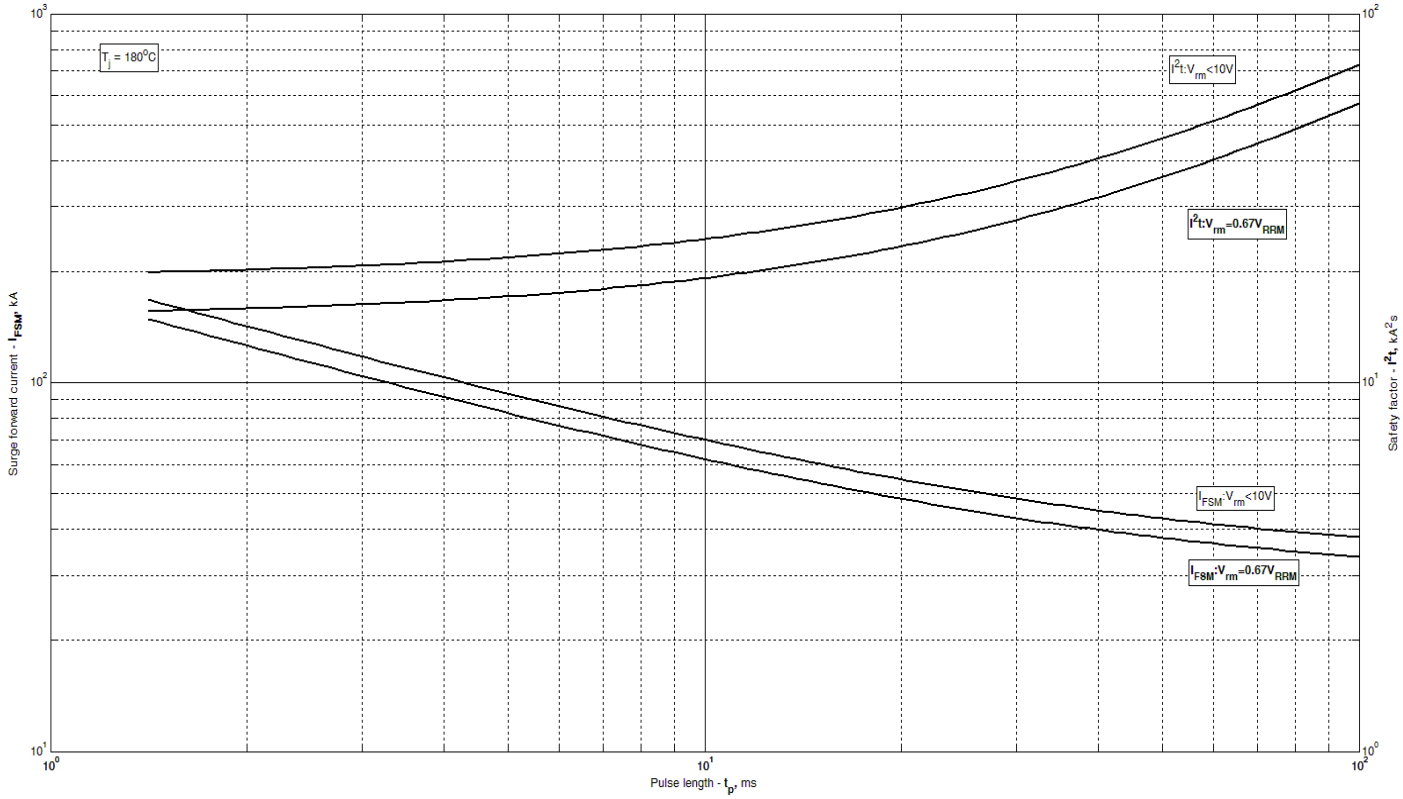


Fig 14 – Maximum surge and I^2t ratings

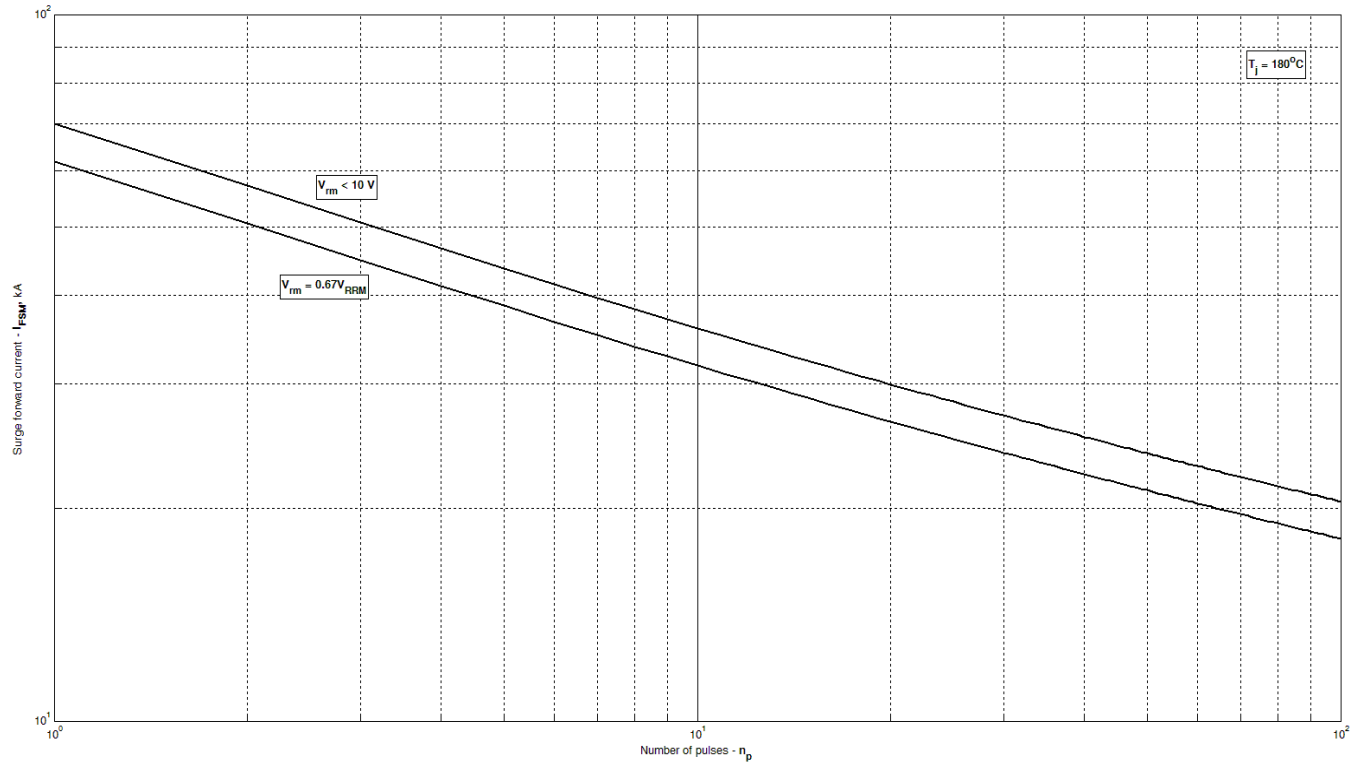


Fig 15 – Maximum surge ratings

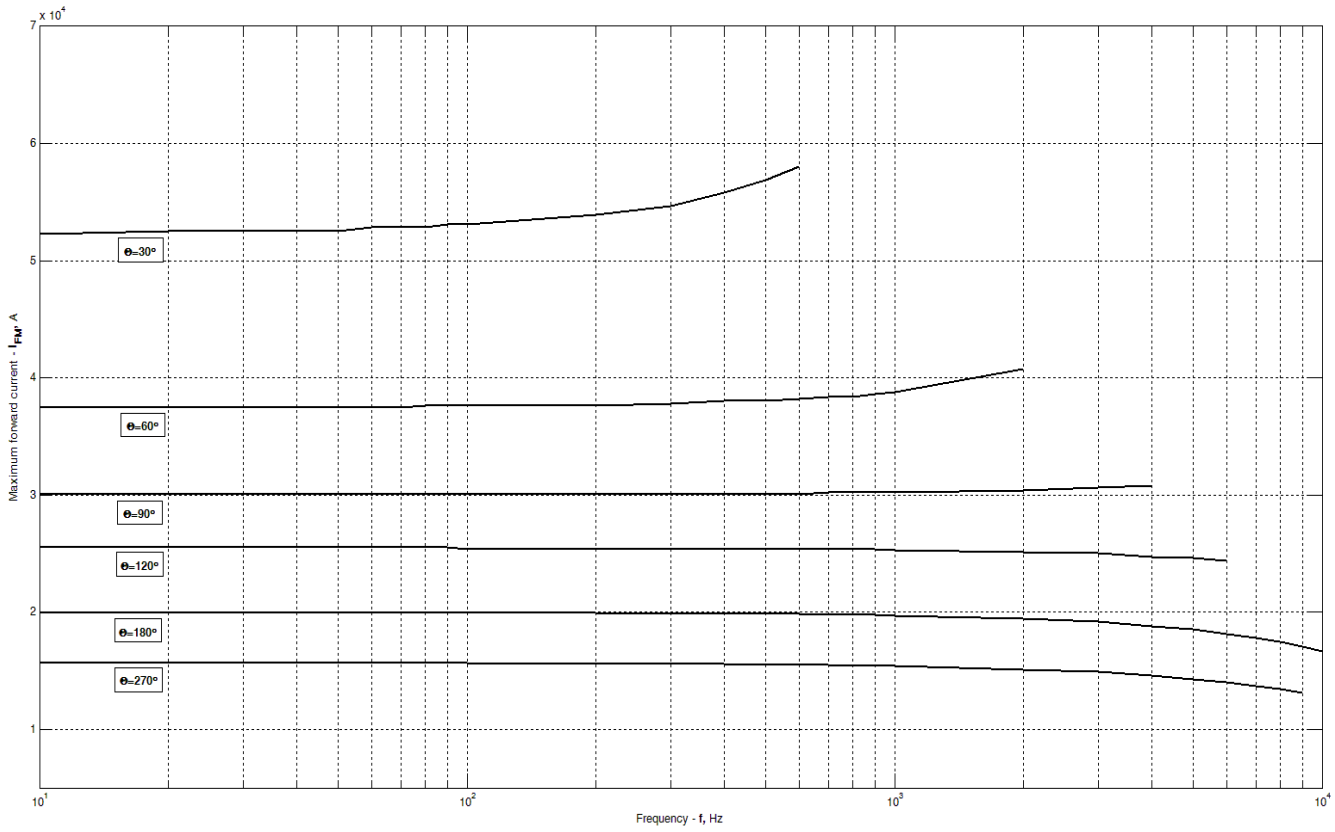


Fig 16 –Maximum forward current vs. frequency, trapezoid waveform, T_C=85 °C, di_F/dt=±500 A/µs, V_R=100 V

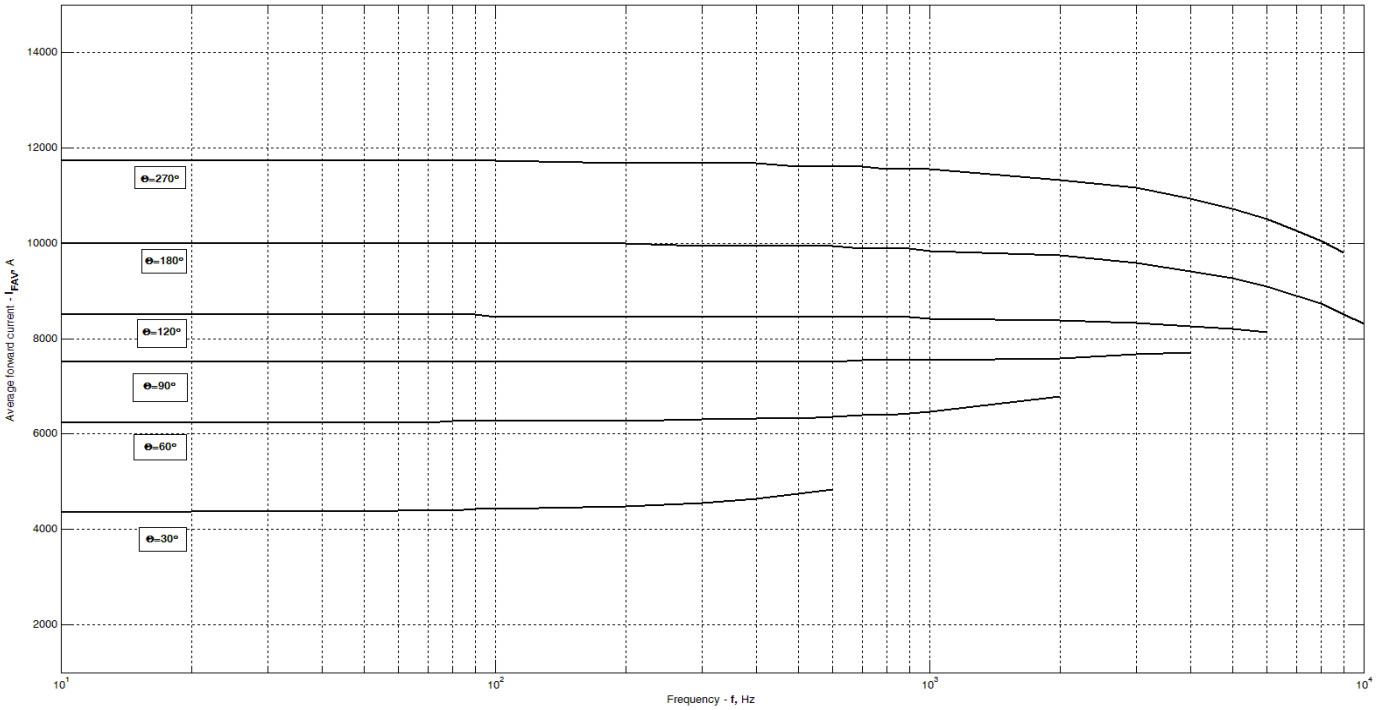


Fig 17 –Average forward current vs. frequency, trapezoid waveform, T_C=85 °C, di_F/dt=±500 A/µs, V_R=100 V