



PROTON-ELECTROTEX RUSSIA

High power cycling capability
Low on-state and switching losses
Optimized for line frequency rectifiers
Designed for traction and industrial applications

Power Rectifier Avalanche Diodes Type DA153-2000-20

Average forward current		I _{FAV}	2000 A
Repetitive peak reverse voltage		V _{RRM}	1600...2000 V
V _{RRM} , V	1600	1800	2000
Voltage code	16	18	20
T _{ij} , °C	−60...+175		

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I _{FAV}	Maximum allowable average forward current	A	2000 2191	T _c =109 °C; Double side cooled; T _c =100 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I _{FRMS}	RMS forward current	A	3140	T _c =109 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I _{FSM}	Surge forward current	kA	32.0 38.0	T _j =T _{j max} T _j =25 °C	180° half-sine wave; t _p =10 ms; single pulse; V _R =0 V;
			34.0 41.0	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	5100 7200	T _j =T _{j max} T _j =25 °C	180° half-sine wave; t _p =10 ms; single pulse; V _R =0 V;
			4700 6900	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	1600...2000	T _{j min} < T _j < T _{j max} ; 180° half-sine wave; 50 Hz;	
V _(BR)	Breakdown voltage	V	2000...2450	T _j =25 °C; I _{br} =100 mA; t _p =10 ms; 5 Hz	
V _R	Reverse continuous voltages	V	0.6·V _{RRM}	T _j =T _{j max} ;	
P _{RSM}	Surge reverse power dissipation	kW	16	T _j = T _{j max} ; t _p = 100 μs; 180° half-sine current waveforms; single pulse	
THERMAL					
T _{stg}	Storage temperature	°C	−60...+50		
T _j	Operating junction temperature	°C	−60...+175		
MECHANICAL					
F	Mounting force	kN	24.0...28.0		
a	Acceleration	m/s ²	50	Device clamped	

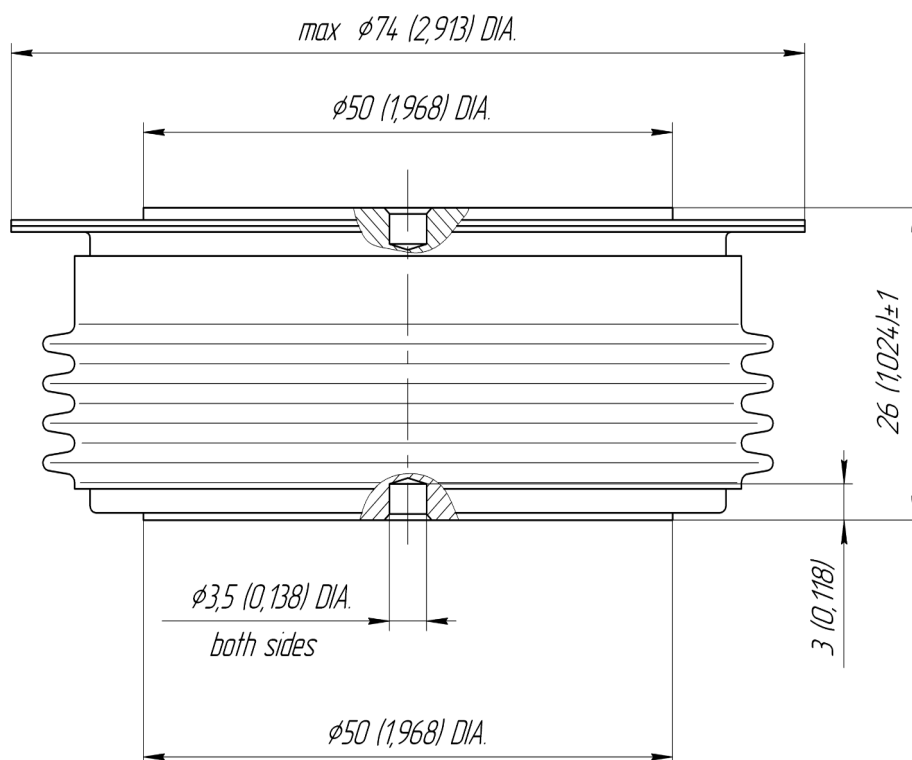
CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions
ON-STATE				
V_{FM}	Peak forward voltage, max	V	1.80	$T_j=25\text{ }^{\circ}\text{C}; I_{FM}=6280\text{ A}$
$V_{F(TO)}$	Forward threshold voltage, max	V	0.956	$T_j=T_{j\text{ max}};$
r_T	Forward slope resistance, max	$m\Omega$	0.176	$0.5 \pi I_{FAV} < I_T < 1.5 \pi I_{FAV}$
BLOCKING				
I_{RRM}	Repetitive peak reverse current, max	mA	50	$T_j=T_{j\text{ max}};$ $V_R=V_{RRM}$
SWITCHING				
Q_r	Recovered charge, max	μC	5390	$T_j=T_{j\text{ max}}; I_{FM}=1000\text{ A};$
t_{rr}	Reverse recovery time, max	μs	46	$di_R/dt=-10\text{ A}/\mu\text{s};$
I_{rr}	Reverse recovery current, max	A	234	$V_R=100\text{ V}$
THERMAL				
R_{thjc}	Thermal resistance, junction to case, max	$^{\circ}\text{C}/\text{W}$	0.0180	Double side cooled
R_{thjc-A}			0.0396	Anode side cooled
R_{thjc-K}			0.0324	Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	$^{\circ}\text{C}/\text{W}$	0.0040	Direct current
MECHANICAL				
m	Weight, max	g	550	
D_s	Surface creepage distance	mm (inch)	38.84 (1.529)	
D_a	Air strike distance	mm (inch)	22.50 (0.886)	

PART NUMBERING GUIDE

DA	153	2000	20	N
1	2	3	4	5

1. DA — Avalanche Diode
2. Design version
3. Average forward current, A
4. Voltage code
5. Ambient conditions: N – normal; T – tropical



All dimensions in millimeters (inches)

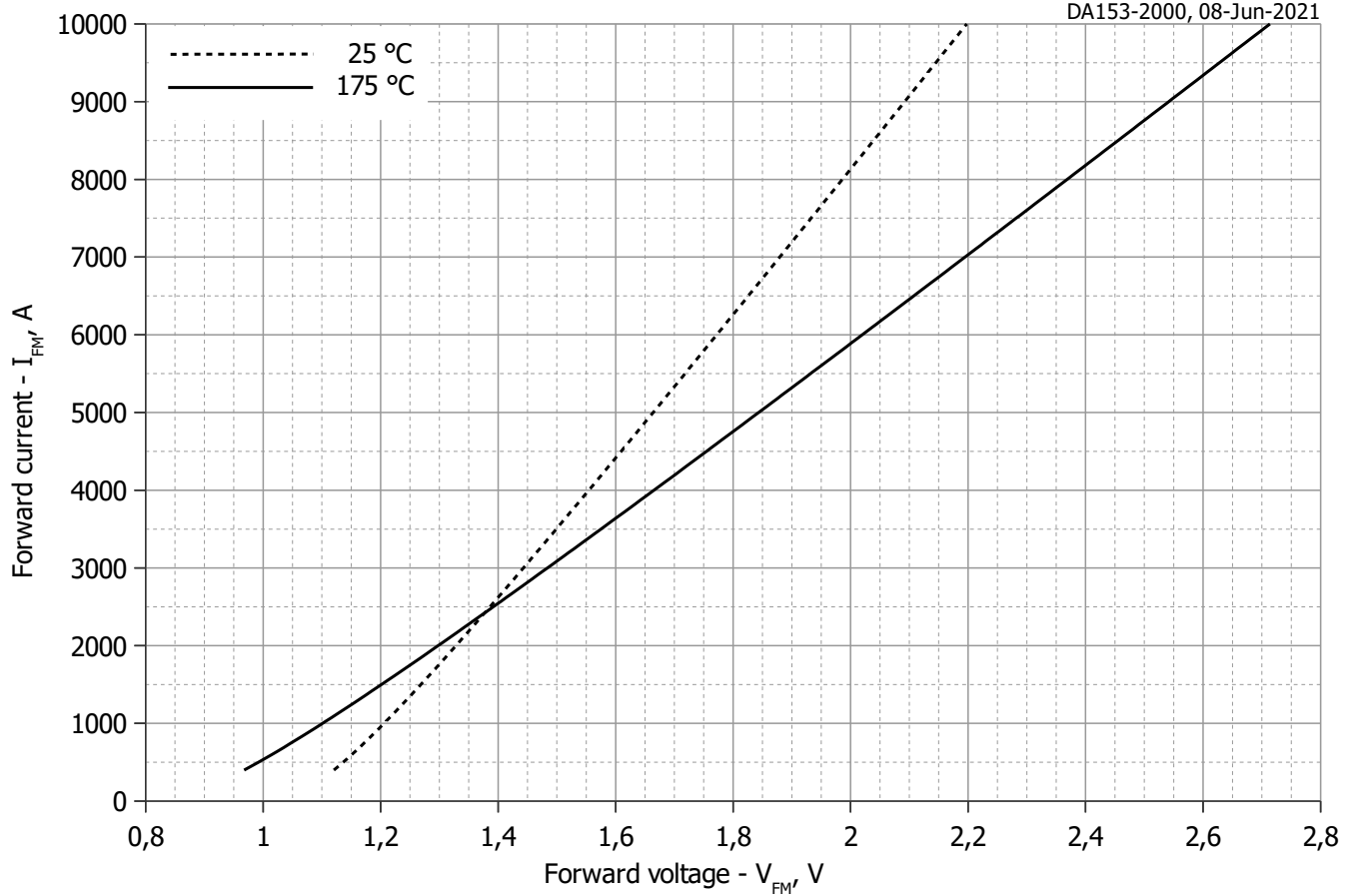


Fig 1 – Forward characteristics of Limit device

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	0.95602596	0.76369292
B	0.00009985	0.00016118
C	0.01827148	0.01733801
D	0.00074930	0.00178541

Forward characteristic model (see Fig. 1).

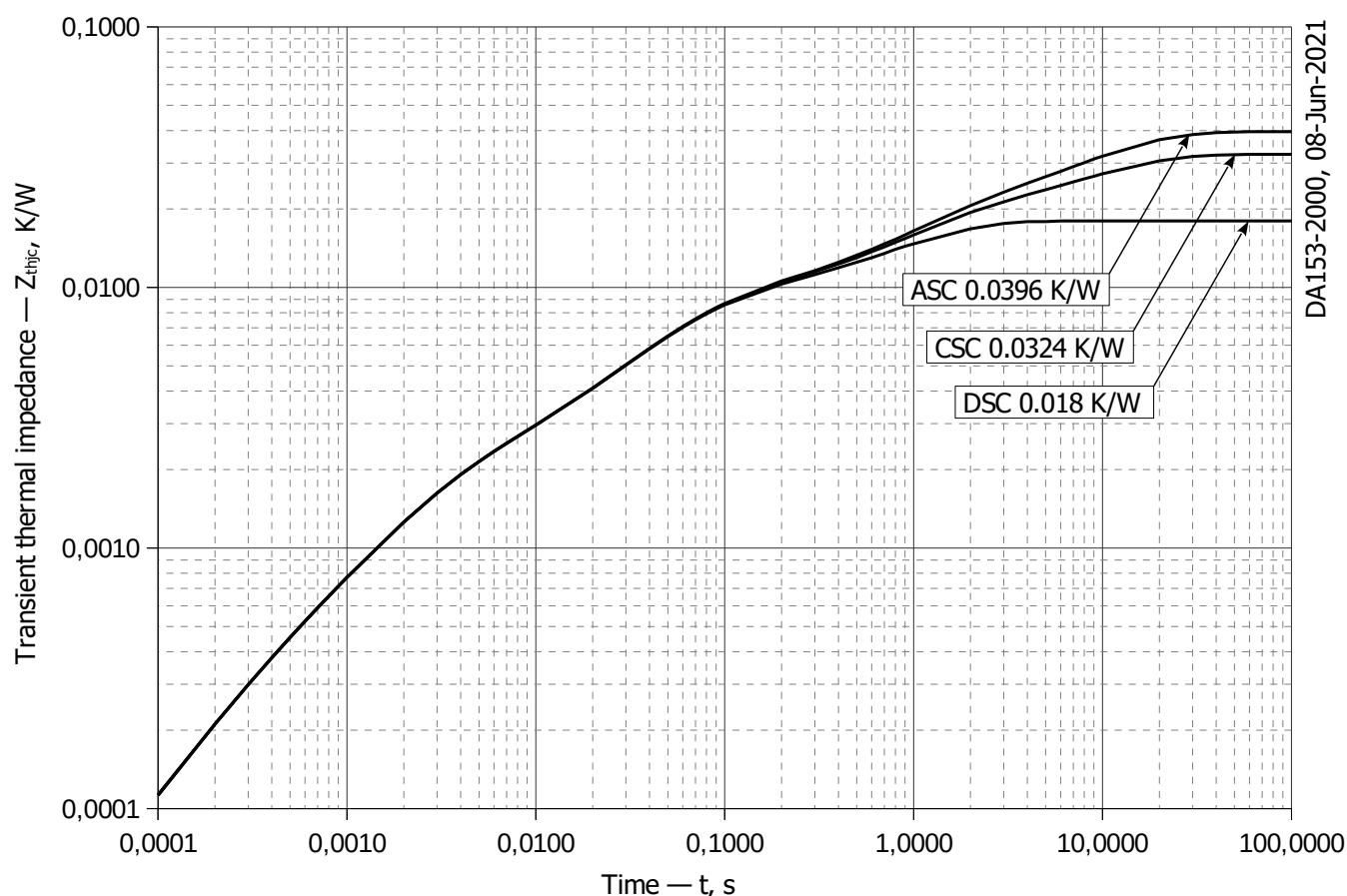


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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	0.009241	0.006037	0.001231	0.001054	0.0003396	0.00009575
τ_i , s	0.9673	0.04967	0.002733	0.07734	0.001638	0.0002248

DC Cathode side cooled

i	1	2	3	4	5	6
R_i , K/W	0.0144	0.009281	0.006055	0.001018	0.001535	0.0001182
τ_i , s	9.745	1.028	0.05591	0.03732	0.002468	0.0002687

DC Anode side cooled

i	1	2	3	4	5	6
R_i , K/W	0.0216	0.009325	0.006949	0.0001252	0.001516	0.0001119
τ_i , s	9.752	1.065	0.05344	0.01407	0.002421	0.0002554

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

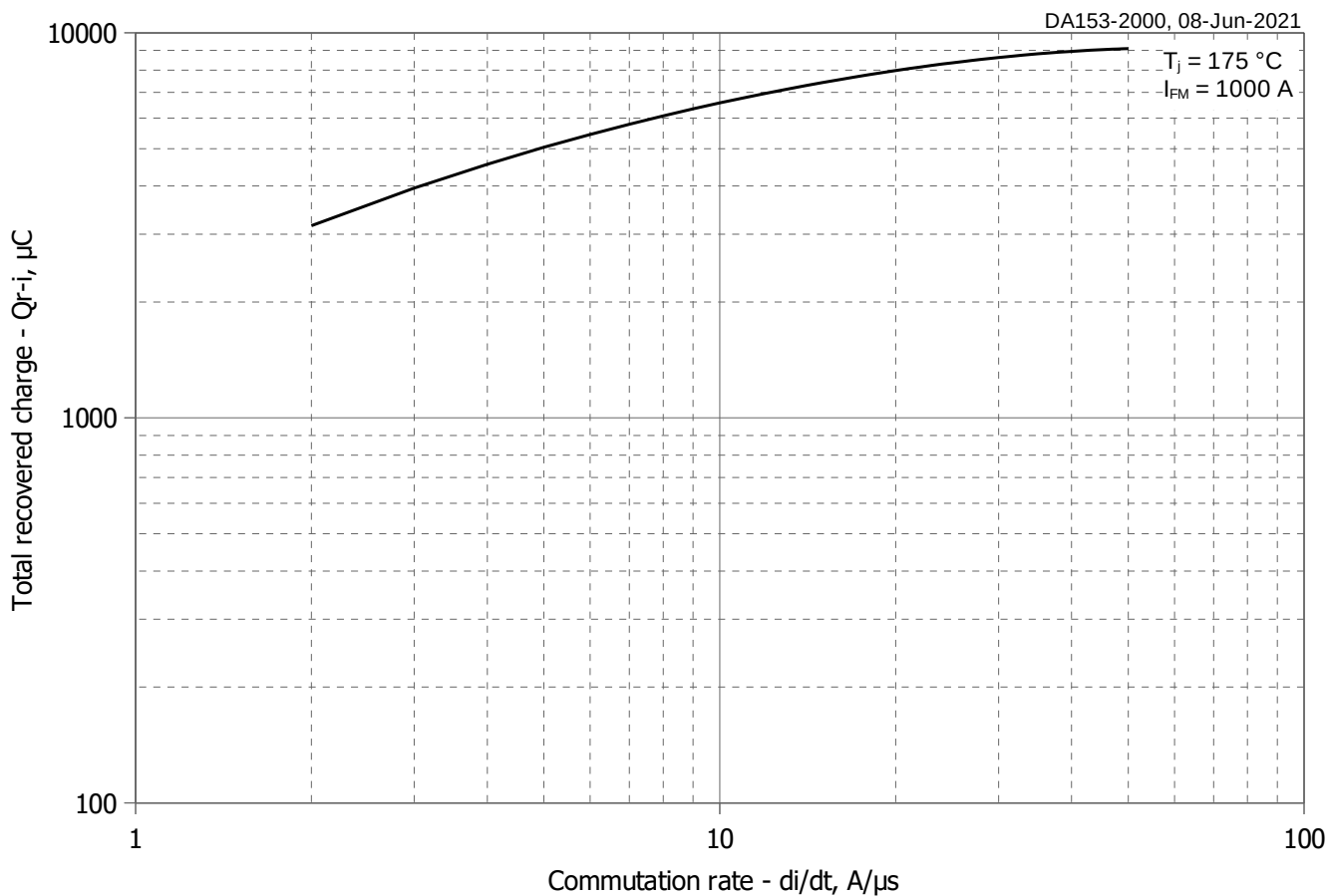


Fig 3 - Total recovered charge Q_{r-i} (integral) vs. commutation rate di_R/dt

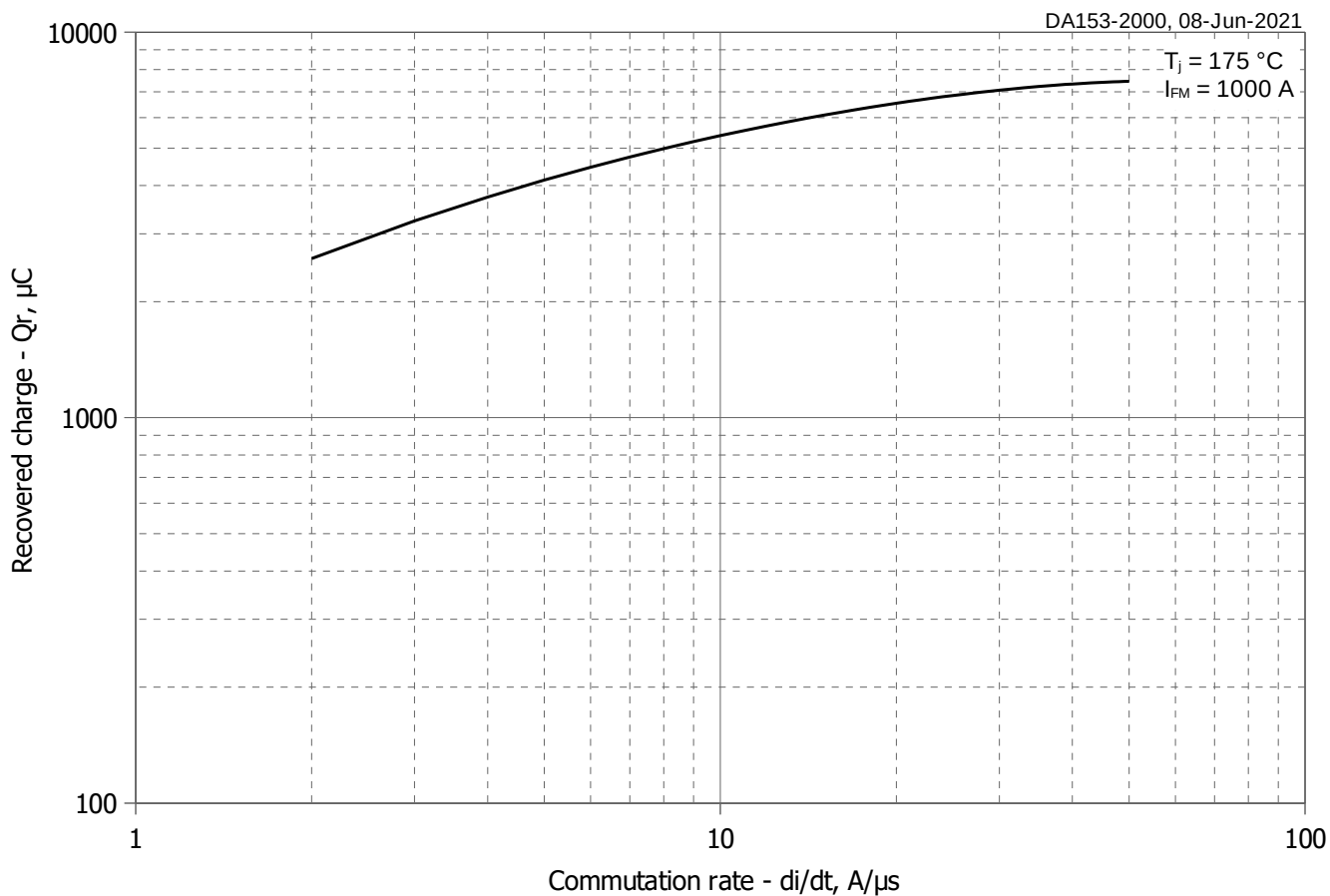


Fig 4 - Maximum recovered charge Q_r vs. commutation rate di_R/dt (25% chord)

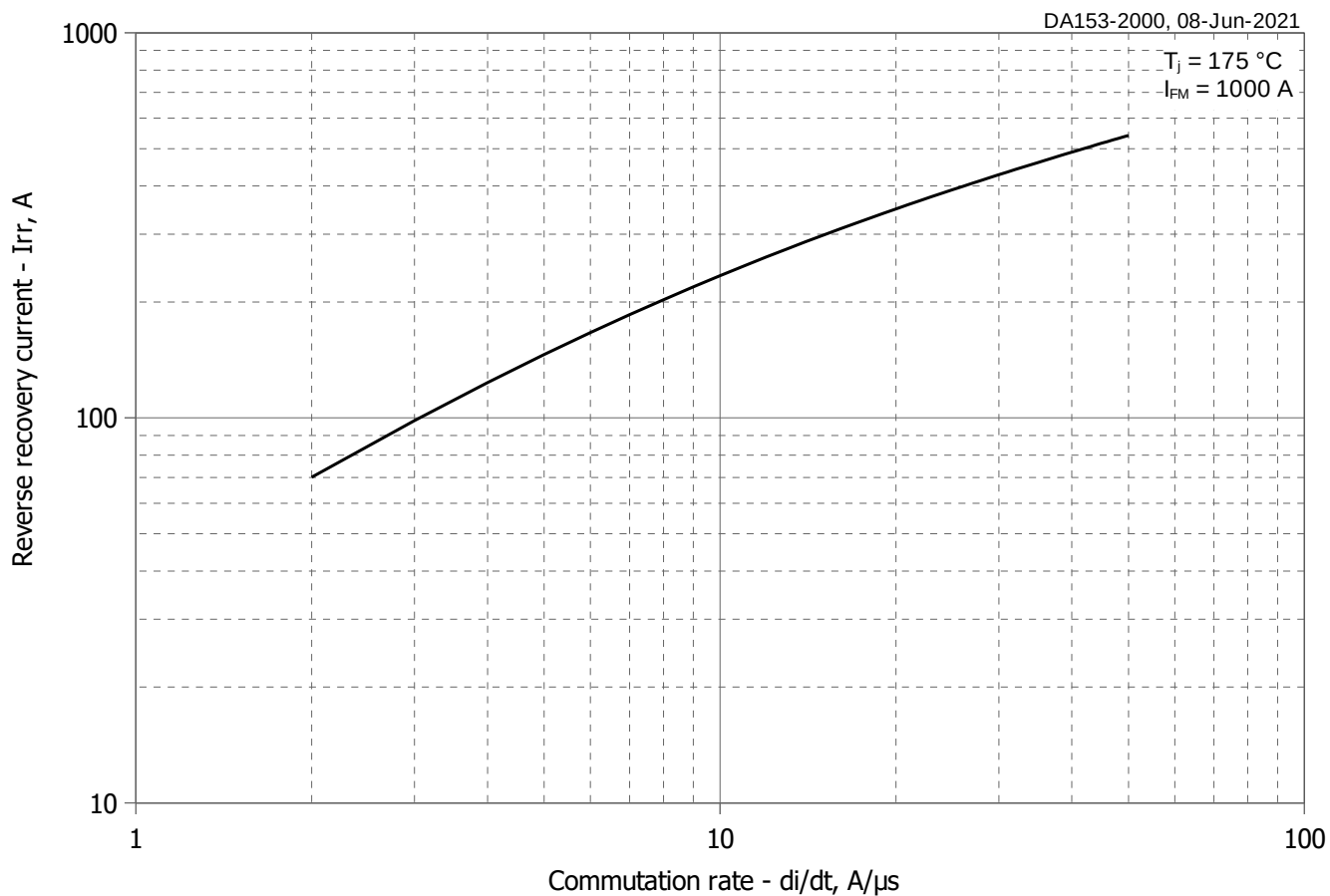


Fig 5 - Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

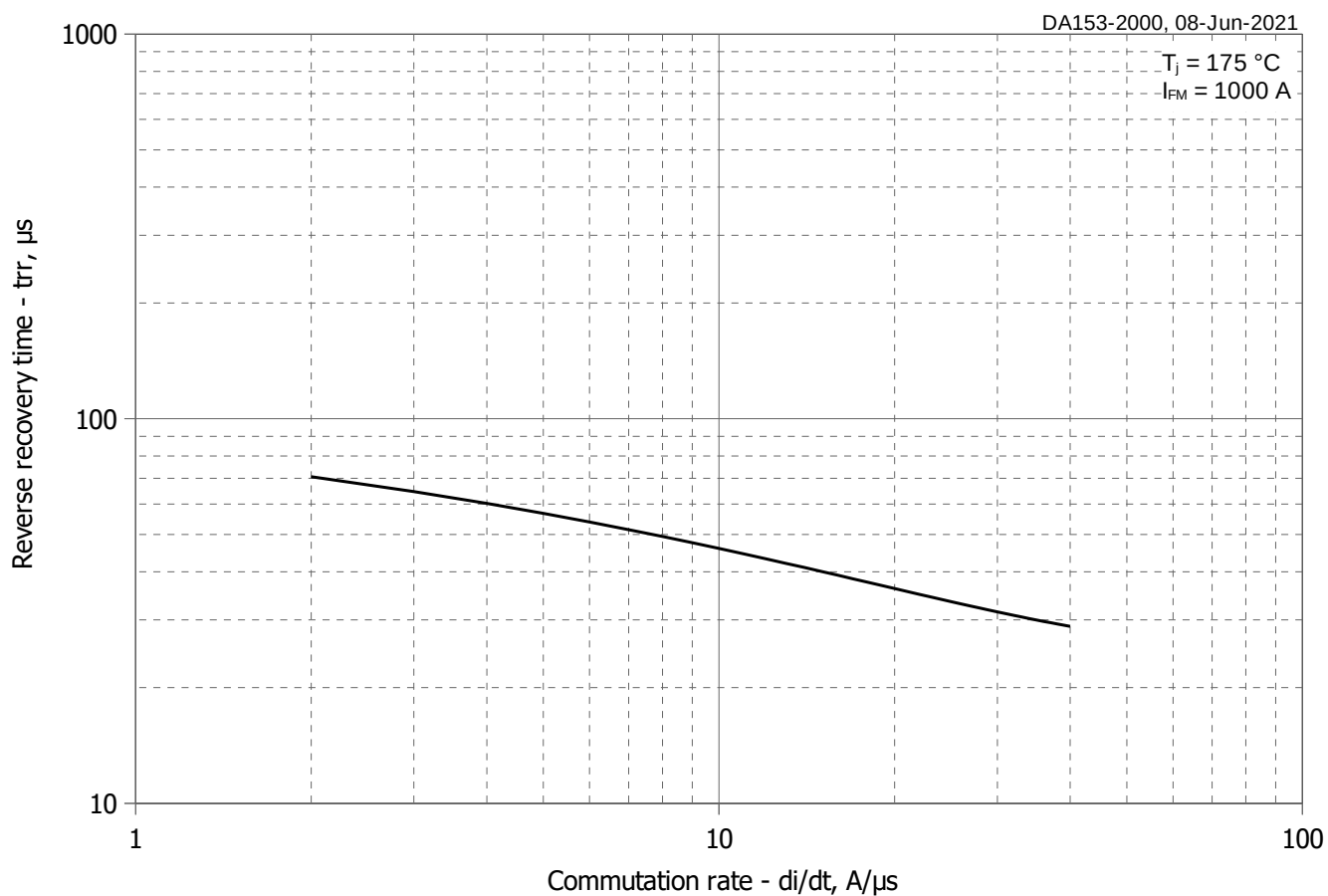


Fig 6 - Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

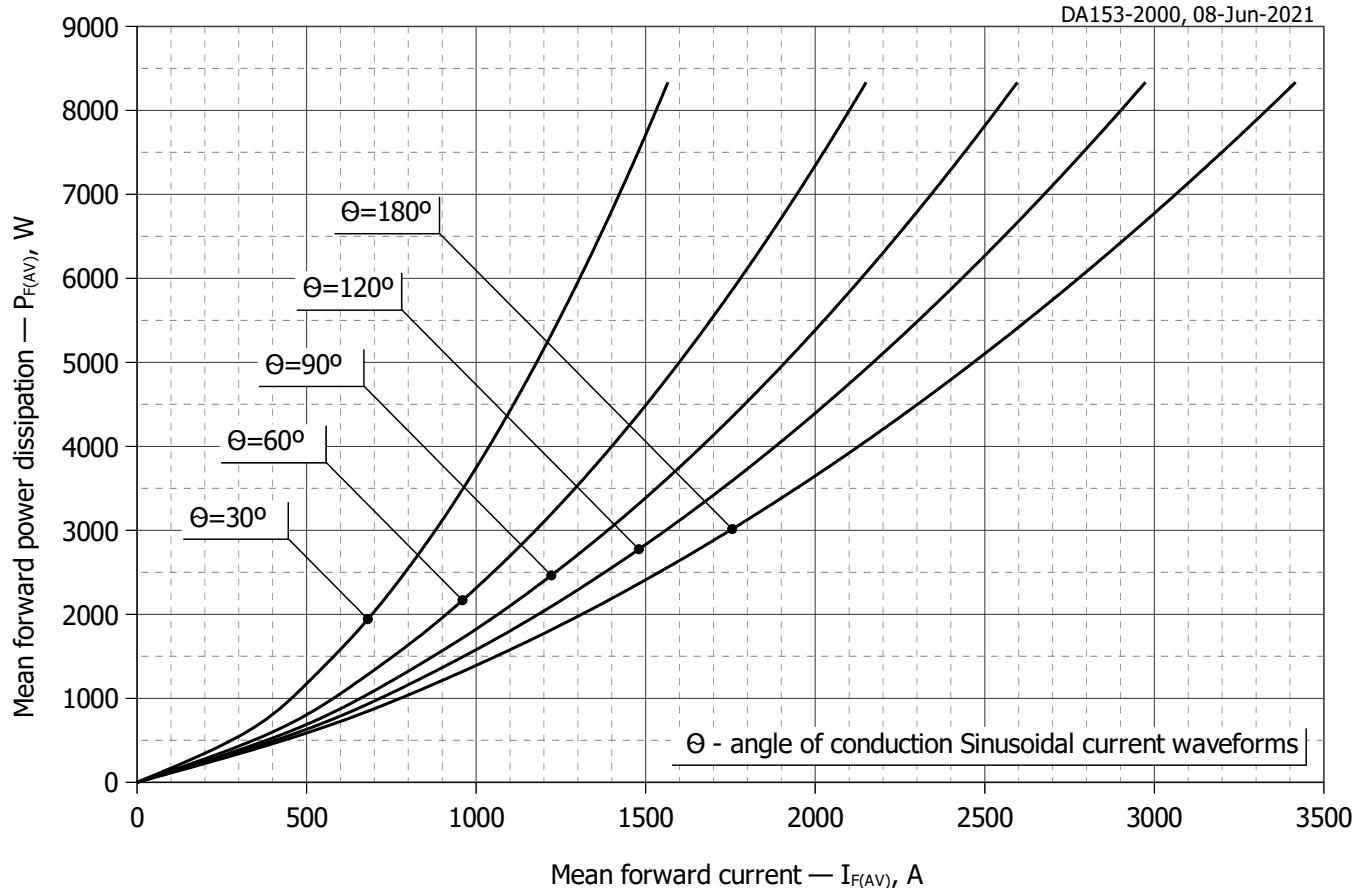


Fig. 7 - Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$, DSC)

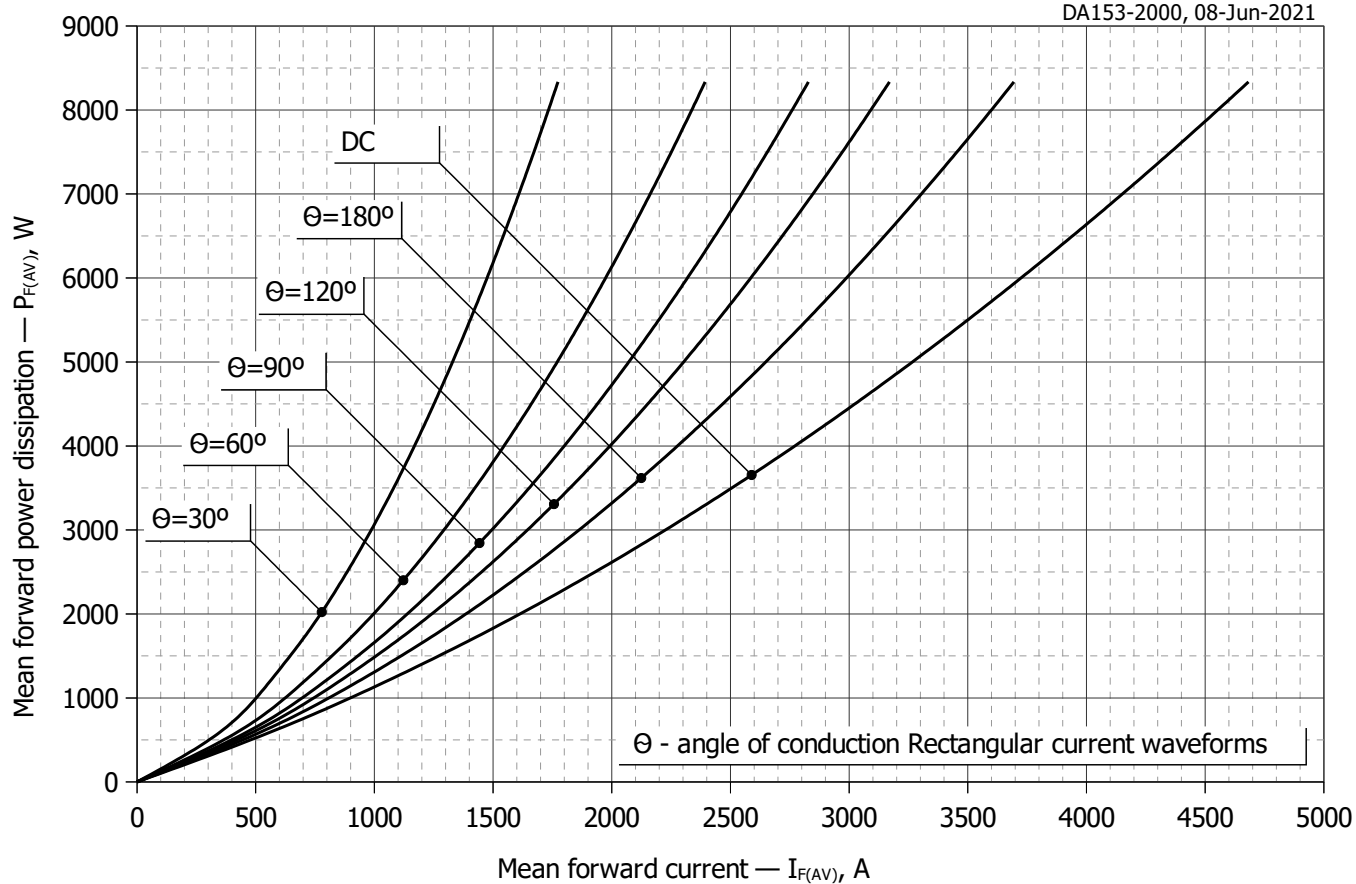


Fig. 8 - Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$, DSC)

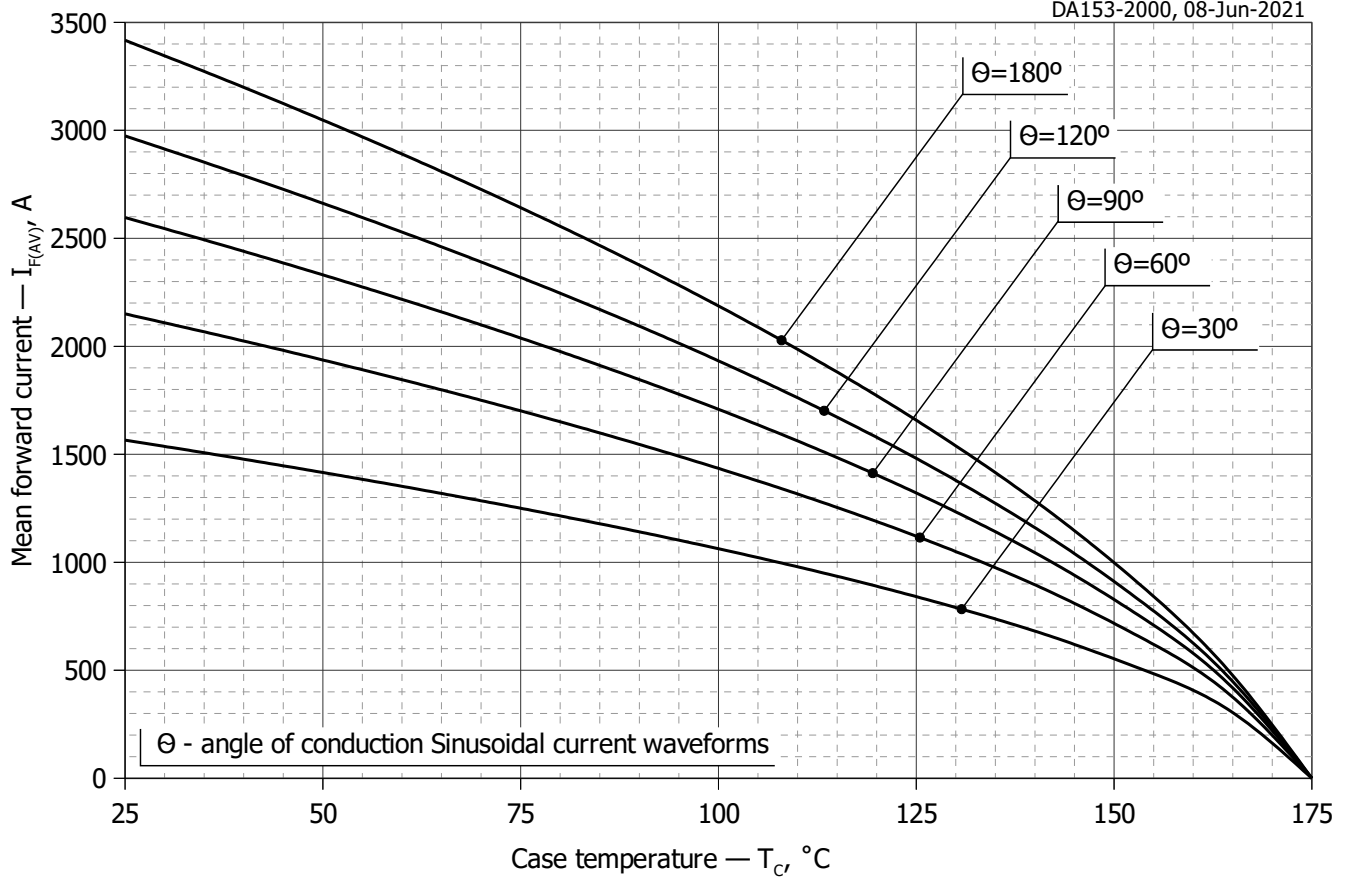


Fig. 9 – Mean forward current I_{FAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$, DSC)

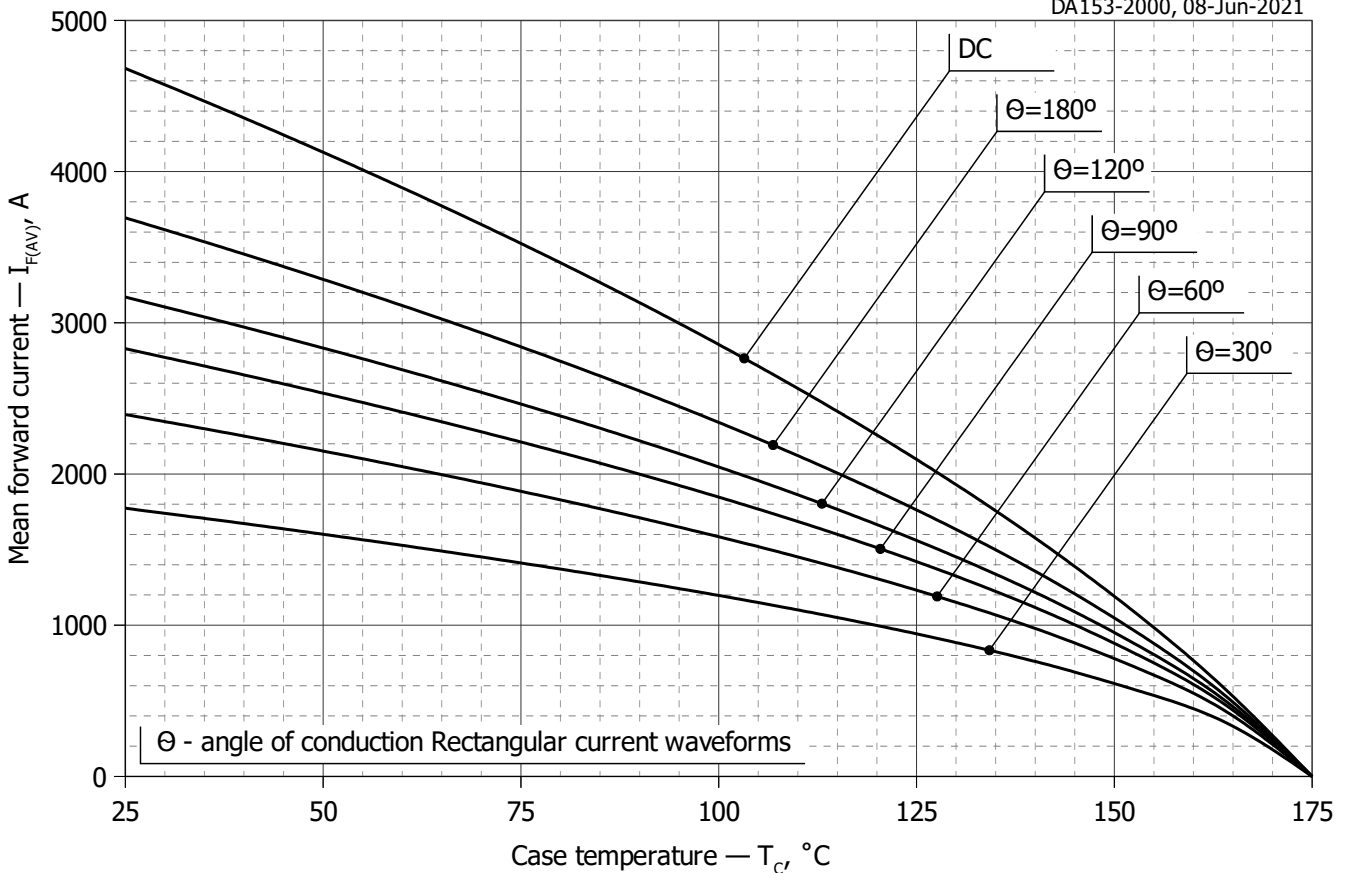


Fig. 10 - Mean forward current I_{FAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$, DSC)

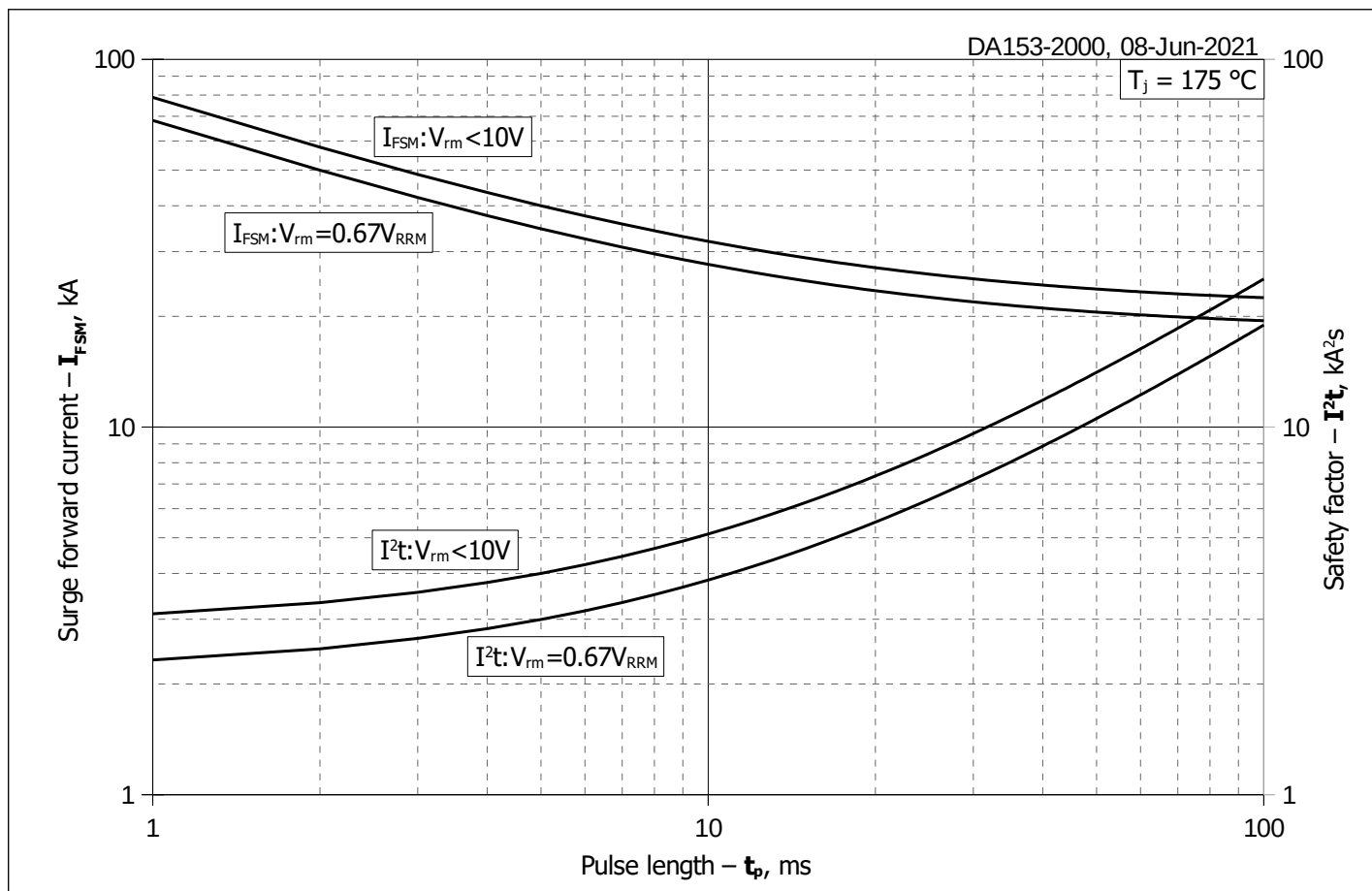


Fig. 11 – Maximum surge forward current I_{FSM} and safety factor I^2t vs. pulse length t_p

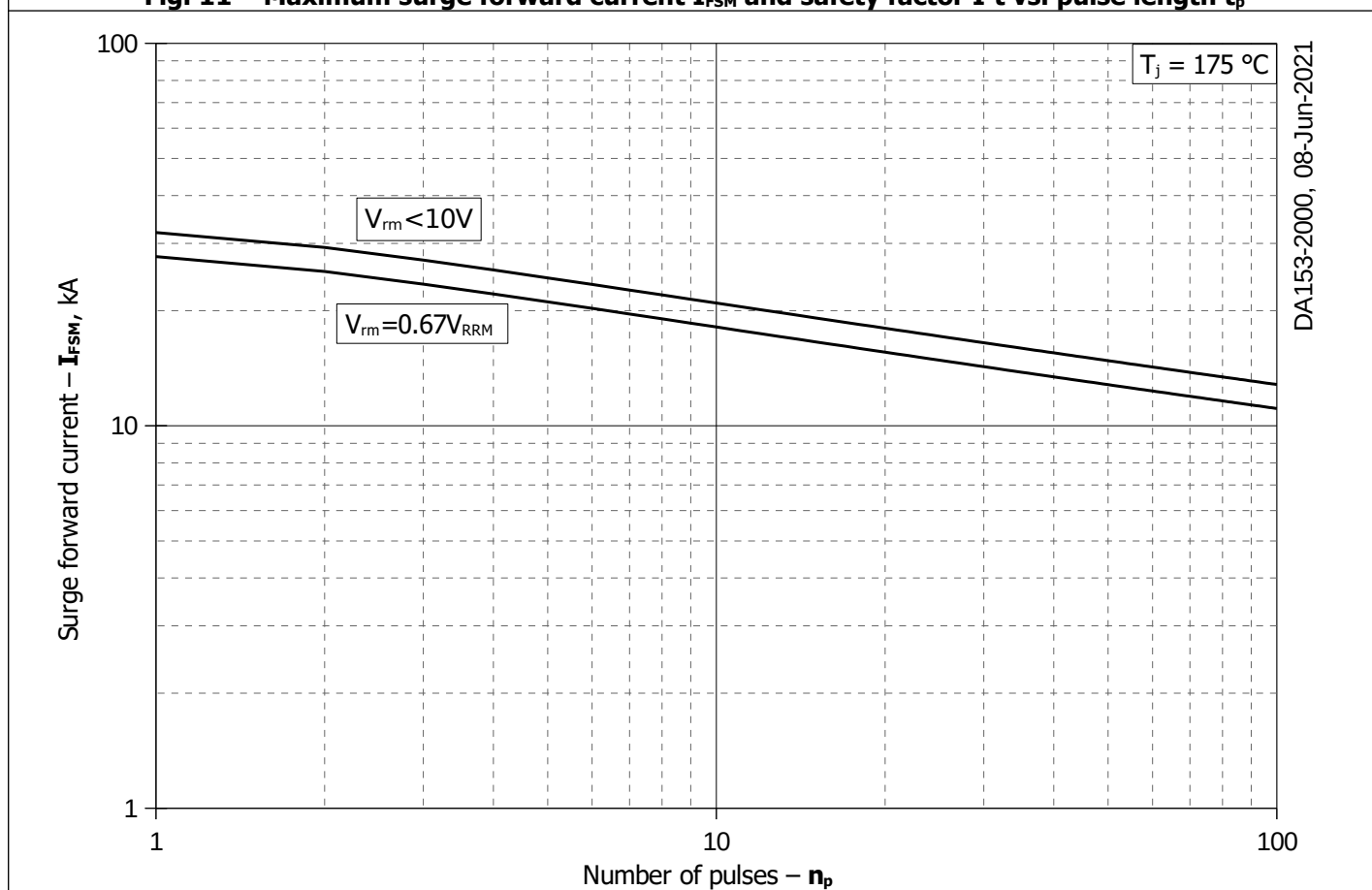


Fig. 12 - Maximum surge forward current I_{FSM} vs. number of pulses n_p