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

Rectifier Diode
Type D133-400-40

Average forward current		I_{FAV}	400 A
Repetitive peak reverse voltage		V_{RRM}	3800...4000 V
V_{RRM}, V	3800		4000
Voltage code	38		40
T_j, °C	–60...+150		

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{FAV}	Maximum allowable average forward current	A	400 632	T_c=124 °C; Double side cooled; T_c=100 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{FRMS}	RMS forward current	A	628	T_c=124 °C; Double side cooled; 180° half-sine wave; 50 Hz	
I_{FSM}	Surge forward current	kA	7.0 7.5	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; t_p=10 ms; single pulse; V_R=0 V
			7.5 8.5	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^2t	Safety factor	$A^2s\cdot10^3$	240 280	T_j=$T_{j\,max}$ T_j=25 °C	180° half-sine wave; t_p=10 ms; single pulse; V_R=0 V
			230 290	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	3800...4000	$T_{j\,min}$< T_j <$T_{j\,max}$; 180° half-sine wave; 50 Hz	
V_{RSM}	Non-repetitive peak reverse voltages	V	3900...4100	$T_{j\,min}$< 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...+50		
T_j	Operating junction temperature	°C	–60...+150		
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	1.85	T_j=25 °C; I_{FM}=1256 A	
$V_{F(TO)}$	Forward threshold voltage, max	V	1.089	$T_j=T_{j\,max}$; 0.5 π I_{FAV} < I_T < 1.5 π I_{FAV}	
r_T	Forward slope resistance, max	mΩ	0.714		
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	2410	T_j=150 °C; I_{TM}=400 A; di_R/dt=-5 A/μs; V_R=100 V	
t_{rr}	Reverse recovery time, max	μs	37		
I_{rr}	Reverse recovery current, max	A	130		
THERMAL					
R_{thjc}	Thermal resistance, junction to case, max	°C/W	0.036	Direct current	Double side cooled
R_{thjc-A}			0.079		Anode side cooled
R_{thjc-K}			0.065		Cathode side cooled
R_{thck}	Thermal resistance, case to heatsink, max	°C/W	0.008	Direct current	
MECHANICAL					
m	Weight, max	g	180		
D_s	Surface creepage distance	mm (inch)	23.69 (0.933)		
D_a	Air strike distance	mm (inch)	19.10 (0.752)		

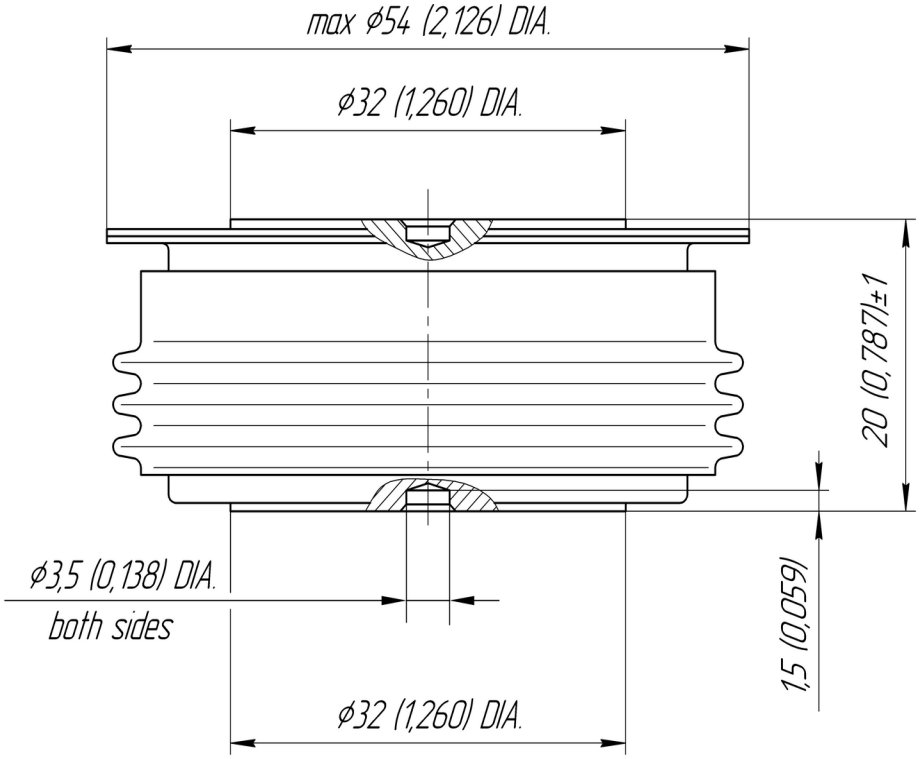
PART NUMBERING GUIDE

D	133	400	40	N
1	2	3	4	5

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

OVERALL DIMENSIONS

Package type: D.B2



All dimensions in millimeters (inches)

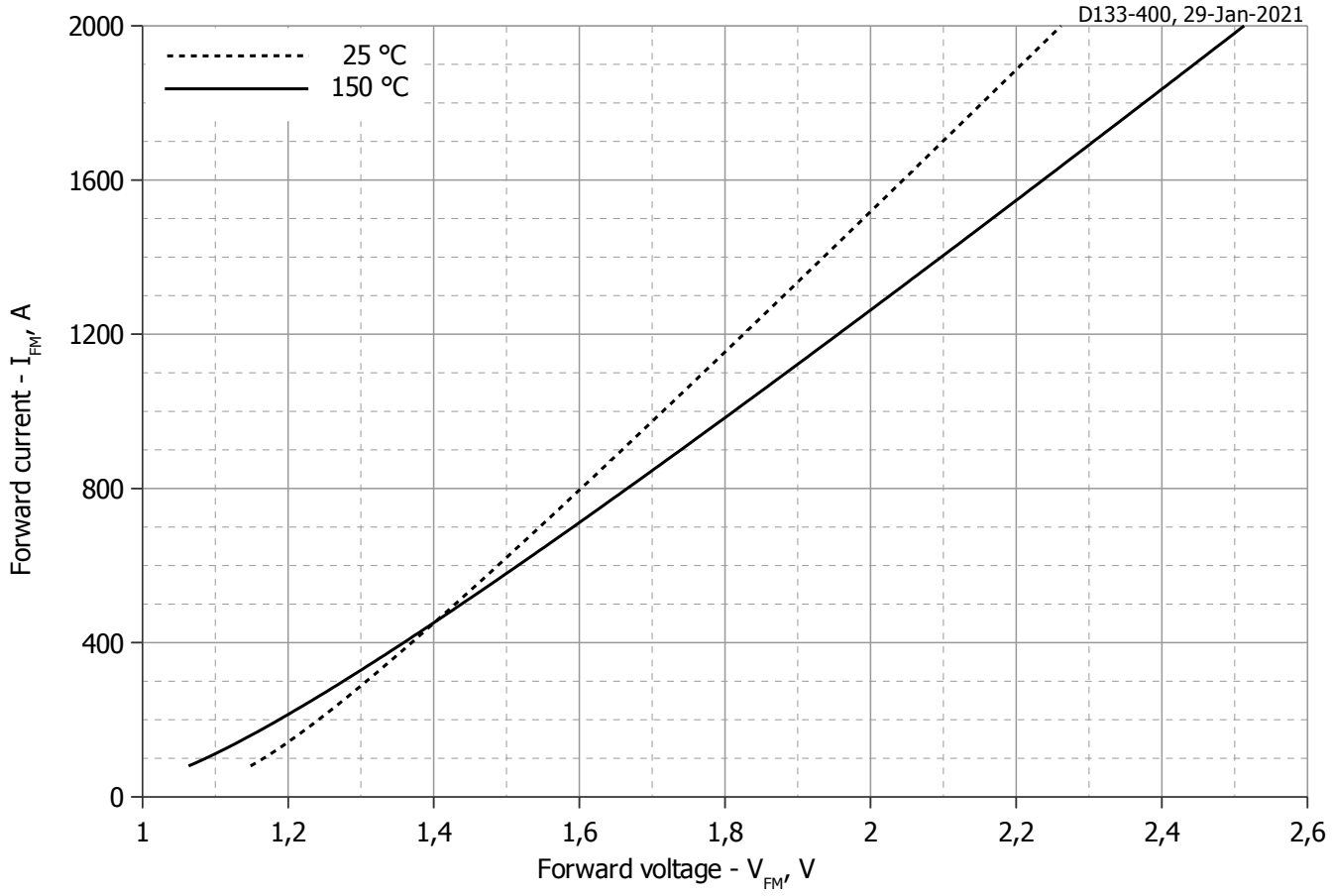


Fig 1 – Forward characteristics of Limit device

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°C	$T_j = T_{j\,max}$
A	0.95907119	0.85955567
B	0.00052398	0.00061229
C	0.03357297	0.02405616
D	-0.00001234	0.00550143

Forward characteristic model (see Fig. 1).

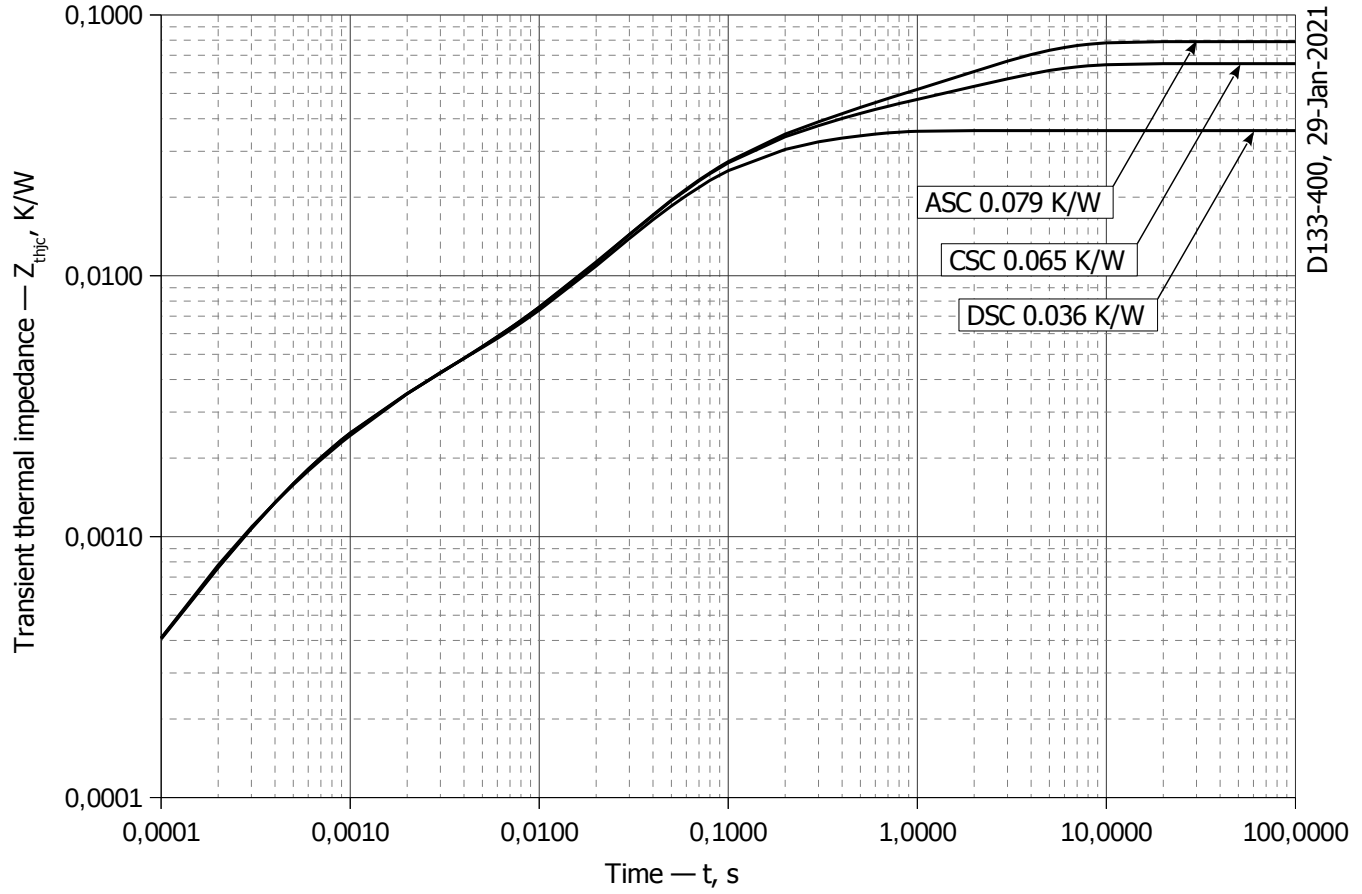


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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 constatnt of r_{th} term.

DC Double side cooled

i	1	2	3	4	5	6
R_i, K/W	0.0102	0.01906	0.003576	0.002535	-4.67e-005	0.000648
τ_i, s	0.265	0.05901	0.03499	0.001252	0.000001	0.0002488

DC Cathode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.02506	0.01306	0.002934	0.0206	0.00149	0.00179
τ_i, s	2.647	0.2831	0.1455	0.05284	0.002255	0.0005519

DC Anode side cooled

i	1	2	3	4	5	6
R_i, K/W	0.03904	0.001789	0.01342	0.0215	0.00137	0.00195
τ_i, s	2.651	0.4195	0.2622	0.05451	0.002585	0.0005847

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

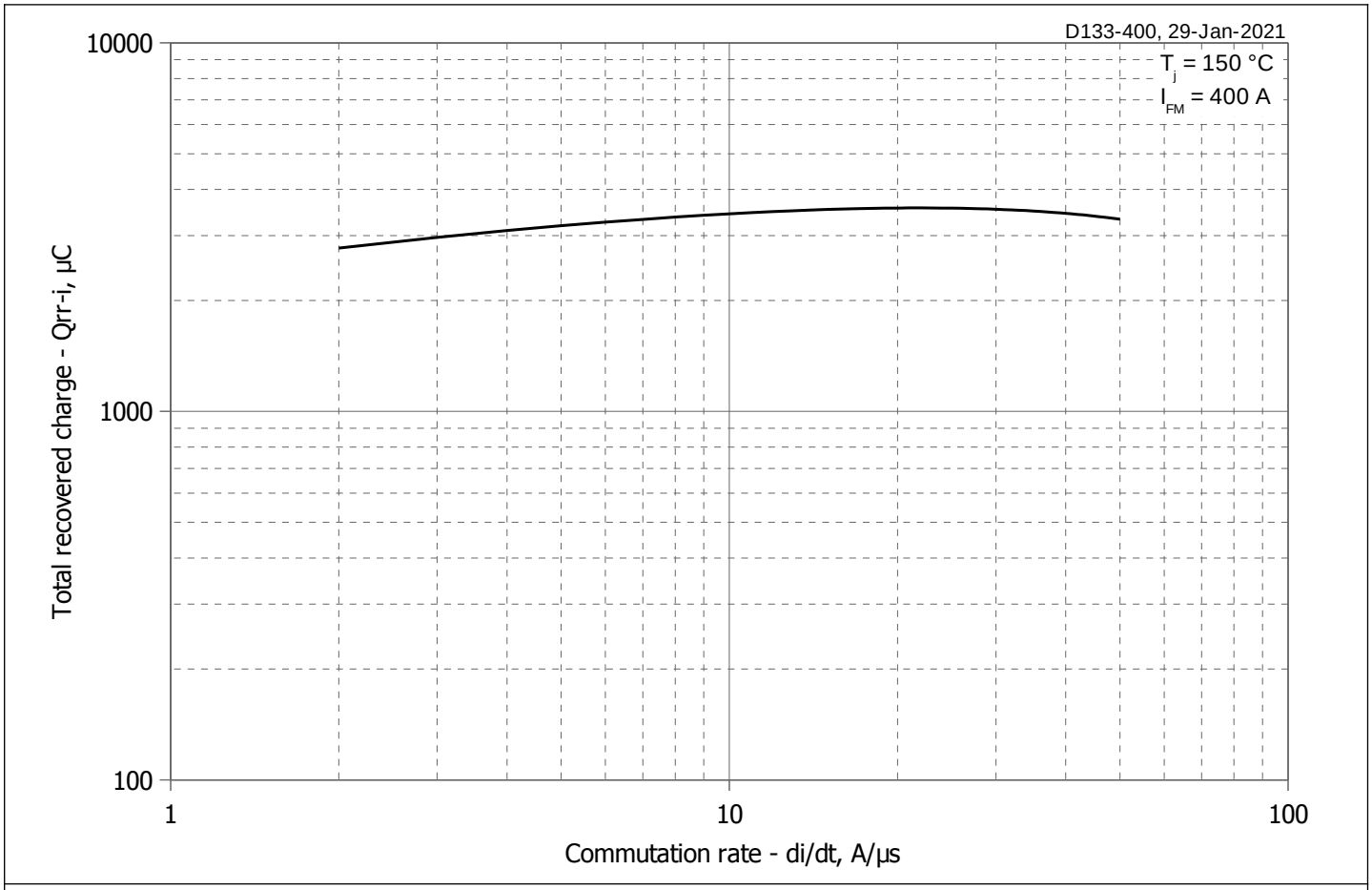


Fig 3 - Total recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

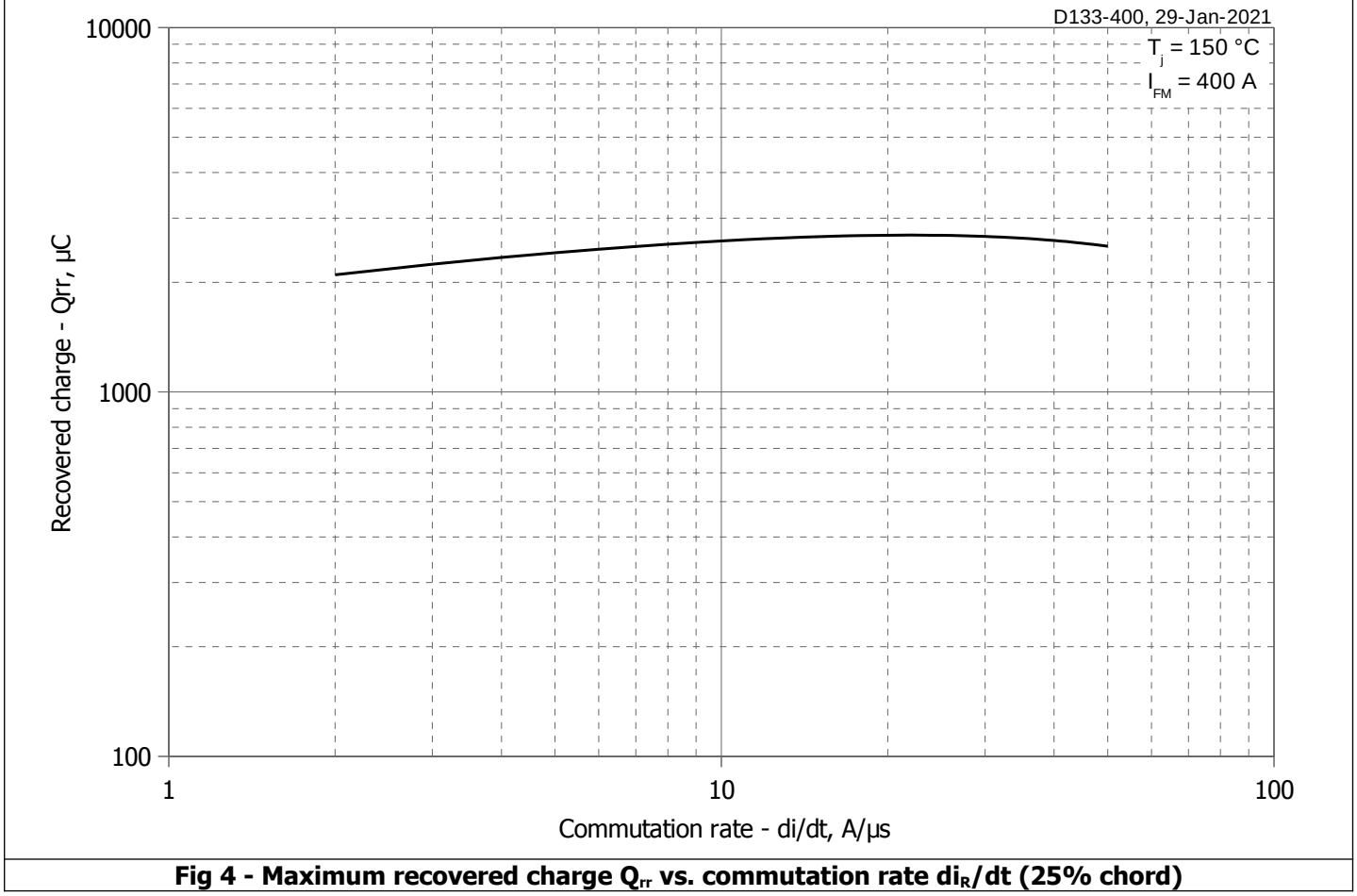


Fig 4 - Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

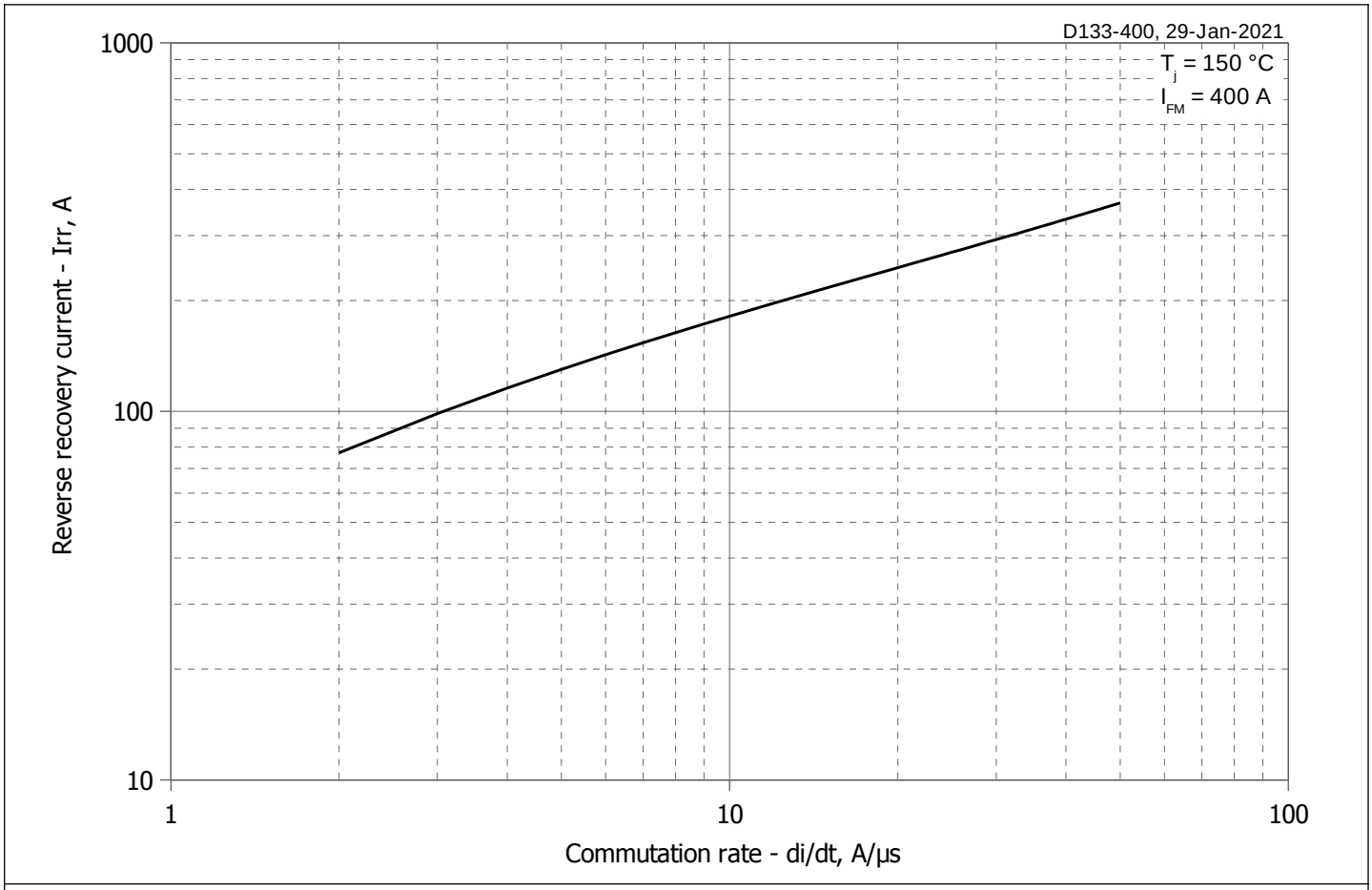


Fig 5 - Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

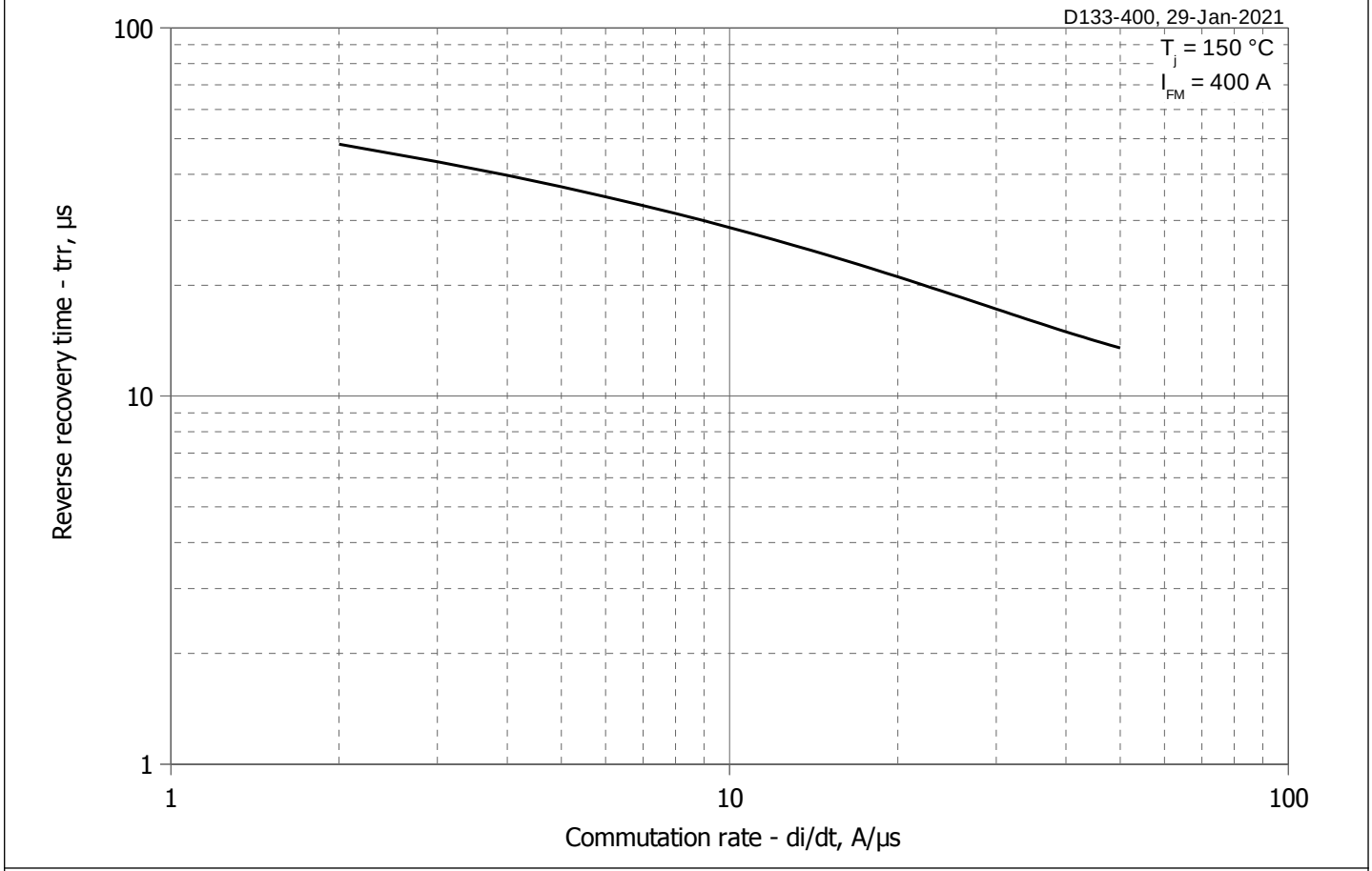


Fig 6 - Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

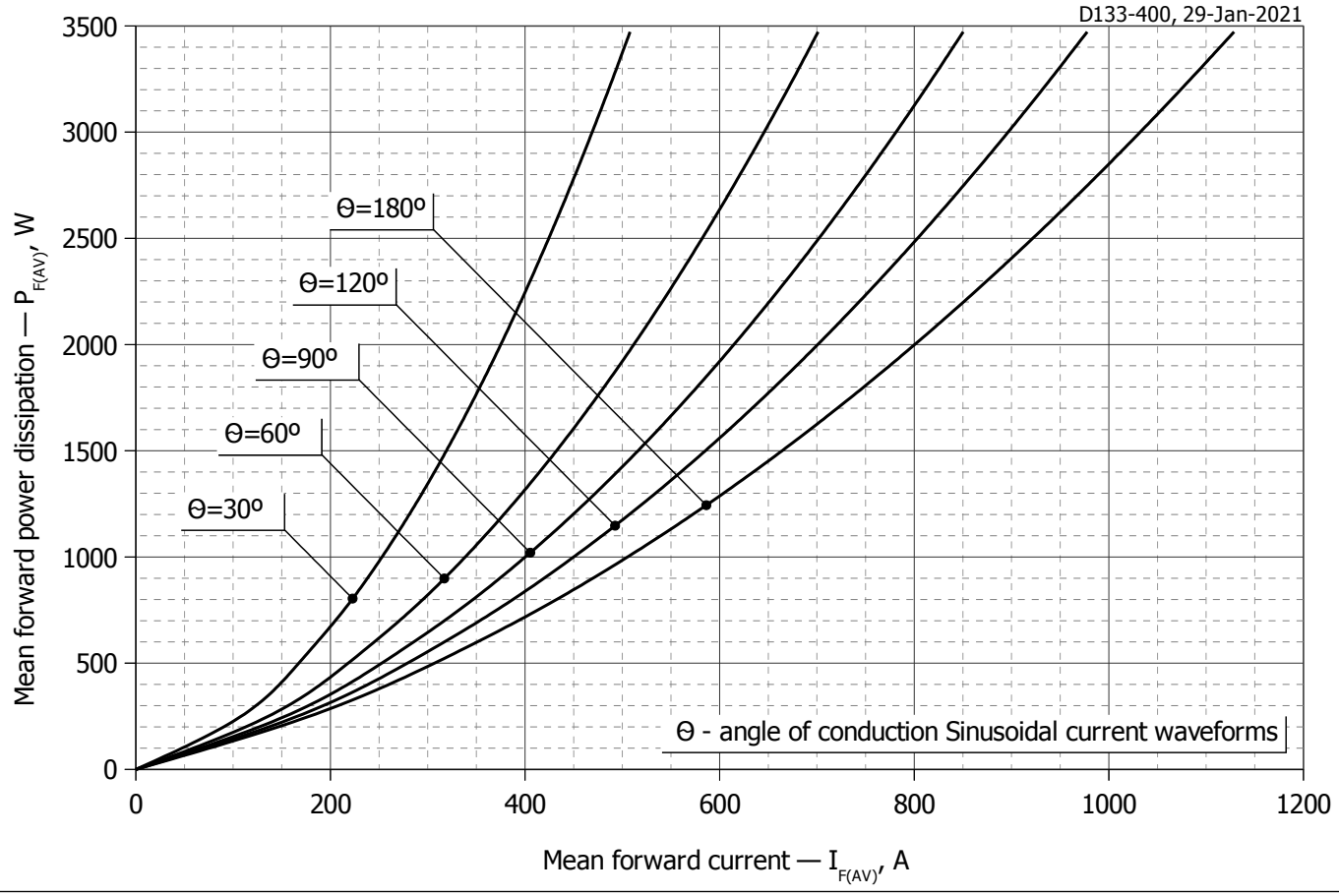


Fig. 7 - Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

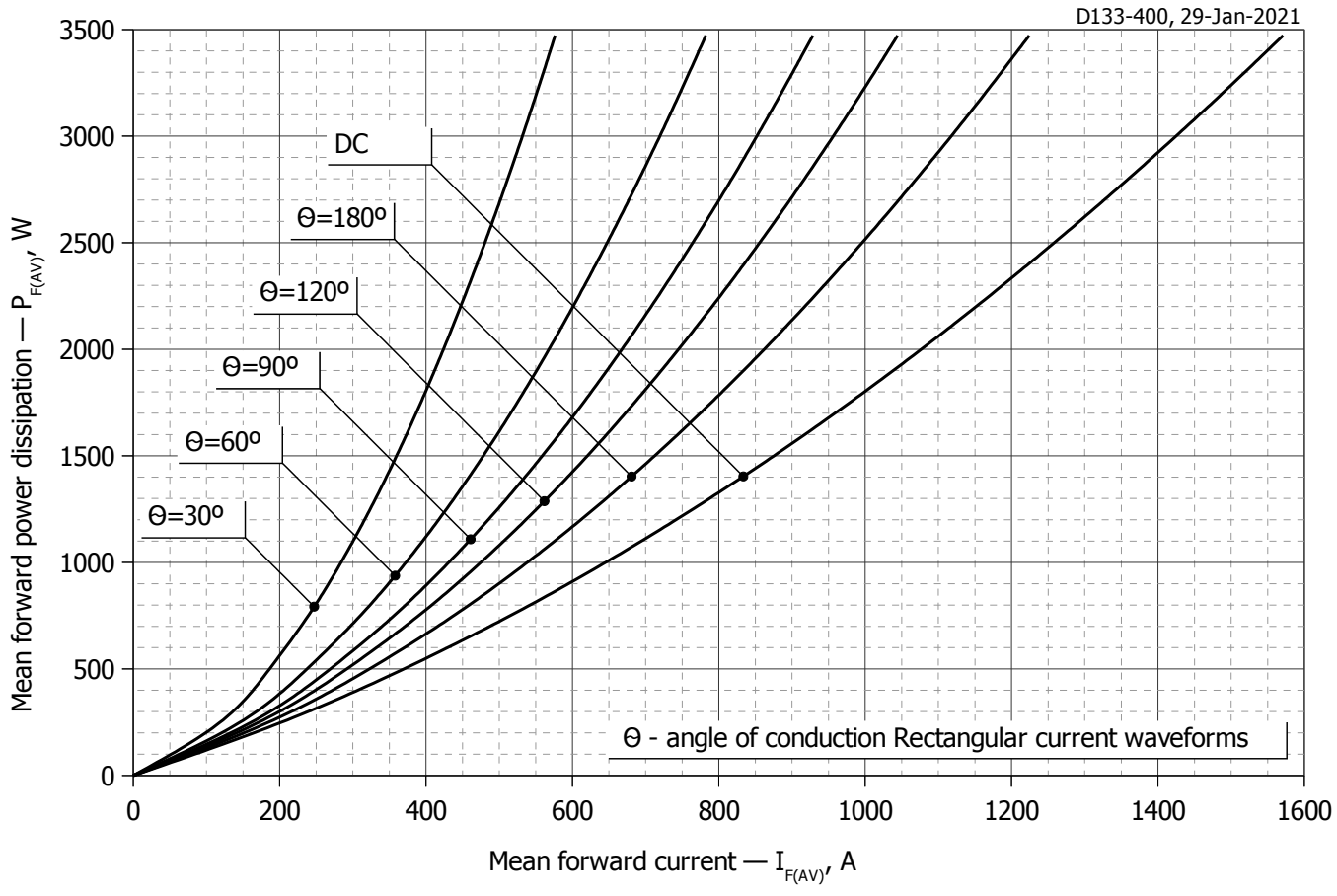


Fig. 8 – Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

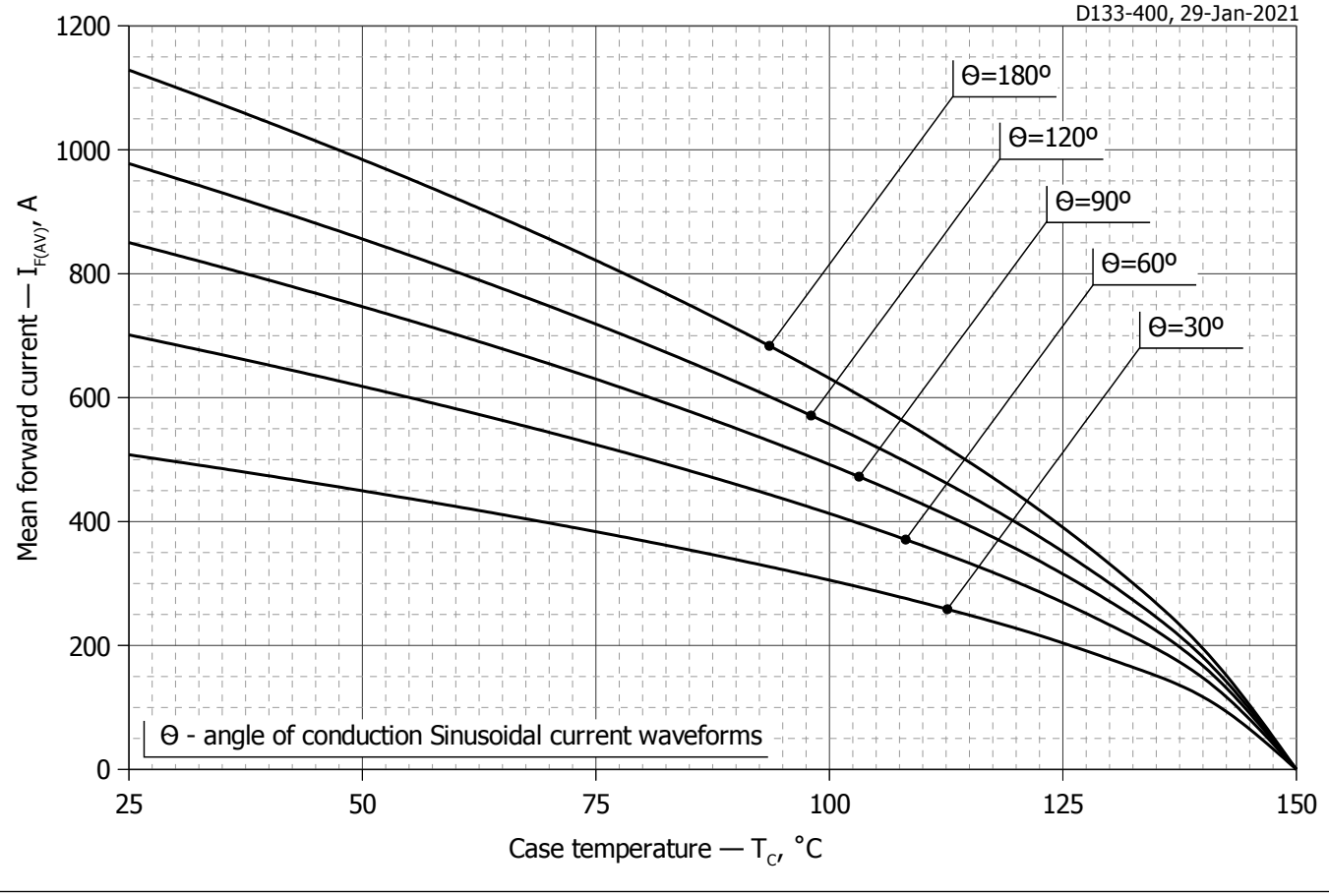


Fig. 9 – Mean forward current I_{FAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

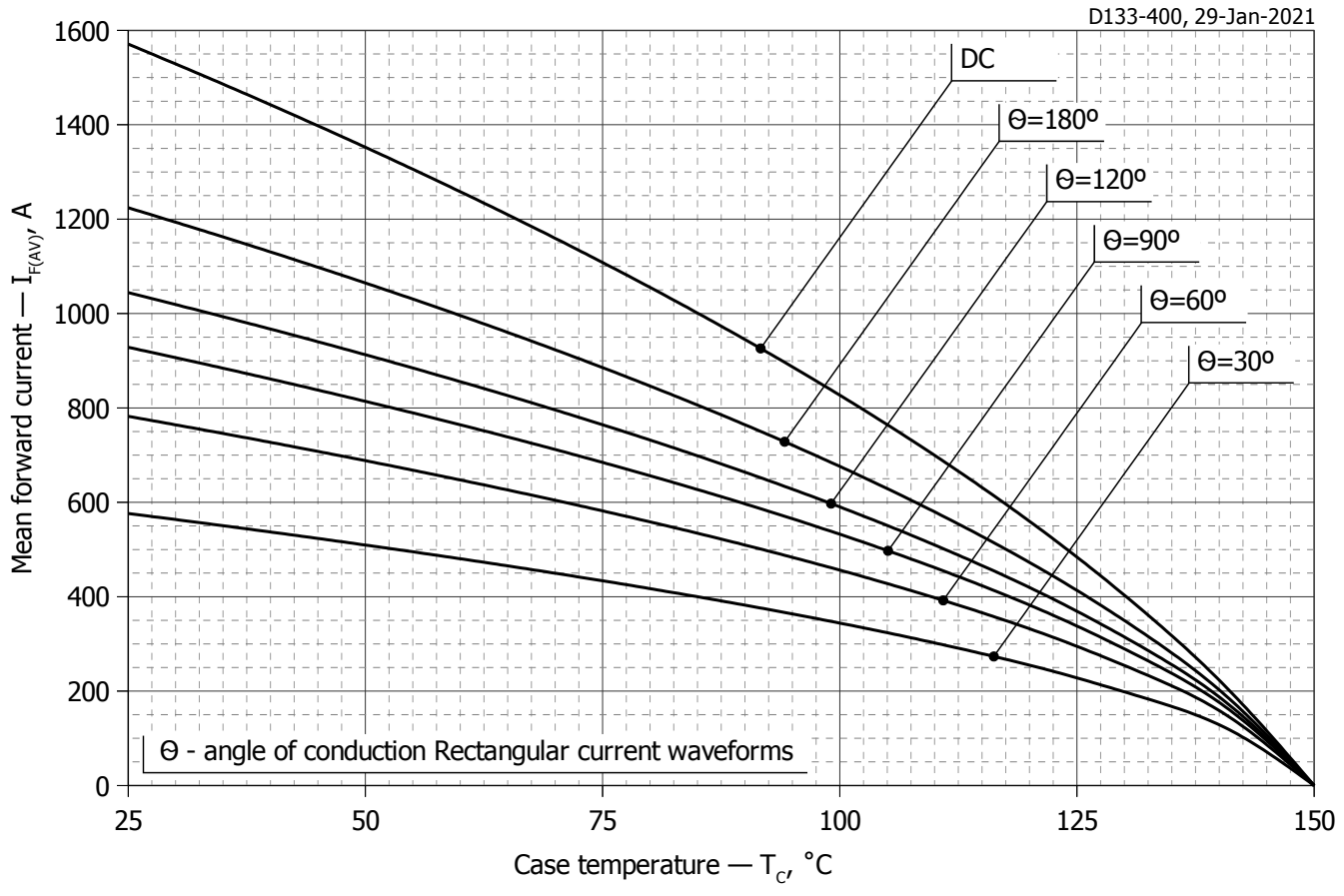


Fig. 10 - Mean forward current I_{FAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

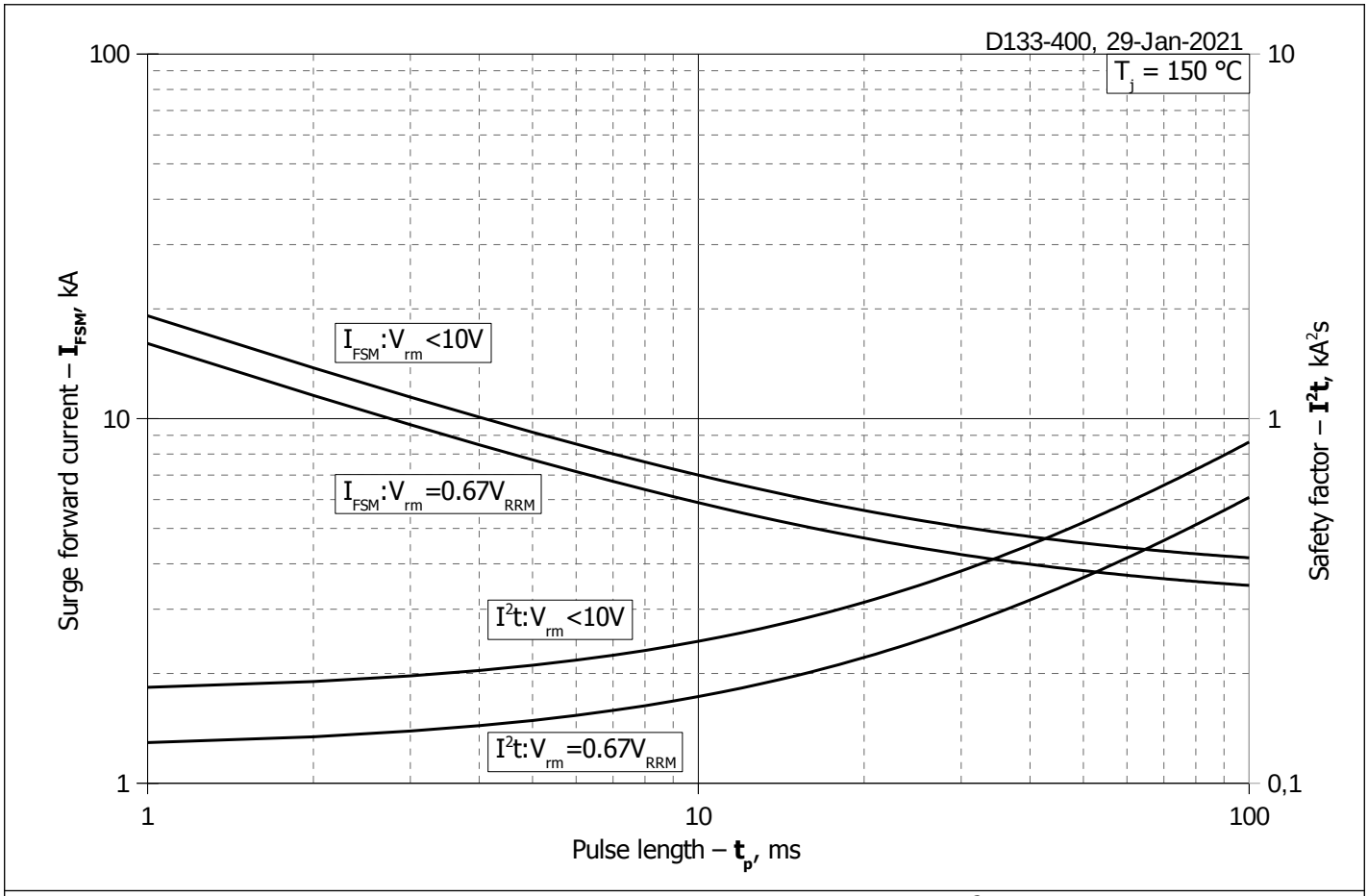


Fig. 11 – Maximum surge forward current I_{FSM} and safety factor I^2t vs. pulse length t_p

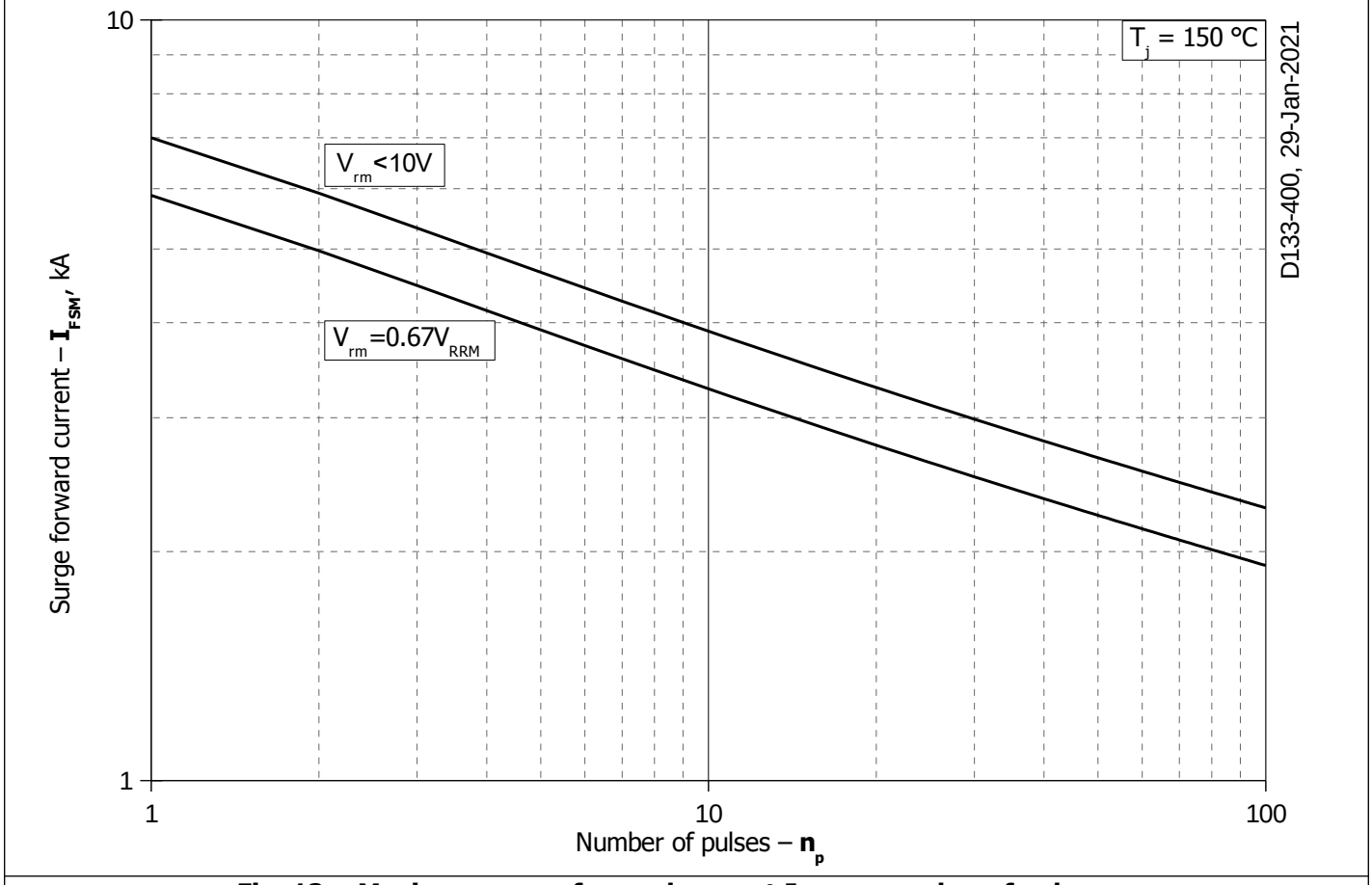


Fig. 12 - Maximum surge forward current I_{FSM} vs. number of pulses n_p