



Electrically isolated base plate
Industrial standard package
Simplified mechanical design, rapid assembly
Pressure contact

**Double Diode Module
For Phase Control
MDx-400-18-C1**

Average forward current				I_{FAV}	400 A			
Repetitive peak reverse voltage				V_{RRM}	1000 ÷ 1800 V			
V_{RRM}, V	1000	1100	1200	1300	1400	1500	1600	1800
Voltage code	10	11	12	13	14	15	16	18
$T_j, °C$	- 40 ÷ 150							

MD3	MD4	MD5

All dimensions in millimeters (inches)

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions
ON-STATE				
I_{FAV}	Average forward current	A	400 445	$T_c=106\text{ }^\circ\text{C}$; $T_c=100\text{ }^\circ\text{C}$; 180° half-sine wave; 50 Hz
I_{FRMS}	RMS forward current	A	628	$T_c=106\text{ }^\circ\text{C}$; 180° half-sine wave; 50 Hz
I_{FSM}	Surge forward current	kA	12.0 14.0	$T_j=T_{j\max}$ $T_j=25\text{ }^\circ\text{C}$ 180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_R=0\text{ V}$;
			13.0 15.0	$T_j=T_{j\max}$ $T_j=25\text{ }^\circ\text{C}$ 180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_R=0\text{ V}$;
I^2t	Safety factor	$A^2s\cdot 10^3$	720 980	$T_j=T_{j\max}$ $T_j=25\text{ }^\circ\text{C}$ 180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_R=0\text{ V}$;
			700 930	$T_j=T_{j\max}$ $T_j=25\text{ }^\circ\text{C}$ 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	1000÷1800	$T_{j\min} < T_j < T_{j\max}$; 180° half-sine wave; 50 Hz;
V_{RSM}	Non-repetitive peak reverse voltages	V	1100÷1900	$T_{j\min} < T_j < T_{j\max}$; 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	$^\circ\text{C}$	- 40 ÷ 50	
T_j	Operating junction temperature	$^\circ\text{C}$	- 40 ÷ 150	
$T_{c\text{ op}}$	Operating temperature	$^\circ\text{C}$	- 40 ÷ 125	
MECHANICAL				
a	Acceleration under vibration	m/s^2	50	

CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions
ON-STATE				
V_{FM}	Peak forward voltage, max	V	1.20	$T_j=25\text{ }^\circ\text{C}$; $I_{FM}=785\text{ A}$
$V_{F(TO)}$	Forward threshold voltage, max	V	0.75	$T_j=T_{j\max}$;
r_T	Forward slope resistance, max	$\text{m}\Omega$	0.250	$0.5\pi I_{FAV} < I_T < 1.5\pi I_{FAV}$
BLOCKING				
I_{RRM}	Repetitive peak reverse current, max	mA	30	$T_j=T_{j\max}$; $V_R=V_{RRM}$
SWITCHING				
Q_{rr}	Total recovered charge, max	μC	1280	$T_j=T_{j\max}$; $I_{TM}=400\text{ A}$;
t_{rr}	Reverse recovery time, max	μs	19	$di_R/dt=-10\text{ A}/\mu\text{s}$;
I_{rrM}	Peak reverse recovery current, typ	A	135	$V_R=100\text{ V}$
THERMAL				
R_{thjc}	Thermal resistance, junction to case			180° half-sine wave, 50 Hz
	per module	$^\circ\text{C}/\text{W}$	0.0550	
	per arm	$^\circ\text{C}/\text{W}$	0.1100	
R_{thch}	Thermal resistance, case to heatsink			
	per module	$^\circ\text{C}/\text{W}$	0.0200	
	per arm	$^\circ\text{C}/\text{W}$	0.0400	

INSULATION					
V _{ISOL}	Insulation test voltage	kV	3.00	Sine wave, 50 Hz; RMS	t=60 sec
			3.60		t=1 sec
MECHANICAL					
M ₁	Mounting torque (M6) ¹⁾	Nm	6.00	Tolerance ± 15%	
M ₂	Terminal connection torque (M8) ¹⁾	Nm	9.00	Tolerance ± 15%	
w	Weight, max	g	860		

PART NUMBERING GUIDE						NOTES					
MD	3	-	400	-	18	-	C1	-	N		¹⁾ The screws must be lubricated
1	2		3		4		5		6		
1. MD - Rectifier Diode 2. Circuit Schematic 3. Average Forward Current, A 4. Voltage Code 5. Package Type (M.C1) 6. Ambient Conditions: N – Normal											

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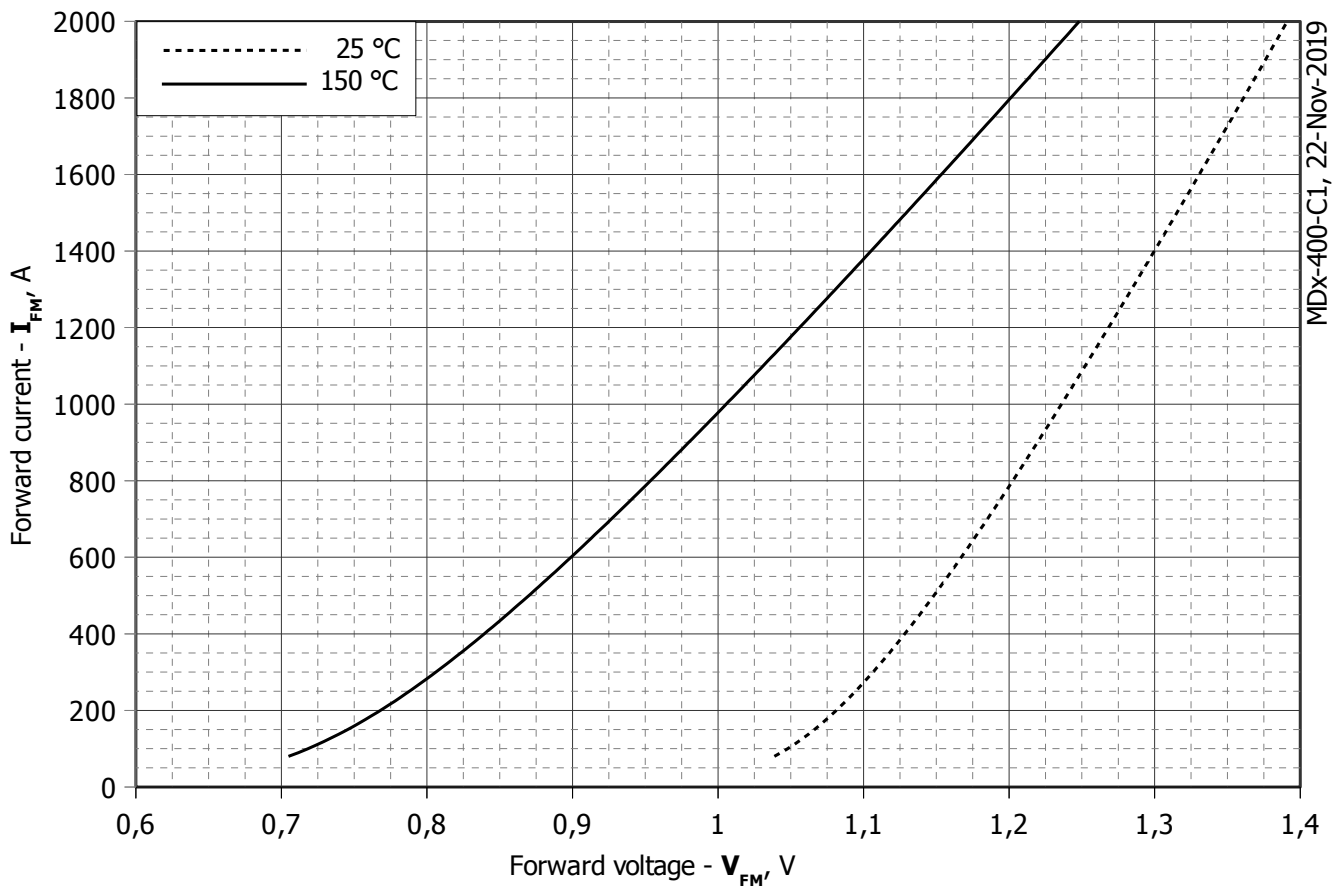


Fig 1 – Forward characteristics of Limit device

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	0.90122000	0.507080000
B	0.00013450	0.000213209
C	0.02871700	0.040971000
D	0.00005889	0.000070017

Forward characteristic model (see Fig. 1).

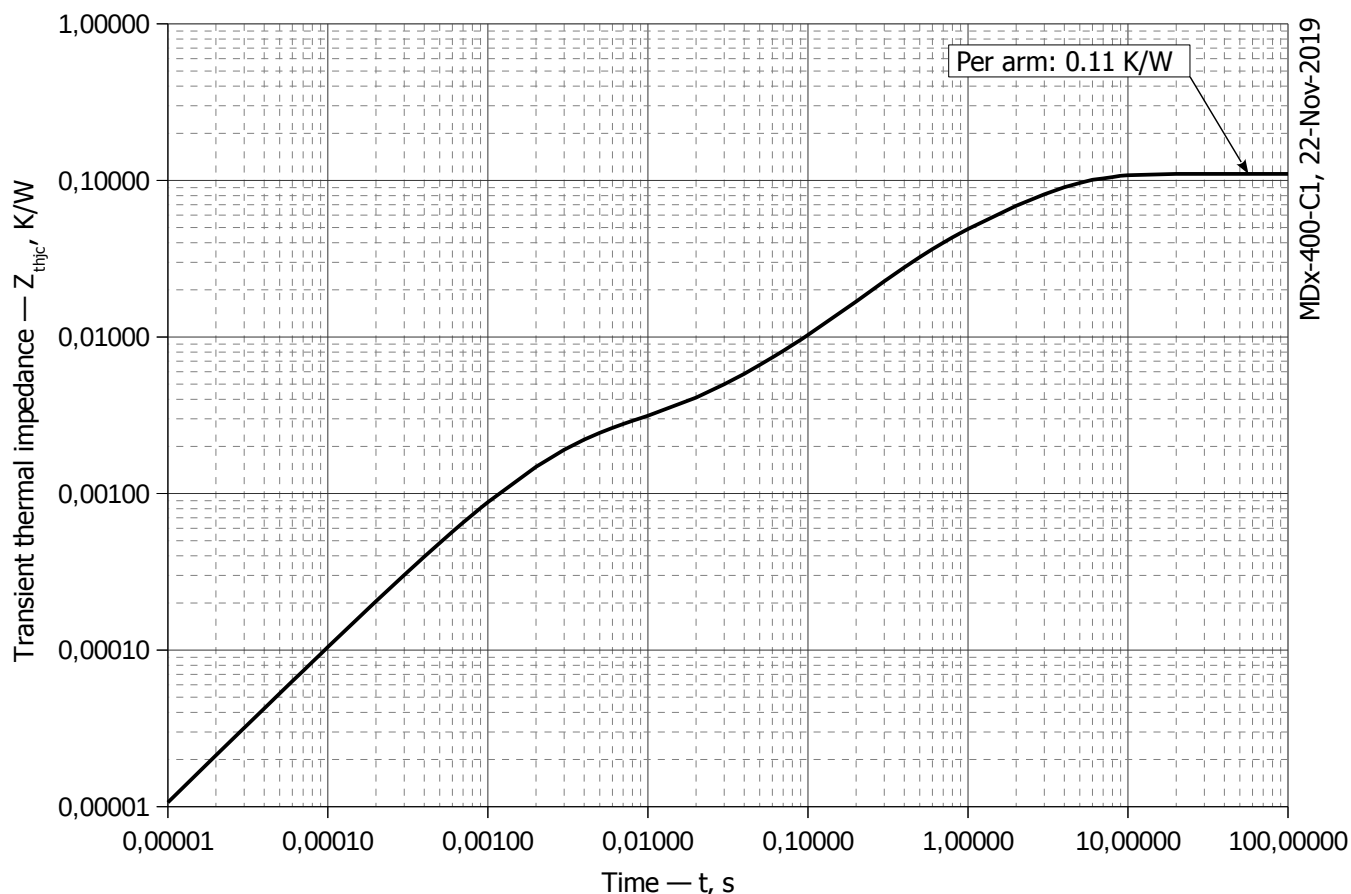


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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

i	1	2	3	4	5	6
R_i, K/W	0.0808	0.007806	0.02226	-0.007688	0.00471	0.00217
τ_i, s	2.801	1.283	0.3281	0.09408	0.0572	0.002255

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

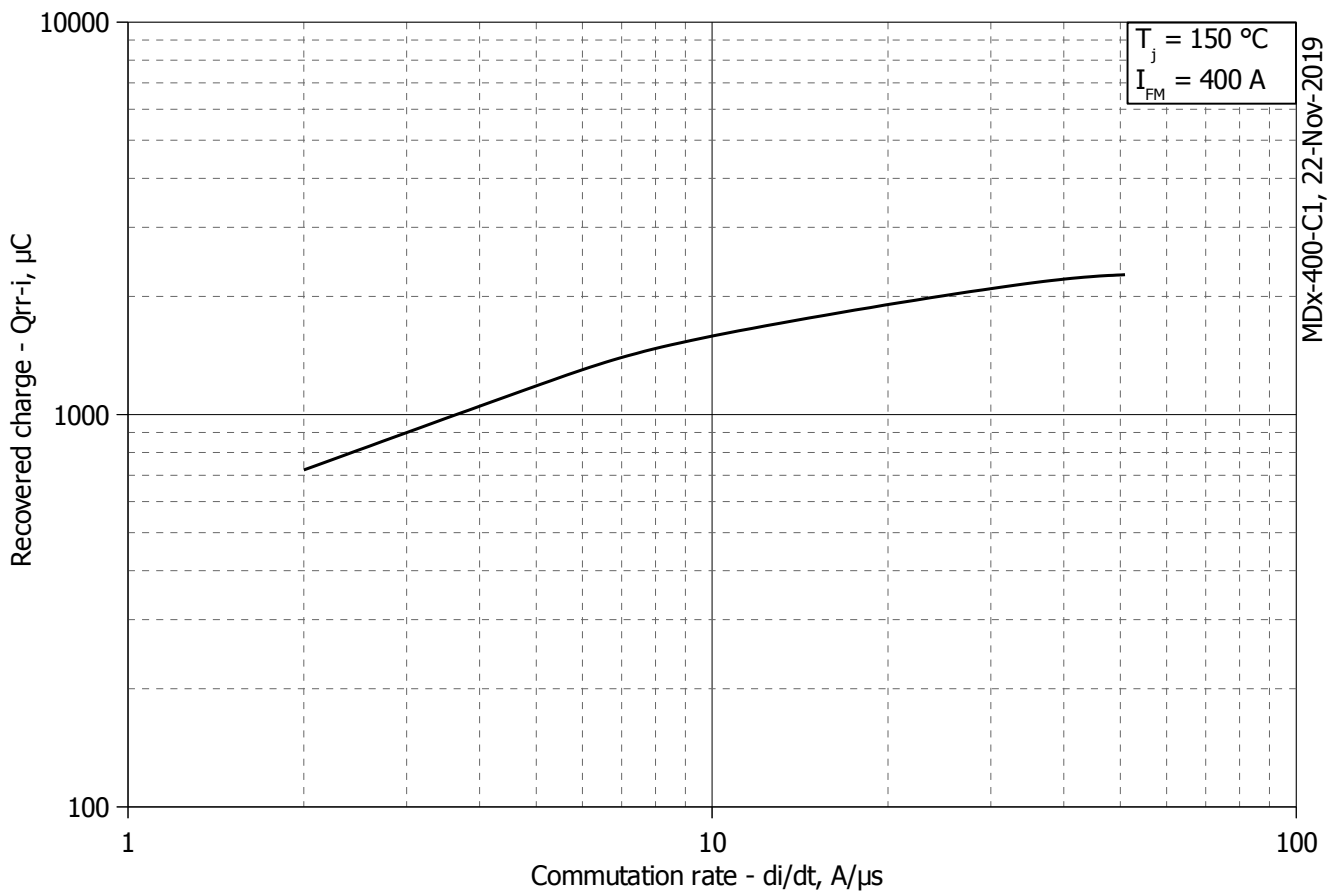


Fig 3 – Maximum recovered charge Q_{rr-i} (integral) vs. commutation rate di_R/dt

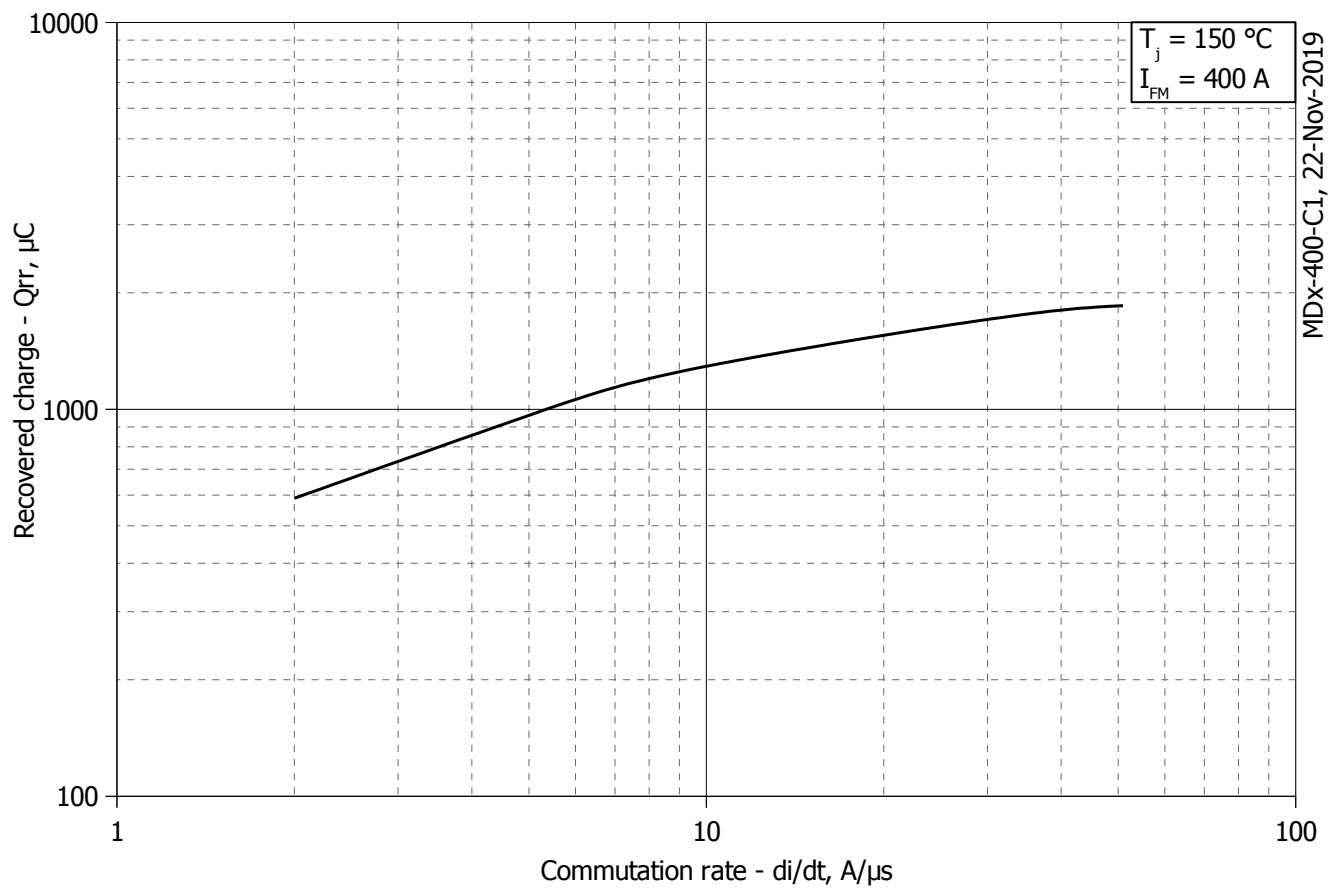


Fig 4 – Maximum recovered charge Q_{rr} vs. commutation rate di_R/dt (25% chord)

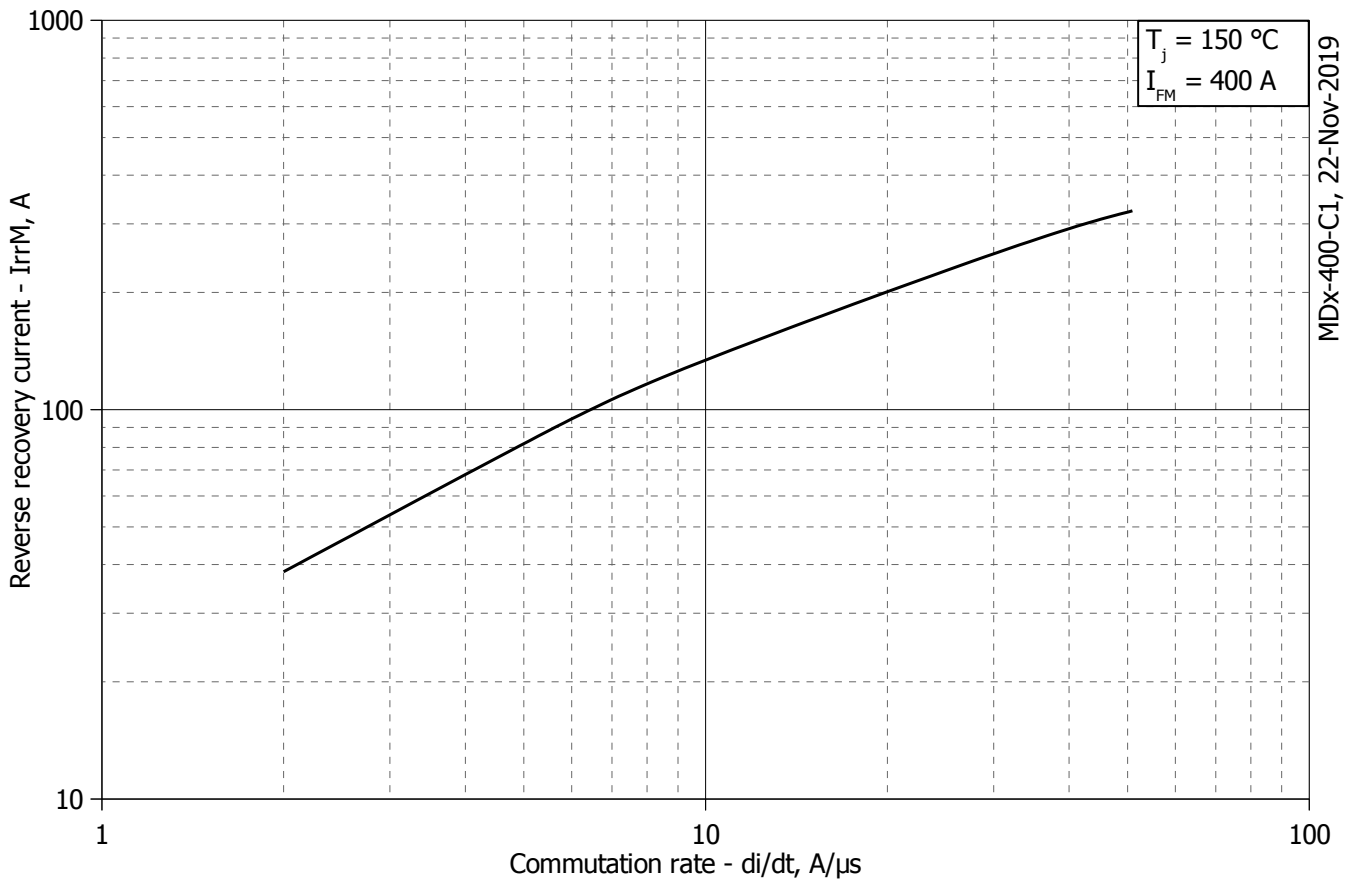


Fig 5 – Maximum reverse recovery current I_{rrM} vs. commutation rate di_R/dt

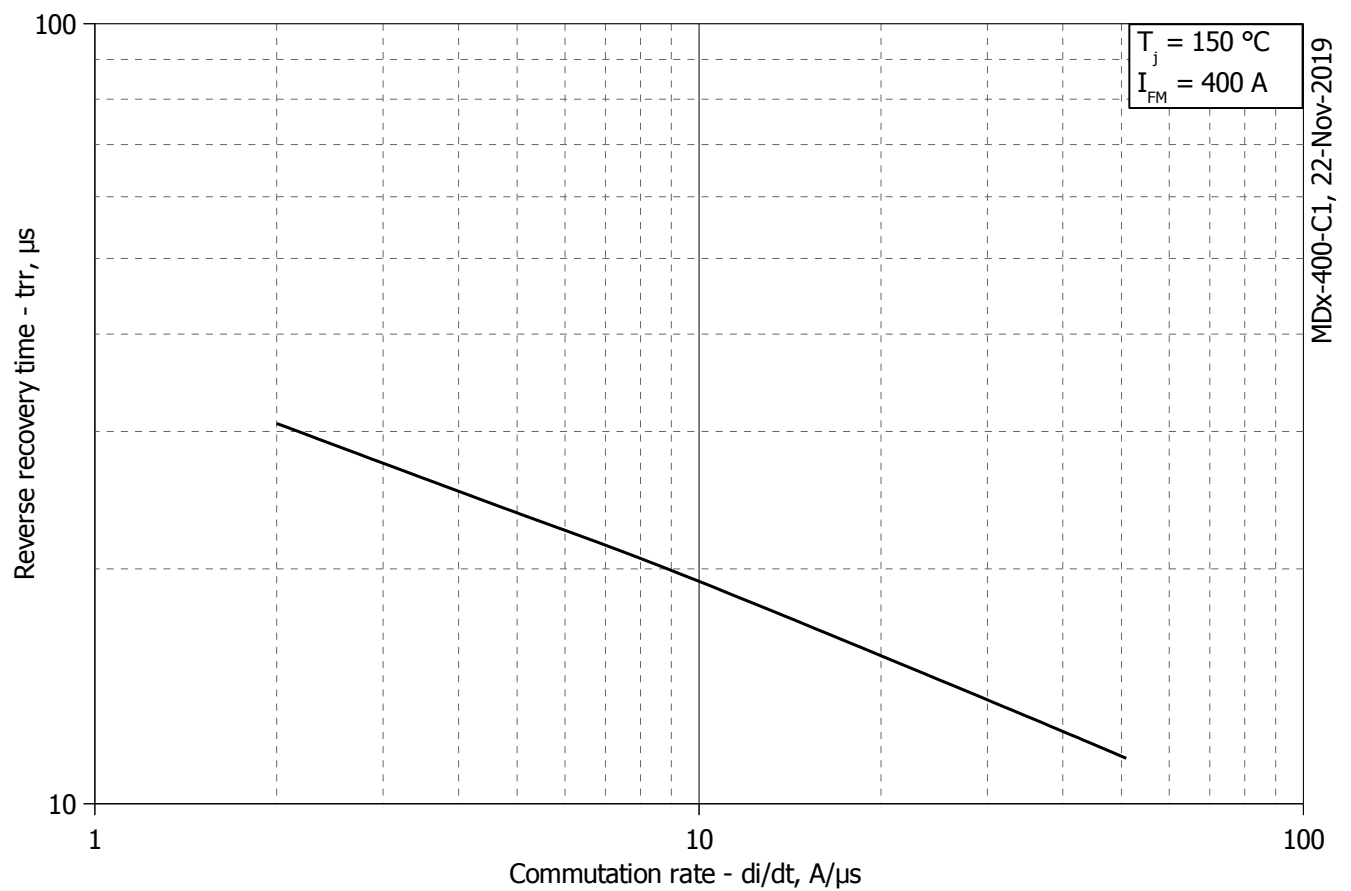


Fig 6 – Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

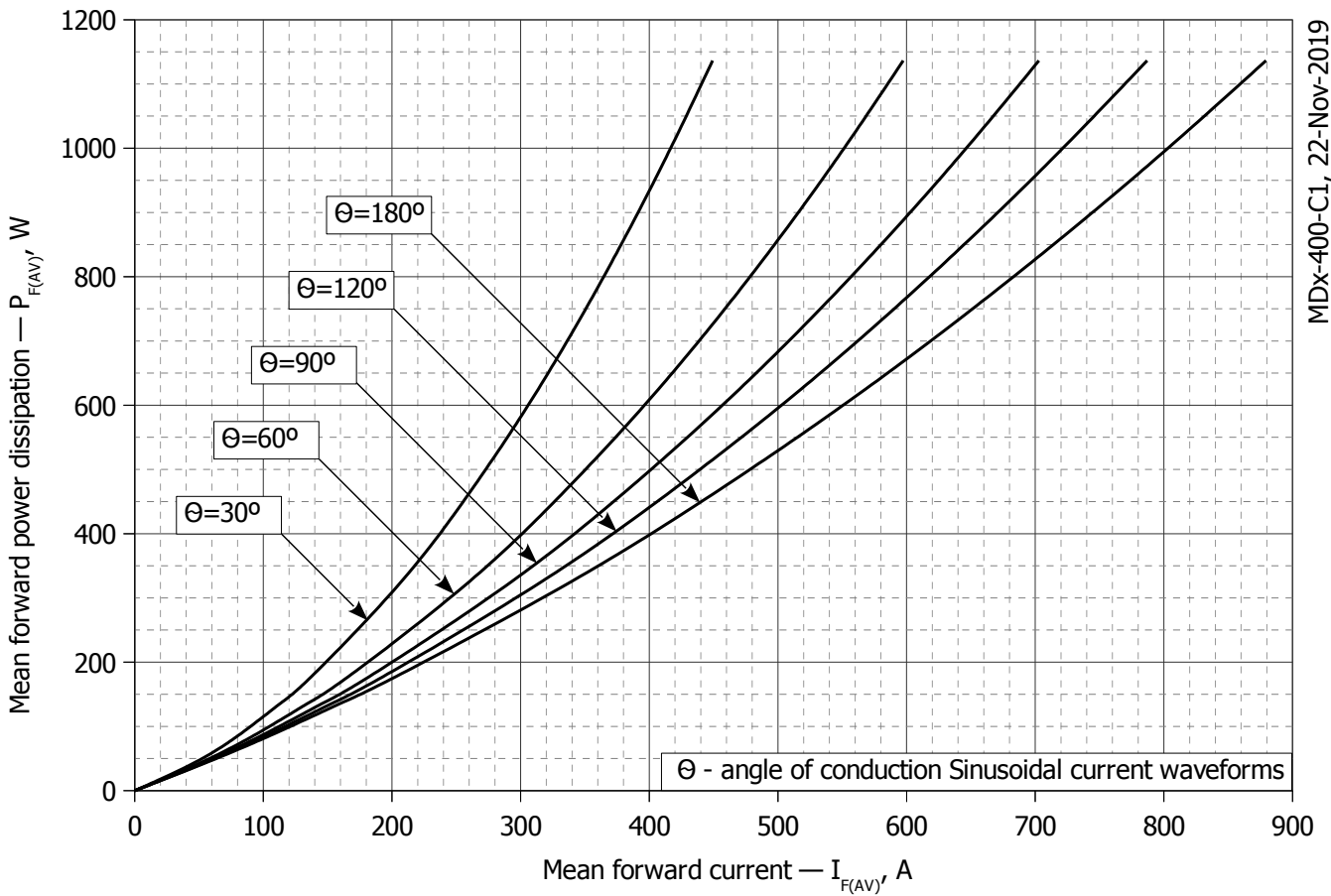


Fig. 7 - Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for sinusoidal current waveforms at different conduction angles (f=50Hz, DSC)

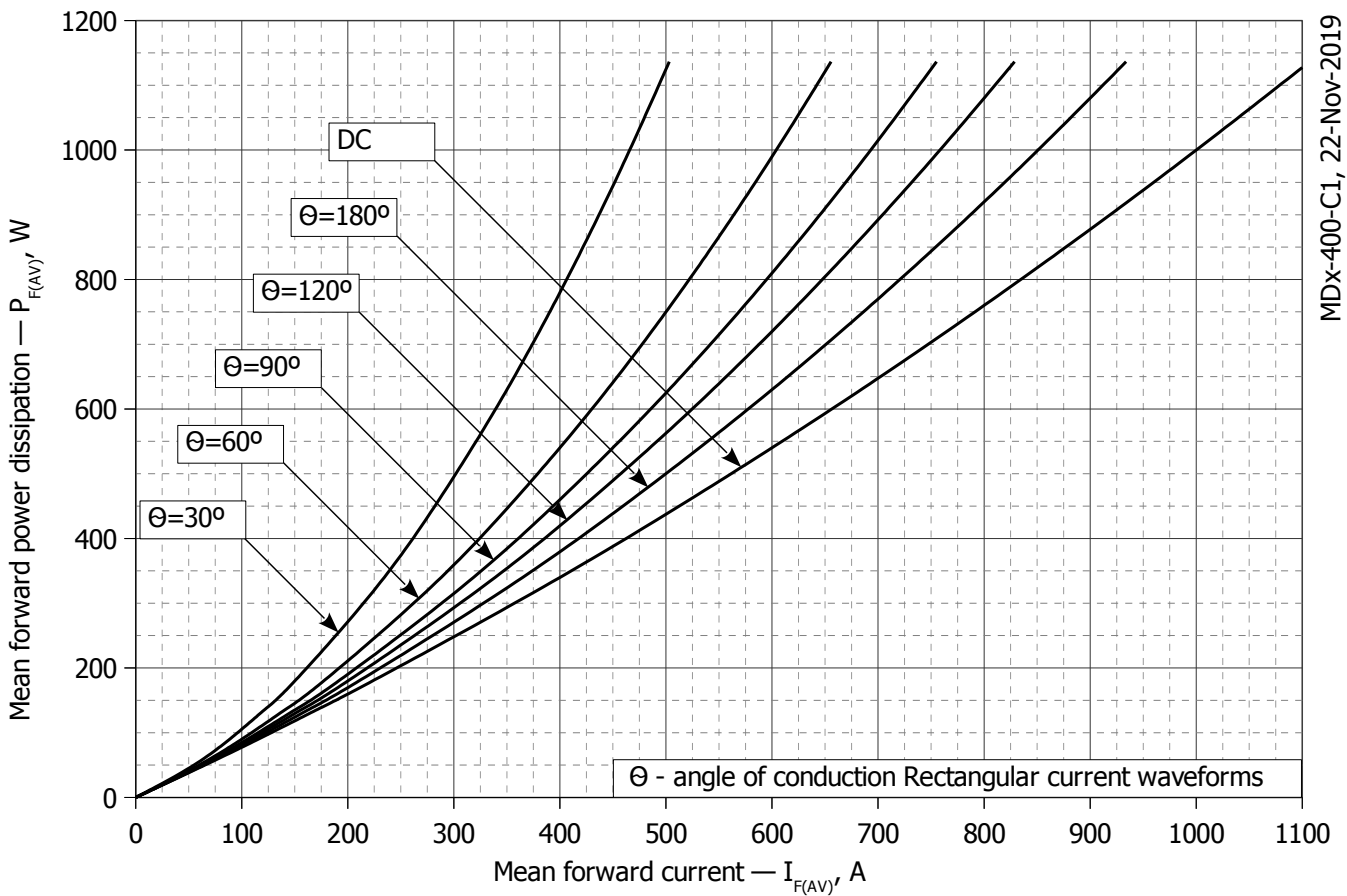


Fig. 8 - Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for rectangular current waveforms at different conduction angles and for DC (f=50Hz, DSC)

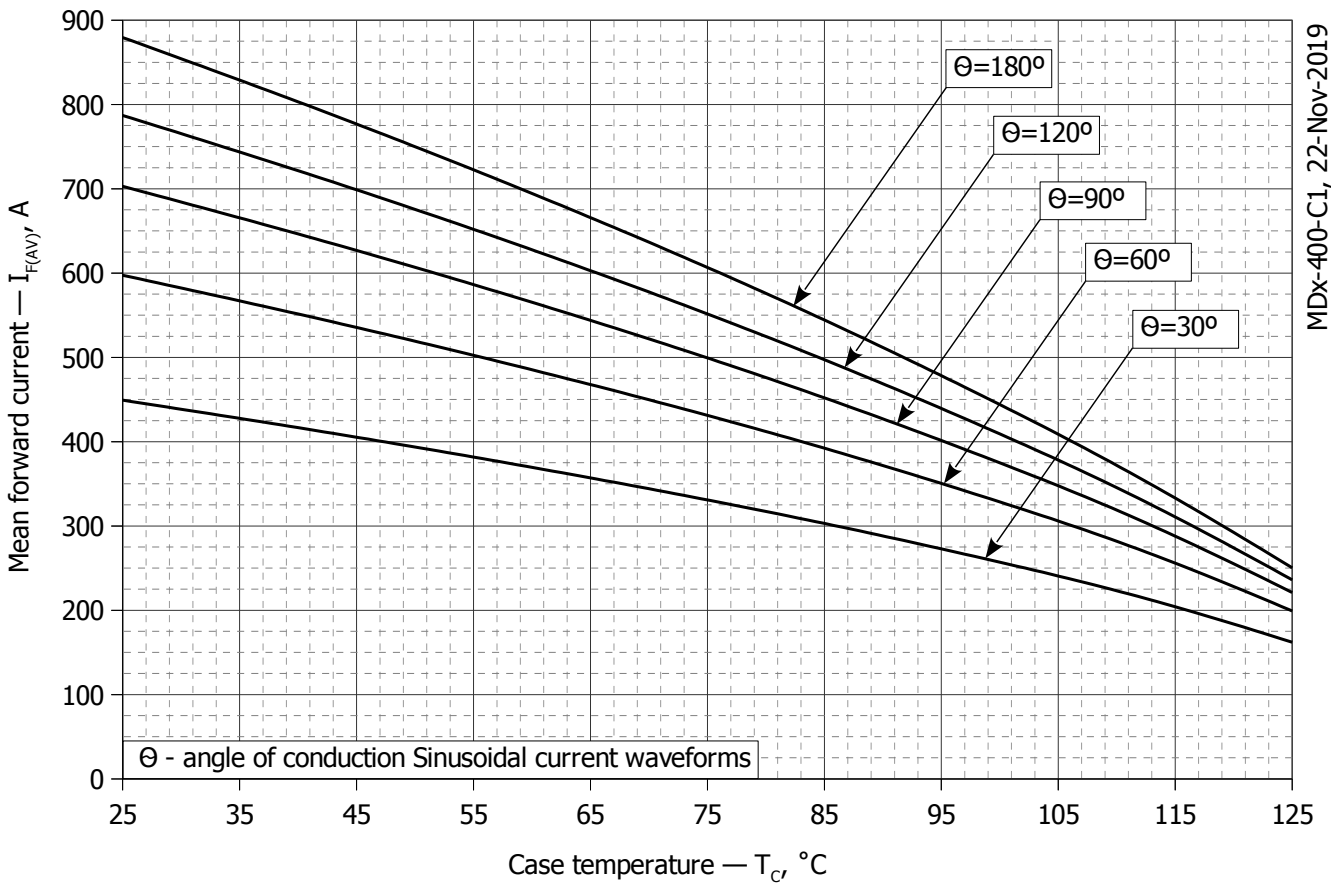


Fig. 9 – Mean forward current I_{FAV} vs. case temperature T_c for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$, DSC)

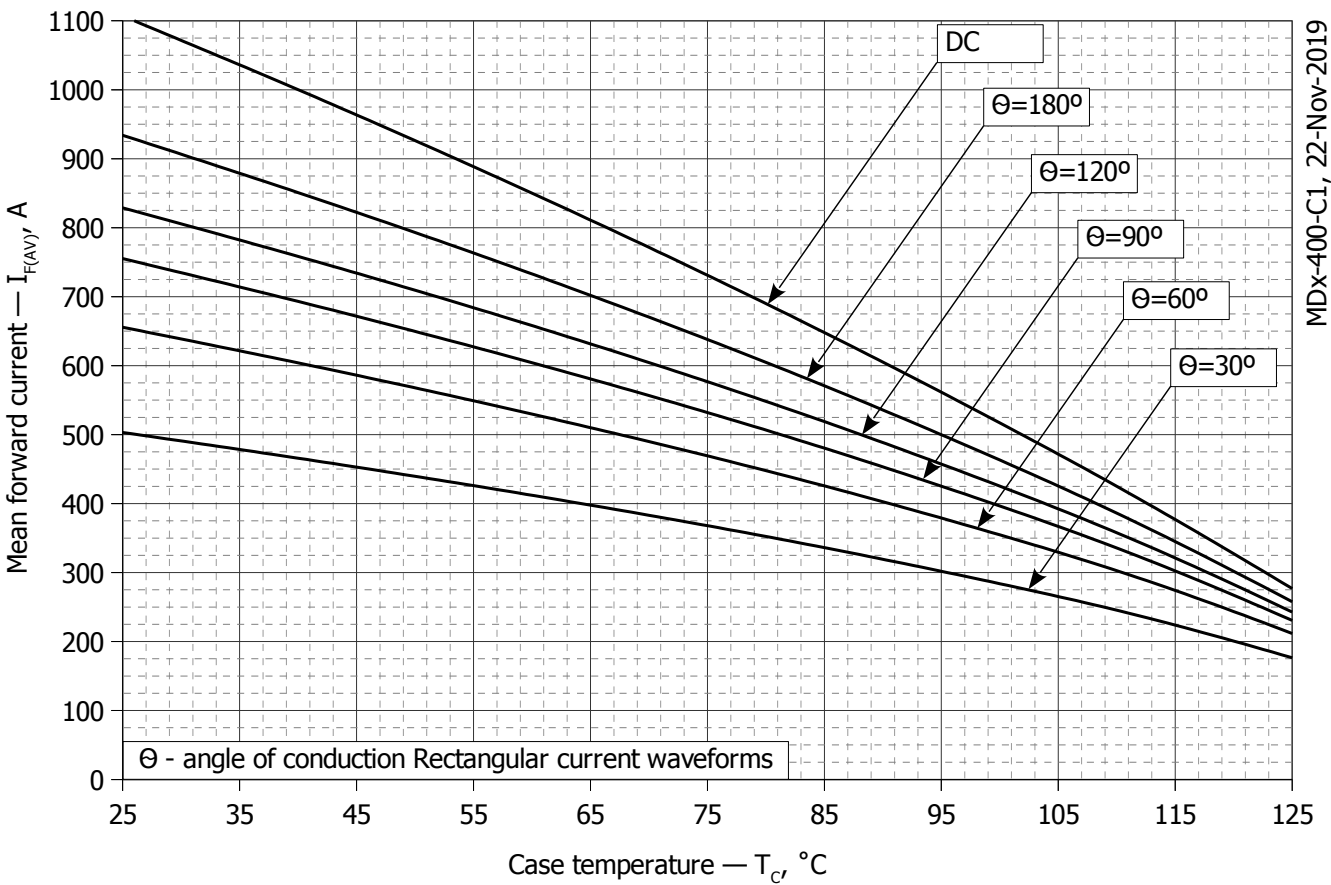


Fig. 10 - Mean forward current I_{FAV} vs. case temperature T_c for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$, DSC)

$T_j = 150\text{ }^\circ\text{C}$

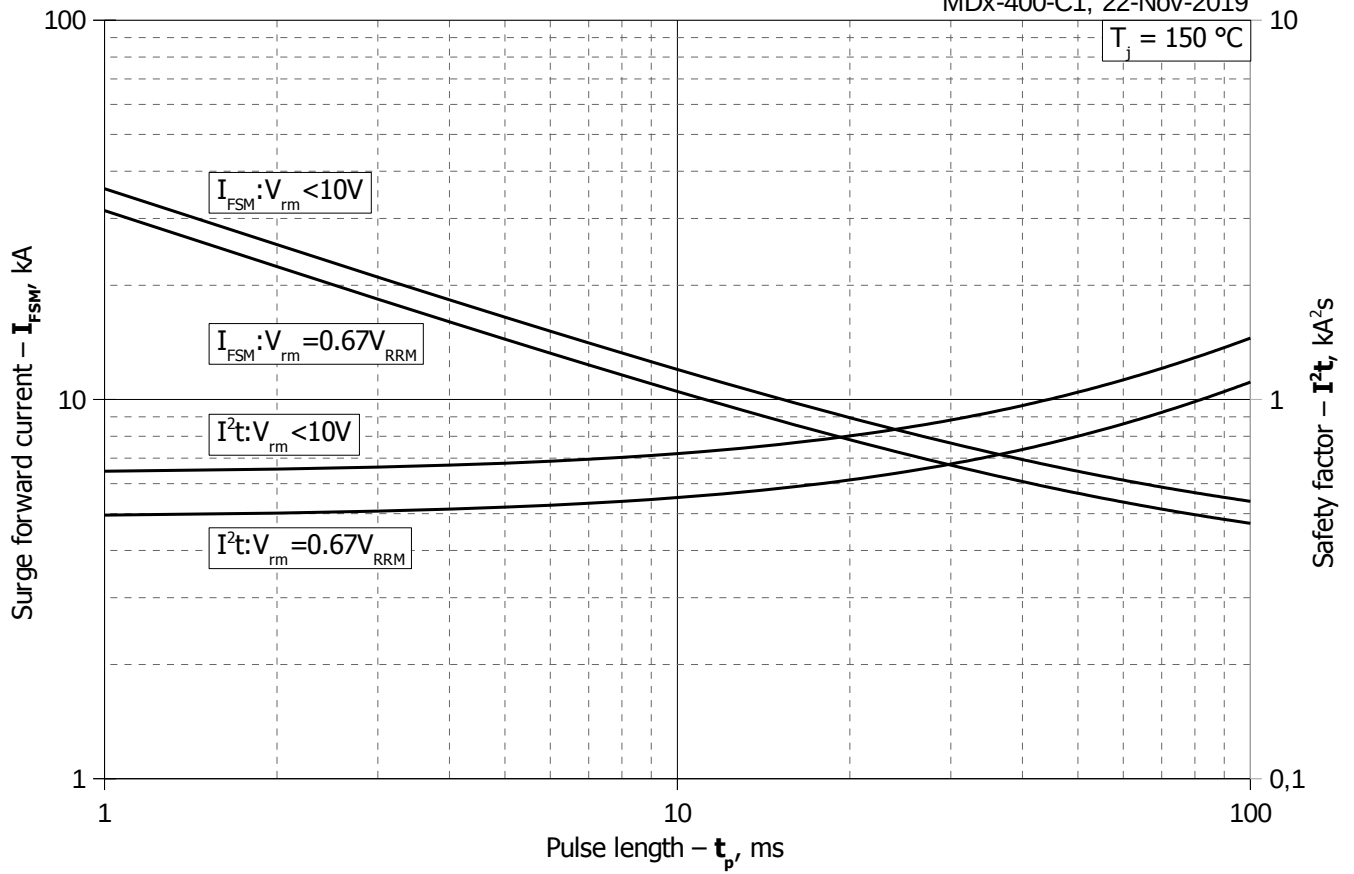


Fig. 11 – Maximum surge forward current I_{FSM} and safety factor I^2t vs. pulse length t_p

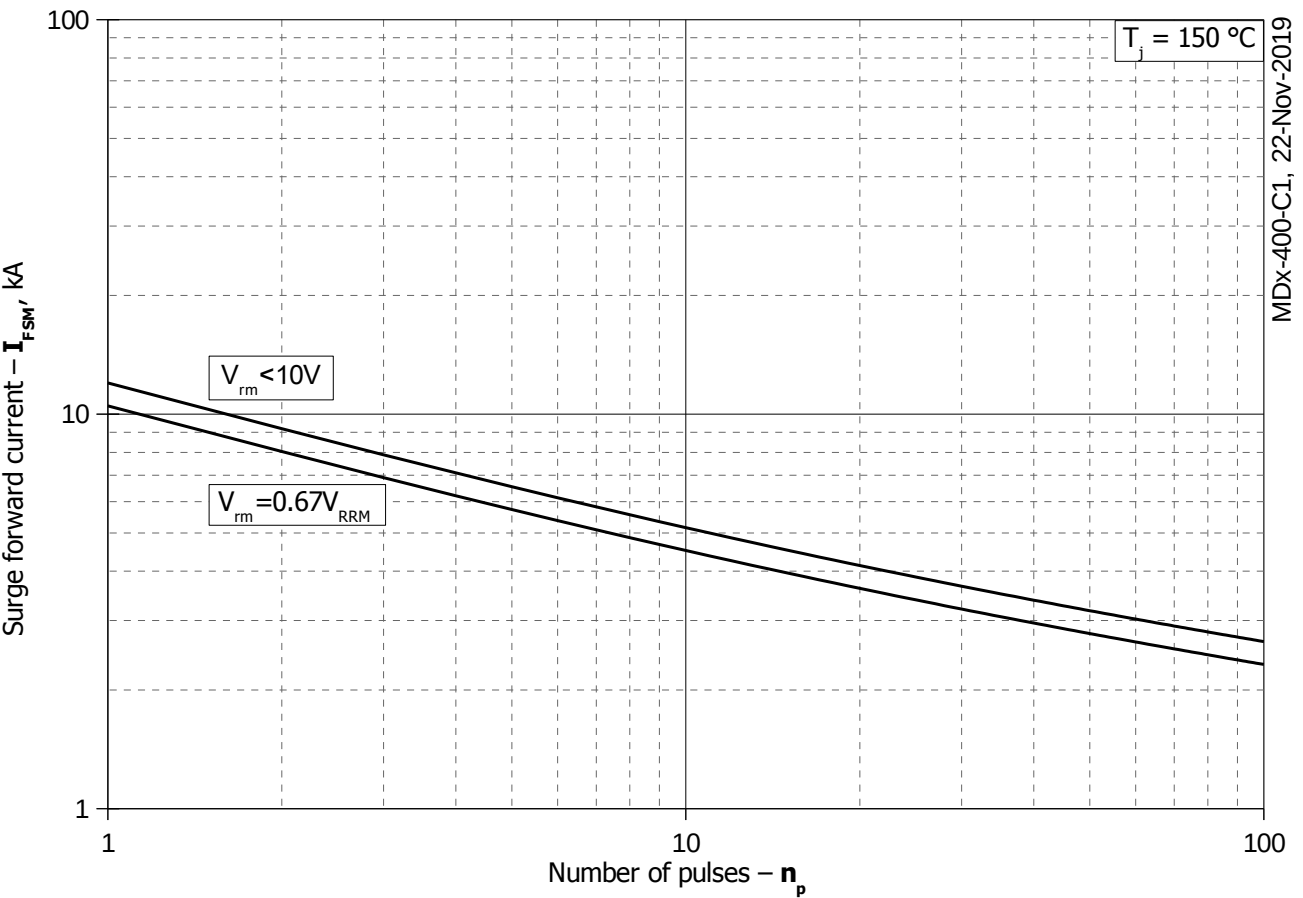


Fig. 12 - Maximum surge forward current I_{FSM} vs. number of pulses n_p