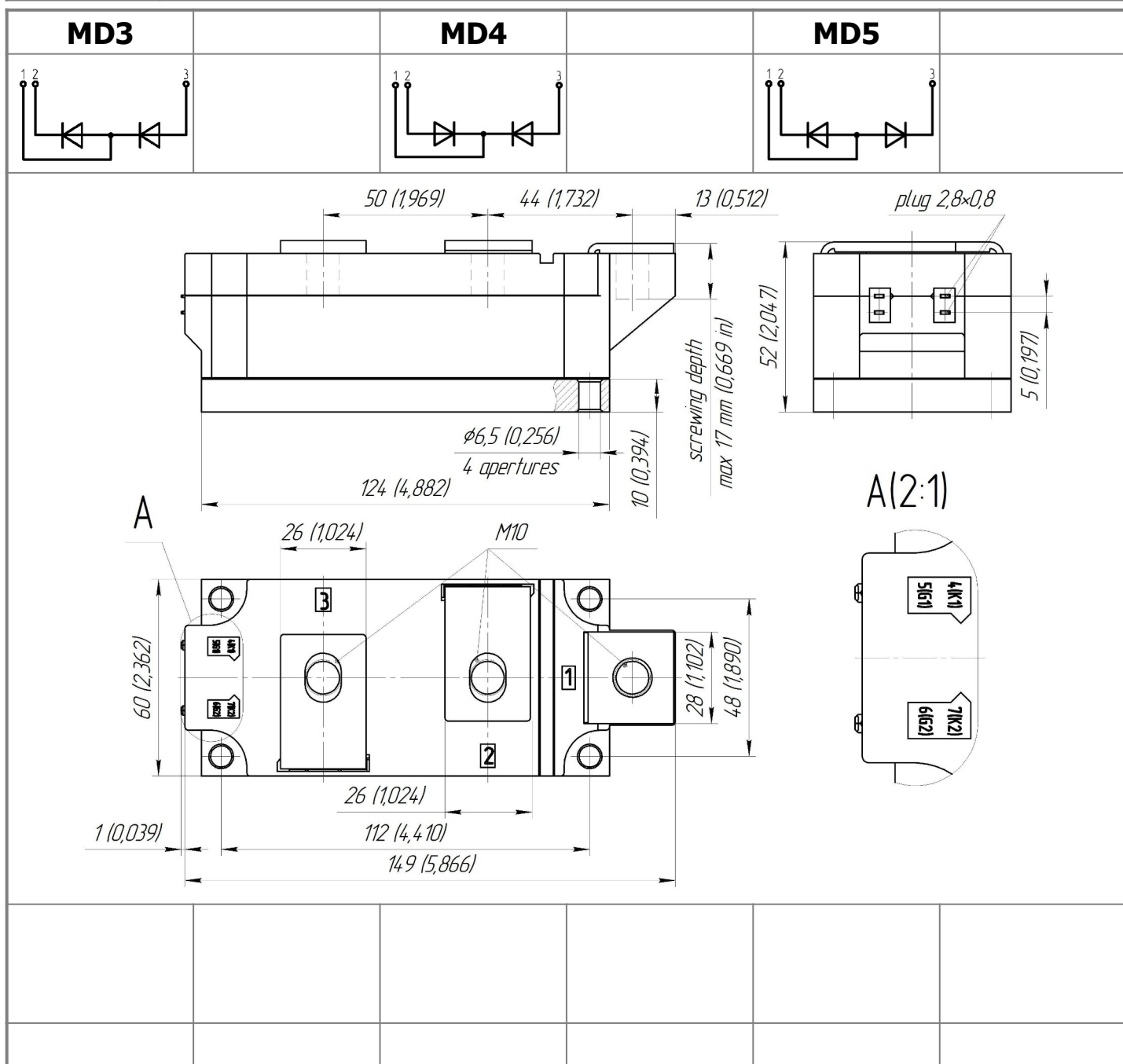




Electrically isolated base plate
Industrial standard package
Simplified mechanical design, rapid assembly
Pressure contact

Double Diode Module For Phase Control MDx-400-52-A2

Average forward current		I_{FAV}	400 A	
Repetitive peak reverse voltage		V_{RRM}	4600...5200 V	
V_{RRM} , V	4600	4800	5000	5200
Voltage code	46	48	50	52
T_j , °C	-40...+140			



All dimensions in millimeters (inches)

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{FAV}	Maximum allowable average forward current	A	415 400	$T_c=100\text{ }^{\circ}\text{C};$ $T_c=102\text{ }^{\circ}\text{C};$ 180° half-sine wave; 50 Hz	
I_{FRMS}	RMS forward current	A	628	$T_c=102\text{ }^{\circ}\text{C};$ 180° half-sine wave; 50 Hz	
I_{FSM}	Surge forward current	kA	11.0 13.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_R=0\text{ V};$
			12.0 14.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_R=0\text{ V};$
I^2t	Safety factor	$A^2s\cdot 10^3$	600 840	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_R=0\text{ V};$
			590 810	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	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	4600...5200	$T_{j\text{ min}} < T_j < T_{j\text{ max}};$ 180° half-sine wave; 50 Hz;	
V_{RSM}	Non-repetitive peak reverse voltages	V	4700...5300	$T_{j\text{ min}} < T_j < T_{j\text{ max}};$ 180° half-sine wave; single pulse;	
V_R	Reverse continuous voltages	V	$0.6\cdot V_{RRM}$	$T_j=T_{j\text{ max}};$	
THERMAL					
T_{stg}	Storage temperature	°C	−40...+50		
T_j	Operating junction temperature	°C	−40...+140		
$T_{c\text{ op}}$	Operating temperature	°C	−40...+125		
MECHANICAL					
a	Acceleration under vibration	m/s ²	50		

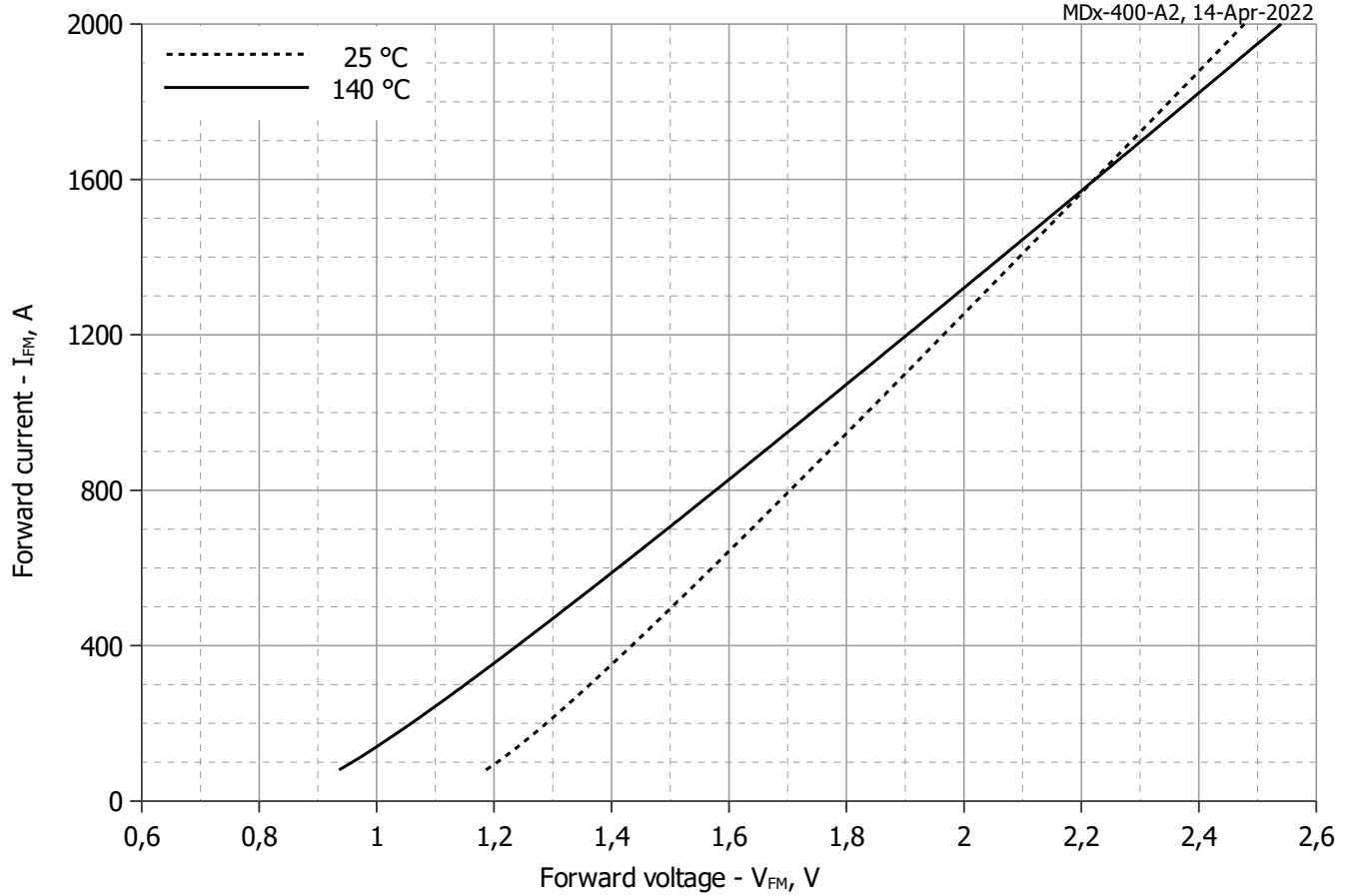
CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V _{FM}	Peak forward voltage, max	V	2.20	T _j =25 °C; I _{FM} =1570 A	
V _{F(TO)}	Forward threshold voltage, max	V	0.927	T _j =T _{j max} ;	
r _T	Forward slope resistance, max	mΩ	0.808	0.5 π I _{FAV} < I _T < 1.5 π I _{FAV}	
BLOCKING					
I _{RRM}	Repetitive peak reverse current, max	mA	100 3.00	T _j =T _{j max} T _j =25 °C	V _R =V _{RRM}
SWITCHING					
Q _r	Recovered charge, max	μC	3410	T _j =T _{j max} ; I _{TM} =I _{FAV} ;	
t _{rr}	Reverse recovery time, max	μS	63	di _R /dt=-5 A/μs;	
I _{rr}	Reverse recovery current, max	A	108	V _R =100 V	
THERMAL					
R _{thjc}	Thermal resistance, junction to case				
	per module	°C/W	0.0275	180° half-sine wave, 50 Hz	
	per arm	°C/W	0.0550		
	per module	°C/W	0.0265	DC	
	per arm	°C/W	0.0530		
R _{thch}	Thermal resistance, case to heatsink				
	per module	°C/W	0.0100		
	per arm	°C/W	0.0200		
INSULATION					
V _{ISOL}	Insulation test voltage	kV	3.00	Sine wave, 50 Hz;	t=60 sec
			3.60	RMS	t=1 sec

MECHANICAL				
M ₁	Mounting torque (M6) ¹⁾	Nm	6.00	Tolerance ± 15%
M ₂	Terminal connection torque (M10) ¹⁾	Nm	12.00	Tolerance ± 15%
m	Weight, max	g	1550	

PART NUMBERING GUIDE										NOTES
MD	3	-	400	-	52	-	A2	-	N	1) The screws must be lubricated
1	2		3		4		5		6	
1. MD - Rectifier Diode 2. Circuit Schematic: 3 – serial connection 4 – common Cathode 5 – common Anode 3. Average Forward Current, A 4. Voltage Code 5. Package Type (M.A2) 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	1.00131830	0.77354580
B	0.00062044	0.00073873
C	0.03067351	0.01589651
D	0.00004966	0.00376523

Forward characteristic model (see Fig. 1).

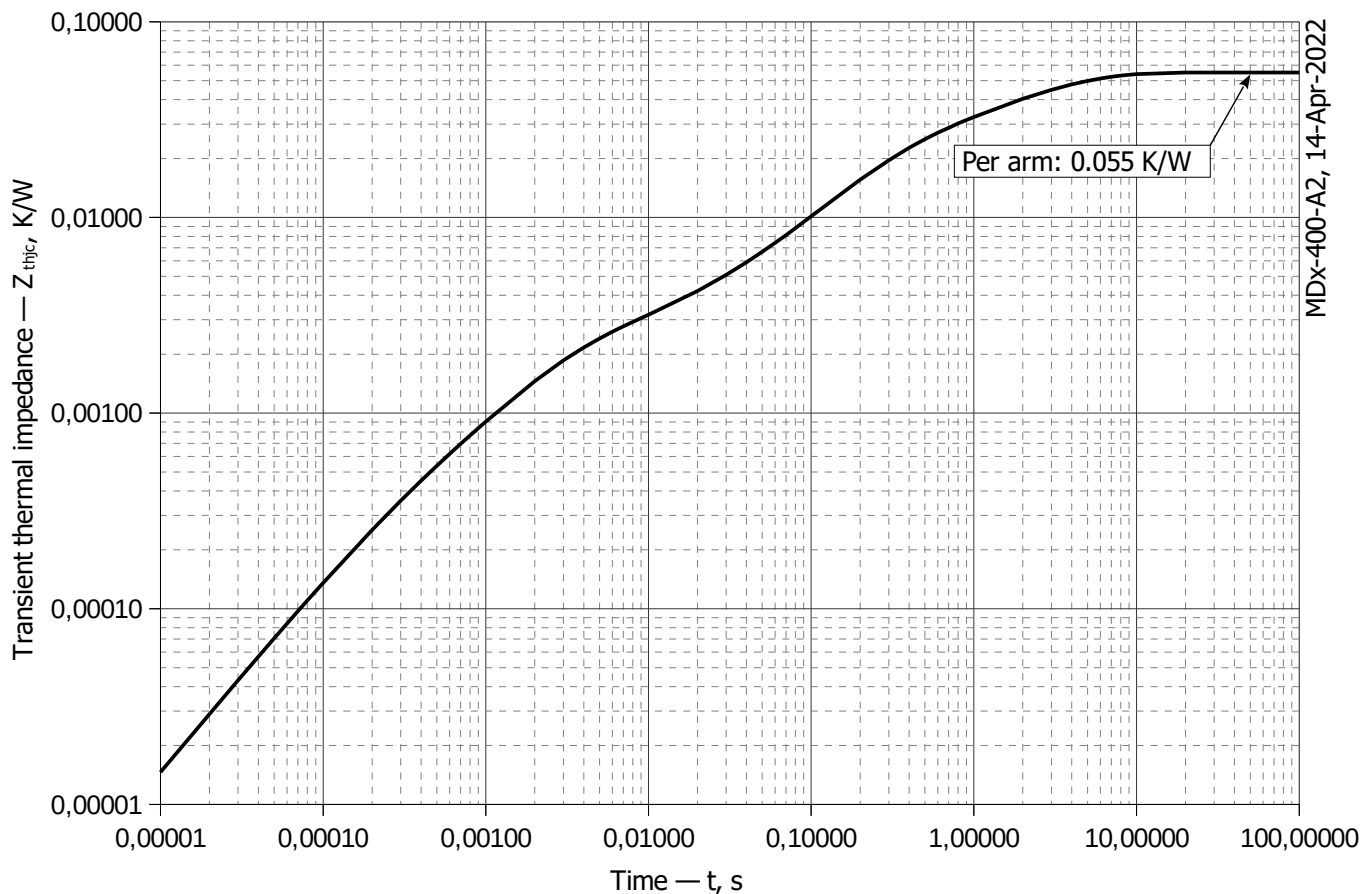


Fig 2 – Transient thermal impedance Z_{thjc} vs. time t

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.

i	1	2	3	4	5	6
R_i , K/W	0.0249	0.0112	0.01635	0.0006528	0.00179	0.000136
τ_i , s	3.132	1	0.2335	0.01038	0.002348	0.0002448

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

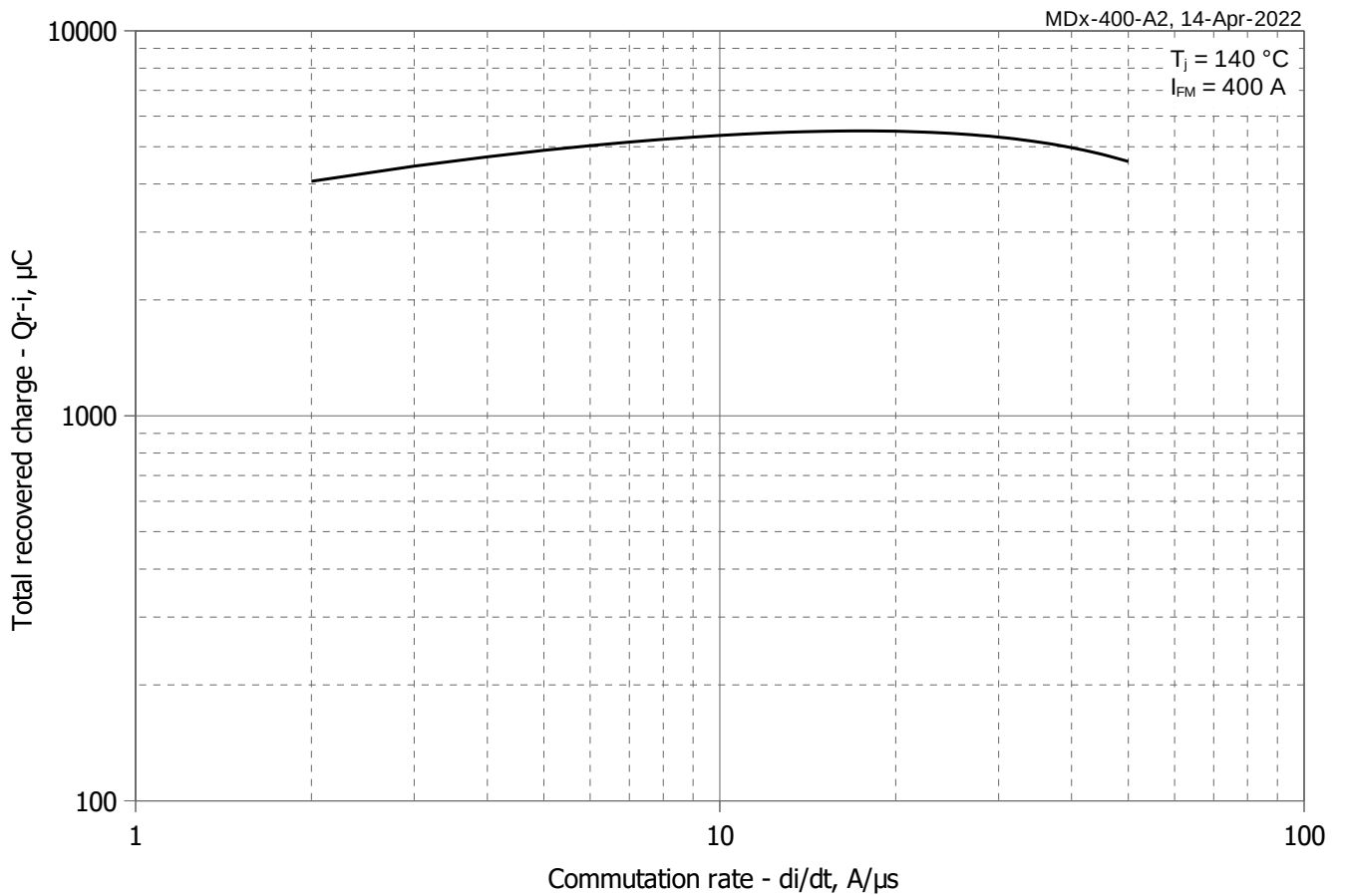


Fig 3 - Maximum recovered charge Q_{r-i} (integral) vs. commutation rate di_R/dt

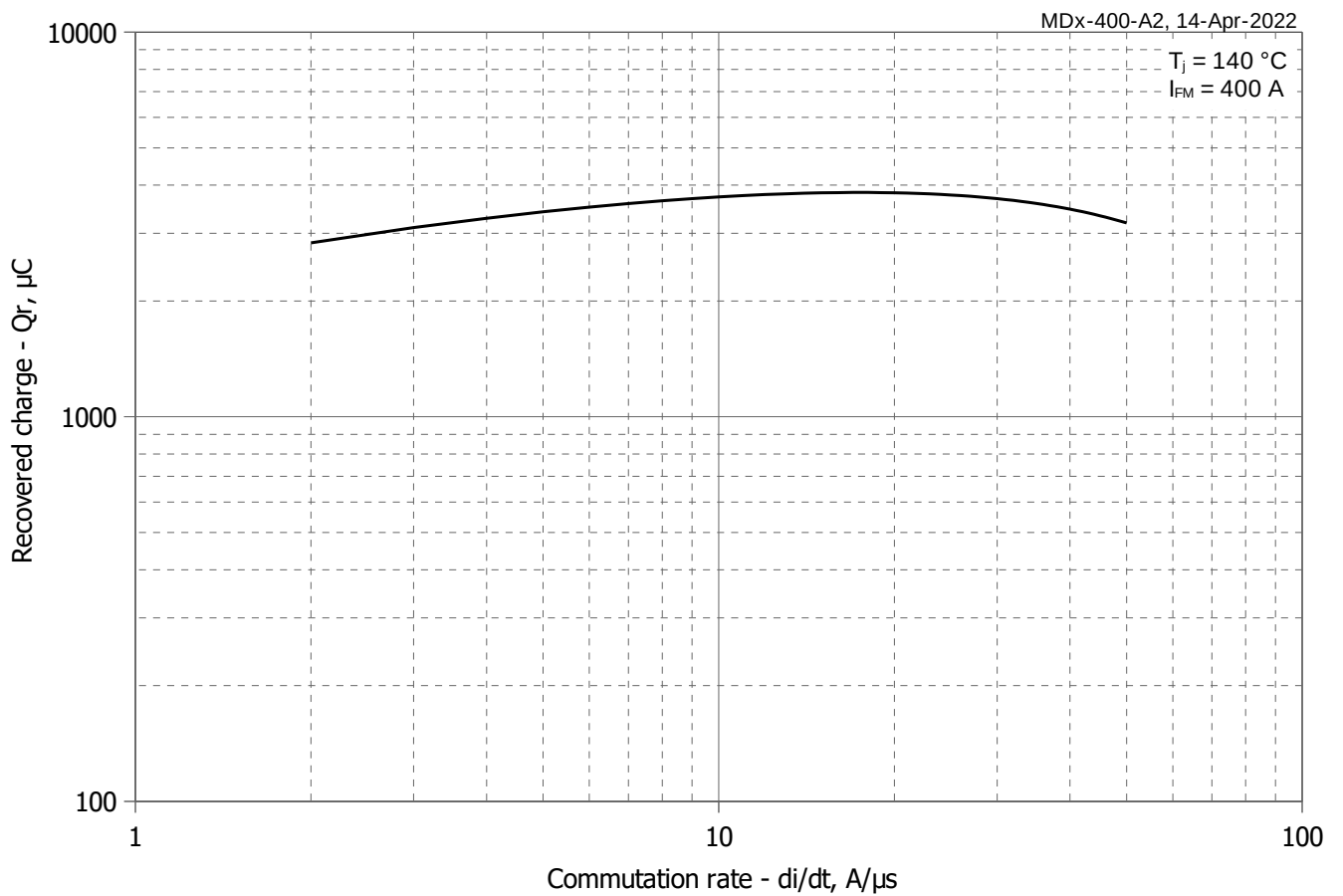


Fig 4 - Maximum recovered charge Q_r vs. commutation rate di_R/dt (25% chord)

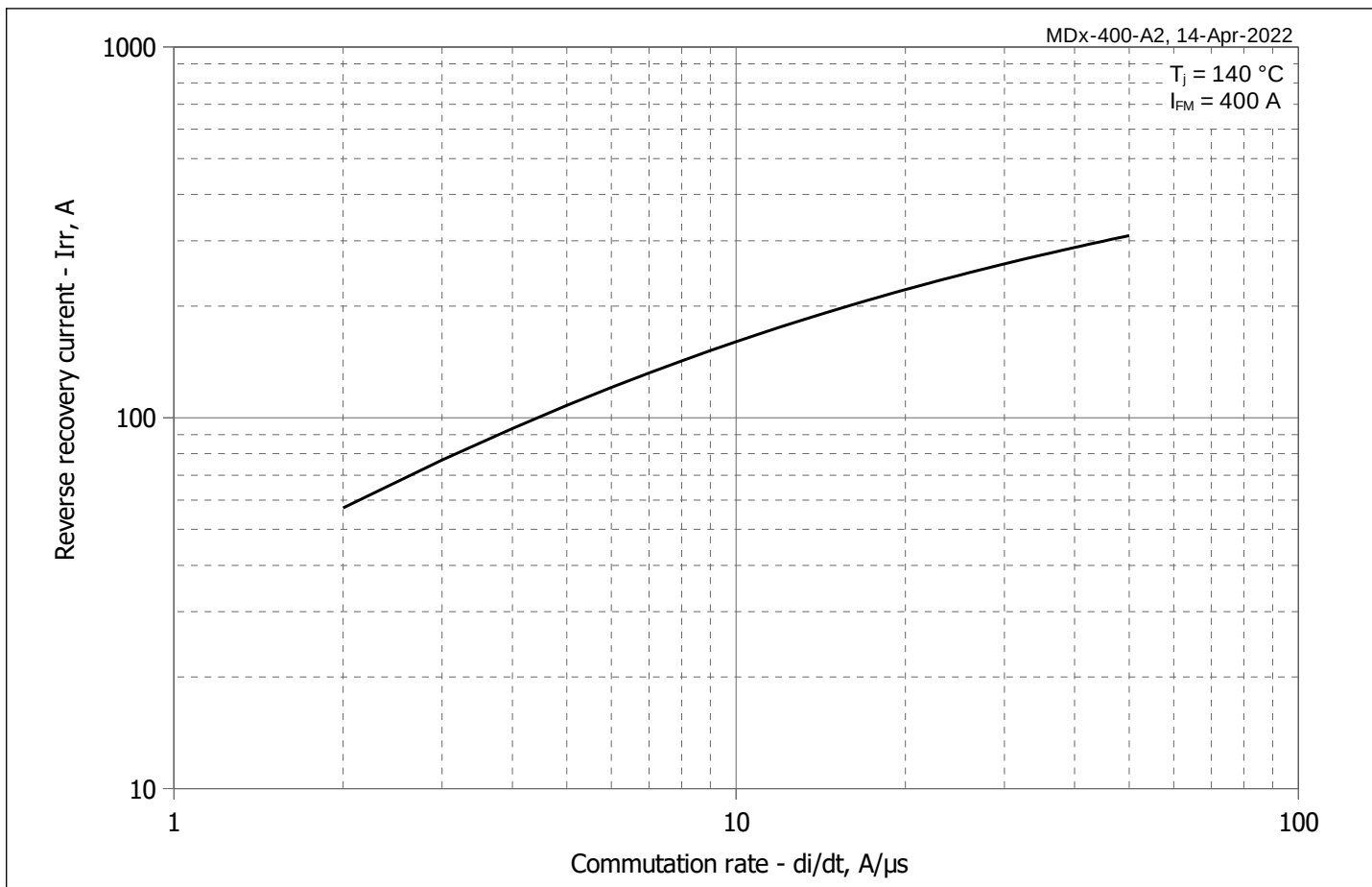


Fig 5 - Maximum reverse recovery current I_{rr} vs. commutation rate di_R/dt

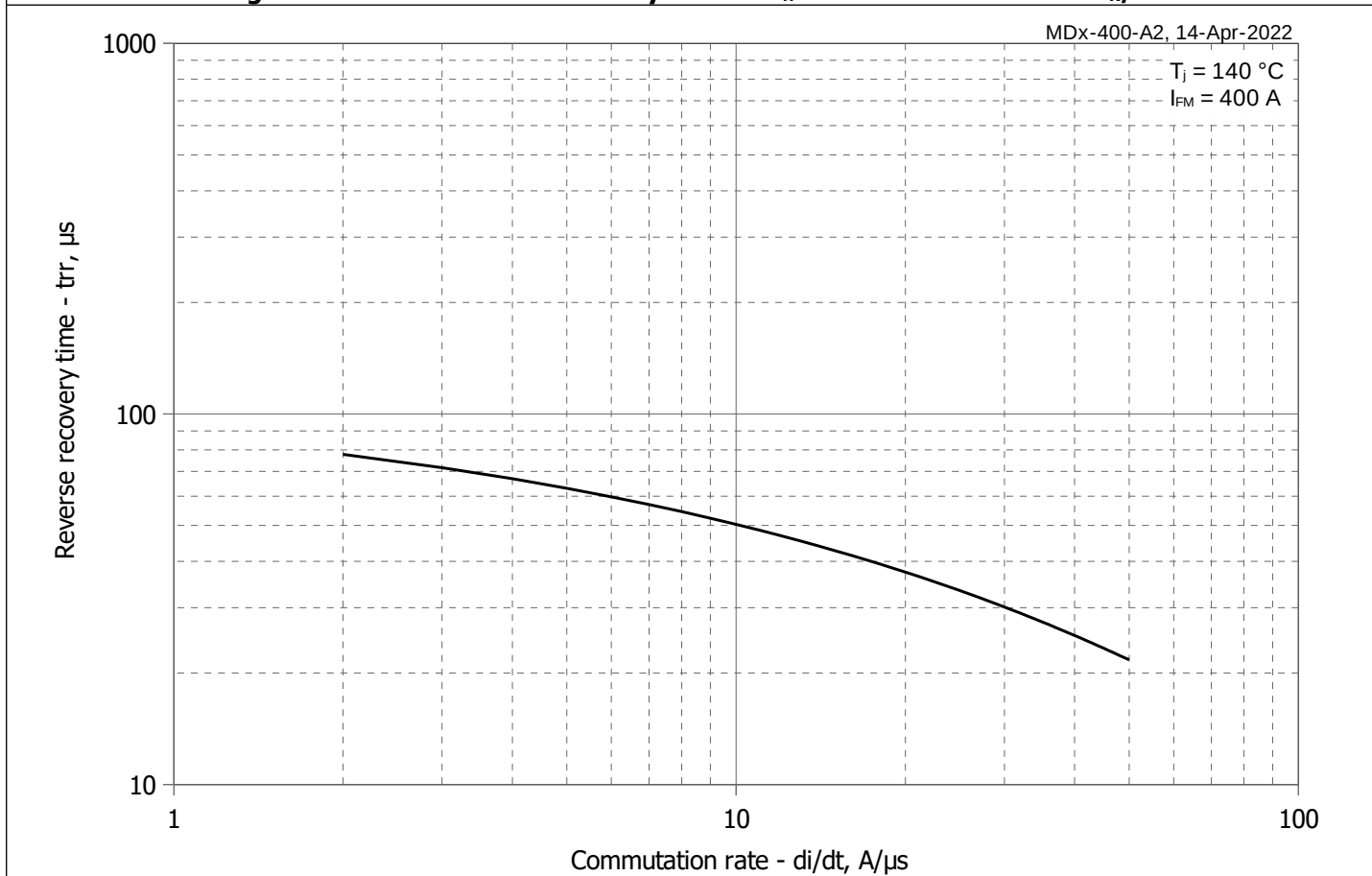


Fig 6 - Maximum recovery time t_{rr} vs. commutation rate di_R/dt (25% chord)

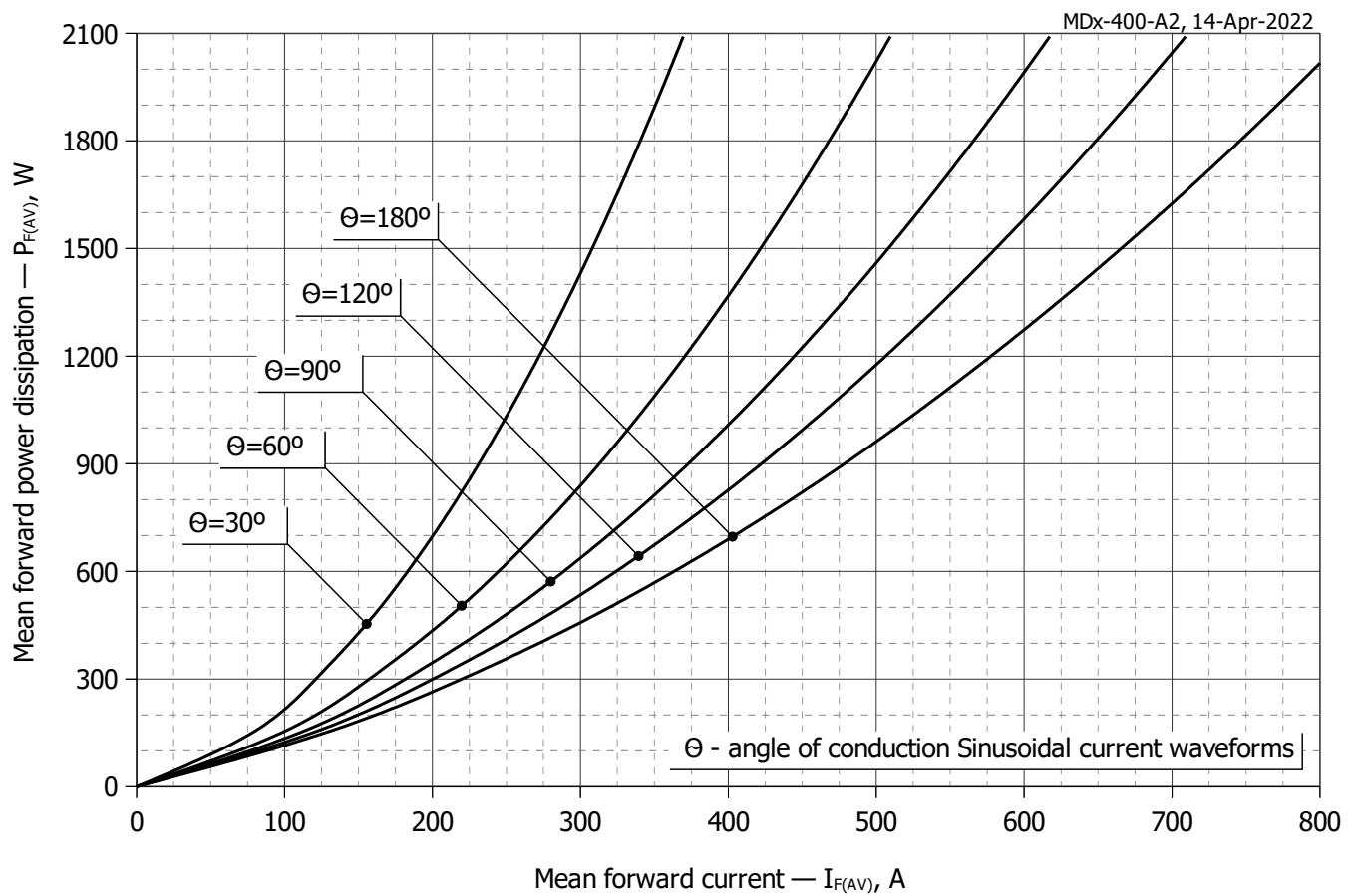


Fig. 7 - Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$)

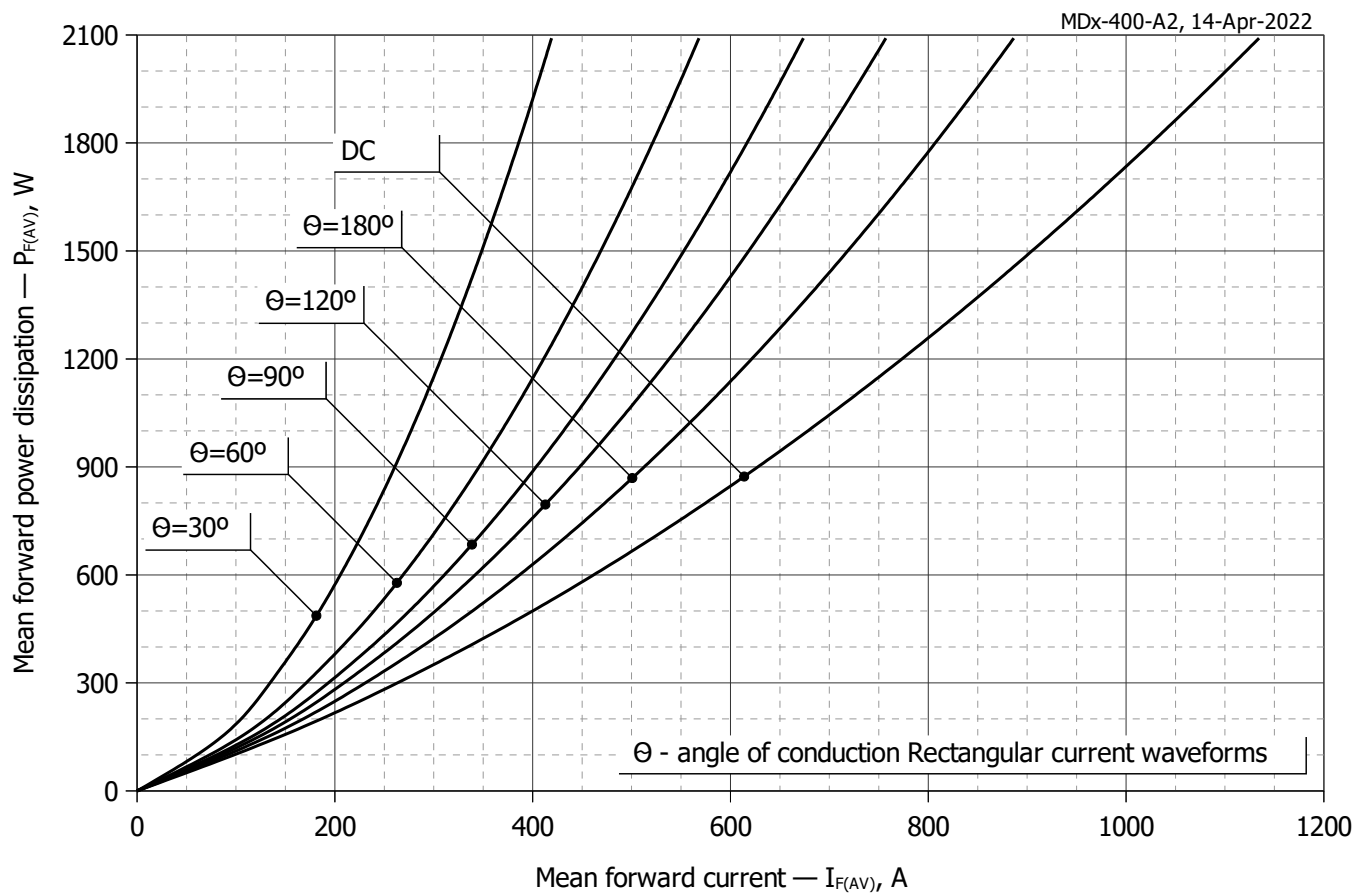


Fig. 8 – Mean forward power dissipation P_{FAV} vs. mean forward current I_{FAV} for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$)

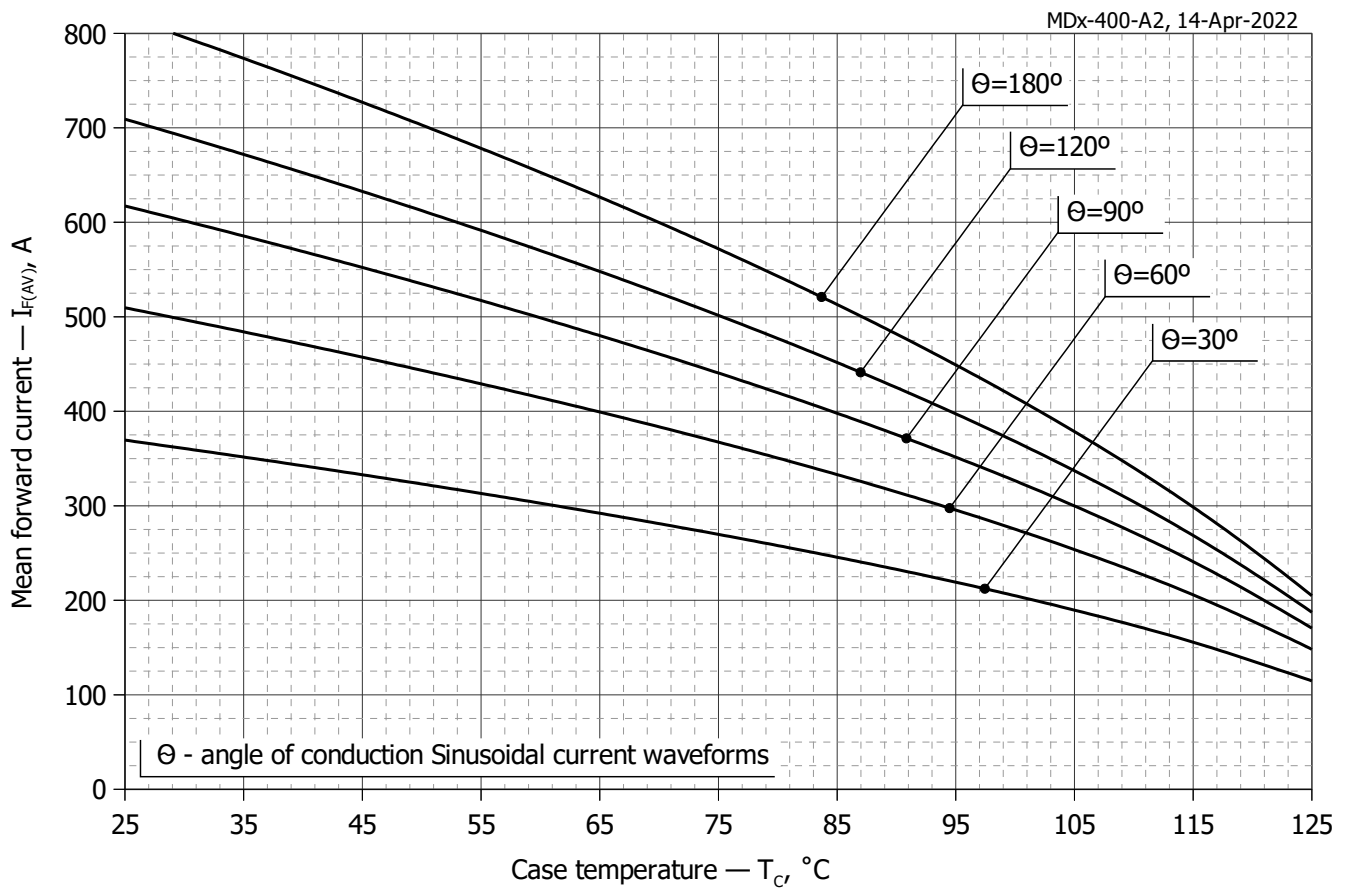


Fig. 9 – Mean forward current I_{FAV} vs. case temperature T_C for sinusoidal current waveforms at different conduction angles ($f=50\text{Hz}$)

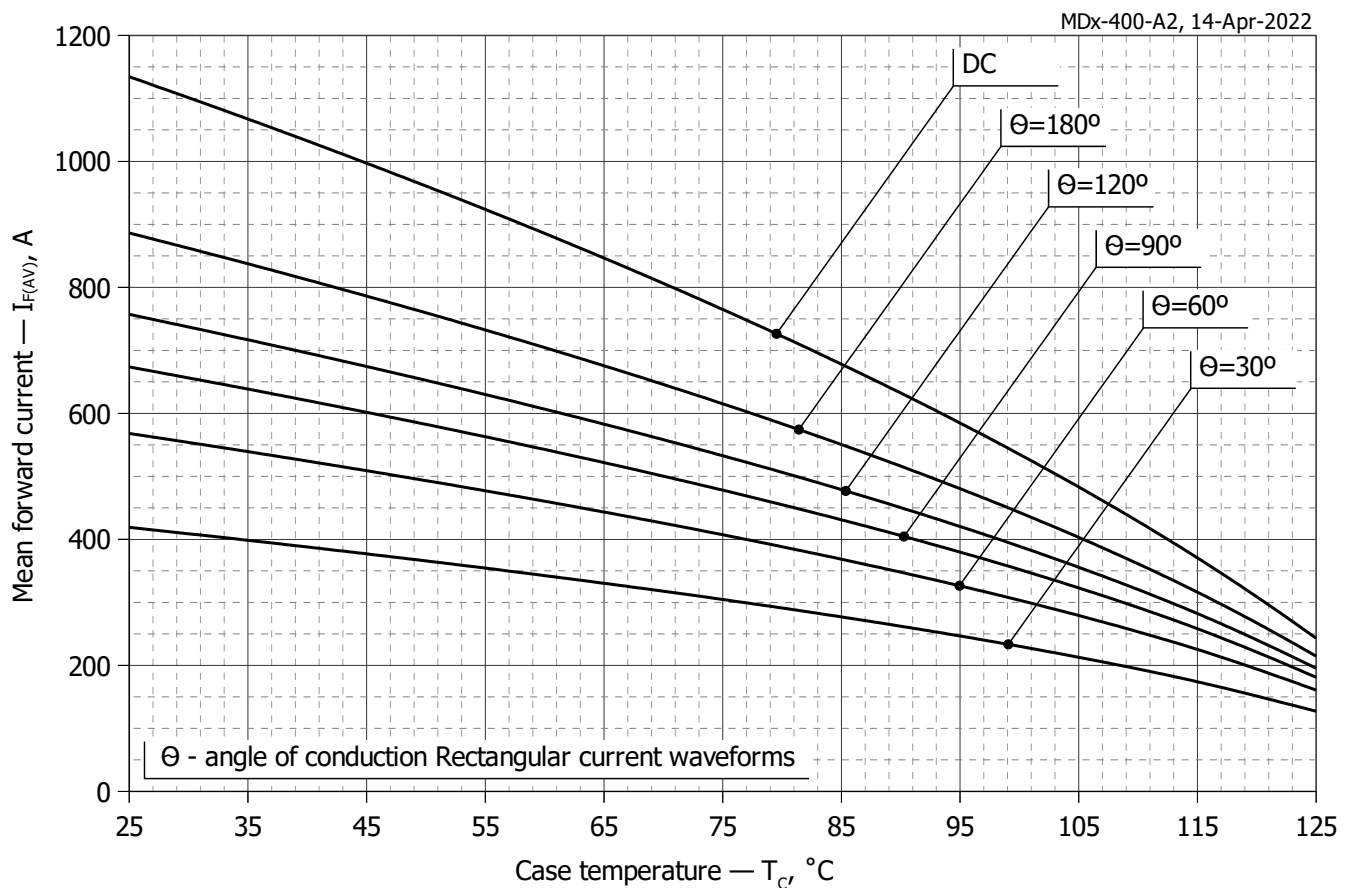


Fig. 10 - Mean forward current I_{FAV} vs. case temperature T_C for rectangular current waveforms at different conduction angles and for DC ($f=50\text{Hz}$)

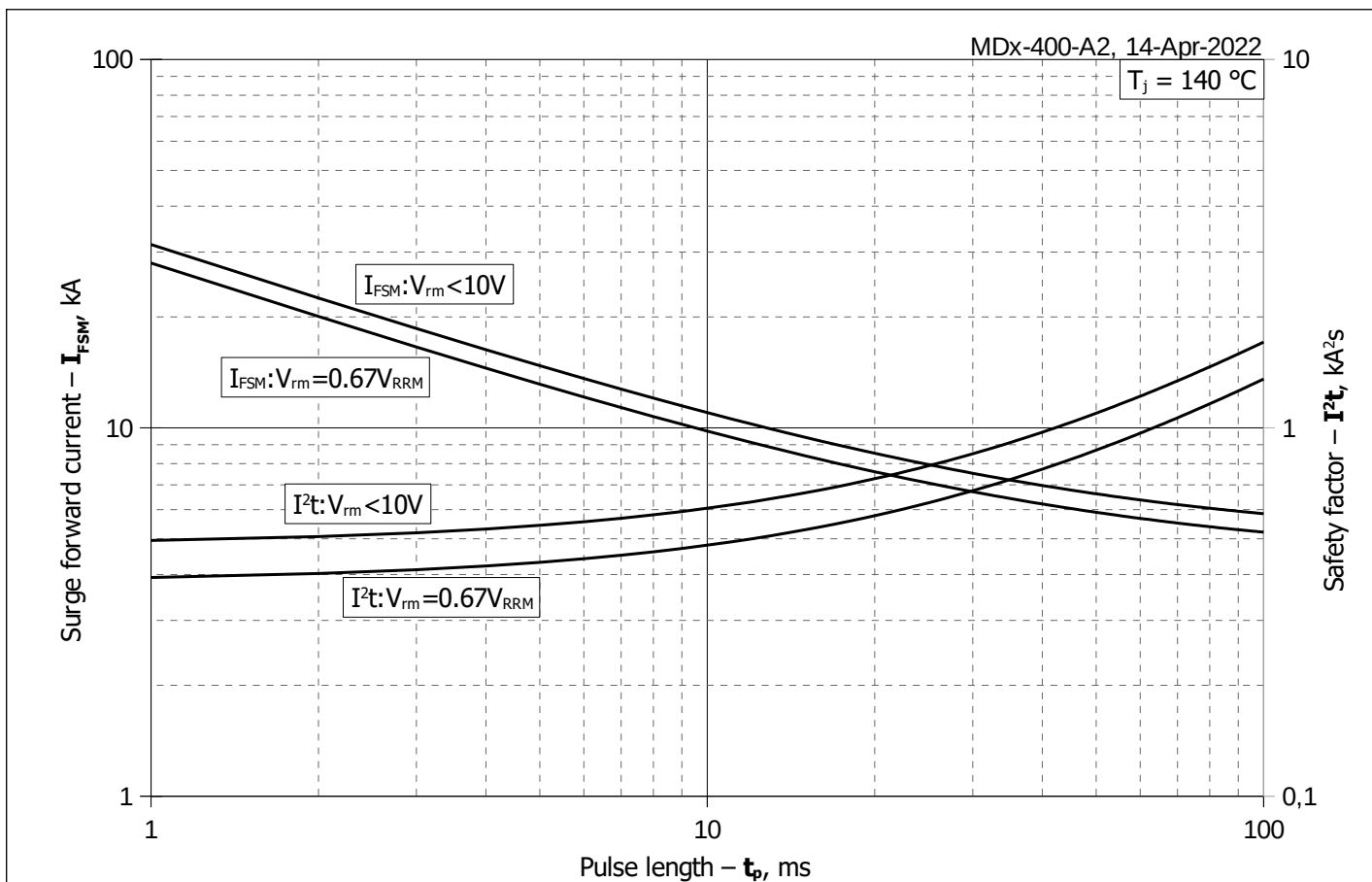


Fig. 11 – Maximum surge forward current I_{FSM} and safety factor I^2t vs. pulse length t_p

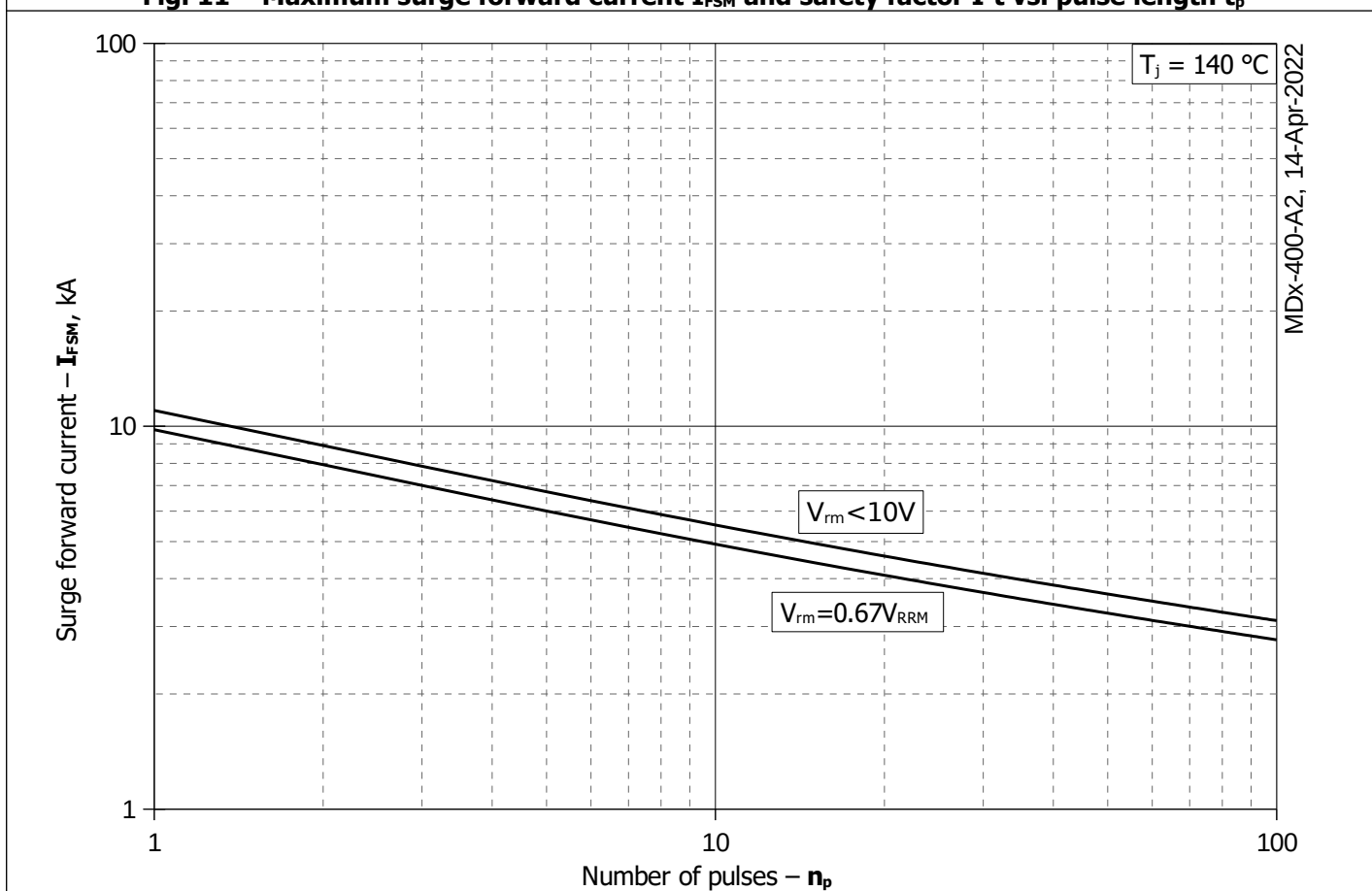


Fig. 12 - Maximum surge forward current I_{FSM} vs. number of pulses n_p