

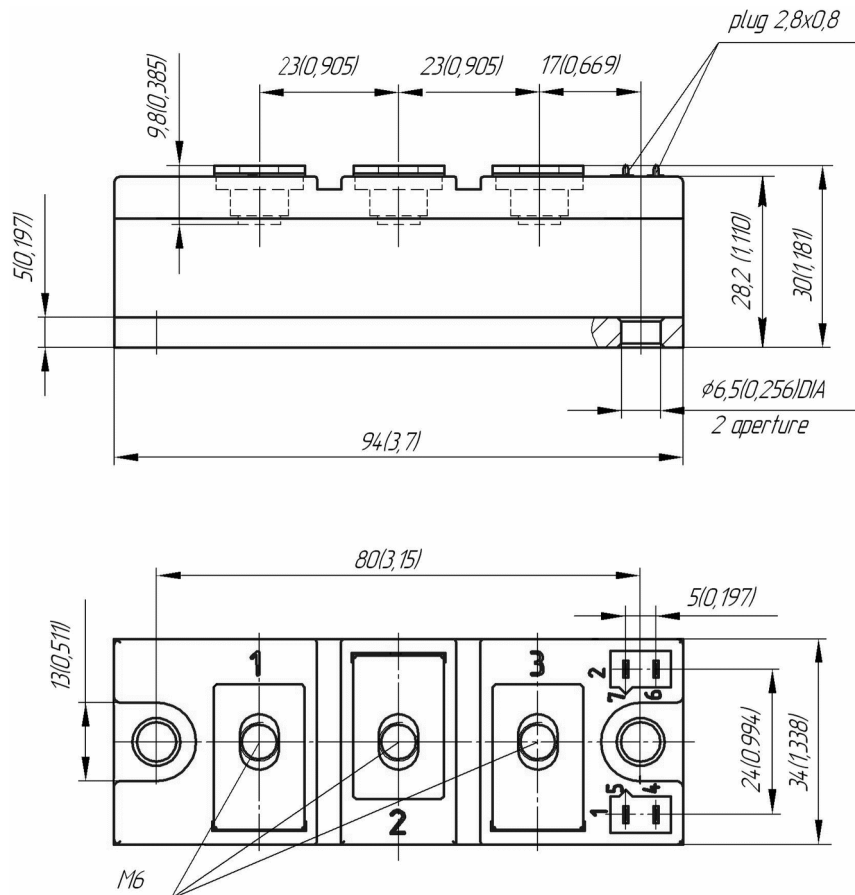


# Diode Modules MDx-200-28-F



Average forward current		$I_{FAV}$		200 A	
Repetitive peak reverse voltage		$V_{RRM}$		2000...2800 V	
$V_{RRM}, V$	2000	2200	2400	2600	2800
Voltage code	20	22	24	26	28
$T_j, ^\circ C$	-40...+150				

MD3	MD4	MD5



## MAXIMUM ALLOWABLE RATINGS

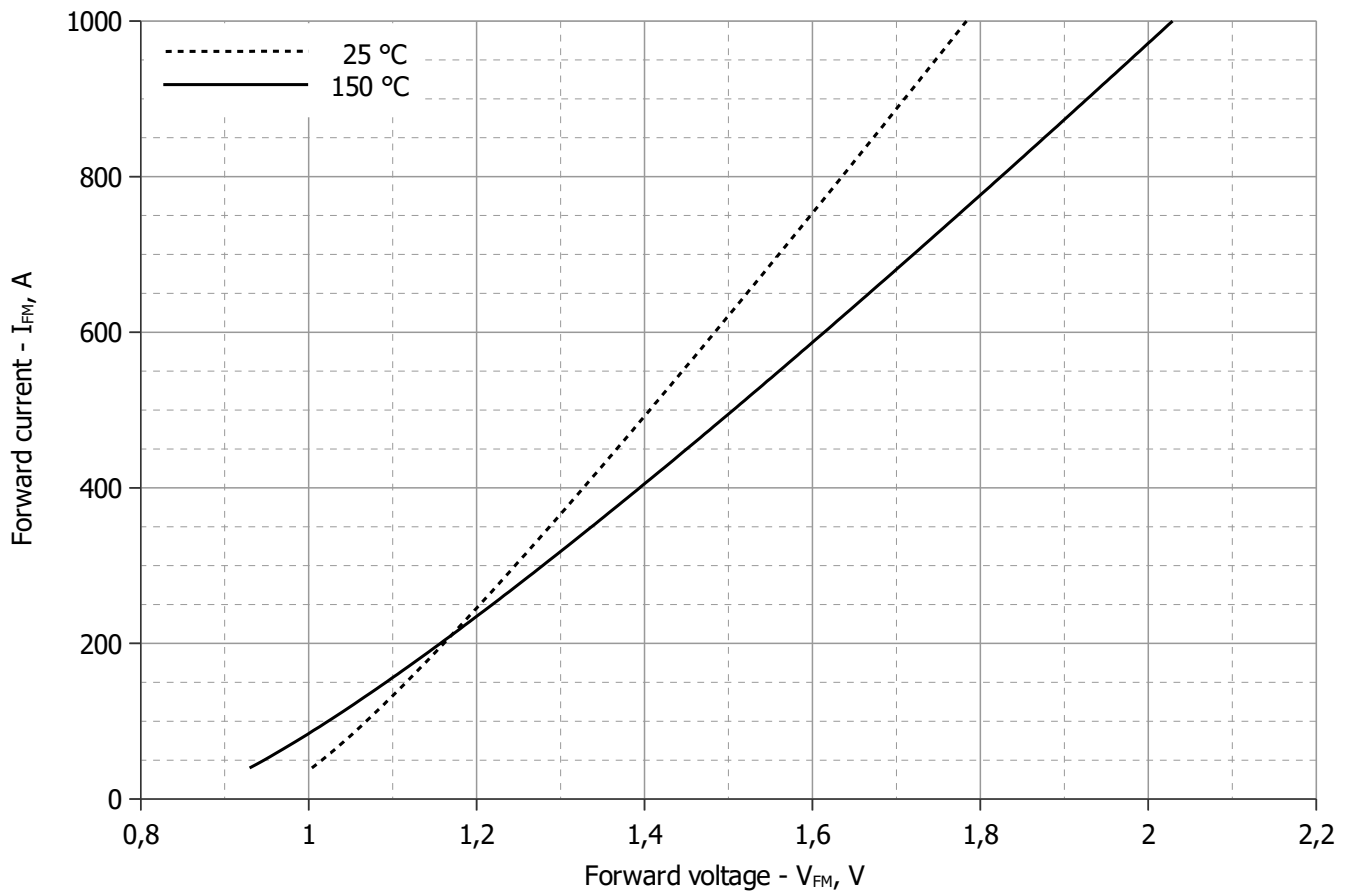
Symbols and parameters		Units	Values	Test conditions	
<b>ON-STATE</b>					
$I_{FAV}$	Maximum allowable average forward current	A	200 198	$T_c = 99\text{ }^\circ\text{C};$ $T_c = 100\text{ }^\circ\text{C};$ 180° half-sine wave; 50 Hz	
$I_{FRMS}$	RMS forward current	A	314	$T_c = 99\text{ }^\circ\text{C};$ 180° half-sine wave; 50 Hz	
$I_{FSM}$	Surge forward current	kA	6.4 7.5	$T_j = T_{j\text{ max}}$ $T_j = 25\text{ }^\circ\text{C}$	180° half-sine wave; $t_p = 10\text{ ms};$ single pulse; $V_R = 0\text{ V};$
			6.5 7.5	$T_j = T_{j\text{ max}}$ $T_j = 25\text{ }^\circ\text{C}$	180° half-sine wave; $t_p = 8.3\text{ ms};$ single pulse; $V_R = 0\text{ V};$
$I^2t$	Safety factor	$A^2s \cdot 10^3$	200 280	$T_j = T_{j\text{ max}}$ $T_j = 25\text{ }^\circ\text{C}$	180° half-sine wave; $t_p = 10\text{ ms};$ single pulse; $V_R = 0\text{ V};$
			170 230	$T_j = T_{j\text{ max}}$ $T_j = 25\text{ }^\circ\text{C}$	180° half-sine wave; $t_p = 8.3\text{ ms};$ single pulse; $V_R = 0\text{ V};$
<b>BLOCKING</b>					
$V_{RRM}$	Repetitive peak reverse voltages	V	2000...2800	$T_{j\text{ min}} < T_j < T_{j\text{ max}};$ 180° half-sine wave; 50 Hz;	
$V_{RSM}$	Non-repetitive peak reverse voltages	V	2100...2900	$T_{j\text{ min}} < T_j < T_{j\text{ max}};$ 180° half-sine wave; single pulse;	
$V_R$	Reverse continuous voltages	V	$0.6 \cdot V_{RRM}$	$T_j = T_{j\text{ max}};$	
<b>THERMAL</b>					
$T_{stg}$	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		
<b>MECHANICAL</b>					
a	Acceleration under vibration	$\text{m/s}^2$	50		

## CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
<b>ON-STATE</b>					
$V_{FM}$	Peak forward voltage, max	V	1.40	$T_j = 25\text{ }^\circ\text{C}; I_{FM} = 500\text{ A}$	
$V_{F(TO)}$	Forward threshold voltage, max	V	0.958	$T_j = T_{j\text{ max}};$	
$r_T$	Forward slope resistance, max	$\text{m}\Omega$	1.076	$0.5 \pi I_{FAV} < I_T < 1.5 \pi I_{FAV}$	
<b>BLOCKING</b>					
$I_{RRM}$	Repetitive peak reverse current, max	mA	20 2.50	$T_j = T_{j\text{ max}}$ $T_j = 25\text{ }^\circ\text{C}$	$V_R = V_{RRM}$
<b>SWITCHING</b>					
$Q_r$	Recovered charge, max	$\mu\text{C}$	1350	$T_j = T_{j\text{ max}}; I_{FM} = I_{FAV};$	
$t_{rr}$	Reverse recovery time, max	$\mu\text{s}$	25	$di_R/dt = -10\text{ A}/\mu\text{s};$	
$I_{rr}$	Reverse recovery current, max	A	108	$V_R = 100\text{ V};$	
<b>THERMAL</b>					
$R_{thjc}$	Thermal resistance, junction to case				
	per module	$^\circ\text{C}/\text{W}$	0.0850	180° half-sine wave, 50 Hz	
	per arm	$^\circ\text{C}/\text{W}$	0.1700		
	per module	$^\circ\text{C}/\text{W}$	0.0800	DC	
per arm	$^\circ\text{C}/\text{W}$	0.1600			
$R_{thch}$	Thermal resistance, case to heatsink				
	per module	$^\circ\text{C}/\text{W}$	0.0300		
	per arm	$^\circ\text{C}/\text{W}$	0.0600		

<b>INSULATION</b>					
V <sub>ISOL</sub>	Insulation test voltage	kV	3.00	Sine wave, 50 Hz; RMS	t=60 sec
			3.60		t=1 sec
<b>MECHANICAL</b>					
M <sub>1</sub>	Mounting torque (M6) <sup>1)</sup>	Nm	6.00	Tolerance ± 15%	
M <sub>2</sub>	Terminal connection torque (M6) <sup>1)</sup>	Nm	6.00	Tolerance ± 15%	
m	Weight, max	g	350		

<b>PART NUMBERING GUIDE</b>						<b>NOTES</b>				
MD	3	-	200	-	28	-	F	-	N	<sup>1)</sup> 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.F) 6. Ambient Conditions: N – Normal										



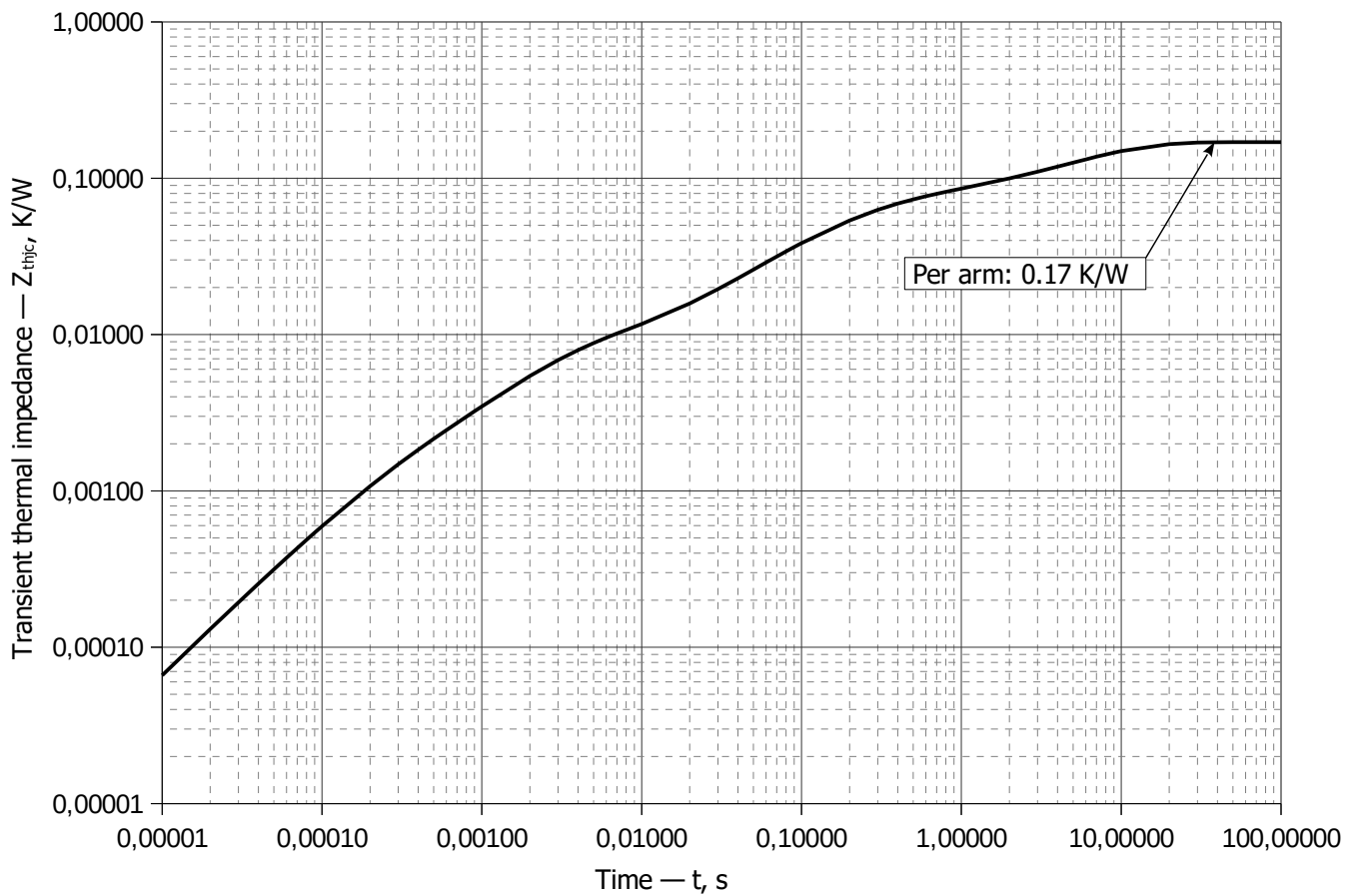
**Fig 1 – Forward characteristics of Limit device**

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	
	$T_j = 25^\circ\text{C}$	$T_j = T_{j\text{max}}$
<b>A</b>	0.92504472	0.83885667
<b>B</b>	0.00062831	0.00078347
<b>C</b>	0.00325009	-0.00934651
<b>D</b>	0.00656660	0.01489701

**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.

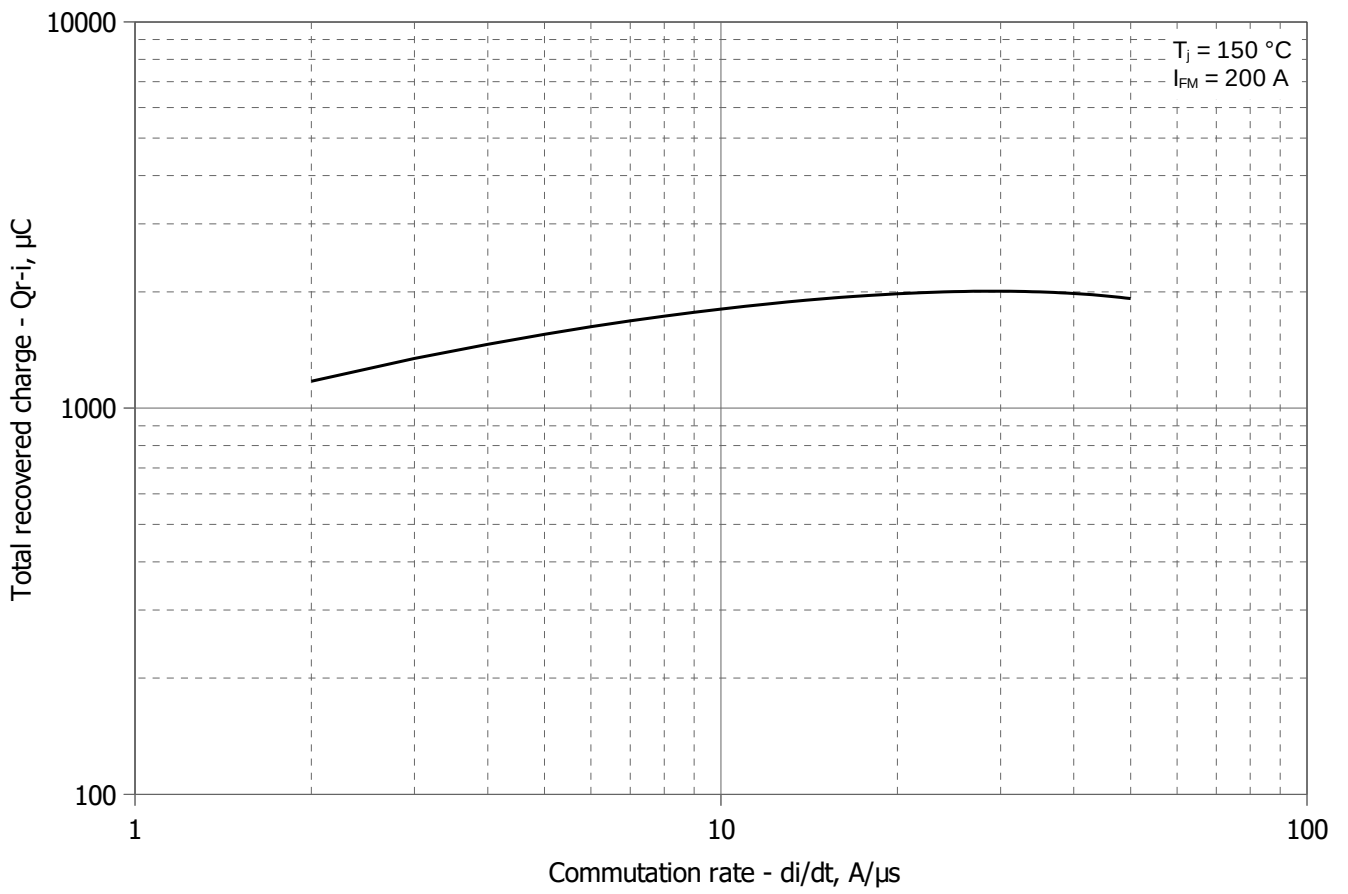
$Z_{thjc}$  = Thermal resistance at time  $t$ .

$R_i$  = Amplitude of  $p_{th}$  term.

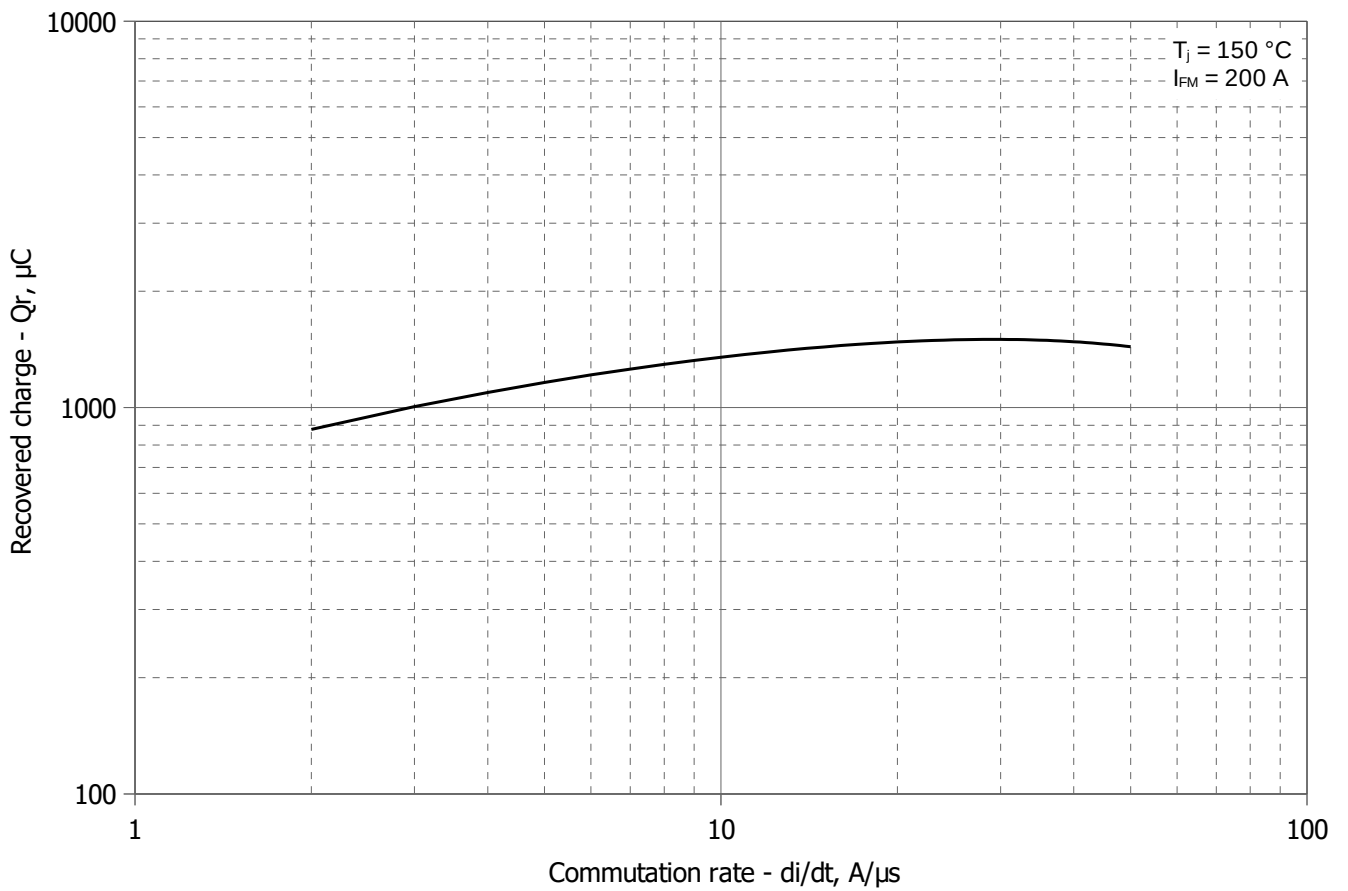
$\tau_i$  = Time constant of  $r_{th}$  term.

<b>i</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b><math>R_i</math>, K/W</b>	0.0007228424	0.006639986	0.0153862565	0.0389709604	0.0142906115	0.09398934
<b><math>\tau_i</math>, s</b>	0.0002111	0.002366	0.06905	0.1909	0.6646	6.64

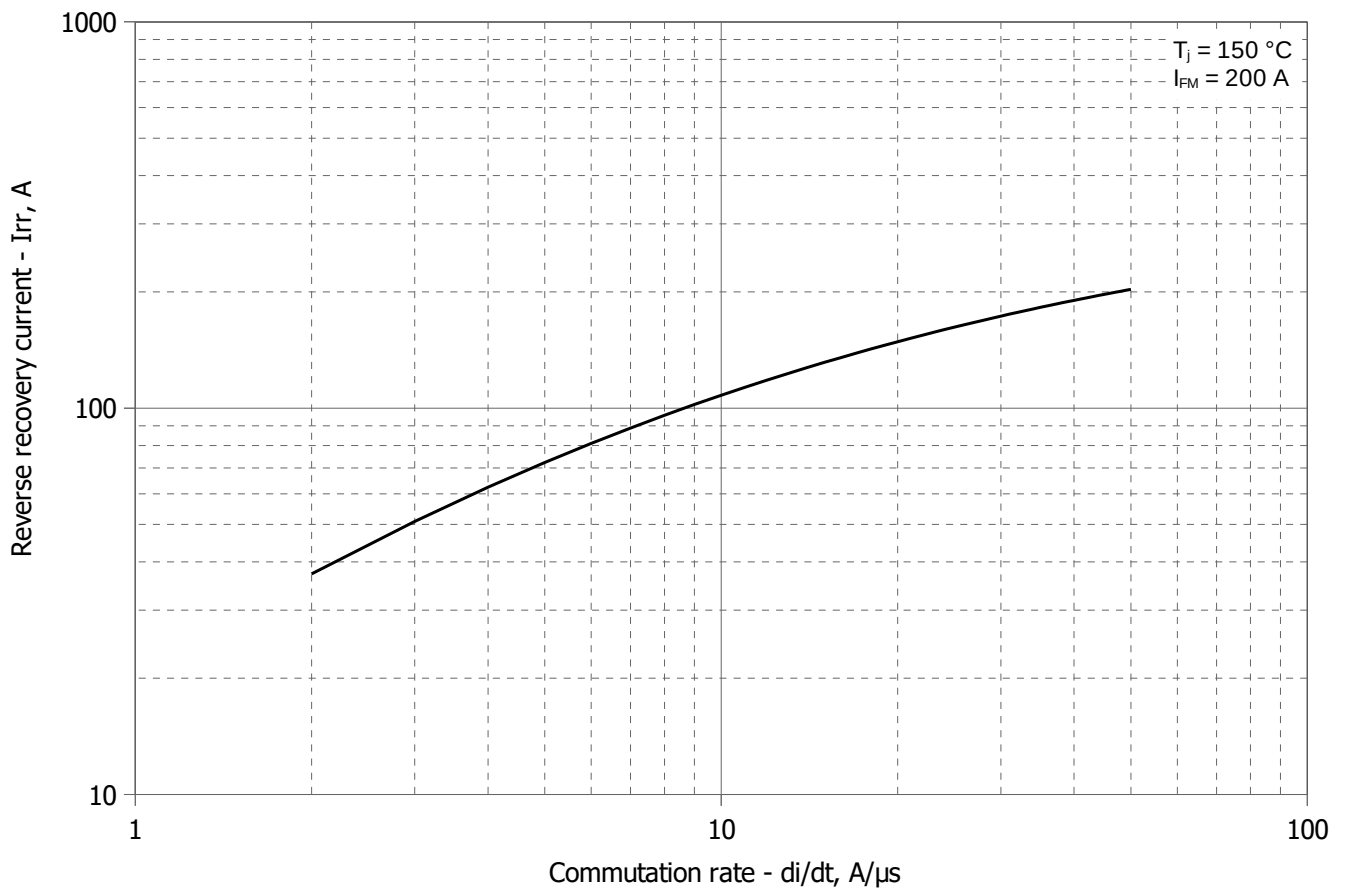
**Transient thermal impedance junction to case  $Z_{thjc}$  model (see Fig. 2)**



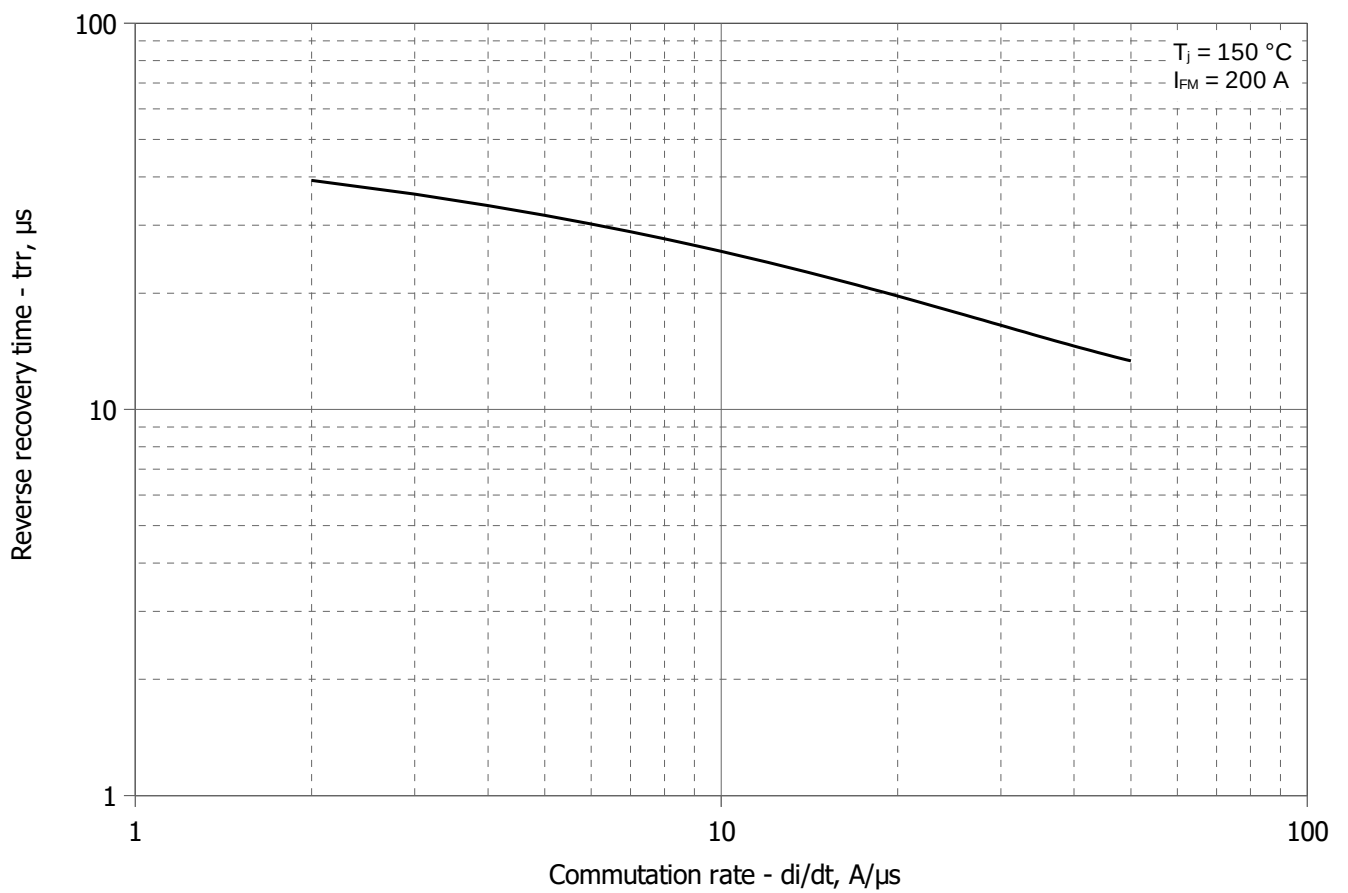
**Fig 3 - Maximum recovered charge  $Q_{r-i}$  (integral) vs. commutation rate  $di_R/dt$**



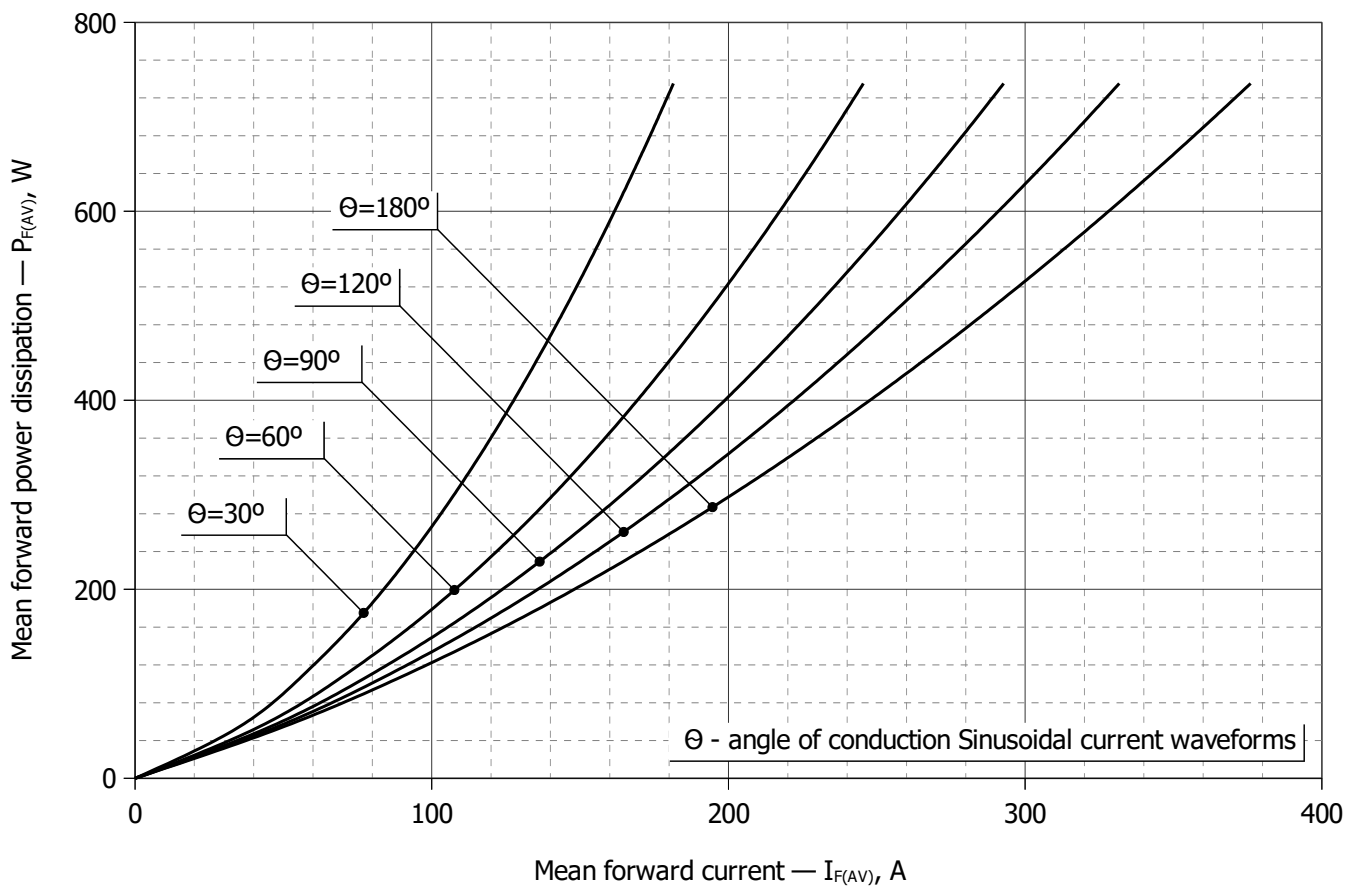
**Fig 4 - Maximum recovered charge  $Q_r$  vs. commutation rate  $di_R/dt$  (25% chord)**



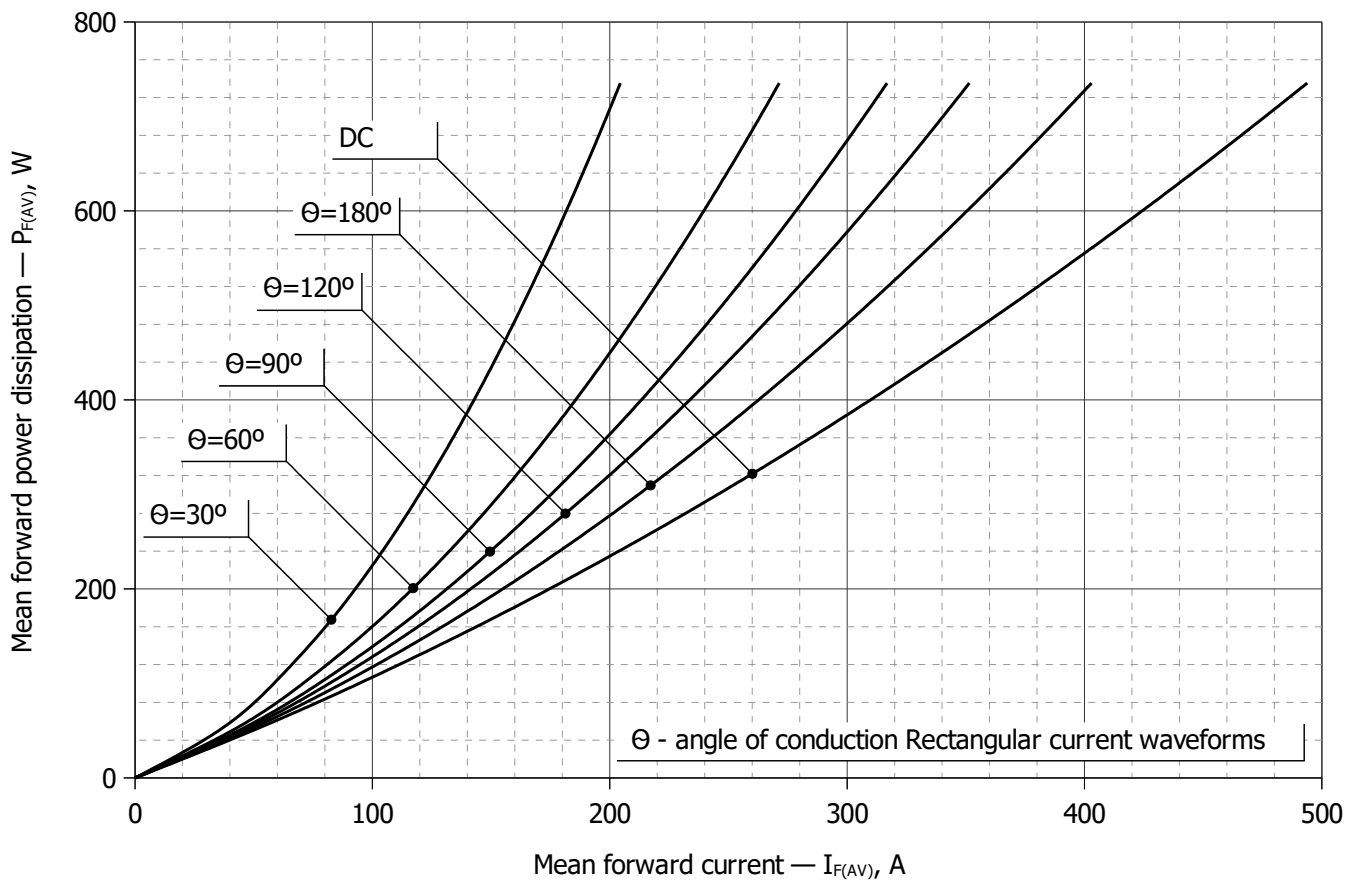
**Fig 5 - Maximum reverse recovery current  $I_{rr}$  vs. commutation rate  $di_R/dt$**



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

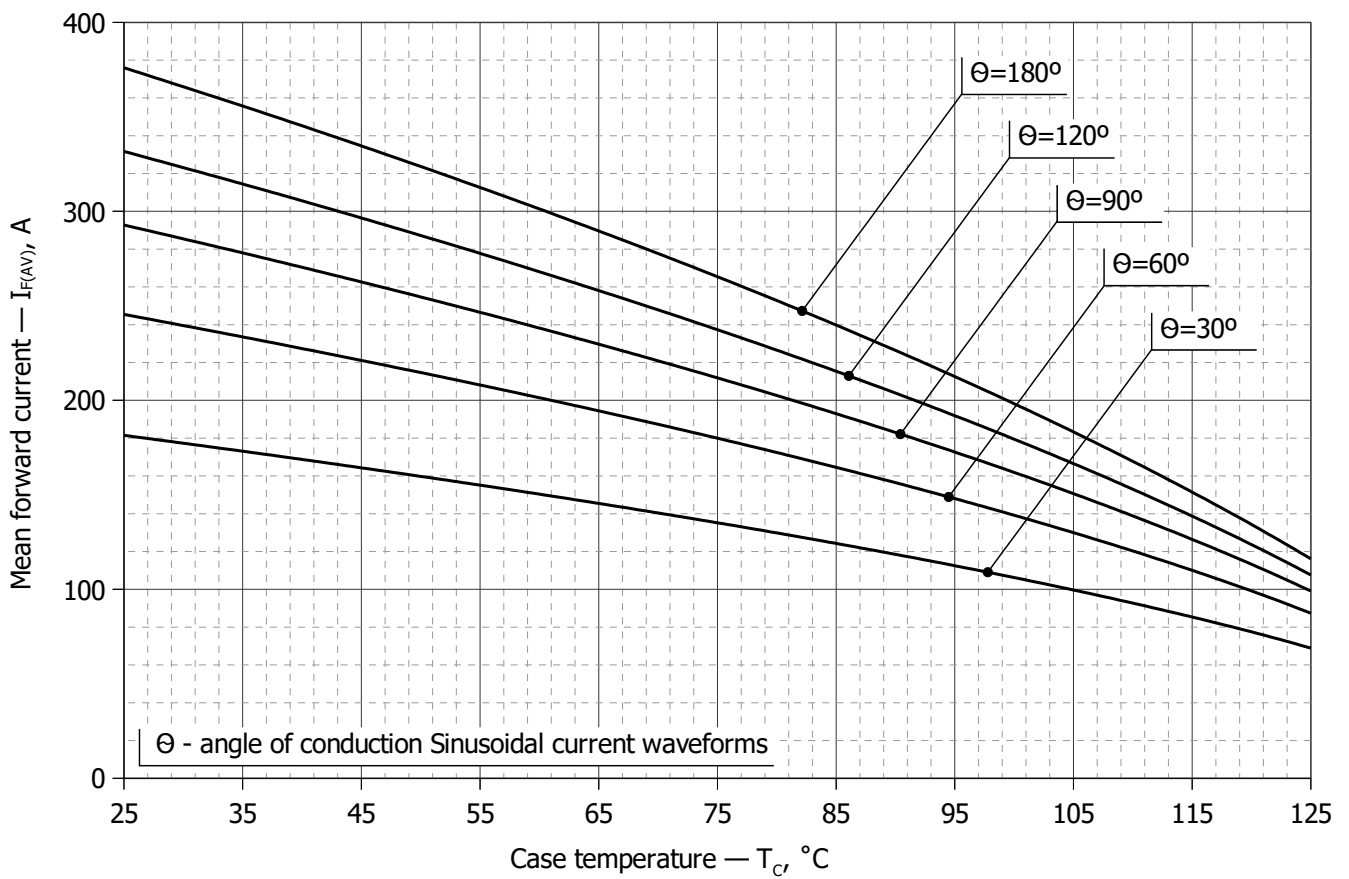


**Fig. 7 - Mean forward power dissipation  $P_{FAV}$  vs. mean forward current  $I_{FAV}$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ )**

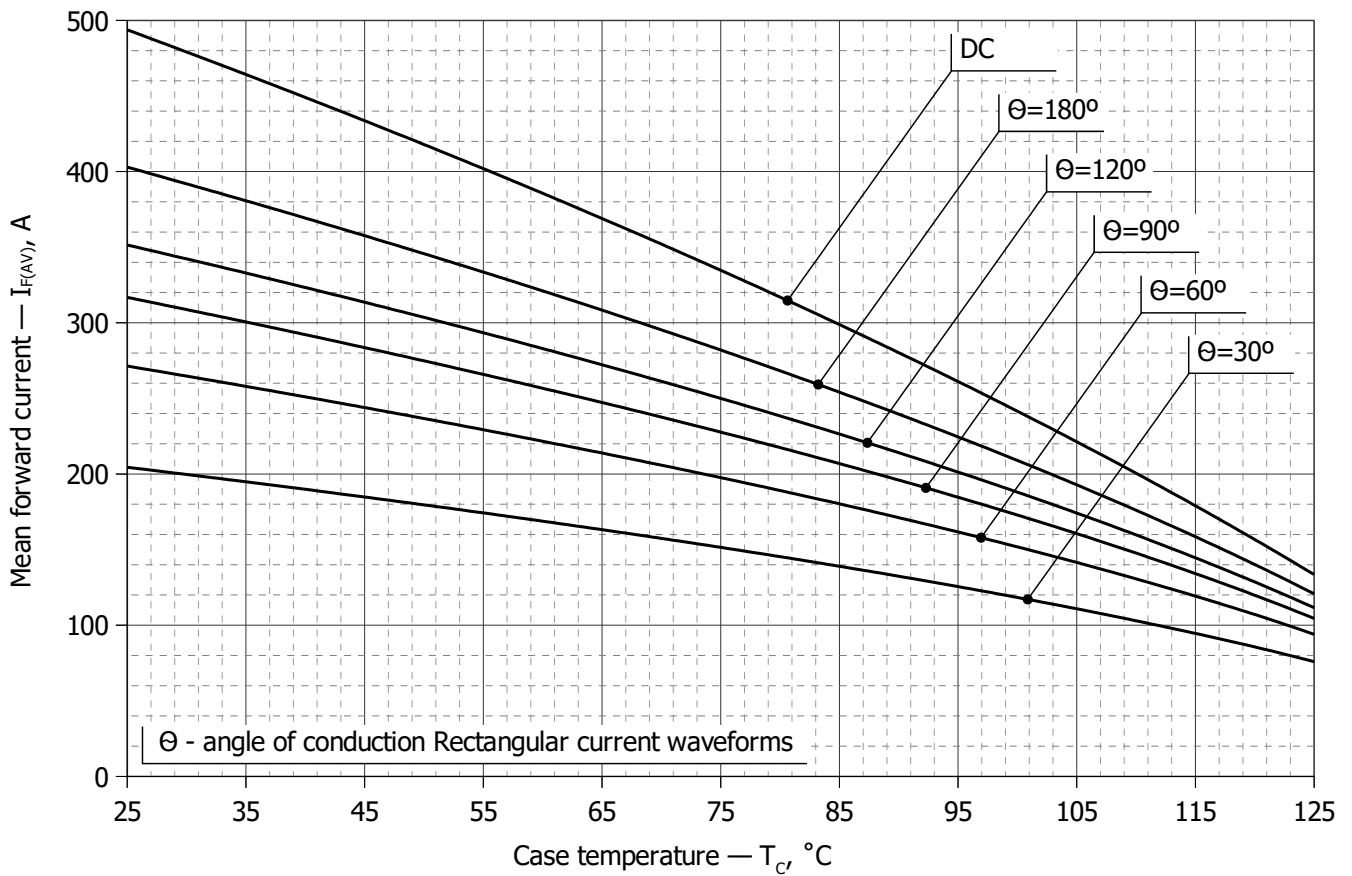


**Fig. 8 - Mean forward power dissipation  $P_{FAV}$  vs. mean forward current  $I_{FAV}$  for rectangular current waveforms at different conduction angles and for DC ( $f=50\text{Hz}$ )**

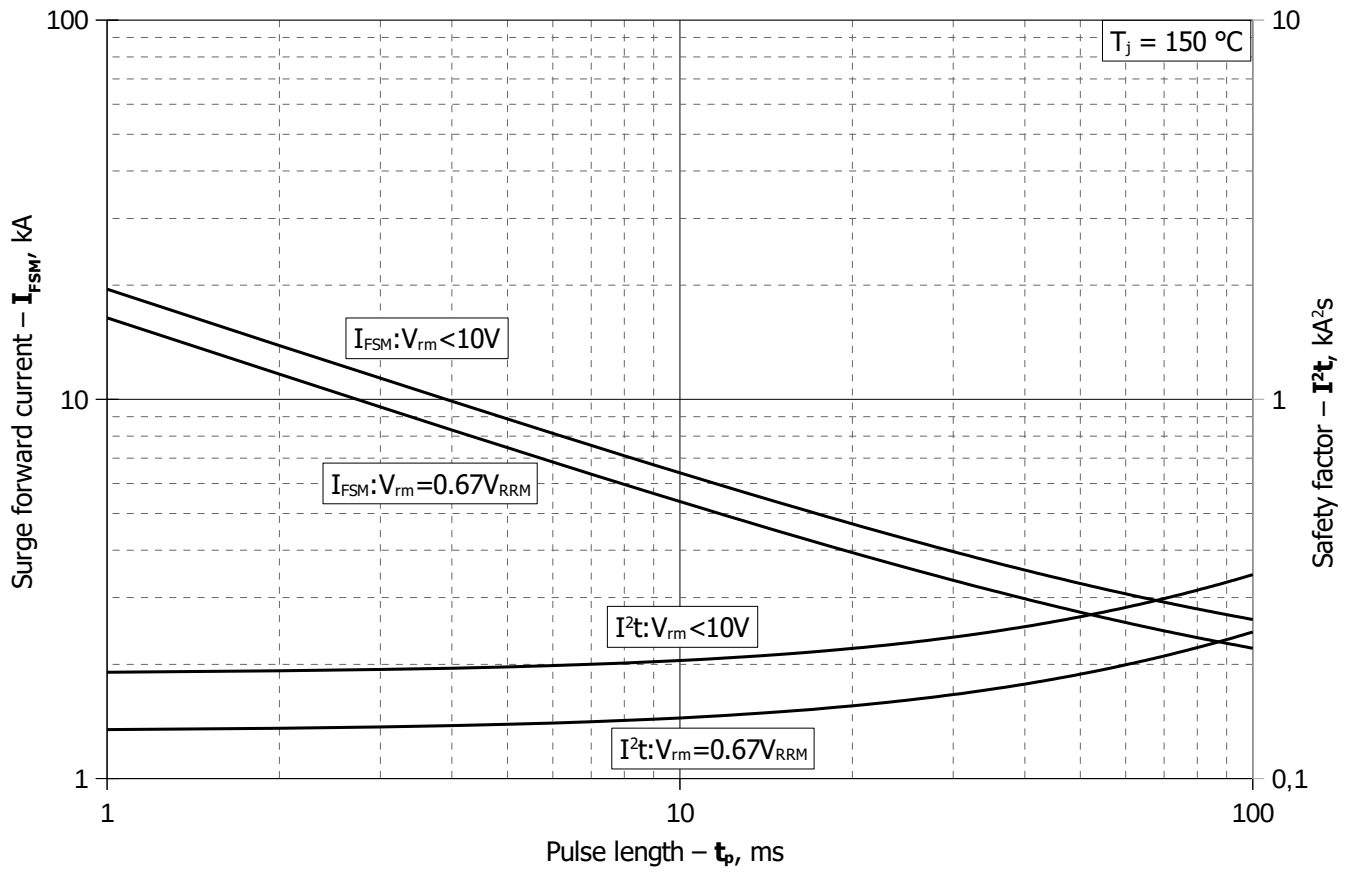




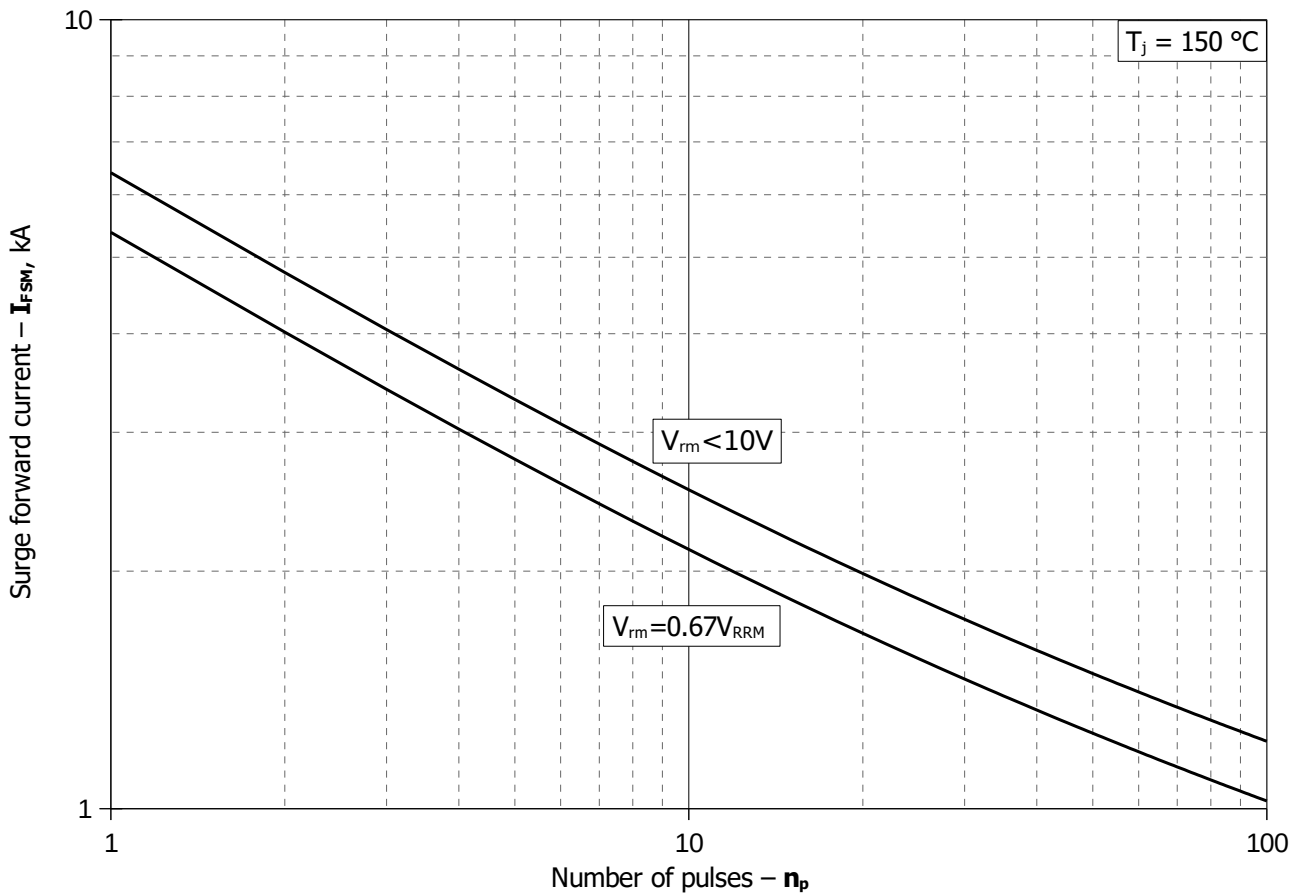
**Fig. 9 – Mean forward current  $I_{FAV}$  vs. case temperature  $T_C$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ )**



**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  $n_p$**