



# Diode Modules MDx-160-36-F



Average forward current		$I_{FAV}$	160 A	
Repetitive peak reverse voltage		$V_{RRM}$	3000...3600 V	
$V_{RRM}, V$	3000	3200	3400	3600
Voltage code	30	32	34	36
$T_j, ^\circ C$	-40...+150			

MD3	MD4	MD5
<p>plug 2,8x0,8</p> <p>9,8(0,385)</p> <p>23(0,905)</p> <p>23(0,905)</p> <p>17(0,669)</p> <p>5(0,197)</p> <p>28,2(1,110)</p> <p>30(1,181)</p> <p>94(3,7)</p> <p><math>\phi 6,5(0,256) DIA</math></p> <p>2 aperture</p> <p>80(3,15)</p> <p>5(0,197)</p> <p>13(0,511)</p> <p>24(0,994)</p> <p>34(1,338)</p> <p>M6</p>		

## MAXIMUM ALLOWABLE RATINGS

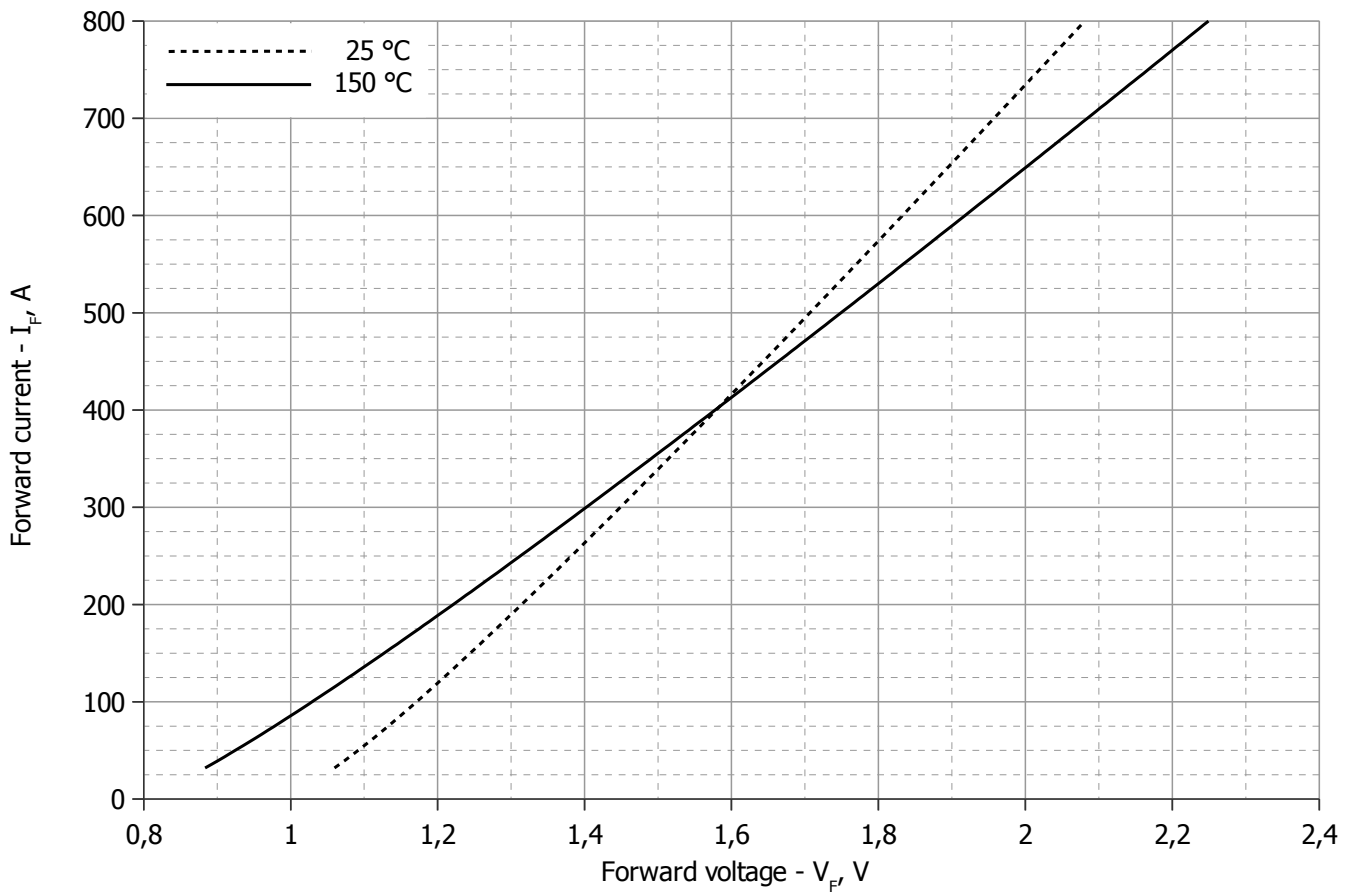
Symbols and parameters		Units	Values	Test conditions	
<b>ON-STATE</b>					
$I_{FAV}$	Maximum allowable average forward current	A	179 160	$T_c=100\text{ }^\circ\text{C}$ ; $T_c=107\text{ }^\circ\text{C}$ ; 180° half-sine wave; 50 Hz	
$I_{FRMS}$	RMS forward current	A	251	$T_c=107\text{ }^\circ\text{C}$ ; 180° half-sine wave; 50 Hz	
$I_{FSM}$	Surge forward current	kA	4.5 5.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^\circ\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$ ; single pulse; $V_R=0\text{ V}$
			4.5 5.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^\circ\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$ ; single pulse; $V_R=0\text{ V}$
$I^2t$	Safety factor	$A^2s\cdot 10^3$	100 120	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^\circ\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$ ; single pulse; $V_R=0\text{ V}$
			80 100	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^\circ\text{C}$	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	3000...3600	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$ ; 180° half-sine wave; 50 Hz	
$V_{RSM}$	Non-repetitive peak reverse voltages	V	3100...3700	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$ ; 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	1.70	$T_j=25\text{ }^\circ\text{C}$ ; $I_{FM}=I_{FAV}$	
$V_{F(TO)}$	Forward threshold voltage, max	V	0.886	$T_j=T_{j\text{ max}}$ ;	
$r_T$	Forward slope resistance, max	$\text{m}\Omega$	1.709	$0.5\pi I_{FAV} < I_T < 1.5\pi I_{FAV}$	
<b>BLOCKING</b>					
$I_{RRM}$	Repetitive peak reverse current, max	mA	50 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	$\mu\text{C}$	2150	$T_j=T_{j\text{ max}}$ ; $I_{FM}=I_{FAV}$ ;	
$t_{rr}$	Reverse recovery time, max	$\mu\text{s}$	65	$di_R/dt=-5\text{ A}/\mu\text{s}$ ;	
$I_{rr}$	Reverse recovery current, max	A	66	$V_R=100\text{ V}$	
<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>					
$V_{ISOL}$	Insulation test voltage	kV	3.00	Sine wave, 50 Hz;	t=60 sec
			3.60	RMS	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 - 160 - 36 - 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		



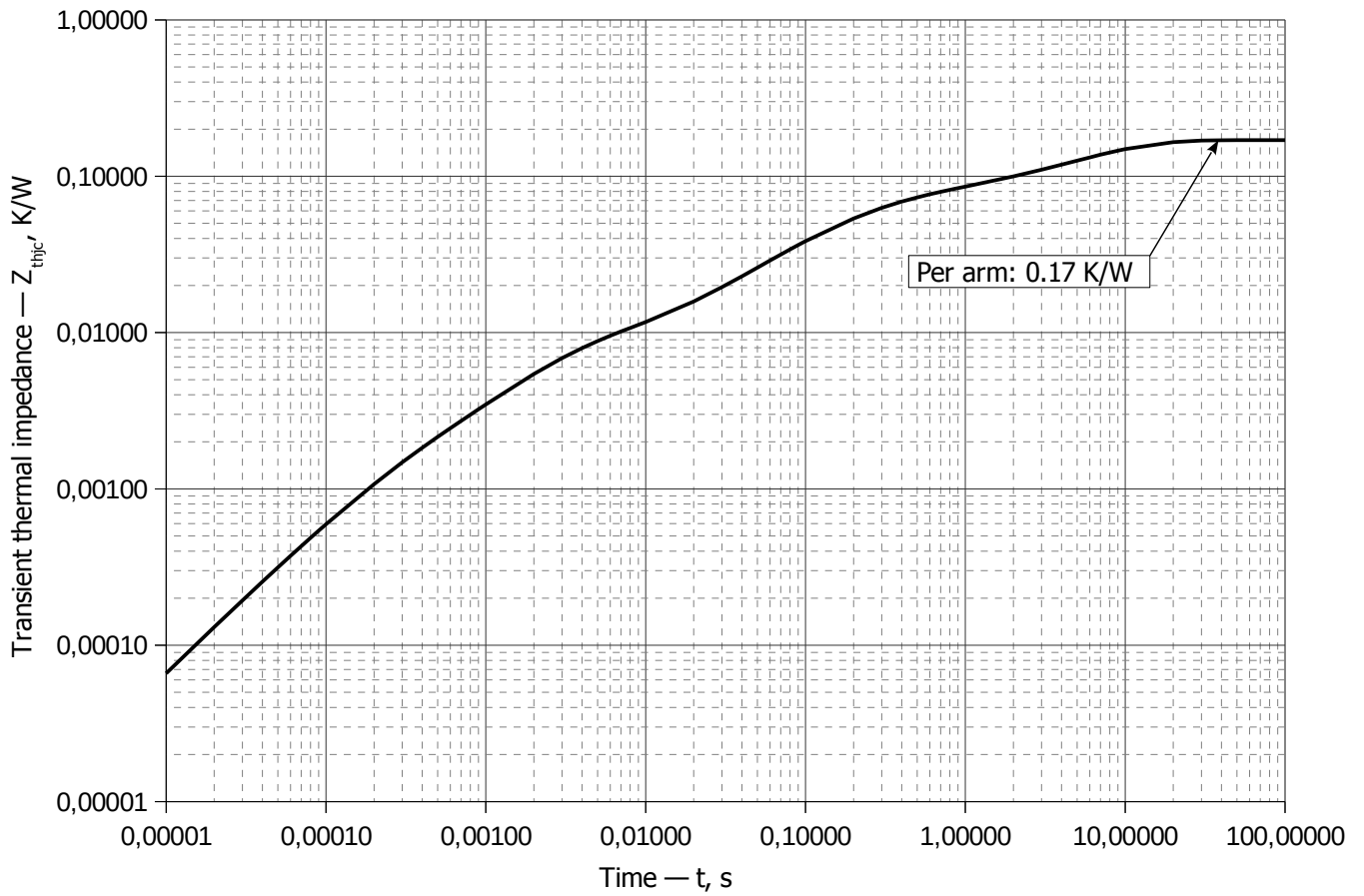
**Fig 1 – Forward characteristics of Limit device**

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>	0.96264779	0.79328135
<b>B</b>	0.00110372	0.00140620
<b>C</b>	0.00670937	-0.00967186
<b>D</b>	0.00673239	0.01398987

**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.

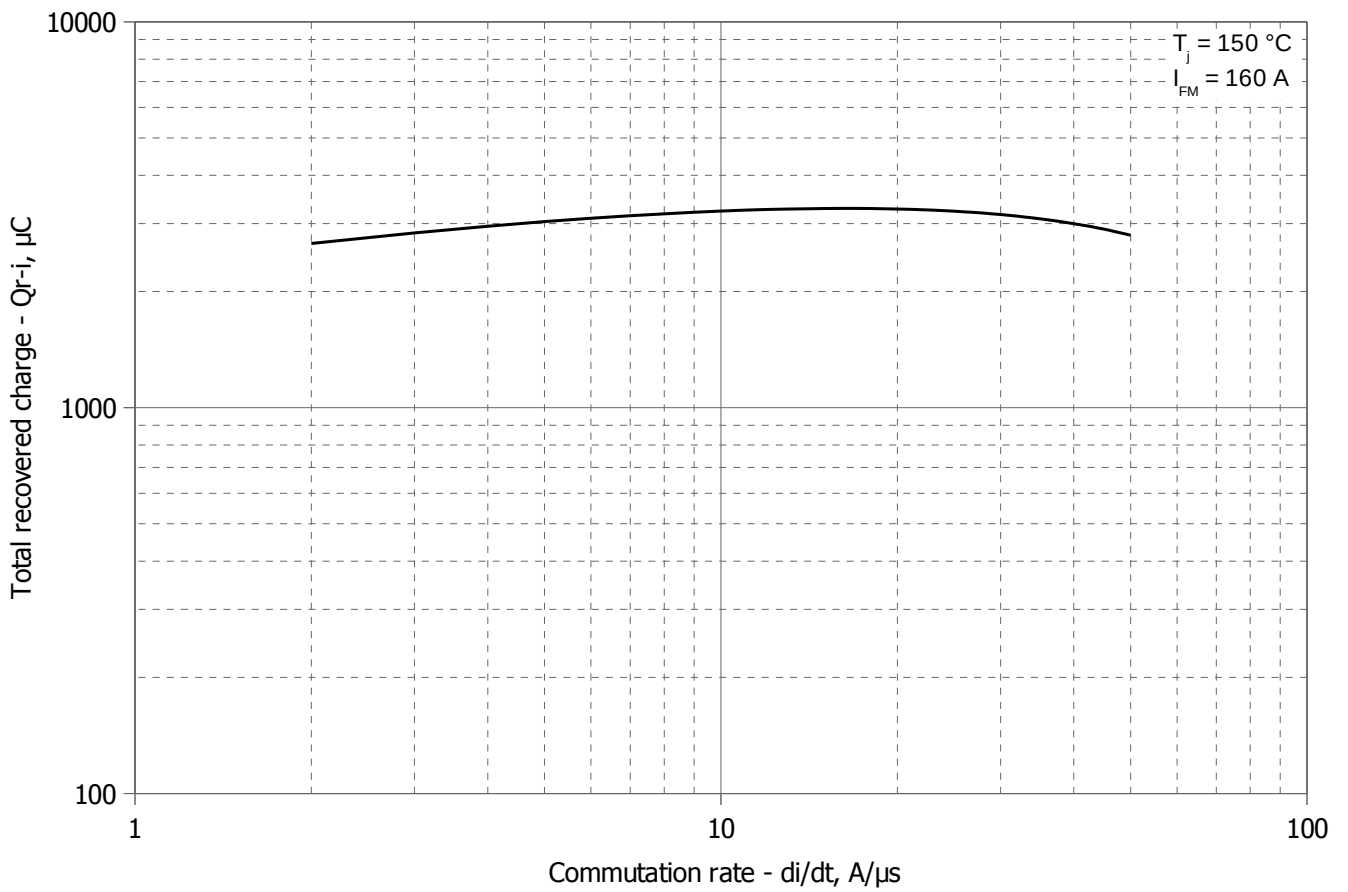
$Z_{thjc}$  = Thermal resistance at time  $t$ .

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

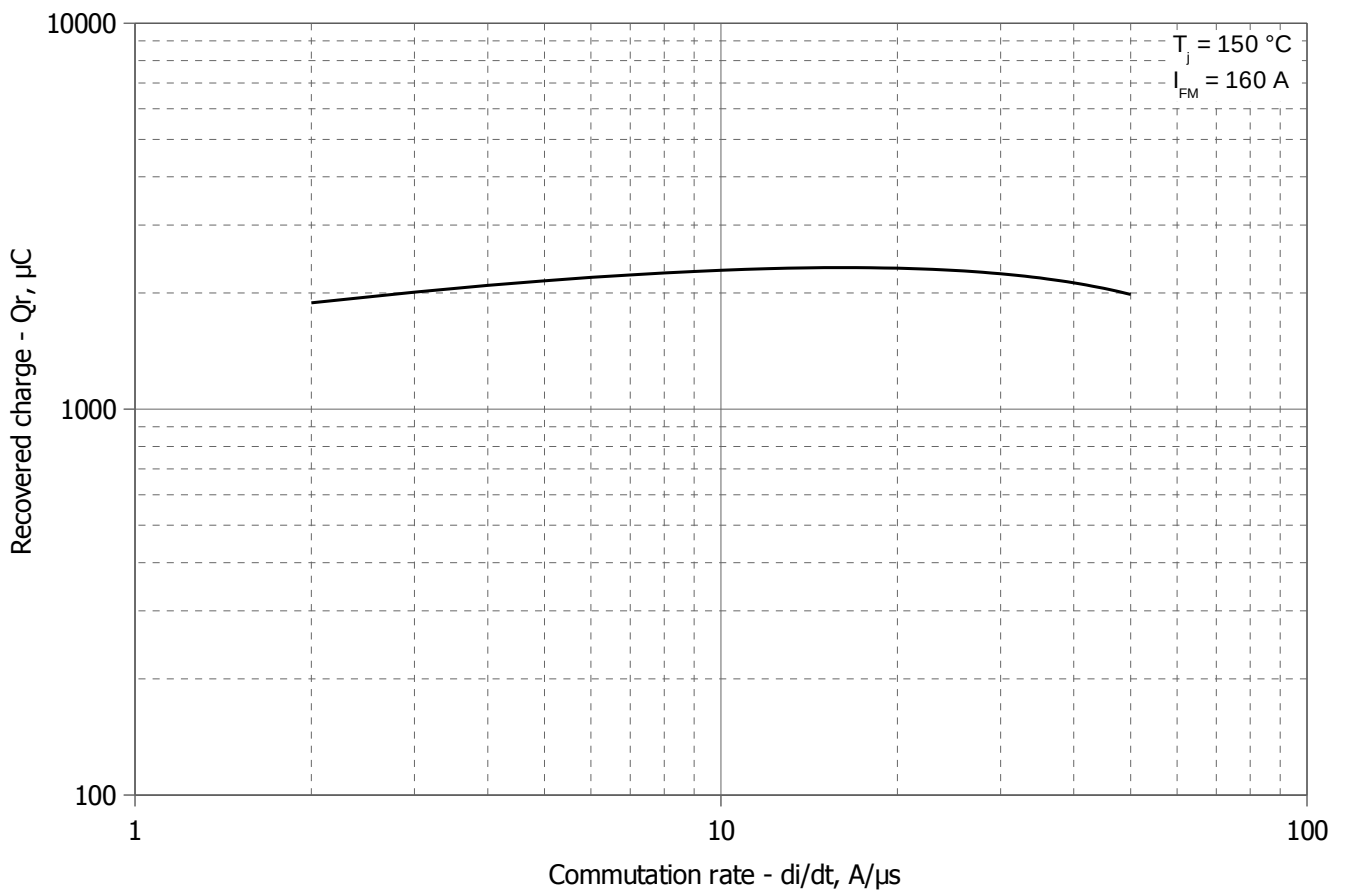
$\tau_i$  = Time constant of  $r_{th}$  term.

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

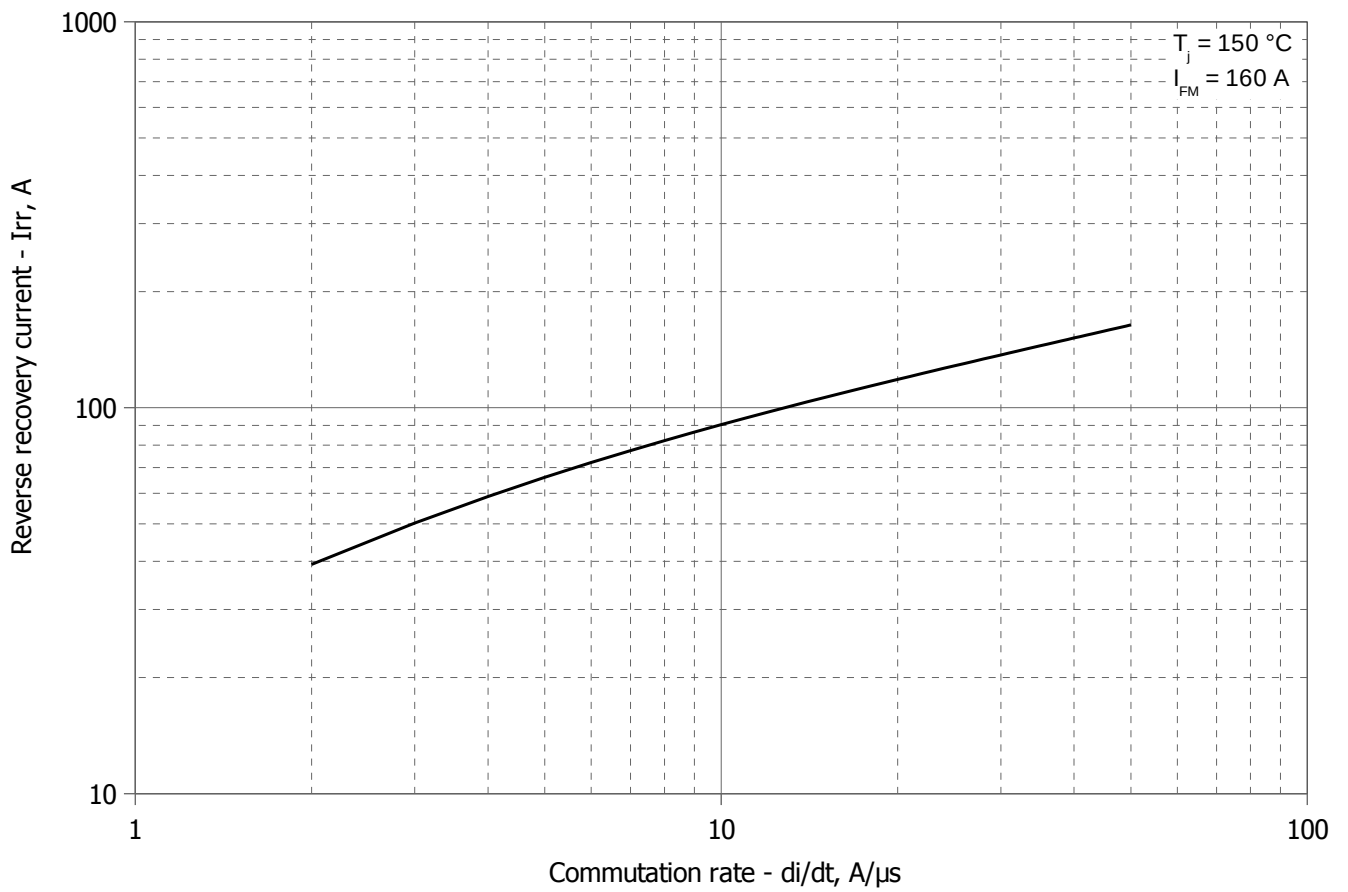
**Transient thermal impedance junction to case  $Z_{thjc}$  model (see Fig. 2)**



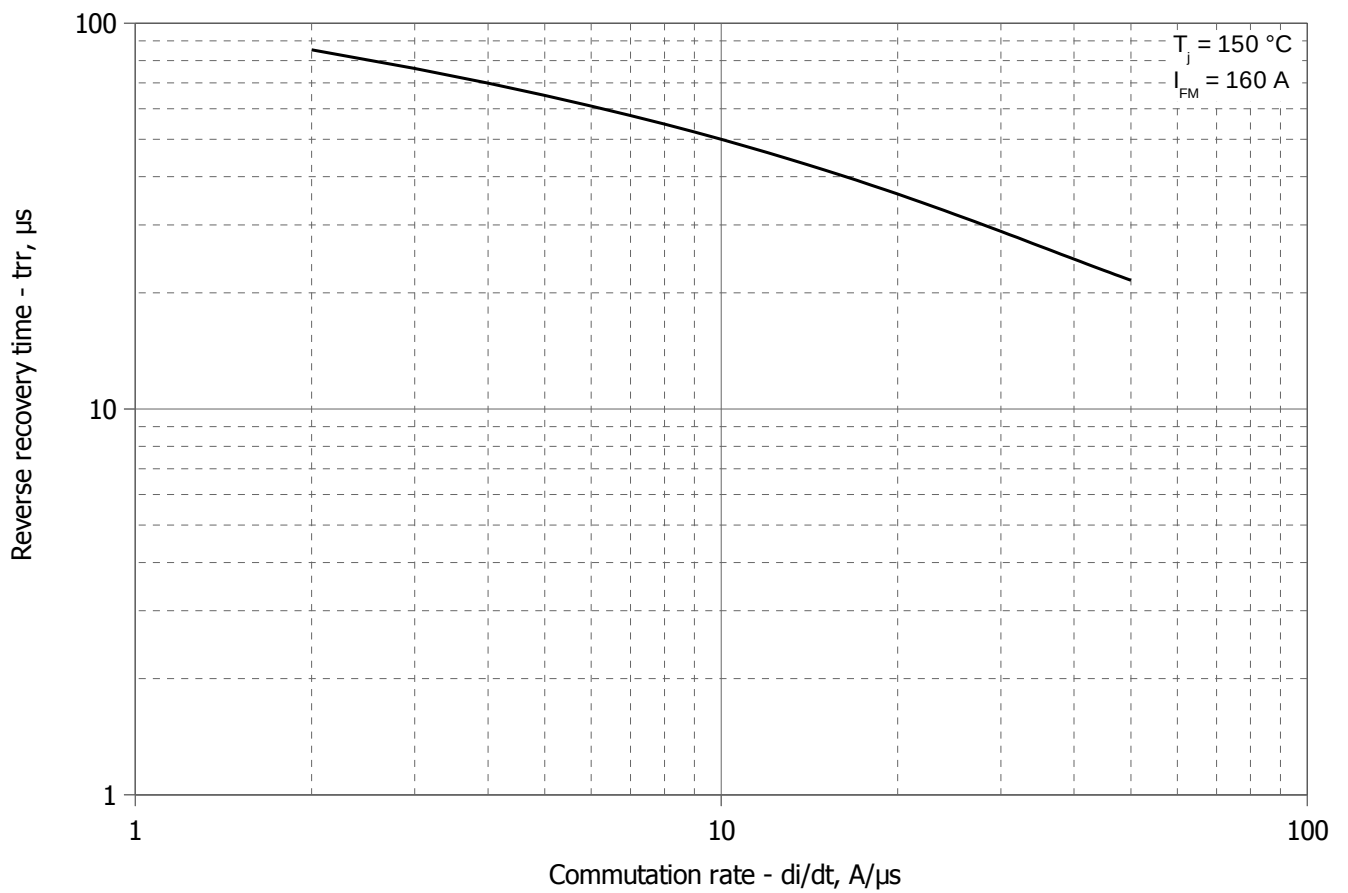
**Fig 3 - Maximum recovered charge  $Q_{r-i}$  (integral) vs. commutation rate  $di_R/dt$**



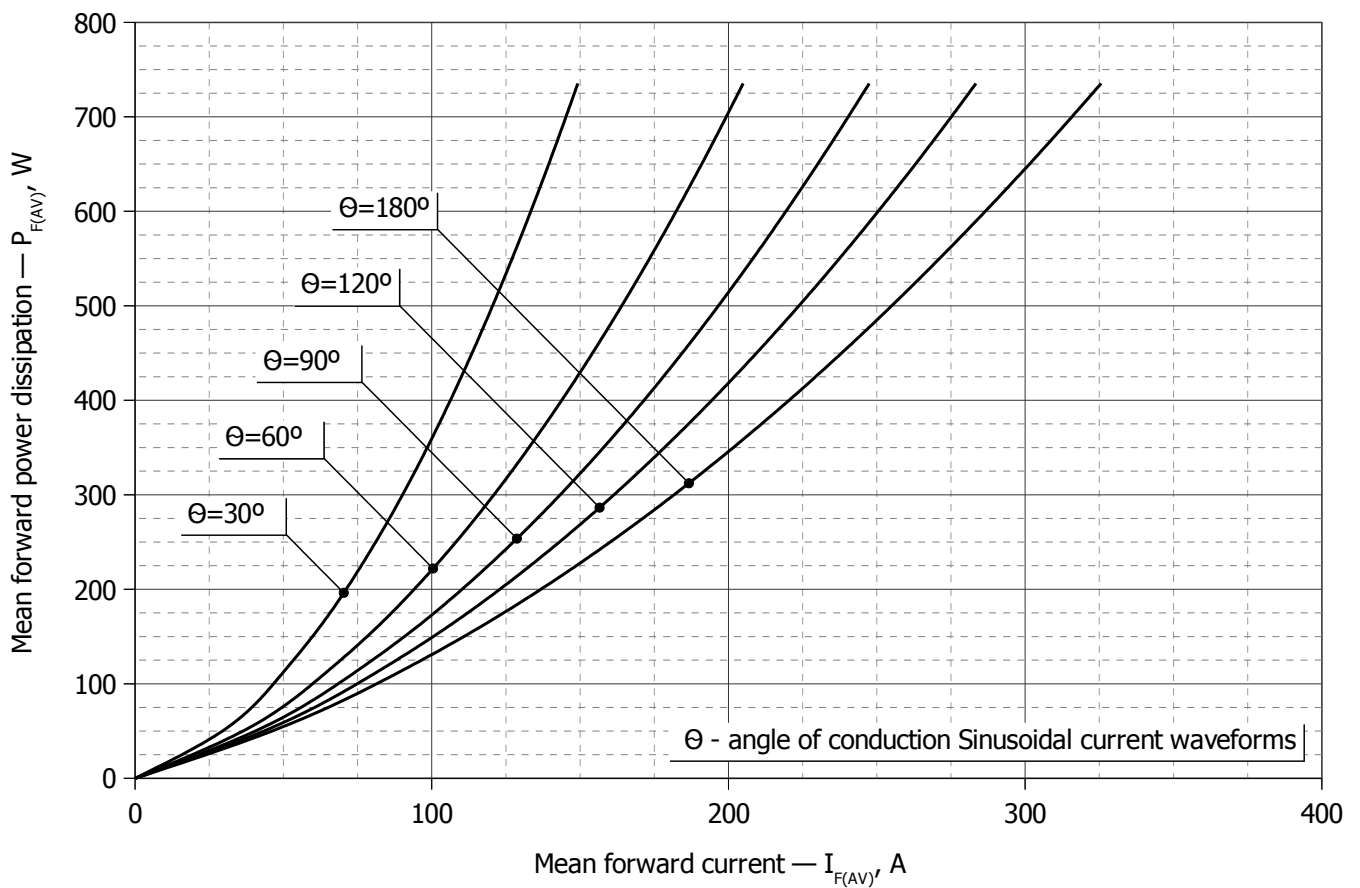
**Fig 4 - Maximum recovered charge  $Q_r$  vs. commutation rate  $di_R/dt$  (25% chord)**



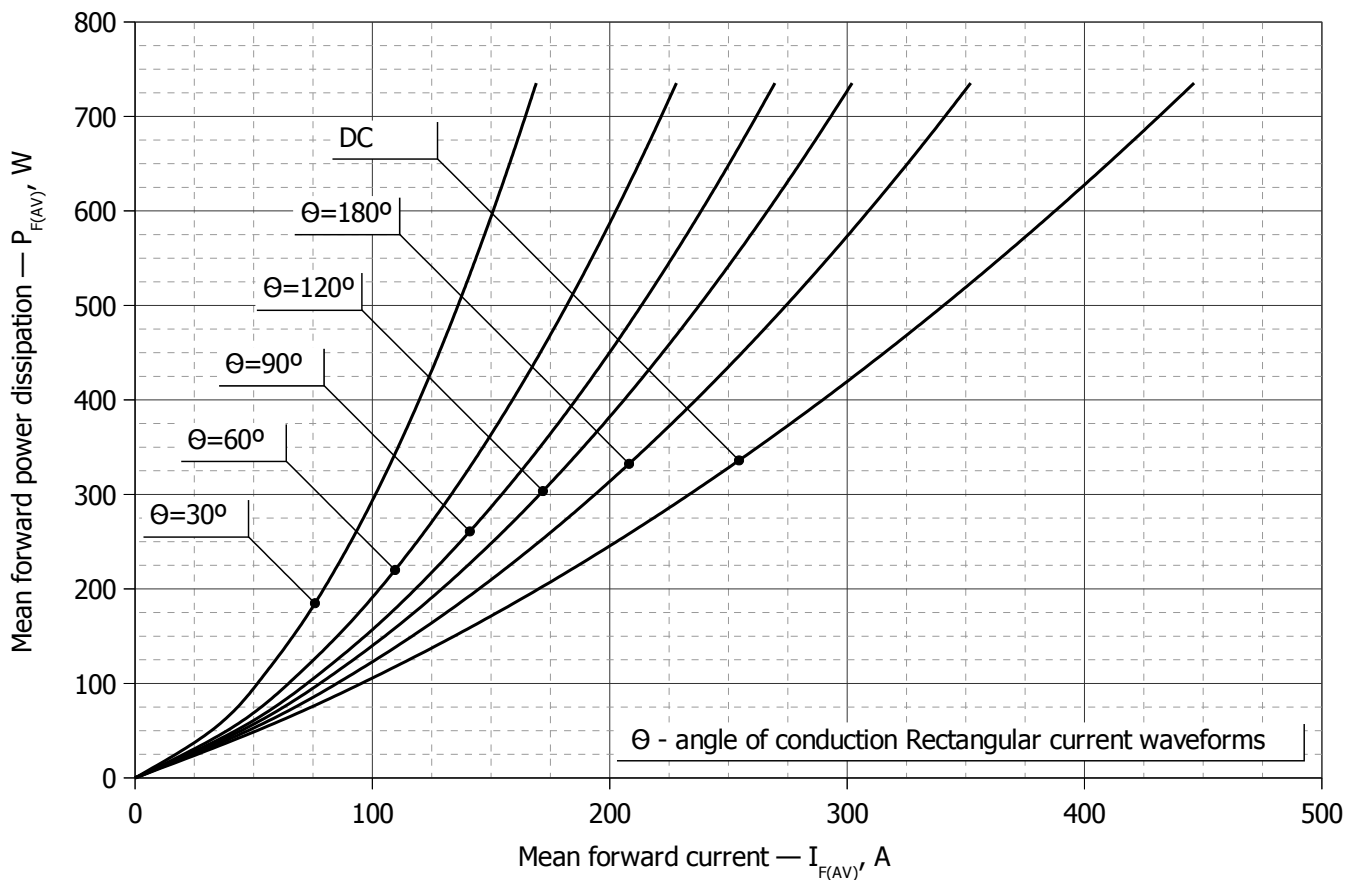
**Fig 5 - Maximum reverse recovery current  $I_{rr}$  vs. commutation rate  $di_R/dt$**



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

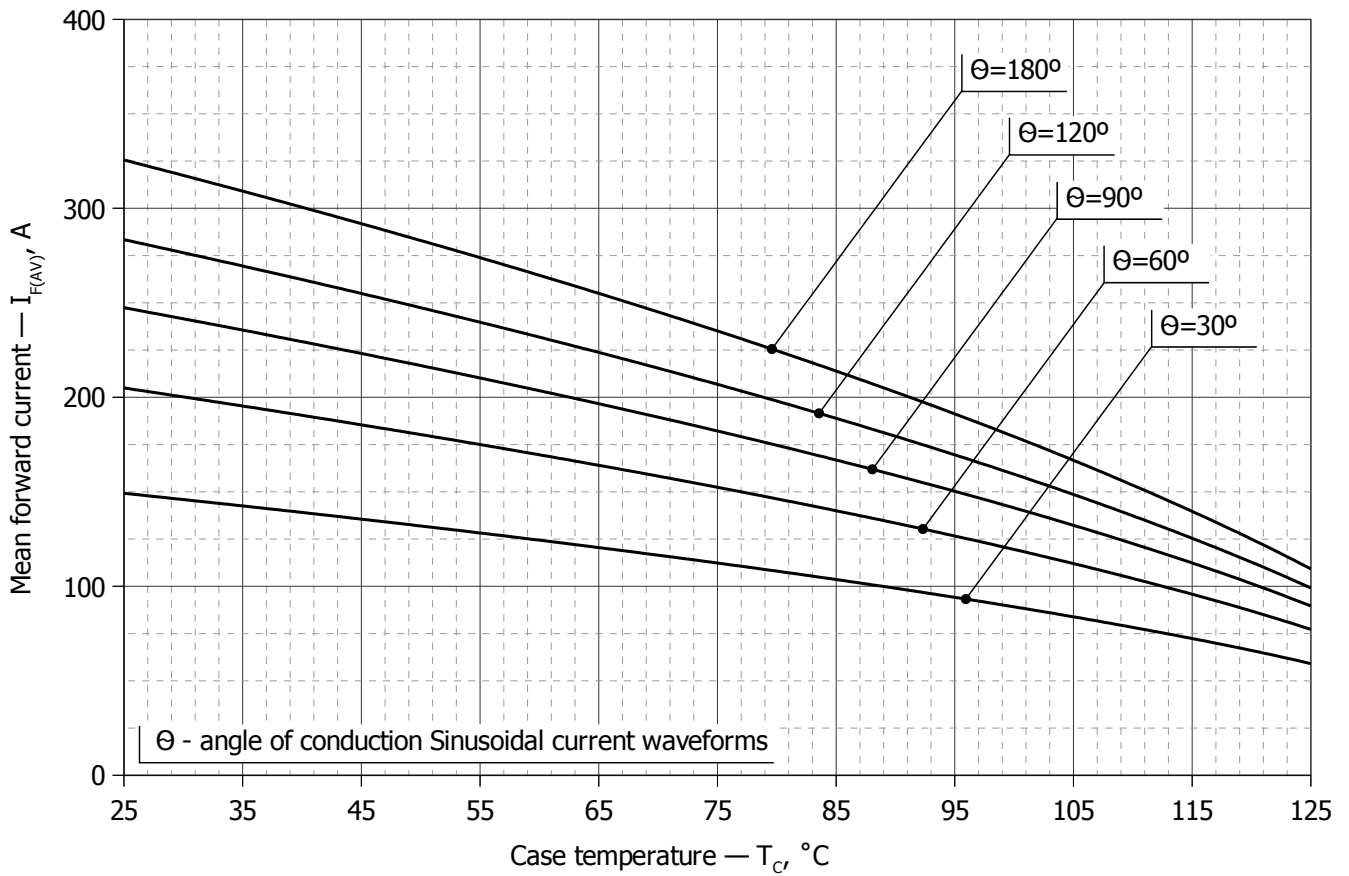


**Fig. 7 - Mean forward power dissipation  $P_{FAV}$  vs. mean forward current  $I_{FAV}$  for sinusoidal current waveforms at different conduction angles ( $f=50\text{Hz}$ )**

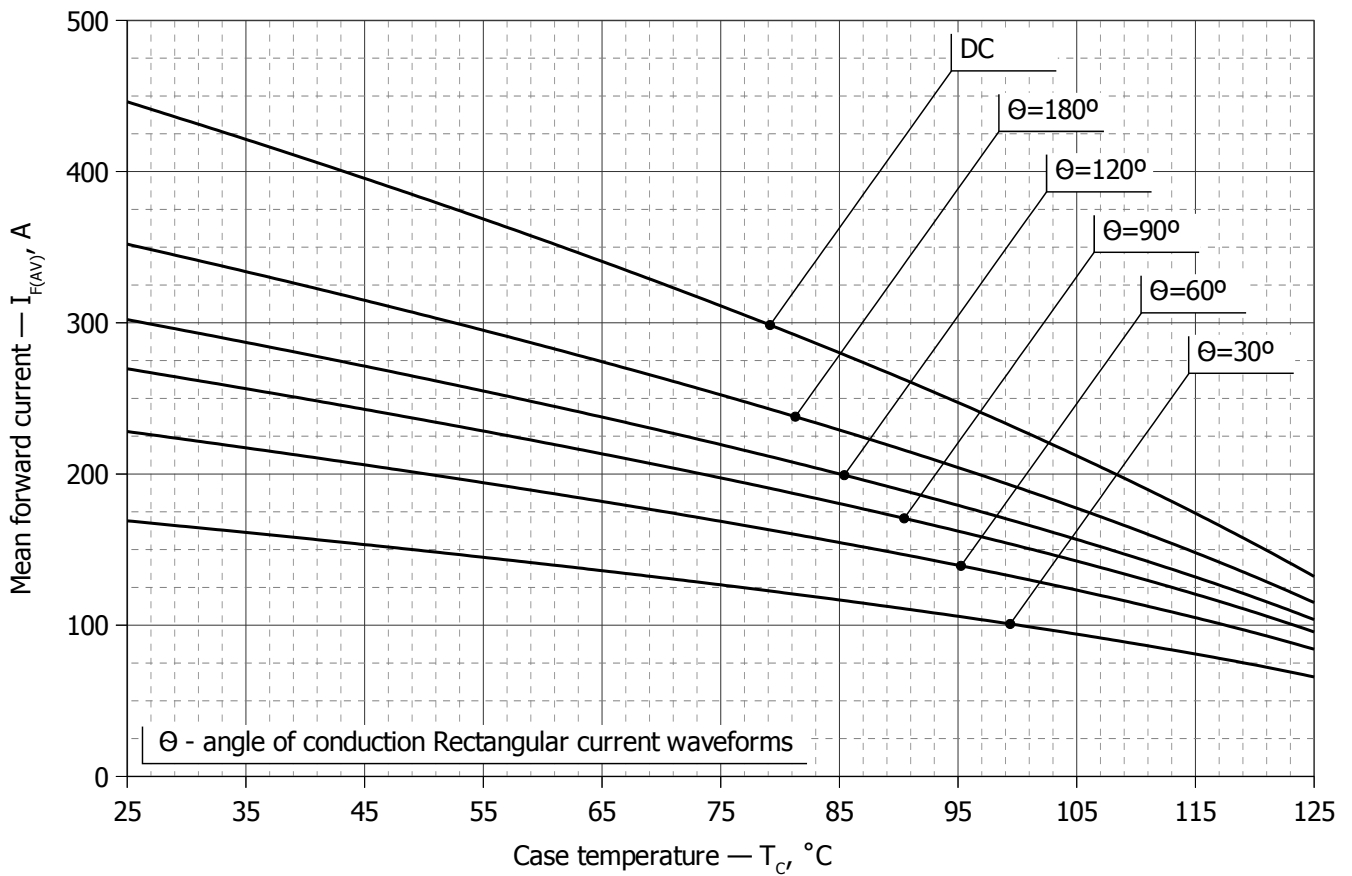


**Fig. 8 - Mean forward power dissipation  $P_{FAV}$  vs. mean forward current  $I_{FAV}$  for rectangular current waveforms at different conduction angles and for DC ( $f=50\text{Hz}$ )**

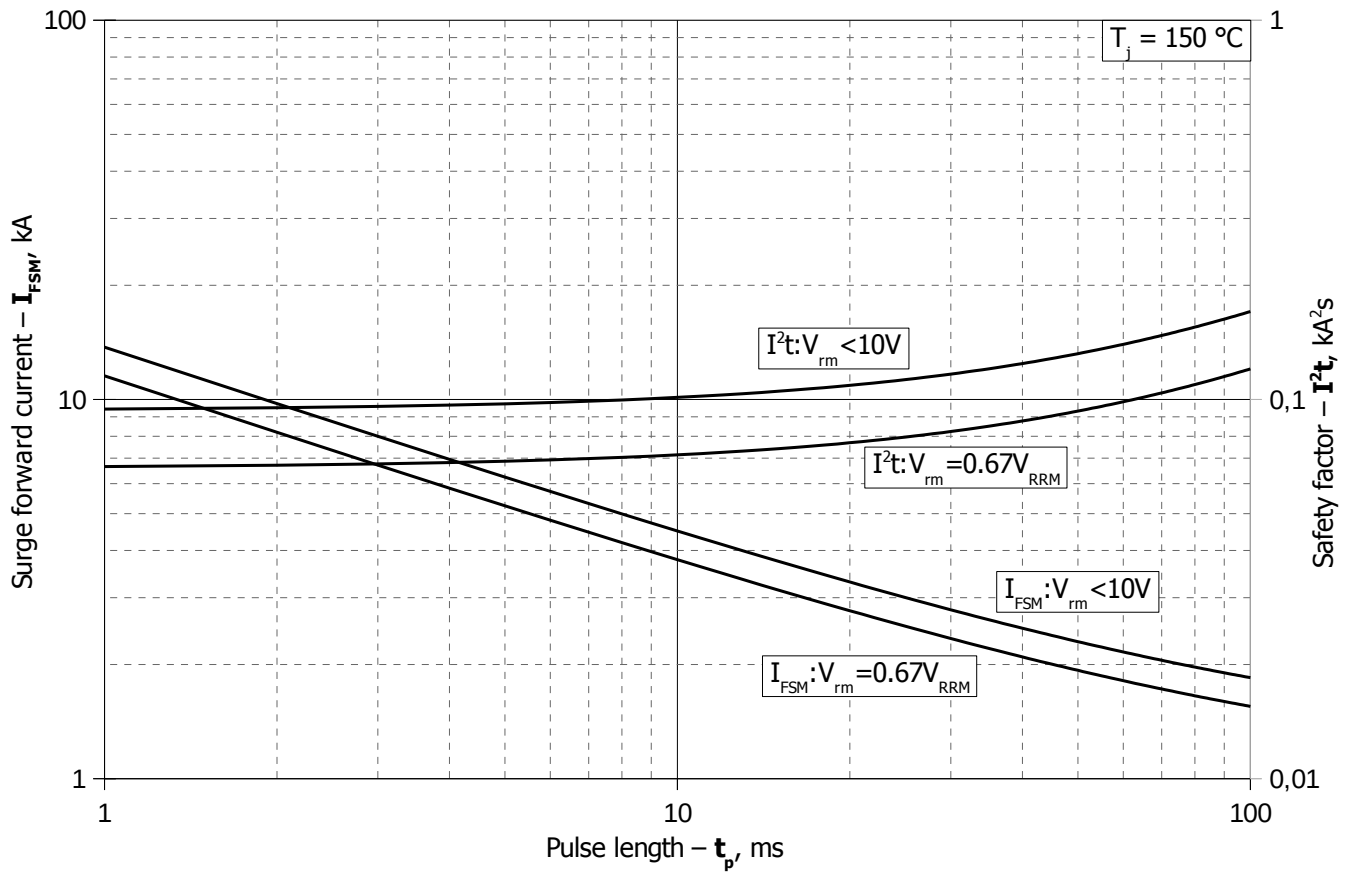




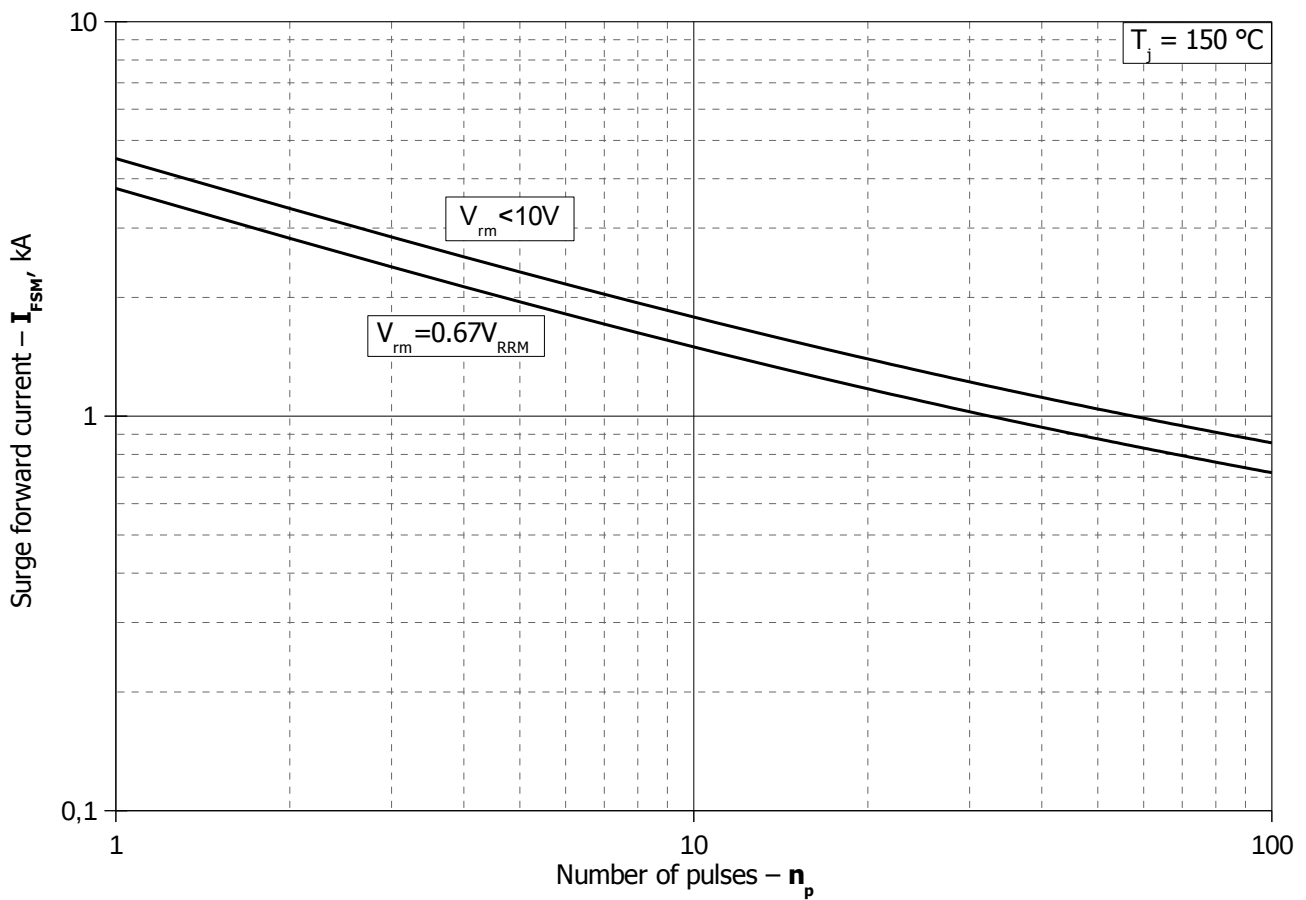
**Fig. 9 – Mean forward current  $I_{FAV}$  vs. case temperature  $T_c$  for sinusoidal current waveforms at different conduction angles ( $f=50Hz$ )**



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



**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  $n_p$**