



P H A S E C O N T R O L T H Y R I S T O R - D I O D E M O D U L E S

MTT-160, MTTC-160, MTTA-160**MTD-160, MTDC-160, MTDA-160****MDT-160, MDTC-160, MDTA-160**♦ $V_{DRM}/V_{RRM} = \underline{400 - 1600 \text{ V}}$ ♦ $I_{T(AV)} = \underline{160 \text{ A}}$ ($T_C = 85 \text{ °C}$)♦ $I_{TSM} = \underline{5 \text{ kA}}$ ($T_{Vj} = 125 \text{ °C}$)

- ♦ Heat transfer through AlN ceramic isolated metal baseplate
- ♦ Presspack construction
- ♦ High reliability at thermal cycles (10^5 at $\Delta T_C = 70 \text{ °C}$)
- ♦ Case width 34 mm

**MAXIMUM RATED VALUES**

Parameter and conditions	Symbol	Values			Units
		min.	typ.	max.	
Repetitive peak off-state voltage / Repetitive peak reverse voltage, $T_{Vj} = -60 \text{ °C} \dots +125 \text{ °C}$	V_{DRM} / V_{RRM}	400 -		1600	V
Non-repetitive peak off-state voltage/Non- repetitive peak reverse voltage, $T_{Vj} = -60 \text{ °C} \dots +125 \text{ °C}$	V_{DSM} / V_{RSM}	500	-	1700	
Repetitive peak off-state current/ Repetitive peak reverse current, $T_{Vj} = 125 \text{ °C}$, $V_D / V_R = V_{DRM} / V_{RRM}$	I_{DRM} / I_{RRM}	-	-	25	mA
Max. average on-state current, $f = 50 \text{ Hz}$, double side cooled, $T_C = 85 \text{ °C}$	$I_{T(AV)}$ -		-	160	A
RMS on-state current	I_{RMS}	-	-	250	
Surge non-repetitive current, $V_R = 0$, $T_{Vj} = 125 \text{ °C}$, $t_p = 10 \text{ ms}$	I_{TSM}	-	-	5	kA
Safety factor	I^2t	-	-	125	kA ² s
Critical rate of rise of on-state current, $V = 0,67V_{DRM}$, $I_T = 320 \text{ A}$, $I_{FG} = 1 \text{ A}$, $t_r = 1 \text{ } \mu\text{s}$, $f = 50 \text{ Hz}$, $T_{Vj} = 125 \text{ °C}$	$(di_T/dt)_{crit}$ -		-	320	A/ μs
Critical rate of rise of off-state voltage $V_D = 0,67V_{DRM}$, $T_{Vj} = 125 \text{ °C}$	$(dV_D/dt)_{crit}$ 500		-	1000	V/ μs
Gate power loss, DC	P_{GM}	-	-	4	W
Operation junction temperature range	T_{Vj}	- 60	-	+ 125	°C
Storage temperature range	T_{stg}	- 60	-	+ 50	



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ELECTRICAL CHARACTERISTICS					
Maximum peak on-state voltage, $I_T = 502 \text{ A}$, $T_{Vj} = 25^\circ \text{C}$	V_{TM}	--		1,50	V
On-state threshold voltage, $T_{Vj} = 125^\circ \text{C}$, $I_T = 200 - 800 \text{ A}$	$V_{(TO)}$	--		1,00	
On-state slope resistance, $T_{Vj} = 125^\circ \text{C}$, $I_T = 200 - 800 \text{ A}$	r_T	--		1,05	mΩ
Delay time, $V = 0,67V_{DRM}$, $I_T = 160 \text{ A}$, $I_{FG} = 1 \text{ A}$, $t_r = 1 \mu\text{s}$, $T_{Vj} = 25^\circ \text{C}$	t_d	--		1,0	μs
Circuit-commutated turn off-time, $I_T = 160 \text{ A}$, $di_T/dt = -5 \text{ A}/\mu\text{s}$, $V_R \geq 100 \text{ V}$, $V_D = 0,67V_{DRM}$, (dV_D/dt) = $50 \text{ V}/\mu\text{s}$, $T_{Vj} = 125^\circ \text{C}$	t_q	--		150	
Recovery charge, $di_T/dt = -5 \text{ A}/\mu\text{s}$, $T_{Vj} = 125^\circ \text{C}$, $I_T = 160 \text{ A}$, $V_R \geq 100 \text{ V}$	Q_{rr}	--		300	μAs
Holding current, $V_D = 12 \text{ V}$, $T_{Vj} = 25^\circ \text{C}$	I_H	--		200	mA
Gate trigger voltage, $V_D = 12 \text{ V}$, $T_{Vj} = -60^\circ \text{C}$ $T_{Vj} = 25^\circ \text{C}$ $T_{Vj} = 125^\circ \text{C}$	V_{GT}	--		4,5 2,5 2,0	V
Gate trigger current, $V_D = 12 \text{ V}$, $T_{Vj} = -60^\circ \text{C}$ $T_{Vj} = 25^\circ \text{C}$ $T_{Vj} = 125^\circ \text{C}$	I_{GT}	--		350 200 150	mA
Gate non-trigger voltage, $V_D = 0,67V_{DRM}$, $T_{Vj} = 125^\circ \text{C}$	V_{GD}	0,25 -		-	V
Gate non-trigger current, $V_D = 0,67V_{DRM}$, $T_{Vj} = 125^\circ \text{C}$	$I_{GD} 10$		-	-	mA
Insulation test voltage (RMS), $f = 50 \text{ Hz}$, $t = 1 \text{ sec}/1 \text{ min}$	V_{isol}	--		3600/3000	V



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THERMAL PARAMETERS					
Thermal resistance junction to case, per thyristor (diode) per module	R_{thjc}	- -		0,170 0,085	°C/W
Thermal resistance case to heatsink, per thyristor (diode) per module	R_{thch} -		-	0,10 0,05	
MECHANICAL PARAMETERS					
Weight w		-	0,5	-	kg
Terminal connection torque	M_t	4 -		6	Nm
Heatsink mounting torque	M_s	4 -		6	Nm
Maximum acceleration (at nominal mounting force)	a -		-	50	m/s ²

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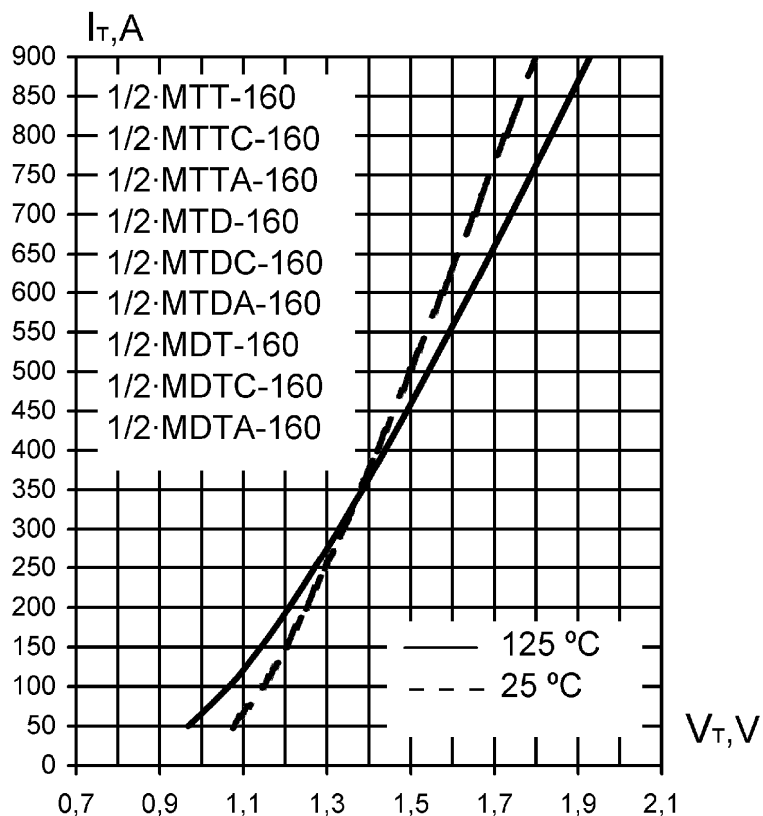


Fig. 1. Maximum on-state characteristics
(Limit device, 10 ms, half sine)

On-state characteristics model

$$V_T = A + B \cdot I_T + C \cdot \ln(I_T + 1) + D \cdot \sqrt{I_T}$$

Valid for $I_T = 50 - 900\text{ A}$

	$T_{vj} = 125\text{ °C}$	$T_{vj} = 25\text{ °C}$
A	0.638	0.802
B	0.0007 763	0.0007297
C	0.065	0.067
D	0.0049 9	-0.003767



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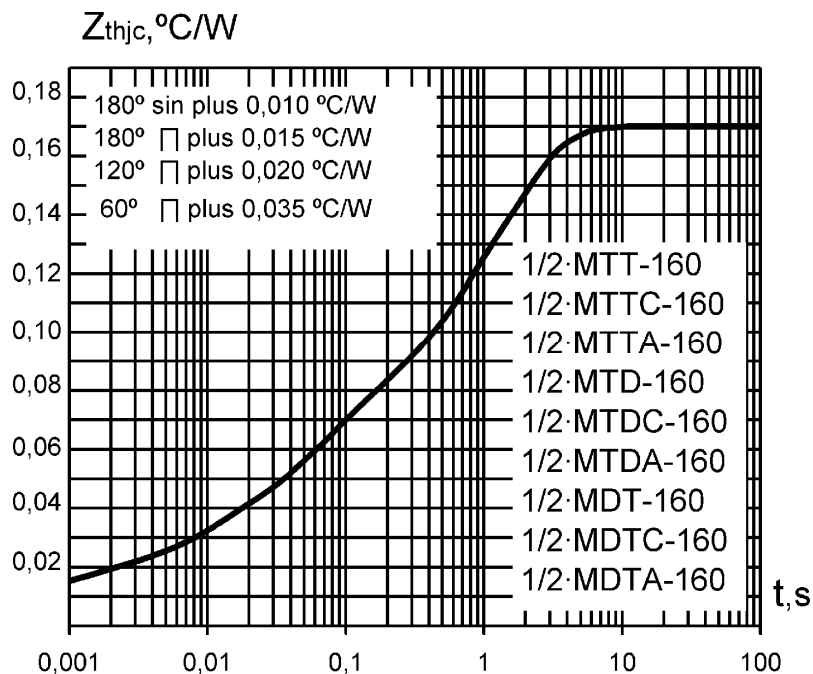


Fig. 2. Transient thermal impedance junction to case (DC)



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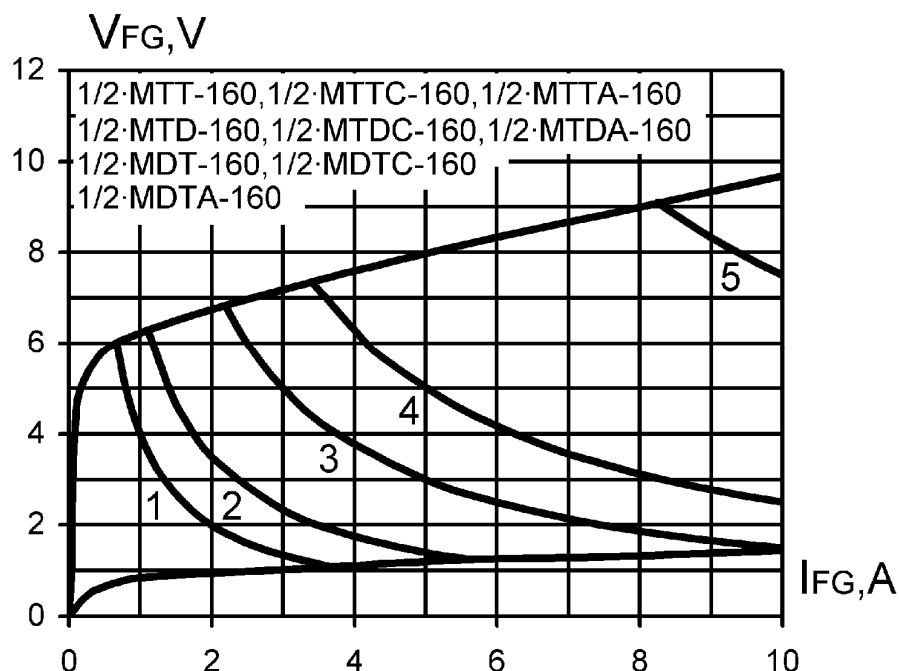


Fig. 3. Maximum peak gate power losses

Position at fig. 3	Duty cycle, $D = f \cdot t_p$	Gate pulse length, t_p , ms	Maximum gate pulse power P_{GM} , W
1 1		DC	4
2 2		10	7
3 20		1,0	15
4 40		0,5	25
5 200		0,1	75

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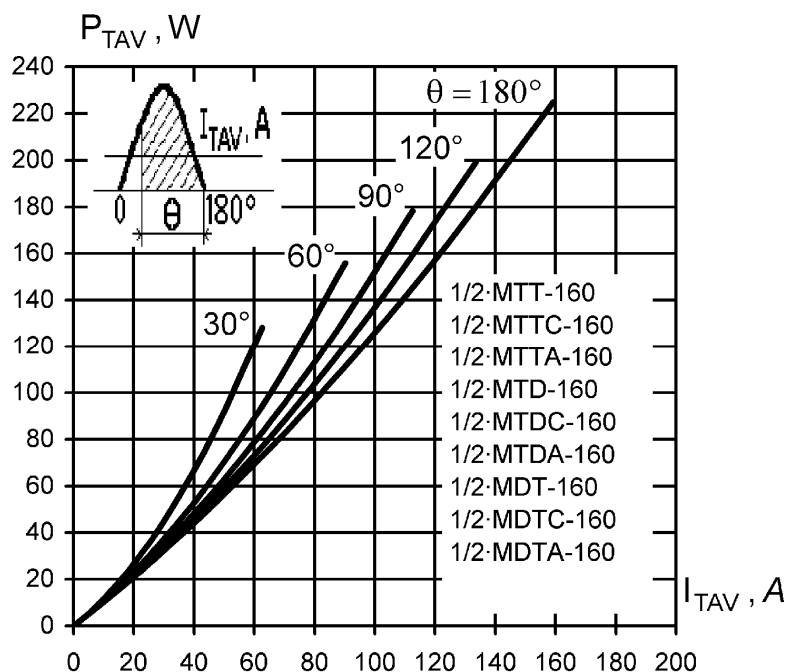


Fig. 4. On-state power loss vs. on-state current
(sine)

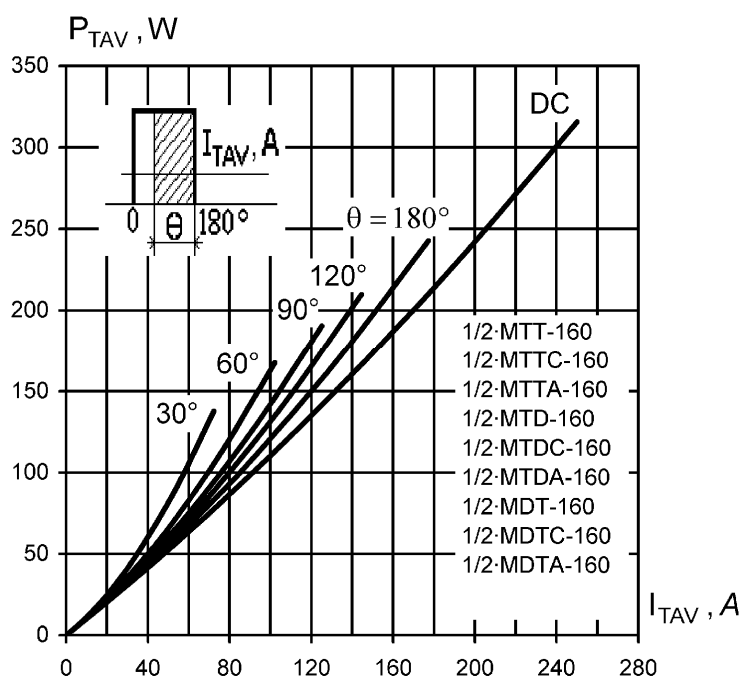


Fig. 5. On-state power loss vs. on-state current
(rectangular)



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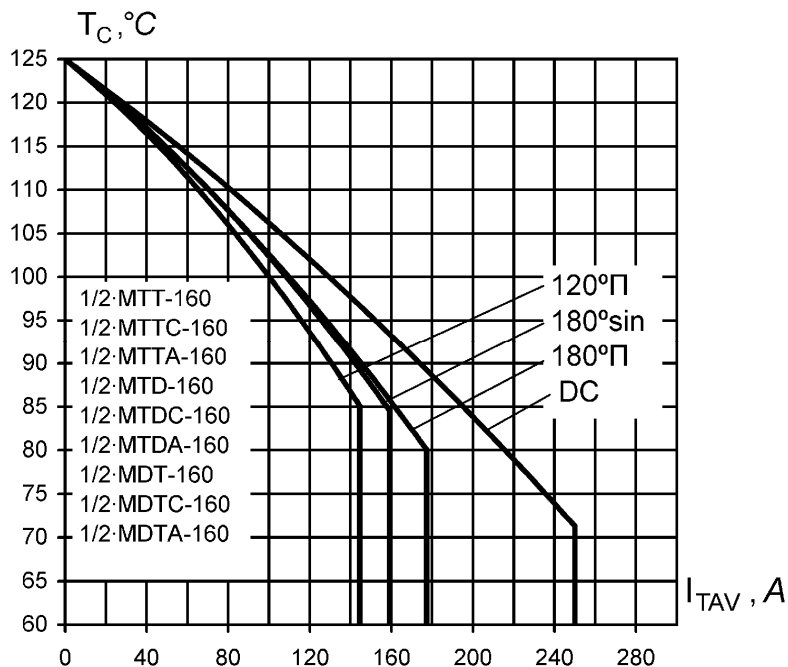


Fig. 6. Max. permissible case temperature vs. mean on-state current

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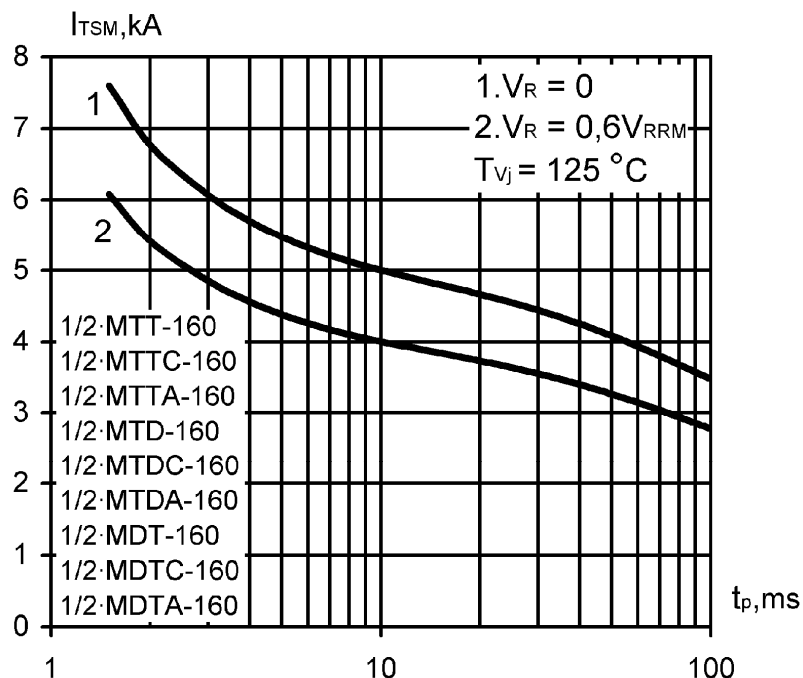


Fig. 7. Surge on-state current vs. pulse length
(half-sine)

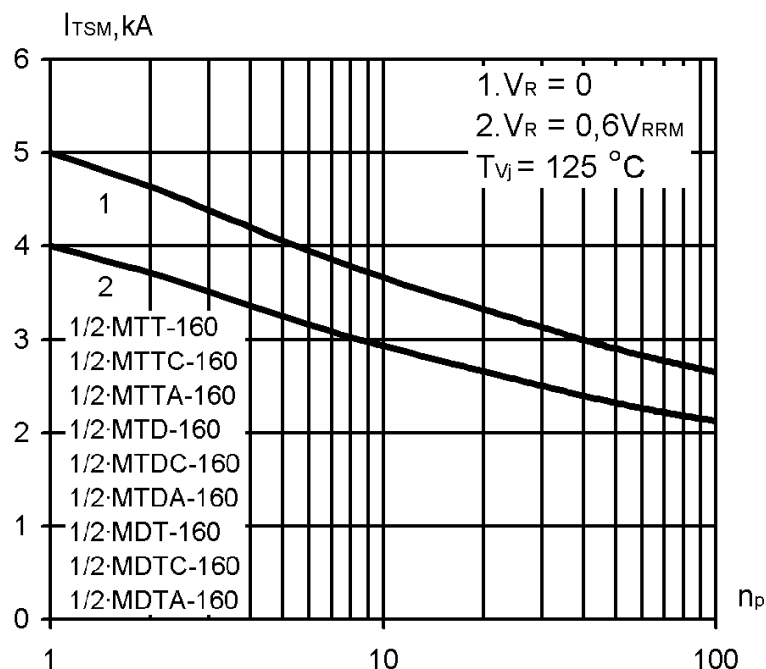


Fig. 8. Surge on-state current vs. number of pulses
(half-sine, 10 ms, 50 Hz)

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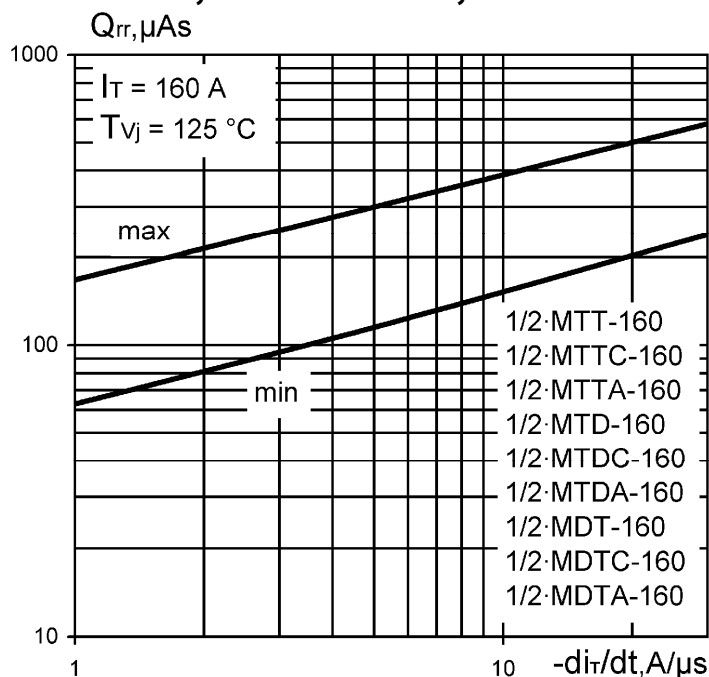


Fig. 9. Recovery charge vs. decay rate of on-state current

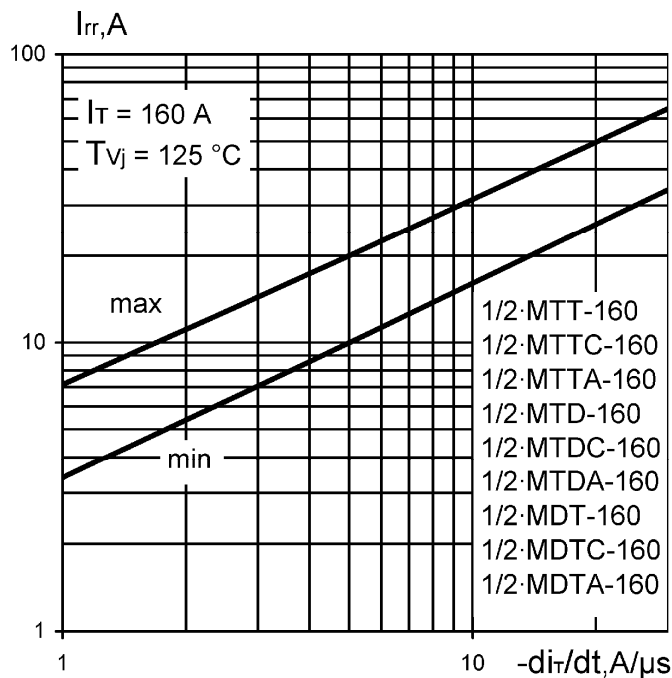


Fig. 10. Peak reverse recovery current vs. decay rate of on-state current

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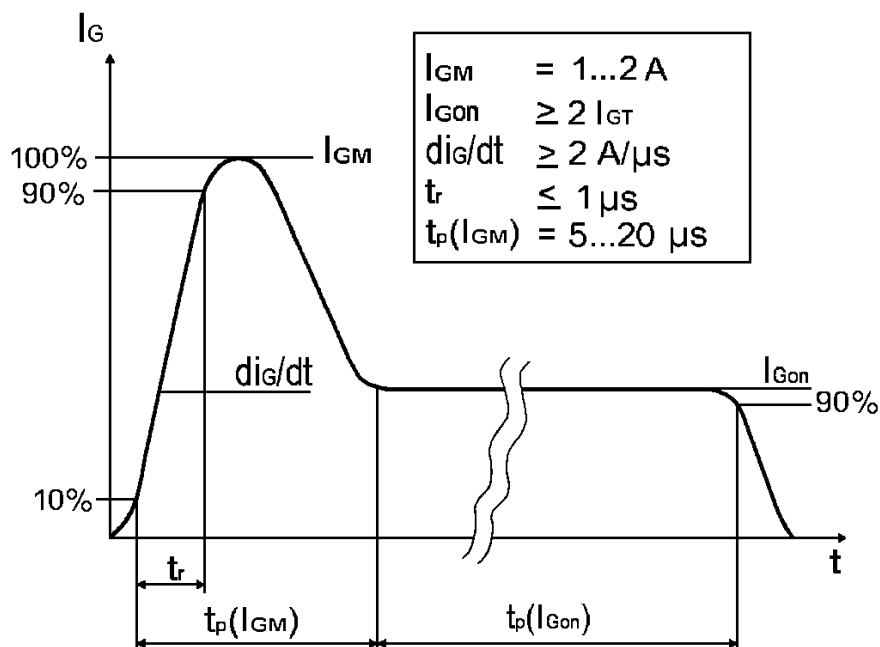
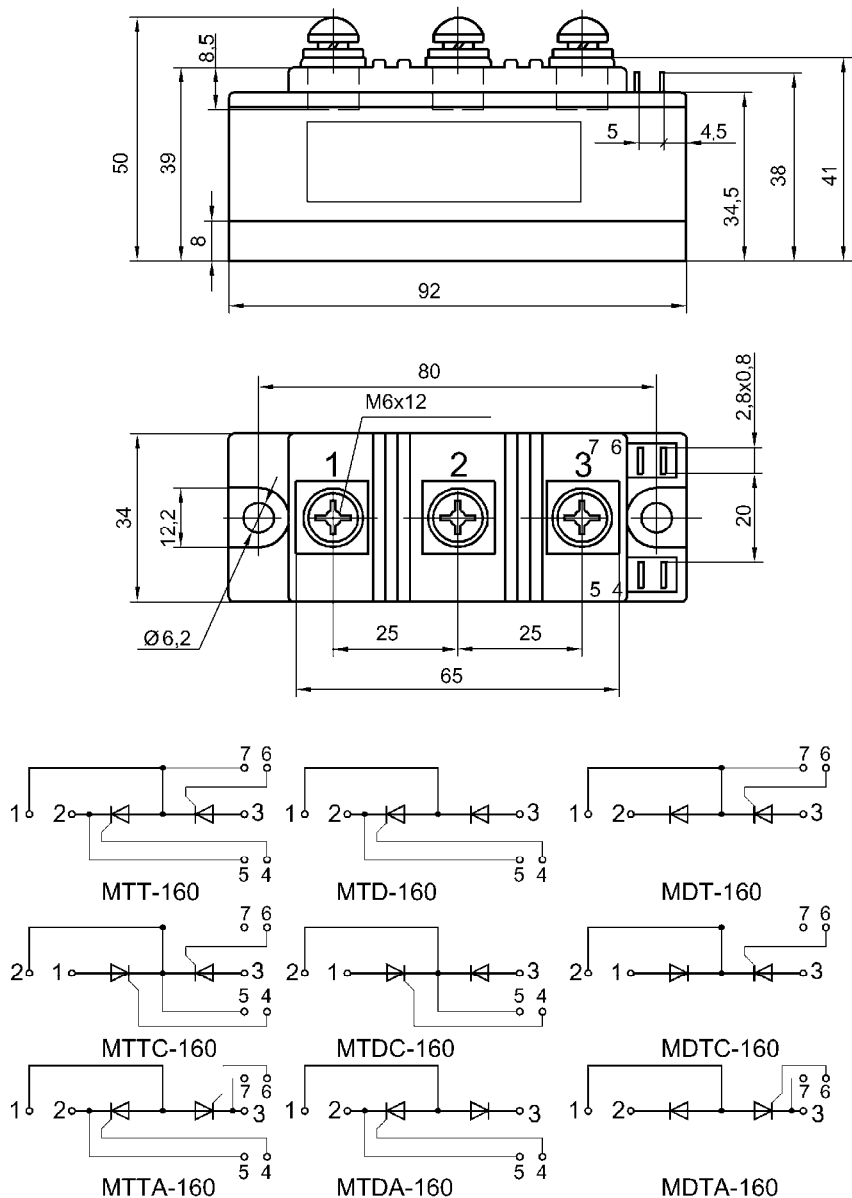


Fig. 11. Recommended gate current waveform



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