



Fast Thyristor Type TFI233-400-24

Low switching losses
Low reverse recovery charge
Distributed amplified gate for high di_T/dt

Mean on-state current		I_{TAV}	400 A
Repetitive peak off-state voltage		V_{DRM}	2000...2400 V
Repetitive peak reverse voltage		V_{RRM}	
Turn-off time		t_q	50.0, 63.0 μs
V_{DRM}, V_{RRM}, V	2000	2200	2400
Voltage code	20	22	24
$T_{ij}, ^\circ C$	-60...+125		

MAXIMUM ALLOWABLE RATINGS

Symbols and parameters		Units	Values	Test conditions	
ON-STATE					
I_{TAV}	Mean on-state current	A	371 400 544	$T_c=85\text{ }^{\circ}\text{C}$; Double side cooled; $T_c=80\text{ }^{\circ}\text{C}$; Double side cooled; $T_c=55\text{ }^{\circ}\text{C}$; Double side cooled; 180° half-sine wave; 50 Hz	
I_{TRMS}	RMS on-state current	A	628	$T_c=80\text{ }^{\circ}\text{C}$; Double side cooled; 180° half-sine wave; 50 Hz	
I_{TSM}	Surge on-state current	kA	6.6 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; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=I_{FGM}$; $V_G=20\text{ V}$; $t_{GP}=50\text{ }\mu\text{S}$; $di_G/dt=1\text{ A}/\mu\text{S}$
			7.0 8.0	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=I_{FGM}$; $V_G=20\text{ V}$; $t_{GP}=50\text{ }\mu\text{S}$; $di_G/dt=1\text{ A}/\mu\text{S}$
I^2t	Safety factor	$A^2s\cdot 10^3$	210 280	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=10\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=I_{FGM}$; $V_G=20\text{ V}$; $t_{GP}=50\text{ }\mu\text{S}$; $di_G/dt=1\text{ A}/\mu\text{S}$
			200 260	$T_j=T_{j\text{ max}}$ $T_j=25\text{ }^{\circ}\text{C}$	180° half-sine wave; $t_p=8.3\text{ ms}$; single pulse; $V_D=V_R=0\text{ V}$; Gate pulse: $I_G=I_{FGM}$; $V_G=20\text{ V}$; $t_{GP}=50\text{ }\mu\text{S}$; $di_G/dt=1\text{ A}/\mu\text{S}$
BLOCKING					
V_{DRM}, V_{RRM}	Repetitive peak off-state and Repetitive peak reverse voltages	V	2000...2400	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$; 180° half-sine wave; 50 Hz; Gate open	
V_{DSM}, V_{RSM}	Non-repetitive peak off-state and Non-repetitive peak reverse voltages	V	2100...2500	$T_{j\text{ min}} < T_j < T_{j\text{ max}}$; 180° half-sine wave; single pulse; Gate open	
V_D, V_R	Direct off-state and Direct reverse voltages	V	$0.6\cdot V_{DRM}$ $0.6\cdot V_{RRM}$	$T_j=T_{j\text{ max}}$; Gate open	

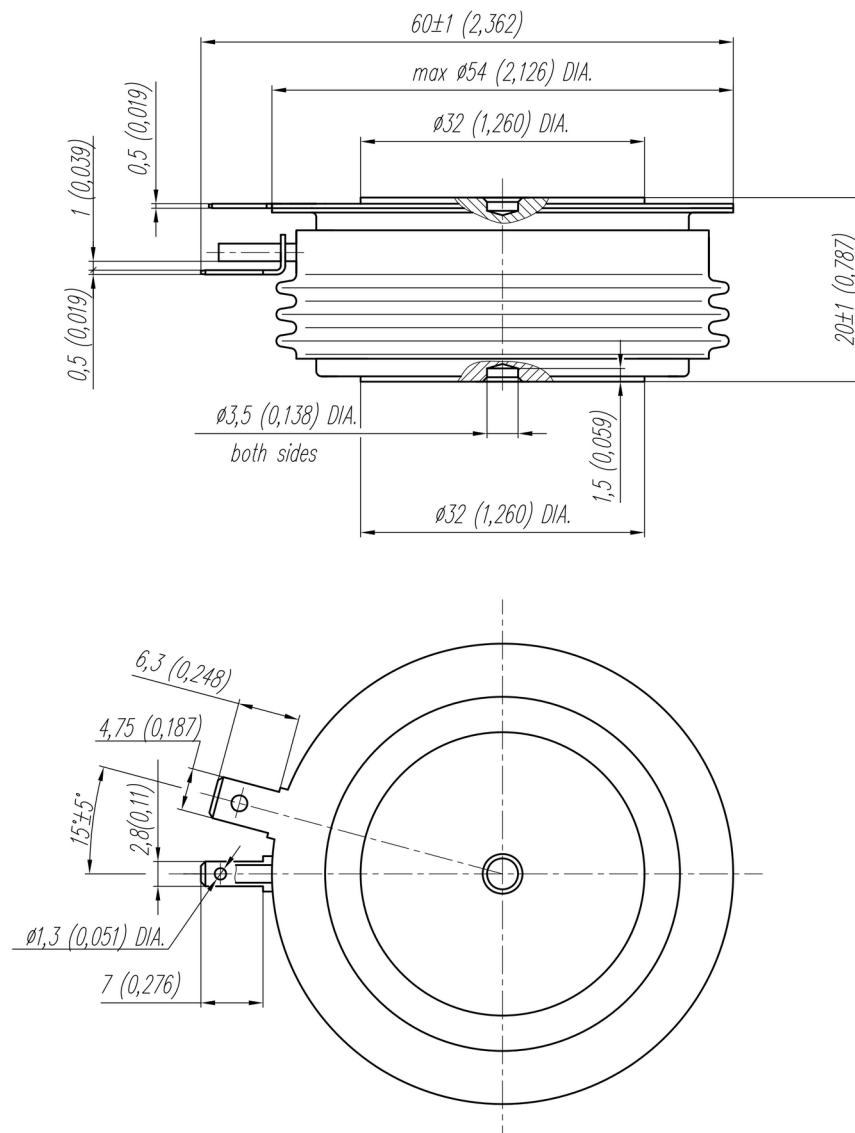
TRIGGERING				
I_{FGM}	Peak forward gate current	A	6	$T_j = T_{j \max}$
V_{RGM}	Peak reverse gate voltage	V	5	
P_G	Gate power dissipation	W	3	$T_j = T_{j \max}$ for DC gate current
SWITCHING				
$(di_T/dt)_{crit}$	Critical rate of rise of on-state current non-repetitive (f=1 Hz)	A/ μ s	1600	$T_j = T_{j \max}$; $V_D = 0.67 \cdot V_{DRM}$; $I_{TM} = 1700$ A; Gate pulse: $I_G = 2$ A; $V_G = 20$ V; $t_{GP} = 50$ μ s; $di_G/dt = 2$ A/ μ s
THERMAL				
T_{stg}	Storage temperature	$^{\circ}$ C	-60...+50	
T_j	Operating junction temperature	$^{\circ}$ C	-60...+125	
MECHANICAL				
F	Mounting force	kN	9.0...11.0	
a	Acceleration	m/s ²	50	Device clamped

CHARACTERISTICS

Symbols and parameters		Units	Values	Conditions	
ON-STATE					
V _{TM}	Peak on-state voltage, max	V	2.20	T _j =25 °C; I _{TM} =1256 A	
V _{T(TO)}	On-state threshold voltage, max	V	1.248	T _j =T _{j max} ;	
r _T	On-state slope resistance, max	mΩ	0.992	0.5 π I _{TAV} < I _T < 1.5 π I _{TAV}	
I _H	Holding current, max	mA	500	T _j =25 °C; V _b =12 V; Gate open	
BLOCKING					
I _{DRM} , I _{RRM}	Repetitive peak off-state and Repetitive peak reverse currents, max	mA	50	T _j =T _{j max} ; V _D =V _{DRM} ; V _R =V _{RRM}	
(dv _D /dt) _{crit}	Critical rate of rise of off-state voltage ¹⁾ , min	V/μs	200, 320, 500, 1000, 1600, 2000, 2500	T _j =T _{j max} ; V _D =0.67·V _{DRM} ; Gate open	
TRIGGERING					
V _{GT}	Gate trigger direct voltage, max	V	3.00 2.50 1.50	T _j = T _{j min} T _j =25 °C T _j = T _{j max}	V _D =12 V; I _D =3 A; Direct gate current
I _{GT}	Gate trigger direct current, max	mA	500 300 150	T _j = T _{j min} T _j = 25 °C T _j = T _{j max}	
V _{GD}	Gate non-trigger direct voltage, min	V	0.35	T _j =T _{j max} ; V _D =0.67·V _{DRM} ;	
I _{GD}	Gate non-trigger direct current, min	mA	35.00	Direct gate current	
SWITCHING					
t _{gd}	Delay time, max	μs	0.85	T _j =25 °C; V _D =1000 V; I _{TM} =I _{TAV} ; di/dt=200 A/μs;	
t _{gt}	Turn-on time ²⁾ , max	μs	2.00, 2.50, 3.20, 4.00	Gate pulse: I _G =2 A; V _G =20 V; t _{GP} =50 μs; di _G /dt=2 A/μs	
t _q	Turn-off time ³⁾ , max	μs	50.0, 63.0	dv _D /dt=50 V/μs	T _j =T _{j max} ; I _{TM} = I _{TAV} ; di _R /dt=-10 A/μs; V _R =100V; V _D =0.67 V _{DRM}
			63.0, 80.0	dv _D /dt=200 V/μs	
Q _{rr}	Total recovered charge, max	μC	400	T _j =T _{j max} ; I _{TM} =400 A;	
t _{rr}	Reverse recovery time, typ	μs	5.0	di _R /dt=-50 A/μs;	
I _{rrM}	Peak reverse recovery current, max	A	160	V _R =100 V	

THERMAL					
R _{thjc}	Thermal resistance, junction to case, max	°C/W	0.0500	Direct current	Double side cooled
R _{thjc-A}			0.1100		Anode side cooled
R _{thjc-K}			0.0900		Cathode side cooled
R _{thck}	Thermal resistance, case to heatsink, max	°C/W	0.0060	Direct current	
MECHANICAL					
w	Weight, max	g	176		
D _s	Surface creepage distance	mm (inch)	19.44 (0.765)		
D _a	Air strike distance	mm (inch)	12.10 (0.476)		

PART NUMBERING GUIDE								NOTES																							
TFI	233	400	24	A2	C3	H4	N	1) Critical rate of rise of off-state voltage																							
1	2	3	4	5	6	7	8	<table><tr><td>Symbol of Group</td><td>P2</td><td>K2</td><td>E2</td><td>A2</td><td>T1</td><td>P1</td><td>M1</td></tr><tr><td>$(dv_D/dt)_{crit}$, V/μs</td><td>200</td><td>320</td><td>500</td><td>1000</td><td>1600</td><td>2000</td><td>2500</td></tr></table>								Symbol of Group	P2	K2	E2	A2	T1	P1	M1	$(dv_D/dt)_{crit}$, V/ μ s	200	320	500	1000	1600	2000	2500
Symbol of Group	P2	K2	E2	A2	T1	P1	M1																								
$(dv_D/dt)_{crit}$, V/ μ s	200	320	500	1000	1600	2000	2500																								
1. TFI — fast inverter thyristor								2) Turn-on time																							
2. Design version								<table><tr><td>Symbol of group</td><td>P4</td><td>M4</td><td>K4</td><td>H4</td></tr><tr><td>t_{gt}, μs</td><td>2.00</td><td>2.50</td><td>3.20</td><td>4.00</td></tr></table>								Symbol of group	P4	M4	K4	H4	t_{gt} , μ s	2.00	2.50	3.20	4.00						
Symbol of group	P4	M4	K4	H4																											
t_{gt} , μ s	2.00	2.50	3.20	4.00																											
3. Mean on-state current, A								3) Turn-off time ($dv_D/dt=50$ V/ μ s)																							
4. Voltage code								<table><tr><td>Symbol of group</td><td>E3</td><td>C3</td></tr><tr><td>t_{q}, μs</td><td>50.0</td><td>63.0</td></tr></table>								Symbol of group	E3	C3	t_{q} , μ s	50.0	63.0										
Symbol of group	E3	C3																													
t_{q} , μ s	50.0	63.0																													
5. Critical rate of rise of off-state voltage																															
6. Group of turn-off time ($dv_D/dt=50$ V/ μ s)																															
7. Group of turn-on time																															
8. Ambient conditions: N – normal; T – tropical																															



All dimensions in millimeters (inches)