

Optimum power handling  
Low on-state and switching losses  
Designed for traction and industrial applications

## Phase Control Thyristor Type T161-160

|                                   |            |                           |     |     |     |     |     |      |      |      |      |      |      |      |      |
|-----------------------------------|------------|---------------------------|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|
| Mean on-state current             | $I_{TAV}$  | 160 A                     |     |     |     |     |     |      |      |      |      |      |      |      |      |
| Repetitive peak off-state voltage | $V_{DRM}$  | 300 ÷ 1800 V              |     |     |     |     |     |      |      |      |      |      |      |      |      |
| Repetitive peak reverse voltage   | $V_{RRM}$  |                           |     |     |     |     |     |      |      |      |      |      |      |      |      |
| Turn-off time                     | $t_q$      | 80; 100; 160; 250 $\mu$ s |     |     |     |     |     |      |      |      |      |      |      |      |      |
| $V_{DRM}, V_{RRM}, V$             | 300        | 400                       | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1800 |
| Voltage code                      | 3          | 4                         | 5   | 6   | 7   | 8   | 9   | 10   | 11   | 12   | 13   | 14   | 15   | 16   | 18   |
| $T_i, ^\circ C$                   | – 60 ÷ 125 |                           |     |     |     |     |     |      |      |      |      |      |      |      |      |

### MAXIMUM ALLOWABLE RATINGS

| Symbols and parameters |                                                                               | Units                          | Values                                     | Test conditions                                                                                                                               |
|------------------------|-------------------------------------------------------------------------------|--------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ON-STATE</b>        |                                                                               |                                |                                            |                                                                                                                                               |
| $I_{TAV}$              | Mean on-state current                                                         | A                              | 160                                        | $T_c=87^\circ\text{C}$ ;<br>180° half-sine wave, 50 Hz                                                                                        |
| $I_{TRMS}$             | RMS on-state current                                                          | A                              | 251                                        | $T_c=87^\circ\text{C}$ ;<br>Full cycle sine wave, 50 Hz                                                                                       |
| $I_{TSM}$              | Surge on-state current                                                        | kA                             | 4.0<br>4.4                                 | $T_j=T_{j\max}$<br>$T_j=25^\circ\text{C}$<br>180° half-sine wave, 50 Hz,<br>single pulse;<br>$V_R=0\text{ V}$ ;                               |
| $I^2t$                 | Safety factor                                                                 | $\text{A}^2\text{s}\cdot 10^3$ | 80<br>100                                  | $T_j=T_{j\max}$<br>$T_j=25^\circ\text{C}$<br>Gate pulse: 20 V, 5 $\Omega$ ,<br>1 $\mu$ s rise time, 500 $\mu$ s                               |
| <b>BLOCKING</b>        |                                                                               |                                |                                            |                                                                                                                                               |
| $V_{DRM}, V_{RRM}$     | Repetitive peak off-state and<br>Repetitive peak reverse voltages             | V                              | 300÷1800                                   | $T_j=T_{j\max}$ ;<br>180° half-sine wave, 50 Hz;<br>Gate open                                                                                 |
| $V_{DSM}, V_{RSM}$     | Non-repetitive peak off-state and<br>Non-repetitive peak reverse voltages     | V                              | 335÷2000                                   | $T_j=T_{j\max}$ ;<br>180° half-sine wave, 50 Hz,<br>single pulse<br>Gate open                                                                 |
| $V_D, V_R$             | Direct off-state and<br>Direct reverse voltages                               | V                              | $0.75\cdot V_{DRM}$<br>$0.75\cdot V_{RRM}$ | $T_j=T_{j\max}$ ;<br>Gate open                                                                                                                |
| <b>TRIGGERING</b>      |                                                                               |                                |                                            |                                                                                                                                               |
| $P_{GM}$               | Peak gate power dissipation                                                   | W                              | 40                                         | $T_j=T_{j\max}$                                                                                                                               |
| $P_{G(AV)}$            | Mean gate power dissipation                                                   | W                              | 6                                          | $T_j=T_{j\max}$                                                                                                                               |
| $V_{RGM}$              | Peak gate reverse voltage                                                     | V                              | 5                                          | $T_j=T_{j\max}$                                                                                                                               |
| <b>SWITCHING</b>       |                                                                               |                                |                                            |                                                                                                                                               |
| $(di_T/dt)_{crit}$     | Critical rate of rise of<br>on-state current:<br>non-repetitive<br>repetitive | A/ $\mu$ s                     | 125<br>60                                  | $T_j=T_{j\max}$ ; $V_D=0.67\cdot V_{DRM}$ ;<br>$I_{TM}\leq 2I_{T(AV)}$ ;<br>Gate pulse: 20 V, 5 $\Omega$ ,<br>1 $\mu$ s rise time, 50 $\mu$ s |
| <b>THERMAL</b>         |                                                                               |                                |                                            |                                                                                                                                               |
| $T_{stg}$              | Storage temperature                                                           | $^\circ\text{C}$               | – 60 ÷ 50                                  |                                                                                                                                               |
| $T_j$                  | Junction temperature                                                          | $^\circ\text{C}$               | – 60 ÷ 125                                 |                                                                                                                                               |

## CHARACTERISTICS

| Symbols and parameters                |                                                                   | Units | Values                  | Conditions                                                                                                                                                                                               |
|---------------------------------------|-------------------------------------------------------------------|-------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ON-STATE                              |                                                                   |       |                         |                                                                                                                                                                                                          |
| V <sub>TM</sub>                       | Peak on-state voltage                                             | V     | 1.70                    | T <sub>j</sub> =25°C; I <sub>TM</sub> =3.14·I <sub>TAV</sub>                                                                                                                                             |
| V <sub>T(TO)</sub>                    | On-state threshold voltage                                        | V     | 1.05                    | T <sub>j</sub> =T <sub>j max</sub>                                                                                                                                                                       |
| r <sub>T</sub>                        | On-state slope resistance                                         | mΩ    | 1.36                    | T <sub>j</sub> =T <sub>j max</sub>                                                                                                                                                                       |
| I <sub>L</sub>                        | Latching current                                                  | mA    | 700                     | T <sub>j</sub> =25°C; V <sub>D</sub> =12 V;<br>Gate pulse: 20 V, 5 Ω,<br>1 μs rise time, 50 μs                                                                                                           |
| I <sub>H</sub>                        | Holding current                                                   | mA    | 250                     | T <sub>j</sub> =25°C; V <sub>D</sub> =12 V;<br>Gate open                                                                                                                                                 |
| BLOCKING                              |                                                                   |       |                         |                                                                                                                                                                                                          |
| I <sub>DRM</sub> , I <sub>RRM</sub>   | Repetitive peak off-state and<br>repetitive peak reverse currents | mA    | 15                      | T <sub>j</sub> =T <sub>j max</sub> ;<br>V <sub>D</sub> =V <sub>DRM</sub> ; V <sub>R</sub> =V <sub>RRM</sub>                                                                                              |
| (dV <sub>D</sub> /dt) <sub>crit</sub> | Critical rate of rise of<br>off-state voltage <sup>1)</sup>       | V/μs  | 20<br>1000              | T <sub>j</sub> =T <sub>j max</sub> ;<br>V <sub>D</sub> =0.67·V <sub>DRM</sub> ;<br>Gate open                                                                                                             |
| TRIGGERING                            |                                                                   |       |                         |                                                                                                                                                                                                          |
| V <sub>GT</sub>                       | Gate trigger direct voltage                                       | V     | 3.50                    | T <sub>j</sub> =25°C; V <sub>D</sub> =12 V;<br>Direct gate current                                                                                                                                       |
| I <sub>GT</sub>                       | Gate trigger direct current                                       | A     | 0.20                    |                                                                                                                                                                                                          |
| V <sub>GD</sub>                       | Gate non-trigger direct voltage                                   | V     | 0.45                    | T <sub>j</sub> =T <sub>j max</sub> ; V <sub>D</sub> =0.67·V <sub>DRM</sub> ;<br>Direct gate current                                                                                                      |
| I <sub>GD</sub>                       | Gate non-trigger direct current                                   | mA    | 5.0                     |                                                                                                                                                                                                          |
| SWITCHING                             |                                                                   |       |                         |                                                                                                                                                                                                          |
| t <sub>gt</sub>                       | Turn-on time                                                      | μs    | 8.0                     | T <sub>j</sub> =25°C; V <sub>D</sub> =100 V; I <sub>TM</sub> =I <sub>TAV</sub> ;<br>Gate pulse: 20 V, 5 Ω,<br>1 μs rise time, 50 μs                                                                      |
| t <sub>gd</sub>                       | Delay time                                                        | μs    |                         |                                                                                                                                                                                                          |
| t <sub>q</sub>                        | Turn-off time <sup>2)</sup>                                       | μs    | 80<br>100<br>160<br>250 | T <sub>j</sub> =T <sub>j max</sub> ;<br>I <sub>TM</sub> =I <sub>TAV</sub> ;<br>di <sub>R</sub> /dt=5 A/μs; V <sub>R</sub> =100 V;<br>V <sub>D</sub> =0.67 V <sub>DRM</sub> ; dV <sub>D</sub> /dt=50 V/μs |
| Q <sub>rr</sub>                       | Recovered charge                                                  | μC    | 350                     | T <sub>j</sub> =T <sub>j max</sub> ; I <sub>TM</sub> =I <sub>TAV</sub> ;<br>di <sub>R</sub> /dt=5 A/μs; V <sub>R</sub> =100 V;                                                                           |
| t <sub>rr</sub>                       | Reverse recovery time                                             | μs    | 15.0                    |                                                                                                                                                                                                          |
| THERMAL                               |                                                                   |       |                         |                                                                                                                                                                                                          |
| R <sub>thjc</sub>                     | Thermal resistance junction to case                               | °C/W  | 0.15                    | Direct current, double side cooled                                                                                                                                                                       |

### Note:

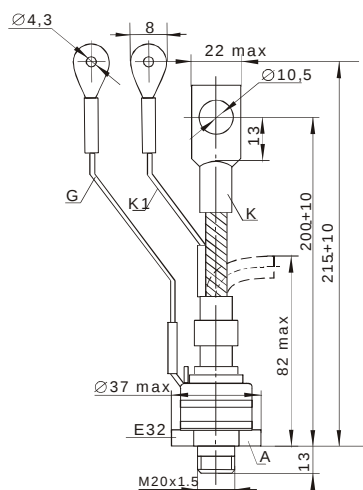
<sup>1)</sup> Critical rate of rise of off-state voltage

| Symbol of group                       | P3 | E3 | A3  | P2  | K2  | E2  | A2   |
|---------------------------------------|----|----|-----|-----|-----|-----|------|
| $(dV_D/dt)_{crit}$ , V/ $\mu\text{s}$ | 20 | 50 | 100 | 200 | 320 | 500 | 1000 |

<sup>2)</sup> Turn-off time

| Symbol of group       | B3 | A3  | T2  | M2  |
|-----------------------|----|-----|-----|-----|
| $t_q$ , $\mu\text{s}$ | 80 | 100 | 160 | 250 |

### OVERALL DIMENSIONS



### PART NUMBERING GUIDE

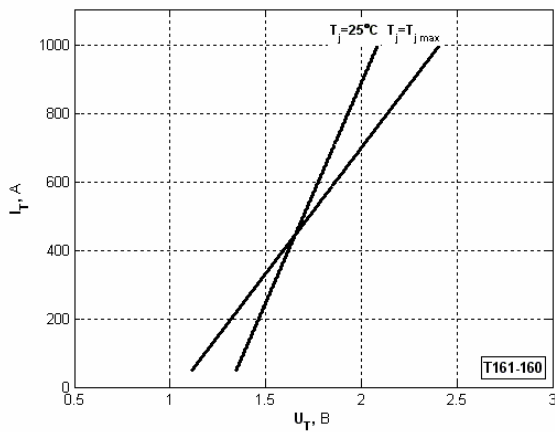
| T | 161 | 160 | 18 | A2 | B3 | N |
|---|-----|-----|----|----|----|---|
| 1 | 2   | 3   | 4  | 5  | 6  | 7 |

- Thyristor
- Design version
- Mean on-state current, A
- Voltage code
- Critical rate of rise of off-state voltage
- Group of turn-off time
- Ambient conditions: N – normal; T – tropical

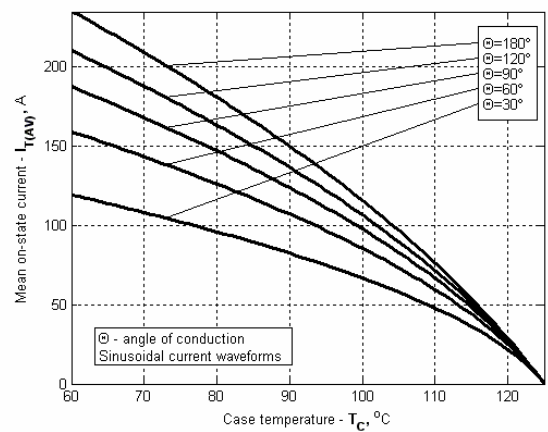
Weight: 240 grams

Tightening torque: 20 ÷ 30 Nm

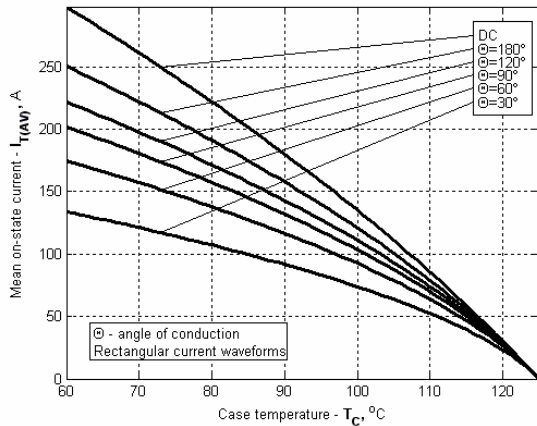
Recommended heatsink: O171; O271; O371



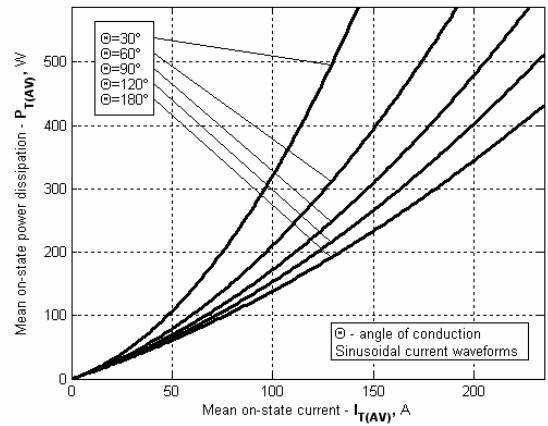
**Fig 1** On-state characteristics



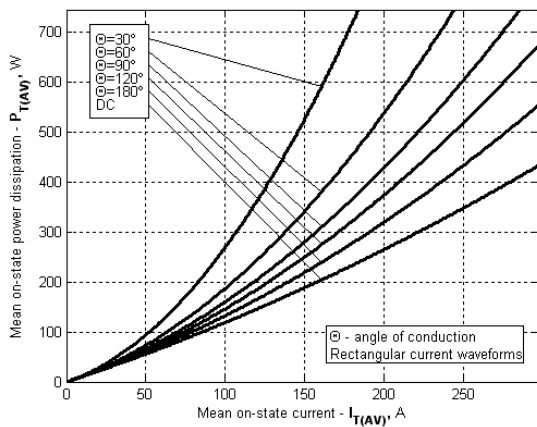
**Fig 2** Maximum allowable mean on-state current  $I_{TAV}$  vs. case temperature  $T_C$  for sinusoidal current waveforms,  $f=50$  Hz



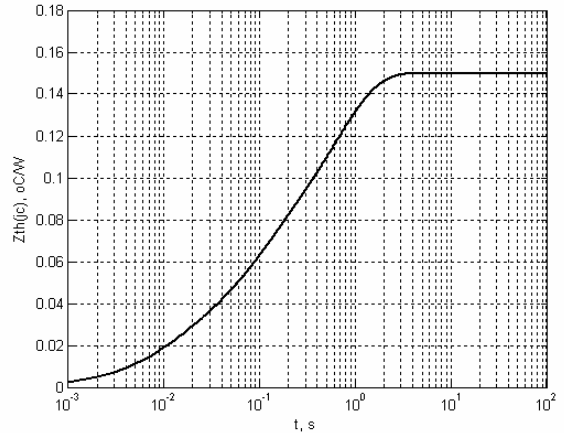
**Fig 3** Maximum allowable mean on-state current  $I_{TAV}$  vs. case temperature  $T_C$  for rectangular current waveforms and for DC,  $f=50$  Hz



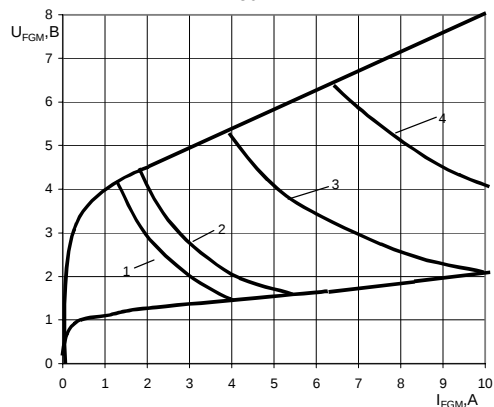
**Fig 4** On-state power dissipation  $P_{TAV}$  vs. mean on-state current  $I_{TAV}$  for sinusoidal current waveforms at different conduction angles,  $f=50$  Hz



**Fig 5** On-state power dissipation  $P_{TAV}$  vs. mean on-state current  $I_{TAV}$  for rectangular current waveforms and for DC at different conduction angles,  $f=50$  Hz



**Fig 6** Transient thermal impedance junction to case  $Z_{th(jc)}$



**Fig 7** Max. peak gate power loss:

| Position<br>(See Fig. 7) | On-Off time<br>ratio | Gate pulse<br>length,<br>ms | Gate Pulse<br>Power,<br>W |
|--------------------------|----------------------|-----------------------------|---------------------------|
| 1                        | 1                    | DC                          | 6                         |
| 2                        | 2                    | 10                          | 8                         |
| 3                        | 20                   | 1                           | 20                        |
| 4                        | 40                   | 0,5                         | 40                        |