TYRAK XS

Single phase thyristor convertor
INSTALLATION

Assembly

Physical assembly

The convertor unit is to be installed vertically with the connection terminals downwards. It can be mounted directly on a wall, open, or in a cubicle. No special cubicle type or assembly method is necessary except that:

- The cooling air temperature must not exceed 40 °C at a point approximately 10 cm under the convertor module. The entry and exhaust for the cooling air are to have a free area ≥ 300 cm². The exhaust is to be located above the top of the convertor module.

- The convertor module requires a space with a least distance of 10 cm to equipment above and below.

- Apparatus generating appreciable heat is not to be located under the convertor module.

Wiring

Power cables are not to be mounted closer than approximately 10 cm from the convertor module. Signal cables are to be routed as far as possible from cables generating interference e.g. power cables, control cables for contactors and relays. Maximum distance: 10 cm. The signal cables are to be screened but the screens need no earthing.

Earthing

A special earthing clamp is provided on the bottom panel of the convertor module for protective earthing.

Connection

A.c. voltage

The a.c. voltage is to be connected to the main circuit and to the rectifier for the field excitation supply. (See fig. 1.

Semiconductor fuses

The thyristors should be protected with special fuses in the phase supply conductors. The following fuse types (or equal) are recommended:

- Silized 5 SD, 4 A, 25 A/500 V, size DII
  Catalogue number: 5672 001-3

- Silized 5 SD, 4 A, 50 A/500 V, size DIII
  Catalogue number: 5672 001-5

Field excitation supply

The maximum permissible a.c. voltage supply $U_v$ is 440 V.

The rectified field voltage,

\[ U_{field} = \frac{U_v}{1,1} \]

Dc. voltage

The rotor and field circuits of the motor are connected to the convertor module as shown in the figure, 1.

Control circuits

For speed control, the speed reference and actual value are connected to the contact X1 on the control board. See figure, 1.

Speed reference

- In the simplest case, a potentiometer (5 kohm, 2 W) is used as shown in the figure, 1.

- The inputs SP REF 1 and SP REF 2 are also intended for connection to external reference generators with signal level 0 to +10 V.

- Input SP REF 4 is intended for connection to the reference generator with signal level 0 (or 4) 20 mA. With signal level 4 - 20 mA, input SP REF 3 is connected to –15 V and pot. "IR" is used for compensation of 4 mA.

Speed actual value

- For speed control with tachometer feedback, the tachometer generator is connected as shown in the figure, page 5. The max. voltage permitted is 330 V.

  Note the polarity!

- For speed control with voltage feedback the d.c. voltage is used as an actual value and is connected as shown in the figure 1. The electronics circuits are thereby connected galvanically to the main circuit.

NOTE that the reference potentiometer must be of such a type and installed with sufficient isolation distance that there is no danger to personnel.
Fig. 1.

1) Connection for speed control with voltage feedback.
2) External control.

Max. cable areas:

<table>
<thead>
<tr>
<th>Connector</th>
<th>Area (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1:1 - 15</td>
<td>2.5</td>
</tr>
<tr>
<td>X3</td>
<td>1.5</td>
</tr>
<tr>
<td>X4:1 - 4</td>
<td>16</td>
</tr>
<tr>
<td>X4:5 - 8</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Dimensions

(Dimension print 4893 0884-C)

Removal of the circuit board:
1. Unlock the screws 2 turns

Removal of the front panel:
1. Unlock the screws 2 turns

Mounting holes
4 holes for screw M5

Weight: 5 kg

For cable gland Pr. 37 (2 x)
For cable gland Pr. 22.5 (3 x)

TyraK X-3

Terminal Connectible Conductor
Plast, Aussen, bar X1, X2, X3

2.5

1.5
COMMISSIONING

Safety measures

Safety measures important!

The voltage to the convertor is to be switched off before work is begun if there is any risk of contact with convertor parts normally carrying current.

There is also mains voltage on the control board in this convertor. For speed control with voltage feed-back the zero of the electronics section is in addition connected to the motor voltage when the actual value of the voltage is used instead of the tachometer.

Commissioning equipment

2 st Multimeters 0-1000 V, a.d./d.c. RI ≥ 10 kohm/V d.c. One of the instruments can be of the digital type.

1 st Potentiometer 10 kohm, ≥ 0.5 W for setting references.

1 sat set of test leads with testing probes (miniature type)

Preliminary checks and presetting

Perform the following checks:

- Check that the convertor is connected to the correct mains voltage and that this is within ± 10% of the rated value.
- Check also that the convertor is fused with semiconductor fuses.
- Check that the speed reference has the correct sign (positive).
- Check that the speed actual value has the correct sign (negative).

Preliminary setting of trimpotentiometers

Make the following preliminary settings:

- "IR" (R45) IR-compensation: Turn to the extreme anticlockwise position
- "LIM" (R38) Current limit: Turn to approx 25% of the full scale reading
- "GAIN" (R40) P-ampl. control: Turn to the extreme anticlockwise position

Fig 1 Control board YXT 120 A
The final setting is performed as follows:

- "I" (R102) Adaption I-actual value:
  Turn from one extreme position to the other and check where the extreme anticlockwise position is in the screw driver slot. Then turn this slot to the scale value which corresponds to the rated current of the motor in amperes. (Marked 10 .. 25 .. 40).

The purpose of this setting is to obtain 5 V as the current actual value "ARM CUR" (X21.3) with the rated current of the motor.

If the convorctor release circuit (RDY F REF) is connected with external release contact, this can be bypassed during the commissioning by inserting a temporary strap S2.3-4.

**Trimming of current control**

The current control function normally needs no trimming, except for the adaption of the current actual value as performed previously with potentiometer "I" (R102).

For very high and special requirements the current control function can be trimmed in the conventional manner with steps in the reference and study of the current actual value with the recorder. For adjustment purposes the components R49 (P-section) and C15 (I-section) can be removed with a soldering iron as they are installed on solder posts.

The following should be remembered during this trimming:

- The field is to be disconnected
- If necessary, lock the rotor
- The reference is given via the speed controller which is P-connected by short circuiting C11.
- Make small step changes of the reference in the range continuous current. (Check that the converter does not go to the current limit. It may be necessary to increase the current limit).

**Speed control with voltage feed-back**

With rotor voltage 140 - 530 V, the jumpers must be set as follows:

Closed jumper: S1:1-2

Open jumpers: S1:3-4, 5-6, 7-8, 9-10 and 11-12

For the basic setting, turn the potentiometer "SIGN ADJ" (R7), to its extreme clockwise position.

**Warning!** With this type of control, the zero "COM" on the control board is connected to the rotor voltage and the greatest care should be taken. If a recorder or oscilloscope is connected, the zero on these should not be earthed. The instructions given in Speed control with tachometer feedback, should be followed when trimming this control operation.

**Speed control with tachometer feedback**

Calculate with data from the tachometer and highest speed maximum tachometer voltage. Make a preliminary adjustment by means of jumpers as in the table.

**Approximate setting of tachometer feedback**

<table>
<thead>
<tr>
<th>Tachometer voltage (V)</th>
<th>S1:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3-4</td>
</tr>
<tr>
<td>10,2 - 10,7</td>
<td>X</td>
</tr>
<tr>
<td>14,2 - 25,0</td>
<td>X</td>
</tr>
<tr>
<td>23,0 - 57,0</td>
<td>X</td>
</tr>
<tr>
<td>42,0 - 126,0</td>
<td>X</td>
</tr>
<tr>
<td>99,0 - 338,0</td>
<td>-</td>
</tr>
</tbody>
</table>

(X = jumper connected, - = no jumper)

If two ranges can be selected, the range for the highest voltage is to be selected.

Turn then the potentiometer "SIGN ADJ" (R7) anticlockwise to its extreme position.

The speed regulation is trimmed as follows:

- Unlock any devices restraining the rotor.
- Check that the potentiometer "GAIN" (R40) is at its extreme anticlockwise position.
- Connect the motor field.
- Connect a variable d.c. current to a vacant input for speed reference, without using the ramp unit. If necessary disconnect the external speed reference. The reference is to be 0 V (X1.8) to +10 V (+11 V at X1.9).
- Set the speed reference to 0 V.
Preliminary check of controllability

Switch on voltage to the converter and increase the speed reference to approx. +0.5 V. Check at the same time that the motor begins to rotate without racing. Be prepared to switch off the supply immediately. If the motor races, i.e. accelerates to top speed, the tachometer response or excitation supply has been connected with incorrect polarity.
- If the motor races in the correct direction, the tachometer response polarity must be reversed.
- If the motor rotates in the wrong direction, the excitation supply must be reversed.
- If the motor is controllable by means of the reference potentiometer but rotates in the wrong direction, the polarities of both tachometer response and excitation supply must be reversed.

Current limit

It is now convenient to set the final current limit.

Switch off the supply, disconnect temporarily the edge contact X2 (trigger pulse signals) and connect a voltmeter to the current reference (X21:6).

Switch on the supply and increase the speed reference to +10.0 V. Then adjust the potentiometer "LIM" (R38), so that the current reference (X21:6) is limited to the maximum permissible "current". If the setting has been performed according to section 3, 5 V in the current reference corresponds to motor rated voltage. When this setting is completed, switch off the supply and connect the edge contact X2.

Fine setting of max. speed

Connect a voltmeter to the tachometer response X1:1. (When controlling voltage, the rotor voltage is measured.)

Switch on the supply voltage and slowly increase the speed reference to +10.0 V. Check at the same time that the maximum speed of the motor is not exceeded. Adjust the potentiometer "SIGN ADJ" (R7), so that the maximum speed is obtained.

Optimization of speed control dynamic

Connect a multimeter to the current reference (X21:6). Select measurement range 25 V d.c. Set a speed of approximately 85 % of the maximum speed of the motor. Note that the motor is not to be loaded. Increase the speed reference so that the motor speed increases from 85 % to 100 % and then return to 85 %.
Watch the indicating needle on the multimeter and make the reference changes quickly. Check that the instrument indication returns to its original position without hunting.

Repeat this stepping procedure with different amplifications, "GAIN", in the speed controller. Begin with setting 0 % i.e. potentiometer "GAIN" (R40), at its extreme anticklockwise position.

Increase then successively to 25 %, 50 %, 75 % and 100 % indications on the potentiometer until the needle begins to hunt. Reduce the setting 25 % from that "GAIN" at which the instrument needle begins to hunt, this being the final setting. Note that in certain operational situations, hunting can also develop when the "GAIN" setting is too low.

If the speed control is to be even faster, the function can be trimmed in the conventional manner with changes of the reference by steps and observation of the speed value (or voltage value) on the recorder. Larger changes can be made by introducing alternative components for the P-section (R41) and the I-section (C11). These components are installed on solder posts.

Trimming of IR-compensation

To reduce the effects of the stator reaction and stator voltage fall on the control characteristics when controlling speed with voltage feed-back, the IR-compensation can be trimmed according to the following:
- Increase motor speed to rated speed.
- Measure the no-load speed accurately.
- Load the motor so that the rated current is reached (not the current limit). The speed then sinks slightly because of the stator reaction and the stator voltage drop.
- Adjust the potentiometer "IR" (R45), so that the speed increases to the no-load value.

This trimming means compensation at rated speed. If compensation is required at another speed, the trimming is to be performed with respect to this.

Setting of ramp unit

If the speed reference is to go via the ramp unit, the jumpers are to be checked, referring to the circuit diagram. The ramp is set with the potentiometer "TIME" (R33), in the range 0.4 - 8.0 secs for speed reference 0 - 10.0 V. If other ramp times are required, the capacitor C6 must be changed.

Final measures

Disconnect the variable reference voltage used during the preceding operations. If the external speed reference has been disconnected, this is now to be reconnected and its strapping corrected. Check the tightness of the screw at all terminal blocks. Check that the circuit board is screwed firmly in place. Check that the soldered connections made are correct.
PREVENTIVE MAINTENANCE

General

The convertor contains no components which are subject to "wear" in its usual meaning. In addition to the check points listed here, the convertor requires general maintenance if operational disturbances are not to occur. This type of maintenance is common to all electrical equipment and is therefore well established in service routines.

Check points

The convertor should be inspected at regular intervals, determined by the nature of the operations concerned and by environmental factors such as vibrations, humidity, dust etc.

Under conditions favourable for the convertor operation inspections can be performed at intervals of up to one year.

Note danger to personnel!

In the case of all inspections, the a.c. supply to the convertor must be disconnected.

Fouling

When dust and dirt have accumulated, the convertor must be cleaned, preferably using a vacuum cleaner but applying compressed air if necessary.

After cleaning, a visual inspection should be performed to detect any mechanical damage, overheated components etc.

Terminal connections

• Check the tightness of all screw terminals in the convertor with a suitable tool.

• Check that the different units in the convertor are firmly screwed in place and that there are no loose screws or nuts.

• Check that no cables or wires in the convertor chafe against sharp edges.
# FAULT TRACING

## Service principle

### Introduction

TYRAK XS convertors have a simple and clean functional design with few components and component units. The frequency of faults caused by internal component malfunction when the convertor is in regular operations is therefore very low.

### Personnel safety

When tracing faults, it may be necessary to work on the convertor with the supply voltage switched on. TYRAK XS convertors are however designed for the greatest possible personnel safety, the electronic circuits being galvanically insulated from the main circuit.

**N.B.** The RC-circuits and the two pulse transformers, located on the upper part of the control board are directly connected to the main circuit.

## Fault tracing routine

- Determine if the fault is of mechanical or electrical nature.
- Determine if an electrical fault is external or in the convertor.
- In the case of an internal error:
  - Localise the error to, for example, a thyristor-diode or circuit board.
  - Replace the faulty component with a spare.
- Faulty circuit boards are to be repaired in an ASEA workshop.

## Measuring instruments

A multimeter is necessary for fault tracing in the convertor.

In the case of certain faults and for detailed fault tracing, it may be necessary to use a recorder and/or an oscilloscope.

## Fault symptoms and causes

<table>
<thead>
<tr>
<th>Fault Symptom</th>
<th>Indication</th>
<th>Probable Fault Cases</th>
</tr>
</thead>
</table>
| The motor does not operate | Green LED does not illuminate | • Supply voltage absent  
• Supply voltage to electronics board absent  
• Release control signal absent  
• Control board faulty |
| Motor speed incorrect but controllable | Green LED illuminates | • Field current too low  
• Break between convertor and motor  
• Motor torque load too large  
• Speed reference absent  
• Current limit "LIM" too low  
• Current actual value potentiometer "I" setting incorrect  
• Thyristor/diode faulty |
| The motor races | | • Tachometer generator faulty  
• Voltage divider for speed actual value is adjusted incorrectly (SIGN ADJ).  
• Speed reference incorrect  
• Control board faulty |
| Semi-conductor fuses trip at switch-on | Green LED illuminates | • Polarity of speed actual value incorrect  
• Speed actual value absent  
• Incorrect polarity in field excitation  
• Control board faulty |
| Semi-conductor fuses trip during operations | | • Short circuited thyristor/diode  
• Short circuit/earth fault in rotor circuit  
• Fault in current measurement circuits (current transformer or current actual value setting "I")  
• Control board faulty |
| | | • Thyristor/diode faulty  
• Faulty motor or earth fault  
• Unstable current control  
• Intermittent error on control board |
## Tabulation of measured values

### Measurement with multimeter

All signals are measured against "COM" (X21.2).

<table>
<thead>
<tr>
<th>Measurement Point on Control Board</th>
<th>Control Board Signal Designation</th>
<th>Measured Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>X21:1</td>
<td>+15 V</td>
<td>+14,5 - +15,5 V DC</td>
</tr>
<tr>
<td>.2</td>
<td>COM</td>
<td>0 V DC</td>
</tr>
<tr>
<td>.3</td>
<td>ARM CUR</td>
<td>0 - +10 V DC</td>
</tr>
<tr>
<td>.4</td>
<td>CONTR VOLT</td>
<td>0 - +10 V DC</td>
</tr>
<tr>
<td>.5</td>
<td>SP REF 2</td>
<td>0 - +10 V DC</td>
</tr>
<tr>
<td>.6</td>
<td>ARM CUR REF</td>
<td>0 - -10 V DC</td>
</tr>
<tr>
<td>.7</td>
<td>RAMP GEN</td>
<td>0 - +10 V DC</td>
</tr>
<tr>
<td>.8</td>
<td>SP REF 1</td>
<td>0 - +10 V DC</td>
</tr>
<tr>
<td>.9</td>
<td>ARM CUR SEC</td>
<td>+10 mV - +0,6 V DC</td>
</tr>
<tr>
<td>.10</td>
<td>TG</td>
<td>0 - -10 V DC</td>
</tr>
<tr>
<td>X1:9</td>
<td>+11 V</td>
<td>+10,5 - +11,5 V DC</td>
</tr>
<tr>
<td>.10</td>
<td>Q1 +</td>
<td>+22 - +29 V DC</td>
</tr>
<tr>
<td>.11</td>
<td>-15 V</td>
<td>-13,5 - -16,5 V DC</td>
</tr>
<tr>
<td>.13</td>
<td>AC SUPPL VOLT</td>
<td>19 - 24 V AC</td>
</tr>
<tr>
<td>.15</td>
<td>AC SUPPL VOLT</td>
<td>19 - 22 V AC</td>
</tr>
</tbody>
</table>

1) Recommended setting +5 V with rated motor current  
2) Ca Approx 0 V with 0 V d.c., approx +10 V with max. d.c. voltage  
3) Mains voltage dependent

### Measurement with oscilloscope

An oscillogram is shown in the circuit diagram, appendix 1, which illustrates the curve forms at 13 different measurement points on the control board. All signals are measured against "COM" (X21.2).

### Replacement of faulty units

#### Circuit boards

- Disconnect the board connectors.
- Disconnect the d.c. cable which passes through the current transformer.  
  **Make a note of the direction of the passage of the cable through the current transformer.**
- The circuit board can be removed as shown in fig 1.

---

![Fig. 1.](image)

1. Loosen the screws two turns  
2. Push the board to the left  
3. Lift the right hand side  
4. Push the board to the right  
5. Lift the complete board

- The following actions must be taken before the spare board is inserted.
  - Check that the programming straps are located in the correct positions by comparing with the original board and the circuit diagram.
  - Set the potentiometers in accordance with the original board or follow the commissioning instructions.

### Thyristor/diode

- The use of the ASEA thyristor tester, catalogue number YS 900-102-A, is recommended for a complete check of thyristor/diodes. To determine only that a thyristor/diode is short circuited or not, resistance measurement with a multimeter is sufficient.
- When replacing a thyristor module/diode module, it is important that the contact surface are well cleaned with a suitable solvent, then dried and that a very thin layer of silicone grease is applied to the surfaces.
- The fixing screws are to be tightened alternately.

The recommended tightening torque is 2.5 - 3.7 Nm.
Fig. 2.

**Warning!**
The casing of the thyristor/diode module is to remain intact to avoid spreading of poisonous beryllium oxide.
# APPARATUS LIST

<table>
<thead>
<tr>
<th>Convertor type YFFB</th>
<th>$U_{\text{VN}}$ (V)</th>
<th>Item</th>
<th>No</th>
<th>Designation</th>
<th>Data</th>
<th>Catalogue No</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 - 25</td>
<td>220</td>
<td>1</td>
<td>1</td>
<td>Thyristor module</td>
<td>18 A/ 800 V</td>
<td>4858 233 -8</td>
</tr>
<tr>
<td>310 - 25</td>
<td>380, 415</td>
<td>2</td>
<td>1</td>
<td>Thyristor module</td>
<td>18 A/ 1400 V</td>
<td>-14</td>
</tr>
<tr>
<td>340, 360 - 25</td>
<td>440</td>
<td></td>
<td></td>
<td></td>
<td>18 A/ 1600 V</td>
<td>-16</td>
</tr>
<tr>
<td>180 - 40</td>
<td>220</td>
<td>1</td>
<td>1</td>
<td>Diode module</td>
<td>40 A/ 800 V</td>
<td>4858 232 -8</td>
</tr>
<tr>
<td>310 - 40</td>
<td>380, 415</td>
<td>2</td>
<td>1</td>
<td>Diode module</td>
<td>40 A/ 1400 V</td>
<td>-14</td>
</tr>
<tr>
<td>340, 360 - 40</td>
<td>440</td>
<td></td>
<td></td>
<td></td>
<td>40 A/ 1600 V</td>
<td>-16</td>
</tr>
<tr>
<td>180 - 25</td>
<td>220</td>
<td>2</td>
<td>1</td>
<td>Transformer</td>
<td>25 A/ 800 V</td>
<td>4858 229 -8</td>
</tr>
<tr>
<td>310 - 25</td>
<td>380, 415</td>
<td>4</td>
<td>1</td>
<td>Transformer 1)</td>
<td>25 A/ 1400 V</td>
<td>-14</td>
</tr>
<tr>
<td>340, 360 - 25</td>
<td>440</td>
<td></td>
<td></td>
<td></td>
<td>25 A/ 1600 V</td>
<td>-16</td>
</tr>
<tr>
<td>180 ..</td>
<td>220</td>
<td>1</td>
<td>1</td>
<td>Field rectifier</td>
<td>SLMF 61, 2 x 20 V, 16 VA</td>
<td>4781 020 -SA</td>
</tr>
<tr>
<td>310 ..</td>
<td>380</td>
<td>5</td>
<td>1</td>
<td>Varistor</td>
<td>-SA</td>
<td></td>
</tr>
<tr>
<td>340 ..</td>
<td>415</td>
<td>6</td>
<td>1</td>
<td></td>
<td>-SB</td>
<td></td>
</tr>
<tr>
<td>360 ..</td>
<td>440</td>
<td>7,8</td>
<td>2</td>
<td>Fuse</td>
<td>-SC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td>Control board</td>
<td>-SC</td>
<td></td>
</tr>
</tbody>
</table>

1) When exchanging the transformer, a cover plate No 2689 386-Z is also to be ordered.