Dynamic Power Factor Correction
Thyristor Module TSM-AT

General:

Conventional systems for power factor correction are used to optimize the power factor and reduce the level of harmonics in the net. The usage of new technologies in modern industry has negative impacts on electrical power quality of the main supply networks, eg. frequent high load fluctuations and harmonic oscillation. Excessive currents, increased losses and flickering will not only influence the supply capacity but will also have a significant impact on the operation of sensitive electronic devices. The solution for this are dynamic power factor correction systems.
With the TSM-AT module we provide the main component – „electronic switch“ – for dynamic power factor correction. The TSM-AT is a fast electronically controlled, self-observing thyristor switch for capacitive loads up to 100 kVAr, which is capable to switch PFC capacitors within a few milliseconds as often as required.

Features:

- Real 3-phase switching
  (usage only with single-phase capacitors L-N)
- Output up to 120 kVAr at 690 V
- Usage for PFC-systems with and without reactors (programmable)
- Connected load (output) programmable
- Easy programming for the individual application via multi-lingual plain language display
- Indication of all relevant parameters of the grid
  (voltage, current, temperature...)
- Alarm output and error message storage

Technical Data

Voltage	max. 690V (3 x 400V L-N)
Max. power	up to 120 kVAr at 690 V up to 100 kVAr at 525 V
Parameter setting via display	nominal voltage, degree of detuning, overcurrent, alarm temperature, frequency, error message storage, delay time during cascading
Control features	permanent monitoring of net voltage, phasing, capacitor current, module temperature. Malfunction shown in plain language and evaluated; former errors are stored in an error message storage
Display	3-phase indication of net voltage and capacitor current temperature values and all parameters programmed can be retrieved
Controlling	10-24 VDC , internally DC-insulated; manual operation possible
Power circuit	connection: three-pole via clamp (25qmm)
Losses	Pv(in W)= 3.0 * I (in A) at 690V / 100 kVAr approx. 240W)
Fuses	electronic fuse „superfast“ 160 A (NH00)
Dimensions	300 x 300 x 200 mm (w x h x d)

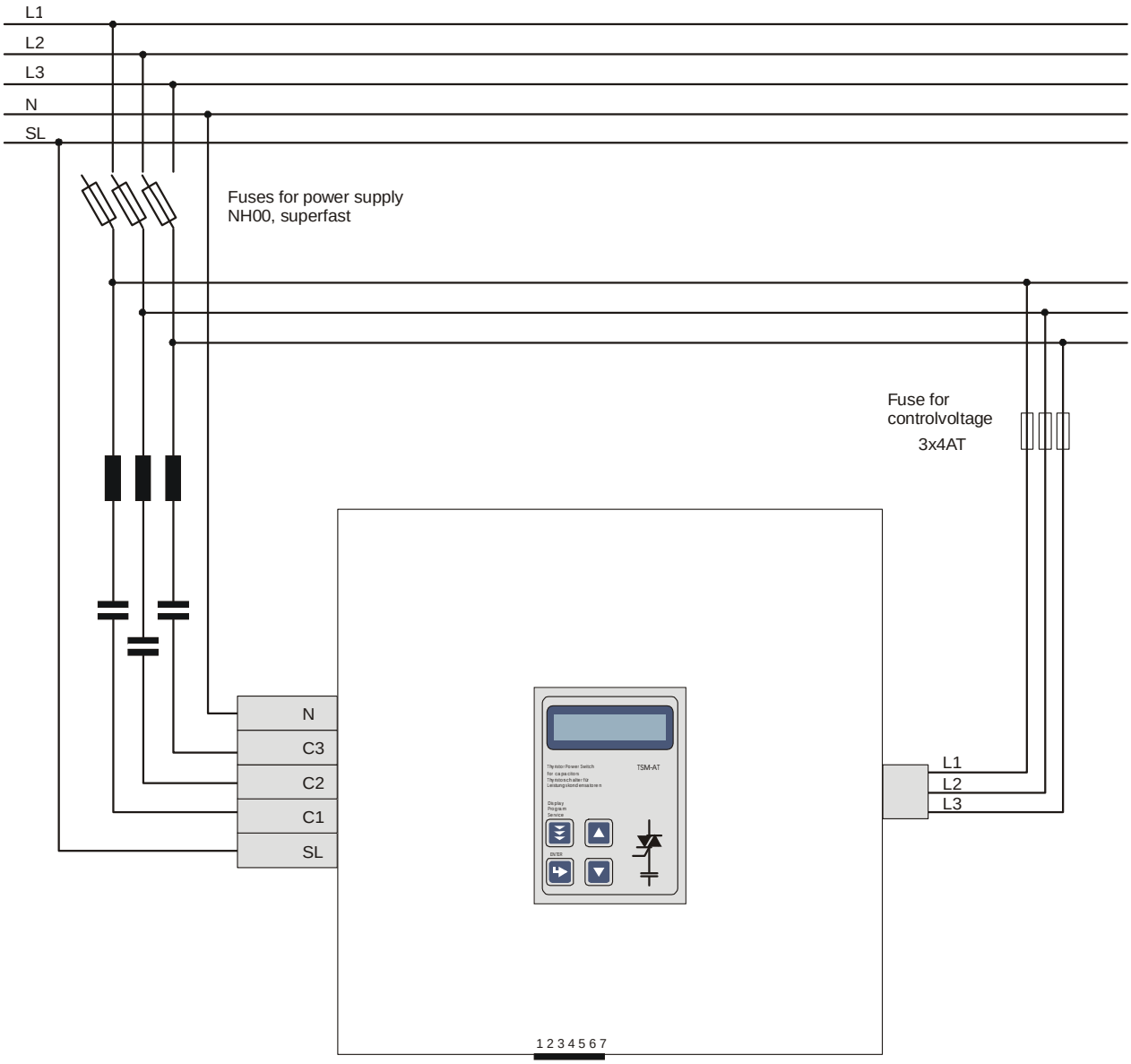
Description

TSM-AT Thyristor-switches are used for dynamic PFC equipment. The connection is made via three phases according to picture 1. Take care for a correct phase sequence! (If the phase-sequence is not correct, the module will be blocked.)

Main-fuses have to be electronic-fuses (superfast) for protection of the semiconductor components. Please observe the correct fuse rating.
Activation of the modules is done by a 10-24 VDC signal (by a dynamic reactive power regulator) which is connected to terminals X3:1 and 2.

For cascading of several modules (for increase of the kVAr-output) parallel-connection is possible. For additional modules, programming of delay time is possible.

Pic. 1



Thyristor-switch TSM-AT

here: for 690V grid
3xC - star-connection

Control-Input:
1 activation signal - 12V
2 activation signal +12V
3 and 4 alarm output (zero-potential) max 250V,6A
5 and 6 n.c.

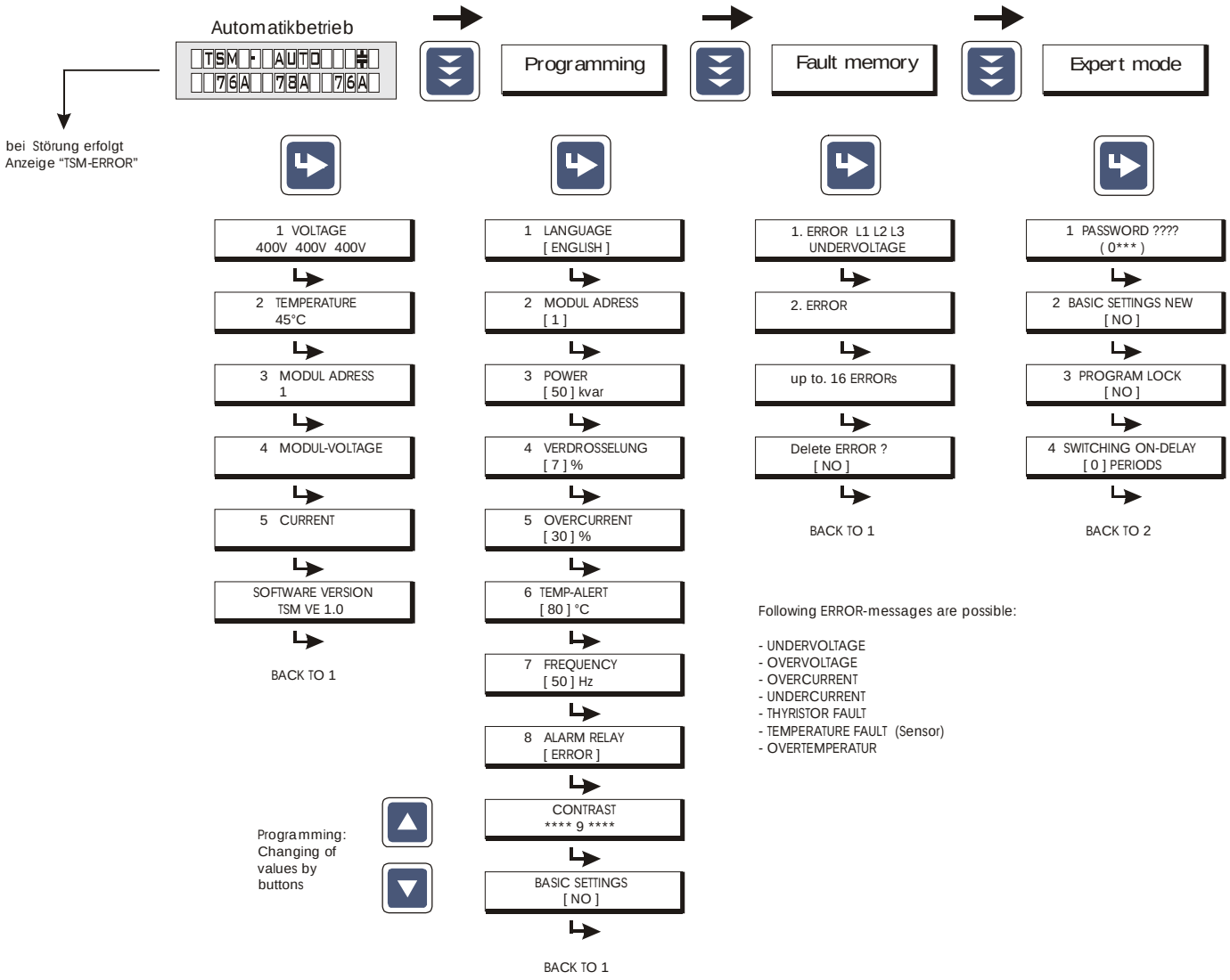
Putting into operation

After connection of the module according to above instructions, it can put into operation.

After applying up of net voltage (inserting of the branch fuse) the module is ready for operation. No triggering signal should be connected! Charging of the capacitors is indicated in the display by a momentarily blinking diode-symbol. The permanent diode-symbol indicates the operational readiness of the TSM-AT. (In case a triggering signal is active at the input of the TSM, this is indicated by the letter “X” in the display next to the diode-symbol.

The menu item “programming” is activated via the menu-button. The parameterizing of the module is done here (see operation diagram). Change of values is done via the arrow buttons ↑↓; safe with “ENTER”. After entry of all parameters, the module is ready for operation (automatic operation).
During automatic operation, the module can be turned ON and OFF via arrow buttons ↑↓ manually (manual operation). The operation mode is indicated in the display (AUTO/HAND).
The ON-mode of the module is indicated in the display by a capacitor-symbol.

Operating diagram



Control functions / Alarm messages

The TSM-AT observes permanently:
- voltage (availability & value)
- phase sequence
- capacitor rated current
- temperature of the power switches

When voltage, current or temperature-problems occur, the TSM turns-off and shows the Error at the display.
At the same time, the error-description is stored in the error storage register (max. 16). In the menu item “Error storage” the errors can be read out. So it is possible to recognize also short-term malfunctions afterwards.

By supervising the capacitor current it is possible to identify dangerous operating conditions, such as harmonic distortion. High current harmonics may cause the destruction of the connected PFC capacitor. Over currents are measured by an integrated measuring system. The module turns-off as long as the overload exists.
The highly advanced measuring circuit for self-observing of the thyristor switch protects the capacitor and the application as well.
The alarm-signal of the temperature trigger switches-off the corresponding capacitor branch. After disconnection the thyristor switch will cool down again. If the temperature drops below the preset threshold value, the module will reconnect.

Errors are indicated via relay contact and visualized via Display.
All error messages are summarized as a centralized error message and the output occurs via a relay contact. In the programming menu it can be selected if this output should be stored or whether it should only be displayed during the malfunction.

NOTE THE FOLLOWING INSTRUCTIONS !

The power capacitors are permanent on high voltage (up to 1500 VDC)
EVEN IF THE TSM-AT IS SWITCHED OFF !!

Please follow the instructions:

- ➔ Don’t touch live parts in the PFC equipment !!
- ➔ Warning signs in the equipment required!!
- ➔ Wait 10 minutes after the main switch is turned off – until the voltage in the system is down to an uncritical value.
- ➔ In systems (690V grid) you need single-phase capacitors with a min. voltage of 440V! All capacitors have to switch in star-circuit. (L-N)
- ➔ In systems (525V grid) you need single-phase capacitors with a min. voltage of 380V ! All capacitors have to switch in star-circuit. (L-N)
- ➔ In dynamical PFC systems discharge reactors cannot be used!
  (this would be a shortcut of the high-voltage DC)
- ➔ In PFC systems without filter circuit reactors current limiting reactors are required (e.g. BD-100) for the TSM.
- ➔ For short circuit protection superfast electronic fuses for protection of the thyristor are required, standard HRC fuses are not suitable